Procedures for Completing the Qualitative Habitat Evaluation Index

B-003-OWQ-WAP-XX-23-T-R2
Technical Standard Operating Procedure
Office: Office of Water Quality
Branch: Watershed Assessment and Planning Branch
Section: All

Last Revised: February 28, 2023
Revision Cycle: Every 4 years
Originally Effective: December 21, 2016

Purpose

This technical standard operating procedure (TSOP) describes the methods for completing the Qualitative Habitat Evaluation Index (QHEI) to ensure that habitat evaluations are scored in a consistent manner. This TSOP follows the QHEI scoring calculations and definitions developed by the Ohio Environmental Protection Agency (OHEPA 2006). A detailed analysis of the development and use of the QHEI is available in Rankin 1989 and Rankin 1995. The QHEI is used to evaluate a stream's ability to support fish and macroinvertebrate communities by evaluating substrate; instream cover; channel morphology; bank erosion and riparian zone; pool/glide and riffle/run quality; and gradient. Following the collection of fish and macroinvertebrate community samples, these six metrics are scored individually and added together to produce a total QHEI score for the site, with a minimum score of zero and a maximum score of 100.

Scope

This TSOP applies to agency staff in the Office of Water Quality (OWQ) Probabilistic and Targeted Monitoring Sections who complete the QHEI for a sampling site immediately following the collection of fish or macroinvertebrate community samples.

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Authorizing Signatures

I approve and authorize this technical standard operating procedure:

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This technical standard operating procedure is consistent with agency requirements.

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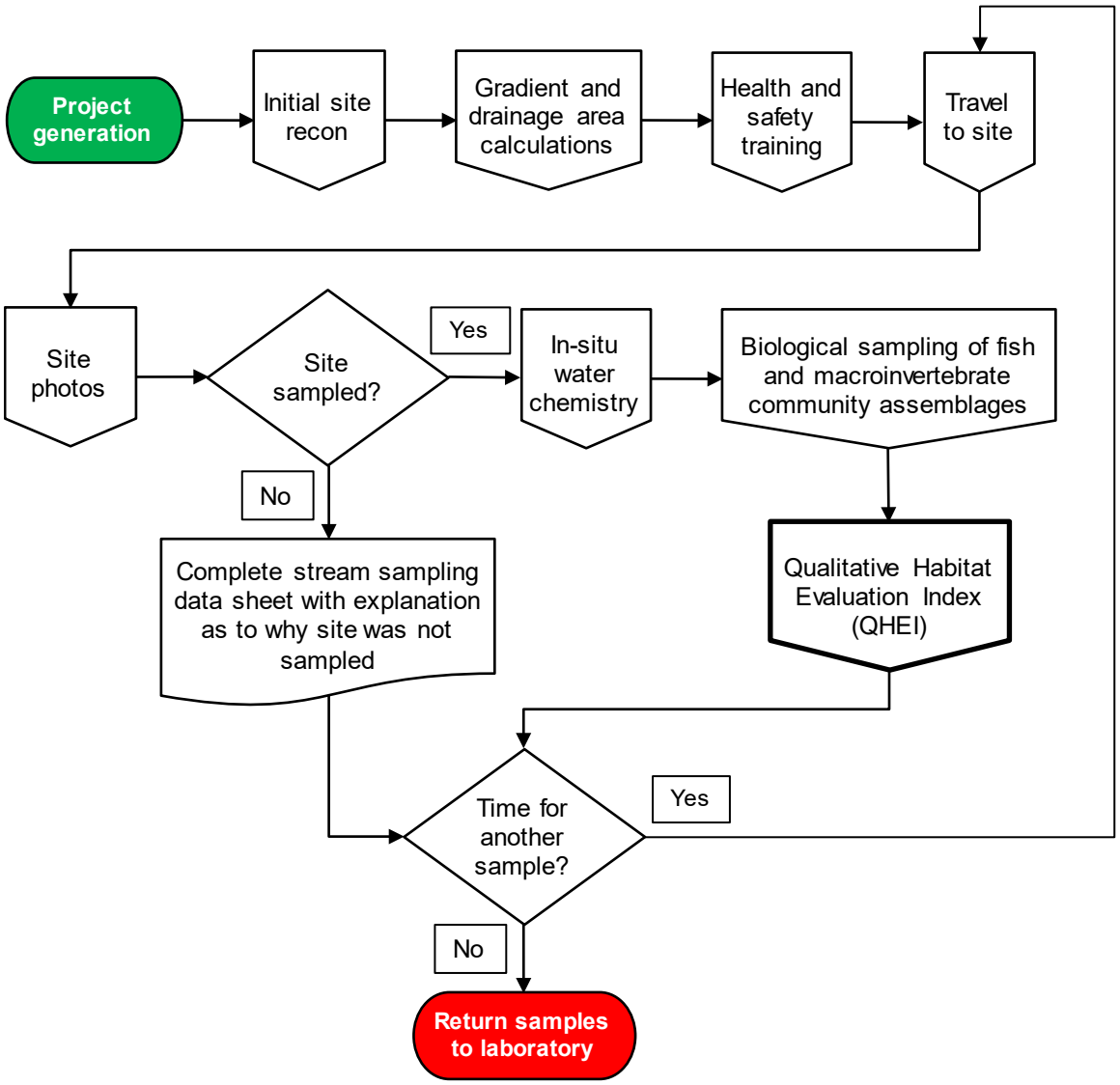
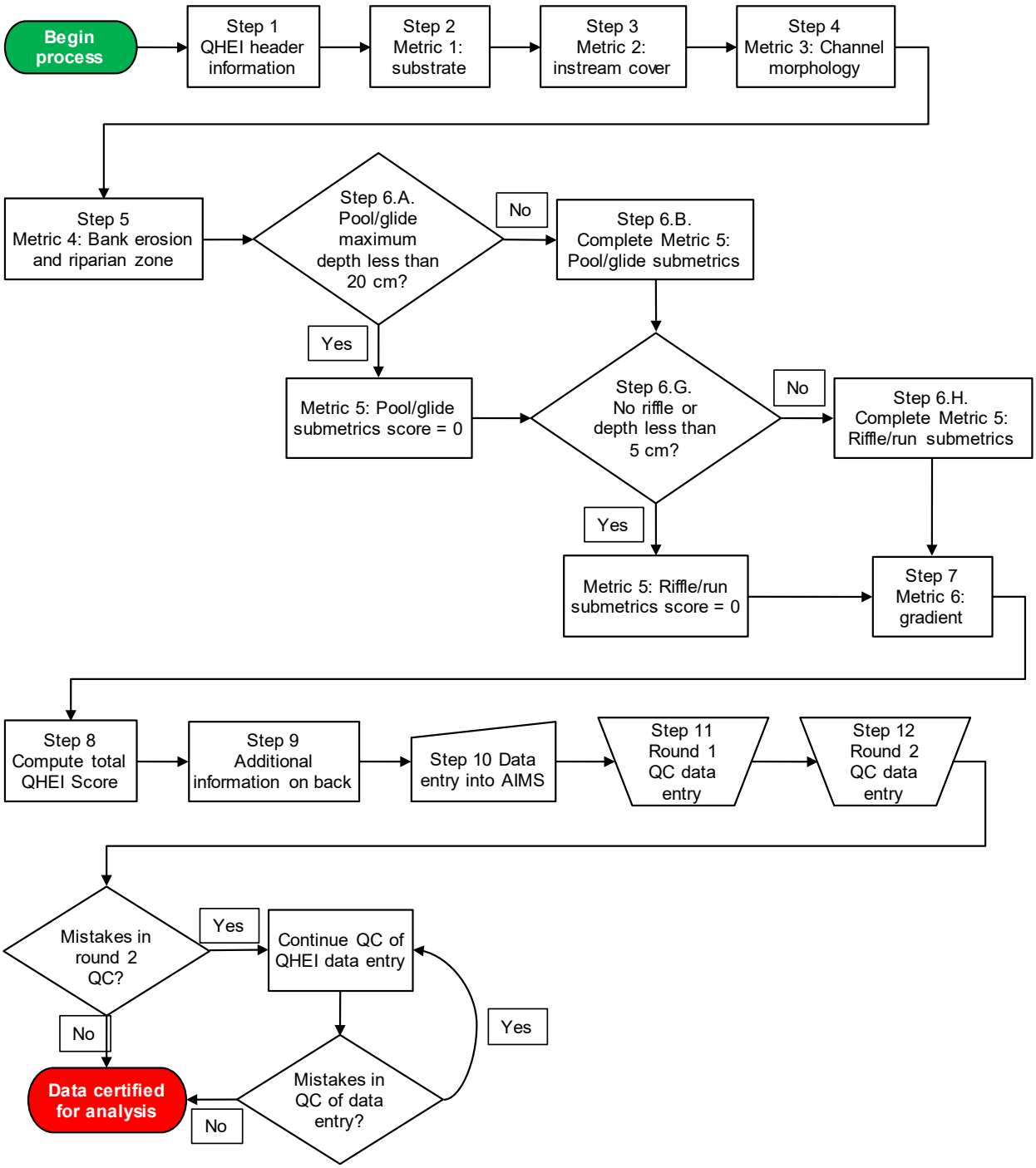
1.0. Overview Flowchart



2.0. Procedure

2.1. Procedural Flowchart



2.2. Procedural Steps

The QHEI datasheet used by IDEM is a modified version of OHEPA's 2006 QHEI field sheet and can be viewed in Appendix 1. The project manager will print QHEI datasheets on "Rite in the Rain"® copier paper to ensure data will not be lost due to weather or splashing of water while conducting the habitat evaluation. Following the biological sampling event, the crew chief will complete the QHEI or assign a field crew member to be the surveyor. The assigned surveyor should have completed the one-day QHEI office and field training, and have at least one year experience completing a QHEI. All procedural steps are to be performed by the surveyor except when noted otherwise.

In certain cases, the surveyor may decide that a habitat characteristic falls between the multiple choices. Two boxes may be checked, and their scores averaged where it is noted by the phrase "Check ONE (Or 2 & average)."

Staff must finish water chemistry and biological sample collection before starting the QHEI. This will prevent disturbing the sampling area and invalidating sample results.

All QHEI evaluations are conducted over the same stream reach as the respective biological community sampling. As specified in the respective work plans, this length is:

- 50 m for macroinvertebrate community sampling
- 15 times the average wetted width, with a minimum of 50 m and a maximum of 500 m, for fish community sampling.

Step 1. QHEI Header Information

The following sample and location information need to be completed prior to the six metrics:

A. Sample #: AA/AB/AC number assigned to each individual watershed sampling event conducted by OWQ field crews and used to identify the sampling event in the Assessment Information Management System (AIMS) database. This can be copied from the Stream Sampling Field Data Sheet, which is prepopulated by AIMS upon printing.

B. bioSample #: Either of the:

1. Event identification number for fish community samples, consisting of the last two digits for the year in which the sample was collected and the three digit site number (YY_ _ _).

2. Macroinvertebrate sample number for macroinvertebrate community samples, consisting of the last two digits for the year, two digits for the month, two digits for the day, one digit for the team number (based on the assigned biologist's logbook ID), and the number of samples collected for that day (YYMMDD_ _ _).

For example, site INRB14-031 sampled on 7/30/2014 by Team 1 and third sample for the day would be Event identification number 14031 for fish community or 140730103 for macroinvertebrate community.

C. Stream Name: Name of the sampled waterbody. This can be copied from the Stream Sampling Field Data Sheet.
D. Location: Description of the nearest road or intersection to the site. This can be copied from the Site Description field on the Stream Sampling Field Data Sheet.
E. Surveyor: Initials (all capital letters) of the person completing the datasheet
F. Sample Date: MM/DD/YYYY
G. County: County where the site is located. This can be copied from the Stream Sampling Field Data Sheet.
H. Macro Sample Type (if macro sample was collected): MHAB for multiple habitats, KICK for kick only, or HD for Hester-Dendy.
I. The Habitat Complete box is checked after all six metrics have been scored and a final total QHEI Score is written in the header.

Step 2. Metric 1: *SUBSTRATE*

The metric includes four components: type (BEST TYPES and OTHER TYPES), origin, and quality, which includes silt cover (SILT) and embeddedness.

A. There are two columns for substrate type (BEST TYPES and OTHER TYPES).

The two columns of checkboxes in front of each substrate type are to indicate predominant substrate.
The two columns of checkboxes after each substrate type are to indicate presence of substrate and whether it is present in a pool or glide (P/G), or in a riffle or run (R/R).

Per the Ohio EPA 2006 manual (OHEPA 2006), substrate types are defined as:

1. Boulder/Slabs* (BLDR/SLABS) – large "slabs" more than 256 mm (10 in.) in length

2. Boulder* – rounded stones over 256 mm (10 in.) in diameter
3. Cobble* – stones from 64-256 mm (2.5-10 in.) in diameter
4. Gravel* – mixture of rounded coarse material from 2-64 mm (0.08-2.5 in.) in diameter
5. Sand* – materials 0.06-2.0 mm in diameter and have a gritty texture when rubbed between fingers.
6. Bedrock* – solid rock forming a continuous surface.
7. Hardpan – particles less than 0.004 mm in diameter, usually clay, which forms a dense, gummy surface that is difficult to penetrate.
8. Detritus – dead, unconsolidated organic material that could include sticks, wood, and other partially or un-decayed coarse plant material.
9. Muck – black, fine, flocculent, completely decomposed organic matter (does not include sewage sludge)
10. Silt – materials 0.004-0.06 mm in diameter and feels "greasy" when rubbed between fingers.
11. Artificial – substrates such as bricks, rip rap, concrete, or other unnatural substrates placed in the stream.

*Denotes a qualitative preferred or "best" habitat type for purposes of the QHEI calculation.

Score only natural substrates; ignore sludge from point-sources. Sludge was intentionally dropped from the substrate metric, but impacts from livestock or wastewater treatment plants should be noted on the back of the QHEI under "Issues" with more detail in the comments.

B. PRESENT – Check every substrate type present in the pool and glide (P/G) habitat and the riffle and run (R/R) habitat. For a substrate type to be present, it must be in at least 5% of the habitat type (e.g., if both P/G and R/R habitats have 5% boulder coverage, both boxes would be checked under "Present").

C. PREDOMINANT – Check the two substrate types that are predominant in the stream reach. If one substrate type predominates (greater than 75-80% or is clearly the most functional predominant substrate), then check this substrate type twice. DO NOT check more than two boxes.

D. Check the box for the number of Best Types present: “4 or more” or “3 or less”.

E. ORIGIN – Substrate origin refers to the parent material from which the substrate type(s) originated. Check one box. If the parent material is from multiple sources (e.g., rip/rap and tills), check two boxes and average the points. Consulting geological maps may be helpful in completing this metric (see IndianaMap).

Substrate origins are defined as:

1. Limestone – sedimentary rock consisting mainly of calcium carbonate, usually bedrock or flat boulders and cobble.
2. Tills – sediments deposited by glaciers; can be carried into non-glaciated areas. Particles are often rounded, randomly arranged without bedding, and can range from clay to boulder size.
3. Wetlands – substrate typically rich in organic muck and detritus with stream originating in swamp or marsh.
4. Hardpan – general term for relatively hard layer of soil at or just below the ground surface, consisting of impervious clay cemented together.
5. Sandstone – sedimentary rock composed primarily from sediments derived from persisting rock (predominately quartz grains) or fossils.
6. Rip/rap – pile of large, angular boulders placed along the shore to prevent erosion by currents.
7. Lacustrine – stream substrate influenced by lake or lentic habitat.
8. Shale – sedimentary rock composed of detrital sediment particles (predominantly clay grade), which tend to be red, brown, black, or gray; and usually originate in relatively still waters. These may be rich in fossils.
9. Coal Fines – finely crushed coal fragments, usually composed of dark, pyritic minerals. These are often the result of coal mining.

F. SILT – Silt cover is the extent that substrates are covered by silt. Check one box or two and average.

1. Heavy – more than 75% of the stream bottom (pool/glides and all but the fastest areas of riffle/runs) is layered with a deep covering of silt (greater than one inch thick).

2. Moderate – 50 to 75% of the stream bottom is covered by silt, but with some areas of cleaner substrate (e.g., riffle areas).
3. Normal – silt deposited in small amounts or a “dusting” along the stream margin that appears to have little functional significance.
4. Free – substrates are exceptionally clean throughout the sampling area. (Note: If silt was present in at least 5% of the reach, Silt Free should not be checked.)

G. EMBEDDEDNESS – Embeddedness is the extent that gravel, cobble, and boulder substrates are surrounded or covered by fine material (sand and silt). Substrates should be considered embedded if greater than 50% of their surfaces are surrounded by fine material. Embedded substrates cannot be easily dislodged. Naturally sandy streams are not considered embedded. However, a sand predominated stream that results from human activities is considered embedded. Check one box or two and average.
1. Extensive – greater than 75% of sampling area is embedded; pools and riffles are usually heavily embedded.
2. Moderate – 50-75% of sampling area is embedded; pools are usually heavily embedded.
3. Normal – 25-50% of sampling area is embedded; some outside of natural depositional areas.
4. None – less than 25% of sampling area is embedded, only in natural depositional areas.

H. Write down any comments.

I. Total up the points given to predominant substrate type, number of best types, origin, silt quality, and embeddedness quality. Do not round the metric components, only the final metric score. Round the final metric score; if one half or greater, round up to the next whole number. Although the theoretical maximum metric score is greater than 20, the maximum score allowed for the substrate metric is limited to 20 points. The minimum score is zero.

Step 3. Metric 2: *INSTREAM COVER*

This metric consists of two components: instream cover types and the amount (availability) of instream cover.

A. Each cover type present should be in at least 5% of the reach sampled and in areas with sufficient depth, usually greater than 20 cm, to be useful for biological organisms. The presence of a cover type should be indicated 0 to 3.

0 – Absent

1 – Very small amounts or if more common of marginal quality. Quality is dependent on functionality. Functionality varies throughout the sampling season.

2 – Moderate amounts, but not of highest quality or in small amounts of highest quality

3 – Highest quality in moderate or greater amounts (e.g., very large boulders in deep or fast water; larger diameter logs that are stable; well-developed root wads in deep or fast water; or deep, well-defined, functional pools).

Instream cover types are defined as:

1. Undercut banks – banks that have significant erosion occurring at the water level. This means the below water level portion is undercut and the above water level portion extends out over the stream.
2. Overhanging vegetation – vegetation hanging over the stream.
3. Shallows (in slow water) – areas where the water moves slower than the rest of the stream, which can be usually found at the stream edge (nursery areas for small fish).
4. Root mats – fine, fibrous roots tightly woven and extending into the stream.
5. Pools > 70 cm – areas where the current is slow, and the depth is significantly greater than the surrounding waters. Where deep pools are located, the stream bed is often concave, and the stream width is often greatest.
6. Root wads – tree roots that extend into the stream.
7. Boulders – rounded stones over 256 mm (10 in.) in diameter.
8. Oxbows, backwaters – sections of the stream that have been cut off from the main stem due to erosion and deposition as the stream changed course over time. Flooding events can reconnect these stagnant waters with the stream.
9. Aquatic macrophytes – emergent or submergent plants found in aquatic environments, not algae or algal mats.

10. Logs or woody debris – dead tree limbs and logs that may accumulate along areas with slow current or restricted flow.

B. AMOUNT – For the amount or availability of instream cover, check one box. If cover is intermediate between two categories, check two boxes and average the points. If a SINGLE type of cover is extensive, the total is scored as moderate due to a low diversity of cover types.
   1. Extensive – present throughout the sampling area, generally greater than 75%.
   2. Moderate – occurs over 25-75% of the sampling area.
   3. Sparse – present in less than 25% of the sampling area; usually present in isolated patches.
   4. Nearly absent – no large patch of any type of cover is present anywhere in the sampling area; usually found in recently channelized streams or other highly modified reaches.

C. Write down any comments.

D. Total up the points given to the two components (presence and amount). Sum up the points for cover types present. There is no relationship between points and the 0-3 presence score. All cover types, except for pools (which are worth two points), are worth one point each. Do not round the metric components, only the final metric score. Round the final metric score; if one half or greater, round up to the next whole number. Although the theoretical maximum metric score is greater than 20, the maximum score allowed for the instream cover metric is limited to 20 points.

Step 4. Metric 3: *CHANNEL MORPHOLOGY*

The metric includes four categories: sinuosity, development, channelization, and stability. Check one box in each category. If conditions are intermediate between two categories, check two boxes and average the points.

A. SINUOSITY – Sinuosity is the degree to which the stream meanders.
   1. High – a channel with more than 2 or 3 well-defined outside bends with deep areas outside and shallow areas inside.

2. Moderate – a channel with more than 2 outside bends, with at least one well defined bend.
3. Low – a channel with only 1 or 2 poorly defined outside bends within the sampling area, or slight meandering within modified banks.
4. None – a straight channel.

B. DEVELOPMENT – Development refers to the development of riffle/pool complexes.
   1. Excellent – deep riffles and runs are present with larger substrates (gravel, cobble, or boulder) and depth greater than 0.5 m. Pools have a maximum depth greater than 1 m and there is a distinct transition between pools and riffles.
   2. Good – better defined riffles are present with larger substrates (gravel, cobble, or boulder). Pools have variation in depth and there is a distinct transition between pools and riffles.
   3. Fair – riffles are poorly developed or absent. Pools are more developed with greater variation in depth.
   4. Poor – riffles are absent or, if present, shallow with sand and fine gravel substrates. If present, pools are shallow (less than 20 cm). Glide habitats, if predominant, receive a poor rating.

C. CHANNELIZATION – Channelization refers to man-made channel modifications.
   1. None – no man-made channel alterations.
   2. Recovered – the stream was channelized in the past and has recovered most of its natural channel characteristics.
   3. Recovering – the channelized stream is in the process of regaining its natural characteristics. These habitats are still degraded.
   4. Recent or no recovery – the stream was recently channelized or does not show significant recovery of habitats (e.g., drainage ditches, grass lined or rock rip-rap banks).

D. STABILITY - Stability refers to channel stability. Artificially stable (concrete) stream channels receive a high rating. Even though they generally have a negative influence on fish assemblages, the negative effects are related to features other than their stability.
   1. High – channels with stable banks and substrates, little or no erosion, and no moving bedload.
   2. Moderate – channels that maintain stable riffle/pool and channel characteristics, but exhibit some symptoms of

instability (e.g., high bedload, eroding or false banks, or shows the effects of wide fluctuations in water level).

3. Low – channels have fine substrates in riffles that often change location, unstable and severely eroding banks, and high bedload that slowly creeps downstream. Sometimes, these unstable riffles form diagonally across the channel.

E. Write down any comments.

F. Total up the points given to the four categories (sinuosity, development, channelization, and stability). Do not round the metric components, only the final metric score. Round the final metric score; if one half or greater, round up to the next whole number. The maximum score for the channel morphology metric is 20 points.

Step 5. Metric 4: *BANK EROSION AND RIPARIAN ZONE*

The metric consists of three components: erosion, riparian width, and floodplain quality, to assess quality of riparian buffer zone and quality of floodplain vegetation. Each of the three components require scoring of the LEFT and RIGHT banks (looking downstream). The value for each component is calculated by averaging the scores of the LEFT and RIGHT banks. Check one box per bank unless conditions are intermediate, then check two boxes per bank and average the points. Do not round the metric components, only the final metric score.

A. EROSION – Bank erosion is the degradation of streambanks by water flow or animals. False banks refer to banks that are no longer adjacent to the normal flow of the channel but have been moved back into the floodplain most commonly because of livestock trampling (Platts et al. 1983).

1. None/little – streambanks are stable and not altered by water flows or animals (i.e., livestock). Less than 25% of the streambank is receiving any kind of stress. Less than 25% of the streambank is false, broken down, or eroding.
2. Moderate – streambanks are receiving moderate alteration along the reach. At least 50% of the streambank is in a natural stable condition. Less than 50% of the streambank is false, broken down, or eroding.
3. Heavy/severe – streambanks have received major alterations along the reach. Less than 50% of the streambank is in a stable condition. Over 50% of the streambank is false, broken down, or eroding.

B. RIPARIAN WIDTH – Riparian width is the width of streambank vegetation. Width estimates are only done for forest, shrub, swamp, and old field vegetation if it has woody components. Urban, residential, industrial, pasture, and row crops are not included in the width of the riparian zone.

C. FLOODPLAIN QUALITY – Floodplain quality refers to the land uses of the areas immediately outside of the riparian zone or greater than 100 meters from the stream, whichever is wider on each side of the stream. These adjacent areas can have direct runoff and erosion effects during normal wet weather. The aerial map for the site can be useful in determining floodplain quality.

D. Write down any comments.

E. Total up the points given to the three components (erosion, riparian width, and floodplain quality). Again, do not round the metric component scores, only the final metric score. Round the final metric score; if one half or greater, round up to the next whole number. The maximum score for the bank erosion and riparian zone metric is 10 points.

Step 6. Metric 5: *POOL/GLIDE AND RIFFLE/RUN QUALITY*

The metric consists of six categories: Maximum depth, channel width, and current velocity make up the Pool/Glide score for the Pool/Glide quality section. Riffle depth, run depth, riffle/run substrate, and riffle/run embeddedness make up the Riffle/Run score for the Riffle/Run quality section.

A. MAXIMUM DEPTH – Is the maximum depth of pools or glides less than 20 cm (<0.2 m)? If yes, check the appropriate box and proceed to Step 6.G. Pools or glides with maximum depths less than 20 cm (<0.2 m) are considered to have lost their function and the entire pool/glide quality section is scored 0. No other characteristics (channel width and current velocity) need to be scored.

If maximum depth is greater than or equal to 20 cm (≥0.2 m), check the appropriate box and proceed to Step 6.B.

B. CHANNEL WIDTH – Check one box for channel width (unless morphology varies throughout the site, then check two boxes and average the points). If the entire stream area (including areas outside of the sampling zone) is pool or riffle, then check “pool width = riffle width”.

C. CURRENT VELOCITY – For current velocity, check all current types that are present in the sampling area.
   1. Torrential – extremely turbulent and fast flowing water with large standing waves. Water surface is very broken with no definable, connected surface. This type is usually limited to gorges and dam spillway tailwaters.
   2. Very fast – turbulent flow that may make it difficult to stand and creates pulsating effect against leg.
   3. Fast – mostly non-turbulent flow with small standing waves in riffle-run areas. Water surface may be partially broken, but there is a visibly connected surface. Fast current has adequate energy to flow over objects.
   4. Moderate – non-turbulent flow that is detectable and visible (i.e., floating objects are readily transported downstream). Water surface is visibly connected.
   5. Slow – water flow is perceptible but very sluggish.
   6. Interstitial – water flow that is perceptible only in the interstitial spaces between substrate particles in riffle-run areas.
   7. Intermittent – no flow is evident anywhere, leaving standing pools that are separated by dry areas.
   8. Eddies – small areas of circular current motion usually formed in pools immediately downstream from riffle-run areas.

D. Check one box for recreation potential and comment on back.
   Primary contact for areas with access points or trails to deep pools capable of supporting swimming activities. A deep pool is characterized as having an area greater than 100 ft^2 and a depth greater than 3 ft.
   Secondary contact for areas with access points or trails for wading in the stream but no deep pools for swimming.

E. Write down any comments.

F. Total up the points given to the three categories (maximum depth, channel width, and current velocity). Do not round the metric components, only the final metric score. Round the final metric score; if one half or greater, round up to the next whole number. Although the theoretical maximum metric score is greater than 12, the maximum score allowed for the pool/glide quality section is limited to 12 points. The minimum score is zero.

G. RIFFLE DEPTH – Is the depth of the best riffle in the area less than 5 cm or are no riffles present? If yes, check NO RIFFLE

box (located on the far right of the metric) and proceed to Step 7. The entire riffle/run section is scored 0 and no other characteristics (run depth, riffle/run substrate, and riffle/run embeddedness) need to be scored.
If riffle depth is greater than 5 cm, check the appropriate box under riffle depth and proceed to Step 6.H.

H. RUN DEPTH – Check one box that describes the maximum depth of the runs.

I. RIFFLE/RUN SUBSTRATE – Check one box that describes the substrate and stability of the riffle habitats. If stability is intermediate between two categories, check two boxes and average the points.

J. RIFFLE/RUN EMBEDDEDNESS – Check one box that describes the embeddedness in the riffle areas. If embeddedness is intermediate between two categories, check two boxes and average the points.
   1. None – less than 25% of sampling area is embedded; only in natural depositional areas.
   2. Low – 25-50% of sampling area is embedded; some outside of natural depositional areas.
   3. Moderate – 50-75% of sampling area is embedded; pools are usually heavily embedded.
   4. Extensive – greater than 75% of sampling area is embedded; pools and riffles are usually heavily embedded.

K. Write down any comments.

L. Total up the points given to the four categories (riffle depth, run depth, riffle/run substrate, and riffle/run embeddedness). Do not round the metric components, only the final metric score. Round the final metric score; if one half or greater, round up to the next whole number. The maximum score for the riffle/run quality section is 8 points. The minimum score is zero.

Step 7. Metric 6: *GRADIENT*

The metric is based on local gradient and stream size.

A. Use Table 1 as the scoring criteria. If drainage area is not available, use stream width. Check one box.

(GRADIENT) Computing local gradient:
Local gradient is calculated either using United States Geological Survey (USGS) 7.5-minute topographic maps or

ESRI's ArcGIS. This is done by measuring the stream length (not the straight-line distance) between the first contour line upstream and the first contour line downstream of the sampling site and dividing the contour interval by the stream distance (refer to the TSOP titled "Calculation of Gradient").

(DRAINAGE AREA) Computing drainage area:

Drainage area of a stream at a specified location is that area measured in a horizontal plane, enclosed by a topographic divide from which direct surface runoff from precipitation normally drains by gravity into the stream.

- Drainage area is best estimated by using USGS' StreamStats application (refer to the TSOP titled "Calculation of Drainage Area").

Average stream width is the measurement from wetted edge to wetted edge at a point that best represents the sampling reach. Keep in mind narrow riffles and wide pools. Record width to the nearest tenth of a meter on the back of the QHEI near the canopy measurements. It is the same as the average stream width value recorded on the fish community datasheet.

Table 1. Scoring for the gradient metric based on stream width or drainage area, and local gradient. Score values are in bold.

Stream Width	Drainage Area (sq mi)	Gradient (feet/mile)						
		Very Low	Low	Low-Moderate	Moderate	Moderate-High	High	Very High[1]
≤ 4.7	< 9.2	0 - 1.0 **2**	1.1 - 5.0 **4**	5.1 - 10.0 **6**	10.1 - 15.0 **8**	15.1 - 20 **10**	20.1 - 30 **10**	30.1 - 40 **8**
4.8 - 9.2	9.2 - 41.6	0 - 1.0 **2**	1.1 - 3.0 **4**	3.1 - 6.0 **6**	6.1 - 12.0 **10**	12.1 - 18 **10**	18.1 - 30 **8**	30.1 - 40 **6**
9.3 - 13.8	41.7 - 103.7	0 - 1.0 **2**	1.1 - 2.5 **4**	2.6 - 5.0 **6**	5.1 - 7.5 **8**	7.6 - 12 **10**	12.1 - 20 **8**	20.1 - 30 **6**
13.9 - 30.6	103.8 - 622.9	0 - 1.0 **4**	1.1 - 2.0 **6**	2.1 - 4.0 **8**	4.1 - 6.0 **10**	6.1 - 10 **10**	10.1 - 15 **8**	15.1 - 25 **6**
> 30.6	> 622.9		0 - 0.5 **6**	0.6 - 1.0 **8**	1.1 - 2.5 **10**	2.6 - 4.0 **10**	4.1 - 9 **10**	> 9 **8**
[1]Any site with a gradient greater than the upper bound of the "very high" gradient classification is assigned a score of 4.								

B. Estimate the respective percentages of pool, glide, run, and riffle habitat. The total for all habitat types should be 100%.

C. The maximum score for the gradient metric is 10 points.

Step 8. Computing the Total QHEI Score

Sum the metric scores. The QHEI metric scores cannot exceed the Metric Maximum Score indicated in Table 2.

Table 2. The scoring range and maximum score for each QHEI metric.

QHEI Metric	Metric Component	Component Scoring Range	Metric Max. Score
1) Substrate	a) Type	0 to 20	20
	b) Origin	-2 to 1	
	c) Silt Cover	-2 to 1	
	d) Embeddedness	-2 to 1	
2) Instream Cover	a) Type	0 to 11	20
	b) Amount	1 to 11	
3) Channel Morphology	a) Sinuosity	1 to 4	20
	b) Development	1 to 7	
	c) Channelization	1 to 6	
	d) Stability	1 to 3	
4) Bank Erosion and Riparian Zone	a) Bank Erosion	1 to 3	10
	b) Riparian Width	0 to 4	
	c) Floodplain Quality	0 to 3	
5a) Pool/Glide Quality	a) Maximum Depth	0 to 6	12
	b) Channel Width	0 to 2	
	c) Current Velocity	-2 to 5	
5b) Riffle/Run Quality	a) Riffle Depth	0 to 2	8
	b) Run Depth	1 to 2	
	c) Substrate Stability	0 to 2	
	d) Substrate Embeddedness	-1 to 2	
6) Gradient		2 to 10	10
		Total Maximum Score	100

Step 9. Additional Information on back of QHEI Datasheet

This is not needed to calculate a QHEI score but is useful in biological assessments and identifying potential causes or sources of any impairment.

A-Canopy (% open) – The percentage of a typical point in the sampling site that is not covered or shaded by woody bank vegetation, as measured with a spherical densitometer in accordance with the instructions on the lid or in Appendix 9.3.

B-Aesthetics – Select the boxes that apply to the site.

C-Recreation – Check either box if the pool is greater than 100 ft^2 in area and/or greater than 3 ft. in depth. This is used to estimate whether full body immersion is possible.

D-Maintenance – Record what types of stream maintenance activities or special features occur in the sampling area.

E-Issues – Record various potential sources of impact that may occur in or near the site.

F-Stream Drawing – Sketch the entire sampling area. Important physical features are noted on the map with standard symbols where possible. Some elements that might be included are cardinal directions, flow direction, floodplain and riparian zone characteristics, pools, riffles, runs, “X” (where water chemistry measurements were collected), and sampling reach start and end points.

Step 10. Data Entry into AIMS

The crew chief will assign a staff member within the Watershed Assessment and Planning Branch (WAPB) to the role of data entry. This person will enter the data from the QHEI datasheet into AIMS. This should be a staff member who has not been assigned the role of round 1 quality control (QC) of QHEI data entry or round 2 QC of QHEI data entry for the site. Then the staff member who entered the data will place their initials and entry date at the bottom of the QHEI datasheet.

Step 11. Round 1 QC of Data Entry

A WAPB staff member will be assigned to perform round 1 QC of the QHEI data entry into AIMS. This person will check the values entered into AIMS against the paper copy of the QHEI datasheet. This should be a staff member who has not been assigned data entry into AIMS or round 2 QC of QHEI data entry for the site. If mistakes are found, they should be corrected in AIMS and noted. Then the staff member who performed round 1 QC of data entry will place their initials and QC date at the bottom of the QHEI datasheet.

Step 12. Round 2 QC of Data Entry

A full-time WAPB staff member, who has at least one year of experience, will perform round 2 QC of the QHEI data entry into AIMS. This person will check the values entered into AIMS against the paper copy of the QHEI datasheet. This should be a staff member who has not been assigned the role of data entry into

AIMS or round 1 QC of QHEI data entry for the site. If mistakes are found, they should be corrected in AIMS and noted. Then the staff member who performed round 2 QC of data entry will place their initials and date at the bottom of the QHEI datasheet. If mistakes are found in Round 2 QC, additional rounds of QC need to be performed until mistakes cannot be found. A staff member, who has not been involved in data entry and QC, will be assigned to this task.

Step 13. Interpretation of QHEI Score
In Indiana, habitat is likely having a negative impact on aquatic communities when the total QHEI score is less than 51.

2.3. Related Technical Issues

A. Health and Safety Warnings

1. Safety issues are the responsibility of all crew members; however, any questions in the field should be directed to the crew chief. The crew chief is responsible for the completion of all work listed in the TSOP, the health and safety aspects of the sampling event, and successful interactions with landowners and members of the public.
2. Due to the remoteness of sampling sites or limited access to medical assistance, all field staff are required to complete basic first aid and cardiopulmonary resuscitation (CPR) training.
3. Due to the possibility of injury or illness arising in the field, staff will follow the IDEM Injury and/or Illness Resulting from Occupational Exposure Policy (IDEM 2016).
4. According to the memorandum “Change in status of Water Assessment Branch staff in accordance with the Agency training policy” dated November 29, 2010, OWQ WAPB staff are exempt from initial and annual training requirements set forth in Section 6.0 of IDEM Health and Safety Training Policy (IDEM 2010a, 2010b). The memorandum also states, “as an alternative to the training requirements of the policy, the Branch will conduct in-service training at a minimum of four hours per year on topics directly related to duties performed by staff.” New hires or those changing job responsibilities without the minimum four-hour training must be accompanied in the field by a staff member who has met the requirements of the branch health and safety training.
5. Field personnel will follow policies and procedures established in the IDEM Hazard Communication (HazCom) Plan (IDEM 2019).

6. Operating in and around waterbodies carries inherent risks of drowning. Sampling on surface waters requires safety consciousness of staff members and the use of specialized equipment. Thus, personnel involved in sample collection will wear appropriate clothing and PPE when operating boats or sampling in deep water or swift currents per the IDEM Personal Protective Equipment (PPE) Policy (IDEM 2008). According to the memorandum “Use of Personal Flotation Devices (PFDs) by Branch Personnel” dated February 29, 2000, staff must wear U.S. Coast Guard approved Type I, II, or III PFDs whenever:
    - The planned work requires them to enter the water and the maximum water depth at any place at the work site is over their knee. Note that this depth depends on the employee, but it will usually be between 12 to 20 inches or 300 to 500 mm.
    - The employee is in watercraft which is launched, operating on the water, or during retrieval from the water.
    - The employee must work from structures that do not possess guard rails and are over or alongside water where the water depth is, or could reasonably be expected to be, 3 feet or more.
7. In addition, when work is being done in boats on boundary waters as defined by Indiana Code (IC) 14-8-2-27 or between sunset and sunrise on any waters of the state, all personnel in the watercraft must wear a high intensity whistle and Safety of Life at Sea (SOLAS) certified strobe light.

B. Cautions
    1. Be sure to record the correct information in the header of the QHEI datasheet and to fill out the entire datasheet (all six metrics, additional information on the back, and stream drawing).
    2. Remember to finish water chemistry and biological sample collection before starting the QHEI. This will prevent disturbing the sampling area and invalidating sample results.
    3. The QHEI should be completed immediately following biological sampling. This allows the surveyor to walk the stream reach if needed and record accurate scoring information.

C. Interferences
    Not applicable.

D. Calibration
    1. Surveyors will attend a calibration day annually to ensure that each surveyor’s total QHEI score will not differ by more than 10%. Surveyors will score and discuss the reasoning behind their scores to reach a consensus.

E. Troubleshooting
Not applicable.

3.0. Roles

3.1. Responsibilities

A. Project manager
1. The project manager will print QHEI datasheets on "Rite in the Rain"® copier paper to ensure data will not be lost due to weather or splashing of water while conducting the habitat evaluation.

B. Crew chief
1. Attends the annual QHEI training and calibration day
2. Completes the QHEI or assigns an experienced field crew member to be the surveyor. If a less experienced field crew member is filling out QHEI datasheet, the crew chief is responsible for monitoring observations and decisions.
3. Makes sure QHEI is completed accurately
4. Completes basic first aid and CPR training.
5. Completes annual health and safety training
6. Follows policies and procedures established in the IDEM Hazard Communication (HazCom) Plan (IDEM 2019)

C. Surveyor
1. Attends the annual QHEI training and calibration day
2. Reviews and follows this TSOP
3. Completes Basic First Aid and CPR training
4. Completes annual health and safety training

D. Data entry person
1. Enters QHEI datasheet into AIMS accurately
2. Initials and dates bottom of QHEI datasheet

E. QC Round 1
1. Reviews AIMS database entries to reflect QHEI datasheet
2. Takes note of any discrepancies and corrects them
3. Initials and dates bottom of QHEI datasheet

F. QC Round 2
1. Performed by an experienced full-time staff member
2. Reviews AIMS database entries to reflect QHEI datasheet
3. Takes note of any discrepancies and corrects them
4. Initials and dates bottom of QHEI datasheet

3.2. Training requirements

A. Annual QHEI Training and Calibration Day
   1. Crew chief
   2. Surveyor

B. Training in QHEI
   1. Project manager
   2. Crew chief
   3. Surveyor
   4. Data entry person
   5. QC Round 1 and 2

C. Training in USGS StreamStats
   1. Project manager
   2. Crew chief
   3. Surveyor

D. Training in ESRI ArcGIS
   1. Project manager
   2. Crew chief
   3. Surveyor

E. Training in AIMS database management
   1. Project manager
   2. Crew chief
   3. Data entry person
   4. QC Round 1 and 2

F. Basic first aid and CPR training
   1. Project manager
   2. Crew chief
   3. Surveyor

G. Annual health and safety training
   1. Project manager
   2. Crew chief
   3. Surveyor

4.0. Required Forms, Equipment, or Software List

4.1. Forms

A. QHEI Datasheet printed on “Rite in the Rain”® copier paper

4.2. Equipment

A. Clipboard
B. Pencil
C. Spherical crown densitometer
D. First aid kit
E. Hip boots
F. Chest waders
G. Life jacket (U.S. Coast Guard approved Type I, II, or III)
H. Tape measure or rangefinder for stream width

4.3. Software

A. AIMS

B. ESRI ArcGIS

C. USGS StreamStats

5.0. Records Management

5.1. Information recorded on the QHEI datasheet is entered into the AIMS database by WAPB staff and checked twice for data entry errors. The original hard copy is kept in the sample folder and stored in the project filing cabinet in the WAPB library of the IDEM Shadeland office.

5.2. Following aquatic life use assessments for the Integrated Report, the hard copy of the QHEI datasheet is scanned and stored in the IDEM Virtual File Cabinet (VFC).

5.3. Once scanned, the file attached in VFC is checked for completeness and clarity before the original copies are recycled.

6.0. Definitions

6.1. “Agency staff” – Any employee or representative of Indiana Department of Environmental Management (IDEM) including regular employees, temporary employees, contractors, and interns.

6.2. “Assessment Information Management System database (AIMS database)” – IDEM database containing information related to water chemistry; aquatic habitat; macroinvertebrate, fish, and algae communities; fish tissue analyses; sediments; and *E. coli* bacteria data collected by agency staff from watershed sampling events.

6.3. “Channel morphology” – The shape and structure of a stream as described by its sinuosity, riffle or pool development, channelization, and substrate stability.

6.4. “Crew chief” – The agency staff person who leads a field crew when conducting field sampling activities.

6.5. “Current velocity” – The speed of the water flowing in the stream in distance per time.

6.6. “Field crew” – The team of agency staff who conducts field sampling activities. Field crews must contain at least one full-time agency staff member from the Probabilistic or Targeted Monitoring Sections in the crew chief position, and one or more full-time IDEM employees or Governor’s Summer Interns.

6.7. “Glide” – An area common to most modified stream channels that do not have distinguishable pool, run, and riffle habitats; the current and flow is like that of a canal; the local [water] gradient is nearly zero.

6.8. “Governor’s Summer Intern” – An intern selected under the Governor’s Public Service Internship program; a program created to introduce college students to the operations and officials of state government. Governor’s Summer Interns are compensated, intermittent employees, usually working full-time hours from May to September.

6.9. “Instream cover” – Areas in a stream channel that provide aquatic organisms with shelter from the current and protection from predators.

6.10. “Local gradient” – The ratio of drop in elevation of a stream per unit of horizontal distance.

6.11. “Ohio Environmental Protection Agency (OHEPA)” – An agency of the Ohio state government whose mission is to protect the environment and public health by ensuring compliance with environmental laws and demonstrating leadership in environmental stewardship.

6.12. “Pool” – An area of the stream with slow current velocity and a depth greater than riffle and run areas; the stream bed is often concave and stream width frequently is the greatest; the water surface slope is nearly zero.

6.13. “Quality control” – The overall system of technical activities that measures the attributes and performance of a process, item, or service against defined standards to verify that they meet the stated requirements established by the customer; operational techniques and activities that are used to fulfill requirements for quality. In other words, QC involves measuring the "thing produced" against a standard to ensure it is a quality product that meets the identified need.

6.14. “Riffle” – The shallow parts of the stream where water flows swiftly over completely or partially submerged pebble to boulder sized rocks to produce surface agitation.

6.15. “Riparian zone” – The narrow strip of transitional land between upland habitats and perennial or intermittent bodies of water, including creeks, streams, rivers, wetlands, and lakes.

6.16. “Run” – Areas of the stream that have a rapid non-turbulent flow; runs are deeper than riffles, with a faster current velocity than pools, and are generally located downstream from riffles where the stream narrows; the stream bed is often flat beneath a run and the water surface is not visibly broken.

6.17. “Stream reach” – A segment of a stream used for fish community sampling equal in length to 15 times the average wetted width of the stream, with a minimum length of 50 meters and a maximum length of 500 meters. For macroinvertebrate community sampling, the stream reach is 50 meters of all available habitat.

6.18. “Substrate” – The material that composes the stream or riverbed.

6.19. “Substrate type” – The distribution of stream bed material that is characterized by particle size.

6.20. “Technical Standard Operating Procedure (TSOP)” – A standard operating procedure that involves environmental data generation, manipulation, or compilation of an analytical process.

6.21. “Wetted edge” – The point where the stream meets the bank.

7.0. Quality Assurance and Quality Control

7.1. New and current field staff will review the TSOP and attend QHEI training annually before participating in any field monitoring activities. QHEI training will include a classroom and field component. This is led by a staff member who has taken OHEPA QHEI training. The classroom component will go over the six metrics and additional information on the back of the QHEI datasheet as well as how to score each individual metric under different habitat conditions. The field component allows staff to visually observe habitat characteristics that classify with poor and good QHEI scores. Each person will individually complete a QHEI and score each site. This blinded check calibrates each person’s scoring of the same site and allows for discussion.

7.2. The QHEI is completed once a year at each site. For 10% of the sites, the biological communities and QHEI will be resampled for a duplicate. The duplicate sample for macroinvertebrate community and QHEI are conducted on the same day by the crew chief. The duplicate fish community sampling and QHEI are conducted as a revisit after two weeks, which gives the biological community time to recover from the disturbance caused by the initial sampling event. The fish community revisit sampling and QHEI are completed by a different biologist than the original surveyor.

7.3. The QHEI datasheet is completed in the field by the surveyor after water chemistry and biological samples are collected. Then the completed datasheet will be entered into the AIMS database. Following data entry, two rounds of quality control will be performed on the database entries to ensure they reflect the paper copy of the QHEI datasheet. Additional rounds of quality control will be performed as necessary. Staff who review the data entries will place their initials and the date performed on the bottom of the paper copy of the QHEI datasheet. When quality control has been completed on the database entries, the QHEI data is available for use in other work products.

8.0. References

8.1. U.S. Department of Agriculture Methodologies:

A. Platts, W.S., Megahan, W.F., and Minshall, G.W. 1983. Methods For Evaluating Stream, Riparian, and Biotic Conditions. General Technical Report INT-138. U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station, Ogden, Utah.

8.2. Indiana Codes or Indiana Administrative Codes:

A. IC 14-8-2-27, Boundary Waters.

8.3. Agency Policies:

A. IDEM. 2000. Use of Personal Flotation Devices (PFDs) by Branch Personnel. State Form 4336. Assessment Branch, Indiana Department of Environmental Management, Indianapolis, Indiana.
B. IDEM. 2008. Personal Protective Equipment Policy. A-059-OEA-08-P-R0. Office of External Affairs, Indiana Department of Environmental Management, Indianapolis, Indiana.
C. IDEM. 2010a. Health and Safety Training, revised October 1, 2010. A-030-OEA-10-P-R2. Office of External Affairs, Indiana Department of Environmental Management, Indianapolis, Indiana.
D. IDEM. 2010b. Change in status of Water Assessment Branch staff in accordance with the Agency training policy. State Form 4336. Office of Health & Safety, Indiana Department of Environmental Management, Indianapolis, Indiana.
E. IDEM. 2016. Injury and/or Illness Resulting from Occupational Exposure, revised February 12, 2016. A-034-AW-16-P-R3. Office of the Commissioner, Indiana Department of Environmental Management, Indianapolis, Indiana.
F. IDEM. 2019. IDEM Hazard Communication (HazCom) Plan. IDEM, Office of Program Support, Indianapolis, Indiana.

8.4. Agency Standard Operating Procedures:

A. Calculation of Drainage Area, B-005-OWQ-WAP-XXX-20-T-R1, effective December 31, 2020. Office of Water Quality, Indiana Department of Environmental Management, Indianapolis, Indiana.
B. Calculation of Gradient, B-006-OWQ-WAP-XXX-21-T-R1, effective January 31, 2021. Office of Water Quality, Indiana Department of Environmental Management, Indianapolis, Indiana.

8.5. Ohio EPA Methodologies:

A. OHEPA. 2006. Methods for Assessing Habitat in Flowing Waters: Using the Qualitative Habitat Evaluation Index (QHEI). Ohio EPA Technical Bulletin EAS/2006-06-1. Division of Surface Water, Ecological Assessment Section, Columbus, Ohio.

B. Rankin, E.T. 1989. The Qualitative Habitat Evaluation Index (QHEI): Rationale, methods, and application. Division of Water Quality Planning & Assessment, Ecological Assessment Section, Columbus, Ohio.
C. Rankin, E.T. 1995. The use of habitat assessments in water resource management programs, pp. 181-208 in W.S. Davis and T.P. Simon (eds.). Biological Assessment and Criteria: Tools for Water Resource Planning and Decision Making. Lewis Publishers, Boca Raton, Florida.

8.6. Other Guidance:

A. IndianaMap
B. Hoggatt, R.E. 1975. Drainage areas of Indiana streams. U.S. Geological Survey, Indianapolis, Indiana.
C. USGS StreamStats Program.

9.0. Appendices

Appendix 1 – QHEI Datasheet
Appendix 2 – Example of a completed QHEI Datasheet
Appendix 3 – Instructions for using a spherical densitometer to measure open canopy.

Appendix 1 – QHEI Datasheet (front)

OWQ Biological QHEI (Qualitative Habitat Evaluation Index)

Sample #	bioSample #	Stream Name	Location

Surveyor	Sample Date	County	Macro Sample Type	☐ Habitat Complete	QHEI Score:

1] *SUBSTRATE* Check ONLY Two predominant substrate TYPE BOXES and check every type present

BEST TYPES PREDOMINANT	PRESENT P/G R/R	OTHER TYPES PREDOMINANT	PRESENT P/G R/R
☐☐ BLDR/SLABS [10]	☐☐	☐☐ HARDPAN [4]	☐☐
☐☐ BOULDER [9]	☐☐	☐☐ DETRITUS [3]	☐☐
☐☐ COBBLE [8]	☐☐	☐☐ MUCK [2]	☐☐
☐☐ GRAVEL [7]	☐☐	☐☐ SILT [2]	☐☐
☐☐ SAND [6]	☐☐	☐☐ ARTIFICIAL [0]	☐☐
☐☐ BEDROCK [5]	☐☐	(Score natural substrates; ignore sludge from point-sources)	

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

Check ONE (Or 2 & average)

ORIGIN
- ☐ LIMESTONE [1]
- ☐ TILLS [1]
- ☐ WETLANDS [0]
- ☐ HARDPAN [0]
- ☐ SANDSTONE [0]
- ☐ RIP/RAP [0]
- ☐ LACUSTRINE [0]
- ☐ SHALE [-1]
- ☐ COAL FINES [-2]

QUALITY

SILT
- ☐ HEAVY [-2]
- ☐ MODERATE [-1]
- ☐ NORMAL [0]
- ☐ FREE [1]

MAN-INFLUENCED
- ☐ EXTENSIVE [-2]
- ☐ MODERATE [-1]
- ☐ NORMAL [0]
- ☐ NONE [1]

Substrate Maximum 20

Comments

2] *INSTREAM COVER* Indicate presence 0 to 3: 0–Absent; 1–Very small amounts or if more common of marginal quality; 2–Moderate amounts, but not of highest quality or in small amounts of highest quality; 3–Highest quality in moderate or greater amounts (e.g., very large boulders in deep or fast water, large diameter log that is stable, well developed root wad in deep/fast water, or deep, well-defined, functional pools.)

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

AMOUNT
Check ONE (Or 2 & average)
- ☐ EXTENSIVE > 75% [11]
- ☐ MODERATE 25 - 75% [7]
- ☐ SPARSE 5 - < 25% [3]
- ☐ NEARLY ABSENT < 5% [1]

Cover Maximum 20

Comments

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

SINUOSITY	DEVELOPMENT	CHANNELIZATION	STABILITY
☐ HIGH [4]	☐ EXCELLENT [7]	☐ NONE [6]	☐ HIGH [3]
☐ MODERATE [3]	☐ GOOD [5]	☐ RECOVERED [4]	☐ MODERATE [2]
☐ LOW [2]	☐ FAIR [3]	☐ RECOVERING [3]	☐ LOW [1]
☐ NONE [1]	☐ POOR [1]	☐ RECENT OR NO RECOVERY [1]	

Channel Maximum 20

Comments

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

River right looking downstream

L R EROSION	L R RIPARIAN WIDTH	L R FLOOD PLAIN QUALITY	L R
☐☐ NONE/LITTLE [3]	☐☐ WIDE > 50m [4]	☐☐ FOREST, SWAMP [3]	☐☐ CONSERVATION TILLAGE [1]
☐☐ MODERATE [2]	☐☐ MODERATE 10-50m [3]	☐☐ SHRUB OR OLD FIELD [2]	☐☐ URBAN OR INDUSTRIAL [0]
☐☐ HEAVY/SEVERE [1]	☐☐ NARROW 5-10m [2]	☐☐ RESIDENTIAL, PARK, NEW FIELD [1]	☐☐ MINING /CONSTRUCTION [0]
	☐☐ VERY NARROW [1]	☐☐ FENCED PASTURE [1]	Indicate predominant land use(s) past 100m riparian.
	☐☐ NONE [0]	☐☐ OPEN PASTURE, ROWCROP [0]	

Riparian Maximum 10

Comments

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

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

CHANNEL WIDTH Check ONE (Or 2 & average)
- ☐ POOL WIDTH > RIFFLE WIDTH [2]
- ☐ POOL WIDTH = RIFFLE WIDTH [1]
- ☐ POOL WIDTH < RIFFLE WIDTH [0]

CURRENT VELOCITY Check ALL that apply
- ☐ TORRENTIAL [-1]
- ☐ VERY FAST [1]
- ☐ FAST [1]
- ☐ MODERATE [1]
- ☐ SLOW [1]
- ☐ INTERSTITIAL [-1]
- ☐ INTERMITTENT [-2]
- ☐ EDDIES [1]

Indicate for reach – pools and riffles.

Recreation Potential (Check one and comment on back)
- ☐ Primary Contact
- ☐ Secondary Contact

Pool/ Current Maximum 12

Comments

Indicate for functional riffles; Best areas must be large enough to support a population of riffle-obligate species:

☐ NO RIFFLE [metric = 0]

Check ONE (Or 2 & average)

RIFFLE DEPTH
- ☐ BEST AREAS > 10cm [2]
- ☐ BEST AREAS 5 - 10cm [1]
- ☐ BEST AREAS < 5cm [metric = 0]

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

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

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

Riffle/ Run Maximum 8

Comments

6] *GRADIENT* (ft/mi)

DRAINAGE AREA (mi^2)

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

%POOL: ☐ %GLIDE: ☐

%RUN: ☐ %RIFFLE: ☐

Gradient Maximum 10

Entered _____ QC1 _____ QC2 _____ IDEM 02/01/2023

Appendix 1 – QHEI Datasheet (

OWQ Biological QHEI (Qualitative Habitat Evaluation Index)

COMMENT _____

A-CANOPY
- ☐ > 85% - Open
- ☐ 55% - < 85%
- ☐ 30% - < 55%
- ☐ 10% - < 30%
- ☐ < 10% - Closed

B-AESTHETICS
- ☐ Nuisance algae
- ☐ Invasive macrophytes
- ☐ Excess turbidity
- ☐ Discoloration
- ☐ Foam/Scum
- ☐ Oil sheen
- ☐ Trash/Litter
- ☐ Nuisance odor
- ☐ Sludge deposits
- ☐ CSOs/SSOs/Outfalls

C-RECREATION

Area Depth
Pool: ☐ > 100 ft² ☐ > 3 ft

D-MAINTENANCE
- ☐ Public ☐ Private
- ☐ Active ☐ Historic
- Succession: ☐ Young ☐ Old
- ☐ Spray ☐ Islands ☐ Scoured
- Snag: ☐ Removed ☐ Modified
- Leveed: ☐ One sided ☐ Both banks
- ☐ Relocated ☐ Cutoffs
- Bedload: ☐ Moving ☐ Stable
- ☐ Armoured ☐ Slumps
- ☐ Impounded ☐ Desiccated
- ☐ Flood control ☐ Drainage

E-ISSUES
- ☐ WWTP ☐ CSO ☐ NPDES
- ☐ Industry ☐ Urban
- ☐ Hardened ☐ Dirt & Grime
- ☐ Contaminated ☐ Landfill
- BMPs: ☐ Construction ☐ Sediment
- ☐ Logging ☐ Irrigation ☐ Cooling
- Erosion: ☐ Bank ☐ Surface
- ☐ False bank ☐ Manure ☐ Lagoon
- ☐ Wash H_2O ☐ Tile ☐ H_2O Table
- Mine: ☐ Acid ☐ Quarry
- Flow: ☐ Natural ☐ Stagnant
- ☐ Wetland ☐ Park ☐ Golf
- ☐ Lawn ☐ Home
- ☐ Atmospheric deposition
- ☐ Agriculture ☐ Livestock

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

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

Stream Width (m):

Stream Drawing:

IDEM 02/01/2023

Note: The QHEI datasheet used by IDEM is a modified version of OHEPA's 2006 QHEI field sheet**.** IDEM replaced the header of OHEPA's 2006 QHEI field sheet with IDEM identifiers for sample and site information. In the substrate metric, IDEM removed the percent estimates of substrate type so substrate type presence are represented by checkmarks. Lines were added to the bottom front of the datasheet to record who entered and performed quality control checks and when. On the back of the datasheet (additional information that do not affect the overall QHEI score), IDEM chose to only keep the canopy information of the sampling characteristics and used the additional space to detail densiometer readings. The part on quantitative measurements was also omitted.

Appendix 2 – Example of a completed QHEI Datasheet (front)

OWQ Biological QHEI (Qualitative Habitat Evaluation Index)

Sample #	bioSample #	Stream Name	Location
AB17197	14031	Whitewater River	Silver Creek Rd

Surveyor	Sample Date	County	Macro Sample Type	☑ Habitat Complete	QHEI Score:
KJC	7/30/14	Franklin	FISH		82

1] *SUBSTRATE* Check ONLY Two predominant substrate TYPE BOXES and check every type present

BEST TYPES	PREDOMINANT	PRESENT
BLDR/SLABS [10]	☐	☐
BOULDER [9]	☐	☑
COBBLE [8]	☑	☑
GRAVEL [7]	☐	☑
SAND [6]	☑	☑
BEDROCK [5]	☐	☐

OTHER TYPES	PREDOMINANT	PRESENT
HARDPAN [4]	☐	☐
DETRITUS [3]	☐	☑
MUCK [2]	☐	☐
SILT [2]	☐	☑
ARTIFICIAL [0]	☐	☐

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

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

Check ONE (Or 2 & average)

ORIGIN	QUALITY
☑ LIMESTONE [1]	☐ HEAVY [-2]
☐ TILLS [1]	☐ MODERATE [-1]
☐ WETLANDS [0]	☑ NORMAL [0]
☐ HARDPAN [0]	☐ FREE [1]
☐ SANDSTONE [0]	
☐ RIP/RAP [0]	☐ EXTENSIVE [-2]
☐ LACUSTRINE [0]	☐ MODERATE [-1]
☐ SHALE [-1]	☑ NORMAL [0]
☐ COAL FINES [-2]	☐ NONE [1]

Substrate: 17 (Maximum 20)

Comments

2] *INSTREAM COVER* Indicate presence 0 to 3: **0**–Absent; **1**–Very small amounts or if more common of marginal quality; **2**-Moderate amounts, but not of highest quality or in small amounts of highest quality; **3**-Highest quality in moderate or greater amounts (e.g., very large boulders in deep or fast water, large diameter log that is stable, well developed root wad in deep/fast water, or deep, well-defined, functional pools.)

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

AMOUNT Check ONE (Or 2 & average)

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

Cover Maximum 20: 16

Comments

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

SINUOSITY	DEVELOPMENT	CHANNELIZATION	STABILITY
☐ HIGH [4]	☐ EXCELLENT [7]	☑ NONE [6]	☐ HIGH [3]
☐ MODERATE [3]	☑ GOOD [5]	☐ RECOVERED [4]	☑ MODERATE [2]
☑ LOW [2]	☐ FAIR [3]	☐ RECOVERING [3]	☐ LOW [1]
☐ NONE [1]	☐ POOR [1]	☐ RECENT OR NO RECOVERY [1]	

Channel Maximum 20: 15

Comments

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

River right looking downstream

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

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

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

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

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

Riparian Maximum 10: 8

Comments

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

MAXIMUM DEPTH Check ONE (ONLY!)

☑ > 1m [6]
☐ 0.7 - < 1m [4]
☐ 0.4 - < 0.7m [2]
☐ 0.2 - < 0.4m [1]
☐ < 0.2m [0] [metric = 0]

CHANNEL WIDTH Check ONE (Or 2 & average)

☐ POOL WIDTH > RIFFLE WIDTH [2]
☐ POOL WIDTH = RIFFLE WIDTH [1]
☑ POOL WIDTH < RIFFLE WIDTH [0]

CURRENT VELOCITY Check ALL that apply

☐ TORRENTIAL [-1]	☑ SLOW [1]
☐ VERY FAST [1]	☐ INTERSTITIAL [-1]
☑ FAST [1]	☐ INTERMITTENT [-2]
☑ MODERATE [1]	☐ EDDIES [1]

Indicate for reach – pools and riffles.

Recreation Potential (Check one and comment on back)
☐ Primary Contact
☐ Secondary Contact

Pool/Current Maximum 12: 9

Comments

Indicate for functional riffles; Best areas must be large enough to support a population of riffle-obligate species:

☐ NO RIFFLE [metric = 0]

RIFFLE DEPTH
☑ BEST AREAS > 10cm [2]
☐ BEST AREAS 5 - 10cm [1]
☐ BEST AREAS < 5cm [metric = 0]

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

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

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

Riffle/Run Maximum 8: 7

Comments

6] *GRADIENT* (5.274 ft/mi)
DRAINAGE AREA (150.475 mi²)

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

%POOL: 30 %GLIDE: ___
%RUN: 40 %RIFFLE: 30

Gradient Maximum 10: 10

Entered KJW 1.5.15 QC1 KJM 1/7/15 QC2 RAC 2.11.15

IDEM 02/28/2018

Appendix 2 – Example of a completed QHEI Datasheet (back)

OWQ Biological QHEI (Qualitative Habitat Evaluation Index)

COMMENT

A-CANOPY
- ☑ >85% - Open
- ☐ 55% - <85%
- ☐ 30% - <55%
- ☐ 10% - <30%
- ☐ <10% - Closed

B-AESTHETICS
- ☐ Nuisance algae
- ☐ Invasive macrophytes
- ☐ Excess turbidity
- ☐ Discoloration
- ☐ Foam/Scum
- ☐ Oil sheen
- ☐ Trash/Litter
- ☐ Nuisance odor
- ☐ Sludge deposits
- ☐ CSOs/SSOs/Outfalls

C-RECREATION
Area Depth
Pool: ☐ > 100 ft² ☐ > 3 ft

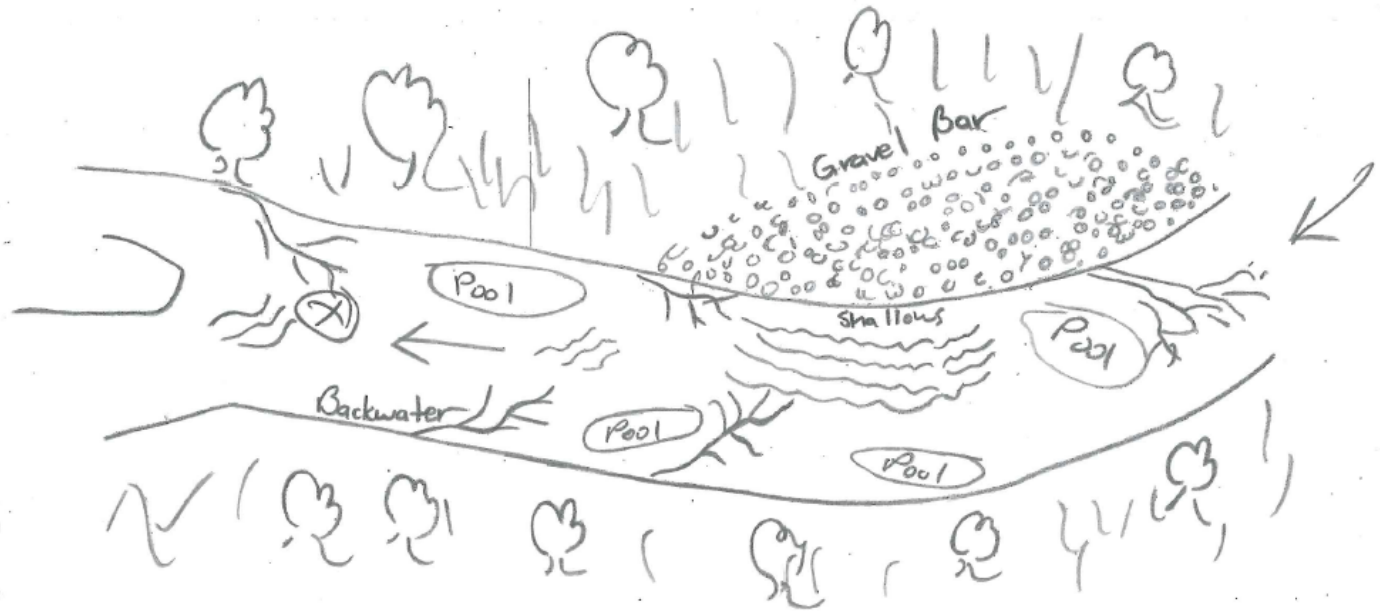
D-MAINTENANCE
☐ Public ☐ Private
☐ Active ☐ Historic
Succession: ☐ Young ☐ Old
☐ Spray ☐ Islands ☐ Scoured
Snag: ☐ Removed ☐ Modified
Leveed: ☐ One sided ☐ Both banks
☐ Relocated ☐ Cutoffs
Bedload: ☐ Moving ☐ Stable
☐ Armoured ☐ Slumps
☐ Impounded ☐ Desiccated
☐ Flood control ☐ Drainage

E-ISSUES
☐ WWTP ☐ CSO ☐ NPDES
☐ Industry ☐ Urban
☐ Hardened ☐ Dirt & Grime
☐ Contaminated ☐ Landfill
BMPs: ☐ Construction ☐ Sediment
☐ Logging ☐ Irrigation ☐ Cooling
Erosion: ☐ Bank ☐ Surface
☐ False bank ☐ Manure ☐ Lagoon
☐ Wash H_2O ☐ Tile ☐ H_2O Table
Mine: ☐ Acid ☐ Quarry
Flow: ☐ Natural ☐ Stagnant
☐ Wetland ☐ Park ☐ Golf
☐ Lawn ☐ Home
☐ Atmospheric deposition
☐ Agriculture ☐ Livestock

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

	Right	Middle	Left	Total Average
% open	78 %	97 %	100 %	92 %
	94 / 96 / 25 / 85	96 / 96 / 85 / 96	96 / 96 / 96 / 96	

Stream Drawing:



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Appendix 3 – Instructions for using a spherical densitometer to measure open canopy

Step 1. Move to the middle of the stream channel.

Step 2. While facing upstream, count the number of squares that are open and record on the data sheet. The spherical densitometer has 24 squares, and each square is divided into 4 squares for a total of 96 squares.

Step 3. Then, standing in the same location, turn 90 degrees to the right and count/record the number of squares open.

Step 4. Turn another 90 degrees to the right and you should be facing downstream to count/record the number of squares open.

Step 5. Finally, turn another 90 degrees to the right to count/record the number of squares open on the opposite bank.

Step 6. Average the four numbers.

Step 7. Multiply the average by 1.04.

Step 8. Round to the nearest whole percentage.

For example,

$$\frac{26 + 40 + 7 + 32}{4} = 26.25$$

$$26.25 \times 1.04 = 27.3 \approx 27\%$$

Step 9. If the stream is wider than 10 m, go to Step 10. Otherwise, skip to Step 13.

Step 10. Repeat steps 2-8 from the left bank (looking upstream).

Step 11. Repeat steps 2-8 from the right bank (looking upstream).

Step 12. Average the three readings (mid-channel, left bank, and right bank) to generate a total average value.

Step 13. Use the average % canopy open to check the appropriate box for canopy.