# Technical Memorandum

# Charles River Watershed 2002
# Fish Population
# Monitoring and Assessment

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**Worcester, MA**

October 2006

**CN 077.3**

# Introduction

Fish population surveys were conducted using techniques similar to Rapid Bioassessment Protocol V as described originally by Plafkin et al. (1989) and later by Barbour et al. (1999). Standard Operating Procedures are described in MassDEP Method CN 075.1 *Fish Population SOP*. Surveys also included a habitat assessment component modified from that described in the aforementioned document (Barbour et al. 1999).

Fish populations in the Charles River watershed were sampled by electrofishing during the late summer of 2002 using a Smith Root Model 12 battery powered backpack electrofisher. A reach of between 80m and 100m was sampled by passing a pole- mounted anode ring, side to side through the stream channel and in and around likely fish holding cover. All fish shocked were netted and held in buckets. Sampling proceeded from an obstruction or constriction upstream to an endpoint at another obstruction or constriction, such as a waterfall or shallow riffle. Following completion of a sampling run, all fish were identified to species, measured, and released.  Results of the fish population surveys can be found in Table 1. It should be noted that young-of-the-year (yoy) fish from most species, with the exception of salmonids, are not targeted for collection. Young-of-the-year fishes that are collected, either on purpose or inadvertently, are noted in Table 1.

# Habitat Assessment

An evaluation of physical and biological habitat quality is critical to any assessment of ecological integrity (Karr et al. 1986; Barbour et al. 1999). Habitat assessment supports understanding of the relationship between physical habitat quality and biological conditions, identifies obvious constraints on the attainable potential of a site, assists in the selection of appropriate sampling stations, and provides basic information for interpreting biosurvey results (US EPA 1995). Before leaving the sample reach during the 2002 Charles River fish population surveys, habitat qualities were scored using a modification of the evaluation procedure in Barbour et al. (1999). The matrix used to assess habitat quality is based on key physical characteristics of the water body and the immediate riverfront area. Most parameters evaluated are instream physical attributes often related to overall land use and are potential sources of limitation to the aquatic biota (Barbour et al. 1999). The ten habitat parameters are as follow: instream cover for fish, epifaunal substrate, embeddedness, sediment deposition, channel alteration, velocity/depth combinations, channel flow status, right and left (when facing downstream) bank vegetative protection, right and left bank stability, right and left bank riparian vegetative zone width.  Habitat parameters are scored, totaled, and when appropriate compared to a reference station to provide relative habitat ranking. (See Table 2)

# Fish Sample Processing and Analysis

The RBP V protocol (Plafkin et al. 1989 and Barbour et al. 1999) calls for the analysis of the data generated from fish collections using an established Index of Biotic Integrity (IBI) similar to that described by Karr et al. (1986). Since no formal IBI for Massachusetts currently exists, the data provided by this sampling effort were used to qualitatively assess the general condition of the resident fish population as a function of the overall abundance (number of species and individuals) and species composition classifications listed below.

1. Tolerance Classification - Classification of tolerance to environmental stressors similar to that provided in Plafkin et al. (1989), Barbour et al. (1999), and Halliwell et al. (1999). Final tolerance classes are those provided by Halliwell et al. (1999).

2. Macrohabitat Classification – Classification by common macrohabitat use as presented by Bain (1996) modified regionally following discussions with MassDEP and MA Division of Fisheries and Wildlife (DFW) biologists.

3. Trophic Classes - Classification which utilizes both dominant food items as well as feeding habitat type as presented in Halliwell et al. (1999).

**Station Habitat Descriptions and Results**


**BV01 Beaver Brook (Bellingham)**

Beaver Brook was sampled downstream of the abandoned railroad bed located off Nason Street in Bellingham .The 200-meter low-gradient reach was comprised of mostly shallow run habitat. There was a small pool located just downstream of the railroad bed at the terminal end of the sampling reach. There were three locations within the reach with impassable tangles of shrubs and vegetative growth that had to be bypassed. Only two habitat parameters scored in the "optimal" category. Three were scored as "suboptimal", three were scored as "marginal", and two scored "poor". Both parameters that scored "poor" (Epifaunal Substrate and Embeddedness) were related to epifaunal substrates associated with riffles and these were essentially non-existent. Substrates were predominantly sand and mud. Instream cover for fish, velocity-depth combinations, and channel flow status all scored "marginal" due to the low flow condition of the stream at time of sampling. It should be noted that even at higher flows these parameters would have scored less than optimal. The final habitat score was 122. Fish sampling efficiency at BV01 was rated as only fair (due to the three areas that were impassable).

The fish community was comprised of nineteen redfin pickerel *Esox americanus* and three yellow bullhead *Ameiurus natalis*. Beaver Brook exits Beaver Pond and then skirts a large sand and gravel operation for much of its length. It is unclear whether or not the sandy substrates which presently predominate the sampled reach are natural, or if sediments from the sand and gravel operations have impacted the brook over time. Fish present are macrohabitat generalists that are classified as tolerant and moderately tolerant to degraded conditions. Although redfin pickerel are classified as moderately tolerant we have observed them in other streams that are definitely impacted by sedimentation.  Instream flow is also a concern in this stream as reduced instream flow seriously reduces the available fish habitat, which is primarily comprised of over hanging streambank vegetation.


**MB02    Mine Brook downstream of Route 140 in Franklin**

The sampled reach was of moderate gradient and contained mostly riffle/run habitat. Pools were lacking. Only three habitat parameters scored in the "optimal" category. Riparian vegetative zone width on the left bank (looking downstream) scored "poor" due to the presence of Route 140. Velocity-depth combinations scored "marginal" due to a lack of deep water. Channel flow status, epifaunal substrate, embeddedness, sediment deposition, and channel alteration all scored "suboptimal". Instream cover for fish, bank stability and bank vegetative protection all scored "optimal". The final habitat score was 144 (of a possible 200). Fish sampling efficiency at MB02 was rated as good.

Fish species captured included yellow bullhead, brown trout *Salmo trutta,* golden shiner *Notemigonus crysoleucas*, pumpkinseed *Lepomis gibbosus*, and redfin pickerel (Table 1). Although a few additional cyprinids were observed but not netted, the total number of fish collected (or observed) was very low for the amount of habitat available. The brown trout was the only fluvial species collected, however, it appeared to be a stocked fish as evidenced by deformed pectoral fins.  The remainder of the fish present were macrohabitat generalists which are tolerant or moderately tolerant of pollution.

The Mine Brook sub-watershed has undergone an incredible amount of development (commercial and industrial) over the last 20 years, especially in the vicinity of MB02.  Much of the immediate watershed is impervious, and road runoff and stormwater are most likely impacting the fish community in this reach. The low number of fish is likely related to water and or habitat quality problems. In addition, the absence of fluvial species would suggest streamflow problems.

**CR60.5  Charles River downstream of Maple Street in Bellingham**

The sampled reach was of moderate gradient and contained riffles, runs and pools. Epifaunal substrate and embeddedness were not scored. Five of the remaining eight habitat parameters scored in the "optimal" category. Bank vegetative protection, bank stability, and riparian vegetative zone width all scored "marginal" on at least one bank. This was due to a parking lot located on the left bank (looking downstream) and some erosional areas on the right bank. Instream cover for fish was scored "optimal" due to the presence of very stable habitat in the form of boulders, logs and undercut banks. The final habitat score was 127 (of a possible 160). Fish sampling efficiency was rated as good to excellent.

The survey resulted in the collection of nine yellow bullhead, a tolerant macrohabitat generalist. In light of the excellent fish habitat, we initially had questions regarding electroshocker efficiency. Therefore, the station was re-sampled with the help of Mass Wildlife on September 9th (Table 1). Re-sampling resulted in the collection of twelve yellow bullhead, three pumpkinseed, two redfin pickerel, and two young-of-the-year largemouth bass. Although more fish were captured, numbers were still extremely low. All fish collected were macrohabitat generalists which are tolerant or moderately tolerant to pollution. In light of the excellent dissolved oxygen, pH and habitat at this location, the paucity of fish remains a mystery. Future biological monitoring should include macroinvertebrate sampling as well.

### HB01    Hopping Brook downstream of West Street in Medway

The sampled reach was of moderate gradient and contained a diverse mix of riffles, runs and pools. Six of the ten habitat parameters scored in the "optimal" category. Channel flow status scored "poor". Sediment deposition, velocity-depth combinations, and riparian vegetative zone widths scored "suboptimal". Instream cover for fish was scored "optimal", however much of the habitat present was de-watered due to extremely low flow. The final habitat score was 155 (of a possible 200). Fish sampling efficiency at HB01 was rated as poor. Notes were recorded with regard to the reactions (or lack thereof) of fish to the electrical current. It is possible that the backpack shocker was not performing properly.

The fish sample included only twelve redfin pickerel and one yellow bullhead. In addition, a school of what appeared to be young-of-the-year eastern blacknose dace was observed but not captured.  It was the failure to capture these dace and the reactions of the redfin pickerel to the shocker that led us to believe we might be having equipment problems. Flows were extremely low in light of the approximately 10 square miles of drainage area upstream from HB01. These low flow conditions may be impacting the stream community in this reach. In light of the questions regarding electroshocker operation, Hopping Brook should be re-sampled.

### SR03    Stop River downstream from Noon Hill Street in Medfield.

The sampled reach was low-gradient and contained mostly sandy substrates. There was a large pool located at the upper end of the reach just downstream of the road. The riparian zone was dominated by vegetated wetland habitat. Stream margins were densely vegetated which, together with the high stream flows, made sampling difficult. Collection efficiency was only rated as fair. The habitat assessment field sheet from the fish survey was lost, however, the macroinvertebrate survey crew also performed a habitat assessment and these scoring criteria are herein reported. Five of the ten habitat parameters scored in the "optimal" category. Velocity-depth combinations scored "marginal" and all other categories scored "suboptimal". The final habitat score was 152 (of a possible 200).

The overall numbers of fish were low given the amount of fish habitat present but this may be attributable to the low sampling efficiencies. The fish community was dominated by yellow bullhead, a tolerant macrohabitat generalist. Other species captured included redbreast sunfish *Lepomis auritus*, redfin pickerel, largemouth bass, and yellow perch *Perca flavescens*. All fish collected were macrohabitat generalists which are tolerant or moderately tolerant to pollution. The preponderance of wetlands (and associated low gradient habitat) both upstream and downstream of SR03 may be influencing the fish community of the Stop River.

### TB01    Trout Brook downstream of Haven Street in Dover.

The sampled reach was a series of moderate to low gradient riffles, pools, and runs. Nine of ten habitat parameters were rated in the "optimal" category.  Only velocity-depth combinations scored in the "suboptimal" category. Riparian vegetation was so thick that it at times made electroshocking impossible. The final habitat score was 184 (out of 200). Fish sampling efficiency at TB01 was rated as fair/poor due to the aforementioned vegetative growth

Although relatively few fish were observed/collected, the fish community was dominated by multiple age classes of brook trout *Salvelinus fontinalis* (n=10). White sucker and redfin pickerel were also present. The presence of wild reproducing brook trout is a testament to the largely undeveloped nature of the Trout Brook watershed. Approximately fifty percent of the watershed is either forested or agricultural (mostly forested). The riparian zone of Trout Brook is mostly undeveloped as well, and there appears to be a good buffer between agricultural fields and the brook. It should

be noted that in 1997 a total of 49 brook trout were collected, however, sampling efficiency is not noted as being problematic such as it was in 2002. Continued protection of the watershed and riparian zone is essential to maintaining wild brook trout in Trout Brook.. Future biomonitoring should include a more thorough survey of Trout Brook to document the distribution and abundance of reproducing brook trout.

**CK00     Chicken Brook downstream from Village Street in Medway.**

The sampled reach was a series of low-gradient riffles, pools, and runs. Two of ten habitat parameters were rated in the "optimal" category. Seven categories were rated "suboptimal". Channel flow status was rated as "marginal" and was definitely contributing to the "suboptimal" instream cover for fish. The final habitat score was 139 (of a possible 200). A large portion of the watershed is developed residentially and there are a number of small impoundments and ponds located upstream of the sampling station.

Fish species captured in order of abundance included brown bullhead *Ameiurus nebulosus*, bluegill *Lepomis macrochirus,* pumpkinseed, chain pickerel *Esox niger*, redbreast sunfish, largemouth bass, redfin pickerel, yellow bullhead and white sucker (Table 1). All fish collected (with the exception of an individual white sucker) are macrohabitat generalists, which are classified as being either tolerant or moderately tolerant to pollution. In light of the fact that the majority of fish collected (65%) were young-of-the-year macrohabitat generalists, it appears that instream flow may be a problem in this sub-basin. Flows were noted as being very low on the date of the survey. The presence of impoundments upstream may be contributing young-of-the-year to this reach of Chicken Brook.

**ST01     Stony Brook (SW channel) downstream of Church Street in Weston.**

The sampled reach was a series of moderate gradient riffles, pools, and runs. Eight of the ten habitat parameters were rated in the "optimal" category. Channel alteration and channel flow status were rated as "suboptimal". The final habitat score was 180 (of a possible 200). A large portion of the watershed is developed residentially and there are a number of small impoundments and ponds located well upstream of the sampling station, however, historically this station has been considered a "regional reference station" for biomonitoring surveys.

The fish sample included only three American eel (two others observed but not captured) and two bluegill. The bluegill and one American eel were young-of-the-year. Flows were low and may have been impacting the fish community in this reach. It should be noted that in 1997, reproducing brook trout and one "native" brown trout were collected from Stony Brook. It is unclear if the absence of trout during the 2002 fish survey is a result of water quality/habitat changes or natural variability such as low flow conditions. Future biomonitoring should include a more thorough survey of Stony Brook to document the presence and abundance of reproducing brook and/or brown trout.

**FB02     Fuller Brook upstream of Cameron Street in Wellesley.**

The sampled reach was a series of low gradient riffles and runs with some deep pools. Much of the substrate was sand and silt especially in the deeper areas. None of the ten habitat parameters were rated in the "optimal" category. Six of the ten parameters were rated as "suboptimal", the remainder of the parameters were rated as only "marginal". The final habitat score was 112 (of a possible 200). The Fuller Brook watershed originates in an extensive wetland. However, the lower half of the watershed is almost entirely developed residentially. Fish sampling efficiency was rated as fair to poor due to deep pools and the presence of a large amount course particulate organic matter (CPOM) which became suspended when disturbed.

The fish sample included mostly white sucker, (15 captured, additional 20 observed), two redfin pickerel, one brown trout (stocked fish), and one yellow bullhead. Most of the fish habitat present was in the form of woody snags and debris along with deep pools. White sucker, redfin pickerel, and yellow bullhead are considered either tolerant or moderately tolerant to pollution. Lack of stable fish habitat (especially under low flow conditions) threatens the fish population in Fuller Brook.

# References

Bain, M. B., and M. S. Meixler. 2000. Defining a target fish community for planning and evaluating enhancement of the Quinebaug River in Massachusetts and Connecticut. Final report by the New York Cooperative Fish and Wildlife Research Unit, Cornell University, Ithaca, NY to the New England Interstate Water Pollution Control Commission, Lowell, MA. 51 p.

Barbour, M. T., J. Gerritsen, B. D. Snyder, and J. B. Stribling. 1999. Rapid Bioassessment Protocols for Use in Streams and Rivers: Periphyton, Benthic Macroinvertebrates, and Fish. Second Edition. EPA 841-B-99-002. Office of Water, US Environmental Protection Agency, Washington, DC. 151 p. + appendices

Halliwell, D.B, Langdon, R.W., Daniels, R.A., Kurtenbach, J.P., and R.A. Jacobson. 1999. Classification of Freshwater Fish Species of the Northeastern United States for Use in the Development of Indices of Biological Integrity, with Regional Applications. pp. 301-338 in T. P. Simon (ed.). Assessing the Sustainability and Biological Integrity of water Resources Using Fish Communities. CRC Press, Boca Raton, FL. 671 p.

Hartel, K. E., D.B. Halliwell, and A. E. Launer. 2002. Inland fishes of Massachusetts. Massachusetts Audubon Society. Lincoln, Massachusetts.

Karr, J. R., K. D. Fausch, P. L. Angermeier, P. R. Yant, and I. J. Schlosser. 1986. Assessing Biological Integrity in Running Waters: A Method and Its Rationale. Special Publication 5. Illinois Natural History Survey. Champaign, IL. 28 p.

Nelson, J. S., E. J. Crossman, H. Espinosa-Perez, L. T. Findley, C. R. Gilbert, R. N. Lea, and J. D. Williams. 2004. Common and scientific names of fishes from the United States, Canada, and Mexico. American Fisheries Society. Special Publication 29, Bethesda, Maryland

Plafkin, J. L., M. T. Barbour, K. D. Porter, S. K. Gross, and R. M. Hughes. 1989. Rapid Bioassessment Protocols for Use in Streams and Rivers: Benthic Macroinvertebrates and Fish. EPA/440/4-89-001. Office of Water, US Environmental Protection Agency, Washington, DC.

Tetra Tech, Inc. 1995. Massachusetts DEP Preliminary Biological Monitoring and Assessment Protocols for Wadeable Rivers and Streams. Method 003: Preliminary biological monitoring and assessment protocols for pulsed DC electrofishing. Prepared for Massachusetts Department of Environmental Protection, Division of Watershed Management. Worcester, MA. 7 p.

US EPA. 1995. Generic Quality Assurance Project Plan Guidance for Programs Using Community Level Biological Assessment in Wadeable Streams and Rivers. U.S. Environmental Protection Agency, Office of Water. 71 p.

**Table 1.** List of fish biomonitoring station locations and fish population data from the 2002 Charles River Watershed survey.

| Station Description | Collection Date | Species Code[1] | | | | | | | | | | | | | | | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | AE | B | BB | CP | WS | EBT | LMB | RBS | YP | RFP | YB | BT | GS | P | BND | |
| BV01 Beaver Brook, Bellingham, reach beginning 200 m downstream of abandoned railroad bed off Nason Street ending at abandoned railroad bed. | 5 Aug. 2002 | - | - | - | - | - | - | - | - | - | 19 | 3(2) | - | - | - | - | YB less than 40 mm counted as young-of-the-year (yoy). |
| MB02 Mine Brook, Franklin, reach beginning 100 m downstream of Rte 140 and ending just downstream of Rte 140 bridge. | 5 Aug. 2002 | - | - | - | - | - | - | - | - | - | 1 | 6(2) | 1 | 1 | 1 | - | YB less than 80 mm counted as yoy. Brown trout with deformed left pectoral fin. |
| CR60.5 Charles River, Bellingham, reach beginning approximately 130 m downstream of Maple Street and ending at riffle approximately 30 m downstream of bridge. | 5 Aug. 9 Sept 2002 | - - | - - | - - | - - | - - | - - | - (2) | - - | - - | - 2 | 9 12 | - - | - - | - 3 | - - | 9 Sept with MDFW equipment |
| HB01 Hopping Brook, Medway, reach beginning 150 m downstream of West Street ending at riffle below pool downstream of bridge. | 8 Aug. 2002 | - | - | - | - | - | - | - | - | - | 12 | 1 | - | - | - | * | *one school of yoy BND observed but not counted. |
| SR03 Stop River, Medfield, reach beginning approximately 80 m downstream of Noon Hill Street just upstream of deep pool ending at riffle just downstream of bridge. | 27 Aug. 2002 | - | - | - | - | - | - | 2(1) | 9 | 1 | 3 | 17 | - | - | - | - | LMB less than or equal to 60 mm counted as young-of-the-year (yoy) |
| TB01 Trout Brook, Dover, reach beginning 100 m downstream of Haven Street, ending at riffle downstream of West Street bridge. | 27 Aug. 2002 | - | - | - | - | 4(3) | 10(4) | - | - | - | 2 | - | - | - | - | - | EBT less than 90 mm counted as young-of-the-year (yoy). WS less than 70 mm counted as young-of-the-year (yoy) |

| Location | Date | AE | YB | EBT | BND | LMB | WS | B | BB | CP | RBS | YP | BT | GS | P | RFP | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CK00 Chicken Brook, Medway, from confluence with Charles River upstream to the pool below the Village Street bridge. | 27 Aug. 2002 | - | (8) | (8) | 5 | 1 | - | (3) | 5(1) | - | 2 | (2) | - | - | (6) | - | CP less than or equal to 62 mm counted as yoy BB less than or equal to 60 mm counted as young-of-the-year (yoy) B and P less than or equal to 80 mm counted as young-of-the-year (yoy) |
| ST01 Stony Brook (SW channel), Weston, 65 m reach beginning just upstream of confluence of two channels approximately 80 m downstream of Church Street, ending at riffle below pool just downstream of bridge. | 28 Aug. 2002 | 3(1) | (2) | - | - | - | - | - | - | - | - | - | - | - | - | - | AE total count includes 2 individuals which were observed but not collected. |
| FB02 Fuller Brook, Wellesley, reach beginning just upstream of Cameron Street, continuing approximately 80 m upstream to a point where Fuller Brook splits into two channels. | 28 Aug. 2002 | - | - | - | - | 15 | - | - | - | - | 2 | 1 | 1 | - | - | - | Many additional white sucker observed but not captured due to the depth of pools within reach. |

[1]SPECIES CODE | COMMON NAME | SCIENTIFIC NAME

[2] number in parentheses indicate young-of-the-year

| [1]SPECIES CODE | COMMON NAME | SCIENTIFIC NAME |
|---|---|---|
| AE | American eel | *Anguilla rostrata* |
| YB | yellow bullhead | *Ameiurus natalis* |
| EBT | brook trout | *Salvelinus fontinalis* |
| BND | eastern blacknose dace | *Rhinichthys atratulus* |
| LMB | largemouth bass | *Micropterus salmoides* |
| WS | white sucker | *Catostomus commersonii* |
| B | bluegill | *Lepomis macrochirus* |
| BB | brown bullhead | *Ameiurus nebulosus* |
| CP | chain pickerel | *Esox niger* |
| RBS | redbreast sunfish | *Lepomis auritus* |
| YP | yellow perch | *Perca flavescens* |
| BT | brown trout | *Salmo trutta* |
| GS | golden shiner | *Notemigonus crysoleucas* |
| P | pumpkinseed | *Lepomis gibbosus* |
| RFP | redfin pickerel | *Esox americanus* |

**Table 2.** Habitat assessment summary for fish population stations sampled during the 2002 Charles River watershed survey. For primary parameters, scores ranging from 16-20 = optimal; 11-15 = suboptimal; 6-10 = marginal; 0-5 = poor. For secondary parameters, scores ranging from 9-10 = optimal; 6-8 = suboptimal; 3-5 = marginal; 0-2 = poor. Refer to Table 1 for a listing and description of sampling stations.

| Stations | | Beaver Brook | Mine Brook | Charles River | Hopping Brook | Stop River[1] | Trout Brook | Chicken Brook | Stony Brook | Fuller Brook |
|---|---|---|---|---|---|---|---|---|---|---|
| **Primary Habitat Parameters** | | **Score (0-20)** | | | | | | | | |
| Instream Cover (for fish) | | 8 | 16 | 19 | 18 | 15 | 18 | 12 | 18 | 10 |
| Epifaunal Substrate | | 3 | 15 | N/A | 17 | 11 | 18 | 16 | 18 | 15 |
| Embeddedness | | 3 | 15 | N/A | 17 | 16 | 17 | 16 | 19 | 14 |
| Channel Alteration | | 19 | 15 | 18 | 19 | 15 | 20 | 14 | 15 | 11 |
| Sediment Deposition | | 15 | 13 | 17 | 14 | 11 | 18 | 15 | 19 | 13 |
| Velocity-Depth Combinations | | 10 | 10 | 18 | 15 | 6 | 15 | 12 | 17 | 12 |
| Channel Flow Status | | 10 | 13 | 16 | 5 | 20 | 18 | 8 | 14 | 8 |
| **Secondary Habitat Parameters** | | **Score (0-10)** | | | | | | | | |
| Bank Vegetative Protection | Left | 10 | 9 | 8 | 9 | 9 | 10 | 9 | 10 | 7 |
| | Right | 10 | 9 | 5 | 9 | 10 | 10 | 7 | 10 | 8 |
| Bank Stability | Left | 8 | 9 | 8 | 9 | 9 | 10 | 8 | 10 | 4 |
| | Right | 8 | 9 | 5 | 9 | 10 | 10 | 6 | 10 | 4 |
| Riparian Vegetative Zone Width | Left | 8 | 2 | 4 | 7 | 10 | 10 | 8 | 10 | 5 |
| | Right | 10 | 9 | 9 | 7 | 10 | 10 | 8 | 10 | 1 |
| **Total Score** | | **122** | **144** | **127[2]** | **155** | **152** | **184** | **139** | **180** | **112** |

N/A      not assessed
[1] score from macroinvertebrate habitat sheets (fish sheets lost)
[2] out of a possible 160