

Midwest Biodiversity Institute
Center for Applied Bioassessment and Biocriteria



West Branch DuPage River

**Quality Assurance Project Plan: Biological and Water Quality
Assessment of the DuPage and Salt Creek Watersheds**

DuPage and Cook Counties, Illinois

DuPage River-Salt Creek Workgroup
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Naperville, IL 60565

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Effective Date: July 1, 2006

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Introduction

Illinois EPA requires the development of a Quality Assurance Project Plan (QAPP) for any activity involving the collection and analysis of environmental data. A QAPP presents the policies and procedures, organization, objectives, quality assurance requirements, and quality control activities designed to achieve the type and quality of environmental data necessary to support project or program objectives. It is the policy of Illinois EPA that no data collection or analyses will occur without an approved QAPP or equivalent documentation, per the agency Quality Management Plan (QMP). All in-house and external environmental data collection activities are subject to this requirement. All contracts must address quality assurance requirements (e.g., data quality and reporting requirements) when those contracts pertain to, or have an impact on, data collection or analysis activities. Additionally, all grants and contracts need to address quality assurance requirements specified in applicable state acquisition or procurement regulations. The DuPage-Salt Creek QAPP presented herein follows U.S. EPA guidance for the development of a project specific QAPP.

Group A: Project Management Elements

A.3: Distribution List

The proposed project is of interest and potential use to Illinois state agencies and non-governmental organizations, each with specific interests in the protection and restoration of aquatic ecosystems. The following agency staff are recognized as technical advisers given their regional and/or statewide knowledge and expertise:

Illinois EPA, Roy Smogor, Springfield
Illinois EPA, Howard Essig, DesPlaines
Illinois DNR, Steve Pescitelli, Plano

In addition, the following entities will also be included in the distribution list as follows:

DuPage River-Salt Creek Working Group (all members)
Forest Preserve District of DuPage Co.
Forest Preserve District of Cook Co.
Metropolitan Water Reclamation District
DuPage Co. Sewer Districts and Municipalities

A.4: Project/Task Organization

All phases of the proposed study will be coordinated and overseen by the Midwest Biodiversity Institute. Chris O. Yoder will serve as the principal investigator and project coordinator. In this capacity he will provide the primary oversight and management of all aspects of the project, including direct oversight of field sampling and laboratory

procedures thus ensuring that all methods and procedures are followed. He will also be directly responsible for maintenance of the QAPP through the project period of July 1, 2006 through June 30, 2008. A functional table of organization appears in Figure 1.

Quality Assurance Project Plan: Functional Table of Organization

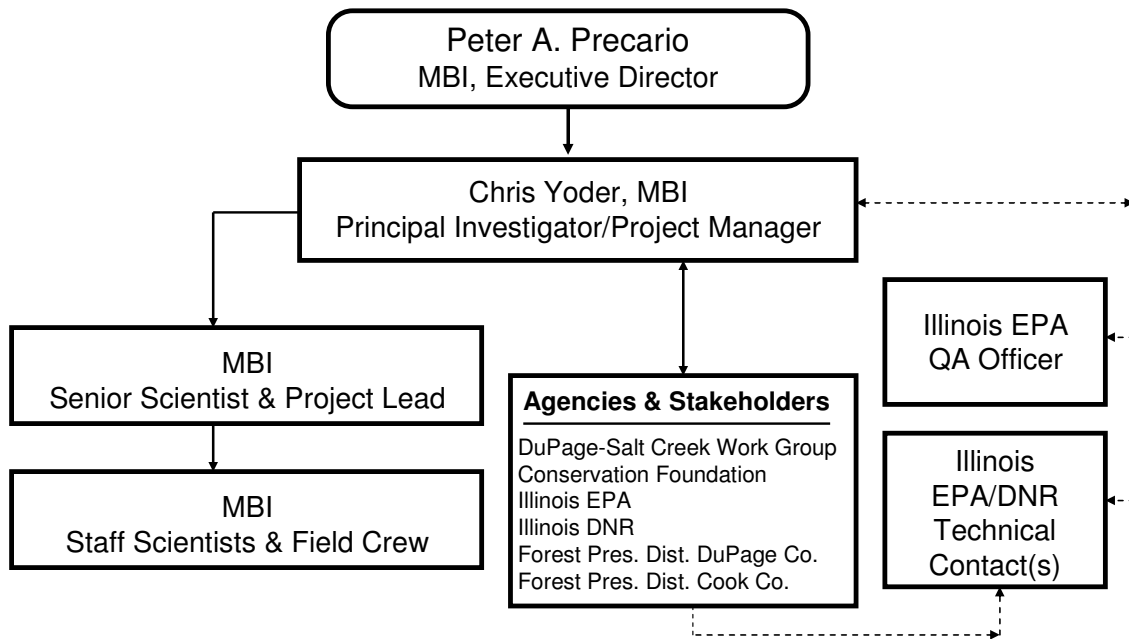


Figure 1. Functional table of organization for project implementation and management.

Advice and assistance with the design of the proposed study has been sought and will continue to be provided by members of the DuPage-Salt Creek watershed group and Illinois EPA and DNR. Each agency and organization will benefit from the data and analyses produced by the proposed study as it affects key water quality management issues such as NPDES permitting, stormwater management, TMDL development and assessment, and standards setting. Users of this study will benefit from the results and how it relates to the development of water quality and biological criteria that are protective of the indigenous aquatic fauna.

A.5: Problem Definition and Background

The proposed study will document the existing status of the rivers and streams in the watersheds of the DuPage and Salt Creek watersheds within DuPage County and Cook County, Illinois. The study will emphasize the direct assessment of biological assemblages

by sampling fish and macroinvertebrates using standardized sampling and watershed assessment methodologies. In addition to determining status, the project will also ascertain the associated causes and sources associated with biological impairments by using allied chemical, physical, and other stressor data and information within a systematic analytical process detailed in a comprehensive plan of study (Appendix A).

A.6: Project Description

This study will be performed in the DuPage and Salt Creek subbasins located in the northeastern region of Illinois and in accordance with the bioassessment plan (Appendix A) and the MBI project proposal (Appendix B). Biological sampling will consist of utilizing two assemblages, fish and macroinvertebrates. The biological assessment plan specifies the methods and equipment that will be used in different sizes of streams in the study area. Table 1 shows a general breakdown of sites in accordance with the application of the different fish and macroinvertebrate field methods described in the biological assessment plan. These estimates are based on the anticipated application of the specific protocols that will likely be used – some adjustments may be required based on the pre-survey reconnaissance and during sampling. A Qualitative Habitat Evaluation Index (QHEI) will be collected at each fish sampling site and will be completed by the crew leader (Appendix C). Field chemical/physical parameters will be collected using a commercially available field meter capable of measuring temperature, dissolved oxygen (D.O.), conductivity, and pH. Biological laboratory methods will also follow the assigned methods and will include fish voucher verification and macroinvertebrate taxonomy to the lowest practicable level as specified by the request for proposals. All habitat and biological assessment methods and their specifications are described in detail in Appendices C-G.

A.7: Quality Objectives and Criteria

The accuracy and precision of the biological assessments are a product of the congruence of methods and their execution. Biological assemblage data typified by this study has been previously documented by Ohio EPA (Ohio EPA 1989, Rankin and Yoder 1990, Fore et al. 1993). These types of methods have been shown to minimize variability in assessment results, sources of variability are known and controlled, and because we wish the results to be directly applicable to Illinois EPA, DNR, and other organizations. An important goal of bioassessment programs is to employ methods and equipment which are sufficiently effective so as to produce a sufficiently representative sample (accuracy), ensure reproducibility (precision), do so with a reasonable effort (cost-effective), and minimize potential bias induced by different operators (variability), thus making the results of the assessment comparable.

Data Attributes - Fish Assemblage:

The basic attributes of the data are counts and weights of fish delineated either individually or in the aggregate by species. Species level taxonomy is the minimum data quality objective and identifications to subspecies will be determined when appropriate. Scientific nomenclature will follow that adopted by the American Fisheries Society (AFS; Nelson et al. 2004). The historical and spatial distribution of the Illinois ichthyofauna and taxonomy

is well described in Smith (1979). Information will also be recorded about the occurrence of external anomalies, diseases, parasites, and other abnormalities that are observed on each fish that is weighed and or counted following the methods used by Ohio EPA (1989) and further described by Sanders et al. (1999). Qualitative habitat data will also be produced at each fish sampling location using the methodology originally developed by Rankin (1989, 1995; Appendix C). This includes the characterization and categorization

Table 1. Estimate of the stratification of fish and macroinvertebrate sampling sites by method and protocol for each major basin in the DuPage-Salt Creek watershed study area. Fish sites are expressed as number of samples with two sampling passes at boat and tow barge sites; single pass sampling will be performed at longline and backpack sites.

Assemblage Method (hrs./site)	West Branch 2006		East Branch 2007		Salt Creek 2007		Reference 2006- 2007		Total Sites	Total Hours
	Sites	Total Hours WB	Sites	Total Hours EB	Sites	Total Hours SC	Total Hours Ref.			
Fish - Boat Tow										
Barge (6 hrs.)	28	168	20	120	46	276	10	60	104	624
Longline (3 hrs.)	18	54	9	27	11	33	5	15	43	129
Backpack (3 hrs.)	13	39	17	51	19	57			49	147
Totals	59	261	46	198	76	366	15	75	196	900
Macroinvertebrates										
Multi-Habitat (4 hrs.)	32	128	19	76	34	136	10	40	95	380
Qual./MAIS (2 hrs.)	13	26	17	34	19	38	5	10	54	108
Totals	45	154	36	110	53	174	15	50	149	488

of habitat attributes including substrate types and quality, cover types and extent, channel morphology and modification, riparian and bank composition and condition, pool-run-riffle quality and extent, and local gradient.

Data Attributes - Macroinvertebrate Assemblage:

The basic attributes of the macroinvertebrate data to be produced by the proposed study are counts of each taxa identified to the lowest taxonomic level that is practical for most orders and families. All samples will be processed in the laboratory following Illinois EPA methods and the Macroinvertebrate Aggregate Index for Streams (MAIS; Smith and Voshell 1997) as modified for application to the study area. Keys specified in Ohio EPA (1989) and by Illinois EPA will be used to make the identifications.

Data Attributes – Field Water Quality:

The basic attributes of the data to be produced by field measurement are listed in Table 2. The parameters include temperature (°C), dissolved oxygen (D.O.; mg/l), conductivity (µS/cm²), and pH (S.U.) and these will be measured at each biological sampling site at the time of each sampling event.

Table 2: Precision, accuracy, and measurement range for field parameters.

Parameter	Meter	Precision	Accuracy @20°C	Measurement Range
pH	YSI 60	±0.2 S.U.	±0.01 S.U.	0-14 S.U.
Dissolved Oxygen	YSI 60	±0.01 mg/l	±0.3 mg/l	0-20 mg/l
Conductivity	YSI 60	±2%	±2%	0-4000 µS/cm
Temperature	YSI 60	±0.5°C	±0.5°C	0-100°C

Representativeness – Reference Sites

Data will be collected from selected regional reference sites in northeastern Illinois preferably to include the core of Illinois EPA reference sites, potentially being supplemented with other sites that meet the Illinois EPA criteria for reference conditions. The purpose of this data will be to index the biological methods used in this study that are different from Illinois EPA and/or DNR to the reference condition and biological index calibration as defined by Illinois EPA. In addition, the current Illinois EPA reference network does not yet include small, headwater streams, hence reference data will be needed to accomplish an assessment of the data.

Representativeness of Fish Data

Pulsed D.C. electrofishing is a widely used methodology for collecting data on stream fish assemblages in the Midwestern U.S. While electrofishing does not collect all of the species present in a stream, it can collect more than 75-80% of the species that are present and approximate their relative abundances. This meets the purposes and requirements for biological assessments and biological criteria in that sufficiently representative data is produced to provide reliable signal about the health and well-being of the entire resource

without the need to accomplish an exhaustive faunal inventory. The collection of relative abundance data includes the use of a standardized sampling procedure designed to produce a sufficiently representative sample of the fish assemblage at a site with a reasonable expenditure of effort (i.e., 2-3 hours/site).

Representativeness of Macroinvertebrate Data

The multi-habitat methodology of Illinois EPA (Appendix E) will be the primary method employed in this study. It produces a 300 organism subsample that represents all habitat types present at a site. In headwater streams that are outside of the normal use of this protocol, a modification of the MAIS method (Voshell 1999; Appendix F) will be used. This method also samples multiple habitats at a site.

Precision and Accuracy - Fish and Macroinvertebrate Assemblages:

MBI employs fish and macroinvertebrate methods of which the precision and accuracy of the resulting data are known. Ohio EPA (1987) extensively tested the reproducibility, accuracy, and precision of their electrofishing sampling protocols in both wadeable streams and non-wadeable rivers and of their macroinvertebrate field methods. Based on a combination of data analyses from specially designed methods testing studies and the aggregate Ohio database, the reproducibility of an Ohio IBI and ICI score was determined to be 4 units out of a 0-60 (12-60 for IBI) scoring scale (Rankin and Yoder 1999). Rankin and Yoder (1990) showed coefficient of variations (CV) were on the order of 8-10% at least impacted and high quality sites. CVs increased at sites with lower IBI and ICI scores, presumably due to the effect of stressors at increasingly impacted sites. Fore et al. (1993) performed more extensive statistical analyses of the Ohio database and determined that IBI scores were reproducible to an error margin of 2-3 units when fish numbers were >200/0.3 km. Their power analysis confirmed that the Ohio IBI was capable of distinguishing 6 discrete scoring ranges that approximate the delineations of the IBI scale into the qualitative descriptions of exceptional, good, fair, poor, and very poor. Angermier and Karr (1986) analyzed other statistical properties of the IBI focusing on the extent of redundancy among metrics. The results of their analysis showed that careful construction and derivation of an IBI following the original guidance of Karr et al. (1986) should produce a robust and non-redundant set of metrics.

Accuracy can also be examined in terms of the assessment produced by the subject method. Biological assessments are viewed as a direct measure of the aquatic life protection goals of the Clean Water Act (CWA) and State water quality standards (as opposed to the surrogate assessment provided by chemical water quality criteria). This has given rise to the concept and interest in biological criteria and adoption by U.S. EPA of a national program, methods, and the development of formal implementation procedures. The issue at stake here is the accuracy of the delineation of waters as impaired or unimpaired for CWA purposes (e.g., TMDLs, NPDES). Historically, States and U.S. EPA based these decisions on chemical water quality data and comparison to State and national water quality criteria. However, studies that compared the relative performance of chemical and biological data

and their respective abilities to detect impairment showed that biological data was far superior in its ability to detect impairment and minimize type II assessment error (Rankin and Yoder 1990; Yoder and Rankin 1998). It is implicit in these studies that the better standardized and calibrated the biological assessment method and assessment criteria, the more able the method is to detect impairment and establish a relative degree of departure from a baseline criterion and a measurement of biological condition that is continuous along the Biological Condition Gradient (BCG).

Measurement Range and Comparability

Theoretically there is no upper limit to most of the raw data parameters that comprise the baseline biological data that will be produced by this study. The practical range of these parameters is dependent on the natural attributes of the regional fish assemblage and the effectiveness of the sampling gear and procedure. For example, in a warmwater Ohio stream we expect a wading electrofishing sample to produce 15-25 species and several hundred fish among those species. In exceptional quality areas, the number of species might increase to more than 30 with thousands of individuals. However, in terms of regional reference condition and potential, the resulting biological assessment should rate a biological assemblage from Ohio and Illinois the same with respect to its similarity to or departure from a regional reference condition. This is critical to establishing biological assessments that are comparable across the U.S. Thus the derivation of reference condition is a critical step in the bioassessment process and is one of the factors that influence comparability.

The resulting assessments and biological indices have discrete scoring ranges, within which the raw data is stratified and compressed. For example, the original IBI and many of its contemporary applications use a scoring range of 12-60, i.e., metric scores of 5, 3, and 1 are assigned to each of 12 metrics. Newly developed IBIs have employed a scoring range of 0-100, which is intuitively more meaningful as a theoretical scoring range and communication tool. The rigor, adequacy of the method, development, and calibration ultimately determines the accuracy, precision, and reproducibility of the index, its statistical rigor, and its resulting assessment.

Completeness

It is expected that all of the data collected by the proposed study will be used for multiple purposes. The collection of the biological, habitat, and water and sediment chemistry will be spatially integrated. This will provide enough information to compare the biological responses exhibited by the fish and macroinvertebrate assemblages with the exposure suggested by the habitat and water quality data at the same sampling sites. Sediment data integrates conditions over time more so than the water column grab sample data. All sampling protocols are designed to control the conditions under which sampling takes place so as to minimize external and confounding influences (e.g., high flows) and to ensure the data is comparable and representative.

A.8: Training and Certification

The methods and protocols used in the proposed study require implementation by adequately trained and skilled biologists and field technicians. The lead biologist(s) must be well trained and experienced in all aspects of conducting the sampling, making decisions that affect quality in the field, being familiar with the study area, and knowing how to identify all species of fish and taxa of macroinvertebrates that will be encountered. Biological crew leaders must also be knowledgeable about safety procedures for boat electrofishing and boat and water safety.

The principal investigator designed and instructed in this training and a prior biocriteria certification course since its inception in 1997. MBI field personnel assigned to this project will be directly supervised by the principal investigator and will have been trained in an apprenticeship format. Of particular importance will be training in the electrofishing procedure, use of the modified Qualitative Habitat Evaluation Index (QHEI), and the identification of external anomalies on fish. Each will follow the procedures outlined in Ohio EPA (1989) and Rankin (1989). The biological crew leaders have taken the Ohio Qualified Data Collectors training required by the Ohio Credible Data law.

A.9: Documents and Records

The Quality Assurance Project Plan and all updates will be maintained by the MBI Principal Investigator and provided to the lead biologist(s). Revisions to the QAPP will be noted as to version and date and signed by the lead signatories. A detailed plan of study will be used to guide the execution of the field sampling.

Field Data Recording

Field data and observations will be recorded using standard data forms and field sheets. Fish data is recorded using the data sheet in Figure 2. Habitat data will be recorded using the QHEI data sheet in Figure 3. All data will be entered into a relational database. MBI uses a version of the Ohio ECOS data management system for the entry, storage, and retrieval of biological and habitat data.

Reporting

Progress reports will be made on a quarterly basis and in accordance with the grant that supports the study. These will be distributed to the same agencies and organizations that receive the QAPP (see Section A.3). A final report will be produced in accordance with the requirements of the bioassessment plan. This report will include a basic reporting of the data, including the distribution and relative abundance of fish and macroinvertebrate assemblages, any significant environmental assessment issues, an initial assessment of the relationship between biological assemblage responses and key stressor variables, and recommendations for sustained monitoring and applied research.

Figure 3. Field data sheet for recording electrofishing collection data and for entry into the Ohio ECOS database.

**Midwest
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Institute**

Fish Data Sheet

MBI

Crew Leader Boat Driver Netter

Mixing Zone:

Field Crew: _____ Time of Day: _____ Page ____ of ____

River/Stream: _____ Location: _____

Date: _____ Sampler Type: _____ Secchi Disk: _____ Time Fished: ' ____"

River Code: _____ Depth: _____ Color: _____ Total Seconds: _____

RM: _____ Data Source: _____ Temp (°C): _____ Observed Flow: _____

Distance: _____ Settings: _____ Number of Entries: _____

Anomalies: A-anchor worm; B-black spot; C-leeches; D-deformities; E-eroded fins; F-fungus; L-lesions; M-multiple DELT anomalies; N-blind; P-parasites; Y-popeye; S-emaciated; W-swirled scales; T-tumors; Z-other/. [Heavy (H) or Light (L) code may be combined with above codes]

SPECIES	# WEIGHED							ANOMALIES
V: <input type="checkbox"/>	10X							
V: <input type="checkbox"/>	10X							
V: <input type="checkbox"/>	10X							
V: <input type="checkbox"/>	10X							
V: <input type="checkbox"/>	10X							
V: <input type="checkbox"/>	10X							
V: <input type="checkbox"/>	10X							
V: <input type="checkbox"/>	10X							
V: <input type="checkbox"/>	10X							

(Revised 6/01)

Mass Weighing
Convention:

→ 536 (12) ←

Number Weighed Vouchers

Figure 3. MBI fish data sheet (continued)

Page ___ of ___

	SPECIES	# WEIGHED						ANOMALIES			
<input type="checkbox"/> V:		10X									
<input type="checkbox"/> V:		10X									
<input type="checkbox"/> V:		10X									
<input type="checkbox"/> V:		10X									
<input type="checkbox"/> V:		10X									
<input type="checkbox"/> V:		10X									
<input type="checkbox"/> V:		10X									
<input type="checkbox"/> V:		10X									
<input type="checkbox"/> V:		10X									
<input type="checkbox"/> V:		10X									
<input type="checkbox"/> V:		10X									
<input type="checkbox"/> V:		10X									

(Revised 6/01)

Figure 4. Qualitative habitat evaluation index (QHEI) field sheet.

Midwest Biodiversity Institute

MBI

Qualitative Habitat Evaluation Index Field Sheet QHEI Score:

River Code: _____ RM: _____ Stream: _____
 Date: _____ Location: _____

Scorers Full Name: _____ Affiliation: _____

1] SUBSTRATE (Check ONLY Two Substrate TYPE BOXES; Estimate % present)

TYPE <input type="checkbox"/> BLDR /SLBS [10] _____ <input type="checkbox"/> BOULDER [9] _____ <input type="checkbox"/> COBBLE [8] _____ <input type="checkbox"/> HARDPAN [4] _____ <input type="checkbox"/> MUCK [2] _____ <input type="checkbox"/> SILT [2] _____	POOL RIFFLE <input type="checkbox"/> GRAVEL [7] _____ <input type="checkbox"/> SAND [6] _____ <input type="checkbox"/> BEDROCK [5] _____ <input type="checkbox"/> DETRITUS [3] _____ <input type="checkbox"/> ARTIFICIAL [0] _____ NOTE: Ignore Sludge Originating From Point Sources	POOL RIFFLE SUBSTRATE ORIGIN Check ONE (OR 2 & AVERAGE) <input type="checkbox"/> LIMESTONE [1] _____ <input type="checkbox"/> TILLS [1] _____ <input type="checkbox"/> WETLANDS [0] _____ <input type="checkbox"/> HARDPAN [0] _____ <input type="checkbox"/> SANDSTONE [0] EMBEDDED _____ <input type="checkbox"/> RIP/RAP [0] _____ <input type="checkbox"/> LACUSTRINE [0] _____ <input type="checkbox"/> SHALE [-1] _____ <input type="checkbox"/> COAL FINES [-2] _____	SUBSTRATE QUALITY Check ONE (OR 2 & AVERAGE) SILT: <input type="checkbox"/> SILT HEAVY [-2] _____ <input type="checkbox"/> SILT MODERATE [-1] _____ <input type="checkbox"/> SILT NORMAL [0] _____ <input type="checkbox"/> SILT FREE [1] _____ EXTENSIVE [-2] _____ NESS: <input type="checkbox"/> MODERATE [-1] _____ <input type="checkbox"/> NORMAL [0] _____ <input type="checkbox"/> NONE [1] _____
---	---	--	--

NUMBER OF SUBSTRATE TYPES: (High Quality Only, Score 5 or >)
 4 or More [2] 3 or Less [0]

COMMENTS: _____

2] INSTREAM COVER (Give each cover type a score of 0 to 3; see back for instructions)

(Structure) TYPE: Score All That Occur <input type="checkbox"/> UNDERCUT BANKS [1] _____ <input type="checkbox"/> OVERHANGING VEGETATION [1] _____ <input type="checkbox"/> SHALLOWS (IN SLOW WATER) [1] _____ <input type="checkbox"/> ROOTMATS [1] _____	POOLS > 70 cm [2] _____ ROOTWADS [1] _____ BOULDERS [1] _____	OXBOWS, BACKWATERS [1] _____ AQUATIC MACROPHYTES [1] _____ LOGS OR WOODY DEBRIS [1] _____
--	---	---

AMOUNT: (Check ONLY One or check 2 and AVERAGE)
 EXTENSIVE > 75% [11] _____
 MODERATE 25-75% [7] _____
 SPARSE 5-25% [3] _____
 NEARLY ABSENT < 5% [1] _____

COMMENTS: _____

3] CHANNEL MORPHOLOGY (Check SINUOSITY DEVELOPMENT CHANNELIZATION STABILITY MODIFICATIONS/OTHER ONLY One PER Category OR check 2 and AVERAGE)

SINUOSITY <input type="checkbox"/> HIGH [4] _____ <input type="checkbox"/> MODERATE [3] _____ <input type="checkbox"/> LOW [2] _____ <input type="checkbox"/> NONE [1] _____	DEVELOPMENT <input type="checkbox"/> EXCELLENT [7] _____ <input type="checkbox"/> GOOD [5] _____ <input type="checkbox"/> FAIR [3] _____ <input type="checkbox"/> POOR [1] _____	CHANNELIZATION <input type="checkbox"/> NONE [6] _____ <input type="checkbox"/> RECOVERED [4] _____ <input type="checkbox"/> RECOVERING [3] _____ <input type="checkbox"/> RECENT OR NO RECOVERY [1] _____	STABILITY <input type="checkbox"/> HIGH [3] _____ <input type="checkbox"/> MODERATE [2] _____ <input type="checkbox"/> LOW [1] _____	MODIFICATIONS/OTHER <input type="checkbox"/> SNAGGING _____ <input type="checkbox"/> RELOCATION _____ <input type="checkbox"/> CANOPY REMOVAL _____ <input type="checkbox"/> DREDGING _____ <input type="checkbox"/> ONE SIDE CHANNEL MODIFICATIONS _____	IMPOUND. _____ ISLANDS _____ LEVEED _____ BANK SHAPING _____
--	--	--	---	--	---

COMMENTS: _____

4] RIPARIAN ZONE AND BANK EROSION (check ONE box per bank or check 2 and AVERAGE per bank) River Right Looking Downstream

RIPARIAN WIDTH L R (Per Bank) <input type="checkbox"/> WIDE > 50m [4] _____ <input type="checkbox"/> MODERATE 10-50m [3] _____ <input type="checkbox"/> NARROW 5-10 m [2] _____ <input type="checkbox"/> VERY NARROW < 5m [1] _____ <input type="checkbox"/> NONE [0] _____	FLOOD PLAIN QUALITY (PAST 100 Meter RIPARIAN) L R (Most Predominant Per Bank) <input type="checkbox"/> FOREST, SWAMP [3] _____ <input type="checkbox"/> SHRUB OR OLD FIELD [2] _____ <input type="checkbox"/> RESIDENTIAL, PARK, NEW FIELD [1] _____ <input type="checkbox"/> FENCED PASTURE [1] _____	BANK EROSION L R (Per Bank) <input type="checkbox"/> CONSERVATION TILLAGE [1] _____ <input type="checkbox"/> URBAN OR INDUSTRIAL [0] _____ <input type="checkbox"/> OPEN PASTURE, ROWCROP [0] _____ <input type="checkbox"/> MINING /CONSTRUCTION [0] _____	RIPARIAN L R (Per Bank) <input type="checkbox"/> NONE/LITTLE [3] _____ <input type="checkbox"/> MODERATE [2] _____ <input type="checkbox"/> HEAVY/SEVERE [1] _____
---	---	--	--

COMMENTS: _____

5.] POOL/GLIDE AND RIFFLE/RUN QUALITY

MAX. DEPTH (Check 1 ONLY!) <input type="checkbox"/> >1m [6] _____ <input type="checkbox"/> 0.7-1m [4] _____ <input type="checkbox"/> 0.4-0.7m [2] _____ <input type="checkbox"/> 0.2- 0.4m [1] _____ <input type="checkbox"/> < 0.2m [POOL=0] _____	MORPHOLOGY (Check 1 or 2 & AVERAGE) <input type="checkbox"/> POOL WIDTH > RIFFLE WIDTH [2] _____ <input type="checkbox"/> POOL WIDTH = RIFFLE WIDTH [1] _____ <input type="checkbox"/> POOL WIDTH < RIFFLE W. [0] _____	CURRENT VELOCITY (Check All That Apply) <input type="checkbox"/> EDDIES [1] _____ <input type="checkbox"/> FAST [1] _____ <input type="checkbox"/> MODERATE [1] _____ <input type="checkbox"/> SLOW [1] _____
--	--	---

COMMENTS: _____

6] GRADIENT (ft/mi): _____ DRAINAGE AREA (sq.mi.) : _____

RIFFLE DEPTH <input type="checkbox"/> Best Areas >10 cm [2] _____ <input type="checkbox"/> Best Areas 5- 10 cm [1] _____ <input type="checkbox"/> Best Areas < 5 cm [RIFFLE=0] _____	RUN DEPTH <input type="checkbox"/> MAX > 50 [2] _____ <input type="checkbox"/> MAX < 50 [1] _____	CHECK ONE OR CHECK 2 AND AVERAGE RIFFLE/RUN SUBSTRATE <input type="checkbox"/> STABLE (e.g., Cobble, Boulder) [2] _____ <input type="checkbox"/> MOD. STABLE (e.g., Large Gravel) [1] _____ <input type="checkbox"/> UNSTABLE (Fine Gravel, Sand) [0] _____	RIFFLE/RUN EMBEDDEDNESS <input type="checkbox"/> NONE [2] _____ <input type="checkbox"/> LOW [1] _____ <input type="checkbox"/> MODERATE [0] _____ <input type="checkbox"/> EXTENSIVE [-1] _____
---	---	--	--

COMMENTS: _____

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

* Best areas must be large enough to support a population of riffle-obligate species

Figure 4. QHEI field data sheet (continued).

Is Sampling Reach Representative of the Stream (Y/N) Yes No. If Not, Explain: _____

Tail Long (Long)
 Tail Long (Mid)
 Tail Long (End)
 Tail Long (% Long)

Subjective Rating (1-10)
 Gradient: Low Moderate High

First Sampling Point: _____
 Clear: _____ Distance: _____ Water Clarity: _____ Water Stage: _____ Canopy % Open: _____

Average Width: _____ Average Depth: _____ Maximum Av. Bank Width: _____ Bank/Reach Ratio: _____
 Average Width: _____ Average Depth: _____ Maximum Av. Bank Width: _____ Bank/Reach Ratio: _____
 Average Width: _____ Average Depth: _____ Maximum Av. Bank Width: _____ Bank/Reach Ratio: _____

Stream Measurements:
 Average Width: _____ Average Depth: _____ Maximum Av. Bank Width: _____ Bank/Reach Ratio: _____
 Average Width: _____ Average Depth: _____ Maximum Av. Bank Width: _____ Bank/Reach Ratio: _____

Major Suspected Sources of Impacts (Check All That Apply):
 None
 Industrial
 WWT/P
 Ag
 Livestock
 S/Med/Land
 Construction
 Urban Runoff
 CSOs
 Suburban Impacts
 Mining
 Channel/Bank
 Riparian Removal
 Landfill
 Natural
 Dams
 Other Flow Alteration
 Other: _____

Is Stream Ephemeral (no flow, totally dry or only campy)? Yes No
 Is there water upstream? Yes No
 How Far: _____
 Is There Water Close Downstream? Yes No
 How Far: _____
 Is Dry Channel Usually Natural? Yes No

Stream Drawing:

Instructions for scoring the alternate cover metric: Each cover type should receive a score of between 0 and 3. Where: 0 - Cover type absent; 1 - Cover type present in very small amounts, but not of highest quality or in small amounts of highest quality; 2 - Cover type present in moderate amounts, but not of highest quality or in small amounts of highest quality; 3 - Cover type of highest quality in moderate or greater amounts. Examples of highest quality include very large boulders in deep or fast water, large diameter logs that are stable, well developed rootwads in deepest water, or deep, well-defined, functional pools.

Group B: Data Generation and Acquisition

B.1: Sampling Process Design

The bioassessment plan calls for sampling 149 sites in the W. Branch, E. Branch, and Salt Creek subbasins and 15 regional reference sites (some may be located in adjacent watersheds) as flow, water clarity, and weather conditions permit. A combined stratified-random and targeted-intensive survey design was used to allocate sampling sites throughout each subbasin. This design is employed to fulfill multiple management purposes and goals in addition to the determination of the existing status of the extant biological assemblages. The specific rationale for the design and the allocation of sites is more thoroughly described in Appendices A and B. Sites are designated in descending order by drainage area range as levels 1-7 in the final bioassessment plan (Appendix A).

B.2: Sampling Methods

Biological sampling for fish and macroinvertebrate assemblage data should follow established protocols of the Illinois DNR (2001) and Illinois EPA (1997, 2005) or be capable of producing comparable data and assessments. The final bioassessment plan (Appendix A) specifies the probable sampling protocols for each sampling site. In some cases the best protocol will need to be determined in the field, thus the best two candidates were listed in these instances. The specifications for the different equipment and methods are described in Table 3 for fish assemblage and Table 4 for macroinvertebrates.

Fish Assemblage Methods

Methods for the collection of fish at wadeable sites will be performed using a tow-barge or long-line pulsed D.C. electrofishing equipment based on a T&J 1736 DCV electrofishing unit described by Ohio EPA (1989) and as used by MBI. A Wisconsin DNR battery powered backpack electrofishing unit will be used as an alternative to the long line and in accordance with the restrictions described by Ohio EPA (1989). Generally, a three person crew is required to execute the sampling protocol for each type of wading equipment. Sampling effort is determined by distance and ranges from 150-200 meters in length. Non-wadeable sites will be sampled with a boat-mounted pulsed D.C. electrofishing device. A Smith-Root 5.0 GPP unit will be used on a 12' john boat following the design of Ohio EPA. Sampling effort for this method is 500 meters. A summary of the key aspects of each method appear in Table 3.

Fish Sampling Reach Selection and Delineation

Sampling distance will be measured with a GPS unit or laser range finder. When using the GPS unit each zone is measured by determining cumulative lineal distance based on waypoints established by the GPS unit. When using the laser range finder, measurements are taken in increments of 50-100 meters using fixed objects as focal points. Sampling site locations are delineated using the GPS mechanism and indexed to latitude/longitude and

Table 3. Fish assemblage sampling method and gear specifications for the DuPage-Salt Creek biological assessment by geometric site level.

Parameter	Site Levels ¹		
	Levels 6-7	Levels 2-6	Levels 1-2
Waterbody Size ² Channel Dimensions: ³	<1.0-5.0 mi ² <0.3-0.5m depth; 1-2m width	5.0-75 mi ² 0.5-1.0m depth; 2-10m width	75-150 mi ² >1.0m depth; 10-100m width
Platform:	Backpack or Bank set/long line	Tow boat or Bank set/long line	12' boat
Power Source: ⁴	12v battery or 300W alternator; ⁵ 1750 W alternator ⁶	1750-2500W alternator	3500-5000 W alternator
Amperage Output:	1.5-2A; 2-4A	4-8A	8-20A
Volts D.C. Output:	100-200; 150-300	150-300; 300-1000	500-1000
Anode Location:	Net ring w/assist netters	Net ring w/assist netters	Boom w/droppers; bow netter
Sampling Direction:	Upstream	Upstream	Downstream
Distance Sampled:	0.10-0.15km	0.15-0.20km	0.5km
CPUE Basis: ⁷	per 0.3km	per 0.3km	per 1.0km
Time Sampled	1800-3600 sec	1800-3600 sec	2500-3500 sec
Time of Sampling:	Daylight	Daylight	Daylight
Crew Size ⁸	2-3	3	2

¹ Site levels described under Watershed Monitoring Design and described for each site in Tables 7-9.

² Watershed size upstream from the sampling site.

³ Size dimensions are approximate and may vary by site – these should not be used as primary criteria.

⁴ Wattage (W) is sustained output (not peak output).

⁵ Back pack units can be either battery or generator powered.

⁶ This is used with the long line sampling method.

⁷ Basis for determining relative abundance parameters.

⁸ Crew consists of a qualified crew leader and field technicians.

UTM coordinates at the beginning, end, and mid-point of each site. Range finders are calibrated prior to being used in the field on a marked course and adjusted as necessary. The boundaries of each electrofishing zone are clearly marked on stationary objects (e.g. trees, bridge piers, etc.) with trail flagging or spray marking and fixed landmarks are referenced. This enables accurate relocation of sites in the event repeat visits are made. The location of each sampling site will be indexed by river mile (using river mile zero as the mouth of the river) if such a system exists for the DuPage watershed. A description of the sampling location should also include proximity to a fixed local landmark such as a bridge, road, discharge outfall, railroad crossing, park, tributary, dam, etc. The field crew involved with the sampling is noted on the field sheet with crew duties listed (driver, netters, primary I.D., etc.).

Sampling Procedure

The tow-barge or longline pulsed D.C. electrofishing apparatus will be the preferred gear employed at wadeable sites. Electric current is converted, controlled, and regulated by a T&J 1736DCV alternator-pulsator that produces up to 1750 Watts at 100-300 volts DC at 2-7 amperes. The electrode anode array consists of the metal net ring hoop. The cathode consists of a woven steel cable strand on the front of the towboat or trailing the longline behind the sampler. A wading electrofishing crew consists of a primary netter who operates the anode, an assist netter and a third member who pulls the tow barge or attends to the long-line and keeps the collected fish cool and oxygenated by frequently changing water in a live well, bucket, or floating live well.

At wadeable sites, the accepted procedure is to slowly and methodically sample *upstream* sampling the best available habitat along the shoreline and/or midstream and sampling in and around submerged cover (undercut banks, log jams, root wads, emergent beds of vegetation, etc) to advantageously position the netters to capture stunned and immobilized fish. Riffle/run areas are sampled using strategies that include “riffle raking”, which consists of “casting” the primary net ring (anode) upstream and allowing it to “float” downstream into the assist net. The assist netter also looks for fish attempting to swim downstream around the anode. Backwater and other margin habitats are sampled if present. Although sampling effort is measured by distance, the time fished is an important indicator of adequate effort. Time fished can legitimately vary over the same distance as dictated by cover and current conditions and the number of fish encountered. In all cases, there is a minimum time that should be spent sampling each zone regardless of the catch. In our experience this is generally in the range of 1200-1500 seconds for 150-200 meters and upwards to 2500 seconds where there is extensive instream cover and diverse current flows. Safety features include easily accessible toggle switches on the electrofishing unit and positive pressure thumb switches operated by the netter. All crew members wear rubber gloves and chest waders. Sampling will be conducted during a June 15-October 15 seasonal index period.

Boat sites will be sampled using a boat-rigged, pulsed D.C. electrofishing apparatus. This consists of a 12' john boat that is specifically constructed and modified for electrofishing. Electric current is converted, controlled, and regulated by Smith-Root 5.0 GPP alternator-pulsator that produces up to 1000 volts DC at 2-20 amperes depending on the relative conductivity. The pulse configuration consists of a fast rise, slow decay wave that can be adjusted to 30, 60, or 120 Hz (pulses per second). Generally, electrofishing is conducted at 120 Hz, depending on which selection is producing the optimum combination of voltage and amperage output and most effectively stunning fish. This is determined on a trial and error basis at the beginning of each boat electrofishing zone and the settings will generally hold for all similar rivers and reaches. The voltage range is selected based on what percentage of the power range produces the highest amperage readings. Generally, the high range is used at conductivity readings less than 50-100 $\mu\text{s}/\text{m}^2$ and the low range is used at higher conductivities up to 1200 $\mu\text{s}/\text{m}^2$. Lower conductivities usually produce lower amperage readings.

The electrode array consists of four 8-10' long cathodes (negative polarity; 1" diameter flexible steel conduit) which are suspended from the bow and 4 anodes (positive polarity) suspended from a retractable boom, the number used being dependent on the conductivity of the water. Each anode consists of a 3/8" woven steel cable strand 4' in length that are spaced equally on the boom cross member. Gangs of anodes can be added or detached as conductivity conditions change; anodes are increased at low conductivity and reduced at high conductivity. The anodes are suspended from a retractable boom that extends 2.75 meters in front of the bow. The width of the array is 0.9 meters. Anodes and cathodes are replaced when they are lost, damaged, or become worn.

A 12' boat electrofishing crew consists of a boat driver and one netter. Limited access to free-flowing segments may necessitate launching at an upstream location and recovering at a downstream location. Put-in and take-out sampling is conducted where navigational barriers preclude contiguous navigation. The accepted sampling procedure is to slowly and methodically maneuver the electrofishing boat in a *down current* direction along the shoreline maneuvering in and around submerged cover to advantageously position the netter(s) to pick up stunned and immobilized fish. This may require frequent turning, backing, shifting between forward and reverse, changing speed, etc. depending on current velocity and cover density and variability. The driver's task is to maneuver the electrofishing boat in a manner that advantageously positions the netter to pick up stunned and immobilized fish. The driver also monitors and adjusts the 5.0 GPP pulsator to provide the maximum, yet safe operational mode in terms of voltage range, pulse setting, and amperage. In areas with extensive woody debris and submergent aquatic macrophytes, it is necessary to maneuver the boat in and out of these "pockets" of habitat and wait for fish to appear within the netters field of view. In moderately swift to fast current the procedure is to electrofish with or slightly ahead of the current through the fast water sections and then return upstream to more thoroughly sample the eddies and side edges of the faster water. It is often necessary to pass over these swift water areas twice to ensure an

adequate sample. Electrofishing efficiency is enhanced by keeping the boat and electric field moving with or at a slightly faster rate than the prevailing current velocity. Fish are usually oriented into the current and must turn sideways or swim into the approaching electric field to escape. As such they present an increased voltage gradient making the fish more susceptible to being immobilized by the electric current. Sampling in an upstream direction is prohibited as this compresses the electrical field towards the surface, which significantly diminishes sampling effectiveness. Although sampling effort is measured by distance, the time fished is an important indicator of adequate effort. Time fished can legitimately vary over the same distance as dictated by cover and current conditions and the number of fish encountered. In all cases, there is a minimum time that should be spent sampling each zone regardless of the catch. In our experience this is generally in the range of 2000-2500 seconds for a 0.5 km site, but could range higher where there is extensive instream cover and slack flows.

Safety features include easily accessible toggle switches on the pulsator unit and next to the driver and a foot pedal switch operated by the primary netter. The netters wear jacket style life preservers, rubber gloves, and all crew members wear chest waders. Netters are required to wear polarized sunglasses to facilitate seeing stunned fish in the water during each daytime boat electrofishing run. Boat nets with a 2.5m long handle and 7.62mm Atlas mesh knotless netting are used to capture stunned fish as they are attracted to the anode array and/or stunned. A concerted effort is made to capture every fish sighted by both the netters and driver. Since the ability of the netters to see stunned and immobilized fish is partly dependent on water clarity, sampling is conducted only during periods of "normal" water clarity and flows. Periods of high turbidity and high flows are avoided due to their negative influence on sampling efficiency. If high flow conditions prevail, sampling will be delayed until flows and water clarity return to seasonal, low flow norms.

All netters for both the wadeable and non-wadeable methods are required to wear polarized sunglasses to facilitate seeing stunned fish in the water during each daytime electrofishing run. The nets in the anode and in the assist net each consist of 7.62mm Atlas mesh knotless netting. A concerted effort is made to capture every fish sighted by all crew members. Since the ability of the netters to see stunned and immobilized fish is partly dependent on water clarity, sampling is conducted only during periods of "normal" water clarity and flows. Periods of high turbidity and high flows are avoided due to their negative influence on sampling efficiency and site access. If high flow conditions prevail, sampling will be delayed until flows and water clarity return to seasonal, low flow norms.

General Cautions Concerning Field Conditions

Electrofishing should be conducted only during "normal" summer-fall water flow and clarity conditions. What constitutes normal can vary considerably from region to region. Generally normal water conditions in the Midwest occur during below annual average river flows. Under these conditions the surface of the water generally will have a placid appearance. Abnormally turbid conditions are to be avoided as are high water levels and elevated current

velocities. In addition to safety concerns, any of these conditions can adversely affect sampling efficiency and may rule out data applicability for bioassessment purposes. Since the ability of the netter to see and capture stunned fish is crucial, sampling should take place only during periods of normal water clarity and flow. Floating debris such as twigs, tree limbs, flotsam, and other trash are usually visible on the surface during elevated flow events. Such conditions should be avoided and sampling delayed until the water returns to a "normal" flow and clarity. High flows should also be avoided for obvious safety reasons in addition to the reductions in sampling efficiency. Boat mounted methods are particularly susceptible as it becomes more difficult to maneuver the boat into areas of cover and the fish assemblage is locally displaced by the elevated flow events. It may take several days or even weeks for the assemblage to return to their normal summer-fall distribution patterns. Thus sampling may need to be delayed by a similar time period if necessary. Knowing this requires local knowledge and a familiarity with flow gage readings and conditions. Generally, these conditions coincide with low flow durations of approximately 80% or greater, i.e., flows that are exceeded 80% of the time for the period of record. These statistics are available for most Midwest rivers from the U.S. Geological Survey at: <http://waterdata.usgs.gov/>.

Field Sample Processing Procedures

Captured fish are immediately placed in a live well, bucket, or live net for processing. Water is replaced and/or aerated regularly to maintain adequate dissolved oxygen levels in the water and to minimize mortality. Special handling procedures may be necessary for species of special concern. Fish not retained for voucher or other purposes are released back into the water after they have been identified to species, examined for external anomalies, and weighed, except at level 6 and 7 sites where only numbers are recorded. Every effort is made to minimize holding and handling times. The majority of captured fish are identified to species in the field; however, any uncertainty about the field identification of individual fish requires their preservation for later laboratory identification. Fish are preserved for future identification in borax buffered 10% formalin and labeled by date, river or stream, and geographic identifier (e.g., river mile). Identification is required to the species level at a minimum and may be necessary to the sub-specific level in certain instances. A number of regional ichthyology keys will be used and include the Fishes of Illinois (Smith 1979). Dr. Ted Cavender of The Ohio State University Museum of Biodiversity (OSUMB) will assist with the verification of voucher specimens that will be retained at the OSUMB. Assistance will also be solicited from Illinois DNR.

The sample from each zone is processed by enumerating and recording weights by species. Weights will be recorded at level 1-5 sites. Fish weighing less than 1000 grams will be weighed to the nearest gram on a spring dial scale (1000 g x 2g) with those weighing more than 1000 grams weighed to the nearest 25 grams on a 12 kg spring dial scale (12 kg x 50 g) or a hand held spring scale for fish larger than 12 kg. Scales are checked before each sampling run with National Bureau of Standards check weights and adjusted accordingly. Samples that are comprised of two or more distinct size classes of fish (e.g., y-o-y, juveniles,

and adults) are processed as separate size groupings. These are recorded separately on the field data sheet by adding an A, B, or Y to the species code, A for adults, B for juveniles, and Y for young-of-year. For example, if both adult and juvenile white suckers occur in the same sample the adult numbers and weights are recorded as family-species code 40-016A with juvenile numbers and weights recorded as 40-016B. Although each is listed separately on the fish data sheet they are treated in the aggregate as a single sample of the same species in any subsequent data analyses. The data management programs used by MBI are designed to calculate relative numbers and weight data based on the input of the weighted subsample data. Larval fish will not be included in the data, as these are difficult to identify and offer questionable information to an assemblage assessment (Angermier and Karr 1986). Fish measuring less than 15-20 mm in length are not included in the data recording as a matter of practice.

The incidence of external anomalies will be recorded following procedures outlined by Ohio EPA (1989) and refinements made by Sanders et al. (1999). The frequency of DELT anomalies (deformities, eroded fins and body parts, lesions, and tumors) is a good indication of stress caused by chronic agents, intermittent stresses, and chemically contaminated sediments. The percent DELT anomalies is a metric of most fish assemblage assessments that have been developed across the U.S.

A qualitative habitat assessment using an appropriate modification of the Qualitative Habitat Evaluation Index (QHEI; Ohio EPA 1989; Rankin 1989) will be completed by the fish crew leader. The QHEI is a physical habitat index designed to provide an empirical, quantified evaluation of the lotic macrohabitat characteristics that are important to fish assemblages. The QHEI was developed within several constraints associated with the practicalities of conducting a large-scale monitoring program, i.e., the need for a rapid assessment tool that yields meaningful information and which takes advantage of the knowledge and insights of experienced field biologists who are conducting biological assessments. This index has been used widely outside of Ohio and parallel habitat evaluation techniques are in widespread existence throughout the U.S. The QHEI incorporates the types and quality substrate, the types and amounts of instream cover, several characteristics of channel morphology, riparian zone extent and quality, bank stability and condition, and pool-run-riffle quality and characteristics. Slope or gradient is also factored into the QHEI score. We will follow the specific guidance and scoring procedures outlined in Ohio EPA (1989) and Rankin (1989). A QHEI users guide appears in Appendix 3.

Macroinvertebrate Assemblage Methods

The macroinvertebrate assemblage will be sampled using two principal methods, with a third used if needed. The attributes of each are summarized in Table 4. The Illinois EPA multihabitat method (Appendix E) will be used at all level 1-5 sites. The MAIS method

Table 4. Macroinvertebrate assemblage sampling method and gear specifications for the DuPage-Salt Creek biological assessment by geometric site level.

Parameter	Site Levels ⁹		
	Levels 6-7	Levels 2-6	Levels 1-2
Waterbody Size ¹⁰ Channel Dimensions: ¹¹	<1.0-5.0 mi ² <0.3-0.5m depth; 1-2m width	5.0-75 mi ² 0.5-1.0m depth; 2-10m width	75-150 mi ² >1.0m depth; 10-100m width
Protocol:	Qualitative Dip- Net, handpick	Multi-habitat IEPA Method	Multi-habitat or Artificial Substrate
Collection device:	D-frame dip net	D-frame dip net	D-frame dip net; Modified Hester- Dendy sampler
Effort:	30 minutes and >until no new taxa	20 sweeps; habitat defined	20 sweeps; 6 weeks H-D ¹²
CPUE Basis: ¹³	No. individuals per site	No. individuals per site	No. ind./site; No./m ²
Subsample:	Time based;	300 organisms	300 organisms; Proportioned
Taxonomic Resolution:	Lowest Practicable	Lowest practicable	Lowest practicable
Crew Size ¹⁴	2	2	2

⁹ Site levels described under Watershed Monitoring Design and described for each site in Tables 7-9.

¹⁰ Watershed size upstream from the sampling site.

¹¹ Size dimensions are approximate and may vary by site – these should not be used as primary criteria.

¹² Artificial substrates used in non-wadeable sites that are deeper and wider; used where multi-habitat method is impractical as defined by IEPA 2005.

¹³ Basis for determining relative abundance parameters.

¹⁴ Crew consists of a qualified crew leader and one field technician.

(Appendix F) adapted for application to Illinois streams will be used where the multihabitat method is not feasible, most likely at level 6 and 7 sites.

IEPA Multi-habitat Sampling Procedure

The Illinois EPA multi-habitat method for sampling stream macroinvertebrates provides information useful for determining the biological integrity of a stream, as reflected in selected attributes of the macroinvertebrate assemblage living in a stream. These biological attributes represent how macroinvertebrates respond to and integrate the chemical, physical, and biological effects of human-induced impacts (both negative and positive) on streams and their watersheds, e.g., point- or nonpoint-source impacts, stream-restoration efforts. The multi-habitat approach allocates sampling effort based on the relative amounts of several predefined macroinvertebrate habitat types that occur in the sampling reach.

The IEPA multi-habitat method specifies the selection of a sampling reach that has instream and riparian habitat conditions typical of the entire assessment reach, has flow conditions that approximate typical summer base flow, has no highly influential tributary streams, contains one riffle/pool sequence or analog (i.e., run/bend meander or alternate point-bar sequence), if present, **and**, where the multi-habitat method is applicable, is at least 300 feet long. The method is applicable if conditions allow the sampler to collect macroinvertebrates (i.e., to take samples with a dip net) in all bottom-zone and bank-zone habitat types that occur in a sampling reach. The habitat types are defined explicitly in Appendix E. Conditions must also allow the sampler to apply the 11-transect habitat-sampling method, as described in "*Wadeable Streams Transect Approach*" in *Appendix 1, Section E: Stream Habitat and Discharge Monitoring*, in *Quality Assurance Project Plan* (Illinois EPA 1994) or to estimate with reasonable accuracy—via visual or tactile cues the amount of each of several bottom-zone and bank-zone habitat types. If conditions (e.g., inaccessibility, water turbidity, or excessive water depths) prohibit the sampler from estimating with reasonable accuracy the composition of the bottom zone or bank zone throughout the entire sampling reach, then the multi-habitat method is not applicable. In most cases, if more than one-half of the wetted stream channel cannot be seen, touched, or otherwise reliably characterized by the sampler, it is unlikely that reasonably accurate estimates of the bottom-zone and bank-zone habitat types are attainable; thus, the multi-habitat method is not applicable.

Macroinvertebrate Aggregated Index for Streams (MAIS)

The MAIS method was originally developed for use in eastern Appalachian streams as a screening tool for assessing mine drainage and other impacts (Smith and Voshell 1997). MAIS scores are based on macroinvertebrates collected with a prescribed number of kick and dip net sweeps following the U.S. EPA Rapid Bioassessment Protocols described by Barbour et al. (1999). The current MAIS specifies a family level of taxonomy. MBI is in the process of developing a refinement of the methodology based on a lowest practicable level of taxonomy and calibrated to regional reference conditions. This will meet the specifications of the bioassessment plan, but it will necessitate modifications to the “stock”

MAIS metrics and scoring criteria. The reference data collected as a part of the survey will be used for this purpose.

The MAIS method will be used in lieu of the IEPA Multi-habitat Method where small channel size precludes use of the latter. This will likely occur at the level 6 and 7 sites and a decision about this will be made at each site with guidance from Illinois EPA. Samples are collected with a 1 m² fiber glass screened 500 micron kick net to sample the riffle and run habitats at each site. The macroinvertebrates and debris are washed into a storage container after each consecutive kick and composited into a single sample. The sample is strained through a number 30 (600 micron mesh) standard sieve; large debris is washed and scrubbed into the container and then discarded. The entire sample including debris is placed into jars and preserved with 70% ethanol.

Quantitative Macroinvertebrate Assessment: Artificial Substrates

While the bioassessment plan does not specify the use of this method, the prohibitions about using the IEPA Multi-habitat Method may necessitate the use of artificial substrates in larger streams. Quantitative samples will be collected using modified Hester-Dendy (HD) artificial substrate samplers (Ohio EPA 1989). An individual HD consists of a series of 8 hardboard plates (1/8" thickness) and 12 spacers. One HD sampler represents 1 ft² of stream bottom (artificial substrate). Each plate measures 3 in², and each spacer is 1 in.² The plates and spacers are center drilled and mounted to a 4-in.-long eye bolt and secured by a nut. The spacers separate the plates at different distances and create different velocities across the plates. One spacer is placed between the first three plates, two spacers between the next three plates, and three spacers between the last two plates to create a variety of microhabitats. A "set" consists of five HD samplers attached to a single concrete block. At any station where there is a risk of vandalism or damage a second set may be placed in case the first is damaged or lost. Samplers are placed in the stream for colonization between June 15 to September 30 (the latest date for retrieval under normal circumstances). Ohio EPA (1989) describes details of placement of the samplers to ensure adequate stream flow over the plates, but in general samplers should be set where flow is 0.3 ft/sec over the plates. The HD set is retrieved and preserved in 10 percent formalin as individual units and later combined to form a composite sample. From these results, the density of macroinvertebrates per square foot will be determined, as well as a taxonomic list and a biological index score.

A qualitative sample from the natural substrate is collected at the time of substrate retrieval. Samples are collected using a triangular frame 30-mesh dip net. All available habitats are sampled at a given site for a minimum time of 30 minutes and thereafter until no new taxa are observed. This generally includes 20+ jabs taken from all available habitats in the sampling area including snags, wood, submerged vegetation, vegetated banks, root wads, and riffles. The 20+ dip sample will be placed into a white pan to enhance picking macroinvertebrates from the sample. All macroinvertebrates in the pan will be field-picked, placed into 70% ethanol for preservation and transported to the lab for later

identification. An MAIS sample is also collected as part of the qualitative sample partly for the purpose of expanding the database for this developing tool. One qualitative sample is collected at each site at the time of artificial substrate retrieval. MBI has added to the Ohio EPA protocol by preserving all individuals collected, not just a few representatives of each taxa group. This preserves the presence/absence data by sampling the reach in the same manner with the exception of preserving more individuals in relation to their abundance. The goal is to obtain a relative abundance data for each taxa to replace general observations of abundance recorded on field sheets. Qualitative samples are processed through a visual sort and standard taxonomic processing to the lowest practicable level (genus/species). Sorting is based on organism maturity, condition, and life stage (larva, pupa, adult).

B.3: Sample Handling and Custody

The principal sample products produced by this project will be fish and macroinvertebrate assemblage data and habitat assessments. All data will be collected and managed by MBI. All samples will be documented with appropriate data sheets and notations of the primary collectors and constitute a documentation of the chain-of-custody process. Completed field and laboratory forms the qualitative habitat assessment data sheets will comprise the hard copy documentation. All field data sheets are logged by the field crew leader (back-up copies are made to prevent loss) and assure that all sites are sampled according to the bioassessment plan. Data is entered from the field and laboratory sheets into the Ohio ECOS data management system in the format presented in the field data sheets (Figures 3 and 4). Each entry is logged by basin-river code, date of entry, river mile or other site locator, and date of sampling. The data sheets are assembled in a notebook along with site description sheets, maps of the sampling sites, the QHEI field sheet, and the bioassessment plan. Any subsequent changes that are made to the field and lab sheets are initialed and dated. After the data have been entered into Ohio ECOS the entries are proofread by the lead biologist for accuracy. All corrections or updates are then entered into the database.

Fish voucher specimens and macroinvertebrate samples will be archived for the purpose of confirming identifications and to serve as a permanent record. Photographs will also be used to record fish species occurrence, particularly larger species that are not easily preserved and stored. Fish will be transferred from 10% formalin to wash water and then to a series of ethyl alcohol washes from 35% to 50% to 70%. Voucher specimens will be deposited in the vertebrate collection at The Ohio State University Museum of Biodiversity. All photographs will be maintained by MBI in an archived electronic file. Macroinvertebrates are transferred from 10% formalin to 70% ethyl alcohol for processing and permanent storage. All samples are archived at MBI.

B.4: Analytical Methods

The principal analytical tools used for the biological data are those associated with basic data analysis. Data manipulation will be performed on personal computers using relational databases such as FoxPro, Access, and Excel. MBI uses the data storage, retrieval, and calculation routines available in the Ohio ECOS system. Appropriate modifications to

those routines are initiated as needed to satisfy project objectives. Data will also be exported to various statistical and graphic packages such as Kaliedagraph for presentation graphics and S-Plus for statistical analyses. Habitat will be assessed using the QHEI following the methods in Appendix C.

Fish and macroinvertebrate data will be reduced to standard relative abundance and species/taxa richness and composition metrics. The Illinois Index of Biotic Integrity (IBI) will be calculated with the fish data. The macroinvertebrate data will be analyzed using existing and developing indices of Illinois EPA. In the case of the MAIS data, MBI will attempt to develop an interim index based on regional reference conditions. In all cases, methods comparability may be an additional issue. MBI will use the results gained by the comparability sampling conducted as part of the National Wadeable Stream Survey (NWSA) bioassessment comparability sampling of 2005.

Products of this study will include a determination of biological status for all flowing waters, identification of stressor variables associated with biological impairments, spatial analyses of patterns in biological response variables, and recommendations for management actions as appropriate. This will be contingent on the integrated analysis of the water quality and other stressor data that is also being collected as part of the overall watershed assessment.

B.5: Quality Control

Quality control consists of ensuring that the data collected are the result of the proper execution of the sampling protocols and that the data are reproducible and precise. The precautions taken for each assemblage group and in the field and laboratory are different, but the objective remains the same, to produce data that is of a sufficient quality so as to reduce type I and type II assessment errors.

Fish Assemblage

Quality control of electrofishing includes adhering to sampling protocols and monitoring the power output variables. Other important measures of adequate effort include time electrofished and the effort made by the netters to capture stunned and immobilized fish. There is an inherent degree of judgment involved in the assessment of individual crew member performance and this will be performed by the MBI crew leader and the principal investigator. The quality of identifications made in the field will be evaluated by the principal investigator and also based on the retention of voucher specimens that will be verified independent of the field crew. Approximately 10% of the sites (n = 15) will be re-sampled by a second crew to assess crew performance and comparability. Selected field audits of crew performance will be performed by the principal investigator.

Habitat Assessment

Annual crew leader training in using the QHEI is a requirement that assures consistent interpretation of QHEI variables and the resulting QHEI score. Visual identity is key to

being able to properly use the QHEI and this is reinforced by the required training, the annual refresher, and in the QHEI field guide which contains ample photographs and illustrations. QHEI comparability will be accomplished by the 10% re-sampling of the fish sites.

Macroinvertebrate Assemblage

The quality of macroinvertebrate sample collection and processing involves strict adherence to the specific protocols, re-sampling selected sites, and independent identification and enumeration of selected samples. A 10% subset of all sites (n=15) will be re-sampled with the IEPA multi-habitat and MAIS methods, whichever is applicable. This will allow the establishment of baseline variability within a seasonal index period to be established. A 10% subset of laboratory processed samples will be identified and enumerated by an independent taxonomist. The results of this process will be used to reconcile the data prior to its use in the bioassessment.

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

All equipment is used and maintained in accordance with manufacturer's specifications. The electrofishing equipment is evaluated for performance during all phases of sampling as described previously in B.2. All connections and switches must be in good condition to ensure acceptable performance and are inspected several times each day by the sampling crew. Malfunctioning and worn parts are replaced immediately. All engines undergo maintenance as prescribed by the manufacturer for intensive use. Analytical field meters used by the sampling crew are maintained in accordance with the manufacturer's specifications.

B.7: Instrument/Equipment Calibration and Frequency

Field meters used by the field crews are calibrated in accordance with the manufacturer's recommendations and specifications and in accordance with the parameters in Table 2. Other equipment is adjusted on an as needed basis following the procedures in B.6.

B.8: Inspection/Acceptance of Supplies and Consumables

All supplies used in this project undergo an initial inspection for usability and suitability. No hazardous reagents or analytical sensitive supplies will be used in the field during this project.

B.9: Non-direct Measurements

We will make an effort to access historical information about the fish and macroinvertebrate fauna of the study area. This will be especially valuable in evaluating the historical trends through time. Some expert judgment may be necessary to evaluate the quality and accuracy of this information.

B.10: Data Management

MBI uses an adaptation of the Ohio ECOS data management system developed to store, retrieve, and analyze biological and habitat assessment data and information. Fish and macroinvertebrate assemblage data and habitat data are entered directly via the electronic data entry routine from the field sheets (Figures 3 and 4). All data entry codes follow those specified in Ohio EPA (1987) and those added by MBI for non-Ohio fish species. All entries are proofread by the data entry analyst and corrections are made in the electronic database. All corrections are noted and initialed by the data entry operator and confirmed by the project manager. Other checks on data entry accuracy are made via the routine processing and analysis of the data. The procedure for retaining and filing of data sheets and field notes was described in B.2.

Group C: Assessment and Oversight

C.1: Assessments and Response Actions

Due to the well defined and relatively localized scope of the project, assessment and oversight will be the joint responsibility of the DRSCW project coordinator and the MBI principal investigator. However, the stakeholder agencies and organizations will be afforded an opportunity to make inspections and audits of the field sampling, the equipment, laboratory procedures, and the results. This will be coordinated by the DRSCW project coordinator and the MBI principal investigator.

C.2: Reports to Management

The principal investigator will file quarterly reports with the DRSCW project coordinator. Recipients may comment directly to the project sponsor lead and the principal investigator.

Group D: Data Validation and Usability

D.1: Data Review, Validation, and Verification

Data acceptance will initially be evaluated in the field using the processes described in B.2 and B.5. However, later inspection of the data may also raise issues of acceptance. A systematic process will be used to reconcile any inconsistencies or issues prior to conditioning or disqualifying already collected data.

D.2: Verification and Validation of Methods

Most of the raw data will be field validated in accordance with the processes described in B.2, B.3, B.4, and B.10. Post-sampling validation will entail verification of identifications made in the field and later in the laboratory. Laboratory generated data will follow established procedures detailed in Appendices E, F, and G.

D.3: Reconciliation with User Requirements

The sampling and analytical approach proposed for this project are designed to provide the opportunity to adjust and modify methods as appropriate to obtain results that meet the project goals and objectives. Initial methods scoping may be done to assure comparability and making adjustments, modifications, and refinements to the methods described in B.2. Other changes and modifications may not be apparent until the project is completed and the data is fully analyzed and discussed. These changes will be documented in progress reports and the final report and will include a detailed description of all data analyses used.

References

- Angermier, P.L. and J.R. Karr. 1986. Applying an index of biotic integrity based on stream-fish communities: considerations in sampling and interpretation. *N. Am. J. Fish. Mgmt.* 6: 418-427.
- Fore, L.S., J.R. Karr, and L.L. Conquest. 1993. Statistical properties of an index of biotic integrity used to evaluate water resources. *Can. J. Fish. Aquatic Sci.* 51: 1077-1087.
- Illinois EPA. 2005. Methods of collecting macroinvertebrates in streams (July 11, 2005 draft). Bureau of Water, Springfield IL. BOW No. xxxx. 6 pp.
- Illinois EPA. 2002. Water monitoring strategy 2002-2006. Bureau of Water, Springfield, IL. 54 pp. + appendices.
- Illinois EPA. 1997. Quality assurance methods manual. Section G: Procedures for fish sampling, electrofishing safety, and fish contaminant methods. Bureau of Water, Springfield, IL. 39 pp.
- Illinois DNR. 2001. IDNR stream fisheries sampling guidelines. Watershed Protection Section, Springfield, IL. 9 pp.
- Karr, J. R., K. D. Fausch, P. L. Angermier, 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 pp.
- Nelson, J.S. and 6 others. 2004. Common and Scientific Names of Fishes from the United States, Canada, and Mexico. Sixth Edition. *American Fisheries Society Spec. Publ.* 29. 386 pp.
- Ohio Environmental Protection Agency. 1989. Biological criteria for the protection of aquatic life. volume III: standardized biological field sampling and laboratory methods for assessing fish and macroinvertebrate communities, Division of Water Quality Monitoring and Assessment, Surface Water Section, Columbus, Ohio.
- Ohio Environmental Protection Agency. 1987. Biological criteria for the protection of aquatic life: volume II. users manual for biological field assessment of Ohio surface waters, Division of Water Quality Monitoring and Assessment, Surface Water Section, Columbus, Ohio.

- Rankin, E.T. 1995. Habitat indices in water resource quality assessments, in W.S. Davis and T.P. Simon (Eds.), *Biological Assessment and Criteria: Tools for Water Resource Planning and Decision Making*, Lewis Publishers, Boca Raton, FL, 181-208.
- Rankin, E.T. and C.O. Yoder. 1999. Adjustments to the Index of Biotic Integrity: a summary of Ohio experiences and some suggested modifications, pp. 625-638. . in T.P. Simon (ed.), *Assessing the Sustainability and Biological Integrity of Water Resources Using Fish Communities*. CRC Press, Boca Raton, FL.
- Rankin E. T. and Yoder, C. O. 1990. The nature if sampling variability in the Index of Biotic Integrity (IBI) in Ohio streams, pp. 9-18. in Davis, W. S. (ed.). *Proceedings of the 1990 Midwest Pollution Control Biologists Conference*, U.S. EPA, Region V, Environmental Sciences Division, Chicago, IL, EPA-905-9-90/005.
- Sanders, R.S.,
- Smith, P.W. 1979. *The fishes of Illinois*. Univ. Illinois Press, Urbana, IL. 314 pp.
- Smith, E. P. and J. R. Voshell. 1997. Studies of benthic macroinvertebrates and fish in streams within EPA Region 3 for development of Biological Indicators of Ecological Condition. Part 1, Benthic Macroinvertebrates. Report to U. S. Environmental Protection Agency. Cooperative Agreement CF821462010. EPA, Washington, D.C.
- Yoder, C.O. and E.T. Rankin. 1998. The role of biological indicators in a state water quality management process. *J. Env. Mon. Assess.* 51(1-2): 61-88.