



Tennessee Department of Environment and Conservation
 Division of Water Resources
 William R. Snodgrass Tennessee Tower,
 312 Rosa L. Parks Avenue, 11th Floor, Nashville, Tennessee 37243
 1-888-891-8332 (TDEC)

Phase II Small Municipal Separate Storm Sewer System (MS4) Annual Report

1. MS4 Information

Name of MS4: City of Lebanon		MS4 Permit Number: TNS075426
Contact Person: Brian Chomicki		Email Address: brian.chomicki@lebanontn.org
Telephone: (615) 708-6444		MS4 Program Web Address: http://www.lebanontn.org/251/Storm-Water-Water-Sewer-Inspection
Mailing Address: 200 N Castle Heights Ave. (Suite 300)		
City: Lebanon	State: TN	ZIP code: 37087

What is the current population of your MS4? 38,431+

What is the reporting period for this annual report? July 1 2021 to June 30 2022

2. Discharges to Waterbodies with Unavailable Parameters or Exceptional Tennessee Waters (Section 3.1)

- 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
- B. Are there established and approved TMDLs (<http://www.tn.gov/environment/article/wr-ws-tennessees-total-maximum-daily-load-tmdl-program>) with waste load allocations for MS4 discharges in your jurisdiction? If yes, attach a list. Yes No
- C. Does your MS4 discharge to any Exceptional Tennessee Waters (ETWs - http://environment-online.tn.gov:8080/pls/enf_reports/f?p=9034:34304:4880790061142)? If yes, attach a list. Yes No
- D. Are you implementing specific Best Management Practices (BMPs) to control pollutant discharges to waterbodies with unavailable parameters or ETWs? If yes, describe the specific practices: Lebanon's Stormwater Ordinance has requirements for permanent (and construction) buffers: 'An undisturbed vegetative buffer of sixty (60) feet minimum (as measured from the top-of bank) shall be maintained. The 60-foot criterion for the width of the buffer zone can be established on an average width basis at a project, as long as the minimum width of the buffer zone is more than 30 feet at any measured location. Lebanon also requires and enforces TDEC design and BMP standards for discharges to waterbodies with unavailable parameters or ETWs. Pre-construction meetings are required for all development bordering these waters. Yes No

3. Public Education/Outreach and Involvement/Participation (Sections 4.2.1 and 4.2.2)

- 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: See attached PIE spreadsheet for complete details. Yes No

- C. Do you have a webpage dedicated to your stormwater program? If yes, provide a link/URL: <http://www.lebanontn.org/251/Storm-Water-Water-Sewer-Inspection> Yes No
- D. Summarize how you advertise and publicize your public education, outreach, involvement and participation opportunities: The 'Upcoming Events' section of the City of Lebanon website is used to post information related to public education, outreach, involvement and participation opportunities in addition to various social media platforms (Facebook, Instagram, etc.) and posted flyers. Local newspapers (Lebanon Democrat); Local radio station (98.9 FM W.A.N.T.); email blasts through the City of Lebanon Employees list and the 'Mayor's Office' distribution list are also used. Information is also presented in monthly Public Infrastructure Committee meetings and City Council meetings that are open to the public. Lebanon Special School District will also post links on their web platforms to upcoming MS4 related activities involving their schools.
- E. Summarize the public education, outreach, involvement and participation activities you completed during this reporting period: See attached PIE spreadsheet for complete details.
- 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: See the 'Goals / Results' column in the attached PIE spreadsheet for complete details.

4. Illicit Discharge Detection and Elimination (Section 4.2.3)

- A. Have you developed and do you continue to update a storm sewer system map that shows the location of system outfalls where the municipal storm sewer system discharges into waters of the state or conveyances owned or operated by another MS4? Yes No
- B. If yes, does the map include inputs into the storm sewer collection system, such as the inlets, catch basins, drop structures or other defined contributing points to the sewershed of that outfall, and general direction of stormwater flow? Yes No
- C. How many outfalls have you identified in your storm sewer system? 284
- D. Do you have an ordinance, or other regulatory mechanism, that prohibits non-stormwater discharges into your storm sewer system? Yes No
- 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: Evidence of non-stormwater discharges and illegal disposals are identified and looked for during regular stream assessments and routine (wet and dry weather) outfall inspections. Lebanon has an Illicit Discharge Hotline (615-708-6444) for citizens to report concerns. 'No dumping, drains to creek' signage are added to all stormdrains. Monthly meetings occur with Codes Enforcement Department to coordinate identification and elimination efforts. Stormwater Department frequently communicates with Public Works and Utility Departments to encourage their field staff to report any IDDE concerns. Yes No
- F. How many illicit discharge related complaints were received this reporting period? 12
- G. How many illicit discharge investigations were performed this reporting period? 29+
- H. Of those investigations performed, how many resulted in valid illicit discharges that were addressed and/or eliminated? 27

5. Construction Site Stormwater Runoff Pollutant Control (Section 4.2.4)

- 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 construction sites disturbing at least one acre or greater were active in your jurisdiction this reporting period? 122 active sites > 1-acre. 8 active sites < 1-acre.
- F. How many active priority and non-priority construction sites were inspected this reporting period? 121 non-priority sites and 9-priority sites were actively inspected during this period. A total of 1,001(+) site inspections of commercial, industrial, or residential developments and 1,372+ single family home construction inspections were completed.
- G. How many construction related complaints were received this reporting period? 50+

6. Permanent Stormwater Management at New Development and Redevelopment Projects (Section 4.2.5)

- 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
 Yes No
- B. Do you have an ordinance or other regulatory mechanism requiring:
- 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 buffers? If yes, specify requirements: Please see attached documents. Yes No
- 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 projects.
- D. How many development and redevelopment project plans were reviewed for this reporting period? 141
- E. How many development and redevelopment project plans were approved? 117
- F. How many permanent stormwater related complaints were received this reporting period? 27+ related to private stormwater infrastructure, 101+ related to public infrastructure.
- G. How many enforcement actions were taken to address improper installation or maintenance? 22 private resolutions achieved. 128 City work orders issued with 98 completed.

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

7. Stormwater Management for Municipal Operations (Section 4.2.6)

- A. As applicable, have stormwater related operation and maintenance plans that include information related to maintenance activities, schedules and the proper disposal of waste from structural and non-structural stormwater controls been developed and implemented at the following municipal operations:

- Streets, roads, highways? Yes No
- Municipal parking lots? Yes No
- Maintenance and storage yards? Yes No
- Fleet or maintenance shops with outdoor storage areas? Yes No
- Salt and storage locations? Yes No
- Snow disposal areas? Yes No
- Waste disposal, storage, and transfer stations? Yes 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
- If yes, are new applicable employees trained within six months, and existing applicable employees trained and/or retrained within the permit term? Yes No

8. Reviewing and Updating Stormwater Management Programs (Section 4.4)

- 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. We now require pond anti-seep collar inspections by our Stormwater Department prior to backfilling. A drone was purchased to inspect larger sites that may be inaccessible during wet conditions. The drone is also used to characterize stream/wetland buffers pre-/post- development and for IDDE and non-permitted property violation inspections. An emphasis on ARAP required trench plug/checkdam proper installation is discussed during applicable pre-construction meetings. These requirements and proper installation methods are reviewed with both the contractor and City Utility Inspector.

Changes to the program as required by the division to satisfy permit requirements. A March 2021 TDEC Audit identified three sentences in Lebanon's Stormwater Ordinance that need to be updated. These updates will be incorporated into the City's new Stormwater Ordinance that will incorporate this and all new changes associated with the 2021-2026 MS4 permit. In the interim, all Ordinance regulations will be applied to satisfy the MS4 permit requirements consistent with the proposed changes.

Information (e.g. additional acreage, outfalls, BMPs) on newly annexed areas and any resulting updates to your program. 11 properties were annexed into City limits during this period, totalling 255.87 acres. This property consisted of mostly undeveloped farmland and residential structures. Approximately 8,000' of Sinking creek was added to our watershed by these annexations.

- 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. Given the intensity of development and significant staff turnover, our Stormwater Program is overall successful and effective at meeting our Permit requirements. One area identified for improvements is our post-construction SCM program. Updates to our post-construction SCM program are scheduled and include measures to ensure SCM measures are installed with the appropriate volume. The Stormwater Department has begun to utilize our GIS Department to verify any questionable elevations or grades associated with SCMs prior to releasing bonds. We've also discussed updating our as-built requirements to be more specific for specific SCMs. Our plan to continue incorporating previously unmapped SCMs into our Rokmaps GIS system. We've also begun to implement new inspection software to improve on our Construction Site Inspection and SCM documentation and correspondence efficiency. The new software will automate inspection photos into a report and instantly email all responsible parties.

Yes No

9. Enforcement Response Plan (Section 4.5)

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

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>	
Verbal warnings	#5-10+ / weekly	#2	#22	<input checked="" type="checkbox"/> Yes	<input type="checkbox"/> No
Written notices	#5-10+ / monthly	#3	#29	<input checked="" type="checkbox"/> Yes	<input type="checkbox"/> No
Citations with administrative penalties	#3	#0	#6	<input checked="" type="checkbox"/> Yes	<input type="checkbox"/> No
Stop work orders	#5	#1	#3	<input checked="" type="checkbox"/> Yes	<input type="checkbox"/> No
Withholding of plan approvals or other authorizations	#2	#0	#2	<input type="checkbox"/> Yes	<input type="checkbox"/> No
Additional Measures	#0	#2	#3	Describe: <u>Required additional measures/redesign, condemned a property, required TMSP permit coverage, required property swap.</u>	

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? Neglected slit fence repairs, construction entrance trackout, missing SWPPP documents, failure to stabilize inactive areas within 14 days, ineffective or missing intermediate stage EPSC measures to route stormwater into appropriate areas prior to road completion.

10. Monitoring, Recordkeeping and reporting (Section 5)

A. Summarize any analytical monitoring activities (e.g., planning, collection, evaluation of results) performed during this reporting period. Particle size distribution analysis was completed on two soils listed as 'critical' in our subdivision regulations. This was completed out of general structural suitability interest for our Engineering and Stormwater Departments. Several Bioretention analyses were completed to determine if questionable media was suitable. Results indicated poor media was installed and needed to be replaced. Two streams were analyzed for over 150 different constituent as part of a public education and outreach project with the Lebanon High School. See PIE chart for additional details

B. Summarize any non-analytical monitoring activities (e.g., planning, collection, evaluation of results) performed during this reporting period. The Stormwater Department started to implement site assessments using a drone. Assessments were done to characterize predevelopment status of water resources, buffers, and other critical areas. Area footage obtained by the drone was also successfully used for IDDE program activities.

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

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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 6.7.2 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."

Rick Bell Mayor
Printed Name and Title


Signature

9-29-22
Date

Annual reports must be submitted by September 30 of each calendar year (Section 5.4) to the appropriate Environmental Field Office (EFO), identified in the table below:

EFO	Street Address	City	Zip Code	Telephone
Chattanooga	1301 Riverfront Pkwy, Suite 206	Chattanooga	37402	(423) 634-5745
Columbia	1421 Hampshire Pike	Columbia	38401	(931) 380-3371
Cookeville	1221 South Willow Ave.	Cookeville	38506	(931) 520-6688
Jackson	1625 Hollywood Drive	Jackson	38305	(731) 512-1300
Johnson City	2305 Silverdale Road	Johnson City	37601	(423) 854-5400
Knoxville	3711 Middlebrook Pike	Knoxville	37921	(865) 594-6035
Memphis	8383 Wolf Lake Drive	Bartlett	38133	(901) 371-3000
Nashville	711 R S Gass Boulevard	Nashville	37216	(615) 687-7000

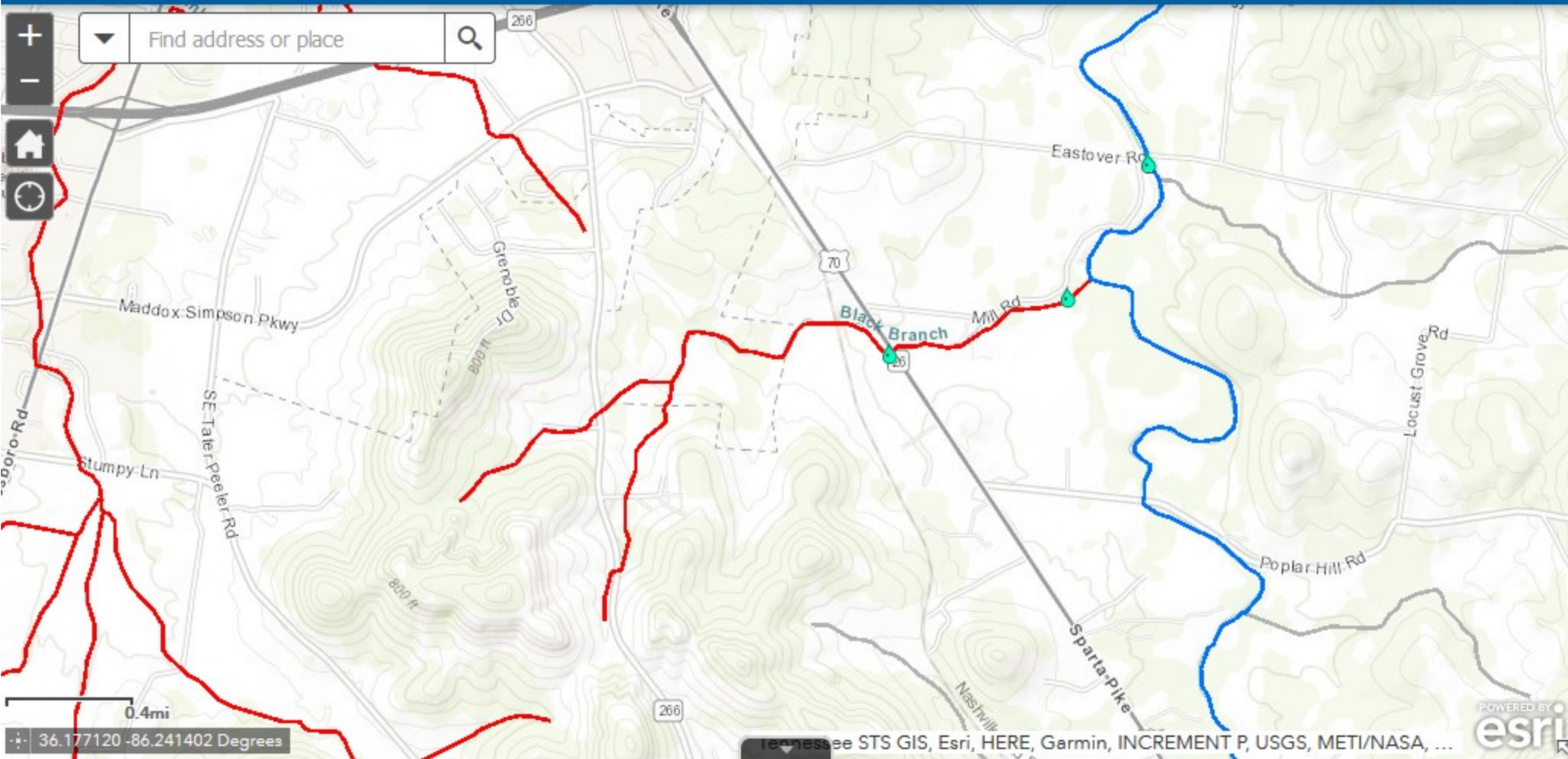


Rick Bell, Mayor

200 North Castle Heights Avenue
Lebanon, Tennessee 37087

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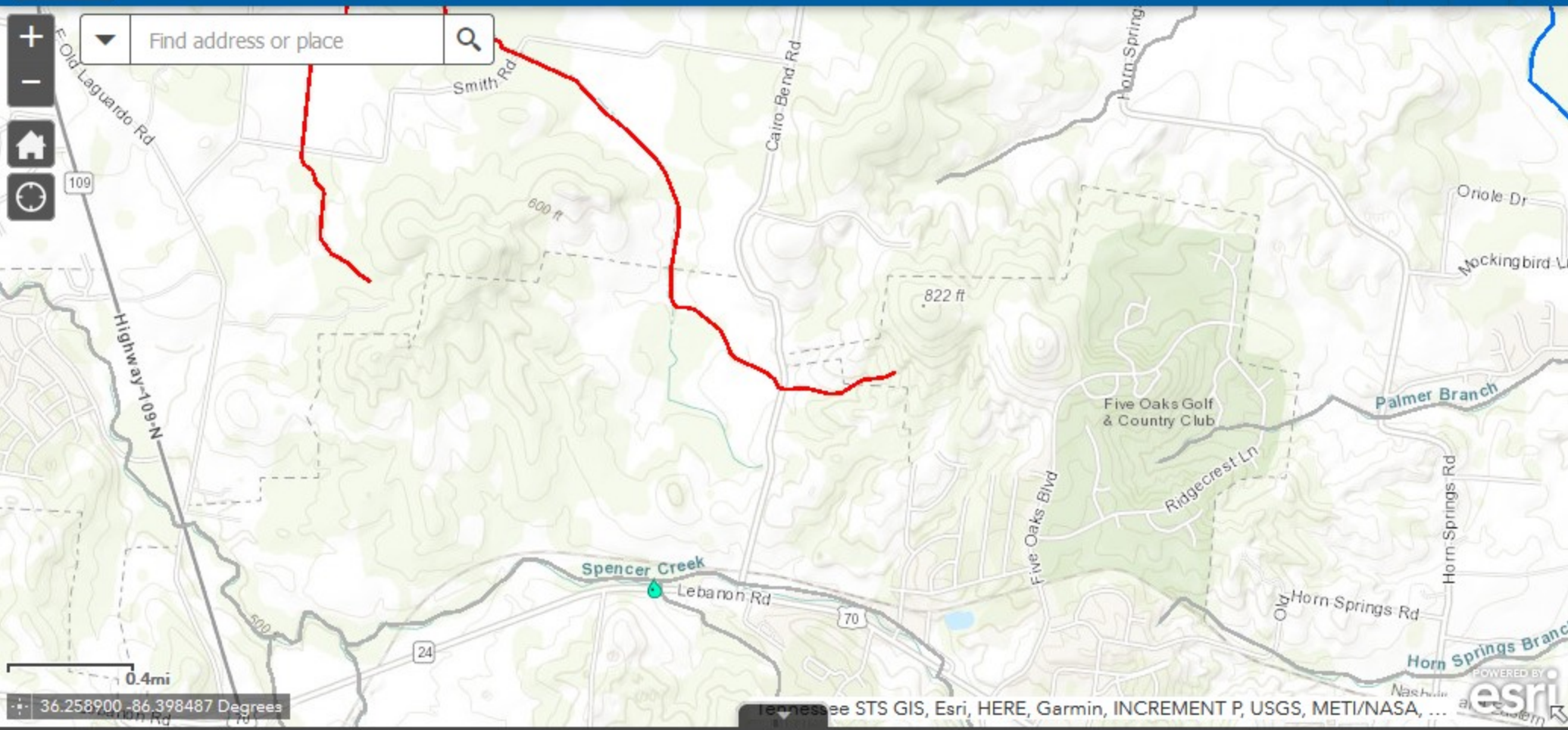
Section 2A – City of Lebanon Unavailable Parameter Waters



Water Resources Permits | Monitoring Sites | Water Quality Assessment | Water Quality Assessment Waterbodies | Counties | **DWR_Public - WPC_WQA_Parameters_2020** x

Options Filter by map extent Zoom to Clear selection Refresh

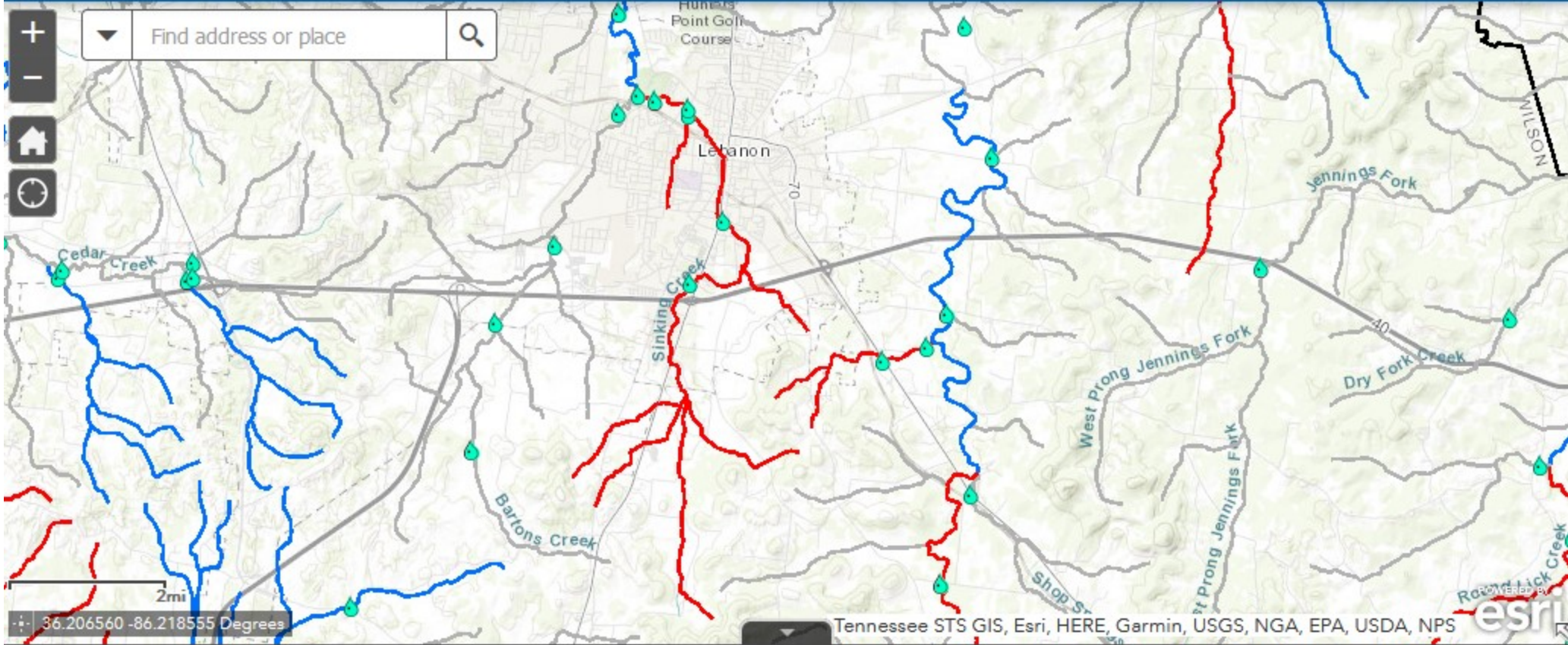
ASSESSMENT_UNIT_ID	ASSESSMENT_UNIT_NAME	WATER_TYPE	WATER_SIZE	PARAM_NAME	SOURCE_NAME
TN05130201013_0300	Black Branch	RIVER	3.29	NUTRIENTS	GRAZING IN RIPARIAN OR SHORELINE ZONES
TN05130201013_0300	Black Branch	RIVER	3.29	ALTERATION IN STREAM-SIDE OR LITTORAL VEGETATIVE COVERS	GRAZING IN RIPARIAN OR SHORELINE ZONES



- Water Resources Permits
- Monitoring Sites
- Water Quality Assessment
- Water Quality Assessment Waterbodies
- Counties
- DWR_Public - WPC_WQA_Parameters_2020 x

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ASSESSMENT_UNIT_ID	ASSESSMENT_UNIT_NAME	WATER_TYPE	WATER_SIZE	PARAM_NAME	SOURCE_NAME
TN05130201001T_1700	Dry Fork Branch	RIVER	7.90	SEDIMENTATION/SILTATION	GRAZING IN RIPARIAN OR SHORELINE ZONES
TN05130201001T_1700	Dry Fork Branch	RIVER	7.90	ALTERATION IN STREAM-SIDE OR LITTORAL VEGETATIVE COVERS	GRAZING IN RIPARIAN OR SHORELINE ZONES



[Water Resources Permits](#) |
 [Monitoring Sites](#) |
 [Water Quality Assessment](#) |
 [Water Quality Assessment Waterbodies](#) |
 [Counties](#) |
 [DWR_Public - WPC_WQA_Parameters_2020](#) x

Options ▾ |
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 Clear selection |
 Refresh

ASSESSMENT_UNIT_ID	ASSESSMENT_UNIT_NAME	WATER_TYPE	WATER_SIZE	PARAM_NAME	SOURCE_NAME
TN05130201055_0200	Sinking Creek	RIVER	17.34	ESCHERICHIA COLI (E. COLI)	SANITARY SEWER OVERFLOWS (COLLECTION SYSTEM FAILURES)
TN05130201055_0200	Sinking Creek	RIVER	17.34	ESCHERICHIA COLI (E. COLI)	MUNICIPAL (URBANIZED HIGH DENSITY AREA)
TN05130201055_0200	Sinking Creek	RIVER	17.34	NUTRIENTS	MUNICIPAL (URBANIZED HIGH DENSITY AREA)
TN05130201055_0200	Sinking Creek	RIVER	17.34	OTHER ANTHROPOGENIC SUBSTRATE ALTERATIONS	MUNICIPAL (URBANIZED HIGH DENSITY AREA)



Rick Bell, Mayor

200 North Castle Heights Avenue
Lebanon, Tennessee 37087

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Section 2B – TMDL Information

TOTAL MAXIMUM DAILY LOAD (TMDL)
for
E. Coli
in the
Old Hickory Lake Watershed (HUC 05130201)
Macon, Smith, Sumner, Trousdale, and Wilson Counties,
Tennessee

FINAL

Prepared by:

Tennessee Department of Environment and Conservation
Division of Water Pollution Control
6th Floor L & C Annex
401 Church Street
Nashville, TN 37243-1534

Submitted March 19, 2008
Approved by EPA Region 4 – March 28, 2008



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LIST OF ABBREVIATIONS

ADB	Assessment Database
AFO	Animal Feeding Operation
BMP	Best Management Practices
BST	Bacteria Source Tracking
CAFO	Concentrated Animal Feeding Operation
CFR	Code of Federal Regulations
CFS	Cubic Feet per Second
CFU	Colony Forming Units
DEM	Digital Elevation Model
DWPC	Division of Water Pollution Control
E. coli	Escherichia coli
EPA	Environmental Protection Agency
GIS	Geographic Information System
HSPF	Hydrological Simulation Program - Fortran
HUC	Hydrologic Unit Code
LA	Load Allocation
LDC	Load Duration Curve
LSPC	Loading Simulation Program in C ⁺⁺
MGD	Million Gallons per Day
MOS	Margin of Safety
MRLC	Multi-Resolution Land Characteristic
MS4	Municipal Separate Storm Sewer System
MST	Microbial Source Tracking
NHD	National Hydrography Dataset
NMP	Nutrient Management Plan
NPS	Nonpoint Source
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resources Conservation Service
PCR	Polymerase Chain Reaction
PDFE	Percent of Days Flow Exceeded
PFGE	Pulsed Field Gel Electrophoresis
Rf3	Reach File v.3
RM	River Mile
SSO	Sanitary Sewer Overflow
STP	Sewage Treatment Plant
SWMP	Storm Water Management Program
TDA	Tennessee Department of Agriculture
TDEC	Tennessee Department of Environment & Conservation
TDOT	Tennessee Department of Transportation
TMDL	Total Maximum Daily Load
TWRA	Tennessee Wildlife Resources Agency
USGS	United States Geological Survey
UCF	Unit Conversion Factor
WCS	Watershed Characterization System
WLA	Waste Load Allocation
WWTF	Wastewater Treatment Facility

SUMMARY SHEET

Total Maximum Daily Load for E. coli in Old Hickory Lake Watershed (HUC 05130201)

Impaired Waterbody Information

State: Tennessee

Counties: Wilson

Watershed: Old Hickory Lake (HUC 05130201)

Constituents of Concern: E. coli

Impaired Waterbodies Addressed in This Document:

Waterbody ID	Waterbody	Miles Impaired
TN05130201013 – 4000	SPRING CREEK	9.0
TN05130201015 – 0200	JOHNSON BRANCH	7.6
TN05130201021 – 0300	NEAL BRANCH	3.7
TN05130201021 – 0400	BEECH LOG CREEK	8.5
TN05130201021 – 2000	ROUND LICK CREEK	8.7
TN05130201028 – 0100	LITTLE GOOSE CREEK	12.7
TN05130201028 – 0150	LITTLE GOOSE CREEK	10.0
TN05130201055 – 0200	SINKING CREEK	17.4
TN05130201055 – 1000	BARTONS CREEK	5.0

Designated Uses:

The designated use classifications for waterbodies in the Old Hickory Lake Watershed include fish and aquatic life, irrigation, livestock watering & wildlife, and recreation.

Water Quality Targets:

Derived from *State of Tennessee Water Quality Standards, Chapter 1200-4-3, General Water Quality Criteria, January, 2004* for recreation use classification (most stringent):

The concentration of the E. coli group shall not exceed 126 colony forming units per 100 mL, as a geometric mean based on a minimum of 5 samples collected from a given sampling site over a period of not more than 30 consecutive days with individual samples being collected at intervals of not less than 12 hours. For the purposes of determining the geometric mean, individual samples having an E. coli concentration of less than 1 per 100 mL shall be considered as having a concentration of 1 per 100 mL. In addition, the concentration of the E. coli group in any individual sample taken from a lake, reservoir, State Scenic River, or Tier II or III stream (1200-4-3-.06) shall not exceed 487 colony forming units per 100 mL. The concentration of the E. coli group in any individual sample taken from any other waterbody shall not exceed 941 colony forming units per 100 mL.

Note: At the time of this TMDL analysis, high quality waters were designated as Tier II and Tier III streams. The proposed revised water quality standards redefine high quality waters as Exceptional Tennessee Waters. For further information on Tennessee's current general water quality standards, see:

<http://www.state.tn.us/sos/rules/1200/1200-04/1200-04-03.pdf>

For further information on the proposed revised general water quality standards and Tennessee's Antidegradation Statement, including the definition of Exceptional Tennessee Waters, see:

http://www.state.tn.us/environment/wpc/publications/1200_04_03_2nd_draft.pdf

TMDL Scope:

Waterbodies identified on the Final 2006 303(d) list as impaired due to E. coli. TMDLs were developed for impaired waterbodies on a HUC-12 subwatershed or waterbody drainage area basis.

Analysis/Methodology:

The TMDLs for impaired waterbodies in the Old Hickory Lake Watershed were developed using a load duration curve methodology to assure compliance with the E. Coli 126 CFU/100 mL geometric mean and the 487 CFU/100 mL maximum water quality criteria for lakes, reservoirs, State Scenic Rivers, or Tier II or Tier III waterbodies and 941 CFU/100 mL maximum water quality criteria for all other waterbodies. A duration curve is a cumulative frequency graph that represents the percentage of time during which the value of a given parameter is equaled or exceeded. Load duration curves are developed from flow duration curves and can illustrate existing water quality conditions (as represented by loads calculated from monitoring data), how these conditions compare to desired targets, and the region of the waterbody flow regime represented by these existing loads. Load duration curves were also used to determine percent load reduction goals to meet the target maximum loading for E. coli. When sufficient data were available, load reductions were also determined based on geometric mean criterion.

Critical Conditions:

Water quality data collected over a period of 10 years for load duration curve analysis were used to assess the water quality standards representing a range of hydrologic and meteorological conditions.

For each impaired waterbody, critical conditions were determined by evaluating the percent load reduction goals, for each hydrologic flow zone, to meet the target (TMDL) loading for E. coli. The percent load reduction goal of the greatest magnitude corresponds with the critical flow zone.

Seasonal Variation:

The 10-year period used for LSPC model simulation period for development of load duration curve analysis included all seasons and a full range of flow and meteorological conditions.

Margin of Safety (MOS):

Explicit MOS = 10% of the E. coli water quality criteria for each impaired subwatershed or drainage area.

**Summary of TMDLs, WLAs, & LAs expressed as daily loads for Impaired Waterbodies
in the Old Hickory Lake Watershed (HUC 05130201)**

HUC-12 Subwatershed (05130201___) or Drainage Area (DA)	Impaired Waterbody Name	Impaired Waterbody ID	TMDL	MOS	WLAs			LAs
					WWTFs ^a	Collection Systems	MS4s	
					[CFU/day]	[CFU/day]	[CFU/day/acre]	
0105	Johnson Branch	TN05130201015 – 0200	$2.30 \times 10^{10} * Q$	$2.30 \times 10^9 * Q$	NA	NA	NA	$6.893 \times 10^6 * Q$
0106	Spring Creek	TN05130201013 – 4000	$1.20 \times 10^{10} * Q$	$1.20 \times 10^9 * Q$	NA	NA	NA	$7.653 \times 10^5 * Q$
0107	Bartons Creek	TN05130201055 – 1000	*b	*b	*b	*b	*b	*b
	Sinking Creek	TN05130201055 – 0200	$2.30 \times 10^{10} * Q$	$2.30 \times 10^9 * Q$	NA	0	$2.175 \times 10^6 * Q$	$2.175 \times 10^6 * Q$
	Sinking Creek	TN05130201055 – 0250	$2.30 \times 10^{10} * Q$	$2.30 \times 10^9 * Q$	NA	0	$2.175 \times 10^6 * Q$	$2.175 \times 10^6 * Q$
0201	Beech Log Creek	TN05130201021 – 0400	$2.30 \times 10^{10} * Q$	$2.30 \times 10^9 * Q$	NA	0	$5.692 \times 10^6 * Q$	$5.692 \times 10^6 * Q$
	Neal Branch	TN05130201021 – 0300	$2.30 \times 10^{10} * Q$	$2.30 \times 10^9 * Q$	NA	0	$1.723 \times 10^7 * Q$	$1.723 \times 10^7 * Q$
	Round Lick Creek	TN05130201021 – 2000	$2.30 \times 10^{10} * Q$	$2.30 \times 10^9 * Q$	9.617×10^9	0	$1.194 \times 10^6 * Q - 5.546 \times 10^5$	$1.194 \times 10^6 * Q - 5.546 \times 10^5$
0302	Little Goose Creek	TN05130201028 – 0100	$2.30 \times 10^{10} * Q$	$2.30 \times 10^9 * Q$	NA	NA	NA	$1.131 \times 10^6 * Q$
	Little Goose Creek	TN05130201028 – 0150	$2.30 \times 10^{10} * Q$	$2.30 \times 10^9 * Q$	NA	NA	NA	$1.651 \times 10^6 * Q$

Notes: NA = Not Applicable.

- a. WLAs for WWTFs are expressed as E. coli loads (CFU/day). All current and future WWTFs must meet water quality standards as specified in their NPDES permit.
- b. Detailed TMDL analyses were not performed on Bartons Creek. It is assumed that water quality standards for E. coli will be attained in this waterbody when the requirements of the Commissioner's Order against Lebanon STP are complete and Lebanon STP complies with the terms of its NPDES permit.

E. COLI TOTAL MAXIMUM DAILY LOAD (TMDL) OLD HICKORY LAKE WATERSHED (HUC 05130201)

1.0 INTRODUCTION

Section 303(d) of the Clean Water Act requires each state to list those waters within its boundaries for which technology based effluent limitations are not stringent enough to protect any water quality standard applicable to such waters. Listed waters are prioritized with respect to designated use classifications and the severity of pollution. In accordance with this prioritization, states are required to develop Total Maximum Daily Loads (TMDLs) for those waterbodies that are not attaining water quality standards. State water quality standards consist of designated uses for individual waterbodies, appropriate numeric and narrative water quality criteria protective of the designated uses, and an antidegradation statement. The TMDL process establishes the maximum allowable loadings of pollutants for a waterbody that will allow the waterbody to maintain water quality standards. The TMDL may then be used to develop controls for reducing pollution from both point and nonpoint sources in order to restore and maintain the quality of water resources (USEPA, 1991).

2.0 SCOPE OF DOCUMENT

This document presents details of TMDL development for waterbodies in the Old Hickory Lake Watershed, identified on the Final 2006 303(d) list as not supporting designated uses due to E. coli. TMDL analyses were performed primarily on a 12-digit hydrologic unit area (HUC-12) basis. In some cases, where appropriate, TMDLs were developed for an impaired waterbody drainage area only.

3.0 WATERSHED DESCRIPTION

The Old Hickory Lake Watershed (HUC 05130201) is located in Middle Tennessee (Figure 1), primarily in Macon, Smith, Sumner, Trousdale, and Wilson Counties. The Old Hickory Lake Watershed lies within one Level III ecoregion (Interior Plateau) and contains five Level IV ecoregions as shown in Figure 2 (USEPA, 1997):

- **Western Pennyroyal Karst (71e)** is a flatter area of irregular plains, with fewer perennial streams, compared to the open hills of the Western Highland Rim (71f). Small sinkholes and depressions are common. The productive soils of this notable agricultural area are formed mostly from a thin loess mantle over residuum of Mississippian-age limestones. Most of the region is cultivated or in pasture; tobacco and livestock are the principal agricultural products, with some corn, soybeans, and small grains. The natural vegetation consisted of oak-hickory forest with mosaics of bluestem prairie. The barrens of Kentucky, that extended south into Stewart, Montgomery, and Robertson counties, were once some of the largest natural grasslands in Tennessee.
- **Western Highland Rim (71f)** is characterized by dissected, rolling terrain of open hills, with elevations of 400 to 1000 feet. The geologic base of Mississippian-age limestone, chert, and shale is covered by soils that tend to be cherty, acidic and low to moderate in fertility. Streams are characterized by coarse chert gravel and sand substrates with

areas of bedrock, moderate gradients, and relatively clear water. The oak-hickory natural vegetation was mostly deforested in the mid to late 1800's, in conjunction with the iron ore related mining and smelting of the mineral limonite, but now the region is again heavily forested. Some agriculture occurs on the flatter areas between streams and in the stream and river valleys: mostly hay, pasture, and cattle, with some cultivation of corn and tobacco.

- **Eastern Highland Rim (71g)** has level terrain, with landforms characterized as tablelands of moderate relief and irregular plains. Mississippian-age limestone, chert, shale and dolomite predominate, and karst terrain sinkholes and depressions are especially noticeable between Sparta and McMinnville. Numerous springs and spring-associated fish fauna also typify the region. Natural vegetation for the region is transitional between the oak-hickory type to the west and the mixed mesophytic forests of the Appalachian ecoregions to the east. Bottomland hardwoods forests were once abundant in some areas, although much of the original bottomland forest has been inundated by several large impoundments. Barrens and former prairie areas are now mostly oak thickets or pasture and cropland.
- **Outer Nashville Basin (71h)** is a heterogeneous region, with rolling and hilly topography and slightly higher elevations. The region encompasses most all of the outer areas of the generally no-cherty Mississippian-age formations, and some Devonian-age Chattanooga shale, remnants of the Highland Rim. The region's limestone rocks and soils are high in phosphorus, and commercial phosphate is mined. Deciduous forest with pasture and cropland are the dominant land covers. Streams are low to moderate gradient, with productive, nutrient-rich waters, resulting in algae, rooted vegetation and occasionally high densities of fish. The Nashville Basin as a whole has a distinctive fish fauna, notable for fish that avoid the region, as well as those that are present.
- **Inner Nashville Basin (71i)** is less hilly and lower than the Outer Nashville Basin. Outcrops of the Ordovician-age limestone are common, and the generally shallow soils are redder and lower in phosphorus than those of the Outer Basin. Streams are lower gradient than surrounding regions, often flowing over large expanses of limestone bedrock. The most characteristic hardwoods within the Inner Basin are a maple-oak-hickory-ash association. The limestone cedar glades of Tennessee, a unique mixed grassland/forest/cedar glades vegetation type with many endemic species, are located primarily on the limestone of the Inner Nashville Basin. The more xeric, open characteristics and shallow soils of the cedar glades also result in a distinct distribution of amphibian and reptile species.

The Old Hickory Lake Watershed, located in Macon, Smith, Sumner, Trousdale, and Wilson Counties, Tennessee, has a drainage area of approximately 986 square miles (mi²). Watershed land use distribution is based on the Multi-Resolution Land Characteristic (MRLC) databases derived from Landsat Thematic Mapper digital images from the period 1990-1993. Although changes in the land use of the Old Hickory Lake Watershed have occurred since 1993 as a result of development, this is the most current land use data available. Land use for the Old Hickory Lake Watershed is summarized in Table 1 and shown in Figure 3. Predominant land use in the Old Hickory Lake Watershed is forest (54.4%) followed by pasture (27.1%). Urban areas represent approximately 3.4% of the total drainage area of the watershed. Details of land use distribution of impaired subwatersheds in the Old Hickory Lake Watershed are presented in Appendix A.

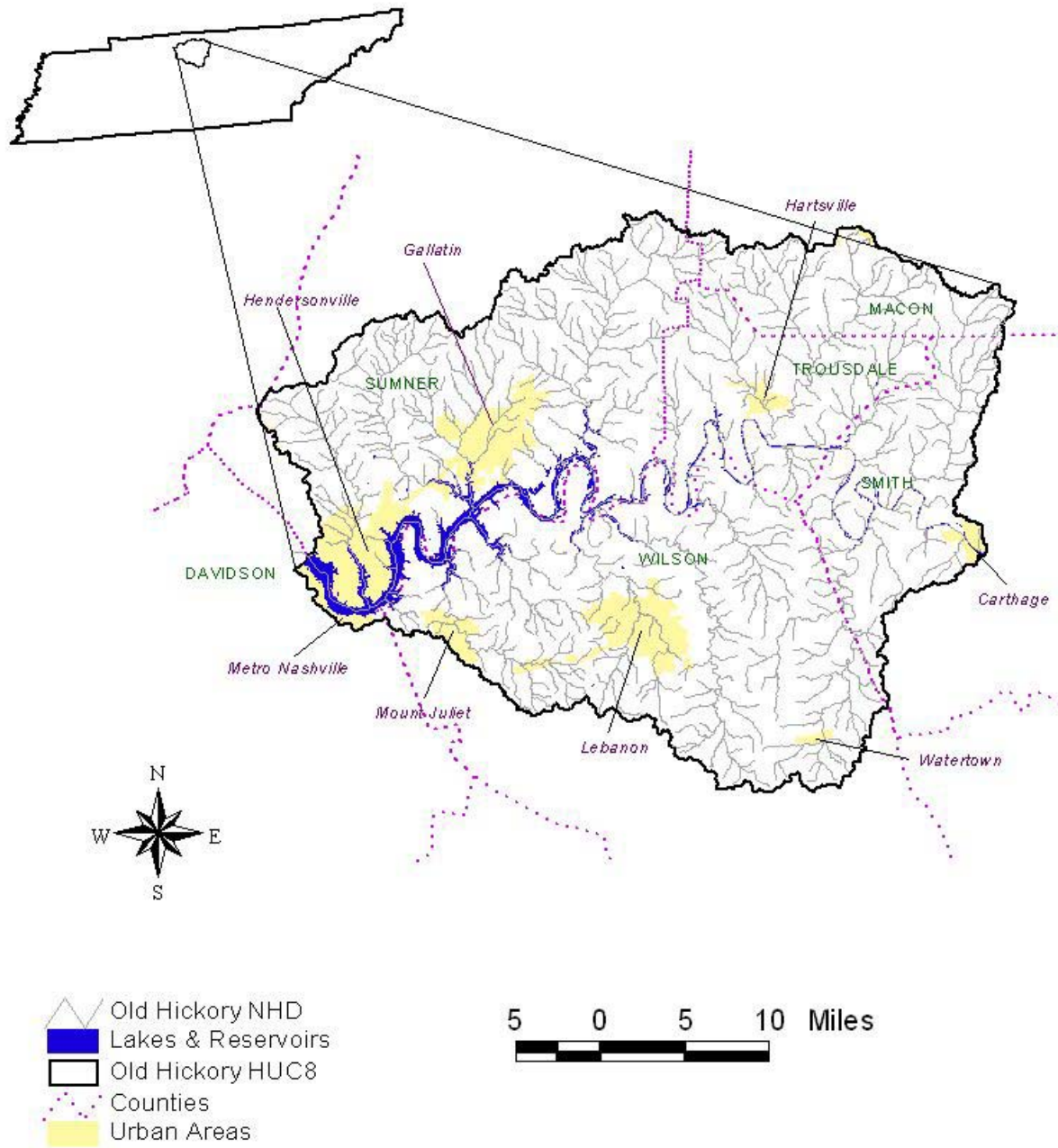


Figure 1. Location of the Old Hickory Lake Watershed.

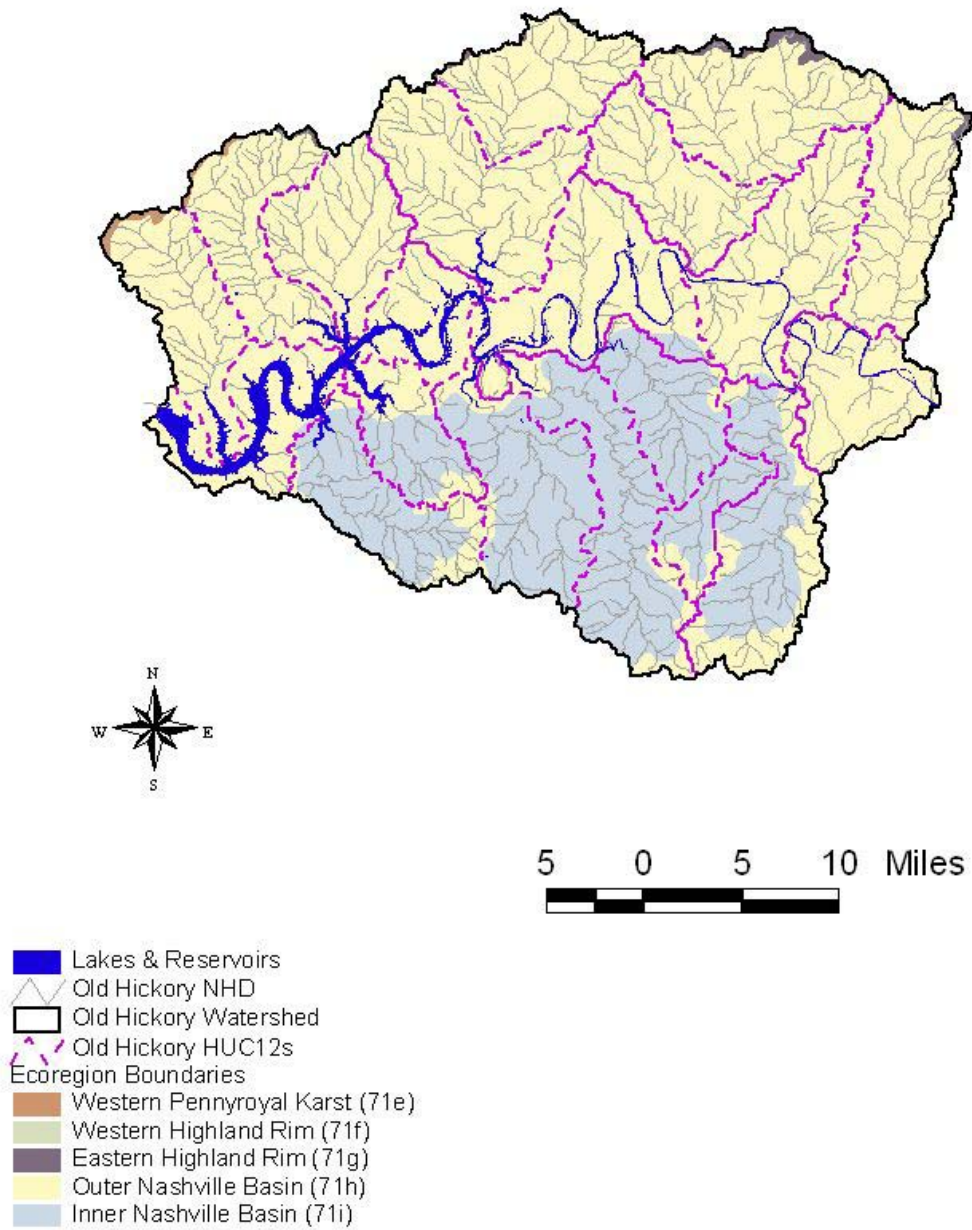


Figure 2. Level IV Ecoregions in the Old Hickory Lake Watershed.

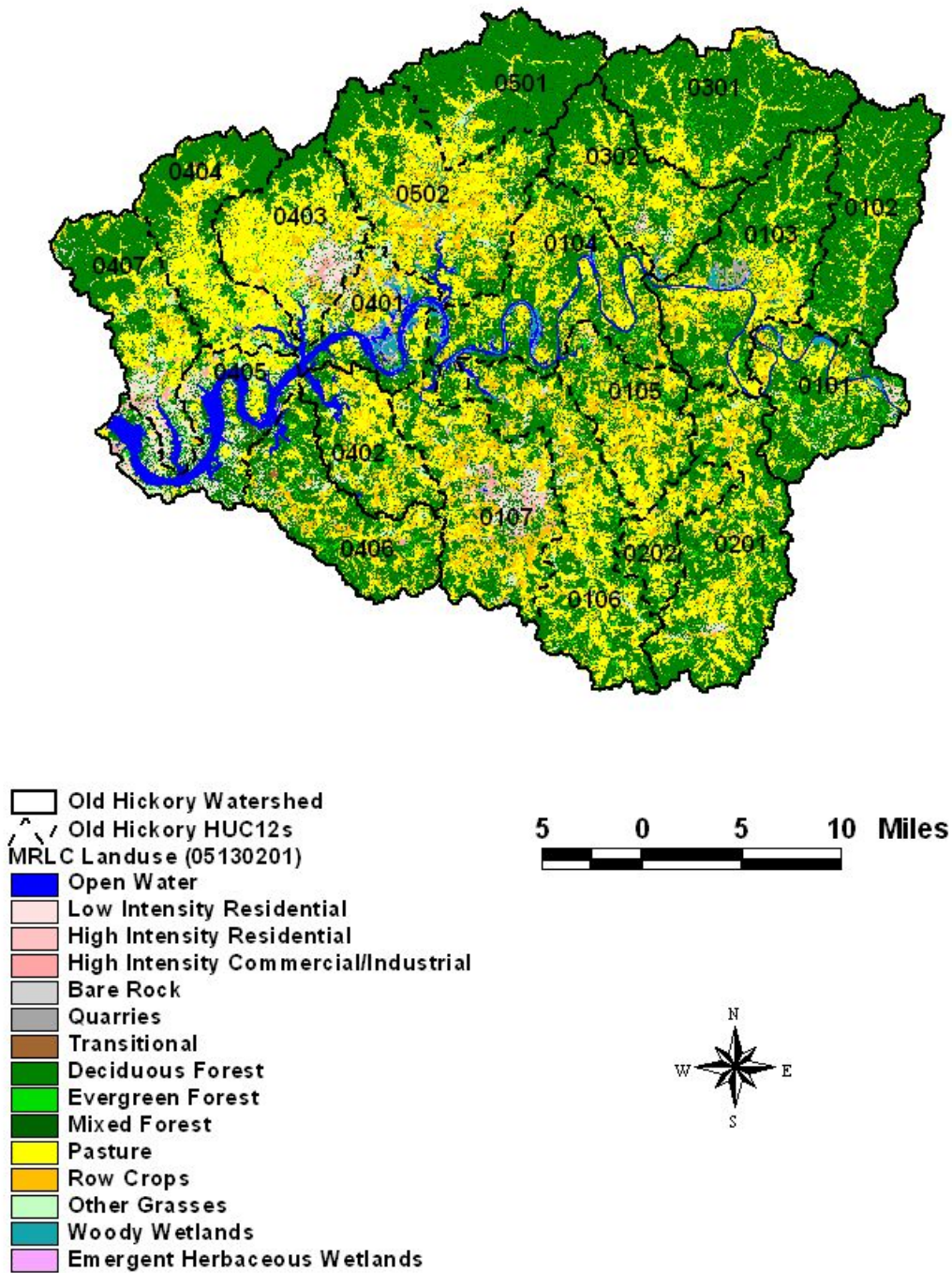


Figure 3. Land Use Characteristics of the Old Hickory Lake Watershed.

Table 1. MRLC Land Use Distribution – Old Hickory Lake Watershed

Land Use	Area	
	[acres]	[%]
Bare Rock/Sand Clay	2.9	0.0
Deciduous Forest	230,850.3	36.6
Emergent Herbaceous Wetlands	1,374.4	0.2
Evergreen Forest	27,561.1	4.4
High Intensity Commercial/Industrial/Transportation	5,488.7	0.9
High Intensity Residential	1,787.8	0.3
Low Intensity Residential	14,073.4	2.2
Mixed Forest	84,254.8	13.4
Open Water	19,788.5	3.1
Other Grasses (Urban/recreational)	9,140.9	1.4
Pasture/Hay	170,899.5	27.1
Quarries/Strip Mines/Gravel Pits	1,093.1	0.2
Row Crops	59,507.5	9.4
Transitional	311.1	0.0
Woody Wetlands	4,678.8	0.7
Total	630,813	100.0

4.0 PROBLEM DEFINITION

The State of Tennessee's final 2006 303(d) list (TDEC, 2006), <http://www.state.tn.us/environment/wpc/publications/303d2006.pdf>, was approved by the U.S. Environmental Protection Agency (EPA), Region IV in October of 2006. This list identified portions of eight waterbodies in the Old Hickory Lake Watershed as not fully supporting designated use classifications due, in part, to E. coli (see Table 2 & Figure 4). The designated use classifications for these waterbodies include fish and aquatic life, irrigation, livestock watering & wildlife, and recreation.

5.0 WATER QUALITY CRITERIA & TMDL TARGET

As previously stated, the designated use classifications for the Old Hickory Lake waterbodies include fish & aquatic life, recreation, irrigation, and livestock watering & wildlife. Of the use classifications with numeric criteria for E. coli, the recreation use classification is the most stringent and will be used to establish target levels for TMDL development. The coliform water quality criteria, for protection of the recreation use classification, is established by *State of Tennessee Water Quality Standards, Chapter 1200-4-3, General Water Quality Criteria, January 2004* (TDEC, 2004a).

Portions of Spring Creek (within Old Hickory Wildlife Management Area and within Sellars Farm State Archaeological Area) have been classified as Tier II. As of February 8, 2008, none of the other impaired waterbodies in the Old Hickory Lake Watershed have been classified as high quality waters.

The geometric mean standard for the E. coli group of 126 colony forming units per 100 ml (CFU/100 ml) and the sample maximum of 487 CFU/100 ml have been selected as the appropriate numerical targets for TMDL development for impaired waterbodies classified as lakes, reservoirs, State Scenic Rivers, or Tier II or Tier III streams. The geometric mean standard for the E. coli group of 126 colony forming units per 100 ml (CFU/100 ml) and the sample maximum of 941 CFU/100 ml have been selected as the appropriate numerical targets for TMDL development for the other impaired waterbodies.

Table 2 Final 2006 303(d) List for E. coli Impaired Waterbodies – Old Hickory Lake Watershed

Waterbody ID	Impacted Waterbody	Miles/Acres Impaired	Cause (Pollutant)	Pollutant Source
TN05130201013 – 4000	SPRING CREEK	9.0	Escherichia coli	Pasture Grazing Livestock in Stream
TN05130201015 – 0200	JOHNSON BRANCH	7.6	Escherichia coli	Pasture Grazing
TN05130201021 – 0300	NEAL BRANCH	3.7	Phosphorus Loss of biological integrity due to siltation Escherichia coli	Livestock in Stream
TN05130201021 – 0400	BEECH LOG CREEK	8.5	Phosphorus Loss of biological integrity due to siltation Escherichia coli	Pasture Grazing
TN05130201021 – 2000	ROUND LICK CREEK	8.7	Nutrients Loss of biological integrity due to siltation Low dissolved oxygen Other habitat alterations Escherichia coli	Minor Municipal Point Source Pasture Grazing
TN05130201028 – 0100	LITTE GOOSE CREEK	12.7	Other Habitat Alteration Escherichia coli	Hydromodification Undetermined Source
TN05130201028 – 0150	LITTE GOOSE CREEK	10.0	Escherichia coli	Pasture Grazing
TN05130201055 – 0200	SINKING CREEK	7.4	Nutrients Other Anthropogenic Substrate Alterations Escherichia coli	Collection System Failure Discharges from MS4 Area
TN05130201055 – 0250	SINKING CREEK	10.0	Alteration in stream-side or littoral vegetative cover Other Anthropogenic Substrate Alterations Escherichia coli	Pasture Grazing Land Development Highway, Road, and Bridge Construction
TN05130201055 – 1000	BARTONS CREEK	5.0	Escherichia coli	Collection System Failure

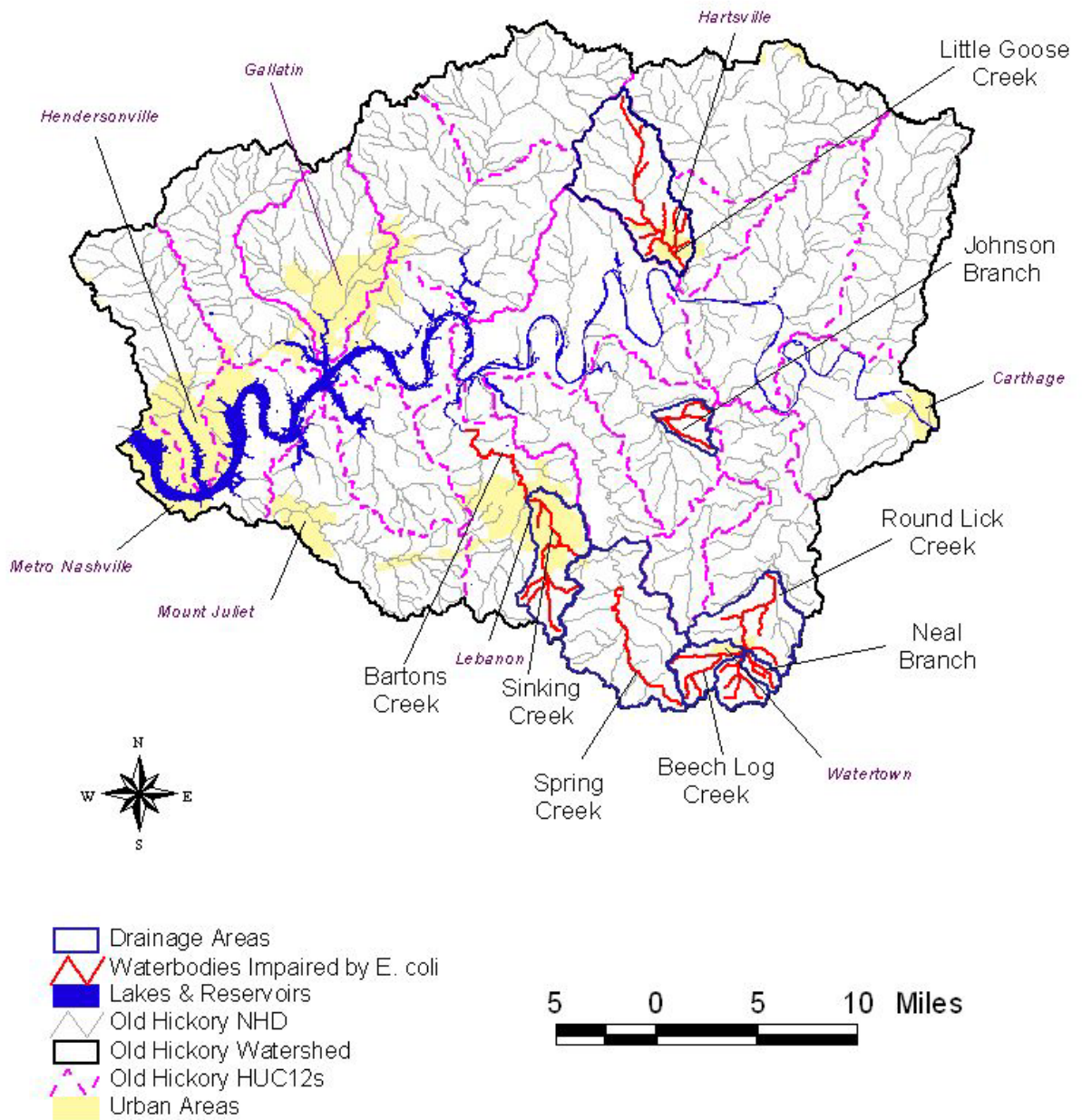


Figure 4. Waterbodies Impaired by E. Coli (as Documented on the Final 2006 303(d) List).

6.0 WATER QUALITY ASSESSMENT AND DEVIATION FROM TARGET

There are multiple water quality monitoring stations that provide data for waterbodies identified as impaired for E. coli in the Old Hickory Lake Watershed. Monitoring stations located on lakes, reservoirs, State Scenic Rivers, or Tier II or Tier III waterbodies have been italicized:

- HUC-12 05130201_0105:
 - JOHNS000.1WS – Johnson Branch, at Big Springs Rd.
 - JOHNS000.4WS – Johnson Branch, 1.4 mi u/s Big Springs Rd.
- HUC-12 05130201_0106:
 - SPRIN016.0WS – Spring Creek, at Spring Creek Rd.
 - *SPRIN019.2WS* – *Spring Creek, at Eastover Rd.*
 - SPRIN027.0WS – Spring Creek, u/s Chicken Rd.
- HUC-12 05130201_0107:
 - BARTO007.4WS – Bartons Creek, at Maple Hill Rd. (off Trice Rd.)
 - BARTO009.6WS – Bartons Creek, at Hartmann Dr.
 - BARTO011.5WS – Bartons Creek, at Hidden Acres off Hwy 70/26
 - BARTO015.3WS – Bartons Creek, at Franklin Rd.
 - BARTO017.6WS – Bartons Creek, at Old Shannon Rd.
 - SINKI000.9WS – Sinking Creek, off Castle Heights N. @ J. Floud F.L.C.
 - SINKI004.0WS – Sinking Creek, at Highway 231 u/s Lebanon
- HUC-12 05130201_0201:
 - BEECH000.6WS/BLOG000.6WS – Beech Log Creek, at Old Statesville Rd. (Hwy 70)
 - NEAL000.1WS – Neal Branch, at Neal Rd.
 - RLICK017.1WS – Round Lick Creek, 200 yds u/s Wherley Rd.
 - RLICK018.7WS – Round Lick Creek, d/s Watertown STP at bridge
 - RLICK019.1WS – Round Lick Creek, 100 yds d/s Watertown STP, off Commerce Rd.
 - RLICK019.2WS/RLICK019.4WS – Round Lick Creek, 150 ft u/s Watertown STP
 - RLICK019.4WS – Round Lick Creek, approx. 150 ft u/s Watertown STP
 - RLICK020.2WS – Round Lick Creek, u/s of Hwy 267
- HUC-12-05130201_0302:
 - LGOOS004.7TR – Little Goose Creek, at E. Main Street, at ball fields
 - LGOOS007.5TR – Little Goose Creek, at Hwy 260

The location of these monitoring stations is shown in Figure 5. Water quality monitoring results for these stations are tabulated in Appendix B. Examination of the data shows exceedances of the 487 CFU/100 mL (lakes, reservoirs, State Scenic Rivers, or Tier II or Tier III waterbodies) and 941 CFU/100 mL (all other waterbodies) maximum E. coli standard at many monitoring stations. Water quality monitoring results for those stations with 10% or more of samples exceeding water quality maximum criteria are summarized in Table 3. Whenever a minimum of 5 samples was collected at a given monitoring station over a period of not more than 30 consecutive days, the geometric mean was calculated.

Table 3 Summary of TDEC Water Quality Monitoring Data

Monitoring Station	Date Range	E. Coli (Max WQ Target = 941 CFU/100 mL)**				
		Data Pts.	Min.	Avg.	Max.	No. Exceed. WQ Max. Target
			[CFU/100 ml]	[CFU/100 ml]	[CFU/100 ml]	
BARTO009.6WS	2000 – 2005	18	26	354	1,400	2
BARTO017.6WS	2000 – 2001	5	22	567	>2,400	1
BEECH000.6WS	2004 – 2005	9	80	476	>2,400	1
JOHNS000.1WS	2004 – 2004	11	93	524	1,600	2
JOHNS000.4WS	2000 – 2001	4	140	813	2,000	1
LGOOS004.7TR	2004 – 2005	11	96	661	2,400	2
LGOOS007.5TR	2004 – 2005	11	50	513	2,400	2
NEAL000.1WS	2001 – 2005	15	410	1,357	>2,400	8
RLICK018.7WS	2000 – 2005	16	36	721	>2,400	4
SINKI000.9WS	2004 – 2005	11	84	613	2,400	2
SINKI004.0WS	2000 – 2001	3	>2,400	2,400	>2,400	3
<i>SPRIN019.2WS</i>	<i>2004 – 2005</i>	<i>10</i>	<i>16</i>	<i>331</i>	<i>1,600</i>	<i>1</i>
SPRIN027.0WS	2000 – 2001	5	530	1,132	>2,400	3

** Maximum water quality target is 487 CFU/100 mL for lakes, reservoirs, State Scenic Rivers, or Tier II or Tier III waterbodies and 941 CFU/100 mL for other waterbodies. Waterbodies utilizing the 487 CFU/100 mL target are italicized.

Several of the water quality monitoring stations (Table 3 and Appendix B) have at least one E. coli sample value reported as >2400. In addition, at six of these sites, the maximum E. coli sample value is >2400. For the purpose of calculating summary data statistics, TMDLs, Waste Load Allocations (WLAs), and Load Allocations (LAs), these data values are treated as (equal to) 2400. Therefore, the calculated results are considered to be estimates. Future E. coli sample analyses at these sites should follow established protocol. See Section 9.4.

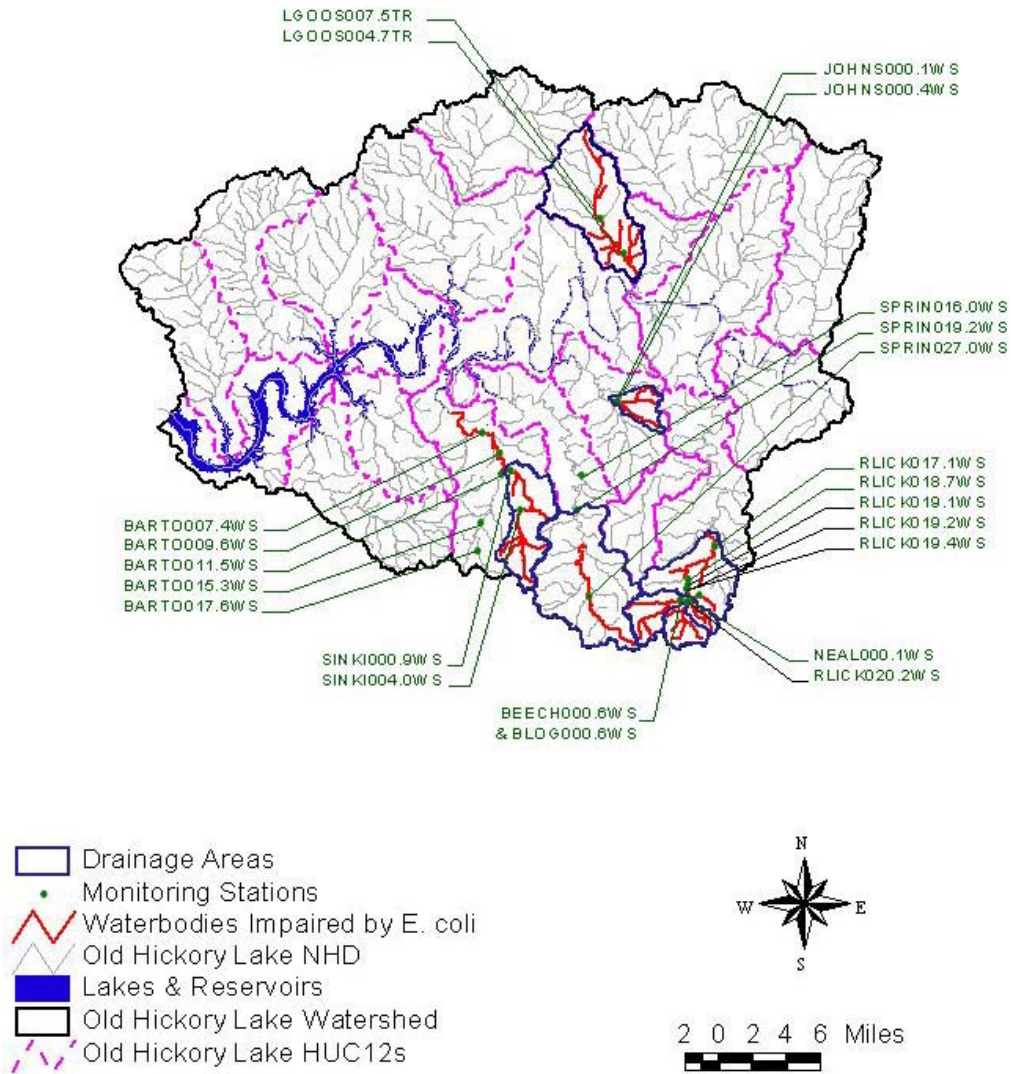


Figure 5. Water Quality Monitoring Stations in the Old Hickory Lake Watershed

7.0 SOURCE ASSESSMENT

An important part of TMDL analysis is the identification of individual sources, or source categories of pollutants in the watershed that affect pathogen loading and the amount of loading contributed by each of these sources.

Under the Clean Water Act, sources are classified as either point or nonpoint sources. Under 40 CFR §122.2, (<http://www.epa.gov/epacfr40/chapt-I.info/chi-toc.htm>), a point source is defined as a discernable, confined, and discrete conveyance from which pollutants are or may be discharged to surface waters. The National Pollutant Discharge Elimination System (NPDES) program (<http://cfpub1.epa.gov/npdes/index.cfm>) regulates point source discharges. Point sources can be described by three broad categories: 1) NPDES regulated municipal (http://cfpub1.epa.gov/npdes/home.cfm?program_id=13) and industrial (http://cfpub1.epa.gov/npdes/home.dfm?program_id=14) wastewater treatment facilities (WWTFs); 2) NPDES regulated industrial and municipal storm water discharges (http://cfpub1.epa.gov/npdes/home.cfm?program_id=6); and 3) NPDES regulated Concentrated Animal Feeding Operations (CAFOs) (http://cfpub1.epa.gov/npdes/home.cfm?program_id=7). A TMDL must provide Waste Load Allocations (WLAs) for all NPDES regulated point sources. Nonpoint sources are diffuse sources that cannot be identified as entering a waterbody through a discrete conveyance at a single location. For the purposes of this TMDL, all sources of pollutant loading not regulated by NPDES permits are considered nonpoint sources. The TMDL must provide a Load Allocation (LA) for these sources.

7.1 Point Sources

7.1.1 NPDES Regulated Municipal and Industrial Wastewater Treatment Facilities

Both treated and untreated sanitary wastewater contain coliform bacteria. There are 14 WWTFs in the Old Hickory Lake Watershed that have NPDES permits authorizing the discharge of treated sanitary wastewater. Two of these facilities are located in an impaired subwatershed or drainage area (see Table 4 & Figure 6). The permit limits for discharges from these WWTFs are in accordance with the coliform criteria specified in Tennessee Water Quality Standards for the protection of the recreation use classification.

Non-permitted point sources of (potential) E. coli contamination of surface waters associated with STP collection systems include leaking collection systems (LCSs) and sanitary sewer overflows (SSOs).

Note: As stated in Section 5.0, the current coliform criteria are expressed in terms of E. coli concentration, whereas previous criteria were expressed in terms of fecal coliform and E. coli concentration. Due to differences in permit issuance dates, some permits still have fecal coliform limits instead of E. coli. As permits are reissued, limits for fecal coliform will be replaced by E. coli limits.

Table 4 NPDES Permitted WWTFs in Impaired Subwatersheds or Drainage Areas

NPDES Permit No.	Facility	Design Flow	Receiving Stream
		[MGD]	
TN0025488	Watertown STP	0.27	Round Lick Creek at Mile 19.2
TN0028754	Lebanon STP	7.5	Old Hickory Lake at Mile 252.2

All treatment processes were in operation at the Watertown STP and the effluent was clear at the time of a Compliance Evaluation Inspection conducted in February 2000. However, insufficient documentation of sampling test results and standard instrument calibration was noted.

According to a Pretreatment Audit Inspection conducted at the Watertown STP in February 2005, there were numerous concerns regarding one of the industrial permittees, Technical Plating & Rubber (TPR). At the time of the inspection, a copy of the current permit application for the industrial permittee could not be located and several discharge violations had occurred for the permittee. It was also noted that the Watertown STP has a history of late submittals of Pretreatment Semi-Annual Reports (SARs).

The Lebanon STP serves the Lebanon municipality and discharges to Old Hickory Lake at mile 252.2. The sanitary sewer collection system has documented long-term wet-weather overflow problems and has historically been a significant contributor to E. coli impairment in the Bartons Creek watershed. The Lebanon STP is operating under Commissioner's Order 04-0146 for chronic violations of NPDES permit limits from May 2002 thru May 2004 (suspended solids, settleable solids, fecal, chlorine, CBOD, DO, Whole Effluent Toxicity, bypasses, and 160 collection system overflows). The Order mandates elimination of overflows by June 30, 2010. Lebanon has been pursuing significant infiltration and inflow reduction programs. The City also plans to begin a construction program at the STP in spring 2008 that will provide additional peak flow capacity. These efforts are intended to result in compliance with the Order.

7.1.2 NPDES Regulated Municipal Separate Storm Sewer Systems (MS4s)

Municipal Separate Storm Sewer Systems (MS4s) are considered to be point sources of E. coli. Discharges from MS4s occur in response to storm events through road drainage systems, curb and gutter systems, ditches, and storm drains. Phase I of the EPA storm water program (<http://cfpub.epa.gov/npdes/stormwater/swphases.cfm#phase1>) requires large and medium MS4s to obtain NPDES storm water permits. Large and medium MS4s are those located in incorporated places or counties serving populations greater than 100,000 people. At present, Metro Nashville/Davidson County is the only large or medium (Phase I) MS4 in the Old Hickory Lake Watershed.

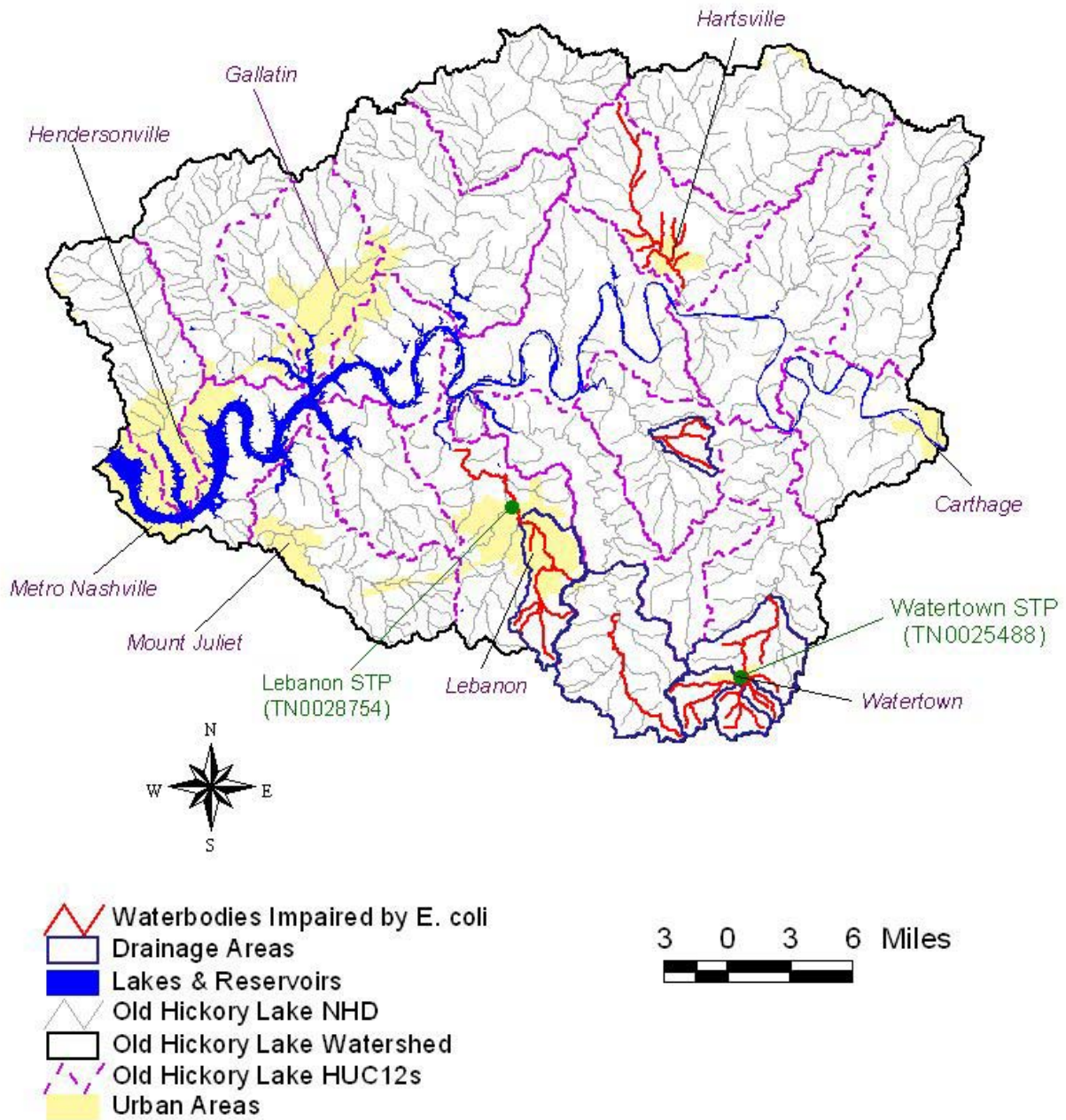


Figure 6. NPDES Regulated Point Sources in and near Impaired Subwatersheds and Drainage Areas of the Old Hickory Lake Watershed.

As of March 2003, regulated small MS4s in Tennessee must also obtain NPDES permits in accordance with the Phase II storm water program (<http://cfpub.epa.gov/npdes/stormwater/swphases.cfm#phase2>). A small MS4 is designated as *regulated* if: a) it is located within the boundaries of a defined urbanized area that has a residential population of at least 50,000 people and an overall population density of 1,000 people per square mile; b) it is located outside of an urbanized area but within a jurisdiction with a population of at least 10,000 people, a population density of 1,000 people per square mile, and has the potential to cause an adverse impact on water quality; or c) it is located outside of an urbanized area but contributes substantially to the pollutant loadings of a physically interconnected MS4 regulated by the NPDES storm water program. Most regulated small MS4s in Tennessee obtain coverage under the *NPDES General Permit for Discharges from Small Municipal Separate Storm Sewer Systems* (<http://state.tn.us/environment/wpc/ppo/TN%20Small%20MS4%20Modified%20General%20Permit%202003.pdf>) (TDEC, 2003). Gallatin, Hendersonville, Lebanon, Mount Juliet, Sumner County, and Wilson County are covered under Phase II of the NPDES Storm Water Program.

The Tennessee Department of Transportation (TDOT) has been issued an individual MS4 permit (TNS077585) that authorizes discharges of storm water runoff from State roads and interstate highway right-of-ways that TDOT owns or maintains, discharges of storm water runoff from TDOT owned or operated facilities, and certain specified non-storm water discharges. This permit covers all eligible TDOT discharges statewide, including those located outside of urbanized areas. TDOT's individual MS4 permit may be obtained from the Tennessee Department of Environment and Conservation (TDEC) website: <http://state.tn.us/environment/wpc/stormh2o/TNS077585.pdf>.

For information regarding storm water permitting in Tennessee, see the TDEC website:

<http://www.state.tn.us/environment/wpc/stormh2o/>.

7.1.3 NPDES Concentrated Animal Feeding Operations (CAFOs)

Animal feeding operations (AFOs) are agricultural enterprises where animals are kept and raised in confined situations. AFOs congregate animals, feed, manure and urine, dead animals, and production operations on a small land area. Feed is brought to the animals rather than the animals grazing or otherwise seeking feed in pastures, fields, or on rangeland (USEPA, 2002a). Concentrated Animal Feeding Operations (CAFOs) are AFOs that meet certain criteria with respect to animal type, number of animals, and type of manure management system. CAFOs are considered to be potential point sources of pathogen loading and are required to obtain an NPDES permit. Most CAFOs in Tennessee obtain coverage under TNA000000, *Class II Concentrated Animal Feeding Operation General Permit* (<http://state.tn.us/environment/wpc/ppo/CAFO%20Final%20PDF%20Modified.pdf>), while larger, Class I CAFOs are required to obtain an individual NPDES permit.

As of November 26, 2007, there are no Class I CAFOs with individual permits and no Class II CAFOs with coverage under the general NPDES permit located in the Old Hickory Lake Watershed. There is one Class II CAFO with an application pending. Crooked Oaks Farms (TNA000150) is located near Goose Creek. This facility is not located in an impaired subwatershed or drainage area.

7.2 Nonpoint Sources

Nonpoint sources of coliform bacteria are diffuse sources that cannot be identified as entering a waterbody through a discrete conveyance at a single location. These sources generally, but not always, involve accumulation of coliform bacteria on land surfaces and wash off as a result of storm events. Nonpoint sources of E. coli loading are primarily associated with agricultural and urban land uses. Many of the waterbodies identified on the Final 2006 303(d) list as impaired due to E. coli are attributed to nonpoint sources.

7.2.1 Wildlife

Wildlife deposit coliform bacteria, with their feces, onto land surfaces where it can be transported during storm events to nearby streams. The overall deer density for Tennessee was estimated by the Tennessee Wildlife Resources Agency (TWRA) to be 23 animals per square mile.

7.2.2 Agricultural Animals

Agricultural activities can be a significant source of coliform bacteria loading to surface waters. The activities of greatest concern are typically those associated with livestock operations:

- Agricultural livestock grazing in pastures deposit manure containing coliform bacteria onto land surfaces. This material accumulates during periods of dry weather and is available for washoff and transport to surface waters during storm events. The number of animals in pasture and the time spent grazing are important factors in determining the loading contribution.
- Processed agricultural manure from confined feeding operations is often applied to land surfaces and can provide a significant source of coliform bacteria loading. Guidance for issues relating to manure application is available through the University of Tennessee Agricultural Extension Service and the Natural Resources Conservation Service (NRCS).
- Agricultural livestock and other unconfined animals often have direct access to waterbodies and can provide a concentrated source of coliform bacteria loading directly to a stream.

Data sources related to livestock operations include the 2002 Census of Agriculture (<http://www.nass.usda.gov/census/census02/volume1/tn/index2.htm>). Livestock data for counties located within the Old Hickory Lake watershed are summarized in Table 5. Note that, due to confidentiality issues, any tabulated item that identifies data reported by a respondent or allows a respondent's data to be accurately estimated or derived is suppressed and coded with a 'D' (USDA, 2004).

7.2.3 Failing Septic Systems

Some coliform loading in the Old Hickory Lake Watershed can be attributed to failure of septic systems and illicit discharges of raw sewage. Estimates from 1997 county census data of people in the Old Hickory Lake Watershed utilizing septic systems were compiled using the WCS and are summarized in Table 6. WCS is an Arcview geographic information system (GIS) based program developed by USEPA Region IV to facilitate watershed characterization and TMDL development. In middle and eastern Tennessee, it is estimated that there are approximately 2.37 people per household on septic systems, some of which can be reasonably assumed to be failing. As with livestock in streams, discharges of raw sewage provide a concentrated source of coliform bacteria directly to waterbodies.

7.2.4 Urban Development

Nonpoint source loading of coliform bacteria from urban land use areas is attributable to multiple sources. These include: stormwater runoff, illicit discharges of sanitary waste, runoff from improper disposal of waste materials, leaking septic systems, and domestic animals. Impervious surfaces in urban areas allow runoff to be conveyed to streams quickly, without interaction with soils and groundwater. Urban land use area in impaired subwatersheds in the Old Hickory Lake Watershed ranges from 0.1% to 19.3%. Land use for the Old Hickory Lake impaired drainage areas is summarized in Figures 7 through 10 and tabulated in Appendix A.

Table 5 Livestock Distribution in the Old Hickory Lake Watershed

County	Livestock Population (2002 Census of Agriculture)						
	Beef Cow	Milk Cow	Poultry		Hogs	Sheep	Horse
			Layers	Broilers			
Macon	D	D	978	D	3,738	58	2,104
Smith	16,756	520	975	105	D	540	1,687
Sumner	22,246	884	1,451	336	592	537	3,590
Trousdale	5,807	64	119	D	27	167	468
Wilson	29,077	873	1,873	103	2,194	762	4,498

* In keeping with the provisions of Title 7 of the United States Code, no data are published in the 2002 Census of Agriculture that would disclose information about the operations of an individual farm or ranch. Any tabulated item that identifies data reported by a respondent or allows a respondent's data to be accurately estimated or derived is suppressed and coded with a 'D' (USDA, 2004).

Table 6 Estimated Population on Septic Systems in the Old Hickory Lake Watershed

County	Total Population (2000 Census)	Population on Septic Systems
Macon	20,386	13,012
Smith	17,712	10,878
Sumner	130,449	55,440
Trousdale	7,259	3,861
Wilson	88,809	442

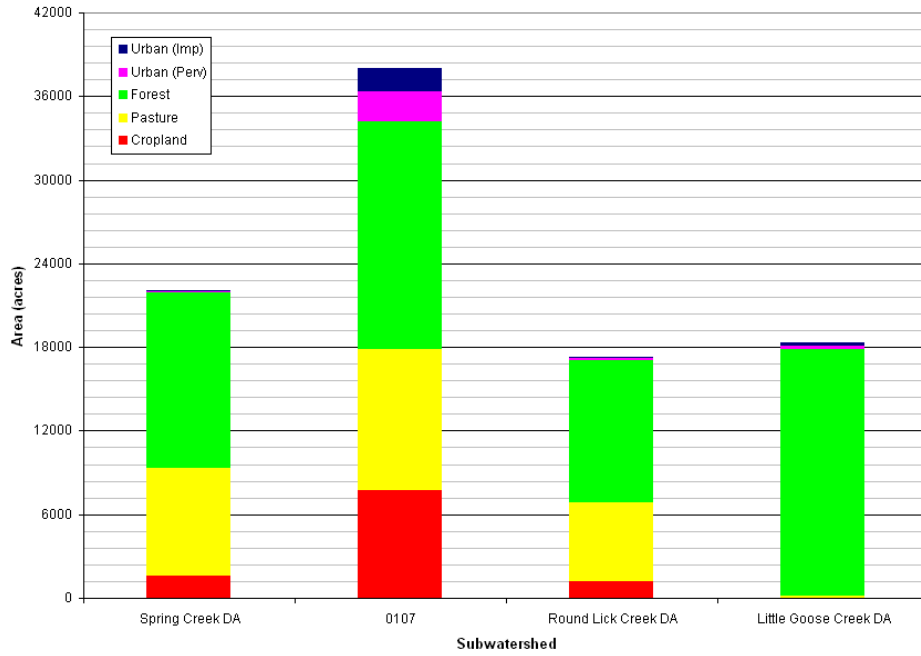


Figure 7. Land Use Area of Old Hickory Lake E. coli-Impaired Subwatersheds – Drainage Areas Greater Than 10,000 Acres

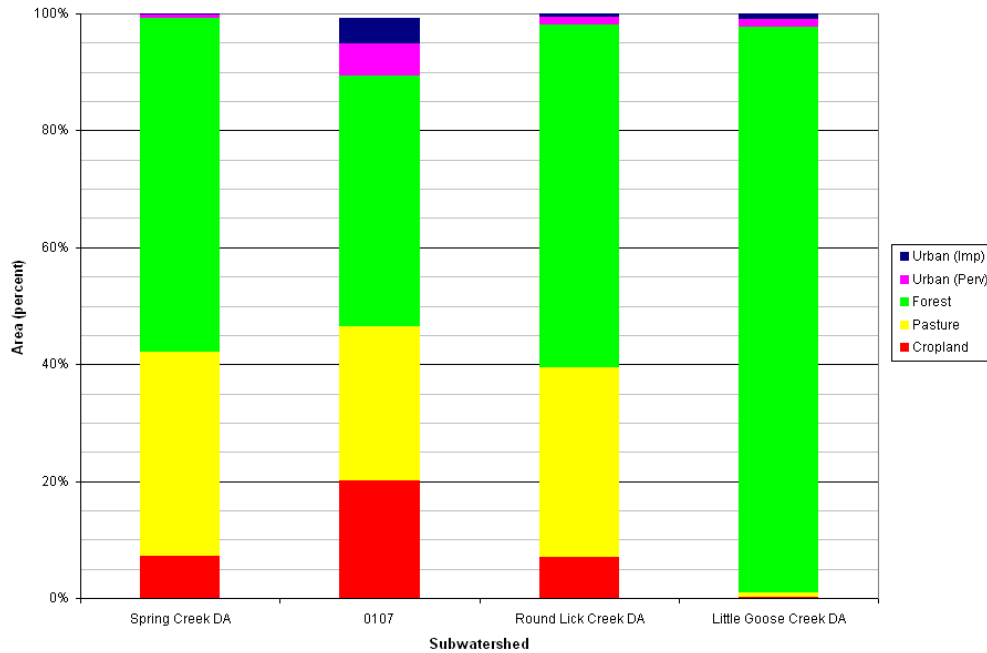


Figure 8. Land Use Percent of the Old Hickory Lake E. coli-Impaired Subwatersheds – Drainage Areas Greater Than 10,000 Acres

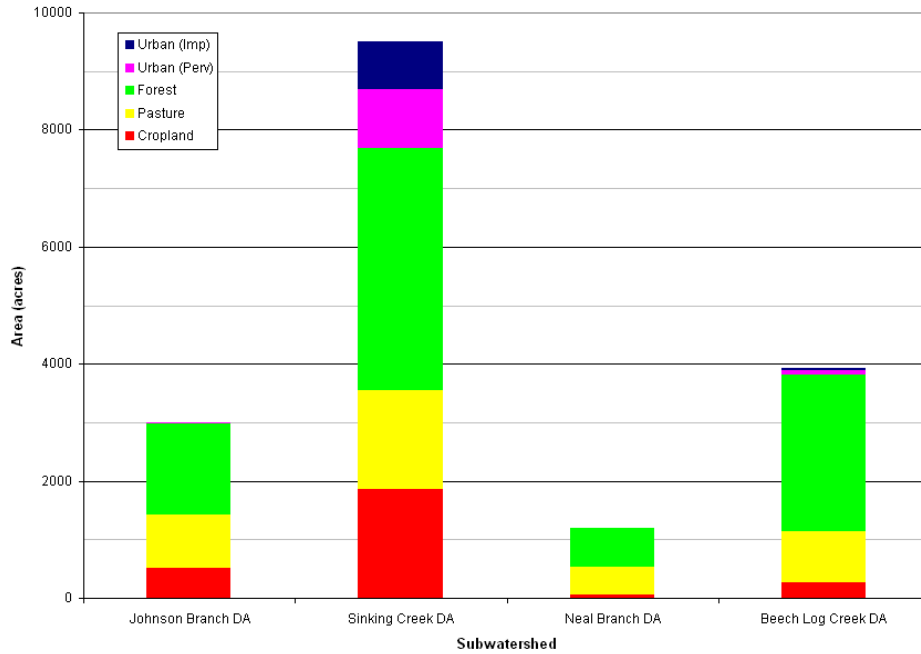


Figure 9. Land Use Area of Old Hickory Lake E. coli-Impaired Subwatersheds – Drainage Areas Less Than 10,000 Acres

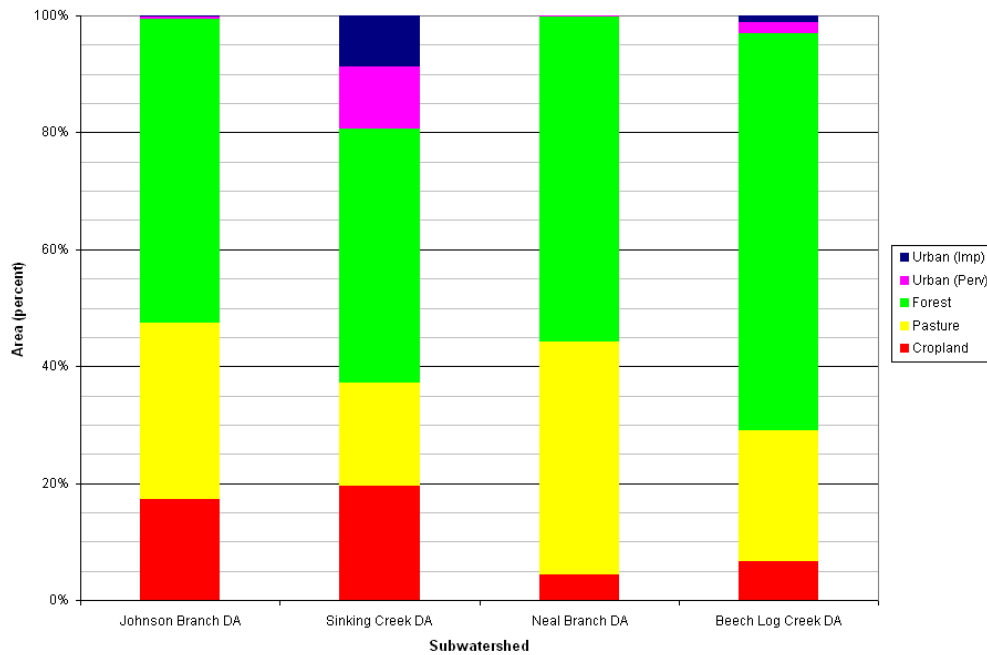


Figure 10. Land Use Percent of the Old Hickory Lake E. coli-Impaired Subwatersheds – Drainage Areas Less Than 10,000 Acres

8.0 DEVELOPMENT OF TOTAL MAXIMUM DAILY LOADS

The Total Maximum Daily Load (TMDL) process quantifies the amount of a pollutant that can be assimilated in a waterbody, identifies the sources of the pollutant, and recommends regulatory or other actions to be taken to achieve compliance with applicable water quality standards based on the relationship between pollution sources and in-stream water quality conditions. A TMDL can be expressed as the sum of all point source loads (Waste Load Allocations), non-point source loads (Load Allocations), and an appropriate margin of safety (MOS) that takes into account any uncertainty concerning the relationship between effluent limitations and water quality:

$$\text{TMDL} = \sum \text{WLAs} + \sum \text{LAs} + \text{MOS}$$

The objective of a TMDL is to allocate loads among all of the known pollutant sources throughout a watershed so that appropriate control measures can be implemented and water quality standards achieved. 40 CFR §130.2 (i) (<http://www.epa.gov/epacfr40/chapt-I.info/chi-toc.htm>) states that TMDLs can be expressed in terms of mass per time, toxicity, or other appropriate measure.

This document describes TMDL, Waste Load Allocation (WLA), Load Allocation (LA), and Margin of Safety (MOS) development for waterbodies identified as impaired due to E. coli on the Final 2006 303(d) list.

8.1 Expression of TMDLs, WLAs, & LAs

In this document, the E. coli TMDL is a daily load expressed as a function of mean daily flow (daily loading function). For implementation purposes, corresponding percent load reduction goals (PLRGs) to decrease E. coli loads to TMDL target levels, within each respective flow zone, are also expressed. WLAs & LAs for precipitation-induced loading sources are also expressed as daily loading functions in CFU/day/acre. Allocations for loading that is independent of precipitation (WLAs for WWTFs and LAs for “other direct sources”) are expressed as CFU/day.

8.2 Area Basis for TMDL Analysis

The primary area unit of analysis for TMDL development was the HUC-12 subwatershed containing one or more waterbodies assessed as impaired due to E. coli (as documented on the 2006 303(d) List). In some cases, however, TMDLs were developed for an impaired waterbody drainage area only. Determination of the appropriate area to use for analysis (see Table 7) was based on a careful consideration of a number of relevant factors, including: 1) location of impaired waterbodies in the HUC-12 subwatershed; 2) land use type and distribution; 3) water quality monitoring data; and 4) the assessment status of other waterbodies in the HUC-12 subwatershed.

Table 7 Determination of Analysis Areas for TMDL Development

HUC-12 Subwatershed (05130201____)	Impaired Waterbody	Area
0105	Johnson Branch	DA
0106	Spring Creek	DA
0107	Sinking Creek	HUC-12
0201	Beech Log Creek Neal Branch Round Lick Creek	DA
0302	Little Goose Creek	DA

Note: HUC-12 = HUC-12 Subwatershed
 DA = Waterbody Drainage Area

8.3 TMDL Analysis Methodology

TMDLs for the Old Hickory Lake Watershed were developed using load duration curves for analysis of impaired HUC-12 subwatersheds or specific waterbody drainage areas. A load duration curve (LDC) is a cumulative frequency graph that illustrates existing water quality conditions (as represented by loads calculated from monitoring data), how these conditions compare to desired targets, and the portion of the waterbody flow zone represented by these existing loads. Load duration curves are considered to be well suited for analysis of periodic monitoring data collected by grab sample. LDCs were developed at monitoring site locations in impaired waterbodies and daily loading functions were expressed for TMDLs, WLAs, LAs, and MOS. In addition, load reductions (PLRGs) for each flow zone were calculated for prioritization of implementation measures according to the methods described in Appendix E.

8.4 Critical Conditions and Seasonal Variation

The critical condition for non-point source E. coli loading is an extended dry period followed by a rainfall runoff event. During the dry weather period, E. coli bacteria builds up on the land surface, and is washed off by rainfall. The critical condition for point source loading occurs during periods of low streamflow when dilution is minimized. Both conditions are represented in the TMDL analysis.

The ten-year period from October 1, 1995 to September 30, 2005 was used to simulate flow. This 10-year period contained a range of hydrologic conditions that included both low and high streamflows. Critical conditions are accounted for in the load duration curve analyses by using the entire period of flow and water quality data available for the impaired waterbodies.

In all subwatersheds, water quality data have been collected during most flow ranges. For each Subwatershed, the critical flow zone has been identified based on the incremental levels of impairment relative to the target loads. Based on the location of the water quality exceedances on the load duration curves and the distribution of critical flow zones, no one delivery mode for E. coli appears to be dominant for waterbodies in the Old Hickory Lake watershed (see Section 9.3 and Table 8).

Seasonal variation was incorporated in the load duration curves by using the entire simulation period and all water quality data collected at the monitoring stations. The water quality data were collected during all seasons.

8.5 Margin of Safety

There are two methods for incorporating MOS in TMDL analysis: a) implicitly incorporate the MOS using conservative model assumptions; or b) explicitly specify a portion of the TMDL as the MOS and use the remainder for allocations. For development of E. coli TMDLs in the Old Hickory Lake Watershed, an explicit MOS, equal to 10% of the E. coli water quality targets (ref.: Section 5.0), was utilized for determination of WLAs and LAs:

Instantaneous Maximum (lakes, reservoirs, State Scenic Rivers, or Tier II or Tier III waterbodies):	MOS = 49 CFU/100 ml
Instantaneous Maximum (all other waterbodies):	MOS = 94 CFU/100 ml
30-Day Geometric Mean:	MOS = 13 CFU/100 ml

8.6 Determination of TMDLs

E. coli daily loading functions were calculated for impaired segments in the Old Hickory Lake Watershed using LDCs to evaluate compliance with the single maximum target concentrations according to the procedure in Appendix C. These TMDL loading functions for impaired segments and subwatersheds are shown in Table 8.

8.7 Determination of WLAs & LAs

WLAs for MS4s and LAs for precipitation induced sources of E. coli loading were determined according to the procedures in Appendix C. These allocations represent the available loading after application of the explicit MOS. WLAs for existing WWTFs are equal to their existing NPDES permit limits. Since WWTF permit limits require that E. coli concentrations must comply with water quality criteria (TMDL targets) at the point of discharge (with few exceptions in Tennessee) and recognition that loading from these facilities are generally small in comparison to other loading sources, further reductions were not considered to be warranted. WLAs for CAFOs and LAs for “other direct sources” (non-precipitation induced) are equal to zero. WLAs, & LAs are summarized in Table 8.

Table 8 TMDLs, WLAs, & LAs for Impaired Subwatersheds and Drainage Areas in the Old Hickory Lake Watershed

HUC-12 Subwatershed (05130201___) or Drainage Area (DA)	Impaired Waterbody Name	Impaired Waterbody ID	TMDL	MOS	WLAs			LAs
					WWTFs ^a	Leaking Collection Systems	MS4s	
					[CFU/day]	[CFU/day]	[CFU/day/acre]	
0105	Johnson Branch	TN05130201015 – 0200	$2.30 \times 10^{10} * Q$	$2.30 \times 10^9 * Q$	NA	NA	NA	$6.893 \times 10^6 * Q$
0106	Spring Creek	TN05130201013 – 4000	$1.20 \times 10^{10} * Q$	$1.20 \times 10^9 * Q$	NA	NA	NA	$7.653 \times 10^5 * Q$
0107	Bartons Creek	TN05130201055 – 1000	*b	*b	*b	*b	*b	*b
	Sinking Creek	TN05130201055 – 0200	$2.30 \times 10^{10} * Q$	$2.30 \times 10^9 * Q$	NA	0	$2.175 \times 10^6 * Q$	$2.175 \times 10^6 * Q$
	Sinking Creek	TN05130201055 – 0250	$2.30 \times 10^{10} * Q$	$2.30 \times 10^9 * Q$	NA	0	$2.175 \times 10^6 * Q$	$2.175 \times 10^6 * Q$
0201	Beech Log Creek	TN05130201021 – 0400	$2.30 \times 10^{10} * Q$	$2.30 \times 10^9 * Q$	NA	0	$5.692 \times 10^6 * Q$	$5.692 \times 10^6 * Q$
	Neal Branch	TN05130201021 – 0300	$2.30 \times 10^{10} * Q$	$2.30 \times 10^9 * Q$	NA	0	$1.723 \times 10^7 * Q$	$1.723 \times 10^7 * Q$
	Round Lick Creek	TN05130201021 – 2000	$2.30 \times 10^{10} * Q$	$2.30 \times 10^9 * Q$	9.617×10^9	0	$1.194 \times 10^6 * Q - 5.546 \times 10^5$	$1.194 \times 10^6 * Q - 5.546 \times 10^5$
0302	Little Goose Creek	TN05130201028 – 0100	$2.30 \times 10^{10} * Q$	$2.30 \times 10^9 * Q$	NA	NA	NA	$1.131 \times 10^6 * Q$
	Little Goose Creek	TN05130201028 – 0150	$2.30 \times 10^{10} * Q$	$2.30 \times 10^9 * Q$	NA	NA	NA	$1.651 \times 10^6 * Q$

Notes: NA = Not Applicable.

- a. WLAs for WWTFs are expressed as E. coli loads (CFU/day). All current and future WWTFs must meet water quality standards at the point of discharge as specified in their NPDES permit; at no time shall concentration be greater than the appropriate E. coli standard (487 CFU/100 mL or 941 CFU/100 mL).
- b. Detailed TMDL analyses were not performed on Bartons Creek. It is assumed that water quality standards for E. coli will be attained in this waterbody when the requirements of the Commissioner's Order against Lebanon STP are complete and Lebanon STP complies with the terms of its NPDES permit.

9.0 IMPLEMENTATION PLAN

The TMDLs, WLAs, and LAs developed in Section 8 are intended to be the first phase of a long-term effort to restore the water quality of impaired waterbodies in the Old Hickory Lake watershed through reduction of excessive E. coli loading. Adaptive management methods, within the context of the State's rotating watershed management approach, will be used to modify TMDLs, WLAs, and LAs as required to meet water quality goals.

TMDL implementation activities will be accomplished within the framework of Tennessee's Watershed Approach (ref: <http://www.state.tn.us/environment/wpc/watershed/>). The Watershed Approach is based on a five-year cycle and encompasses planning, monitoring, assessment, TMDLs, WLAs/LAs, and permit issuance. It relies on participation at the federal, state, local and non-governmental levels to be successful.

9.1 Application of Load Duration Curves for Implementation Planning

The Load Duration Curve (LCD) methodology (Appendix C) is a form of water quality analysis and presentation of data that aids in guiding implementation by targeting management strategies for appropriate flow conditions. One of the strengths of this method is that it can be used to interpret possible delivery mechanisms of E. coli by differentiating between point and non-point source problems. The load duration curve analysis can be utilized for implementation planning. See Cleland (2003) for further information on duration curves and TMDL development, and: <http://www.tmdls.net/tipstools/docs/TMDLsCleland.pdf>.

9.1.1 Flow Zone Analysis for Implementation Planning

A major advantage of the duration curve framework in TMDL development is the ability to provide meaningful connections between allocations and implementation efforts (USEPA, 2006). Because the flow duration interval serves as a general indicator of hydrologic condition (i.e., wet versus dry and to what degree), allocations and reduction goals can be linked to source areas, delivery mechanisms, and the appropriate set of management practices. The use of duration curve zones (e.g., high flow, moist, mid-range, dry, and low flow) allows the development of allocation tables (USEPA, 2006) (Appendix E), which can be used to guide potential implementation actions to most effectively address water quality concerns.

For the purposes of implementation strategy development, available E. coli data are grouped according to flow zones, with the number of flow zones determined by the HUC-12 subwatershed or drainage area size, the total contributing area (for non-headwater HUC-12s), and/or the baseflow characteristics of the waterbody. In general, for drainage areas greater than 40 square miles, the duration curves will be divided into five zones (Figure 11): high flows (exceeded 0-10% of the time), moist conditions (10-40%), median or mid-range flows (40-60%), dry conditions (60-90%), and low flows (90-100%). For smaller drainage areas, flows occurring in the low flow zone (baseflow conditions) are often extremely low and difficult to measure accurately. In many small drainage areas, extreme dry conditions are characterized by zero flow for a significant percentage of time. For this reason, the low flow zone is best characterized as a broader range of conditions (or percent time) with subsequently fewer flow zones. Therefore, for most HUC-12 subwatershed drainage areas less than 40 square miles, the duration curves will be divided into four zones: high flows (exceeded 0-10% of the time), moist conditions (10-40%), median or mid-range flows (40-70%), and

low flows (70-100%). Some small (<40 mi²) waterbody drainage areas have sustained baseflow (no zero flows) throughout their period of record. For these waterbodies, the duration curves will be divided into five zones.

Given adequate data, results (allocations and percent load reduction goals) will be calculated for all flow zones; however, less emphasis is placed on the upper 10% flow range for pathogen (E. coli) TMDLs and implementation plans. The highest 10 percent flows, representing flood conditions, are considered non-recreational conditions: unsafe for wading and swimming. Humans are not expected to enter the water due to the inherent hazard from high depths and velocities during these flow conditions. As a rule of thumb, the *USGS Field Manual for the Collection of Water Quality Data* (Lane, 1997) advises its personnel not to attempt to wade a stream for which values of depth (ft) multiplied by velocity (ft/s) equal or exceed 10 ft²/s to collect a water sample. Few observations are typically available to estimate loads under these adverse conditions due to the difficulty and danger of sample collection. Therefore, in general, the 0-10% flow range is beyond the scope of pathogen TMDLs and subsequent implementation strategies.

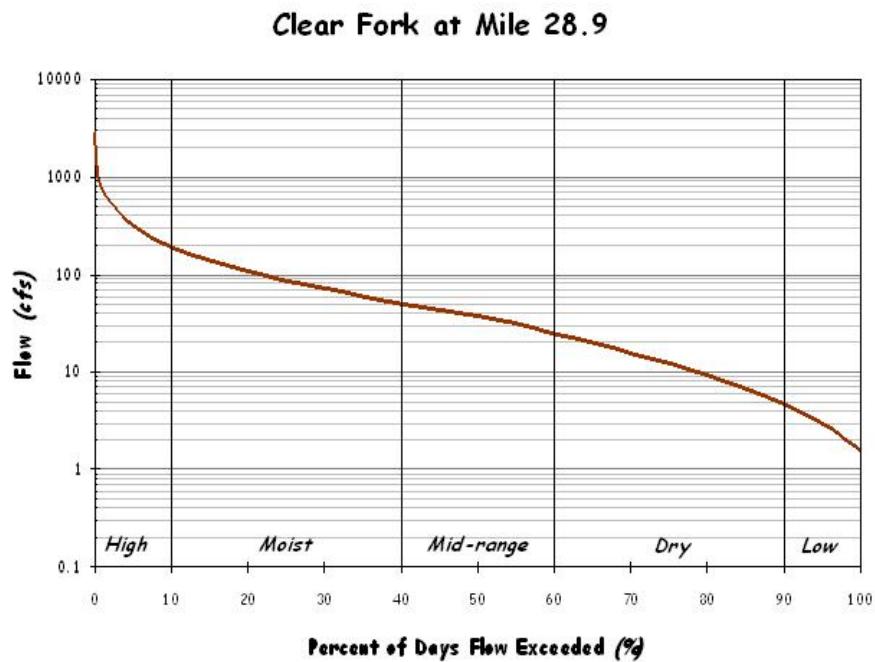


Figure 11. Five-Zone Flow Duration Curve for Clear Fork at RM 28.9

9.1.2 Existing Loads and Percent Load Reductions

Each impaired waterbody has a characteristic set of pollutant sources and existing loading conditions that vary according to flow conditions. In addition, maximum allowable loading (assimilative capacity) of a waterbody varies with flow. Therefore, existing loading, allowable loading, and percent load reduction expressed at a single location on the LDC (for a single flow condition) do not appropriately represent the TMDL in order to address all sources under all flow conditions (i.e., at all times) to satisfy implementation objectives. The LDC approach provides a methodology for determination of assimilative capacity and existing loading conditions of a waterbody for each flow zone. Subsequently, each flow zone, and the sources contributing to impairment under the corresponding flow conditions, can be evaluated independently. Lastly, the critical flow zone (with the highest percent load reduction goal) can be identified for prioritization of implementation actions.

Existing loading is calculated for each individual water quality sample as the product of the sample flow (cfs) times the single sample E. coli concentration (times a conversion factor). A percent load reduction is calculated for each water quality sample as that required to reduce the existing loading to the product of the sample flow (cfs) times the single sample maximum water quality standard (times a conversion factor). For samples with negative percent load reductions (non-exceedance: concentration below the single sample maximum water quality criterion), the percent reduction is assumed to be zero. The percent load reduction goal (PLRG) for a given flow zone is calculated as the mean of all the percent load reductions for a given flow zone. See Appendix E.

9.1.3 Critical Conditions

The critical condition for each impaired waterbody is defined as the flow zone with the largest PLRG, excluding the “high flow” zone because these extremely high flows are not representative of recreational flow conditions, as described in Section 9.1.1. If the PLRG in this zone is greater than all the other zones, the zone with the second highest PLRG will be considered the critical flow zone. The critical conditions are such that if water quality standards were met under those conditions, they would likely be met overall.

9.2 Point Sources

9.2.1 NPDES Regulated Municipal and Industrial Wastewater Treatment Facilities

All present and future discharges from industrial and municipal wastewater treatment facilities are required to be in compliance with the conditions of their NPDES permits at all times, including elimination of bypasses and overflows. In Tennessee, permit limits for treated sanitary wastewater require compliance with coliform water quality standards (ref: Section 5.0) prior to discharge. No additional reduction is required. WLAs for WWTFs are derived from facility design flows and permitted E. coli limits and are expressed as average loads in CFU per day.

9.2.2 NPDES Regulated Municipal Separate Storm Sewer Systems (MS4s)

For present and future regulated discharges from municipal separate storm sewer systems (MS4s), WLAs are and will be implemented through Phase I & II MS4 permits. These permits will require the development and implementation of a Storm Water Management Program (SWMP) that will

reduce the discharge of pollutants to the "maximum extent practicable" and not cause or contribute to violations of State water quality standards. Both the *NPDES General Permit for Discharges from Small Municipal Separate Storm Sewer Systems* (TDEC, 2003) and the TDOT individual MS4 permit (TNS077585) require SWMPs to include minimum control measures. The permits also contain requirements regarding control of discharges of pollutants of concern into impaired waterbodies, implementation of provisions of approved TMDLs, and descriptions of methods to evaluate whether storm water controls are adequate to meet the requirements of approved TMDLs.

For guidance on the six minimum control measures for MS4s regulated under Phase I or Phase II, a series of fact sheets are available at: http://cfpub1.epa.gov/npdes/stormwater/swfinal.cfm?program_id=6 .

For further information on Tennessee's *NPDES General Permit for Discharges from Small Municipal Separate Storm Sewer Systems*, see: <http://state.tn.us/environment/wpc/ppo/TN%20Small%20MS4%20Modified%General%20Permit%202003.pdf> .

In order to evaluate SWMP effectiveness and demonstrate compliance with specified WLAs, MS4s must develop and implement appropriate monitoring programs. An effective monitoring program could include:

- Effluent monitoring at selected outfalls that are representative of particular land uses or geographical areas that contribute to pollutant loading before and after implementation of pollutant control measures.
- Analytical monitoring of pollutants of concern (e.g., monthly) in receiving waterbodies, both upstream and downstream of MS4 discharges, over an extended period of time. In addition, intensive collection of pollutant monitoring data during the recreation season (June – September) at sufficient frequency to support calculation of the geometric mean.

When applicable, the appropriate Division of Water Pollution Control Environmental Field Office should be consulted for assistance in the determination of monitoring strategies, locations, frequency, and methods within 12 months after the approval date of TMDLs or designation as a regulated MS4. Details of the monitoring plans and monitoring data should be included in annual reports required by MS4 permits.

9.2.3 NPDES Regulated Concentrated Animal Feeding Operations (CAFOs)

WLAs provided to most CAFOs will be implemented through NPDES Permit No. TNA000000, General NPDES Permit for *Class II Concentrated Animal Feeding Operation* or the facility's individual permit. Provisions of the general permit include development and implementation of Nutrient Management Plan (NMPs), requirements regarding land application BMPs, and requirements for CAFO liquid waste management systems. For further information, see: <http://state.tn.us/environment/wpc/ppo/CAFO%20Final%20PDF%20Modified.pdf> .

9.3 Nonpoint Sources

The Tennessee Department of Environment & Conservation has no direct regulatory authority over most nonpoint source (NPS) discharges. Reductions of E. coli loading from nonpoint sources will be achieved using a phased approach. Voluntary, incentive-based mechanisms will be used to

implement NPS management measures in order to assure that measurable reductions in pollutant loadings can be achieved for the targeted impaired waters. Cooperation and active participation by the general public and various industry, business, and environmental groups is critical to successful implementation of TMDLs. There are links to a number of publications and information resources on EPA's Nonpoint Source Pollution web page (<http://www.epa.gov/owow/nps/pubs.html>) relating to the implementation and evaluation of nonpoint source pollution control measures.

Local citizen-led and implemented management measures have the potential to provide the most efficient and comprehensive avenue for reduction of loading rates from nonpoint sources. An excellent example of stakeholder involvement is the Cumberland River Coalition. The Cumberland River Compact is a non-profit group made up of businesses, individuals, community organizations, and agencies working in the Cumberland River watershed. Members of the Compact work with educators, landowners, contractors, marinas and other interested groups to coordinate informational education programs that encourage all of us to be better stewards of our water resources. The Compact works with local, state and federal agencies and officials to promote and strengthen cooperative working relationships and encourage the development of reliable, easy-to-understand data about water quality. Members of the Compact work with local communities to develop watershed forums where citizens come together to learn more about their watershed and participate in developing a shared vision for the future. The Compact also serves as a clearing-house of available public education programs to landowner assistance. Information regarding the accomplishments of the Cumberland River Compact is available at their website:

<http://www.cumberlandrivercompact.org/>.

9.3.1 Urban Nonpoint Sources

Management measures to reduce pathogen loading from urban nonpoint sources are similar to those recommended for MS4s (Sect. 9.2.2). Specific categories of urban nonpoint sources include stormwater, illicit discharges, septic systems, pet waste, and wildlife:

Stormwater: Most mitigation measures for stormwater are not designed specifically to reduce bacteria concentrations (ENSR, 2005). Instead, BMPs are typically designed to remove sediment and other pollutants. Bacteria in stormwater runoff are, however, often attached to particulate matter. Therefore, treatment systems that remove sediment may also provide reductions in bacteria concentrations.

Illicit discharges: Removal of illicit discharges to storm sewer systems, particularly of sanitary wastes, is an effective means of reducing pathogen loading to receiving waters (ENSR, 2005). These include intentional illegal connections from commercial or residential buildings, failing septic systems, and improper disposal of sewage from campers and boats.

Septic systems: When properly installed, operated, and maintained, septic systems effectively reduce pathogen concentrations in sewage. To reduce the release of pathogens, practices can be employed to maximize the life of existing systems, identify failed systems, and replace or remove failed systems (USEPA, 2005a). Alternatively, the installation of public sewers may be appropriate.

Pet waste: If the waste is not properly disposed of, these bacteria can wash into storm drains or directly into water bodies and contribute to pathogen impairment. Encouraging pet owners to properly collect and dispose of pet waste is the primary means for reducing the impact of pet waste

(USEPA, 2002b).

Wildlife: Reducing the impact of wildlife on pathogen concentrations in waterbodies generally requires either reducing the concentration of wildlife in an area or reducing their proximity to the waterbody (ENSR, 2005). The primary means for doing this is to eliminate human inducements for congregation. In addition, in some instances population control measures may be appropriate.

Two additional urban nonpoint source resource documents provided by EPA are:

National Management Measures to Control Nonpoint Source Pollution from Urban Areas (<http://www.epa.gov/owow/nps/urbanmm/index.html>) helps citizens and municipalities in urban areas protect bodies of water from polluted runoff that can result from everyday activities. The scientifically sound techniques it presents are among the best practices known today. The guidance will also help states to implement their nonpoint source control programs and municipalities to implement their Phase II Storm Water Permit Programs (Publication Number EPA 841-B-05-004, November 2005).

The Use of Best Management Practices (BMPs) in Urban Watersheds (<http://www.epa.gov/nrmrl/pubs/600r04184/600r04184chap1.pdf>) is a comprehensive literature review on commonly used urban watershed Best Management Practices (BMPs) that heretofore was not consolidated. The purpose of this document is to serve as an information source to individuals and agencies/municipalities/watershed management groups/etc. on the existing state of BMPs in urban stormwater management (Publication Number EPA/600/R-04/184, September 2004).

9.3.2 Agricultural Nonpoint Sources

BMPs have been utilized in the Old Hickory Lake watershed to reduce the amount of coliform bacteria transported to surface waters from agricultural sources. These BMPs (e.g., animal waste management systems, waste utilization, stream stabilization, fencing, heavy use area treatment, livestock exclusion, etc.) may have contributed to reductions in in-stream concentrations of coliform bacteria in one or more Old Hickory Lake watershed E. coli-impaired subwatersheds during the TMDL evaluation period. The Tennessee Department of Agriculture (TDA) keeps a database of BMPs implemented in Tennessee. Those listed in the Old Hickory Lake watershed are shown in Figure 12. It is recommended that additional information (e.g., livestock access to streams, manure application practices, etc.) be provided and evaluated to better identify and quantify agricultural sources of coliform bacteria loading in order to minimize uncertainty in future modeling efforts.

It is further recommended that additional BMPs be implemented and monitored to document performance in reducing coliform bacteria loading to surface waters from agricultural sources. Demonstration sites for various types of BMPs should be established and maintained, and their performance (in source reduction) evaluated over a period of at least two years prior to recommendations for utilization for subsequent implementation. E. coli sampling and monitoring are recommended during low-flow (baseflow) and storm periods at sites with and without BMPs and/or before and after implementation of BMPs.

For additional information on agricultural BMPs in Tennessee, see: <http://state.tn.us/agriculture/nps/bmpa.ntml>.

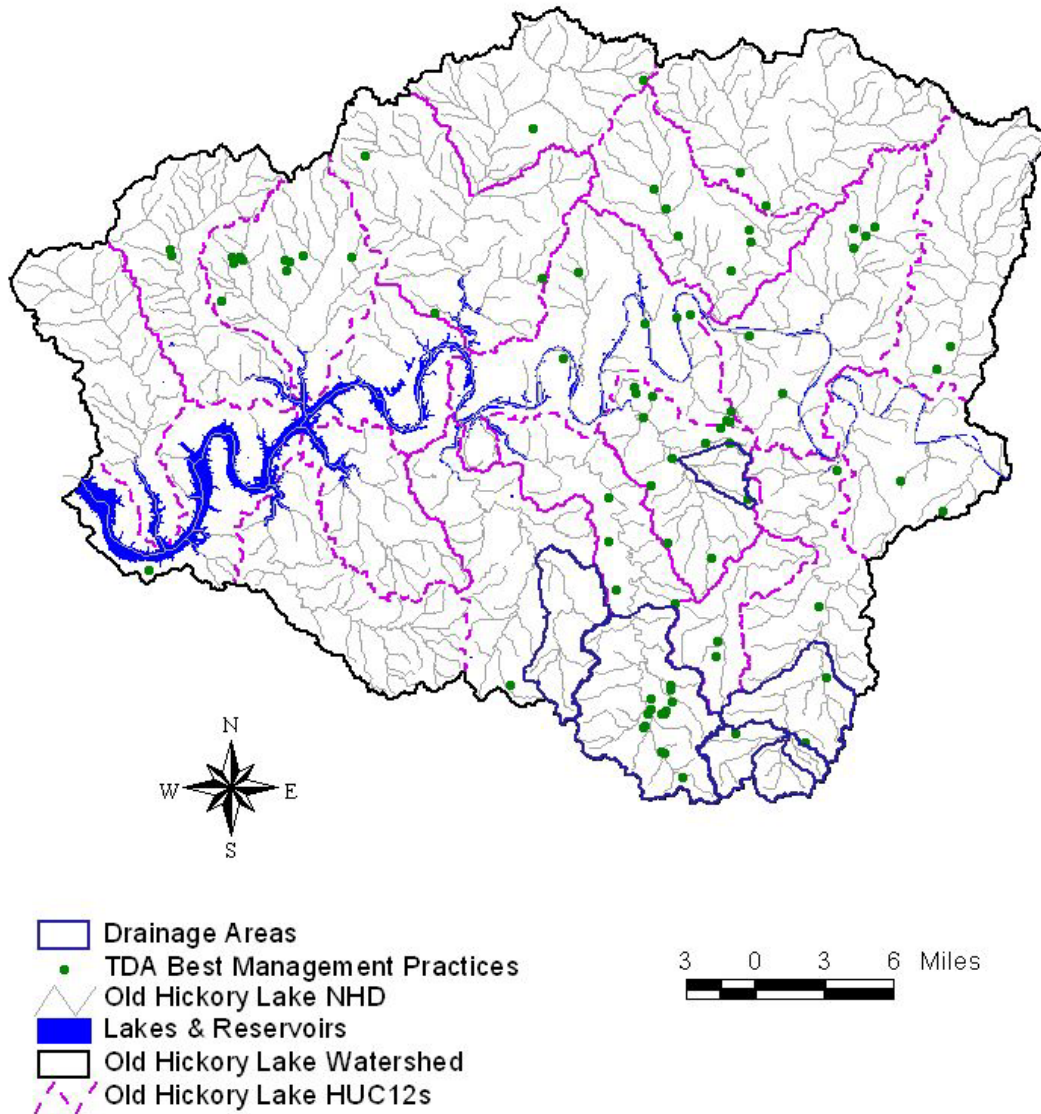


Figure 12. Tennessee Department of Agriculture Best Management Practices located in the Old Hickory Lake Watershed.

An additional agricultural nonpoint source resource provided by EPA is *National Management Measures to Control Nonpoint Source Pollution from Agriculture* (<http://www.epa.gov/owow/nps/agmm/index.html>): a technical guidance and reference document for use by State, local, and tribal managers in the implementation of nonpoint source pollution management programs. It contains information on the best available, economically achievable means of reducing pollution of surface and groundwater from agriculture (EPA 841-B-03-004, July 2003).

9.3.3 Other Nonpoint Sources

Additional nonpoint source references (not specifically addressing urban and/or agricultural sources) provided by EPA include:

National Management Measures to Control Nonpoint Source Pollution from Forestry (<http://www.epa.gov/owow/nps/forestrymgmt/>) helps forest owners protect lakes and streams from polluted runoff that can result from forestry activities. These scientifically sound techniques are the best practices known today. The report will also help states to implement their nonpoint source control programs (EPA 841-B-05-001, May 2005).

In addition, the EPA website, <http://www.epa.gov/owow/nps/bestnpsdocs.html>, contains a list of guidance documents endorsed by the Nonpoint Source Control Branch at EPA headquarters. The list includes documents addressing urban, agriculture, forestry, marinas, stream restoration, nonpoint source monitoring, and funding.

9.4 Additional Monitoring

Additional monitoring and assessment activities are recommended to determine whether implementation of TMDLs, WLAs, & LAs in tributaries and upstream reaches will result in achievement of in-stream water quality targets for E. coli.

Activities recommended for the Old Hickory Lake watershed:

Verify the assessment status of stream reaches identified on the Final 2006 303(d) List as impaired due to E. coli. If it is determined that these stream reaches are still not fully supporting designated uses, then sufficient data to enable development of TMDLs should be acquired. TMDLs will be revisited on 5-year watershed cycle as described above.

Evaluate the effectiveness of implementation measures (see Sect. 9.6). Includes BMP performance analysis and monitoring by permittees and stakeholders. Where required TMDL loading reduction has been fully achieved, adequate data to support delisting should be collected.

Provide additional data to clarify status of ambiguous sites (e.g., geometric mean data) for potential listing. Analyses of existing data at several monitoring sites on unlisted waterbodies in the Old Hickory Lake watershed suggest levels of impairment. Therefore, additional data are required for listing determination.

Continue ambient (long-term) monitoring at appropriate sites and key locations.

Comprehensive water quality monitoring activities include sampling during all seasons and a broad range of flow and meteorological conditions. In addition, collection of E. coli data at sufficient frequency to support calculation of the geometric mean, as described in Tennessee's General Water Quality Criteria (TDEC, 2004a), is encouraged. Finally, for individual monitoring locations, where historical E. coli data are greater than 1000 colonies/100 mL (or future samples are anticipated to be), a 1:100 dilution should be performed as described in Protocol A of the *Quality System Standard Operating Procedure for Chemical and Bacteriological Sampling of Surface Water* (TDEC, 2004b).

9.4.2 Source Identification

An important aspect of E. coli load reduction activities is the accurate identification of the actual sources of pollution. In cases where the sources of E. coli impairment are not readily apparent, Microbial Source Tracking (MST) is one approach to determining the sources of fecal pollution and E. coli affecting a waterbody. Those methods that use bacteria as target organisms are also known as Bacterial Source Tracking (BST) methods. This technology is recommended for source identification in E. coli impaired waterbodies.

Bacterial Source Tracking is a collective term used for various emerging biochemical, chemical, and molecular methods that have been developed to distinguish sources of human and non-human fecal pollution in environmental samples (Shah, 2004). In general, these methods rely on genotypic (also known as "genetic fingerprinting"), or phenotypic (relating to the physical characteristics of an organism) distinctions between the bacteria of different sources. Three primary genotypic techniques are available for BST: ribotyping, pulsed field gel electrophoresis (PFGE), and polymerase chain reaction (PCR). Phenotypic techniques generally involve an antibiotic resistance analysis (Hyer, 2004).

The USEPA has published a fact sheet that discusses BST methods and presents examples of BST application to TMDL development and implementation (USEPA, 2002b). Various BST projects and descriptions of the application of BST techniques used to guide implementation of effective BMPs to remove or reduce fecal contamination are presented. The fact sheet can be found on the following EPA website: <http://www.epa.gov/owm/mtb/bacsortk.pdf>.

A multi-disciplinary group of researchers at the University of Tennessee, Knoxville (UTK) has developed and tested a series of different microbial assay methods based on real-time PCR to detect fecal bacterial concentrations and host sources in water samples (McKay, 2005). The assays have been used in a study of fecal contamination and have proven useful in identification of areas where cattle represent a significant fecal input and in development of BMPs. It is expected that these types of assays could have broad applications in monitoring fecal impacts from Animal Feeding Operations, as well as from wildlife and human sources. Additional information can be found on the following UTK website: <http://web.utk.edu/~hydro/Research?McKayAGU2004Abstract.pdf>.

BST technology was utilized in a study conducted in Stock Creek (Little River watershed) (Layton, 2004). Microbial source tracking using real-time PCR assays to quantify *Bacteroides* 16S rRNA genes was used to determine the percent of fecal contamination attributable to cattle. *E. coli* loads attributable to cattle were calculated for each of nine sampling sites in the Stock Creek subwatershed on twelve sampling dates. At the site on High Bluff Branch (tributary to Stock Creek), none of the sample dates had *E. coli* loads attributable to cattle above the threshold. This suggests that at this site removal of *E. coli* attributable to cattle would have little impact on the total *E. coli* loads. The *E. coli* load attributable to cattle made a large contribution to the total *E. coli* load at each of the eight remaining sampling sites. At two of the sites (STOCK005.3KN and GHOLL000.6KN), 50–75% of the *E. coli* attributable to cattle loads alone was above the 126 CFU/100mL threshold. This suggests that removal of the *E. coli* attributable to cattle at these sites would reduce the total *E. coli* load to acceptable limits.

9.5 Source Area Implementation Strategy

Implementation strategies are organized according to the dominant landuse type and the sources associated with each (Table 9 and Appendix E). Each HUC-12 subwatershed is grouped and targeted for implementation based on this source area organization. Three primary categories are identified: predominantly urban, predominantly agricultural, and mixed urban/agricultural. See Appendix A for information regarding landuse distribution of impaired subwatersheds. For the purpose of implementation evaluation, urban is defined as residential, commercial, and industrial landuse areas with predominant source categories such as point sources (WWTFs), collection systems/septic systems (including SSOs and CSOs), and urban stormwater runoff associated with MS4s. Agricultural is defined as cropland and pasture, with predominant source categories associated with livestock and manure management activities. A fourth category (infrequent) is associated with forested (including non-agricultural undeveloped and unaltered [by humans]) landuse areas with the predominant source category being wildlife.

All impaired waterbodies and corresponding HUC-12 subwatersheds or drainage areas have been classified according to their respective source area types in Table 9. The implementation for each area will be prioritized according to the guidance provided in Sections 9.5.1 and 9.5.2, below. For all impaired waterbodies, the determination of source area types serves to identify the predominant sources contributing to impairment (i.e., those that should be targeted initially for implementation). However, it is not intended to imply that sources in other landuse areas are not contributors to impairment and/or to grant an exemption from addressing other source area contributions with implementation strategies and corresponding load reduction. For mixed use areas, implementation will follow the guidance established for both urban and agricultural areas, at a minimum.

Appendix E provides source area implementation examples for urban and agricultural subwatersheds, development of percent load reduction goals, and determination of critical flow zones (for implementation prioritization) for *E. coli* impaired waterbodies. Load duration curve analyses (TMDLs, WLAs, LAs, and MOS) and percent load reduction goals for all flow zones for all *E. coli* impaired waterbodies in the Old Hickory Lake watershed are summarized in Table E-12.

Table 9. Source area types for waterbody drainage area analyses.

Waterbody ID	Source Area Type*			
	Urban	Agricultural	Mixed	Forested
Johnson Branch		✓		
Spring Creek		✓		
Sinking Creek			✓	
Beech Log Creek			✓	
Neal Branch		✓		
Round Lick Creek		✓		
Little Goose Creek			✓	

* All waterbodies potentially have significant source contributions from other source type/landuse areas.

9.5.1 Urban Source Areas

For impaired waterbodies and corresponding HUC-12 subwatersheds or drainage areas classified as predominantly urban, implementation strategies for E. coli load reduction will initially and primarily target source categories similar to those listed in Table 10 (USEPA, 2006). Table 10 presents example urban area management practices and the corresponding potential relative effectiveness under each of the hydrologic flow zones. Each implementation strategy addresses a range of flow conditions and targets point sources, non-point sources, or a combination of each. For each waterbody, the existing loads and corresponding PLRG for each flow zone are calculated according to the method described in Section E.4. The resulting determination of the critical flow zone further focuses the types of urban management practices appropriate for development of an effective load reduction strategy for a particular waterbody.

9.5.2 Agricultural Source Areas

For impaired waterbodies and corresponding HUC-12 subwatersheds or drainage areas classified as predominantly agricultural, implementation strategies for E. coli load reduction will initially and primarily target source categories similar to those listed in Table 11 (USDA, 1988). Table 11 present example agricultural area management practices and the corresponding potential relative effectiveness under each of the hydrologic flow zones. Each implementation strategy addresses a range of flow conditions and targets point sources, non-point sources, or a combination of each. For each waterbody, the existing loads and corresponding PLRG for each flow zone are calculated according to the method described in Section E.4. The resulting determination of the critical flow zone further focuses the types of agricultural management practices appropriate for development of an effective load reduction strategy for a particular waterbody.

9.5.3 Forestry Source Areas

There are no impaired waterbodies with corresponding HUC-12 subwatersheds or drainage areas classified as source area type predominantly forested, with the predominant source category being wildlife, in the Old Hickory Lake watershed.

Table 10. Example Urban Area Management Practice/Hydrologic Flow Zone Considerations.

Management Practice	Duration Curve Zone (Flow Zone)				
	High	Moist	Mid-Range	Dry	Low
Bacteria source reduction					
Remove illicit discharges			L	M	H
Address pet & wildlife waste		H	M	M	L
Combined sewer overflow management					
Combined sewer separation		H	M	L	
CSO prevention practices		H	M	L	
Sanitary sewer system					
Infiltration/Inflow mitigation	H	M	L	L	
Inspection, maintenance, and repair		L	M	H	H
SSO repair/abatement	H	M	L		
Illegal cross-connections					
Septic system management					
Managing private systems		L	M	H	M
Replacing failed systems		L	M	H	M
Installing public sewers		L	M	H	M
Storm water infiltration/retention					
Infiltration basin		L	M	H	
Infiltration trench		L	M	H	
Infiltration/Biofilter swale		L	M	H	
Storm Water detention					
Created wetland		H	M	L	
Low impact development					
Disconnecting impervious areas		L	M	H	
Bioretention	L	M	H	H	
Pervious pavement		L	M	H	
Green Roof		L	M	H	
Buffers		H	H	H	

Table 10 (cont'd). Example Urban Area Management Practice/Hydrologic Flow Zone Considerations.

Management Practice	Duration Curve Zone (Flow Zone)				
	High	Moist	Mid-Range	Dry	Low
New/existing on-site wastewater treatment systems					
Permitting & installation programs		L	M	H	M
Operation & maintenance programs		L	M	H	M
Other					
Point source controls		L	M	H	H
Landfill control		L	M	H	
Riparian buffers		H	H	H	
Pet waste education & ordinances		M	H	H	L
Wildlife management		M	H	H	L
Inspection & maintenance of BMPs	L	M	H	H	L
Note: Potential relative importance of management practice effectiveness under given hydrologic condition (H: High, M: Medium, L: Low)					

Table 11. Example Agricultural Area Management Practice/Hydrologic Flow Zone Considerations.

Flow Condition	High	Moist	Mid-range	Dry	Low
% Time Flow Exceeded	0-10	10-40	40-60	60-90	90-100
Grazing Management					
Prescribed Grazing (528A)	H	H	M	L	
Pasture & Hayland Mgmt (510)	H	H	M	L	
Deferred Grazing (352)	H	H	M	L	
Planned Grazing System (556)	H	H	M	L	
Proper Grazing Use (528)	H	H	M	L	
Proper Woodland Grazing (530)	H	H	M	L	
Livestock Access Limitation					
Livestock Exclusion (472)			M	H	H
Fencing (382)			M	H	H
Stream Crossing			M	H	H

Table 11 (cont'd). Example Agricultural Area Management Practice/Hydrologic Flow Zone Considerations.

Flow Condition	High	Moist	Mid-range	Dry	Low
% Time Flow Exceeded	0-10	10-40	40-60	60-90	90-100
Alternate Water Supply					
Pipeline (516)			M	H	H
Pond (378)			M	H	H
Trough or Tank (614)			M	H	H
Well (642)			M	H	H
Spring Development (574)			M	H	H
Manure Management					
Managing Barnyards	H	H	M	L	
Manure Transfer (634)	H	H	M	L	
Land Application of Manure	H	H	M	L	
Composting Facility (317)	H	H	M	L	
Vegetative Stabilization					
Pasture & Hayland Planting (512)	H	H	M	L	
Range Seeding (550)	H	H	M	L	
Channel Vegetation (322)	H	H	M	L	
Brush (& Weed) Mgmt (314)	H	H	M	L	
Vegetative Stabilization (cont'd)					
Conservation Cover (327)		H	H	H	
Riparian Buffers (391)		H	H	H	
Critical Area Planting (342)		H	H	H	
Wetland restoration (657)		H	H	H	
CAFO Management					
Waste Management System (312)	H	H	M		
Waste Storage Structure (313)	H	H	M		
Waste Storage Pond (425)	H	H	M		
Waste Treatment Lagoon (359)	H	H	M		

Table 11 (cont'd). Example Agricultural Area Management Practice/Hydrologic Flow Zone Considerations.

Flow Condition	High	Moist	Mid-range	Dry	Low
% Time Flow Exceeded	0-10	10-40	40-60	60-90	90-100
CAFO Management (cont'd)					
Mulching (484)	H	H	M		
Waste Utilization (633)	H	H	M		
Water & Sediment Control Basin (638)	H	H	M		
Filter Strip (393)	H	H	M		
Sediment Basin (350)	H	H	M		
Grassed Waterway (412)	H	H	M		
Diversion (362)	H	H	M		
Heavy Use Area Protection (561)					
Constructed Wetland (656)					
Dikes (356)	H	H	M		
Lined Waterway or Outlet (468)	H	H	M		
Roof Runoff Mgmt (558)	H	H	M		
Floodwater Diversion (400)	H	H	M		
Terrace (600)	H	H	M		
Potential for source area contribution under given hydrologic condition (H: High; M: Medium; L: Low)					

Note: Numbers in parentheses are the U.S. Soil Conservation Service practice number.

9.6 Evaluation of TMDL Implementation Effectiveness

Evaluation of the effectiveness of TMDL implementation strategies should be conducted on multiple levels, as appropriate:

- HUC-12 or waterbody drainage area (i.e., TMDL analysis location)
- Subwatersheds or intermediate sampling locations
- Specific landuse areas (urban, pasture, etc.)
- Specific facilities (WWTF, CAFO, uniquely identified portion of MS4, etc.)
- Individual BMPs

In order to conduct an implementation effectiveness analysis on measures to reduce E. coli source loading, monitoring results should be evaluated in one of several ways. Sampling results can be compared to water quality standards (e.g., load duration curve analysis) for determination of impairment status, results can be compared on a before and after basis (temporal), or results can be evaluated both upstream and downstream of source reduction measures or source input (spatial). Considerations include period of record, data collection frequency, representativeness of data, and sampling locations.

In general, periods of record greater than 5 years (given adequate sampling frequency) can be evaluated for determination of relative change (trend analysis). For watershed in second or successive TMDL cycles, data collected from multiple cycles can be compared. If implementation efforts have been initiated to reduce loading, evaluation of routine monitoring data may indicate improving or worsening conditions over time and corresponding effectiveness of implementation efforts.

Water quality data for implementation effectiveness analysis can be presented in multiple ways. For example, Figure 13 shows fecal coliform concentration data statistics for Oostanaula Creek at mile 28.4 (Hiwassee River watershed) for a historical (2002) TMDL analysis period versus a recent post-implementation period of sampling data (revised TMDL). The individual flow zone analyses are presented in a box and whisker plot of recent [2] versus historical [1] data. Figure 14 shows a load duration curve analysis (of recent versus historical data) of fecal coliform loading statistics for Oostanaula Creek. Lastly, Figure 15 shows best fit curve analyses of flow (percent time exceeded) versus fecal coliform loading relationships (regressions) plotted against the LDC of the single sample maximum water quality standard. Note that Figures 13-15 present the same data, from approved TMDLs (2 cycles), each clearly illustrating improving conditions between historical and recent periods.

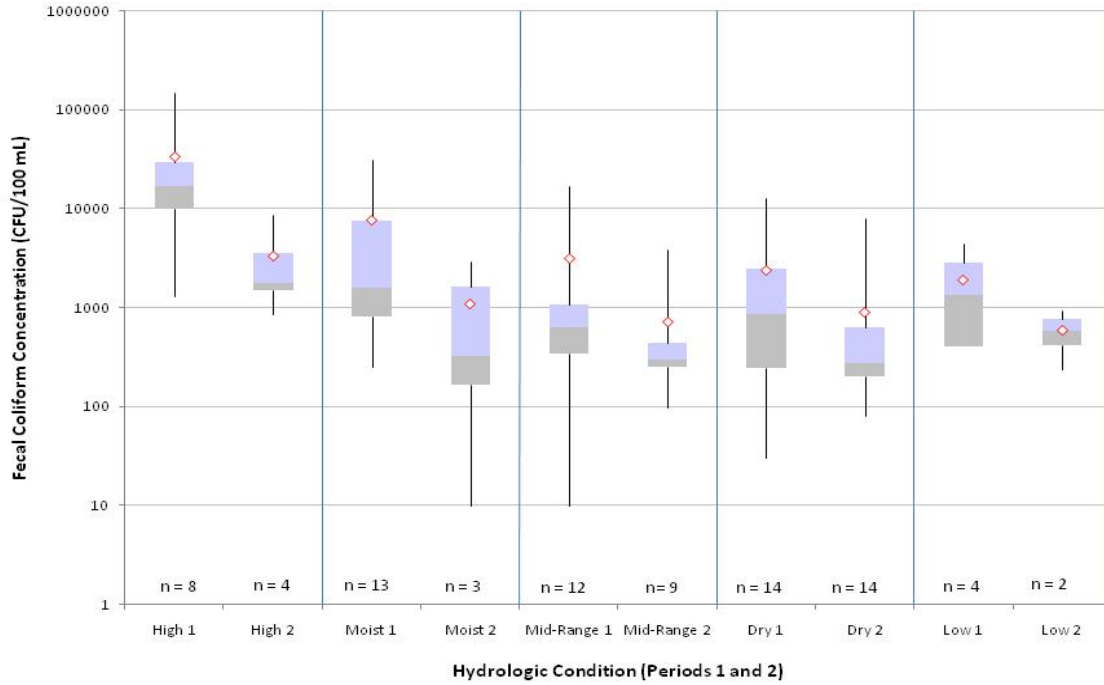


Figure 13. Oostanaula Creek TMDL implementation effectiveness (box and whisker plot).

Oostanaula Creek
 Load Duration Curve (1982 - 2004 Monitoring Data)
 Site: OOSTA028.4MM

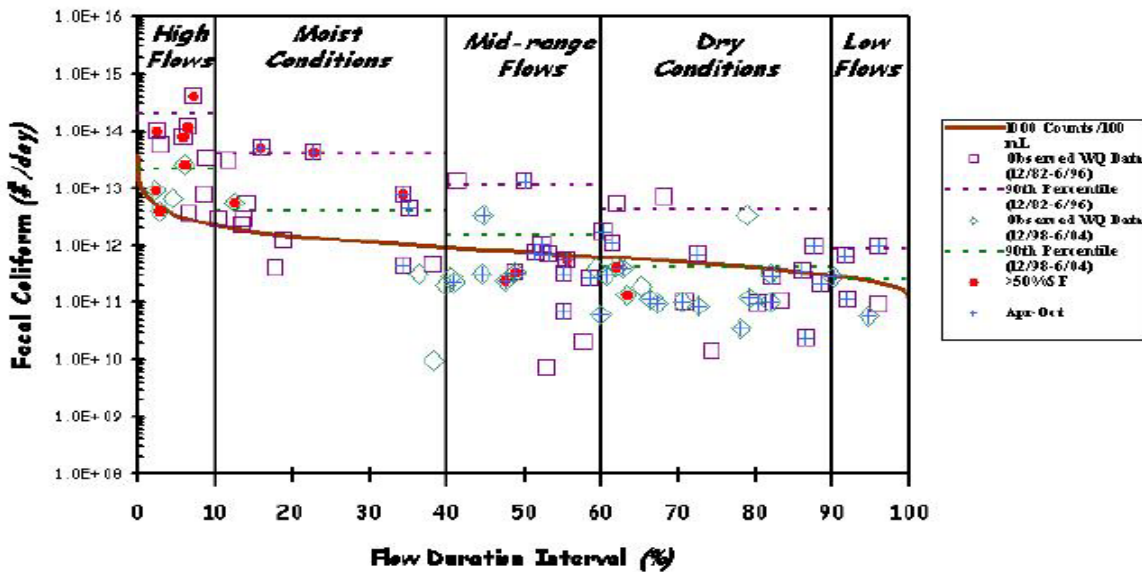


Figure 14. Oostanaula Creek TMDL implementation effectiveness (LDC analysis).

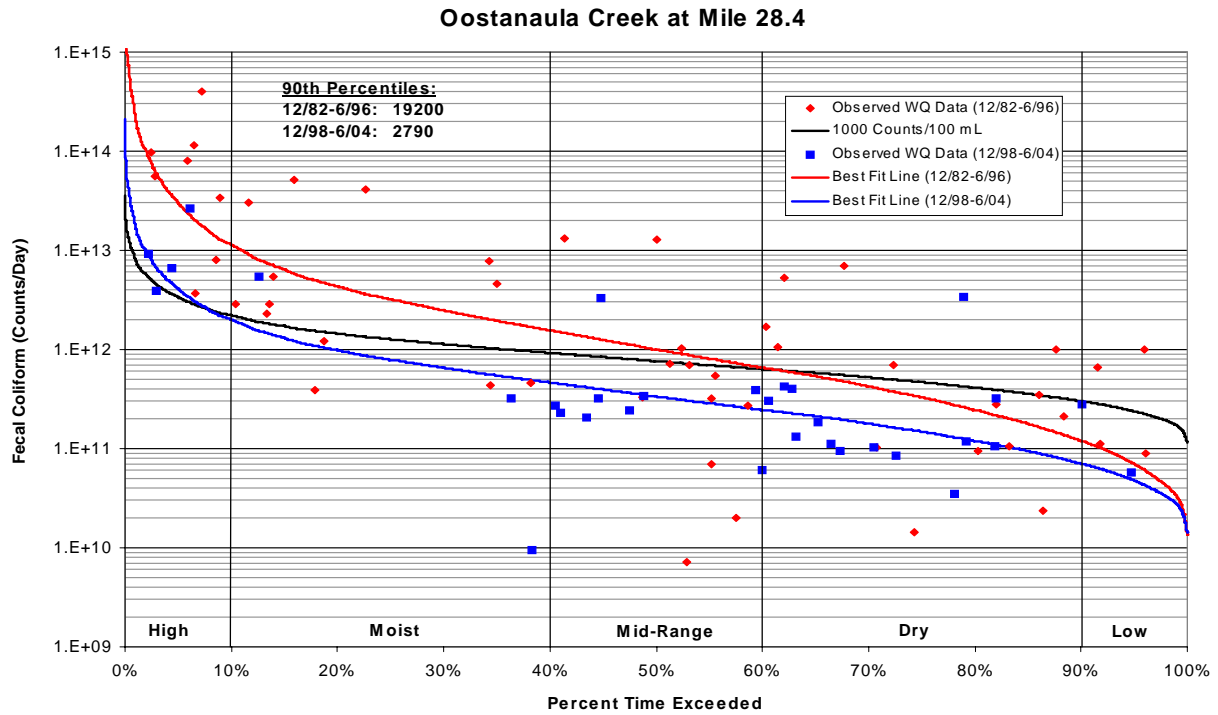


Figure 15. Oostanaula Creek TMDL implementation effectiveness (LDC regression analysis).

10.0 PUBLIC PARTICIPATION

In accordance with 40 CFR §130.7, the proposed pathogen TMDLs for the Old Hickory Lake Watershed was placed on Public Notice for a 35-day period and comments solicited. Steps that were taken in this regard include:

- 1) Notice of the proposed TMDLs was posted on the Tennessee Department of Environment and Conservation website. The announcement invited public and stakeholder comment and provided a link to a downloadable version of the TMDL document.
- 2) Notice of the availability of the proposed TMDLs (similar to the website announcement) was included in one of the NPDES permit Public Notice mailings which is sent to approximately 90 interested persons or groups who have requested this information.
- 3) Letters were sent to WWTFs located in E. coli-impaired subwatersheds or drainage areas in the Old Hickory Lake Watershed, permitted to discharge treated effluent containing pathogens, advising them of the proposed TMDLs and their availability on the TDEC website. The letters also stated that a copy of the draft TMDL document would be provided on request. A letter was sent to the following facilities:

Watertown STP (TN0025488)

- 4) A draft copy of the proposed TMDL was sent to those MS4s that are wholly or partially located in E. coli-impaired subwatersheds. A draft copy was sent to the following entities:

Metro Nashville/Davidson County (TNS068047)
City of Gallatin, Tennessee (TNS077534)
City of Hendersonville, Tennessee (TNS075353)
City of Lebanon, Tennessee (TNS075426)
City of Mount Juliet, Tennessee (TNS075451)
Sumner County, Tennessee (TNS075680)
Wilson County, Tennessee (TNS075809)
Tennessee Dept. of Transportation (TNS077585)

- 5) A letter was sent to water quality partners in the Old Hickory Lake Watershed advising them of the proposed pathogen TMDLs and their availability on the TDEC website. The letter also stated that a written copy of the draft TMDL document would be provided upon request. A letter was sent to the following partners:

Cumberland Coalition
Cumberland River Compact
Mid-Cumberland Watershed Committee
Natural Resources Conservation Service
Tennessee Valley Authority
United States Forest Service
Tennessee Department of Agriculture
Tennessee Wildlife Resources Agency
The Nature Conservancy

11.0 FURTHER INFORMATION

Further information concerning Tennessee's TMDL program can be found on the Internet at the Tennessee Department of Environment and Conservation website:

<http://www.state.tn.us/environment/wpc/tmdl/>

Technical questions regarding this TMDL should be directed to the following members of the Division of Water Pollution Control staff:

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APPENDIX A

Land Use Distribution in the Old Hickory Lake Watershed

Table A-1. MRLC Land Use Distribution of Old Hickory Subwatersheds

Land Use	HUC-12 Subwatershed (05130201__) or Drainage Area					
	Johnson Branch DA		Spring Creek DA		0107	
	[acres]	[%]	[acres]	[%]	[acres]	[%]
Deciduous Forest	896.5	29.9	7,163.1	32.5	9,483.8	24.8
Emergent Herbaceous Wetlands	0.0	0.0	0.0	0.0	55.2	0.1
Evergreen Forest	173.9	5.8	1,385.1	6.3	1,218.3	3.2
High Intensity Commercial/Industrial/Transp.	6.4	0.2	36.0	0.2	1,230.5	3.2
High Intensity Residential	0.0	0.0	0.2	0.0	596.0	1.6
Low Intensity Residential	8.7	0.3	140.3	0.6	1,980.4	5.2
Mixed Forest	493.9	16.4	3,798.5	17.2	4,533.8	11.8
Open Water	0.0	0.0	7.8	0.0	276.9	0.7
Other Grasses (Urban/recreation; e.g. parks)	0.0	0.0	202.4	0.9	831.8	2.2
Pasture/Hay	903.4	30.1	7,720.0	35.0	10,097.0	26.4
Quarries/Strip Mines/Gravel Pits	0.0	0.0	0.0	0.0	169.0	0.4
Row Crops	520.4	17.3	1,591.7	7.2	7,722.0	20.2
Transitional	0.0	0.0	16.5	0.1	1.1	0.0
Woody Wetlands	0.0	0.0	0.0	0.0	91.4	0.2
Total	3,003.2	100.0	22,061.6	100.0	38,287.2	100.0

Table A-1 (Cont.). MRLC Land Use Distribution of Old Hickory Subwatersheds

Land Use	HUC-12 Subwatershed (05130201__) or Drainage Area					
	Sinking Creek DA		Round Lick Creek DA		Beech Log Creek DA	
	[acres]	[%]	[acres]	[%]	[acres]	[%]
Deciduous Forest	2,461.7	25.9	5,732.5	33.1	1,675.5	42.6
Emergent Herbaceous Wetlands	0.0	0.0	0.0	0.0	0.0	0.0
Evergreen Forest	282.2	3.0	1,119.1	6.5	235.3	6.0
High Intensity Commercial/Industrial/Transp.	526.0	5.5	55.6	0.3	26.7	0.7
High Intensity Residential	414.3	4.4	45.4	0.3	13.3	0.3
Low Intensity Residential	893.4	9.4	215.1	1.2	81.4	2.1
Mixed Forest	1,093.3	11.5	3,143.8	18.1	652.1	16.6
Open Water	5.6	0.1	7.8	0.0	0.7	0.0
Other Grasses (Urban/recreation; e.g. parks)	291.6	3.1	163.0	0.9	110.3	2.8
Pasture/Hay	1,679.3	17.6	5,647.7	32.6	877.3	22.3
Quarries/Strip Mines/Gravel Pits	7.8	0.1	0.0	0.0	0.0	0.0
Row Crops	1,862.3	19.6	1,210.9	7.0	263.5	6.7
Transitional	1.1	0.0	0.0	0.0	0.0	0.0
Woody Wetlands	0.0	0.0	0.0	0.0	0.0	0.0
Total	9,518.5	100.0	17,340.9	100.0	3,936.2	100.0

Table A-1 (Cont.). MRLC Land Use Distribution of Old Hickory Subwatersheds

Land Use	HUC-12 Subwatershed (05130201__) or Drainage Area			
	Neal Branch DA		Little Goose Creek DA	
	[acres]	[%]	[acres]	[%]
Deciduous Forest	445.7	37.1	2,810.0	15.4
Emergent Herbaceous Wetlands	0.0	0.0	0.0	0.0
Evergreen Forest	40.3	3.4	5,569.9	30.4
High Intensity Commercial/ Industrial/Transp.	0.2	0.0	125.7	0.7
High Intensity Residential	0.0	0.0	40.0	0.2
Low Intensity Residential	0.9	0.1	261.3	1.4
Mixed Forest	184.1	15.3	1,230.5	6.7
Open Water	0.0	0.0	5.1	0.0
Other Grasses (Urban/recreation; e.g. parks)	0.0	0.0	4.7	0.0
Pasture/Hay	477.3	39.7	146.6	0.8
Quarries/Strip Mines/Gravel Pits	0.0	0.0	7,276.3	39.8
Row Crops	52.7	4.4	31.1	0.2
Transitional	0.0	0.0	798.0	4.4
Woody Wetlands	0.0	0.0	0.0	0.0
Total	1,201.2	100.0	18,299.2	100.0

APPENDIX B
Water Quality Monitoring Data

There are a number of water quality monitoring stations that provide data for waterbodies identified as impaired for pathogens in the Old Hickory Lake Watershed. The location of these monitoring stations is shown in Figure 5. Monitoring data recorded by TDEC at these stations are tabulated in Table B-1.

Table B-1. TDEC Water Quality Monitoring Data – Old Hickory Subwatersheds

Monitoring Station	Date	E. Coli
		[cts./100 mL]
BARTO007.4WS	8/25/04	180
	9/7/04	56
	10/20/04	260
	11/16/04	100
	12/14/04	110
	1/5/05	330
	2/10/05	580
	3/8/05	230
	4/11/05	91
	5/18/05	80
	6/14/05	130
BARTO009.6WS	7/26/00	440
	8/2/00	1300
	9/26/00	410
	10/24/00	26
	11/29/00	370
	12/6/00	120
	1/22/01	82
	8/25/04	61
	9/7/04	160
	10/20/04	440
	11/16/04	120
	12/14/04	170
	1/5/05	390
	2/10/05	110
	3/8/05	580
	4/11/05	130
5/18/05	1400	
6/14/05	62	

Table B-1 (Cont.). TDEC Water Quality Monitoring Data – Old Hickory Subwatersheds

Monitoring Station	Date	E. Coli
		[cts./100 mL]
BARTO011.5WS	8/25/04	920
	9/7/04	35
	10/20/04	610
	11/16/04	99
	12/14/04	86
	1/5/05	120
	2/10/05	110
	3/8/05	230
	4/11/05	160
	5/18/05	920
6/14/05	87	
BARTO015.3WS	8/25/04	47
	9/7/04	51
	10/20/04	920
	11/16/04	650
	12/14/04	150
	1/5/05	370
	2/10/05	120
	3/8/05	460
	4/11/05	170
	5/18/05	78
6/14/05	52	
BARTO017.6WS	1/4/00	>2400
	5/1/00	220
	7/20/00	64
	10/31/00	22
	6/12/01	130
BEECH000.6WS	9/8/04	190
	10/25/04	490
	11/15/04	190
	12/15/04	120
	1/13/05	>2400
	2/24/05	370
	3/30/05	290
	4/6/05	80
5/25/05	150	

Table B-1 (Cont.). TDEC Water Quality Monitoring Data – Old Hickory Subwatersheds

Monitoring Station	Date	E. Coli
		[cts./100 mL]
BLOG000.6WS	8/2/00	650
	9/26/00	330
	10/24/00	370
	11/20/00	75
	12/6/00	520
	1/22/01	110
JOHNS000.1WS	8/25/04	460
	9/8/04	1600
	10/25/04	520
	11/15/04	390
	12/15/04	93
	1/13/05	410
	2/24/05	130
	3/30/05	460
	4/6/05	610
	5/25/05	1000
6/22/05	93	
JOHNS000.4WS	1/3/00	820
	4/19/00	140
	7/19/00	2000
	5/31/01	290
LGOOS004.7TR	8/23/04	820
	9/21/04	650
	10/19/04	2400
	11/29/04	490
	12/16/04	160
	1/10/05	920
	2/15/05	260
	3/14/05	130
	4/27/05	1200
	5/24/05	140
6/21/05	96	
LGOOS007.5TR	8/23/04	50
	9/21/04	140
	10/19/04	2400
	11/29/04	1000
	12/16/04	180

Table B-1 (Cont.). TDEC Water Quality Monitoring Data – Old Hickory Subwatersheds

Monitoring Station	Date	E. Coli
		[cts./100 mL]
LGOOS007.5TR (cont'd)	1/10/05	390
	2/15/05	86
	3/14/05	190
	4/27/05	580
	5/24/05	260
	6/21/05	370
NEAL000.1WS	8/2/00	870
	9/26/00	650
	11/29/00	2400
	12/6/00	1100
	1/22/01	>2400
	9/8/04	550
	10/25/04	>2400
	11/15/04	2000
	12/15/04	410
	1/13/05	>2400
	2/24/05	490
	3/30/05	610
	4/6/05	1200
	5/25/05	870
6/22/05	2000	
RLICK017.1WS	11/17/99	34
RLICK018.7WS	7/26/00	600
	8/2/00	580
	9/26/00	1600
	10/24/00	36
	11/29/00	490
	12/6/00	130
	1/22/01	2000
	9/8/04	1200
	10/25/04	520
	12/15/04	160
	1/13/05	>2400
	2/24/05	150

Table B-1 (Cont.). TDEC Water Quality Monitoring Data – Old Hickory Subwatersheds

Monitoring Station	Date	E. Coli
		[cts./100 mL]
RLICK018.7WS (cont'd)	3/30/05	550
	4/6/05	86
	5/25/05	920
	6/22/05	120
RLICK019.1WS	11/17/99	1
RLICK019.2WS	11/17/99	1
RLICK019.4WS	7/26/00	110
	8/2/00	58
	9/26/00	250
	10/24/00	24
	11/29/00	100
	12/6/00	330
	1/22/01	180
RLICK019.8WS	11/17/99	2
RLICK020.2WS	11/29/00	70
	1/22/01	160
SINKI000.9WS	8/25/04	520
	9/7/04	580
	10/20/04	2400
	11/16/04	100
	12/14/04	91
	1/5/05	550
	2/10/05	84
	3/8/05	1100
	4/11/05	250
	5/18/05	200
	6/14/05	870
SINKI004.0WS	1/4/00	>2400
	4/18/00	>2400
	5/31/01	>2400
SPRIN016.0WS	1/3/00	41
	4/19/00	240
	7/19/00	190
	11/1/00	190
	5/31/01	580

Table B-1 (Cont.). TDEC Water Quality Monitoring Data – Old Hickory Subwatersheds

Monitoring Station	Date	E. Coli
		[cts./100 mL]
SPRIN019.2WS	9/8/04	1600
	10/25/04	130
	11/15/04	150
	12/15/04	140
	1/13/05	460
	2/24/05	180
	3/30/05	440
	4/6/05	140
	5/25/05	16
	6/22/05	49
SPRIN027.0WS	1/4/00	>2400
	4/18/00	530
	7/18/00	770
	11/2/00	960
	5/30/01	1000

APPENDIX C

Load Duration Curve Development and Determination of Daily Loading

The TMDL process quantifies the amount of a pollutant that can be assimilated in a waterbody, identifies the sources of the pollutant, and recommends regulatory or other actions to be taken to achieve compliance with applicable water quality standards based on the relationship between pollution sources and in-stream water quality conditions. A TMDL can be expressed as the sum of all point source loads (Waste Load Allocations), non-point source loads (Load Allocations), and an appropriate margin of safety (MOS) that takes into account any uncertainty concerning the relationship between effluent limitations and water quality:

$$\text{TMDL} = \sum \text{WLAs} + \sum \text{LAs} + \text{MOS}$$

The objective of a TMDL is to allocate loads among all of the known pollutant sources throughout a watershed so that appropriate control measures can be implemented and water quality standards achieved. 40 CFR §130.2 (i) (<http://www.epa.gov/epacfr40/chapt-I.info/chi-toc.htm>) states that TMDLs can be expressed in terms of mass per time, toxicity, or other appropriate measure.

C.1 Development of TMDLs

E. coli TMDLs, WLAs, and LAs were developed for impaired subwatersheds and drainage areas in the Old Hickory Lake Watershed using Load Duration Curves (LDCs). Daily loads for TMDLs, WLAs, and LAs are expressed as a function of daily mean in-stream flow (daily loading function).

C.1.1 Development of Flow Duration Curves

A flow duration curve is a cumulative frequency graph, constructed from historic flow data at a particular location, that represents the percentage of time a particular flow rate is equaled or exceeded. Flow duration curves are developed for a waterbody from daily discharges of flow over an extended period of record. In general, there is a higher level of confidence that curves derived from data over a long period of record correctly represent the entire range of flow. The preferred method of flow duration curve computation uses daily mean data from U.S. Geological Survey (USGS) continuous-record stations (<http://waterdata.usgs.gov/tn/nwis/sw>) located on the waterbody of interest. For ungaged streams, alternative methods must be used to estimate daily mean flow. These include: 1) regression equations (using drainage area as the independent variable) developed from continuous record stations in the same ecoregion; 2) drainage area extrapolation of data from a nearby continuous-record station of similar size and topography; and 3) calculation of daily mean flow using a dynamic computer model, such as the Loading Simulation Program C++ (LSPC).

Flow duration curves for impaired waterbodies in the Old Hickory Lake Watershed were derived from LSPC hydrologic simulations based on parameters derived from calibrations at USGS Station No. 03430147 (see Appendix D for details of calibration). For example, a flow-duration curve for Neal Branch at RM 0.1 was constructed using simulated daily mean flow for the period from 10/1/95 through 9/30/05 (RM 0.1 corresponds to the location of monitoring station NEAL000.1WS). This flow duration curve is shown in Figure C-1 and represents the cumulative distribution of daily discharges arranged to show percentage of time specific flows were exceeded during the period of record (the highest daily mean flow during this period is exceeded 0% of the time and the lowest daily mean flow is equaled or exceeded 100% of the time). Flow duration curves for other impaired waterbodies were derived using a similar procedure.

C.1.2 Development of Load Duration Curves and TMDLs

When a water quality target concentration is applied to the flow duration curve, the resulting load duration curve (LDC) represents the allowable pollutant loading in a waterbody over the entire range of flow. Pollutant monitoring data, plotted on the LDC, provides a visual depiction of stream water quality as well as the frequency and magnitude of any exceedances. Load duration curve intervals can be grouped into several broad categories or zones, in order to provide additional insight about conditions and patterns associated with the impairment. For example, the duration curve could be divided into five zones: high flows (exceeded 0-10% of the time), moist conditions (10-40%), median or mid-range flows (40-60%), dry conditions (60-90%), and low flows (90-100%).

Impairments observed in the low flow zone typically indicate the influence of point sources, while those further left on the LDC (representing zones of higher flow) generally reflect potential nonpoint source contributions (Stiles, 2003).

E. coli load duration curves for impaired waterbodies in the Old Hickory Lake Watershed were developed from the flow duration curves developed in Section C.1.1, E. coli target concentrations, and available water quality monitoring data. LDCs and daily loading functions were developed using the following procedure (Neal Branch is shown as an example):

1. A target load-duration curve (LDC) was generated for Neal Branch by applying the E. coli target concentration of 941 CFU/100 mL to each of the ranked flows used to generate the flow duration curve (ref.: Section C.1) and plotting the results. The E. coli target maximum load corresponding to each ranked daily mean flow is:

$$(\text{Target Load})_{\text{Neal Branch}} = (941 \text{ CFU}/100 \text{ mL}) \times (Q) \times (\text{UCF})$$

where: Target Load = TMDL (CFU/day)
Q = daily instream mean flow
UCF = the required unit conversion factor

$$\text{TMDL} = (2.30 \times 10^{10}) \times (Q) \text{ CFU/day}$$

2. Daily loads were calculated for each of the water quality samples collected at monitoring station NEAL000.1WS (ref.: Table B-1) by multiplying the sample concentration by the daily mean flow for the sampling date and the required unit conversion factor. NEAL000.1WS was selected for LDC analysis because the sample were well distributed across the full range of flow conditions and there were multiple exceedances of the target concentration.

Note: In order to be consistent for all analyses, the derived daily mean flow was used to compute sampling data loads, even if measured ("instantaneous") flow data was available for some sampling dates.

Example – 11/15/04 sampling event:

*Modelled Flow = 1.82 cfs
Concentration = 2000 CFU/100 mL
Daily Load = 8.88x10¹⁰ CFU/day*

- Using the flow duration curves developed in C.1.1, the “percent of days the flow was exceeded” (PDFE) was determined for each sampling event. Each sample load was then plotted on the load duration curves developed in Step 1 according to the PDFE. The resulting E. coli load duration curve for is shown in Figure C-2.

LDCs of other impaired waterbodies were derived in a similar manner and are shown in Appendix E.

C.2 Development of WLAs, LAs and MOS

As previously discussed, a TMDL can be expressed as the sum of all point source loads (WLAs), nonpoint source loads (LAs), and an appropriate margin of safety (MOS) that takes into account any uncertainty concerning the relationship between effluent limitations and water quality:

$$\text{TMDL} = \Sigma \text{WLAs} + \Sigma \text{LAs} + \text{MOS}$$

Expanding the terms:

$$\text{TMDL} = [\Sigma \text{WLAs}]_{\text{WWTF}} + [\Sigma \text{WLAs}]_{\text{MS4}} + [\Sigma \text{WLAs}]_{\text{CAFO}} + [\Sigma \text{LAs}]_{\text{DS}} + [\Sigma \text{LAs}]_{\text{SW}} + \text{MOS}$$

For E. coli TMDLs in each impaired subwatershed or drainage area, WLA terms include:

- $[\Sigma \text{WLAs}]_{\text{WWTF}}$ is the allowable load associated with discharges of NPDES permitted WWTFs located in impaired subwatersheds or drainage areas. Since NPDES permits for these facilities specify that treated wastewater must meet in-stream water quality standards at the point of discharge, no additional load reduction is required. WLAs for WWTFs are calculated from the facility design flow and the Monthly Average permit limit.
- $[\Sigma \text{WLAs}]_{\text{CAFO}}$ is the allowable load for all CAFOs in an impaired subwatershed or drainage area. All wastewater discharges from a CAFO to waters of the state of Tennessee are prohibited, except when either chronic or catastrophic rainfall events cause an overflow of process wastewater from a facility properly designed, constructed, maintained, and operated to contain:
 - All process wastewater resulting from the operation of the CAFO (such as wash water, parlor water, watering system overflow, etc.); plus,
 - All runoff from a 25-year, 24-hour rainfall event for the existing CAFO or new dairy or cattle CAFOs; or all runoff from a 100-year, 24-hour rainfall event for a new swine or poultry CAFO.

Therefore, a WLA of zero has been assigned to this class of facilities.

- $[\Sigma \text{WLAs}]_{\text{MS4}}$ is the allowable E. coli load for discharges from MS4s. E. coli loading from MS4s is the result of buildup/wash-off processes associated with storm events.

LA terms include:

- $[\Sigma \text{LAs}]_{\text{DS}}$ is the allowable E. coli load from “other direct sources”. These sources include leaking septic systems, illicit discharges, and animals access to streams. The LA specified for all sources of this type is zero CFU/day (or to the maximum extent feasible).

- $[\Sigma LAs]_{SW}$ represents the allowable E. coli loading from nonpoint sources indirectly going to surface waters from all land use areas (except areas covered by a MS4 permit) as a result of the buildup/wash-off processes associated with storm events (i.e., precipitation induced).

Since $[\Sigma WLAs]_{CAFO} = 0$ and $[\Sigma LAs]_{DS} = 0$, the expression relating TMDLs to precipitation-based point and nonpoint sources may be simplified to:

$$TMDL - MOS = [WLAs]_{WWTF} + [\Sigma WLAs]_{MS4} + [\Sigma LAs]_{SW}$$

As stated in Section 8.4, an explicit MOS, equal to 10% of the E. coli water quality targets (ref.: Section 5.0), was utilized for determination of the percent load reductions necessary to achieve and WLAs and LAs:

Instantaneous Maximum (lake, reservoir, State Scenic River, Tier II, and Tier III):

$$Target - MOS = (487 \text{ CFU}/100 \text{ ml}) - 0.1(487 \text{ CFU}/100 \text{ ml})$$

$$Target - MOS = 438 \text{ CFU}/100 \text{ ml}$$

Instantaneous Maximum (other):

$$Target - MOS = (941 \text{ CFU}/100 \text{ ml}) - 0.1(941 \text{ CFU}/100 \text{ ml})$$

$$Target - MOS = 847 \text{ CFU}/100 \text{ ml}$$

30-Day Geometric Mean:

$$Target - MOS = (126 \text{ CFU}/100 \text{ ml}) - 0.1(126 \text{ CFU}/100 \text{ ml})$$

$$Target - MOS = 113 \text{ CFU}/100 \text{ ml}$$

C.2.1 Daily Load Calculation

Since WWTFs discharge must comply with instream water quality criteria (TMDL target) at the point of discharge, WLAs for WWTFs are expressed as a constant term. In addition, WLAs for MS4s and LAs for precipitation-based nonpoint sources are equal on a per unit area basis and may be expressed as the daily allowable load per unit area (acre) resulting from a decrease in in-stream E. coli concentrations to TMDL target values minus MOS:

$$WLA[MS4] = LA = \{TMDL - MOS - WLA[WWTFs]\} / DA$$

where: DA = waterbody drainage area (acres)

Using Neal Branch as an example:

$$\begin{aligned} TMDL_{Neal \text{ Branch}} &= (941 \text{ CFU}/100 \text{ mL}) \times (Q) \times (UCF) \\ &= 2.30 \times 10^{10} \times Q \end{aligned}$$

$$\text{MOS}_{\text{Neal Branch}} = \text{TMDL} \times 0.10 = 2.30 \times 10^9 \times Q$$

$$\text{MOS} = (2.30 \times 10^9) \times (Q) \text{ CFU/day}$$

$$\begin{aligned} \text{LA}_{\text{Neal Branch}} &= \{ \text{TMDL} - \text{MOS} - \text{WLA}[\text{WWTFs}] \} / \text{DA} \\ &= \{ (2.30 \times 10^{10} \times Q) - (2.30 \times 10^9 \times Q) - (0) \} / (1.20 \times 10^4) \end{aligned}$$

$$\text{LA} = [1.723 \times 10^7 \times Q]$$

Since the Neal Branch drainage area does not include a WWTF, Round Lick Creek is also presented as an example that does include a WWTF:

$$\begin{aligned} \text{WLA}[\text{MS4}]_{\text{Round Lick Creek}} &= \text{LA}_{\text{Round Lick Creek}} \\ &= \{ \text{TMDL} - \text{MOS} - \text{WLA}[\text{WWTFs}] \} / \text{DA} \\ &= \{ (2.30 \times 10^{10} \times Q) - (2.30 \times 10^9 \times Q) - (9.617 \times 10^9) \} / \\ &\quad (1.73 \times 10^4) \end{aligned}$$

$$\text{WLA}[\text{MS4}] = \text{LA} = [1.194 \times 10^6 \times Q] - [5.546 \times 10^5]$$

TMDLs, WLAs, & LAs for other impaired subwatersheds and drainage areas were derived in a similar manner and are summarized in Table C-1.

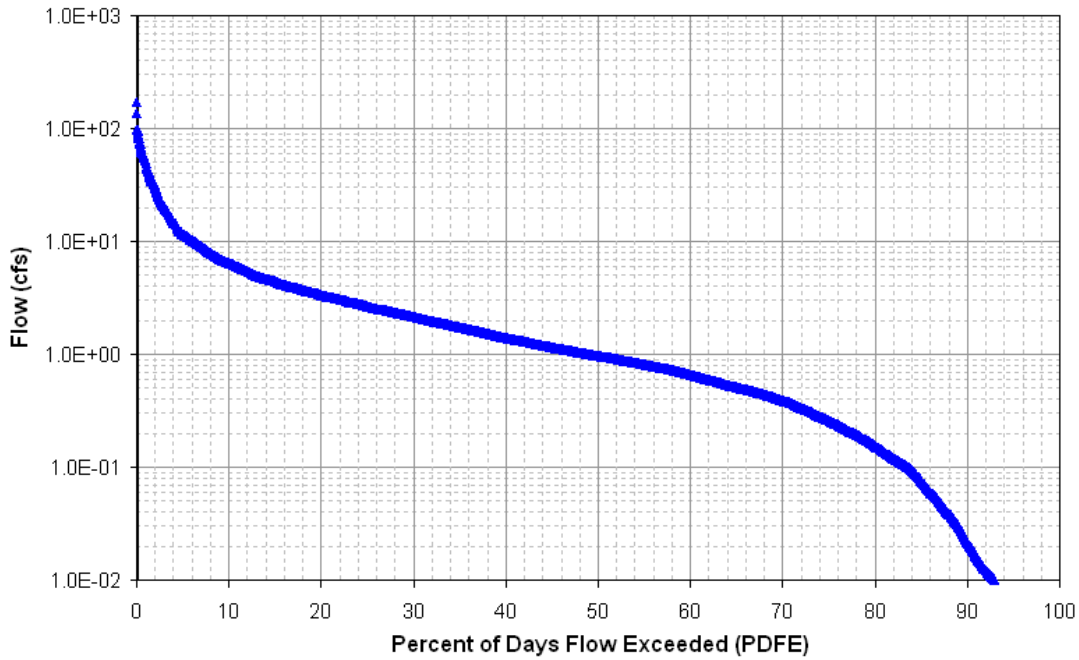


Figure C-1. Flow Duration Curve for Neal Branch at Mile 0.1

Neal Branch
 Load Duration Curve (2000-2005 Monitoring Data)
 Site: NEAL000.1WS

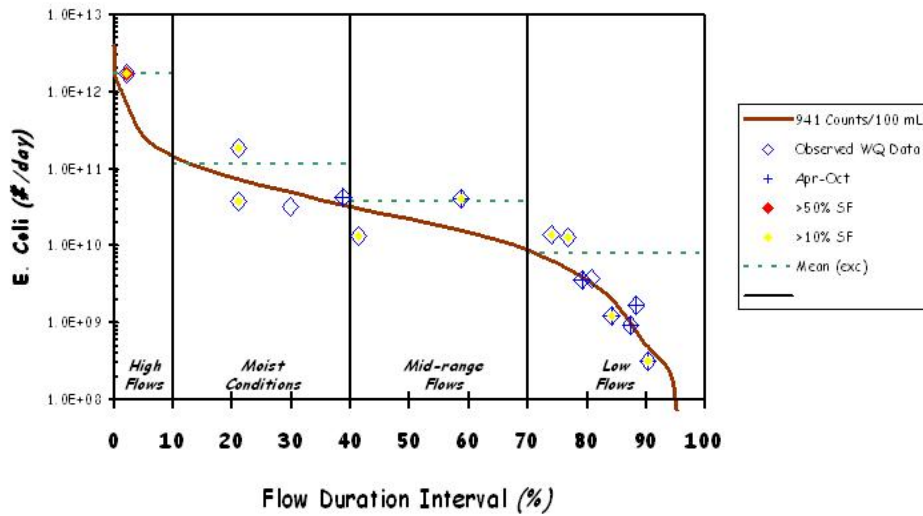


Figure C-2. E. Coli Load Duration Curve for Neal Branch at Mile 0.1

Table C-1 Summary of TMDLs, WLAs, & LAs expressed as daily loads for Impaired Waterbodies in the Old Hickory Lake Watershed (HUC 05130201)

HUC-12 Subwatershed (05130201___) or Drainage Area (DA)	Impaired Waterbody Name	Impaired Waterbody ID	TMDL	MOS	WLAs			LAs
					WWTFs ^a	Collection Systems	MS4s	
					[CFU/day]	[CFU/day]	[CFU/day/acre]	
0105	Johnson Branch	TN05130201015 – 0200	$2.30 \times 10^{10} * Q$	$2.30 \times 10^9 * Q$	NA	NA	NA	$6.893 \times 10^6 * Q$
0106	Spring Creek	TN05130201013 – 4000	$1.20 \times 10^{10} * Q$	$1.20 \times 10^9 * Q$	NA	NA	NA	$7.653 \times 10^5 * Q$
0107	Bartons Creek	TN05130201055 – 1000	*b	*b	*b	*b	*b	*b
	Sinking Creek	TN05130201055 – 0200	$2.30 \times 10^{10} * Q$	$2.30 \times 10^9 * Q$	NA	0	$2.175 \times 10^6 * Q$	$2.175 \times 10^6 * Q$
	Sinking Creek	TN05130201055 – 0250	$2.30 \times 10^{10} * Q$	$2.30 \times 10^9 * Q$	NA	0	$2.175 \times 10^6 * Q$	$2.175 \times 10^6 * Q$
0201	Beech Log Creek	TN05130201021 – 0400	$2.30 \times 10^{10} * Q$	$2.30 \times 10^9 * Q$	NA	0	$5.692 \times 10^6 * Q$	$5.692 \times 10^6 * Q$
	Neal Branch	TN05130201021 – 0300	$2.30 \times 10^{10} * Q$	$2.30 \times 10^9 * Q$	NA	0	$1.723 \times 10^7 * Q$	$1.723 \times 10^7 * Q$
	Round Lick Creek	TN05130201021 – 2000	$2.30 \times 10^{10} * Q$	$2.30 \times 10^9 * Q$	9.617×10^9	0	$1.194 \times 10^6 * Q - 5.546 \times 10^5$	$1.194 \times 10^6 * Q - 5.546 \times 10^5$
0302	Little Goose Creek	TN05130201028 – 0100	$2.30 \times 10^{10} * Q$	$2.30 \times 10^9 * Q$	NA	NA	NA	$1.131 \times 10^6 * Q$
	Little Goose Creek	TN05130201028 – 0150	$2.30 \times 10^{10} * Q$	$2.30 \times 10^9 * Q$	NA	NA	NA	$1.651 \times 10^6 * Q$

Notes: NA = Not Applicable.

- a. WLAs for WWTFs are expressed as E. coli loads (CFU/day). All current and future WWTFs must meet water quality standards as specified in their NPDES permit.
- b. Detailed TMDL analyses were not performed on Bartons Creek. It is assumed that water quality standards for E. coli will be attained in this waterbody when the requirements of the Commissioner's Order against Lebanon STP are complete and Lebanon STP complies with the terms of its NPDES permit.

APPENDIX D

Hydrodynamic Modeling Methodology

HYDRODYNAMIC MODELING METHODOLOGY

D.1 Model Selection

The Loading Simulation Program C++ (LSPC) was selected for flow simulation of pathogen-impaired waters in the subwatersheds of the Old Hickory Lake Watershed. LSPC is a watershed model capable of performing flow routing through stream reaches. LSPC is a dynamic watershed model based on the Hydrologic Simulation Program - Fortran (HSPF)

D.2 Model Set Up

The Old Hickory Lake Watershed was delineated into subwatersheds in order to facilitate model hydrologic calibration. Boundaries were constructed so that subwatershed “pour points” coincided with HUC-12 delineations, 303(d)-listed waterbodies, and water quality monitoring stations. Watershed delineation was based on the NHD stream coverage and Digital Elevation Model (DEM) data. This discretization facilitates simulation of daily flows at water quality monitoring stations.

Several computer-based tools were utilized to generate input data for the LSPC model. The Watershed Characterization System (WCS), a geographic information system (GIS) tool, was used to display, analyze, and compile available information to support hydrology model simulations for selected subwatersheds. This information includes land use categories, point source dischargers, soil types and characteristics, population data (human and livestock), and stream characteristics.

An important factor influencing model results is the precipitation data contained in the meteorological data files used in these simulations. Weather data from multiple meteorological stations were available for the time period from January 1970 through December 2005. Meteorological data for a selected 11-year period were used for all simulations. The first year of this period was used for model stabilization with simulation data from the subsequent 10-year period (10/1/95 – 9/30/05) used for TMDL analysis.

D.3 Model Calibration

Hydrologic calibration of the watershed model involves comparison of simulated streamflow to historic streamflow data from U. S. Geological Survey (USGS) stream gaging stations for the same period of time. A USGS continuous record station located near the Old Hickory Lake Watershed with a sufficiently long and recent historical record was selected as the basis of the hydrology calibration. The USGS stations were selected based on similarity of drainage area, Level IV ecoregion, land use, and topography. The calibration involved comparison of simulated and observed hydrographs until statistical stream volumes and flows were within acceptable ranges as reported in the literature (Lumb, et al., 1994).

Initial values for hydrologic variables were taken from an EPA developed default data set. During the calibration process, model parameters were adjusted within reasonable constraints until acceptable agreement was achieved between simulated and observed streamflow. Model parameters adjusted include: evapotranspiration, infiltration, upper and lower zone storage, groundwater storage, recession, losses to the deep groundwater system, and interflow discharge.

The results of the hydrologic calibration for Stoners Creek near Hermitage, USGS Station 03430147, drainage area 20.67 square miles, are shown in Table D-1 and Figures D-1 and D-2.

Table D-1. Hydrologic Calibration Summary: Stoners near Hermitage (USGS 03430147)

		19.62910261	
Simulation Name:	USGS03430147	Simulation Period:	
		Watershed Area (ac):	12566.65
Period for Flow Analysis			
Begin Date:	10/01/92	Baseflow PERCENTILE:	2.5
End Date:	09/30/02	<i>Usually 1%-5%</i>	
Total Simulated In-stream Flow:	198.55	Total Observed In-stream Flow:	206.51
Total of highest 10% flows:	121.77	Total of Observed highest 10% flows:	121.66
Total of lowest 50% flows:	12.65	Total of Observed Lowest 50% flows:	14.05
Simulated Summer Flow Volume (months 7-9):	12.42	Observed Summer Flow Volume (7-9):	10.18
Simulated Fall Flow Volume (months 10-12):	41.45	Observed Fall Flow Volume (10-12):	39.35
Simulated Winter Flow Volume (months 1-3):	87.27	Observed Winter Flow Volume (1-3):	101.24
Simulated Spring Flow Volume (months 4-6):	57.41	Observed Spring Flow Volume (4-6):	55.74
Total Simulated Storm Volume:	197.76	Total Observed Storm Volume:	204.72
Simulated Summer Storm Volume (7-9):	12.22	Observed Summer Storm Volume (7-9):	9.73
<i>Errors (Simulated-Observed)</i>		<i>Recommended Criteria</i>	
Error in total volume:	-3.85		10
Error in 50% lowest flows:	-9.92		10
Error in 10% highest flows:	0.10		15
Seasonal volume error - Summer:	22.00		30
Seasonal volume error - Fall:	5.35		30
Seasonal volume error - Winter:	-13.80		30
Seasonal volume error - Spring:	3.00		30
Error in storm volumes:	-3.40		20
Error in summer storm volumes:	25.54		50
Last run			
Criteria for Median Monthly Flow Comparisons			
Lower Bound (Percentile):	25		
Upper Bound (Percentile):	75		

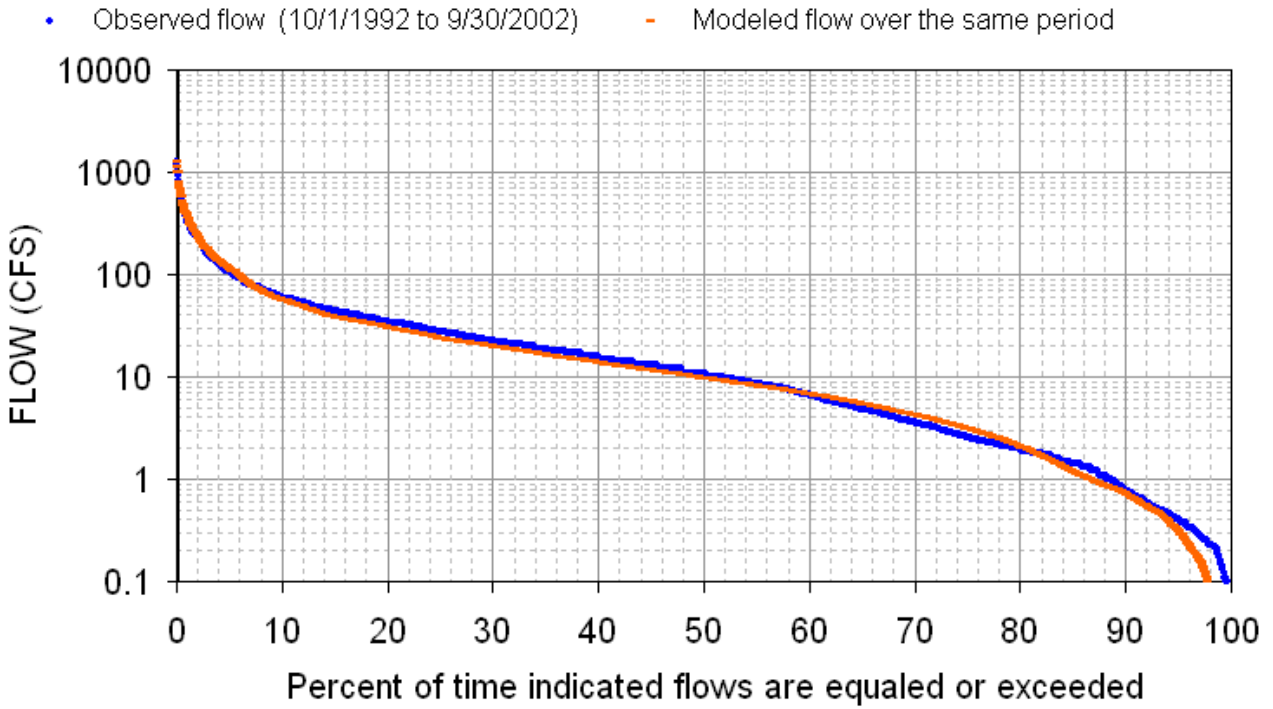


Figure D-1. Hydrologic Calibration: Stoners Creek, USGS 03430147 (WYs1993-2002)

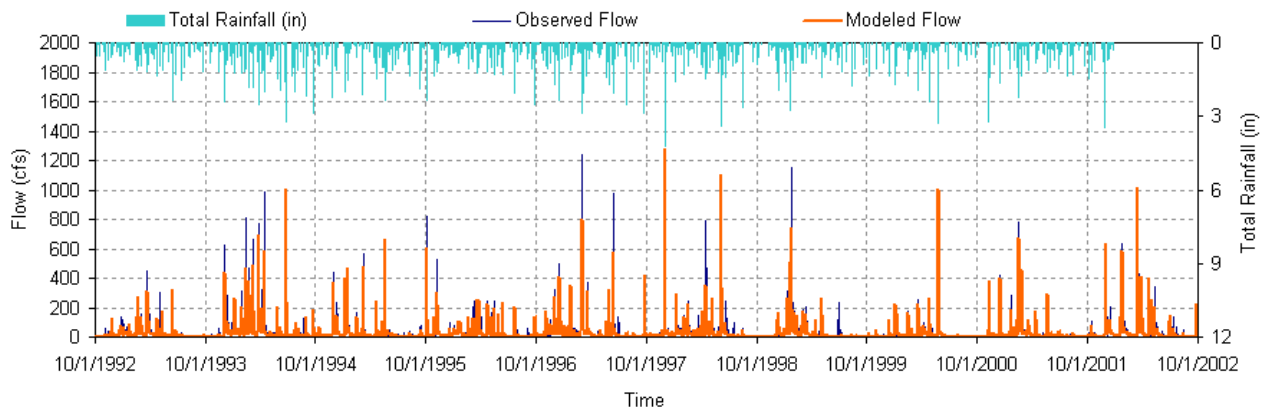


Figure D-2. 10-Year Hydrologic Comparison: Stoners Creek, USGS 03430147

APPENDIX E
Source Area Implementation Strategy

All impaired waterbodies and corresponding HUC-12 subwatersheds or drainage areas have been classified according to their respective source area types in Section 9.5, Table 10. The implementation for each area will be prioritized according to the guidance provided in Section 9.5.1 and 9.5.2, with examples provided in Section E.1 and E.2, below. For all impaired waterbodies, the determination of source area types serves to identify the predominant sources contributing to impairment (i.e., those that should be targeted initially for implementation). However, it is not intended to imply that sources in other landuse areas are not contributors to impairment and/or to grant an exemption from addressing other source area contributions with implementation strategies and corresponding load reduction. For mixed use areas, implementation will follow the guidance established for both urban and agricultural areas, at a minimum.

E.1 Urban Source Areas

For impaired waterbodies and corresponding HUC-12 subwatersheds or drainage areas identified as predominantly urban source area types, the following example for Sinking Creek provides guidance for implementation analysis:

The Sinking Creek watershed, HUC-12 051302010107, lies near Lebanon. The drainage area for Sinking Creek at mile 0.9 is approximately 9,518 acres (14.9 mi²); therefore, four flow zones were used for the duration curve analysis (see Sect. 9.1.1).

Note: The Final 2006 303(d) List includes Collection System Failure and Discharges from MS4 Area as Pollutant Source categories for Sinking Creek. However, based on the MRLC Land Use, the Sinking Creek watershed is approximately 37% agricultural. Therefore, Sinking Creek is listed in the Mixed source area type in Section 9.5, Table 10.

The flow duration curve for Sinking Creek at mile 0.9 was constructed using simulated daily mean flow for the period from 10/1/95 through 9/30/05 (mile 0.9 corresponds to the location of monitoring station SINKI000.9WS). This flow duration curve is shown in Figure E-1 and represents the cumulative distribution of daily discharges arranged to show percentage of time specific flows were exceeded during the period of record. Flow duration curves for other impaired waterbodies were developed using a similar procedure (Appendix C).

The E. coli LDC for Sinking Creek at Mile 0.9 (Figure E-2) was analyzed to determine the frequency with which observed daily water quality loads exceed the E. coli target maximum daily loading (941 CFU/100 mL x flow [cfs] x conversion factor) under four flow conditions (low, mid-range, moist, and high). Observation of the plot illustrates that exceedances occur under high flow and moist conditions indicating the Sinking Creek watershed may be impacted by non-point sources. LDCs for other impaired waterbodies were developed using a similar procedure (Appendix C) and are shown in Figures E-4 to E-10.

Critical conditions for the Sinking Creek watershed (HUC-12 051302010107) occur during moist conditions, typically indicative of non-point source contributions (see Table E-3, Section E.4). According to hydrograph separation analysis, the exceedances in the high flow range occur during stormflow events. These factors indicate that non-point sources are significant contributors to impairment in the Sinking Creek watershed. However, it is possible that both point and non-point type sources contribute to exceedances of the E. coli standard in Sinking Creek.

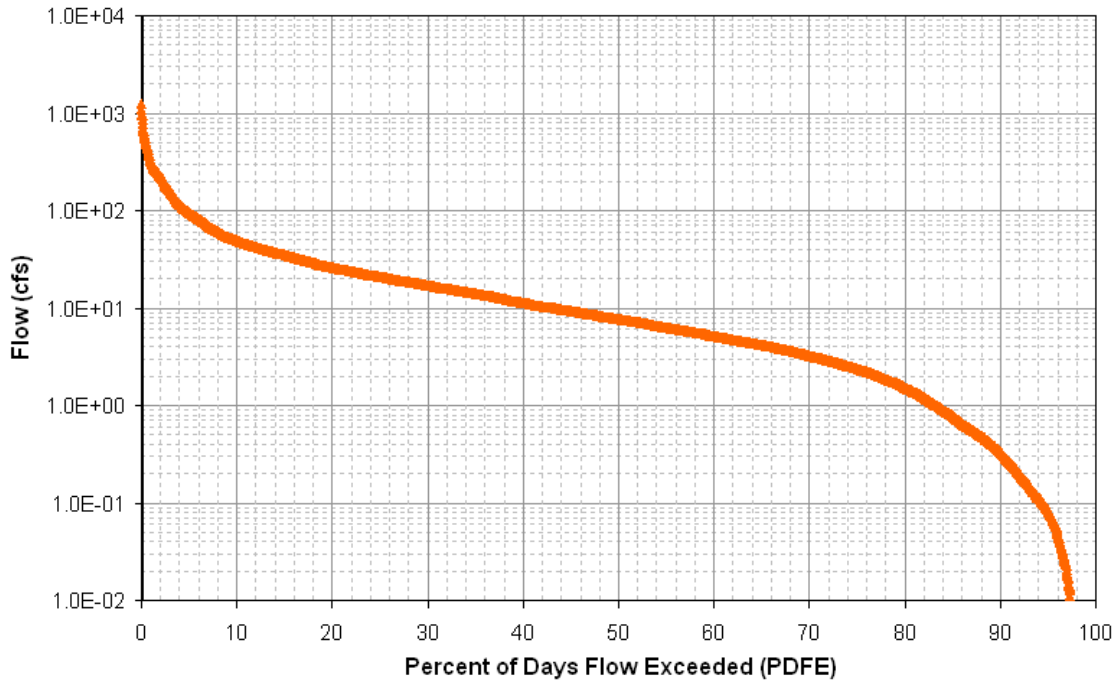


Figure E-1. Flow Duration Curve for Sinking Creek at Mile 0.9

Sinking Creek
 Load Duration Curve (2004-2005 Monitoring Data)
 Site: SINKI000.9WS

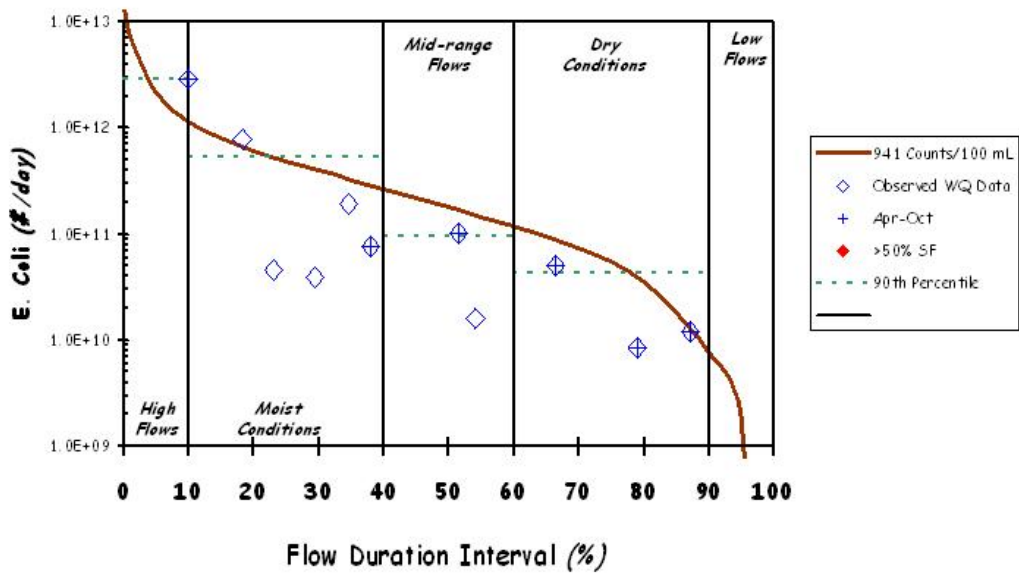


Figure E-2. E. Coli Load Duration Curve for Sinking Creek at Mile 0.9

Table E-1. Load Duration Curve Summary for Implementation Strategies (Example: Sinking Creek subwatershed, HUC-12 051302010107) (4 Flow Zones).

Hydrologic Condition		High	Moist	Mid-range	Low*
% Time Flow Exceeded		0-10	10-40	40-70	70-100
Sinking Creek (051302010107)	Number of Samples	1	5	3	2
	% > 941 CFU/100 mL ¹	100.0	20.0	0.0	0.0
	Load Reduction ²	60.8	2.9	NR	NR
TMDL (CFU/day)		2.190E+12	4.851E+11	1.454E+11	1.817E+10
Margin of Safety (CFU/day)		2.190E+11	4.851E+10	1.454E+10	1.817E+09
WLA (WWTFs) (CFU/day)		NA	NA	NA	NA
WLAs (MS4s) (CFU/day/acre) ³		2.071E+08	4.586E+07	1.374E+07	1.718E+06
LA (CFU/day/acre) ³		2.071E+08	4.586E+07	1.374E+07	1.718E+06
Implementation Strategies⁴					
Municipal NPDES			L	M	H
Stormwater Management			H	H	
SSO Mitigation		H	M	L	
Collection System Repair			H	M	L
Septic System Repair			L	M	H
Potential for source area contribution under given flow condition (H: High; M: Medium; L: Low)					

* The Moist Conditions Flow zone represents the critical conditions for E. coli loading in the Sinking Creek subwatershed.
¹ Tennessee Maximum daily water quality criterion for E. coli.
² Reductions (percent) based on mean of observed percent load reductions in range.
³ LAs and MS4s are expressed as daily load per unit area in order to provide for future changes in the distribution of LAs and MS4s (WLAs).
⁴ Watershed-specific Best Management Practices for Urban Source reduction. Actual BMPs applied may vary and should not be limited according to this grouping.

Results indicate the implementation strategy for the Sinking Creek watershed will require BMPs targeting non-point sources (dominant under high flow/runoff conditions). Table E-1 presents an allocation table of LDC analysis statistics for Sinking Creek E. coli and implementation strategies for each source category covering the entire range of flow (Stiles, 2003). The implementation strategies listed in Table E-1 are a subset of the categories of BMPs and implementation strategies available for application to the Old Hickory Lake watershed for reduction of E. coli loading and mitigation of water quality impairment from urban sources. Targeted implementation strategies and LDC analysis statistics for other impaired waterbodies and corresponding HUC-12 subwatersheds and drainage areas identified as predominantly urban source area types can be derived from the information and results available in Tables 11 and E-12.

Table E-12 presents LDC analyses (TMDLs, WLAs, LAs, and MOS) and PLRGs for all flow zones for all E. coli impaired waterbodies in the Old Hickory Lake watershed.

E.2 Agricultural Source Areas

For impaired waterbodies and corresponding HUC-12 subwatersheds or drainage areas identified as predominantly agricultural source area types, the following example for Neal Branch provides guidance for implementation analysis:

The Neal Branch subwatershed, HUC-12 051302010201, lies in a non-urbanized area near Watertown in Wilson county. The drainage area for Neal Branch at Mile 0.1 is approximately 1,200 acres (1.9 mi²); therefore, four flow zones were used for the duration curve analysis (see Sect. 9.1.1). The landuse for Neal Branch is approximately 42% agricultural, with most of the remainder being forested. Urban areas make up less than 1% of the total area. Therefore, the predominant landuse type and sources are agricultural.

The flow duration curve for Neal Branch at Mile 0.1 was constructed using simulated daily mean flow for the period from 1/1/96 through 12/31/05. This flow duration curve is shown in Figure E-3 and represents the cumulative distribution of daily discharges arranged to show percentage of time specific flows were exceeded during the period of record. Flow duration curves for other impaired waterbodies were developed using a similar procedure (see Appendix C).

The E. coli LDC for Neal Branch at Mile 0.1 (Figure E-4) was analyzed to determine the frequency with which observed daily water quality loads exceed the E. coli target maximum daily loading (941 CFU/100 mL x flow [cfs] x conversion factor) under four flow conditions (low, mid-range, moist, and high). Observation of the plot illustrates that exceedances occur under all flow zones indicating the Neal Branch watershed is impacted by point and non-point-type sources. LDCs for other impaired waterbodies were developed using a similar procedure (Appendix C) and are shown in Figures E-2 thru E-10.

Critical conditions for the Neal Branch HUC-12 occur during mid-range flows, typically indicative of both point and non-point source contributions (see Table E-3, Section E.4). Exceedances of the E. coli water quality standard are fairly well distributed across the full range of flows and all flow zones, though the magnitude of exceedances varies. According to hydrograph separation analysis, most of the exceedances occur during stormflow events. Therefore, it is reasonable to say that non-point type sources contribute to exceedances of the E. coli standard in Neal Branch.

Results indicate the implementation strategy for the Neal Branch watershed will require BMPs targeting non-point sources (dominant under high flow/runoff conditions). Table E-2 presents an allocation table of Load Duration Curve analysis statistics for Neal Branch E. coli and targeted implementation strategies for each source category covering the entire range of flow (Stiles, 2003). The implementation strategies listed in Table E-2 are a subset of the categories of BMPs and implementation strategies available for application to the Old Hickory Lake watershed for reduction of E. coli loading and mitigation of water quality impairment from agricultural sources. Targeted implementation strategies and LDC analysis statistics for other impaired waterbodies and corresponding HUC-12 subwatersheds and drainage areas identified as predominantly agricultural source area types can be derived from the information and results available in Tables 12 and E-12.

Table E-12 presents LDC analyses (TMDLs, WLAs, LAs, and MOS) and PLRGs for all flow zones for all E. coli impaired waterbodies in the Old Hickory Lake watershed.

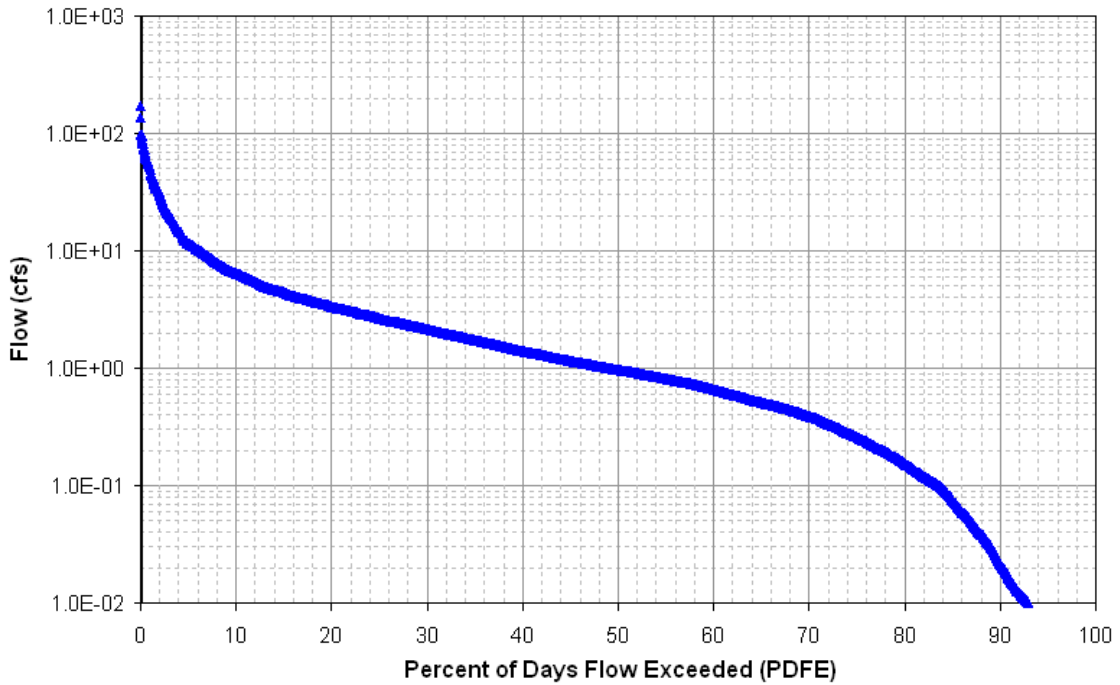


Figure E-3. Flow Duration Curve for Neal Branch at Mile 0.1

Neal Branch
 Load Duration Curve (2000-2005 Monitoring Data)
 Site: NEAL000.1WS

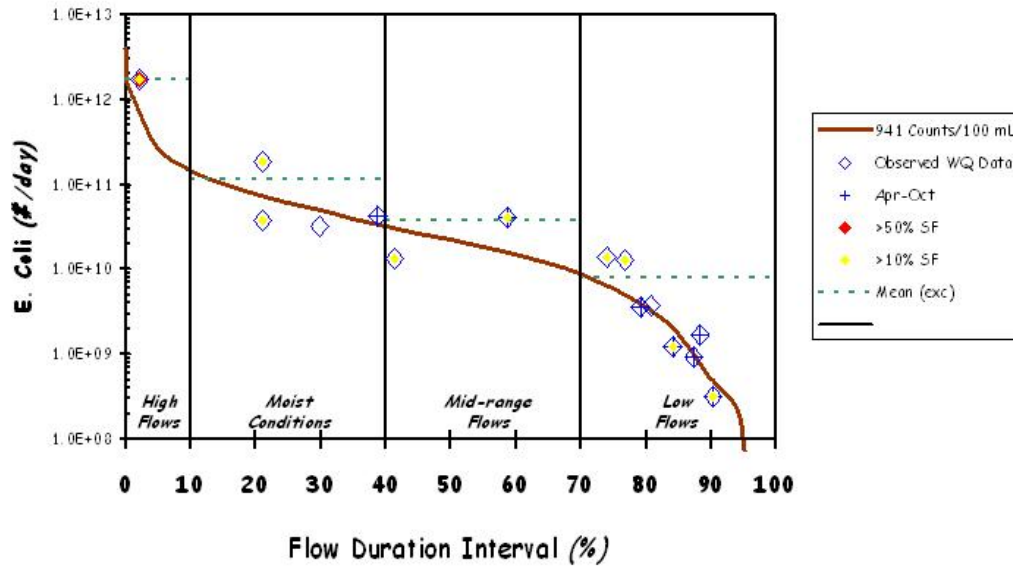


Figure E-4. E. Coli Load Duration Curve for Neal Branch at Mile 0.1

Table E-2. Load Duration Curve Summary for Implementation Strategies (Example: Neal Branch subwatershed, HUC-12 051302010201) (4 Flow Zones).

Hydrologic Condition		High	Moist	Mid-range*	Low
% Time Flow Exceeded		0-10	10-40	40-70	70-100
Neal Branch (051302010201)	Number of Samples	1	4	2	8
	% > 941 CFU/100 mL ¹	100	50.0	50.0	50.0
	Load Reduction ²	60.8	20.6	30.4	22.6
TMDL (CFU/day)		2.663E+11	6.095E+10	1.863E+10	1.610E+09
Margin of Safety (CFU/day)		2.663E+10	6.095E+09	1.863E+09	1.610E+08
WLA (WWTFs) (CFU/day)		NA	NA	NA	NA
WLA (MS4s) (CFU/day/acre) ³					
LAs (CFU/day/acre) ³		1.956E+08	4.388E+07	1.315E+07	1.423E+06
Implementation Strategies⁴					
Pasture and Hayland Management		H	H	M	L
Livestock Exclusion				M	H
Fencing				M	H
Manure Management		H	H	M	L
Riparian Buffers		L	M	H	M
Potential for source area contribution under given flow condition (H: High; M: Medium; L: Low)					

* The Mid-range flow zone represents the critical conditions for E. coli loading in the Neal Branch subwatershed.

¹ Tennessee Maximum daily water quality criterion for E. coli.

² Reductions (percent) based on mean of observed percent load reductions in range.

³ LAs and MS4s are expressed as daily load per unit area in order to provide for future changes in the distribution of LAs and MS4s (WLAs).

⁴ Example Best Management Practices for Agricultural Source reduction. Actual BMPs applied may vary and should not be limited according to this grouping.

E.3 Forestry Source Areas

There are no impaired waterbodies with corresponding HUC-12 subwatersheds or drainage areas classified as source area type predominantly forested, with the predominant source category being wildlife, in the Old Hickory Lake watershed.

E.4 Calculation of Percent Load Reduction Goals and Determination of Critical Flow Zones

In order to facilitate implementation, corresponding percent reductions in loading required to decrease existing, in-stream E. coli loads to TMDL target levels (percent load reduction goals) were calculated. The following example is from Neal Branch at mile 0.1.

1. For each flow zone, the mean of the percent exceedances of individual loads relative to their respective target maximum loads (at their respective PDFEs) was calculated. Each negative percent exceedance was assumed to be equal to zero.

Date	Sample Conc. (CFU/100 mL)	Flow (cfs)	Existing Load (CFU/Day)	Target (TMDL) Load (CFU/Day)	Percent Reduction
1/22/01	2400	3.19	1.87E+11	7.34E+10	60.8
2/24/05	490	3.19	3.82E+10	7.34E+10	0 (-92)
3/30/05	610	2.17	3.23E+10	4.99E+10	0 (-54.3)
4/6/05	1200	1.47	4.31E+10	3.38E+10	21.6
Percent Load Reduction Goal (PLRG) for Moist Flow Zone (Mean)					20.6

2. The PLRGs calculated for each of the flow zones, not including the high flow zone, were compared and the PLRG of the greatest magnitude indicates the critical flow zone for prioritizing implementation actions for Neal Branch.

Example – Moist Conditions Flow Zone Percent Load Reduction Goal = 20.6
Mid-Range Flow Zone Percent Load Reduction Goal = 30.4
Low Flow Zone Percent Load Reduction Goal = 22.6

Therefore, the critical flow zone for prioritization of Neal Branch implementation activities is the Mid-Range Zone and subsequently actions targeting point source controls.

PLRGs and critical flow zones of the other impaired waterbodies were derived in a similar manner and are shown in Table E-12.

Table E-3. Summary of Critical Conditions for Impaired Waterbodies in the Old Hickory Lake Watershed.

Waterbody ID	Moist	Mid-range	Dry	Low
Johnson Branch		✓		
Spring Creek				✓
Sinking Creek	✓			
Beech Log Creek				
Neal Branch		✓		
Round Lick Creek	✓			
Little Goose Creek	✓			

* All Waterbody(ies) have 4 flow zones.

Geometric Mean Data

For cases where five or more samples were collected over a period of not more than 30 consecutive days, the geometric mean E. coli concentration was determined and compared to the target geometric mean E. coli concentration of 126 CFU/100 mL. If the sample geometric mean exceeded the target geometric mean concentration, the reduction required to reduce the sample geometric mean value to the target geometric mean concentration was calculated.

Example: Insufficient monitoring data were available for all Old Hickory Lake watershed impaired waterbody monitoring stations. The following example is from the Clear Fork of the Cumberland River watershed:

*Monitoring Location = Little Elk Creek
 Sampling Period = 7/1/04 – 7/29/04
 Geometric Mean Concentration = 1128.4 CFU/100 mL
 Target Concentration = 126 CFU/100 mL
 Reduction to Target = 88.8%*

For impaired waterbodies where monitoring data are limited to geometric mean data only, results can be utilized for general indication of relative impairment and, when plotted on a load duration curve, may indicate areas for prioritization of implementation efforts. For impaired waterbodies where both types of data are available, geometric mean data may be utilized to supplement the results of the individual flow zone calculations.

Johnson Branch
 Load Duration Curve (2004-2005 Monitoring Data)
 Site: JOHNS000.1WS

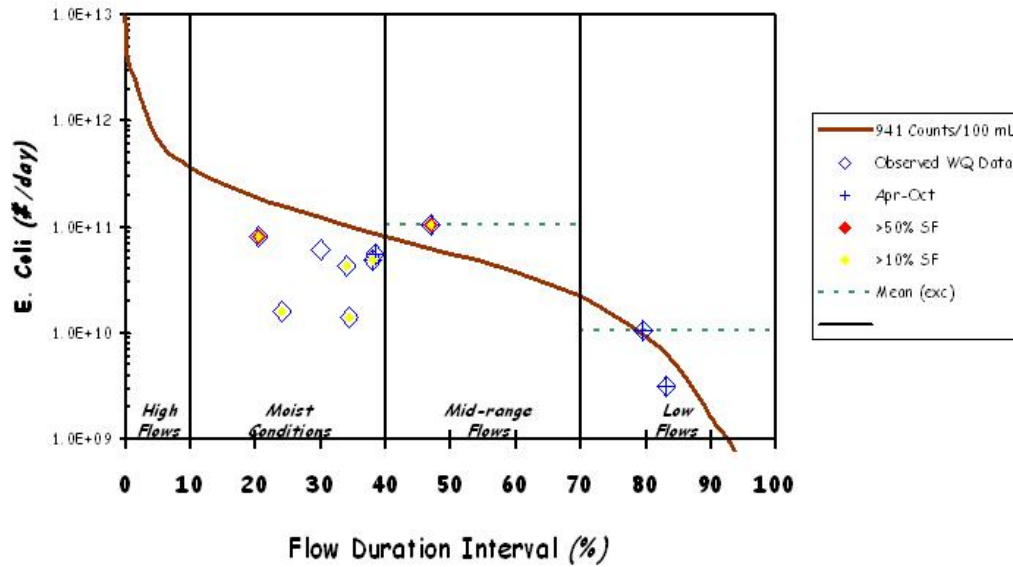


Figure E-5. E. Coli Load Duration Curve for Johnson Branch at Mile 0.1

Spring Creek
 Load Duration Curve (2004-2005 Monitoring Data)
 Site: SPRIN019.2WS

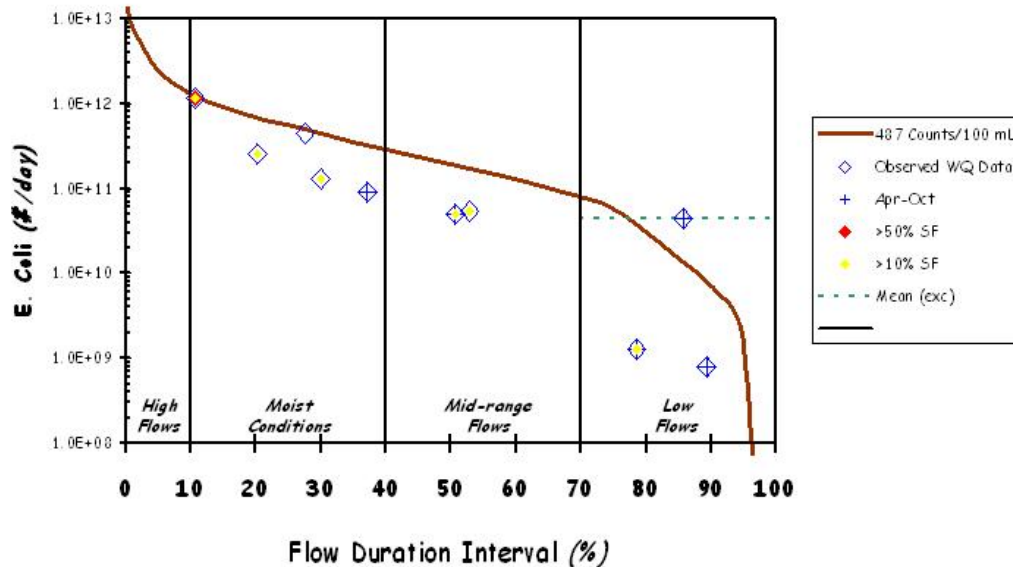


Figure E-6. E. Coli Load Duration Curve for Spring Creek at Mile 19.2

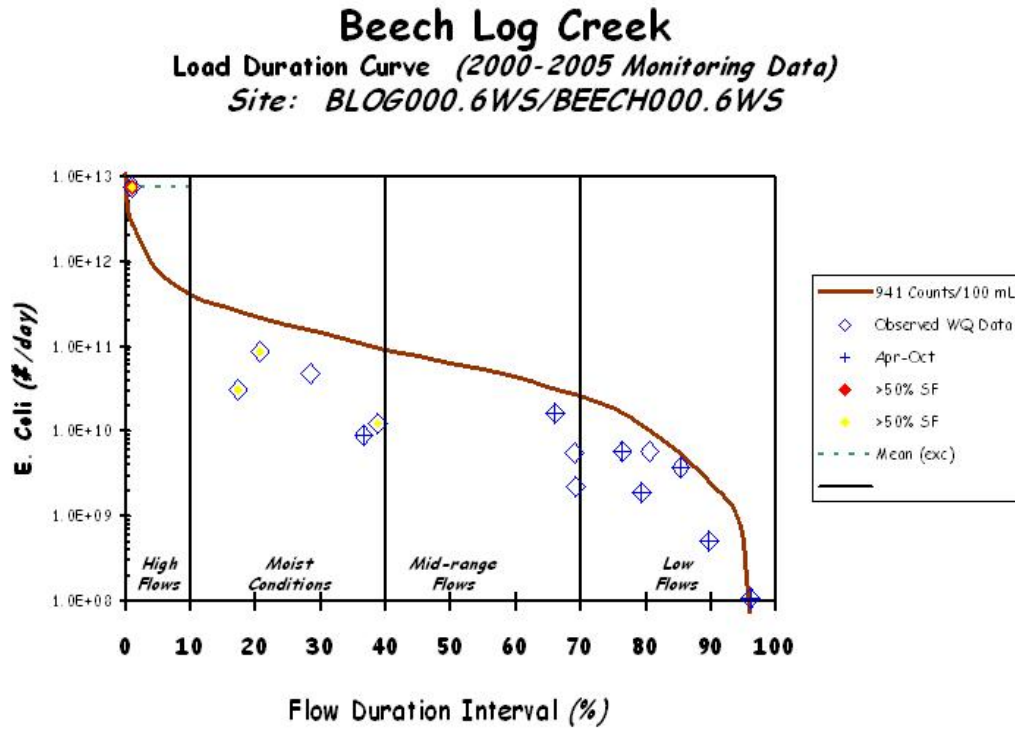


Figure E-7. E. coli Load Duration Curve for Beech Log Creek at Mile 0.6

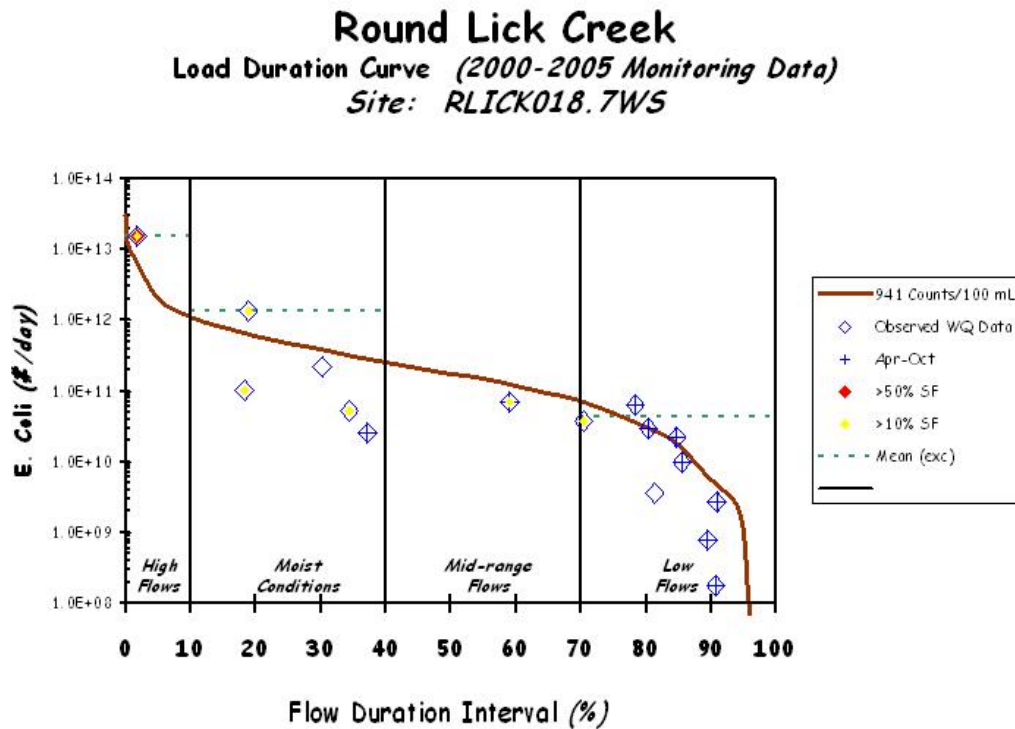


Figure E-8. E. coli Load Duration Curve for Round Lick Creek at Mile 18.7

Little Goose Creek
 Load Duration Curve (2004-2005 Monitoring Data)
 Site: LGOOS004.7TR

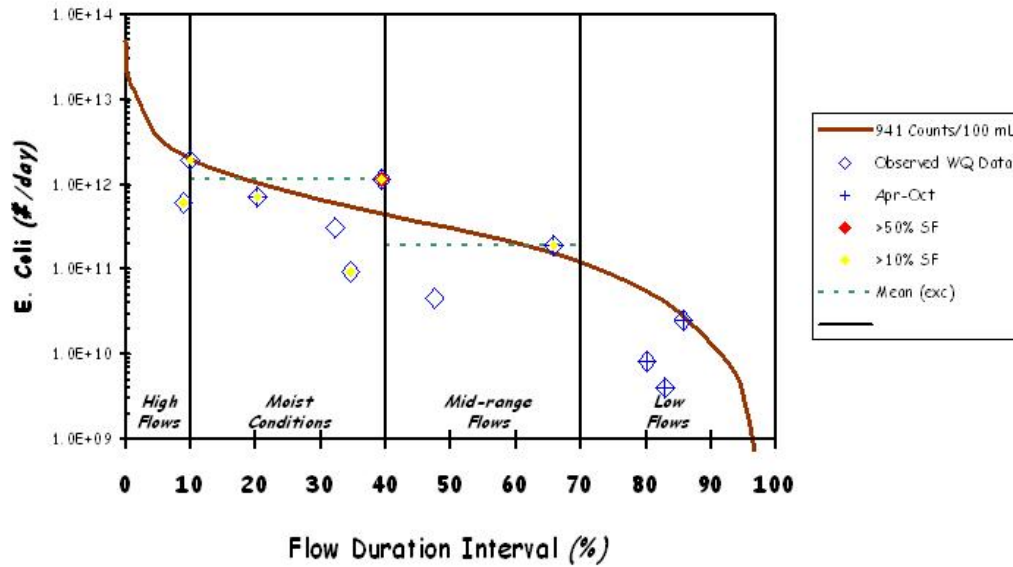


Figure E-9. E. Coli Load Duration Curve for Little Goose Creek at Mile 4.7

Little Goose Creek
 Load Duration Curve (2004-2005 Monitoring Data)
 Site: LGOOS007.5TR

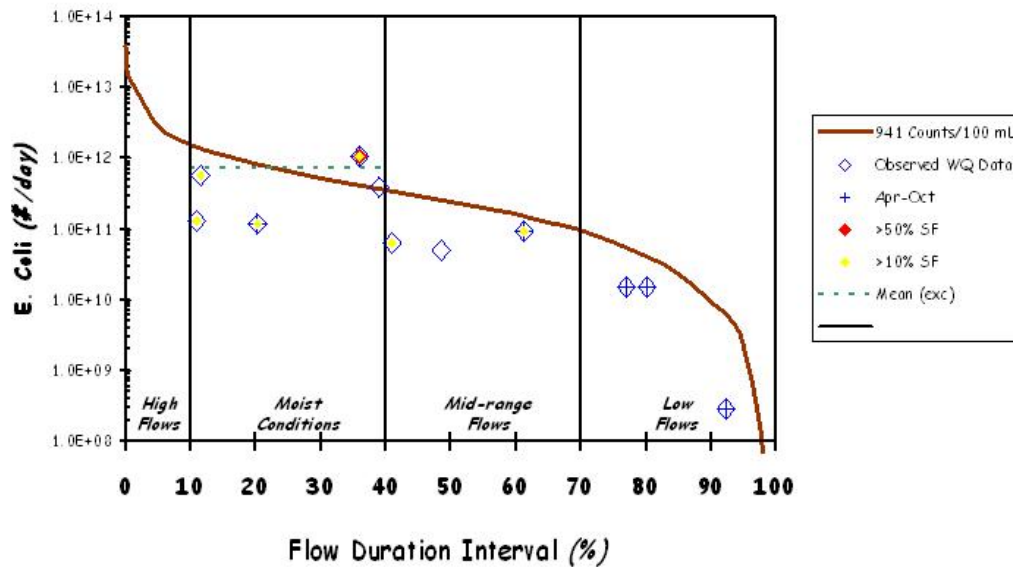


Figure E-10. E. Coli Load Duration Curve for Little Goose Creek at Mile 7.5

Table E-4. Calculated Load Reduction Based on Daily Loading – Johnson Branch – Mile 0.1

Sample Date	Flow Regime	Flow	PDFE	Concentration	Load	% Reduction to Achieve TMDL	Average of Load Reductions	% Reduction to TMDL – MOS
		[cfs]	[%]	[CFU/100 ml]	[CFU/day]	[%]	[%]	[%]
1/13/05	Moist Conditions	8.14	20.6%	410	8.17E+10	0.0		
12/15/04		6.96	24.2%	93	1.58E+10	0.0		
3/30/05		5.41	30.0%	460	6.09E+10	0.0		
11/15/04		4.55	34.0%	390	4.34E+10	0.0		
2/24/05		4.44	34.5%	130	1.41E+10	0.0		
10/25/04		3.82	38.1%	520	4.86E+10	0.0		
4/6/05		3.74	38.5%	610	5.58E+10	0.0		
9/8/04	Mid-Range	2.71	47.0%	1600	1.06E+11	41.2	41.2	47.1
5/25/05	Low Flows	0.43	79.6%	1000	1.05E+10	5.9		
8/25/04		0.28	83.2%	460	3.11E+09	0.0		
6/22/05		0.09	89.2%	93	1.97E+08	0.0		

Note: NR = No reduction required
 NA = Not applicable

Table E-5. Calculated Load Reduction Based on Daily Loading – Spring Creek – Mile 19.2

Sample Date	Flow Regime	Flow	PDFE	Concentration	Load	% Reduction to Achieve TMDL	Average of Load Reductions	% Reduction to TMDL – MOS
		[cfs]	[%]	[CFU/100 ml]	[CFU/day]	[%]	[%]	[%]
1/13/05	Moist Conditions	104.16	10.7%	460	1.17E+12	0.0		
2/24/05		58.23	20.3%	180	2.56E+11	0.0		
3/30/05		41.55	27.7%	440	4.47E+11	0.0		
12/15/04		37.50	30.0%	140	1.28E+11	0.0		
4/6/05		27.02	37.3%	140	9.26E+10	0.0		
							NR	1.0
10/25/04	Mid-Range Flows	16.03	50.7%	130	5.10E+10	0.0		
11/15/04		14.56	53.0%	150	5.34E+10	0.0		
							NR	NR
5/25/05	Low Flows	3.22	78.7%	16	1.26E+09	0.0		
9/8/04		1.15	85.9%	1600	4.50E+10	69.6		
6/22/05		0.67	89.5%	49	7.99E+08	0.0		
							23.2	24.2

Note: NR = No reduction required
 NA = Not applicable

Table E-6. Calculated Load Reduction Based on Daily Loading – Sinking Creek – Mile 0.9

Sample Date	Flow Regime	Flow	PDFE	Concentration	Load	% Reduction to Achieve TMDL	Average of Load Reductions	% Reduction to TMDL – MOS
		[cfs]	[%]	[CFU/100 ml]	[CFU/day]	[%]	[%]	[%]
10/20/04	High Flow	49.79	9.9%	2400	2.92E+12	60.8	60.8	64.7
3/8/05	Moist Conditions	28.68	18.4%	1100	7.72E+11	14.5		
2/10/05		22.53	23.2%	84	4.63E+10	0.0		
12/14/04		17.58	29.4%	91	3.91E+10	0.0		
1/5/05		14.34	34.7%	550	1.93E+11	0.0		
4/11/05		12.43	38.0%	250	7.61E+10	0.0		
9/7/04	Mid-Range Flows	7.27	51.6%	580	1.03E+11	0.0	NR	NR
11/16/04		6.56	54.1%	100	1.60E+10	0.0		
8/25/04		3.93	66.6%	520	5.00E+10	0.0		
5/18/05	Low Flows	1.71	79.1%	200	8.37E+09	0.0	NR	NR
6/14/05		0.56	87.2%	870	1.19E+10	0.0		

Note: NR = No reduction required
 NA = Not applicable

Table E-7. Calculated Load Reduction Based on Daily Loading – Beech Log Creek – Mile 0.6

Sample Date	Flow Regime	Flow	PDFE	Concentration	Load	% Reduction to Achieve TMDL	Average of Load Reductions	% Reduction to TMDL – MOS
		[cfs]	[%]	[CFU/100 ml]	[CFU/day]	[%]	[%]	[%]
1/13/05	High Flow	130.00	0.9%	2400	7.63E+12	60.8	60.8	64.7
1/22/01	Moist Conditions	11.39	17.3%	110	3.07E+10	0.0	NR	NR
2/24/05		9.50	20.8%	370	8.60E+10	0.0		
3/30/05		6.68	28.5%	290	4.74E+10	0.0		
4/6/05		4.66	36.6%	80	9.12E+09	0.0		
12/15/04		4.20	38.9%	120	1.23E+10	0.0		
10/25/04	Mid-Range Flows	1.39	66.2%	490	1.67E+10	0.0	NR	NR
11/15/04		1.21	69.1%	190	5.62E+09	0.0		
11/20/00		1.20	69.3%	75	2.20E+09	0.0		
9/26/00	Low Flows	0.73	76.4%	330	5.89E+09	0.0	NR	NR
5/25/05		0.52	79.5%	150	1.91E+09	0.0		
12/6/00		0.45	80.7%	520	5.73E+09	0.0		
8/2/00		0.24	85.4%	650	3.74E+09	0.0		
9/8/04		0.11	89.9%	190	5.11E+08	0.0		
10/24/00		0.01	96.2%	370	1.08E+08	0.0		

Note: NR = No reduction required
 NA = Not applicable

Table E-8. Calculated Load Reduction Based on Daily Loading – Neal Branch– Mile 0.1

Sample Date	Flow Regime	Flow	PDFE	Concentration	Load	% Reduction to Achieve TMDL	Average of Load Reductions	% Reduction to TMDL – MOS
		[cfs]	[%]	[CFU/100 ml]	[CFU/day]	[%]	[%]	[%]
1/13/05	High Flow	30.00	2.1%	2400	1.76E+12	60.8	60.8	64.7
1/22/01	Moist Conditions	3.19	21.2%	2400	1.87E+11	60.8	20.6	23.5
2/24/05		3.19	21.2%	490	3.82E+10	0.0		
3/30/05		2.17	29.9%	610	3.23E+10	0.0		
4/6/05		1.47	38.8%	1200	4.31E+10	21.6		
12/15/04	Mid-Range Flows	1.33	41.4%	410	1.33E+10	0.0	30.4	32.4
10/25/04		0.70	58.8%	2400	4.11E+10	60.8		
11/15/04	Low Flows	0.28	74.2%	2000	1.37E+10	53.0	22.6	26.0
11/29/00		0.22	76.8%	2400	1.29E+10	60.8		
5/25/05		0.17	79.2%	870	3.66E+09	0.0		
12/6/00		0.14	80.9%	1100	3.77E+09	14.5		
9/8/04		0.09	84.3%	550	1.21E+09	0.0		
8/2/00		0.04	87.4%	870	9.45E+08	0.0		
6/22/05		0.03	88.5%	2000	1.71E+09	53.0		
9/26/00		0.02	90.4%	650	3.18E+08	0.0		

Note: NR = No reduction required
 NA = Not applicable

Table E-9. Calculated Load Reduction Based on Daily Loading – Round Lick Creek– Mile 18.7

Sample Date	Flow Regime	Flow	PDFE	Concentration	Load	% Reduction to Achieve TMDL	Average of Load Reductions	% Reduction to TMDL – MOS
		[cfs]	[%]	[CFU/100 ml]	[CFU/day]	[%]	[%]	[%]
1/13/05	High Flow	260.00	1.8%	2400	1.53E+13	60.8	60.8	64.7
2/24/05	Moist Conditions	28.27	18.4%	150	1.04E+11	0.0		
1/22/01		27.62	19.0%	2000	1.35E+12	53.0		
3/30/05		16.70	30.2%	550	2.25E+11	0.0		
12/15/04		13.68	34.5%	160	5.36E+10	0.0		
4/6/05		12.33	37.3%	86	2.59E+10	0.0		
10/25/04	Mid-Range	5.44	59.1%	520	6.92E+10	0.0	NR	NR
11/29/00	Low Flows	3.07	70.5%	490	3.68E+10	0.0		
9/26/00		1.61	78.5%	1600	6.30E+10	41.2		
5/25/05		1.32	80.5%	920	2.98E+10	0.0		
12/6/00		1.14	81.4%	130	3.63E+09	0.0		
9/8/04		0.76	84.9%	1200	2.23E+10	21.6		
8/2/00		0.68	85.6%	580	9.62E+09	0.0		
6/22/05		0.27	89.6%	120	7.99E+08	0.0		
10/24/00		0.20	90.8%	36	1.76E+08	0.0		
7/26/00	0.19	91.0%	600	2.72E+09	0.0	7.0	9.4	

Note: NR = No reduction required
 NA = Not applicable

Table E-10. Calculated Load Reduction Based on Daily Loading – Little Goose Creek– Mile 4.7

Sample Date	Flow Regime	Flow	PDFE	Concentration	Load	% Reduction to Achieve TMDL	Average of Load Reductions	% Reduction to TMDL – MOS
		[cfs]	[%]	[CFU/100 ml]	[CFU/day]	[%]	[%]	[%]
2/15/05	High Flow	97.74	8.9%	260	6.22E+11	0.0	NR	NR
1/10/05		86.78	10.0%	920	1.95E+12	0.0		
9/21/04	Moist Conditions	45.02	20.3%	650	7.16E+11	0.0	15.2	16.2
11/29/04		26.39	32.3%	490	3.16E+11	0.0		
12/16/04		23.80	34.7%	160	9.32E+10	0.0		
10/19/04		19.64	39.4%	2400	1.15E+12	60.8		
3/14/05	Mid-Range	14.42	47.6%	130	4.59E+10	0.0	10.8	14.7
4/27/05		6.69	66.0%	1200	1.96E+11	21.6		
5/24/05	Low Flows	2.37	80.3%	140	8.13E+09	0.0	NR	NR
6/21/05		1.71	83.1%	96	4.01E+09	0.0		
8/23/04		1.24	85.8%	820	2.49E+10	0.0		

Note: NR = No reduction required
 NA = Not applicable

Table E-11. Calculated Load Reduction Based on Daily Loading – Little Goose Creek– Mile 7.5

Sample Date	Flow Regime	Flow	PDFE	Concentration	Load	% Reduction to Achieve TMDL	Average of Load Reductions	% Reduction to TMDL – MOS
		[cfs]	[%]	[CFU/100 ml]	[CFU/day]	[%]	[%]	[%]
2/15/05	Moist Conditions	62.86	11.0%	86	1.32E+11	0.0		
1/10/05		59.77	11.5%	390	5.70E+11	0.0		
9/21/04		35.30	20.4%	140	1.21E+11	0.0		
10/19/04		17.80	36.1%	2400	1.05E+12	30.8		
11/29/04		15.84	39.1%	1000	3.88E+11	5.9		
12/16/04	Mid-Range	14.59	41.0%	180	6.43E+10	0.0	NR	NR
3/14/05		10.89	48.7%	190	5.06E+10	0.0		
4/27/05		6.69	61.3%	580	9.49E+10	0.0		
5/24/05	Low Flows	2.37	77.1%	260	1.51E+10	0.0	NR	NR
6/21/05		1.71	80.3%	370	1.54E+10	0.0		
8/23/04		0.23	92.5%	50	2.81E+08	0.0		

Note: NR = No reduction required
 NA = Not applicable

**Table E-12 Summary of TMDLs, WLAs, & LAs expressed as daily loads for Impaired Waterbodies
in the Old Hickory Lake Watershed (HUC 05130201)**

Waterbody Description	Hydrologic Condition			Flow ^a [cfs]	PLRG [%]	TMDL [CFU/d]	MOS [CFU/d]	WLAs			LAs [CFU/d/ac]	
	Flow Regime	PDFE Range	Flow Range					WWTFs ^b [CFU/d]	CS [CFU/d]	MS4s [CFU/d/ac]		
		[%]	[cfs]									
Johnson Branch Waterbody ID: TN05130201015 – 0200 HUC-12: 0105	High Flows	0 – 10	16.02 – 124.5	29.14	NA	6.702×10^{11}	6.702×10^{10}	NA	NA	NA	2.009×10^8	
	Moist	10 – 40	3.51 – 16.02	6.64	NR	1.527×10^{11}	1.527×10^{10}				4.577×10^7	
	Mid-Range	40 – 60	0.98 – 3.51	2.43	41.2	5.589×10^{10}	5.589×10^9				1.675×10^7	
	Low Flows	90 – 100	0 – 0.98	0.21	2.0	4.830×10^9	4.830×10^8				1.447×10^6	
Spring Creek Waterbody ID: TN05130201013 – 4000 HUC-12: 0106	High Flows	0 – 10	108.9 – 674.9	205.82	NA	2.470×10^{12}	2.470×10^{11}	NA	NA	NA	1.008×10^8	
	Moist	10 – 40	24.10 – 108.9	46.75	NR	5.610×10^{11}	5.610×10^{10}				2.289×10^7	
	Mid-Range	40 – 70	6.74 – 24.10	13.40	NR	1.608×10^{11}	1.608×10^{10}				6.560×10^6	
	Low Flows	70 – 100	0 – 6.74	1.27	23.2	1.524×10^{10}	1.524×10^9				6.217×10^5	
Sinking Creek Waterbody IDs: TN05130201055 – 0200 TN05130201055 – 0250 HUC-12: 0107	High Flows	0 – 10	49.37 – 312.5	95.22	60.8	2.190×10^{12}	2.190×10^{11}	NA	0		2.071×10^8	2.071×10^8
	Moist	10 – 40	11.37 – 49.37	21.09	2.9	4.851×10^{11}	4.851×10^{10}				4.586×10^7	4.586×10^7
	Mid-Range	40 – 70	3.25 – 11.37	6.32	NR	1.454×10^{11}	1.454×10^{10}				1.374×10^7	1.374×10^7
	Low Flows	70 – 100	0 – 3.25	0.79	NR	1.817×10^{10}	1.817×10^9				1.718×10^6	1.718×10^6
Beech Log Creek Waterbody ID: TN05130101021 – 0400 HUC-12: 0201	High Flows	0 – 10	18.28 – 122.3	34.36	60.8	7.903×10^{11}	7.903×10^{10}	NA	0		2.071×10^8	2.071×10^8
	Moist	10 – 40	4.01 – 18.28	7.71	NR	1.773×10^{11}	1.773×10^{10}				4.586×10^7	4.586×10^7
	Mid-Range	40 – 70	1.16 – 4.01	2.31	NR	5.313×10^{10}	5.313×10^9				1.374×10^7	1.374×10^7
	Low Flows	70 – 100	0 – 1.16	0.25	NR	5.750×10^9	5.750×10^8				1.718×10^6	1.718×10^6
Neal Branch Waterbody ID: TN05130201021 – 0300 HUC-12: 0201	High Flows	0 – 10	6.41 – 49.68	11.58	60.8	2.663×10^{11}	2.663×10^{10}	NA	0		1.956×10^8	1.956×10^8
	Moist	10 – 40	1.40 – 6.41	2.65	20.6	6.095×10^{10}	6.095×10^9				4.388×10^7	4.388×10^7
	Mid-Range	40 – 70	0.39 – 1.40	0.81	30.4	1.863×10^{10}	1.863×10^9				1.315×10^7	1.315×10^7
	Low Flows	70 – 100	0 – 0.39	0.07	22.6	1.610×10^9	1.610×10^8				1.423×10^6	1.423×10^6
Round Lick Creek Waterbody ID: TN05130201021 – 2000 HUC-12: 0201	High Flows	0 – 10	49.63 – 386.9	90.19	60.8	2.074×10^{12}	2.074×10^{11}	9.617×10^9	0		1.982×10^8	1.982×10^8
	Moist	10 – 40	10.92 – 49.64	20.62	10.6	4.743×10^{11}	4.743×10^{10}				4.453×10^7	4.453×10^7
	Mid-Range	40 – 70	3.18 – 10.92	6.38	NR	1.467×10^{11}	1.467×10^{10}				1.307×10^7	1.307×10^7
	Low Flows	70 – 100	0 – 3.18	0.74	7.0	1.702×10^{10}	1.702×10^9				6.084×10^6	6.084×10^6
Little Goose Creek Waterbody ID: TN05130201028 – 0100 HUC-12: 0302	High Flows	0 – 10	86.66 – 613.4	162.03	NR	3.727×10^{12}	3.727×10^{11}	NA	NA	NA	2.107×10^8	
	Moist	10 – 40	19.13 – 86.66	36.39	15.2	8.370×10^{11}	8.370×10^{10}				4.731×10^7	
	Mid-Range	40 – 70	5.37 – 19.13	11.07	10.8	2.546×10^{11}	2.546×10^{10}				1.439×10^7	
	Low Flows	70 – 100	0 – 5.37	1.36	NR	3.128×10^{10}	3.128×10^9				1.768×10^6	

**Table E-12 (cont'd) Summary of TMDLs, WLAs, & LAs expressed as daily loads for Impaired Waterbodies
 in the Old Hickory Lake Watershed (HUC 05130201)**

Waterbody Description	Hydrologic Condition			Flow ^a [cfs]	PLRG [%]	TMDL [CFU/d]	MOS [CFU/d]	WLAs			LAs [CFU/d/ac]
	Flow Regime	PDFE Range	Flow Range					WWTFs ^b	CS	MS4s	
		[%]	[cfs]					[CFU/d]	[CFU/d]	[CFU/d/ac]	
Little Goose Creek Waterbody ID: TN05130201028 – 0150 HUC-12: 0302	High Flows	0 – 10	68.25 – 497.4	127.74	NA	2.938×10^{12}	2.938×10^{11}	NA	NA	NA	2.109×10^8
	Moist	10 – 40	15.15 – 68.25	28.82	15.2	6.629×10^{11}	6.629×10^{10}				4.758×10^7
	Mid-Range	40 – 70	8.81 – 15.15	8.81	NR	2.026×10^{11}	2.026×10^{10}				1.455×10^7
	Low Flows	70 – 100	0 – 8.81	1.03	NR	2.369×10^{10}	2.369×10^9				1.701×10^6

Notes: NA = Not Applicable.
 NR = No Reduction Required.
 PLRG = Percent Load Reduction Goal to achieve TMDL.
 CS = Collection Systems
 Shaded Flow Zone for each waterbody represents the critical flow zone.

- a. Flow applied to TMDL, MOS, and allocation (WLA[MS4] and LA) calculations. Flows represent the midpoint value in the respective hydrologic flow regime.
- b. WLAs for WWTFs are expressed as E. coli loads (CFU/day). All current and future WWTFs must meet water quality standards at the point of discharge as specified in their NPDES permit; at no time shall concentration be greater than the appropriate E. coli standard (487 CFU/100 mL or 941 CFU/100 mL).

APPENDIX F

Supplemental Load Duration Curve Analysis of E. Coli Data

Load duration curve (LDC) methodology is a form of water quality analysis and presentation of data that aids in guiding implementation by targeting strategies to appropriate flow conditions. The LDC can be analyzed to determine the frequency with which water quality monitoring data exceed the target maximum concentration under five flow “zones” (low, dry, mid-range, moist, and high). LDC zones can provide insight about conditions and patterns associated with the impairment.

One of the strengths of the LDC methodology is that it can be used to identify possible delivery mechanisms of pathogens by differentiating between point source and nonpoint source problems. Once the delivery mechanism has been identified, best management practices and potential implementation actions can be applied to effectively address water quality concerns.

However, the LDC is only as good as the data used to create it. If data is not representative of all seasons and flow conditions, incorrect conclusions can be drawn. The following two examples are presented to illustrate the importance of having sampling data that are representative of all seasons and flow conditions.

Figure F-1 is a load duration curve for Beech Log Creek at Mile 0.6. The data appear to be representative of all flow conditions. Figure F-2 displays E. coli concentrations with known rain events highlighted. The only occasion when the E. coli concentration exceeded 2000 CFU/100 mL coincided with a rain event. This suggests that stormwater runoff is a likely source of E. coli. Figures F-3 and F-4 display E. coli concentrations and rainfall measured at the Nashville Airport, confirming that the sampling event in which E. coli concentration exceeded 2000 CFU/100 mL occurred during or immediately following rain events.

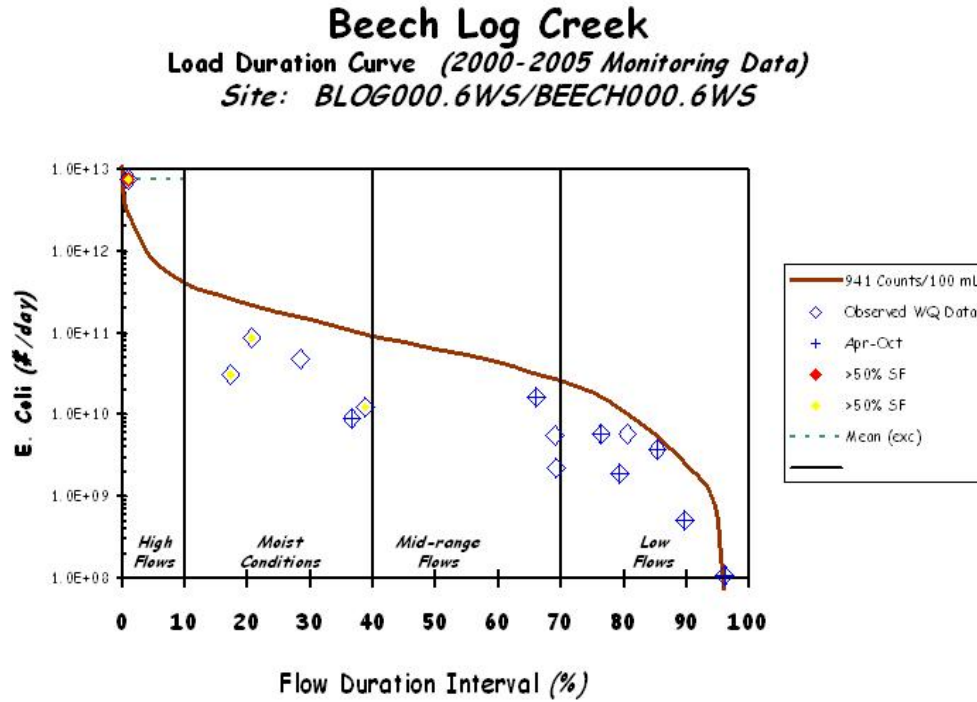


Figure F-1. E. coli Load Duration Curve for Beech Log Creek at RM0.6

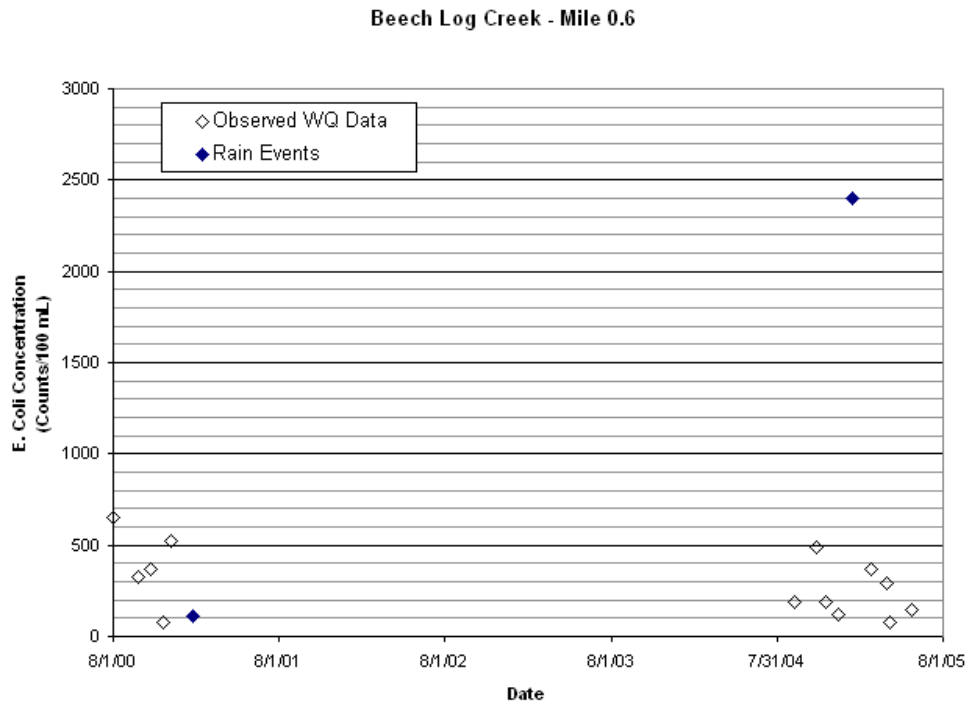


Figure F-2. E. coli Concentrations for Beech Log Creek at RM0.6 (2000-2005)

Beech Log Creek - Mile 0.6

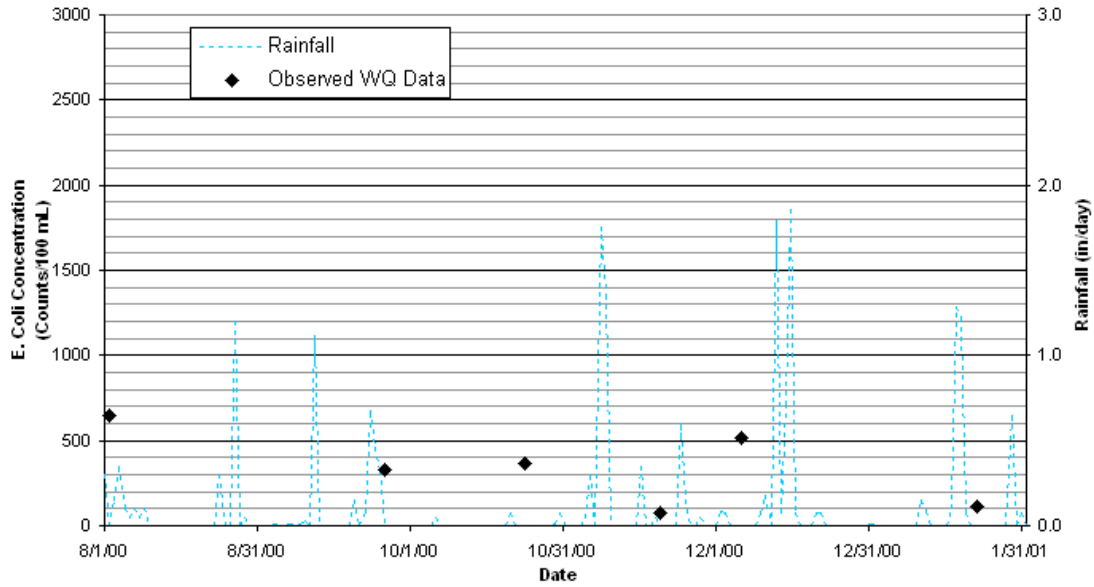


Figure F-3. E. coli Concentrations for Beech Log Creek at RM0.6 and Measured Rainfall at Nashville Airport (08/00-01/01)

Beech Log Creek - Mile 0.6

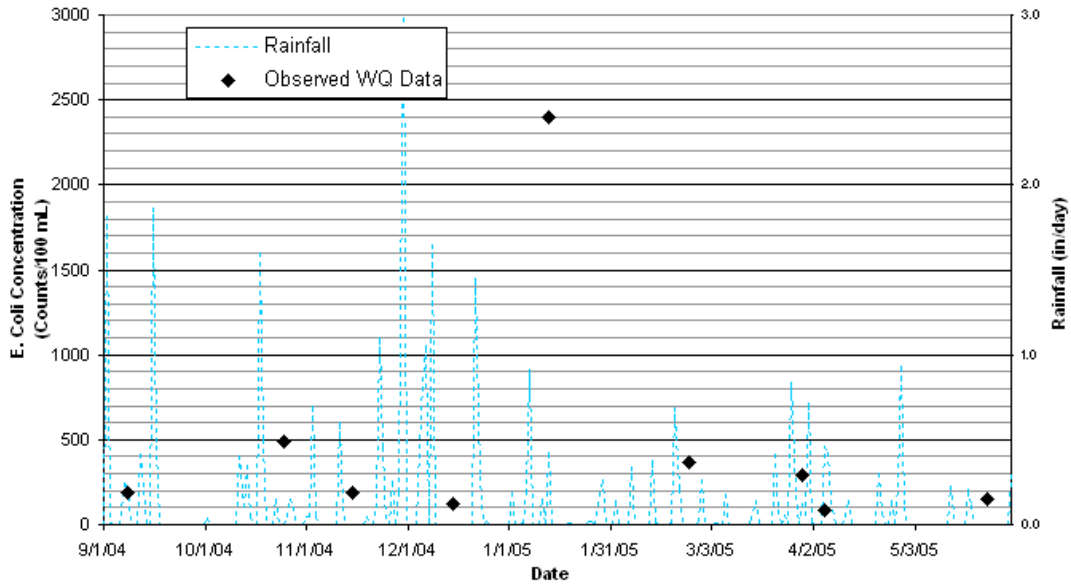


Figure F-4. E. coli Concentrations for Beech Log Creek at RM0.6 and Measured Rainfall at Nashville Airport (09/04-06/05)

Figure F-5 is a load duration curve for Johnson Branch at Mile 0.1. The data are not representative of all flow conditions. Figure F-6 displays E. coli concentrations with known rain events highlighted. None of the sampling events coincided with known rain events. Figure F-7 displays E. coli concentrations and rainfall measured at the Nashville Airport, confirming that none of the sampling events occurred during or immediately following rain events.

Johnson Branch Load Duration Curve (2004-2005 Monitoring Data) Site: JOHNS000.1WS

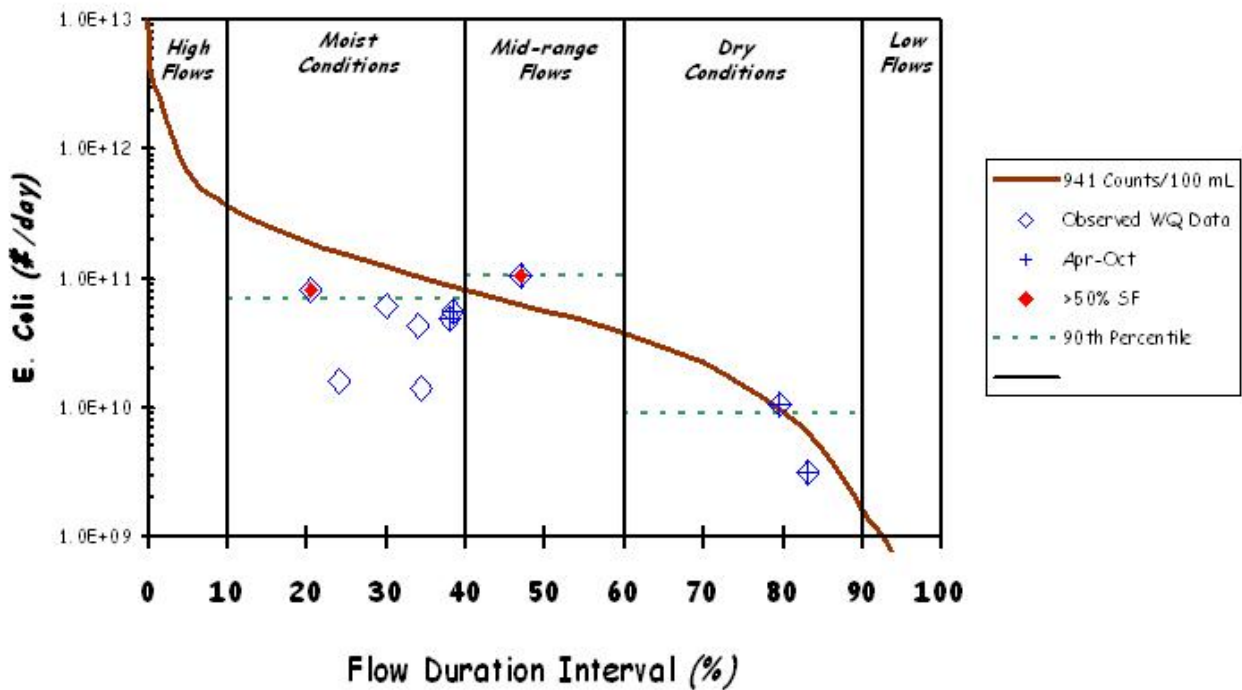


Figure F-5. E. coli Load Duration Curve for Johnson Branch at RM0.1

Johnson Branch - Mile 0.1

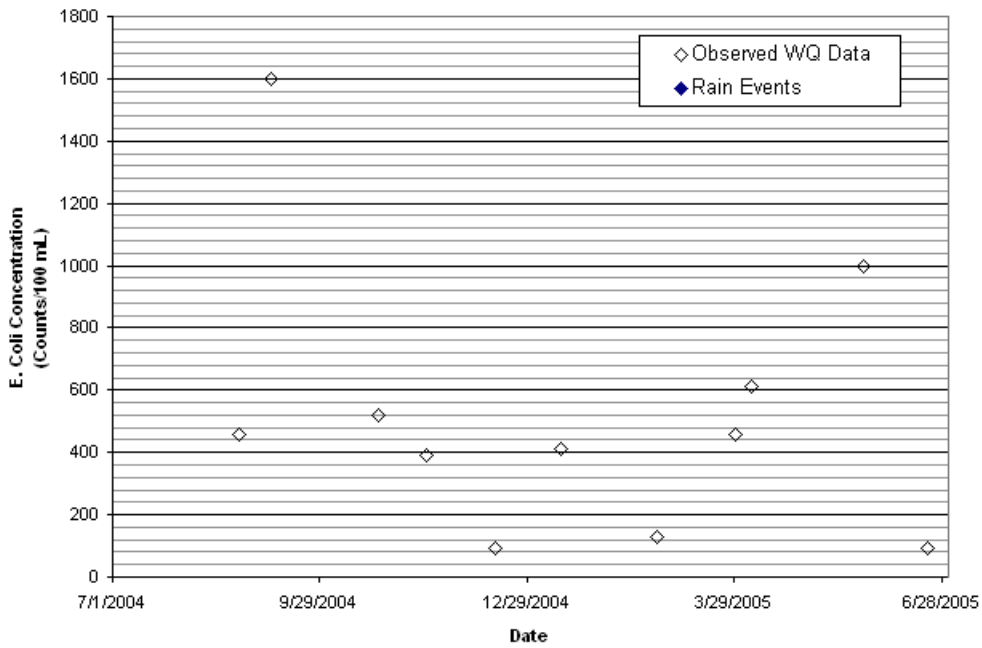


Figure F-6. E. coli Concentrations for Johnson Branch at RM0.1 (07/04-04/05)

Johnson Branch - Mile 0.1

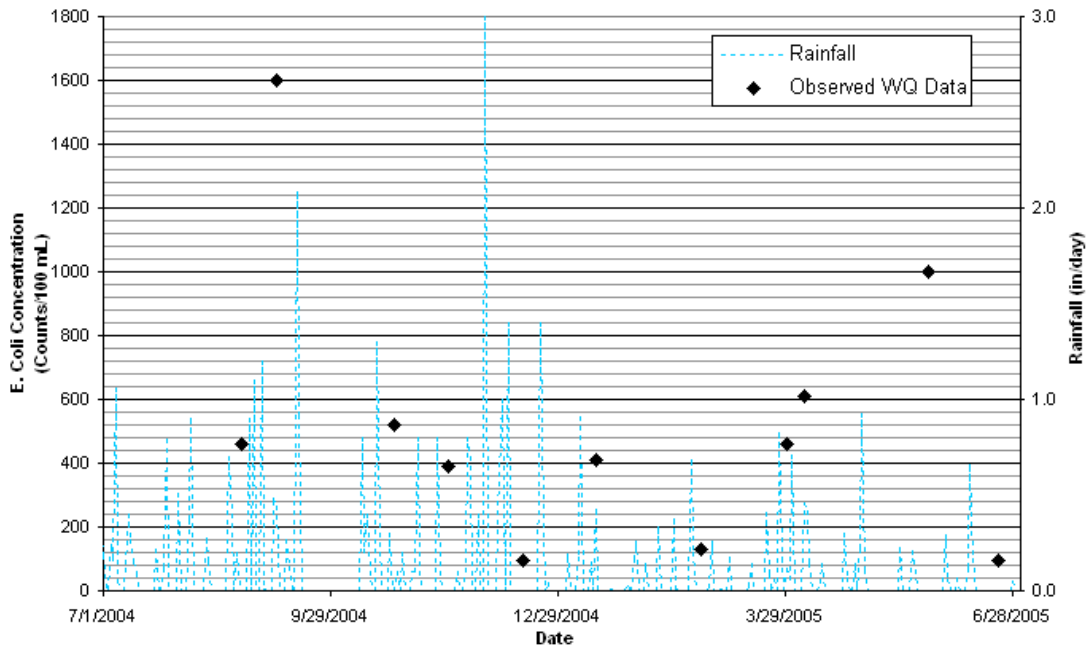


Figure F-7. E. coli Concentrations for Johnson Branch at RM0.1 and Measured Rainfall at Nashville Airport (07/04-07/05)

APPENDIX G

Public Notice Announcement

**STATE OF TENNESSEE
DEPARTMENT OF ENVIRONMENT AND CONSERVATION
DIVISION OF WATER POLLUTION CONTROL**

**PUBLIC NOTICE OF AVAILABILITY OF PROPOSED
TOTAL MAXIMUM DAILY LOAD (TMDL) FOR E. COLI
IN
OLD HICKORY LAKE WATERSHED (HUC 05130201), TENNESSEE**

Announcement is hereby given of the availability of Tennessee's proposed Total Maximum Daily Load (TMDL) for E. coli in the Old Hickory Lake watershed, located in middle Tennessee. Section 303(d) of the Clean Water Act requires states to develop TMDLs for waters on their impaired waters list. TMDLs must determine the allowable pollutant load that the water can assimilate, allocate that load among the various point and nonpoint sources, include a margin of safety, and address seasonality.

A number of waterbodies in the Old Hickory Lake watershed are listed on Tennessee's Final 2006 303(d) list as not supporting designated use classifications due, in part, to pasture grazing and collection system failure. The TMDL utilizes Tennessee's general water quality criteria, continuous flow data from a USGS discharge monitoring station located in proximity to the watershed, site specific water quality monitoring data, a calibrated hydrologic model, load duration curves, and an appropriate Margin of Safety (MOS) to establish allowable loadings of pathogens which will result in the reduced in-stream concentrations and attainment of water quality standards. The TMDL requires reductions of pathogen loading on the order of 3-41% in the listed waterbodies.

Old Hickory Lake E. coli TMDL may be downloaded from the Department of Environment and Conservation website:

<http://www.state.tn.us/environment/wpc/tmdl/>

Technical questions regarding this TMDL should be directed to the following members of the Division of Water Pollution Control staff:

Vicki S. Steed, P.E., Watershed Management Section
Telephone: 615-532-0707

Sherry H. Wang, Ph.D., Watershed Management Section
Telephone: 615-532-0656

Persons wishing to comment on the proposed TMDLs are invited to submit their comments in writing no later than March 17, 2008 to:

Division of Water Pollution Control
Watershed Management Section
7th Floor, L & C Annex
401 Church Street
Nashville, TN 37243-1534

All comments received prior to that date will be considered when revising the TMDL for final submittal to the U.S. Environmental Protection Agency.

The TMDL and supporting information are on file at the Division of Water Pollution Control, 6th Floor, L & C Annex, 401 Church Street, Nashville, Tennessee. They may be inspected during normal office hours. Copies of the information on file are available on request.

APPENDIX H

Public Comments Received



FEB 20 2008

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Water Management Services, LLC

ENGINEERING • PLANNING • OPERATIONS • RATE STUDIES

February 19, 2008

Dr. Sherry Wang, Ph.D.
Tennessee Division of Water Pollution Control
Watershed Management Section
7th Floor, L & C Annex
401 Church Street
Nashville, TN 37243-1534

Re: TMDL for E. coli, Old Hickory Lake Watershed, Tennessee

Dear Ms. Wang:

I have reviewed the above document and wish to provide the Division with comments. Our firm is a consultant to the City of Lebanon, and it is in their interest that I have reviewed this document and am making these comments.

On page ix, on the Summary Sheet, concerning the table entitled: Impaired Waterbodies Addressed in This Document: Under the Waterbody Bartons Creek, the miles impaired is listed as 16.9. However, on page 8, in Table 2, the miles of Bartons Creek that are Impaired is listed as 5.0 miles. (The other milages in this table match with the Summary Sheet table).

In Section 7, Source Assessment, under subsection 7.1.1, the only municipality specifically mentioned is Watertown. It is well known that Lebanon's municipal sewer collection system, which is located on Barton's Creek, has wet weather SSO's. These are all reported to the Division. These overflows would constitute a significant E. coli source, when those overflows are occurring. It should also be noted that Lebanon is under a Consent Order that mandates elimination of these overflows by June 30, 2010. Lebanon has been pursuing significant infiltration and inflow reduction programs. The City will also implement a construction program at the WWTP this spring that will provide additional peak flow capacity. The two efforts are intended to result in compliance with the Order.

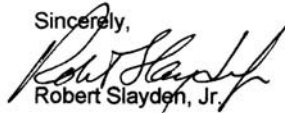


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Dr. Sherry Wang, Ph.D.
February 19, 2008

Section 9.2.1: This section states that all NPDES dischargers are in compliance, and no additional reduction is required. The above noted situation with Lebanon and the expected reduction of E. coli after the elimination of the ongoing SSO may be worth noting here.

Thank you for this opportunity to comment. If you have questions, please feel free to call.

Sincerely,



Robert Slayden, Jr.

Cc: Chuck Boyett, City of Lebanon

APPENDIX I

Response to Public Comments

Note: responses correspond to comments (see Appendix H).

1. The “miles impaired” listed for Bartons Creek has been corrected.
2. Information relating to the Lebanon STP and the Commissioner’s Order have been incorporated into Section 7.1.1.
3. Section 9.2.1 states that “all present and future discharges from industrial and municipal wastewater treatment facilities are required to be in compliance with the conditions of their NPDES permits at all time”. While the Lebanon STP is not currently in compliance with their permit, compliance with the Commissioner’s Order will result in future compliance with the NPDES permit.



Rick Bell, Mayor

200 North Castle Heights Avenue
Lebanon, Tennessee 37087

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Section 2C – City of Lebanon Exceptional Waters

City of Lebanon Exceptional Tennessee Waters

HUC	Watershed Name	Waterbody	County	Description	Basis for Inclusion	From Lat.	From Long.	To Lat.	To Long.	Inclusion Date
5130201	Cumberland-Old Hickory Lake	Tarver Branch	Wilson	From Sinking Creek to origin.	State threatened Yellow Sunnybell.	36.2168	-86.2996	36.1996	-86.3046	NOV-13-2007
5130201	Cumberland-Old Hickory Lake	Bartons Creek Unnamed Tributary Wetland	Wilson	Two wetlands in headwaters of unnamed tributary to Bartons Creek. WTL-B (0.06 acres) 36.238885/-86.323946 and WTL-A (0.21 acres) 36.23836/-86.323363..	The Limestone Seep Glade wetland plant community, in a high quality condition exhibits outstanding ecological value and resource values. These wetlands are globally rare, increasingly degraded through agriculture and development and therefore are locally increasingly rare, have a high likelihood of supporting state or federally listed aquatic or semi-aquatic plant species, and are not readily restored once degraded thereby contributing to the rarity of high quality examples and the risk of extirpation.	36.238177	-86.322535	36.23903	-86.32432	DEC-17-2018
5130201	Cumberland-Old Hickory Lake	Walker Branch	Wilson	Walker Branch from confluence with McCarmel Branch to origin,.	State endangered streamside salamander <i>Ambystoma barbouri</i>	36.241041	-86.298412	36.23848	-86.26803	FEB-14-2019
5130201	Cumberland-Old Hickory Lake	Sinking Creek Tributary	Wilson	Unnamed tributary to Sinking Creek at Tennessee Blvd off E Baddour Pkwy.	State endangered streamside salamander <i>Ambystoma barbouri</i>	36.202303	-86.278537	36.20217	-86.26515	FEB-14-2019



Rick Bell, Mayor

200 North Castle Heights Avenue
Lebanon, Tennessee 37087

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Section 3 – PIE Spreadsheet

City of Lebanon (TN) Public Information and Education Plan (PIE) July 1, 2021 through June 30, 2022

Public Information and Education Plan Targeted Educational Campaigns							
(A) General public awareness on the impacts on water quality from general housekeeping maintenance/activities.	(B) Home owner associations and other operators of permanent BMPs awareness of the importance of maintenance activities	(C) Local engineering and development community awareness of the stormwater ordinances, regulations, and guidance materials related to long-term water quality impacts.	(D) General public and professional chemical applicators awareness on the proper storage, use, and disposal of pesticides, herbicides, and fertilizers use.	(E) General public and professional chemical applicators awareness on the proper storage, use, and disposal of oil and other automotive-related fluids.	(F) General public and municipal employees on the awareness of identifying and reporting procedures for illicit connections/discharges, sanitary sewer seepage, spills, etc.	(G) Local engineering, development, and construction community awareness of stormwater ordinances, regulations and guidance materials related to construction phase water quality impacts	(H) Municipal employee/contractor and community awareness of water quality impacts from daily operations

Organizations	Activity	Description	Date	Participants	Target Audience	Target Pollutants	Target Stream	Goals / Results
City of Lebanon	Inflow and infiltration (I&I) Meeting	Monthly meeting to discuss the reduction and prevention of sanitary sewer overflows.	4th Wednesday, Monthly	Varies	(C, F, G, H) Attendees include the City's Water and Sewer consultant, Public Works Commissioner, City/Utilities Engineer, Water Distribution Manager, Wastewater Treatment Plant Manager, Sewer Collection Manager, and other City Engineering Department Staff.	Sanitary Sewer Over-flow	All	The main goal of the Program is to eliminate/reduce overflows of the sanitary sewer system. A reduction of system overflows can only be accomplished by eliminating inflow and infiltration (I&I) of stormwater and groundwater into our sanitary sewer collection system. I&I Progress meetings keep staff on track to meet the goals established in the Program. Updates to ongoing issues and projects are discussed as well as any new items that need to be addressed.
City of Lebanon	Public Infrastructure Committee Meetings	The Public Infrastructure Committee consists of engineers, contractors, and community leaders that review new and ongoing issues within the city that pertain to public work projects such as sanitary sewer improvements, waterline improvements, roadway improvements, stormwater quality and drainage issues. Additionally, City policies and practices related to such projects are discussed and residents can address issues that they might have. A summary of active construction permits, issued violations, and water quality related MS4 items are presented in meetings.	4th week of every month	Varies	(A-H) All Audiences	All	All	Allow citizens to address the public works and transportation commission with any issues they might have an adverse effect on the community
City of Lebanon	Planning Commission Meeting	The City of Lebanon Planning Commission reviews proposed plats, annexations, re-zonings, and makes recommendations to City Council.	4th Tuesday, Monthly	Varies	(A-H) All Audiences	All	All	Allow citizens to address the planning commission with any issues they might have an adverse effect on the community
City of Lebanon	Spring Cleanup	City wide two-week cleanup in April for our annual spring cleanup in which the city collects hundreds of tons of debris	April 5 - April 15	All City of Lebanon Residents	(A-H) All Audiences	Old appliances, computers, microwaves, metal and wood materials. No hazardous waste pickup	All	To reduce the potential for illegal dumping of appliances and various waste material
City of Lebanon	Fats, Oils & Grease (FOG)	Tracking system to prevent sewer system blockages and obstruction in its sewer system caused by the collection of fats, oils and greases (FOG). Methods to prevent sanitary sewer overflows and sewer by-passes. FOG obstruction in the sewer system is one of the causes of sanitary sewer overflows. Also, NPDES permit violations related to FOG of discharges to the receiving stream may result from operational upsets at the WWTP.	Ongoing	City of Lebanon Waste Water Treatment Plant Employees. Compiles list of restaurants within city limits.	(A, E) Any establishment, business or facility engaged in preparing, serving or making food available for consumption. Single family residences are not a FSE, however, multi-residential facilities may be considered a FSE at the discretion of the Director	Organic polar compounds derived from animal and/or plant sources. Sanitary Sewer over-flow	All	To prevent sanitary and combined sewer system blockages, obstructions and overflows due to the contribution and accumulation of fats, oils and grease from food service establishments, commercial facilities and industrial facilities.
City of Lebanon	IDDE Hotline	Stormwater Webpage with IDDE hotline number and IDDE form that is emailed to Stormwater Coordinator	Ongoing	on-going, voicemail & email	(A-H) All Audiences	General public and municipal employees on the awareness of identifying and reporting procedures for illicit connections/discharges, sanitary sewer seepage, spills, etc.	All	Establish a method for citizens to address concerns of illicit discharge and potential environmental problems
City of Lebanon	Website	Stormwater webpage with summaries of past events, 6 minimum measures listed with links to recommended TDEC & EPA BMP's.	Ongoing	on-going, web counter	(A-H) All Audiences	All	All	To present information related to the 6 minimum measures as defined in the NPDES permit
City of Lebanon	Hot spot investigations for illicit discharge. Target facilities include automotive industries, carwashes, laundromats, pet stores, TDEC TMSP permit holders, and restaurants.	On-site inspections of various facilities and water quality discussions after inspections. BMP and water quality information was provided.	Ongoing	Varies	(A) General public awareness on the impacts on water quality from general housekeeping maintenance/activities. (E) General public and professional chemical applicators awareness on the proper storage, use, and disposal of oil and other automotive-related fluids. (F) General public and municipal employees on the awareness of identifying and reporting procedures for illicit connections/discharges, sanitary sewer seepage, spills, etc.	Organic polar compounds derived from animal and/or plant sources. Fecal coliforms from animal wastes. Cleaning supplies & chemicals associated with these industries. Petroleum products, automotive cleaning supplies & chemicals, and grease traps.	All	To raise awareness and importance of proper BMP's for companies related to food service. To raise awareness on the proper storage and disposal of materials associated with automotive industries. To raise awareness on the proper storage and disposal of materials associated with these industries
City of Lebanon	City Council Meeting	The City of Lebanon's City Council generally acts as the legislative branch of city government, as well as its policy making body. The council also reviews the city's goals, major projects, infrastructure improvements, community growth, land use plans, finances and strategic planning.	Twice Monthly. 1st and 3rd Tuesday of every month.	Varies	(A-H) All Audiences	All	All	Allow citizens to address the city council with any issues they might have an adverse effect on the community

City of Lebanon (TN) Public Information and Education Plan (PIE) July 1, 2021 through June 30, 2022

Public Information and Education Plan Targeted Educational Campaigns							
(A) General public awareness on the impacts on water quality from general housekeeping maintenance/activities.	(B) Home owner associations and other operators of permanent BMPs awareness of the importance of maintenance activities	(C) Local engineering and development community awareness of the stormwater ordinances, regulations, and guidance materials related to long-term water quality impacts.	(D) General public and professional chemical applicators awareness on the proper storage, use, and disposal of pesticides, herbicides, and fertilizers use.	(E) General public and professional chemical applicators awareness on the proper storage, use, and disposal of oil and other automotive-related fluids.	(F) General public and municipal employees on the awareness of identifying and reporting procedures for illicit connections/discharges, sanitary sewer seepage, spills, etc.	(G) Local engineering, development, and construction community awareness of stormwater ordinances, regulations and guidance materials related to construction phase water quality impacts	(H) Municipal employee/contractor and community awareness of water quality impacts from daily operations

Organizations	Activity	Description	Date	Participants	Target Audience	Target Pollutants	Target Stream	Goals / Results
General Public, Cumberland University, City of Lebanon, local non-profits/churches	Let Lebanon Shine - Community Cleanup Day	Litter pickup, creek cleanup, landscaping public areas.	April 30th	Approximately 50 community members, adults and children.	(A) General public awareness on the impacts on water quality from general housekeeping maintenance/activities.	Litter and soil erosion.	Entire Lebanon Watershed.	Engage the community to cleanup litter pollutants and replant vegetation in stream buffers and other areas to improve water quality and reduce erosion.
City of Lebanon Public Works and Stormwater Department	Social Media engagement	Facebook, Instagram, and Twitter posts about various water quality and environmental bmp's, concerns, etc.	Ongoing	Followers	(A-H) All Audiences	Various	Entire Lebanon Watershed.	Public education, engagement, and notification of upcoming events and concerns.
City of Lebanon Stormwater and Muesum	Lebanon History Museum Spring Fling - Interactive watershed/non-pointsource, model.	Hands-on, interactive demonstration of the sources and effects of water pollution. Easily demonstrate how storm water runoff carries pollutants through the watershed to a pond, lake, river, bay, or ocean – and the best management practices to prevent this type of pollution from occurring. Waterquality activity books are also available for youth visitors.	Ongoing at museum. March 18, 2022 at Don Fox Park	Any muesum visitors, field trips, tourists, etc.	(A-H) All Audiences but primarily parents and their children.	All pollutants common to any MS4.	Entire Lebanon Watershed.	Youth engagement in a fun activity. Encourage discussion on how they see these activities potentially encouraging in their community. Engage with social media posts.
City of Lebanon, TN Environmental Council, Green Interchange.	Tree Give-Away in support of Tennessee Environmental Council's Tennessee Tree Day 2022, and Green Interchanges Plant a Tree for Tennessee.	Tree Giveaway: 1,300 trees total	3/18/2022 and 4/23/22	City of Lebanon Residents	(A, H) General public awareness on the impacts on water quality from general housekeeping maintenance/activities and daily operations.	Stormwater erosion & sediment runoff	All	Education on the benefits of planting trees. Encouraged community to plant in riparian zones. 1,300 trees planted by citizens throughout the community. Engaged community on stormwater related issues as they picked up their orders.
Rotary Club and Lebanon Stormwater Department	Stream buffer enhancement:	Planted trees, flowers, and removed non-native species and litter in the stream buffer at two locations.	11/5/2021 and 3/4/22	Rotary Club and Lebanon Stormwater Department	(A,B,C,H) General community awareness on the importance and function of stream buffers as they relate to urban runoff.	Surface runoff from public urban areas.	Sinking Creek	Educate community members on the importance of stream buffers on water quality and erosion stabilization. Promote native species in stream buffers. Remove litter from watershed.
Lebanon and Wilson County Schools	Think Green Think Clean	City of Lebanon Stormwater together with City of Lebanon Beautification Commission, City of Mt. Juliet Stormwater, and Wilson County Stormwater held 12th Annual Think Green Think Clean Youth Litter Challenge on Saturday, April 30, 2022. Students/teachers/families of Wilson County Schools and Lebanon Special School District were out in force collecting trash in their communities. Schools with the most trash removed qualified to win prize money for their school to be used in beautification and/or environmental projects (for example: butterfly gardens, eco-friendly drinking fountains, or environmental science materials for their classrooms). This county-wide program emphasizes to students and families the importance of pollution prevention in our communities and helps to raise awareness of environmental concerns that are present in our daily lives.	4/30/2022	10 schools, 350 participants (students, faculty, and parents).	(A) General public awareness on the impacts on water quality from general housekeeping maintenance/activities.	Litter	Entire Wilson County watershed.	To reduce litter, develop public participation, and raise awareness and importance of protecting the environment (356 bags of garbage were collected during this year's event). \$10,000 donated to Wilson County and LSSD schools.
Lebanon High School and Stormwater Department	Stream Sampling and Ecological Exploration	Stream samples were collected with students at two different streams. Over 150 constituents were analyzed at a laboratory. Grading plans of the school were used to identify detected pollutant pathways to trace back to source areas. Stream surveys were conducted to characterize the health of two different streams associated with different landscape uses (rural residential vs. urban paved/multiuse recreational).	3/3/2022	Approximately 20 students in Ms. Kim Atwoods Biology Class	(A,D,F,H) Students developing their understanding of how various urban activities contribute to the ecological health of watershed.	Urban and sports field pollutants.	Bartons Creek and Walkers Branch	The City of Lebanon Stormwater department, joined by David Withers of TDEC, collaborated with Lebanon High School teacher Mrs. Kimberly Atwood and her biology class to conduct sampling and ecological exploration of the stream running beside Lebanon High School. David Withers, a zoologist with the TDEC Natural Heritage Program, led the students in exploring the stream and looking for ecological habitats and stream wildlife. By lifting rocks and utilizing nets the students were able to find numerous specimens and learned more about the ecosystems residing near their school. The Stormwater department led stream sampling with the students, including data collection using a YSI Multi-probe and sample collections. Students were able to get hands on learning by using the multi-probe to collect data for parameters such as water temperature, pH, dissolved oxygen, and turbidity. They collected data at multiple locations along the stream section and hypothesized why various parameters might change from one location to the next, considering the proximity of the schools parking lot, as well as the farm on the other side of the stream. The students were also able to practice collecting samples, learning how to properly collect the sample as well as learning about the different tests the lab would conduct, such as testing for nitrogen, phosphorus, and herbicides/pesticides. Finally, the students learned how to fill out the sample labels, including information about the sampling event. The samples were then sent off to the local lab and the results will be shared with Mrs. Atwood's class to facilitate discussions about why a certain parameter might be higher or lower than what they had expected.
Lebanon Museum, Stormwater Department, and Lebanon Special School District	Lebanon History Day	Stormwater Department educated students on our local geology as it relates to our watershed with a geologic display and demonstration.	3/23/2022	LSSD students, faculty, and staff. Lebanon Stormwater Department employees, and other City employees.	(A) General public awareness on how our watershed is interconnected through surface water runoff, karst aquifers, and springs.	General urban stormwater runoff.	All	Students learn about the geologic composition of Lebanon with a demonstration on how limestone dissolution creates fissures, potholes, and sinkholes and how stormwater runoff flows through these systems. Students will also learn about the extensive cave systems located in the area. oCave Maps oTennessee Geologic Composition Figure oGeology of Lebanon Display and Demonstration

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Public Information and Education Plan Targeted Educational Campaigns							
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Organizations	Activity	Description	Date	Participants	Target Audience	Target Pollutants	Target Stream	Goals / Results
Lebanon Stormwater Department, LSSD Family Resource Center, and LSSD students, faculty, and parents	Adopt-A-Stream: Raingarden, buffer repair, and planting trees with historical significance.	The City of Lebanon Stormwater department collaborated with Lebanon Special School District to host Adopt-A-Stream Saturday, May 7 th . The event included approximately 20 community members, including students from Winfree-Bryant Middle School. Lebanon Special School District STEM teacher Ms. Adrema Higgins taught students about the importance of stream habitats and riparian buffers, and stormwater staff taught the volunteers about the benefits of rain gardens and pollinator gardens to the health of local environments and streams. The Stormwater department provided approximately fifty native plants which were planted in a rain garden along the walking trail between Winfree-Bryant Middle School and the South Hartmann Park. Additionally, member of the stormwater department aided the volunteers in planting ten trees in the area and added mulch to existing trees along the walking trail and surrounding the park.	All activities occurred on May 17th, 2022, with students, faculty, staff, and Stormwater Department employees.	LSSD students, faculty, and staff. Lebanon Stormwater Department employees, and LSSD Family Resource Center.	(A, D, H) General public awareness on the impacts on water quality from general housekeeping maintenance/activities and daily operations. Primarily targeted to LSSD students and parents.	Stormwater, erosion & sediment runoff, parking lot runoff, herbicides, pesticide, fertilizer/nutrient reduction.	Barton's Creek	Students were educated on the benefits and functions of native plants, pollinators, riparian buffers and rain gardens. Approximately 35 community members, including about 20 students participated in these activities. Nine historical trees were planted with informational markers to act as a historical learning grove. The trees came from historical backgrounds associated with Alex Halex, Alvin C. York, Apollo 14 Space Mission, Franklin D. Roosevelt, Rober Frost, and George Washington. Native plant species were planted in a rain garden on school property. The function and beneficial aspects of rain gardens were presented to students helping with the planting. The rain garden and historical trees will serve as a continuing education subject matter, showcasing native plants, pollinator species, erosion, stormwater, and history topics.
City of Lebanon, TNSA, TDEC various other MS4's and government agencies.	Metro Urban Waters 5K	The City of Lebanon Stormwater Department sponsored and participated in the 8 th Annual Urban Runoff 5K and Water Quality Festival which took place in Nashville, TN, on August 7 th , 2021. The Stormwater Department acted as a performance sponsor for the race and had a booth display with informational items including booklets, Tennessee wildflower seeds, rain gauges, and a weather station which was raffled off. Approximately 60 people interacted with the booth, signing up for the weather station raffle and engaging in conversations about stormwater, runoff, and water quality.	8/7/2021	5k participants and Shelby Park Visitors.	(A-H) All Audiences	MS4 related stormwater pollutants.	All	Educate and promote MS4 water quality related issues. Distribute project wet books to youth. Answer questions from community members.
Wilson County Stormwater Group	Builders Expo at the Wilson County Expo Center (Fairgrounds)	Two-day event in which citizens and businesses associated with the construction industry gather to promote their products & services. Stormwater educational material is distributed.	2/11/22 - 2/12/22	Participants registered for gift card giveaway when visiting the booth for education materials.	(A-H) All Audiences	All	All	To raise awareness of the importance of proper BMP's for construction activities and impact of water quality
Wilson County Stormwater Group	Stormwater Group Meetings	Local/regional stormwater discussion	Quarterly to Semi-annually.	Varies	(A-H) All Audiences	Stormwater erosion & sediment runoff	All	To promote and educate the community on stormwater related issues. Covid-19 reduced the frequency of these gatherings. Often moved to phone call to local, nearby MS4 programs.



Rick Bell, Mayor

200 North Castle Heights Avenue
Lebanon, Tennessee 37087

MS4 2021-2022 Annual Report Supplemental Information

Section 6B – Permanent Riparian Buffer Information

- ix. Infiltration rates, where applicable;
- x. Culvert, stormwater sewer, ditch and/or other stormwater conveyance capacities;
- xi. Flow velocities;
- xii. Data on the increase in rate and volume of runoff for the design storms referenced in the MS4 BMP manual; and
- xiii. Documentation of sources for all computation methods and field test results.

(e) Soils information: If a stormwater management control measure depends on the hydrologic properties of soils (e.g., infiltration basins), then a soils report shall be submitted. The soils report shall be based on on-site boring logs or soil pit profiles and soil survey reports. The number and location of required soil borings or soil pits shall be determined based on what is needed to determine the suitability and distribution of soil types present at the location of the control measure.

(9) Maintenance and repair plan. The design and planning of all permanent stormwater management facilities shall include detailed maintenance and repair procedures to ensure their continued performance. These plans will identify the parts or components of a stormwater management facility that need to be maintained and the equipment and skills or training necessary. Provisions for the periodic review and evaluation of the effectiveness of the maintenance program and the need for revisions or additional maintenance procedures shall be included in the plan.

(10) Buffer Zone Requirements. The water quality buffer zone is required to protect waters of the state (e.g., perennial and intermittent streams, rivers, lakes, wetlands) located within or immediately adjacent to the boundaries of the project. The goal of the water quality buffer is to preserve undisturbed vegetation that is native to the streamside habitat in the area of the project. Vegetated, preferable native, water quality buffers protect water bodies by providing structural integrity and canopy cover, as well as stormwater infiltration, filtration and evapotranspiration. Buffer zones are not primary sediment control measures and should not be relied upon as such. Rehabilitation, restoration and enhancement of a natural buffer zone is allowed, if necessary, for improvement of its effectiveness of protection of the waters of the state with proper permit(s).

(a) Permanent Vegetative Buffer

Permanent buffers shall be maintained adjacent to all waters of the state including perennial and intermittent streams, rivers, ponds, lakes and wetlands. All new development and redevelopment sites are required to preserve water quality buffers. Buffers shall be clearly marked on site development plans, plats, grading permit applications, and/or concept plans. Buffer width depends on the size of a drainage

area and/or status of receiving stream (impaired or high quality/exceptional).

i. *Streams or other drainage areas less than 1 square mile*

An undisturbed vegetative buffer of thirty (30) feet minimum (as measured from the top-of-bank) shall be maintained.

ii. *Streams or other drainage areas greater than or equal to 1 square mile*

An undisturbed vegetative buffer of sixty (60) feet minimum (as measured from the top-of-bank) shall be maintained. The 60-foot criterion for the width of the buffer zone can be established on an average width basis at a project, as long as the minimum width of the buffer zone is more than 30 feet at any measured location.

iii. *Impaired or High Quality/Exceptional Streams*

An undisturbed vegetative buffer of sixty (60) feet minimum (as measured from the top-of-bank) shall be maintained. The 60-foot criterion for the width of the buffer zone can be established on an average width basis at a project, as long as the minimum width of the buffer zone is more than 30 feet at any measured location.

(b) Construction Buffer

A construction buffer applies to all waters of the state adjacent to construction sites. Every effort shall be made for construction activities to not take place within the buffer and the buffer should remain in its undisturbed vegetated state.

i. A 30-foot natural riparian buffer zone adjacent to all waters of the state at the construction site shall be preserved, to the maximum extent practical, during construction activities at the site except for those designated as impaired or high quality/exceptional by TDEC. The 30-foot criterion for the width of the buffer zone can be established on an average width basis at a project, as long as the minimum width of the buffer zone is more than 15 feet at any measured location.

ii. A 60-foot natural riparian buffer zone adjacent to all receiving streams designated as impaired or high quality/exceptional waters shall be preserved, to the maximum extent practical, during construction activities at the site. The 60-foot criterion for the width of the buffer zone can be established on an average width basis at a project, as long as the minimum width of the buffer zone is more than 25 feet at any measured location.

(c) Variance

Every attempt should be made for development and redevelopment activities to not take place within the buffer zone. If water quality widths, as defined above, cannot be fully accomplished on-site, the City of Lebanon Public Works Committee may grant a variance to the water quality buffer requirements. When a variance is granted by the Public Works Committee, mitigation must be at least as protective of the natural resources and the environment as the undisturbed buffer. A determination that standards cannot be met may not be based solely on the difficulty or cost of implementing measures, but must include multiple criteria, such as type of project, existing land use and physical conditions that preclude use of these practices.

If it is not feasible to provide an undisturbed naturally vegetated buffer, of any size, between the disturbed portion of the site and any waters of the state, sediment and erosion controls certified by a TN licensed professional engineer to achieve the equivalent sediment load reduction as an undisturbed naturally vegetated, 30-foot buffer (or 60-foot for impaired or exceptional streams) may be implemented on approval by the City Engineer. A justification for use and design shall be included in the SWPPP. These projects include, but are not limited to, utility line construction, roadway construction, greenway construction, construction of a permanent outfall or a velocity dissipating structures, etc.

(d) Exemption

If pre-existing development on the site has resulted in significant disturbances within the 30-foot or 60-foot buffer (for example, sites where all vegetation in the 30-foot buffer areas has been removed and replaced with impervious surfaces as a result of prior development), the site is exempt from complying with the buffer requirements as long as the area of encroachment is not extended.

Section 6. Permanent Stormwater Management: Operation, Maintenance, and Inspection.

- (1) As built plans. All applicants are required to submit actual as built plans for any structures located on-site after final construction is completed. The plan must show the final design specifications for all stormwater management facilities and must be sealed by a registered professional engineer licensed to practice in Tennessee. A final inspection by the City of Lebanon is required before any performance security will be released. The City of Lebanon shall have the discretion to adopt provisions for a partial pro-rata release of the performance security on the completion of various stages of development. In addition, occupation permits shall not be granted until corrections to all BMP's



Rick Bell, Mayor

200 North Castle Heights Avenue
Lebanon, Tennessee 37087

MS4 2021-2022 Annual Report Supplemental Information

Section 6I – Offsite Mitigation/Stormwater Fund

4.2.5.2.3 – Offsite Mitigation

The following information is from the City of Lebanon Stormwater Ordinances Section 5 – Stormwater System Design: Construction and Permanent Stormwater Management, General design performance criteria for permanent stormwater management:

- (6) (Items a-g *Effective 6/ 8/ 2015*): the following performance criteria shall be addressed for permanent stormwater management at all development sites:
- (a) Site design standards for all new and redevelopment require, in combination or alone, management measures that are designed, built and maintained to infiltrate, evapotranspire, harvest and/or use, at a minimum, the first inch of every rainfall event preceded by 72 hours of no measurable precipitation. This first inch of rainfall must be 100% managed with no discharge to surface waters.
 - (b) Limitations to the application of runoff reduction requirements include, but are not limited to:
 - i. Where a potential for introducing pollutants into the groundwater exists, unless pretreatment is provided;
 - ii. Where pre-existing soil contamination is present in areas subject to contact with infiltrated runoff;
 - iii. Presence of sinkholes or other karst features.
 - (c) Pre-development infiltrative capacity of soils at the site must be taken into account in selection of runoff reduction management measures.

(d) Incentive Standards for re-developed sites: a 10% reduction in the volume of rainfall to be managed for any of the following types of development. Such credits are additive such that a maximum reduction of 50% of the standard in the paragraph above is possible for a project that meets all 5 criteria:

- i. Redevelopment;
- ii. Brownfield redevelopment;
- iii. (iii)High density (>7 units per acre);
- iv. (iv)Vertical Density, (Floor to Area Ratio (FAR) of 2 or >18 units per acre); and
- v. Mixed use and Transit Oriented Development (within ½ mile of transit).

(e) For projects that cannot meet 100% of the runoff reduction requirement unless subject to the incentive standards, the remainder of the stipulated amount of rainfall must be treated prior to discharge with a technology documented to remove 80% total suspended solids (TSS) unless an alternative provided under this ordinance is approved. The treatment technology must be designed, installed and maintained to continue to meet this performance standard.

(f) For projects that cannot meet 100% of the runoff reduction requirements, the City Engineer may allow runoff reduction measures to be implemented at another location within the same USGS 12-digit hydrologic unit code (HUC) as the original project. Off-site mitigation must be a minimum of 1.5 times the amount of water not managed on site. The off-site mitigation location (or alternative location outside the 12-digit HUC) and runoff reduction measures must be approved by the City Engineer. The City Engineer shall identify priority areas within the watershed in which mitigation projects can be completed. The City Engineer

must create an inventory of appropriate mitigation projects, and develop appropriate institutional standards and management systems to value, evaluate and track transactions. Mitigation can be used for retrofit or redevelopment projects, but should be avoided in areas of new development.

- (g) For projects that cannot meet 100% of the runoff reduction and pollutant removal standards, and cannot provide for off-site mitigation, the City of Lebanon may allow the owner to make payment in a public stormwater project fund established by the City of Lebanon. Payment into the public stormwater fund must be at a minimum 1.5 times the estimated cost of on-site reduction controls.

4.2.5.2.4 – Payment into Public Stormwater Project Fund

The following information is from the City of Lebanon Stormwater Ordinances Section 5 – Stormwater System Design: Construction and Permanent Stormwater Management, General design performance criteria for permanent stormwater management:

- (6) (Items a-g *Effective 6/ 8/ 2015*): the following performance criteria shall be addressed for permanent stormwater management at all development sites:
- (a) Site design standards for all new and redevelopment require, in combination or alone, management measures that are designed, built and maintained to infiltrate, evapotranspire, harvest and/or use, at a minimum, the first inch of every rainfall event preceded by 72 hours of no measurable precipitation. This first inch of rainfall must be 100% managed with no discharge to surface waters.
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Rick Bell, Mayor

200 North Castle Heights Avenue
Lebanon, Tennessee 37087

MS4 2021-2022 Annual Report Supplemental Information

Section 10A – Analytical Monitoring Data

For general agriculture or horticulture questions please first try contacting your local county Extension office:

utextension.tennessee.edu

BRIAN CHOMICKI
 200 N. CASTLE HEIGHTS AVE.
 LEBANON TN 37087

08/11/2021
 Customer County: Wilson
 Sample County: Wilson

Lab Number: 607419

Sample Name: AGEESILTY

Farm Name:

Soil Results

pH		Phosphorus	Potassium	Calcium	Magnesium	Zinc	Iron	Manganese	Boron	Sodium
Soil pH	Buffer Value	P	K	Ca	Mg	Zn	Fe	Mn	B	Na
Pounds per acre - Mehlich 1										

Crop/plant Interpretation ranges on last sheet

L = Low, M= Medium, H=High, V= Very High, S = Sufficient

<i>Additional tests, if they were requested</i>											
Sulfur	Nitrogen			Carbon	C/N Ratio	Organic Matter	Soluble Salts	Particle Size Analysis - Hydrometer Method			
LBS/ACRE	NH4-N ppm	NO3-N ppm	Total N %	%	%	%	dS/m	% Sand	% Silt	% Clay	Soil Texture
								24	54	22	Silt Loam

Recommendations

Crop	Fertilizer				Lime
	Nitrogen (as N)	Phosphate (as P2O5)	Potash (as K2O)	Rate	As 65% RNV
Results Only	See	text	below		0
No Crop	See	text	below		0

Please read any text below or on next sheet for additional suggestions and resources

Sample Number: AGEESILTY --- Crop: Results Only

Sample Number: AGEESILTY --- Crop: No Crop

No crop code was indicated on the submission sheet. Please contact us to let us know for which plants or crops you would like recommendations.

Programs in agriculture and natural resources, 4-H youth development, family and consumer sciences, and resource development.

University of Tennessee Institute of Agriculture, U.S. Department of Agriculture and county governments cooperating.

UT Extension provides equal opportunities in programs and employment.

For general agriculture or horticulture questions please first try contacting your local county Extension office:

utextension.tennessee.edu

BRIAN CHOMICKI
 200 N. CASTLE HEIGHTS AVE.
 LEBANON TN 37087

08/11/2021
 Customer County: Wilson
 Sample County: Wilson

Lab Number: 607420

Sample Name: WOODMONT

Farm Name:

Soil Results

pH		Phosphorus	Potassium	Calcium	Magnesium	Zinc	Iron	Manganese	Boron	Sodium
Soil pH	Buffer Value	P	K	Ca	Mg	Zn	Fe	Mn	B	Na
Pounds per acre - Mehlich 1										

Crop/plant Interpretation ranges on last sheet

L = Low, M= Medium, H=High, V= Very High, S = Sufficient

Additional tests, if they were requested

Sulfur	Nitrogen			Carbon	C/N Ratio	Organic Matter	Soluble Salts	Particle Size Analysis - Hydrometer Method			
LBS/ACRE	NH4-N ppm	NO3-N ppm	Total N %	%	%	%	dS/m	% Sand	% Silt	% Clay	Soil Texture
								24	60	16	Silt Loam

Recommendations

Crop	Fertilizer				Lime
	Nitrogen (as N)	Phosphate (as P2O5)	Potash (as K2O)	Rate	As 65% RNV
Results Only	See	text	below		0
No Crop	See	text	below		0

Please read any text below or on next sheet for additional suggestions and resources

Sample Number: WOODMONT --- Crop: Results Only

Sample Number: WOODMONT --- Crop: No Crop

No crop code was indicated on the submission sheet. Please contact us to let us know for which plants or crops you would like recommendations.

Programs in agriculture and natural resources, 4-H youth development, family and consumer sciences, and resource development.

University of Tennessee Institute of Agriculture, U.S. Department of Agriculture and county governments cooperating.

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Interpretation Page

Soil pH interpretations

Lime Recommended when soil pH is less than:

5.6	Sweet Potatoes, brambles
6.1	Corn, wheat, soybeans, red/white clovers, Lawns, most vegetables
6.6	Alfalfa, Apples, Pears, Peaches

Buffer pH helps tell us how much resistant the soil has to being limed. The buffer starts at pH 7.9, the lower the buffer value is from 7.9 the more lime that is required.

Nutrient Interpretations

	Phosphorus (P)	Potassium (K) Lbs. / acre	Potassium Cotton	Yield response to fertilizer
Low	0 to 17	0 to 90	0 to 140	High probability
Medium	18 to 30	90 to 160	141 to 280	Probable
High	31 to 120	161 to 320	281 to 320	None
Very High	120+	320+	320+	None

Calcium is sufficient when greater than 500 pounds per acre.

Magnesium is sufficient when greater than 40 pounds per acre.

Zinc is recommended for: Corn or Snap Beans when Zn levels are less than 2 lbs per acre

Iron: Availability is controlled by soil pH. If the pH is greater than 7.3 one may begin to see iron deficiency symptoms.

Manganese is recommended for: Soybeans when the soil pH is greater than 7 and Mn levels are less than 16 lbs.per acre.

Boron is recommended for: Cotton when boron levels are less than 0.8 lbs per acre, or the soil pH is greater than 6, or when lime is used.

Tobacco when the B levels are less than 1.2 lbs per acre.

General low dose application recommended annually for Alfalfa, Cauliflower, and broccoli.

Soluble Salts

dS/m	approximate ppm	Rating
0.4	560	Low
0.8	1120	Very Slightly Saline
1.6	2240	Slightly Saline
2.4	3360	Moderately Saline
3.2	4480	Strongly Saline
3.2	4480+	Very Strongly Saline

Resources

Please visit:

soilLab.tennessee.edu

Bio-Pond Screening Results

Lab #: 50,498

Reported July 29, 2021

Submission Information

Submitted by:

Brian Chomicki
 200 N Castle Heights Ave

Lebabnon ,TN 37087

Sample ID provided by submitter: A

Submitted For:

Project ID provided by submitter: Candle Wood

Results	
Moisture (as received)	22 % weight to weight
<i>Approximate: Some hardened soil aggregates do not shatter in the flail. Some large organic pieces will also break into <2 mm size pieces.</i>	
Portion > 2 mm	34 % Weight DM basis
Portion < 2 mm	66 % Weight DM basis
Of portion less than 2 mm	
	Percent
Organic content	3.5
Sand	77
Silt	17
Clay	3

*Results on dry matter (DM) basis
 Percents on weight to weight basis*

Method Used
1) Take about a 400mL sample
2) Dry at 105C for at least 12 hours
3) Weigh to tenth gram
4) Flail sample and sieve to 2mm
5) Weigh 2mm fraction
6) Take at least 60 gram sub sample of < 2mm portion
7) Ash at 360 C for 3 hours in 300 mL beaker
8) Weigh mass lost
9) Add 50mL dispersing agent
10) Shake overnight, or 10 min in malt mixer
11) Pour into 1 L settling cylinder
12) Fill to volume, shake well
13) Measure sand at 40 seconds with hydrometer
14) Measure silt at 24 hours

Bio-Pond Screening Results

Lab #: 50,499

Reported July 29, 2021

Submission Information

Submitted by:

Brian Chomicki
 200 N Castle Heights Ave

Lebabnon ,TN 37087

Sample ID provided by submitter: B

Submitted For:

Project ID provided by submitter: Candle Wood

Results	
Moisture (as received)	14 % weight to weight
<i>Approximate: Some hardened soil aggregates do not shatter in the flail. Some large organic pieces will also break into <2 mm size pieces.</i>	
Portion > 2 mm	26 % Weight DM basis
Portion < 2 mm	74 % Weight DM basis
Of portion less than 2 mm	
	Percent
Organic content	3.7
Sand	78
Silt	15
Clay	3

*Results on dry matter (DM) basis
 Percents on weight to weight basis*

Method Used
1) Take about a 400mL sample
2) Dry at 105C for at least 12 hours
3) Weigh to tenth gram
4) Flail sample and sieve to 2mm
5) Weigh 2mm fraction
6) Take at least 60 gram sub sample of < 2mm portion
7) Ash at 360 C for 3 hours in 300 mL beaker
8) Weigh mass lost
9) Add 50mL dispersing agent
10) Shake overnight, or 10 min in malt mixer
11) Pour into 1 L settling cylinder
12) Fill to volume, shake well
13) Measure sand at 40 seconds with hydrometer
14) Measure silt at 24 hours

Bio-Pond Screening Results

Lab #: 50,500

Reported July 29, 2021

Submission Information

Submitted by:

Brian Chomicki
 200 N Castle Heights Ave

Lebabnon ,TN 37087

Sample ID provided by submitter: C

Submitted For:

Project ID provided by submitter: Candle Wood

Results	
Moisture (as received)	16 % weight to weight
<i>Approximate: Some hardened soil aggregates do not shatter in the flail. Some large organic pieces will also break into <2 mm size pieces.</i>	
Portion > 2 mm	37 % Weight DM basis
Portion < 2 mm	63 % Weight DM basis
Of portion less than 2 mm	
	Percent
Organic content	4.0
Sand	79
Silt	13
Clay	3

*Results on dry matter (DM) basis
 Percents on weight to weight basis*

Method Used
1) Take about a 400mL sample
2) Dry at 105C for at least 12 hours
3) Weigh to tenth gram
4) Flail sample and sieve to 2mm
5) Weigh 2mm fraction
6) Take at least 60 gram sub sample of < 2mm portion
7) Ash at 360 C for 3 hours in 300 mL beaker
8) Weigh mass lost
9) Add 50mL dispersing agent
10) Shake overnight, or 10 min in malt mixer
11) Pour into 1 L settling cylinder
12) Fill to volume, shake well
13) Measure sand at 40 seconds with hydrometer
14) Measure silt at 24 hours

Bio-Pond Screening Results

Lab #: 50,501

Reported July 29, 2021

Submission Information

Submitted by:

Brian Chomicki
 200 N Castle Heights Ave

Lebabnon ,TN 37087

Sample ID provided by submitter: D

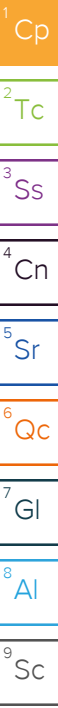
Submitted For:

Project ID provided by submitter: Candle Wood

Results	
Moisture (as received)	13 % weight to weight
<i>Approximate: Some hardened soil aggregates do not shatter in the flail. Some large organic pieces will also break into <2 mm size pieces.</i>	
Portion > 2 mm	26 % Weight DM basis
Portion < 2 mm	74 % Weight DM basis
Of portion less than 2 mm	
	Percent
Organic content	5.0
Sand	82
Silt	10
Clay	3

*Results on dry matter (DM) basis
 Percents on weight to weight basis*

Method Used
1) Take about a 400mL sample
2) Dry at 105C for at least 12 hours
3) Weigh to tenth gram
4) Flail sample and sieve to 2mm
5) Weigh 2mm fraction
6) Take at least 60 gram sub sample of < 2mm portion
7) Ash at 360 C for 3 hours in 300 mL beaker
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12) Fill to volume, shake well
13) Measure sand at 40 seconds with hydrometer
14) Measure silt at 24 hours



Lebanon Storm Water Depart - Lebanon, TN

Sample Delivery Group: L1467568
Samples Received: 03/03/2022
Project Number: LHS
Description: 3.3.22

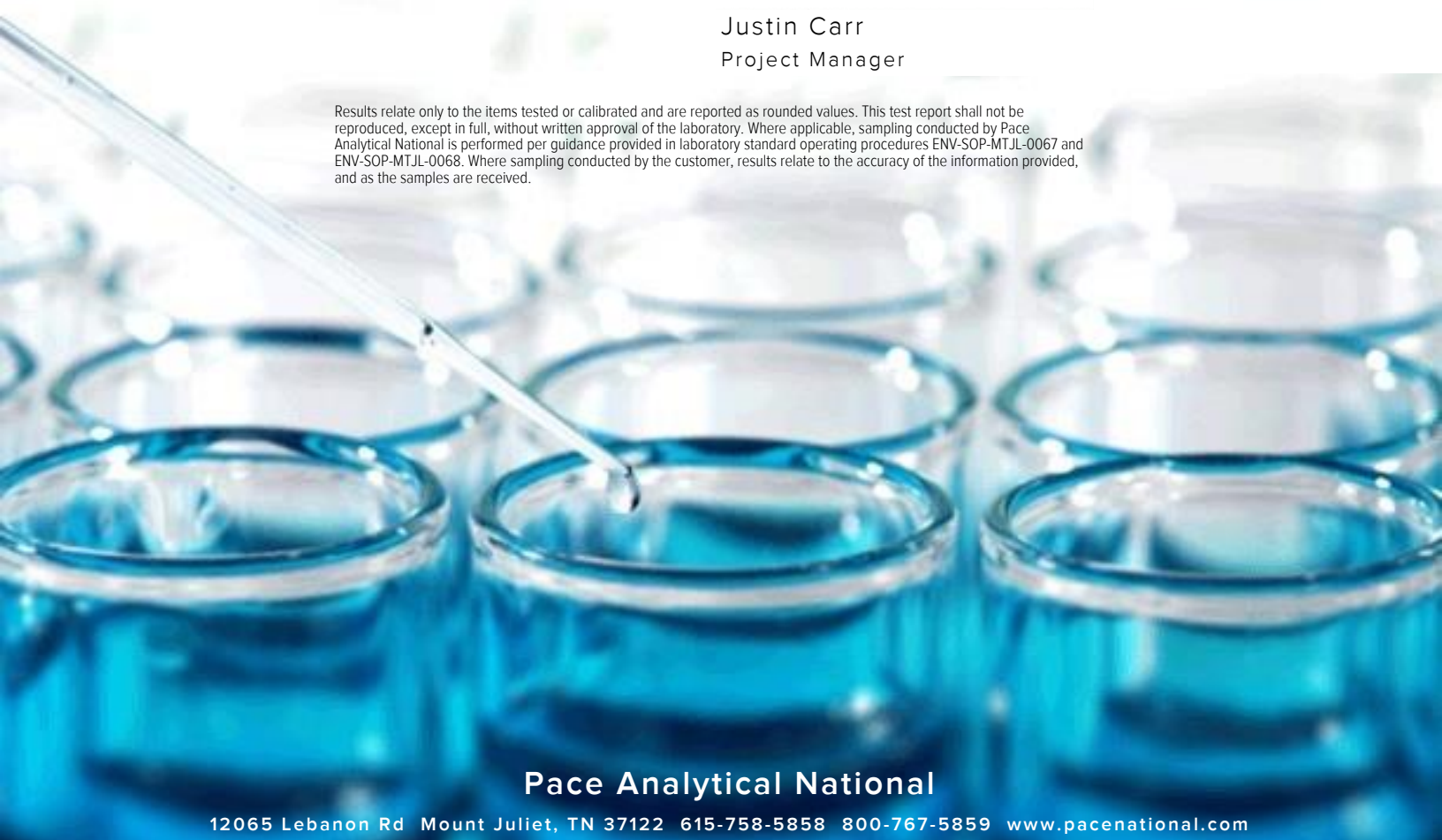
Report To: Brian Chomicki
200 N. Castle Heights Ave.
Suite 300
Lebanon, TN 37087

Entire Report Reviewed By:



Justin Carr
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.

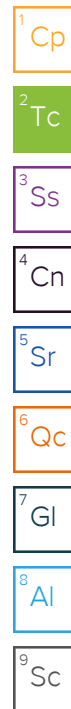


Pace Analytical National

12065 Lebanon Rd Mount Juliet, TN 37122 615-758-5858 800-767-5859 www.pacenational.com

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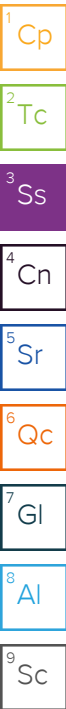


SAMPLE SUMMARY

STROUD WB L1467568-01 WW

Collected by: Brian Chomicki
 Collected date/time: 03/03/22 12:50
 Received date/time: 03/03/22 19:30

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst	Location
Microbiology by Method 9223 B-2016	WG1827440	1	03/04/22 09:40	03/04/22 09:40	HAB	Mt. Juliet, TN
Calculated Results	WG1829629	1	03/15/22 13:51	03/15/22 13:51	LDT	Mt. Juliet, TN
Wet Chemistry by Method 1664A	WG1827723	1	03/05/22 10:01	03/05/22 21:37	ABP	Mt. Juliet, TN
Wet Chemistry by Method 351.2	WG1830394	1	03/13/22 07:41	03/15/22 13:51	LDT	Mt. Juliet, TN
Wet Chemistry by Method 353.2	WG1829629	1	03/15/22 07:51	03/15/22 07:51	MCG	Mt. Juliet, TN
Wet Chemistry by Method 365.4	WG1832626	1	03/13/22 07:41	03/15/22 18:32	LDT	Mt. Juliet, TN
Wet Chemistry by Method 410.4	WG1828357	1	03/07/22 08:50	03/07/22 14:53	BMD	Mt. Juliet, TN
Wet Chemistry by Method 5210 B-2016	WG1827441	1	03/04/22 14:05	03/09/22 09:43	KFO	Mt. Juliet, TN
Mercury by Method 245.1	WG1828088	1	03/06/22 11:31	03/07/22 11:07	MRW	Mt. Juliet, TN
Metals (ICP) by Method 200.7	WG1827776	1	03/05/22 07:54	03/08/22 20:45	CCE	Mt. Juliet, TN
Volatile Organic Compounds (GC) by Method 8015D/GRO	WG1827827	1	03/06/22 04:11	03/06/22 04:11	JAH	Mt. Juliet, TN
Volatile Organic Compounds (GC/MS) by Method 624.1	WG1828022	1	03/06/22 10:01	03/06/22 10:01	ADM	Mt. Juliet, TN
Semi-Volatile Organic Compounds (GC) by Method 8015	WG1829761	1	03/11/22 06:30	03/12/22 07:11	DMG	Mt. Juliet, TN
Semi-Volatile Organic Compounds (LCMS) by Method SW-846 8321	WG1827478	1	03/04/22 12:35	03/04/22 16:45	SHG	Mt. Juliet, TN
Pesticides (GC) by Method EPA 608.3	WG1828554	1	03/08/22 15:43	03/09/22 02:52	AMM	Mt. Juliet, TN
Polychlorinated Biphenyls (GC) by Method EPA-608.3	WG1828554	1	03/08/22 15:43	03/09/22 02:52	AMM	Mt. Juliet, TN
Semi Volatile Organic Compounds (GC/MS) by Method 625.1	WG1829116	1	03/09/22 03:55	03/09/22 13:32	BJP	Mt. Juliet, TN



Collected by: Brian Chomicki
 Collected date/time: 03/03/22 14:00
 Received date/time: 03/03/22 19:30

LHS2 L1467568-02 WW

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst	Location
Calculated Results	WG1829629	1	03/15/22 13:31	03/15/22 13:31	LDT	Mt. Juliet, TN
Wet Chemistry by Method 1664A	WG1827724	1	03/05/22 10:04	03/05/22 22:28	ABP	Mt. Juliet, TN
Wet Chemistry by Method 351.2	WG1830394	1	03/13/22 07:41	03/15/22 13:31	LDT	Mt. Juliet, TN
Wet Chemistry by Method 353.2	WG1829629	1	03/15/22 07:52	03/15/22 07:52	MCG	Mt. Juliet, TN
Wet Chemistry by Method 365.4	WG1832626	1	03/13/22 07:41	03/15/22 18:37	LDT	Mt. Juliet, TN
Wet Chemistry by Method 410.4	WG1828357	1	03/07/22 08:50	03/07/22 14:54	BMD	Mt. Juliet, TN
Wet Chemistry by Method 5210 B-2016	WG1827441	1	03/04/22 14:05	03/09/22 09:45	KFO	Mt. Juliet, TN
Mercury by Method 245.1	WG1828088	1	03/06/22 11:31	03/07/22 11:09	MRW	Mt. Juliet, TN
Metals (ICP) by Method 200.7	WG1827776	1	03/05/22 07:54	03/08/22 20:47	CCE	Mt. Juliet, TN
Volatile Organic Compounds (GC) by Method 8015D/GRO	WG1827827	1	03/06/22 04:35	03/06/22 04:35	JAH	Mt. Juliet, TN
Volatile Organic Compounds (GC/MS) by Method 624.1	WG1828022	1	03/06/22 10:25	03/06/22 10:25	ADM	Mt. Juliet, TN
Semi-Volatile Organic Compounds (GC) by Method 8015	WG1829761	1.18	03/11/22 06:30	03/12/22 07:37	DMG	Mt. Juliet, TN
Semi-Volatile Organic Compounds (LCMS) by Method SW-846 8321	WG1827478	1	03/04/22 12:35	03/04/22 17:36	SHG	Mt. Juliet, TN
Pesticides (GC) by Method EPA 608.3	WG1828554	1	03/08/22 15:43	03/09/22 03:01	AMM	Mt. Juliet, TN
Polychlorinated Biphenyls (GC) by Method EPA-608.3	WG1828554	1	03/08/22 15:43	03/09/22 03:01	AMM	Mt. Juliet, TN
Semi Volatile Organic Compounds (GC/MS) by Method 625.1	WG1829116	1	03/09/22 03:55	03/09/22 13:53	BJP	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.



Justin Carr
Project Manager

¹ Cp

² Tc

³ Ss

⁴ Cn

⁵ Sr

⁶ Qc

⁷ Gl

⁸ Al

⁹ Sc

Microbiology by Method 9223 B-2016

Analyte	Result	Qualifier	Dilution	Analysis date / time	Batch
E.Coli	93.3		1	03/04/2022 09:40	WG1827440
Coliform, Total	>2419.6		1	03/04/2022 09:40	WG1827440

Calculated Results

Analyte	Result	Qualifier	RDL	Dilution	Analysis date / time	Batch
Total Nitrogen	0.526		0.100	1	03/15/2022 13:51	WG1829629

Wet Chemistry by Method 1664A

Analyte	Result	Qualifier	RDL	Dilution	Analysis date / time	Batch
Oil & Grease (Hexane Extr)	ND		5.26	1	03/05/2022 21:37	WG1827723

Wet Chemistry by Method 351.2

Analyte	Result	Qualifier	RDL	Dilution	Analysis date / time	Batch
Kjeldahl Nitrogen, TKN	ND	P1	0.250	1	03/15/2022 13:51	WG1830394

Wet Chemistry by Method 353.2

Analyte	Result	Qualifier	RDL	Dilution	Analysis date / time	Batch
Nitrate-Nitrite	0.384		0.100	1	03/15/2022 07:51	WG1829629

Wet Chemistry by Method 365.4

Analyte	Result	Qualifier	RDL	Dilution	Analysis date / time	Batch
Phosphorus, Total	ND	P1	0.100	1	03/15/2022 18:32	WG1832626

Wet Chemistry by Method 410.4

Analyte	Result	Qualifier	RDL	Dilution	Analysis date / time	Batch
COD	ND		20.0	1	03/07/2022 14:53	WG1828357

Wet Chemistry by Method 5210 B-2016

Analyte	Result	Qualifier	RDL	Dilution	Analysis date / time	Batch
BOD	ND	B1	3.33	1	03/09/2022 09:43	WG1827441

Mercury by Method 245.1

Analyte	Result	Qualifier	RDL	Dilution	Analysis date / time	Batch
Mercury	ND		0.000200	1	03/07/2022 11:07	WG1828088

Metals (ICP) by Method 200.7

Analyte	Result	Qualifier	RDL	Dilution	Analysis date / time	Batch
Arsenic	ND		0.0100	1	03/08/2022 20:45	WG1827776
Barium	0.0276		0.00500	1	03/08/2022 20:45	WG1827776
Boron	ND		0.200	1	03/08/2022 20:45	WG1827776
Cadmium	ND		0.00200	1	03/08/2022 20:45	WG1827776
Chromium	ND		0.0100	1	03/08/2022 20:45	WG1827776

1 Cp

2 Tc

3 Ss

4 Cn

5 Sr

6 Qc

7 Gl

8 Al

9 Sc

STROUD WB

Collected date/time: 03/03/22 12:50

SAMPLE RESULTS - 01

L1467568

Metals (ICP) by Method 200.7

Analyte	Result	Qualifier	RDL	Dilution	Analysis	Batch
	mg/l		mg/l		date / time	
Lead	ND		0.00500	1	03/08/2022 20:45	WG1827776
Potassium	ND		1.00	1	03/08/2022 20:45	WG1827776
Selenium	ND		0.0100	1	03/08/2022 20:45	WG1827776
Silver	ND		0.00500	1	03/08/2022 20:45	WG1827776
Sulfur	6.06		1.00	1	03/08/2022 20:45	WG1827776
Zinc	ND		0.0500	1	03/08/2022 20:45	WG1827776

Volatile Organic Compounds (GC) by Method 8015D/GRO

Analyte	Result	Qualifier	RDL	Dilution	Analysis	Batch
	mg/l		mg/l		date / time	
TPH (GC/FID) Low Fraction	ND		0.100	1	03/06/2022 04:11	WG1827827
(S) a,a,a-Trifluorotoluene(FID)	97.5		78.0-120		03/06/2022 04:11	WG1827827

Volatile Organic Compounds (GC/MS) by Method 624.1

Analyte	Result	Qualifier	RDL	Dilution	Analysis	Batch
	mg/l		mg/l		date / time	
Benzene	ND		0.00100	1	03/06/2022 10:01	WG1828022
Bromodichloromethane	ND		0.00100	1	03/06/2022 10:01	WG1828022
Bromoform	ND		0.00100	1	03/06/2022 10:01	WG1828022
Bromomethane	ND		0.00500	1	03/06/2022 10:01	WG1828022
Carbon tetrachloride	ND		0.00100	1	03/06/2022 10:01	WG1828022
Chlorobenzene	ND		0.00100	1	03/06/2022 10:01	WG1828022
Chlorodibromomethane	ND		0.00100	1	03/06/2022 10:01	WG1828022
Chloroethane	ND		0.00500	1	03/06/2022 10:01	WG1828022
2-Chloroethyl vinyl ether	ND		0.0500	1	03/06/2022 10:01	WG1828022
Chloroform	ND		0.00500	1	03/06/2022 10:01	WG1828022
Chloromethane	ND		0.00250	1	03/06/2022 10:01	WG1828022
1,2-Dichlorobenzene	ND		0.00100	1	03/06/2022 10:01	WG1828022
1,3-Dichlorobenzene	ND		0.00100	1	03/06/2022 10:01	WG1828022
1,4-Dichlorobenzene	ND		0.00100	1	03/06/2022 10:01	WG1828022
Dichlorodifluoromethane	ND		0.00500	1	03/06/2022 10:01	WG1828022
1,1-Dichloroethane	ND		0.00100	1	03/06/2022 10:01	WG1828022
1,2-Dichloroethane	ND		0.00100	1	03/06/2022 10:01	WG1828022
1,1-Dichloroethene	ND		0.00100	1	03/06/2022 10:01	WG1828022
trans-1,2-Dichloroethene	ND		0.00100	1	03/06/2022 10:01	WG1828022
1,2-Dichloropropane	ND		0.00100	1	03/06/2022 10:01	WG1828022
cis-1,3-Dichloropropene	ND		0.00100	1	03/06/2022 10:01	WG1828022
trans-1,3-Dichloropropene	ND		0.00100	1	03/06/2022 10:01	WG1828022
Ethylbenzene	ND		0.00100	1	03/06/2022 10:01	WG1828022
Methylene Chloride	ND		0.00500	1	03/06/2022 10:01	WG1828022
Methyl tert-butyl ether	ND		0.00100	1	03/06/2022 10:01	WG1828022
Naphthalene	ND		0.00500	1	03/06/2022 10:01	WG1828022
1,1,2,2-Tetrachloroethane	ND		0.00100	1	03/06/2022 10:01	WG1828022
Tetrachloroethene	ND		0.00100	1	03/06/2022 10:01	WG1828022
Toluene	ND		0.00100	1	03/06/2022 10:01	WG1828022
1,1,1-Trichloroethane	ND		0.00100	1	03/06/2022 10:01	WG1828022
1,1,2-Trichloroethane	ND		0.00100	1	03/06/2022 10:01	WG1828022
Trichloroethene	ND		0.00100	1	03/06/2022 10:01	WG1828022
Trichlorofluoromethane	ND		0.00500	1	03/06/2022 10:01	WG1828022
Vinyl chloride	ND		0.00100	1	03/06/2022 10:01	WG1828022
(S) Toluene-d8	108		80.0-120		03/06/2022 10:01	WG1828022
(S) 4-Bromofluorobenzene	102		80.0-120		03/06/2022 10:01	WG1828022
(S) 1,2-Dichloroethane-d4	89.0		70.0-130		03/06/2022 10:01	WG1828022

1 Cp

2 Tc

3 Ss

4 Cn

5 Sr

6 Qc

7 Gl

8 Al

9 Sc

Semi-Volatile Organic Compounds (GC) by Method 8015

Analyte	Result	Qualifier	RDL	Dilution	Analysis	Batch
	mg/l		mg/l		date / time	
TPH (GC/FID) High Fraction	ND	<u>J3</u>	0.100	1	03/12/2022 07:11	WG1829761
(S) o-Terphenyl	71.4		31.0-160		03/12/2022 07:11	WG1829761

Semi-Volatile Organic Compounds (LCMS) by Method SW-846 8321

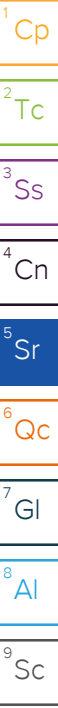
Analyte	Result	Qualifier	RDL	Dilution	Analysis	Batch
	mg/l		mg/l		date / time	
2,4-D	ND		0.00200	1	03/04/2022 16:45	WG1827478
Dalapon	ND		0.00200	1	03/04/2022 16:45	WG1827478
2,4-DB	ND		0.00200	1	03/04/2022 16:45	WG1827478
Dicamba	ND		0.00200	1	03/04/2022 16:45	WG1827478
Dichloroprop	ND		0.00200	1	03/04/2022 16:45	WG1827478
Dinoseb	ND		0.00200	1	03/04/2022 16:45	WG1827478
MCPA	ND		0.00200	1	03/04/2022 16:45	WG1827478
MCPP	ND		0.00200	1	03/04/2022 16:45	WG1827478
2,4,5-T	ND		0.00200	1	03/04/2022 16:45	WG1827478
2,4,5-TP (Silvex)	ND		0.00200	1	03/04/2022 16:45	WG1827478
(S) 2,4-DB-D3	101		70.0-130		03/04/2022 16:45	WG1827478

Pesticides (GC) by Method EPA 608.3

Analyte	Result	Qualifier	RDL	Dilution	Analysis	Batch
	mg/l		mg/l		date / time	
Aldrin	ND		0.0000500	1	03/09/2022 02:52	WG1828554
Alpha BHC	ND		0.0000500	1	03/09/2022 02:52	WG1828554
Beta BHC	ND		0.0000500	1	03/09/2022 02:52	WG1828554
Delta BHC	ND		0.0000500	1	03/09/2022 02:52	WG1828554
Gamma BHC	ND		0.0000500	1	03/09/2022 02:52	WG1828554
Chlordane	ND		0.00500	1	03/09/2022 02:52	WG1828554
4,4-DDD	ND		0.0000500	1	03/09/2022 02:52	WG1828554
4,4-DDE	ND		0.0000500	1	03/09/2022 02:52	WG1828554
4,4-DDT	ND		0.0000500	1	03/09/2022 02:52	WG1828554
Dieldrin	ND		0.0000500	1	03/09/2022 02:52	WG1828554
Endosulfan I	ND		0.0000500	1	03/09/2022 02:52	WG1828554
Endosulfan II	ND		0.0000500	1	03/09/2022 02:52	WG1828554
Endosulfan sulfate	ND		0.0000500	1	03/09/2022 02:52	WG1828554
Endrin	ND		0.0000500	1	03/09/2022 02:52	WG1828554
Endrin aldehyde	ND		0.0000500	1	03/09/2022 02:52	WG1828554
Endrin ketone	ND		0.0000500	1	03/09/2022 02:52	WG1828554
Heptachlor	ND		0.0000500	1	03/09/2022 02:52	WG1828554
Heptachlor epoxide	ND		0.0000500	1	03/09/2022 02:52	WG1828554
Hexachlorobenzene	ND		0.0000500	1	03/09/2022 02:52	WG1828554
Methoxychlor	ND		0.0000500	1	03/09/2022 02:52	WG1828554
Toxaphene	ND		0.000500	1	03/09/2022 02:52	WG1828554
gamma-Chlordane	ND		0.0000500	1	03/09/2022 02:52	WG1828554
alpha-Chlordane	ND		0.0000500	1	03/09/2022 02:52	WG1828554
(S) Decachlorobiphenyl	87.1		10.0-144		03/09/2022 02:52	WG1828554
(S) Tetrachloro-m-xylene	85.8		10.0-135		03/09/2022 02:52	WG1828554

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	03/09/2022 02:52	WG1828554
PCB 1221	ND		0.000500	1	03/09/2022 02:52	WG1828554
PCB 1232	ND		0.000500	1	03/09/2022 02:52	WG1828554
PCB 1242	ND		0.000500	1	03/09/2022 02:52	WG1828554
PCB 1248	ND		0.000500	1	03/09/2022 02:52	WG1828554



Polychlorinated Biphenyls (GC) by Method EPA-608.3

Analyte	Result	Qualifier	RDL	Dilution	Analysis	Batch
	mg/l		mg/l		date / time	
PCB 1254	ND		0.000500	1	03/09/2022 02:52	WG1828554
PCB 1260	ND		0.000500	1	03/09/2022 02:52	WG1828554
Total PCBs	ND		0.000500	1	03/09/2022 02:52	WG1828554
(S) Decachlorobiphenyl	80.4		10.0-144		03/09/2022 02:52	WG1828554
(S) Tetrachloro-m-xylene	92.5		10.0-135		03/09/2022 02:52	WG1828554

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	03/09/2022 13:32	WG1829116
Acenaphthylene	ND		0.00100	1	03/09/2022 13:32	WG1829116
Anthracene	ND		0.00100	1	03/09/2022 13:32	WG1829116
Benzidine	ND		0.0100	1	03/09/2022 13:32	WG1829116
Benzo(a)anthracene	ND		0.00100	1	03/09/2022 13:32	WG1829116
Benzo(b)fluoranthene	ND		0.00100	1	03/09/2022 13:32	WG1829116
Benzo(k)fluoranthene	ND		0.00100	1	03/09/2022 13:32	WG1829116
Benzo(g,h,i)perylene	ND		0.00100	1	03/09/2022 13:32	WG1829116
Benzo(a)pyrene	ND		0.00100	1	03/09/2022 13:32	WG1829116
Bis(2-chloroethoxy)methane	ND		0.0100	1	03/09/2022 13:32	WG1829116
Bis(2-chloroethyl)ether	ND		0.0100	1	03/09/2022 13:32	WG1829116
2,2-Oxybis(1-Chloropropane)	ND		0.0100	1	03/09/2022 13:32	WG1829116
4-Bromophenyl-phenylether	ND		0.0100	1	03/09/2022 13:32	WG1829116
2-Chloronaphthalene	ND		0.00100	1	03/09/2022 13:32	WG1829116
4-Chlorophenyl-phenylether	ND		0.0100	1	03/09/2022 13:32	WG1829116
Chrysene	ND		0.00100	1	03/09/2022 13:32	WG1829116
Dibenz(a,h)anthracene	ND		0.00100	1	03/09/2022 13:32	WG1829116
3,3-Dichlorobenzidine	ND		0.0100	1	03/09/2022 13:32	WG1829116
2,4-Dinitrotoluene	ND		0.0100	1	03/09/2022 13:32	WG1829116
2,6-Dinitrotoluene	ND		0.0100	1	03/09/2022 13:32	WG1829116
1,2-Diphenylhydrazine	ND		0.0100	1	03/09/2022 13:32	WG1829116
Fluoranthene	ND		0.00100	1	03/09/2022 13:32	WG1829116
Fluorene	ND		0.00100	1	03/09/2022 13:32	WG1829116
Hexachlorobenzene	ND		0.00100	1	03/09/2022 13:32	WG1829116
Hexachloro-1,3-butadiene	ND		0.0100	1	03/09/2022 13:32	WG1829116
Hexachlorocyclopentadiene	ND		0.0100	1	03/09/2022 13:32	WG1829116
Hexachloroethane	ND		0.0100	1	03/09/2022 13:32	WG1829116
Indeno(1,2,3-cd)pyrene	ND		0.00100	1	03/09/2022 13:32	WG1829116
Isophorone	ND		0.0100	1	03/09/2022 13:32	WG1829116
Naphthalene	ND		0.00100	1	03/09/2022 13:32	WG1829116
Nitrobenzene	ND		0.0100	1	03/09/2022 13:32	WG1829116
n-Nitrosodimethylamine	ND		0.0100	1	03/09/2022 13:32	WG1829116
n-Nitrosodiphenylamine	ND		0.0100	1	03/09/2022 13:32	WG1829116
n-Nitrosodi-n-propylamine	ND		0.0100	1	03/09/2022 13:32	WG1829116
Phenanthrene	ND		0.00100	1	03/09/2022 13:32	WG1829116
Benzylbutyl phthalate	ND		0.00300	1	03/09/2022 13:32	WG1829116
Bis(2-ethylhexyl)phthalate	ND		0.00300	1	03/09/2022 13:32	WG1829116
Di-n-butyl phthalate	ND		0.00300	1	03/09/2022 13:32	WG1829116
Diethyl phthalate	ND		0.00300	1	03/09/2022 13:32	WG1829116
Dimethyl phthalate	ND		0.00300	1	03/09/2022 13:32	WG1829116
Di-n-octyl phthalate	ND		0.00300	1	03/09/2022 13:32	WG1829116
Pyrene	ND		0.00100	1	03/09/2022 13:32	WG1829116
1,2,4-Trichlorobenzene	ND		0.0100	1	03/09/2022 13:32	WG1829116
4-Chloro-3-methylphenol	ND		0.0100	1	03/09/2022 13:32	WG1829116
2-Chlorophenol	ND		0.0100	1	03/09/2022 13:32	WG1829116
2,4-Dichlorophenol	ND		0.0100	1	03/09/2022 13:32	WG1829116
2,4-Dimethylphenol	ND		0.0100	1	03/09/2022 13:32	WG1829116

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
4,6-Dinitro-2-methylphenol	ND		0.0100	1	03/09/2022 13:32	WG1829116
2,4-Dinitrophenol	ND		0.0100	1	03/09/2022 13:32	WG1829116
2-Nitrophenol	ND		0.0100	1	03/09/2022 13:32	WG1829116
4-Nitrophenol	ND		0.0100	1	03/09/2022 13:32	WG1829116
Pentachlorophenol	ND		0.0100	1	03/09/2022 13:32	WG1829116
Phenol	ND		0.0100	1	03/09/2022 13:32	WG1829116
2,4,6-Trichlorophenol	ND		0.0100	1	03/09/2022 13:32	WG1829116
<i>(S) Nitrobenzene-d5</i>	62.7		15.0-314		03/09/2022 13:32	WG1829116
<i>(S) 2-Fluorobiphenyl</i>	61.4		22.0-127		03/09/2022 13:32	WG1829116
<i>(S) p-Terphenyl-d14</i>	70.7		29.0-141		03/09/2022 13:32	WG1829116
<i>(S) Phenol-d5</i>	17.9		8.00-424		03/09/2022 13:32	WG1829116
<i>(S) 2-Fluorophenol</i>	29.9		10.0-120		03/09/2022 13:32	WG1829116
<i>(S) 2,4,6-Tribromophenol</i>	66.0		10.0-153		03/09/2022 13:32	WG1829116

Sample Narrative:

L1467568-01 WG1829116: ® Pyridine and Benzidine are reporting with critically low recovery in the laboratory control sample

1 Cp

2 Tc

3 Ss

4 Cn

5 Sr

6 Qc

7 Gl

8 Al

9 Sc

Calculated Results

Analyte	Result	Qualifier	RDL	Dilution	Analysis date / time	Batch
Total Nitrogen	0.822		0.100	1	03/15/2022 13:31	WG1829629

Wet Chemistry by Method 1664A

Analyte	Result	Qualifier	RDL	Dilution	Analysis date / time	Batch
Oil & Grease (Hexane Extr)	ND		5.88	1	03/05/2022 22:28	WG1827724

Wet Chemistry by Method 351.2

Analyte	Result	Qualifier	RDL	Dilution	Analysis date / time	Batch
Kjeldahl Nitrogen, TKN	0.280	P1	0.250	1	03/15/2022 13:31	WG1830394

Wet Chemistry by Method 353.2

Analyte	Result	Qualifier	RDL	Dilution	Analysis date / time	Batch
Nitrate-Nitrite	0.542		0.100	1	03/15/2022 07:52	WG1829629

Wet Chemistry by Method 365.4

Analyte	Result	Qualifier	RDL	Dilution	Analysis date / time	Batch
Phosphorus, Total	ND		0.100	1	03/15/2022 18:37	WG1832626

Wet Chemistry by Method 410.4

Analyte	Result	Qualifier	RDL	Dilution	Analysis date / time	Batch
COD	ND		20.0	1	03/07/2022 14:54	WG1828357

Wet Chemistry by Method 5210 B-2016

Analyte	Result	Qualifier	RDL	Dilution	Analysis date / time	Batch
BOD	ND	B1	3.33	1	03/09/2022 09:45	WG1827441

Mercury by Method 245.1

Analyte	Result	Qualifier	RDL	Dilution	Analysis date / time	Batch
Mercury	ND		0.000200	1	03/07/2022 11:09	WG1828088

Metals (ICP) by Method 200.7

Analyte	Result	Qualifier	RDL	Dilution	Analysis date / time	Batch
Arsenic	ND		0.0100	1	03/08/2022 20:47	WG1827776
Barium	0.0342		0.00500	1	03/08/2022 20:47	WG1827776
Cadmium	ND		0.00200	1	03/08/2022 20:47	WG1827776
Chromium	ND		0.0100	1	03/08/2022 20:47	WG1827776
Lead	ND		0.00500	1	03/08/2022 20:47	WG1827776
Potassium	1.52		1.00	1	03/08/2022 20:47	WG1827776
Selenium	ND		0.0100	1	03/08/2022 20:47	WG1827776
Silver	ND		0.00500	1	03/08/2022 20:47	WG1827776

1 Cp

2 Tc

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9 Sc

Volatile Organic Compounds (GC) by Method 8015D/GRO

Analyte	Result	Qualifier	RDL	Dilution	Analysis	Batch
	mg/l		mg/l		date / time	
TPH (GC/FID) Low Fraction	ND		0.100	1	03/06/2022 04:35	WG1827827
(S) <i>a,a,a</i> -Trifluorotoluene(FID)	97.3		78.0-120		03/06/2022 04:35	WG1827827

Volatile Organic Compounds (GC/MS) by Method 624.1

Analyte	Result	Qualifier	RDL	Dilution	Analysis	Batch
	mg/l		mg/l		date / time	
Benzene	ND		0.00100	1	03/06/2022 10:25	WG1828022
Bromodichloromethane	ND		0.00100	1	03/06/2022 10:25	WG1828022
Bromoform	ND		0.00100	1	03/06/2022 10:25	WG1828022
Bromomethane	ND		0.00500	1	03/06/2022 10:25	WG1828022
Carbon tetrachloride	ND		0.00100	1	03/06/2022 10:25	WG1828022
Chlorobenzene	ND		0.00100	1	03/06/2022 10:25	WG1828022
Chlorodibromomethane	ND		0.00100	1	03/06/2022 10:25	WG1828022
Chloroethane	ND		0.00500	1	03/06/2022 10:25	WG1828022
2-Chloroethyl vinyl ether	ND		0.0500	1	03/06/2022 10:25	WG1828022
Chloroform	ND		0.00500	1	03/06/2022 10:25	WG1828022
Chloromethane	ND		0.00250	1	03/06/2022 10:25	WG1828022
1,2-Dichlorobenzene	ND		0.00100	1	03/06/2022 10:25	WG1828022
1,3-Dichlorobenzene	ND		0.00100	1	03/06/2022 10:25	WG1828022
1,4-Dichlorobenzene	ND		0.00100	1	03/06/2022 10:25	WG1828022
Dichlorodifluoromethane	ND		0.00500	1	03/06/2022 10:25	WG1828022
1,1-Dichloroethane	ND		0.00100	1	03/06/2022 10:25	WG1828022
1,2-Dichloroethane	ND		0.00100	1	03/06/2022 10:25	WG1828022
1,1-Dichloroethene	ND		0.00100	1	03/06/2022 10:25	WG1828022
trans-1,2-Dichloroethene	ND		0.00100	1	03/06/2022 10:25	WG1828022
1,2-Dichloropropane	ND		0.00100	1	03/06/2022 10:25	WG1828022
cis-1,3-Dichloropropene	ND		0.00100	1	03/06/2022 10:25	WG1828022
trans-1,3-Dichloropropene	ND		0.00100	1	03/06/2022 10:25	WG1828022
Ethylbenzene	ND		0.00100	1	03/06/2022 10:25	WG1828022
Methylene Chloride	ND		0.00500	1	03/06/2022 10:25	WG1828022
Methyl tert-butyl ether	ND		0.00100	1	03/06/2022 10:25	WG1828022
Naphthalene	ND		0.00500	1	03/06/2022 10:25	WG1828022
1,1,2,2-Tetrachloroethane	ND		0.00100	1	03/06/2022 10:25	WG1828022
Tetrachloroethene	ND		0.00100	1	03/06/2022 10:25	WG1828022
Toluene	ND		0.00100	1	03/06/2022 10:25	WG1828022
1,1,1-Trichloroethane	ND		0.00100	1	03/06/2022 10:25	WG1828022
1,1,2-Trichloroethane	ND		0.00100	1	03/06/2022 10:25	WG1828022
Trichloroethene	ND		0.00100	1	03/06/2022 10:25	WG1828022
Trichlorofluoromethane	ND		0.00500	1	03/06/2022 10:25	WG1828022
Vinyl chloride	ND		0.00100	1	03/06/2022 10:25	WG1828022
(S) Toluene-d8	111		80.0-120		03/06/2022 10:25	WG1828022
(S) 4-Bromofluorobenzene	106		80.0-120		03/06/2022 10:25	WG1828022
(S) 1,2-Dichloroethane-d4	90.1		70.0-130		03/06/2022 10:25	WG1828022

Semi-Volatile Organic Compounds (GC) by Method 8015

Analyte	Result	Qualifier	RDL	Dilution	Analysis	Batch
	mg/l		mg/l		date / time	
TPH (GC/FID) High Fraction	ND	<u>J3</u>	0.118	1.18	03/12/2022 07:37	WG1829761
(S) <i>o</i> -Terphenyl	82.1		31.0-160		03/12/2022 07:37	WG1829761

Sample Narrative:

L1467568-02 WG1829761: Dilution due to sample volume.

1 Cp

2 Tc

3 Ss

4 Cn

5 Sr

6 Qc

7 Gl

8 Al

9 Sc

Semi-Volatile Organic Compounds (LCMS) by Method SW-846 8321

Analyte	Result mg/l	Qualifier	RDL mg/l	Dilution	Analysis date / time	Batch
2,4-D	ND		0.00200	1	03/04/2022 17:36	WG1827478
Dalapon	ND		0.00200	1	03/04/2022 17:36	WG1827478
2,4-DB	ND		0.00200	1	03/04/2022 17:36	WG1827478
Dicamba	ND		0.00200	1	03/04/2022 17:36	WG1827478
Dichloroprop	ND		0.00200	1	03/04/2022 17:36	WG1827478
Dinoseb	ND		0.00200	1	03/04/2022 17:36	WG1827478
MCPA	ND		0.00200	1	03/04/2022 17:36	WG1827478
MCPP	ND		0.00200	1	03/04/2022 17:36	WG1827478
2,4,5-T	ND		0.00200	1	03/04/2022 17:36	WG1827478
2,4,5-TP (Silvex)	ND		0.00200	1	03/04/2022 17:36	WG1827478
(S) 2,4-DB-D3	96.0		70.0-130		03/04/2022 17:36	WG1827478

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	03/09/2022 03:01	WG1828554
Alpha BHC	ND		0.0000500	1	03/09/2022 03:01	WG1828554
Beta BHC	ND		0.0000500	1	03/09/2022 03:01	WG1828554
Delta BHC	ND		0.0000500	1	03/09/2022 03:01	WG1828554
Gamma BHC	ND		0.0000500	1	03/09/2022 03:01	WG1828554
Chlordane	ND		0.00500	1	03/09/2022 03:01	WG1828554
4,4-DDD	ND		0.0000500	1	03/09/2022 03:01	WG1828554
4,4-DDE	ND		0.0000500	1	03/09/2022 03:01	WG1828554
4,4-DDT	ND		0.0000500	1	03/09/2022 03:01	WG1828554
Dieldrin	ND		0.0000500	1	03/09/2022 03:01	WG1828554
Endosulfan I	ND		0.0000500	1	03/09/2022 03:01	WG1828554
Endosulfan II	ND		0.0000500	1	03/09/2022 03:01	WG1828554
Endosulfan sulfate	ND		0.0000500	1	03/09/2022 03:01	WG1828554
Endrin	ND		0.0000500	1	03/09/2022 03:01	WG1828554
Endrin aldehyde	ND		0.0000500	1	03/09/2022 03:01	WG1828554
Endrin ketone	ND		0.0000500	1	03/09/2022 03:01	WG1828554
Heptachlor	ND		0.0000500	1	03/09/2022 03:01	WG1828554
Heptachlor epoxide	ND		0.0000500	1	03/09/2022 03:01	WG1828554
Hexachlorobenzene	ND		0.0000500	1	03/09/2022 03:01	WG1828554
Methoxychlor	ND		0.0000500	1	03/09/2022 03:01	WG1828554
Toxaphene	ND		0.000500	1	03/09/2022 03:01	WG1828554
gamma-Chlordane	ND		0.0000500	1	03/09/2022 03:01	WG1828554
alpha-Chlordane	ND		0.0000500	1	03/09/2022 03:01	WG1828554
(S) Decachlorobiphenyl	93.3		10.0-144		03/09/2022 03:01	WG1828554
(S) Tetrachloro-m-xylene	88.4		10.0-135		03/09/2022 03:01	WG1828554

Polychlorinated Biphenyls (GC) by Method EPA-608.3

Analyte	Result mg/l	Qualifier	RDL mg/l	Dilution	Analysis date / time	Batch
PCB 1016	ND		0.000500	1	03/09/2022 03:01	WG1828554
PCB 1221	ND		0.000500	1	03/09/2022 03:01	WG1828554
PCB 1232	ND		0.000500	1	03/09/2022 03:01	WG1828554
PCB 1242	ND		0.000500	1	03/09/2022 03:01	WG1828554
PCB 1248	ND		0.000500	1	03/09/2022 03:01	WG1828554
PCB 1254	ND		0.000500	1	03/09/2022 03:01	WG1828554
PCB 1260	ND		0.000500	1	03/09/2022 03:01	WG1828554
Total PCBs	ND		0.000500	1	03/09/2022 03:01	WG1828554
(S) Decachlorobiphenyl	86.6		10.0-144		03/09/2022 03:01	WG1828554
(S) Tetrachloro-m-xylene	96.3		10.0-135		03/09/2022 03:01	WG1828554

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
Acenaphthene	ND		0.00100	1	03/09/2022 13:53	WG1829116
Acenaphthylene	ND		0.00100	1	03/09/2022 13:53	WG1829116
Anthracene	ND		0.00100	1	03/09/2022 13:53	WG1829116
Benzidine	ND		0.0100	1	03/09/2022 13:53	WG1829116
Benzo(a)anthracene	ND		0.00100	1	03/09/2022 13:53	WG1829116
Benzo(b)fluoranthene	ND		0.00100	1	03/09/2022 13:53	WG1829116
Benzo(k)fluoranthene	ND		0.00100	1	03/09/2022 13:53	WG1829116
Benzo(g,h,i)perylene	ND		0.00100	1	03/09/2022 13:53	WG1829116
Benzo(a)pyrene	ND		0.00100	1	03/09/2022 13:53	WG1829116
Bis(2-chloroethoxy)methane	ND		0.0100	1	03/09/2022 13:53	WG1829116
Bis(2-chloroethyl)ether	ND		0.0100	1	03/09/2022 13:53	WG1829116
2,2-Oxybis(1-Chloropropane)	ND		0.0100	1	03/09/2022 13:53	WG1829116
4-Bromophenyl-phenylether	ND		0.0100	1	03/09/2022 13:53	WG1829116
2-Chloronaphthalene	ND		0.00100	1	03/09/2022 13:53	WG1829116
4-Chlorophenyl-phenylether	ND		0.0100	1	03/09/2022 13:53	WG1829116
Chrysene	ND		0.00100	1	03/09/2022 13:53	WG1829116
Dibenz(a,h)anthracene	ND		0.00100	1	03/09/2022 13:53	WG1829116
3,3-Dichlorobenzidine	ND		0.0100	1	03/09/2022 13:53	WG1829116
2,4-Dinitrotoluene	ND		0.0100	1	03/09/2022 13:53	WG1829116
2,6-Dinitrotoluene	ND		0.0100	1	03/09/2022 13:53	WG1829116
1,2-Diphenylhydrazine	ND		0.0100	1	03/09/2022 13:53	WG1829116
Fluoranthene	ND		0.00100	1	03/09/2022 13:53	WG1829116
Fluorene	ND		0.00100	1	03/09/2022 13:53	WG1829116
Hexachlorobenzene	ND		0.00100	1	03/09/2022 13:53	WG1829116
Hexachloro-1,3-butadiene	ND		0.0100	1	03/09/2022 13:53	WG1829116
Hexachlorocyclopentadiene	ND		0.0100	1	03/09/2022 13:53	WG1829116
Hexachloroethane	ND		0.0100	1	03/09/2022 13:53	WG1829116
Indeno(1,2,3-cd)pyrene	ND		0.00100	1	03/09/2022 13:53	WG1829116
Isophorone	ND		0.0100	1	03/09/2022 13:53	WG1829116
Naphthalene	ND		0.00100	1	03/09/2022 13:53	WG1829116
Nitrobenzene	ND		0.0100	1	03/09/2022 13:53	WG1829116
n-Nitrosodimethylamine	ND		0.0100	1	03/09/2022 13:53	WG1829116
n-Nitrosodiphenylamine	ND		0.0100	1	03/09/2022 13:53	WG1829116
n-Nitrosodi-n-propylamine	ND		0.0100	1	03/09/2022 13:53	WG1829116
Phenanthrene	ND		0.00100	1	03/09/2022 13:53	WG1829116
Benzylbutyl phthalate	ND		0.00300	1	03/09/2022 13:53	WG1829116
Bis(2-ethylhexyl)phthalate	ND		0.00300	1	03/09/2022 13:53	WG1829116
Di-n-butyl phthalate	ND		0.00300	1	03/09/2022 13:53	WG1829116
Diethyl phthalate	ND		0.00300	1	03/09/2022 13:53	WG1829116
Dimethyl phthalate	ND		0.00300	1	03/09/2022 13:53	WG1829116
Di-n-octyl phthalate	ND		0.00300	1	03/09/2022 13:53	WG1829116
Pyrene	ND		0.00100	1	03/09/2022 13:53	WG1829116
1,2,4-Trichlorobenzene	ND		0.0100	1	03/09/2022 13:53	WG1829116
4-Chloro-3-methylphenol	ND		0.0100	1	03/09/2022 13:53	WG1829116
2-Chlorophenol	ND		0.0100	1	03/09/2022 13:53	WG1829116
2,4-Dichlorophenol	ND		0.0100	1	03/09/2022 13:53	WG1829116
2,4-Dimethylphenol	ND		0.0100	1	03/09/2022 13:53	WG1829116
4,6-Dinitro-2-methylphenol	ND		0.0100	1	03/09/2022 13:53	WG1829116
2,4-Dinitrophenol	ND		0.0100	1	03/09/2022 13:53	WG1829116
2-Nitrophenol	ND		0.0100	1	03/09/2022 13:53	WG1829116
4-Nitrophenol	ND		0.0100	1	03/09/2022 13:53	WG1829116
Pentachlorophenol	ND		0.0100	1	03/09/2022 13:53	WG1829116
Phenol	ND		0.0100	1	03/09/2022 13:53	WG1829116
2,4,6-Trichlorophenol	ND		0.0100	1	03/09/2022 13:53	WG1829116
(S) Nitrobenzene-d5	59.9		15.0-314		03/09/2022 13:53	WG1829116
(S) 2-Fluorobiphenyl	50.4		22.0-127		03/09/2022 13:53	WG1829116

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
(S) p-Terphenyl-d14	43.1		29.0-141		03/09/2022 13:53	WG1829116
(S) Phenol-d5	16.5		8.00-424		03/09/2022 13:53	WG1829116
(S) 2-Fluorophenol	23.6		10.0-120		03/09/2022 13:53	WG1829116
(S) 2,4,6-Tribromophenol	39.6		10.0-153		03/09/2022 13:53	WG1829116

Sample Narrative:

L1467568-02 WG1829116: ® Pyridine and Benzidine are reporting with critically low recovery in the laboratory control sample

1 Cp

2 Tc

3 Ss

4 Cn

5 Sr

6 Qc

7 Gl

8 Al

9 Sc

Method Blank (MB)

(MB) R3766757-1 03/05/22 21:37

Analyte	MB Result	MB Qualifier	MB MDL	MB RDL
Oil & Grease (Hexane Extr)	U		1.16	5.00

1 Cp

2 Tc

3 Ss

Laboratory Control Sample (LCS) • Laboratory Control Sample Duplicate (LCSD)

(LCS) R3766757-2 03/05/22 21:37 • (LCSD) R3766757-3 03/05/22 21:37

Analyte	Spike Amount	LCS Result	LCSD Result	LCS Rec.	LCSD Rec.	Rec. Limits	LCS Qualifier	LCSD Qualifier	RPD	RPD Limits
Oil & Grease (Hexane Extr)	40.0	36.1	35.2	90.3	88.0	78.0-114			2.52	20

4 Cn

5 Sr

L1467263-02 Original Sample (OS) • Matrix Spike (MS) • Matrix Spike Duplicate (MSD)

(OS) L1467263-02 03/05/22 21:37 • (MS) R3766757-4 03/05/22 21:37 • (MSD) R3766757-5 03/05/22 21:37

Analyte	Spike Amount	Original Result	MS Result	MSD Result	MS Rec.	MSD Rec.	Dilution	Rec. Limits	MS Qualifier	MSD Qualifier	RPD	RPD Limits
Oil & Grease (Hexane Extr)	40.0	37.1	84.6	79.8	119	107	1	78.0-114	J5		5.84	18

6 Qc

7 Gl

8 Al

9 Sc

Method Blank (MB)

(MB) R3766755-1 03/05/22 22:28

Analyte	MB Result	MB Qualifier	MB MDL	MB RDL
Oil & Grease (Hexane Extr)	U		1.16	5.00

¹Cp

²Tc

³Ss

Laboratory Control Sample (LCS) • Laboratory Control Sample Duplicate (LCSD)

(LCS) R3766755-2 03/05/22 22:28 • (LCSD) R3766755-3 03/05/22 22:28

Analyte	Spike Amount	LCS Result	LCSD Result	LCS Rec.	LCSD Rec.	Rec. Limits	LCS Qualifier	LCSD Qualifier	RPD	RPD Limits
Oil & Grease (Hexane Extr)	40.0	37.9	35.8	94.8	89.5	78.0-114			5.70	20

⁴Cn

⁵Sr

⁶Qc

L1467570-01 Original Sample (OS) • Matrix Spike (MS)

(OS) L1467570-01 03/05/22 22:28 • (MS) R3766755-4 03/05/22 22:28

Analyte	Spike Amount	Original Result	MS Result	MS Rec.	Dilution	Rec. Limits	MS Qualifier
Oil & Grease (Hexane Extr)	40.0	ND	56.9	142	1	78.0-114	<u>J5</u>

⁷Gl

⁸Al

⁹Sc

Method Blank (MB)

(MB) R3769942-1 03/15/22 13:18

Analyte	MB Result	MB Qualifier	MB MDL	MB RDL
Kjeldahl Nitrogen, TKN	U		0.140	0.250

¹Cp

²Tc

³Ss

⁴Cn

⁵Sr

⁶Qc

⁷Gl

⁸Al

⁹Sc

L1467568-01 Original Sample (OS) • Duplicate (DUP)

(OS) L1467568-01 03/15/22 13:51 • (DUP) R3769942-3 03/15/22 13:27

Analyte	Original Result	DUP Result	Dilution	DUP RPD	DUP Qualifier	DUP RPD Limits
Kjeldahl Nitrogen, TKN	ND	ND	1	200	P1	20

L1467568-02 Original Sample (OS) • Duplicate (DUP)

(OS) L1467568-02 03/15/22 13:31 • (DUP) R3769942-6 03/15/22 13:35

Analyte	Original Result	DUP Result	Dilution	DUP RPD	DUP Qualifier	DUP RPD Limits
Kjeldahl Nitrogen, TKN	0.280	ND	1	40.9	P1	20

Laboratory Control Sample (LCS)

(LCS) R3769942-2 03/15/22 13:20

Analyte	Spike Amount	LCS Result	LCS Rec.	Rec. Limits	LCS Qualifier
Kjeldahl Nitrogen, TKN	10.2	10.8	106	75.2-121	

L1467568-01 Original Sample (OS) • Matrix Spike (MS) • Matrix Spike Duplicate (MSD)

(OS) L1467568-01 03/15/22 13:51 • (MS) R3769942-4 03/15/22 13:28 • (MSD) R3769942-5 03/15/22 13:29

Analyte	Spike Amount	Original Result	MS Result	MSD Result	MS Rec.	MSD Rec.	Dilution	Rec. Limits	MS Qualifier	MSD Qualifier	RPD	RPD Limits
Kjeldahl Nitrogen, TKN	5.00	ND	5.61	5.57	109	109	1	90.0-110			0.716	20

L1467568-02 Original Sample (OS) • Matrix Spike (MS)

(OS) L1467568-02 03/15/22 13:31 • (MS) R3769942-7 03/15/22 13:36

Analyte	Spike Amount	Original Result	MS Result	MS Rec.	Dilution	Rec. Limits	MS Qualifier
Kjeldahl Nitrogen, TKN	5.00	0.280	5.65	107	1	90.0-110	

Method Blank (MB)

(MB) R3769775-1 03/15/22 07:19

Analyte	MB Result	MB Qualifier	MB MDL	MB RDL
Nitrate-Nitrite	U		0.0500	0.100

¹Cp

²Tc

³Ss

⁴Cn

⁵Sr

⁶Qc

⁷Gl

⁸Al

⁹Sc

L1466475-01 Original Sample (OS) • Duplicate (DUP)

(OS) L1466475-01 03/15/22 07:21 • (DUP) R3769775-3 03/15/22 07:23

Analyte	Original Result	DUP Result	Dilution	DUP RPD	DUP Qualifier	DUP RPD Limits
Nitrate-Nitrite	0.695	0.694	1	0.144		20

L1467571-01 Original Sample (OS) • Duplicate (DUP)

(OS) L1467571-01 03/15/22 07:53 • (DUP) R3769775-6 03/15/22 07:54

Analyte	Original Result	DUP Result	Dilution	DUP RPD	DUP Qualifier	DUP RPD Limits
Nitrate-Nitrite	0.653	0.647	1	0.923		20

Laboratory Control Sample (LCS)

(LCS) R3769775-2 03/15/22 07:20

Analyte	Spike Amount	LCS Result	LCS Rec.	Rec. Limits	LCS Qualifier
Nitrate-Nitrite	2.50	2.57	103	90.0-110	

L1466475-01 Original Sample (OS) • Matrix Spike (MS) • Matrix Spike Duplicate (MSD)

(OS) L1466475-01 03/15/22 07:21 • (MS) R3769775-4 03/15/22 07:24 • (MSD) R3769775-5 03/15/22 07:25

Analyte	Spike Amount	Original Result	MS Result	MSD Result	MS Rec.	MSD Rec.	Dilution	Rec. Limits	MS Qualifier	MSD Qualifier	RPD	RPD Limits
Nitrate-Nitrite	2.50	0.695	3.25	3.26	102	103	1	90.0-110			0.307	20

L1467571-01 Original Sample (OS) • Matrix Spike (MS)

(OS) L1467571-01 03/15/22 07:53 • (MS) R3769775-7 03/15/22 07:56

Analyte	Spike Amount	Original Result	MS Result	MS Rec.	Dilution	Rec. Limits	MS Qualifier
Nitrate-Nitrite	2.50	0.653	3.34	107	1	90.0-110	

Method Blank (MB)

(MB) R3770109-1 03/15/22 18:14

Analyte	MB Result	MB Qualifier	MB MDL	MB RDL
Phosphorus,Total	0.0377	↓	0.0350	0.100

¹Cp

²Tc

³Ss

L1467568-01 Original Sample (OS) • Duplicate (DUP)

(OS) L1467568-01 03/15/22 18:32 • (DUP) R3770109-3 03/15/22 18:33

Analyte	Original Result	DUP Result	Dilution	DUP RPD	DUP Qualifier	DUP RPD Limits
Phosphorus,Total	ND	ND	1	200	P1	20

⁴Cn

⁵Sr

⁶Qc

L1467568-02 Original Sample (OS) • Duplicate (DUP)

(OS) L1467568-02 03/15/22 18:37 • (DUP) R3770109-6 03/15/22 18:38

Analyte	Original Result	DUP Result	Dilution	DUP RPD	DUP Qualifier	DUP RPD Limits
Phosphorus,Total	ND	ND	1	7.87		20

⁷Gl

⁸Al

⁹Sc

Laboratory Control Sample (LCS)

(LCS) R3770109-2 03/15/22 18:15

Analyte	Spike Amount	LCS Result	LCS Rec.	Rec. Limits	LCS Qualifier
Phosphorus,Total	1.33	1.33	100	81.2-118	

L1467568-01 Original Sample (OS) • Matrix Spike (MS) • Matrix Spike Duplicate (MSD)

(OS) L1467568-01 03/15/22 18:32 • (MS) R3770109-4 03/15/22 18:34 • (MSD) R3770109-5 03/15/22 18:36

Analyte	Spike Amount	Original Result	MS Result	MSD Result	MS Rec.	MSD Rec.	Dilution	Rec. Limits	MS Qualifier	MSD Qualifier	RPD	RPD Limits
Phosphorus,Total	2.50	ND	2.37	2.34	93.0	91.8	1	90.0-110			1.27	20

Method Blank (MB)

(MB) R3767163-1 03/07/22 12:47

Analyte	MB Result	MB Qualifier	MB MDL	MB RDL
COD	U		11.7	20.0

¹Cp

²Tc

³Ss

⁴Cn

⁵Sr

⁶Qc

⁷Gl

⁸Al

⁹Sc

L1467707-01 Original Sample (OS) • Duplicate (DUP)

(OS) L1467707-01 03/07/22 14:56 • (DUP) R3767163-5 03/07/22 14:56

Analyte	Original Result	DUP Result	Dilution	DUP RPD	DUP Qualifier	DUP RPD Limits
COD	504	509	1	1.08		20

L1467732-01 Original Sample (OS) • Duplicate (DUP)

(OS) L1467732-01 03/07/22 14:56 • (DUP) R3767163-6 03/07/22 14:56

Analyte	Original Result	DUP Result	Dilution	DUP RPD	DUP Qualifier	DUP RPD Limits
COD	593	589	1	0.640		20

Laboratory Control Sample (LCS)

(LCS) R3767163-2 03/07/22 12:47

Analyte	Spike Amount	LCS Result	LCS Rec.	Rec. Limits	LCS Qualifier
COD	500	504	101	90.0-110	

L1467568-01 Original Sample (OS) • Matrix Spike (MS) • Matrix Spike Duplicate (MSD)

(OS) L1467568-01 03/07/22 14:53 • (MS) R3767163-3 03/07/22 14:54 • (MSD) R3767163-4 03/07/22 14:54

Analyte	Spike Amount	Original Result	MS Result	MSD Result	MS Rec.	MSD Rec.	Dilution	Rec. Limits	MS Qualifier	MSD Qualifier	RPD	RPD Limits
COD	500	ND	464	465	90.2	90.4	1	80.0-120			0.267	20

Method Blank (MB)

(MB) R3768091-1 03/09/22 12:13

Analyte	MB Result	MB Qualifier	MB MDL	MB RDL
BOD	0.610	B1	0.200	0.200

1 Cp

2 Tc

3 Ss

L1467265-02 Original Sample (OS) • Duplicate (DUP)

(OS) L1467265-02 03/09/22 09:35 • (DUP) R3768091-3 03/09/22 09:38

Analyte	Original Result	DUP Result	Dilution	DUP RPD	DUP Qualifier	DUP RPD Limits
BOD	21.4	21.1	1	1.74		30

4 Cn

5 Sr

L1467568-02 Original Sample (OS) • Duplicate (DUP)

(OS) L1467568-02 03/09/22 09:45 • (DUP) R3768091-4 03/09/22 09:47

Analyte	Original Result	DUP Result	Dilution	DUP RPD	DUP Qualifier	DUP RPD Limits
BOD	ND	ND	1	0		30

6 Qc

7 Gl

8 Al

9 Sc

Laboratory Control Sample (LCS)

(LCS) R3768091-2 03/09/22 08:51

Analyte	Spike Amount	LCS Result	LCS Rec.	Rec. Limits	LCS Qualifier
BOD	198	169	85.4	84.6-115	

Laboratory Control Sample (LCS)

(LCS) R3768091-5 03/09/22 10:18

Analyte	Spike Amount	LCS Result	LCS Rec.	Rec. Limits	LCS Qualifier
BOD	198	190	96.1	84.6-115	

Method Blank (MB)

(MB) R3767053-1 03/07/22 10:47

Analyte	MB Result	MB Qualifier	MB MDL	MB RDL
Mercury	U		0.000100	0.000200

1 Cp

2 Tc

3 Ss

Laboratory Control Sample (LCS)

(LCS) R3767053-2 03/07/22 10:49

Analyte	Spike Amount	LCS Result	LCS Rec.	Rec. Limits	LCS Qualifier
Mercury	0.00300	0.00278	92.6	85.0-115	

4 Cn

5 Sr

6 Qc

L1467688-01 Original Sample (OS) • Matrix Spike (MS) • Matrix Spike Duplicate (MSD)

(OS) L1467688-01 03/07/22 10:51 • (MS) R3767053-3 03/07/22 10:53 • (MSD) R3767053-4 03/07/22 10:55

Analyte	Spike Amount	Original Result	MS Result	MSD Result	MS Rec.	MSD Rec.	Dilution	Rec. Limits	MS Qualifier	MSD Qualifier	RPD	RPD Limits
Mercury	0.00300	ND	0.00244	0.00225	81.3	75.0	1	70.0-130			8.04	20

7 Gl

8 Al

L1468154-01 Original Sample (OS) • Matrix Spike (MS) • Matrix Spike Duplicate (MSD)

(OS) L1468154-01 03/07/22 10:57 • (MS) R3767053-5 03/07/22 10:59 • (MSD) R3767053-6 03/07/22 11:01

Analyte	Spike Amount	Original Result	MS Result	MSD Result	MS Rec.	MSD Rec.	Dilution	Rec. Limits	MS Qualifier	MSD Qualifier	RPD	RPD Limits
Mercury	0.00300	ND	0.00307	0.00313	102	104	1	70.0-130			1.85	20

9 Sc

Method Blank (MB)

(MB) R3767693-1 03/08/22 09:07

Analyte	MB Result mg/l	MB Qualifier	MB MDL mg/l	MB RDL mg/l
Arsenic	U		0.00645	0.0100
Barium	0.00123	U	0.000795	0.00500
Boron	U		0.0396	0.200
Cadmium	U		0.000552	0.00200
Chromium	0.00224	U	0.00163	0.0100
Lead	0.00314	U	0.00227	0.00500
Potassium	U		0.313	1.00
Selenium	U		0.00616	0.0100
Silver	U		0.00131	0.00500
Sulfur	0.148	U	0.0912	1.00
Zinc	U		0.00578	0.0500

1 Cp

2 Tc

3 Ss

4 Cn

5 Sr

6 Qc

7 Gl

8 Al

9 Sc

Laboratory Control Sample (LCS)

(LCS) R3767693-2 03/08/22 09:10

Analyte	Spike Amount mg/l	LCS Result mg/l	LCS Rec. %	Rec. Limits %	LCS Qualifier
Arsenic	1.00	1.04	104	85.0-115	
Barium	1.00	1.06	106	85.0-115	
Boron	1.00	1.02	102	85.0-115	
Cadmium	1.00	1.04	104	85.0-115	
Chromium	1.00	1.02	102	85.0-115	
Lead	1.00	1.05	105	85.0-115	
Potassium	10.0	10.5	105	85.0-115	
Selenium	1.00	1.08	108	85.0-115	
Silver	0.200	0.190	95.0	85.0-115	
Sulfur	10.0	10.7	107	85.0-115	
Zinc	1.00	1.03	103	85.0-115	

L1466084-02 Original Sample (OS) • Matrix Spike (MS) • Matrix Spike Duplicate (MSD)

(OS) L1466084-02 03/08/22 09:13 • (MS) R3767693-4 03/08/22 09:18 • (MSD) R3767693-5 03/08/22 09:21

Analyte	Spike Amount mg/l	Original Result mg/l	MS Result mg/l	MSD Result mg/l	MS Rec. %	MSD Rec. %	Dilution	Rec. Limits %	MS Qualifier	MSD Qualifier	RPD %	RPD Limits %
Arsenic	1.00	ND	1.05	1.07	105	107	1	70.0-130			1.23	20
Barium	1.00	0.0146	1.05	1.07	104	105	1	70.0-130			1.34	20
Boron	1.00	ND	1.14	1.14	102	102	1	70.0-130			0.0209	20
Cadmium	1.00	ND	1.05	1.06	105	106	1	70.0-130			1.15	20
Chromium	1.00	ND	1.01	1.01	101	101	1	70.0-130			0.658	20

L1466084-02 Original Sample (OS) • Matrix Spike (MS) • Matrix Spike Duplicate (MSD)

(OS) L1466084-02 03/08/22 09:13 • (MS) R3767693-4 03/08/22 09:18 • (MSD) R3767693-5 03/08/22 09:21

Analyte	Spike Amount mg/l	Original Result mg/l	MS Result mg/l	MSD Result mg/l	MS Rec. %	MSD Rec. %	Dilution	Rec. Limits %	MS Qualifier	MSD Qualifier	RPD %	RPD Limits %
Lead	1.00	ND	1.06	1.07	105	107	1	70.0-130			1.00	20
Potassium	10.0	9.42	20.5	20.7	111	113	1	70.0-130			0.896	20
Selenium	1.00	ND	1.09	1.10	109	110	1	70.0-130			0.887	20
Silver	0.200	ND	0.192	0.192	96.2	96.1	1	70.0-130			0.0989	20
Sulfur	10.0	15.9	26.9	27.4	110	115	1	70.0-130			1.65	20
Zinc	1.00	ND	1.05	1.06	102	103	1	70.0-130			1.43	20

L1467307-03 Original Sample (OS) • Matrix Spike (MS) • Matrix Spike Duplicate (MSD)

(OS) L1467307-03 03/08/22 09:25 • (MS) R3767693-6 03/08/22 09:28 • (MSD) R3767693-7 03/08/22 09:31

Analyte	Spike Amount mg/l	Original Result mg/l	MS Result mg/l	MSD Result mg/l	MS Rec. %	MSD Rec. %	Dilution	Rec. Limits %	MS Qualifier	MSD Qualifier	RPD %	RPD Limits %
Arsenic	1.00	ND	1.25	1.41	125	141	1	70.0-130	V3	J5 V3	12.3	20
Barium	1.00	2.38	2.95	3.18	57.8	80.7	1	70.0-130	J6 V3	V3	7.45	20
Boron	1.00	57.9	53.3	57.0	0.000	0.000	1	70.0-130	E V	E V	6.72	20
Cadmium	1.00	ND	0.0267	0.445	2.67	44.5	1	70.0-130	J6 V3	J3 J6 V3	177	20
Chromium	1.00	ND	0.764	0.813	75.5	80.5	1	70.0-130	V3	V3	6.32	20
Lead	1.00	0.0316	0.0696	0.394	3.81	36.3	1	70.0-130	J6 V3	J3 J6 V3	140	20
Potassium	10.0	1020	817	893	0.000	0.000	1	70.0-130	E V	E V	8.89	20
Selenium	1.00	0.0888	1.33	1.49	125	140	1	70.0-130	V3	J5 V3	10.8	20
Silver	0.200	ND	0.00793	0.113	3.96	56.6	1	70.0-130	J6 V3	J3 J6 V3	174	20
Sulfur	10.0	337	311	341	0.000	40.9	1	70.0-130	E V V3	E V V3	9.05	20
Zinc	1.00	ND	0.771	0.815	72.4	76.8	1	70.0-130	V3	V3	5.51	20

1 Cp

2 Tc

3 Ss

4 Cn

5 Sr

6 Qc

7 Gl

8 Al

9 Sc

Method Blank (MB)

(MB) R3767168-2 03/05/22 23:18

Analyte	MB Result	MB Qualifier	MB MDL	MB RDL
TPH (GC/FID) Low Fraction	U		0.0314	0.100
(S) a,a,a-Trifluorotoluene(FID)	97.5			78.0-120

Laboratory Control Sample (LCS)

(LCS) R3767168-1 03/05/22 22:07

Analyte	Spike Amount	LCS Result	LCS Rec.	Rec. Limits	LCS Qualifier
TPH (GC/FID) Low Fraction	5.50	5.97	109	72.0-127	
(S) a,a,a-Trifluorotoluene(FID)			99.6	78.0-120	

L1467583-01 Original Sample (OS) • Matrix Spike (MS) • Matrix Spike Duplicate (MSD)

(OS) L1467583-01 03/06/22 06:55 • (MS) R3767168-3 03/06/22 08:05 • (MSD) R3767168-4 03/06/22 08:29

Analyte	Spike Amount	Original Result	MS Result	MSD Result	MS Rec.	MSD Rec.	Dilution	Rec. Limits	MS Qualifier	MSD Qualifier	RPD	RPD Limits
TPH (GC/FID) Low Fraction	55.0	64.1	112	100	87.1	65.3	10	10.0-160	E		11.3	22
(S) a,a,a-Trifluorotoluene(FID)					101	100		78.0-120				

1 Cp

2 Tc

3 Ss

4 Cn

5 Sr

6 Qc

7 Gl

8 Al

9 Sc

Method Blank (MB)

(MB) R3767868-2 03/06/22 07:21

Analyte	MB Result mg/l	MB Qualifier	MB MDL mg/l	MB RDL mg/l
Benzene	U		0.0000941	0.00100
Bromodichloromethane	U		0.000136	0.00100
Bromoform	U		0.000129	0.00100
Bromomethane	U		0.000605	0.00500
Carbon tetrachloride	U		0.000128	0.00100
Chlorobenzene	U		0.000116	0.00100
Chlorodibromomethane	U		0.000140	0.00100
Chloroethane	U		0.000192	0.00500
2-Chloroethyl vinyl ether	U		0.000575	0.0500
Chloroform	U		0.000111	0.00500
Chloromethane	U		0.000960	0.00250
1,2-Dichlorobenzene	U		0.000107	0.00100
1,3-Dichlorobenzene	U		0.000110	0.00100
1,4-Dichlorobenzene	U		0.000120	0.00100
Dichlorodifluoromethane	U		0.000374	0.00500
1,1-Dichloroethane	U		0.000100	0.00100
1,2-Dichloroethane	U		0.0000819	0.00100
1,1-Dichloroethene	U		0.000188	0.00100
trans-1,2-Dichloroethene	U		0.000149	0.00100
1,2-Dichloropropane	U		0.000149	0.00100
cis-1,3-Dichloropropene	U		0.000111	0.00100
trans-1,3-Dichloropropene	U		0.000118	0.00100
Ethylbenzene	U		0.000137	0.00100
Methylene Chloride	U		0.000430	0.00500
Methyl tert-butyl ether	U		0.000101	0.00100
Naphthalene	U		0.00100	0.00500
1,1,2,2-Tetrachloroethane	U		0.000133	0.00100
Tetrachloroethene	U		0.000300	0.00100
Toluene	U		0.000278	0.00100
1,1,1-Trichloroethane	U		0.000149	0.00100
1,1,2-Trichloroethane	U		0.000158	0.00100
Trichloroethene	U		0.000190	0.00100
Trichlorofluoromethane	U		0.000160	0.00500
Vinyl chloride	U		0.000234	0.00100
(S) Toluene-d8	109			80.0-120
(S) 4-Bromofluorobenzene	102			80.0-120
(S) 1,2-Dichloroethane-d4	90.3			70.0-130

¹Cp

²Tc

³Ss

⁴Cn

⁵Sr

⁶Qc

⁷Gl

⁸Al

⁹Sc

Laboratory Control Sample (LCS)

(LCS) R3767868-1 03/06/22 06:37

Analyte	Spike Amount mg/l	LCS Result mg/l	LCS Rec. %	Rec. Limits %	<u>LCS Qualifier</u>
Benzene	0.00500	0.00498	99.6	65.0-135	
Bromodichloromethane	0.00500	0.00448	89.6	65.0-135	
Bromoform	0.00500	0.00382	76.4	70.0-130	
Bromomethane	0.00500	0.00592	118	15.0-185	
Carbon tetrachloride	0.00500	0.00428	85.6	70.0-130	
Chlorobenzene	0.00500	0.00506	101	65.0-135	
Chlorodibromomethane	0.00500	0.00455	91.0	70.0-135	
Chloroethane	0.00500	0.00588	118	40.0-160	
2-Chloroethyl vinyl ether	0.0250	0.0259	104	0.100-225	
Chloroform	0.00500	0.00505	101	70.0-135	
Chloromethane	0.00500	0.00511	102	0.100-205	
1,2-Dichlorobenzene	0.00500	0.00506	101	65.0-135	
1,3-Dichlorobenzene	0.00500	0.00489	97.8	70.0-130	
1,4-Dichlorobenzene	0.00500	0.00500	100	65.0-135	
Dichlorodifluoromethane	0.00500	0.00523	105	49.0-155	
1,1-Dichloroethane	0.00500	0.00462	92.4	70.0-130	
1,2-Dichloroethane	0.00500	0.00510	102	70.0-130	
1,1-Dichloroethene	0.00500	0.00503	101	50.0-150	
trans-1,2-Dichloroethene	0.00500	0.00521	104	70.0-130	
1,2-Dichloropropane	0.00500	0.00506	101	35.0-165	
cis-1,3-Dichloropropene	0.00500	0.00471	94.2	25.0-175	
trans-1,3-Dichloropropene	0.00500	0.00439	87.8	50.0-150	
Ethylbenzene	0.00500	0.00487	97.4	60.0-140	
Methylene Chloride	0.00500	0.00530	106	60.0-140	
Methyl tert-butyl ether	0.00500	0.00433	86.6	64.0-123	
Naphthalene	0.00500	0.00446	89.2	62.0-128	
1,1,2,2-Tetrachloroethane	0.00500	0.00470	94.0	60.0-140	
Tetrachloroethene	0.00500	0.00508	102	70.0-130	
Toluene	0.00500	0.00499	99.8	70.0-130	
1,1,1-Trichloroethane	0.00500	0.00458	91.6	70.0-130	
1,1,2-Trichloroethane	0.00500	0.00494	98.8	70.0-130	
Trichloroethene	0.00500	0.00502	100	65.0-135	
Trichlorofluoromethane	0.00500	0.00486	97.2	50.0-150	
Vinyl chloride	0.00500	0.00575	115	5.00-195	
<i>(S) Toluene-d8</i>			105	80.0-120	
<i>(S) 4-Bromofluorobenzene</i>			103	80.0-120	
<i>(S) 1,2-Dichloroethane-d4</i>			92.6	70.0-130	

¹ Cp

² Tc

³ Ss

⁴ Cn

⁵ Sr

⁶ Qc

⁷ Gl

⁸ Al

⁹ Sc

Method Blank (MB)

(MB) R3769293-1 03/11/22 19:42

Analyte	MB Result mg/l	MB Qualifier	MB MDL mg/l	MB RDL mg/l
TPH (GC/FID) High Fraction	U		0.0247	0.100
<i>(S) o-Terphenyl</i>	86.0			31.0-160

Laboratory Control Sample (LCS) • Laboratory Control Sample Duplicate (LCSD)

(LCS) R3769293-2 03/11/22 20:08 • (LCSD) R3769293-3 03/11/22 20:34

Analyte	Spike Amount mg/l	LCS Result mg/l	LCSD Result mg/l	LCS Rec. %	LCSD Rec. %	Rec. Limits %	LCS Qualifier	LCSD Qualifier	RPD %	RPD Limits %
TPH (GC/FID) High Fraction	1.50	1.43	0.913	95.3	60.9	50.0-150		J3	44.1	20
<i>(S) o-Terphenyl</i>				78.0	52.5	31.0-160				

1 Cp

2 Tc

3 Ss

4 Cn

5 Sr

6 Qc

7 Gl

8 Al

9 Sc

Method Blank (MB)

(MB) R3766816-2 03/04/22 15:04

Analyte	MB Result	MB Qualifier	MB MDL	MB RDL
	mg/l		mg/l	mg/l
2,4-D	U		0.00100	0.00200
Dalapon	U		0.000621	0.00200
2,4-DB	U		0.00100	0.00200
Dicamba	U		0.000548	0.00200
Dichloroprop	U		0.000367	0.00200
Dinoseb	U		0.000639	0.00200
MCPA	U		0.000363	0.00200
MCPP	U		0.000323	0.00200
2,4,5-T	U		0.000573	0.00200
2,4,5-TP (Silvex)	U		0.000807	0.00200
(S) 2,4-DB-D3	97.0			70.0-130

Laboratory Control Sample (LCS)

(LCS) R3766816-1 03/04/22 14:47

Analyte	Spike Amount	LCS Result	LCS Rec.	Rec. Limits	LCS Qualifier
	mg/l	mg/l	%	%	
2,4-D	0.0200	0.0210	105	70.0-130	
Dalapon	0.0200	0.0212	106	70.0-130	
2,4-DB	0.0200	0.0219	110	70.0-130	
Dicamba	0.0200	0.0210	105	70.0-130	
Dichloroprop	0.0200	0.0193	96.5	70.0-130	
Dinoseb	0.0200	0.0258	129	70.0-130	
MCPA	0.0200	0.0196	98.0	70.0-130	
MCPP	0.0200	0.0199	99.5	70.0-130	
2,4,5-T	0.0200	0.0207	104	70.0-130	
2,4,5-TP (Silvex)	0.0200	0.0202	101	70.0-130	
(S) 2,4-DB-D3			91.0	70.0-130	

L1467568-01 Original Sample (OS) • Matrix Spike (MS) • Matrix Spike Duplicate (MSD)

(OS) L1467568-01 03/04/22 16:45 • (MS) R3766816-3 03/04/22 17:02 • (MSD) R3766816-4 03/04/22 17:19

Analyte	Spike Amount	Original Result	MS Result	MSD Result	MS Rec.	MSD Rec.	Dilution	Rec. Limits	MS Qualifier	MSD Qualifier	RPD	RPD Limits
	mg/l	mg/l	mg/l	mg/l	%	%		%			%	%
2,4-D	0.0200	ND	0.0198	0.0206	99.0	103	1	70.0-130			3.96	30
Dalapon	0.0200	ND	0.0221	0.0211	111	105	1	70.0-130			4.63	30
2,4-DB	0.0200	ND	0.0197	0.0199	98.5	99.5	1	70.0-130			1.01	30
Dicamba	0.0200	ND	0.0199	0.0193	99.5	96.5	1	70.0-130			3.06	30
Dichloroprop	0.0200	ND	0.0178	0.0180	89.0	90.0	1	70.0-130			1.12	30

1 Cp

2 Tc

3 Ss

4 Cn

5 Sr

6 Qc

7 Gl

8 Al

9 Sc

L1467568-01 Original Sample (OS) • Matrix Spike (MS) • Matrix Spike Duplicate (MSD)

(OS) L1467568-01 03/04/22 16:45 • (MS) R3766816-3 03/04/22 17:02 • (MSD) R3766816-4 03/04/22 17:19

Analyte	Spike Amount mg/l	Original Result mg/l	MS Result mg/l	MSD Result mg/l	MS Rec. %	MSD Rec. %	Dilution	Rec. Limits %	MS Qualifier	MSD Qualifier	RPD %	RPD Limits %
Dinoseb	0.0200	ND	0.0233	0.0230	117	115	1	70.0-130			1.30	30
MCPA	0.0200	ND	0.0188	0.0189	94.0	94.5	1	70.0-130			0.531	30
MCPP	0.0200	ND	0.0182	0.0179	91.0	89.5	1	70.0-130			1.66	30
2,4,5-T	0.0200	ND	0.0193	0.0191	96.5	95.5	1	70.0-130			1.04	30
2,4,5-TP (Silvex)	0.0200	ND	0.0184	0.0182	92.0	91.0	1	70.0-130			1.09	30
(S) 2,4-DB-D3					85.5	98.0		70.0-130				

- 1 Cp
- 2 Tc
- 3 Ss
- 4 Cn
- 5 Sr
- 6 Qc
- 7 Gl
- 8 Al
- 9 Sc

Method Blank (MB)

(MB) R3767749-1 03/09/22 01:07

Analyte	MB Result mg/l	MB Qualifier	MB MDL mg/l	MB RDL mg/l
Aldrin	U		0.0000198	0.0000500
Alpha BHC	U		0.0000172	0.0000500
Beta BHC	U		0.0000208	0.0000500
Delta BHC	U		0.0000150	0.0000500
Gamma BHC	U		0.0000209	0.0000500
Chlordane	U		0.0000198	0.00500
4,4-DDD	U		0.0000177	0.0000500
4,4-DDE	U		0.0000154	0.0000500
4,4-DDT	U		0.0000198	0.0000500
Dieldrin	U		0.0000162	0.0000500
Endosulfan I	U		0.0000160	0.0000500
Endosulfan II	U		0.0000164	0.0000500
Endosulfan sulfate	U		0.0000217	0.0000500
Endrin	U		0.0000161	0.0000500
Endrin aldehyde	U		0.0000237	0.0000500
Endrin ketone	U		0.0000219	0.0000500
Heptachlor	U		0.0000148	0.0000500
Heptachlor epoxide	U		0.0000183	0.0000500
Hexachlorobenzene	U		0.0000176	0.0000500
Methoxychlor	U		0.0000193	0.0000500
Toxaphene	U		0.000168	0.000500
gamma-Chlordane	U		0.0000137	0.0000500
alpha-Chlordane	U		0.0000149	0.0000500
(S) Decachlorobiphenyl	22.8			10.0-144
(S) Tetrachloro-m-xylene	81.6			10.0-135

¹Cp

²Tc

³Ss

⁴Cn

⁵Sr

⁶Qc

⁷Gl

⁸Al

⁹Sc

Laboratory Control Sample (LCS)

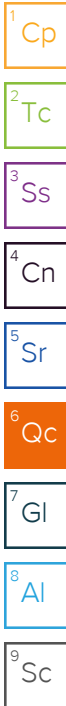
(LCS) R3767749-2 03/09/22 01:17

Analyte	Spike Amount mg/l	LCS Result mg/l	LCS Rec. %	Rec. Limits %	LCS Qualifier
Aldrin	0.00100	0.000949	94.9	42.0-140	
Alpha BHC	0.00100	0.000983	98.3	37.0-140	
Beta BHC	0.00100	0.00101	101	17.0-147	
Delta BHC	0.00100	0.000847	84.7	19.0-140	
Gamma BHC	0.00100	0.00100	100	32.0-140	
4,4-DDD	0.00100	0.000899	89.9	31.0-141	
4,4-DDE	0.00100	0.000870	87.0	30.0-145	
4,4-DDT	0.00100	0.000887	88.7	25.0-160	

Laboratory Control Sample (LCS)

(LCS) R3767749-2 03/09/22 01:17

Analyte	Spike Amount mg/l	LCS Result mg/l	LCS Rec. %	Rec. Limits %	<u>LCS Qualifier</u>
Dieldrin	0.00100	0.000983	98.3	36.0-146	
Endosulfan I	0.00100	0.000914	91.4	45.0-153	
Endosulfan II	0.00100	0.000950	95.0	1.00-202	
Endosulfan sulfate	0.00100	0.000872	87.2	26.0-144	
Endrin	0.00100	0.000908	90.8	30.0-147	
Endrin aldehyde	0.00100	0.000866	86.6	56.0-128	
Endrin ketone	0.00100	0.000851	85.1	54.0-142	
Heptachlor	0.00100	0.000856	85.6	34.0-140	
Heptachlor epoxide	0.00100	0.000920	92.0	37.0-142	
Hexachlorobenzene	0.00100	0.000904	90.4	35.0-120	
Methoxychlor	0.00100	0.000844	84.4	44.0-160	
gamma-Chlordane	0.00100	0.000894	89.4	45.0-140	
alpha-Chlordane	0.00100	0.000888	88.8	45.0-140	
(S) Decachlorobiphenyl			56.5	10.0-144	
(S) Tetrachloro-m-xylene			85.9	10.0-135	



L1467779-02 Original Sample (OS) • Matrix Spike (MS) • Matrix Spike Duplicate (MSD)

(OS) L1467779-02 03/09/22 03:20 • (MS) R3767749-3 03/09/22 03:30 • (MSD) R3767749-4 03/09/22 03:39

Analyte	Spike Amount mg/l	Original Result mg/l	MS Result mg/l	MSD Result mg/l	MS Rec. %	MSD Rec. %	Dilution	Rec. Limits %	<u>MS Qualifier</u>	<u>MSD Qualifier</u>	RPD %	RPD Limits %
Aldrin	0.00100	ND	0.000893	0.000843	89.3	84.3	1	42.0-140			5.76	35
Alpha BHC	0.00100	ND	0.000937	0.000881	93.7	88.1	1	37.0-140			6.16	36
Beta BHC	0.00100	ND	0.000922	0.000848	92.2	84.8	1	17.0-147			8.36	44
Delta BHC	0.00100	ND	0.000791	0.000734	79.1	73.4	1	19.0-140			7.48	52
Gamma BHC	0.00100	ND	0.000950	0.000897	95.0	89.7	1	32.0-140			5.74	39
4,4-DDD	0.00100	ND	0.000845	0.000793	84.5	79.3	1	31.0-141			6.35	39
4,4-DDE	0.00100	ND	0.000814	0.000755	81.4	75.5	1	30.0-145			7.52	35
4,4-DDT	0.00100	ND	0.000852	0.000805	85.2	80.5	1	25.0-160			5.67	42
Dieldrin	0.00100	ND	0.000928	0.000865	92.8	86.5	1	36.0-146			7.03	49
Endosulfan I	0.00100	ND	0.000954	0.000916	95.4	91.6	1	45.0-153			4.06	28
Endosulfan II	0.00100	ND	0.000850	0.000792	85.0	79.2	1	1.00-202			7.06	53
Endosulfan sulfate	0.00100	ND	0.000890	0.000832	89.0	83.2	1	26.0-144			6.74	38
Endrin	0.00100	ND	0.000831	0.000795	83.1	79.5	1	30.0-147			4.43	48
Endrin aldehyde	0.00100	ND	0.000762	0.000740	76.2	74.0	1	56.0-128			2.93	20
Endrin ketone	0.00100	ND	0.000818	0.000723	81.8	72.3	1	54.0-142			12.3	20
Heptachlor	0.00100	ND	0.000859	0.000807	85.9	80.7	1	34.0-140			6.24	43
Heptachlor epoxide	0.00100	ND	0.000876	0.000811	87.6	81.1	1	37.0-142			7.71	26
Hexachlorobenzene	0.00100	ND	0.000801	0.000752	80.1	75.2	1	35.0-120			6.31	25

L1467779-02 Original Sample (OS) • Matrix Spike (MS) • Matrix Spike Duplicate (MSD)

(OS) L1467779-02 03/09/22 03:20 • (MS) R3767749-3 03/09/22 03:30 • (MSD) R3767749-4 03/09/22 03:39

Analyte	Spike Amount mg/l	Original Result mg/l	MS Result mg/l	MSD Result mg/l	MS Rec. %	MSD Rec. %	Dilution	Rec. Limits %	MS Qualifier	MSD Qualifier	RPD %	RPD Limits %
Methoxychlor	0.00100	ND	0.000797	0.000818	79.7	81.8	1	44.0-160			2.60	22
gamma-Chlordane	0.00100	ND	0.000849	0.000787	84.9	78.7	1	45.0-140			7.58	35
alpha-Chlordane	0.00100	ND	0.000825	0.000762	82.5	76.2	1	45.0-140			7.94	35
<i>(S) Decachlorobiphenyl</i>					77.9	78.6		10.0-144				
<i>(S) Tetrachloro-m-xylene</i>					80.2	75.8		10.0-135				

- 1 Cp
- 2 Tc
- 3 Ss
- 4 Cn
- 5 Sr
- 6 Qc
- 7 Gl
- 8 Al
- 9 Sc

Method Blank (MB)

(MB) R3767749-1 03/09/22 01:07

Analyte	MB Result	MB Qualifier	MB MDL	MB RDL
	mg/l		mg/l	mg/l
PCB 1016	U		0.000270	0.000500
PCB 1221	U		0.000270	0.000500
PCB 1232	U		0.000270	0.000500
PCB 1242	U		0.000270	0.000500
PCB 1248	U		0.000173	0.000500
PCB 1254	U		0.000173	0.000500
PCB 1260	U		0.000173	0.000500
Total PCBs	U		0.000173	0.000500
(S) Decachlorobiphenyl	20.9			10.0-144
(S) Tetrachloro-m-xylene	88.6			10.0-135

¹Cp

²Tc

³Ss

⁴Cn

⁵Sr

⁶Qc

⁷Gl

⁸Al

⁹Sc

Laboratory Control Sample (LCS)

(LCS) R3767749-5 03/09/22 01:26

Analyte	Spike Amount	LCS Result	LCS Rec.	Rec. Limits	LCS Qualifier
	mg/l	mg/l	%	%	
PCB 1016	0.00250	0.00256	102	50.0-140	
PCB 1260	0.00250	0.00222	88.8	8.00-140	
(S) Decachlorobiphenyl			48.8	10.0-144	
(S) Tetrachloro-m-xylene			95.7	10.0-135	

L1467779-02 Original Sample (OS) • Matrix Spike (MS) • Matrix Spike Duplicate (MSD)

(OS) L1467779-02 03/09/22 03:20 • (MS) R3767749-6 03/09/22 03:49 • (MSD) R3767749-7 03/09/22 03:58

Analyte	Spike Amount	Original Result	MS Result	MSD Result	MS Rec.	MSD Rec.	Dilution	Rec. Limits	MS Qualifier	MSD Qualifier	RPD	RPD Limits
	mg/l	mg/l	mg/l	mg/l	%	%		%			%	%
PCB 1016	0.00250	ND	0.00278	0.00283	111	113	1	50.0-140			1.78	36
PCB 1260	0.00250	ND	0.00241	0.00230	96.4	92.0	1	8.00-140			4.67	38
(S) Decachlorobiphenyl					76.3	77.4		10.0-144				
(S) Tetrachloro-m-xylene					85.7	88.2		10.0-135				

Method Blank (MB)

(MB) R3768023-4 03/09/22 14:04

Analyte	MB Result mg/l	MB Qualifier	MB MDL mg/l	MB RDL mg/l
Acenaphthene	U		0.000886	0.00100
Acenaphthylene	U		0.000921	0.00100
Anthracene	U		0.000804	0.00100
Benzidine	U		0.00374	0.0100
Benzo(a)anthracene	U		0.000199	0.00100
Benzo(b)fluoranthene	U		0.000130	0.00100
Benzo(k)fluoranthene	U		0.000120	0.00100
Benzo(g,h,i)perylene	U		0.000121	0.00100
Benzo(a)pyrene	U		0.0000381	0.00100
Bis(2-chlorethoxy)methane	U		0.000116	0.0100
Bis(2-chloroethyl)ether	U		0.000137	0.0100
2,2-Oxybis(1-Chloropropane)	U		0.000210	0.0100
4-Bromophenyl-phenylether	U		0.0000877	0.0100
2-Chloronaphthalene	U		0.0000648	0.00100
4-Chlorophenyl-phenylether	U		0.0000926	0.0100
Chrysene	U		0.000130	0.00100
Dibenz(a,h)anthracene	U		0.0000644	0.00100
3,3-Dichlorobenzidine	U		0.000212	0.0100
2,4-Dinitrotoluene	U		0.0000983	0.0100
2,6-Dinitrotoluene	U		0.000250	0.0100
Azobenzene	U		0.000105	0.0100
Fluoranthene	U		0.000102	0.00100
Fluorene	U		0.0000844	0.00100
Hexachlorobenzene	U		0.0000755	0.00100
Hexachloro-1,3-butadiene	U		0.0000968	0.0100
Hexachlorocyclopentadiene	U		0.0000598	0.0100
Hexachloroethane	U		0.000127	0.0100
Indeno(1,2,3-cd)pyrene	U		0.000279	0.00100
Isophorone	U		0.000143	0.0100
Naphthalene	U		0.000159	0.00100
Nitrobenzene	U		0.000297	0.0100
n-Nitrosodimethylamine	U		0.000998	0.0100
n-Nitrosodiphenylamine	U		0.00237	0.0100
n-Nitrosodi-n-propylamine	U		0.000261	0.0100
Phenanthrene	U		0.000112	0.00100
Benzylbutyl phthalate	U		0.000765	0.00300
Bis(2-ethylhexyl)phthalate	U		0.000895	0.00300
Di-n-butyl phthalate	U		0.000453	0.00300
Diethyl phthalate	U		0.000287	0.00300
Dimethyl phthalate	U		0.000260	0.00300

¹Cp

²Tc

³Ss

⁴Cn

⁵Sr

⁶Qc

⁷Gl

⁸Al

⁹Sc

Method Blank (MB)

(MB) R3768023-4 03/09/22 14:04

Analyte	MB Result mg/l	MB Qualifier	MB MDL mg/l	MB RDL mg/l
Di-n-octyl phtalate	U		0.000932	0.00300
Pyrene	0.000112	J	0.000107	0.00100
1,2,4-Trichlorobenzene	U		0.0000698	0.0100
4-Chloro-3-methylphenol	U		0.000131	0.0100
2-Chlorophenol	U		0.000133	0.0100
2,4-Dichlorophenol	U		0.000102	0.0100
2,4-Dimethylphenol	U		0.0000636	0.0100
4,6-Dinitro-2-methylphenol	U		0.00112	0.0100
2,4-Dinitrophenol	U		0.00593	0.0100
2-Nitrophenol	U		0.000117	0.0100
4-Nitrophenol	U		0.000143	0.0100
Pentachlorophenol	U		0.000313	0.0100
Phenol	U		0.00433	0.0100
2,4,6-Trichlorophenol	U		0.000100	0.0100
(S) Nitrobenzene-d5	66.0			15.0-314
(S) 2-Fluorobiphenyl	73.0			22.0-127
(S) p-Terphenyl-d14	74.4			29.0-141
(S) Phenol-d5	16.8			8.00-424
(S) 2-Fluorophenol	32.4			10.0-120
(S) 2,4,6-Tribromophenol	62.5			10.0-153

1 Cp

2 Tc

3 Ss

4 Cn

5 Sr

6 Qc

7 Gl

8 Al

9 Sc

Laboratory Control Sample (LCS) • Laboratory Control Sample Duplicate (LCSD)

(LCS) R3768023-1 03/09/22 13:00 • (LCSD) R3768023-2 03/09/22 13:22

Analyte	Spike Amount mg/l	LCS Result mg/l	LCSD Result mg/l	LCS Rec. %	LCSD Rec. %	Rec. Limits %	LCS Qualifier	LCSD Qualifier	RPD %	RPD Limits %
Acenaphthene	0.0500	0.0388	0.0342	77.6	68.4	47.0-145			12.6	48
Acenaphthylene	0.0500	0.0385	0.0345	77.0	69.0	33.0-145			11.0	74
Anthracene	0.0500	0.0423	0.0368	84.6	73.6	27.0-133			13.9	66
Benzidine	0.100	0.00701	0.000	7.01	0.000	1.00-120		J3 J4	200	36
Benzo(a)anthracene	0.0500	0.0410	0.0355	82.0	71.0	33.0-143			14.4	53
Benzo(b)fluoranthene	0.0500	0.0403	0.0350	80.6	70.0	24.0-159			14.1	71
Benzo(k)fluoranthene	0.0500	0.0400	0.0339	80.0	67.8	11.0-162			16.5	63
Benzo(g,h,i)perylene	0.0500	0.0451	0.0388	90.2	77.6	1.00-219			15.0	97
Benzo(a)pyrene	0.0500	0.0405	0.0347	81.0	69.4	17.0-163			15.4	72
Bis(2-chlorethoxy)methane	0.0500	0.0348	0.0310	69.6	62.0	1.00-219			11.6	54
Bis(2-chloroethyl)ether	0.0500	0.0353	0.0310	70.6	62.0	33.0-185			13.0	108
2,2-Oxybis(1-Chloropropane)	0.0500	0.0333	0.0295	66.6	59.0	36.0-166			12.1	76
4-Bromophenyl-phenylether	0.0500	0.0390	0.0346	78.0	69.2	53.0-127			12.0	43

Laboratory Control Sample (LCS) • Laboratory Control Sample Duplicate (LCSD)

(LCS) R3768023-1 03/09/22 13:00 • (LCSD) R3768023-2 03/09/22 13:22

Analyte	Spike Amount mg/l	LCS Result mg/l	LCSD Result mg/l	LCS Rec. %	LCSD Rec. %	Rec. Limits %	<u>LCS Qualifier</u>	<u>LCSD Qualifier</u>	RPD %	RPD Limits %
2-Chloronaphthalene	0.0500	0.0396	0.0350	79.2	70.0	60.0-120			12.3	24
4-Chlorophenyl-phenylether	0.0500	0.0385	0.0338	77.0	67.6	25.0-158			13.0	61
Chrysene	0.0500	0.0432	0.0374	86.4	74.8	17.0-168			14.4	87
Dibenz(a,h)anthracene	0.0500	0.0453	0.0396	90.6	79.2	1.00-227			13.4	126
3,3-Dichlorobenzidine	0.100	0.0996	0.0814	99.6	81.4	1.00-262			20.1	108
2,4-Dinitrotoluene	0.0500	0.0460	0.0386	92.0	77.2	39.0-139			17.5	42
2,6-Dinitrotoluene	0.0500	0.0420	0.0359	84.0	71.8	50.0-158			15.7	48
Azobenzene	0.0500	0.0408	0.0361	81.6	72.2	37.0-125			12.2	20
Fluoranthene	0.0500	0.0423	0.0358	84.6	71.6	26.0-137			16.6	66
Fluorene	0.0500	0.0408	0.0356	81.6	71.2	59.0-121			13.6	38
Hexachlorobenzene	0.0500	0.0430	0.0376	86.0	75.2	1.00-152			13.4	55
Hexachloro-1,3-butadiene	0.0500	0.0350	0.0312	70.0	62.4	24.0-120			11.5	62
Hexachlorocyclopentadiene	0.0500	0.0265	0.0240	53.0	48.0	10.0-120			9.90	31
Hexachloroethane	0.0500	0.0360	0.0314	72.0	62.8	40.0-120			13.6	52
Indeno(1,2,3-cd)pyrene	0.0500	0.0464	0.0398	92.8	79.6	1.00-171			15.3	99
Isophorone	0.0500	0.0349	0.0309	69.8	61.8	21.0-196			12.2	93
Naphthalene	0.0500	0.0328	0.0291	65.6	58.2	21.0-133			12.0	65
Nitrobenzene	0.0500	0.0358	0.0320	71.6	64.0	35.0-180			11.2	62
n-Nitrosodimethylamine	0.0500	0.0157	0.0143	31.4	28.6	10.0-120			9.33	34
n-Nitrosodiphenylamine	0.0500	0.0396	0.0330	79.2	66.0	44.0-120			18.2	21
n-Nitrosodi-n-propylamine	0.0500	0.0355	0.0309	71.0	61.8	1.00-230			13.9	87
Phenanthrene	0.0500	0.0404	0.0351	80.8	70.2	54.0-120			14.0	39
Benzylbutyl phthalate	0.0500	0.0408	0.0345	81.6	69.0	1.00-152			16.7	60
Bis(2-ethylhexyl)phthalate	0.0500	0.0376	0.0323	75.2	64.6	8.00-158			15.2	82
Di-n-butyl phthalate	0.0500	0.0434	0.0369	86.8	73.8	1.00-120			16.2	47
Diethyl phthalate	0.0500	0.0421	0.0363	84.2	72.6	1.00-120			14.8	100
Dimethyl phthalate	0.0500	0.0404	0.0351	80.8	70.2	1.00-120			14.0	183
Di-n-octyl phthalate	0.0500	0.0391	0.0327	78.2	65.4	4.00-146			17.8	69
Pyrene	0.0500	0.0423	0.0369	84.6	73.8	52.0-120			13.6	49
1,2,4-Trichlorobenzene	0.0500	0.0372	0.0333	74.4	66.6	44.0-142			11.1	50
4-Chloro-3-methylphenol	0.0500	0.0324	0.0278	64.8	55.6	22.0-147			15.3	73
2-Chlorophenol	0.0500	0.0304	0.0262	60.8	52.4	23.0-134			14.8	61
2,4-Dichlorophenol	0.0500	0.0360	0.0309	72.0	61.8	39.0-135			15.2	50
2,4-Dimethylphenol	0.0500	0.0336	0.0294	67.2	58.8	32.0-120			13.3	58
4,6-Dinitro-2-methylphenol	0.0500	0.0424	0.0364	84.8	72.8	1.00-181			15.2	203
2,4-Dinitrophenol	0.0500	0.0333	0.0310	66.6	62.0	1.00-191			7.15	132
2-Nitrophenol	0.0500	0.0353	0.0317	70.6	63.4	29.0-182			10.7	55
4-Nitrophenol	0.0500	0.0118	0.00970	23.6	19.4	1.00-132			19.5	131
Pentachlorophenol	0.0500	0.0333	0.0267	66.6	53.4	14.0-176			22.0	86
Phenol	0.0500	0.00989	0.00872	19.8	17.4	5.00-120			12.6	64

- 1 Cp
- 2 Tc
- 3 Ss
- 4 Cn
- 5 Sr
- 6 Qc
- 7 Gl
- 8 Al
- 9 Sc

Laboratory Control Sample (LCS) • Laboratory Control Sample Duplicate (LCSD)

(LCS) R3768023-1 03/09/22 13:00 • (LCSD) R3768023-2 03/09/22 13:22

Analyte	Spike Amount mg/l	LCS Result mg/l	LCSD Result mg/l	LCS Rec. %	LCSD Rec. %	Rec. Limits %	<u>LCS Qualifier</u>	<u>LCSD Qualifier</u>	RPD %	RPD Limits %
2,4,6-Trichlorophenol	0.0500	0.0381	0.0331	76.2	66.2	37.0-144			14.0	58
<i>(S) Nitrobenzene-d5</i>				69.6	60.4	15.0-314				
<i>(S) 2-Fluorobiphenyl</i>				78.5	70.8	22.0-127				
<i>(S) p-Terphenyl-d14</i>				85.5	72.1	29.0-141				
<i>(S) Phenol-d5</i>				19.7	15.7	8.00-424				
<i>(S) 2-Fluorophenol</i>				33.8	28.3	10.0-120				
<i>(S) 2,4,6-Tribromophenol</i>				89.0	75.5	10.0-153				

1 Cp

2 Tc

3 Ss

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7 Gl

8 Al

9 Sc

GLOSSARY OF TERMS

Guide to Reading and Understanding Your Laboratory Report

The information below is designed to better explain the various terms used in your report of analytical results from the Laboratory. This is not intended as a comprehensive explanation, and if you have additional questions please contact your project representative.

Results Disclaimer - Information that may be provided by the customer, and contained within this report, include Permit Limits, Project Name, Sample ID, Sample Matrix, Sample Preservation, Field Blanks, Field Spikes, Field Duplicates, On-Site Data, Sampling Collection Dates/Times, and Sampling Location. Results relate to the accuracy of this information provided, and as the samples are received.

Abbreviations and Definitions

MDL	Method Detection Limit.
ND	Not detected at the Reporting Limit (or MDL where applicable).
RDL	Reported Detection Limit.
Rec.	Recovery.
RPD	Relative Percent Difference.
SDG	Sample Delivery Group.
(S)	Surrogate (Surrogate Standard) - Analytes added to every blank, sample, Laboratory Control Sample/Duplicate and Matrix Spike/Duplicate; used to evaluate analytical efficiency by measuring recovery. Surrogates are not expected to be detected in all environmental media.
U	Not detected at the Reporting Limit (or MDL where applicable).
Analyte	The name of the particular compound or analysis performed. Some Analyses and Methods will have multiple analytes reported.
Dilution	If the sample matrix contains an interfering material, the sample preparation volume or weight values differ from the standard, or if concentrations of analytes in the sample are higher than the highest limit of concentration that the laboratory can accurately report, the sample may be diluted for analysis. If a value different than 1 is used in this field, the result reported has already been corrected for this factor.
Limits	These are the target % recovery ranges or % difference value that the laboratory has historically determined as normal for the method and analyte being reported. Successful QC Sample analysis will target all analytes recovered or duplicated within these ranges.
Original Sample	The non-spiked sample in the prep batch used to determine the Relative Percent Difference (RPD) from a quality control sample. The Original Sample may not be included within the reported SDG.
Qualifier	This column provides a letter and/or number designation that corresponds to additional information concerning the result reported. If a Qualifier is present, a definition per Qualifier is provided within the Glossary and Definitions page and potentially a discussion of possible implications of the Qualifier in the Case Narrative if applicable.
Result	The actual analytical final result (corrected for any sample specific characteristics) reported for your sample. If there was no measurable result returned for a specific analyte, the result in this column may state "ND" (Not Detected) or "BDL" (Below Detectable Levels). The information in the results column should always be accompanied by either an MDL (Method Detection Limit) or RDL (Reporting Detection Limit) that defines the lowest value that the laboratory could detect or report for this analyte.
Uncertainty (Radiochemistry)	Confidence level of 2 sigma.
Case Narrative (Cn)	A brief discussion about the included sample results, including a discussion of any non-conformances to protocol observed either at sample receipt by the laboratory from the field or during the analytical process. If present, there will be a section in the Case Narrative to discuss the meaning of any data qualifiers used in the report.
Quality Control Summary (Qc)	This section of the report includes the results of the laboratory quality control analyses required by procedure or analytical methods to assist in evaluating the validity of the results reported for your samples. These analyses are not being performed on your samples typically, but on laboratory generated material.
Sample Chain of Custody (Sc)	This is the document created in the field when your samples were initially collected. This is used to verify the time and date of collection, the person collecting the samples, and the analyses that the laboratory is requested to perform. This chain of custody also documents all persons (excluding commercial shippers) that have had control or possession of the samples from the time of collection until delivery to the laboratory for analysis.
Sample Results (Sr)	This section of your report will provide the results of all testing performed on your samples. These results are provided by sample ID and are separated by the analyses performed on each sample. The header line of each analysis section for each sample will provide the name and method number for the analysis reported.
Sample Summary (Ss)	This section of the Analytical Report defines the specific analyses performed for each sample ID, including the dates and times of preparation and/or analysis.

Qualifier	Description
B1	The blank depletion was greater than the recommended maximum depletion of 0.2mg/L.
E	The analyte concentration exceeds the upper limit of the calibration range of the instrument established by the initial calibration (ICAL).
J	The identification of the analyte is acceptable; the reported value is an estimate.
J3	The associated batch QC was outside the established quality control range for precision.
J4	The associated batch QC was outside the established quality control range for accuracy.
J5	The sample matrix interfered with the ability to make any accurate determination; spike value is high.
J6	The sample matrix interfered with the ability to make any accurate determination; spike value is low.
P1	RPD value not applicable for sample concentrations less than 5 times the reporting limit.
V	The sample concentration is too high to evaluate accurate spike recoveries.
V3	The internal standard exhibited poor recovery due to sample matrix interference. The analytical results will be biased high. BDL results will be unaffected.

1 Cp

2 Tc

3 Ss

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8 Al

9 Sc

ACCREDITATIONS & LOCATIONS

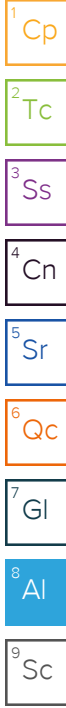
Pace Analytical National 12065 Lebanon Rd Mount Juliet, TN 37122

Alabama	40660	Nebraska	NE-OS-15-05
Alaska	17-026	Nevada	TN000032021-1
Arizona	AZ0612	New Hampshire	2975
Arkansas	88-0469	New Jersey–NELAP	TN002
California	2932	New Mexico ¹	TN00003
Colorado	TN00003	New York	11742
Connecticut	PH-0197	North Carolina	Env375
Florida	E87487	North Carolina ¹	DW21704
Georgia	NELAP	North Carolina ³	41
Georgia ¹	923	North Dakota	R-140
Idaho	TN00003	Ohio–VAP	CL0069
Illinois	200008	Oklahoma	9915
Indiana	C-TN-01	Oregon	TN200002
Iowa	364	Pennsylvania	68-02979
Kansas	E-10277	Rhode Island	LA000356
Kentucky ^{1,6}	KY90010	South Carolina	84004002
Kentucky ²	16	South Dakota	n/a
Louisiana	AI30792	Tennessee ^{1,4}	2006
Louisiana	LA018	Texas	T104704245-20-18
Maine	TN00003	Texas ⁵	LAB0152
Maryland	324	Utah	TN000032021-11
Massachusetts	M-TN003	Vermont	VT2006
Michigan	9958	Virginia	110033
Minnesota	047-999-395	Washington	C847
Mississippi	TN00003	West Virginia	233
Missouri	340	Wisconsin	998093910
Montana	CERT0086	Wyoming	A2LA
A2LA – ISO 17025	1461.01	AIHA-LAP,LLC EMLAP	100789
A2LA – ISO 17025 ⁵	1461.02	DOD	1461.01
Canada	1461.01	USDA	P330-15-00234
EPA–Crypto	TN00003		

¹ Drinking Water ² Underground Storage Tanks ³ Aquatic Toxicity ⁴ Chemical/Microbiological ⁵ Mold ⁶ Wastewater n/a Accreditation not applicable

* Not all certifications held by the laboratory are applicable to the results reported in the attached report.

* Accreditation is only applicable to the test methods specified on each scope of accreditation held by Pace Analytical.



Company Name/Address: **Lebanon Storm Water Depart - Lebanon, TN**
 200 N. Castle Heights Ave.

Billing Information: **Brian Chomicki**
 200 N. Castle Heights Ave.
 Suite 300
 Lebanon, TN 37087

Report to: **Brian Chomicki**
 Email To: **brian.chomicki@lebanontn.org**

Project Description: **LHS 3.3.22** City/State: **Lebanon, TN** Please Circle: **PT MT CT ET**

Phone: **615-708-6444** Client Project #: **LHS** Lab Project #

Collected by (print): **Brian Chomicki** Site/Facility ID # P.O. #

Collected by (signature): *[Signature]* Rush? (Lab MUST Be Notified)
 Same Day Five Day
 Next Day 5 Day (Rad Only)
 Two Day 10 Day (Rad Only)
 Three Day

Immediately Packed on Ice N Y Quote # Date Results Needed

Sample ID	Comp/Grab	Matrix *	Depth	Date	Time	No. of Cntrs	Analysis / Container / Preservative										Remarks	Sample # (lab only)
							608.3 100ml Amb-NoPres	625.1 100ml Amb-NaTio	8321HERB 40mlAmb-NoPres-WT	BOD 500mlHDPE-NoPres	DRO 100ml Amb-HCI	GROTN 40mlAmb HCI	Metals 250mlHDPE-HNO3	OGHEX 1L-Clr-WT-HCI	V624.1 40mlAmb-HCI	WetChem 250mlHDPE-H2SO4		
Stroud WB	grab	GW	SW	3/3/22	12:50	18	X	X	X	X	X	X	X	X	X	X	X	-01
LHS2	grab	GW	SW	3/3/22	14:00	18	X	X	X	X	X	X	X	X	X	X	X	-02

* Matrix: SS - Soil AIR - Air F - Filter
 GW - Groundwater B - Bioassay
 WW - WasteWater
 DW - Drinking Water
 OT - Other

Remarks: pH _____ Temp _____
 Flow _____ Other _____

Samples returned via: UPS FedEx Courier Tracking #

Relinquished by: (Signature) *[Signature]* Date: **3/3/22** Time: **19:30** Received by: (Signature) Trip Blank Received: Yes / No No

Relinquished by: (Signature) Date: Time: Received by: (Signature) Temp: **0.9/20.9** °C Bottles Received: **38**

Relinquished by: (Signature) Date: **3/3/22** Time: **1930** Received for lab by: (Signature) Date: Time: Hold: Condition: **NCF / OK**

Chain of Custody Page ___ of ___

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 PEOPLE ADVANCING SCIENCE

MT JULIET, TN
 12065 Lebanon Rd Mount Juliet, TN 37122
 Submitting a sample via this chain of custody constitutes acknowledgment and acceptance of the Pace Terms and Conditions found at: <https://info.pacelabs.com/hubs/pas-standard-terms.pdf>

SDG # **1467568**
G120

Acctnum: **LEBSTOLTN**
 Template: **T204201**
 Prelogin: **P906235**
 PM: **807 - Justin Carr**
 PB: **Bf 2/21/22**
 Shipped Via: **Client**