# Hydromorphological Indices description

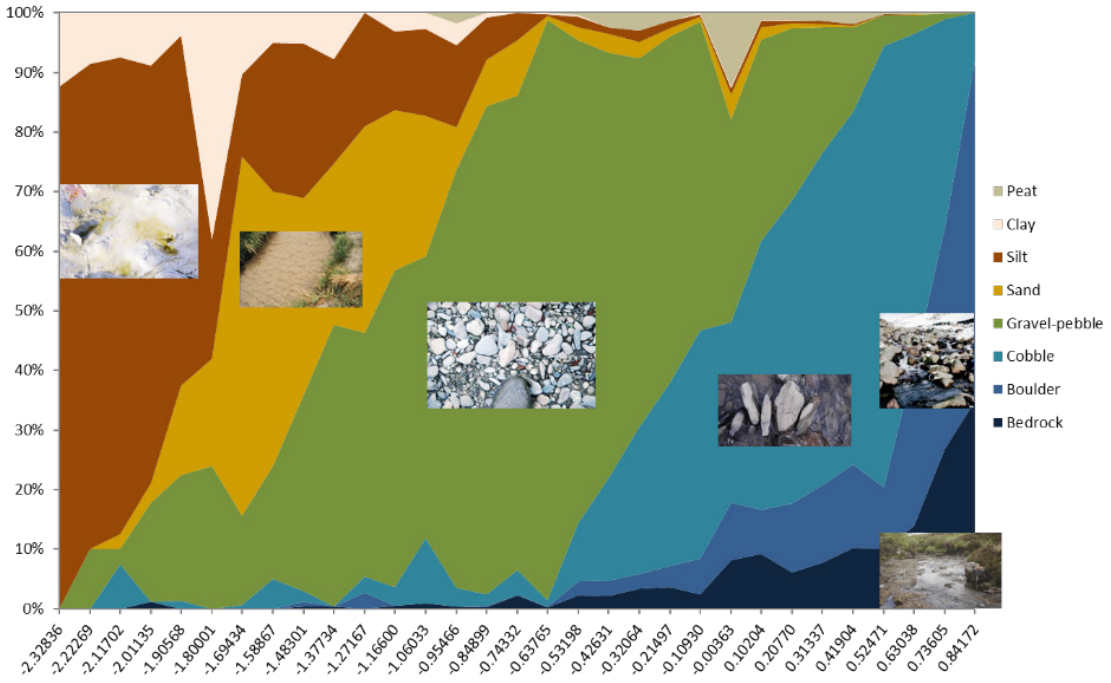
11/04/2020

Four hydromorphological indices representing major dimensions in the distribution of hydromorphological features were derived from RHS data:

- Channel Substrate Index (CSI)
- Flow Regime Index (FRI)
- Geomorphic Activity Index (GAI)
- Channel Vegetation Index (CVI).

The following figures illustrate, for each index (x scale), the relative occurrence of constituting morphological features in percentage. The indices and figures were built using RHS semi-natural sites with little or no signs of channel/bank modification. For example, on the Channel Substrate Index figure and table below, a CSI score of -2.3 is associated with sites generally composed of silt (88%) and/or clay (12%).

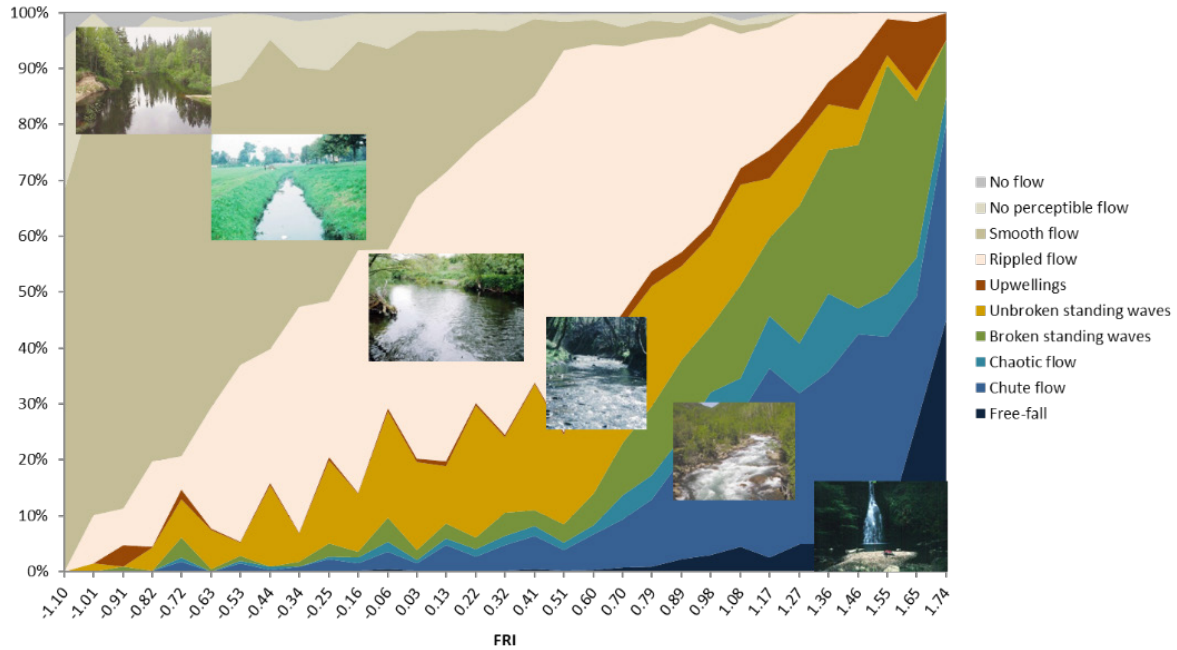
- The **Channel Substrate Index** represents a gradient in average channel substrate size. The gradient is correlated with measures and attributes relating to stream power, shear stress, climate and sediment supply. At the lower end of the scale, sites are dominated by fine substrate. As we progress through the scale, we see a gradual increase in average sediment size and a shift towards coarser substrate types.



Below is the table on which the graph above is based. It shows the relative occurrence of channel substrate types with increasing CSI scores (proportion < 1% have been hidden).

| Index value | Bedrock | Boulder | Cobble | Gravel-pebble | Sand | Silt | Clay | Peat | total |
|---|---|---|---|---|---|---|---|---|---|
| -2.33 | | | | | | 88% | 12% | | 100% |
| -2.22 | | | | 10% | | 81% | 9% | | 100% |
| -2.12 | | | 8% | 3% | 3% | 80% | 8% | | 100% |
| -2.01 | 1% | | | 17% | 3% | 70% | 9% | | 100% |
| -1.91 | | | 1% | 21% | 15% | 59% | 4% | | 100% |
| -1.80 | | | | 24% | 18% | 20% | 38% | | 100% |
| -1.69 | | | | 15% | 60% | 14% | 10% | | 100% |
| -1.59 | | | 5% | 19% | 46% | 25% | 5% | | 100% |
| -1.48 | | | 2% | 33% | 33% | 26% | 5% | | 100% |
| -1.38 | | | | 47% | 27% | 18% | 8% | | 100% |
| -1.27 | | 3% | 3% | 41% | 35% | 19% | | | 100% |
| -1.17 | | | 3% | 53% | 27% | 13% | 3% | | 100% |
| -1.06 | | | 11% | 47% | 24% | 15% | 3% | | 100% |
| -0.95 | | | 3% | 70% | 7% | 14% | 4% | 2% | 100% |
| -0.85 | | | 2% | 82% | 8% | 7% | | | 100% |
| -0.74 | 2% | | 4% | 80% | 9% | 5% | | | 100% |
| -0.64 | | | 1% | 97% | | | | | 100% |
| -0.53 | 2% | 2% | 10% | 81% | 2% | 2% | | | 100% |
| -0.43 | 2% | 3% | 17% | 71% | 3% | 1% | | 2% | 100% |
| -0.32 | 3% | 2% | 25% | 62% | 3% | 2% | | 3% | 100% |
| -0.21 | 4% | 4% | 31% | 58% | 1% | 1% | | 1% | 100% |
| -0.11 | 2% | 6% | 38% | 52% | | | | | 100% |
| 0.00 | 8% | 10% | 30% | 34% | 4% | 1% | | 12% | 100% |
| 0.10 | 9% | 7% | 45% | 34% | 2% | 1% | | 1% | 100% |
| 0.21 | 6% | 12% | 51% | 29% | | | | 1% | 100% |
| 0.31 | 8% | 13% | 56% | 21% | | | | 1% | 100% |
| 0.42 | 10% | 14% | 59% | 14% | | | | 2% | 100% |
| 0.52 | 10% | 10% | 74% | 5% | | | | | 100% |
| 0.63 | 14% | 27% | 56% | 3% | | | | | 100% |
| 0.74 | 27% | 37% | 35% | | | | | | 100% |
| 0.84 | 35% | 57% | 8% | | | | | | 100% |

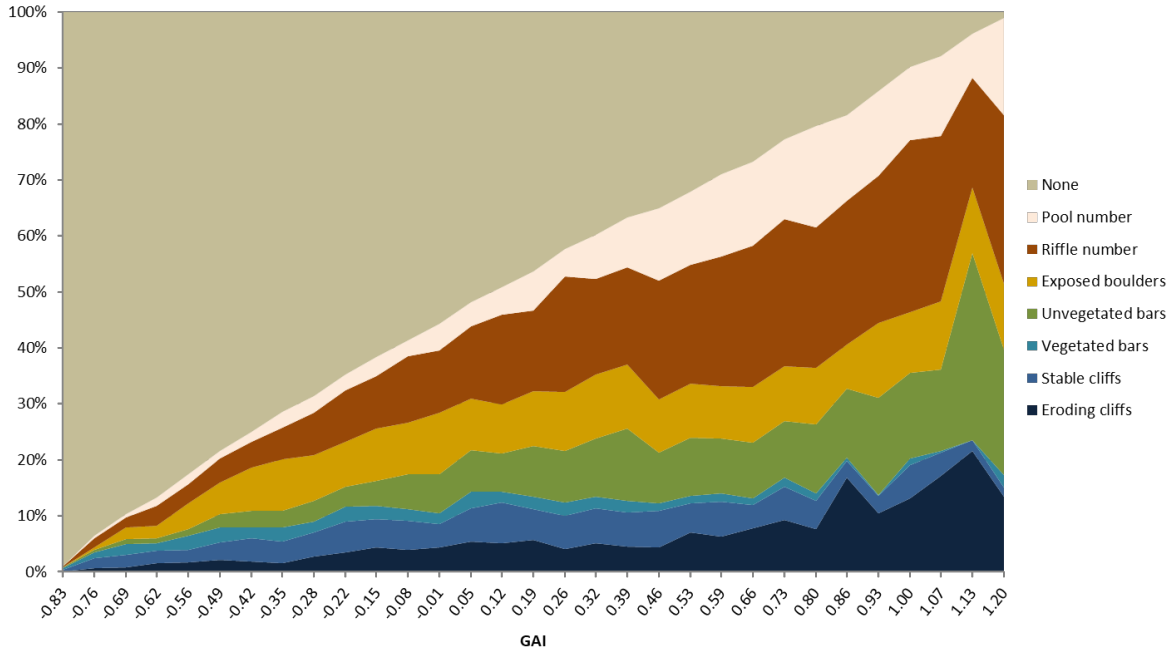
- The **Flow Regime Index** represents a gradient between slow tranquil and fast turbulent flow-types. The index ranges from sites dominated by slow flowing less turbulent features such as glides and pools to sites dominated by fast flowing features such as waterfalls, cascades and rapids. The gradient is strongly correlated to measures of discharge and slope as well as altitude and geology.



Below is the table on which the graph above is based. It shows the relative occurrence of flow-types with increasing FRI scores (proportion < 1% have been hidden).

| FRI | Free-fall | Chute flow | Chaotic flow | Broken standing waves | Unbroken standing waves | Upwellings | Rippled flow | Smooth flow | No perceptible flow | No flow (dry) | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| -1.10 | | | | | | | | 68% | 27% | 5% | 100% |
| -1.01 | | | | | 1% | | 9% | 76% | 14% | | 100% |
| -0.91 | | | | | | 4% | 7% | 69% | 15% | 5% | 100% |
| -0.82 | | | | | 4% | | 15% | 64% | 15% | | 100% |
| -0.72 | | 2% | | 3% | 7% | 2% | 6% | 60% | 17% | 2% | 100% |
| -0.63 | | | | | 7% | | 22% | 57% | 12% | 1% | 100% |
| -0.53 | | 1% | | | 2% | | 32% | 51% | 12% | | 100% |
| -0.44 | | | | | 15% | | 24% | 55% | 4% | | 100% |
| -0.34 | | | | | 5% | | 40% | 43% | 8% | 2% | 100% |
| -0.25 | | 2% | | 2% | 15% | | 28% | 41% | 9% | 1% | 100% |
| -0.16 | | 1% | 1% | 1% | 10% | | 43% | 38% | 5% | | 100% |
| -0.06 | | 3% | 2% | 4% | 19% | | 28% | 36% | 6% | | 100% |
| 0.03 | | 1% | | 2% | 16% | | 47% | 30% | 3% | | 100% |
| 0.13 | | 5% | 1% | 3% | 10% | | 52% | 25% | 3% | | 100% |
| 0.22 | | 3% | 1% | 2% | 24% | | 47% | 20% | 3% | | 100% |
| 0.32 | | 5% | 2% | 4% | 13% | | 56% | 16% | 3% | | 100% |
| 0.41 | | 6% | 2% | 3% | 23% | | 51% | 14% | 1% | | 100% |
| 0.51 | | 4% | 1% | 3% | 16% | | 68% | 5% | 1% | | 100% |
| 0.60 | | 6% | 2% | 6% | 24% | 1% | 55% | 5% | | | 100% |
| 0.70 | | 9% | 4% | 9% | 21% | 2% | 48% | 4% | 2% | | 100% |
| 0.79 | | 12% | 4% | 12% | 21% | 3% | 41% | 3% | 1% | | 100% |
| 0.89 | 2% | 18% | 4% | 14% | 17% | 2% | 39% | 2% | 2% | | 100% |
| 0.98 | 3% | 20% | 9% | 12% | 16% | 2% | 36% | 2% | | | 100% |
| 1.08 | 4% | 24% | 6% | 17% | 18% | 3% | 24% | 1% | 1% | 1% | 100% |
| 1.17 | 3% | 34% | 9% | 14% | 11% | 5% | 22% | | 1% | | 100% |
| 1.27 | 5% | 27% | 9% | 25% | 11% | 3% | 20% | | | | 100% |
| 1.36 | 5% | 31% | 14% | 26% | 8% | 4% | 12% | | | | 100% |
| 1.46 | 12% | 31% | 5% | 29% | 6% | 10% | 8% | | | | 100% |
| 1.55 | 8% | 34% | 8% | 41% | 2% | 7% | 1% | | | | 100% |
| 1.65 | 26% | 23% | 7% | 28% | 2% | 12% | 2% | | | | 100% |
| 1.74 | 45% | 35% | 5% | 10% | | 5% | | | | | 100% |

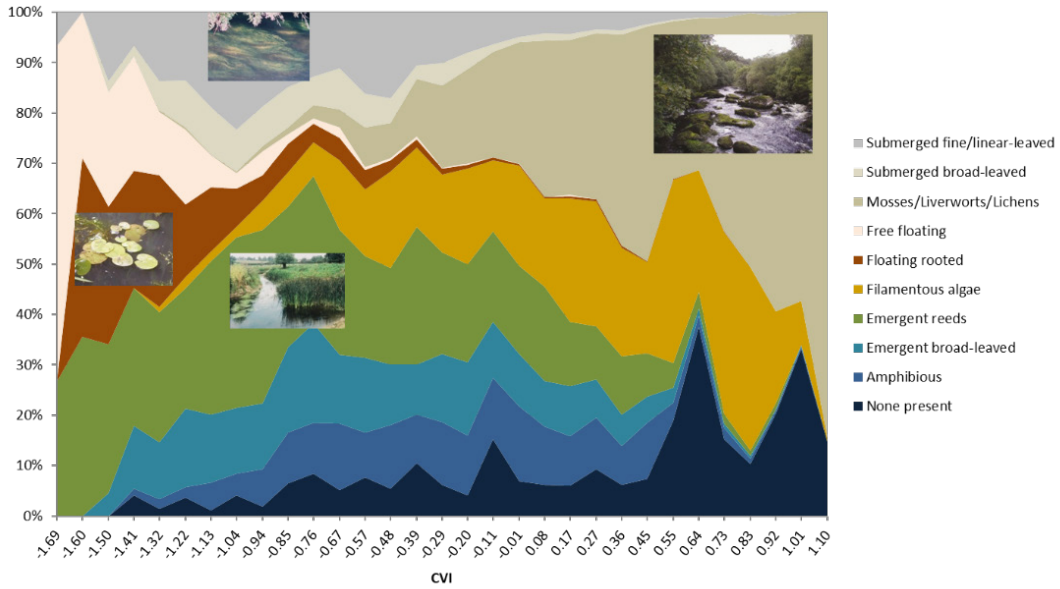
- The **Geomorphic Activity Index** represents a gradient of increased activity. It is based on the relative occurrence of erosion and deposition features such as bars, cliffs, riffles and pools. Sites at the bottom of the scale display few or no signs of activity whilst sites at the upper-end of the scale are dominated by active erosion and deposition features. The index is not simply a representation of the number of eroding/depositing features, it also differentiates between types of activity. The lower end of the scale displays a higher proportion of stable erosion and deposition features (i.e. stable cliffs and vegetated bars) compared to the upper end of the scale which is dominated by more active features (i.e. eroding cliffs and unvegetated bars). The GAI was correlated to measures of stream power, shear stress as well as attributes relating to climatic, land-use and geological controls.




Below is the table on which the graph above is based. It shows the relative occurrence of geomorphic features with increasing GAI scores (proportion < 1% have been hidden).

| GAI | Eroding cliffs | Stable cliffs | Vegetated bars | Unvegetated bars | Exposed boulders | Riffle number | Pool number | None | Total |
|---|---|---|---|---|---|---|---|---|---|
| -0.83 | | | | | | | | 99% | 100% |
| -0.76 | | 2% | 1% | | | 2% | | 94% | 100% |
| -0.69 | | 2% | 2% | | 2% | 2% | | 90% | 100% |
| -0.62 | 2% | 2% | 1% | | 2% | 4% | 1% | 87% | 100% |
| -0.56 | 2% | 2% | 2% | 1% | 5% | 4% | 2% | 83% | 100% |
| -0.49 | 2% | 3% | 3% | 2% | 6% | 4% | 1% | 78% | 100% |
| -0.42 | 2% | 4% | 2% | 3% | 8% | 5% | 2% | 75% | 100% |
| -0.35 | 2% | 4% | 3% | 3% | 9% | 6% | 3% | 71% | 100% |
| -0.28 | 3% | 4% | 2% | 4% | 8% | 7% | 3% | 69% | 100% |
| -0.22 | 3% | 5% | 3% | 4% | 8% | 9% | 3% | 65% | 100% |
| -0.15 | 4% | 5% | 2% | 4% | 9% | 9% | 3% | 62% | 100% |
| -0.08 | 4% | 5% | 2% | 6% | 9% | 12% | 3% | 59% | 100% |
| -0.01 | 4% | 4% | 2% | 7% | 11% | 11% | 5% | 56% | 100% |
| 0.05 | 5% | 6% | 3% | 7% | 9% | 13% | 4% | 52% | 100% |
| 0.12 | 5% | 7% | 2% | 7% | 9% | 16% | 5% | 49% | 100% |
| 0.19 | 6% | 6% | 2% | 9% | 10% | 14% | 7% | 46% | 100% |
| 0.26 | 4% | 6% | 2% | 9% | 11% | 21% | 5% | 42% | 100% |
| 0.32 | 5% | 6% | 2% | 11% | 11% | 17% | 8% | 40% | 100% |
| 0.39 | 5% | 6% | 2% | 13% | 11% | 17% | 9% | 37% | 100% |
| 0.46 | 4% | 7% | 1% | 9% | 10% | 21% | 13% | 35% | 100% |
| 0.53 | 7% | 5% | 1% | 10% | 10% | 21% | 13% | 32% | 100% |
| 0.59 | 6% | 6% | 1% | 10% | 9% | 23% | 15% | 29% | 100% |
| 0.66 | 8% | 4% | 1% | 10% | 10% | 25% | 15% | 27% | 100% |
| 0.73 | 9% | 6% | 2% | 10% | 10% | 26% | 14% | 23% | 100% |
| 0.80 | 8% | 5% | 1% | 12% | 10% | 25% | 18% | 20% | 100% |
| 0.86 | 17% | 3% | | 12% | 8% | 26% | 15% | 18% | 100% |
| 0.93 | 10% | 3% | | 17% | 13% | 26% | 15% | 14% | 100% |
| 1.00 | 13% | 6% | 1% | 15% | 11% | 31% | 13% | 10% | 100% |
| 1.07 | 17% | 4% | | 15% | 12% | 30% | 14% | 8% | 100% |
| 1.13 | 22% | 2% | | 33% | 12% | 20% | 8% | 4% | 100% |
| 1.20 | 13% | 2% | 2% | 22% | 12% | 30% | 17% | 1% | 100% |

- The **Channel Vegetation Index** follows a gradient of flow velocity, energy and channel condition. The lower end of the scale is dominated by floating vegetation typical of slow flowing environments with stable hydrographs. As we progress along the scale, submerged and emergent vegetation types become dominant followed by filamentous algae, mosses, liverworts and lichens. The CVI gradient is strongly correlated with stream energy, geology and altitude.




Below is the table on which the graph above is based. It shows the relative occurrence of channel vegetation types with increasing CVI scores (proportion < 1% have been hidden).

| CVI | None present | Amphibious | Emergent broad-leaved | Emergent reeds | Filamentous algae | Floating rooted | Free floating | Mosses Liverworts Lichens | Submerged broad-leaved | Submerged fine/linear-leaved | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| -1.69 | | | | 27% | | | 67% | | | 7% | 100% |
| -1.60 | | | | 36% | | 36% | 29% | | | | 100% |
| -1.50 | | | 5% | 30% | | 27% | 23% | | 2% | 14% | 100% |
| -1.41 | 4% | 1% | 12% | 27% | | 23% | 23% | | 2% | 7% | 100% |
| -1.32 | 1% | 2% | 11% | 26% | 1% | 26% | 13% | | 6% | 14% | 100% |
| -1.22 | 4% | 2% | 15% | 24% | 2% | 14% | 15% | | 9% | 14% | 100% |
| -1.13 | 1% | 5% | 14% | 31% | 2% | 13% | 6% | | 9% | 19% | 100% |
| -1.04 | 4% | 4% | 13% | 34% | 2% | 7% | 3% | | 8% | 23% | 100% |
| -0.94 | 2% | 7% | 13% | 34% | 6% | 5% | 5% | | 8% | 19% | 100% |
| -0.85 | 6% | 10% | 17% | 28% | 7% | 6% | 2% | 1% | 8% | 15% | 100% |
| -0.76 | 8% | 10% | 20% | 29% | 7% | 4% | | 3% | 6% | 13% | 100% |
| -0.67 | 5% | 13% | 14% | 25% | 14% | 4% | 2% | 3% | 8% | 11% | 100% |
| -0.57 | 8% | 9% | 15% | 20% | 13% | 4% | | 8% | 7% | 16% | 100% |
| -0.48 | 5% | 13% | 12% | 19% | 19% | 2% | | 7% | 5% | 17% | 100% |
| -0.39 | 11% | 10% | 10% | 27% | 16% | 2% | | 11% | 3% | 11% | 100% |
| -0.29 | 6% | 12% | 14% | 20% | 15% | 1% | | 16% | 4% | 10% | 100% |
| -0.20 | 4% | 12% | 15% | 19% | 19% | | | 19% | 3% | 8% | 100% |
| -0.11 | 15% | 12% | 11% | 18% | 14% | | | 21% | 2% | 6% | 100% |
| -0.01 | 7% | 15% | 10% | 18% | 20% | | | 24% | 1% | 5% | 100% |
| 0.08 | 6% | 12% | 9% | 19% | 18% | | | 31% | 2% | 4% | 100% |
| 0.17 | 6% | 10% | 10% | 13% | 25% | | | 31% | 1% | 4% | 100% |
| 0.27 | 9% | 10% | 8% | 11% | 25% | | | 33% | | 3% | 100% |
| 0.36 | 6% | 8% | 6% | 12% | 21% | | | 42% | | 4% | 100% |
| 0.45 | 7% | 11% | 5% | 9% | 18% | | | 47% | | 2% | 100% |
| 0.55 | 19% | 4% | 3% | 5% | 36% | | | 31% | | 1% | 100% |
| 0.64 | 38% | 2% | 1% | 3% | 24% | | | 30% | | 1% | 100% |
| 0.73 | 15% | 2% | | 2% | 36% | | | 43% | | | 100% |
| 0.83 | 10% | 1% | | 1% | 36% | | | 50% | | | 100% |
| 0.92 | 20% | | | 1% | 18% | | | 59% | | | 100% |
| 1.01 | 33% | | | | 9% | | | 57% | | | 100% |
| 1.10 | 15% | | | | | | | 84% | | | 100% |

Information on how to calculate indices can be found on the river habitat survey website: http://www.riverhabitatsurvey.org/manual/rhs-indices/

Additionally, you can download an Excel spreadsheet to calculate indices by hand: www.riverhabitatsurvey/RHSfiles/RHSHydromorphologicalIndicesCalculation.xlsx