3. Results

3.1 State of the Environment (SoE) sites

3.1.1 Biotic indices

Raw macroinvertebrate data is tabled in Appendix D. Taxonomic richness at the 37 SoE sites ranged from three at the Wairua River @ Purua site, to 26 at the Waipapa @ Forest Ranger and Waipoua @ SH12 Rest Area sites (Fig. 6). The mean number of taxa was 15.5 ± 2.0 (95% CI, n=37).

The Ngunguru @ Waipoka Rd, Waitangi River @ Watea, Wairua River @ Purua, and Paparoa Stream @ walking bridge SoE sites recorded no insect taxa from the orders Ephemeroptera, Plecoptera and Trichoptera (excludes Hydroptilidae) (EPT*). In addition, Waiarohia @ Kamo Tributary Culvert only recorded one EPT* taxon, which was a single individual of small size. Of the 37 SoE sites which recorded EPT* taxa, the range was 11.1–53.8% (Fig. 7). Fourteen sites (38%) scored at least 40% EPT*, however 18 sites in total (49%) scored below 30% EPT* taxa. The mean %EPT* for all 37 SoE sites was 29.3% ± 5.2 (95% CI, n=37).

Macroinvertebrate Community Index (MCI) scores for the 37 SoE sites ranged from 49.4 (Waitangi @ Watea) to 118.8 (Waipoua River @ State Highway 12 rest area) (Fig. 8), with a mean of 89.8 ± 5.3 (95% CI, n=37). Nine (24%) of the sites recorded MCI scores of 80 or less, which can be interpreted as water of probable severe ‘organic’ pollution (Boothroyd & Stark 2000). No sites scored above 120, which is accepted as the ‘clean water’ lower limit, however Waipoua River @ SH12 Rest Area could potentially fall into this category if the ± 5 unit buffer is considered.

Semi-Quantitative Macroinvertebrate Community Index (SQMCI) results ranged from 1.53 (Waitangi @ Watea) to 6.98 (Mangamuka @ Iwiatua Rd Bridge) (Fig. 9). Twenty-two (59%) of the sites recorded SQMCI scores of less than 4.00, which is interpreted as water of probable ‘severe pollution’. However, a further eight sites (22%) were recorded in the ‘moderate pollution’ interpretation, which is indicated by a low-scoring mean of just 3.71 ± 0.43 (95% CI, n=37). Only two (5%) sites, Waipoua @ SH12 Rest Area and Mangamuka @ Iwiatua Rd Bridge, scored above 6.00, which is accepted as the ‘clean water’ lower limit.

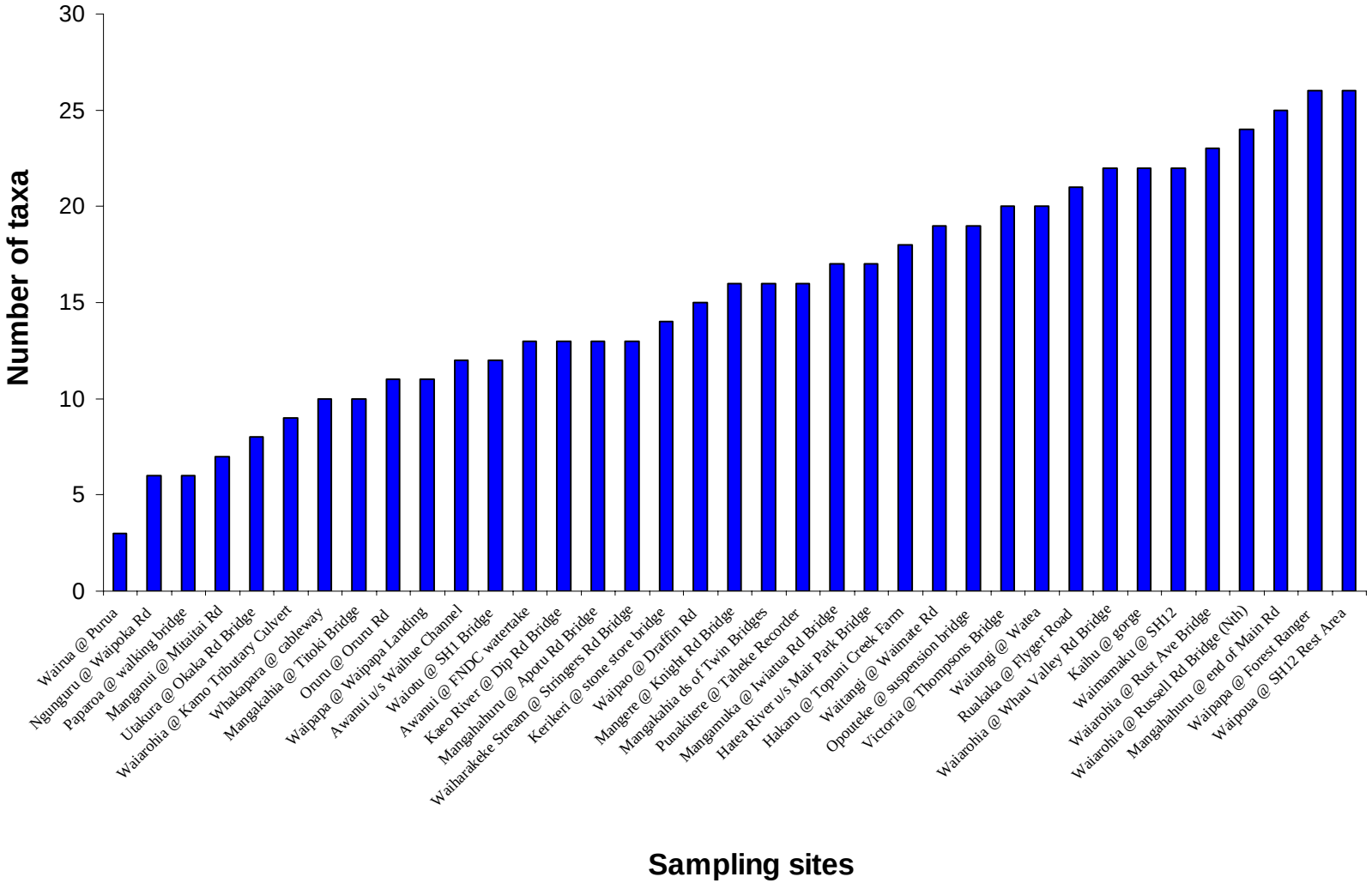

Figure 6. Number of macroinvertebrate taxa recorded from the 37 State of Environment sites for April 2009.

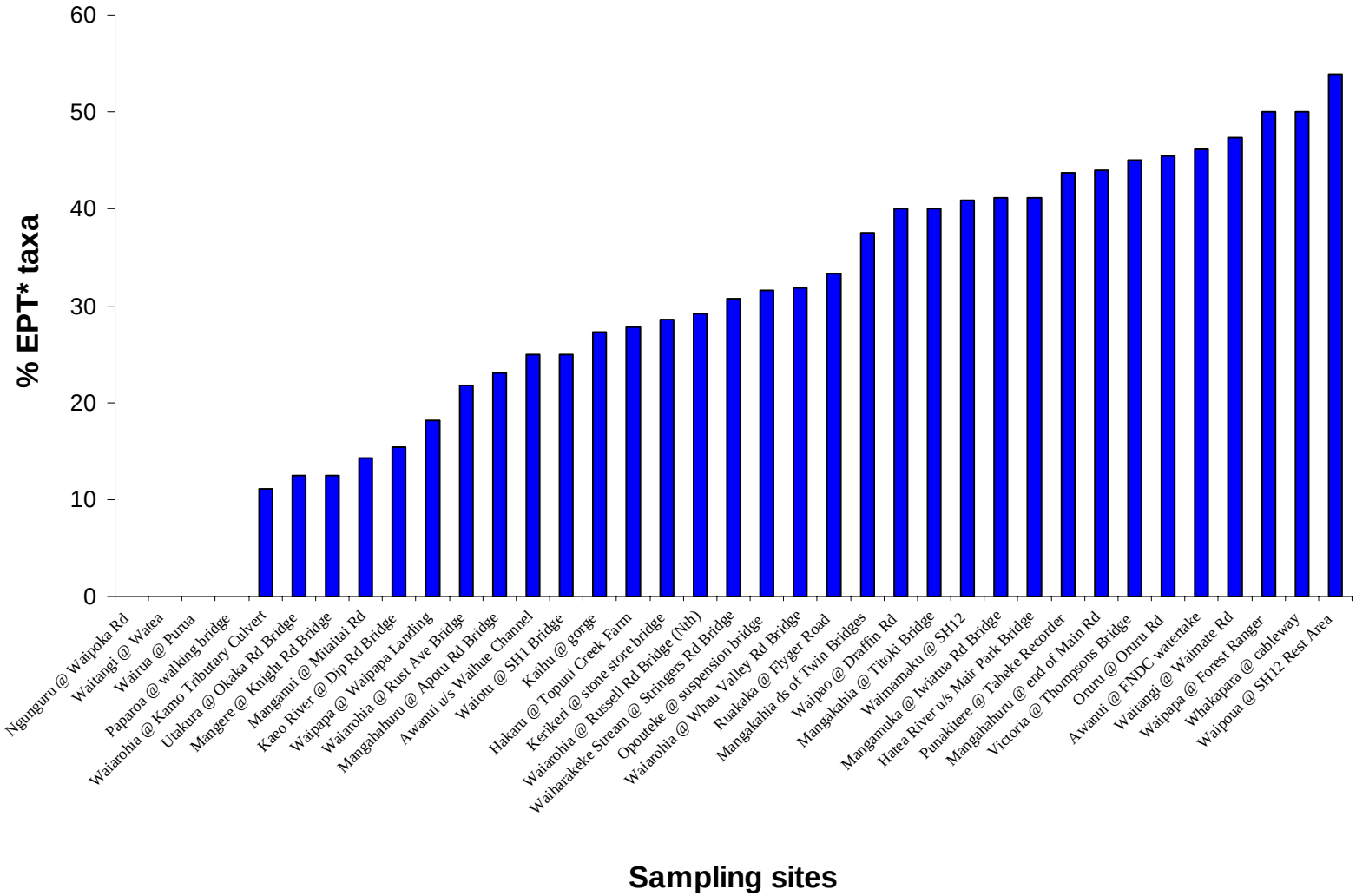

Figure 7. Percentage of Ephemeroptera, Plecoptera, and Trichoptera (excluding Hydroptilidae) taxa from the 37 State of Environment sites for April 2009.

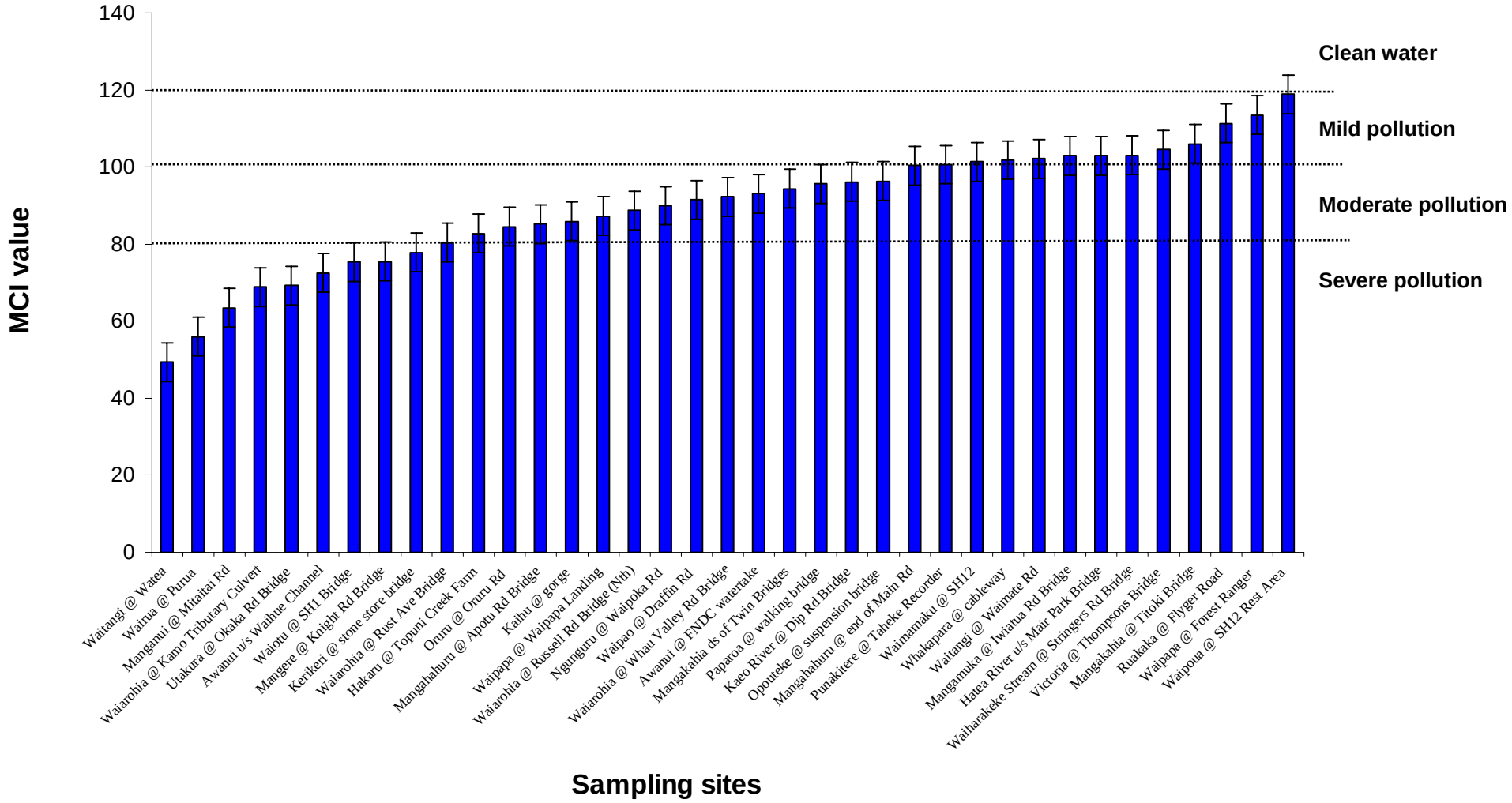

Figure 8. MCI scores for the 37 State of Environment sites for April 2009. Error bars represent ± 5 MCI units.

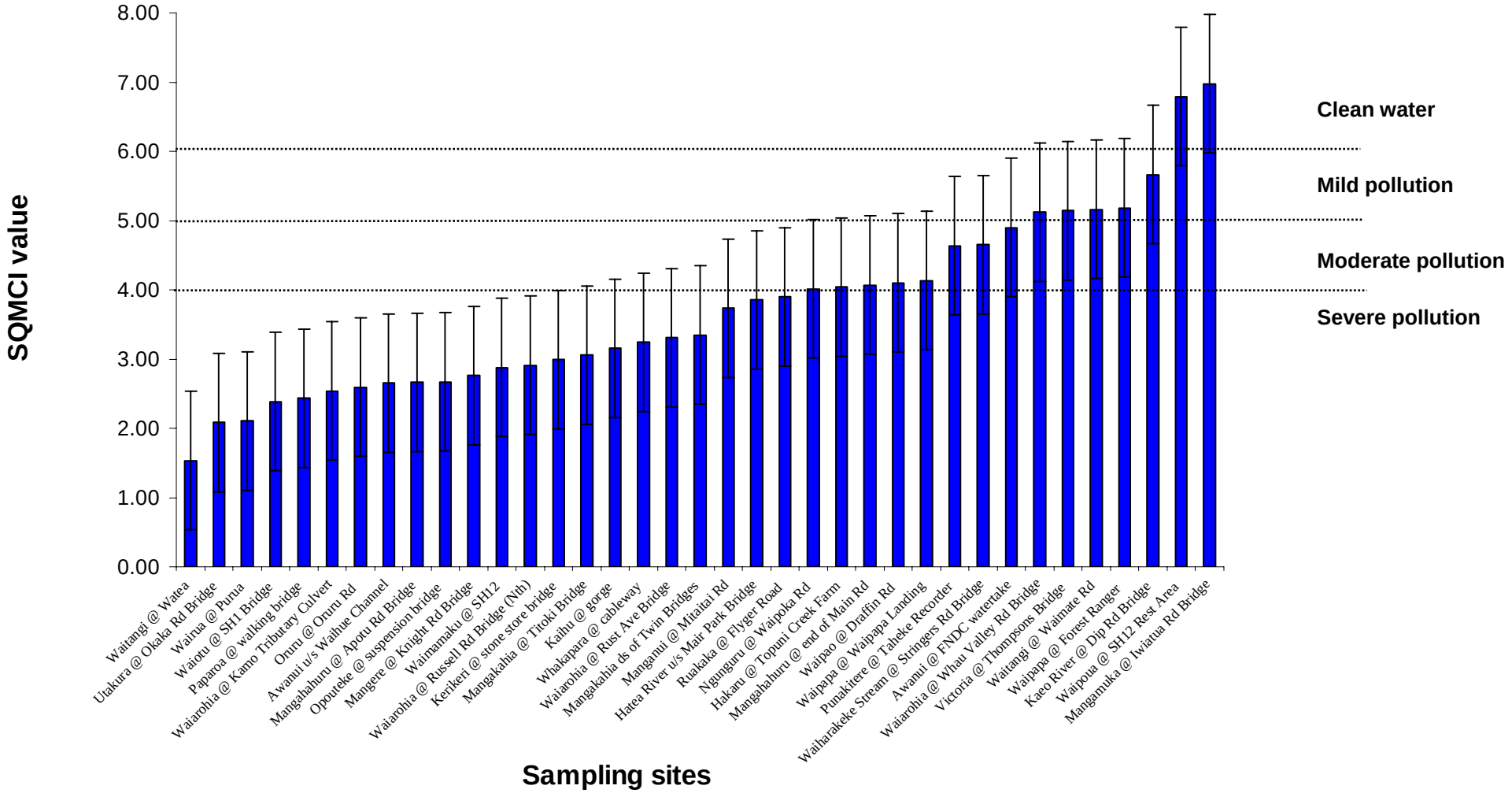

Figure 9. SQMCI scores of the 37 State of Environment sites for April 2009. Error bars represent ± 1 SQMCI unit.

3.2 Resource Consent (RC) sites

3.2.1 Biotic indices

Raw macroinvertebrate data is tabled in Appendix E. Taxonomic richness recorded at the five Resource Consent activities (upstream and downstream) ranged from eight upstream of the Meatworks, to 23 downstream of Oxidation Pond B (Fig. 10). The mean number of taxa was 15.4 ± 3.2 (95% CI, n=10).

The range of %EPT* taxa was 0.0–56.3% with a mean of 28.4% ± 12.7 (95% CI, n=10) (Fig. 11). Three (30%) of the sites scored highly, these being Dam upstream, Oxidation Pond B downstream, and Oxidation Pond B upstream (42.9, 47.8, and 56.3% respectively).

MCI values ranged from 48.8 (Oxidation Pond A d/s) to 111.0 (Dam upstream) (Fig. 12), with a mean of 87.3 ± 15.7 (95% CI, n=10). Only upstream and downstream of Oxidation Pond A (20%) recorded an MCI score of less than 80, which can be interpreted as water of 'probable severe pollution' (Boothroyd & Stark 2000). No RC sites scored above 120 this year, which is accepted as the 'clean water' lower limit.

The general array of SQMCI results generally indicated lower-quality conditions than the MCI results, with 70% of sites recorded in the 'probable severe pollution' class. Scores ranged from 2.02–7.00; the mean being 3.84 ± 1.06 (95% CI, n=10) (Fig. 13). One site recorded 'clean water' (Dam upstream) and a second recorded just below (Oxidation pond B upstream).

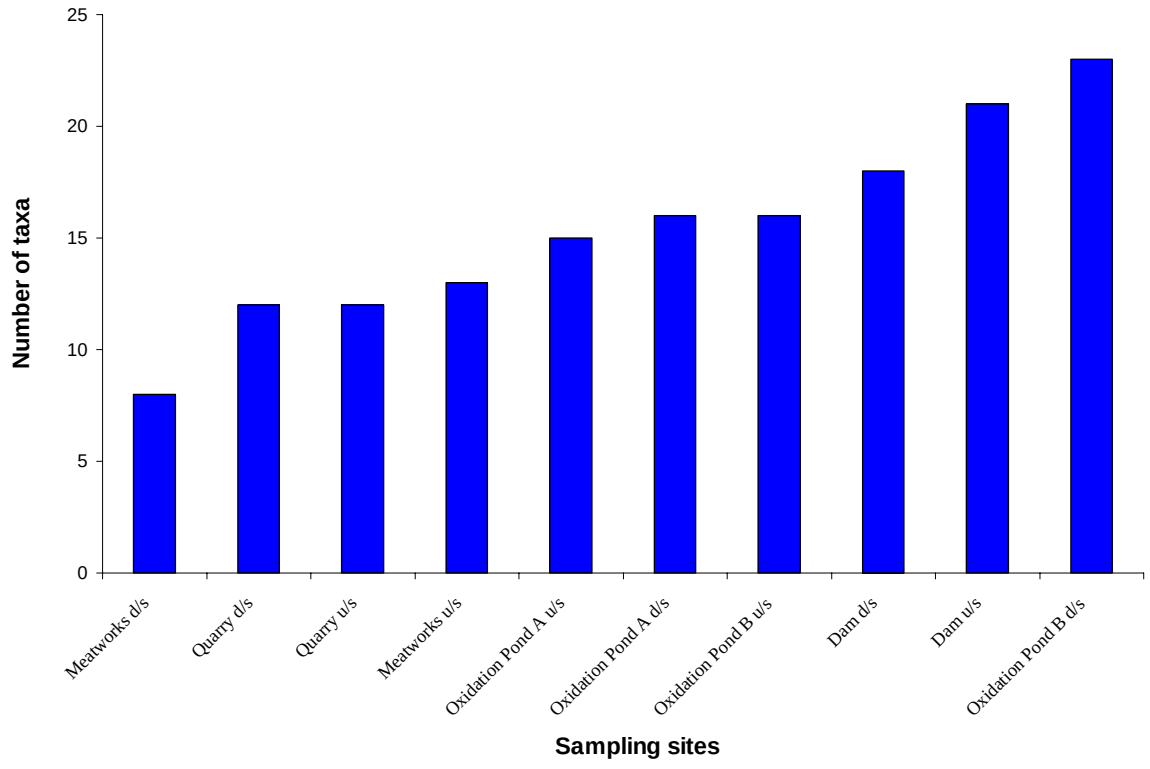

Figure 10. Macroinvertebrate taxonomic richness at the five Resource Consent activities for April 2009, u/s = upstream, d/s = downstream.

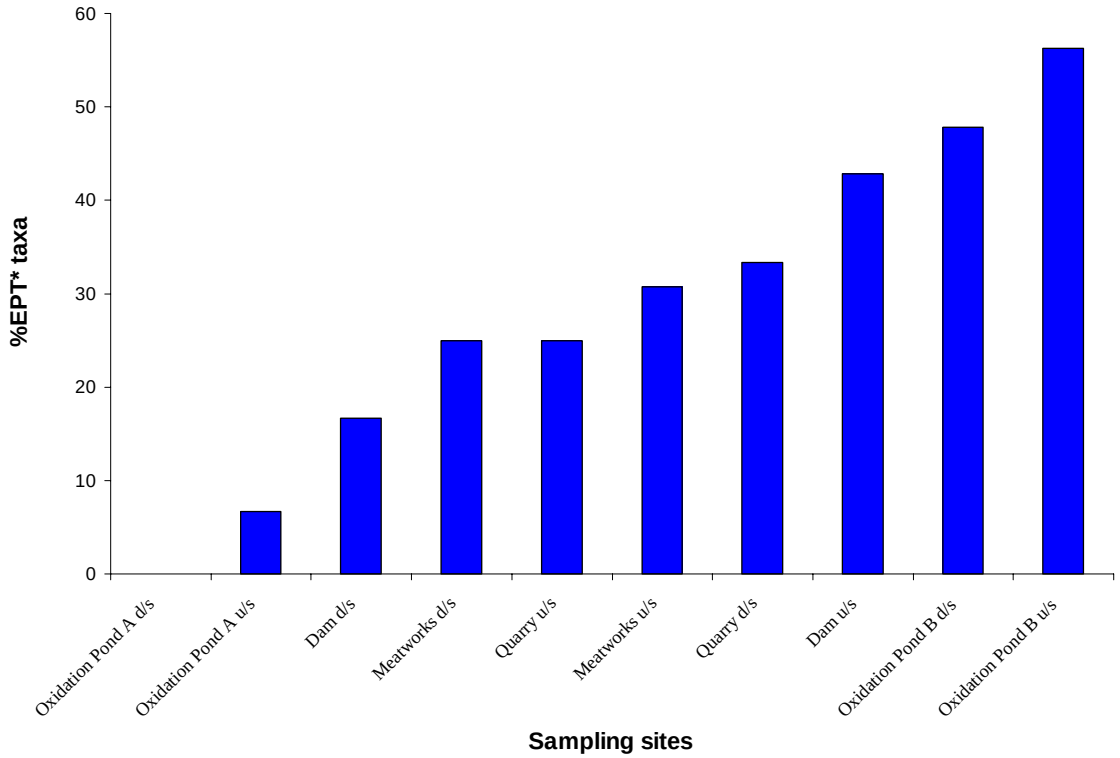

Figure 11. Percentage of Ephemeroptera, Plecoptera, and Trichoptera orders within each sample for the five Resource Consent activities for April 2009, u/s = upstream, d/s = downstream.

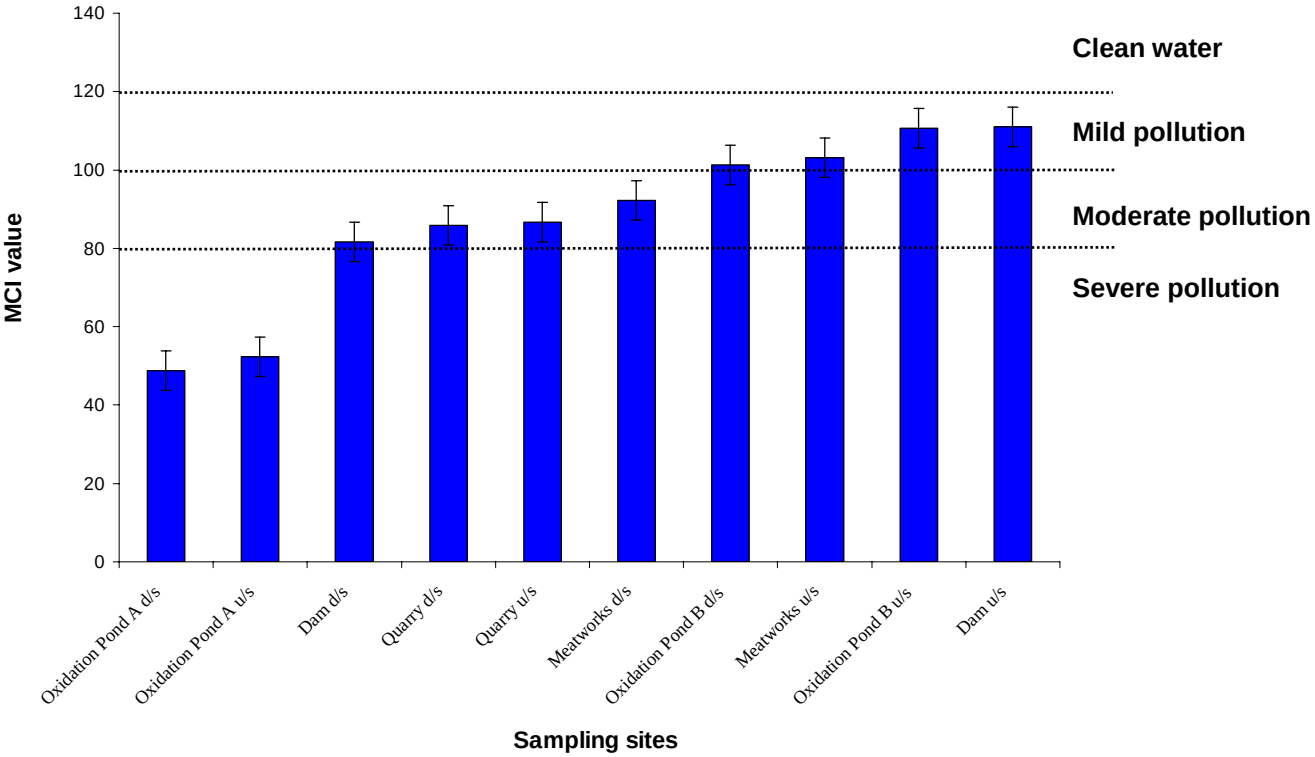

Figure 12. MCI scores for the five Resource Consent activities for April 2009. Error bars represent ± 5 MCI units, which potentially separate water quality classes, u/s = upstream, d/s = downstream.

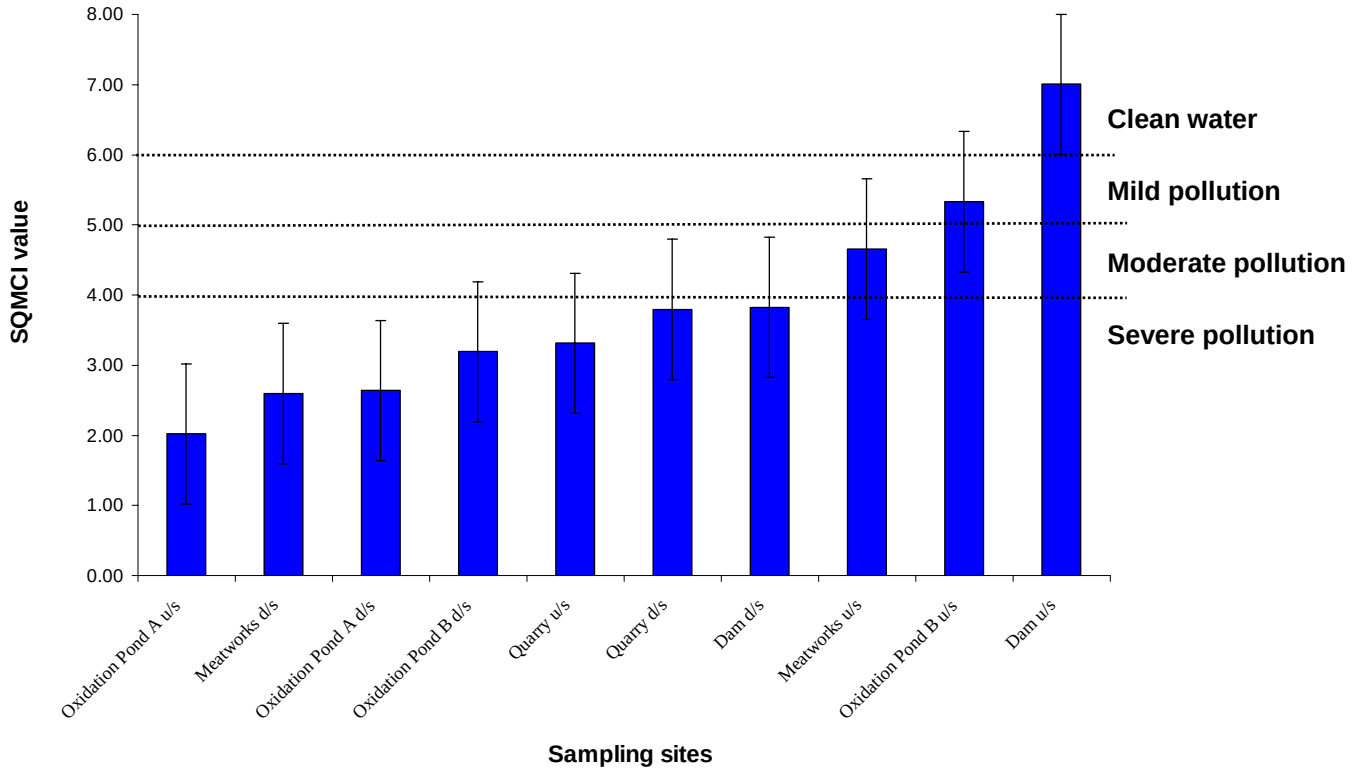

Figure 13. SQMCI scores for the five Resource Consent activities for April 2009. Error bars represent ± 1 SQMCI unit, which potentially separate water quality classes, u/s = upstream, d/s = downstream.

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 affects on the waterway. Three of the five Resource Consent locations showed a considerable difference between the downstream and upstream SQMCI values (Figs 14, 15). Most noticeable was the difference of the Dam activity.

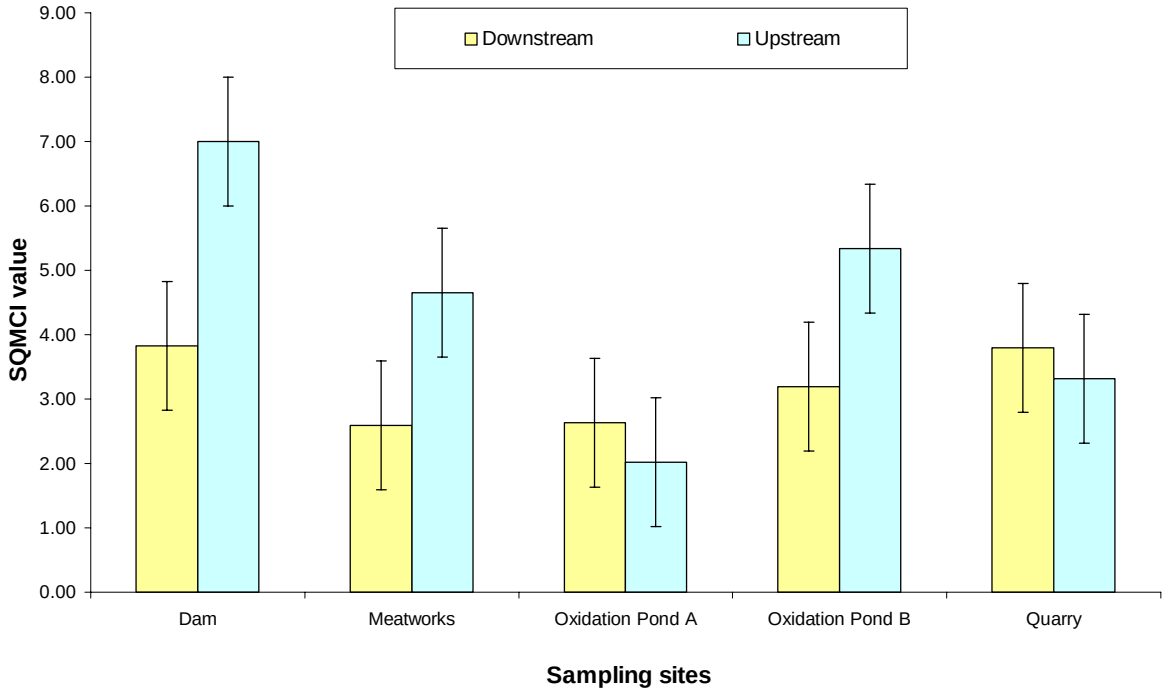

Figure 14. SQMCI values comparing the upstream and downstream sites for April 2009. Error bars represent ± 1 SQMCI unit.

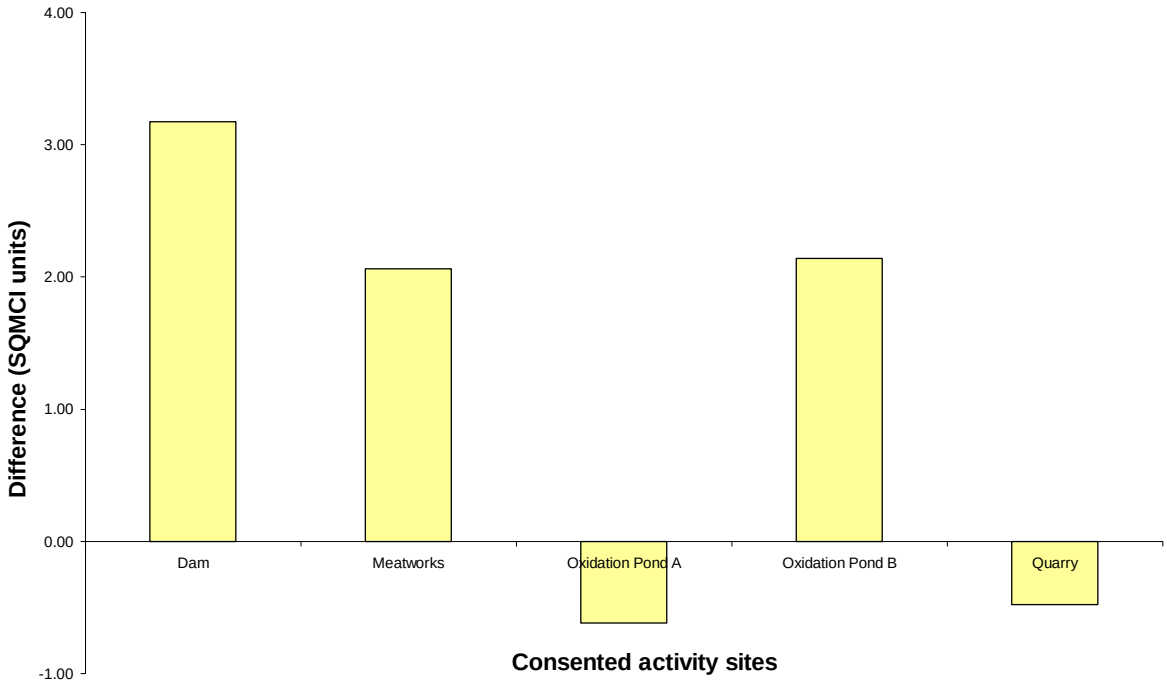

Figure 15. Resource Consent sites showing the difference between upstream and downstream SQMCI values.

3.3 Trend analysis

Analysis of 22 (of 37) SoE sites and all (10) of the Resource Consent activities was carried out, looking at the MCI and SQMCI results over time (Figs 16, 17). Fifteen (32%) of the 46 sites have been established over the last four years, and 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) treads in invertebrate data, thus caution should be taken for several of the reported analyses.

When considering the MCI and SQMCI trend results collectively, 13 (40.5%) of the 32 sites analysed indicated a reduction in their biotic index. A further 13 (40.5%) sites indicated little change. Only six sites (19%) indicated an increase in their biotic index, though two of these were not convincing.

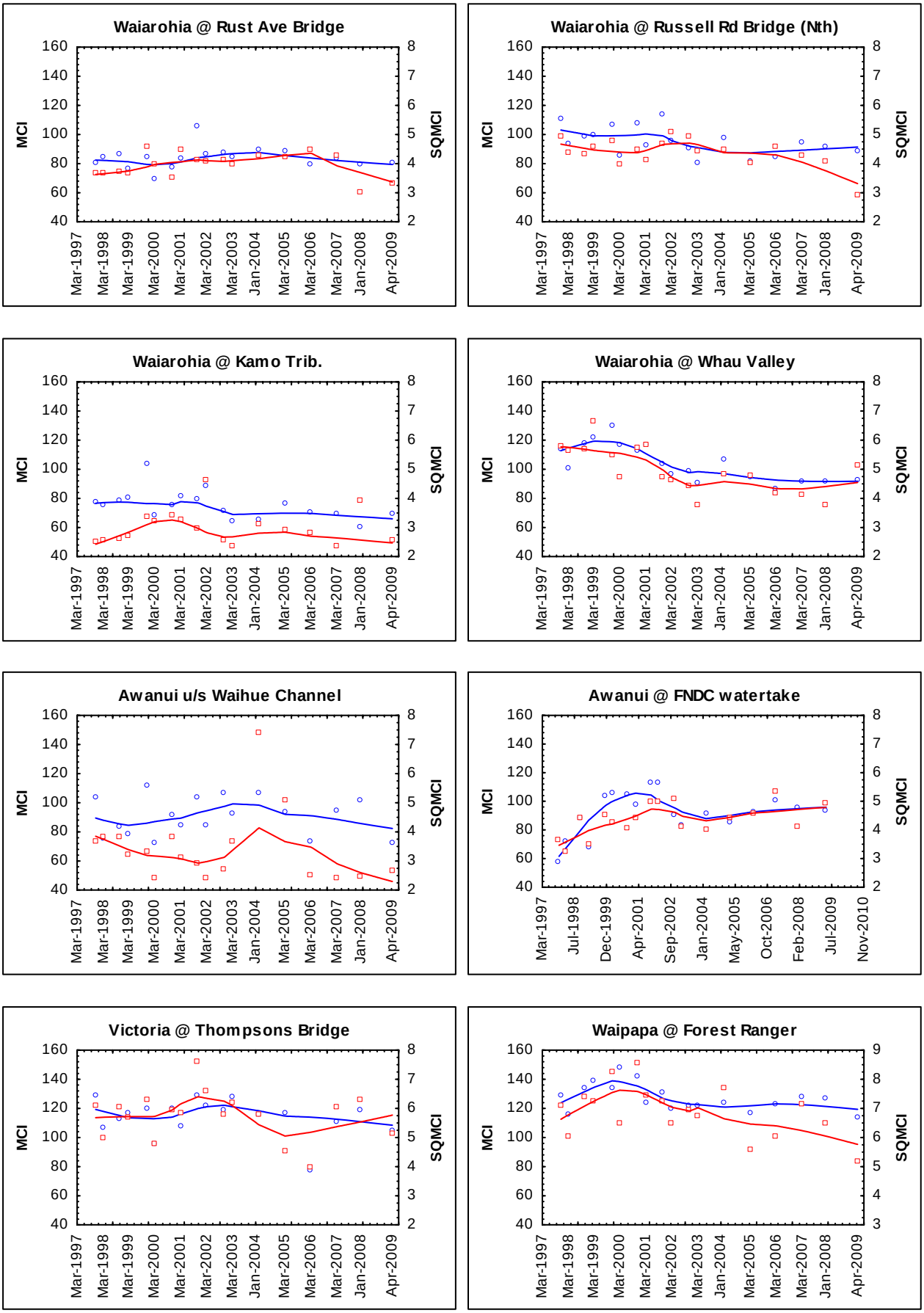

Figure 16. MCI and SQMCI trends (LOWESS fitted at 0.4) of the SoE sites over time. Note that Waipapa @ Forest Ranger has a unique SQMCI scale.

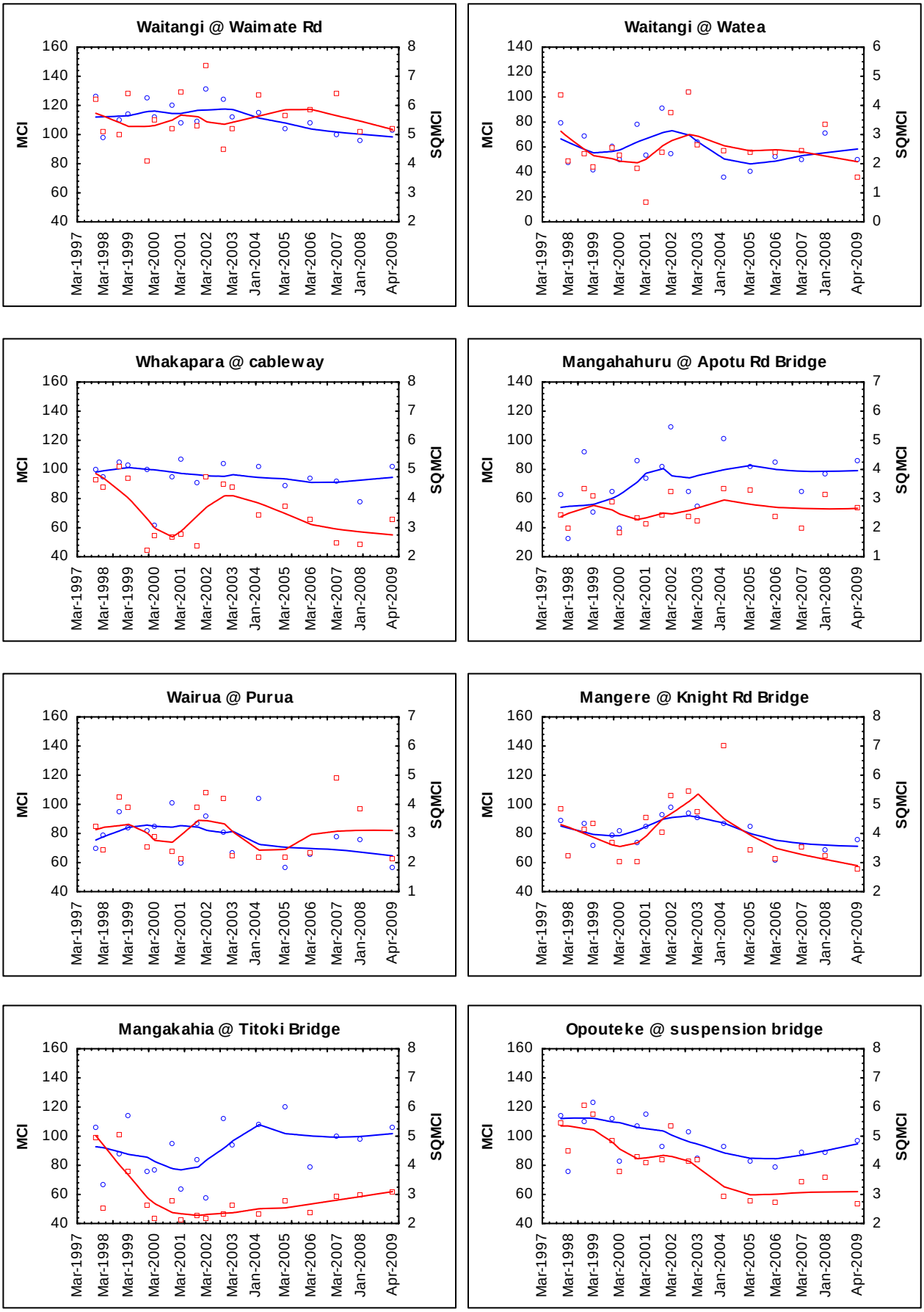

Figure 16 continued. MCI and SQMCI trends (LOWESS fitted at 0.4) of the SoE sites. Note that some sites have unique scales.

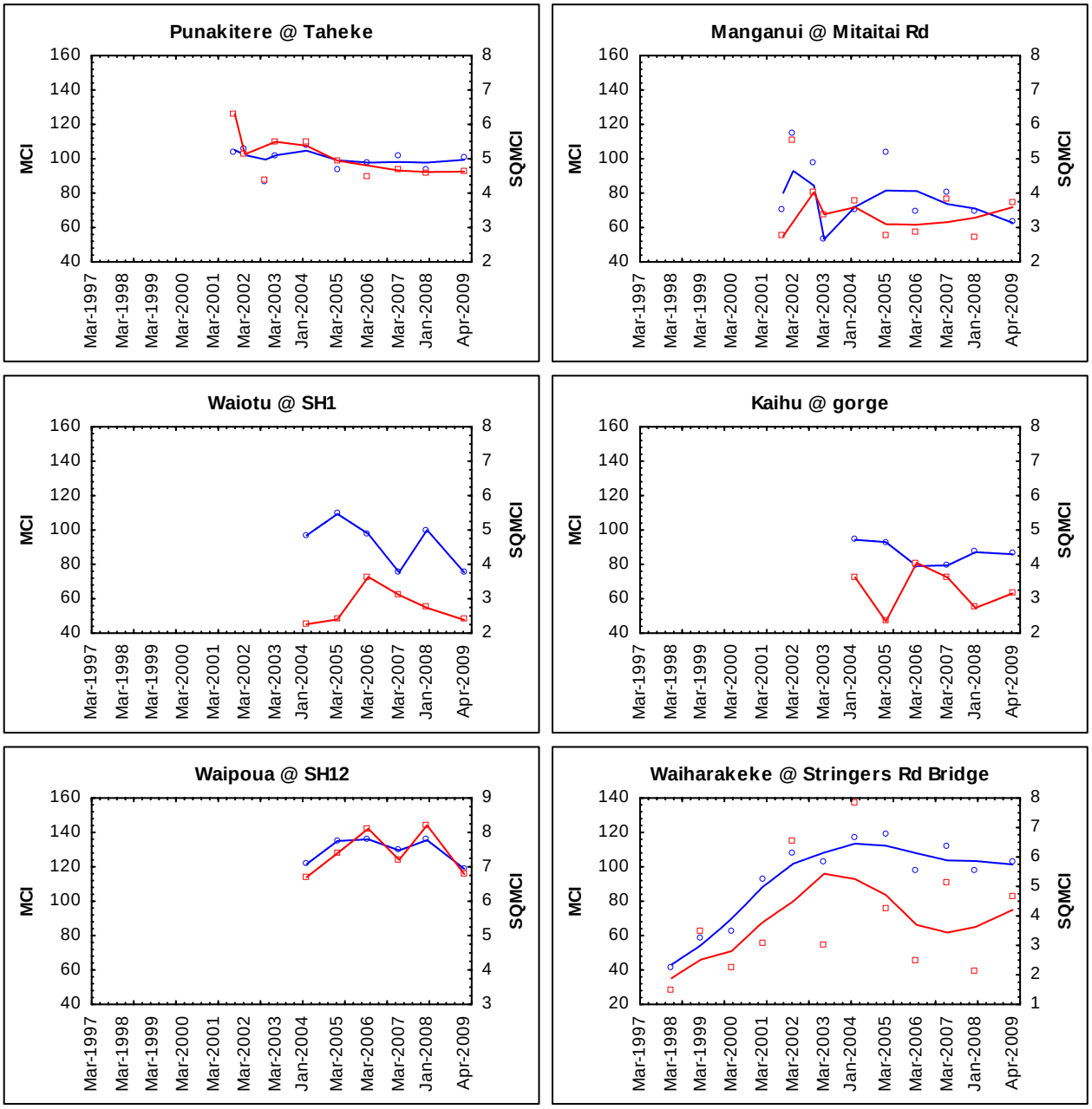

Figure 16 continued. MCI and SQMCI trends (LOWESS fitted at 0.4) of the SoE sites. Note that some sites have unique scales.

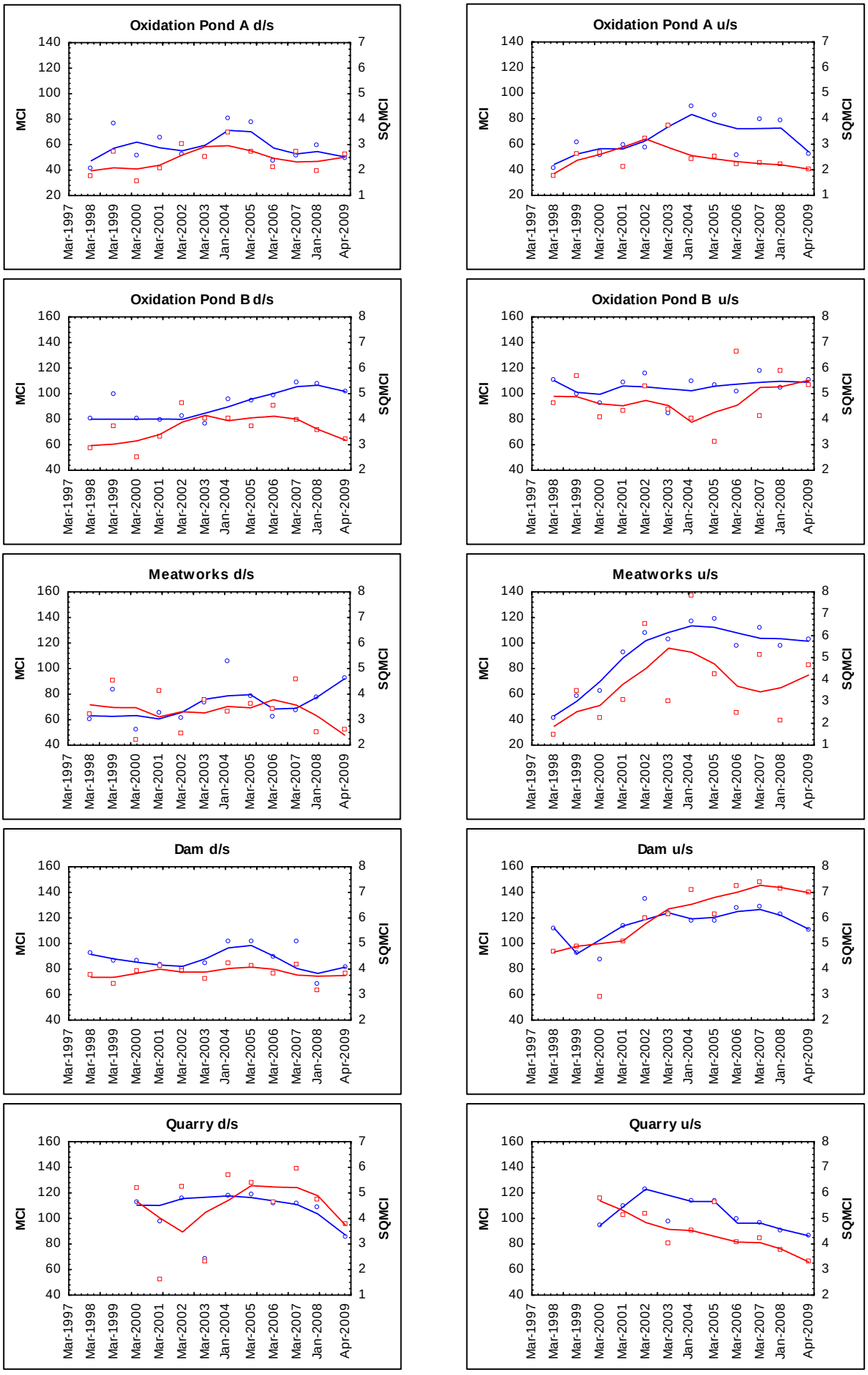

Figure 17. MCI and SQMCI trends (LOWESS fitted at 0.4) of the Resource Consent activity sites.

4. Conclusions

- Waipoua River @ SH12 Rest Area, Waipapa River @ Forest Road, Victoria River @ Thompson's Bridge, Mangamuka River @ Iwiatua Road Bridge (all SoE sites), and the Dam upstream site (RC) recorded clean water this year, based on MCI and/or SQMCI results. These were the same 'top' five sites as last year.

- Fifty-nine percent of the sites (22 sites) recorded SQMCI scores of less than 4.00, which is interpreted as water of probable 'severe pollution'. However, a further 22% of sites were recorded in the 'moderate pollution' interpretation. The worst of the SoE sites for 2009, based on MCI and SQMCI results were (worst site first):

  - Waitangi @ Watea,
  - Wairua @ Purua,
  - Utakura @ Okaka Rd Bridge, and
  - Waiarohia @ Kamo Tributary Culvert.

- The worst of the RC sites for 2009, based on MCI and SQMCI results were:

  - Oxidation Pond A u/s
  - Oxidation Pond A d/s

- Also of concern, though not as obvious from the results, were Ngunguru @ Waipoka Rd, Paparoa @ walking bridge, and Manganui @ Mitaitai Rd. These sites contained low diversity communities, and the use of MCI values for these should be treated with caution. If there are a low number of taxa, the average sensitivity score becomes less reliable. Although not considered relevant for this years dataset, it is also important to be aware that MCI values can be unreliable in cases where several taxa may appear in a habitat in which they would not normally occur e.g. flood events can carry 'sensitive' taxa from the clean to the less favourable waters.

- When considering the MCI and SQMCI trend results collectively, 13 (40.5%) of the 32 sites analysed indicated a reduction in their biotic index. A further 13 (40.5%) sites indicated little change. Only six sites (19%) indicated an increase in their biotic index, though two of these were not convincing. The following five sites indicated the most apparent decreasing trends, though no statistical tests were undertaken:

  - Quarry upstream
  - Quarry downstream
  - Mangere @ Knight Rd Bridge
  - Waiarohia @ Whau Valley Rd Bridge
  - Opouteke @ suspension bridge

- Stark & Maxted (2007b) have recommended reporting MCI and MCI-sb results rather than SQMCI and SQMCI-sb results, due to the temporal element involved in collecting large numbers of samples for a SoE programme. They believe that if a 'programmes' sample collecting is delayed (e.g. due to adverse weather) for several weeks, or is carried out over several weeks (due to large spatial component), it is likely that the river's conditions will change and the resulting "biotic indices will be different" when compared on a common basis. Stark & Maxted (2007b) go on to say that "This problem affects the MCI to a lesser extent than SQMCI or QMCI, because the list of species present at a site is affected less when samples are collected than the densities". In contrast, for compliance monitoring of resource consents, it is acknowledged that SQMCI and SQMCI-sb "are more suited" as samples are collected on the same day (Stark & Maxted 2007b). We have reported SQMCI, as well as MCI, to be consistent with previous years, knowing that the complete 2009 dataset was collected over a ten-day period.

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6. Acknowledgements

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7. Appendix A

Table 4. Results of QC as reported by an independent taxonomist. Note that only the format of the QC results have been modified, to allow clarity within the report.

NorthTec QC 2009			Kaeo	Ruakaka	Waipoua	Waitangi	Whakapara
Taxa	**MCI**	**MCI-sb**	**102674**	**105008**	**103304**	**101752**	**102249**
	score	**score**	14/4/09	6/4/09	16/4/09	14/4/09	11/4/09
Mayfly *Acanthophlebia*	7	9.6			R		
Mayfly *Ameletopsis*	10	10.0			R		
Mayfly *Austroclima*	9	6.5		R	R		C
Mayfly *Coloburiscus*	9	8.1			A		
Mayfly *Deleatidium*	8	5.6	A		VA		R
Mayfly *Mauiulus*	5	4.1		R			R
Mayfly *Neozephlebia*	7	7.6		C	R		
Mayfly *Nesameletus*	9	8.6			A		
Mayfly *Zephlebia*	7	8.8	R	VA	C	skin only	VA
Caddisfly *Aoteapsyche*	4	6.0			C		
Caddisfly *Beraeoptera*	8	7.0			A		
Caddisfly *Helicopsyche*	10	8.6			VA		
Caddisfly *Hudsonema*	6	6.5		R			R
Caddisfly *Hydrobiosis*	5	6.7			C		
Caddisfly *Olinga*	9	7.9	R		C		
Caddisfly *Oxyethira*	2	1.2	C			A	A
Caddisfly *Psilochorema*	8	7.8			R		
Caddisfly *Pycnocentria*	7	6.8		C			A
Caddisfly *Pycnocentrodes*	5	3.8			A		
Caddisfly *Triplectides*	5	5.7		VA			
Damselfly *Xanthocnemis*	5	1.2				A	
Dragonfly Aeshnidae	5	1.4				R	
Dragonfly *Procordulia*	6	3.8				C	
Bug *Anisops*	5	2.2				C	
Bug *Microvelia*	5	4.6		R			
Bug *Sigara*	5	2.4				C	
Dobsonfly *Archichauliodes*	7	7.3			C		
Beetle Elmidae	6	7.2	A	R	C		
Beetle Hydraenidae	8	6.7			R		
Beetle Hydrophilidae	5	8.0		R			
Beetle Scirtidae	8	6.4	C				
True Fly *Aphrophila*	5	5.6			R		
True Fly *Austrosimulium*	3	3.9			R		C
True Fly *Chironomus*	1	3.4	R	R			
True Fly Eriopterini	9	7.5	R				
True Fly Orthocladiinae	2	3.2	C		A	C	VA
True Fly *Paradixa*	4	8.5		C			
True Fly *Polypedilum*	3	8.0		R			R
True Fly Psychodidae	1	6.1				R	
True Fly Tanypodinae	5	6.5	C	R	R	R	
True Fly Tanytarsini	3	4.5			R	R	R
Collembola	6	5.3		R		R	
Crustacea Amphipoda	5	5.0		A		R	
Crustacea Cladocera	5	0.7				R	
Crustacea Copepoda	5	2.4				VA	
Crustacea	3	5.1					R
Crustacea Ostracoda	3	1.9		R			
Crustacea Paratya	5	3.6		VA			
MITES	5	5.2			R	R	
Mollusc *Ferrissia*	3	2.4			R		
Mollusc *Latia*	3	6.1		R	R		
Mollusc Lymnaeidae	3	1.2				C	
Mollusc *Melanopsis*	3	1.9	R				
Mollusc *Physella*	3	0.1				VA	
Mollusc *Potamopyrgus*	4	2.1	A	VA	R	A	VA
Mollusc Sphaeriidae	3	2.9				R	
OLIGOCHAETES	1	3.8	C	R	R	C	
FLATWORMS	3	0.9				VA	
NEMERTEANS	3	1.8	R		R	R	
HYDROIDS	3	1.6				R	
Number of Taxa			**14**	**21**	**29**	**23**	**13**
EPT Value			**4**	**7**	**15**	**1**	**7**
%EPT (taxa number)			**28.6%**	**33.3%**	**51.7%**	**4.3%**	**53.8%**
MCI Value			**97.1**	**97.1**	**119.3**	**82.6**	**95.4**
SQMCI Value			**5.30**	**5.24**	**7.90**	**3.68**	**4.40**
MCI-sb Value			**96.1**	**114.3**	**123.4**	**64.6**	**102.0**
SQMCI-sb			**4.78**	**5.15**	**6.77**	**1.38**	**4.65**

7. Appendix B

Table 5. Physico-chemical data (flow, water temperature, pH, dissolved oxygen, air saturated dissolved oxygen, conductivity, temperature compensated conductivity, and salinity) recorded at the 37 State of the Environment sites throughout Northland. u/s = upstream, d/s = downstream.

Site name	Flow (ms^{-2})	Temp (°C)	pH	D.O. (mg/L)	D.O. (%)	Cond. (µS/cm)	Cond. 25°C‡ (µS/cm)	Sal. (ppt)
Awanui River @ FNDC watertake	0.85	16.1	7.96	9.79	99.4	157.6	180.0	0.1
Awanui River u/s of Waihue Channel	0.21	16.1	7.97	9.58	97.2	164.5	198.3	0.1
Hakaru River @ Topuni Creek farm	0.48	15.1	8.01	10.67	106.1	122.1	150.5	0.1
Hatea River u/s Mair Park Bridge	0.36	14.4	7.89	10.40	101.9	160.3	201.1	0.1
Kaeo River @ Dip Road	0.40	19.0	7.17	9.23	99.5	108.2	122.3	0.1
Kaihu River @ gorge	0.52	14.1	7.90	10.63	103.5	88.1	111.2	0.1
Kerikeri River @ stone store bridge	0.15	15.5	7.50	10.32	103.6	60.2	73.5	0.0
Mangahahuru Stream @ Apotu Road Bridge	0.09	13.5	7.05	10.29	98.6	88.1	113.1	0.1
Mangahahuru Stream @ end of Main Road	0.35	13.2	7.28	9.34	89.1	66.8	86.3	0.0
Mangakahia River @ Titoki Bridge	0.22	16.1	7.39	9.74	98.9	123.0	148.3	0.1
Mangakahia River d/s of Twin Bridges	0.11	16.4	8.38	9.96	101.7	104.6	125.3	0.1
Mangamuka River @ Iwiatua Road Bridge	0.78	16.1	7.84	9.96	101.2	130.6	157.4	0.1
Manganui River @ Mitaitai Road	0.22	16.6	7.63	9.29	95.4	146.1	173.9	0.1
Mangere Stream @ Knight Road	0.13	12.7	7.42	9.07	85.7	109.5	143.0	0.1
Ngunguru River @ Waipoka Road	<0.08	12.5	6.95	8.26	77.9	111.7	146.7	0.7
Opouteke River @ suspension bridge	0.13	16.3	7.76	9.02	92.1	110.5	132.5	0.1
Oruru River @ Oruru Road	0.82	16.4	7.91	10.32	105.4	130.6	156.3	0.1
Paparoa Stream @ walking bridge	<0.08	16.7	7.32	7.68	80.7	5490	6530	3.6
Punakitere River @ Taheke Recorder	0.41	15.3	8.40	11.42	113.9	102.9	126.4	0.1
Ruakaka River @ Flyger Road	0.68	14.2	7.44	8.07	78.7	164.0	206.4	0.1
Utakura River @ Okaka Road Bridge	0.35	15.9	7.54	8.57	86.8	74.1	89.8	0.0
Victoria River @ Thompsons Bridge	0.56	17.2	7.65	9.22	95.8	129.7	152.6	0.1
Waiarohia Stream @ Kamo tributary culvert	0.27	16.6	7.09	8.73	84.9	69.1	82.3	0.0
Waiarohia Stream @ Russell Road Bridge Nth	0.19	17.9	8.39	11.06	116.5	46.3	53.6	0.0
Waiarohia Stream @ Rust Ave Bridge	0.61	18.6	7.48	10.72	114.8	218.6	249.1	0.1
Waiarohia Stream @ Whau Valley Road	0.35	16.3	7.40	8.61	87.8	243.8	292.5	0.1
Waiharakeke Stream @ Stringers Road Bridge	0.30	13.9	7.56	9.06	87.7	118.4	150.5	0.1
Waimamaku River @ SH12	0.36	16.2	7.90	10.41	105.9	94.1	113.2	0.1
Waiotu River @ SH1	0.38	13.8	7.60	10.79	104.4	62.7	79.7	0.0
Waipao River @ Draffin Road	0.24	14.2	7.50	10.02	97.8	135.3	170.5	0.1
Waipapa River @ Forest Ranger	0.59	15.1	7.85	10.53	104.7	90.2	111.2	0.1
Waipapa River @ Waipapa Landing Bridge	0.15	16.3	7.36	9.21	93.9	60.4	72.5	0.0
Waipoua River @ SH12 Rest Area	0.45	12.9	7.73	10.27	97.4	74.3	96.5	0.0
Wairua River @ Purua	0.15	15.3	7.44	9.70	96.8	91.4	112.2	0.1
Waitangi River @ Watea	0.08	15.3	7.45	10.16	101.4	89.1	109.6	0.1
Waitangi River @ Waimate Road	0.22	15.1	7.29	11.33	112.6	70.8	87.3	0.0
Whakapara River @ cableway	0.70	14.3	7.59	12.18	118.9	54.4	68.4	0.0

‡ Conductivity temperature compensated to 25°C.

Table 6. Physico-chemical data (flow, water temperature, pH, dissolved oxygen, air saturated dissolved oxygen, conductivity, temperature compensated conductivity, and salinity) recorded at the 10 Resource Consent sites throughout Northland. u/s = upstream, d/s = downstream.

Site name	Flow (ms^{-2})	Temp. (°C)	pH	D.O. (mg/L)	D.O. (%)	Cond. (µS/cm)	Cond. @ 25°C[§] (µS/cm)	Sal. (ppt)
Dam d/s	0.18	17.6	7.56	8.19	85.8	93.6	109.0	0.1
Dam u/s	<0.08	15.0	8.07	9.92	98.3	89.0	110.2	0.1
Meatworks d/s	0.28	14.0	7.32	7.07	68.8	124.3	156.8	0.1
Meatworks u/s	0.30	13.9	7.56	9.06	87.7	118.4	150.5	0.1
Oxidation Pond A d/s	0.09	14.2	7.22	10.52	102.6	81.3	102.5	0.1
Oxidation Pond A u/s	0.09	14.1	7.37	10.69	103.9	78.7	99.5	0.0
Oxidation Pond B d/s	0.19	15.0	7.57	9.65	95.8	100.2	123.8	0.1
Oxidation Pond B u/s	0.15	14.9	7.71	10.75	106.4	72.7	90.0	0.0
Quarry d/s	0.28	14.0	7.14	8.31	80.7	65.1	82.4	0.0
Quarry u/s	0.20	14.8	7.04	9.29	91.8	65.6	81.6	0.0

[§] Conductivity temperature compensated to 25°C.

7. Appendix C

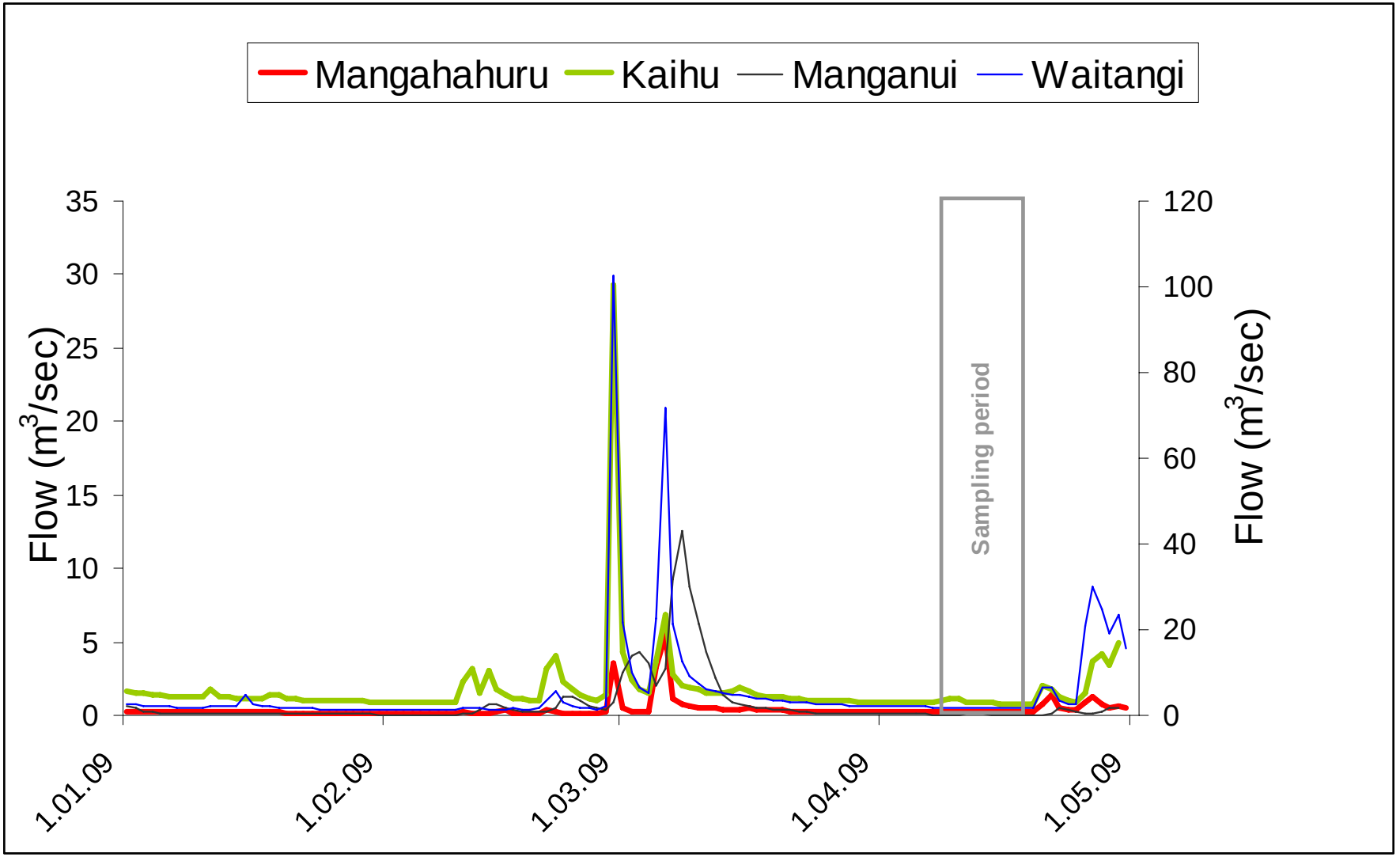

Figure 18. Select river flows (m^3/sec) across Northland prior to commencement of sampling. For Mangahahuru and Kaihu (bold lines) refer to the primary axis and for Manganui and Waitangi (weak lines) refer to the secondary axis.

7. Appendix D

Table 7. Raw macroinvertebrate data for the 37 State of Environment sites, April 2009. Sites marked in red have been reprocessed by an independent taxonomist as a measure of Quality Control.

Site Name			Waiarohia @ Rust Ave Bridge	Waiarohia @ Russell Rd Bridge (Nth)	Waiarohia @ Kamo Tributary Culvert	Waiarohia @ Whau Valley Rd Bridge	Ngunguru @ Waipoka Rd	Awanui u/s Waihue Channel	Awanui @ FNDC watertake	Victoria @ Thompsons Bridge	Utakura @ Okaka Rd Bridge	Mangamuka @ Iwiatua Rd Bridge	Oruru @ Oruru Rd	Waipapa @ Forest Ranger	Waitangi @ Waimate Rd	Waitangi @ Watea	Kaeo River @ Dip Rd Bridge	Waipapa @ Waipapa Landing	Kerikeri @ stone store bridge	Whakapara @ cableway	Mangahahuru @ Apotu Rd Bridge
Site Number			**105672**	**105674**	**105677**	**107773**	**109100**	**100370**	**100363**	**105532**	**109020**	**108978**	**108979**	**101751**	**103178**	**101752**	**102674**	**101524**	**101530**	**102249**	**100281**
TAXA	Tolerance Values																				
	HB	SB [1]																			
INSECTA																					
Ephemeroptera																					
Acanthophlebia	7	9.6												1							
Ameletopsis	10	10.0																			
Atalophlebioides	9	4.4																			
Austroclima	9	6.5											1							1	
Coloburiscus	9	8.1				5				20		1		20							
Deleatidium	8	5.6	100	100		100				100		100	1	100			20				
Mauiulus	5	4.1		1				5	5	5			1	5	5						
Neozephlebia	7	7.6				1															
Nesameletus	9	8.6																			
Rallidens	9	3.9													1						
Zephlebia	7	8.8						20	20		1		1	1	100				1	100	1
Plecoptera																					
Acroperla	5	5.1																			
Zelandobius	5	7.4	1									1		1							
Megaloptera																					
Archichauliodes	7	7.3	1	1		5				20		1		1							
Odonata																					
Adversaeshna	5	1.4														1					
Antipodochlora	6	6.3													1						
Hemicordulia	5	0.4														5		1			
Xanthocnemis	5	1.2			1						1					5		5			1
Hemiptera																					
Anisops	5	2.2														5					
Mesoveliidae [2]	**5**	**5.0**					1														
Microvelia	5	4.6																			
Sigara	5	2.4														5					1
Coleoptera																					
Elmidae	6	7.2	100	100		5			5	100		20		20			20		1		
Hydraenidae	8	6.7																			
Hydrophilidae	5	8.0									1										
Scirtidae	8	6.4															5				
Diptera																					
Aphrophila	5	5.6	1	1		5				5				1							
Austrosimulium	3	3.9	1	1		5						1	1		20					1	
Chironominae [2]	**2.5**	**4.7**	1	1		5			5	20		1		20		1	1		5		20
Ephydridae	4	1.4		1																	
Eriopterini	9	7.5								1		5		1			1				
Hexatomini	5	6.7												1							
Muscidae	3	1.6	1						1	5				1					1		
Orthocladiinae	2	3.2	100	100		20		20	20	100		5		100	1	5	1		20	100	5
Paradixa	4	8.5																			
Psychodidae	1	6.1			1											1					
Tabanidae	3	6.8								1											
Tanypodinae	5	6.5						5	5			1		1	1		5				1
Trichoptera																					
Aoteapsyche	4	6.0	20	20	1	20			1	100		1		20					1		
Beraeoptera	8	7.0								1				1							
Costachorema	7	7.2												1							
Helicopsyche	10	8.6												1							
Hudsonema	6	6.5													1					1	
Hydrobiosis	5	6.7	1	5		1			1	1				5	1				1		
Neurochorema	6	6.0								1											
Oecetis [1]	6	6.8																		1	1
Olinga	9	7.9										1		5			1				
Orthopsyche	9	7.5				1															
Oxyethira	2	1.2	500	100	20	20		20	1	1		1	1	1	100	5	5		5	5	5
Paroxyethira	2	3.7																1			
Polyplectropus	8	8.1													1			1			
Psilochorema	8	7.8		5					1					5	1						
Pycnocentria	7	6.8		1					20	5		1			100					5	
Pycnocentrodes	5	3.8	1	100		1				1									5		
Triplectides	5	5.7						1				1	1		20			1			1
Collembola	6	5.3		1	5										1						1
Acarina	5	5.2	1			1										1					

Site Name			Waiarohia @ Rust Ave Bridge	Waiarohia @ Russell Rd Bridge (Nth)	Waiarohia @ Kamo Tributary Culvert	Waiarohia @ Whau Valley Rd Bridge	Ngunguru @ Waipoka Rd	Awanui u/s Waihue Channel	Awanui @ FNDC watertake	Victoria @ Thompsons Bridge	Utakura @ Okaka Rd Bridge	Mangamuka @ Iwiatua Rd Bridge	Oruru @ Oruru Rd	Waipapa @ Forest Ranger	Waitangi @ Waimate Rd	Waitangi @ Watea	Kaeo River @ Dip Rd Bridge	Waipapa @ Waipapa Landing	Kerikeri @ stone store bridge	Whakapara @ cableway	Mangahahuru @ Apotu Rd Bridge
CRUSTACEA																					
Amarinus	**3**	5.1					1	1												1	1
Amphipoda	5	5.5	100	1	5	5	5									1					
Cladocera	5	0.7						20			20					1					
Copepoda	5	2.4						500								5		1			
Helice [1]	**3**	6.6																			
Isopoda	5	4.5					1														
Mysidae [1]	**5**	6.4																			
OSTRACODA	3	1.9	20	1																	
Paranephrops	5	8.4													1						
Paratya	5	3.6	1	5			1	100		1	20		100	1				20	1		
MOLLUSCA																					
Ferrissia	3	2.4	1	1		1					1										1
Glyptophysa	5	0.3																			
Gyraulus	3	1.7	20	1	5	20															
Latia	3	6.1																	1		
Lymnaeidae	3	1.2														1		1			
Melanopsis	3	1.9											100				1	5	5		
Physella	3	0.1	5					5							1	20		5			
Potamopyrgus	4	2.1	100	20	5	5	500	100	20		500		100		5	5	20	100	5	500	100
Sphaeriidae	3	2.9														1			1		
HIRUDINEA	3	1.2				5															
NEMATODA	3	3.1	500									5	1								
NEMERTEA	3	1.8		5		5				1				1		1	1				
OLIGOCHAETA	1	3.8	20	500	20	20						5		5	1	5	1				
PLATYHELMINTHES	3	0.9									20					20					
Total (Minimum) coded abundances (c_i)			1596	1072	63	256	509	797	105	489	564	151	308	320	362	94	82	141	53	715	139
Taxonomic richness			23	24	9	22	6	12	13	20	8	17	11	26	19	20	13	11	14	10	13
MCI value			80.4	88.8	68.9	92.3	90.0	85.0	93.1	104.5	92.5	102.9	98.2	113.5	102.1	72.5	96.2	87.3	77.9	98.0	85.4
MCI-sb value			81.4	86.2	73.1	92.8	86.0	72.5	102.6	104.6	69.3	112.8	84.5	119.6	104.4	49.4	92.0	55.3	85.4	101.8	85.2
SQMCI value			3.31	2.91	2.54	5.12	4.01	4.76	4.90	5.15	4.04	6.98	4.03	5.18	5.16	3.43	5.66	4.13	2.99	4.16	3.71
SQMCI-sb value			3.03	4.02	2.96	4.49	2.15	2.65	5.27	5.60	2.08	5.68	2.59	5.13	5.44	1.53	4.87	2.27	3.31	3.24	2.66
EPT* count			5	7	1	7	0	3	6	9	1	7	5	13	9	0	2	2	4	5	3
%EPT*			21.7	29.2	11.1	31.8	0.0	25.0	46.2	45.0	12.5	41.2	45.5	50.0	47.4	0.0	15.4	18.2	28.6	50.0	23.1

* Excludes *Oxyethira* & *Paroxyethira* (Hydroptilidae) [1] Addition from Stark & Maxted (2007). [2] Further additions to list. **Bold** tolerance values are additional values assigned based on professional judgement or hard-bottomed tolerances.

Table 7 continued. Raw macroinvertebrate data for the 37 State of Environment sites, April 2009. Sites marked in red have been reprocessed by an independent taxonomist as a measure of Quality Control.

Site Name			Mangahahuru @ end of Main Rd	Wairua @ Purua	Waipao @ Draffin Rd	Mangere @ Knight Rd Bridge	Mangakahia @ Titoki Bridge	Opouteke @ suspension bridge	Mangakahia ds of Twin Bridges	Punakitere @ Taheke Recorder	Waiotu @ SH1 Bridge	Kaihu @ gorge	Waipoua @ SH12 Rest Area	Waimamaku @ SH12	Manganui @ Mitaitai Rd	Ruakaka @ Flyger Road	Hakaru @ Topuni Creek Farm	Paparoa @ walking bridge	Hatea River u/s Mair Park Bridge	Waiharakeke Stream @ Stringers Rd Bridge
Site Number			**100237**	**101753**	**108941**	**101625**	**101038**	**102258**	**109096**	**105231**	**102248**	**102256**	**103304**	**109098**	**102257**	**105008**	**109021**	**108977**	**100194**	**100007**
TAXA	Tolerance Values																			
INSECTA	HB	SB [1]																		
Ephemeroptera																				
Acanthophlebia	7	9.6											1							
Ameletopsis	10	10.0											1							
Atalophlebioides	9	4.4														1				
Austroclima	9	6.5	20		5			1												
Coloburiscus	9	8.1	20					5	1	5			5	5			1		5	
Deleatidium	8	5.6	20					20	1	1		1	20	5					1	
Mauiulus	5	4.1			20					20				1		5				
Neozephlebia	7	7.6												1		5				
Nesameletus	9	8.6											20							
Rallidens	9	3.9												1						
Zephlebia	7	8.8	5		5	5	20		5	5	20		1		5	20	1			20
Plecoptera																				
Acroperla	5	5.1	1																	
Zelandobius	5	7.4						1												
Megaloptera																				
Archichauliodes	7	7.3	5					1	1	5		5	5	5					1	
Odonata																				
Adversaeshna	5	1.4																		
Antipodochlora	6	6.3																		
Hemicordulia	5	0.4										1								
Xanthocnemis	5	1.2				1					5				1					
Hemiptera																				
Anisops	5	2.2																		
Mesoveliidae [2]	**5**	**5.0**																		
Microvelia	5	4.6														1				
Sigara	5	2.4																		
Coleoptera																				
Elmidae	6	7.2	20					5	5	5		1	5	20		1	1			1
Hydraenidae	8	6.7						1					1							
Hydrophilidae	5	8.0					1				1					1				
Scirtidae	8	6.4																		
Diptera																				
Aphrophila	5	5.6	1			1			1	1			1	1					1	
Austrosimulium	3	3.9	5		20	1			1	5		20	1	5		1				
Chironominae [2]	**2.5**	**4.7**	5			1		20	20	5		20	1	100		1	20		1	
Ephydridae	4	1.4																		
Eriopterini	9	7.5	1																	
Hexatomini	5	6.7																		
Muscidae	3	1.6						20				1	1	5			1		1	
Orthocladiinae	2	3.2	5		1	5		100	20	5	1	100	20	100		1	20		100	1
Paradixa	4	8.5														1				
Psychodidae	1	6.1																		
Tabanidae	3	6.8																		
Tanypodinae	5	6.5						1		1				1		1				
Trichoptera																				
Aoteapsyche	4	6.0	20					5	5	5		20	5	20			100		20	
Beraeoptera	8	7.0										5	5							
Costachorema	7	7.2										1	1							
Helicopsyche	10	8.6											5						1	
Hudsonema	6	6.5	1		1		1				1					1			1	20
Hydrobiosis	5	6.7	1					20	1			5	1	1			1			
Neurochorema	6	6.0																	1	
Oecetis [1]	6	6.8																		
Olinga	9	7.9											20	5						
Orthopsyche	9	7.5																		
Oxyethira	2	1.2	5	1		5		5	5		5	20		100			5			
Paroxyethira	2	3.7																		
Polyplectropus	8	8.1			1															
Psilochorema	8	7.8											1							
Pycnocentria	7	6.8	5		100		1			20						1				5
Pycnocentrodes	5	3.8	5						1	1		1	5	5			1		100	
Triplectides	5	5.7	1			5	20				5					20				20
Collembola	6	5.3														1				
Acarina	5	5.2	1		1			1				20	1	5						1

Site Name			Mangahahuru @ end of Main Rd	Wairua @ Purua	Waipao @ Draffin Rd	Mangere @ Knight Rd Bridge	Mangakahia @ Titoki Bridge	Opouteke @ suspension bridge	Mangakahia ds of Twin Bridges	Punakitere @ Taheke Recorder	Waiotu @ SH1 Bridge	Kaihu @ gorge	Waipoua @ SH12 Rest Area	Waimamaku @ SH12	Manganui @ Mitaitai Rd	Ruakaka @ Flyger Road	Hakaru @ Topuni Creek Farm	Paparoa @ walking bridge	Hatea River u/s Mair Park Bridge	Waiharakeke Stream @ Stringers Rd Bridge
CRUSTACEA																				
Amarinus [1]	**3**	5.1		1	1	5	1				1									5
Amphipoda	5	5.5			500	100	100					100			500	20	100	5	1	
Cladocera	5	0.7																		
Copepoda	5	2.4																		
Helice [1]	**3**	6.6																1		
Isopoda	5	4.5																5		
Mysidae [1]	**5**	6.4																5		
OSTRACODA	3	1.9						1												
Paranephrops	5	8.4																		
Paratya	5	3.6					100		5					5	5	100	5	100	20	100
MOLLUSCA																				
Ferrissia	3	2.4	20		1	5					1	100	1				20			
Glyptophysa	5	0.3			1															
Gyraulus	3	1.7																		
Latia	3	6.1											1			1	1		1	5
Lymnaeidae	3	1.2				1														
Melanopsis	3	1.9																	1	
Physella	3	0.1			1						1	1			20		1			
Potamopyrgus	4	2.1	5	500	500	500	500	1	1	5	500	100		5	500	100	20	500	20	20
Sphaeriidae	3	2.9				5											1			1
HIRUDINEA	3	1.2																		
NEMATODA	3	3.1	5			1														
NEMERTEA	3	1.8						5				20								
OLIGOCHAETA	1	3.8	100			5		100	5	20		100	1	20		1				5
PLATYHELMINTHES	3	0.9	5				1				1	1			5		1			
Total (Minimum) coded abundances (c_i)			282	502	1158	646	745	313	78	109	542	643	130	416	1036	284	300	616	276	204
Taxonomic richness			25	3	15	16	10	19	16	16	12	22	26	22	7	21	18	6	17	13
MCI value			100.4	60.0	100.0	70.6	100.0	96.3	94.4	100.6	80.0	85.9	118.8	101.4	91.4	97.6	82.8	90.0	102.9	87.7
MCI-sb value			102.2	56.0	91.5	75.5	106.0	98.4	102.0	109.4	75.3	79.6	125.7	99.6	63.4	111.3	83.2	95.7	101.4	103.1
SQMCI value			4.07	3.99	4.73	4.10	4.38	2.67	3.35	4.64	4.11	3.16	6.79	2.88	4.48	4.80	4.04	4.19	3.85	5.03
SQMCI-sb value			4.85	2.10	4.10	2.76	3.06	3.95	4.54	5.25	2.39	3.56	6.43	3.68	3.74	3.90	4.89	2.43	3.75	4.65
EPT* count			11	0	6	2	4	6	6	7	3	6	14	9	1	7	5	0	7	4
%EPT*			44.0	0.0	40.0	12.5	40.0	31.6	37.5	43.8	25.0	27.3	53.8	40.9	14.3	33.3	27.8	0.0	41.2	30.8

* Excludes *Oxyethira* & *Paroxyethira* (Hydroptilidae) [1] Addition from Stark & Maxted (2007). [2] Further additions to list. **Bold** tolerance values are additional values assigned based on professional judgement or hard-bottomed tolerances.

7. Appendix E

Table 8. Raw macroinvertebrate data for the Resource Consent sites, April 2009.

Site Name			Dam d/s	Dam u/s	Oxidation Pond A d/s	Oxidation Pond A u/s	Meatworks d/s	Meatworks u/s	Oxidation Pond B d/s	Oxidation Pond B u/s	Quarry d/s	Quarry u/s
Site Number			**106508**	**106509**	**100280**	**100279**	**100010**	**100007**	**103317**	**103316**	**103824**	**103823**
TAXA	Tolerance Values											
INSECTA	HB	SB [1]										
Ephemeroptera												
Austroclima	9	6.5							1	1		
Coloburiscus	9	8.1		1					20	20		1
Deleatidium	8	5.6		100					20	20		
Mauiulus	5	4.1		1					1			
Neozephlebia	7	7.6		5								
Nesameletus	9	8.6		1					5	5		
Zephlebia	7	8.8		1			20	20	1	1		
Plecoptera												
Acroperla	5	5.1									1	1
Megaloptera												
Archichauliodes	7	7.3		20					1	1		1
Odonata												
Antipodochlora	6	6.3			1							
Hemicordulia	5	0.4			5	1						1
Xanthocnemis	5	1.2	1		1	1					1	
Coleoptera												
Elmidae	6	7.2		1				1	5	1	5	5
Hydraenidae	8	6.7										
Hydrophilidae	5	8.0					1					
Diptera												
Aphrophila	5	5.6							5			
Austrosimulium	3	3.9	5	1		1					20	20
Chironominae [2]	**2.5**	**4.7**	1	1	20	20			1	5	20	
Empididae	3	5.4	1									
Eriopterini	9	7.5		5								
Muscidae	3	1.6							1			
Orthocladiinae	2	3.2	1	5	1	5		1	100	20		20
Paralimnophila	6	7.4		5								
Psychodidae	1	6.1							1			
Tanypodinae	5	6.5		1								
Trichoptera												
Aoteapsyche	4	6.0	1	5					20	5	1	
Costachorema	7	7.2							1			
Ecnomina / Zelandoptila	8	**8.3**	5									
Hudsonema	6	6.5						20				
Hydrobiosis	5	6.7		1					5	1		1
Neurochorema	6	6.0							1			
Olinga	9	7.9		1								
Orthopsyche	9	7.5									5	
Oxyethira	2	1.2			1	20					1	5
Polyplectropus	8	8.1	1									
Pycnocentria	7	6.8						5	5	1		
Pycnocentrodes	5	3.8								20		
Triplectides	5	5.7				1	5	20			1	
Collembola	6	5.3	5									
Acarina	5	5.2	5	1				1				
CRUSTACEA												
Amarinus [1]	**3**	5.1			5	1	1	5				
Cladocera	5	0.7			1		1					
Copepoda	5	2.4	20		1							
OSTRACODA	3	1.9	1	5								
Paranephrops	5	8.4	1									
Paratya	5	3.6					100	100				
MOLLUSCA												
Ferrissia	3	2.4			1	5			20	5		
Gyraulus	3	1.7	1									
Latia	3	6.1						5				
Lymnaeidae	3	1.2			1	5						
Physella	3	0.1									1	
Potamopyrgus	4	2.1	20	1	20	100	500	20	20	20	20	20
Sphaeriidae	3	2.9	1				1	1	5			
HIRUDINEA	3	1.2							5			
NEMERTEA	3	1.8			1	1						1
OLIGOCHAETA	1	3.8	20	5	1	100		5	100	5		1
PLATYHELMINTHES	3	0.9	5		5	20					1	

Site Name			Dam d/s	Dam u/s	Oxidation Pond A d/s	Oxidation Pond A u/s	Meatworks d/s	Meatworks u/s	Oxidation Pond B d/s	Oxidation Pond B u/s	Quarry d/s	Quarry u/s
CNIDARIA												
Hydra	3	1.6			20	500						
Total (Minimum) coded abundances (c_i)			95	167	85	781	629	204	344	131	77	77
Taxonomic richness			18	21	16	15	8	13	23	16	12	12
MCI value			81.7	111.0	69.4	63.3	92.5	87.7	101.3	110.6	85.8	86.7
MCI-sb value			83.8	118.2	48.8	52.3	92.3	103.1	106.5	114.5	76.0	84.7
SQMCI value			3.83	7.00	3.29	2.83	4.26	5.03	3.19	5.33	3.79	3.31
SQMCI-sb value			3.45	5.79	2.64	2.02	2.59	4.65	4.16	4.78	4.00	3.37
EPT* count			3	9	0	1	2	4	11	9	4	3
%EPT*			16.7	42.9	0.0	6.7	25.0	30.8	47.8	56.3	33.3	25.0

* Excludes *Oxyethira* & *Paroxyethira* (Hydroptilidae) [1] Addition to Stark *et al*. 2001 list. [2] Stark & Maxted 2007. **Bold** tolerance values are assigned based on professional judgement.