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Waihou catchment ecological monitoring 2011



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Contents

Exec	utive	summary1			
1	Intro	duction3			
	1.1	Background3			
	1.2	Study brief3			
2	Methodology				
	2.1	Sites4			
	2.2	Fish6			
	2.3	Macroinvertebrates6			
	2.4	Macrophytes & periphyton6			
3	Resu	lts7			
	3.1	Ecological monitoring 20117			
	3.2	Comparison with 2009 results19			
4	Conc	lusion23			
5	Ackn	owledgements23			
6	References24				
Арре	ndix	1: Field assessment and habitat assessment forms25			
Арре	ndix	2: Fish Surveys55			
Арре	ndix	3: Macroinvertebrate results65			
Арре	endix 4	4: Macrophyte and periphyton results68			

Tables

Table 2-1:	Ecological monitoring site locations.	4
Table 3-1:	Summary of species captured by electric fishing at Site 1.	7
Table 3-2:	Macroinvertebrate scores for Site 1.	8
Table 3-3:	Summary of species captured by electric fishing at Site 2.	9
Table 3-4:	Macroinvertebrate scores for Site 2.	9
Table 3-5:	Summary of species captured by electric fishing at Site 3.	10
Table 3-6:	Macroinvertebrate scores for Site 3.	10
Table 3-7:	Summary of species captured by electric fishing at Site 4.	11
Table 3-8:	Macroinvertebrate scores for Site 4.	11
Table 3-9:	Summary of species captured by electric fishing at Site 5.	12
Table 3-10	:Macroinvertebrate scores for Site 5.	13

Table 3-11: Summary of species captured by electric fishing at Site 6.	13
Table 3-12: Macroinvertebrate scores at Site 6.	14
Table 3-13: Summary of species captured by electric fishing at Site 7.	14
Table 3-14: Macroinvertebrate scores at Site 7.	15
Table 3-15: Summary of species captured by electric fishing at Site 8.	15
Table 3-16: Macroinvertebrate scores at Site 8.	16
Table 3-17: Summary of species captured by electric fishing at Site 9.	17
Table 3-18: Macroinvertebrate scores at Site 9.	17
Table 3-19: Summary of species captured by electric fishing at Site 10.	18
Table 3-20: Macroinvertebrate scores at Site 10.	18
Table A31: Full species list for macroinvertebrates.	65

Figures

Figure 2-1: Map showing the location of the ten ecological monitoring sites within the	
Waihou River catchment.	5
Figure 3-1: Comparison of fish species diversity between 2009 and 2011.	20
Figure 3-2: Comparison between the relative abundance of fish captured in the 2009	
and 2011 surveys.	21
Figure 3-3: Comparison of MCI scores between survey years.	22

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Executive summary

Waikato Regional Council (WRC) is in the process of assessing the status of water resource availability and allocation in the Waihou River catchment. One of the key objectives of the water allocation process is to ensure the protection of instream values from the effects of water resource exploitation.

A network of baseline ecological monitoring sites was established in the Waihou catchment in 2009 as part of the assessment process. This report describes the results of the second round of monitoring, carried out in 2011.

At present it is not possible to identify long-term temporal trends or distinguish patterns in natural population dynamics due to the small sample size. However, it is already becoming evident that, at the reach scale, populations of the more mobile, pelagic fish species are naturally more variable than those of the more cryptic benthic species. Fish species diversity also appears to be lower in the low gradient agricultural streams, relative to the steeper gradient streams with more intact riparian cover. A similar distinction between low gradient agricultural streams and the steeper gradient streams is also apparent in the MCI scores for macroinvertebrates. At present, there are however no clear differences in the ecological communities of the control and impacted survey sites.

Potential implications of the results for the water allocation process may include protection of high diversity sites and/or rehabilitation of degraded sites (e.g., through riparian planting, to compensate for the potential impacts of increased allocation). As the length of the time series increases, the ability to identify trends in community composition and population dynamics improves. This is valuable in implementing adaptive management strategies.

1 Introduction

1.1 Background

Waikato Regional Council (WRC) is in the process of assessing the status of water resource availability and allocation in the Waihou River catchment. One of the key objectives of the water allocation process is to ensure the protection of instream values from the effects of water resource exploitation.

A network of baseline ecological monitoring sites was established in the Waihou catchment in 2009 as part of the assessment process (Franklin & Booker 2009). WRC requested that NIWA undertake repeat surveys of the eight original sites, plus two further sites located in the Waiteariki and Wairere sub-catchments, during the summer of 2011. This was to contribute towards establishing long-term temporal records of ecological status in both control and impacted sites across the catchment, thus supporting the water allocation decision making process.

1.2 Study brief

The scope of this study is to repeat the baseline ecological monitoring of fish, macroinvertebrates and macrophytes at the eight sites surveyed in 2009 and to establish two new assessment sites in the Waiteariki and Wairere sub-catchments. The 2011 monitoring results are to be compared to those from 2009.

2 Methodology

2.1 Sites

A total of ten sites were surveyed throughout the Waihou catchment during the week 21-25 February 2011 (Table 2-1; Figure 2-1). The survey sites have been selected on the basis of their representativeness of differing river types and potential abstraction pressure, but are concentrated in the middle and lower catchment where abstraction pressure is currently highest.

Sites 1-8 were all surveyed in 2009. Sites 1 and 2 are lowland agricultural streams. Sites 3-8 are paired surveys carried out upstream and downstream of existing abstractions. Sites 9 and 10 were added to the survey programme this year at the request of EW staff. The Waiteariki Stream (Site 9) is subject to abstraction for the Matamata town water supply and Wairere Stream (Site 10) was selected by WRC as a suitable control site for comparison.

Site	Stream	Easting*	Northing*	Comments
1	Depression Stream	2757273	6386560	Lowland agricultural stream
2	Karengorengo Stream	2758628	6384754	Lowland agricultural stream
3	Paiakarahi Stream	2751431	6429122	Downstream of public water supply abstraction
4	Paiakarahi Stream	2751347	6429422	Upstream of public water supply abstraction
5	Omahu Stream	2746560	6435409	Downstream of irrigation abstraction
6	Omahu Stream	2746688	6435516	Upstream of irrigation abstraction
7	Unnamed tributary of Homunga Stream	2765475	6420947	Downstream of irrigation abstraction
8	Unnamed tributary of Homunga Stream	2765847	6420687	Upstream of irrigation abstraction
9	Waiteariki Stream	2762794	6379697	Downstream of public water supply abstraction
10	Wairere Stream	2761891	6381355	Unimpacted control steam for comparison to Waiteariki site

Table 2-1: Ecological monitoring site locations.

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

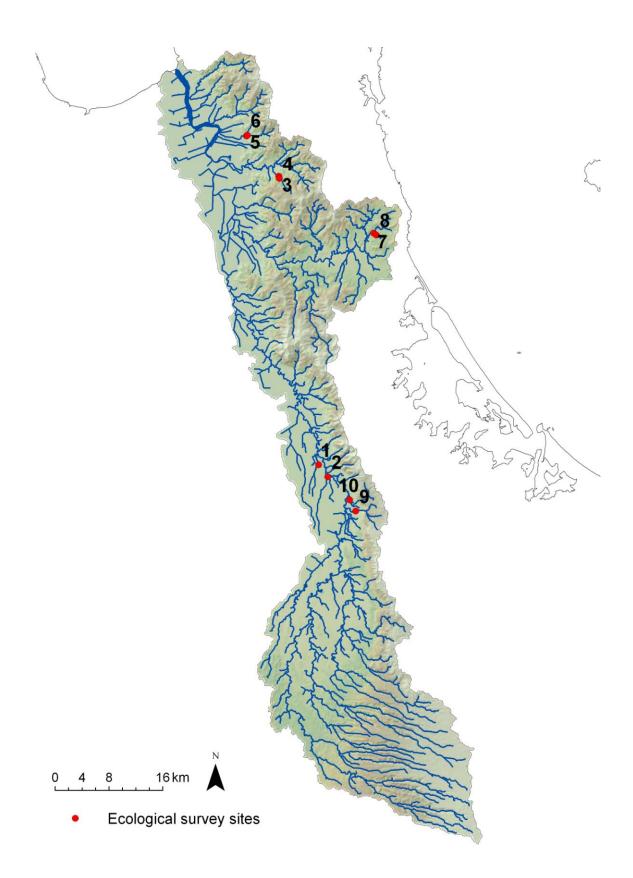


Figure 2-1: Map showing the location of the ten ecological monitoring sites within the Waihou River catchment.

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 minimum and maximum fish lengths were recorded for every 15 m sub-reach.

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

These values are based on single pass electric fishing, which is a semi-quantitative method, and thus these values are not equivalent to fish density and should not be used for comparison between sites. Interpretation of the relative abundance values 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 EW 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 percent abundance data suitable for the calculation of most invertebrate parameters (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 Ecological monitoring 2011

3.1.1 Site 1 – Depression Stream

Site characteristics

Depression Stream is a lowland agricultural stream which had a mean wetted width of 2m and mean depth of 0.4m at the time of the survey. It is dominated by run and glide mesohabitat types, with occasional deep pools (approximately 25% of the reach). Since the last survey in 2009 riparian fencing had been installed, but there was evidence to suggest that it was not effective at preventing access to some areas of the riparian zone by cattle. The field assessment cover form and qualitative habitat assessment field data sheet are included in Appendix 1 for further detail.

Fish

The high abundance of aquatic macrophytes in this reach meant that fishing efficiency was reduced and thus fish abundance is likely to have been underestimated by this survey. Three fish species were captured during the survey (Table 3-1). Shortfin eels (*Anguilla australis*) were the dominant species with a relative abundance of 90 individuals per 100m². Several size classes were present, but the population was dominated by eels less than 400mm in length. The abundance of Cran's bullies (*Gobiomorphus basalis*) was relatively low, but this may be an artefact of the reduced fishing efficiency. Small benthic species are particularly liable to being missed in conditions where macrophytes are present in abundance. Inanga (*Galaxias maculatus*) were present in the reach and were the second most abundant species.

Species	Count	Relative abundance (Individuals per 100m ²)	Minimum length (mm)	Maximum length (mm)
Shortfin eel	246	90.1	90	600
Cran's bully ¹	5	1.8	50	100
Inanga	45	16.5	90	100
Koura	29	10.6	NA	NA

Table 3-1:	Summary of	species ca	ptured by	electric fishing at	t Site 1.
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Macroinvertebrates

Due to the high abundance of macrophytes and dominance of run habitat, macroinvertebrate sampling effort was concentrated on these habitats. MfE protocol C2 for soft-bottomed streams was followed, with 10 replicate samples of approximately 0.3 m² collected. The macroinvertebrate community was dominated by the mollusc *Potamopyrgus antipodarum*. Total species richness was twelve, with only a single EPT (Ephemeroptera, Plecoptera, Trichoptera) species identified (Table 3-2). Consequently, the MCI (Macroinvertebrate Community Index) at 76.0 was low, which places it in the 'poor' quality class as defined by Stark and Maxted (2007). It should, however, be noted that the MCI scores used (Collier & Kelly 2005) were developed for hard-bottomed streams.

¹ Recent genetic work indicates that both Cran's and common bully may be present in this stream (Dimetrus, unpublished data)

Parameter	Score
Total taxa richness	12
EPT richness	1
%EPT	8.3
MCI	76.0

Table 3-2: Macroinvertebrate scores for Site 1.

Macrophytes and periphyton

Total macrophyte cover (MTC) in the reach was calculated as 39%, with a channel clogginess index (MCC) of 38.5. These values are low given the observed abundance of macrophytes in the reach. It appears this was a result of the location of the survey transects, which by chance all happened to fall at sites where the abundance of macrophytes was relatively lower. It is the nature of objective, random sampling methods, that this can sometimes occur. The community was dominated by the exotic *Glyceria maxima*. A walk over survey of the whole reach also identified occasional *Elodea canadensis, Nasturtium officinale* and the native *Nitella hookeri*.

Periphyton cover was dominated by long filamentous algae and was relatively high. The periphyton enrichment index (PEI) for the reach was 75.8 compared to a maximum value of 90. Care should be exercised in interpreting this result because the PEI was developed for stony streams rather than silty, macrophyte dominated streams. The periphyton mat index (PMI) was zero. The periphyton proliferation index (PPI) was 100, reflecting the high abundance of filamentous algae in the reach. Collier et al. (2006) stated that PPI values >30 were generally associated with percentage of EPT <25% and MCI values <90, which is consistent with the macroinvertebrate community of this site (%EPT=8.3; MCI=74.5). The periphyton sliminess index (PSI) was 28.8

3.1.2 Site 2 – Karengorengo Stream

Site characteristics

Karengorengo Stream is also a lowland agricultural stream. The mean wetted width was about 2m and mean depth 0.3m at the time of the February 2011 survey. The habitat is predominantly run, with very occasional pools present. The substrate is dominated by sand and is thus relatively mobile. The stream is not fenced, but use of the riparian area by cattle appears to be relatively infrequent.

Fish

A greater diversity of fish species were captured at this site, relative to the nearby Depression Stream. A total of six fish species were caught, including one non-indigenous species, brown trout (*Salmo trutta*) (Table 3-3). The fish community was dominated by shortfin eels. A wide range of size classes were present in the reach, but the population was again dominated by eels of less than 400mm. Also present were smelt (*Retropinna retropinna*), and in much lower abundance, common bullies (*Gobiomorphus cotidianus*), longfin eels (*Anguilla* dieffenbachii) and inanga.

Species	Count	Relative abundance (Individuals per 100m ²)	Minimum length (mm)	Maximum length (mm)
Shortfin eel	254	79.1	90	740
Common bully	2	0.6	60	80
Smelt	65	20.3	65	NA
Inanga	1	0.3	NA	80
Brown trout	3	0.9	180	340
Longfin eel	2	0.6	300	340
Koura	37	11.5	NA	NA

Table 3-3: Summary of species captured by electric fishing at Site 2.

Macroinvertebrates

This site was also sampled according to MfE protocol C2 for soft-bottomed streams, with 10 replicate samples of approximately 0.3 m2 collected. A combination of macrophytes (80%) and stream edge (20%), all located in run habitat was sampled. Species richness was similar to the hard bottomed streams surveyed in this study and in terms of abundance the community was dominated by Ephemeroptera species, particularly *Zephlebia dentate* (Table 3-4). The MCI score was 102.1, which means it falls into the 'good' quality class as defined by Stark and Maxted (2007). Again it should be noted that the MCI scores used (Collier & Kelly 2005) were developed for hard-bottomed streams.

Table 3-4: Macroinvertebrate scores for Site 2.

Parameter	Score
Total taxa richness	22
EPT richness	7
%EPT	31.8
MCI	102.1

Macrophytes and periphyton

The main macrophyte species present at this site was *Nasturtium officinale*, which was relatively abundant along the stream margins. MTC and MCC for the reach were both 27%.

No periphyton growth was identified in the surveyed cross-sections. The mobile nature of the sandy substrate limits the potential for periphyton establishment. Full results are presented in Appendix 1.

3.1.3 Site 3 – Paiakarahi Stream downstream

Site characteristics

This site is located approximately 100m downstream of a public water supply abstraction. Mean wetted width in the survey reach was approximately 4.5m and mean depth about 0.2m at the time of the survey. Habitat in the reach is diverse, with a cobble and boulder substrate, and woody debris. Riparian vegetation is dominated by native bush species. There was evidence of recent bank slumping and recruitment of new woody debris in the reach. Further details of the habitat characteristics of the reach are included in Appendix 1.

Fish

Six species of fish were captured during the survey, including shortfin and longfin eels, Cran's bullies, rainbow trout (*Oncorhynchus mykiss*), torrentfish (*Cheimarrichthys fosteri*) and banded kokopu (*Galaxias fasciatus*) (Table 3-5). Cran's bullies were the most common species with a relative abundance of 12.6 individuals per 100m², with a range of different sizes from 20mm to 70mm indicating the presence of several year classes. A number of elvers were captured during the survey, with juvenile banded kokopu and torrentfish also present. This indicates successful recruitment of fish to the catchment and a lack of migration barriers downstream of the survey reach. The majority of the trout captured were also juveniles c.110mm, indicating that trout must be successfully spawning in the catchment.

Species	Count	Relative abundance (Individuals per 100m ²)	Minimum length (mm)	Maximum length (mm)
Shortfin eel	10	1.5	100	250
Longfin eel	14	2.1	110	600
Cran's bully	83	12.6	20	70
Elver	11	1.7	80	110
Torrentfish	9	1.4	40	115
Banded kokopu	5	0.8	70	130
Rainbow trout	20	3.0	80	250
Unidentified eel	4	0.6	110	150
Koura	20	3.0	NA	NA

Table 3-5:	Summary of species captured by electric fishing at Site 3.
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Macroinvertebrates

This site was sampled according to MfE protocol C1 for hard-bottomed streams, with an area of approximately 1 m² sampled at each site. Species richness was high at 26, as was the proportion of EPT taxa (57.7%) (Table 3-6). The ephemeroptera *Coloburiscus humeralis* was relatively common, as was the megaloptera *Archichauliodes diversus* and the trichoptera *Aoteapsyche colonica*. Elmidae larvae were the most abundant macroinvertebrate. The MCI score for the site was 127.8 placing it in the 'excellent' quality class as defined by Stark and Maxted (2007).

Table 3-6:	Macroinvertebrate scores for Site 3.
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Parameter	Score
Total taxa richness	26
EPT richness	15
%EPT	57.7
MCI	127.8

Macrophytes and periphyton

No macrophytes were recorded at any of the surveyed cross-sections. Periphyton abundance was also relatively low and primarily characterised by a thin mat/film on the cobble substrate. The PEI for this site was 22.0, with the PPI 8.39, both reflecting the relatively low abundance of algae.

3.1.4 Site 4 – Paiakarahi Stream upstream

Site characteristics

This site is also located in native bush, approximately 500m upstream of the public water supply take. Mean wetted width was about 7m at the time of the survey and mean depth 0.3m. The dominant habitat type was rapid, but the habitat was diverse and included pools, riffles, runs and cascade areas. The quantity of woody debris was much lower than at Site 3. Further details of the habitat characteristics of the reach are included in Appendix 1.

Fish

The same species of fish were present in this reach as at Site 3, which is located downstream (Table 3-7). The relative abundance of all species except for rainbow trout is also similar between the two sites. The relative abundance of rainbow trout was lower and probably reflects the differences in habitat types between the two reaches. The presence of migratory species such as elvers, banded kokopu and torrentfish indicate that the dam which forms part of the intake structure for the abstraction is not a complete barrier to fish movement.

Species	Count	Relative abundance (Individuals per 100m ²)	Minimum length (mm)	Maximum length (mm)
Shortfin eel	14	1.48	100	150
Longfin eel	16	1.69	100	450
Cran's bully	117	12.38	30	90
Torrentfish	6	0.63	70	110
Elver	10	1.1	90	100
Banded kokopu	6	0.6	120	195
Rainbow trout	7	0.7	95	115
Unidentified eel	3	0.3	150	250
Koura	36	3.8	NA	NA

Table 3-7: Summary of species captured by electric fishing at Site 4.

Macroinvertebrates

The diversity of macroinvertebrate species recorded at this site was slightly lower than at the downstream site and the number of EPT taxa also marginally lower (Table 3-8). However, EPT taxa were still an important part of the community, with the trichoptera *Aoteapsyche colonica* and *Pycnocentrodes spp.* both relatively common, along with the ephemeroptera *Coloburiscus humeralis.* The MCI score of 126.4 also places it in the 'excellent' quality class.

Parameter	Score
Total taxa richness	23
EPT richness	11
%EPT	47.8
MCI	126.4

Table 3-8:	Macroinvertebrate	scores	for Site 4.

Macrophytes and periphyton

No macrophytes were recorded in the survey. Green filamentous algae was the dominant periphyton type, with some thin mat/films also present on some of the coble substrate. PEI was 70.3 and PPI 67.5, which is more normally associated with low %EPT and MCI values.

3.1.5 Site 5 – Omahu Stream downstream

Site characteristics

Site 5 is located downstream of an irrigation abstraction. The stream was on average about 6m wide at the time of the survey and mean depth 0.25m, with habitat characterised by a combination of runs, riffles and pools. The dominant substrate was gravel. Some riparian cover was present, with the dominant riparian landuse being horticulture. Further details of the characteristics of the site are included in Appendix 1.

Fish

Six native and two introduced fish species were present in the reach (Table 3-9). The most abundant species were shortfin eels, Cran's bullies and torrentfish, which all had a relative abundance of 4.2 individuals per 100m². Despite having the same relative abundance, the habitat use of these three species is quite different, with the torrentfish mainly occurring in the riffles, the Cran's bullies in riffles and runs, and the eels in runs and pools. The presence of inanga and smelt in the reach indicates unimpeded access to the reach from downstream. Most of the trout captured were juveniles.

Species	Count	Relative abundance (Individuals per 100m ²)	Minimum length (mm)	Maximum length (mm)
Shortfin eel	39	4.2	85	350
Longfin eel	7	0.8	340	650
Cran's bully	39	4.2	20	75
Inanga	3	0.3	85	105
Torrentfish	39	4.2	40	140
Smelt	5	0.5	70	85
Brown trout	5	0.5	110	250
Rainbow trout	1	0.1	NA	100
Elver	19	2.0	70	100
Koura	14	1.5	NA	NA

Table 3-9:	Summarv of s	pecies captured	by electric fishing a	at Site 5.
	•••••••••••••••••••••••••••••••••••••••	pooloo ouptuiou		

Macroinvertebrates

This site was sampled according to MfE protocol C1 for hard-bottomed streams, with an area of approximately 1 m² sampled. Species richness was very high at this site, with a total of 27 different species identified in the sample (Table 3-10). A good number of both ephemeroptera and trichoptera species were present, with the most abundant being *Aoteapsyche colonica* and *Pycnocentrodes spp.* The MCI score of 121.0 falls into the 'excellent' quality class as defined by Stark and Maxted (2007).

Table 3-10:	Macroinvertebrate	scores	for Site 5	s.

Parameter	Score
Total taxa richness	27
EPT richness	13
%EPT	48.1
MCI	121.0

Macrophytes and periphyton

Macrophyte cover was again low, with only a small amount of marginal *Glyceria maxima* present. Periphyton cover was relatively low (PEI=17.6) and primarily characterised by thin mats on the cobble substrate.

3.1.6 Site 6 – Omahu Stream upstream

Site characteristics

Site 6 is located upstream of the irrigation abstraction on the Omahu Stream. Mean wetted width at the time of the survey was approximately 7m, with depth ranging from <0.05m to >1.00m. Habitat was varied, with a fairly even split between, pools, riffles and runs and a substrate dominated by gravel. Further details are included in the site assessment forms included in Appendix 1.

Fish

A similar fish community occurred (Table 3-11) to that found in the downstream site. The main difference was the absence of smelt at this site and the relatively higher abundance of shortfin eels (relative abundance 9.8 individuals per 100m²) and Cran's bullies (13.6 individuals 100m²). There was also a slightly lower abundance of torrentfish in the reach, but this reflects the difference in habitat types present, with a lower frequency of riffles in this reach.

Species	Count	Relative abundance (Individuals per 100m ²)	Minimum length (mm)	Maximum length (mm)
Shortfin eel	92	9.8	90	650
Longfin eel	8	0.9	190	1100
Cran's bully	127	13.6	15	65
Torrentfish	25	2.7	40	155
Inanga	13	1.4	60	105
Brown trout	1	0.1	NA	110
Elver	37	4.0	80	100
Koura	29	3.1	NA	NA

Table 3-11: Summary of species captured by electric fishing at Site 6.

Macroinvertebrates

This site was sampled according to MfE protocol C1 for hard-bottomed streams, with an area of approximately 1 m² sampled. Total taxa richness (24) and EPT richness (10) was slightly lower at this site, relative to the downstream survey reach (Table 3-12). It is likely that this

reflects the differences in habitat, with a greater proportion of riffles present in the downstream site. However, the MCI score (124.4) at this site is slightly higher than the downstream survey reach and falls into the 'excellent' quality class. The most abundant species present were *Elmidae* larvae and *Potamopygrus antipodarum*, followed by the trichoptera *Pycnocentrodes spp.*

Table 3-12: Macroinvertebrate scores at Site 6.

Parameter	Score
Total taxa richness	24
EPT richness	10
%EPT	41.7
MCI	124.4

Macrophytes and periphyton

Macrophyte cover was low, with marginal areas of *Glyceria maxima* being the main species present. The PEI (44.2) and PPI (36.8) were higher at this site, relative to the downstream site, primarily reflecting the presence of long green filamentous algae in the reach. Overall, however, periphyton was relatively low in abundance and primarily characterised by thin mats on the cobble substrate.

3.1.7 Site 7 – Unnamed tributary of the Homunga Stream downstream

Site characteristics

This site is located in the Ohinemuri sub-catchment and downstream of an irrigation abstraction. Mean wetted width at the time of the survey was approximately 3.0m. Habitat is dominated by pool and run habitat, with occasional riffles also present. The stream channel is quite incised and substrate was a combination of silt and gravel. Adjacent land-use was pasture, with both sides fenced. Additional details of habitat characteristics can be found in Appendix 1.

Fish

Only three fish species were captured during this survey (Table 3-13). It is likely this is a consequence of the Ohinemuri weir restricting upstream fish passage. Common bully² were most abundant (52.0 individuals per 100m²), followed by shortfin eel (22.2 individuals per 100m²). A broad size range of both species were present indicating regular successful recruitment to the reach and good downstream connectivity for eels. Longfin eels were relatively rare and those that were present were relatively large (>560mm).

Species	Count	Relative abundance (Individuals per 100m ²)	Minimum length (mm)	Maximum length (mm)
Shortfin eel	98	22.2	100	860
Longfin eel	3	0.7	560	900
Common bully ²	230	52.0	15	62
Koura	46	10.4	NA	NA

Table 3-13	Summary of	f species captured	by electric	fishing at Site 7.
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² Recent genetic work suggests that these may be Cran's bully (Dimetrus, unpublished data)

Macroinvertebrates

Site 7 was again sampled according to MfE protocol C1 for hard-bottomed streams, with an area of approximately 1 m² sampled. Samples were collected from riffles. Total species richness was 21, which is similar to the other sites sampled in this survey (Table 3-14). The dominant species numerically was the mollusca *Potamopygrus antipodarum*, with *Austroclima sepia* the most abundant EPT species. The abundance of EPT taxa was generally low, but they still accounted for approximately 43% of total species richness. The MCI score for the reach was 102.5 meaning the site is classified as being of 'good' quality.

Parameter	Score
Total taxa richness	21
EPT richness	9
%EPT	42.9
MCI	102.5

Table 3-14:	Macroinvertebrate	scores at	Site 7.

Macrophytes and periphyton

Aquatic macrophyte cover was again low. The main species identified was the native charophyte *Nitella hookeri*, which was present in very low abundance. Periphyton abundance was also relatively low with a PEI of 23.6. Periphyton primarily occurred in the form of thin and medium brown mats.

3.1.8 Site 8 – Unnamed tributary of the Homunga Stream upstream

Site characteristics

Site 8 is located upstream from Site 7 and the irrigation abstraction. Mean wetted width at the time of the survey was around 3.0m. The gradient of this reach is slightly higher than the downstream survey site, with a greater diversity of habitats including a greater proportion of riffles and a number of bedrock outcrops. Land-use on both banks is pastoral, but a larger riparian buffer exists at this site. Further details are available in Appendix 1.

Fish

The same species of fish were present in this reach as at Site 7, but at slightly lower relative abundance (Table 3-15). The dominant species was again common bully², followed by shortfin eels. A noticeable difference to Site 7, was the absence of the smallest size classes of common bully². The reason for this is unclear, but the presence of shortfin eel elvers at Site 8 suggests there is no major downstream barrier to eel migration. Koura (*Paranephrops planifrons*) the freshwater crayfish was relatively more abundant at this site.

Species	Count	Relative abundance (Individuals per 100m ²)	Minimum length (mm)	Maximum length (mm)
Shortfin eel	49	12.7	90	600
Longfin eel	3	0.8	650	850
Common bully ²	164	42.5	45	55
Koura	65	16.9	NA	NA

Table 3-15: Summary of species captured by electric fishing at Site 8.

Macroinvertebrates

Macroinvertebrates were again sampled according to MfE protocol C1 for hard-bottomed streams, with a riffle area of approximately 1 m² sampled. Total taxa richness (22) and percentage EPT (40.9%) were similar to Site 7 (Table 3-16). However, MCI was slightly lower at 101.2, but remains in the 'good' quality class. *Elimdae* larvae were the most abundant taxa present in the sample. The abundance of EPT taxa was also lower, relative to the downstream site.

Table 3-16:	Macroinvertebrate	scores	at Site 8.

Parameter	Score
Total taxa richness	22
EPT richness	9
%EPT	40.9
MCI	101.2

Macrophytes and periphyton

No macrophytes were recorded as present in the cross-sections that were surveyed. Occasional patches of *Nitella hookeri* were observed in the remainder of the reach. Periphyton was relatively abundant in the reach as reflected by a PEI score of 50.8 and PPI of 73.6. This occurred mainly in the form of a light brown thick mat of periphyton covering the stream bed.

3.1.9 Site 9 – Waiteariki Stream

Site characteristics

Site 9 is located on the Waiteariki Stream, below the Matamata public water supply abstraction. The stream has a mean wetted width of approximately 6m and is heterogeneous in character, being a mix of pools, riffles, runs and rapids. The substrate is primarily a mix of boulders and cobbles, with occasional gravel patches. The stream drains the Kaimai hills and the gradient is relatively steep at the location of the survey.

Fish

Six species of fish were captured during this survey (Table 3-17). Cran's bullies were the most common species in the reach, followed by both eel species. Torrentfish were also abundant in the riffle and rapid areas of the reach. A range of age classes were present for each of the four most abundant fish species, indicating that successful and regular recruitment is occurring in the reach. In combination with the presence of smelt, this also indicates good downstream connectivity with limited barriers to migration. One non-indigenous fish species, brown trout, was identified in the reach, with five juveniles captured. During the survey one fish, which was thought to be a galaxiid species was seen, but not captured. A relatively high abundance of koura were present (8.0 individuals per 100m²).

Species	Count	Relative abundance (Individuals per 100m ²)	Minimum length (mm)	Maximum length (mm)
Shortfin eel	14	1.5	100	420
Longfin eel	14	1.5	250	850
Cran's bully	34	3.7	25	55
Torrentfish	12	1.3	45	135
Smelt	1	0.1	NA	95
Brown trout	5	0.6	105	150
Unidentified galaxiid	1	0.1	NA	NA
Unidentified eel	3	0.3	NA	NA
Koura	73	8.0	NA	NA

Table 3-17: Summary of species captured by electric fishing at Site 9.

Macroinvertebrates

Twenty four different macroinvertebrate taxa were recorded from this site, including a relatively high percentage of EPT taxa (54%) relative to the other sites surveyed. The most abundant taxa was *Elmidae*. Key EPT taxa included *Zelandoperla decorate* and *Zeolessia cheira*. The MCI score for the reach was 125 placing it in the 'excellent' quality class.

Table 3-18: Macroinvertebrate scores at Site 9.

Parameter	Score	
Total taxa richness	24	
EPT richness	13	
%EPT	54.2	
MCI	125.0	

Macrophytes and periphyton

No macrophytes were recorded in the survey cross-sections. It is likely that their absence reflects the large substrate size, stream gradient and likely frequency of disturbance in the reach. Periphyton were present mainly in the form of thin films on the cobble substrate, resulting in a PEI of 17.2 and PPI of 0.0.

3.1.10 Site 10 – Wairere Stream

Site characteristics

Site 10 was located on the Wairere Stream and is used as a control with no abstraction for comparison to Site 9. Wairere Stream also drains the Kaimai hills and therefore experiences a similar flow regime to the adjacent Waiteariki Stream. The survey reach is primarily characterised by run and pool habitat with a gravel substrate, which contrasts with the more diverse habitat at Site 9. Mean wetted width was about 6.5m and riparian cover was quite dense with an overhead canopy present throughout the majority of the reach. Adjacent land-use is mainly pasture. Further details of the habitat characteristics can be found in Appendix 1.

Fish

Six different fish species were captured during the electric fishing survey (Table 3-19). The dominant species was shortfin eel (11.4 individuals per 100m²). Cran's bullies (4.2 individuals per 100m²) and koura (5.6 individuals per 100m²) were also present in relatively good numbers. One adult rainbow trout was present in the survey reach, located in the deepest pool close to instream woody debris. The presence of inanga, juvenile torrentfish and elvers indicate the downstream connectivity is good, with no significant barriers to migration.

Species	Count	Relative abundance (Individuals per 100m ²)	Minimum length (mm)	Maximum length (mm)
Shortfin eel	103	11.4	90	600
Longfin eel	4	0.4	600	1000
Cran's bully	38	4.2	40	70
Inanga	2	0.2	NA	105
Rainbow trout	1	0.1	NA	300
Torrentfish	6	0.7	45	60
Koura	51	5.6	NA	NA

Table 3-19:	Summary of	species	captured by	y electric	fishing at Site 10.
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Macroinvertebrates

The total number of taxa identified in the samples from this site was 22 (Table 3-20). The percentage of EPT taxa was very high (72.7%). There were seven ephemeroptera species present, including *Oniscigaster wakefieldi* which was only found at this site. The most abundant species were the mollusca *Potamopygrus antipodarum* and *Elmidae*. The high number of important EPT taxa contributed to a very high MCI score of 142.9.

Table 3-20: Macroinvertebrate scores at Site 1	0.
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Parameter	Score
Total taxa richness	22
EPT richness	16
%EPT	72.7
MCI	142.9

Macrophytes and periphyton

Minimal macrophytes were present in this reach, with only a small amount of *Nitella hookeri* identified in one cross-section. It is likely that this reflects the high level of shading and relatively flashy nature of the flow regime. The PEI for the reach was 13.3 reflecting the dominance of thin periphyton mats. The PPI was again low at only 5.1.

3.2 Comparison with 2009 results

Sites one to eight were all sampled using the same standardised protocols in 2009 (Franklin & Booker 2009) allowing comparison with the 2011 survey results.

As far as practicable, fishing effort during the 2011 survey attempted to replicate that of the 2009 survey. On average, fishing effort was slightly lower in 2011 (shock time mean 92% of 2009 values, SD±7%). This most likely reflects differences in operators and greater familiarity with the survey sites. At some sites, EFM voltage was slightly different between years, but this was to account for subtle differences in environmental variables and maintain fishing efficiency at equivalent levels. These differences are not thought to affect the comparability of the results. This is illustrated in comparisons of species diversity and species accumulation rates at each of the survey sites (Figure 3-1). These show that total species diversity was similar at all sites, with two sites showing no change, two sites with one additional species in 2011 and four sites with one less species in 2011, with the mean distance to capture of full diversity being 71.25m in 2011 (n=8) and 88.13m in 2009 (n=8).

In general, the differences in total diversity between years are a consequence of either the presence or absence of the highly mobile pelagic species such as smelt, inanga and trout (Figure 3-2). The high mobility of these species means they are more capable of avoiding capture by seeking refuge in deep water habitats where backpack electric fishing is less efficient, or by fleeing ahead of the electric field and beyond the survey reach (pers. obs.). At several of the sites, these species were also only present in relatively low abundance and thus the observed differences may only reflect a change of a single fish.

The standardised fishing protocol used for this survey is primarily designed for maximising the likelihood of capturing the full diversity of fish species present in a reach (David et al. 2010). However, the information collected can also be used to calculate estimates of relative abundance (individuals per 100m²). These values can be used to give an indication of interannual variability in fish numbers at a site, and as the number of surveys increases with time, an indication of potential long-term trends in fish numbers.

Figure 3-2 compares the relative abundance of each fish species captured, at each site, for the two survey years. At Site 1, the number of shortfin eel, inanga and koura was noticeably higher in the 2011 survey. It is our opinion that this largely reflects the slightly reduced abundance of aquatic macrophytes in the reach, which increased the effectiveness of the survey methodology.

At Site 2, there was a large reduction in the number of smelt captured in 2011, with smaller reductions in the number of shortfin eel and common bullies. During the 2009 survey, a number of large shoals of smelt were present and captured in the survey reach. In 2011 only one of these shoals was present in the reach at the time of the survey. A high level of natural variability in the relative abundance of such a mobile species is to be expected. Of greater significance is the presence of brown trout in the reach during the 2011 survey. It is known that in 2009, when no trout were present, this site experienced low dissolved oxygen conditions at summer low flows (Franklin 2010). Brown trout are known to be intolerant of low DO and it is possible the lack of brown trout in the 2009 survey was indicative of the poor DO. In 2011, summer flood events in mid-January are likely to have prevented low DO conditions developing in the reach, thus possibly allowing the brown trout to remain in this reach.

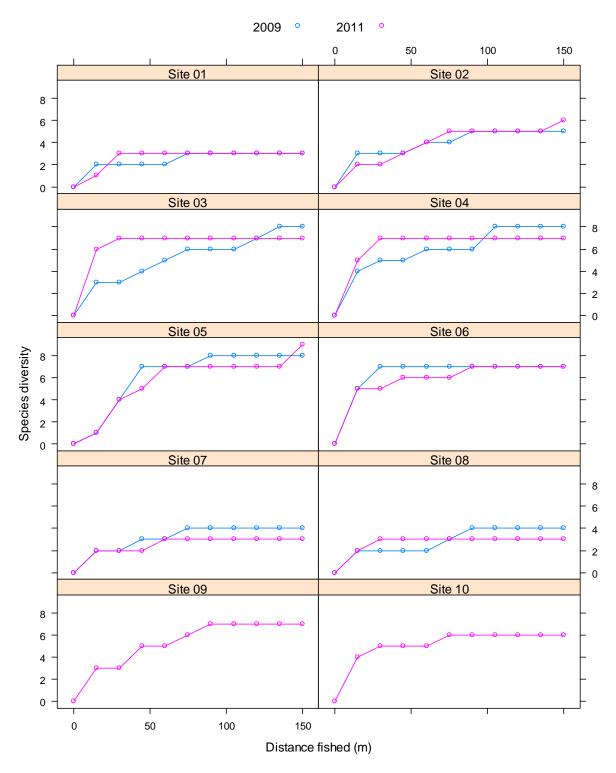
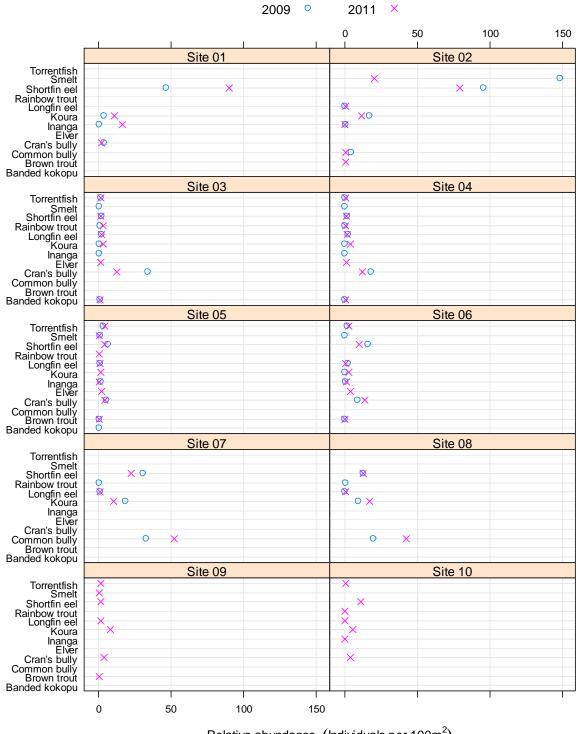


Figure 3-1: Comparison of fish species diversity between 2009 and 2011.

Similar patterns were observed at both Sites 3 and 4, with smelt and inanga both absent in the 2011 surveys, and a reduction in the number of Cran's bullies captured. At Sites 5 and 6, there was very little difference in the relative abundance of fish between the two survey years. The main difference was the absence of banded kokopu at Site 5 in 2011. At Site 7 and Site 8, the abundance of common bullies was higher in 2011, but rainbow trout were no longer present in either of the survey reaches.



Relative abundance (Individuals per 100m²)

Figure 3-2: Comparison between the relative abundance of fish captured in the 2009 and 2011 surveys. N.B. Recent genetic work suggests that the common bullies at Site 7 and 8 may be Cran's bullies (Demitrus, unpublished data).

The MCI score provides an aggregate summary of macroinvertebrate community structure and is used here as the best indicator of overall community changes between survey years. There is relatively little change in the MCI scores for each site between 2009 and 2011 (Figure 3-3). The biggest changes were observed at Site 5, where the MCI score improved from the 'good' to 'excellent' class, and Site 7 which improved significantly from the 'poor' to the 'good' quality class. The only site where the MCI score was lower in 2011 was Site 3, but it still remained in the 'excellent' quality class. The most notable difference is between sites, with those located in low gradient agricultural areas typically having a lower MCI score.

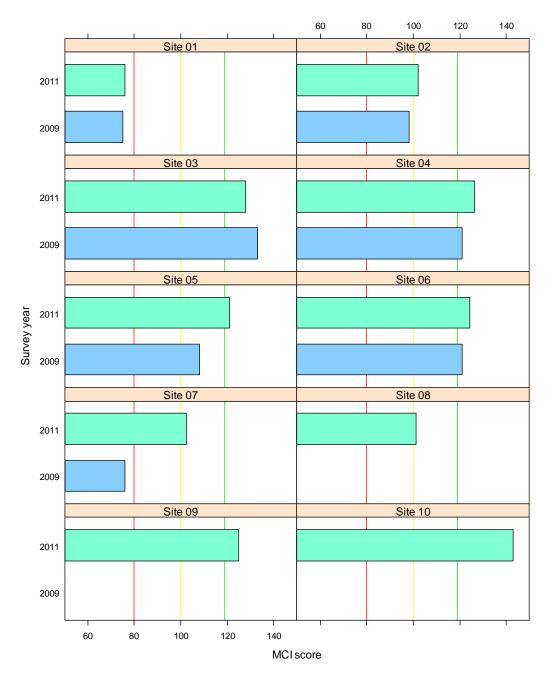


Figure 3-3: Comparison of MCI scores between survey years. Vertical lines indicate boundaries for quality classes. Anything below the red line is 'poor', between the red and yellow lines is 'fair', between the yellow and green lines is 'good' and above the green line is 'excellent' (Stark & Maxted 2007).

4 Conclusion

Knowledge of natural variability in ecological communities in New Zealand is relatively limited, but is essential for being able to distinguish and detect anthropogenic impacts on aquatic ecosystems. Establishment of long-term, regular ecological monitoring sites sets the foundation for addressing this knowledge gap and developing robust and defensible environmental management policies.

This report describes the results of the second round of ecological monitoring in the Waihou catchment. At present it is not possible to identify long-term temporal trends or distinguish patterns in natural population dynamics due to the small sample size. However, it is already becoming evident that, at the reach scale, populations of the more mobile, pelagic fish species are naturally more variable than those of the more cryptic benthic species. Fish species diversity also appears to be lower in the low gradient agricultural streams, relative to the steeper gradient streams with more intact riparian cover. A similar distinction between low gradient agricultural streams and the steeper gradient streams is also apparent in the MCI scores. At present, there is however no clear differences in the ecological communities of the control and impacted survey 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. Establishing and maintaining a routine ecological monitoring network allows the identification of values and develops an understanding of their status. This can be used to support development of appropriate management policies and as the length of the time series increases, allowing identification of trends and differences in community population dynamics over time and between sites, adaptive management strategies can be implemented.

5 Acknowledgements

The cooperation of all landowners, who have allowed us access to each of the monitoring sites, is greatly appreciated.

6 References

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Appendix 1: Field assessment and habitat assessment forms

Stream name: Dep	ression Stream	n			Assessor: Paul Franklin						
Site number: 1		Sample numbe	er: 1		Date: 2	2/02/1	1	Time: 17.00			
GPS coordinates		Downstream:		E27572	273		N63	86560			
		Upstream:		E27572	201		N63	86488			
Channel & ripar	ian features				Instrea	am h	ydraulio	c co	nditions		
Canopy cover:					Estimate	d or m	easured r	each	average:		
Open	Partly sh										
Fencing:	Dominant r	iparian vegetat	tion:		Stream	width	(active of	chan	nel): 4 m		
None/ineffective	Crops	Ret	tired veg	etation	Stream	width	(water):	2.1 ı	m		
One side/partial	Pasture	Nat	tive shru	b	Stream	depth	: 0.6 m				
Complete	Exotic tree	s Nat	tive tree	S	Surface	e veloo	;ity: 0.2 r	n s⁻¹			
Water quality											
Temperature:	22.0	°C			Conduc	tivity:		273	μS cn	'n	
Dissolved oxygen:	97	%			8.5			mg	-1	_	
Turbidity:	Clear	Slightly	turbid	Highly	turbid	Stair	ned		Other		
Stream-bottom	substrata										
Compaction (inor	ganic substra	ta):			% surfi compo			sub;	ostratum siz	е	
Assorted sizes tigh	tly packed &/o	r overlapping			Substra		Dimens	sion	Percentag	ne	
Moderately packed	• •				Bedrock -		-		1 oroontag	,-	
Mostly a loose ass					Boulder >256m						
No packing/loose		•			Cobble >64-25			6mm			
Embeddedness:					Gravel >2-64m			n			
(% gravel-boulder par	ticles covered by	/ fine sediment)			Sand >0.06-2			ım	50		
<5% 5-2	5% 26-50	0% 51-75%	%	>75%	Silt		0.004-0.0	6mm	50		
<5% 5-2	5% 26-50	0% 51-75%	%	>75%	Silt Clay		0.004-0.0 <0.004mr		50		
Ι		9% 51-75%	%	>75%	Clay	t tvp	<0.004mr	m			
Organic materia	ıl (% cover))% 51-759	%	>75%	Clay			m			
Organic materia Large wood (>10cr	n diameter)			> 75%	Clay Habita	ort)	<0.004mr	m plec			
Organic materia Large wood (>10cr	II (% cover) n diameter) 5% 26-50)% 51-75%	%		Clay Habita (% of eff	ort)	<0.004mr	m			
Organic materia Large wood (>10cr <5% 5-2	II (% cover) n diameter) 5% 26-5(nall wood, stick)% 51-75% (s, leaves etc. :	% >1mm)		Clay Habita (% of eff Stones:	ort)	<0.004mr	m plec %	ł		
Organic materia Large wood (>10cr <5%	II (% COVER) n diameter) 5% 26-50 nall wood, stick 5% 26-50)% 51-75% (s, leaves etc. :	% >1mm)	>75%	Clay Habita (% of eff Stones: Wood: Macrop	ort) hyte:	<0.004mr	m plec % %	Riffles:		
Organic materia Large wood (>10cr <5% 5-2 Coarse detritus (sr	II (% cover) n diameter) 5% 26-50 nall wood, stick 5% 26-50 inic deposits)% 51-75% ks, leaves etc. :)% 51-75%	% >1mm) %	>75%	Clay Habita (% of eff Stones: Wood: Macrop Edges:	ort) hyte: 50	<0.004mr	m plec % % %	Riffles: Runs: 100		
Organic materia Large wood (>10cr <5%	I (% cover) n diameter) 5% 26-50 nall wood, stick 5% 26-50 ic deposits 5% 26-50 ic deposits 5% 26-50)% 51-75% ks, leaves etc. :)% 51-75%	% >1mm) %	>75% >75%	Clay Habita (% of eff Stones: Wood: Macrop Edges:	ort) hyte: 50 r of in	<0.004mr es sam 50	m plec % % % %	Riffles: Runs: 100		
Organic materia Large wood (>10cr <5%	II (% cover) n diameter) 5% 26-50 nall wood, stick 5% 26-50 ic deposits 5% 26-50 cover (% stream))% 51-75% ks, leaves etc. :)% 51-75%	% >1mm) %	>75% >75%	Clay Habita (% of eff Stones: Wood: Macrop Edges: Numbe Koura:	ort) hyte: 50 r of in	<0.004mr es sam 50	m plec % % % % % ses re Shri	Riffles: Runs: 100 eturned: mps: O		
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Wadeable Soft-B	otto	med	l St	rear	ns																
Qualitative Habitat A					Data	She	et														
Stream name: Depre	essio	n Sti	eam	-			_			-	ber:										
Sample number: 1	1			A	sses	sor:	Pau	l Fra					Date	e: 09,	/03/0)9					
Habitat parameter		O	ptim	al			Sub	oopti		Cate	egory		argin	nal				Poo	r		
1. Riparian vegetative zone width	•	Bank vege >10r Cont dens	tation n inuou	n buff	er	•	vege is <1	kside etatior 0m tly co	n buff			Path and/o Most over	or sto	ck	ent	•					
Left bank:	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	
Right bank:	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	
Mean: 6																	1	1			
2. Vegetative protection	•	imme ripar cove vege Tree store non- pres Vege	ediate ian ze red b station s, un ey shi wood ent etativ	ones by nat der- rubs o ly pla	ive or nts	•	cove nativ Disru Bank	c surf red n re veç uptior cs ma red b stry	nainly getati n evid ay be	on lent	•	Bank cove mixtu grass black & intr spec Vege disru Bare cropp vege com	red b ure of ses/sl berry roducties etation ption soil/co bed tatior	y hrubs , will ced n obvie close	ow	 Bank surfaces covered by grasses & shrubs Disruption of stream bank vegetation very high Grass heavily grazed Significant stock damage to bank 					
Left bank:	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	
Right bank:	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	
Mean: 5																					
3. Bank stability	•	Banł Eros failui abse <5% affec	ion/b e nt/mi of ba	ank inima	I	 Moderately stable Infrequent, small areas of erosion mostly healed over 5-30% of bank eroded 						Mode unsta 30-60 reach of ere High poter flood	able 0% of h has osion erosi htial c	f ban area	S	 Unstable Many eroded areas 60-100% of bank has erosional scars 					
Left bank:	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	
Right bank:	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	
Mean: 15		<u> </u>		<u> </u>	<u> </u>							·					<u> </u>				
4. Channel sinuosity	•	strea time	ım lei s long	reasingth 3 ger th traigh	3-4 an	•	strea times	ds inc am lei s long vas 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 s	straig	ht	
Score: 14	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	
5. Channel alteration	•	abse Strea	nel/d nt/mi am w	lredgi inima	I	•	channel/dredgingEvidence of past channel/dredging						ankm struc ent or s 0% of	dredg nents/ ctures n both f read ed &	/sh s n	 Banks shored with gabion/cement >80% of stream reach channelized or disrupted Instream habitat altered/absent 					
Score: 15	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	

Habitat parameter			atego Optim			Ha	bitat	para	amet	er			atego ptim			Ha	bita	Habitat parameter						
6. Sediment deposition	•	poin <20 affect sedi	e/no is t bars % of t cted b ment osition	s pres pottor by	sent	•	New bar fe most grave fine s 20-50 affec Sligh in po	orma ily fro el, sa sedim 0% o ted it dep	tion, om and 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 osits a ructio trictic	ne on ol f bott	d & om	•	 fine material Increased bar development >80% of bottom changing frequently Pools almost absent due to sediment deposition 							
Score: 5	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1				
7. Pool variability	•	mixe Larg large sma	ls eve ed ge/sha e/dee ill/sha ill/dee	allow, p, llow,		•	Majo large Very pools	/dee few :	p'		•		alenc ow p			•		ority o all/sha		IS				
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	•	favo inve colo wide woo riffle Sna subr logs banl prov abun cove	nerge /unde ks/col vides ndant	e for ate on & ety of bris, ot mate ed ercut obles fish be ne	ts	•	30-50 favou inver color Snag subn logs/ bank Fish comr Mode of ha can some mate	urable tebra nisations gs/ nerge unde s/cot cove mon erate ubitat cons e nev	e for ate on ed ercut obles r varie type: ist of	ety 5.	•	favor inver color Fish 60-9 easil foot Woo rare	urable tebra cove 0% s y mo dy de or ma	ite on ubstr ved b ebris ay be	chy ate y	•	 favourable for invertebrate colonisation Fish cover rare or absent Substrate unstable or lacking 							
Score: 5	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1				
9. Periphyton	•	evid held (ma woo	phyto ent or subs croph d etc. ments	n han trates ytes,) or fi	id s	•	Perip visibl subs obvio	le on trates	s but		•	<20% avail	6 cov	n visi ver of s		•	obv >20 ava	iphyto ious & % co ilable strate	k proli ver of					
Score: 12	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1				
TOTAL SCORE: 89																								

Stream name: Kare	ngorengo Str	eam			Assessor: Brenda Aldridge							
Site number: 2		Sam	ple number: 2		Date: 2	22/02/1	1 T	ïme:	17:45			
GPS coordinates		nstream:	E2758	628	N	16384	4754					
		Upst	E2758	672	Ν	16384	4606					
Channel & riparia	an features	5			Instre	am h	ydraulic	con	ditions			
Canopy cover:		Estimat	ed or m	easured rea	ach av	/erage:						
Open	Partly sh											
Fencing:	Dominant	riparia	an vegetation:		Stream	n width	(active ch	anne	el): 3			
None/ineffective	Crops		Retired v	egetation/	Stream	n width	(water): 2	.3				
One side/partial	Pasture		Native sh	nrub	Stream	n depth	n: 0.4					
Complete	Exotic tree	S	Native tre	es	Surfac	e veloo	city: 0.2					
Water quality												
Temperature:	20.1		°C		Condu	ctivity:		43	µS cm			
Dissolved oxygen:	80		%		7.5		n	mg l⁻¹				
Turbidity:	Clear		Slightly turb	id Highly	turbid	Stai	ned	С	other			
Compaction (inorg	anic substra	ata):			compo	osition): 		tratum size			
Assorted sizes tight	y packed &/c	or ove	rlapping		Substr	Substratum Dim		on	Percentage			
Moderately packed			-		Bedroo	Bedrock -						
Mostly a loose asso			•			Boulder >256m						
No packing/loose a	assortment e	easily	moved			Cobble >64-25						
Embeddedness:						Gravel >2-6-			35			
(% gravel-boulder parti		-	1	I	Sand	>0.06-2mm	00					
<5 % 5-25	% 26-5	0%	51-75%	>75%	Silt Clay		0.004-0.06r <0.004mm	nm	5			
Organic material	(% aavar)				,	at tura						
Large wood (>10cm	• •				(% of ef		es samp	ieu				
<5% 5-25	· · · ·	00/	51-75%	>75%	Stones	,	%	I				
Coarse detritus (sm					Wood:		%	Piff	iles: 9			
<5% 5-25	1		51-75%	>75%	Macron		80 %					
Fine (<1mm) organi		070	017070	21070	Edges		20 %	T CO	10. 100 /			
<5% 5-25	· · ·	0%	51-75%	>75%	Number of invertebrates returned:							
Instream plant co					Koura:		1	Shrimps: A				
Filamentous algae &	Crabs:			Mussels:								
<5% 5-25												
Macrophytes:	1 0				Musse	l type:						
<5% 5-25	% 26-5	0%	51-75%	>75%	Hyride			Cucui	merunio			
Mosses/liverworts:	I		I	I								
1	% 26-5	0%	51-75%	>75%								
<5% 5-25												

Wadeable Soft-B	otto	moc	64	oar	20															
Qualitative Habitat A						She	et													
Stream name: Karen	igore	engo	Stre	am					Site ı	numl	ber: 2	2								
Sample number: 2				A	sses	ssor:	Brer	nda /	Aldrid	dge			Date	e: 22/	/02/1	1				
										Cate	gory									
Habitat parameter		0	ptim	al			Sub	oopti					argir	nal				Poo	r	
1. Riparian vegetative zone width	•	Bank vege >10n Cont dens	tation n inuor		er	•	vege is <1	kside etatior Om tly co			•	Path and/o Most over	or sto	ck	ent	•		nan a	equer ctivity	
Left bank:	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Right bank:	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Mean: 7.5				1				1		1								1		1
2. Vegetative protection	•	vege Trees store non-v prese Vege	ediate an ze red b tation s, un y shi wood ent etativ	e ones by nat n der- rubs o ly pla	ive or nts	•	cove nativ Disru Bank	c surf red n re veg uptior cs ma red b stry	nainly getati n evid iy 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 Disru strea vege high Gras graz Sign	ered b ses & uption am ba etatio ss he ed ificar	shru n of ank n very	/ :k
Left bank:	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Right bank:	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Mean: 8																				
3. Bank stability	•	Bank Eros failur abse <5% affec	ion/b e nt/mi of ba	ank nima	I	•	Infreater areat most over	% of	t, sma erosio aled	all n	•	Mode unsta 30-60 reach of ere High poter flood	able 0% o n has osion eros ntial o	f ban area	S	•	Man area 60-1	00% erosi	of ba	nk
Left bank:	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Right bank:	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Mean: 8.5																				
4. Channel sinuosity	•	Benc strea times if it w	m lei s long	ngth : ger th	3-4 an	•	strea times	ds inc am lei s long vas st	ngth 2 ger th	2-3 an		Benc strea times if it w	m ler s long	ngth ' ger th	I-2 an	•	Cha	nnel	straig	ht
Score: 10	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
5. Channel	L			to		•	Som	e cha	inges	to	•	Char	nel			٠		ks sh	ored	
alteration	•	Strea	nel/d nt/mi am w	redgi nima	I	•	chan Evide chan Rece chan	inel/d ence inel/d	of pa redgi redgi	ist ng	•	chan exter Emb oring prese bank 40-80 Char disru	ankm strucent of s 0% o nneliz	ients/ ctures	ˈsh s n	•	>80° reac char disru Instr	on/ce % of : h neliz upted eam	ement strean ed or habita osent	n at

Habitat parameter			atego Optim			Ha	bitat	para	amet	er			atego ptim			Ha	bita	t para	amet	er
6. Sediment deposition	•	poin <20 affect sedi	e/no is t bars % of t cted b ment osition	s pres pottor by	ent	•	bar for most grave fine s 20-5 affect	ted t dep	tion, m nd or nent f bott	om	•	of ne sand sedir new 50-8 affec Sedi depc obstr	w gra or fin hent bars 0% o ted ment sits a ructio trictic	ne on ol f bott	d & om	•	fine lncr dev >80 cha freq Poc abs sed	avy de mate eased elopm % of l nging uently ols alm ent du iment ositio	rial d bar hent bottor / nost ue to	
Score: 16	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
7. Pool variability	•	mixe Larg large sma	ls eve ed ge/sha e/dee ill/sha ill/dee	allow, p, llow,		•	large	rity o /deej few s	p		•	Prev shall	alenc ow p			•		ority o all/sha		IS
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	•	favo inve colo wide woo riffle Sna subr logs banl prov abui cove	nerge /unde ks/col vides ndant	e for ate on & ety of bris, ot mate ed ercut obles fish be ne	ts	•	favor inver color Snag subn logs/ bank Fish com Mode of ha Can	nerge unde s/cot cove mon erate bitat consi e new	e for ate on ed rcut obles r varie types ist of	ety 5.	•	favor inver color Fish 60-9 easil foot Woo rare	urable tebra cove 0% s y mo dy de or ma here	ite on ubstr ved b ebris ay be	chy ate yy	•	favo inve colo Fish abs Sub uns lack Stal lack	strate table	e for ate on er rare or bitats r limite	e or
Score: 11	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
9. Periphyton	•	evid held (ma woo	phyto ent or subs croph d etc. ments	n han trates ytes,) or fi	id S	•	visib subs	ohyto le on trates ous to	s but		•		6 cov able	n visi ver of s		•	obv >20 ava	iphyto ious & % cov ilable strate	k proli ver of	
Score: 16	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
TOTAL SCORE: 100)																			

Stream name: Paiak	arahi Strear	m (d/s)			Ass	essor: Pa	ul Franklir	1	
Site number: 3		Sam	ole number: 3		Dat	e: 23/02/	11 7	ime:	11:40
GPS coordinates		Dowr	nstream:		E27	51347	١	16429	422
		Upsti	ream:		E27	51418	١	16429	342
Channel & riparia	an feature	S			Ins	tream h	ydraulic	conc	litions
Canopy cover:					Estir	nated or m	easured rea	ach av	erage:
Open	Partly s	shaded	l Very	/ shaded					
Fencing:	Dominant	riparia	an vegetation:		Stre	am width	(active ch	anne): 8 m
None/ineffective	Crops			vegetatio			(water): 5	m	
One side/partial	Pasture		Native	shrub		am depth			
Complete	Exotic tree	es	Native	trees	Sur	ace velo	city: 0.3 m	S ⁻¹	
Water quality									
Temperature:	18.2		°C		Con	ductivity:		09	µS cm⁻¹
Dissolved oxygen:	85		%		8.0		r	ng l ⁻¹	
Turbidity:	Clear		Slightly turb	id Hig	hly turbid	Stai	ned	O	ther
Stream-bottom s	ubstrata								
Compaction (inorg	anic substr	ata):				urficial in apositior		subst	ratum size
Assorted sizes tight	y packed &/	or ove	rlapping		Sub	stratum	Dimensi	on	Percentage
Moderately packed	with some	overla	apping		Bed	rock	-		
Mostly a loose asso	rtment with I	ittle ov	erlap		Bou	lder	>256mm		5
No packing/loose as	sortment ea	sily mo	oved		Cob	ble	>64-256mr	n	85
Embeddedness:					Gra	vel	>2-64mm		10
(% gravel-boulder parti	cles covered b	by fine s	sediment)		San	d	>0.06-2mm	1	
<5% 5-25	% 26-5	50%	51-75%	>75%	Silt		0.004-0.06	mm	
					Clay		<0.004mm		
Organic material					Hal	oitat typ	es samp	led	
Large wood (>10cm	· · ·		I	1	(% c	f effort)		1	
<5% 5-25			51-75%	>75%		nes:	100%		
Coarse detritus (sma	1		1	ı [′]	Woo	od:	%	Riffl	
<5% 5-25 °		50%	51-75%	>75%		rophyte:	%	Run	IS: %
Fine (<1mm) organi			1	1	Edg		%		
<5% 5-25			51-75%	>75%			vertebrate		
Instream plant co		eambe	d area)			ra:C		Shrimp	
Filamentous algae &			I	1	Cra		Ν	/lusse	ls:
<5% 5-25°	% 26-5	0%	51-75%	>75%					
••	v ~~ -			—— ——————————————————————————————————		sel type:		_	
Macrophytes:	% 26-5	0%	51-75%	>75%	Hyr	idella		Jucun	nerunio
<5% 5-25	I				1				
	1		51-75%	>75%					

Wadeable Hard-E Qualitative Habitat A						Sha	ot													
Stream name: Paiak						one			Site i	numt	ber :	3								
Sample number: 3	ara		oum	· /	sses	sor:	Pau			-		-	Date	: 23	/02/1	11				
•										Cate	gory									
Habitat parameter		С	ptim	al			Sub	oopti					argin	nal				Poo	r	
1. Riparian vegetative zone width	•	vege >10r	n tinuoi	n buff us &	er	•	is <1	tatior 0m	n buff ntinu		•	Path and/o Most over	or sto	ck	ent	•		nan a	equei ctivity	
Left bank:	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Right bank:	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Mean: 19.5	-				1		1			1								1	1	1
2. Vegetative protection	•	imm ripar cove vege Tree store non- pres Vege	ediate ian ze ered b etation es, un ey shi wood ent etativ	ones by nat der- rubs o ly pla	ive or nts	•	nativ Disru Bank	ered n 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/sl berry roducties etation ption soil/co bed tatior	y hrubs , will ced n obvi	ow	•	cove gras Disr strea vege high Gras graz Sign	ered b ses 8 uption am ba etation ss hea ed iificar	shru n of ank n ver	ubs y ck
Left bank:	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Right bank:	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Mean: 20																				
3. Bank stability	•	Eros failu abse	ent/mi	ank inima	I	•	Infreater areat most over	quen s of e tly he % of	ly sta t, sma erosio aled bank	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	ink
Left bank:	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Right bank:	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Mean: 14																				
4. Frequency of riffles	•	frequ Dista riffle strea	uent ance s divi am wi ety of	ativel betwe ded k dth= habi	een by 5-7	•	Dista riffles	s infre ance s divi	ce of equer betwe ded b dth=7	een 9y	•	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 y	•	wate riffle Poo Dista riffle	s r habi ance s divi	allow	een oy
Score: 17	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
5. Channel alteration	•	char abse Strea	ent/mi 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 Emba oring prese bank 40-80 chan disru	ges/o nsive ankm struc ent or s 0% of nelize	ients, cture: n botl	/sh s n	•	with gabi >80° reac char disru	on/ce % of s h nneliz upted ream	ement strear	m r at

Habitat parameter	-		atego ptim			Ha	bitat	para	amet	er			atego ptim			Ha	abitat	para	amet	er
6. Sediment deposition	•	<pre>point <20% affect seding </pre>	bars		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 50-80 affec Sedir depo obstr	0% of ted ment sits a ructio trictic	avel, ne on ol f bott f bott ns,	d & om	•	fine Incrededeve >809 char frequ Pool abse sedii	vy de matei eased elopm % of k iging uently s alm ent du ment ositior	ial bar ent oottor ost e to	
Score: 14	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 st/sha ing th e low	iresei Ilow i nen		•	regin If fas slow/	4 nes p t/sha /shall ing, s	reser llow o ow a	or	•	velo regir	inate city/do ne ally de	əptń	
Score: 16	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 prov abur cove	urable tebra isati varie dy de s, roc gs/ nerge unde s/col ides idant r	ate on & ety of bris, of mate ed ercut obles fish be ne	S	•	favor inver color Snag subn logs/ bank Fish com Mode of ha Can	nerge /unde ss/colt cove mon erate abitat cons e nev	e for ate on ed rcut obles r varie types ist of	ety 5.	•	favou inver color Fish 60-9 easil foot Woo rare	nisatio cove 0% so y mov dy de or ma hereo	e for te on ubstra ved b bris 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: 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 bstrat rough	d te	•	visib Stab Perip	ohyto le on le sul ohyto ous to	ston bstra n	es te	•	<20% avail	ohytor 6 cov able trates	er of		•	obvi >209 avail	ohyto ous & % cov able trates	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: 140).5																			

eriounn name. Falana	arahi Stream (u/	s)		Assess	or: Pa	ul Franklir	1	
Site number: 4	Sar	nple number:		Date: 2	3/02/1	1 T	ïme:	14:50
GPS coordinates	Dov	wnstream:		E27514	431	N	642	9122
	Ups	stream:		E2751	550	Ν	642	9031
Channel & riparia	n features			Instre	am h	ydraulic	con	ditions
Canopy cover:				Estimate	ed or m	easured rea	ach a	verage:
Open	Partly shad	ed Very	shaded					
Fencing:	Dominant ripa	rian vegetation:		Stream	width	(active ch	anne	el): 12 m
None/ineffective	Crops	Retired v	egetation	Stream	width	(water): 7	m	
One side/partial	Pasture	Native sl	hrub	Stream	depth	i: 0.3 m		
Complete	Exotic trees	Native to	rees	Surface	e veloo	city: 0.35 n	า s ⁻¹	
Water quality								
Temperature:	18.2	°C		Condu	ctivity:		09	µS cm⁻¹
Dissolved oxygen:	85	%		8.0		n	ng l ⁻¹	
Turbidity:	Clear	Slightly turbic	d Highly	turbid	Stair	ned	C	Other
Compaction (inorga				compo	sition	:		tratum size
Assorted sizes tightly	•			Substra		Dimensi	on	Percentage
Moderately packed				Bedroc		-		
Mostly a loose assor		•		Boulde		>256mm		30
No packing/loose as	sortment easily r	noved		Cobble		>64-256mn	ר	70
Embeddedness:	les several buffe			Gravel		>2-64mm		
(% gravel-boulder partic	1	- I - I		Sand		>0.06-2mm 0.004-0.06i		
<5% 5-25%	6 26-50%	51-75%	>75%	Silt Clay		<0.004-0.001		
Organia material	(%)				* * * * *	es samp	lad	
Organic material Large wood (>10cm	. ,			(% of eff		es samp	ieu	
<5% 5-25%	,	51-75%	>75%	Stones	,	100%		
Coarse detritus (sma				Wood:	•	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	Rif	fles: 100 %
<5% 5-25%	1	51-75%	>75%	Macrop	hvte:	%	Ru	
Fine (<1mm) organic		1		Edges:		%		
< 5% 5-25%	-	51-75%	>75%	Numbe	r of in	vertebrate	s ret	urned:
Instream plant co	ver (% streamb	ped area)		Koura:	0	s	hrim	ips: R
Filamentous algae &		,		Crabs:		N	luss	els:
<5 % 5-25 %	6 26-50%	51-75%	>75%	Other:				
Macrophytes:	I	· I		Mussel	type:			
<5% 5-25%	6 26-50%	51-75%	>75%	Hyride	la	0	Cucu	merunio
	·	-						
Mosses/liverworts:						1		

Wadeable Hard-B Qualitative Habitat A						She	et													
Stream name: Paiak									Site ı	numl	ber: 4	4								
Sample number: 4				· /		sor:	Pau	l Fra		-			Date	: 23	/02/1	1				
Habitat parameter		O	ptim	al			Sub	oopti		Cate	egory		argin	nal				Poo	r	
1. Riparian vegetative zone width	•	Bank vege >10r Cont dens	etatio n inuo	n buff	er	•	Bank vege is <1	side tatior 0m			•	Path and/o Most over	or sto	ck	ent	•		aks fro nan ao ous	•	
Left bank:	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Right bank:	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Mean: 20								L						L						
2. Vegetative protection	•	imme ripar cove vege Tree store non- pres Vege	ediate ian z red b etation s, un ey she wood ent etativ	ones by nat der- rubs o ly pla	ive or nts	•	cove nativ Disru Bank	e veo uptior s ma red b	nainly getati n evic	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 close	s, low ous	•	cove gras Disr strea vege high Gras graz Sigr	ss he	by & shru ank n very avily avily	ubs y ck
Left bank:	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Right bank:	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Mean: 17																				
3. Bank stability	•	Eros failui	re ent/m of ba	ank inima	I	•	Infreater areat most over	quen s of e ly he % of	ly sta t, sma erosic aled bank	all n	•	Mode unsta 30-60 reach of ero High poter flood	able 0% of n has osion erosi ntial c	f ban area	as	•	Man area 60-1	00% erosi	of ba	nk
Left bank:	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Right bank:	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Mean: 14														l						
4. Frequency of riffles	•	frequ Dista riffles strea	uent ance s divi am wi ety of	ativel betwe ded k dth= habi	een y 5-7	•	riffles Dista riffles	s infre ance s divi	ce of equer betwe ded b dth=7	nt een by	•	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 oy	•	wate riffle Poo Dist riffle	erally er, shi s r habi ance s divi am wi	allow itat betwe ded b	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	•	abse Strea	nel/c nt/m am w	lredgi inima	I	•	chan Evide chan Rece chan	inel/d ence inel/d ent	anges iredgi of pa iredgi iredgi nt	ing ist ing	•	Char chan exter Emba oring prese bank 40-80 chan disru	ges/c nsive ankm struc ent or s 0% of nelize	ients, cture n bot	/sh s h	•	with gabi >80 read char disru	on/ce % of s	ement strear ed or habita	m at
Score: 20	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	•	<pre>point <20% affect seding </pre>	t bars % of b	,	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	l or fir ment bars 0% o ted ment sits a ructio trictic	avel, ne on ol f bott at ns,	d & om	•	fine Incrededededededededededededededededededed	vy de mate easec elopm % of b nging uently s alm ent du ment osition	rial l bar ent pottor nost lie 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 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 /shall	iresei llow o ow a	or	•	velo regir	ninate city/d ne ally de	epth	
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 riffles Snag subn 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	•	favor inver color Snag subn logs/ bank Fish com Mode of ha Can	nerge /unde ss/col cove mon erate abitat cons e nev	e for ate on ed rcut obles r varie types ist of	ety	•	favou inver color Fish 60-9	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 Sub unst lack Stat lack	strate able (e for ate 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	• •			er of		•	obvi >20° avai	phyto ous 8 % cov lable strate	proli ver 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: 148	3																			

Stream name: Omal	nu Stream (d	/s)				Assess	or: Pa	ul Franklir	١	
Site number: 5		Sam	ple number:			Date: 2	4/02/1	1 1	Time:	11:45
GPS coordinates		Dow	nstream:			E2746	560	١	1643	5409
		Upst	ream:			E27466	610	١	1643	5540
Channel & riparia	an features	;				Instre	am h	ydraulic	con	ditions
Canopy cover:						Estimate	ed or m	easured rea	ach av	verage:
Open	Partly s	hade	d Ver	y shao	ded					
Fencing:	Dominant	riparia	an vegetation:	:		Stream	width	(active ch	nanne	el): 10 m
None/ineffective	Crops		Retired	d vege	tation	Stream	width	(water): 6	m	
One side/partial	Pasture		Native	shrub		Stream	depth	i: 0.25 m		
Complete	Exotic tre	es	Native	trees		Surface	e veloo	city: 0.2 m	s ⁻¹	
Water quality										
Temperature:	18.3		°C			Condu	ctivity:		37	μS cm
Dissolved oxygen:	83		%			7.8		r	ng l ⁻¹	
Turbidity:	Clear		Slightly turb	bid	Highly t	urbid	Stair	ned	С	Other
Stream-bottom s	ubstrata									
Compaction (inorg	anic substra	ata):				% surf compo	icial ir	norganic : :	subs	tratum size
Assorted sizes tight	y packed &/c	or ove	rlapping			Substra	atum	Dimensi	on	Percentage
Moderately packed	with some	overl	apping			Bedroc	k	-		
Mostly a loose assor	rtment with lit	ttle ov	verlap			Boulde	r	>256mm		
No packing/loose as	sortment eas	sily m	oved			Cobble		>64-256mr	n	80
Embeddedness:						Gravel		>2-64mm		20
(% gravel-boulder partie	cles covered b	y fine	sediment)			Sand		>0.06-2mm	n	
<5% 5-25 °	% 26-5	0%	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% 5-259	% 26-5	0%	51-75%	>	75%	Stones	:	100%		
Coarse detritus (sma	all wood, stic	ks, le	aves etc. >1m	nm)		Wood:		%	Rif	fles:
<5% 5-259	% 26-50	0%	51-75%	>	75%	Macrop	-	%	Ru	ns: 100
Fine (<1mm) organic			1			Edges:		%		
<5% 5-259	% 26-5	0%	51-75%	>	75%	Numbe	r of in	vertebrate	s reti	urned:
Instream plant co		ambe	ed area)			Koura:		5	Shrim	ips:
Filamentous algae 8			1			Crabs:		N	Auss	els:
<5% 5-259	% 26-5	0%	51-75%	>	75%	Other:				
	1		1			Mussel				
	% 26-5	0%	51-75%	>	75%	Hyride	la	0	Cucu	merunio
Macrophytes: <5% 5-259										
	% 26-50		51-75%	1	75%					

Wadeable Hard-E Qualitative Habitat A						She	ot													
Stream name: Omal					Jala	One			Site i	numt	er f	5								
Sample number: 5			. (a,	-	sses	sor:	Pau					-	Date	: 24	/02/1	11				
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 tinuoi	n buff us &	er	•	is <1	tatior 0m	n buff ntinu			Path and/o Most over	or sto	ck	ent	•		nan a	equei ctivity	
Left bank:	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Right bank:	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Mean: 12		1																		
2. Vegetative protection	•	imm ripar cove vege Tree store non- pres Vege	ediate ian ze ered b etation es, un ey shi wood ent etativ	ones by nat der- rubs o ly pla	ive or nts	•	nativ Disru Bank	ered n re veç uptior ks ma red b	nainly getati n evid	on lent	•	Bank cove mixtu grass black & intr spec Vege disru Bare cropp vege comr	red b ure of ses/sl cberry roducties etation ption soil/c bed tatior	y hrubs , will ced n obvi	ow	•	cove gras Disr strea vege high Gras graz Sigr	ered b ses 8 uption am ba etation ss hea ed iificar	shru n of ank n ver	ubs y ck
Left bank:	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Right bank:	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Mean: 10																				
3. Bank stability	•	Eros failu abse	ent/mi	ank inima	I	•	Infreater areat most over	quen s of e tly he % of	ly sta t, sma erosio aled bank	all n	•	Mode unsta 30-60 reach of ero High poter flood	able 0% of n has osion erosi ntial c	f ban area	S	•	Man area 60-1	00% erosi	of ba	ınk
Left bank:	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Right bank:	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Mean: 16.5																				
4. Frequency of riffles	•	frequ Dista riffle strea	uent ance s divi am wi ety of	ativel betwo ded b dth= habi	een by 5-7	•	Dista riffles	s infre ance s divi	ce of equer betwe ded b dth=7	een 9y	•	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 y	•	wate riffle Poo Dist riffle	s r habi ance s divi	allow	een Dy
Score: 8	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	inel/d ence inel/d ent	anges redgi of pa redgi redgi nt	ng Ist ng	•	exter Emba oring	ges/c nsive ankm struc ent or s 0% of nelize	ients, cture: n botl	/sh s n	•	with gabi >80 read char disru	on/ce % of s h nneliz upted ream	ement strear	m at
		1						-	-	-								1	1	1

Habitat parameter			atego ptim			Ha	bitat	para	amet	er			atego ptim	•		Ha	abitat	para	amet	er
6. Sediment deposition	•	<pre>point <20% affect seding </pre>	bars	,	ent	•	bar for most	0% o ted it 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 fir nent bars 0% o ted ment sits a ructio trictic	avel, ne on ol f bott at ns,	d & om	•	fine Incrededededededededededededededededededed	vy de matei eased elopm % of t iging uently s alm ent du ment ositior	ial bar ent oottor ost e to	
Score: 16	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
7. Velocity/depth regimes	•	regin Slow slow	nes p /deej /shall shallo	ów,		•	regin If fas miss	city/de	resei Ilow i ien		• •	2 of 4 veloc regin If fas slow/ miss low	t/shall	resei llow o ow a	or	•	velo regir	inate city/de ne ally de	əptń	
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 prov abur cove	urable tebra isatio varie dy de s, roo gs/ nerge unde s/cot ides idant r	te on & ety of bris, t mat rcut obles fish oe ne	S	•	favou inver color Snag subm logs/ bank Fish comm Mode of ha Can	herge junde s/cot cove mon erate bitat consi e new	e for ite on ed rcut 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% si y mo y mo dy de or ma here	e for ite on r pato ubstrived b ebris ay be	chy ate y	•	favo inve colo Fish abse Subs unst lacki Stab	strate able o	e for ite on r rare or bitats limite	e or
Score: 12	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 sul aces	n not n han es bstrat rough	d te	•	visibl Stab Perip	ohyto le on le sul ohyto ous to	ston bstra n	es te	• •	Perip <20% avail subs	able	er of		•	obvi >209 avai	ohyto ous & % cov able trates	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: 107	' .5																			

Stream name: Omal	hu Stream (u	/s)				Assess	or: Pa	ul Franklir	۱		
Site number: 6		Sam	ple number: 6	6		Date: 2	4/02/1	1 T	ime:	14:40	
GPS coordinates		Dow	nstream:			E27466	688	١	1643	5516	
		Upst	ream:			E27468	306	Ν	16435	5488	
Channel & riparia	an features	;				Instre	am h	ydraulic	con	dition	S
Canopy cover:						Estimate	ed or m	easured rea	ach av	/erage:	
Open	Partly s	hade	d Ver	y shaded							
Fencing:	Dominant	riparia	an vegetation:	:		Stream	width	(active ch	anne	el): 12 i	m
None/ineffective	Crops		Retired	l vegetati	on	Stream	width	(water): 8	m		
One side/partial	Pasture		Native	shrub		Stream	depth	i: 0.4 m			
Complete	Exotic tre	es	Native	trees		Surface	e veloo	city: 0.3 m	s ⁻¹		
Water quality											
Temperature:	18.3		°C			Conduc	ctivity:	8	57	μ	S cm ⁻¹
Dissolved oxygen:	83		%			7.8		n	ng l ⁻¹		
Turbidity:	Clear		Slightly turb	oid Hig	ghly tu	urbid	Stair	ned	C	ther	
Stream-bottom s	ubstrata										
Compaction (inorg	anic substra	ata):				% surf compo	icial in sition	norganic :	subs	tratum	n size
Assorted sizes tightl	y packed &/c	or ove	rlapping			Substra		Dimensi	on	Perce	entage
Moderately packed					F	Bedroc	k	-			0
Mostly a loose asso						Boulde	r	>256mm			
No packing/loose as	sortment eas	sily m	oved			Cobble		>64-256mm	n	60	
Embeddedness:		-				Gravel		>2-64mm		20	
(% gravel-boulder parti	cles covered b	y fine	sediment)			Sand		>0.06-2mm	1	20	
<5% 5-25 °	% 26-5	0%	51-75%	>75%	6	Silt		0.004-0.06	mm		
			•			Clay		<0.004mm			
Organic material	(% cover)					Habita	at typ	es samp	led		
Large wood (>10cm	diameter)					(% of eff	fort)				
<5% 5-25°	% 26-5	0%	51-75%	>75%	6	Stones	:	100%			
Coarse detritus (sma	all wood, stic	ks, le	aves etc. >1m	nm)		Wood:		%	Riff	les:	100 %
<5% 5-25°	% 26-5	0%	51-75%	>75%	6	Macrop	hyte:	%	Ru	ns:	%
Fine (<1mm) organi	c deposits			•		Edges:		%			
<5% 5-25°	% 26-50	0%	51-75%	>75%	6	Numbe	r of in	vertebrate	s retu	urned:	
Instream plant co	over (% stre	ambe	ed area)			Koura:		S	Shrim	ps:	
Filamentous algae 8	a mats:					Crabs:		Ν	lusse	els:	
<5% 5-25 °	% 26-5	0%	51-75%	>75%	6	Other:					
Macrophytes:	•			•		Mussel	type:				
<5% 5-25°	% 26-5	0%	51-75%	>75%	6	Hyridel	la	0	Cucur	meruni	io
Mosses/liverworts:											
<5% 5-25°	% 26-50	0%	51-75%	>75%	6						
<5% 5-25°											

Qualitative Habitat A	sses	ssme			ms Data	She	et													
Stream name: Omal	nu St	trean	n (u/:	s)					Site ı	numt	ber: (6								
Sample number: 6	1			A	sses	sor:	Pau	l Fra	nklin	I			Date	: 24	/02/1	1				
Habitat parameter										Cate	egory									
habitat parameter		С)ptim	al			Sub	oopti	mal			Ma	argin	al				Poo	r	
1. Riparian vegetative zone width	•	vege >10r	kside etatio n tinuo		er	•	is <1	tatior 0m	n buff ntinu		•	Path and/o Most over	or sto	ck	ent	•		aks fre nan a ous		
		dens	se					, 									-	-	1	1
Left bank:	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Right bank:	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Mean: 12																				
2. Vegetative protection	•	imm ripar cove vege Tree store non- pres Vege	k surf ediate ian z ered b etation es, un ey shi evooc ent etativ uptior	e ones by nat der- rubs o ly pla e	ive or nts	•	nativ Disru Bank	ered n 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/sl berry roducties etation ption soil/co bed tatior	y hrubs /, will æd n obvie close	ow	•	cove gras Disr strea vege high Gras graz Sigr	ss he	by & shru ank n very avily at stoo	ubs y ck
Left bank:	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Right bank:	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Mean: 10				<u> </u>										i				<u> </u>		
3. Bank stability	•	Eros failu abse	ent/m	ank inima	I	•	Infreater areat most over	quen s of e tly he % of	ly sta t, sma erosio aled bank	all n	•	Mode unsta 30-60 reach of ero High poter flood	able 0% of has osion erosi ntial c	f bani area	S	•	Mar area 60-1	00% erosi	of ba	nk
Left bank:	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Right bank:	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Mean: 15		1		I	I		I	I	I	I		II						<u> </u>		1
4. Frequency of riffles	•	frequ Dista riffle strea	ance s divi am wi ety of	betwe ded b dth={	een y 5-7	•	Dista riffles	s infre ance s divi	ce of equer betwe ded b dth=7	een 9y	•	Occa or ru Botto provi habit Dista riffles strea 25	n de so at ince l s divio	ontour ome oetwe ded b	rs een y	•	wate riffle Poo Dist riffle	erally er, sh s r habi ance s divi am wi	allow itat betwo ded b	een by
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	nges nnel/c ent/m am w nal pa	lredgi inima ith	I	•	chan Evide chan Rece chan	inel/d ence inel/d ent	anges redgi of pa redgi redgi nt	ng Ist ng	•	Char chan exter Emba oring prese bank 40-80 chan disru	ges/c nsive ankm struc ent or s 0% of nelize	ients/ ctures n botl	/sh s n	•	with gabi >80 read chai disru	on/ce % of s	ement strear ed or habit	m at
	1		1	1		15	14	13				-	-			l	1	-	1	1

Habitat parameter			atego ptim			Ha	bitat	para	amet	er			atego ptim			Ha	abitat	para	amet	er
6. Sediment deposition	•	point <20% affect sedir	t bars % of t ted b	,	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	or fir nent bars 0% of ted ment sits a ructio trictic	avel, ne on ol f bott f bott ns,	d & om	•	fine Incrededeve >809 char frequ Pool abse sedii	vy de matei eased elopm % of k iging uently s alm ent du ment ositior	ial bar ent oottor ost e to	
Score: 17	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
7. Velocity/depth regimes	•	regir	nes p //dee /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	reser llow o ow a	or	•	velo regir	inate city/de ne ally de	əptń	
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	•	favor inver color wide wood riffle Snag subn 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	•	favor inver color Snag subn logs/ bank Fish com Mode of ha Can	nerge /unde ss/colt cove mon erate abitat cons e nev	e for ate on ed rcut obles r varie types ist of	ety 5.	•	favou inver color Fish 60-9 easil foot Woo rare	tebra cove 0% si y mov dy de or ma	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	e or
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	ohyto le on le sul ohyto ous to	ston bstra n	es te	• •			er of		•	obvi >209 avail	ohyto ous & % cov able trates	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: 113	3																			

Stream name: Unna	med trib. of H	omunga Stream	(d/s)	Assess	sor: Pa	ul Franklin	1	
Site number: 7	S	Sample number:		Date: 2	25/02/1	1 T	ïme: '	12:15
GPS coordinates	[Downstream:		E2765	475	Ν	6420	947
	ι	Jpstream:		E2765	584	Ν	6421	032
Channel & ripari	an features			Instre	am h	ydraulic	cond	litions
Canopy cover:				Estimat	ed or m	easured rea	ach ave	erage:
Open	Partly sha	ded Ver	y shaded					
Fencing:	Dominant ri	parian vegetatior	า:	Stream	n width	(active ch	annel): 4 m
None/ineffective	Crops	Retired	vegetatio	n Stream	width	(water): 3	m	
One side/partial	Pasture	Native s	shrub	Stream	n depth	n: 0.4 m		
Complete	Exotic trees	Native t	rees	Surfac	e veloo	city: 0.2 m	s ⁻¹	
Water quality								
Temperature:	17.8	°C		Condu	ctivity:		17	µS cm ⁻
Dissolved oxygen:	86	%		8.1		n	ng l ⁻¹	
Turbidity:	Clear	Slightly tur	bid Hig	hly turbid	Stair	ned	Ot	her
Stream-bottom s	ubstrata							
Compaction (inorg	anic substrat	a):		% surf compo			subst	ratum size
Assorted sizes tigh	ntly packed &	/or overlapping		Substr	atum	Dimensi	on	Percentage
Moderately packed	with some ove	rlapping		Bedroo	:k	-		
Mostly a loose asso	rtment with litt	le overlap		Boulde	r	>256mm		
No packing/loose as	sortment easi	ly moved		Cobble	•	>64-256mm	n	30
Embeddedness:				Gravel		>2-64mm		20
(% gravel-boulder parti	cles covered by	fine sediment)		Sand		>0.06-2mm		30
<5% 5-25	% 26-50	% 51-75%	>75%	Silt		0.004-0.06r	nm	20
				Clay		<0.004mm		
Organic material	(% cover)			Habit	at typ	es samp	led	
Large wood (>10cm	diameter)			(% of ef	fort)			
<5% 5-25	% 26-50	% 51-75%	>75%	Stones	:	100%		
Coarse detritus (sm	all wood, stick	s, leaves etc. >1	mm)	Wood:		%	Riffl	es: 100 %
	% 26-50	% 51-75%	>75%	6 Macro	ohyte:	%	Run	s: %
<5 % 5-25	r denosits			Edges		%		
1	o dopoono			5 Numbe	er of in	vertebrate	s retu	rned:
<5 % 5-25		% 51-75%	>75%				Shrimp	os:
< 5 % 5-25 Fine (<1mm) organi	% 26-50		>75%	Koura:		5		
<5% 5-25 Fine (<1mm) organi <5% 5-25	% 26-50 over (% strea		>75%	Koura: Crabs:			lusse	IS:
<5%	% 26-50 over (% strea a mats:	mbed area)	>75%	Crabs:			lusse	IS:
<5%	% 26-50 over (% strea mats:	mbed area)		Crabs:			lusse	IS:
<5%	% 26-50' Over (% streating a mats: % 26-50'	mbed area) % 51-75%		Crabs: Other: Musse	l type:	N		ls: nerunio
<5%	% 26-50* Over (% streating streat	mbed area) % 51-75%	>75%	Crabs: Other: Musse	l type:	N		

Wadeable Hard-E Qualitative Habitat A						She	et													
Stream name: Unna) (Site ı	numl	ber: 7	7								
Sample number:	1			-			Pau		nklir	1			Date	e: 24	/02/1	1				
Habitat parameter	-	O	ptim	al			Sub	popti		Cate	egory		argin	nal				Pool	r	
1. Riparian vegetative zone width	•	Bank vege >10r Cont dens	tation n inuou	n buff us &	er	•	is <1	tation	n buff		•	Path and/o Most over	or sto	ck	ent	•		aks fre nan ae ous		
Left bank:	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Right bank:	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Mean: 13																				
2. Vegetative protection	•	imme ripar cove vege Tree store non- pres Vege	ediate ian ze red b station s, un ey shi wood ent etativ	ones ly nat der- ubs o ly pla	ive or nts	•	cove nativ Disru Bank	c surf red n e veç uptior cs ma red b stry	nainly getati n evic ay be	on lent	•	Bank cove mixtu grass black & intu spec Vege disru Bare cropp vege com	red b ure of ses/s berry roducties etation ption soil/c bed tatior	y hrubs , will ced n obvi	ow	•	cove gras Disr strea vege high Gras graz Sign	s hea	by & shru ank n very avily avily	y ck
Left bank:	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Right bank:	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Mean: 10																				
3. Bank stability	•	Eros failui	e nt/mi of ba	ank nima	I	•	Infreater areat most over	erate quen s of e ly he % of ed	t, sm erosic aled	all on	•	Mode unsta 30-60 reach of ere High poter flood	able 0% of n has osion erosi ntial c	f ban area	IS	•	Man area 60-1	00% erosio	of ba	nk
Left bank:	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Right bank:	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Mean: 15																				
4. Frequency of riffles	•	frequ Dista riffle: strea	ient ance s divi im wi ety of	ativel betwo ded b dth={ habi	een by 5-7	•	riffles Dista riffles	urrend s infre ance s divie im wi	equei betwe ded b	nt 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 yy	•	wate riffle Poo Dista riffle	erally er, sha s r habi ance s divi am wi	allow itat betwe ded b	у
Score: 11	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
5. Channel alteration	•	abse Strea	nel/d nt/mi am w	redgi nima	I	•	chan Evide chan Rece chan	e cha inel/d ence inel/d ent inel/d prese	lredgi of pa lredgi lredgi	ing ist ing	•	Char chan exter Emb oring prese bank 40-8 chan disru	ges/c nsive ankm struc ent or s 0% of nelize	ients, cture: n botl	/sh s h	•	with gabi >80° reac char disru	on/ce % of s	ement strear ed or habita	n 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	bars 6 of t ted b nent	,	ent	•	bar f most	0% o ted nt dep	tion, m nd or nent f bott	om	• • •	of ne sand sedir new 50-8 affec	l or fir ment bars 0% o ted ment sits a ructio trictic	avel, ne on ol f bott at ns,	d & om	•	fine Incrededededededededededededededededededed	vy de matei eased elopm % of t iging uently s alm ent du ment ositior	ial bar ent oottor ost 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 /dee /shall shallo	low,		•	regin If fas miss	city/d nes p	iresei Ilow i nen		• •	2 of 4 veloc regin If fas slow/ miss low	city/de nes p t/shall /shall	iresei llow o ow a	or	•	velo regir	inate city/d ne ally de	əptń	
Score: 7	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 prov abur cove	urable tebra nisati varie dy de s, roc gs/ nerge unde s/col ides idant r : not l	ate on & ety of bris, ot mat ed ercut obles fish be ne	S	•	favor inver color Snag subn logs/ bank Fish com Mode of ha Can	nerge /unde ss/col cove mon erate abitat cons e nev	e for ate on ed rcut obles r varie types ist of	ety	•	favou inver color Fish 60-9	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 Subs unst lacki Stab	strate able o	e for ite on r rare or bitats limite	ed
Score: 11	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	• •			er of		•	obvi >209 avai	ohyto ous & % cov able trates	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: 100)																			

Stream name: Unna	med trib. of H	lomur	nga Stream (u/s)		Assess	or: Pa	ul Franklir	1		
Site number: 8		Samp	le number:			Date: 2	5/02/1	1 1	Time:	14:45	
GPS coordinates		Down	stream:			E27658	347	1	642	0687	
		Upstr	eam:			E		١	١		
Channel & riparia	an features					Instre	am h	ydraulic	con	dition	าร
Canopy cover:						Estimate	ed or m	easured rea	ach a	verage:	
Open	Partly sh	aded	Very	/ shad	ded						
Fencing:	Dominant r	iparia	n vegetation	:		Stream	width	(active ch	nanne	əl): 3.5	m
None/ineffective	Crops		Retired	vege	tation	Stream	width	(water): 2	2.8 m		
One side/partial	Pasture		Native s	shrub				n: 0.3 m			
Complete	Exotic trees	3	Native t	rees		Surface	e veloo	city: 0.2 m	s ⁻¹		
Water quality											
Temperature:	17.8		°C			Condu	ctivity:		17		uS cm ⁻
Dissolved oxygen:	86		%			8.1		r	ng l ⁻¹		
Turbidity:	Clear		Slightly turk	bid	Highly t	urbid	Stair	ned	C	Other	
Stream-bottom s	ubstrata										
Compaction (inorg	anic substra	ta):				% surf compo		norganic : i:	subs	tratun	n size
Assorted sizes tightl	y packed &/o	r over	lapping			Substra	atum	Dimensi	on	Perce	entage
Moderately packed	with some o	overla	pping			Bedroc	k	-		5	
Mostly a loose asso	rtment with lit	tle ove	erlap			Boulde	r	>256mm		5	
No packing/loose as	sortment eas	ily mo	oved			Cobble		>64-256mr	n	10	
Embeddedness:						Gravel		>2-64mm		30	
(% gravel-boulder parti	cles covered by	fine s	ediment)			Sand		>0.06-2mm	n	40	
<5% 5-25	% 26-50	%	51-75%	>	75%	Silt		0.004-0.06	mm	10	
						Clay		<0.004mm			
Organic material	(% cover)					Habita	at typ	es samp	led		
Large wood (>10cm						(% of ef	fort)				
<5% 5-25 °	% 26-50)%	51-75%	>	75%	Stones	:	100%			
Coarse detritus (sma	all wood, stick	s, lea	ves etc. >1n	nm)		Wood:		%	Rif	fles:	100 %
<5% 5-25	% 26-50)%	51-75%	>	75%	Macrop	-	%	Ru	ns:	%
Fine (<1mm) organi	-	1		1		Edges:		%			
<5% 5-25	% 26-50)%	51-75%	>	75%	Numbe	er of in	vertebrate	s ret	urned:	
Instream plant co	•	ambeo	d area)			Koura:		S	Shrim	ips:	
Filamentous algae 8	1	i		i		Crabs:		P	Auss	els:	
<5% 5-25	% 26-50)%	51-75%	>	75%	Other:					
Macrophytes:	1	1		ı		Mussel					
	% 26-50)%	51-75%	>	75%	Hyride	la	0	Cucu	merun	io
< 5% 5-25											
	% 26-50	1	51-75%	1	75%						

Stream name: Unna	med	trih	Hom	nina	a Ctr	aam	(µ/e) (Sito •	numb	nor (2								
Sample number:	meu	und.					Pau	,		-		-	Date	. 25	/02/1	1				
Gample Humber.				1	0000	5301.	1 au	iiia		Cate	aory		Daic	. 20/	02/1					
Habitat parameter		O	ptim	al			Sub	oopti		Oalc	,gory		argin	al				Poo	r	
1. Riparian vegetative zone width	•	Bank vege >10r Cont dens	tation n inuou	n buff us &	er	•	is <1	tation 0m	n buff ntinue		•	Path and/o Most over	or sto	ck	ent	•		aks fra nan a ous		
Left bank:	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Right bank:	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Mean: 12.5			L		1		<u> </u>					11			L			1	1	-
2. Vegetative protection	•	imme ripar cove vege Tree store non- pres Vege	ediate ian ze red b station s, un ey shi wood ent etativ	ones ly nat der- ubs o ly pla	ive or nts	•	nativ Disru Bank	ered n re veç uptior ks ma red b	nainly getati n evid	on lent	•	Bank cove mixtu grass black & intr 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	ss he	by & shru n of ank n very avily avily	ubs y ck
Left bank:	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Right bank:	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Mean: 9																				
3. Bank stability	•	Banł Eros failur abse <5% affec	ion/b e nt/mi of ba	ank nima	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 n has osion erosi ntial c	f ban area	S	•	Mar area 60-1	00% erosi	of ba	nk
Left bank:	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Right bank:	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Mean: 15															1					
4. Frequency of riffles	•	frequ Dista riffle strea	ient ance s divi im wi ety of	ativel betwo ded b dth={ habi	een y 5-7	•	Dista riffles	s infre ance s divi	ce of equer betwe ded b dth=7	een 9y	•	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	•	wate riffle Poo Dist riffle	erally sr, sh s r hab ance s divi am w	allow itat betwo ded b	een oy
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	redgi nima	I	•	chan Evide chan Rece chan	inel/d ence inel/d ent	anges redgi of pa redgi redgi nt	ng Ist ng	•	Char chan exter Emba oring prese bank 40-80 chan disru	ges/c nsive ankm struc ent or s 0% of nelize	ients/ ctures n botl	/sh s n	•	with gabi >80 read chai disru	on/ce % of :	ement strear ced or habit	m - at

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	•	bar for most grave fine s 20-5 affect	nt dep	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 nent bars 0% o ted ment sits a ructio trictic	avel, ne on ol f bott f bott ns,	d & om	•	fine Incrededededededededededededededededededed	vy de mater eased elopm % of t nging uently s alm ent du ment ositior	ial bar ent oottor ost e to	
Score: 11	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
7. Velocity/depth regimes	•		nes p /dee /shall shallo	low,		•	regin If fas miss	4 nes p st/sha ing th e low	oresei Illow 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	iinate city/d ne ally de	əptń	
Score: 16	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 nisati varie dy de s, roc gs/ nerge unde s/col ides idant r : not l	ate on & ety of bris, ot mate ed ercut obles fish be ne	S	•	favor inver color Snag subn logs/ bank Fish com Mode of ha Can	nerge /unde ss/col 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 cove 0% si y mo dy de or ma here	e for te on r pato ubstra ved b ebris ay be	chy ate y	•	favo inve colo Fish abse Subs unst lacki Stab	strate able o	e for ite on r rare or bitats limite	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	•	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		•	obvi >209 avai	ohyto ous & % cov able strates	proli er of	
Score: 22	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
TOTAL SCORE: 99.	5																			

Stream name: Waite	eariki Stream	١			Assess	or: Pa	ul Franklir	ו	
Site number: 9		Sam	ple number:		Date: 2	22/02/1	1 T	Time	: 10:00
GPS coordinates		Dow	nstream:		E2762	794	١	1637	9697
		Upst	ream:		E2762	925	٩	1637	9759
Channel & riparia	an feature	s			Instre	am h	ydraulic	con	ditions
Canopy cover:					Estimat	ed or m	easured rea	ach a	verage:
Open	Partly s	hadeo	d Very	shaded					
Fencing:	Dominant	riparia	an vegetation:		Stream	n width	(active ch	ann	el): 9 m
None/ineffective	Crops		Retired v	egetation	Stream	n width	(water): 6	m	
One side/partial	Pasture		Native sh	nrub	Stream	n depth	n: 0.4 m		
Complete	Exotic tree	es	Native tr	ees	Surfac	e veloo	city: 0.3 m	s ⁻¹	
Water quality									
Temperature:	16.9		°C		Condu	ctivity:	5	51	µS cm⁻¹
Dissolved oxygen:	91		%		8.8		n	ng l ⁻¹	
Turbidity:	Clear		Slightly turbi	d Highly	turbid	Stai	ned	C	Other
Stream-bottom s Compaction (inorg		ata):			% surf			subs	stratum size
Assorted sizes tight	v packed &/	or ove	rlapping		Substr		Dimensi	on	Percentage
Moderately packed					Bedroo	:k	-	-	
Mostly a loose asso					Boulde	r	>256mm		30
No packing/loose as	sortment ea	sily m	oved		Cobble	•	>64-256mm	n	70
Embeddedness:					Gravel		>2-64mm		
(% gravel-boulder parti	cles covered b	by fine	sediment)		Sand		>0.06-2mm	n	
<5 % 5-25	% 26-5	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	% 26-5	50%	51-75%	>75%	Stones	:	100%		
Coarse detritus (sma	all wood, stic	cks, le	aves etc. >1mr	m)	Wood:		%	Rif	fles: 100 %
<5% 5-25 °	% 26-5	50%	51-75%	>75%	Macrop	ohyte:	%	Ru	ins: %
Fine (<1mm) organi	c deposits				Edges		%		
<5% 5-25	% 26-5	50%	51-75%	>75%	Numbe	er of in	vertebrate	s ret	urned:
Instroom plant of	over (% stre	eambe	ed area)		Koura:	А	S	Shrim	nps: R
instream plant co	mats:				Crabs:		Ν	Auss	els:
Filamentous algae 8		50%	51-75%	>75%	Other:				
-	% 26-5				Musse	l type:			
Filamentous algae 8	% 26-5								
Filamentous algae 8 <5%	1	50%	51-75%	>75%	Hyride	lla	0	Cucu	merunio
Filamentous algae 8 <5% 5-25 Macrophytes:	1		51-75%	>75% >75%	Hyride	lla	0	Сиси	merunio

Wadeable Hard-E Qualitative Habitat A						She	et													
Stream name: Waite					Julia	one		9	Site i	numl	per: 9	9								
Sample number:		0.10		A	sses	sor:	Pau					-	Date	e: 22	/02/1	1				
Habitat parameter										Cate	egory	/								
		0	ptim	al			Sub	popti	mal			M	argin	nal				Poo	r	
1. Riparian vegetative zone width	•	>10r Cont	etation n tinuou	n buff us &	er	•	is <1	tatior 0m	n buff ntinu		•	Path and/o Most over	or sto	ck	ent	•		aks fre nan ae ous	•	
l off hould		dens	-	47	40	45		40	40		40	0	0	-7		-			0	
Left bank:	20 20	19 19	18 18	17 17	16 16	15 15	14 14	13 13	12 12	11 11	10 10	9 9	8 8	7 7	6 6	5 5	4	3 3	2	1
Right bank: Mean: 11	20	19	18	17	16	15	14	13	12	11	10	9	8	/	6	5	4	3	2	1
2. Vegetative protection	•	imme ripar cove vege Tree store non- pres Vege	ediate ian ze etation s, un ey shi wood ent etativ	ones ly nat der- ubs o ly pla	ive or nts	•	cove nativ Disru Bank	e veo uptior s ma red b	nainly getati n evid	on lent	•	Bank cove mixtu grass black & intr spec Vege disru Bare cropp vege com	red b ure of ses/s berry roducties etation ption soil/c bed tatior	y hrubs , will ced n obvi	ow	•	cove gras Disr strea vege high Gras graz Sign	s hea	by & shru ank n very avily at stoo	ubs y ck
Left bank:	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Right bank:	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Mean: 10																				
3. Bank stability	•	Eros failui	re ent/mi of ba	ank nima	I	•	Infreater areat most over	quen s of e ly he % of	ly sta t, sma erosio aled bank	all n	•	Mode unsta 30-60 reach of ere High poter flood	able 0% of n has osion erosi ntial c	f ban area	IS	•	Man area 60-1	00% erosio	of ba	ınk
Left bank:	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Right bank:	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Mean: 17																				
4. Frequency of riffles	•	frequ Dista riffles strea	uent ance s divi am wi ety of	ativel betwe ded b dth={ habi	een by 5-7	•	riffles Dista riffles	s infre ance s divi	ce of equer betwe ded b dth=7	nt 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 yy	•	wate riffle Poo Dista riffle	erally er, sha s r habi ance s divi am wi	allow itat betwo ded b	een Dy
Score: 17	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
5. Channel alteration	•	abse Strea	nel/d nt/mi am w	redgi nima	I	•	chan Evide chan Rece chan	inel/d ence inel/d ent	anges iredgi iredgi iredgi nt	ing ist ing	•	Char chan exter Emb oring prese bank 40-80 chan disru	ges/c nsive ankm struc ent or s 0% of nelize	ients, cture: n botl	/sh s h	•	with gabi >80° reac char disru Instr	on/ce % of s	ement strear red or habit	m - at
Score:20	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	•	<pre>point <20% affect seding </pre>	bars	,	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	l or fir ment bars 0% o ted ment sits a ructio trictic	avel, ne on ol f bott f bott at ns,	d & om	•	fine Incrededededededededededededededededededed	vy de mate easec elopm % of b nging uently s alm ent du ment osition	rial l bar ent pottor nost lie 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 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 /shall	reser llow o ow a	or	•	velo regir	ninate city/d ne ally de	epth	
Score: 20	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 prov abur cove	urable tebra isati varie dy de s, roc gs/ nerge unde s/col ides idant r	ate on & ety of bris, ot mate ed ercut obles fish be ne	S	•	favor inver color Snag subn logs/ bank Fish com Mode of ha Can	nerge /unde ss/col cove mon erate abitat cons e nev	e for ate on ed rcut obles r varie types ist of	ety	•	favou inver color Fish 60-9	tebra cove 0% si y mo dy de or ma	e for ite on r pato ubstra ved b ebris ay be	chy ate y	•	favo inve colo Fish abse Sub unst lack Stab	strate able (e for ate on r rare or bitats limite	ed
Score: 16	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	• •			er of		•	obvi >20° avai	phyto ous 8 % cov lable strates	proli ver 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: 141																				

oncammanic. Wanci	e Stream					Assess	or: Pa	ul Franklir	۱	
Site number: 10		Sam	ole number:			Date: 2	2/02/1	1 T	ime:	15:00
GPS coordinates		Dowr	nstream:			E27618	391	Ν	1638	1355
		Upst	ream:			E27619	942	Ν	1638	1276
Channel & riparia	n features	;				Instre	am h	ydraulic	con	ditions
Canopy cover:						Estimate	ed or m	easured rea	ach a	verage:
Open	Partly sh	aded	Very	y shad	ed					
Fencing:	Dominant	riparia	an vegetation	:		Stream	width	(active ch	anne	el): 12 m
None/ineffective	Crops		Retired	vegeta	ation	Stream	width	(water): 6	m	
One side/partial	Pasture		Native s	shrub		Stream	depth	n: 0.5 m		
Complete	Exotic tre	es	Native t	rees		Surface	e veloo	city: 0.3 m	s ⁻¹	
Water quality										
Temperature:	18.7		°C			Conduc	ctivity:	6	6	µS cm ⁻
Dissolved oxygen:	91		%			8.4		n	ng l ⁻¹	
Turbidity:	Clear		Slightly turk	bid	Highly t	urbid	Stair		1	Dther
Stream-bottom su	Ibstrata		•							
Compaction (inorga	nic substra	ita):				% surf compo			subs	stratum size
Assorted sizes tightly	packed &/c	r ove	rlapping			Substra	atum	Dimensi	on	Percentage
Moderately packed	with some	overla	apping			Bedroc	k	-		
Mostly a loose assort	ment with lit	tle ov	erlap			Boulde	r	>256mm		15
No packing/loose ass	ortment eas	sily m	oved			Cobble		>64-256mm	n	80
Embeddedness:						Gravel		>2-64mm		
(% gravel-boulder partic	es covered b	y fine s	sediment)			Sand		>0.06-2mm	ı –	5
<5 % 5-25 %	26-50	0%	51-75%	>7	75%	Silt		0.004-0.06	mm	
				-		Clay		<0.004mm		
Organic material	(% cover)					Habita	at typ	es samp	led	
Large wood (>10cm of	diameter)					(% of eff	ort)			
<5 % 5-25 %	26-50	0%	51-75%	>7	75%	Stones	:	100%		
Coarse detritus (sma	I wood, stic	ks, lea	aves etc. >1n	nm)		Wood:		%	Rif	fles: 100 %
<5 % 5-25 %	26-50)%	51-75%	>7	75%	Macrop	hyte:	%	Ru	ns: %
Fine (<1mm) organic			1			Edges:		%		
<5% 5-25%	26-50	0%	51-75%	>7	75%	Numbe	r of in	vertebrate	s ret	urned:
Instream plant co	ver (% stre	ambe	d area)			Koura:	С	S	Shrim	nps: R
Filamentous algae &	mats:					Crabs:		Ν	/luss	els:
<5% 5-25%	26-50)%	51-75%	>7	75%	Other:				
Macrophytes:			I			Mussel	type:			
<5% 5-25%	26-50	0%	51-75%	>7	75%	Hyridel	la	0	Cucu	merunio
Mosses/liverworts:			51-75%	1						
<5% 5-25%	26-50				75%					

Qualitative Habitat A Stream name: Waire	re S	trear						ç	Site	numl	her.	10								
Sample number:		tical		A	sses	sor:	Brer			-		-	Date	: 22	/02/1	1				
				-						Cate	aorv									
Habitat parameter		С	ptim	al			Sub	oopti			.g,		argin	nal				Poo	r	
1. Riparian vegetative zone width	•	vege >10r	n inuo	n buff us &	er	•	is <1	tatior			•	Path and/o Most over	or sto	ck	ent	•		aks fr nan a ous		
Left bank:	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Right bank:	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Mean: 12.5														1						<u>.</u>
2. Vegetative protection	•	imm ripar cove vege Tree store non- pres Vege	ediate ian z red b etation s, un ey she wood ent etativ	ones by nat der- rubs o ly pla	ive or nts	•	cove nativ Disru Bank	c surf red n re veg uptior cs ma red b stry	nainly getati n evic ay be	on lent	•	Bank cove mixtu grass black & intri spec Vege disru Bare cropp vege comr	red b ure of ses/sl berry roducties etation ption soil/co bed tatior	y hrubs , will ced n obvi	ow	•	cove gras Disr strea vege high Gras graz Sigr	ss he	by & shru n of ank n very avily avily	y ck
Left bank:	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Right bank:	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Mean: 9.5																				
3. Bank stability	•	Eros failu	re ent/m of ba	ank inima	I	•	Infreater areat most over	% of	t, sm erosic aled	all n	•	Mode unsta 30-60 reach of ero High poter flood	able 0% of has osion erosi ntial c	f ban area	IS	•	Mar area 60-1	00% erosi	of ba	nk
Left bank:	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Right bank:	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Mean: 14			•	<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 dth={ habi	een by 5-7	•	riffles Dista riffles	urrend s infre ance I s divid am wi	equei betwe ded b	een by	•	Occa or run Botto provi habit Dista riffles strea 25	n de so at ince l s divid	ontou ome betwe ded b	rs een yy	•	wate riffle Poo Dist riffle	erally er, sh s r hab ance s divi am w	allow itat betwo ded b	у
Score: 11	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
alteration channel/dredging absent/minimal channel/dredging bsent/minimal channel/dredging Evidence of past channel/dredging channel/dredging extern • Stream with normal pattern • Recent channel/dredging not present • Emb oring pres bank							Char chan exter Emba oring prese bank 40-80 chan	ges/o nsive ankm struc ent or s 0% of	ients, cture: n botl	/sh s h	•	with gabi >80 read chai disru	on/ce % of :	ement strear ced or habit	m					

Habitat parameter			atego ptim			Ha	bitat	para	amet	er			atego ptim			Ha	bitat	para	amet	er
6. Sediment deposition	•	<pre>point <20% affect seding </pre>	t bars	,	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	l or fir ment 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 ost e to	
Score: 12	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 city/de 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 /shall	iresei llow o ow a	or	•	velo regir	iinate city/d ne ally de	əptń	
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	•	favor inver color wide wood riffles Snag subn 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	•	favor inver color Snag subn logs/ bank Fish com Mode of ha Can	nerge /unde ss/col cove mon erate abitat cons e nev	e for ate on ed rcut obles r varie types ist of	ety	•	favou inver color Fish 60-9	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 Subs unst lacki Stab	strate able o	e for ite on r rare or bitats limite	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	•	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	• •			er of		•	obvi >209 avai	ohyto ous & % cov able strates	proli er of	
Score: 13	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
TOTAL SCORE: 113	3																			

Appendix 2: Fish Surveys

Team memb	pers:			GPS	2757273	NG	386560	Site		pression Stre				Date:	22/02/11	
Paul Frankli	n (NIWA)			(d/s):	_2151215	INO.	300300	Sile	. Dep		an			Date.	22/02/11	
Josh Smith	(NIWA)			GPS (u/s):	2757201	N6	386488	N	ot fished	Fished r collect		shed 10 sub- reaches	Fished 5-9 sub-reaches		<5 sub- ches	FLAG for fished/not fished
Fish sample id:		al shock (min):	47	Fishing time:	Start Finish	16:00 17:15	Sample distance	(m):	150	Wetted v (m):	vidth <u>A</u> B	<u>1.5</u> 1.5 D			G 1.0 H 2.0	l 2.5 J 2.0
Sampling ge		ight	EFM	Se		ength (m) lesh (mm)		Wat visit	ter bility:	Good	Average	Poor	Water temp. (°C):	22.0	Conducti (µS):	vity 273
EFM anode:	Big Small	EFM	volts (x100)	: 2			se rate (Hz	or pps):	65	EFM puls	se width (n		Spotl	ight (watts		
Species		А	В	С	D	E	ach tally F	G	Н		J	Total count	Sample count	Length (Min.	mm) Max.	FLAG
Shortfin eel		6	6	30	14	27	35	50	25	35	18	246		90	600	
Cran's bully			1			1	1	1			1	5		50	100	
Koura			1	3	3	7	3	4	2	4	2	29		NA	NA	
Inanga			1		25			2	17			45		90	100	
				_												
	omment		i chable 0 2			1	1	FLA	G Cor	nment	1			1		<u> </u>
	each D – Deep each G – Saw ir		Isnable 2m	manga pre	sent.											
	each I – Saw Ir		ites mid rea	ch made fie	hing difficul	t 4m ²										
	each J – Mid po															

Team member Brenda Aldric				GPS (d/s): E	2758628	N63	384754	Site	: Kare	engorengo S	tream				Date:	22/02/1	1	
Kathryn Julia	n (NIWA)			GPS (u/s): E	2758672	N63	384606	N	ot fished	Fished n collecte		ned 10 sub- reaches		ed 5-9 eaches		<5 sub- ches	fish	AG for ed/not shed
Fish sample id:		shock (min):	55	Fishing time:	Start Finish	16:00 17:45	Sample distance	(m): 1	50	Wetted w (m):	vidth A B	2.5 C 2.0 D	2.2 2.0			G 1.8 H 2.0		2.8 2.1
Sampling gea	ar: Spotli	ght	EFM	Sei		ength (m) esh (mm)		Wat visit	er bility:	Good	Average	Poor	Water temp.		20.1	Conduct (µS):	tivity	243
EFM anode:	Big Small	EFM	volts (x100)	: 3			se rate (Hz	or pps):	65	EFM puls	e width (ms): 2		Spot	ight (watts	s):		
Species		А	В	С	D	Sub-rea	F	G	Н		J	Total count	San cou		Length (Min.	(mm) Max.	FL	AG
Shortfin eel		26	26	32	23	25	31	16	29	26	20	254			90	740		
Koura		2	4	5	5	4	7	5	2	1	2	37			NA	NA		
Common bul	у				1			1				2			60	80		
Smelt		60			1						4	65			65	NA		
Inanga											1	1			NA	80		
Longfin eel				1	1							2			300	340		
Brown trout						1			1		1	3			180	340		
	nment							FLA	.G Com	nment								
	tion 15-25m fro I reach length =		nit not fishe	d because to	po deep, up	per limit ext	ended so											
	5																	

Team members: Paul Franklin (NIWA)			GPS (d/s):	2751347	N6	429422	Site	e: Pai	akarahi Strea	am (d/s)				Date:	23/02/11	
Josh Smith (NIWA) Kathryn Julian (NIWA)			GPS (u/s):	E2751418	N6	429342	Ν	Not fished	Fished r collect		ned 10 sub- reaches		ed 5-9 eaches		<5 sub- ches	FLAG for fished/not fished
	tal shock e (min):	64	Fishing time:	Start Finish	9:30 11:40	Sample distance		150	Wetted v (m):	vidth <u>A</u> B	6.0 C 3.0 D				G 4.0 H 7.0	l 6.0 J 3.5
•	tlight	EFM	Se	ine Le	ength (m) esh (mm)	distance	Wa	ter bility:		Average	Poor	Water temp.		18.2	Conducti (µS):	
EFM anode: Big Small	EFM	l volts (x100)	: 3		EFM puls	se rate (Hz	or pps):	65	EFM puls	e width (ms): 2		Spotli	ight (watts	s):	
Species	A	B	С	D	Sub-rea	ach tally F	G	н		J	Total count	Sarr cour		Length (Min.	(mm) Max.	FLAG
Shortfin eel	1	3	2	1			1	2			10			100	250	
Longfin eel	2	1	2	1	1	2		1	4		14			110	600	
Cran's bully	14	2	11	13	8	4	10	4	11	6	83			20	70	
Torrentfish	2			1		2		4			9			40	115	
Koura	1	2	6		2	3	1		3	2	20			NA	NA	
Elver		1		1	2			2	3	2	11			80	110	
Banded kokopu		2	1		1	1					5			70	130	
Rainbow trout	3			1		1	1	4	5	5	20			80	250	
Unidentified eel	1							1	2		4			110	150	
												1				
FLAG Comment					· .		FLA	AG Coi	mment		1	1				
F1 Reach F – Large	amounts	of woody de	bris made f	shing difficu	ult											

Team members: Paul Franklin (NIWA)			GPS (d/s): E	2751431	N64	129122	Site	: Paia	karahi Strea	m (u/s)				Date:	23/02/11	
Josh Smith (NIWA) Kathryn Julian (NIWA)			GPS (u/s): E	2751550	N64	129031	N	ot fished	Fished no collecte		ned 10 sub- reaches		ed 5-9 eaches		<5 sub- ches	FLAG for fished/not fished
-	al shock e (min):	93	Fishing time:	Start Finish	12:40 14:51	Sample distance	(m): 1	42	Wetted w (m):	idth A B	5.0 C 6.0 D	4.0 5.0			G 7.0 H 9.0	l 8.0 J 8.0
Sampling gear: Spot	light	EFM	Sei		ength (m) esh (mm)	-	Wat visit	er pility:	Good A	Verage	Poor	Water temp.	(°C):	18.2	Conducti (µS):	^{vity} 109
EFM anode: Big Small	EFM	volts (x100)): 3			e rate (Hz	or pps):	65	EFM pulse	e width (ms): 2		Spotli	ght (watts	s):	
Species	А	В	С	D	Sub-rea	ich tally F	G	н	1	J	Total count	Sam cour	•	Length (Min.	(mm) Max.	FLAG
Shortfin eel	2	2		1		1	4	3		1	14			100	150	
_ongfin eel		1	1			4	5	2	1	2	16			100	450	
Cran's bully	12	12	14	34	6	5	9	8	12	5	117			30	90	
Elver	2	2	2	1	1		1	1			10			90	100	
Koura	5	4	4	8		2		7	4	2	36			NA	NA	
Torrentfish	2				2		1			1	6			70	110	
Unidentified eel					1	1	1				3			150	250	
Banded Kokopu	1		1	1			1		2		6			120	195	
Rainbow trout	2	1				2		1		1	7			95	115	
FLAG Comment F1 Skipped deep poo	ol (20m²) a	at base of w	aterfall (not	included in	area fished)	FLA	.G Com	nment							

Team me Paul Frar	embers: hklin (NIWA	.)			GPS (d/s):	E2746560	N64	435409	Site	e: Om	ahu Stream	(d/s)				Date:	24/02/11	
	th (NIWA) Julian (NIW	A)			GPS (u/s):	E2746610	N64	435540		lot fished	Fished r collect		hed 10 sub- reaches		ed 5-9 eaches		<5 sub- ches	FLAG for fished/not fished
Fish sample id	d:	Total time (shock (min):	94	Fishing time:	Start Finish	9:55 11:45	Sample distance		150	Wetted v (m):	vidth <u>A</u> B	6.0 C 3.0 D				G 8.0 H 7.0	l 6.0 J 7.0
Sampling		Spotlig	jht	EFM	Se	Le Le	ength (m) lesh (mm)		Wa	ter bility:		Average	Poor	Water temp.		18.3	Conducti (µS):	
EFM ano	de:	Big Small	EFM	l volts (x100): 3		EFM puls	se rate (Hz	or pps):	65	EFM puls	e width (m	s): 2	•		ght (watts):	
Species			A	В	C	D	Sub-rea	ach tally F	G	Н		J	Total count	Sam cour		Length (Min.	mm) Max.	FLAG
Shortfin e	el			3	4	2	1	7	4	5	9	4	39			85	350	
Longfin e	el					2		1	1	2		1	7			340	650	
Cran's bu	ılly			5	8	5	1	2	6	5	1	6	39			20	75	
Inanga						1			1	1			3			85	105	
Torrentfis	sh			1	3		7	10	1			17	39			40	140	
Smelt												5	5			70	85	
Brown tro	but				1			2				2	5			110	250	
Rainbow	trout											1	1			NA	100	
Elver			1	2	6		1		1	1	1	6	19			70	100	
Koura			1	2	2	2		1	2	1	2	1	14			NA	NA	
FLAG	Comment			1					FLA	AG Cor	mment							
	90-115 m f 150 m read			fished due	to excess d	epth. Reach	extended s	o full										

Team members:	GPS													
Paul Franklin (NIWA)	(d/s):	E2746688	N64	435516	Site:	Oma	ahu Stream ((u/s)				Date:	24/02/11	
Josh Smith (NIWA) Kathryn Julian (NIWA)	GPS (u/s):	E2746806	N64	435488	No	t fished	Fished n collecte		ned 10 sub- reaches	Fishe sub-re	ed 5-9 eaches		<5 sub- ches	FLAG for fished/not fished
Fish Total shock 124 time (min):	Fishing time:	Start Finish	12:40 14:35	Sample distance	(m): 1	50	Wetted w (m):	vidth <u>A</u> B	7.0 C 5.0 D	1.5 8.0			G 7.0 H 7.5	l 7.5 J 7.0
Sampling gear: Spotlight EFM	Se		ength (m) esh (mm)		Wate visibi		Good	Average	Poor	Water temp.	(°C):	18.6	Conducti (µS):	^{vity} NA
EFM anode: Big Small EFM volts (x10	D): 4			se rate (Hz	or pps):	65	EFM puls	e width (ms): 2		Spotli	ght (watts):	
Species A B	C	D	Sub-rea	ach tally F	G	Н	1	J	Total count	Sam cour		Length (Min.	mm) Max.	FLAG
Cran's bully 4 25	5	15	23	10	9	21	6	9	127			15	65	
Shortfin eel 4 11	10	11	10	16	9	14	4	3	92			90	650	
Longfin eel 1 3		1				1	2		8			190	1100	
Brown trout				1					1			NA	110	
Torrentfish 2	4	7	3	1		3	3	2	25			40	155	
Koura 5 6	2	4	2	2		3	3	2	29			NA	NA	
Elver 3 5	3	2	6	6	7		1	4	37			80	100	
Inanga	2		3	6				2	13			60	105	
FLAG Comment					FLAC	G Con	nment							
F1 Reach G – Pool too deep to fish (45m														
F2 135-150m too deep to fish, reach exte	ended by 15n	n u/s												

Fish c		on forn	n – W	adeable		s/rivers														
	nklin (NIWA	۹)			GPS (d/s):	E2765475	N64	420947	Site	: Unn	named tribut	ary of Ho	munga	Stream	(d/s)		Date:	25/02/1	11	
	Aldridge (NI Julian (NIW				GPS (u/s):	E2765584	N6	421032	N	ot fished	Fished collect		Fished 1 reacl			ed 5-9 eaches		<5 sub- ches	fis	LAG for shed/not fished
Fish sample id	d:		shock (min):	60	Fishing time:	Start Finish	10:30 12:10	Sample distance		50	Wetted (m):	width /		8 C 2.3 D	2.7 3	Έ Γ		G 2. H 3.		2.8 3.3
Sampling	g gear:	Spotli	ght	EFM	S	eine <u>Le</u> M	ength (m) esh (mm)		Wat visit	er oility:	Good	Average	F	Poor	Water temp.		17.8	Conduc (µS):	ctivity	117
EFM and	ode:	Big Small	EFM	l volts (x100)	: 3			se rate (Hz	or pps):	65	EFM puls	se width (ms):	2		Spotli	ght (watts			
Species			А	В	С	D	Sub-rea	ach tally F	G	Н		J		otal ount	San cour		Length Min.	(mm) Max.	F	LAG
Shortfin (9	6	6	7	8	15	13	11	17	6		98			100	860		
Longfin e					_	1			1	-	1	-		3	_		560	900		
Common	n bully		12	36	20	6	23	23	41	26	27	16		230	_		15	62		
Koura			3	4	6	11	2	4	1	3	7	5		46	-		NA	NA		
					_	-						-								
						_									-					
FLAG	Comment								FLA	G Cor	nment									
F1	Majority of					(10 2)														
F2 F3				of reach too		n (12m⁻)														
гз	Reach I -	new ofid	ge cons	tructed over	reach															

	llection for	'm – W	adeable	streams	/rivers												
Team mem Paul Frankli				GPS (d/s):	E2765847	N6	420687	Site:	Unn	amed tributa	ry of Homu	nga Stream	(u/s)		Date:	25/02/1	1
Brenda Aldı Kathryn Juli	lridge (NIWA) lian (NIWA)			GPS (u/s):	E	Ν		No	ot fished	Fished no collecte		ned 10 sub- reaches		ed 5-9 eaches		<5 sub- ches	FLAG for fished/not fished
Fish sample id:		al shock e (min):	62	Fishing time:	Start Finish	13:05 14:40	Sample distance	(m): 1	50	Wetted w (m):	idth <u>A</u> B	3.5 C 3.5 D	2.8 4.0			G 1.7 H 2.0	J 1.8
Sampling g	· · ·	tlight	EFM	Se		ength (m) esh (mm)		Wate visib		Good A	Average	Poor	Water temp.		17.8	Conduc (µS):	tivity 117
EFM anode	e: Big Small	EFN	l volts (x100)	: 3			se rate (Hz	or pps):	65	EFM pulse	e width (ms): 2		Spotli	ght (watts		
Species		А	В	С	D	Sub-rea	ach tally F	G	Н	1	J	Total count	Sarr cour	•	Length Min.	(mm) Max.	FLAG
Shortfin eel		11	11	3		4	8	5	3		4	49			90	600	
Longfin eel			1					1		1		3			650	850	
Common bu	oully	20	20	18	5	11	33	16	8	23	10	164			45	55	
Koura		13	26	4	1	3	7	3	4	2	2	65			NA	NA	
			-														
	comment	1	1	1	1	I	1	FLA	G Com	nment	I	<u> </u>				1	
	lo upstream GP	S coordin	ate recordec														
F2 60	0-75m skipped l	because t	oo deep to f	sh, reach e	xtended by	15m u/s											

Fish c	ollectio	n forn	n – W	adeable	stream	s/rivers												
Team me Paul Fra	embers: nklin (NIWA	۹)			GPS (d/s):	E2762794	N6	379697	Site	: Wai	teariki Strean	٦				Date:	22/02/11	I
	iith (NIWA); Julian (NIW		Aldridge	e (NIWA)	GPS (u/s):	E2762925	N6	379759	N	ot fished	Fished no collecte		ned 10 sub- reaches	Fished sub-rea		Fished - reac		FLAG for fished/not fished
Fish sample i	d:		l shock (min):	80	Fishing time:	Start Finish	10:10 12:15	Sample distance	(m):	150	Wetted w (m):	idth <u>A</u> B	6 C 6 D				<u>G 5.5</u> H 7	J 5.5
Sampling	g gear:	Spotli	ght	EFM	Se		ength (m) esh (mm)		Wat visit	ter bility:	Good A	verage	Poor	Water temp. (°	C): 10	6.9	Conduct (µS):	^{ivity} 51
EFM and	ode:	Big Small	EFM	l volts (x100)	: 4			se rate (Hz	or pps):	65	EFM pulse	e width (ms): 2		Spotlight			
Species			А	В	С	D	Sub-rea	ach tally F	G	Н		J	Total count	Samp count		ength (r lin.	nm) Max.	FLAG
Shortfin	eel		1	1	4	2	2	1				3	14			100	420	
Longfin e	eel		3		1	2	1	1	1	2	2	1	14			250	850	
Cran's b	ully		8	1	11	2	5	2				5	34			25	55	
Torrentfi	sh				4	1	1		6				12			45	135	
Smelt					1								1			NA	95	
Brown tr	out							2		2	1		5			105	150	
Unidenti	fied galaxiio	ł					1						1			NA	NA	
Unidenti	fied eel				1					1	1		3			NA	NA	
Koura			7	5	12	9	6	7	7	8	5	7	73			NA	NA	
																	-	
																		<u> </u>
FLAG	Comment			<u> </u>					FLA	G Cor	nment							

sample id: time (min): 78 time: Finish 15:00 distance (m): 15:00 (m): B 6.5 D 7 F 6.5 H 6 J 5 Sampling gear: Spotight EFM Seine Length (m) Water visibility: Good Average Poor Water temp. (°C): 18.7 Conductivity (µS): 66 Small EFM volts (x100): 3 EFM pulse rate (Hz or ps): 65 EFM pulse width (ms): 2 Spotlight (watts): Species Sub-reach tally Sample Length (mm) FLAG Shortfin eel 22 19 7 5 12 6 5 6 5 16 103 90 600 Bullies 1 5 2 10 4 2 7 3 4 38 40 70 1 Rainbow trout 1 1 1 2 3 6 45 60 1 1 1 1 1 1 1 1 1 1	Fish o	collection	form	1 – Wa	adeable	streams	/rivers												
Kathryn Julian (NIWA) GPS E2761942 N6381276 Not fished Paned note Pished Sub- reaches Pished Sub- sub-reaches Pished Sub- reaches Pished Sub- reaches Pished Sub- reaches Pished Sub- reaches Pished Sub- reaches Pished Sub- sub-reaches Pished Sub- reaches Pished Sub- Sub- reaches							2761891	N63	381355	Site:	Wair	rere Stream					Date:	22/02/1 ⁻	1
sample id: time (min): 10 time: Finish 15:00 distance (m): 100 (m): B 6.5 D 7 F 6.5 H 6 J 5 Sampling gear: Spotlight EFM Seine Length (m) Water (wishility: wishility: wishil		· · · ·		Aldridge	e (NIWA)		2761942	N63	381276	No	t fished				-				fished/not
Sampling geal. Spotlight EFM Selfe Mesh (mm) visibility: Good Average Pool temp. (°C): 16.7 (µS): 0 do EFM anode: Big Small EFM volts (x100): 3 EFM pulse rate (Hz or pps): 65 EFM pulse width (ms): 2 Spotlight (watts): Species A B C D E F G H I J Good Sample Length (mm) FLAG Shortfin eel 22 19 7 5 12 6 5 6 5 16 103 90 600 Longfin eel 1 5 2 10 4 2 7 3 4 38 400 70 Bullies 1 5 2 10 4 2 7 3 4 38 400 70 Rainbow trout 1 1 2 3 6 45 60 5 Koura 8 14 3 5 5 1 1 2 1 1 1 1 Koura 8 14 3 5 5 1 1 2 6 <td>Fish sample i</td> <td>d:</td> <td></td> <td></td> <td>78</td> <td></td> <td>Finish</td> <td>15:00</td> <td></td> <td>(m):</td> <td></td> <td></td> <td></td> <td></td> <td>7</td> <td>F</td> <td>-</td> <td>H 6</td> <td>J 5</td>	Fish sample i	d:			78		Finish	15:00		(m):					7	F	-	H 6	J 5
EFM anode: Small EFM pulse rate (H2 or pps): 65 EFM pulse width (ms): 2 Spotight (watts): Species A B C D E F G H I J Count Count Length (mm) (matts): FLAG Shortfin el 22 19 7 5 12 6 5 6 5 16 103 90 600 Longfin el 1 5 2 10 4 2 7 3 4 38 40 70 - Bullies 1 5 2 10 4 2 7 3 4 38 40 70 - Bullies 1 5 2 10 4 2 7 3 4 38 40 70 - Rainbow trout 1 1 2 3 6 45 60 - Koura 8 14 3 5 1 1 6 2 6 51 NA NA	Samplin			ght	EFM	Sei						Good A	verage	Poor			18.7		^{ivity} 66
Species A B C D E F G H I J count Nin. Max. PLAG Shortfin el 22 19 7 5 12 6 5 6 5 16 103 90 600 Longfin el 1 - - 2 1 4 600 1000 Bullies 1 5 2 10 4 2 7 3 4 38 40 70 Inanga 1 1 - - - - 1 4 800 1000 Rainbow trout 1 1 - - - - 1 NA 300 Torrentfish 1 - - 1 6 2 6 51 NA NA Koura 8 14 3 5 5 1 1 6 2 6 51 NA NA Longfinel - - - - - - 1 NA NA Rainbow trout 1 1 - - - 1 NA NA Koura<	EFM and			EFM	volts (x100)): 3				or pps):	65	EFM pulse	e width (ms): 2		•	0 (,	
Longfin el 1 1 1 1 1 4 600 1000 Bullies 1 5 2 10 4 2 7 3 4 38 40 70 Inanga 1 1 1 1 2 NA 105 Rainbow trout 1 1 1 2 NA 105 Torrentfish 1 1 2 3 6 45 60 Koura 8 14 3 5 5 1 1 6 2 6 51 NA NA Koura 8 14 3 5 5 1 1 6 2 6 51 NA NA L 1 1 2 3 6 45 60 45 60 45 60 45 60 45 60 45 60 45 60 45 60 45 60 45 60 45 60 45 60 45 60	Species							E	F			1	J	count			Min.	Max.	FLAG
Bullies 1 5 2 10 4 2 7 3 4 38 40 70 Inanga 1 1 1 2 NA 105 Rainbow trout 1 1 1 NA 300 Torrentfish 1 1 2 3 6 45 60 Koura 8 14 3 5 5 1 1 6 2 6 51 NA NA Koura 8 14 3 5 5 1 1 6 2 6 51 NA NA L 1 1 1 1 1 6 2 6 51 NA NA L 1	Shortfin	eel		22	19	7	5	12	6	5	-	5	16	103					
Inanga 1 1 Image 1 1 Image 1 1 Image 1 1 Image 1 NA 105 Rainbow trout 1 1 1 1 1 NA 300 1 Torrentfish 1 2 3 6 45 60 Koura 8 14 3 5 5 1 1 6 2 6 51 NA NA Koura 8 14 3 5 5 1 1 6 2 6 51 NA NA Main 1 2 3 6 1 NA NA NA NA Koura 8 14 3 5 5 1 1 6 2 6 51 NA NA L 1 1 1 1 1 1 1 1 1 1 1 1 L 1 1 1 1 1 1 1 1 1 1 1 1 L 1 1 1 1 1 1 1 1 1 <		eel		1									1						
Rainbow trout 1 1 NA 300 Torrentfish 1 2 3 6 45 60 Koura 8 14 3 5 5 1 1 6 2 6 51 NA NA Koura 8 14 3 5 5 1 1 6 2 6 51 NA NA Koura 8 14 3 5 5 1 1 6 2 6 51 NA NA Koura 8 14 3 5 5 1 1 6 2 6 51 NA NA Koura 8 14 3 5 5 1 1 6 2 6 51 NA NA Ma Ma Ma Ma Ma Ma Ma Ma Ma Ma Ma Ma Ma Ma Ma Ma Ma Ma Ma Ma Ma Ma Ma Ma Ma Ma Ma Ma Ma Ma Ma Ma Ma Ma Ma Ma	Bullies				5	2		10	4	2	7	3	4						
Torrentfish 1 2 3 6 45 60 Koura 8 14 3 5 5 1 1 6 2 6 51 NA NA Koura 8 14 3 5 5 1 1 6 2 6 51 NA NA Koura 8 14 3 5 5 1 1 6 2 6 51 NA NA Koura 1 1 1 6 2 6 51 NA NA Koura 1 1 1 1 6 2 6 51 NA NA Koura 1 1 1 1 6 2 6 51 NA NA Main 1 1 1 1 1 1 1 1 1 Main 1 1 1 1 1 1 1 1 1 1 Main 1 1 1 1 1 1 1 1 1 1 Main 1 1 1 1 1 1 1 <	Inanga			1	I									2					
Koura 8 14 3 5 5 1 1 6 2 6 51 NA NA NA Image: Note of the set of t					1									1					
Image: Second		sh						1				-		-			-		
F1 Reach C - Large pool centre of reach too deep to fish 6m ² edges fished F2 Reach C/D - large tree in river making fishing difficult 6m ² F3 Reach F - Pool mid reach too deep to fish 10m ²	Koura			8	14	3	5	5	1	1	6	2	6	51			NA	NA	
F1 Reach C - Large pool centre of reach too deep to fish 6m ² edges fished F2 Reach C/D - large tree in river making fishing difficult 6m ² F3 Reach F - Pool mid reach too deep to fish 10m ²																			
F1 Reach C - Large pool centre of reach too deep to fish 6m ² edges fished F2 Reach C/D - large tree in river making fishing difficult 6m ² F3 Reach F - Pool mid reach too deep to fish 10m ²																			
F2 Reach C/D - large tree in river making fishing difficult 6m ² F3 Reach F - Pool mid reach too deep to fish 10m ²	FLAG						<u> </u>			FLAG	G Com	nment							
F3 Reach F - Pool mid reach too deep to fish 10m ²								ges fished											
							ult 6m ⁻												
F4 Reach G - Deep pool mid reach not fished 4m ⁻																			
	⊢4	Reach G - D	eep po	oi mid r	reach not fis	ned 4m ⁻													

Appendix 3: Macroinvertebrate results

Table Error! No text of specified style in document.-1: **Full species list for macroinvertebrates.** R = Scan for rare taxa.

	ι.									
Species	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8	Site 9	Site 10
MEGALOPTERA										
Archichauliodes diversus			9	15	3	5	5	2	7	1 R
ODONATA										
Xanthocnemis zelandica	2 R	1								
EPHEMEROPTERA										
Austroclima sp.		15		9		2				7
Austroclima sepia		22	4		8	4	23	6	10	17
Deleatidium spp.			3	11	1	3				
Coloburiscus humeralis			30	15	2	2			13	3
Nesameletus sp.			3	11	2				1	1
Zephlebia spp.		16								
Zephlebia versicolor		17								
Zephlebia dentata		53					1			10
Zephlebia borealis				1						
Zephlebia spectabilis			4	1		1			4 R	2
Oniscigaster wakefieldi										2
PLECOPTERA										
Austroperla cyrene				1						
Megaleptoperla grandis			1R							
Zelandoperla decorata			3	1 R	1	2			3	1
Zelandoperla spp.										1
TRICHOPTERA										
Aoteapsyche colonica			35	18	20	10	14	2	7	1
Aoteapsyche raruraru							1			
Aoteapsyche tepoka									2	
Aoteapsyche spp.					1			1	1	
Beraeoptera roria			10	1						
Costachorema callistum			5							
Costachorema xanthopterum				3						

Species	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8	Site 9	Site 1
Hudsonema alienum		1 R								
Hudsonema amabilis							4	5		4
Hydrobiosis spp.				1	1			2		
Hydrobiosis copis							1			
Neurochorema armstrongi					2	1			1	2 R
Olinga feredayi								1		
Orthopsyche sp.									3	
Orthopsyche fimbriata									1	
Oxyethira albiceps	3 R		11	2	14	6	1	14	3	
Polyplectropus sp.	1 R									
Psilochorema sp.					1					1
Pycnocentria evecta				1	1	1	8	1		14
Pycnocentrodes spp.			27	4	43	25	11	6	8	1
Triplectides sp.										
Triplectides obsoleta/dolichos		2		3	6		1	6		4
Zelolessia cheira									8	
HEMIPTERA										
Microvelia macgregori	1 R	1 R								
COLEOPTERA										
Elmidae (larvae)			21	87	36	84	21	91	55	41
Hydraenidae (A)						1				
Hydrophilidae (L)		1 R								
DIPTERA										
Aphrophila neozealandica			1	3	3	3	15	1 R	18	
Austrosimulium sp.	1 R	1 R	8	4	3	2	6	9	2	26
Cricotopus sp.			2 R		5	2	30	20	11	
Kaniwhaniwhanus									5	
Eriopterini sp.										1
Eukiefferiella sp.					1	4	1			
Macropelopiini sp.			1		3			1		1
Maoridiamesa sp.			1	1					6	
Muscidae			2	1					7	
Naonella forsythi			1 R		1	1	4	2		
Paradixa sp.		5								
Stratiomydidae		1 R								
Polypedilum spp.	1 R	1 R			1					

Species	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8	Site 9	Site 10
Tabanidae						1 R				
Tanytarsus spp.			3	4	1	2		1	13	
Tanyderidae								1 R		
MOLLUSCA										
Potamopygrus antipodarum	200	39	32	13	25	50	35	21	19	70
P. acuta	2 R	1 R								
Sphaerium sp.							1			
OTHERS										
Paracalliope fluviatillus		25		1	18	1	1			
Paratya curvirostris		1			1 R					
Oliogochatae unident	2 R	2 R						4		
Planaria	3 R	3		1		2	3	9		
Hirudinea	14 R	2 R								
Ostracoda	3 R	3								

Appendix 4: Macrophyte and periphyton results

Periphyton Assessm	nent						
Stream: Depression Strea	m	Date: 22	/02/11				
Sample Number:		Located	number:	Site 1			
Thickness category	Colour category	A	в	с	D	Е	Mean cover
Thin (<0.5mm) Mat/Film	NA						0
Medium mat/film (0.5- 3mm thick)	Green (% cover)						0
	Light brown (% cover)						0
	Black/dark brown (% cover)						0
Thick (>3mm) mat/film	Green/light brown (% cover)						0
	Black/dark brown (% cover)						0
Filaments short (<2cm)	Green (% cover)						0
	Brown/Reddish (% cover)						0
Filaments long (>2cm)	Green (% cover)				15	80	19
	Brown/Reddish (% cover)	30		35	20		17
Submerged bryophytes	NA						0
Iron Bacteria growths	NA						0

Macrophyt	te recording	sheet									
Stream: Depr	ression Stream		Located r	number: Site 1		Sample Number	:		Date: 22/02/	/11	
						Vegetation co	over (% w	etted area)			
	Wetted	Channel width			Subi	merged plants			Emergent plants		
Transect	width (m)	(m)	Total		Sur	ace-reaching	Belo	ow surface			
			cover	Total submerged	Sub- total	Species	Sub- total	Species	Total emergent	Species	
1	2.5	4.0	10	5	5	Gm			5	Gm	
2	1.5	4.0	100						100	Gm	
3	2.0	5.0	15	5	5	Ed			10	Gm	
4	1.5	5.0	60						60	Gm	
5	2.0	6.0	10						10	Gm	

Periphyton Assessn	nent						
Stream: Karengorengo Str	ream	Date: 22	/02/11				
Sample Number:		Located number: Site 2					
Thickness category	Colour category	A	В	с	D	Е	Mean cover
Thin (<0.5mm) Mat/Film	NA						0
Medium mat/film (0.5- 3mm thick)	Green (% cover)						0
	Light brown (% cover)						0
	Black/dark brown (% cover)						0
Thick (>3mm) mat/film	Green/light brown (% cover)						0
	Black/dark brown (% cover)						0
Filaments short (<2cm)	Green (% cover)						0
	Brown/Reddish (% cover)						0
Filaments long (>2cm)	Green (% cover)						0
	Brown/Reddish (% cover)						0
Submerged bryophytes	NA						0
Iron Bacteria growths	NA						0

Macrophy	te recording	sheet								
Stream: Kar	engorengo Strea	m	Located	number: Site 2		Sample Numb	er:		Date: 22/02	/11
			Vegetatio	n cover (% wetted area	ı)					
				Submerged plants					Emergent p	lants
					Surfac	e-reaching	Below	surface		
Transect	Wetted width (m)	Channel width (m)	Total cover	Total submerged	Sub- total	Species	Sub- total	Species	Total emergent	Species
1	2.2	3.0	10						10	Na
2	2.0	3.0	30						30	Na
3	1.8	3.0	40						40	Na
4	1.5	3.0	50						50	Na
5	2.0	3.0	5						5	Na

Periphyton Assessm	nent						
Stream: Paiakarahi Stream	n	Date: 23	/02/11				
Sample Number:		Located	number:	Site 3			
Thickness category	Colour category	A	в	с	D	Е	Mean cover
Thin (<0.5mm) Mat/Film	NA	2	8		5		3
Medium mat/film (0.5- 3mm thick)	Green (% cover)						0
	Light brown (% cover)					4	0.8
	Black/dark brown (% cover)						0
Thick (>3mm) mat/film	Green/light brown (% cover)						0
	Black/dark brown (% cover)				2		0.4
Filaments short (<2cm)	Green (% cover)	10		4	3	3	4
	Brown/Reddish (% cover)						0
Filaments long (>2cm)	Green (% cover)	7		13	18	41	15.8
	Brown/Reddish (% cover)						0
Submerged bryophytes	NA						0
Iron Bacteria growths	NA						0

tream: Paiak	arahi Stream		Located n	umber: Site 3		Sample Number	:		Date: 23/02/11		
						Vegetation co	ver (% w	etted area)			
	Wetted	Channel width			Subr	nerged plants			Emergent plants		
Transect	width (m)	(m)	Total		Surf	ace-reaching	Belo	ow surface			
			cover	Total submerged	Sub- total	Species	Sub- total	Species	Total emergent	Species	
1	3.5	5.0	0								
2	4.5	10.0	0								
3	4.0	7.0	0								
4	4.5	5.0	0								
5	3.5	12.0	0								

Periphyton Assessn	nent						
Stream: Paiakarahi Stream	n	Date: 23	/02/11				
Sample Number:		Located	number:	Site 4			
Thickness category	Colour category	A	В	с	D	Е	Mean cover
Thin (<0.5mm) Mat/Film	NA		11	30	21	17	15.8
Medium mat/film (0.5- 3mm thick)	Green (% cover)						0
	Light brown (% cover)	29	15		4		9.6
	Black/dark brown (% cover)						0
Thick (>3mm) mat/film	Green/light brown (% cover)	12					2.4
	Black/dark brown (% cover)						0
Filaments short (<2cm)	Green (% cover)	1	3				0.8
	Brown/Reddish (% cover)						0
Filaments long (>2cm)	Green (% cover)						0
	Brown/Reddish (% cover)						0
Submerged bryophytes	NA						0
Iron Bacteria growths	NA						0

Macrophyte	e recording	sheet								
Stream: Paiak	arahi Stream		Located r	number: Site 4		Sample Number	:		Date: 23/02/	/11
						Vegetation co	ver (% w	vetted area)		
	Wetted	Channel width			Subr	merged plants				Emergent plants
Transect	width (m)	(m)	Total		Sur	ace-reaching	Bel	ow surface		
			cover	Total submerged	Sub- total	Species	Sub- total	Species	Total emergent	Species
1	6.5	10.0	0							
2	7.5	12.0	0							
3	7.0	13.0	0							
4	8.0	12.0	0							
5	9.0	11.0	0							

Periphyton Assessn	nent						
Stream: Omahu Stream		Date: 24	/02/11				
Sample Number:		Located	number:	Site 5			
Thickness category	Colour category	A	в	с	D	Е	Mean cover
Thin (<0.5mm) Mat/Film	NA	20	25	18	11	5	15.8
Medium mat/film (0.5- 3mm thick)	Green (% cover)						0
	Light brown (% cover)	4		14	13	7	7.6
	Black/dark brown (% cover)					10	2
Thick (>3mm) mat/film	Green/light brown (% cover)						0
	Black/dark brown (% cover)						0
Filaments short (<2cm)	Green (% cover)	2					0.4
	Brown/Reddish (% cover)						0
Filaments long (>2cm)	Green (% cover)	2					0.4
	Brown/Reddish (% cover)						0
Submerged bryophytes	NA						0
Iron Bacteria growths	NA						0

Stream: Omal	nu Stream		Located number: Site 5 Sample Number:				Date: 24/02/11				
				Vegetation cover (% wetted area)							
Wetted		Channel width			Subi	merged plants			I	Emergent plants	
Transect	width (m)	(m)	Total		Sur	ace-reaching	Belo	ow surface			
			cover	Total submerged	Sub- total	Species	Sub- total	Species	Total emergent	Species	
1	3.5	8.0	0								
2	5.5	7.0	0								
3	7.0	9.0	0								
4	8.0	10.0	1						1	Gm	
5	7.0	11.0	0								

Periphyton Assessm	nent									
Stream: Omahu Stream		Date: 24/02/11								
Sample Number:		Located number: Site 6								
Thickness category	Colour category	A	В	с	D	Е	Mean cover			
Thin (<0.5mm) Mat/Film	NA	13	1	6	5	6	6.2			
Medium mat/film (0.5- 3mm thick)	Green (% cover)						0			
	Light brown (% cover)			18	12		6			
	Black/dark brown (% cover)					18	3.6			
Thick (>3mm) mat/film	Green/light brown (% cover)						0			
	Black/dark brown (% cover)						0			
Filaments short (<2cm)	Green (% cover)						0			
	Brown/Reddish (% cover)						0			
Filaments long (>2cm)	Green (% cover)	20	18	7	1		9.2			
	Brown/Reddish (% cover)						0			
Submerged bryophytes	NA						0			
Iron Bacteria growths	NA						0			

tream: Omal	e recording		Located number: Site 6 Sample Number:					Date: 24/02/11				
				Vegetation cover (% wetted area)								
Wotted		Channel width			Subn	erged plants			I	Emergent plants		
Transect	Wetted width (m)	Channel width (m)			Total		Surfa	ace-reaching	Belo	ow surface		
			cover	Total submerged	Sub- total	Species	Sub- total	Species	Total emergent	Species		
1	6.0	12.0	0									
2	3.5	7.0	0									
3	3.0	10.0	1						1	Gm		
4	6.0	12.0	0									
5	5.0	9.0	0									

Periphyton Assessm	nent								
Stream: Unnamed tributar	y Homunga Stream (d/s)	Date: 25/02/11							
Sample Number:		Located number: Site 7							
Thickness category	Colour category	A	в	с	D	Е	Mean cover		
Thin (<0.5mm) Mat/Film	NA	46				15	12.2		
Medium mat/film (0.5- 3mm thick)	Green (% cover)						0		
	Light brown (% cover)			20	60	20	20		
	Black/dark brown (% cover)						0		
Thick (>3mm) mat/film	Green/light brown (% cover)						0		
	Black/dark brown (% cover)						0		
Filaments short (<2cm)	Green (% cover)						0		
	Brown/Reddish (% cover)						0		
Filaments long (>2cm)	Green (% cover)						0		
	Brown/Reddish (% cover)		5				1		
Submerged bryophytes	NA						0		
Iron Bacteria growths	NA						0		

Macrophyte	e recording	sheet								
Stream: Unna	med tributary H	omunga Stream	Located r	number: Site 7		Sample Number	:		Date: 25/02/	11
			Vegetation cover (% wetted area)							
	Transact Wetted Channel				Subn	nerged plants			I	Emergent plants
Transect	width (m)	Channel width (m)	Total		Surf	ace-reaching	Bel	ow surface		
			cover	Total submerged	Sub- total	Species	Sub- total	Species	Total emergent	Species
1	2.3	3.0	2						2	Ph
2	2.7	3.0	3	3			3	Nh		
3	3.5	5.0	<1	<1			<1	Nh		
4	3.7	4.0	<1	<1			<1	Nh		
5	3.3	4.0	0							

Periphyton Assessm	nent								
Stream: Unnamed tributar	y Homunga Stream (u/s)	Date: 25/02/11							
Sample Number:		Located number: Site 8							
Thickness category	Colour category A B C D				Е	Mean cover			
Thin (<0.5mm) Mat/Film	NA		10				2		
Medium mat/film (0.5- 3mm thick)	Green (% cover)						0		
Shim trick)	Light brown (% cover)	60					12		
	Black/dark brown (% cover)						0		
Thick (>3mm) mat/film	Green/light brown (% cover)			60	60	60	36		
	Black/dark brown (% cover)		10				2		
Filaments short (<2cm)	Green (% cover)						0		
	Brown/Reddish (% cover)						0		
Filaments long (>2cm)	Green (% cover)				5		1		
	Brown/Reddish (% cover)						0		
Submerged bryophytes	NA		30			5	7		
Iron Bacteria growths	NA						0		

Macrophyte	e recording	sheet										
Stream: Unna	med tributary H	omunga Stream	Located r	number: Site 8		Sample Number	:		Date: 25/02/	/11		
	Wetted Channel width				Subr	nerged plants				Emergent plants		
Transect	width (m)	Channel width (m)			Total		Surf	ace-reaching	Bel	ow surface		
			cover	Total submerged	Sub- total	Species	Sub- total	Species	Total emergent	Species		
1	3.5	4.0	0									
2	2.8	3.0	0									
3	1.9	2.5	0									
4	2.0	3.0	0									
5	1.8	2.5	0									

Periphyton Assessn	nent									
Stream: Waiteariki Stream		Date: 22/02/11								
Sample Number:		Located number: Site 9								
Thickness category	Colour category	A	В	С	D	Е	Mean cover			
Thin (<0.5mm) Mat/Film	NA	34	42	20	34	39	33.8			
Medium mat/film (0.5- 3mm thick)	Green (% cover)		12		12		4.8			
	Light brown (% cover)	10		10	10		6			
	Black/dark brown (% cover)	13		15		6	6.8			
Thick (>3mm) mat/film	Green/light brown (% cover)						0			
	Black/dark brown (% cover)						0			
Filaments short (<2cm)	Green (% cover)	1	1	2	3	2	1.8			
	Brown/Reddish (% cover)						0			
Filaments long (>2cm)	Green (% cover)						0			
	Brown/Reddish (% cover)						0			
Submerged bryophytes	NA		40				8			
Iron Bacteria growths	NA						0			

Stream: Waite	ariki Stream		Located number: Site 9 Sample Number:				Date: 22/02/11				
				Vegetation cover (% wetted area)							
\\/attad		Channel width			Subr	nerged plants			I	Emergent plants	
Transect	Wetted width (m)	(m)	Total		Surf	ace-reaching	Belo	ow surface			
		cover	Total submerged	Sub- total	Species	Sub- total	Species	Total emergent	Species		
1	6	10	0								
2	8	10	0								
3	6	10	0								
4	6	8	0								
5	7	10	0								

Periphyton Assessm	nent									
Stream: Wairere Stream		Date: 22/02/11								
Sample Number:		Located number: Site 10								
Thickness category	Colour category	A	в	С	D	Е	Mean cover			
Thin (<0.5mm) Mat/Film	NA	40	20	12	25	15	22.4			
Medium mat/film (0.5- 3mm thick)	Green (% cover)			6			1.2			
	Light brown (% cover)						0			
	Black/dark brown (% cover)	5			12	15	6.4			
Thick (>3mm) mat/film	Green/light brown (% cover)						0			
	Black/dark brown (% cover)				6		1.2			
Filaments short (<2cm)	Green (% cover)						0			
	Brown/Reddish (% cover)						0			
Filaments long (>2cm)	Green (% cover)				2		0.4			
	Brown/Reddish (% cover)						0			
Submerged bryophytes	NA	4	15			24	8.6			
Iron Bacteria growths	NA						0			

Macrophyte	e recording	sheet											
Stream: Waire	ere Stream		Located r	number: Site 10		Sample Number	:		Date: 22/02/	Date: 22/02/11			
				Vegetation cover (% wetted area)									
Wetted		Channal width			Sub	merged plants				Emergent plants			
Transect	width (m)	Channel width (m)				Total		Sur	face-reaching	Bel	ow surface		
			cover	Total submerged	Sub- total	Species	Sub- total	Species	Total emergent	Species			
1	7	8	0										
2	6	8	0										
3	5	8	0										
4	5.5	7	0										
5	6	7	2	2			2	Nh					