Quality Assurance Project Plan

Indian Creek Watershed Management Plan

Harrison County, Indiana

Prepared for: Harrison County Regional Sewer District

Quality Assurance Project Plan
Indian Creek Watershed Management Plan

Harrison County, Indiana

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Quality Assurance Project Plan

for

Indian Creek Watershed Management Plan

ARN # A305-6-106

Prepared by:

FMSM Engineers, Inc.

Prepared for:

Indiana Department of Environmental Management
Office of Water Management
Watershed Management Section

Version 2.0 (May 2, 2007)

Approved By:

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NPS/TMDL QA Manager:	Betty Ratcliff	6/26/07 Date
NPS/TMDL Section Chief:	Andrew Pelloso	6/27/07 Date
NPS/TMDL Branch Chief:	Mary Lou Renshaw	6/25/07 Date

Quality Assurance Project Plan
Indian Creek Watershed Management Plan

Harrison County, Indiana

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1. Study Description

A Section 205(j) Water Quality Management Planning Grant was awarded to Harrison County, Indiana in 2005 to develop and implement a Watershed Management Plan for the Indian Creek Watershed. One of the tasks in the project is to collect monitoring data for chemical, habitat and biological (benthic macroinvertebrate) conditions to address data gaps and improve the understanding of sources and causes of water quality impairments. The Indian Creek watershed consists of 256 square miles and drains significant portions of Harrison and Floyd Counties, as well as a small portion of Clark County.

1.1. Historical Information

Eight sites along the Indian Creek mainstem have been sampled by IDEM for e. coli bacteria. Five (5) sites were sampled in 2000 and 3 were sampled in 2005. One or more samples from each site indicated elevated levels of e. coli. IDEM attributed elevated pathogens to nonpoint sources or unknown sources. This monitoring plan will provide new information regarding bacterial contamination and potential pollution sources.

In lower Indian Creek, aquatic life impairments were attributed to low dissolved oxygen, which was measured at one location (OBS100-006). This station is located near the confluence of Indian Creek and the Ohio River and may be affected by Ohio River backwater. Dissolved oxygen (DO) was at or below 4 ppm in 4 of 5 samples collected in July and August, 2000. IDEM attributed this impairment to organic enrichment. This monitoring program includes collection of DO and nutrients at 3 locations in the impaired segment to better understand current conditions, the spatial extent of impairment and factors that may contribute to low DO.

The following water quality impairments were identified on the 2006 303(d) List 5A:

14-DIGIT HUC	COUNTY	WATERBODY SEGMENT ID	WATERBODY SEGMENT NAME	CAUSE OF IMPAIRMENT
5140104080020	FLOYD CO	INN0482_00	LITTLE INDIAN CREEK (NORTH)	IMPAIRED BIOTIC COMMUNITIES
5140104090040	HARRISON CO	INN0494_00	INDIAN CREEK-CRANDALL BRANCH	E. COLI
5140104090060	HARRISON CO	INN0496_T1051	INDIAN CREEK	E. COLI
5140104100030	HARRISON CO	INN04A3_00	INDIAN CREEK-DEVILS BACKBONE	DISSOLVED OXYGEN
5140104100030	HARRISON CO	INN04A3_00	INDIAN CREEK-DEVILS BACKBONE	E. COLI

Impairment Category 5 was defined by IDEM as follows: (IDEM, 2006)

> **Category 5.** The water quality standard is not attained. Waterbodies may be listed in both 5A and 5B depending on the parameters causing the impairment.

Category 5A. The waterbodies are impaired or threatened for one or more designated uses by a pollutant(s), and require a TMDL. This category constitutes the Section 303(d) list of waters impaired or threatened by a pollutant(s) for which one (1) or more TMDL(s) are needed. A waterbody should be listed in this category if it is determined in accordance with the state's assessment and listing methodology that a pollutant has caused, is suspected of causing, or is projected to cause impairment. Where more than one (1) pollutant is associated with the impairment of a single waterbody, the waterbody will remain in Category 5 until TMDLs for all pollutants have been completed and approved by U.S. EPA.

IDEM uses Category 5B to list waters that do not meet Fish Consumption Designated Use and 5C to identify waters for which TMDLs are scheduled to be developed for the next listing cycle. None of the Indian Creek impaired waterbodies were included on the Category 5B or 5C lists.

To date, monitoring and assessments have focused on the middle and lower HUC watersheds. Significant percentages of stream miles in all 3 HUCs have not been assessed for one or more designated uses (aquatic life 54%; fish consumption 62%; primary contact 72%).

1.2. Study Goals

The goals of the monitoring program are outlined below:

a. Evaluate current conditions in waters on the 303(d) List
b. Identify sources and causes of impairments
c. Address data gaps
d. Support development of the Indian Creek Watershed Plan

Data will be used by the Indian Creek Watershed Plan Subcommittee to meet the goals identified above.

1.3. Study Sites

This monitoring program includes 10 sites for bacteria and water quality monitoring and 5 sites for biological monitoring. Sites are located in reaches identified as impaired for primary contact or biological uses, reaches with known or suspected pollution sources and reaches not recently sampled by IDEM or other entities to address data gaps.

Quality Assurance Project Plan
Indian Creek Watershed Management Plan

Harrison County, Indiana

Indian Creek Watershed Sampling Sites					
Site #	**IDEM Site ID**	**Location**	**WQ**	**AQL**	**Rationale**
1	OBS080-0001	Indian Creek North at Banet Road, IDEM Site OBS080-0001		X	303(d) Segment – Aquatic Life
2		Georgetown Creek below Georgetown at Malinee Ott Road	X		Unassessed reach below Georgetown
3	OBS080-0005	Indian Creek above Georgetown Creek, IDEM Site OBS080-0005	X		Floyd County drainage, near County boundary, developing
4		Crandall Branch above SR335 Bridge	X		303(d) Segment – Recreation (may be an artifact of mapping?)
5	OBS090-0004	Indian Creek above SR355 Bridge, IDEM Site OBS090-0004	X		303(d) Segment – Recreation
6		Indian Creek above Little Indian Creek at Water Street	X		Downstream end of HUC, 303(d) Segment – Recreation, above WWTP, receives Corydon runoff
7		Indian Creek at Mathis Road bridge	X	X	Upstream end of 303(d) Segment – Recreation, Aquatic Life
8	OBS100-0001	Indian Creek above Rocky Hollow Road Bridge, IDEM Site OBS100-0001	X	X	303(d) Segment – Recreation, Aquatic Life
9	OBS100-0006	Indian Creek above Lickford Road Bridge, IDEM Site OBS100-0006	X	X	303(d) Segment – Recreation, Aquatic Life
10		Little Indian Creek above Water Street Bridge	X	X	Major tributary, classified as “unassessed” by IDEM
11		Little Indian Creek below Lanesville at State Road 62	X		Upper reach of major tributary classified as “unassessed” by IDEM, downstream of Lanesville and Lanesville STP
		Number of Sites	**10**	**5**	

1.4. Sampling Design

A targeted sampling design will be used in order to meet the goals for the monitoring program identified in Section 2.2.

E. Coli: E. coli data will be collected to support calculation of geometric means; 5 evenly spaced e. coli and flow samples will be collected during a 30-day period. One set of 5 samples will be collected at each of 10 sites. Flow readings will be collected concurrently.

Water Quality: Six water quality sample events will be conducted at each of 10 sites. Samples will be collected under baseflow (3 events) and elevated flow (3 events) to evaluate water quality over a range of hydrologic conditions. Grab samples will be analyzed for Total Kjeldahl Nitrogen (TKN), Nitrate-Nitrogen (NO3), Total Ammonia (NH3+NH4), Total Phosphorus (TP), Ortho-Phosphorous (PO4), Total Solids (TS). Field parameters and flow will be collected concurrently.

Biological: Biological (benthic macroinvertebrate) data will be collected at 5 sites. Samples will be collected between July and October 2007. Field parameters and flow will be collected concurrently at each site. Water quality will be collected concurrently at 4 of 5 sites. Habitat data will be collected at 11 sites.

Field Parameters: Field parameters collected during each sample event include: pH, Dissolved Oxygen (DO), Temperature (T), Specific Conductivity (SC), Turbidity.

Flow: Flow condition (i.e. baseflow and elevated flow) for sampling will be qualitatively determined by evaluating recent precipitation data and comparing current flow to the long term daily median for the nearby USGS Gage 03302220 Buck Creek near New Middletown. Dry conditions are defined as 3 or more days of dry conditions and wet conditions are defined as 0.25 inches or greater of wet precipitation or snowmelt. Since this amount of precipitation does not always produce runoff due to soil moisture deficits, baseflow and elevated flow conditions are also defined. Baseflow is defined for this study as less than the long term daily median flow and elevated flow is greater than the 65th percentile. This qualitative approach is necessary because USGS no longer operates flow gages in the Indian Creek watershed.

The sample design is summarized on the following table.

Sample Design Summary

Sample Type	# Parameters	# Sites	# Sample Events	# Results
E. Coli	1	10	5	50
Water Quality	6	10	6	360
Biological	1	5	1	5
Field Parms	5	11	6	330
Flow	1	11	11	115
Habitat	1	11	1	11

This sampling design will allow the goals of the monitoring program to be met as described below.

Goal 1. Support development of the Indian Creek Watershed Plan

Analysis of data collected in this monitoring program will be used to support identification of watershed improvement strategies to be included in the Indian Creek Watershed Plan.

Goal 2. Evaluate current conditions in waters on the 303(d) List

Each reach on the 2006 303d List will have one or more sites.

Goal 3. Identify sources and causes of impairments

Analysis of data collected under low flow and elevated flow conditions will be used to indicate relative contribution of point and nonpoint sources of pollutants. Nutrient and flow data will be used to identify possible factors contributing to low dissolved oxygen. Habitat and field parameters will be used to identify factors that may be contributing to aquatic life impairments.

Pollution source assessments will be evaluated qualitatively using IDEM's Pollutant Load Reduction Worksheet, effluent data and other pollution source information gathered through the course of the project.

***Goal 4.* Address data gaps**

Reaches classified as unassessed by IDEM on Georgetown Creek and Little Indian Creek will be sampled. Three sites in Indian Creek-Devils Backbone will be used to clarify the spatial extent of impairment.

1.5. Study Schedule

The study schedule is shown on the following table. This schedule will be adjusted as necessary to accommodate unforeseen circumstances such as lack of the necessary flow conditions. IDEM approval will be sought as needed for schedule revisions.

Study Schedule

Activity	Start Date	End Date
Draft QAPP submitted to IDEM	6/2007	6/2007
IDEM Approval of QAPP	7/2007	7/2007
Water quality: field parameters, water quality and flow (6 events - 3 baseflow & 3 elevated flow, at 10 sites)	8/2007	10/2007
Benthic invertebrates: field parameters, benthic macroinvertebrates, habitat and flow (1 event, 5 sites)	8/2007	10/2007
E. coli: 5 evenly spaced samples within 30 days, 10 sites	8/2007	10/2007
QA review of data	8/2007	11/2007
Data management	8/2007	11/2007
Data assessment	8/2007	11/2007
Integrate results into Watershed Management Plan	9/2007	11/2007
Publish monitoring results to watershed website	9/2007	11/2007

2. Study Organization and Responsibility

2.1. Key Personnel

Betty Ratcliff, IDEM Quality Assurance Manager
Nonpoint Source/TMDL Section
Indiana Department of Environmental Management
Role: Review and approve QAPP, assist with quality assurance questions

Alice Rubin, IDEM Project Manager
Nonpoint Source/TMDL Section
Indiana Department of Environmental Management
Role: Assist with ensuring that monitoring design is consistent with project goals

Dan Lee, PE
Harrison County Regional Sewer District
Role: Harrison County Project Manager, final approval of monitoring locations, approval of data interpretation

Anthony Combs
Harrison County Health Department
Role: Monitoring coordinator, Coordination of field work, technical lead on monitoring locations and data interpretation

Stephen Hall
Project Manager
FMSM Engineers, Inc.

Role: Technical assistance with watershed plan, monitoring design and data interpretation

Karen Schaffer
Watershed Coordinator
FMSM Engineers, Inc.
Role: Data management and analysis team lead; develop and implement QAPP

Sam Call
Project Biologist
FMSM Engineers, Inc.
Role: Habitat and biological (benthic macroinvertebrate) sample collection and data analysis

Brian Fox
Environmental Scientist
FMSM Engineers, Inc.
Role: Field sample team lead; sample collection

Stacey Jarboe
Environmental Scientist
FMSM Engineers, Inc.
Role: Sample collection

Craig Hinshaw
Lab Director
Indiana State Department of Health
Role: Overall project coordination

Bharat Patel
Lab Supervisor, Inorganic Section
Indiana State Department of Health
Role: Oversee lab analysis

Ray Beebe
Lab Quality Assurance Coordinator
Indiana State Department of Health
Role: Oversee quality assurance review

Ken Ford
Laboratory Director
Microbac Laboratories, Inc.
Role: Oversee E. coli Analysis

2.2. Organizational Chart

An organizational chart for the Indian Creek Watershed Monitoring Program is shown on the following page.

Quality Assurance Project Plan
Indian Creek Watershed Management Plan

IDEM Project Manager

IDEM QA Officer

Project Manager
Dan Lee, PE

Quality Control
Steven D. Hall
Craig Hinshaw

Watershed Coordinator
Karen Schaffer

Monitoring Coordinator
Tony Combs

Sample Collection
Sam Call
Brian Fox
Stacey Jarboe

Sample Analysis
Ray Beebe
Bharat Patel
Ken Ford
Sam Call

Data Management and Analysis
Karen Schaffer
Sam Call

3. Data Quality Objectives (DQOs)

3.1. Precision

Precision measures the degree to which two or more measurments are in agreement and is often expressed as relative percent difference (RPD) between duplicates. Precision will be calculated using Equation 1. Better precision is reflected in smaller relative percent differences. Precision of the field and laboratory efforts will be measured by field and laboratory duplicates, respectively. The precision of meter readings will be estimated using duplicate readings.

Equation 1: Relative Percent Difference

$$RPD = \frac{|R_X - R_Y|}{0.5(R_X + R_Y)} \times 100$$

where:
R_X = calibrated unit
R_Y = deployed unit (pre-calibration)

Biological precision will be extimated by calculating RPD at one of five (5) stations (20%). Additionally, all biological samples will be collected by the same trained crew of experienced scientists. Except for sorting, the actual samples replicated will be chosen at random. All sample methods have built-in bias, but by using the same methods at each sampling location the bias will become a minimal problem when analyzing the data. The first sample sorted will be checked for accurrcay at the 90% level. If the sorter fails, each sample will be checked until the sorter passes. This will insure that any sorting problems are resolved at the beginning of sampling process. The goal is to achieve RPD of less that 10% for the macroinvertebrate index scores.

3.2. Accuracy

Accuracy measures the degree of agreement between an observed value and an accepted reference value. The percent recovery is calculated by comparing the concentrations of the original sample and the spiked sample using the following equation:

Equation 2. Percent Recovery

$$\%R = \frac{SSR - SR}{SA} X100$$

where:
%R = Recovery (percent)
SSR = Spike sample result (concentration units)
SR = Original sample result (concentration units)
SA = Spike added (concentration added)

%R=((SSR - SR)/(SA))*100 Excel Formula

For chemical parameters, accuracy in the field is determined through the use of field and trip blanks and through the adherence to all sample handling SOPs, preservation, and holding times. Laboratory accuracy is shown on Table 3.1.

Due to the lack of ideal, standard, or pristine biological assemblages with which to make comparisons, the accuracy of macroinvertebrate, fish and habitat sampling cannot be

quantified. The accuracy of biological samples must be referred to in terms of the adherence to the quality assurance/quality control objectives.

For discharge (volume of flow per unit time), the accuracy of the method cannot be readily determined because of the fact that this is not a direct measurement. With selection of good cross-sections, and careful measurements of depth and velocity, measured flow shall be within 15% of true flow (Montana Dept. of Environmental Quality, 2002).

The accuracy of field meter readings will be measured via the calibration process.

Bias is evaluated by the use of field and laboratory blanks. To measure field bias, field blanks will be collected using deionized water from Microbac Laboratories, Inc. Lab blanks will be analyzed by Microbac (for e.coli) and ISDH Laboratory (other water chemistry parameters). Acceptable bias is less than 5 times of the method detection. If any contaminant is detected in blanks, the concentration will tagged with a "V" code (value affected by contamination) as per table 9.1. An investigation will be initiated to find the source of the contamination as per Chapter 13. Corrective Action.

To reduce systematic error in biological sampling the following controls will be used:

- Field equipment will be properly maintained and inspected before each sampling event.
- The same identification tools and references will be used for each sample.
- Twenty percent (20%) of the samples will be checked by a second person for identification accuracy.
- Sample events will occur under similar flow conditions. Periods of high flow will be avoided.

3.3. Completeness

Completeness measures the degree of valid data obtained compared to the degree of data that is expect to be obtained under normal operating conditions. Completeness may be reduced by field equipment failure, exceedence of holding times, compromised sample containers, etc. The completeness DQO for field parameters and grab sample collection is 90%; for laboratory analyses, the completeness DQO is 95%.

Equation 3. Percent Completeness

$$\%C = \frac{(M_V)}{(M_P)} \times 100$$

where
%C= completeness (percent)
MV = number of valid measurements
MP = number of planned measurements

%C=(MV/ MP)*100 Excel Formula

Data quality objectives are summarized on the table below.

Table 3.1. Data Quality Objectives

Parameter	Precision	Accuracy	Completeness
Field Parameters			
Dissolved Oxygen (DO)	0.01 mg/L	±0.2 mg/L at ≤ 20 mg/ ±0.6 mg/L at > 20 mg/L	90%
pH	0.01 units	±0.2 units	90%
Temperature (T)	0.01°C	±0.10° C	90%
Specific Conductivity (SC)	4 digits	±1%	90%
Turbidity	3 digits	±2 %	90%
Field Quality			
Dissolved Oxygen (DO)	20 % RPD	90-110%	90%
pH	20 % RPD	90-110%	90%
Temperature (T)	20 % RPD	90-110%	90%
Specific Conductivity (SC)	20 % RPD	90-110%	90%
Turbidity	20 % RPD	90-110%	90%
Laboratory Analysis			
Total Phosphorus (TP)	5%	94-101%	95%
Ortho-Phosphate (PO4)	5%	94-101%	95%
Total Kjeldahl Nitrogen (TKN)	17%	96-108%	95%
Nitrate-Nitrogen (NO3)	5%	97-110%	95%
Total Ammonia (NH4-N)	5%	91-103%	95%
Total Solids (TS)	5%	96-103%	95%
E. coli	1 CFU/ 100 ml.	46 – 119%	95%

3.4. Representativeness

Representativemess expresses the degree to which data accurately and precisely represents the population as a whole, parameter variations at a sampling point, a process condition, or an environmental condition. Monitoring sites will be established that are representative of impaired and un-impaired reaches. Water quality samples will be collected under baseflow and elevated flow conditions to represent water quality over a range of hydrologic conditions.

3.5. Comparability

Comparability expresses the confidence with which one data set can be compared to another data set. The degree to which existing and future analytical data will be comparable depends on the similarity of sampling and analytical methods.

Comparability of the sampling and analytical programs are evaluated separately.

Sampling comparability will be evaluated based on the following:

- A consistent approach to sampling was applied throughout the program
- Sampling was consistent with established methods for the media and analytical procedures
- Samples were properly handled and preserved

Analytical comparability will be evaluated based upon the following:

- Consistent methods for sample preparation and analysis
- Sample preparation and analysis was consistent with specific method requirements
- The analytical results for a given analysis were reported with consistent detection limits and consistent units of measure

4. Sampling Procedures

E. Coli: Grab samples will be collected from the center of channel from bridges using a clean bucket. Samples will be transferred into a pre-labeled, sterile sample container with sodium thiosulfate preservative and stored on ice. Samples will be delivered to Microbac Laboratories in Louisville, KY within the holding time.

Water Quality: Grab samples will be collected from the center of channel from bridges using a clean bucket. Samples will be transferred to clean, pre-labeled sample containers provided by the laboratory and stored on ice. Samples will be shipped on ice to the State Department of Health Laboratory in Indianapolis.

Benthic Macroinvertebrates: Benthic macroinvertebrates will be collected from 5 sites during the sampling period, between July and October. Macroinvertebrate sampling will be conducted during low- to moderate-flow periods. Periods of high flow will be avoided. Samples will be collected with a 500 µm dip-net and preserved in 70% ethanol. Large sticks, rocks, and leaves will be thoroughly washed and removed from the sample. The samples will be returned to the laboratory for sorting, identification, and analysis. Qualitative habitat will be measured using protocols developed by Ohio EPA (1989) and modified by IDEM.

Field Parameters: Field parameters will be collected with a calibrated Hydrolab Minisonde 4a. The instrument will be calibrated using standards that have not expired. Calibration will be perfomed on the day of sampling prior to the collection of field data. If the meter is not operating properly, it will not be used until repairs are made and proper calibration according to the manufactures instructions can be achieved.

Flow: Flow measurements will be collected with a Flow Probe flowmeter. Stream discharge will be calculated by multiplying cross sectional area by flow velocity to obtain discharge in cubic feet per second. Note that discharge data may not be obtained during high flow events due to safety considerations.

Field notebooks will be used by Field Staff to document site conditions and a digital camera will be used to document each sample event. Holding times for each parameter will be printed on each chain of custody sheet. Samples containers will be pre-labeled with a site identification number, date code and a consecutive number.

Sampling procedures for each parameter in the monitoring program are summarized on the table below.

Table 4.1. Sampling Procedures

Parameter	Sample Matrix	Sampling Frequency	Sampling Method	Sample Container	Sample Volume	Holding Time
Dissolved Oxygen (DO)	Water	~1 per month	Field Meter	NA	NA	NA
pH	Water	~1 per month	Field Meter	NA	NA	NA
Temperature (T)	Water	~1 per month	Field Meter	NA	NA	NA
Specific Conductivity (SC)	Water	~1 per month	Field Meter	NA	NA	NA
Turbidity	Water	~1 per month	Field Meter	NA	NA	NA
Total Phosphorus (TP)	Water	~1 per month	Grab Sample	Two 1 liter plastic bottle	2 liters	28 days
Ortho-Phosphate (PO4)	Water	~1 per month	Grab Sample	Two 1 liter plastic bottle	2 liters	48 hrs
Total Kjeldahl Nitrogen (TKN)	Water	~1 per month	Grab Sample	Two 1 liter plastic bottle	2 liters	28 days
Nitrate-Nitrogen (NO3)	Water	~1 per month	Grab Sample	Two 1 liter plastic bottle	2 liters	28 days
Total Ammonia (NH4-N)	Water	~1 per month	Grab Sample	Two 1 liter plastic bottle	2 liters	28 days
Total Solids (TS)	Water	~1 per month	Grab Sample	Two 1 liter plastic bottle	2 liters	7 days
E. coli	Water	5 per month	Grab Sample	Sterile plastic bottle w/ sodium thiosulfate preservative	4 oz.	6 hours
Benthic Macroinvertebrate	Biological	1	Dip Net	NA	NA	

5. Sample Custody Procedures

E. Coli: Samples will remain in the custody of the field staff until relinquished to the laboratory, Microbac Laboratories, Louisville, KY. Chain of Custody forms provided by the laboratory will be used to document a responsible person, date and time for each step of the custody process.

Water Quality Samples will remain in the custody of the field staff until mailed to the Indiana State Department of Health Laboratory, Indianapolis, IN. Chain of Custody forms provided by the laboratory will be enclosed with the shipment of samples and used to document a responsible person, date and time for each step of the custody process.

6. Calibration Procedures and Frequency

Each field and laboratory instrument will be calibrated once per day prior to use with calibration standards within shelf-life and according to manufacturing specifications. Calibration standards that have exceeded shelf-life will not be used. If an instrument cannot be calibrated, it will be serviced or repaired prior to use.

7. Sample Analysis Procedures

Analytical procedures are described on the table below.

Table 7.1. Analytical Procedures

Parameter	Analytical Method	Performance Range or Detection Limits/ Reporting Limits	Units
Dissolved Oxygen (DO)	Hydrolab Minisonde 4a Users Manual April 1998 EPA 360.1	0 to 50	mg/L
pH	Hydrolab Minisonde 4a Users Manual April 1998 EPA 150.1	0 to 14	S.U.
Temperature (T)	Hydrolab Minisonde 4a Users Manual April 1998 EPA 170.1	-5 to 50	°C
Specific Conductivity (SC)	Hydrolab Minisonde 4a Users Manual April 1998 EPA 120.1	0 to 100	mS/cm
Turbidity	LaMotte 2020 Turbidimeter EPA 180.1	0-1,100	NTU
Total Phosphorus (TP)	EPA 365.1	0.03 RL	mg/L
Ortho-Phosphate (PO4)	EPA 365.1	0.03 RL	mg/L
Total Kjeldahl Nitrogen (TKN)	EPA 351.2	0.1 RL	mg/L
Nitrate-Nitrogen (NO3)	EPA 353.1	0.1 RL	mg/L
Total Ammonia (NH4-N)	EPA 350.1	0.1 RL	mg/L
Total Solids (TS)	EPA 160.3	10.0 RL	mg/L
E. coli	EPA 1603	1 CFU/ 100 ml.	CFU
Habitat	QHEI	N/A	N/A
Benthic Macroinvertebrate	IDEM Macro Program SOPs Dufour, Ronda. (Undated) *Guide to Appropriate Metric Selection for Calculating the macroinvertebrate Index of Biotic Integrity (mIBI) for Indiana Rivers and Streams*.	N/A	N/A
Flow	FP101-FP201 Global Flow Probe User's Manual 2004	0.3-15	FPS

Biological: Each macroinvertebrate sample will be analyzed using the following metrics: taxa richness (TR), Ephemeroptera-Trichoptera-Plecoptera index (EPT), percent EPT (EPT%), Hilsenhoff Biotic index (HBI), and percent clingers (CL%).

8. Quality Control Procedures

Quality control procedures are summarized on the table below.

Table 8.1. Quality Control Procedures

Quality Control Procedures	Frequency
Field sampling technique documentation	QAPP approved prior to initial sampling
Laboratory Accuracy and Precision Capability	As per Laboratory QAPP and SOP
Field Blanks	E. Coli – one blank Water Quality – one (1) blank, analyzed for six (6) parameters
Field Duplicate	Bacteria – five (5) field duplicate samples (10%) Water Quality- 1 low flow field duplicate, 2 elevated flow field duplicates, each analyzed for 6 parameters (36 results, 10%) Habitat – 1 field duplicate (20%) Biological – one (1) sample (20%) will be identified by two scientists
Equipment / Instrument Calibration	Day of use according to manufacturer's instructions
Laboratory Method Blank	As per Laboratory QAPP and SOP
Laboratory Duplicate	As per Laboratory QAPP and SOP
Laboratory Matrix Spike	As per Laboratory QAPP and SOP
Laboratory Control Standard	As per Laboratory QAPP and SOP
Laboratory Quality Control Standard	As per Laboratory QAPP and SOP
System Audit	To be performed if DQOs are not met

9. Data Review, Reduction, Analysis, and Reporting

9.1. Data Review

After each sample event, field data sheets, chain of custody and laboratory records will be reviewed by the project Quality Control officers for adherence to this Quality Assurance Project Plan. Raw data will be compared to data quality objectives identified in Chapter 3 and data that do not meet the specified DQOs will be identified with a data flag.

Field data and chain of custody review will occur after each sample event. Laboratory data review will occur as each batch of data is received. Investigation of data quality issues will occur prior to the next sample event.

The USGS National Water Information System (NWIS) codes will be used to identify result values that may require additional consideration from a quality assurance perspective. Data Qualifier Codes are shown on the table below**.** The NWIS codes can be found at: http://waterdata.usgs.gov/nwis/help?codes_help

Table 9.1. Data Qualifier Codes

Code	Definition	Notes
<	Actual value known to be less than the value shown	Measured value is less than the Method Detection Limit (MDL) and the MDL is reported
>	Actual value is known to be greater than the value shown	Measured value is greater than the analytical range and the highest measurable concentration is reported
A	Arithmetic Mean	
E	Estimated value	Use if holding time is exceeded
G	Geometric Mean	
K	Colony count is outside the accepted range for the analytical method	
V	Value affected by contamination	Analyte was detected in both the environmental sample and associated blanks

9.2. Data Reduction

For each parameter, basic summary statistics will be calculated, including number of measurements, minimum, maximum, average, median, number and percent of values meeting and exceeding water quality criteria or other non-regulatory water quality comparison value (See **Appendix B**).

The percent saturation of dissolved oxygen (% DO saturation) and concentration of un-ionized ammonia will be calculated.

9.3. Data Analysis

The percent (%) difference between baseflow and elevated flow samples will be evaluated using t-test. Results from stations with statistically significant differences will be used to evaluate relative importance of point source and nonpoint source contributions to in-stream concentrations. To the extent possible, sources of e. coli will be identified through watershed assessments using GIS data.

Data will be analyzed using IDEM protocols specified in *Appendix C: Indiana's 305(b) Assessment and 303(d) Listing Methodology, 2006*, or most recent update as appropriate. If data indicate that water quality has improved, the Project Manager will work cooperatively with IDEM to pursue de-listing.

9.4. Data Reporting

Data will be presented in a water quality monitoring report to be developed as a component of the Indian Creek Watershed Management Plan. Reporting will include sample results, quality assurance review and data interpretation.

10. Performance and System Audits

Performance and System Audits will be conducted if the Data Quality Objectives in Chapter 3 are not met on a consistent basis. Audits will be conducted by the Quality Control Officer and assistance from IDEM may be requested. IDEM reserves the right to conduct external performance and/or systems audits of any component of this study.

The audit reviews, but is not limited to, the following items:

1. Calibration procedures and documentation;
2. Data review and validation procedures;
3. Data storage, filing, and record keeping procedures;
4. Chain of custody procedures;
5. Standard Operating Procedures;
    a. Sample collection
    b. Chain of Custody sample login
    c. Sample preparation
    d. Analytical Procedures
    e. Quality Assurance/Quality Control Procedures
    f. Sample Container Preparation
6. Documentation;
    a. Bench Sheets
    b. Computer Entry for Sample Login
    c. Sample Analysis
7. Sample Storage;
    a. Adequate storage space (refrigerator, freezer, etc.) to store samples
    b. Stock or Quality Control Standards stored separately from samples
8. QA/QC procedures in the laboratory;
    a. Corrective actions or approved changes made to existing data
9. Maintenance Records:
    a. Provide documentation of all routine and non-routine maintenance on equipment
        and instruments
    b. Instruction/Vendor Manuals on file for equipment and instruments
10. Proficiency Documentation maintains records to demonstrate analysts have been trained in the analytical procedures;
11. Training includes maintaining records relating to additional training and attendance at workshops/seminars by personnel
12. Worksheet Review
13. On-site Analyst Work Review

14. Quality Control Standard Review
15. Annual Review by the Indiana Water Pollution Control Association Laboratory Committee
16. Unknown Sample Accuracy

11. Preventative Maintenance

Preventative maintenance procedures for field equipment are designed to minimize maintenance issues in the field and include the following:

- Perform a calibration check of the hydrolab sonde and flow meter prior to each sample event
- Maintain sufficient parts for equipment as per manufacturer's recommendation, including DO meter membranes and filling solutions.
- Order new replacement parts upon use of in-house replacement parts

Preventative maintenance procedures for laboratory instrument are designed to minimize maintenance issues in the laboratory.

Laboratory instruments will be maintained as per the requirements of the Indiana State Board of Health Laboratory Quality Control Plan and Standard Operating Procedures.

12. Data Quality Assessment

All data will be screened to ensure that it is valid in terms of precision, accuracy and completeness and that it meets the data quality objectives stated in Chapter 3.

12.1. Precision

The Relative Percent Difference of field and laboratory duplicate samples will be used to evaluate precision. The equation and data quality objectives for precision of each parameter are provided in Chapter 3. See Table 3.1 Data Quality Objectives. If precision falls out of limits in table 3.1 corrective action wil be triggered.

The same scientists will perform all habitat assessments.

12.2. Accuracy

The percent recovery of spiked samples will be used to calculate accuracy. The equation and Data Quality Objectives for accuracy are provided in Chapter 3.

Accuracy in macroinvertebrate analysis is dependent on maintenance of standard procedures for sample processing, labeling, sorting, identification, and counts. A definitive measurement of accuracy in biological assessments cannot be made because there is not a "true" value for reference. However, by stressing conformance with the procedures outlined in this plan, we expect to achieve a high degree of accuracy.

See Table 3.1 Data Quality Objectives. If accuracy falls out of limits in table 3.1 corrective action wil be triggered.

12.3. Completeness

Completeness will be assessed by comparing the number of field samples and laboratory results to the Data Quality Objectives contained in this QAPP. The equation and Data Quality Objectives for completeness are provided in Chapter 3.

See Table 3.1 Data Quality Objectives. If completeness is not achieved as required in table 3.1 corrective action wil be triggered.

13. Corrective Action

Quality control issues identified by the field or laboratory teams will be reported immediately to the Quality Control Officers. Corrective action to address identified quality assurance or quality control problems includes performance of a system audit to clearly identify the source of the problem, developing measures to address the problem, communicating the measures through a meeting and written documentation and post-assessments to ensure that data quality objectives are met. Corrective actions (as necessary) will be initiated prior to the next sample event.

14. Quality Assurance Reports

The status of the data with respect to data quality objectives will be discussed in a section of each data report. The report section will discuss the results of the data quality assessment conducted as per Chapter 12 and Corrective Actions if needed, as per Chapter 13 of the most recent Quality Assurance Project Plan.

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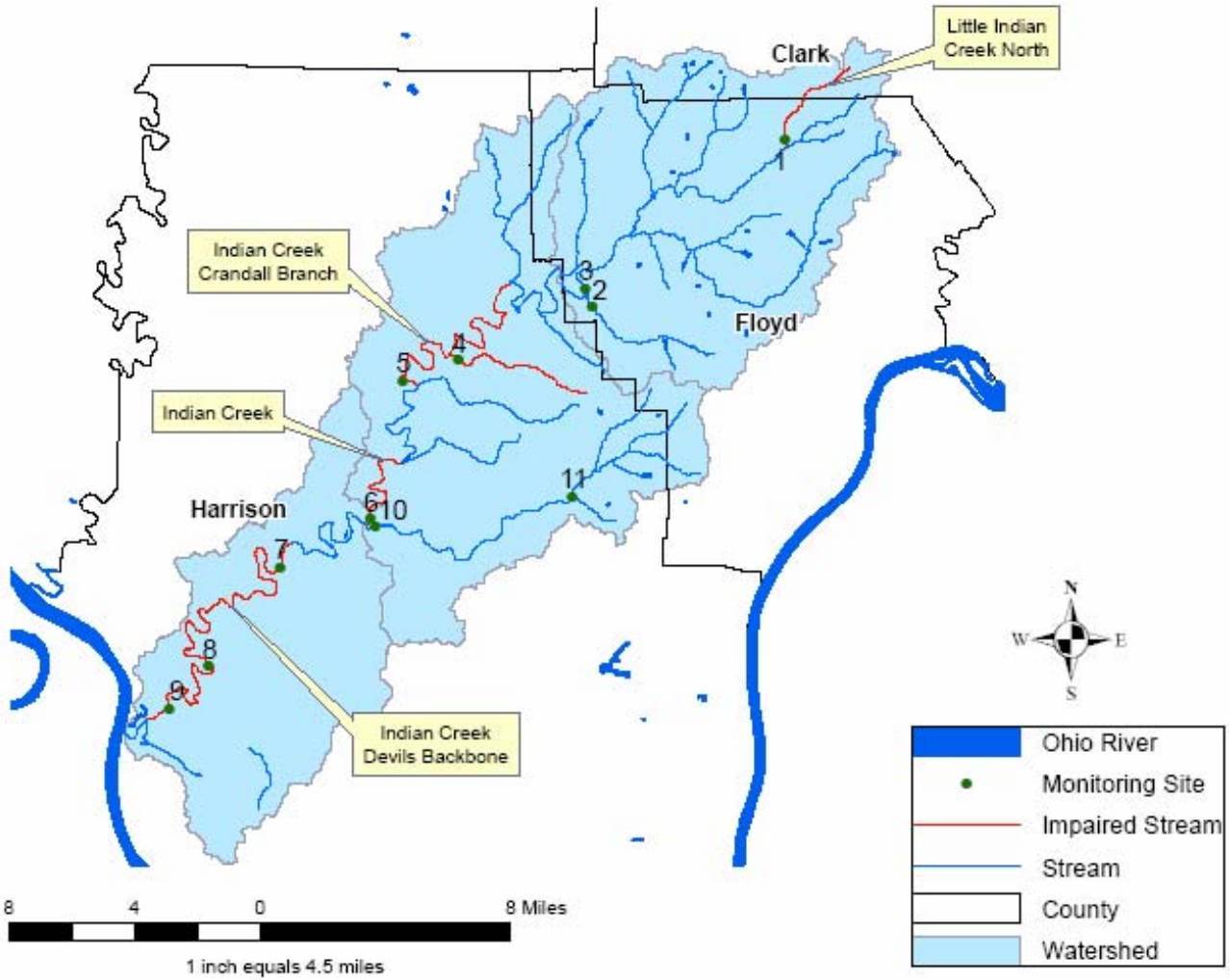
Appendix A

Indian Creek Sampling Sites

Indian Creek Watershed Monitoring Sites



Appendix B

Water Quality Criteria and Other Comparison Values

Parameter (Units)	Warm Water Aquatic Habitat Acute Criterion	Warm Water Aquatic Habitat Chronic Criterion	Domestic Water Supply Source	Other Comparison Value	Notes
Dissolved Oxygen (DO) (mg/L)	≥ 4.0 instantaneous	≥5.0 daily avg.	NA	>12 mg	**Comparison Value:** From IDEM, 2006 Integrated Report, Appendix C.
% DO Saturation	NA	NA	NA	<60% or >120%	% DO Saturation less than 60% or greater than 120% generally indicates eutrophication
pH (pH units)	≥ 6.0 and ≤ 9.0	NA	NA		
Temperature (°C)	See Table Below				
Specific Conductance (µS/cm @ 25 °C)	1,200	NA	NA		
Turbidity (NTU)	NA	NA	NA	5 – 25 NTU	**Comparison Value:** 5 NTU was recommended by AWWA, 1990 for recreation and 25 NTU was recommended by Harvey, 1989 for aquatic life
Total Solids (TS) (mg/L)	NA	NA	NA	261 mg/L	**Comparison Value:** Median of 99 results from the Indian Creek Watershed (4/7/99 to 2/8/06). Data collected by IDEM.
E. coli (CFU/100 ml)	**April 1 – Oct 31:** Geomean ≤ 125 / 100 ml and no single sample can exceed 576 / 100 ml		NA	NA	Geometric mean (geomean) based on a minimum of 5 samples in 30 days.
Total Kjeldahl Nitrogen (TKN) (mg/L)				0.26 – 0.50 mg/L	**Comparison Value:** < 0.25 mg/L was recommended by NHDES as ideal, with 0.26 – 0.50 mg/L recognized as an average value.
Nitrate-Nitrogen (NO3-N) (mg/L)	10	NA	NA	5 mg/L	**Comparison Value:** Concentrations greater than 5 mg/L trigger additional monitoring in finished drinking water.

Parameter (Units)	Warm Water Aquatic Habitat Acute Criterion	Warm Water Aquatic Habitat Chronic Criterion	Domestic Water Supply Source	Other Comparison Value	Notes
Ammonia-Nitrogen (NH4-N)					Un-ionized ammonia concentration is calculated using the equation below and compared to criteria tables in 327 IAC 2-1-6
Total Phosphorus (TP) (mg/L)	NA	NA	NA	0.3 mg/L	**Comparison Value:** From IDEM, 2006 Integrated Report, Appendix C.

Table 6-4

	Ohio River Main Stem °F(°C)	Other Indiana Streams °F(°C)
January	50 (10.0)	50 (10.0)
February	50 (10.0)	50 (10.0)
March	60 (15.6)	60 (15.6)
April	70 (21.1)	70 (21.1)
May	80 (26.7)	80 (26.7)
June	87 (30.6)	90 (32.2)
July	89 (31.7)	90 (32.2)
August	89 (31.7)	90 (32.2)
September	87 (30.7)	90 (32.2)
October	78 (25.6)	78 (25.5)
November	70 (21.1)	70 (21.1)
December	57 (14.0)	57 (14.0)

***To calculate total ammonia, divide the number in the table by the value determined by: $1/(10^{pK_a - pH} + 1)$.

Where: pK_a = $0.09018 + (2729.92/(T + 273.2))$

pH = pH of water

T = °C

DO at 100% saturation based on temperature is shown on the table below. % DO saturation is also affected by barometric pressure. More detailed tables that include this effect have been published by USGS, 1998.

DO (mg/L) at 100% Saturation

$$DO\ (percent\ saturation) = \frac{measured\ DO\ (mg/L)}{DO\ (mg/L\ at\ 100\ percent\ saturation)} \times 100$$

Temperature (°C)	DO (mg/l)	Temperature (°C)	DO (mg/l)
0	14.60	23	8.56
1	14.19	24	8.40
2	13.81	25	8.24
3	13.44	26	8.09
4	13.09	27	7.95
5	12.75	28	7.81
6	12.43	29	7.67
7	12.12	30	7.54
8	11.83	31	7.41
9	11.55	32	7.28
10	11.27	33	7.16
11	11.01	34	7.16
12	10.76	35	6.93
13	10.52	36	6.82
14	10.29	37	6.71
15	10.07	38	6.61
16	9.85	39	6.51
17	9.65	40	6.41
18	9.45	41	6.41
19	9.26	42	6.22
20	9.07	43	6.13
21	8.90	44	6.04
22	8.72	45	5.95

Appendix C

Microbac Laboratories, Inc., KTL Division, Standard Operating Procedures and Registration

E. coli MF (using modified mTEC agar)

PREPARED BY: Alison Schleck
APPROVED BY: Dee Cutrera
SUPERCEDES:
REFERENCES: EPA 1603
APPLICATION: Ambient Water and Wastewater
CONC. RANGE: N/A

1. PRELIMINARY COMMENTS

This method is approved for LT2 testing. Method 1603 describes a membrane filter (MF) procedure for the detection and enumeration of Escherichia coli in ambient waters and disinfected wastewater. This method is a single-step modification of EPA method 1103.1.

2. PRESERVATION & HOLDING TIMES

Samples should be held at <10°C. Sample analysis is preferably begun within 2 hours of collection. The maximum transport time to the laboratory is 6 hours, and samples should be processed within 2 hours of receipt at the lab.

3. INTERFERENCES

4. SAFETY CONSIDERATIONS

All samples should be handled as if they contain pathogens.

5. CLEANING CONSIDERATIONS

Disinfect work area before and after handling each sample.

6. APPARATUS AND EQUIPMENT

6.1 Autoclave
6.2 Water bath capable of maintaining 44.5 ± 0.2°C
6.3 Water bath for tempering agar
6.4 Vacuum source
6.5 Filter flask
6.6 Forceps
6.7 Sterile filtration apparatus
6.8 Magnifying lens or stereoscope
6.9 Thermometer, checked against a NIST certified thermometer, graduated to 0.1 °C.

7. REAGENTS AND SUPPLIES

7.1 Sterile phosphate buffered rinse water with MgCl
7.2 mTEC agar, modified (laboratory or commercially prepared)
  7.2.1 Prepare according to directions on container. Adjust volumes to amount of media needed
  7.2.2 Sterilize by autoclaving
  7.2.3 pH should be 7.3 ± 0.2
  7.2.4 Pour 4-6ml of tempered agar into petri dishes
  7.2.5 Allow to solidify and dry completely. Refrigerate for up to two weeks.
7.3 Sterile disposable plastic petri dishes (50x11mm)
7.4 Sterile borosilicate pipettes (1.00 & 10.0ml)
7.5 Membrane filters, sterile, gridded, 47mm, with 0.45 micron pore size
7.6 Ethanol for flame-sterilizing equipment

8. STANDARDS

8.1 Positive control culture: *Escherichia coli*, ATCC traceable
8.2 Negative control culture: *Enterobacter aerogenes*, ATCC traceable

9. SAMPLE PREPARATION

10. INSTRUMENT CALIBRATION

Refer to SOP Balances Operation and Calibration Program, SOP Thermometers Operation and Calibration Program, SOP Autoclave Market Forge Operation and SOP Thermo pH Meter Operation for specific instrument calibration indications.

11. PROCEDURE

11.1 Place bottom portion of filtration unit on vacuum flask.
11.2 Using sterile forceps, place membrane filter on bottom portion of filtration unit.
11.3 Carefully place top portion of filtration unit on top of filter (do not wrinkle filter) and attach clamp.
11.4 Shake the sample at least 25 times to distribute the bacteria uniformly.
11.5 Measure the desired volume into the funnel and filter under low vacuum. Select sample volumes that will yield counts between 20 and 80 *E.coli* per membrane. A minimum of three dilutions is recommended to ensure that a countable plate is obtained. For volumes of 20ml or less, add 20-30ml sterile buffered rinse water to the filter prior to adding sample aliquot. When sample is completely filtered rinse filter with (2) 20-30ml aliquots of sterile phosphate buffered rinse water with MgCl.
11.6 Turn off the vacuum and remove the top portion of the filtration apparatus.
11.7 Using sterile forceps, transfer filter to petri dish with modified mTEC agar, ensuring that no bubbles are trapped.
11.8 To rejuvenate stressed or injured cells, invert, and incubate for 2 ± 0.5 hours @ 35 ± 0.5°C.
11.9 After a 2 ± 0.5 hour incubation at 35 ± 0.5°C, transfer the plates to a Whirl-Pak® bag, seal and submerge in a 44.5 ± 0.2°C water bath for 22 ± 2 hours.
11.10 Remove plates from the water bath, and count and record the number of red or magenta colonies with the aid of a magnifying lens or stereoscope.
11.11 If required, verify a portion of typical and atypical colonies using Enterotube II, a commercially available multi-test identification system.

12. CALCULATIONS

Colonies per 100ml = C*100/S

Where: C = Colonies Counted
S = Sample Volume (ml)

13. QUALITY ASSURANCE

13.1 Analyst must be trained per DW and LT2 requirements and SOP Training
13.2 Check each batch of media for performance with positive and negative control organisms.
13.3 Each lot of membrane filters is checked for sterility by placing one filter in a non-selective broth and checking for growth (turbidity) after 24 hours incubation at 35±0.5°C.
13.4 Once per month repeat counts will be performed on at least one positive sample and compared with the counts of other analysts. Replicate counts for the same analyst should agree within 5% and those between analysts agree within 10%.
13.5 Each batch of Buffered Rinse water is checked for sterility by adding 50 ml of buffer water to 50 ml TSB 2X and checking for growth (turbidity) after 48 hours incubation at 35 ± 0.5°C.
13.6 All media and supplies shall be checked for sterility and documented in the Sterility Log and/or the Micro Working Reagents Log. Results and date read must be included with the data.
13.7 Each lot of pipets or autoclave batch of pipet tips is checked for sterility by placing one tip in TSB 1X or by repeatedly pipetting TSB through the pipet and checking for growth (turbidity) after 48 hours incubation at 35 ± 0.5°C.
13.8 The filter apparatus is checked for sterility for each filtration series by an initial blank, performing a blank after every 10 samples, and performing a final blank. If a control indicates contamination, the data shall be rejected and a new sample requested.
13.9 Each analyst on record will perform a set of PE or Blind studies every six months.

13.10 An IPR (Initial precision and recovery) study should be conducted by the laboratory prior to running client samples.

14. MAJOR SOURCES OF UNCERTAINTY

14.1. Holding temperature and time
14.2. Interference from other species
14.3. Interference from colloidal or suspended particulate material
14.4. Homogeneity of sample

Help

Logout

LT2 *E. coli* Lab Registration

Thank you for registering your organization as a participating *E. coli* lab for the LT2 Data Collection System. Below is a summary of the information you submitted to the system. Please click the edit link at the bottom of the screen to edit the information, or click the continue link to complete the registration process.

The LT2 Data Collection System has record of the following information for your *E. coli* lab:

Lab ID	KY00074
Lab Name	Microbac Laboratories, Inc. Kentucky Testing Division
Lab Type	*E. coli*, Membrane Filtration
Primary User Name	Delores Cutrera
Mailing Address	3323 Gilmore Industrial Blvd.
City	Louisville
State	KY
Zip Code	40213
Phone Number	5029626400
Fax Number	(502) 962-6411
E-mail	dcutrera@microbac.com

Please send the certification information to LT2ESWTR and Stage 2 DBPR by fax: (937) 586-6557, or by mail: to LT2ESWTR and Stage 2 DBPR ATTN: E. coli LT2 Data Collection and Tracking System Laboratory Registration, P.O. Box 98, Dayton, OH 45401. After certification is verified, the system administrator is notified to activate your laboratory in the system.

Edit Information Continue with Registration

Revised: June 2006
LT2 Technical Support: stage2mdbp@epa.gov