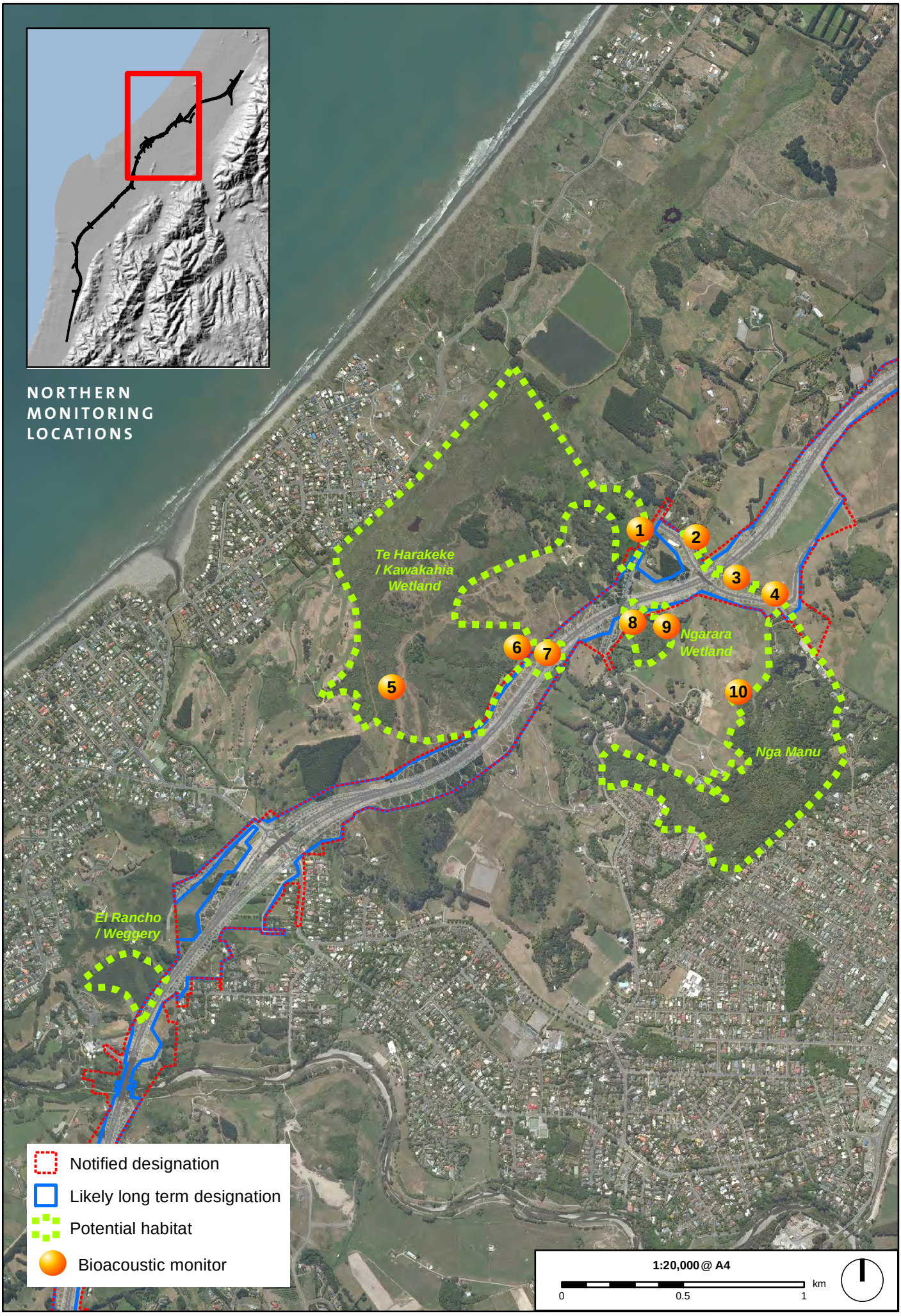
APPENDIX 2: Avifauna Monitoring and Management Maps



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NZ TRANSPORT AGENCY WAKA KOTAHI

Mackays to Peka Peka

POTENTIAL FERNBIRD HABITAT & BIOACOUSTIC MONITORING SITES

1

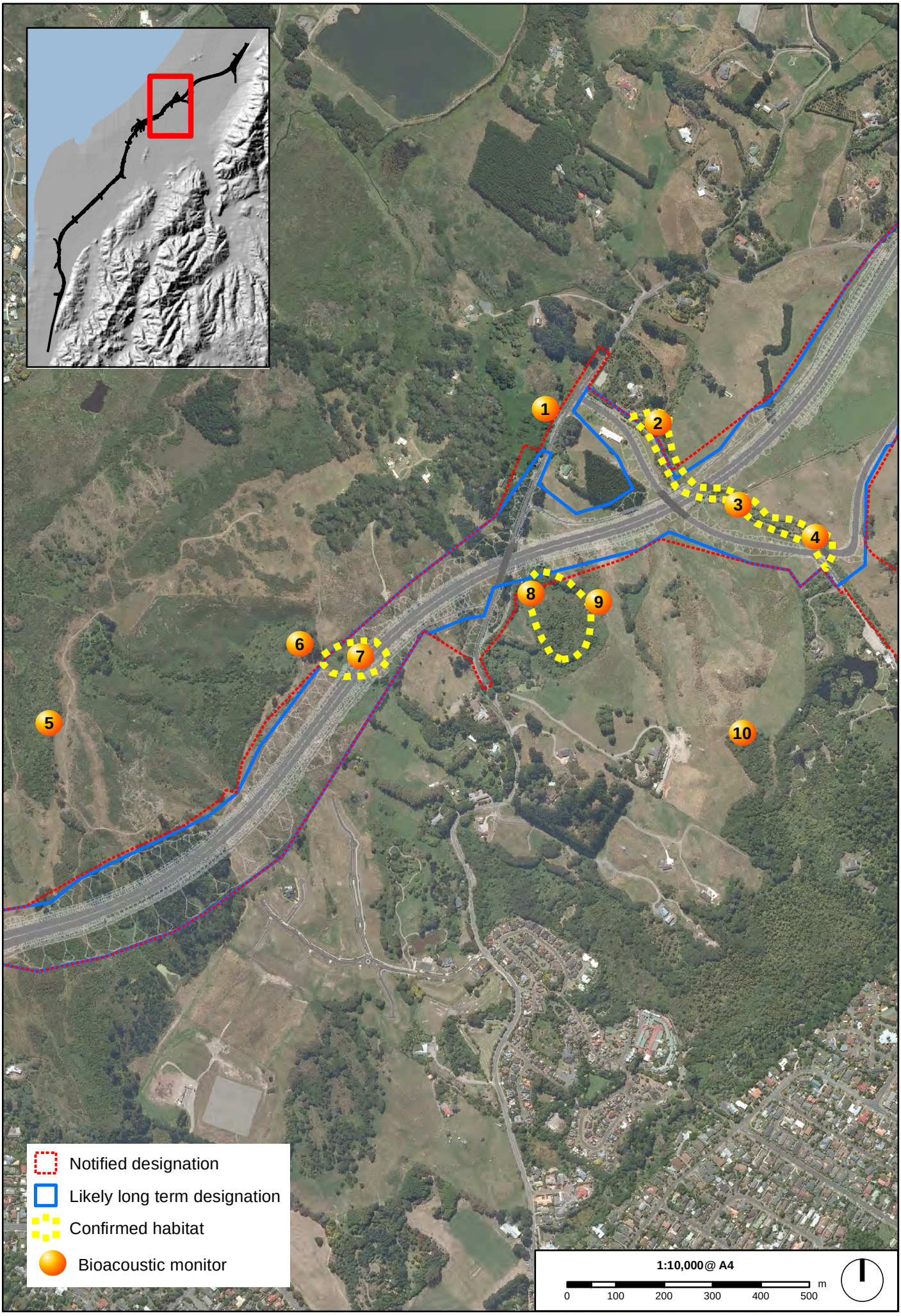
June 05, 2013 W09181B_AVI_FernbirdHabitatPotential_A4mb.mxd

NZ TRANSPORT AGENCY WAKA KOTAHI

Mackays to Peka Peka

POTENTIAL FERNBIRD HABITAT & BIOACOUSTIC MONITORING SITES

2



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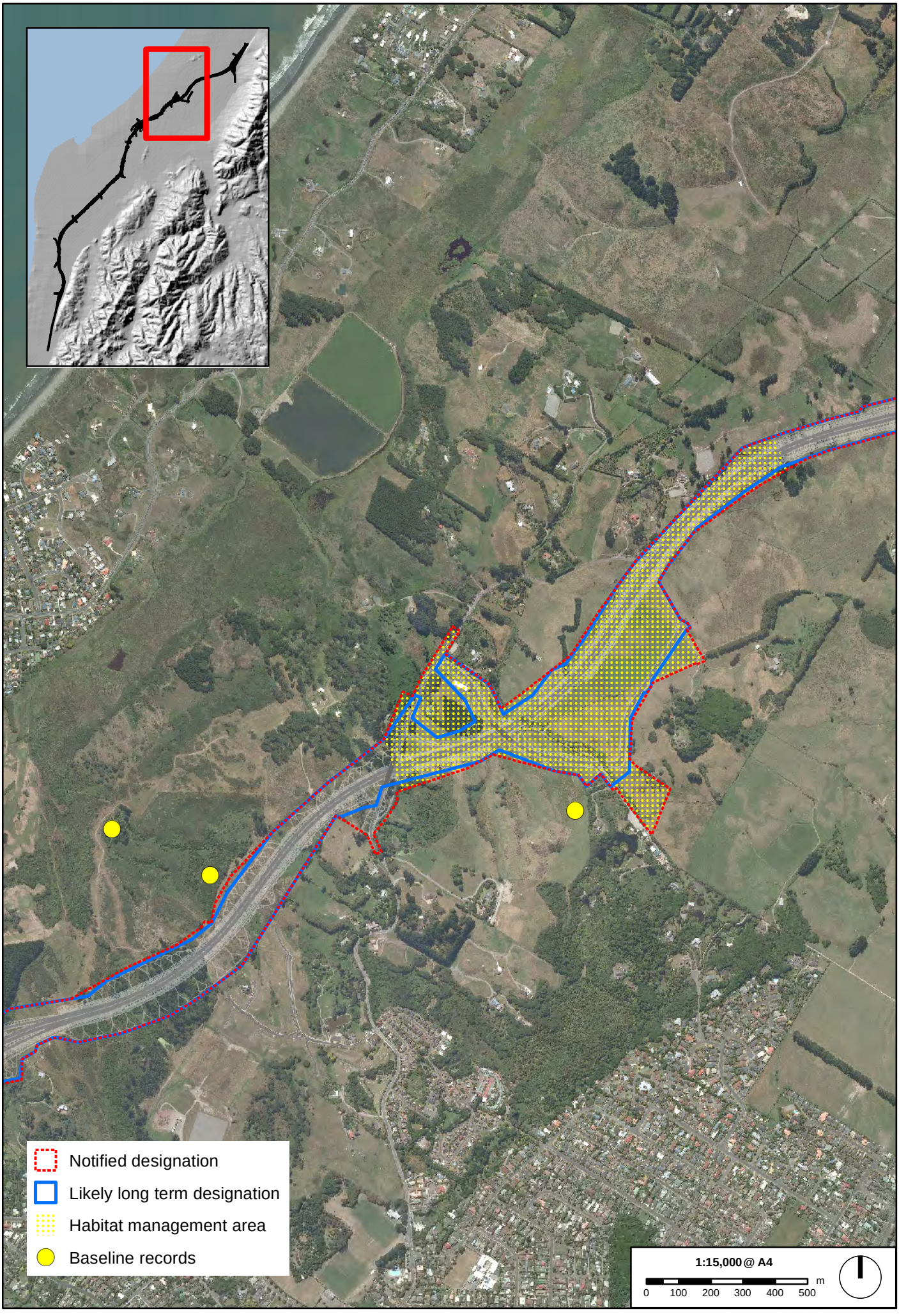
Mackays to Peka Peka

CONFIRMED (BASELINE) FERNBIRD HABITAT & BIOACOUSTIC MONITORING SITES

3



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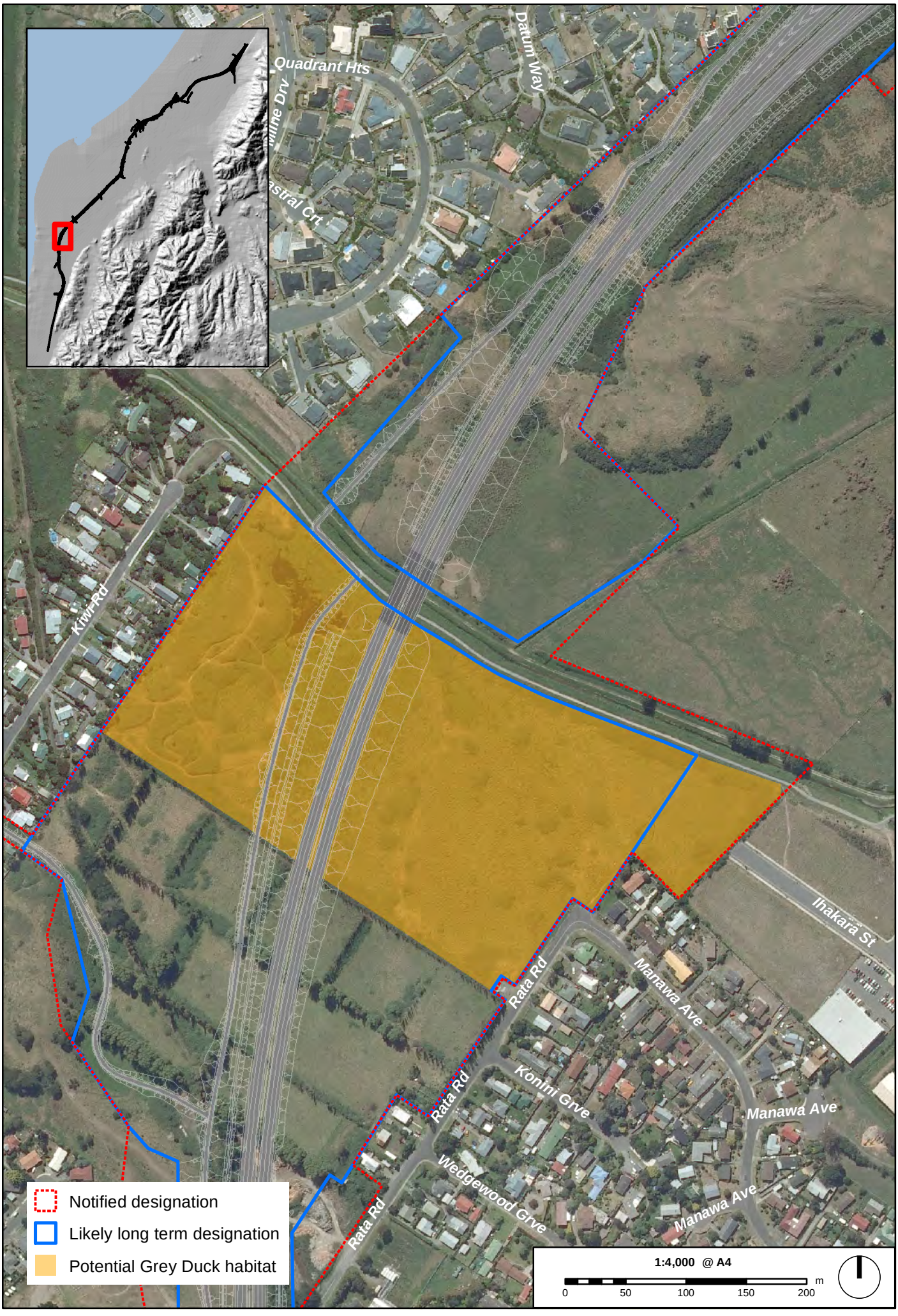
NZ TRANSPORT AGENCY WAKA KOTAHI

Mackays to Peka Peka

PIPIT RECORDS & HABITAT MANAGEMENT AREA

4



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NZ TRANSPORT AGENCY WAKA KOTAHI

Mackays to Peka Peka

POTENTIAL GREY DUCK HABITAT / SEARCH AREA **5**

EMP Attachment 4: Aquatic Monitoring and Management Plan

17 June 2013

NZ TRANSPORT AGENCY
WAKA KOTAHI

1 MacKays to Peka Peka Expressway

Revision History

Revision Nº	Prepared By	Description	Date
A	Dr Vaughan Keesing	First draft for internal review	4 April 2013
B	Dr Vaughan Keesing	Draft incorporating KCDC & GWRC review comments for internal review	30 April 2013
C	Dr Vaughan Keesing	Final draft	3 May 2013
D	Dr Vaughan Keesing	Final Report incorporating Kessels et al peer review comments	5 June 2013

Document Acceptance

Action	Name	Signed	Date
Prepared by	Dr Vaughan Keesing	Final Report	6 May 2013
Reviewed by	Matiu Park		17 June 2013
Approved by	Stephen Fuller		
on behalf of	MacKays to Peka Peka Alliance		

CONTENTS

APPENDICES

1 Introduction

As part of the Environment Management Programme (the EMP) for freshwater ecology a baseline ecological sampling programme and a construction monitoring programme has been prepared for the MacKays to Peka Peka State Highway Project (the Project). In addition to monitoring effects this EMP section (freshwater) provides information on fish trap and transfer methods for stream lengths lost to diversions, an over arching guidance of new diversion creation and other freshwater mitigation aspects. The detailed design guidance for new diversions which are to also service as mitigation will be produced in each SEMP and related to each final diversion area.

The baseline ecological studies (mudfish survey, Waikanae River bridge section survey and NTU logger installations) are aimed to further extend the comprehensive aquatic studies carried out in all water bodies as part of the assessment of ecological effects for this Project (Boffa Miskell, 2012) and (Boffa Miskell, 2012). The locations of historic sampling sites, and a summary of sampling results are presented in this report and assist in information relevant to a baseline condition. The fish presence and IBI data is up dated here using data from two of the new baseline surveys. Details of the methods used (historically) details the additional mud fish and Waikanae specific surveys undertaken. Section 5 describes the Construction monitoring programme, section 6 the triggers and reactions to trigger breaches and sections 7 and 8 the fish monitoring and salvage and section 9 describes the post construction monitoring checks and methods to measure freshwater mitigation success.

We believe the early AEE work is sufficient as a baseline for construction or post construction monitoring in regard to benthic aquatic macroinvertebrates and fish presence that may be required in all but one waterway (i.e. not the Waikanae River).

In summary the objectives of the baseline sampling are:

- To sufficiently describe existing in-stream biota and habitat quality, so that any changes during and at the completion of construction can be identified and appropriate strategies put in place to remedy or mitigate any adverse effects.
- To establish both impact and control sites in appropriate locations so that it is possible to determine whether any recorded changes to water quality, in-stream biota, or habitat quality are attributable to this Project or are the result of other activities within the affected catchments.
- To provide sampling methods for monitoring effects and to monitor mitigation success.
- To further assure the absence of mudfish within disturbed habitats
- To ensure fish adverse effects are kept to a minimum
- To establish a detailed benthic community and physical habitat description of the area of the Waikane River that will be disturbed.

- To ensure the appropriate condition, quantity and quality of freshwater mitigation occurs as and where it should.

1.1 Consent conditions

There are a large number of consent conditions that relate the protection and management of streams. A number of these are the responsibility of other disciplines (G.27, W, GT and GD) but are likely to require ecological input.

The consent conditions that relate specifically to freshwater are listed in full in Attachment 1. In summary, they require:

Condition	Activity / Title
G.27	Shall submit erosion and sediment control management plan. Purpose describe methods and practices to manage effects on aquatic receiving environments ii) with particular emphasis on high-risk areas which include Waikanae River, Wharemauku Stream and the Kakariki Stream;
G.34	Shall submit Ecological Management Plan. Shall include details of the following b) how outcomes will be achieved to iv) minimise effects on fish and fish habitat.
G.38A	Shall undertake monitoring of water quality which shall include a) continuous (telemetered) turbidity loggers in the following waterbodies Waikanae River, Wharemauku Stream and Kakariki Stream, and prior to diversions to i) establish a 6 month baseline ii) monitor until earthworks are stabilised iii) monitor stream diversion until turbidity have returned to baseline levels. Logs to be monitored on a daily basis, combined with rainfall alert of 7mm/hr b) Event triggered monitoring shall occur i) Where an exceedence of thresholds grab sample ii) Within 2 hours of exceedence or event c) For Earthworks if 20% or greater increase in NTU shall i) audit erosion and sediment control measures ii) Remedy any causes of exceedence iii) Notify the manager iv) If persists for 48hrs or more carry out sampling of macro-invertebrates v) prepare a report on sampling which includes 1. Results 2. causes of discharge and response to remedy 3. Assessment of whether thresholds have been exceeded including i QMCI thresholds ii Sensitive taxa threshold vi) If thresholds exceeded recommend and carry out mitigation d) For Diversion if 20% or greater increase in NTU shall i) audit erosion and sediment control measures ii) Remedy any causes of exceedence iii) Notify the manager iv) If persists for 48hrs or more carry out sampling of macro-invertebrates v) prepare a report on sampling which includes

	1. Results 2. causes of discharge and response to remedy 3. Assessment of whether thresholds have been exceeded including i QMCI thresholds ii Sensitive taxa threshold vi) If thresholds exceeded recommend and carry out mitigation e) Waikanae River and Muaupoko diversion monitoring.
G.42	a) Shall undertake 40.7 ha of planting and restoration b) in Ecological Mitigation Areas which shall include iii) 5,240 metres of stream mitigation and 17.7 ha of riparian planting, and removal of fish barriers. iv) within flood storage areas a further 1.4 km of new stream and 10 ha or riparian planting
WS.1	Shall use natural rock and soil to reclaim stream bed.
WS.2	Shall work in the dry bed of the stream as far as practicable.
WS.3	Shall design permanent diversions to maintain stream flows
WS.5	Shall undertake flow monitoring of the Wharemauku and Drain 5. Flow monitoring in 15 minute intervals for a period of a) 12 months prior to excavation b) during construction c) up to 12 months following construction Flow monitoring shall be at these locations. Results shall be included in groundwater monitoring reports.
WS.8	Shall prepare mitigation strategy for stream modifications and structures as part of LMP (DC.53C - DC.57A). Shall include a) details riparian planting including i) target SEV scores ii) location and length of riparian planting iii) landscape details b) monitoring and maintenance for 4 years for riparian vegetation
WS.10	Removal of temporary stream crossings and reinstatement of stream bed
WS.11	Structures to be inspected and maintained so that a) water body clear of debris b) erosion of bank and beds is remedied c) fish passage is not impeded.
GT.5	Bores for water take tested and report to manager containing a) details of testing carried out d) assessment of potential effects on streams f) mitigation measures for adverse effects Report approved before bore can be utilised.
GD.8A	a) Shall monitor surface and shallow groundwater in the vicinity of Otaihanga Landfill as follows i) at the following locations to monitor construction effect on surface water b) Shall commence 12 months in advance of construction, through works, and 2 years after c) shall be collected six monthly and results provide to manager d) Details shall be provided in CSGMP and GMP e) if a departure from baseline shall i) increase frequency of testing to every 2 months ii) Provide a report which will include 1 analysis of monitoring 2 recommendations for treatment 3 Treatment options and timeframes 4 Further monitoring requirements

	f) Shall instigate treatment and confirm effectiveness

1.2 Integration between Ecology, Landscape and Stormwater

1.2.1 Construction monitoring

Conditions relating to the protection of stream habitat downstream of works require close integration between the EMP and Erosion and Sediment Control Plan and coordination between the project ecologist and construction monitoring team.

The ESCMP (which is part of the CEMP) details the methods for managing site works to minimise discharge of contaminants including sediment to the streams and rivers crossed by the Project (G.27 and E.9). The project ecologist is responsible for carrying out baseline studies of the health of key streams, establishing management triggers, ongoing construction and post construction monitoring, and liaising with the project construction team on a regular basis and in the event of exceedences and/or significant changes to stream condition (G.38 and G.40).

1.2.2 Mitigation

Conditions relating to the mitigation of stream effects require close integration between the EMP and LMP and coordination between the project ecologist, hydrologist and landscape architect.

The LMP and more detailed SSLMPs are responsible for developing, designing and implementing all landscape mitigation measures including stream diversion design and riparian revegetation. This involves input into the shaping and final form of streams, plant selection for riparian planting and setting criteria for contract management and supervision of site establishment and planting. The project landscape architect will act as an adviser to the project construction team on the successful delivery of the planting contracts for all ecological, landscape, stormwater and urban design mitigation planting (See conditions DC53 to DC.58 and G.42C).

The EMP and more detailed SSEMPS (which will be prepared for each of the six specific mitigation sites) are responsible for establishing objectives for stream design, riparian revegetation and triggers for success of mitigation and remedial works. The project ecologist is responsible for liaising with the project landscape architect and project hydrologist during development of the SSEMPs, through the formation of each stream diversion, and for monitoring the success of each diversion design.

2 Methodology

2.1 Sampling Carried Out for the AEE (A Baseline)

Development of an assessment of ecological effects for the Project involved ecological investigations of all the perennial or intermittent streams and drains that will be crossed by the project. All sampling was carried out as per the methods provided in the following sections and in the AEE. Except where identified all sampling was carried out at the location where the proposed Project alignment crosses the waterway (culvert or bridge). The sample site locations and details are as follows.

Table 1 – Detail of each sampled waterway (listed north to south)

	Northing (NZTM)	Easting (NZTM)	Altitude a s l (m)	Distance from coast (m)	Catchment area (ha)	Total length of waterway (m)
Kowhai Stream Catchment						
Hadfield Kowhai Stream	1750515	405017	8	3,100	330	2,000
Waimeha Stream Catchment						
Paetawa Drain	1750050	405351	8	2,900	148	1,500
Smithfield Drain	1750602	405340	6	1,700	32	640
Kakariki Stream	1750249	405141	7	2,040	1,192	6,500
Ngarara Creek	1750249	405141	7	1,540	164	900
Waimeha Stream	1752040	405204	2	1,300	218	2,200
Waikanae River Catchment						
Waikanae River	1750139	405239	2	1,900	13,005	12,000
Otaihanga Wetlands	1750116	405331	7	1,967	4	na
Muaupoko Stream	1750139	405241	2	2,020	-	5,100
Mazengarb (WWTP)	175010	405341	6	2,430	17	600
Mazengarb Stream	1755351	405351	6	2,650	378	4,560
Wharemauku Stream Catchment						
Wharemauku	1745933	405452	3	2,450	1,008	6,400
Drain 7 Lower	1745927	405506	3	2,020	151	2,000
Drain 7 Upper	1745928	405506	5	1,420	44	890
Whareroa Stream Catchment						
Whareroa Drain	1745908	405642	6	3,200	179	450
Whareroa Trib (Waterfall Rd)	1745913	405719	14	2,500	179	2,600
Whareroa Stream Catchment						
Waimeha Stream Mouth	-	-	0	0	1,754	-
Waikanae Estuary	-	-	0	0	13,400	-
Wharemauku Stream Mouth	-	-	0	0	1,203	-

Sampling type used in each waterway is presented in the Table 2.

Table 2 – Sampling methods used in each water body.

Name	SEV	PHA	EFM	Macro-invertebrates	Sediment Sampling	Water Quality Sampling	Other (photo, site visit
Hadfield Drain Catchment							
Hadfield Drain	✓	✓	✓	✓	✓	✓	✓
Waimeha Stream Catchment							
Paetawa Stream	✓	✓	✓	✓			✓
Smithfield Drain	✓	✓	✓	✓			✓
Kakariki	✓	✓	✓	✓	✓	✓	✓
Ngarara Drain	✓	✓	✓	✓			✓
Waimeha Stream	✓	✓	✓	✓	✓	✓	✓
Waikanae River Catchment							
Waikanae River	✓	✓	✓	✓	✓	✓	✓
Waikanae River Upper *		✓				✓	
Muaupoko Stream	✓	✓	✓	✓			✓
Mazengarb (WWTP)	✓	✓	✓	✓			✓
Mazengarb Stream	✓	✓	✓	✓	✓	✓	✓
Wharemauku Stream Catchment							
Wharemauku	✓	✓	✓	✓	✓	✓	✓
Drain 7 Wharemauku	✓	✓	✓	✓		✓	✓
Upper Drain 7	✓	✓	✓	✓			✓
Whareroa Stream Catchment							
Whareroa Drain	✓	✓	✓	✓			✓
Whareroa Trib	✓	✓	✓	✓			✓
Wetlands							
Otaihanga Wetlands*			✓				Mudfish
Raumati Manuka Wetland*							Mudfish

SEV –Stream Ecological Valuation; PHA –Physical Habitat; EFM – Electric fishing machine;
* Sampling not within project footprint

In summary:

- 16 sites fished by EFM[1];
- Mud fish traps set at 2 wetlands, over 7 nights;
- 15 sites sampled for aquatic macro invertebrates;
- 15 full SEV protocol sample sites;
- 8 sites sampled for baseline water quality and sediment;
- 6 sites sampled for storm water contaminants in first flush rainfall events.

The results of this sampling is summarised in Section 3.

1 Electric Fishing Machine

2.2 Methodologies Used to Date

The following sampling methods were used between January 2011 and February 2012 for the Ecological Impact Assessment for the Project (i.e. MacKays to Peka Peka Expressway Technical Reports 26 & 30). For a number of streams the data collected is proposed to form part of the baseline data for construction and post construction monitoring.

2.2.1 River Environment Classification (REC)

The REC (NIWA, 2004) database was used to measure the different lengths of each streams and to determine the REC class within affected sections of each of the waterways. Since the REC system does not recognise first order streams, the LINZ GIS data set (NZMS 260 TOPO maps) was used to generate an additional class of first order intermittent/ephemeral streams.

Water sheds (catchment) were defined using GIS and topography layers and were divided into the various sub-catchment and catchment areas. The catchment sizes were calculated and these sizes assisted in determining requirements for fish passage. For this site, catchments greater than 10km2 are generally considered large enough to maintain flows that sustain fish.

2.2.2 SEV – Habitat Descriptions

Stream Ecological Valuation (SEV) was carried out according to the revised methodology (Version 10) issued by NIWA on November-December 2011 (Storey et al, 2011). The data that was collected was analysed using the NIWA supplied SEV worksheets (Version 2.1, 2011).

Both field sampling and data analysis were carried out by BML Staff who have completed Wellington Regional Councils SEV training course.

The SEV system was applied to assist the valuation of the water bodies along the proposed alignment. At each of the 15 SEV sample sites listed in Table 1, a range of physical habitat characteristics were recorded using standard SEV field sheets. These characteristics included width, depth, velocity, and clarity of the stream, substrate composition, riparian vegetation and shade, temperature, dissolved oxygen, pH, and conductivity.

This data was combined with the other biological criteria (presence/absence of fish species etc) and analysed using the SEV Worksheets (V.9 Updated December, 2009).

The SEV analysis requires reference streams. A reference stream is a stream of a type that is representative of the area, and which is in pristine or near pristine condition, i.e. with values that are not influenced by human occupation and land use. In the absence of real stream examples, the SEV tool allows for the generation of a hypothetical stream with natural meander, regenerating native riparian cover with natural substrate for the area, and which shows what the potential for the 'real' sites and what measure they should be to be considered "fully" functional.

All waterways within the study area are highly modified and none were suitable. After a review of potential reference sites on the Kāpiti Coast and discussions with the Department of Conservation (DOC), Greater wellington Regional Council (GWRC) and Kapiti Coast District Council (KCDC) staff it was decided that the model reference sites provided with the SEV workbook were not sufficiently representative of the channels waterbodies within the study area and could not be used. The decision was made to modify the SEV from the Kakariki Stream (which scored well in some metrics) to improve some of the scores including riparian habitat.

Data was analysed in accordance with the methods described in the SEV manual (Rowe et.al., 2008). The latest version of the SEV calculator was used (designated as Version 8.2, dated 23 December, 2009)

2.2.3 Freshwater Fish

Mudfish

Initial mudfish surveys were undertaken in December 2012 by a recent graduate freshwater mudfish ecologist, at two potentially affected wetlands (the Raumati Manuka Wetland and Otaihanga Landfill wetlands). Fifteen-Twenty 4 mm mesh Gee minnow traps were used in each wetland as described in mudfish monitoring methodology (Ling, O'Brien, Miller, & Lake, 2009)). This monitoring technique gives qualitative information on mudfish within a wetland.

In the Raumati Manuka wetland the traps were set for three nights, the 6th to 9th of December, while at Otaihanga they were set for five nights, the 9th, 13th, 20th, 21st, 22nd of December 2011. A single fyke net was employed in the Otaihanga for 4 nights in December 2012 as an addition to the mudfish baseline survey effort.

Freshwater fish

EFM sampling was carried out by NIWA certified operators using a Kainga 300 backpack electro-fishing machine over January -February 2011 and November-January 2011-2012 using the following methodology:

- A suitable sample reach was selected. Sampling began at the downstream end of the reach and proceeded upstream;
- Sampling at each study reach consisted of 10 (or more) runs targeting habitat and cover features. Habitat and cover features included riffles, logs and dams of loose debris, overhanging and trailing vegetation, beds of aquatic plants, bank undercuts, and boulders;
- Each run was typically 5 m in length and the width of the stream. If the stream was more than 1.5 metres wide it was fished in two parallel runs;
- Fishing was multiple pass depletion fishing, with a minimum of four passes, continuing until no fish were caught;

- Fish from each run were captured by scoop net and downstream stop net and transferred to buckets. They were then be counted, identified, their length measured, and returned to their habitats, once EFM fishing of that reach was complete; and
- Once a run had been finished, the samplers moved upstream to the next run and repeated steps C to E. Each run was separated by at least 5-6 metres.

The initial sampling returned 11 of the 15 historic species (recorded in the freshwater fish database post 1990). Those species not observed during this sampling were typically found in more cobbled streams or faster flowing waters (Crans bully, torrent fish) at higher altitude, or were species typically found closer to the coast than the Project alignment (e.g. mullet). Those fish of higher catchment position not caught, but in the historic records were "rare" occurrences, i.e. short jaw kokopu, giant kokopu, giant bully and lamprey. Torrent fish were caught in abundance in the Waikanae River in 2013 during "baseline" Waikanae surveys.

The significance of individual species was assessed using the conservation threat status for indigenous freshwater fish (Allibone, et al., 2010) and by evaluating their occurrence in the Wellington Region using data from the New Zealand Freshwater Fish Database (NIWA).

The value of the fish communities was assessed by comparison with other streams in the region and is summarized in Table 3. This included evaluation using IBI, (the Fish Index of Biological Integrity (Joy, 2005) and classification following the regional ranking system of Strickland and Quarterman (2001).

Table 3 – Attributes and Integrity Classes for the Wellington IBI (after Joy, 2005)

Total IBI score	Integrity class	Attributes
50 – 60	Excellent	Comparable to the best situations without human disturbance; all regionally expected species for the stream position are present. Site is above the 97th percentile.
42 - 49	Very good	Site is above the 90th percentile of all Wellington sites species richness is slightly less than best for the region.
36 - 41	Good	Site is above the 70th percentile of Wellington sites but species richness and habitat or migratory access reduced some signs of stress.
28 - 35	Fair	Score is just above average but species richness is significantly reduced habitat and or access impaired.
18 - 27	Poor	Site is less than average for Wellington region IBI scores, less than the 50th percentile, thus species richness and or habitat are severely impacted.
6 - 17	Very poor	Site is impacted or migratory access almost non existent
0	No fish	Site is grossly impacted or access non existent

2.2.4 Aquatic Macroinvertebrates

Communities were sampled using the MfE sampling protocol 'C2' (soft-bottomed, semi-quantitative, or 'C1' Hard bottom, depending on the waterway). This involved the use of a

0.5 mm kick net, using the national standard kick-sampling protocol described by Stark et al (2001). Species were identified to the lowest possible taxa (sufficient for MCI allocation) and abundances were recorded as quantitative sampling as per Stark 1998 (Protocol P3).

Samples were forwarded to a lab (Ryder Consulting) for identification. Species were identified to MCI level and abundance records were full count (Method P3).

The results for each sample sites three replicates were both averaged to give mean values and confidence intervals, and pooled to give total taxa counts and abundances for the sample site.

The following six invertebrate indices were calculated for each replicate at each site and averaged. These biotic indices use the tolerances of New Zealand macroinvertebrate taxa to assess water quality and the health of aquatic habitats.

- Total abundance;
- Taxa Richness;
- EPT taxa;
- EPT abundance;
- Macroinvertebrate Community Index (MCI); and
- Quantitative MCI (QMCI).

2.2.5 Water Quality

During the collection of the SEV and Physical Habitat (PHA) data, basic water quality measurements, pH, dissolved oxygen, turbidity, temperature and total suspended solids (TSS) were recorded in the field by BML at the biological sampling locations (down stream and prior to other sampling). During ecological investigations, BML used a TPS 90FLT Field Lab Multimeter and an Insite IG3150 to carry out basic water quality parameters.

Environmental Laboratory Services (ELS) also undertook an extensive water and sediment quality study in eight streams which is analysed and described in the Baseline Water and Sediment Quality Investigation (BECA, 2011 & Bibby 2011).

An attempt was made to carryout water and sediment quality sampling at the same locations sampled by the ecological investigations. For various reasons this could not always be achieved, however, these differences in locations were not considered to affect the ecological findings or assessment as those quality assessments were designed to provide a general catchment-waterway/sediment contaminant back ground. The results are applicable across each waterway catchment and the sample specific aspects of quality associated with the biologically sampling were carried out at each site by BML.

3 Summary of results for base line

A summary of all biological data collected using the methods described above is provided in the following tables and figures. This data has been developed into summary sheets describing each of the waterways under consideration and these can be found in Attachment 2.

Table 4 below summarises the scores (in some cases mean scores) derived for each waterway over the seven key metrics that were considered in the assessment of effects.

Table 5 then presents the same data but as a percentage of the reference site value (for SEV); or as a percentage of the Regional mean – IBI (Joy, 2005) and SOE– (GWRC, 2008).

Table 4 – Sampling scores (key metrics for stream assessment).

Score	Physical Habitat	SEV Score	FISH IBI	Richness	% EPT Abundance	MCI	QMCI
Hadfield Drain	0.41	0.40	18	24	17%	87	4.6
Paetawa	0.16	0.49	30	15	20%	88	4.4
Smithfield Drain	0.32	0.38	16	18	6%	70	2.7
Kakariki	0.26	0.45	37	19	21%	77	4.5
Ngarara Drain	0.35	0.29	16	11	9%	75	4.3
Waimeha	0.30	0.34	14	15	13%	78	4.7
Waikanae	0.57	0.66	40	34	53%	116	6.4
Muaupoko Stream	0.38	0.48	32	24	25%	88	4.2
Mazengarb (WWTP)	0.49	0.39	22	5	0%	41	1.7
Mazengarb Stream	0.48	0.37	22	12	8%	68	4.5
Wharemauku	0.26	0.44	28	31	26%	90	3.7
Drain 7 Lower	0.27	0.36	22	9	11%	60	3.0
Drain 7 Upper	0.06	0.30	16	11	9%	73	2.5
Whareroa Drain	0.07	0.28	16	13	15%	81	3.7
Whareroa Stream	0.41	0.54	36	30	30%	96	4.3
Reference Site / Regional Mean	0.86	0.78	28	20	43%	-	-

Table 5 – Scores as % of reference site or regional mean (key metrics for stream assessment).

% of Reference / Regional Mean	Physical Habitat	SEV Score	FISH IBI	Richness	% EPT Abundance	MCI	QMCI
Hadfield Drain	48%	50%	81%	120%	39%	82%	83%
Paetawa	19%	63%	94%	75%	46%	83%	79%
Smithfield Drain	37%	49%	87%	90%	13%	66%	48%
Kakariki	30%	58%	132)	95%	49%	73%	82%
Ngarara Drain	41%	37%	57%	55%	21%	71%	77%
Waimeha	35%	44%	50%	75%	31%	73%	85%
Waikanae	66%	85%	143%	170%	123%	110%	115%
Muaupoko Stream	44%	61%	131%	120%	58%	83%	75%
Mazengarb (WWTP)	57%	50%	79%	25%	0%	38%	30%
Mazengarb Stream	56%	48%	79%	60%	19%	64%	80%
Wharemauku	30%	56%	100%	155%	60%	85%	67%
Drain 7 Lower	31%	46%	79%	45%	26%	56%	53%
Drain 7 Upper	7%	39%	112%	55%	21%	68%	45%
Whareroa Drain	8%	36%	57%	65%	36%	76%	66%
Whareroa Stream	48%	69%	129%	150%	69%	90%	78%
As a proportion of:	Reference Site	Reference Site	Regional Mean	Regional Mean	Regional Mean	Regional Mean	Regional Mean

in red is an increase in IBI from the AEE related to new data from baseline studies (see below).

Figure 1 presents the community composition of macroinvertebrates in each waterway as a percentage of abundance within each taxonomic group. Figure 2 presents community composition as the percentage of taxa present within each taxonomic group. Both provide insights into the health of the waterways.

Figure 1 Macroinvertebrate community composition (% abundance) at each sampled site.

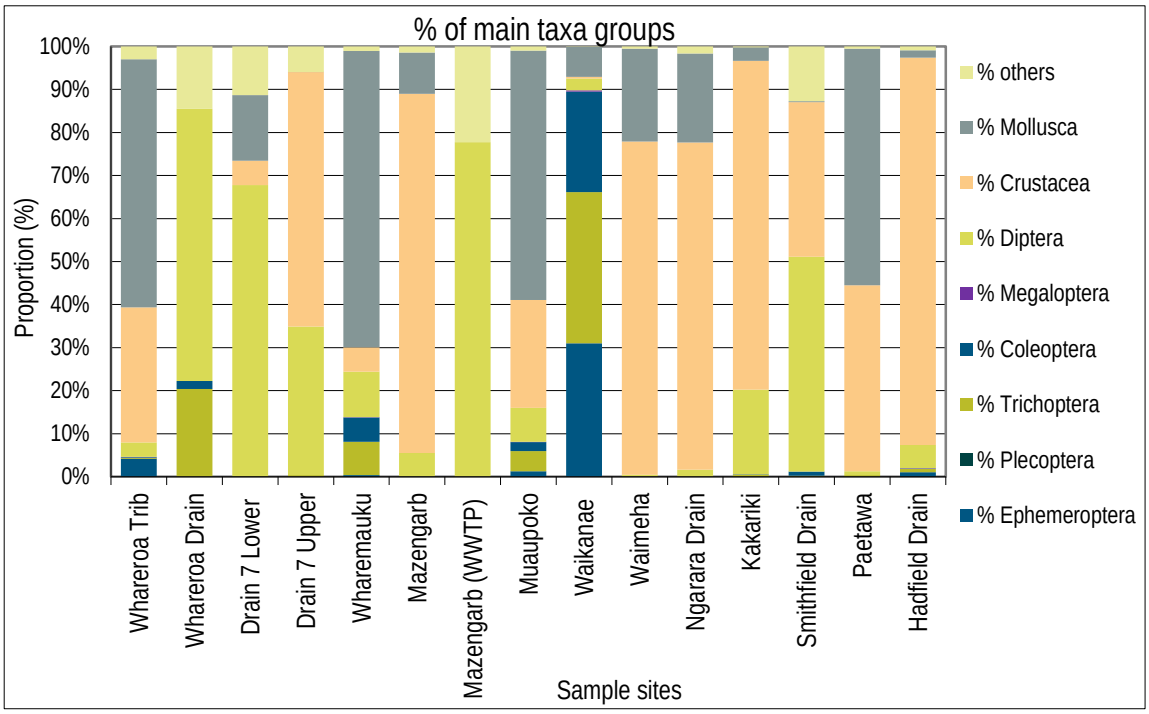
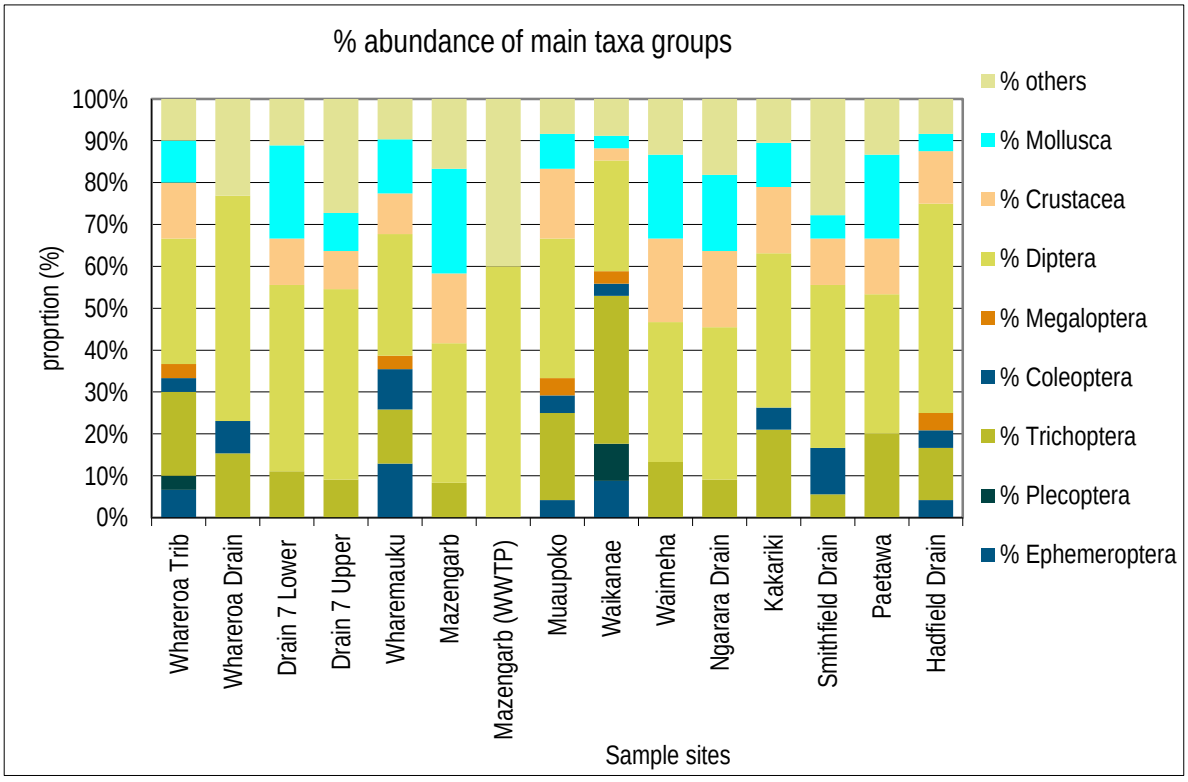


Figure 2Macroinvertebrate community composition (% Taxa) at each sampled site.



The most highly represented taxa in terms of abundance across all sites (with the exception of the Waikanae River) are Crustacea and Mollusca, and in particular Paricalliope (which have no soft-bottom MCI value) and a hard bottomed MCI score of 5, and Potomopyrgus with a soft bottom MCI value of 2.1. Midges (*Chironomus* sp.) dominate in some waterways. Only the Waikanae River had a notable varied assemblage with evident EPT fauna, in particular Trichoptera and Ephemeroptera, making up the greater proportion of the species within the samples. Attachment 3 provides the baseline data for sensitive taxa, species and abundance comparisons in line with the trigger conditions (discussed in section 6 below).

3.1 New Fish Data from Baseline Studies

Additional sampling of the Waikanae and from several of the potential mudfish streams (Drain 7, Muaupoko, Smithfield Drain, Hadfield/Kowhai Stream and the Paetawa Stream returned a number of fish not initially sampled by EFM in the earlier surveys. Those additional fishes are reported below in Table 6.

Table 6 – New fish taxa presence data from further baseline studies (total abundances from all baseline trapping provided).

Site code or name	Common Name	Paetawa	Muaupoko Stream	Waikanae Proposed Bridge	Hadfield Drain / Kowhai	Drain 7 Upper	Smithfield Drain
Anguilla australis	Shortfin eel		5	12	1	4	1
Anguilla dieffenbachii	Longfin eel	17	3	15	2	5	11
Galaxias argenteus	Giant kokopu						
Galaxias fasciatus	Banded kokopu	22	7		80	2	
Galaxias maculatus	Inanga		53			1	4
Gobiomorphus cotidianus	Common bully		5	38			1
Gobiomorphus huttoni	Redfin bully			6			
Retropinna retropinna	Common smelt	2	10				
Cheimarrichthys fosteri	Torrentfish			101			
Rhombosolea retiaria	Black flounder			2			

Noticeable differences are the addition of torrent fish to the Waikanae River and the addition of banded kokopu and inanga to upper drain 7.

Table 7 – Resultant IBI change.

	Hadfield Drain / Kowhai	Paetawa	Smithfield Drain	Waikanae Proposed Bridge	Muaupoko Stream	Drain 7 Upper
Previous IBI score	18	30	16	40	32	16
	Poor	Fair	Very Poor	Good	Fair	Very Poor
After additional surveys of 2013	26	30	28	40	42	36
	Poor	Fair	Poor	Good	Good	Fair

4 Additional Baseline Sampling Requirements

4.1 Additional Baseline Monitoring

In addition to the baseline metrics supplied by the AEE studies three further areas of study were undertaken to assist in the management or recognition of effects. These were:

- Additional mudfish surveys;
- Detail survey of the Waikanae River in-stream condition within the area to be affected;
- Installation of control and effect telemetric NTU loggers.

In addition to the above, the ecological team has also monitored bed movement via sediment pit fall traps within the Kakariki and Paetawa Streams. The method and results as they relate to baseline sediment movements in the sandy soft bottoms streams are also useful and are included below

4.2 Mudfish Survey (Condition G38D).

The mudfish survey condition reads:

Prior to the commencement of the diversion work, surveys targeting brown mudfish will be carried out in the proposed diversion reaches by a suitably qualified ecologist (who has prior experience with mudfish surveys) in the following stream reaches:

i) Smithfield Drain;

ii) Hadfield Stream;

iii) Paetawa Drain;

iv) Muaupoko Stream; and

v) Lower Drain 7.

These surveys are to include at minimum, the setting in appropriate mudfish habitat of 20 fine meshed (4mm) gee-minnow traps and six fine meshed (4 mm) fyke nets over two consecutive nights at each stream site to be surveyed. Fyke nets will contain a "large fish exclusion" compartment.

Where site conditions preclude the carrying out the method detailed above, suitable alternatives will be discussed with the Manager.

Results of the mudfish survey will be provided to the Manager within 10 working days following completion of the data collection and will inform the fish transfer requirements (as required by Condition G.34 (r)) for the diversion and update the SEV data held as a measure against which mitigation diversion success is to be measured against.

Full details of the proposed mud fish survey methodology shall be submitted to the Manager for certification prior to undertaking the survey. The survey shall be carried out in accordance with the certified methodology.

Results of fish surveys will be included in the EMP (so as to affect the mitigation targets) prior to the EMP being supplied to the Manager for certification

The additional Mudfish Surveys were carried out over December 2012-Janurary 2013.

All mudfish sampling under this condition was undertaken by Mr M Park, Ms B. Risi and Dr V Keesing (Boffa Miskell Ltd) to ensure consistency with sampling under taken to date, and their knowledge of the sites to be sampled, as well as utilisation of existing relationship with the local landowners.

Following on from the initial mudfish surveys, and in line with the above condition, we undertook the surveys at the general middle point of the designation (and especially the foot print) of the proposed expressway.

Gee Minnow trapping

Surveys involved the deployment of 20 individual 4mm mesh gee-minnow traps (in accordance with the Ling et al. (2009) mudfish monitoring methodology) set over two consecutive nights in each of the following streams.

- Smithfield Drain;
- Hadfield Stream;
- Paetawa Drain;
- Muaupoko Stream; and
- Lower Drain 7;

The traps were set partially submerged, providing a surface oxygen supply for trapped fish. Traps were set along a stream bank either as a row of 20, or in two rows of ten on each bank. The traps were spaced at 5m intervals. The traps were checked each morning.

Specific trap locations will utilise the surveyors specific site knowledge and knowledge of the affected areas for best placement. Features such as emergent vegetation were taken into account when positioning the traps so as to maximise the entrapment of any fish feeding along vegetation boundaries.

Any fish (of any species) found within the traps was recorded (size and species and abundance), and then released.

Fyke netting

A total of six fyke (4mm) nets (with separator compartments) were deployed and distributed within and beyond the gee-minnow traps were sufficient water was present and set over two consecutive nights in each of the following streams.

- Smithfield Drain;
- Hadfield Stream;
- Paetawa Drain;
- Muaupoko Stream; and
- Lower Drain 7;

The traps were set partially submerged, providing a surface oxygen supply for trapped fish.

As with the minnow traps features such as emergent vegetation were taken into account when positioning the traps so as to maximise the entrapment of fish.

The traps were checked each morning. Any fish (of any species) found within the traps was recorded (size and species and abundance), and released.

Note:

It was the case that fyke nets were not always all employable in all of the proposed waterways, some of the drains were not large enough in width and in water flow and depth to place the fyke nets. As part of this certification, GWRC accepted that some discretion of the sampler in use and number of fyke nets per site was appropriate.

Fish release

All releases of fish caught in the first morning check were made a small distance up stream, but repeat catches cannot be accounted for other than undertaking fish tagging. Tagging is a perturbative measure requiring permits and fish anaesthetic and has some risk. In this instance for the purposes of the survey such tagging was not be undertaken.

Reporting

The total record of all catch, presence of mudfish, representative photographs etc was reported to NZTA and GWRC within 10 working days of completion of the surveys.

That report is appended to this EMP section as Attachment 4. No mud fish have been recorded in any survey effort.

4.3 Survey of the Affected Waikanae River Reach (Condition G38).

In order to establish the affected aquatic communities with the Waikanae River a series of transects were established at 5 intervals incorporating the 160m reach proposed to be disturbed for flood management and bridging purposes. A focus of the study was on the resident and potential most stable components of the communities and less emphasis is paced on those highly mobile and transitory taxa (e.g. inanga, trout, smelt, mackel etc). The aim was to describe in some detail the substrate types present the flow and depths of

aquatic habitat, the periphyton cover as well as the resident fish densities and the densities and community composition of benthic macroinvertebrates.

4.3.1 Methodologies Employed

The physical habitat descriptions followed the methods in Harding et al 2009 and consisted of a tape measured transect placed across the stream perpendicular to the flow and then at every 1m the depth measured. Every 2m the substrate types (using descriptor and size classes based on Wentworth (1922)) were recorded and the percentage cover of a 1 m square quadrat made. Within each of these quadrats the percentage cover of periphyton on the substrate surface was made and the general type (matting, filamentous (long or short) was recorded. Some samples were taken for analysis so as to record the species present but due to failure of the courier system samples perished prior to arrival at the laboratory. Flows at two locations at each transect were estimated using the method of timing 3 surface floats over a 10m distance. This is a rough method to estimate the surface velocity of water, and as an average approximation of river velocity, is sufficient to approximate water speed and allow an approximation of the quantum of water (wetted with X average depth X speed (ms^{-1}). This estimate was checked against the GW Waikanae River volume records (accessible on line - http://graphs.gw.govt.nz/rivers-and-streams-2/).

Across each transect at roughly equal spacings, 3 kick net samples were taken using a 500 µm NIWA kick net and the disturbance area was measure to cover an area of 30 cm by 40cm area. In addition 3 standard surber samples were also taken, making 6 invertebrate benthic samples per transect. Samples were stored in 90% ethanol and shipped to Ryder Associates laboratories for species identification and enumeration.

Near to or on each transect, fish sampling was undertaken using a Kainga 300 electric fishing machine and a standard chain bottom 2m wide stop net and a hand held scoop net. The transect was methodically worked in 2m lots across the river at each transect. A standard of 10 passes sweeping a total area of around 4m was applied to each position and all fish stunned or capture were transferred to a holding buckets. At the end of each transect (typically constituting 10 sampling sweep areas) the fish caught were identified to species measured nose to tail fork and released.

In this way the area actively sampled was recorded and the number of fish caught per that area from depleted sampling recorded so as to provide an approximate of species density.

Five River transects were completed and those locations are shown on Figure 3.

In addition photographs of each transect, the substrate and habitat types along the entire river reach were taken so as to typify the sampled transects.

The methods and locations recorded will allow a post activities repeat of the above sampling and therefore also a comparison of the post activities in-stream community and habitat condition.

The results of the above survey are provided in Attachment 5. In brief the Waikanae has an abundance of small torrent fish and bully but other fish appear transitory. The bed is predominantly cobble with little periphyton, somewhat imbedded, but with little deposited sediment evidence. The fauna has a strong EPT component and densities are relatively high.

4.4 Sediment Bed Movement Monitoring in the Paetawa and Kakariki Waterways

To establish what amounts of sediment and bed movement was occurring in representative waterways of the project area the Kakariki and Paetawa streams were investigated. A novel measure was utilised involving "pit trapping" of mobile bed substrates (Sterling 2002). In essence containers are dug into the bed of a known volume and left for a set time period and the "catch" then removed weighed and analysis for composition. In this way an estimate of the quantum of bed moving material can be made. Where flows are also known correlations can be made between these factors.

Three sets of 5 11 Litre stainless steel traps were installed, 5 traps in the lower Paetawa near its confluence with the Kakariki, 5 traps below the road bridge on the Kakariki and 5 traps above the proposed road foot print (as a control). These traps were run over a period of 6 weeks and measures of bed movement collected and analysis undertaken in a laboratory. The analysis was for wet weight of portion <63 µms and that portion above as well as organic content of portion < 63 µm and above. The 63 µm cut off is a measure of muds and fine sediments versus larger (sand and above) constituents of the substrate.

The results are presented in Attachment 6 and form part of the baseline for continued biannual construction monitoring in the Paetawa and Kakariki streams. In summary the lower Kakariki stream bed is very mobile (10-11 litres of bed load movement per day) and sandy with 1/3 organic. The upper Kakariki is less but still mobile and heavy in silts and organics. The Paetawa stream bed is still mobile but less so than the Kakariki.

5 Construction Monitoring

Identification of waterways that should or can be monitored during construction is challenging for this project for a number of reasons. Most of the waterways traversed by the proposed Project alignment are highly modified and many are constructed drains with very low aquatic biometrics, often so low as to make measurement of change redundant.

In terms of stream value and habitat quality all streams and drains have QMCI's that are below 5, with some as low as QMCI 1.7. Biota found in these waterways are typically robust and resilient to change. In these waterways a change in QMCI from 3.0 to 2.0 is a change from poor to poor, and is unlikely to be an ecologically meaningful change.

Many of the waterways traversed are open to the sky, surrounded by pasture and weedlands, and are highly enriched by rural discharge or urban stormwater leading to excessive macrophyte and periphyton growth. This situation is managed by KCDC, GWRC and landowners through annual excavation using diggers and/or mowers. In these streams this ongoing maintenance will cause dramatic variability in macro-invertebrate and fish abundance, and stream bed and sedimentation, which will, in our opinion, mask any potential discharge effects during construction.

Finally, a majority of potentially affected streams have a silt/sand substrate. Given the discharges from earthworks are also likely to be silt and sand, monitoring of these waterways is unlikely to detect meaningful change unless the change is gross (which modelling suggests is unlikely).

These factors will make measuring significant adverse changes that can be ascribed to the project, problematic in most waterways. These factors have directed our thinking for construction site monitoring and therefore baseline monitoring requirements.

Table 7 summarises both the scope of potential construction activity within or adjacent to each watercourse and our assessment of the construction and post construction monitoring that is required.

In summary it is proposed that the current levels of data collection are sufficient for most watercourses. Additional baseline sampling is, however, recommended in relation to the most ecologically important freshwater environment along the route.

While the Waikanae River is one of those (important and better condition) waterways and will be affected by disturbances to the bed, despite this no construction monitoring within the Waikanae River is proposed because of the additional flood protection works that will disturb around 160 m of the bed at the time of bridge construction. Instead a detailed baseline additional survey was conducted (as described above) and that data forms a post check for the post construction final condition.

Table 7 – Summary of proposed construction activity in each watercourse and anticipated monitoring requirements. Note all SEV surveys include fish and macroinvertebrate sampling as well.

Waterway	Key works	Anticipated Construction Monitoring	Anticipated fish rescue (diversions & culverts)	Anticipated Post construction monitoring
Hadfield Drain / Kowhai Stream	Drain realignment & works on existing culverts at SH1 and NIMT crossings.	Nil	Yes	-
Paetawa Stream	Bridge main channel Drain realignment & works on existing culverts at SH1 and NIMT crossings. Focus site for stream mitigation & riparian planting.	Macroinvertebrate Sediment	Yes	SEV / habitat
Smithfield Drain	Significant drain realignment Extensive flood storage works Focus site for stream mitigation & riparian planting.	Nil	Yes	SEV / habitat
Kakariki Stream	Bridge Diversion Major roading works in proximity Upstream realignments (Smithfield) Focus site for stream mitigation & riparian planting.	NTU logger Macroinvertebrate Sediment	-	SEV / habitat
Ngarara Creek	Culverted crossing.	Nil	Yes	-
Waimeha Stream	Three bridges Major interchange Diversions of small drains to south.	Nil	-	-
Waikanae River	Bridge Flood plain widening Temporary channel diversions Armoring and willow planting Extensive landscape planting.	NTU logger Geomorphology Periphyton Macroinvertebrate Fish densities as a detailed baseline only	-	Post construction a re-survey of the river condition as per the baseline to establish appropriate level of recovery has occurred.
Muaupoko Stream	Diversion at confluence with Waikanae Focus site for stream mitigation & riparian planting.	Nil	Yes	SEV / habitat Fish passage
Mazengarb (WWTP) Drain	Culverted crossing. Focus site for stream mitigation & riparian planting.	Nil	-	SEV / habitat
Mazengarb Stream	Culverted crossing.	Nil	Yes	-
Wharemauku Stream	Bridged	NTU logger	-	-

Waterway	Key works	Anticipated Construction Monitoring	Anticipated fish rescue (diversions & culverts)	Anticipated Post construction monitoring
Drain 7 Lower	Minor drain realignment & culverted crossing Focus site for stream mitigation & riparian planting.	Nil	Yes	SEV / habitat
Drain 7 Upper	Minor drain realignment & culverted crossing.	Nil	Yes	-
Whareroa Drain	Drain realignment & works on existing culverts at SH1 and NIMT crossings.	Nil	-	-
Whareroa Stream Tributary (Waterfall Road)	No works due to revised project extent	Nil	-	-

The proposed monitoring reaches are centred on the locations described in Table 8 below. The final locations may be subject to refinement to ensure security of monitoring equipment, access issues, and safe access during rainfall events. A map identifying the locations of these sites are included inthe EMP.

Table 8 – Monitoring site descriptions and locations (North to South)

Site Code	Description	Provisional Location (NZMG)	
		Northing	Easting
Paetawa Drain			
PAD-01	Downstream Effect (above confluence with Kakariki)	1773139	5475448
Kakariki Creek			
KAC-01	NTU logger Upstream Control (Nga Manu).	1773587	5474770
KAC-02	NTU logger Downstream Effect 1 (Ngarara Road bridge)	1773181	5475330
Waikanae River			
WAR-01	NTU logger Upstream Control	1771092	5472920
WAR-02	NTY logger Within works (recovery - upper)	1770726	5472867
Wharemauku Stream			
WHA-01	NTU logger up stream control (potentially under SH1)		
WHA-02	NTU logger down stream (potentially at foot bridge by air field)		

The methodologies to be used are described in the following sections.

5.1 Kakariki and Paetawa Streams – Construction

5.1.1 Purpose

- The purpose of baseline sampling of bed sediment movement is to determine the current degree of sediment deposition and movement within the two contributing streams to the Te Harakeke wetland (the Paetawa and Kakariki streams) against which to measure any additional discharge that may occur during construction.
- It is expected that any discharge from the construction site to these streams and the wetland will be of sands and silts which will be largely indistinguishable from the current stream beds. This means that visual observations will not be effective except if there is a major event that block channels and/or overtops banks and deposit materials onto the adjacent floodplains or within the wetland.
- Sampling is proposed at three sites as follows:
  - KAC-01 – a control site upstream of works in the Kakariki Stream,
  - KAC-02 – an impact site downstream of works and upstream of the confluence with the Paetawa,
  - PAD-01 – an impact site in the Paetawa upstream of the confluence with the Kakariki.

The method for this monitoring is provided above under baseline monitoring additions and the results in terms of the sensitive taxa that will form the baseline comparison measure for triggering effects are reported in Attachment 7.

5.1.2 Macro-Invertebrates

Description

Sampling of macro-invertebrates will be carried out downstream of each suspended sediment sampling site. It will be used to determine if, at any point, deposition of sediments have an adverse effect on the robust communities currently present in these streams.

Method

Communities of freshwater macroinvertebrates will be sampled following a period of stable flow of no less than 1 week.

The sampling technique will follow the national standard protocol C2 (soft-bottomed, semi-quantitative) (Stark, Boothroyd, Harding, Maxted, & Scarsbrook, 2001). This acknowledges that some parts of the Kakariki Stream channel has some areas of gravel and sand substrate, silts and muds are the predominant stream bed material throughout the catchment.

- Species will be identified to MCI level.

- Presence of algae, periphyton and aquatic macrophytes will be recorded and their relative abundance described.
- Each site will be photographed.

Frequency

Four times during construction over two seasons.

- Summer – February and March.
- Winter – July and August.

Duration

Monitoring will cease after four sampling runs unless it is then triggered by an event.

5.2 Waikanae River

It is expected that fish and invertebrate communities and the periphyton cover upon which these communities rely will be largely lost within the 160 m reach of river that will be subject to flood plain widening, armouring and creation of bridge abutments.

No construction sampling is proposed because of the massive habitat disturbance although an continuous NTU logger and control will be established to identify and manage sediment discharge. A post construction/disturbance condition measure will be made however. That measurement will follow the "baseline" measurement protocol of physical habitat, fish, macroinvertebrate and periphyton 6 months after completion of in-stream works. A comparison of the new system will be made with the baseline to ascertain sufficient restoration of the benthic communities has occurred.

5.3 NTU Logger Monitoring of Sediment (Condition G.38A)

In three of the most valuable and sediment sensitive waterways permanent construction period sediment (NTU) loggers are proposed to be established, one downstream of the earthworks (designation) the other, as a control, up stream. These loggers are to be telemetriced such that measurements are recorded every 15minutes and sent to a central receiving computer.

Conditions require that once a day the daily results are checked to ensure that the logger is functioning and that no sediment discharges of any note have occurred.

During and prior to rain fall a rain alert of 7ml/hr will also trigger inspection of the logger data.

Initial consent conditions required the loggers to be installed and collecting data 6 months prior to earthworks. This baseline however, is not required as the trigger is tested against the control logger and no baseline is required. However, installation prior to works is

required to ensure the loggers and telemetric system is functional and to align and correlate the control and effects loggers.

The locations for installation of the loggers has been problematic due largely to the waterways being shallow and without stable pools with sheltering riparian areas for installation. In addition the Wharemakau is very exposed and loggers are likely to be prone to public interference (vandalism). Therefore while consent conditions prescribe certain location parameters in consultation with GWRC (via Dr Boothroyd) it has been agreed that practical solutions are required and the following locations are suggested as potentially feasible:

- Kakariki Stream – up 150m downstream of the works and 100m up stream of the Smithfield confluence.
- Waikanae River – up to 300m downstream and 150m up stream of the road foot print.
- Wharemauku Stream – up to 900m up stream (under SH1 crossing) and 520m downstream (under the foot bridge @ the airfield).

The locations are shown on a map in Attachment 1.

The trigger for a breach of the sediment discharge (indicating a device failure or other management system failure) is a 20% increase in the downstream logger result from the upstream control logger.

For the Wharemauku Stream NTU loggers, given the site restrictions on where they can be located, and the potential for other water quality influences over this distance, a number of grab samples will need to be taken during the establishment phase of the loggers. Those grab samples will be taken during several (we suggest three) rain events with a minimum intensity of 4mm/hour so as to measure the inputs of the various additional contributors to the water quality below (and between) the upstream and downstream logger. The grab samples for each event will be taken therefore from the end of Ihakara Road just below the input from a side tributary, and at the end of Kiwi Road. The grab samples are to allow a calibration between the upper and lower loggers. That water sediment level check is required to test the influence of these other sources and ensure the 20% threshold can be accurately utilised. This is primarily to ensure the accuracy of the upstream (control) NTU levels.

5.4 Other Monitoring of Sediment in Waterways (Condition G.38A)

In addition to the NTU permanent loggers, “grab samples” (or hand held NTU readings) are to be collected 20m downstream and up stream of any event triggered release of sediments. The collection of that data is to be as soon as practically possible to the release or alert and preferably within 2 hours. The conditions arising that require this relate to those streams not permanently NTU logged and are caused by a threshold breach in the ESCP or circumstances in Condition E.9 (i.e. a failure of an erosion or sediment control measure, or a storm event in exceedance of the design volume of the sediment devices).

5.5 Post Construction (mitigation success) monitoring

Following construction and in particular following the creation and livening of the various diversion reaches, the success of those diversions as aquatic habitat will require monitoring and potentially additional works to best cause the anticipated aquatic biodiversity gains. Table 7 shows that the function will be assessed via the SEV process which includes presence absence of macroinvertebrates and fish as well as a range of physical habitat characteristics (including the success of the riparian revegetation). In addition a PHA (physical habitat assessment following Harding et al 2009) will also be undertaken and the results compared to the original PHA scores and to a reference site of good quality. That analysis will assist in recognition of habitat structural issues (if any).

6 Sediment Triggered Monitoring

6.1 Sediment triggered events (Condition G.38A c))

During construction, condition monitoring of the benthic communities will be carried out following triggered sediment release events. In accordance with consent condition G.38A, where the NTU logger records (or "grab samples") comparison between the downstream and control (upstream) results in a 20% increase in suspended sediment (NTU) and where the NTU is > 5, a first trigger breach will have occurred.

Within 24 hours of that trigger, a complete recorded audit will be made of the erosion and sediment control measures within the earthworks areas and a source of discharge identified.

All remedies will then be undertaken and the Manager notified (by email) within 1 working day of the breach.

If the NTU threshold remains elevated (above 20% beyond 48 hours) then this will trigger a benthic macroinvertebrate sampling event. That sampling will be at or near the baseline sampling position. Attachment 1 provides a map of those areas to be sampled in the event of a sediment release trigger breach. The sampling will require the C1 or C2 protocol (Stark et al 2001) etc so as to allow comparisons of the biometrics of the baseline data (recorded above).

Condition G.38c(v) requires a report with 10 working days to the Manager. This will depend to an extent on the processing laboratory and that time frame should be considered a target rather than an absolute. That report is to identify the causes of the release (failure) and the resultant impacts. Impact triggers are as described in Condition G.38A, c (v), 3. Whereby a decline in the QMCI of more than 1.5 or a decline of greater than 20% in sensitive invertebrate taxa (taxa with an MCI score of ≥5) compared to up stream or the baseline (there is an option to test also the control sites as the comparison).

If these thresholds (suggesting impact to the benthic community) are breached then mitigation works are to be established (in consultation with the Manager).

6.2 Recognition of and actions to mitigate adverse sediment deposition effects

Secondary triggered events following a 48 hour raised sediment event and samples indicating an adverse effect require both further monitoring of the persistence of the adverse effect but also expansion of the monitoring to scope the extent of the effect.

Adaptive management in this case will entail expanding the monitoring to include visual surveys of the reaches further downstream to establish where or if there is a noticeable increase in benthic deposition of sediments. Discovery of new or obvious sediment depositions will trigger further macroinvertebrate samples in that area and a comparison of those results with the baseline data (assumed to be representative in general of the waterway).

Parallel with this process of establishing stream health and effect will be further revision of the erosion and sediment management processes and devices. A failure resulting in a trigger breach of macroinvertebrate community should cause (as part of the adaption to management) a strengthening of the sediment controls and procedures, which may include additional sediment ponds, inclusion of flocculation, additional sediment fencing, better rain alert responses etc.

Where the adverse effect on the benthic fauna is found to persist beyond 6 months (i.e. the change appears persistent and / or widely spread) some additional in-or-out of stream mitigation actions will be required. In consultation with the Manger, these could range from machine clearance or raking of the deposited sediments either to promote flushing in another rain event of removal to the dry. This should allow the previous and desired community to re-establish.

Where such remedial actions are considered inappropriate then further and additional in-stream habitat mitigation such as undertaking more riparian enhancement and increased in-stream restoration in other waterways of the area (in consultation with Regional Council, but also KCDC and potentially stream care groups) may be an option.

6.3 At diversion reconnections (Condition G.38A d))

The monitoring of sediment discharge upon reconnection of a diversion channel to the parent stream requires monitoring of the suspended sediment. The positioning of a permanent 15min recording NTU logger not more than 20m downstream of the reconnection (and an upstream control logger) is required. As with the wider earthworks, a suspended sediment threshold of a 20% difference (increase) where the NTU level of > 5 after 24 hours is the threshold for potential benthic community effects.

Within 24 hours of the reconnection the NTU logger comparison should be $<20\%$ different. Where it is not remedial actions are required up to and including disconnection of the new stream (diversion). Those remedial actions are to be recorded and reported to the Manager.

Where closure has not occurred and after remedial actions the next test is a further 24 hours in which to establish that the NTU is less than 20% raised to that of the upstream control.

After 48 hours of raised ($>20\%$ difference) NTU, where that eventuates then benthic macroinvertebrate sampling will be undertaken (as above following protocol and at or below the logger monitoring position).

The same macroinvertebrate thresholds as above apply with the same resultant management and remedial actions (including closure of the diversion while issues are addressed).

7 Fish Rescue and Relocation (Condition G.34.b) and n))

Prior to and during the permanent diversion of streams including any temporary diversion required for culvert installation, all practicable steps shall be taken to isolate the diversion reach, and find, capture and relocate native fish from the affected reach either to the new diversion where habitat permits, or upstream or downstream (whichever is most appropriate) of the reclaimed channel.

As many fish will be removed from the flowing stream prior to diversion as possible. This is necessary to reduce the risk of fish burrowing into sediments and banks and becoming unfishable as the reclaimed channel is dewatered. Capture of fish from the stream prior to any water diversion will include an active nocturnal location and capture, a passive nocturnal capture and an active daylight capture system.

As soon as the diversion reach has been completed and at least 5 working days prior to livening of the new channel, a plan for capture and relocation of fish will be finalised and provided to GWRC.

In general the plan will include the following steps:

- All capture and relocation shall be completed by a suitably qualified ecologist;
- After the diversion is approved by GWRC three days prior to livening the diversion, the reach to be reclaimed will be isolated by nets or other permeable barriers in order to prevent fish movement while maintaining stream flows;
- For two nights prior to livening the diversion, baited minnow traps and fyke nets will be placed in the reach to be reclaimed. One night prior to the diversion spot light active capture will be undertaken to locate and capture and remove fish. The numbers and locations of nets will be determined at the time according to stream depth, width and flow and included in the plan submitted to Council, All nets will be cleared in the morning.
- Each morning the reach to be reclaimed will be fished by EFM. Fish will be captured using EFM and stopper nets. A multiple pass depletion method will be used whereby passes are repeated until no catches occur (with a pause in between);
- The numbers and sizes of all fish caught, the habitat and an estimate of that habitats general area) from which they were caught, and their release locations will be recorded.
- All native fish captured the day prior to diversion will be transferred upstream to appropriate habitat. On the day of diversion fish will be temporarily placed in holding tanks (which allow for natural water flow through) that will be put in shaded locations within the stream. No fish will be held for more than 12 hours;
- On the day of diversion, and following fish removal, the upper end of the reclaimed stream will be stopped and flows directed into the new diversion channel. At this time a digger will establish several “holes” in the bed to be drained so as to make deeper water refugia as the reach dries.

- Soon after the flows have been diverted and stabilised in the diversion channel, and as the dewatering reach is dewatered the reach will be again searched for fish, especially the dug refugia holes.
- Fish collected from the stream to be "closed" shall be recorded and counted from measured areas of habitat and by habitat type to give an existing density of fish species by habitat type. This estimate will inform the habitat carrying capacity of the new diversion habitat which will be set to half that of the "established" and fished out habitat density.
- A number of the fish collected on the day of diversion (i.e. post diversion or just prior to diversion) shall be relocated to the new diversion channel commensurate with an estimate of half the habitat carrying capacity of the habitat from which they were just fished out from. The additional fish will be relocated to suitable habitat upstream of the diversion (from where they may in time re-colonise the diversion);
- Any pest fish found shall be removed from the catchment and humanely euthanised.
- An advisory note will be prepared and forwarded to The Manager, Environmental Regulation, Wellington Regional Council, within five days of completion of the relocation of fish.

8 Fish Passage Monitoring (Conditions G34.j), G38e), WS3A and WS3B)

Condition WS 3Aa) requires that the consent holder design, construct and maintain all culverts and bridges, including temporary crossings, in or over permanently and intermittently flowing water bodies to ensure on-going fish passage through these structures in accordance with GWRC publication "Fish Friendly Culverts and Rock Ramps in Small Streams" or equivalent industry best practice methods.

For the purposes of the condition, ephemeral water bodies do not require fish passage.

In the first instance the culvert design and installation method needs to be checked by an appropriately qualified aquatic ecologist with culvert experience. The success of that design and installation then needs to be verified and that is addressed in condition WS3B,b.

8.1 Visual inspections of culvert installations

Resource consent condition WS3B,b) states the following:

> *The Consent Holder shall engage a suitably qualified and experienced aquatic ecologist to inspect and confirm in writing that each new permanent structure/area of works/scour protection works which must provide for fish passage in accordance with conditions of this consent has been constructed and installed in a manner that will provide for the passage of fish species present or likely to be present in that water body. The written confirmation shall be supplied to the Manager within 20 working days of the completion of the relevant area of works in the water body.*

One year after the installation of any culvert a suitably experienced aquatic ecologist shall visually inspect the culverts to examine the relationship of the out and in lets with the "natural" bed, and the velocity and depth of the water within the culvert as compared to that above and below the culvert. It is anticipated that this inspection will ensure appropriate non-barrier installation of all culverts and new stream section openings.

This inspection will be repeated 4 years after installation.

Specifically inspections will include:

- That the substrate bed of the water body is being retained within the culverts, or appropriate baffle or rock fixtures are in place;
- Whether there are any signs of erosion or scour of the stream bed or banks around the structures/works/depositions;
- The condition of the structures/works.
- That stream flow velocities are not increased in any areas within the structures/works or upstream/downstream of the structures/works that could compromise fish passage (e.g. baffles and rock protection are adequate and in good condition); and

- Whether there is debris that could block the passage of fish or increase velocities.

If it is found that fish passage may be restricted, inspections and appropriate remedial actions shall be occur and be repeated (for the specific structure/area of works/scour protection where the restriction occurs) annually until the Manager is satisfied that fish passage is being appropriately provided for. The actions could include the following:

- Addition of an erosion resistant fish climbable apron where the outlet has been undermined,
- addition of cobble and or gravels to fill any erosion holes at the outlet,
- Insertion of baffles, rings or other velocity remedial features within a culvert,
- addition of gravels to the culvert as a bed,
- reworking the installation of the culver mouths to remove erosion gaps (potentially major works involving introduction of new concreted areas),
- cutting of longitudinal groves within the culver base, or cutting off edges of the mouth or any other structure causing water turbulence or to direct low flows.

8.2 Muaupoko Stream diversion

For the Muaupoko Stream, a visual inspection (as detailed above) and a fish survey shall be undertaken (in accordance with the timeframes listed above.

The visual inspection will look to establish the connection between the new diversion mouth and existing Waikanae River edge and that the confluence is natural and the flow unhindered and substrates appropriate

A fish survey shall be carried out but here the method deviates from the conditions (which are a confusion of diversion and culvert installation needs). The survey will seek to ascertain if an appropriate array of differently aged native fish remain or are present within the Muaupoko Stream above the diversion reach (i.e. illustrating passage).

There will be no “appropriate area immediately downstream” as denoted by Condition WS3B,d)ii).

The survey should involve:

- A suitable sample reach 0f 150m be selected. Sampling begins at the downstream end of the reach and proceeds upstream;
- Sampling at each study reach will consist of the David et al 2010 method using a 1 pass continuous survey;
- Fish will be captured by scoop net and downstream stop net and transferred to buckets. They will then be counted, identified, their length measured, and then returned to their habitats, once EFM fishing of that reach is complete.

Successful fish passage will be confirmed by:

- The presence of whitebait, elver, and inanga upstream of stream works, in locations where they have previously been recorded.
- The size class distribution (especially the presence of white bait or that years young fish) of banded kokopu, eel, and bully within the diversion reaches and upstream.

If no juvenile whitebait, elver or inanga are recorded upstream of works for two consecutive seasons it will be determined that there is a likely failure of fish passage and remedial work will be required.

8.3 Reporting

The Consent Holder shall submit a report from a suitably qualified ecologist to the Manager within 3 months of undertaking the inspections required above. The report shall include the following information:

i) The results of the fish survey undertaken for the Muaupoko Stream, the methods used to survey fish species, the location of the surveys and the dates that they were undertaken;

ii) The results of the visual inspections undertaken of culverts;

iii) An assessment of effects on fish passage using the results of the visual inspections; and

iv) Measures/works that will be implemented to address any actual or potential effects on fish passage as a result of the inspections, when these measures/works will be implemented by and further monitoring proposed (if any).

v) The Consent Holder shall implement the measures/works required to address any actual or potential effects on fish passage within 3 months of submitting the report to the Manager (where practicable).

9 Aquatic Mitigation Measures

9.1 Stream Diversions

Condition G42 (ii&iv) recognise the requirement for at least 5,240 linear metres of stream mitigation, including naturalisation of channels and 17.7 ha of enrichment of riparian habitat and removal of any barriers to fish passage within these areas. Riparian planting is to have a minimum width of 20m on each side of each water body, unless otherwise agreed by the Manager (for example, where the margin of a water body is close to a road or another property).

Within flood storage areas 2A and 3, the formation of at least 1.4km of new permanently flowing streams.

Each and all waterway diversion channels built to improve or replace stream reaches form part of the total stream mitigation/offset package and are required to provide better aquatic habitat than that lost.

The total linear length of proposed diversion stream enhancement is 5,277m (Table 9). Therefore the total length is approximately 31m more than that required by the ECR projected requirement. The proposed riparian mitigation will be 10-20m wide (both sides)[2] and will result in roughly 17 ha of riparian planting.

Table 9 - Linear lengths of diversion and existing waterway enhancement for mitigation

FEATURE	Map codes (Annexure C)	TYPE	Diversion Length (m)	Waterway Enhancement length (m)
Upper Drain 7	1W	water way		327
Lower Drain 7	2D	diversion		452
Mazengarb WWTP Drain	3D & 3W	diversion	293	148
Muaupoko Stream	4D & 4W	diversion	31	44
Kakariki Stream	5W	waterway		1010
Smithfield Drain	5D	diversion	1373	
Paetawa Stream	6D & 6W	waterway	54	171
Hadfield / Kowhai Stream	7D & 7D	waterway	1220	154
Sub Totals			2,971	2,306
Total				5,277

The ecological diversions are a critical component of the freshwater ecological mitigation. It is important that the diversions are not considered as flood management drains but as

2 This width is required to offer sufficient benefits to the aquatic system. See Parkyn, S., W. Shaw & P. Eades (2000).

the reinstatement (and enhancement) of a stream system to replace an existing waterway lost as a result of the Project. The key to ensuring the success of the mitigation will be:

- the maintenance of sufficient water in the channel;
- the development of the riparian vegetation;
- an absence of drain maintenance activities (i.e. the clearing of macrophyte and sediments by digger along the stream bed).

At or about each stream that will be lost is an SEV set of measures describing in-stream function, physical habitat and biological richness. The diversion channels are required to meet or exceed these SEV parameters and the baseline SEV scores provide the measure of success.

Guidance as to the construction of each diversion channel is required and SEMP's for each area will detail the exact design in terms of meander, quantum of riffle, pool and run, substrate distribution, bank treatment, cover items riparian planting etc. A guide as to the aspects each SEMP specific design should follow is proved in this EMP and is presented in Attachment 8.

The aquatic mitigation is also coupled, in many areas, the wetland mitigation and the landscape treatment. The mitigation (6 sites in regard to the aquatic mitigation) are required to be consistent with the LMP and it is the LMP that will articulate and govern the details of the planting and soil treatments. To that end the following riparian guidance has been developed as a general and indicative approach to revegetating the new stream lengths and from which the LMP will take its lead in terms of the specific riparian treatment of new diversion lengths and lengths of stream identified as mitigation enhancement areas.

Wetland riparian (such as at the Smithfield, Otaihanga wetlands and south of the Wharemauku Stream (Kiwi Pond) sites).

Extent. On both sides of the new channel and from the average wetted width back 20m (as measured perpendicular to the channel) for riparian planting.

This planting assumes that the created banks, being within a wider wetland setting will not be large and steep faces but consist of gentle and undulated short sloped banks (or a small bund) and then generally flat and depressed grounds beyond the immediate bank/bund edge. Table 10 provides the expected and typical riparian/wetland species of the area and recommended for use.

Table 10 – Indicative plant species to be used.

Sedges	Where	Typical spacing (m)	Size	Typical mixture (%)
Baumea rubiginosa	Wet edge and depressions	0.3		5
Carex geminata	Dryer areas	0.3		10
Carex secta	Waters edge, 4m band nearest waterway	0.5		20
Carex virgata	Dryer grounds	0.3		10
Cyperus ustulatus	Waters edge	0.5		5
Rushes and allied plants				
Juncus edgariae	Throughout damp soils	0.3		10
Juncus pallidus	Throughout	0.5		5
Juncus planifolius	Throughout	0.3		5
Juncus sarophorus	Throughout	0.3		5
Shrub & flax				
Phormium tenax	Bank/bund top	2	Pb 2	15
Cordyline australis	Any where	1	Pb 2	5
Coprosma propinqua subsp. propinqua	Bank / bund slope and drier areas	2	Pb 2	5

Enrichment (final canopy trees)

At or about year three as general maintenance finishes enrichment planting of final canopy type trees for these wetlands should be added in small numbers throughout. The taxa suggested in Table 11 would be appropriate.

Table 11 – Enrichment species

Names	Spacing	Size	
Syzygium maire (swamp maire)	Small groups of 3 at 2m spacing	PB 5	
Dacrycarpus dacrydioides (kahikatea)	Scattered in clusters of 10, at 1m spacing	PB 5	

Shrubland riparian (such as at the Drain 7, Kakariki and Hadfield sites)

Extent. On both sides of the new channel back 20m (as measured perpendicular to the channel) from the dry edge (either bottom of the bank slope or, if vertical bank, 1m back from the bank edge).

These riparian areas will usually be on drier slopes and bank tops and not be generally wet soils. They may be entirely on slopes or flat grounds back from an existing bank (such as along the Kakariki stream.

Generally native shrubland and low canopy tree species are indicated below (Table 12) with an enrichment planting of potential final canopy species in year three of the maintenance (table 13).

Table 12 – Dry bank riparian vegetation appropriate to the area and situation.

Name	Common name	Typical spacing (m)	Size	Mixture
Coprosma robusta *	karamu	1	PB 2	20
Geniostoma ligustrifolium *	hangehange	1	PB 2	5
Hoheria sexstylosa	houhere, lacebark	2	PB 2	10
Kunzea ericoides agg.	kanuka	1	Root trainer	10
Leptospermum scoparium	manuka	1	Root trainer	10
Melicytus ramiflorus	mahoe	2	PB 2	10
Myrsine australis	mapou	2	PB 2	5
Pennantia corymbosa	kaikamako	2	PB 2	10
Pittosporum eugenioides	tarata, lemonwood	2	PB 2	5
Pseudopanax arboreus	five finger	2	PB 2	10
Pseudopanax crassifolius	lancewood	1	PB 2	5

* generally relegated to under canopy after 5 years.

Enrichment species (final canopy trees)

The enrichment species contain those still found in the wider landscape and form a valuable avian resource.

Table 13 – Enrichment species

Name	Common name	Spacing (m)	Size
Alectryon excelsus subsp. excelsus	titoki	5	Pb 5
Beilschmiedia tawa	tawa	3	Pb 5
Dysoxylum spectabile	kohekohe	5	Pb 5

Performance standards for these riparian areas that are part of the stream mitigation should follow those stipulated in the Designation conditions: DC.53C c) ii) as governs also the landscape planting performance standards.

These are that the plantings shall reach 80% canopy closure. In terms of the mitigation success the riparian criteria also need to for fill their SEV functional roles also – so as to affect the SEV scoring compliance requirement.

The Riparian function of the SEV recognises the strong inter-dependence between streams and riparian vegetation. The many roles (e.g. keeping summer water temperatures low in WTC, filtering overland run-off in DOP, providing an input of organic matter in OMI) of riparian vegetation in maintaining stream ecosystem function is recognised in a number of SEV functional measures separate from the specific riparian ones and these will be reflected in the SEV measure of mitigation success. But in terms of the riparian element specifically the riparian planting will also need to cause the following functions of the SEV system under biodiversity:

The following (Table 14) is an example of the riparian portion of the SEV (Riparian vegetation intact) for the Kakariki Stream (as measured) covering riparian condition (Vripcon), riparian connectivity (Vripconn) and Organic matter input from leaf fall, measured by assessing the total amount of overhead cover provided by the canopy of vegetation within the riparian zone (i.e. Vripar).

These parameters must also be measured and meet at least the existing value where riparian vegetation exist, or where it does not, then meet at least 50% of the target (reference) value.

Table 14 – Kakariki riparian SEV score (example)

			SEV paramter	Reference value (target)	Current value
			Vripcond	0.60	0.30
			Vripconn	1.00	1.00
			Vripar	0.80	0.10
Biodiversity	5.16	RVI	=	0.80	0.47

9.2 Threshold Targets for Diversion Channel Habitat (Condition G.34.O)

Successful establishment of the aquatic habitat within the diversion reaches is a combination of successful riparian vegetation establishment and correct substrate, depth, flow, macrophyte and in-stream cover development. Post development of each diversion reach a SEV measurement is the required to measure functional and biological condition. These measurements are to be undertaken at year 3 (one year before the end of plant maintenance) and 5 year time frame. Once the SEV (and other metrics) meet the standard for success (baseline measures) then no further mitigation success measurement in regard to the waterway diversions will be required.

The Diversion SEV thresholds against which to test the development of the reaches are provided in Attachment 9 and are the measures for comparison with the built and developed diversion channel habitat.

9.3 Response Measures to Failure of Mitigation Success

An initial assessment using visual and measured parameters (including SEV (fish and macroinvertebrates)) will establish by year three in the diversion / new channels the initial success and stabilisation of the riparian communities and the in stream communities. Throughout the first three years, the period of maintenance, riparian plantings will be managed, monitored and replaced where failures occur. The completion of this management cannot cease until 80% canopy cover is achieved (i.e. 80% of ground cover).

At year three a series of SEV's are to be required and from these measures that include macroinvertebrates and fish, a comparison of the functions and biota will confirm success or alert to issues. The measures will allow recognition of which functions are failing and direct efforts to correct those issues. In the main it is likely to be in-stream organic

matter, algae and macrophyte extent that are the likely retarding issues. Woody debris and other appropriate organic matter and cover items can be added were these are of issue and may assist. Macrophyte beds, where they are too extensive (i.e. constrain flows (>50% flowing channel) and form >70% bed cover) can also be managed (on an annual basis) until the riparian cover (shade) has a mitigating effect.

Where fish or macroinvertebrate communities are failing to establish in diversion reaches it may be a case of access. In either cases re-introductions can be undertaken which may stimulate "returns". The macroinvertebrates can be introduced via samples of substrate being taken from other areas downstream (or up) and distributed into the new channel areas (carting with it periphyton and eggs of a variety of species). Fish (upward swimming migratory species) can be captured at the mouths, or below the diversion confluence (were it is a tributary) and transported to the new channels and released. Such releases (assuming there is no passage barrier) may stimulate the formation of a local population.

10 Reporting

There are a range of reporting requirements for the baseline monitoring for the ongoing construction monitoring and for the completion of mitigation actions and for the monitoring of success of those actions. The conditions also stipulate a range of reporting requirements for triggered events and the ensuing actions to remedy any adverse effects.

In general and as a rule NZTA, through their monitoring and environmental teams have obligations to inform and keep informed the Manger (GWRC).

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11 Appendices

Appendix 1 Consent Condition

G.11	The Consent Holder shall ensure that personnel responsible for supervising earthwork site staff (i.e. foremen, supervisors and managers) shall undergo environmental awareness training, required by the CEMP. This training shall occur prior to the commencement of Work in any Stage and shall be given by a suitably qualified and experienced person certified by the Manager to deliver practical on-site training. Specifically, training may include (as relevant) but not be limited to: b) Details of any stream diversions or other in-stream work and works in wetlands, briefing on the values of the streams and wetlands, the objectives for stream and culvert design and construction erosion and sediment control measures, the requirements of native fish for fish passage, and the sensitivity of the receiving environment to sediment discharges;
G.27	The Consent Holder shall submit a draft Erosion and Sediment Control Management Plan (ESCP) to the Manager at least 30 working days prior to Work commencing. The final ESCP will be submitted to the Manager for certification at least 15 working days prior to commencement of Work. The ESCP shall be submitted with the CEMP as an appendix. The purpose of the ESCP is to describe the methods and practices to be implemented to ensure the effects of sediment generation and yield on the aquatic receiving environments associated with the Project will be appropriately managed. In addition, the ESCP shall: ii) Identify areas susceptible to erosion and sediment deposition and implement erosion and sediment control measures appropriate to each situation with particular EMPhasis on high-risk areas, including El Rancho Wetland (Weggery), Raumati Manuka Wetland (between Poplar Avenue and Raumati Road), Southern Otaihanga Wetland, the Northern Otaihanga Wetland (adjacent to Otaihanga Landfill) Waikanae River, Wharemauku Stream and the Kakariki Stream;
G.34	The Consent Holder shall submit a draft Ecological Management Plan (EMP) to the Manager at least 30 working days prior to Work commencing. The final EMP will be submitted for certification, and a copy provided to KCDC, at least 15 working days prior to Work commencing. The EMP shall be submitted with the CEMP as an appendix. The EMP shall include, but need not be limited to, information required in other conditions of this consent and details of the following: b) Information on how the following outcomes will be achieved: iv) Minimise effects on fish and fish habitats during stream work;
G.38A	The Consent Holder shall undertake monitoring of water quality in permanently and intermittently flowing water bodies upstream and downstream of potential earthwork discharge areas in accordance with the methods, locations, frequency, reporting and all operation and maintenance procedures as outlined in the EMP. This monitoring shall include the following: a) Continuous (telemetered) turbidity loggers shall be installed, operated and maintained in the Waikanae River, Wharemauku Stream and Kakariki Stream upstream and downstream of the proposed discharge points to these water bodies. In addition (to the Waikanae River, Wharemauku Stream and Kakariki Stream), continuous telemetered turbidity loggers shall be installed upstream and downstream of all water body diversions 48 hours prior to works to divert the waterway and for 1 week following completion of the diversion. The proposed locations of the monitoring shall be identified in the EMP this distance shall not exceed 20m downstream of the discharge point or diversion works. The locations of these sites shall be chosen to avoid other potential sources of sediment interfering with the results of monitoring. The Consent Holder shall install, operate and maintain continuous (telemetered) turbidity monitoring in the water bodies referenced in a) above to: i) In the case of the Waikanae River, Wharemauku Stream and Kakariki Stream, monitor turbidity levels at upstream and downstream monitoring locations above and below the area of Work on a continuous basis for a duration of at least 6 months prior to the Commencement of that Work upstream to establish a correlation between turbidity levels;

ii) In the case of discharges from Works areas in the Waikanae River, Wharemauku Stream and Kakariki Stream, monitor discharges on a continuous basis until the relevant earthworks areas discharging to those water bodies are stabilised; and

iii) In the case of stream diversions, monitor until turbidity thresholds specified below have not been exceeded for at least 1 week.

The logs shall be monitored by the Consent Holder on a daily basis (including weekends and holidays). The continuous (telemetered) turbidity loggers shall have a rainfall induced alert (alerting a cell phone number) of 7mm/hr so as to ensure the logs are checked where rain events occur. The 7mm/hr alert may be revised as more specific information becomes available in consultation with the Manager.

b) Triggered event monitoring (grab samples):

i) In addition to the continuous telemetered turbidity monitoring, where there is an exceedance of any site monitoring thresholds detailed in the ESCP or EMP, or where any of the circumstances detailed under condition E.9 occur, and there is a discharge to any water body, the Consent Holder shall measure turbidity (NTU) levels at sites located no greater than 20m upstream and downstream of the relevant discharge point/s. The upstream and downstream locations shall be chosen to avoid other potential sources of sediment interfering with the results of monitoring.

ii) This sampling will be carried out within 2 hours of the exceedance or event (as far as practicable);

c) Thresholds and response actions – earthworks

Except in the case of water body diversions, in the event that there is a 20% or greater increase in NTU between the downstream and corresponding upstream monitoring locations (only in those situations where NTU is above 5 NTU at the downstream monitoring location) for either continuous turbidity monitoring or triggered event monitoring (grab samples), the Consent Holder shall undertake the following:

i) Within 24hrs of the 20% threshold breach, carry out and record in writing a full audit of the condition of all erosion and sediment control measures within the earthworks area discharging to the relevant stream,

ii) Remedy any causes on site that may have contributed to the 20% threshold breach as soon as practicable, and record what remedial measures were undertaken,

iii) Notify the Manager by email within 1 working day of the 20% threshold breach, including providing details of the percentage change in turbidity and any remedial measures taken,

iv) If the NTU threshold remains generally elevated above 20% for more than 48hrs, then macro-invertebrate sampling shall be undertaken following Protocols C1 or C2, as set out in Protocols for Sampling Macro-invertebrates in Wadeable Streams, MfE 2001(for hard and soft-bottomed streams, respectively) within 2 working days at upstream and downstream sites agreed to by the Manager. For known discharge points, these shall be specified in the EMP. All laboratory analysis of these samples shall be full macroinvertebrate count.

v) Within 10 working days of the collection of the macro-invertebrate samples, a report shall be provided to the Manager which has been prepared by a suitably qualified and experienced aquatic ecologist and which includes the following:

1. The results of the macro-invertebrate sampling,
2. The causes of the discharge, the response to remedy the cause and measures proposed to avoid a recurrence of this cause,
3. An assessment undertaken by a suitably qualified and experienced aquatic ecologist which details whether the following thresholds have been exceeded:
    i. A decline in the Quantitative Macro-invertebrate Community Index (QMCI) score of 1.5 or greater from the corresponding upstream monitoring site or baseline monitoring scores; or
    ii. A decline of greater than 20% in sensitive invertebrate taxa (in this case taxa with an MCI score of ≥ 5) compared to the upstream monitoring site or baseline monitoring scores.

vi) If the thresholds in v) above have been exceeded, the Consent Holder shall carry out mitigation

	works, which may include raking or other sediment clearance procedure. As part of the report required under v), the Consent Holder shall, in consultation with the Manager, detail what mitigation measures are proposed and the timeframes for implementing these. The Consent Holder shall implement the mitigation measures approved by the Manager. These measures shall be implemented to the Manager's satisfaction and within the timeframe specified by the Manager. d) Thresholds and response actions – water body diversions In the case of water body diversions, in the event that there is a 20% or greater increase in NTU between the downstream and corresponding upstream monitoring locations (where the baseline monitoring NTU is above 5 NTU at the downstream monitoring location) for continuous turbidity monitoring, the Consent Holder shall undertake the following: i) Within 24hrs of the 20% threshold breach, carry out and record in writing a full audit of the condition of the diversion works area, including all erosion and sediment control measures within that area, ii) Remedy any causes that may have contributed to the 20% threshold breach as soon as practicable, and record what remedial measures were undertaken, iii) Notify the Manager by email within one working day of the 20% threshold breach, including providing details of the percentage change in turbidity and any remedial measures taken, iv) If the NTU threshold remains elevated above 20% for more than 48hrs, then macro-invertebrate sampling shall be undertaken following Protocols C1 or C2, as set out in Protocols for Sampling Macroinvertebrates in Wadeable Streams, MfE 2001(for hard and soft-bottomed streams, respectively) within 2 working days at upstream and downstream sites agreed to by the Manager. For Known discharge points these shall be specified in the EMP. All laboratory analysis of these samples shall be full macroinvertebrate count. v) Within 10 working days of the collection of the macro-invertebrate samples a report shall be provided to the Manager which has been prepared by a suitably qualified and experience aquatic ecologist and which includes the following: 1. The results of the macro-invertebrate sampling, 2. The causes of the discharge, the response to remedy the cause and measures proposed to avoid a recurrence of this cause, 3. An assessment undertaken by a suitably qualified and experienced aquatic ecologist which details whether the following thresholds have been exceeded: i. A decline in the Quantitative Macroinvertebrate Community Index (QMCI) score of 1.5 or greater from the corresponding upstream monitoring site or baseline monitoring scores; or ii. A decline of greater than 20% in sensitive invertebrate taxa (in this case taxa with an MCI score of ≥ 5) compared to the upstream monitoring site or baseline monitoring scores. vi) If the thresholds specified in v) above have been exceeded, the Consent Holder shall carry out remedial and mitigation works, which may include closing the diversion and remedying any sediment sources. As part of the report required under d), the Consent Holder shall, in consultation with the Manager, detail what remedial and mitigation measures are proposed and the timeframes for implementing these. The Consent Holder shall implement the mitigation measures approved by the Manager. These measures shall be implemented to the Manager's satisfaction and within the timeframe specified by the Manager. e) Sediment monitoring of the Waikanae River in relation to the potential deposition of sediments associated with the opening of the diversion at the confluence of the Muaupoko Stream with the Waikanae River.
G.42	a) The Consent Holder shall undertake a combined total of at least 40.7 ha of vegetation, wetlands, and streams planting and restoration for the purposes of landscape and ecological mitigation. b) In order to achieve the total mitigation outlined in a) above the Consent Holder shall undertake ecological mitigation in accordance with the Plan Set "Proposed Ecological Mitigation Sites" (dated 29 November 2012) unless otherwise approved by the Manager which shall comprise the

	following; iii) At least 5,240 linear metres of stream mitigation, including naturalisation of channels and 17.7 ha of enrichment of riparian habitat and removal of any barriers to fish passage within these areas, with riparian planting to have a minimum width of 20m on each side of each water body, unless otherwise agreed by the Manager (for example, where the margin of a water body is close to a road or another property); plus iv) Within flood storage areas 2A and 3, the formation of at least 1.4km of new permanently flowing streams and 10ha of wetland and riparian planting..
WS.1	The Consent Holder shall use natural rock and soil material to reclaim the stream bed. All fill material shall be placed and compacted so as to minimise any erosion and/or instability insofar as it is practicable.
WS.2	The Consent Holder shall ensure that all construction Work authorised by this consent is undertaken and completed in the dry bed of the stream as far as practicable.
WS.3	The Consent Holder shall design and construct all permanent diversions in a manner that maintains as far as practicable stream flows (both volume and velocity) in a similar state to its natural state at the time of commencement of Work.
WS.5	The Consent Holder shall undertake flow monitoring in the Wharemauku Stream and Drain 5 in order to determine whether there are any changes in flow levels following the construction of the flood storage areas 2, 3A and wetland 3. The flow monitoring shall record in-stream flows at 15 minute intervals (unless a different interval is otherwise approved by the Manager) for a period of: a) 12 months prior to commencement of excavation of flood offset storage areas 2, 3A and wetland 3; b) During construction of flood offset storage areas 2, 3A and wetland 3; and c) Up to 12 months following completion of flood offset storage areas 2, 3A and wetland 3, or a shorter period if no effects on base flows are recorded and it is agreed by the Manager. Flow monitoring stations shall be established at the approximate locations on the Wharemauku Stream and Drain 5 identified in Appendix A of the draft Groundwater Management Plan (CEMP, Appendix I) provided with the application. The exact location of the gauges shall be determined based on stream bed conditions such that they record the full range of flows as far as practicable. The Consent Holder shall present the results of the flow monitoring as part of the groundwater monitoring reports required in condition GD.3. Details of the flow monitoring locations and methods, reporting procedures, and response procedures shall be included in the Groundwater Management Plan as set out in condition G.29.
WS.8	The Consent Holder shall prepare and implement a revegetation and mitigation strategy for the stream modifications and structures authorised by this consent. The strategy shall be submitted to the Manager as part of the LMP (as required by DC.53C – DC.57A) 15 working days prior to commencement of Work and shall include, but not be limited to: a) Details of riparian planting required under conditions DC.53C – DC.57A, including but not limited to: i) the target Stream Ecological Valuation (SEV) scores for all areas of mitigation riparian planting; ii) plans of the locations and lengths of riparian planting along water bodies, including along existing and new stream channels, all exposed areas of stream bank, dewatering channel and culvert fill slopes; and iii) full landscaping details for each of these areas, including planting plans, timing of planting, plant spacing, species schedules, planting preparation procedures, monitoring and methods of legal and physical protection details; b) Monitoring and maintenance processes and procedures for all areas of riparian planting, including for replacement of dead or diseased plants, for a minimum period of 2 years for terrestrial vegetation and 4 years for wetland and riparian vegetation from completion of construction.
WS.9	Temporary stream crossings shall be constructed across the Waimeha Stream and the Wharemauku

	Stream in accordance with the Scheme Plans identified in condition G.1. Unless otherwise agreed in writing by the Manager, all temporary stream crossings shall be removed within two years of their installation.
WS.10	Unless otherwise agreed in writing with the Manager, upon removal of any temporary crossing, the Consent Holder shall reinstate the stream bed to, as far as practicable, a natural state to closely match the upstream and downstream riparian and instream habitats and visual appearance.
WS.11	The structures installed as part of the Work shall be regularly inspected and maintained by the Consent Holder so that: a) The water body within or over the culverts remains substantively clear of debris; b) Any erosion of the stream banks or bed that is attributable to the stream work authorised by this consent is remedied as soon as practicable by the Consent Holder; and c) Fish passage through and past culverts and other structures is not impeded.
GT.5	Within 3 months of the completion of each pumping test, the Consent Holder shall submit a report to the Manager, which contains but need not be limited to, the following information: a) Details of the testing carried out; d) An assessment of the potential effect on nearby streams / wetlands; f) The mitigation measures to address any adverse effects identified in the analysis in items b), c) and d). This report must be approved by the Manager before the bore can be utilised for construction water supply purposes.
GD.8A	a) The Consent Holder shall undertake surface water and shallow groundwater monitoring in the vicinity of the Otaihanga Landfill as follows: i) Surface water monitoring at one location upstream and three locations downstream of the Expressway alignment to check that construction Work does not materially alter overall surface water quality draining from the site; and b) Monitoring shall commence at each of these monitoring locations at least 12 months (where practicable) in advance of construction Work commencing that has the potential to affect surface water and groundwater quality in this area in order to provide a baseline (additional to that of the routine monitoring undertaken on behalf of KCDC) to determine any post-construction effects. Monitoring at each of these locations shall continue for the duration of Works and shall continue for a period of 2 years following completion of construction Works, unless additional monitoring is required to measure the effectiveness of treatment measures as required later in this condition. c) Samples of both shallow groundwater and surface water shall be collected in each of these monitoring locations every 6 months pre, during and post construction (surface water sampling at one monthly intervals) and these shall be analysed for a representative range of cations, anions, nutrients and (dissolved) metals. The results of the monitoring shall be provided in reports to be submitted to the Manager within 30 working days. d) The details of the proposed baseline monitoring shall be provided in the CSGMP as required by conditions G.31-G.33. Details of the pre and post construction monitoring shall also be included in the GMP. e) If monitoring indicates any significant departure from the baseline, which is not consistent with the results and trends of the baseline or historical monitoring and which can be attributed to Expressway construction, the Consent Holder shall undertake one of the following actions, depending on the significance of the departure: i) If the concentration of the test parameters as set out in the GMP is confirmed (through repeat sampling) to be at least 3 times the maximum value recorded in the last 3 years for the Consent Holder monitoring or the routine KCDC monitoring, the Consent Holder shall increase the frequency of testing to once every 2 months. ii) If the concentration of the test parameters as set out in the GMP is confirmed (through repeat sampling) to be at least 10 times the maximum value recorded in the last 3 years for the Consent Holder monitoring, or the routine KCDC monitoring, the Consent Holder shall provide a report to the Manager and KCDC, within 30 working days, which will include (but not be limited to):

	1. Analysis of the results of the monitoring; 2. Recommendations regarding the need for additional treatment to surface runoff or shallow groundwater through-flow before exiting the landfill site boundary; 3. Treatment options including a preferred treatment option, and timeframes for implementing this; and 4. Further monitoring proposed of this treatment measure and subsequent actions based on the results of this further monitoring. f) The Consent Holder shall implement any treatment measures or other remedial or mitigation measures agreed with the Manager within a timeframe also agreed with the Manager. The Consent Holder shall undertake further monitoring of the effectiveness of the treatment option as agreed with the Manager and implement any subsequent actions agreed with the Manager.

Appendix 2 Summary Sheets Describing Sampling sites and waterways.

Appendix 2. Summary Sheets Describing Sampling sites and waterways.

Hadfield Drain/Kowhai Stream

10.1.1 Origins

Assume was a natural stream but historically channelized and modified. Cuts through large areas of peats and consolidated sands.

Little or no maintenance apparent.

Summary of Values

At location of alignment, low value.

Bed of gravel and sand with sediments. Stream surrounded by dairy and pine shelterbelts.

Physical Habitat = L. SEV = 0.4 (50% of reference site).

Riparian vegetation = pasture, weedland, mature pine

An MCI of 77 (fair) and QMCI of 4.7 (fair).

Two species of fish. IBI score of 18 (poor).

Catchment	Fish species
BML 2010 / 2011 (project footprint only)	short fin eel (1), banded kokopu (21)

FFDB 1990 to present (full stream)	No data for this water body

General Description

- At the alignment the waterway lies under a shelterbelt pine canopy, stock fenced, with an understory of rank grass, ferns and areas of blackberry.

At the time of sampling the existing culvert entrance beneath SH1 was inundated with monkey musk limiting flow.

The stream has sharply channelised banks (stable) typical of a managed farm drain, with a pebbled sandy substrate in some locations and sediment deposits in others. Stream depth varies from 0.3 to 0.4 m, with an average channel width of 1.5 m.

The habitat is very simple with relatively uniform run (20%), pool (80%) with low velocity flow. Eventual removal of plantation pines is likely to have a significant effect on this waterway which would obscure any construction effects.

Scale of works

Channel realignment and replacement of existing culverts at SH1 / NIMT.

Reclamation and diversion to a new channel in some areas. Small areas of planting but not a primary site for mitigation.

Works Monitoring

Ecologically we do not believe monitoring is justified during construction.

Fish recovery will be needed at any diversion.

Mitigation Monitoring

No mitigation works proposed.

Paetawa Drain

Origins

A main drain of a network of drains cut through large areas of peat.

This and associated drains regularly cleared by landowner to maintain stream flows.

Values

At location of alignment, low value.

Physical Habitat = L. SEV = 0.49 (63% of reference site).

Bed of deep muds and sediments. Stream surrounded by dairy, both sides.

Riparian vegetation = weedland and pasture.

An MCI of 88 (fair) and QMCI of 4.4 (fair).

Three species of fish and IBI score of 30 (fair).

Catchment	Fish species
BML 2010 / 2011 (project footprint only)	Banded kokopu (7), long fin eel (8), smelt (8)
FFDB 1990 to present (full stream)	No data for this water body

The Paetawa Drain is a channelised waterway, sourced from within a predominantly plantation pine catchment east of SH1. At the sampling site the drain waterbody runs through pasture, partially stock fenced but stock access is apparent.

Stream bank vegetation is made up of pastoral weeds (almost entirely covering the waterway over the summer months) with occasional Carex geminata. Much of the stream banks are under cut, heavily grazed and pugged. The substrate is deep mud (up to 50 cm) over sand. The water is made up of pools with occasional runs.

Downstream of the sampling site this drain waterbody combines with a number of other lowland farm drains before entering Ngarara Stream and to eventuate as part of the Te Harakeke / Kawakahia Wetland system. The Paetawa Drain is regularly cleared to maintain stream flows.

General Description

Scale of works

Some significant lengths of diversion to new channels.

Bridge crossing over main channel.

Focus area for stream and wetland mitigation (upstream).

Works Monitoring

Proposed to monitor bugs immediately prior to confluence with Kakariki Stream.

Fish rescue will be needed at all diversions.

Mitigation Monitoring

Monitoring of diversion success at 4 and 10 years following successful establishment of riparian planting and stabilisation of stream bed and banks.

Smithfield Drain

Origins

Formed drain through large areas of peat.

Evidence of some historical maintenance and recent KCDC maintenance north of Smithfield Road.

Values

At location of alignment, low value.

Bed of silts and peats. Stream surrounded by dairy.

Physical Habitat = L. SEV = 0.38 (49% of reference site).

Riparian vegetation pasture, weedland.

An MCI of 70 (poor) and QMCI of 2.7 (poor).

2 species of fish and IBI score of 16 (very poor).

Catchment	Fish species
BML 2010 / 2011 (project footprint only)	Shortfin eel (1), longfin eel (2)
FFDB 1990 to present (full stream)	No data for this water body

Highly modified drain cut through peatlands which would originally have been extensive wetlands. The drain is choked with aquatic weeds, and surrounded by wet pasture with Juncus.

Deep muds predominate and there is unrestricted cattle access.

General Description

Scale of works

Some significant lengths of diversion to new channels (almost entire length).

Large flood storage area through which a new stream will pass will be the focus for stream and wetland mitigation in this area.

Works Monitoring

Main drain is either diverted into new channels or untouched. Ecologically we do not believe monitoring is justified during construction.

Fish rescue will be needed at all diversions.

Mitigation Monitoring

Monitoring of diversion success at 4 and 10 years following successful establishment of riparian planting and stabilisation of stream bed and banks.

Kakariki Stream

Origins

Natural stream but channelised along an access road.

Subject of extensive historical riparian planting by councils and community groups.

Values

At location of alignment, low value.

Bed of silts and peats. Stream surrounded by dairy.

Physical Habitat = L. SEV = 0.454 (58% of reference site).

Riparian vegetation Pasture, weedland / exotic scrub (gorse).

An MCI of 77 (Fair) and QMCI of 4.5 (Fair).

4 species of fish and IBI score of 37 (good).

Catchment	Fish species
BML 2010 / 2011 (project footprint only)	longfin eel (2), shortfin eel (1), common bully (3),smelt (16), waitbat & elver (8).
FFDB 1990 to present (full stream)	long fin eel*, short fin eel, banded kokopu, giant kokopu, inanga , Cran's, common, giant and redfin bully.

General Description

At the sampling site, the Kakariki Stream is a channelised stream with high quality upstream components, which add to its potential ecological

values. The habitat type consists of 80% run and 20% back water combined with in-stream macrophyte (monkey musk, watercress, water pepper) which provides good fish cover. The substrate type consists of fine gravels, and sands with fine sediments (not anoxic).

Water quality monitoring show elevated turbidity, low dissolved oxygen and pH indicative of organic matter and degradation.

Connects Nga Manu to Te Harakeke wetland. Nga Manu Nature Reserve has undertaken riparian planting along both sides of the Stream at the location of the sampling site.

Scale of works

Will be crossed by two bridges and a small associated diversion.

Focus area for stream and wetland mitigation upstream.

Works Monitoring

Sampling bugs upstream and downstream of works and at Te Harakeke Wetland.

Mitigation Monitoring

Monitoring of riparian revegetation success at 4 and 10 years following successful establishment of riparian planting and stabilisation of stream bed and banks.

Ngarara Creek

Origin

Formed drain through peats and sand country.

Maintained by excavator, recent plantation pine clearance at sample site.

Values

At location of alignment, low value.

Bed of silts and peats. Stream surrounded by dairy.

Physical Habitat = L. SEV = 0.294 (37% of reference site).

Riparian vegetation Pasture / weedland / Macrocarpa treeland

An MCI of 75 (Poor) and QMCI of 4.3 (Fair).

2 species of fish and IBI score of 16 (very poor).

Catchment	Fish species
BML 2010 / 2011 (project footprint only)	longfin eel (1), shortfin eel (1), elver (6)
FFDB 1990 to present (full stream)	long fin eel*, short fin eel, banded kokopu giant bully, inanga

General Description

Occasional ferns and mahoe occur on stream banks, but recent clearing of the plantation pine has damaged the riparian vegetation and rendered much of the stream bank unstable. The sampling site was separated by a low gradient culvert under a farm track, which allows for fish passage.

Downstream of the culvert the drain has deeply incised banks with still backwater and pool habitat under pine forest. The pool habitat of this portion of the waterbody, combined with the excessive pine leaf litter, traps suspended solids, rendering the water dark red/brown in colour. The stream bed sediments consequently have become highly anoxic in this zone, and while the in-stream debris would normally provide good habitat for fish, the water quality is severely degraded.

The average depth is 0.1m. Max depth is 0.27 m, with average width of 1.6m, with a substrate of silt/sand.

The upstream section of Ngarara Creek is subject to regular stream maintenance to improve flows. At the time of this survey, the stream had recently been cleared

Scale of works

Will be culverted.

Works Monitoring

Ecologically we do not believe monitoring is justified.

Fish rescue will be needed at all diversions.

Mitigation Monitoring

No mitigation works proposed.

Waimeha Stream

Origins

Natural spring fed stream but moved from original alignment and channelised.

Twice annual stream maintenance by excavator to remove weeds and maintain flows (photo taken immediately post clearance).

Values

At location of alignment, low value.

Bed of muddy substrate over sand. Stream urbanised south bank, farmland and regeneration on north bank.

Physical Habitat = L. SEV = 0.34 (44% of reference site).

Riparian vegetation, grasses & weedland with some revegetation upstream.

An MCI of 78 (Poor) and QMCI of 4.7 (Fair).

2 species of fish and IBI score of 14 “very poor”. Recent disturbance may have affected score.

Catchment	Fish species
BML 2010 / 2011 (project footprint only)	shortfin eel (1), common bully (1), elver (9)
FFDB 1990 to present (full stream)	Shortfin eel, longfin* eel, giant and banded kokopu, inanga, common bully, redfin bully* and giant bully

General Description

A large (5 m wide) stream in a mix of urban back yard and rural land. Parts of the urban section of this stream has a riparian vegetation buffer and is a backyard feature for many bordering properties. Downstream riparian vegetation was made up of pasture grass (grazed to the edge), Carex geminata and blackberry, with a few willows. No riparian fencing was present. Along the sampled reach, the habitat consists of run pool 80%/20% flow. Water quality studies show elevated nutrients, bacteriological counts.

The Waimeha Stream is listed by GWRC as containing habitat for threatened indigenous fish species and being habitat for six or more

indigenous fish species in the catchment, and is listed as having inanga spawning habitat in the catchment.

Scale of works

Three bridges will cross floodplain. Close proximity to large area of earthworks associated with Te Moana interchange.

Stream works associated with floodplain management and installation of bridge embankments.

Works Monitoring

Ecologically we do not believe monitoring is justified. Assume will continue to be managed by GWRC as at present

Mitigation Monitoring

No mitigation works proposed.

Waikanae River

Origins

A natural river, but areas subject to GWRC gravel extraction, rip rap and willow management, floodplain modification.

Values

Bed of gravels.

Highest value in the alignment, regionally recognised and ecologically significant.

Physical Habitat = M. SEV = 0.66 (85% of reference site).

Riparian vegetation Native shrubs, grasses, weedland, willow.

An MCI of 116 (Good) and QMCI of 6.4 (Excellent).

6 species of fish and IBI score of 40 (good).

Catchment	Fish species
BML 2010 / 2011 (project footprint only)	long fin eel (1), short fin eel (10), common bully (9), red fin bully (3),Inanga (3), flounder (2), whitebait & elver (10)
FFDB 1990 to present (full stream)	long fin eel*, short fin eel, common bully, red fin bully*,Inanga*, flounder, yellow eyed mullet, Torrentfish*, brown trout, lamprey, inanga*,

General Description

The river width ranges from 15-20 m wide at the proposed Waikanae River bridge location. The substrate is made up of a combination of cobbles, pebbles and gravels, with excellent fish habitat provided by the presence of pool, run, riffle and cascades throughout the channel length.

The river is buffered by KCDC Council reserve-land until it reaches the coast. Riparian vegetation within the sampling site is made up of native forest (much of which is enhancement planting by local community groups), exotics (willows) and flood control planting.

Water quality sampling suggests generally good quality, with just periodic exceedences of zinc, nutrients, E Coli and acid soluble aluminium. SKM (2010) state the background soil concentrations of aluminium are the likely cause of the elevated levels of this metal in

storm water. SOE faunal studies have returned a range of results since 1999.

Scale of works

Construction of bridge piers and channel widening for flood control. Will require temporary diversions of the channel over approx 160 m metres.

The new floodplain and terrace risers will be treated in relation to amenity and flood management.

Works Monitoring

Within works area to monitor recovery following diversions.

At estuary to monitor potential construction effects.

Mitigation Monitoring

No mitigation works proposed.

Muaupoko Stream

Origins

At location of works, natural stream but may have been channelised.

No obvious maintenance by excavator.

Values

Bed of sands.

Physical Habitat = M. SEV = 0.48 (61% of reference site).

Riparian vegetation = pasture / restoration planting (8-10 yrs old)

An MCI of 88 (Fair) and QMCI of 4.2 (Fair).

5 species of fish and IBI score of 32 (fair).

Catchment	Fish species
BML 2010 / 2011 (project footprint only)	long fin eel (1), short fin eel (3), common bully (2), Inanga (23), smelt (8), elver (9).
FFDB 1990 to present (full stream)	No specific recordings

General Description

At the sampling site, long pasture grasses and exotics (willow and blackberry) dominate the bank side vegetation. This portion of the stream had stable vegetated banks, and in-stream macrophyte provided good fish cover

Below the culvert/public walkway, the stream flows through part of the Waikanae River restoration area, with riparian plantings of planted species, amongst occasional willow.

This portion of the stream has very unstable sand banks with no vegetation. The stream measures approximately 2m wide with depths ranging from 0.30-0.70 m. The stream substrate consists of fine gravels, sand with areas of fine mud deposits.

Scale of works

Diversion of the lower 30-50 m of stream above the confluence with the Waikanae.

Construction monitoring

Fish rescue will be needed at diversion.

Mitigation monitoring

Monitoring of diversion success at 4 and 10 years following successful establishment of riparian planting and stabilisation of stream bed and banks.

In addition, fish passage from the Waikanae to Muaupoko through new confluence channel

Mazengarb Drain (WWTP)

Origins

Formed drain through sand country associated with waste water treatment plant.

The channel is maintained by excavator annually or biannually to maintain flow and control weeds.

Values

Low value drain flowing through highly modified wetland dominated by blackberry.

Bed of muds.

Physical Habitat = L. SEV = 0.39 (50% of reference site).

Riparian vegetation weedland (blackberry)

An MCI of 41 (Poor) and QMCI of 1.7 (Poor).

3 species of fish and IBI score of 22 (poor).

Catchment	Fish species
BML 2010 / 2011 (project footprint only)	long fin eel (15), short fin eel (61), common bully (1), elver (13).
FFDB 1990 to present (full stream)	No specific recordings

Receiving the outflows of the treatment plant the surveyed section of the drain is a regular sided, 5-8m wide, 0.5m deep, soft bottomed drain surrounded by a pine plantation (riparian). More recently the riparian pine has been thinned (chopped down) and the stream is relatively open along its riparian edges. The bed has deep muddy and algae drifts over a sandy-muddy bottom with numerous woody debris. While abundant in eel the general water and habitat condition is poor and habitat variety (substrate, water and bank) low.

General Description

Scale of works

Culverted crossing.

Focus area for stream replanting and a new wetland area.

Construction Monitoring

Ecologically we do not believe construction monitoring is justified.

Mitigation monitoring

Monitoring of diversion success at 4 and 10 years following successful establishment of riparian planting and stabilisation of stream bed and banks.

Mazengarb Stream

Origin

Drain through peats.

No obvious maintenance at site of works

Values

Bed of muds. Stream urbanised.

Physical Habitat = L. SEV = 0.37 (48% of reference site).

Riparian vegetation pasture, weedland, exotic treeland (macrocarpa)

An MCI of 68 (Poor) and QMCI of 4.5 (Fair).

3 species of fish and IBI score of "poor".

Catchment	Fish species
BML 2010 / 2011 (project footprint only)	long fin eel (2), short fin eel (3), common bully (11), elvers (18)
FFDB 1990 to present (full stream)	No specific data for this site

General Description

A natural stream that has been extensively modified upstream of works by upgrade works at SH1 and NIMT, stream diversion works through a series of large open artificial ponds, and a residential subdivision.

The Mazengarb Stream is a tributary of the Waikanae River. It has a number of point source discharges of contamination in its catchment including potentially the Otaihanga Landfill and Paraparaumu Waste Water Treatment Plant, with the WWTP Drain entering the Mazengarb Stream just downstream of the sampling location.

At the sampling location, the stream flows beneath an old stand of macrocarpa and pine, with a thick mat of Tradescantia fluminensis covering the stream banks to the water's edge. The substrate is predominantly muds over sand.

Water quality is generally 'poor' with many water quality parameters and metal contaminants at levels which did not meet the relevant guideline values. In general, the stormwater samples had low dissolved oxygen,

and elevated E coli, acid soluble aluminium (Al), and both dissolved copper (Cu) and zinc (Zn).

Scale of works

Stream to be culverted.

Construction monitoring

Ecologically we do not believe monitoring is justified.

Fish rescue will be needed at all diversions.

Mitigation monitoring

No mitigation works proposed.

Wharemauku Stream

Origin

Natural stream that has been channelized and modified for flood capacity associated with urbanisation of catchment.

Regularly maintained by mower.

Values

Bed of gravels. Stream urbanised.

Physical Habitat = M. SEV = 0.44 (56% of reference site).

Riparian vegetation pasture / macrophyte weedland

An MCI of 90 (Fair) and QMCI of 3.7 (Poor).

4 species of fish and IBI score of "poor".

Catchment	Fish species
BML 2010 / 2011 (project footprint only)	long fin eel (16), short fin eel (2), inanga (2), common bully (5), elver (6)
FFDB 1990 to present (full stream)	Yellow eyed mullet, shortfin eel, longfin eel*, torrent fish*, koaro, giant kokopu banded kokopu, inanga*, shortjaw kokopu, lamprey, redfin bully*, smelt, black flounder

General Description

The Wharemauku Stream is a highly modified urban drain, channelised and influenced by urban (Paraparaumu Town) and industrial activities, as

well as discharge from adjoining drains from peat lands and residential areas.

The substrate comprises embedded cobbles and sand with a run/pool habitat with little instream debris. Despite being highly modified, the Wharemauku Stream does provide valuable habitat and is a known migratory pathway for many native fish species.

Riparian vegetation consists of grasses and water weeds e.g. water pepper, Willow weed, swamp willow herb (but there are no shade trees).

Water quality is generally 'poor' with some evidence of localised degradation of the stream bed sediments. Acid soluble aluminium and dissolved copper and dissolved zinc were also elevated relative to the ANZECC (2000) guideline at the 95% level of detection.

Scale of works

No earthworks in close proximity due to bridging and allowance for future roading underpass and walkway and flooding.

Works monitoring

A potential issue is effect on aquifer and stream flows of forming significant flood storage areas to the south.

Ecologically we do not believe monitoring is justified.

Mitigation monitoring

No mitigation works proposed.

Drain 7 (lower)

Origins

A formed drain in peat.

No signs of regular maintenance, but known to have been historically managed by KCDC.

Values

Physical Habitat = L. SEV = 0.36 (46% of reference site).

Riparian vegetation Pasture / willows

An MCI of 90 (Fair) and QMCI of 3.7 (Poor).

3 species of fish and IBI score of “poor”.

Catchment	Fish species
BML 2010 / 2011 (project footprint only)	long fin eel (3), short fin eel (5),inanga (14), whitebait (33), elvers (4)
FFDB 1990 to present (full stream)	No specific data for this site

General Description

Very low value, vegetation highly modified weed field. Freshwater community highly robust and unlikely to be adversely affected.

Scale of works

One crossing by culvert (in location of existing culvert).

A diversion from a linear channel to meandering stream for ecological mitigation west of M2PP alignment is proposed.

A focus site for stream restoration and use of flood storage for wetland development.

Works Monitoring

No monitoring of construction effects on in stream values proposed.

Fish rescue will be needed at all diversions.

Mitigation Monitoring

Monitoring of diversion success at 4 and 10 years following successful establishment of riparian planting and stabilisation of stream bed and banks.

Drain 7 (upper)

Origins

A formed drain in peat.

Regularly maintained by excavator (annually or bi-annually) managed by machine to maintain flows and control weeds.

Values

Physical Habitat = L. SEV = 0.3 (39% of reference site).

Riparian vegetation Pasture / willows

An MCI of 90 (Fair) and QMCI of 3.7 (Poor).

3 species of fish and IBI score of “poor”.

Catchment	Fish species
BML 2010 / 2011 (project footprint only)	long fin eel (3)
FFDB 1990 to present (full stream)	No specific data for this site

General Description

Very low value, vegetation highly modified weed field. Freshwater community highly robust and unlikely to be adversely affected.

Scale of works

Extent of earthworks in vicinity is small.

One crossing by culvert (in location of existing culvert).

Works Monitoring

No monitoring of construction effects on in stream values proposed.

Fish rescue will be needed at all diversions.

Mitigation Monitoring

No mitigation works proposed.

Whareroa Drain

Origin

At the site of works, an historic drain cut through peat swamps in QE Park.

Regularly maintained by excavator.

Values

Physical Habitat = L. SEV = 0.28 (36% of reference site).

Riparian vegetation Pasture / shrubs (manuka, gorse)

MCI 81 (Poor), QMCI 3.7 (Poor)

Fish IBI is 16 (Very poor)

General Description

These headwater drains are seasonally wet depressions and in most cases summer dry or ephemeral.

Where they lie along SHI and NIMT they are managed as part of road infrastructure.

These drains form the northern headwaters of a more natural stream which discharges to the coast, although waterbody connections are almost entirely subsurface flows.

Alignment only affects the small drain to the north. Potential for sediment to move down these channels to the main stem is minimal and we consider risk of direct and indirect effects are negligible.

Works Monitoring

No construction monitoring is proposed.

Mitigation Monitoring

No mitigation works proposed.

Scale of works