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Waihou catchment ecological monitoring 2011

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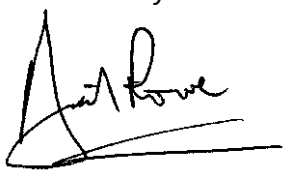

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Executive summary

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.

Table 2-1: Ecological monitoring site locations.

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

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

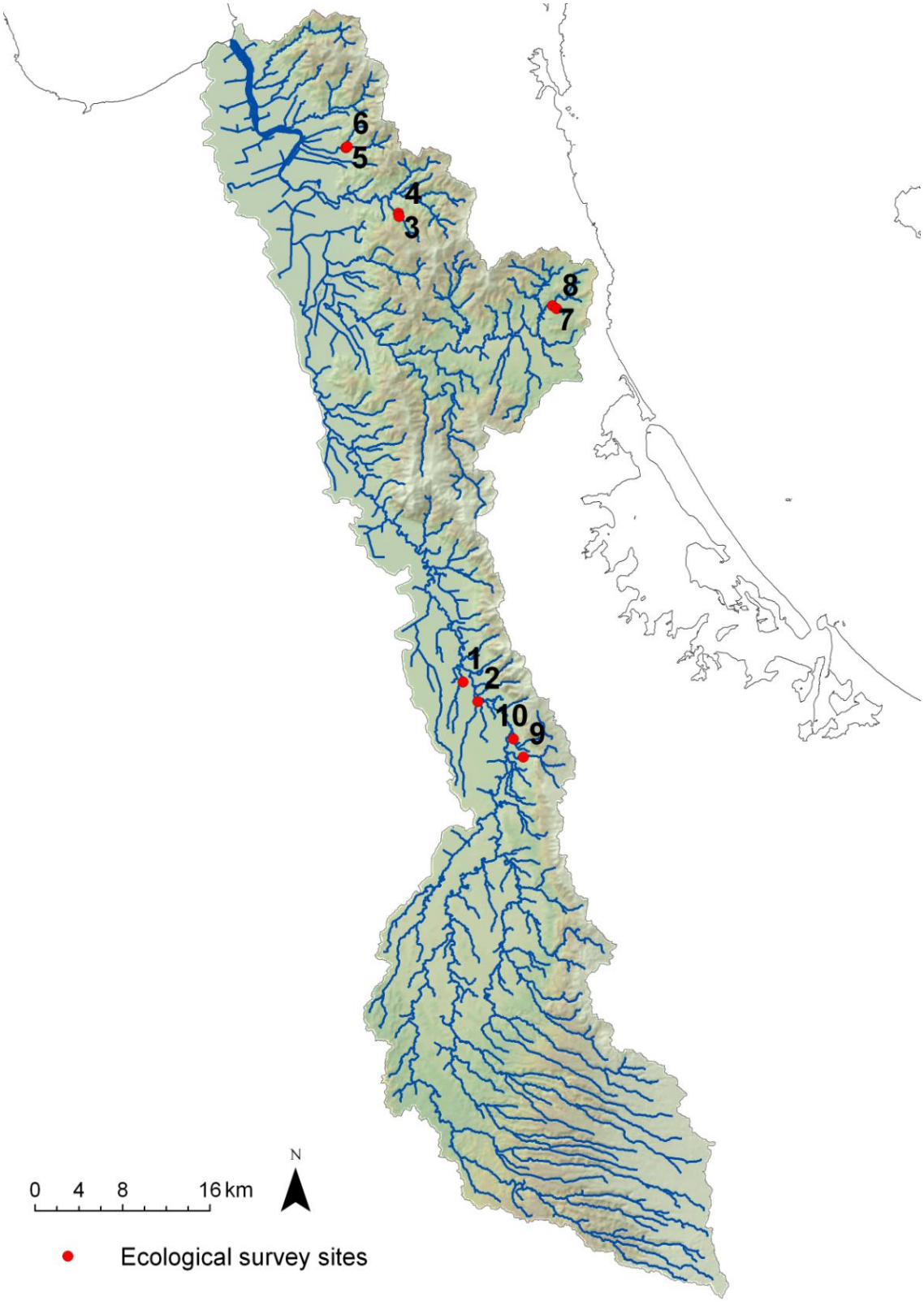

Figure 2-1: Map showing the location of the ten ecological monitoring sites within the Waihou River catchment.

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 100m^2. 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.

Table 3-1: Summary of species captured by electric fishing at Site 1.

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

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 m^2 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)

Table 3-2: Macroinvertebrate scores for Site 1.

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

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.

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

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

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 100m^2, 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.

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

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

Macroinvertebrates

This site was sampled according to MfE protocol C1 for hard-bottomed streams, with an area of approximately 1 m^2 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.

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.

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

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

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.

Table 3-8: Macroinvertebrate scores for Site 4.

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

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 100m^2. 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.

Table 3-9: Summary of species captured by electric fishing at Site 5.

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

Macroinvertebrates

This site was sampled according to MfE protocol C1 for hard-bottomed streams, with an area of approximately 1 m^2 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.

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 100m^2) and Cran's bullies (13.6 individuals 100m^2). 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.

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

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

Macroinvertebrates

This site was sampled according to MfE protocol C1 for hard-bottomed streams, with an area of approximately 1 m^2 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 bully[2] were most abundant (52.0 individuals per 100m^2), followed by shortfin eel (22.2 individuals per 100m^2). 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).

Table 3-13: Summary of species captured by electric fishing at Site 7.

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

[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 m^2 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.

Table 3-14: Macroinvertebrate scores at Site 7.

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

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 bully[2], followed by shortfin eels. A noticeable difference to Site 7, was the absence of the smallest size classes of common bully[2]. 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.

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

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

Macroinvertebrates

Macroinvertebrates were again sampled according to MfE protocol C1 for hard-bottomed streams, with a riffle area of approximately 1 m^2 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 100m^2).

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

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

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 Waitearikiki 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 100m^2). Cran's bullies (4.2 individuals per 100m^2) and koura (5.6 individuals per 100m^2) 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.

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

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

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 10.

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. Species accumulation rates were also more rapid at five of the eight sites 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 $100m^2$). These values can be used to give an indication of inter-annual 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.

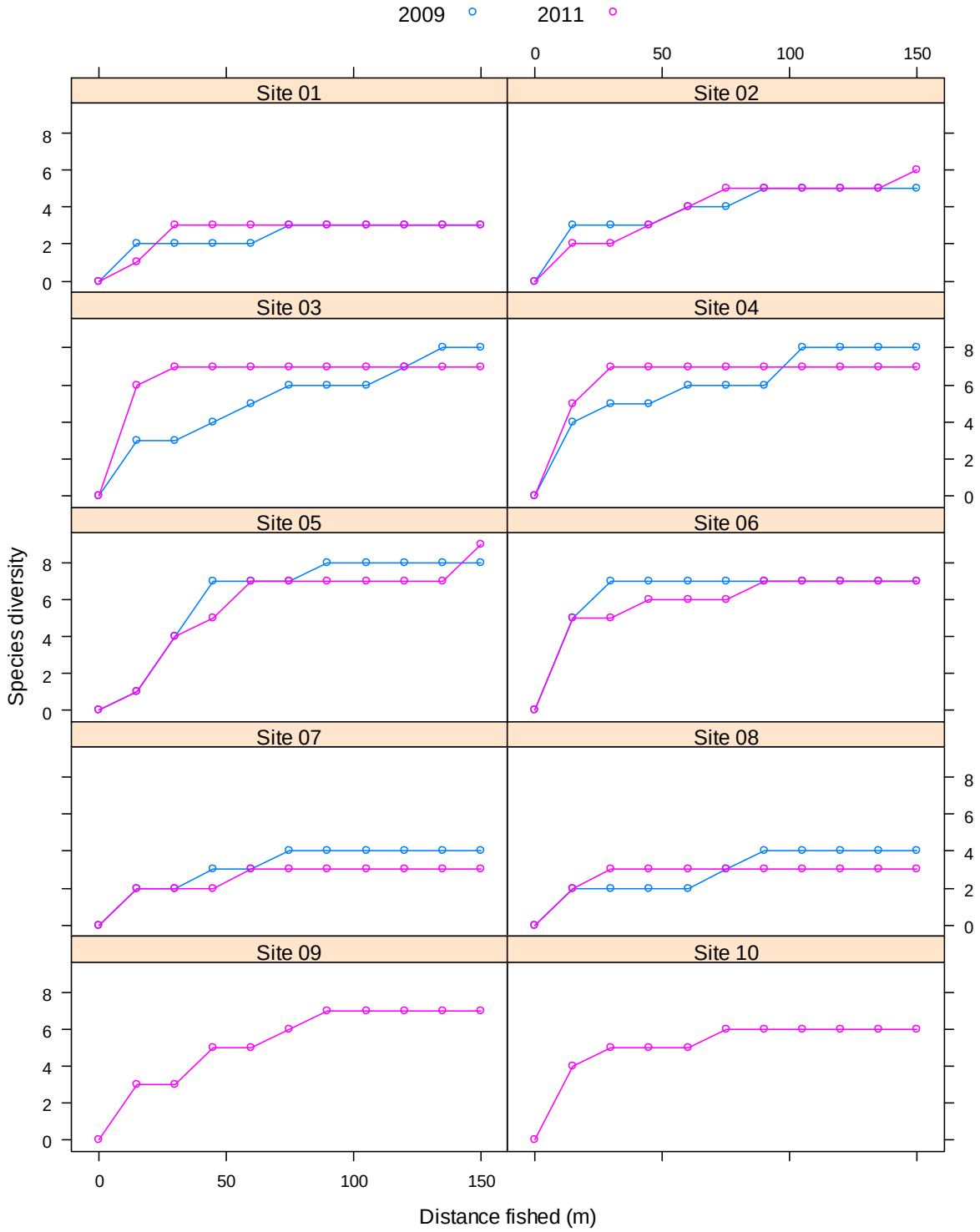

Figure 3-1: Comparison of fish species diversity between 2009 and 2011.

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.

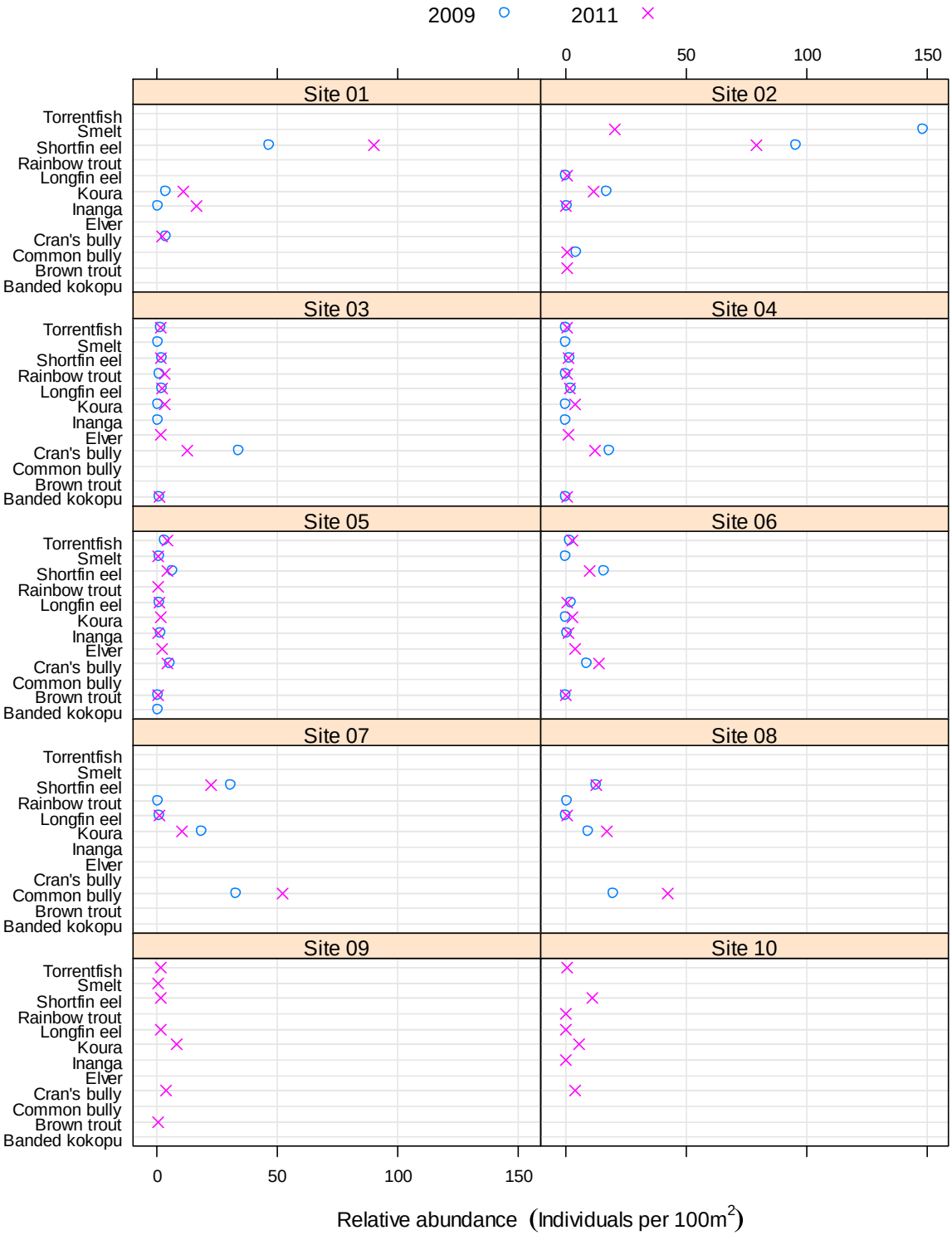

Figure 3-2: Comparison between the relative abundance of fish captured in the 2009 and 2011 surveys. N.B. Recent genetic work suggests that the common bullies at Site 7 and 8 may be Cran's bullies (Demitrus, unpublished data).

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.

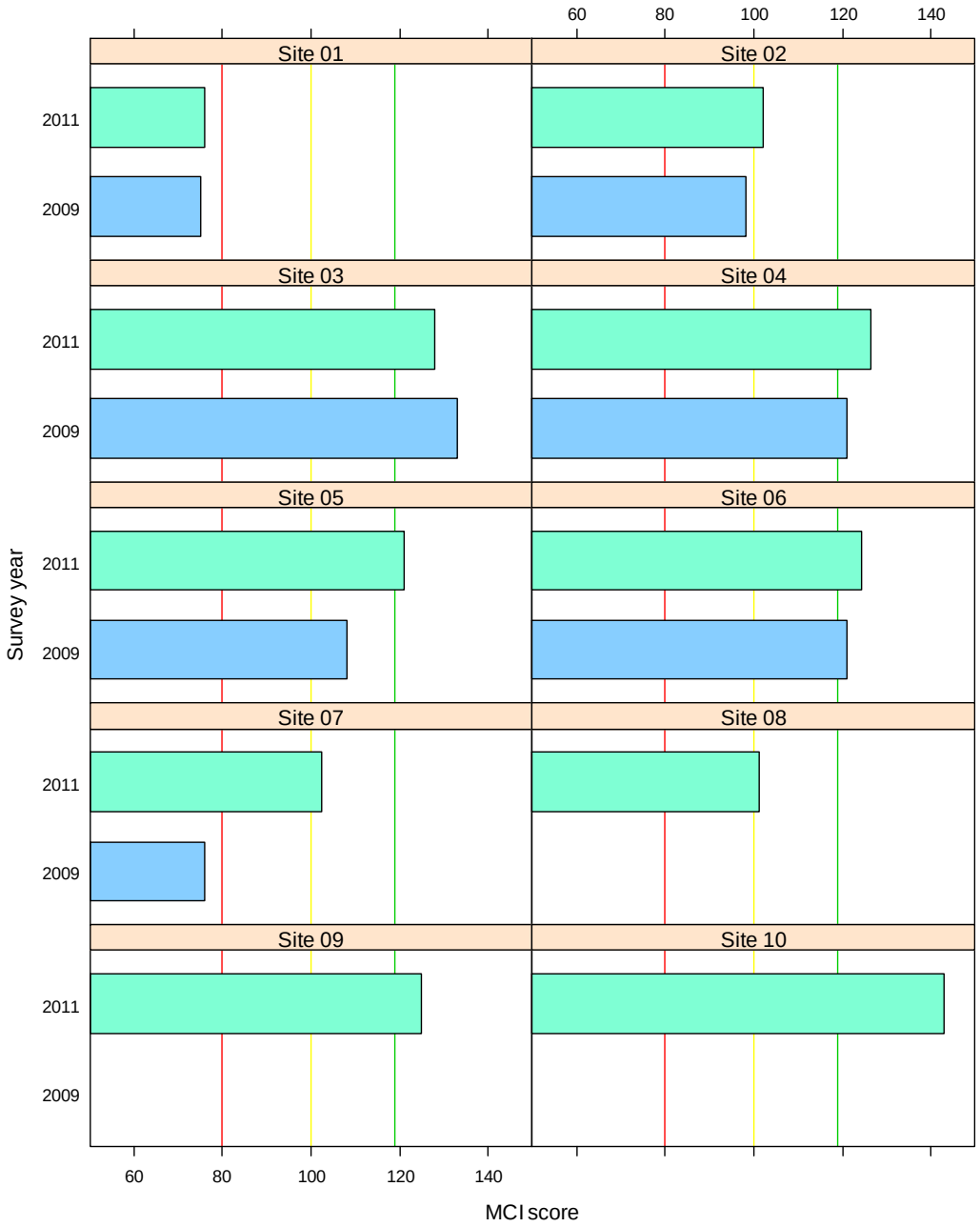

Figure 3-3: Comparison of MCI scores between survey years. Vertical lines indicate boundaries for quality classes. Anything below the red line is 'poor', between the red and yellow lines is 'fair', between the yellow and green lines is 'good' and above the green line is 'excellent' (Stark & Maxted 2007).

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

Field Assessment Cover Form
Wadeable Hard-Bottomed and Soft-Bottomed Streams

Stream name: Depression Stream		Assessor: Paul Franklin	
Site number: 1	Sample number: 1	Date: 22/02/11	Time: 17.00
GPS coordinates	Downstream:	E2757273	N6386560
	Upstream:	E2757201	N6386488

Channel & riparian features

Canopy cover:

Open	Partly shaded	Very shaded

Fencing:	Dominant riparian vegetation:	
None**/ineffective**	Crops	Retired vegetation
One side/partial	**Pasture**	Native shrub
Complete	Exotic trees	Native trees

Instream hydraulic conditions

Estimated or measured reach average:

Stream width (active channel): 4 m
Stream width (water): 2.1 m
Stream depth: 0.6 m
Surface velocity: 0.2 m s^{-1}

Water quality

Temperature:	22.0	°C	Conductivity:	273 µS cm^{-1}
Dissolved oxygen:	97	%	8.5	mg l^{-1}

Turbidity:	**Clear**	Slightly turbid	Highly turbid	Stained	Other

Stream-bottom substrata

Compaction (inorganic substrata):

Assorted sizes tightly packed &/or overlapping
Moderately packed with some overlapping
Mostly a loose assortment with little overlap
No packing/loose assortment easily moved

Embeddedness:

(% gravel-boulder particles covered by fine sediment)

<5%	5-25%	26-50%	51-75%	**>75%**

% surficial inorganic substratum size composition:

Substratum	Dimension	Percentage
Bedrock	-	
Boulder	>256mm	
Cobble	>64-256mm	
Gravel	>2-64mm	
Sand	>0.06-2mm	50
Silt	0.004-0.06mm	50
Clay	<0.004mm	

Organic material (% cover)

Large wood (>10cm diameter)

<5%	5-25%	26-50%	51-75%	>75%

Coarse detritus (small wood, sticks, leaves etc. >1mm)

<5%	**5-25**%	26-50**%**	51-75%	>75%

Fine (<1mm) organic deposits

<5%	**5-25**%	26-50**%**	51-75%	>75%

Habitat types sampled

(% of effort)

Stones:	%		
Wood:	%	Riffles:	%
Macrophyte: 50	%	Runs: 100	%
Edges: 50	%		

Instream plant cover (% streambed area)

Filamentous algae & mats:

<5%	5-25**%**	26-50%	51-75%	>75%

Macrophytes:

<5%	5-25%	26-50%	**51-75**%	>75**%**

Mosses/liverworts:

<5%	5-25%	26-50%	51-75%	>75%

Number of invertebrates returned:

Koura: C	Shrimps: O
Crabs:	Mussels:
Other:	
Mussel type:	
Hyridella	*Cucumerunio*

Comments:

Wadeable Soft-Bottomed Streams
Qualitative Habitat Assessment Field Data Sheet

Stream name: Depression Stream	Site number: 1	
Sample number: 1	Assessor: Paul Franklin	Date: 09/03/09

Habitat parameter	Category: Optimal	Suboptimal	Marginal	Poor
1. Riparian vegetative zone width	• Bankside vegetation buffer >10m • Continuous & dense	• Bankside vegetation buffer is <10m • Mostly continuous	• Pathways present and/or stock • Mostly healed over	• Breaks frequent • Human activity obvious
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				
2. Vegetative protection	• Bank surfaces & immediate riparian zones covered by native vegetation • Trees, under-storey shrubs or non-woody plants present • Vegetative disruption minimal	• Bank surfaces covered mainly by native vegetation • Disruption evident • Banks may be covered by exotic forestry	• Bank surfaces covered by mixture of grasses/shrubs, blackberry, willow & introduced species • Vegetation disruption obvious • Bare soil/closely cropped vegetation common	• 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	• Banks stable • Erosion/bank failure absent/minimal • <5% of bank affected	• Moderately stable • Infrequent, small areas of erosion mostly healed over • 5-30% of bank eroded	• Moderately unstable • 30-60% of bank in reach has areas of erosion • High erosion potential during floods	• 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				
4. Channel sinuosity	• Bends increase stream length 3-4 times longer than if it was straight	• Bends increase stream length 2-3 times longer than if it was straight	• Bends increase stream length 1-2 times longer than if it was straight	• Channel straight
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	• Changes to channel/dredging absent/minimal • Stream with normal pattern	• Some changes to channel/dredging • Evidence of past channel/dredging • Recent channel/dredging not present	• Channel changes/dredging extensive • Embankments/shoring structures present on both banks • 40-80% of reach Channelized & disrupted	• 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	Category Optimal					Habitat parameter					Category Optimal					Habitat parameter				
6. Sediment deposition	• Little/no islands or point bars present • <20% of bottom affected by sediment deposition					• New increase in bar formation, mostly from gravel, sand or fine sediment • 20-50% of bottom affected • Slight deposition in pools					• Some deposition of new gravel, sand or fine sediment on old & new bars • 50-80% of bottom affected • Sediment deposits at obstructions, constrictions & bends					• Heavy deposits of 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	• Pools evenly mixed • Large/shallow, large/deep, small/shallow, small/deep					• Majority of pools large/deep • Very few shallow pools					• Prevalence of shallow pools					• Majority of pools small/shallow				
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	• >50% substrate favourable for invertebrate colonisation & wide variety of woody debris, riffles, root mats • Snags/ submerged logs/undercut banks/cobbles provides abundant fish cover • Must not be new or transient					• 30-50% substrate favourable for invertebrate colonisation • Snags/ submerged logs/undercut banks/cobbles • Fish cover common • Moderate variety of habitat types. Can consist of some new material					• 10-30% substrate favourable for invertebrate colonisation • Fish cover patchy • 60-90% substrate easily moved by foot • Woody debris rare or may be smothered by sediment					• <10% substrate favourable for invertebrate colonisation • Fish cover rare or absent • Substrate unstable or lacking • Stable habitats lacking or limited to macrophytes				
Score: 5	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
9. Periphyton	• Periphyton not evident on hand held substrates (macrophytes, wood etc.) or fine sediments					• Periphyton not visible on substrates but obvious to touch					• Periphyton visible • <20% cover of available substrates					• Periphyton obvious & prolific • >20% cover of available substrates				
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																				

Field Assessment Cover Form
Wadeable Hard-Bottomed and Soft-Bottomed Streams

Stream name: Karengorengo Stream		Assessor: Brenda Aldridge	
Site number: 2	Sample number: 2	Date: 22/02/11	Time: 17:45
GPS coordinates	Downstream:	E2758628	N6384754
	Upstream:	E2758672	N6384606

Channel & riparian features

Canopy cover:

Open	Partly shaded	Very shaded

Fencing:	Dominant riparian vegetation:	
None/ineffective	Crops	**Retired vegetation**
One side/partial	Pasture	Native shrub
Complete	Exotic trees	Native trees

Instream hydraulic conditions

Estimated or measured reach average:

Stream width (active channel): 3
Stream width (water): 2.3
Stream depth: 0.4
Surface velocity: 0.2

Water quality

Temperature:	20.1	°C	Conductivity:	243	µS cm^{-1}
Dissolved oxygen:	80	%	7.5		mg l^{-1}

Turbidity:	**Clear**	Slightly turbid	Highly turbid	Stained	Other

Stream-bottom substrata

Compaction (inorganic substrata):

Assorted sizes tightly packed &/or overlapping
Moderately packed with some overlapping
Mostly a loose assortment with little overlap
No packing/loose assortment easily moved

Embeddedness:

(% gravel-boulder particles covered by fine sediment)

<5%	5-25**%**	26-50%	51-75%	>75%

% surficial inorganic substratum size composition:

Substratum	Dimension	Percentage
Bedrock	-	
Boulder	>256mm	
Cobble	>64-256mm	
Gravel	>2-64mm	35
Sand	>0.06-2mm	60
Silt	0.004-0.06mm	5
Clay	<0.004mm	

Organic material (% cover)

Large wood (>10cm diameter)

<5%	5-25%	26-50%	51-75%	>75%

Coarse detritus (small wood, sticks, leaves etc. >1mm)

<5%	5-25**%**	26-50%	51-75%	>75%

Fine (<1mm) organic deposits

<5%	5-25**%**	26-50%	51-75%	>75%

Instream plant cover (% streambed area)

Filamentous algae & mats:

<5%	5-25%	26-50%	51-75%	>75%

Macrophytes:

<5%	5-25**%**	**26-50**%	51-75%	>75%

Mosses/liverworts:

<5%	5-25%	26-50%	51-75%	>75%

Habitat types sampled

(% of effort)

Stones:	%		
Wood:	%	Riffles:	%
Macrophyte:	80 %	Runs:	100 %
Edges:	20 %		

Number of invertebrates returned:

Koura: C	Shrimps: A
Crabs:	Mussels:
Other:	
Mussel type:	
Hyridella	*Cucumerunio*

Comments:

Wadeable Soft-Bottomed Streams
Qualitative Habitat Assessment Field Data Sheet

Stream name: Karengorengo Stream	Site number: 2	
Sample number: 2	Assessor: Brenda Aldridge	Date: 22/02/11

Habitat parameter	Category																			
	Optimal					Suboptimal					Marginal					Poor				
1. Riparian vegetative zone width	• Bankside vegetation buffer >10m • Continuous & dense					• Bankside vegetation buffer is <10m • Mostly continuous					• Pathways present and/or stock • Mostly healed over					• Breaks frequent • Human activity obvious				
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																				
2. Vegetative protection	• Bank surfaces & immediate riparian zones covered by native vegetation • Trees, under-storey shrubs or non-woody plants present • Vegetative disruption minimal					• Bank surfaces covered mainly by native vegetation • Disruption evident • Banks may be covered by exotic forestry					• Bank surfaces covered by mixture of grasses/shrubs, blackberry, willow & introduced species • Vegetation disruption obvious • Bare soil/closely cropped vegetation common					• 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: 8																				
3. Bank stability	• Banks stable • Erosion/bank failure absent/minimal • <5% of bank affected					• Moderately stable • Infrequent, small areas of erosion mostly healed over • 5-30% of bank eroded					• Moderately unstable • 30-60% of bank in reach has areas of erosion • High erosion potential during floods					• 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: 8.5																				
4. Channel sinuosity	• Bends increase stream length 3-4 times longer than if it was straight					• Bends increase stream length 2-3 times longer than if it was straight					• Bends increase stream length 1-2 times longer than if it was straight					• Channel straight				
Score: 10	20	19	18	17	16	15	14	13	12	11	**10**	9	8	7	6	5	4	3	2	1
5. Channel alteration	• Changes to channel/dredging absent/minimal • Stream with normal pattern					• Some changes to channel/dredging • Evidence of past channel/dredging • Recent channel/dredging not present					• Channel changes/dredging extensive • Embankments/shoring structures present on both banks • 40-80% of reach Channelized & disrupted					• Banks shored with gabion/cement • >80% of stream reach channelized or disrupted • Instream habitat altered/absent				
Score: 11	20	19	18	17	16	15	14	13	12	**11**	10	9	8	7	6	5	4	3	2	1

Habitat parameter	Category	Habitat parameter	Category	Habitat parameter
	Optimal		Optimal	
6. Sediment deposition	• Little/no islands or point bars present • <20% of bottom affected by sediment deposition	• New increase in bar formation, mostly from gravel, sand or fine sediment • 20-50% of bottom affected • Slight deposition in pools	• Some deposition of new gravel, sand or fine sediment on old & new bars • 50-80% of bottom affected • Sediment deposits at obstructions, constrictions & bends	• Heavy deposits of fine material • Increased bar development • >80% of bottom changing frequently • Pools almost absent due to sediment deposition
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	• Pools evenly mixed • Large/shallow, large/deep, small/shallow, small/deep	• Majority of pools large/deep • Very few shallow pools	• Prevalence of shallow pools	• Majority of pools small/shallow
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	• >50% substrate favourable for invertebrate colonisation & wide variety of woody debris, riffles, root mats • Snags/ submerged logs/undercut banks/cobbles provides abundant fish cover • Must not be new or transient	• 30-50% substrate favourable for invertebrate colonisation • Snags/ submerged logs/undercut banks/cobbles • Fish cover common • Moderate variety of habitat types. Can consist of some new material	• 10-30% substrate favourable for invertebrate colonisation • Fish cover patchy • 60-90% substrate easily moved by foot • Woody debris rare or may be smothered by sediment	• <10% substrate favourable for invertebrate colonisation • Fish cover rare or absent • Substrate unstable or lacking • Stable habitats lacking or limited to macrophytes
Score: 11	20 19 18 17 16	15 14 13 12 **11**	10 9 8 7 6	5 4 3 2 1
9. Periphyton	• Periphyton not evident on hand held substrates (macrophytes, wood etc.) or fine sediments	• Periphyton not visible on substrates but obvious to touch	• Periphyton visible • <20% cover of available substrates	• Periphyton obvious & prolific • >20% cover of available substrates
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				

Field Assessment Cover Form
Wadeable Hard-Bottomed and Soft-Bottomed Streams

Stream name: Paiakarahi Stream (d/s)		Assessor: Paul Franklin	
Site number: 3	Sample number: 3	Date: 23/02/11	Time: 11:40
GPS coordinates	Downstream:	E2751347	N6429422
	Upstream:	E2751418	N6429342

Channel & riparian features

Canopy cover:

Open	Partly shaded	**Very shaded**

Fencing:	Dominant riparian vegetation:	
None/ineffective	Crops	Retired vegetation
One side/partial	Pasture	Native shrub
Complete	Exotic trees	**Native trees**

Instream hydraulic conditions

Estimated or measured reach average:

Stream width (active channel): 8 m
Stream width (water): 5 m
Stream depth: 0.3 m
Surface velocity: 0.3 m s^{-1}

Water quality

Temperature:	18.2	°C	Conductivity:	109	µS cm^{-1}
Dissolved oxygen:	85	%	8.0		mg l^{-1}

Turbidity:	**Clear**	Slightly turbid	Highly turbid	Stained	Other

Stream-bottom substrata

Compaction (inorganic substrata):

Assorted sizes tightly packed &/or overlapping
Moderately packed with some overlapping
Mostly a loose assortment with little overlap
No packing/loose assortment easily moved

Embeddedness:

(% gravel-boulder particles covered by fine sediment)

<5%	5-25%	26-50%	51-75%	>75%

% surficial inorganic substratum size composition:

Substratum	Dimension	Percentage
Bedrock	-	
Boulder	>256mm	5
Cobble	>64-256mm	85
Gravel	>2-64mm	10
Sand	>0.06-2mm	
Silt	0.004-0.06mm	
Clay	<0.004mm	

Organic material (% cover)

Large wood (>10cm diameter)

<5%	**5-25%**	26-50%	51-75%	>75%

Coarse detritus (small wood, sticks, leaves etc. >1mm)

<5**%**	**5-25**%	26-50%	51-75%	>75%

Fine (<1mm) organic deposits

<5%	5-25%	26-50%	51-75%	>75%

Habitat types sampled

(% of effort)

Stones:	100%		
Wood:	%	Riffles:	100 %
Macrophyte:	%	Runs:	%
Edges:	%		

Number of invertebrates returned:

Koura:C	Shrimps:A
Crabs:	Mussels:
Other:	
Mussel type:	
Hyridella	*Cucumerunio*

Instream plant cover (% streambed area)

Filamentous algae & mats:

<5%	5-25%	26-50%	51-75%	>75%

Macrophytes:

<5%	5-25%	26-50%	51-75%	>75%

Mosses/liverworts:

<5%	5-25%	26-50%	51-75%	>75%

Comments:

Wadeable Hard-Bottomed Streams
Qualitative Habitat Assessment Field Data Sheet

Stream name: Paiakarahi Stream (d/s)	Site number: 3	
Sample number: 3	Assessor: Paul Franklin	Date: 23/02/11

Habitat parameter	Category																			
	Optimal					Suboptimal					Marginal					Poor				
1. Riparian vegetative zone width	• Bankside vegetation buffer >10m • Continuous & dense					• Bankside vegetation buffer is <10m • Mostly continuous					• Pathways present and/or stock • Mostly healed over					• Breaks frequent • Human activity obvious				
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																				
2. Vegetative protection	• Bank surfaces & immediate riparian zones covered by native vegetation • Trees, under-storey shrubs or non-woody plants present • Vegetative disruption minimal					• Bank surfaces covered mainly by native vegetation • Disruption evident • Banks may be covered by exotic forestry					• Bank surfaces covered by mixture of grasses/shrubs, blackberry, willow & introduced species • Vegetation disruption obvious • Bare soil/closely cropped vegetation common					• 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: 20																				
3. Bank stability	• Banks stable • Erosion/bank failure absent/minimal • <5% of bank affected					• Moderately stable • Infrequent, small areas of erosion mostly healed over • 5-30% of bank eroded					• Moderately unstable • 30-60% of bank in reach has areas of erosion • High erosion potential during floods					• 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: 14																				
4. Frequency of riffles	• Riffles relatively frequent • Distance between riffles divided by stream width=5-7 • Variety of habitat is key					• Occurrence of riffles infrequent • Distance between riffles divided by stream width=7-15					• Occasional riffle or run • Bottom contours provide some habitat • Distance between riffles divided by stream width=15-25					• Generally flat water, shallow riffles • Poor habitat • Distance between riffles divided by stream width=>25				
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	• Changes to channel/dredging absent/minimal • Stream with normal pattern					• Some changes to channel/dredging • Evidence of past channel/dredging • Recent channel/dredging not present					• Channel changes/dredging extensive • Embankments/shoring structures present on both banks • 40-80% of reach channelized & disrupted					• 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	Category Optimal					Habitat parameter					Category Optimal					Habitat parameter				
6. Sediment deposition	• Little/no islands or point bars present • <20% of bottom affected by sediment deposition					• New increase in bar formation, mostly from gravel, sand or fine sediment • 20-50% of bottom affected • Slight deposition in pools					• Some deposition of new gravel, sand or fine sediment on old & new bars • 50-80% of bottom affected • Sediment deposits at obstructions, constrictions & bends					• Heavy deposits of fine material • Increased bar development • >80% of bottom changing frequently • Pools almost absent due to sediment deposition				
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	• 4 velocity/depth regimes present • Slow/deep, slow/shallow, fast/shallow, fast/deep					• 3 0f 4 velocity/depth regimes present • If fast/shallow is missing then score lower					• 2 of 4 velocity/depth regimes present • If fast/shallow or slow/shallow are missing, score low					• Dominated by 1 velocity/depth regime • Usually deep/slow				
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	• >50% substrate favourable for invertebrate colonisation & wide variety of woody debris, riffles, root mats • Snags/ submerged logs/undercut banks/cobbles provides abundant fish cover • Must not be new or transient					• 30-50% substrate favourable for invertebrate colonisation • Snags/ submerged logs/undercut banks/cobbles • Fish cover common • Moderate variety of habitat types. Can consist of some new material					• 10-30% substrate favourable for invertebrate colonisation • Fish cover patchy • 60-90% substrate easily moved by foot • Woody debris rare or may be smothered by sediment					• <10% substrate favourable for invertebrate colonisation • Fish cover rare or absent • Substrate unstable or lacking • Stable habitats lacking or limited to macrophytes				
Score: 15	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
9. Periphyton	• Periphyton not evident on hand held stones • Stable substrate • Surfaces rough to touch					• Periphyton not visible on stones • Stable substrate • Periphyton obvious to touch					• Periphyton visible • <20% cover of available substrates					• Periphyton obvious & prolific • >20% cover of available substrates				
Score: 10	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
TOTAL SCORE: 140.5																				

Field Assessment Cover Form
Wadeable Hard-Bottomed and Soft-Bottomed Streams

Stream name: Paiakarahi Stream (u/s)		Assessor: Paul Franklin	
Site number: 4	Sample number:	Date: 23/02/11	Time: 14:50
GPS coordinates	Downstream:	E2751431	N6429122
	Upstream:	E2751550	N6429031

Channel & riparian features

Canopy cover:

Open	**Partly shaded**	Very shaded

Fencing:	Dominant riparian vegetation:	
None/ineffective	Crops	Retired vegetation
One side/partial	Pasture	Native shrub
Complete	Exotic trees	**Native trees**

Instream hydraulic conditions

Estimated or measured reach average:

Stream width (active channel): 12 m
Stream width (water): 7 m
Stream depth: 0.3 m
Surface velocity: 0.35 m s^{-1}

Water quality

Temperature:	18.2	°C	Conductivity:	109	µS cm^{-1}
Dissolved oxygen:	85	%	8.0		mg l^{-1}

Turbidity:	**Clear**	Slightly turbid	Highly turbid	Stained	Other

Stream-bottom substrata

Compaction (inorganic substrata):

Assorted sizes tightly packed &/or overlapping
Moderately packed with some overlapping
Mostly a loose assortment with little overlap
No packing/loose assortment easily moved

Embeddedness:

(% gravel-boulder particles covered by fine sediment)

<5%	5-25%	26-50%	51-75%	>75%

% surficial inorganic substratum size composition:

Substratum	Dimension	Percentage
Bedrock	-	
Boulder	>256mm	30
Cobble	>64-256mm	70
Gravel	>2-64mm	
Sand	>0.06-2mm	
Silt	0.004-0.06mm	
Clay	<0.004mm	

Organic material (% cover)

Large wood (>10cm diameter)

<5%	5-25%	26-50%	51-75%	>75%

Coarse detritus (small wood, sticks, leaves etc. >1mm)

<5%	5-25%	26-50%	51-75%	>75%

Fine (<1mm) organic deposits

<5%	5-25%	26-50%	51-75%	>75%

Habitat types sampled

(% of effort)

Stones:	100%		
Wood:	%	Riffles:	100 %
Macrophyte:	%	Runs:	%
Edges:	%		

Number of invertebrates returned:

Koura: O	Shrimps: R
Crabs:	Mussels:
Other:	
Mussel type:	
Hyridella	*Cucumerunio*

Instream plant cover (% streambed area)

Filamentous algae & mats:

<5**%**	**5-25**%	26-50%	51-75%	>75%

Macrophytes:

<5%	5-25%	26-50%	51-75%	>75%

Mosses/liverworts:

<5%	5-25%	26-50%	51-75%	>75%

Comments:

Wadeable Hard-Bottomed Streams
Qualitative Habitat Assessment Field Data Sheet

Stream name: Paiakarahi Stream (u/s)	Site number: 4	
Sample number: 4	Assessor: Paul Franklin	Date: 23/02/11

Habitat parameter	Category: Optimal	Suboptimal	Marginal	Poor
1. Riparian vegetative zone width	• Bankside vegetation buffer >10m • Continuous & dense	• Bankside vegetation buffer is <10m • Mostly continuous	• Pathways present and/or stock • Mostly healed over	• Breaks frequent • Human activity obvious
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				
2. Vegetative protection	• Bank surfaces & immediate riparian zones covered by native vegetation • Trees, under-storey shrubs or non-woody plants present • Vegetative disruption minimal	• Bank surfaces covered mainly by native vegetation • Disruption evident • Banks may be covered by exotic forestry	• Bank surfaces covered by mixture of grasses/shrubs, blackberry, willow & introduced species • Vegetation disruption obvious • Bare soil/closely cropped vegetation common	• 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: 17				
3. Bank stability	• Banks stable • Erosion/bank failure absent/minimal • <5% of bank affected	• Moderately stable • Infrequent, small areas of erosion mostly healed over • 5-30% of bank eroded	• Moderately unstable • 30-60% of bank in reach has areas of erosion • High erosion potential during floods	• 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: 14				
4. Frequency of riffles	• Riffles relatively frequent • Distance between riffles divided by stream width=5-7 • Variety of habitat is key	• Occurrence of riffles infrequent • Distance between riffles divided by stream width=7-15	• Occasional riffle or run • Bottom contours provide some habitat • Distance between riffles divided by stream width=15-25	• Generally flat water, shallow riffles • Poor habitat • Distance between riffles divided by stream width=>25
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	• Changes to channel/dredging absent/minimal • Stream with normal pattern	• Some changes to channel/dredging • Evidence of past channel/dredging • Recent channel/dredging not present	• Channel changes/dredging extensive • Embankments/shoring structures present on both banks • 40-80% of reach channelized & disrupted	• Banks shored with gabion/cement • >80% of stream reach channelized or disrupted • Instream habitat altered/absent
Score: 20	**20** 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1

Habitat parameter	Category Optimal					Habitat parameter					Category Optimal					Habitat parameter				
6. Sediment deposition	• Little/no islands or point bars present • <20% of bottom affected by sediment deposition					• New increase in bar formation, mostly from gravel, sand or fine sediment • 20-50% of bottom affected • Slight deposition in pools					• Some deposition of new gravel, sand or fine sediment on old & new bars • 50-80% of bottom affected • Sediment deposits at obstructions, constrictions & bends					• Heavy deposits of fine material • Increased bar development • >80% of bottom changing frequently • Pools almost absent due to sediment deposition				
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	• 4 velocity/depth regimes present • Slow/deep, slow/shallow, fast/shallow, fast/deep					• 3 0f 4 velocity/depth regimes present • If fast/shallow is missing then score lower					• 2 of 4 velocity/depth regimes present • If fast/shallow or slow/shallow are missing, score low					• Dominated by 1 velocity/depth regime • Usually deep/slow				
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	• >50% substrate favourable for invertebrate colonisation & wide variety of woody debris, riffles, root mats • Snags/ submerged logs/undercut banks/cobbles provides abundant fish cover • Must not be new or transient					• 30-50% substrate favourable for invertebrate colonisation • Snags/ submerged logs/undercut banks/cobbles • Fish cover common • Moderate variety of habitat types. Can consist of some new material					• 10-30% substrate favourable for invertebrate colonisation • Fish cover patchy • 60-90% substrate easily moved by foot • Woody debris rare or may be smothered by sediment					• <10% substrate favourable for invertebrate colonisation • Fish cover rare or absent • Substrate unstable or lacking • Stable habitats lacking or limited to macrophytes				
Score: 17	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
9. Periphyton	• Periphyton not evident on hand held stones • Stable substrate • Surfaces rough to touch					• Periphyton not visible on stones • Stable substrate • Periphyton obvious to touch					• Periphyton visible • <20% cover of available substrates					• Periphyton obvious & prolific • >20% cover of available substrates				
Score: 10	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
TOTAL SCORE: 148																				

Field Assessment Cover Form
Wadeable Hard-Bottomed and Soft-Bottomed Streams

Stream name: Omahu Stream (d/s)		Assessor: Paul Franklin	
Site number: 5	Sample number:	Date: 24/02/11	Time: 11:45
GPS coordinates	Downstream:	E2746560	N6435409
	Upstream:	E2746610	N6435540

Channel & riparian features

Canopy cover:

Open	**Partly shaded**	Very shaded

Fencing:	Dominant riparian vegetation:	
None/ineffective	Crops	Retired vegetation
One side/partial	Pasture	Native shrub
Complete	**Exotic trees**	Native trees

Instream hydraulic conditions

Estimated or measured reach average:

Stream width (active channel): 10 m
Stream width (water): 6 m
Stream depth: 0.25 m
Surface velocity: 0.2 m s^{-1}

Water quality

Temperature:	18.3	°C	Conductivity:	87	µS cm^{-1}
Dissolved oxygen:	83	%	7.8		mg l^{-1}

Turbidity:	**Clear**	Slightly turbid	Highly turbid	Stained	Other

Stream-bottom substrata

Compaction (inorganic substrata):

Assorted sizes tightly packed &/or overlapping
Moderately packed with some overlapping
Mostly a loose assortment with little overlap
No packing/loose assortment easily moved

Embeddedness:

(% gravel-boulder particles covered by fine sediment)

<5**%**	**5-25**%	26-50%	51-75%	>75%

% surficial inorganic substratum size composition:

Substratum	Dimension	Percentage
Bedrock	-	
Boulder	>256mm	
Cobble	>64-256mm	80
Gravel	>2-64mm	20
Sand	>0.06-2mm	
Silt	0.004-0.06mm	
Clay	<0.004mm	

Organic material (% cover)

Large wood (>10cm diameter)

<5%	5-25%	26-50%	51-75%	>75%

Coarse detritus (small wood, sticks, leaves etc. >1mm)

<5%	5-25%	26-50%	51-75%	>75%

Fine (<1mm) organic deposits

<5%	5-25%	26-50%	51-75%	>75%

Habitat types sampled

(% of effort)

Stones:	100%		
Wood:	%	Riffles:	%
Macrophyte:	%	Runs:	100 %
Edges:	%		

Instream plant cover (% streambed area)

Filamentous algae & mats:

<5%	5-25%	26-50%	51-75%	>75%

Macrophytes:

<5%	5-25%	26-50%	51-75%	>75%

Mosses/liverworts:

<5%	5-25%	26-50%	51-75%	>75%

Number of invertebrates returned:

Koura:	Shrimps:
Crabs:	Mussels:
Other:	
Mussel type:	
Hyridella	*Cucumerunio*

Comments:

Wadeable Hard-Bottomed Streams
Qualitative Habitat Assessment Field Data Sheet

Stream name: Omahu Stream (d/s)	Site number: 5	
Sample number: 5	Assessor: Paul Franklin	Date: 24/02/11

Habitat parameter	Category																			
	Optimal					Suboptimal					Marginal					Poor				
1. Riparian vegetative zone width • Bankside vegetation buffer >10m • Continuous & dense						• Bankside vegetation buffer is <10m • Mostly continuous					• Pathways present and/or stock • Mostly healed over					• Breaks frequent • Human activity obvious				
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 • Bank surfaces & immediate riparian zones covered by native vegetation • Trees, under-storey shrubs or non-woody plants present • Vegetative disruption minimal						• Bank surfaces covered mainly by native vegetation • Disruption evident • Banks may be covered by exotic forestry					• Bank surfaces covered by mixture of grasses/shrubs, blackberry, willow & introduced species • Vegetation disruption obvious • Bare soil/closely cropped vegetation common					• 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: 10																				
3. Bank stability • Banks stable • Erosion/bank failure absent/minimal • <5% of bank affected						• Moderately stable • Infrequent, small areas of erosion mostly healed over • 5-30% of bank eroded					• Moderately unstable • 30-60% of bank in reach has areas of erosion • High erosion potential during floods					• 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: 16.5																				
4. Frequency of riffles • Riffles relatively frequent • Distance between riffles divided by stream width=5-7 • Variety of habitat is key						• Occurrence of riffles infrequent • Distance between riffles divided by stream width=7-15					• Occasional riffle or run • Bottom contours provide some habitat • Distance between riffles divided by stream width=15-25					• Generally flat water, shallow riffles • Poor habitat • Distance between riffles divided by stream width=>25				
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 • Changes to channel/dredging absent/minimal • Stream with normal pattern						• Some changes to channel/dredging • Evidence of past channel/dredging • Recent channel/dredging not present					• Channel changes/dredging extensive • Embankments/shoring structures present on both banks • 40-80% of reach channelized & disrupted					• 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	Category Optimal					Habitat parameter					Category Optimal					Habitat parameter				
6. Sediment deposition	• Little/no islands or point bars present • <20% of bottom affected by sediment deposition					• New increase in bar formation, mostly from gravel, sand or fine sediment • 20-50% of bottom affected • Slight deposition in pools					• Some deposition of new gravel, sand or fine sediment on old & new bars • 50-80% of bottom affected • Sediment deposits at obstructions, constrictions & bends					• Heavy deposits of fine material • Increased bar development • >80% of bottom changing frequently • Pools almost absent due to sediment deposition				
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	• 4 velocity/depth regimes present • Slow/deep, slow/shallow, fast/shallow, fast/deep					• 3 0f 4 velocity/depth regimes present • If fast/shallow is missing then score lower					• 2 of 4 velocity/depth regimes present • If fast/shallow or slow/shallow are missing, score low					• Dominated by 1 velocity/depth regime • Usually deep/slow				
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	• >50% substrate favourable for invertebrate colonisation & wide variety of woody debris, riffles, root mats • Snags/ submerged logs/undercut banks/cobbles provides abundant fish cover • Must not be new or transient					• 30-50% substrate favourable for invertebrate colonisation • Snags/ submerged logs/undercut banks/cobbles • Fish cover common • Moderate variety of habitat types. Can consist of some new material					• 10-30% substrate favourable for invertebrate colonisation • Fish cover patchy • 60-90% substrate easily moved by foot • Woody debris rare or may be smothered by sediment					• <10% substrate favourable for invertebrate colonisation • Fish cover rare or absent • Substrate unstable or lacking • Stable habitats lacking or limited to macrophytes				
Score: 12	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
9. Periphyton	• Periphyton not evident on hand held stones • Stable substrate • Surfaces rough to touch					• Periphyton not visible on stones • Stable substrate • Periphyton obvious to touch					• Periphyton visible • <20% cover of available substrates					• Periphyton obvious & prolific • >20% cover of available substrates				
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																				

Field Assessment Cover Form
Wadeable Hard-Bottomed and Soft-Bottomed Streams

Stream name: Omahu Stream (u/s)		Assessor: Paul Franklin	
Site number: 6	Sample number: 6	Date: 24/02/11	Time: 14:40
GPS coordinates	Downstream:	E2746688	N6435516
	Upstream:	E2746806	N6435488

Channel & riparian features

Canopy cover:

Open	**Partly shaded**	Very shaded

Fencing:	Dominant riparian vegetation:	
None/ineffective	Crops	Retired vegetation
One side/partial	Pasture	Native shrub
Complete	**Exotic trees**	Native trees

Instream hydraulic conditions

Estimated or measured reach average:

Stream width (active channel): 12 m
Stream width (water): 8 m
Stream depth: 0.4 m
Surface velocity: 0.3 m s^{-1}

Water quality

Temperature:	18.3	°C	Conductivity:	87	µS cm^{-1}
Dissolved oxygen:	83	%	7.8		mg l^{-1}

Turbidity:	**Clear**	Slightly turbid	Highly turbid	Stained	Other

Stream-bottom substrata

Compaction (inorganic substrata):

Assorted sizes tightly packed &/or overlapping
Moderately packed with some overlapping
Mostly a loose assortment with little overlap
No packing/loose assortment easily moved

Embeddedness:

(% gravel-boulder particles covered by fine sediment)

<5**%**	**5-25**%	26-50%	51-75%	>75%

% surficial inorganic substratum size composition:

Substratum	Dimension	Percentage
Bedrock	-	
Boulder	>256mm	
Cobble	>64-256mm	60
Gravel	>2-64mm	20
Sand	>0.06-2mm	20
Silt	0.004-0.06mm	
Clay	<0.004mm	

Organic material (% cover)

Large wood (>10cm diameter)

<5%	5-25%	26-50%	51-75%	>75%

Coarse detritus (small wood, sticks, leaves etc. >1mm)

<5%	5-25%	26-50%	51-75%	>75%

Fine (<1mm) organic deposits

<5%	5-25%	26-50%	51-75%	>75%

Instream plant cover (% streambed area)

Filamentous algae & mats:

<5**%**	**5-25**%	26-50%	51-75%	>75%

Macrophytes:

<5%	5-25%	26-50%	51-75%	>75%

Mosses/liverworts:

<5%	5-25%	26-50%	51-75%	>75%

Habitat types sampled

(% of effort)

Stones:	100%		
Wood:	%	Riffles:	100 %
Macrophyte:	%	Runs:	%
Edges:	%		

Number of invertebrates returned:

Koura:	Shrimps:
Crabs:	Mussels:
Other:	
Mussel type:	
Hyridella	*Cucumerunio*

Comments:

Wadeable Hard-Bottomed Streams
Qualitative Habitat Assessment Field Data Sheet

Stream name: Omahu Stream (u/s)	Site number: 6	
Sample number: 6	Assessor: Paul Franklin	Date: 24/02/11

Habitat parameter	Category																			
	Optimal					Suboptimal					Marginal					Poor				
1. Riparian vegetative zone width	• Bankside vegetation buffer >10m • Continuous & dense					• Bankside vegetation buffer is <10m • Mostly continuous					• Pathways present and/or stock • Mostly healed over					• Breaks frequent • Human activity obvious				
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	• Bank surfaces & immediate riparian zones covered by native vegetation • Trees, under-storey shrubs or non-woody plants present • Vegetative disruption minimal					• Bank surfaces covered mainly by native vegetation • Disruption evident • Banks may be covered by exotic forestry					• Bank surfaces covered by mixture of grasses/shrubs, blackberry, willow & introduced species • Vegetation disruption obvious • Bare soil/closely cropped vegetation common					• 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: 10																				
3. Bank stability	• Banks stable • Erosion/bank failure absent/minimal • <5% of bank affected					• Moderately stable • Infrequent, small areas of erosion mostly healed over • 5-30% of bank eroded					• Moderately unstable • 30-60% of bank in reach has areas of erosion • High erosion potential during floods					• 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																				
4. Frequency of riffles	• Riffles relatively frequent • Distance between riffles divided by stream width=5-7 • Variety of habitat is key					• Occurrence of riffles infrequent • Distance between riffles divided by stream width=7-15					• Occasional riffle or run • Bottom contours provide some habitat • Distance between riffles divided by stream width=15-25					• Generally flat water, shallow riffles • Poor habitat • Distance between riffles divided by stream width=>25				
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	• Changes to channel/dredging absent/minimal • Stream with normal pattern					• Some changes to channel/dredging • Evidence of past channel/dredging • Recent channel/dredging not present					• Channel changes/dredging extensive • Embankments/shoring structures present on both banks • 40-80% of reach channelized & disrupted					• Banks shored with gabion/cement • >80% of stream reach channelized or disrupted • Instream habitat altered/absent				
Score: 11	20	19	18	17	16	15	14	13	12	**11**	10	9	8	7	6	5	4	3	2	1

Habitat parameter	Category Optimal	Habitat parameter	Category Optimal	Habitat parameter
6. Sediment deposition	• Little/no islands or point bars present • <20% of bottom affected by sediment deposition	• New increase in bar formation, mostly from gravel, sand or fine sediment • 20-50% of bottom affected • Slight deposition in pools	• Some deposition of new gravel, sand or fine sediment on old & new bars • 50-80% of bottom affected • Sediment deposits at obstructions, constrictions & bends	• Heavy deposits of fine material • Increased bar development • >80% of bottom changing frequently • Pools almost absent due to sediment deposition
Score: 17	20 19 18 **17** 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
7. Velocity/depth regimes	• 4 velocity/depth regimes present • Slow/deep, slow/shallow, fast/shallow, fast/deep	• 3 0f 4 velocity/depth regimes present • If fast/shallow is missing then score lower	• 2 of 4 velocity/depth regimes present • If fast/shallow or slow/shallow are missing, score low	• Dominated by 1 velocity/depth regime • Usually deep/slow
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	• >50% substrate favourable for invertebrate colonisation & wide variety of woody debris, riffles, root mats • Snags/ submerged logs/undercut banks/cobbles provides abundant fish cover • Must not be new or transient	• 30-50% substrate favourable for invertebrate colonisation • Snags/ submerged logs/undercut banks/cobbles • Fish cover common • Moderate variety of habitat types. Can consist of some new material	• 10-30% substrate favourable for invertebrate colonisation • Fish cover patchy • 60-90% substrate easily moved by foot • Woody debris rare or may be smothered by sediment	• <10% substrate favourable for invertebrate colonisation • Fish cover rare or absent • Substrate unstable or lacking • Stable habitats lacking or limited to macrophytes
Score: 14	20 19 18 17 16	15 **14** 13 12 11	10 9 8 7 6	5 4 3 2 1
9. Periphyton	• Periphyton not evident on hand held stones • Stable substrate • Surfaces rough to touch	• Periphyton not visible on stones • Stable substrate • Periphyton obvious to touch	• Periphyton visible • <20% cover of available substrates	• Periphyton obvious & prolific • >20% cover of available substrates
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				

Field Assessment Cover Form
Wadeable Hard-Bottomed and Soft-Bottomed Streams

Stream name: Unnamed trib. of Homunga Stream (d/s)		Assessor: Paul Franklin	
Site number: 7	Sample number:	Date: 25/02/11	Time: 12:15
GPS coordinates	Downstream:	E2765475	N6420947
	Upstream:	E2765584	N6421032

Channel & riparian features

Canopy cover:

Open	Partly shaded	Very shaded

Fencing:	Dominant riparian vegetation:	
None/ineffective	Crops	**Retired vegetation**
One side/partial	Pasture	Native shrub
Complete	Exotic trees	Native trees

Instream hydraulic conditions

Estimated or measured reach average:

Stream width (active channel): 4 m
Stream width (water): 3 m
Stream depth: 0.4 m
Surface velocity: 0.2 m s^{-1}

Water quality

Temperature:	17.8	°C	Conductivity:	117	µS cm^{-1}
Dissolved oxygen:	86	%	8.1		mg l^{-1}

Turbidity:	**Clear**	Slightly turbid	Highly turbid	Stained	Other

Stream-bottom substrata

Compaction (inorganic substrata):

Assorted sizes tightly packed &/or overlapping
Moderately packed with some overlapping
Mostly a loose assortment with little overlap
No packing/loose assortment easily moved

Embeddedness:

(% gravel-boulder particles covered by fine sediment)

<5%	**5-25%**	26-50%	51-75%	>75%

% surficial inorganic substratum size composition:

Substratum	Dimension	Percentage
Bedrock	-	
Boulder	>256mm	
Cobble	>64-256mm	30
Gravel	>2-64mm	20
Sand	>0.06-2mm	30
Silt	0.004-0.06mm	20
Clay	<0.004mm	

Organic material (% cover)

Large wood (>10cm diameter)

<5%	5-25%	26-50%	51-75%	>75%

Coarse detritus (small wood, sticks, leaves etc. >1mm)

<5%	5-25**%**	26-50%	51-75%	>75%

Fine (<1mm) organic deposits

<5%	5-25%	26-50%	51-75%	>75%

Instream plant cover (% streambed area)

Filamentous algae & mats:

<5%	5-25%	26-50%	51-75%	>75%

Macrophytes:

<5%	5-25%	26-50%	51-75%	>75%

Mosses/liverworts:

<5%	5-25%	26-50%	51-75%	>75%

Habitat types sampled

(% of effort)

Stones:	100%		
Wood:	%	Riffles:	100 %
Macrophyte:	%	Runs:	%
Edges:	%		

Number of invertebrates returned:

Koura:	Shrimps:
Crabs:	Mussels:
Other:	
Mussel type:	
Hyridella	*Cucumerunio*

Comments:

Wadeable Hard-Bottomed Streams
Qualitative Habitat Assessment Field Data Sheet

Stream name: Unnamed trib. Homunga Stream (d/s)	Site number: 7	
Sample number:	Assessor: Paul Franklin	Date: 24/02/11

Habitat parameter	Category: Optimal					Suboptimal					Marginal					Poor				
1. Riparian vegetative zone width	• Bankside vegetation buffer >10m • Continuous & dense					• Bankside vegetation buffer is <10m • Mostly continuous					• Pathways present and/or stock • Mostly healed over					• Breaks frequent • Human activity obvious				
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	• Bank surfaces & immediate riparian zones covered by native vegetation • Trees, under-storey shrubs or non-woody plants present • Vegetative disruption minimal					• Bank surfaces covered mainly by native vegetation • Disruption evident • Banks may be covered by exotic forestry					• Bank surfaces covered by mixture of grasses/shrubs, blackberry, willow & introduced species • Vegetation disruption obvious • Bare soil/closely cropped vegetation common					• 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: 10																				
3. Bank stability	• Banks stable • Erosion/bank failure absent/minimal • <5% of bank affected					• Moderately stable • Infrequent, small areas of erosion mostly healed over • 5-30% of bank eroded					• Moderately unstable • 30-60% of bank in reach has areas of erosion • High erosion potential during floods					• 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																				
4. Frequency of riffles	• Riffles relatively frequent • Distance between riffles divided by stream width=5-7 • Variety of habitat is key					• Occurrence of riffles infrequent • Distance between riffles divided by stream width=7-15					• Occasional riffle or run • Bottom contours provide some habitat • Distance between riffles divided by stream width=15-25					• Generally flat water, shallow riffles • Poor habitat • Distance between riffles divided by stream width=>25				
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	• Changes to channel/dredging absent/minimal • Stream with normal pattern					• Some changes to channel/dredging • Evidence of past channel/dredging • Recent channel/dredging not present					• Channel changes/dredging extensive • Embankments/shoring structures present on both banks • 40-80% of reach channelized & disrupted					• Banks shored with gabion/cement • >80% of stream reach channelized or disrupted • Instream habitat altered/absent				
Score: 13	20	19	18	17	16	15	14	**13**	12	11	10	9	8	7	6	5	4	3	2	1

Habitat parameter	Category Optimal					Habitat parameter					Category Optimal					Habitat parameter				
6. Sediment deposition	• Little/no islands or point bars present • <20% of bottom affected by sediment deposition					• New increase in bar formation, mostly from gravel, sand or fine sediment • 20-50% of bottom affected • Slight deposition in pools					• Some deposition of new gravel, sand or fine sediment on old & new bars • 50-80% of bottom affected • Sediment deposits at obstructions, constrictions & bends					• Heavy deposits of fine material • Increased bar development • >80% of bottom changing frequently • Pools almost absent due to sediment deposition				
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	• 4 velocity/depth regimes present • Slow/deep, slow/shallow, fast/shallow, fast/deep					• 3 0f 4 velocity/depth regimes present • If fast/shallow is missing then score lower					• 2 of 4 velocity/depth regimes present • If fast/shallow or slow/shallow are missing, score low					• Dominated by 1 velocity/depth regime • Usually deep/slow				
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	• >50% substrate favourable for invertebrate colonisation & wide variety of woody debris, riffles, root mats • Snags/ submerged logs/undercut banks/cobbles provides abundant fish cover • Must not be new or transient					• 30-50% substrate favourable for invertebrate colonisation • Snags/ submerged logs/undercut banks/cobbles • Fish cover common • Moderate variety of habitat types. Can consist of some new material					• 10-30% substrate favourable for invertebrate colonisation • Fish cover patchy • 60-90% substrate easily moved by foot • Woody debris rare or may be smothered by sediment					• <10% substrate favourable for invertebrate colonisation • Fish cover rare or absent • Substrate unstable or lacking • Stable habitats lacking or limited to macrophytes				
Score: 11	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
9. Periphyton	• Periphyton not evident on hand held stones • Stable substrate • Surfaces rough to touch					• Periphyton not visible on stones • Stable substrate • Periphyton obvious to touch					• Periphyton visible • <20% cover of available substrates					• Periphyton obvious & prolific • >20% cover of available substrates				
Score: 10	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
TOTAL SCORE: 100																				

Field Assessment Cover Form
Wadeable Hard-Bottomed and Soft-Bottomed Streams

Stream name: Unnamed trib. of Homunga Stream (u/s)		Assessor: Paul Franklin	
Site number: 8	Sample number:	Date: 25/02/11	Time: 14:45
GPS coordinates	Downstream:	E2765847	N6420687
	Upstream:	E	N

Channel & riparian features

Canopy cover:

Open	Partly shaded	Very shaded

Fencing:	Dominant riparian vegetation:	
None/ineffective	Crops	**Retired vegetation**
One side/partial	Pasture	Native shrub
Complete	Exotic trees	Native trees

Instream hydraulic conditions

Estimated or measured reach average:

Stream width (active channel): 3.5 m
Stream width (water): 2.8 m
Stream depth: 0.3 m
Surface velocity: 0.2 m s^{-1}

Water quality

Temperature:	17.8	°C	Conductivity:	117	µS cm^{-1}
Dissolved oxygen:	86	%	8.1		mg l^{-1}

Turbidity:	**Clear**	Slightly turbid	Highly turbid	Stained	Other

Stream-bottom substrata

Compaction (inorganic substrata):

Assorted sizes tightly packed &/or overlapping
Moderately packed with some overlapping
Mostly a loose assortment with little overlap
No packing/loose assortment easily moved

Embeddedness:

(% gravel-boulder particles covered by fine sediment)

<5%	**5-25%**	26-50%	51-75%	>75%

% surficial inorganic substratum size composition:

Substratum	Dimension	Percentage
Bedrock	-	5
Boulder	>256mm	5
Cobble	>64-256mm	10
Gravel	>2-64mm	30
Sand	>0.06-2mm	40
Silt	0.004-0.06mm	10
Clay	<0.004mm	

Organic material (% cover)

Large wood (>10cm diameter)

<5**%**	**5-25**%	26-50%	51-75%	>75%

Coarse detritus (small wood, sticks, leaves etc. >1mm)

<5%	5-25%	26-50%	51-75%	>75%

Fine (<1mm) organic deposits

<5**%**	**5-25**%	26-50%	51-75%	>75%

Habitat types sampled

(% of effort)

Stones:	100%		
Wood:	%	Riffles:	100 %
Macrophyte:	%	Runs:	%
Edges:	%		

Number of invertebrates returned:

Koura:	Shrimps:
Crabs:	Mussels:
Other:	
Mussel type:	
Hyridella	*Cucumerunio*

Instream plant cover (% streambed area)

Filamentous algae & mats:

<5**%**	**5-25**%	26-50%	51-75%	>75%

Macrophytes:

<5%	5-25%	26-50%	51-75%	>75%

Mosses/liverworts:

<5**%**	5-25%	**26-50**%	51-75%	>75%

Comments:

Wadeable Hard-Bottomed Streams
Qualitative Habitat Assessment Field Data Sheet

Stream name: Unnamed trib. Homunga Stream (u/s)	Site number: 8	
Sample number:	Assessor: Paul Franklin	Date: 25/02/11

Habitat parameter	Category																			
	Optimal					Suboptimal					Marginal					Poor				
1. Riparian vegetative zone width	• Bankside vegetation buffer >10m • Continuous & dense					• Bankside vegetation buffer is <10m • Mostly continuous					• Pathways present and/or stock • Mostly healed over					• Breaks frequent • Human activity obvious				
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																				
2. Vegetative protection	• Bank surfaces & immediate riparian zones covered by native vegetation • Trees, under-storey shrubs or non-woody plants present • Vegetative disruption minimal					• Bank surfaces covered mainly by native vegetation • Disruption evident • Banks may be covered by exotic forestry					• Bank surfaces covered by mixture of grasses/shrubs, blackberry, willow & introduced species • Vegetation disruption obvious • Bare soil/closely cropped vegetation common					• 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: 9																				
3. Bank stability	• Banks stable • Erosion/bank failure absent/minimal • <5% of bank affected					• Moderately stable • Infrequent, small areas of erosion mostly healed over • 5-30% of bank eroded					• Moderately unstable • 30-60% of bank in reach has areas of erosion • High erosion potential during floods					• 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																				
4. Frequency of riffles	• Riffles relatively frequent • Distance between riffles divided by stream width=5-7 • Variety of habitat is key					• Occurrence of riffles infrequent • Distance between riffles divided by stream width=7-15					• Occasional riffle or run • Bottom contours provide some habitat • Distance between riffles divided by stream width=15-25					• Generally flat water, shallow riffles • Poor habitat • Distance between riffles divided by stream width=>25				
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	• Changes to channel/dredging absent/minimal • Stream with normal pattern					• Some changes to channel/dredging • Evidence of past channel/dredging • Recent channel/dredging not present					• Channel changes/dredging extensive • Embankments/shoring structures present on both banks • 40-80% of reach channelized & disrupted					• Banks shored with gabion/cement • >80% of stream reach channelized or disrupted • Instream habitat altered/absent				
Score:16	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1

Habitat parameter	Category Optimal	Habitat parameter	Category Optimal	Habitat parameter
6. Sediment deposition	• Little/no islands or point bars present • <20% of bottom affected by sediment deposition	• New increase in bar formation, mostly from gravel, sand or fine sediment • 20-50% of bottom affected • Slight deposition in pools	• Some deposition of new gravel, sand or fine sediment on old & new bars • 50-80% of bottom affected • Sediment deposits at obstructions, constrictions & bends	• Heavy deposits of fine material • Increased bar development • >80% of bottom changing frequently • Pools almost absent due to sediment deposition
Score: 11	20 19 18 17 16	15 14 13 12 **11**	10 9 8 7 6	5 4 3 2 1
7. Velocity/depth regimes	• 4 velocity/depth regimes present • Slow/deep, slow/shallow, fast/shallow, fast/deep	• 3 0f 4 velocity/depth regimes present • If fast/shallow is missing then score lower	• 2 of 4 velocity/depth regimes present • If fast/shallow or slow/shallow are missing, score low	• Dominated by 1 velocity/depth regime • Usually deep/slow
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	• >50% substrate favourable for invertebrate colonisation & wide variety of woody debris, riffles, root mats • Snags/ submerged logs/undercut banks/cobbles provides abundant fish cover • Must not be new or transient	• 30-50% substrate favourable for invertebrate colonisation • Snags/ submerged logs/undercut banks/cobbles • Fish cover common • Moderate variety of habitat types. Can consist of some new material	• 10-30% substrate favourable for invertebrate colonisation • Fish cover patchy • 60-90% substrate easily moved by foot • Woody debris rare or may be smothered by sediment	• <10% substrate favourable for invertebrate colonisation • Fish cover rare or absent • Substrate unstable or lacking • Stable habitats lacking or limited to macrophytes
Score: 9	20 19 18 17 16	15 14 13 12 11	10 **9** 8 7 6	5 4 3 2 1
9. Periphyton	• Periphyton not evident on hand held stones • Stable substrate • Surfaces rough to touch	• Periphyton not visible on stones • Stable substrate • Periphyton obvious to touch	• Periphyton visible • <20% cover of available substrates	• Periphyton obvious & prolific • >20% cover of available substrates
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				

Field Assessment Cover Form
Wadeable Hard-Bottomed and Soft-Bottomed Streams

Stream name: Waiteariki Stream		Assessor: Paul Franklin	
Site number: 9	Sample number:	Date: 22/02/11	Time: 10:00
GPS coordinates	Downstream:	E2762794	N6379697
	Upstream:	E2762925	N6379759

Channel & riparian features

Canopy cover:

Open	**Partly shaded**	Very shaded

Fencing:	Dominant riparian vegetation:	
None/ineffective	Crops	Retired vegetation
One side/partial	Pasture	Native shrub
Complete	Exotic trees	**Native trees**

Instream hydraulic conditions

Estimated or measured reach average:

Stream width (active channel): 9 m
Stream width (water): 6 m
Stream depth: 0.4 m
Surface velocity: 0.3 m s^{-1}

Water quality

Temperature:	16.9	°C	Conductivity:	51	µS cm^{-1}
Dissolved oxygen:	91	%	8.8		mg l^{-1}

Turbidity:	**Clear**	Slightly turbid	Highly turbid	Stained	Other

Stream-bottom substrata

Compaction (inorganic substrata):

Assorted sizes tightly packed &/or overlapping
Moderately packed with some overlapping
Mostly a loose assortment with little overlap
No packing/loose assortment easily moved

Embeddedness:

(% gravel-boulder particles covered by fine sediment)

<5%	5-25**%**	26-50%	51-75%	>75%

% surficial inorganic substratum size composition:

Substratum	Dimension	Percentage
Bedrock	-	
Boulder	>256mm	30
Cobble	>64-256mm	70
Gravel	>2-64mm	
Sand	>0.06-2mm	
Silt	0.004-0.06mm	
Clay	<0.004mm	

Organic material (% cover)

Large wood (>10cm diameter)

<5%	5-25%	26-50%	51-75%	>75%

Coarse detritus (small wood, sticks, leaves etc. >1mm)

<5**%**	**5-25**%	26-50%	51-75%	>75%

Fine (<1mm) organic deposits

<5%	5-25%	26-50%	51-75%	>75%

Habitat types sampled

(% of effort)

Stones:	100%		
Wood:	%	Riffles:	100 %
Macrophyte:	%	Runs:	%
Edges:	%		

Instream plant cover (% streambed area)

Filamentous algae & mats:

<5%	5-25%	26-50%	51-75%	>75%

Macrophytes:

<5%	5-25%	26-50%	51-75%	>75%

Mosses/liverworts:

<5%	5-25%	26-50%	51-75%	>75%

Number of invertebrates returned:

Koura: A	Shrimps: R
Crabs:	Mussels:
Other:	
Mussel type:	
Hyridella	*Cucumerunio*

Comments:

Wadeable Hard-Bottomed Streams
Qualitative Habitat Assessment Field Data Sheet

Stream name: Waiteariki Stream	Site number: 9	
Sample number:	Assessor: Paul Franklin	Date: 22/02/11

Habitat parameter	Category: Optimal	Suboptimal	Marginal	Poor
1. Riparian vegetative zone width	• Bankside vegetation buffer >10m • Continuous & dense	• Bankside vegetation buffer is <10m • Mostly continuous	• Pathways present and/or stock • Mostly healed over	• Breaks frequent • Human activity obvious
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: 11				
2. Vegetative protection	• Bank surfaces & immediate riparian zones covered by native vegetation • Trees, under-storey shrubs or non-woody plants present • Vegetative disruption minimal	• Bank surfaces covered mainly by native vegetation • Disruption evident • Banks may be covered by exotic forestry	• Bank surfaces covered by mixture of grasses/shrubs, blackberry, willow & introduced species • Vegetation disruption obvious • Bare soil/closely cropped vegetation common	• 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: 10				
3. Bank stability	• Banks stable • Erosion/bank failure absent/minimal • <5% of bank affected	• Moderately stable • Infrequent, small areas of erosion mostly healed over • 5-30% of bank eroded	• Moderately unstable • 30-60% of bank in reach has areas of erosion • High erosion potential during floods	• 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: 17				
4. Frequency of riffles	• Riffles relatively frequent • Distance between riffles divided by stream width=5-7 • Variety of habitat is key	• Occurrence of riffles infrequent • Distance between riffles divided by stream width=7-15	• Occasional riffle or run • Bottom contours provide some habitat • Distance between riffles divided by stream width=15-25	• Generally flat water, shallow riffles • Poor habitat • Distance between riffles divided by stream width=>25
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	• Changes to channel/dredging absent/minimal • Stream with normal pattern	• Some changes to channel/dredging • Evidence of past channel/dredging • Recent channel/dredging not present	• Channel changes/dredging extensive • Embankments/shoring structures present on both banks • 40-80% of reach channelized & disrupted	• Banks shored with gabion/cement • >80% of stream reach channelized or disrupted • Instream habitat altered/absent
Score:20	**20** 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1

Habitat parameter	Category Optimal	Habitat parameter	Category Optimal	Habitat parameter
6. Sediment deposition	• Little/no islands or point bars present • <20% of bottom affected by sediment deposition	• New increase in bar formation, mostly from gravel, sand or fine sediment • 20-50% of bottom affected • Slight deposition in pools	• Some deposition of new gravel, sand or fine sediment on old & new bars • 50-80% of bottom affected • Sediment deposits at obstructions, constrictions & bends	• Heavy deposits of fine material • Increased bar development • >80% of bottom changing frequently • Pools almost absent due to sediment deposition
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	• 4 velocity/depth regimes present • Slow/deep, slow/shallow, fast/shallow, fast/deep	• 3 0f 4 velocity/depth regimes present • If fast/shallow is missing then score lower	• 2 of 4 velocity/depth regimes present • If fast/shallow or slow/shallow are missing, score low	• Dominated by 1 velocity/depth regime • Usually deep/slow
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	• >50% substrate favourable for invertebrate colonisation & wide variety of woody debris, riffles, root mats • Snags/ submerged logs/undercut banks/cobbles provides abundant fish cover • Must not be new or transient	• 30-50% substrate favourable for invertebrate colonisation • Snags/ submerged logs/undercut banks/cobbles • Fish cover common • Moderate variety of habitat types. Can consist of some new material	• 10-30% substrate favourable for invertebrate colonisation • Fish cover patchy • 60-90% substrate easily moved by foot • Woody debris rare or may be smothered by sediment	• <10% substrate favourable for invertebrate colonisation • Fish cover rare or absent • Substrate unstable or lacking • Stable habitats lacking or limited to macrophytes
Score: 16	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
9. Periphyton	• Periphyton not evident on hand held stones • Stable substrate • Surfaces rough to touch	• Periphyton not visible on stones • Stable substrate • Periphyton obvious to touch	• Periphyton visible • <20% cover of available substrates	• Periphyton obvious & prolific • >20% cover of available substrates
Score: 10	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
TOTAL SCORE: 141				

Field Assessment Cover Form
Wadeable Hard-Bottomed and Soft-Bottomed Streams

Stream name: Wairere Stream		Assessor: Paul Franklin	
Site number: 10	Sample number:	Date: 22/02/11	Time: 15:00
GPS coordinates	Downstream:	E2761891	N6381355
	Upstream:	E2761942	N6381276

Channel & riparian features

Canopy cover:

Open	Partly shaded	**Very shaded**

Fencing:	Dominant riparian vegetation:	
None/ineffective	Crops	Retired vegetation
One side/partial	Pasture	Native shrub
Complete	**Exotic trees**	Native trees

Instream hydraulic conditions

Estimated or measured reach average:

Stream width (active channel): 12 m
Stream width (water): 6 m
Stream depth: 0.5 m
Surface velocity: 0.3 m s^{-1}

Water quality

Temperature:	18.7	°C	Conductivity:	66	µS cm^{-1}
Dissolved oxygen:	91	%	8.4		mg l^{-1}

Turbidity:	**Clear**	Slightly turbid	Highly turbid	Stained	Other

Stream-bottom substrata

Compaction (inorganic substrata):

Assorted sizes tightly packed &/or overlapping
Moderately packed with some overlapping
Mostly a loose assortment with little overlap
No packing/loose assortment easily moved

Embeddedness:

(% gravel-boulder particles covered by fine sediment)

<5%	5-25**%**	26-50%	51-75%	>75%

% surficial inorganic substratum size composition:

Substratum	Dimension	Percentage
Bedrock	-	
Boulder	>256mm	15
Cobble	>64-256mm	80
Gravel	>2-64mm	
Sand	>0.06-2mm	5
Silt	0.004-0.06mm	
Clay	<0.004mm	

Organic material (% cover)

Large wood (>10cm diameter)

<5**%**	**5-25**%	26-50%	51-75%	>75%

Coarse detritus (small wood, sticks, leaves etc. >1mm)

<5**%**	**5-25**%	26-50%	51-75%	>75%

Fine (<1mm) organic deposits

<5%	5-25%	26-50%	51-75%	>75%

Habitat types sampled

(% of effort)

Stones:	100%		
Wood:	%	Riffles:	100 %
Macrophyte:	%	Runs:	%
Edges:	%		

Number of invertebrates returned:

Koura: C	Shrimps: R
Crabs:	Mussels:
Other:	
Mussel type:	
Hyridella	*Cucumerunio*

Instream plant cover (% streambed area)

Filamentous algae & mats:

<5%	5-25%	26-50%	51-75%	>75%

Macrophytes:

<5%	5-25%	26-50%	51-75%	>75%

Mosses/liverworts:

<5%	5-25%	26-50%	51-75%	>75%

Comments:

Wadeable Hard-Bottomed Streams
Qualitative Habitat Assessment Field Data Sheet

Stream name: Wairere Stream	Site number: 10	
Sample number:	Assessor: Brenda Aldridge	Date: 22/02/11

Habitat parameter	Category																			
	Optimal					Suboptimal					Marginal					Poor				
1. Riparian vegetative zone width • Bankside vegetation buffer >10m • Continuous & dense						• Bankside vegetation buffer is <10m • Mostly continuous					• Pathways present and/or stock • Mostly healed over					• Breaks frequent • Human activity obvious				
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																				
2. Vegetative protection • Bank surfaces & immediate riparian zones covered by native vegetation • Trees, under-storey shrubs or non-woody plants present • Vegetative disruption minimal						• Bank surfaces covered mainly by native vegetation • Disruption evident • Banks may be covered by exotic forestry					• Bank surfaces covered by mixture of grasses/shrubs, blackberry, willow & introduced species • Vegetation disruption obvious • Bare soil/closely cropped vegetation common					• 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: 9.5																				
3. Bank stability • Banks stable • Erosion/bank failure absent/minimal • <5% of bank affected						• Moderately stable • Infrequent, small areas of erosion mostly healed over • 5-30% of bank eroded					• Moderately unstable • 30-60% of bank in reach has areas of erosion • High erosion potential during floods					• 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: 14																				
4. Frequency of riffles • Riffles relatively frequent • Distance between riffles divided by stream width=5-7 • Variety of habitat is key						• Occurrence of riffles infrequent • Distance between riffles divided by stream width=7-15					• Occasional riffle or run • Bottom contours provide some habitat • Distance between riffles divided by stream width=15-25					• Generally flat water, shallow riffles • Poor habitat • Distance between riffles divided by stream width=>25				
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 • Changes to channel/dredging absent/minimal • Stream with normal pattern						• Some changes to channel/dredging • Evidence of past channel/dredging • Recent channel/dredging not present					• Channel changes/dredging extensive • Embankments/shoring structures present on both banks • 40-80% of reach channelized & disrupted					• Banks shored with gabion/cement • >80% of stream reach channelized or disrupted • Instream habitat altered/absent				
Score:14	20	19	18	17	16	15	**14**	13	12	11	10	9	8	7	6	5	4	3	2	1

Habitat parameter	Category Optimal					Habitat parameter					Category Optimal					Habitat parameter				
6. Sediment deposition	• Little/no islands or point bars present • <20% of bottom affected by sediment deposition					• New increase in bar formation, mostly from gravel, sand or fine sediment • 20-50% of bottom affected • Slight deposition in pools					• Some deposition of new gravel, sand or fine sediment on old & new bars • 50-80% of bottom affected • Sediment deposits at obstructions, constrictions & bends					• Heavy deposits of fine material • Increased bar development • >80% of bottom changing frequently • Pools almost absent due to sediment deposition				
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	• 4 velocity/depth regimes present • Slow/deep, slow/shallow, fast/shallow, fast/deep					• 3 0f 4 velocity/depth regimes present • If fast/shallow is missing then score lower					• 2 of 4 velocity/depth regimes present • If fast/shallow or slow/shallow are missing, score low					• Dominated by 1 velocity/depth regime • Usually deep/slow				
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	• >50% substrate favourable for invertebrate colonisation & wide variety of woody debris, riffles, root mats • Snags/ submerged logs/undercut banks/cobbles provides abundant fish cover • Must not be new or transient					• 30-50% substrate favourable for invertebrate colonisation • Snags/ submerged logs/undercut banks/cobbles • Fish cover common • Moderate variety of habitat types. Can consist of some new material					• 10-30% substrate favourable for invertebrate colonisation • Fish cover patchy • 60-90% substrate easily moved by foot • Woody debris rare or may be smothered by sediment					• <10% substrate favourable for invertebrate colonisation • Fish cover rare or absent • Substrate unstable or lacking • Stable habitats lacking or limited to macrophytes				
Score: 13	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
9. Periphyton	• Periphyton not evident on hand held stones • Stable substrate • Surfaces rough to touch					• Periphyton not visible on stones • Stable substrate • Periphyton obvious to touch					• Periphyton visible • <20% cover of available substrates					• Periphyton obvious & prolific • >20% cover of available substrates				
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																				

Appendix 2: Fish Surveys

Fish collection form – Wadeable streams/rivers

Team members: Paul Franklin (NIWA) Josh Smith (NIWA)	GPS (d/s): E2757273 N6386560 GPS (u/s): E2757201 N6386488	Site: Depression Stream				Date: 22/02/11
		Not fished	Fished none collected	Fished 10 sub-reaches	Fished 5-9 sub-reaches	Fished <5 sub-reaches	FLAG for fished/not fished

Fish sample id:	Total shock time (min): 47	Fishing time: Start 16:00 Finish 17:15	Sample distance (m): 150	Wetted width (m):	A	1.5	C	2.0	E	2.0	G	1.0	I	2.5
					B	1.5	D	1.2	F	2.5	H	2.0	J	2.0

Sampling gear: Spotlight	EFM	Seine	Length (m) Mesh (mm)	Water visibility:	Good	Average	Poor	Water temp. (°C): 22.0	Conductivity (µS): 273

EFM anode: Big / Small	EFM volts (x100): 2	EFM pulse rate (Hz or pps): 65	EFM pulse width (ms): 2	Spotlight (watts):

Species	Sub-reach tally A	B	C	D	E	F	G	H	I	J	Total count	Sample count	Length (mm) Min.	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	

FLAG	Comment	FLAG	Comment
F1	Reach D – Deep pool not fishable 2m^2. Inanga present.		
F2	Reach G – Saw inanga.		
F3	Reach I – Lots of macrophytes mid reach made fishing difficult 4m^2		
F4	Reach J – Mid point too deep to fish 6m^2		

Fish collection form – Wadeable streams/rivers

Team members: Brenda Aldridge (NIWA) Kathryn Julian (NIWA)	GPS (d/s): E2758628 N6384754	Site: Karengorengo Stream		Date: 22/02/11
	GPS (u/s): E2758672 N6384606			

Not fished	Fished none collected	Fished 10 sub-reaches	Fished 5-9 sub-reaches	Fished <5 sub-reaches	FLAG for fished/not fished
		✓ (highlighted)			

Fish sample id:	Total shock time (min): 55	Fishing time: Start 16:00 Finish 17:45	Sample distance (m): 150	Wetted width (m):	A 2.5	C 2.2	E 1.7	G 1.8	I 2.8				
					B 2.0	D 2.0	F 2.3	H 2.0	J 2.1				

Sampling gear:	Spotlight	EFM	Seine	Length (m) / Mesh (mm)	Water visibility:	Good	Average	Poor	Water temp. (°C): 20.1	Conductivity (µS): 243	

EFM anode: Big / Small	EFM volts (x100): 3	EFM pulse rate (Hz or pps): 65	EFM pulse width (ms): 2	Spotlight (watts):

Species	Sub-reach tally A	B	C	D	E	F	G	H	I	J	Total count	Sample count	Length (mm) Min.	Max.	FLAG
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 bully				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	

FLAG	Comment	FLAG	Comment
F1	Section 15-25m from d/s limit not fished because too deep, upper limit extended so		
	total reach length = 150m		

Fish collection form – Wadeable streams/rivers

Team members: Paul Franklin (NIWA) Josh Smith (NIWA) Kathryn Julian (NIWA)	GPS (d/s): E2751347 N6429422 GPS (u/s): E2751418 N6429342	Site: Paiakarahi Stream (d/s)			Date: 23/02/11
		Not fished	Fished none collected	Fished 10 sub-reaches	Fished 5-9 sub-reaches	Fished <5 sub-reaches	FLAG for fished/not fished

Fish sample id:	Total shock time (min): 64	Fishing time: Start 9:30 Finish 11:40	Sample distance (m): 150	Wetted width (m):	A 6.0	C 3.0	E 4.0	G 4.0	I 6.0
					B 3.0	D 3.5	F 4.0	H 7.0	J 3.5

Sampling gear:	Spotlight	EFM	Seine	Length (m) / Mesh (mm)	Water visibility:	Good	Average	Poor	Water temp. (°C): 18.2	Conductivity (µS): 109
EFM anode:	Big / Small	EFM volts (x100): 3	EFM pulse rate (Hz or pps): 65	EFM pulse width (ms): 2	Spotlight (watts):

Species	Sub-reach tally A	B	C	D	E	F	G	H	I	J	Total count	Sample count	Length (mm) Min.	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	

FLAG	Comment	FLAG	Comment
F1	Reach F – Large amounts of woody debris made fishing difficult		

Fish collection form – Wadeable streams/rivers

Team members: Paul Franklin (NIWA), Josh Smith (NIWA), Kathryn Julian (NIWA)	GPS (d/s): E2751431 N6429122	Site: Paiakarahi Stream (u/s)	Date: 23/02/11
	GPS (u/s): E2751550 N6429031	Not fished / Fished none collected / **Fished 10 sub-reaches** / Fished 5-9 sub-reaches / Fished <5 sub-reaches	**FLAG for fished/not fished**

Fish sample id:	Total shock time (min): 93	Fishing time: Start 12:40 Finish 14:51	Sample distance (m): 142	Wetted width (m): A 5.0, B 6.0, C 4.0, D 5.0, E 4.0, F 7.0, G 7.0, H 9.0, I 8.0, J 8.0
Sampling gear: Spotlight / **EFM** / Seine	Length (m) / Mesh (mm)	Water visibility: **Good** / Average / Poor	Water temp. (°C): 18.2	Conductivity (µS): 109
EFM anode: **Big** / Small	EFM volts (x100): 3	EFM pulse rate (Hz or pps): 65	EFM pulse width (ms): 2	Spotlight (watts):

Species	Sub-reach tally A	B	C	D	E	F	G	H	I	J	Total count	Sample count	Length (mm) Min.	Max.	FLAG
Shortfin eel	2	2		1		1	4	3		1	14		100	150	
Longfin 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	FLAG	Comment
F1	Skipped deep pool (20m^2) at base of waterfall (not included in area fished)		

Fish collection form – Wadeable streams/rivers

Team members: Paul Franklin (NIWA) Josh Smith (NIWA) Kathryn Julian (NIWA)	GPS (d/s): E2746560 N6435409 GPS (u/s): E2746610 N6435540	Site: Omahu Stream (d/s)			Date: 24/02/11

Not fished	Fished none collected	Fished 10 sub-reaches	Fished 5-9 sub-reaches	Fished <5 sub-reaches	FLAG for fished/not fished

Fish sample id:	Total shock time (min): 94	Fishing time: Start 9:55 Finish 11:45	Sample distance (m): 150	Wetted width (m): A 6.0 C 6.0 E 3.0 G 8.0 I 6.0 B 3.0 D 6.5 F 10 H 7.0 J 7.0	

Sampling gear:	Spotlight	EFM	Seine	Length (m) Mesh (mm)	Water visibility:	Good	Average	Poor

Water temp. (°C): 18.3	Conductivity (µS): 87		

EFM anode: Big / Small	EFM volts (x100): 3	EFM pulse rate (Hz or pps): 65	EFM pulse width (ms): 2	Spotlight (watts):

Species	Sub-reach tally A	B	C	D	E	F	G	H	I	J	Total count	Sample count	Length (mm) Min.	Max.	FLAG
Shortfin eel		3	4	2	1	7	4	5	9	4	39		85	350	
Longfin eel				2		1	1	2		1	7		340	650	
Cran's bully		5	8	5	1	2	6	5	1	6	39		20	75	
Inanga				1			1	1			3		85	105	
Torrentfish		1	3		7	10	1			17	39		40	140	
Smelt										5	5		70	85	
Brown trout			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	FLAG	Comment
F1	90-115 m from d/s end not fished due to excess depth. Reach extended so full		
	150 m reach sampled		

Fish collection form – Wadeable streams/rivers

Team members: Paul Franklin (NIWA) Josh Smith (NIWA) Kathryn Julian (NIWA)	GPS (d/s): E2746688 N6435516 GPS (u/s): E2746806 N6435488	Site: Omahu Stream (u/s)	Date: 24/02/11

Not fished	Fished none collected	Fished 10 sub-reaches	Fished 5-9 sub-reaches	Fished <5 sub-reaches	FLAG for fished/not fished

Fish sample id:	Total shock time (min): 124	Fishing time: Start 12:40 Finish 14:35	Sample distance (m): 150	Wetted width (m): A 7.0 C 1.5 E 6.0 G 7.0 I 7.5; B 5.0 D 8.0 F 6.0 H 7.5 J 7.0

Sampling gear: Spotlight	EFM	Seine	Length (m) / Mesh (mm)	Water visibility: Good / Average / Poor	Water temp. (°C): 18.6	Conductivity (µS): NA

EFM anode: Big / Small	EFM volts (x100): 4	EFM pulse rate (Hz or pps): 65	EFM pulse width (ms): 2	Spotlight (watts):

Species	Sub-reach tally A	B	C	D	E	F	G	H	I	J	Total count	Sample count	Length (mm) Min.	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	FLAG	Comment
F1	Reach G – Pool too deep to fish (45m^2)		
F2	135-150m too deep to fish, reach extended by 15m u/s		

Fish collection form – Wadeable streams/rivers

Team members: Paul Franklin (NIWA) Brenda Aldridge (NIWA) Kathryn Julian (NIWA)	GPS (d/s): E2765475 N6420947 GPS (u/s): E2765584 N6421032	Site: Unnamed tributary of Homunga Stream (d/s)		Date: 25/02/11

Not fished	Fished none collected	Fished 10 sub-reaches	Fished 5-9 sub-reaches	Fished <5 sub-reaches	FLAG for fished/not fished

Fish sample id:	Total shock time (min): 60	Fishing time: Start 10:30 Finish 12:10	Sample distance (m): 150	Wetted width (m): A 3, B 2.3, C 2.7, D 3, E 2.7, F 3.5, G 2.5, H 3.7, I 2.8, J 3.3

Sampling gear:	Spotlight	EFM	Seine	Length (m) Mesh (mm)	Water visibility: Good / Average / Poor		Water temp. (°C): 17.8	Conductivity (µS): 117

EFM anode: Big / Small	EFM volts (x100): 3	EFM pulse rate (Hz or pps): 65	EFM pulse width (ms): 2	Spotlight (watts):

Species	Sub-reach tally A	B	C	D	E	F	G	H	I	J	Total count	Sample count	Length (mm) Min.	Max.	FLAG
Shortfin eel	9	6	6	7	8	15	13	11	17	6	98		100	860	
Longfin eel				1			1		1		3		560	900	
Common 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	FLAG	Comment
F1	Majority of bullies were juveniles		
F2	Reach D – pool in middle of reach too deep to fish ($12m^2$)		
F3	Reach I – new bridge constructed over reach		

Fish collection form – Wadeable streams/rivers

Team members: Paul Franklin (NIWA), Brenda Aldridge (NIWA), Kathryn Julian (NIWA)	GPS (d/s): E2765847 N6420687	Site: Unnamed tributary of Homunga Stream (u/s)	Date: 25/02/11			
	GPS (u/s): E N	Not fished	Fished none collected	Fished 10 sub-reaches	Fished 5-9 sub-reaches	Fished <5 sub-reaches	FLAG for fished/not fished

Fish sample id:	Total shock time (min): 62	Fishing time: Start 13:05 Finish 14:40	Sample distance (m): 150	Wetted width (m):	A	3.5	C	2.8	E	2.0	G	1.7	I	2.5
					B	3.5	D	4.0	F	1.9	H	2.0	J	1.8

Sampling gear:	Spotlight	EFM	Seine	Length (m) / Mesh (mm)	Water visibility:	Good	Average	Poor	Water temp. (°C): 17.8	Conductivity (µS): 117

EFM anode: Big / Small	EFM volts (x100): 3	EFM pulse rate (Hz or pps): 65	EFM pulse width (ms): 2	Spotlight (watts):

Species	Sub-reach tally A	B	C	D	E	F	G	H	I	J	Total count	Sample count	Length (mm) Min.	Max.	FLAG
Shortfin eel	11	11	3		4	8	5	3		4	49		90	600	
Longfin eel		1					1		1		3		650	850	
Common bully	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	

FLAG	Comment	FLAG	Comment
F1	No upstream GPS coordinate recorded		
F2	60-75m skipped because too deep to fish, reach extended by 15m u/s		

Fish collection form – Wadeable streams/rivers

Team members: Paul Franklin (NIWA) Josh Smith (NIWA); Brenda Aldridge (NIWA) Kathryn Julian (NIWA)	GPS (d/s): E2762794 N6379697 GPS (u/s): E2762925 N6379759	Site: Waiteariki Stream				Date: 22/02/11
		Not fished	Fished none collected	Fished 10 sub-reaches	Fished 5-9 sub-reaches	Fished <5 sub-reaches	FLAG for fished/not fished

Fish sample id:	Total shock time (min): 80	Fishing time: Start 10:10 Finish 12:15	Sample distance (m): 150	Wetted width (m):	A	6	C	7	E	5.5	G	5.5	I	6						
					B	6	D	6	F	6.5	H	7	J	5.5						

Sampling gear:	Spotlight	EFM	Seine	Length (m) / Mesh (mm)	Water visibility:	Good	Average	Poor	Water temp. (°C): 16.9		Conductivity (µS): 51									
EFM anode: Big / Small	EFM volts (x100): 4		EFM pulse rate (Hz or pps): 65		EFM pulse width (ms): 2		Spotlight (watts):													

Species	Sub-reach tally										Total count	Sample count	Length (mm)		FLAG
	A	B	C	D	E	F	G	H	I	J			Min.	Max.	
Shortfin eel	1	1	4	2	2	1				3	14		100	420	
Longfin eel	3		1	2	1	1	1	2	2	1	14		250	850	
Cran's bully	8	1	11	2	5	2				5	34		25	55	
Torrentfish			4	1	1		6				12		45	135	
Smelt			1								1		NA	95	
Brown trout						2		2	1		5		105	150	
Unidentified galaxiid					1						1		NA	NA	
Unidentified eel			1					1	1		3		NA	NA	
Koura	7	5	12	9	6	7	7	8	5	7	73		NA	NA	

FLAG	Comment	FLAG	Comment

Fish collection form – Wadeable streams/rivers

Team members: Paul Franklin (NIWA); Josh Smith (NIWA); Brenda Aldridge (NIWA); Kathryn Julian (NIWA)	GPS (d/s): E2761891 N6381355 GPS (u/s): E2761942 N6381276	Site: Wairere Stream				Date: 22/02/11
		Not fished	Fished none collected	Fished 10 sub-reaches	Fished 5-9 sub-reaches	Fished <5 sub-reaches	FLAG for fished/not fished

Fish sample id:	Total shock time (min): 78	Fishing time: Start 13:45 Finish 15:00	Sample distance (m): 150	Wetted width (m):	A 6	C 7	E 5	G 6.5	I 6.5					
					B 6.5	D 7	F 6.5	H 6	J 5					

Sampling gear:	Spotlight	EFM	Seine	Length (m) / Mesh (mm)	Water visibility:	Good	Average	Poor	Water temp. (°C): 18.7		Conductivity (µS): 66			
EFM anode:	Big / Small	EFM volts (x100): 3	EFM pulse rate (Hz or pps): 65	EFM pulse width (ms): 2	Spotlight (watts):									

Species	Sub-reach tally A	B	C	D	E	F	G	H	I	J	Total count	Sample count	Length (mm) Min.	Max.	FLAG
Shortfin eel	22	19	7	5	12	6	5	6	5	16	103		90	600	
Longfin eel	1							2		1	4		600	1000	
Bullies	1	5	2		10	4	2	7	3	4	38		40	70	
Inanga	1	1									2		NA	105	
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	

FLAG	Comment	FLAG	Comment
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		
F4	Reach G - Deep pool mid reach not fished 4m^2		

Appendix 3: Macroinvertebrate results

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

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 10
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 Assessment							
Stream: Depression Stream		Date: 22/02/11					
Sample Number:		Located number: Site 1					
Thickness category	**Colour category**	**A**	**B**	**C**	**D**	**E**	**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

Macrophyte recording sheet											
Stream: Depression Stream			**Located number**: Site 1				**Sample Number**:			**Date**: 22/02/11	
Transect	Wetted width (m)	Channel width (m)	Vegetation cover (% wetted area)								
			Total cover	Submerged plants					Emergent plants		
				Total submerged	Surface-reaching		Below surface		Total emergent	Species
					Sub-total	Species	Sub-total	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 Assessment							
Stream: Karengorengo Stream		Date: 22/02/11					
Sample Number:		Located number: Site 2					
Thickness category	**Colour category**	**A**	**B**	**C**	**D**	**E**	**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

Macrophyte recording sheet										
Stream: Karengorengo Stream			**Located number**: Site 2				**Sample Number**:		**Date**: 22/02/11	
			Vegetation cover (% wetted area)							
				Submerged plants					Emergent plants	
					Surface-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 Assessment							
Stream: Paiakarahi Stream		Date: 23/02/11					
Sample Number:		Located number: Site 3					
Thickness category	**Colour category**	**A**	**B**	**C**	**D**	**E**	**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

Macrophyte recording sheet											
Stream: Paiakarahi Stream			**Located number**: Site 3				**Sample Number**:			**Date**: 23/02/11	
Transect	Wetted width (m)	Channel width (m)	Vegetation cover (% wetted area)								
			Total cover	Submerged plants					Emergent plants		
				Total submerged	Surface-reaching		Below surface		Total emergent	Species
					Sub-total	Species	Sub-total	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 Assessment							
Stream: Paiakarahi Stream		Date: 23/02/11					
Sample Number:		Located number: Site 4					
Thickness category	**Colour category**	**A**	**B**	**C**	**D**	**E**	**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 recording sheet

Stream: Paiakarahi Stream			**Located number**: Site 4				**Sample Number**:		**Date**: 23/02/11	
Transect	Wetted width (m)	Channel width (m)	Vegetation cover (% wetted area)							
			Total cover	Submerged plants					Emergent plants	
				Total submerged	Surface-reaching		Below surface		Total emergent	Species
					Sub-total	Species	Sub-total	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 Assessment							
Stream: Omahu Stream		Date: 24/02/11					
Sample Number:		Located number: Site 5					
Thickness category	**Colour category**	**A**	**B**	**C**	**D**	**E**	**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

Macrophyte recording sheet											
Stream: Omahu Stream			**Located number**: Site 5				**Sample Number**:			**Date**: 24/02/11	
Transect	Wetted width (m)	Channel width (m)	Vegetation cover (% wetted area)								
			Total cover	Submerged plants					Emergent plants		
				Total submerged	Surface-reaching		Below surface		Total emergent	Species
					Sub-total	Species	Sub-total	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 Assessment							
Stream: Omahu Stream		Date: 24/02/11					
Sample Number:		Located number: Site 6					
Thickness category	**Colour category**	**A**	**B**	**C**	**D**	**E**	**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

Macrophyte recording sheet											
Stream: Omahu Stream			**Located number**: Site 6				**Sample Number**:			**Date**: 24/02/11	
Transect	Wetted width (m)	Channel width (m)	Vegetation cover (% wetted area)								
			Total cover	Total submerged	Submerged plants				Emergent plants		
					Surface-reaching		Below surface				
					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 Assessment							
Stream: Unnamed tributary Homunga Stream (d/s)		Date: 25/02/11					
Sample Number:		Located number: Site 7					
Thickness category	**Colour category**	**A**	**B**	**C**	**D**	**E**	**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 recording sheet											
Stream: Unnamed tributary Homunga Stream			**Located number**: Site 7				**Sample Number**:			**Date**: 25/02/11	
Transect	Wetted width (m)	Channel width (m)	Vegetation cover (% wetted area)								
			Total cover	Total submerged	Submerged plants				Emergent plants		
					Surface-reaching		Below surface				
					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 Assessment							
Stream: Unnamed tributary Homunga Stream (u/s)		Date: 25/02/11					
Sample Number:		Located number: Site 8					
Thickness category	**Colour category**	**A**	**B**	**C**	**D**	**E**	**Mean cover**
Thin (<0.5mm) Mat/Film	NA		10				2
Medium mat/film (0.5-3mm thick)	Green (% cover)						0
	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 recording sheet											
Stream: Unnamed tributary Homunga Stream			**Located number**: Site 8				**Sample Number**:			**Date**: 25/02/11	
Transect	Wetted width (m)	Channel width (m)	Vegetation cover (% wetted area)								
			Total cover	Submerged plants					Emergent plants		
				Total submerged	Surface-reaching		Below surface		Total emergent	Species
					Sub-total	Species	Sub-total	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 Assessment							
Stream: Waiteariki Stream		Date: 22/02/11					
Sample Number:		Located number: Site 9					
Thickness category	**Colour category**	**A**	**B**	**C**	**D**	**E**	**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

Macrophyte recording sheet											
Stream: Waiteariki Stream			**Located number**: Site 9				**Sample Number**:			**Date**: 22/02/11	
Transect	Wetted width (m)	Channel width (m)	Vegetation cover (% wetted area)								
			Total cover	Submerged plants					Emergent plants		
				Total submerged	Surface-reaching		Below surface		Total emergent	Species
					Sub-total	Species	Sub-total	Species		
1	6	10	0							
2	8	10	0							
3	6	10	0							
4	6	8	0							
5	7	10	0							

Periphyton Assessment							
Stream: Wairere Stream		Date: 22/02/11					
Sample Number:		Located number: Site 10					
Thickness category	**Colour category**	**A**	**B**	**C**	**D**	**E**	**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 recording sheet											
Stream: Wairere Stream			**Located number**: Site 10				**Sample Number**:			**Date**: 22/02/11	
Transect	Wetted width (m)	Channel width (m)	Vegetation cover (% wetted area)								
			Total cover	Submerged plants					Emergent plants		
				Total submerged	Surface-reaching		Below surface		Total emergent	Species
					Sub-total	Species	Sub-total	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		