Minnesota Pollution Control Agency

Biological Monitoring Program

MPCA STREAM HABITAT ASSESSMENT (MSHA) PROTOCOL FOR STREAM MONITORING SITES

I. PURPOSE

To describe the methods used by the Minnesota Pollution Control Agency's (MPCA) Biological Monitoring Program to collect qualitative physical habitat information at stream monitoring sites for the purpose of assessing water quality and developing biological criteria.

II. SCOPE/LIMITATIONS

This procedure applies to all river and stream monitoring sites for which an integrated assessment of water quality is to be conducted. An integrated assessment involves the collection of biological (fish and macroinvertebrate communities), physical habitat, and chemical information to assess stream condition.

III. GENERAL INFORMATION

Sites may be selected for monitoring for a number of reasons including: 1) sites selected for condition monitoring as part of Intensive Watershed Monitoring (IWM), 2) sites randomly selected as part of the Environmental Monitoring and Assessment Program (EMAP), 3) sites selected for the development and calibration of biological criteria, and 4) sites selected for stressor identification. Although the reasons for monitoring a site vary, the MSHA protocol described in this document applies to all monitoring sites unless otherwise noted.

IV. REQUIREMENTS

A. Qualifications of crew leaders: The crew leader must be a professional aquatic biologist with a minimum of a Bachelor of Science degree in aquatic biology or closely related specialization. He or she must have a minimum of six months field experience in physical habitat sampling methodology. Field crew leaders should also possess excellent map reading skills and a demonstrated proficiency in the use of a GPS (Global Positioning System) receiver and orienteering compass.

B. Qualifications of field technicians/interns: A field technician/intern must have at least one year of college education and coursework in environmental and/or biological science.

C. General qualifications: All personnel conducting this procedure must have the ability to perform rigorous physical activity. It is often necessary to wade through streams and/or wetlands, canoe, or hike for long distances to reach a sampling site.

V. RESPONSIBILITIES

A. Field crew leader: Implement the procedures outlined in the action steps and ensure that the data generated meets the standards and objectives of the Biological Monitoring Program.

B. Technicians/interns: Implement the procedures outlined in the action steps, including maintenance and stocking of equipment, data collection and recording.

VI. QUALITY ASSURANCE AND QUALITY CONTROL

Compliance with this procedure will be maintained through annual internal reviews. Technical personnel will conduct periodic self-checks by comparing their results with other trained personnel.

In addition to adhering to the specific requirements of this sampling protocol and any supplementary site specific procedures, the minimum QA/QC requirements for this activity are as follows:

A. Control of deviations: Deviation shall be sufficiently documented to allow repetition of the activity as performed.

B. QC samples: Ten percent of sites sampled in any given year are resampled as a means of determining sampling error and temporal variability.

C. Verification: The field crew leader will conduct periodic reviews of field personnel to ensure that technical personnel are following procedures in accordance with this SOP.

VII. TRAINING

A. All inexperienced personnel will receive instruction from a trainer designated by the program manager. Major revisions in this protocol require that all personnel be re-trained in the revised protocol by experienced personnel.

B. The field crew leader will provide instruction in the field and administer a field test to ensure personnel can execute this procedure.

VIII. ACTION STEPS

A. Equipment list: Verify that either a form and pencil, or a field computer is present before commencement of this procedure.

B. Data collection method: The location and length of the sampling reach is determined during site reconnaissance (see SOP--"***Reconnaissance Procedures for Initial Visit to Stream Monitoring Sites***"). Unless otherwise instructed, observations of physical habitat characteristics should be limited to the sampling reach. Sampling is conducted during daylight hours within the summer index period of mid-June through mid-September. Sampling should occur when streams are at or near base-flow. The habitat evaluation is conducted immediately after fish sampling in order to provide the evaluator a perspective of the fish habitat within the reach.

Habitat characteristics are recorded using a qualitative, observation based method (modified from: Rankin 1989. The Qualitative Habitat Evaluation Index (QHEI): Rationale, Methods, and Application. Ohio EPA, Division of Water Quality Planning and Assessment, Ecological Analysis Section, Columbus, Ohio.). The Ohio QHEI is a physical habitat index designed to provide an empirical evaluation of the lotic macrohabitat characteristics that are important to fish communities and which are generally important to other aquatic life. Although similar to the Ohio QHEI, the MSHA has been modified to more adequately assess important characteristics influencing Minnesota streams. The MSHA incorporates measures of watershed land use, riparian quality, bank erosion, substrate type and quality, instream cover, and several characteristics of channel morphology.

Observations are recorded on the **MPCA Stream Habitat Assessment Worksheet**. A copy is attached and guidelines for filling out this data sheet are described in the following pages.

C. MPCA Stream Habitat Assessment Data Sheet

This data sheet describes the presence and abundance of instream and riparian characteristics within the sampling reach. The variables recorded are as follows:

C.1. Stream Documentation

a) *Field Number* – A seven-digit code that uniquely identifies the station. The first two digits identify the year of sampling, the second two identify the major river basin, and the last three are numerically assigned in sequential order (example: 02UM001).

b) *Stream Name* – The name of the stream as shown on the most recent USGS 7.5" topographic map. Include all parts of the name (i.e. South Branch Wild Rice River).

c) *Date* – The date habitat sampling is conducted in month/day/year format (MM/DD/YY).

d) *Person Scoring* – The personnel completing the MSHA. This person(s) should have walked or boated the entire stream reach paying particular attention to habitat features.

e) *Water Level* – An estimation of water level as it relates to summer base flow expectations. In most streams, the "normal" water level can be determined with relative ease by observing channel characteristics.

C.2. Surrounding Land Use or Floodplain Quality: Record the predominant land use on each bank within approximately 2 to 3 square miles (streams) or within the adjacent and surrounding floodplain (rivers). For streams the emphasis should be on the upstream surrounding land use. For rivers the emphasis is on the area of land adjacent to the stream channel that experiences flooding during periods of high discharge. Check either the most predominant land use, or choose two and average the scores. A land use or aerial map can be used for this assessment if available. Land use categories are as follows:

Forest, Wetland, Prairie, Shrub: Land that is dominated by trees, low-lying areas saturated with water, grasses and forbs, or woody vegetation less than 3 m. in height (i.e. natural land uses).

Old Field/Hay Field: Land that is used for agricultural purposes other than row crops or pasture.

Fenced Pasture: Land that is regularly grazed by livestock, but is fenced to prevent livestock from entering streams.

Residential/Park: Land that has been modified for residential use (housing, residential lawns, city parks).

Conservation Tillage, No Till: Land that is currently in agricultural production, but retains the vegetative material from the previous year's crop to protect the soil.

Diked Wetland: Areas that have been diked from the main stream channel and are wetland in nature. A dike is an embankment constructed of earthen or other suitable material to protect land against overflow or to regulate water. It is more common to see this land use activity on very large rivers.

Urban/Industrial: Land that has been modified for commercial or industrial use (parking lots, malls).

Open Pasture: Land that is regularly grazed by livestock, but is not fenced to prevent livestock from entering streams.

Mining/Construction: Land affected by mining and/or current construction activity (open pits, tailings).

Row Crop: Land that is currently in intensive agricultural production, and doesn't use any conservation tactics (corn, soybeans, sugar beets, potatoes).

C.3. Riparian Zone (check the most appropriate category for each bank)

a) *Riparian Width* – Estimate the width (m) of the undisturbed vegetative zone adjacent to the stream. Beneficial vegetation types include stable grasses, trees, and shrubs with low runoff potential. Disturbed vegetation is not included in the riparian width (i.e. mowed grass). For channelized streams, estimate the width of the grass buffer from the water's edge, along the angle of the ditch bank to the top of bank, and beyond to the point where the grass buffer is disturbed.

b) *Bank Erosion* – Estimate the percentage of the stream bank that is actively eroding. Consider only the portion of the left and right bank that are likely or have the potential to be eroded (i.e. outside bends and high banks but not naturally occurring depositional point bars along inside bends). To be considered as erosion, the banks must be actively eroding through break down, soil sloughing, or false banks. False banks are natural banks that have been cut back, usually by livestock trampling.

c) *Shade* – Estimate the percentage of overhead canopy cover that is shading the stream channel. Canopy cover can be from trees, shrubs or tall grasses that provide shade to the stream at different times of the day. Professional judgment may be required to rate stream shading characteristics in larger streams and rivers as 100% shade cover would not be expected in these systems even in the absence of disturbance. The general intent of the rating is to evaluate the condition of stream canopy characteristics.

C.4. Instream Zone

a) *Substrate* – Document the two predominant substrate types for each channel type present within the reach. One substrate type may be recorded where > 80% of the channel is dominated by a single substrate type. For each channel type present within the reach, estimate the percent of the stream channel represented by that channel type. The percentages should add up to 100. For example, if the majority of your reach was a run, with a few pools and one riffle, the percentage could be 75% run, 20% pool, and 5% riffle. Lastly, note the presence of all substrate types observed within the reach in a significant amount (>5%) in the space provided. The definitions for each channel and substrate type are as follows:

Channel Types

Pool: Water is slow and generally deeper than a riffle or run. Water surface is smooth, no turbulence. A general rule that can be used to distinguish a pool from a run or riffle is if two or more of the following conditions apply; the stream channel is wider, deeper, or slower than average.

Riffle: Higher gradient areas where the water is fast and turbulent, water depths are relatively shallow, and substrates are typically coarse. Water surface is visibly broken. In prairie streams, riffles can be comprised largely of gravels and coarse sands.

Run: The water may be moderately fast to slow but the water surface typically appears smooth with little or no surface turbulence. Generally, runs are deeper than a riffle and shallower than a pool.

Glide: Similar to a run, but where there is no visible flow and the channel is too shallow for a pool. Examples include a channelized stream with a uniform depth and flow. This term should not be used in conjunction with pools, riffles, and runs in a natural stream setting.

Substrate Types

Boulder: Large rocks ranging from 250 mm to 4000 mm in diameter (basketball to car size).

Cobble: Rocks ranging in diameter from 64 mm to 250 mm (tennisball to basketball).

Gravel: Rocks varying in diameter from 2 mm to 64 mm (BB to tennisball).

Sand: Inorganic material that is visible as particles and feels gritty between the fingers, .06 to 2.0 mm in size.

Clay: Very fine inorganic material. Individual particles are not visible or are barely visible to the naked eye. Will support a person's weight and retains its shape when compacted.

Bedrock: A solid slab of rock, > 4000 mm in length (larger than a car).

Silt: Fine inorganic material that is typically dark brown in color. Feels greasy between fingers and does not retain its shape when compacted into a ball. A person's weight will not be supported if the stream bottom consists of silt.

Muck: A fine layer of black, completely decomposed vegetative organic matter.

Detritus: Decaying organic material such as macrophytes, leaves, finer woody debris, etc. that may appear similar to silt when very fine.

Sludge: A thick layer of organic matter of animal or human origin, often originating from wastewater.

b) *Embeddedness* – Indicate the percentage to which coarse substrates are surrounded by or covered with fine sediments throughout the reach. Coarse substrates consist of gravel, cobble, and boulders of sizeable extent and consistency to be viable for spawning and habitat for certain species. A few scattered coarse substrates intermixed with sand does not constitute enough viable coarse substrate to be considered for embeddedness. An embeddedness rating of 0% corresponds to very little or no fine sediments surrounding coarse substrates. Check if coarse substrates are overlain with fine sediment by inserting your fingers into the substrate and pulling up the first inch or so of fine material. Coarse substrate material completely surrounded and covered with sediment is considered 100% embedded. If coarse substrates are not present in the reach, check "no coarse substrate".

c) *Siltation* – Indicate the extent that substrates are covered by a silt layer. Silt cover differs from the embeddedness metric in that it considers silt deposition over the entire stream bed and pertains only to fine silt size particles whereas embeddedness evaluates the degree to which sand and other fines are covering coarse substrates only. Low gradient streams often naturally have a high silt load. When evaluating low gradient streams do not penalize the score for siltation unless the condition is exacerbated by anthropogenic sources. The ratings of siltation are as follows:

Silt Free: Substrates are exceptionally clean of silt.

Silt Normal: Silt is deposited in small amounts along the stream margin or is present as a light covering in expected areas that appears to have little functional significance. Low gradient streams where siltation is not exacerbated by anthropogenic sources should be rated as normal.

Silt Moderate: Extensive covering by silts, but with some areas of cleaner substrates (riffles and fast runs).

Silt Heavy: Nearly the entire stream bottom is layered with a significant covering of silt (pools/glides and all but the fastest areas of riffle/runs).

d) *Substrate Types* – Record the number of substrate types present within the reach; either greater than or equal to 4, or less than 4.

e) *Cover Type* – Indicate the types of cover available to fish within the reach (check all that apply). Cover for fish consists of objects or features that provide complete or partial shelter from the stream current or concealment from predators or prey. In order to be considered cover, the water depth must be at least 10 cm where the cover type occurs and the amount of cover should be in sufficient quantity to support associated fish species. Cover types are as follows:

Undercut Banks: Stream banks where the stream channel has cut underneath the bank. The bank could overhang the water surface when water levels are low. The undercut bank must overhang (horizontally) the wetted stream channel a minimum of 15 cm and the bottom of the undercut bank must be no more than 15 cm above the water level in order to be considered cover for fish.

Overhanging Vegetation: Terrestrial vegetation overhanging the wetted stream channel. Vegetation must be no more than 15 cm above the water level to be considered cover for fish.

Deep Pools: Area where the channel is particularly deep, often near a bend. Deep pools are judged relative to the stream size being assessed. As a general rule, a deep pool is at least four times deeper than the shallowest part of the thalweg.

Logs or Woody Debris: Logs, branches, or aggregations of smaller pieces of wood in contact with or submerged in water.

Boulders: Large rocks as described under *Substrate Type* and providing shelter from stream current.

Rootwads: Aggregation of tree roots that extend into the stream and provide concealment or shelter from current.

Oxbows, Backwaters: Remnant of a former channel meander within the floodplain or other adjacent and connected area with little or no current.

Shallows (in slow water): Habitats in shallow slackwater that provide nursery areas for small fish. These areas are often apparent when walking the stream or electrofishing by the presence of small and young of year fish.

Macrophytes: Check the box for macrophytes if the amount or density of plants is sufficient to provide cover for fish and check the box for each type present (i.e. emergent, floating leaf, submergent).

Emergent Macrophytes: Vascular plants that typically have a significant portion of their biomass above the water surface. Examples include cattail, bulrush, and wild rice.

Floating Leaf Macrophytes: Vascular plants with a significant amount of their biomass floating on the water in the form of leaves and flowers. Examples include duckweed and water lily.

Submergent Macrophytes: Vascular plants that have all of their biomass (except flowers) at or below the surface of the water and are of a sufficient density to provide cover for fish. Examples include: coontail, and potamogeton species. Filamentous algae is also included if it is dense enough to provide cover for small fish.

f) *Cover Amount* – Estimate the total percentage of fish cover within the reach. This metric is also assessed relative to stream size. If the channel is completely filled with aquatic vegetation, check the "choking vegetation only" option. Note: A stream that has at least a small raceway or path adequate for fish to navigate through aquatic vegetation is not considered "choking vegetation only."

C.5. Channel Morphology (check the most appropriate category for each)

a) *Depth Variability* – The difference in thalweg depth between the shallowest stream cross section and the deepest stream cross section. The thalweg depth is the deepest point along a stream cross section. Indicate the degree to which the thalweg depths vary within the stream reach. Please note: for very shallow streams that are moderate in width (8 to 10 m), consider whether or not the depth variability is less than what you would expect to find. For example, if the water depth is only 4 inches at the shallowest thalweg point and 20 inches at the deepest, but the stream is overwidened with excess sedimentation, do not score as >4 times.

b) *Channel Stability* – The ability of a stream channel to maintain its bed and banks, without eroding or moving particles downstream. A riffle that forms diagonally across the channel and has a high amount of fine substrates that change location is indicative of an unstable stream bed. Channelized streams often have high bank stability but low bed stability as the substrate is typically comprised of fine materials that are susceptible to moving downstream. The ratings of channel stability are as follows:

High: Channel with stable banks and substrates, little or no erosion of the banks, and little or no bedload within the stream. Artificial channels (i.e. concrete) exhibit a high degree of stability even though they typically have a negative effect on biological communities.

Moderate/High: Channel has the ability to maintain stable riffle, run, and pool characteristics. A minor amount of bank erosion and/or bedload is present in a slightly higher degree than would be expected for natural streams in the region.

Moderate: Channel that exhibits some instability characterized by erosion, bedload, or shows the effects of wide fluctuations in water level.

Low: Channels that have a high degree of bedload and severely eroding banks. A homogenous stream bed characterized by shifting sand substrates has low stability. To score low, the stream has to demonstrate both bank erosion and high bedload.

c) *Velocity Types* – Indicate which flow types are present within the reach (check all that apply). Velocity types are as follows:

Fast: Mostly non-turbulent flow with small standing waves in riffle-run areas, water surface may be partially broken.

Moderate: Non-turbulent flow that is detectable (i.e. floating objects are visibly moved downstream).

Slow: Water flow is detectable, but barely perceptible.

Eddies: Areas of circular motion within the current, usually formed in pools immediately downstream of riffles/runs.

Torrential: Extremely turbulent and fast flow; water surface is broken, usually limited to gorges and dam spillways.

None: Water flow is not detectable.

Interstitial: Water flow that infiltrates a streambed, and moves through gravel substrates in riffle-run areas.

Intermittent: No flow is present, with standing pools separated by dry reaches.

d) *Sinuosity* – Indicate the degree to which the stream meanders. Sinuosity is defined as the ratio of stream channel distance to straight line distance between two points on a stream. For wide streams or rivers it may be necessary to consider a longer stream reach, as the true meander cycle is often not adequately represented in these systems within the sampling reach. The ratings of sinuosity are as follows:

Excellent: Streams exhibiting a high degree of meandering. Presence of 2 or more well defined bends (deep areas outside and shallow areas on the inside of the bend).

Good: Stream with more than 2 bends, with at least one well defined bend.

Fair: Channel with 1 or 2 poorly defined outside bends, or slight meandering within a modified reach. Channelized reaches that demonstrate some degree of meandering are considered fair.

Poor: Straight channel with no bends in the reach. Channelized streams or ditches are often rated as poor.

e) *Pool Width/Riffle Width* – Indicate the ratio of pool width to riffle width within the reach. If there is no riffle or pool within the sampling reach, select "no riffle" and/or "no pool". If the sampling reach is predominantly impounded by an anthropogenic structure (i.e. dam) select "impounded". Impounded characteristics within the sampling reach caused by beaver dams or other natural occurrences are not penalized.

f) *Channel Development* – Indicate the complexity of the stream channel or the degree to which the stream has developed different channel types, creating sequences of riffles, runs, and pools. Consider the stream size when evaluating the channel development of a stream reach. In small streams; riffles, runs, and pools should occur more frequently within the sampling reach. For large streams or rivers it may be necessary to consider a longer stream reach, as the true meander cycle is often not adequately represented in these systems within the sampling reach. Additionally, complex channel development on a large river may not be as distinct or pronounced as on a smaller riverine system. The ratings of channel development are as follows:

Excellent: Well defined riffles present with gravel, cobble, or boulder substrates; pools vary in depth, and there is a clear transition between pools, riffles, and runs. Multiple sequences of riffles, runs, and pools are present within the reach. In prairie streams, riffles can be comprised only of gravels and coarse sands.

Good: Riffles, runs, and pools are all present, but with less frequency, and are less distinct. Riffles have large substrates (gravel, rubble, or boulder), and pools have variation in depth.

Fair: Riffles are absent or poorly developed (shallow with sand and fine gravel substrates). Some deeper pools may exist, but transitions are generally not abrupt.

Poor: Riffles are absent; pools if present are shallow or lack variation in depth. Channelized streams generally have poor channel development. Some wetland streams without riffles can be rated as "poor" even if the condition is natural.

g) *Modifications* – Indicate any modifications made within or along the stream or river reach (check all that apply). Modification types are as follows:

Leveed: A stream or river reach in which a levee or levees have been constructed. A levee is an embankment or floodbank that is an artificially constructed fill or wall, which regulates water levels. It is usually earthen and often parallel to the course of a river in its floodplain. They are often constructed to prevent flooding or to slow natural course changes in a waterway.

Dredged: Excavation activity or operation usually carried out at least partly underwater with the purpose of gathering bottom sediments and disposing of them at a different location. This technique is often used to keep waterways navigable or facilitate the movement of water.

Bank Shaping: Excavation activity that involves the removal of soil to reduce the slope of stream banks to a more stable angle.

Railroad Ties: Railroad beds and other railroad infrastructure are common along many waterways, especially larger navigational rivers. Railroad ties have also been commonly used as waterfront retaining walls or for stream bank stabilization.

Cemented: A stream bed or bank that has been reinforced with cement. Typically this type of modification only occurs in very urbanized areas where any movement of the stream bed or bank is greatly discouraged.

Bulkheads: Sheet steel used for erosion control, seawall construction, soil stabilization, construction, bridge foundations and cofferdams, and to armor stream banks. Often used as a retaining wall along a waterfront or in large navigational rivers to allow barges or freighters adequate shore-to-shore navigation.

Rip Rap: Stream reaches that have rock material used to armor streambanks, bridge abutments, pilings and other shoreline structures against scour, water or ice erosion. Rip rap is made from a variety of rock types and occasionally concrete rubble from building and paving demolition.

Const. Island: Constructed island(s) - in large navigational rivers man-made islands are often created or re-created to provide habitat or dispose of dredge material.

Wood Pilings: A column of wood or logs that have been driven into the stream bed or bank. Typically this was done to provide support for a structure or bank protection.

C.5. Aquatic Vegetation: Indicate presence and abundance of aquatic vegetation present within the wetted width of the stream channel as follows: Abundant=[3]; Moderate=[2]; Sparse=[1].

a) *Beneficial Aquatic Vegetation* – Indicate the presence and abundance of beneficial aquatic vegetation including; pond lilies (*Nymphaea*/*Nuphar*), sedge (*Cyperaceae*), wild celery (*Vallisneria*), wild rice (*Zizania*), pond weed (*Potamogeton*), bulrush (*Scirpus*), waterweed (*Elodea*), coontail (*Ceratophyllum*), and water Cress (*Nasturtium*).

b) *Invasive and Negative Aquatic Vegetation* – Indicate the presence and abundance of invasive and negative aquatic vegetation including; Eurasian milfoil (*Myriophyllum*), purple loosestrife (*Lythrum*), reed canary (*Phalaris*), cattails (*Typha*), duckweed (*Lemna*), algae (floating mats), algae (planktonic), and algae (benthic).

If no aquatic vegetation is present, or not in sufficient density or quantity to provide cover, check the box for "no vegetation noted". Provide any additional comments regarding quantity and quality of vegetation in the space provided.

D. Scoring the MSHA

Following are instructions on how to score the completed MSHA form. The maximum score is 100.

D.1. Surrounding Land Use: Average the scores of the two banks. For example, if residential/park was the land use selected on the left bank, and forest, wetland, prairie, shrub was selected on the right bank, then the land use score would be (2+5)/2=3.5. In the case of two land uses selected for one bank, the two scores are averaged together, and then averaged with the score of the other bank. The maximum land use score is 5.

D.2. Riparian Zone: Average the scores of the two banks for Riparian Width, Bank Erosion, and Shade; then add the three scores. For example, if moderate riparian width (3) was chosen for the left bank and very narrow (1) on the right bank; little bank erosion (4) on the left bank, and moderate (3) on the right bank; heavy shade (5) on the left bank, and substantial (4) on the right bank; the riparian zone score would be: [(3+1)/2] + [(4+3)/2] + [(5+4)/2] = 10. The maximum riparian score is 14.

D.3. Instream Zone

a) *Substrate, Embeddedness, Siltation, and Substrate Types* – Add the scores of substrate, embeddedness, siltation and substrate type. The substrate score is calculated by adding the two substrate scores for each channel type, multiplying by the percentage of the channel type, and adding the scores for each channel type present. If only one substrate type is chosen because it makes up more than 80% of the channel type, multiply the one substrate score by 2 before multiplying it by the percentage of the channel type. The maximum substrate score is 28.

b) *Cover Type and Cover Amount* – Add the scores of cover type and cover amount. The cover type score can range from 0 to 9. The highest macrophyte score is 1, even if all three macrophyte types are present. The maximum cover score is 18.

D.4. Channel Morphology: Add the scores of Depth Variability, Channel Stability, Velocity Types, Sinuosity, Pool Width/Riffle Width, Channel Development, and Modifications. The modifications score can range from -8 to 3. The maximum channel morphology score is 35.

D.5. Total Score: Add the Surrounding Land Use, Riparian Zone, Instream Zone, and Channel Morphology scores together to get the total MSHA score for the site. The maximum MSHA score is 100.

MPCA STREAM HABITAT ASSESSMENT (MSHA)

(revised April 2014)

1. Stream Documentation

Field Number: _____ Stream Name: _____ Date: _____

Person Scoring: _____ Water Level (circle one): Flood / High / Normal / Low / Interstitial

MSHA SCORE ☐ **Max=100**

2. Surrounding Land Use (Streams) or Floodplain Quality (Rivers)

(check the most predominant or check two and average scores) **[L=left bank/R =right bank, facing downstream]**

L	R			L	R		
☐	☐	Forest, Wetland, Prairie, Shrub	[5]	☐	☐	Diked Wetland	[2]
☐	☐	Old Field/Hay Field	[3]	☐	☐	Urban/Industrial	[0]
☐	☐	Fenced Pasture	[2]	☐	☐	Open Pasture	[0]
☐	☐	Residential/Park	[2]	☐	☐	Mining/Construction	[0]
☐	☐	Conservation Tillage, No Till	[2]	☐	☐	Row Crop	[0]

Land Use ☐ **Max=5**

3. Riparian Zone (check the most predominant)

A. Riparian Width

L	R			
☐	☐	Extensive	> 100 m	[5]
☐	☐	Wide	50-100 m	[4]
☐	☐	Moderate	10-50 m	[3]
☐	☐	Narrow	5-10 m	[2]
☐	☐	Very Narrow	1-5 m	[1]
☐	☐	None		[0]

B. Bank Erosion

L	R			
☐	☐	None		[5]
☐	☐	Little	5-25%	[4]
☐	☐	Moderate	25-50%	[3]
☐	☐	Heavy	50-75%	[1]
☐	☐	Severe	75-100%	[0]

C. Shade

L	R			
☐	☐	Heavy	>75%	[4]
☐	☐	Substantial	50-75%	[3]
☐	☐	Moderate	25-50%	[2]
☐	☐	Light	5-25%	[1]
☐	☐	None		[0]

Riparian ☐ **Max=14**

4. Instream Zone

A. Substrate (check two for each channel type)

	[10] Boulder	[9] Cobble	[8] Gravel	[6] Sand	[5] Clay	[5] Bedrock	[2] Silt	[1] Muck	[1] Detritus	[0] Sludge	Channel Type %
Pool	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	_____
Riffle	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	_____
Run	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	_____
Glide	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	_____
Note	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	Presence

B. Embeddedness

☐	None	[5]
☐	Light 25-50%	[3]
☐	Moderate 50-75%	[1]
☐	Severe 75-100%	[-1]
☐	No coarse substrate	[0]

C. Siltation

☐	Silt Free	[1]
☐	Silt Normal	[0]
☐	Silt Moderate	[-1]
☐	Silt Heavy	[-2]

D. Substrate Types

☐	≥4	[2]
☐	<4	[0]

Substrate ☐ **Max=28**

E. Cover Type (check all that apply)

☐	Undercut Banks	[1]	☐	Oxbows, Backwaters [1]
☐	Overhanging Vegetation	[1]	☐	Shallows (in slow water) [1]
☐	Deep Pools	[1]	☐	Macrophytes [1]
☐	Logs or Woody Debris	[1]	☐	Submergent
☐	Boulders	[1]	☐	Emergent
☐	Rootwads	[1]	☐	Floating Leaf

F. Cover Amount (check one)

☐	Extensive >50%	[9]
☐	Moderate 25-50%	[7]
☐	Sparse 5-25%	[3]
☐	Nearly Absent	[0]
☐	Choking Vegetation only	[-1]

Cover ☐ **Max=18**

5. Channel Morphology

A. Depth Variability

☐	Greatest Depth >4X Shallow Depth	[4]
☐	Greatest Depth 2-4X Shallow Depth	[2]
☐	Greatest Depth <2X Shallow Depth	[0]

B. Channel Stability

☐	High	[9]
☐	Moderate/High	[6]
☐	Moderate	[3]
☐	Low	[0]

C. Velocity Types (check all that apply)

☐	Fast	[1]
☐	Moderate	[1]
☐	Slow	[1]
☐	Eddies	[1]
☐	Torrential	[-1]
☐	None	[-1]
☐	Interstitial	[-1]
☐	Intermittent	[-2]

D. Sinuosity

☐	Excellent	[4]
☐	Good	[3]
☐	Fair	[2]
☐	Poor	[0]

E. Pool Width/Riffle Width

☐	Pool Width > Riffle Width	[2]
☐	Pool Width = Riffle Width	[1]
☐	Pool Width < Riffle Width	[0]
☐	No Riffle	[0]
☐	No Pool	[0]
☐	Impounded	[-2]

F. Channel Development

☐	Excellent	[9]
☐	Good	[6]
☐	Fair	[3]
☐	Poor	[0]

G. Modifications (check all that apply)

☐	Leveed	[-1]	☐	Rip Rap [1]
☐	Dredged	[-1]	☐	Const. Island [1]
☐	Bank Shaping	[-1]	☐	Wood Pilings [1]
☐	Railroad Ties	[-1]		
☐	Cemented	[-2]		
☐	Bulkheads	[-2]		

Channel ☐ **Max=35**

Aquatic Vegetation (indicate as follows for observed abundance: Abundant=[3]; Moderate=[2]; Sparse=[1])

A. Beneficial Aquatic Vegetation

____ Pond Lilies (*Nymphaea*/*Nuphar*)	____ Sedge (*Cyperaceae*)	____ Wild Celery (*Vallisneria*)
____ Wild Rice (*Zizania*)	____ Pond Weed (*Potamogeton*)	____ Bulrush (*Scirpus*)
____ Waterweed (*Elodea*)	____ Coontail (*Ceratophyllum*)	____ Water Cress (*Nasturtium*)

B. Invasive and Negative Aquatic Vegetation

____ Eurasian Milfoil (*Myriophyllum*)	____ Purple Loosestrife (*Lythrum*)	____ Reed Canary Grass (*Phalaris*)
____ Cattails (*Typha*)	____ Duckweed (*Lemna*)	____ Algae (Floating Mats)
____ Algae (Planktonic)	____ Algae (Benthic)	

No Vegetation Noted ☐

Comments: _____

Red River Basin River Watch

Adapted MPCA Stream Monitoring Protocol

Stream Reach Determination: To obtain the reach length multiply the mean stream width (MSW) by 35, round to the nearest meter. Divide by 4 to determine the distance to proceed upstream and downstream from the x-site. The minimum and maximum reach length is 75 m and 250 m, respectively.

Supplies (Per Group)

D-frame dipnets with 500 micron mesh nets
Cloth tape
Forceps (plastic)
Toilet scrub brush
Large plastic funnel
Flags
A bucket with 500 micron sieves
A 5 gallon bucket
Pencil (no ink)
Rite-in-the-rain paper for labels
95% Ethanol
Plastic wide-mouth one liter screw top jar
Rain-gear (optional)
Chest-high waders (optional)

Method: Collect a composite sample from up to five different habitat types such that it is representative of the invertebrate community for a particular reach. The method is qualitative and does not require a rigorous sampling design, but rather good judgment. Target 50 animals per habitat. Each group will end up with a single composite sample ideally packed in one jar for processing. Depending on the size of the class, students should work in groups of three (fewer if small class or up to four for large classes).

1. Walk from upstream to downstream identifying how many of the following five habitats exist: hard bottom, macrophytes, undercut banks, snags, and leaf packs. Place a flag at the upstream, midstream, and downstream starting area.

2. Each group will take 10 samples, divided equally among however many habitats exist. Start sampling downstream and work upstream. The way a sample is taken will differ depending on the habitat type as listed below. Always work to not take excess materials (e.g., sand, leaves, wood, rocks, and etc.).

3. Once all 10 samples have been collected, thoroughly rinse them into the plastic jar. Drain and squeeze out as much water as you can being careful not to lose animals. Add a label inside of the jar on Rite-in-the-Rain paper with pencil. Add Ethanol to a final concentration of between 70-80%. Students can eyeball about 1 part sample to four parts EtOH. If they need more room they may need to use more than one jar.

Habitat Descriptions & Sampling Methods

Hard bottom (riffle/cobble/boulder): This category is intended to cover all hard, rocky substrates, not just riffles; however, the surfaces of large boulders and areas of flat, exposed bedrock are generally quite unproductive, avoid including these habitats in the sampling area if possible. The D-net should be placed firmly and squarely on the substrate downstream of the area to be sampled. Ideally, if the water is shallow enough, the area directly in front of the net should be disturbed with the hands, taking care to scrub large rocks off directly into the net. If the water is too deep for this, kicking the substrate in front of the net is adequate.

Aquatic Macrophytes (submerged/emergent vegetation): Include all submerged vegetation but only submersed portions of emergent vegetation. Plants should be sampled sweeping them horizontally and vertically until sampler feels like they have sampled representatively. The idea is to knock invertebrates off the plants. You do not want to take plant material home. If the net fills with weeds, the weeds should be hand washed vigorously or jostled in the net for a few moments and then discarded.

Undercut Banks (undercut banks/overhanging veg): This category is meant to cover in-bank or near-bank habitats, shaded areas away from the main channel that typically are buffered from high water velocities. Sampling should consist of upward thrusts of the net, beating the undercut portion of the bank or the overhanging vegetation, so as to dislodge any clinging organisms.

Snags (snags/rootwads) Snags include any piece of large woody debris found in the stream channel. Given their variable nature, there is not one best method for sampling snags. Using something like a toilet brush or kitchen brush works well for large pieces of wood, whereas kicking and beating with the net works best for masses of smaller branches. The person taking the sample must determine the best method for each particular situation.

Leaf Packs: Leaf packs are dense accumulations of leaves. They are found in deposition zones, generally near stream banks, around logjams, or in current breaks behind large boulders. One square foot of leaf pack surface area that has two cubic feet of leaf underneath should be sampled near the surface. In most situations leaf packs will not be dominate enough to be included in a sample. If leaf packs are sampled, it is suggested that time be spent streamside washing invertebrates off of leaves and discarding the leaves, as a leaf pack sample can easily become overwhelmingly large.

Macroinvertebrate Family Identification

Common Name	Family Name	Tolerance Value	Identification	Photo
Dobsonflies	Corydalidae	0	• large head • filaments on sides of body • forked claws on end of legs • two pairs of claws on end of abdomen	
Stoneflies	Perlidae	1	• Two tails • Bushy gills on underside of thorax • Long antennae	
Dragonfly Darner	Aeshnidae	3	• No tails • No visible gills • Large eyes • Long cylindrical body	
Craneflies	Tipulidae	3	• Worm-like • No legs • Head usually concealed • Terminal gill filaments	
Minnow mayflies	Baetidae	4	• Antennae at least 2x length of head • Lateral oval-shaped gills • 2 or 3 tails	
Flathead mayflies	Heptageniidae	4	• Flat head and body • Lateral gills • 2 or 3 tails	
Net-spinner caddisflies	Hydropsychidae	4	• Never has a case • Branched gills on underside of abdomen • Brush of hairs at end of abdomen • All three thoracic segments sclerotized (brown shell)	
Long-horned Case-maker Caddisflies	Leptoceridae	4	• Antennae length at least 6x width • Only first 2 thoracic segments sclerotized (brown shell) • Cone-shaped case of stones or wood • Usually stripes on head	

Photo credits: Chironomidae Research Group, University of Minnesota, St. Paul

Riffle Beetles	Elmidae	4	• Single claw at the end of each leg • Antennae shorter than head • Body cylindrical	
Scuds	Gammaridae	4	• Freshwater shrimp • 7 pairs of segmented legs • White/grayish color	
Broad-wing Damselflies	Calopterygidae	5	• Long antennae • Gills on end of body • Large scoop-mouth	
Aquatic moths	Pyralidae	5	• Dark head and fleshy body • 6 legs plus 8 hook rings on underside • With or without filaments on sides of body	
Non-biting midges	Chironomidae (other)	6	• Worm-like • Tiny • Head visible • Not blood-red (see below) • Two tiny front legs	
Black flies	Simuliidae	6	• Long fans on mouth • Tiny • Circle of hooks on end of body • Two tiny front legs	
Square-gilled mayflies	Caenidae	7	• Square-shaped gills on abdomen • Three tails • Antennae longer than head	
Bloodworm	Chironomini	8	• Blood-red body • Worm-like • Tiny • Head visible • Two tiny front legs	
Narrow-winged damselflies	Coenagrionidae	9	• Feather-like gills on end of abdomen • Spoon-shape mouth underneath body • Tiny antennae	
Skimmer Dragonflies	Libelluidae	9	• No gills visible • Spoon-shape mouth underneath body • Tiny antennae • Wide body and head	

Photo credits: Chironomidae Research Group, University of Minnesota, St. Paul

Hilsenhoff Family Biotic Index (FBI)

The FBI is calculated by multiplying the number in each family by the tolerance value for that family (Table 1), summing the products, and dividing by the total arthropods in the sample (Hilsenhoff 1988).

Use the numbers from Table 1 and Table 2 to complete the equation below.

$$\textbf{HBI} = \frac{\textbf{Total}^{(nxa)}}{\textbf{Total}^{(n)}} : \quad \_\_\_ : \_\_\_ = \_\_\_ \_\_\_ \_\_\_$$

Family Biotic Index | Water Quality | Degree of Organic Pollution

Table 1. Tolerance values for families of stream arthropods in the western Great Lakes region (Hilsenhoff 1988).

Order	Family	Tolerance Value (a)	Tally (n)	Product (n x a)
Plecoptera	Perlidae	1		
Ephemeroptera	Baetidae	4		
	Caenidae	7		
	Heptageniidae	4		
	Leptophyphidae	4		
Odonata	Aeshnidae	3		
	Calopterygidae	5		
	Coenagrionidae	9		
	Libelluidae	9		
Trichoptera	Hydropsychidae	4		
	Hydroptilidae	4		
	Leptoceridae	4		
Megaloptera	Corydalidae	0		
Lepidoptera	Pyralidae	5		
Coleoptera	Elmidae	4		
Diptera	Ceratopogonidae	6		
	Chironomini (blood-red)	8		
	Chironomidae (other)	6		
	Empididae	6		
	Psychodidae	10		
	Simuliidae	6		
	Tabanidae	6		
	Tipulidae	3		
Amphipoda	Gammaridae	4		
Isopoda	Asellidae	8		
			Total$^{(n)}$:	**Total$^{(nxa)}$:**

Table 2. Evaluation of water quality using the family-level biotic index.

Family Biotic Index	Water Quality	Degree of Organic Pollution
0.00-3.75	Excellent	Organic pollution unlikely
3.76-4.25	Very Good	Possible slight organic pollution
4.26-5.00	Good	Some organic pollution probable
5.01-5.75	Fair	Fairly substantial pollution likely
5.76-6.50	Fairly poor	Substantial pollution likely
6.51-7.25	Poor	Very substantial pollution likely
7.26-10.00	Very poor	Severe organic pollution likely

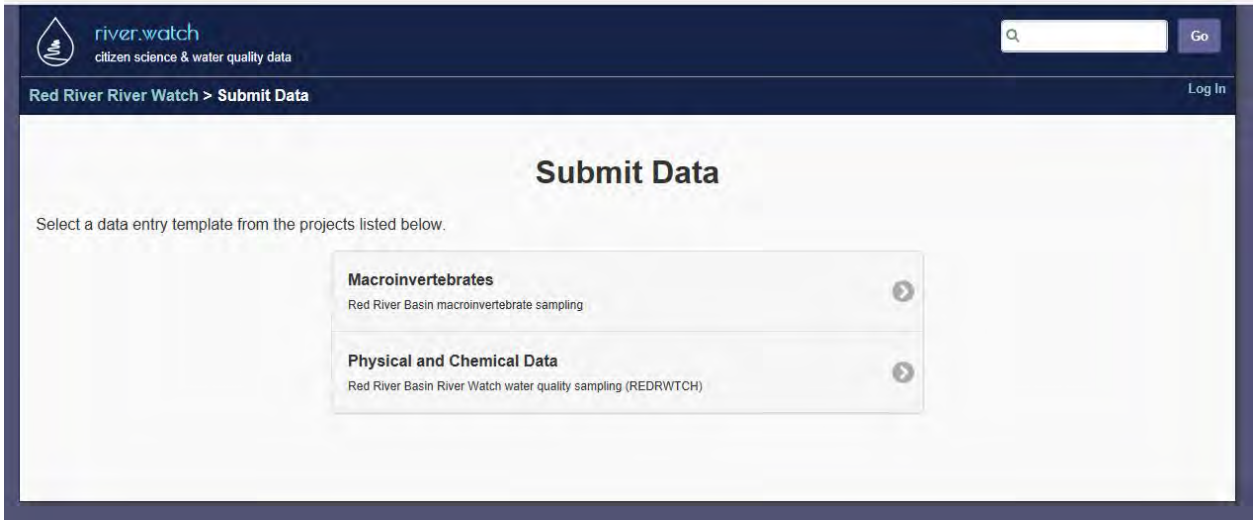
Hilsenhoff, William L. 1988. Rapid Field Asessment of Organic Pollution with a Family-Level Biotic Index. Journal of the North American Benthological Society, Vol. 7, No. 1, pp. 65-68.

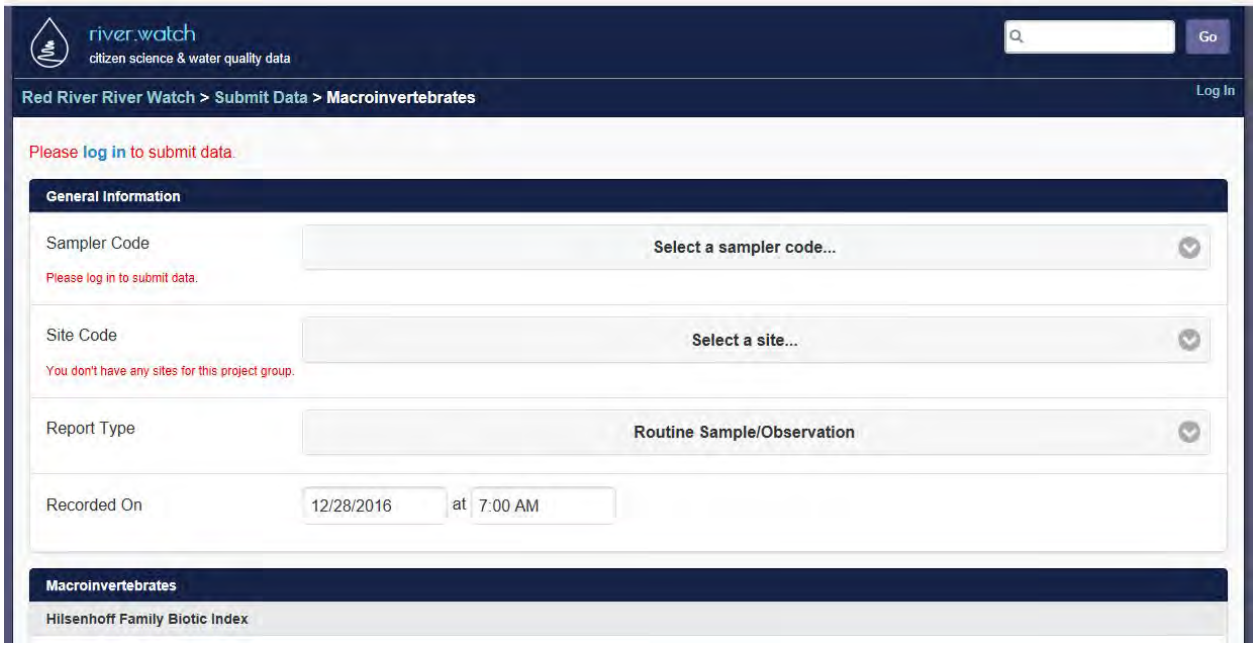
River Watch Macroinvertebrate Data Portal

The macroinvertebrate data portal was created to provide students access to monitoring and identification tools and to allow for data entry. The portal can be accessed at:

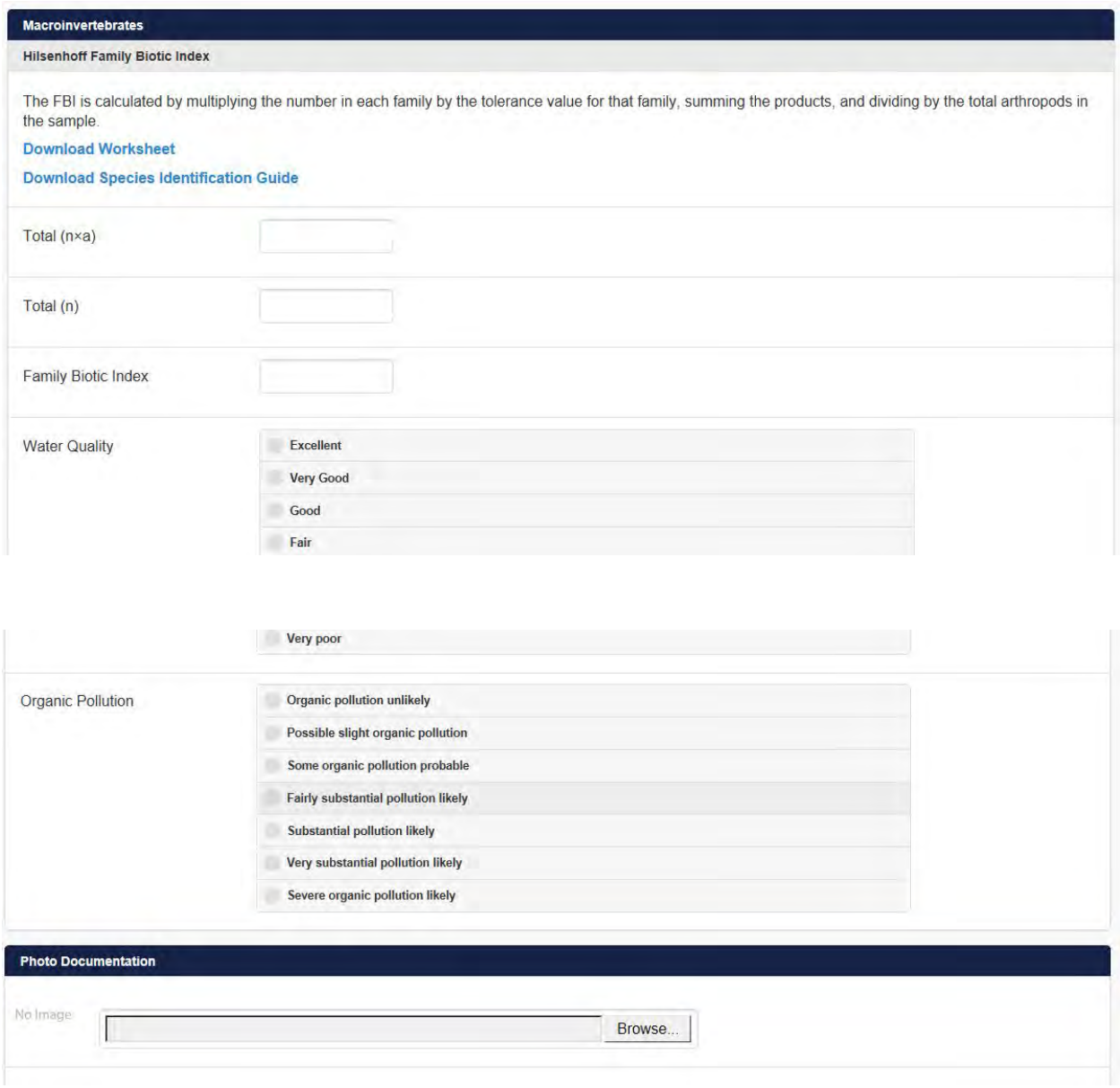
https://river.watch/red-river/projects?target=/reports/new

Screen Shot Portal Overview





Screen Shot Portal Overview Continued



Bio Ref Site Research_RW Macro Project 2016

FieldNum	WBName	Location	HUC8_name	Drain Area (Sq. Mi.)	Gradient (m/km)	Channel Status	LAT8xDD	LON8xDD
05RD005	Unnamed trib. to Wild Rice River	Downstream of County Route 31, 1/4 mile N of Fossum	Wild Rice River	59.7	2.2	natural	47.24283388640	-96.18150628180
05RD115	Wild Rice River	Upstream of CR29, NE side of Twin Valley	Wild Rice River	926.3	1.2	natural	47.26451942870	-96.24462129190
05RD101	Ruffy Brook	5 miles SE of Clearbrook, upstream of CR 79	Clearwater River	26.1	2.6	natural	47.66835144300	-95.33515947060
05RD013	Rabbit River	upstream of CR 158, ~10 miles SE of Breckenridge	Bois de Sioux River	319.1	0.0	natural	46.12574371560	-96.52817627720
05RD080	Red Lake River	1.5 mi. W. of Crookston, MN; downstream of Alt. 75	Red Lake River	5354.6	0.2	natural	47.77645129410	-96.64861307710
05RD110	Buffalo River	In Hawley just upstream of the Hwy 10 Bridge	Buffalo River	315.9	0.4	channelized	46.87927658710	-96.31126412330
05RD097	Mud River	Downstream of 360th Ave NE, 4 mi. NW of Grygla	Thief River	157.4	0.5	natural	48.32421980980	-95.70371258610
05RD119	Whiskey Creek	1 mi. downstream of CR 21, 6.5 mi W of Barnesville	Buffalo River	84.4	0.4	channelized	46.67707648780	-96.54575338200
05RD125	Mustinka River	Just W of Wheaton	Mustinka River	793.0	0.6	channelized	45.79493964560	-96.54068752990
07RD012	Hay Creek	Upstream of 150th St, 2 mi. S of Downer	Buffalo River	87.8	0.8	channelized	46.72333000000	-96.48253000000
09RD003	Hay Creek	Downstream of 265th St N, 3.5 mi. NE of Hawley	Buffalo River	44.2	2.3	natural	46.89855000000	-96.24940000000
09RD021	Whiskey Creek	Upstream of CR 56, 2 mi. NW of Barnesville	Buffalo River	69.1	1.7	channelized	46.66166667000	-96.46120000000
09RD022	Spring Creek	Downstream of 170th St S, 2 mi SE of Downer	Buffalo River	9.2	3.1	natural	46.73660000000	-96.44240000000
09RD023	Hay Creek	Upstream of 110th Ave S, 1.5 mi. SE of Downer	Buffalo River	75.2	1.4	channelized	46.73288333000	-96.46080000000
09RD039	Buffalo River	Downstream of 28th Ave N, 5.5 mi. NE of Hawley	Buffalo River	257.2	0.2	natural	46.90295000000	-96.24581667000
09RD040	Buffalo River	Downstream of 240th St N, 0.5 mi E of Hawley	Buffalo River	308.6	1.8	natural	46.88115000000	-96.30461667000
09RD042	Buffalo River	Downstream of County Hwy 23, 4.5 mi. SW of Hawley	Buffalo River	360.1	3.6	natural	46.86076667000	-96.40885000000
09RD028	Trib. to Buffalo River	Upstream of CR 115, 1 mi. NE of Hawley	Buffalo River	6.5	2.3	channelized	46.89271667000	-96.29623333000
94RD002	Rabbit River	Upstream of 480th St, 2.25 mi W of River Center	Bois de Sioux River	116.3	0.0	natural	46.07846000000	-96.35468000000
10RD005	Rabbit River	Upstream of Hwy 75, 5 mi. NW of Campbell	Bois de Sioux River	303.4	0.2	natural	46.11101000000	-96.48918000000
10RD032	Mustinka River	Upstream of Hwy 75, 1 mi. N of Wheaton	Mustinka River	761.3	0.1	channelized	45.82189000000	-96.48749000000
10RD036	Mustinka River	Upstream of CR 11, 3.5 mi. E of Norcross	Mustinka River	171.3	0.1	natural	45.87294000000	-96.12934000000
10RD045	Eighteen Mile Creek	Upstream of CR 7, 2 mi. SW of Wheaton	Mustinka River	50.1	0.6	natural	45.78863000000	-96.53017000000
10RD050	Trib. to Five Mile Creek	Upstream of 320th Ave, 3.5 mi W of Herman	Mustinka River	65.0	0.5	channelized	45.80345000000	-96.21206000000
10RD078	Judicial Ditch 4	Upstream of 750th Ave, 2 mi. W of Graceville	Mustinka River	16.8	0.9	channelized	45.56890000000	-96.47502000000
11RD060	Mud River	Upstream of 390th Ave NE, 1 mi. W of Grygla	Thief River	135.9	0.9	channelized	48.30527000000	-95.63455000000
12RD004	Red Lake River	Downstream of Hwy 75, 0.5 mi W of Crookston	Red Lake River	5352.6	0.2	natural	47.77666000000	-96.63169000000
12RD013	Red Lake River	Downstream of CSAH 11, 5.5 mi. E of Crookston	Red Lake River	5274.6	0.3	natural	47.78680000000	-96.49015000000
12RD108	Red Lake River	1 mi. upstream of Crookston	Red Lake River	5347.9	0.1	natural	47.76732000000	-96.57914000000
12RD112	Red Lake River	1.5 mi. downstream of Crookston	Red Lake River	5355.1	0.0	natural	47.78514000000	-96.65227000000
94RD513	Red Lake River	Downstream of Woodland Ave, in Crookston	Red Lake River	5351.4	0.0	natural	47.77768000000	-96.60789000000
12RD013	Red Lake River	Downstream of CSAH 11, 5.5 mi. E of Crookston	Red Lake River	5274.6	0.3	natural	47.78680000000	-96.49015000000
12RD108	Red Lake River	1 mi. upstream of Crookston	Red Lake River	5347.9	0.1	natural	47.76732000000	-96.57914000000
14RD234	Ruffy Brook	Downstream of 480th St, 3 mi. NE of Clearbrook	Clearwater River	42.5	3.0	natural	47.71777000000	-95.37674000000
14RD235	Silver Creek	Upstream of CR 74, 1 mi. W of Clearbrook	Clearwater River	16.3	2.1	natural	47.68739000000	-95.45124000000
14RD011	Unnamed creek	Upstream of CR 31, 4 mi. SE of Twin Valley	Wild Rice River	59.1	3.0	natural	47.23714000000	-96.17810000000
14RD015	Coon Creek	Upstream of CR 28, 3 mi. W of Twin Valley	Wild Rice River	45.9	2.6	natural	47.26363000000	-96.34169000000
14RD041	Wild Rice River	Downstream of Hwy 32, in Twin Valley	Wild Rice River	931.7	0.8	natural	47.28065000000	-96.27982000000
14RD044	Coon Creek	Upstream of 355th St, 3.5 mi. SW of Twin Valley	Wild Rice River	25.1	2.1	natural	47.23780000000	-96.32618000000
14RD080	Coon Creek	Upstream of 170th Ave, 3 mi. W of Twin Valley	Wild Rice River	32.6	2.1	natural	47.25197000000	-96.32817000000
05RD115	Wild Rice River	Upstream of CR29, NE side of Twin Valley	Wild Rice River	926.3	1.2	natural	47.26451942870	-96.24462129190
14RD303	Ruffy Brook	Upstream of CR 3, 3 mi. NE of Leonard	Clearwater River	33.6	4.2	natural	47.67088000000	-95.33768000000
14RD015	Coon Creek	Upstream of CR 28, 3 mi. W of Twin Valley	Wild Rice River	45.9	2.6	natural	47.26363000000	-96.34169000000
14RD014	Mashaug Creek	Upstream of CR 160, 1 mi. NE of Heiberg	Wild Rice River	68.2	0.7	natural	47.29863000000	-96.25765000000
15EM098	Silver Creek	Downstream of CSAH 6, 1 mi. SW of Clearbrook	Clearwater River	14.2	3.1	natural	47.67766090410	-95.44739832900