

## UKTAG LAKE ASSESSMENT METHODS BENTHIC INVERTEBRATE FAUNA

### LAKE ACIDIFICATION MACROINVERTEBRATE METRIC (LAMM)

by  
Water Framework Directive - United Kingdom Advisory Group  
(WFD-UKTAG)

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SNIFFER  
25 Greenside Place  
Edinburgh  
EH1 3AA  
Scotland  
[www.wfduk.org](http://www.wfduk.org)

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## **HEALTH AND SAFETY STATEMENT**

**WARNING**— working in or around water is inherently dangerous; persons using this standard should be familiar with normal laboratory and field practice. This published monitoring system does not purport to address all of the safety problems, if any, associated with its use. It is the responsibility of the user to establish appropriate health and safety practices and to ensure compliance with any national regulatory guidelines.

It is also the responsibility of the user if seeking to practise the method outlined here, to gain appropriate permissions for access to water courses and their biological sampling.

**UKTAG LAKE ASSESSMENT METHODS  
BENTHIC INVERTEBRATE FAUNA  
LAKE ACIDIFICATION MACROINVERTEBRATE METRIC (LAMM)**

## **1. Introduction**

This method statement describes a monitoring system for monitoring, assessing and classifying lakes in accordance with the requirements of Article 8; Section 1.3 of Annex II; and Annex V of the Water Framework Directive (2000/60/EC).

### **1.1 Geographic application of the method**

The method can be applied to lakes in England, Scotland and Wales.

### **1.2 Quality element assessed by the method**

The method enables the assessment of the condition of the quality element, "benthic invertebrates", listed in Table 1.2.2 of Annex V to the Water Framework Directive.

### **1.3 Pressures to which the method is known to be sensitive**

The method has been designed to detect the impact of acidification on the quality element.

### **1.4 Indicators of the quality element used**

The method assesses the condition of the quality element using, "lake acidification macroinvertebrate metric (LAMM)".

## **2. Sampling and analysis**

### **2.1 Sampling method**

To apply the method, invertebrates should be collected from a stony-bottomed section of the littoral zone of the lake with a depth of  $\leq 75$  cm. Two samples should be collected from each location sampled.

Sampling should normally be undertaken between March and May.

The invertebrates should be collected by disturbing the substratum with the feet ("kick sampling") and passing a hand net (nominal mesh size: 1 mm) through the water above the disturbed area.

All habitats in the chosen sampling site should be sampled within a 3-minute period. In addition, a pre-sample sweep to collect surface dwelling invertebrates and a post sample manual search, lasting one minute, should be undertaken during which any invertebrates

attached to submerged plant stems, stones, logs or other solid surfaces should be collected by hand and placed in the net.

The sampling method used should comply with BS EN 27828:1994, ISO 7828-1985 Water quality. Methods for biological testing. Methods of biological sampling: guidance on handnet sampling of aquatic benthic macro-invertebrates.

## 2.2 Sample analysis

The invertebrate samples should be analysed to identify the number of individual invertebrates of each of the invertebrate taxa listed in Column 1 of Table 2 which are present in the sample.

## 3. Procedure for deriving the ecological quality ratio for the parameters

### 3.1 Calculation of the observed value of LAMM

The observed value of the parameter, LAMM, should be calculated using the equation:

$$\text{Observed value for LAMM} = \frac{\sum_{k=1}^n Sh_k \times Wh_k \times Hh_k}{\sum_{k=1}^n Wh_k \times Hh_k}$$

where:

"Sh<sub>k</sub>" is the acid sensitivity score for taxon "k" given in Column 2 of Table 2

"k" represents a taxon listed in Column 1 of Table 2 and present in the sample.

"Wh<sub>k</sub>" is the corresponding weighting score for taxon "k" given in Column 3 of Table 2; and

"Hh<sub>k</sub>" is the relative abundance score in Column 2 of Table 3 corresponding to the range in Column 1 of that Table which describes the proportion of the number of individuals of taxon "k" in the sample to the total number of individuals of the taxa listed in Column 1 of Table 2 and present in the sample.

### 3.2 Calculation of the reference value for each parameter

The lake should be assigned to the lake water type in Column 1 of Table 1 ("humic water lakes" or "clear water lakes") which corresponds with the annual mean concentration of dissolved organic carbon in Column 2 of that Table which is applicable to the lake.

The value, 5.205, should be used as the value for LAMM in humic lakes as the reference conditions applicable to the lake.

The value, 5.941, should be used as the value for LAMM in clear lakes as the reference conditions applicable to the lake.

### 3.3 Calculation of the ecological quality ratio for the parameter, LAMM

The ecological quality ratio ( $EQR_{HLAMM}$ ) for the parameter, LAMM, in humic lakes, should be calculated using the following equation:

$$EQR_{HLAMM} = \text{observed value of LAMM} \div 5.205$$

The ecological quality ratio ( $EQR_{CLAMM}$ ) for the parameter, LAMM, in clear lakes, should be calculated using the following equation:

$$EQR_{CLAMM} = \text{observed value of LAMM} \div 5.941$$

### 3.4 Application of the method for the purposes of classification

When using the method for the purposes of classifying the ecological status or potential of a water body, the mean value for the period 1st March to 31st May of  $EQR_{HLAMM}$  or  $EQR_{CLAMM}$ , as applicable, should be used.

| Table 1: Lake types to which the different parameters apply |  |
|---|--|
| Column 1  | Column 2   |
| Lake water type   | Annual mean concentration of dissolved organic carbon (mg/l) |
| Humic water lakes   | $\geq 5$   |
| Clear water lakes   | $< 5$  |

| Table 2: List of benthic invertebrate taxa and associated information applicable for the calculation of LAMM. |                                   |                            |
|---|-----------------------------------|----------------------------|
| Column 1  | Column 2                          | Column 3                   |
| Benthic invertebrate taxon  | Acid sensitivity score ( $Sh_k$ ) | Weighting score ( $Wh_k$ ) |
| <i>Adicella reducta</i>   | 2                                 | 0.352                      |
| <i>Agapetus ochripes</i>  | 6.67                              | 0.469                      |
| <i>Agapetus</i> sp. (excl. <i>Agapetus ochripes</i> )   | 8                                 | 0.469                      |
| <i>Agrypnia obsoleta</i>  | 2                                 | 0.328                      |
| <i>Agrypnia</i> sp.   | 2                                 | 0.32                       |
| <i>Alainites muticus</i>  | 8                                 | 0.432                      |
| <i>Ameletus inopinatus</i>  | 5                                 | 0.648                      |
| <i>Amphinemura standfussi</i>   | 4                                 | 0.384                      |
| <i>Amphinemura sulciollis</i>   | 2.5                               | 0.384                      |
| <i>Ancylus fluviatilis</i>  | 7                                 | 0.529                      |
| <i>Anodonta</i> sp.   | 7                                 | 0.268                      |

**Table 2: List of benthic invertebrate taxa and associated information applicable for the calculation of LAMM.**

| Column 1                          | Column 2                          | Column 3                   |
|-----------------------------------|-----------------------------------|----------------------------|
| Benthic invertebrate taxon        | Acid sensitivity score ( $Sh_k$ ) | Weighting score ( $Wh_k$ ) |
| <i>Arthroplea congener</i>        | 2                                 | 0.577                      |
| <i>Asellus aquaticus</i>          | 4                                 | 0.284                      |
| <i>Asellus meridianus</i>         | 8                                 | 0.287                      |
| <i>Athripsodes aterrimus</i>      | 2.67                              | 0.378                      |
| <i>Athripsodes bilineatus</i>     | 8                                 | 0.378                      |
| <i>Athripsodes cinereus</i>       | 5.33                              | 0.306                      |
| <i>Baetis rhodani</i>             | 6                                 | 0.685                      |
| <i>Baetis scambus / fuscatus</i>  | 7.33                              | 0.581                      |
| <i>Baetis vernus</i> group.       | 6                                 | 0.581                      |
| <i>Bathymphalus contortus</i>     | 7.33                              | 0.67                       |
| <i>Brachycentrus subnubilus</i>   | 8                                 | 0.604                      |
| <i>Brachyptera risi</i>           | 3                                 | 0.55                       |
| <i>Caenis horaria</i>             | 6.67                              | 0.455                      |
| <i>Caenis luctuosa</i> group.     | 8                                 | 0.617                      |
| <i>Caenis rivulorum</i>           | 8                                 | 0.413                      |
| <i>Caenis robusta</i>             | 8                                 | 0.413                      |
| <i>Callicorixa wollastoni</i>     | 2                                 | 0.6                        |
| <i>Calopteryx virgo</i>           | 6                                 | 0.387                      |
| <i>Capnia atra</i>                | 6                                 | 0.661                      |
| <i>Capnia bifrons</i>             | 4                                 | 0.661                      |
| <i>Capnia vidua</i>               | 2                                 | 0.661                      |
| <i>Centoptilum luteolum</i>       | 5.33                              | 0.45                       |
| <i>Ceraclea annulicornis</i>      | 8                                 | 0.566                      |
| <i>Chaetopteryx villosa</i>       | 2                                 | 0.659                      |
| <i>Cheumatopsyche lepida</i>      | 8                                 | 0.58                       |
| <i>Chloroperla tripunctata</i>    | 8                                 | 0.261                      |
| <i>Cloeon dipterum/inscriptum</i> | 6                                 | 0.411                      |
| <i>Cloeon simile</i>              | 6                                 | 0.366                      |
| <i>Crangonyx pseudogracilis</i>   | 6                                 | 0.585                      |
| <i>Crenobia alpina</i>            | 5                                 | 0.057                      |
| <i>Cyrrnus flavidus</i>           | 2.67                              | 0.391                      |
| <i>Cyrrnus insolutus</i>          | 2                                 | 0.316                      |
| <i>Cyrrnus trimaculatus</i>       | 2.67                              | 0.529                      |
| <i>Cyrrnus</i> sp.                | 2.67                              | 0.392                      |
| <i>Dicranota</i> sp.              | 2                                 | 0.472                      |
| <i>Diplectrona felix</i>          | 8                                 | 0.58                       |

**Table 2: List of benthic invertebrate taxa and associated information applicable for the calculation of LAMM.**

| Column 1  | Column 2                          | Column 3                   |
|---|-----------------------------------|----------------------------|
| Benthic invertebrate taxon                      | Acid sensitivity score ( $Sh_k$ ) | Weighting score ( $Wh_k$ ) |
| <i>Diura bicaudata</i>                          | 4.67                              | 0.587                      |
| <i>Dixa</i> sp.                                 | 7                                 | 0.408                      |
| <i>Ecdyonurus</i> sp.                           | 8                                 | 0.577                      |
| <i>Electrogena lateralis</i>                    | 8                                 | 0.577                      |
| <i>Elmis aenea</i>                              | 6                                 | 0.307                      |
| Empididae                                       | 6                                 | 0.608                      |
| <i>Ephemera danica</i>                          | 8                                 | 0.544                      |
| <i>Ephemera vulgata</i>                         | 6.67                              | 0.631                      |
| <i>Erpobdella octoculata</i>                    | 6                                 | 0.31                       |
| <i>Erpobdella testacea</i>                      | 6                                 | 0.365                      |
| <i>Esolus parallelepipedus</i>                  | 7                                 | 0.307                      |
| <i>Galba truncatula</i>                         | 7.33                              | 0.386                      |
| <i>Gammarus lacustris</i>                       | 7.33                              | 0.517                      |
| <i>Gammarus pulex</i> / <i>Gammarus duebeni</i> | 7                                 | 0.464                      |
| <i>Glossiphonia complanata</i>                  | 7                                 | 0.304                      |
| <i>Glossosoma</i> sp.                           | 8                                 | 0.469                      |
| <i>Glyphotaelius pellucidus</i>                 | 2                                 | 0.344                      |
| <i>Goera pilosa</i>                             | 4                                 | 0.324                      |
| <i>Gyraulus albus</i>                           | 6.67                              | 0.637                      |
| <i>Habrophlebia fusca</i>                       | 8                                 | 0.353                      |
| <i>Halesus radiatus</i>                         | 2                                 | 0.325                      |
| <i>Helobdella stagnalis</i>                     | 6.5                               | 0.288                      |
| <i>Hemiclepsis marginata</i>                    | 7                                 | 0.308                      |
| <i>Heptagenia sulphurea</i>                     | 5.5                               | 0.608                      |
| <i>Holocentropus dubius</i>                     | 2.67                              | 0.281                      |
| <i>Hydraena gracilis</i>                        | 8                                 | 0.096                      |
| <i>Hydropsyche angustipennis</i>                | 3.33                              | 0.58                       |
| <i>Hydropsyche instabilis</i>                   | 8                                 | 0.58                       |
| <i>Hydropsyche pellicidula</i>                  | 5.5                               | 0.58                       |
| <i>Hydropsyche siltalai</i>                     | 4.5                               | 0.58                       |
| <i>Hydroptila</i> sp.                           | 7                                 | 0.465                      |
| <i>Isoperla grammatica</i>                      | 8                                 | 0.618                      |
| <i>Isoperla obscura</i>                         | 4                                 | 0.618                      |
| <i>Ithytrichia</i> sp.                          | 6.67                              | 0.457                      |
| <i>Kageronia fuscogrisea</i>                    | 2                                 | 0.577                      |
| <i>Lepidostoma hirtum</i>                       | 6                                 | 0.538                      |
| <i>Leptophlebia</i>                             | 2                                 | 0.321                      |



**Table 2: List of benthic invertebrate taxa and associated information applicable for the calculation of LAMM.**

| Column 1  | Column 2                          | Column 3                   |
|---|-----------------------------------|----------------------------|
| Benthic invertebrate taxon                                  | Acid sensitivity score ( $Sh_k$ ) | Weighting score ( $Wh_k$ ) |
| <i>marginata</i>  |                                   |                            |
| <i>Leptophlebia vespertina</i>                              | 2                                 | 0.133                      |
| <i>Leptophlebia sp.</i>                                     | 2                                 | 0.133                      |
| <i>Leuctra fusca</i>  | 4                                 | 0.438                      |
| <i>Leuctra geniculata</i>                                   | 8                                 | 0.438                      |
| <i>Leuctra hippopus</i>                                     | 2                                 | 0.438                      |
| <i>Leuctra inermis</i>                                      | 4                                 | 0.438                      |
| <i>Leuctra nigra</i>  | 2                                 | 0.438                      |
| <i>Limnebius truncatellus</i>                               | 8                                 | 0.096                      |
| <i>Limnephilus centralis</i>                                | 2                                 | 0.325                      |
| <i>Limnephilus extricatus</i>                               | 2                                 | 0.325                      |
| <i>Limnephilus flavicornis</i>                              | 2                                 | 0.325                      |
| <i>Limnephilus lunatus</i>                                  | 2                                 | 0.325                      |
| <i>Limnephilus rhombicus</i>                                | 2                                 | 0.325                      |
| <i>Limnephilus stigma</i>                                   | 2                                 | 0.325                      |
| <i>Limnephilus vittatus</i>                                 | 2                                 | 0.325                      |
| <i>Limnephilus sp.</i>                                      | 2                                 | 0.325                      |
| <i>Limnius volckmari</i>                                    | 6                                 | 0.39                       |
| Limoniidae/Pediciidae (not including <i>Dicranota sp.</i> ) | 4                                 | 0.472                      |
| <i>Lype sp.</i>   | 6                                 | 0.546                      |
| <i>Micropterna lateralis</i>                                | 2                                 | 0.325                      |
| <i>Molanna angustata</i>                                    | 3                                 | 0.569                      |
| <i>Mystacides azurea</i>                                    | 5.5                               | 0.48                       |
| <i>Mystacides longicornis/nigra</i>                         | 6                                 | 0.69                       |
| <i>Mystacides sp.</i>                                       | 5.5                               | 0.394                      |
| <i>Nemotaulius punctatolineatus</i>                         | 2                                 | 0.175                      |
| <i>Nemoura avicularis</i>                                   | 3                                 | 0.526                      |
| <i>Nemoura cambrica</i>                                     | 2                                 | 0.399                      |
| <i>Nemoura cineria</i>                                      | 2                                 | 0.323                      |
| <i>Nemoura sp.</i>  | 2                                 | 0.399                      |
| <i>Nemurella pictetii</i>                                   | 2                                 | 0.384                      |
| <i>Neureclipsis bimaculata</i>                              | 2                                 | 0.29                       |
| <i>Nigrobaetis digitatus</i>                                | 8                                 | 0.432                      |
| <i>Nigrobaetis niger</i>                                    | 5                                 | 0.432                      |
| <i>Notidobia ciliaris</i>                                   | 6                                 | 0.192                      |
| <i>Oecetis testacea</i>                                     | 5.5                               | 0.304                      |

**Table 2: List of benthic invertebrate taxa and associated information applicable for the calculation of LAMM.**

| Column 1                             | Column 2                          | Column 3                   |
|--------------------------------------|-----------------------------------|----------------------------|
| Benthic invertebrate taxon           | Acid sensitivity score ( $Sh_k$ ) | Weighting score ( $Wh_k$ ) |
| <i>Oulimnius</i> sp.                 | 4                                 | 0.329                      |
| <i>Oxyethira</i> sp.                 | 3.33                              | 0.512                      |
| <i>Paraleptophlebia submarginata</i> | 8                                 | 0.353                      |
| <i>Paraleptophlebia</i> sp.          | 8                                 | 0.353                      |
| <i>Perlodes dispar</i>               | 4                                 | 0.618                      |
| <i>Perlodes microcephala</i>         | 8                                 | 0.618                      |
| <i>Phagocata vitta</i>               | 2                                 | 0.057                      |
| <i>Phryganea grandis</i>             | 2                                 | 0.255                      |
| <i>Physa fontinalis</i>              | 6                                 | 0.396                      |
| <i>Pisidium</i> sp.                  | 5                                 | 0.504                      |
| <i>Planorbis carinatus</i>           | 8                                 | 0.413                      |
| <i>Planorbis planorbis</i>           | 8                                 | 0.413                      |
| <i>Plectrocnemia conspersa</i>       | 2                                 | 0.008                      |
| <i>Plectrocnemia geniculata</i>      | 2                                 | 0.103                      |
| <i>Polycelis felina</i>              | 4                                 | 0.183                      |
| <i>Polycentropus flavomaculatus</i>  | 2                                 | 0.409                      |
| <i>Polycentropus irroratus</i>       | 2                                 | 0.369                      |
| <i>Polycentropus</i> sp.             | 2                                 | 0.333                      |
| <i>Potamophylax cingulatus</i>       | 2                                 | 0.222                      |
| <i>Potamophylax laticornis</i>       | 2                                 | 0.222                      |
| <i>Potamopyrgus antipodarum</i>      | 7.33                              | 0.34                       |
| <i>Procladius bifidus</i>            | 8                                 | 0.432                      |
| <i>Procladius meyeri</i>             | 2                                 | 0.384                      |
| <i>Procladius praecox</i>            | 8                                 | 0.384                      |
| <i>Radix balthica</i> (L. peregra)   | 7                                 | 0.627                      |
| <i>Rhyacophila</i> sp.               | 8                                 | 0.577                      |
| <i>Rhyacophila dorsalis</i>          | 4                                 | 0.62                       |
| <i>Rhyacophila munda</i>             | 4                                 | 0.62                       |
| <i>Serratella ignita</i>             | 7                                 | 0.475                      |
| <i>Sericopteryx personatum</i>       | 5.5                               | 0.204                      |
| <i>Sialis fuliginosa</i>             | 5                                 | 0.289                      |
| <i>Sialis lutaria</i>                | 4                                 | 0.25                       |
| <i>Sialis pallipes</i>               | 5.33                              | 0.324                      |
| Simuliidae                           | 4                                 | 0.494                      |

**Table 2: List of benthic invertebrate taxa and associated information applicable for the calculation of LAMM.**

| Column 1                       | Column 2                          | Column 3                   |
|--------------------------------|-----------------------------------|----------------------------|
| Benthic invertebrate taxon     | Acid sensitivity score ( $Sh_k$ ) | Weighting score ( $Wh_k$ ) |
| <i>Siphonurus alternatus</i>   | 6                                 | 0.502                      |
| <i>Siphonurus lacustris</i>    | 4.67                              | 0.502                      |
| <i>Siphonurus sp.</i>          | 4.67                              | 0.502                      |
| <i>Siphonoperla torrentium</i> | 2                                 | 0.261                      |
| <i>Spaerium corneum</i>        | 4.67                              | 0.537                      |
| <i>Stenophylax permistus</i>   | 2                                 | 0.325                      |
| <i>Tabanus group.</i>          | 4                                 | 0.289                      |
| <i>Taeniopteryx nebulosa</i>   | 2.67                              | 0.55                       |
| <i>Theromyzon tessulatum</i>   | 7                                 | 0.541                      |
| <i>Tinodes waeneri</i>         | 6                                 | 0.256                      |
| Tipulidae                      | 4                                 | 0.472                      |
| <i>Trianodes bicolor</i>       | 6                                 | 0.3                        |
| <i>Wormaldia sp.</i>           | 8                                 | 0.57                       |

**Table 3: Relative abundance scores for taxa**

| Column 1  | Column 2                            |
|---|-------------------------------------|
| Proportion of individuals of a taxon to the total number of all individuals of taxa listed in Column 1 of Table 2 and present in the sample (%) | Relative abundance score ( $Hh_k$ ) |
| < 5   | 1                                   |
| 5 - 20  | 3                                   |
| > 20  | 5                                   |

## Annex 1: Worked example

The following taxon list was obtained from an analysis of a sample collected from a clear water lake in Wales

The first column has the taxon name, the second column shows the number of individuals of each taxon found.

| Lake invertebrate taxon         | Abundance |
|---------------------------------|-----------|
| <i>Ancylus fluviatilis</i>      | 2         |
| <i>Asellus aquaticus</i>        | 25        |
| <i>Athripsodes aterrimus</i>    | 1         |
| <i>Athripsodes cinereus</i>     | 10        |
| <i>Bathyomphalus contortus</i>  | 1         |
| <i>Caenis luctuosa</i> gp.      | 81        |
| <i>Chironomidae</i>             | 70        |
| <i>Crangonyx pseudogracilis</i> | 150       |
| <i>Erpobdella octoculata</i>    | 15        |
| <i>Glossiphonia heteroclita</i> | 11        |
| <i>Helobdella stagnalis</i>     | 9         |
| <i>Heptagenia lateralis</i>     | 1         |
| <i>Isoperla grammatica</i>      | 1         |
| <i>Lepidostoma hirtum</i>       | 1         |
| <i>Leptophlebia marginata</i>   | 1         |
| <i>Limnius volckmari</i>        | 1         |
| <i>Micronecta</i>               | 26        |
| <i>Mystacides azurea</i>        | 3         |
| <i>Nebrioporus elegans</i>      | 2         |
| <i>Oligochaeta</i>              | 110       |
| <i>Oulimnius</i> sp             | 37        |
| <i>Pisidium</i> sp.             | 16        |
| <i>Polycelis tenius/nigra</i>   | 48        |
| <i>Procladius bifidus</i>       | 2         |
| <i>Sigara dorsalis</i>          | 2         |
| <i>Siphonurus lacustris</i>     | 1         |
| <i>Theromyzon tessulatum</i>    | 1         |
| <i>Tinodes waeneri</i>          | 2         |

Note that seven taxa (*Chironomidae*, *Glossiphonia heteroclita*, *Micronecta*, *Nebrioporus elegans*, *Oligochaeta*, *Polycelis tenius/nigra*, *Sigara dorsalis*) are not listed in Table 2. These are ignored in the analyses.

The first step is to calculate the percentage of each taxon relative to the total number of individuals of all scoring taxa and then to convert this to a relative abundance score ( $Hh_k$ ) using Table 3.

| Column 1                        | Column 2   | Column 3   | Column 4 |
|---------------------------------|------------|------------|----------|
| Taxon                           | Abundance  | Percentage | $Hh_k$   |
| <i>Athripsodes aterrimus</i>    | 1          | <1.0       | 1        |
| <i>Athripsodes cinereus</i>     | 10         | 2.8        | 1        |
| <i>Caenis luctuosa</i> gp.      | 81         | 22.4       | 5        |
| <i>Heptagenia lateralis</i>     | 1          | <1.0       | 1        |
| <i>Isoperla grammica</i>        | 1          | <1.0       | 1        |
| <i>Lepidostoma hirtum</i>       | 1          | <1.0       | 1        |
| <i>Leptophlebia marginata</i>   | 1          | <1.0       | 1        |
| <i>Mystacides azurea</i>        | 3          | <1.0       | 1        |
| <i>Procloeon bifidum</i>        | 2          | <1.0       | 1        |
| <i>Siphonurus lacustris</i>     | 1          | <1.0       | 1        |
| <i>Tinodes waeneri</i>          | 2          | <1.0       | 1        |
| <i>Ancylus fluviatilis</i>      | 2          | <1.0       | 1        |
| <i>Asellus aquaticus</i>        | 25         | 6.9        | 3        |
| <i>Bathyomphalus contortus</i>  | 1          | <1.0       | 1        |
| <i>Crangonyx pseudogracilis</i> | 150        | 41.6       | 5        |
| <i>Erpobdella octoculata</i>    | 15         | 4.2        | 1        |
| <i>Helobdella stagnalis</i>     | 9          | 2.5        | 1        |
| <i>Limnius volckmari</i>        | 1          | <1.0       | 1        |
| <i>Oulimnius</i> sp             | 37         | 10.2       | 3        |
| <i>Pisidium</i> sp.             | 16         | 4.4        | 1        |
| <i>Theromyzon tessulatum</i>    | 1          | <1.0       | 1        |
| <b>Total Scoring Taxa</b>       | <b>361</b> |            |          |

The taxa are then given their acid sensitivity scores ( $Sh_k$ ) and weighting scores ( $Wh_k$ ) according to Columns 2 and 3 of Table 2, respectively.

| Taxon                           | $Sh_k$ | $Wh_k$ | $Hh_k$ |
|---------------------------------|--------|--------|--------|
| <i>Ancylus fluviatilis</i>      | 7      | 0.529  | 1      |
| <i>Asellus aquaticus</i>        | 4      | 0.284  | 3      |
| <i>Bathyomphalus contortus</i>  | 7.33   | 0.67   | 1      |
| <i>Crangonyx pseudogracilis</i> | 6      | 0.585  | 5      |
| <i>Erpobdella octoculata</i>    | 6      | 0.31   | 1      |

|                               |      |       |   |
|-------------------------------|------|-------|---|
| <i>Helobdella stagnalis</i>   | 6.5  | 0.288 | 1 |
| <i>Athripsodes aterrimus</i>  | 2.67 | 0.378 | 1 |
| <i>Athripsodes cinereus</i>   | 5.33 | 0.306 | 1 |
| <i>Caenis luctuosa</i> gp.    | 8    | 0.617 | 5 |
| <i>Heptagenia lateralis</i>   | 8    | 0.577 | 1 |
| <i>Isoperla grammatica</i>    | 8    | 0.618 | 1 |
| <i>Lepidostoma hirtum</i>     | 6    | 0.538 | 1 |
| <i>Leptophlebia marginata</i> | 2    | 0.321 | 1 |
| <i>Limnius volckmari</i>      | 6    | 0.39  | 1 |
| <i>Mystacides azurea</i>      | 5.5  | 0.48  | 1 |
| <i>Oulimnius</i> sp           | 4    | 0.329 | 3 |
| <i>Pisidium</i> sp.           | 5    | 0.504 | 1 |
| <i>Procladius bifidus</i>     | 8    | 0.432 | 1 |
| <i>Siphonurus lacustris</i>   | 4.67 | 0.502 | 1 |
| <i>Theromyzon tessulatum</i>  | 7    | 0.541 | 1 |
| <i>Tinodes waeneri</i>        | 6    | 0.256 | 1 |

EQR<sub>LAMM</sub> for this sample is calculated as follows:

1. Calculate the observed value for LAMM using the equation in Section 3.1:

| <b>Taxon</b>                    | $Sh_k \times Wh_k \times Hh_k$ | $Wh_k \times Hh_k$ |
|---------------------------------|--------------------------------|--------------------|
| <i>Ancylus fluviatilis</i>      | 3.70                           | 0.53               |
| <i>Asellus aquaticus</i>        | 3.41                           | 0.85               |
| <i>Bathyomphalus contortus</i>  | 4.91                           | 0.67               |
| <i>Crangonyx pseudogracilis</i> | 17.55                          | 2.93               |
| <i>Erpobdella octoculata</i>    | 1.86                           | 0.31               |
| <i>Helobdella stagnalis</i>     | 1.87                           | 0.29               |
| <i>Athripsodes aterrimus</i>    | 1.01                           | 0.38               |
| <i>Athripsodes cinereus</i>     | 1.63                           | 0.31               |
| <i>Caenis luctuosa</i> gp.      | 24.68                          | 3.09               |
| <i>Heptagenia lateralis</i>     | 4.62                           | 0.58               |
| <i>Isoperla grammatica</i>      | 4.94                           | 0.62               |
| <i>Lepidostoma hirtum</i>       | 3.23                           | 0.54               |
| <i>Leptophlebia marginata</i>   | 0.64                           | 0.32               |
| <i>Limnius volckmari</i>        | 2.34                           | 0.39               |
| <i>Mystacides azurea</i>        | 2.64                           | 0.48               |
| <i>Oulimnius</i> sp             | 3.95                           | 0.99               |
| <i>Pisidium</i> sp.             | 2.52                           | 0.504              |

|                              |        |       |
|------------------------------|--------|-------|
| <i>Procloeon bifidum</i>     | 3.46   | 0.43  |
| <i>Siphonurus lacustris</i>  | 2.34   | 0.50  |
| <i>Theromyzon tessulatum</i> | 3.79   | 0.54  |
| <i>Tinodes waeneri</i>       | 1.54   | 0.26  |
| <b>Totals:</b>               | 140.95 | 21.05 |

Observed value for LAMM =  $141.12 \div 21.05 = 6.704$

2. Calculate  $EQR_{LMM}$  using the applicable equation in Section 3.3:

$$EQR_{CLMM} = 6.704 \div 5.941 = 1.128$$

### **Annex 3: Further Reading**

McFarland B.P (2008) *Lake Macroinvertebrate Acidification Method – HLAMM & CLAMM*. UK TAG Report 142.