

Report

Annual Waikanae Borefield Report 2016-17 (Consent WGN130103 [34384])

Prepared for Greater Wellington Regional Council On behalf of Kāpiti Coast District Council Prepared by CH2M Beca Ltd



22 September 2017



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on behalf of	CH2M Beca Ltd		

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Highlights

This 2016/17 annual report has been prepared for Kāpiti Coast District Council (Council) as part of the consenting requirements for the River Recharge with Groundwater scheme. It reports on operational aspects and monitoring undertaken in relation to the Council's groundwater take from the Waikanae Borefield during the year 1 July 2016 to 30 June 2017.

The Waikanae Borefield was not used for recharging the Waikanae River this year because the relatively wet summer on the Kapiti Coast kept river flow high enough so that the river recharge scheme was not required. The Council's take from the Waikanae Borefield was only used for operational and maintenance purposes and was within the requirements of the consent. The Borefield was also not used for supplementary public water supply in the 2016/17 period.

A comprehensive monitoring regime for the Borefield was undertaken during the 2016/17 monitoring period. The monitoring for the Borefield investigates groundwater levels and electrical conductivity to check that saline intrusion is not occurring. Similarly, there was a comprehensive programme for monitoring five small coastal stream sites and 13 wetlands during the months of December 2016 to April 2017.

The collated baseline monitoring data from the three years of baseline monitoring collected to date will be used to develop a longer term monitoring programme and ongoing trigger levels as part of the On-going Mitigation Plan for the Waikanae Borefield. The Wetland, Borefield and Small Coastal Streams On-going Mitigation Plans will take effect from the 1 December 2017 (pending GWRC approval), otherwise the approved BMPs will continue to be used to monitor Council's groundwater take.

The Adaptive Management Group which comprises representatives of the Council, GWRC and Te Ati Awa ki Whakarongotai met in August 2017 to discuss this report, alongside representatives of key stakeholder groups. The key recommendations from the Adaptive Management Group was to progress with the development of the Borefield, Wetlands and Small Coastal Streams OMPs. The Adaptive Management Group believes baseline monitoring has achieved the required outcomes and sufficient data has been collected for setting an ongoing mitigation regime.



Executive Summary

This annual report for the Waikanae Borefield has been prepared on behalf of Kāpiti Coast District Council (Council) in accordance with Condition 42 of consent WGN130103 [34384]. This is the fourth annual Waikanae Borefield report, and covers the period from 1 July 2016 through to 30 June 2017.

The consent authorises the abstraction of groundwater from eight wells within the Waikanae Borefield (K4, K5, K6, Kb4, K10, Kb7, K12 and N2). These bores were monitored throughout the 2016/17 period.

The Waikanae Borefield was not used for River Recharge with groundwater in the 2016/17 year.

The Borefield was only used for operation and maintenance activities (short term discharges), and for construction water supply for the Mackays to Peka Peka (M2PP) Expressway, although the M2PP use is under a separate consent held by the NZ Transport Agency. The maximum total daily take from the Borefield was 4,489 m³/day on 23 March 2017. This is significantly less than 23,600 m³/day which is the maximum take for Stage 1 of the River Recharge with Groundwater Scheme (RRwGW). The Borefield was also not used for supplementary public water supply in the 2016/17 period.

Baseline monitoring of the aquifers, small coastal streams and wetlands was carried out in accordance with the relevant baseline monitoring plans. From the borefield monitoring results, none of the established interim trigger levels for groundwater levels (deep and shallow) or electrical conductivity have been exceeded. Similarly none of the interim triggers for wetlands or small coastal streams monitoring were exceeded.

The baseline monitoring data collected during the 2016/17 summer/autumn adds to the data collected in past years. The data collected over the 3-year baseline monitoring period will be used to develop an on-going monitoring regime for the Wetlands, Small Coastal Streams and Borefield and inform the development of management trigger levels and cease abstraction compliance limits as part of the On-going Mitigation Plans.

A website providing groundwater level monitoring information for these well users and the general public was launched in November 2015. No queries relating to abstraction from the Borefield were received by Council during the 2016/16 period.

Looking ahead to the coming year (2017/18), there is no additional mitigation or adaptive management that is anticipated at this stage, other than the development of management trigger levels and cease abstraction compliance limits as part of the On-going Mitigation Plans. Groundwater abstracted from the bores may be used for river recharge if required due to low flows in the Waikanae River. The recharge will be undertaken in accordance with the approved Bore Preference Hierarchy Plan and approved River Operations and Maintenance Manual (ROMM).

As required by Condition 15 of consent WGN050025 [33147], Council confirms that the back-up public water bores PW1 and PW5 were not used in the 2016/17 year for public water supply.



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1 Introduction

Kāpiti Coast District Council (Council) holds resource consent (WGN130103 [34384]) to take groundwater from bores within the Waikanae Borefield for the purpose of supplementary public water supply through river recharge or emergency public water supply.

The consent authorises the abstraction of groundwater from eight production wells within the Waikanae Borefield. All eight of these wells were operable throughout the 2016/17 year. The locations of the eight production wells and monitoring bores are shown in Figure 2.

An annual Waikanae Borefield report is required by Condition 42 of consent WGN130103 [34384]. This is the fourth annual Waikanae Borefield report, and covers the period from 1 July 2016 through to 30 June 2017. The requirements of Condition 42 are listed in Table 1 below with cross-references to the relevant section in this report.

Table 1: Requirements for Annual Waikanae Borefield report

Conditi	ion 42 of consent WGN130103 [34384]	Section in this annual report
The co Borefie	onsent holder shall, by 30 th September each year, submit an annual Waikanae eld report to the Manager, or by another date as agreed with the Manager.	
The an inclusiv	nual Waikanae Borefield report shall report on the year 1st July to 30th June ve, and include the following information:	
a) A	copy of the records to demonstrate compliance with Condition 20 of this onsent;	Sections 2.1 and 2.2
b) D a	etails of the use (including daily and total volumes of groundwater abstracted) nd reasons for that use of the water from the Borefield;	Section 2.1
c) A	summary of Waikanae River flow gauging required by Condition 25 of this onsent, if undertaken that year;	Section 3
d) R co re p	Results of all monitoring undertaken that year required by conditions of this onsent (if applicable), including a comprehensive analysis of the monitoring esults, assessment against any relevant guidelines and comparison with revious years' results (i.e. trend analysis);	Sections 4, 5 and 6
e) R	Results or evidence to demonstrate compliance with Condition 7 of this consent	Section 8
f) D th 	Details of any trigger levels or compliance limits that were reached (if occurred nat year) and specifically the findings of saline monitoring compared with the alert', 'action' or 'cease' triggers;	Sections 4 and 5
g) D to th	Details of any actions and/or mitigation/adaptive management taken in response to trigger levels or compliance limits being reached, including an assessment of the effectiveness of these actions and/or mitigation/adaptive management;	Sections 4, 5 and 6
h) A of rr C N	ny recommendations for changes to the monitoring plan required by conditions f this consent, including triggers, compliance limits or actions and/or mitigation neasures or changes to the operations and maintenance manual, required by condition 19 of this consent, including any recommendations of the Adaptive flanagement Committee (referred to in Condition 43 of this consent);	Section 7, Section 2.3 and Section 11
i) A th	discussion on any mitigation/adaptive management that may be required in ne coming year;	Section 10
_j) A	copy of the complaints record required by Condition 45 of this consent;	Section 9
k) S	ummary of any maintenance undertaken.	Section 2.2
The an Kāpiti (date as	nual Waikanae Borefield report shall be made available to the public on the Coast District Council website by 30th September each year, or by another s agreed with the Manager.	Refer www.kapiticoast.govt.nz
Note: T time to	The consent holder may request, with the Manager's approval, an extension of submit the annual report to the Manager and make it available to the public on	



Condition 42 of consent WGN130103 [34384]	Section in this annual report
the website, if the Adaptive Management Group requires more time to consider the draft annual report and provide their recommendations as required by part (h) of this condition.	

In addition to the above Council holds resource consent WGN050025 [33147] to abstract groundwater from two wells (PW1 and PW5) for the purpose of back up water supply for the communities of Waikanae, Paraparaumu and Raumati. Requirements of Condition 15 are discussed in section 4.6.

There are a number of plans and manuals required by the RRwGW suite of consents and various reports have been produced from the 2016/17 monitoring. These documents are set out in the following figure (Figure 1).





Figure 1: Key documents for RRwGW consent and 2016/17 Monitoring





Figure 2: Location Plan - Waikanae Borefield Abstraction Wells and Monitoring Bores



2 Borefield Operation

2.1 Abstraction Volumes and Rates

Abstraction from each production well (L/s and m³/day) is measured and recorded in accordance with Conditions 13, 14 and 20 of consent WGN130103 [34384]. Council submits full abstraction records automatically in SCADA to GWRC as required by Condition 18. A summary of the abstraction for this reporting period is provided below.

The total volume pumped from the production wells for the period 1 July 2016 to 30 June 2017 was 28,759m³, which is significantly less than the annual volume permitted by Condition 8 of the groundwater take consent (2,300,000 m³/year). Of this volume, 5,489 m³ was abstracted from bore K4 for construction water supply for the Mackays to Peka Peka (M2PP) Expressway Alliance. The use of bore K4 by the M2PP Alliance is outside the consent WGN130103 [34384] and is exercised under a separate consent held by the NZ Transport Agency.

The total daily abstraction from the Waikanae Borefield is plotted in Figure 3. The maximum total daily take was 4,489 m³/day on 31 May 2017, which is also less the maximum daily take permitted by Condition 8.

There is a marked drop in the borefield abstraction compared to the 2015/16 period as the borefield was only used for M2PP construction activities and short duration maintenance discharges. The production wells are generally pumped once per month (towards the end of the month) at maximum flow for a short period to flush the pipeline and check the operation of the bore pumps. The Borefield was not used for river recharge or supplementary supply in 2016/17.

The total instantaneous abstraction rate is plotted in Figure 4. The maximum combined abstraction was 244L/s, which occurred for 4 hours on 31 May 2017 (short duration discharge).

Summary graphs of the instantaneous rates for the individual wells are included in Appendix A. On two occasions the pumping rates for the production wells K4 and Kb4 were greater than the instantaneous abstraction rates given by Table 2 of Condition 8. In both cases the flow exceedances that was over was in the order of 0.5% of the total flow, which is within the allowable flows as defined by Condition 8 of up to 15% for a maximum duration of 15 minutes.

2.2 Operations Log and Maintenance Undertaken

Council has confirmed that its existing SCADA system together with the NCS system are an 'electronic data management system' which records and stores the information required by Condition 20 of consent WGN130103 [34384]. Borefield abstraction data is automatically transmitted from Council's SCADA system to GWRCs Water Use Data Management System. Council has implemented WaterOutlook as a system to store and report data and operational information relating to the Waikanae Borefield

A copy of the site logs for each production well is included in Appendix B. The following key events are noted:

- Various power cuts through the Borefield required communications to be reset by Council Operations staff (K4, K6, K10 and Kb7).
- Well K4 was used by the M2PP Alliance for construction water during 2016. The M2PP outlet was
 plugged on 22 May 2017 as the construction of the Expressway is now complete.
- Audits of the wells' Network and Electronic Drives were undertaken in December 2016 by Council.
- Relief valve on well K10's surge vessel was replaced 31 March 2017.



• Faulty smoke alarm at well K12 required investigation throughout the monitoring period.

2.3 Operation and Maintenance Manual

The updated Waikanae Borefield Operation and Maintenance Manual (BOMM) was resubmitted to GWRC for approval on 1 February 2017 in accordance with Condition 19 of consent WGN130103 [34384], and the revised BOMM was and approved on 16 February 2017.

The changes to the revised BOMM included:

- Inclusion of new interim triggers for the "new" monitoring wells installed at the commencement of the consent, approved by GWRC on 14 February 2017
- Inclusion of the finalised Waikanae Borefield Operation and Maintenance document by Downer (this document sets out the daily operation of the Borefield with the new wells (Kb7, K12 and N2) in operation)
- Updated Bore Hierarchy Plan (which includes Kb7, K10, K12 and N2) as approved by GWRC on 7 December 2016.
- Updated KCDC RRwGW Consent Compliance Functional Description





Figure 3: Daily Abstraction Volumes from Production Wells







3 Waikanae River Flow Gauging

Flow gauging of the Waikanae River is required by Condition 25 of consent WGN130103 [34384]. One of the aims of this gauging is to determine whether a relationship between river flows, river abstraction rates and groundwater pumping can be identified by monitoring flows in the river downstream of the Waikanae WTP. This is to establish whether additional groundwater pumping, from historic volumes abstracted, reduces flows in the Waikanae River downstream of the WTP due to increased losses through the bed of the river as a result of lowered groundwater levels. Another reason for the hydrological monitoring is to confirm river flows at the periphyton and water quality monitoring locations to allow correlation of monitoring and effects.

Due to the high river flows and no river recharge activities this year, no flow gauging was undertaken by NIWA this summer as per condition 21 of consent WGN130103 [34400] *"Flow gauging may not be required during times when River Recharge is not in operation if the flow is known based on existing flow information".*

The hydrological correlation was satisfactorily determined in the 2015/16 annual report (refer Figure 5). The key findings were:

- Confirmation of the existing understanding that the Waikanae River loses about 300 L/s between SH1 and Jim Cooke Park, when flows at the WTP are lower than about 1,000 L/s.
- Once flows get above about 1500 L/s, there is no net loss of flow between the two gauging points.

The total abstraction from the borefield did not reach 23,000m³/day throughout the 2016/17 year so Condition 24 (relating to part 1D of Appendix A) of consent WGN130103 [34384] was not applicable.



Figure 5: Waikanae River Flow Gaugings near SH1 and Jim Cooke Park



4 Borefield Monitoring

4.1 Borefield Baseline Monitoring

The Borefield Baseline Monitoring Plan (Borefield BMP) and addendum to the Borefield BMP describes the procedures for collecting and reporting water level data from shallow and deep monitoring wells within the Waikanae Borefield, as well as electrical conductivity monitoring from saline intrusion monitoring wells along the coast. The locations of these monitoring wells are shown in Figure 2.

Some of the borefield monitoring sites are operated by GWRC. For these sites GWRC and Council's monitoring systems have been configured such that water level information is automatically transferred from GWRC to Council's SCADA system approximately every two hours.

The Council's SCADA system has been updated with the inclusion of the hydrotel numbers provided by GWRC. Hydrotel numbers are used as the basis of the link to automatically transmit monitoring data to the GWRC SCADA system. All of the monitoring sites are now integrated into the SCADA system. GWRC confirmed on 20 March 2017 that GWRC bore IDs were not required to identify the monitoring wells. The wells are named as per the KCDC naming convention.

Interim trigger levels are in place for most monitoring wells (some electrical conductivity (EC) monitoring sites do not have interim trigger levels as the baseline data is not conducive to setting triggers). These interim trigger levels are summarised in the tables below. If interim trigger levels are exceeded, alarms are generated by Council's SCADA system and automatic notifications are emailed to Council, GWRC and CH2M Beca.

Ongoing trigger levels for the borefield are being set following the completion of three years of baseline monitoring. These ongoing trigger levels will be included in the Borefield Ongoing Mitigation Plan (OMP).

4.2 Shallow Aquifer Drawdown Monitoring

Table 2 below lists the shallow aquifer monitoring sites, the applicable interim trigger levels and the minimum water level (daily average) recorded during this year's report period compared to last year. Graphs of the shallow aquifer monitoring data for this reporting period are presented in Appendix C.

No "true" interim alert trigger levels for the shallow monitoring bores were exceeded during the reporting period. Operations and maintenance activities caused the following alarm notifications:

- Sentinel #5 Shallow, Taiata Street Level : Alert, Action and Cease notifications on 9 November 2016
- Waikanae CHP Shallow Level: Alert, Action and Cease notifications on 18 November 2016, 19 November 2016 and 22 November 2016
- KCDC W1 Level: Alert, Action and Cease notifications on 9 January 2017 and 10 January 2017
- Te Harakeke 03 : Alert, Action and Cease notifications on 31 January 2017
- K12 Obs Shallow Smithfield Road Level : Alert, Action and Cease notifications on 22 February 2017, 7 February 2017, 11 November 2016 and 27 November 2016 (Power cut)
- Rangihiroa St TW2-MW3 Level : Alert, Action and Cease notifications on 01 February 2017



Well Name	GWRC Bore Number	Interim Trigger Level			Status	Min level this repo <u>rting</u>	Min level last repo <u>rting</u>
		Alert	Action	Cease		period 2016/17	period 2015/16*
		(mm AMSL)	(mm AMSL)	(mm AMSL)		(mm AMSL)	(mm AMSL)
KCDC K6 Obs Shallow	R26/6992	2180	1980	1580	Existing well previously monitored by GWRC, now monitored by KCDC.	3373	3122
GWRC Nga Manu	R26/6991	7460	7260	6860	Existing well operated by GWRC	8153	7868
KCDC W1	R26/7025	4440	4240	3840	Existing well operated by GWRC	4321	4911
Rangihiroa St TW2-MW3	R26/6287	1340	1140	740	Existing well operated by GWRC	2039	1834
Te Harakeke 03	R26/6886	2760	2560	2160	Existing well operated by GWRC	3723	3663
Waikanae CHP Shallow	R26/6916	1740	1540	1140	Existing well operated by GWRC	2335	2188
K12 Obs Shallow, Smithfield Road	R26/6300	5184	4984	4784	Online monitoring since May 2016.	5375	5592
JCMP Shallow, Jim Cooke Memorial Park	GWRC confirmed not required	6681	6481	6281	Monitored since Dec 2014	7445	7304
Kb1 Obs Shallow, Ngaio Road	R26/6304	Water le analysis as agree	evel natura and is rel ed with GV	ally falls be moved fro VRC	elow well bottom and so this m interim trigger and on-goin	well is exclud	led from ogramme
K3A Obs Shallow, Cemetery	R26/6290	6964	6764	6564	Online monitoring since Dec 2014	8225	7864
Greenhill North Shallow, Greenhill Road North	GWRC confirmed not required	6387	6187	5987	Monitored since Dec 2014	7341	7091
Greenhill South Shallow, Greenhill Road South	GWRC confirmed not required	11846	11646	11446	Monitored since Dec 2014	13318	12565

Table 2: Shallow Aquifer Drawdown Monitoring Wells and Interim Trigger Levels

*note – in the 2015/16 Annual Borefield Report the water levels were raw data minimum values not daily averages. Values shown above are daily averages.

4.3 Deep Aquifer Drawdown Monitoring

Table 3 lists the deep aquifer monitoring sites, the applicable interim trigger levels and the minimum water level (daily average) recorded during this year's reporting period compared to last year. Graphs of the deep aquifer monitoring data for this reporting period are presented in Appendix C.



No "true" interim alert trigger levels for the deep monitoring bores were exceeded during the reporting period. Operations and maintenance activities caused the following alarm notifications:

- Sentinel #4 Deep, Peka Peka Road Level : Alert, Action and Cease notifications on 9 November 2016
- Sentinel #5 Intermediate, Taiata Street Level Alert, Action and Cease notifications on 9 November 2016
- Waikanae CHP Deep Level Alert, Action and Cease notifications on 18 November 2016, 19 November 2016 and 22 November 2016
- Sentinel #3 Intermediate, Old WWTP Level Alert, Action and Cease notifications on 21 December 2016

 Table 3: Deep Aquifer Drawdown Monitoring Wells and Interim Trigger Levels

Well Name	GWRC Bore	Interim Trigger Level			Status	Min level	Min level
	Number	Alert	Action	Cease		reporting	reporting
		[mm AMSL1	[mm AMSL1	[mm AMSL1		2016/17	2015/16*
						(mm AMSL)	(mm AMSL)
Sentinel #1 Deep, Rutherford Drive	R26/6378	-1537	-3787	-5475	Existing well. Equipment replaced and monitoring re-started Dec 2014	3449	2768
Sentinel #1 Intermediate, Rutherford Drive	GWRC confirmed not required	-2526	-4776	-6463	Monitored since Dec 2014	2207	1549
Sentinel #2 Deep, Hodgkins Rd	GWRC confirmed not required	-898	-2698	-4048	Monitored since Dec 2014	3030	2634
Sentinel #2 Intermediate, Hodgkins Rd	GWRC confirmed not required	-1757	-3557	-4907	Monitored since Dec 2014	1961	1477
Sentinel #3 Deep, Old WWTP	R26/6776	-2090	-4490	-6290	Online monitoring since Dec 2014	3287	2465
Sentinel #3 Intermediate, Old WWTP	GWRC confirmed not required	-2547	-4947	-6747	Monitored since Dec 2014	2338	1885
Sentinel #4 Deep, Peka Peka Road	GWRC confirmed not required	1832	932	257	Monitored since Dec 2014	4120	3855
Sentinel #4 Intermediate, Peka Peka Road	GWRC confirmed not required	284	-616	-1291	Monitored since Dec 2014	2262	2089
Sentinel #5 Shallow, Taiata Street	R26/6673	-404	-1454	-2242	Existing well previously monitored by GWRC, now monitored by KCDC. Equipment replaced and	1927	1802



Well Name	GWRC Bore	Interim Trigger Level			Status	Min level	Min level
	Number	Alert	Action	Cease		reporting	reporting
		[mm AMSL1	[mm AMSL1	[mm AMSL1		2016/17	2015/16*
						(mm AMSL)	(mm AMSL)
					monitoring re-started Dec 2014		
Sentinel #5 Intermediate, Taiata Street	R26/6955	-393	-1443	-2231	Existing well previously monitored by GWRC, now monitored by KCDC. Equipment replaced and monitoring re-started Dec 2014	1898	1773
Sentinel #5 Deep, Taiata Street	GWRC confirmed not required	19	-1031	-1819	Monitored since Dec 2014	2239	2042
Sentinel #6 Deep, Tamati Place	GWRC confirmed not required	560	-190	-752	Monitored since Dec 2014	2225	1473
Sentinel #6 Intermediate, Tamati Place	GWRC confirmed not required	599	-151	-714	Monitored since Dec 2014	2184	1534
Waikanae CHP Deep	R26/6594	540	-510	-1298	Existing well operated by GWRC	1994	2617
Waikanae Park	R26/6284	4611	2511	936	Existing well operated by GWRC	9093	8663

*note – in the 2015/16 Annual Borefield Report the water levels provided were raw data minimum values not daily averages. Values in the Table above are daily averages.

Old Estuary Shallow PW1-MW1/1 and Old Estuary Deep PW1-MW1/2 are no longer included in the monitoring programme as they have been replaced by Sentinel #6 Intermediate, Tamati Place and Sentinel #6 Deep, Tamati Place respectively as detailed in Tables 2 and 3 of Appendix A to consent WGN130103. The Sentinel #6 sites were commissioned in late 2014.

4.4 Saline Intrusion Monitoring

Table 4 lists the saline intrusion monitoring sites, the applicable interim trigger levels and the maximum electrical conductivity (daily average) recorded during this year's reporting period compared to last year. Graphs of the electrical conductivity (EC) monitoring data for this reporting period are presented in Appendix C.

The interim EC trigger levels for previously existing monitoring wells (i.e. in existence and monitored for EC at the commencement of the consent) are a continuation of the already established triggers from the previous abstraction consent.

It was noted in the 2014/15 Borefield Annual Report that EC measurement equipment and sensor placement within the existing saline intrusion monitoring wells may have changed over time such that the existing EC



trigger values based on data collected over the period 2005 - 2009 may no longer be representative of current conditions. The interim trigger levels for the existing wells were reviewed when the new well interim triggers were calculated in February 2016, and it was found that the magnitude of difference with the inclusion of recent data did not justify changing the existing interim triggers. Ongoing triggers are being set for the wells following the completion of the third year of baseline monitoring.

No "true" interim alert trigger levels for the shallow monitoring bores were exceeded during the reporting period. Operations and maintenance activities caused the following alarm notifications:

- Sentinel #3 Deep, Old WWTP Conductivity: Alert, Action and Cease notifications on 9 November 2016
- Sentinel #3 Intermediate, Old WWTP Conductivity : Alert, Action and Cease notifications on 9 November 2016
- Sentinel #4 Deep, Peka Peka Road Conductivity : Alert, Action and Cease notifications on 9 November 2016
- Sentinel #4 Intermediate, Peka Peka Road Conductivity : Alert, Action and Cease notifications on 9 November 2016
- Sentinel #5 Deep, Taiata Street Conductivity : Alert, Action and Cease notifications on 9 November 2016
- Sentinel #5 Shallow, Taiata Street Conductivity : Alert, Action and Cease notifications on 9 November 2016
- Sentinel #5 Intermediate, Taiata Street Conductivity : Alert, Action and Cease notifications on 9 November 2016
- Sentinel #1 Deep, Rutherford Drive Conductivity : Alert, Action and Cease notifications on 11 November 2016
- Sentinel #2 Deep, Hodgkins Road Conductivity: Alert, Action and Cease notifications on 17 November 2016
- Sentinel #2 Intermediate, Hodgkins Road Conductivity : Alert, Action and Cease notifications on 15 November 2016

EC monitoring data collection is proceeding according to plan. Council is continuing to investigate noted issues with the EC monitoring equipment and data and is liaising with GWRC on matters as they arise. Development of trends used to set trigger levels is the goal of baseline monitoring and not the determination of absolute values. Discussions with GWRC staff indicate that previous EC monitoring experienced similar anomalies and the data is useful for trend identification but not absolute values of EC.

The yearly check of conductivity measurement equipment against standard solutions was completed in November 2016. The depth of the EC sensor was also checked and adjusted as necessary to ensure that the sensor was within the screened section of the well.

Well Name	GWRC Bore Number	Interim T	rigger Leve	əl	Status	Max this reporting period 2016/17 (μS/cm)	Max last reporting period 2015/16* (μS/cm)
		Alert (µS/cm)	Action (µS/cm)	Cease (µS/cm)			
Sentinel #1 Deep, Rutherford Drive	R26/6378	1500	1875	2188	Existing well repaired. Equipment replaced and monitoring re- started Dec 2014	997	1007

Table 4: Saline Intrusion Monitoring Wells Electrical Conductivity Interim Trigger Levels



Well Name	GWRC Bore	Interim T	rigger Lev	el	Status	Max this reporting	Max last reporting
	Number	Alert (µS/cm)	Action (µS/cm)	Cease (µS/cm)		period 2016/17 (µS/cm)	period 2015/16* (μS/cm)
Sentinel #1 Intermediate, Rutherford Drive	GWRC confirmed not required	TBD	TBD	TBD	Monitored since Dec 2014 Triggers to be outlined in OMP.	486	1556
Sentinel #2 Deep, Hodgkins Rd	GWRC confirmed not required	1532	1915	2234	Monitored since Dec 2014	1201	1258
Sentinel #2 Intermediate, Hodgkins Rd	GWRC confirmed not required	1671	2089	2437	Monitored since Dec 2014	1305	1421
Sentinel #3 Deep, Old WWTP	R26/6776	1342	1677	1956	Monitored since Dec 2014	1061	1125
Sentinel #3 Intermediate, Old WWTP	GWRC confirmed not required	2422	3027	3531	Monitored since Dec 2014	1088	1324
Sentinel #4 Deep, Peka Peka Road	GWRC confirmed not required	866	1082	1262	Monitored since Dec 2014	736	727
Sentinel #4 Intermediate, Peka Peka Road	GWRC confirmed not required	738	923	1077	Monitored since Dec 2014	645	583
Sentinel #5 Shallow, Taiata Street	R26/6673	430	537	627	Equipment replaced and monitoring re- started Dec 2014	370	525
Sentinel #5 Intermediate, Taiata Street	R26/6955	3079	3849	4491	Existing well previously monitored by GWRC, now monitored by KCDC. Equipment replaced and monitoring re- started Dec 2014	3042	2840
Sentinel #5 Deep, Taiata Street	GWRC confirmed not required	6119	7648	8923	Monitored since Dec 2014	5062	4955
Sentinel #6 Deep, Tamati Place	GWRC confirmed	TBD	TBD	TBD	Monitored since Dec 2014	8018	7966



Well Name	GWRC Bore Number	Interim Trigger Level			Status	Max this reporting	Max last reporting
		Alert (µS/cm)	Action (µS/cm)	Cease (µS/cm)		period 2016/17 (uS/cm)	period 2015/16* (uS/cm)
						(poreni)	(porein)
	not required				Triggers to be outlined in OMP.		
Sentinel #6 Intermediate, Tamati Place	GWRC confirmed not required	TBD	TBD	TBD	Monitored since Dec 2014 Triggers to be outlined in OMP.	1419	1396

*note – in the 2015/16 Annual Borefield Report the EC levels provided were raw data maximum values not daily averages. Values above show daily averages.

Old Estuary Shallow PW1-MW1/1 and Old Estuary Deep PW1-MW1/2 are no longer included in the monitoring programme as they have been replaced by Sentinel #6 Intermediate, Tamati Place and Sentinel #6 Deep, Tamati Place respectively as detailed in Table 3 of Appendix A to consent WGN130103[34399]. The Sentinel #6 sites were commissioned in late 2014.

4.5 Bore Water Quality Monitoring

Bore water quality sampling was not required this year as the Borefield was not used for river recharge.

Bore water quality samples are required to be taken from production bores approved for use as defined in the Bore Preference Hierarchy Plan (dated 26/03/2016), if a bore had been used for more than one day and again prior to turning off a bore if it has been used for three days or more. This sampling regime aligns with Condition 26 of consent WGN130103 [34384].

When blended bore water is discharged to the river, the blended bore water is sampled as per the minimum requirements under condition 21 of WGN130103 [34400] at the same frequency as required by condition 26 (j) of consent WGN130103 [34384]. This will allow for comparison of the individual bore water quality sampling with the blended bore water sampling if necessary. GWRC confirmed this sampling regime for blended bore water on 19 August 2016.

4.6 PW1 and PW5 Well Abstraction

Consent WGN050025 [33147] allows for a combined total of 7000 m³/day to be abstracted from wells PW1 and PW5 for back up public water supply to the surrounding communities. The wells were not used for back up water supply in the 2016/17 year.

5 Wetlands monitoring

The results of the 2016/17 baseline monitoring are documented in the report "Wetland Baseline Monitoring Annual Report" by Boffa Miskell, which is included as Appendix D. Wetland interim trigger levels are applicable to wetlands that are less than 2 km from Council's operable production wells.

Monitoring of changes to water levels in the wetlands (specified in parts 1F and 1G of Appendix A of consent WGN130103 [34384]) is accomplished by recording groundwater levels in piezometers installed in close



proximity to these wetlands. The "alert" and "action" trigger levels do not apply to the monitored wetlands located greater than 2 kilometres from any well in the Waikanae Borefield actively being pumped for water supply or river recharge. Graphs presenting the wetland groundwater levels for the monitoring period (July 2016 - June 2017) are presented in the report in Appendix D.

For the 2016/17 reporting period the following wetlands were within 2 km from the Waikanae Borefield production wells: Nga Manu Wetland, El Rancho Wetland, Te Harakeke Wetland, Ngarara Rd Wetland, Ngarara Bush Wetland, Otaihanga Wetland, and Peka Peka Rd Swamp. These wetlands were checked against trigger levels. Water levels measured were within expected levels and no approved trigger levels were exceeded. Due the wet summer period the water levels within the wetlands remained fairly constant. In previous drier years a decline in water level over late summer/early autumn has been evident.

Whilst no "true" trigger levels were exceeded, some alarm notifications have been received and communicated to GWRC and appear to be a result of maintenance work by GWRC. They are detailed below:

- El Rancho Wetland (Weggery) Level : Alert, Action and Cease notifications on 18 November 2016, 19 November 2016 & 22 November 2016
- Te Harakeke 01 / Kawakahia Wetland Level : Alert, Action and Cease notifications on 31 January 2017

Condition monitoring of Te Harakeke Wetland could not be undertaken this year due to access being denied by the land owner.

6 Small Coastal Streams Monitoring

The results of the 2016/17 baseline monitoring are documented in the report "Small Coastal Streams Baseline Aquatic Monitoring Annual Report" by Boffa Miskell, which is included as Appendix E. This year's baseline monitoring for small coastal streams commenced mid December 2016 and aligned with the certified Small Coastal Streams Baseline Monitoring Plan (Streams BMP). GWRC confirmed that the two week delay in start (due to heavy rainfall disturbing Upper Muaupoko stream alignment, leaving the sensor out of water) could be made up at the end of the monitoring period as per discussion in early December 2016, and it was.

There are five small coastal stream monitoring sites. The small coastal streams baseline monitoring generally involved recording shallow groundwater level adjacent to each stream, instream water depth, and instream dissolved oxygen and temperature.

The data collected over the 3 year baseline monitoring period is being used to develop an on-going monitoring regime for the streams and inform the development of management triggers as part of the OMP for the Small Coastal Streams. Despite some data gaps due to equipment failure, the data collected from the small coastal streams between 15 December 2016 and 30 May 2017 is adequate in providing the final of three years of baseline monitoring measures of relevant instream habitat parameters and potentially associated ground water levels.

When comparing the shallow groundwater level changes with the instream water depth changes we have observed that there are roughly parallel responses of groundwater level and instream water depth to rain. The stream water depth increase response is ahead of the increase in groundwater level (responding first to rainfall) at almost all sites. Investigation into the correlation between stream depth, shallow piezo water level and abstraction from production bores is being undertaken to inform the development of On-going Mitigation Trigger levels. Sites that show a correlation are potential options for on-going monitoring sites.



No interim trigger levels for the small coastal streams as per Condition 23 of consent WGN130103 [34384] were exceeded. The maximum daily abstraction from the borefield was 4,488m³/day well under the trigger level for abstraction of 23,000m³/day for three or more consecutive days.

7 Monitoring Plans

7.1 Borefield Baseline Monitoring Plan

The Borefield Baseline Monitoring Plan is set to be replaced by the Borefield OMP which will take effect on 1 December 2017 (pending GWRC approval).

The Borefield Operation modelling report has been updated to take into consideration baseline monitoring data collected to date and will be used as input to the Borefield, Streams and Wetlands OMPs.

7.2 Wetlands Baseline Monitoring Plan

The Wetlands Baseline Monitoring Plan is set to be replaced by the Wetlands OMP which will take effect on 1 December 2017 (pending GWRC approval).

7.3 Small Coastal Streams Baseline Monitoring Plan

The revised Small Coastal Streams Baseline Monitoring Plan (Streams BMP) which included the changes from the previous two years was submitted to GWRC and approved on 18 January 2017. Changes to the approved Streams BMP are discussed in the 2015/16 Annual Report.

The Streams Baseline Monitoring Plan is set to be replaced by the Streams OMP which will take effect on 1 December 2017 (pending GWRC approval).

8 Potentially Affected Existing Private Wells

Condition 7 of consent WGN130103 [34384] requires work to be undertaken to identify potentially affected existing authorised wells (and also actions (b)-(d) listed in the condition) prior to implementing each stage of the project as referenced in Condition 6. Condition 6 outlines the staging plan for the Waikanae Borefield extension and abstraction. The Stage One construction works were completed and commissioned in early 2015, but abstraction from the extended borefield (i.e. the new bores Kb7, K12 and N2) was only for testing and maintenance i.e. not recharge or supply for the 2015/16 reporting period. As such, Stage One will be implemented when abstraction from bores Kb7, K12 or N2 for either water supply or river recharge commences. GWRC confirmed on 21 July 2016 that Council has met all requirements of condition 7.

A website provides groundwater level monitoring information as well as contact details if well users wish to discuss issues arising or make complaints. This website was launched to the public in November 2015.



9 Complaints Record

Condition 45 requires Council to maintain an on-going record of any complaints received alleging adverse effects from, or related to, abstraction from the Waikanae Borefield, including complaints of any adverse effects on private bores. During the reporting period Council received no queries that were related to Borefield pumping.

10 Mitigation/Adaptive Management in the Coming Year

Looking ahead to the coming year (2017/18) there is no additional mitigation or adaptive management that is anticipated at this stage, other than the development of management trigger levels and cease abstraction compliance limits as part of the OMP for the Small Coastal Streams, Borefield and Wetlands. Refinement of the monitoring requirements and inclusion of the ongoing triggers levels in Appendix A of the consents will transform the current monitoring consent to an "operational" consent for the longer term.

Monitoring activities will be in accordance with the OMP's which are due to be submitted to GWRC by 31 October 2017. If an OMP is not approved by GWRC by 1 December 2017, it is proposed that the approved BMP's will remain in place until the approved is received.

11 Recommendations of the Adaptive Management Group

The Adaptive Management Group (AMG) for the RRwGW scheme comprises three members who are representatives of GWRC, Council and Te Āti Awa ki Whakarongotai. Figure 6 shows the stages of AMG and key stakeholder involvement in the lead up to the submission of this annual report to GWRC.

Council held a briefing session with the AMG and key stakeholders on 4 May 2017. Representatives of Wellington Fish and Game Council, The Kapiti Fly Fishing Club, the Department of Conservation, Friends of the Waikanae River and Regional Public Health were present at the briefing. The purpose of this briefing session was to discuss the observations from the baseline monitoring undertaken to date as well as any observations of the AMG and key stakeholders during the 2016/17 period, and to make an early start in the process of considering the potential for adaptive management in regards to these observations ahead of the AMG meeting on the annual reports in August 2017.

The AMG met on 30 August 2017 to discuss the draft version of this report, and the proposed triggers and monitoring sites based on the data gathered during the three year baseline monitoring period to meet condition 22 of the consent. The draft version of the annual River and River Recharge report was also discussed.

Friends of the Waikanae River were the only key stakeholder to attend this meeting. Apologies were received from the other key stakeholders.

The key recommendations from the Adaptive Management Group was to progress with the development of the Borefield, Wetlands and Small Coastal Streams OMP's. The Adaptive Management Group believes baseline monitoring has achieved the required outcomes and sufficient data has been collected for setting an ongoing mitigation regime.

The OMP process is being conducted in parallel with the annual reporting process as detailed in Figure 6.





Figure 6: AMG activities associated with this year's RRwGW activities (Annual Reports – Green, OMP - Blue)



Appendix A

Borefield Abstraction Summary Graphs



Production Bores: —— K10 Figure A1: Instantaneous Abstraction for K10



Figure A2: Instantaneous Abstraction for K4













Production Bores: ——Kb4















Appendix B

Borefield Log Books

К4

24/05/16	Bore water sample - TA
26/05/16	Read meters - CG
2/06/16	Read meters - BB
9/06/16	Read meters & check filter - TA
16/06/16	Read meters - BB
21/06/16	Read meters - TA
28/06/16	Take sample - BB
30/06/16	Read meter - BB
7/07/16	Read meters - TA
14/07/16	Read meters - BB
21/07/16	Read meters - BB
25/07/16	Reset drive meter after power cut - BN
27/07/16	Bore water sample - TA
28/07/16	Read meters - BB
4/08/16	Read meters and change filter element - TA
11/08/16	Read meters - BB
18/08/16	Read meters - TA
24/08/16	Turn off valve to M2PP Pond - BB
25/08/16	Meter read - CK
31/08/16	Take sample - BN
1/09/16	Meter read - CK
8/09/16	Read meters - BB
15/09/16	Meter read - CK
22/09/16	Meter read - Ck
28/09/16	Bore sample - CK
29/09/16	Turned on valve for M2PP. Left padlock in place - CK
29/09/16	Meter readings - TA
6/10/16	Meter readings and filter change - TA
13/10/16	Read meters - Bb
20/10/16	Read meters - BB
27/10/16	Bore sample - BB
27/10/16	Read meters - TA
3/11/16	Meter read - CK
8/11/16	Reset driver - BN
8/11/16	Read meters and reset drive again - CK/RY
8/11/16	Charger/Inverter bypassed - Bill B
16/11/16	Read meters - BB
24/11/16	Read meters - Ry
25/11/16	Run bore take bore sample - TA
1/12/16	Read meters - RY
8/12/16	Read meters - RY
16/12/16	Meter read - CK



K4	
19/12/16	Take sample - BB
20/12/16	DRN Audit - Simon Fraser
22/12/16	Meter readings - TA
29/12/16	Read meters - BB
12/01/17	Read meters - BB
19/01/17	Meter readings and change filter - TA
27/01/17	Take samples - BN
27/01/17	Read meters - BB
3/02/17	Read meters - RY
8/02/17	Turn off VSD and lockout - RY
13/02/17	Turn-on VSD and read meters - RY
16/02/17	Meter read, clean filter - TA
23/02/17	Read meters - BB
27/02/17	Take bore water sample - TA
2/03/17	Read meters - TA
9/03/17	Read meters - RY
16/03/17	Site check and read meters - TA
23/03/17	Read meters - BB
29/03/17	Take sample - BB
30/03/17	Read meters - RY
7/04/17	Read meters - BB
14/04/17	Meter read - CK
20/04/17	Read meters - BB
26/04/17	Bore water sample and read meters - TA
5/05/17	Read meters - BB
11/05/17	Read meters - RY
19/05/17	Meter read - ?
22/05/17	Plug the M2PP outlet - BB
25/05/17	Check bore and take readings - RY
31/05/17	Take samples - BN/DB
2/06/17	Read meters - BB
8/06/17	Read meters - RY
15/06/17	Meter read - CK
22/06/17	Read meters and check well head - RY
28/06/2017	Samples taken and weekly checks completed - BB.



KB4

7/07/16	Read meters & check site - TA
14/07/16	Read meters - BB
21/07/16	Read meters - BB
25/07/16	Reset drive after power cut - BN
27/07/16	Bore sample - TA
28/07/16	Read meters - BB
4/08/16	Read meters - TA
11/08/16	Read meters - BB
18/08/16	Site visit meter read - TA
25/08/16	Meter read - CK
31/08/16	Take samples - BN
1/09/16	Meter read - CK
8/09/16	Read meters - BB
15/09/17	Meter read - CK
22/09/16	Meter read - CK
28/09/16	Bore Samples - CK
29/09/16	Meter read - TA
6/10/16	Meter read change filter - TA
13/10/16	Read meters - BB
20/10/16	read meters - BB
27/10/16	Meter reading - TA/RY
27/10/16	Bore sample - CK
3/11/16	Meter read - CK
8/11/16	Meter read - CK/RY
17/11/16	Read meters - BB
24/11/16	Read meters - RY
25/11/16	Run bore take water sample - TA
1/12/16	Read meters - RY
8/12/16	Read meters - RY
16/12/16	Meter read - CK
19/12/16	Take samples - BB
20/12/16	Audit of drive/network - Simon Fraser
22/12/16	Meter read clean filter - TA
29/12/16	Read meters - BB
5/01/17	Read meter - BN
12/01/17	Read meter - BB
19/01/17	Meter read, change filter element - TA
27/01/17	Take samples - BN
27/01/17	Read meters - BB
3/02/17	Read Meters - RY
8/02/17	Turn off VSD + Lock out - RY
13/02/17	Turn on VSD + read meters - RY



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17/02/17	Read meters clean filter - TA
23/02/17	Read meters - BB
27/02/17	Take bore sample - TA
2/03/17	Meter readings - RY
9/03/17	Meter readings - RY
13/03/17	Reset smoke alarm - CK
16/03/17	Site check meter read - TA
23/03/17	Read meters - BB
28/03/17	Take samples and reset drive - BB
30/03/17	Read meters and clean filter - BN
7/04/17	Read meters - BB
13/04/17	Meter read - CK
20/04/17	Read meters - BB
26/04/17	Bore water sample and read meters - TA
5/05/17	Read meters - BB
11/05/17	Read meters - Ry
19/05/17	Meter read - CK
25/05/17	Check bores and read meter - Ry
31/05/17	Take samples - BN/DB
2/06/17	Read meters - BB
7/06/17	Read meters - ?
15/06/17	Read meters - CK
22/06/17	Read meters and check well head - RY
28/06/2017	Samples taken and weekly checks completed - BB.


К5

7/07/16	Read meters check site - TA
14/07/16	Read meters - BB
21/07/16	Read meters - BB
25/07/16	Reset driver from power cut - BN
27/07/16	Bore water sample - TA
28/07/16	Read meters - BB
4/08/16	Meter read - change filter element - TA
11/08/16	Read meters - BB
18/08/16	Read meters check site - TA
25/08/16	Meter read - CK
31/08/16	Take sample - BN
1/09/16	Meter Read - ?
8/09/16	Read meters - BB
22/09/16	Meter read - CK
28/09/16	Bore sample - CK
29/09/16	Read meters - TA
6/10/16	Read meters check filter - TA
20/10/16	Read meters - BB
24/10/16	Diesel spill north of Bore about 3500mm by 2000mm -
27/10/16	Bore sample - CK
27/10/16	Read meters - TA/RY
3/11/16	Meter read - CK
8/11/16	Meter read - CK/RY
17/11/16	Read meters - Tree branches put over fence - BB
24/11/16	Read meters - RY
25/11/16	Run bore take water sample - TA
1/12/16	Read meters - RY
8/12/16	Read meters - RY
16/12/16	Meter read - CK
19/12/16	Take sample - BB
20/12/16	DRN Audit - Simon Fraser
22/12/16	Meter reading and change filter - TA
29/12/16	Read meters - BB
5/01/17	Read meters - ?
12/01/17	Read meters - BB
19/01/17	Meter read change filters - TA
27/01/17	read meters - BB
3/02/17	Read meters - Ry
8/02/17	Turn off VSD + lock out - RY
13/02/17	Turn on VSD + read meters - RY
16/02/17	Meter read clean filter - TA
23/02/17	Read meters - BB



К5	
27/02/17	Take bore water sample - TA
2/03/17	Meter readings - TA
9/03/17	Read meters - RY
16/03/17	Site check read meters - TA
23/03/17	Read meters - BB
28/03/17	Take sample - BB
30/03/17	Read meters - RY
7/04/17	Read meters - BB
13/04/17	Meter read - CK
20/04/17	Read meters - BB
26/04/17	Take bore water sample read meters - TA
5/05/17	Read meters - BB
11/05/17	Read meters - RY
18/05/17	Meter Read - CK
25/05/17	Check bores and take readings - RY
31/05/17	Take samples - BN/DB
2/06/17	Read meters - BB
8/06/17	Read meters - RY
15/06/17	Meter read - CK
22/06/17	Read meters and check well head - RY
28/06/2017	Samples taken and weekly checks completed - BB.



К6

6/07/16	Power failure - reset equipment - BN & BB
	Earth leakage trip - unable to find cause. Test earth leakage at single phase
6/07/16	power point and it tripped at the power point and not at the main switch Bill B
7/07/16	Site visit, meter readings - TA
14/07/16	Read meters - BB
21/07/16	Read meters - BB
25/07/16	Reset driver from Sunday 24th's power cuts - BN
25/07/16	Reinstall compressor - Jason Car
27/07/16	Take sample - TA
28/07/16	Isolate compressor ring air controls from action BN
28/07/16	Read meters - BB
4/08/16	Meter read - replace cabinet filter element - TA
11/08/16	Read meters - BB
	Rest comms, Main ISOL switch behind control panel door - Switch off then on
12/08/16	ТА
18/08/16	Plant check - meter read - TA
22/08/16	Reboot comms - BN
25/08/16	Meter read - CK
29/08/16	Reset comms - CK
30/08/16	Replace compressor contractor, ok - Kapiti Elec - Paul
31/08/16	Reset driver take sample - BN
1/09/16	Meter read - CK
8/09/16	Read meters - BB
13/09/16	Swapped PLC - AFI/PM
15/09/16	Meter read - CK
22/09/16	meter read - CK
28/09/16	Bore sample - CK
29/09/16	Meter readings - TA
6/10/16	Meter readings - TA
13/10/16	Read meters - BB
20/10/16	Read meters - BB
27/10/16	Bore sample - CK
27/10/16	Read meters check filter - TA
3/11/16	Meter read - Ck
8/11/16	Read meters - CK
17/11/16	Read meters - BB
24/11/16	Read meters - Ry
25/11/16	Run bore take water sample - TA
1/12/16	Read meters - RY
8/12/16	Read meters - Ry
16/12/16	Meter read - CK
19/12/16	Take Sample - BB



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22/12/16	Meter readings - TA
29/12/16	Read meters - BB
5/01/17	Read meters - BN
12/01/17	Read meters - BN
19/01/17	Meer read change filter - TA
27/01/17	Take Sample - BN
27/01/17	Read meters - BB
3/02/17	Read meters - RY
8/02/17	Turn off VSD + lock out drain and isolate surge tank - RY
9/02/17	Drained surge tank, meter read - CK/BB
13/02/17	Turned on VSD - RY
16/02/17	Meter read clean filter replace - TA
23/02/17	read meters - BB
27/02/17	Reset surge tank level sensor - CK
2/03/17	Read meters - TA
9/03/17	Read meters - ??
16/03/17	Site check read meters - TA
22/03/17	Read meters - BB
28/03/17	Take Sample - BB
30/03/17	Read meters - RY
7/04/17	Read meters - BB
13/04/17	Meter read - CK
20/04/17	Read meters - BB
26/04/17	Take bore water sample read meters - TA
5/05/17	Read meters - BB
11/05/17	Read meters - RY
19/05/17	Meter read - CK
25/05/17	Check bore and take readings - RY
	Checked compressor and level. Level on 0% won't reset, compressor won't run
31/05/17	rang Bill B CK/RY
31/05/17	Isolated tank and started to drain - CK
31/05/17	Take samples - BN/BB
31/05/17	Fitted new level sensor to tank (surge) - CK/BB
2/06/17	Read meters - BB
8/06/17	Read meters - RY
15/06/17	Meter read - CK
22/06/17	Read meters and check well head/surge tank - RY
28/06/2017	Samples taken and weekly checks completed - BB.



К10

7/07/16	Read meters - TA
14/07/16	Read meters - BB
27/07/16	Bore sample - TA
28/07/16	Read meters - BB
	Read meters, inspect site. Removed graffiti off control cabinet. Advised DB & BN
	of possible diesel contamination adjacent to site from diesel powered night flood
4/08/16	lights. Took photos TA
11/08/16	Read meters - BB
18/08/16	Read meters check site - TA
25/08/16	Read meters - CK
31/08/16	Turn on manual and run pump/take sample - BN
1/09/16	Meter read - CK
8/09/16	Read meters - BB
15/09/16	Meter read - CK
22/09/16	Meter read - CK
28/09/16	Bore sample - CK
29/09/16	Site inspection, meter read and replace filter in cabinet - TA
6/10/16	Site inspection meter readings - TA
13/10/16	Read meters - BB
20/10/16	Read meters - BB
27/10/16	Bore samples - CK
13/11/16	Meter read - CK
17/11/16	Meter read - BB
24/11/16	Read meters - RY
25/11/16	Start bore manually and run. Take bore water sample - TA
1/12/16	Take meter readings - RY
8/12/16	Meter readings - RY
16/12/16	Meter read - CK
19/12/16	Take samples - BB
20/12/16	Digital redo audit - Simon Fraser
22/12/16	Site visit, meter readings - TA
29/12/16	Read meters - BB
5/01/17	Read meters - BN
12/01/17	Read meters - BB
26/01/17	Read meters - BB
27/01/17	Take samples - BN
3/02/17	Read meters - RY
8/02/17	Turn off VSD + Lock out - RY
9/02/17	Meter read, surge tank drain - CK/BB
13/02/17	Turn on VSD reinstate surge chamber - RY/BB
16/02/17	Meter readings clean filter - TA
27/02/17	Take bore sample - TA



K10	
2/03/17	Meter readings - TA
9/03/17	Meter reading - RY
10/03/17	Clean in and out cabinet - RY
16/03/17	Site check, meter readings - TA
29/03/17	Take samples - BB
30/03/17	Meter readings - ?
7/04/17	Meter read - BB
13/04/17	Meter read - CK
20/04/17	Read meter - BB
26/04/17	Take bore sample - read meter - TA
5/05/17	Read meters - BB
11/05/17	Read meters - ?
18/05/17	Meter read - CK
25/05/17	Check bore + read meter - RY
	Checked compressor long running, found off loader valve stuck on, turned off
31/05/17	compressor CK
2/06/17	Read meters - BB
7/06/17	Read meters - RY
15/06/17	Meter read - CK
22/06/17	Site maintenance visit. Meter read - TA
28/06/2017	Samples taken and weekly checks completed - BB.



K12

7/07/16	Read meters, site check - TA
14/07/16	Read meters - BB
21/07/16	Read meters - BB
25/07/16	Reset drive after power cut - BN/DB/BB
28/07/16	Read meters - BB
28/07/16	Take bore water samples - TA
4/08/16	Read meters, change filter element - TA
18/08/16	Site check read meters - TA
31/08/16	Take samples - BN/DB/BB
1/09/16	Meter read - CK
15/09/16	Meter read - CK
22/09/16	Meter read - CK
29/09/16	Bore sample - CK
29/09/16	Meter readings - TA
6/10/16	Meter readings - TA
13/10/16	Read meter - BB
20/10/16	Read meter - BB
27/10/16	Bore sample - CK
27/10/16	Meter readings - TA
3/11/16	Meter read - CK
8/11/16	Meter read - CK
17/11/16	Read meters - BB
24/11/16	Read meter - RY
25/11/16	Run bore, take water sample - TA
1/12/16	Read meters - RY
8/12/16	Read meters - RY
16/12/16	Meter read - CK
19/12/16	Take sample - BB
22/12/16	Meter readings filter ok - TA
29/12/16	Smoke alarm tripped, checked ok - RY
29/12/16	Read meters - BB
5/01/17	Read meters - BB
12/01/17	Read meters - BN
19/01/17	Read meters change filter - TA
27/01/17	Take sample - BN
27/01/17	Read meters - BR?
3/02/17	Read meters - RY
8/02/17	Turn off VSD + lock out - RY
13/02/17	Turn on VSD + read meters - RY
16/02/17	Meter read clean filter - TA
23/02/17	Read meters - BB
24/02/17	Electrical surge capture circuiting installed - Bill B



v	1	2
n	т	2

27/02/17	Reset drive, ext fault - CK
27/02/17	Take bore water sample - TA
2/03/17	Meter readings - TA
9/03/17	Read meters - RY
16/03/17	Site check meter read - TA
23/03/17	Read meters - BB
28/03/17	Take sample - BB
30/03/17	Read meters - RY
	Smoke detector activation. Check cabinet all ok. Talked with Bill Borkin - maybe
6/04/17	2nd faulty until. He will investigate further. 1700/1730hrs on site - TA
7/04/17	Read meters - BB
13/04/17	Meter read - CK
20/04/17	Read meters - BB
26/04/17	Bore water sample. Read meters - TA
5/05/17	Read meters - BB
11/05/17	Read meters - RY
19/05/17	Meter read - RY
25/05/17	Check bore and take readings - RY
31/05/17	Take samples bore - DB
2/06/17	Read meters - BB
8/06/17	Read meters - Ry
15/06/17	Meter read - CK
22/06/17	Read meters + check well head - RY
28/06/2017	Samples taken and weekly checks completed - BB.



Kb7

7/07/16	Read meters and check site - TA
14/07/16	Read meters - BB
21/07/16	Read meters - BB
25/07/16	Reset drive from power cut - BN
27/07/16	Reset comm's - BN
27/07/16	Take bore water sample - TA
28/07/16	Read meters - BB
4/08/16	Meter read, change filter element - TA
08/08/16	Reboot comm's - BN
11/08/16	Read meters - BB
18/08/16	Site check read meters - TA
19/08/16	Turn off and on main ISOL switch to fix comms fail - BB
22/08/16	Reboot comms - BN
25/08/16	Meter read - CK
31/08/16	Reset coms and take sample - BN
1/09/16	Meter read - CK
8/09/16	Read meters - BB
13/09/16	Swapped PLC - AFI/PM
15/09/16	Meter read - CK
22/09/16	Meter read - CK
28/09/16	Reset drive from power cut -
29/09/16	Meter readings - TA
6/10/16	Meter readings - TA
13/10/16	Read meters - BB
20/10/16	Read meters - BB
27/10/16	Bore sample - CK
27/10/16	Meter readings - TA
3/11/16	Meter read - CK
8/11/16	Meter read - CK
17/11/16	Read meters - BB
24/11/16	Read meters - Ry
25/11/16	Run bore take water sample - TA
1/12/16	Read meters - RY
8/12/16	Read meters - RY
16/12/16	Meter read - CK
19/12/16	Take sample - BB
19/12/16	Reset ISOL switch - BB
22/12/16	Take meter readings - TA
29/12/16	Read meters - BB
5/01/17	Read meters - BN
12/01/17	Read meters - BB
19/01/17	Read meters, change filter - TA



Kb7

27/01/17	Take sample - BN
27/01/17	Read meters - BB
3/02/17	Read meters - RY
8/02/17	Turn off VSD + lock out - RY
13/02/17	Turn on VSD + read meters - RY
16/02/17	Meter read, clean filter - TA
23/02/17	Read meters - BB
27/02/17	Take bore water sample - TA
2/03/17	Meter readings and check bore head & valve chamber - TA
9/03/17	Read meters - RY
16/03/17	Site check read meters - TA
23/03/17	Read meters - BB
28/03/17	Take sample - BB
30/03/17	Read meters - RY
7/04/17	Read meters - BB
13/04/17	Meter read - CK
20/04/17	Read meters - BB
26/04/17	Take bore water sample, read meters - TA
5/05/17	Read meters - BB
11/05/17	Read meters - Ry
19/05/17	Meter read - CK
25/05/17	Check bore + take readings - RY
31/05/17	Take samples - BN/DB
2/06/17	Read meters - BB
8/06/17	Read meters - RY
15/06/17	Meter Read - ?
22/06/17	Read meters, check well head - RY
28/06/17	Samples taken and weekly checks completed - BB.



N2

7/07/16	Meter Readings - TA
16/07/16	Read Meters - BB
25/07/16	Reset Driver - BN
27/07/16	Take bore water sample - TA
4/08/16	Site Visit Meter Readings - TA
11/08/16	Read Meters - BB
18/08/16	Meter Readings - TA
25/08/16	Meter read - CK
31/08/16	Take Sample - BN
1/09/16	Meter read - CK
8/09/16	Read meters - BB
15/09/16	Meter read - CK
22/09/16	Meter read - CK
22/09/16	Meter read - CK
28/09/16	Bore Sample - CK
29/09/16	Meter read - TA
6/10/16	Meter readings - TA
13/10/16	Read meters - BB
20/10/16	Read Meters - BB
27/10/16	Bore Sample - CK
27/10/16	Meter Readings - TA
3/11/16	Meter read - CK
8/11/16	Meter read - CK
17/11/16	Read Meters - BB
24/11/16	Read Meters - RY
25/11/16	Run Bore take sample - TA
1/12/16	Read meters - RY
8/12/16	Read meters - RY
16/12/16	Meter read - CK
19/12/16	Take Sample - BB
29/12/16	Read meters - BB
12/01/17	Read meters - BB
19/01/17	Read meter and replace filter - TA
26/01/17	Read meters - BB
27/01/17	Take sample - BN
2/02/17	Read meters - RY
8/02/17	Turn off VSD + lockout - RY
13/02/17	Turn on VSD + read meters - RY
16/02/17	Meter read and check filter - TA
23/02/17	Read meter - BB
27/02/17	Take core water sample - TA
2/03/17	Meter readings - TA



N2	
9/03/17	Read meters - RY
16/03/17	Site check read meters - TA
23/03/17	Read meters - BB
29/03/17	Take sample - BB
30/03/17	Read meters - change filter - RY
7/04/17	Read meters - BB
13/04/17	Meter read - CK
20/04/17	Read meters - BB
26/04/17	Take borewater sample and take meter readings - TA
5/05/17	Read meters - BB
11/05/17	Read meters - RY
14/05/17	Meter read - CK
25/05/17	Bore checks plus meters - RY
31/05/17	Take samples - BN/DB
2/06/17	Read meters - BB
7/06/17	Read meters - RY
15/06/17	Meter read - CK
22/06/17	Read meters and check well head - RY
28/06/17	Samples taken and weekly checks completed - BB.



Appendix C

Groundwater Level and Electrical Conductivity Monitoring Results



C.1 Shallow Aquifer Water Level Monitoring











Figure C1. 3 Water Levels at KCDC K1 Monitoring Bore (R26/7025)



Figure C1. 4 Water Levels at Rangirohoa Street TW2-MW3 Monitoring Bore (R26/6287)





Figure C1. 5 Water Levels at Te Harakeke 03 Monitoring Bore (R26/6886)



Figure C1. 6 Water Levels at Waikanae CHP Shallow Monitoring Bore (R26/6916)





Figure C1. 7 Water Levels at Jim Cooke Memorial Park Shallow Monitoring Bore (R26/7209)



Figure C1. 8 Water Levels at Kb1 Observation Shallow, Ngaio Road Monitoring Bore (R26/76304). Note: Triggers not applicable to this site because the water level naturally falls below the bottom of the well.





Figure C1. 9 Water Levels at K3A Observation Shallow, Cemetery Monitoring Bore (R26/6290)



Greenhill North Shallow, Greenhill Rd Nth

Figure C1. 10 Water Levels at Greenhill North Shallow Greenhill Rd North Monitoring Bore





Greenhill South Shallow, Greenhill Rd Sth





Figure C1. 12 Water Levels at K12 Obs Shallow, Smithfield Road Monitoring Bore





C.2 Deep Aquifer Water Level Monitoring









Sentinel #2 Deep Hodgkins Rd

Figure C2.3: Water Levels in Sentinel #2 Deep Monitoring Bore at Hodgkins Rd



Sentinel #2 Intermediate Hodgkins Rd

Figure C2.4: Water Levels in Sentinel#2 Intermediate Monitoring Bore at Hodgkins Rd





Sentinel #3 Deep, Old WWTP

Figure C2.5: Water Levels in Sentinel #3 Deep Monitoring Bore at Old WWTP (R26/6776)



Figure C2.6: Water Levels in Sentinel #3 Intermediate Monitoring Bore at Old WWTP (R26/6776)





Sentinel #4 Deep, Peka Peka Rd

Figure C2.7: Water Levels in Sentinel #4 Deep Monitoring Bore at Peka Peka Rd



Sentinel #4 Intermediate, Peka Peka Rd

Figure C2.8: Water Levels in Sentinel #4 Intermediate Monitoring Bore at Peka Peka Rd





Sentinel #5 Deep, Taiata St

Figure C2.9: Water Levels in Sentinel #5 Deep at Taiata St









Figure C2.11: Water Levels in Sentinel #5 Shallow at Taiata St (R26/6673).



Sentinel #6 Deep, Tamiti Place

Figure C2.12: Water Levels in Sentinel #6 Deep at Tamati Place





Sentinel #6 Intermediate, Tamiti Place





Figure C2. 14: Water Levels in Waikanae CHP Deep Monitoring Bore (R26/6594).





Figure C2.15: Water Levels in Waikanae Park Monitoring Bore (R26/6284).





C.3 Electrical Conductivity Monitoring

Figure C3.1: Electrical Conductivity in Sentinel #1 Deep Rutherford Drive Monitoring Bore (R26/6378).



Sentinel #1 Intermediate, Rutherford Drive

Figure C3.2: Electrical Conductivity in Sentinel #1 Intermediate Rutherford Drive Monitoring Bore





Sentinel #2 Deep, Hodgkins Rd

Figure C3.3: Electrical Conductivity in Sentinel #2 Deep Hodgkins Rd Monitoring Bore



Sentinel #2 Intermediate, Hodgkins Rd

Figure C3.4: Electrical Conductivity in Sentinel #2 Intermediate Hodgkins Rd Monitoring Bore





Figure C3.5: Electrical Conductivity in Sentinel #3 Deep Old WWTP Monitoring Bore (R26/6776)



Figure C3.6: Electrical Conductivity in Sentinel #3 Intermediate Old WWTP Monitoring Bore (R26/6776)





Sentinel #4 Deep, Peka Peka

Figure C3.7: Electrical Conductivity in Sentinel #4 Deep Peka Peka Rd Monitoring Bore



Sentinel #4 Intermediate, Peka Peka Rd

Figure C3.8: Electrical Conductivity in Sentinel #4 Intermediate Peka Peka Rd Monitoring Bore





Sentinel #5 Deep, Taiata Street

Figure C3.9: Electrical Conductivity in Sentinel #5 Deep Taiata St Monitoring Bore



Figure C3.10: Electrical Conductivity in Sentinel #5 Intermediate Taiata St Monitoring Bore (R26/6955).





Figure C3.11: Electrical Conductivity in Sentinel #5 Shallow Taiata St Monitoring Bore



Sentinel #6 Deep, Tamati Place

Figure C3.12: Electrical Conductivity in Sentinel #6 Deep Tamati Place Monitoring Bore





Sentinel #6 Intermediate, Tamati Place

Figure C3.13: Electrical Conductivity in Sentinel #6 Intermediate Tamati Place Monitoring Bore



Appendix D

Wetlands Baseline Monitoring Annual Report 2016/17

Wetland Baseline Monitoring Annual Report

A report on 2016/17 data collection for water permit WGN130103[34384] Prepared for Kapiti Coast District Council

15 September 2017


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Appendices

Appendix A Raw data sheets

Appendix B: Photo Points

1. Introduction

There are thirteen wetlands being monitored on the Kapiti Coast associated with the Kapiti Coast District Council (KCDC) consents River Recharge with Groundwater project (RRwGW). This monitoring is being carried out in accordance with the approved wetland baseline monitoring plan (WBMP) under consent WGN 130103 [34384] condition 29.

The purpose of the baseline monitoring is to gather information that will form the pre- activity measures of the wetlands condition and variability in the absence of the potential effect.

The wetlands (mapped in Figure 1) are as follows:

- 1. Poplar Ave Wetland
- 2. Crown Hill Manuka Bush Wetland
- 3. Muaupoko Swamp Forest
- 4. Otaihanga Southern Wetland
- 5. Tini Bush Wetland
- 6. El Rancho Wetland (Weggery)
- 7. Te Harakeke / Kawakahia Wetland
- 8. Nga Manu Wetland
- 9. Ngarara Wetland
- 10. Ngarara Bush Wetland
- 11. Peka Peka Road Swamp
- 12. Te Hapua Swamp Complex A
- 13. Te Hapua Swamp Complex D

The baseline wetland monitoring for the period of December 2014 – May 2017 comprises of:

- Water level piezometer monitoring; as measured at 15min intervals over the December – May monitoring season.
- Annual Summer wetland condition monitoring, including photo points and set permanent vegetation plots;
- A map of high resolution aerial photography and associated vegetation communities.

This report details the results of the third and final baseline monitoring survey for the period December 2016 to May 2017 and is required to present:

- Details of the results of Wetland Condition Monitoring as prescribed in the Wetland Condition Monitoring Sheets ¹, including photographs of fixed photo-points for each wetland.
- Updated information of fauna presence, based on observations during Wetland Condition Monitoring and botanical survey work (and any other known information).

1

¹ B. R. Clarkson et al., *Handbook for Monitoring Wetland Condition: Coordinated Monitoring of New Zealand Wetlands* (Wellington: Ministry for the Environment, 2004).

- Updated information on wetland classification as per Johnson and Gerbeaux ².
- Groundwater levels of each wetland from each of the water level piezometers.

In the report following, these areas will be covered site by site, except for the wetland condition indices (Section 3.1, page 5) and wetland classification (Section 4, page 5) which are covered in one table addressing all sites.

A detailed high-resolution aerial photograph of each monitored wetland, with associated vegetation communities (as per Atkinson ³) overlaid, was presented in 2014/15 Wetland Condition monitoring baseline report .This is to remain the baseline reference map and are kept within this year's report for additional reference. It is proposed that any significant changes measured in subsequent impact monitoring (as opposed to the three-year baseline monitoring) of the wetland condition monitoring indices or vegetation communities, will trigger remapping of the wetlands to further ascertain the extent of the change.

² Wetland Types in New Zealand (Wellington: Department of Conservation, 2004).

³ "Derivation of Vegetation Mapping Units for an Ecological Survey of Tongariro National Park North Island, New Zealand," *New Zealand Journal of Botany* 23 (1985): 361–78.



Figure 1. Monitored wetland locations

2. Methods

The monitoring methods are set out in the Wetland BMP and follow the Handbook for Monitoring Wetland Condition ⁴. In February 2015 two monitoring plots were established in each of the monitored wetlands, with the exception of Ngarara wetland whose small size only allowed for one plot. Plot placement targeted representative vegetation communities that bordered most obvious wet to dry ecotone, as to easily record subtle changes within the wetland. Photo points were established at staked points to further encapsulate future changes to wetland form.

Some monitoring sites are on, or accessed from, private landowners properties and as such access is not guaranteed. In 2016/2017 access was not available to the Te Harakeke site and so no data apart from piezometer water levels is available for this current period.

Vegetation species found in plots were then classified according to fidelity to a wetland environment as identified in the vegetation tool for wetland delineation ⁵. Any additional species that appeared in monitoring which were not included ⁶, were classified according to fidelity through discussions with suitably experienced plant ecologists.

Piezometers for the purpose of recording groundwater levels for project consents were installed in mid-November 2014 in Muaupoko Swamp Forest, Peka Peka Rd Swamp, Crown Hill Manuka Bush, and Poplar Ave Wetland. Additional groundwater information was gained from other piezometers within the region from both existing council piezometers and those related to the MacKays to Peka Peka expressway construction.

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⁴ Clarkson et al., Handbook for Monitoring Wetland Condition: Coordinated Monitoring of New Zealand Wetlands.

⁵ B. R. Clarkson, "A Vegetation Tool for Wetland Delineation in New Zealand" (Landcare Research for Meridian Energy Ltd, December 2013).

⁶ Ibid.

3. Results

The wetland condition monitoring for the 2016-17 baseline monitoring survey and analysis were carried out by Boffa Miskell (BML) staff and Pat Enright, a local botanist on the 2nd and 3rd of March 2017. Weather at the time of sampling was overcast.

The monitoring period for wetlands as set out by Condition 22 of consent WGN130103 [34384] require monitoring to be undertaken between 01 December and 31 May each year. Outside of this period, monitoring of the wetlands is only required if river recharge activities have occurred.

For the 2016-17 monitoring period river recharge was not used due to the wet summer period.

Raw data of wetland condition monitoring collected at each site is presented in Appendix A.

3.1 Kapiti Coast Climate Summer 2016/17

The climate in the year preceding the 2016/2017 summer surveys was unusually warm and wet. Paraparaumu recorded the highest annual average temperature, highest mean minimum temperature and highest daily maximum temperature since records began. Rainfall was also well above normal for the Kapiti Coast with 175% above average spring rainfall, and between 120-149% above normal for the year (NIWA annual climate summary, 2017).

3.2 Wetland classes

For each monitoring period the wetland classification ⁷ is assessed and reported in the Table 1 below. It compares the wetland classifications from the wetland BMP with the classification determined for the monitoring site following the annual wetland condition monitoring survey. Note that the 2015/16 survey showed no changes to the initial 2014/15 survey. Similarly, the 2016/17 surveys showed no changes to the initial 2014/15 survey.

Wetland name	BMP Wetland class	2014/15 classification	2015/16 classification	2016/17 classification	Description
		Nationally	or Regionally Sig	gnificant Wetland	
Muaupoko Swamp forest	Fen	Fen	Fen	Fen	Forest (upper section) with lower wetland dominated by shrubland (swamp Coprosma) with areas of sedgeland.

Table 1: Showing wetland classifications as per⁸ for the 2017 wetland monitoring survey.

⁷ Johnson and Gerbeaux, Wetland Types in New Zealand.

⁸ Ibid.

Wetland name	BMP Wetland class	2014/15 classification	2015/16 classification	2016/17 classification	Description
Nga Manu wetland	Fen	Fen	Fen	Fen	Predominantly forest with small, scattered areas of sedgeland dominated by <i>Carex secta</i> and <i>Carex</i> <i>virgata</i> and areas of shrubland and open water.
Te Hapua Swamp complex A	Swamp	Swamp	Swamp	Swamp	Tussockland (flaxland) with areas of reedland dominated by raupo. Occasional areas of shrubland.
Te Hapua Swamp complex D	Fen	Fen	Fen	Fen	Tussockland (flaxland) with areas of reedland dominated by raupo.
Te Harakeke / Kawakahi wetland	Swamp	Fen	Fen	Fen	Tussockland (flaxland) with areas of reedland dominated by raupo.
		Locally signi	ficant or informat	ion deficit wetland	ls
El rancho (Weggery) wetland	Fen	Fen	Fen	Fen	Shrubland with small, scattered areas of sedgeland dominated by <i>Carex secta</i> and <i>Carex</i> <i>virgata</i> and occasional rushland dominated by <i>Baumea.</i>
Peka Peka Rd swamp	Swamp	Swamp	Swamp	Swamp	Tussockland (flaxland) with areas of reedland dominated by raupo. Occasional areas of shrubland dominated by swamp Coprosma.
Tini bush wetland	Fen	Fen	Fen	Fen	Forest with small, scattered areas of sedgeland dominated by <i>Carex secta</i> and <i>Carex virgata.</i>
Ngarara bush wetland	Fen	Fen	Fen	Fen	Forest. Small fragment of kohekohe forest and a very small area of swamp forest

Wetland name	BMP Wetland class	2014/15 classification	2015/16 classification	2016/17 classification	Description
Ngarara Road wetland	Fen	Fen	Fen	Fen	Shrubland with small, scattered areas of sedgeland dominated by <i>Carex secta</i> and <i>Carex</i> <i>virgata.</i>
Otaihanga Southern Wetland	Fen	Fen	Fen	Fen	Sedgeland dominated by <i>Carex secta</i> and <i>Carex</i> <i>virgata</i> with small areas of Baumea rushland.
Crown hill manuka bush wetland	Fen	Fen	Fen	Fen	Shrubland with small, scattered areas of sedgeland and flaxland.
Poplar Ave wetland	Fen	Fen	Fen	Fen	Shrubland dominated by manuka with sedgelands and rushlands.

3.3 Wetland Condition Indices

Four elements make up the wetland condition score. The results of these elements, communicated as indices, are summarised in the following tables for all three baseline monitoring years.

The wetland condition index (Table 2), uses hydrological integrity, physio-chemical parameters, fire, intactness, dominance of native species, as sub-indices.

The wetland pressure index (Table 3), uses assessments of modification, water quality, animal access, and weed presence sub-indices. These indices are applied to the entire wetland (not to each plot).

The third index is the indicator score (Table 4), it uses: canopy cover, understory and species "health" sub-indices. This index is scored on the permanent plots.

The scores established are out of a total possible of 25 for condition, 30 for pressure and 20 for plot indices. These scores set the basis for the wetland monitoring programme where an increase in wetland condition, or indicator score reflects an increase in condition, and an increase in pressure reflects a decrease in condition.

Each of the monitored wetlands are further discussed below in respect to their baseline vegetation communities, fauna present and piezometer records in 2017.

Raw data in wetland plot sheets for each site can be found in Appendix A

Wetland condition index	2015 Survey	2016 Survey	2017 Survey
Poplar Ave	19.00	17.75	18.83
Crown Hill Manuka Bush	20.67	18.92	17.00
Muaupoko Swamp Forest	20.67	21.00	21.00
Tini Bush	18.33	18.33	19.58
Otaihanga Southern	13.25	16.00	15.58
El Rancho	18.00	19.17	19.00
Ngarara Rd	15.42	14.67	18.00
Nga Manu	20.17	20.92	20.83
Ngarara Bush	17.92	17.58	19.08
Te Harakeke / Kawakahia	18.83	17.83	No Data.
Peka Peka Rd	19.58	19.58	20.67
Te Hapua Swamp Complex A	18.75	18.58	20.67
Te Hapua Swamp Complex D	20.67	18.92	18.00

Table 2 Wetland condition index for each monitored wetland for the 2015, 2016 and 2017 summer monitoring surveys.

Table 3: Wetland pressure index for each monitored wetland for the 2015, 2016 and 2017 summer monitoring surveys.

Wetland pressure index	2015 Survey	2016 Survey	2017 Survey
Poplar Ave	14.00	16.00	17.00
Crown Hill Manuka Bush	20.00	15.00	16.00
Muaupoko Swamp Forest	11.00	12.00	10.00
Tini Bush	15.00	12.00	12.00
Otaihanga Southern	24.00	20.00	20.00
El Rancho	15.00	12.00	18.00
Ngarara Rd	18.00	16.00	17.00
Nga Manu	12.00	12.00	14.00
Ngarara Bush	17.00	18.00	14.00
Te Harakeke / Kawakahia	7.00	10.00	No Data.
Peka Peka Rd	15.00	15.00	15.00
Te Hapua Swamp Complex A	18.00	18.00	14.00
Te Hapua Swamp Complex D	20.00	15.00	16.00

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Wetland indicator score		Plot 1			Plot 2	
Year of survey	2015	2016	2017	2015	2016	2017
Poplar Ave	17	17	20	18	17	18
Crown Hill Manuka Bush	17	12	10	20	20	20
Muaupoko Swamp Forest	20	20	20	18	17	20
Tini Bush	20	20	20	18	18	18
Otaihanga Southern	12	10	10	17	16	15
El Rancho	17	18	18	17	18	20
Ngarara Rd	12	12	15	Only one plot.		
Nga Manu	19	19	20	18	18	18
Ngarara Bush	19	20	20	17	18	18
Te Harakeke / Kawakahia	16	16		12	12	
Peka Peka Rd	20	20	20	18	20	17
Te Hapua Swamp Complex A	6	7	18	15	11	20
Te Hapua Swamp Complex D	17	12	10	20	20	18

Table 4: Wetland indicator scores for each wetland plot for the 2015, 2016 and 2017 summer monitoring surveys.

Note: No access was granted for the 2017 surveys of Te Harakeke

3.5 Poplar Ave Wetland

3.5.1 Wetland fauna

A fantail was observed during this wetland survey.

3.5.2 Wetland photo points

Appendix B shows the photos from the photo points and these shots form one of the assessment factors for recognising wetland assemblage change.

3.5.3 Vegetation communities

Raw data for vegetation communities can be found within field data sheets, Appendix A. The summary of these in Table 5.

The baseline map of Poplar Ave wetland, consisting of an aerial map and overlaid vegetation communities, both recorded during surveys undertaken in 2015 is presented as Figure 3. The community boundaries are indicative only. They change seasonally to a small degree but where hydrology is stable the boundaries should also be relatively stable.

Poplar Ave Plot 1 is a manuka-machaerina wetland; Poplar Ave Plot 2 is a reedland (Isolepis), moss field with a thin scattering of manuka. Table 5 summarises the plot vegetation species presence and cover data.

Paran	neters	Poplar Ave_1	Poplar Ave_2
	Exotic	4	2
	Native	104	106
Proportion of visual	UPL	0	0
estimates of	FACU	0	0
vegetation cover	FACW	8	44
(%)	FAC	19	43
	OBL	81	21
	Total % cover	108	108
	Exotic	1	1
	Native	6	8
	UPL	0	0
Proportion of	FACU	0	0
species.	FACW	2	3
	FAC	2	3
	OBL	3	3
	Total no. of spp	8	10

Table 5. Showing proportions (as a % of total) of vegetation within permanent plots, as classified into wetland fidelity groups, of both plot vegetative cover and species presence for Poplar Ave Wetland.



Figure 2: Local wetland vegetation communities at Poplar Ave Wetland (based on March 2015 aerial photography and vegetation surveys).



Figure 3: Shallow groundwater levels for Poplar Ave wetland during the 2016/17 monitoring period

3.6 Crown Hill Manuka Bush Wetland

3.6.1 Wetland fauna

During the 2017 survey no native fauna was seen.

3.6.2 Wetland photo points

Appendix B shows the photos from the photo points and these shots form one of the assessment factors for recognising wetland assemblage change.

3.6.3 Vegetation communities

Raw data for vegetation communities can be found in Appendix A.

Table 6 summarises the plot vegetation species presence and cover data. Crown Hill Plot 1 is a kanuka swamp forest with pukatea; Crown Hill Plot 2 is a manuka swamp.

The baseline map of Crown Hill Manuka Bush wetland, consisting of an aerial map and overlaid vegetation communities, both recorded during 2015 surveys is presented as Figure 5. The community boundaries are indicative only. They change seasonally to a small degree but where hydrology is stable the boundaries should also be relatively stable.

Parameters		Crown Hill_1	Crown Hill_2
	Exotic	0	0
	Native	117	110
Duran antian afairmal	UPL	2	4
Proportion of Visual	FACU	0	34
vegetation cover (%)	FACW	10	23
vegetation cover (76)	FAC	90	49
	OBL	15	0
	Total % cover	117	110
	Exotic	0	0
	Native	4	10
	UPL	1	1
Proportion of	FACU	0	2
species.	FACW	1	4
	FAC	1	3
	OBL	1	0
	Total no. of spp	4	10

Table 6. Showing proportions (as a % of total cover) of vegetation within permanent plots, as classified into wetland fidelity groups, of both plot vegetative cover and species presence for Crown Hill Wetland.



Figure 4. Local wetland vegetation communities at Crown Hill Manuka Bush Wetland (based on March 2015 aerial photograph).

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Figure 5: Shallow groundwater levels for Crown Hill Manuka Bush wetland during the 2016/17 reporting period.

3.7 Muaupoko Swamp Forest

3.7.1 Wetland fauna

Fantails were seen and grey warbler heard.

3.7.2 Wetland photo points

Appendix B shows the photos from the photo points and these shots form one of the assessment factors for recognising wetland assemblage change.

3.7.3 Vegetation communities

Raw data for vegetation communities can be found in Appendix A.

Table 7 summarises the plot vegetation species presence and cover data. Muaupoko Plot 1 is a wetland forest with pukatea, nikau and *Freycinetia banksii*; Muaupoko Plot 2 is a coastal wetland forest with swamp maire, ngaio and broadleaf over hen and chicken fern.

The baseline map of Muaupoko Swamp wetland, consisting of an aerial map and overlaid vegetation communities, both recorded during 2015 surveys is presented as Figure 6. The community boundaries are indicative only. They change seasonally to a small degree but where hydrology is stable the boundaries should also be relatively stable.

Paran	neters	Muaupoko Swamp forest_1	Muaupoko Swamp forest_2
	Exotic	0	0
	Native	99	176
Proportion of visual	UPL	0	0
estimates of	FACU	8	123
vegetation cover	FACW	40	0
(%).	FAC	51	53
	OBL	0	0
	Total % cover	99	176
	Exotic	0	0
	Native	10	7
	UPL	0	0
Proportion of	FACU	4	4
species.	FACW	1	0
	FAC	5	3
	OBL	0	0
	Total no. of spp	11	7

Table 7 Showing proportions (as a % of total) of vegetation within permanent plots, as classified into wetland fidelity groups, of both plot vegetative cover and species presence for Muaupoko Swamp Forest



Figure 6: Local wetland vegetation communities at Muaupoko Swamp forest with position of permanent monitoring plots and photopoints (March 2015 aerial photograph).

3.7.4 Piezometer records



Figure 7: Shallow groundwater levels for Muaupoko swamp forest during the 2016/17 monitoring period

3.8 Otaihanga Southern Wetland

3.8.1 Wetland fauna

No fauna were recorded in the 2017 survey.

3.8.2 Wetland photo points

Appendix B shows the photos from the photo points and these shots form one of the assessment factors for recognising wetland assemblage change.

3.8.3 Vegetation communities

Raw data for vegetation communities can be found in Appendix A.

Table 8 summarises the plot vegetation species presence and cover data. Otaihanga Southern Plot 1 is a sedgeland with a dominance of *Carex secta* and the weed beggars tick; Otaihanga Southern Plot 2 is a sedgeland dominated by *Carex virgata*.

Paran	neters	Otaihanga South_1	Otaihanga South_2
	Exotic	87	32
	Native	9	61
Proportion of	UPL	0	1
visual estimates of	FACU	1	6
vegetation cover	FACW	37	28
(%)	FAC	50	6
	OBL	8	52
	Total % cover	96	93
	Exotic	4	4
	Native	5	7
	UPL	0	1
Proportion of	FACU	1	2
species.	FACW	3	3
	FAC	1	2
	OBL	4	3
	Total no. of spp	9	11

Table 8 Showing proportions (as a % of total) of vegetation within permanent plots, as classified into wetland fidelity groups, of both plot vegetative cover and species presence for Otaihanga South Wetland.

The baseline map of Otaihanga Southern wetland, consisting of an aerial map and overlaid vegetation communities, both recorded during 2015 surveys is presented as Figure 8. The community boundaries are indicative only. They change seasonally to a small degree but where hydrology is stable the boundaries should also be relatively stable.



Figure 8: Local Wetland vegetation communities at Otaihanga South Wetland (March 2015 aerial photograph)



Figure 9: Shallow groundwater levels for Otaihanga wetland site BH 10 during the 2016/17 reporting period.



Figure 10: Shallow groundwater levels for Otaihanga wetland site BH 305N during the 2016/17 reporting period.



Figure 11: Shallow groundwater levels for Otaihanga wetland site BH 305S during the 2016/17 reporting period.

3.9 Tini Bush Wetland

3.9.1 Wetland fauna

Tui were observed in the 2017 survey.

3.9.2 Wetland photo points

Appendix B shows the photos from the photo points and these shots form one of the assessment factors for recognising wetland assemblage change.

3.9.3 Vegetation communities

Raw data for vegetation communities can be found in Appendix A.

Table 9 summarises the plot vegetation species presence and cover data. Plot 1 is a Pukatea swamp forest with *Freycinetia banksii*; Tini Bush Plot 2 is a tree fern developing wetland forest with young kahikatea and pukatea under mamaku.

The baseline map of Tini Bush wetland, consisting of an aerial map and overlaid vegetation communities, both recorded during 2015 surveys is presented as Figure 12. The community boundaries are indicative only. They change seasonally to a small degree but where hydrology is stable the boundaries should also be relatively stable.

Para	meters	Tini Bush_1	Tini Bush_2
Proportion of visual	Exotic	0	1
	Native	16	49
	UPL	0	0
	FACU	1	35
vegetation	FACW	1	7
cover (%)	FAC	14	2
	OBL	0	6
	Total % cover	16	50
Proportion of species.	Exotic	0	1
	Native	5	9
	UPL	0	0
	FACU	1	3
	FACW	1	4
	FAC	3	1
	OBL	0	2
	Total no. spp	6	11

Table 9 Showing proportions (as a % of total) of vegetation within permanent plots, as classified into wetland fidelity groups, of both plot vegetative cover and species presence for Tini Bush Wetland.



Figure 12. Local wetland vegetation communities at Tini Bush Wetland (March 2015 aerial photograph), Note second plot is enlarged in insert for clarity.

3.9.4 Piezometer Records



Figure 13: Shallow groundwater levels for Tini Bush wetland during the 2016/17 reporting period.

3.10 El Rancho Wetland (Weggery)

3.10.1 Wetland fauna

No wetland fauna was recorded during the 2017 survey.

3.10.2 Wetland photo points

Appendix B shows the photos from the photo points and these shots form one of the assessment factors for recognising wetland assemblage change.

3.10.3 Vegetation communities

Raw data for vegetation communities can be found in Appendix A.

Table 10 summarises the plot vegetation species presence and cover data. El Rancho Plot 1 is a manuka swamp; El Rancho Plot 2 is also a manuka swamp.

The baseline map of El Rancho wetland, consisting of an aerial map and overlaid vegetation communities, both recorded during 2015 surveys is presented as Figure 14. The community boundaries are indicative only. They change seasonally to a small degree but where hydrology is stable the boundaries should also be relatively stable.

Par	ameters	El Rancho_1 (east)	Elrancho_2
Proportion of visual estimates of vegetation cover (%)	Exotic	3	0
	Native	83	75
	UPL	0	0
	FACU	1	1
	FACW	2	3
	FAC	82	71
	OBL	1	0
	Total % cover	86	75
Proportion of species.	Exotic	2	0
	Native	4	6
	UPL	0	0
	FACU	1	1
	FACW	2	3
	FAC	2	2
	OBL	1	0
	Total no. spp	6	6

Table 10 Showing proportions (as a % of total) of vegetation within permanent plots, as classified into wetland fidelity groups, of both plot vegetative cover and species presence for El Rancho Wetland.



Figure 14: Local wetland vegetation communities at El Rancho wetland (March 2015 aerial photograph).

3.10.4 Piezometer records



Figure 15: Shallow groundwater levels for El Rancho (Weggery) wetland logger R26_6916 during the 2016/17 reporting period.



Figure 16 Shallow groundwater levels for El Rancho (Weggery) wetland logger HA WM05, during the 2016/17 reporting period.

3.11 Te Harakeke / Kawakahia Wetland

This wetland did not undergo a wetland condition monitoring survey in 2017 due to access being denied by the landowner.



Figure 17. Local wetland vegetation communities Te Harakeke / Kawakahia wetland over the March 2015 aerial photograph.

3.11.1 Piezometer records



Figure 18: Shallow groundwater levels for Te Harakeke wetland during the 2016/17 monitoring period

3.12 Nga Manu Wetland

3.12.1 Wetland fauna

Tui, kereru and a large number of waterfowl were observed at the site.

3.12.2 Wetland photo points

Appendix B shows the photos from the photo points and these shots form one of the assessment factors for recognising wetland assemblage change.

3.12.3 `Vegetation communities

Raw data for vegetation communities can be found in Appendix A.

Table 11 summarises the plot vegetation species presence and cover data. Nga Manu Plot 1 is a flaxland fen with wetland shrubs; Nga Manu Plot 2 is a sedge/grassland fen with a dominance of *Carex virgata*, and bracken.

The baseline map of Nga Manu wetland, consisting of an aerial map and overlaid vegetation communities, both recorded during 2015 surveys is presented as Figure 19. There are several wetland types present, but the dominant classes are carex sedgeland and flaxland-wet shrubland. Note the community boundaries are indicative only. They change seasonally to a small degree but where hydrology is stable the boundaries should also be relatively stable.

Para	ameters	Nga Manu_1	Nga Manu_2
Proportion of visual estimates of vegetation cover (%)	Exotic	1	2
	Native	89	106
	UPL	0	0
	FACU	55	11
	FACW	13	13
	FAC	19	1
	OBL	3	83
	Total % cover	90	108
Proportion of species.	Exotic	1	1
	Native	13	9
	UPL	0	0
	FACU	6	4
	FACW	3	3
	FAC	3	1
	OBL	2	2
	Total no. spp	15	10

Table 11 Showing proportions (as a % of total) of vegetation within permanent plots, as classified into wetland fidelity groups, of both plot vegetative cover and species presence for Nga Manu Wetland.


Figure 19. Baseline Map (from March 2015 survey) of vegetation communities within Nga Manu wetland over the aerial photograph

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3.12.4 Piezometer records



Figure 20: Shallow groundwater levels for Nga Manu wetland during the 2016/17 reporting period.

3.13 Ngarara Wetland

3.13.1 Wetland fauna

No native fauna were recorded in the 2017 survey. Fernbird have been recorded previously in the wider area.

3.13.2 Wetland photo points

Appendix B shows the photos from the photo points and these shots form one of the assessment factors for recognising wetland assemblage change.

3.13.3 Vegetation communities

Raw data for vegetation communities can be found in Appendix A.

The fens here are Carex sedgeland that are strongly invaded by blackberry. Table 12 summarises the plot vegetation species presence and cover data. Ngarara Plot 1 is a blackberry growth over Carex. Plot 2 is a *Carex virgata* sedgeland.

The baseline map of Ngarara wetland, consisting of an aerial map and overlaid vegetation communities, both recorded during 2015 surveys is presented as Figure 21. The community boundaries are indicative only. They change seasonally to a small degree but where hydrology is stable the boundaries should also be relatively stable.

Pa	rameters	Ngarara Road _1
Dremention of viewel	Exotic	31
	Native	90
	UPL	0
Proportion of Visual	FACU	30
vegetation cover (%)	FACW	1
	FAC	0
	OBL	90
	Total % cover	121
	Exotic	2
	Native	3
	UPL	0
Proportion of	FACU	1
species.	FACW	1
	FAC	0
	OBL	3
	Total no. spp	5

Table 12 Showing proportions (as a % of total) of vegetation within permanent plots, as classified into wetland fidelity groups, of both plot vegetative cover and species presence for Ngarara Road Wetland.



Figure 21. Local wetland vegetation communities at Ngarara Wetland over the March 2015 aerial photograph.

3.13.4 Piezometer records



Figure 22: Shallow groundwater levels for Ngarara wetland during the 2016/17 reporting period.

3.14 Ngarara Bush Wetland

3.14.1 Wetland fauna

During the 2017 survey common native bird species were observed i.e.: grey warbler and tui.

3.14.2 Wetland photo points

Appendix B shows the photos from the photo points and these shots form one of the assessment factors for recognising wetland assemblage change.

3.14.3 Vegetation communities

Raw data for vegetation communities can be found in Appendix A.

Table 13 summarises the plot vegetation species presence and cover data. Ngarara Bush Plot 1 is a mahoe-kahikatea swamp forest with a drier kohekohe edge and typical limited (by shading) damp forest under canopy species. Ngarara Bush Plot 2 is a mahoe forest with regenerating pukatea and kohekohe and broadleaf native shrub and lower canopy species.

The baseline map of Ngarara wetland, consisting of an aerial map and overlaid vegetation communities, both recorded during 2015 surveys is presented as Figure 23. The community boundaries are indicative only. They change seasonally to a small degree but were hydrology is stable the boundaries should also be relatively stable. The vegetation is principally a pukatea, kahikatea, semi-swamp forest, with kohekohe on margins.

Parameter	S	Ngarara Bush_1	Ngarara Bush_2
	Exotic	0	2
Proportion of visual	Native	159	80
	UPL	1	1
	FACU	146	70
cover (%)	FACW	12	3
cover (%)	FAC	0	8
	OBL	0	0
	Total % cover	159	82
	Exotic	0	2
	Native	9	9
	UPL	1	1
Droportion of choosing	FACU	7	5
Proportion of species.	FACW	1	1
	FAC	0	4
	OBL	0	0
	Total no. spp	9	11

Table 13 Showing proportions (as a % of total) of vegetation within permanent plots, as classified into wetland fidelity groups, of both plot vegetative cover and species presence for Ngarara Bush Wetland.



Figure 23. Local wetland vegetation communities at Ngarara Bush wetland over the March 2015 aerial photograph.

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3.14.4 Piezometer records



Figure 24: Shallow groundwater levels for Ngarara Bush wetland during the 2016/17 reporting period.

3.15 Peka Peka Road

3.15.1 Wetland fauna

No wetland fauna recorded in the 2017 survey.

3.15.2 Wetland photo points

Appendix B shows the photos from the photo points and these shots form one of the assessment factors for recognising wetland assemblage change.

3.15.3 Vegetation communities

Raw data for vegetation communities can be found in Appendix A.

Table 14 summarises the plot vegetation species presence and cover data. Peka Plot 1 is a harakeke, raupo fen with edge wetland mingimingi. Peka Peka Plot 2 is a toitoi, wetland mingimingi wetland shrubland.

The Peka Peka site is a "fen" with toitoi, raupo and native wetland shrubs with areas of blackberry and willow. The baseline map of Peka Peka Road wetland, consisting of an aerial map and overlaid vegetation communities, both recorded during 2015 surveys is presented as Figure 25. The community boundaries are indicative only. They change seasonally to a small degree but were hydrology is stable the boundaries should also be relatively stable.

Parameters		Pekapeka_1	Pekapeka_2
	Exotic	0	5
	Native	79	65
Proportion of	UPL	0	0
visual	FACU	8	0
estimates of	FACW	5	37
cover (%)	FAC	43	3
	OBL	23	30
	Total % cover	79	70
	Exotic	0	1
	Native	8	5
	UPL	0	0
Proportion of	FACU	1	0
species.	FACW	2	3
	FAC	3	2
	OBL	2	1
	Total no. spp	9	6

Table 14 Showing proportions (as a % of total) of vegetation within permanent plots, as classified into wetland fidelity groups, of both plot vegetative cover and species presence for Peka Peka Wetland.



Figure 25. Local wetland vegetation communities of Peka Peka Road swamp over the March 2015 aerial photograph.

3.15.4 Piezometer records



Figure 26 Shallow groundwater levels for Peka Peka Road swamp during the 2016/17 reporting period.

3.16 Te Hapua Swamp Complex A

3.16.1 Wetland fauna

No fauna were observed during the vegetation surveys.

3.16.2 Wetland photo points

Appendix B shows the photos from the photo points and these shots form one of the assessment factors for recognising wetland assemblage change.

3.16.3 Vegetation communities

Raw data for vegetation communities can be found in Appendix A.

Table 15 summarises the plot vegetation species presence and cover data. Te Haupua swamp complex A Plot 1 is an *Isolepis* reedland. Te Haupua swamp complex A Plot 2 is a *Juncus* reedland with exotic weeds.

The wetland is largely a wet reed and sedgeland with *Isolepis* and *Carex-Juncus* and bracken. The baseline map of Te Haupua swamp complex A, consisting of an aerial map and overlaid vegetation communities, both recorded during 2015 surveys is presented as Figure 27. The community boundaries are indicative only. They change seasonally to a small degree but were hydrology is stable the boundaries should also be relatively stable.

Parameters		Te Hapua Complex A_1	Te Hapua Complex A_2	
	Exotic	2	0	
Broportion of	Native	75	98	
	UPL	0	0	
visual estimates	FACU	0	0	
of vegetation	FACW	2	45	
cover (%)	FAC	0	0	
	OBL	75	53	
	Total % cover	77	98	
	Exotic	1	0	
	Native	5	5	
	UPL	0	0	
Proportion of	FACU	0	0	
species.	FACW	1	1	
	FAC	0	0	
	OBL	5	4	
	Total no. spp	7	6	

Table 15 Showing proportions (as a % of total) of vegetation within permanent plots, classified into wetland fidelity groups, of both plot vegetative cover and species presence for Te Hapua Swamp Complex A.



Figure 27. Local wetland vegetation communities of Te Hapua Swamp Complex A over the March 2015 aerial photograph.

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3.16.4 Piezometer records



Figure 28: Shallow groundwater levels for Te Hapua Swamp Complex A during the 2016/17 reporting period.

3.17 Te Hapua Swamp Complex D

3.17.1 Wetland fauna

Native pukeko were observed on site. Royal spoonbill, also native, was reported as present by the land owner.

3.17.2 Wetland photo points

Appendix B shows the photos from the photo points and these shots form one of the assessment factors for recognising wetland assemblage change.

3.17.3 Vegetation communities

Raw data for vegetation communities can be found in Appendix A.

Table 16 summarises the plot vegetation species presence and cover data. Te Haupua swamp complex D Plots 1 and 2 are a sedgelands with a dominance of *Carex geminate*.

There are several wetland types present, ranging from carex sedgeland fen, raupo swamp, to harakeke semi-swamp. The baseline map of Te Hapua Swamp Complex D wetland, consisting of an aerial map and overlaid vegetation communities, both recorded during 2015 surveys is presented as Figure 29. The community boundaries are indicative only. They change seasonally to a small degree but were hydrology is stable the boundaries should also be relatively stable.

Parameters		TeHapua complex D_1	TeHapua complex D_2	
	Exotic	1	75	
	Native	106	35	
Proportion of	UPL	25	0	
visual	FACU	2	75	
vegetation	FACW	60	35	
cover (%)	FAC	0	0	
	OBL	20	0	
	Total % cover	107	110	
	Exotic	1	1	
	Native	4	1	
	UPL	1	0	
Proportion of	FACU	2	1	
species.	FACW	1	1	
	FAC	0	0	
	OBL	1	0	
	Total no. spp	6	3	

Table 16 Showing proportions (as a % of total) of vegetation within permanent plots, classified into wetland fidelity groups, of both plot vegetative cover and species presence for Te Hapua Swamp Complex D.



Figure 29. Local wetland vegetation communities of Te Hapua Swamp Complex D over the March 2015 aerial photograph.

3.17.4 Piezometer records



Figure 30: Shallow groundwater levels for Te Hapua Swamp Complex D during the 2016/17 reporting period.

4. Summary

This report presents the third year of a total three year baseline monitoring period for wetland condition, pressure and indicator values. Established vegetation plots provide records of species and proportional cover which has been classified into groups of wetland fidelity.

The third year of baseline monitoring for the river recharge with groundwater consent, occurred during a very warm, and wet summer.

The data did not show any significant declines or changes in wetland conditions and therefore a new aerial photograph and vegetation map was not triggered.

5. References

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Appendix A Raw data sheets

Poplar Ave Wetland

WETLAND RECORD SHEET					
Project:	Kapiti water supply	Date: 2 March 2017			
Wetland name:	Poplar ave	Time:	8am		
Region:	Kapiti Coast	Personal:	TR, PE		
Altitude:	7m elevation	# of Plots sampled:	2		

Classification: I System	IA Subsystem	II Wetland Class	IIA Wetland Form	
Palustrine	Permanent	Fen	Basin	

Indicator	Indicator components	Score 0– 5 ¹	Mean score	
	Impact of manmade structures	Induced historical drainage as part of drain 7 adjacent. Residential and roading construction. Water extraction bores in surroundings.	2	3.33
Change in hydrological integrity	Water table depth	Higher than normal due to previous years wet climate.	4	
	Dryland plant invasion	Minimal, some blackberry and gorse on edges, willow and elder samplings found. Regular control due to being a regional park	4	
Change in physico- chemical parameters	Fire damage	nil	5	4.25
	Degree of sedimentation/erosion	Minimal from surrounding farming practice	4	
	Nutrient levels	Some farming and stormwater run off presumed.	4	
	Von Post index	scored a 6	4	
Change in ecosystem intactness	Loss in area of original wetland	Some noted infilling and changed hydrology and earthworks: Fragmented by poplar ave road. Large clearance and drainage for farming.	3	2.50

	Connectivity barriers	Farmland, residential and roading	2	
Change in browsing, predation & harvesting regimes	Damage by domestic or feral animals	Some hare browse.	4	4.00
	Introduced predator impacts on wildlife	Low. Domestic and feral cats presumed.	3	
	Harvesting levels	ng levels Nil		
Change in	Introduced plant canopy cover	Nil	5	4.75
dominance of native plants	Introduced plant understorey cover	Nil	4.5	
Total wetland condition index /25				

¹ Assign degree of modification as follows: 5=v. low/ none, 4=low, 3=medium, 2=high, 1=v. high, 0=extreme

Main Vegetation types: Edge manuka canopy grading internally into a Flax Baumea and Isolepis prolifera and sphagnum community. Manuka edge encroaching inward.

Native fauna: Pukeko

Other comments: Within QE Regional Park - well maintained by volunteers and park staff, newly constructed metalled bicycle path to the western edge of the wetland.

Pressure	Score ²	Specify and Comment
Modifications to catchment hydrology	3	Expressway to east and ongoing drain maintenance in Drain 7 and Wharemauku stream adjacent, likely affecting water levels (same bed of peat). Extraction bores in the surroundings also likely to impact hydrology
Water quality within the catchment	4	Some farming and minimal road runoff.
Animal access	2	Fenced from stock. Some rabbit presence noted in area. Domestic cats likely to be main issue
Key undesirable species	4	Gorse, blackberry, Yorkshire fog, Lotus, bindweed all present. However, this appears to be moderately controlled.
% catchment in introduced vegetation	4	Much of the catchment in gorse, blackberry farmland and adjacent residential housing.
Other landuse threats	0	
Total wetland pressure index /30	17	

²Assign pressure scores as follows: 5=very high, 4=high, 3=medium, 2=low, 1=very low, 0=none

Plot 1: Poplar Ave Wetland

WETLAND PLOT SHEET						
Wetland name:	Poplar Ave	Date:	2 March 2017	Plot no:	1	
Plot size:	2mx2m	Altitude:	14 masl	Structure:	Rushland/mossland	
Personal:	TR, PE	Northing Easting	5466148 1766852	Composition:	Baumea/ Isolepis/ sphagnum	

Canopy (bird's eye view)		Subcanopy		Groundcover				
Species ¹ (or Substrate)	%	H (m)	Species	%	H (m)	Species	%	H (m)
Open Water	5	0.11	Holcus lanatus	4	0.5	Hydrocotyle pterocarpa	1	0.05
Leptospermum scoparium	15	1.7	Isolepis prolifera	50	0.4	Sphagnum	30	0.1
Machaerina teretifolia	4	1.2						

¹ % = % cover: total Canopy % cover = 100%; H = maximum height in m; indicate introduced species by *

Additional species in vicinity in same vegetation type: Carex virgata, lotus pedunculatus, Blechnum NZ

Fauna seen: pukeko.

Comments: Very wet

Indicator (use plot data only)	%	Score 0–5²	Specify & Comment
Canopy: % cover introduced species ²	0	5	Nil
Understorey: % cover introduced spp ³	0	5	Nil
Total species: % number introduced spp	0	5	
Total species: overall stress/dieback	NA	5	
	Total /20	20	

 2 5=0%: none, 4=1– 24%: very low, 3=25–49%; low, 2=50–75%: medium, 1=76–99%: high, 0=100%; v. high. 3 Add subcanopy and groundcover % cover for introduced species

Field measurements:	
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Water table cm	0.55	Water conductivity uS (if present)	0.187
Water pH (if present)	4.83	Von Post peat decomposition index	5

Plot 2: Poplar Ave Wetland

WETLAND PLOT SHEET						
Wetland name:	Poplar Ave	Date:	03.03.2017	Plot no:	2	
Plot size:	2mx2m	Altitude:	12 masl	Structure:	Shrubland - sedgeland	
Personal:	TR, PE	Northing Easting	5466195 1766834	Composition:	Manuka/baumea/ isolepis	

Canopy (bird's eye view)			Subcanopy			Groundcover		
Species ¹ (or Substrate)	%	h(m)	Species	%	h(m)	Ѕрр	%	h(m)
Open water	0	0	Machaerina teretifolia	20	2	Holcus lanatus	2	0.05
Leptospermum scoparium	40	2	Isolepis prolifera	10	0.6	Sphagnum moss	10	0.05
			Hypolepis distans	1	0.5	Carex virgata	1	0.8
			Phormium tenax	4	1.8	Lotus pedunculatus	2	0.2

¹ % = % cover: total Canopy % cover = 100%; H = maximum height in m; indicate introduced species by *

Additional species in vicinity in same vegetation type: Blechnum nz increasing

Fauna Seen: Pukeko, fantail

Comments: Weeds have reduced with raised water levels

Indicator (use plot data only)	%	Score 0–5 ²	Specify & Comment
Canopy: % cover introduced species	0	5	-
Understorey: % cover introduced spp ³	4	4	Yorkshire fog, lotus
Total species: % number introduced spp	4	4	
Total species: overall stress/dieback	0	5	

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Total /20 1	18	
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²5=0%: none, 4=1-24%: very low, 3=25-49%; low, 2=50-75%: medium, 1=76-99%: high, 0=100%; v. high

³Add subcanopy and groundcover % cover for introduced species

Field measurements:					
Water table cm	28	Water conductivity uS (if present)	0.095		
Water pH (if present)	4.45	Von Post peat decomposition index	4		

Crown Hill, Manuka Bush Wetland

WETLAND RECORD SHEET				
Project:	Kapiti water supply	Date:	03.03.2017	
Wetland name:	Crown hill/manuka bush	Time:	3/03/2017	
Region:	Kapiti Coast	Personal:	10.00am	
Altitude:	19	# of Plots sampled:	TR, PE	

Classification: I System	IA Subsystem	II Wetland Class	IIA Wetland Form
Palustrine	Permanent	Fen	Basin

Indicator	Indicator components	Specify and Comment	Score 0– 5 ¹	Mean score
Change in hydrological integrity	Impact of manmade structures	Small remnant remains, situated within residential area, with houses either side, M2PP expressway to the East.	2	2.33
	Water table depth	No surface water but wet underfoot.	2	
	Dryland plant invasion	Some annual weeds and blackberry invading.	3	
Change in physico- chemical parameters	Fire damage	Nil	5	4.00
	Degree of sedimentation/erosion	Currently nil, past development will of impacted site.	5	
	Nutrient levels	Presumed low (no outside influence).	4	
	Von Post index	Scored 7	2	
Change in ecosystem intactness	Loss in area of original wetland	Due to topography of site and surrounds, this was likely part of a bigger wetland complex	2	2.00
	Connectivity barriers	Housing segments wetland on two sides.	2	
Change in browsing,	Damage by domestic or feral animals	area fenced, possible possum damage	4	3.67

1

predation & harvesting regimes	Introduced predator impacts on wildlife	Very close to residential area, most likely high cat population. No predator control.	2		
	Harvesting levels	Nil	5		
Change in dominance of	Introduced plant canopy cover	Weeds have reduced with increased surface water.	5	5	
	Introduced plant understorey cover	Nil	5		
Total wetland condition index /25					

¹ Assign degree of modification as follows: 5=v. low/ none, 4=low, 3=medium, 2=high, 1=v. high, 0=extreme

Main Vegetation types: pukatea-kahikatea Semi-swamp forest, some large hinau present. Small area of Raupo.

Fauna:

Other comments: Small piece of relict vegetation. Margins have been planted with large specimen trees (Kahikatea, Rimu).

Pressure	Score ²	Specify and Comment
Modifications to catchment hydrology	4	Small area of wetland within built-up residential zone.
Water quality within the catchment	2	Nearby GW monitoring sites read water quality as good or, fair.
Animal access	3	pest animals associated with residential areas (cats, rats etc)
Key undesirable species	2	Blackberry, Willow, climbing asparagus
% catchment in introduced vegetation	4	Most of catchment, residential or farming.
Other landuse threats	1	Development, dumping of garden waste
Total wetland pressure index /30	16	

²Assign pressure scores as follows: 5=very high, 4=high, 3=medium, 2=low, 1=very low, 0=none

Plot 1 Crown Hill Manuka Bush

WETLAND PLOT SHEET						
Wetland name:	Crown hill	Date:	2/03/2017	Plot no:	1	
Plot size:	2mx2m	Altitude:	12 masl	Structure:	semi-swamp forest	
Personal:	TR, PE	Northing Easting	5470433 1769125	Composition:	Laurelia novae- zelandiae/Kunzea/ Carex virgata	

Canopy (bird's	bird's eye view) Subcanopy Groundcover							
Species ¹ (or Substrate)	%	H (m)	Species	%	H(m)	Species	%	H(m)
Open water	0	0	Hypolepis ambigua	2	0.3	Muehlenbeckia australis	1	0.1
Kunzea robusta	90	6	Carex virgata	15	0.7			
Muehlenbeckia complex	1	4	Coprosma tenuicaulis	10	2			
Leptospermum scoparium	1	3						

¹ % = % cover: total Canopy % cover = 100%; H = maximum height in m; indicate introduced species by *

Additional species in vicinity in same vegetation type: Histoptera incisa, Cordyline australis, Myrsine australis, Melicope ternata

Comments: Very dry, some garden waste / lawn clippings have been dumped nearby

Indicator (use plot data only)	%	Score 0–5 ²	Specify & Comment
Canopy: % cover introduced species	0	5	Nil
Understorey: % cover introduced spp ³	0	5	Nil
Total species: % number introduced spp	0	5	
Total species: overall stress/dieback	0	5	
٦	「otal /20	20	

²5=0%: none, 4=1- 24%: very low, 3=25-49%; low, 2=50-75%: medium, 1=76-99%: high, 0=100%; v. high

³Add subcanopy and groundcover % cover for introduced species

Field measurements:						
Water table cm	n/a	Water conductivity uS (if present)	n/a			
Water pH (if present)	n/a	Von Post peat decomposition index	7			

Plot 2 Crown Hill Manuka Bush:

WETLAND PLOT SHEET						
Wetland name:	Crown hill	Date:	2/3/2017	Plot no:	2	
Plot size:	2mx2m	Altitude:	13 masl	Structure:	Semi-swamp forest	
Personal:	TR, PE	Northing Easting	5470433 1769125	Composition :	Laurelia novae- zelandiae/broadleaf	

Canopy (bird's eye vie	Canopy (bird's eye view)		Subcanopy		Groundcover			
Species ¹ (or Substrate)	%	н	Species	%	Н	Species	%	H
Open Water	0	0	Phormium tenax	1	2	Carex geminata	4	0.6
Leptospermum scoparium	4	2	Coprosma tenuicaulis	10	2.5	Laurelia novae- zelandiae	2	0.01
Myrsine australis	20	3.5	Histiopteris incisa	30	2	Diplazium australe	8	0.9
Kunzea robusta	15	2.5	Hypolepis ambigua	4	0.6	Asplenium oblongifolium	4	0.6
Muehlenbeckia australis	14	1.8						

¹ % = % cover: total Canopy % cover = 100%; H = maximum height in m; indicate introduced species by *

Additional species in vicinity in same vegetation type: Carex virgata, kahikatea, Asplenium polyodon, blackberry on the margins.

Comments: Margins planted - kaihikatea and rimu, vines thick, fern land in centre thick

Indicator (use plot data only)	%	Score 0–5 ²	Specify & Comment
Canopy: % cover introduced species	0	5	Nil

Understorey: % cover introduced spp ³	0	5	Nil
Total species: % number introduced spp	0	5	
Total species: overall stress/dieback	0	5	
Total /20		20	

²5=0%: none, 4=1-24%: very low, 3=25-49%; low, 2=50-75%: medium, 1=76-99%: high, 0=100%; v. high

³Add subcanopy and groundcover % cover for introduced species

Field measurements:					
Water table cm	n/a	Water conductivity uS (if present)	b		
Water pH (if present)	n/a	Von Post peat decomposition index	7		

Muaupoko Swamp Forest

WETLAND RECORD SHEET						
Project:	Kapiti water supply	Date:	02/03/2017			
Wetland name:	Muaupoko Swamp forest	Personal:	TR, PE			
Region:	Kapiti Coast	# of Plots sampled:	2			

Classification: I System	IA Subsystem	II Wetland Class	IIA Wetland Form
Palustrine	Permanent	Fen	Basin

Indicator	Indicator components Specify and Comment		Score 0– 5 ¹	Mean score	
	Impact of manmade structures	rail runs along NW side of forest, road along SE.	3		
Change in hydrological	Water table depth	moderate for this time of year	4	3.67	
integrity	Dryland plant invasion	Some blackberry encroaching, some exotic species on SE edge from rubbish tipping.	4		
	Fire damage	Nil	5		
Change in physico-chemical parameters	Degree of sedimentation/erosion	Past road construction of SE sale would have resulted in some sedimentation	4	4.00	
	Nutrient levels	Subject to some road runoff	4		
	Von Post index	moderate decomposition	3		
Change in ecosystem intactness	Loss in area of original wetland	reduced from original 4			
	Connectivity barriers	SH1, rail and development has reduced connectivity	4	4.00	

Change in browsing,	Damage by domestic or feral animals	No stock access.	4		
predation & harvesting regimes	Introduced predator impacts on wildlife	Some predator control	4	4.33	
Change in dominance of	Harvesting levels	Nil	5		
	Introduced plant canopy cover	Some blackberry in NW edge	5	5.00	
native plants	Introduced plant understorey cover	none seen.	5		
	21.00				

¹ Assign degree of modification as follows: 5=v. low/ none, 4=low, 3=medium, 2=high, 1=v. high, 0=extreme

Main Vegetation types: Mature Pukatea-Kahikatea/Nikau-broadleaf.

Native fauna: Fantail.

Other comments: Part of a Paraparaumu Scenic Reserve Bait line runs through this area.

Pressure	Score ²	Specify and Comment
Modifications to catchment hydrology	3	Road and rail bordering two sides of wetland forest.
Water quality within the catchment	2	subject to some road runoff
Animal access	2	minimal
Key undesirable species	2	Minimal. Some old man's beard, willow.
% catchment in introduced vegetation	1	Upper catchment native reserve.
Other landuse threats	0	Nearby residential area, local bore abstraction.
Total wetland pressure index /30	10	

²Assign pressure scores as follows: 5=very high, 4=high, 3=medium, 2=low, 1=very low, 0=none

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Plot 1: Muaupoko Swamp Forest

WETLAND PLOT SHEET						
Wetland name:	Muaupoko	Date:	02/03/2017	Plot no:	1	
Plot size:	2m x 2m	Elevation:	15m a.s.l	Northing:	5470568	
Personal:	TR, PE	Structure:	Coastal swamp forest	Easting	1770775	

Canopy (bird's eye view)		Subcanopy			Groundcover			
Species ¹ (or Substrate)	%	H (m)	Species	%	H (m)	Species	%	H (m)
Open water	10	6	Geniostoma ligustrifolium	1	1.5	Dysoxylum spectabile	1	0.6
Rhopalostylis sapida	40	8	Dicksonia squarrosa	4	1	Asplenium bulbiferum	2	0.2
Freycinetia banksii	40	8	Ripogonum scandens	4	4			
Laurelia novae- zelandiae	2	12	Microsorum scandens	1	1.3			
			Cyathea medularus	2	9			

¹ % = % cover: total Canopy % cover = 100%; H = maximum height in m; indicate introduced species by *

Additional species in vicinity in same vegetation type: Pate, cabbage tree, ground floor covered in pukatea seedlings.

Fauna seen: none

Comments: very wet underfoot, deep muds.

Indicator (use plot data only)	%	Score 0–5 ²	Specify & Comment
Canopy: % cover introduced species	0	5	Nil
Understorey: % cover introduced spp ³	0	5	Nil
Total species: % number introduced spp	0	5	
Total species: overall stress/dieback	0	5	
Total /20		20	

²5=0%: none, 4=1- 24%: very low, 3=25-49%; low, 2=50-75%: medium, 1=76-99%: high, 0=100%; v. high.

³Add subcanopy and groundcover % cover for introduced species

Field measurements:			
Water table cm	6	Water conductivity uS (if present)	0.121
Water pH (if present)	4.47	Von Post peat decomposition index	6

Plot 2: Muaupoko Swamp Forest

WETLAND PLOT SHEET						
Wetland name:	Muaupoko	Date:	02/03/2017	Plot no:	2	
Plot size:	2m x 2m	Elevation:	15m a.s.l	Northing:	5470601	
Personal:	TR, PE	Structure:	Coastal swamp forest	Easting	1770715	

Canopy (bird's eye view)		Subcanopy			Groundcover			
Species ¹ (or Substrate)	%	H (m)	Species	%	H (m)	Species	%	H (m)
Open water	10	2	Asplenium bulbiferum	50	0.8	Dysoxylum spectabile	1	0.1 5
Geniostoma ligustrifolium	70	4	Rhopalostylis sapida	2	1	Ripogonum scandens	1	0.1
Myoporum laetum	50	6	Piper excelsum	2	0.8			
Laurelia novae- zelandiae	2	6						

1 % = % cover: total Canopy % cover = 100%; H = maximum height in m; indicate introduced species by *

Additional species in vicinity in same vegetation type: Coprosma robusta Coprosma grandifolia Schefflera digitate, Carex virgata, Phormium tenax. Typha orientalis

Fauna seen: none.

Comments: Plot in adjacent to running channel and near weedy border of house.

Indicator (use plot data only)	%	Score 0–5 ²	Specify & Comment
Canopy: % cover introduced species	0	5	
Understorey: % cover introduced spp ³	0	5	
Total species: % number introduced spp	0	5	

Total species: overall stress/dieback	0	5	
Total /20		20	

 2 5=0%: none, 4=1– 24%: very low, 3=25–49%; low, 2=50–75%: medium, 1=76–99%: high, 0=100%; v. high 3 Add subcanopy and groundcover % cover for introduced species

Field measurements:					
Water table cm	2	Water conductivity uS (if present)	n/a		
Water pH (if present)	n/a	Von Post peat decomposition index	4		

Tini Bush

WETLAND RECORD SHEET						
Project:	Kapiti water supply	Date:	03.03.2017			
Wetland name:	Tini Bush	Time:	11.05			
Region:	Kapiti Coast	Personal:	TR, PE			
Altitude:	19	# of Plots sampled:	2			

Classification: I System	IA Subsystem	II Wetland Class	IIA Wetland Form
Palustrine	Permanent	Fen	Basin

Indicator	Indicator components	Specify and Comment	Score 0– 5 ¹	Mean score	
Change in hydrological integrity	Impact of manmade structures	road and rail run through either end.	4	4	
	Water table depth	n/a			
	Dryland plant invasion	kohekohe seedlings	4		
Change in physico- chemical parameters	Fire damage	Nil	5	4	
	Degree of sedimentation/erosion	Surroundings farmed	4		
	Nutrient levels	Surroundings farmed	4		
	Von Post index	5	3		
Change in ecosystem intactness	Loss in area of original wetland	Originally part of a bigger wetland complex	2	2.5	
	Connectivity barriers	Farm drains present.	3		
Change in browsing, predation & harvesting regimes	Damage by domestic or feral animals	Fenced. Some bait lines.	4	4.33	
	Introduced predator impacts on wildlife	Some predator control	4		
	Harvesting levels	Nil	5		
	Introduced plant canopy cover	Nil	5	4.75	
Change in dominance of native plants	Introduced plant understorey cover	Blackberry and yorkshire fog	4.5		
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Total wetland condition index /25					

Main Vegetation types: pukatea-kahikatea swamp forest

Native fauna: Fantail, pukeko

Other comments: Some pest control work as area is part of a QE2 covenant.

Pressure	Score ²	Specify and Comment		
Modifications to catchment hydrology	3	Surroundings drained for farmland, bore extraction.		
Water quality within the catchment	3	Nutrients from surrounding farmland		
Animal access	1	Fenced and trapping carried out.		
Key undesirable species	1	Old man's beard, Bidens, willow in catchment		
% catchment in introduced vegetation	3	Most of the catchment in farmland		
Other landuse threats	1	Roading projects nearby		
Total wetland pressure index /30	12			
² Assign pressure scores as follows: 5=very high, 4=high, 3=medium, 2=low, 1=very low, 0=none				

Plot 1: Tini Bush

WETLAND PLOT SHEET					
Wetland name:	Tini Bush	Date:	03.03.2017	Plot no:	1
Plot size (2m x 2m default):	2m x 2m	Altitude:	19	GPS	1773004.905 5474766.681
Personal:	TR, KS	Structure:	Semi swamp forest	Composition:	Pukatea - Kahikatea

Canopy (bird's eye view)	Subcanopy	Groundcover
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Species ¹ (or Substrate)	%	Н	Species	%	Н	Species	%	н
Open water	60	6	Coprosma grandifolia	4	1.5	Laurelia novae- zelandiae	1	0.1
Syzigium maire	90	14	Freycenitia banksii	30	6	Rhodostylis sapida	1	0.5
Laurelia novae- zelandiae	10	16	Piper excelsum	1	1.4	Dacrycarpus dacrydioides	1	0.05
Ripogonum scandens	2	8				Asplenium bulbiferum	8	0.8
						Dysoxylum spectabile	1	0.6

Additional species in vicinity in same vegetation type: Cyathea medullaris, pigeonwood, Nikau, Dacrycarpus dacrydioides, Coprosma tenufolium

Comments: Coastal influenced semi swamp forest

Indicator (use plot data only)	%	Score 0–5 ²	Specify & Comment
Canopy: % cover introduced species	0	5	Nil
Understorey: % cover introduced spp ³	0	5	Nil
Total species: % number introduced spp	0	5	
Total species: overall stress/dieback	0	5	
Total /20		20	

 2 5=0%: none, 4=1- 24%: very low, 3=25-49%; low, 2=50-75%: medium, 1=76-99%: high, 0=100%; v. high 3 Add subcanopy and groundcover % cover for introduced species

Field measurements:						
Water table cm	10	Water conductivity uS (if present)	0.121			
Water pH (if present)	5.46	Von Post peat decomposition index	5			

Plot 2: Tini Bush

WETLAND PLOT SHEET						
Wetland name:	Tini Bush	Date:	03.03.2017	Plot no:	2	
Plot size	(2m x 2m default):	Altitude:	11m	Northing	5471425	
Personal:	TR, KS	Structure:	Shrubland	Easting	1771511	

Canopy (bird's	eye vi	ew)	Subcanopy			Groundcover		
Species ¹ (or Substrate)	%	H(m)	Species	%	H(m)	Species	%	H(m)
Open water	2	3	Laurelia novae-zelandiae 4 2.2		Deperia petersenii	2	0.3	
Cordyline australis	2	3	Coprosma grandifolia 2 1		Pyrrosia eleagnifolia	1	0.2	
Cyathea medullaris	30	3.5	Carex virgata	5	2	Lemna disperma	1	0.001
Coprosma robusta	4	2	Blechnum minus	2	0.8	Ludwigia palustris	1	0.1
Melicytus ramiflorus	2	0.7	Parsonsia hetrophylla	1	0.5	Rhodostylis sapidia	1	0.1
			Dysoxylum spectabile	1	0.1	Holcus Ianatus	2	0.5
			Rubus fruticosus	1	0.8	Dacrycarpus dacryoidies	1	0.3

¹ % = % cover: total Canopy % cover = 100%; H = maximum height in m; indicate introduced species by *

Additional species in vicinity in same vegetation type: Pasia scabrosa, Hypolepis ambigua, kawakawa, blackberry on the sides, muehlenbeckia australis arum lily, carex secta and carex dissita.

Fauna seen: none

Comments: Set on side of wetland. Some Yorkshire fog, gully fern

Indicator (use plot data only)	%	Score 0– 5 ²	Specify & Comment
Canopy: % cover introduced species		5	Nil

Understorey: % cover introduced spp ³	3	4	Blackberry and Yorkshire fog
Total species: % number introduced spp	3	4	
Total species: overall stress/dieback	0	5	
Total /20		18	

²5=0%: none, 4=1– 24%: very low, 3=25–49%; low, 2=50–75%: medium, 1=76–99%: high, 0=100%;

Field measurements:						
Water table cm	18	Water conductivity uS (if present)	0.115			
Water pH (if present)	6.23	Von Post peat decomposition index	5			

Otaihanga South Wetland

WETLAND RECORD SHEET				
Project:	M2PP	Wetland name:	Otaihanga South	
Date:	03/03/2017	Region:	Kapiti Coast, Wellington	
Time:	2.53pm	Altitude:	8 m.a.s.l	
Personal:	TR, PE	# of Plots sampled:	2	

Classification: I System	IA Subsystem	II Wetland Class	IIA Wetland Form
Palustrine	Permanent	Fen	Basin

Indicator	Indicator components	Specify and Comment	Score 0– 5 ¹	Mean score
Change in hydrological integrity	Impact of manmade structures	Landfill nearby. Motorway dissects this wetland into two parts, with controlled flow between via culvert.	2	
	Water table depth	Lowered flow and catchment through motorway has caused the eastern edge to increase in held water, while the western edge has dried out.	1	2
	Dryland plant invasion	Blackberry, beggars tick, Yorkshire fog, gorse and arum lily invading centre of the western plot.	3	
Change in physico-chemical parameters	Fire damage	Nil	5	
	Degree of sedimentation/erosion	Almost nil. Some dust from construction and sedimentation from landfill capping.	4	4
	Nutrient levels		3	
	Von Post index	Moderate decomposition (5)	4	

Change in ecosystem intactness	Loss in area of original wetland	Past loss from, pine plantations, residential and landfill use. Current loss through expressway development	2				
	Connectivity barriers	Connection has been temporarily severed by motorway construction. Culvert letting some flow from east (upstream) to west (downstream).	2	2			
Change in browsing, predation & harvesting	Damage by domestic or feral animals	Rabbit scrapping seen on edges. Canadian geese breeding in wetland.	4				
regimes	Introduced predator impacts on wildlife	Possibly feral cats in the area.	4	4.33			
	Harvesting levels	nil	5				
Change in dominance of pative plants	Introduced plant canopy cover	Bidens frondosa still dominant.	3.5				
	Introduced plant understorey cover	nt Holcus lanatus now prominent within the 3 understory.		3.25			
	Total wetland condition index /25						

Main Vegetation types: Carex secta, Carex virgata sedgeland with thinning scattered manuka. Mostly overtopped with beggars' tick (Bidens frondosa)

Native fauna: none seen within wetland

Other comments: Wetland very dry,

Pressure	Score ²	Specify and Comment
Modifications to catchment hydrology	4	Flow from east severed by motorway construction.
Water quality within the catchment	4	Possibly slightly effected by landfill runoff
Animal access	2	Canadian geese. Possibly feral/domestic cats

Key undesirable species	3	Blackberry/Bidens/Canadian geese/Yorkshire fog.
% catchment in introduced vegetation	4	Almost entire catchment in landfill, farming and plantation pine.
Other landuse threats	3	Landfill, is now capped.
Total wetland pressure index /30	20	

²Assign pressure scores as follows: 5=very high, 4=high, 3=medium, 2=low, 1=very low, 0=none

Plot 1: Otaihanga South Wetland

WETLAND PLOT SHEET 1.					
Wetland name:	Otaihanga South	Conditions	Sunny, calm		
Plot no:	1	Easting	1770147		
Date:	03/03/2017	Northing	5471252		
Time:	3.20am	Structure:	Herbfield/sedgeland		
Personal:	TR, PE	Composition:	Bidens/carex		

Canopy (bird's eye view)		Subcanopy			Groundcover			
Species ¹ (or Substrate)	%	H(m)	Species	%	H(m)	Species	%	H(m)
Carex secta	4	0.9	Isolepis prolifera	1	0.2	Sphagnum	1	0.05
Carex virgata	2	0.7	Holcus lanatus	50	0.5	Blechnum minus	1	0.05
Bidens frondosa	35	1.5	Ulex europaeus	1	0.5			
Juncus effusus	1	0.7						

¹% = % cover: total Canopy % cover = 100%; H = maximum height in m; indicate introduced species by *

Additional species in vicinity in same vegetation type: Cordyline australis, Austroderia fulvida, Leptospermum scoparium, Carex secta, Rubus fruticosus, Ulex europaeus, Pinus radiata seedlings, Isolepis prolifera, Hypolepis distans.

Fauna seen: None

Comments: Bidens frondosa, Ulex europaeus and Rubus fruticosus are increasing with the dry conditions. Continued loss of sphagnum and manuka.

Indicator (use plot data only)	%	Score 0–5 ²	Specify & Comment
Canopy: % cover introduced species	50	2	Bidens frondosa now dominates canopy
Understorey: % cover introduced spp ³	21	3	Bidens seedlings, Holcus lanatus
Total species: % number introduced spp	71	2	
Total species: overall stress/dieback		3	Starting to see dieback of carex and sphagnum
Total /20		10	

²5=0%: none, 4=1- 24%: very low, 3=25-49%; low, 2=50-75%: medium, 1=76-99%: high, 0=100%; v. high

³Add subcanopy and groundcover % cover for introduced species

Field measurements:			
Water table cm	n/a	Water conductivity uS (if present)	n/a
Water pH (if present)	n/a	Von Post peat decomposition index	7

Plot 2: Otaihanga South Wetland

WETLAND PLOT SHEET 2.					
Wetland name:	Otaihanga South	Conditions	Sunny, calm		
Plot no:	2 (cabbage tree)	Easting	1770103		
Date:	03/03/2017	Northing	5471212		
Time:	11.30am	Structure:	Sedgeland		
Personal:	TR, PE	Composition:	Carex		

Canopy (bird's eye view)		Subcanopy			Groundcover			
Species ¹ (or Substrate)	%	H(m)	Species % H(n		H(m)	Species	%	H(m)
Bidens frondosa	25	1.6	Hypolepis ambigua	1	1.4	Rubus fruticosus	2	1.5

Carex virgata	50	1.6	Juncus pallidus	1	1.8	Hydrocotyle novae- zeelandiae	1	0.05
Austroderia fulvida	5	2	Blechnum minus	2	1.4	Lemna minor	1	0.05
Ulex europaeus	4	1.7	Isolepis prolifera	1	0.25	Azolla pacifica	1	0.05
			Senecio bipinnatisectus	1	0.1			

Additional species in vicinity in same vegetation type: Hypolepis ambigua, Leptospermum scoparium, coprosma robusta, Rubus fruticosus

Fauna seen: none

Comments: Wetland plant dieback/dryland exotic plant encroachment noticeable.

Indicator (use plot data only)	%	Score 0–5 ²	Specify & Comment
Canopy: % cover introduced species	6	4	Bidens
Understorey: % cover introduced spp ³	1	4	Blackberry
Total species: % number introduced spp	7	4	
Total species: overall stress/dieback	30	3	Carex, sphagnum dieback
Total /20		15	

5=0%: none, 4=1-24%: very low, 3=25-49%; low, 2=50-75%: medium, 1=76-99%: high, 0=100%; v. high

Field measurements:						
Water table cm	n/a	Water conductivity uS (if present)	n/a			
Water pH (if present)	n/a	Von Post peat decomposition index	7			

El Rancho Wetland

WETLAND RECORD SHEET					
Project:	M2PP	Date:	03/03/2017		
Wetland name:	El Rancho	Time:	12.47		
Region:	Kapiti Coast	Personal:	TR, PE		
Altitude:	3	# of Plots sampled:	2		

Classification: I System	IA Subsystem	II Wetland Class	IIA Wetland Form
Palustrine	Permanent	Fen	Basin

Indicator	Indicator components	Specify and Comment	Score 0– 51	Mean score	
Change in hydrological integrity	Impact of manmade structures	New culvert installation at Weggary drive has increased drainage. Expressway now runs across the eastern edge	2		
	Water table depth	Drain cuts through interior of the wetland. Some water abstraction bores.	2	3	
	Dryland plant invasion	Some pastoral grasses and weeds establishing.	3		
Change in	Fire damage	Nil	5		
parameters	Degree of sedimentation/erosion	Minimal amount from the expressway	4	3.75	
	Nutrient levels	Reasonably high	4		
	Von Post index	Low decomposition.	2		
Change in ecosystem intactness	Loss in area of original wetland	Historic loss through development. Current loss on eastern edge from motorway		3.5	
	Connectivity barriers	Connected to the Waikanae River through small stream.	4		

Change in browsing, predation & harvesting regimes	Damage by domestic or feral animals	No browse seen.	5	4.67	
	Introduced predator impacts on wildlife	Low.	4		
	Harvesting levels	Nil	5		
Change in dominance of	Introduced plant canopy cover	Blackberry, gorse.	5	4 75	
nauve plants	Introduced plant understorey cover	Violet found	4.5	4.75	
		Total wetland condition i	ndex /25	19.00	

Main Vegetation types: Both plots in main wetland were within a regenerating manuka wetland.

Native fauna: None seen

Other comments: Eastern edge of manuka stand has been cut back for expressway construction.

Pressure	Score ²	Specify and Comment
Modifications to catchment hydrology	4	Drainage ditch and new Weggery drive culvert has reduced surface water table
Water quality within the catchment	4	Some runoff from farm, rubbish dumping
Animal access	4	fenced
Key undesirable species	3	Next to weedy Waikanae River Corridor
% catchment in introduced vegetation	2	Mainly pasture, weedy scrub.
Other landuse threats	1	Gas pipeline
Total wetland pressure index /30	18	

²Assign pressure scores as follows: 5=very high, 4=high, 3=medium, 2=low, 1=very low, 0=none

WETLAND PLOT SHEET 1.					
Wetland name:	El Rancho	Conditions	Sunny, calm		
Plot no:	1	X coordinates (m):	1,770,890.714		

Date:	03.03.2017	Y coordinates (m):	5,473,235.161
Time:	12.00am	Structure:	Shrubland
Personal:	TR, PE	Composition:	Manuka swamp

Canopy (bird's e	ye viev	/)	Subcanopy	nopy Groundcover			ver		
Species ¹ (or Substrate)	%	н	Species	%	н	Species	%	H	
Open water	0	0	Viola riviniana	2	0.1	Coprosma tenuicaulis	1	0.2	
Leptospermum scoparium	80	4	Galium propinquum	1	0.05				
			Hydrocotyle pterocarpa	1	0.05				
			Carex dissita	1	0.3				

Additional species in vicinity in same vegetation type: Gorse, blackberry, tree fern seedlings starting to pop up in light gaps.

Fauna seen:

Comments: dense uniform canopy of manuka helps to deter weed introductions. Some blackberry is surviving beneath canopy, yet not spreading.

Indicator (use plot data only)	%	Score 0–5 ²	Specify & Comment
Canopy: % cover introduced species	0	5	Thick Manuka Canopy
Understorey: % cover introduced spp ³	2	4	Violets remain
Total species: % number introduced spp	2	4	
al species: overall stress/dieback 0		5	
Total /20			

 2 5=0%: none, 4=1- 24%: very low, 3=25-49%; low, 2=50-75%: medium, 1=76-99%: high, 0=100%; v. high 3 Add subcanopy and groundcover % cover for introduced species

Field measurements:			
Water table cm	n/a	Water conductivity uS (if present)	n/a

Water pH (if present)	n/a	Von Post peat decomposition index	7
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Plot 2: El Rancho Wetland

WETLAND PLOT SHEET 1.						
Wetland name:	El Rancho	Conditions	Sunny, calm			
Plot no:	2	X coordinates (m):	1,770,901.668			
Date:	03.03.2017	Y coordinates (m):	5,473,223.784			
Time:	12.46am	Structure:	Shrubland			
Personal:	TR, PE	Composition:	Manuka swamp			

Canopy (bird's eye view)			Subcanopy			Groundcover		
Species ¹ (or Substrate)	%	н	Species	%	H	Species	%	н
Open water	0	0	Microlaena stipoides	1	0.05	Coprosma tenuicaulis	1	0.2
Leptospermum scoparium	70	4	Schoenus maschalinus	1	0.05	Blechnum minus	1	0.4
						Dichondra repens	1	0.1
						Dicksonia spp	1	0.2

¹ % = % cover: total Canopy % cover = 100%; H = maximum height in m; indicate introduced species by *

Additional species in vicinity in same vegetation type: Blackberry, carex dissita, psudopanex hybrid, Blechnum novae-zelandiae

Fauna seen: none

Comments: Dryer than plot 1.

Indicator (use plot data only)	%	Score 0–5 ²	Specify & Comment
Canopy: % cover introduced species	0	5	Nil
Understorey: % cover introduced spp ³	0	5	Nil
Total species: % number introduced spp	0	5	
Total species: overall stress/dieback	0	5	

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	Total /20	20	
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 2 5=0%: none, 4=1– 24%: very low, 3=25–49%; low, 2=50–75%: medium, 1=76–99%: high, 0=100%; v. high ³Add subcanopy and groundcover % cover for introduced species

Field measurements:					
Water table cm	n/a	Water conductivity uS (if present)	n/a		
Water pH (if present)	n/a	Von Post peat decomposition index	8		

Ngarara Road

WETLAND RECORD SHEET					
Project:	Kapiti Water Supply	Wetland name:	Ngarara Road Wetland		
Date:	03.03.2017	Region:	Kapiti Coast, Wellington		
Time:	2.53pm	Elevation (m.a.s.l)	10 m.a.s.l		
Personal:	TR, PE	# of Plots sampled:	1		

Classification: I System	IA Subsystem	II Wetland Class	IIA Wetland Form
Palustrine	Permanent	Fen	Basin

Indicator	Indicator components	Specify and Comment	Score 0– 5 ¹	Mean score	
Change in hydrological integrity	Impact of manmade structures	Expressway, nearby possibly effecting drainage. Surrounded by farmland. Ground bores.	3		
	Water table depth	This particularly wet spring and completion of the expressway (and groundwater pumping), has reinstated water levels in the wetland.	4	3.33	
	Dryland plant invasion	Blackberry is not as prolific with the wet season.	3		
Change in	Fire damage	Nil	5		
parameters	Degree of sedimentation/erosion	Minimal amount from surrounding farmland	4	4.00	
	Nutrient levels	Moderate	4		
	Von Post index	Low (4)	3		
Change in ecosystem	Loss in area of original wetland	Past lost minor.	4		
intactness	Connectivity barriers	Farmland, culverts and surrounding road development will present minor barriers	3	3.50	

Change in browsing, predation & barvesting	Damage by domestic or feral animals	Thick blackberry boarders to wetland will limit most mammalian pests.	4	
regimes	Introduced predator impacts on wildlife	Remnant fernbird population in the area.	2	3.67
	Harvesting levels	nil	5	
Change in dominance of	Introduced plant canopy cover	Blackberry cover halved.	3	2.50
	Introduced plant understorey cover	Beggars tick	4	5.50
	18.00			

Main Vegetation types: Sedgeland (Carex secta, Carex virgata and Cyperus ustulatus) with blackberry and ferns. Some manuka in wetter areas, kanuka on raised mounds and wetland edges,

Native fauna: Tui, Kereru (close to Nga Manu)

Other comments: Blackberry coverage has significantly decreased with wet summer.

Pressure	Score ²	Specify and Comment
Modifications to catchment hydrology	3	Farm drainage, bore extraction
Water quality within the catchment	2	Run off from surrounding farms
Animal access	2	Predator pests presumed, fenced from stock.
Key undesirable species	3	Blackberry dominant, willow present.
% catchment in introduced vegetation	4	Majority of catchment in farming. Nga Manu found nearby
Other land use threats	3	Bore extraction, farming, Expressway, subdivision introducing garden weed species.
Total wetland pressure index /30	17	

²Assign pressure scores as follows: 5=very high, 4=high, 3=medium, 2=low, 1=very low, 0=none

Plot 1: Ngarara Road

WETLAND PLOT SHEET 1					
Wetland name:	Ngarara Road	Conditions	Sunny, calm		
Plot no:	1	Easting	1773006		
Date:	03.03.2017	Northing	5474765		
Time:	10.40am	Structure:	shrub/sedge		
Personal:	TR, PE	Composition:	blackberry/carex		

Canopy (bird's eye view)		Subcanopy			Groundcover			
Species ¹ (or Substrate)	%	H(m)	Species	%	H(m)	Species	%	H(m)
Carex virgata	35	1.6	Bidens frondosa	1	0.7	Lemna disperma	50	0.05
Carex secta	5	1.2						
Rubus fruticosus	30	2.5						

¹ % = % cover: total Canopy % cover = 100%; H = maximum height in m; indicate introduced species by *

Additional species in vicinity in same vegetation type: Dominated by blackberry, with kanuka broadleaved shrub present on raised margins. Gorse also entering from margins

Fauna seen:

Comments: Blackberry has reduced and carex now substational

Indicator (use plot data only)	%	Score 0–5 ²	Specify & Comment
Canopy: % cover introduced species	30	3	Blackberry cover halved.
Understorey: % cover introduced spp ³	1	4	Beggars tick
Total species: % number introduced spp	31	3	
Total species: overall stress/dieback	n/a	5	
Т	otal /20	15	

5=0%: none, 4=1-24%: very low, 3=25-49%; low, 2=50-75%: medium, 1=76-99%: high, 0=100%; v. high

Field measurements:						
Water table cm	25	Water conductivity uS (if present)	0.186			
Water pH (if present)	5.28	Von Post peat decomposition index	7			

Nga Manu Wetland

WETLAND RECORD SHEET				
Project:	Kapiti water supply	Date:	03.03.2017	
Wetland name:	Nga Manu	Personal:	TR, PE	
Region:	Kapiti Coast	# of Plots sampled:	2	

Classification: I System	IA Subsystem	II Wetland Class	IIA Wetland Form	
Palustrine	Permanent	Fen	Basin	

Indicator	Indicator components	Specify and Comment	Score 0– 5 ¹	Mean score	
Change in hydrological integrity	Impact of manmade structures	Some drainage channels/culverting/ constructed ponds can be found within the nature reserve	4	4	
	Water table depth	increased with wet summer	4	-	
	Dryland plant invasion	Minimal due to wet summer	4		
Change in	Fire damage	Nil	5		
parameters	Degree of sedimentation/erosion	low = nature reserve	5	4.25	
	Nutrient levels	low , farmed surrounds	4		
	Von Post index	6	3		
Change in ecosystem intactness	Loss in area of original wetland	Originally part of a bigger complex	4	25	
	Connectivity barriers	Fragmented by road, residential and farmland	3	3.5	
Change in browsing, predation &	Damage by domestic or feral animals	Fenced. Possum control	4		
harvesting regimes	Introduced predator impacts on wildlife	controlled, althought still present in low numbers	4	4.33333333 3	
	Harvesting levels	Nil	5		

Change in dominance of	Introduced plant canopy cover	Nil	5	4 75
native plants	Introduced plant understorey cover	Lotus.	4.5	4.75
Total wetland condition index /25				

Main vegetation types: Wetland Complex of: Phormium tenax, Raupo, Carex, Coprosma grandifolia, Coprosma rigida, Dacrycarpus dacrydioides

Native fauna: Many native birds, both passerine and waterfowl

Other comments: diverse and high bird life (nature reserve). Large degree of management.

Pressure	Score ²	Specify and Comment
Modifications to catchment hydrology	2	Some drainage channels, constructed ponds. Expressway to the west has modified drainage.
Water quality within the catchment	3	Farmland surrounds, large population of waterfowl
Animal access	2	Fenced, intensive trapping
Key undesirable species	3	Willow, large amounts of Blackberry, Bidens are found in the surrounding area.
% catchment in introduced vegetation	3	Mostly farmland/residential
Other landuse threats	1	Residential subdivison proposed nearby.
Total wetland pressure index /30	14	

²Assign pressure scores as follows: 5=very high, 4=high, 3=medium, 2=low, 1=very low, 0=none

Plot 1: Nga Manu (south)

WETLAND PLOT SHEET						
Wetland name:	Nga Manu	Date:	03.03.2017	Plot no:	1	
Plot size:	2m x 2m	Elevation:	15m a.s.l	Northing:	5474506	
Personal:	TR, KS	Structure:	Carex sedgeland	Easting	1773506	

Canopy (bird's eye view)		Subcanopy			Groundcover			
Species1 (or Substrate)	%	H (m)	Species	%	H (m)	Species	%	H (m)

Open Water	10	0.3	Blechnum novae- zelandiae	2	0.8	Rubus fruticosus	1	0.3
Coprosma Hybrid	7	4	Carex secta	2	1	Carex virgata	1	0.5
Phormium tenax	10	3	Pseudopanax Hybrid	2	1	Muehlenbeckia australis	1	0.5
Geniostoma ligustrifolium	20	3	Myrsine australis	1	0.7	Coprosma tenuicaulis	1	0.5
Coprosma robusta	30	3.5	Coprosma areolata	3	1.4	Rubus australis	1	0.2
Coprosma grandifolia	15	4	Melicytus ramiflorus	1	1.6			

Additional species in vicinity in same vegetation type: Histiopteris incisa, Dicksonia squarrosa, puesdopanex arboreus, Puesdopanex crassifolia, Syzygium maire, coprosma propinqua

Fauna seen: Tui abundant

Comments:

Indicator (use plot data only)	%	Score 0–5 ²	Specify & Comment
Canopy: % cover introduced species	0	5	Nil
Understorey: % cover introduced spp ³	0	5	Nil
Total species: % number introduced spp	0	5	
Total species: overall stress/dieback	0	5	
	Total /20	20	

5=0%: none, 4=1-24%: very low, 3=25-49%; low, 2=50-75%: medium, 1=76-99%: high, 0=100%; v. high

³Add subcanopy and groundcover % cover for introduced species

Field measurements:					
Water table cm	3	Water conductivity uS (if present)	0.208		
Water pH (if present)	5.88	Von Post peat decomposition index	7		

Plot 2: Nga Manu (south)

WETLAND PLOT SHEET		
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Wetland name:	Nga Manu	Date:	03.03.2017	Plot no:	2
Plot size:	2m x 2m	Elevation:	10m a.s.l	Northing:	5474372
Personal:	TR, PE	Structure:	Manuka – broadleaved / flax	Easting	1773492

Canopy (bird's eye view)		Sub-canopy			Groundcover			
Species ¹ (or Substrate)	%	H(m)	Species	%	H(m)	Species	%	H(m)
Open water	0	0	Muehlenbeckia australis	3	1.2	Rubus fruticosus	2	0.7
Carex geminata	10	2.5	Carex virgata	80	1.6	Juncus pallidus	2	0.8
Phormium tenax	1	2.4	Geniostoma ligustrifolium	1		Lotus pedunculatus	1	1
Carpodetus serrata	1	4	Pteridium esculentum	5	2	Coprosma lucida	1	0.8
Typha orientalis	3	3						

Additional species in vicinity in same vegetation type: Coprosma propinquum, mahoe, Apium nodoflorum, Juncus articulatus.

Fauna seen: Fantail, Kereru.

Comments: 10m east of track, Drainage ditch nearby

Indicator (use plot data only)	%	Score 0–5 ²	Specify & Comment
Canopy: % cover introduced species	0	5	Nil
Understorey: % cover introduced spp ³	1	4	Lotus.
Total species: % number introduced spp	1	4	
Total species: overall stress/dieback	0	5	
	Total /20	18	

²5=0%: none, 4=1- 24%: very low, 3=25-49%; low, 2=50-75%: medium, 1=76-99%: high, 0=100%; v. high

Field measurements:			
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Water table cm	n/a	Water conductivity uS (if present)	n/a
Water pH (if present)	n/a	Von Post peat decomposition index	7

Ngarara Bush

WETLAND RECORD SHEET					
Project:	Kapiti Water Supply	Wetland name:	Ngarara Bush		
Date:	03.03.2017	Region:	Kapiti Coast, Wellington		
Time:	2.30pm	Altitude:	14 m		
Personal:	TR, PE	# of Plots sampled:	2		

Classification: I System	IA Subsystem	II Wetland Class	IIA Wetland Form
Palustrine	Permanent	Fen	Basin

Indicator	Indicator components	Specify and Comment	Score 0– 5 ¹	Mean score	
Change in hydrological	3.666666667	3.666666667	3.66666 6667		
integrity	Water table depth	Higher than normal with wet summer	4	3.67	
	Dryland plant invasion	ryland plant invasion Yes kohekohe pasture grasses and some Tawa			
Change in	4	4	4		
parameters	Degree of sedimentation/erosion	Nil	5	4	
	Nutrient levels	Assumed low from surronding farmland	4	4	
	Von Post index	High	2		
Change in ecosystem	3	3	3		
intactness	Connectivity barriers	Roads and farmland drainage will have some effect on connectivity	3	3	
Change in browsing,	3.666666667	3.666666667	3.66666 6667		
predation & harvesting regimes	Introduced predator impacts on wildlife	Some cats, possums, rats, mustaileds, presummed present. No trapping	3 3.67		
	Harvesting levels	Nil	5		
	4.75	4.75	4.75	4.75	

Change in dominance of native plants	Introduced plant understorey cover	Nil	4.5			
Total wetland condition index /25						

Main Vegetation types: pukatea, kahikatea, Semi-swamp forest, with kohekohe on margins.

Native fauna:

Other comments: Kohekohe on surrounding higher points. Near Nga Manu reserve nearby - to the north

Pressure	Score ²	Specify and Comment
Modifications to catchment hydrology	3	Most of the catchment is in drained farmland.
Water quality within the catchment	3	mostly farmed
Animal access	3	Fenced, no control
Key undesirable species	1	Tradescantia and willow present in low numbers
% catchment in introduced vegetation	3	farmed and forested with pockets of native bush.
Other landuse threats	1	residential development to the east.
Total wetland pressure index /30	14	

²Assign pressure scores as follows: 5=very high, 4=high, 3=medium, 2=low, 1=very low, 0=none

Plot 1: Ngarara Bush (north)

WETLAND PLOT SHEET 1.						
Wetland name:	Ngarara Bush	Conditions	Sunny, calm			
Plot no:	1	X coordinates (m):	1773006			
Date:	03.03.2017	Y coordinates (m):	5474765			
Time:	2.30pm	Structure:	Pukatea-kahikatea swamp forest			

Canopy (bird's eye view)		Subcanopy			Groundcover			
Species1 (or Substrate)	%	H(m)	Species	%	H(m)	Species	%	H(m)
Open water	0	0	Dysoxylum spectabile	60	1.8	Muehlenbeckia australis	1	0.1

Melicytus ramiflorus	80	4	Geniostoma ligustrifolium	2	1.5	Myrsine australis	1	0.3
Dacrycarpus dacrydioides	12	5	Hypolepis ambigua	1	0.9	Laurelia novae- zelandiae	1	0.4
						Parsonsia capsularis	1	0.4
						Beilschmiedia tawa	1	0.3

Additional species in vicinity in same vegetation type: Laurelia novae-zealandiae, Hinau on margins, coastal kohekohe forest on higher terrace

Fauna seen: None

Comments: Plot corners not marked - mahoe x2 kahikatea, kohekohe. See photos for ref.

Indicator (use plot data only)	%	Score 0–5 ²	Specify & Comment
Canopy: % cover introduced species	0	5	Nil
Understorey: % cover introduced spp ³	0	5	Nil
Total species: % number introduced spp	0	5	
Total species: overall stress/dieback	0	5	
	Total /20	20	

5=0%: none, 4=1- 24%: very low, 3=25-49%; low, 2=50-75%: medium, 1=76-99%: high, 0=100%; v. high

³Add subcanopy and groundcover % cover for introduced species

Field measurements:						
Water table cm	n/a	Water conductivity uS (if present)	n/a			
Water pH (if present)	n/a	Von Post peat decomposition index	6			

Plot 2: Ngarara Bush (South)

WETLAND PLOT SHEET 2.					
Wetland name:	Ngarara Bush	Conditions	Sunny, calm		
Plot no:	2	Easting	1773829		
Date:	03.03.2017	Northing	5475040		

Canopy (bird's eye view)		Subcanopy			Groundcover			
Species ¹ (or Substrate)	%	H(m)	Species	%	H(m)	Species	%	H(m)
open water	0	0	Rubus fruticosus	1	0.6	Digitalis purpurea	1	0.4
Melicytus ramiflorus	50	5	Geniostoma ligustrifolium	15	2	Dacrycarpus dacrydioides	3	0.2
Parsonsia heterophyllus	2	4	Laurelia novae- zelandiae	15	1.5	Cyathea sp	1	0.1
			Hedycarya arborea	4	3	Histiopteris incisa	1	0.1
						Dicksonia squarrosa	2	0.2
						Dysoxylum spectabile	2	0.2

Additional species in vicinity in same vegetation type: Two large kaihiatea to the north. Large mamaku surrounding.

Fauna seen: none.

Comments: Plot corner is Melicytus ramiflorus marked then from that 90 degrees west and south for 2m. See pics for ref.

Indicator (use plot data only)	%	Score 0–5 ²	Specify & Comment
Canopy: % cover introduced species	0	5	nil
Understorey: % cover introduced spp ³	2	4	foxglove and blackberry
Total species: % number introduced spp	2	4	
Total species: overall stress/dieback	0	5	
	Total /20	18	

5=0%: none, 4=1-24%: very low, 3=25-49%; low, 2=50-75%: medium, 1=76-99%: high, 0=100%; v. high

Field measurements:						
Water table cm	n/a	Water conductivity uS (if present)	n/a			
Water pH (if present)	n/a	Von Post peat decomposition index	7			

Te Harakeke - Wetland Record Sheet

This wetland was not accessible for the 2017 Baseline survey.

Peka Peka Rd Wetland

WETLAND RECORD SHEET						
Project:	Kapiti Water Supply	Wetland name:	Peka Peka Rd Wetland			
Date:	03.03.2017	Region:	Kapiti Coast, Wellington			
Time:	11.15am	Altitude:	14m			
Personal:	TR, PE	# of Plots sampled:	2			

Classification: I System	IA Subsystem	II Wetland Class	IIA Wetland Form
Palustrine	Permanent	Fen	Basin

Indicator	Indicator components	Specify and Comment	Score 0– 5 ¹	Mean score	
Change in hydrological integrity	Impact of manmade structures	Surrounding farmland drained, some impact of road to the north. Area of 4 Peat replacement for the Expressway		4 00	
	Water table depth	wetter than normal due to wet summer	4	4.00	
	Dryland plant invasion	Blackberry on margins, 1 poisoned willow	4		
Change in	Fire damage	nil	5		
parameters	Degree of sedimentation/erosion	Possible small amount of dust of peat replacement works	4	4.00	
	Nutrient levels	Surrounding farmland	4		
	Von Post index	scored moderate (5)	3		
Change in ecosystem	Loss in area of original wetland	originally part of a bigger wetland complex	3	3.50	
	Connectivity barriers	Road, pasture	4		

Change in browsing, predation & harvesting regimes	Damage by domestic or feral animals	No sign of browse	5	
	Introduced predator impacts on wildlife	Cats, rats, stoats preying on birdlife	4	4.67
	Harvesting levels	Nil	5	
Change in dominance of	Introduced plant canopy cover	Willow	4.5	4 50
native plants	Introduced plant understorey cover	Yorkshire fog	4.5	4.50
	20.67			

Main Vegetation types: Austroderia toetoe, Raupo, Coprosma tenuicaulis, Coprosma ridgia, Carex secta, Phormium tenax

Native fauna: Grey warbler, grey heron

Other comments: Access > enter wetland at fence line then walk south under tree canopy, plot is 5m in from the end of this row of trees/willows. Sand replacement with peat as part of the M2PP expressway construction has occurred to the east of the wetland.

Pressure	Score ²	Specify and Comment
Modifications to catchment hydrology	2	Most of catchment in drained farmland, forestry.
Water quality within the catchment	2	Runoff from farming.
Animal access	3	Fenced
Key undesirable species	1	Willow, blackberry, gorse, Bidens within catchment (and wetland)
% catchment in introduced vegetation	4	Kapiti Coast developed into farmland/forestry and residential
Other landuse threats	3	Development occurring to the east of the wetland. Expressway peat replacement works.
Total wetland pressure index /30	15	

²Assign pressure scores as follows: 5=very high, 4=high, 3=medium, 2=low, 1=very low, 0=none

Plot 1:	Peka	Peka	Road	(north)	
---------	------	------	------	---------	--

WETLAND PLOT SHEET 1					
Wetland name:	Peka Peka	Conditions	Sunny, calm		

Plot no:	1	X coordinates (m):	1773808
Date:	03.03.2017	Y coordinates (m):	5477103
Time:	3.06	Structure:	Raupo, sedgeland
Personal:	TR, PE	Composition:	Raupo Carex

Canopy (bird's eye view)		Subcanopy			Groundcover			
Species ¹ (or Substrate)	%	H(m)	Species	%	H(m)	Species	%	H(m)
Open water	20	0.3	Blechnum minus	4	0.6	Hypolepis distans	5	0.4
Typha oreintalis	15	2.5	Dicksonia squarrosa	8	2	Coprosma tenuicaulis	1	0.25
Coprosma propinqua	30	2.1						
Carex secta	8	2						

Additional species in vicinity in same vegetation type: Willow, blackberry, Austroderia fulvida outside plot. Fauna seen:

Comments: Carex secta within plot dead

Indicator (use plot data only)	%	Score 0–5 ²	Specify & Comment
Canopy: % cover introduced species	0	5	Nil
Understorey: % cover introduced spp ³	0	5	Nil
Total species: % number introduced spp	0	5	
Total species: overall stress/dieback	0	5	
Total /20		20	

5=0%: none, 4=1- 24%: very low, 3=25-49%; low, 2=50-75%: medium, 1=76-99%: high, 0=100%; v. high

Field	measurements:
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Water table cm (in relation to soil surface)	30cm	Water conductivity uS (if present)	0.125
Water pH (if present)	5.33	Von Post peat decomposition index	4

Plot 2: Peka Peka Road (south)

WETLAND PLOT SHEET 2.					
Wetland name:	Peka Peka Road	Conditions	Sunny, calm		
Plot no:	2	X coordinates (m):	1774481		
Date:	03.03.2017	Y coordinates (m):	5476995		
Time:	5.30	Structure:	Shrubland/sedgeland		
Personal:	TR, PE	Composition:	Coprosma/Flax/Isolepis		

Canopy (bird's eye view)			Subcanopy			Groundcover		
Species ¹ (or Substrate)	%	H(m)	Species	%	H(m)	Species	%	H(m)
open water	10	0.4	Holcus lanatus	2	0.8	Eleocharis acuta	30	0.5
Phormium tenax	2	1.5	Blechnum minus	30	0.4	Austroderia fulvida	1	0.6
Coprosma propinqua	2	1.4	Isolepis prolifera	30	0.6			
Salix spp	5	1		30	0.6			
Leptospermum scoparium	2	1.8						

¹ % = % cover: total Canopy % cover = 100%; H = maximum height in m; indicate introduced species by *

Additional species in vicinity in same vegetation type: Sphagnum, *Juncus pallidus*, Hypolepis distans, toetoe, Epilobium pallidum, Crepis capillaris, Bidens, blackberry

Fauna seen:

Comments: Salix spp rapidly increasing in extent and needs controlling

Indicator (use plot data only)	%	Score 0–5 ²	Specify & Comment
Canopy: % cover introduced species	5	4	Willow
Understorey: % cover introduced spp ³	2	4	Yorkshire fog
Total species: % number introduced spp	7	4	

Total species: overall stress/dieback	0	5	
	17		

5=0%: none, 4=1- 24%: very low, 3=25-49%; low, 2=50-75%: medium, 1=76-99%: high, 0=100%; v. high

Field measurements:							
Water table cm (in relation to soil surface)	20	Water conductivity uS (if present)	0.122				
Water pH (if present)	6.55	Von Post peat decomposition index	4				

Te Hapua Complex A

WETLAND RECORD SHEET						
Project:	Kapiti water supply	Date:	03.03.2017			
Wetland name:	Te Hapua Complex A	Personal:	TR, PE			
Region:	Kapiti Coast, Wellington	# of Plots sampled:	2			

Classification: I System IA Subsyster		IA Subsystem	II Wetland Class	IIA Wetland Form		
	Palustrine	Permanent	Fen	Basin		

Indicator	Indicator components	Specify and Comment	Score 0– 5 ¹	Mean score	
Change in hydrological integrity	Impact of manmade structures	Drained surrounding farmland. Amenity ponds have also been constructed	4	3.67	
	Water table depth	higher than normal due to wet summer	3		
	Dryland plant invasion	Pasture grass species.	4		
Change in	Fire damage	nil	5		
parameters	Degree of sedimentation/erosion	minimal	5	4.25	
	Nutrient levels	farmland surrounds	4		
	Von Post index	Average	3		
Change in ecosystem	Loss in area of original wetland	was once part of a larger complex.	4		
Intactness	Connectivity barriers	road, farming, devolpment has fragmented wetland	4	4	
Change in browsing, predation & harvesting regimes	Damage by domestic or feral animals	Rabbits, canadian geese.	3		
	Introduced predator impacts on wildlife	Trapping carried out. Likely some cats, roadents, mustelids	4	4	
	Harvesting levels	None	5		

Change in dominance of	Introduced plant canopy cover	Bidens frondosa	4.5	4 75	
native plants	Introduced plant understorey cover	Nil	5	4.75	
Total wetland condition index /25					

Main Vegetation types: Wetland complex of varying degrees of coprosma/flax/carex/lsolepis/standing water

Native fauna: fantail

Other comments: Majority of wetland planted. Boardwalk running through. Both weed and pest mammals controlled.

Pressure	Score ²	Specify and Comment
Modifications to catchment hydrology	3	Majority of the catchment in forestry, farming or residential.
Water quality within the catchment	3	Assumed some from surrounding farmland
Animal access	2	fenced, some predator control.
Key undesirable species	2	willow and bidens in catchment. Control carried out.
% catchment in introduced vegetation	3	Farmland
Other landuse threats	1	Groundwater abstraction.
Total wetland pressure index /30	14	

²Assign pressure scores as follows: 5=very high, 4=high, 3=medium, 2=low, 1=very low, 0=none

Plot 1: Te Haupua Complex A (south)

WETLAND PLOT SHEET								
Wetland name:	Te Haupua Complex A	Date:	03.03.2017	Plot no:	1			
Plot size:	2m x 2m	Elevation:	10m a.s.l	Northing:	5479213			
Personal:	TR, PE	Structure:	Juncus-carex – sedgeland, herbfield	Easting	1774728			

Canopy (bird's eye view)		Subcanopy			Groundcover			
Species1 (or Substrate)	%	H(m)	Species	%	H(m)	Species	%	H(m)

Open water	10	0.45	Isolepis prolifera	1	0.4	Azolla rubra	5	0.005
Cyprus ustulatus	2	1				Lemna dispersa	45	0.005
Juncus effusus	2	0.7				Wolffia australiana	20	0.005
Eleocharis acuta	4	0.6						
Bidens Frondosa	5	0.6						

Additional species in vicinity in same vegetation type: *Isolepis,* forget me not, *Carex virgata, Austroderia toetoe, Cyprus australis*

Fauna seen: Pukeko

Comments: Plot to the west of boardwalk, adjacent to the Waimeha river, by Cabbage tree.

Indicator (use plot data only)	%	Score 0–5 ²	Specify & Comment
Canopy: % cover introduced species	5	4	Bidens frondosa
Understorey: % cover introduced spp ³	0	5	Nil
Total species: % number introduced spp	5	4	
Total species: overall stress/dieback	0	5	
	Total /20	18	

5=0%: none, 4=1-24%: very low, 3=25-49%; low, 2=50-75%: medium, 1=76-99%: high, 0=100%; v. high.

³Add subcanopy and groundcover % cover for introduced species

Field measurements:						
Water table cm	45	Water conductivity uS (if present)	0.112			
Water pH (if present)	0.54	Von Post peat decomposition index	6			

Plot 2: Te Haupua Complex A (south)

WETLAND PLOT SHEET						
Wetland name:	Te Haupua Complex A	Date:	03.03.2017	Plot no:	2	
Plot size:	2m x 2m	Elevation:	10m a.s.l	Northing:	5479378	
Personal:	TR, PE	Structure:	Juncus-carex rush- sedgeland	Easting	1774778	

Canopy (bird's	eye viev	/)	Subcanopy			Groundcover		
Species1 (or Substrate)	%	H(m)	Species	%	H(m)	Species	%	H(m)
Open water	80	0.5	Isolepis prolifera	3	0.6	Wolffia australiana	10	0.005
Carex secta	20	2	Persicaria decipiens	45	0.1	Lemna disperma	20	0.005

Additional species in vicinity in same vegetation type: flax, Raupo. Bidens, Austroderia, cabbage tree, Cyprus ustulatus

Fauna seen: none

Comments: Very wet.

Indicator (use plot data only)	%	Score 0–5 ²	Specify & Comment
Canopy: % cover introduced species	0	5	Nil
Understorey: % cover introduced spp ³	0	5	Nil
Total species: % number introduced spp	0	5	
Total species: overall stress/dieback	0	5	
	Total /20	20	

5=0%: none, 4=1- 24%: very low, 3=25-49%; low, 2=50-75%: medium, 1=76-99%: high, 0=100%; v. high

Field measurements:					
Water table cm	0.5	Water conductivity uS (if present)	0.121		
Water pH (if present)	5.34	Von Post peat decomposition index	6		
Te Hapua Complex D (Pateke Lagoon)

WETLAND RECORD SHEET					
Project:	Kapiti water supply	Date:	03.03.2017		
Wetland name:	Te Hapua Complex D	Personal:	TR, PE		
Region:	Kapiti Coast, Wellington	# of Plots sampled:	2		

Classification: I System	IA Subsystem	II Wetland Class	IIA Wetland Form
Palustrine	Permanent	Fen	Basin

Indicator	Indicator components	Specify and Comment	Score 0– 5 ¹	Mean score
Change in hydrological	Impact of manmade structures	Roadway and housing has constrained this wetland.	4	
integrity	Water table depth	Surrounding farmland drained	3	3
	Dryland plant invasion	Blackberry, Yorkshire fog, gorse	2	
Change in	Fire damage	Nil	5	
physico- chemical	Degree of sedimentation/erosion	Some from surrounding farmland	4	4.25
parameters	Nutrient levels	Some presumed from farm	4	
	Von Post index	Moderate	4	
Change in ecosystem intactness	Loss in area of original wetland	Some loss through farming, road and residential development.	3	3
	Connectivity barriers	Culverted under road.	3	
Change in browsing,	Damage by domestic or feral animals	minimal	4	
predation & harvesting	Introduced predator impacts on wildlife	minimal	3	4
regimes	Harvesting levels	nil	5	
Change in dominance of	Introduced plant canopy cover	Nil	3	2 75
native plants	Introduced plant understorey cover	Kikuyu grass	4.5	5.75
		Total wetland co	ndition index /25	18.00

¹ Assign degree of modification as follows: 5=v. low/ none, 4=low, 3=medium, 2=high, 1=v. high, 0=extreme

Main Vegetation types: Harakeke, Raupo, *Carex lessoniana*, Blackberry Native fauna: Pukeko, mallards

Other comments: Wetland has been restored.

Pressure	Score ²	Specify and Comment
Modifications to catchment hydrology	3	Majority of the catchment in forestry, farming or residential.
Water quality within the catchment	3	Some of the catchment farmed.
Animal access	2	Fenced, some predator control.
Key undesirable species	4	Willow and Bidens in catchment. Blackberry taking over northern wetland
% catchment in introduced vegetation	3	Large area of catchment in farmland.
Other landuse threats	1	Bore extraction
Total wetland pressure index /30	16	

²Assign pressure scores as follows: 5=very high, 4=high, 3=medium, 2=low, 1=very low, 0=none

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Plot 1: Te Haupua Complex D (Pateke Lagoon) (north)

WETLAND PLOT SHEET						
Wetland name:	Te Haupua Complex D	Date:	03.03.2017	Plot no:	1	
Plot size:	2m x 2m	Elevation:	10m a.s.l	Northing:	5479476	
Personal:	TR, PE	Structure:	Juncus-carex rush- sedgeland	Easting	1775876	

Canopy (bird's eye view)		Subcanopy		Groundcover				
Species1 (or Substrate)	%	H (m)	Species	%	H (m)	Species	%	H (m)
Open Water	10	0.25						
Carex geminata	35	1.4						
Rubus fruticosus	75	1						

¹% = % cover: total Canopy % cover = 100%; H = maximum height in m; indicate introduced species by *

Additional species in vicinity in same vegetation type: Ink weed to the north of plot, *Muehlenbeckia australis* to the east. Bracken to the west. Bidens and Raupo also nearby.

Fauna seen: Pukeko

Comments: Blackberry is thick and needs controlling - if it continues to grow will not be able to access plot

Indicator (use plot data only)	%	Score 0–5 ²	Specify & Comment
Canopy: % cover introduced species	75	1	Blackberry
Understorey: % cover introduced spp ³	0	5	Nil
Total species: % number introduced spp	75	1	
Total species: overall stress/dieback	20	3	Carex dying back
	Total /20	10	

5=0%: none, 4=1-24%: very low, 3=25-49%; low, 2=50-75%: medium, 1=76-99%: high, 0=100%; v. high. ³Add subcanopy and groundcover % cover for introduced species

Field measurements:					
Water table cm	25	Water conductivity uS (if present)	0.114		
Water pH (if present)	5.43	Von Post peat decomposition index	6		

Plot 2: Te Haupua Complex D (Pateke Lagoon) (south)

WETLAND PLOT SHEET							
Wetland name:	Te Haupua Complex D	Date:	03.03.2017	Plot no:	2		
Plot size:	2m x 2m	Elevation:	10m a.s.l	Northing:	5479221		
Personal:	TR, PE	Structure:	Juncus-carex rush- sedgeland	Easting	1775818		

Canopy (bird's eye view)		Subcanopy			Groundcover			
Species1 (or Substrate)	%	H (m)	Species	%	H (m)	Species	%	H (m)
Open water	5	0.3	Cenchrus clandestinus	1	1.5	Hypolepis ambigua	25	0.5
Typha orientalis	20	2.5	Muehlenbeckia australis	1	1.4			
Carex geminata	60	1.5						

¹% = % cover: total Canopy % cover = 100%; H = maximum height in m; indicate introduced species by *

Additional species in vicinity in same vegetation type: Dicksonia squarrosa, Muehlenbeckia complexa, convolvulus, Ragwort, Blackwood

Fauna seen: Swamp Harrier, pukeko

Comments: Plot located North of house between pine shelter belt and tree group containing *Dicksonia squarrosa* and Blackwood,

Indicator (use plot data only)	%	Score 0–5 ²	Specify & Comment
Canopy: % cover introduced species	0	5	Nil
Understorey: % cover introduced spp ³	1	4	Kikuyu grass
Total species: % number introduced spp	1	4	
Total species: overall stress/dieback	0	5	
	Total /20	18	

² 5=0%: none, 4=1- 24%: very low, 3=25-49%; low, 2=50-75%: medium, 1=76-99%: high, 0=100%; v. high

³Add subcanopy and groundcover % cover for introduced species

Field measurements:

Water table cm	30	Water conductivity uS (if present)	0.118
Water pH (if present)	5.1	Von Post peat decomposition index	5

Appendix B: Photo Points

Photo 1: Poplar Ave photopoint 1 looking eastwards across wetland



Photo 2: Poplar Ave photopoint 2 looking northward along edge of pond.

Poplar Ave Wetland

Crown Hill Manuka Bush Wetland



Photo 3: Crown Hill Manuka Bush wetland photopoint 1 (north) Looking from stake northwest to the outer edge of bush



Photo 4 :Crown Hill Manuka bush photopoint 2 (south) Looking northeast towards monitoring plot 2.

Muaupoko Swamp Forest



Photo 5: Muaupoko Swamp Forest Photopoint 1 (east).



Photo 6: Muaupoko Swamp forest photopoint 2 (west)

Otaihanga Southern Wetland



Photo 7: Otaihanga Southern wetland Photopoint 1, looking from cycleway looking West into northern end of wetland



Photo 8: Otaihanga Southern Wetland Photopoint 2, looking from cycleway southwest into the southern end of wetland.

Tini Bush Wetland



Photo 9: Tini Bush photopoint 1 (south) looking north from southern edge of swamp forest (can see permanent monitoring plot in background.



Photo 10: Tini Bush photopoint 2 (north) looking Southwest from under trees, across ditch.

El Rancho Wetland



Photo 11: El Rancho wetland photopoint 2. Looking from expressway north into Manuka stand.



Photo 12: El Rancho Wetland photopoint 1. Looking from M2PP expressway road West into Manuka stand. Note this photopoint has relocated to a position which will record a greater amount of change

Te Harakeke

Te Harakeke was not accessible in the summer of 2017



Nga Manu Wetland

Photo 13: Nga Manu photopoint 1 (north). Looking south towards viewing area along pond shoreline



Photo 14: Nga Manu photopoint 2 (south). Looking south towards water level /pond edge from piezometer.

Ngarara Wetland



Photo 15: Ngarara Rd wetland, photopoint looking from northern bank southeast into the wetland.

Ngarara Bush wetland



Photo 16: Ngarara Bush Photopoint 1, Looking Southeast from Post alongside driveway.



Photo 17: Ngarara Bush Photopoint 2, looking Northeast from bank in front of house



Photo 18: Peka Peka Road Swamp photopoint 2 (south). Looking Northeast at edge of wetland under willow tree.



Photo 19: Peka Peka Road Swamp photopoint 1 (north), looking south.

Te Hapua Swamp Complex A



Photo 20: Te Hapua swamp complex A photopoint 1, looking NE towards monitoring plot 1 to the east of the boardwalk



Photo 21: Te Hapua swamp complex A photopoint 2, looking NE towards monitoring plot 2 between cabbage tree and pittosporum



Photo 22: Te Hapua swamp complex A photopoint 1, Looking NE towards house.



Photo 23: Te Hapua swamp complex A photopoint 1, taken from corner of front garden looking NW towards pond edge along fence

Appendix E

Small Coastal Streams Baseline Monitoring Annual Report 2016/17

Small Coastal Streams Annual Aquatic Baseline Monitoring Report

A report on 2016/2017 aquatic data collection for water permit WGN130103 [34384] Prepared for Kapiti Coast District Council 10 July 2017



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Cover photograph: Lower Muaupoko Stream monitoring site, © Boffa Miskell, 2014

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1.0 Introduction

1.1 Background

Resource consent condition 33 of Consent WGN130103 [34384] for the River Recharge with Groundwater Project (RRwGW Project) requires a baseline monitoring programme of small coastal streams to be carried out, following the methods approved in the revised Small Coastal Streams (SCS) Baseline Aquatic Monitoring Plan Part B (BMP) (Boffa Miskell Ltd, dated 22 December 2016).

That plan, re-certified by Greater Wellington Regional Council (GWRC), requires the collection of continuous¹ shallow groundwater level adjacent to each monitored stream, continuous¹ instream water depth (by pressure inducer), continuous¹ instream temperature, and continuous¹ instream continuous dissolved oxygen.

Monthly manual measurements are also taken in conjunction with the logger data to highlight any calibration issues with equipment. These include: instream water level, groundwater level and point measures of conductivity and temperature.

Full details of the consent conditions and requirements for monitoring can be found in the SCS BMP Part B dated 22 December 2016.

1.2 Scope

This report outlines the 2016/2017 season of data collection for the baseline monitoring programme for small coastal streams. The 2016/2017 season is the 3rd year of the baseline monitoring programme.

¹ Where "continuous" means a recorded reading every 15 minutes.

2.0 Methodology

2.1 Monitoring Locations

The monitoring locations have been determined in the SCS BMP and certified amendments, and consist of five sites (refer to Map 1 for locations and Section 2.3 for site photographs):

- Hadfield Stream;
- Ngarara Stream; •
- Kakariki Stream: •
- Lower Muaupoko Stream; •
- Upper Muaupoko •

The reasoning behind each location of these streams can be found in the scoping document Characterising Small Coastal Streams BMP Part A (Boffa Miskell Ltd, 2014) and specific monitoring locations are described in full in the SCS BMP B (Boffa Miskell Ltd, 2016). At each site, a piezometer has been installed near to the stream bank. Upper Muaupoko stream has an automated logging device installed which automatically sends data to Kapiti Coast District Council SCADA - and is therefore not included in the monthly field monitoring programme.

2.2 Monitoring Methods

The SCS BMP Part B provides in-depth detail of monitoring methodologies, but in summary the following parameters are required to be measured at each site for the period 1 December 2016 to 1 May 2017:

- Groundwater level (mm AMSL) •
 - Every 15 minutes via in-situ piezometer and logger
 - Manual measurements taken monthly by ecologists
- Stream water level (mm above stream level)
 - Every 15 minutes via in-situ pressure inducer and logger
 - Manual measurements taken monthly by ecologists
- Temperature (°C)
 - Every 15 minutes via in-situ temperature probes
 - Manual measurements taken monthly by ecologists
- Dissolved oxygen (mg/L)
 - Every 15 minutes via in-situ DO probes _
 - Manual measurements taken monthly by ecologists

Once a month the four monitoring sites (excluding Upper Muaupoko) were visited, manual measurements conducted by ecologists and data downloaded from in-situ Almeno 2590 data loggers. Manual measurements were taken using a Horiba U-50 hand held water quality meter (for temperature and dissolved oxygen readings), Solinst 101 water level meter (for

groundwater level readings) and a Fatmax measuring tape (for stream water level measurement). The Horiba U-50 hand held water quality meter was calibrated immediately before each monthly visit, using automated calibration protocols outlined in the Horiba U-50 manual.

Data downloaded from the Almeno 2590 data loggers and results of the monthly manual measurements were uploaded into WaterOutlook (KCDC data management and reporting system).



Map 1: Map showing locations of small coastal stream monitoring sites

2.3 Site Photos illustrating the monitoring locations



Photo 1: Hadfield Stream monitoring site

Photo 2: Ngarara Stream monitoring site



Photo 3: Kakariki Stream monitoring site

Photo 4: Upper Muaupoko Stream monitoring site



Photo 5: Lower Muaupoko Stream monitoirng site

3.0 Results

Instream data logger results for the 2016/2017 season are provided in the following section.

The season's rainfall and daily average flow of the Waikanae River (as a proxy for all streams on the Kapiti Coast) measured by GWRC at the Waikanae WTP is shown for context below (Figure 1).

The 2016/2017 summer was a wet season. There were several heavy rain events (>5mm/hour) during the monitoring season (December - May) and 5 periods with high daily rainfall (Figure 1). These rain events caused a loosely associated increase in Waikanae River flows. There were 7 river flow spikes, one of which was very high, 235m³/s on 3 February 2017 (Figure 1).



Waikanae River at Water Treatment Plant

Figure 1: Daily rainfall (mm) and flow (m³/s) recorded for Waikanae River at the Waikanae Water Treatment Plant

Instream Data Logger Results 3.1

Below (Sections 3.1.1 to 3.1.5) are a compilation of graphs showing the data collected for each "continuously"² measured parameter; groundwater level (mm), instream water level (mm), temperature (°C) and dissolved oxygen (mg/L). Almeno data loggers located by the small streams recorded data at each monitoring site during the period of 1st December 2016 to 1st May 2017 (data provided to late May).

These charts are automatically compiled from the WaterOutlook system to which all data downloaded from monitoring sites is uploaded.

At some of the monitoring sites there are data gaps which relate to equipment failure (largely battery issues and wiring) and while these sites underwent maintenance to resolve the issues there remains the data gap. None are extreme or result in insufficient baseline data.

² Measurements are taken every 15 minutes

3.1.1 Hadfield Stream

Groundwater levels between December to February were consistently over 2000mm AMSL and varied (roughly correlated with rainfall) more in the latter part of the summer. There was a data gap in March due to logger battery failure. Stream level was "stable" until mid-February and then declined steadily through April to May (despite the rainfall).

These data show the groundwater level increasing through time (likely due to the relatively wet summer with persistent rain events) and yet the stream declined in water depth in late summer. The two parameters do not appear well correlated.

The dissolved oxygen showed a similar trend with stream water depth although there were frequent low oxygen periods beyond the natural diurnal fluctuation throughout. More regular low oxygen levels were seen in the late April period.

In stream temperature followed the expected daily fluctuation between 15 and 20 degrees, and then (as with the stream water depth pattern) began to decline after summer (from March to May). There was no obvious mid-summer peak this year in these data.



Figure 2: Ground water levels at Hadfield Stream throughout the monitoring period December 2016 to June 2017



Figure 3: Stream depth above bed level at Hadfield Stream throughout the monitoring period December 2016 to June 2017



Figure 4: Dissolved oxygen levels at Hadfield Stream throughout the monitoring period December 2016 to June 2017



Figure 5: Temperature levels at Hadfield Stream throughout the monitoring period December 2016 to June 2017

3.1.2 Ngarara Stream

Battery issues (and several loose wires) have resulted in the loggers not recording data post early March.

The groundwater level between December to March was consistently over 3500mm AMSL, with one raised spike (around 20 February) perhaps related to the large and two small rain events earlier in February. The stream water depth profile follows closely the groundwater level pattern. Neither show a decline through the monitoring period (although data collection was suspended after the middle of March).

The dissolved oxygen data is poor this season, with the probe and or logger having recording issues from January. Temperature was as expected with a daily fluctuation of around 5°C and perhaps a slight increase through summer, but no clear pattern. Stream water depth did not vary much this year and so no potentially correlated temperature change was able to be measured.



Figure 6: Ground water levels, Ngarara stream through the monitoring period December 2016 to June 2017



Figure 7: Stream depth above bed level, Ngarara Stream through the monitoring period December 2016 to June 2017



Figure 8: Dissolved oxygen levels, Ngarara Stream through the monitoring period December 2016 to June 2017



Figure 9: Temperature levels, Ngarara Stream through the monitoring period December 2016 to June 2017

3.1.3 Kakariki Stream

Groundwater remained relatively consistent (noting the March data gap) with increased variability in April-May). The stream water level varied more and appears to have responded to rainfall far more substantially than any other stream monitoring site and the groundwater level. As with the Ngarara monitoring system the stream water level and groundwater level appear reasonably well correlated.

Dissolved oxygen results show a normal and persistant level throughout the moniotirng season. Similar to the Hadfield site the temperature began to fall after summer, from April (Autumn).



Figure 10: Ground water levels, Kakariki Stream through the monitoring period December 2016 to June 2017



Figure 11: Stream levels above stream bed, Kakariki Stream through the monitoring period December 2016 to June 2017



Figure 12: Dissolved oxygen levels, Hadfield Stream through the monitoring period December 2016 to June 2017



Figure 13: Temperature levels, Kakariki Stream through the monitoring period December 2016 to June 2017

3.1.4 Lower Muaupoko

Groundwater level remained relatively consistent (~5900mm AMSL) throughout the monitoring period (and higher than last year (5500mm AMSL). An increase in fluctuations is seen from April. The stream level was sustained but had numerous short periods of increase (with rainfall). Oxygen levels remained high and fluctuated daily with a slight increase into autumn when the temperature also dropped. The data suggest that the stream level is more responsive to rain than the groundwater level, but both respond to similar events in a similar time frame.



Figure 14: Ground water levels, Lower Muaupoko Stream through the monitoring period December 2016 to June 2017



Figure 15: Stream levels above stream bed, Lower Muaupoko Stream through the monitoring period December 2016 to June 2017



Figure 16: Dissolved oxygen levels, Lower Muaupoko Stream through the monitoring period December 2016 to June 2017



Figure 17: Temperature levels, Lower Muaupoko Stream through the monitoring period December 2016 to June 2017

3.1.5 Upper Muaupoko

The groundwater level was relatively stable about 14500mm AMSL with a small set of fluctuations increasing into autumn and a slight general increase over the monitoring period. The stream water level had a different pattern, with larger fluctuations and a decline in depth through time, but markedly so after mid-April. The peaks of water level did follow the increases in groundwater depth and are likely rain related.

Oxygen levels on two occasions declined markedly (~ 15th January and ~ 20th February), but was otherwise generally normal. These lower periods do not coincide with stream depth changes of any magnitude. Temperature followed the trend already noted with is daily variation normal and no middle summer peak but an autumn decline.



Figure 18: Ground water levels, upper Muaupoko Stream through the monitoring period December 2016 to June 2017



Figure 19: Stream levels above stream bed, upper Muaupoko Stream through the monitoring period December 2016 to June 2017



Figure 20: Dissolved oxygen levels, upper Muaupoko Stream through the monitoring period December 2016 to June 2017



Figure 21: Temperature levels, upper Muaupoko Stream through the monitoring period December 2016 to June 2017

4.0 Discussion

River Recharge was not used during the 2016/17 monitoring season. Attaining uninterrupted data this season was difficult with the loggers and probes affected by various issues of wiring and batteries; resulting in data gaps.

Given that the baseline data set is for three years and that the recordings are over 5 months of the year at 15 minute intervals these data gaps remain (as noted before) of little consequence in the ability to look at the longer term (three year) baseline patterns. Baseline data collected to date is sufficient to; determine normal state levels, the level of stream depth to groundwater level correlation, stream depth to oxygen and temperature correlations; and determine ongoing triggers levels as maybe appropriate.

As reported before, when comparing the shallow groundwater level changes with the instream water depth changes it is observable that there are roughly parallel responses of groundwater level and instream water depth to rain. There are some sites where the monitoring period patterns between groundwater and surface water levels appear to be similar (correlated) and others where that is not the case (e.g. Hadfield).

It was a wet summer and no stream or groundwater piezometer showed water declines of any magnitude. Only the upper Muaupoko site had an observable decrease in surface water levels and only after summer.

3 years of baseline data is now collected and includes a wet, dry and normal summer season. The next phase is to combine the years of data and explore what patterns in groundwater and stream depth are present, and what relationships (if any) between stream depth and oxygen, and stream depth and temperature are also present.

Most importantly (and outside of this report) will be evidence of bore water abstraction affecting deep groundwater levels and these changes being correlated with shallow groundwater change.

5.0 Summary

Despite some data gaps due to equipment failure, the data collected from the small coastal streams between 1 December 2016 and 30 May 2017 is adequate to provide a third of the baseline monitoring data. Even though there was no River Recharge activities this year, the data collected provides relevant instream habitat parameters and potentially links to the associated groundwater levels.

6.0 References

- Boffa Miskell Ltd. (2014). Characterisation of Small Coastal Streams: Identifying Monitoring Locations Part A (Report No. W13118_20140307). Kapiti Coast District Council.
- Boffa Miskell Ltd. (2016). Small Coastal Streams Baseline Monitoring Plan Part B (Report No. W13118). Kapiti Coast District Council.
- Goodman, J; Dunn, N; Ravenscroft, P; Allibone, R; Boubee, J; David, B; Griffiths, M; Ling, N; Hitchmough, R; and Rolfe, J. 2014. Conservation Status of NZ freshwater fish, 2013. Department of Conservation, NZ threat classification series.

