



West Branch DuPage River

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

Second Revision

DuPage, Cook, and Will Counties, Illinois

DuPage River-Salt Creek Work Group
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Lower DuPage Watershed Coalition
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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)
Lower DuPage River Watershed Council (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 biological and habitat assessment will be coordinated and overseen by the Midwest Biodiversity Institute. Chris O. Yoder, Research Director will serve as the principal investigator and overall project coordinator. Senior MBI staff will be assigned

various aspects of the project under the oversight of the P.I. He will also be directly responsible for maintenance of the QAPP through the project period of July 1, 2012 through June 30, 2013. A functional table of organization appears in Figure 1.

Quality Assurance Project Plan: Functional Table of Organization

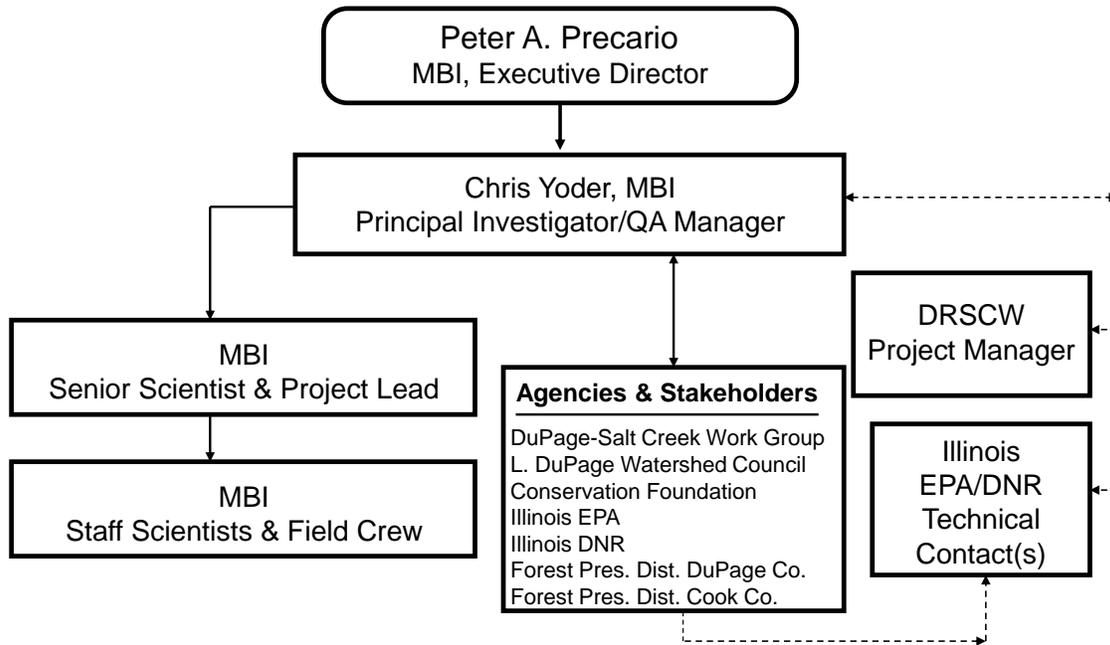


Figure 1. Functional table of organization for project implementation and management.

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, Cook, and Will Counties, Illinois. The study will emphasize the direct assessment of biological assemblages by sampling fish and macroinvertebrates using standardized sampling and

assessment methodologies. In addition to determining aquatic life status, the project will also ascertain the associated causes and sources associated with biological impairments by using paired 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 and the Lower DuPage River located in the northeastern region of Illinois and in accordance with the bioassessment plan (Appendix A) and the original 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. Habitat and biological 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 is a product of the congruence of the 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 fish 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) and by the Illinois Natural History Survey¹. 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; Ohio EPA 2006; Appendix C) and with the most recent updates by MBI. This includes the characterization and categorization of habitat attributes including

Table 1. Number of fish and macroinvertebrate sampling sites by method and protocol for each major subbasin in the DuPage River-Salt Creek watershed study areas updated for 2009-12. Fish sites are expressed as number of samples with two sampling passes at all sites. Ten percent of the macroinvertebrate sites will be resampled.

Assemblage Method (hrs./site)	West Branch 2012	East Branch 2011	Salt Creek 2010	Lower DuPage 2012	Reference Sites 2009-12	Total Sites
Fish – Boat/Tow						
Barge	16	12	24	15	8	75
Longline	18	12	20	10		60
Backpack	8	7	7	0		22
Totals	42	31	51	25	8	157
Macroinvertebrates						
IEPA Multi-Habitat	42	31	51	25	8	157
Totals	42	31	51	25	8	157

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

¹ The Fishes of Illinois maintained by INHS at: http://www.inhs.uiuc.edu/animals_plants/fish/

for most orders and families. All samples will be processed in the laboratory following Illinois EPA and Ohio EPA (1989) methods. 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.) ad 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 556	±0.2 S.U.	±0.01 S.U.	0-14 S.U.
Dissolved Oxygen	YSI 556	±0.01 mg/l	±0.3 mg/l	0-20 mg/l
Conductivity	YSI 556	±2%	±2%	0-4000 µS/cm
Temperature	YSI 556	±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 existing Illinois EPA and Illinois DNR reference sites, potentially being supplemented with other sites that meet the Illinois EPA criteria for reference conditions. One 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 smaller headwater streams, hence reference data is needed to accomplish an assessment of that data. Presently a total of eight (8) reference sites have been established with some sampled twice during 2006-2009 and the remainder to be sampled in 2012.

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. A minimum 300 feet long reach is established and is intended to meet qualitative criteria of representativeness and including one stream habitat cycle (i.e., pool-run-riffle sequence). Wider width sites will be extended to 600 feet.

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 the DuPage and Salt Creek subbasins we expect a wading electrofishing sample to produce 15-25 species and several hundred fish among those species. In higher 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 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. All of the MBI crew leaders have been certified as Level 3 Qualified Data Collectors under the Ohio Credible Data Law (OCDL).

The principal investigator designed and instructs in the OCDL 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).

A.9: Documents and Records

The Quality Assurance Project Plan and all updates will be jointly maintained by the DRSCWG and LDWC. 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 annual 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 MBI revised 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. The DRSCWG is currently developing a comprehensive database for the entire project. All biological and habitat data is initially managed by MBI, transformed, analyzed, and then transferred to DRSCWG.

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



Fish Data Sheet

Page ____ of ____

Field Crew: _____

River/ Stream: _____

Date: _____

River Code: _____

RMT: _____

Voltage: _____

% Range: _____

Time of Day: _____

Location: _____

Temp: _____

Conductivity: _____

Diss. Oxy: _____

D.O. %sat: _____

pH: _____

Project Code: _____

Site Code: _____

Seconds Fished: _____

Lat/Long (Beg): _____

Lat/Long (Mid): _____

Lat/Long (End): _____

Lat/Long (X-Loc): _____

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- warped scales, T- tumors, Z- other. [Heavy (H) or Light (L) code may be combined with above codes.]

Species	# Weighed	# Counted	Individual or Batch Weights or Length/ Weight	Anomalies	Lunker
W	10x				<input type="checkbox"/>
W	10x				<input type="checkbox"/>
W	10x				<input type="checkbox"/>
W	10x				<input type="checkbox"/>
W	10x				<input type="checkbox"/>
W	10x				<input type="checkbox"/>
W	10x				<input type="checkbox"/>
W	10x				<input type="checkbox"/>
W	10x				<input type="checkbox"/>

Mass Weighing Convention: _____

Total Weight: 536 (12)

Number Weighed: _____

Vouchers Collected:

Figure 3. MBI fish data sheet (continued)

Page ____ of ____

Species	# Weighed	# Counted	Individual or Batch Weights or Length/ Weight				Anomalies			Lunker
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>								<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>								<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>								<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>								<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>								<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>								<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>								<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>								<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>								<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>								<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>								<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>								<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>								<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>								<input type="checkbox"/>

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

MBI Midwest Biodiversity Institute **Qualitative Habitat Evaluation Index Field Sheet** QHEI Score:

River Code: _____ RM: _____ Stream: _____
 Site Code: _____ Project Code: _____ Location: _____
 Date: _____ Score: _____ Latitude: _____ Longitude: _____

1.1 SUBSTRATE (Check ONLY Two Substrate TYPE BOXES; Estimate % percent)

TYPE	POOL	RIFFLE	POOL	RIFFLE	SUBSTRATE ORIGIN	SUBSTRATE QUALITY	
<input type="checkbox"/> <input type="checkbox"/> BLD/SLBS [10]	<input type="checkbox"/> <input type="checkbox"/> GRAVEL [7]	<input type="checkbox"/> <input type="checkbox"/> SAND [6]	<input type="checkbox"/> <input type="checkbox"/> LIMESTONE [1]	<input type="checkbox"/> <input type="checkbox"/> SILT	<input type="checkbox"/> <input type="checkbox"/> SILT HEAVY [-2]		Substrate <input type="text"/> Max 20
<input type="checkbox"/> <input type="checkbox"/> BOULDER [9]	<input type="checkbox"/> <input type="checkbox"/> BEDROCK [5]	<input type="checkbox"/> <input type="checkbox"/> TILLS [1]	<input type="checkbox"/> <input type="checkbox"/> WETLANDS [0]	<input type="checkbox"/> <input type="checkbox"/> -SILT MODERATE [-1]	<input type="checkbox"/> <input type="checkbox"/> -SILT NORMAL [0]		
<input type="checkbox"/> <input type="checkbox"/> COBBLE [8]	<input type="checkbox"/> <input type="checkbox"/> DETRITUS [3]	<input type="checkbox"/> <input type="checkbox"/> HARDPAN [1]	<input type="checkbox"/> <input type="checkbox"/> SANDSTONE [9]	<input type="checkbox"/> <input type="checkbox"/> EMBEDDED	<input type="checkbox"/> <input type="checkbox"/> -SILT FREE [1]		
<input type="checkbox"/> <input type="checkbox"/> HARDPAN [4]	<input type="checkbox"/> <input type="checkbox"/> ARTIFICIAL [3]	<input type="checkbox"/> <input type="checkbox"/> RIP / RAP [0]	<input type="checkbox"/> <input type="checkbox"/> LACUSTRINE [3]	<input type="checkbox"/> <input type="checkbox"/> NESS	<input type="checkbox"/> <input type="checkbox"/> -EXTENSIVE [-2]		
<input type="checkbox"/> <input type="checkbox"/> MUCK [2]	<input type="checkbox"/> <input type="checkbox"/> SILT [2]	<input type="checkbox"/> <input type="checkbox"/> -SHALE [-1]	<input type="checkbox"/> <input type="checkbox"/> -COAL FINES [-2]	<input type="checkbox"/> <input type="checkbox"/> NONE [1]	<input type="checkbox"/> <input type="checkbox"/> -MODERATE [-1]		

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

COMMENTS: _____

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

(Structure)	TYPE: Score All That Occur	AMOUNT: (Check ONLY one or check 2 and AVERAGE)	
<input type="checkbox"/> UNDERCUT BANKS [1]	<input type="checkbox"/> POOLS > 70 cm [2]	<input type="checkbox"/> -EXTENSIVE > 75% [11]	Cover <input type="text"/> Max 20
<input type="checkbox"/> OVERHANGING VEGETATION [1]	<input type="checkbox"/> ROOTWADS [1]	<input type="checkbox"/> -MODERATE 25 - 75% [7]	
<input type="checkbox"/> SHALLOWS (IN SLOW WATER) [1]	<input type="checkbox"/> BOULDERS [1]	<input type="checkbox"/> -SPARSE 5 - 25% [3]	
<input type="checkbox"/> ROOTMATS [1]	<input type="checkbox"/> OXBOWS, BACKWATERS [1]	<input type="checkbox"/> -NEARLY ABSENT < 5% [1]	
	<input type="checkbox"/> AQUATIC MACROPHYTES [1]		
	<input type="checkbox"/> LOGS OR WOODY DEBRIS [1]		

COMMENTS: _____

3.1 CHANNEL MORPHOLOGY (Check ONLY one PER Category OR check 2 and AVERAGE)

SINUOSITY	DEVELOPMENT	CHANNELIZATION	STABILITY	MODIFICATIONS / OTHER	
<input type="checkbox"/> -HIGH [4]	<input type="checkbox"/> -EXCELLENT [7]	<input type="checkbox"/> -NONE [0]	<input type="checkbox"/> -HIGH [3]	<input type="checkbox"/> -SNAGGING	Channel <input type="text"/> Max 20
<input type="checkbox"/> -MODERATE [3]	<input type="checkbox"/> -GOOD [5]	<input type="checkbox"/> -RECOVERED [4]	<input type="checkbox"/> -MODERATE [2]	<input type="checkbox"/> -RELOCATION	
<input type="checkbox"/> -LOW [2]	<input type="checkbox"/> -FAIR [3]	<input type="checkbox"/> -RECOVERING [3]	<input type="checkbox"/> -LOW [1]	<input type="checkbox"/> -CANOPY REMOVAL	
<input type="checkbox"/> -NONE [1]	<input type="checkbox"/> -POOR [1]	<input type="checkbox"/> -RECENT OR NO RECOVERY [1]		<input type="checkbox"/> -DREDGING	
		<input type="checkbox"/> -IMPOUNDED [-1]		<input type="checkbox"/> -BANK SHAPING	
				<input type="checkbox"/> -ONE SIDE CHANNEL MODIFICATIONS	

COMMENTS: _____

4.1 RIPARIAN ZONE AND BANK EROSION (check ONE box PER bank or check 2 and AVERAGE per bank)

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

COMMENTS: _____

5.1 POOL / GLIDE AND RIFFLE / RUN QUALITY

MAX DEPTH	MORPHOLOGY	CURRENT VELOCITY (POOLS & RIFFLES)	
(Check 1 ONLY)	(Check 1 or 2 & AVERAGE)	(Check All That Apply)	Pool / Current <input type="text"/> Max 12
<input type="checkbox"/> - 1m [6]	<input type="checkbox"/> -POOL WIDTH > RIFFLE WIDTH [2]	<input type="checkbox"/> -EDDIES [1]	
<input type="checkbox"/> - 0.7m [4]	<input type="checkbox"/> -POOL WIDTH = RIFFLE WIDTH [1]	<input type="checkbox"/> -FAST [1]	
<input type="checkbox"/> - 0.4 to 0.7m [2]	<input type="checkbox"/> -POOL WIDTH < RIFFLE WIDTH [0]	<input type="checkbox"/> -MODERATE [1]	
<input type="checkbox"/> - 0.2 to 0.4m [1]	<input type="checkbox"/> -IMPOUNDED [-1]	<input type="checkbox"/> -SLOW [1]	
<input type="checkbox"/> - < 0.2m [POOL = 0]		<input type="checkbox"/> -NONE [-1]	
		<input type="checkbox"/> -TORRENTIAL [-1]	
		<input type="checkbox"/> -INTERMITTENT [-1]	
		<input type="checkbox"/> -INTERMITTENT [-2]	
		<input type="checkbox"/> -VERY FAST [1]	

COMMENTS: _____

CHECK ONE OR CHECK 2 AND AVERAGE

RIFFLE DEPTH	RUN DEPTH	RIFFLE / RUN SUBSTRATE	RIFFLE / RUN EMBEDDEDNESS	
<input type="checkbox"/> -Best Areas > 10cm [2]	<input type="checkbox"/> -MAX > 50 cm [2]	<input type="checkbox"/> -STABLE (e.g., Cobble, Boulder) [2]	<input type="checkbox"/> -NONE [2]	Rifle / Run <input type="text"/> Max 8
<input type="checkbox"/> -Best Areas 5 - 10cm [1]	<input type="checkbox"/> -MAX < 50 cm [1]	<input type="checkbox"/> -MOD. STABLE (e.g., Large Gravel) [1]	<input type="checkbox"/> -LOW [1]	
<input type="checkbox"/> -Best Areas < 5cm [0]		<input type="checkbox"/> -UNSTABLE (Fine Gravel, Sand) [0]	<input type="checkbox"/> -MODERATE [0]	
<input type="checkbox"/> -NO RIFFLE but RUNS present [0]			<input type="checkbox"/> -EXTENSIVE [-1]	
<input type="checkbox"/> -NO RIFFLE / NO RUN (Metric = 0)				

COMMENTS: _____

6.1 GRADIENT (ft / mi): _____ **DRAINAGE AREA (sq. mi.):** _____

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

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

Gradient Score from Table 7 of Open Channel Assessment guidelines and drainage area

Max 10

Figure 4. QHEI field data sheet (continued).

Is Sampling Reach Representative of the Stream? (Y/N) _____ If Not, Explain: _____

Lat / Long (Beg): _____
 Lat / Long (Mid): _____
 Lat / Long (End): _____
 Lat / Long (X-Loc): _____

Substrate Rating (1-10) _____ _____
 Asbestos Rating (1-10) _____ _____

Stream Drawing: Low Moderate High

First Sampling Pass _____ Gear: _____ Distance: _____ Water Clarity: _____ Water Stage: _____ Canopy- % open: _____
 Year No. _____

Is Stream Ephemeral (no pools, totally dry or only damp spots)?
 Is there water upstream? How far: _____
 Is there water close downstream? How far: _____
 Is Dry Channel mostly natural?

Major Suspected Sources of Impacts (Check All That Apply):
 None
 Industrial
 WWTP
 Agriculture
 Livestock
 Silviculture
 Construction
 Urban Rural
 CSOs
 Suburban Impacts
 Mining
 Channelization
 Riparian Removal
 Landfills
 Natural Dams
 Other Flow Alteration
 Other: _____

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 in very small amounts or if more common of marginal 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 deep / fast water, or deep, well-defined, functional pools.

Reporting

Progress reports will be made on a periodic basis and in accordance with the contract that supports the survey. These will be distributed by the DuPage River Salt Creek Watershed Group (see Section A.3). A final report will be produced in accordance with the requirements of the original bioassessment plan.

Group B: Data Generation and Acquisition

B.1: Sampling Process Design

The original bioassessment plan called 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. The first round of sampling conducted in 2006-7 was done at 123 sites and 6 reference sites. These were sampled again in 2009-11 with some site adjustments and additions in each year. The 2012 sampling will be the third for the West Branch DuPage River and the first for the Lower DuPage River. A combined stratified-random and targeted-intensive pollution survey design is 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 plans (Appendix A).

B.2: Sampling Methods

Biological sampling for fish and macroinvertebrate assemblage data will follow established protocols of the Illinois DNR (2001) and Illinois EPA (1997, 2005) and be capable of producing comparable data and assessments. The final bioassessment plan (Appendix A) specified the probable sampling protocols for each sampling site. In some cases the applicable 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 channel dimension 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

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

Parameter	Site Levels ²		
	Levels 6-7	Levels 2-6	Levels 1-2
Waterbody Size ³ Channel Dimensions: ⁴	<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 14' raft
Power Source: ⁵	12v battery or 300W alternator; ⁶ 1750 W alternator ⁷	1750-2500W alternator	2500 or 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: ⁸	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 ⁹	2-3	3	2

² Site levels described under Watershed Monitoring Design and described for each site in Tables 7-9.

³ Watershed size upstream from the sampling site.

⁴ Size dimensions are approximate and may vary by site – these should not be used as primary criteria.

⁵ Wattage (W) is sustained output (not peak output).

⁶ Back pack units can be either battery or generator powered.

⁷ This is used with the long line sampling method.

⁸ Basis for determining relative abundance parameters.

⁹ Crew consists of a qualified crew leader and field technicians.

from 150-200 meters in length. Non-wadeable sites will be sampled with either a boat or raft -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. A Smith-Root 2.5 GPP unit is used on a 14' raft. 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 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 or 14' raft 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/raft

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/raft in a manner that advantageously positions the netter to pick up stunned and immobilized fish. The driver also monitors and adjusts the 2.5/5.0 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/raft 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/raft 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/raft electrofishing run. 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 and the Field Museum of Natural History.

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 generally 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 and updated modification of the Qualitative Habitat Evaluation Index (QHEI; Ohio EPA 1989,2006; 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 (1989,2006) and Rankin (1989) with more recent modifications made by MBI that may not appear in the 2006 manual. A QHEI users guide appears in Appendix 3.

Macroinvertebrate Assemblage Methods

The macroinvertebrate assemblage will be sampled using three principal methods. The attributes of each are summarized in Table 4. The Illinois EPA multihabitat method (Appendix E) will be used as a matter of preference at all sites where it is feasible. The

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

Parameter	Site Levels ¹⁰		
	Levels 6-7	Levels 2-6	Levels 1-2
Waterbody Size ¹¹ Channel Dimensions: ¹²	<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;
Effort:	20 sweeps habitat defined 300 feet	20 sweeps; habitat defined 300 feet	20 sweeps; habitat defined 300-600 feet
CPUE Basis: ¹³	No. individuals per site	No. individuals per site	No. ind./site; No./m ²
Subsample:	300 organisms	300 organisms	300 organisms;
Taxonomic Resolution:	Lowest Practicable	Lowest practicable	Lowest practicable
Crew Size ¹⁴	2	2	2

¹⁰ Site levels described under Watershed Monitoring Design and described for each site in Tables 7-9.

¹¹ Watershed size upstream from the sampling site.

¹² Size dimensions are approximate and may vary by site – these should not be used as primary criteria.

¹³ Basis for determining relative abundance parameters.

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

MAIS method (Appendix F) adapted for application to Illinois streams will be used in lieu of the multihabitat method in small headwater streams and artificial substrates (Ohio EPA 1989) will be used at larger sites. This will be determined during sampling.

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 and up to 800 feet long in order to meet the qualitative criteria for a site. 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 multihabitat-sampling method, as described in "*Quality Assurance and Field Methods Manual*" in *Section C: Macroinvertebrate Monitoring* (Illinois EPA 2010) 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.

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 and as subsequently modified by MBI.

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.

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. 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 and to make users aware of any recent modifications and updates. Visual identity is the 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. Each QHEI is re-examined at all two pass fish sampling 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 will be re-sampled with the IEPA multi-habitat method. This will allow the establishment of baseline variability within a seasonal index period to be established. A 10% subset of laboratory processed samples will also 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. Equipment is adjusted as needed following 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 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 and LDWC project coordinators

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 if they so wish. This will be coordinated by the DRSCW and LDWC project coordinators and the MBI principal investigator.

C.2: Reports to Management

The principal investigator will file periodic verbal and/or written reports with the DRSCW and LDWC project coordinators. 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.

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