

### 3. Results

#### 3.1 State of the Environment (SoE) sites

##### 3.1.1 Biotic indices

Raw macroinvertebrate SoE data is presented in Appendix E (Table 6). Taxonomic richness at the 38 SoE sites ranged from 11 at the Mangakahia River @ Titoki Bridge site to 39 at Pukenui Stream u/s Ridge Track crossing site (Fig. 6). The mean number of taxa was  $22.8 \pm 1.2$  (SE,  $n=38$ ).

Two SoE sites recorded no insect taxa from the orders Ephemeroptera, Plecoptera and Trichoptera (EPT\*) this year. In addition, ten other sites recorded less than four EPT\* taxa. Of the 38 SoE sites, the range of %EPT\* taxa was 0.0–62.5% (Fig. 7). Sixteen sites (42.1%) scored at least 40% EPT\*, however 16 sites (42.1%) also scored  $\leq 30\%$  EPT\* taxa. Mean %EPT\* for all SoE sites was  $32.1\% \pm 2.8$  (SE,  $n=38$ ).

Macroinvertebrate Community Index (MCI) scores for the SoE sites ranged from 55.4 (Manganui River @ Mitaitai Rd) to 133.6 (Pukenui Stream u/s Ridge Track crossing) (Fig. 8), with a mean of  $91.1 \pm 3.1$  (SE,  $n=38$ ). Eleven (28.9%) sites recorded MCI scores less than 80.0, which can be interpreted as water of probable severe organic pollution (Boothroyd & Stark 2000). Two sites (5.3%) scored above 120 (Waipoua River @ SH12 Rest Area and Pukenui Stream u/s Ridge Track crossing), which is accepted as the 'clean water' lower limit. Waipapa River @ Forest Ranger likely also falls into this category if the  $\pm 5$  unit buffer is considered.

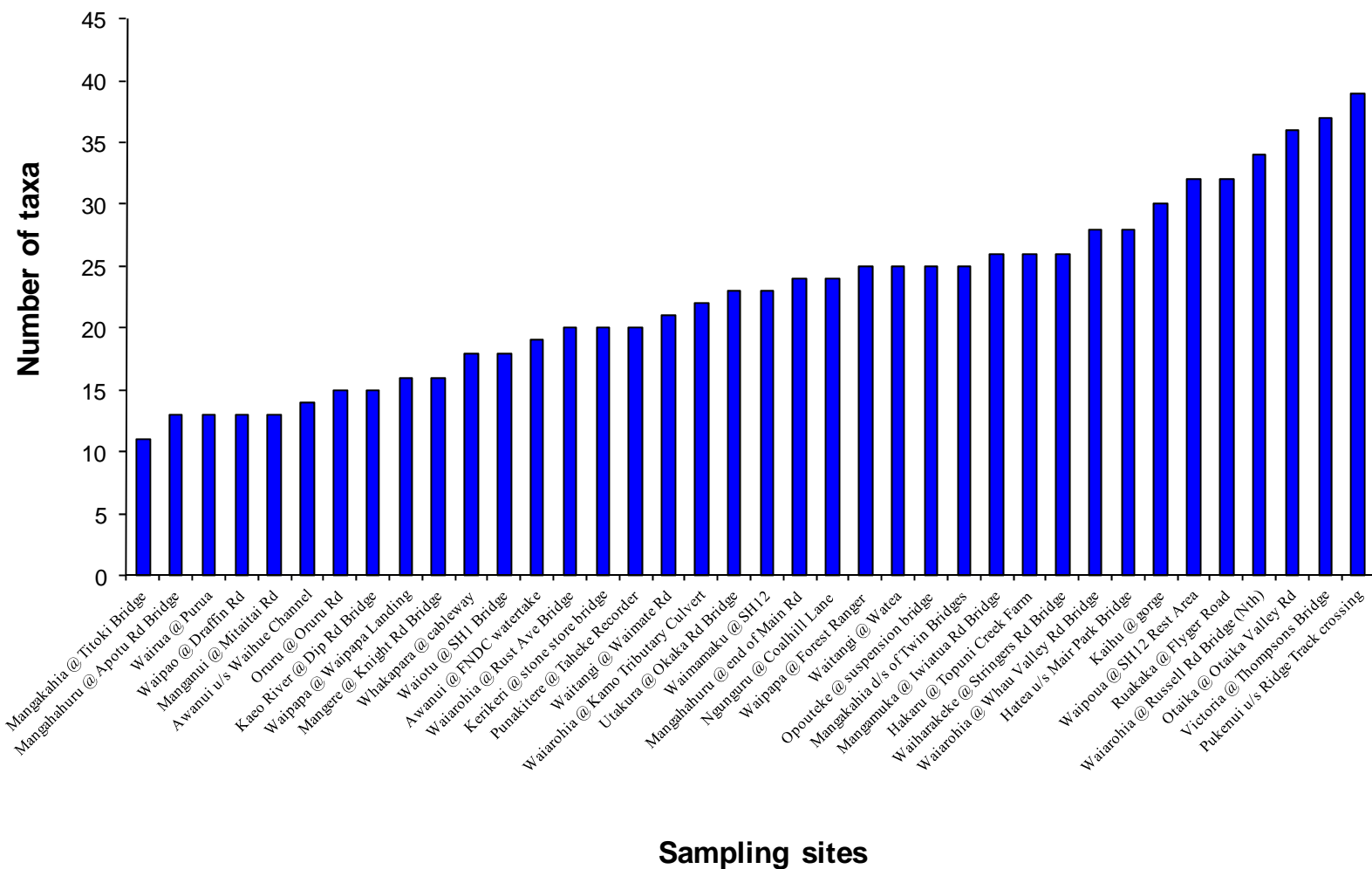
Semi-Quantitative Macroinvertebrate Community Index (SQMCI) results ranged from 1.84 (Waiahoia Stream @ Kamo Tributary Culvert) to 7.89 (Waipoua River @ SH12 Rest Area) (Fig. 9). Twenty sites (52.6%) recorded SQMCI scores of less than 4.00, which is interpreted as water of probable 'severe pollution' (worst five listed below). However, a further 11 sites (28.9%) were recorded in the 'moderate pollution' interpretation (**a total of 81.6% of sites in poorly polluted categories**), which is indicated by a low-scoring mean of  $3.90 \pm 0.24$  (SE,  $n=38$ ). Only three sites (7.9%) scored above 6.00 (listed below), which is interpreted as the SQMCI 'clean water' lower limit. Two others likely fall into this category if the  $\pm 1$  unit buffer is considered.

Worst five streams/ivers recorded in the SQMCI 'severe pollution' category this year:

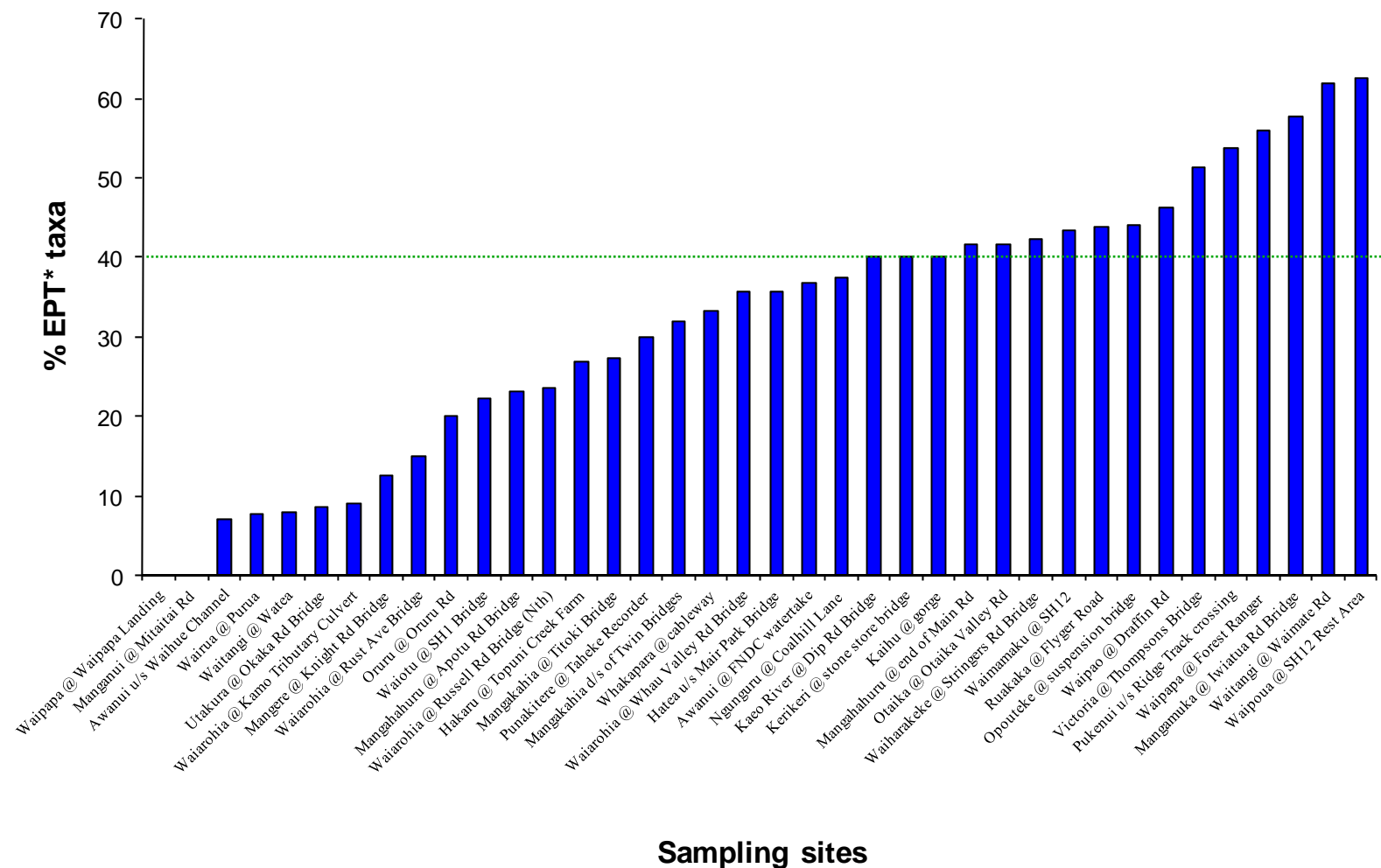
Stream/River	SQMCI value
Waiahoia Stream @ Kamo Tributary Culvert	1.84
Waitangi River @ Watea	2.13
Utakura River @ Okaka Rd Bridge	2.21
Waiotu River @ SH1 Bridge	2.24
Oruru River @ Oruru Rd	2.25

Top five streams/ivers recorded in the SQMCI 'clean water' category this year:

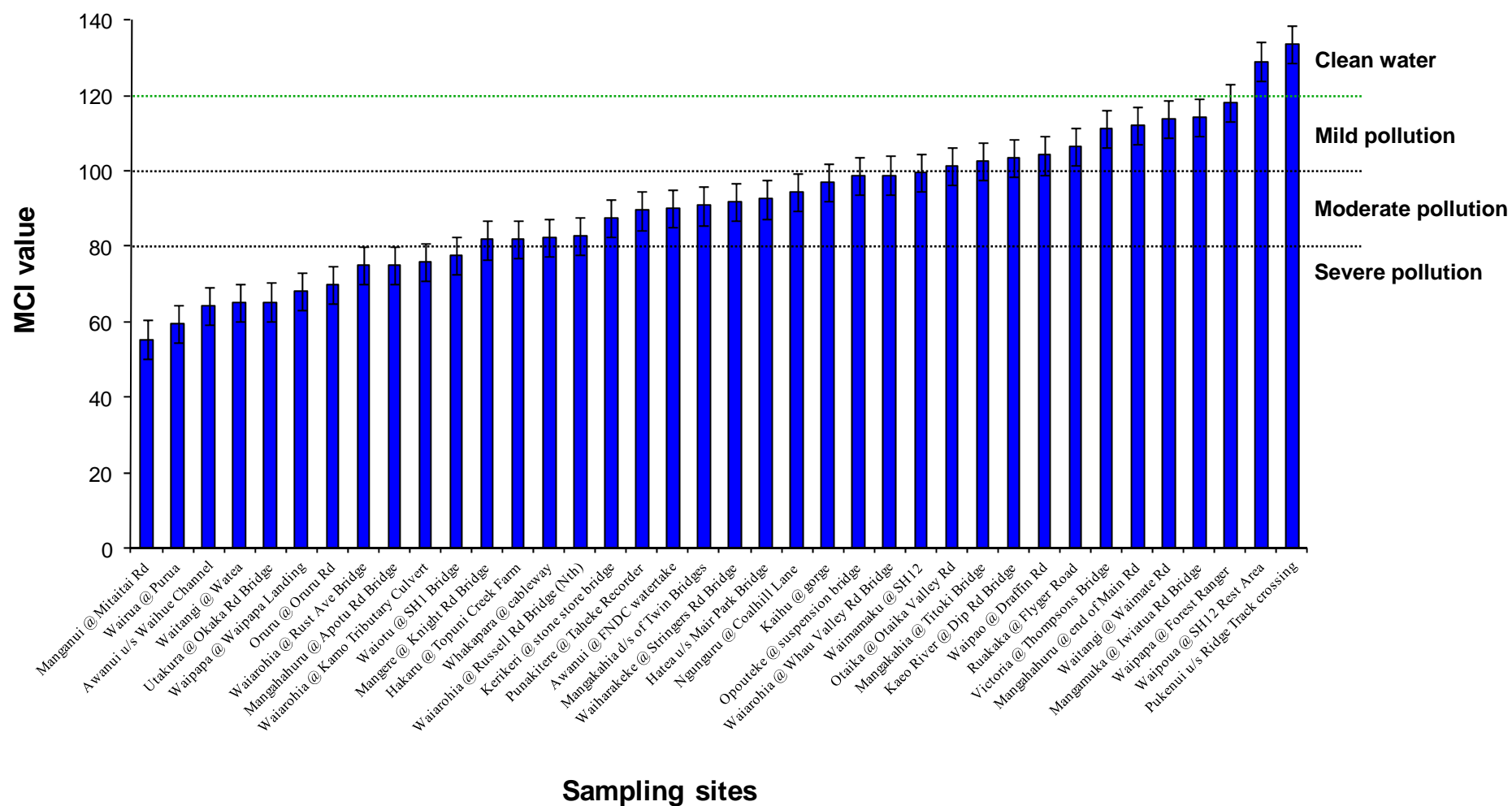
Stream/River	SQMCI value
Waipoua River @ SH12 Rest Area	7.89
Pukenui Stream u/s Ridge Track crossing	7.22
Mangahuru Stream @ end of Main Rd	6.99
Otaika Stream @ Otaika Valley Rd	5.63
Victoria River @ Thompsons Bridge	5.53



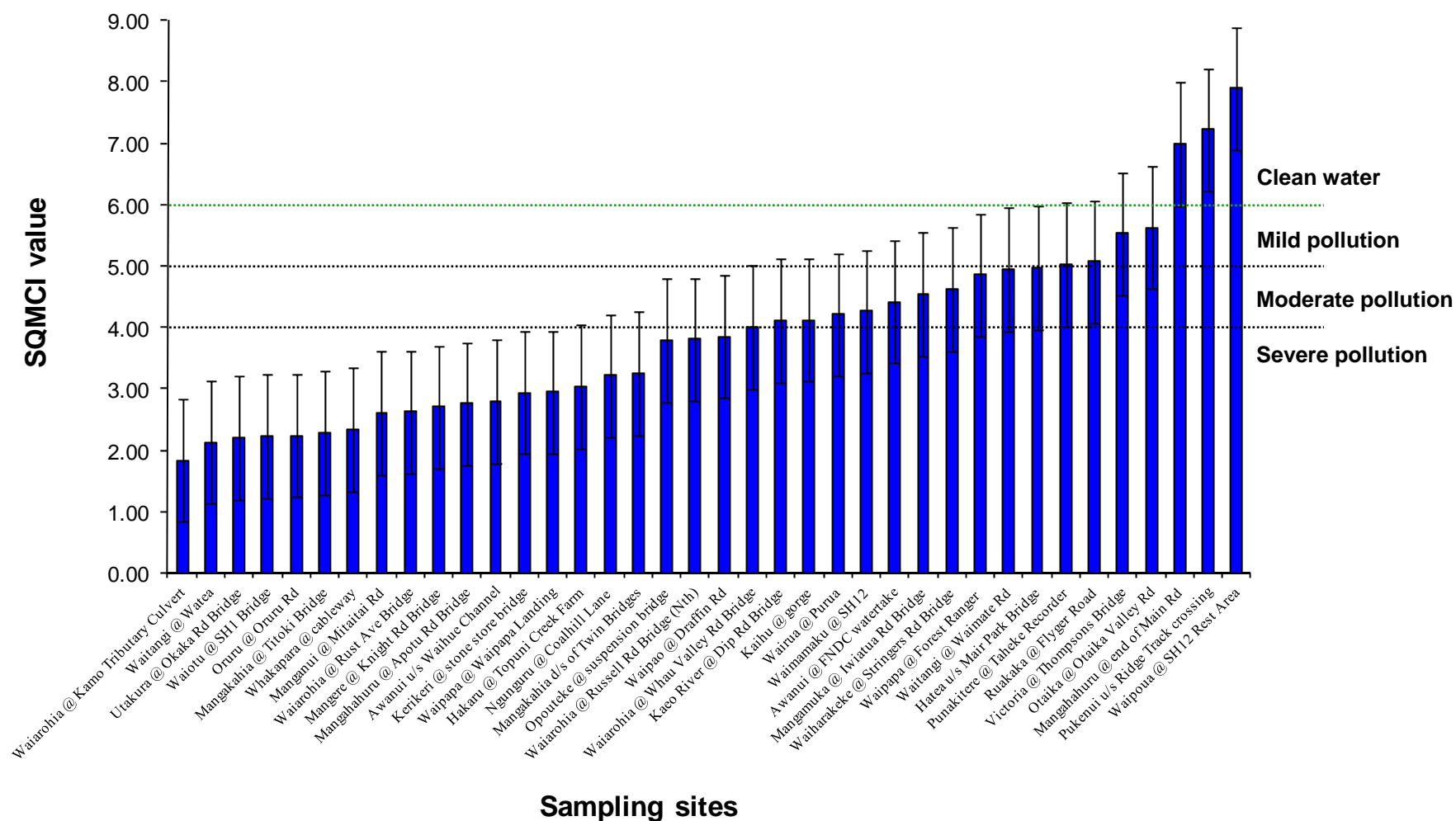
**Figure 6.** Number of macroinvertebrate taxa recorded from the 38 State of Environment sites for 2012.



**Figure 7.** Percentage of Ephemeroptera, Plecoptera, and Trichoptera (excluding Hydroptilidae) taxa from the 38 State of Environment sites for 2012. Green dashed line indicates approximate lower limit of 'healthy' stream communities.



**Figure 8.** MCI scores for the 38 State of Environment sites for 2012. Error bars represent  $\pm 5$  MCI units. Green dashed line indicates lower limit of 'healthy' stream communities.



**Figure 9.** SQMCI scores of the 38 State of Environment sites for 2012. Error bars represent  $\pm 1$  SQMCI unit. Green dashed line indicates lower limit of 'healthy' stream communities.

### 3.2 Resource Consent (RC) activities

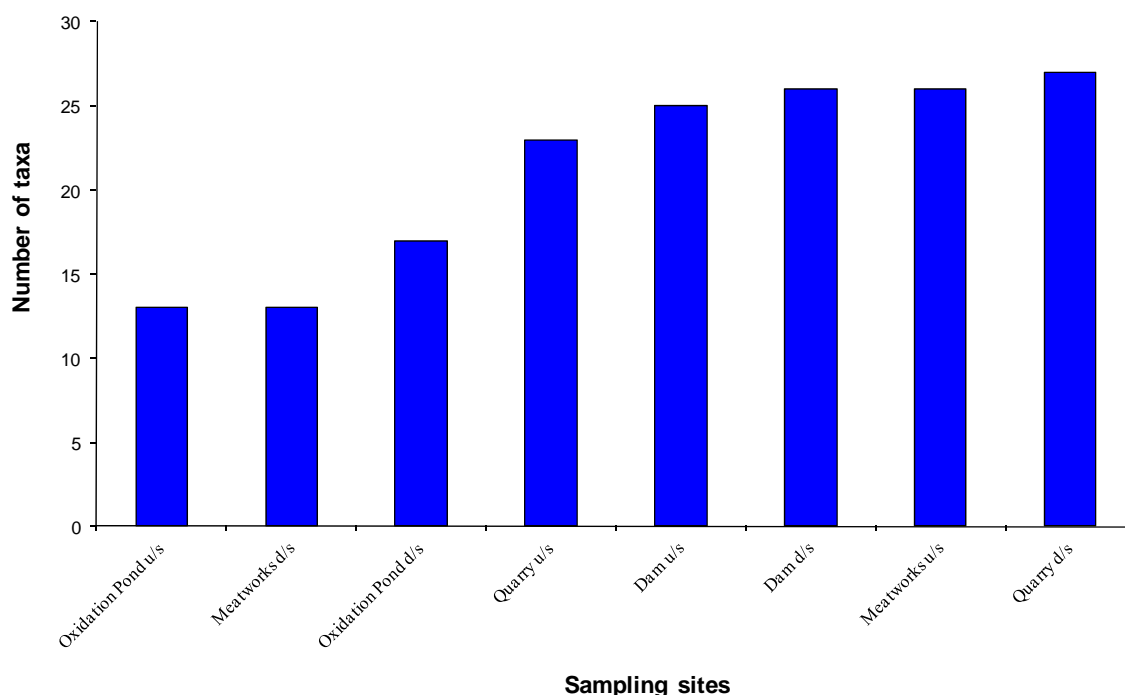
#### 3.2.1 Biotic indices

Raw macroinvertebrate RC data is tabled in Appendix F (Table 7). Taxonomic richness recorded at the four Resource Consent activities (upstream and downstream) ranged from 13 upstream of Oxidation Pond, to 27 downstream of the Quarry (Fig. 10). The mean number of taxa was  $21.3 \pm 2.1$  (SE,  $n=8$ ).

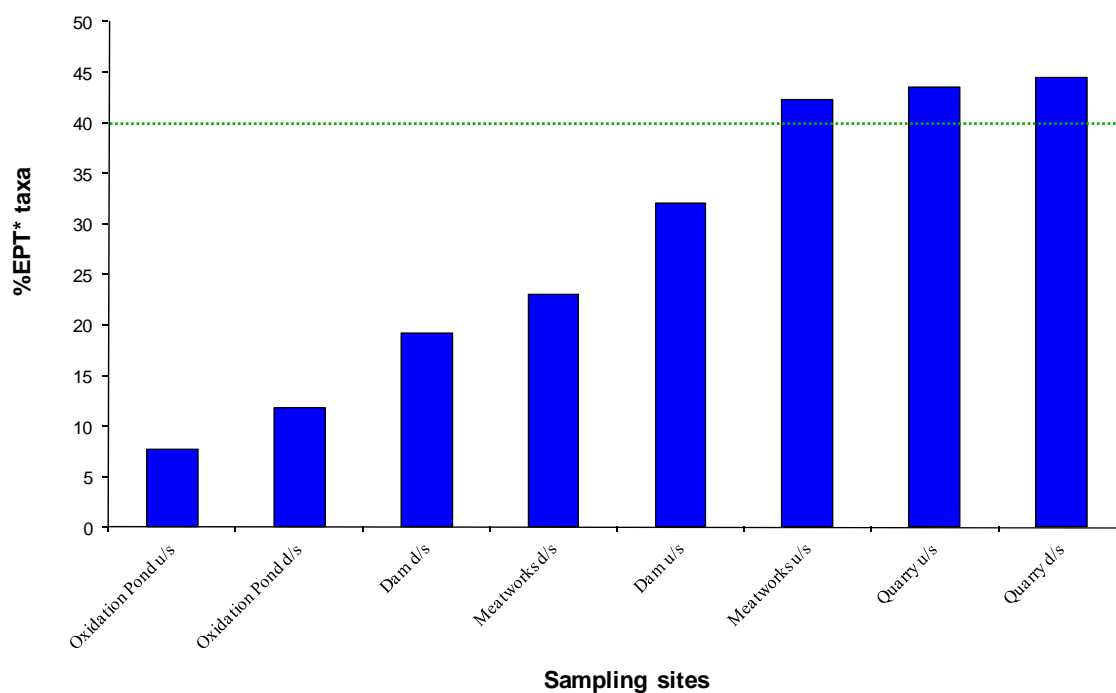
The range of %EPT\* taxa was 7.7–44.4% with a mean of  $28.0\% \pm 5.2\%$  (SE,  $n=8$ ) (Fig. 11). Three sites (37.5%) scored >40%, these being Meatworks u/s, Quarry u/s and Quarry d/s (42.3, 43.5, and 44.4%, respectively).

MCI values ranged from 67.8 (Oxidation Pond d/s) to 111.7 (Quarry u/s) (Fig. 12) with a mean of  $89.6 \pm 5.9$  (SE,  $n=8$ ). Upstream and downstream of the Oxidation Pond, and downstream of the Meatworks, recorded MCI scores less than 80, which can be interpreted as water of 'probable severe pollution' (Boothroyd & Stark 2000). Three RC sites recorded MCI values in the 'mild pollution' category but no RC sites scored in the 'clean water' category this year.

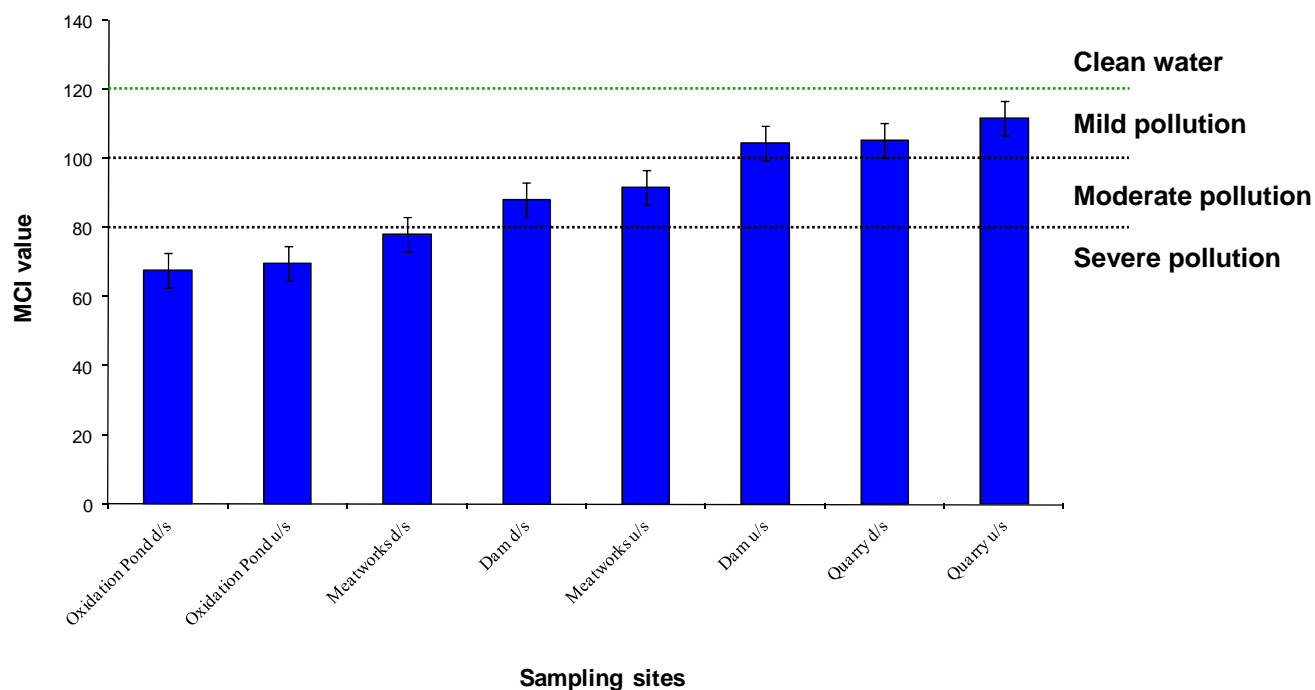
SQMCI scores ranged from 2.22–5.51 (Fig. 13); the mean being  $3.77 \pm 0.46$  (SE,  $n=8$ ). Upstream and downstream of the Oxidation Pond, Meatworks downstream and Dam downstream results all suggested water with 'probable severe pollution'. Upstream of the Meatworks, Quarry and Dam, as well as downstream of the Quarry, all recorded reasonable water quality, but some level of impairment is likely.



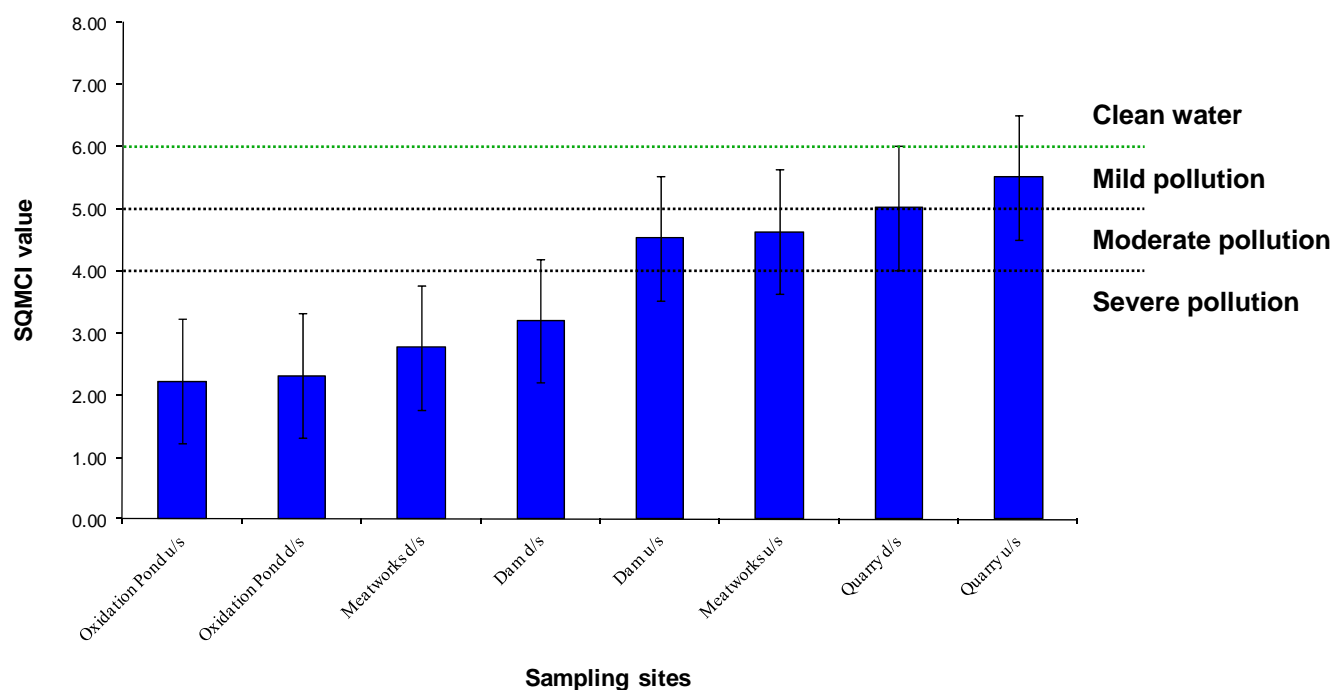
**Figure 10.** Macroinvertebrate taxonomic richness at the four Resource Consent activities for February 2012, u/s = upstream, d/s = downstream.



**Figure 11.** Percentage of Ephemeroptera, Plecoptera, and Trichoptera orders within each sample for the four Resource Consent activities for February 2012, u/s = upstream, d/s = downstream. Green dashed line indicates approximate lower limit of 'healthy' stream communities.

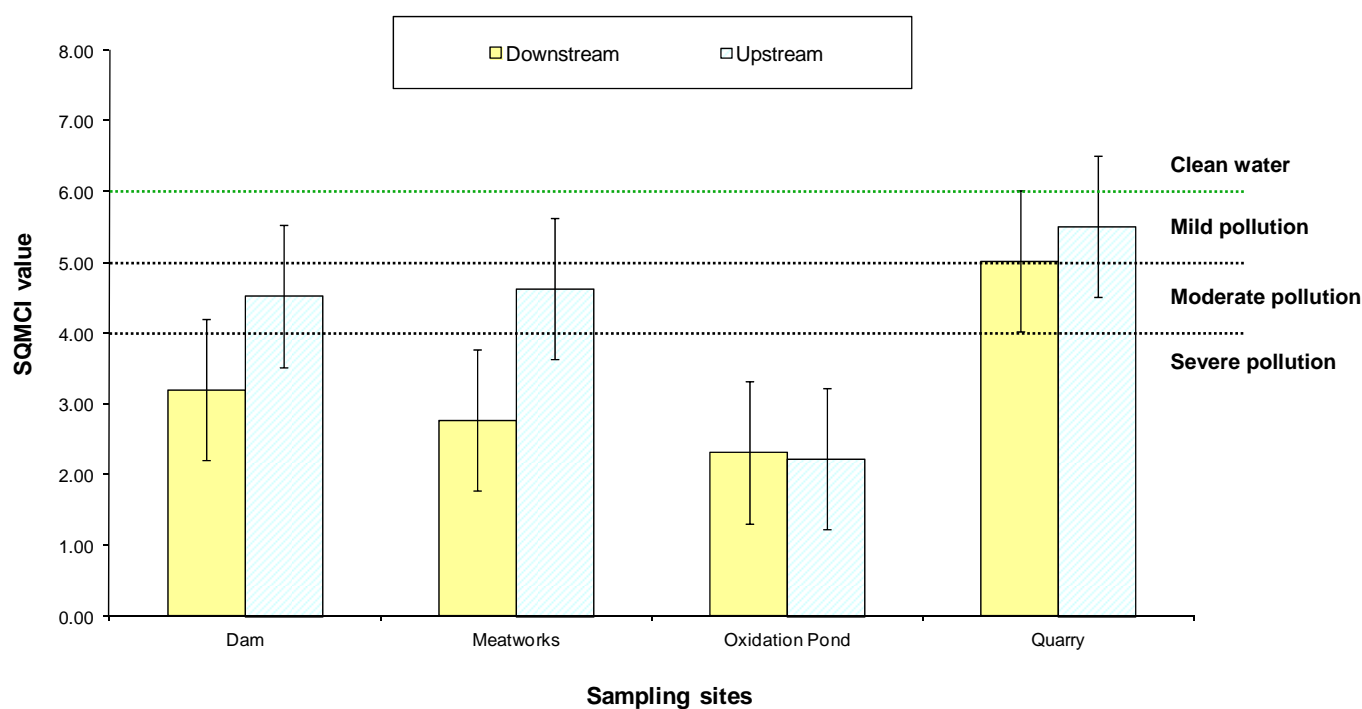


**Figure 12.** MCI scores for the four Resource Consent activities for February 2012. Error bars represent  $\pm 5$  MCI units, which potentially separate water quality classes, u/s = upstream, d/s = downstream. Green dashed line indicates lower limit of 'healthy' stream communities.



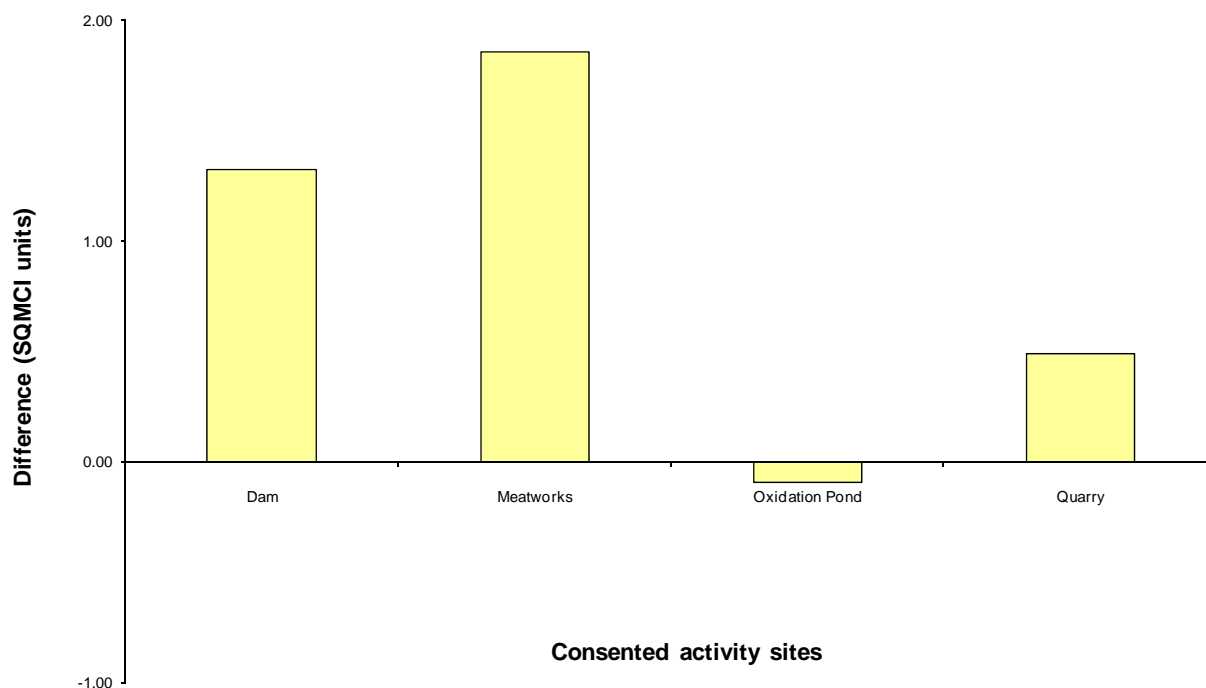
**Figure 13.** SQMCI scores for the four Resource Consent activities for February 2012. Error bars represent  $\pm 1$  SQMCI unit, which potentially separate water quality classes, u/s = upstream, d/s = downstream. Green dashed line indicates lower limit of 'healthy' stream communities.

The change in community composition, reflected through SQMCI index scores, from upstream to downstream of the activity, is important in determining whether the consented discharge is having adverse effects on the waterway. The Meatworks activity, and to a lesser extent the Dam operation, showed a considerable difference between the downstream and upstream SQMCI values (Figs 14, 15).



**Figure 14.** SQMCI values comparing the upstream and downstream sites for February 2012. Error bars represent  $\pm 1$  SQMCI unit. Green dashed line indicates lower limit of 'healthy' stream communities.





**Figure 15.** Resource Consent sites showing the difference between upstream and downstream SQMCI values for February 2012.

### 3.3 Trend analysis

Analysis of 32 (of 38) SoE sites and eight (of eight) Resource Consent activity sites was carried out, looking at the MCI and SQMCI results over time (Figs 16, 17). Six (of 38) other SoE sites have been established over the last five years, but were considered inadequate to produce reliable trends, thus were excluded from analysis. Collier & Kelly (2006) considered that a minimum time series of eight occasions were sufficient to detect meaningful ecological (but not statistical) trends in invertebrate data, thus caution should be taken for several of the reported analyses e.g., Kaeo @ Dip Road, Ruakaka @ Flyger Road, Utakura @ Okaka Rd Bridge (and others on that page).

A 'shotgun' inspection of collective MCI and SQMCI index trends overtime, for SoE sites, indicated that 19 of the 32 sites (59.4%) showed little ecological change. A further nine sites (28.1%) indicated a reduction in their biotic index over time and four sites (12.5%) indicated an increase in their biotic index over time.

When looking at the trend results of MCI and SQMCI collectively (and again very much a 'shotgun' inspection), and loosely fitting them into the water quality classes presented in Boothroyd & Stark (2000), 65.6% of sites can be interpreted as 'probable moderate' or 'probable severe pollution', 28.1% as 'mild pollution' and 6.3% as 'clean water'.