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James E Bailey
IDEM Quality Assurance Manager
01 Nov 2020
Date

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Introduction to the QAPP and Summary

The Indiana Department of Environmental Management (IDEM) requires the development of a Quality Assurance Project Plan (QAPP) for any activity involving the collection and analysis of environmental data. A QAPP contains elements of the overall project management; data generation and acquisition; assessment and oversight; and data validation and usability. This QAPP describes procedures that will be implemented to obtain diatom, macroinvertebrate, and fish assemblage information as well as habitat data of known quality which is adequate for aquatic life use assessments.

The ability of Indiana rivers and streams to support aquatic life is assessed by collecting aquatic organisms such as diatoms, macroinvertebrates, and fish. Conducting sampling of aquatic organisms provides a biological community assessment which is a measure of the effect of environmental stressors (such as pollutants or habitat disturbance) on the organisms living in the water and the resulting impact on the ecosystem.

Indiana narrative biological criteria [327 IAC 2-1-3] states “(2) All waters, except as described in subdivision (5), will be capable of supporting: (A) a well-balanced, warm water aquatic community.” The water quality standard definition of a “Well-balanced aquatic community” is “[327 IAC 2-1-9 (59)] 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.” When biological community assessments, aquatic habitat quality measurements, and water quality chemical parameter analyses and measurements of a waterbody are performed in combination, compliance with narrative biological criteria and ability to support aquatic life can be determined. The assessments and measurements also provide a more complete picture of the overall ecological health of a watershed.

Between June and November, IDEM scientists visit both randomly selected and targeted stream sites located throughout a selected watershed. At each site, one to eight hours are spent collecting biological communities, measuring water chemistry parameters, and evaluating habitat quality.

Water chemistry parameters measured include temperature, dissolved oxygen, pH (the acidity of water), specific conductance (the amount of dissolved solids in the water), and turbidity (the clarity of water). Habitat quality is characterized by completing a Qualitative Habitat Evaluation Index (QHEI). The QHEI estimates stream width and depth measurements; stream bed substrate composition; riffle, run or pool habitat quality evaluations; riparian vegetation evaluations (amount of shade provided by trees surrounding the stream bank); and adjacent land use. Degradation of habitat

quality is determined by measuring the amount of siltation, bank erosion, and stream modification (removal of riparian vegetation or stream channelization), as well as identifying any direct point sources of chemical pollution. Measurements of chemical and habitat variables are used to determine if ecological health impairments can be attributed to site specific habitat degradation or sources of water quality pollution.

The health and diversity of biological communities living in Indiana's rivers and streams reflect the ecological condition of the watershed. To determine ecological health, field crews perform aquatic life surveys.

- For diatoms, algae is scraped from rocks or sticks and returned to IDEM's laboratory for slide mounting, identification, and enumeration.
- Crews use nets to collect macroinvertebrates from riffles and other habitat within the stream channel and along the banks (e.g., root mats, logs, woody debris). Once the stream reach has been sampled, the crew leader will pick and remove as many different macroinvertebrate taxa as possible for 15 minutes and return the specimens to IDEM's laboratory for lowest practical taxonomic level identification.
- Electrofishing equipment is used to temporarily stun fish for collection, followed by species level identification, total number of individuals per species, minimum and maximum length for each species, total weight for each species, and other measurements to evaluate fish condition or health.

The data obtained from the fish and macroinvertebrate samples are then analyzed and evaluated using an index of biotic integrity (IBI). The IBI for fish and macroinvertebrates (mIBI) provides numerical values for observations of the compositional, structural, and functional integrity of the biological community. The resulting numerical value is used to determine the site's ecological health and classification of the biological community as fully supporting or nonsupporting.

IDEM reports the biological community assessments to the U.S. Environmental Protection Agency (U.S. EPA) in Indiana's Integrated Water Monitoring and Assessment Report, which describes the condition of streams, lakes, and ground water in several Indiana watersheds.

Staff, involved in biological community and habitat evaluation programs, will use this QAPP to achieve specific project data quality objectives (DQOs). Data quality assessments (DQAs) assign data usability levels from 1 to 4 which determine what data may be used for regulatory decisions. This QAPP serves as a guide to project officers, field personnel, and quality assurance staff charged with the collection and review of biological community and

habitat evaluation data. The QAPP is expected to satisfy U.S. EPA requirements for data collection projects funded in whole or in part by U.S. EPA grants. IDEM and U.S. EPA depend upon precise, accurate, and complete data to make decisions used to implement projects which improve and maintain clean waters in the State of Indiana.

A. Project Management

A.1. Title and Approval Sheet

See Approvals page ii.

A.2. Table of Contents

See Table of Contents page iii.

A.3. Distribution List

The following individuals and associated organizations will be individually notified concerning the availability of this document. Electronic copies of this QAPP will be available to all interested parties.

Name	Organization
Ed Hammer	U.S. EPA Region 5, Water Division
Jim Bailey	IDEM, Office of Program Support, Quality Assurance (QA)
Martha Clark Mettler	IDEM Office of Water Quality (OWQ)
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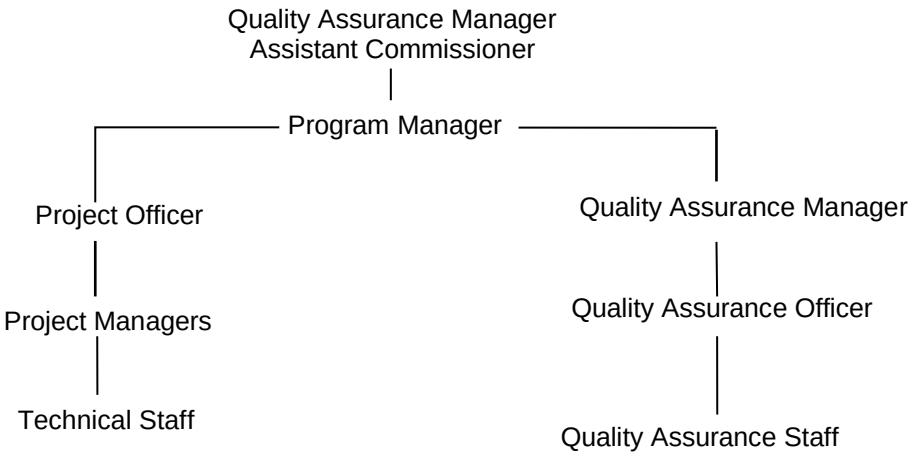
Kassia Groszewski	IDEM OWQ, WAPB, Targeted Monitoring Section
Timothy Bowren	IDEM OWQ, WAPB, Technical and Logistical Services Section

A.4. Project/Task Organization

The major areas of activity and responsibilities are described in the chart and illustration below.

Name	Affiliation	Role
Agency Quality Assurance Manager (AQAM)	IDEM, OPS, QA	Manages IDEM's quality management system including agency QAPP approval and management
Assistant Commissioner	IDEM, OWQ	Program QAPP approval
Program Manager	IDEM, OWQ, WAPB, branch chief	Final authority and responsibility for managing monitoring programs and projects
Project Officer	IDEM, OWQ, WAPB, section chief	Guide and supervise data collection projects including quality control procedure implementation and project data collection activities; identify and document nonconformities through corrective action
Project Manager	IDEM, OWQ, WAPB	Prepare QAPPs, establish project in database, oversee data entry and quality control of data entered, determine results not meeting water quality criteria, report nonconformities to the project officer
Quality Assurance Manager	IDEM, OWQ, WAPB, Technical and Logistical Services section chief	Coordinating all quality assurance and laboratory activities, assigning laboratory and field performance audits to QAO and QA staff.
Quality Assurance Officer (QAO)	IDEM, OWQ, WAPB	Coordinate and audit quality assurance and quality control activities, prepare and review QAPPs, liaison to external laboratories, report to management on quality assurance aspects of project
Quality Assurance (QA) Staff	IDEM, OWQ, WAPB	Data validation review, data assessment, data qualification, and internal performance and system audits for projects under direction of the QAM
Technical Staff	IDEM, OWQ, WAPB	Follow work plans or SOPs, collect and enter data, report nonconformities to the project manager



A.5. Problem Definition/Background

Biological community (diatom, macroinvertebrate, and fish) information will be collected to decide if a waterbody is capable of supporting a well-balanced aquatic community. Indiana narrative biological criteria [327 IAC 2-1-3] states that:

(2) All waters, except as described in subdivision (5), will be capable of supporting:

(A) a well-balanced, warm water aquatic community.

The water quality standard definition [327 IAC 2-1-9 (59)] 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."

IDEM uses a scale called the Index of Biotic Integrity (IBI) to evaluate fish and macroinvertebrate (mIBI) assemblages in Indiana streams and rivers. An IBI is in development for diatoms to evaluate nutrient conditions in the watershed. The IBI is composed of 12 metrics that assess the aquatic communities' structural, compositional, and functional integrity. The IBI scale range is 0 (no organisms, for fish communities) or 12 (for macroinvertebrate communities) to 60 (excellent). In Indiana, a stream segment is nonsupporting for Aquatic Life Use (ALUS) and listed as an Impaired Biotic Community (IBC) when the monitored macroinvertebrate assemblage or fish assemblage receives a mIBI or IBI score of less than 36.

The QHEI is used to score the available habitat for potential biological community structure. The QHEI scale range is 0 (very poor) to 100 (excellent). A QHEI total score of less than 51 is considered poor for

habitat, meaning habitat quality could have a negative effect on the biological communities present. Aquatic life use impairments are determined soley on the IBI or mIBI score. The QHEI is only used as ancillary information to explain why the biology may or may not be impaired for aquatic life use. For example, if the biology is poor and the habitat is good, then water chemistry would be analyzed to find a cause for the poor biological communities.

Once the biological specimens are identified and the data finalized for calculating a final IBI or mIBI score, sites will be evaluated as supporting or nonsupporting following the decision-making processes described in Indiana's Consolidated Assessment Listing Methodology and Water Quality Criteria [327 IAC 2-1-6]. Where biological criteria are nonsupporting for aquatic life use, the site may be considered for possible addition to a Targeted Monitoring Program watershed characterization sampling project to determine the extent, causes, and likely sources of the ALUS nonattainment area.

A.6. Project/Task Description

Deadlines and time frames for sampling activities include:

Activity	Date(s)	Frequency of Sampling-related activity	Parameter to be sampled	How evaluated
Biological Sampling	June – mid November	Fish Assemblage (Once, between June and mid-October)	Fish: Identification to species, number of individuals, minimum and maximum length, batch weight, deformities, eroded fins, lesions, tumors (DELTs)	Fish and Macroinvertebrates are evaluated using the appropriate IBI. If IBI less than 36, the site is impaired for aquatic life use
		Macroinvertebrate Assemblage (Once, between mid-July and mid-November)	Macroinvertebrates: 15 minute field pick of individual specimens for diversity with identifications to lowest practical taxonomic level in lab	Same as above.
		Algal Samples (Diatoms) (Once, with water chemistry sample between August and mid-November)	Algal Diatoms: scraped from rock, stick, or sand; 600 valves are identified to lowest practical taxonomic level in lab	Diatom identification and enumeration used to develop IBI
Habitat Evaluation	June – mid November	Qualitative Habitat Evaluation Index (QHEI) completed separately for fish and macroinvertebrate assemblage following each sampling event as sampling reaches may be different	Habitat quality based on substrate compositions, in stream habitat availability and riparian land use	A QHEI score of less than 51 indicates habitat may be impacting integrity of biological community

The geographic locations of biological community and QHEI sampling will vary by project objectives for the monitoring of targeted or probabilistic sites; thus, a map of specific areas in the State of Indiana is not provided.

A.7. Quality Objectives and Criteria

Data Quality Objectives (DQOs) are qualitative and quantitative statements which specify study objectives and acceptable criteria for the collection, evaluation, or use of environmental data. As such, each monitoring project with its various data uses may require different levels of data quality. Moreover, each monitoring project has separate goals addressed through specific tasks and programs. This QAPP is intended for all of the Biological Community and Habitat Evaluation Monitoring occurring in many different projects. Therefore, a comprehensive description of DQOs for all the monitoring projects is beyond the scope of this QAPP.

A.7.1. Fish Assemblage Performance or Acceptance Criteria

The data used to calculate an IBI score consists of species level taxonomy, number of individuals per species, total weight in grams for each species, and count of individuals with deformities, eroded fins, lesions, or tumors (DELT) anomalies. Data are recorded on the Fish Collection Data Sheet (Figure A9-5) and entered into the Assessment Information Management System (AIMS II) database. See Appendix 1 for instructions on how the IBI is calculated for fish.

a. Accuracy for fish assemblage sample collection is dependent on strict adherence to established field methods. Methods include laying out the proper sampling reach; using the proper electrofishing equipment (dependent on stream size); making adjustments to the equipment settings to collect a representative sample (based on fish response which could be impacted by conductivity and water temperature); and direction and technique of electrofishing the reach by an experienced crew of staff (IDEM 2018a). If the fish community sample appears nonrepresentative (lower than expected fish counts based on best professional judgement or fish escaping electrical current), write “No” in the line for “Is reach representative” on the Fish Collection Data Sheet with a note explaining why (possibly due to equipment problems, higher than normal water, etc.). The sample will not be used for aquatic life use assessments.

b. To measure precision or reproducibility of the sampling method for fish assemblage collections, 10% of the sampling sites will be revisited and sampled at least two weeks after the initial sampling event. Revisit samples are chosen randomly by

selecting the first n sites (where n = 10% x the total number of sites rounded to the nearest whole number) whose site identification numbers appear on a random numbers table. During the revisit, the sampling reach and type of equipment (backpack, boat, etc.) should be the same. However, the equipment and crew members should be different, since the intent is to measure the precision (or reproducibility) of the sampling methodology to produce a similar IBI score. Looking at revisit samples (n=94) over several years, the average difference between the normal visit and revisit IBI score was 4.6 points. Thus, the overall average difference between normal and revisit IBI scores should be 4 points out of a 0-60 scoring range. If that overall range is exceeded, corrective action should be taken through equipment calibration or checks and calibration of sampling methodology for the sampling crews to ensure all crews are sampling with the same efficiency at all sites.

c. In addition to the examination of IBI score differences, the relative percent difference (RPD) for number of species at the revisit sites should be less than 25% to measure precision or reproducibility of the sampling method for fish assemblage collections.

$$\mathrm{RPD} = \left(\frac{|\mathrm{S}-\mathrm{D}|}{(\mathrm{S}+\mathrm{D})/2}\right) \mathrm{x}\ 100$$

Where:
S = the first sample value (original number of species)
D = the second sample value (revisit number of species)

If the RPD is exceeded, corrective action should be taken through equipment calibration or checks and calibration of sampling methodology for the sampling crews to ensure all crews are sampling with the same efficiency at all sites.

d. Completeness (%C) can be calculated for a project to summarize the number of samples collected as a proportion of those that were originally planned.

$$\%\mathrm{C} = \left(\frac{\mathrm{v}}{\mathrm{T}}\right) \mathrm{x}\ 100$$

Where:
v = number of valid samples obtained to satisfy a project objective;

T = total number of planned samples.

The completeness goal is project dependent. However, 100% of planned samples may not be achieved if natural conditions prevent sampling (i.e., high water levels, turbid flows, sampling time frame exceeded, dry sites, etc.).

e. Taxonomic accuracy is evaluated based on the experience and technical expertise of the individuals(s) performing identifications, consistent use of accepted scientific nomenclature in all identifications, and use of appropriate taxonomic references.

Individuals performing the identifications should have at least one year of experience in taxonomy of fish in the region (verified through resume, reference check, and Scientific Purposes License). Taxonomic characteristics for possible species encountered in the basin of interest will be reviewed prior to field work. For each field taxonomist (generally the crew leader), a complete set of fish vouchers are retained for any species encountered during the summer sampling season. Also, prior to sampling, 10% of all sites sampled in a project will be randomly selected for vouchering a few representative individuals of all species found at the site. Vouchers may consist of either preserved specimens or digital images. Fish specimens should also be preserved if they cannot be positively identified in the field; are individuals that appear to be hybrids or have unusual anomalies; are dead specimens that are taxonomically valuable for undescribed taxa (i.e., Red Shiner or Jade Darter); life history studies; or research projects. These fish should be kept separate from the voucher specimens.

Scientific nomenclature will follow the American Fisheries Society (AFS; Page et al. 2013):

Page, L. M., H. Espinosa-Perez, L. T. Findley, C. R. Gilbert, R. N. Lea, N. E. Mandrak, R. L. Mayden, and J. S. Nelson. 2013. Common and scientific names of fishes from the United States, Canada, and Mexico, 7th edition. American Fisheries Society, Special Publication 34, Bethesda, Maryland.

Appropriate taxonomic references used for fish identification include:

Becker, George C., 1983. Fishes of Wisconsin. The University of Wisconsin Press, Madison, Wisconsin.

Etnier, David A., and Wayne C. Starnes, 1993. The Fishes of Tennessee. The University of Tennessee Press, Knoxville, Tennessee.

Jenkins, Robert E., and Noel M. Burkhead, 1993. Freshwater Fishes of Virginia. American Fisheries Society, Bethesda, Maryland.

Kuehne, Robert A., and Roger W. Barbour, 1983. The American Darters. The University Press of Kentucky, Lexington, Kentucky.

Mettee, Maurice F., Patrick E. O'Neil, and J. Malcolm Pierson, 1996. Fishes of Alabama and the Mobile basin. Oxmoor House, Inc., Birmingham, Alabama.

Pflieger, William L., 1997. The Fishes of Missouri, Revised Edition. Conservation Commission of the State of Missouri, Jefferson City, Missouri.

Simon, Thomas P., 2011. Fishes of Indiana. Indiana University Press, Bloomington, Indiana.

Smith, Philip W., 2002. The Fishes of Illinois. University of Illinois Press, Urbana, Illinois.

Page, Lawrence M., 1983. Handbook of Darters. Illinois Natural History Survey, Champaign, Illinois, T.F.H. Publications, Inc., Ltd.

Trautman, Milton B., 1981. The Fishes of Ohio. Ohio State University Press, Columbus, Ohio.

f. Taxonomic precision is calculated as percent taxonomic disagreement (PTD). PTD uses a comparison of taxonomic identifications recorded by IDEM staff with identifications by a fisheries biologist external to the organization, using voucher specimens collected at 10% of the sites sampled during the season.

$$\text{PTD} = \left[1 - \left(\frac{\text{a}}{\text{N}}\right)\right] \text{x } 100$$

Where:
a = the number of agreements;
N = the total number of individuals in the larger of two counts.

An overall mean for the PTD should be less than or equal to 15%. Individual samples exceeding 15% disagreement will be investigated and taxonomy reviewed to ensure other samples with those species are also corrected.

A.7.2 Macroinvertebrate Assemblage Performance or Acceptance Criteria: The data used to calculate an mIBI score consists of counts for each taxa identified to the lowest practical taxon (generally the genus or species level, if possible and practical). See Appendix 2 for instructions on how the mIBI is calculated for macroinvertebrates. A partial list of hierarchical goals for macroinvertebrate identification is presented in Appendix 3.

a. Accuracy for macroinvertebrate assemblage sample collection is dependent on strict adherence to established field methods which include optimal deployment location for Hester-Dendy samplers (IDEM 2019a) or for the multihabitat sampling method (IDEM 2019b); determining the shoreline most representative of the surrounding stream condition; and sampling all available instream habitats.

Macroinvertebrate assemblage field sampling methodology precision (or reproducibility) is measured using duplicate samples collected from 10% of the sampling sites. Duplicate samples are chosen randomly by selecting the first n sites (where n = 10% x the total number of sites rounded up to the nearest whole number) whose site identification numbers appear on a random numbers table. Duplicate samples are collected during the same site visit as the original sample, by the same collector with the same types of equipment. The duplicate sample will utilize a different 50 meter section of stream and riffle from the original, but attempts will be made to match the original as closely as possible. The intent of collecting duplicate samples is to measure the precision (or reproducibility) of the sampling methodology to produce a similar macroinvertebrate assemblage. The RPD for number of taxon for duplicate samples should be less than 25%.

$$\mathrm{RPD} = \left(\frac{|\mathrm{S}-\mathrm{D}|}{(\mathrm{S}+\mathrm{D})/2}\right) \mathrm{x}\ 100$$

Where:
S = the first sample value (original number of taxa);
D = the second sample value (duplicate number of taxa).

If that overall range is exceeded, corrective action should be taken through calibration of the sampling crews' implementation of the sampling methodology, to ensure correct application of the methodology by everyone.

b. A project's completeness (%C) can be calculated to summarize the number of samples collected as a proportion of the number originally planned.

$$\%C = \left(\frac{v}{T}\right) x\ 100$$

Where:
v = number of valid samples obtained to satisfy a project objective;
T = total number of planned samples.

Achievement of the project's completeness goal is dependent upon natural conditions which may prevent sampling (i.e., high water levels, turbid flows, sampling time frame exceeded, dry sites, etc.). 100% collection of planned samples may not be possible.

c. Laboratory samples' percent sorting efficiency (PSE) will be determined by a second sorter checking for additional organisms in the sample residuals immediately after the first sorter has finished sorting the original sample.

$$PSE = \left(\frac{(A + B) - B}{A + B}\right) x\ 100$$

Where:
A = the number of organisms found by the first sorter.
B = the number of recoveries (organisms missed by the primary sort and found during the quality control (QC) check).

The second sorter examines the sample residuals, records the number of recoveries, and initials and dates the Macroinvertebrate Bench Sheet (Figure A9-12). This information will be entered into the AIMS II database to calculate a PSE% for the sample report. Mean PSE for each taxonomist will be calculated using the first five samples processed every year and then every 10th sample thereafter (i.e., the 15th and 25th samples). Mean PSE should always be less than 10%. If mean PSE exceeds 10% at any point, then corrective action will be taken. Samples examined for PSE should not include those samples that will be sent out for external PTD and percent difference in enumeration (PDE) calculations.

d. Taxonomic accuracy is evaluated based on the experience and technical expertise of the individuals performing the identifications which includes the ability to make taxonomic identifications to the lowest practical taxon when possible,

consistent use of accepted scientific nomenclature in all identifications, and use of appropriate taxonomic references.

Individuals performing the identifications should have at least one year of experience in the taxonomy of macroinvertebrates in the Midwestern region (verified through resume and reference check). To calculate a mIBI for macroinvertebrates, specimens are generally identified to the lowest practical taxon (generally the genus or species level). However, family-level or higher identifications may be acceptable for some specimens (i.e., leeches, water mites, some snails, and several families of true flies). Refer to Appendix 3 for a list of hierarchical goals for macroinvertebrate identification. Microscope power plays an important role in dissections and identifications of specimens. Therefore, the laboratory is equipped with dissecting microscopes with a magnification range of 6.7-80x and a compound microscope with a magnification range of 40-1000x, also equipped with phase contrast capabilities. At each lowest taxonomic level, the specimens will be counted and placed in vials. The vials for the entire laboratory sample will be kept together for the site in a 16 ounce glass olive jar with 80% isopropyl alcohol for a minimum of 10 years in the Shadeland lab. Scientific nomenclature will follow the Integrated Taxonomic Information System (ITIS).

e. Taxonomic precision is calculated as PTD. IDEM taxonomic results from a macroinvertebrate sample are compared with the results of whole sample re-identifications. An internal macroinvertebrate taxonomist, typically the program manager, will re-identify the entire sample for the first five samples every year and then every 10th sample (i.e., the 15th and 25th samples) processed by each taxonomist. The internal re-identification of samples should occur immediately after the samples are processed to ensure needed corrective actions are implemented immediately. After all macroinvertebrate samples have been processed, an external macroinvertebrate taxonomist will re-identify the samples collected at sites where a duplicate macroinvertebrate sample are collected (a.k.a., the “normal” sample). Samples re-identified by the internal macroinvertebrate taxonomist should not include samples collected for re-identification by the external macroinvertebrate taxonomist. External re-identifications take priority over internal re-identification (i.e., If the third processed sample is designated

for external re-identification, then the internal taxonomist will re-identify samples 1-2 and 4-6). These processes should result in 10% re-identifications by both the internal and external macroinvertebrate taxonomists, or about 20% re-identifications for each sample processer in total.

$$\mathrm{PTD} = \left[1 - \left(\frac{\mathrm{a}}{\mathrm{N}}\right)\right] \mathrm{x}\ 100$$

Where:
a = the number of agreements;
N = the total number of individuals in the larger of two counts.

An overall mean for the PTD should be less than or equal to 15% for the samples re-identified by both the internal and external macroinvertebrate taxonomists. Individual samples exceeding 15% disagreement will be investigated and taxonomy reviewed to ensure other samples with those taxa are also corrected.

f. Percent difference in enumeration (PDE) will also be performed on the macroinvertebrate samples used for PTD to compare counts between the IDEM taxonomist and the internal and external taxonomists.

$$\mathrm{PDE} = \left(\frac{|\mathrm{n1} - \mathrm{n2}|}{\mathrm{n1} + \mathrm{n2}}\right) \mathrm{x}\ 100$$

Where:
n1 = number of specimens counted in sample by IDEM taxonomist;
n2 = number of specimens counted in sample by external taxonomist.

An overall mean for the PDE should be less than or equal to 5%.

If the IDEM internal taxonomist (typically the program manager) did not collect any macroinvertebrate field samples during the field season, the internal taxonomist will select and process a number of macroinvertebrate samples equivalent to 10% of samples processed by each of the other macroinvertebrate taxonomists, usually 3-4 samples. These samples will also be submitted for verification by an external taxonomist and follow the same requirements for PTD and PDE.

A.7.3 Diatom Assemblage Performance or Acceptance Criteria:
Data consists of counts for each diatom taxa identified. During identification and enumeration, staff will refer to taxonomic

literature, keys, and archived photographic images to resolve uncertainty regarding taxa present in the sample in order to avoid making taxonomic errors (IDEM 2015a).

a. Accuracy for diatom assemblage sample collection is dependent on strict adherence to established field methods for the removal of algae from appropriate substrate type (IDEM 2018b).

b. To measure diatom assemblage field samples precision, 10% of the sampling sites will have duplicate samples collected. Duplicate samples will be collected from the same type of substrate but from a different substrate than the original. (i.e., rocks, sticks, or sand). The collector and equipment will be the same. However, the substrate will be different. The intent of collecting duplicate samples is to measure the sampling methodology's precision (or reproducibility) to produce a similar diatom assemblage. The RPD for number of taxon for duplicate samples should be less than 25%.

$$\mathrm{RPD} = \left(\frac{|\mathrm{S}-\mathrm{D}|}{(\mathrm{S}+\mathrm{D})/2}\right) \mathrm{x}\ 100$$

Where:
S = the first sample value (original number of taxa);
D = the second sample value (duplicate number of taxa).

c. Completeness (%C) can be calculated for a project to summarize the number of samples collected versus the planned number of samples.

$$\%\mathrm{C} = \left(\frac{\mathrm{v}}{\mathrm{T}}\right) \mathrm{x}\ 100$$

Where:
v = number of valid samples obtained to satisfy a project objective;
T = total number of planned samples.

The completeness goal is project dependent. However, 100% of planned samples may not be achieved if natural conditions prevent sampling (i.e., high, turbid flows, sampling time frame exceeded, dry sites, etc.).

c. Taxonomic accuracy is evaluated based on the experience and technical expertise of the individuals(s) performing the identifications; taxonomic identifications to the lowest practical taxon; consistent use of accepted scientific nomenclature in all

identifications; and use of appropriate taxonomic references (Appendix 4).

Most diatom taxa entered into the database will have a North American Diatom Ecological Database (NADED) code assigned to them. The Academy of Natural Sciences of Drexel University developed and maintains the North American Diatom Ecological Database. The United States Geological Survey (USGS) and U.S. EPA, among others, use a NADED code specific to individual species in order to maximize taxonomic consistency among analysts and comparability among datasets.

d. Taxonomic precision is calculated as PTD. IDEM taxonomic identifications are compared with an external algal taxonomist sample re-identifications for 10% of diatom samples collected.

$$\mathrm{PTD} = \left[1 - \left(\frac{\mathrm{a}}{\mathrm{N}}\right)\right] \mathrm{x}\ 100$$

Where:
a = the number of agreements;
N = the total number of individuals in the larger of two counts.

An overall mean for the PTD should be less than or equal to 15%. Individual samples exceeding 15% disagreement will be investigated and taxonomy reviewed to ensure other samples with those taxa are also corrected.

A.7.4. Habitat Evaluation Performance or Acceptance Criteria:

Data consist of scoring the observed presence or absence of habitat characteristics and tallying the scores. (IDEM 2019c).

a. To measure precision for habitat evaluations, 10% of the sampling sites are evaluated a second time by a different staff member to produce a similar QHEI score (could be the same trip or a later visit). The RPD between the two total QHEI scores should be less than 10%.

$$\mathrm{RPD} = \left(\frac{|\mathrm{S} - \mathrm{D}|}{(\mathrm{S} + \mathrm{D})/2}\right) \mathrm{x}\ 100$$

Where:
S = the first sample value;
D = the second sample value.

For an RPD greater than 10%, corrective action should be taken through calibration of sampling methodology for the sampling crews, ensuring all crews are using the same sampling methodology.

A.8. Special Training/Certification

Watershed Assessment and Planning Branch (WAPB) field staff will maintain a certificate of completion for Basic First Aid and Cardiopulmonary Resuscitation (CPR). These classes are typically offered free of charge by the State of Indiana.

Four hours of in-service training provided specifically for WAPB field staff will be documented through sign-in sheets or certificates of completion.The training can be provided by IDEM health and safety agency director or delegated to technical staff with expertise in a certain field (i.e. wilderness first aid, operation of GPS units, wader safety, boat operation safety, etc.). Staff lacking the four hour training will be accompanied in the field at all times by a WAPB staff that meets health and safety training requirements.

Taxonomic characteristics for possible fish species encountered in the basin of interest will be reviewed prior to field work. Additional training will take place for those taxa routinely misidentified.

At least one year of experience in sampling methodology (electrofishing, multihabitat sampling) and taxonomy of aquatic communities in the region for the field crew chief will be verified through resume or a reference check email from a prior supervisor.

Annual review of relevant safety procedures, standard operating procedures (SOPs), and project Work Plans will be completed by all crew members prior to field operations (verified through signature and date on Checklist of Annual Review for Safety Procedures, Standard Operating Procedures (SOPs), and Project Work Plans Appendix 5).

At least one year of experience in taxonomy of aquatic communities in the region will be verified for all laboratory staff through resume or a reference check email from a prior supervisor.

Annual review of relevant safety procedures and laboratory operation SOPs will be completed by all laboratory staff (verified through signature and date on Checklist of Annual Review for Safety Procedures and SOPs Appendix 5).

All new laboratory staff will complete hands-on training provided by the most experienced staff member for laboratory sample processing methodology prior to participation in laboratory sample processing activities. Hands-on training will be documented by program manager through an email to the supervisor and copying the person trained.

A.9. Documentation and Records

IDEM QA staff post the most up-to-date versions of each agency QAPP and SOP in the SharePoint IDEM QA Library. All program managers are expected to direct staff participating in data operations or QAPP implementation to refer to the *Employee Resources: Standards, Policies, and Mailcodes, Quality Assurance System Tools* page to find the most up-to-date versions of all active IDEM QAPPs under *Currently Active IDEM Quality Assurance Project Plans (QAPPs)*. All agencywide and program SOPs documenting QAPP activities are also on the IDEM InfoDUMP site under *Employee Resources: Standard, Policies, and Mailcodes* > *Standard Operating Procedures (SOPs)*. In addition, it remains the responsibility of the program staff with oversight roles designated in this QAPP to ensure all participants are working from the same, most up-to-date version of this QAPP.

Field measurements and completion of datasheets will follow technical SOPs for each activity performed. Field activities which require direct reading of equipment and observations will be recorded on the following hard copy forms (Appendix 6):

- Stream Sampling Field Data Sheet (Figure A9-1)
- Photographic Image Chain of Custody (Figure A9-2)
- Algal Biomass Lab Datasheet (Figure A9-3)
- Physical Description of Stream Site (Figure A9-4, optional)
- Fish Collection Data Sheet (Figure A9-5)
- OWQ Macroinvertebrate Header (Figure A9-6)
- OWQ Biological Qualitative Habitat Evaluation Index (Figure A9-7)
- OWQ Chain of Custody Form (Figure A9-8)

Data reduction, calculations, and verification will be performed in the office upon return by field crews. For each fish and macroinvertebrate community sampling event, an entry will be made in a field notebook (Appendix 6, Figure A9-9) and scanned into the office Shared Drive for the project officer to stay current on the status of sampling events. Field Notebook entries are scanned into a pdf format and renamed in the following format: MM-DD-YYYY + crew chief's initials + Macro (or Fish if applicable) Field Notebook (for example: 07-15 - 018_PDM_Macro Field Notebook). The file is saved at the following location: S:\IGCN\OWQ\WSP\OWM\RANDOM\Corvallis2018\Chain of Custody\Field Notebook Note: "Corvallis2018" can be changed to the current project and year in which field sampling activities are being

conducted. When not in use, the Field Notebook is kept in the IDEM Shadeland Macroinvertebrate (or Fish) Laboratory for review, in perpetuity.

Laboratory activities will be followed using technical SOPs and the Laboratory Chain of Custody (Appendix 6, Figure A9-10). Laboratory observations will be recorded on the following hard copy forms (Appendix 6):

- Fish Collection Data Sheet (Figure A9-5)
- Diatom Lab Datasheet (Figure A9-11)
- Macroinvertebrate Bench Sheet example (Figure A9-12)

All data will be entered into the AIMS II database. All entered data will be checked at least two times for errors prior to finalization for assessments.

Quality Assurance staff audit field data reduction, validation, and reporting as a component of performance audits described in Section C.1., Assessments and Response Actions.

Senior environmental managers for biological community assessments (diatoms, fish and macroinvertebrate communities) will produce a quality assurance report for the sampling program year including results for Performance or Acceptance Criteria found in Section A.7 of this QAPP (Appendix 7 for example).

Following aquatic life use assessments (typically the year after data collection), datasheets, forms, and reports are stored in either AIMS II database or the Virtual File Cabinet following instructions in the technical SOPs. Please see the AIMS II User Guide (IDEM 2017c) and Virtual File Cabinet guide for more information on uploading and indexing. Once the records are uploaded or indexed, the records are recycled.

B. Data Generation and Acquisition

B.1. Sampling Process Design (Experimental Design)

Refer to individual project work plans as each project calls for a different number of sampling sites, different frequencies of sample collection, and measurement parameters of interest depending on the project objectives. For a general description of project network design and rationale, refer to the Indiana Water Quality Monitoring Strategy.

B.2. Sampling Methods

Fish Assemblage: Fish assemblage assessments will be performed in a sampling reach of 15 times the average wetted width of the stream, with a minimum reach of 50 meters and a maximum reach of 500 meters (IDEM 2018a). Sampling distance will be measured with a laser range finder or handheld GPS unit. An attempt will be made to sample all habitat types available (i.e., pools, shallows; see IDEM 2019c, pg. 10-11, for more potential habitat types) within the sample reach to ensure adequate representation of the fish community present at the time of the sampling event. Nonrepresentative samples will be avoided by not collecting samples 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.
- Late autumn due to the cooling water temperature which may decrease the responsiveness of some species to the electrical field, resulting in samples which are not representative of the stream's fish assemblage (IDEM 2018a).

Fish assemblage sampling will be performed using various standardized electrofishing equipment depending on stream size and site accessibility. The possible list of electrofishers to be utilized include:

- Smith-Root LR-24 or LR-20B Series backpack electrofishers.
- Smith-Root 1.5kVa electrofishing system.
- Smith-Root 2.5 Generator Powered Pulsator electrofisher with RCB-6B junction box and rat tail cathode cable.
- Midwest Lake Electrofishing Systems (MLES) Infinity Control Box with MLES junction box and rat tail cathode cable.

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 foot Loweline boat; or the Smith-Root Type VI-A electrofisher or MLES Infinity Control Box assembled in a 16 foot Loweline boat (IDEM 1992a, 1992b, 1992c, 2018a). A summary of the key aspects of each method appear in Appendix 8.

Fish will be collected using dip nets with fiberglass handles and netting of 1/8-inch bag mesh. Fish collected in the sampling reach will be sorted by species into baskets or buckets. Young-of-the year fish less than 20 millimeters (mm) total length will not be retained in the assemblage sample (IDEM 2018a).

Prior to beginning field work, taxonomic characteristics for possible species encountered in the basin of interest will be reviewed. Prior to sampling, 10% of the sites will be randomly selected for a revisit.

For each field taxonomist, generally the crew leader, a complete set of fish vouchers are retained for each new species encountered during the summer sampling season. Prior to processing fish specimens and completion of the Fish Collection Data Sheet, one to two individuals per new species encountered will serve as representative fish vouchers. Vouchers will either be preserved or digital images will be taken. Vocher fish specimens, preserved in 3.7% formaldehyde solution, must be positively identified and small enough to fit in a 2000 mL jar. The 2000 mL jar(s) will have the IDEM Sample Number and Event ID written on the lid of the jar as well as the label stored inside. The jars will be stored upright in a tote for transportation to the laboratory. Digital images will be taken of fish specimens too large to preserve. Photos of key characteristics (e.g., fin shape, lips, spines) will be taken for later examination (IDEM 2018a; IDEM 2018b, p. 7). Fish specimens should also be preserved if

- Identification cannot be made positively in the field.
- Those co-occurring like the Striped and Common Shiners or are difficult to identify when immature.
- Individuals appear to be hybrids or have unusual anomalies.
- Dead specimens that are taxonomically valuable for undescribed taxa (e.g., Red Shiner or Jade Darter).
- Life history studies.
- Research projects (IDEM 2018a).

At revisit sites, a few representative individuals of each species found will serve as vouchers and either be preserved or photographed.

The following data will be recorded for nonpreserved fish on the IDEM Fish Collection Data Sheet (Figure A9-5): 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). Once the data have been recorded, specimens will be released within the sampling reach, if possible.

Following taxonomic identification in the laboratory, data will be recorded for the preserved fish specimens. The fish assemblage will be evaluated for aquatic life use support assessments using the appropriate IBI.

If the crew leader suspects equipment failure or unusually high water that precludes the collection of a representative sample, the site will be revisited at least two weeks later in the season to see if a more representative sample can be collected. The crew leader will note that the revisit sample will be used for assessment purposes (noted on original sample as: suspect equipment failure or high water).

Macroinvertebrate Assemblage: Aquatic benthic macroinvertebrate samples are collected using a modification of the U.S. EPA Rapid Bioassessment Protocol multihabitat (MHAB) approach using a D-frame dip net (Plafkin et al. 1989; Barbour et al. 1999; Klemm et al. 1990; IDEM 2019b). The IDEM MHAB approach (IDEM 2019b) is composed of a 1-minute kick sample within a riffle or run and a 50 meter “sweep” sample of shoreline habitats.

If a riffle or run habitat is present and wadeable, a 1-minute kick sample will be performed to collect dislodged macroinvertebrates by disturbing one square meter of stream bottom substrate with a dip net.

50 meter sweep samples collect macroinvertebrates dislodged from disturbed habitats such as emergent vegetation, root wads, coarse particulate organic matter, depositional zones, logs, and sticks with a dip net. The 50 meter riparian sampling corridor at each site will be defined using a rangefinder, handheld GPS unit, or a 50 meter tape measure. If the entire stream reach is too deep to wade, a boat will be used to sample the best available habitat along the shoreline within the 50 meter zone.

1-minute kick and 50 meter sweep samples are combined in a bucket of clear stream water. The water will be elutriated through a U.S. standard number 35 (500 µm) sieve a minimum of five times or until all rocks, gravel, sand, and large pieces of organic debris are removed from the sample. The remaining sample is then transferred from the sieve to a white plastic tray. The collector, while still onsite, will conduct a 15-minute pick of macroinvertebrates at a single organism rate. During the pick, maximum organism diversity and relative abundance is achieved through turning the tray and examining the entire sample. After completion of the 15 minute pick for the macroinvertebrate assemblage, the crew leader fills out a sample label and inserts it into the macroinvertebrate sample jar(s) filled with 80% isopropyl alcohol. These labels should be preprinted with the AA/AB Number, stream name, county, distance from nearest road or town, and latitude and longitude. Using a lead pencil, the sample collector’s initials, date of collection, and the macroinvertebrate sample number are added to the

sample label. If a duplicate sample is collected or if multiple sample containers are used, additional sample labels can be made in the field using a small piece of Rite-in-the-Rain paper, and should include all of the previously listed types of information. If multiple sample containers are used for a single sample, the labels should also include “1 of 2” and “2 of 2“. The crew leader will then affix a piece of white tape to the lid of the sample container listing IDEM Sample Number, Macroinvertebrate sample number and stream name. Before leaving the sampling location, an IDEM OWQ Macroinvertebrate Header Form (Figure A9-6) will be completed for the sample (IDEM 2019d). Prior to leaving the sampling site, the OWQ Chain of Custody Form (Figure A9-8) and field notebook (Figure A9-9) will be completed.

The resulting picked sample will be returned to the laboratory for identification at the lowest practical taxonomic level (usually genus or species level, if possible). Following identification and data entry in the office, the sample will be evaluated using the MHAB mIBI.

Diatom Assemblage: In order to obtain a representative community sample, collection must occur during low or base flow. Do not sample directly following a major precipitation event (i.e., a sudden rain event that quickly increases the stream flow above low or base flow), which can be determined either by viewing recent data from USGS stream flow monitoring gages or by best professional judgment during the site visit. Following major weather events, sampling must be postponed for a week to allow the algal communities to return to a representative state.

Diatom samples will be collected from any of three substrate types: epilithic (rocks), epidendric (sticks), or episammic and epipelic (sand and silt) (IDEM 2018b).

For the diatom assemblage sample, 200 mL of slurry will be poured into a 250 mL high density polyethylene (HDPE) Nalgene© bottle and placed in a backpack out of direct sunlight. Upon returning to the truck, the diatom sample is preserved by adding 2 mL of 100% Formalin to the bottle for every 50 mL of slurry collected (i.e., 200 mL slurry would be preserved with 8 mL of Formalin). After preservation, the diatom sample is placed in a separate closed cooler without ice for transport to the laboratory. All sample labels must be accurately and thoroughly completed, including IDEM sample numbers, date, stream name, and sampling location. Chain of Custody forms will be completed in the field to document the collection and transfer of samples to the laboratory. To decrease the potential for cross contamination and bias

of the algal samples, all equipment coming in contact with the sample will be cleaned with detergent and rinsed with ASTM D1193-91 Type III water after sampling has been completed at a given site.

See IDEM 2015a for a description of methods used in Diatom Identification and Enumeration.

Habitat Assessment: Habitat assessments will be completed immediately following macroinvertebrate and fish community sample collections at each site. IDEM's assessment uses a slightly modified version of the Ohio Environmental Protection Agency (OHEPA) QHEI, 2006 edition (Rankin 1995; OHEPA 2006). A separate QHEI (Figure A9-7) must be completed for each (fish or macroinvertebrate) sample type, since the sampling reach length may differ (i.e., 50 meters for macroinvertebrates and between 50 and 500 meters for fish). A QHEI must be completed for each sample collected, whether it is a normal or original, duplicate for macroinvertebrates, or revisit for fish community. See IDEM 2019c for a description of the method used in completing the QHEI.

B.3. Sample Handling and Custody

Prior to leaving the sampling site, the OWQ Chain of Custody Form (Figure A9-8), field notebook (Figure A9-9), and if necessary the Photographic Image Chain of Custody Form (Figure A9-2) will be completed.

Upon return to the laboratory, the fish community crew leader will check in the jars with a laboratory supervisor using the OWQ Chain of Custody Form (Figure A9-8). Fish specimens must sit in the 3.7% formaldehyde solution for a minimum of two weeks for proper fixation of tissue, prior to removal and identification.

Upon return to the laboratory, the macroinvertebrate community crew leader will check in the jars with a laboratory supervisor using the OWQ Chain of Custody Form (Figure A9-8).

Upon return to the laboratory, the diatom crew leader will check in the bottles with a laboratory supervisor using the OWQ Chain of Custody Form (Figure A9-8).

When any type of samples are moved between any different laboratories for processing, staff will complete the Laboratory Chain of Custody (Figure A9-10) to track the location of the samples.

B.4. Analytical Methods

Fish, macroinvertebrate, and diatom assemblage data will be reduced to counts of individuals per lowest taxonomic level, and in the case of fish, minimum and maximum lengths, mass weight, and anomalies. Data entry and manipulation will take place in the AIMS II database. The IBI and mIBI will be calculated with the fish and macroinvertebrate assemblage data.

Details from the QHEI will be entered into the AIMS II database which automatically calculates individual metric scores and the total QHEI score.

Products of the biological collections will include aquatic life use assessments and ancillary habitat information.

B.5. Quality Control

Fish community revisit sampling will be performed at a rate of 10 percent of the total fish community sites sampled. Revisit sampling will be performed with at least 2 weeks of recovery between the initial and revisit sampling events. The fish community revisit sampling will be performed with either a partial or complete change in field team members. The resulting IBI score between the initial visit and the revisit will be used to evaluate precision. The IDEM OWQ Chain of Custody Form is used to track samples from the field to the laboratory (Figure A9-8). Fish vouchers will be verified by regionally recognized non-IDEM freshwater fish taxonomists. All data are 1) checked for completeness 2) total count and mass weight calculations performed 3) data entered into the database and 4) checked again for data entry errors.

Duplicate macroinvertebrate field samples will be collected at a rate of 10 percent of the total macroinvertebrate community sites sampled. The macroinvertebrate community duplicate sample will be performed by the same team member who performed the original sample, immediately after the initial sample is collected. This will result in a precision evaluation based on a 10% duplicate of samples collected. The IDEM OWQ Chain of Custody Form is used to track samples from the field to the laboratory (Figure A9-8). Macroinvertebrate re-identifications will take place for each sample processer by an internal taxonomist (10% of the samples) and an external taxonomist (10% of the samples). All data are 1) checked for completeness 2) data entered into the database and 3) checked again for data entry errors.

Quality control of the diatom sampling, enumeration, and identification program will be documented by QC checks of both field and laboratory data. See IDEM 2015a and IDEM 2018b for descriptions of quality assurance and quality control protocols used in the collection of diatoms in the field and the identification and enumeration processes in the laboratory. IDEM taxonomic identifications are compared with an external algal taxonomist sample re-identifications for 10% of diatom samples collected. All data are 1) checked for completeness 2) data entered into the database and 3) checked again for data entry errors.

Revisit habitat evaluations will be performed on the same site by completing the QHEI during revisit fish and duplicate macroinvertebrate community sampling. This will result in a precision evaluation based on 10% of samples collected. All data are 1) checked for completeness 2) data entered into the database and 3) checked again for data entry errors.

B.6. Instrument/Equipment Testing, Inspection, and Maintenance

Electrofishing equipment required for the collection of fish is used and maintained according to manufacturer's specifications in the instruction manual and evaluated for performance prior to each sampling season. Nets are checked for holes and repaired prior to each use. Scales used for weighing fish are calibrated annually.

Equipment required for the collection of macroinvertebrates does not require calibration. Nets, sieves, and buckets are checked for holes or defects prior to each use. Forceps are checked for even, nonbent tips.

Equipment required for the collection of diatoms includes: a toothbrush, cloth measuring tape, petri dish top, spatula, stencil brush, small hobby knife with a chisel blade, a dissection probe, a modified syringe with a rubber O-ring attached, Nalgene© HDPE plastic 250 mL sample bottles, plastic bins, and a unitary wash bottle filled with tap water. None of this equipment requires calibration. Equipment has been field tested to ensure its capability of appropriately removing periphyton from different types of substrate (rocks, sticks, sand, silt).

Laboratory equipment used for the preparation of permanent diatom mounts include: a hot plate, fume hood, centrifuge, glass beakers, centrifuge tubes, glass microscope slides, microscope cover glasses, micropipetter, and micropipetter tips. The micropipetter was purchased new and came with a calibration certificate as proof it was calibrated at the factory. Other than the micropipetter, none of the laboratory

equipment requires calibration. The micropipetter will be checked and recalibrated as necessary according to manufacturer's specifications.

A Nikon© DIC microscope and Nikon© Elements D camera and imaging system will be used for identification and enumeration of diatoms. Branch staff calibrate the ocular reticle in the microscope. The ocular reticle was calibrated at each magnification with a stage micrometer.

Habitat evaluation is done qualitatively through observation with no equipment; thus, no testing, inspection, or maintenance required. Staff who complete the QHEI meet annually to review the methodology and sign an attendance sheet.

B.7. Instrument/Equipment Calibration and Frequency

Equipment used for fish, macroinvertebrate, and diatom data generation or collection activities is calibrated according to manufacturer's recommendations and specifications. Records of calibration and maintenance will be maintained in a relational database.

B.8. Inspection/Acceptance of Critical Supplies and Consumables

Supplies and consumables used to collect biological samples undergo annual inspection for usability by the program managers per IDEM DOA regulations and the IDEM QMP Element 4.0 (IDEM 2018c).

B.9. Nondirect Measurements

Scientific literature will be reviewed for tolerance values and feeding behaviors when conducting IBI revisions. This could include reviewing database traits published by the U.S. Geological Survey BioData database, Indiana Department of Natural Resources, American Fisheries Society, and Society of Freshwater Science. Values will be accepted based on a team of regional taxonomists.

B.10. Data Management

Prior to leaving a site, it is the responsibility of the crew leader to review handwritten biological and habitat data on the forms. Per technical SOPs, all fish and habitat data are entered directly from the field sheets (Figure A9-5, Figure A9-7) via AIMS II database forms. Macroinvertebrate and diatom data are entered from the laboratory sheets (Figure A9-12, Figure A9-11). All entries will be saved as "Edit" in the database until "Submitted" for quality control (QC) processes. All entries are checked at least twice by two different staff for data entry errors (Round 1 and Round 2 QC). Ideally, if sufficient staff are

available, three different people should participate in the QC process. However, if staff are unavailable or time constraints exist, the person originally entering the data may perform the final QC check. Corrections will be made directly to the AIMS II database through the form. Updates to the data will be tracked in the Status of the Sample Record. Initials and date of check are written at the bottom of each field or lab sheet to document the quality control process. Once a round of quality control has been completed, the status of the sample record will need to be changed until no mistakes are found and the data is “Approved” in the AIMS II database. Once data are “Approved” in AIMS II, the information can be sent to U.S. EPA STORET using the Water Quality Exchange (WQX). For information on using AIMS II to enter, retrieve, and analyze the biological and habitat data, refer to the AIMS II User Guide (IDEM 2017c).

Database uploads: “Per 6.4.4. Data Security Standards, of the U.S. EPA R5 approved IDEM 2018 Quality Management Plan, the Indiana Office of Information Technology provides an Information Security Network which secures all IDEM information assets” (IDEM 2018c).

C. Assessment and Oversight

Field, lab and data entry activities will be targeted for assessment. Performance and system audits will be conducted to verify quality control procedures are being followed and the quality assurance system is functioning effectively. Data quality is evaluated by the OWQ WAPB program manager (Fish, Macroinvertebrates, and Diatoms) following each sampling season. Field performance measurements include: completeness, examination of fish IBI score differences and the RPD for number of fish species at the revisit sites, RPD for number of taxon for macroinvertebrate duplicate samples, RPD for number of taxon for diatom duplicate samples, and RPD between the two total QHEI scores. Lab performance measurements include: PTD for fish, macroinvertebrates and diatoms; as well as PDE and PSE for macroinvertebrates. The findings will be reported to the project officer (section chief) and program officer (branch chief). Corrective actions will be outlined in the report and could include further training on equipment, additional experience with a long-term employee on the methodology, or review of taxonomic characteristics between professionals.

C.1. Assessments and Response Actions

Assessments include system audits and performance audits to monitor the performance of the program and the ability to meet data quality objectives for biological and habitat parameters.

The quality assurance manager (QAM) coordinates all quality assurance and laboratory activities, assigning system audits to quality assurance (QA) staff. Once a year, QA staff perform a system audit during the field season on data collection and sampling procedures to ensure continuity and reliability of data acquisition. System audits for field work include work plan reviews, equipment calibration, and checklist for crew members adherence to standard operating procedures.

Field and laboratory performance audits are quantitative measurements to assess data usability including precision, accuracy, and completeness (see Section A.7 Performance or Acceptance Criteria).

Response actions are developed by technical staff to correct any nonconformities. The project officer has final approval for corrective actions which could be documented through additional taxonomic training, mentoring with program manager, or recalibration events to make sure all staff are interpreting the SOPs consistently.

C.2. Reports to Management

QA staff provide an evaluation of the checklist for following standard operating procedures to the quality assurance officer (QAO) annually. The QAO uses this information with performance measures to generate a report (Appendix 7) for the project officer which provides a list of sample identification and locations, notes, system audit summaries, and suggested corrective action. The project officer is responsible for documenting nonconformities, notifying the QAO of nonconformities, and progress made on the response actions.

D. Data Validation and Usability

Data reduction, validation, and reporting, for both field and laboratory activities, are performed by field staff for data acquired in the field and by the program managers in compliance with this QAPP for the samples analyzed in the laboratory. Data reduction is the process of converting raw analytical data into final results (list of representative biological community assemblages, IBI, mIBI, and QHEI). Equations are used in AIMS II to calculate the IBI, mIBI, and QHEI scores. Data

validation is the process of qualifying analytical and measurement data on the performance of the field and laboratory quality control measures incorporated into the sampling and analysis procedures. Field staff are responsible for validating data acquired in the field. Program managers are responsible for validating data from samples analyzed in the laboratory. Program managers also review and perform data validation for results received from a contract laboratory. Data reporting is the detailed description of the data deliverables used to completely document the calibration, analysis, quality control measures, and calculations. Data acquired in the field are reported after reduction and validation by the responsible technical staff. Data from laboratory analyses are reported by the program managers. After laboratory reports, the data are reviewed, assessed for quality assurance, and the data usability is determined by assigning 1 of 4 Data Quality Assessments (DQAs) Levels to the data.

D.1. Data Review, Verification, and Validation

The following data sheets are reviewed to ensure they are complete per SOPs (cited in Appendix 5):

- Stream Sampling Field Data Sheet (Figure A9-1, IDEM 2020)
- Algal Biomass Lab Datasheet (Figure A9-3, IDEM 2018b)
- Fish Collection Data Sheet (Figure A9-5, IDEM 2018a)
- OWQ Macroinvertebrate Header (Figure A9-6, IDEM 2019d)
- OWQ Biological Qualitative Habitat Evaluation Index (Figure A9-7, IDEM 2019c)
- OWQ Chain of Custody Form (Figure A9-8, IDEM 2020)
- Diatom Lab Datasheet (Figure A9-11, IDEM 2015a)
- Macroinvertebrate Bench Sheet (Figure A9-12)

Field and laboratory data sheets should be legible for data entry. Confusion will be brought to the attention of the crew leader or laboratory taxonomist for clarification of text. Data entered into the AIMS II database will go through two rounds of quality control by different staff members to ensure no data entry errors. Staff will initial and date at the bottom of the data sheet once QC has been done in AIMS II. The status of the data entered into AIMS II is tracked by changing the status of the records from New > Edit > Submit > QA Round 1 > QA Round 2. The IBI or QHEI scores will be calculated in AIMS II for aquatic life use assessments, and the status of the data will be moved from QA Round 2 to Approved or Rejected (to prevent further editing of records).

The criteria for accepting or rejecting data is listed in A.7 (Quality Objectives and Criteria).

Fish Community: Sampling precision = RPD between # of Species between the original and revisit samples <25% and the overall average difference between normal and revisit IBI scores should be <=4 points; Taxonomic precision = PTD between taxonomists <=15%. At 10% of the fish community sites, voucher specimens identified by IDEM staff will be compared to identifications by a fisheries biologist external to the organization for PTD calculations.

Macroinvertebrate Community: Sampling precision = RPD between # of Taxa between the original and duplicate samples <25%; PSE for samples >=90%; Taxonomic precision = PTD between taxonomists <=15%; PDE between taxonomists <=5%. Ten percent of macroinvertebrate samples will be verified by taxonomists external to the organization for PDE and PTD calculations.

Diatom Community: Sampling precision = RPD between # of Taxa between the original and duplicate samples <25%; Taxonomic precision = PTD between taxonomists <=15%. Ten percent of diatom samples will be verified by taxonomists external to the organization for PTD calculations.

Habitat Evaluation: Sampling precision = RPD between staff members total QHEI Score <10%.

Flags for biological or habitat results can be assigned and entered into the AIMS II database for both the individual sample result and QA/QC Review Reports.

Flags	Application for Biological or Habitat Results
ALT	Alternate Method
CON	Value Confirmed
EFAI	Equipment Failure
FEQ	Field Equipment Questionable
FQC	Quality Control, failed
HIB	Likely Biased High
ISP	Improper Sample Preservation
JCW	Sample Container Damaged, Sample Lost
LAC	No Result Reported, Lab Accident

OTHER	Other, explain in Comments
R	Rejected
RPO	%RPD outside of acceptable limits
SCF	Suspected contamination, field
SCP	Suspected contamination, lab preparation
SCX	Suspected contamination, unknown
SUS	Result value is defined as suspect by data owner.
UNC	Value Not Confirmed
Fn	Micellaneous flags (n=1,2,etc.) assigned by a field crew during a particular sampling visit (also used for qualifying samples). Explain reason for using each flag in Comments. For example, F1=seconds fished high for stream reach sampled; F2=net mesh larger than SOP.

D.2. Verification and Validation Methods

Prior to approving the taxa records for a project, the list of identified taxa will be reviewed by 8-digit Hydrologic Unit Code (HUC) to flag any new taxa record for the watershed. Any new or questionable occurrences of taxa will be verified through voucher collections. If the two identifying biologists don't agree, the specimen will be sent to a third party to break the tie.

At least 10% of the IBI and QHEI calculations are checked for accuracy since data reduction occurs in the database to produce metric scores and the final total score.

D.3. Reconciliation with User Requirements

Program managers are responsible for producing QA/QC Review Reports (Appendix 7 Example) and assigning Data Quality Assessment Levels to the data for a specific project in AIMS II. Data Quality Assessment (DQA) is the process of determining the scientific and statistical quality of data collected to satisfy the project data quality objectives. Field data and laboratory results are assessed for usability with regard to each specific project data quality objectives.

Data Quality Assessment (DQA) Levels

DQA Level 1 Screening Data: The results are usually generated onsite and have no QC checks. Analytical results, which include no QC checks, precision or accuracy information, or detection limit

calculations are included in this category. Primarily, onsite data are used for presurveys and for preliminary rapid assessment.

DQA Level 2 **Field Analysis Data**: Data is recorded in the field or laboratory on calibrated or standardized equipment. Field duplicates are measured on a regular periodic basis. Calculations may be done in the field or later at the office. Analytical results with limited QC checks are included in this category. The QC checks information for field or laboratory results is useable for estimating precision, accuracy, and completeness for the project. Data from this category are used independently for rapid assessment and preliminary decisions.

DQA Level 3 **Laboratory Analytical Data**: Analytical results include QC check samples for each batch of samples from which precision, accuracy, and completeness can be determined. Raw data and bench sheets are not included as part of the analytical report, but are maintained by the laboratory for easy retrieval and review upon request. Data can be elevated from DQA Level 3 to DQA Level 4 by the inclusion of this information in the data report.

DQA Level 4 **Enforcement Data**: Raw data and bench sheets are included as part of the analytical report. Data falling under this category are considered as complete, legally quantitative in value, and used for regulatory decisions.

Data Quality Assessment (DQA) Level 1, for Screening Data, is used in surface water quality monitoring programs for presurveys and preliminary rapid assessment when precision and accuracy are not of concern. Stream and lake water quality assessment field measurements require DQA Level 2 in order to assess compliance with water quality standards. DQA Level 3 is required for most laboratory results and uses QA/QC protocols. Laboratory data can be elevated from DQA Level 3 to DQA Level 4 by the inclusion of raw data and bench sheets in the analytical data reports.

Environmental data are qualified and classified into four categories:

1. **Enforcement capable** results are DQA Level 3 or 4 data which meet all QC checks.

2. **Acceptable data** are DQA Level 2, 3 or 4 data suitable for decision making. Although a few data may be estimated or even unusable, the sample set as a whole has scientific and statistical integrity. Scientific and statistical decisions may be made with respect to the data quality objectives.

3. **Estimated data** may be suitable for enforcement or decision making on a case by case basis. Estimated data are suitable for determining future sampling needs.

4.**Rejected data** are not suitable for enforcement or for decision making.

Corrective action is the process of modifying procedures or actions in order to remedy out of control deviations from the Quality Assurance Project Plan (QAPP) and bring them back into control. Corrective action is approved by the responsible section chief or project officer and the QAO or designee. Each project section maintains a corrective action file to document corrective actions.

The field crew chief assigned to the sampling event is responsible for all field decisions including corrective action. Any unusual or unexpected occurrence during data or sample collection is brought to the attention of the crew chief who decides: what actions should be taken immediately; what actions, if any, are necessary as a follow up. Field corrective actions are at the discretion of the field crew chief and are documented by the crew chief on return to the office. The section chief or project officer will assign a staff member to follow up and document any further needed action.

The laboratory is required to maintain a corrective action program to document any corrective actions taken as a result of problems during the handling, preparation, analysis, or reporting of data. Corrective actions are documented in the case narrative section of the report for each program. Problems indicating the laboratory quality assurance system may be out of control will trigger a system audit by the QAO or a designee.

Problems arising during data assessment and qualification which are due to laboratory or QA actions are brought to the attention of the QAO who determines if immediate corrective action is required. The laboratory or quality assurance coordinator then assigns a QA staff member to develop, and after approval, implement in-house corrective action.

E. Appendices

Appendix 1. IDEM Fish Community Assessments for Aquatic Life Use

IDEM collects fish along with other data (chemical parameters, nutrients, macroinvertebrate, and habitat) to monitor the health of streams and rivers in Indiana. There are many advantages of using fish for monitoring stream health:

- Many fish have life spans of greater than 3 years allowing detection of degradation in habitat or water chemistry over time which will alter 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.
- Identification of fish species can usually be made in the field so fish are returned to the stream and time for laboratory identifications kept minimal.

The Indiana Administrative Code [327 IAC 2-1-3(2)] has narrative biological criteria that states “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 which 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 is meeting this definition, IDEM uses an Index of Biotic Integrity (IBI) which is composed of 12 fish community characteristics chosen based on what part of the state you are sampling (ecoregion) and size of stream (drainage area). The 12 different characteristics can score a 0, 1, 3, or 5 which represents the deviation from expected fish community structure (i.e. 5 = no deviation from expectations, 1 = severe deviation from expected fish community structure). The 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 taxa.
45-52	Good	Decreased taxa richness (intolerant taxa in particular), sensitive taxa present.
36-44	Fair	Intolerant and sensitive taxa absent, skewed trophic structure.
23-35	Poor	Many expected taxa absent or rare, tolerant taxa dominant.
12-22	Very Poor	Few taxa and individuals present, tolerant taxa dominant.
<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 for the Index of Biotic Integrity (IBI) looking at species composition, trophic levels, and tolerance to water pollution or habitat disturbance…see next page.

1. *Number of Species* (generally more species = better quality stream)

2. *Number of Darter, Madtom, Sculpin Species* (species require high dissolved oxygen and clean rocky substrates so higher number = better quality stream)
    - Examples: rainbow darter, brindled madtom, mottled sculpin

    % 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

3. *% Headwater Individuals* (species in small streams occupying permanent habitat with low environmental stress so greater percentage = better quality stream)
    - Examples: western blacknose dace, southern redbelly dace, fantail darter

    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

4. *Number of Sucker or Round Body Sucker Species* (species do not tolerate habitat and water quality degradation so more = better quality stream)
    - Examples: black redhorse, northern hog sucker

    Number of Minnow Species (generally more minnow species = better quality stream)
    - Examples: spotfin shiner, silverjaw minnow, hornyhead chub

5. *Number of Sensitive Species* (species sensitive to pollution so more species = better quality stream)
    - Examples: greenside darter, smallmouth bass, longear sunfish

6. *% Tolerant Individuals* (species tolerant to pollution so greater percentage = low quality stream)
    - Examples: yellow bullhead, green sunfish, central mudminnow

7. *% 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; thus, greater percentage = lower quality stream)
    - Examples: bluntnose minnow, white sucker, gizzard shad

8. *% Insectivore/Invertivore Individuals* (species whose diet is mainly benthic insects so the metric is a reflection of the food source; thus, lower percentage = lower quality stream)
    - Examples: blackstripe topminnow, emerald shiner, logperch

9. *% 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, grass pickerel

    % 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

10. *Number of Individuals* (generally more individuals = better quality stream)

11. *% 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

12. *% 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 2. IDEM Macroinvertebrate Community Assessments for Aquatic Life Use

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). The index period for collection of macroinvertebrate samples with the MHAB sampling method is July 15th to October 30th. The entire sample is processed in the laboratory as subsampling has already been performed in the field. All macroinvertebrate individuals are counted with the exception of empty snail and clam shells, micro-crustaceans (Ostracoda, Branchiopoda, Copepoda), larval and pupal insect exuviae, and terrestrial insects (including the terrestrial adults of aquatic insect larvae); invertebrate specimens missing their head are also excluded. The level of taxonomic resolution used in the identification of macroinvertebrates may depend in large part on the condition (instar and physical condition) of the specimens and the availability of taxonomic resources that are 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) or genus and species (all other insects). After all organisms in the sample have been identified to the lowest practical taxon, those 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 those specific metrics (this may become more evident while looking at the metric example). For taxa metrics, all of the taxa listed for a specific group (EPT, Diptera) are counted, regardless of level of identification (i.e.,. if there were 4 taxa under the Chironomidae family (1 family level ID, 1 *Cricotopus* genus level ID, and 2 distinct species level IDs under the *Cricotopus* genus) this would be considered 4 taxa).

The metrics are then calculated 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, that 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 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 all metrics have been scored, the individual metric scores are summed 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.

Appendix 3. Hierarchical goals for Macroinvertebrate Identification.

The following table lists insect genera that are 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*, *Berosu*s, *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 (sub-genus/species group)
Polypedilum: Maschwitz and Cook 2000 (sub-genus/species group)
Cricotopus/*Orthocladius*: Merritt et al 2007 (sub-genus/species group)

Taxonomic References

Bednarik A.F. and W.P. McCafferty. 1979. Biosystematic revision of the genus *Stenonema* Ephemeroptera: Heptageniidae). Canadian Bulletin of Fisheries and

Aquatic Sciences 201: 1-73.
http://www.insecta.bio.spbu.ru/z/pdf/BednarikMcCafferty1979p1.pdf

Brigham, W.L. 1996. Key to adult *Peltodytes* of the U.S. and Canada (Coleoptera: Haliplidae).
https://matthewpintar.net/wp-content/uploads/2019/09/Peltodytes-key.pdf

Glover, J.B. and M. A. Floyd. 2004. Larvae of the genus *Nectopsyche* (Trichoptera:Leptoceridae) in eastern North America, including a new species from North Carolina. Journal of the North American Benthological Society 23(3) 526-541.
https://files.nc.gov/ncdeq/Water Quality/Environmental Sciences/Benthos Reference/Taxonomy Doc Trichoptera 2025Jan2010.pdf

Hilsenhoff WL. 1982. Using a biotic index to evaluate water quality in streams. Department of Natural Resources, Technical Bulletin 132, Madison, Wisconsin.
https://dnr.wi.gov/files/PDF/pubs/ss/SS0132.pdf

Hilsenhoff, W.L. 1984. Aquatic Hemiptera of Wisconsin. Great Lakes Entomologist 17: 29-50.
https://scholar.valpo.edu/cgi/

Hilsenhoff, W.L. 1995. Aquatic Hydrophilidae and Hydraenidae of Wisconsin (Coleoptera). I. Introduction, key to genera of adults, and distribution, habitat, life cycle, and identification of species of *Helophorus* Fabricius, *Hydrochus* Leach, and *Berosus* Leach (Hydrophilidae), and Hydraenidae. The Great Lakes Entomologist 28(1): 25-53.

Hilsenhoff, W.L. 1995. Aquatic Hydrophilidae and Hydraenidae of Wisconsin (Coleoptera). II. Introduction, key to genera of adults, and distribution, habitat, life cycle, and identification of species of Hydrobini and Hydrophili (Hydrophilidae: Hydrohilinae). The Great Lakes Entomologist 28(2): 97-126.

Hilsenhoff, W.L. and K.L. Schmude. 1992. Riffle beetles of Wisconsin (Coleoptera: Dryopidae, Elmidae, Lutrochidae, Psepheniidae) with notes on distribution, habitat, and identification. The Great Lakes Entomologist 25(3): 191-213.

Hungerford H.B. 1948. The Corixidae of the Western Hemisphere (Hemiptera). Reprint of The University of Kansas Science Bulletin 32:1-827, reprinted (1977) by Entomological Reprint Specialists: Los Angeles, California.

Larson, D.J., Y. Alarie, and R.E. Roughley. 2000. Predaceous Diving Beetles (Coleoptera: Dytiscidae) of the Nearctic Region, with emphasis on the fauna of Canada and Alaska. NRC Research Press, Ottawa.

Maschwitz, D.E. and E. F. Cook. 2000. Revision of the Nearctic Species of the Genus *Polypedilum* Kieffer (Diptera: Chironomidae) in the Subgenera P.

(Polypedilum) Kieffer and P. (Urespedilum) Oyewo and Saether. Ohio Biological Survey Bulletin (New Series) 12(3). 135 pp.

Morihara D.K. and McCafferty W.P. 1979. The *Baetis* larvae of North America (Ephemeroptera: Baetidae). Transactions of the American Entomological Society 105:139-221.
https://www.gunnisoninsects.org/ephemeroptera/key_baetis_nymph.html

Provonsha A.V. 1990. A revision of the genus *Caenis* in North America (Ephemeroptera: Caenidae). Transactions of the American Entomological Society 116:801-884.

Rasmussen, A.K. and M.L. Pescador. 2002. A Guide to the Megaloptera and Aquatic Neuroptera of Florida.
http://publicfiles.dep.state.fl.us/dear/labs/biology/biokeys/megaloptera.pdf

Roback, S.S. 1985. The immature chironomids of the eastern United States VI - genus *Ablabesmyia*. Proceedings of the Academy of Natural Sciences of Philadelphia 137(2): 153-212.

Schuster, G.A. and D.A. Etnier. 1978. Manual for the Identification of the Larvae of the Caddisfly Genera *Hydropsyche* Pictet and *Symphitopsyche* Ulmer in Eastern and Central North America (Trichoptera:Hydropsychidae) EPA 600/4-78-060.
https://nepis.epa.gov/Exe/ZyNET.exe/30000PGM.TXT

Westfall, M.J., Jr. and M.L. May. 2006. Damselflies of North America (Revised Edition).

Westfall, M.J. Jr. and K.J. Tennessen. 1979. Taxonomic clarification within the genus *Dromogomphus* Selys (Odonata: Gomphidae). Florida Entomologist 62(3). 266-273.
https://journals.flvc.org/flaent/article/view/57386/55065

Appendix 4. List of diatom taxonomic references.

1) “Freshwater flora of Central Europe” (“Suesswasserflora von mitteleuropa”) series published by Gustav Fischer Verlag, Germany, editors: H. Ettl, J. Gerloff, H. Heynig, D. Mollenhauer.

- Band 2/1: Bacillariophyceae: Naviculaceae 1986.
- Band 2/2: Bacillariophyceae: Bacillariaceae, Epithemiaceae, Surirellaceae 1988.
- Band 2/3: Bacillariophyceae: Centrales, Fragillariaceae, Eunotia 1991. Orders Centrales: Melosira, Orthoseira, Ellerbeckia, Aulacoseira, Cyclotella, Cyclostephanos, Stephanodiscus, Thalassiosira, Stephanocostis, Skeletonema, Acanthoceras, Chaetoceros, Rhizosolenia, Pleurosira, Actinocyclus. In der Familie Fragilariaceae: Tetracyclus, Diatoma, Meridion, Asterionella, Tabellaria, Synedra, Fragilaria, Opephora, Hannaea, Centronella. Eunotiaceae: Eunotia, Actinella, Peronia.
- Band 2/4: Bacillariophyceae: Achnanthaceae und Gomphonema 1-4 1991.

2) “Freshwater Algae of North America: Ecology and Classification.” Wehr, Sheath, and Kociolek 2nd ed. 2018.

3) “How To Know the Freshwater Algae.” Prescott 3rd ed. 1970.

4) “The Freshwater Algal Flora of the British Isles.” John, Whitton, and Brookes 2002.

5) “Diatoms of North America.” William Vinyard 1979.

6) “Diatoms of North America.” https://diatoms.org/. 2019.

Appendix 5. Checklist of Annual Review for Safety Procedures, Standard Operating Procedures (SOPs), and Project Work Plans.

IDEM. 1992a, revision 1. Section 4, Standard Operating Procedures for Fish Collections, Use of Seines, Electrofishers, and Sample Processing. Pages 496 – 534 in IDEM. 1992. Biological Studies Section Standard Operating Procedures Manual (SOP). Biological Studies Section, Surveillance and Standards Branch, Office of Water Management, Indiana Department of Environmental Management, Indianapolis, Indiana.

IDEM. 1992b, revision 1. Section 11, Standard Operating Procedures-Appendices of Operational Equipment Manuals and Procedures. Page 1386 – 3313 in IDEM. 1992. Biological Studies Section Standard Operating Procedures Manual (SOP). Biological Studies Section, Surveillance and Standards Branch, Office of Water Management, Indiana Department of Environmental Management, Indianapolis, Indiana.

IDEM. 1992c, revision 1. Section 2, Biological Studies Section Hazards Communications Manual (List of Contents). Biological Studies Section, Surveillance and Standards Branch, OWM, IDEM, Indianapolis, Indiana.

IDEM. 1997. Water Quality Surveys Section Laboratory and Field Hazard Communication Plan Supplement. IDEM 032/02/018/1998, Revised October 1998. Assessment Branch, Indiana Department of Environmental Management, Indianapolis, Indiana.

IDEM. 2002. Water Quality Surveys Section Field Procedure Manual. IDEM 32/02/055/2002. Indiana Department of Environmental Management, Office of Water Quality, Assessment Branch, Surveys Section, Indianapolis, Indiana.

IDEM. 2008. IDEM Personal Protective Equipment Policy, revised May 1 2008. A-059-OEA-08-P-R0. Office of External Affairs, Indiana Department of Environmental Management, Indianapolis, Indiana.

IDEM. 2010. IDEM Health and Safety Training Policy, revised October 1 2010. A-030-OEA-10-P-R2. IDEM, Indianapolis, Indiana.

IDEM. 2010. IDEM Injury and Illness Resulting from Occupational Exposure Policy, revised October 1 2010. A-034-OEA-10-P-R2. IDEM, Indianapolis, Indiana.

IDEM. 2015a. Processing and Identification of Diatom Samples. B-002-OWQ-WAP-TGM-15-T-R0. Office of Water Quality, Watershed Assessment and Planning Branch. Indianapolis, Indiana.

IDEM. 2015b. Global Positioning System (GPS) Data Creation. B-001-OWQ-WAP-XXX-15-T-R0. Office of Water Quality, Watershed Assessment and Planning Branch. Indianapolis, Indiana.

IDEM. 2017a. Indiana Water Quality Monitoring Strategy 2017-2021. Watershed Assessment and Planning Branch, Office of Water Quality, Indiana Department of Environmental Management, Indianapolis, Indiana.

IDEM. 2017b. Quality Assurance Project Plan for Indiana Surface Water Programs, Revision 4. B-001-OWQ-WAP-XX-17-Q-R4. Indiana Department of Environmental Management, Office of Water Quality, Watershed Assessment and Planning Branch, Indianapolis, Indiana.

IDEM. 2017c. AIMS II Database User Guide. Watershed Assessment and Planning Branch. Office of Water Quality, Indiana Department of Environmental Management. Indianapolis, Indiana.

IDEM. 2018a. Fish Community Field Collection Procedures. B-009-OWQ-WAP-XXX-18-T-R0. Office of Water Quality, Watershed Assessment and Planning Branch. Indianapolis, Indiana.

IDEM. 2018b. Phytoplankton and Periphyton Field Collection Procedures. B-004-OWQ-WAP-XX-18-T-R1. Office of Water Quality, Watershed Assessment and Planning Branch. Indianapolis, Indiana.

IDEM. 2018c. IDEM Quality Management Plan. Indiana Department of Environmental Management, Indianapolis, Indiana.

IDEM. 2019a. Hester-Dendy (H-D) Multiplate Artificial Substrate Macroinvertebrate Collection Procedure. B-012-OWQ-WAP-XXX-19-T-R0. Office of Water Quality, Watershed Assessment and Planning Branch, Indianapolis, Indiana.

IDEM. 2019b. Multihabitat (MHAB) Macroinvertebrate Collection Procedure. B-011-OWQ-WAP-XXX-19-T-R0. Office of Water Quality, Watershed Assessment and Planning Branch, Indianapolis, Indiana.

IDEM. 2019c. Procedures for Completing the Qualitative Habitat Evaluation Index (QHEI) Technical Standard Operating Procedure. B-003-OWQ-WAP-XX-19-T-R1. Office of Water Quality, Watershed Assessment and Planning Branch, Indianapolis, Indiana.

IDEM. 2019d. Procedures for Completing the Macroinvertebrate Header Field Data Sheet. B-010-OWQ-WAP-XXX-19-T-R0. Office of Water Quality, Watershed Assessment and Planning Branch, Indianapolis, Indiana.

IDEM. 2020. Water Chemistry Field Sampling Procedures. B-015-OWQ-WAP-XXX-20-T-R0. Office of Water Quality, Watershed Assessment and Planning Branch. Indianapolis, Indiana.

Appendix 6. Forms and Data Sheets for Field and Laboratory.

Figure A9-1. 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		Bottle Types	
GC	General Chemistry: Ice	2000P	2000mL Plastic, Narrow Mouth
Nx	Nutrients: H2SO4	1000P	1000mL Plastic, Narrow Mouth
Metals	Metals: HNO3	500P	500mL Plastic, Narrow Mouth
CN	Cyanide: NaOH	250P	250mL Plastic, Narrow Mouth
O&G	Oil & Grease: H2SO4	1000G	1000mL Glass, Narrow Mouth
Toxics	Toxics: Ice	500G	500mL Glass, Wide Mouth
Ecoli	Bacteriology: Ice	250G	250mL Glass, Wide Mouth
VOA	Volatile Organics: HCl & Thiosulfate	125G	125mL Glass, Wide Mouth
Pest	Pesticides: Ice	40GV	40mL Glass Vial
Phen	Phenols: H2SO4	120PB	120ml Plastic (Bacteria Only)
Sed	Sediment: Ice	1000PF	1000mL Plastic, Corning Filter
Gly	Glyphosate: Thiosulfate	500PF	500mL Plastic, Corning Filter
Hg	Mercury(1631): HCl	60P	60mL Plastic
Cr6	ChromiumVI(1636): NaOH	250T	250mL Teflon
MeHg	Methyl Mercury(1630): HCl	500T	500mL Teflon
		125T	125mL Teflon

Data Entered By: _____ QC1: _____
QC2: _____

Figure A9-2. Photographic Image Chain of Custody

INDIANA DEPARTMENT OF ENVIRONMENTAL MANAGEMENT
OFFICE OF WATER QUALITY/ WATERSHED ASSESSMENT AND PLANNING BRANCH
Original Photographic Image Chain of Custody

CERTIFICATION: I certify that the following original photography images were taken by me or were later formally transferred to my custody and have been in my possession since that time.	**Print Name:**	**DOCUMENT RETENTION** This document must be retained as future verification of authenticity of the following original photographic images.
Date:	**Signature:**	

Site Name (Corvallis No., Subject of Photo, Initials of Photographer)	Photo No.	# of Photos	Date& Time Taken	Photographer Name	Digital Storage Media (floppy, CD, etc)	Folder Name (for digital only)
Example: 12W008 US SLS	016	1	5/26/2012 16:00	SLS	Shared (\\state.in.us\file1\IDEM) (S:)	S:\IGCN\OWQ\WSP\OWM\... (RANDOM, Reference Sites, Baseline Studies, Measure W)

Previous Transfer Record: (if applicable)

Comments:

Transfer of Custody- I certify receipt of the above photographic images	Date	Time
Relinquished by:		
Received By:		
Relinquished by		
Received By:		

Figure A9-3. Algal Biomass Lab Datasheet

Algal Biomass Lab Datasheet

Sample #	Site	Stream

Supporting Site Information

Traditional Forestry % Closed Canopy: ☐ <=10m ☐ >10m (Measure center only if width <=10m, record to nearest whole percent)

	North	East	South	West	Average x 1.04 =
Left Bank					
Center					
Right Bank					
Total %CC (Average from above, or Center only = %CC)				100 - %CC	

Phytoplankton Information

Sampling Method: ☐ Grab Sample (Dip) ☐ Multiple Verticles Number of Verticles:

Chlorphyll A	Blank	Filter 1	Filter 2	Filter 3	Filter 4
Sample Time					
Sample Volume (mL)					

Periphyton Information

Periphyton Habitat: ☐ Epilithic (Area-Scape) ☐ Epidendric (Cylinder Scrape) ☐ Epipsammic (Petri Dish)

Diatom Sample Collected: ☐ Yes ☐ No Diatom Volume: mL Formalin Volume: mL Slurry Volume mL

Chlorphyll A	Blank	Filter 1	Filter 2	Filter 3	Filter 4
Sample Time					
Sample Volume (mL)					

Periphyton Area Calculation

Cylinder Scrape

Snag #	Length (cm)(L)	Circumference U_1	U_2	U_3	U	Area (L * U)
1						
2						
3						
4						
5						
					Total Area (cm^2)	

Area Scrape (Using SG-92)

Rock#	1	2	3	4	5
Area (cm^2)	7.38	7.38	7.38	7.38	7.38
Total (cm^2)	36.9				

Petri Dish

Number of Discrete Samples (n):	
Total Area of One Sampler (a):	19.01 cm^2
Total Sample Area (n * a):	

Stream Discharge / Rainfall Information

Nearest USGS Gage Site: ☐ Upstream ☐ Downstream ☐ No USGS Gage Near

River miles from site: Discharge CFS at sampling: CFS

Gage location: Discharge days since 50% flow exceeded: days

Rainfall data source: ☐ NOAA ☐ CoCoRaHS ☐ Indiana State Climate Office ☐ USGS gage rain gauge ☐ Other:

Total precipitation at sampling: in. on date: Cumulative rain 7 days previous to sampling: in.

Inches since last rainfall previous to sampling: in.

Rain station location, county: Days since last rainfall previous to sampling: days

Identifier	Date	Reviewer 1	Date	Reviewer 2	Date	Notes:
		☐ Review 1 Completed		☐ Review 2 Completed		

Figure A9-4. Physical Description of Stream Site (front)

Revised 4/20/12

Probabilistic Monitoring Section Physical Description of Stream Site

Stream :_____ **AIMS #**_____ **Program #:**_____

Date: _____ **Time:** _____ **Crew Chief:**_____ **Crew**_____

General Stream Description:

_____
_____
_____
_____
_____

Characteristics at the site and immediately upstream (check All that apply).

Outer Riparian Zone L R	Inner Riparian Zone L R	L.Width(m)	R.Width(m)
☐ ☐ Agricultural Row crop	☐ ☐ Agricultural Rowcrop	_____	_____
☐ ☐ Agricultural Pasture	☐ ☐ Agricultural Pasture	_____	_____
☐ ☐ Devoid of Vegetation	☐ ☐ Devoid of Vegetation	_____	_____
☐ ☐ Fallow	☐ ☐ Fallow	_____	_____
☐ ☐ Forested	☐ ☐ Forest	_____	_____
☐ ☐ Residential	☐ ☐ Residential	_____	_____
☐ ☐ Commercial/Industrial	☐ ☐ Commercial/Industrial	_____	_____
☐ ☐ Weeds and Scrub	☐ ☐ Treeline	_____	_____
☐ ☐ Other _____	☐ ☐ Weeds and Scrub		
	☐ ☐ Other _____	_____	_____

Flow above site	Flow at site	Substrate (if visable)
☐ Riffle	☐ Riffle	☐ Cobble
☐ Pool	☐ Pool	☐ Boulder
☐ Eddy	☐ Eddy	☐ Sand
☐ Run	☐ Run	☐ Muck
☐ Glide	☐ Glide	☐ Silt
☐ Other _____	☐ Other _____	☐ Gravel
_____	_____	☐ Bedrock
_____	_____	☐ Other _____

Characteristics at site and immediately upstream (check ONE).

Water Description	Sinuosity of Channel	Discharge Pipe Present
☐ Clear	☐ High	☐ No
☐ Grey (Septic)	☐ Moderate	☐ Yes
☐ Murky	☐ Low	If yes, Effluent Flowing?
☐ Black	☐ Channelized	☐ No
☐ Brown		☐ Yes
☐ Green		Description of Effluent _____
☐ Other _____		_____

Continued on back

Figure A9-4. Physical Description of Stream Site (back)

Revised 4/20/12

Stream Bank

Functional Slope: L R	Bank Erosion: L R	Percent Canopy Closed: _____
☐☐ 0-30°	☐☐ Low	Stream Stage 1-5 (Low-High): _____
☐☐ 31-50°	☐☐ Moderate	
☐☐ 51-70°	☐☐ High	Velocity of Stream 1-5 (Slow-Fast): _____
☐☐ 71-90°		

Visible Stream Degradation? ☐ Yes ☐ No

Description: _____

Aquatic Life Observed? ☐ Yes ☐ No

Description: _____

Algae Observed? ☐ Yes ☐ No

Description: _____

Rooted Macrophytes Observed? ☐ Yes ☐ No

Description: _____

Additional Comments:

_____
_____
_____
_____

Follow Up Date:_____Time:_____Crew Chief:_____Crew:_____
_____
_____
_____
_____

Follow Up Date:_____Time:_____Crew Chief:_____Crew:_____
_____
_____
_____
_____

Photography Date:_____ Time:_____ Number(s):_____; _____;_____

Notes (include items relevant for determining scale – items of known measurement, etc.)

_____
_____
_____

Figure A9-5. Fish Collection Data Sheet

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________

Figure A9-6. OWQ Macroinvertebrate Header

Office of Water Quality: Macroinvertebrate Header

L-Site	Stream Name	Location	County	Surveyor

Sample Date	Sample #	Macro#	# Containers

☐ Habitat Complete ☐ Sample Quality Rejected

Macro Sample Type:
☐ Black Light ☐ Kick
☐ CPOM ☐ MHAB
☐ Hester-Dendy ☐ Qualitative

☐ Normal _____
☐ Duplicate _____
☐ Replicate _____

Macro Sub Sample (Field or Lab): _____

Macro Reach Sampled (m): _____

Riparian Zone/Instream Features

Watershed Erosion:
☐ Heavy
☐ Moderate
☐ None

Watershed NPS Pollution:
☐ No Evidence
☐ Obvious Sources
☐ Some Potential Sources

Stream Depth Riffle (m):	Stream Depth Run (m):	Stream Depth Pool (m):	Distances Riffle-Riffle (m):	Distances Bend-Bend (m):

Stream Width (m):	High Water Mark (m):

Stream Type:
☐ Cold
☐ Warm

Turbidity (Est):
☐ Clear ☐ Slightly Turbid
☐ Opaque ☐ Turbid

☐ Channelization ☐ Dam Present

Predominant Surrounding Land Use: ☐ Forest ☐ Field/Pasture ☐ Agricultural ☐ Residential ☐ Commercial ☐ Industrial
Other

Sediment

Sediment Odors: ☐ Normal ☐ Sewage ☐ Petroleum ☐ Chemical ☐ Anaerobic ☐ None Other

Sediment Deposits: ☐ Sludge ☐ Sawdust ☐ Paper Fiber ☐ Sand ☐ Relic Shells Other

Sediment Oils: ☐ Absent ☐ Moderate ☐ Profuse ☐ Slight

☐ Are the undersides of stones, which are not deeply embedded, black?

Substrate Components

(Note: Select from 0%, 10%, 20%, 30%, 40%, 50%, 60%, 70%, 80%, 90%, or 100% for each inorganic/ organic substrate component)

Inorganic Substrate Components (% Diameter)						
Bedrock	Boulder (>10 in)	Cobble (2.5-10 in)	Gravel (0.1-2.5 in)	Sand (gritty)	Silt	Clay (slick)

Organic Substrate Components (% Type)			
Detritus (sticks, wood)	Detritus (CPOM)	Muck/Mud (black, fine FPOM)	Marl(gray w/ shell fragments)

Water Quality

Water Odors: ☐ Normal ☐ Sewage ☐ Petroleum ☐ Chemical ☐ None Other

Water Surface Oils: ☐ Slick ☐ Sheen ☐ Glob ☐ Flocks ☐ None

IDEM 03/8/18

Figure A9-7. OWQ Biological Qualitative Habitat Evaluation Index

OWQ Biological QHEI (Qualitative Habitat Evaluation Index)

IDEM

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 R/R)	OTHER TYPES PREDOMINANT	OTHER TYPES PRESENT (P/G 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	L R RIPARIAN WIDTH	L R FLOOD PLAIN QUALITY	L R
☐☐ NONE/LITTLE [3]	☐☐ WIDE > 50m [4]	☐☐ FOREST, SWAMP [3]	☐☐ CONSERVATION TILLAGE [1]
☐☐ MODERATE [2]	☐☐ MODERATE 10-50m [3]	☐☐ SHRUB OR OLD FIELD [2]	☐☐ URBAN OR INDUSTRIAL [0]
☐☐ HEAVY/SEVERE [1]	☐☐ NARROW 5-10m [2]	☐☐ RESIDENTIAL, PARK, NEW FIELD [1]	☐☐ MINING /CONSTRUCTION [0]
	☐☐ VERY NARROW [1]	☐☐ FENCED PASTURE [1]	Indicate predominant land use(s) past 100m riparian.
	☐☐ NONE [0]	☐☐ OPEN PASTURE, ROWCROP [0]	

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:

☐ 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
Check ONE (Or 2 & average)
- ☐ 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 02/28/2018

Figure A9-7. OWQ Biological Qualitative Habitat Evaluation Index (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	___ %	___ %	___ %	___ %
	X	X	X	

Stream Drawing:

Figure A9-8. 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

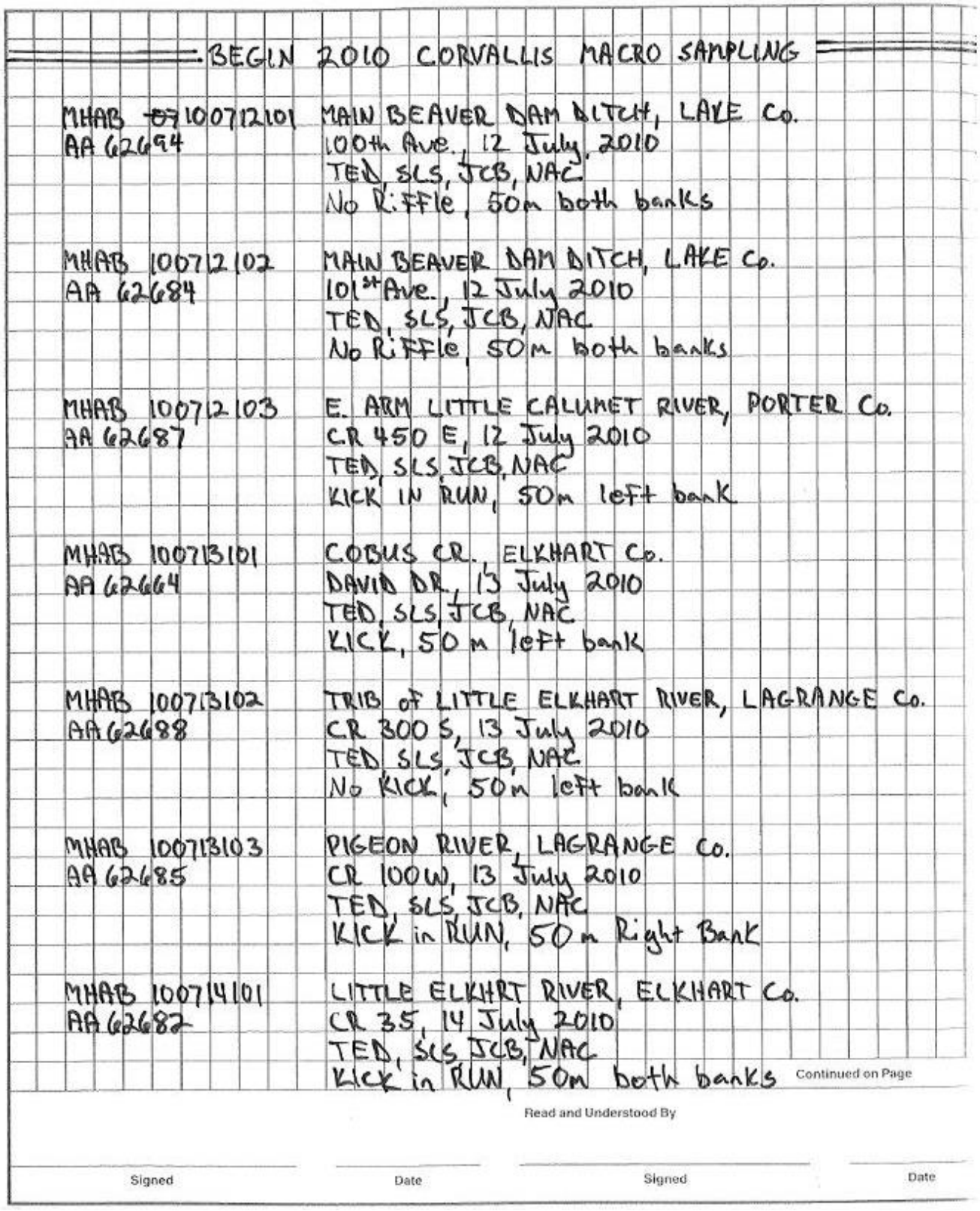
I certify that I have received the above sample(s), which has/have been recorded in the official record book. The same sample(s) will be in the custody of competent laboratory personnel at all times, or locked in a secured area.

Signature:_____ Date:_____ Time:_____

Lab:_____ Address:_____

Revision Date: 4/27/2016

Figure A9-9. Field notebook example



BEGIN 2010 CORVALLIS MACRO SAMPLING

MHAB ~~07~~ 10071210 1
AA 62694
MAIN BEAVER DAM DITCH, LAKE Co.
100th Ave., 12 July, 2010
TED, SLS, JCB, NAC
No Riffle, 50m both banks

MHAB 10071210 2
AA 62684
MAIN BEAVER DAM DITCH, LAKE Co.
101st Ave., 12 July 2010
TED, SLS, JCB, NAC
No Riffle, 50m both banks

MHAB 10071210 3
AA 62687
E. ARM LITTLE CALUMET RIVER, PORTER Co.
CR 450 E, 12 July 2010
TED, SLS, JCB, NAC
KICK IN RUN, 50m left bank

MHAB 10071310 1
AA 62664
COBUS CR., ELKHART Co.
DAVID DR, 13 July 2010
TED, SLS, JCB, NAC
KICK, 50 m left bank

MHAB 10071310 2
AA 62688
TRIB of LITTLE ELKHART RIVER, LAGRANGE Co.
CR 300 S, 13 July 2010
TED, SLS, JCB, NAC
No KICK, 50m left bank

MHAB 10071310 3
AA 62685
PIGEON RIVER, LAGRANGE Co.
CR 100W, 13 July 2010
TED, SLS, JCB, NAC
KICK in RUN, 50 m Right Bank

MHAB 10071410 1
AA 62682
LITTLE ELKHRT RIVER, ELKHART Co.
CR 35, 14 July 2010
TED, SLS, JCB, NAC
KICK in RUN, 50m both banks

Continued on Page

Read and Understood By

Signed | Date | Signed | Date

Figure A9-10. Laboratory Chain of Custody

INDIANA DEPARTMENT OF
ENVIRONMENTAL MANAGEMENT
OFFICE OF WATER QUALITY BIOLOGICAL SAMPLES
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 Close 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

Figure A9-11. Diatom Lab Datasheet

IDEM

Diatom Lab Datasheet

Sample #	Site	Stream Name
AB01259	OLP070-0064 (CR 1300 N)	Anderson River

Taxon Results		Slide #
Taxon	Count	Notes
Total:		

Transect Results			
#	X	Y	Notes

Identifier	Date Counted	Reviewer 1	Date	Reviewer 2	Date	Notes:
		☐ Review 1 Completed		☐ Review 2 Completed		

Figure A9-12. Macroinvertebrate Bench Sheet example

IDEM

OWQ Biological Studies: Macroinvertebrates
Phase I Community Assessments

Sample#:	Macro#	Macro Sample Type	Stream Name / Location	County

- ☐ 100-Organism SubSample
- ☐ 15-minute SubSample
- ☐ 100-Organism (Lab Dup)

Sample Date	# of Vials	☐ SubSample Completed			☐ Phase 1 Completed		☐ Phase 2 Completed	
		Sorter	Sort Date	# Squares	Identifier	ID Date	Identifier	ID Date

QC Initials:

Taxon	Count	Notes	HBI Tolerance

Type	Value	Metric Score
HBI:		
# of Taxa:		
# of Individuals:		
% Dominant Taxon:		
EPT Index:		
EPT Count:		
EPT/Total Ratio:		
EPT/Chironomid Ratio:		
Chironomid Count:		
Individuals/Square:		

mIBI Metric Score:

Appendix 7. Quality Assurance Report Example

Quality Assurance of Biological and Habitat Data for Samples from the 2015 Fish Community Sampling Program

Fish Community and Habitat Evaluation

Sampling Date(s): 06/2015 – 10/2015

Probabilistic Monitoring Section, WAPB/OWQ

QA/QC Review Report: IDEM/XXX/XX/XXX/XX/2016

Laboratory:
Indiana Department of Environmental Management (IDEM)
Office of Water Quality (OWQ), Watershed Assessment and Planning Branch (WAPB)

Contact Person:

- Stacey Sobat
- Telephone: 317-308-3191

Date Report Prepared: 04/29/2016

Chain of Custody: A check mark (✓) below indicates information about each item is complete and acceptable.

- Sampler Signature ✓
- Custodian Signature ✓
- Collection Time(s) ✓
- Collection Date(s) ✓
- Receiving Time(s) ✓
- Receiving Date(s) ✓
- Containers ✓
- Preservatives ✓

A. Fish Community:

A list of sample identification and locations begin on page 3.

Notes: 2015 Corvallis n=38, South Fork Blue River n=21, 2015 Reference Sites n=25, 2015 Performance Measures n=2; thus, Normal Samples = 86, Revisits = 11 (>10% of planned samples revisited). Wettest July since the late 1800's delayed sampling during the field season.

Precision for fish assemblage samples: The overall average difference between normal and revisit IBI scores was 3 points out of a 0-60 range (should be <= 4). The average Relative Percent Difference (RPD) for number of species between the initial visit and revisit was 17% (should be <25%).

Completeness for this project was 100% (86 valid samples were collected out of 86 planned samples).

Taxonomic precision is calculated as Percent Taxonomic Disagreement (PTD) by comparing IDEM taxonomic results with voucher specimens at 10% of the sites sampled during the season re-identified by a fisheries biologist external to the organization. The overall mean for the PTD was 4% (should be <= 15%).

B. Qualitative Habitat Evaluation Index (QHEI):

Precision for habitat evaluations: The average Relative Percent Difference (RPD) for QHEI total score between the initial visit and revisit was 8% (should be <10%).

Sample Identification and Sampling Locations:

SampleID	EventID	Sample Date/Time	Sample Type	Site Name	River/Stream/Creek	Sample Location	County	Distance Fished	Equipment	IBI Score	# of Species	Change in IBI Score	RPD # of species	QHEI Surveyor	QHEI Total Score	RPD QHEI
AB22108	15R022	6/23/15 9:45	Normal	GMW010-0044	Morgan Creek	Gilmer Road	Wayne	120	Backpack	54	15			KAG	76	
AB23057	15R022.5	9/21/15 9:00	Revisit	GMW010-0044	Morgan Creek	Gilmer Road	Wayne	60	Backpack	56	19	2	24	RLM	78	3
AB22105	15R020	6/24/15 9:35	Normal	GMW020-0035	Whitewater River	CR 450 N	Fayette	500	Scanoe	54	32			KAG	78	
AB22109	15R021	6/23/15 12:30	Normal	GMW-02-0014	Greens Fork	Smoky Row Road	Wayne	150	Longline	44	19			AKS	76	
AB22110	15R019	7/27/15 9:55	Normal	GMW040-0040	Little Williams Creek	Williams Road	Fayette	105	Backpack	46	15			KAG	77	
AB22101	15R018	6/17/15 11:30	Normal	GMW-04-0019	Bear Creek	Little Bear Road	Fayette	50	Backpack	50	13			KAG	72	
AB23056	15R018.5	9/21/15 12:15	Revisit	GMW-04-0019	Bear Creek	Little Bear Road	Fayette	50	Backpack	46	13	4	0	RLM	76	5
AB22111	15R016	6/15/15 5:10	Normal	GMW060-0021	Jim Run	Jim Run Road	Franklin	50	Backpack	18	7			RAC	46	
AB22103	15R015	6/15/15 10:55	Normal	GMW060-0022	Pipe Creek	Pipe Creek Road	Franklin	120	Backpack	58	24			KAG	75	
AB22104	15R014	7/27/15 12:10	Normal	GMW070-0117	Silver Creek	Stout Road	Union	90	Backpack	46	12			RAC	78	
AB22102	15R013	6/15/15 14:15	Normal	GMW080-0036	Blue Creek	Blue Creek Road	Franklin	150	Backpack	42	16			RAC	69	
AB22138	15T017	6/22/15 16:30	Normal	OBS-06-0002	South Fork Blue River	Bowers Knob Road	Washington	150	Backpack	32	14			RLM	48	
AB22137	15T016	6/22/15 15:00	Normal	OBS-06-0003	Jeff Branch	East Blue River Road	Washington	75	Backpack	38	11			RLM	65	
AB22132	15T011	9/8/15 16:55	Normal	OBS-06-0004	South Fork Blue River	Martinsburg Road	Washington	150	Longline	52	25			RLM	58	
AB22141	15T020	6/23/15 12:30	Normal	OBS-06-0005	Springle Creek	Blue River Road	Washington	75	Backpack	44	16			RLM	58	
AB22133	15T012	6/22/15 10:45	Normal	OBS-06-0006	Tributary of South Fork Blue River	Shorts Corner Rd	Washington	75	Backpack	42	6			RLM	60	
AB22161	15T007	6/29/15 15:50	Normal	OBS-06-0007	Dutch Creek	Dutch Creek Rd	Washington	75	Backpack	34	8			KAG	60	
AB22162	15T008	9/8/15 16:30	Normal	OBS-06-0008	South Fork Blue River	State Road 135	Washington	225	Longline	52	22			KRW	67	
AB22144	15T010	6/29/15 10:45	Normal	OBS-06-0009	Punch Run	Shorts Corner Rd	Washington	100	Backpack	24	7			RLM	62	
AB22142	15T021	6/23/15 14:00	Normal	OBS-06-0010	South Fork Blue River	Casey Hollow Road	Washington	75	Backpack	30	9			RLM	50	
AB23265	15T021.5	9/8/15 10:45	Revisit	OBS-06-0010	South Fork Blue River	Casey Hollow Road	Washington	60	Backpack	32	12	2	29	RLM	47	6
AB22140	15T019	6/23/15 11:00	Normal	OBS-06-0011	Honey Run	North Honey Run Road	Washington	75	Backpack	44	15			RLM	56	
AB22134	15T013	6/22/15 12:00	Normal	OBS-06-0012	Tributary of South Fork Blue River	Mahuron Rd	Washington	90	Backpack	36	15			RLM	46	
AB23266	15T013.5	9/8/15 12:45	Revisit	OBS-06-0012	Tributary of South Fork Blue River	Mahuron Rd	Washington	75	Backpack	38	14	2	7	RLM	63	31
AB22160	15T006	6/30/15 9:00	Normal	OBS-06-0013	Bear Creek	State Road 135	Washington	135	Backpack	48	19			KAG	71	
AB22159	15T005	6/29/15 13:25	Normal	OBS-06-0014	Bear Creek	Martinsburg Fire Rd	Washington	135	Backpack	40	17			KAG	72	
AB23267	15T005.5	9/16/15 12:15	Revisit	OBS-06-0014	Bear Creek	Martinsburg Fire Rd	Washington	120	Longline	46	20	6	16	RLM	68	6
AB22157	15T003	7/27/15 11:15	Normal	OBS-06-0015	Licking Creek	Palmyra Rd	Washington	70	Backpack	46	14			RLM	60	
AB22154	15T002	9/8/15 14:15	Normal	OBS-06-0016	South Fork Blue River	Palmyra Road	Washington	150	Backpack	48	16			AKM	59	
AB22135	15T014	9/8/15 14:20	Normal	OBS-06-0018	South Fork Blue River	Main Street	Washington	150	Longline	40	16			RLM	55	
AB22139	15T018	6/23/15 9:00	Normal	OBS-06-0019	Jeff Branch	Bethel Road	Washington	75	Backpack	42	14			RLM	62	
AB22163	15T009	9/16/15 9:45	Normal	OBS-06-0020	South Fork Blue River	Big Springs Rd	Washington	175	Longline	52	18			RLM	70	
AB22158	15T004	6/29/15 11:30	Normal	OBS-06-0021	Bear Creek	Wetzel Rd	Washington	90	Backpack	34	14			KAG	64	
AB22136	15T015	6/22/15 12:50	Normal	OBS-06-0022	South Fork Blue River	Lockenour Road	Washington	150	Backpack	40	16			RLM	47	
AB22143	15T001	9/8/15 12:10	Normal	OBS130-0002	South Fork Blue River	Fredericksburg Road	Washington	120	Backpack	48	22			KAG	69	
AB22112	15R026	6/17/15 8:45	Normal	OML030-0015	West Fork Tanners Creek	Villa Lane	Dearborn	120	Backpack	44	15			RAC	68	
AB22621	15R025	7/27/15 15:25	Normal	OML040-0008	South Hogan Creek	CR 50 N.	Ripley	90	Longline	38	15			RAC	84	
AB22106	15R024	6/16/15 17:40	Normal	OML040-0012	Little Hogan Creek	Union Ridge Road	Dearborn	75	Backpack	42	15			RAC	57	
AB22107	15R023	6/16/15 10:25	Normal	OML200-0004	Indian Creek	Posten Road	Switzerland	150	Longline	48	25			KAG	77	
AB22131	15W005	6/16/15 13:30	Normal	OML200-0018	Indian Creek	Posten Rd	Switzerland	150	Longline	42	23			RAC	65	
AB22768	15015	7/29/15 8:55	Normal	WAE-02-0002	Eel River	Carroll Road	Allen	120	Longline	36	15			KAG	28	
AB22752	15012	8/4/15 17:40	Normal	WAE-04-0001	Swank Creek	East Street	Wabash	60	Backpack	30	9			KAG	42	
AB22772	15W003	8/4/15 16:05	Normal	WAE060-0007	Wilson Rhodes Ditch	Warsaw Trail	Miami	75	Backpack	44	9			KRW	55	
AB22770	15022	7/28/15 16:05	Normal	WAE-06-0003	Flowers Creek	Broadway Street	Miami	120	Backpack	44	11			KAG	71	
AB22754	15006	8/11/15 9:11	Normal	WAE-07-0002	Eel River	CR 400 N	Cass	500	Canoe	54	27			KAG	84	
AB22761	15039	8/11/15 14:00	Normal	WAE-07-0003	Eel River	Eel River Road	Cass	500	Canoe	50	26			TAF	83	
AB22656	15055	8/5/15 9:30	Normal	WAW-01-0001	Mud Creek	SR 26	Howard	150	Longline	50	18			RLM	51	
AB22654	15045	8/24/15 14:00	Normal	WAW-03-0036	South Fork Wildcat Creek	Ripple Creek Drive	Tippecanoe	400	Canoe	50	30			RLM	89	
AB22644	15011	8/5/15 12:45	Normal	WAW-04-0001	Honey Creek	CR 600 S	Howard	50	Backpack	36	9			RLM	18	

Sample Identification and Sampling Locations (continued):

SampleID	EventID	Sample Date/Time	Sample Type	Site Name	River/Stream/Creek	Sample Location	County	Distance Fished	Equipment	IBI Score	# of Species	Change in IBI Score	RPD # of species	QHEI Surveyor	QHEI Total Score	RPD QHEI
AB22649	15018	8/25/15 10:00	Normal	WAW-04-0002	Wildcat Creek	CR 350 S	Carroll	250	Canoe	56	30			RLM	78	
AB22651	15034	8/26/15 10:30	Normal	WAW-04-0003	Wildcat Creek	CR 750 W	Howard	500	Scanoe	52	30			RLM	78	
AB22076	15R012	7/22/15 10:15	Normal	WBU030-0060	North Branch Otter Creek	Fontanet Rd	Vigo	150	Backpack	36	14			RLM	65	
AB22646	15023	8/3/15 14:15	Normal	WDE-01-0003	Galbreath Ditch	CR 250 N	Cass	50	Backpack	40	7			RLM	69	
AB23291	15058	9/29/15 10:15	Normal	WDE-01-0004	Wabash River	Georgetown Road	Cass	500	Scanoe	44				RLM	78	
AB22642	15003	8/3/15 16:15	Normal	WDE-03-0001	Pleasant Run	CR 550 N	Carroll	100	Backpack	46	12			RLM	66	
AB22645	15014	8/11/15 10:30	Normal	WDE-05-0007	Little Deer Creek	CR 200 N	Carroll	150	Canoe	46	28			RLM	71	
AB23063	15014.5	9/2/15 11:45	Revisit	WDE-05-0007	Little Deer Creek	CR 200 N	Carroll	100	Canoe	50	29	4	4	RLM	71	0
AB22077	15R011	8/4/15 14:00	Normal	WLV010-0022	Burnett Creek	Prophet St	Tippecanoe	100	Backpack	34	8			RLM	72	
AB23058	15R011.5	9/14/15 13:30	Revisit	WLV010-0022	Burnett Creek	Prophet St	Tippecanoe	75	Longline	34	12	0	40	RLM	68	6
AB22078	15R010	8/24/15 10:15	Normal	WLV060-0005	Big Pine Creek	SR 55	Warren	150	Canoe	48	27			RLM	77	
AB22079	15R009	8/11/15 15:30	Normal	WLV070-0013	Big Shawnee Creek	Green Bay Rd.	Fountain	100	Backpack	46	15			RLM	82	
AB22080	15R008	7/22/15 15:45	Normal	WLV080-0015	Opossum Run	Browns Hill Rd	Warren	150	Backpack	46	15			RLM	80	
AB23059	15R008.5	9/22/15 10:30	Revisit	WLV080-0015	Opossum Run	Browns Hill Rd	Warren	105	Backpack	44	19	2	24	RLM	78	3
AB22081	15R007	7/22/15 13:15	Normal	WLV110-0006	Prairie Creek	CR 170 W	Fountain	75	Backpack	48	20			RLM	58	
AB22082	15R006	8/17/15 13:15	Normal	WLV160-0013	Big Raccoon Creek	Lane off SR 236, east of US 231, Raccoon	Putnam	300	Longline	54	32			RLM	81	
AB22083	15R005	8/17/15 10:00	Normal	WLV160-0020	Big Raccoon Creek	At CR 775	Montgomery	100	Longline	54	23			RLM	74	
AB22075	15R004	8/12/15 9:30	Normal	WLV160-0038	Cornstalk Creek	CR 1150 S	Montgomery	150	Longline	48	24			RLM	77	
AB22084	15R003	6/24/15 10:15	Normal	WLV200-0002	Tributary of Norton Creek	CR 1150 S Behind House at Big Rock	Vermillion	50	Backpack	40	6			RLM	58	
AB22756	15013	8/3/15 11:45	Normal	WMI-01-0008	Mississinewa River	CR 300 E	Randolph	150	Longline	46	22			KAG	62	
AB22757	15025	8/3/15 15:25	Normal	WMI-02-0021	Mississinewa River	CR 900 E	Delaware	315	Longline	46	32			KAG	73	
AB22759	15021	8/5/15 16:20	Normal	WMI-05-0018	Mississinewa River	CR 700 S	Grant	500	Canoe	48	35			KAG	74	
AB22760	15009	8/5/15 9:55	Normal	WMI-05-0019	Mississinewa River	Cardinal Drive	Grant	500	Canoe	46	28			KAG	78	
AB22763	15037	7/28/15 10:05	Normal	WMI-05-0020	Tippey Ditch	CR 600 E	Grant	50	Backpack	34	10			KAG	34	
AB22758	15038	8/25/15 10:15	Normal	WMI-06-0006	Mississinewa River	Peru Circus Lane	Miami	500	Canoe	50	36			KAG	80	
AB22753	15005	8/24/15 10:30	Normal	WSA-02-0003	Salamonie River	CR 550 N	Jay	255	Longline	44	28			KAG	66	
AB22085	15R002	8/12/15 13:00	Normal	WSU010-0010	Spring Creek	Lane on North side of SR 47 East of US 52	Boone	150	Backpack	40	17			RLM	66	
AB22764	15044	8/17/15 11:40	Normal	WTI-03-0014	Tippecanoe River	Park Schram Road	Kosciusko	360	Canoe	40	23			KAG	60	
AB22653	15040	8/19/15 9:05	Normal	WTI-05-0015	Tippecanoe River	CR 375 N	Fulton	450	Canoe	54	30			KAG	68	
AB22650	15024	8/18/15 14:30	Normal	WTI-06-0008	Tippecanoe River	CR 550 N	Fulton	500	Canoe	54	30			KAG	73	
AB22655	15052	8/18/15 9:00	Normal	WTI-06-0010	Tippecanoe River	CR 200 E	Pulaski	500	Canoe	52	31			KAG	71	
AB22657	15004	7/28/15 14:00	Normal	WTI-07-0001	Graffis Ditch	CR 225 E	Pulaski	50	Backpack	42	5			RLM	55	
AB22652	15035	8/10/15 10:15	Normal	WTI-08-0004	Indian Creek	CR 1000 S	White	150	Longline	42	13			RLM	77	
AB23064	15035.5	9/28/15 10:15	Revisit	WTI-08-0004	Indian Creek	CR 1000 S	White	150	Canoe	40	16	2	21	RLM	79	3
AB22658	15020	7/28/15 12:00	Normal	WTI-10-0010	Lincoln Ditch	CR 800 W	Pulaski	75	Backpack	14	4			RLM	31	
AB22659	15043	7/28/15 10:15	Normal	WTI-10-0012	Hansell Ditch	SR 14	Pulaski	50	Backpack	34	6			RLM	30	
AB22647	15027	8/3/15 10:15	Normal	WTI-12-0004	Hoagland Ditch	CR 600 W	White	75	Backpack	44	13			RLM	47	
AB22643	15007	8/10/15 12:45	Normal	WTI-13-0002	Pike Creek	SR 39	White	75	Backpack	38	10			RLM	57	
AB22755	15001	7/28/15 12:30	Normal	WUW-07-0014	Mossburg Ditch	CR 550 W	Wells	90	Backpack	40	14			KAG	55	
AB23061	15001.5	8/31/15 10:20	Revisit	WUW-07-0014	Mossburg Ditch	CR 550 W	Wells	70	Backpack	36	15	4	7	PDM	47	16
AB22771	15031	7/29/15 10:50	Normal	WUW-10-0001	Seegar Ditch	Eme Road	Allen	75	Backpack	40	13			KAG	59	
AB22765	15047	8/10/15 11:30	Normal	WUW-10-0002	Little River	Gundy Road	Huntington	225	Longline	42	22			KAG	40	
AB22769	15033	7/29/15 14:00	Normal	WUW-11-0004	Flat Creek	Mayne Road	Huntington	120	Backpack	38	19			TAF	79	
AB23062	15033.5	8/31/15 2:05	Revisit	WUW-11-0004	Flat Creek	Mayne Road	Huntington	70	Backpack	40	16	2	17	KAG	70	12
AB22766	15054	8/4/15 14:15	Normal	WUW-14-0002	Treaty Creek	CR 50 E	Wabash	60	Backpack	34	12			KAG	67	
AB22648	15010	8/4/15 8:45	Normal	WUW-15-0001	Honey Creek	CR 400 N	Howard	50	Backpack	48	15			RLM	23	
AB22762	15042	8/4/15 8:35	Normal	WUW-15-0002	Pipe Creek	US 31	Miami	285	Longline	42	20			KAG	81	
AB22074	15R001	8/18/15 10:15	Normal	WWE-04-0003	Big Walnut Creek	480 East	Putnam	400	Longline	52	28			RLM	82	
									Average Change:			3	17			8

Appendix 8. Characteristics of Electrofishing Sampling Methods

Sampler Type			
	A, B, C	D, E, F	G, H
Gear Used:	A: 17' boat B: 16' boat C: 12' or 14' boat	D: Canoe w/ rattail cathode E: Tote Barge System w/ cathode plate F: Longline (150m extension cord)	G: Smith-Root 1.5 KVA w/ Longline (75m extension cord) H: Smith-Root Model LR-20B or LR-24 backpack
Power Source:	A, B: EG 5000 X Honda Generator with a Smith Root type VI-A (17' or 16' boat) C: Briggs & Stratton 5 HP Generator, Smith Root GPP 2.5 portable electrofisher (RCB-6B Junction Box) in 12' or 14' boat	D, E: Honda5 HP Generator with Smith Root GPP 2.5 portable electrofisher (RCB-6B Junction Box), or 3650W Champion Generator with MLES Infinity Box (MLES Junction Box) F: Honda5 HP Generator, Smith Root GPP 2.5 portable electrofisher (RCB-6B Junction Box)	G: Honda EU2000iA generator H: 24V 7Ah battery with will run 40 minutes continuous at 100W
Current Type:	Pulsed DC	Pulsed DC	Pulsed DC
Wattage: (AC Power Source)	A,B: 5000 (17' or 16' boat) C: 2500 (12' or 14' boat)	2500 (Honda) 3650 (Champion)	G:2000
Volts: (DC Output)	A,B: 0-1020, (suggest 340) C: 50-1000 (suggest 300)	50-1000 (suggest 300)	G: 0-560 H: 50-990 (suggest 100-300)
Amperage: (Output)	A,B: 3-6 C: 5	2-4 (Smith Root) 8-12 (MLES)	2-4
Anode Location:	A,B: Electrosphere on boom C: Electrosphere on boom (Large River) or Smith-Root dropper (river with fast current and/or nonwadeable pools)	ring anode, or dropper anode	Smith-Root teardrop or ring anode
Number of Netters & Net Mesh Size:	A,B:2 people netting in the front of the boat with 1/8 inch nets C: 1 person with 1/8 inch net	2 people netting near anode with 1/8 inch nets	1-2 people netting near anode with 1/8 inch net
Distance Sampled: (meters)	15 times the width up to a maximum of 500 m (both banks)	15 times the width, maximum 500 m minimum 50 m	15 times the width, maximum 500 m minimum 50 m
Sampling Direction:	Downstream and circling around to net fish behind boat (dependent on flow)	Upstream zigzag to collect from all habitats possible	Upstream zigzag to collect from all habitats possible
Stream Size:	A,B: large/great rivers C: Nonwadeable streams	Wadeable streams to headwater tributaries	Headwater tributaries
Sampling Period:	Mainstem White River >1000 square miles: Aug.13-Oct.15; mainstem Wabash River sites: Sept.15-Oct. 15; otherwise: June-Oct. 15; all daytime electrofishing	June-Oct. 15, daytime	June-Oct.15, daytime