INTRODUCTION

Complex interactions of biological, chemical, and physical components shape stream ecosystems. The evaluation of physical habitat is essential to the assessment of stream ecosystem health and biological integrity (Plafkin et al. 1989; Barbour and Stribling 1991). The intent of this document is to provide standard procedures for gathering and evaluating biological and physical habitat data collected from wadeable streams and rivers in Iowa. The information obtained from these sites defines biological indicies and stream habitat conditions in the ecoregions of Iowa.

Four main components (Fish Management Wadeable Stream Survey)
1. Stream & site selection
2. Fish community assessment
3. Habitat assessment
4. Riparian area assessment

1. Stream & site selection

Stream selection
Stream selection is an important component of surveying wadable streams. With over 19,000 miles of inland streams in the state of Iowa, it is unrealistic and inefficient to contemplate effectively sampling all stream reaches. Thus, it is imperative that a prioritization schedule be developed to guide the stream selection process. Twelve-digit Hydrologic Unit Codes (HUCs) are watersheds of similar size that have been identified and standardized nationwide by the US Geological Survey and the US Department of Agriculture’s Natural Resources Conservation Service. HUC 12 watersheds are logically derived, based on nesting small watersheds (Iowa mean ~ 22,000 acres, range 5,625 – 39,687 acres) within contiguous drainages of increasingly larger river systems. Mean stream order at the outlet of headwater HUC 12 is 3.5, and a second- or third-order stream is approximately the smallest sampling area to be considered for representative, perennial, fish-inhabited stream. Therefore, stream selection should be based on HUC 12 watersheds, with one stream per HUC 12 being surveyed.

The following priorities should be considered when selecting which HUC 12 watersheds to sample within IDNR Fisheries Management Districts:
- Importance as a recreational fishery
- Elapsed time since the most recent survey within the HUC 12
- Necessity of collecting current information

The importance of the stream as a recreational fishery is assumed to be locally derived knowledge, as would be the necessity to collect current information on a particular stream. In the absence of a significant need presented in either of the above mentioned
scenarios, the elapsed time since the most recent survey should be used to select streams for further investigation.

Information regarding when, or if, a stream has been sampled is readily available from the Iowa Stream Fish Database, which can be accessed via the Iowa Rivers Information System (IRIS). IRIS is an online tool which provides very detailed information to help managers and researchers assess certain site attributes before leaving the office. IRIS contains a catalogue of all known stream fish samples collected between approximately 1850 and 2002. Efforts are currently underway to update the system to include recent samples as well. Information from the Iowa Stream Fish Database available from IRIS includes sample location, sampling date, author or field investigator, sampling gear and species present. Other information available includes recent rainfall, USGS gaging station data, links to EPA water quality data, current weather radar, documented species lists for all stream reaches where samples have been collected, and modeled species lists from Aquatic GAP for all unsampled stream reaches in Iowa. All of these items are available via map-based query tools on IRIS at http://ortho.gis.iastate.edu/iris/

Many HUC 12 watersheds have never had their fish community sampled, thus these watersheds should form the first priority list for developing a stream sampling plan. Other priorities would include re-sampling stream reaches that were sampled by Menzel et al. in the 1970s and 1980s in preparation for the republishing of Iowa Fish and Fishing. Stream reaches that have been sampled since the mid-1990s by either the Stream Research team of the Fisheries Bureau’s Research Section (Gelwicks et al.), or the Biological Assessment team from the Environmental Services Division of IDNR (Wilton et al.), should not be a priority for resampling.

Site selection
Once a stream has been selected as a potential target for further investigation, site selection is the next important component in the stream survey protocol. The stream reach intended for a survey needs to be reflective of the overall characteristics of the stream. Other site considerations include; accessibility (for getting equipment in and out of stream), depth (is it wadable), flow height (surveys should be conducted during base flow or lower conditions), stream width (can it be done effectively with equipment on hand), bottom substrate (too much silt will make survey difficult), and landowner permission if site is on private land. Prior to conducting a field visit, managers should investigate the site using the tools available on IRIS to peruse the area via aerial photographs. Multiple potential stream reaches should be identified, looking at potential accessibility, riparian land use, and lack of confluences with other streams in the sampling reach. Potential species lists for each potential sampling reach should be compared prior to conducting site visits, to assist in the determination of the most preferable sampling reach.

Stream reach selection for sampling purposes occurs after completing a reconnaissance visit to the stream. Reconnaissance usually takes place in the spring prior to the sampling season. The objectives of sampling reconnaissance are:

(1) identify the most desirable area to sample within a targeted segment of stream;
(2) determine the best sampling access point and obtain permission if the site is located on private property;
(3) tentatively define sampling reach boundaries; and
(4) assess fish sampling equipment needs

The habitat characteristics of the designated sampling reach should be consistent with sampling objectives and representative of other stream habitats in the region. The designated sampling reach should be free of abrupt changes in channel morphology and riparian land uses. For example, a length of stream that includes both a section of channelized stream and a section of meandering stream lacks uniformity in channel morphology. Therefore, the reach could not be considered representative of either habitat (i.e., channelized stream or natural stream channel).

The designated sampling reach should be located in such a way as to avoid including stream confluences or artificial structures (e.g., low head dams, bridges). At the majority of sites, road crossings are the access to the stream sampling areas. The sampling reach should be located sufficiently upstream or downstream from the bridge to exclude any artificial habitat or channel straightening associated with the bridge.

2. Fish community sampling

Equipment needed

Location
- County Platt book(s)
- Aerial photo
- GPS handheld

Fish Sampling
- 1-2 Back-pack electrofisher or barge shocker
- 2 short handled dip-nets (1/16 - 1/8th bar mesh)
- 1-2 (5) gal bucket w/ handle
- Fish tub (optional)
- Plastic minnow jars (pint) w/preservative (alcohol) & labels
- Chest waders
- Fish measuring board
- Fish Data sheets (water proof)
- Fish ID book
- Upstream block net

I. DATA COLLECTED

The sampling methods described below provide a representative, semi-quantitative sample of the fish community inhabiting the designated sampling reach. The data collected allow the estimate of the following community parameters of the fish sample:

1) species composition;
2) species relative abundance (i.e., number of fish of each species as a percentage of the total number of captured fish);
3) fish abundance (i.e., catch per unit effort);
4) proportion of fish with external abnormalities.

The methods employed do not provide quantitative information suitable for fish population or biomass estimates.

II. SAMPLING CREW
A crew of three to six members using electrofishing techniques samples the fish in the designated sampling reach. A professional biologist with expertise in electrofishing technique and fish identification supervises the crew. The members of the crew must have an educational background in fisheries or aquatic biology. Training in proper electrofishing technique and fish identification is also required. The crew leader is responsible for reviewing sampling duties and safety precautions with the sampling crew before initiating sampling.

III. SAMPLING APPROACH
Fish sampling occurs in the designated stream reach, generally ranging in length from minimum 500 to a maximum of 1500 feet. Sampling reach distance is calculated at 40x the average stream width (estimated) e.g. A stream with an average width of approximately 20 feet would require a sampling distance of 20ft x 40 = 800ft. Sketch a map of the sampling reach, including benchmarks and major habitat features, during the physical habitat evaluation.

For this project, fish sampling requires the use of direct current electricity supplied by the electrofishing gear. Sample small headwater streams, with average base-flow widths of less than 20 feet, using a single backpack shocker. Two backpack shockers are used simultaneously in wadeable streams that are too wide (>20 feet) to sample effectively with a single backpack unit. A tow boat electrofishing unit consisting of generator, electrical control box, retractable electrodes, and a live well is used in relatively deep or wide wadeable streams which cannot be effectively sampled with backpack shockers. Record the equipment used during fish sampling on the Fish Data Sheet (Appendices 6.2-6.4).

The crew completes a single pass through the sampling reach proceeding from downstream to upstream to capture fish. The downstream starting point should be the same as the habitat assessment transect #1. It is important to uniformly sample all types of fish habitat. Sample riffles, woody debris snags, and other productive habitats thoroughly by
methodically sweeping each area with the shocker electrode(s) in an effort to capture all fish. All stunned fish are collected in 3/16"-mesh landing nets and transferred to plastic buckets or holding tanks until processing. Whenever practical, the upstream and downstream boundaries of the sampling reach are blocked using 3/4" block nets to prevent highly mobile fish (e.g., Catostomid species) from leaving the sampling area.

The amount of time elapsed and distance sampled during the fishing effort is recorded on the Fish Data Sheet (Appendices 6.2-6.4) to allow the catch per unit effort to be determined. This recording can be the elapsed time in hours and minutes or as total seconds used on the backpack shocker(s). Record measurements of stream reach length and average stream width during the habitat evaluation. These measurements allow calculations of the catch per unit effort on a linear or aerial basis.

IV. FISH ID & EXAMINATION
Capture stunned fish in the 3/16"-mesh landing nets and transfer the catch to plastic buckets or holding tanks. To prevent unnecessary fish mortality, provide fresh water periodically and keep captivity time to a minimum. At the end of the reach or chosen stopping point, identify and enumerate captured fish before releasing. Fish can be processed and released at several points along the sampling reach or processed at the end of the reach, whichever is more efficient. **Exclude fish collected that are less than one inch long from the sample.** In addition, examine each for the presence of external abnormalities such as skeletal deformities, eroding fins, lesions, and tumors (DELTs). Record the number of fish per species on the Fish Data Sheet (Appendices 6.2-6.4). Tally the number of fishes exhibiting one or more abnormality that is external and the types of external abnormalities by species on the Field Data Sheet. Fish examination and DELT coding procedures are adopted from the Ohio EPA fish sampling procedures (OEPA 1989; Appendix 6.5). Fish taxonomy references are available in the field (e.g., IDNR 1987) to assist crewmembers with identification. Preserve all unidentifiable fish in the field with a 10% formalin solution for later laboratory identification by a state fish taxonomist. A voucher/reference collection is currently being established to facilitate accurate future identifications.
5.0 References


Introduction

Complex interactions of biological, chemical, and physical components shape stream ecosystems. The evaluation of physical habitat is essential to the assessment of stream ecosystem health and biological integrity (Plafkin et al. 1989; Barbour and Stribling 1991). The intent of this document is to provide standard procedures for gathering and evaluating physical habitat data collected from wadeable streams and rivers in Iowa. The information obtained from these sites defines stream habitat conditions in the ecoregions of Iowa and complements the development of biological criteria.

The habitat evaluation procedures described below, initiated during the 1994 pilot stream biocriteria sampling study, are evaluated on a continual basis (IDNR 1994). This document has received some modification because of the experience gained from the pilot study. This habitat evaluation protocol is a working document that requires periodical updating to reflect any future procedural modifications.

General approach

There are three separate but equally important steps in the evaluation of the physical habitat at biocriteria sampling sites: (1) data gathering; (2) data compilation; and (3) habitat quality assessment.

Evenly distributed stream cross-section transects throughout a designated sampling reach are used to systematically gather habitat data. Several habitat variables are measured or observed at each transect. Completion of a sketched map, showing the major habitat features of the stream reach, also occurs during the sampling process.

Habitat transect data are compiled and summarized using a standardized format. The compiled transect data are used to rate variables contained in two habitat assessment models. Each model consists of an assessment form and documentation that describes how to evaluate the instream and riparian habitat variables contained in the model. Each assessment form yields an overall habitat quality score that relates to qualitative categories (i.e., excellent, good, fair, or poor) or the scores of other sampling sites.

Data Gathering

I. DATA SHEETS

Recorded and compiled on five data sheets (Appendix 1.0) are the sampling site information and habitat data. The following list contains the forms used during a habitat analysis:

- Form A - Sampling Site Information (Appendix 1.1);
- Form B - Stream Transect Habitat Data (Appendix 1.2);
- Form C - Sampling Reach Map (Appendix 1.3); and
- Form D - Habitat Data Summary (Appendix 1.4)

Evaluation of the above prototype data sheets occurred during the 1994 pilot study. It was determined that the data sheets are adequate and their use has continued. The next several sections describe how information is gathered and recorded on the data sheets.
II. SAMPLING SITE INFORMATION

Record the information needed to properly document the sampling site on Form A - Sampling Site Information (Appendix 1.1). Record the stream name and sampling date on the top line of the form. On the next line, provide a brief description of where the sampling site is located in relation to a town or other landmark on a transportation map. Assign a unique ecoregion site number and a six-digit STORET number prior to sampling and record in the spaces next to “Site No.” and “STORET No.” Record the U.S. EPA waterbody system number for the stream segment in which the sampling site is located in the space next to “Waterbody No.”

Several pieces of information are obtained from 7.5 minute USGS quadrangle maps and recorded on Form A, including: legal description, latitude and longitude, stream order, gradient and sinuosity. Obtain the drainage basin area from ”Drainage Areas of Iowa Streams” (Larimer 1957). Also record the names of the 7.5-minute map and the USGS 1:100,000-scale map on which the sampling site is located on Form A in the spaces provided.

Follow the standard procedure below to estimate the gradient of the stream segment containing the sampling site:

1. Define the segment endpoints by using the first intersection of the stream and a contour line upstream from the sampling site and the first intersection of the stream and a contour line downstream from the sampling site.
2. Following the course of the stream, measure the distance between the two segment endpoints using a planimeter.
3. Divide the change in elevation between endpoints (either 10’ or 20’ depending on the contour interval) by the segment length.
4. Express the result as the number of feet per mile change in stream elevation (i.e., stream gradient).

Follow the protocol below to estimate channel sinuosity for the same stream segment used to estimate stream gradient:

1. Divide the stream segment length by the straight-line distance between the segment endpoints.
2. Express the sinuosity of the stream channel as a multiplication factor of the straight-line distance between the stream segment endpoints. For example, a sinuosity factor of two indicates the stream segment length is twice as long as the straight-line distance between segment endpoints.

Spaces are provided on Form A to record the following field observations: air temperature, water temperature, water clarity, stream flow level, specific conductance, turbidity, dissolved oxygen, pH, and channel condition. Collect stream width measurements to determine the appropriate length of stream to sample (discussed in Section 3.4.2). Record the individual measurements and the average of the measurements on Form A. Use the spaces provided on Form A to record the subjects and frame numbers of any photographs taken of the sampling area.
III. SAMPLING AREA

1. Scale
Biological sampling and physical habitat evaluation for biocriteria development purposes take place in a designated sampling reach. The stream reach is widely recognized by fishery biologists and aquatic ecologists as a useful spatial scale for evaluating the effects of human activities on streams. The terms sampling site and sampling reach are interchangeable throughout this document.

In terms of scale, a stream reach encompasses a greater area than a bedform unit (e.g., pool, run), but less area than a stream segment (Frissell et al. 1986). A generalized definition of a stream reach is "breaks in physiography, land use, or channel morphology and usually includes several repetitions of bedform units define a stream reach." Typically, a stream segment encompasses several reaches of stream and segment boundaries are often confluences of major tributaries.

2. Representation
Stream reach selection for sampling purposes occurs after a completing a reconnaissance visit to the stream. Reconnaissance usually takes place in the spring prior to the sampling season. The objectives of sampling reconnaissance are:

(5) identify the most desirable area to sample within a targeted segment of stream;
(6) determine the best sampling access point and obtain permission if the site is located on private property;
(7) tentatively define sampling reach boundaries; and
(8) assess fish sampling equipment needs

The habitat characteristics of the designated sampling reach should be consistent with sampling objectives and representative of other stream habitats in the region. If the site is a candidate reference site, the sampling reach must represent the most natural, undisturbed stream habitats found in the region. In addition, sampling occurs at sites representing impacted or degraded stream habitats. In these cases, the habitat characteristics of the sampling reach should reflect the alleged type of impact occurring in the reach.

The designated sampling reach should be free of abrupt changes in channel morphology and riparian land uses. For example, a length of stream that includes both a section of channelized stream and a section of meandering stream lacks uniformity in channel morphology. Therefore, the reach could not be considered representative of either habitat (i.e., channelized stream or natural stream channel).

The designated sampling reach should be located in such a way as to avoid including stream confluences or artificial structures (e.g., low head dams, bridges). At the majority of sites, road crossings are the access to the stream sampling areas. The sampling reach should be located sufficiently upstream or downstream from the bridge to exclude any artificial habitat or channel straightening associated with the bridge.
3. Stream length
The length of stream encompassed by a designated sampling reach can vary from 500 - 1500 feet depending on the width of the stream and the frequency of repetition of the major types of habitat (e.g., pools, riffles, runs, channel bends). To ensure adequate habitat coverage, a sampling reach should include either: (a) two distinguishable pool/riffle sequences or (b) two well defined channel bends (in streams lacking well-defined pools and riffles).

A sampling reach length of 150 meters (492.13 feet) is the recommended minimum for wadeable streams (OEPA 1989; Meador et. al 1993). A designated sampling reach of 500 feet shall be the minimum length of stream sampled regardless of the frequency of habitat repetition. Apply the following protocol to determine the length of the designated sampling reach:

1) To ensure adequate habitat representation in streams with pool/riffle sequences or channel bends, the designated sampling reach should include:
   a) two distinguishable pool/riffle sequences or
   b) two well defined channel bends (in streams lacking pool/riffle sequences)
2) For those streams lacking pool/riffle sequences or channel bends, the following criteria apply:
   a) Streams ≤40 feet in mean width, the designated sampling reach shall be 30X the mean width with a 1200 feet maximum length.
   b) Streams >40 feet in mean width, the designated sampling reach shall be 20X the mean width with 1200 feet maximum length.

The above are guidelines with the realization that some sampling reaches may extend longer than 1200 feet due to an erroneous estimate of stream width or because of the distance between adequate pool/riffle sequences or channel bends.

IV. HABITAT TRANSECTS
1. General considerations
The sequence of biocriteria sampling tasks is described in “Biological Sampling Procedures for Wadeable Streams of Iowa” (IDNR 1994). To avoid disrupting the sampling environment, collect transect measurements and make habitat observations after the collection of biological samples. A crew of at least three crewmembers gathers the habitat data. Transect data collection is normally completed in 1-1.5 hours. Field crewmembers should become familiar with the data collection procedures before participating in sampling. It is the sampling crew leader’s responsibility to ensure that crewmembers follow all applicable procedures for measurement and observation of habitat variables.

Equipment needed

Location
- County Platt book(s)
- Aerial photo
• GPS handheld

Habitat Sampling
• 100’ measuring tape (stream width)
• foldable 48-72” ruler (stream depth by 1/10 increments)
• Stadia rod (bank angle & depth)
• Clinometer (bank angle in degrees)
• Spherical Densiometer (overhead canopy cover)
• Range finder (bank full width & sampling reach length)
• Marking flags for start, middle, and finish transects (riparian buffer)
• Flow meter
• Other misc. meters (conductivity & temp.)
• Data sheets (water proof)
• Digital camera

Miscellaneous
• Clip board
• Bug spray
• Drinking water & cups
• Cell phone (emergencies)

2. Transect spacing
Several important habitat variables are measured, or visually estimated, at 10 stream cross-section transects evenly spaced throughout the designated sampling reach and Form B: Transect Observations (Appendix 1.2) is used to record the data. Figure 1 is a hypothetical example of a stream sampling reach. The first transect is established at the downstream boundary of the sampling reach. All of the remaining transects are located at regularly spaced intervals upstream from the first transect at distance approximately equal to three times the average wetted channel width (i.e., stream width) of the stream sampling reach. The final transect should coincide with the end point of the fish sampling reach, and the total length of stream sampled should be divided by nine (9) to determine the appropriate distance between transects. If the average stream width is estimated to be fifty feet or more, a transect interval of two times the stream width is used to establish new transects.

3. Establishing transects and mapping
Establish transect #1 at the downstream boundary of the designated sampling reach. Stretch a 100’ (30 meter) fiberglass tape across the stream perpendicular to the main direction of flow. Establish new transects by
measuring one-ninth of the total stream length to be sampled upstream from the previous transect following the middle of the channel. Each new transect line is established again by measuring this same distance upstream tape from the previous transect line. If you encounter sharp bends while moving to the next transect line, make sure the mid-channel course of the stream is followed. If the sampling reach is extremely sinuous, it may be necessary to move upstream in short segments in order to move the correct distance following the mid-channel line.

As the habitat evaluation proceeds upstream, sketch a map of the sampling reach on Form C: Sampling Reach Map (Appendix 1.3). Show the locations of cross-section transects and major habitat features such as channel bends, pools, riffles, sediment bars, and woody debris snags on the map. Indicate the locations of the sampling reach boundaries, the stream access point, the deepest spot of the sampling reach, and any landmarks that may be helpful later for returning to the sampling reach. It is also helpful to indicate the place of collection within the sampling reach for the Hess or Artificial Substrate samples, where the electrofishing began and ended, and to characterize the riparian vegetation and land uses.

Along the left side of Form C, a tally is kept of the types of macrohabitat (i.e., pool, riffle, run) encountered and the presence of submersed large woody debris. Macrohabitat type and large woody debris are observed systematically while moving upstream from one transect to the next. Observations are recorded at each established transect and at each interval equal to one times the average stream width of the sampling reach.

The observer views the stream cross-section at each observation point and records the predominant type of macrohabitat and the presence of large, submersed woody debris. Whichever macrohabitat type is clearly dominant is recorded on Form C in the "Macro Hab." column using the following abbreviations: pool (po); riffle (ri); or run (ru). If the cross-section is divided relatively equally between two types of macrohabitat (e.g., 1/2 pool, 1/2 run), it is permissible to record both types in the space provided. Record the presence of large woody debris by simply placing a check mark in the "Lrg. Wdy Dbrs" column. Large woody debris is operationally defined as at least one submersed piece of wood of \( \geq 3'' \) diameter and \( \geq 3' \) length.

3.4.4 Transect measurements and observations

Collect the following measurements and observations at all stream cross-section transects and record sequentially on Form B: Stream Transect Habitat Data (Appendix 1.2).

**Macrohabitat type:** Record the dominant type of macrohabitat in the “Macro Hab.” column using the following abbreviations: PO = pool/glide; RI = riffle; RU = run.

**Stream width:** Measure the wetted channel width (i.e., stream width) to the nearest 1/10 foot using a fiberglass tape stretched across the stream channel perpendicular to the main axis of flow. Record the measurement in the “Stream Width” column. As a matter of convention, the width of an exposed sediment bar is included in the total stream width measurement; however, the width of an island is subtracted from the stream width measurement. Sediment bars are composed of rock, sand, or silt deposits and differ from
islands in that they are inundated during minor episodes of elevated flow and lack permanent terrestrial vegetation.

**Water depth and substrate type:** Observe water depth and substrate types at five points along each transect line. Determine the interval between observation points by dividing the stream width by five (i.e., interval is equal to 1/5 X stream width). Establish the first point by using a distance equal to 1/2 the interval (i.e., 1/10 X stream width) from the left shore (facing upstream). The remaining four transect points are spaced equidistantly from each other across the stream (i.e., 3/10, 5/10, 7/10, and 9/10 X stream width). For example, if the stream width is 10', the five transect observation points would be located at 1', 3', 5', 7' and 9' from the left shoreline.

Using a graduated wading rod, or staff, measure water depth to the nearest 0.1' or cm at each transect observation point. Take care not to push the staff or rod into the bottom when soft substrates are encountered. Record each measurement on Form B in the "Depth" column and circle the appropriate unit of measurement (ft or m).

Looking straight down at the stream bottom below each observation point on the transect line, determine the dominant type of substrate (excluding living plant matter). The dominant substrate type is that which occupies 50% or more of the surface area directly below the observation point. When visibility is obscured, determine substrate type by feeling the bottom or probing it with the wading rod or staff. Using the abbreviations and size criteria listed below (adapted from Platts et al. 1983), record each substrate observation on Form B in the "Substrate Type" column.

<table>
<thead>
<tr>
<th>Substrate code</th>
<th>Code abbreviation</th>
<th>Size (maximum diameter)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bedrock</td>
<td>be</td>
<td>no criterion</td>
</tr>
<tr>
<td>Boulder</td>
<td>bo</td>
<td>&gt; 10 inches</td>
</tr>
<tr>
<td>Cobble</td>
<td>co</td>
<td>10 - 2.5 inches</td>
</tr>
<tr>
<td>Gravel</td>
<td>gr</td>
<td>2.5 - 0.10 inches</td>
</tr>
<tr>
<td>Sand</td>
<td>sa</td>
<td>2 - 0.062 millimeters</td>
</tr>
<tr>
<td>Silt</td>
<td>si</td>
<td>0.062 - 0.004 millimeters</td>
</tr>
<tr>
<td>Clay/Hardpan</td>
<td>cl</td>
<td>0.004 - 0.00024 millimeters</td>
</tr>
<tr>
<td>Detritus/Muck</td>
<td>de</td>
<td>no criterion</td>
</tr>
<tr>
<td>Wood</td>
<td>wo</td>
<td>no criterion</td>
</tr>
</tbody>
</table>

**Maximum depth:** Find the deepest point along the transect line by probing with the wading rod or staff. Record the depth on Form B in the "Max Depth" column and circle the appropriate unit of measurement (ft or m).

**Embeddedness rating:** At each shallow riffle or run transect (average depth ≤1.5’) rate the degree of coarse substrate embeddedness. Using the following 1-5 rating scheme, estimate the average percent surface area of coarse substrate particles (i.e., large gravels, cobbles or small boulders) that is surrounded by fine sediments: 1 = 0-20%; 2 = 20-40%; 3 = 40-60%; 4 = 60-80%; and 5 = 80-100%. Rate the embeddedness of three or more
substrate particles along the transect line and record the average rating on Form B in the “Embed Rating” column.

Instream cover: Instream cover is defined as any place where fish rest, hide, and feed (Hamilton and Bergersen 1984). Cover may be associated with many different habitat features including, but not limited to, deep pools, undercut banks, woody debris, aquatic vegetation, boulders, overhanging terrestrial vegetation, and foreign objects (e.g., discarded tires). Cover may be further defined according to the following acceptable depth and current velocity criteria: depth ≥0.5’ and current velocity ≤0.5 ft./sec. (Wesche, 1980). Estimate the amount of instream cover by identifying all potential areas of cover intercepted by the transect line and determine whether these areas meet the depth and velocity criteria. Total the width of all acceptable cover areas intercepted by the transect line and express the total as a percentage of the stream width at that transect line (to the nearest 5%). Record the percentage estimate and type of instream cover on Form B in the “% Instr. Cover/Type” column.

Bare stream bank: Estimate the percent stream bank that is bare on both the left and right stream banks (facing upstream). Bare stream bank is defined as "not anchored by plant tops or roots, rock, or artificial material such as concrete rip-rap." Restrict your observations to the first five feet (or 1.5 meters) of stream bank extending back from the shoreline on the transect line. Record the estimates of percent bare stream bank (to the nearest 5%) for both the left and right stream banks on Form B in the “% Bare Stream Bank” column.

Buffer strip width: The definition of a buffer strip is "a well-vegetated, undisturbed strip of land adjacent to a stream." In Iowa, deciduous woodland vegetation, perennial herbaceous vegetation, or a combination of the two usually covers buffer strips. Buffer strips may exist on one side or both sides of a stream and they do not necessarily encompass the entire riparian zone. Often, a very narrow strip of undisturbed land along the stream is all that remains as a buffer against human activities in the flood plain. Through the encroachment of various riparian land use activities (livestock grazing, mining, row crop cultivation, road construction, and urban/suburban development), buffer strips are often eliminated or reduced in size thus rendering streams more susceptible to pollution and habitat degradation. Estimate the widths of both the left and right side buffer strips to the nearest 10' at transects 1, 5, and 10. Be sure to follow the contour of the land from the top of the stream bank to the landward edge of the buffer strip. Record the buffer strip width and type on From B in the "Buffer Strip Width &
"Veg" column. Record buffer strips that are wider than 100' as >100' and where there is evidence of disturbance along the stream corridor (e.g., livestock grazing) record the buffer strip width as zero (0).

**Number of open canopy observations:** At each transect, estimate the amount of open canopy (i.e. not shaded by overhead vegetation) at three places along the transect line using a concave spherical densiometer. The spherical densiometer uses a concave mirror surface with a grid of horizontal and vertical lines etched on the surface. There are 37 corner and line intersection points in the grid. Hold the densiometer at waist level, face upstream, and view the overhead riparian vegetation canopy reflected onto the mirror surface. Take the counts of where the line intersections or corners are covered by overhead vegetation while facing upstream standing at the left shoreline, in the middle of the stream, and at the right shoreline. Record the number of grid observation points that intercept open sky at each transect position on Form B in the "Sph. Dens. # Open Canopy" column.

**5. Stream flow**

Measure stream flow at an appropriate point in the designated sampling reach with the following characteristics: moderate current, free of obstructions, and has a relatively homogeneous stream bottom contour. Obtain the flow data by taking measurements of depth and current velocities using the Aquacalc AQ5000 flowmeter® (JBS Instruments, Division of JBS Energy, 311 D Street, West Sacramento, CA 95605), along a cross-section transect of the stream. Use the guidelines below as general criteria to select an appropriate measurement interval:

<table>
<thead>
<tr>
<th>Transect width</th>
<th>Measurement interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤5' (≤1.5m)</td>
<td>0.5' (0.2 m)</td>
</tr>
<tr>
<td>6-10' (2.5-4 m)</td>
<td>1' (0.3 m)</td>
</tr>
<tr>
<td>11-20' (4.5-6 m)</td>
<td>2' (0.5 m)</td>
</tr>
<tr>
<td>&gt;20' (&gt;6 m)</td>
<td>3' (1.0 m)</td>
</tr>
</tbody>
</table>

Shorten the measurement interval when working in a section of stream that has an irregular bottom contour and significant variability in current velocity. Collect velocity readings at 0.6 X water depth when depth does not exceed 2.5 feet and the Aquacalc AQ5000® flowmeter automatically calculates the flow. If the selected velocity location exceeds this depth, take velocity readings at 0.2X depth and 0.8X depth and average the two.
V. DATA COMPILATION

Compile and summarize data on Form D - Habitat Field Data Summary (Appendix 1.4). The purpose of compiling the data is to aid in completing the habitat assessment forms discussed in the next section. Much of the data compilation process involves calculating simple arithmetic means from the transect data recorded on Form B. A scientific calculator or computer spreadsheet with simple statistical functions may suffice for this purpose. The data compilation process, described below, follows systematically through each of the habitat variables listed on Form D.

**Stream Reach Dimensions:**
Mean and Standard Deviation of Stream Width: Calculate the mean and standard deviation of stream width (i.e., wetted channel width) from the ten transect measurements of stream width. Record these on Form D next to “Mean Stream Width” and “Standard Deviation Stream Width” and circle the appropriate unit of measurement (feet or meters).

Reach Length and Reach Area: Reach length is equal to the number of transects multiplied by the transect interval. Record this figure in the space next to “Reach Length” and circle the appropriate unit of measurement (feet or meters). Calculate reach area by multiplying the reach length times the mean stream width. Record the reach area on Form D in the space next to “Reach Area” and circle the appropriate unit of measurement (feet$^2$ or meters$^2$).

Maximum Water Depth: Record the maximum depth observed in the designated sampling reach. Maximum depth is usually measured while wading the stream during transect data collection. Habitat observers should be aware that deep areas in the reach may not be intercepted by a transect line. Record maximum depth on Form D in the space next to “Maximum Water Depth” and circle the appropriate unit of measurement (feet or meters). If the deepest area is too deep to wade, indicate the maximum depth as >5’.

Mean Thalweg Depth: Calculate the mean of all 10 habitat transect maximum depth measurements. Record the value on Form D in the space next to “Mean Thalweg Depth” and circle the appropriate unit of measurement (feet or meters).

Mean Depth and Standard Deviation of Depth: Calculate the mean, and standard deviation, of the 50 depth measurements obtained from the 10 habitat transects. Record these values on Form D in the spaces next to “Mean Water Depth” and “Std. Dev. Depth.” Circle the appropriate unit of measurement (feet or meters).

Stream Width:Thalweg Depth: Divide the mean stream width by the mean thalweg depth to calculate the stream width:thalweg depth ratio. Record this ratio on Form D in the space next to “Stream Width:Thalw. Depth.”

**Substrate Composition and Quality:**
Substrate Composition and Quality: Tally the number of observations of each substrate type and calculate the value as a percentage of the total number (50) of observations. Sum the percentages of clay/hardpan, silt, and sand substrates to obtain total percent fine substrates (% total fines). Record substrate composition percentages on Form D in the spaces next to their respective substrate classifications.

Average Embeddedness Rating: Using the embeddedness ratings recorded on Form B, calculate the average amount of coarse substrate embeddedness in riffles and runs. Average the individual transect embeddedness ratings and choose the most appropriate percentage range from those provided on Form D (i.e., 0-20%; 20-40%; 40-60%; 60-80%; 80-100%).

Instream Habitat/Stream Morphology:
Percent (%) Instream Cover: Calculate the average of the percent cover observations on Form B and round to the nearest five percent. Record the average on Form D in the space next to “% Instream Cover.”

Percent (%) Occurrence of Large Woody Debris: Tally the number of check marks in the column titled “Lrg Wdy Dbrs.” on Form C and divide the number by 27. Multiply the number by 100 and record the value on Form D in the space next to “% Occurrence of Large Woody Debris.”

Macrohabitat: Percent (%) Pool/Glide; % Run; % Riffle: Tally the number of pool/glide, run, and riffle macrohabitat type observations recorded on Form C and divide each number by 27. Multiply each value by 100 and record the percentages on Form D in the spaces labeled: “%Pool/Glide,” “%Run,” and “%Riffle.”

Streambank/Riparian:
Percent (%) Closed Canopy Observations: On Form B in the three columns under “Sph. Dens. # Open Canopy,” determine the highest and lowest average of out of the ten transects. Subtract both numbers from 37, then divide each number by 37 (the maximum possible observation), and lastly multiply by 100 to obtain percentages. Record the maximum percent closed canopy observation on Form D in the space next to “Maximum” and the minimum percent open canopy in the space next to “Minimum.” Calculate the mean and standard deviation of the 30 spherical densiometer observations recorded on Form B. Repeat the process to convert the numbers to percentages and record them on Form D in the spaces next to “Mean” and “Standard Deviation.”

Average Percent (%) Bare Left Bank, Average Percent (%) Bare Right Bank, Average Percent (%) Bare L&R Banks: Calculate the average percent bare stream bank for the left and right banks from the ten transect observations on Form B. Round off each number to the nearest five percent and record on Form D in the spaces next to “Average % Bare Left Bank” and “Average % Bare Right Bank.” Average the left and right bank percentages, round off the number to the nearest five percent, and record it on Form D next to “Average % Bare L&R Banks.”
Buffer strip:
Buffer strip and floodplain observations: Refer to Form B to obtain the minimum and the estimated range of the buffer strip widths for the left and right sides of the stream. Record them on Form D in the spaces provided. Indicate the predominant type of buffer strip vegetation on each side of the stream. Use the following guidelines:
- Woody = >66% deciduous trees and shrubs;
- Herbs = >66% herbaceous grasses and other forbs;
- Mixed = Approximately even proportions of woody and herbaceous species.

Channel sinuosity, stream gradient, stream flow: Methods for estimating channel sinuosity and stream gradient are described in Section 3.2 and the estimates may be obtained from Form A. Stream flow is available from Form D.

Ripple:riffle distance or bend:bend distance: A simple estimate of the average distance between ripples or channel bends (for streams lacking ripples) is obtained by dividing the sampling reach length by the number of ripples or major channel bends (i.e., a bend that changes the direction of the stream by 45 degrees or more) that occur within the reach. The number of ripples or channel bends in the sampling reach should be available from the site map (Form C). Divide the average distance between ripples or bends by the mean stream width in order to express the distance as a factor of stream width.

VI. HABITAT QUALITY ASSESSMENT

1. Habitat models
IDNR currently uses two habitat models to assess the physical habitat quality of the biocriteria sampling sites:
- (1) Iowa Wadeable Stream Habitat Index (IWSHI) and
- (2) Modified Rapid Bioassessment Protocol (MRBP) (Barbour and Stribling 1991)

The assessment form of each model is routinely completed within 48 hours of sampling and by following the guidelines provided with the model. Each assessment form yields an overall habitat quality score that can be related to qualitative assessment categories (e.g., poor, fair, good, excellent) or ranked against the scores of other sampling sites. Copies of the habitat assessment forms can be found in Appendix 2.0.

2. Model variables
Listed below are the variables or categories of variables included in both the habitat models used in Iowa. Each variable is evaluated and assigned a score based on model guidelines. The summarized data from Form D are used wherever applicable to help evaluate habitat variables.

Iowa Wadeable Stream Habitat Index (IWSHI) (Appendix 2.1)
1. Flow
2. Maximum Water Depth
3. Mean Width:Mean Thalweg Depth
4. Mean Depth + SD
5. Percent Fine Substrates
6. Percent Large Rock Substrate
7. Percent Embeddedness
8. % Occurrence Large Woody Debris
9. Percent Reach as Pool-Glide/Riffle/Run 10. Percent Reach Providing Instream Cover
11. Amount of Stream Shading 12. Ave. % of Bare Lower Stream Bank
15. Average Width of Stream Buffer Strip

**Modified Rapid Bioassessment Protocol (MRBP) (Appendix 2.2):**

1. Bottom substrate/instream cover
2a. Embeddedness (riffle/run streams)
2b. Pool substrate characterization (glide/pool streams)
3a. Stream flow and velocity/depth characterization (riffle/run streams)
3b. Pool variability (glide/pool streams)
4. Canopy cover (shading)
5. Channel alteration
6a. Bottom scouring & deposition (riffle/run streams).
6b. Deposition (pool/glide streams)
7a. Pool/riffle, run/bend ratio (riffle/run streams)
7b. Channel sinuosity (pool/glide streams)
8. Lower bank channel capacity.
9. Upper bank stability
10. Bank vegetative protection, OR grazing/disruptive pressure
11. Streamside cover
12. Riparian vegetative zone width.

**VII. PHOTO DOCUMENTATION**

Photographs taken on slide film provide a permanent visual record of the designated sampling reach. Take a minimum of four photographs of each site. Take the first two pictures from the downstream reach boundary (Transect #1), with one picture looking upstream and the second picture looking downstream. Take the next two pictures from the upstream reach boundary (Transect #10) with one looking downstream and the last picture looking upstream. Photographs of biological specimens, sampling procedures, or unique habitat features are also subjects to consider. There is space provided on the back of Form C: Sampling Reach Map (Appendix 1.3) to record photographic subjects and exposure numbers.
References


Rankin, E.T. 1989. The qualitative habitat evaluation index (QHEI): rationale, methods, and application. Ohio Environmental Protection Agency, Division of Water Quality Planning and Assessment, Ecological Assessment Section. Columbus, Ohio. 72p.


Appendices

Appendix 1.0  Habitat data sheets:
- Appendix 1.1 Form A: Sampling Site Information
- Appendix 1.2 Form B: Transect Observations
- Appendix 1.3 Form C: Sampling Reach Map
- Appendix 1.4 Form D: Habitat Data Summary

Appendix 2.0  Habitat Assessment Forms
- Appendix 2.1 Iowa Wadeable Stream Habitat Index (IWSHI)
- Appendix 2.2 Modified Rapid Bioassessment Protocol (MRBP) (Barbour and Stribling 1991)
  (1) Riffle/Run Prevalence
  (2) Glide/Pool Prevalence
7.5.3 Bank Characteristics
The procedure for obtaining bank and channel dimension measurements is presented in Table 7-8. Data are recorded in the “Bank Measurements” section of the Channel/Riparian Cross-section Form as shown in Figure 7-7. Bank angle and bank undercut distance are determined on the left and right banks at each cross section transect. Other features include the wetted width of the channel (as determined in Section 7.5.2), the width of exposed mid-channel bars of gravel or sand, estimated incision height, and the estimated height and width of the channel at bankfull stage as described in Table 7-8.

Bankfull height and incised height are both measured relative to the present water surface. In other words, both are measured up from the level of the wetted edge of the stream.

The “bankfull” or “active” channel is defined as the channel that is filled by moderate-sized flood events that typically occur every one or two years. Such flows do not generally overtop the channel banks to inundate the valley floodplain, and are believed to control channel dimensions in most streams. Spotting the level of bankfull flow during baseflow conditions requires judgement and practice; even then it remains somewhat subjective. In many cases there is an obvious slope break that differentiates the channel from a relatively flat floodplain terrace higher than the channel. Because scouring and inundation from bankfull flows are typically frequent enough to inhibit the growth of terrestrial vegetation, the bankfull channel may be evident by a transition from exposed stream sediments to terrestrial vegetation. Similarly, it may be identified by noting moss growth on EMAP-

Riparian area

The methods and instructions for field operations presented in this manual for surveys of wadeable streams were initially developed and tested during 5 years of pilot and demonstration projects (1993 through 1997). These projects were conducted under the sponsorship of the U.S. Environmental Protection Agency and its collaborators through the Environmental Monitoring and Assessment Program (EMAP).

7.5.5 Riparian Vegetation Structure
The previous section (7.5.4) described methods for quantifying the cover of canopy over the stream channel. The following visual estimation procedures supplement those measurements with a semi-quantitative evaluation of the type and amount of various types of riparian vegetation. These data are used to evaluate the health and level of disturbance of the stream corridor. They also provide an indication of the present and future potential for various types of organic inputs and shading.

Riparian vegetation observations apply to the riparian area upstream 5 meters and downstream 5 meters from each of the 11 cross-section transects (refer to Figure 7-1). They include the visible area from the stream back a distance of 10m (-30 ft) shoreward from both the left and right banks, creating a 10 m × 10 m riparian plot on each side of the stream (Figure 7-11). The riparian plot dimensions are estimated, not measured. On steeply sloping channel margins, the 10 m × 10 m plot boundaries are defined as if they were projected down from an aerial view. If the wetted channel is split by a mid-channel bar, the bank and riparian measurements are made at each side of the channel, not the bar.
Table 7-10 presents the procedure for characterizing riparian vegetation structure and composition. Figure 7-7 illustrates how measurement data are recorded in the “VISUAL RIPARIAN ESTIMATES” section of the Channel/Riparian Cross-section Form. Conceptually divide the riparian vegetation into three layers: a CANOPY LAYER (> 5 m high), an UNDERSTORY (0.5 to 5 m high), and a GROUND COVER layer (< 0.5 m high). Note that several vegetation types (e.g., grasses or woody shrubs) can potentially occur in more than one layer. Similarly note that some things other than vegetation are possible entries for the "Ground Cover" layer (e.g., barren ground).

Before estimating the areal coverage of the vegetation layers, record the type of **woody** vegetation (Deciduous, Coniferous, broadleaf Evergreen, Mixed, or None) in each of the two taller layers (Canopy and Understory). Consider the layer "Mixed" if more than 10% EMAP-Western Pilot Field Operations Manual for Wadeable Streams, Section 7 (Physical Habitat Characterization), Rev. 3, April 2003 Page 40 of 60

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**TABLE 7-10. PROCEDURE FOR CHARACTERIZING RIPARIAN VEGETATION STRUCTURE**

1. Standing in mid-channel at a cross-section transect, estimate a 5 m distance upstream and downstream (10 m total length).
2. Facing the left bank (left as you face downstream), estimate a distance of 10 m back into the riparian vegetation.
   On steeply-sloping channel margins, estimate the distance into the riparian zone as if it were projected down from an aerial view.
3. Within this 10 m × 10 m area, conceptually divide the riparian vegetation into three layers: a CANOPY LAYER (>5m high), an UNDERSTORY (0.5 to 5 m high), and a GROUND COVER layer.
layer (<0.5 m high).
4. Within this 10 m × 10 m area, determine the dominant vegetation type for the CANOPY LAYER (vegetation > 5 m high) as either Deciduous, Coniferous, broadleaf Evergreen, Mixed, or None. Consider the layer “Mixed” if more than 10% of the areal coverage is made up of the alternate vegetation type. Indicate the appropriate vegetation type in the “VISUAL RIPARIAN ESTIMATES” section of the Channel/Riparian Cross-section Form.
5. Determine separately the areal cover class of large trees (> 0.3 m [1 ft] diameter at breast height [DBH]) and small trees (< 0.3 m DBH) within the canopy layer. Estimate areal cover as the amount of shadow that would be cast by a particular layer alone if the sun were directly overhead. Record the appropriate cover class on the field data form ("0"=absent: zero cover, "1"=sparse: <10%, "2"=moderate: 10-40%, "3"=heavy: 40-75%, or "4"=very heavy: >75%)
6. Look at the UNDERSTORY layer (vegetation between 0.5 and 5 m high). Determine the dominant woody vegetation type for the understory layer as described in Step 4 for the canopy layer. If there is no woody vegetation in the understory layer, record the type as “None”.
7. Determine the areal cover class for woody shrubs and saplings separately from non-woody vegetation within the understory, as described in Step 5 for the canopy layer.
8. Look at the GROUND COVER layer (vegetation < 0.5 m high). Determine the areal cover class for woody shrubs and seedlings, non-woody vegetation, and the amount of bare ground present as described in Step 5 for large canopy trees.
9. Repeat Steps 1 through 8 for the right bank.
10. Repeat Steps 1 through 9 for all cross-section transects, using a separate field data form for each transect.

TABLE 7-11. PROCEDURE FOR ESTIMATING INSTREAM FISH COVER
1. Standing mid-channel at a cross-section transect, estimate a 5m distance upstream and downstream (10 m total length).
2. Examine the water and the banks within the 10-m segment of stream for the following features
and types of fish cover: filamentous algae, aquatic macrophytes, large woody debris, brush
and small woody debris, in-channel live trees or roots, overhanging vegetation, undercut
banks, boulders, and artificial structures.

3. For each cover type, estimate the areal cover. Record the appropriate cover class in the “FISH
COVER/OTHER” section of the Channel/Riparian Cross-section Form:
"0"=absent: zero cover,
"1"=sparse: <10%,
"2"=moderate: 10-40%,
"3"=heavy: 40-75%, or
"4"=very heavy: >75%

4. Repeat Steps 1 through 3 at each cross-section transect, recording data from each transect on
a separate field data form.

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are living trees that are within the channel -- estimate the areal cover provided by the parts
of these trees or roots that are inundated. For ephemeral channels, estimate the proportional
cover of these trees that is inundated during bankfull flows. “Overhanging vegetation”
includes tree branches, brush, twigs, or other small debris that is not in the water but is
close to the stream (within 1 m of the surface) and provides potential cover. “Boulders” are
typically basketball- to car-sized particles. “Artificial structures” include those designed for
fish habitat enhancement, as well as in-channel structures discarded (e.g., concrete,
asphalt, cars, or tires) or purposefully placed for diversion, impoundment, channel stabilization,
or other purposes.

7.5.7 Human Influence

The field evaluation of the presence and proximity of various important types of
human land use activities in the stream riparian area is used in combination with mapped
watershed land use information to assess the potential degree of disturbance of the sample
stream reaches.

For the left and right banks at each of the 11 detailed Channel and Riparian Cross-
Sections, evaluate the presence/absence and the proximity of 11 categories of human
influences with the procedure outlined in Table 7-12. Relate your observations and
proximity evaluations to the stream and riparian area within 5 m upstream and 5 m downstream
from the station (Figure 7-11). Four proximity classes are used: In the stream or on
the bank within 5 m upstream or downstream of the cross-section transect, present within
the 10 m × 10 m riparian plot but not in the stream or on the bank, present outside of the
riparian plot, and absent. Record data on the Channel/Riparian Cross-section Form as
shown in Figure 7-7. If a disturbance is within more than one proximity class, record the
one that is closest to the stream (e.g., “C” takes precedence over “P”).

A particular influence may be observed outside of more than one riparian observation
plot (e.g., at both transects “D” and “E”). Record it as present at every transect where
you can see it without having to sight through another transect or its 10 m × 10 m riparian
plot.

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TABLE 7-12. PROCEDURE FOR ESTIMATING HUMAN INFLUENCE

1. Standing mid-channel at a cross-section transect, look toward the left bank (left when facing downstream), and estimate a 5 m distance upstream and downstream (10 m total length). Also, estimate a distance of 10 m back into the riparian zone to define a riparian plot area.

2. Examine the channel, bank and riparian plot area adjacent to the defined stream segment for the following human influences: (1) walls, dikes, revetments, riprap, and dams; (2) buildings; (3) pavement/cleared lot (e.g., paved, gravelled, dirt parking lot, foundation); (4) roads or railroads, (5) inlet or outlet pipes; (6) landfills or trash (e.g., cans, bottles, trash heaps); (7) parks or maintained lawns; (8) row crops; (9) pastures, rangeland, hay fields, or evidence of livestock; (10) logging; and (11) mining (including gravel mining).

3. For each type of influence, determine if it is present and what its proximity is to the stream and riparian plot area. Consider human disturbance items as present if you can see them from the cross-section transect. Do not include them if you have to sight through another transect or its 10 m × 10 m riparian plot.

4. For each type of influence, record the appropriate proximity class in the “HUMAN INFLUENCE” part of the “VISUAL RIPARIAN ESTIMATES” section of the Channel/Riparian Cross-section Form.

   Proximity classes are:
   B (“Bank”) Present within the defined 10 m stream segment and located in the stream or on the stream bank.
   C (“Close”) Present within the 10 × 10 m riparian plot area, but away from the bank.
   P (“Present”) Present, but outside the riparian plot area.
   O (“Absent”) Not present within or adjacent to the 10 m stream segment or the riparian plot area at the transect

5. Repeat Steps 1 through 4 for the right bank.

6. Repeat Steps 1 through 5 for each cross-section transect, recording data for each transect on a separate field form.
Data entry

Once data has been collected in the field, the final step in the streams protocol is to enter the data into the online Biocriteria system developed by DNR-Environmental Service Division and Iowa State University. This system is accessible on the internet at http://sargasso.gis.iastate.edu/BAD/login.htm, a screenshot of which is shown below. All Fisheries Bureau employees have access to the system with a username and password. If you need assistance gaining access to the site, contact Jeff Kopaska at Jeff.Kopaska@dnr.iowa.gov. The username for all employees is their email address, Firstname.Lastname@dnr.iowa.gov. Each user has an individualized password.

Once users have entered the web site, they will be directed to a Database Home screen. Navigation to different parts of the web site may be accomplished by clicking the tabs above the white Database Home window.

This site can be used to enter data from stream assessment activities, or access data from other individual stream sampling events, or to peruse summarized data from all related stream sampling activities. For data entry activities, navigate to the “Enter New Data” tab; for individual site or sample information, navigate to the “Search the Database” tab; and for perusing summarized data, navigate to the “Assessment Statistics” tab.
In a data entry exercise, a user selects the “Enter New Data” tab. The user is directed to a page where they can either enter new data about an existing site, or enter information about a new sampling location. Select the appropriate button for your particular situation.
If you are entering new data about an existing site, simply type in the stream name, and the database will find a matching suite of sites and provide you with a list to select you stream from. If your site is not on that list, back up and enter new site information. Navigate from this page using the back and next buttons.

Once you have determined to enter new site information, the following set of pages will pop up for you to enter your data. These pages should ask for the data that you have filled out on your Stream Sampling Cover Data Sheet. Complete the pages by filling in all of the appropriate data, and navigate by using the back and next buttons at the bottom of the page. Data entry blanks with red asterisks (*) are required.

When entering stream name and place name information, be sure to use appropriate capitalization for these proper names.

After entering stream name and place names, enter the location information for the downstream starting point of your sampling effort as the official UTM location of the site. Locational information should be collected in the field using a GPS, set up with NAD83 as the datum, and the units being UTM, Zone 15N. Once you have entered the UTM location of the site, the remaining geographical location information should be derived by the database and those data entry points should be self-populated. The sampling point should also be displayed on the map to the right as a push-pin icon. If UTM locations were not recorded in the field, users can select the sampling point by zooming in to the appropriate area on the mapping window to the right, and then place a push-pin icon on the location of the stream sample to select the sampling site. This options should rarely be used, as superior locational information can be gathered using GPS units in the field.
Drainage area at the point of the stream sample must be entered. If the exact drainage area is unknown, it should be estimated using the Drainage Area of Iowa Streams publication from the Iowa Department of Transportation. Using the drainage area from the nearest point of the listed in the book, estimate the drainage area at your sampling point. An example of a completed Site Information page is shown below. Navigate forward using the “Next” button.
On the “Surrounding Area” tab, information at the top of the page should already be entered for you. You need only to select any site impacts that were noted on your data cover sheet, then navigate to the next page.

The “Site Location Description” tab allows you to enter any comments that you have about the sampling site. If you have none, navigate on to the landowner contact page.
If your site was located on public ground, simply navigate on to the submit data page using the next button. If your site was on private ground, unclick the check box, then click the green plus button to add landowner contact information to the database.

After you have entered the required landowner contact information, select “Add Landowner.” Proceed to the Submit Data page using the next button.
Review the summarized information on the “Submit Data” tab, and if it is correct, click submit. You will be automatically directed to the first page of the sampling information set of data entry screens.

Some information on this first page will be populated already from the site information you previously entered. Enter the remaining information for this page from your sampling data cover sheet. Comments may be as descriptive and inclusive as the user desires. Sampling crew members who are not full-time DNR employees may also be listed in the comment box. To enter the names and roles of remaining crew members, navigate to the “Crew Data” page using the Next button.

All permanent employees of the Fisheries Bureau should be listed in the drop-down of crew names on the “Crew Data” page. Individuals can be easily selected by typing in the first few letters of their first name. Seasonal employees or other non-DNR staff who may assist in sampling need not be listed on this page. Individuals who were involved in field data collection and fish ID should be listed by name, with the associated role of “Fish Collection/ID [Field].” Use the green plus button to add a name and associated role to the database, this step must be completed to save the crew data. Entered data will show up in the window below the white data entry boxes. If an individual performed both field collections and sample data entry, they should be added two times, with both crew roles associated with that individual’s name. In the example below, Kopaska collected the data in the field, Conover perform field QA/QC, and Waters performed sample data entry into the online system.
Once crew data is entered, proceed to the “Fish Metadata Data” tab using the Next button. Data entered on this page will come from the header on the field fish data collection data sheet.

When entering the date, use the calendar option by clicking the button next to the data entry box for date. Typing in the date in an incorrect format has sometimes resulted in data loss, and using the calendar button eliminates the potential for such an unfortunate occurrence.
Sample time should be recorded in military time format, and should be the time you arrived at the stream to the time you left the stream. All required data should be entered, including distance sampled, shocking time, if block nets were used, and conditional information about flow levels, turbidity, and sample quality. Distance sampled entered here should be the length of stream that was sampled for fish, not habitat. These two distances sampled may not be the same. If sample quality was fair or poor, record the reason why. Add and comments written on your data sheet to the comments section at the bottom of this page.

Record the total number of fish that were observed to have DELTs (Deformities, Eroded fins, Lesions, Tumors) in the DELTs box. Record the total number of fish observed to have other abnormalities or maladies in the non-DELTs box. Some type of numerical data must be recorded in these boxes in order for IBI scores to be calculated for the sample.

Once data entry is completed for this page, it is a good practice to select “Save & Finish Later” in order to insert your data into the database and make sure it is saved. After hitting “Save & Finish Later,” you will be directed to the Database Home page, and your sample will be listed under “Latest Updates.” If you encounter an error at this point, there has likely been some required data that was not entered. You will need to start over with the sample data entry. The stream site information will not need to be re-entered, though. Contact Jeff Kopaska if you encounter problems at this point of data entry.

If things worked properly, simply hit the “Continue” button to be directed back to the Fish Metadata page. At this point, you should double check the data that you entered for blocknets and for reasons for fair/poor sampling effectiveness. Preliminary data entry exercises have shown that the system currently loses some of this data when you choose the option to “Save & Finish Later.” If you are missing that data, re-enter it at this point in time. You should also check this data again after data entry has been completed. We are attempting to correct the
current error, but until such time as it is corrected, please check your data. Of course, checking your data for quality and agreement with data sheet information should be a part of all data entry exercises. After looking over the this data tab once you have returned, proceed to the “Fish Data” tab using the Next button.

Fish data is entered according to species, size classes, and number of individuals enumerated, and follows the field data sheets. Data entry is facilitated by first clicking in the Fish Species data box, and then typing the first few letters of the common name of the fish you collected. Once a drop-down list is populated from the species matching the letters you typed, select the appropriate species by clicking on it with your mouse. Most of the fish species collected in stream surveys do not have size classes associated with them. If you have collected game fish that do have size-class breakdowns, select the appropriate size-class using your mouse and the drop-down list. Otherwise, simply click in the fish number box with your mouse and type in the number of fish collected. After this number is entered, click on the green plus symbol to add the data to the window below. This will clear data entry boxes and allow you to enter new data. Fish data that has been entered will be shown below, and the most recently entered data will be at the top of the list. If data was entered incorrectly, simply delete the record using the icon to the left, and re-enter the data anew at the top of the page.

Once fish data entry is complete, navigate forward using the Next button.

Stream transect data entry also follows well with the field data sheets, and data is entered one transect at a time. This page is set up to work well using the keyboard and number pad, rather than just mouse clicks. You can enter stream width and depths on the transect using the number pad, and hitting either the Enter button or the Tab button on your keyboard will move you to the next data entry box. The drop down boxes for substrate can be easily navigated using the
keyboard. Typing the first letter of the substrate type will automatically populated the dropdown list with the first word that starts with that letter, thus typing G will automatically select Gravel, and M will select Muck. Typing C once will get you Clay, and a second tap on the C key will move you to Cobble. Similarly, typing S once will get you Sand, and a second tap on S will get you Silt. Hitting the Enter key or the Tab key will move you to the next box. In the second column of substrate data, you can leave the boxes empty by simply hitting Enter or Tab as you land on that box. After entering the last substrate data, Tab or Enter will move you to the first Bank Angle box. You can continue to type in bank angle and open canopy data at that location, then return to the radio button after you have completed data entry that requires typing. To select the appropriate scores for Embeddedness, Filamentous Algae, etc., click on the radio button next to the score you gave that criteria in the field. The default score is always the smallest value. Once the data entry for a transect is complete, proceed by clicking the Next Transect button at the bottom of the page. The transect number is always displayed in the upper left box of the data entry window.

An example of a transect will all data entered is shown in the next screen shot.
Once all ten transects are entered, a summary data screen will appear. Data can be edited on any transect by clicking the pencil icon to the right of the particular transect.
Once the entered data has been reviewed, at this point the option to “Save & Finish Later” should be taken. This will again direct you to the Database Home page where your sample will be listed under “Latest Updates.” Simply hit the “Continue” button to be directed back to the Stream Transect Data page. At this point, hit the Next button to proceed.

The Reach Map Data tab is next. It is important to enter data in all appropriate portions of this page, especially Estimated Stream Width and Maximum Depth. It should be noted that if you entered all of the stream transect widths on the previous page, all transect intervals will be populated on this page. These intervals are calculated using the assumption that when stream width is measured at Transect 1, the habitat assessment crew will then proceed upstream three-times that stream width to Transect 2. Stream width at Transect 2 will then be measured, and the crew will proceed upstream three-times the width of Transect 2 to get to Transect 3. This process will be repeated in this manner all the way to Transect 10.

The remainder of this data entry tab closely mimics the field data sheet. Data entry starts at Transect 10, which is at the top of the data sheet. The tab order on this page is set up to allow the user to enter all Macro Habitat types first, then type in all Thalweg Depths. Similar to substrate types, you can type the first letter of the habitat type (i.e. R for riffle, P for Pool, G for Glide) to populate the data entry box, and hitting R twice will move Run into the appropriate location. The user can then use Tab or Enter to move down to the next box. Changing Soft/Small sediment from Yes to No (Yes is the default) is best accomplished using the mouse.

Once data entry on the Reach Map Data tab is completed, proceed using the Next button. An example of a completed, editable Reach Map Data tab is shown in the next screen shot.
The final data entry tab is the Riparian Data tab. This data is collected at Transects 1, 5, and 10. To initiate data entry, select the Enter New Transect option, which will direct you to the page below.

Change the values away from the default minimums using the mouse. Click Next Transect when finished to move on. After Transect 10 has been entered, you will proceed to an editable
summary page, as shown in the next screen shot. If the data is correct, click the Next button to proceed.

You have now completed data entry for the stream sample. Click the submit button to push the remaining data to the database.
To search for data about stream or sample, click on the Search The Database tab, and you will be directed to the page below. Enter the first few letters of the stream name you are interested in to get a trimmed down list of streams. Clicking the mouse in the empty data box will populated the box with all streams in the database.

After entering, for example, “wa” for Walnut Creek, the following list of stream names will appear:
Highlighting the stream you are interested in, like Walnut Creek – Ames, will populate the selection box. You can then move forward by clicking the Magnifying Glass icon to proceed to the next page:
Again, clicking on the magnifying glass icon (upper right corner) will lead you to the sampling session data, which can be edited at this time. You can edit data in the database by clicking on the Pencil Icon.

Users can move through the data sheets to the Fish Data sheet to view the list of fish collected in the survey. Fish size classes can also be viewed, and the data can be exported into an Excel spreadsheet. Fish IBI for the site can be viewed and exported by clicking the Fish IBI button in the upper right corner.
The Fish IBI page displays as shown below.

Clicking on the Assessment Statistics tab will direct you to the page shown next. The buttons in the upper right provide standardized reports from the entire database.