OWQ- WATERSHED ASSESSMENT & PLANNING BRANCH
IDEM/OWQ/WAPB/WM
VIRTUAL FILE CABINET INDEX FORM

Program: Water Monitoring

Document Type: Report

***Document Date:** 5/16/2023

***Security:** Public

***Project Name:** 2023 Stream Regional Monitoring Network

***Project Type:** Special Projects

***Report Type:** Work Plan

HUC Code: 00000000 Statewide

Site #:

Route Name:

Document Control # B-059-OWQ-WAP-XXX-23-W-R0

Analysis Set #

County: No Selection

Cross Reference ID:

Comments: 2023 REGIONAL MONITORING NETWORK FOR INDIANA STREAMS WORK PLAN

Redaction Reference ID:

2023 REGIONAL MONITORING NETWORK FOR INDIANA STREAMS WORK PLAN

Prepared by

Kevin Gaston
Probabilistic Monitoring Section

Indiana Department of Environmental Management
Office of Water Quality
Watershed Assessment and Planning Branch
Probabilistic Monitoring Section
100 North Senate Avenue
MC65-40-2 Shadeland
Indianapolis, Indiana 46204-2251

May 16, 2023

B-059-OWQ-WAP-XXX-23-W-R0

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Approval Signatures

Stacey Sobat, Section Chief
Probabilistic Monitoring Section

5-16-2023
Date

Caleb Rennaker, Section Chief
Technical and Logistical Services Section

5-16-2023
Date

Timothy Bowren, Project Quality Assurance Officer
Technical and Logistical Services Section

5-16-2023
Date

Kristen Arnold, Branch Chief
Branch Quality Assurance Coordinator

5/22/2023
Date

This work plan is consistent with agency requirements.

Quality Assurance Staff
IDEM Office of Program Support

5/26/2023
Date

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Work Plan Organization

This work plan is an extension of the existing Indiana Department of Environmental Management (IDEM) Office of Water Quality (OWQ) Watershed Assessment and Planning Branch (WAPB), March 2017 Quality Assurance Project Plan (QAPP) for Indiana Surface Water Programs (Surface Water QAPP) (IDEM 2017) and October 2020 QAPP for Biological Community and Habitat Measurements (IDEM 2020a). Per the United States Environmental Protection Agency (U.S. EPA) Guidance on Systematic Planning using the Data Quality Objectives (DQO) Process (U.S. EPA 2006) and the U.S. EPA Guidance for Quality Assurance Project Plans (U.S. EPA 2002), the work plan establishes criteria and specifications pertaining to a specific water quality monitoring project usually described in the following four QAPP groups and associated elements.

Group A. Project Management

A.1. Project Objective
A.2. Project Organization and Schedule
A.3. Background and Problem Description
A.4. Data Quality Objectives
A.5. Training and Staff Requirements

Group B. Data Generation and Acquisition

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B.2. Sampling Methods
B.3. Analytical Methods
B.4. Quality Control and Custody Requirements
B.5. Field Parameter Measurements and Instrument Testing and Calibration
B.6. Data Management

Group C. Assessment and Oversight

C.1. Assessments and Response Actions
C.2. Data Quality Assessment Levels

Group D. Data Validation and Usability

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D.2. Reconciliation with User Requirements
D.3. Information, Data, and Reports
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List of Acronyms

AIMS	Assessment Information Management System
ALUS	Aquatic Life Use Support
ASTM	American Society for Testing and Materials
CAC	Chronic Aquatic Criteria
CALM	Consolidated Assessment Listing Methodology
DO	Dissolved oxygen
IAC	Indiana Administrative Code
IDOH	Indiana Department of Health
IBI	Index of Biotic Integrity
IDEM	Indiana Department of Environmental Management
MHAB	Multihabitat
MLES	Midwest Lake Electrofishing Systems
OHEPA	Ohio Environmental Protection Agency
OWQ	Office of Water Quality
QA	Quality Assurance
QA/QC	Quality Assurance and Quality Control
QC	Quality Control
QAPP	Quality Assurance Project Plan
QHEI	Qualitative Habitat Evaluation Index
RMN	Regional Monitoring Network
S.U.	Standard Units
SOP	Standard Operating Procedures
U.S. EPA	United States Environmental Protection Agency
WAPB	Watershed Assessment and Planning Branch
WP	Work Plan

Definitions

Assessment Unit	Reaches of waterbodies, with similar features, assigned unique identifiers, to which all assessment information for a specific reach is associated, and which allow for mapping with geographic information systems.
Backwater	A part of the river not reached by the current, where the water is stagnant.
Elutriate	To purify, separate, or remove lighter or finer particles by washing, decanting, and settling.
15-minute pick	A multihabitat macroinvertebrate sampling method in which the 1-minute kick sample and 50-meter sweep sample collected at a site are first combined and elutriated. Macroinvertebrates are then manually removed from the resulting sample for 15 minutes.
50-meter sweep	A multihabitat macroinvertebrate sampling method in which approximately 50 m of all available habitat in a stream or river is sampled with a standard 500 µm mesh width D-frame dip net by taking 20 to 25 individual jab or sweep samples, which are then composited.
Impoundment	A body of water confined within an enclosure, such as a reservoir.
Lotic	A waterbody, such as a stream or river, in which the water is flowing.
Macroinvertebrate	Aquatic animals which lack a backbone, are visible without a microscope, and spend some period of their lives in or around water.
Marsh	An area of low-lying land that is flooded in wet seasons and typically remains waterlogged at all times.
1-minute kick sample	A multihabitat macroinvertebrate sampling method in which approximately 1 m² of riffle or run substrate habitat in a stream or river is sampled with a standard 500 µm mesh width D-frame dip net for approximately one minute.
Ocular reticle	A thin piece of glass marked with a linear or areal scale inserted into a microscope ocular,

	superimposing the scale onto the image viewed through the microscope.
Perennial Stream	A stream that has continuous flow in the stream bed all year during years of normal rainfall. Water must be present in at least 50% of the stream reach during the time of fish community sampling.
Reach	A segment of a stream used for sampling.
Wetland	Land areas that are wet for at least part of the year, and poorly drained and are characterized by hydrophytic vegetation, hydric soils, and wetland hydrology.

A. Project Management

A.1 Project Objective

The main objective of the regional monitoring network (RMN) for Indiana streams is to track changes in biological, thermal, hydrologic, habitat, and water chemistry at high quality sites over time with changes in thermal and hydrological conditions. As listed in the Generic Stream Monitoring Network QAPP (U.S. EPA 2016), data from these sites can also be used for:

- IDEM's Integrated Report, thus satisfying 305(b) and 303(d) reporting requirements to U.S. EPA
- Informing criteria development or refinement (e.g., defining natural conditions)
- Quantifying natural variability
- Investigating relationships between biological, thermal, and hydrologic data
- Exploring ecosystem responses and recovery from extreme weather events

A.2 Project Organization and Schedule

Sampling for this project will begin April 2023 and continue year-round, conditions permitting, with collected samples analyzed for chemical, physical, and biological parameters. Project laboratory processing and data analysis will continue throughout the year(s) (Table 1).

A.3 Background and Project Description

The RMN project operates within the WAPB. Other organizations assisting with data preparation, collection, and analysis include private laboratories under contract with the state of Indiana, U.S. EPA Region 5, and the Indiana Department of Natural Resources.

The regional monitoring network project provides data to track changes in biological, thermal, hydrologic, habitat, and water chemistry data at high quality sites over time with changes in thermal and hydrological conditions. The WAPB is conducting this study as part of a partnership with the U.S. EPA along with states and tribes within EPA's Region 5 to establish a Regional Monitoring Network to detect long-term changes in the baseline conditions of streams due to changes in weather patterns.

Table 1. Tasks, Schedule, and Evaluation

Activity	Dates	Number of sites	Frequency of sampling related activity	Parameters to be sampled	How evaluated
Site reconnaissance	February through end of March	3	Until confirmation of 3 accessible target sites or the March deadline	Safety to access stream, viable location for weather station and sensors, and proper equipment for sampling	Landowner approval and best professional judgment
Biological sampling	Apr15 through Oct 31	3	Once for Fish community (Jun 1 –Sept 18) Twice for Macroinvertebrate community (Apr 15-May 15 and Sept 1 – Oct 31)	Fish community Macroinvertebrate community Habitat quality	Fish Index of Biotic Integrity (IBI) Macroinvertebrate IBI (mIBI) Qualitative Habitat Evaluation Index (QHEI) evaluated separately for fish and macroinvertebrate communities
Water chemistry	Monthly	3	Monthly with a minimum 30 days between sampling events	Total Phosphorous Nitrogen, Nitrate and Nitrite Dissolved Oxygen pH Dissolved Metals (See Table 6) Dissolved Arsenic Nitrogen Ammonia Chloride Sulfate Total Dissolved Solids Dissolved Organic Carbon	>0.3 mg/L (nutrients). >10.0 mg/L (nutrients). <4.0 mg/L (warm water aquatic life); dissolved oxygen >120% saturation (nutrients). >9.0 Standard Units (SU) (nutrients). <6.0 or >9.0 SU (warm water aquatic life). Chronic Aquatic Criteria (CAC) based on hardness. CAC based on concentration of 150 µg/L, a conversion factor and water-effect ratio of 1. CAC based on pH and temperature. CAC based on hardness and sulfate. CAC based on hardness and chloride. 750 mg/L (public water supply criterion). There are no criteria for this parameter in the Indiana Administrative Code (IAC).

A.4 Data Quality Objectives

U.S. EPA recommends the DQO seven-step systematic planning process (U.S. EPA 2006) for all significant environmental data collection activities. The process provides a basis for balancing decision uncertainty with available resources. The DQO planning process clarifies study objectives; defines the types and quantity of data needed to achieve the objectives; and establishes decision criteria for evaluating data quality. The results from the DQO process seven steps provide the basis for the 2023 regional monitoring network project plan.

1. **State the Problem**
   Indiana is required to assess all waters of the state to determine their designated use attainment status. Surface waters of the state "will be capable of supporting" a "well-balanced, warm water aquatic community" [327 IAC 2-1-3]. This project gathers chemical, biological (fish and macroinvertebrate communities) and habitat data at fixed station sites to assess aquatic life use support (ALUS) and detect long-term changes in baseline conditions due to variability in water temperature and hydrology.

2. **Identify the Goals of the Study**
   The project's objectives are to sample sites throughout Indiana to:
   - Detect temporal trends.
   - Investigate relationships between biological, thermal, and hydrologic data.
   - Explore ecosystem responses and recovery from extreme weather events.
   - Test hypotheses and predictive models related to changes in natural variability.
   - Collect reference data against which to measure ALUS.

3. **Identify Information Inputs**
   Field monitoring activities require collection of physical description, chemical, biological, and habitat data. Group B. Data Generation and Acquisition describes collection procedures for field measurements, chemical, biological, and habitat data in detail.
   a. Water Quality Criteria
      Evaluate each site as supporting or nonsupporting when compared with water quality criteria shown in Table 2, derived from tables contained in [327 IAC 2-1-6] and following Indiana's 2022 Consolidated Assessment Listing Methodology (CALM) (IDEM 2022a).

Table 2. Water Quality Criteria for Non-Great Lakes [327 IAC 2-1-6]

Parameter	Level	Criterion
Metals (dissolved)	Calculated based on hardness	Calculated CAC (Non-Great Lakes)
Arsenic III (dissolved)	190 µg/L	Calculated CAC (Non-Great Lakes)
Ammonia as nitrogen	Calculated based on pH and temperature	Calculated CAC (Non-Great Lakes)
Chloride	Calculated based on hardness and sulfate values	Calculated CAC (Non-Great Lakes)
Dissolved oxygen (DO)	At least 5.0 mg/L (warm water aquatic life)	Not less than 4.0 mg/L at any time.
pH	6.0 – 9.0 S.U.	Must remain between 6.0 and 9.0 S.U. except for daily fluctuations exceeding 9.0 due to photosynthetic activity
Nitrogen, nitrate and nitrite	≤10 mg/L	Human health point of drinking water intake
Sulfate	Calculated based on hardness and chloride	In all waters outside the mixing zone (Non-Great Lakes)
Dissolved solids	750 mg/L	Not-to-Exceed at point of drinking water intake

CAC = Chronic Aquatic Criteria, S.U. = Standard Units

b. Nutrient Criteria

Assuming a minimum of three sampling events, if two or more of the conditions below are met on the same date, classify the waterbody assessment unit as non-supporting due to nutrients.

- Total phosphorus: one or more measurements >0.3 mg/L
- Nitrogen, (nitrate + nitrite): one or more measurements >10.0 mg/L
- DO: one or more measurements <4.0 mg/L, or measurements that are consistently at or close to the standard, in the range of 4.0 – 5.0 mg/L, or DO percent saturation >120%
- pH: one or more measurements >9.0 S.U. or measurements consistently at or close to the standard, ranging from 8.7 – 9.0 S.U.

c. Biological Criteria

Indiana narrative biological criteria [327 IAC 2-1-3] states that “all waters, except as described in subdivision (5),” (i.e., limited use waters) “will be capable of supporting” a “well-balanced, warm water aquatic community”. The water quality standard definition of a “well-balanced aquatic community” is “an aquatic community that: (A) is diverse in species composition; (B) contains several different trophic levels; and (C) is not composed mainly of pollution tolerant species” [327 IAC 2-1-9 (59)]. The table in Appendix 2 illustrates an interpretation or translation of narrative biological criteria into numeric criteria.

A stream segment is nonsupporting for aquatic life use when the monitored fish or macroinvertebrate community receives an IBI score of less than 36 which is considered Poor or Very Poor (IDEM 2022a). Stream segments with IBI scores greater than or equal to 36 (Fair to Excellent on the scale of 0 to 60) are supporting for aquatic life use.

Report each sampled site's assessment in the U.S. EPA 2026 update of Indiana's Integrated Water Monitoring and Assessment Report (Integrated Report). Use site specific data to classify associated assessment units (AU) into one of five major categories in the state's consolidated 303(d) list. Category definitions are available in Indiana's CALM (IDEM 2022a).

4. **Define the Boundaries of the Study**
   The 2023 RMN sites are within the geographic borders of Indiana and contained in the eight-digit Hydrologic Unit Codes 05120104, 05120106, and 05120207. B.1. Sampling Design and Site Locations provides further explanation of site selection.

5. **Develop the Analytical Approach**
   Samples will be collected for physical, chemical, and biological communities when the flow is not dangerous for staff to enter the stream (e.g., water levels at or below median base flow); barring any hazardous weather conditions (e.g., thunderstorms or heavy rain in the vicinity); or unexpected physical barriers to accessing the site. The field crew chief makes the final determination as to whether a waterbody is safe to enter. Even if the weather conditions and stream flow are safe, sample collections for biological communities may be postponed at a particular site for one to four weeks due to scouring of the stream substrate or instream cover following a high water event resulting in nonrepresentative samples.

   Evaluate all potential RMN sites for ALUS status. For the Integrated Report assessment purposes, ALUS decisions include independent evaluations of chemical and biological criteria as outlined in Indiana's 2022 CALM (IDEM 2022a). The fish assemblage will be evaluated at each site using the appropriate IBI (Simon and Dufour 1998, 2005). Macroinvertebrate multihabitat samples will also be evaluated using a statewide mIBI developed for lowest practical taxonomic level identifications. Specifically, a site will be considered nonsupporting for aquatic life use when IBI or mIBI scores are less than 36. Report assessment decisions in the 2026 Integrated Report.

6. **Specify Performance or Acceptance Criteria**
   Acceptable data are essential for minimizing decision error. Identifying errors in physical, chemical, and biological parameter sampling design, *in-situ*

measurements, and laboratory measurements, results in more confidence in IBI calibrations, biological threshold determinations, and ALUS decisions.

Site specific ALUS assessments include program specific controls to identify errors. Controls include biological site revisits or duplicates and laboratory verification of species identifications described in IDEM QAPPs and standard operating procedures (SOPs) (IDEM 2017, 2020a, 2020b, 2020c, 2020d, 2023c, 2023d, 2023e).

The quality assurance and quality control (QA/QC) process detects deficiencies in the data collection as set forth in the QAPP (IDEM 2017, 2020a). The QAPP requires all contract laboratories to adhere to rigorous standards during sample analyses and to provide acceptable and usable data. Chemists within the WAPB provide a QA review of the laboratory analytical results. Any data which is "Rejected" due to analytical problems or errors will not be used for water quality assessment decisions. Any data flagged as "Estimated" may be used on a case by case basis and is noted in the QA/QC report. Criteria for acceptance or rejection of results as well as application of data quality flags is presented in the Surface Water QAPP, Table D3-1: Data Qualifiers and Flags, page 184 (IDEM 2017) and Biological and Habitat QAPP, pages 32-36 (IDEM 2020a). Precision and accuracy goals with acceptance limits for applicable analytical methods are provided in the Surface QAPP, Table A7-1: Precision and Accuracy Goals for Data Acceptability by Matrix, pages 61–63; and Table B2.1.1.8-2 Field Parameters, page 117 (IDEM 2017). Further investigation will be conducted in response to consistent "rejected" data in determining the source of error. Field techniques used during sample collection and preparation, along with laboratory procedures will be subject to evaluation by both the WAPB QA Manager and Project Manager in troubleshooting error introduced throughout the entire data collection process. Corrective actions will be implemented once the source of error is determined per the QAPP (IDEM 2017, IDEM 2020a).

7. Develop the Plan for Obtaining Data

Sampling locations that are part of the Fixed Station Water Quality Monitoring Program co-located at bridges with USGS stream gages installed is optimal for the Stream RMN project because water chemistry is already sampled monthly and water levels are measured at the gage stations. Sampling locations also need to be wadeable (preferably with a good riffle) and have a nearby location to deploy a weather station and trail camera.

Ideally, sample RMN sites at least once a year to monitor changes in the biological expectations. Regional Monitoring Network site sampling should include at a minimum two biological communities (fish and macroinvertebrates);

habitat evaluations; and at least *in-situ* water chemistry. As resources allow, collect an additional macroinvertebrate sample in the Spring.

A.5 Training and Staffing Requirements

Table 3. Project Roles, Experience, and Training

Role	Required Training/ Experience	Responsibilities	Training References
Project manager	-Database experience -Experience in project management and QA/QC procedures	-Establish project in the Assessment Information Management System (AIMS) II database. -Oversee development of project work plan. -Oversee entry and quality control (QC) of field data. -Oversee querying data from AIMS II database to determine results not meeting ALUS.	-IDEM 2017, 2018, 2020a, 2020b, 2022a, 2022c, 2023a, 2023b -U.S. EPA 2002, 2006, 2016
Field crew chief macroinvertebrate and fish community sampling	-At least one year of experience in sampling methodology and taxonomy of aquatic communities in the region -Annual review of the Principles and Techniques of Electrofishing -Annual review of relevant safety procedures -Annual review of relevant field operations' SOPs	-Complete field data sheets -Taxonomic accuracy -Sampling efficiency and representation -Voucher specimen tracking -Overall operation of the field crew -Adherence to safety and field SOP procedures by crew members -Ensure that multiprobe analyzers are calibrated weekly prior to field sampling activities -Ensure that field sampling equipment is functioning properly and loaded into field vehicles prior to field sampling activities	-IDEM 2008, 2010a, 2010b, 2019, 2020a, 2020c, 2020d, 2021, 2022a, 2022b, 2023b, 2023c, 2023d, 2023e -Simon and Dufour 1998, 2005 -U.S. EPA 2016 -Xylem 2017, 2018
Field crew members – macroinvertebrate and fish community sampling	-Completion of hands-on sampling methodology training prior to field sampling activities -Review of the Principles and Techniques of Electrofishing -Review of relevant safety procedures -Review of relevant field operation SOPs	-Follow all safety and SOP procedures while engaged in field sampling activities. -Follow direction of field crew chief while conducting field sampling activities.	-IDEM 2008, 2010a, 2010b, 2019, 2020c, 2020d, 2021, 2022b, 2023c, 2023d, 2023e -U.S. EPA 2016 -Xylem 2017, 2018
Field crew chief – water chemistry	-At least one year of experience in sampling methodology -Annually review relevant safety procedures	-Completion of field data sheets -Sampling efficiency and representation -Overall operation of the field crew	-IDEM 2008, 2010a, 2010b, 2017, 2019, 2020b, 2020c, 2020d, 2021, 2022b, 2023b

Role	Required Training/ Experience	Responsibilities	Training References
	-Annually review relevant SOP documents for field operations	-Adherence to safety and field SOP procedures by crew members -Ensure that multiprobe analyzers are calibrated weekly prior to field sampling activities -Ensure that field sampling equipment is functioning properly and loaded into field vehicles prior to field sampling activities	-Xylem 2017, 2018
Laboratory supervisor – macroinvertebrate and fish community sample processing	-At least one year of experience in taxonomy of aquatic communities in the region -Annual review of relevant safety procedures -Annual review of relevant laboratory operations' SOPs	-Identification of fish and macroinvertebrate specimens collected during field sampling -Completion of laboratory data sheets -Verify taxonomic accuracy of processed samples -Voucher specimen tracking -Adherence to safety and SOP procedures by laboratory staff -Check data for completeness -Perform all necessary calculations on the data -Ensure that data are entered into the AIMS II Database -Ensure that required QA/QC are performed on the data -Querying data from AIMS II to determine results not meeting Water Quality Criteria	-IDEM 2008, 2010a, 2010b, 2019, 2020a, 2021, 2022c - U.S. EPA 2016
Laboratory staff – macroinvertebrate and fish community sample processing	-Complete hands-on training for laboratory sample processing methodology prior to participation in laboratory sample processing activities -Annually review relevant safety procedures -Annually review relevant SOP documents for laboratory operations	-Adhere to safety procedures and SOPs. -Follow laboratory supervisor direction while processing samples. -Identify fish and macroinvertebrate specimens. -Perform necessary calculations on data and entry onto field sheets.	-IDEM 2008, 2010a, 2010b, 2019, 2020a, 2021, 2022c -U.S. EPA 2016
Laboratory supervisor – water chemistry	-Annually review relevant safety procedures -Annually review relevant SOP documents for field operations	-Completion of laboratory data sheets -Adherence to safety and SOP procedures by laboratory staff -Check data for completeness -Perform all necessary calculations on the data -Ensure that data are entered into the AIMS Data Base -Ensure that required QA/QC are performed on the data	-IDEM 2008, 2010a, 2010b, 2017, 2019, 2020b, 2020c, 2020d, 2021b, 2022c

Role	Required Training/ Experience	Responsibilities	Training References
		-Querying data from AIMS II to determine results not meeting Water Quality Criteria	
Quality assurance officer	-Familiarity with QA/QC practices and methodologies -Familiarity with the QAPPs and data qualification methodologies	-Ensure adherence to QA/QC requirements of QAPP -Evaluate data collected by sampling crews for adherence to project work plan -Review data collected by field sampling crews for completeness and accuracy -Perform a data quality analysis of data generated by the project -Assign data quality levels based on the data quality analysis -Import data into the AIMS data base -Ensure that field sampling methodology audits are completed according to WAPB procedures	-IDEM 2017, 2018, 2020a, 2020b, 2021a, 2022a, 2022c, 2023b, 2023c, 2023d, 2023e -U.S. EPA 2002, 2006, 2016
All staff (safety and reference manuals)	-Basic first aid and cardiopulmonary resuscitation (CPR) -Familiarity with PPE Policy -Familiarity with the Personal Flotation Devices (PFD) WAPB internal memorandum regarding use of approved PFDs and [IC 14-8-2-27]	-Must complete a minimum of 4 hours of in-service training provided by WAPB (IDEM 2010a). -Must follow the policy when working. -When in a watercraft, must wear a PFD at all times when working on boundary waters, as defined by Indiana Code (IC) [IC 14-8-2-27] and between sunset and sunrise on any waters of the state must wear a high intensity whistle and Safety of Life at Sea (SOLAS) certified strobe light.	Personal Protective Equipment (PPE) Policy (IDEM 2008) -Personal Flotation Devices (PFD) February 29, 2000, internal WAPB memorandum - [IC 14-8-2-27]
Staff lacking 4 hours of in-service training or appropriate certification	Same as all staff and must be accompanied by WAPB staff, meeting health and safety training requirements at all times in the field	-Always follow trained staff directions.	WAPB staff meeting health and safety training requirements

B. Data Generation and Acquisition

B.1 Sampling Design and Site Locations

The proposed RMN locations are sites sampled as part of the Fixed Station Program and where a USGS stream gage is present. Temperature dataloggers, a trail camera to take photos of the flow, and a weather station will be deployed during spring of 2023 at these locations to collect continuous data. Fish and macroinvertebrate data

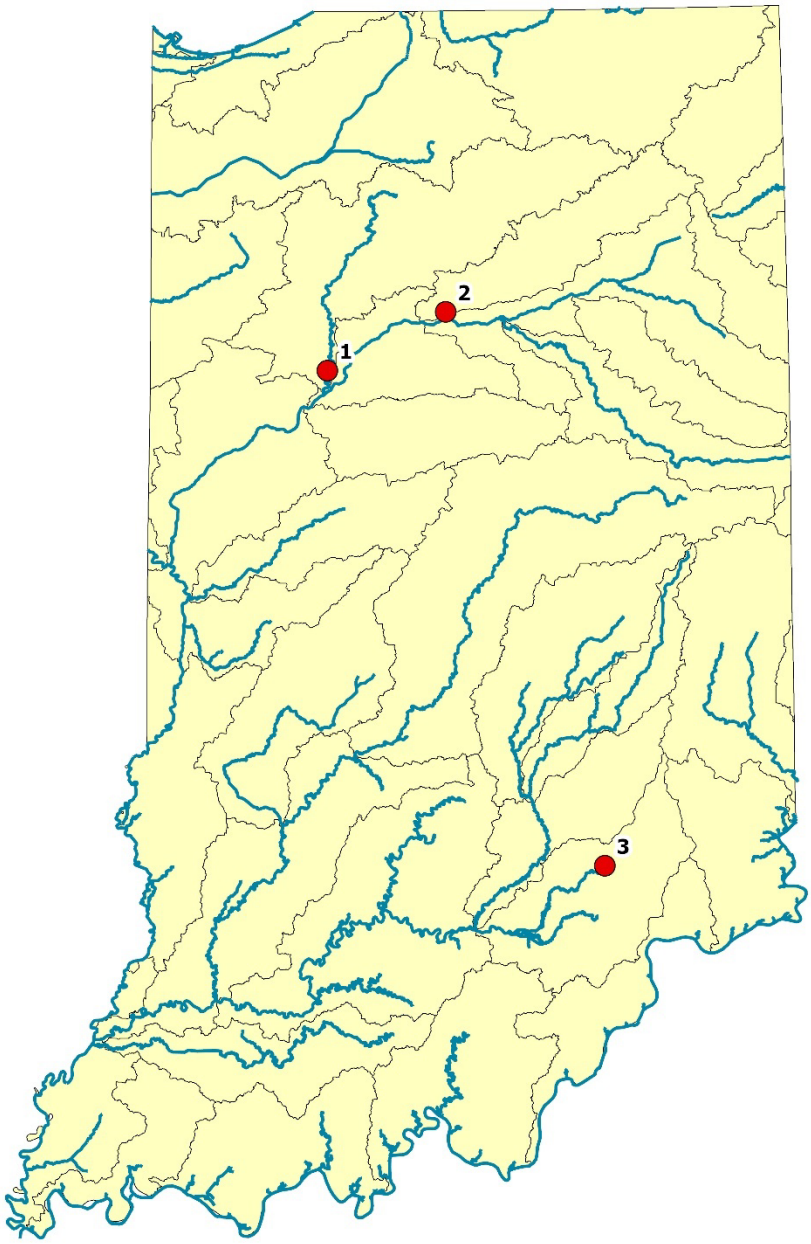
collection during the 2023 season from these three sites will be used for biological community assessments. Water chemistry will be sampled as part of the Fixed Station Water Quality Monitoring Program and will occur monthly (IDEM 2020b). Sites 23RMN01 and 23RMN02 are sampled on the North Central Route, and site 23RMN03 is sampled as part of the Southeast Route.

Conduct site reconnaissance activities in house and through physical site visits (2023a). In-house activities include preparation and review of site maps and aerial photographs. Physical site visits include verification of accessibility, safety considerations, equipment needed to properly sample the site, and property owner consultations, if required. Record all information on the Site Reconnaissance Form (Attachment 1) and enter the information into the Assessment Information Management System (AIMS II) database. Determine precise coordinates for each site during the reconnaissance site visits or at the beginning of site sampling. Use an agency approved handheld Global Positioning System (GPS) unit which can verify horizontal precision within five meters or less, described in GPS Data Creation (IDEM 2022b, 2023b). Enter GPS coordinates into the AIMS ll database. Table 4 provides 2023 RMN sites' sampling locations information. Figure 1 provides RMN sites' map locations.

Table 4. List of Potential 2023 Regional Monitoring Network (RMN) Sites.

L-Site	Event ID	Fixed Station Site ID	Stream Name and Location	County	Hydrologic Unit Code (HUC)	Latitude (DD)	Longitude (DD)	Fixed Station Route
WTI150-0011	23RMN01	TR-9	Tippecanoe River at State Road 18	Carroll	05120106	40.5938229	-86.77070859	North Central
WAE070-0011	23RMN02	ELL-7	Eel River at CR 150 North	Cass	05120104	40.782326	-86.26449731	North Central
WEM070-0001	23RMN03	VF-38	Vernon Fork Muscatatuck River at CR 60 South	Jennings	05120207	38.97639	-85.62	Southeast

Figure 1. 2023 Regional Monitoring Network (RMN) Sites.



This map is intended to serve as an aid in graphic representation only.
This information is not warranted for accuracy or other purposes.

Mapped By: Kevin Gaston, Office of Water Quality
Date: March 15, 2023

Sources:
Regional Monitoring Network Site Data - Obtained from the IDEM AIMS Database
Non Orthophotography Data - Obtained from the State of Indiana Geographic Information Office Library

Map Projection: UTM Zone 16 N **Map Datum:** NAD83

N
W E
S

0 10 20 40 Miles
0 10 20 40 Kilometers

Regional Monitoring Network Sites
Navigable Streams
HUC8 Boundaries

B.2 Sampling Methods

1. **Field Parameter Measurements**
   Measure DO, pH, water temperature, specific conductance, and DO percent saturation with a data sonde, during each sample collection event regardless of the sample media type collected (i.e., chemical, physical, biological). Perform measurement procedures and operation of the data sonde in accordance with the manufacturers' manuals (Xylem Inc. 2017; Xylem Inc. 2018), Calibration of YSI Multiparameter Data Sondes (IDEM 2020c) and Water Chemistry Field Sampling Procedures (IDEM 2020d). Measure turbidity with a Hach™ turbidity kit and write the meter number in the comments under the field parameter measurements. If a Hach™ turbidity kit is not available, record the data sonde measurement for turbidity and note in the comments. Record all field parameter measurements and weather codes on the IDEM Stream Sampling Field Data Sheet (Attachment 2). Also take a digital photo upstream and downstream of the site during each sampling event (IDEM 2023c).

2. **Water Chemistry**
   Water chemistry grab samples will be collected per the Water Chemistry Field Sampling Procedures (IDEM 2020d) monthly at each site as part of the Fixed Station Water Quality Monitoring Program (IDEM 2020b).

3. **Fish Community Sampling**
   Perform fish community sampling using standardized electrofishing methodologies depending on stream size and site accessibility. For the purposes of the RMN sampling methodology, perform fish assemblage assessments in a sampling reach 35 times the average wetted width, with a minimum of 100 meters and a maximum of 500 meters (U.S. EPA 2016). Fish collected within 15 times the average wetted width, with a minimum of 50 meters and a maximum of 500 meters will be separated from the sample (IDEM 2023c). Attempt to sample all habitat types available (i.e., pools, shallows) within the sample reach to ensure adequate representation of the fish community present at the time of the sampling event. List of possible electrofishers for use with sampling include: the Midwest Lake Electrofishing Systems (MLES) Infinity XStream, Smith-Root LR-24 or LR-20B Series backpack electrofishers; or MLES Infinity Control Box with MLES junction box and rat-tail cathode cable, assembled in a canoe (if parts of the stream are not wadeable, the system may require the use of a dropper boom array outfitted in a canoe or possibly a 12 or 14 foot Loweline boat); or, for nonwadeable sites, the Smith-Root Type VI-A electrofisher or MLES Infinity Control Box assembled in a 16 foot Loweline or Blazer boat (IDEM 2023c).

Avoid sample collection during high flow or turbid conditions due to 1) low collection rates which result in nonrepresentative samples and 2) safety considerations for the sampling team. Avoid sample collection during late autumn due to the cooling water temperature, which may affect the responsiveness of some species to the generated electric field. This lack of responsiveness can result in samples not representative of the stream's fish assemblage (IDEM 2023c).

Collect fish using dipnets with fiberglass handles and netting of 1/8-inch bag mesh. Sort fish collected in the sampling reach by species into baskets or buckets. Separate individuals for each species that are 20- 24 millimeters. These individuals are not recorded according to the RMN sampling protocol (U.S. EPA 2016); however, those individuals are necessary for standard IDEM fish community sampling. Do not retain young-of-the-year fish less than 20 millimeters (mm) total length in the community sample (IDEM 2023c).

For each field taxonomist (generally the crew leader), retain a complete set of fish vouchers for any different species encountered during the summer sampling season. Vouchers may consist of either preserved specimens or digital images. Prior to processing fish specimens and completion of the fish community datasheet, possibly preserve one to two individuals per new species encountered in 3.7% formaldehyde solution to serve as representative fish vouchers. Fish specimens must be positively identified and small enough to fit in a 2000 mL jar. If, however, a specimen is too large to preserve, take a photo of key characteristics (e.g., fin shape, size, body coloration) for later examination (IDEM 2023c. Also, prior to sampling, randomly select 10% of the sites for revisits. Preserve a few representative individuals of all species found at the site or photograph to serve as vouchers (IDEM 2020a). Review taxonomic characteristics for possible species encountered in the basin of interest prior to field work. Also preserve fish specimens if they cannot be positively identified in the field (i.e., those co-occurring like the Striped and Common Shiners or are difficult to identify when immature); individuals appearing to be hybrids or have unusual anomalies; and dead specimens taxonomically valuable for undescribed taxa (e.g., Red Shiner or Jade Darter), life history studies, or research projects (IDEM 2023c).

Record the following data for non-preserved fish on the IDEM Fish Collection Data Sheet (Attachment 3): number of individuals, minimum and maximum total length (mm), mass weight in grams (g), and number of individuals with deformities, eroded fins, lesions, tumors, and other anomalies (DELTs). Upon recording the data, release specimens within the sampling reach from which they were collected. Record data for

preserved fish specimens following taxonomic identification in the laboratory (IDEM 2023c).

4. Macroinvertebrate Sampling

If scheduled, crews of two to three staff conduct macroinvertebrate community sampling immediately following the fish community sampling event or on a different date. Collect samples using a modification of the U.S. EPA Rapid Bioassessment Protocol multihabitat (MHAB) approach (IDEM 2023d; U.S. EPA 2020). This method involves collecting dislodged macroinvertebrates, with a D-frame 500 µm mesh dip net, from a sweep sample consisting of 20 sweeps taken at all available habitats from a sample reach that is 35 times the average wetted width with a minimum of 100 meters and a maximum of 500m. Define the sampling reach length of riparian sampling corridor at each site using a rangefinder. If the stream is too deep to wade, use a boat to sample the sampling reach along the shoreline with the best available habitat. Sampling effort will be divided proportionally amongst the habitats present within the reach (U.S. EPA 2016). A sweep consists of disturbing an area the size of the width of the D-frame net for approximately 30 seconds. The net should be swept through the disturbed area multiple times in order to collect an adequate sample. An effort covers approximately 0.09 m^2. This results in a total sample area of all 20 sweeps to 1.8 m^2. In addition to the sweep, inspect any large objects (e.g., rocks, woody debris, etc.) in the area immediately in front of the D-frame net for macroinvertebrates and place them in the net (U.S. EPA 2016). If riffles are common, collection of a riffle-only sample for one year is encouraged as a supplemental sample for comparison to the MHAB composite sample. These samples will be subsampled in the lab, using a gridded tray for a 300-organism pick. In addition to this sampling, a sample utilizing the IDEM MHAB approach (IDEM 2023d) will also be collected.

At one RMN sites (roughly 10% of sites), collect an additional duplicate set of all three sampling methods. Further information regarding macroinvertebrate community sampling revisits is in B.4 Quality Control and Custody Requirements.

5. Habitat Assessments

Complete habitat assessments immediately following macroinvertebrate and fish community sample collections at each site using a slightly modified version of the Ohio EPA (OHEPA) QHEI (Rankin 1995; OHEPA 2006). Complete a separate IDEM OWQ QHEI form (Attachment 4) for each of the two sample types, since the sampling reach length may differ (i.e., 50 meters for macroinvertebrates and between 50 and 500 meters for fish). IDEM 2023e describes the method for completion of the QHEI.

6. Weather Station

An Onset MicroRX Station will be deployed at each of the RMN sites (Onset 2021a, U.S. EPA 2016). The Onset MicroRX will be oriented facing south for the attached solar panel to receive the maximum amount of sunlight to charge the internal battery. Each MicroRX Station will collect data for air temperature using a 12-bit temperature Smart Sensor with solar radiation shield (Onset 2021b), precipitation using a Davis 0.2mm Rain Gauge Smart Sensor (Onset 2020), and barometric pressure using a Smart Barometric Pressure Senor (Onset 2017). Measures will be taken for each parameter every 15 minutes (U.S. EPA 2014, 2016). Collected data will be uploaded into Onset's HOBOlink cloud platform and accessed through the HOBOlink software (Onset 2021a).

7. Continuous Water Temperature Data Logger Measurements

An Onset HOBO® Water Temperature Pro v2 (U22-001) Water Temperature Data Logger will be deployed in April (or May if necessary) in a representative location within the targeted stream at each site. Temperature measurements are recorded at 30-minute intervals. With stainless steel wire and heavy-duty zip ties, attach a programmed and calibrated data logger to an appropriate size block (dependent on the minimum depth of the stream) and secure the block to a tree, root mass or bridge pylon with heavy-duty stainless-steel cable. Some sites may have two temperature data loggers deployed on separate blocks if the streambed load (sand or silt) looks unstable or there is a likelihood of vandalism due to a public site. Place in a calm glide portion of the stream segment with a water depth of between 0.3 and 1.0 meters. Do not place the data logger directly below a riffle, a turbulent run, or in a deep pool. For very shallow streams, it may be necessary to place the block in a pool to keep the temperature data logger submerged. Place, as near as possible in the center of the cross-sectional location of the channel. In addition to a float being tied to the block, determine the GPS coordinates point of the exact placement of each data logger using an agency approved handheld GPS unit which can verify horizontal precision within 5 meters or less, Global Position System (GPS) Data Creation (IDEM 2022b, 2023b). Take at least one photograph or digital image of this placement point in relation to the stream reach to document location and stream flow conditions, to the extent possible, in a photograph. Record in-situ water quality measurements at the time of each data logger deployment and when downloading data every other month. Data will be offloaded as a CSV file using Onset HOBOmobile® for IOS and then sent via email to IDEM staff. The time-series data sets will subsequently be uploaded to AIMS II.

8. Flowtography

A Reconyx Hyperfire 2 trail camera will be deployed at each of the sites. The camera will be positioned according to the Flow Photo Explorer User Guide (USGS 2022) and will take a photograph of the flow condition every 30 minutes. Images will be retrieved every six months from the SD card inside the camera and uploaded to the Flow Photo Explorer website (https://www.usgs.gov/apps/ecosheds/fpe/#/explorer). Batteries for each unit will be replaced on a yearly basis.

B.3 Analytical Methods

Table 5 lists the field parameters, respective test method, and IDEM quantification limits. Table 6 lists parameters collected during water chemistry sampling as part of the Fixed Station Water Quality Monitoring Program. The OWQ Chain of Custody Form (Attachment 5) accompanies each sample set through the analytical process.

Table 5. Field Parameters Showing Method and IDEM Quantification Limit

Parameters	Method (SM=Standard Method)	IDEM Quantification Limit
DO (data sonde optical)	ASTM D888-09	0.05 mg/L
DO (data sonde membrane probe)	SM 4500-OG	0.05 mg/L
DO % Saturation (data sonde optical)	ASTM D888-09	0.05%
DO % Saturation (data sonde)	SM 4500-OG	0.01%
pH (data sonde)	U.S. EPA 150.2	0.10 S.U.
pH (field pH meter)	SM 4500H-B [1]	0.10 S.U.
Specific Conductance (data sonde)	SM 2510B	1.00 µmho/cm
Temperature (data sonde)	SM 2550B(2)	0.1 °C
Temperature (field meter)	SM 2550B(2) [1]	0.1 °C
Turbidity (data sonde)	SM 2130B	0.02 NTU [2]
Turbidity (Hach™ turbidity kit)	EPA 180.1	0.05 NTU [2]

[1] Method used for Field Calibration Check
[2] NTU = Nephelometric Turbidity Unit(s)
SM = Standard Method
ASTM = American Society for Testing and Materials

Table 6. Parameters Collect During Water Chemistry Sampling

Parameters	23RMN01 (VF-38)	23RMN02 (ELL-7)	23RMN03 (TR-9)
Alkalinity ($CaCO_3$)	X	X	X
Hardness (CaCO3)	X	X	X
Calcium (CaCO3)	X	X	X
Magnesium (CaCO3)	X	X	X
Ammonia-N	X	X	X
Nitrate and Nitrite-N	X	X	x
Nitrogen - TKN	X	X	X
Phosphorous - Total	X	X	X
COD	X	X	X
TOC	X	X	X
DOC			X
BOD		X	X
Solids - Total	X	X	X
Solids - Suspended	X	X	X
Solids - Dissolved	X	X	X
Chloride	X	X	X
Sulfate	X	X	X
Arsenic (µg/l)	X	X	X
Cadmium (µg/l)	X	X	X
Chromium - Total	X	X	X
Copper (µg/l)	X	X	X
Iron (µg/l)	X	X	X
Lead (µg/l)	X	X	X
Nickel (µg/l)	X	X	X
Potassium			X
Sodium			X
Zinc (µg/l)	X	X	X
Boron (µg/l)	X	X	X
Strontium (µg/l)	X	X	X

B.4 Quality Control and Custody Requirements

QA protocols will follow part of the Surface Water QAPP (IDEM 2017, p. 170) and B.5 of the Biological and Habitat QAPP (IDEM 2020a, p. 27).

1. **Water Chemistry Data**

   Sample bottles and preservatives certified for purity will be used. Sample collection procedures, including the container and preservative used for each parameter and holding times will adhere to U.S. EPA requirements for water chemistry testing (see Table 8). Field duplicates and matrix spike/matrix spike duplicates (MS/MSD) shall be collected at the rate of one per sample analysis set or one per every 20 samples, whichever is greater (IDEM 2017). Additionally, field blank samples using American Society for Testing and Materials (ASTM) D1193-91 Type I water will be taken at a rate of one set per sampling crew for each week of sampling activity (IDEM 2020d). All samples collected for water chemistry analysis will be processed by IDOH (Indianapolis, Indiana).

2. **Fish Community Data**

   Perform fish community sampling revisits at a rate of 10% of the total fish community sites sampled (approximately 3) (IDEM 2023c). Perform revisit sampling with at least 2 weeks of recovery between the initial and revisit sampling events. Perform fish community revisit sampling and habitat assessment with either a partial or complete change in field team staff (IDEM 2023c). Use the resulting IBI and QHEI total score between the initial visit and the revisit to evaluate precision (IDEM 2020a). Use the IDEM OWQ Chain of Custody Form to track samples from the field to the laboratory (Attachment 5). Regionally recognized non-IDEM freshwater fish taxonomists may verify fish taxonomic identifications made by IDEM staff in the laboratory. For all raw data: 1) check for completeness; 2) utilize to calculate derived data (i.e., total weight of all specimens of a taxon) and enter into the AIMS II database; and 3) check again for data entry errors.

3. **Macroinvertebrate Community Data**

   Prior to beginning the field season, randomly select 10% of the total macroinvertebrate community sampling sites (approximately 1) for collection of duplicate macroinvertebrate field samples. Immediately after collecting the initial macroinvertebrate community sample and performing the habitat assessment, the same staff collects the duplicate sample and performs another habitat assessment. Base the precision evaluation on the duplicate of samples collected (IDEM 2020a). Use the IDEM OWQ Chain of Custody Form (Attachment 5) to track samples from the field to the laboratory. The IDEM macroinvertebrate laboratory supervisor maintains Laboratory identifications and QA/QC of taxonomic work. A Biological Samples Laboratory Chain of Custody Form (Attachment 6) will be used to document when the sample is removed from storage to be

processed and when the sample is returned to storage. Ten percent of samples (the initial samples taken at sites where duplicate samples were collected) will be verified by an outside taxonomist (IDEM 2020a).

B.5 Field Parameter Measurements and Instrument Testing and Calibration

Calibrate the data sonde prior to each week's sampling (IDEM 2020c). Record, maintain, store, and archive calibration results and drift values in logbooks located in the calibration laboratories at the Shadeland facility. Drift value is the difference between two successive calibrations. Field parameter calibrations will conform to the procedures described in the instrument users' manuals (Xylem Inc. 2017; Xylem Inc. 2018) and the OWQ technical standard operating procedure (IDEM 2020c). Use the air calibration method (IDEM 2020c) to conduct the DO component of the calibration procedure. Conduct an accuracy field check for the unit once during the week by comparison with an YSI DO meter, Hach™ turbidity, and a pH and temperature meter. Record weekly calibration and verification results on the field calibrations portion of the Stream Sampling Field Data Sheet (Attachment 2) and enter in the AIMS II database. Also use the YSI DO meter at sites where the DO concentration is 4.0 mg/L or less.

Collect *in-situ* water chemistry data in the field using calibrated or standardized equipment. Perform calculations in the field or later in the office. Analytical results, which have limited QC checks, are included in this category. Detection limits and ranges are set for each analysis (Table 5). Perform QC checks on information for field or laboratory results to estimate precision, accuracy, and completeness for the project, as described in the Surface Water QAPP (IDEM 2017 Section C1.1 p. 176).

B.6. Data Management

IDEM field crew chief will initially review analytical data. Then data will be reviewed against the Generic Stream Monitoring Network QAPP (U.S. EPA 2016), and the criteria presented in it. Once the field data is compiled and corrections will be brought to the attention of the Project Manager.

Continuous temperature data will be reviewed and corrected (if needed) using HOBOware Pro prior to being submitted to the EPA Regional Lead (U. S. 2016). Corrections to the data can include:

- Trimming data to remove measurements taken before and after the sensors are installed and prior to them reaching equilibrium.
- Plotting the data and visually checking for anomalies and missing data.

C. Assessment and Oversight

C.1. Assessments and Response Actions

Conduct performance and system audits to ensure good quality data.

Field and laboratory performance checks include:

- Precision measurements by relative percent difference (RPD) of field and laboratory duplicate (IDEM 2017, pp. 56, 61–63)
- Accuracy measurements by percent of recovery of MS/MSD samples analyzed in the laboratory (IDEM 2017, pp. 58, 61–63)
- Completeness measurements by the percent of planned samples collected, analyzed, reported, and usable for the project (IDEM 2017, p. 58)

For biological and habitat measurements, field performance measurements include:

- Completeness (IDEM 2020a, pp. 10-11, 14, 17)
- Examination of fish IBI score differences and the (RPD) for number of fish species at revisit sites (IDEM 2020a, pp. 9-10)
- Examination of macroinvertebrate IBI score differences and RPD for number of taxa for macroinvertebrate duplicate samples (IDEM 2020a, p. 13)
- RPD between the two total QHEI scores (IDEM 2020a, p. 18)

Lab performance measurements include:

- Percent Taxonomic Disagreement (PTD) for fish (IDEM 2020a, p. 12)
- Percent Taxonomic Disagreement (PTD), Percent Difference in Enumeration (PDE) and Percent Sorting Efficiency (PSE) for macroinvertebrates (IDEM 2020a, pp. 14-16)

IDEM WAPB staff conduct field audits every other year to ensure sampling activities adhere to approved SOPs. WAPB QA staff conduct systematic audits to include all WAPB staff engaged in field sampling activities. QA staff, trained in the associated sampling SOPs and in the processes related to conducting an audit, evaluate WAPB field staff involved with sample collection and preparation. QA staff produce an evaluation report documenting each audit for review by field staff audited and WAPB management. As a result of the audit process, communicate corrective actions to field staff who will implement the corrections (IDEM 2017, pp. 176 – 177; IDEM 2020a, p. 31).

Require contract laboratories to have NELAC audits at the beginning of a laboratory contract and at least once a year during the contract. In addition,

IDEM QA staff annually review performance studies conducted by the contract laboratories. The audit includes any or all the operational QC elements of the laboratory's QA system. Address all applicable elements of the QAPP and the laboratory contract requirements including, but not limited to, sampling handling, sample analysis, record keeping, preventative maintenance, proficiency testing, staff requirements, training, and workload (IDEM 2017, pp. 177-178).

For macroinvertebrate verifications by an external lab, the lab must maintain Society for Freshwater Science taxonomic certifications for their taxonomists. Genus level taxonomic certifications are required for 1. Eastern General Arthropods, 2. Eastern Ephemeroptera, Plecoptera and Trichoptera, 3. Chironomidae and 4. Oligochaeta.

C.2 Data Quality Assessment Levels

Surface Water QAPP (IDEM 2017, pp. 182 – 183) and the Biological and Habitat QAPP (IDEM 2020a, pp. 34-35) describe the intent to collect samples and various types of data to meet the QA criteria and rated Data Quality Assessment (DQA) Level 3.

D. Data Validation and Usability

QA reports to management, and data validation and usability are also important components of the QAPP ensuring good quality data. Should problems arise and require investigation and correction, submit a QA audit report to the QA manager and project manager for review. The following steps ensure data meet the project DQO and allow assessment by users:

- Reduce by converting raw analytical data into final results in proper reporting units.
- Validate by qualifying data based on the performance of field and laboratory QC measures incorporated into the sampling and analysis procedures.)
- Report by completely documenting the calibration, analysis, QC measures, and calculations.)

D.1. Quality Assurance, Data Qualifiers, and Flags

Use the various data qualifiers and flags for QA and validation of the data found in the Surface Water QAPP (IDEM 2017 pp. 184 – 185) and Biological and Habitat QAPP (IDEM 2020a pp. 33-34).

D.2. Reconciliation with User Requirements

Qualify the environmental project data, each lab or field result, usability per Surface Water QAPP (IDEM 2017 p. 184) and Biological and Habitat QAPP

(IDEM 2020a pp. 35-36). Categorize data in one or more of the following classifications.

- Acceptable Data
- Enforcement Capable Results
- Estimated Data
- Rejected Data

D.3. Information, Data, and Reports

Record the 2023 data collected in the AIMS II database. Present in compilation summaries:

- A database report format containing biological results and habitat evaluations, produced for inclusion in the Integrated Report and individual site folders.
- Laboratory bench sheets containing the species taxa names and enumerations.

Maintain all site folders at the WAPB facility until uploaded into the IDEM Virtual File Cabinet. All data and reports are available to public and private entities which may find the data useful for municipal, industrial, agricultural, and recreational decision-making processes (TMDL, NPDES permit modeling, watershed restoration projects, water quality criteria refinement).

D.4. Laboratory and Estimated Cost

Project laboratory analysis and data reporting should comply with the Surface Water QAPP and TMDL Program (B-001-OWQ-WAP-XX-17-Q-R4, see IDEM 2017), Biological and Habitat QAPP (IDEM 2020a), and the IDEM 2018 Quality Management Plan (IDEM 2018).

The following labs perform analytical tests:

- Analytical tests on the water chemistry parameters will be performed by IDOH in Indianapolis, Indiana
- Collection and analysis of all macroinvertebrate samples – IDEM staff
- Validation of 10% of macroinvertebrate samples – External Contract Lab with Society for Freshwater Science Certified Taxonomists.
- Collection and analysis of all fish samples – IDEM staff

Table 7 outlines the anticipated budget for the project's laboratory costs.

Table 7. Total Estimated Laboratory Cost for the Project.

Analysis	Laboratory	Estimated Cost
Macroinvertebrate Identification	External Contract Lab with Society for Freshwater Science Certified Taxonomists	$460
	Total	$460

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*Documents may be inspected at the Watershed and Assessment Branch office, located at 2525 North Shadeland Avenue, Indianapolis, IN.

F. Distribution List

Electronic Distribution Only

Name	Organization
Kristen Arnold	IDEM, OWQ, WAPB, Branch Chief
Timothy Bowren	IDEM, OWQ, WAPB, Technical and Logistical Services Section
Angela Brown	IDEM, OWQ, WAPB, Watershed Planning and Restoration Section
Dylan Brown	IDEM, OWQ, WAPB, Probabilistic Monitoring Section
McKenzie Bruder	IDEM, OWQ, WAPB, Probabilistic Monitoring Section
Pat Colcord	IDEM, Office of Program Support, Recycling, Education, and QA Section
Marissa Cubbage	IDEM, OWQ, WAPB, Probabilistic Monitoring Section
Kevin Gaston	IDEM, OWQ, WAPB, Probabilistic Monitoring Section
Paul Higginbotham	Deputy Assistant Commissioner IDEM, OWQ
Kathleen Hagan	IDEM, OWQ, WAPB, Watershed Planning and Restoration Section
Charles Hostetter	IDEM, OWQ, WAPB, Technical and Logistical Services Section
David Jordan	IDEM, OWQ, WAPB, Technical and Logistical Services Section
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Mitchell Owens	IDEM, OWQ, WAPB, Probabilistic Monitoring Section
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Michael Schneider	IDEM, OWQ, WAPB, Probabilistic Monitoring Section
Stacey Sobat	IDEM, OWQ, WAPB, Probabilistic Monitoring Section
Kristi Todd	IDEM, OWQ, WAPB, Watershed Planning and Restoration Section
Kayla Werbianskyj	IDEM, OWQ, WAPB, Targeted Monitoring Section
Cameron Yeakle	IDEM, OWQ, WAPB, Targeted Monitoring Section

G. Attachments

Attachment 1. IDEM Site Reconnaissance Form

Attachment 2. IDEM Stream Sampling Field Data Sheet

Attachment 3. IDEM Fish Collection Data Sheet

Attachment 4. IDEM OWQ Biological Qualitative Habitat Evaluation Index

Attachment 5. IDEM OWQ Chain of Custody Form

Attachment 6. Biological Samples Laboratory Chain of Custody Form

Attachment 1. IDEM Site Reconnaissance Form

Site Reconnaissance Form

EPA Site Identifier	Rank
INRB15-001	1
Recon #: R-6551 Trip #: R15WQW-1	

Site Number: WUW-07-0014 Stream: Mossburg Ditch County: Wells

Location Description: CR 550 W

Reconnaissance Data Collected

Recon Date	Crew Members		
3/9/2015	TAF	KAG	

Avg. Width (m)	Avg. Depth (m)	Max. Depth (m)	Nearest Town
2	.2	.5	Liberty Center

Water Present?	Site Wadeable?	Riffle/Run Present?	Road/Public Access Possible?
☑	☑	☐	☑

Site Impacted by Livestock?	Collect Sediment?	Gauge Present?
☐	☐	☐

Landowner/Contact Information

First Name | Last Name

Street Address

City | State | Zip

Telephone | E-Mail Address

Pamphlet Distributed?	Please Call In Advance?	Results Requested?
☐	☐	☐

Rating, Results, Comments, and Planning

Site Rating By Category (1=easy, 10=difficult)
Access Route
2
Safety Factor
4
Sampling Effort
3

Reconnaissance Decision

Pre-Recon
Recon in process
(Approved Site)
No, Landowner denied access
No, Dry
No, Stream channel missing
No, Physical barriers
No, Impounded stream
No, Marsh/Wetland
No, Bridge gone or not accessible
No, Unsafe due to traffic or location
No, Site impacted by backwater
No, Other

Equipment Selected

Circle Equipment Needed

(Backpack)
Boat
Totebarge
Longline
Scanoe
Seine
Weighted Handline
Waders
Gill Net

Comments

Sketch of Stream & Access Route – Indicate Flow, Direction, Obstacles, & Land Use (Use Back of Page, if Necessary)

All crews park off of the CR 550 W bridge, frozen during recon so it was hard to tell where the best parking is. May have to park at the cemetary N of site if there isn't a good pull off. Site ~ 250 feet W of bridge. Site was zipped back to the ditch during recon. Walk N bank to site, do not have S bank permission.

ENT KAG 3.16.15
QC1 KRW 3/16/15
QC2 TAF 3/19/15

40 43 17.540711
-85 19 39.426530

1/16/2015 15:34:42 PM Site Reconnaissance Form, Page 2 of 101

Attachment 2. IDEM Stream Sampling Field Data Sheet

Stream Sampling Field Data Sheet

Analysis Set #	EPA Site ID	Rank

Sample #	Site #	Sample Medium	Sample Type	Duplicate Sample #

Stream Name:		River Mile:		County:	

Site Description:

Survey Crew Chief	Sample Collectors 1	2	3	4	Sample Collected Date	Time	Hydrolab #	Water Depth/Gage Ht (ft)	Water Flow (cf/sec)	Flow Estimated?	Algae?	Aquatic Life?
										☐	☐	☐

Sample Taken?	Aliquots	Water Flow Type	Water Appearance	Canopy Closed %
◇ Yes ◇ No; Frozen	◇ 1 ◇ 2 ◇ 3 ◇ 4	◇ Riffle ◇ Dry ◇ Stagnant	◇ Clear ◇ Green ◇ Sheen	◇ 0-20% ◇ 60-80%
◇ No; Stream Dry ◇ No; Other	◇ 6 ◇ 8 ◇ 12 ◇ 24	◇ Pool ◇ Run ◇ Flood	◇ Murky ◇ Black ◇ Other	◇ 20-40% ◇ 80-100%
◇ No; Owner refused Access	◇ 48 ◇ 72 ◇ AS-Flow	◇ Glide ◇ Eddy ◇ Other	◇ Brown ◇ Gray (Septic/Sewage)	◇ 40-60%

Special Notes:

Field Data:

Date (m/d/yy)	24-hr Time (hh:mm)	D.O. (mg/l)	pH	Water Temp (°C)	Spec Cond (µohms/cm)	Turbidity (NTU)	% Sat.	Chlorine (mg/l)	Chloride (mg/l)	Chlorophyll (mg/l)	Weather Codes SC	WD	WS	AT
Comments														
Comments														
Comments														
Comments														
Comments														
Comments														

Measurement Flags	
<	< Min. Meter Measurement
>	> Max. Meter Measurement
E	Estimated (See Comments)
R	Rejected (See Comments)

Weather Code Definitions

SC Sky Conditions		WD Wind Direction	WS Wind Strength	AT Air Temp
1 Clear	8 Rain	00 North (0 degrees)	0 Calm	1 < 32
2 Scattered	9 Snow	09 East (90 degrees)	1 Light	2 33-45
3 Partly	10 Sleet	18 South (180 degrees)	2 Mod./Light	3 46-60
4 Cloudy		27 West (270 degrees)	3 Moderate	4 61-75
5 Mist			4 Mod./Strong	5 76-85
6 Fog			5 Strong	6 > 86
7 Shower			6 Gale	

Field Calibrations:

Date (m/d/yy)	Time (hh:mm)	Calibrator Initials	Calibrations Type	Meter #	Value	Units

Calibration Type
pH
DO
Turbidity

Preservatives/Bottle Lots:

Group: Preservative	Preservative Lot #	Bottle Type	Bottle Lot #

Groups: Preservatives	
GC	General Chemistry: Ice
Nx	Nutrients: H2SO4
Metals	Metals: HNO3
CN	Cyanide: NaOH
O&G	Oil & Grease: H2SO4
Toxics	Toxics: Ice
Ecoli	Bacteriology: Ice
VOA	Volatile Organics: HCl & Thiosulfate
Pest	Pesticides: Ice
Phen	Phenols: H2SO4
Sed	Sediment: Ice
Gly	Glyphosate: Thiosulfate
Hg	Mercury(1631): HCl
Cr6	ChromiumVI(1636): NaOH
MeHg	Methyl Mercury(1630): HCl

Bottle Types	
2000P	2000mL Plastic, Narrow Mouth
1000P	1000mL Plastic, Narrow Mouth
500P	500mL Plastic, Narrow Mouth
250P	250mL Plastic, Narrow Mouth
1000G	1000mL Glass, Narrow Mouth
500G	500mL Glass, Wide Mouth
250G	250mL Glass, Wide Mouth
125G	125mL Glass, Wide Mouth
40GV	40mL Glass Vial
120PB	120ml Plastic (Bacteria Only)
1000PF	1000mL Plastic, Corning Filter
500PF	500mL Plastic, Corning Filter
60P	60mL Plastic
250T	250mL Teflon
500T	500mL Teflon
125T	125mL Teflon

Data Entered By: _____ QC1: _____
QC2: _____

Attachment 3. IDEM Fish Collection Data Sheet (front)

IDEM
OWQ-WATERSHED ASSESSMENT AND PLANNING BRANCH

Event ID_____________ Voucher jars_______ Unknown jars________ Equipment________________ Page _____ of ______
Voltage_______ Time fished (sec)________ Distance fished (m)_________ Max. depth (m)_________ Avg. depth (m)________
Avg. width (m)______ Bridge in reach_____ Is reach representative_____ If no, why______________________________________
Elapsed time at site (hh:mm)____:____ Comments____

____

____

Museum data: Initials__________ ID date__________ Jar count__________ Fish Total__________

Coding for Anomalies: D – deformities E – eroded fins L – lesions T – tumor M – multiple DELT anomalies O – other (A – anchor worm C – leeches W – swirled scales Y – popeye S – emaciated F – fungus P – parasites) H – heavy L – light (these codes may be combined with above codes)

TOTAL # OF FISH				WEIGHT (s) (mass g)				(length mm)	ANOMALIES					
								Min length	D	E	L	T	M	O
								Max length						
V		P												
								Min length	D	E	L	T	M	O
								Max length						
V		P												
								Min length	D	E	L	T	M	O
								Max length						
V		P												
								Min length	D	E	L	T	M	O
								Max length						
V		P												
								Min length	D	E	L	T	M	O
								Max length						
V		P												
								Min length	D	E	L	T	M	O
								Max length						
V		P												

KRW: Rev/09.26.18 Calculation:________ QC1 + Entry________ QC 1 ________ QC 2________

Attachment 4. IDEM OWQ Biological Qualitative Habitat Evaluation Index (front)

OWQ Biological QHEI (Qualitative Habitat Evaluation Index)

Sample #	bioSample #	Stream Name	Location

Surveyor	Sample Date	County	Macro Sample Type	☐ Habitat Complete	QHEI Score:

1] *SUBSTRATE* Check ONLY Two predominant substrate TYPE BOXES and check every type present

BEST TYPES PREDOMINANT	BEST TYPES PRESENT P/G	BEST TYPES PRESENT R/R	OTHER TYPES PREDOMINANT	OTHER TYPES PRESENT P/G	OTHER TYPES PRESENT R/R
☐☐ BLDR/SLABS [10]	☐	☐	☐☐ HARDPAN [4]	☐	☐
☐☐ BOULDER [9]	☐	☐	☐☐ DETRITUS [3]	☐	☐
☐☐ COBBLE [8]	☐	☐	☐☐ MUCK [2]	☐	☐
☐☐ GRAVEL [7]	☐	☐	☐☐ SILT [2]	☐	☐
☐☐ SAND [6]	☐	☐	☐☐ ARTIFICIAL [0]	☐	☐
☐☐ BEDROCK [5]	☐	☐	(Score natural substrates; ignore sludge from point-sources)		

NUMBER OF BEST TYPES: ☐ 4 or more [2] ☐ 3 or less [0]

Check ONE (Or 2 & average)

ORIGIN
- ☐ LIMESTONE [1]
- ☐ TILLS [1]
- ☐ WETLANDS [0]
- ☐ HARDPAN [0]
- ☐ SANDSTONE [0]
- ☐ RIP/RAP [0]
- ☐ LACUSTRINE [0]
- ☐ SHALE [-1]
- ☐ COAL FINES [-2]

QUALITY

SILT
- ☐ HEAVY [-2]
- ☐ MODERATE [-1]
- ☐ NORMAL [0]
- ☐ FREE [1]

EMBEDDEDNESS
- ☐ EXTENSIVE [-2]
- ☐ MODERATE [-1]
- ☐ NORMAL [0]
- ☐ NONE [1]

Substrate Maximum 20

Comments

2] *INSTREAM COVER* Indicate presence 0 to 3: **0**–Absent; **1**–Very small amounts or if more common of marginal quality; **2**–Moderate amounts, but not of highest quality or in small amounts of highest quality; **3**–Highest quality in moderate or greater amounts (e.g., very large boulders in deep or fast water, large diameter log that is stable, well developed root wad in deep/fast water, or deep, well-defined, functional pools.)

___ UNDERCUT BANKS [1]
___ OVERHANGING VEGETATION [1]
___ SHALLOWS (IN SLOW WATER) [1]
___ ROOTMATS [1]
___ POOLS > 70cm [2]
___ ROOTWADS [1]
___ BOULDERS [1]
___ OXBOWS, BACKWATERS [1]
___ AQUATIC MACROPHYTES [1]
___ LOGS OR WOODY DEBRIS [1]

AMOUNT
Check ONE (Or 2 & average)
- ☐ EXTENSIVE > 75% [11]
- ☐ MODERATE 25 - 75% [7]
- ☐ SPARSE 5 - < 25% [3]
- ☐ NEARLY ABSENT < 5% [1]

Cover Maximum 20

Comments

3] *CHANNEL MORPHOLOGY* Check ONE in each category (Or 2 & average)

SINUOSITY
- ☐ HIGH [4]
- ☐ MODERATE [3]
- ☐ LOW [2]
- ☐ NONE [1]

DEVELOPMENT
- ☐ EXCELLENT [7]
- ☐ GOOD [5]
- ☐ FAIR [3]
- ☐ POOR [1]

CHANNELIZATION
- ☐ NONE [6]
- ☐ RECOVERED [4]
- ☐ RECOVERING [3]
- ☐ RECENT OR NO RECOVERY [1]

STABILITY
- ☐ HIGH [3]
- ☐ MODERATE [2]
- ☐ LOW [1]

Channel Maximum 20

Comments

4] *BANK EROSION AND RIPARIAN ZONE* Check ONE in each category for EACH BANK (Or 2 per bank & average)

River right looking downstream

L R	EROSION
☐☐	NONE/LITTLE [3]
☐☐	MODERATE [2]
☐☐	HEAVY/SEVERE [1]

L R	RIPARIAN WIDTH
☐☐	WIDE > 50m [4]
☐☐	MODERATE 10-50m [3]
☐☐	NARROW 5-10m [2]
☐☐	VERY NARROW [1]
☐☐	NONE [0]

L R	FLOOD PLAIN QUALITY
☐☐	FOREST, SWAMP [3]
☐☐	SHRUB OR OLD FIELD [2]
☐☐	RESIDENTIAL, PARK, NEW FIELD [1]
☐☐	FENCED PASTURE [1]
☐☐	OPEN PASTURE, ROWCROP [0]

L R	
☐☐	CONSERVATION TILLAGE [1]
☐☐	URBAN OR INDUSTRIAL [0]
☐☐	MINING /CONSTRUCTION [0]

Indicate predominant land use(s) past 100m riparian.

Riparian Maximum 10

Comments

5] *POOL/GLIDE AND RIFFLE/RUN QUALITY*

MAXIMUM DEPTH
Check ONE (ONLY!)
- ☐ > 1m [6]
- ☐ 0.7 - < 1m [4]
- ☐ 0.4 - < 0.7m [2]
- ☐ 0.2 - < 0.4m [1]
- ☐ < 0.2m [0] [metric = 0]

CHANNEL WIDTH
Check ONE (Or 2 & average)
- ☐ POOL WIDTH > RIFFLE WIDTH [2]
- ☐ POOL WIDTH = RIFFLE WIDTH [1]
- ☐ POOL WIDTH < RIFFLE WIDTH [0]

CURRENT VELOCITY
Check ALL that apply
- ☐ TORRENTIAL [-1]
- ☐ VERY FAST [1]
- ☐ FAST [1]
- ☐ MODERATE [1]
- ☐ SLOW [1]
- ☐ INTERSTITIAL [-1]
- ☐ INTERMITTENT [-2]
- ☐ EDDIES [1]

Indicate for reach – pools and riffles.

Recreation Potential (Check one and comment on back)
- ☐ Primary Contact
- ☐ Secondary Contact

Pool/ Current Maximum 12

Comments

Indicate for functional riffles; Best areas must be large enough to support a population of riffle-obligate species:

Check ONE (Or 2 & average) ☐ NO RIFFLE [metric = 0]

RIFFLE DEPTH
- ☐ BEST AREAS > 10cm [2]
- ☐ BEST AREAS 5 - 10cm [1]
- ☐ BEST AREAS < 5 cm [metric = 0]

RUN DEPTH
- ☐ MAXIMUM > 50cm [2]
- ☐ MAXIMUM < 50cm [1]

RIFFLE/RUN SUBSTRATE
- ☐ STABLE (e.g., Cobble, Boulder) [2]
- ☐ MOD. STABLE (e.g., Large Gravel) [1]
- ☐ UNSTABLE (e.g., Fine Gravel, Sand) [0]

RIFFLE/RUN EMBEDDEDNESS
- ☐ NONE [2]
- ☐ LOW [1]
- ☐ MODERATE [0]
- ☐ EXTENSIVE [-1]

Riffle/ Run Maximum 8

Comments

6] *GRADIENT* (ft/mi)

DRAINAGE AREA (mi²)

- ☐ VERY LOW - LOW [2 – 4]
- ☐ MODERATE [6 - 10]
- ☐ HIGH - VERY HIGH [10 - 6]

%POOL: ____ %GLIDE: ____

%RUN: ____ %RIFFLE: ____

Gradient Maximum 10

Entered _____ QC1 _____ QC2 _____ IDEM 02/01/2023

Attachment 4. IDEM OWQ Biological QHEI (back)

OWQ Biological QHEI (Qualitative Habitat Evaluation Index)

COMMENT _____

A-CANOPY
- ☐ > 85% - Open
- ☐ 55% - < 85%
- ☐ 30% - < 55%
- ☐ 10% - < 30%
- ☐ < 10% - Closed

B-AESTHETICS
- ☐ Nuisance algae
- ☐ Invasive macrophytes
- ☐ Excess turbidity
- ☐ Discoloration
- ☐ Foam/Scum
- ☐ Oil sheen
- ☐ Trash/Litter
- ☐ Nuisance odor
- ☐ Sludge deposits
- ☐ CSOs/SSOs/Outfalls

C-RECREATION

	Area	Depth
Pool:	☐ > 100 ft^2	☐ > 3 ft

D-MAINTENANCE
- ☐ Public ☐ Private
- ☐ Active ☐ Historic
- Succession: ☐ Young ☐ Old
- ☐ Spray ☐ Islands ☐ Scoured
- Snag : ☐ Removed ☐ Modified
- Leveed: ☐ One sided ☐ Both banks
- ☐ Relocated ☐ Cutoffs
- Bedload: ☐ Moving ☐ Stable
- ☐ Armoured ☐ Slumps
- ☐ Impounded ☐ Desiccated
- ☐ Flood control ☐ Drainage

E-ISSUES
- ☐ WWTP ☐ CSO ☐ NPDES
- ☐ Industry ☐ Urban
- ☐ Hardened ☐ Dirt & Grime
- ☐ Contaminated ☐ Landfill
- BMPs: ☐ Construction ☐ Sediment
- ☐ Logging ☐ Irrigation ☐ Cooling
- Erosion: ☐ Bank ☐ Surface
- ☐ False bank ☐ Manure ☐ Lagoon
- ☐ Wash H_2O ☐ Tile ☐ H_2O Table
- Mine: ☐ Acid ☐ Quarry
- Flow: ☐ Natural ☐ Stagnant
- ☐ Wetland ☐ Park ☐ Golf
- ☐ Lawn ☐ Home
- ☐ Atmospheric deposition
- ☐ Agriculture ☐ Livestock

Looking upstream (> 10m, 3 readings; ≤ 10m, 1 reading in middle); Round to the nearest whole percent

	Right	Middle	Left	Total Average
% open	____ %	____ %	____ %	____ %

Stream Width (m):

Stream Drawing:

IDEM 02/01/2023

Attachment 5. IDEM OWQ Chain of Custody Form

Indiana Department of Environmental Management

OWQ Chain of Custody Form

Project:
OWQ Sample Set or Trip #:

I Certify that the sample(s) listed below was/were collected by me, or in my presence. Date:_____

Signature:_____ Section:_____

Sample Media (☐ Water, ☐ Algae,☐ Fish, ☐ Macro, ☐ Cyanobacteria/Microcystin, ☐ Sediment)

Lab Assigned Number / Event ID	IDEM Control Number	Sample Type	ID	1000 ml P.N.M.	1000 ml G.N.M.	40 ml Vial	120 ml P (Bact)	2000 ml Nalgene	250 ml Nalgene	125 ml Glass	Date and Time Collected		One check per bottle present
											Date	Time	
P = Plastic	G = Glass	N.M. = Narrow Mouth		Bact = Bacteriological Only							Should samples be iced?	Y	N
M = MS/MSD	B = Blank	D = Duplicate		R = Revisit									

Carriers

I certify that I have received the above sample(s).

Signature	Date	Time	Seals Intact		Comments
Relinquished By:			Y	N	
Received By:					
Relinquished By:			Y	N	
Received By:					
Relinquished By:			Y	N	
Received By:					
IDEM Storage Room #					

Lab Custodian

I certify that I have received the above sample(s), which has/have been recorded in the official record book. The same sample(s) will be in the custody of competent laboratory personnel at all times, or locked in a secured area.

Signature:_____ Date:_____ Time:_____

Lab:_____ Address:_____

Revision Date: 4/27/2016

Attachment 6. Biological Samples Laboratory Chain of Custody Form

IDEM

INDIANA DEPARTMENT OF
ENVIRONMENTAL MANAGEMENT
OFFICE OF WATER QUALITY BIOLOGICAL STUDIES SECTION
LABORATORY CHAIN OF CUSTODY

ROOM # ______

By placing your initials below, you are certifying that the sample(s) listed below was/were processed by you or in your presence in the processing room noted below and returned to the noted storage room.

Sample Type AD = Algae Diatom AS = Algae, Soft F = fish M = macro	Event ID or Macro #	IDEM Sample #	# of 2000 mL Nalgene Jar	# of 250 mL Nalgene Jar	# of 125 mL Glass Jar	Removed from Storage for Processing		Processing Room #	Initials	Placed in Storage after Processing		Storage Room #	Initials	# of Olive Voucher Jars	# of Slides	# of Clear Top Test Tubes	Sample Split P = Permanent T = Temporary
	(YY____) or ( )	(AB)				Date (mm/dd/yyyy)	Time (24hr)			Date (mm/dd/yyyy)	Time (24hr)						
							:				:						
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Lab: Indiana Department of Environmental Management | Address: 2525 N. Shadeland Ave., Laboratory Room 121, 124, 125, Indianapolis, IN 46219

H. Appendices

Appendix A. IDEM Fish Community Assessments for Aquatic Life Use

Appendix B. Calculating IDEM Macroinvertebrate Index of Biotic Integrity (mIBI)

Appendix A. IDEM Fish Community Assessments for Aquatic Life Use

IDEM collects fish assemblages, chemical parameters, nutrient parameters, macroinvertebrate assemblages, and habitat evaluations to monitor the health of streams and rivers in Indiana. The many advantages of using fish assemblages for monitoring stream health:

- Many fish have life spans of greater than three years, allowing detection of degradation in habitat or water chemistry over time which alters the expected fish community structure.
- The knowledge of fish life history, feeding, and reproductive behavior is well known and can be used to detect changes in water chemistry or habitat alterations.
- Fish species identification can usually be made in the field so that fish are returned to the stream and time utilized for laboratory identifications kept minimal.

The Indiana Administrative Code [327 IAC 2-1-3(a)(2); 327 IAC 2-1.5-5(a)(2)] contains narrative biological criteria stating, “all waters, except those designated as limited use, will be capable of supporting a well-balanced, warm water aquatic community.” The water quality standard definition of a “well-balanced aquatic community” is “an aquatic community that is diverse in species composition, contains several different trophic levels, and is not composed mainly of pollution tolerant species” [327 IAC 2-1-9(59)]. To measure whether or not the fish community meet the definition, IDEM uses an Index of Biotic Integrity (IBI) composed of 12 fish community characteristics chosen based upon the part of the state (ecoregion) from which the sample is collected and the size of stream (drainage area). The 12 different characteristics score either a 0, 1, 3, or 5, each score represents a deviation from expected fish community structure (i.e., 5 = no deviation from expectations, 1 = severe deviation from expected fish community structure). A total score can range from 0 (no fish) to 60 (excellent, comparable to least impacted conditions). Indiana expects streams to score at least 36 out of 60 to meet aquatic life use water quality standards. The chart below, modified from a table developed by Karr et al. 1986, uses total IBI score, integrity class, and attributes to define the fish community characteristics in Indiana streams and rivers.

Total IBI Score	Integrity Class	Attributes
53 – 60	Excellent	Comparable to least impacted conditions, exceptional assemblage of species.
45 – 52	Good	Decreased species richness (intolerant species in particular), sensitive species present.
36 – 44	Fair	Intolerant and sensitive species absent, skewed trophic structure.
23 – 35	Poor	Top carnivores and many expected species absent or rare, omnivores and tolerant species dominant.
12 – 22	Very Poor	Few species and individuals present, tolerant species dominant, diseased fish frequent.
<12	No Fish	No fish captured during sampling.

Karr, J.R., K.D. Fausch, P.L. Angermeier, P.R. Yant, and I.J Schlosser. 1986. Assessing biological integrity in running waters: a method and its rationale. Illinois Natural History Survey Special Publication 5. 28 p.

Some examples of metrics and fish specimens used for the Index of Biotic Integrity (IBI) looking at species composition, trophic levels, and tolerance to water pollution or habitat disturbance.

1. *Number of Species* (generally more species = better quality stream)
2. *Number of Darter, Madtom, Sculpin Species* (species require high DO and clean, rocky substrates, so higher number = better quality stream)
   Examples: Rainbow darter, Brindled madtom, Mottled sculpin
3. *% Large River Individuals* (species require habitats typical in great rivers in terms of bottom substrates, current velocity, backwater areas, etc., so higher percentage = better quality river)
   Examples: Chestnut lamprey, Channel catfish, Bullhead minnow, Silver chub
4. *% Headwater Individuals* (species in small streams occupying permanent habitat with low environmental stress, so greater percentage = better quality stream)
   Examples: Blacknose dace, Southern redbelly dace, Fantail darter
5. *Number of Sunfish or Centrarchidae Species* (species occupy pools which act as sinks for potential pollutants and silt, so fewer number of these species = low quality stream)
   Examples: Rock bass, Bluegill, Largemouth bass
6. *Number of Sucker or Round Body Sucker Species* (species do not tolerate habitat and water quality degradation, so more species = better quality stream)
   Examples: Black redhorse, Northern hog sucker
7. *Number of Minnow Species* (generally more minnow species = better quality stream)
   Examples: Spotfin shiner, Silverjaw minnow, Hornyhead chub
8. *Number of Sensitive Species* (species sensitive to pollution, so more species = better quality stream)
   Examples: Greenside darter, Smallmouth bass, Longear sunfish
9. *% Tolerant Individuals* (species tolerant to pollution, so greater percentage = low quality stream)
   Examples: Yellow bullhead, Green sunfish, Central mudminnow

10. *% Omnivore/Detritivore Individuals* (species that consume at least 25% plant and 25% animal material which makes them opportunistic feeders when other food sources are scarce, so greater percentage = lower quality stream)
    Examples: Bluntnose minnow, White sucker, Gizzard shad
11. *% Insectivore/Invertivore Individuals* (species whose diet is mainly benthic insects, so the metric is a reflection of the food source, so lower percentage = lower quality stream)
    Examples: Blackstripe topminnow, Emerald shiner, Logperch
12. *% Carnivore Individuals* (species whose diet is carnivorous and also reflects the availability of the food source; too high or too low percentage of carnivores = lower quality stream and imbalance of trophic levels)
    Examples: Spotted bass, Redfin pickerel
13. *% Pioneer Individuals* (species that are first to colonize a stream after environmental disturbance, so higher percentage of pioneer individuals = lower quality stream)
    Examples: Creek chub, Central stoneroller, Johnny darter
14. *Number of Individuals* (generally more individuals = better quality stream)
15. *% Simple Lithophilic Individuals* (species that require clean gravel or cobble for successful reproduction since they simply broadcast their eggs on the substrate, fertilize, and provide no parental care; thus, heavy siltation or environmental disturbance will result in a lower percentage of simple lithophilic species = lower quality stream)
    Examples: Bigeye chub, Striped shiner, Orangethroat darter
16. *% Individuals with Deformities, Eroded Fins, Lesions, and Tumors (DELT's)* (diseased individuals with external anomalies as a result of bacterial, fungal, viral, and parasitic infections, chemical pollutants, overcrowding, improper diet, and other environmental degradation. Percentages should be absent or very low naturally, so higher percentage = low quality stream)
    Examples: deformed Blackstripe topminnow, Creek chub with tumors

Appendix B. Calculating IDEM Macroinvertebrate Index of Biotic Integrity (mIBI)

The purpose of this document is to describe the laboratory processing and data analysis procedures used by the Indiana Department of Environmental Management (IDEM) to calculate the macroinvertebrate Index of Biotic Integrity (mIBI). IDEM is currently developing a SOP for calculating the mIBI.

Multihabitat (MHAB) Macroinvertebrate Collection Procedure describes IDEM's multihabitat (MHAB) sampling method for collecting macroinvertebrate samples. The index period for collection of macroinvertebrate samples with the MHAB sampling method is July 15 to October 30. Process the entire sample in the laboratory, as subsampling was already performed in the field. Count all macroinvertebrate individuals with the exception of empty snail and clam shells; microcrustaceans (Ostracoda, Branchiopoda, Copepoda); larval and pupal insect exuviate; and terrestrial insects (including the terrestrial adults of aquatic insect larvae); and invertebrate specimens missing heads.

The level of macroinvertebrate taxonomic identification resolution may depend in large part on the condition (instar and physical condition) of the specimens and the availability of taxonomic resources comprehensive and appropriate for Indiana's fauna. Specimens are generally identified to the lowest practical taxonomic level.

- Oligochaeta (aquatic worms, Hirudinea and Branchiobdellida), Planaria and Acari are only identified to family or a higher level.
- Freshwater snails and clams are identified to genus.
- Freshwater crustacea are identified to genus (Amphipoda and Isopoda) or species (Decapoda).
- Aquatic insects are identified to family (Collembola and several Dipteran families).
- Genus and species (all other insects).

The following lists identifies insect genera often identified to species (and may contain multiple species in a sample) and taxonomic resources commonly used by IDEM biologists for their identification. Full citations for these resources are listed in the Taxonomic References at the end of this document.

Ephemeroptera

Baetidae: *Baetis* (separate *B. intercalaris* and *B. flavistriga* with Moriharra and McCafferty 1979, leave everything else at *Baetis)*

Caenidae: *Caenis:* Provonsha 1990

Heptageniidae: *Mccaffertium* (formerly *Stenonema* subgenus *Mccaffertium*): Bednarik and McCafferty 1979

Odonata

Gomphidae: *Dromogomphus*: Westfall and Tennessen 1979

Coenagrionidae: *Argia* and *Enallagma*: Westfall and May 1996

Hemiptera

Corixidae: *Trichocorixa* and *Palmacorixa*: Hungerford 1948, Hilsenhoff 1984

Megaloptera

Corydalidae: *Chauliodes* and *Nigronia*: Rasmussen and Pescador 2002

Coleoptera

Haliplidae: *Peltodytes*: Brigham 1996
Dytiscidae: *Neoporus*, *Heterosternuta*, *Laccophilus*, *Coptotomus*: Larson et al. 2000
Hydrophilidae: *Tropisternus*, *Berosus*, *Enochrus*: Hilsenhoff 1995A and 1995B
Elmidae: *Stenelmis*, *Dubiraphia*, *Optioservus*: Hilsenhoff and Schmude, Hilsenhoff 1982

Trichoptera
Philopotamidae: *Chimarra*: Hilsenhoff 1982
Leptoceridae: *Nectopsyche*: Glover and Floyd 2004
Hydropsychidae: *Hydropsyche*: Schuster and Etnier 1978

Diptera
Chironomidae: *Ablabesmyia*: Roback 1985 (subgenus/ species group)
Polypedilum: Maschwitz and Cook 2000 (subgenus/ species group)
Cricotopus/Orthocladius: Merritt et al 2007 (subgenus/ species group)

After identification of all organisms in the sample to the lowest practical taxon, taxa are then associated with their corresponding tolerance, functional feeding group, and habit values (found in the spreadsheet Indiana Macroinvertebrate Attributes). Organisms without a tolerance value, functional feeding group, or habit are not included in the calculations for specific metrics (this may become more evident while looking at the metric example provided). For taxa metrics, all of the taxa listed for a specific group (EPT, Diptera) are counted, regardless of level of identification (i.e., if 1 family level ID, 1 *Cricotopus* genus level ID, and 2 distinct species level IDs under the *Cricotopus* genus in the Chironomidae family were counted would equal 4 taxa).

Calculate the metrics as follows:

1. Total Number of Taxa: Numerical count of all identified taxa in the sample
2. Total Number of Individuals: Numerical count of the number of individual specimens in the sample
3. Total Number of EPT Taxa: Numerical count of all Ephemeroptera, Plecoptera and Trichoptera taxa in the sample
4. Total Number of Diptera Taxa: Numerical count of all Diptera taxa in the sample
5. % Orthocladiinae + Tanytarsini of Chironomidae: Number of individuals in the chironomid subfamily Orthocladiinae and tribe Tanytarsini divided by the total number of Chironomidae in the sample
6. % Non-insect (minus crayfish): Number of individuals, except for crayfish, which are not in the Class Insecta (Isopoda, Amphipoda, Acari, snails, freshwater clams, Oligochaeta, Nematoda, Nematomorpha) divided by the total number of individuals in the sample
7. % Intolerant: Number of individuals with a tolerance value of 0—3 divided by the total number of individuals in the sample
8. % Tolerant: Number of individuals with a tolerance value of 8—10 divided by the total number of individuals in the sample
9. % Predators: Number of individuals with a functional feeding group designation of Predator divided by the total number of individuals in the sample

10. % Shredders + Scrapers: Combined number of individuals in the functional feeding groups Shredder and Scraper divided by the total number of individuals in the sample
11. % Collector-Filterers: Number of individuals in the functional feeding group Collector-Filterer divided by the total number of individuals in the sample
12. % Sprawlers: Number of individuals with a habit specificity of Sprawler divided by the total number of individuals in the sample

These metric values are then scored as a 1, 3, or 5 according to the criteria in the following table:

Metric	1	3	5
Number of Taxa	< 21	≥ 21 and <41	≥ 41
Number of Individuals	< 129	≥ 129 and < 258	≥ 258
Number of EPT Taxa			
Drainage Area: < 5 mi^2	< 2	≥ 2 and < 4	≥ 4
Drainage Area: ≥ 5 and < 50 mi^2	< 4	≥ 4 and < 8	≥ 8
Drainage Area: ≥ 50 mi^2	< 6	≥ 6 and < 12	≥ 12
% Orthocladiinae + Tanytarsini of Chironomidae	≥ 47	≥ 24 and < 47	< 24
% Non-insects Minus Crayfish	≥ 35	≥ 18 and < 35	< 18
Number of Diptera Taxa	< 7	≥ 7 and < 14	≥ 14
% Intolerant	< 15.9	≥ 15.9 and < 31.8	≥ 31.8
% Tolerant	≥ 25.3	≥ 12.6 and < 25.3	< 12.6
% Predators	< 18	≥ 18 and < 36	≥ 36
% Shredders + Scrapers	< 10	≥ 10 and < 20	≥ 20
% Collector-Filterers	≥ 20	≥ 10 and < 20	< 10
% Sprawlers	< 3	≥ 3 and < 6	≥ 6

Most scoring classifications are the same regardless of stream drainage area; the exception is the Number of EPT Taxa metric which increases with increasing drainage area. After scoring all metrics, sum the individual metric scores and the total is the mIBI score for that particular site. Scores less than 36 are considered impaired while those greater than or equal to 36 are unimpaired.

Example of Derivation of Metric Scores for the Macroinvertebrate Index of Biotic Integrity

TAXA NAME	FEED GRP	TOL	HAB/BHV	# OF IND
Heptagenia	SC	3		1
Leucrocuta	SC	2	cn	1
Acerpenna pygmaea	OM	2	sw	1
Baetis flavistriga	GC	3	sw	1
Callibaetis	GC	6	sw	1
Ephemera simulans				1
Ischnura verticalis	PR			1
Berosus peregrinus	SH	6	sw	1
Dubiraphia	GC	5	cn	1
Macronychus glabratus	OM	3	cn	1
Ceratopsyche bronta		5		1
Pycnopsyche	SH	3	sp	1
Chrysops	GC	5		1
Procladius	PR	7	sp	1
Paraphaenocladius	GC		sp	1
Lirceus	GC	8	cr	1
Ferrissia rivularis	SC	6		1
Physella	SC	8		1
Corbicula fluminea	FC	6		1
NAIDIDAE	GC	8		1
Acariformes		4		1
Maccaffertium pulchellum	SC	2		2
Tricorythodes	GC	3	sw	2
Boyeria vinosa	PR	4	cb	2
Rheumatobates	PR		sk	2
Trepobates	PR			2
Stenelmis	SC	5	cn	2
Polypedilum flavum				2
Stictochironomus	OM	4	bu	2
Caenis latipennis	GC			3
Palmacorixa nana	PI	4	sw	3
Cheumatopsyche	FC	3	cn	3
Orconectes	GC	4		3
Hetaerina americana	PR			4
Ancyronyx variegatus	OM	4		5
Baetis intercalaris	OM	3	sw	6

Peltodytes duodecimpunctata				6
Trepobates inermis				7
Dubiraphia minima				7
Hyalella azteca	GC	8	cr	9
Polypedilum illinoense		7		16
Stenelmis sexlineata				18
Grand Total				127

Metrics	**Metric Values**	**Metric Scores**
Total Number of Taxa	42	**3**
Total Abundance of Individuals	127	**1**
Number of EPT Taxa	13	**5**
% Orthocladinae + Tanytarsinii of Chironomidae	4.55	**5**
% Noninsects-Crayfish	11.81	**5**
Number of Diptera Taxa	6	**1**
% Intolerant Taxa (Score 0—3)	14.96	**1**
% Tolerant Taxa (Score 8—10)	9.45	**5**
% Predators	9.45	**1**
% Shredders + Scrapers	7.87	**1**
% Collector-Filterers	3.15	**5**
% Sprawlers	2.36	**1**
mIBI Score		**34**

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If you have further questions regarding the IDEM mIBI please contact:

Mitchell Owens
Senior Environmental Manager
Indiana Department of Environmental Management
Office of Water Quality, Watershed Assessment and Planning Branch

Probabilistic Monitoring Section
100 N. Senate Ave.
MC 65-40-2 Shadeland
Indianapolis, IN 46204-2251
317-308-3135
MCOwens@idem.in.gov