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Prepared for Waikato Regional Council

August 2016



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Executive summary

The Waikato Regional Council (WRC) is responsible for managing the status of water resources in the Waikato region. WRC have initiated investigations in the Waihou and Piako catchments to support and inform the scheduled water allocation review process in these catchments. One of the key objectives of the water allocation process is to safeguard the life-supporting capacity of freshwater ecosystems.

The scope of this study was to undertake monitoring of fish, macroinvertebrates, macrophytes and periphyton at ten sites across the Waihou and Piako catchments. Five sites were to be surveyed in each catchment. The aim was to build on and consolidate the previous ecological monitoring studies in the catchments by adding to the time series of data for these sites.

The results of this survey indicate that, at the Piako survey sites, the relative abundance of fish was generally higher in 2016 than in 2015 and approximately the same or slightly higher than in 2014. The exception to this trend was a decrease in shortfin eels in the Waitakaruru site from 2014 to 2016. Inanga were captured for the first time since 2012 in Mangapapa Stream, although they continued to be absent from the other four sites, including Waitoa, where they were also captured in 2012. A koaro was also captured for the first time in Piakonui Stream. In the Waihou catchment results were more variable. In three of the five sites shortfin and longfin eel abundances were lower in 2016 than in 2015, whereas the abundances of Cran's and common bullies were higher in 2016 than in 2015, although still lower than 2014, in two sites. Fewer trout were captured in 2016 than previous years. Inanga were also absent from one of the two sites in which they were observed in 2015, and banded kokopu were not recorded from two out of three sites in which they had previously been captured. However, redfin bullies were captured for the first time in Waitawheta Stream and mosquitofish, an invasive species, was also recorded for the first time in Karengorengo Stream. Although the introduction of mosquitofish is not optimal, it does suggest, along with the addition or recurrence of inanga, koaro, and redfin bullies, that connectivity within these catchments has improved after several years of low flows and fish are moving more freely throughout the stream network.

Macroinvertebrate communities in the Piako sites improved in total taxonomic richness and EPT richness relative to previous surveys. Percent EPT abundance was more variable, declining in some sites and improving in others. MCI scores were higher in 2016 than 2015 in four of the five sites, although only two were also higher than the 2014 MCI score. In the Waihou catchment, taxonomic richness was lower than 2015 in three sites, although 2016 scores were similar to 2014 scores. EPT richness declined in two sites, increased in two sites, and remained constant in one site between 2015 and 2016. MCI scores, however, were higher than in previous surveys in all sites. In both catchments, macroinvertebrate communities were linked to habitat quality, particularly changes in bank stability and sediment deposition. Macrophyte and periphyton cover also affected macroinvertebrate community composition.

It is recommended that annual ecological monitoring continues at these ten sites. The year-to-year variation observed in the past three years indicates the importance of determining the natural interannual variability of native fish and macroinvertebrate populations to provide a more robust baseline against which to monitor the effects of human impacts on these river ecosystems. To improve the spatial coverage of the monitoring, it may be valuable to introduce a further group of sites for monitoring once every 3-5 years. This ecological monitoring will support WRC in setting appropriate, targeted and robust freshwater objectives and associated protection levels in the Waihou and Piako catchments.

1 Introduction

The Waikato Regional Council (WRC) is responsible for managing the status of water resources in the Waikato region. WRC's approach to the protection, management and use of water resources is set out in the Waikato Regional Plan (WRC 2012), hereafter referred to as the Plan. As required by the National Policy Statement for Freshwater Management (MfE 2011; MfE 2014), the Plan includes minimum flow and allocation limits for all catchments in the region (Table 3-5; WRC 2012). Scheduled reviews of the flow and allocation limits are also specified in the Plan (Table 3-4A; WRC 2012).

WRC have initiated investigations in the Waihou and Piako catchments to support and inform the scheduled allocation review process in these catchments. One of the key objectives of the water allocation process is to safeguard the life-supporting capacity of freshwater ecosystems (MfE 2014). WRC are seeking to improve their understanding of the ecological status of aquatic ecosystems in the Waihou and Piako river systems and have initiated ecological monitoring studies in the two catchments (Franklin and Booker 2009; Franklin et al. 2011; Franklin and Bartels 2012; Franklin et al. 2013; Franklin et al. 2014; Graham et al. 2015a).

The objective of this study was to undertake repeat monitoring of fish, macroinvertebrates, macrophytes and periphyton at ten sites across the Waihou and Piako catchments. Five sites were chosen for annual surveying in each catchment based on the recommendations in Franklin et al. (2013). The aim was to build on and consolidate the previous ecological monitoring studies in the catchments by adding to the time series of data for these sites. The results will contribute knowledge of the ecological values in the catchments to the water allocation decision-making process.

2 Methodology

2.1 Sites

Monitoring was carried out at ten sites in early March 2016 during the summer low flow period (Table 2-1 & Figure 2-1). The sites were those sampled in 2014 and 2015 following the recommendations of Franklin et al. (2013). The previous samplings were also undertaken in early March; consistency in sampling time is required for accurate comparisons of fish populations between years. All sites other than Site 10 on the Waitawheta River had also been sampled at least once prior to 2014. Site 10 was established in 2014 as a new site in the Ohinemuri sub-catchment, downstream of the Ohinemuri weir which is considered a barrier to upstream migration of most fish species.

Table 2-1:Location of the 2014-2016 ecological monitoring sites in the Waihou and Piako catchments.Easting and Northing given for downstream limit of survey reach (NZTM coordinates).

Site	Catchment	Stream	Easting	Northing	Distance inland (km)	Elevation (m)
1	Piako	Mangakahika Stream	1818698	5838814	59	62
2	Piako	Waitoa Stream	1831974	5803819	125	157
3	Piako	Mangapapa Stream	1836783	5809932	107	86
4	Piako	Waitakaruru Stream	1817745	5815748	92	63
5	Piako	Piakonui Stream	1831211	5815768	100	160
6	Waihou	Paiakarahi Stream D/S	1841027	5867879	34	60
7	Waihou	Karengorengo Stream	1848393	5823235	100	30
8	Waihou	Wairere Stream	1851649	5819801	108	40
9	Waihou	Waiteariki Stream	1852566	5818150	112	97
10	Waihou	Waitawheta River	1845480	5849662	71	177

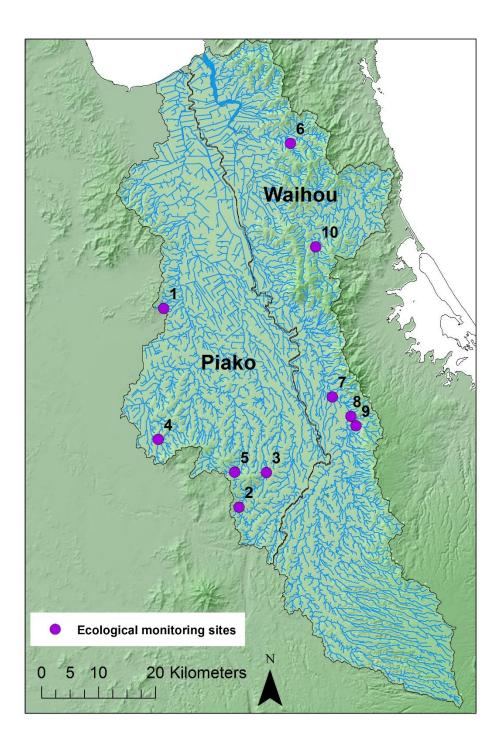


Figure 2-1:Location of the 10 ecological survey sites sampled in the Waihou and Piako catchments during2014 – 2016.Site numbers refer to those listed in Table 2-1.

2.2 Fish

Fish surveys were carried out by electric fishing using the standardised methods outlined by WRC (David and Hamer 2010). At each site, a 150 m reach was surveyed by single pass electric fishing using an EFM300 with voltage adjusted dependent on local conditions. In each site, the same voltage was used as in both 2014 and 2015. Electric-fishing effort was standardized between years by matching the duration of time the electric-fishing machine was operating during each sampling. The number of each species captured, along with fish lengths, were recorded for every 15 m sub-reach.

This survey approach is designed to maximise the likelihood of capturing the full diversity of species present by encompassing the full range of habitats within a stream reach. Results are presented as relative abundance standardised by survey area (number of fish divided by total area sampled).

These abundance estimates are based on single pass electric fishing, which is a semi-quantitative method, and thus they are not equivalent to fish density and should not be used for comparison between sites. Interpretation of the relative abundance estimates are restricted to temporal comparisons at the same site, assuming that the same reach is sampled, with the same level of effort and sampling efficiency on each sampling occasion.

2.3 Macroinvertebrates

Macroinvertebrate sampling was carried out following the standardised procedures for wadeable streams as outlined by WRC (Collier and Kelly 2005). In soft-bottomed streams, woody debris, macrophytes and stream banks were sampled, as appropriate, using a hand net (0.5 mm mesh) following MfE Protocol C2 (Stark et al. 2001). For hard-bottomed streams, a kick-sampling approach targeting riffle areas and following MfE Protocol C1 was utilised (Stark et al. 2001). At each site the WRC REMS (Regional Ecological Monitoring of Streams) habitat assessment protocol was also carried out, with a Field Assessment Cover Form and a Habitat Assessment Field Data Sheet completed. All samples were preserved and returned to the laboratory for processing.

Samples were processed using the recommended MfE Protocol P2 (200 individual fixed counts and scan for rare taxa) (Stark et al. 2001). This provides proportional abundance data suitable for the calculation of most invertebrate parameters (Collier and Kelly 2005). Complete taxonomic lists were compiled and a range of community metrics calculated at the taxa level indicated in Collier and Kelly (2005).

2.4 Macrophytes & periphyton

Macrophyte and periphyton surveys were carried out following the standardised procedures for wadeable streams as outlined by WRC (Collier et al. 2006). At each of five transects located in the reach, periphyton cover was assessed at five points (10%, 30%, 50%, 70% and 90%) across the wetted width of the stream and the area of macrophyte cover occupying the 1 m wide band upstream of the transect was estimated.

Details of the thickness and cover of periphyton were recorded allowing calculation of the Periphyton Enrichment Index (PEI), Periphyton Sliminess Index (PSI) and a range of periphyton biomass indices as defined in Collier et al. (2006). The percentage cover of different submerged and emergent species of macrophytes was also recorded, allowing calculation of the macrophyte cover indices (Collier et al. 2006).

3 Results

3.1 Piako catchment

3.1.1 Fish

Five of the six native fish species found across the five survey sites in the Piako catchment during the 2014 and 2015 surveys were captured in 2016, as were two additional species not recorded in the previous two years (Table 3-1). No exotic species were captured, even though they are known to be locally abundant in some areas of the Piako catchment. Shortfin eels (Anguilla australis) were present at all five sites, while longfin eels (Anguilla dieffenbachii) were only present at three sites. Longfin eel populations appear to be variable over time; longfin eels were captured in Waitoa stream, where they were absent in 2015, but not captured in Piakonui stream, where they were found in both 2014 and 2015. Koura (Paranephrops planifrons), the freshwater crayfish, were found in all five sites, and freshwater shrimp (Paratya curvirostris) were recorded for the first time in Waitoa Stream. Bullies were present at all sites in 2016, as they had been in both previous surveys, with common bullies (Gobiomorphus cotidianus) present at the sites on the Mangakahika and Piakonui Streams, and Cran's bullies (Gobiomorphus basalis) recorded at the sites on the Waitoa, Mangapapa and Waitakaruru Streams. Greater numbers of bullies were captured in all streams in 2016 compared to previous surveys. Banded kokopu (Galaxias fasciatus) were captured in the Mangakahika and Piakonui Streams, similar to 2014 and 2015, although abundances were lower in Mangakahika Stream than in past years. Torrentfish (Cheimarrichthys fosteri) were not captured in any of the Piako streams, including the Waitakaruru, where they were present in 2014 and 2015. Inanga (Galaxias maculatus) were found in Mangapapa stream for the first time since 2012, and a koaro (Galaxias brevipinnis) was also captured for the first time in Piakonui Stream. Koaro have never previously been recorded in the Piako catchment based on records in the New Zealand Freshwater Fish Database (NZFFD).

The relative abundance of fish was higher in 2016 than in 2015 in Mangakahika Stream, Waitoa Stream, and Mangapa Stream (Table 3-1, Figure 3-1). In the Mangakahika, shortfin and longfin eel abundances were higher in 2016 than 2015, and similar to the abundances found in 2014. Common bully abundance was also substantially higher in 2016. However, fewer banded kokopu were caught than in either 2014 or 2015.

Waitoa Stream also had greater abundances of shortfin and longfin eels, as well as Cran's bullies, in 2016. Shortfin eel and Cran's bully abundances were the highest observed over all three survey years in this site in 2016.

Mangapapa Stream likewise had the greatest abundances to date of shortfin eels, longfin eels, and Cran's bullies. All three taxa were approximately twice as abundant in 2016 as they had been in 2015. Inanga were also found for the first time in the Piako catchment streams in this site in 2016.

Shortfin eel abundance was lower in Waitakaruru Stream in 2016 than 2015, while the abundance of Cran's bullies was higher than in the previous year. Torrentfish, which had been found in the Waitakaruru in 2014 and 2015, were not captured this year.

In Piakonui Stream, shortfin eel abundances were comparable to previous years, but longfin eels were not found for the first time in the three years of annual surveys. Bully abundance, however, was higher than in previous years, and the relative abundance of banded kokopu was the same as in

2015. Additionally, a koaro was found for the first time in this site; this is also the first time koaro has been captured in any of the monitored Piako or Waihou sites. A sub-sample of bullies were checked for identification in the laboratory and all identified as common bullies. However, given the relative distance inland and size range of some of the bullies captured, and the questions regarding the accuracy of existing keys for distinguishing common and Cran's bullies, some doubt remains regarding the true identification of the bullies at this site. It is likely this will only be resolved with genetic analyses.

Fish species richness was higher in two sites, Mangapapa and Piakonui, in 2016 due to the finding of inanga and koaro, respectively. Fish richness was also higher in Waitoa Stream in 2016 and back to previous levels due to the re-addition of longfin eels which were absent in 2015. Fish species richness in Mangakahika and Waitakaruru Streams remained the same as in 2015.

Ordinations based on dissimilarity between community matrices can be used to study assemblage composition, or relative balance of different species, over time. In an ordination plot, communities which are more similar are plotted closer together and those that are less similar are further apart. An ordination of the fish assemblages for each survey year show that the Piako communities are more similar within streams than between streams (i.e., the three sampling dates for each stream cluster closely together; Figure 3-2). The five streams are also all relatively close to the centre of the ordination, indicating they have similar overall composition. Moreover, there is little variation in community composition within each stream over time. The largest change in assemblage structure occurred in Mangakahika Stream between 2014 and 2015; however, by 2016 the community was again similar to the 2014 composition. This pattern reflects the much lower abundances of shortfin and longfin eels in Mangakahika Stream in 2015 than 2014 and 2016. Additionally, Mangapapa is the only site in which the community has continued to shift in the same direction over all three survey years, perhaps indicating a trend. This trend is likely at least partially driven by the large increase in proportion of Cran's bullies within the community in 2016.

Fish length data provide information on fish recruitment and survival rates. A comparison of probability density functions (i.e., the probability of observing a particular value based on the distribution of the data; Quinn and Keough 2002) in each survey year 2014 – 2016 for shortfin eels and the two bully species at the Piako survey sites are shown in Figure 3-3. The remaining species were not captured in sufficient numbers for development of size distributions. The size ranges of shortfin and longfin eels as well as Cran's and common bullies are given in Table 3-2.

The size distribution of shortfin eels within a site has been fairly consistent between years (Figure 3-3). The size distribution of shortfin eels was right-skewed in most sites, due to the greater numbers of smaller eels than larger eels. This was particularly apparent for the 200-400 mm size class, over which probability density declined in all sites. Moreover, abundances of eels in the smallest size classes (<200 mm) may be slightly under-represented in Figure 3-3 as elvers (juvenile eels) were often too small to be identified as shortfins or longfins in the field and thus recorded as a separate category (Table 3-1). However, unidentified elvers typically were a small proportion of the total eel abundance in each site (Table 3-1).

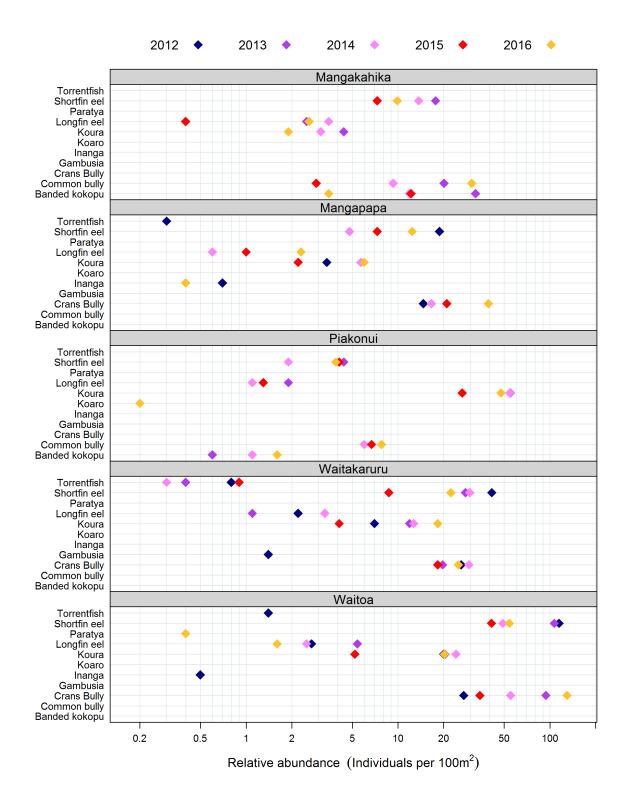
There were more medium (200-400 mm in length) shortfin eels captured in Mangakahika and Piakonui Streams in 2016 than in previous years, although there continued to be an absence of eels larger than 400 mm in the Piakonui. On the other hand, there were more large (400-800 mm in length) and very large (>800 mm in length) eels captured in Waitoa Stream than in either 2015 or 2014 (Figure 3-3). The scarcity of large eels is consistent with known habitat constraints (i.e., lack of large pools for large eels). The downstream migration of adult male eels, which typically migrate at between 350-500 mm in length (Todd 1980), intraspecific competition and commercial or traditional harvest pressure may also be contributing factors to low numbers of large eels in these sites.

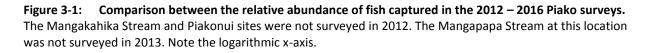
The size distribution of bullies was variable between years in most sites. The size distributions were sometimes right-skewed, but often approximately normal (i.e., greatest number of median-sized fish). The distributions were also bimodal in several streams/years, indicating peak densities of multiple size classes. There were more large adults (>50 mm) as well as more juvenile (<30 mm) and young adult (30-40 mm) Cran's bullies in the three sites (Mangapapa, Waitakaruru and Waitoa) where they are present in 2016 than in 2015 (Figure 3-3). In fact, the 2016 distributions more closely resembled the 2014 size distributions than those observed in 2015. However, there were fewer small Cran's bullies in 2016 than in 2014 in both Mangapapa and Waitakaruru Streams. In the Waitoa, on the other hand, the size distribution for 2015 was more right-skewed, indicating more small fish and increased recruitment, than either the 2014 or 2015 size distribution, which was left-skewed towards large adult fish. These variations suggest that recruitment is inconsistent between years. In Piakonui Stream, the size distribution of common bullies in 2016 was very similar to that in 2015 (Figure 3-3), and the population consisted primarily of adult fish (>50 mm). This suggests that this population is primarily sourced by migration/re-distribution within the stream, rather than recruitment. Contrastingly, the common bully population in Mangakahika Stream in 2016 was dominated by juvenile fish, compared to greater proportions of adults in 2014 and 2015 (Figure 3-3).

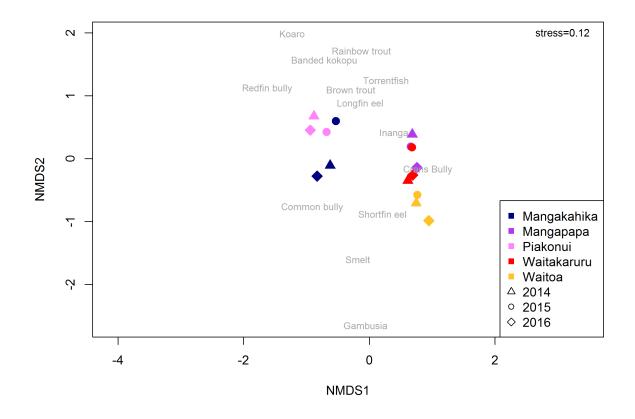
Longfin eels were only present in low numbers at all sites and the majority of those captured were >400 mm in length. Compared to the shortfin eel populations in the Piako, the smaller size classes appear to be significantly under-represented in the longfin eel population; Mangapapa Stream was the only site in which a longfin elver (<100 mm) was captured (Table 3-2). The lack of juvenile longfin eels may relate to either poor recruitment of this species, or an artefact of the limited sampling, as longfin elvers tend to have patchier distributions and may stay closer to the coast for longer compared to shortfins.

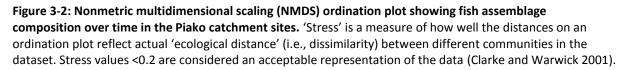
 Table 3-1:
 Results of 2014-2016 electric fishing surveys at the five Piako catchment monitoring sites. A = Number caught (abundance); RA = Relative abundance (individuals per 100 m²). The results from the 2016 survey are in blue; the results from the 2014 and 2015 surveys are included in black for comparison.

Site	Year	Short	fin eel	Long	fin eel	E	lver	Cran	's bully		nmon Illy	Torre	entfish	Ina	inga		nded kopu	Ко	aro	Ко	ura	Parat	ya
		Α	RA	Α	RA	Α	RA	Α	RA	Α	RA	Α	RA	Α	RA	Α	RA	Α	RA	Α	RA	Α	RA
1. Mangakahika	2016	31	9.9	8	2.6	-	-	-	-	96	30.6	-	-	-	-	11	3.5	-	-	6	1.9	-	-
	2015	18	7.3	1	0.4	3	1.2	-	-	7	2.9	-	-	-	-	30	12.2	-	-	-	-	-	-
	2014	31	13.7	8	3.5	-	-	-	-	21	9.3	-	-	-	-	27	11.9	-	-	7	3.1	-	-
2. Waitoa	2016	134	54.1	4	1.6	9	3.6	321	129.7	-	-	-	-	-	-	-	-	-	-	50	20.2	1	0.4
	2015	80	41.3	-	-	22	11.4	67	34.6	-	-	-	-	-	-	-	-	-	-	10	5.2	-	-
	2014	120	49.1	6	2.5	-	-	135	55.2	-	-	-	-	-	-	-	-	-	-	59	24.1	-	-
3. Mangapapa	2016	70	12.4	13	2.3	1	0.2	222	39.4	-	-	-	-	2	0.4	-	-	-	-	34	6.0	-	-
	2015	36	7.3	5	1	7	1.4	104	21	-	-	-	-	-	-	-	-	-	-	11	2.2	-	-
	2014	26	4.8	3	0.6	-	-	91	16.6	-	-	-	-	-	-	-	-	-	-	31	5.7	-	-
4. Waitakaruru	2016	17	3.9	-	-	-	-	74	25	-	-	-	-	-	-	-	-	-	-	54	18.3	-	-
	2015	30	8.7	-	-	4	1.2	63	18.3	-	-	3	0.9	-	-	-	-	-	-	14	14.1	-	-
	2014	89	29.7	10	3.3	-	-	88	29.3	-	-	1	0.3	-	-	-	-	-	-	38	12.7	-	-
5. Piakonui	2016	17	3.9	-	-	3	0.7	-	-	34	7.8	-	-	-	-	7	1.6	1	0.2	207	47.7	-	-
	2015	13	4.1	4	1.3	6	1.9	-	-	21	6.7	-	-	-	-	5	1.6	-	-	83	26.5	-	-
	2014	7	1.9	4	1.1	-	-	-	-	22	6.0	-	-	-	-	4	1.1	-	-	200	54.6	-	-









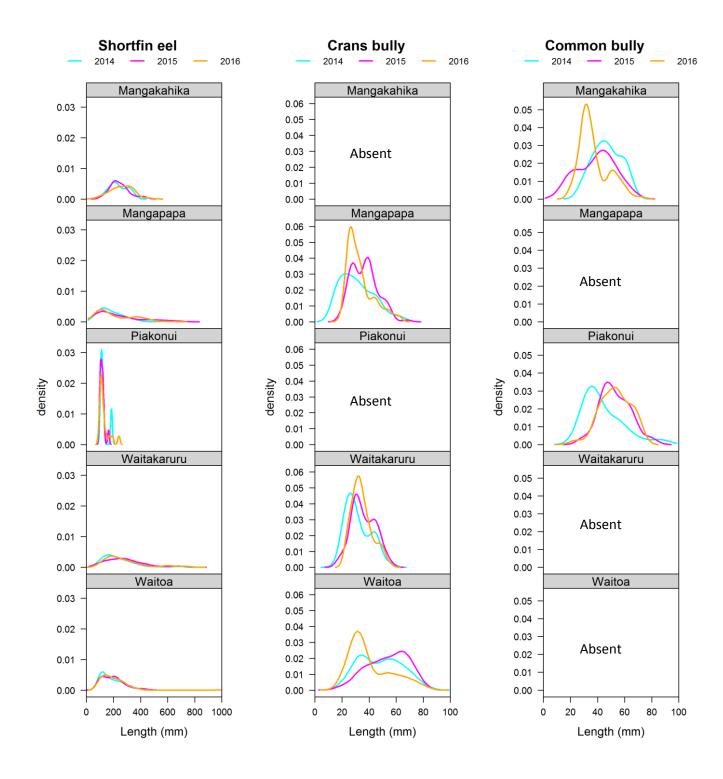


Figure 3-3: Size distributions (probability density functions) for the most abundant fish species at each site in the Piako catchment between 2014 and 2016. 2014 is shown in blue, 2015 is shown in pink, and 2016 is shown in orange.

Site	Year		Shortfin e	el		Longfin eel			Cran's bully		Common bully					
		min	max	median	min	max	median	min	max	median	min	max	median			
1. Mangakahika	2016	103	450	251	179	950	500	-	-	-	20	72	33			
	2015	125	422	230	795	795	795	-	-	-	21	59	42			
	2014	70	350	220	163	820	435	-	-	-	30	63	46			
2. Waitoa	2016	81	1000	180	330	760	586.5	19	85	34	-	-	-			
	2015	95	450	198	-	-	-	20	78	56	-	-	-			
	2014	91	395	168	91	880	280	20	85	49	-	-	-			
3. Mangapapa	2016	86	590	162	92	520	238.5	19	62	31	-	-	-			
	2015	84	650	164	101	700	320	20	68	37	-	-	-			
	2014	90	610	150	500	700	600	15	65	30	-	-	-			
4. Waitakaruru	2016	105	740	226	-	-	-	23	55	33	-	-	-			
	2015	87	718	266.5	-	-	-	18	55	35	-	-	-			
	2014	90	700	200	90	740	550	15	57	30	-	-	-			
5. Piakonui	2016	94	240	115	-	-	-	-	-	-	24	70	53			
	2015	97	163	111	438	642	455	-	-	-	30	79	50			
	2014	105	185	115	400	650	620	-	-	-	30	87	38			

Table 3-2: Size ranges for most abundant fish (eels and bullies) captured in the Piako catchment in 2014-2016. The results from the 2016 survey are in blue; the results from the 2014 and 2015 surveys are included in black for comparison.

3.1.2 Macroinvertebrates

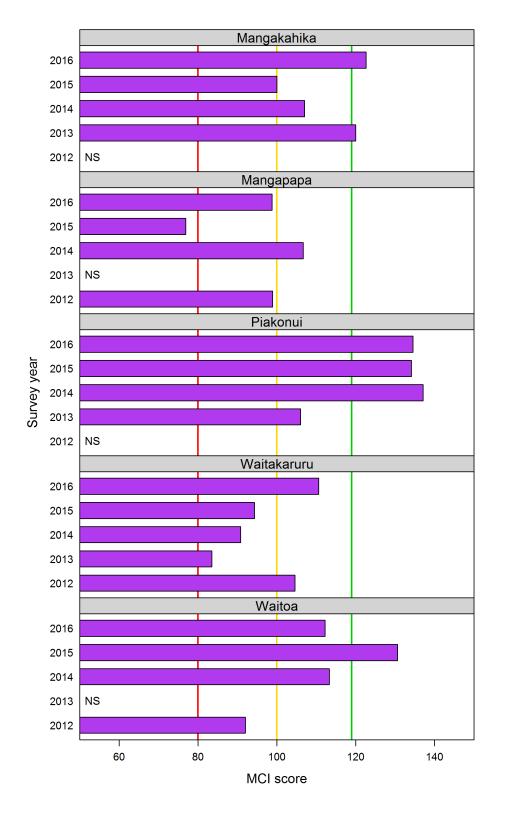
All sites were sampled according to the MfE protocol C1 for hard-bottomed streams, with an area of approximately 1 m² sampled at each site. A full taxonomic list for each site is included in Appendix D and is summarised at the taxa level in Table 3-3 according to the methods and requirements of (Collier and Kelly 2005). Total taxa richness describes the total number of different types of macroinvertebrates present at a site. Broadly speaking, the higher the total taxa richness, the greater the quality and diversity of habitats present. Benthic invertebrates such as Ephemeroptera (mayflies), Plecoptera (stoneflies) and Trichoptera (caddisflies) collectively known by the acronym EPT are widely utilised as bio-indicators in freshwater ecosystems due to their 'heightened sensitivity' to habitat degradation or pollution. Pristine or native forest habitats typically have greater biodiversity and a higher proportion of these types of sensitive species than intensively developed (i.e., pasture) catchments (Boothroyd and Stark 2000). EPT richness and %EPT (Table 3-3) are used to summarise the presence and significance of these taxa at a site. The Macroinvertebrate Community Index (MCI), in contrast, was developed as an indicator of the tolerance of macroinvertebrate communities to organic pollution (Stark and Maxted 2007) and therefore provides a complementary measure of stream health. Scores of less than 80 are classified as poor, those of 80-100 as fair, those of 100-120 as good, and those of greater than 120 as excellent (Stark and Maxted 2007).

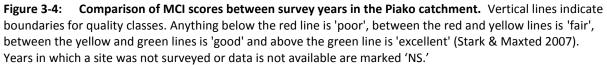
Invertebrate taxa richness was higher at all sites except Piakonui in 2016 compared to 2015, continuing the increasing trend observed between 2014 and 2015 (Table 3-3). EPT richness was also higher at all sites in 2016 than in 2015, although the relative abundance of EPT only increased in two sites (Mangakahika and Waitakaruru Streams). MCI scores were also higher in all sites excluding Waitoa Stream in 2016, although scores in Mangapapa and Piakonui remained below the 2014 values.

As in 2014 and 2015, the Piakonui site had the highest total taxa richness and EPT richness out of all sites; the %EPT and MCI scores were also highest at this site (Table 3-3). The Mangapapa and Waitakaruru sites were tied for lowest taxonomic richness in 2016 (Table 3-3), although the number of EPT taxa in both sites had increased. The MCI scores also improved in both sites, a reversal of the previous year's decline (Figure 3-4), indicating the presence of more pollution-sensitive taxa. Mangapapa moved from a 'poor' to a 'fair' score, while Waitakaruru moved from 'fair' to 'good.' The MCI score for Mangakahika went from 'fair' to 'excellent.' This improvement is possibly linked to the concurrent improvement in habitat score at this site between 2015 and 2016 (see Figure 3-8). The MCI score in the Piakonui remained in the 'excellent' category, similar to the previous two years (Figure 3-3). The Waitoa site, on the other hand, went from 'excellent' to 'good,' perhaps due to the increase in algal abundance that was also observed at this site in 2016 (see Figure 3-4).

Table 3-3:Summary of macroinvertebrate results for the Piako monitoring sites in 2014-2016. The resultsfrom 2016 are in blue; the results from the 2014 and 2015 surveys are included in black for comparison. MCIscores less than 80 are classified as 'poor,' scores 80-100 are 'fair,' scores 100-120 are 'good,' and scoresgreater than 120 are considered 'excellent' (Stark & Maxted 2007).

Site	Year	Total taxa richness	EPT richness	%EPT	MCI
1. Mangakahika Stream	2016	31	15	40.8	122.6
	2015	27	10	24.1	100
	2014	20	11	58.7	107.0
2. Waitoa Stream	2016	18	12	61.4	112.2
	2015	17	11	77.2	130.6
	2014	15	10	69.9	113.3
3. Mangapapa Stream	2016	17	10	21.7	98.8
	2015	13	8	38.7	76.9
	2014	9	6	2.0	106.7
4. Waitakaruru Stream	2016	17	9	42.8	110.6
	2015	14	7	15.9	94.3
	2014	13	5	38.6	90.8
5. Piakonui Stream	2016	33	23	76.1	134.5
	2015	34	20	86.8	134.1
	2014	28	15	83.5	137.1





3.1.3 Macrophytes & periphyton

Three of the five sites have no or low macrophyte cover present (Figure 3-5). Macrophyte cover also declined in the other two sites compared to the previous year, from nearly 50% to 20% (similar to the 2014 level) in Waitakaruru Stream and from 30% to 25% in Waitoa Stream (Figure 3-5). The change in the Waitakaruru was largely due to reduced abundance of *Potamogeton crispus*, an exotic submerged macrophyte. The Waitoa site, on the other hand, continued to be dominated by emergent watercress (*Nasturtium officinale*).

The periphyton enrichment (PEI) and sliminess (PSI) indices have remained relatively stable over time at the Piakonui and Mangakahika sites (Figure 3-6 & Figure 3-7). Although the Waitoa had very low periphyton scores in 2015, the higher 2016 scores for PEI and PSI in 2016 were consistent with those observed in 2013 and 2014. In the Waitakaruru, both PEI and PSI scores have declined between 2014 and 2016 (Figure 3-6 & Figure 3-7), indicating that nutrient enrichment has been alleviated at this site. Conversely, the PEI score for Mangapapa Stream in 2016 was nearly double the 2015 score, which had been the highest recorded score for that site to date. The 2016 PSI score for Mangapapa was also approximately twice as large as the 2015 score, though it was much lower (23.2) than the PEI score (90).

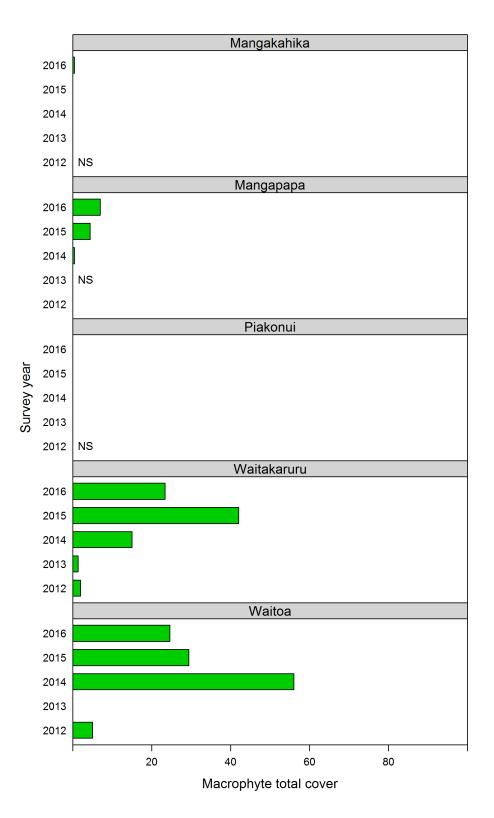


Figure 3-5: Comparison of macrophyte total cover (MTC) scores over time at the Piako survey sites. Years in which a site was not surveyed are marked 'NS.'

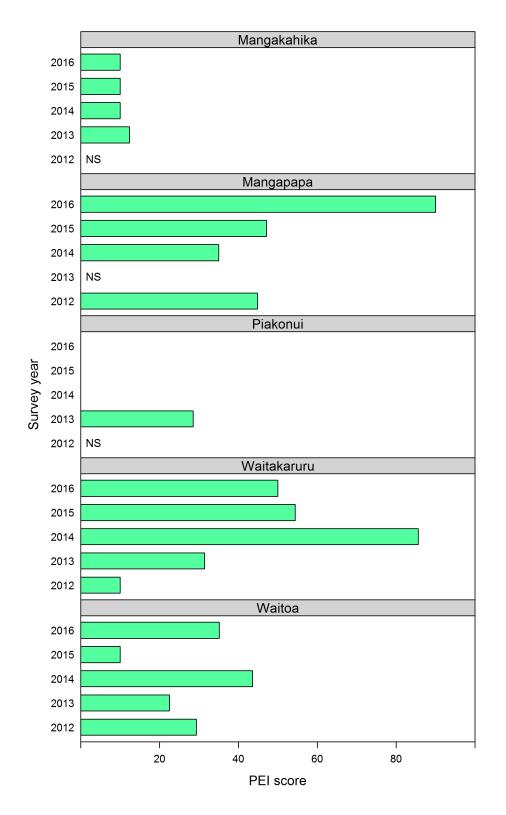
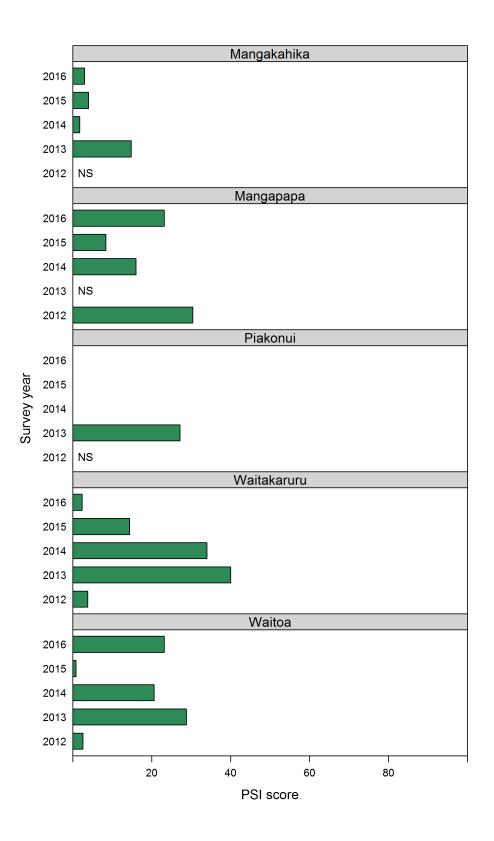
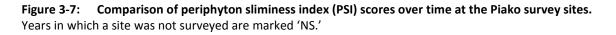


Figure 3-6: Comparison of periphyton enrichment index (PEI) scores over time at the Piako survey sites. Years in which a site was not surveyed are marked 'NS.'





3.1.4 Habitat quality scores

The habitat assessment scores provide a composite index of both reach scale and biotic characteristics of the stream, which can be used as an indicator of habitat quality. Full details of the habitat assessment results are included in Appendix A.

The habitat scores for the Piako sites have fluctuated between years but show few overall trends (Figure 3-8). However, there has been a gradual decline in scores in the Mangapapa site (Figure 3-8), which lacks adequate fencing to prevent stock from accessing the stream. The lower habitat scores were primarily caused by decreases in riparian vegetation and increased stream bank erosion. The Waitoa site habitat scores were also declining until 2014, improved slightly in 2015, and declined again in 2016. Fencing is also absent at this site, and the variability in scores may reflect access and damage by livestock. Habitat scores for Mangakahika and Waitakaruru streams had decreased in 2015, but increased again in 2016, likely in association with increased bank stability and reduced sediment deposition, as well as lower periphyton cover. Piakonui stream had a slightly higher habitat score in 2016 than 2015, continuing a positive trend observed since 2013. Improved scores in this site are related to continued growth of riparian buffers as well as increased bank stability and reduced sediment deposition.

Correlations between habitat score and biotic indices were evaluated using the non-parametric Spearman's rank correlation (ρ). Samples from all survey years were pooled (n=21). The macroinvertebrate indices all correlated positively with the habitat score indicating a general improvement in macroinvertebrate communities with increasing habitat score. There was a modest correlation between the habitat score and MCI score (ρ =0.45; Figure 3-9). Interestingly, the correlation appears to have been stronger in the early surveys (2012-2014), whereas in 2015 and 2016 higher MCI scores were observed even in sites with low habitat scores. Nonetheless, the highest MCI scores were found in the site which also had the highest habitat score, Piakonui Stream (Figure 3-8). The correlations between habitat score, total macroinvertebrate richness and fish species richness were also modest but positive (ρ =0.47), indicating that fish may be more influenced by in-stream physical habitat conditions than invertebrates (Figure 3-10, Table 3-3).

Biotic index	Spearman's rank correlation coefficient
MCI	0.45
Macroinvertebrate total richness	0.44
EPT richness	0.44
% EPT	0.33
Fish richness	0.47

Table 3-4:	Correlation coefficients between the habitat score and various biotic indices for the Piako
catchment i	n 2016.

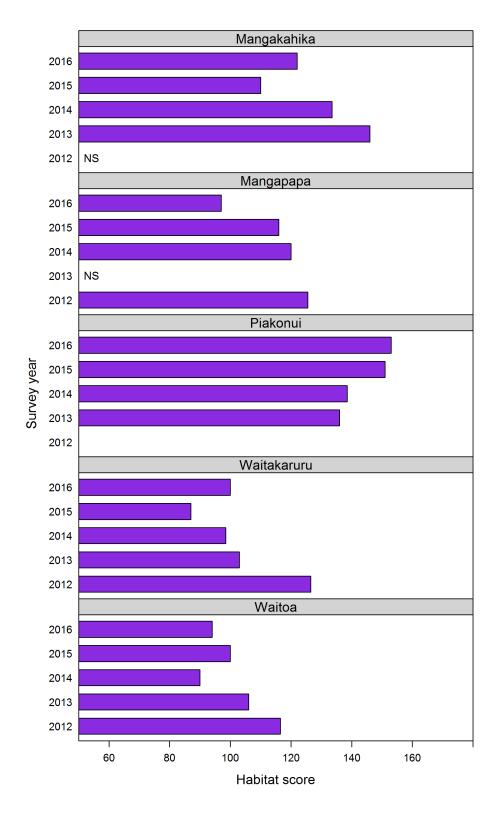


Figure 3-8: Comparison of habitat scores over time for the Piako survey sites. Years in which a site was not surveyed are marked 'NS.'

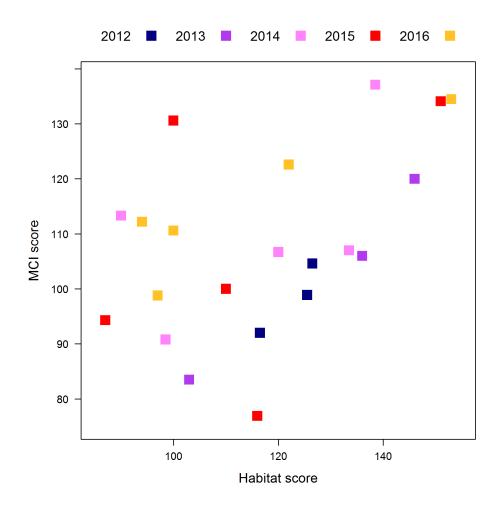


Figure 3-9: Scatterplot of habitat score against MCI score at the Piako survey sites in different survey years (ρ=0.45). No MCI score was available for the Waitoa site in 2013.

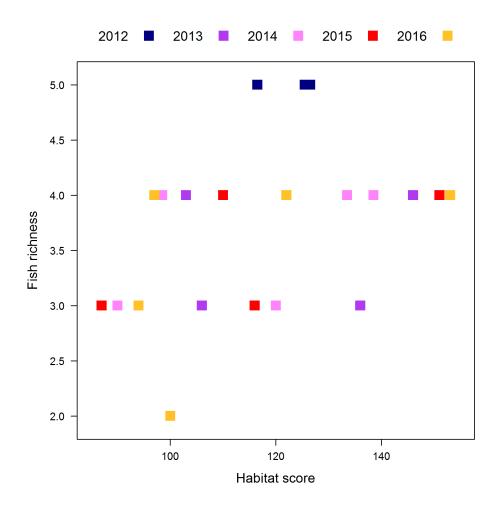


Figure 3-10: Scatterplot of habitat score against fish species richness at the Piako survey sites in different survey years (ρ =0.47).

3.2 Waihou catchment

3.2.1 Fish

Twelve different fish species were recorded among the five Waihou survey sites in 2015, nine of which were native and three of which were exotic species (mosquitofish, rainbow trout, and brown trout; Table 3-5). Shortfin eels were the only fish species present at all five sites, while longfin eels were recorded at four sites. Koura (freshwater crayfish), were also present at all five sites and freshwater shrimp (*Paratya curvirostris*) were found at one site. Banded kokopu were only captured at one site, similar to 2015, although it was a different site. Inanga were also only found at one site, compared to two sites in 2015. Redfin bully were captured for the first time in any of the sampled Waihou or Piako streams, as was *Gambusia affinis*, the invasive mosquitofish. The greatest species richness (8 total, including 6 native species and 2 exotic species) was recorded in the Karengorengo survey site, where shortfin eels, longfin eels, Cran's bully, torrentfish, inanga, banded kokopu, rainbow trout (*Oncorhynchus mykiss*), and brown trout (*Salmo trutta*) were captured (Table 3-5). This is lower than the maximum richness of eight species observed at the Paiakarahi site in 2015 (only four taxa were captured at that site in 2016). The greatest abundance of fish was recorded from the Wairere Stream site, due to high numbers of common bullies and shortfin eels, although Karengorengo Stream had the greatest abundance of shortfin eels alone.

The total and relative abundance of fish is compared between survey years for each site in Figure 3-11. A high abundance of macrophytes at the Karengorengo Stream site severely inhibited electric fishing in 2014; it was suspected that the low abundances recorded that year were underestimates caused by the low capture efficiency. Macrophyte cover at this site has continued to decrease over time, to the lowest level observed in 2016 (Figure 3-15). The numbers of fish captured have increased correspondingly in the past two years, with the greatest number of bullies and shortfin eels found in 2016. However, the reduced macrophyte cover was not associated with increased capture of longfin eels or inanga (one present in 2015 and 2016), both of which were found in greater abundance in surveys prior to 2014. A new exotic species, *Gambusia*, was also captured for the first time in this site in 2016, although it is possible it has been present in all sampling years but was not found due to the electric-fishing difficulties.

At the Paiakarahi sampling site, the abundance of shortfin eels, torrentfish, and brown trout were consistent with ranges observed in the previous two surveys (Figure 3-11, Table 3-5). Abundance of Cran's bullies was greater than that observed in 2015, and similar to 2014 numbers. However, inanga and banded kokopu, both of which were found in low numbers in previous surveys, were not captured in 2016, nor were rainbow trout, which were also present in 2014 and 2015.

At the Wairere Stream site, the relative abundances of both shortfin and longfin eels in 2016 were similar to those observed in 2015 (Figure 3-11, Table 3-5). Greater numbers of common bullies were caught in 2016 compared to 2015, although the relative abundance was still much less than in 2014. Torrentfish abundance increased in 2016, while inanga continued to be absent (only recorded in the 2011 survey).

At the Waiteariki survey site, fewer shortfin and longfin eels were recorded in 2016 compared to 2015 (Figure 3-11, Table 3-5). Cran's bully abundance, on the other hand, was higher in 2016 than in 2015. There was also a greater abundance of torrentfish. Unlike previous years, no trout were captured. Banded kokopu were also recorded again after not being captured in 2015.

At the Waitawheta site, shortfin and longfin eel abundances have shown a continued decline since 2014, whereas common bully abundance was the highest recorded in 2016. Brown trout, which had been present in 2014 and 2015, were not captured, but one rainbow trout was recorded. No banded kokopu were captured (last observed in 2014). Koura abundance was lower than in 2015, but comparable with the 2014 level.

Community composition was similar among the five Waihou sites, and also did not vary widely within each stream, except for in Karengorengo Stream, in which there were large shifts in assemblage composition between years (Figure 3-12). These shifts are likely associated with the substantial reduction in macrophyte cover during this period. This could reflect either changes in composition related to changes in macrophyte cover or, more likely, simply be an artefact of the improvement in electric-fishing efficiency in low macrophyte conditions. There was also a shift in community composition in Wairere Stream between 2014 and 2015, while the 2016 community was again very similar to the 2014 assemblage. The community in Waitawheta Stream has moved in the same direction on the ordination over the three survey years, perhaps indicating a directional trend.

Size distributions show that shortfin eel population structure has remained consistent over time in Karengorengo, Paiakarahi, and Wairere Streams (Figure 3-13). As in the Piako streams, shortfin eel size distributions tended to be right-skewed with a greater proportion of small eels (median size 123-187 mm across the five sites; Table 3-6). There were very few large shortfin eels >400 mm at any site. In fact, in Waitawheta there were no large eels >250 mm. This may indicate lack of suitable habitat for large eels within this site or high fishing pressure. In Waiteariki Stream there were also high numbers of small (<200 mm) eels, indicating increased recruitment, but few medium-sized (200 mm – 400 mm in length) eels, perhaps due to the migration of adult males to sea. The few longfin eels captured at these sites were all much larger (>300 mm, Table 3-6), suggesting that instream habitat may be more suited to longfin eels (i.e., hard substrate) rather than shortfin eels. On the other hand, the scarcity of longfin elvers (no longfin eels <200 mm caught in 2016 and only 3 in 2015) suggests that either recruitment of longfin eels in these streams has been poor in recent years, or it could represent an artefact of the limited sampling, as longfin elvers tend to have a patchy distribution.

Bully distributions were more normal with little skew. However, the peak of the distribution shifted between years within sites, and was bimodal in multiple years, indicating high proportions of small and large fish but few median-sized individuals. There were fewer small (<30 mm) bullies of both species in 2016 than 2015 in all but one site (Wairere), indicating less recruitment of juveniles (Figure 3-13). This is the opposite of the pattern observed in 2015, when there were more small fish, indicating increased recruitment, and less large fish. This suggests that there are natural inter-annual variations in recruitment in these populations.

Site	Year	Shor	tfin eel		ngfin eel	Eľ	ver	Cran'	s bully		imon illy		dfin Illy		rrent- fish	In	anga	Sn	nelt	Gam	busia		nded xopu		inbow rout		rown rout		nid. out	Ко	ura	Ра	aratya
		Α	RA	Α	RA	Α	RA	Α	RA	Α	RA	Α	RA	Α	RA	Α	RA	Α	RA	Α	RA	Α	RA	Α	RA	Α	RA	Α	RA	Α	RA	Α	RA
6.	2016	8	1.4	-	-	-	-	61	10.5	-	-	-	-	3	0.5	-	-	-	-	-	-	-	-	-	-	1	0.2	-	-	5	0.9	-	-
Paiakarahi	2015	6	1.3	10	2.2	-	-	33	7.3	-	-	-	-	1	0.2	2	0.4	-	-	-	-	1	0.2	2	0.4	2	0.4	-	-	34	7.6	3	0.7
	2014	8	1.6	8	1.6	-	-	64	13	-	-	-	-	5	1	1	0.2	-	-	-	-	1	0.2	3	0.6	-	-	-	-	32	6.5	-	-
7.	2016	360	103.4	1	0.3	-	-	-	-	25	7.2	-	-	-	-	1	0.3	13	3.7	1	0.3	-	-	-	-	-	-	-	-	75	21.6	-	-
Karengorengo	2015	98	32	-	-	-	-	-	-	17	5.6	-	-	-	-	1	0.3	24	7.8	-	-	-	-	-	-	-	-	4	1.3	31	10.1	-	-
	2014	33	9.1	-	-	-	-	-	-	3	0.8	-	-	-	-	-	-	2	0.6	-	-	-	-	-	-	1	0.3	-	-	9	2.5	-	-
8.	2016	120	16	1	0.1	16	2.1	-	-	293	39.1	-	-	7	0.9	-	-	-	-	-	-	-	-	-	-	1	0.1	-	-	35	4.7	8	1.1
Wairere	2015	148	17.5	1	0.1	34	4	-	-	208	24.6	-	-	2	0.2	-	-	-	-	-	-	-	-	3	0.4	5	0.6	-	-	15	1.8	6	0.7
	2014	254	31.1	2	0.3	-	-	-	-	965	118	-	-	1	0.1	-	-	-	-	-	-	-	-	-	-	1	0.1	-	-	58	7.1	-	-
9.	2016	28	2.2	4	0.3	-	-	173	13.4	-	-	-	-	7	0.5	-	-	-	-	-	-	5	0.4	-	-	-	-	-	-	120	9.3	-	-
Waiteariki	2015	51	5.5	15	1.6	-	-	87	9.4	-	-	-	-	2	0.2	-	-	-	-	-	-	-	-	1	0.1	1	0.1	-	-	125	13.5	-	-
	2014	20	2.1	10	1.1	-	-	47	5	-	-	-	-	1	0.1	-	-	-	-	-	-	7	0.7	-	-	6	0.6	-	-	88	9.4	-	-
10.	2016	8	1.3	3	0.5	-	-	-	-	96	15.3	15	2.4	-	-	-	-	-	-	-	-	-	-	1	0.2	-	-	-	-	10	1.6	-	-
Waitawheta	2015	12	2.9	17	4	-	-	-	-	53	12.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0.2	-	-	25	6	-	-
	2014	23	4.5	16	3.1	-	-	-	-	64	12.6	-	-	-	-	-	-	-	-	-	-	1	0.2	-	-	3	0.6	-	-	10	2.0	-	-

 Table 3-5:
 Results of 2014-2016 electric fishing surveys at the five Waihou catchment monitoring sites.
 A = Number caught (abundance); RA = Relative abundance (individuals per 100 m²). The results from 2016 are in blue; the results from the 2014 and 2015 surveys are included in black for comparison.

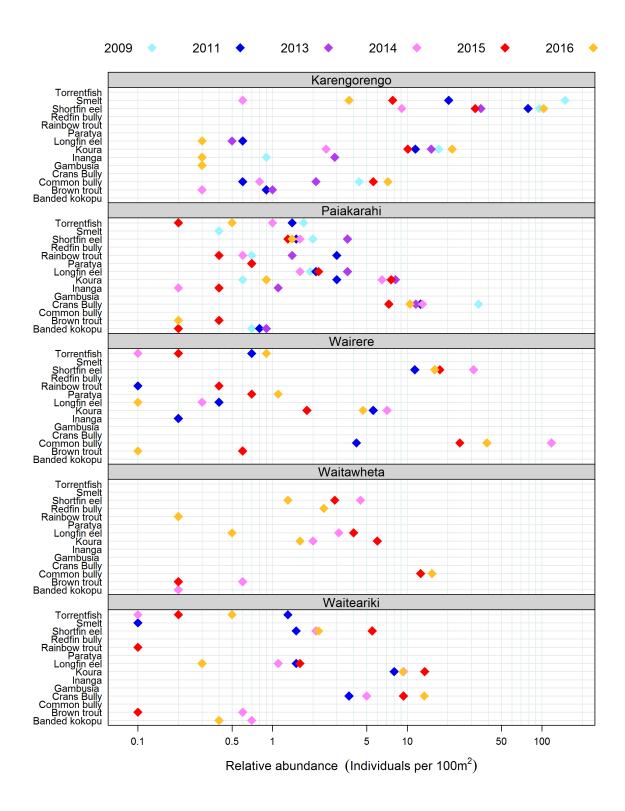
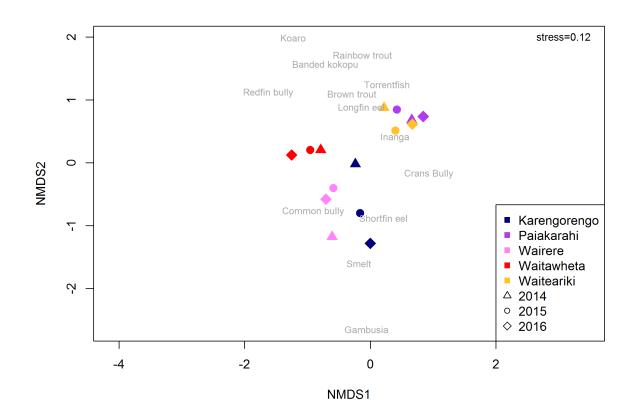
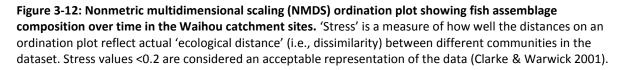


Figure 3-11: Comparison between the relative abundance of fish captured in the 2009, 2011, and 2013 - 2016 Waihou surveys. Wairere Stream and Waiteariki Stream were only sampled in 2011 and 2014-2016. The Waitawheta was only sampled in 2014-2016. Note the logarithmic x-axis.





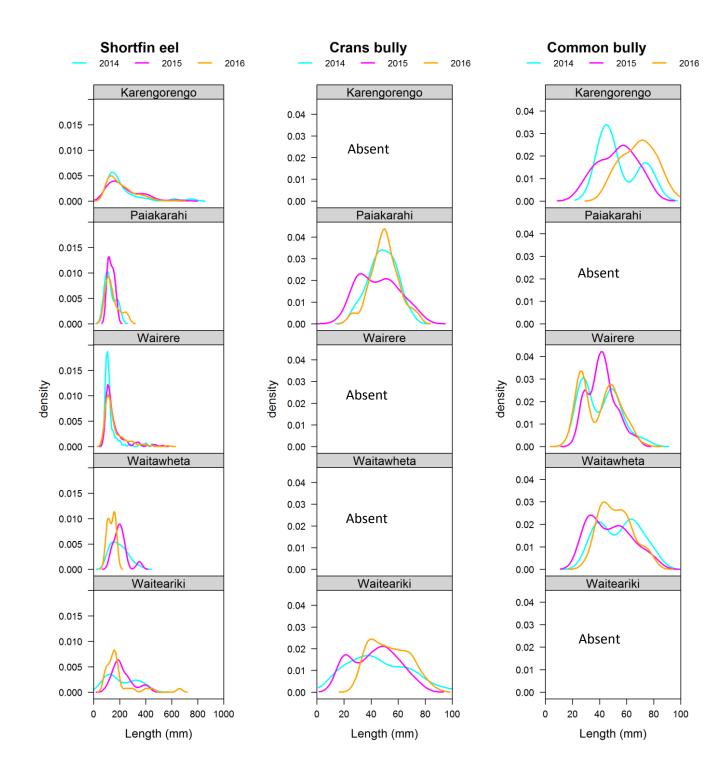


Figure 3-13: Size distributions (probability density functions for the most abundant fish species at each site in the Waihou catchment between 2014 and 2016. 2014 is shown in blue, 2015 is shown in pink, and 2016 is shown in orange.

Site	Year		Shortfin e	el		Longfin eel			Cran's bully	,	(Common bul	ly
		min	max	median	min	max	median	min	max	median	min	max	median
6. Paiakarahi	2016	92	250	124.5	-	-	-	25	74	50	-	-	-
	2015	108	170	131	162	650	259	20	75	47	-	-	-
	2014	86	190	115	98	1002	207.5	26	70	49.5	-	-	-
7. Karengorengo	2016	76	620	187	350	350	350	-	-	-	47	93	70
	2015	75	675	200	-	-	-	-	-	-	30	74	56
	2014	100	750	165	-	-	-	-	-	-	45	74	45
8. Wairere	2016	85	570	123	1000	1000	1000	-	-	-	16	74	42
	2015	86	530	128	930	930	930	-	-	-	21	68	42
	2014	75	450	110	880	930	905	-	-	-	20	76	40.5
9. Waiteariki	2016	89	660	156	450	600	570	30	90	51	-	-	-
	2015	95	430	200	150	850	490	20	75	42	-	-	-
	2014	90	410	170	350	850	505	14	95	42	-	-	-
10. Waitawheta	2016	100	173	139	345	470	350	-	-	-	30	81	52
	2015	132	351	195	205	710	360	-	-	-	30	80	46
	2014	115	350	190	250	750	350	-	-	-	30	85	57.5

Table 3-6: Size ranges for most abundant fish (eels and bullies) captured in the Waihou catchment in 2014-2016. The results from the 2016 survey are in blue; the results from the 2014 and 2015 surveys are included in black for comparison.

3.2.2 Macroinvertebrates

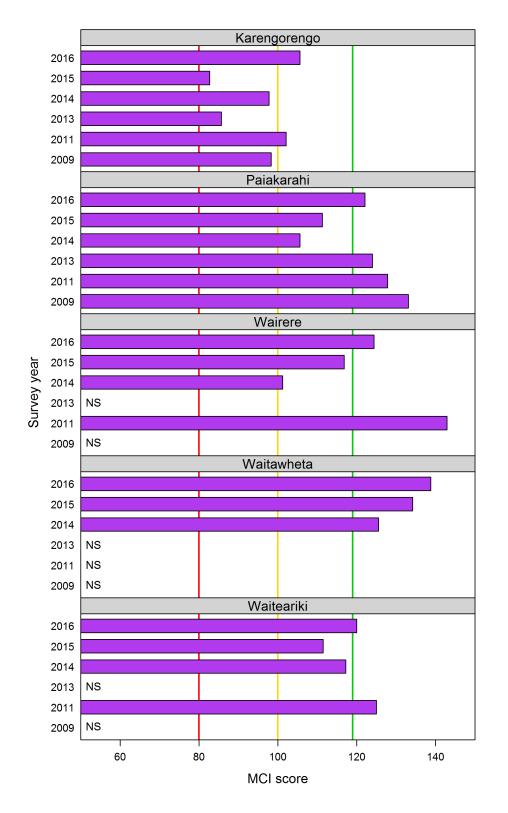
Taxa richness was lower in 2016 than in 2015 at the Paiakarahi, Karengorengo and Wairere sites and showed no change at the Waiteariki site. However, the taxa richness values in 2015 were the highest ever recorded for four of the five sites, and the 2016 scores were on par with those observed in 2014 (Table 3-7). EPT richness was also lower than in 2015 but higher than in 2014 at the Wairere and Paiakarahi sites, and remained the same at the Karengorengo site. The percentage of EPT was lower in 2016 in Paiakarahi Stream and Wairere Stream, but remained similar to previous years in Karengorengo and Waiteariki Streams. The Waitawheta Stream was the only site to show increased taxa richness, EPT richness and percent EPT from 2015 to 2016 (Table 3-5).

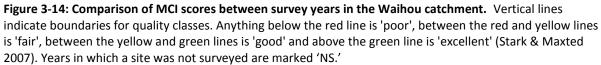
Despite the decreases in taxa and EPT richness, however, MCI scores were higher in all sites in 2016 than 2015, indicating increased prevalence of pollution-sensitive species (Figure 3-14). The MCI score for Karengorengo improved from 'fair' to 'good' while MCI scores for Paiakarahi, Wairere, and Waiteariki went from 'good' to 'excellent.' Waitawheta stream remained in the 'excellent' category as well.

The higher MCI score for Karengorengo Stream in 2016 may be associated with the large decrease in macrophyte cover which also occurred between the 2015 and 2016 samplings (Figure 3-15). Macrophytes have been shown to influence invertebrate community composition in streams, including increased dominance by pollution-tolerant taxa such as chironomids (Collier 2004) and/or gastropods, particularly *Potamopyrgus* snails (Jaschinski et al. 2010; Graham et al. 2015b). Improved MCI scores may also be attributed to decreased periphyton cover, as in Paiakarahi Stream, which had over a 50% decline in both PEI and PSI between 2015 and 2016. However, the MCI score also improved in Waiteariki stream, which had increased periphyton cover in 2016, indicating that periphyton cover is not the main factor driving changes in MCI scores.

Table 3-7:Summary of macroinvertebrate results for the Waihou monitoring sites in 2014-2016. Theresults from 2016 are in blue; the results from the 2014 and 2015 surveys are included in black for comparison.MCI scores less than 80 are classified as 'poor,' scores 80-100 are 'fair,' scores 100-120 are 'good,' and scoresgreater than 120 are considered 'excellent' (Stark & Maxted 2007).

Site	Year	Total taxa richness	EPT richness	%EPT	MCI
6. Paiakarahi Stream	2016	19	13	43.0	122.1
	2015	32	19	61.6	111.3
	2014	18	9	50.2	105.6
7. Karengorengo Stream	2016	18	7	25.7	105.6
	2015	22	7	22.1	82.7
	2014	18	7	22.1	97.8
8. Wairere Stream	2016	18	12	30.1	124.4
	2015	32	20	51.2	116.8
	2014	17	10	35.2	101.2
9. Waiteariki Stream	2016	26	16	72.7	120
	2015	26	13	74.2	111.5
	2014	29	20	78.3	117.2
10. Waitawheta River	2016	33	26	42.9	138.8
	2015	31	22	25.6	134.2
	2014	29	21	23.5	125.5

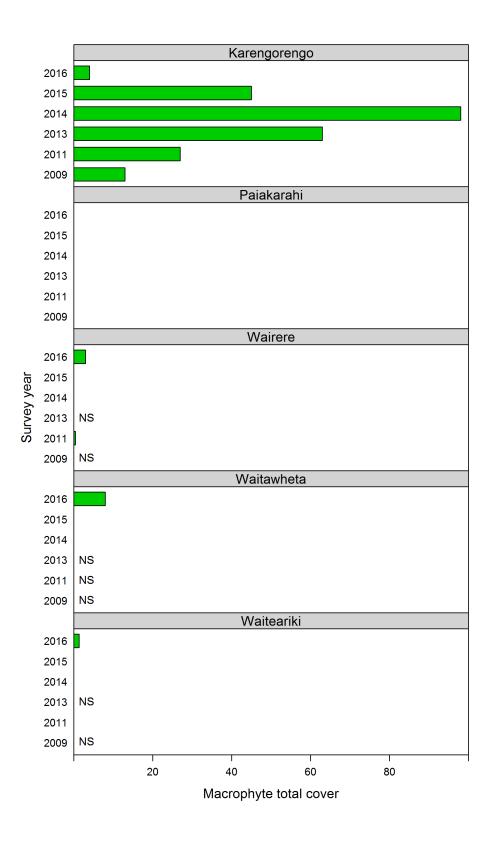


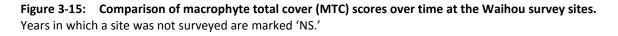


3.2.3 Macrophytes & periphyton

Macrophyte cover was low at all the Waihou survey sites in 2016, including Karengorengo Stream, which has had high coverage in previous years (Figure 3-15). Small amounts of macrophyte cover (<10%) were recorded for the first time in Waitawheta and Waiteariki Streams and for the first time since 2011 in Wairere Stream. Continued monitoring will show if this is an increasing trend.

Periphyton enrichment scores (PEI) were lower than 2015 in the Paiakarahi, Wairere, and Waitawheta sites and higher in the Karengorengo and Waiteariki sites (Figure 3-16). The increase in periphyton in Karengorengo Stream is likely correlated with the decrease in macrophyte cover; extensive macrophyte beds probably out-shaded benthic periphyton in previous years. The PSI score, however, only increased slightly in both Karengorengo and Waiteariki Streams (Figure 3-17), indicating that the new growth was thin film algae rather than long filamentous algae. Wairere Stream and Waitawheta Stream showed the opposite pattern; PEI scores were lower than 2015 but PSI scores were higher, indicating greater relative abundance of long filamentous algae. Paiakarahi Stream, on the other hand, had a lower PSI score as well as a lower PEI score in 2016 compared to 2015, indicating reduced algal growth overall.





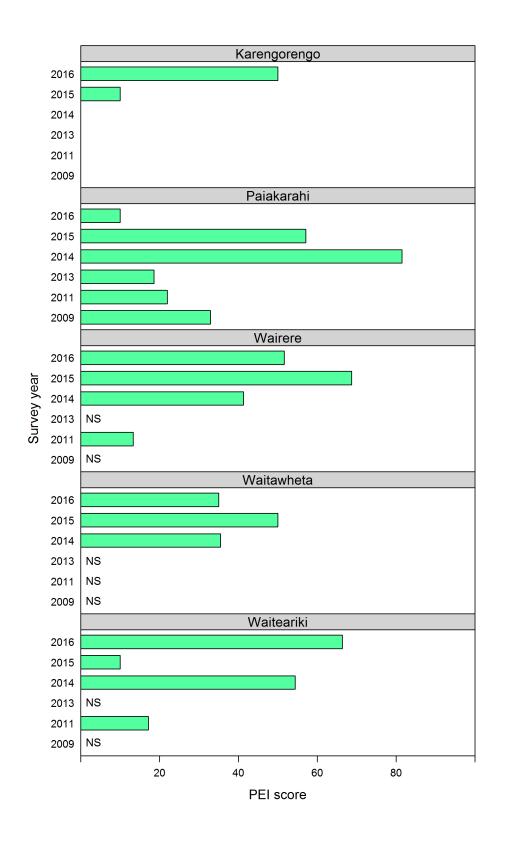
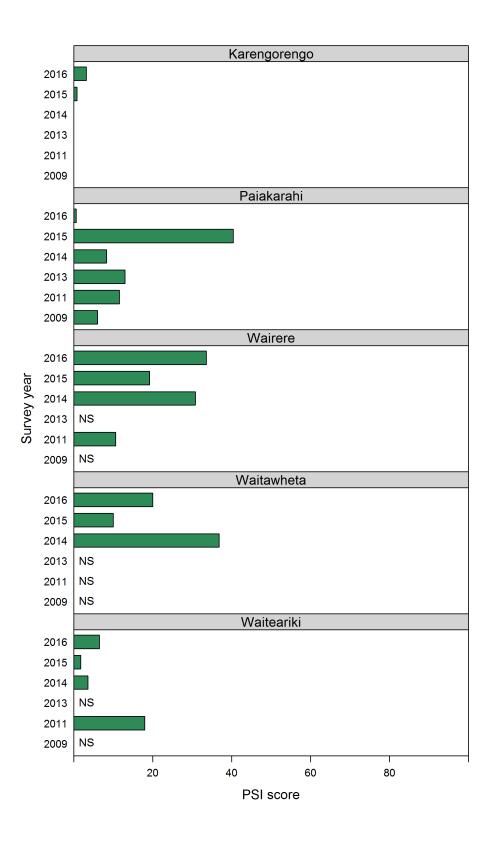
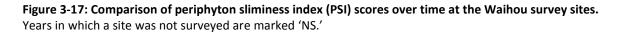


Figure 3-16: Comparison of periphyton enrichment index (PEI) scores over time at the Waihou survey sites. Years in which a site was not surveyed are marked 'NS.'





3.2.4 Habitat quality scores

The habitat quality scores have fluctuated over time at all of the Waihou survey sites, but remain largely within the same range (Figure 3-18). Waitawheta Stream is the only site with a constant trend over time; the habitat score in this site has been increasing since 2014. The other four sites also showed slight increases in habitat score between 2015 and 2016. In Karengorengo Stream, however, the habitat score remains lower than all other previous samplings except 2015. The decline in habitat score between 2014 and 2015 was associated with increased stream bank erosion, and this year's sampling indicated that recovery has been slow.

Correlations between habitat scores and biotic indices indicated a positive association between the macroinvertebrate indices and habitat quality, as in the Piako catchment (n=23; MCI ρ =0.42; %EPT ρ =0.69) (Table 3-8 & Figure 3-19). There was also a positive correlation between fish species richness and habitat score at the Waihou sites (ρ =0.36; Figure 3-20), although it was not as strong as in past years (2015: ρ =0.69). This may be a reflection of the changes in fish species richness between the 2015 and 2016 samplings.

Biotic index	Spearman's rank correlation coefficient
MCI	0.42
Macroinvertebrate total richness	0.37
EPT richness	0.44
% EPT	0.69
Fish richness	0.36

Table 3-8:Correlation coefficients between the habitat score and various biotic indices for the Waihoucatchment in 2016.

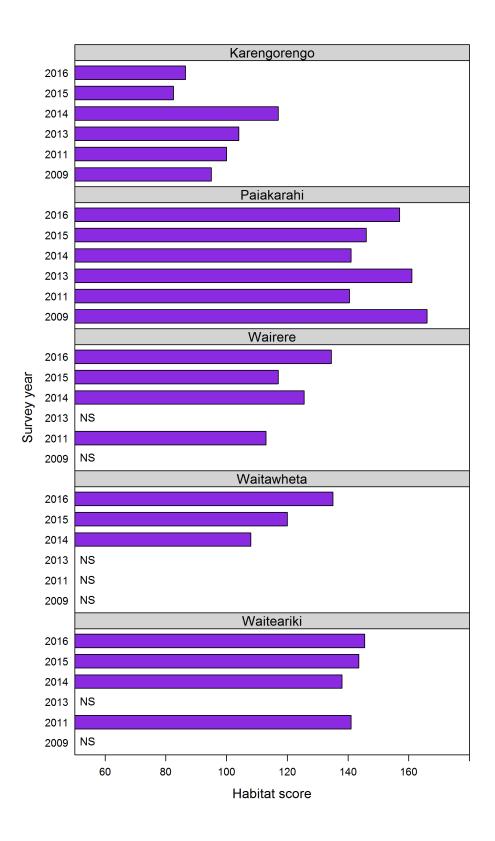


Figure 3-18: Comparison of habitat scores over time for the Waihou survey sites. Years in which a site was not surveyed are marked 'NS.'

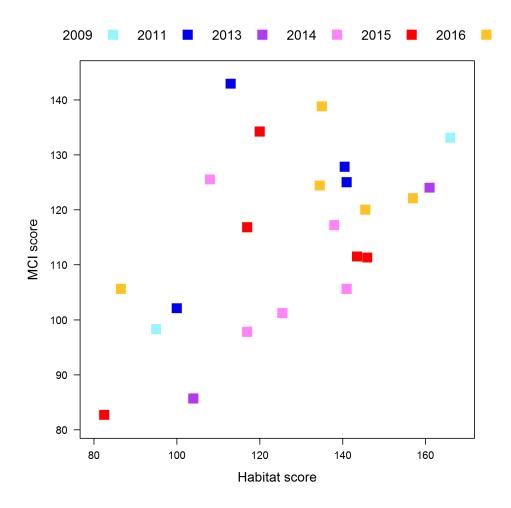


Figure 3-19: Scatterplot of habitat score against MCI score at the Waihou survey sites in different survey years (ρ =0.42).

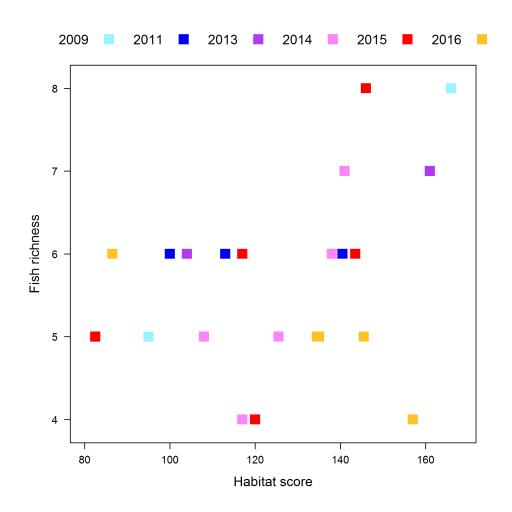


Figure 3-20: Scatterplot of habitat score against fish species richness at the Waihou survey sites in different survey years (p=0.36).

4 Discussion

One of the fundamental objectives of setting water resource use limits is the protection of ecosystem health. Setting robust limits requires an understanding of both the current status of ecological communities and changes in their status over time. The current status of ecological communities represents the combined effects of both natural environmental and biotic controls, e.g., distance inland, elevation, river type, species' life histories, and the consequences of human induced changes to the environment, e.g., land use change, reduced water quality and river channel engineering. Changes in status over time will also be driven by a combination of natural variability in environmental and biotic conditions (i.e., wet v. dry years; warm v. cold years; good v. bad recruitment; high v. low survival), and human induced changes to the environment, e.g., water abstraction, pollutant discharges, land drainage and stream restoration.

Ecological monitoring is essential to understanding ecological status and trends. Franklin et al. (2013) proposed five sites in each of the Waihou and Piako catchments where annual ecological monitoring should take place with the aim of supporting the water allocation decision making process. This recommendation was based on attaining a compromise between spatial coverage of the catchments and characterising natural inter-annual variations in the biotic communities. The ten sites are representative of a range of river types typical of each catchment (i.e., lowland, upland, more modified, less modified, different tributaries), with the aim of providing a broad catchment scale overview of ecological status. These ten sites have now been monitored for three years (2014 – 2016), and all but one (Waitawheta) of the selected sites were also surveyed in either 2009, 2011, or 2013 (or a combination of those years).

4.1 Piako catchment

The results of the present survey indicate that at the Piako catchment sites, the relative abundance of fish was generally higher in 2016 than 2015, but not greater than in other previous survey years. Inanga were found for the first time since 2012 in one site, Mangapapa Stream (although they were also present in Waitoa Stream in 2012). The recurrence of inanga in Mangapapa Stream may reflect the increased downstream connectivity or changes in habitat availability associated with the higher summer flows which occurred in 2015-2016, compared to past years. If so, this finding is a positive indication that inanga can recolonise reaches previously disconnected by low flows. The presence of another native fish, koaro, in the Piako catchment for the first time is also an encouraging sign of dispersal/migration throughout the catchment. The relative proportion of species was fairly consistent in each stream over time; although small inter-annual variations were apparent there were no strong directional trends in assemblage composition in four of the five streams. There was, however, some indication of a directional trend in Mangapapa Stream, which is likely to be driven by the increased abundance of Cran's bullies. Comparison of size distributions between years indicated that shortfin eel population dynamics have remained consistent, although there is a lack of large eels in two (Mangakahika and Piakonui) of the five sites. Bully size distributions have not been similar between years, indicating inter-annual variability in recruitment. In fact, with three years of data it appears there may be cyclical trends in population dynamics which span multiple years. Further annual monitoring is necessary to clarify the patterns and duration of these trends.

The macroinvertebrate community scores for streams in the Piako catchment improved in three sites (Mangakahika, Mangapapa, Waitakaruru) and remained constant in one site (Piakonui). The MCI score for Waitoa Stream declined back to the 2014 level after improving from 'good' to 'excellent' in 2015. Overall, these fluctuations are consistent with observed inter-annual variability in MCI scores.

Increased periphyton coverage, after a decline in 2015, may be associated with the lower MCI score at the Waitoa Stream site. The enhanced periphyton growth is likely to be a consequence of the reduced macrophyte cover in 2015; the macrophytes were probably out-shading the algae in previous years. Further monitoring of concurrent macrophyte and periphyton cover changes in subsequent years will be required to confirm this hypothesis. Habitat scores remained within the range of past fluctuations, and changes in score were most frequently associated with changes in bank stability and/or sediment deposition.

4.2 Waihou catchment

In the Waihou catchment, the numbers of shortfin eels were lower at three sites (Wairere, Waiteariki, and Waitawheta) in 2016 than in 2015, they remained relatively constant at one site (Paiakarahi), and were substantially higher at one site (Karengorengo; though this may have been due to inefficient electric-fishing as a result of high macrophyte cover in past years). Common and Cran's bully abundances, on the other hand, were higher in all sites in 2016 than in 2015. Redfin bullies were captured for the first time, in Waitawheta Stream. The redfin bullies at this site ranged from 40 to 76 mm in length, with the overall mix of fish sizes likely indicative of two cohorts being present. Given that there are relatively few records of redfin bullies in the Waihou catchment, and that they have not been recorded in the previous two surveys at this site, the appearance of redfin bullies at this site is of interest. Gambusia were also captured for the first time in the Waihou catchment in Karengorengo Stream. Banded kokopu were only found in one of the three sites in which they have been previously observed, and inanga in one of two previous locations. However, distributions of these species are often patchy, and it is likely that they are just rare in these reaches, rather than absent. This conjecture is supported by the fact that banded kokopu were found in 2016 in a site in which they were not captured in 2015, and inanga were found in Karengorengo stream in 2015, despite being absent from that site in 2014. Community composition remained similar between years in most sites, although there were indications of possible directional trends in assemblage composition in Karengorengo and Waitawheta Streams. Like in the Piako streams, the size distributions of eels were similar between years, while bully populations were more variable, perhaps reflecting inter-annual cycles in recruitment.

Macroinvertebrate taxa richness was lower in four of the five sites in 2016 compared to 2015. However, the 2015 counts were the highest to date, and this year's values are similar to those observed in 2014. Interestingly, MCI scores still improved in all sites despite the declines in taxa richness, EPT richness, and percent EPT abundance. Consequently, all but one of the sites (Karengorengo) were in the 'excellent' class. Karengorengo improved from 'fair' to 'good,' possibly in association with reduced macrophyte cover. MCI scores were correlated with habitat scores, which also improved in all five Waihou sites between 2015 and 2016.

In both catchments, few juvenile longfin eels were captured, indicating that the recruitment of longfin eels may currently be relatively poor. For shortfin eels, on the other hand, there were very few large female fish captured, perhaps indicating poor growth/survival rates for this species, high fishing pressure, or a lack of suitable habitat.

The 2016 survey results indicate that higher summer flows appear to improve connectivity within these catchments. Several new species were found in sites where they had not previously been present in the past several years, including inanga, koaro, and redfin bullies (as well as the exotic species *Gambusia*). There was also an increase in torrentfish abundance in multiple sites, which may also be linked to higher rainfall and thus higher base flows in 2016. Determining the levels of flow

which support dispersal and migration in these catchments is of extreme relevance to any future water allocation plans, but also a challenging task.

5 Conclusions

Ecosystem health has been identified as a core national value that must be sustained (MfE 2014). The NPS-FM requires that regional councils set freshwater objectives and associated limits to water resource use that will ensure those objectives are met (MfE 2014). Reliable information on the status and temporal dynamics of instream ecosystems is therefore critical to both setting appropriate protection levels and ensuring that freshwater objectives are met.

Knowledge of natural dynamics and variability in New Zealand's freshwater ecological communities is relatively limited, particularly for fish. Conducting long-term routine ecological monitoring allows the identification of instream values and characterisation of trends and differences in community population dynamics over time and between sites. This provides the knowledge that can be used to support development of robust and transparent management policies.

The results of this survey help to support the water allocation decision making process by informing WRC on the status and trends in ecological communities of the Waihou and Piako. The reported inter-annual variation between yearly samplings highlight the need for long-term monitoring to accurately characterise natural population dynamics and recruitment cycles versus long-term trends in stream communities and stream health that result from human activities. In addition, the preliminary indication of associations between flow levels and the occurrence of rarer species in some of the sites, possibly linked to enhanced connectivity, suggests that it will be important to determine minimum flows for safeguarding native fish populations. Therefore, it is recommended that the same ten sites continue to be monitored annually using the same survey methods. It would also be beneficial to install continuous flow monitoring gauges at each of the sample sites, or at the very least establish correlative relationships with existing nearby gauging stations, to help relate observed changes in ecological communities with flow. This will help to build understanding of the natural variability in the ecological communities of these sites and to identify critical interactions and drivers of community stability and/or change.

In addition to the annual monitoring sites, it may be valuable to monitor a further group of sites at less frequent intervals (i.e., every 3-5 years) to improve the spatial coverage of the monitoring. Some sites may already be included in the standard WRC REMS monitoring programme and it may be beneficial to include reference to these data as they are collected. It may also be useful to collect additional data on water quality at the annual monitoring sites, including continuous measurements of water temperature and dissolved oxygen via in-stream loggers to better understand the relative importance of different environmental variables in determining the observed variations in ecology.

The establishment of this ecological monitoring programme in the Waihou and Piako catchments is a first step to understanding the ecological communities and dynamics that exist and therefore in setting appropriate protection levels. Evidence from these surveys already demonstrates the differences in structure and functioning of the ecological communities at different sites and particularly a difference is emerging between more and less heavily modified sites e.g., Piakonui versus Waitoa in the Piako catchment, and Paiakarahi versus Karengorengo in the Waihou catchment. This will support WRC in identifying appropriate freshwater objectives and setting related ecosystem protection levels in these catchments.

6 Recommendations

- It is recommended that annual ecological monitoring continues at these ten sites. This will help to determine and understand the temporal dynamics of ecological communities, providing a more robust baseline against which to monitor the effects of human impacts on these river ecosystems over time.
- Installing flow gauges at each site to collect continuous flow data would be helpful for establishing relationships between ecological response variables and flow. There are indications that flow may influence the occurrence of rarer fish species within these catchments; understanding this relationship is critical for informing future water allocations decisions.
- It would be beneficial for additional physico-chemical variables to also be collected at each of the sites, e.g., water temperature and water quality. This would allow evaluation of the relative importance of different environmental variables in determining the observed variations in ecology. Where possible, this should include regular sampling (preferably continuous), rather than one-off spot samples.
- To improve the spatial coverage of the monitoring, it may be valuable to introduce a further group of sites for monitoring once every 3-5 years. It is likely possible that suitable sites already exist as part of the WRC REMS network.
- It would be beneficial to collate historical ecological monitoring data (e.g., REMS) collected by WRC in the catchments to supplement the analyses undertaken as part of this programme.

7 Acknowledgements

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Appendix A Habitat assessment forms

	kahika Strean	n			Assesso	r: Mike	Martin			
Site number: 376-4		Samp	le number: 1		Date: 02	2/03/2	016	Time	e: 09:15	
GPS coordinates		Dowr	nstream:		E 18186	98		N 58	38814	
		Upstr	eam:		E 18186	518		N 58	38767	
Channel & riparian	features				Instrea	m hye	draulic co	ndi	tions	
Canopy cover:					Estimate	d or me	asured read	h ave	erage:	
Open	Partly s	haded	Very sl	naded						
Fencing:	Dominant	ripariar	n vegetation:		Stream	width	active cha	inne	l): 4.6m	
None/ineffective	Crops		Retired veg	etation	Stream	width	(water): 2.	85m		
One side/partial	Pasture		Native shru	ıb	Stream	depth:	0.13m			
Complete	Exotic tree	S	Native tree	S	Surface	velocit	:y:			
Water quality					<u> </u>					
Temperature:	18.1		°C		Conduc	tivity:		127.	6 μ	5 cm ⁻¹
Dissolved oxygen:	81		%		7.66			mg l	-1	
Turbidity:	Clear		Slightly turbid	Highly t	urbid	Stair	ed		Other	
Stream-bottom sub					% surfic	ial ino	rganic sub	stra	tum size	
Compaction (inorgani			ning		compos	ition:	-		1	+
Assorted sizes tightly		-			Substra		Dimensi	on	Percen	itage
Moderately packed w			-		Bedrock Boulder		- >256mm		5	
Mostly a loose assort No packing/loose asso					Cobble		>64-256mr	n	80	
Embeddedness:	intent easily	ymove	u		Gravel		>2-64mm		10	
(% gravel-boulder particle	es covered by fi	ine sedi	ment)		Sand		>0.06-2mm	1	5	
<5% 5-25	1		51-75%	>75%	Silt		0.004-0.06		5	
				. , 0, 0	Clay		<0.004mm			
Organic material (%	(cover)					t type	s sample	d		
Large wood (>10cm d					(% of eff		o oumpre			
<5% 5-25	1 ⁻	50%	51-75%	>75%	Stones:		80%	1		
Coarse detritus (small	1		I I		Wood:		20%		iffles:	50 9
<5% 5-25	, i		51-75%	>75%	Macrop	hyte:	%		uns:	50
	leposits		1 1		Edges:	-	%			
Fine (<1mm) organic o		50%	51-75%	>75%	Numbe	r of inv	ertebrates	s retu	urned:	
Fine (<1mm) organic (% 26-5	/0/0			Koura: \	(Shrir	nps: N	
< 5% 5-25			ea)		nouru.				sels: N	
<5% 5-25	er (% stream		ea)		Crabs: N	J		Mus	5015.14	
<5% 5-25	er (% streaml	bed are	ea) 51-75%	>75%		1		Mus	5015.14	
<5% 5-25° Instream plant cove Filamentous algae & r <5% 5-25°	er (% streaml	bed are		>75%	Crabs: N			Mus		
<5% 5-25 Instream plant cove Filamentous algae & r	er (% streaml nats: % 26-5	bed are		>75%	Crabs: N Other:	type:			imerunio	
<5% 5-25 Instream plant cove Filamentous algae & r <5% 5-25 Macrophytes:	er (% streaml nats: % 26-5	bed are	51-75%		Crabs: N Other: Mussel	type:				

Wadeable Hard-B Qualitative Habitat A						She	et													
Stream name: Manga	akał	nika							Site ı	numt	ber: :	374-4	1							
Sample number: 1				A	sses	sor:	Mike	e Ma	rtin				Date	e: 02	/03/2	2016	;			
Habitat parameter		С	ptim	al			Sub	popti		Cate	gory		argir	nal				Poo	r	
1. Riparian vegetative zone width	•	Bank vege >10r Cont dens	tation n inuou	n buff us &	er	•	vege is <1	tatior 0m ly co	n buff		•	Path and/o Most over	or sto	ck	ent	•		nan a	equei ctivity	
Left bank:9	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Right bank:12	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Mean: 10.5																				
2. Vegetative protection	•	imme ripar cove vege Tree store non- pres Vege	ediate ian ze red b station s, un ey shi wood ent etativ	ones y nat der- ubs o ly pla	ive or nts	•	cove nativ Disru Bank	c surf red n e veg uptior cs ma red b stry	nainly getati n evic ay be	on lent	•	Bank cove mixtu grass black & intr spec Vege disru Bare cropp vege com	red b ure of ses/s berry roducties etation ption soil/ bed tatior	y hrubs , will ced n obvi close	ow	•	cove gras Disr strea vege high Gras graz Sigr	ered t ses & uption am ba etatio ss he ced iificar	shru n of ank n ver	ubs y ck
Left bank: 8	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Right bank:10	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
3. Bank stability	•	Eros failur	e nt/mi of ba	ank nima	I	•	Infreater areat most over	erate quen s of e ly he % of ed	t, sm erosic aled	all n	•	Mode unsta 30-60 reach of ero High poter flood	able 0% o n has osion eros ntial o	f ban area	IS	•	Mar area 60-1	00% erosi	of ba	ank
Left bank:10	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Right bank:13	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Mean: 11.5		1	L		1		<u> </u>			<u> </u>				L				<u> </u>	<u> </u>	
4. Frequency of riffles	•	frequ Dista riffles strea	ient ance s divi im wi ety of	ativel betwe ded b dth=5 habit	een y 5-7	•	riffles Dista riffles	urrend s infre ance I s divid im wi	equei betwe ded b	een by	•	Occa or ru Botto provi habit Dista riffles strea 25	n om co de so at ince l s divio	ontou ome betwe ded b	rs een y	•	wate riffle Poo Dist riffle	s r hab ance s divi	allow	een by
Score: 18	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
5. Channel alteration	•	abse Strea	nel/d nt/mi am w	redgi nima	I	•	chan Evide chan Rece chan	e cha inel/d ence inel/d ent inel/d orese	redgi of pa redgi redgi	ing ist ing	•	Char chan exter Emb oring prese bank 40-80 chan disru	ges/o nsive ankm struc ent or s 0% o neliz	ients, cture n bot	/sh s h	•	with gabi >80 read chai disru	ion/ce % of th nneliz upted ream	ement strear	t m r

Habitat parameter			atego)ptim			На	bitat	para	amet	er			atego ptim			Ha	bitat	para	amet	er
6. Sediment deposition	•	point <209 affect sedir	e/no is t bars % of t ted b ment ositior	ottor pottor	ent	•	bar for most grave fine s 20-5 affect	ted t dep	tion, m nd or nent f bott	om	•	of ne sand sedir new 50-80 affec Sedir depo obstr	w gra or fir nent bars 0% o ted ment sits a ructio trictic	ne on ol f bott at	d & om	•	fine Incrededeve >809 char frequ Pool abse sedir	vy de mater eased elopm % of t uging uently s alm ent du ment ositior	ial bar ent oottor ost e to	
Score: 11	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
7. Velocity/depth regimes	2019181716•4 velocity/depth regimes present•Slow/deep, slow/shallow, fast/deep2019181716•>50% substrate					•	regin If fas miss	4 city/denes p t/sha ing the e low	iresei Ilow i nen		•	•	city/de nes p t/shall /shall	resei llow o ow a	or	•	velo regir	inate city/d ne ally de	epth	
Score: 18	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
8. Abundance & diversity of habitat	•	favo invei color wide wood riffle Snag subr logs/ bank prov abur cove	urable rtebra nisatie varie dy de s, roo gs/ nerge (unde s/cot ides ndant	e for tte on & ety of bris, ot mat ed rcut obles fish oe ne	S	•	favor inver color Snag subn logs/ bank Fish com Mode of ha Can	herge Junde s/col cove mon erate bitat cons e nev	e for ate on ed rcut obles r varie types ist of	łty	•	favou inver color Fish	urable tebra nisatio cove 0% si y mo dy de or ma hereo	ite on r pato ubstr ved b ebris ay be	chy ate y	•	favo inver color Fish abse Subs unst lacki Stab lacki	strate	e for ite on r rare or bitats limite	e or
Score:15	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
9. Periphyton	•	evid held Stab	ohyto ent or stone le sul aces h	n han es bstrat	d te	•	visib Stab Perip	ohyto le on le sul ohyto ous to	ston bstra n	es te	•	Perip <20% avail subs	6 cov able			•	obvi >209 avail	ohyto ous & % cov able trates	proli er of	
Score: 12	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
TOTAL SCORE: 122	2																			

	Stream U/S				Assesso	r: Josh	Smith			
Site number: 1249-12	1	Samp	ole number: 2		Date: 02	2/03/2	016 .	Time:	16:40	
GPS coordinates		Dowr	nstream:		E183197	74		N5803	819	
		Upstr	'eam:		E183187	78	I	N5803	808	
Channel & riparian	features				Instrea	m hye	draulic co	nditi	ons	
Canopy cover:					Estimate	d or me	asured reac	h avera	age:	
Open	Partly s	haded	Very sł	naded						
Fencing:	Dominant	ripariar	n vegetation:		Stream	width	(active cha	nnel):	7m	
None/ineffective	Crops		Retired veg	etation	Stream	width	(water): 1.	6m		
One side/partial	Pasture		Native shru	b	Stream	depth:	0.2m			
Complete	Exotic tree	es.	Native trees	S	Surface	velocit	ty: 0.3m s⁻¹	L		
Water quality										
Temperature:	21		°C		Conduct	tivity:		-	I	µS cm⁻¹
Dissolved oxygen:	97.8		%		8.65		I	mg l-1		
Turbidity:	Clear		Slightly turbid	Highly t	urbid	Stair	ied	0	ther	
Stream-bottom sub	ostrata									
Compaction (inorgani	c substrata):	:			% surfic compos		rganic sub	stratu	m size	•
Assorted sizes tightly	packed &/or	r overla	apping		Substrat	tum	Dimensi	on	Perce	entage
Moderately packed wi	ith some ove	rlappin	g		Bedrock		-			
Mostly a loose assorting	nent with litt	le over	lap		Boulder		>256mm		5	
No packing/loose asso	ortment easil [,]	y move	d		Cobble		>64-256mn	n	70	
Embeddedness:					Gravel		>2-64mm		5	
(% gravel-boulder particle	es covered by f	fine sedi	ment)		Sand		>0.06-2mm		5	
		50%	51-75%	>75%	Silt		0.004-0.06	nm	5	
<5% 5-25%	~ 20-		1							
<5% 5-25%	/0 20-:				Clay		<0.004mm		10	
<5% 5-25%						t type	<0.004mm	d	10	
	6 cover)							d	10	
Organic material (%	6 cover)	50%	51-75%	>75%	Habita			I	10	
I Organic material (% Large wood (>10cm di	6 cover) iameter) % 26-1		I I	>75%	Habitat (% of effo		s sample		10 les:	209
Organic material (% Large wood (>10cm di <5% 5-25%	6 cover) iameter) % 26-! wood, sticks		I I	>75%	Habitat (% of effo Stones:	ort)	s sample 45%	Riff	les:	209
Organic material (% Large wood (>10cm di <5% 5-25% Coarse detritus (small	6 cover) iameter) % 26-! wood, sticks % 26-!	, leaves	s etc., >1mm)		Habitat (% of effo Stones: Wood:	ort)	s sample 45% %	Riff Rur	les: ns:	
Organic material (% Large wood (>10cm di <5%	6 cover) iameter) % 26-! wood, sticks % 26-! deposits	, leaves	s etc., >1mm)		Habitat (% of effo Stones: Wood: Macrop Edges:	brt)	s sample 45% % 20%	Riff Rur Poc	les: ns: ols:	759
Organic material (% Large wood (>10cm di <5%	6 cover) iameter) % 26-1 wood, sticks % 26-1 deposits % 26-1	s, leaves 50% 50%	s etc., >1mm) 51-75% 51-75%	>75%	Habitat (% of effo Stones: Wood: Macrop Edges:	hyte:	s sample 45% % 20% 35% ertebrates	Riff Rur Poc	les: ns: ols:	759 5%
Organic material (% Large wood (>10cm di <5%	6 cover) iameter) % 26-! wood, sticks % 26-! deposits % 26-! % 26-!	s, leaves 50% 50%	s etc., >1mm) 51-75% 51-75%	>75%	Habitat (% of effo Stones: Wood: Macrop Edges: Number	hyte:	s sample 45% % 20% 35% ertebrates	Riff Rur Poc	les: ns: ols: ned: os: Y(1	759 5%
Organic material (% Large wood (>10cm di <5% 5-259 Coarse detritus (small <5% 5-259 Fine (<1mm) organic c <5% 5-259 Instream plant cove	6 cover) iameter) % 26-1 wood, sticks % 26-2 deposits % 26-1 er (% stream nats:	s, leaves 50% 50%	s etc., >1mm) 51-75% 51-75%	>75%	Habitat (% of effo Stones: Wood: Macrop Edges: Number Koura: Y	hyte:	s sample 45% % 20% 35% ertebrates	Riff Rur Poc retur Shrim	les: ns: ols: ned: os: Y(1	759 5%
Organic material (% Large wood (>10cm di <5% 5-259 Coarse detritus (small <5% 5-259 Fine (<1mm) organic c <5% 5-259 Instream plant cove Filamentous algae & n	6 cover) iameter) % 26-1 wood, sticks % 26-2 deposits % 26-1 er (% stream nats:	s, leaves 50% 50% ibed are	s etc., >1mm) 51-75% 51-75% 2a)	>75% >75%	Habitat (% of effo Stones: Wood: Macrop Edges: Number Koura: Y Crabs: N	hyte: • of inv	s sample 45% % 20% 35% ertebrates	Riff Rur Poc retur Shrim	les: ns: ols: ned: os: Y(1	759 5%
Organic material (% Large wood (>10cm di <5%	6 cover) iameter) % 26-! wood, sticks % 26-! deposits % 26-! er (% stream nats: % 26-!	s, leaves 50% 50% ibed are	s etc., >1mm) 51-75% 51-75% 2a)	>75% >75%	Habitat (% of effo Stones: Wood: Macrop Edges: Number Koura: Y Crabs: N Other:	hyte: of inv , I	s sample 45% 20% 35% ertebrates	Riff Rur Poc retur Shrimp Musse	les: ns: ols: ned: os: Y(1	759 5% only)
Organic material (% Large wood (>10cm di <5%	6 cover) iameter) % 26-! wood, sticks % 26-! deposits % 26-! er (% stream nats: % 26-!	5, leaves 50% 50% bed are 50%	s etc., >1mm) 51-75% 51-75% ea) 51-75%	>75% >75% >75%	Habitat (% of effo Stones: Wood: Macrop Edges: Number Koura: Y Crabs: N Other: Mussel	hyte: of inv , I	s sample 45% 20% 35% ertebrates	Riff Rur Poc retur Shrimp Musse	les: hs: hed: hs: Y(1 ls: N	759 5% only)

Wadeable Hard-Bo Qualitative Habitat As					Shee	et														
Stream name: Waitoa	Strea	am U	/S					9	Site n	umb	er: 1	249-1	21							
Sample number: 2				A	ssess	or: Jo	osh S	mith					Date	: 02/	03/2	016				
Habitat parameter	-	С	ptim	al			Sub	oopti	mal	Cate	egory		argir	nal				Poor	ſ	
1. Riparian vegetative zone width	•	>10n	tatior n inuou	ı buffe s &	er	•	<10m	tation			•	and/	or sto	presei ck aled o		•		iks fre nan ac ous	•	:
Left bank:4	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Right bank:4	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Mean: 4																				
2. Vegetative protection	•	imme zone nativ Trees shrul wood prese Vege	ediate s cove e veg s, und os or i dy pla ent tative	nts	ian Y n orey	•	cover nativ Disru Bank	surfa red m e veg ption s may red by try	ainly etatio evide be	n ent	•	of gra black & int speci Vege disru Bare	red by asses/ berry roduc es tatior ption soil/c ped ve	/ mixt /shrut /, willc :ed	os, ow ous	•	cove & sh Disru strea vege high Gras graz Sign	s hea	y gras i of nk i very vily : stock	¢
Left bank:4	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Right bank:4	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
3. Bank stability	•	Erosi failur abse	nt/mi of bai	ank nimal		•	Infree areas most	eratel quent s of er ly hea % of b ed	, sma osion aled o	11	•	unsta 30-60 reach erosi High	0% of n has a on erosio ntial c	bank areas	of	•	60-1	able y eroo 00% c erosio	of ban	k
Left bank:11	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Right bank:11	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Mean: 11		1					1	1	<u> </u>			<u> </u>	1	<u>.</u>	1		1		1	-
4. Frequency of riffles	•	frequ Dista riffle strea	ient nce b s divio m wio	tively etwee ded by dth=5 habita	en / -7	•	riffles Dista riffles	rrence s infre nce b s divic m wic	equen etwee ded by	en /	•	run Botto provi habit Dista riffles	om co de so at nce b s divic	l riffle ntour me etwee ded by dth=1	s en /	•	wate riffle Poor Dista riffle	erally er, sha es r habit ance b es divie am wie	at etwee ded by	y
Score: 15	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
5. Channel alteration	•	chan abse Strea		redgir nimal th		•	chan Evide chan Recei chan	e char nel/di ence o nel/di nt nel/di oresen	redgir of past redgir redgir	ng t ng	•	exter Emba ing st prese banks 40-80	ges/d nsive ankme tructu ent on s 0% of nelize	reach	hor	•	gabi >809 reac or di Instr	ks sho on/ce % of st h chai srupto ream h red/at	ment ream nneliz ed nabita	ed
Score:16	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1

Habitat parameter			itego ptim			Ha	bitat	parai	nete	r			atego ptim			На	ıbitat	para	mete	r
6. Sediment deposition	•	Little point <20% affec sedin depo	bars of bo ted by nent	prese ottom /	nt	•	from	ation, grave e sed 0% of ted ted	most I, san iment botto	ly d t m		new fine s old & 50-80 affec Sedin at ob	ted nent o struct rictio	l, sand ent or bars botto depos :ions,	d or n m	•	fine Incre deve >809 char freq Pool abse sedi	mate eased elopm	bar ent ottom ost e to	
Score: 11	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
7. Velocity/depth regimes	 4 velocity/depth regimes present Slow/deep, slow/shallow, fast/shallow, fast/deep 20 19 18 17 16 					•	regin If fast	ity/de nes pr t/shal ng the	esent low is			regin If fas slow,	ity/de nes pr	esent low o ow are	r e	•	velo regii	city/d ne	d by 1 epth ep/slo	
Score: 13	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
8. Abundance & diversity of habitat	•	favou inver color varie debri mats Snag logs/ bank	irable tebra isatio ty of v s, riff s/ sub under s/cob des a over not b	for te woody les, ro merg cut bles bunda	y oot ed ant	•	favou inver colon Snags logs/ banks Fish c Mode of ha Can c	under s/cobl	for te n merg cut bles comm variet cypes. t of sc	ed non sy	•	favou inver color Fish o 60-90 easily foot Wood or ma	ay be herec	for te n patch bstrat ed by bris ra	y e	•	favo inve colo Fish abse Subs or la Stab lack	urabl rtebra nisati cover ent strate cking le hal	ite on rare o unsta bitats limite	ble
Score: 15	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
9. Periphyton	•	held Stabl	nt on stone e sub ces ro	hand s		•	Perip visibl Stabl Perip to to	e on s e subs hyton	tones strate		• •	<20%	hytor cove able s	r of		•	& pr >209	olific % cov	n obvi er of substr	
Score: 5	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
TOTAL SCORE: 94																				

Stream name: Manga	bapa Stream				Assesso	r: Josh	Smith			
Site number: 433-14		Samp	le number: 3		Date: 03	3/03/2	016	Time	e: 14:00	
GPS coordinates		Down	stream:		E 18367	83		N 58	09932	
		Upstr	eam:		E 18367	50		N 58	09802	
Channel & riparian	features				Instrea	m hye	draulic co	ondit	tions	
Canopy cover:					Estimate	d or me	asured read	ch ave	erage:	
Open	Partly s	haded	Very s	haded						
Fencing:	Dominant	ripariar	vegetation:		Stream	width	(active cha	annel	l): 6.5m	
None/ineffective	Crops		Retired veg	getation	Stream	width	(water): 4	m		
One side/partial	Pasture		Native shru	du	Stream	depth:	0.15m			
Complete	Exotic tree	S	Native tree	es	Surface	velocit	:y: 0.2m s⁻	1		
Water quality										
Temperature:	20.1		°C		Conduct	tivity:		NA	μS c	m ⁻¹
Dissolved oxygen:	107.8		%		9.73			mg l-	1	
Turbidity:	Clear		Slightly turbid	Highly t	urbid	Stair	ied		Other	
Stream-bottom sub	strata									
Compaction (inorgani	c substrata):	-SEE BI	EDROCK		% surfic		rganic sub	ostrat	tum size	
Assorted sizes tightly	backed &/or	overlap	ping		Substra	tum	Dimensi	on	Percenta	ge
Moderately packed wi	ith some over	rlapping	g		Bedrock	:	-		95	_
Mostly a loose assortr	nent with litt	le overl	ар		Boulder		>256mm			
No packing/loose asso	ortment easily									
	intinent cash	y move	d		Cobble		>64-256mr	n		
		ymoved	d		Cobble Gravel		>64-256mr >2-64mm	n		
Embeddedness: (% gravel-boulder particle		-							3	
Embeddedness:	es covered by fi	ine sedir		>75%	Gravel		>2-64mm	n	3 2	
Embeddedness: (% gravel-boulder particle	es covered by fi	ine sedir	nent)	>75%	Gravel Sand		>2-64mm >0.06-2mn	n mm		
Embeddedness: (% gravel-boulder particle <5%	es covered by fi % 26-5	ine sedir	nent)	>75%	Gravel Sand Silt Clay	t type	>2-64mm >0.06-2mn 0.004-0.06	n mm		
Embeddedness: (% gravel-boulder particle <5%	es covered by fi % 26-5 6 cover)	ine sedir	nent)	>75%	Gravel Sand Silt Clay	••	>2-64mm >0.06-2mn 0.004-0.06 <0.004mm	n mm		
Embeddedness: (% gravel-boulder particle <5% 5-25% Organic material (%	s covered by fi 26-5 cover) ameter)	ine sedir 50%	nent)	>75%	Gravel Sand Silt Clay Habita	••	>2-64mm >0.06-2mn 0.004-0.06 <0.004mm	n mm • d		
Embeddedness: (% gravel-boulder particle <5% 5-259 Organic material (% Large wood (>10cm di	es covered by fi % 26-5 6 cover) ameter) % 26-5	ine sedir 50%	nent) 51-75%		Gravel Sand Silt Clay Habita (% of effe	••	>2-64mm >0.06-2mn 0.004-0.06 <0.004mm s sample	n mm e d	2	.009
Embeddedness: (% gravel-boulder particle <5%	6 covered by fi 6 cover) ameter) 7 26-5 6 cover) 8 26-5 8 26-5 9 26-5 9 26-5 9 26-5	ine sedir 50% 50% , leaves	nent) 51-75%		Gravel Sand Silt Clay Habita (% of effo Stones:	ort)	>2-64mm >0.06-2mn 0.004-0.06 <0.004mm s sample	n mm c d 6 Ri	2	
Embeddedness: (% gravel-boulder particle <5%	es covered by fi 6 26-5 6 cover) ameter) 7 26-5 wood, sticks, 8 26-5	ine sedir 50% 50% , leaves	nent) 51-75% 51-75% etc., >1mm)	>75%	Gravel Sand Silt Clay Habita (% of effo Stones: Wood:	ort)	>2-64mm >0.06-2mn 0.004-0.06 <0.004mm s sample 100%	n mm 6 6 Ri 6 Ri 6 Ri	2 Iffles: 1	
Embeddedness: (% gravel-boulder particle <5%	es covered by fi 26-5 6 cover) ameter) % 26-5 wood, sticks, % 26-5 leposits	ine sedir 50% 50% , leaves 50%	nent) 51-75% 51-75% etc., >1mm)	>75%	Gravel Sand Silt Clay Habita (% of effo Stones: Wood: Macrop Edges:	brt) hyte:	>2-64mm >0.06-2mn 0.004-0.06 <0.004mm s sample 100% %	n mm d 6 Ri 6 Ri 6 Ri 6 Ri	2 iffles: 1 uns:	
Embeddedness: (% gravel-boulder particle <5%	es covered by fi % 26-5 6 cover) ameter) % 26-5 wood, sticks, % 26-5 leposits % 26-5	ine sedir 50% 50% , leaves 50%	nent) 51-75% 51-75% etc., >1mm) 51-75% 51-75%	>75% >75%	Gravel Sand Silt Clay Habita (% of effo Stones: Wood: Macrop Edges:	bort) hyte: r of inv	>2-64mm >0.06-2mn 0.004-0.06 <0.004mm s sample 100% % % ertebrates	n mm 6 Ri 6 Ri 6 Ri 6 Ri 8 s retu	2 iffles: 1 uns:	
Embeddedness: (% gravel-boulder particle <5%	es covered by fi % 26-5 6 cover) ameter) % 26-5 wood, sticks, % 26-5 deposits % 26-5 er (% streaml	ine sedir 50% 50% , leaves 50%	nent) 51-75% 51-75% etc., >1mm) 51-75% 51-75%	>75% >75%	Gravel Sand Silt Clay Habita (% of effe Stones: Wood: Macrop Edges: Number	hyte:	>2-64mm >0.06-2mn 0.004-0.06 <0.004mm s sample 100% % % ertebrates	n mm ć Ri ć Ri ć Ri ć s retu Shrin	2 iffles: 1 uns: urned:	
Embeddedness: (% gravel-boulder particle <5%	es covered by fi % 26-5 6 cover) ameter) % 26-5 wood, sticks, % 26-5 deposits % 26-5 er (% streaml nats:	ine sedir 50% , leaves 50% 50% bed are	nent) 51-75% 51-75% etc., >1mm) 51-75% 51-75%	>75% >75%	Gravel Sand Silt Clay Habita (% of effe Stones: Wood: Macrop Edges: Number Koura: N	hyte:	>2-64mm >0.06-2mn 0.004-0.06 <0.004mm s sample 100% % % ertebrates	n mm ć Ri ć Ri ć Ri ć s retu Shrin	2 iffles: 1 uns: urned: nps: N	
Embeddedness: (% gravel-boulder particle <5%	es covered by fi % 26-5 6 cover) ameter) % 26-5 wood, sticks, % 26-5 deposits % 26-5 er (% streaml nats:	ine sedir 50% , leaves 50% 50% bed are	nent) 51-75% 51-75% etc., >1mm) 51-75% 51-75% a)	>75% >75% >75%	Gravel Sand Silt Clay Habita (% of effe Stones: Wood: Macrop Edges: Number Koura: N Crabs: N	hyte: r of inv	>2-64mm >0.06-2mn 0.004-0.06 <0.004mm s sample 100% % % ertebrates	n mm ć Ri ć Ri ć Ri ć s retu Shrin	2 iffles: 1 uns: urned: nps: N	
Embeddedness: (% gravel-boulder particle <5%	es covered by fi 26-5 6 cover) ameter) % 26-5 wood, sticks, % 26-5 deposits % 26-5 er (% streaml nats: % 26-5	ine sedir 50% , leaves 50% bed are	nent) 51-75% 51-75% etc., >1mm) 51-75% 51-75% a)	>75% >75% >75%	Gravel Sand Silt Clay Habita (% of effe Stones: Wood: Macrop Edges: Number Koura: N Crabs: N Other:	hyte: r of inv / I	>2-64mm >0.06-2mn 0.004-0.06 <0.004mm s sample 100% % % ertebrates	n mm ś Ri ś Ri ś Sretu Shrin Muss	2 iffles: 1 uns: urned: nps: N	.009 9
Embeddedness: (% gravel-boulder particle <5%	es covered by fi 26-5 6 cover) ameter) % 26-5 wood, sticks, % 26-5 deposits % 26-5 er (% streaml nats: % 26-5	ine sedir 50% , leaves 50% bed are	nent) 51-75% etc., >1mm) 51-75% 51-75% a) 51-75%	>75% >75% >75%	Gravel Sand Silt Clay Habita (% of effe Stones: Wood: Macrop Edges: Number Koura: N Crabs: N Other: Mussel	hyte: r of inv / I	>2-64mm >0.06-2mn 0.004-0.06 <0.004mm s sample 100% % % ertebrates	n mm ś Ri ś Ri ś Sretu Shrin Muss	2 iffles: 1 uns: urned: nps: N sels: Y	

Stream name: Manga	рара	Strea	m					9	Site n	umb	er: 43	33-14	Ļ							
Sample number: 6				A	ssess	or: J	oshua	a Smi	th				Date	: 03/	03/2	016				
Habitat parameter										Cate	gory									
Habitat parameter		С	ptim	al			Sub	ooptii	mal			Μ	argin	nal				Poor	ſ	
1. Riparian vegetative zone width	•	>10n	tatior n inuou	n buffe is &	er	•	<10m	tation			•	Pathy and/o Most	or sto	ck		•		iks fre nan ac ous	•	
Left bank:8	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Right bank:8	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Mean:8									•											
2. Vegetative protection	•	imme zone nativ Trees shrul wood prese Vege	ediate s cove re veg s, und bs or r dy pla ent tative	nts	ian y n orey	• • •	cover nativ Disru Bank	surfa red m e vege ption s may red by try	ainly etatio evide be	n ent	•	of gra black & intr speci Vege disru Bare	red by asses/ berry roduc es tation ption soil/c ped ve	y mixt /shrut , willc ed n obvio	os, ow ous	•	cove & sh Disro strea vege high Gras graz Sign	s hea	y gras i of nk i very vily : stock	c
Left bank:4	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Right bank:	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Mean: 4																				
3. Bank stability	•	Erosi failui abse	nt/mi of bai	ank nimal		•	Infre areas most	eratel quent s of er ly hea % of b ed	, sma osion Iled o	II	•	reach erosi High	ible)% of i has a on erosic ntial d	bank areas	of	•	60-1	able ay eroo 00% c erosio	of ban	k
Left bank:13	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Right bank:13	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Mean: 13																				
4. Frequency of riffles	•	frequ Dista riffle strea	uent ince b s divio im wio	tively etwee ded by dth=5 habita	en / -7	•	Dista riffle:	rrence s infre nce b s divic m wic	quen etwee led by	en /	•	run Botto provi habit Dista riffles	om co de so at nce b s divic	me	s en /	•	wate riffle Poor Dista riffle	erally er, sha es r habit ance b es divid am wit	at etwee ded by	ý
Score:10	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
5. Channel alteration	•	chan abse Strea		redgir nimal th	ng	•	chan Evide chan Rece chan	e chan nel/dr ence o nel/dr nt nel/dr oresen	edgir f past edgir edgir	ng : ng	•	exter Emba	ges/di isive inkme iructu int on 5 0% of	res both reach	hor	•	gabi >809 reac or di Instr	ks sho on/ce % of st h chai srupte ream h red/at	ment ream nneliz ed nabita	ed

Habitat parameter	-	Catego Optima			Ha	abita	t para	amet	er			atego ptim			На	ıbitat	para	imete	r
6. Sediment deposition	poin <209 affe	e/no isla t bars p 6 of bot cted by osition	rese tom	nt	•	bar mos grav fine 20-5 affe Sligl	v incre forma stly fro vel, sa sedin 50% o cted nt dep ools	ation, om nd or nent f bott	om	• • •	Some new (fine s old & 50-80 affec Sedin at ob const bend	grave edim new 0% of ted nent o struct	l, sand ent or bars botto depos tions,	dor า m	•	fine Incre deve >809 char freq Pool abse sedii	mate eased elopm	bar ent ottom / ost e to	
Score: 16	20 19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
7. Velocity/depth regimes	regir • Slow slow fast/	ocity/d nes pre /deep, /shallov shallow deep		•	regi If fa miss	4 mes p st/sha sing th re low	oreser allow nen	nt	• •	2 of 4 veloc regin If fas slow, missi	ity/de nes pr t/shal (shallo	esent low o ow are	r e	•	velo regii	city/d ne	d by 1 epth eep/slo		
Score: 13	20 19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
8. Abundance & diversity of habitat	favo inve colo varie debr mat: Snag logs, banl prov fish	s/ subn /underc s/cobb ides ab cover t not be	for a & w boody es, ro nerge tut les unda	/ ot ed ant	•	favo inve colo Snay logs ban Fish com Moo of h Can som	50% si purabl rrtebr onisati gs/ su /unde ks/col cove imon derate abitat consi e nev erial	e for ate on bmer ercut bbles r e varie type st of	ged	•	10-30 favou inver color Fish c 60-90 easily foot Wood or ma smot sedin	urable tebra iisatic cover 0% su 7 mov dy de ay be herec	for te patch bstrat ed by bris ra	y e	•	favo inve colo Fish abse Subs or la Stab lacki	urable rtebra nisatie cover ent strate cking le hat	ate on rare o unsta bitats limite	ble
Score: 10	20 19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
9. Periphyton	evid ston • Stab	le subst aces rou	nand trate		•	visik Stak Peri	phyto ble on ble sul phyto ious t	stone bstrat on	es e	• •	<20%	cove	n visib r of ubstra		•	& pr >20%	olific % cove	n obvi er of substr	
Score: 7	20 19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
TOTAL SCORE: 97		·							-		-	-		-	·				

Stream name: Waita	ıkaruru Stre	am			Assess	or: Mi	ke Martin	1		
Site number: 1231-5	4	Samp	ole number: 4		Date: 0	4/03/2	2016	Time	: 10:15	
GPS coordinates		Dowr	nstream:		E 1817	745		N 58	15748	
		Upstr	eam:		E 1817	903		N 58	15670	
Channel & riparia	an feature	s			Instre	am h	ydraulic	c cor	nditior	IS
Canopy cover:					Estimate	ed or m	easured re	each a	average:	
Open	Partly s	shaded	Very sl	naded						
Fencing:	Dominant	t riparia	in vegetation:		Stream	width	(active c	hann	el):3m	
None/ineffective	Crops		Retired ve	getation	Stream	width	(water):	2m		
One side/partial	Pasture		Native shr	ub	Stream	depth	i: 0.3m			
Complete	Exotic tre	es	Native tree	es	Surface	e veloo	ty: 0.2m	I S ⁻¹		
Water quality										
Temperature:	18.2		°C		Conduc	ctivity:		138.′	1 µ	ıS cm⁻¹
Dissolved oxygen:	89.7		%		8.43			mg l ⁻	1	
Turbidity:	Clear		Slightly turbid	Highly	turbid	Stair	ned	(Other	
Stream-bottom s	ubstrata									
Compaction (inorg	anic subst	rata):			% surf compo		norganic :	sub	stratun	n size
Assorted sizes tightl	y packed &/	or over	rlapping		Substra	atum	Dimens	sion	Perce	entage
Moderately packed	with some o	verlapp	bing		Bedroc	k	-			
Mostly a loose ass	ortmont wi									
,	orument wi	th little	overlap		Boulde	r	>256mm			
No packing/loose as			-		Boulde Cobble		>256mm >64-256m	nm	25	
-			-						25 25	
No packing/loose as	sortment ea	asily mo	oved		Cobble		>64-256m		-	
No packing/loose as Embeddedness :	sortment ea	asily mo	oved	>75%	Cobble Gravel		>64-256m >2-64mm	m	-	
No packing/loose as Embeddedness: (% gravel-boulder parti	sortment ea	asily mo	oved	>75%	Cobble Gravel Sand		>64-256m >2-64mm >0.06-2m	m 6mm	25	
No packing/loose as Embeddedness: (% gravel-boulder parti	sortment ea cles covered % 26-	asily mo by fine s 50%	oved	>75%	Cobble Gravel Sand Silt Clay		>64-256m >2-64mm >0.06-2m 0.004-0.0	m 6mm n	25 25 25	
No packing/loose as Embeddedness: (% gravel-boulder parti <5% 5-25%	sortment eacles covered % 26-4	asily mo by fine s 50%	oved	>75%	Cobble Gravel Sand Silt Clay	at typ	>64-256m >2-64mm >0.06-2m 0.004-0.0 <0.004mm	m 6mm n	25 25 25	
No packing/loose as Embeddedness: (% gravel-boulder parti <5% 5-259 Organic material	sortment eacher cles covered % 26- (% cover) diameter)	asily mo by fine s 50%	oved	>75%	Cobble Gravel Sand Silt Clay Habita	at typ	>64-256m >2-64mm >0.06-2m 0.004-0.0 <0.004mm	m 6mm n pled	25 25 25	
No packing/loose as Embeddedness: (% gravel-boulder parti <5% 5-25% Organic material Large wood (>10cm	sortment ea cles covered % 26-4 (% cover) diameter) % 26-4	asily mo by fine s 50%	51-75%	>75%	Cobble Gravel Sand Silt Clay Habita (% of eff	at typ	>64-256m >2-64mm >0.06-2m 0.004-0.0 <0.004mn es sam	m 6mm n pled	25 25 25	45%
No packing/loose as Embeddedness: (% gravel-boulder parti <5% 5-250 Organic material Large wood (>10cm <5% 5-250 Coarse detritus (small)	sortment eacher cles covered % 26- (% cover) diameter) % 26- all wood, sti	by fine s 50% 50% cks, lea	51-75%	>75%	Cobble Gravel Sand Silt Clay Habita (% of eff Stones	at typ fort)	>64-256m >2-64mm >0.06-2m 0.004-0.0 <0.004mm es sam	m 6mm n pled	25 25 25	45% 50%
No packing/loose as Embeddedness: (% gravel-boulder parti <5% 5-250 Organic material Large wood (>10cm <5% 5-250 Coarse detritus (small)	sortment ea cles covered % 26-4 (% cover) diameter) % 26-4 all wood, sti % 26-4	by fine s 50% 50% cks, lea	51-75%	>75%))	Cobble Gravel Sand Silt Clay Habita (% of eff Stones Wood:	at typ fort) : ohyte:	>64-256m >2-64mm >0.06-2m 0.004-0.0 <0.004mn es sam 50% 25%	m 6mm n pled 6 Ri 6 Ri	25 25 25 ffles: uns:	
No packing/loose as Embeddedness: (% gravel-boulder parti <5% 5-25% Organic material Large wood (>10cm <5% 5-25% Coarse detritus (sma <5% 5-25%	sortment ea cles covered % 26- (% cover) diameter) % 26- all wood, sti % 26- c deposits	by fine s 50% 50% cks, lea	51-75%	>75%))	Cobble Gravel Sand Silt Clay Habita (% of eff Stones Wood: Macrop Edges:	at typ fort) : bhyte:	>64-256m >2-64mm >0.06-2m 0.004-0.0 <0.004mn es sam 50% 25% 25%	m 6mm n pled 6 Ri 6 Ri 6 Rc	25 25 25 ffles: uns: pols:	50%
No packing/loose as Embeddedness: (% gravel-boulder parti <5% 5-25 Organic material Large wood (>10cm <5% 5-25 Coarse detritus (sma <5% 5-25 Fine (<1mm) organic	sortment ea cles covered % 26-4 (% cover) diameter) % 26-4 all wood, sti % 26-4 c deposits % 26-4	asily mo by fine s 50% 50% 50% 50%	sediment) 51-75% 51-75% aves etc., >1mm 51-75% 51-75%	>75% 1) >75%	Cobble Gravel Sand Silt Clay Habita (% of eff Stones Wood: Macrop Edges:	at typ fort) : ohyte: er of int	>64-256m >2-64mm >0.06-2m 0.004-0.0 <0.004mn es sam 50% 25% 25% % vertebrat	m 6mm n pled 6 Ri 6 Ri 6 Ri 6 Ri 8 ret	25 25 25 ffles: uns: pols:	50%
No packing/loose as Embeddedness: (% gravel-boulder parti <5%	sortment ea cles covered % 26-4 (% cover) diameter) % 26-4 all wood, sti % 26-4 classing 26-4 % 26-4 <td>asily mo by fine s 50% 50% 50% 50%</td> <td>sediment) 51-75% 51-75% aves etc., >1mm 51-75% 51-75%</td> <td>>75% 1) >75%</td> <td>Cobble Gravel Sand Silt Clay Habita (% of eff Stones Wood: Macrop Edges: Numbe</td> <td>at typ fort) : ohyte: er of in Y</td> <td>>64-256m >2-64mm >0.06-2m 0.004-0.0 <0.004mm es sam 25% 25% 25% % vertebrat</td> <td>m 6mm n pled 6 Ri 6 Ri 6 Ri 6 Pc es ret</td> <td>25 25 25 ffles: uns: pols: turned:</td> <td>50%</td>	asily mo by fine s 50% 50% 50% 50%	sediment) 51-75% 51-75% aves etc., >1mm 51-75% 51-75%	>75% 1) >75%	Cobble Gravel Sand Silt Clay Habita (% of eff Stones Wood: Macrop Edges: Numbe	at typ fort) : ohyte: er of in Y	>64-256m >2-64mm >0.06-2m 0.004-0.0 <0.004mm es sam 25% 25% 25% % vertebrat	m 6mm n pled 6 Ri 6 Ri 6 Ri 6 Pc es ret	25 25 25 ffles: uns: pols: turned:	50%
No packing/loose as Embeddedness: (% gravel-boulder parti <5% 5-25% Organic material Large wood (>10cm <5% 5-25% Coarse detritus (sma <5% 5-25% Fine (<1mm) organic <5% 5-25% Instream plant co	sortment ea cles covered % 26-4 (% cover) diameter) % 26-4 all wood, sti % 26-4 c deposits % 26-4	asily mo by fine s 50% 50% 50% 50%	sediment) 51-75% 51-75% aves etc., >1mm 51-75% 51-75%	>75% 1) >75%	Cobble Gravel Sand Silt Clay Habita (% of eff Stones Wood: Macrop Edges: Numbe Koura:	at typ fort) : ohyte: er of in Y	>64-256m >2-64mm >0.06-2m 0.004-0.0 <0.004mm es sam 25% 25% 25% % vertebrat	m 6mm n pled 6 Ri 6 Ri 6 Ri 6 Pc es ret	25 25 25 ffles: uns: pols: turned: nps: N	50%
No packing/loose as Embeddedness: (% gravel-boulder parti <5% 5-25 Organic material Large wood (>10cm <5% 5-25 Coarse detritus (sma <5% 5-25 Fine (<1mm) organic <5% 5-25 Fine to the second secon	sortment ea cles covered % 26-4 (% cover) diameter) % 26-4 all wood, sti % 26-4 c deposits % 26-4	asily mo by fine s 50%) 50% 50% 50% eambe	sediment) 51-75% 51-75% aves etc., >1mm 51-75% 51-75% d area)	>75% 1) >75% >75%	Cobble Gravel Sand Silt Clay Habita (% of eff Stones Wood: Macrop Edges: Numbe Koura: Crabs:	at typ fort) : bhyte: r of in Y N	>64-256m >2-64mm >0.06-2m 0.004-0.0 <0.004mm es sam 25% 25% 25% % vertebrat	m 6mm n pled 6 Ri 6 Ri 6 Ri 6 Pc es ret	25 25 25 ffles: uns: pols: turned: nps: N	50%
No packing/loose as Embeddedress: (% gravel-boulder parti <5%	sortment ea cles covered % 26-4 (% cover) diameter) % 26-4 all wood, sti % 26-4 c deposits % 26-4 c deposits % 26-4 % 26-4 c deposits % 26-4 x 26-4 % 26-4 % 26-4 % 26-4 % 26-4 % 26-4 % 26-4 % 26-4 % 26-5 % 26-5 % 26-5	asily mo by fine s 50%) 50% 50% 50% eambe	sediment) 51-75% 51-75% aves etc., >1mm 51-75% 51-75% d area)	>75% 1) >75% >75%	Cobble Gravel Sand Silt Clay Habita (% of eff Stones Wood: Macrop Edges: Numbe Koura: Crabs: Other:	at typ fort) : ohyte: er of in Y N type:	>64-256m >2-64mm >0.06-2m 0.004-0.0 <0.004mn es sam 25% 25% 25% % vertebrat	m 66mm n pled 6 Ri 6 Ri 6 Ri 6 Ri 8 Ri 8 Shrin Muss	25 25 25 ffles: uns: pols: turned: nps: N	50% 5%
No packing/loose as Embeddedness: (% gravel-boulder parti <5% 5-25% Organic material Large wood (>10cm <5% 5-25% Coarse detritus (sma <5% 5-25% Fine (<1mm) organic <5% 5-25% Instream plant co Filamentous algae & <5% 5-25% Macrophytes:	sortment ea cles covered % 26-4 (% cover) diameter) % 26-4 all wood, sti % 26-4 c deposits % 26-4 c deposits % 26-4 % 26-4 c deposits % 26-4 x 26-4 % 26-4 % 26-4 % 26-4 % 26-4 % 26-4 % 26-4 % 26-4 % 26-5 % 26-5 % 26-5	asily mo by fine s 50% 50% cks, lea 50% eambe	byed sediment) 51-75% 51-75% aves etc., >1mm 51-75% 51-75% d area) 51-75%	>75% 1) >75% >75%	Cobble Gravel Sand Silt Clay Habita (% of eff Stones Wood: Macrop Edges: Numbe Koura: Crabs: Other: Mussel	at typ fort) : ohyte: er of in Y N type:	>64-256m >2-64mm >0.06-2m 0.004-0.0 <0.004mn es sam 25% 25% 25% % vertebrat	m 66mm n pled 6 Ri 6 Ri 6 Ri 6 Ri 8 Ri 8 Shrin Muss	25 25 25 ffles: uns: pols: turned: nps: N sels: N	50% 5%

Sample number: 4 Assessor: Mike Martin Date: 04/03/2016 Habitat parameter Optimal Suboptimal Marginal cases of the set o	Habitat parameter Optimal Suboptimal Marginal Poor 1. Riparian egetative sone width Bankside vegetation buffer is -10m Bankside vegetation is -00m Bankside vegetation - 10m B	Stream name: Waital	karuru	Str	eam					5	Site n	umb	er: 1	231-5	54							
Habitat parameter Optimal Suboptimal Marginal Marginal Poor 1. Rightain Bankside vegetation buffer 10m 6 Bankside vegetation buffer 10m Falthway, present, and the standard stand	Habitat parameter Optimal Suboptimal Marginal Poor 1. Rigarian regetative zone with • Bankside vegetation outfor >10m • Bankside vegetation common & dense • Bankside vegetation vegetation buffer is • Pathways present and/or stock •	Sample number: 4				A	ssess	or: N	/ike I	Marti	n				Date	: 04/	03/2	016				
Optimal Suboptimal Marginal Parkale	Optimal Suboptimal Marginal Pathways present Bank stafferquen 1. Biparian 0. Bankidki vegetatilon 6. Bankidki vegetatilon buffer is 6. Bankidki vegetatilon 8. Bankidki vegetatilon buffer is 8. Bankidki vegetatilon 8. Bankidkidvegetatilon 8. Bankidkidki vegetatilon											Cate	gory									
undef burlie JUT	under buffer > 10m under	Habitat parameter			Optin	nal			Sub	ooptii	mal			Μ	argin	al				Poc	or	
Note: The second secon	Auge the bank: 10 20 10 10 10 0 8 7 6 5 4 3 2 Wean: 9.5 . . Bank surfaces 8. immediale inparial zones covered by matter sourced by excite forestry willow also blackberry. Willow 8 introduced by excite forestry willow also blackberry. Willow 8 introduced species . Bank surfaces covered by matter source by matter sourced by excite forestry willow 8 introduced species . Bank surfaces covered by matter source by matter source by excite forestry willow 8 introduced species . Bank surfaces covered by matter source by excite forestry willow 8 introduced species . Bank surfaces covered by matter source by excite forestry by matter source by excite forestry willow 8 introduced by excite forestry and 8 introduced by excite forestry willow 8 introduced by excite forestry	vegetative zone		buff	uffer >10m vegetation buffer is and/or stock ontinuous & dense <10m • Mostly healed over										Hum	nan a	•					
Note: 1Note: 1Note: 1Note: 12. Vegetative protection•Bank surfaces & immediate riparian antive vegetation sprube or non- woody plantice present .•Bank surfaces & covered mainly by native vegetation to simutouce bis-uption evident bis-uption evident 	$ \begin{array}{ c c c c c c c c c c c c c c c c c c c$	Left bank:9	20	19	9 18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
2. Vegetative protection • Bank surfaces & immediate riparian antive vegetation • Trees, under-storey woody plats present • Vegetative disruption minimal • Bank surfaces covered main by native vegetation • Disruption evident Banks may be covered by exotic forestry: • Bank surfaces covered main by native vegetation • Disruption evident Banks may be covered by exotic forestry: • Bank surfaces covered main by antive vegetation • Disruption evident Banks may be covered by exotic forestry: • Bank surfaces covered by mixture species • Bank surfaces covered by exotic forestry: • Use species • Bank surfaces covered by mixture species • Disruption of stream bank vegetation very high errospecies • Disruption of stream bank vegetation very high crospecies • Disruption of stream bank vegetation very high errospecies • Disruption of stream bank vegetation very errospecies • Disruption of stream bank vegetation very erro	2. Vegetative protection Bank surfaces & immediate riparian concess covered by mative spresent Trees, understorry mody plants Trees, understorry woody plants Vegetation Trees, understorry woody plants Vegetation Trees, understorry Vegetation Trees, understorry Vegetation Vegetation Vegetation Trees, understorry Vegetation Trees, understorry Vegetation Vegetation Vegetation Sank stability Vegetative Vegetative	Right bank:10	20	19	9 18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
immediate riparian zones covered by native vegetation. covered mainly by native vegetation. covered mainly by native vegetation. covered mainly by of gasses/strubs. blackberry. willow. covered by misture of gasses/strubs. blackberry. willow. covered by misture. stream bank strub covered by misture. covered by misture. covered by misture. covered by misture. stream bank strub. covered by misture. covered by mist	immediate riparian zones covered by instrue vegetation native vegetation native vegetation evident Banks may be grace by exote by exote by exote of grasser/shrubs, blackberry, willow, a fintroduced by exote of grasse	Mean: 9.5																				
Right bank:9201918171615141312111098765432Mean: 8.5	Night bank:9 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 Wean: 8.5 • • Banks stability • Banks stability • Banks stability • Moderately stable • So 60% of bank in reach has areas of erosion potential during floods • So 60% of bank in reach has areas of erosion potential during floods • So 60% of bank in reach has areas of erosion • So 60% of bank in reach has areas of erosion potential during floods • So 60% of bank in reach has areas of erosion • So 60% of bank in reach has itreas with so floods •	•	•	imm zon nati Tree shru woo pres Veg	nediate es cove ve veg es, unc ubs or ody pla sent etative	e ripari ered b etatio ler-sto non- nts	y n rey	•	cover nativ Disru Bank cover	red m e vege ption s may red by	ainly etatio evide be	n	•	cover of gra black & int speci Vege disru Bare cropp	red by asses/ berry roduc es tation ption soil/c ped ve	mixt shrut , willo ed obvio	os, ow ous	•	cove & sh Disru strea vege high Gras graz Signi	ered k rubs uptio am ba etatio s hea ed ifican	n of ank on very avily	, ĸ
$ Mean: 8.5 \\ 3. Bank stability \\ absent/minimal \\ < 5\% of bank \\ affected \\ . Frosion/bank failure \\ absent/minimal \\ < 5\% of bank \\ affected \\ . Frosion/bank failure \\ absent/minimal \\ . < 5\% of bank \\ affected \\ . Infrequent, small \\ areas of erosion \\ mostly healed over \\ . 5 . 30\% of bank \\ eroded \\ . Infrequent, small \\ areas of erosion \\ . High eros \\ . High eros$	Wean: 8.53. Bank stability•Banks stable•Moderately stable•Moderately stable•Moderately unstable•Many eroded aabsent/minimal• $<5\%$ of bankinfrequent, smallareas of erosion• $30-60\%$ of bank in• $60-100\%$ of bank• $<5\%$ of bankaffected• 11 1098765432.eft bank:13201918171615141312111098765432Mean: 14 <td>Left bank:8</td> <td>20</td> <td>19</td> <td>9 18</td> <td>17</td> <td>16</td> <td>15</td> <td>14</td> <td>13</td> <td>12</td> <td>11</td> <td>10</td> <td>9</td> <td>8</td> <td>7</td> <td>6</td> <td>5</td> <td>4</td> <td>3</td> <td>2</td> <td>1</td>	Left bank:8	20	19	9 18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
3. Bank stability•Banks stable Erosion/bank failure absent/minimal • <5% of bank affected•Moderately stable ••Moderately unstable•Unstable ••Unstable ••Many eroded area •60-100% of bank has erosion mostly healed over ••Moderately unstable•Moderately unstable•Many eroded area •60-100% of bank has erosion potential during foods•Unstable ••Many eroded area •60-100% of bank has erosion potential during foods•Unstable ••Many eroded area •60-100% of bank has erosion areado•Many eroded area •60-100% of bank has erosion·Many eroded area •60-100% of bank has erosion areado·Many eroded area •60-100% of bank has erosion·Many eroded area •60-100% of bank mostly head dower···<	3. Bank stability Banks stabile Frosion/bank failure absent/minimal <5% of bank affected -5% of bank affected Infrequent, small areas of erosion mostly healed over erosion S-30% of bank in reach has areas of erosion High erosion potential during floods Left bank:13 20 19 18 17 16 15 14 13 12 11 10 8 7 6 5 4 3 2 11 10 8 7 6 5 4 3 2 11 10 8 7 6 5 4 3 2 11 10 8 7 6 5 4 3 2 11 10 8 7 6 5 4 3 2 11 10 8 7 6 6 4 3 2 11 10 8 7 6 4 3 2 4 3 4 13 14 13 12 11 10 8 7 6 6 4 3 2 11 10 8 7 6 4 3 2 2 3 4 13 <l< td=""><td>Right bank:9</td><td>20</td><td>19</td><td>9 18</td><td>17</td><td>16</td><td>15</td><td>14</td><td>13</td><td>12</td><td>11</td><td>10</td><td>9</td><td>8</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td></l<>	Right bank:9	20	19	9 18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Introduction<	 Erosion/bank failure absent/minimal < 5% of bank affected < 1nfrequent, small areas of erosion mostly healed over affected < 5% of bank eroded < 5% of bank eroded < 5% of bank eroded < 19 18 17 16 15 14 13 12 11 10 8 7 5 4 20 19 18 17 16 14 13 12 11 10 8 7 5 4 2 13 14 13 11 10 8 7 5 4 2 13 14 13 12 11 10 8 7 5 4 2 4 3 2 11 10 8 7 5 4 3 2 11 10 8 7 5 4 3 2 4 3 4 3 4 13 12 11 10 8 7 6 4 3 2 4 3 4 4 4 13 14 14 13 14 14 14 13 14 14 14 14 14	Mean: 8.5				<u> </u>			<u>.</u>	1	L	L			L		1					-
Right bank:15201918171615141312111098765432Mean: 144. Frequency of riffles•Riffles relatively frequent ••Riffles relatively frequent •• $0 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - $	Right bank:15201918171615141312111098765432Mean: 144. Frequency of riffles••Riffles relatively frequent•Occurrence of riffles divided by stream width=5-7•Occurrence of riffles divided by stream width=5-7•Occurrence of riffles divided by stream width=7-15•Occurrence of run•Occurrence of run•Occurrence run•Occurrence occurrence•Occurrence run•Occurrence run•Occurrence run•Occurrence run• <td< td=""><td>3. Bank stability</td><td>•</td><td>Eros abso <5%</td><td>sion/ba ent/mi 6 of ba</td><td>ank fai nimal</td><td>lure</td><td>•</td><td>Infrease areas most 5-309</td><td>quent s of er ly hea % of b</td><td>, sma osion lled o</td><td>II</td><td>•</td><td>unsta 30-60 reach erosia High poter</td><td>able 0% of n has a on erosic ntial d</td><td>bank areas</td><td>of</td><td>•</td><td>Man 60-1</td><td>iy ero .00%</td><td>of ban</td><td>ık</td></td<>	3. Bank stability	•	Eros abso <5%	sion/ba ent/mi 6 of ba	ank fai nimal	lure	•	Infrease areas most 5-309	quent s of er ly hea % of b	, sma osion lled o	II	•	unsta 30-60 reach erosia High poter	able 0% of n has a on erosic ntial d	bank areas	of	•	Man 60-1	iy ero .00%	of ban	ık
Mean: 14 Image: Contract of the	Mean: 14 Image: construct of the second	Left bank:13	20	19	9 18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
4. Frequency of riffles • Riffles relatively frequent • Occurrence of riffles infrequent • Occasional riffle or run • Generally flat water, shallow riffles • Distance between riffles divided by stream width=5-7 • Distance between riffles divided by stream width=5-7 • Bottom contours provide some habitat • Distance between riffles divided by stream width=7-15 • Distance between riffles divided by stream width=15-25 Score: 11 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 Score: 11 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 Score: 11 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 Score: 11 20 19 <	 A. Frequency of frequent Riffles relatively frequent Distance between riffles divided by stream width=5-7 Variety of habitat is key Variety of habitat is key Cocasional riffle or run Distance between riffles divided by stream width=7-15 Variety of habitat is key Score: 11 20 19 18 17 16 15 14 13 12 11 10 8 7 5 4 2 3 2 5 Channel Changes to channel/dredging absent/minimal Stream with normal pattern Stream with normal pattern Stream vith normal pattern A. Stream vith normal pattern<td>Right bank:15</td><td>20</td><td>19</td><td>9 18</td><td>17</td><td>16</td><td>15</td><td>14</td><td>13</td><td>12</td><td>11</td><td>10</td><td>9</td><td>8</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td>	Right bank:15	20	19	9 18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
riffles $1 + 2 + 2 + 2 + 2 + 2 + 2 + 2 + 2 + 2 + $	<pre>frequent Distance between riffles divided by stream width=5-7 Variety of habitat is key Variety of habitat Variety of habitat Variety of habitat is key Variety of habitat Variety of habit</pre>	Mean: 14																				
5. Channel alteration • Changes to channel/dredging absent/minimal • Some changes to channel/dredging absent/minimal • Channel • Changes/dredging extensive • Banks shored with gabion/cement • Stream with normal pattern • Stream vith normal not present • Channel/dredging • Channel/credging • Stream vith normal pattern • Stream vith normal not present • Channel/credging • Stream vith normal channel/dredging • Embankments/shor ing structures present on both banks • Instream habitat altered/absent	 5. Channel alteration Changes to channel/dredging absent/minimal Stream with normal pattern Stream with normal channel/dredging not present Stream with normal pattern S		•	freq Dist riffle stre Vari	uent ance b es divi am wi iety of	etwee ded by dth=5-	7		riffle: Dista riffle:	s infre nce b s divic	quen etwee led by	en v	•	run Botto provi habit Dista riffles strea	om co de so at nce b s divic	ntour me etwee led by	s en /		wate riffle Poor Dista riffle	er, sh es r habi ance es div	allow itat betwe ided b	у
alteration channel/dredging absent/minimal channel/dredging bittern channel/dredging channel/dredging changes/dredging extensive gabion/cement • Stream with normal pattern • Stream with normal pattern • Recent channel/dredging not present • Embankments/shor ing structures present on both banks • Instream habitat altered/absent	channel/dredging absent/minimal • Stream with normal pattern • Recent channel/dredging not present • 40-80% of reach Channelized & disrupted • Changes/dredging • Embankments/shor ing structures present on both banks • 40-80% of reach Channelized & disrupted	Score: 11	20	19	9 18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
disrupted				cha abso Stre	nnel/d ent/mi eam wi	redgin nimal	•	•	chan Evide chan Rece chan	nel/dr ence o nel/dr nt nel/dr	edgir f past edgir edgir	ig ig	•	chang exter Emba ing st prese banks 40-80 Chan	ges/di nsive ankme ructu ent on s 0% of nelize	ents/s res both reach	hor	•	gabi >809 reac or di Instr	on/ce % of s h cha isrupt eam	ement stream anneliz ted habita	ed
	Score: 16 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2			1		-			1	1							1			—		

Habitat parameter		Ca	atego	ory		На	bitat	para	mete	r		Ca	itego	ry		Ha	bitat	para	mete	r
Habitat parameter		0	ptim	al								0	ptim	al						
6. Sediment deposition	•	point <20% affec sedin	bars of bo ted by		nt	•	form from or fin 20-50 affec	ation, grave le sed 0% of ted t depo	ase in most l, san iment botto ositior	ly d t m	•	Some new § fine s old & 50-80 affect Sedin at ob const bend	gravel edime new 0% of ted nent o struct rictio	l, sand ent or bars botto depos :ions,	d or n m	•	fine r Incre devel >80% chang frequ Pools abser sedin	nater ased lopme of bo ging lently almo nt due	bar ent ottom ost e to	
Score: 13	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
7. Velocity/depth regimes	•		nes pr /deep /shallo shallo	ow,		•	regin If fas	tity/de nes pr t/shal	epth esent low is en sco		•	2 of 4 veloc regim If fast slow/ missi	ity/de ies pr :/shal /shallo	esent low o ow are	r e	•	veloc regin	ity/de ne	d by 1 epth ep/slo	
Score: 10	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
8. Abundance & diversity of habitat	•	varie debri mats Snags logs/ banks provi fish c	irable tebra iisatic ty of v s, riff under s/cob des a over not b	for te on & w woody les, ro omerg cut	ed ant	•	favou inver color Snag logs/ bank Fish o Mode of ha Can o	urable tebra hisatic s/ sub under s/cob cover erate bitat	te on rcut bles comn variet types t of so	ed non sy	•	10-30 favou invert colon Fish c 60-90 easily foot Wood or ma smot sedim	irable tebra isatio over 0% sul mov dy del ay be hered	for te n patch bstrat ed by bris ra	y e	•	favou inver color Fish o abser Subst or lao Stabl lackir	nt trate i tking e hab	for te on rare c unstal itats limite	ble
Score: 9	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
9. Periphyton	•	evide held (mac	subst rophy l etc.,	hand rates		•	visibl subst	rates		1	•	Perip <20% availa	cove	r of		•	& pro	olific cove	n obvi er of ubstra	
Score: 9	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
TOTAL SCORE: 100																				

Stream name: Piakon	ui Stream				Assesso	r: Josh	Smith		
Site number: 765-15		Samp	le number: 5		Date: 03	/03/2	016	Time	e: 17:30
GPS coordinates		Dowr	nstream:		E 18312	11		N 58	15768
		Upstr	ream:		E 18312	10		N 58	809980
Channel & riparian	features				Instrea	m hyo	draulic c	ondi	tions
Canopy cover:					Estimate	d or me	asured rea	ch ave	erage:
Open	Partly s	haded	Very s	haded					
Fencing:	Dominant	riparia	n vegetation:		Stream	width	active ch	anne	l): 3.5m
None/ineffective	Crops		Retired veg	getation	Stream	width	(water): 2	.6m	
One side/partial	Pasture		Native shru	ap	Stream	depth:	0.15m		
Complete	Exotic tree	es	Native tree	es	Surface	velocit	y: 0.20m	S⁻¹	
Water quality									
Temperature:	16.4		°C		Conduct	ivity:		NA	μS cn
Dissolved oxygen:	95.1			9.3			mg l	-1	
Turbidity:	Clear		Slightly turbid	Highly t	urbid	Stain	ed		Other
Stream-bottom sub	ostrata		•	-					
Compaction (inorgani	ic substrata):	:			% surfic compos		rganic sul	bstra	tum size
Assorted sizes tightly	packed &/o	r overla	pping		Substrat	um	Dimens	ion	Percentag
Moderately packed w	ith some ove	rlappin	g		Bedrock		-		-
Mostly a loose assortr	ment with litt	tle over	lap		Boulder		>256mm		40
No packing/loose asso	ortment easil	y move	d		Cobble		>64-256m	m	25
Embeddedness:					Gravel		>2-64mm		10
(% gravel-boulder particle	es covered by f	fine sedi	ment)		Cond		>0.06-2mi	n	5
() Brater boarder parties			/		Sand				0
<5% 5-25%	1	50%	51-75%	>75%	Silt		0.004-0.06		20
1	1		1 1	>75%				ōmm	-
<5% 5-25	% 26-		1 1	>75%	Silt Clay	type	0.004-0.06	5mm 1	-
<5% 5-25 Organic material (%	% 26-: % cover)		1 1	>75%	Silt Clay		0.004-0.06 <0.004mn	5mm 1	-
<5% 5-25 Organic material (%	% 26-: 6 cover) iameter)		1 1	>75%	Silt Clay Habitat		0.004-0.06 <0.004mn	omm n ed	-
<5% 5-25 Organic material (% Large wood (>10cm d	% 26-: 6 cover) iameter) % 26-:	50%	51-75%		Silt Clay Habitat (% of effo		0.004-0.06 <0.004mm s sample	5mm n ed	-
<5% 5-25 Organic material (% Large wood (>10cm d <5% 5-25	% 26-: 6 cover) iameter) % 26-: wood, sticks	50%	51-75%		Silt Clay Habitat (% of effo Stones:	ort)	0.004-0.06 <0.004mm s sample 509	5mm n e d % Ri	20
<5% 5-25% Organic material (% Large wood (>10cm d <5% 5-25% Coarse detritus (small <5% 5-25%	% 26-: 6 cover) iameter) % 26-: wood, sticks % 26-:	50% 50% 5, leaves	51-75% 51-75% s etc., >1mm)	>75%	Silt Clay Habitat (% of effo Stones: Wood:	ort)	0.004-0.06 <0.004mm s sample 509	5mm 2 ed 6 Ri 6 Ri	20 iffles: 2
<5% 5-25 Organic material (% Large wood (>10cm d <5% 5-25 Coarse detritus (small	% 26-: 6 cover) iameter) % 26-: wood, sticks % 26-: deposits	50% 50% 5, leaves	51-75% 51-75% s etc., >1mm)	>75%	Silt Clay Habita (% of effo Stones: Wood: Macrop Edges:	brt) hyte:	0.004-0.06 <0.004mm s sample 509 9	5mm e d % Ri % Ri % Pi	20 iffles: 2 uns: 2 ools: 10%
<5% 5-25% Organic material (% Large wood (>10cm d <5% 5-25% Coarse detritus (small <5% 5-25% Fine (<1mm) organic of	% 26-3 6 cover)	50% 50% 50% 50%	51-75% 51-75% s etc., >1mm) 51-75% 51-75%	>75% >75%	Silt Clay Habita (% of effo Stones: Wood: Macrop Edges:	hyte:	0.004-0.00 <0.004mm s sample 509 9 9 509	5mm 2 ed 6 Ri 6 Ri 6 Pi 8 retu	20 iffles: 2 uns: 2 ools: 10%
<5% 5-25% Organic material (% Large wood (>10cm d <5% 5-25% Coarse detritus (small <5% 5-25% Fine (<1mm) organic of <5% 5-25%	% 26-1 6 cover)	50% 50% 50% 50%	51-75% 51-75% s etc., >1mm) 51-75% 51-75%	>75% >75%	Silt Clay Habita (% of effe Stones: Wood: Macrop Edges: Number	hyte:	0.004-0.00 <0.004mm s sample 509 9 9 509	5mm 2 6 6 7 6 8 7 8 8 1 1 1 1 1 1 1 1 1 1 1 1 1	20 iffles: 2 uns: 2 ools: 10% urned:
<5% 5-25 Organic material (% Large wood (>10cm d <5% 5-25 Coarse detritus (small <5% 5-25 Fine (<1mm) organic of <5% 5-25 Instream plant cover	% 26-: 6 cover) . iameter) % 26-: % 26-: . deposits % 26-: % 26-: . deposits % 26-: mats:	50% 50% 50% 50%	51-75% 51-75% s etc., >1mm) 51-75% 51-75%	>75% >75%	Silt Clay Habita t (% of effo Stones: Wood: Macrop Edges: Number Koura: Y	hyte:	0.004-0.00 <0.004mm s sample 509 9 9 509	5mm 2 6 6 7 6 8 7 8 8 1 1 1 1 1 1 1 1 1 1 1 1 1	20 iffles: 2 uns: 2 ools: 10% urned: mps: N
<5% 5-25% Organic material (% Large wood (>10cm d <5% 5-25% Coarse detritus (small <5% 5-25% Fine (<1mm) organic of <5% 5-25% Instream plant cove Filamentous algae & r <5% 5-25%	% 26-: 6 cover) . iameter) % 26-: % 26-: . deposits % 26-: % 26-: . deposits % 26-: mats:	50% 50% 50% 50% bed are	51-75% 51-75% s etc., >1mm) 51-75% 51-75% ea)	>75% >75% >75%	Silt Clay Habita (% of effo Stones: Wood: Macrop Edges: Number Koura: Y Crabs: N	hyte:	0.004-0.00 <0.004mm s sample 509 9 9 509	5mm 2 6 6 7 6 8 7 8 8 1 1 1 1 1 1 1 1 1 1 1 1 1	20 iffles: 2 uns: 2 ools: 10% urned: mps: N
<5% 5-25% Organic material (% Large wood (>10cm d <5% 5-25% Coarse detritus (small <5% 5-25% Fine (<1mm) organic o <5% 5-25% Instream plant cove Filamentous algae & r	% 26-1 6 cover)	50% 50% 50% 50% bed are	51-75% 51-75% s etc., >1mm) 51-75% 51-75% ea)	>75% >75% >75%	Silt Clay Habita (% of effe Stones: Wood: Macrop Edges: Number Koura: Y Crabs: N Other:	hyte: of inv	0.004-0.00 <0.004mm s sample 509 9 9 509	ed 6 Ri 6 Ri 6 Ri 6 Ri 8 retu Shrir Mus:	20 iffles: 2 uns: 2 ools: 10% urned: mps: N
<5% 5-25% Organic material (% Large wood (>10cm d <5% 5-25% Coarse detritus (small <5% 5-25% Fine (<1mm) organic of <5% 5-25% Instream plant cove Filamentous algae & r <5% 5-25% Macrophytes:	% 26-1 6 cover)	50% 50% 50% 50% bed are	51-75% 51-75% s etc., >1mm) 51-75% 51-75% sa) 51-75%	>75% >75% >75%	Silt Clay Habitat (% of effe Stones: Wood: Macrop Edges: Number Koura: Y Crabs: N Other: Mussel	hyte: of inv	0.004-0.00 <0.004mm s sample 509 9 9 509	ed 6 Ri 6 Ri 6 Ri 6 Ri 8 retu Shrir Mus:	20 iffles: 2 uns: 2 ools: 10% urned: mps: N sels: N

Stream name: Piakonu	ui Stro	eam						0	Site n	umb	er: 5									
Sample number: 753-2	15			A	ssess	or: J	osh S	mith					Date	: 03/	03/2	016				
										Cate	gory									
Habitat parameter	-	С	ptim	al			Sub	opti	mal			Μ	argin	al				Poor	-	
1. Riparian vegetative zone width	•	>10n	tatior n inuou	ı buffe s &	er	•	Bank veget <10m Most	tation			•	Pathy and/o Most	or sto	ck		•		iks fre nan ac ous		
Left bank:19	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Right bank:17	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Mean: 18								•												
2. Vegetative protection	•	imme zone nativ Trees shrul wood prese Vege	ediate s cove e veg s, und os or i dy pla ent tative	nts	ian y n orey	•	nativ Disru Bank	red m e veg ption s may red by	ainly etatio evide be	ent	•	of gra black & intr speci Vege	red by asses/ berry roduc es tation ption soil/c ped ve	y mixt /shrub , willo ed obvio losely	us	•	cove & sh Disre strea vege high Gras graz Sign	s hea	y gras of nk very vily	Ĩ
Left bank:19	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Right bank:17	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Mean: 18																				
3. Bank stability	•	Erosi failur abse	nt/mi of bai	ank nimal		•	Infree areas	of er ly hea 6 of b	, sma osion iled o	II	•	Mode unsta 30-60 reach erosid High poter flood	ible)% of i has a on erosic ntial d	, bank areas	of	•	Mar 60-1	able ay eroo 00% c erosio	of ban	k
Left bank:18	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Right bank:18	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Mean: 18					1		1		1										1	<u>.</u>
4. Frequency of riffles	•	frequ Dista riffle strea	ient nce b s divio m wio	tively etwee led by dth=5- habita	en / -7	•	Dista riffles	s infre	equen etwee led by	en /	•	Occas run Botto provi habit Dista riffles strea 25	om co de so at nce b s divic	ntour me etwee led by	s en	•	wate riffle Poor Dista riffle	erally er, sha es r habit ance b es divid am wid	llow at etwe ded by	/
Score: 16	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
5. Channel alteration	•	chan abse Strea		redgir nimal th	0	•	Evide chan Rece chan	nel/di ince c nel/di	redgir of past redgir redgir	ng t ng	•	exter Emba	ges/di isive inkme iructu int on 5 0% of	res both reach	hor	•	gabi >809 reac or d Instr	ks sho on/ce % of st h chai srupto ream h red/at	ment ream nneliz ed nabita	ed

Habitat parameter		Ca	itego	ry		На	bitat	para	mete	r		Ca	itego	ry		Ha	bitat	para	mete	r		
Habitat parameter		0	ptim	al								0	ptim	al								
6. Sediment deposition	•	Little, point <20% affect sedin depo	bars of bo ted by nent	prese ottom /	nt	•	form from or fin 20-50 affec	ation, grave le sed 0% of ted t depo	ase in most l, san liment botto ositior	ly d t m	•	Some new { fine s old & 50-80 affect Sedin at ob const bend	gravel edim new 0% of ted nent o struct	l, sand ent or bars botto depos cions,	d or n m	•	absent due to sediment deposition					
Score: 15	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1		
7. Velocity/depth regimes	•	4 velo regim Slow/ slow/ fast/s fast/o	nes pr /deep /shallo shallo	esent , ow,		•	regin If fas	tity/de nes pr t/shal	epth esent llow is en sco		•	2 of 4 veloc regim If fast slow/ missi	ity/de nes pr t/shal (shallo	esent low o ow are	r e	•	Domi veloc regin Usua					
Score: 15	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1		
8. Abundance & diversity of habitat	•	>50% favou inver colon variet debri mats Snags logs/ banks provi fish c Must trans	irable tebra isatio ty of v s, riffl s/ sub under s/cob des al over not b	for te woody es, ro merg cut bles bunda	ed ant	•	favou inver color Snags logs/ bank Fish o Mode of ha Can o	urable tebra hisatic s/ sub under s/cob cover erate bitat	te omerg rcut bles comn variet types t of so	ed non sy	•	10-30 favou inver colon Fish c 60-90 easily foot Wood or ma smot sedin	irable tebra isatio cover 0% sul v mov dy del ay be hered	for te n patch bstrat ed by bris ra	y e	•	abser Subst or lac Stabl lackir	irable tebra iisatic cover nt crate i cking e hab	for te n rare c unstal itats imite	ble		
Score: 17	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1		
9. Periphyton	•		substi rophy l etc.,	hand rates tes,		•	visibl subst	rates		ı	•	Perip <20% availa	cove	r of		•	& pro	lific cove	r of ubstra			
Score: 19	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1		
TOTAL SCORE: 153																			•			

Stream name: Paiaka	rahi Stream D	/S			Assesso	r: Kath	ryn Reeve			
Site number: 718-5		Samp	ole number: 6		Date: 0	3/03/2	016 1	ime:	16:05	
GPS coordinates		Dowi	nstream:		E18410	27	1	15867	7879	
		Upsti	ream:		E18410	98	1	1586	7799	
Channel & riparian	features				Instrea	m hy	draulic co	nditi	ons	
Canopy cover:					Estimate	d or me	asured reac	n aver	age:	
Open	Partly s	haded	Very s	haded						
Fencing:	Dominant	riparia	n vegetation:		Stream	width	(active cha	nnel)	: 7.2m	
None/ineffective	Crops		Retired ve	getation	Stream	width	(water): 3.9	€m		
One side/partial	Pasture		Native shr	ub	Stream	depth:	0.44m			
Complete	Exotic tree	S	es	Surface	veloci	ty:				
Water quality										
Temperature:	17.5		°C		Conduc	tivity:	7	'3	μ	S cm⁻¹
Dissolved oxygen:	85.8		%		8.13 mg l ⁻¹					
Turbidity:	Clear		Slightly turbid	Highly t	turbid	Stair	ned	C	Other	
Stream-bottom sul	ostrata									
Compaction (inorgan	ic substrata):				% surfic		rganic sub	stratu	um size	
Assorted sizes tightly	packed &/or	overlap	oping		Substra	tum	Dimensio	on	Percer	ntage
Moderately packed w	vith some ove	erlappi	ng		Bedrock	(-			
Mostly a loose assort	ment with litt	le over	lap		Boulder		>256mm		50	
No packing/loose asso	ortment easily	y move	ed		Cobble		>64-256mm		30	
Embeddedness:					Gravel		>2-64mm		20	
(% gravel-boulder particl	es covered by f	ine sedi	ment)		Sand		>0.06-2mm			
<5% 5-25	% 26-5	50%	51-75%	>75%	Silt		0.004-0.06n	nm		
	I		· ·		Clay		<0.004mm			
Organic material (%	6 cover)				Habita	t type	s sampled	1		
Large wood (>10cm d	iameter)				(% of eff	ort)				
<5% 5-25	% 26-5	50%	51-75%	>75%	Stones:		100%			
Coarse detritus (small	wood, sticks	, leave	s etc., >1mm)		Wood:		%	Rif	fles:	60 %
<5% 5-25	% 26-5	50%	51-75%	>75%	Macrop	hyte:	%	Ru	ns:	40%
Fine (<1mm) organic	deposits				Edges:		%			
<5% 5-25	% 26-5	50%	51-75%	>75%	Numbe	r of inv	ertebrates	retur	rned:	
Instream plant cov	er (% stream	bed are	ea)		Koura: `	ſ	5	hrim	ps: N	
Filamentous algae & r	mats:				Crabs: N	١	r	Ausse	els: N	
< 5% 5-25	% 26-5	50%	51-75%	>75%	Other: I	N				
Macrophytes:	Į		ı İ		Mussel	type:				
<5% 5-25	% 26-5	50%	51-75%	>75%	Hyridell	а	c	Cucun	nerunio	
Mosses/liverworts:	·									
1	% 26-5	50%	51-75%	>75%						
<5% 5-25										

Wadeable Hard-Bot Qualitative Habitat Ass					Shee	et														
Stream name: Paiakara	ahi S [.]	trean	n D/S					0	Site n	umb	er: 7	18-5								
Sample number: 6				A	ssess	or: K	athry	/n Re	eves				Date	: 03/	03/1	6				
Habitat parameter	-	С)ptim	al			Sut	oopti	mal	Cate	gory		argin	nal				Ροοι	ſ	
1. Riparian vegetative zone width	•	Bank vege >10n	side tatior n inuou	ı buffe	er	•	Bank veget <10m	side tation	buffe		•	Pathv and/o	ways p or sto	prese		•		iks fre nan ac ous		
Left bank:20	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Right bank:20	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Mean: 20																				
2. Vegetative protection	•	imme zone nativ Trees shrul wood prese Vege	ediate s cove re veg s, und bs or r dy pla ent tative	nts	ian y n orey	•	cover nativ Disru Bank	surfa red m e veg ption s may red by try	ainly etatio evide be	n ent	•	of gra black & intr speci Vege disru Bare	red by asses/ berry roduc es tation ption soil/c ped ve	/ mixt /shrut , willc ed	os, ow ous	•	cove & sh Disru strea vege high Gras graz Sign	s hea	y gras i of nk i very vily : stock	ζ.
Left bank:18	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Right bank:18	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Mean: 18																				
3. Bank stability	•	Erosi failur abse	nt/mi of bai	ank nimal		•	Infre areas most	eratel quent s of er ly hea % of b ed	, sma osion iled o	II	•	reach erosi High	able 0% of n has a on erosic ntial d	bank areas	of	•	Man 60-1	able ay eroo 00% c erosio	of ban	k
Left bank:14	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Right bank:12	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Mean: 13																				
4. Frequency of riffles	•	frequ Dista riffle strea	uent ince b s divio im wio	tively etwee led by dth=5 habita	en / -7	•	riffle: Dista riffle:	rrenco s infre nce b s divic m wic	equen etwee led by	en /	•	run Botto provi habit Dista	om co de so at nce b s divic	etwee led by	s en /	•	wate riffle Poor Dista riffle	erally er, sha es r habit ance b es divio am wio	at etwee ded by	Ý
Score: 18	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
5. Channel alteration	•	chan abse Strea		redgir nimal th	ng	•	chan Evide chan Rece chan	e char nel/di ence c nel/di nt nel/di oresen	redgir of past redgir redgir	ng : ng	•	exter Emba ing st prese banks 40-80	ges/d nsive ankme ructu ent on s 0% of nelize	res both reach	hor	•	gabi >809 reac or di Instr	ks sho on/ce % of st h chai srupto ream h red/at	ment ream nneliz ed nabita	ed
Score: 20	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1

Uspitat paramatar		Ca	atego	ory		На	bitat	para	mete	r		Ca	atego	ory		Ha	bitat	para	mete	r
Habitat parameter		0	ptim	al								0	ptim	al		 Habitat paran Heavy deporing materia Increased b development >80% of bot changing frequently Pools almost absent due sediment deposition 5 4 3 Dominated velocity/depregime Usually dee 5 4 3 <10% subst favourable tinvertebratic colonisation Fish cover r absent Substrate u or lacking or lacking or lacking or lacking or lacking or lacking or light backs or lacking or lacking or light backs or lacks or lacking or light backs or lacks o				
6. Sediment deposition	•	point	bars of bo ted by nent		nt	•	form from or fin 20-50 affec	ation, grave e sed 0% of ted t depo	ase in most l, san liment botto psitior	ly d t m	•	Some new { fine s old & 50-80 affect Sedin at ob const bend	grave edim new 0% of ted nent o struct	l, sand ent or bars botto depos tions,	dor n m	•	fine r Incre deve >80% chan; frequ Pools abset sedin	mater ased opmo of bo ging iently almo nt due nent	ial bar ent ottom ost e to	
Score: 17	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
7. Velocity/depth regimes	•		nes pr /deep /shallo shallo	ow,		•	regin If fas	ity/de nes pr t/shal ng th	epth esent llow is en sco		•	2 of 4 veloc regim If fast slow/ missi	ity/de nes pr t/shall (shallo	iesent low o ow are	r e		veloc regin			
Score: 14	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
8. Abundance & diversity of habitat	•	variet debri mats Snags logs/ banks provi fish c	irable tebra iisatic ty of v s, riff under s/cob des a over not b	for te on & w woody les, ro omerg cut	ed ant	•	favou inver color Snags logs/ banks Fish o Mode of ha Can o	urable tebra iisatic s/ sub under s/cob s/cob cover erate bitat	te omerg rcut bles comn variet types t of so	ed non sy	•	10-30 favou inver colon Fish c 60-90 easily foot Wood or ma smot sedin	urable tebra iisatic cover 0% su y mov dy del ay be herec	for te patch bstrat ed by bris ra	y e	•	favou inver color Fish o abset Subst or lao Stabl lackin	urable tebra iisatic cover nt trate cking e hab ng or	for te n rare c unstal itats limite	ble
Score: 19	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
9. Periphyton	•	held : (mac	ent on subst rophy l etc.,	hand rates		•		e on rates		n	•	Perip <20% availa	, cove	r of		•	& pro			
Score: 18	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
TOTAL SCORE:157								-					-					-		L

	gorengo St	ream			Assess	or: Mi	ke Martin		
Site number: 232-3		Sam	ple number: 7		Date: 0	2/03/2	2016 -	Time	: 14:30
GPS coordinates	•	Dow	nstream:		E 1848	393	1	N 58	23235
		Upst	ream:		E 1848	423	I	N 58	23069
Channel & riparia	n feature	s			Instre	am h	ydraulic	cor	nditions
Canopy cover:					Estimate	ed or m	easured re	ach a	verage:
Open	Partly s	haded	Very s	haded					
Fencing:	Dominant	riparia	an vegetation:		Stream	width	(active cl	nann	el): 3.8m
None/ineffective	Crops		Retired ve	getation	Stream	width	(water): 2	2.3m	
One side/partial	Pasture		Native shr	ub	Stream	depth	n: 0.37m		
Complete	Exotic tree	es	Native tree	es	Surface	e veloo	city: m s ⁻¹		
Water quality									
Temperature:	19.8		°C		Conduc	ctivity:		149.8	β μS cm ⁻¹
Dissolved oxygen:	58.5		%		5.33		r	ng l-	1
Turbidity:	Clear		Slightly turbid	Highly	turbid	Stai	ned	(Other
Stream-bottom si	ubstrata		•						
Compaction (inorga	anic substr	ata):			% surfi			subs	stratum size
Assorted sizes tightly	/ packed &/	or ove	rlapping		Substra	atum	Dimensi	ion	Percentage
Moderately packed v	vith some ov	verlap	ping		Bedroc	k	-		
Mostly a loose assor	tment with I	ittle ov	verlap		Boulde	r	>256mm		
No packing/loose a	ssortment	easily	moved		Cobble		>64-256m	m	
Embeddedness:					Gravel		>2-64mm		40
(% gravel-boulder partic	les covered b	by fine	sediment)		Sand		>0.06-2mm	n	40
<5% 5-25%	6 26-5	0%	51-75%	>75%	Silt		0.004-0.06	mm	20
I	I				Clay		<0.004mm		
Organic material	(% cover)				-	at tvo	es samp	oled	
Large wood (>10cm					(% of eff	•••			
<5% 5-25%	1	0%	51-75%	>75%	Stones	,	%		
Coarse detritus (sma	-		1 1		Wood:		10%		ffles: %
< 5% 5-25%					Macrop	hyte:			uns: 100%
Fine (<1mm) organic	•		ı I		Edges:		%		
<5% 5-25%		0%	51-75%	>75%			vertebrate	s ret	turned:
Instream plant co	ver (% stre	eambe	d area)		Koura:	Y		Shrin	nps: N
Filamentous algae &	,		,		Crabs:	Y			els: N
< 5% 5-25%		0%	51-75%	>75%	Other:				
Macrophytes:	I		ı I		Mussel	type:			
< 5% 5-25%	6 26-5	0%	51-75%	>75%	Hyridel	•••		Сись	imerunio
	I		ı I						
Mosses/liverworts:					1				

Right bank:3 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 Mean: 3 2 Vegetative protection 8 Bank surfaces dimension dimensi dimension dimension dimensi dimension dim					Data																
Habitat parameter Optimal Suboptimal Marginal Pathways present optimal Narginal Pathways present optimal Bankside statum Pathways present optimal Banks statum Banks statum<	Stream name: Karengo	oreng	go St	ream					9	Site n	umb	er: 23	32-3								
Habitat parameter Optimal Suboptimal Marginal Poor 1. Ripatian vegetative zone width Bankiside subm Continuous Bankiside subm Continuous Bankiside subm Suboptimal Bankiside subm Suboptimal Bankiside subm Subp Subp Subp Bankiside subm Subp Subp Bankiside subm Subp Subp Bankiside subm Subp Subp Bank suffaces & immediate right annike subm Subp Bank suffaces & immediate right annike Subp Bank suffaces & immediate right annike Subp Subp Bank suffaces & immediate right annike Subp Subp Bank suffaces & immediate right annike Vegetative sovered protion obvious Bank suffaces sufface Subp Bank suffaces sufface Subp Bank suffaces Subp Subp Bank suffaces Subp Bank suffaces Subp Bank suffaces Subp Bank	Sample number: 7	1			A	ssess	or: N	/ike I	Marti	n				Date	: 02/	03/2	016				
Optimal Sandside wegetative zone width Bankside wegetative zone width Bankside wegetative zone width Bankside wegetative zone width Bankside wegetative zone wegetative zone dense Pathways present and/or stock Breaks frequent West wegetative zone wegetative zone wegetative zone wegetative zone wegetative zone dense Bankside wegetative zone wegetative zone zone zone Pathways present and/or stock Bankside wegetative wegetative zone zone Bankside wegetative protection Bank surfaces wegetative protection Bank surfaces wegetative	Habitat parameter										Cate	gory									
vegetative zone width			(Optim	ial					mal									Poor	•	
Right bank:3 20 19 18 17 16 15 14 13 12 11 10 9 6 7 6 5 4 3 2 1 Mean: 3 . . Bank surfaces & immediate riparian covered mainty by native vegetation bookous plants mody plants way be covered by mixture of grasses/Athery. willow & kintroduces by grasses by by solution of the kintroduces by grasses/Athery. Willow & kintroduces by grasses/Athery. Willow & ki	vegetative zone		vege >10 Con	etation n tinuou		er		veget <10m	tation				and/o	or sto	ck			Hum	an ac		
Mean: 3Note and the surfaces and the surfaces are covered mainly by not evered mainly by not evered the surfaces covered by mixture segretation or surgers and the surfaces are covered by mixture segretation and the vegetation evident.Bank surfaces are covered by mixture of grasses (Shrubs, blackberry, willow bickberry, willow bickberry	Left bank:3	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
2. Vegetative protection Bank surfaces & immediate riparian conce covered by native vegetation Trees, under-storey mody plants present Vegetative disruption minimal Bank surfaces covered mainly by native vegetation Trees, under-storey mody plants present Vegetative disruption minimal Bank surfaces covered by excite forestry Bank surfaces covered by excite forestry Bank surfaces species Vegetative disruption of stream bank grazed Same suble forestry Vegetative disruption for stream bank Vegetative disruption of stream bank Vegetative disruption of stream bank Vegetative disruption of stream bank Vegetative disruption of stream bank Bank surfaces species Vegetative disruption of stream bank Vegetative di	Right bank:3	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
protection immediate riparian zones covered by mative vegetation native vegetation or woody plants present. covered mainly by native vegetation or violation or viol	Mean: 3																				
Right bank:8 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 Mean:8	•	•	imm zone nativ Tree shru woo pres Vege	ediate es cove ve veg es, unc bs or dy pla ent etative	e ripar ered b etatio ler-sto non- ints	ian Y n orey	•	cover nativ Disru Bank cover	red m e veg ption s may red by	ainly etatio evide be	n ent	•	cover of gra black & inte speci Vege disru Bare cropp	red by asses/ berry roduc es tatior ption soil/c ped ve	y mixt /shrut , willo ed obvic losely	os, ow ous	•	cove & sh Disru strea vege high Gras graze Signi	red by rubs iption im ba tatior s heav ed ficant	y gras: of nk very vily	ζ.
Mean:8Image: Statume of the second seco	Left bank:8	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
3. Bank stability • Banks stable • Moderately stable • Moderately stable • Moderately stable • Many eroded areas 3. Bank stability • Frosion/bank failure absent/minimal sees of erosion mostly healed over • $30-60\%$ of bank in reach has areas of erosion potential during floods $30-60\%$ of bank in reach has areas of erosion potential during floods • $Many eroded areas 60-100\% of bank has erosion as erosion set. 60-100\% of bank has erosion Left bank:6 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 Right bank:9 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 Mean: 7.5 -$	Right bank:8	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
$ \begin{array}{ c c c c c } & & & & & & & & & & & & & & & & & & &$	Mean:8				1	<u>.</u>		<u>.</u>	1	L	1		<u> </u>					<u>. </u>	<u>.</u>		-
Right bank:92019181716151413121110987654321Mean: 7.5Image: Stream length 3-4 times longer than if it was straightImage: Stream length 2-3 times longer than if it was straightImage: Stream length 2-3 times longer than if it was straight987654321Score: 82019181716151413121110987654321Score: 82019181716151413121110987654321Score: 82019181716151413121110987654321Score: 82019181716151413121110987654321Score: 82019181716151413121110987654321Score: 8201918171615141312111098765432 <t< td=""><td>3. Bank stability</td><td>•</td><td>Eros failu abse <5%</td><td>ion/ba re ent/mi of ba</td><td>ank nimal</td><td></td><td>•</td><td>Infrease areas most</td><td>quent s of er ly hea % of b</td><td>, sma osion Iled o</td><td>II</td><td>•</td><td>unsta 30-60 reach erosia High poter</td><td>ible)% of i has a on erosio ntial c</td><td>, bank areas on</td><td>of</td><td>•</td><td>Man 60-1</td><td>y eroo 00% c</td><td>of ban</td><td>k</td></t<>	3. Bank stability	•	Eros failu abse <5%	ion/ba re ent/mi of ba	ank nimal		•	Infrease areas most	quent s of er ly hea % of b	, sma osion Iled o	II	•	unsta 30-60 reach erosia High poter	ible)% of i has a on erosio ntial c	, bank areas on	of	•	Man 60-1	y eroo 00% c	of ban	k
Mean: 7.5 Image: Stream length 3-4 times longer than if it was straight Bends increase stream length 3-4 times longer than if it was straight Bends increase stream length 2-3 times longer than if it was straight Bends increase stream length 2-3 times longer than if it was straight Bends increase stream length 1-2 times longer than if it was straight Bends increase stream length 1-2 times longer than if it was straight Bends increase stream length 1-2 times longer than if it was straight Bends increase stream length 1-2 times longer than if it was straight Bends increase stream length 1-2 times longer than if it was straight Bends increase stream length 1-2 times longer than if it was straight Bends increase stream length 1-2 times longer than if it was straight Bends increase stream length 1-2 times longer than if it was straight Bends increase stream length 1-2 times longer than if it was straight Bends increase stream length 1-2 times longer than if it was straight Bends increase stream length 1-2 times longer than if it was straight Bends increase stream length 1-2 times longer than if it was straight Bends increase stream length 1-2 times longer than if it was straight Bends increase stream length 1-2 times longer than if it was straight Bends increase stream length 1-2 times longer than if it was straight Bends increase stream length 1-2 times longer than if it was straight Bends increase stream length 1-2 times longer than if it was straight Bends increase stream length 1-2 times longer than if it was straight Bends increase stream length 1-2 times longer than if it was straight Bends increase stream length 1-2 times long	Left bank:6	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
4. Channel sinuosity Bends increase stream length 3-4 times longer than if it was straight Bends increase stream length 2-3 times longer than if it was straight Bends increase stream length 2-3 times longer than if it was straight Score: 8 20 19 18 17 16 15 14 13 12 10 9 8 7 6 4 3 2 11 10 9 8 7 6 4 3 2 11 10 9 8 7 6 4 3 2 11 10 9 8 7 6 4 3 2 11 10 9 8 7 6 4 3 2 14 13 12 11 10 9 8 7 6 6 6 6 7 6 7 8 9 8	Right bank:9	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
$ \begin{array}{ c c c c c c c c c c c c c c c c c c c$	Mean: 7.5					-		-										-			
5. Channel alteration • Changes to channel/dredging absent/minmal • Some changes to channel/dredging absent/minmal • Channel channel/dredging channel/dredging • Channel changes/dredging extensive • Banks shored with gabion/cement • Stream with normal pattern • Some changes to channel/dredging not present • Channel channel/dredging extensive • Banks shored with gabion/cement • Instream habitat altered/absent • Recent channel/dredging not present • Channel channel/dredging not present • Channel extensive • Instream habitat altered/absent	4. Channel sinuosity	•	strea time	am ler s long	ngth 3 ger tha		•	strea times	m len s long	gth 2- er tha		•	strea times	m len i long	gth 1 er tha		•	Char	nel st	raight	t
alteration channel/dredging absent/minimal channel/dredging absent/minimal channel/dredging extensive changes/dredging extensive gabion/cement • Stream with normal pattern • Stream with normal pattern • Recent channel/dredging not present • Embankments/shor ing structures present on both banks • Instream habitat altered/absent	Score: 8	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
			char abse Stre	nnel/d nt/mi am wi	redgir nimal th	0	•	chan Evide chan Rece chan	nel/di ence c nel/di nt nel/di	edgir f past edgir edgir	ng : ng	•	chang exter Emba ing st prese banks 40-80 chan	ges/d nsive ankme ructu ent on s 0% of nelize	ents/s res both reach	hor	•	gabio >80% react or di Instr	on/ce 6 of st n char srupte eam h	ment ream nnelize ed nabita	ed
					1	r –	<u> </u>				-		นเรเน			1		T	r –	1	

Habitat parameter		Ca	atego	ory		На	bitat	para	mete	r		Ca	atego	ory		or fine material Increased bail development n >80% of bott changing frequently Pools almost absent due to sediment deposition 6 5 4 3 6 5 4 3 6 5 4 3 6 5 4 3 6 5 4 3 6 5 4 3 6 5 4 3 6 5 4 3 7 6 5 4 3 7 7 8 9 Stable habita lacking or lim macrophytes 6 5 4 3 9 9 9 9 9	amete	er			
		С	ptim	al								0	ptim	al							
6. Sediment deposition	•	point <20% affec sedir	/no is bars of bo ted by nent sition	prese ottom /	nt	•	form from	ation, grave e sed 0% of ted ted		ly d : m		new fine s old & 50-80 affec Sedin at ob	grave edim new 0% of ted nent o struct	botto depos tions,	dor n m	•	fine f lncre deve >80% chan frequ Pools abse sedir	mate asec lopn of l ging uent s alm nt du ment	y nost ue to		
Score:8	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	
7. Pool variability	•	Large large smal	s even e/shall /deep l/shall l/deep	low,), low,	ked	•	Majo large Very pools	/deep few s			•		alence ow po			 Majority of pool small/shallow 5 4 3 2 <10% substrate favourable for invertebrate 					
Score: 13	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	
8. Abundance & diversity of habitat	•	favou inver color varie debr mats Snag logs/ bank provi fish c	s/ sub under s/cob des al cover	for te wood les, ro merg cut bles bunda	y oot ed ant	•	favou inver color Snags logs/ banks Fish o Mode of ha	irable tebra isatio s/ sub under s/cob cover erate bitat	te omergo cut bles comm variet types. t of sc	ed non y	•	favou inver color Fish o 60-90 easily foot Wood or ma	urable tebra nisatic cover 0% su y mov dy de ay be herec	te patch bstrat ed by bris ra	γ e		favor inver color Fish abse Subs or la Stabl lacki	urab tebr nisat cove nt trate cking e ha	le for ate ion r rare unsta bitats r limite	or ble	
Score: 8	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	
9. Periphyton	•	evide held Stabl	hytor ent on stone e sub ices ro	hand s strate		•	Stabl	e on s e sub: hytor	n not stones strate n obvie		• •	<20%	, cove	n visib er of ubstra			& pro >20%	olific 6 cov	er of		
Score: 18	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	
TOTAL SCORE: 86.5																					

Stream name. Waitere	e Stream			Assesso	r: Josh	Smith		
Site number: 1224-5	Sam	ple number: 8		Date: 02	2/03/20	016 -	Time:	12:00
GPS coordinates	Dow	nstream:		E 27421	84	I	N 636	5455
	Upst	ream:		E 27420	94	I	N 636	5394
Channel & riparian	features			Instrea	m hyc	Iraulic co	onditi	ons
Canopy cover:						asured reac		
Open	Partly shaded	l Very sh	aded					
Fencing:	Dominant riparia	in vegetation:		Stream	width (active cha	nnel)	: 8.5m
None/ineffective	Crops	Retired veg	etation	Stream	width (water): 6r	n	
One side/partial	Pasture	Native shrul	b	Stream	depth:	0.4m		
Complete	Exotic trees	Native trees	5	Surface	velocit	y: 0.5m s ⁻¹	1	
Water quality	ı							
Temperature:	16.3	°C		Conduct	ivity:		NA	µS cm⁻¹
Dissolved oxygen:	98.5	%		9.72		1	mg l-1	
Turbidity:	Clear	Slightly turbid	Highly t	urbid	Stain			Dther
Stream-bottom sub	strata							
Compaction (inorgani	c substrata):			% surfic compos		rganic sub	stratı	um size
Assorted sizes tightly	packed &/or overl	apping		Substrat	um	Dimensio	on	Percentage
Moderately packed wi	th some overlappi	ng		Bedrock		-		
Mostly a loose assortn	nent with little ove	rlap		Boulder		>256mm		5
No packing/loose asso	rtment easily mov	ed		Cobble		>64-256mm	n	65
Embeddedness:				Gravel		>2-64mm		20
(% gravel-boulder particle	es covered by fine sed	liment)		Sand		>0.06-2mm	n	10
<5% 5-259	% 26-50%	51-75%	>75%	Silt		0.004-0.06r	mm	
	•					<0.004mm		
				Clay		<0.004mm		
Organic material (%	cover)				t type:	s sample		
Organic material (% Large wood (>10cm di								
-	ameter)	51-75%	>75%	Habitat			d	
Large wood (>10cm di	ameter) % 26-50%	1 1	>75%	Habitat (% of effo		s sample	d	fles: 10%
Large wood (>10cm di < 5% 5-25%	ameter) % 26-50% wood, sticks, leave	1 1	>75% >75%	Habitat (% of effc Stones:	ort)	s sample 50%	d Rifi	
Large wood (>10cm di <5% 5-259 Coarse detritus (small	ameter) % 26-50% wood, sticks, leave % 26-50%	es etc., >1mm)		Habitat (% of effo Stones: Wood:	ort)	s sample 50% %	d Rift Rut	
Large wood (>10cm di <5% 5-25% Coarse detritus (small <5% 5-25%	ameter) % 26-50% wood, sticks, leave % 26-50% leposits	es etc., >1mm)		Habitat (% of effo Stones: Wood: Macroph Edges:	byte:	s sample 50% %	d Riff Rui Poo	ns: 80% ols: 10%
Large wood (>10cm di <5% 5-259 Coarse detritus (small <5% 5-259 Fine (<1mm) organic c	ameter) % 26-50% wood, sticks, leave % 26-50% deposits % 26-50%	s etc., >1mm) 51-75% 51-75%	>75%	Habitat (% of effo Stones: Wood: Macroph Edges:	hyte:	s sampled 50% % 50% ertebrates	d Riff Rui Poo	ns: 80% ols: 10% rned:
Large wood (>10cm di <5% 5-25% Coarse detritus (small <5% 5-25% Fine (<1mm) organic c <5% 5-25%	ameter) % 26-50% wood, sticks, leave % 26-50% % 26-50% er (% streambed ar	s etc., >1mm) 51-75% 51-75%	>75%	Habitat (% of effo Stones: Wood: Macroph Edges: Number	hyte:	s sampled 50% % 50% ertebrates	d Riff Rui Poo	ns: 80% ols: 10% rned: ps: N
Large wood (>10cm di <5% 5-25% Coarse detritus (small <5% 5-25% Fine (<1mm) organic d <5% 5-25%	ameter) % 26-50% wood, sticks, leave % 26-50% deposits % 26-50% er (% streambed and and and and and and and and and an	s etc., >1mm) 51-75% 51-75%	>75%	Habitat (% of effo Stones: Wood: Macrop Edges: Number Koura: Y	hyte:	s sampled 50% % 50% ertebrates	d Riff Rui Poo s retur Shrim	ns: 80% ols: 10% rned: ps: N
Large wood (>10cm di <5% 5-259 Coarse detritus (small <5% 5-259 Fine (<1mm) organic d <5% 5-259 Instream plant cove Filamentous algae & n	ameter) % 26-50% wood, sticks, leave % 26-50% deposits % 26-50% er (% streambed ar nats:	es etc., >1mm) 51-75% 51-75% ea)	>75% >75%	Habitat (% of effo Stones: Wood: Macropl Edges: Number Koura: Y Crabs: N	hyte:	s sampled 50% % 50% ertebrates	d Riff Rui Poo s retur Shrim	ns: 80% ols: 10% rned: ps: N
Large wood (>10cm di <5% 5-25% Coarse detritus (small <5% 5-25% Fine (<1mm) organic d <5% 5-25% Instream plant cove Filamentous algae & n <5% 5-25%	ameter) % 26-50% wood, sticks, leave % 26-50% er (% streambed arnats: % 26-50%	es etc., >1mm) 51-75% 51-75% ea)	>75% >75%	Habitat (% of effo Stones: Wood: Macroph Edges: Number Koura: Y Crabs: N Other:	hyte: of inve	s sampled 50% % 50% ertebrates	d Riff Rui Poo s retur Shrim Musse	ns: 80% ols: 10% rned: ps: N
Large wood (>10cm di <5% 5-25% Coarse detritus (small <5% 5-25% Fine (<1mm) organic d <5% 5-25% Instream plant cove Filamentous algae & n <5% 5-25% Macrophytes:	ameter) % 26-50% wood, sticks, leave % 26-50% er (% streambed ar nats: % 26-50%	es etc., >1mm) 51-75% 51-75% ea) 51-75%	>75% >75% >75%	Habitat (% of effo Stones: Wood: Macropl Edges: Number Koura: Y Crabs: N Other: Mussel 1	hyte: of inve	s sampled 50% % 50% ertebrates	d Riff Rui Poo s retur Shrim Musse	ns: 80% ols: 10% rned: ps: N els: N

Wadeable Hard-Bo Qualitative Habitat As					Shee	et														
Stream name: Wairer	e stre	am						0	Site n	umb	er: 1	224-5	5							
Sample number: 8				A	ssess	ior: J	osh S	mith					Date	: 02/	03/2	016				
Habitat parameter		0	ptim	al			Sub	oopti	mal	Cate	gory		argir	nal				Ροοι	ſ	
1. Riparian vegetative zone width	•	>10n	tatior า inuou	n buffe is &	er	•	<10n	tation			•	and/	or sto	presei ck aled o		•		ks fre Ian ac Ous	•	-
Left bank:18	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Right bank:13	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Mean: 15.5																				
2. Vegetative protection	•	imme zone: nativ Trees shrut wood prese Vege	ediate s cove e veg s, und os or i dy pla ent tative	nts	ian y n orey	•	cover nativ Disru Bank	surfa red m e veg ption s may red by try	ainly etatio evide be	n ent	•	of gra black & int speci Vege disru Bare	red by asses/ berry roduc es tatior ption soil/c ped ve	/ mixt /shrut /, willc :ed	os, ow ous	•	cove & sh Disru strea vege high Gras graze Signi	s hea	y gras i of nk i very vily : stock	¢
Left bank: 18	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Right bank:9	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
3. Bank stability	•	Erosi failur absei	nt/mi of bai	ank nimal	17 16 15 14 13 12 11 • Moderately stable • Infrequent, small areas of erosion							unsta 30-60 reach erosi High	0% of n has a on erosio ntial c	bank areas	of	•	60-1	able y eroo 00% c erosio	of ban	k
Left bank:18	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Right bank:13	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Mean: 15.5																				1
4. Frequency of riffles	•	frequ Dista riffle strea	ient nce b s divio m wio	tively etwee ded by dth=5 habita	en / -7	•	Dista riffle:	rrenc s infre nce b s divic m wic	equen etwee led by	en /	•	run Botto provi habit Dista riffles	om co de so at nce b s divic	l riffle ntour me etwee ded by dth=1	s en /	•	wate riffle Poor Dista riffle	erally er, sha s habit ance b s divio am wi	at etwee ded by	y
Score: 14	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
5. Channel alteration	•	chan absei Strea		redgir nimal th	ng	•	chan Evide chan Rece chan	e char nel/di ence d nel/di nt nel/di oresen	redgir of past redgir redgir	ng t ng	•	exter Emba ing st prese banks 40-80	ges/d nsive ankme tructu ent on s 0% of nelize	reach	hor	•	gabi >809 reac or di Instr	ks sho on/ce % of st h chai srupti eam h red/at	ment ream nneliz ed nabita	ed
Score:17	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1

Habitat parameter			tego otima			На	bitat	para	nete	r			itego ptim			На	bitat	para	mete	er
6. Sediment deposition	ې • < a	ittle/ ooint 20% affect edim lepos	bars µ of bo ed by ent	orese ttom	nt	• • •	forma from or fin 20-50 affec	t depo	most I, san iment botto	ly d : m	•	Some new { fine s old & 50-80 affect Sedin at ob const bend	gravel edime new 0% of ted nent of struct rictio	l, sand ent of bars botto depos cions,	dor า m	•	fine i Incre deve >80% chan frequ Pools abse sedir	mater ased lopm 6 of b ging uently s almont due	bar ent ottom ost e to	
Score: 18	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
7. Velocity/depth regimes	r • S s f	l velo egim low/s low/s ast/sl ast/d	es pre deep, shallo hallov	esent w,		 3 Of 4 velocity/depth regimes present If fast/shallow is missing then score lower 15 14 13 12 11 10 9 						2 of 4 veloc regim If fast slow/ missi	ity/de ies pr :/shal /shallo	esent low o ow ar	r e	•	veloo regin	city/d ne	d by 1 epth ep/slo	
Score: 18	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
8. Abundance & diversity of habitat	f iii c v c c r c r s iii v v c c r r s l ii t r f f M v v c c r r s f f i i v v v c c r r r f i i i v c c v v v c c r r r s i i i i i i i i i i i i i i i i	50% avour nvert coloni variet debris nats nats ogs/u oanks, orovic ish cc vlust ransi	rable ebrat sation y of w , riffle / subi indero /cobb les at over not b	for e n & w voody es, ro merg cut oles ounda	/ ot ed	•	favou inver color Snags logs/ bank Fish o Mode of ha Can o	0% sul urable tebra hisatio s/ sub under s/cob cover erate bitat consis mater	for te n merg cut bles comm variet cypes. t of so	ed non y	•	10-30 favou inver colon Fish c 60-90 easily foot Wood or ma smot sedin	irable tebra isatio over 0% sul y mov dy del ay be hered	for te n patch bstrat ed by bris ra	y e	•	favor inver color Fish abse Subs or lac Stabl lackin	urable tebra nisatio cover nt trate cking e hat	ite on rare o unsta bitats limite	ble
Score: 18	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
9. Periphyton	e H S e	Periph evider neld s Stable Surfac ouch	nt on tones subs	hand S trate		 Periphyton not visible on stones Stable substrate Periphyton visible <20% cover of available substrates Periphyton obvious to touch Periphyton visible <20% cover of available substrates >20% cover o available substrates 						er of								
Score: 5	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
TOTAL SCORE 134.5																				

Stream name: Waite	eariki stream	<u>-</u>			Assess	or: Jo	sh Smith			
Site number: 1430-1	0	Sam	ple number: 9		Date: 0	4/03/2	2016	Time:	16:0	0
GPS coordinates		Dowr	nstream:		E 1852	566		N 581	8150	
		Upst	ream:		E 1852	697	I	N 581	8212	
Channel & riparia	an feature	s			Instre	am h	ydraulic	cond	ditio	ns
Canopy cover:					Estimate	ed or m	easured re	ach av	erage	:
Open	Partly s	haded	Very s	shaded						
Fencing:	Dominant	riparia	an vegetation:		Stream	width	(active cl	nanne	l): 9.	5m
None/ineffective	Crops		Retired v	regetation	Stream	width	(water): 8	3m		
One side/partial	Pasture		Native sh	rub	Stream	depth	n: 0.55m			
Complete	Exotic tre	es	Native tre	es	Surface	e veloo	city: 0.8m	S ⁻¹		
Water quality										
Temperature:	16.2		°C		Conduc	ctivity:	I	NA		µS cn
Dissolved oxygen:	98.7		%		9.7		1	ng l ⁻¹		
Turbidity:	Clear		Slightly turbic	d Highly	turbid	Stai	ned	0	ther	
Stream-bottom s	ubstrata			•						
Compaction (inorg	anic substi	rata):			% surf compo		norganic :	subst	ratu	m siz
Assorted sizes tigh	ntly packed	&/or o	overlapping		Substra	atum	Dimens	ion	Perc	entag
Moderately packed	with some o	verlap	oing		Bedroc	k	-			
Mostly a loose asso	rtment with	little ov	rerlap		Boulde	r	>256mm		40	
No packing/loose as	sortment ea	asily m	oved		Cobble		>64-256m	m	50	
Embeddedness:					Gravel		>2-64mm		5	
(% gravel-boulder parti	cles covered	by fine :	sediment)		Sand		>0.06-2mr	n	5	
<5% 5-259	% 26-5	50%	51-75%	>75%	Silt		0.004-0.06	Smm		
Į.	I		1 1		Clay		<0.004mm			
Organic material	(% cover))			Habita	at typ	es samp	bled		
Large wood (>10cm	diameter)				(% of eff	fort)				
<5% 5-259	% 26-5	50%	51-75%	>75%	Stones	:	50%			
Coarse detritus (sma	all wood, sti	cks, lea	aves etc., >1mr	m)	Wood:		%	Riff	les:	50
<5% 5-259	% 26-5	50%	51-75%	>75%	Macrop	hyte:	%	Rur	าร:	40
Fine (<1mm) organi	c deposits				Edges:		50%	Poo	ols:	5%
<5% 5-259	% 26-5	50%	51-75%	>75%	Numbe	r of in	vertebrate	es retu	irned	:
Instream plant co	over (% str	eambe	d area)		Koura:	Y		Shrim	ps: N	
Filamentous algae &	a mats:				Crabs:	N		Musse	els: N	
<5% 5-259	1	50%	51-75%	>75%	Other:					
Macrophytes:	I		· I		Mussel	type:				
<5% 5-259	% 26-5	50%	51-75%	>75%	Hyridel	la		Cucur	nerui	nio
Mosses/liverworts:			. 1							
<5% 5-25 ^o	% 26-5	50%	51-75%	>75%						
~3 70 <u>3-23</u>										

Wadeable Hard-E						She	et													
Stream name: Waite	earik	i Stre	am						Site	numl	per: 9	9								
Sample number: 14	30-1	0		А	sses	sor:	Josł	n Sm	ith				Date	e: 04	/03/2	2016				
Liphitat parameter										Cate	gory									
Habitat parameter		0	ptim	al			Sub	popti	mal			M	argin	nal				Poo	r	
1. Riparian vegetative zone width	•	Bank veget >10m Conti dense	ation 1 nuou		er	•	vege is <1	tatior 0m ly co	n buf		•	Path and/o Most over	or sto	ck	ent	•		aks fro nan ao ous		
Left bank:19	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Right bank:8	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Mean: 13.5																				
2. Vegetative protection		Bank imme zones native Trees store non-v prese Vege disrup	ediate s cov e veg s, unc y shru voody ent tative	ripar ered etatic der- ubs o y plar	ian by on r hts	•	cove nativ Disru Bank	c surf red n e veg uptior cs ma red b stry	nainly getati n evic ay be	on lent	•	Bank cove mixtu grass black & inti spec Vege disru Bare cropp vege com	red b ure of ses/s berry roducties etation ption soil/c bed tatior	y hrubs , will ced n obvi	ow	•	cove gras Disr strea vege high Gras graz Sigr	ss he	by a shru n of ank n very avily at stoo	y ck
Left bank:19	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Right bank:7	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Mean: 13																				
3. Bank stability	•	Bank Erosi failure abser <5% affect	on/ba e nt/mir of ba	ank nimal		•••	Infre area most over	erate quen s of e ly he % of ed	t, sm erosic aled	all on	•	Mode unsta 30-60 reach of ere High poter flood	able 0% of has osion erosi ntial c	f ban area	IS	•	Man area 60-1	00% erosi	of ba	nk
Left bank:18	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Right bank:16	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Mean: 17							1								1					
4. Frequency of riffles	•	Riffle frequ	ent			•	riffles	urren s infre	eque		•	Occa or ru	n			•		erally er, sh		
	•	Dista riffles strea Varie is key	divio m wio ty of	led by hth=5	/ -7	•	riffles	ance s divi im wi	ded b	у	•	Botto provi habit Dista riffles strea 25	de so at ince l s divio	ome betwe ded b	een y	•	Poo Dist riffle	r habi ance s divi am wi	betwe ded b	у
Score: 17	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
5. Channel alteration	•	Chan chani absei Strea norm	nel/dr nt/mir m wit	edgir nimal th	ng	•	chan Evide chan Rece chan	e cha inel/d ence inel/d ent inel/d orese	redg of pa redg redg	ing ist ing	•	Char chan exter Emb oring prese bank 40-80 Char disru	ges/c nsive ankm struc ent or s 0% of nneliz	ients, cture: n botl	/sh s h	•	with gabi >80° read chai disru Instr	on/ce % of s	ement strear ed or habita	m at
Score: 18	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1

Habitat parameter			atego			Ha	bitat	para	mete	r			itego			На	bitat	para	mete	r
6. Sediment deposition	•	Little point <20% affec sedin	bars of bo ted by	lands prese ottom /	nt	•	form from or fin 20-50 affec	ation, grave le sed 0% of ted t depo	ase in most el, san iment botto psitior	ly d : m	•	Some new g fine s old & 50-80 affect Sedin at ob const bend	gravel edim new 0% of ted nent o struct rrictio	osition I, sand ent or bars botto depos tions,	dor า m	•	fine r Incre deve >80% chan; frequ Pools abset sedin	mater ased lopme of bo ging uently s almo nt due	bar ent ottom ost e to	
Score: 18	20	19 4 vel	18 ocity/	17 depth	16	15	14 3.0f/	13	12	11	10	9 2 of /	8	7	6	5	4 Dom	3	2 by 1	1
7. Velocity/depth regimes	•	regin Slow, slow,	nes pr /deep /shallo shallo	esent , ow,	ent velocity/depth regimes present velocity/depth regimes present • If fast/shallow is missing then score lower missing, score low							•	veloc regin	ity/de						
Score: 19	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
8. Abundance & diversity of habitat	•	favou inver color varie debri mats Snag logs/ bank provi fish c	ty of v is, riff under s/cob des a cover : not b	for te on & w woody les, ro omerg cut	ed ant	•	favou inver color Snags logs/ banks Fish o Mode of ha Can o	urable tebra nisatic s/ sub under s/cob cover erate bitat	te on cut bles comn variet types t of so	ed non y	•	10-30 favou inver colon Fish c 60-90 easily foot Wood or ma smot sedin	irable tebra iisatio cover)% sul v mov dy del ay be hered	for te patch bstrat ed by bris ra	y e	•	favou inver color Fish o abset Subst or lao Stabl lackin	nt trate cking e hab	for te n rare c unstal itats limite	ble
Score: 18	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
9. Periphyton	•	evide held (mac wood	subst rophy	hand rates		•	visibl subst	rates		ı	•	Perip <20% availa	cove	r of	e Periphyton obvio & prolific					
Score: 10	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
TOTAL SCORE: 145.5																				

Stream name: Waitaw	vheta River				Assesso	r: Mike	e Martin			
Site number: 1235-11		Samp	le number: 10		Date: 3,	/3/201	6 1	ime:	12:30	
GPS coordinates		Dowr	nstream:		E 18454	80	1	V 5849	9622	
		Upstr	ream:		E 18453	88	1	V 5849	9622	
Channel & riparian	features				Instrea	m hye	draulic co	nditio	ons	
Canopy cover:					Estimate	d or me	asured reac	n avera	age:	
Open	Partly s	haded	Very s	haded						
Fencing:	Dominant	riparia	n vegetation:		Stream	width	(active cha	nnel):	4.9m	
None/ineffective	Crops		Retired veg	getation	Stream	width	(water): 4.2	2m		
One side/partial	Pasture		Native shru	ıb	Stream	depth:	0.13m			
Complete	Exotic tree	s	Native tree	s	Surface	velocit	ty:			
Water quality					•					
Temperature:	14.4		°C		Conduc	tivity:	1	.59	μ	S cm ⁻¹
Dissolved oxygen:	89.2		%		9.01		r	ng l-1		
Turbidity:	Clear		Slightly turbid	Highly t	urbid	Stair	ned	0	ther	
Stream-bottom sub	ostrata									
Compaction (inorgan	ic substrata):				% surfic		rganic sub	stratu	m size	
Assorted sizes tightly	packed &/or o	overlag	pping		Substra		Dimensio	on	Percer	ntage
Moderately packed w	-	-			Bedrock		-			0
Mostly a loose assort			-		Boulder		>256mm		30	
No packing/loose ass					Cobble		>64-256mm	1	60	
Embeddedness:					Gravel		>2-64mm		10	
(% gravel-boulder particl	es covered by fi	ne sedi	ment)		Sand		>0.06-2mm			
< 5% 5-25	% 26-5	60%	51-75%	>75%	Silt		0.004-0.06n	nm		
I	I		1 1		Clay		<0.004mm			
Organic material (%	6 cover)				Habita	t type	s sampled	1		
Large wood (>10cm d	-				(% of eff					
< 5% 5-25	1	60%	51-75%	>75%	Stones:		90%			
Coarse detritus (small	wood, sticks,	leaves	s etc.,. >1mm)		Wood:		10%	Riff	les:	40%
< 5% 5-25	% 26-5	60%	51-75%	>75%	Macrop	hyte:	%	Rur	ns:	60%
Fine (<1mm) organic	deposits		1 1		Edges:		%			
< 5% 5-25	% 26-5	60%	51-75%	>75%	Numbe	r of inv	ertebrates	retur	ned:	
Instream plant cov	er (% streaml	oed are			Koura: \	(5	hrim	os: N	
Filamentous algae & r					Crabs: N	J	r	Ausse	ls: N	
< 5% 5-25	1	50%	51-75%	>75%	Other:					
Macrophytes:	1				Mussel	type:				
< 5% 5-25	% 26-5	60%	51-75%	>75%						
Mosses/liverworts:	I		ı I							
		.0%	51-75%	>75%						
< 5% 5-25	% 26-5	1070								

Wadeable Hard-Bo Qualitative Habitat As					Shee	et														
Stream name: Waitaw	heta	Rive	r					0	Site n	umb	er: 1	235-1	1							
Sample number: 10				A	ssess	or: N	/like l	Marti	n				Date	: 3/0	3/20	16				
Habitat parameter	-	C	ptim	al			Sub	oopti	mal	Cate	gory		argir	nal				Poor	•	
1. Riparian vegetative zone width	•	>10n	tatior n inuou	n buffe is &	er	•	<10m	tation			•	Pathy and/o Most	or sto	ck		•		ks fre ian ac ous		
Left bank:13	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Right bank:14	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Mean: 13.5			•		<u> </u>							<u> </u>		<u> </u>				<u> </u>		
2. Vegetative protection	•	imme zone nativ Trees shrul wood prese Vege	ediate s cove e veg s, und os or i dy pla ent tative	nts	ian Y n orey	•	cover nativ Disru Bank	surfa red m e veg ption s may red by try	ainly etatio evide be	n ent	•	of gra black & int speci Vege disru Bare	red by asses/ berry roduc es tatior ption soil/c ped ve	y mixt /shrut y, willo ed n obvio	os, ow ous	•	cove & sh Disru strea vege high Gras graze Signi	s heav	y gras: of nk very vily	ζ.
Left bank: 13	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Right bank:11	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Mean: 12																				
3. Bank stability	•	Erosi failur abse	nt/mi of bai	ank nimal		•	Infree areas most	eratel quent s of er ly hea % of b ed	, sma osion iled o	II	•	unsta 30-60 reach erosi High	0% of n has a on erosio ntial c	bank areas	of	•	60-1	able y eroc 00% c erosio	of ban	k
Left bank:11	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Right bank:14	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Mean: 12.5																				
4. Frequency of riffles	•	frequ Dista riffle strea	ient nce b s divio m wio	tively etwee ded by dth=5 habita	en / -7	•	riffles Dista riffles	rrenco s infre nce b s divic m wic	equen etwee led by	en /	•	run Botto provi habit Dista riffles	om co de so at nce b s divic	me	s en /	•	wate riffle Poor Dista riffle	erally er, sha s habit ance b s divio am wio	llow at etwee ded by	Y
Score: 18	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
5. Channel alteration	•	chan abse Strea		redgir nimal th		•	chan Evide chan Recei chan	e char nel/di ence o nel/di nt nel/di oresen	redgir of past redgir redgir	ng : ng	•	exter Emba ing st prese banks 40-80	ges/d nsive ankme tructu ent on s 0% of nelize	ires both reach	hor	•	gabi >809 reac or di Instr	ks sho on/ce % of st h char srupte ream h red/ab	ment ream nnelize ed nabita	ed
Score:18	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1

Habitat parameter			atego ptim			Ha	bitat	para	mete	r			itego ptim			На	bitat	para	mete	er
6. Sediment deposition	•	point <20% affec sedin	bars of bo ted b		nt	•	form from	ted t depo	most I, san iment botto	ly d t m	•	Some new § fine s old & 50-80 affect Sedin at ob const bend	grave edim new)% of ted nent o struct	l, san ent o bars botto depos tions,	d or n om	•	fine Incre deve >80% chan frequ Pools abse sedir	mater ased lopm 6 of b ging uently s almont due	bar ent ottom ost e to	
Score: 19 7. Velocity/depth	20 •	19 4 vel	18 ocity/	17 depth	16	15 •	14 3 Of 4	13	12	11	10	9 2 of 4	8	7	6	5	4 Dom	3 inate	2 d by 1	1
regimes	•		nes pr /deep /shallo shallo	esent), ow,		•	veloc regin If fas	ity/de nes pr t/shal ng the	esent low is		•	veloc regim If fast slow/ missi	ity/de nes pr t/shal (shallo	esent low o ow ar	r e	•	veloo regin	city/d ne	'	
Score: 13	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
8. Abundance & diversity of habitat	•	varie debri mats Snag logs/ bank provi fish c	urable tebra iisatic ty of s, riff s/ sub under s/cob des a over not b	e for te on & v wood les, ro omerg rcut	y oot ed	•	favou inver color Snags logs/ bank Fish o Mode of ha Can o	under s/cob	for te merg cut bles comn variet types t of so	ed non sy	•	10-30 favou inver colon Fish c 60-90 easily foot Wood or ma smot sedin	irable tebra iisatic cover)% su y mov dy del ay be herec	for te on patch bstrat ed by bris ra	iy e	•	favor inver color Fish abse Subs or la Stabl lacki	urable tebra nisatio cover nt trate cking e hat	ite on rare o unsta bitats limite	ble
Score:14	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
9. Periphyton	•	held Stabl	ent on stone e sub ces ro	hand	!	•	visibl Stabl	hytor	tones strate		•	Perip <20% availa	cove	r of		•	& pro	olific 6 cove	n obvi er of substr	
Score: 15	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
TOTAL SCORE: 135																				

Appendix B Fish surveys

Fish c	ollection	form	– Wa	adeable	strea	ms/r	ivers												
Team me Kathryn F	embers: Reeves (NIWA	4)			GPS (d/s):	E1	818698	N5	838814	Site	: Man	gakahika	Stream				Date:	02/03/20	016
	rtin (NIWA) Culhane (NIW	/A)			GPS (u/s):	E1	818618	N5	838767	N	ot fished		ed none ected		hed 10 sub- reaches	Fished 5-9 sub-reaches		<5 sub- ches	FLAG for fished/not fished
Fish sample io	d: M.M.	Total s time (n		54	Fishir time:	g	Start Finish	10:45 12:30	Sample distance	(m):	150	Wette (m):	d width	A B	C 2.2 D	1.1 F	2.85	G H 1.15	l J 3.15
Sampling		Spotligh	nt	EFM		Seine		ength (m) esh (mm)		Wa visil	ter bility:	Good	Avera	ge	Poor	Water temp. (°C):	18.1	Conduct (µS):	^{ivity} 127.6
EFM ano		Big nall	EFM	volts (x100)	: 3				se rate (Hz	or pps):	60	EFM p	ulse widt	h (ms		-	ight (watts		
Species			А	В			D	Sub-rea	ach tally F	G	Н			J	Total count	Sample count	Length Min.	Max.	FLAG
Common	bully		11	6	1	1	15	4		17	15	9		8	96		20	72	
Banded k	kokopu		1		1		1	1	1	1	2	1		2	11		53	205	
Shortfin e	eel		3	2	4		1	4	4	2	3	2		5	30		103	450	
Longfin e	el		1		1		1	2	1	1				1	8		179	950	
Koura				1	2	2	2			1					6				
Total			16	9	1	Э	20	11	6	23	20	12		16	152				
-	Comment	I						I	1	FLA	G Com	iment	 				I		
	Missed 17 con							counts)											
	Missed 7 short		1			counts)												
	Missed 1 band	ied koko	ipu (incl	uaed in cour	it)														

Team mem Josh Smith Elizabeth G Samira van Fish sample id:	h (NIWA), G Graham (NI	lenys Crok																			
Samira var Fish			ker (NI\	NA),	GPS (d/s): E	1831914	N 5	803819	Site	: Waite	ba 1249-121	I					Date:	2/3/	2016		
	n Hunen (N				GPS (u/s): E	1831878	N 5	803808	N	ot fished	Fished no collecte			ed 10 sub- eaches		ed 5-9 eaches		l <5 sub iches	-	FLAG fished/i fished	not
oumpic iu.	Y	Total sho time (min		109	Fishing time:	Start Finish	16:40 20:10	Sample distance	(m) [.]	50	Wetted w (m):		A B	1.6 C 1.4 D			1.4 1.9	G H	1.9 2.5	1	1.2 1.7
Sampling g		Spotlight		EFM	Seir	Le	esh (mm)	diotarioc	Wat	er oility:		Average	_	Poor	Water temp.		21		ductivi	ty N	NA
EFM anode		Big mall E	EFM vo	olts (x100):	3		EFM puls	se rate (Hz o	or pps):	60	EFM pulse	e width	(ms):	2		Spotli	ght (watt	s):			
Species			A	В	С	D	Sub-rea	ach tally F	G	н		J	I	Total count	San cou		Length Min.	(mm) Ma	х.	FLAG	3
Cran's bully	/		27	4	19	13	11	31	45	39	72	60	0	321			19)	85		
Shortfin eel			11	10	11	10	7	8	15	17	21	24	4	134			81		1000		
Longfin eel						1			1		1	1		4			330)	760		
Elver						1		3	1	2		2	2	9							
Paratya						1								1							
Koura			4	2	6	2	1	3	9	9	3	1:	1	50							
Total			42	16	36	28	19	45	71	67	97	98	8	519							
																		_			
	Comment								FLA				(00	000mm)	in also de						
St	stream highe	r than norm	al – but	t clear							ed 21 shortf ed 9 elvers			,							
											ed 76 Cran'							count)		

Fish collection form	– Wa	deable	streams	/rivers											
Team members: Glenys Croker (NIWA)			GPS (d/s):	E 1836783	N	5809932	Site:	Mang	gapapa Stre	am 433-14			Date:	3/3/2016	
Josh Smith (NIWA) Kerry Costley (NIWA)			GPS (u/s):	E 1836750	N	5809802	Nc	ot fished	Fished no collecte		ned 10 sub- reaches	Fished 5-9 sub-reaches		<5 sub- ches	FLAG for fished/not fished
Fish Total sample id: time (83	Fishing time:	Start Finish	10:30 14:00	Sample distance	(m): 1	50	Wetted w (m):	idth <u>A</u> B	4.9 C 6.3 D	4 E 3.8 F		G 3 H 5.1	I 4.4 J
Sampling gear: Spotlig	ht	EFM	Sei	ine <u>Le</u> M	ength (m) esh (mm)	•	Wate visib		Good A	verage	Poor	Water temp. (°C):	20.1	Conductiv (µS):	^{rity} NA
EFM anode: Big Small	EFM v	olts (x100)	: 3			se rate (Hz o	or pps):	60	EFM pulse	e width (ms): 2	Spotli	ght (watts	s):	
Species	А	В	С	D	Sub-rea	ach tally F	G	Н	1	J	Total count	Sample count	Length (Min.	(mm) Max.	FLAG
Cran's bully	21	16	51	26	22	24	27	11	19	5	222		19	62	
Shortfin eel	6	6	15	8	8	9	7	8		3	70		86	590	
Longfin eel	2	3	3	1		1	1	1	1		13		92	520	
Inanga				1	1						2		66	85	
Koura	3	1	5	4	1	1	7	6	1	5	34				
Elver							1				1				
Total	32	26	74	40	32	35	43	26	21	13	342				
FLAG Comment						1 1	FLA		ment	I	1				I
Water level higher that	an norma	but clear							ed 25 bullies ed 6 shortfir			ut included with d in count	iin count)		

Team m Mike Ma	embers: Irtin (NIWA)			GPS (d/s):	E 1817745	N 5	815748	Site	: Wa	itakaruru S	tream 12	231-54	1			Date:	04/03/20	016
	Reeve (NIWA Culhane (NIV			GPS (u/s):	E 1817903	N 5	815670	N	ot fished	Fished colle	l none cted		ed 10 sub- eaches		ed 5-9 eaches		<5 sub- ches	FLAG for fished/not fished
Fish sample i	d: SC	Total shock time (min):	78	Fishing time:	Start Finish	10:15 14:15	Sample distance	(m):	150	Wetteo (m):	l width	A B	C 1.8 D		E F		G H 2.2	I J 1.8 5
Samplin	g gear:	Spotlight	EFM	Se	eine <u>L</u> e N	ength (m) lesh (mm)	•	Wat visit	er oility:	Good	Avera	ge	Poor	Water temp.	(°C):	18.2	Conduct (µS):	ivity 138.1
EFM and		Big mall EFN	/I volts (x100): 3		EFM puls	e rate (Hz	or pps):	60	EFM pu	Ise widt	h (ms)	: 2		Spotlig	ght (watts	s):	
Species		А	В	С	D	Sub-rea	ach tally F	G	н			J	Total count	Sam cour		Length (Min.	(mm) Max.	FLAG
Cran's bu	illy	9	11	9	10	9	2	5	3	11		5	74			23	55	
Shortfin e	eel	9	4	1	5	8	5	7	5	12		10	66			105	740	
Koura		3	7	8	2	1	6	13	4	7		3	54					
Total		21	22	18	17	18	13	25	12	30		18	194					
FLAG	Comment							FLA		mment								
	From section	G – H, choked	up with pond	weed and so	ome Lm								350mm – ir)mm – inclu					

Fish o	collectio	on forn	n – Wa	adeable	streams	/rivers													
	nembers: nith (NIWA))			GPS (d/s):	E 1831211	N	5815768	Site:	Piak	onui Stream	753-15				Date:	3/3/20	016	
-	Croker (NIV ostley (NIW				GPS (u/s):	E 1831210	N	5809980	No	ot fished	Fished no collected		shed 10 sub- reaches	Fished sub-rea			<5 sub- ches	fi	FLAG for shed/not fished
Fish sample i	id:		l shock (min):	50	Fishing time:	Start Finish	15:30 17:22	Sample distance	(m):	50	Wetted wi (m):	dth <u>A</u> B	3.22 C 3.6 D	2.2	E F		H 1	.9 .8	l 2.9 J 5.5
Samplin	ig gear:	Spotli	ght	EFM	Se	ine <u>Le</u> M	ength (m) esh (mm)		Wate visib		Good A	verage	Poor	Water temp. (°	C):	16.4	Condu (µS):	uctivity	/ NA
EFM and	ode:	Big Small	EFM	volts (x100)	: 3			se rate (Hz	or pps):	60	EFM pulse	width (m	,			ht (watts			
Species			А	В	С	D	Sub-re E	ach tally F	G	н	1	J	Total count	Samp count		Length (Min.	Max.		FLAG
Common	1			1		1			2	1	4	25	34			24	70		
Banded k				3		2					2		7			90	178		
Shortfin e	eel		4	2	3		2	2	1	1	1	1	17			94	240)	
Elver					1			1				1	3						
Koaro					1								1			80	80		
Koura			24	14	19	17	27	17	19	31	11	28	207						
Total			28	20	24	20	29	20	22	33	18	55	269				_		
FLAG	Comment	t							FLA		nment								
	Koura abu	ndant in a	ll reaches							Miss	ed 3 elvers (included i	in count)						
	Josh fishin	g																	
	Section J -	large pool	I - lots of s	sediment& la	ts of bullies	here.													
	stream hig	her than r	normal bu	it clear															

	Reeve (NIW rtin (NIWA)	/A)																
	, ,				GPS (d/s):	E 184102	7	N 5867879	Site:	Paia	ıkarahi Str	eam D/S	5 718-	5		Date:	3/3/2016	
	Culliane (IN	liwa)			GPS (u/s):	E 184109	98	N 5867799	No	ot fished		d none ected		ed 10 sub- eaches	Fished 5-9 sub-reaches		<5 sub- ches	FLAG for fished/not fished
Fish sample ic	d: K.R.	Total time	shock (min):	51	Fishing time:	Start Finish	16:00 19:15	Sample distance	(m): 1	50	Wetteo (m):	d width	A B	C 3.7 D		3.1	G H 3	l J 5.3
Sampling	gear:	Spotlig	ght	EFM	Sei		ength (m) esh (mm)		Wate visib		Good	Avera	ge	Poor	Water temp. (°C):	17.6	Conducti (µS):	vity 73
EFM ano	ode:	Big Small	EFM	volts (x100)): 4		•	se rate (Hz	or pps):	60	EFM pu	ulse widt	h (ms)			ight (watts	,	
Species			А	В	С	D	Sub-re E	ach tally F	G	н			J	Total count	Sample count	Length Min.	(mm) Max.	FLAG
Shortfin e	el		1		1					1	4		1	8		92	250	1
Cran's bul	lly		9	13	5	4	6	7	3	4	8		2	61		25	74	0
Torrentfis	h								1				2	3		64	145	
Brown tro	out						1							1		124	124	
Koura					1	1		1			1		1	5				
Total			10	13	6	4	7	7	4	5	12		6	72				
-	Comment	nool – to	o deen to	fish (5m) e	rosion of ban	ks TR			FLA		nment sed 5 Crar	n's Bullie	s 30-6	Somm (inclu	ided in count)		• •	- -
	<u> </u>			1 /-	ts , not includ		phyte trans	ect		11100		- o Build						
				than previo t of undercu	us year Itting on TR	bank												

Team m Kathryn	embers: Reeve (NIV	/A)			GPS (d/s):	E 1848393	N 5	823235	Site:	Kare	engorengo S	Stream 2	32-3				Date:	2/3/2016	
	artin (NIWA) Culhane (N	liwa)			GPS (u/s): E	E 1848423	N 5	823069	No	ot fished	Fished i collect			ed 10 sub- eaches		ed 5-9 eaches		l <5 sub- aches	FLAG for fished/not fished
Fish sample i	id. Yes	Total time (shock	58	Fishing time:	Start Finish	14:00 17:38	Sample distance	(m) [.] 1	50	Wetted (m):		A B	C 2.5 D	2.3	E 3 F	1.8	G H 2.4	l J 2.0
Samplin		Spotlig	, ,	EFM	Sei	ne Le	esh (mm)	distance	Wate visib		1 \ /	Average		Poor	Water temp.		19.8	Conductiv (µS):	
EFM an	ode:	Big Small	EFM	volts (x100)	: 3		EFM puls	se rate (Hz	or pps):	60	EFM puls	se width	(ms):	2		Spotli	ght (watt	s):	
Species			A	В	C	D	Sub-rea	ach tally F	G	Н	I	J		Total count	San cou		Length Min.	(mm) Max.	FLAG
Common	bully			4	3	4	4	1	1	1	4	3		25			47	93	
Shortfin	eel		36	40	32	45	40	32	40	29	36	30)	360			76	700	
Inanga												1		1			80	80	
Smelt												13	5	13			72	95	
Gambusi	а						1							1			40	40	
Longfin				1										1			350	350	
Koura			12	5	19	13	14	1	1	5	5			75					
Total			48	50	54	62	59	34	42	35	45	47	,	476					
FLAG	Comment					<u> </u>	L		FLA	G Corr	nment								I
		-	'm – too (deep to fish.	Skipped this	section and i	moved the st	tring up past			sed 32 shor	tfin eels	100 –	- 700mm –	include	ed in cou	unt		

Samira von Hunen (NIWA) GPS (u/s): E 1851719 N 5819721 Not fished Fished 10 sub-reaches Fished 5-9 su	Team me Josh Sm	embers: ith (NIWA),	Glenys	Croker (N	IIWA),	GPS (d/s): E	1851649	N 5	819801	Site:	Wair	ere 1224-5					Date:	2/3/2016		
sample id: Y time (min): 108 time: Finish 14:50 distance (m): 150 (m): B D 6.3 F 5.7 H 6.3 J J Sampling gear: Spotiski EFM Seine Length (m) Water visibility: Good Average Poor Water visibility: forman, (v)		``					1851719	N 5	819721	No	t fished)-				FLAG fished fishe	d/not
Sampling gear:SpotlightEFMSeineLength (m) Mesh (mm)Water visibility:GoodAveragePoorWater temp. (°C):16.3Conductivity (µS):EFM anode:Big SmallEFM volts (x100):3EFM pulse rate (Hz or ps):60EFM pulse width (ms):2Spotlight (wats):716.3Conductivity (µS):17SpeciesNon-reach tellySub-reach tellyTotalSampleLength (m) non-routMax.FIMax.Max.FICommon bully3718142028578435293167474Shortfin el22715132825191202257010001000Longfin el111126161000		d: Y			108	0				(m): 15	50				-				 .	6.5 8
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $				<u> </u>	EFM		ne <u>L</u> e	ength (m)	alotalitoo	Wate		,				Water	-	Conductiv	/ity	NA
SpeciesABCDEFGHIJcountcountMin.Max.Max.Max.Max.Common bully37-18142028578435293-16745Shortfire22-718142028578435293-16745Shortfire22-77151328578435293-167474Longfire12-715131210<	EFM and	ode:		EFM	volts (x100)	: 3		EFM puls	se rate (Hz	or pps):	60	EFM pulse	e width (ms): 2			ght (watts):		
Shortfine 22 1 7 1 5 13 28 25 19 120 22 570 1 Longfine 1 1 5 13 28 25 19 120 22 570 1 Elver 5 1 1 1 1 2 5 1 1 7 5 6 16 0 22 570 1 Torrentfish C 1 1 1 1 2 5 1 1 7 5 6 16 0 000 10	Species			А	В	C	D			G	н		J				U V V		FLA	.G
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	Common	bully		37			18	14	20	28	57	84	35	293	3		16	74		
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	Shortfin e	el		22			7	1	5	13	28	25	19	120)		22	570		
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	Longfin e	el		1										1			1000	1000		
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	Elver			5			1	1	1	2			6	16						
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	Torrentfis	sh									5	1	1	7			51	-		
Paratya Image: state of the	Brown tro	out											1	1			106	106		
Total 74 0 0 28 20 26 46 97 118 67 476 6 6 6 Total 74 0 0 28 20 26 46 97 118 67 476 1 1 1 1 Total 74 0 0 28 20 26 46 97 118 67 476 1 1 1 Image: Constraint of the state of the st	Koura			9			2	4		3	7	8	_							
Image: Section B missed as too deep to fish Image: Section B missed as too de	Paratya				_	_	1		2			2	3	8						
Image: Section B missed as too deep to fish Image: Section B missed as too dee	Tatal			74		-	20	20	20	10	07	110	67	474						
B Section B missed as too deep to fish Missed 54 bullies (no sizes estimated but included within count)	lotal			74	0	0	28	20	26	46	97	118	67	476)					
B Section B missed as too deep to fish Missed 54 bullies (no sizes estimated but included within count)																				
B Section B missed as too deep to fish Missed 54 bullies (no sizes estimated but included within count)																				
	FLAG	Comment			1	1	1	I	. <u> </u>	FLAC	G Com	iment	1			I	1	1	1	
	В	Section B m	issed as t	oo deep t	o fish						Miss	ed 54 bullies	s (no siz	es estimate	d but	included with	nin count)			
	С	Section C m	issed as t	oo deep t	o fish															
Stream clear – but high. 10cm above normal flow Missed 1 shortfin eel (~400mm)		Stream clea	r – but hi	gh. 10cm	above norm	al flow					Miss	ed 1 shortfin	i eel (~4	00mm)						
																				_

Fish o	collectio	n forn	n – Wa	ideable	streams	/rivers											
Team m Josh Sm	embers: hith (NIWA)				GPS (d/s):	1852566	N	5818150	Site	: Wait	eariki 1430-	10			Date:	4/3/2016	i
-	ostley (NIWA Croker (NIW				GPS (u/s):	E 1852697	N	5818212	N	ot fished	Fished no collecte		hed 10 sub- reaches	Fished 5- sub-reach		l <5 sub- iches	FLAG for fished/not fished
Fish sample	id: Yes		l shock (min):	90	Fishing time:	Start Finish	10:45 15:50	Sample distance	(m): 1	50	Wetted w (m):	idth <u>A</u> B	7.6 B D		E 16 F	G 6.1 H	l 6.3 J
Samplin	g gear:	Spotli	ght	EFM	Se	ine <u>Le</u> M	ength (m) lesh (mm)		Wat visit	er oility:	Good /	Average	Poor	Water temp. (°C)	: 196.2	Conducti (µS):	^{ivity} NA
EFM an	ode:	Big Small	EFM	volts (x100)	: 5			se rate (Hz	or pps):	60	EFM puls	e width (m	,		ootlight (watt		
Species			А	В	С	D	Sub-re E	ach tally F	G	н	1	J	Total count	Sample count	Length Min.	Max.	FLAG
Shortfin	eel		8	4	5	2			3	1	1	4	28		89	660	
Longfin e						2	1	1					4		450	600	
Common	ı Bully		30	22	23	30	10	15	10	8	5	20	173		30	90	
Banded k	Kokopu		4		1								5		86	190	
Torrent f	ish				1		2	1	2	1			7		80	125	
Koura			25	8	8	5	4	1	12	22	17	18	120				
Total			67	34	38	39	17	18	27	32	23	42	337				<u> </u>
																	<u> </u>
FLAG	Comment								FLA	G Corr	nment						
			normal bu	t clear - a loi	more water	to fish than	normal			Miss	sed 1 Comm	on Bully					
	Josh fishing									Miss	sed 1 eel (un	identified)	– not include	ed in count			

Fish o	collectio	n forn	n – Wa	adeable	streams	s/rivers												
Team m Kathryn	embers: Reeves (NIN	WA)			GPS (d/s):	E 1845480	N	5849662	Site:	Waita	awheta 123	5-11				Date:	03/03/201	16
	artin (NIWA) 1 Culhane (N	IIWA)			GPS (u/s):	E 1845388	N	5849622	No	ot fished	Fished n collecte		shed 10 sub- reaches	Fished sub-rea			<5 sub- ches	FLAG for fished/not fished
Fish sample i	Mike id: M		shock (min):	70	Fishing time:	Start Finish	09:50 13:20	Sample distance	(m): 1	50	Wetted w (m):	/idth A B	C 5.7 D) 3.3	E F	4.2	G H 3.2	l J 4.5
Samplin	g gear:	Spotli	ght	EFM	Se		ength (m) lesh (mm)		Wate visib		Good	Average	Poor	Water temp. (*	°C):	14.4	Conductiv (µS):	^{vity} 159
EFM and	ode:	Big Small	EFM	volts (x100)): 3			lse rate (Hz	or pps):	60	EFM puls	e width (m				ht (watts		
Species			А	В	С	D	Sub-re	ach tally F	G	н	1	J	Total count	Samp count		Length (Min.	(mm) Max.	FLAG
Common	ı bully		4	8	23	22	9	6	4	5	13	2	96			30	81	
Shortfin e	eel		1	1	2	2		2					8			100	173	
Longfin e	el		1		1					1			3			345	470	
Redfin bu	ully		11	2	2								15			40	76	
Rainbow	trout											1	1			132	132	
Koura			1	2			1	1		2	2	1	10					
Total			18	13	28	24	10	9	4	8	15	4	133					
					_													
																		<u> </u>
FLAG	Comment				1				FLA	G Com	ment							<u> </u>
	Missed 15 c	ommon	bullies 35	-55 mm (incl	uded within	count)												

Appendix C Macrophytes and periphyton

Periphyton Assessmer	nt									
Stream: Mangakahika Strea	m	Date: 2/3/2016								
Sample Number: 1		Located r	number: 3	76-4						
Thickness category	Colour category	A	В	с	D	D E Me				
Thin (<0.5mm) Mat/Film	NA	25	25	10	10	5	15			
Medium mat/film (0.5- 3mm thick)	Green (% cover)									
Shin thek)	Light brown (% cover)									
	Black/dark brown (% cover)									
Thick (>3mm) mat/film	Green/light brown (% cover)									
	Black/dark brown (% cover)									
Filaments short (<2cm)	Green (% cover)									
	Brown/Reddish (% cover)									
Filaments long (>2cm)	Green (% cover)									
	Brown/Reddish (% cover)									
Submerged bryophytes	NA									
Iron Bacteria growths	NA									

Macrophyte	lacrophyte recording sheet											
Stream: Manga	ikahika Stream		Located number: 376-4			Sample Number: 1			Date: 2/3/2016			
						Vegetation co	over (% we	etted area)				
Wetted width Ch	Channel width			Sub	merged plants			Emergent plants				
Transect	(m) (m)		Total cover		Surface-reaching		Below surface					
				cover Total submerged	Sub- total	Species	Sub- total	Species	Total emergent	Species		
1	2.2	2.2	0						0			
2	1.1	1.6	0						0			
3	2.85	4.6	0						0			
4	1.15	3.05	0						0			
5	3.15	4.1	2						2	2 Gr		

Periphyton Assessmer	nt									
Stream: Waitoa Stream U/S		Date: 2/3/2016								
Sample Number: 2		Located r	number: 1	.249-121						
Thickness category	Colour category	A	В	с	D	DE				
Thin (<0.5mm) Mat/Film	NA		5				1			
Medium mat/film (0.5- 3mm thick)	Green (% cover)				40		8			
Sinin thick)	Light brown (% cover)	40	10	40	5	50	29			
	Black/dark brown (% cover)									
Thick (>3mm) mat/film	Green/light brown (% cover)									
	Black/dark brown (% cover)									
Filaments short (<2cm)	Green (% cover)									
	Brown/Reddish (% cover)									
Filaments long (>2cm)	Green (% cover)			5			1			
	Brown/Reddish (% cover)									
Submerged bryophytes	NA									
Iron Bacteria growths	NA									

Macrophyte	Aacrophyte recording sheet											
Stream: Waitoa	a Stream U/S		Located number: 1249-121			Sample Number: 2			Date : 2/3/2016			
				Vegetation cover (% wetted area)								
Wetted width Ch	Channel width		Submerged plants						Emergent plants			
Transect	(m) (m)		Total		Su	rface-reaching	Bel	ow surface				
			cover	Total submerged	Sub- total	Species	Sub- total	Species	Total emergent	Species		
1	1.6	6.4	62						62	Na 60, Ve 2		
2	1.4	8.6	6						6	Na 5, Gr 1		
3	1.1	4.3	2						2	Ve 1, Gr 1		
4	1.7	7.7	3						3	Gr 3		
5	1.5	4.4	50						50	Na 50		

Periphyton Assessmer	nt									
Stream: Mangapapa Stream	1	Date: 3/3	Date: 3/3/2016							
Sample Number: 3		Located r	number: 4	33-14						
Thickness category	Colour category	A	в	с	D	D E				
Thin (<0.5mm) Mat/Film	NA									
Medium mat/film (0.5- 3mm thick)	Green (% cover)									
Shin thek)	Light brown (% cover)									
	Black/dark brown (% cover)									
Thick (>3mm) mat/film	Green/light brown (% cover)									
	Black/dark brown (% cover)									
Filaments short (<2cm)	Green (% cover)									
	Brown/Reddish (% cover)									
Filaments long (>2cm)	Green (% cover)	15	10	10	60	50	29			
	Brown/Reddish (% cover)									
Submerged bryophytes	NA	10	5	0	5	5	5			
Iron Bacteria growths	NA									

Macrophyte	Macrophyte recording sheet											
Stream: Manga	papa Stream		Located number: Sample Number: 3					Date: 3/3/202	16			
				Vegetation cover (% wetted area)								
	Wetted width Channel width				Sub	merged plants				Emergent plants		
Transect	(m)	(m)	Total		Surface-reaching		Below surface					
			cover	r Total submerged	Sub- total	Species	Sub- total	Species	Total emergent	Species		
1	4.9	6.5	0						0			
2	4	6.5	7						7	2 Gr, 5 Le = Lycopus europaeus, GYPSYWORT		
3	2.66	6.8	3	1			1	Ec 1	2	Gr 2		
4	3.1	7.7	17	10			10	Ec 5, Nh 5	7	Le 5, Ph 2		
5	4.4	7.5	8	1			1	Ec 1	7	Le 5, Ph 2		

Periphyton Assessmer	nt									
Stream: Waitakaruru Strear	n	Date: 4/3/2016								
Sample Number: 4		Located number: 1231-54								
Thickness category	Colour category	А	в	с	D	Mean cover				
Thin (<0.5mm) Mat/Film	NA									
Medium mat/film (0.5- 3mm thick)	Green (% cover)									
Shin thek)	Light brown (% cover)									
	Black/dark brown (% cover)									
Thick (>3mm) mat/film	Green/light brown (% cover)									
	Black/dark brown (% cover)									
Filaments short (<2cm)	Green (% cover)	20	0	10	0	0	6			
	Brown/Reddish (% cover)									
Filaments long (>2cm)	Green (% cover)									
	Brown/Reddish (% cover)									
Submerged bryophytes	NA									
Iron Bacteria growths	NA									

Macrophyte	Macrophyte recording sheet											
Stream: Waitak	aruru Stream		Located number: 1231-54			Sample Number: 4	ļ		Date : 4/3/2016			
				Vegetation cover (% wetted area)								
	Wetted width Channel width				Sub	merged plants				Emergent plants		
Transect	(m)	(m)	Total		Surface-reaching Below surface							
			cover	Cover Total submerged	Sub- total	Species	Sub- total	Species	Total emergent	Species		
1	2.1	3.7	45	10	10	Lm 10			35	Gr 20, Ph 10, Bf 5 = Bidens frondosa - BEGGAR'S TICKS		
2	2.2	3.7	25				20	Pk	5	Gr 5		
3	2.2	4.1	30				20	Lm	10	Gr 10		
4	2.4	3.4	5						5	Gr 5		
5	1.7	3.7	12				10	Lm	2	Gr 2		

Periphyton Assessmer	nt									
Stream: Piakonui Stream		Date: 3/3/2016								
Sample Number: 5		Located r	number: 7	53-15						
Thickness category	Colour category	A	в	с	D	DE				
Thin (<0.5mm) Mat/Film	NA									
Medium mat/film (0.5- 3mm thick)	Green (% cover)									
Shin they	Light brown (% cover)									
	Black/dark brown (% cover)									
Thick (>3mm) mat/film	Green/light brown (% cover)									
	Black/dark brown (% cover)									
Filaments short (<2cm)	Green (% cover)									
	Brown/Reddish (% cover)									
Filaments long (>2cm)	Green (% cover)									
	Brown/Reddish (% cover)									
Submerged bryophytes	NA	20	10	20	30	5	17			
Iron Bacteria growths	NA									

Macrophyte	recording she	et									
Stream: Piakon	ui Stream		Located number: 753-15			Sample Number: 5			Date: 3/3/2016		
				Vegetation cover (% wetted area)							
				Submerged plants				Emergent plants			
Transect	Wetted width Channel width (m) (m)		Total		Su	rface-reaching	Bel	ow surface			
			cover	Total submerged	Sub- total	Species	Sub- total	Species	Total emergent	Species	
1	3.6	4.4	0								
2	2.2	3.5	0								
3	2.4	3.4	0								
4	1.8	3.3	0								
5	5.5	7.2	0								

Periphyton Assessmer	nt									
Stream: Paiakarahi Stream	D/S	Date: 3/3/2016								
Sample Number: 6		Located number: 718-5								
Thickness category	Colour category	A	В	с	D	Mean cover				
Thin (<0.5mm) Mat/Film	NA	5	5			5	3			
Medium mat/film (0.5- 3mm thick)	Green (% cover)									
Shin they	Light brown (% cover)									
	Black/dark brown (% cover)									
Thick (>3mm) mat/film	Green/light brown (% cover)									
	Black/dark brown (% cover)									
Filaments short (<2cm)	Green (% cover)									
	Brown/Reddish (% cover)									
Filaments long (>2cm)	Green (% cover)									
	Brown/Reddish (% cover)									
Submerged bryophytes	NA									
Iron Bacteria growths	NA									

Macrophyte	recording she	et										
Stream: Paiaka	rahi Stream D/S		Located number: 718-5 Sample Number: 6						Date : 3/3/2016			
						Vegetation co	over (% we	etted area)	_			
	Channel width			Sub	merged plants	ged plants			Emergent plants			
Transect	(m) (m)		Total		Su	rface-reaching	Bel	ow surface				
			cover	r Total submerged	Sub- total	Species	Sub- total	Species	Total emergent	Species		
1	3.7	9.2	0									
2	4.2	7.5	0									
3	3.1	6.1	0									
4	3	6.3	0									
5	5.3	6.8	0									

Periphyton Assessmer	nt										
Stream: Karengorengo Strea	am	Date: 2/3/2016									
Sample Number: 7		Located number: 232-3									
Thickness category	Colour category	A	В	с	D	E	Mean cover				
Thin (<0.5mm) Mat/Film	NA	0	0	0	0	0	0				
Medium mat/film (0.5- 3mm thick)	Green (% cover)										
Light brown (% cover)											
Black/dark brown (% cover)											
Thick (>3mm) mat/film	Green/light brown (% cover)										
	Black/dark brown (% cover)										
Filaments short (<2cm)	Green (% cover)		20	20			8				
	Brown/Reddish (% cover)										
Filaments long (>2cm)	Green (% cover)										
	Brown/Reddish (% cover)										
Submerged bryophytes	NA										
Iron Bacteria growths NA											

Macrophyte	recording she	et									
Stream: Kareng	gorengo		Located number: 232-3			Sample Number: 7			Date: 2/3/2016		
	Wetted width	width Channel width			Sub	omerged plants			Emergent plants		
Transect	(m)	(m)	Total			Su	rface-reaching	Bel	ow surface		
			cover	Total submerged Sub- total		Species	Sub- total	Species	Total emergent	Species	
1	2.5	3.5	10						10	Na 10	
2	2.3	3.3	0								
3	1.8	4.25	0								
4	2.4	3.2	0								
5	2.6	4.7	10						10	Na 10	

Periphyton Assessmer	t									
Stream: Wairere		Date: 2/3/2016								
Sample Number: 8		Located number: 1224-5								
Thickness category	Colour category	A	В	с	D	E	Mean cover			
Thin (<0.5mm) Mat/Film	NA									
Medium mat/film (0.5- 3mm thick)	Green (% cover)									
Light brown (% cover)		40	40	10	40	30	32			
	Black/dark brown (% cover)									
Thick (>3mm) mat/film	Green/light brown (% cover)									
	Black/dark brown (% cover)									
Filaments short (<2cm)	Green (% cover)									
	Brown/Reddish (% cover)									
Filaments long (>2cm)	Green (% cover)	10	5	50	5	20	18			
	Brown/Reddish (% cover)									
Submerged bryophytes	NA									
Iron Bacteria growths NA										

Macrophyte	recording she	et									
Stream: Wairer	e		Located number: 1224-5			Sample Number: 8			Date: 2/3/2016		
			Vegetation cover (% wetted area)								
	Wetted width	Channel width			Sub	merged plants				Emergent plants	
Transect	(m)	(m)	Total cover			Su	rface-reaching	Bel	ow surface		[
			cover	Total submerged Sub- total		Species	Sub- total	Species	Total emergent	Species	
1	6.2	7.5	6						6	Lp 5, Gr 1	
2	6.3	7.5	2						2	Lp 1, Gr 1	
3	5.9	8.5	3	1	1	Nh 1			2	Ph 2	
4	6.1	8	2						2	Gr 2	
5	5.2	7.5	2						2	Gr 2	

Periphyton Assessmer	nt									
Stream: Waiteariki Stream		Date: 4/3/2016								
Sample Number: 9		Located number: 1430-10								
Thickness category	Colour category	A	в	с	D	E	Mean cover			
Thin (<0.5mm) Mat/Film	NA									
Medium mat/film (0.5- 3mm thick)	Green (% cover)									
Light brown (% cover)										
Black/dark brown (% cover)		0	5	2	5	1	2.6			
Thick (>3mm) mat/film	Green/light brown (% cover)									
	Black/dark brown (% cover)									
Filaments short (<2cm)	Green (% cover)									
	Brown/Reddish (% cover)									
Filaments long (>2cm)	Green (% cover)	1	0	15	10	5	6.2			
	Brown/Reddish (% cover)									
Submerged bryophytes	NA									
Iron Bacteria growths NA										

Macrophyte	recording she	et									
Stream: Waitea	ariki Stream		Located number: 1430-10			Sample Number: 9			Date: 4/3/2016		
	Wetted width	Channel width			Sub	omerged plants				Emergent plants	
Transect	(m)	(m)	Total		Su	rface-reaching Below		ow surface			
			cover	cover Total submerged Su		Species	Sub- total	Species	Total emergent	Species	
1	7.6	8.6	2						2	Gr 2	
2	7	8.1	0						0		
3	16	18.2	1						1	Gr 1	
4	6.1	7.3	2						2	Gr 2	
5	6.3	7.3	2						2	Gr 2	

Periphyton Assessmer	nt										
Stream: Waitawheta River		Date: 3/3/2016									
Sample Number: 10		Located number: 1235-11									
Thickness category	Colour category	A	в	с	D	E	Mean cover				
Thin (<0.5mm) Mat/Film	NA		40	10			10				
Medium mat/film (0.5- 3mm thick)	Green (% cover)				40	60	20				
Shin they	Light brown (% cover)						10				
	Black/dark brown (% cover)										
Thick (>3mm) mat/film	Green/light brown (% cover)										
	Black/dark brown (% cover)										
Filaments short (<2cm)	Green (% cover)										
	Brown/Reddish (% cover)										
Filaments long (>2cm)	Green (% cover)										
	Brown/Reddish (% cover)										
Submerged bryophytes	NA										
Iron Bacteria growths NA											

Macrophyte	recording she	et									
Stream: Waitaw	wheta River		Located number: 1235-11			Sample Number: 10			Date: 3/3/2016		
	Wetted width	Channel width			Sub	merged plants				Emergent plants	
Transect	(m)	(m)	Total		Su	rface-reaching	Bel	ow surface			
			cover	Total submerged Sub- total		Species	Sub- total	Species	Total emergent	Species	
1	5.7	6.5	5						5	5 Gr	
2	3.3	4.5	25						25	25 Gr	
3	4.2	4.9	5						5	5 Gr	
4	3.2	4.3	0								
5	4.5.	5.5	5						5	5 Gr	

O ut of the					Si	tes				
Species	1	2	3	4	5	6	7	8	9	10
Archichauliodes diversus	75	1		35	6	26		13	8	50
Antipodochlora braueri									2	
Xanthocnesis zealandica			1							
Ameletopsis percistus										1
Acanthophlebia cruentata	1				2					1
Atalophlebioides cromwelli					35					
Austroclima sp.			9	53	6		13		8	5
Austroclima jollyae										5
Austroclima sepia				18	4	13	4		8	20
Austronella planulata										
Deleatidium spp.	22	119			30	77		10	8	85
Coloburiscus humeralis					19	26		4	163	70
Neozephlebia scita	9				19					
Nesameletus sp.					4	48		21		35
Ichthybotus hudsoni	1									
Oniscigaster wakefieldi										
Rallidens mcfarlanei						13				
Zephlebia spp.		14		193	41	7	13	13	4	
Zephlebia inconspicua				158					17	
Zephlebia dentata	9	35	1	280	52		37	10		15
Zephlebia borealis	5				19					
Zephlebia spectabilis	1				13			1		25
Zephlebia versicolor					12					5
Zephlebia nebulosa					1					5
Austroperla cyrene										5
Megaleptoperla diminuta		5								
Megaleptoperla grandis										
Zelandobius spp.										
Zelandoperla decorata						16			6	5
Aoteapsyche catherinae		5	9			10			4	
Aoteapsyche colonica	5	1	9	70					17	5
Aoteapsyche raruraru			18							
Aoteapsyche spp.		5	9	70		4			23	25
Helicopsyche spp.	49									30
Hudsonema alienum										
Hudsonema amabilis	31	9			2		5	2		5
Hydrobiosella mixta										20

Appendix D Macroinvertebrate taxa list

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Species					Si	tes						
openes	1	2	3	4	5	6	7	8	9	10		
Hydrobiosis spp.				18						1		
Hydrobiosis copis												
Hydrobiosis parumbripennis												
Hydrobiosis gollanis										5		
Neurochorema spp.												
Neurochorema armstrongi								2				
Neurochorema confusum												
Dlinga feredayi	27	62								1		
Drthopsyche sp.	9				8				10	2		
Drthopsyche fimbriata					2					5		
Orthopsyche thomasi					4							
Paroxyethira sp.									2			
Oxyethira albiceps		5	44			10	8	23	10			
Polyplectropus sp.					2							
Psilochorema sp.												
Pycnocentria sp.					4							
Pycnocentria evecta	9	18	289		4			6		3		
Pycnocentrodes spp.	189	381	202	1120	4	64		12	23	1		
Triplectides obsoleta/dolichos	9		9		4	4	2	10	6			
Zelolessia cheira									6			
Beraeoptera roria						13						
Elmidae (larvae)	14	53	1	1103	6	64		131	10			
Elmidae (adult)								1				
Hydraenidae (A)												
Ptilodactylidae (larvae)					1							
Scirtidae					2							
Rhantus sp.												
Aphrophila neozealandica						7			10	5		
imonia nigrescens	5											
Austrosimulium sp.	5	5	9	18	2	7			15	1		
Chironomus zealandicus					2		2					
Corynoneura sp.												
Cricotopus sp.		5							4			
Eriopterini sp.	5											
Eukiefferiella sp.								2				
Harrisius pallidens					2							
Kaniwhaniwhanus sp.												

					Si	tes	Sites												
Species	1	2	3	4	5	6	7	8	9	10									
Macropelopiini sp.	9																		
Orthocladiinae	5						2												
Empididae									2										
Muscidae							2												
Naonella forsythi									2										
Paradixa sp.	5																		
Paralimnophila skusei																			
Polypedilum spp.							28												
Tabanidae																			
Tanytarsus spp.			1				2		15	10									
Tanyderidae	5			1															
Zelandotipula sp.																			
Potamopygrus antipodarum	329	342	2144	1453	61	268	160	117	50	500									
Physa sp.			1	1															
Latia sp.	5	9		18		32				5									
Lymnaea sp.																			
Sphaerium sp.	1						4												
Oliogochatae unident	22				2		20												
Planaria	9			18						15									
Ostracoda							8												
Hirudinea	5						2												
Paracalliope fluviatillis	44		1				7												
Paranephrops planifrons					8														