2013 SAMPLING AND ANALYSIS WORKPLAN FOR BASELINE MONITORING OF THE DEEP RIVER - PORTAGE BURNS WATERSHED

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SIGNATURE PAGE

2013 Sampling and Analysis Workplan for
Baseline Monitoring of the Deep River - Portage Burns Watershed

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Work Plan versus QAPP:

This Sampling and Analysis Work Plan is an extension of the existing Watershed Assessment and Planning Branch, October 2004 "*Quality Assurance Project Plan (QAPP) for Indiana Surface Water Quality Monitoring and Total Maximum Daily Load (TMDL) Program*" and serves as a link to the existing QAPP as well as an independent QAPP of the project. As per the U.S. EPA QAPP guidance, this Work Plan establishes criteria and specifications pertaining to a specific water quality monitoring project that are usually described in the following four groups (phases) or sections as QAPP elements:

Phase A. Project Management/Planning

The plan documents project history and objectives, and establishes Data Quality Objectives (DQOs).

Phase B. Measurement/Data Acquisition

The plan describes sampling procedures, analytical methods, sample and data acquisition requirements, and the quality control measures specific to the project.

Phase C. Assessment/Oversight

The plan identifies the key elements of external and internal checks, audits, peer reviews, Data Quality Assessments (DQAs), and the preparation of Quality Assurance/Quality Control (QA/QC) Review Reports for management.

Phase D. Data Validation and Usability

The plan describes data handling and associated QA/QC activities including QA/QC Review Reports.

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(QAPP Element A2)

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LIST OF ACRONYMS

ADP:	Acoustic Doppler Profiler
ADV:	Acoustic Doppler Velocimeter
AIMS:	Assessment Information Management System
CCC:	Criterion Continuous Concentration
CFR:	Code of Federal Regulations
CFU:	Colony Forming Units
CLP:	Contract Laboratory Program
CMC:	Criterion Maximum Concentration
COD:	Chemical Oxygen Demand
CPR:	Cardio-Pulmonary Resuscitation
CRQL:	Contract Required Quantification Limit
DO:	Dissolved Oxygen
DQA:	Data Quality Assessment
DQO:	Data Quality Objectives
E. coli:	*Escherichia coli*
EPA:	Environmental Protection Agency
GPS:	Global Positioning System
HUC:	Hydrologic Unit Code
IAC:	Indiana Administrative Code
IBC:	Impaired Biotic Community
IBI:	Index of Biotic Integrity
IDEM:	Indiana Department of Environmental Management
MDL:	Method Detection Limit
mg/L:	Milligram per liter
MHAB:	Multi-habitat
mL:	Milliliter
MPN:	Most Probable Number
MS/MSD:	Matrix Spike/Matrix Spike Duplicate
NTU:	Nephelometric Turbidity Unit(s)
OWQ:	Office of Water Quality
PFD:	Personal Floatation Device
PPE:	Personal Protective Equipment
QA/QC:	Quality Assurance/Quality Control
QAPP:	Quality Assurance Project Plan
QHEI:	Qualitative Habitat Evaluation Index
RFP:	Request for Proposals
RL:	Reporting Limit
RPD:	Relative Percent Difference
SM:	Standard Method
SOP:	Standard Operating Procedures
SU:	Standard Units
TKN:	Total Kjeldahl Nitrogen
TMDL:	Total Maximum Daily Load

TDS:	Total Dissolved Solids
TOC:	Total Organic Carbon
TP:	Total Phosphorus
TS:	Total Solids
TSS:	Total Suspended Solids
µS/cm	Micro Siemens per Centimeter
U.S.:	United States
WAPB:	Watershed Assessment and Planning Branch

Definitions:

Elutriate	To purify, separate, or remove lighter or finer particles by washing, decanting, and settling.
Geometric site	Sampling site chosen according to its drainage area within a watershed.
One (1) minute kick sample	A stationary sampling accomplished using a box shaped net comprised of canvas bottom and/or sides and 504µ nylon mesh back. The designated area is sampled for one minute.
Pour point	The outlet of a subwatershed or the common point where all the water flows out of any given subwatershed.
Targeted site	A sampling site intentionally selected based on specific monitoring objectives or decisions to be made

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Baseline Monitoring of the Deep River - Portage Burns Watershed Objective

Baseline monitoring is an intensive targeted watershed design that characterizes the current condition of an individual watershed. This type of monitoring provides valuable data for the purposes of TMDL development, watershed planning, and allows for future comparisons to evaluate changes in the water quality within the watershed(s) studied. Selecting a spatial monitoring design with sufficient sampling density to accurately characterize water quality conditions is a critical step in the process of developing an adequate local scale watershed study.

The Indiana Department Environmental Management (IDEM) has selected the Deep River - Portage Burns Watershed for this special water quality study and TMDL development. Sample sites were chosen using a geometric site selection and targeted site selection in order to get the necessary spatial representation of the entire study area. Geometric sites within this watershed were selected based on a geometric progression of drainage areas starting with the area at the mouth of the main stem stream and working upstream through the tributaries to the headwaters. Monitoring sites were then located to the nearest bridge. A more complete description of the geometric site selection process is included as attachment 1. Targeted sample sites were chosen at the nearest bridge to the pour point (the lowest point in the basin through which all water flows) of each 12 digit Hydrologic Unit Code (HUC) in the watershed, or chosen to characterize sources for TMDL development.

It is anticipated that the water quality data collected through this monitoring will provide the information to the TMDL program and local water quality managers that are needed to characterize the watershed, identify sources of impairment, designate critical areas, and enable users to make valid and informed watershed decisions. In addition, this project, by design, will add additional stream reaches for assessment of aquatic life and recreational use support.

The draft 2012 303(d) list submitted to the U.S. EPA (IDEM 2012b) details impairments of approximately 125 miles of the Deep River - Portage Burns Watershed in the following ways:

- Impaired Biotic Community (IBC), 91 miles
- *Escherichia coli (E.coli)*, 50 miles
- Polychlorinated Biphenyls (PCBs) in fish (Category 5B), 34 miles
- Dissolved Oxygen (DO), 15 miles
- Siltation, 12 miles

Assessment data in this watershed has been collected by IDEM from multiple programs and projects (Fixed Station Monitoring, Probabilistic Monitoring, Fish Tissues Contaminants Monitoring, Burns Ditch TMDL Assessment, to name a few) conducted between 1984 and 2012. Only the most recent five years of data are used for assessment of impairments. One site in this project has been visited in 2000 and

quarterly between July, 2002 and May, 2006. The remaining 34 sites are new sites not previously assessed.

I. PROJECT MANAGEMENT/PLANNING

(QAPP Elements A4, A5, A6, A7, A8)

Project/Task Organization and Schedule: (QAPP Element A4)

The main objective of this project is to provide a comprehensive assessment of the streams in the Deep River - Portage Burns Watershed for their ability to support aquatic life use and recreational use. Sampling for this project will begin in April 2013 and end in March 2014. Chemical, physical, and biological parameters will be collected for the project.

Time frames for sampling activities include:

Site reconnaissance activities will be completed in January 2013. Reconnaissance activities will be conducted in the office and through physical site visits if needed.

Water chemistry will be sampled monthly during the recreational season, defined as April through October [327 Indiana Administrative Code (IAC) 2-1.5-8] (2013) at targeted sites in the watershed. The sites at the pour point of each 12 digit HUC will be sampled monthly for one year. The first event will begin in April 2013 and conclude in March 2014.

Biological sampling activities will begin in the summer of 2013 and end no later than October 15, 2013. The basin will be sampled for fish community, macroinvertebrate community, and habitat quality at all targeted sites in the watershed.

Bacteriological sampling will take place at all targeted sites in the watershed during the recreational season. Targeted sites will be sampled monthly for *Escherichia coli (E. coli)* during the recreational season along with five times at equally spaced intervals during a 30 day period to determine a geometric mean. The expected time frame for geometric sampling will be September through October 2013.

Stream flow will be quantified at the pour point of each 12 digit HUC monthly for one year. The first event will begin in April 2013 and conclude in March 2014.

Barring any hazardous weather conditions or unexpected physical barriers to access the site, samples will be collected for physical, chemical, and bacteriological parameters as well as biological communities. Sample collections for fish community and

macroinvertebrates may be postponed due to scouring of the stream substrate or in-stream cover caused by a high water event, which would result in non-representative samples.

Background and Project/Task Description: (QAPP Elements A5, A6)

The Baseline Monitoring program was instituted to assist in characterizing existing conditions in watersheds throughout the state. The Deep River - Portage Burns baseline data set will be utilized by the TMDL program and shared with local watershed groups and any other parties interested in the watershed. This monitoring will provide data for TMDL development and watershed planning uses and will aid in the evaluation of future changes within the basin. For this study, the following media will be used for assessment purposes: Water chemistry, stream flow, bacteriological contamination in the form of *E. coli*, fish community, macroinvertebrate assemblages, and habitat evaluations.

Data Quality Objectives (DQOs): (QAPP Element A7)

The Data Quality Objective (DQO) process (U.S. EPA 2000) is a planning tool for data collection activities. It provides a basis for balancing decision uncertainty with available resources. The DQO is required for all significant data collection efforts for a project. It is a seven step systematic planning process used to clarify study objectives, define the appropriate types of data, and establish decision criteria on which to base the final use of the data. The DQO for the Baseline Monitoring of the Deep River - Portage Burns Watershed is identified in the following seven steps:

1. State the Problem

An intensive targeted watershed design of the Deep River - Portage Burns Watershed is needed in order to develop a TMDL and fully characterize the current water quality condition of the watershed. Indiana is required to assess all waters of the state to determine their designated use attainment status**. "**Surface waters of the state are designated for full-body contact recreation and will be capable of supporting a well-balanced, warm water aquatic community" [327 IAC 2-1.5-5] (2013). This project will gather stream flow, water chemistry, bacteriological, biological (fish and macroinvertebrates), and habitat data for the purpose of assessing the designated use attainment status of the Deep River - Portage Burns Watershed.

2. Identify the Decision

The main objective of this study is to fully assess whether the surface waters in this watershed are fully supporting or non-supporting for aquatic life use and recreational use. All targeted sites will be sampled for concentrations of physical, chemical, and biological parameters and evaluated as "supporting" or "non-supporting" when compared with water quality criteria shown in Table 1 [327 IAC 2-1.5-8] (2013).

In addition to the physical, chemical, and bacteriological criteria listed in Table 1, data for several nutrient parameters will be evaluated with the benchmarks described below. Assuming a minimum of three sampling events, if two or more of the conditions below are met on the same date, the waterbody will be classified as non-supporting due to nutrients.

Total Phosphorus (TP): one or more measurements >0.3 mg/L

Nitrogen (measured as Nitrate+Nitrite): one or more measurements >10.0 mg/L

DO: <4.0 mg/L or measurements consistently at or close to the standard, range 4.0-5.0 mg/L or >12.0 mg/L

pH: >9.0 Standard Units (SU) or measurements consistently at or close to the standard, range 8.7-9.0 SU

Biological Criteria:

Indiana narrative biological criteria found at 327 IAC 2-1.5-5 (2013) states that "all waters, except those designated as limited use, will be capable of supporting a well-balanced, warm water aquatic community." The water quality standard found at 327 IAC 2-1.5-2(97), defines a "well-balanced aquatic community" as "an aquatic community which is diverse in species composition, contains several different trophic levels, and is not composed mainly of strictly pollution tolerant species" (2013). An interpretation or translation of narrative biological criteria into numeric criteria would be as follows: A stream segment is non-supporting for aquatic life use when the monitored fish or macroinvertebrate community receives an Index of Biotic Integrity (IBI) score of less than or equal to 35 which is considered "Poor" or "Very Poor" (2013).

Table 1. Water Quality Criteria 327 IAC 2-1.5-8

Parameters	Water Quality Criteria	Criterion Type
E. coli April-October	125 MPN/100 mL	5-Sample Geometric Mean

Parameters	Water Quality Criteria	Criterion Type
(Recreational season)	235 MPN/100 mL	Single Sample Maximum
Total Ammonia (NH_3-N)	Calculated Based on pH and Temperature	CMC, CCC
Nitrate+Nitrite-Nitrogen	10 mg/L	Public Water Supply
Dissolved Oxygen	At least 5.0 mg/L (Warm Waters)	Daily Average
	Not less than 4.0 mg/L at any time	Not to exceed limit
pH	6.0 - 9.0	Unless correlated with photosynthetic activity
Temperature	Varies Monthly	Coldwater criteria apply to salmonid waters
Chloride	Varies based on hardness and sulfate values	CMC, CCC

3. Identify the Inputs to the Decision

Grab samples will be collected at the surface water sampling locations for *E.* Coli and the parameters listed in Table 3. Field measurements (Table 4) will be conducted at each site during each sampling event. Visual field observations will include weather conditions, stream conditions, and percent stream canopy at each sampling location. All samples collected for bacteriological samples will be analyzed for *E. coli* using the Idexx Colilert Enzyme Substrate Standard Method SM9223B (Clesceri et al., 1998). Surface water samples will be collected monthly and processed and analyzed by Heritage Environmental Services using the analytical methods listed in Table 3. Stream discharge will also be measured or estimated monthly at selected sites to determine total stream loadings.

4. Define the Boundaries of the Study

The Deep River - Portage Burns Watershed drains 180 square miles and is situated primarily in Lake County with the eastern portion of the watershed located in Porter County. The watershed is approximately 42% developed and 24% agriculture. See Figure 1 for the Deep River - Portage Burns Watershed land use.

See Figure 2 for the Deep River - Portage Burns Watershed Baseline Monitoring sampling area and Table 2 for the list of sampling locations.

Figure 1. Deep River - Portage Burns Watershed Land Use

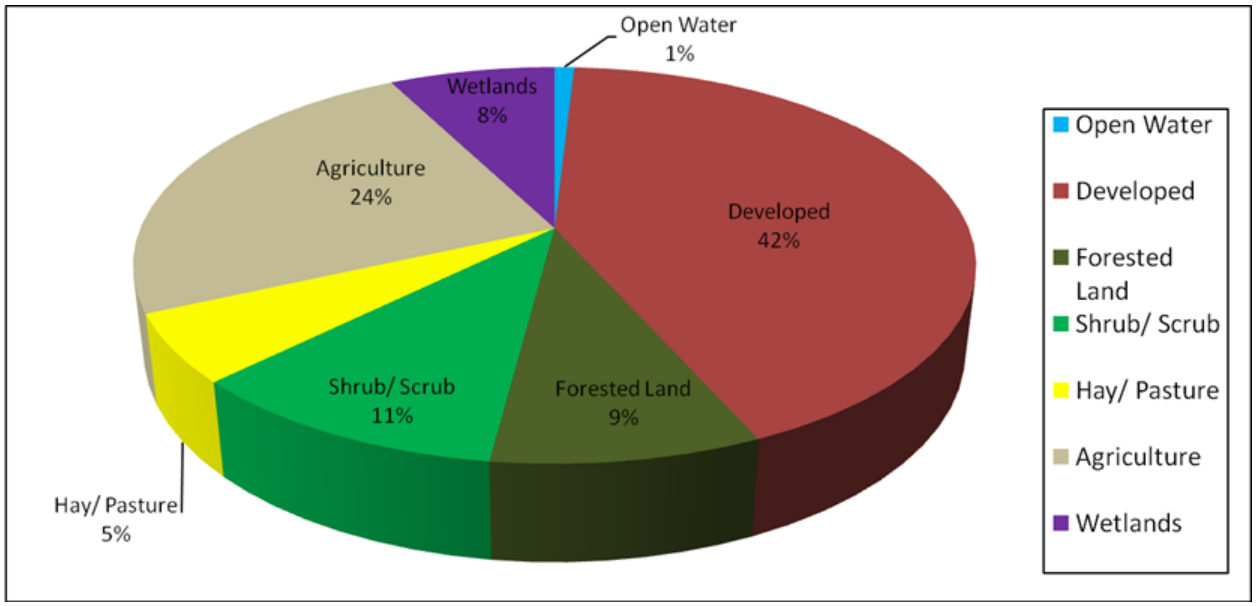

Figure 2. Deep River - Portage Burns Watershed Baseline Monitoring Sampling Area

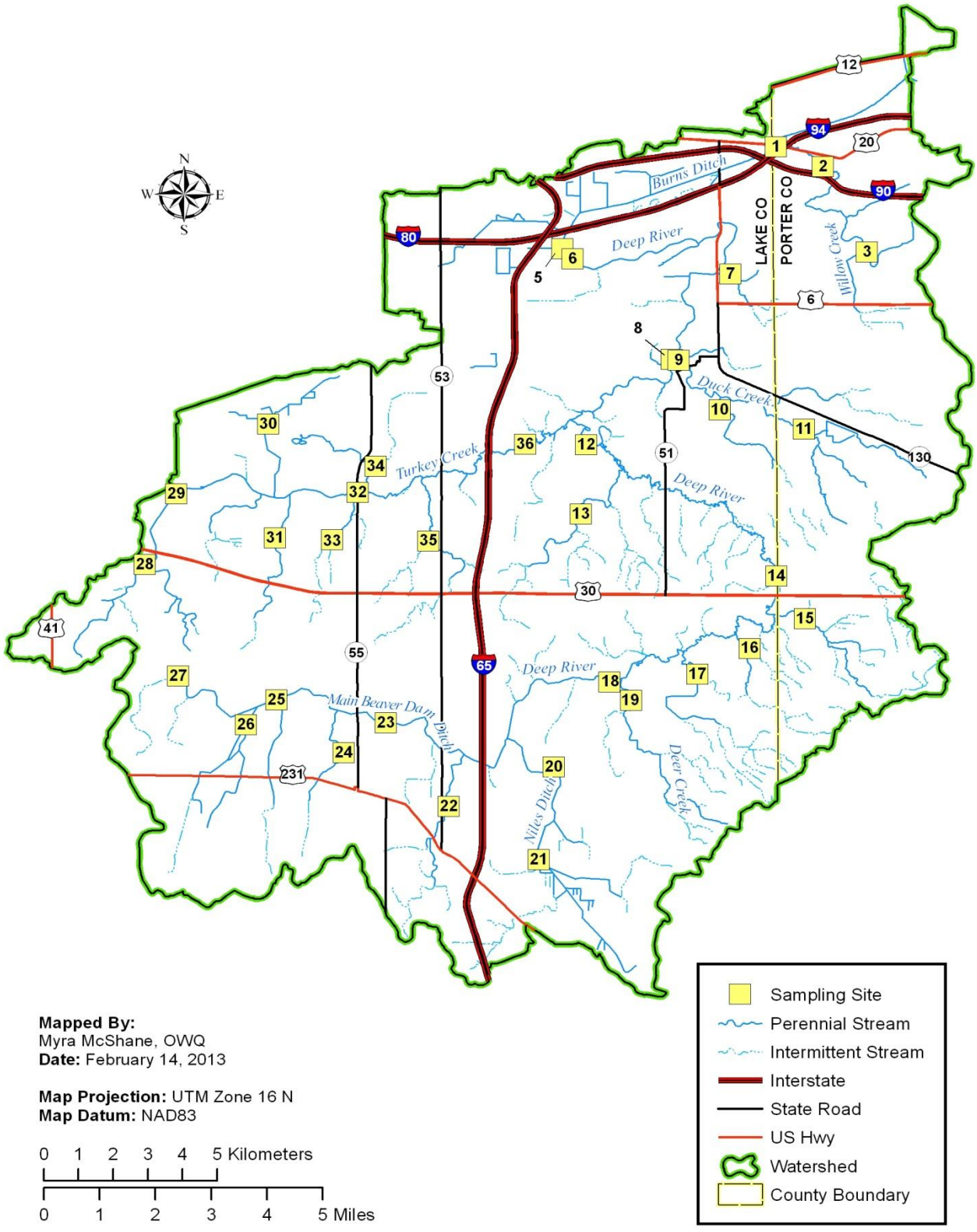

Table 2. Sampling Locations for Baseline Monitoring of the Deep River - Portage Burns Watershed

Site #	AIMS Site #	Stream Name	Location	County	Latitude (Decimal Degree)	Longitude (Decimal Degree)
13T-001	LMG-05-0002	Burns Ditch	US 20	Porter	41.59362084	-87.22069186
13T-002	LMG-05-0003	Willow Creek	Clem Road	Porter	41.58828588	-87.20441822
13T-003	LMG-05-0004	Willow Creek	Stone Avenue	Porter	41.56492476	-87.18905508
13T-005	LMG-05-0006	Deep River	29th Avenue	Lake	41.56558173	-87.29437343
13T-006	LMG-05-0007	Deep River	Liverpool Road	Lake	41.56282272	-87.2907808
13T-007	LMG-05-0008	Tributary of Deep River	Shelby Street	Lake	41.55882944	-87.23635064
13T-008	LMG030-0008	Deep River	Ridge Rd, D/S of Lake George Dam, Hobart	Lake	41.53539722	-87.256425
13T-009	LMG-05-0009	Duck Creek	Front Street	Lake	41.53511356	-87.25405449
13T-010	LMG-05-0010	Tributary of Duck Creek	10th Street	Lake	41.52158603	-87.23983651
13T-011	LMG-05-0032	Duck Creek	750 W	Porter	41.51644236	-87.21075158
13T-012	LMG-05-0011	Deep River	Arizona Street	Lake	41.5118914	-87.28598137
13T-013	LMG-05-0033	Sprout Ditch	70th Avenue	Lake	41.49295911	-87.28762022
13T-014	LMG-05-0012	Deep River	Joliet Road	Lake	41.47613949	-87.22015183
13T-015	LMG-05-0013	Tributary of Deep River	750 W	Porter	41.46451191	-87.21016561
13T-016	LMG-05-0034	Tributary of Deep River	89th Avenue	Lake	41.45633007	-87.22930745
13T-017	LMG-05-0014	Tributary of Deep River	93rd Avenue	Lake	41.44915243	-87.2473032
13T-018	LMG-05-0015	Deep River	Clay Street	Lake	41.44704867	-87.27761876
13T-019	LMG-05-0035	Deer Creek	97th Avenue	Lake	41.44192504	-87.27018527
13T-020	LMG-05-0016	Niles Ditch	Colorado Street	Lake	41.42364618	-87.29667465

Site #	AIMS Site #	Stream Name	Location	County	Latitude (Decimal Degree)	Longitude (Decimal Degree)
13T-021	LMG-05-0017	Niles Ditch	121st Avenue	Lake	41.39829506	-87.30176091
13T-022	LMG-05-0036	Smith Ditch	113th Avenue	Lake	41.41281788	-87.33291957
13T-023	LMG-05-0018	Main Beaver Dam Ditch	Grant Street	Lake	41.43555322	-87.35472546
13T-024	LMG-05-0019	Tributary of Main Beaver Dam Ditch	Summit Street	Lake	41.42732992	-87.36929848
13T-025	LMG-05-0020	Main Beaver Dam Ditch	Clark Road	Lake	41.44174128	-87.39258239
13T-026	LMG-05-0021	Tributary of Main Beaver Dam Ditch	101st Avenue	Lake	41.43495179	-87.40302528
13T-027	LMG-05-0022	Main Beaver Dam Ditch	Blaine Street	Lake	41.44821244	-87.42648335
13T-028	LMG-05-0023	Tributary of Turkey Creek	77th Avenue	Lake	41.47867139	-87.4382747
13T-029	LMG-05-0024	Turkey Creek	Broad Street	Lake	41.49800932	-87.42756557
13T-030	LMG-05-0025	Johnson Ditch	Oak Ridge Prairie County Park	Lake	41.51732394	-87.39592426
13T-031	LMG-05-0026	Tributary of Turkey Creek	W Old Lincoln Hwy	Lake	41.48607445	-87.39339231
13T-032	LMG-05-0027	Turkey Creek	SR 55	Lake	41.49865257	-87.36476355
13T-033	LMG-05-0028	Tributary of Turkey Creek	73rd Avenue	Lake	41.48565713	-87.37361497
13T-034	LMG-05-0029	Tributary of Turkey Creek	Arthur Street	Lake	41.50588109	-87.35870748
13T-035	LMG-05-0030	Tributary of Turkey Creek	73rd Avenue	Lake	41.48546506	-87.3403808
13T-036	LMG-05-0031	Turkey Creek	Liverpool Road	Lake	41.51201251	-87.3069362

5. Develop a Decision Rule

For assessment purposes in the Indiana Integrated Report (IDEM 2012a), recreational use attainment decisions will be based on bacteriological criteria developed to protect primary contact recreational activities [327 IAC 2-1.5-8] (2013). Under these standards, during the recreational season of April through October, *E. coli* measurements in waters of the State shall not exceed 125 MPN/100 mL as a geometric mean and/or 235 MPN/100 mL in any single sample (Table 1). The geometric mean shall consist of five

samples taken at evenly spaced intervals over a thirty day period. If *E. coli* measurements exceed the geometric mean of 125 MPN/100 mL, the site and associated segments will be considered non-supporting for recreational use.

Aquatic life use support decisions will include independent evaluations of biological and chemical data. A site will be considered non-supporting for aquatic life use when narrative biological criteria found at 327 IAC 2-1.5-8 (2013) are not met. A numeric translation of the narrative criteria has been developed to facilitate clear and consistent decision making (IDEM 2010d). Macroinvertebrate multi-habitat samples will be evaluated using an IBI developed for lowest practical taxonomic level. Specifically, a site will be considered non-supporting for aquatic life use when IBI scores are less than or equal to 35. In addition, a site will be considered non-supporting for aquatic life uses when numeric chemical criteria for specific parameters cited in Table 1 are exceeded one or more times during all sampling events.

6. Specify Tolerable Limits on Decision Errors

Sampling design error is minimized by utilizing a comprehensive checklist of informational sources, evaluation of historical information, and a thorough watershed pre-survey. (attachment 2) This sampling design has been formulated to address data deficiencies and render the optimum amount of data needed to fill gaps in the decision process.

Good quality data are essential for minimizing decision error. By minimizing both sampling design error and measurement error for physical and biological parameters, more confidence can be placed in the conclusions drawn on the stressors and sources affecting the water quality in the study area.

Site specific aquatic life use and recreational use assessments include program specific controls to minimize the introduction of errors. These controls include water chemistry and bacteriological blanks and duplicates, biological site revisits or duplicates, and laboratory controls through verification of species identifications. Field Procedure Manuals (IDEM 2002; OHEPA 2006) and Standard Operating Procedures (IDEM 1992b, 1992c, 1992d, 1992e, 2010a) dictate consistent and proven techniques for sample collection to assure representative samples and minimize measurement error.

The QA/QC process detects deficiencies in the data collection as set forth in the IDEM QAPP for the Indiana Surface Water Quality Monitoring Program (IDEM 2004). The QAPP requires all contract laboratories to adhere to rigorous standards during sample analyses and to provide good quality usable data. Chemists within the Watershed Assessment and Planning Branch (WAPB) review the laboratory analytical results for quality assurance. Any data which is “Rejected” due to analytical problems or errors will

not be used for water quality assessment decisions. Any data flagged as "Estimated" may be used on a case by case basis.

7. Optimize the Design for Obtaining Data

A geometric design site selection process is used in this study in order to get the necessary spatial representation of the entire study area. Sites within this watershed have been selected based on a geometric progression of drainage areas and then located to the nearest bridge. Sample sites at road crossings will allow for more efficient sampling of the watershed.

Training and Staffing Requirements: (QAPP Element A8)

The WAPB uses many Standard Operating Procedures (SOPs), so any new staff member must be trained by experienced IDEM professionals on how to operate field and laboratory equipment for the collection of chemical, physical, bacteriological, and biological parameters as well as perform required QA/QC procedures. Before samples are collected, IDEM field personnel (i.e. full-time staff, new hires, and interns) will spend several days in the office and in the field reviewing SOPs and conducting field exercises in accordance with those SOPs.

The fish or macroinvertebrate community team leader should have six or more years experience in or related to bio-assessments (Gibson et al. 1996) with at least three years of experience with the aquatic communities in the region (U.S. EPA 1994). Prior to conducting electrofishing for fish community sampling, crew members should review the Principles and Techniques of Electrofishing correspondence course provided by the U.S. Fish & Wildlife Service, National Conservation Training Center as well as test equipment and conduct field training with less experienced crew members. The field crew leader will be responsible for completion of field data sheets, taxonomic accuracy, sampling efficiency and representation, and voucher specimen tracking.

Staff from the Technical and Logistical Services Section will assist with laboratory work requests and review laboratory data for adherence to QA/QC requirements specified in analytical test methods, contract requirements, and the IDEM QAPP for the Indiana Surface Water Quality Monitoring Program (IDEM 2004) as well as importing electronic data into the Assessment Information Management System (AIMSII) database which is used by the WAPB. The QA Officer will create QA/QC review reports for each laboratory . Staff will oversee data entry into AIMSII of information collected in the field and laboratory as well as perform data QA/QC review for accuracy and completeness.

II. MEASUREMENT/DATA ACQUISITION

Sampling Process Design/ Methods, Sample Handling and Custody

(QAPP Elements B1, B2, B3, B4, B5, B6, B7)

Sampling Sites/Sampling Design: (QAPP Element B1)

The proposed site locations are chosen using a geometric and targeted design as described previously in the "Baseline Monitoring of the Deep River - Portage Burns Watershed Objective" section of this workplan.

Site reconnaissance activities are conducted in-house and through physical site visits. In-house activities include preparation and review of site maps and aerial photographs. Physical site visits include verification of accessibility, safety considerations, equipment needed to properly sample the site, and property owner consultations, if required. Final coordinates for each site will be determined during the physical site visits or at the beginning of the sampling phase of this project using a Trimble Juno ™ SB Global Positioning System (GPS) with an accuracy of one to three meters. These coordinates will be entered into the AIMS II database.

Table 2 provides a list of the selected sampling sites with the stream name, AIMS Site Number, County Name, and the latitude and longitude of each site. The map at Figure 2 paired with that table provides a good overview of the various sampling site locations.

Sampling Methods and Sample Handling: (QAPP Elements B2, B3)

Water Chemistry

One team of two staff will collect grab water chemistry samples and record physical site observations on the stream sampling field data sheet (Attachment 3), during monthly sampling events. All water chemistry sampling will adhere to the Water Quality Surveys Section Field Procedure Manual Section 2.1 (IDEM 2002).

Bacteriological Sampling

The bacteriological sampling will be conducted by one team consisting of one or two staff. Samples will be processed in an IDEM *E. coli* Mobile Laboratory equipped with all materials and equipment necessary for the Colilert® Test Method. Samples will be collected monthly during the recreational season in addition to five samples from each site being collected at equally spaced intervals over a thirty day period. Per Element A4 Project Organization and Schedule (above), the expected time frame for bacteriological sampling will be September and October of 2013. Staff will collect the samples in a 120 mL pre-sterilized wide mouth container from the center of flow if stream is wadeable or from the shoreline using a pole sampler if the stream is not wadeable. All samples will be consistently labeled, cooled, and held at a temperature less than 10ºC during transport. All *E. coli* samples will be collected on a schedule such that any sampling crew can deliver them to the IDEM *E. coli* Mobile Laboratory for analyses within the bacteriological holding time of six hours.

The IDEM *E. coli* Mobile Laboratory is used in this project to facilitate *E. coli* testing by eliminating the necessity of transporting samples to distant contract laboratories within a six hour holding time. The *E. coli* Mobile Laboratory (Van) provides work space containing storage for samples, supplies for Colilert® Quanti-tray testing, and all equipment needed for collecting, preparing, incubating, and analyzing results. All supplies will be obtained from IDEXX Laboratories, Inc., Westbrook, Maine.

Fish Community Sampling

The fish community sampling will be completed by teams of three to five staff. Sampling will be performed using various standardized electrofishing methodologies depending on stream size and site accessibility. Fish assemblage assessments will be performed in a sampling reach of 15 times the average wetted width, with a minimum reach of 50 meters and a maximum reach of 500 meters (Simon 1992, 1997, DRAFT; Simon and Dufour 1998; U.S. EPA 1995). An attempt will be made to sample all habitat types available within the sample reach to ensure adequate representation of the fish community present at the time of the sampling event. The possible list of electrofishers to be utilized include: the Smith-Root LR-24 or LR-20 Series backpack electrofishers, the Smith-Root model 1.5KVA electrofishing system, the Smith-Root model 2.5 Generator Powered Pulsator electrofisher with RCB-6B junction box and rat-tail cathode cable assembled in a canoe (IDEM 1992a, 1992b, 1992c, 1992d).

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 and buckets. Young-of-the year fish less than 20 millimeters (mm), total length, will not be retained in the community sample (Simon 1990; U.S. EPA 1995).

Prior to processing fish specimens and completion of the fish collection datasheet (Attachment 6), one to two individuals per species will be preserved for future reference if there are more than 10 individuals for that species collected in the sampling reach, the specimens can be positively identified, and the individuals for preservation are small enough to fit in a 2000 mL jar. If however, there are few individuals captured or the specimens are too large to preserve, a photo of key characteristics will be taken for later examination. Taxonomic characteristics for possible species encountered in the basin of interest will be reviewed prior to field work. Fish specimens should also be preserved if they cannot be positively identified in the field (especially those that co-occur like the striped and common shiner), individuals that appear to be hybrids or have anomalies, as well as dead specimens that are taxonomically valuable for un-described taxa (like the new stoneroller, red shiner, or jade darter), life history studies, or research projects.

Data will be recorded for non-preserved fish on the fish collection datasheet (Attachment 6) consisting of the following: 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. Once the data have been recorded, specimens will be released within the sampling reach if possible. Data will be recorded for preserved fish specimens following taxonomic identification in the laboratory.

Macroinvertebrate Sampling

The macroinvertebrate community sampling will be conducted by crews of three staff. Samples are collected using a modification of the U.S. Environmental Protection Agency (EPA) Rapid Bioassessment Protocol multi-habitat (MHAB) approach using a D-frame dipnet (Barbour et al. 1999; IDEM 2010a; Klemm et al. 1990; Plafkin et al. 1989). The IDEM MHAB approach is composed of a 1-minute ”kick” sample within a riffle or run (collected by disturbing $1m^2$ of stream bottom substrate and collecting the dislodged macroinvertebrates within the dipnet) and a 50 meter “sweep” sample of shoreline habitats (collected by disturbing habitats such as emergent vegetation, coarse particulate organic matter, depositional zones, logs and sticks and collecting the dislodged macroinvertebrates within the dipnet). The 50 meter length of riparian corridor that is sampled at each site will be defined using a rangefinder or GPS unit. If the stream is too deep to wade, a boat will be used to sample the 50 meter zone along the shoreline that has the best available habitat. The 1-minute “kick” and 50 meter “sweep” samples are combined in a bucket of water which will be elutriated through a - U.S. standard number 35 (500 µm) sieve a minimum of five times so that 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 where the

collector (while still on-site) will conduct a 15-minute pick of macroinvertebrates at a single organism rate with an effort to pick for maximum organism diversity through turning and examination of the entire sample in the tray. The resulting picked sample will be preserved in 70% ethanol and returned to the laboratory for identification at the lowest practical taxonomic level (usually genus or species level, if possible) and evaluated using the multi-habitat macroinvertebrate index of biotic integrity (mIBI). A Qualitative Habitat Evaluation Index (QHEI) multi-habitat scoring sheet (Attachment 4) will also be completed for the sample while on-site. These lowest taxa samples will be evaluated using the multi-habitat IBI. A completed Biological Samples chain of custody form (Attachment 9) accompanies the samples through the identification process.

Habitat Assessments

Habitat assessments will be completed immediately following macroinvertebrate and fish community sample collections at each site using the Ohio Environmental Protection Agency Qualitative Habitat Evaluation Index (QHEI), 2006 edition (OHEPA 2006; Rankin 1995).

Field Parameter Measurements

DO, pH, water temperature, specific conductance, turbidity, and DO percent saturation will be measured with a datasonde during each sampling event (IDEM 2002). Measurement procedures and operation of the datasonde shall be in according to the manufacturers operating manuals (Hydrolab Corporation 2002; YSI 2002) and Sections 2.10 – 2.13 of the Surveys Section Field Procedure Manual (IDEM 2002).

Flow Measurements

Flow measurements are to be taken by the water chemistry crew at the pour point sites during each sampling run using the SonTek Acoustic Doppler Profiler (ADP) at non-wadeable sites and the FlowTracker Handheld Acoustic Doppler Velocimeter (ADV)® at the wadeable sites. Procedures shall be in according to Section 2.6.5 of the Surveys Section Field Procedure Manual (IDEM 2002) and the manufacturers'' operating manuals. (SonTek/YSI Inc 2007; 2001)

Analytical Methods: (QAPP Element B4)

Laboratory Procedure for *E. coli* Measurements:

At the end of each sampling run and while still in the field, water samples are processed and analyzed for *E. coli* within the six-hour holding time for collection and transportation, and the two-hour holding time for sample processing. All waters sampled are processed and analyzed for *E. coli* in the IDEM *E. coli* Mobile Laboratory or IDEM

Shadeland laboratory, which is equipped with required materials and equipment necessary for the Idexx ^{TM} Colilert Test. The Colilert Test is a multiple-tube Enzyme Substrate Standard Method SM-9223 B (Clesceri et al., 1998). The *E.coli* test method and quantification limit are identified below in Table 3.

Nutrient and General Chemistry Parameters Measurements:

Nutrient and general chemistry measurement analysis is performed at Heritage Environmental in accordance with pre-approved test methods and allotted time frames. The nutrient and general chemistry parameters and their respective test methods and quantification limits are identified below in Table 3. A chain of custody form created by the AIMS II database (Attachment 7) and a sample analysis request form (Attachment 8) accompanies each sample set through the analytical process.

Table 3. *E.*coli, Nutrient and General Chemistry Parameters Test Methods

Parameter	Method	Limits of Quantification	Units	Preservative	Holding Times
E. coli	SM-9223 B Enzyme Substrate Test	1.0	*MPN /100 mL	0.0008% $Na_2S_2O_3$	8 hours
Alkalinity (as $CaCO_3$)	EPA 310.2	10.0	mg/L	None	14 days
Total Solids	SM 2540B	10.0	mg/L	None	7 days
Total Suspended Solids	SM 2540D	4.0	mg/L	None	7 days
Total Dissolved Solids	SM 2540C	10.0	mg/L	None	7 days
Sulfate	EPA 300.0	.3	mg/L	None	28 days
Chloride	EPA 300.0	.25	mg/L	None	28 days
Hardness (as $CaCO_3$)	SM 2340B	1.0	mg/L	HNO_3 < pH 2	6 months
Ammonia Nitrogen	EPA 350.1	0.10	mg/L	H_2SO_4 < pH 2	28 days

Parameter	Method	Limits of Quantification	Units	Preservative	Holding Times
TKN	ASTM D3590-89	0.30	mg/L	H_2SO_4 < pH 2	28 days
Nitrate/Nitrite	EPA 353.1	0.05	mg/L	H_2SO_4 < pH 2	28 days
Total Phosphorus	EPA 365.1	0.05	mg/L	H_2SO_4 < pH 2	28 days
TOC	SM 5310C	1.0	mg/L	H_2SO_4 < pH 2	28 days
COD	EPA 410.4	10.0	mg/L	H_2SO_4 < pH 2	28 days

***** Clesceri et al., 1998. 1 MPN = 1 CFU/100 mL

Field Parameters Measurements:

The field measurements of DO, temperature, pH, conductivity, and turbidity are taken each time a sample is collected. The field parameters and their respective test methods and sensitivity limits are identified below in Table 4.

During each sampling run, field observations from each site and ambient weather conditions at the time of sampling are noted and documented on stream sampling field data sheets (Attachment 3). A digital photo of both up-stream and down-stream of the sampling site will be taken, logged, and documented for later references.

Table 4. Field Parameters Test Methods

Parameter	Method	Sensitivity Limit	Units
Dissolved Oxygen (Datasonde)	ASTM D888-09(C)	0.01	mg/L
Dissolved Oxygen (Winkler Titration)	SM 4500-OC[1]	0.2	mg/L
Dissolved Oxygen Saturation (Datasonde)	ASTM D888-09(C)	0.01	%
Turbidity (Hach Turbidimeter)	EPA 180.1[1]	0.02	NTU
Specific Conductance (Datasonde)	SM 2510B	1.0	µS/cm

Parameter	Method	Sensitivity Limit	Units
Temperature (Datasonde)	SM 2550B(2)	0.1	^{o} Celsius
Temperature (field meter)	SM 2550B(2)[1]	0.1	^{o} Celsius
pH (Datasonde)	EPA 150.2	0.01	SU
pH (field meter)	SM 4500-HB[1]	0.01	SU

[1] Method used for Field Calibration Verification

Quality Control and Custody Requirements: (QAPP Element B5)

Quality assurance protocols will follow part B5 of the "Quality Assurance Project Plan for the Indiana Surface Water Quality Monitoring and Total Maximum Daily Load (TMDL) Program," Revision 3, by Timothy Bowren and Dr. Syed Ghiasuddin (IDEM 2004).

Field Instrument Testing and Calibrations: (QAPP Elements B6, B7)

The Datasonde will be calibrated immediately prior to each week's sampling (IDEM 2002). Calibration results and drift values will be recorded, maintained, stored and archived in log books located in the calibration laboratories at the Shadeland facility. The drift value is the difference between two successive calibrations. Field parameter calibrations will conform to the procedures as described in the instrument users manuals (Hydrolab Corporation 2002; YSI 2002). The DO component of the calibration procedure will be conducted using the air calibration method. The unit will be field checked for accuracy once during the week by comparison with a Winkler DO test, as well as Hach™ turbidity, pH and temperature meters. Weekly calibration verification results will be recorded on the stream sampling field data sheets (Attachment 3) and entered into the AIMS II database. A Winkler DO test will also be conducted at sites where the DO concentration is 4.0 mg/L or less.

Field Analysis Data

In-situ water chemistry field data are collected in the field using calibrated or standardized equipment. Calculations may be done in the field or later at the office. Analytical results, which have limited QC checks, are included in this category. Detection limits and ranges have been set for each analysis. Quality control checks (such as duplicate measurements, measurements of a secondary standard, or

measurements using a different test method or instrument) which are performed on field or laboratory data are usable for estimating precision, accuracy, and completeness for the project.

Bacteriological Sampling

Bacteriological samples will be analyzed using the SM 9223 Enzyme Substrate Coliform Test Method, see Table 3 for quantification limits. Samples will be collected using 120 mL pre-sterilized wide mouth containers and adhere to the six hour holding time. Analytical results from the IDEM *E. coli* Mobile Laboratory include QC check sample results from which precision, accuracy and completeness can be determined for each batch of samples. Raw data are archived by analytical batch for easy retrieval and review. Chain of custody procedures must be followed including time of collection, time of setup, time of reading the results, and time and method of disposal. Any method deviations will be thoroughly documented in the raw data. All QA/QC samples will be tested according to the following guidelines:

Field Duplicate: Field Duplicates will be collected at a frequency of 1 per batch or at least 1 for every 20 samples collected (≥ 5%).

Field Blank: Field Blanks will be collected at a frequency of 1 per batch or at least 1 for every 20 samples collected (≥ 5%).

Laboratory Blank: Laboratory Blanks (sterile laboratory water blanks) will be tested at a frequency of 1 per day.

Positive Control: Each lot of media will be tested for performance using bacterial cultures for positive *E. coli*.

Negative Controls: Each lot of media will be tested for performance using bacterial cultures for total coliform other than *E. coli* and a noncoliform.

Water Chemistry Data

Sample bottles and preservatives certified for purity will be used. Sample collection container for each parameter, preservative and holding times will adhere to meet U.S. EPA requirements. Field duplicates and matrix spike/matrix spike duplicates (MS/MSD) shall be collected at the rate of one per sample analysis set or one per every 20 samples, whichever is greater. Additionally, field blank samples will be taken at a rate of one set per sample analysis set or one per every 20 samples, whichever is greater.

Fish Community Data

Replicate fish community sampling will be performed at a rate of 10 percent of the total fish community sites sampled, approximately 4 in the basin (U.S. EPA 1995). Replicate

sampling will be performed once all initial sites have been sampled, with at least 2 weeks of recovery between the initial and replicate sampling events. The fish community replicate sampling and habitat assessment will be performed with either a partial or complete change in field team members (U.S. EPA 1994; U.S. EPA 1995). The resulting IBI and QHEI total score between the initial visit and the revisit will be used to evaluate precision. A chain of custody form is used to track samples from the field to the laboratory. Fish in the laboratory may be verified by regionally recognized non-IDEM freshwater fish taxonomists. All data are checked for:

1) completeness
2) calculations performed
3) data entered into the database
4) checked again for data entry errors.

Macroinvertebrate Community Data

Replicate macroinvertebrate field samples will be collected at every 10th site. This will result in a precision evaluation based on a 10% replicate of samples collected. Laboratory identifications and QA/QC of taxonomic work is maintained by the laboratory supervisor of the Probabilistic Monitoring Section of IDEM.

III. ASSESSMENT/OVERSIGHT: (QAPP Elements C1, C2)

Field and laboratory performance and system audits will be performed to ensure good quality data. The field and laboratory performance includes precision measurements by relative percent difference of field and laboratory duplicate, accuracy measurements by percent of recovery of MS/MSD samples analyzed in the laboratory, and completeness measurements by the percent of planned samples that are actually collected, analyzed, reported, and usable for the project.

Data Quality Assessment Levels

The samples and various types of data collected by this program are intended to meet different DQA Levels as cited in the QAPP for Indiana Surface Water Quality Monitoring Program, Revision 3 (IDEM 2004). The level of QA and the DQA Level to which the analytical data qualifies will be as follows:

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

limit calculations are included in this category. Primarily, onsite data are used for pre-surveys and for preliminary rapid assessment.

DQA Level 2 Field Analysis Data: Data are 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, which have limited QC checks, are included in this category. Detection limits and ranges have been set for each analysis. 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. Method detection limits (MDLs) have been determined using 40 Code of Federal Regulations (CFR) Part 136 Appendix B (CFR 2012). Additionally, all reporting information required in the laboratory contract, and in the IDEM Surface Water Quality Monitoring and TMDL QAPP, especially Table A9-1, are included in the analytical data reports. Raw data, chromatograms, spectrograms, and bench sheets are not included as part of the analytical report, but are maintained by the contract laboratory for easy retrieval and review. Data can be elevated from DQA Level 3 to DQA Level 4 by inclusion of this information in the data report and the QC data are reported using contract laboratory program (CLP) forms or CLP format. Data in this category are considered as complete, legally defensible, and used for regulatory decisions.

DQA Level 4 Enforcement Data: *Analytical results mostly meet the U.S. EPA required CLP data analysis, Contract Required Quantification Limits (CRQL), and validation procedures.* QC data are reported on CLP forms or CLP format. Raw data, chromatograms, spectrograms, and bench sheets are included as part of the analytical report. Additionally, all reporting information required in the laboratory contract, and in the *IDEM Surface Water Quality Monitoring Program and TMDL QAPP,* are included in the analytical data reports. Data falling under this category are considered as complete, legally quantitative in value, and used for regulatory decisions.

All samples collected for bacteriological and laboratory analysis for this project will adhere to DQA Level 3. All field parameters collected for this project will adhere to DQA Level 2. All of the sample data are QA/QC'd for completeness, precision, and accuracy.

IV. DATA VALIDATION AND USABILITY: (QAPP Element D1, D2)

Quality Assurance/Data Qualifiers and Flags:

The various data qualifiers and flags used for QA and validation of the data are outlined below in Table 5.

Table 5. Data Qualifiers and Flags

Flags	Description
R	**Rejected**. Result is not acceptable for use in decision making processes.
J	**Estimated**. The use of the result in decision making processes will be determined on **a case by case basis**.
U	**Between MDL and RL** -- The result of the parameter is **above** the Method Detection Limit (**MDL**) but **below** the Lab Reporting Limit (**RL**) and will be estimated.
Q	**QC Checks or Criteria** -- One or more of the QC checks or criteria is out of control
D	**RPD for Duplicates** -- The Relative Percent Difference (RPD) for a parameter is outside the acceptable control limits. The parameter will be considered estimated or rejected on the basis listed below: 1. If the Sample or Duplicate value is less than the RL, and the other value exceeds 5 times the MDL, then the sample will be **estimated**. 2. If the RPD is **outside** the established control limits (max. RPD) but **below** two times the established control limits (max. RPD), then the sample will be **estimated**. 3. If the RPD is **twice** the established control limits (max. RPD) or greater, then the sample will be **rejected**.

Flags	Description
B	**Blank Contamination** -- This parameter is found in a field or a lab blank. Whether the result is accepted, estimated, or rejected will be based upon the level of contamination listed below: 1. If the result of the sample **is greater than the reporting limit** but **less than five times** the blank contamination, the result will be **rejected**. 2. If the result of the sample is **between five and ten times** the blank contamination, the result will be **estimated**. 3. If the result of the sample is **less than the reporting limit** or **greater than ten times** the blank contamination, the result will be **accepted**.
H	**Holding Time --** The analysis for this parameter was performed out of the holding time. The results will be estimated or rejected on the basis listed below: 1. If the analysis was performed between the holding time limit and 1.5 times the holding time limit, the result will be **estimated.** 2. If the analysis was performed outside the 1.5 times the holding time limit, the result will be **rejected**.

Data Usability:

The environmental data collected and its usability are finally qualified and classified into one or more of the four Categories: Acceptable Data, Enforcement Capable Results, Estimated Data and Rejected Data.

- **Acceptable Data** are suitable for decision making and have no flagged data points.
- **Enforcement Capable Results** meets all QC checks and have no flagged data points.
- **Estimated Data** may be suitable for enforcement or decision making on a case by case basis.
- **Rejected Data** are not suitable for enforcement or for decision making.

Laboratory and Estimated Cost:

Laboratory analysis and data reporting for this project will comply with the QAPP for Indiana Surface Water Quality Monitoring and TMDL Program (IDEM/100/29/338/073/2004, see IDEM 2004), Request for Proposals (RFP) 12-48, and the Office of Water Quality Assessment Branch Quality Management Plan (B-001-

OWQ-A-00-08-R00, see IDEM 2008a). Analytical tests on the general chemistry and nutrient parameters outlined in Table 3 will be performed by Heritage Environmental at an estimated cost of $45,836. Supplies for the bacteriological sampling will come from IDEXX Laboratories, Inc., Westbrook, Maine with a total estimated cost for this project of $1,770. All macroinvertebrate samples will be collected and analyzed by IDEM staff.

Reference Manuals and Personnel Safety:

All staff who participates in the field component of this study are required to have completed Basic First Aid and Cardio-Pulmonary Resuscitation (CPR) training. According to the memorandum "Change in status of Water Assessment Branch staff in accordance with the Agency training policy" dated November 29, 2010, OWQ Watershed Assessment and Planning Branch staff are exempt from initial and annual training requirements set forth in Section 6.0 of the IDEM Health and Safety Training Policy (IDEM 2010b). The memorandum also states "as an alternative to the training requirements of the policy, the Branch will conduct in-service training at a minimum of four (4) hours per year on topics directly related to duties performed by staff." New hires or those changing job responsibilities without the minimum four hour training must be accompanied in the field by a staff member who has met the requirements of the Branch Health and Safety training.

Field personnel collecting water chemistry and bacteriological samples will follow policies and procedures established in the Surveys Section Field Procedures Manual (IDEM 2002) and the Hazardous Communication Plan Supplement (IDEM 1997). Field personnel collecting macroinvertebrate community samples must read and comply with the Biological Studies Section SOP Manual: Section II. Hazard Communications Manual (IDEM 1992e) which includes four, yellow, 3-ring binders consisting of 1) Safety Manual 2) Hazard Communication and SOP 3) Occupational Safety and Health Administration Handbooks 4) Material Safety Data Sheets as well as "Field and Laboratory Operating Procedures for use, handling and storage of chemicals in the laboratory" (Newhouse 1998a) and "Field and Laboratory Operating Procedures for Use, Handling, and Storage of Solutions Containing Formaldehyde" (Newhouse 1998b).

Sampling on surface waters requires safety consciousness of staff members and the use of specialized equipment; thus, staff will comply with the IDEM Personal Protective Equipment (PPE) Policy (IDEM2008b). If an injury or illness arises in the field, staff will follow the IDEM Injury and Illness Resulting from Occupational Exposure Policy (IDEM 2010c). Operating in and around waterbodies carries inherent risks of drowning; thus, personnel involved in sample collection will wear appropriate clothing and PPE when operating boats or sampling in deep water or swift currents. According to the memorandum "Use of Personal Flotation Devices (PFDs) by Branch Personnel" dated February 29, 2000, staff must wear U.S. Coast Guard approved Type I, II, or III PFDs whenever

- the planned work requires them to enter the water and the maximum water depth at any place at the work site is over their knee (note that this depth depends on the employee but it will usually be between 12 and 20 inches or 300-500 mm) or
- the employee is in a watercraft of any kind that is being launched, is in the water, or is being retrieved from the water or
- the employee must work from structures that do not possess guard rails and are over or alongside water where the water depth is or could reasonably be expected to be 3 feet.

Safety issues are the responsibility of all crew members; however, any questions in the field should be directed to the field crew leader. The field crew leader is responsible for the completion of all work listed in the workplan, the health and safety aspects of the sampling event, and successful interactions with landowners and members of the public.

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Attachment 1. Modified Geometric Design Steps for Baseline Studies

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Introduction

A relatively new design that has recently been implemented in Indiana is termed the Geometric Site Selection process. This design is employed within watersheds that correspond to the 12-14 digit HUC scale in order to fulfill multiple water quality management objectives in addition to the conventional focus on status assessment. It is employed at a spatial scale that is representative of the scale at which watershed management is generally being conducted. Sites within the watershed are allocated based on a geometric progression of drainage areas starting with the area at the mouth of the main stem river or stream (pour point) and working “upwards” through the various tributaries to the primary headwaters. This approach allocates sampling sites in a semi-random fashion and according to the stratification of available stream and river sizes based on drainage area. It is then supplemented by a targeted selection of additional sampling sites that are used to focus on localized management issues such as point source discharges, habitat modifications, and other potential impacts within a watershed. This design also fosters data analysis that takes into consideration overlying natural and human caused influences within the streams of a watershed. The design has been particularly useful for watersheds that are targeted for TMDL development in that unassessed waters and incomplete or outdated assessments can be addressed prior to TMDL development.

Selection Process

In ArcGIS, download from NHD Plus site (http://www.horizon-systems.com/nhdplus/HSC-wthMS.php) the following files for Region 5 (and then again for Region 7) and zip into appropriate file structure

File Description	File Name (.zip***)	Format
Region 05, Version 01_01, Catchment Grid	NHDPlus05V01_01_Catgrid	ESRI Grid
Region 05, Version 01_01, Catchment Shapefile	NHDPlus05V01_01_Catshape	Shapefile
Region 05, Version 01_02, Catchment Flowline Attributes	NHDPlus05V01_02_Cat_Flowline_Attr	DBF
Region 05, Version 01_02, Elevation Unit a	NHDPlus05V01_02_Elev_Unit_a	ESRI Grid
Region 05, Version 01_02, Elevation Unit b	NHDPlus05V01_02_Elev_Unit_b	ESRI Grid
Region 05, Version 01_02, Elevation Unit c	NHDPlus05V01_02_Elev_Unit_c	ESRI Grid
Region 05, Version 01_01, Flow Accumulation and Flow Direction Unit a	NHDPlus05V01_01_FAC_FDR_Unit_a	ESRI Grid
Region 05, Version 01_01, Flow Accumulation and Flow Direction Unit b	NHDPlus05V01_01_FAC_FDR_Unit_b	ESRI Grid
Region 05, Version 01_01, Flow Accumulation and Flow Direction Unit c	NHDPlus05V01_01_FAC_FDR_Unit_c	ESRI Grid
Region 05, Version 01_02, National Hydrography Dataset	NHDPlus05V01_03_NHD	Shapefile and DBF
Region 05, Version 01_01, Stream Gage Events	NHDPlus05V01_01_StreamGageEvent	Shapefile
Region 05, Version 01_01, QAQC Sinks Spreadsheet	NHDPlus05V01_01_QAQC_Sinks	Excel Spreadsheet

Create new point shapefile (or geodatabase featureclass) named Geometric Design within ArcCatalog with the same projection as the unzipped layers above

Within an ArcMap project add the; nhdflowline layer, Geometric Design layer, catchment shapefile, and the FlowlineAttributesFlow table.

Add the following fields to the nhdflowline layer:

LENGTHMi (type: double, precision: 9, scale 4)
DrainMi (type: double, precision: 9, scale 4)
MinElev (type: double, precision: 9, scale 4)
MaxElev (type: double, precision: 9, scale 4)

Gradient (type: double, precision: 9, scale 4)

Add the following field to the GeometricDesign layer (use add field-batch tool):

Geometric (type: double, precision: 5, scale 2)
Lat (type: double, precision: 8, scale 5)
Long (type: double, precision: 8, scale 5)
COMID (type: long, precision: 9)

Join the nhdflowline layer with the FlowlineAttributesFlow table based on the COMID field

Use the field calculator within the nhdflowline attribute table, with the appropriate metric to imperial conversion to populate LENGTHMi (from LENGTHKM – kilometers to miles), DrainMia (from CumDrainage – square kilometers to square miles), MinElev (from MinElevSmo – meters to feet), MaxElev (from MaxElevSmo – meters to feet), and Gradient ((MaxElev-MinElev)/LENGTHMI).

Unjoin FlowlineAttributesFlow table.

Label "nhdflowline" layer based new "LengthMi" field – note: this field shows the cumulative drainage at the *end* of the line segment, which rarely is more than 2-3 miles in between nodes.

Calculate the geometric break points (i.e. for a 500sq mi watershed; 500, 250, 125, 62.5, 31, 15, 7, 4, 2).

It is recommended to change the symbology (Symbology: Show Quantities: Classification (Manual)) of the actual flowline to reflect the drainage. This will help identify when and where sites need to be allocated.

Start a new editing session, with the GeometricDesign layer as your target layer.

Add a new point within this layer to the pour point for the watershed (500sq mi in this case)

Travel upstream through the mainstem and "find" the next place on the stream where the river drainage brackets 250sq mi. Use the catchment shapefile layer to identify more precisely the drainage value if needed.

Populate the "Geometric" field within the GeometricDesign layer accordingly to the indentified drainage level, then change the symbology (Symbology: Categories: Unique Values: Geometric field) of this layer to reflect the drainage levels.

Proceed through the watershed (either around the outer portions or start with largest values and work in), adding points accordingly to each geometric level. Change the symbology to find areas or levels that were missed. Note – the drainage level must be exact. Use catchment shapefile to subtract drainage areas from larger drainage areas until the exact drainage level is reached. It is ok to "skip" a geometric level if it is not exactly reached. Sometimes there are large tributaries whose contribution to the mainstem skips a drainage level.

Populate the COMID (manually), and Lat/Long (right click on field and select calculate geometry – lat = x-coordinates and long = y-coordinates) accordingly for reference within the GeometricDesign Layer

Once sites are selected in this fashion they will need to be snapped to a bridge or access point.

Additional sites should be placed at pour points of subwatersheds (12-digit HUCs) to meet TMDL document requirements.

Once the initial sites are selected the following features are taken into account to move or add sites:

Permitted facilities

Urban areas

Historical sampling sites

Assessment Unit IDs (AUID)

External stakeholder information

Resources - maximum of 35 sites per project

After refining site selections there may be additional sites added to ensure spatial representation of project area.

Sites may be removed or changed after site reconnaissance if there are problems accessing the site or if sites are dry.

Notes regarding the NHD dataset:

All units are initially set to metric and need to be converted to imperial accordingly

Within the nhdflowline layer, the GNIS_Name/ID refers to the whole river name and ID, while the COMID is a unique identifier for the particular segment

There is *not* a value GNIS_Name/ID for every river, especially where primary streams and ditches are concerned.

Segments within the nhdflowline layer are based on linear miles between "nodes" which are broken up (typically) by tributary. Typically these lengths are < 2-3 miles.

The cumulative drainage values in the NHD dataset have been compared against other and deemed "reasonable" (read – not statistically compared). Also note that the drainage is calculated through the model to be at the pour point of that segment

However, the elevation values are **not** reliable and require supervision. These values are calculated from the associated DEM and sometimes have null values for either max or min. In addition the length of stream is not long enough (i.e. >1 mile) to calculate gradient. In either case this associated value is helpful to identify contour changes against a USGS contour map. However, to note the calculated gradient from the NHD information has been observed to be within several tenths of mile compared to a manual calculation of gradient.

Important tables from NHD

FlowlineAttributesFlow (found in: Region 05, Version 01_02, Catchment Flowline Attributes)

Key fields: CumDrainag, Max ElevRaw, MinElevSmo,

Important Layers from NHD

Region 05, Version 01_01, Catchment Shapefile

Region 05, Version 01_02, National Hydrography Dataset

Attachment 2: Stressor Identification Process

I. Documented IBCs, IBC/QHEIs, or Non-IBC Impairments

A. 303(d) List

B. First Year Studies

C. Special Requests

II. In-House Data Gathering on Each Impairment

A. Produce Maps

B. Assessment Branch Data

1. Surveys Section Data
2. Biological Studies Section Data
3. AIMS Data
4. Flow Data
5. Climate Data

C. NPDES Point Source Information

D. County Offices Within Watershed

1. County Surveyor
2. County Health Department
3. Soil and Water Conservation District

E. Other Potential Sources

1. IDEM Watershed Group
2. IDEM Wetlands Staff
3. IDNR Contact for Dredge/Fill Permits
4. Purdue Landuse Website
5. NASS Reports
6. NRCS Projects in the Watershed
7. Hoosier River Watchers
8. The Nature Conservancy
9. Internet Searches

III. Site Visit for Ground Truthing if Needed

IV. List Candidate Causes Based on Available Information

V. Analyze Causes Using Four Associations

A. Associations Between Measurements of Candidate Causes and Effects- measurements of candidate causes and effects from the site. The objective is to provide evidence that the candidate cause and the effect are observed at the same time or place and, conversely, that when the candidate cause is not observed, the effect also is not observed. This association can also show the intensity of the causal factor and relation to the magnitude of effect.

1. Spatial Co-occurrence-

    a. Effects are occurring at the same place as exposure.

    b. Effects do not occur where there is no exposure

    c. For candidates with discrete sources on streams and rivers

        1. Effects occur downstream of a source.

        2. Effects do not occur upstream of a source

    d. For candidates with dispersed or regional sources- effects occur where there is exposure but not at carefully matched reference sites where exposure does not occur.

2. Spatial Gradient- Effects decline as exposure declines over space.

3. Temporal Relationship-

    a. Exposure precedes effects in time.

    b Effects are occurring simultaneously with exposure (allowing for lags in re-sponse and recovery).

c. Intermittent sources are associated with intermittent exposure and effects.

4. Temporal Gradient- Effects increase or decline as exposure increases or declines over time.

B. Associating Effects With Site Exposures Using Effects Data From Elsewhere- Measures of exposure from the case at hand can also be matched with measures of effect from other situations. The objective here is to provide evidence that the cause is present in sufficient quantity or frequency at the site so that effects would be based on information from, field tests, or exposure-response relationships developed at other sites.

C. Measurements Associated With the Causal Mechanism- Intermediate steps in the causal process that may be observed or measured. This evidence is useful

when the ultimate effects of multiple candidate causes are similar but when those candidate causes act through different mechanistic pathways. Not practical for our program.

D. Associations of Effects Mitigation With Manipulation of Causes- When effects are diminished after a candidate cause is eliminated or reduced, that provides strong causal evidence. Not practical for our program.

VI. Characterize Causes

A. Eliminate Alternatives- A strong standard of proof when all alternatives but one have been eliminated.

B. Diagnostic Analysis- Whereas the elimination step relies on negative evidence (e.g. and exposure pathway is not present), diagnostic protocols use positive evidence (e.g., a particular symptom is present).Most of the evidence comes from measurements associated with the causal mechanism itself.

C. Strength of Evidence- If candidate causes are not subject to diagnosis, one must compare the strength of evidence for each of the candidate causes. This step is more useful than elimination of alternatives in cases with many candidate causes or when the evidence is ambiguous. Causal considerations are standard logical categories of evidence that would tend to support or to refute a hypothesized cause.

1. Considerations Derived From the Case Itself- Form the strongest basis for causal inference

    a. Co-occurrence- The spatial co-location of the candidate cause and effect.

    b. Temporality- A cause must always precede its effects.

    c. Biological Gradient- The effect should increase with increasing magnitude or duration of exposure.

    d. Complete Exposure Pathway-An exposure pathway is the physical course that a stressor takes from the source to the receptor organisms or communities of interest.

2. Considerations That Can Be Based on the Case At Hand or Drawn From Similar Situations

    a. Consistency of association- Consistency of association refers to the repeated observation of the effect and candidate cause in different places or times.

    b. Experiment- This causal consideration refers to manipulation of a cause by eliminating a source or by altering exposure.

3. Considerations That Combine Information From the Case At Hand With Experience From Other Cases or Test Situations or From Knowledge of Biological, Physical, and Chemical Mechanisms

    a. Plausibility- The degree to which a cause-and-effect relationship would be expected, given the known facts.

        1. Mechanistic plausibility-Given what is known about the biology, physics, and chemistry of the candidate cause, the receiving environment, and the affected organisms, is it plausible that the effect resulted from the cause.

        2. Stressor-response plausibility, given a known relationship between the candidate cause and the effect, would effects be expected at the level of the stressor seen in the environment.

    b. Analogy- Is the hypothesized relationship between cause and effect similar to any well-established cases?

    c. Specificity of Cause-This consideration is applicable only if the proposed cause is plausible or has been consistently associated with the effect at other sites.

    d. Predictive Performance-Does the candidate cause have any initially unobserved properties that were predicted to occur? Was the prediction confirmed at the site? The ability to make and confirm predictions is one of the hallmarks of a good scientific hypothesis.

4. Evaluation of The Relationships Among All The Available Lines of Evidence

    a. Consistency of Evidence-Is the hypothesized relationship between cause and effect consistent with all the available evidence? The strength of this consideration increases with the number of lines of evidence.

    b. Coherence of Evidence- Does a mechanistic conceptual or mathematical model explain any apparent inconsistencies among the lines of evidence?

Attachment 3: Blank Stream Sampling Field Data Sheet

IDEM 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 ☐ Run ☐ Pool ☐ Glide	☐ Dry ☐ Stagnant ☐ Flood ☐ Eddy ☐ Other	☐ Clear ☐ Green ☐ Sheen ☐ Murky ☐ Black ☐ Other ☐ Brown ☐ Gray (Septic/Sewage)	☐ 0-20% ☐ 60-80% ☐ 20-40% ☐ 80-100% ☐ 40-60%
☐ No; Stream Dry ☐ No; Other	☐ 8 ☐ 12 ☐ 24 ☐ 48 ☐ 72 ☐ All-Flow			
☐ No; Owner refused Access				

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
CrS	ChromiumVI(1636): NaOH	250T	250mL Teflon
MeHg	Methyl Mercury(1630): HCl	500T	500mL Teflon
		125T	125mL Teflon

Data Entered By: _____ QC1: _____
QC2: _____

Stream Sampling Field Data Sheet

Attachment 4: Blank OWQ Biological Studies QHEI (Qualitative Habitat Evaluation Index) form (front)

OWQ Biological Studies 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; estimate % and check every type present

BEST TYPES

PREDOMINANT P	R		PRESENT P	R	TOTAL %
☐	☐	BLDR/SLABS [10]	☐	☐	____
☐	☐	BOULDER [9]	☐	☐	____
☐	☐	COBBLE [8]	☐	☐	____
☐	☐	GRAVEL [7]	☐	☐	____
☐	☐	SAND [6]	☐	☐	____
☐	☐	BEDROCK [5]	☐	☐	____

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

OTHER TYPES

PREDOMINANT P	R		PRESENT P	R	TOTAL %
☐	☐	HARDPAN [4]	☐	☐	____
☐	☐	DETRITUS [3]	☐	☐	____
☐	☐	MUCK [2]	☐	☐	____
☐	☐	SILT [2]	☐	☐	____
☐	☐	ARTIFICIAL [0]	☐	☐	____

(Score natural substrates; ignore sludge from point-sources)

ORIGIN Check ONE (Or 2 & average)

☐ 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 and estimate percent: **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.)

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

AMOUNT Check ONE (Or 2 & average)

☐ EXTENSIVE > 75% [11]
☐ MODERATE 25 - 75% [7]
☐ SPARSE 5 - < 25% [3]
☐ NEARLY ABSENT < 5% [1]

Cover Maximum 20

Comments

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

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

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

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

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

Channel Maximum 20

Comments

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

River right looking downstream

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

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

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

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

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

Riparian Maximum 10

Comments

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

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

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 (Circle 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 Check ONE (Or 2 & average)
☐ BEST AREAS > 10cm [2]
☐ BEST AREAS 5 - 10cm [1]
☐ BEST AREAS < 5cm [metric = 0]

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

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

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

Riffle/ Run Maximum 8

Comments

6] *GRADIENT* (ft/mi)

DRAINAGE AREA (mi^2)

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

%POOL: ____ %GLIDE: ____
%RUN: ____ %RIFFLE: ____

Gradient Maximum 10

IDEM 07/06/10

OWQ Biological Studies 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

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

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

Stream Drawing:

IDEM 07/06/10

Blank OWQ Biological Studies QHEI (Qualitative Habitat Evaluation Index) form (back)

Attachment 5: Macroinvertebrate Header form

OWQ/WAPB Macroinvertebrate Community Assessment
Macroinvertebrate Header

Sample #	Macro Event #	Macro Sample Type	# Containers
		☐ Black Light ☐ Kick	
Site Name	EPA ID	☐ Qualitative ☐ CPOM	
		☐ Hester-Dendy ☑ MHAB	

NOTES

Stream Name / Location	County	Sample Date

☐ Habitat Complete ☐ Sample Quality Rejected

Riparian Zone/Instream Features

Watershed	
Erosion	NPS Pollution
☐ None	☐ No Evidence
☐ Moderate	☐ Some Potential Sources
☐ Heavy	☐ Obvious Sources

Stream Depth		
Riffle	Run	Pool

Distances	
Riffle-Riffle	Bend-Bend

Predominant Surrounding Land Use
☐ Forest ☐ Residential
☐ Field/Pasture ☐ Commercial
☐ Agricultural ☐ Industrial
Other
☐ Channelization ☐ Dam Present

Stream Width	High Water Mark	Velocity	Canopy Cover (% Open)

Sediment

Sediment Odors: ☐ Normal ☐ Sewage ☐ Petroleum ☐ Chemical ☐ Anaerobic ☐ None Other
Sediment Deposits: ☐ Sludge ☐ Sawdust ☐ Paper Fiber ☐ Sand ☐ Relic Shells Other
Sediment Oils: ☐ Absent ☐ Moderate ☐ Slight ☐ Profuse
☐ Are the undersides of stones, which are not deeply embedded, black?

Substrate Components

(Note: Select From 0%, 20%, 40%, 60%, 80%, or 100% for each inorganic and organic substrate component)

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

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

Water Quality

Water Odors: ☐ Normal ☐ Sewage ☐ Petroleum ☐ Chemical ☐ None
Water Surface Oils: ☐ Slick ☐ Sheen ☐ Globs ☐ Flocks ☐ None
Stream Type: ☐ Warm ☐ Cold
Barometer
Turbidity (Estimated): ☐ Clear ☐ Slightly Turbid ☐ Turbid ☐ Opaque
Salinity
ORP
Other

Instruments Used for:

Water Temp	DO	pH	Specific Conductivity

7/26/2013 9:49:11 AM OWQ Biological Studies Macroinvertebrate Header Report, Page 1 of 1

Attachment 6, Fish Collection Data Sheet

IDEM

Fish Collection Data Sheet

Analysis Set #	Rank

Sample #:		Stream Name:				EPA Site ID:	
Site #:		Site Description:					

EventID	Equipment Used	Voltage	Time At Site (hh:mm)	Time Fished (sec)	Distance Fished (m)	Water Depth (m) Max.	Water Depth (m) Avg.	Museum Data	
								Initials	ID Date

Avg. Stream Width (m)	Voucher Jars	Unknown Jars	Bridge In Reach?	Is Reach Representative?	Why Is Reach Not Representative?	Special Comments		
			☐	☐			Jar Count	Fish Total

Coding for Anomalies:
D – deformities: E – eroded fins: L – lesion: T – tumor: M – multiple DELT anomalies: AW – anchor worm: LE – leeches: SS – swirled scales: PO – popeye: EM – emaciated: FU – fungus: PA - parasites

Species		Physical Characteristics					Anomalies						
		Weight (g)					D	E	L	T	M	AW	LE
Fish Detail#:		Total	Min	Max	Mean								
Museum Total	Total Fish	Length (mm)			Age (yrs)		SS	PO	EM	FU	PA	Other Anomaly	
		Min	Max	Mean	Min	Max							

Species		Physical Characteristics					Anomalies						
		Weight (g)					D	E	L	T	M	AW	LE
Fish Detail#:		Total	Min	Max	Mean								
Museum Total	Total Fish	Length (mm)			Age (yrs)		SS	PO	EM	FU	PA	Other Anomaly	
		Min	Max	Mean	Min	Max							

Species		Physical Characteristics					Anomalies						
		Weight (g)					D	E	L	T	M	AW	LE
Fish Detail#:		Total	Min	Max	Mean								
Museum Total	Total Fish	Length (mm)			Age (yrs)		SS	PO	EM	FU	PA	Other Anomaly	
		Min	Max	Mean	Min	Max							

Species		Physical Characteristics					Anomalies						
		Weight (g)					D	E	L	T	M	AW	LE
Fish Detail#:		Total	Min	Max	Mean								
Museum Total	Total Fish	Length (mm)			Age (yrs)		SS	PO	EM	FU	PA	Other Anomaly	
		Min	Max	Mean	Min	Max							

Species		Physical Characteristics					Anomalies						
		Weight (g)					D	E	L	T	M	AW	LE
Fish Detail#:		Total	Min	Max	Mean								
Museum Total	Total Fish	Length (mm)			Age (yrs)		SS	PO	EM	FU	PA	Other Anomaly	
		Min	Max	Mean	Min	Max							

Species		Physical Characteristics					Anomalies						
		Weight (g)					D	E	L	T	M	AW	LE
Fish Detail#:		Total	Min	Max	Mean								
Museum Total	Total Fish	Length (mm)			Age (yrs)		SS	PO	EM	FU	PA	Other Anomaly	
		Min	Max	Mean	Min	Max							

OWQ Assessment Branch Biological Studies Section: Fish Collection Data Sheet,

Attachment 7, Chain of Custody Form

Indiana Department of Environmental Management
OWQ Chain of Custody Form

Project: _____
Team: _____
OWQ Analysis Set: _____

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

Signature: _____ Section: _____

Lab Assigned Number	IDEM Control Number	Sample Type	ID	1000 ml P, N, BA.	1000 ml G, N, M.	40 ml VIAL	120 ml G (Back)	250 ml P, N, BA.	250 ml P, N, BA.			Date And Time Collected	
												Date	Time

P = Plastic G = Glass N. M. = Narrow Mouth Bact = Bacteriological Only Should samples be iced? Y N

Carriers

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

Signature	Date	Time	Seals Intact		Comments
Relinquished By:					
Received By:			Y	N	
Relinquished By:					
Received By:			Y	N	
Relinquished By:					
Received By:			Y	N	

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: _____

04/17/2003 12:31:20 PM 04/17/2003 12:31:20 PM Fixed Station Chain of Custody Datasheet, Page 1 of 1

Attachment 8. Sample Analysis Request form.

Indiana Department of Environmental Management
Office of Water Quality
Watershed Planning and Assessment Branch
www.idem.IN.gov

Water Sample Analysis Request

Project Name: 2013 Deep River Baseline Monitoring **Composite ☐ Grab ☒**

OWQ Sample Set	13BLW	IDEM Sample Nos.	
Crew Chief		Lab Sample Nos.	
Collection Date		Lab Delivery Date	

Anions and Physical Parameters

Parameter	Test Method	Total	Dissolved
Alkalinity	310.2	☒ **	☐
Total Solids	SM2540B	☒ **	
Suspended Solids	SM2540D	☒ **	
Dissolved Solids	SM2540C		☒ **
Sulfate	300.0	☐ **	☒ **
Chloride	300.0	☒ **	☐
Hardness (Calculated)	SM-2340B	☒ **	☐
Fluoride	SM4500-F-C	☐ **	☐

Priority Pollutant Metals Water Parameters

Parameter	Test Method	Total	Dissolved
Antimony	200.8	☐	☐
Arsenic	200.8	☐	☐
Beryllium	200.8	☐	☐
Cadmium	200.8	☐	☐
Chromium	200.8	☐	☐
Copper	200.8	☐	☐
Lead	200.8	☐	☐
Mercury, Low Level	1631, Rev E.	☐	☐
Nickel	200.8	☐	☐
Selenium	200.8	☐	☐
Silver	200.8	☐	☐
Thallium	200.8	☐	☐
Zinc	200.8	☐	☐

Cations and Secondary Metals Parameters

Parameter	Test Method	Total	Dissolved
Aluminum	200.7, 200.8	☐	☐
Barium	200.8	☐	☐
Boron	200.8	☐	☐
Calcium	200.7, 200.8	☒ ***	☐
Cobalt	200.8	☐	☐
Iron	200.7	☐	☐
Magnesium	200.7, 200.8	☒ ***	☐
Manganese	200.8	☐	☐
Sodium	200.7	☐	☐
Silica, Total Reactive	200.7	☐	☐
Strontium	200.8	☐	☐

Send reports (Fed. Ex. or UPS) to:
Tim Bowren - IDEM
Mail Code 65-40-2 (Shadeland)
100 N. Senate Ave.
Indianapolis, IN 46204-2251

Deliver reports to:
Tim Bowren - IDEM
STE 100
2525 North Shadeland Ave.
Indianapolis, IN 46219

Organic Water Parameters

Parameter	Test Method	Total
Priority Pollutants: Oranochlorine Pesticides and PCBs	608	☐
Priority Pollutants: VOCs - Purgeable Organics	624	☐
Priority Pollutants: Base/Neutral Extractables	625	☐
Priority Pollutants: Acid Extractables	625	☐
Phenolics, 4AAP	420.4	☐
Oil and Grease, Total	1664A	☐

Nutrient & Organic Water Chemistry Parameters

Parameter	Test Method	Total	Dissolved
Ammonia Nitrogen	SM4500NH3-G	☒	☐
$CBOD_5$	SM5210B	☐	
Total Kjeldahl Nitrogen (TKN)	SM4500N(Org)	☒	☐
Nitrate + Nitrite	353.2	☒	☐
Total Phosphorus	365.1	☒	☐
TOC	SM 5310C	☒	☐
COD	410.4	☒	☐
Cyanide (Total)	335.4	☐	☐
Cyanide (Free)	SM4500CN-I	☐ *	☐
Cyanide (Amenable)	SM4500CN-G	☐ *	☐
Sulfide, Total	376.2	☐	☐

RFP 12-48 Contract Number:	A305-3-1 (HES) PO # 0013533597 (HES)

30 day reporting time required.

Notes:
** = **DO NOT RUN PARAMETER IF SAMPLE IDENTIFIED AS A BLANK ON THE CHAIN OF CUSTODY**
* = **RUN ONLY IF TOTAL CYANIDE IS DETECTED**
*** = *Report Calcium, Magnesium as Total Hardness components*

Testing Laboratory: Heritage Environmental
Attn: Greg Busch
Phone: 317-390-3182 7901 W. Morris St.
Indianapolis, IN 46231

Attachment 9, Biological Samples Chain of Custody Form

IDEM

INDIANA DEPARTMENT OF
ENVIRONMENTAL MANAGEMENT
OFFICE OF WATER QUALITY
BIOLOGICAL STUDIES SECTION

BIOLOGICAL SAMPLES FIELD CHAIN OF CUSTODY

I certify that the sample(s) listed below was/were collected by me or in my presence.

Signature:

Date: ____/____/____

Sample Type:
(ie. fish, macro, algae)

EVENT ID (YY___)/ MACRO # (9 DIGIT)	IDEM SAMPLE # (AB_____)	2000mL Nalgene	250mL Nalgene	125mL Glass	Type (AD or AS)	Volume (mL)	COLLECTED Date (mm/dd/yyyy)	COLLECTED Time (24 hr)	PLACED IN STORAGE Date (mm/dd/yyyy)	PLACED IN STORAGE Time (24 hr)	Storage Room #	Check line for sample present and accounted for! One check per bottle.
								:		:		
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SIGNATURE	DATE AND TIME	Comments:
RELINQUISHED BY:	/ /	
RECEIVED BY:	:	
RELINQUISHED BY:	/ /	
RECEIVED BY:	:	

Lab Custodian

I certify that I received the above sample(s) and is/are recorded in the official record book. The same samples will be in custody of competent laboratory personnel at all times or locked in a secure area.

Signature: ______________________________ Date: / / Time: :

Lab: Indiana Department of Environmental Management | Address: 2525 N. Shadeland Ave., Indianapolis, IN 46219