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Waihou and Piako ecological monitoring 2013



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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 Piako catchment to support and inform the review of water allocation limits in the catchment scheduled for 2014. The aim of this project was to build on the ecological monitoring carried out in the Piako catchment in 2012, and revisit a sub-set of monitoring sites in the Waihou catchment that were previously surveyed in 2009 and 2011.

The combined results of the 2012 and 2013 ecological monitoring surveys provide a valuable baseline assessment of the spatial patterns in aquatic communities across the middle and upper parts of the Piako catchment. The general pattern is for ecological communities to be more diverse and of a higher quality in less modified sites. However, the influence of catchment scale drivers, such as migration barriers, are also evident. Inanga were not recorded at any of the survey sites in the Piako in 2013. Whilst they were only present in low abundance at a few sites in 2012, their absence in 2013 should be noted and monitored in future. Inanga are one of the more sensitive native fish species and therefore are potentially valuable as an indicator species. A significant find during the 2013 survey was the population of banded kokopu in the Mangakahika Stream. This species is relatively rare in the existing fish records for the Piako catchment, thus this represents an important component of the catchment biodiversity.

Results of monitoring in the three sites revisited in the Waihou catchment showed relatively few changes in ecological communities. There was some evidence of a reduction in Macroinvertebrate Community Index (MCI) scores relative to previous years. In the absence of long-term monitoring it is not clear whether this is within the normal range of within site variability, or represents a departure from normal caused by low flows, for example.

Recommendations are made for establishing routine ecological monitoring, to be carried out on an annual basis, at five sites in the Waihou catchment and five sites in the Piako catchment. This will support development of more robust objectives for instream values and enhance WRC's ability to differentiate between natural variability and human induced changes to aquatic ecosystems.

1 Introduction

1.1 Background

The Waikato Regional Council (WRC) is responsible for managing the status of water resources in the Waikato Region. WRC's approach to the protection, allocation and use of water resources is set out in the Waikato Regional Plan: Variation No. 6 – Water Allocation (Waikato Regional Council 2012), which became operative on 10 April 2012. As required by the NPS for Freshwater Management (MfE 2011), the Plan defines minimum flows and allocation limits for all catchments in the region (Table 3-5; Waikato Regional Council 2012).

As a precursor to the review of flow and allocation limits in the Piako catchment scheduled for 1 July 2014 (Table 3-4A; Waikato Regional Council 2012), WRC have initiated investigations in the catchment to support and inform the review process. One of the key objectives of the water allocation process is to safeguard the life-supporting capacity of freshwater ecosystems (MfE 2011). The aim of this project was to build on ecological monitoring initiated in the Piako catchment in 2012 (Franklin & Bartels 2012) and to revisit a subset of monitoring sites in the Waihou catchment previously monitored in 2009 and 2011 (Franklin & Booker 2009, Franklin et al. 2011). The results will contribute knowledge of the ecological values in the catchments to the water allocation decision-making process.

1.2 Study brief

The scope of this study was to undertake monitoring of fish, macroinvertebrates, macrophytes and periphyton at ten sites across the Waihou and Piako catchments. The sites were to include repeat surveys at a minimum of two of the sites surveyed in the Piako catchment during 2012 and two of the sites surveyed in the Waihou catchment during 2011. In addition, up to six new sites were to be surveyed in the Piako catchment. The new sites were to encompass representative habitats from the main tributaries of the Piako, excluding the Topehaehae Stream.

2 Methodology

2.1 Sites

Monitoring was undertaken at ten sites (Table 2-1) in February 2013 during a period of drought. Repeat surveys were carried out at three sites in the Waihou catchment (Sites 3, 4 & 7) and three sites in the Piako catchment (Sites 5, 8 & 9). Four new sites were surveyed in the Piako catchment, two of which were on tributaries previously not surveyed (Sites 1 & 2) and two of which were located upstream of sites surveyed in 2012 (Sites 6 & 10).

_					
_	Site	Catchment	Stream	Easting	Northing
_	1	Piako	Mangakahika Stream*	2728975	6400407
	2	Piako	Riuohauraki Stream*	2729470	6402548
	3	Waihou	Paiakarahi Stream D/S	2751347	6429422
	4	Waihou	Paiakarahi Stream U/S	2751431	6429122
	5	Piako	Waitoa River	2742190	6365404
	6	Piako	Mangapapa Stream*	274443	6368529
	7	Waihou	Karengorengo Stream	2758631	6384786
	8	Piako	Waihekau Stream	2753911	6381502
	9	Piako	Waitakaruru Stream	2727985	6377350
	10	Piako	Piakonui Stream*	2741446	6371572
-					

 Table 2-1:
 Location of 2013 ecological monitoring sites.
 *Denotes new sites in 2013. Easting and northing given for downstream limit of survey reach (NZMG coordinates).

Site descriptions for Sites 3, 4 and 7 can be found in Franklin et al. (2011) and for Sites 5, 8 and 9 in Franklin and Bartels (2012). Sites 1 & 2 were located on tributaries draining the hills on the true left of the Piako, just north of Morrinsville. These new sites were selected primarily on the basis of filling a knowledge gap regarding fish populations in this part of the catchment. The lower reaches of both tributaries flow through relatively intensively developed dairy farming areas and are characterised by modified channel geomorphology (straightening and deepening of the channel), lack of riparian cover, proliferation of aquatic macrophytes, absence of woody debris, soft, silty substrates and degraded water quality. However, in the upper reaches of both tributaries native riparian cover remains relatively intact (although not continuous), and channel structure is more natural, meaning a greater diversity of habitats (pools, runs, riffles) are available. Additionally, substrates are more varied and include boulders, cobbles and gravel. Woody debris and instream cover is also present. Mean stream width at both sites was between 3-4 m.

The new monitoring site on the Mangapapa Stream (Site 6) was located upstream of a site previously surveyed in 2012. The aim of surveying a site further upstream for the 2013 survey was to increase coverage of fish records in the catchment and to survey a different habitat type. Stream width at Site 6 was approximately 3 m and mean depth 0.3 m. Substrate was dominated by boulders and cobble, with some bedrock in the upper part of the reach. There was some riparian cover present, but this was mainly dominated by bramble on the true right bank and exotic trees on the true left.

A new site on the Piakonui Stream (Site 10) was also surveyed in 2013. The aim was again to increase coverage of the fish records in the catchment, particularly within a native bush dominated stream. Site 10 has fully intact native riparian vegetation, a diverse channel structure and abundant instream cover in the form of boulders and woody debris. Due to the low flows at the time of the survey, surface flow was absent from one section of the reach, with water flowing below the substrate. Stream wetted width was about 3 m, but the active channel was about 6.5 m.

2.2 Fish

Fish surveys were carried out by electric fishing using the standardised methods outlined by WRC (David & Hamer 2010). At each site, a 150m reach was surveyed by single pass electric fishing using an EFM300 with voltage adjusted dependent on local conditions. The number of each species captured, along with fish lengths were recorded for every 15 m subreach.

This survey approach is designed to maximise the likelihood of capturing the full diversity of species present by encompassing the full range of habitats present 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 semiquantitative 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 & 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. For hard-bottomed streams, a kick-sampling approach targeting riffle areas and following MfE Protocol C1 was utilised. At each site the WRC REMS 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 count and scan for rare taxa). This provides proportional abundance data suitable for the calculation of most invertebrate parameters (Collier & Kelly 2005). Complete taxonomic lists were compiled and a range of community metrics calculated at the taxa level indicated in (Collier & 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) and a range of periphyton biomass indices (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 Waihou catchment

3.1.1 Fish

A total of ten different fish species were captured across the three sites in the Waihou catchment when re-visited during the 2013 survey (Table 3-1; Appendix B). Of the ten species, eight are native and the remaining two, brown trout (*Salmo trutta*) and rainbow trout (*Oncorhynchus mykiss*), are introduced. At all three sites, migratory species were present, including non-climbing species such as inanga (*Galaxias maculatus*), indicating the absence of any significant barriers downstream. The fish community of Karengorengo Stream was very strongly dominated by shortfin eel, with a number of both inanga and smelt (*Retropinna retropinna*) also present. At both sites on the Paiakarahi Stream, the dominant species was the non-migratory Cran's bully (*Gobiomorphus basalis*), followed by longfin eels (*Anguilla dieffenbachii*), shortfin eels (*Anguilla australis*) and banded kokopu (*Galaxias fasciatus*).

Each of these sites was first surveyed in 2009 and they have subsequently been surveyed biennially. Figure 3-1 compares the relative abundance of each species over time at the three sites. In the Karengorengo Stream, the relative abundance of smelt and shortfin eels in the survey reach was lower in the 2013 survey when compared to 2009 and 2011. A major contributing factor is likely to be the encroachment of emergent macrophytes in the stream due to the very low flows in 2013, meaning that capture efficiency during the 2013 survey was lower than on previous occasions. For other species at this site, there are no consistent patterns or significant differences in abundance between years. The brown trout that were first detected in the 2011 survey were still present in 2013. Species richness at this site is relatively high (6) for a lowland agricultural stream.

At the Paiakarahi sites, the relative abundance of each of the species has been relatively low and consistent between years and across the two sites. The main differences observed in 2013 are the lower abundance of torrentfish (*Cheimarrichthys fosteri*) at both sites, and the return of inanga, which were not recorded in the 2011 survey. There was also a slight increase in the abundance of banded kokopu at the upstream site relative to previous years. At both sites, the abundance of shortfin eels was relatively low, and dominated by smaller fish (<200 mm). Of note was the presence of a longfin eel population in the downstream site with a relatively low mean size (268 mm; range 120-650 mm). However, at the upstream site most of the longfin eels were >300 mm (mean 356 mm). At both sites Cran's bully (*Gobiomorphus basalis*) was the dominant species.

Table 3-1: Results of 2013 electric fishing survey at the three Waihou catchment monitoring sites.	Ab. = Number caught; Rel. Ab. = Relative abundance
(Individuals per 100 m ²).	

Site		ortfin el		igfin el		an's Illy		imon illy	Torre	entfish	Ina	nga	Sn	nelt		nded copu		nbow out		own out	Ko	oura
Site	Ab.	Rel. Ab.	Ab.	Rel. Ab.	Ab.	Rel. Ab.	Ab.	Rel. Ab.	Ab.	Rel. Ab.	Ab.	Rel. Ab.	Ab.	Rel. Ab.	Ab.	Rel. Ab.	Ab.	Rel. Ab.	Ab.	Rel. Ab.	Ab.	Rel. Ab.
3. Paiakarahi Stream D/S	16	3.6	16	3.6	51	11.6	-	-	2	0.5	5	1.1	-	-	4	0.9	6	1.4	-	-	36	8.2
4. Paiakarahi Stream U/S	5	0.7	16	2.3	101	14.5	-	-	1	0.1	1	0.1	-	-	12	1.7	4	0.6	-	-	26	3.7
7. Karengorengo Stream	136	35.3	2	0.5	-	-	8	2.1	-	-	11	2.9	30	7.8	-	-	-	-	4	1	58	15.1

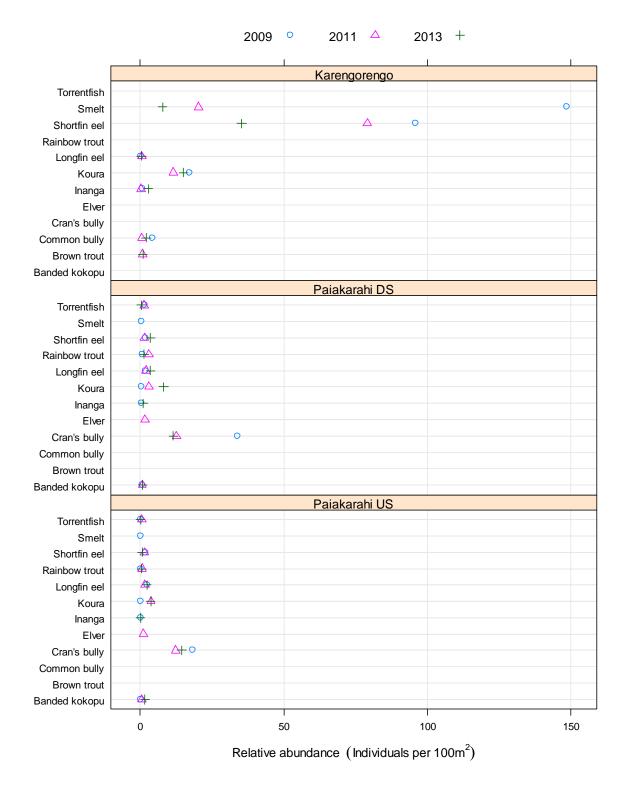


Figure 3-1: Comparison between the relative abundance of fish captured in the 2009, 2011 and 2013 Waihou surveys.

3.1.2 Macroinvertebrates

Sites 3 and 4 were sampled according to MfE protocol C1 for hard-bottomed streams, with an area of approximately 1 m^2 sampled at each site. Sampling at Site 7 followed MFE protocol C2 for soft-bottomed streams.

A full taxonomic list for each site is included in Appendix C and is summarised at the taxa level in Table 3-2 according to the methods of (Collier & 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. The presence and abundance of taxa from the Ephemeroptera, Plecoptera and Trichoptera (EPT) orders is generally considered an indicator of good habitat and water quality. EPT richness and %EPT (Table 3-2) are used to summarise the presence and significance of these taxa at a site. The Macroinvertebrate Community Index (MCI) was originally developed to indicate the tolerance of macroinvertebrate as poor, those of 80-100 as fair, those of 100-120 as good, and those of greater than 120 as excellent (Stark & Maxted 2007). Sites 7 was a soft-bottomed stream, and thus some caution must be applied to interpreting the MCI scores for that site.

Both total taxa richness and EPT richness was noticeably higher in Paiakarahi Stream (Site 3 and 4), compared to the Karengorengo Stream site. This reflects the differences in habitat between the stream sites, with the Paiakarahi Stream sites having a higher gradient, rocky substrates and intact native riparian cover, and the Karangorengo Stream site being a low gradient, agricultural stream. Interestingly, despite both having relatively high EPT richness (16), the two sites on the Paiakarahi Stream had guite different %EPT scores, with Site 4 being relatively low (27%). This appears to be a consequence of a lower abundance of the mayfly (Ephemeroptera) taxa that were present at this site. The MCI scores for Site 3 and 4 on the Paiakarahi Stream placed them in the Excellent and Good classes respectively. The reason for the slightly lower scores for Site 4, which is located upstream of the drinking water abstraction, as opposed to Site 3, which is in the impacted reach downstream of the take, is unclear. It may reflect differences in habitat between the two reaches associated with differences in stream size (Site 3 & 4 mean wetted width of 2.5 m and 6.0 m respectively). MCI score at the Karengorengo Stream site was 85.6, placing it in the Fair quality class, but it must be remembered that this was a soft-bottomed site where MCI scores are typically lower.

Site	Total taxa richness	EPT richness	%EPT	MCI
3. Paiakarahi Stream D/S	25	16	63.6	124.0
4. Paiakarahi Stream U/S	27	16	27.2	110.4
7. Karengorengo Stream	14	6	28.1	85.7

Table 3-2:	Summary of macroinvertebrate results for the three Waihou monitoring sites in
2013.	

Comparison of MCI scores between survey years shows a decline in score at all sites in 2013, but particularly at the Karengorengo Stream (Site 7) and the upstream site on the Paiakarahi Stream (Site 4) relative to 2009 and 2011 (Figure 3-2). The reason for these declines is unknown, but the low flows experienced during the summer of 2013 may be a contributing factor. The lack of a significant impact at the Paiakarahi downstream location (Site 3), may be due to the community already being adapted to the lower flows associated with the abstraction.

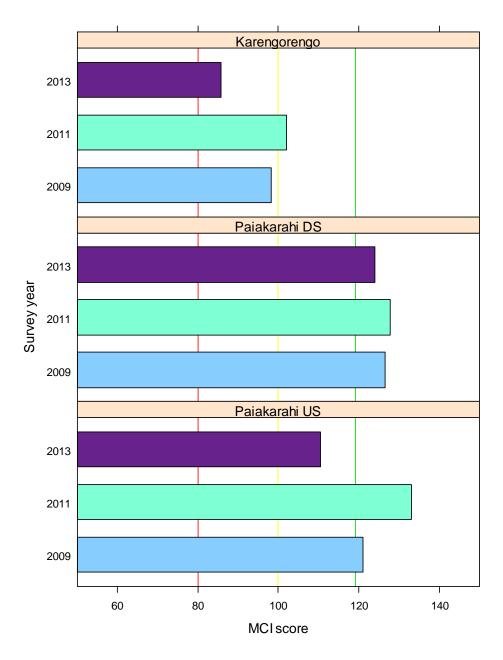


Figure 3-2: Comparison of MCI scores between survey years. Vertical lines indicate boundaries for quality classes. Anything below the red line is 'poor', between the red and yellow lines is 'fair', between the yellow and green lines is 'good' and above the green line is 'excellent' (Stark & Maxted 2007).

3.1.3 Macrophytes & periphyton

Macrophytes were not recorded at either of the sites in the Paiakarahi Stream. This largely reflects the dominance of rocky substrates at these sites, thus limiting the capacity for rooted macrophytes (Table 3-3). At Site 7, the abundance of macrophytes was relatively high in 2013, as reflected by MTC and MCC scores of 63%. This was significantly higher than the scores recorded for this site in 2011, when MTC and MCC were both 27%. The low flows experienced during the summer of 2013 are likely to be the cause of higher macrophyte cover. The dominant species was again *Nasturtium officinale* (Appendix D).

Table 3-3:Summary of macrophyte indices for the three Waihou monitoring sites in 2013.MTC = Macrophyte Total Cover; MCC = Macrophyte Channel Clogginess; MNC = Macrophyte Native Cover.

Site	МТС	MCC	MNC
3. Paiakarahi Stream D/S	0	0	0
4. Paiakarahi Stream U/S	0	0	0
7. Karengorengo Stream	63	63	4

Periphyton cover was relatively low at both sites in the Paiakarahi Stream and absent from the Karengorengo as a consequence of the sandy substrate (Table 3-4; Appendix D). The rocky substrates present in the Paiakarahi Stream make it suitable for the colonisation of periphyton. However, the relatively high level of shading and high proportion of bush cover in the catchment probably contribute to cover being relatively low. The Periphyton Slimyness Index (PSI) is more strongly related to some of the macroinvertebrate indices than the other periphyton indices (Collier & Kelly 2005). However, the values for PSI were relatively low in the Paiakarahi Stream sites. The abundance of periphyton was lower than that recorded in 2011 at both sites.

Table 3-4: Summary of periphyton indices for the three Waihou monitoring sites in 2013. PEI
= Periphyton Enrichment Index; PFI = Periphyton Filamentous Index; PMI = Periphyton Mat Index; PPI
= Periphyton Proliferation Index; PSI = Periphyton Slimyness Index.

Site	PEI	PFI	PMI	PPI	PSI
3. Paiakarahi Stream D/S	18.6	0	0	0	13.0
4. Paiakarahi Stream U/S	14.2	0	3.9	3.9	13.6
7. Karengorengo Stream	0	0	0	0	0

3.2 Piako catchment

3.2.1 Fish

Six different fish species were captured across the seven Piako monitoring sites during the 2013 survey (Table 3-5; Appendix B). Shortfin eel was the only species present at all six sites. Longfin eels were found at all sites except the Waihekau Stream (Site 8). However, it should be noted that the efficiency of the fish survey at the Waihekau site was extremely low due to excessive macrophyte cover (96%). Consequently, the 2013 results for this site should not be considered reliable. The abundance of both shortfin eels and Cran's bully was highest at the Waitoa River U/S survey site (Site 5) at 107 and 94 individuals per 100 m²

respectively. Torrentfish were only recorded at one site (Waitakaruru Stream) and only one individual was captured at that site. Banded kokopu were found at three sites (Sites 1, 2 & 10), including two of the new survey sites. At Site 1, the abundance of banded kokopu was high at 32 individuals per 100 m², although it should be recognised that the majority of individuals here were new recruits (<70 mm). This species is uncommon in the fish records for the Piako catchment, therefore this is a significant finding.

As a result of the poor sampling efficiency at Site 8 in 2013, direct comparison between the results of the 2012 and 2013 surveys was only possible at Sites 5 & 9 (Figure 3-3). Results for all sites surveyed in 2012 and 2013 are included in Figure 3-3 for reference. At Site 5 (Waitoa River), the relative abundance of both eel species was similar between years. However, there was a significant increase in the relative abundance of Cran's bully in 2013, relative to 2012. This appears to be largely a consequence of recent good recruitment, with large numbers of bullies <40 mm recorded in the 2013 survey. In the 2012 survey, both torrentfish and inanga were present at this site in low numbers, but neither were present in 2013. The drought conditions in 2013, may have restricted the upstream passage or recruitment of inanga to the site and may explain their absence as an annual species. However, it is also possible that part of the reason for their absence at the site is a reduction in overhanging cover (preferred habitat) caused by cattle grazing close to and in the stream in 2013. At Site 9 (Waitakaruru), the relative abundance of all species was slightly lower in 2013, when compared to the 2012 results, but it is likely this is within expected levels of inter-annual variation.

The new site on the Mangapapa Stream (Site 6; Mangapapa 2 in Figure 3-3) had lower species richness than the site surveyed further downstream in 2012 (Mangapapa in Figure 3-3). The two species recorded at the downstream site, but absent from the new site were torrentfish and inanga. The difference is likely to be the consequence of a lack of suitable habitat at the 2013 site, and possibly restricted upstream passage under low flows. The new site on the Piakonui Stream (Site 10; Piakonui US2 in Figure 3-3) had a very similar fish community to the nearby site (Piakonui US1 in Figure 3-3) that was visited in 2012.

Fish length data provide information on fish recruitment and survival rates. The length data for the three most common species (shortfin eel, longfin eel and Cran's bully) were pooled from all sites and used as an indicator of fish survival and recruitment at a catchment scale (Figure 3-4). The number of small shortfin eels (<200 mm) indicates reasonably good recruitment of this species occurred in the Piako catchment in 2013. The abundance of shortfin eels in the 300-400 mm range indicates recruitment in previous years was also reasonable. Downstream migration of adult male shortfins typically occurs at between 350-500 mm in length (Todd 1980), which is reflected in a significant drop in abundance at this size class. Shortfins greater >500 mm are generally females, which migrate at a larger size. The very low abundance of shortfin eels in these larger size classes indicates that few females are reaching maturity. This could have implications for future recruitment.

The lower overall abundance of longfin eels means that the length-frequency distribution of this species is less well defined. However, it is clear that the smaller size classes (<300 mm) are significantly underrepresented in the population relative to shortfin eels (Figure 3-4). Longfin males are generally thought to undertake their downstream migration at a length of approximately 500-700 mm, with all larger fish being females (Todd 1980). As with the shortfin eel, the abundance of larger individuals (females) is relatively low. However, of more

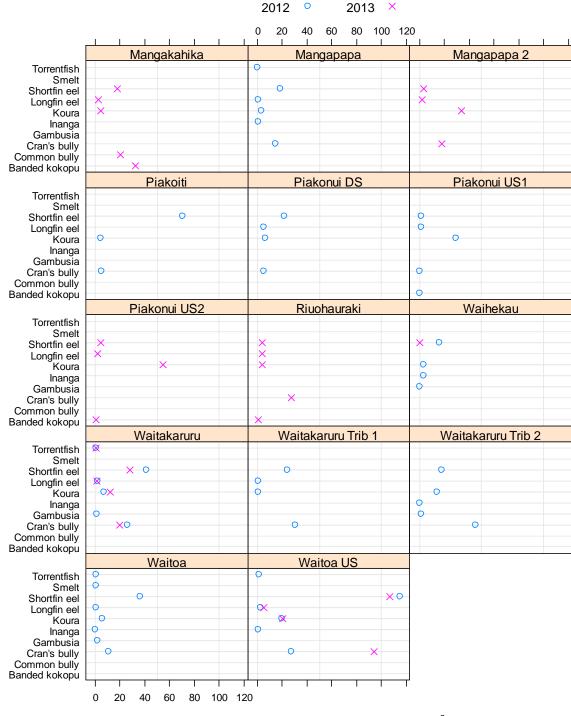
concern is that these larger individuals comprise a relatively large proportion of the overall longfin eel population in the Piako catchment. Given that this species is long-lived (female age at maturity >20 years), this indicates that there may have been poor recruitment of this species for a number of decades.

The Cran's bully length-frequency distribution indicates that in the tributaries where they occur there is good recruitment (as indicated by the high proportion of the population <40 mm) and relatively good survival rates, with a good proportion of the population also reaching the larger size classes (70-90 mm) (McDowall 2000).

No trout were again recorded from any of the Piako monitoring sites and have still not been recorded in the catchment.

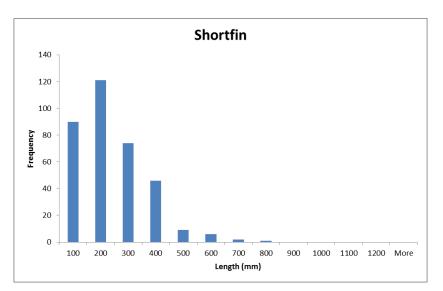
Table 3-5: Results of 2013 electric fishing survey at the seven Piako catchment monitoring sites.Ab. = Number caught; Rel. Ab. = Relative abundance(Individuals per 100 m²).

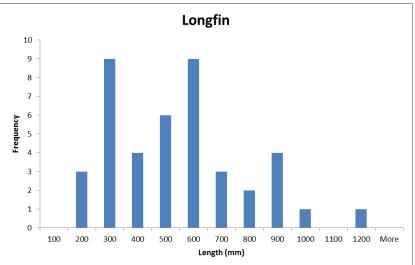
	Short	Shortfin eel		Longfin eel		Cran's bully		Common bully		Torrentfish		Banded kokopu		Koura	
Site	Ab.	Rel. Ab.	Ab.	Rel. Ab.	Ab.	Rel. Ab.	Ab.	Rel. Ab.	Ab.	Rel. Ab.	Ab.	Rel. Ab.	Ab.	Rel. Ab.	
1. Mangakahika Stream	36	17.7	5	2.5	-	-	41	20.1	-	-	66	32.4	9	4.4	
2. Riuohauraki Stream	9	4	9	4	62	27.2	-	-			1	0.4	9	4	
5. Waitoa River U/S	199	107	10	5.4	175	94.1	-	-	-	-	-	-	38	20.4	
6. Mangapapa Stream	16	3.4	8	1.7	86	18.2	-	-	-	-	-	-	160	33.9	
8. Waihekau Stream	1	0.2	-	-	-	-	-	-	-	-	-	-	-	-	
9. Waitakaruru Stream	82	27.8	3	1.1	56	19.7	-	-	1	0.4	-	-	34	11.9	
10. Piakonui Stream	16	4.4	7	1.9	-	-	-	-	-	-	2	0.6	200	54.9	



Relative abundance (Individuals per 100m²)

Figure 3-3: Comparison between the relative abundance of fish captured in the 2012 and 2013 Piako surveys.





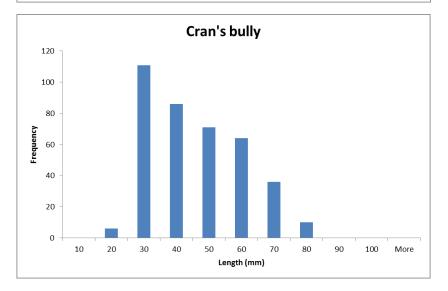


Figure 3-4: Summary of fish length for the three most abundant fish species captured in the 2013 Piako fish surveys. Length data from all seven sites are pooled.

3.2.2 Macroinvertebrates

All sites except Site 8 were sampled according to MfE protocol C1 for hard-bottomed streams, with an area of approximately 1 m^2 sampled at each site. Sampling at Site 8 followed MFE protocol C2 for soft-bottomed streams. A full taxa list is included in Appendix C.

Total taxa and EPT richness were highest at Sites 1 and 2 and lowest at Site 8 (Table 3-6). Both Sites 1 and 2 are relatively small headwater streams, with native riparian cover present through much of the reach. Site 8 is a lowland agricultural stream that has been subject to channel modification and had extremely high macrophyte cover in 2013. Sites 1 and 6 have the highest %EPT and MCI scores (Table 3-6). %EPT is lower at 54.4% for Site 2, but the MCI score for this site is still in the 'Good' quality class. The reduced %EPT score at Site 2 seems to be a consequence of a relatively large number (38) of Archichauliodes (Dobsonfly larva) being present in the sample. The lowest %EPT (27.0) and MCI scores (66.7) were recorded at Site 8 (Waihekau Stream), placing it in the 'Poor' quality class. In most cases, the respective scores for each of the indices broadly match the habitat type, with more natural channel forms with intact riparian cover typically associated with higher scores. The main exception to this pattern was Site 10, which was a headwater stream with diverse habitat in native bush. The scores for all four indices at Site 10 were lower than might be expected for a stream of this type (Table 3-6). The abundance of fish was also low at this site (Table 3-5), although the abundance of koura (Paranephrops planifrons) was very high (55 individuals per 100 m²; Table 3-5). The low abundance of fish may partially be a consequence of distance inland and the presence of downstream migration barriers, but the reason for the low abundance of macroinvertebrates is unclear.

At those sites with results available from both the 2012 and 2013 surveys (Sites 8 & 9), total taxa richness was lower in 2013 at Site 8 and higher at Site 9, but EPT richness very similar at both sites. The %EPT score was slightly higher for both sites in 2013, but the MCI score for Site 9 was significantly lower at 83.5 (Fair) compared to 104.6 (Good) in 2012. MCI score at Site 8 was also lower in 2013, but remained in the same quality class (Poor).

Site	Total taxa richness	EPT richness	%EPT	MCI
1. Mangakahika Stream	24	15	71.0	120.0
2. Riuohauraki Stream	21	13	54.4	111.4
5. Waitoa River	NA	NA	NA	NA
6. Mangapapa Stream	16	8	74.8	115.0
8. Waihekau Stream	9	3	27.0	66.7
9. Waitakaruru Stream	18	8	41.8	83.5
10. Piakonui Stream	10	4	31.3	106.0

Table 3	3-6:	Summary of mac	roinvertebrate r	esults for	the seven P	iako monitorin	g sites in
2013.	The s	sample for Site 5 w	as not preserved	d correctly	and therefore	results are not	available.

3.2.3 Macrophytes & periphyton

The majority of sites surveyed in 2013 were hard-bottomed streams with a low abundance of macrophytes (Table 3-7; Appendix D). The main exception was Site 8 on the Waihekau Stream, where *Elodea canadensis* was highly abundant (MTC 96%) and blocked a significant proportion of the stream. This was a significant increase compared to 2012 (MTC 56%). The proliferation of macrophytes at this site was the main reason for the inability to effectively complete the fish survey. It is likely that the drought conditions, and hence low flows, in 2013 are a significant driver for the expansion of macrophytes at this site. In the 2012 survey, macrophytes were recorded at Site 5 in low abundance, but were absent in 2013. It is likely that this can be attributed to the presence of cattle in the stream in 2013.

Table 3-7:Summary of macrophyte indices for the seven Piako monitoring sites in 2013.MTC = Macrophyte Total Cover; MCC = Macrophyte Channel Clogginess; MNC = Macrophyte Native Cover.

Site	МТС	MCC	MNC
1. Mangakahika Stream	0	0	0
2. Riuohauraki Stream	0	0	0
5. Waitoa River	0	0	0
6. Mangapapa Stream	0.4	0.2	0
8. Waihekau Stream	96	52	0
9. Waitakaruru Stream	1.4	0.7	0
10. Piakonui Stream	0	0	0

Periphyton cover was present at all seven of the Piako monitoring sites in 2013 (Table 3-8; Appendix D). The highest cover was observed at Site 8, where the PEI was 90.0 and the community was dominated by green filamentous algae (PFI 100). No periphyton was recorded at this site in 2012. Lowest periphyton cover was recorded at Sites 1, 5 and 10 (PEI 12.4, 22.5 & 28.5 respectively). PSI was also highest at Site 8 (68.8), and associated with lower macroinvertebrate scores (Table 3-7). However, Site 6 had a PSI score of 49.6, but an MCI score that placed it in the 'Good' quality class.

Table 3-8: Summary of periphyton indices for the seven Piako monitoring sites in 2013. PEI = Periphyton Enrichment Index; PFI = Periphyton Filamentous Index; PMI = Periphyton Mat Index; PPI = Periphyton Proliferation Index; PSI = Periphyton Slimyness Index.

Site	PEI	PFI	PMI	PPI	PSI
1. Mangakahika Stream	12.4	0	0	0	14.8
2. Riuohauraki Stream	35.5	40.3	0	40.3	36.8
5. Waitoa River	22.5	0	0	0	28.8
6. Mangapapa Stream	38.9	0	27.8	27.8	49.6
8. Waihekau Stream	90.0	100.0	0	100.0	68.8
9. Waitakaruru Stream	31.4	0	2.9	2.9	40.0
10. Piakonui Stream	28.5	0	0	0	27.2

3.3 Habitat quality

The habitat assessment provides a composite index of both landscape scale and biotic characteristics of the stream, which can be used as an indicator of habitat quality. Full details of the habitat assessment are included in Appendix A and scores are summarised in Table 3-9. Broadly, the higher the score, the better the habitat is.

Site	Catchment	Habitat Score
1. Mangakahika Stream	Piako	146.0
2. Riuohauraki Stream	Piako	130.5
3. Paiakarahi Stream DS	Waihou	161.0
4. Paiakarahi Stream US	Waihou	137.0
5. Waitoa River	Piako	106.0
6. Mangapapa Stream	Piako	117.5
7. Karengorengo Stream	Waihou	104.0
8. Waihekau Stream	Piako	87.0
9. Waitakaruru Stream	Piako	103.0
10. Piakonui Stream	Piako	136.0

 Table 3-9:
 Habitat assessment scores in 2013.

Correlations between habitat score and biotic indices were evaluated using the nonparametric Spearman's rank correlation (ρ). Sample sizes were small, but the habitat score correlated most strongly with the macroinvertebrate metrics (Total taxa richness ρ =0.78; EPT richness ρ =0.80; MCI ρ =0.73; Figure 3-5). A moderate correlation was also identified with fish species richness (ρ =0.59; Figure 3-5). The lower strength of the correlation with fish species richness reflects the strong effect that distance inland and elevation can have on fish communities dominated by diadromous species. Broadly, the higher the habitat score, the higher the diversity and quality of macroinvertebrate communities and the higher the diversity of fish species. This matches expectations that fish and macroinvertebrate communities are generally degraded in streams with poorer instream and riparian habitat. This was also reflected in strong positive correlations between fish species richness and macroinvertebrate total taxa richness (ρ =0.80) and EPT richness (ρ =0.78), suggesting that where a site supports species rich communities of macroinvertebrates, it is also likely to support species rich communities of fish.

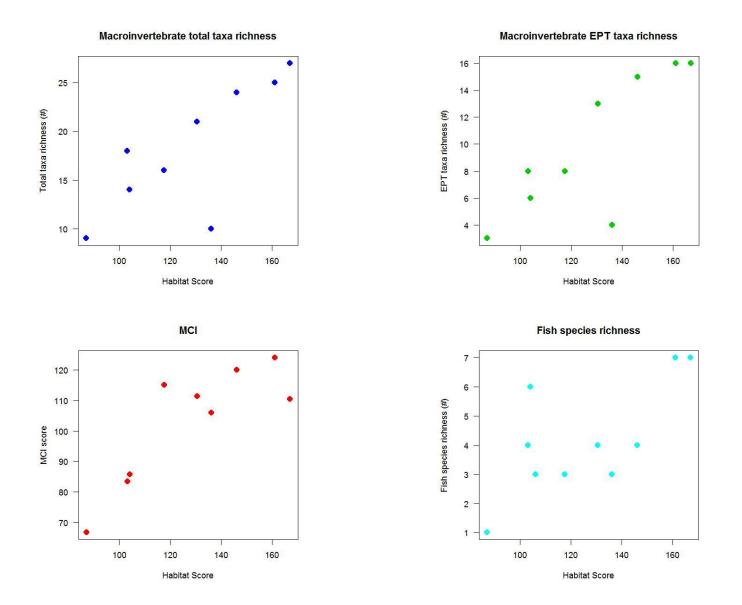


Figure 3-5: Scatterplots of biotic indices against habitat score.

4 Discussion

One of the fundamental objectives of setting water resource use limits is the protection of aquatic ecosystems. 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 changes to the environment made by humans, e.g., water abstraction, pollutant discharges, land drainage and stream restoration.

Ecological monitoring is essential to understanding ecological status and trends. The combined results of the 2012 (Franklin & Bartels 2012) and 2013 ecological monitoring surveys provide a valuable assessment of the spatial patterns in aquatic communities across the middle and upper parts of the Piako catchment. The Piako catchment is significantly impacted by land use change and the effects of agricultural development and intensification. This is evident in the baseline monitoring results, with the low gradient, lowland streams that are subject to the greatest pressures typically supporting poorer quality and less diverse ecological communities. There is also evidence to suggest that fish communities in the Piakoiti/Piakonui sub-catchment are limited by the presence of a downstream migration barrier, as indicated by the continued absence of non-climbing fish species (e.g., inanga) in these sub-catchments. However, given the discovery of good numbers of juvenile banded kokopu in the Mangakahika Stream (downstream of Morrinsville), which indicates they are successfully recruiting to the Piako catchment, the low number of this climbing species recorded in the Piakoiti/Piakonui sites with suitable habitat stands out as requiring further investigation. Despite their presence at a number of sites in the 2012 survey, no inanga were recorded from the Piako survey sites in 2013. Whilst not of immediate concern, as their abundance was low at all sites where they were previously found, it is recommended that this be monitored in future surveys as their absence could be an indicator of instream conditions. The low abundance and poor recruitment and survival of longfin eels at all sites is of potential concern at a catchment scale.

In 2013, a sub-set of three sites in the Waihou catchment were also re-surveyed. Patterns in fish communities were broadly similar to previous surveys in 2009 and 2011 (Franklin & Booker 2009, Franklin et al. 2011). The most notable difference was the lower abundance of shortfin eel and smelt at the Karengorengo Stream site, but it is thought this is largely due to reduced sampling efficiency caused by excessive macrophyte growth. MCI scores were generally lower in 2013 relative to the previous surveys. It is possible this could be attributable to the low flows experienced in 2013, but longer term monitoring would be required to confirm such an effect.

To support the review and ongoing implementation of water allocation limits in the Waihou and Piako catchments, it is recommended that routine ecological monitoring continue in both catchments. It is proposed that monitoring five sites in each catchment annually would provide the best compromise between spatial coverage and characterising natural interannual variations in the biotic communities. Ten locations potentially suitable for an annual ecological monitoring programme are proposed in Table 4-1. These sites are representative of a range of river types typical of each catchment (i.e., lowland, upland, more modified, less modified, different tributaries). Nine of the ten sites have been included in this or the previous surveys of the Waihou and Piako (Franklin & Bartels 2012, Franklin & Booker 2009, Franklin et al. 2011), and thus build on the existing dataset. These sites were selected based on their spatial coverage of the catchments, representativeness of different stream types, ease of access and suitability for the standard sampling methodologies. It is suggested that the tenth site be located in the Ohinemuri River sub-catchment. Consideration should be given to establishing a new site on a tributary downstream of the Ohinemuri Weir, which may be more suitable for long-term monitoring than the sites previously surveyed in this catchment (tributary of the Homunga Stream), which targeted an irrigation abstraction. It is recognised that WRC may have alternative preferences or sites they wish to include.

In addition to establishing annual monitoring sites, it may also be valuable to identify an additional group of sites that would be monitored every 3-5 years, to improve the spatial coverage of the monitoring. It may also be useful to collect additional data on characteristics such as flow, water temperature, dissolved oxygen and water quality at the annual monitoring sites to better understand the relative importance of different environmental variables in determining the observed variations in ecology (and their associations with flow).

Catchment	Stream	Easting*	Northing*
Waihou	Karengorengo Stream	2758628	6384754
Waihou	Paiakarahi Stream	2751431	6429122
Waihou	Waiteariki Stream	2762794	6379697
Waihou	Wairere Stream	2761891	6381355
Waihou	Tributary of the Ohinemuri River	TBC	TBC
Piako	Mangapapa Stream	2747006	6371508
Piako	Waitakaruru Stream	2727985	6377350
Piako	Waitoa Stream	2742190	6365404
Piako	Piakonui Stream	2741486	6371826
Piako	Mangakahika Stream	2728975	6400407

 Table 4-1:
 Proposed annual ecological monitoring sites for the Waihou and Piako catchments.

*Easting and northing given for downstream limit of survey reach (NZMG coordinates).

5 Conclusion

Reliable information on the status and dynamics of instream ecosystems is a key component of achieving a sustainable water allocation framework that meets freshwater objectives. Knowledge of natural dynamics and variability in New Zealand's freshwater ecological communities is relatively limited. However, to monitor human impacts on aquatic biota it is essential to understand and be able to distinguish natural drivers of change. Establishing a long-term routine ecological monitoring network 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 monitoring that has been carried out so far in the Waihou and Piako catchments has established a baseline against which to measure future changes. Evidence is already emerging of differences in the structure and diversity of ecological communities between more and less heavily modified sites. Potential implications for water allocation may include protection of high diversity sites and/or rehabilitation of degraded sites e.g., riparian planting, to compensate for the potential impacts of increased allocation.

The process of developing water allocation rules must be robust and transparent. The resulting water allocation framework must be sustainable and support adaptive management of water resources. Reliable information on the status and dynamics of instream values is a key component in achieving this.

6 References

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Appendix A Field and habitat assessment forms

Stream name: Mang	gakahika Stre	am		Assess	or: Pa	ul Franklir	1				
Site number: 1		Sample number:		Date: 1	5/02/1	3 Т	ïme	: 10:18			
GPS coordinates		Downstream:		E 2728	975	N	640	00407			
	I	Jpstream:		E 2728	895	Ν	1640	00360			
Channel & riparia	an features			Instream hydraulic conditions							
Canopy cover:				Estimated or measured reach average:							
Open	Partly sha	aded Ver	y shaded								
Fencing:	Dominant ri	parian vegetatior	n:	Stream	width	(active ch	ann	el): 4.0m			
None/ineffective	Crops	Retirec	d vegetation	Stream	width	(water): 2	.0m				
One side/partial	Pasture	Native	shrub	Stream	depth	: 0.1m					
Complete	Exotic trees	Native	trees	Surface	e veloc	;ity: 0.2m	5 ⁻¹				
Water quality											
Temperature:	16.6	°C		Conduc	ctivity:		77	µS cm ⁻			
Dissolved oxygen:	87.0	%		8.5		n	ng l ⁻¹	1			
Turbidity:	Clear	Slightly tur	rbid Highly	turbid	Stair	ned	C	Other			
Compaction (inorg				compo	sition	:	1	stratum size			
Assorted sizes tightly				Substra		Dimensi	on	Percentage			
Moderately packed v				Bedroc		-					
Mostly a loose assor		•		Doulder		>256mm		10			
No packing/loose a	ssortment e	asily moved		Cobble		>04-250mm	1	80			
Embeddedness:		fine andiment)		Gravel		>0.06-2mm		10			
				Sand		20.00-ZIIIII					
(% gravel-boulder partie	1		>75%	Cilt		0 004-0 06	nm				
(% gravel-boulder participant) <5% 5-25%	1		>75%	Silt Clav		0.004-0.06r <0.004mm	nm				
<5% 5-25%	% 26-50		>75%	Clay	ut typ	<0.004mm					
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Wadeable Hard-B Qualitative Habitat A						She	ot													
Stream name: Man					Jala	She	εı		Sito	numt	oor:	1								
Sample number:	jaka	liika	Sue	-		cor	Pau			-	Jei.		Data	:18/	02/1	2				
Sample number.				P	15565	501.	гau	i fia					Dale	:10/	UZ/ I	3				
Habitat parameter		O	ptim	al			Sub	popti		Cate	gory		argir	nal				Poo	r	
1. Riparian vegetative zone width	•	Bank vege >10r Cont dens	tatio n inuo	n buff	er	•	is <1	tation 0m	n buff ntinu		•	Path and/o Most over	or sto	ck	ent	 Breaks frequent Human activity obvious 				
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																				
2. Vegetative protection	•	imme ripar cove vege Tree store non- pres Vege	ediate ian z red t station s, un ey sh wood ent etativ	ones by nat n der- rubs o dy pla	ive or nts	•	cove nativ Disru Bank	re veç uptior ks ma red b	nainly getati n evic	on lent	•	Bank cove mixtu grass black & inti spec Vege disru Bare cropp vege comr	red b ure of ses/s berry roducties etation ption soil/ ped tatior	y hrubs , will ced n obvi	ow	•	cove gras Disr strea vege high Gras graz Sigr	ss he	by shrun of ank n very avily at stoo	ubs y ck
Left bank: 16	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: 16							<u> </u>											<u> </u>		
3. Bank stability	•	Banł Eros failur abse <5% affec	ion/b e nt/m of ba	ank inima	I	 Moderately stable Infrequent, small areas of erosion mostly healed over 5-30% of bank eroded 				•	Mode unsta 30-60 react of ere High poter flood	able 0% o h has osion eros ntial c	f ban area	IS	•	Man area 60-1	00% erosi	of ba	ink	
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		<u> </u>			<u> </u>							<u> </u>			L			<u> </u>		
4. Frequency of riffles	•	frequ Dista riffles strea	ient ance s divi im wi ety of	ativel betwo ded b idth={	een by 5-7	•	Dista riffles	s infre ance l s divi	ce of equer betwe ded b dth=7	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	erally er, sha s r habi ance es divi am wi	allow itat betwo ded b	een by
Score: 19	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
5. Channel alteration	•	Char char abse Strea	nges inel/c int/m am w	to Iredgi inima	ing I	•	Som chan Evide chan Rece chan	e cha inel/d ence inel/d ent	anges Iredgi of pa Iredgi	s to ing ist ing	•	Char chan exter Emb oring prese bank 40-8 chan disru	nnel ges/o nsive ankm strue ent or s 0% o neliz	dredg nents/ ctures n both	ing ′sh S	•	Ban with gabi >80 ^o read char disru	ks sh ion/ce % of s	ored ement strear ed or habit	t m
Score:19	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	amet	er			atego ptim			Ha	abitat	para	amet	er
6. Sediment deposition	•	point bars present					bar formation, mostly from gravel, sand or fine sediment • 20-50% of bottom affected • Slight deposition in pools					Somo of ne sand sedir new 50-8 affec Sedir depo obstr cons bend	w gra l or fin hent bars 0% o ted ment sits a ructio trictic	avel, ne on ol f bott at ns,	d & om	 Heavy deposits of fine material Increased bar development >80% of bottom changing frequently Pools almost absent due to sediment deposition 				
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 p //dee /shal shallo	low,		•	regin If fas miss	city/denes p	oresei Illow i nen		•	2 of 4 veloc regin If fas slow/ miss low	city/de nes p st/shall /shall	llow o llow o	or	•	velo regii	ninate city/d me ally d	epth	
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	 20 19 18 17 16 >50% substrate favourable for invertebrate colonisation & wide variety of woody debris, riffles, root mats Snags/ submerged logs/undercut banks/cobbles provides abundant fish cover Must not be new or transient 					•	favou inver color Snag subn logs/ bank Fish com Mode of ha Can	nerge /unde cove mon erate abitat cons e nev	e for ate on ed ercut obles r varie types ist of	ety 5.	•	10-30 favou inver color Fish 60-90 easil foot Woo rare smot sedir	tebra cove 0% si y mo dy de or ma	e for ate on r pato ubstr ved b ebris ay be	chy ate yy	•	favo inve colo Fish abse unst lack Stab	strate able (e for ate on r rare or bitats limite	ed
Score:19	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
9. Periphyton	•	evide held Stab	ent o ston- le su aces	n not n han es bstrat rough	d te	•	visib Stab Perip		ston bstra n	es te	 Periphyton visible <20% cover of available substrates 					 Periphyton obvious & prolific >20% cover of available substrates 				
Score: 10	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
TOTAL SCORE: 146	6																			

Stream name: Riuoł	nauraki Stream	<u>۱</u>				Assess	or: Pa	ul Franklir	า				
Site number: 2	5	Sample	e number:			Date: 1	8/2/13	з т	Time:	: 15:00)		
GPS coordinates	[Downs	tream:			E 2729	470	1	1 640)2548			
	ι	Jpstre	am:			E 2729382 N 6402591							
Channel & riparia	an features					Instream hydraulic conditions							
Canopy cover:						Estimated or measured reach average:							
Open	Partly sha	ded	Very	shaded	k								
Fencing:	Dominant rip	barian	vegetation:			Stream	width	(active ch	nanne	el): 3m	ı		
None/ineffective	Crops		Retired	vegetati	on	Stream	width	(water): 1	.5m				
One side/partial	Pasture		Native s	shrub		Stream	depth	n: 0.2m					
Complete	Exotic trees		Native tr	rees		Surface	e veloc	city: 0.2m	s ⁻¹				
Water quality													
Temperature:	20.7		°C			Conduc	ctivity:	2	241.9)	µS cm⁻¹		
Dissolved oxygen:	86.5		%					r	ng l ⁻¹				
Turbidity:	Clear		Slightly turb	id Hi	ighly t	urbid	Stair	ned	C	Other			
Stream-bottom s	ubstrata												
Compaction (inorg	anic substrat	a):				% surfi compo		norganic :	subs	stratur	n size		
Assorted sizes tightl	y packed &/or	overla	apping			Substra	atum	Dimensi	nsion Percentage				
Moderately packed	with some o	verlap	ping		ľ	Bedroc	k	-					
Mostly a loose asso	rtment with littl	e ovei	rlap			Boulde	r	>256mm		40			
No packing/loose as	sortment easi	y mov	ved			Cobble >64-25		>64-256mr	n	35			
Embeddedness:						Gravel >2-64		>2-64mm	^{nm} 20				
(% gravel-boulder parti	cles covered by	fine se	diment)			Sand		>0.06-2mm	^{2mm} 5				
<5% 5-25	26-509	%	51-75%	>75	%	Silt		0.004-0.06	.06mm				
						Clay		<0.004mm					
Organic material	(% cover)					Habita	at typ	es samp	led				
Large wood (>10cm	diameter)					(% of eff	ort)						
<5% 5-25	% 26-50%	%	51-75%	>75	%	Stones		100%					
Coarse detritus (sma	all wood, sticks	s, leav	res et al. >1	mm)		Wood:		%	Rif	fles:	100 %		
<5% 5-25	% 26-50%	%	51-75%	>75	%	Macrop	hyte:	%	Ru	ins:	%		
Fine (<1mm) organi	c deposits	i		i		Edges:		%					
<5% 5-25	% 26-50%	%	51-75%	>75	%	Numbe	r of in	vertebrate	s ret	urned:			
Instream plant co	over (% strea	mbed	area)			Koura:		5	Shrim	nps:			
Filamentous algae 8	mats:					Crabs:		Ν	Auss	els:			
<5% 5-25	% 26-50%	%	51-75%	>75	%	Other:							
Macrophytes:	1			1		Mussel	•••						
<5% 5-25°	% 26-50%	%	51-75%	>75	%	Hyridel	la	0	Сиси	merun	nio		
I													
Mosses/liverworts:	% 26-50	1	51-75%	>75									

	3363	ssme	nt Fi	eld [Data	She	et	,												
Stream name: Riuoh	aura	aki St	rear	n				5	Site r	numb	ber: 2	2								
Sample number:				Α	sses	sor:	Pau	l Fra	nklin	1			Date	:18/	02/1:	3				
Habitat parameter										Cate	gory	/								
		С	ptim	al			Sub	oopti	mal			Ma	argin	al				Poo	r	
1. Riparian vegetative zone width	•	vege >10r	n inuoi	n buff us &	er	•	is <1	tatior			•	Path and/o Most over	or sto	ck	ent	•		aks fro nan ao 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:11	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Mean: 12		<u> </u>		<u> </u>													<u> </u>	<u> </u>		
2. Vegetative protection	•	imm ripar cove vege Tree store non- pres Vege	ediate ian zo ered b etation s, un ey shi wood ent etativ	ones by nat n der- rubs o ly pla	ive or nts	•	cove nativ Disru Bank	c surfa red n e veg uptior cs ma red b stry	nainly getation evid iy be	on lent	•	Bank cove mixtu grass black & intri spec Vege disru Bare cropp vege comr	red b ire of ses/s berry roducties etation ption soil/o bed tatior	y hrubs , will ed n obvie close	ow	•	cove gras Disr strea vege high Gras graz Sigr	ss he	by & shru n of ank n very avily avily	ubs y ck
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:10	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Mean: 10.5																				
3. Bank stability	•	Eros failu abse	ent/m of ba	ank inima	I	•	Infre area		t, sma erosio aled	all n	•	Mode unsta 30-60 reach of ero High poter flood	able 0% of has osion erosi ntial c	f ban area	S	•	Man area 60-1	00% erosi	of ba	ınk
Left bank:16	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: 16		1	1				1					I					1	1	1	
4. Frequency of riffles	•	frequ Dista riffle strea	uent ance s divi am wi ety of	ativel betwe ded k dth={	een y 5-7	•	Dista riffles	urrend s infre ance I s divid im wi	equer betwe ded b	een y	•	Occa or run Botto provi habit Dista riffles strea 25	n om co de so at ince l s divio	ontour ome oetwe ded b	rs een y	•	wate riffle Poo Dist riffle	erally er, sha s r hab ance s divi am wi	allow itat betwo ded t	een Dy
Score: 13	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
5. Channel alteration	•	char abse Strea	ent/mi am w	lredgi inima	I	•	chan Evide chan Rece chan	e cha inel/d ence inel/d ent inel/d oresei	redgi of pa redgi redgi	ng Ist ng	•	Char chan exter Emba oring prese bank 40-80 chan disru	ges/onsive ankm structent or s 0% of nelize	ients/ ctures n botl	′sh S n	•	with gabi >80 read chai disru Insti	ion/ce % of s	ement strear ced or habit	m at
	1	19	18	17	16	15	14	13	12	11	10		8	7	6	5	4	1	2	1

Habitat parameter			atego ptim			Ha	bitat	para	amet	er			atego ptim			Ha	abitat	para	amet	er
6. Sediment deposition	•	point <20%	t bars % of t ted b ment	,	ent	•		orma tly fro el, sa sedin 0% o ted ted	tion, om ind or nent f bott	om	•	Somo of ne sand sedir new 50-8 affec Sedir depo obstr cons bend	w gra l or fin hent bars 0% o ted ment sits a ructio trictic	avel, ne on ol f bott at ns,	d & om	•	fine Incrededededededededededededededededededed	vy de mater eased elopm % of t nging uently s alm ent du ment ositior	ial bar ent oottor oost 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	•		nes p //dee /shall shallo	low,		•	regin If fas miss	city/denes p	orese Illow i nen		• •	2 of 4 veloc regin If fas slow/ miss low	city/de nes p st/shall /shall	llow o llow o	or	•	velo regir	iinate city/d ne ally de	eptń	
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	•	favor inver color wide wood riffles Snag subr logs/ bank prov abur cove	urable tebra nisati varie dy de s, roc gs/ nerge unde s/col ides ides idant tr	ate on & ety of bris, ot mate ed ercut obles fish be ne	S	•	favou inver color Snag subn logs/ bank Fish com Mode of ha Can	nerge /unde cove mon erate abitat cons e nev	e for ate on ed ercut obles r varie types ist of	ety 5.	•	10-3 favou inver color Fish 60-9 easil foot Woo rare smot sedir	tebra cove 0% si y mo dy de or ma	e for ate on r pato ubstr ved b ebris ay be	chy ate yy	•	favo inve colo Fish abse unst lacki Stab	strate able o	e for ite on r rare or bitats limite	ed
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 Stab	ent or stone le su aces	n not n han es bstrat rough	d te	•	visib Stab Perip		ston bstra n	es te	• •	Perip <20% avail subs	able	er of		•	obvi >209 avai	ohyto ous & % cov able strates	proli er of	
Score: 9	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
TOTAL SCORE: 130).5																			

	arahi Stream D/S	<u> </u>		Assess	or: Pa	ul Franklir	1	
Site number: 3	San	nple number:		Date: 1	9/02/1	3 Т	ime:	13:10
GPS coordinates	Dov	vnstream:		E27513	347	Ν	6429	422
	Ups	tream:		E27514	18	Ν	16429	342
Channel & riparia	n features			Instre	am h	ydraulic	conc	litions
Canopy cover:				Estimate	ed or m	easured rea	ach av	erage:
Open	Partly shade	d Verys	haded					
Fencing:	Dominant ripar	ian vegetation:		Stream	width	(active ch	anne	l):6m
None/ineffective	Crops	Retired ve	getation	Stream	width	(water): 2	.5m	
One side/partial	Pasture	Native shr	ub	Stream				
Complete	Exotic trees	Native tre	es	Surface	e veloo	tity: 0.3m	S ⁻¹	
Water quality								
Temperature:	18.6	°C		Condu	ctivity:		02	µS cm⁻́
Dissolved oxygen:	98	%	1	9.2	1	n	ng l ⁻¹	
Turbidity:	Clear	Slightly turbid	Highly	turbid	Stair	ned	0	ther
Compaction (inorga				compo	sition	:		ratum size
Assorted sizes tightly	packed &/or ove	erlapping		Substra		Dimensi	on	Percentage
Moderately packed w				Bedroc		-		
Mostly a loose asso		-		Boulde		>256mm		30
No packing/loose ass	ortment easily n	noved		Cobble		>64-256mn	n	60
Embeddedness:				Gravel		>2-64mm		10
(% gravel-boulder partic	1	· · · ·	750/	Sand		>0.06-2mm 0.004-0.06r		
<5% 5-25%	26-50%	51-75%	>75%	Silt Clay		<0.004-0.001		
Organic material	(% covor)			,	t tun	es samp		
Large wood (>10cm of				(% of eff		es samp	leu	
<5% 5-25%		51-75%	>75%	Stones	,	100%		
Coarse detritus (sma		1 1		Wood:	•	100 <i>%</i>	Riff	es: 100 %
, i i i i i i i i i i i i i i i i i i i	1	51-75%	>75%	Macrop	hvte:	%	Rur	
<5% 5-25%		1 1		Edges:	,	%		
	ueposits			J			s retu	rned:
<5% 5-25% Fine (<1mm) organic <5% 5-25%	· ·	51-75%	>75%	Numbe	r of in	vertebrate		
Fine (<1mm) organic <5% 5-25%	26-50%		>75%	Numbe Koura:	r of in	I.	Shrimp	os:
Fine (<1mm) organic <5% 5-25% Instream plant co	26-50%		>75%	-	r of inv	S	Shrimp Ausse	
Fine (<1mm) organic <5% 5-25%	26-50% ver (% streamb mats:		>75% >75%	Koura:	r of in	S		
Fine (<1mm) organic <5% 5-25% Instream plant co Filamentous algae &	26-50% ver (% streamb mats:	ed area)		Koura: Crabs:		S		
Fine (<1mm) organic <5% 5-25% Instream plant co Filamentous algae & <5% 5-25%	26-50% ver (% streamb mats: 26-50% 26-50% 26-50%	ed area)		Koura: Crabs: Other:	type:	S	lusse	
Fine (<1mm) organic <5% 5-25% Instream plant co Filamentous algae & <5% 5-25% Macrophytes:	26-50% ver (% streamb mats:	ed area)	>75%	Koura: Crabs: Other: Mussel	type:	S	lusse	ls:

Wadeable Hard-E Qualitative Habitat A						She	et													
Stream name: Paiak								5	Site r	numt	ber: 3	3								
Sample number:	1			A	sses	sor:	Pau	Fra	nklin	1			Date	: 19/	/02/1	13				
Habitat parameter		-								Cate	gory							_		
1. Riparian vegetative zone width	•	Banl vege >10r	n tinuo	n buff	er	•	Sub Bank vege is <1 Most	tatior 0m	n buff		•	Ma Path and/o Most over	or sto	pres ck	ent	•		nan a	r equei ctivity	
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			<u> </u>		<u> </u>					<u> </u>		·						<u> </u>		
2. Vegetative protection	•	imm ripar cove vege Tree store non- pres Vege	ediate ian z ered t etation s, un ey shi wood ent etativ	ones by nat n der- rubs o dy pla	ive or nts	•		red n e veg iptior is ma red b	nainly getation evid ay be	on lent	•	Bank cove mixtu grass black & intu spec Vege disru Bare cropp vege comr	red b ure of ses/s berry roducties etation ption soil/c bed tatior	y hrubs , will ed n obvie close	ow	•	cove gras Disr streavege high Gras graz Sigr	ered b ses & uption am ba etatio ss he ced ifficar	shru n of ank n ver	ubs y ck
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:20	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Mean: 19																				
3. Bank stability	•	Eros failu abse	ent/m of ba	ank inima	I	•	Mode Infre- area: most over 5-30 erod	quent s of e ly he % of	t, sma erosio aled	all on	•	Mode unsta 30-60 reach of ero High poter flood	able 0% of h has osion erosi ntial c	f ban area	IS	•	Mar area 60-1	00% erosi	of ba	ınk
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:15	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Mean: 17			•		<u> </u>					<u> </u>			<u> </u>					<u> </u>		
4. Frequency of riffles	•	frequ Dista riffle strea	uent ance s divi am wi ety of	ativel betwe ded b idth={	een by 5-7	•	Dista riffles	s infre ince l s divie	equer	een oy	•	Occa or run Botto provi habit Dista riffles strea 25	n om co de so at ince l s divio	ontou ome oetwe ded b	rs een y	•	wate riffle Poo Dist riffle	r hab ance s divi	allow	een oy
Score: 19	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
5. Channel alteration	•	char abse Strea	ent/m am w	lredgi inima	I	•	Evide chan Rece chan	nel/d ence nel/d ent	redgi of pa redgi redgi	ing ist ing	•	Char chan exter Emba oring prese bank 40-80 Char	ges/c nsive ankm struc ent or s 0% of nneliz	ients/ ctures n botl f read	′sh s n	•	with gab >80 read chai disr	ion/ce % of s h nneliz upted ream	ement strear	m r at
										-		disru	pted				-		1	

Habitat parameter	-		atego ptim			Ha	bitat	para	amet	er			itego ptim			Ha	bitat	para	amet	er
6. Sediment deposition	• •	point	bars 6 of t ted b nent	,	ent	•	most	orma tly fro el, sa sedin 0% o ted ted	tion, m nd or nent f bott	om	•	Som of ne sand sedir new 50-8 affec Sedir depo obstr cons bend	w gra or fir hent bars 0% of ted ment sits a fuctio trictic	avel, ne on ol f bott at ns,	d & om	• • • •	fine f Incre deve >80% chan frequ Pool abse sedir	vy de matei eased elopm % of b uging uently s alm ent du ment ositior	ial bar ent oottor oost 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	•		nes p /deej /shall shallo	ow,		•	regin If fas miss	city/denes p	iresei Ilow i nen		•	2 of 4 veloc regin If fas slow/ miss low	city/de nes p t/shall ′shall	i resei llow o ow a	or	•	veloo regir	inate city/d ne ally de	eptń	
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	• • •	favor inver color wide wood riffles Snag subn logs/ bank provi abur cove	urable tebra varie dy de s, roc gs/ nerge unde s/cot des idant r not l	te on & ety of bris, of mat ed frcut obles fish	S	•	inver color Snag subn logs/ bank Fish com Mode of ha Can	urable tebra nisatio gs/ nerge unde s/cot cove mon erate abitat cons e new	e for ate on ed rcut obles r varie types ist of	ty	•	10-30 favou inver color Fish 60-90 easil foot Woo rare smot sedir	urable tebra nisatio cove 0% so y mov dy de or ma hereo	e for ite on r pato ubstruved b ebris ay be	chy ate y	• • • •	favor inver color Fish abse Subs unsta lacki Stab lacki	strate	e for ite on r rare or bitats limite	e or
Score: 20	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	ent or subs roph d etc.	,) or f	d S	•	visib subs	ohyto le on trates ous to	s but		•	Perip <20% avail subs	6 cov able	er of	ble	• •	obvio >20% avail	ohyto ous & % cov able strates	proli er of	
Score: 10	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
TOTAL SCORE:161																				

Stream name: Paiak	arahi Stream L	I/S		Assess	sor: Pa	ul Franklin	1	
Site number: 4	Sa	ample number:		Date: 1	9/02/1	3 T	ïme: 1	5:45
GPS coordinates	D	ownstream:		E2751	431	Ν	16429 [,]	122
	U	pstream:		E2751	550	Ν	64290	031
Channel & riparia	an features			Instre	am h	ydraulic	cond	itions
Canopy cover:				Estimat	ed or m	easured rea	ach ave	erage:
Open	Partly shad	ded Very	shaded					
Fencing:	Dominant ripa	arian vegetation:		Stream	width	(active ch	annel)):12m
None/ineffective	Crops	Retired	vegetation	Stream	width	(water): 6	m	
One side/partial	Pasture	Native s	hrub	Stream	n depth	1: 0.3m		
Complete	Exotic trees	Native t	rees	Surfac	e veloo	city: 0.3m s	s ⁻¹	
Water quality								
Temperature:	18.6	°C		Condu	ctivity:		02	µS cm⁻́
Dissolved oxygen:	98	%		9.2		n	ng l ⁻¹	
Turbidity:	Clear	Slightly turb	id Highly	turbid	Stair	ned	Ot	her
Stream-bottom s	ubstrata			% curf	icial i	organic	ubeti	atum size
Compaction (inorg		•		compo	sition): 	1	
Assorted sizes tight	y packed &/or o	overlapping		Substra		Dimensio	on l	Percentage
Moderately packed				Bedroo		-		
Mostly a loose ass		-		Boulde		>256mm		85
No packing/loose as	sortment easily	moved		Cobble		>64-256mm		10
Embeddedness:				Gravel		>2-64mm		5
(% gravel-boulder parti	1			Sand		>0.06-2mm		
<5% 5-25°	% 26-50%	51-75%	>75%	Silt		0.004-0.06r <0.004mm	nm	
<u> </u>	(0)			Clay				
Organic material						es samp	iea	
Large wood (>10cm	·	E4 750/	750/	(% of ef	,	4000/		
<5% 5-25°		I	>75%	Stones	-	100%	D:#I	1000
Coarse detritus (sma <5% 5-25%	1	1	nm) >75%	Wood: Macror	buta	%	Riffle	
 Sine (<1mm) organic		01-70%	>10%	Edges	,	%	Run	5. 9
<5% 5-25°		51-75%	>75%			% vertebrate:	s retur	ned.
			~10/0	Koura:		1	Shrimp	
Instream plant co Filamentous algae 8		ibeu area)		Crabs:			lussel	
<5% 5-25°	1	51-75%	>75%	Other:		IV.	103361	з.
Macrophytes:	/0 20-00/0	5 51-7570	-10/0	Musse	l type:			
<5% 5-25 ^o	% 26-50%	51-75%	>75%	Hyride	•••		Cucum	erunio
Mosses/liverworts:			1 21070				Journ	0.01110
	% 26-50%	51-75%	>75%					
<5% 5-25°	70 ZN-00-70							

Wadeable Hard-E Qualitative Habitat A						She	et													
Stream name: Paiak									Site ı	numb	oer: 4	1								
Sample number:				1	sses	sor:	Pau	l Fra	nklir	1			Date	: 19/	/02/1	3				
										Cate	gory									
Habitat parameter		(Optim	al		0	Sub	oopti	mal			Ma	argin	al				Poo	r	
1. Riparian vegetative zone width	•	veg >10	tinuo	n buff	er	•	is <1	tation	n buff		•	Path and/o Most over	or sto	ck	ent	•	Hun	aks fro nan ao ious		
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	•	imm ripa cove vege Tree stor non pres Veg	k surf rian z ered b etation es, un ey shi -wood sent etativ uptior	e ones by nat der- rubs o ly pla e	ive or nts	•	cove nativ Disru Bank	s ma red b	nainly getati n evic ny be	on lent	•	Bank cove mixtu grass black & intr spec Vege disru Bare cropp vege comr	red b ire of ses/s berry roducties etation ption soil/o bed tatior	y hrubs , will ed n obvie close	ow	•	cove gras Disr stre veg high Gra graz Sigr	ss he	by & shru n of ank n very avily avily	ubs y ck
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																				
3. Bank stability	•	Eros failu abs <5%	ks sta sion/b re ent/m 6 of ba cted	ank inima	I	•	Infre area	s of e ly he % of	t, sm erosic aled	all on	•	Mode unsta 30-60 reach of ero High poter flood	able 0% of has osion erosi ntial c	f ban area	IS	•	Mar area 60-7	100% erosi	of ba	ınk
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								L							L			1		
4. Frequency of riffles	•	freq Dist riffle stre	es rel uent ance s divi am wi ety of ey	betwe ded b dth={	een by 5-7	•	Dista riffles	urrend s infre ance l s divid im wi	equei betwe ded b	een by	•	Occa or run Botto provi habit Dista riffles strea 25	n om co de so at ince l s divio	ontour ome oetwe ded b	rs een y	•	wate riffle Poo Dist riffle	nerally er, sha s r habi ance es divi am wi	allow itat betwo ded t	een oy
Score: 19	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
5. Channel alteration	•	cha abs Stre	nges nnel/c ent/m am w nal pa	lredgi inima ith	I	•	chan Evide chan Rece chan	e cha inel/d ence inel/d ent inel/d prese	redgi of pa redgi redgi	ing ist ing	•	Char chan exter Emba oring prese bank 40-80 chan disru	ges/onsive ankm structent or s 0% of nelize	ients/ ctures n botl f read	′sh S n	•	with gab >80 read cha disr Inst	ion/ce % of s	ement strear ced or habit	m r at
											l					1			r	1

Habitat parameter	-		atego ptim			Ha	bitat	para	amet	er			itego ptim			Ha	abitat	para	amet	er
6. Sediment deposition	•	point <20%	t bars % of t ted b ment	,	ent	•	bar for most grave fine s 20-5 affect	nt dep	tion, om ind or nent f bott	om	•	Somo of ne sand sedir new 50-8 affec Sedir depo obstr cons bend	w gra or fir nent bars 0% of ted ment sits a uctio trictic	avel, ne on ol f bott f bott ns,	d & om	•	fine Incrededededededededededededededededededed	vy de mater eased elopm % of t uging uently s alm ent du ment ositior	ial bar ent oottor oost e to	
Score: 20	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 p //dee /shall shallo	low,		•	regin If fas miss	4 nes p t/sha ing th e low	oresei Illow i nen		•	2 of 4 veloc regin If fas slow/ miss low	t/shall	reser llow o ow a	or	•	velo regir	inate city/d ne ally de	eptń	
Score: 17	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	•	favor inver color wide wood riffle Snag subr logs/ bank prov abur cove	urable tebra nisati varie dy de s, roc gs/ nerge funde s/col ides ndant	ate on & ety of bris, ot mate ed ercut obles fish be ne	S	•	favou inver color Snag subn logs/ bank Fish com Mode of ha Can	nerge /unde cove mon erate abitat cons e nev	e for ate on ed ercut obles r varie types ist of	ety	• • •	10-30 favou inver color Fish 60-90 easil foot Woo rare smot sedir	urable tebra nisatio cove 0% so y mov dy de or ma hereo	e for te on r pato ubstra 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	ed
Score: 17	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
9. Periphyton	•	evide held Stab	ent or stone le su aces	n not n han es bstrat rough	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	er of	ble	• •	obvi >209 avail	ohyto ous & % cov able strates	proli er of	-
Score: 14	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
TOTAL SCORE: 167	7																			_

Stream name: Waitoa	a Tributary			Assess	or: Pa	ul Frankli	n	
Site number: 5	Sam	ple number:		Date: 2	0/02/1	3 -	Time	: 12:40
GPS coordinates	Dow	nstream:		E 2742	184	1	N 63	65455
	Upst	ream:		E 2742	094	1	N 63	65394
Channel & riparia	n features			Instrea	am hy	ydraulic	cor	nditions
Canopy cover:					-	easured re		
Open	Partly shaded	l Very sha	aded					
Fencing:	Dominant riparia	an vegetation:		Stream	width	(active ch	nann	el):5m
None/ineffective	Crops	Retired vege	etation	Stream	width	(water): 2	2m	
One side/partial	Pasture	Native shrut	b	Stream	depth	: 0.25m		
Complete	Exotic trees	Native trees		Surface	e veloc	ty: 0.7m	s ⁻¹	
Water quality								
Temperature:	18	٦°		Conduc	ctivity:		126	µS cm ⁻
Dissolved oxygen:	89	%	I	8.4		r	ng l´	1
Turbidity:	Clear	Slightly turbid	Highly t	urbid	Stair	ned	(Other
Stream-bottom su	ubstrata							
Compaction (inorga	inic substrata):			% surfi compo			subs	stratum size
Assorted sizes tightly	packed &/or ove	rlapping		Substra	atum	Dimensi	ion	Percentage
Moderately packed	with some overl	apping	•	Bedroc	k	-		
Mostly a loose assort	ment with little ov	verlap		Boulde	r	>256mm		70
No packing/loose ass	sortment easily m	oved		Cobble		>64-256mi	m	15
Embeddedness:				Gravel		>2-64mm		5
(% gravel-boulder partic	les covered by fine	sediment)		Sand		>0.06-2mm	n	5
<5% 5-25%	6 26-50%	51-75%	>75%	Silt		0.004-0.06	imm	5
				Clay		<0.004mm	I	
Organic material	(% cover)			Habita	it typ	es samp	oled	
Large wood (>10cm	diameter)			(% of eff	ort)			
<5% 5-25%	6 26-50%	51-75%	>75%	Stones		100%		
Coarse detritus (sma	1	aves etc., >1mm)		Wood:		%	Ri	ffles: 100%
<5% 5-25%	I	51-75%	>75%	Macrop	hyte:	%		uns: %
Fine (<1mm) organic	· 1			Edges:		%		
<5% 5-25%	6 26-50%	51-75%	>75%		r of in	vertebrate		
Instream plant co		ed area)		Koura:			Shrin	
Filamentous algae &	1	, ,		Crabs:		1	Muss	sels:
<5% 5-25%	26-50%	51-75%	>75%	Other:				
Macrophytes:	I			Mussel			_	
<5% 5-25%	6 26-50%	51-75%	>75%	Hyridel	la	(Сиси	ımerunio
Mosses/liverworts:		1 1						
<5% 5-25%		51-75%	>75%					
Comments: John Sild	cock							
55 Peake Rd RD3 Hamilton								
078234225								

Wadeable Hard-B Qualitative Habitat A						She	et													
Stream name: Waito									Site ı	numl	per:	5								
Sample number:			.,	A	sses	sor:	Pau			-		-	Date	e: 20	/02/1	13				
										Cate	gory	/								
Habitat parameter	-	0	ptim	al			Sub	oopti			0,		argir	nal				Poo	r	
1. Riparian vegetative zone width	•	Bank vege >10r Cont dens	tatio n inuo	n buff	er	•	is <1	tatio 0m	n buff ntinu		•	Path and/o Most over	or sto	ock	ent	•		aks fr nan a ous		
Left bank:3	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: 3.5																				
2. Vegetative protection	•	imme ripar cove vege Tree store non- pres Vege	ediate ian z red t etation s, un ey sh wood ent etativ	ones by nat n der- rubs o dy pla	ive or nts	•	cove nativ Disru Bank	re veç uptior ks ma red b	nainly getati n evic	on lent	•	Bank cove mixtu grass black & inti spec Vege disru Bare cropp vege comr	red b ure of ses/s berry roducties etation soil/oped tation	y hrubs y, will ced n obvi close	ow	•	cove gras Disr streavege high Gras graz Sigr	ss he	by shrun of ank n very avily at stoo	ubs y ck
Left bank:3	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Right bank:2	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Mean: 1.5																				
3. Bank stability	•	Banł Eros failur abse <5% affec	ion/b re ent/m of ba	ank inima	I	•	Infre area	quen s of e tly he % of		all on	•	Mode unsta 30-60 react of ere High poter flood	able 0% o h has osion eros ntial o	f ban area i	IS	•	Mar area 60-1	00% erosi	of ba	ink
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:10	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Mean: 10																				
4. Frequency of riffles	•	frequ Dista riffles strea	uent ance s divi am wi ety of	ativel betwe ded k idth={	een y 5-7	•	Dista riffles	s infre ance s divi	equei	een oy	•	Occa or ru Botto provi habit Dista riffles strea 25	n om co ide so at ance l s divio	ontou ome betwe ded b	rs een ey	•	wate riffle Poo Dist riffle	erally er, sh s r hab ance s divi am w	allow itat betwo ded b	een Dy
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	•	abse Strea	nel/c nt/m am w	lredgi inima	I	•	chan Evide chan Rece chan	inel/d ence inel/d ent	anges Iredgi Iredgi Iredgi Iredgi nt	ing ist ing	•	Char chan exter Emb oring prese bank 40-8 chan disru	iges/o nsive ankm struc ent or ss 0% o ineliz	nents cture n bot f read	/sh s h	•	with gab >80 read chai disr	ion/ce % of :	ement strear ed or habit	m at
Score:16	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	amet	er			atego ptim			Ha	abitat	para	amet	er
6. Sediment deposition	•	point	bars 6 of t ted b nent	,	ent	•		orma tly fro el, sa sedin 0% o ted ted	tion, m nd or nent f bott	om	•	Somo of ne sand sedir new 50-8 affec Sedir depo obstr cons bend	w gra or fir nent bars 0% of ted ment sits a ructio trictio	avel, ne on ol f bott f bott ns,	d & om	•	fine Incrededededededededededededededededededed	vy de mate easec elopm % of b nging uently ls alm ent du ment osition	rial l bar ent pottor nost le 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	•		nes p /dee /shall shallo	low,		•	regin If fas miss	city/denes p	iresei Ilow i nen		•	2 of 4 veloc regin If fas slow/ miss low	city/de nes p t/shall /shall	reser llow o ow a	or	•	velo regir	ninate city/d me ally d	epth	
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	•	favor inver color wide wood riffles Snag subn logs/ bank provi abur cove	urable tebra isati varie dy de s, roc gs/ nerge unde s/col des idant r . not	ate on & ety of bris, ot mate ed ercut obles fish be ne	S	•	favou inver color Snag subn logs/ bank Fish com Mode of ha Can	nerge /unde cove mon erate abitat cons e nev	e for ate on ed rcut obles r varie types ist of	ty	•	10-30 favou inver color Fish 60-90 easil foot Woo rare smot sedir	tebra cove 0% si y mov dy de or ma hereo	e for te on r pato ubstra ved b ebris ay be	chy ate y	•	favo inve colo Fish abse unst lacki Stab	strate able (e for ate on r rare or bitats limite	ed
Score: 14	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
9. Periphyton	•	evide held Stab	ent or stone le su aces	n not n han es bstrat rough	d te	•	visib Stab Perip		ston bstra n	es te	• •	Perip <20% avail subs	able	er of		•	obvi >209 avai	phyto ous 8 % cov lable strate	oproli ver of	
Score: 15	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
TOTAL SCORE:106																				

Stream name: Mang	apapa Stream	۱ <u> </u>				Assess	or: Pa	ul Frankli	า		<u> </u>
Site number: 6	5	Sampl	e number:			Date: 2	0/02/1	3 7	Time	: 14:20	
GPS coordinates	[Downs	stream:			E 2744	443	1	1 636	68529	
	ι	Jpstre	eam:			E 2744	319	1	N 636	68540	
Channel & riparia	an features					Instre	am h	ydraulic	con	dition	S
Canopy cover:						Estimate	ed or m	easured re	ach a	verage:	
Open	Partly sha	aded	Very	y shac	ded						
Fencing:	Dominant ri	pariar	vegetation:	:		Stream	width	(active ch	nann	el):3m	
None/ineffective	Crops		Retired	veget	ation	Stream	width	(water): 2	2.5m		
One side/partial	Pasture		Native s	shrub		Stream	depth	n: 0.3m			
Complete	Exotic tree	S	Native t	rees		Surface	e veloo	city: 0.2m	s ⁻¹		
Water quality											
Temperature:	19.1		°C			Condu	ctivity:	1	02	μ	S cm ⁻
Dissolved oxygen:	89		%			8.2		r	ng l ⁻¹	l	
Turbidity:	Clear		Slightly turb	bid	Highly t	urbid	Stair	ned	(Other	
Stream-bottom s	ubstrata										
Compaction (inorg	anic substrat	a):				% surf compo		norganic :	subs	stratum	size
Assorted sizes tightl	y packed &/or	overl	apping			Substra	atum	Dimensi	on	Perce	ntage
Moderately packed	with some o	verla	pping			Bedroc	k	-			
Mostly a loose asso	rtment with litt	e ove	erlap			Boulde	r	>256mm		80	
No packing/loose as	sortment easi	ly mo	ved			Cobble		>64-256mr	n	20	
Embeddedness:						Gravel		>2-64mm			
(% gravel-boulder parti	cles covered by	fine se	ediment)			Sand		>0.06-2mn	ı		
<5% 5-25	% 26-50	%	51-75%	>	75%	Silt		0.004-0.06	mm		
						Clay		<0.004mm			
Organic material	(% cover)					Habita	at typ	es samp	led		
Large wood (>10cm	diameter)					(% of ef	fort)				
<5% 5-25	% 26-50	%	51-75%	>	75%	Stones	:	100%			
Coarse detritus (sma	all wood, stick	s, leav	ves etc., >1r	mm)		Wood:		%	Ri	fles:	100%
<5% 5-25	% 26-50	%	51-75%	>	75%	Macrop	-	%	Ru	ins:	%
Fine (<1mm) organi		ı				Edges:		%			
<5% 5-25	% 26-50	%	51-75%	>	75%	Numbe	r of in	vertebrate	s ret	urned:	
Instream plant co	over (% strea	mbed	area)			Koura:		5	Shrin	nps:	
Filamentous algae 8	1					Crabs:		ſ	Auss	els:	
<5% 5-25	% 26-50	%	51-75%	>	75%	Other:					
Macrophytes:	1	ı				Mussel	•••				
	% 26-50	%	51-75%	>	75%	Hyridel	la	0	Сиси	meruni	0
<5% 5-25											
<5% 5-25 Mosses/liverworts: <5% 5-25	% 26-50	i.	51-75%	1							

Qualitative Habitat A				t rea eld [She	et													
Stream name: Mang	apap	ba St	rear	n				5	Site r	numb	ber: (6								
Sample number:				Α	sses	sor:	Pau	l Fra	nklin	I			Date	e: 20	/02/1	3				
Habitat parameter										Cate	gory	/								
Habilal parameter		С	ptim	al			Sub	oopti	mal			Ma	argin	nal				Poo	r	
1. Riparian vegetative zone width	•	vege >10r	n inuo	n buff us &	er	•	is <1	tation 0m	n buff ntinu		•	Path and/o Most over	or sto	ck	ent	•		aks fro nan ao ous		
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:9	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Mean: 11.5																				
2. Vegetative protection	•	imm ripar cove vege Tree store non- pres Vege	ediate ian z red t etation s, un ey shi wood ent etativ	ones by nat n der- rubs o ly pla	ive or nts	•	cove nativ Disru Bank	re veç uptior ks ma red b	nainly getati n evid	on lent	•	Bank cove mixtu grass black & intri spec Vege disru Bare cropp vege comr	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 shrun of ank n very avily at stoo	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:8	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Mean: 8																				
3. Bank stability	•	Eros failu abse	ent/m of ba	ank inima	I	•	Infre area	quen s of e tly he % of		all n	•	Mode unsta 30-60 reach of ero High poter flood	able 0% of h has osion erosi ntial c	f ban area	IS	•	Man area 60-1	00% erosi	of ba	ink
Left bank:16	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: 16														1						
4. Frequency of riffles	•	frequ Dista riffle strea	uent ance s divi am wi ety of	ativel betwe ded k dth={	een y 5-7	•	Dista riffles	s infre ance l s divi	ce of equer betwe ded b dth=7	een y	•	Occa or run Botto provi habit Dista riffles strea 25	n om co de so at ince l s divio	ontou ome betwe ded b	rs een yy	•	wate riffle Poo Dist riffle	erally er, sha s r hab ance s divi am wi	allow itat betwe ded b	een oy
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	•	char abse Strea	ent/m am w	lredgi inima	I	•	chan Evide chan Rece chan	inel/d ence inel/d ent	anges lredgi of pa lredgi redgi nt	ng Ist ng	•	Char chan exter Emba oring prese bank 40-80 chan disru	ges/onsive ankm struction s 0% of nelize	ients, cture: n bot	/sh s h	•	with gabi >80 read char disru	ion/ce % of s	ement strear ed or habita	m at
	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	ıbitat	para	amet	er			atego ptim			Ha	abitat	t para	amet	er
6. Sediment deposition	•	point	bars 6 of t ted b nent	,	ent	•	bar fr most grave fine s 20-5 affect	orma ily fro el, sa sedin 0% o ited it dep	m nd oi	om	•	Somo of ne sand sedir new 50-8 affec Sedir depo obstr cons bend	w gra or fin hent bars 0% o ted ment sits a ructio trictic	avel, ne on ol f bott at ns,	d & om	•	fine Increded >80° chai freq Poo abse sedi	vy de mate elopm % of l nging uently Is alm ent du ment osition	rial d bar hent pottor / nost ue to	
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	•		nes p /dee /shall shallo	low, ow,		•	regin If fas miss	city/de	iresei Ilow i nen		•	2 of 4 veloc regin If fas slow/ miss low	city/de nes p t/shall /shall	reser llow o ow a	or	•	velo regii	ninate city/d me ally d	epth	
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	•	favor inver color wide wood riffles Snag subr logs/ bank prov abur cove	urable tebra nisati varie dy de s, roc gs/ nerge unde s/col ides idant r : not	ate on & ety of bris, of mate ed ercut obles fish be ne	ts	•	favou inver color Snag subn logs/ bank Fish com Mode of ha Can	urable tebra nisatio gs/ nerge unde s/cot cove mon erate ubitat cons e new	ed on rcut obles r varie types ist of	ty	•	10-30 favou inver color Fish 60-90 easil foot Woo rare smot sedir	urable tebra cove 0% so y mo dy de or ma here	ite on ubstra ved b ebris ay be	chy ate y	•	favo inve colo Fish abso Sub unst lack Stat lack	strate able	e for ate on er rare or bitats	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	•	evide held Stab	ent or stone le su aces	n not n han es bstra rough	id te	•	visib Stab Perip	le on le sul phyto	n not ston bstra n o touc	es te	•	Perip <20% avail subs	6 cov able		ble	•	obvi >20 avai	phyto ous & % cov lable strate	k proli /er of	
Score: 6	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
TOTAL SCORE: 117	' .5																			

Stream name: Karer	ngorengo Str	eam			Assess	or: Jo	sh Smith		
Site number: 7		Samp	le number:		Date: 2	1/02/1	3 -	Time	e: 12:05
GPS coordinates		Down	stream:		E 2758	631	1	٥3 ۱	84786
		Upstre	eam:		E 2758	661	1	N 63	84650
Channel & riparia	an features	5			Instre	am h	ydraulic	coi	nditions
Canopy cover:					Estimate	ed or m	easured re	ach a	average:
Open	Partly sl	naded	Verys	shaded					
Fencing:	Dominant	riparia	n vegetation:		Stream	width	(active cl	nanr	nel):4m
None/ineffective	Crops		Retired v	regetation	Stream	width	(water): 2	2.5m	1
One side/partial	Pasture		Native sh	rub	Stream	depth	n: 0.4m		
Complete	Exotic tree	es	Native tre	es	Surface	e veloo	city: 0.4m	s ⁻¹	
Water quality									
Temperature:	15.0		°C		Conduc	ctivity:		188.	2 µS cm [°]
Dissolved oxygen:	74.3		%		7.48		r	ng l	
Turbidity:	Clear		Slightly turbic	d Highly	turbid	Stair	ned		Other
Stream-bottom s	ubstrata							•	
Compaction (inorg	anic substra	ata):			% surf			sub	stratum size
Assorted sizes tightl	y packed &/c	or over	lapping		Substra	atum	Dimensi	on	Percentage
Moderately packed	with some ov	erlapp	ing		Bedroc	k	-		
Mostly a loose asso	rtment with li	ttle ove	erlap		Boulde	r	>256mm		
No packing/loose a	ssortment	easily	moved		Cobble		>64-256m	m	
Embeddedness:					Gravel		>2-64mm		5
(% gravel-boulder parti	cles covered b	y fine s	ediment)		Sand		>0.06-2mm	n	90
<5% 5-25°	% 26-5	0%	51-75%	>75%	Silt		0.004-0.06	mm	5
I	I	Ĩ	I		Clay		<0.004mm		
Organic material	(% cover)				Habita	at typ	es samp	led	
Large wood (>10cm					(% of eff	fort)	-		
<5% 5-259	% 26-5	0%	51-75%	>75%	Stones	:	%		
Coarse detritus (sma	all wood, stic	ks, lea	ves etc., >1mi	m)	Wood:		%	Ri	iffles:
<5% 5-25 ^o	% 26-5	0%	51-75%	>75%	Macrop	hyte:	%	R	uns: 100%
Fine (<1mm) organi	c deposits	1	I		Edges:	•	%		
<5% 5-25	% 26-5	0%	51-75%	>75%	Numbe	r of in	vertebrate	es re	turned:
Instream plant co	over (% stre	ambec	d area)		Koura:	comm	ion s	Shrir	nps:common
Filamentous algae 8					Crabs:				sels:
< 5% 5-25 ^o	1	0%	51-75%	>75%	Other:				
Macrophytes:	I	I	I		Mussel	type:			
	% 26-5	0%	51-75%	>75%	Hyridel	•••		Сисі	umerunio
<5% 5-259	I	I	I						
<5% 5-25 Mosses/liverworts:			1						
I	% 26-5	0%	51-75%	>75%					

Wadeable Soft-Bo	otto	med	St	rean	ns															
Qualitative Habitat As	sses	sme	nt Fi	eld [Data	She	et													
Stream name: Karen	gore	engo	Stre	am				5	Site r	numb	ber: 7									
Sample number:				A	sses	ssor:	Josh	n Sm	ith				Date	e: 21/	/02/1	3				
Habitat parameter										Cate	gory	'								
habitat parameter		0	ptim	al			Sub	oopti	mal			M	argir	al				Poo	r	
1. Riparian vegetative zone width	•	Bank vege >10r Cont dens	tation n inuo	n buff	fer	•	is <1	tatior			•	Path and/o Most over	or sto	ck	ent	•		nan a	equer ctivity	
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	20			l			<u> </u>					Ŭ	Ű		Ű		I .	Ů	-	I .
2. Vegetative protection Left bank:7 Right bank:7 Mean: 7 3. Bank stability	• • 20 20 • •	immer ripar cove vege Tree store non- pres Vege disru	ediate ian z red b ttation s, un ey shi woocc ent etativ ption 18 18 18 18 s sta ion/b re ent/mi	ones yy nat n der- rubs o ly pla e mini 17 17 17 17 able ank	tive or nts mal	• • • 15 15 • •	cove nativ Disru Bank cove fores	13 13 eratel quent s of e tly he % of	12 12 12 12 12 12 12 12	11 11 ble all n	• • 10 10 • •	black & inti spec Vege disru Bare cropp vege comr 9 9 9 9 Mode unsta 30-60 react of ere High	red b lure of ses/s bberry roducties etation ption soil/(bed tation mon 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8	y hrubs ced n obvid close n 7 7 7 y f ban area	ow ous ly 6 6 6 8 k in s	• • • 5 5	cove gras Disr streavege high Gras graz Sigr dam	ered k ses & uption am ba etation ss he- ed iificar age t 3 3 3 table y ero s 00% erosi	k shrun n of ank n very avily nt stoco o ban 2 2 2 4 ded of ba	y ck nk
Left bank:8	00	40	40	47	40	45	14	40	12		40	flood 9	s 8	7	6	-	4	3	2	1
Right bank:8	20 20	19 19	18 18	17 17	16 16	15 15	14	13 13	12	11 11	10 10	9	8	7	о 6	5 5	4	3	2	1
Mean: 8	20	19	10	L''	10	10	14	13	12		10	э	0	Ľ	0	5	4	3	2	
4. Channel sinuosity	•	strea times	ım lei s long	crease ngth 3 ger th traigh	3-4 Ian	•	strea times	ds inc am ler s long /as st	ngth 2 ger th	2-3 an	•	Benc strea times if it w	ım ler s long	ngth ' ger th	1-2 an	•	Cha	nnel	straig	ht
Score: 9	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	lredgi inima	l	•	chan Evide chan Rece chan	e cha inel/d ence inel/d ent inel/d presei	redgi of pa redgi redgi	ng Ist ng	•	exter Emb oring	ges/onsive ankm struction s 0% 0	tures n botl	/sh s n	•	with gabi >80° reac char disru Instr	% of s h neliz upted ream	ement strear	m at
												disru	pted							

Habitat parameter	-		atego Optim	•		Ha	bitat	para	amet	er			atego ptim			Ha	bita	at para	amet	er
6. Sediment deposition	•	poir <20 affe sed	e/no is nt bars % of t cted b iment osition	s pres pottor py	ent	• • •	bar f most grave	ted t dep	tion, m nd or nent f bott	om	•	of ne sand sedir new 50-8 affec Sedi depc obstr	w gra l or fin bars 0% o ted ment sits a cuctio trictic	ne on ol f bott at	d & om	•	fine lnci dev >80 cha frec Poo abs sec	avy de mate reased relopm 0% of l unging quently bls alm sent du liment position	rial d bar hent bottor / host ue to	
Score:13	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
7. Pool variability	•	mix Larg larg sma	ls eve ed ge/sha e/dee all/sha all/dee	allow, p, llow,		•			p'		•		alenc ow p			•		jority c all/sha		ls
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 wide woo riffle Sna sub logs ban prov abu cov	merge s/unde ks/col vides ndant	e for ate on & ety of bris, ot mate ed frout obles fish be ne	ts	•	inver color Snag subn logs/ bank Fish com Mode of ha Can	urable tebra nisatio gs/ nerge unde s/cot cove mon erate ubitat consi e new	e for ite on ed rcut obles r varie types ist of	ety 5.	•	10-3 favor inver color Fish 60-9 easil foot Woo rare smot sedir	urable tebra cove 0% s y mo dy de or ma here	e for ate on r pato ubstr ved b ebris ay be	chy ate y	•	favo inve colo Fisl abs Sub uns lack Sta lack	0% sub ourable artebra onisati h cove sent ostrate table king ble ha king of nacrop	e for ate on er rare or bitats	e or
Score: 13	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
9. Periphyton	•	evic helo Stal	iphyto lent or d stone ble su faces ch	n han es bstra	id te	• • •	visib Stab Perip	ohyto le on le sul ohyto ous to	ston bstra n	es te	•	<20% avail	6 cov	n visi ver of s		•	obv >20 ava	iphyto rious & 0% cov iilable ostrate	k prol /er of	
Score: 17	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
TOTAL SCORE: 104	1																			

Stream name: Waih	ekau Strear	n			Asses	sor: Jo	sh Smith		
Site number: 8		Sam	ple number:		Date:	21/2/13	3 7	Гime	: 13:30
GPS coordinates		Dow	nstream:		E 275	3912	1	N 63	81500
		Upst	ream:		E 275	4002	1	N 63	81360
Channel & riparia	an feature	s			Instre	eam h	ydraulic	cor	nditions
Canopy cover:					Estima	ted or m	easured re	ach a	average:
Open	Partly s	haded	l Very	shaded					
Fencing:	Dominant	riparia	an vegetation:		Stream	n width	(active ch	nann	el):4.5m
None/ineffective	Crops		Retired	vegetation	Stream	n width	(water): 4	lm	
One side/partial	Pasture		Native s	hrub	Stream	n depth	n: 0.6m		
Complete	Exotic tre	es	Native tr	ees	Surfac	e velo	city: 0.25m	ז s ⁻¹	
Water quality									
Temperature:	19.3		°C		Condu	ctivity:		237.′	
Dissolved oxygen:	77.8		%		7.18		r	ng l	1
Turbidity:	Clear		Slightly turb	id High	nly turbid	Stai	ned	(Other
Stream-bottom s	ubstrata								
Compaction (inorg	anic substr	ata):				ficial in osition		subs	stratum size
Assorted sizes tightl	y packed &/	or ove	erlapping		Subst	atum	Dimensi	on	Percentage
Moderately packed	with some o	verlap	ping		Bedro	ck	-		
Mostly a loose asso	rtment with	ittle ov	/erlap		Bould	ər	>256mm		
No packing/loose a	ssortment	easily	/ moved		Cobbl	e	>64-256mr	n	
Embeddedness:					Grave	I	>2-64mm		
(% gravel-boulder parti	cles covered	by fine	sediment)		Sand		>0.06-2mn	n	90
<5% 5-25	% 26-5	50%	51-75%	>75%	Silt		0.004-0.06	mm	10
	·				Clay		<0.004mm		
Organic material	(% cover))			Habit	at typ	es samp	led	
Large wood (>10cm	diameter)				(% of e	ffort)			
<5% 5-25	% 26-5	50%	51-75%	>75%	Stone	s:	%		
Coarse detritus (sma	all wood, sti	cks, le	aves etc., >1n	nm)	Wood		%	Ri	ffles: %
<5% 5-25	% 26-5	50%	51-75%	>75%	Macro	phyte:	50%	Ru	uns: 100%
Fine (<1mm) organi	c deposits				Edges	:	50%		
<5% 5-25	% 26-5	50%	51-75%	>75%	Numb	er of in	vertebrate	s ret	urned:
Instream plant co	over (% str	eambe	ed area)		Koura	rare	5	Shrin	nps:
Filamentous algae 8	a mats:				Crabs	:	n	Muss	sels:
<5% 5-25	% 26-5	50%	51-75%	>75%	Other:				
Macrophytes:					Musse	el type:			
	% 26-5	50%	51-75%	>75%	Hyride	ella	0	Сись	imerunio
<5% 5-25	•								
<5% 5-25 Mosses/liverworts:									

Wadeable Soft-Be Qualitative Habitat A						She	et													
Stream name: Waihe	ekau	Stre	am					S	Site r	numt	ber: 8	3								
Sample number:				A	sses	sor:	Josł	ו Sm	ith				Date	: 21/	/02/1	3				
										Cate	gory									
Habitat parameter		0	ptim	al			Sub	oopti			.,		argin	nal				Poo	r	
1. Riparian vegetative zone width	•	Bank vege >10r Cont dens	tation n inuou	n buff	er	•	is <1	tatior			•	Path and/o Most over	or sto	ck	ent	•		nan a	equer ctivity	
Left bank:12	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: 12										1								1		1
2. Vegetative protection	•	imme ripar cove vege Tree store non- prese Vege	ediate ian zo red b tation s, un sy shi wood ent etative	ones by nat n der- rubs o ly pla	ive or nts	•	cove nativ Disru Bank	ks ma red b	nainly getation nevid ny be	on lent	•	Bank cove mixtu grass black & inti spec Vege disru Bare cropp vege comr	red b ire of ses/s berry roducties etation ption soil/o bed tatior	y hrubs , will ced n obvie close	ow	•	cove gras Disr strea vege high Gras graz Sigr	uption am ba etation ss hea ed ificar	by & shru n of ank n very	/ :k
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																				
3. Bank stability	•	Bank Eros failur abse <5% affec	ion/b e nt/mi of ba	ank inima	I	•	Infre area		t, sma erosio aled	all n	•	Mode unsta 30-60 reach of ero High poter flood	able 0% of has osion erosi ntial c	f ban area	S	•	Man area 60-1	00% erosi	of ba	nk
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:14	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Mean: 14																				
4. Channel sinuosity	•	strea times	ım lei s long	crease ngth 3 ger th traigh	3-4 an	•	strea times	ds inc im lei s long ias st	ngth 2 ger th	2-3 an		Benc strea times if it w	m ler s long	ngth ' ger th	1-2 an	•	Cha	nnel :	straig	ht
Score: 3	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	lredgi inima	I	•	chan Evide chan Rece chan	nel/d	redgi of pa redgi redgi	ng Ist ng	•	Char chan exter Embar oring prese bank 40-80	ges/o nsive ankm struc ent or s	ients/ ctures	′sh S n	•	with gabi >80° reac char disru	% of s h neliz upted	ement strear	n
												chan disru	neliz			-			osent	

Habitat parameter	-		atego Optim	•		Ha	bitat	para	amet	er			atego ptim	-		Ha	abita	t para	amet	er
6. Sediment deposition	•	poir <20 affe sed	e/no is nt bars % of t cted b iment osition	s pres pottor y	ent	•	bar for most grave fine s 20-5 affect	nt dep	tion, m nd or nent f bott	om	•	of ne sand sedir new 50-8 affec Sedi depc obstr	w gra l or fin hent bars 0% o ted ment sits a ructio trictic	ne on ol f bott at	d & om	•	fine lncr >80 cha freq Poo abs sed	wy de mate easec elopm % of I nging uently ls alm ent du iment osition	rial d bar hent pottor / nost ue to	
Score: 13	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
7. Pool variability	•	mix Larg larg sma	ls eve ed ge/sha e/dee all/sha all/dee	allow, p, llow,		•	large	ority o e/dee few : s	p		•	Prev shall				•		ority c all/sha		IS
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	•	favo inve colo wid- woo riffle Sna sub logs ban pro- abu cov Mus	merge s/unde ks/col vides ndant	e for ate on & ety of bris, ot mate ercut obles fish be ne	ts	•	favou inver color Snag subn logs/ bank Fish com Mode of ha Can	nerge /unde cove mon erate abitat cons e nev	e for ate on ed rcut obles r varie type: ist of	ety 5.	•	favor inver color Fish 60-9 easil foot Woo	urable tebra cove 0% s y mo dy de or ma here	ate on r pato ubstr ved b ebris ay be	chy ate y	•	favo inve colo Fish abs Sub uns lack Stal lack	strate	e for ate on er rare or bitats	e or s ed
Score: 9	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
9. Periphyton	•	evic helo Sta	iphyto lent o l stone ble su faces ch	n han es bstra	id te	•	visib Stab Perip	ohyto le on le sul ohyto ous to	ston bstra n	es te	•		6 cov able	n visi ver of S		•	obvi >20 avai	iphyto ious 8 % cov ilable strate	k prol /er of	
Score: 2	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
TOTAL SCORE: 87	-	•		-		-		•				•	·	•	•	-	-			·

Stream name: Waita	karuru Strea	m			Assess	sor: Pa	ul Franklir	1	
Site number: 9		Sam	ple number:		Date: 2	22/02/1	3 Т	īme	: 9:25
GPS coordinates		Dow	nstream:		E 2727	7985	Ν	1 63	77350
		Upst	ream:		E 2728	3142	Ν	1 637	77272
Channel & riparia	an features	5			Instre	am h	ydraulic	con	ditions
Canopy cover:					Estimat	ed or m	easured rea	ach a	verage:
Open	Partly sh	nadeo	d Very	shaded					
Fencing:	Dominant I	riparia	an vegetation:		Stream	n width	(active ch	ann	el):3m
None/ineffective	Crops		Retired	vegetation	Stream	n width	(water): 2	.6m	
One side/partial	Pasture		Native s	hrub	Stream	n depth	n: 0.2m		
Complete	Exotic tree	S	Native tr	ees	Surfac	e veloo	city: 0.3m s	s ⁻¹	
Water quality									
Temperature:	18.6		°C		Condu	ctivity:		35	µS cm
Dissolved oxygen:	95		%		8.9		n	ng l ⁻¹	
Turbidity:	Clear		Slightly turb	id Highly	turbid	Stair	ned	C	Other
Stream-bottom s Compaction (inorg		ıta):			% surf			subs	stratum size
Assorted sizes tight	y packed &/o	r ove	rlapping		Substr	atum	Dimensi	on	Percentage
Moderately packed	with some	overl	apping		Bedroo	:k	-		
Mostly a loose assor	rtment with lit	tle ov	verlap		Boulde	er	>256mm		
No packing/loose as	sortment eas	sily m	oved		Cobble)	>64-256mn	n	25
Embeddedness:					Gravel		>2-64mm		50
(% gravel-boulder partie	cles covered by	y fine :	sediment)		Sand		>0.06-2mm	1	10
<5% 5-25%	% 26-50)%	51-75%	>75%	Silt		0.004-0.06	mm	15
					Clay		<0.004mm		
Organic material	(% cover)				Habit	at typ	es samp	led	
Large wood (>10cm	diameter)				(% of et	fort)			
<5% 5-259	% 26-50)%	51-75%	>75%	Stones	5:	100%		
Coarse detritus (sma	all wood, stic	ks, lea	aves etc., >1n	nm)	Wood:		%	Rif	fles: 100
<5% 5-259	% 26-50	0%	51-75%	>75%	Macro	ohyte:	%	Ru	ins:
Fine (<1mm) organic					Edges		%		
<5% 5-259	% 26-50)%	51-75%	>75%	Numbe	er of in	vertebrate	s ret	urned:
Instream plant co	over (% stre	ambe	d area)		Koura:		S	Shrin	nps:
Filamentous algae 8	mats:				Crabs:		N	/luss	els:
<5% 5-259	% 26-50)%	51-75%	>75%	Other:				
••					Musse	•••			
Macrophytes:	% 26-50)%	51-75%	>75%	Hyride	lla	0	Сиси	merunio
<5% 5-259									
	% 26-50		51-75%	>75%					

Wadeable Hard-B Qualitative Habitat A						She	ot													
Stream name: Waita					Jala	One			Sito r	numt	har (a								
Sample number:	Narc		ircai	1	SSAS	sor.	Pau			-		-	Date	. 22	/02/1	3				
Cample number.				1	0000	.001	1 uu	i i iu		Cate	aory		Duit	. 22	02/1					
Habitat parameter		0	ptim	al			Sub	oopti		Outo	, gory		argir	nal				Poo	r	
1. Riparian vegetative zone width	•	vege >10r	n inuo	n buff	er	•	is <1	tation 0m	n buff ntinu		•	Path and/o Most over	or sto	ck	ent	•		aks fro nan ao 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:11	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Mean: 12																				
2. Vegetative protection	•	imme ripar cove vege Tree store non- pres Vege	ediate ian z red t etation s, un ey shi wood ent etativ	ones by nat n der- rubs o ly pla	ive or nts	•	cove nativ Disru Bank	re veç uptior ks ma red b	nainly getati n evid	on lent	•	Bank cove mixtu grass black & inti spec Vege disru Bare cropp vege comr	red b ure of ses/s berry roducties etation ption soil/ ped tatior	y hrubs , will ced n obvi	ow	•	cove gras Disr streavege high Gras graz Sigr	ss he	by shrun of ank n very avily at stoo	ubs y ck
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:10	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Mean: 10																				
3. Bank stability	•	Eros failui abse	ent/m of ba	ank inima	I	•	Infre area	quen s of e tly he % of	erosio aled	all in	•	Mode unsta 30-60 react of ere High poter flood	able 0% o h has osion eros ntial c	f ban area	IS	•	Mar area 60-1	00% erosi	of ba	ink
Left bank:15	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Right bank:15	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Mean: 15		<u> </u>	•	<u> </u>	<u> </u>													<u> </u>		
4. Frequency of riffles	•	frequ Dista riffles strea	uent ance s divi am wi ety of	ativel betwe ded b dth=5 habi	een by 5-7	•	Dista riffles	s infre ance l s divi	ce of equer betwe ded b dth=7	een y	•	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	erally er, sha s r hab ance s divi am wi	allow itat betwo ded b	een oy
Score: 12	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
5. Channel alteration	•	char abse Strea	ent/m am w	lredgi inima	I	•	chan Evide chan Rece chan	inel/d ence inel/d ent	anges iredgi of pa iredgi iredgi nt	ng Ist ng	•	Char chan exter Emb oring prese bank 40-8 Char disru	ges/onsive ankm struction s 0% onneliz	ients, cture: n bot	′sh s n	•	with gab >80 read chai disr	ion/ce % of s	ement strear red or habit	m at
Score:13	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	amet	er			atego ptim			Ha	abitat	para	amet	er
6. Sediment deposition	•	point <20% affect sedir	bars		ent	•	bar for most grave fine s 20-5 affect	ted t dep	tion, m nd or nent f bott	om	•	Som of ne sand sedir new 50-8 affec Sedir depo obstr cons bend	w gra or fin bars 0% o ted ment sits a cuctio trictic	avel, ne on ol f bott at ns,	d & om	•	fine Incrededededededededededededededededededed	vy de mater ased lopm % of k uging uently s alm ent du ment ositior	ial bar ent oottor oost 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	•	regin Slow slow	nes p //deej /shall shallo	low,		•	regin If fas miss	4 nes p st/sha ing th e low	iresei Ilow i nen		•	2 of 4 veloc regin If fas slow/ miss low	city/de nes p t/shall	i resei llow o ow a	or	•	velo regir	inate city/d ne ally de	epth	
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	•	favor inver color wide wood riffles Snag subn logs/ bank provi abur cove Must	urable tebra varie dy de s, roc gs/ nerge unde s/cob ides ides idant	ate on & ety of bris, ot mat ed ercut obles fish be ne	S	•	favou inver color Snag subn logs/ bank Fish com Mode of ha Can	nerge /unde cove mon erate abitat cons e nev	e for ate on ed rcut obles r varie types ist of	ety 5.	•	10-30 favou inver color Fish 60-90 easil foot Woo rare smot sedir	urable tebra cove 0% si y mo dy de or ma here	e for ite on r pato ubstrived 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 ed
Score: 10	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	ent or subs croph	,) or f	d S	•	visib subs	ohyto le on trates ous to	s but		• •	Perip <20% avail subs	6 cov able	er of		•	obvi >209 avail	ohyto ous & % cov able strates	proli er of	
Score: 10	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
TOTAL SCORE: 103	}																			

Stream name: Piako	nui Stream				Assess	sor: Pa	ul Franklir	۱	
Site number: 10		Sam	ple number:		Date: 2	22/02/1	3 T	īme	: 12:35
GPS coordinates		Dow	nstream:		E 2741	446	Ν	1 63	77350
		Upst	ream:		E 2741	436	Ν	1 637	71564
Channel & riparia	an features	S			Instre	am h	ydraulic	con	ditions
Canopy cover:					Estimat	ed or m	easured rea	ach a	verage:
Open	Partly sl	haded	Very	shaded					
Fencing:	Dominant	riparia	an vegetation:		Stream	n width	(active ch	ann	el):6.5m
None/ineffective	Crops		Retired	vegetation	Stream	n width	(water): 3	m	
One side/partial	Pasture		Native s	hrub	Stream	n depth	n: 0.35m		
Complete	Exotic tree	es	Native t	rees	Surfac	e veloo	city: 0.25m	I S ⁻¹	
Water quality									
Temperature:	15.1		°C		Condu	ctivity:	g	1.5	µS cm⁻¹
Dissolved oxygen:	99		%		9.8		n	ng l ⁻¹	l
Turbidity:	Clear		Slightly turb	id Highly	turbid	Stair	ned	(Other
Stream-bottom s	ubstrata								
Compaction (inorg	anic substra	ata):			% surf			subs	stratum size
Assorted sizes tightl	y packed &/@	or ove	rlapping		Substr	atum	Dimensi	on	Percentage
Moderately packed	with some	overl	apping		Bedroo	:k	-		
Mostly a loose asso	rtment with li	ittle ov	verlap		Boulde	r	>256mm		90
No packing/loose as	sortment ea	sily m	oved		Cobble	;	>64-256mm	n	5
Embeddedness:					Gravel		>2-64mm		
(% gravel-boulder parti	cles covered b	by fine	sediment)		Sand		>0.06-2mm	1	
<5% 5-25%	% 26-5	0%	51-75%	>75%	Silt		0.004-0.06	mm	5
					Clay		<0.004mm		
Organic material	(% cover)				Habita	at typ	es samp	led	
Large wood (>10cm	diameter)				(% of ef	fort)		_	
<5% 5-25 °	% 26-5	0%	51-75%	>75%	Stones	:	100%		
Coarse detritus (sma	all wood, stic	cks, le	aves etc., >1n	nm)	Wood:		%	Rif	fles: 100%
<5% 5-25	% 26-5	0%	51-75%	>75%	Macro	ohyte:	%	Ru	ins: %
Fine (<1mm) organi	c deposits			l	Edges		%		
<5% 5-25°	% 26-5	0%	51-75%	>75%	Numbe	er of in	vertebrate	s ret	urned:
Instream plant co	over (% stre	eambe	d area)		Koura:		S	Shrin	nps:
Filamentous algae 8	a mats:				Crabs:		Ν	/luss	els:
<5% 5-25°	% 26-5	0%	51-75%	>75%	Other:				
	I		1	I	Musse	l type:			
Macrophytes:	% 26-5	0%	51-75%	>75%	Hyride	lla	0	Cucu	merunio
Macrophytes: <5% 5-25°					1				
	1		51-75%	l .					

Qualitative Habitat A	sses	ssme	nt Fi	eld [Data	She	et													
Stream name: Piako	nui S	Strea	m					\$	Site ı	numt	ber: ²	10								
Sample number:				A	sses	sor:	Pau	l Fra	nklin	l			Date	: 22/	/02/1	3				
Habitat parameter	-	С	ptim	al			Sub	popti		Cate	egory		argin	ial				Poo	r	
1. Riparian vegetative zone width	•	vege >10r	n tinuo	n buff	er	•	is <1	tation			•	Path and/o Most over	or sto	ck	ent	•	Hur	aks fr nan a ious		
Left bank:16	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: 18																				
2. Vegetative protection	•	imm ripar cove vege Tree store non- pres Vege	ediate ian z ered t etation s, un ey shi wood ent etativ	ones by nat n der- rubs o ly pla	ive or nts	•	cove nativ Disru Bank	s ma red b	nainly getati n evic ny be	on lent	•	Bank cove mixtu grass black & intr spec Vege disru Bare cropp vege comr	red b ire of ses/sl berry roducties etation ption soil/co bed tatior	y hrubs , will ed n obvie close	ow	•	cove gras Disr stre veg high Gra graz Sigr	ss he	by & shru n of ank n very avily nt stoo	ubs y ck
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:18	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Mean: 19																				
3. Bank stability	•	Eros failu abse	ent/m	ank inima	I	•	Infre area	s of e tly he % of	t, sm erosic aled	all in	•	Mode unsta 30-60 reach of ero High poter flood	able 0% of n has osion erosi ntial c	f ban area	IS	•	Mar area	100% erosi	of ba	ink
Left bank:16	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: 16							1		1	1							1			
4. Frequency of riffles	•	frequ Dista riffle strea	uent ance s divi am wi ety of	ativel betwe ded b dth={	een by 5-7	•	Dista riffles	urrend s infre ance I s divid am wi	equei betwe ded b	een y	•	Occa or run Botto provi habit Dista riffles strea 25	n om co de so at ince t s divio	ontour ome oetwe ded b	rs een y	•	wate riffle Poc Dist riffle	erally er, sh s r hab ance es divi am w	allow itat betwo ded t	een 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	•	char abse Stre	ent/m am w	lredgi inima	I	•	chan Evide chan Rece chan	e cha inel/d ence inel/d ent inel/d prese	redgi of pa redgi redgi	ng Ist ng	•	Char chan exter Emba oring prese bank 40-80 Char disru	ges/consive ankm structent or s 0% of aneliz	ients/ ctures n botl f read	′sh s n	•	with gab >80 read cha disr Inst	ion/ce % of :	ement strear ced or habit	m at
		r	18	17	16	15	14	13	12			-				<u> </u>		1	2	l l

Habitat parameter			atego ptim			На	bitat	para	amet	er			itego ptim			Ha	bitat	para	amet	er
6. Sediment deposition	•	point	bars 6 of b ted b nent	,	ent	•	most	orma tly fro el, sa sedin 0% o ted tted	tion, om ind or nent f bott	om	•	Som of ne sand sedir new 50-8 affec Sedir depo obstr cons bend	w gra or fir bars 0% o ted ment sits a uctio trictic	avel, ne on ol f bott at ns,	d & om	•	fine Incrededededededededededededededededededed	vy de matei eased elopm % of k uging uently s alm ent du ment ositior	ial bar ent oottor oost e to	
Score: 10	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 p /deep /shall shallo	ów,		•	regin If fas miss	city/d nes p	oresei Illow i nen		•	2 of 4 veloc regin If fas slow/ miss low	city/de nes p t/shall ′shall	resei llow o ow a	or	•	velo regir	inate city/d ne ally de	eptń	
Score: 12	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	•	favor inver color wide wood riffles Snag subn logs/ bank provi abur cove	urable tebra nisatio varie dy de s, roo gs/ nerge unde s/cot des idant r not l	te on & ety of bris, ot mat ed rcut obles fish be ne	S	•	bank Fish com Mode of ha Can	urable tebra nisati gs/ nerge unde s/cole cove mon erate abitat cons e nev	e for ate on ed ercut obles r varie types ist of	ety 5.	•	10-3 favou inver color Fish 60-9 easil foot Woo rare smot sedir	urable tebra isatio cove 0% so y mo dy de or ma here	e for ite on r pato ubstrived b ebris ay be	chy ate y	•	favo inver color Fish abse unst lacki Stab lacki	strate	e for ite on r rare or bitats limite	e or ed
Score: 17	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	ent or subs roph d etc.	,) or f	d S	•	visib subs	le on trate	n not s but o touc		• •	Perip <20% avail subs	6 cov able	er of		•	obvi >209 avail	ohyto ous & % cov able strates	proli er of	
Score: 8	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
TOTAL SCORE: 136	6																			

Appendix B Fish surveys

Fish collectio	n forn	n – W	adeable	strea	ns/rivers												
Team members: Paul Franklin (NIW/	4)			GPS (d/s):	E2728975	5 N6	400407	Site	: Mai	ngakahik	a Stream	١			Date:	18/02/13	
Josh Smith (NIWA)	Glenys	Croker ((NIWA)	GPS (u/s):	E2728895	5 N6	400360	N	ot fished		ned none ollected		ed 10 sub- eaches	Fished 5-9 sub-reaches		l <5 sub- aches	FLAG for fished/not fished
Fish sample id:		l shock (min):	54	Fishin time:	g Start Finish	10:45 12:30	Sample distance	(m): 1	50	Wett (m):	ed width	AB	1.5 C 1.2 D	-	1.2 1.0	G 1.1 H 0.9	l 1.6 J 2.0
Sampling gear:	Spotli	ght	EFM			Length (m) Mesh (mm)		Wat visit	er pility:	Good	Aver	age	Poor	Water temp. (°C):	16.8	Conducti (µS):	vity 177
EFM anode:	Big Small	EFM	l volts (x100)): 3			se rate (Hz	or pps):	60	EFM	pulse wie	dth (ms)			light (watt		_
Species		А	В	С	D	Sub-re	ach tally F	G	н			J	Total count	Sample count	Length Min.	Max.	FLAG
Banded Kokopu		3	8	6	4			11	5	2	2	7	66		50	152	
Shortfin Eel		4	3	3	2	2	2	6	7		•	6	36		120	450	
Longfin Eel			1			1				2	2	1	5		280	1000	
Common Bully		7	6	3	5	3	1	6	4		4	2	41		30	77	
Koura		3						2	2		1	1	9				
FLAG Comment								FLA	G Coi	mment							
L								I									

Fish collectio	n forn	n – Wao	deable	streams	rivers											
Team members: Paul Franklin (NIWA	()			GPS (d/s): E	2729470	N6	402548	Site:	Riuoł	nauraki Strea	am			Date:	18/02/13	
Josh Smith (NIWA);	Glenys	Croker (NI	WA)	GPS (u/s): E	2729382	N64	402591	No	t fished	Fished no collected		ed 10 sub- eaches	Fished 5-9 sub-reaches		<5 sub- ches	FLAG for fished/not fished
Fish sample id:		l shock (min):	54	Fishing time:	Start Finish	14:00 15:15	Sample distance	(m): 1	50	Wetted wi (m):	dth A B	1.8 C 1.5 D			G 1.6 H 1.2	l 1.7 J 0.8
Sampling gear:	Spotli	ght	EFM	Seir		ength (m) esh (mm)		Wate visib		Good A	verage	Poor	Water temp. (°C):	20.7	Conductiv (µS):	^{vity} 241.9
EFM anode:	Big Small	EFM v	olts (x100):	3		-	se rate (Hz	or pps):	60	EFM pulse	width (ms)		Spotl	ight (watts		
Species		А	В	С	D	Sub-rea	ach tally F	G	н		J	Total count	Sample count	Length (Min.	mm) Max.	FLAG
Banded Kokopu										1		1		197	197	
Shortfin Eel		1				1	1	4	1	1		9		100	450	
Longfin Eel			1	3		1	1	1	1		1	9		130	600	
Cran's Bully		7	9	12	19	15						62		32	69	
Elver							1					1		100	100	
Koura		5	4									9				
FLAG Comment			<u> </u>		I	<u> </u>		FLAG	G Com	ment				I		I
Missed 6 b	oullies 35	5-65 mm														

Big Small EFM volts (x100): 3 EFM pulse rate (Hz or pps): 60 EFM pulse width (ms): 2 Spotlig	Fished <5 sub- reaches FLAG f fished/r fished/r fished/r 2.8 G 2.5 I 3.5 H 3.7 J 18.6 Conductivity (µS): 1 ight (watts): Length (mm) Min. FLAG 160 191 1 70 83 1
sample id:time (min):64time:Finish13:00distance (m):150(m):B3.0D3.1FSampling gear:SpotightEFMSeineLength (m)Water visibility:Big SmallSouth colspan="6">FGHIJave rate (Hz or pps):60EFM pulse width (ms):2SouthSpeciesABCDEFGHIJave rate (Hz or pps):60EFM pulse width (ms):2SpotigSpeciesABCDEFGHIJave rate (Hz or pps):60EFM pulse width (ms):2SpotigSpeciesABCDEFGHIJave rate (Hz or pps):60B305Sp	3.5 H 3.7 J 18.6 Conductivity (μS): 1 ight (watts): 1 Length (mm) Min. Max. FLAG 160 191 1
Sampling gear:SpotlightEFMSelleMesh (mm)visibility:GoodAveragePoortemp. (°C):EFM anode:Big SmallEFM volts (x100):3EFM pulse rate (Hz or pps):60EFM pulse width (ms):2SpotligSpeciesABCDEFGHIJSample count<	18.6 Conductivity (μS): 1 ight (watts): Length (mm) Min. FLAG 160 191
$\begin{array}{ c c c c c c c c c c c c c c c c c c c$	Length (mm) FLAG Min. Max. 160 191
SpeciesTotal countSample countBanded Kokopu11111JCountCountBanded Kokopu111111141Inanga111111141Cran's Bully53551063743511Torrentfish112341112211Shortfin Eel213441116111Elver1121121116111Rainbow TroutR-1R-13261	Min. Max. FLAG 160 191
Inanga 1 3 1 5 Cran's Bully 5 3 5 5 10 6 3 7 4 3 51 Torrentfish 1 1 2 2 <t< td=""><td></td></t<>	
Cran's Bully 5 3 5 5 10 6 3 7 4 3 51 1 Torrentfish 1 1 2 2 4 16 2 Shortfin Eel 1 2 3 4 2 4 16 1 Longfin Eel 2 1 3 4 4 1 1 16 1 Elver 1 2 1 3 2 6 4 4 1 1 16 4 4 4 4 4	70 83
Torrentfish 1 1 2 2 2 Shortfin Eel 1 1 2 3 4 2 4 16 Longfin Eel 2 1 3 4 4 16 Elver 1 2 1 1 16 Rainbow Trout 1 4 Parataya R R	10 03
Shortfin Eel 1 2 3 4 2 2 4 16 16 Longfin Eel 2 1 3 4 4 1 1 16 1 Elver 1 1 2 1 3 4 4 1 1 16 1 Rainbow Trout 1 1 2 1 3 2 6 1	25 72
Longfin Eel 2 1 3 4 4 1 1 16	69 82
Elver 1 2 1 4 4 Rainbow Trout 1 1 3 2 6 6 1 Parataya R R R R R 1 <td>110 350</td>	110 350
Rainbow Trout Image: Constraint of the second	140 650
Parataya R R O	100 100
	81 150
	150 250
Koura 2 2 4 7 6 2 2 7 2 2 36	
FLAG Comment FLAG Comment	

Team m Paul Fra					GPS (d/s):	E27	51431	N6	429122	Site	: Paia	karahi Str	eam U/S	6				Date:	19/2/1	13	
Josh Sm	nith				GPS (u/s):	E27	51550	N6	429031	No	ot fished	Fished colle			ed 10 sub- eaches		ed 5-9 eaches		<5 sub- ches		FLAG for ished/not fished
Fish sample i	id:	Total : time (101	Fishin time:		Start Finish	14:05 16:25	Sample distance	(m):	50	Wetteo (m):	l width	A B	6.0 C 5.6 D	4.8		5.3 4.5	H 4	1.5 4.6	l 5.1 J 5.3
Samplin		Spotlig	ht	EFM		Seine		ength (m) esh (mm)		Wat visib		Good	Avera	ge	Poor	Water temp.	(°C):	18.6	Cond (µS):	uctivit	/ 102
EFM and		Big mall	EFM	volts (x100)): 3				se rate (Hz	or pps):	60	EFM pu	Ise widt	h (ms)	: 2		Spotli	ight (watts	s):		
Species			А	В	c	I	D	Sub-rea	ach tally F	G	н	1	1.	J	Total count	Sarr cour		Length Min.	(mm) Max.		FLAG
Banded	Kokopu		1				1	2	5		2	1			12			38	18		
Inanga											1				1			90	90		
Cran's b	,		9	7	14		9	10	24	2	6	11		10	102			20	92		
Torrentfi	-			1											1			114	11		
Shortfin	-		1	2								1		1	5			100	21	-	
Longfin	Eel		1	3	2					1	4	3		2	16			130	65		
Elver			1		1							1			3			100	10	-	
Rainbow	/ Trout		1								1	1		1	4			80	12	5	
Koura			9				1	8			1	6		1	26						
FLAG	Comment									FLA	G Com	nment									
	Reach F-G: distance 150		pped du	ue to deep p	ool, con	tinued f	ishing e	xtra 7m to l	keep total												

Fish o	collection f	orm – W	adeable	streams	/rivers												
Team m Paul Fra	embers: Inklin (NIWA)			GPS (d/s):	E 2742184E	i N	6365455	Site:	Wait	oa Tributary					Date:	20/02/1	3
Josh Sm	hith (NIWA)			GPS (u/s):	E 2742094	N	6365394	No	ot fished	Fished n collecte		hed 10 sub- reaches	Fishe sub-re			<5 sub- ches	FLAG for fished/not fished
Fish sample i		Total shock time (min):	96	Fishing time:	Start Finish	10:00 12:50	Sample distance	(m): 1	50	Wetted w (m):	ridth A B	1.1 C 1.4 D				G 1.3 H 1.2	2 J 1.2
Samplin		Spotlight	EFM	Sei		ength (m) esh (mm)		Wate visib		Good	Average	Poor	Water temp. ((°C):	18	Conduc (µS):	tivity 126
EFM and	ode: Bi Sm		1 volts (x100	: 3			se rate (Hz	or pps):	60	EFM puls	e width (ms	,		Spotli	ght (watts		
Species		А	В	С	D	Sub-re E	ach tally F	G	Н		J	Total count	Sam coun		Length (Min.	(mm) Max.	FLAG
Cran's b	ully	15	40	8	3	5	20	13	23	30	18	175			17	160	
Shortfin	Eel	7	50	22	18	20	13	25	14	20	10	199			85	400	
Longfin	Eel		2	1	2				1	2	2	10			200	900	
Elver		6	8								6	20			85	100	
Koura		6	6	4		3	3	7	4	5		38					
FLAG	Comment							FLA	G Com	nment							
	Missed 61 bu	lies															
	Missed 44 elv	ers															
	Missed 1 SF e																

$ \begin{array}{ c c c c c c c c c c c c c c c c c c c$	Fished <5 sub-reaches	0 J 2.1 ctivity 102 FLAG
sample id: time (min): 62 time: Finish 16:10 distance (m): 150 (m): B 3.0 D 4.0 F Sampling gear: Spotlight EFM Seine Length (m) Water visibility: Good Average Poor Water temp. (°C): EFM anode: Big EFM volts (x100): 3 EFM pulse rate (Hz or pps): 60 EFM pulse width (ms): 2 Spo Species A B C D E F G H I J Count Count Cran's Bully 9 9 5 22 4 13 7 10 6 1 86 Shortfin Eel 3 1 3 1 3 1 1 16 16	3.2 H 4.0 19.1 Conduc (μS): light (watts): Length (mm) Min. Max. 22 65 85 400	0 J 2.1 ctivity 102 FLAG
Sampling gear:SpotlightEFMSeineLength (m)Water visibility:GoodAveragePoorWater temp. (°C):EFM anode:Big SmallEFM volts (x100):3EFM pulse rate (Hz or pps):60EFM pulse width (ms):2SpoSpeciesABCDEFGHIJcountCran's Bully995224137106186Shortfin Eel3131331111616	19.1 Conduct (μS): light (watts): Length (mm) Min. Max. 22 65 85 400	FLAG
Big Small EFM volts (x100): 3 EFM pulse rate (Hz or pps): 60 EFM pulse width (ms): 2 Spo Species A B C D E F G H I J count count count Cran's Bully 9 9 5 22 4 13 7 10 6 1 86 Shortfin Eel 3 1 3 1 3 3 1 1 1 16	ight (watts): Length (mm) Min. Max. 22 65 85 400	
A B C D E F G H I J count count Cran's Bully 9 9 5 22 4 13 7 10 6 1 86 Shortfin Eel 3 1 3 1 3 1 1 1 16	Min. Max. 22 65 85 400	
Shortfin Eel 3 1 3 1 3 1 1 16	85 400	1
Longfin Eel 2 2 1 1 2 8 Image: Image		
Image: state of the state	400 850	
FLAG Comment FLAG Comment		
End of reach D skipped 8m deep water before starting reach E		
Missed around 55 bullies		
Missed 1 Elver		

Team m Josh Sm				GPS (d/s):	E2758631	N6	384786	Site	: Kare	engorengo	Stream				Date:	20/02/13	3
	/right-Stow			GPS (u/s):	E2758661	N6	384650	N	ot fished	Fished collec		Fished 10 sub- reaches		ned 5-9 reaches		<5 sub- ches	FLAG for fished/not fished
Fish sample i	id: Yes	Total shock time (min):	48	Fishing time:	Start Finish	10:00 12:05	Sample distance	(m): 1	50	Wetted (m):	width		C 2.3			G 3.0 H 2.0	
Samplin	g gear:	Spotlight	EFM	S		ength (m) lesh (mm)	•	Wat visit	er bility:	Good	Average	Poor	Water temp.		15.2	Conduct (µS):	ivity 188.2
EFM and		Big mall EFI	V volts (x10	D): 3		EFM pul	se rate (Hz	or pps):	60	EFM pul	se width	ms): 2		Spotl	ight (watts	s):	
Species		A	В	C	D	Sub-re	ach tally F	G	н	1	J	Total count	Sar cou	nple int	Length Min.	(mm) Max.	FLAG
Commo	n Bully	1	2		2		1	1			1	8			51	58	
Shortfin		19	31	13	15	10	9	12	6	10	11	136			76	600	
Longfin	Eel		1						1			2			220	330	
Inanga			2	2	2	1		1		1	2	11			68	95	
Smelt		19	3						8			30			65	87	
Brown T	rout	1		2					1			4			130	300	
Koura		6	8	7	8	4	6	6	4	6	3	58					
													_				
FLAG	Comment							FLA	.G Cor	nment							
	Shrimp com Lots of eels	mon missed due to	o abundant	nacrophyte	s and deep v	vater reache	es A, H, I, J										

Fish collection form – Wa	deable	streams/	rivers													
Team members: Josh Smith		GPS (d/s): E	2742190	N63	365404	Site:	Waił	nekau Stream	ו					Date:	210/2/13	
Aslan Wright-Stow		GPS (u/s): E	2742003	N63	365272	No	t fished	Fished no collected			ed 10 sub- eaches		ïshed 5-9 Ib-reaches		<5 sub- ches	FLAG for fished/not fished
Fish Yes Total shock time (min):	21	Fishing time:	Start Finish	13:20 13:53	Sample distance	(m): 1	50	Wetted wi (m):		A B	4.1 C 4.0 D		4.2 E 4.0 F		G 4.1 H 4.0	I 3.8 J 4.0
Sampling gear: Spotlight	EFM	Seir	Le	ength (m) esh (mm)		Wate visib			verage	9	Poor	Wa		19.3	Conductiv (µS):	
EFM anode: Big Small EFM v	olts (x100)	: 3		EFM puls	se rate (Hz c	or pps):	60	EFM pulse	width	(ms):	2		Spot	light (watts	s):	
Species A	В	С	D	Sub-rea	ach tally F	G	н		J		Total count		ample ount	Length Min.	(mm) Max.	FLAG
Shortfin Eel 1												1		300	300	
Koura		1										1				
FLAG Comment						FLAG	G Com	nment	I	I						
Schools of Smelt or Inanga s	een but no	t caught														

Team members:				GPS (d/s):	E 2727985	N6	377350	Site	: Wai	takaruru Stre	eam			Date:	22/02/13	
Josh Smith Paul Franklin				(u/s): (u/s):	E2728142	N6	377272	N	ot fished	Fished n collect		hed 10 sub- reaches	Fished 5-9 sub-reaches		<5 sub- ches	FLAG for fished/not fished
Fish sample id:		shock (min):	54	Fishing time:	Start Finish	09:20 11:00	Sample distance	(m): 1	150	Wetted w (m):	vidth A B	1.8 C 1.5 D			G 2.3 H 2.5	l 1.8 J 1.7
Sampling gear:	Spotli	ght	EFM	S		ength (m) lesh (mm)		Wat visit	er bility:	Good	Average	Poor	Water temp. (°C):	18.6	Conductiv (µS):	^{/ity} 135
EFM anode:	Big Small	EFM	/olts (x100)	: 3		-	se rate (Hz	or pps):	60	EFM puls	e width (ms	s): 2	Spot	ight (watts):	
Species		А	В	C	D	Sub-re	ach tally F	G	н		J	Total count	Sample count	Length (Min.	mm) Max.	FLAG
Cran's Bully		7	3	8	8	4	6	7	5	6	2	56		18	60	
Torrentfish									1			1		97	97	
Shortfin Eel		4	7	6	13	10	10	11	10	3	8	82		120	750	
Longfin Eel		1	1					1				3		580	1150	
Koura			2	7	3	2	5	7	1	3	4	34				
						1										
FLAG Comment	t		1			1		FLA	.G Con	nment	I				<u> </u>	I
1 Elver m																

			II — W0	adeable	Stream	s/rivers											
Team m Josh Sm					GPS (d/s):	E 2741446	Ne	6377350	Site	Piak	onui Stream	ı			Date:	22/02/13	i
Paul Fra	Inklin				GPS (u/s):	E 2741436	N	6371564	No	ot fished	Fished r collect		ished 10 sub- reaches	Fished 5-9 sub-reaches		l <5 sub- iches	FLAG for fished/not fished
Fish sample i	d:		l shock (min):	29	Fishing time:	Start Finish	12:15 13:20	Sample distance	(m): 1	50	Wetted v (m):	vidth A B	3.0 C 3.1 D		2.5 2.2	G 1.8 H 2.4	J 2.2
Samplin	g gear:	Spotl	ight	EFM	S		ength (m) lesh (mm)		Wate Visib		Good	Average	Poor	Water temp. (°C):	15.1	Conduct (µS):	ivity 92
EFM and	ode:	Big Small	EFM	volts (x100): 3			se rate (Hz	or pps):	60	EFM puls	se width (r		-	ight (watts		
Species			А	В	С	D	Sub-re	ach tally F	G	Н		J	Total count	Sample count	Length Min.	(mm) Max.	FLAG
Banded	Kokopu			1					1				2		60	64	
Shortfin	Eel		1	1		1	1		8	1	3		16		95	120	
Longfin I	Eel				1			1		1	3	1	7		110	800	
Elvers							1	1	10		3	1	16				
																	<u> </u>
FLAG	Comme		I			I	1	I	FLA	G Com	ment				I		
		abundant ir	all reach	nes													
		ers missed															
		er goes und pped 10m				reach started	d at u/s limit										
		••															-

Appendix C Macroinvertebrate taxa list

Orașta					Site	es				
Species	1	2	3	4	5*	6	7	8	9	10
Archichauliodes diversus	8	39	5	9	2	1			7	
Xanthocnemis zealandica								2		
Acanthophlebia cruentata		1 R								
Austroclima sp.	2	3	8	4			1		1	
Austroclima sepia			3	3		7	11		1	
Deleatidium spp.	47	48	20	4		55				
Coloburiscus humeralis	5	2	27	6						
Ichthybotus hudsoni				1						
Neozephlebia scita	12	2								
Nesameletus sp.	2		14	6						
Rallidens Mcfarlanei			1							
Zephlebia spp.		1								
Zephlebia borealis	4	1 R								
Zephlebia dentata	6	3 R				22	24		12	12
Zephlebia inconspicua									1	
Zephlebia spetabilis				1 R						
Zephlebia versicolor							1 R			
Acroperla trivacuata										1
Austroperla cryene			1							1
Megaloptoperla grandis			2							
Zelandoperla decorata			7	1						
Aoteapsyche colonica	18	1 R	12	9					6	6
Aoteapsyche spp.	1	5	26	6		13				
Beraeoptera roria			2	1						
Costachorema spp.			2							
Helicopsyche spp.	12									
Hudsonemia alienum							1			
Hudsonema amabilis	6	5		1		5				
Hydrobiosis spp.	5	5	1	2			2		2	
Hydrobiosis budjei		1 R								

Species	Sites												
Species	1	2	3	4	5*	6	7	8	9	10			
Hydrobiosis copis									2				
Hydrobiosis gollanis	3 R	1											
Hydrobiosis parumbripennis	1			2									
Neurochorema spp.	5			4									
Neurochorema armstrongi				2									
Ocetis unicolor									1				
Olinga feredayi	5					20							
Oxyethira albiceps		2	2	1			6	39	13				
Paroxythira sp.				1				1					
Plectrocnomia maclachani				1									
Psilochorema macroharpax	1												
Psilochorema mimicum		1 R											
Pycnocentria evecta	9		1		1	6							
Pycnocentrodes sp.	10	18	2	5	5	119			52				
Triplectides obsoletus		5	2				10	1 R	1 R				
Aphrophila neozelandica			9	7		1 R	1 R						
Austrosimulium sp.						2	9		5				
Chironomus zealandicus									1				
Cricotopus spp.		16	7	3	1		1	57	2				
Empididae	1	1							1				
<i>Eukiefferiella</i> sp.	1		2	1					1				
Kaniwhaniwhanus			4		1								
Lobodiamesinae					2								
Tanypodinae =Macropelopiini sp.	2	6		13									
Maoridiamesa sp.			8	3	1								
Molophilus sp.													
Muscidae			1 R	4	2								
Naonella forsythi	3		2	4				11	1				
Paradixa sp.		1					13						
Pirara		7							2				
Polypedilum spp.	2	5					1						
Stictocladius spp.							1						

Species					Sit	es				
Species	1	2	3	4	5*	6	7	8	9	10
Tanytarsus spp.	5	25	15	64				38		
Tanytarsus vespertinus									3	
Hygraula nitens								2		
Elmidae (larvae)	5	3	6	18		7			80	1
Ptilodactylidae (larvae)						1				
Ferrissia sp.	1 R									
Gyraulus corinna							1	38		
Latia neritoides					11					
Physa sp.				1				17		
Potamopyrgus antipodarum	37	8	30	42	5	69	115	13	23	22
Eiseniella sp.		1								
Oligochatea	2			1		1 R	2		1 R	
Plathylminthes			1	1		1			5	
Leach								3		
Ostracoda							1 R		2	
Paracorophium										1
Paracalliope fluviatus							17		2	
Paranephropus planiforins										10
Spring tail			1 R							

* Sample not preserved correctly. Consequent loss of species.

Appendix D Macrophytes and periphyton

Periphyton Assessn	nent						
Stream: Mangakahika Stre	eam	Date: 18	/02/13				
Sample Number: 1		Located	number:	er:			
Thickness category	Colour category	A	в	с	D	E	Mean cover
Thin (<0.5mm) Mat/Film	NA	30	50	60	80	90	62
Medium mat/film (0.5- 3mm thick)	Green (% cover)			5	5	10	4
	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						

Macrophyt	e recording	sheet								
Stream: Mang	gakahika Stream	1	Located r	number:		Sample Number	: 1		Date: 18/02/	13
						Vegetation co	ver (% w	vetted area)		
	Wetted	Channel width			Subr	Submerged plants				Emergent plants
Transect	width (m)	m) (m) Total			Surf	ace-reaching	Below surface			
			cover	Total submerged	Sub- total	Species	Sub- total	Species	Total emergent	Species
1	1.5	1.5	0							
2	2.0	2.4	0							
3	1.2	1.3	0							
4	1.1	1.3	0							
5	1.6	2.1	0							

Periphyton Assessm	nent						
Stream: Riuohauraki Strea	am	Date: 18	/02/13				
Sample Number: 2		Located	number:				
Thickness category	Colour category	A	в	с	D	Е	Mean cover
Thin (<0.5mm) Mat/Film	NA		20	30	20	40	22
Medium mat/film (0.5- 3mm thick)	Green (% cover)						
	Light brown (% cover)	20	40				18
	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)	70	20				27
Submerged bryophytes	NA						
Iron Bacteria growths	NA						

Macrophyt	e recording	sheet									
Stream: Riuo	hauraki Stream		Located r	number:		Sample Number	: 2		Date: 18/02/	/13	
						Vegetation co	over (% w	vetted area)			
	Wetted	Channel width			Subr	nerged plants			Emergent plants		
Transect	width (m)	(m) (m) Total			Surf	ace-reaching	Below surface				
			cover	Total submerged	Sub- total	Species	Sub- total	Species	Total emergent	Species	
1	1.8	3.6	0								
2	1.1	4.0	0								
3	2.5	3.2	0								
4	1.2	3.5	0								
5	0.8	3.0	0								

Periphyton Assessn	nent						
Stream: Paiakarahi Strear	n D/S	Date: 19	/02/13				
Sample Number: 3		Located	number:				
Thickness category	Colour category	A	в	с	D	E	Mean cover
Thin (<0.5mm) Mat/Film	NA	20	10	30	20	20	20
Medium mat/film (0.5- 3mm thick)	Green (% cover)						
	Light brown (% cover)		50		20	5	15
	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						

Macrophyt	te recording	sheet									
Stream: Paia	karahi Stream D	/S	Located r	number:	:	Sample Number	: 3		Date: 19/2/1	3	
						Vegetation co	over (% w	vetted area)	-		
	Wetted	Channel width			Subn	nerged plants			Emergent plants		
Transect	width (m) (m)		Total		Surface-reaching Belo		ow surface				
			cover	Total submerged	Sub- total	Species	Sub- total	Species	Total emergent	Species	
1	1.5	4	0								
2	3.0	4.5	0								
3	2.8	3.5	0								
4	3.5	5.0	0								
5	3.7	4.8	0								

Periphyton Assessm	nent						
Stream: Paiakarahi Strear	n U/S	Date: 19	/02/13				
Sample Number: 4		Located	ed number:				
Thickness category	Colour category	A	в	с	D	Е	Mean cover
Thin (<0.5mm) Mat/Film	NA	30	50	40	60	50	46
Medium mat/film (0.5- 3mm thick)	Green (% cover)					10	2
	Light brown (% cover)		10				2
	Black/dark brown (% cover)						
Thick (>3mm) mat/film	Green/light brown (% cover)		10				2
	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						

Macrophyt	e recording	sheet									
Stream: Paiak	karahi Stream U	/S	Located r	number:		Sample Number	: 4		Date: 19/02/	13	
						Vegetation co	ver (% w	vetted area)			
	Wetted	Channel width			Subr	nerged plants	•		Emergent plants		
Transect	width (m)	width (m) (m) Tota		Total		ace-reaching	Below surface				
			cover	Total submerged	Sub- total	Species	Sub- total	Species	Total emergent	Species	
1	5.0	12.5	0								
2	6.1	10.8	0								
3	5.6	9.7	0								
4	4.5	14.0	0								
5	6.2	14.8	0								

Periphyton Assessn	nent						
Stream: Waitoa Tributary		Date: 20	/02/13				
Sample Number: 5		Located	number:				
Thickness category	Colour category	A	в	с	D	E	Mean cover
Thin (<0.5mm) Mat/Film	NA	40	20	20	10	30	24
Medium mat/film (0.5- 3mm thick)	Green (% cover)						
	Light brown (% cover)	30	40		90	40	40
	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						

Macrophyt	e recording	sheet								
Stream: Waite	oa Tributary		Located number: 5				Date: 20/02/	/13		
					-					
	Wetted	Channel width			Subr	nerged plants				Emergent plants
Transect	width (m)	(m)	Total		Surf	ace-reaching	Bel	ow surface		
			cover	Total submerged	Sub- total	Species	Sub- total	Species	Total emergent	Species
1	2.0	3.0	0							
2	3.0	3.5	0							
3	2.5	3.4	0							
4	1.0	1.5	0							
5	1.5	2.2	0							

Periphyton Assessn	nent									
Stream: Mangapapa Strea	am	Date: 20/02/13								
Sample Number: 6		Located number:								
Thickness category	Colour category	A	в	с	D	Е	Mean cover			
Thin (<0.5mm) Mat/Film	NA					20	4			
Medium mat/film (0.5-	Green (% cover)			25		5	6			
3mm thick)	Light brown (% cover)	90		10	90	20	42			
	Black/dark brown (% cover)									
Thick (>3mm) mat/film	Green/light brown (% cover)		100				20			
	Black/dark brown (% cover)									
Filaments short (<2cm)	Green (% cover)									
	Brown/Reddish (% cover)									
Filaments long (>2cm)	Green (% cover)									
	Brown/Reddish (% cover)									
Submerged bryophytes	NA			10		30	8			
Iron Bacteria growths	NA									

Macrophyt	e recording	sheet								
Stream: Man	gapapa Stream		Located number: 6 Sample Number: 6				Date: 20/02/	/13		
				Vegetation cover (% wetted area)						
	Wetted	Channel width			Subr	nerged plants				Emergent plants
Transect	width (m)	(m)	Total		Surf	ace-reaching	Bel	ow surface		
			cover	Total submerged	Sub- total	Species	Sub- total	Species	Total emergent	Species
1	3.2	3.5	0							
2	4.0	6.0	0							
3	3.8	4.5	2	2			2	Lm Pk		
4	3.0	7.2	0							
5	3.5	5.1	0							

Periphyton Assessn	nent									
Stream: Karengorengo Str	ream	Date: 21/02/13								
Sample Number: 7		Located number:								
Thickness category	Colour category	А	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)									
3mm thick)	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									

Macrophyt	e recording	sheet										
Stream: Kare	ngorengo		Located n	number:		Sample Number	: 7		Date: 21/02/13			
				Vegetation cover (% wetted area)								
Transect Wetted width (m)	Wetted	Channel width			Sub	merged plants				Emergent plants		
		(m)	Total		Sur	face-reaching	Bel	ow surface				
			cover	Total submerged	Sub- total	Species	Sub- total	Species	Total emergent	Species		
1	2.5	4.0	70						70	Na		
2	2.5	4.0	50						50	Na		
3	2.3	3.5	80						80	Na, Ps		
4	3.0	4.5	55						55	Na, Ps		
5	2.4	3.8	60						60	Na, Ps		

Periphyton Assessn	nent								
Stream: Waihekau Stream	1	Date: 21/02/13							
Sample Number: 8		Located number:							
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)								
3mm thick)	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)	80	80	90	90	90	86		
	Brown/Reddish (% cover)								
Submerged bryophytes	NA								
Iron Bacteria growths	NA								

Macrophy	te recording	sheet									
Stream: Wai	hekau Stream		Located number: 8 Sample Number: 8				Date: 21/02/	/13			
				Vegetation cover (% wetted area)							
	Wetted	Channel width			Subr	nerged plants				Emergent plants	
Transect	width (m)	(m)	Total		Surf	ace-reaching	Bel	ow surface			
			cover	Total submerged	Sub- total	Species	Sub- total	Species	Total emergent	Species	
1	4.1	6.0	85	80				Ec	5	Ph	
2	4.2	6.0	100	90				Ec	10	Ph	
3	3.8	6.0	100	90				Ec	10	Ph	
4	4.1	6.0	95	90				Ec	5	Ph	
5	3.8	6.0	100	90				Ec	10	Ph	

Periphyton Assessn	nent									
Stream: Waitakaruru Strea	am	Date: 22/02/13								
Sample Number: 9		Located number:								
Thickness category	Colour category	A	в	с	D	E	Mean cover			
Thin (<0.5mm) Mat/Film	NA			20			4			
Medium mat/film (0.5- 3mm thick)	Green (% cover)									
	Light brown (% cover)	50	60	70	50	60	58			
	Black/dark brown (% cover)									
Thick (>3mm) mat/film	Green/light brown (% cover)					10	2			
	Black/dark brown (% cover)									
Filaments short (<2cm)	Green (% cover)									
	Brown/Reddish (% cover)	30					6			
Filaments long (>2cm)	Green (% cover)									
	Brown/Reddish (% cover)									
Submerged bryophytes	NA									
Iron Bacteria growths	NA									

Macrophyt	e recording	sheet									
Stream: Waita	akaruru Stream		Located number: Sample Number: 9					Date: 22/02/	/13		
				Vegetation cover (% wetted area)							
	Wetted	Channel width			Subr	nerged plants				Emergent plants	
Transect	width (m)	(m)	Total		Surf	ace-reaching	Bel	ow surface			
			cover	Total submerged	Sub- total	Species	Sub- total	Species	Total emergent	Species	
1	1.5	2.5					2	Ec			
2	1.3	3.0									
3	1.8	3.2									
4	2.0	3.5					5	Ec			
5	2.2	4.0									

Periphyton Assessn	nent									
Stream: Piakonui Stream		Date: 22/02/13								
Sample Number: 10		Located	number:							
Thickness category	Colour category	A	в	с	D	E	Mean cover			
Thin (<0.5mm) Mat/Film	NA		20		20	10	10			
Medium mat/film (0.5- 3mm thick)	Green (% cover)			30			6			
	Light brown (% cover)	50	20		50	60	36			
	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	10	10	20			8			
Iron Bacteria growths	NA									

Macrophy	te recording	sheet									
Stream: Piak	onui Stream		Located number: Sample Number: 10					Date: 22/02/	Date: 22/02/13		
				Vegetation cover (% wetted area)							
	Wetted	Channel width			Subr	nerged plants				Emergent plants	
Transect	width (m)	(m)	Total		Surf	ace-reaching	Bel	ow surface			
			cover	Total submerged	Sub- total	Species	Sub- total	Species	Total emergent	Species	
1	2.5	5	0								
2	2.6	6.5	0								
3	2.7	7.1	0								
4	2.2	6.3	0								
5	3.0	5.8	0								