# 6 INTERPRETING OUTPUTS

Interpretation of the physical and chemical character of a test site involves examination of the outputs for each individual variable at each individual site. This enables the user to flag variables that have values that sit outside the range found at the corresponding reference sites. These variables can then be considered alongside AUSRIVAS O/E scores to indicate the specific physical and chemical factors that may be contributing to biological degradation at a test site. The AUSRIVAS physical and chemical reporting software does not produce a quantitative assessment of physical and chemical 'condition'. It is a tool for the electronic reporting and examination of test site physical and chemical character and as such, its usefulness is based upon user examination and interpretation of the outputs.

## 6.1 Deciding which reference site classification group to use

As discussed in Part 5, the outputs of the AUSRIVAS physical and chemical reporting software are a box plot for continuous variables and a frequency count for categorical variables. The variables and sites selected for inclusion in the report are plotted for each reference site classification group present in a model, as well as for all reference sites present in a model. These groups correspond to the macroinvertebrate-based classification groups used in the construction of the AUSRIVAS biological models. Test site variables are compared against each group of reference sites because a test site often does not have a 100% chance of belonging to a reference site group. Thus, users will need to select the group, or groups, that are most relevant for any one test-site. The probability of test site group membership is available on the "group probabilities" tab of the AUSRIVAS output, as follows:

| Site | Group 1 | Group 2 | Group 3 | Group 4 | Group 5 | Group 6 |
|------|---------|---------|---------|---------|---------|---------|
| 1.1b | 0.08 | 0.39 | 0.01 | 0.14 | 0.37 | 0.00 |
| 1.1bx | 0.08 | 0.39 | 0.01 | 0.14 | 0.37 | 0.00 |
| 1.1a | 0.08 | 0.39 | 0.01 | 0.14 | 0.37 | 0.00 |
| 1.1ax | 0.08 | 0.39 | 0.01 | 0.14 | 0.37 | 0.00 |
| 1.2bx | 0.09 | 0.17 | 0.01 | 0.37 | 0.36 | 0.00 |
| 1.2a | 0.09 | 0.17 | 0.01 | 0.37 | 0.36 | 0.00 |
| 1.2ax | 0.09 | 0.17 | 0.01 | 0.37 | 0.36 | 0.00 |
| 1.2b | 0.09 | 0.17 | 0.01 | 0.37 | 0.36 | 0.00 |
| 2.1b | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 1.00 |
| 2.1a | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 1.00 |
| 2.2a | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 1.00 |
| 2.2b | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 1.00 |
| 3.1b | 0.00 | 0.00 | 0.00 | 1.00 | 0.00 | 0.00 |
| 3.1a | 0.00 | 0.00 | 0.00 | 1.00 | 0.00 | 0.00 |
| 3.2b | 0.00 | 0.00 | 0.00 | 1.00 | 0.00 | 0.00 |
| 3.2a | 0.00 | 0.00 | 0.00 | 1.00 | 0.00 | 0.00 |
| 4.1a | 0.17 | 0.00 | 0.00 | 0.00 | 0.83 | 0.00 |
| 4.1b | 0.17 | 0.00 | 0.00 | 0.00 | 0.83 | 0.00 |
| 4.2b | 0.18 | 0.00 | 0.00 | 0.00 | 0.82 | 0.00 |
| 4.2a | 0.18 | 0.00 | 0.00 | 0.00 | 0.82 | 0.00 |
| 5.1b | 0.31 | 0.02 | 0.00 | 0.00 | 0.66 | 0.00 |
| 5.1a | 0.31 | 0.02 | 0.00 | 0.00 | 0.66 | 0.00 |
| 5.2a | 0.35 | 0.01 | 0.00 | 0.01 | 0.63 | 0.00 |
| 5.2b | 0.35 | 0.01 | 0.00 | 0.01 | 0.63 | 0.00 |
| 6.1b | 0.00 | 0.00 | 0.00 | 1.00 | 0.00 | 0.00 |
| 6.1a | 0.00 | 0.00 | 0.00 | 1.00 | 0.00 | 0.00 |
| 6.2b | 0.00 | 0.00 | 0.00 | 1.00 | 0.00 | 0.00 |
| 6.2a | 0.00 | 0.00 | 0.00 | 1.00 | 0.00 | 0.00 |

AUSRIVAS output

Group probabilities tab

Bug Data | Phys/Chem Data | Group Probabilities | Taxa Probabilities | P

Ready | R:1 (188), C:1 (6) | NUM

In this example, test Site 8.1b has a 100% probability of belonging to Group 4.  Thus, the user would examine outputs from the physical and chemical reporting software in relation to Group 4, or if required, in relation to all sites together.

On the other hand, test Site 11.1b has a 62% probability of belonging to Group 4, and a 36% chance of belonging to Group 3.  Thus, the user may wish to examine outputs from the physical and chemical reporting software in relation to Groups 3 and 4, or if required, in relation to all sites together.

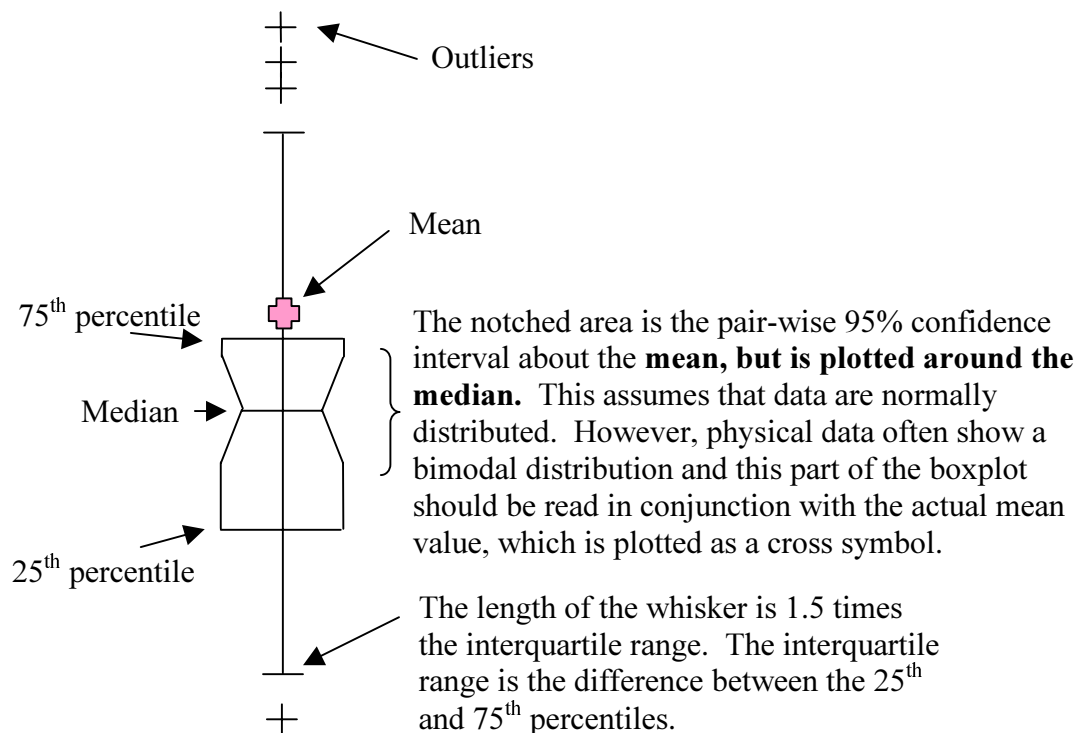## 6.2     Interpretation of outputs

Lets use the example test data set portrayed in Part 5 to analyse and interpret different types of data for Sites TRA302, TRA307 and TRA311.  The reason that we have chosen these sites is that they have returned low O/E ratios in the AUSRIVAS biological predictive model, and we want to investigate the physical and chemical factors that may be contributing to biological degradation:

| Site No. | O/E Ratio | Band |
|----------|-----------|------|
| TRA302 | 0.21 | D |
| TRA307 | 0.45 | C |
| TRA311 | 0.34 | D |

Lets also assume that we wish to consider all the reference sites together, rather than the classification group to which the test site is most strongly matched.

### 6.1.1    Continuous variables

For a continuous variable, the range of values present at the reference sites is displayed as a box plot.  One box plot is displayed for each classification group and also for all sites together.  The properties of the box plot are:



The test site is then plotted onto this box plot.  This enables the user to examine where the test site sits in relation to the reference site data.  The outputs and interpretations for the continuous variables are as follows.  Note that several sites are included on each box plot.  There is no limit to the number of sites that can be arrayed on any one box plot, but for ease of viewing, it is best to limit each run of data to around 5-10 sites.
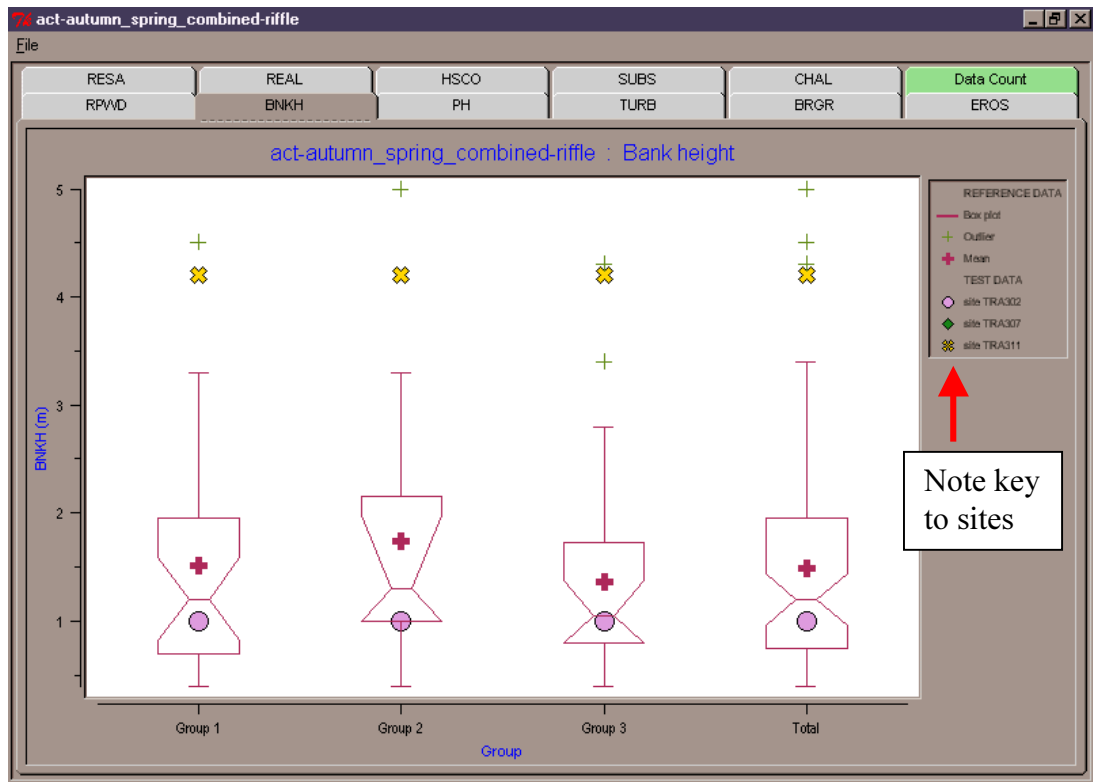
**Riparian width** - Site TRA302 has a riparian width within the range of reference sites, but Sites TRA307 and TRA311 have a riparian width that is lower than reference sites.
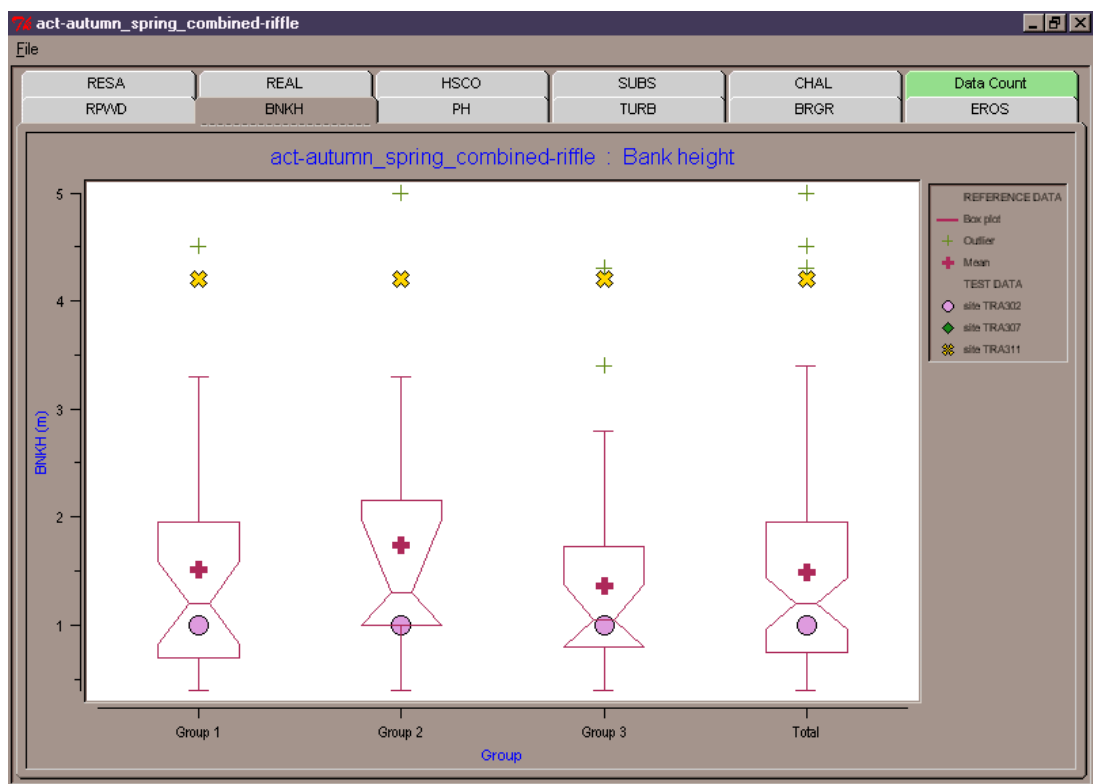


**Bank height -** Sites TRA302 and TRA307 have a bank height within the range of reference sites, but Site TRA311 has a bank height that is outside the range of reference sites.
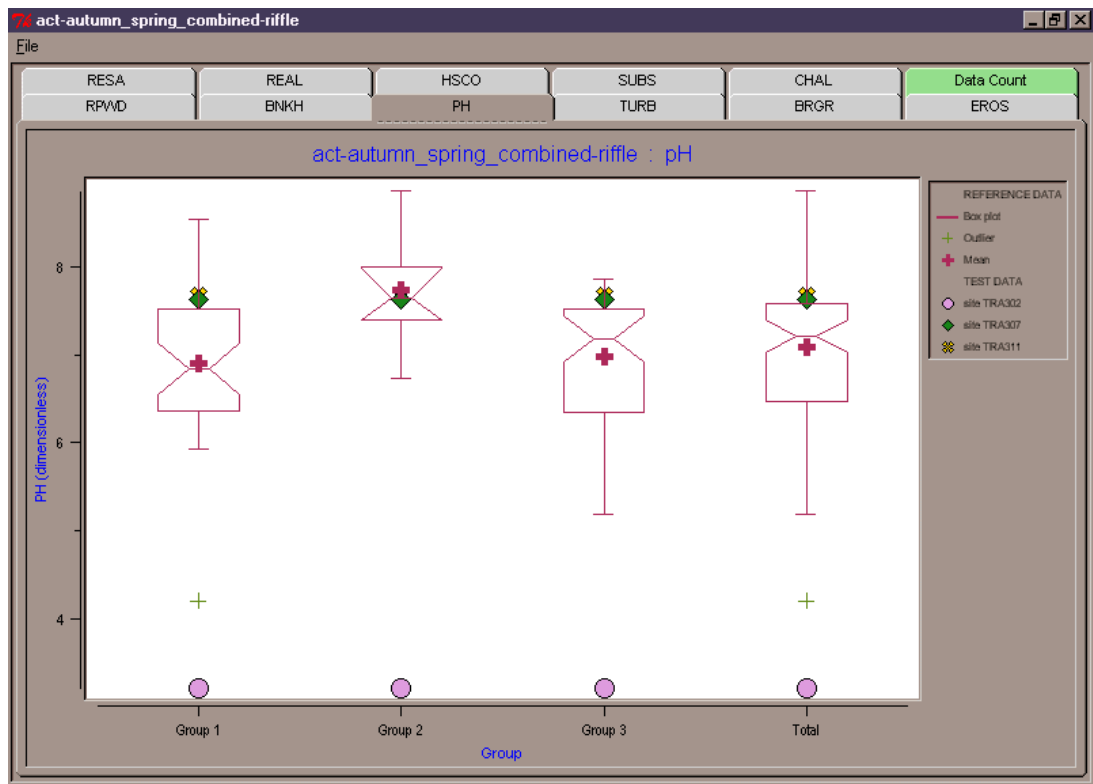
**pH** - Sites TRA307 and TRA311 have a pH that is within the range of reference site measurements, but Site TRA302 has a pH that is acidic.
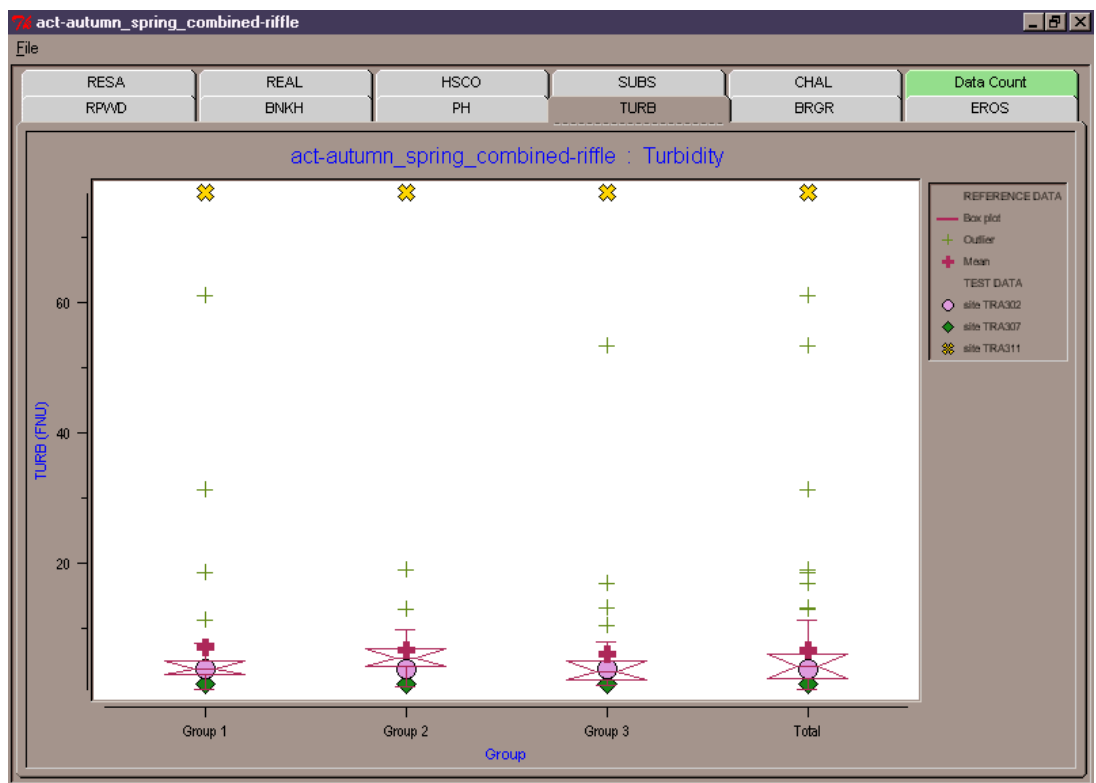


**Turbidity -** Sites TRA302 and TRA307 have turbidity levels inside the range recorded at the reference sites, but Site TRA311 has a very high turbidity reading.

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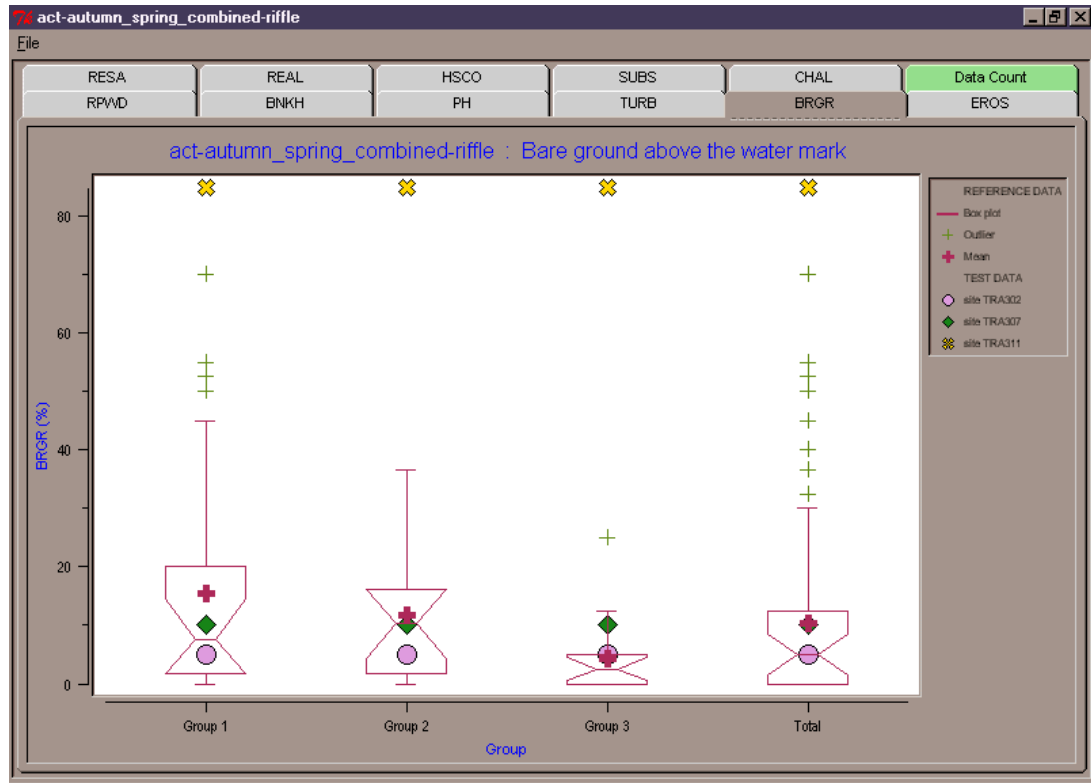
**Bare ground above the water mark -** Sites TRA302 and TRA307 are within the range recorded at the reference sites, but Site TRA311 has a much higher percent bare ground above the water mark than the reference sites.
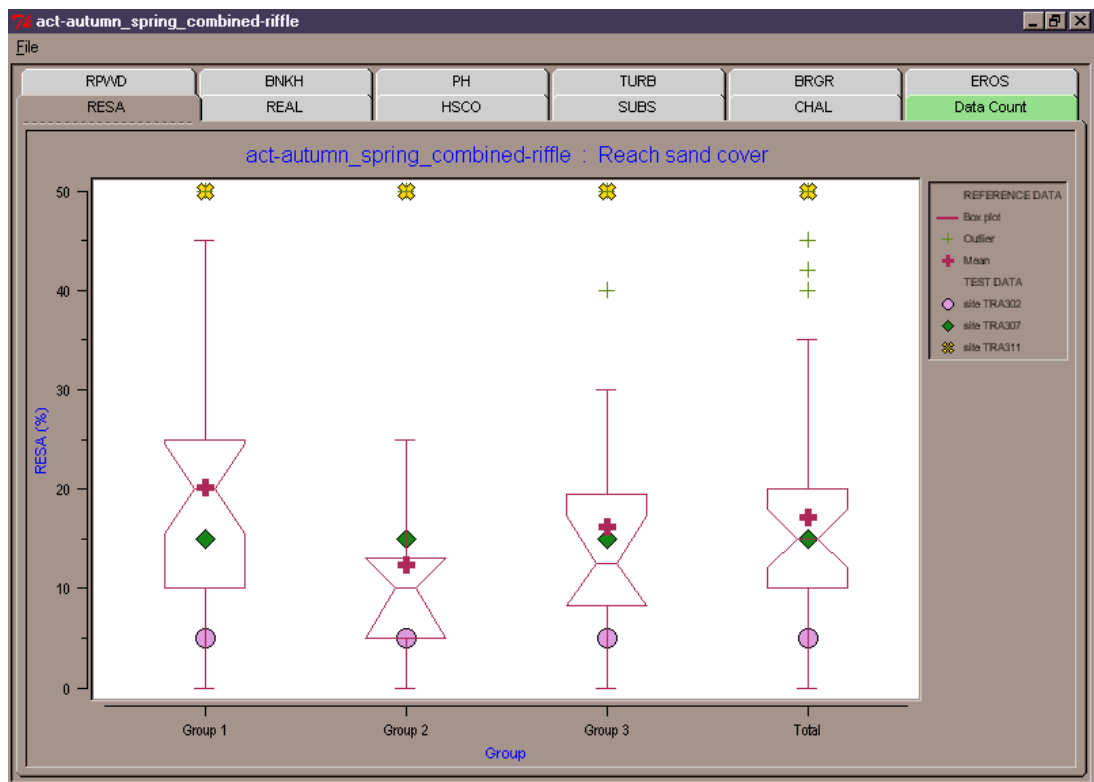


**Reach sand cover -** Sites TRA302 and TRA307 have amounts of sand substrate that are within the range found at the reference sites, but Site TRA311 has a high percentage of reach sand cover in comparison to the reference sites.
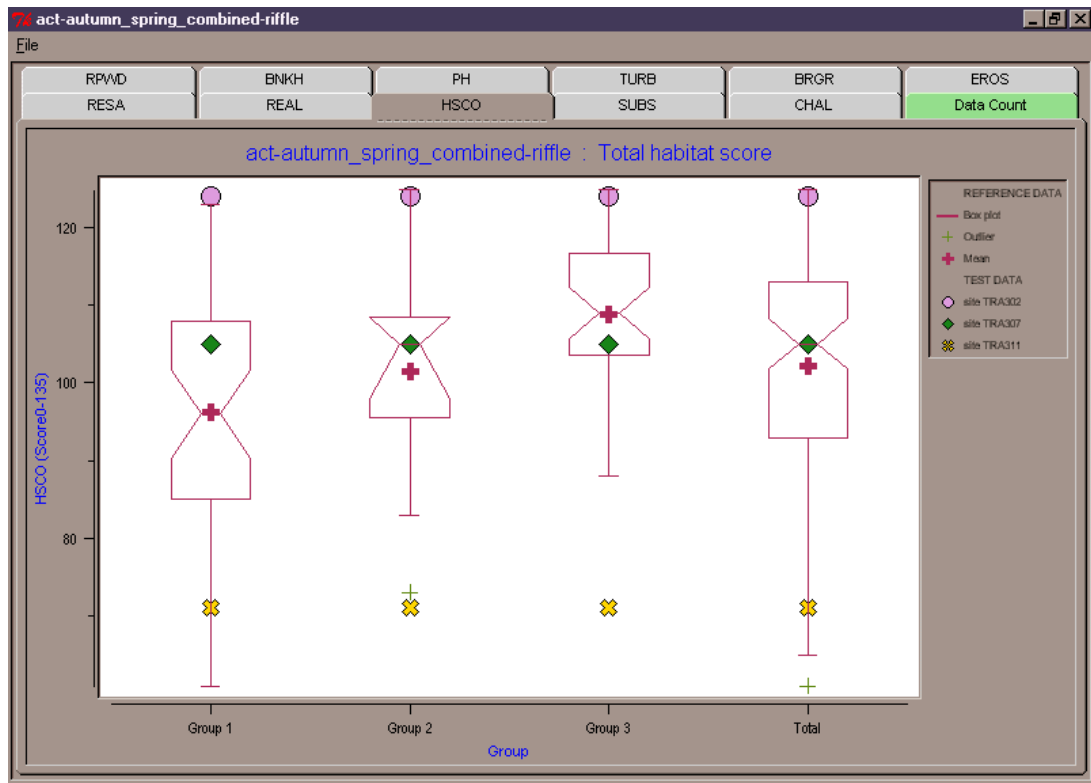
**Total habitat score -** All three test sites are within the range expected at the reference sites (we are only considering the total boxplot here - the trend is different for other groups). However, Site TRA302 is at the higher end of the interquartile range, Site TRA307 is close to the mean and Site TRA311 is at the lower end of the interquartile range.
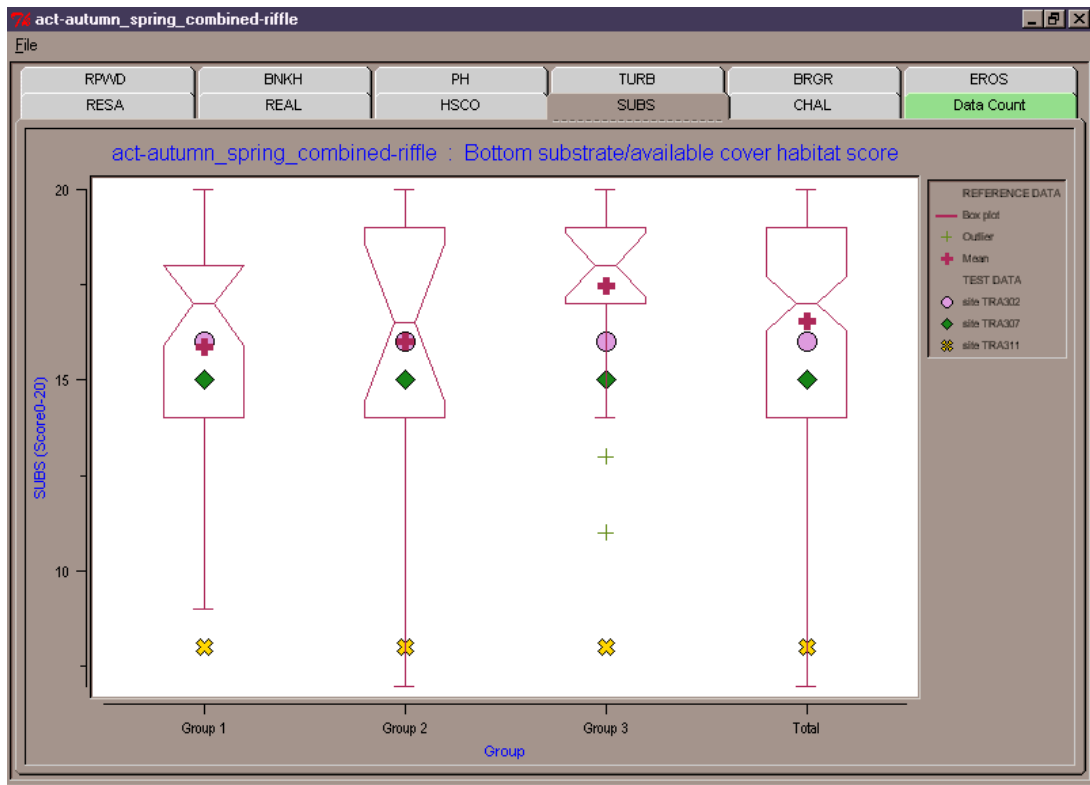
**Bottom substrate/available cover habitat score -** All three test sites sit within the range recorded at the reference sites (total boxplot). However, Site TRA311 has a score that is at the lower end of the interquartile range.
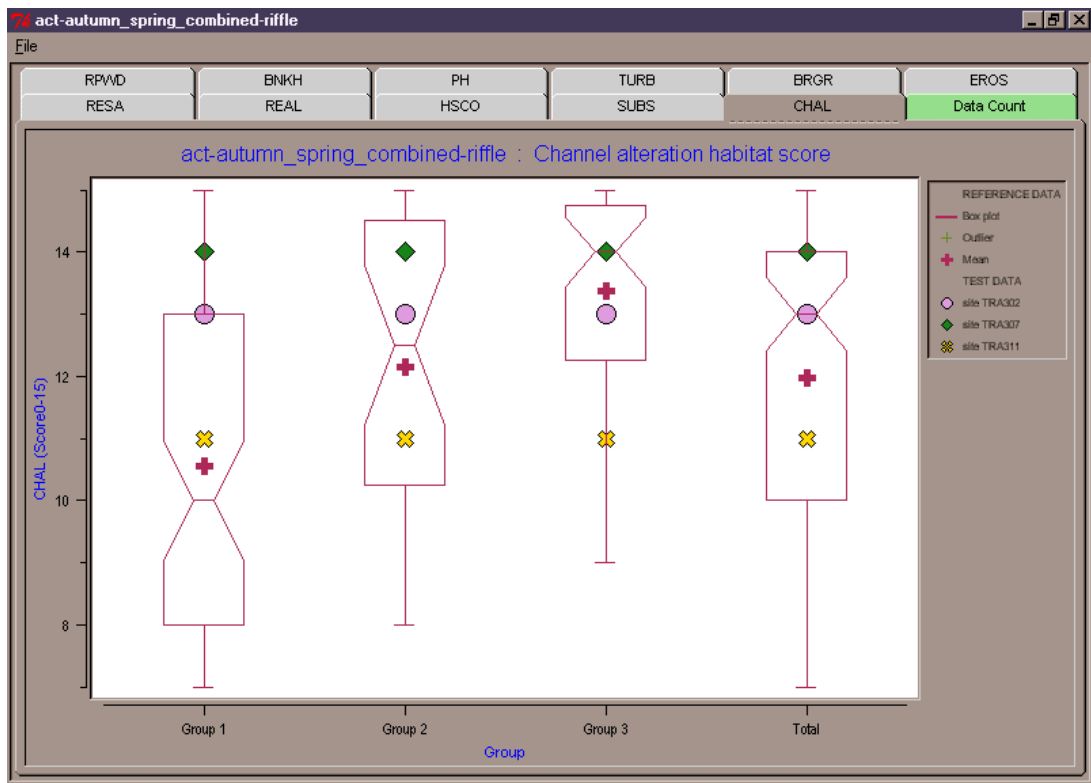


**Channel alteration habitat score -** All three test sites sit within the range recorded at the reference sites (total boxplot).

### 6.1.2 Categorical variables

For categorical variables, the range of values present at the reference sites is displayed as a frequency count. The number of reference sites belonging to each category is tabulated by classification group, and for all sites together. The category to which the test site belongs is also displayed in the frequency table. Some example outputs for categorical variables are as follows:
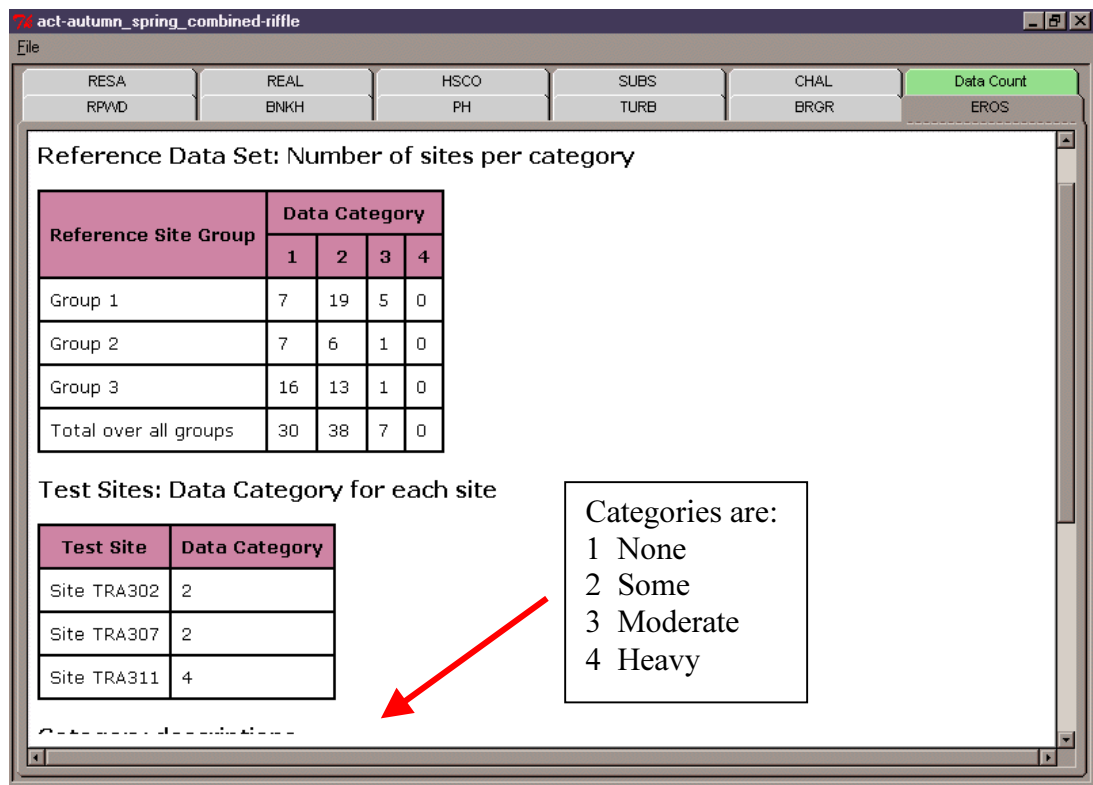


**Local catchment erosion -** Sites TRA302 and TRA307 fall in the "some erosion" category and are within the categories recorded at the reference sites (predominantly "none" or "some"). Site TRA311 falls in the "heavy erosion" category and is outside the categories recorded at the reference sites (i.e. no reference sites were recorded in the "heavy erosion" category).
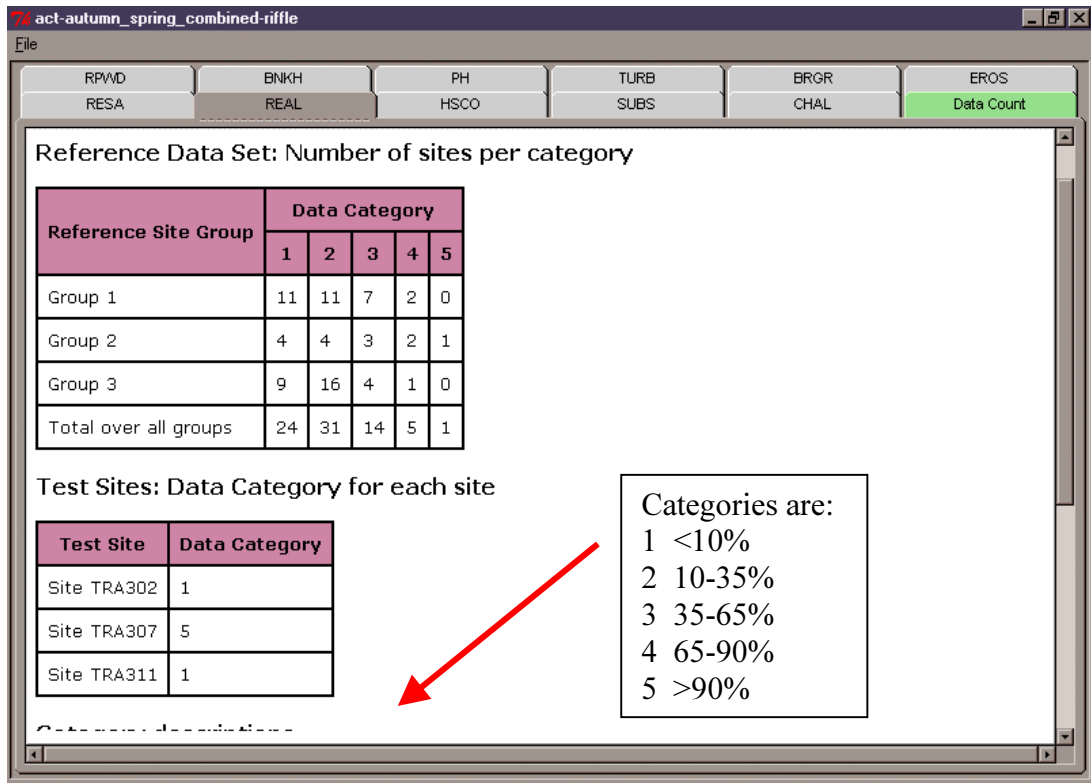
**Reach filamentous algae cover -** Sites TRA302 and TRA311 have <10% filamentous algae cover and match the categories found at the reference sites (predominantly "<10% cover" or "10-35% cover").  Site TRA307 has a ">90%" filamentous algae cover.  One of the reference sites also has a ">90%" filamentous algae cover, but this is a rare event and the test site can be considered to sit outside the most common categories recorded at the reference sites.

### 6.1.3    Bringing it all together

Based on the variables selected for analysis, the user then draws together the outputs to form an assessment of the physical and chemical character of each test site, and of the factors that **may** be associated with low O/E ratios from the AUSRIVAS biological models.  It is important to note that these associations are not causal.  Rather, they give an indication of the factors that sit outside the range found at the reference sites and hence, which are likely candidates for further investigation.  For the example outlined above, the character of test sites TRA302, TRA311 and TRA307 is as follows:

### Test site TRA302

Habitat assessment, riparian vegetation and other physical characteristics are within the range found at the reference sites, but Site TRA302 has an extremely low pH.  Further investigation revealed that Site TRA302 is located downstream of an unused mine site.  Thus, biological degradation at this site is probably related to acidic water conditions associated with the unused mine.

### Test site TRA307

Bank height, water chemistry, substrate, habitat assessment and other physical characteristics are within the range found at the reference sites.  However, Site TRA307 has reduced riparian vegetation cover and a high percent cover of filamentous algae.  Further investigation revealed that Site TRA307 was located in an urban stream that had recently been subjected to riparian vegetation removal.  Increased filamentous algal growth might be related to a change in light conditions, or to nutrient input from the catchment.  Biological degradation may be related to these factors, but because the stream is located in an urban area there are also likely to be other factors involved.

### Test site TRA311

pH, channel alteration habitat score and reach filamentous algae cover are within the range of values recorded at the reference sites.  However, Site TRA311 has low riparian cover, high banks, lots of bare ground on the banks, high turbidity, sand dominated substrate, heavy catchment erosion, a low bottom substrate/available cover habitat assessment score and a low habitat assessment total score.  This indicates that Site TRA311 is subject to catchment degradation and erosion and localised bank degradation, sediment deposition and channel incision.  Habitat scores indicate that the habitat available to macroinvertebrates has also been reduced at this site, most probably via sand deposition and removal of riparian vegetation.  Further investigation of this site reveals that it is located at the lower end of a catchment that is heavily degraded and which is subject locally to both agricultural and forestry activity.  Thus, biological degradation is probably related to the poor condition of instream habitat at this site.

# 6.3    Additional points

- Usefulness of the physical and chemical reporting software is directly dependent upon the types of variables included in the reference data set, and selected by the user for analysis. In particular, many of the variables useful in constructing the AUSRIVAS biological models are not those that provide detailed information about the characteristics that may be contributing to biological degradation at a test site. For example, latitude, longitude and distance from source locate the test site in a landscape context, but reveal little about specific factors that may be deleteriously influencing the macroinvertebrate community at a test site. Rather, variables describing aspects of physical and chemical character such as substrate composition, algae and detritus, channel morphology, riparian vegetation, water chemistry, catchment degradation and habitat assessment can provide an indication of the factors most likely to be associated with observed biological degradation. Thus, users should examine the variables available in the reference data set and select those that are the most suitable candidates for describing aspects of physical and chemical character that may subsequently be related to biological degradation.

- There may be additional 'site observation'-type data that were collected at reference sites, but which were not entered electronically into the reference site data sets. For example, variables such as landuse, sediment deposits, catchment erosion and dams/barriers are often recorded in the field but not used for analysis. This data can potentially provide valuable information about the physical and chemical factors that may be related to biological degradation at a test site. The physical and chemical reporting software is able to cope with categorical and text based variables, so users may wish to add this information to reference site data sets. The procedure for updating reference site data is outlined in Part 7.