Ohio Environmental Protection Agency

Quality Assurance Project Plan (QAPP) for the Biological and Water Quality Study of the Licking River Watershed, 2025



Ohio EPA Technical Report AMS/2025-LICKG-1

Division of Surface Water

April 2025

TMDL DEVELOPMENT | ●○○○○

Group A: Project Management and Information/Data Quality Objectives

A1. Title Page

Quality Assurance Project Plan (QAPP) for the Biological and Water Quality Study of the Licking River Watershed, 2025

Fairfield, Knox, Licking, Muskingum, and Perry Counties

April 2025

Version 1.0 - Effective 2025

Prepared by:

Ohio Environmental Protection Agency
Division of Surface Water
Lazarus Government Center
50 W. Town Street, Suite 700
Columbus, Ohio 43215

Ohio Environmental Protection Agency
Ecological Assessment Section
4675 Homer Ohio Lane
Groveport, Ohio 43125

Ohio Environmental Protection Agency
Central District Office
50 W. Town Street, Suite 700
Columbus, Ohio 43215

Mail to:
P.O. Box 1049
Columbus, Ohio 43216-1049

R. Mike DeWine
Governor, State of Ohio

John Logue
Director, Ohio Environmental Protection Agency

A2. Approval Page

Quality Assurance Project Plan for the Biological and Water Quality Study of the Licking River Watershed, 2025.

Erin Sherer, Division Assistant Chief — Date: _____

Katherine Harris, DSW Quality Assurance Coordinator — Date: _____

Marissa Ganzfried, Ecological Assessment/Study Coordinator — Date: _____

List of Acronyms

ALU	Aquatic Life Use
AMS	Assessment and Modeling Section
BNA	Base/Neutral and Acid
BOD	Biochemical Oxygen Demand
C	Celsius
cBOD	Carbonaceous Biochemical Oxygen Demand
CWA	Clean Water Act
DDAGW	Division of Drinking and Ground Waters
DES	Division of Environmental Services
DQO	Data Quality Objective
DSW	Division of Surface Water
DO	Dissolved Oxygen
DOC	Dissolved Organic Carbon
EA3	Ecological Assessment and Analysis Application
EPA	Environmental Protection Agency
FEG	Fish Evaluation Group
GFO	Groveport Field Office
GC/MS	Gas Chromatograph/ Mass Spectrometer
H_2SO_4	Sulfuric Acid
HNO_3	Nitric Acid
HUC	Hydrological Unit Code
IBI	Index of Biotic Integrity
ICI	Invertebrate Community Index
ID	Identification
IR	Integrated Report
ITS	Information Technology Services
Mlwb	Modified Index of well-being
NPDES	National Pollutant Discharge Elimination System
NPS	Nonpoint Source
OAC	Ohio Administrative Code
Ohio EPA	Ohio Environmental Protection Agency
QAPP	Quality Assurance Project Plan
QA/QC	Quality Assurance/Quality Control
QAM	Quality Assurance Manager
QHEI	Qualitative Habitat Evaluation Index
PCB	Polychlorinated Biphenyl
pH	Potential Hydrogen
PWS	Public Water Supply
RL	Reporting Limit
RM	River Mile
S-VOCs	Semi-volatile Organic Chemicals
UAA	Use Attainability Analysis
U.S. EPA	United States Environmental Protection Agency
USGS	United States Geological Survey
SM	Standard Method
SOP	Standard Operating Procedure

SO_4	Sulfate
SOCC	State of Ohio Computer Center
TMDL	Total Maximum Daily Load
TOC	Total Organic Carbon
TSD	Technical Support Document
WAU	Watershed Assessment Unit
WQ	Water Quality
WQS	Water Quality Standards
WWTP	Wastewater Treatment Plant

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Document Format

This Quality Assurance Project Plan follows the Quality Assurance Project Plan Standard, Directive Number ***CIO 2105-S-02.0***, effective July 18, 2023.

A4. Project Purpose, Problem Definition, and Background

Watershed Monitoring and Assessment History

As part of Ohio's statewide monitoring strategy, biological and water quality assessments will be performed during the 2025 field season in the Licking River watershed. The study area encompasses Fairfield, Knox, Licking, Muskingum, and Perry counties, spans one 8-digit hydrologic unit code (HUC) and is composed of thirty 12-digit watershed assessment units (WAUs). The WAUs and their descriptions are listed in Table 3, and Figure 2 is a map of the watershed with proposed monitoring stations. Information collected as part of this survey will support the Data Quality Objectives (DQOs) listed in A7.

The biological, chemical, and physical water quality of this study area was last assessed by Ohio EPA in 2008. Of the 89 sites sampled that year, 78 locations (87.6%) were in full attainment, eight locations were in partial attainment (9.0%) and three locations (3.4%) were in non-attainment of Clean Water Act (CWA) goals. The 11 impaired sites were scattered across the basin and were impacted by various causes associated with urban development and rural land use practices including sedimentation/siltation, nutrient and/or organic enrichment, high ammonia, and low dissolved oxygen. A Loading Analysis Plan (LAP) for the Licking River watershed, published by Ohio EPA in 2023, recommends strategies for addressing the documented impairments. The sites impacted by sedimentation/siltation in 2008 will be incorporated into the state's multi-watershed sediment Total Maximum Daily Load (TMDL), which is currently in development. The remaining impaired sites will be resampled and their status updated in the 2025 study. Sites impaired for recreation use (bacteria) in 2008 that are included in the statewide bacteria TMDL will also be revisited in the 2025 study.

In previous surveys, recommendations were made to improve water quality including removing trash from waterways, increasing community stream awareness, and slowing and abating polluted runoff. Multiple implementation projects have been completed within the Licking River watershed to address nonpoint source (NPS) impairments. Nine-Element NPS Implementation Plans have been approved in the South Fork of the Licking River and in Buckeye Lake WAUs. Surface Water Improvement Fund (SWIF) and CWA Section 319 grants have also been awarded to projects in these watersheds to reduce nutrient loads, control stormwater and improve habitat in the Licking River and its tributaries since the last survey was completed. The 2025 survey will, in part, evaluate the collective effectiveness of these projects as well as benchmark present conditions as the watershed continues to experience increased population growth and development.

More information on previous studies conducted in the Licking River watershed by Ohio EPA can be found at ***Ohio EPA's TMDL page***.

A5. Project Task Description

During the 2025 sampling year, the biological, physical, and chemical integrity of the Licking River watershed will be assessed at 93 locations (Figure 2, Appendix 2). The Licking River mainstem begins at the confluence of its North and South forks in Newark and flows southeast to Zanesville where it meets the Muskingum River. Approximately 10 miles of the Licking River is impounded by a dam at RM 6.2 that forms Dillon Lake, which is a flood control and recreation lake managed by the US Army Corps of Engineers and the Ohio Department of Natural Resources. The South Fork Licking River, which is the largest tributary to the Licking River at 287 mi^2, originates in the city of Pataskala and both feeds and receives water from Buckeye Lake. Raccoon Creek, the

third largest tributary in the study area and the largest tributary to the South Fork, drains the rapidly growing communities of Johnstown, Alexandria, and Granville. The North Fork Licking River, which originates in the village of Centerburg, is the second largest tributary to the Licking River at 240 mi^2. The only Public Water Supply (PWS) in the watershed exists in the lower North Fork near the city of Newark. Overall, the study area drains 779 mi^2.

Sampling will be focused largely on biological and habitat monitoring to determine achievement of the designated Aquatic Life Use (ALU) biocriteria. Water chemistry sampling will be conducted watershed-wide to determine whether water quality criteria, where applicable, are exceeded for a given parameter, as well as for generating statistical and weight-of-evidence relationships between the biological communities and ambient chemical concentrations. Water quality sondes and chlorophyll-*a* sampling will be co-located in areas of historical or suspected nutrient over-enrichment. The public water supply intake on the North Fork Licking River will be chemically assessed for the public drinking water supply use. Bacteriological monitoring (*Escherichia coli, or E. coli*) will be conducted in various streams to determine achievement of recreational use criteria as well as update the existing statewide bacteria TMDL. Sport fish will be collected at select locations and their tissues processed for bioaccumulated contaminants pursuant to the human health beneficial use in the Ohio Fish Tissue Consumption Monitoring Program. Select streams that are either unlisted or without verified beneficial uses in the Ohio Water Quality Standards will be also sampled to support appropriate use designation recommendations.

The assessment portion of this project will incorporate biological and chemical data collected in Raccoon Creek by Midwest Biodiversity Institute (MBI) in 2022. MBI performs biological and water quality assessments on par with Ohio EPA's monitoring efforts via Level 3 certification by its scientists in the Ohio Credible Data Program. This data was collected to update attainment of the Warmwater Habitat (WWH) aquatic life use as well as assess potential impacts immediately upstream and downstream from the Johnstown WWTP on Raccoon Creek.

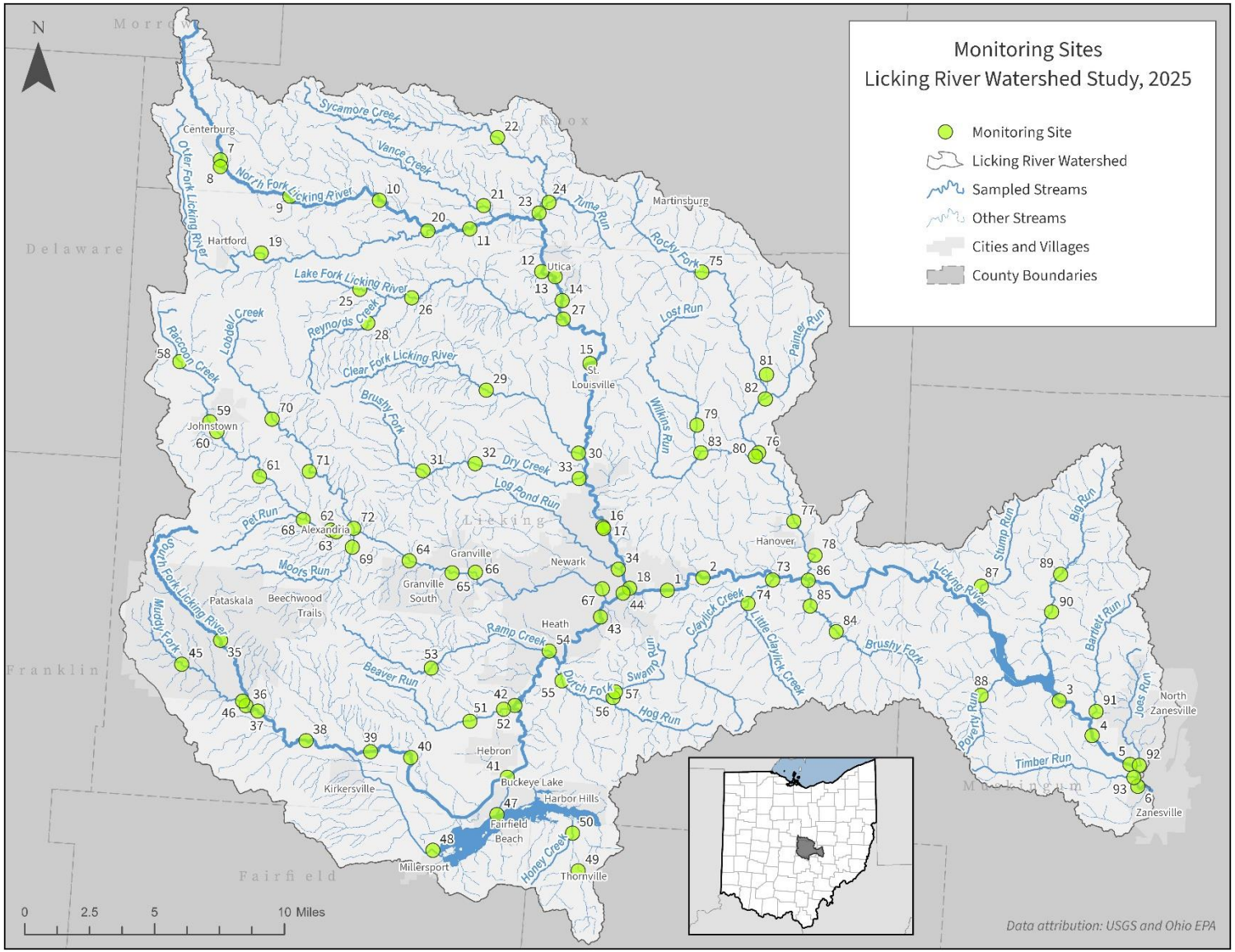
Following the survey, the results of the Licking River watershed study will be synthesized into a Technical Support Document (TSD). While the TSD is the primary support document for the TMDL program, the TSD also supports numerous additional Ohio EPA programs and regulatory actions including but not limited to Director's Orders, National Pollutant Discharge Elimination System (NPDES), Water Quality Standards (WQS), Public Water Supply, Ohio NPS Assessment, and the biennial Integrated Water Quality Monitoring and Assessment Report (305[b] and 303[d] report).

Depending on the sampling type, the field sampling season will run from May 1 to October 31, 2025. The index period for fish and nutrient sampling is during the summer low flow period of June 15 to October 15. The macroinvertebrate sampling index period is slightly shorter, from June 15 to September 30. Bacteria sampling to evaluate recreation use will be conducted within a 90-day period during the recreation season, May 1 to October 31.

Table 3 – List of Watershed Assessment Units (WAU) in Study Area

HUC8	HUC10	HUC12	
05040006	Licking		
	05040006 01	Headwaters North Fork Licking River	
		05040006 01 01	Otter Fork Licking River
		05040006 01 02	Headwaters North Fork Licking River
		05040006 01 03	Sycamore Creek
		05040006 01 04	Vance Creek-North Fork Licking River
	05040006 02	Lake Fork Licking River-North Fork Licking River	
		05040006 02 01	Lake Fork Licking River
		05040006 02 02	Clear Fork Licking River
		05040006 02 03	Dog Hollow Run-North Fork Licking River
		05040006 02 04	Dry Creek
		05040006 02 05	Log Pond Run-North Fork Licking River
	05040006 03	Raccoon Creek	
		05040006 03 01	Headwaters Raccoon Creek
		05040006 03 02	Lobdell Creek
		05040006 03 03	Moots Run-Raccoon Creek
		05040006 03 04	Salt Run-Raccoon Creek
	05040006 04	South Fork Licking River	
		05040006 04 01	Muddy Fork
		05040006 04 02	Headwaters South Fork Licking River
		05040006 04 03	Town of Kirkersville-South Fork Licking River
		05040006 04 04	Buckeye Lake Reservoir Feeder
		05040006 04 05	Buckeye Lake
		05040006 04 06	Bell Run-South Fork Licking River
		05040006 04 07	Ramp Creek
		05040006 04 08	Dutch Fork
		05040006 04 09	Beaver Run-South Fork Licking River
	05040006 05	Rocky Fork-Licking River	
		05040006 05 01	Claylick Creek
		05040006 05 02	Lost Run
		05040006 05 03	Rocky Fork
		05040006 05 04	Bowling Green Run-Licking River
	05040006 06	Big Run-Licking River	
		05040006 06 01	Brushy Fork
		05040006 06 02	Big Run
		05040006 06 03	Dillon Lake-Licking River
		05040006 06 04	Timber Run-Licking River

Figure 2 – Sampling Locations Map. Sample numbers correspond to those listed in Appendix 2.

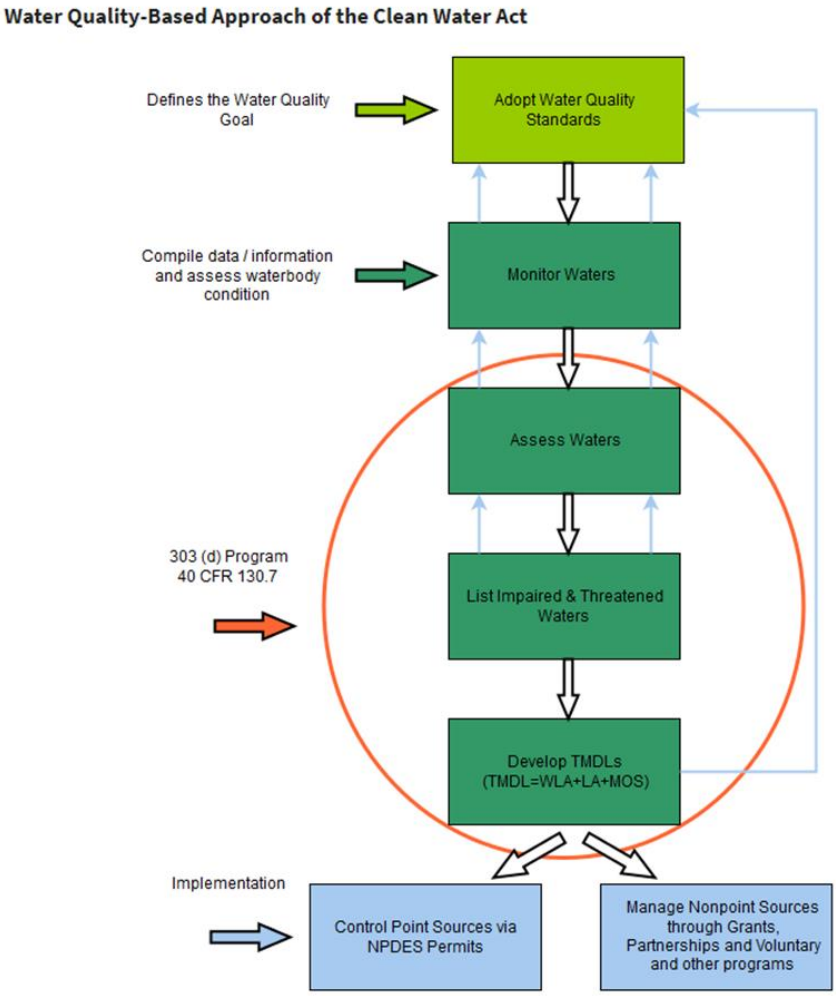


A6. Information/Data Quality Objectives and Performance/Acceptance Criteria

The data collected during this watershed survey fulfills multiple objectives:

- Assess and report on the status of WAUs as required by the Clean Water Act (CWA) 305(b) and 303(d);
- Assess causes and sources of impairment;
- Support water quality standards development;
- Provide data for the Ohio Fish Tissue Consumption Monitoring Program;
- Support the National Permit Discharge Elimination System (NPDES) permitting;
- Revise and/or develop and implement Total Maximum Daily Loads (TMDLs);
- Determine and evaluate water quality trends at watershed, stream, and site level scales.

Figure 3 – Water Quality-Based Approach of the Clean Water Act



Source: ***https://www.epa.gov/tmdl/overview-identifying-and-restoring-impaired-waters-under-section-303d-cwa***

Monitor and Assess Ohio's Waters

Under Section 305(b) of the Clean Water Act (CWA), Ohio EPA is required to assess and report on the quality of Ohio's waters. Ohio EPA determines attainment/non-attainment status of water quality standards in three main ways:

- Three aquatic community indices serve as the principal arbiters of ALU attainment or condition status of Ohio's lotic waters: ***Index of Biotic integrity (IBI), Modified Index of well-being (MIwb) and the Invertebrate Community Index (ICI)***. Where quantitative macrobenthos data are unavailable, corresponding narrative equivalents derived from qualitative sampling are used in lieu of ICI scores. Further explanations of Ohio EPA's biocriteria can be found in ***Ohio Administrative Code (OAC) Chapter 3745-1-07***.
- *E. coli* is used as an indicator to determine attainment/non-attainment of recreational uses as codified in OAC 3745-1-07. Water quality must meet a 90-day geometric mean and a statistical threshold not to be exceeded more than 10% of the time. Each WAU will have at least one site sampled. Most effort will focus on streams with public access that are more highly used for recreation.
- Chemical concentrations in fish tissue are used to determine attainment/non-attainment of non-drinking water human health water quality standards and for the development of fish consumption advisories.

Under Section 303(d) of the CWA, Ohio EPA is federally obligated to list impaired and threatened waters by determining attainment/non-attainment status of water quality standards. To support this objective, the following data is planned to be collected: fish and macroinvertebrate community assemblages, physical stream habitat evaluation (Qualitative Habitat Evaluation Index, or QHEI), organic and inorganic water column chemistry (parameters in Appendix 4), continuous sonde measurements, continuous temperature measurements, *E. coli* bacteria, and fish tissue chemical concentrations.

Assess Causes and Sources of Impairment

Chemical and physical monitoring is a direct measure of the CWA goals and can be used to determine the factors that limit biologic attainment. Specific objectives for each planned measurement are included below:

- **Physical Habitat Assessments:** The Qualitative Habitat Evaluation Index (QHEI) (Rankin 1989, 1995, and Ohio EPA 2006) is a method that evaluates microhabitat necessary to support biological assemblages consistent with Ohio's tiered ALU designations. Channel morphology, lithography, gradient, and riparian conditions are fundamental components of riverine habitat, affecting the diversity, structure, organization, and viability of aquatic communities. Because the QHEI explicitly measures the presence, absence, or relative function of these key attributes, it serves as an important and cost-efficient monitoring tool to describe and rank macrohabitat quality, evaluate habitat effects in surface water assessments, and aid in establishing ALU potential for underperforming waters.
- **Inorganic Surface Water Chemistry:** A standard suite of inorganic surface water chemical parameters will be collected at every site listed in Appendix 2, except one site designated as "PWS" and three sites designated as "B" for the sampling type. Six sites designated as Large River chemistry sites (>500mi^2) will have the standard suite of inorganic water chemistry parameters, as well as additional sampling for Biochemical Oxygen Demand (BOD), bromide, orthophosphate, and sestonic chlorophyll-*a.* Impairment due to chemical contaminants in the water column can be assessed by comparing water column chemical concentrations to numeric criteria in Ohio EPA's rules: aquatic life (Table 35-1), wildlife (Table 35-12), recreation/aesthetics (Table 37-1), water supply (Table 33-1) and human health (Table 34-1).

- **Nutrient Enrichment:** The water quality parameter sondes will be deployed to capture about 48 continuous hours of hourly diel dissolved oxygen flux, pH, temperature, and specific conductance measurements. Benthic and/or sestonic chlorophyll-*a* samples are to be collected during every sonde deployment if site conditions are appropriate. Continuous measurements will be evaluated against water quality criteria and, along with chlorophyll-*a* results, will be used to provide lines of evidence for causes of biological impairment such as nutrient or organic enrichment.
- **Organic Surface Water Chemistry**: Water column samples may be analyzed for organic constituents (see Appendix 4 for parameters) at a subset of sites in Year 2. Sites are selected based on local knowledge of dischargers or legacy issues. Semi-volatile organic carbons (S-VOCs) (U.S. EPA Method 625) testing is generally focused on industrial facilities, municipal areas with categorical users of these constituents, and/or historic reference locations. Once one S-VOC pass is conducted, district WQ staff may evaluate the data to determine whether more passes are necessary. This evaluation should be based on parameters with results above method detection. Herbicide (U.S. EPA Methods 515.1 and 525.2) testing is focused in agricultural areas and used as an indicator of potential overall agrichemical impact to biology. Organochlorine insecticides (U.S. EPA Method 608/8081) mostly are compounds that are no longer used and are typically not water soluble. For that reason, these constituents are generally only sampled if there is evidence of legacy pollution or knowledge of current site conditions warrant an investigation. Each site where pesticides are collected is sampled a minimum of two times. The objective of two passes is to screen whether select organic constituents are present in the water column; a statistic evaluation or geometric mean does not need to be calculated for each site. Samples for agricultural chemicals such as herbicides are collected early in the sampling season to coincide with typical timing of applications.
- **Sediment**: Sediment sampling can be an important component of a pollution monitoring program. The analytical results serve as valuable lines of evidence for identifying impacted areas, determining the magnitude and extent of contamination, and elucidating probable causes and sources of beneficial use impairment that may not be detected in water column sampling alone. Sediment contaminant data can be used to locate historical, intermittent, point and nonpoint contaminant sources, or contaminant concentrations of concern, which include direct discharge, groundwater infiltration, soil erosion, aerial deposition, and sediment translocation and redeposition. Sediment sampling will occur in Year 2 at reference sites and sites where sediment is suspected to contribute to biological impairment.

Support Water Quality Standards Development

- **Use Designations**: All data collected as part of this survey will form the basis of use attainability analyses (UAAs) for unassessed waters, verify or reaffirm existing beneficial uses, or readjust the current ALU designations as appropriate for updates to the WQS.
- **Antidegradation**: The collection of biological and habitat data will support updates to the State's list of special high-quality waters.

Provide Data for the Ohio Fish Tissue Consumption Monitoring Program

Fish tissue samples will be collected from 14 locations as part of the Ohio Fish Tissue Consumption Monitoring Program. Sampling locations may vary based on the availability of sport fish collected at each location. Fillet samples of regulation-size sport fish will be tested for organochlorinated pesticides, PCBs, mercury, lead, cadmium, arsenic, and selenium. Results will be used in the Ohio Sport Fish Consumption Advisory Program and used to determine attainment status of non-drinking water human health criteria in the Integrated Report.

Support NPDES Permitting

A list of NPDES-permitted dischargers in the survey area is presented in Appendix 3. Survey data will be collected to provide the NDPES program with necessary biological and/or chemical sampling data. Seven entities will be bracketed (sampling upstream/downstream from the discharge outfall) in this survey, including Pataskala, Buckeye Lake, Licking Regional Water District, Heath, Hebron, Newark, and Casting Solutions.

There are two locations within the survey area where new municipal WWTPs are proposed. This study will include short-term (i.e., 7 to 9 months) streamflow gaging in Moots Run and Pet Run where these WWTPs are slated to discharge. This involves the installation of a water level logger at two assessment sites. These loggers will record the water stage every 15 minutes at a fixed location in each of these streams. Streamflow measurements throughout the hydrograph will allow these stage measurements to be converted into a continuous record of streamflow. Additionally, due to the small size of these watersheds, water detection loggers will be installed upstream of the proposed short-term gaging sites to provide information about if and when the various tributaries feeding the gaged locations dry up at any point during the 2025 season. This streamflow gaging will allow a comparison of the hydrology of these tributaries to long-term USGS flow gages on downstream, higher-order streams. This information will be useful in understanding the hydrologic influences of new WWTP were they to be built as well as improving the accuracy of calculating background low streamflow statistics that are needed for permit limit calculations.

TMDL Implementation

The TMDL program, established under Section 303(d) of the Clean Water Act, focuses on identifying and restoring polluted rivers, streams, lakes, and other surface water bodies. TMDLs are prepared for waters identified as impaired on the 303(d) list in the Integrated Report. A TMDL is a written, quantitative assessment of water quality problems in a water body and contributing sources of pollution. It specifies the amount a pollutant needs to be reduced to meet WQS, allocates pollutant load reductions, and provides the basis for taking actions needed to restore a water body. The objectives of the TMDL process are to estimate pollutant loads from the various sources within the basin, define or characterize allowable loads to support the various beneficial uses, and to allocate pollutant loads among different pollutant sources through appropriate controls (e.g., NPDES permitting, storm water management, 319 proposals, NPS controls or other abatement strategies). The components of the TMDL process supported by this survey are

primarily the identification of impaired waters, verification (and re-designation if necessary) of beneficial use designations, gathering ambient information that will factor into the wasteload allocation, and ascribing causes and sources of use impairment. These data are necessary precursors to the development of effective control or abatement strategies.

A7. Distribution List

This QAPP will be distributed to the following division management and staff, saved on the Division of Surface Water (DSW) collaboration site and posted on the DSW Biological and Water Quality Monitoring and Assessment webpage.

Table 1 — Distribution List

Name/Title	Contact Email/Phone	
DSW Central Office		
Mark Johnson, Environmental Administrator	*mark.johnson@epa.ohio.gov*	614.644.2274
Erin Sherer, Asst. Environmental Administrator	*erin.sherer@epa.ohio.gov*	614.644.2018
Ashley Ward, Asst. Environmental Administrator	*ashley.ward@epa.ohio.gov*	614.644.4852
Joby Jackson, Asst. Environmental Administrator	*joby.jackson@epa.ohio.gov*	937.285.6029
Standards and Technical Support		
Melinda Harris, Environmental Manager	*melinda.harris@epa.ohio.gov*	614.728.1357
Mariah Hood, Environmental Specialist 3	*mariah.hood@epa.ohio.gov*	614.644.2865
Bob Miltner, Environmental Specialist 3	*robert.miltner@epa.ohio.gov*	614.836.8796
Katherine Harris, Environmental Specialist 2	*katherine.harris@epa.ohio.gov*	614.644.2014
Bridget McGovern, Environmental Specialist 2	*bridget.mcgovern@epa.ohio.gov*	614.448.1410
NPDES/Permitting		
Walter Ariss, Environmental Manager	*walter.arriss@epa.ohio.gov*	614.644.3075
John Owen, Environmental Specialist 3	*john.owen@epa.ohio.gov*	614.728.3849
Assessment and Modeling		
Mari Piekutowski, Environmental Manager	*marianne.mansfield@epa.ohio.gov*	614.644.2876
James Kiourtsis, Environmental Supervisor	*james.kiourtsis@epa.ohio.gov*	614.644.2148
Holly Stanley, Environmental Specialist 2	*holly.stanley@epa.ohio.gov*	
Ruth Briland, Environmental Specialist 3	*ruth.briland@epa.ohio.gov*	614.644.2046
Paul Gledhill, Environmental Specialist 3	*paul.gledhill@epa.ohio.gov*	614.644.2881
Ben Rich, Environmental Supervisor	*benjamin.rich@epa.ohio.gov*	614.836.8772
Marissa Ganzfried, Environmental Specialist 2	*marissa.ganzfried@epa.ohio.gov*	
Angela Dripps, Environmental Specialist 2	*angela.dripps@epa.ohio.gov*	614.836.8798
Murphy Coan, Environmental Specialist 2	*murphy.coan@epa.ohio.gov*	614.836.8755
Grace Brubaker, Environmental Specialist 2	*grace.brubaker@epa.ohio.gov*	
Water Quality		
Chloe Welch, Environmental Manager	*chloe.welch@epa.ohio.gov*	614.728.3852
Kelly Capuzzi, Environmental Supervisor	*kelly.capuzzi@epa.ohio.gov*	740.380.5283
Jenna Houdashelt, Environmental Specialist 2	*jenna.houdashelt@epa.ohio.gov*	614.728.3850
Lauren Woodgeard, Environmental Specialist 2	*lauren.woodgeard@epa.ohio.gov*	614.728.3847
TMDL		
Joshua Griffin, Environmental Manager	*joshua.griffin@epa.ohio.gov*	614.644.2874
Shante Eisele, Environmental Specialist 2	*shante.eisele@epa.ohio.gov*	614.644.2001
Division of Environmental Services		
Jennifer Kraft, Environmental Manager	*jennifer.kraft@epa.ohio.gov*	614.644.3020
Steve Roberts, Environmental Supervisor	*steven.roberts@epa.ohio.gov*	614.644.4225
Kristin Sowards, Sample Receiving Coordinator	*kristin.sowards@epa.ohio.gov*	614.644.4243

Name/Title	Contact Email/Phone	
DDAGW Central Office		
Allison Reed, Environmental Manager	***allison.reed@epa.ohio.gov***	937.285.6447
Callie Nauman, Environmental Specialist 2	***callie.nauman@epa.ohio.gov***	614.644.2752

A8. Project Organization

Table 2 — Roles and Responsibilities

Individual(s) Assigned:	Responsible for:	Authorized to:
DSW Central Office Administration		
Mark Johnson DSW Chief	Overall administration of division.	Confirm project existence; approve staff and capital resources; approve plans; edit reports.
Erin Sherer Assistant Chief	Overall administration of division.	Confirm project existence; approve staff and capital resources; approve plans; edit reports.
Ashley Ward Assistant Chief	Overall administration of division.	Confirm project existence; approve staff and capital resources; approve plans; edit reports.
Joby Jackson Assistant Chief	Overall administration of division.	Confirm project existence; approve staff and capital resources; approve plans; edit reports.
Standards and Technical Support		
Melinda Harris Standards and Tech Support Section Manager	Quality management (QAPPs, SOPs); staff training; water quality standard rules.	Approve plans and edit reports.
Mariah Hood Standards and Tech Support Lead Worker	Water quality standard criteria development and rule updates.	Help plan study. Make recommended beneficial use changes.
Bob Miltner Standards and Tech Support Lead Worker	Water quality standard criteria development and rule updates.	Help plan study. Review project actions and documents in relation to listed responsibilities.
Bridget McGovern Standards and Tech Support Staff	Represent agency in fish and wildlife consumption and contact advisory matters.	Help plan study. Make waterbody specific consumption and contact advisory recommendations.
Katherine Harris Standards and Tech Support Staff	DSWs quality management program.	Develop and implement field Quality Assurance/Quality Control (QA/QC) guidelines. Track field QA/QC and staff training.
NPDES/Permitting		
Walter Ariss Municipal NPDES Section Manager	NPDES permitting guidance and rule development.	Ensure NPDES staff involvement in planning, provide technical guidance and communication assistance to project team, and coordinate with NPDES staff to review and edit reports.
John Owen Central District Permits & Enforcement Lead Worker	NPDES permit-related issues.	Obtain wastewater and storm water permit information needed for planning and reporting.
Assessment, Modeling, and TMDL		
Mari Piekutowski Assessment & Modeling Section Manager	Overall management of monitoring section.	Assign staff; approve plans; edit reports.

Individual(s) Assigned:	Responsible for:	Authorized to:
Ruth Briland Ecological Assessment Unit Lead Worker	Track project progress, manage data, create EA3 database queries for reports, and compile information for the Integrated Report.	Create and edit sampling stations in EA3 database, Upload fish, bug, and chemistry data into EA3. Review and comment on reports. Write assigned Integrates Report Sections
Paul Gledhill Modeling Unit Lead Worker	Modeling and assessment technical guidance and review. Dissolved oxygen surveys, stream flow measurements, and chemistry sampling.	Help plan study. Schedule and complete assigned field activities. Tabulate data and write discussion for technical report.
James Kiourtsis Modeling Unit Supervisor	Support modeling field crews with supplies, equipment, and training.	Obtain approvals and signatures; develop budgets; conduct field audits; edit reports.
Holly Stanley Modeling Unit Staff	Conduct dissolved oxygen surveys, stream flow measurements and chemistry sampling.	Help plan study. Schedule and complete assigned field activities. Tabulate data and write discussion for technical report.
Ben Rich Ecological Assessment Unit Supervisor	Support biological field crews with supplies, equipment, and training.	Obtain approvals and signatures; develop budgets; conduct field audits; edit reports.
Marissa Ganzfried Ecological Assessment Unit **Study Coordinator** Macroinvertebrate Crew Leader	Macroinvertebrate population assessments and overall study coordination.	Plan and coordinate study. Schedule and complete assigned field activities. Tabulate data and write discussion for technical report.
Angela Dripps Ecological Assessment Unit Macroinvertebrate Crew Leader	Macroinvertebrate population assessments.	Help plan study. Schedule and complete assigned field activities. Tabulate data and write discussion for technical report.
Murphy Coan Grace Brubaker Ecological Assessment Unit Fish Crew Leaders	Fish population and stream habitat assessments.	Help plan study. Schedule and complete assigned field activities. Tabulate data and write discussion for technical report.
TMDL		
Josh Griffin TMDL and IR Unit Manager	Oversee coordination of biennial Integrated Report; TMDL program development.	Assign and support staff; approve plans; edit reports.
Shante Eisele TMDL & IR Unit Staff	Develop TMDL reports. Oversee data collection and management.	Write assigned TMDL sections. Complete technical data management tasks associated with QA spreadsheet and EA3.
Water Quality		
Chloe Welch Statewide Water Quality Manager	Implement division goals. Support water quality field crews with supplies, equipment, and training.	Review documents and reports; suggest changes and edits; obtain approvals and signatures; develop budgets; conduct field audits.
Kelly Capuzzi Statewide Water Quality Supervisor	Support water quality field crews with supplies, equipment, and training.	Obtain approvals and signatures; develop budgets; conduct field audits; edit reports.

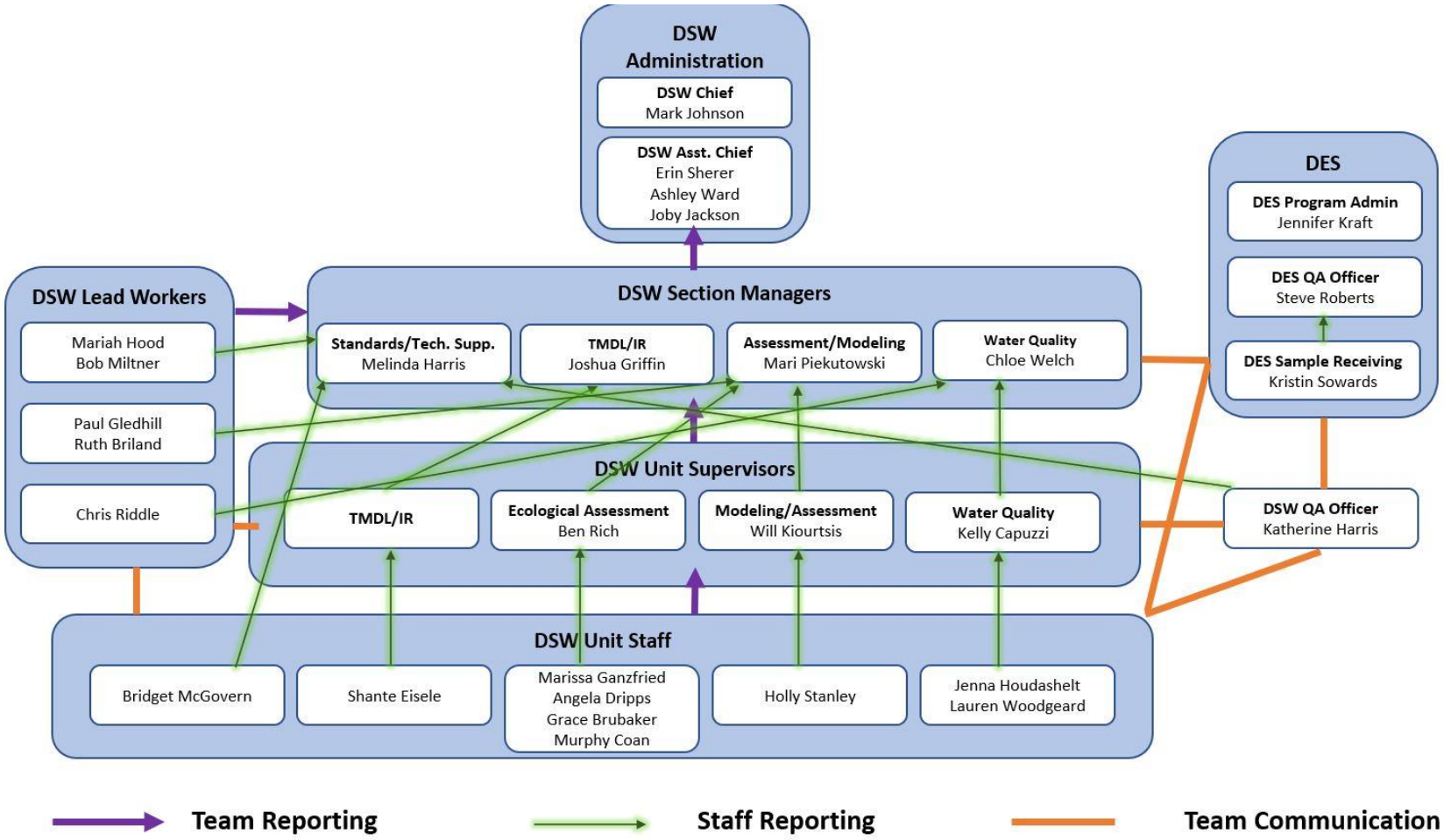
Individual(s) Assigned:	Responsible for:	Authorized to:
Jenna Houdashelt Central District Water Quality Unit	Water and sediment data collection, validation, and management.	Help plan study. Schedule and complete assigned field activities. Tabulate data and write discussion for technical report.
Lauren Woodgeard Central District Water Quality Unit	Water and sediment data collection, validation, and management.	Help plan study. Schedule and complete assigned field activities. Tabulate data and write discussion for technical report.
Division of Environmental Services		
Jennifer Kraft Program Administrator	Overall administration of laboratory activities.	Help solve laboratory information management system problems. Develop analytical methods and SOPs.
Steve Roberts QA Officer	DES quality management program.	Oversee data completeness, validation, and delivery.
Kristin Sowards Sample Receiving Coord.	Intake of laboratory samples, coordination with field staff	Help solve daily sample scheduling and sample submission issues.
Division of Drinking and Ground Waters		
Allison Reed Source Water Characterization and Protection Manager	Management of source water characterization and protection section.	Coordinate with DSW on drinking water intake and inland lake monitoring. Assign staff, approve plans, and edit reports.
Callie Nauman Central Office Emerging Contaminants	Harmful Algal Bloom program implementation	Coordinate with DSW on drinking water intake and inland lake monitoring.

A9. Project Quality Assurance Manager Independence

The Project Quality Assurance Manager (QAM) shall be independent of environmental information operations. The Project QAM's independence is ensured through separation of sections and reporting chains within Ohio EPA's Division of Surface Water. The Project QAM has oversight authority and responsibilities for planning, documenting, coordinating, and assessing effectiveness of the QAPP. The QAM has the authority to access and discuss quality-related issues with senior management outside of the direct supervisory chain as necessary.

A10. Project Organization Chart and Communications

Figure 1 – Organization Chart



A11. Personnel Training/Certification

All staff who conduct surface water sampling, whether from streams or lakes, receive initial training by someone experienced in the proper techniques required, usually a supervisor or veteran employee. Mandatory refresher training is done on an annual basis for all Agency surface water samplers. Annual boating safety refresher training is required by internal safety policy SP 10-12. Employees who operate watercraft must also demonstrate proficiency in boat operation to their supervisor on an annual basis. Supervisors should also conduct an annual field audit to verify standard operating procedures are followed.

A12. Documents and Records

Microsoft® SharePoint is used as a library for documents. Access is through Ohio EPA's Intranet collaboration site.

Examples of documents posted to this location include:

Pre-sampling documents:

- Preliminary information sheets
- Property access forms
- Draft and final QAPP versions

Project documents:

- All data files
- Draft report sections
- Changes to sites, staff, parameters, etc. should be filed in the project folder by the study team leader
- Project photos will be moved to and stored in the Lynx Photo System. All files and original data sheets will be initially retained by Ohio EPA at the Groveport Field Office while the survey report is being finalized in accordance with established retention schedules.
- Long-term survey information and data storage will take place at the State’s Storage Facility in accordance with established retention schedules.

Changes in project leadership or major actions which might affect the DQOs require an updated QAPP and signoff sheet. The study team leader shall retain copies of all management reports, memoranda, and all correspondence between team members.

For analytical samples, the original chain of custody form is delivered to Ohio EPA’s Division of Environmental Services (DES) along with the samples and retained according to Agency retention policy. A copy of the form may be kept in a binder by the sample collector as well. After water samples are analyzed and the results are approved by the DES QA Officer, the data will be released to Sample Master® and subsequently uploaded to DSW's Ecological Assessment and Analysis Application (EA3). The sample collector reviews laboratory sheets for completeness and accuracy, validates field QC, adds comments and completes edits if necessary and approves the data sheet. All data approved in EA3 is sent to U.S. EPA's Water Quality Exchange (WQX).

Datalogger stream level (used to calculate discharge), water detection, and temperature data files will be created for each stream location. The district study team will download the data files from the dataloggers and transmit them to the Assessment and Modeling Section staff for data reduction and analysis.

Original fish and QHEI data sheets will be retained at the Groveport Field Office. Data from the field sheet is manually entered into the EA3 database using the appropriate data entry screen. The sheets are double entered to minimize mistakes.

Group B: Implementing Environmental Information Operations

B1. Identification of Project Environmental Information Operations

The site selection process for aquatic life beneficial uses is designed to systematically sample principal streams in the targeted study area with enough locations to ensure alignment with the DQOs listed in Section A7. Principal streams are roughly defined as those that drain a surface area >8 mi^2, though smaller drainages may be sampled as deemed necessary. Each WAU (HUC 12) is independently evaluated to determine its existing, relevant characteristics that contribute to the fulfillment of study objectives. These characteristics include, but are not limited to historical biological impairment, active watershed TMDLs, known and suspected point and nonpoint discharges, land use changes (e.g., agriculture to urban, forest to agriculture, etc.), historical reference sites, unlisted/undesignated streams in the WQS, known restoration activities, and other miscellaneous local impacts that may contribute to beneficial use impairment.

For WAUs with monotonous character (consistent land use, few/no known water quality issues, lack of development, etc.), one sampling location will be placed at or near the HUC outlet, preferably where biological sampling has been historically conducted. Larger, longer streams that flow across multiple WAUs are additionally evaluated holistically to ensure adequate longitudinal sampling coverage. Available USGS gage sites may be selected to obtain accurate stream flow data for load calculation purposes. The site selection process for the recreation beneficial use is designed to obtain a representative picture of conditions in an assessment unit as well as to evaluate areas of significant stream recreation. A minimum of one site per WAU is desired, though more sites may be included as recreation uses deem necessary.

A summary of the planned sampling effort is shown in Appendix 1. A detailed list of sampling sites and the type of sampling at each is shown in Appendix 2. A list of facilities regulated by individual NPDES permit is shown in Appendix 3.

B2. Methods for Environmental Information Acquisition

Stream Habitat Evaluation

Physical habitat is evaluated based on methods described in Qualitative Habitat Evaluation Index (QHEI); Rationale, Methods, and Application (Rankin 1989, 1995, and Ohio EPA 2006). Various attributes of the available habitat are scored based on their overall importance to the establishment of viable, diverse aquatic faunas. Habitat attributes scored include the type and quality of substrate, amount of instream cover, channel morphology, extent of riparian canopy, pool and riffle development and quality and gradient are among the metrics used to evaluate the characteristics of a stream segment, not just the characteristics of a single sampling site.

Biological Community Assessment

Fish and macroinvertebrate sampling protocols are detailed in ***Ohio EPA Biological Criteria for the Protection of Aquatic Life: Volume III. Standardized Biological Field Sampling and Laboratory Methods for Assessing Fish and Macroinvertebrate Communities*** (Ohio EPA 2015b).

A combination of quantitative and qualitative methods will be employed to monitor benthic macroinvertebrate communities. Quantitative collections are made using modified Hester-Dendy multiple plate artificial substrate samplers, typically deployed at most biomonitoring sites draining more than 20 mi^2, or at reference sites regardless of size. Once deployed, artificial substrates are left to colonize, in-stream, for a six-week period. Qualitative sampling will be conducted at all biomonitoring stations. This sampling method consists of a basic inventory of macroinvertebrate taxa from natural substrates, noting dominant taxa among major habitat types.

Fish will be sampled at each designated location using pulsed DC headwater, wading, backpack, or boat electrofishing methods depending on stream size at each sampling zone. Sites may be sampled once, twice, or more through the summer sampling season. Reasons why sites may be sampled twice (or even more) during the sampling index period could include: sites downstream from permitted dischargers, reference site locations, sites that did not meet goals during the first sampling pass, or areas that are prone to greater fluctuations or system instability. Typically, at least four weeks should elapse between sampling at a particular site. The number of passes may be adjusted as necessary based on best professional judgment of the Ohio EPA field staff. Reasons for a single pass monitoring at sites may include extremely difficult or time-consuming access, work delays related to weather, or the emergence of alterations (natural or otherwise) at points of access or sampling reach, rendering replication of the initial effort hazardous or costly. At least 10% of fish sampling locations will receive a second electrofishing sampling event. Fish are processed in the field, which includes identifying each specimen to species level, counting individuals at all sites, weighing individuals at wading and boat sites, and recording external abnormalities. Some specimens are preserved for further identification in the laboratory (if necessary) or to document new or noteworthy species records.

Surface Water

Surface water grab samples will be collected and preserved using appropriate methods as outlined in Version 10.0 of DSW's Surface Water Field Sampling Manual (Ohio EPA 2025). Staff will utilize Version 10.0 or a more

current version when available. This document will henceforth be referred to simply as the *Surface Water Field Sampling Manual*. The *Surface Water Field Sampling Manual* and its Appendices II-VI are published as ***Technical Bulletins*** on Ohio EPA's website.

When feasible, surface water physical and chemical testing will be done to coincide with biological monitoring. Ideally these samples will be collected across a variety of flow conditions. A minimum of five sets of samples will be collected. If this is not feasible, sites where n<3 will be noted in the report to question the validity of any arithmetic or geometric mean calculated.

Inorganic surface water chemical parameters will be collected at every site listed in Appendix 2, except one site designated as "PWS" and three sites designated as "B." Physical water quality measurements will be taken with a multimeter probe each time a grab sample is collected. Analytical methods and laboratory reporting levels for chemical and physical parameters for different media samples collected within the study are listed in Appendix 4.

Surface water grab samples are delivered by field staff or via courier to DES for analyses. Field measurements of dissolved oxygen, pH, temperature and conductivity will be made using properly calibrated YSI® Professional Plus, ProDSS, or EXO meters.

Laboratory reporting limits (RLs) are adequate to evaluate most pollutants. Potential exceptions include nitrate-nitrite and ammonia. It is common for nitrogen to become depleted during the summer in aquatic environments. In instances where a value is needed to calculate a mean concentration and the result is below the RL, the reported "value" will be used in the calculation.

Water Quality Sonde Deployments

A subset of the stream assessment sites are designated as nutrient sites. Continuous multi-parameter measurement sondes will be deployed during stable, baseflow conditions for this assessment. Ideally, two sonde surveys will be carried out at each nutrient assessment site. Water quality sondes will be placed at select locations indicated as a nutrient site on Appendix 2 to evaluate diel measurements of dissolved oxygen, pH, temperature, and conductivity. The goal of each sonde deployment is to capture about 48 continuous hours of hourly measurements. Sestonic and benthic chlorophyll-*a* samples are to be collected during each sonde deployment, as site conditions allow. All sampling, analysis and procedures adhere to those specified in the *Surface Water Field Sampling Manual* and Appendix II of the *Surface Water Field Sampling Manual*. Sections D, E, and G of the *Surface Water Field Sampling Manual* outline equipment preparation, deployment, equipment retrieval, data management, quality control testing, and maintenance.

Stream Discharge (Flow) Gaging

At two of the assessment sites, a stilling well with a level logger will be installed to understand the hydrologic dynamics of these two small watersheds. The determination of site appropriateness will occur after a field reconnaissance trip to the study area. Stilling well and level logger deployments will follow standard methods used by the DSW modeling unit. Stream discharge measurements will occur at these locations to rate the water stage detected by the level loggers. Stream discharge measurements will follow the protocols outlined

in the *Surface Water Field Sampling Manual*. Level logger installation will occur in the spring of 2025 and be removed late in the year prior to ice formation.

Water Detection

Continuous temperature and water-detection sensors will be installed at five of the stream assessment sites in Appendix 2 using Onset HOBO® TidbiT MX Temperature 400' Data Logger. These temperature and water-detection measurements will be collected in glides within the sampling reach. The sampling will be conducted in accordance with procedures outlined in Section E of the *Surface Water Field Sampling Manual*. The loggers are accurate to approximately 0.2°C with an expected drift of approximately 0.1°C per year. Water conductivity level of 100 µS/cm or greater is necessary for reliable detection of water. The water conductivity circuit may not reliably detect water that has frozen around the electrodes, i.e. below 0°C (32°F). Accuracy of the logger will be tested against a calibrated thermometer prior to deployment, ensuring the readings are within the accuracy range provided by the manufacturer. A stream temperature datapoint will be collected every 30 minutes to determine the presence of water for the streams during the same deployment period as the level loggers explained in the above section.

Bacteria

Attainment/non-attainment of recreational uses will be determined using *E. coli* criteria codified in OAC 3745-1-37, Table 37-2. Each WAU will have at least one site sampled. Water quality must meet a 90-day geometric mean and a statistical threshold not to be exceeded more than 10% of the time. Bacteria sampling to evaluate recreation use will be done within a 90-day period that falls from May 1 to October 31. Each site will have at least five sets of *E. coli* samples tested. Water samples will be collected into appropriate containers, cooled to 4°C, and transported to a contract laboratory and/or DES within six hours of sample collection. All samples will be analyzed for *E. coli* bacteria using U.S. EPA-approved methods.

Chlorophyll-*a*

Benthic and sestonic chlorophyll-*a* will be collected, filtered, and preserved using appropriate methods, as outlined in Appendix II of the *Surface Water Field Sampling Manual* and delivered to DES for analyses.

Sediment

Sediment sampling will be conducted in Year 2 at 17 reference sites. For the remaining sites, sediment sampling may be conducted in Year 2 if evaluation of biological, chemical and/or physical data indicate the need for sediment investigation as a potential cause of impairment. Fine-grained, multi-incremental sediment samples will be collected in the upper four inches of bottom material using either decontaminated stainless steel scoops or dredges. Potential sediment sampling parameters are listed in Appendix 4. Collected sediment will be placed into appropriate containers, placed on ice (to maintain <6°C) and delivered to DES for analysis. Sampling and decontamination protocols will follow those listed in Appendix III of the *Surface Water Field Sampling Manual.*

Fish Tissue

Tissue fillet samples will be collected from fish of regulation size and species preferred for analysis may include Spotted Bass (*Micropterus punctatus*), Largemouth Bass (*Micropterus salmoides*), Smallmouth Bass

(*Micropterus dolomieu*), Flathead Catfish (Pylodictus olivaris), Walleye (*Sander vitreus vitreus*), Saugeye (S*ander vitreus vitreus x Sander canadensis*), White Bass (*Morone chrysops*), Common Carp (*Cyprinus carpio*), Freshwater Drum (*Aplodinotus grunniens*), buffalo and Channel Catfish (*Ichtalurus punctatus*). When possible, composite samples (by species) should include a minimum of three fish, yielding at least 150 grams of tissue. At each fish tissue sampling location, an attempt will be made to collect five fish species for analysis. Fish will be collected using standard electrofishing methods (Ohio EPA 2015b). Sampling locations are listed in Appendix 2 and the parameters to be analyzed are listed in Appendix 4. Fish used for tissue analysis will be filleted in the field or at the Ohio EPA Groveport Field Office using decontaminated stainless-steel fillet knives. Samples will be wrapped in aluminum foil, placed in a sealed plastic bag, along with necessary site documentation. Temporary storage in the field may take one of two forms. Samples may be stored on wet ice for a period not exceeding 48 hours. For longer periods of field storage, samples must be placed on dry ice. Collection, decontamination, and field processing of tissue samples will follow protocols listed in the Ohio EPA *Fish Tissue Collection Guidance Manual* (Ohio EPA 2021). From the field, fish tissue samples will be stored and inventoried in chest freezers at the Ohio EPA Groveport Field Office prior to delivery to DES. For more information on inland lakes sampling, please see the *Quality Assurance Project Plan (QAPP) for Inland Lakes Assessments – Statewide Project 2025 (draft, TBD)*.

B3. Integrity of Environmental Information

Sample Master® software is used by DES to manage laboratory information. The sample collector logs into the system and places an order by selecting the appropriate project, stations to be sampled, and test group(s) to be analyzed. The program creates a chain of custody form and container labels for each site.

The analytical methods to be used in this study are provided in Appendix 4 along with the preservatives, holding times, and reporting limits. Standard Operating Procedures (SOPs) for the analytical methods are available upon request.

B4. Quality Control

Stream Habitat Evaluation

To ensure technical proficiency and promote standardized observations between and among all Ohio EPA field staff tasked with macrohabitat assessment, participation in annual QHEI refresher training is required. The training pre-dates the onset of sampling activities by several weeks, is field-based, and typically organized and lead by a senior Fish Evaluation Group (FEG) biologist. Participants are asked to independently generate a QHEI from one or several target stream segments; this followed by a group discussion, on-site, where each component of each of the five metrics that comprise the QHEI are reviewed in detail. In this way, all investigators are obliged to revisit guidance material and reaffirm the various definitions, categories, and related classifications that underpin this key assessment tool. The annual refresher has proved an efficient method to discipline observations made by front-line field staff and as such has served as a practical check on investigator drift.

Water Quality Sonde Deployments

Sondes will be calibrated according to manufacturer specifications prior to deployment. A calibration record is kept for all sondes at the Groveport Field Office (GFO). After each deployment, sondes undergo a precision quality control check. For more details, see Section G of the *Surface Water Field Sampling Manual*. All field quality control requirements and data validation methods are detailed in the *Surface Water Field Sampling Manual* and Appendix VI of the *Surface Water Field Sampling Manual*.

Stream Discharge (Flow) Gaging

Quality assurance methods are carried out during and after streamflow measurements. These are documented in the *Surface Water Field Sampling Manual.* All instruments/equipment will be inspected prior to each use. All field meters are serviced annually to verify that they are operating within specifications. Parts are repaired or replaced at this time if necessary.

Water Detection

The internal clock is not expected to deviate more than about one minute per month. The internal battery should be checked prior to deployment of the logger to ensure there is enough remaining charge to last throughout the planned deployment. The battery check is usually conducted during programming.

The water sensing aspect of the TidbiT MX is verified prior to deployment. This procedure involves putting the probe in and out of water repetitively while tracking the time of each movement. Tap the probe with a dry towel each time is taken out of the water. The record of change should be near instantaneous.

Surface Water Chemistry

Ten percent of the total number of water samples will be submitted to the laboratory as field QC samples. About 5% will be duplicates, including replicates if natural variability is a concern, and about 5% will be blanks, including field blanks and equipment blanks. Matrix spike duplicates will be collected for organic water samples at a minimum of 5%. Data will be validated based on the results of the field QC samples as outlined in Section G and Appendix VI of the *Surface Water Field Sampling Manual*. The laboratory will validate data according to the requirements defined in the applicable analytical method (see Appendix 4). Field instruments will be calibrated according to manufacturer guidelines. Field instruments utilizing electrochemical sensors must be calibrated daily.

Chlorophyll-*a*

Ten percent of the total number of chlorophyll-α samples collected will be QC samples. Approximately 5% will be blanks and 5% will be duplicates. Equipment blanks for benthic and sestonic samples are collected following two separate procedures that are each outlined in Appendix II of the *Surface Water Field Sampling Manual*. Duplicates are collected as two aliquots pulled from the same sample, designed to measure the variability in sample processing (not sample collection). Chlorophyll-α data will be validated based on the results of the blanks and duplicates as outlined in Appendix VI of the *Surface Water Field Sampling Manual*.

Sediment

Ten percent of the number of sediment samples should be collected as QC samples, approximately 5% should be duplicates and 5% equipment blanks. Field duplicate samples are collected to determine laboratory

analytical variability and/or field compositing techniques and of sediment heterogeneity within a single collected sample. QC sampling protocols will follow those listed in Section G and Appendix III of the *Surface Water Field Sampling Manual*. Sediment data will be validated based on the results of the equipment blanks and duplicates as procedures outlined in Appendix VI of the *Surface Water Field Sampling Manual*.

B5. Instruments/Equipment Calibration, Testing, Inspection, and Maintenance

All instruments/equipment will be inspected prior to each use. All field meters are serviced annually by the manufacturer to verify that they are operating within specifications. Parts are repaired or replaced at this time if necessary.

The appropriate calibration procedure, as specified in the instrument's user manual, must be followed. All calibration solutions used will be checked for expiration dates before utilized. All equipment is assigned a logbook that will detail the equipment's calibration and maintenance history. For more details, see Section D of the *Surface Water Field Sampling Manual*. Other equipment used will follow specifications provided in the biological and habitat methods cited.

B6. Inspection/Acceptance of Supplies and Services

Supplies and consumables will be inspected upon receipt by the field sampling teams. Nearly all supplies utilized for this project are maintained and used during Ohio EPA's normal business operations. The field team leaders will be responsible for ensuring that all sample containers and all needed supplies and consumables are available in advance of all field work. It will be their responsibility to maintain and replenish stock when needed. Consumable supplies include, but are not limited to: sample containers, acid preservatives, buffers, filters and miscellaneous supplies such as distilled water, disposable gloves, and towels. Field personnel will confirm that all reagents are within applicable shelf life.

B7. Environmental Information Management

Data collected for this project and other data previously collected by Ohio EPA will be used to develop data summaries for each waterbody.

The data management process is shared by DSW and DES. DES uses Sample Master® software to manage laboratory information and DSW uses the Ecological Assessment and Analysis Application (EA3) to manage data. These programs are linked together to allow the transfer of information between the two systems. EA3 software is used to assign a permanent six-digit station ID number to each sampling location and to create a project name to associate locations so data can subsequently be exported and assessed in groups.

Field measurements are collected instantaneously using a multi-parameter meter and saved in an internal file storage system. These files are downloaded to the manufacturer's software, exported to Microsoft Excel® and then uploaded to Sample Master® so field data can be associated with chemistry data in the database.

Field and chemistry data tabulated in Sample Master® are eventually uploaded into EA3. Then, in EA3, the sample collector will review each data sheet for accuracy, validate field QC, add comments and complete

edits, if necessary, before approving the sheet. This data is then available for use in Integrated Reports (IRs). Once data sheets are approved in EA3, they are batch queried and imported into WQX by the Assessment and Modeling Lead Worker. Imported data is exported to the Water Quality Portal (WQP) by WQX and made available to the public. All agency files are ultimately backed up and housed in the State of Ohio Computer Center (SOCC).

Water quality sonde data are stored on an Ohio EPA-maintained, dedicated SQL database. Level logger, streamflow, and TidbiT water detection data will be maintained on network drives accessible to all DSW staff.

The study coordinator will maintain the project file in a dedicated folder on SharePoint. The goal or objective is to have a complete record of all decisions about modifications of data collection, validation, or interpretation between the QAPP signoff and project report completion. To achieve this, the study coordinator will need to be included on emails or otherwise receive summaries of all actions that meet the above description. Project photos should all be filed in the Lynx photo management system.

Group C: Assessment, Response Actions and Oversight

C1. Assessment and Response Actions

Assessments

Periodic assessment of field sites, field equipment, and laboratory equipment is necessary to ensure that data obtained meets project needs. This is an ongoing process that continues every day during project implementation, as well as on larger scale assessments that take place less frequently (*e.g.*, annually). The assessments generally focus on readiness and consistency of implementation but also are looking for continual improvement opportunities.

Daily assessments (for each day of project activities, as applicable) include assessment of field equipment and supplies, laboratory equipment and supplies, completeness of the day's samples and associated field notes, future needs, etc.

Response Actions

Despite best preparations, assessments may find situations requiring corrective actions. Small day-to-day level assessment findings are often addressed by the individual doing the assessment in the field or in the laboratory and are common enough to the process to not necessitate a formal response.

Laboratory personnel are aware that response may be necessary. Many of these will result in changes to the analytical reporting via data qualifiers and comments. For more information, see Appendix VI of the *Surface Water Field Sampling Manual* if:

- QC data are outside the warning or acceptable windows for precision and accuracy,
- Blanks contain target analytes above acceptable levels,
- Undesirable trends are detected in spike recoveries or relative percent difference (RPD) between duplicates,

- There are unusual changes in detection limits,
- Deficiencies are detected by the laboratory and/or Project QAM during any internal or external audits or from the results of performance evaluation samples, or
- Inquiries concerning data quality are received.

Corrective action implementation will be determined by the likelihood that the situation may affect the quality of the data. Field corrective actions will be brought to the attention of the study team for consideration as to their impact on the data, their potential interest to other sampling teams/subcontractors, any future considerations for process improvement, and for their potential inclusion to the quarterly reports. Laboratory corrective actions will follow regular laboratory procedures and SOPs. Any laboratory corrective action with the potential to affect data quality will be conveyed to the sample collector by the laboratory.

The datalogger installations will be visited periodically over the summer to make sure the logger remains in place within the stream. The dataloggers will be checked as soon as possible after large storm events which may dislodge or bury a logger. It is critical to reset the logger as soon as possible to prevent the loss of no more than several days of the entire data record. Weather and stream conditions will also be monitored if streams are at risk of going dry. Loggers may need to be relocated to deeper pools in the same area.

Reporting and Resolution of Issues

Any audits or other assessments that reveal findings of practice or procedure that do not conform to the written QAPP will be corrected as soon as possible. The study team and Project QAM will be notified regarding deviations.

Data Completeness

Success of the project will be judged by the resulting data fulfilling the needs outlined in the data objectives. Potential data gaps will be monitored as the project progresses and the project schedule will be revised to fill these gaps where they are determined to be significant or to potentially impact the fulfillment of project objectives.

C2. Oversight and Reports to Management

The study coordinator or statewide supervisor will receive regular updates from field staff throughout the sampling season and will report to division management during Senior Management Team meetings. Any problems that jeopardize completion of the project will lead to memorandum and consultation with program management and QA staff.

The final TSD will report all study results and findings. ALU attainment will be determined by biological criteria. Causes and sources of ALU impairment will be identified and supported by water chemistry, sediment chemistry, and stream habitat evaluations. Public water supply use will be determined on surface water chemistry and recreational use will be determined on bacteriological results.

Group D: Environmental Information Review and Usability Determination

D1. Environmental Information Review

Data verification will be conducted by the study team with assistance from other DSW staff. This process will confirm that sample results received are congruent with samples submitted and parameters requested from the laboratory. The process will also result in summaries of any differences between initial sampling and methods planned in the QAPP and results reported and available. Differences may result from samples not being collected (due to weather, scheduling, etc.), samples not being submitted (due to accidents like broken containers, or delays resulting in exceedance of holding times, etc.), problems at the laboratory (methods changing, containers or equipment breaking), or other reasons. It is also possible that additional sampling would take place because of field observations/conditions. Documenting deviations from the QAPP is the responsibility of the study coordinator.

The DES laboratory does the initial validation on all data and may qualify data based on laboratory QA/QC alone or with feedback from the sampler (regarding specific sampling procedures, variable sampling matrix, conditions, blank contamination, duplicate agreement, matrix spike recovery, etc.). The data user can evaluate the data given their knowledge of sampling conditions, expected variability given location and matrix, data uses, etc.

All fish, macroinvertebrate, and habitat data are hand-entered into the EA3 database using a double data entry method. This helps to minimize data entry errors. Final approval of data involves a reconciliation between the paper forms and the electronic data which is completed by the data collector or a database administrator in the Ecological Assessment Unit.

Upon approval in EA3, field and laboratory data cannot be revised without intervention from database administrators in the Agency's Office of Information Technology Services (ITS).

D2. Useability Determination

Biological and habitat field sampling results will be verified and validated based on field staff experience and qualifications and adherence to training and QA/QC procedures for current and new field staff available in Subsection 1, Part A (macroinvertebrates) and Subsection 2, Part A (Fish and Habitat) in *Biological Criteria for the Protection of Aquatic Life: Volume III. Standardized Biological Field Sampling and Laboratory Methods for Assessing Fish and Macroinvertebrate Communities*.

In addition to verifying data completeness, the study team will oversee data validation for the project that will include confirmation of sample holding times, proper preservatives, sample containers, analysis methods, QA/QC results (including assessment of results for blanks, spikes, and duplicates), etc. This will be an ongoing effort.

The study team will make final decisions regarding validity and usability and will evaluate the sample collection, analysis, and data reporting processes to determine if the data is of sufficient quality to meet the project objectives. Data validation involves all procedures used to accept or reject data after collection and prior to use. These include screening, editing, verifying, and reviewing. Data validation procedures ensure that objectives for data precision and bias will be met, that data will be generated in accordance with the QAPP and SOPs, and that data are traceable and defensible. The process is both qualitative and quantitative and is used to evaluate the project.

The laboratory QA staff will conduct a systematic review of the analytical data for compliance with the established QC criteria using batch and sample QA/QC information including spike, duplicate, and blank results. All technical holding times will be reviewed, the laboratory analytical instrument performance will be evaluated, and results of initial and continuing calibration will be reviewed and evaluated.

Field QC sample results will be evaluated using procedures available in Appendix VI of the *Surface Water Field Sampling Manual*. Much of this work is facilitated by a centralized automated QC data evaluation Excel file. Use of this file is explained in the document "QC Tracking and Data Qualification" available in SharePoint in DSW Quality Management/Documents/DSW Procedures.

For most DSW chemical water quality data, data validation is generally confined to evaluation of blank results, duplicate/replicate results, paired parameter results, and confirming that samples were properly preserved/prepared (including filtration, *etc*. – if indicated by the method). Standards for evaluation of analytical results of those QC sample types and general field samples are described in Section G and Appendix VI of the *Surface Water Field Sampling Manual*.

Issues related to biological and habitat data uncertainty, including any patterns of analytical or field QC uncertainties, will be assessed by field staff and their management. For most situations, issues can be addressed with acknowledgement of factors captured in the sample metadata which can confirm, explain, and document the data quality concern. Significant, persistent, or unresolved issues will be brought to the attention of the project study team, division QC personnel, and Ecological Assessment Unit and/or DSW management for further evaluation. This combination of personnel will assess how to best label affected data for storage in the EA3 database and how to eliminate or limit any similar problems going forward. Consideration will also be given on how best to memorialize data limitations or anomalies as the data is transferred to other databases, including the WQ Portal, so that future users of the sampling data are aware of any data quality issues or limitations.

Appendix 1. Summary of Sampling Effort

Type of Sample	# of sites	# of passes or HD Equivalents[1]	Total #
Biology			
Fish	83 (+8 resampled)	1	91
Macroinvertebrate (Quantitative)	43	43	56 Total HD Equivalents
Macroinvertebrate (Qualitative)	40	13	
Fish Tissue			
Fish Tissue	14	1	14
Water Quality			
Inorganic Samples	89	5	445
Nutrient (sonde deployment & Chlorophyll-*a*)	54	At least 1	At least 54
Semi-volatile Organic Samples (BNA)	0	0	0
Herbicides/Insecticides	0	0	0
Drinking Water Intake	1	5	5
Temperature Dataloggers			
Sediment Quality			
Metals	17	1	17
Pesticides/PCBs and Semi-volatile Organics	17	1	17
Bacteria			
E. coli Cultures	43	5	215

1 – Hester Dendy (HD) equivalents = Quant Total + (Qual Total/3). This is an estimate of macroinvertebrate lab processing effort and is based on the effort of processing three qualitative samples, which is approximately equal to the effort required to process one full quantitative HD site in the lab.

Appendix 2. Streams, Sampling Locations, and Sampling Types

Station	River Code	Site Name	River Mile	Area (mi2)	HUC12	County	Latitude	Longitude	Sampling	Map #
R13W07R	17-200-000	LICKING R. 0.1 MI. UPST. NEWARK WWTP	28.65	531.00	05040006 05 04	Licking	40.052400	-82.364500	F,QT,LR,S,N	1
601770	17-200-000	LICKING R. NEAR NEWARK @ ST. RT. 16 (STADDEN BRIDGE)	26.75	537.00	05040006 05 04	Licking	40.059357	-82.338680	F,FT,QT,B,LR,N	2
R13S28R	17-200-000	LICKING R. @ DILLON DAM	6.20	742.00	05040006 06 04	Muskingum	39.990176	-82.080210	F,FT,QT,B,LR,N	3
R13S27R	17-200-000	LICKING R. AT DILLON FALLS @ DILLON FALLS RD.	3.68	753.00	05040006 06 04	Muskingum	39.970700	-82.056500	F,QT,B,LR,S,N	4
R13S34	17-200-000	LICKING R. AT ZANESVILLE, DST. BURNHAM BOILER	1.70	755.00	05040006 06 04	Muskingum	39.954500	-82.029200	F,QT,LR,N	5
R13P13	17-200-000	LICKING R. AT ZANESVILLE @ STATE ST.	0.56	775.00	05040006 06 04	Muskingum	39.942200	-82.023600	F,FT,QT,B,LR,N	6
R13W38R	17-250-000	N. FK. LICKING R. UPST. CENTERBURG WWTP TRIB @ CROTON RD.	38.20	6.30	05040006 01 02	Knox	40.292200	-82.689700	F,QT,C,S,N	7
R13W35	17-250-000	N. FK. LICKING R. DST. CENTERBURG WWTP TRIB @ CROTON RD.	37.91	7.20	05040006 01 02	Knox	40.288350	-82.689650	F,QT,C,N	8
300443	17-250-000	N. FK. LICKING R. @ DUTCH CROSS RD.	33.80	16.80	05040006 01 02	Licking	40.272000	-82.639000	C	9
300444	17-250-000	N. FK. LICKING R. @ MINK ST.	28.90	28.60	05040006 01 02	Knox	40.269800	-82.573900	F,QL,B,C	10
R13S12R	17-250-000	N. FK. LICKING R. DST. HOMER @ TWP. RD. 70	23.90	64.00	05040006 01 04	Licking	40.253900	-82.508100	F,FT,QT,B,C,S	11
R99Q32	17-250-000	N. FK. LICKING R. AT UTICA @ U.S. RT. 62	17.70	115.00	05040006 02 03	Licking	40.230000	-82.455600	F,FT,QT,C	12
R13S06	17-250-000	N. FK. LICKING R. DST. UTICA WWTP	17.10	116.00	05040006 02 03	Licking	40.227200	-82.445800	F,QT,C,N	13

Station	River Code	Site Name	River Mile	Area (mi2)	HUC12	County	Latitude	Longitude	Sampling	Map #
R13S05	17-250-000	N. FK. LICKING R. DST. UTICA @ GINGER HILL RD.	15.50	119.00	05040006 02 03	Licking	40.213900	-82.440800	F,QT,C,N	14
R13S04R	17-250-000	N. FK. LICKING R. UPST ST. LOUISVILLE @ ST. RT. 13	11.13	158.00	05040006 02 03	Licking	40.178900	-82.420600	F,FT,QT,B,C,S	15
R13S02	17-250-000	N. FK. LICKING R. AT NEWARK @ HORNS HILL RD.	2.90	225.90	05040006 02 05	Licking	40.087808	-82.411364	B,PWS	16
R13P04R	17-250-000	N. FK. LICKING R. AT NEWARK @ WATER WORKS RD.	2.82	229.00	05040006 02 05	Licking	40.086900	-82.410700	F,FT,QT,C,S	17
R13S01	17-250-000	N. FK. LICKING R. AT NEWARK @ OHIO ST.	0.05	241.00	05040006 02 05	Licking	40.053600	-82.391900	F,FT,QT,B,C	18
300445	17-267-000	OTTER FORK LICKING R. E OF HARTFORD @ CROUSE-WILLISON RD.	9.28	14.70	05040006 01 01	Licking	40.240286	-82.659850	F,QL,C	19
201207	17-267-000	OTTER FORK LICKING R. W OF HOMER @ LOCK RD.	0.20	28.90	05040006 01 01	Licking	40.252800	-82.538600	F,QL,B,C,N	20
201206	17-264-000	VANCE CREEK NW OF UTICA @ CO. RD. 29 (BERGER RD)	0.70	9.80	05040006 01 04	Knox	40.266900	-82.497900	F,QL,C,N	21
300447	17-262-000	SYCAMORE CREEK @ WEAVER RD.	5.87	13.00	05040006 01 03	Knox	40.304775	-82.487730	F,QL,C	22
201205	17-262-000	SYCAMORE CREEK N OF UTICA AT MOUTH @ CO. RD. 29	0.10	30.70	05040006 01 03	Knox	40.262800	-82.457500	F,QL,B,C,N	23
300448	17-263-000	TUMA RUN @ ST. RT. 13	0.46	6.80	05040006 01 03	Knox	40.268631	-82.450240	F,QL,C	24
300449	17-260-000	LAKE FORK LICKING R. @ SHIPLEY RD.	10.86	4.50	05040006 02 01	Licking	40.220164	-82.588090	F,QL,C	25
300450	17-260-000	LAKE FORK LICKING R. @ U.S. RT. 62	7.95	17.80	05040006 02 01	Licking	40.215422	-82.550290	F,QL,C	26
R13S08R	17-260-000	LAKE FORK LICKING R. S OF UTICA @ ST. RT. 13	0.05	34.80	05040006 02 01	Licking	40.203600	-82.440000	F,QT,B,C,S	27
304612	17-260-001	REYNOLDS CREEK W OF UTICA AT US 62	1.60	4.72	05040006 02 01	Licking	40.201387	-82.582218	F,QL,C,N	28

Station	River Code	Site Name	River Mile	Area (mi2)	HUC12	County	Latitude	Longitude	Sampling	Map #
300452	17-257-000	CLEAR FORK LICKING R. @ AGAPE RETREAT CENTER DRIVEWAY	5.50	12.10	05040006 02 02	Licking	40.164000	-82.496000	F,QL,B,C	29
R13P06	17-257-000	CLEAR FORK LICKING R. AT MOUTH @ ST. RT. 13	0.13	22.10	05040006 02 02	Licking	40.128900	-82.428900	F,QL,B,C,N	30
300453	17-252-000	DRY CREEK @ DRY CREEK RD.	7.60	7.80	05040006 02 04	Licking	40.119000	-82.542000	F,QL,C	31
300454	17-252-000	DRY CREEK @ DRY CREEK RD.	4.97	19.00	05040006 02 04	Licking	40.123000	-82.504000	F,QL,B,C	32
R13P11	17-252-000	DRY CREEK N OF NEWARK @ ST. RT. 13	0.36	24.40	05040006 02 04	Licking	40.114700	-82.428600	F,QL,B,C,N	33
300455	17-251-000	LOG POND RUN AT NEWARK @ RIVERSIDE DRIVE	0.10	1.30	05040006 02 05	Licking	40.064131	-82.400070	F,QL,B,C,N	34
R14S28R	17-220-000	S. FK. LICKING R. UPST. PATASKALA @ CABLE RD.	31.55	11.40	05040006 04 02	Licking	40.024400	-82.688900	F,QT,B,C,S,N	35
R14P18	17-220-000	S. FK. LICKING R. UPST. PATASKALA WWTP	28.25	30.00	05040006 04 03	Licking	39.988100	-82.670300	F,QT,C,N	36
R14S03	17-220-000	S. FK. LICKING R. DST. PATASKALA, NEAR FARM LANE	27.60	30.60	05040006 04 03	Licking	39.985000	-82.661700	F,QT,B,C,N	37
R14S27	17-220-000	S. FK. LICKING R. SE OF PATASKALA @ YORK RD.	24.45	43.00	05040006 04 03	Licking	39.968600	-82.626700	F,QT,B,C	38
R14P11	17-220-000	S. FK. LICKING R. E OF KIRKERSVILLE @ GALE RD.	21.24	51.00	05040006 04 06	Licking	39.962500	-82.580000	F,QT,C,N	39
201173	17-220-000	S. FK. LICKING R. UPST. U.S. RT. 40 ADJ. DRAG STRIP	19.10	55.00	05040006 04 06	Licking	39.959200	-82.550800	F,QT,C	40
R14P07R	17-220-000	S. FK. LICKING R. N OF BUCKEYE LAKE @ ST. RT. 79	12.96	69.00	05040006 04 06	Licking	39.948200	-82.480700	F,FT,QT,B,C,S,N	41
R14P08	17-220-000	S. FK. LICKING R. UPST. NEWARK @ RIDGELY TRACT RD.	8.88	133.00	05040006 04 09	Licking	39.988300	-82.475300	F,FT,QT,C,N	42

Station	River Code	Site Name	River Mile	Area (mi2)	HUC12	County	Latitude	Longitude	Sampling	Map #
603370	17-220-000	S. FK. LICKING R. AT NEWARK @ HOPEWELL DR.	1.80	183.00	05040006 04 09	Licking	40.037500	-82.413100	F,QT,C,N	43
R14P01	17-220-000	S. FK. LICKING R. AT NEWARK @ S. SECOND ST.	0.35	288.00	05040006 04 09	Licking	40.050800	-82.396700	F,FT,QT,B,C,N	44
300418	17-235-000	MUDDY FORK LICKING R. @ COLUMBIA RD.	3.70	6.30	05040006 04 01	Licking	40.011000	-82.717000	F,QL,C,N	45
R14P15	17-235-000	MUDDY FORK AT PATASKALA @ CREEK RD.	0.08	14.10	05040006 04 01	Licking	39.990600	-82.672800	F,QL,B,C,N	46
R14P09	17-220-001	WASTEWEIR RUN NEAR BUCKEYE LAKE OVERFLOW @ ST. RT. 79	1.55	44.30	05040006 04 05	Licking	39.927500	-82.488300	F,QT,B,C,N	47
R99Q27M	17-220-002	RESERVOIR FEEDER @ MILLERSPORT RD.	0.50	20.10	05040006 04 04	Fairfield	39.907500	-82.534700	F,QT,B,C,S,N	48
R14S21	17-220-005	HONEY CREEK DST. THORNVILLE WWTP @ ST. RT. 204	2.35	2.80	05040006 04 05	Perry	39.896100	-82.429400	C,N	49
300410	17-220-005	HONEY CREEK @ HONEY CREEK RD.	0.80	6.60	05040006 04 05	Perry	39.917032	-82.433570	C	50
R14S18	17-233-000	BEAVER RUN UPST. HEBRON WWTP @ CANYON RD.	2.07	5.00	05040006 04 09	Licking	39.979500	-82.507900	F,QT,C,N	51
R14S17	17-233-000	BEAVER RUN DST. HEBRON WWTP, DST. ST. RT. 79	0.45	7.40	05040006 04 09	Licking	39.986200	-82.483500	F,QT,C,N	52
300417	17-232-000	RAMP CREEK @ DEEDS RD.	5.73	4.90	05040006 04 07	Licking	40.009000	-82.536000	F,QL,C	53
R14P17	17-232-000	RAMP CREEK AT HEATH @ ST. RT. 79	0.22	16.70	05040006 04 07	Licking	40.018600	-82.450300	F,QL,B,C,N	54
300413	17-228-000	DUTCH FORK @ WHITE CHAPEL RD.	0.92	21.00	05040006 04 08	Licking	40.002000	-82.441000	F,QL,B,C,N	55
304611	17-230-000	HOG RUN AT FLEATOWN @ HIRST ROAD	0.10	8.45	05040006 04 08	Licking	39.992597	-82.403940	F,QL,C	56
304610	17-229-000	SWAMP RUN NEAR FLEATOWN @ WHITE CHAPEL ROAD	0.18	4.82	05040006 04 08	Licking	39.995825	-82.402320	F,QL,C	57

Station	River Code	Site Name	River Mile	Area (mi2)	HUC12	County	Latitude	Longitude	Sampling	Map #
R99Q29	17-221-000	RACCOON CREEK NE OF JOHNSTOWN @ CLOVER VALLEY RD.	28.20	4.70	05040006 03 01	Licking	40.179700	-82.718900	F,QL,C,N	58
R14P23R	17-221-000	RACCOON CREEK 0.1 MI. UPST. JOHNSTOWN WWTP	23.90	12.40	05040006 03 01	Licking	40.142969	-82.693924	C,S,N	59
R14S13	17-221-000	RACCOON CREEK JUST DST. JOHNSTOWN WWTP	23.70	12.40	05040006 03 01	Licking	40.140800	-82.691900	C,N	60
201175	17-221-000	RACCOON CREEK NEAR HAZELTON CORNERS @ ST. RT. 310	19.70	23.00	05040006 03 01	Licking	40.115800	-82.660800	B,C,N	61
300407	17-221-000	RACCOON CREEK UPST. ALEXANDRIA WWTP	15.35	37.40	05040006 03 03	Licking	40.086000	-82.609000	F,QT,B,C,N	62
300406	17-221-000	RACCOON CREEK NEAR ALEXANDRIA @ ST. RT. 37	15.12	37.90	05040006 03 03	Licking	40.085000	-82.605000	F,QT,B,C,N	63
R14P28	17-221-000	RACCOON CREEK JUST W OF GRANVILLE @ CR 539 A	11.70	78.00	05040006 03 04	Licking	40.068900	-82.551900	F,QT,C,N	64
R14P33	17-221-000	RACCOON CREEK UPST. GRANVILLE WWTP @ ST. RT. 37	9.18	82.70	05040006 03 04	Licking	40.062200	-82.520800	F,QT,C,N	65
R14P31	17-221-000	RACCOON CREEK SE OF GRANVILLE, NEAR RR	8.25	86.00	05040006 03 04	Licking	40.062500	-82.503900	F,FT,QT,B,C,N	66
603380	17-221-000	RACCOON CREEK AT NEWARK @ WILSON ST.	0.54	102.00	05040006 03 04	Licking	40.053300	-82.411700	F,FT,QT,B,C	67
R14P26	17-226-000	PET RUN W OF ALEXANDRIA @ JERSEY MILL RD.	0.10	3.20	05040006 03 03	Licking	40.091700	-82.628900	F,QL,C,N,LL,WD	68
R14P24	17-224-000	MOOTS RUN SE OF ALEXANDRIA @ ST. RT. 161	0.55	9.60	05040006 03 03	Licking	40.076400	-82.593300	F,QL,C,N,LL,WD	69
201187	17-223-000	LOBDELL CREEK E OF JOHNSTOWN, DST. NICHOLS LANE	8.60	8.30	05040006 03 02	Licking	40.147800	-82.651700	F,QL,C,N	70

Station	River Code	Site Name	River Mile	Area (mi2)	HUC12	County	Latitude	Longitude	Sampling	Map #
R99Q30	17-223-000	LOBDELL CREEK NW OF ALEXANDRIA @ SADIE THOMAS RD.	4.80	14.80	05040006 03 02	Licking	40.118600	-82.624700	F,QL,C	71
201182	17-223-000	LOBDELL CREEK E OF ALEXANDRIA @ RACCOON VALLEY RD.	0.20	18.80	05040006 03 02	Licking	40.086900	-82.592200	F,QL,B,C,N	72
300459	17-208-000	CLAYLICK CREEK @ BROWNSVILLE RD.	0.10	20.70	05040006 05 01	Licking	40.058000	-82.288000	F,QL,B,C,N	73
300460	17-209-000	LITTLE CLAYLICK CREEK @ TWP. RD. 353 (COLLING RD.)	0.17	8.90	05040006 05 01	Licking	40.045000	-82.306000	F,QL,C	74
R13S25R	17-210-000	ROCKY FORK LICKING R. W OF CAMP OHIO	16.00	20.40	05040006 05 03	Licking	40.229700	-82.338900	F,QT,C,S	75
300470	17-210-000	ROCKY FORK LICKING R. @ JOBES RD.	6.40	45.80	05040006 05 03	Licking	40.129000	-82.298000	F,QT,C,N	76
R13S10R	17-210-000	ROCKY FORK LICKING R. UPST. HANOVER @ WOLFORD RD.	2.91	74.00	05040006 05 03	Licking	40.090600	-82.272500	F,FT,QT,C,S	77
R13S26	17-210-000	ROCKY FORK LICKING R. @ ST. RT. 16	1.20	77.50	05040006 05 03	Licking	40.071700	-82.257200	B	78
R13S21R	17-211-000	LOST RUN N OF WILKENS CORNERS @ MAHARG RD.	4.08	11.10	05040006 05 02	Licking	40.144400	-82.342800	F,QT,C,S	79
R13S20R	17-211-000	LOST RUN S OF HICKMAN, NEAR MOUTH	0.20	23.00	05040006 05 02	Licking	40.126900	-82.300300	F,QT,B,C,S,N	80
R13S23R	17-215-000	LONG RUN N OF ROCKY FORK @ TWP. RD. 211 (BAKER RD.)	0.54	5.80	05040006 05 03	Licking	40.172500	-82.292200	F,QT,C,S	81
R13S22R	17-214-000	PAINTER RUN NE OF HICKMAN @ ST. RT. 79 (LOWER CROSSING)	0.23	6.20	05040006 05 03	Licking	40.158900	-82.293100	F,QT,C,S	82
300472	17-212-000	WILKINS RUN AT WILKINS CORNERS @ WILKINS RUN RD.	0.15	7.10	05040006 05 02	Licking	40.129000	-82.340000	F,QL,C	83
300500	17-207-000	BRUSHY FORK LICKING R. @ STONEPILE RD.	3.14	13.90	05040006 06 01	Muskingum	40.029064	-82.241950	F,QL,C	84

Station	River Code	Site Name	River Mile	Area (mi2)	HUC12	County	Latitude	Longitude	Sampling	Map #
300501	17-207-000	BRUSHY FORK LICKING R. DST. BRUSHY FORK RD.	1.30	17.30	05040006 06 01	Muskingum	40.043417	-82.260890	B	85
R13W22	17-207-000	BRUSHY FORK LICKING R. S OF HANOVER @ MOUTH	0.01	18.30	05040006 06 01	Licking	40.057800	-82.262200	F,QL,B,C,N	86
300502	17-206-000	STUMP RUN @ ST. RT. 146	1.02	6.30	05040006 06 03	Muskingum	40.054202	-82.136520	F,QL,B,C	87
300503	17-205-000	POVERTY RUN @ PINECREST RD.	1.47	4.40	05040006 06 03	Muskingum	39.993395	-82.136900	F,QL,C	88
201161	17-204-000	BIG RUN SE OF SHANNON @ FAWN DRIVE	5.10	15.80	05040006 06 02	Muskingum	40.060600	-82.078900	F,QL,C,N	89
300504	17-204-000	BIG RUN @ CREAMERY RD.	3.28	20.20	05040006 06 02	Muskingum	40.039670	-82.085490	B	90
300506	17-203-000	BARTLETT RUN N OF DILLON FALLS @ ST. RT. 146	0.44	9.00	05040006 06 04	Muskingum	39.984085	-82.053530	F,QL,B,C	91
300507	17-202-000	JOES RUN AT ZANESVILLE @ OLD NEWARK RD.	0.20	8.60	05040006 06 04	Muskingum	39.953842	-82.022380	F,QL,B,C,N	92
201150	17-201-000	TIMBER RUN AT ZANESVILLE @ MOUTH	0.10	11.80	05040006 06 04	Muskingum	39.947200	-82.026400	F,QL,B,C,N	93

M – modified reference site. **R** – reference site.

Code	Sample Type
F	Fish – 1 Pass
FT	Fish Tissue
QT	Macroinvertebrate - Quantitative (HD)
QL	Macroinvertebrate – Qualitative
C	Chemistry
LR	Chemistry – Large River Site

Code	Sample Type
S	Sediment
N	Nutrient site
PWS	Public Water Supply
LL	Level Logger
WD	Water Detection Sensor
B	*E. coli* bacteria

Appendix 3. NPDES-Permitted Facilities

Nested Sub-watershed	Ohio Permit Number	Facility Name	Design Flow[1] (MGD)	Average Flow[2] (MGD)	Type of Waste	Stream and River Mile at Discharge	County
05040006-							
01-01	4IK00016*CD	Trillium Farm Holdings LLC - Layer Site 3	0.083	0.1379	Industrial	UNT to Otter Fork Licking River at RM 12.78	Licking
01-01	4IK00018*CD	Trillium Farm Holdings LLC - Pullet Site 1	0.00015	0.0344	Industrial	UNT to Bowl Run at RM 0.05	Licking
01-01	4IK00019*DD	Trillium Farm Holdings LLC - Pullet Site 2	0.00015	0.029	Industrial	Otter Fork Licking River at RM 12.62	Licking
01-01	4IK00023*BD	Trillium Farm Holdings LLC Hatchery Breeder Pullet	0.023	0.2571	Industrial	Bowl Run at RM 3.65	Licking
01-01	4PA00105*DD	Hartford WWTP	0.06	0.0337	Public	UNT to Otter Fork Licking River (1.08) at RM 9.68	Licking
01-02	4PB00111*CD	Centerburg WRF	0.3	0.211	Public	North Fork Licking River at RM 36.82	Knox
02-01	4PT00108*FD	Northridge High School	0.02	0.0034	Public	UNT to Lake Fork Licking River at RM 3.15	Licking
02-03	4IH00015*GD	Velvet Ice Cream Co	0.18	0.0167	Industrial	North Fork Licking River at RM 16.02	Licking
02-03	4IJ00110*DD	Shelly Materials St Louisville	1.6	3.8034	Industrial	UNT to North Fork Licking River at RM 9.30	Licking
02-03	4IJ00115*CD	Olen Corp St Louisville Plant	3.6	---	Industrial	North Fork Licking River at RM 12.00	Licking
02-03	4PB00022*ID	Utica WWTP	0.423	0.5425	Public	North Fork Licking River at RM 17.14	Licking
02-05	4IN00002*GD	Owens Corning Insulating Systems LLC	0.0504	0.0557	Industrial	North Fork Licking River at RM 1.85 and UNT to North Fork Licking River at RM 1.90	Licking
02-05	4PX00049*AD	Buckeye Lake Music Center, Inc	0.02	---	Public	UNT to Jonathan Creek at RM 25.68	Licking
03-01	4IK00014*BD	Trillium Farm Holdings LLC - Layer Site 1	0.063	0.0949	Industrial	UNT to Otter Fork Licking River at RM 11.72	Licking
03-01	4IK00017*BD	Trillium Farm Holdings LLC - Layer Site 4	0.0775	0.1644	Industrial	UNT to Raccoon Creek (3.10) at RM 27.39	Licking
03-01	4IW01002*HD	Johnstown WTP	0.05	0.0304	Industrial	UNT to Raccoon Creek at RM 23.47	Licking
03-01	4PC00001*KD	Johnstown WWTP	1.2	0.6446	Public	Raccoon Creek at RM 23.78	Licking
03-01	4PX00056*CD	Kyber Run Golf Course Inc	0.0035	0.0003	Public	UNT to Kiber Run at RM 0.51	Licking
03-02	4IK00015*CD	New Day Farms - Croton	0.0636	0.0611	Industrial	UNT to Raccoon Creek at RM 27.39	Licking
03-02	4IK00020*CD	Trillium Farm Holdings LLC - Breeder Layer 2	0.0636	0.0567	Industrial	Lobdell Creek at RM 14.17	Licking

Nested Sub-watershed	Ohio Permit Number	Facility Name	Design Flow[1] (MGD)	Average Flow[2] (MGD)	Type of Waste	Stream and River Mile at Discharge	County
05040006-							
03-02	4IK00021*CD	Trillium Farm Holdings LLC - Pullet Site 3	0.00015	0.0722	Industrial	UNT to Lobdell Creek at RM 13.78	Licking
03-03	4IJ00114*BD	Brookside Materials LLC	2.3	0.2954	Industrial	Raccoon Creek at RM 16.26 and Simpson Run at RM 0.11	Licking
03-03	4IN00214*AD	Kurtz Brothers - Brookside	0.0025	---	Industrial	UNT to Simpson Run at RM 0.07 and UNT to Simpson Run at RM 0.31	Licking
03-03	4PQ00005*AD	Pet Run Wastewater Treatment Center	0.25	---	Public	Pet Run at RM 2.25	Licking
03-03	4PA00106*ED	Alexandria WWTP	0.08	0.0365	Public	Raccoon Creek at RM 15.35	Licking
03-04	4IN00001*KD	Tectum Inc Newark Plant	0.02	0.0002	Industrial	Raccoon Creek at RM 0.39	Licking
03-04	4IN00047*OD	Owens Corning Science and Technology Center	0.15	0.0351	Industrial	UNT to Raccoon Creek at RM 11.25	Licking
03-04	4IN00166*FD	Heritage Cooperative Newark	0.0015	0.0002	Industrial	Raccoon Creek/South Fork Licking River via storm sewer	Licking
03-04	4PC00006*JD	Granville WWTP	0.911	0.4013	Public	Raccoon Creek at RM 9.04	Licking
04-02	4PX00037*ED	Pataskala Shell	0.002	0.0016	Public	South Fork Licking River at RM 37.45	Licking
04-03	0PB00045*ID	Thornville WWTP	0.4	0.2784	Public	Honey Creek at RM 2.60	Perry
04-04	4IY00132*DD	Millersport WTP	0.0245	0.012	Industrial	Ohio Canal at RM 0.90	Fairfield
04-04	4PB00023*JD	Millersport STP	0.302	0.2039	Public	Reservoir Feeder at RM 0.32	Fairfield
04-04	4PX00047*DD	Regal Inn	0.0035	0.0011	Public	UNT to Reservoir Feeder (0.06) at RM 5.00	Licking
04-05	4IZ00051*DD	Pataskala WTP	0.0839	0.048	Industrial	South Fork Licking River at RM 25.70	Licking
04-05	4PB00009*LD	Pataskala WWTP	3	0.9329	Public	South Fork Licking River at RM 28.16	Licking
04-06	4IN00158*ED	Pilot Travel Center LLC No 285	0.014	---	Industrial	UNT to Bell Run at RM 0.23	Licking
04-06	4PB00104*FD	Kirkersville WWTP	0.1	0.0601	Public	South Fork Licking River at RM 21.80	Licking
04-06	4PD00101*GD	Southwest Licking W & SD Gale Rd Envir Ctrl Fac	4.3	1.6387	Public	South Fork Licking River at RM 21.57	Licking
04-06	4PJ00000*LD	Buckeye Lake WWTP	2	1.0707	Public	South Fork Licking River at RM 14.20	Licking
04-08	4PV00116*FD	Suburban MHP	0.015	0.0084	Public	UNT to Swamp Run at RM 0.65	Licking
04-09	4PB00005*MD	Hebron Village WRF	1.5	0.703	Public	Beaver Run at RM 0.65	Licking
04-09	4PC00007*MD	Heath WWTP	2.25	1.2838	Public	South Fork Licking River at RM 2.20	Licking
04-09	4PV00113*ED	Villa Vista MHP	0.033	0.0096	Public	UNT to South Fork Licking River (0.80) at RM 10.42	Licking
04-09	4PW00011*BD	Carson Realty 2	0.003	0.001	Public	UNT to Dutch Fork via field tile	Licking
05-02	4PV00012*FD	Wilkins MHP	0.00645	0.003	Public	Wilkins Run at RM 0.17	Licking

Nested Sub-watershed	Ohio Permit Number	Facility Name	Design Flow[1] (MGD)	Average Flow[2] (MGD)	Type of Waste	Stream and River Mile at Discharge	County
05040006-							
05-02	4PV00124*ED	Winding Creek Estates	0.01	0.0043	Public	Wilkins Run at RM 0.75	Licking
05-03	4PB00110*DD	Hanover WWTP	0.16	0.068	Public	Rocky Fork Licking River at RM 1.33	Licking
05-03	4PX00040*ED	4H Camp Ohio Treatment System	0.014	---	Public	Rocky Fork Licking River at RM 15.10	Licking
05-03	4PY00009*FD	Country Hills MHP	0.01	0.00555	Public	Rocky Fork Licking River at RM 4.94	Licking
05-04	4IN00182*ED	Newark City Landfill	0.226	0.2144	Industrial	UNT to Licking River at RM 29.72	Licking
05-04	4PE00001*ND	Newark WWTP	8	7.9902	Public	Licking River at RM 28.55	Licking
05-04	4PV00119*DD	Marne Manor LLC	0.0025	0.0003	Public	Bowling Green Run at RM 0.93	Licking
06-04	0IN00163*FD	Coopermill Road Landfill	0.071	0.0133	Industrial	Chaps Run at RM 1.45	Muskingum
06-04	0IN00241*ED	Polk Scrap Iron & Metal	0.039	0.05	Industrial	Timber Run at RM 0.84	Muskingum
06-04	0IN00265*BD	Cooper US Inc	0.1512	0.0387	Industrial	Chaps Run at RM 1.53	Muskingum
06-04	0IS00000*MD	Casting Solutions LLC	0.383	0.1069	Industrial	Licking River at RM 2.00	Muskingum

1 Design flows that are greater than 1.0 million gallons per day (MGD) classify a facility as a major discharger.
2 Average flows are displayed for January 2020 through January 2025 unless otherwise noted.

Appendix 4. List of Physical/Chemical Parameters and Reporting Limits

Parameter	Method	Water (RL)	Sediment (RL)	Fish Tissue
Oxygen Demand				
BOD, 5 day	SM 5210B	2 mg/L		
cBOD, 20 day	OHIO EPA 310.2	2 mg/L		
COD	SM 5220D	20 mg/L		
Physical Properties				
Alkalinity	U.S. EPA 310.1	5 mg/L		
Hardness	U.S. EPA 200.7	10 mg/L		
Dissolved Oxygen (mg/l and % saturation)	Field Meter/Sonde	0 mg/L 0% sat		
pH	Field Meter/Sonde	0 s.u.		
pH	SM 4500-H	0 s.u.	0 s.u.	
Specific Conductance	SM 2510B	1 µmhos/cm		
Specific Conductance	Field Meter/Sonde	1 µS/cm		
Temperature	Field Meter/Sonde	0 °C		
Total Dissolved Solids	SM 2540C	10 mg/L		
Total Suspended Solids	SM 2540D	5 mg/L		
% Solids	SM 2540G		0%	
% Lipids	OHIO EPA 581.5			0%
Nutrients				
Ammonia-N	U.S. EPA 350.1	0.05 mg/L	7 mg/kg	
Nitrate-Nitrite	U.S. EPA 350.1	0.1 mg/L		
Nitrite	U.S. EPA 353.2	0.02 mg/L		
Total Kjeldahl Nitrogen	U.S. EPA 351.2	0.3 mg/L		
Total Phosphorus	U.S. EPA 365.4	0.02 mg/L	50 mg/kg	
Orthophosphate (as P)	U.S. EPA 365.4	0.01 mg/L		
Total Organic Carbon	SM 5310B	2 mg/L	0.1%	
Dissolved Organic Carbon	SM 5310C	2 mg/L		
Anions				
Carbonate/Bicarbonate	SM 2320B			
Chloride	U.S. EPA 325.1	5 mg/L		
Sulfate	U.S. EPA 375.2	10 mg/L		
Cations				
Aluminum	U.S. EPA 200.7	200 µg/L	200 µg/L	
Barium	U.S. EPA 200.7	15 µg/L	15 µg/L	
Calcium	U.S. EPA 200.7	2 mg/L	2 µg/L	
Iron	U.S. EPA 200.7	50 µg/L	50 µg/L	

Parameter	Method	Water (RL)	Sediment (RL)	Fish Tissue
Magnesium	U.S. EPA 200.7	1 mg/L	1 µg/L	
Manganese	U.S. EPA 200.7	10 µg/L	10 µg/L	
Potassium	U.S. EPA 200.7	2 mg/L	2 µg/L	
Sodium	U.S. EPA 200.7	5 mg/L	5 µg/L	
Strontium	U.S. EPA 200.7	30 µg/L	30 µg/L	
Metals				
Arsenic	U.S. EPA 200.8/SM 3113B	2 µg/L	0.8 mg/kg	0.05mg/kg
Beryllium	U.S. EPA 200.8		20 µg/L	
Cadmium	U.S. EPA 200.8/SM 3113B	0.2 µg/L	0.08 mg/kg	.004 mg/kg
Chromium	U.S. EPA 200.8	2 µg/L	0.8 mg/kg	
Cobalt	U.S. EPA 200.8		2 µg/L	
Copper	U.S. EPA 200.8	2 µg/L	0.8 mg/kg	
Lead	U.S. EPA 200.8/SM 3113B	2 µg/L	0.8 mg/kg	0.04 mg/kg
Nickel	U.S. EPA 200.8	2 µg/L	0.8 mg/kg	
Selenium	U.S. EPA 200.8/SM 3113B	2 µg/L	0.8 mg/kg	0.05 mg/kg
Silver	U.S. EPA 200.8		0.08 mg/kg	
Titanium	U.S. EPA 200.7		50 µg/L	
Vanadium	U.S. EPA 200.7		50 µg/L	
Mercury	U.S. EPA 245.1/SM 3113B		0.02 mg/kg	0.02 mg/kg
Zinc	U.S. EPA 200.7	10 µg/L	8 mg/kg	
Bacteria				
Escherichia coliform	U.S. EPA 1603	2 CFU		
Algal Biomass				
Chlorophyll-*a*	U.S. EPA 445.0	2 µg/L		
Anatoxin	OHIO EPA 706.0	0.4 µg/L		
Cylindrospermopsin	OHIO EPA 703.0	0.05 µg/L		
Microcystin	OHIO EPA 701.0	0.24 µg/L		
Saxitoxin	OHIO EPA 702.0	0.022 µg/L		
Organic Compounds				
Chlorinated Herbicides	U.S. EPA 515.1	40 µg/L		
Acid Herbicides	U.S. EPA 525.2	200 µg/L		
Semi-volatile organics	U.S. EPA 625	2-20 µg/L		
Semi-volatile organics	U.S. EPA 8270C	2 – 10 mg/l	0.4-2 mg/kg	
Organochlorine Pesticides	U.S. EPA 8082A/OHIO EPA 590.1	1-10 µg/L	4 µg/kg	10 µg/kg
PCBs	U.S. EPA 8082A/OHIO EPA 590.1		20 µg/kg	50 µg/kg

Appendix 5. Safety Contacts and Hospital Locations

Safety:	
County Wildlife Officers:	**County Sheriff:**
Fairfield County – (614) 902-4210 Knox County – (614) 400-0731 Licking County – (614) 400-0744 Muskingum County – (740) 589-9991 Perry County – (614) 565-0137	Fairfield County – (740) 652-7900 Knox County – (740) 397-3333 Licking County – (740) 670-5555 Muskingum County – (740) 452-3637 Perry County – (740) 342-4123
OEMA:	**State Highway Patrol:**
Fairfield County – (740) 342-4123 Knox County – (740) 399-3993 Licking County – (740) 522-9031 Muskingum County – (740) 453-1655 Perry County – (740) 342-1141	Fairfield/Perry County – (740) 654-1523 Knox County – (419) 768-3955 Licking County – (740) 927-0065 Muskingum County – (740) 453-0541
Hospitals:	
Fairfield Medical Center 401 N Ewing Street Lancaster, OH 43130 (800) 548-2627	Knox Community Hospital 1330 Coshocton Avenue Mt. Vernon, OH 43050 (740) 393-9000
Licking Memorial Hospital 1320 W Main Street Newark, OH 43055 (220) 564-4000	Genesis Hospital 2951 Maple Ave Zanesville, OH 43701 (740) 454-5000
Genesis Perry County Medical Center 301 Dr Mike Clouse Dr Suite 2 Somerset, OH 43783 (740) 743-3800	

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