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Report

Annual Waikanae Borefield Report 2013/14 (Consent WGN130103 [31992])

Prepared for Greater Wellington Regional Council

On behalf of Kāpiti Coast District Council

Prepared by CH2M Beca Ltd

26 August 2014

Revision History

Revision Nº	Prepared By	Description	Date
1	**Kirsten Fraser** **Mike Law** **Dora Avanidou**	Draft for Council review	11 July 2014
2	Kirsten Fraser	For Adaptive Management Group	29 July 2014
3	Kirsten Fraser	Final for submission to GWRC	26 August 2014
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5			

Document Acceptance

Action			
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Approved by	**Andrew Watson**	**Signed:** 	**Date:** **26 August 2014**
on behalf of	CH2M Beca Ltd		

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 [31992]. This is the first annual Waikanae Borefield report, and covers the period from commencement of the consent (7 October 2013) through to 30 June 2014.

The consent authorises the abstraction of groundwater from eight wells within the Waikanae Borefield for the purpose of supplementary public water supply through river recharge or emergency public water supply. Currently only five of these wells (K4, K5, K6, Kb4 and K10) are operable.

The Waikanae Borefield was used for supplementary public water supply on three occasions during 2013/14 due to low river flows: 25 February to 6 March 2014, 9-17 March 2014, and 25 March to 17 April 2014. The other periods of the Borefield use were associated with operation and maintenance activities. The maximum total daily take was 15,069 m^3/day on 8 April 2014. This is significantly less than 23,600 m^3/day which is the maximum take for Stage 1 of the river recharge with groundwater scheme (RRwGW).

From the borefield monitoring results, none of the established interim trigger levels for groundwater levels (deep and shallow) or electrical conductivity have been reached.

Groundwater levels in two piezometers for wetlands monitoring under Part 1F dropped below alert and alarm levels for periods of a few to several days in mid-March to late April (one piezometer at El Rancho wetland and one at Ngarara Road wetland). We note that these low summer/autumn wetland levels are the lowest observed on the Kāpiti Coast for some years, and certainly the lowest observed by the RRwGW project Ecologist, Mr Park (Boffa Miskell) since monitoring and botanical survey work commenced in 2010. Mr Park undertook Wetland Condition Monitoring (Landcare, 2004) of the wetlands in accordance with consent requirements but did not recommend any adaptive management response at this time. A decline in groundwater levels was seen in the data district-wide, with no change in gradient evident from the time of Council's commencement or cessation of pumping as would be expected if pumping were contributing to lowering levels. It is noted that if the methodology for the setting of triggers proposed in Part 1G for wells with less than 12 months of regular monitoring (a similar methodology to that agreed for wetland monitoring as part of the M2PP Expressway project) were applied, no triggers would have been breached. *We recommend applying this methodology, which considers district-wide seasonal variations in groundwater level, to all wetland monitoring in the baseline monitoring period, in accordance with the adaptive management approach intended by the consents.*

Piezometers for wetlands listed in Part 1G have not yet been installed (the Wetland BMP was not approved until February 2014), and therefore existing M2PP piezometers in the general vicinity of the wetlands that could be used in the interim have been identified. None of the M2PP Expressway project triggers for these piezometers were reached during the monitoring period. However, these piezometers are all at a greater distance from the wetlands required to be monitored than desirable, particularly as the order of magnitude of water level change anticipated as a result of long term pumping is in the range of 0 – 200 mm at most. It is further noted that of the 1G wetlands, three of the four (Poplar Ave wetland, Muaupoko Swamp Forest and Tini Bush) are located several kilometres from the Council's water supply wells that currently exist and are able to be pumped to supply. A number of the 1F wetlands are also located many kilometres from wells that are currently in supply. *We propose that while monitoring of piezometers close to wetlands that are more than 2 km from Council's operable production wells should be carried out to establish background understanding of these wetlands, application of even interim triggers to data collected from these monitoring points is premature*. This would be consistent with the Borefield BMP approach.

Suggested changes to the Wetland BMP have been discussed with GWRC and agreed amendments will be incorporated in an updated plan.

No complaints relating to abstraction from the Borefield were received by Council during this period.

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1 Introduction

Kāpiti Coast District Council (Council) holds resource consent (WGN130103 [31992]) 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 wells within the Waikanae Borefield. Five of these wells (K4, K5, K6, KB4 and K10) are currently operational and connected to the raw water pipeline to the Waikanae water treatment plant (WTP). Construction works are underway to bring the remaining three wells (KB7, K12 and N2) into operation and connect them to the pipeline. The locations of the production wells and monitoring bores are shown in Figure 1.

An annual Waikanae Borefield report is required by Condition 42 of consent WGN130103 [31992]. This is the first annual Waikanae Borefield report, and covers the period from commencement of the consent (7 October 2013) through to 30 June 2014. The requirements of Condition 42 are listed in the table below with cross-references to the relevant section in this report.

Table 1: Requirements for Annual Waikanae Borefield report

Condition 42 of consent WGN130103 [31992]		Section in this annual report
The consent holder shall, by 30th August each year, submit an annual Waikanae Borefield report to the Manager. The annual Waikanae Borefield report shall report on the year 1st July to 30th June inclusive, and include the following information:		
a)	A copy of the records to demonstrate compliance with Condition 20 of this consent;	Sections 2.1 and 2.2
b)	Details of the use (including daily and total volumes of groundwater abstracted) and 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 consent, if undertaken that year;	Section 3
d)	Results of all monitoring undertaken that year required by conditions of this consent (if applicable), including a comprehensive analysis of the monitoring results, assessment against any relevant guidelines and comparison with previous years' results (i.e. trend analysis);	Sections 0, 5 and 6
e)	Results or evidence to demonstrate compliance with Condition 7 of this consent	Section 8
f)	Details of any trigger levels or compliance limits that were reached (if occurred that year) and specifically the findings of saline monitoring compared with the 'alert', 'action' or 'cease' triggers;	Sections 4.4 and 5
g)	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 5
h)	Any recommendations for changes to the monitoring plan required by conditions of this consent, including triggers, compliance limits or actions and/or mitigation measures or changes to the operations and maintenance manual, required by Condition 19 of this consent, including any recommendations of the Adaptive Management Committee (referred to in Condition 43 of this consent);	Section 7, Section 2.3 and Section 11
i)	A discussion on any mitigation/adaptive management that may be required in the coming year;	Section 10
j)	A copy of the complaints record required by Condition 45 of this consent;	Section 9
k)	Summary of any maintenance undertaken.	Section 2.2
The annual Waikanae Borefield report shall be made available to the public on the Kāpiti Coast District Council website by 30th August each year.		Refer www.kapiticoast.govt.nz

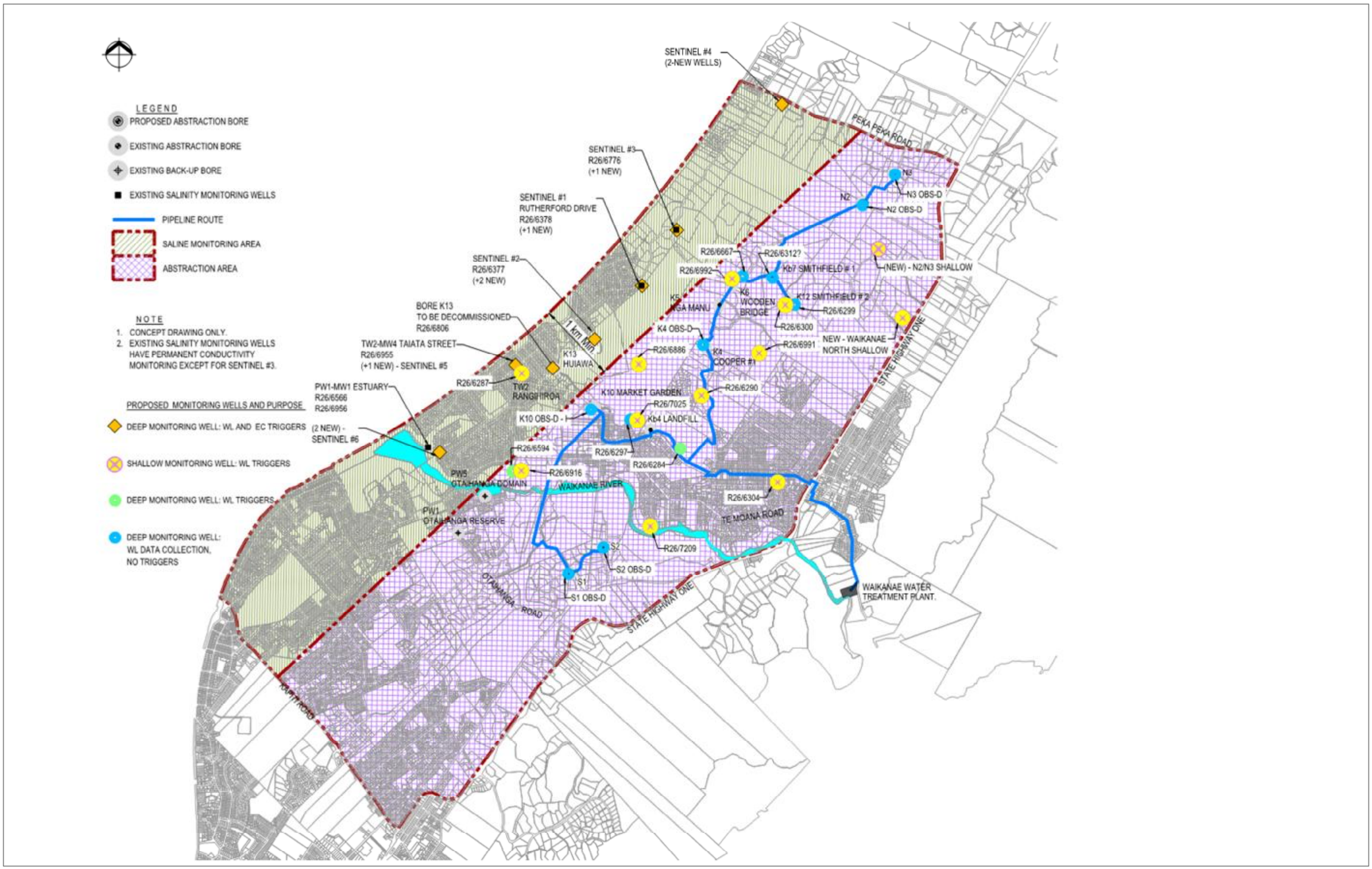


Figure 1: Location Plan – Waikanae Borefield Abstraction Wells and Monitoring Bores

2 Borefield Operation

2.1 Abstraction Volumes and Rates

Abstraction from each production well (L/s and m^3/day) is measured and recorded in accordance with Conditions 13,14 and 20 of consent WGN130103 [31992]. Council regularly submits full abstraction records 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 October 2013 to 30 June 2014 was 350,887 m^3, which is significantly less than the annual volume permitted by Condition 8 of the groundwater take consent (2,300,000 m^3/year).

The maximum total daily take was 15,069 m^3/day on 8 April 2014, which is also less the maximum daily take permitted by Condition 8.

The daily abstraction volumes for each production well during the reporting period are plotted in Figure 2. The Waikanae Borefield was used for supplementary supply on three occasions during 2013/14 due to low river flows: 25 February to 6 March 2014 (10 days), 9 to 17 March 2014 (9 days), and 25 March to 17 April 2014 (24 days).

The other periods of the Borefield use were associated with operation and maintenance activities. The production wells are generally pumped once per month (towards the end of the month) at maximum flow for two or three hours to flush the pipeline, check the operation of the bore pumps and collect water samples for water quality testing.

The total instantaneous abstraction rate is plotted in Figure 3. The maximum combined abstraction was 220 L/s, which occurred for 4.5 hours on 21 February (maintenance testing) and 2.75 hours on 25 February (supplementary supply and maintenance testing).

A summary table of the instantaneous rates for the individual wells is included in Appendix A. On occasions the maximum pumping rates for the individual wells exceeded both the design capacity of the pumps and the maximum instantaneous abstraction rates given by Table 2 of Condition 8. The previous consent for the Waikanae Borefield did not specify instantaneous abstraction rates and the upgrade of Council's control system to take this change into account is not scheduled until later this year. As a result the controls for the instantaneous take from each well were not implemented during the 2013/14 reporting period. Council has since implemented interim controls for the bore pumps to limit the maximum pumping rates so that the maximum instantaneous abstraction rates specified by the consent for each well cannot be exceeded. From the monitoring of groundwater levels and groundwater conductivity, there were no deleterious environmental effects from the higher instantaneous pumping rates at the individual well. In particular, none of the interim trigger levels for the deep and shallow aquifers were reached. During this reporting period, the total abstraction volume and duration of pumping were both much less than the scenario of borefield use presented during the consent hearing.

Redevelopment and testing of well K10 was carried out over a 6-week period in March and April. Abstraction associated with this development and testing is not included in the abstraction volumes above or the summaries of abstraction (Figure 2 and Appendix A). Development took place from 10 March to 15 April and was followed by aquifer testing. Stepped rate testing at K10 was conducted on 17 April at five rates from 13.5 L/s up to 19.7 L/s. Each rate was maintained for a period of 60 minutes. The constant rate test was run for 7 days (22 - 29 April) at an average rate of 18.4 L/s.

There has been no abstraction during this reporting period from the production wells Kb7, K12, or N2 as part of commissioning/testing these wells for future operation.

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 [31992]. Council are working with the GWRC to enable borefield abstraction records to be submitted in a format compatible with GWRC's systems.

A copy of the site logs for each production well is included in Appendix B. It is noted that:

- Redevelopment and testing of well K10 was carried out over a 6-week period in March and April
- There was an electrical fault with well K4's pump which was resolved in February 2014
- There were no changes in operational procedures or any unusual events.

In addition to maintenance of the existing production wells and monitoring bores, construction of the infrastructure required for Stage 1 of River Recharge and drilling of additional monitoring bores is currently underway.

Council are currently implementing a new electronic system (WaterOutlook) that will be used to store and report data and operational information relating to the Waikanae Borefield. This is expected to be in place by December 2014.

2.3 Operation and Maintenance Manual

The Waikanae Borefield Operation and Maintenance Manual (BOMM) is being prepared for Council by Cardno. The BOMM is due for completion by 7 April 2015 in accordance with Condition 19. In the interim period Council is continuing to use the operations and maintenance manual from the previous water permit WGN050025 [32191].

There are no recommended changes to the BOMM at this time.

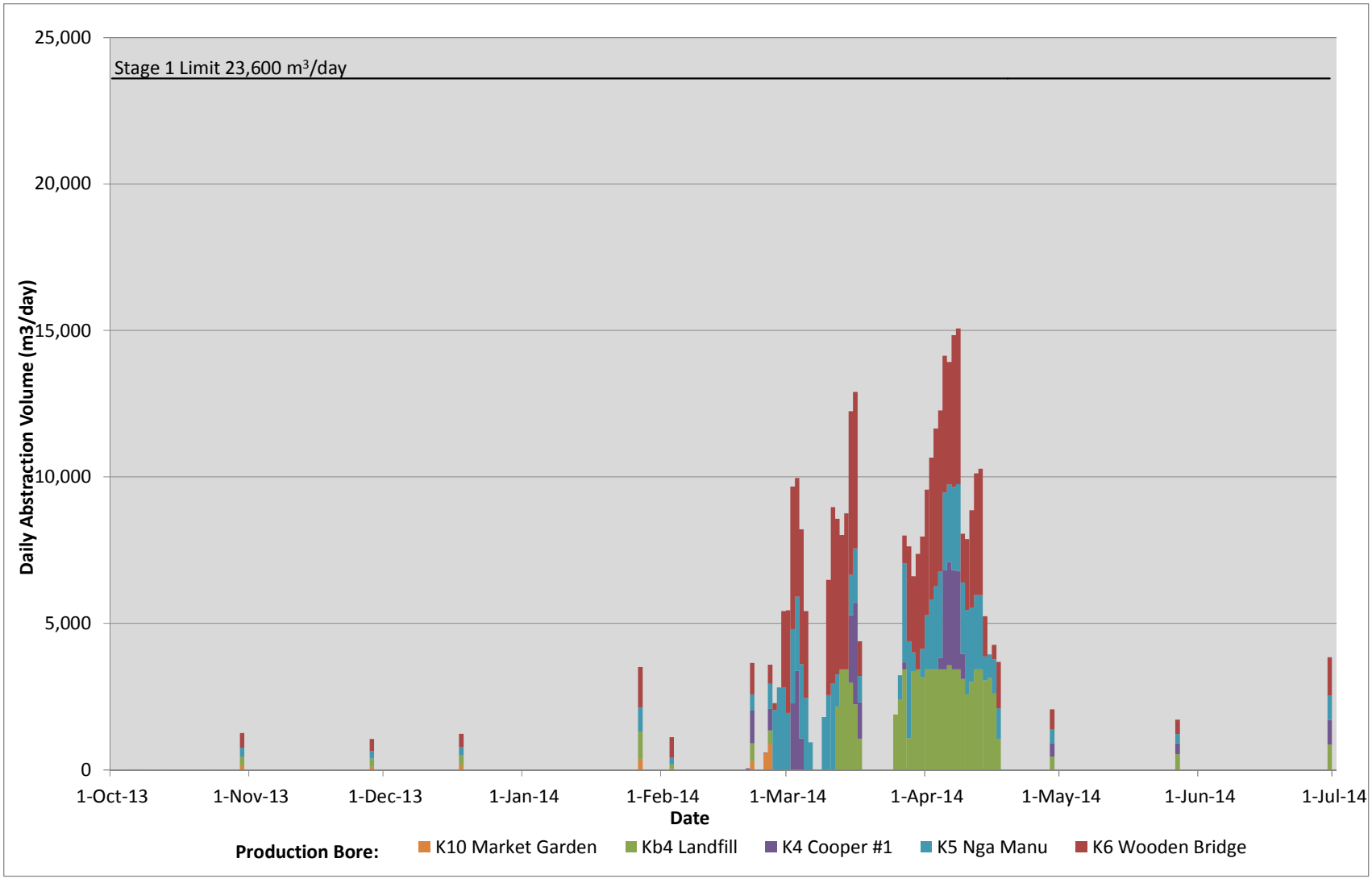


Figure 2: Daily Abstraction Volumes from Production Wells

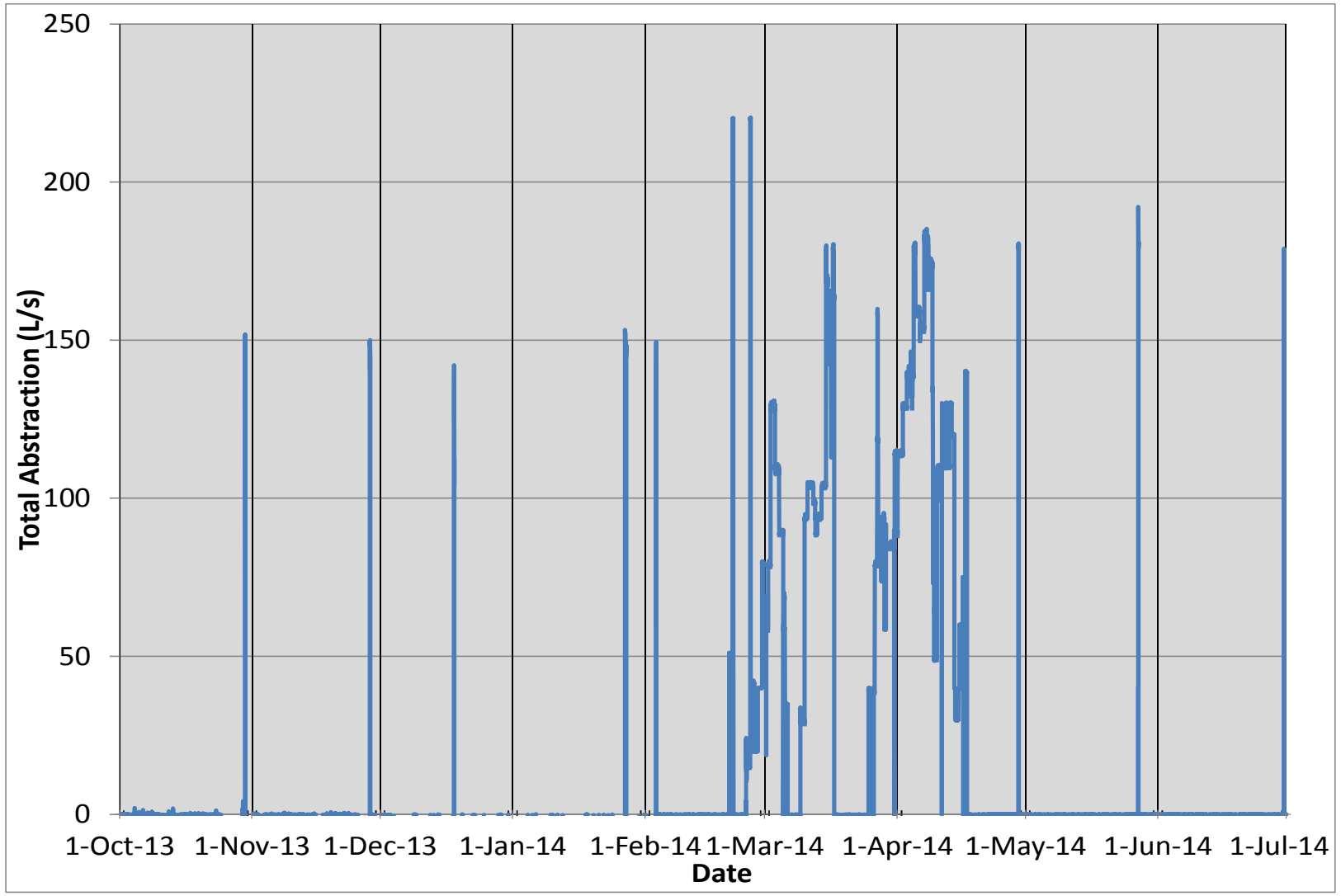


Figure 3: Total Instantaneous Abstraction from Production Wells

3 Waikanae River Flow Gauging

Flow gauging of the Waikanae River is required by Condition 25 of consent WGN130103 [31992]. 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 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.

Two sets of flow gauging were conducted by NIWA at the locations specified in the Waikanae River BMP; just downstream of SH1 and alongside Jim Cooke Park. The gauging results are summarised in Table 2 together with the flow recorded at GWRC's monitoring site upstream of the WTP, the abstraction rate measured by Council and the calculated flow immediately downstream of the WTP.

Table 2: Gauging on the Waikanae River

Date	Water treatment plant			Site	Flow (L/s)	Area (m^2)	Velocity (m/s)	Time (NZST)
	Upstream flow (L/s)	River abstraction (L/s)	Calculated downstream flow (L/s)					
11 March 2014	850	87	763	Below SH1	850	3.18	0.268	13:45
				Jim Cooke Park	564	2.49	0.227	15:08
10 April 2014	799	52	747	Below SH1	719	2.62	0.275	11:10
				Jim Cooke Park	536	2.55	0.210	12:30

The two gaugings undertaken by NIWA indicate:

- Net gain of 87 L/s and net loss of 28 L/s between the water treatment plant and the gauging location just downstream of SH1. The gain occurred when upstream river flows were higher than when the loss occurred.
- Net losses of 286 L/s and 183 L/s between SH1 and Jim Cooke Park, with the greater loss occurring when river flows (as recorded at the WTP) were slightly higher.

More flow gaugings are required to develop this relationship.

4 Borefield Monitoring

4.1 Borefield Baseline Monitoring

The Borefield Baseline Monitoring Plan (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.

Interim trigger levels are used during the baseline monitoring period (currently) and until on-going trigger levels have been set. These interim trigger levels are given in Condition 21 and Appendix A of consent WGN130103 [31992].

4.2 Shallow Aquifer Drawdown Monitoring

None of the interim alert trigger levels for the shallow monitoring bores have been exceeded. Graphs of the monitoring data for this reporting period for the wells that are currently monitored are presented in Appendix C.

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

Well Name	Location Name	GWRC Bore Number	Interim Trigger Level			Status: E = Existing M = Monitored currently	Minimum Level during Reporting Period (mm AMSL)
			Alert (mm AMSL)	Action (mm AMSL)	Cease (mm AMSL)		
TW3_obs Shallow	KCDC K6 Obs Shallow	R26/6992	2180	1980	1580	E, M	2929
GWRC Nga Manu	GWRC Nga Manu	R26/6991	7460	7260	6860	E, M	7475
KCDC W1	Landfill obs Shallow	R26/7025	4440	4240	3840	E, M	4734
TW2-MW3	Rangihiroa St	R26/6287	1340	1140	740	E, M	1751
Te Harakeke 03	Te Harakeke 03	R26/6886	2760	2560	2160	E, M	3310
Waikanae CHP Shallow	Waikanae CHP Shallow	R26/6916	1740	1540	1140	E, M	1878
K12 obs Shallow	Smithfield #2 obs Shallow	R26/6299	TBD	TBD	TBD	E, Manually measured weekly since 03/10/2013	1700 mm below top of bore tube
TW1-MW1	Jim Cooke Memorial Park Shallow	R26/7209	TBD	TBD	TBD	E, Not M	n/a
Kb1 obs Shallow	Ngaio Rd Shallow	R26/6304	TBD	TBD	TBD	E, Not M	n/a
K3 obs S	Ngarara Rd	R26/6290	TBD	TBD	TBD	E, Manually measured weekly since 03/10/2013	4800 mm below top of bore tube
N2-N3 Shallow	Greenhill Rd North	proposed	TBD	TBD	TBD	Not E, Not M	n/a
Waikanae North	Greenhill Rd South	proposed	TBD	TBD	TBD	Not E, Not M	n/a

4.3 Deep Aquifer Drawdown Monitoring

None of the interim alert trigger levels for the deep monitoring bores have been exceeded. Graphs of the available monitoring data for this reporting period for the wells currently monitored are presented in Appendix C.

Table 4: Deep Aquifer Drawdown Monitoring Wells and Interim Trigger Levels

Well Name	Location Name	GWRC Bore Number	Interim Trigger Level			Status: E = Existing M = Monitored currently	Minimum Level during Reporting Period [mm AMSL]
			Alert [mm AMSL]	Action [mm AMSL]	Cease [mm AMSL]		
Sentinel #1 Deep	Rutherford Dr Deep	R26/6378	-1537	-3787	-5475	E, M	-63
TW2-MW4/1	Taiata St Inter 1 (formerly "Shallow")	R26/6673	-404	-1454	-2242	E, M	1332
TW2-MW4/2	Taiata St Inter 2 (formerly "Deep")	R26/6955	-393	-1443	-2231	E, M	1330
Old Estuary Shallow	Old Estuary Shallow	R26/6566	694	64	-409	E, M, BMP only*	1611
Old Estuary Deep	Old Estuary Deep	R26/6956	682	52	-421	E, M, BMP only*	1686
Waikanae CHP Deep	Waikanae CHP Deep	R26/6594	-540	-510	-1298	E, M	1442
Waikanae Park	Waikanae Park	R26/6284	4611	2511	936	E, M	8499
Sentinel #1 Intermediate	Rutherford Dr Intermediate	proposed	TBD	TBD	TBD	Not E, Not M	
Sentinel #2 Deep	Hodgkins Rd Deep	proposed	TBD	TBD	TBD	Not E, Not M	
Sentinel #2 Intermediate	Hodgkins Rd Intermediate	proposed	TBD	TBD	TBD	Not E, Not M	
Sentinel #3 Deep	Old WWTP Deep	R26/6776	TBD	TBD	TBD	E, M weekly since 03/10/2014	3310 mm below top of tube
Sentinel #3 Intermediate	Old WWTP Intermediate	proposed	TBD	TBD	TBD	Not E, Not M	
Sentinel #4 Deep	Peka Peka Rd D	proposed	TBD	TBD	TBD	Not E, Not M	
Sentinel #4 Intermediate	Peka Peka Rd Intermediate	proposed	TBD	TBD	TBD	Not E, Not M	
Sentinel #5 Deep	Taiata St New Deep	proposed	TBD	TBD	TBD	Not E, Not M	
Sentinel #6 Deep	Queens Rd Deep	proposed	TBD	TBD	TBD	Not E, Not M	
Sentinel #6 Intermediate	Queens Rd Intermediate	proposed	TBD	TBD	TBD	Not E, Not M	

* BMP = during the baseline monitoring period only until new wells and monitoring in them are established

The Rutherford Drive Deep data only goes up to 26 May 2014 as equipment was removed for refurbishment of the bore head.

4.4 Saline Intrusion Monitoring

Interim Electrical Conductivity (EC) trigger levels for existing monitoring wells (i.e. existing and currently monitored for EC) are a continuation of the already established triggers from the previous abstraction consent. However EC measurement equipment and sensor placement within the existing saline intrusion monitoring wells 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. For this reason, the current interim trigger levels will only be used for the baseline monitoring period.

The EC trigger levels are set to protect the deep aquifers and allow salt water intrusion to be arrested should it be indicated. The current interim trigger levels are presented in Table 5.

None of the interim alert trigger levels for these monitoring wells have been exceeded.

GWRC has advised that there is no conductivity data for the Old Estuary Shallow well (R26/6566) and the data from the Taiata St bores is not available because there are some issues with the data and its quality. The Rutherford Drive Deep data only goes up to 26 May 2014 as equipment was removed for refurbishment of the bore head.

Graphs of the available monitoring data for this reporting period together with the interim trigger levels for these monitoring wells are presented in Appendix C. The interim triggers for EC will be revised following consideration of the first year of monitoring data collected.

Table 5: Saline Intrusion Monitoring Wells Electrical Conductivity Interim Trigger Levels

Well Name	Location Name	GWRC Bore Number	Interim Trigger Level			Status: E = Existing M = Monitored currently	Maximum Level during Reporting Period (µS/cm)
			Alert (µS/cm)	Action (µS/cm)	Cease (µS/cm)		
Sentinel #1 Deep	Rutherford Dr Deep	R26/6378	1500	1875	2188	E, M	1201
TW2-MW4/1	Taiata St Intermediate 1 (formerly "Shallow")	R26/6673	430	537	627	E, M	No data
TW2-MW4/2	Taiata St Intermediate 2 (formerly "Deep")	R26/6955	3079	3849	4491	E, M	No data
Old Estuary Shallow	Old Estuary Shallow	R26/6566	7152	12500	15000	E, M, BMP only	No data
Old Estuary Deep	Old Estuary Deep	R26/6956	11797	12500	15000	E, M, BMP only	9799
Sentinel #1 Intermediate	Rutherford Dr Intermediate	proposed	TBD	TBD	TBD	Not E, Not M	
Sentinel #2	Hodgkins Rd	proposed	TBD	TBD	TBD	Not E, Not M	

Well Name	Location Name	GWRC Bore Number	Interim Trigger Level			Status: E = Existing M = Monitored currently	Maximum Level during Reporting Period (µS/cm)
			Alert (µS/cm)	Action (µS/cm)	Cease (µS/cm)		
Deep	Deep						
Sentinel #2 Intermediate	Hodgkins Rd Intermediate	proposed	TBD	TBD	TBD	Not E, Not M	
Sentinel #3 Deep	Old WWTP Deep	R26/6776	TBD	TBD	TBD	E, Not M	
Sentinel #3 Intermediate	Old WWTP Intermediate	proposed	TBD	TBD	TBD	Not E, Not M	
Sentinel #4 Deep	Peka Peka Rd Deep	proposed	TBD	TBD	TBD	Not E, Not M	
Sentinel #4 Intermediate	Peka Peka Rd Intermediate	proposed	TBD	TBD	TBD	Not E, Not M	
Sentinel #5 D	Taiata St New Deep	proposed	TBD	TBD	TBD	Not E, Not M	
Sentinel #6 D	Queens Rd Deep	proposed	TBD	TBD	TBD	Not E, Not M	
Sentinel #6 Intermediate	Queens Rd Intermediate	proposed	TBD	TBD	TBD	Not E, Not M	

4.5 Bore Water Quality Monitoring

Water samples are collected from the production wells in the Waikanae Borefield by Council on a monthly basis to characterise the water quality of the wells. A summary of the water quality sampling results obtained to date is included in Appendix D. Fewer samples have been collected from well K10 and K4. This is because of the redevelopment of well K10 and the electrical fault with the pump in well K4.

The full water quality sampling results will be submitted with the Bore Preference Hierarchy Plan required by Condition 16 of consent WGN130103 [31994].

5 Wetlands Monitoring

5.1 Wetlands Baseline Monitoring

The Wetland Baseline Monitoring Plan (Wetland BMP) lists the 13 wetlands that were identified in the "Proposed Wetland Monitoring and Adaptive Management Programme" as part of the consenting phase of the RRwGW Project. Monitoring of water levels in piezometers was proposed to determine the likely natural water level fluctuations in each wetland. Some of the wetlands listed in Part 1F of the interim trigger levels are already subject to piezometer monitoring and Wetland Condition Monitoring by Greater Wellington Regional Council (GWRC), Council and the MacKays to Peka Peka Expressway Project (M2PP), and therefore for these wetlands there is already more than 12 months of regular baseline monitoring. Some of the wetlands listed in Part 1F and all of the wetlands listed in Part 1G have either less than one year of

regular baseline monitoring or monitoring piezometers are not yet in place. The interim trigger levels for all wetlands as set out in the resource consent WGN130103 [31992] are summarised in Figure 5. The recommended wetland monitoring locations (listed in Table 1 of Appendix 3 of the Wetland BMP) are summarised in Table 6 below.

Until the monitoring infrastructure described in the Wetland BMP is established for the wetlands listed in part 1G (and some of those in Part 1F) of Appendix A of the resource consent, monitoring data obtained from selected piezometers already installed in the wider vicinity of the wetlands as part of the M2PP project has been considered. The M2PP trigger levels have not been breached over the period addressed in this report (October 2013 – June 2014[1]).

Installation of additional piezometers in the wetlands is anticipated prior to December 2014, with the establishment of fixed photo-points, aerial photography and mapping and Wetland Condition Monitoring to be undertaken in mid-summer 2014/15 in accordance with the Wetland BMP.

Currently, only Council wells K10, Kb4, K4, K5 and K6 are complete and able to be pumped to supply. The locations of these wells are shown in relation to the wetlands to be monitored in Figure 4. These wells are located several kilometres from some of the wetlands. In the future, this will change as the wells proposed to meet future demand are drilled and brought on-line. We have therefore identified monitoring bores and presented data from them in Appendix E, but we have not attempted to apply trigger levels to wells more than 2 km from the existing pumping wells, other than those already applied as part of the M2PP project.

Table 6: Recommended Wetland Monitoring Locations as set out in the Wetland BMP

Wetland Location	Existing Shallow Groundwater Wells	Wetland Condition Monitoring undertaken?	Resource Consent Interim Trigger Level
Muaupoko Swamp Forest	Locations to be confirmed	No	1G
Peka Peka Road Swamp	Locations to be confirmed	No	1G
Tini Bush	Locations to be confirmed	No	1G
Poplar Ave Wetland	Locations to be confirmed	Yes – site of GWRC Wetland Monitoring Programme	1G
Nga Manu Wetland	GWRC Nga Manu, Well Site K5 Nga Manu	No	1F
Te Hapua Swamp Complex A	GWRC Monitoring Bores – Locations to be confirmed	No	1F
Te Hapua Swamp Complex D	GWRC Monitoring Bores – Locations to be confirmed	No	1F
Te Harakeke Wetland	Te Harakeke 03, M2PP 2011/BH209, 2012/BH18	No	1F
El Rancho Wetlands	Waikanae CHP Shallow, M2PP 2011/HA WM5, 2007/BH-O, 2008/BH205P, 2007/BH-Q	Yes – in El Rancho (Weggery Wetland M2PP)	1F

[1] Water levels in GWRC piezometer R26/6991 at Nga Manu dropped below alert and alarm trigger levels in June 2014, a month or so after pumping by KCDC had ceased. Jon Marks of GWRC has confirmed that the recording device failed and was replaced, causing a downward spike, however GWRC continue to have some problems with the replacement device and a new one has been ordered.

Wetland Location	Existing Shallow Groundwater Wells	Wetland Condition Monitoring undertaken?	Resource Consent Interim Trigger Level
Ngarara Bush	KCDC/K12, 2012/BH20N	No	1F
Ngarara Road Wetland D	Well Site K4- Cooper #1, M2PP 2011/BH210	No	1F
Otaihanga Landfill South	M2PP 2012/BH210, 2011/BH305, 2012/BH11 2011/BH307	Yes – in Otaihanga Central, Southern and Northern (M2PP)	1F
Crown Hill Manuka Bush	M2PP 2012/BH09	No	1F

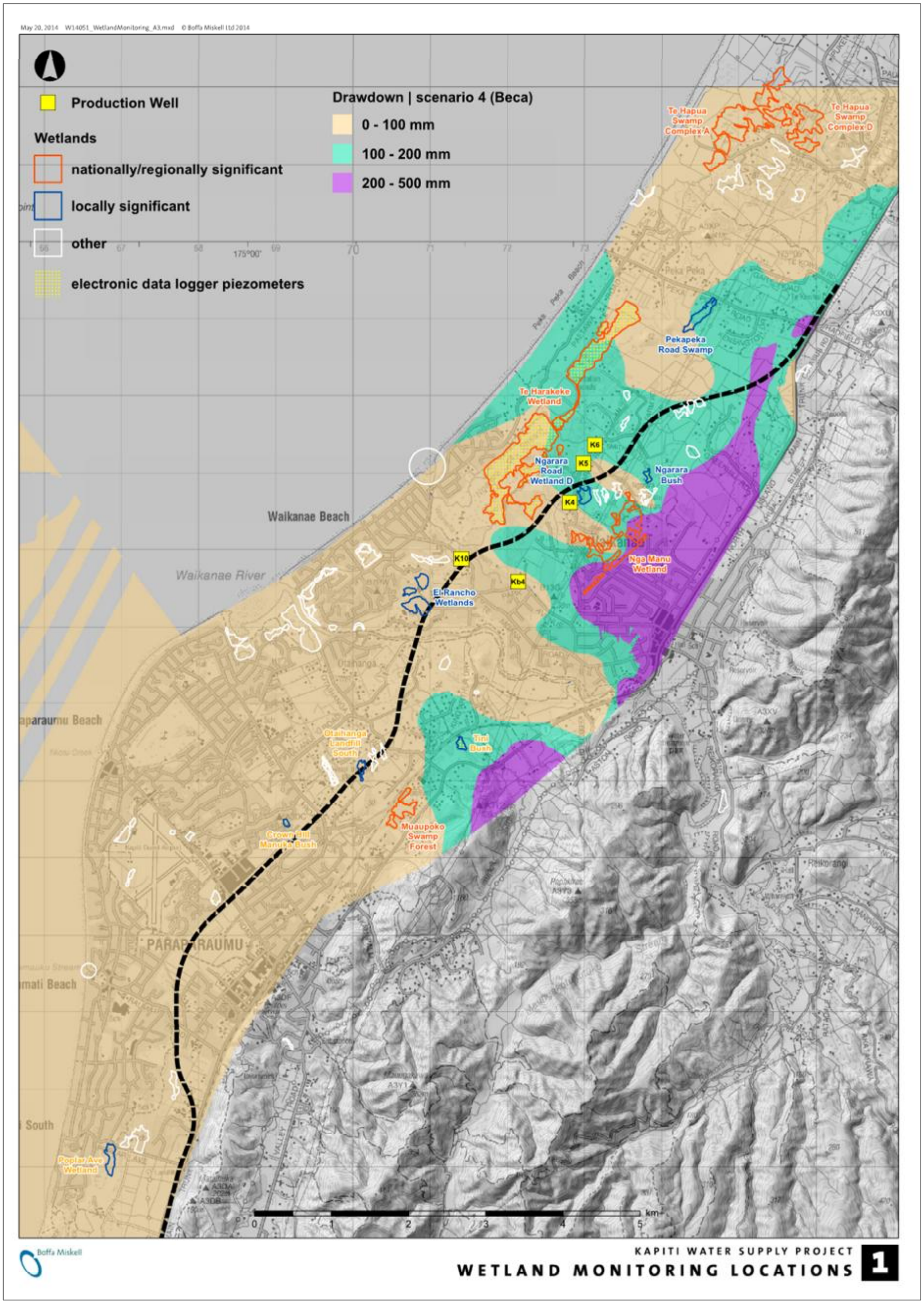


Figure 4: Locations of Monitored Wetlands

		ALERT		ACTION		CEASE	
		Level	Action	Level	Action	Level	Action
1. Groundwater Abstraction – Effect of Waikanae Borefield pumping	1F For those wetlands where there is more than one year's regular baseline monitoring • Nga Manu Wetland • Te Hapua Swamp Complex A • Te Hapua Swamp Complex D • Te Harakeke Wetland • El Rancho Wetlands • Ngarara Bush • Ngarara Road Wetland D • Otaihanga Landfill South • Crown Hill Manuka Bush	100 mm below the lowest historical water level recorded	Evaluate monitoring results to check whether KCDC wells are the cause of the exceedance; and Review monitoring frequency.	50mm below the alert level (150mm)	Undertake an ecological assessment of the affected wetland of the exceedance of the trigger level and compare it against the wetland characterization information (aerial photography and wetland condition assessment) as set out in the Proposed Wetland & Adaptive Management Programme; and Recommend and implement any mitigation measures necessary, including reconfiguring bore pumping regime; management of affected wetland system (controlling water levels though placement of weirs, redirecting drains, direct wetting of wetlands, restricting bore use in the area of wetlands during significant drought periods); Restoration and/or replanting of similar wetland communities.	Ecological experts are agreed that no interim cease trigger levels should be set for wetlands at this stage; rather the adaptive management approach to be implemented at the action level should be sufficient in itself given the likely minor and temporary drawdown effects caused by bore pumping in the early stages of the river recharge scheme. Cease levels may be developed for wetlands in the future as monitoring information is further collected and assessed against pumping activity over time.	
	1G For those wetlands where there is less than 1 year of regular baseline monitoring • Muaupoko Swamp Forest • Peka Peka Road Swamp • Tini Bush • Poplar Ave Wetland	100mm below the lowest historical water levels recorded in telemetered GWRC bores	Evaluate monitoring results to check whether KCDC wells are the cause of the exceedance; and Review monitoring frequency.	50mm below the alert level (150mm)			

Figure 5: Wetland Interim Trigger Levels, Appendix A to Consent WGN130103

5.2 Wetlands Monitoring Results

5.2.1 Wetlands listed in Part 1F

The Nga Manu, Te Harakeke, El Rancho and Te Hapua wetlands (listed in Part 1F) are monitored by GWRC and have more than one year's regular baseline monitoring (based on daily recordings) from shallow wetland piezometers. There is not currently more than one year of regular data for the remaining wetlands listed in Part 1F (Ngarara Bush and Crown Hill Manuka Bush) and we therefore propose that interim trigger levels for them be established in accordance with the methodology established for Part 1G which relates groundwater levels at the monitoring locations to district-wide groundwater levels, thereby taking into account district-wide effects of seasonal changes. Graphs of the monitoring data and trigger levels for all of the following wetland monitoring piezometers are presented in Appendix E.

5.2.1.1 Nga Manu Wetland

Figure 6: Nga Manu Wetland and location of GWRC R26/6991 piezometer in the vicinity

Table 7: Nga Manu Wetland piezometer details

Piezometer ID	Screen Depth Top (mBGL)	Screen Depth Bottom (mBGL)	Screened Material	Minimum Historical Water Level Recorded (mm AMSL)	Minimum Level Recorded after January 2014 (mm AMSL)	Recorded Drawdown from Baseline (mm)
R26/6991 Nga Manu	3.7	4.7	Not known	7684	7634	50

The interim alert trigger level for this piezometer was not exceeded during the monitoring period. However in June the water level dropped below alert and alarm trigger levels, a month or so after pumping by Council had ceased. GWRC confirmed that the recording device failed and was replaced, causing the observed downward spike. Problems with the replacement device continue to be experienced and a new one has been ordered.

5.2.1.2 Te Hapua Swamp Complex

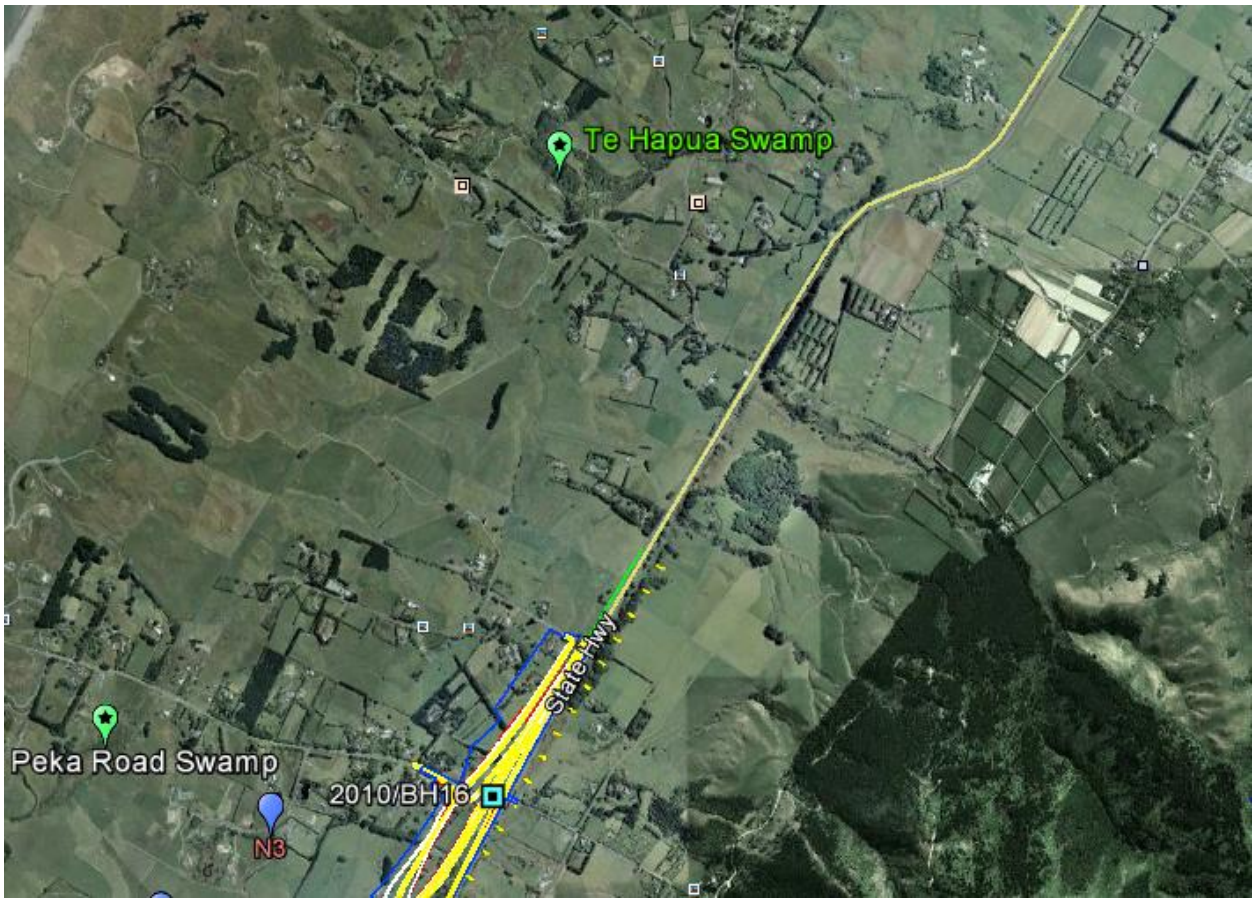


Figure 7: Te Hapua Swamp Complex location

Table 8: Te Hapua Swamp Complex A & D piezometer details

Piezometer ID	Screen Depth Top (mBGL)	Screen Depth Bottom (mBGL)	Screened Material	Approximate Distance from Wetland (m)	Minimum Historical Water Level Recorded (mRL)	Minimum Level Recorded after January 2014 (mRL)	Recorded Drawdown from Baseline (mm)
M2PP 2010/BH16	6	15	Sand	2200	9.67	9.59	77

For the Te Hapua Swamp Complex A & D the monitoring infrastructure locations are still to be confirmed and the piezometers constructed. The closest existing monitoring piezometer (2010/BH16) from the M2PP

project is almost 3 km from the closest Council well (N2, which is not equipped with a pump or connected to supply and was therefore not pumped over the period considered) and, although identified in the Wetland BMP, is not considered to be appropriate for long term monitoring aimed at detecting a water level change of less than 100 mm. We note that the closest well pumping in the 2013/2014 period considered here is K6, some 5 km from the Te Hapua Swamp complex.

We have also identified two GWRC wells (R25/7086 and R25/7087) that are telemetered and have been monitored by GWRC since April 2009. The data from these bores should be considered once well N2 is commissioned and pumping from it is established.

5.2.1.3 Te Harakeke Wetland

Figure 8: Te Harakeke Wetland and location of M2PP 2011/BH209 and 2012/BH18GW and GWRC R26/6886

Table 9: Te Harakeke Wetland piezometer details

Piezometer ID	Screen Depth Top (mBGL)	Screen Depth Bottom (mBGL)	Screened Material	Minimum Historical Water Level Recorded	Minimum Level Recorded after January 2014	Recorded Drawdown from Baseline (mm)
Te Harakeke 03 (R26/6886)	5.5	6		3108 mm AMSL	3310 mm AMSL	-202
M2PP 2011/BH209	17	20	Sand	4.53 mRL	5.61 mRL	-1080
M2P 2012/BH18GW	7	8	Sand	3.86 mRL	4.29 mRL	-430

The interim alert trigger levels for these piezometers have not been exceeded. Piezometer R26/6886 is monitored by GWRC. Water levels have been measured monthly since December 2012 as part of the M2PP project in piezometers 2011/BH209 and 2012/BH18. We note a downward spike resulting from a single measurement in April. The cause is unknown (may be reading error) and as full recovery was recorded at the time of the following reading, we do not consider it to be of significance. A similar drop was not seen in the nearby piezometer.

5.2.1.4 El Rancho Wetland

Figure 9: El Rancho Wetland and location of monitoring piezometers

Table 10 shows that the interim alert and action trigger levels for piezometer R26/6916 were exceeded for periods of a few to several days in March and April 2014 (water levels recovered in late April following rainfall). This piezometer is in the relative vicinity of K4, K5 and K6, although the closer wells, Kb7 and K12 have not yet been commissioned and were not operating. Appendix A of resource consent WGN130103 [31992] indicates that an ecological assessment should be undertaken.

Table 10: El Rancho Wetland piezometers details

Piezometer ID	Screen Depth Top (mBGL)	Screen Depth Bottom (mBGL)	Screened Material	Minimum Historical Water Level Recorded	Minimum Level Recorded after January 2014	Recorded Drawdown from Baseline (mm)
Waikanae CHP Shallow (R26/6916)	20	21	Sand	2041 mm AMSL	1876 mm AMSL	165
M2PP 2011/HA WM05	0.60	0.90	Sand	2.20 mRL	2.37 mRL	-170
M2PP 2007/BH-O	10	13	Sand	2.28 mRL	2.45 mRL	-170
M2PP 2008/BH205P	6.40	9.40	Sand	2.79 mRL	2.60 mRL	190
M2PP 2007/BH-Q	27	30	Sand	2.04 mRL	1.91 mRL	130

Ecological Assessment

In response to the exceedance, Matiu Park (Boffa Miskell) visited the El Rancho Wetland on 8 May 2014 to review the wetland health and compare historical Wetland Condition Monitoring information undertaken as part of the Expressway Project. Mr Park noted that the water levels in this wetland had recharged somewhat from his previous site visit (February 2014 as part of bi-annual monitoring for the M2PP Expressway project), although the wetland was still observed to be drier than observed historically. However, Mr Park also noted that there were no observed changes that would suggest any significant wetland stresses (such as indigenous wetland plant die-back, increased invasive weed/exotic species density etc.) resulting from water level changes. Mr Park notes that the recent high rainfall in this area would assist with peat recharge within this wetland, which is likely to continue in the coming months with the onset of winter.

Although the trigger level exceedance persisted for short periods of up to 8 days within the El Rancho Wetland, Mr Park did not consider that any adaptive management or mitigation measures were necessary. However, Mr Park noted that Wetland Condition Monitoring will be undertaken again in winter 2014 as part of the Expressway project consent requirements and that this information should also assist with background understanding on wetland health and whether there were any permanent effects as a result of the 2013/2014 summer drought.

5.2.1.5 Ngarara Bush

Figure 10: Ngarara Bush and location of monitoring piezometers

Table 11: Ngarara Bush piezometer details

Piezometer ID	Screen Depth Top (mBGL)	Screen Depth Bottom (mBGL)	Screened Material	Minimum Historical Water Level Recorded	Minimum Level Recorded after January 2014	Recorded Drawdown from Baseline (mm)
KCDC/K12 (R26/6299)	Details not known and monitoring data limited therefore it is suggested that this proposed monitoring bore is not suitable for monitoring unless more details are determined					
M2PP 2012/BH20N	1.80	2.30	Alluvium/ Silt	2.38 mRL	2.30 mRL	80
M2PP 2012/BH20S	7.00	10.00	Sand	2.38 mRL	2.30 mRL	80

The interim alert trigger levels for these piezometers have not been exceeded. Piezometer R26/6299 has been manually measured by Council since 02/01/2014. Piezometers 2012/BH20N & S have been monitored monthly as part of the M2PP project since 17/08/2014.

5.2.1.6 Ngarara Road Wetland

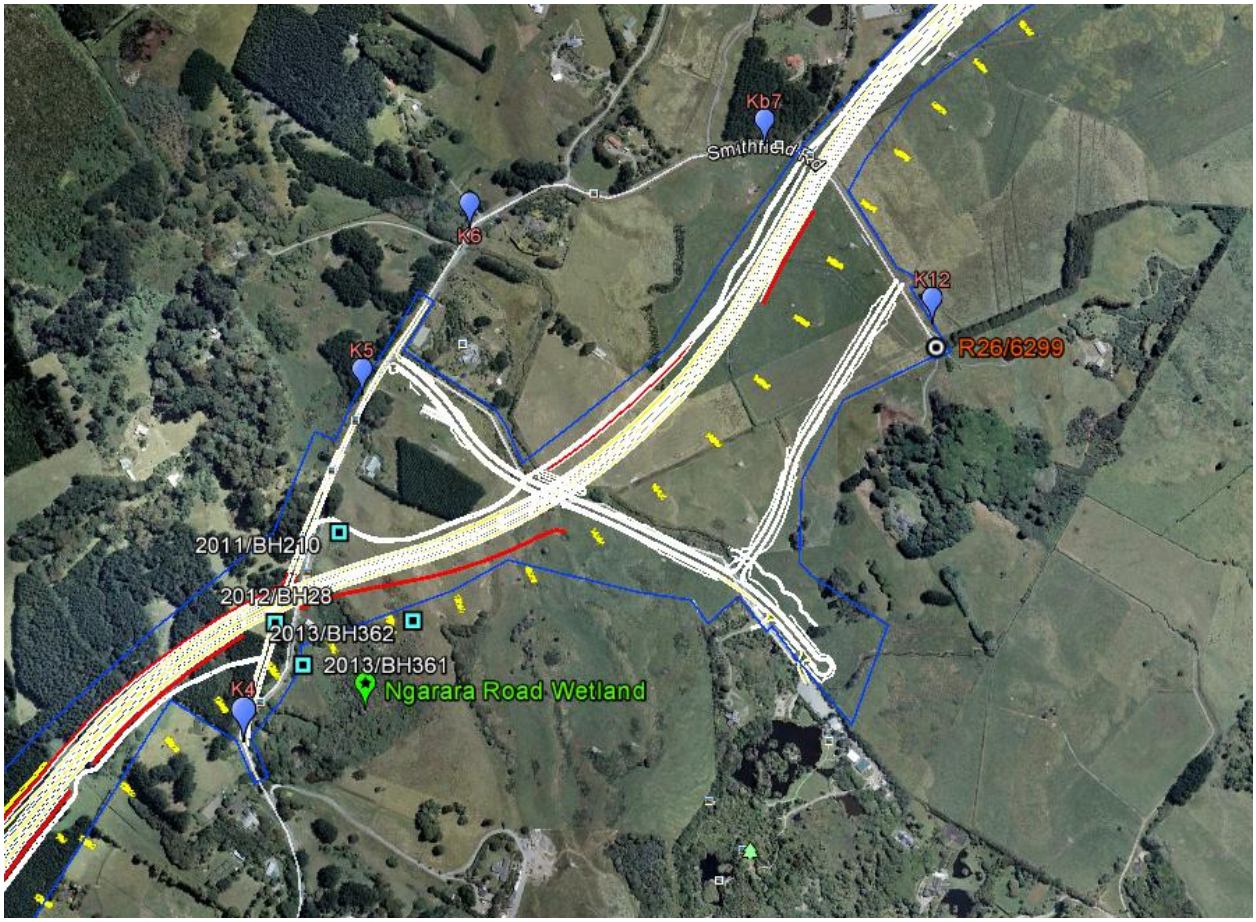


Figure 11: Ngarara Road Wetland and location of monitoring piezometers

Table 12: Ngarara Road Wetland piezometer details

Piezometer ID	Screen Depth Top (mBGL)	Screen Depth Bottom (mBGL)	Screened Material	Minimum Historical Water Level Recorded (mRL)	Minimum Level Recorded after January 2014 (mRL)	Recorded Drawdown from Baseline (mm)
M2PP 2011/BH210	17	20	Sand	4.38	3.99	390
M2PP 2013/BH361	12	15	Sand	4.85	4.58	270
M2PP 2013/BH362	5	8	Sand	4.86	4.65	210
M2PP 2012/BH28	16	22	Sand	4.86	4.57	290

The interim alert and action trigger levels for piezometer 2011/BH210 have been exceeded. Piezometer 2011/BH210 is located on the edge of a sand hill some distance from the wetland. We have therefore also considered piezometers 2013/BH361, 2013/BH362 and 2012/BH28 that are closer to the wetland, are now

equipped with data loggers (installed on 27/01/2014) and are monitored for the M2PP project in accordance with actions to be carried out for exceedance of an alert set out in Appendix A of consent WGN130103 [31992] (Figure 5). Triggers for these piezometers have not been exceeded. Therefore no further action should be required, however as the triggered bores are in the broad vicinity of Council's well K4 which has been pumping, an ecological assessment has been carried out.

Ecological Assessment

Matiu Park (Boffa Miskell) visited the Ngarara Road Wetland on 8 May 2014 to review the wetland health and compare it with historical Wetland Condition Monitoring information undertaken as part of the Expressway Project in response to the exceedance. Mr Park noted that the water levels in this wetland had recharged somewhat since his previous site visit (February 2014 as part of the Expressway project) and that there were no observed changes that would suggest any significant wetland stresses (such as indigenous wetland plant die-back, increased invasive weed/exotic species density etc.) that could be attributable to the RRwGW Project. Mr Park noted that the recent high rainfall in this area would assist with peat recharge within this wetland.

Mr Park did not consider that any adaptive management or mitigation measures were necessary. However, as for the El Rancho Wetland, Mr Park noted that Wetland Condition Monitoring will be undertaken in winter 2014 as part of the Expressway project consent requirements and that this information will assist with understanding of wetland health and whether there were any permanent effects as a result of the 2013/2014 summer drought.

5.2.1.7 Otaihanga Landfill South

Figure 12: Otaihanga Landfill South and location of monitoring piezometers

The interim alert trigger levels for these piezometers have not been exceeded.

Table 13: Otaihanga Landfill South piezometer details

Piezometer ID	Screen Depth Top (mBGL)	Screen Depth Bottom (mBGL)	Screened Material	Minimum Historical Water Level Recorded (mRL)	Minimum Level Recorded after January 2014 (mRL)	Recorded Drawdown from Baseline (mm)
M2PP 2012/ BH10	3.50	6.00	Sand	5.79	5.83	-40
M2PP 2011/BH305N	2.50	4.00	Sand	6.34	6.30	40
M2PP 2011/BH305S	7.50	10.50	Sand	6.28	6.25	30
M2PP 2012/BH11	8.30	11.30	Sand	6.02	5.97	50
M2PP 2011/BH307N	1.00	2.00	Fill	6.54	6.45	90
M2PP 2011/BH307S	7.50	10.50	Sand	7.48	7.15	330

5.2.1.8 Crown Hill Manuka Bush

Groundwater levels in this piezometer have been measured monthly since December 2012 as part of the M2PP project. As this piezometer is more than 4 km from the nearest Council well that has been pumped over the last 3 months (well K10), we consider it most unlikely that pumping from the Council well has influenced this level.

Figure 13: Crown Hill Manuka Bush and location of monitoring piezometer

Table 14: Crown Hill Manuka Bush Piezometer Details

Piezometer ID	Screen Depth Top (mBGL)	Screen Depth Bottom (mBGL)	Screened Material	Minimum Historical Water Level Recorded (mRL)	Minimum Level Recorded after January 2014 (mRL)	Recorded Drawdown from Baseline (mm)
M2PP 2012/BH09	4.00	6.00	Sand	5.49	5.38	110

5.2.2 Wetlands listed in Part 1G

No existing piezometers were proposed in Appendix 3 of the Wetland BMP to monitor water level changes in the vicinity of the wetlands listed in Part 1G. For the purpose of this annual report, we have therefore identified existing M2PP piezometers in the general vicinity of the wetlands that could be used up until the infrastructure specified in the Wetland BMP is installed. However for Part 1G wetlands, these piezometers are all located at a greater distance from the wetlands than desirable, particularly as the order of magnitude of water level change anticipated as a result of long term pumping is in the range of 0 – 200 mm at most. Further, we note that of the 1G wetlands, Poplar Ave wetland, Muaupoko Swamp Forest and Tini Bush are all located several kilometres from Council water supply wells that are currently complete and able to be pumped to supply. Graphs showing the groundwater level data recorded are presented in Appendix E, together with the triggers agreed for the M2PP project for those piezometers (where these exist).

5.2.2.1 Muaupoko Swamp Forest

Figure 14: Muaupoko Swamp Forest and Location of M2PP 2007/BH-I piezometer in the vicinity

This piezometer has only a high groundwater level trigger as its purpose is to check against ponding of groundwater as part of the M2PP project. The piezometer shows a steady decline in groundwater level from December through to April. We note that lower than previously recorded water levels were measured in piezometers across the district in January 2014 before either the M2PP works or the Council water supply abstraction began.

Table 15: Muaupoko Swamp Forest: piezometer details

Piezometer ID	Screen Depth Top (mBGL)	Screen Depth Bottom (mBGL)	Screened Material	Approximate Distance from Wetland (m)	Minimum Baseline Water Level Recorded (mRL)	Minimum Level Recorded after January 2014 (mRL)	Recorded drawdown from Baseline (mm)
M2PP 2007/BH-I	6.00	9.00	Sand/ Gravel	400	6.25	6.17	80

5.2.2.2 Peka Peka Road Swamp

Figure 15: Peka Peka Road Swamp and location of M2PP piezometers in the vicinity

Table 16: Peka Peka Road Swamp piezometer details

Piezometer ID	Screen Depth Top (mBGL)	Screen Depth Bottom (mBGL)	Screened Material	Approximate Distance from Wetland (m)	Minimum Baseline Water Level Recorded (mRL)	Minimum Level recorded after January 2014 (mRL)	Recorded Drawdown from Baseline (mm)
M2PP 2011/BH309 N	0.50	3.50	Peat	1000	7.69	7.44	250
M2PP 2011/BH309 S	9.00	12.00	Sand	1000	7.46	7.31	150
M2PP 2011/BH308 N	0.40	2.40	Peat	1100	7.28	7.27	10
M2PP 2011/BH308 S	8.00	10.00	Sand	1100	7.16	7.11	50

The M2PP triggers were not exceeded in these piezometers and it is most unlikely that pumping from the Council wells contributed to the lowering of groundwater levels in BH309 as the closest Council pumping well (K6) is more than 2 km from the Peka Peka Road wetland. Dry conditions district-wide and perhaps pumping of a private well R26/7201 located 175 m (Figure 15b) from the 2011/BH309 N and S piezometers are more likely to have contributed to reducing groundwater levels over the period November to April. Once pumping from N2 is possible, we suggest consideration be given to monitoring GWRC R26/6987 and R26/6986.

Figure 16: Location of Private Well R26/7201

5.2.2.3 Tini Bush

Figure 17: Tini Bush and Location of M2PP 2011/BH216 and 2011/BH307 N and S Piezometers

Table 17: Tini Bush Piezometer Details

Piezometer ID	Screen Depth Top (mBGL)	Screen Depth Bottom (mBGL)	Screened material	Approximate Distance from Wetland (m)	Minimum Baseline Water Level Recorded (mRL)	Minimum Level Recorded after January 2014 (mRL)	Recorded Drawdown from Baseline (mm)
M2PP 2011/BH216	15.50	17.50	Gravel	770	6.12	6.13	-10
M2PP 2011/BH307N	1.00	2.00	Fill	770	6.54	6.45	90
M2PP 2011/BH307S	7.50	10.50	Sand	770	7.48	7.15	330

The M2PP alert and action trigger levels for this group of piezometers have not been exceeded. A water level 0.27 m below the lowest previously recorded was measured in January before pumping from the Council wells or M2PP works began. Level loggers were installed in piezometers 2011/BH307 North and South on 27/01/2014 to monitor water levels adjacent to the Otaihanga Northern wetland as part of the M2PP project and will provide additional data going forward.

5.2.2.4 Poplar Avenue Wetland

Figure 18: Poplar Avenue Wetland and location of M2PP 2010/BH04 and 2011/BH205 piezometers

Table 18: Poplar Avenue Wetland Piezometer Details

Piezometer ID	Screen Depth Top (mBGL)	Screen Depth Bottom (mBGL)	Screened Material	Approximate Distance from Wetland (m)	Minimum Baseline Water Level Recorded (mRL)	Minimum Level Recorded after January 2014 (mRL)	Recorded Drawdown from Baseline (mm)
M2PP 2010/BH04	6.00	15.00	Gravel/Sand	300	4.41	4.43	-20
M2PP 2011/BH205	2.40	5.40	Peat	440	4.83	4.82	10

No trigger levels have been established for these piezometers. The data indicate similar trends to those recorded for the other 1F monitoring points.

6 Small Coastal Streams Monitoring

The Small Coastal Streams Baseline Monitoring Plan (Small Coastal Streams BMP) Part A (characterisation survey of the streams and identification of monitoring locations) was completed in March 2014. Based on the stream characterisations and their locations within the different groundwater drawdown zones, a total of eight monitoring sites are proposed within the Hadfield/Kowhai, Paetawa, Kakariki, Ngarara and Muaupoko streams.

The Small Coastal Streams BMP Part B (monitoring plan) was completed in May 2014.

The monitoring infrastructure for the small streams will be installed over the coming months following landowner access agreements being agreed. Baseline monitoring for the small coastal streams will commence in December 2014 in accordance with the certified BMP.

7 Changes to Monitoring Plans

7.1 Borefield Baseline Monitoring Plan

Following completion of drilling of all of the new borefield monitoring bores an updated Borefield BMP will be submitted to GWRC that confirms the locations of all monitoring bores that have been constructed.

7.2 Wetlands Baseline Monitoring Plan

A meeting with GWRC was held on 26 June 2014 to discuss the wetlands monitoring and trigger levels, as well as clarification on other conditions of consent. Discussions are ongoing and the Wetland BMP will be updated to reflect agreed changes.

7.3 Small Coastal Streams Baseline Monitoring Plan

No changes to the Small Coastal Streams BMP are proposed at this stage. If there are any changes through the implementation of the monitoring infrastructure, these will be agreed with GWRC and the BMP will updated to reflect agreed changes.

8 Potentially Affected Existing Private Wells

Condition 7 of consent [31992] 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 four stages of the project, which is currently in Stage One. However, operation of Stage One (abstraction from the extended borefield) will not actually commence until construction of the items listed in Table 1 is completed and commissioned (by April 2015).

CH2M Beca has commenced identifying authorised existing wells and working on the systems for collection and reporting of water levels. Council's programme for completing the tasks required by Condition 7 of consent [31992] is December 2014 in time for the 2014/15 summer period. This programme has been discussed and agreed with GWRC.

A report will be submitted to GWRC in accordance with Condition 7(c) following completion of the actions in December 2014. This report will also provide the evidence required by Condition 7(e).

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 complaint of any adverse effects on private bores. During the reporting period Council did not receive any complaints regarding effects related to abstraction from the Borefield.

10 Mitigation/Adaptive Management in the Coming Year

Looking ahead to the coming year (2014/15), there is no additional mitigation or adaptive management that is anticipated at this stage.

Further baseline monitoring will be carried out over the coming year in accordance with the certified Waikanae Borefield, Wetland and Small Coastal Streams BMPs.

The Waikanae Borefield will be used for supplementary supply during 2014/15 if abstraction is restricted by low river flows, until such time as river recharge is permitted.

11 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. The AMG met on 12 August 2014 to discuss this annual report, as well as the annual Waikanae River and Recharge report and procedural matters. Representatives of The Kapiti Fly Fishing Club, Regional Public Health and Friends of the Waikanae River also attended this meeting.

A recommendation of the AMG was that the due date for submitting the annual reports to GWRC (30 August each year) be extended. As the annual reports are required to report on the period 1 July to 30 June, it was discussed that the two month period from 1 July to 30 August was a tight timeframe to enable sufficient time for preparation of the report, consideration of the report by the AMG and stakeholders, hold an AMG meeting, and include the recommendations of the AMG in the final reports submitted to GWRC.

GWRC confirmed that there may be cases whereby an extension of this due date would be acceptable. However, it was noted that the conditions currently do not provide this flexibility. The AMG acknowledged that there may be times where the 30 August due date will be met. However, additional time would be required if there were more than minor compliance or monitoring matters to resolve or recommended changes to operations, monitoring and adaptive management. The members of the AMG agreed that the best approach would be to include flexibility in the consent whereby an extension to the due date could be agreed with GWRC. As such an application to change consent conditions 42 of consent [31992], 24 of consent [31993] and 26 of consent [31994] has been lodged with GWRC to action this recommendation.

Appendix A

Borefield Abstraction Summary Table

Table A.1: Summary of instantaneous abstraction from each production well 1 October 2013 to 30 June 2014

Date	K10		Kb4		K4		K5		K6		Total	
	Average (L/s)	Maximum (L/s)	Average (L/s)	Maximum (L/s)	Average (L/s)	Maximum (L/s)	Average (L/s)	Maximum (L/s)	Average (L/s)	Maximum (L/s)	Average (L/s)	Maximum (L/s)
1 Oct to 29 Oct 2013	0	0	0	0	0	0	0	0	0	0	0	0
30 Oct 2013	1.4	15.0	3.7	40.1	0.0	0.0	3.3	35.0	5.6	61.9	14.1	151.9
31 Oct to 27 Nov 2013	0	0	0	0	0	0	0	0	0	0	0	0
28 Nov 2013	1.2	15.0	3.3	40.1	0.0	0.0	2.9	35.1	4.7	60.1	12.2	150.0
29 Nov to 17 Dec 2013	0	0	0	0	0	0	0	0	0	0	0	0
18 Dec 2013	1.6	15.0	4.2	40.0	0.0	0.0	3.3	35.1	5.2	58.9	14.3	142.1
19 Dec 2013 to 26 Jan 2014	0	0	0	0	0	0	0	0	0	0	0	0
27 Jan 2014	4.2	15.0	11.1	40.1	0.0	0.1	9.7	35.0	16.1	63.6	41.1	153.2
28 Jan to 2 Feb 2014	0	0	0	0	0	0	0	0	0	0	0	0
3 Feb 2014	0.6	15.0	1.7	40.0	0.0	0.1	2.6	35.1	8.0	60.3	12.9	149.6
4 Feb to 20 Feb 2014	0	0	0	0	0	0	0	0	0	0	0	0
20 Feb 2014	0.0	0.0	0.0	0.3	0.5	51.5	0.0	0.0	0.0	0.0	0.5	51.5
21 Feb 2014	3.1	15.0	7.5	40.1	13.1	70.3	6.6	35.1	12.5	60.3	42.8	220.3
22 Feb 2014	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
23 Feb 2014	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2
24 Feb 2014	6.2	26.2*	0.0	0.1	0.0	0.0	0.0	2.3	0.3	11.7	6.5	26.8
25 Feb 2014	10.6	15.1	5.2	40.1	8.8	70.3	10.0	35.1	7.9	60.4	42.5	220.4
26 Feb 2014	0.0	0.0	0.0	0.3	0.0	0.0	24.3	42.4	2.5	40.2	26.8	42.4
27 Feb 2014	0.0	0.0	0.0	0.1	0.0	0.0	33.1	40.1	0.0	0.0	33.1	40.1
28 Feb 2014	0.0	0.0	0.0	0.0	0.0	0.0	33.3	40.0	29.9	50.4	63.2	80.4
1 Mar 2014	0.0	0.0	0.0	0.0	0.0	0.1	23.0	30.0	40.7	50.6	63.8	80.6
2 Mar 2014	0.0	0.0	0.0	0.0	26.7	41.0	30.0	30.1	56.7	60.3	113.4	131.0
3 Mar 2014	0.0	0.0	0.0	0.0	40.1	41.0	30.0	30.1	47.3	60.3	117.4	131.2
4 Mar 2014	0.0	0.0	0.0	0.0	12.9	40.8	30.0	30.1	53.5	60.4	96.4	111.2
5 Mar 2014	0.0	0.0	0.0	0.0	0.0	0.1	28.9	35.0	34.6	60.4	63.5	90.4
6 Mar 2014	0.0	0.0	0.0	0.1	0.0	0.1	11.3	35.0	0.0	0.0	11.3	35.0

Date	K10		Kb4		K4		K5		K6		Total	
7 Mar 2014	0.0	0.0	0.0	0.2	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.2
8 Mar 2014	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9 Mar 2014	0.0	0.0	0.0	0.1	0.0	0.0	21.1	35.1	0.0	0.0	21.2	35.1
10 Mar 2014	0.0	0.0	0.0	0.2	0.0	0.0	30.1	35.0	45.4	70.0	75.5	105.0
11 Mar 2014	0.0	0.0	0.0	0.2	0.0	0.5	35.0	35.1	70.0	70.3	105.0	105.4
12 Mar 2014	0.0	0.0	25.0	40.1	0.0	0.1	13.1	35.0	62.0	70.3	100.1	105.3
13 Mar 2014	0.0	0.0	40.0	40.1	0.0	0.0	0.0	0.0	53.5	55.4	93.5	95.4
14 Mar 2014	0.0	0.0	40.0	40.1	0.0	0.1	0.0	0.0	62.0	65.4	102.0	105.4
15 Mar 2014	0.0	0.0	34.8	40.1	27.2	50.0	16.3	25.1	64.9	65.4	143.3	180.0
16 Mar 2014	0.0	0.0	26.3	40.1	41.6	60.4	22.4	35.0	61.5	65.8	151.8	180.6
17 Mar 2014	0.0	0.0	10.8	40.1	12.5	60.2	9.2	36.2	12.2	45.4	44.7	180.4
18 March - 24 March	0	0	0	0	0	0	0	0	0	0	0	0
25 Mar 2014	0.0	0.0	22.7	40.2	0.0	0.0	0.0	0.0	0.0	0.0	22.7	40.2
26 Mar 2014	0.0	0.0	28.8	40.2	0.0	0.0	11.2	40.0	0.0	0.0	40.1	80.1
27 Mar 2014	0.0	0.0	40.0	40.3	2.9	40.7	40.0	40.1	11.1	40.3	93.9	160.4
28 Mar 2014	0.0	0.0	12.1	40.2	0.0	0.0	38.8	40.0	38.4	55.6	89.2	95.6
29 Mar 2014	0.0	0.0	40.0	40.2	0.0	0.1	6.5	20.1	31.1	46.4	77.7	93.2
30 Mar 2014	0.0	0.0	40.0	40.2	0.0	0.1	0.0	0.0	46.0	46.6	86.0	86.6
31 Mar 2014	0.0	0.0	36.9	40.1	0.0	0.1	11.4	25.1	44.7	50.4	93.0	115.4
1 Apr 2014	0.0	0.0	40.0	40.1	0.0	0.0	22.8	25.1	50.0	50.3	112.8	115.4
2 Apr 2014	0.0	0.0	40.0	40.2	0.0	0.1	28.4	30.1	56.8	60.4	125.2	130.4
3 Apr 2014	0.0	0.0	40.0	40.1	0.0	0.1	33.6	35.1	63.1	68.1	136.7	143.1
4 Apr 2014	0.0	0.0	40.0	40.1	6.2	41.0	35.0	35.1	64.1	72.7	145.3	181.1
5 Apr 2014	0.0	0.0	40.0	40.1	40.0	41.0	31.3	35.0	53.9	65.4	165.2	181.0
6 Apr 2014	0.0	0.0	40.0	40.2	40.0	41.2	30.0	30.1	46.6	50.5	156.6	161.3
7 Apr 2014	0.0	0.0	40.0	40.2	40.1	41.1	33.5	35.2	60.3	69.7	174.0	185.3
8 Apr 2014	0.0	0.0	40.0	40.1	39.9	41.1	35.0	35.2	62.0	68.8	176.9	183.9
9 Apr 2014	0.0	0.0	36.3	40.1	10.4	40.9	28.8	35.1	19.8	60.2	95.2	175.9
10 Apr 2014	0.0	0.1	30.0	30.1	0.0	0.0	34.0	40.1	27.9	40.4	91.9	110.5
11 Apr 2014	0.0	0.1	35.1	40.3	0.0	0.1	30.3	40.0	38.8	60.1	104.3	130.2

Date	K10		Kb4		K4		K5		K6		Total	
12 Apr 2014	0.0	0.0	40.0	40.1	0.0	0.1	30.0	30.1	48.3	60.4	118.3	130.3
13 Apr 2014	0.0	0.0	40.0	40.1	0.0	0.1	30.0	30.2	50.2	60.4	120.2	130.4
14 Apr 2014	0.0	0.1	35.6	40.1	0.0	0.0	10.0	31.0	16.2	50.4	61.8	120.4
15 Apr 2014	0.0	0.1	36.4	40.2	0.0	0.2	9.4	20.1	0.0	0.0	45.8	60.1
16 Apr 2014	0.0	0.0	30.2	40.2	0.0	0.1	13.8	40.0	5.6	60.2	49.6	140.3
17 Apr 2014	0.0	0.1	12.5	40.1	0.0	0.1	12.4	40.0	18.8	60.3	43.7	140.3
18 Apr to 28 Apr 2014	0	0	0	0	0	0	0	0	0	0	0	0
29 Apr 2014	0.0	0.1	5.3	40.1	5.4	41.0	5.4	40.0	8.1	60.1	24.2	180.7
30 Apr to 27 May 2014	0	0	0	0	0	0	0	0	0	0	0	0
27 May 2014	0.0	0.0	6.2	40.1	3.9	52.0	3.8	40.0	5.6	60.2	19.5	192.1
28 May - 29 Jun 2014	0	0	0	0	0	0	0	0	0	0	0	0
30 Jun 2014	0.0	0.0	0.8	40.0	0.8	39.7	0.8	39.3	1.3	60.0	3.7	179.0

* There were three 15-minute flow readings at 26.2 L/s for well K10 on 24 February 2014. This flow rate is beyond the pump curve for the pump which only goes to 21.5 L/s. Also when the K10 pump was removed for development work it was found that the pump impeller was damaged. Therefore this maximum flow seems unlikely. The second highest flow on this day was 15.1 L/s.

Appendix B

Borefield Log Books

K4

Date	Activity	By
3/07/14	Read meters and dipped	MCW
30/06/14	Samples	BN & DB
26/06/14	Read and dip	CG
19/06/14	Read and dip	
12/06/14	Read meter and dip	TA
5/06/14	Read and dip	CG
29/05/14	Read and dip	CG
27/05/14	Samples	BN & DB
22/05/14	Meter read and dip	
22/05/14	Start bore manually. 0850hrs - comms fail on Auto. Leave running on manual. 0902hrs - Back on Auto - comms fail cleared.	TA
15/05/14	Meter read and dip	TA
8/05/14	Meter read and dip	CK
1/05/14	Read and dip	CG
29/04/14	Samples	BN & DB
24/04/14	Read and dip	CK
16/04/14	Read and dip	CG
10/04/14	Read meters and dip well	BB
3/04/14	Read meters and dipped	TA
27/03/14	Taken samples	BN & DB
20/03/14	Read meters and dipped	MCW
13/03/14	Read meters and dip	BB
11/03/14	Fitted tapping band	CK
6/03/14	Meter readings and dip	TA
27/02/14	Read and dip	CK
25/02/14	Water testing	DB
20/02/14	No power, just dip	CG
13/02/14	Read and dip	BB
5/02/14	Read and dip	CG
29/01/14	Read and dip	CK
23/01/14	Read and dip	CG
16/01/14	Meter read and dip	BB
9/01/14	Meter read and dip	TA
2/01/14	Meter read and dip	CK
28/12/13	Meter read and dip	TA
19/12/13	Meter read and dip	TA
12/12/13	Meter read and dip	TA
5/12/13	Meter read and dip	CK
28/11/13	Read and dip	CG

21/11/13	Read and dip	BB
14/11/13	Read meter and dip	TA
7/11/13	Read and dip	CK
31/10/13	Read and dip	CG
29/10/13	No DC power, unable to start bore. Replaced drive for pump, no joy. Will need to remove pump.	BN
24/10/13	Read meters and dip	BB
17/10/13	Meter readings and dip	TA
10/10/13	Read and dip	CK
3/10/13	Read and dip	CG
30/09/13	Samples	BN
26/09/13	Read meters and dip	BB
19/09/13	Read meters and dip	TA
12/09/13	Read meters and dip	CK
5/09/13	Read meters and dip well	BB
29/08/13	Meter read, dip and samples	CK
28/08/13	1338 Lockout tag out removed	
26/08/13	Tagged out locked out VSD drive didn't start.	TA
23/08/13	Turned off pump for surge tank inspection on Wednesday.	CK & TA
22/08/13	Read and dip	CK
16/08/13	Checked tamper and input - OK and pulsing, turns off with FC button. No beeping.	CK
15/08/13	Read and dip	CK
8/08/13	Read and dip	CG
31/07/13	Meter read, dip and samples	TA

KB4

Date	Activity	By
3/07/2014	Read meters	MCW
30/06/2014	Take samples	BN & DB
26/06/2014	Read and dip	CG
19/06/2014	Read meters	BB
12/06/2014	Read meter	TA
5/06/2014	Read meters	CG
29/05/2014	Read meters	CG
27/05/2014	Samples	BN & DB
22/05/2014	Read meters	BB
15/05/2014	Meter read	TA
8/05/2014	Meter read	CK
1/05/2014	Read meters	CG
29/04/2014	Samples	BN & DB
24/04/2014	Read meters	CK
16/04/2014	Read meters	CG
10/04/2014	Read meters	BB
3/04/2014	Read meters	TA
27/03/2014	Samples	BN & DB
27/03/2014	Read meters	MCW
20/03/2014	Read meters	MCW
13/03/2014	Read meters	BB
10/03/2014	Meter readings	TA
27/02/2014	Meter read	CK
25/02/2014	Take samples	BN & DB
20/02/2014	Read meters	CG
13/02/2014	Read meters	BB
5/02/2014	Read meters	CG
29/01/2014	Read meters	CK
27/01/2014	Samples	BN & DB
23/01/2014	Read meter	CG
16/01/2014	Meter read	BB
2/01/2014	Meter read	CK
2/01/2014	Meter read	TA
26/12/2013	Meter readings and sample	TA
19/12/2013	Meter read	TA
18/12/2013	Samples	BN & DB
12/12/2013	Meter read	TA
5/12/2013	Meter read and dip	
28/11/2013	Read and dip	CG
28/11/2013	Take samples	BN & DB

21/11/2013	Read meters	BB
14/11/2013	Read meters	TA
7/11/2013	Read meters	CK
31/10/2013	Read meters	CG
30/10/2013	Take full samples	BN & DB
24/10/2013	Read meters	BB
17/10/2013	Meter read	TA
10/10/2013	Meter read	
8/10/2013	Replace air filter	BB
3/10/2013	Read meters	CG
30/09/2013	Sample	BN
26/09/2013	Read meters	BB
19/09/2013	Read meters	TA
12/09/2013	Read meters	CK
5/09/2013	Read meters	BB
28/08/2013	1340 Tag out lockout removed	
26/08/2013	VSD Locked out	Tony H
23/08/2013	Turn off pump in prep for surge tank visuals	
22/08/2013	Meter read	CK
13/08/13	Read and dip	CK
8/08/13	Read and dip	CG
31/07/13	Meter readings and sample	TA
25/07/13	Meter read	TA
16/07/13	Meter read	CG
11/07/13	Read meters	CG
4/07/13	Read meters	BB
27/06/13	Read, dip and sample	CG & BN
20/06/13	Read meters	CG & TA
13/06/13	Read meters	CG & CK
6/06/13	Read meters	CK & BB
30/05/13	Read meters	MCW & CG
29/05/13	Take samples	BN
23/05/13	Read meters	MCW
5/05/13	Read meters	MCW
29/04/13	Read meters and sample	BN
15/04/13	Read meters	DH
10/04/13	Read meters	DH
2/04/13	Read meters	DH
28/03/13	Sample, read meters	BN
21/03/13	Read meters	MCW
12/03/13	Read meters	DH
5/03/13	Read meters	DH

26/02/13	Read meters	DH
20/02/13	Sample, meters	BN
14/02/13	Read meters	BN
7/02/13	Read meters	BB

K5

Date	Activity	By
3/07/14	Read meters and dipped	MCW
30/06/14	Sample	BN & DB
19/06/14	Read and Dip	
12/06/14	Read meter and dip	VA
5/06/14	Read and Dip	CG
29/05/14	Read and Dip	CG
27/05/14	Take sample	BN & DB
22/05/14	Meter read and dip	BB
8/05/14	Meter read and dip	CK
8/05/14	Meter read and dip	TA
1/05/14	Read and Dip	CG
29/04/14	Sample	BN & DB
26/04/14	Read and Dip	CG
24/04/14	Meter read and dip	CK
16/04/14	Read and Dip	CG
16/04/14	Read and Dip	FB
3/04/14	Meter read and dip	Tony
27/03/14	Taken samples	BN & DB
27/03/14	Read meters and dipped bore	MCW
20/03/14	Read, metered and dipped bore	MCW
13/03/14	Read and dip	BB
6/03/14	meter readings and Dip	TH
27/02/14	Read and Dip	CK
26/02/14	Checked pump drive after pump faulted at 50l/S set point. Pump drive OK. Pump not.	CK
25/02/14	Water testing	DB
20/02/14	Read and dip	CG
5/02/14	Read and dip	CG
29/01/14	Read and dip	CK
27/01/14	Sample	BN & DB
23/01/14	Read and dip	CG
16/01/14	Meter read and dip	BB
9/01/14	Meter read and dip	TA
2/01/14	Meter read and dip	CK
26/12/13	Meter read and dip	TA

19/12/13	Meter read and dip	TA
18/12/13	Samples	BN & DB
12/12/13	Meter read and dip	TA
5/12/13	Meter read and dip	
28/11/13	Take samples	BN & DB
28/11/13	Read and dip	CG
21/11/13	Read and dip	BB
14/11/13	Read meter and dip	TA
7/11/13	Read and dip	CK
31/10/13	Read and dip	CG
30/10/13	Take samples	BN & DB
24/10/13	Read meters and dip well	BB
17/10/13	Meter read and dip	TA
10/10/13	Meter read and dip	
8/10/13	Replace air filter	BB
3/10/13	Read and dip	CG
30/09/13	Sample	BN
26/09/13	Read meters and dip	BB
19/09/13	Read meters and dip	TA
12/09/13	Read meters and dip	CK
5/09/13	Read meters and dipped well	BB
29/08/13	Meter read and dip and took sample	CK
28/08/13	1330 Lockout tag cut removed	TA
27/08/13	Tagged and locked out for Audit on Key 14 surge tanks (VSD lockout)	
22/08/13	Read and dip	CK
15/08/13	Read and dip	CK
8/08/13	Read and dip	CG
31/07/13	Meter read and dip and sample	TA
25/07/13	Meter read and dip	TA
23/07/13	Reset VSD	
18/07/13	Meter read and dip	CK
11/07/13	Read and dip	CG
4/07/13	Read meters and dipped well	BL
27/06/13	Readings and dip and sample	BN & CG
20/06/13	Readings and dip	CG & TA
13/06/13	Read and dip	CG & CK
6/06/13	Read meters and dipped well	CK

K6

Date	Activity	By
3/07/14	Read meters and dipped	MCW
30/06/14	Samples	BN & DB
26/06/14	Read and dip	CG
19/06/14	Read and dip	BA
12/06/14	Read meter and dip	TA
5/06/14	Read and dip	CG
29/05/14	Meter read and dip	CG
27/05/14	Samples	BN & DB
22/05/14	Meter read and dip	BB
15/05/14	Meter read and dip	TA
8/05/14	Meter read and dip	CK
1/05/14	Read and dip	CG
29/04/14	Samples	BN & DB
24/04/14	Read and dip	CK
16/04/14	Read and dip	CG
10/04/14	Meter read and dip	BB
3/04/14	Meter read and dip	TA
27/03/14	Samples	BN & DB
27/03/14	Meter read and dipped bore	MCW
20/03/14	Meter read and dip	MCW
6/03/14	Meter read and dip	TA
27/02/14	Meter read and dip	
26/02/14	Refitted compressor	CG & BB
25/02/14	Water testing	DB
24/02/14	Isolated compressor for removal and repair	
20/02/14	Meter read and dip	CG
13/02/14	Meter read and dip	BB
5/02/14	Meter read and dip	CG
3/02/14	Checked flow meter terminations at flow meter. Flow reading -20l/s before the chock, now reading zero	BHB
29/01/14	Meter read and dip	CK
27/01/14	Samples	BN & DB
23/01/14	Meter read and dip	CG
16/01/14	Meter read and dip	BB
9/01/14	Meter read and dip	TA
2/01/14	Meter read and dip	CK
26/12/13	Meter read and dip	TA
19/12/13	Meter read and dip	TA
18/12/13	Sample	BN & DB
12/12/13	Meter read and dip	TA

5/12/13	Meter read and dip	CK
28/11/13	Read and dip	CG
28/11/13	Take samples	BN & DB
21/11/13	Read and dip	BB
14/11/13	Meter read and dip	TA
7/11/13	Read and dip	CK
31/10/13	Read and dip	CG
30/10/13	Full samples	BN & DB
24/10/13	Read meters and dip well	BB
17/10/13	Meter read and dip	TA
10/10/13	Meter read and dip	CK
8/10/13	Replace air filter	BB
3/10/13	Read and Dip	CG
30/09/13	Sample	BD
26/09/13	Read meters and dip	BB
19/09/13	Read meters and dip bore	TA
12/09/13	Read meters and dip	CK
5/09/13	Read meters and dip well	BB
29/08/13	Meter read, dip and tank sample	CK
28/08/13	Surge vessel refilled after survey. Lockout tag out removed	TA
27/08/13	Tagged out locked out VSD Drive	TA
23/08/13	Turned pump off - prep surge tank for inspection next Tuesday	TA & CK
22/08/13	Read and dip	CK
15/08/13	Read and dip	CK
8/08/13	Read and dip	CG
31/07/13	Read meters, dip and sample	TA
25/07/13	Read meters and dip	TA
23/07/13	Reset VSD	
11/07/13	Read and dip	CG
2/07/13	Read meters and dipped well	BB
27/06/13	Read, dip and sample	CG & BN
13/06/13	Read and dip	CG & CK
6/06/13	Read meters and dipped bore	CK & BB
30/05/13	Read meters and dipped bore	CG & MCW
29/05/13	Samples	BN & DB
23/05/13	Read meters and dipped well	MCW
16/05/13	Read meters and dip well	MCW
9/05/13	Read meters and dip well	BB
29/04/13	Start bongs manually. Readings, dip and sample	BN
15/04/13	Read meters and dip well	DH
10/04/13	Read meters and dip well	DH
2/04/13	Read meters and dip well	DH
28/03/13	Meters, dip and sample	BN

21/03/13	Read meters and dip well	BB
12/03/13	Read meters and dip well	DH
5/03/13	Read meters and dip well	DH
26/02/13	Read meters and dip well	DH
20/02/13	Readings, dip, sample	BN
14/02/13	Read meters and dip well	BN
7/02/13	Read meters and dip well	BB
31/01/13	Read meters and dip well	BB
23/01/13	Take samples	IK
23/01/13	Read meters and dip well	BB
16/01/13	Read meters and dip well	BB
6/01/13	Read meters and dipped well	DH
20/12/12	Take water samples	BB
18/12/12	Read meters and dip well	DH
11/12/12	Read meters and dipped well	DH
4/12/12	Read meters and dipped well	IK
27/11/12	Read meters and dipped well	DH

K10

Date	Activity	By
3/07/14	Meters checked and dipped	MCW
12/06/14	Meter readings and dips	TA
15/05/14	Meter read and dips	TA
8/05/14	Meter read and dip	CG
1/05/14	Read and dip	CG
24/04/14	Meter read and dip	CK
3/04/14	Site checks and meter readings	TA
28/02/14	Disconnect bore pump (preserve)	D & C
27/02/14	Read and dip	CK
25/02/14	Take samples	BN & DB
20/02/14	Read and dip	CG
13/02/14	Read and dip	BB
5/02/14	Read and dip	CG
29/01/14	Read and dip	CG
27/01/14	Samples	BN & DB
23/01/14	Read and dip	CG
16/01/14	Dip and meters	BB
9/01/14	Meter read and dip	TA
2/01/14	Meter read and dip	CK
26/12/13	Meter read and dip	TA
19/12/13	Meter read and dip	TA
13/12/13	Samples	BN & DB
12/12/13	Meter readings and dip	TA
11/12/13	Magflow calibration	CK & H
28/11/13	Read and dip	CG
28/11/13	Sample	BN & DB
21/11/13	Read and dip	BB
14/11/13	Meter read and dip	TA
7/11/13	Read and dip	CK
5/11/13	Meter read and dip	CK
31/10/13	Read and dip	CG
30/10/13	Take full samples	BN & DB
24/10/13	Read meters and dip	BB
17/10/13	Meter read and dip	TA
10/10/13	Meter read and dip	CK
8/10/13	Replace air filter	BB
3/10/13	Read and dip	CG

K13

Date	Activity	By
3/07/14	Read meters and dipped	MCW
26/06/14	Read and dip	CG
19/06/14	Read and dip	BB
12/06/14	Read meter and dipped	TA
5/06/14	Read and dip	CG
29/05/14	Read and dip	CG
22/05/14	Meter read and dip	BB
15/05/14	Meter read and dip	TA
8/05/14	Meter read and dip	CK
1/05/14	Read and dip	CG
24/04/14	Read and dip	CK
16/04/14	Read and dip	CG
10/04/14	Read and dip	BB
3/04/14	Meter readings and dip	TA
27/03/14	Read meter and dipped	MCW
20/03/14	Read and dip	MCW
13/03/14	Read and dip	BB
6/03/14	Read and dip	TA
27/02/14	Read and dip	CK
25/02/14	Re-check work on tapping band after recharging pipe work - all good! Run compressor on manual to achieve 45% air pressure in surge vessel. Put compressor back to Auto.	TA
24/02/14	Fit tapping band for air valve	BB & TA
20/02/14	Read power	CG
13/02/14	Read and dip	BB
5/02/14	Read and dip	CG
29/01/14	Read and dip	CK
23/01/14	Read and dip	CG
16/01/14	Dip and meters	BB
9/01/14	Meter read and dip	TA
2/01/14	Meter read and dip	
26/12/13	Meter read and dip	TA
19/12/13	Meter read and dip	TA
12/12/13	Meter read and dip	TA
5/12/13	Meter read and dip	CK
28/11/13	Read and dip	CG
21/11/13	Read and dip	BB
14/11/13	Read meters and dip	TA
7/11/13	Read and dip	CK

31/10/13	Read and dip	CG
24/10/13	Read meters and dip well	BB
17/10/13	Meter read and dip	BB
10/10/13	Meter read and dip	
8/10/13	Replace air filter	BB
3/10/13	Read and dip	CG
26/09/13	Read meters and dip	BB
19/09/13	Read meters and dip	TA
12/09/13	Read meters and dip	CK
5/09/13	Read meters and dip well	BB
29/08/13	Meter read and dip	CK
28/08/13	1352 Tag out lock out removed	TH
26/08/13	VSD lock/tagged out	Tony H
23/08/13	Turned off pump and isolated surge tank for inspection on Wednesday	CK & TA
16/08/13	Checked tamper switch, input 7 on and pulsing. No beeping from panel. Pulse stops with F4 button	CK
15/08/13	Read and dip	CK
8/08/13	Read and dip	CG
31/07/13	Meter readings, dip and sample	TA
25/07/13	Meter readings and dip	TA
18/07/13	Meter read and dip	CK
11/07/13	Read and dip	CG
4/07/13	Read meters and dip well	BB
27/06/13	Read and dip and samples	BN & CG
20/06/13	Read and dip	CG & TA
13/06/13	Read and dip	CG & CK
6/06/13	Read meters and dip well	
9/05/13	Read meters and dip well	
24/04/13	Read and dip	BN
15/04/13	Read meters and dip well	DH
10/04/13	Read meters and dip well	DH
2/04/13	Read meters and dip well	DH
28/03/13	Read meters and dip well	BN
21/03/13	Read meters and dip well	MCW
12/03/13	Read meters and dip well	DH
5/03/13	Read meters and dip well	DH
26/02/13	Read meters and dip well	DH

Appendix C

Groundwater Level and Electrical Conductivity Monitoring Results

C.1 Shallow Aquifer Water Level Monitoring

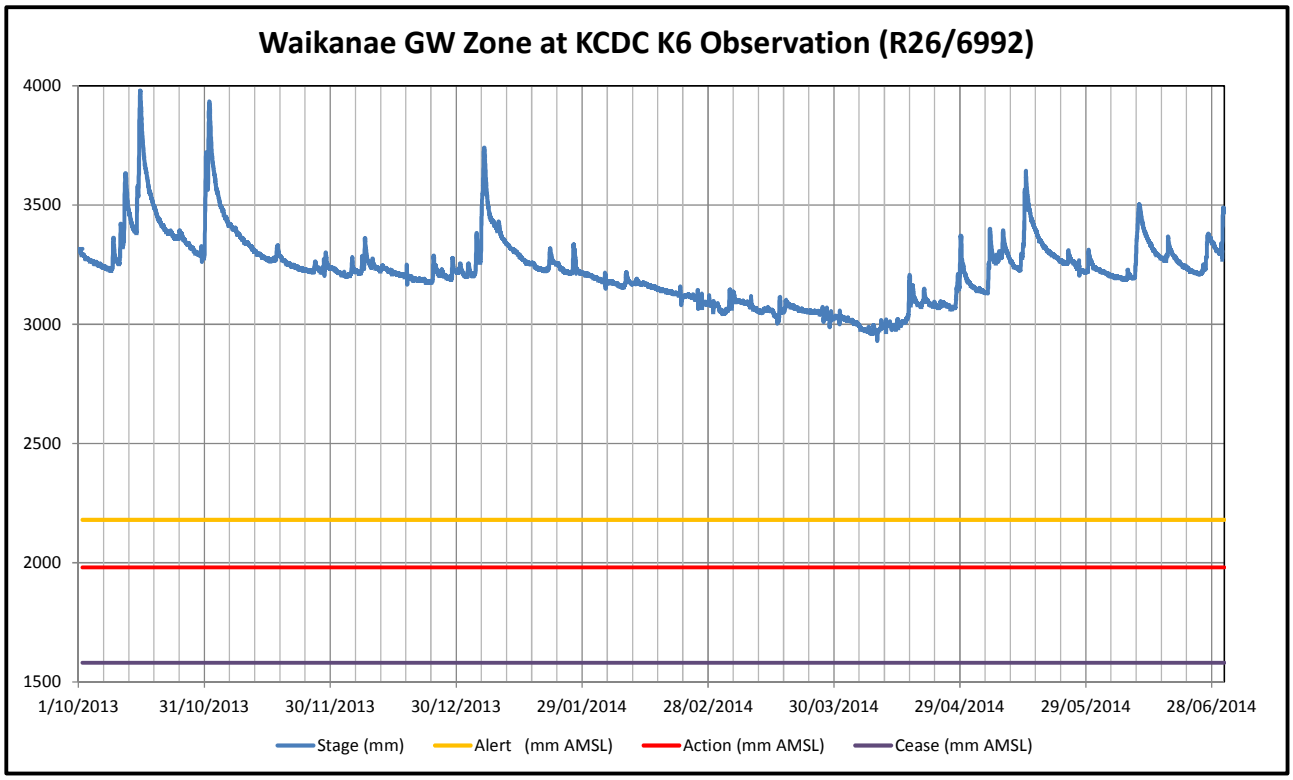


Figure C1: Water Levels at KCDC K6 Observation Shallow Bore (R26/6992) [Level data from GWRC – Quality checked up to 27 March 2014 @ 14:45]

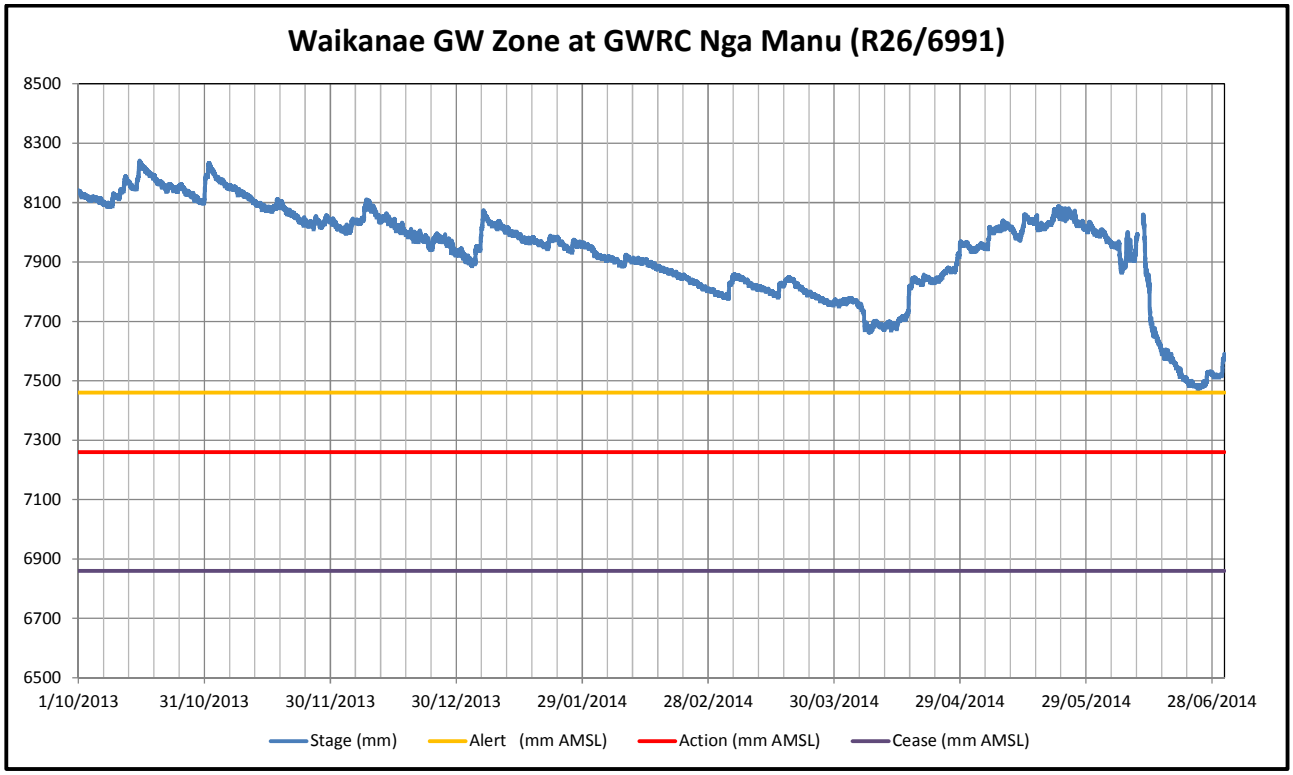


Figure C2: Water Levels at GWRC Nga Manu Bore (R26/6991) [Level data from GWRC – Quality checked up to 27 March 2014 @ 15:00]

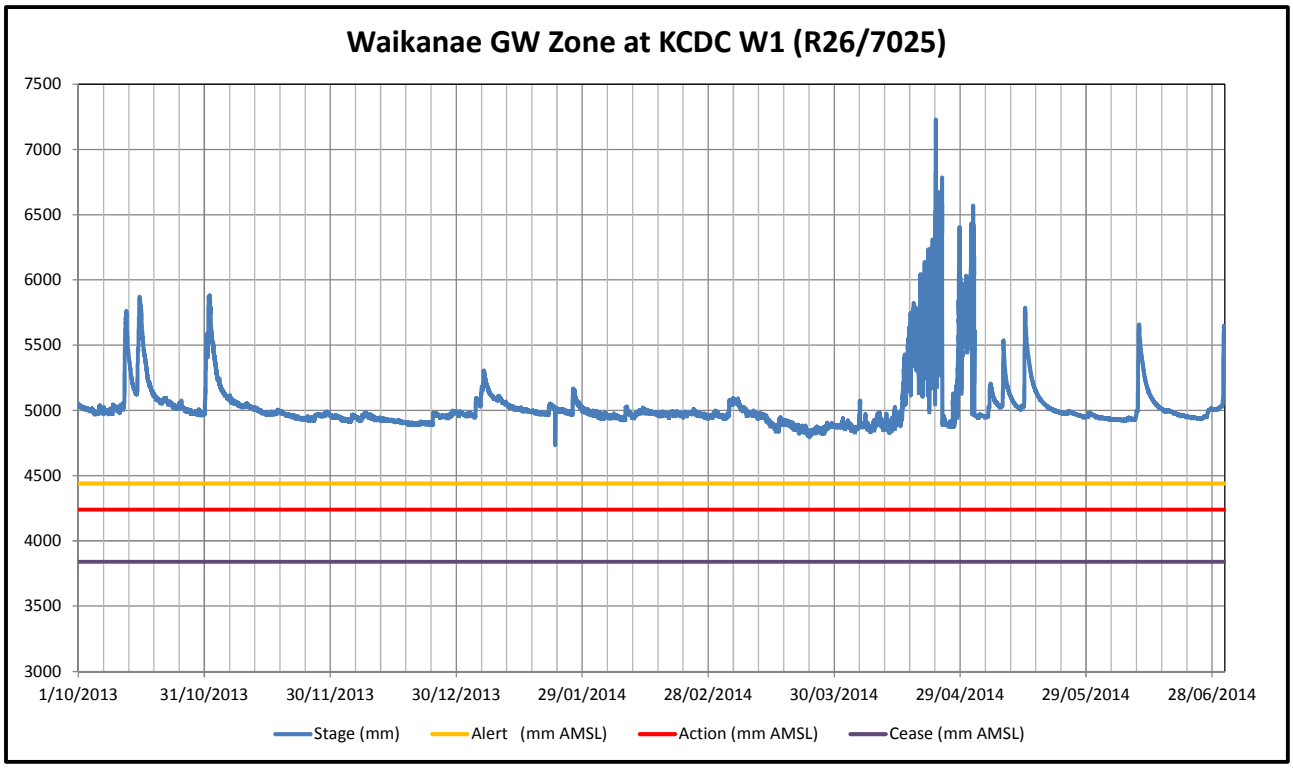


Figure C3: Water Levels at KCDC W1 Bore (R26/7025) [Level data from GWRC, quality checked up to 27 March 2014 @ 14:00]

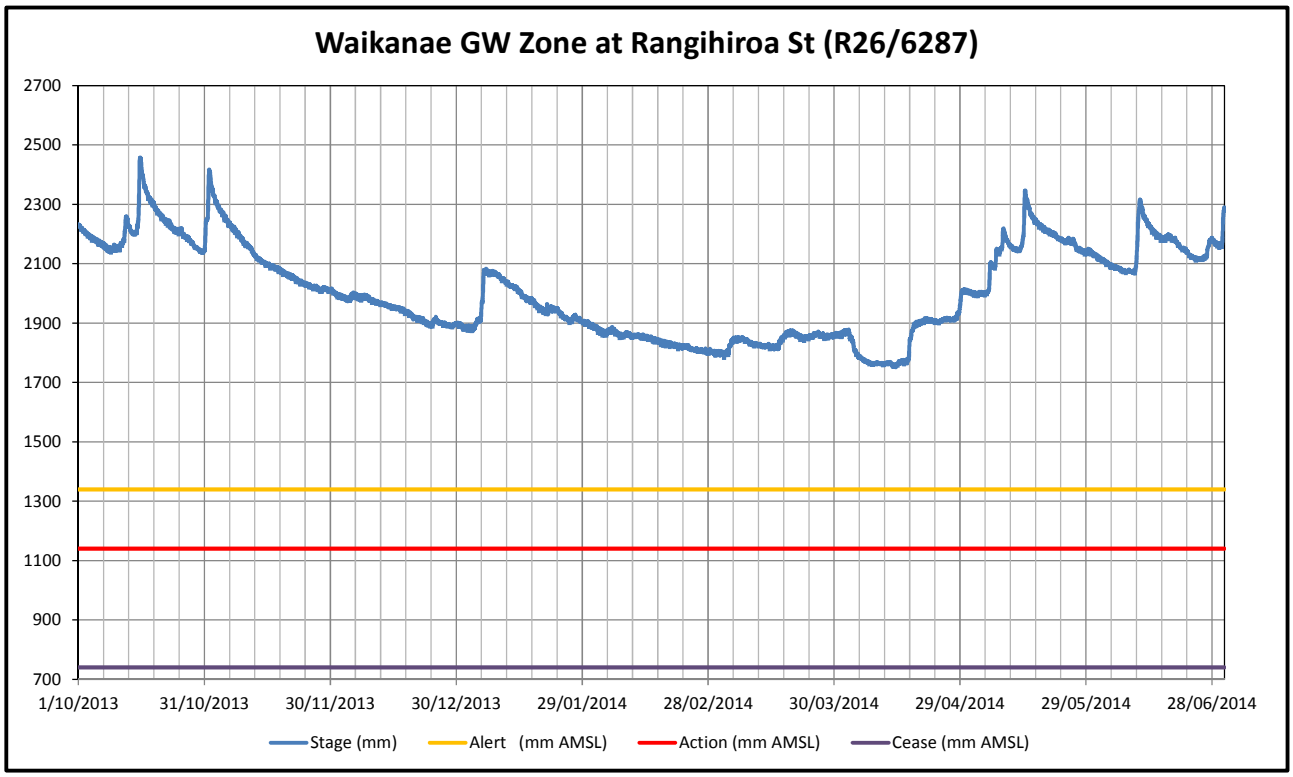


Figure C4: Water Levels at Rangihiroa St Bore (R26/6287) [Level data from GWRC, quality checked up to 27 March 2014 @ 12:00]

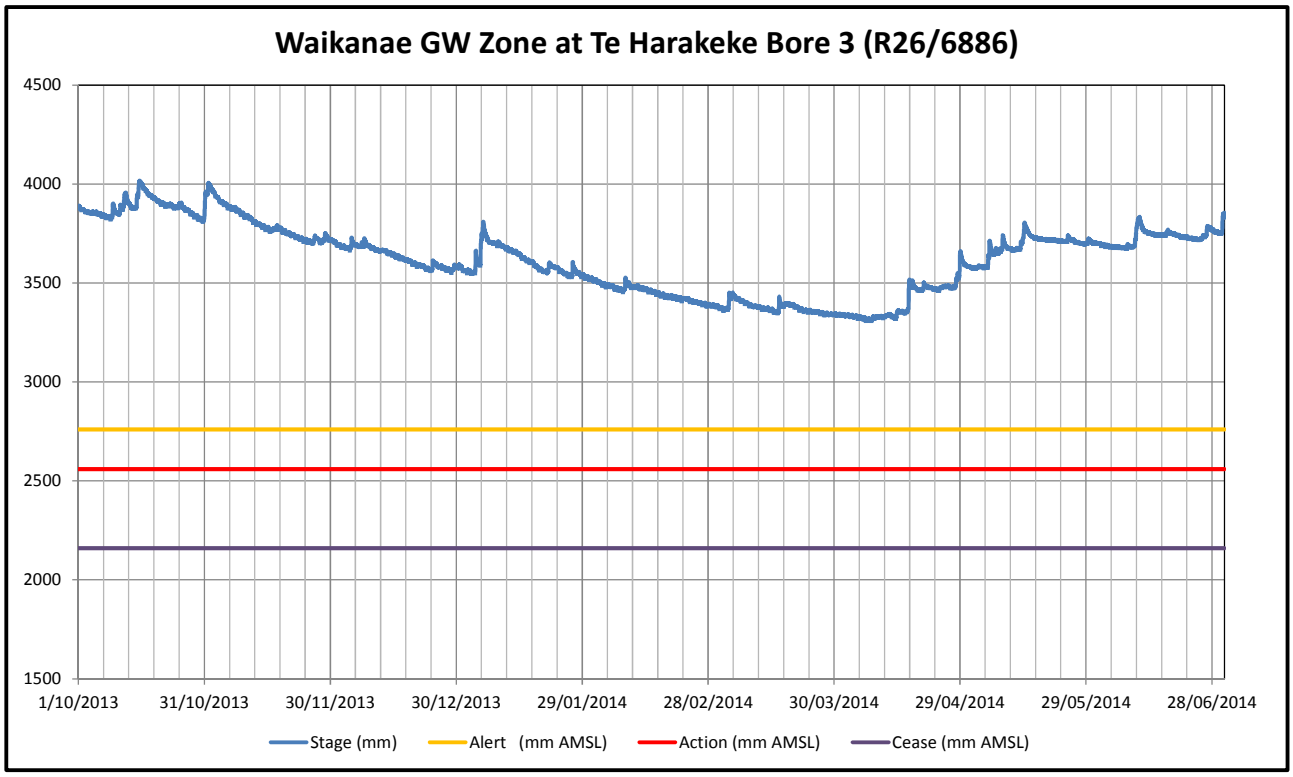


Figure C5: Water Levels at Te Harakeke Bore 3 (R26/6286) [Level data from GWRC, quality checked up to 4 April 2014 @ 09:00]

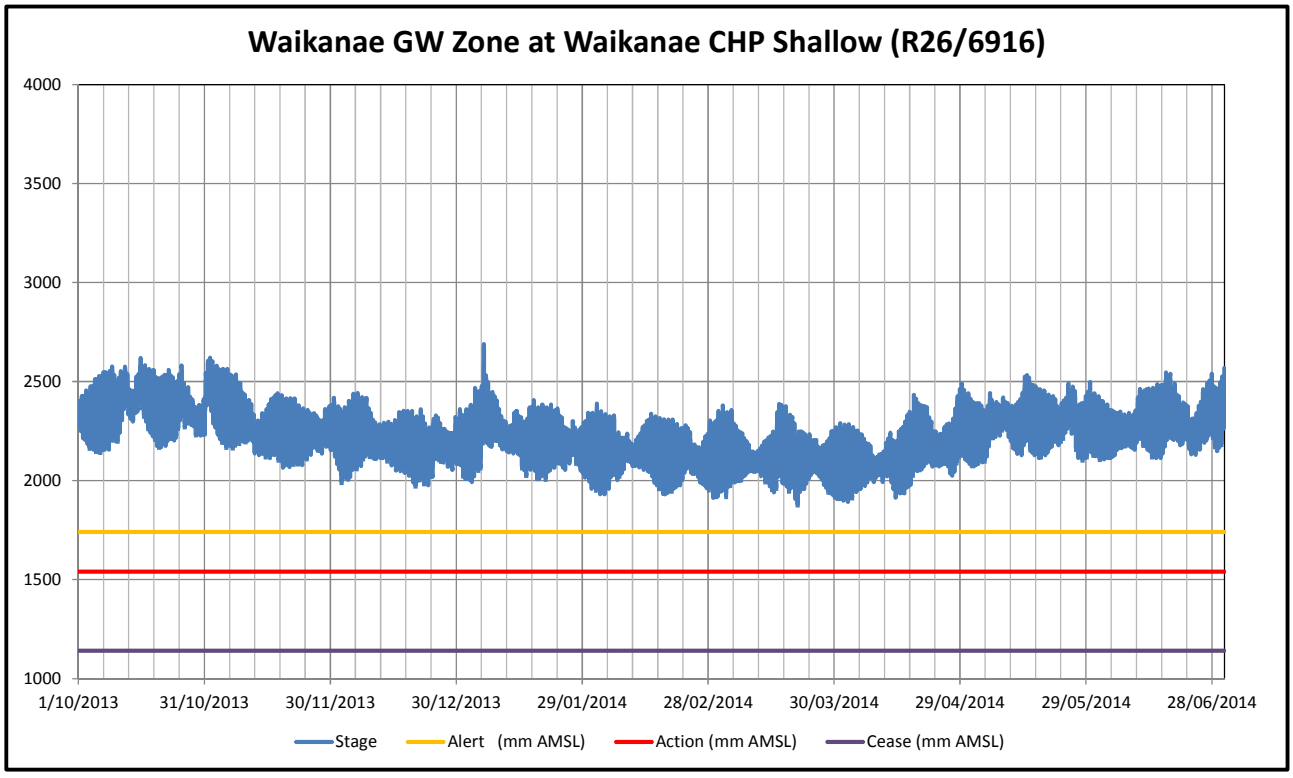


Figure C6: Water Levels at Waikanae CHP Shallow Bore (R26/6916) [Level data from GWRC, quality checked up to 27 March 2014 @ 11:30]

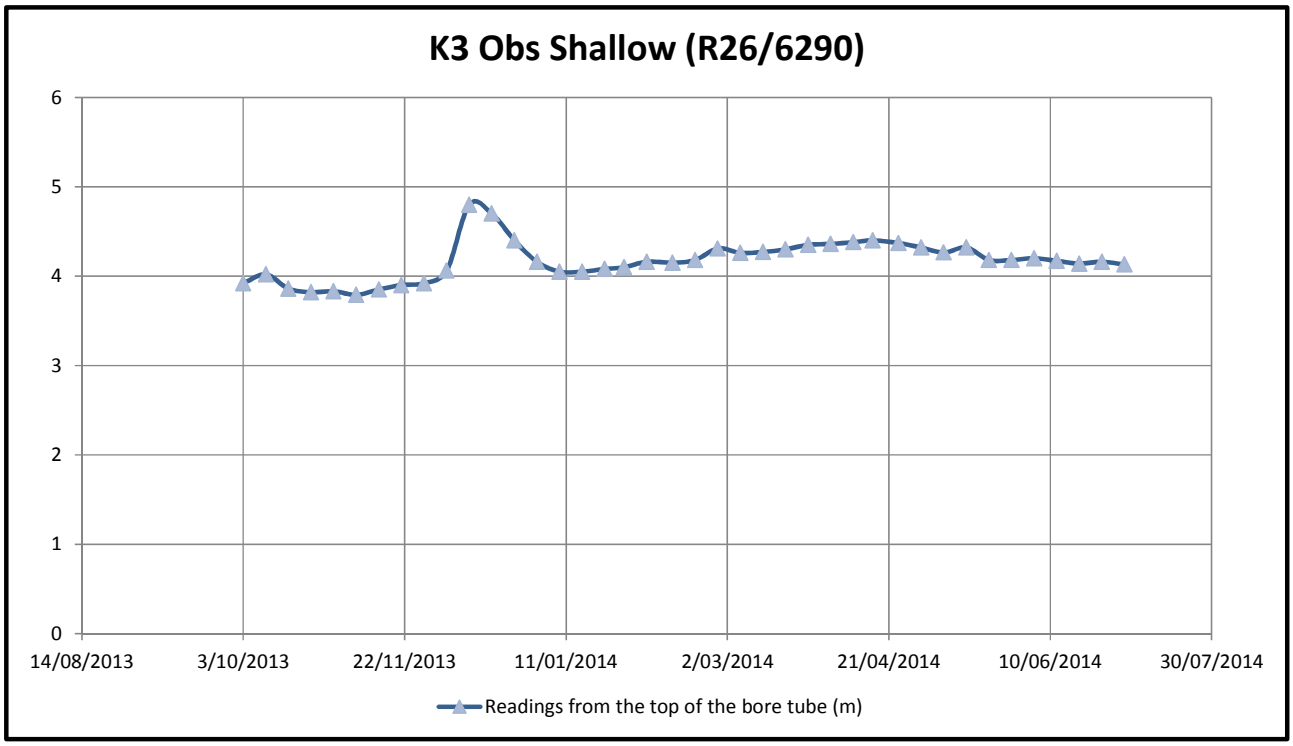


Figure C7: Water Levels at K12 Obs Shallow Bore (R26/6299) [Manual data from Council]

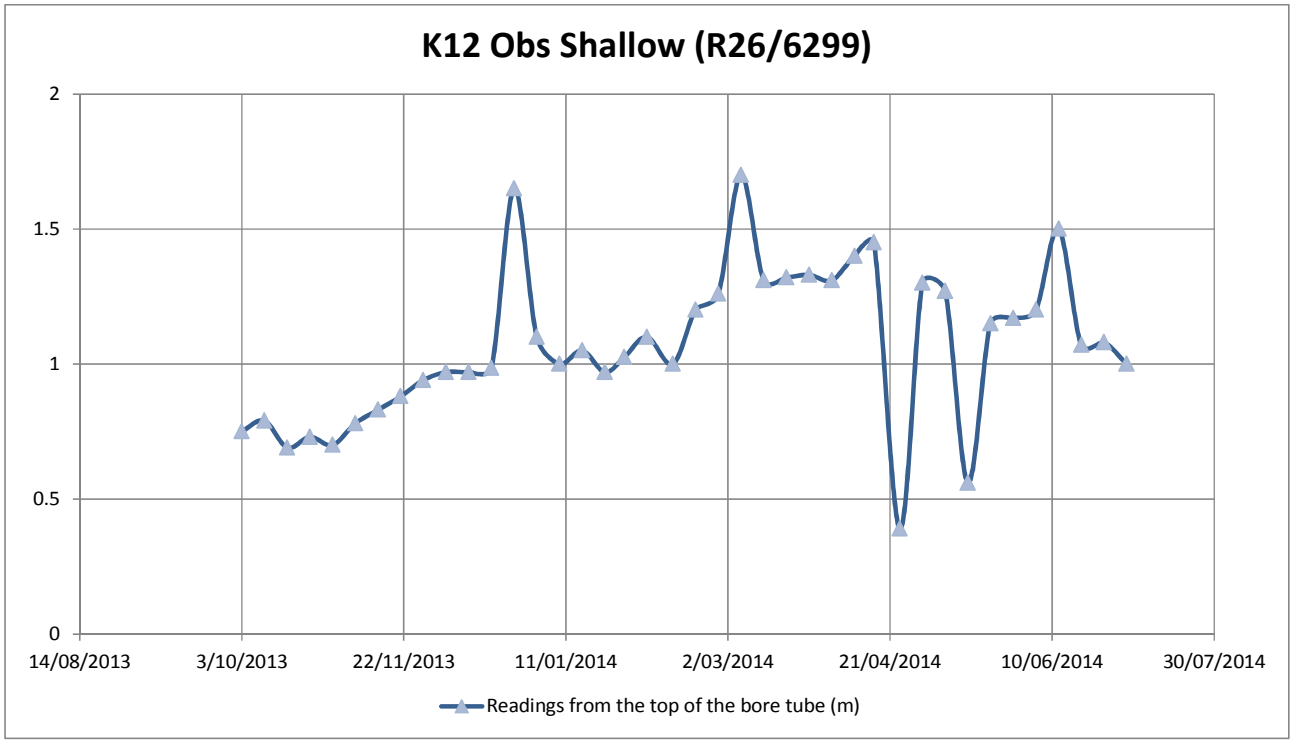


Figure C8: Water Levels at K3 Obs Shallow Bore (R26/6290) [Manual data from Council]

C.2 Deep Aquifer Water Level Monitoring

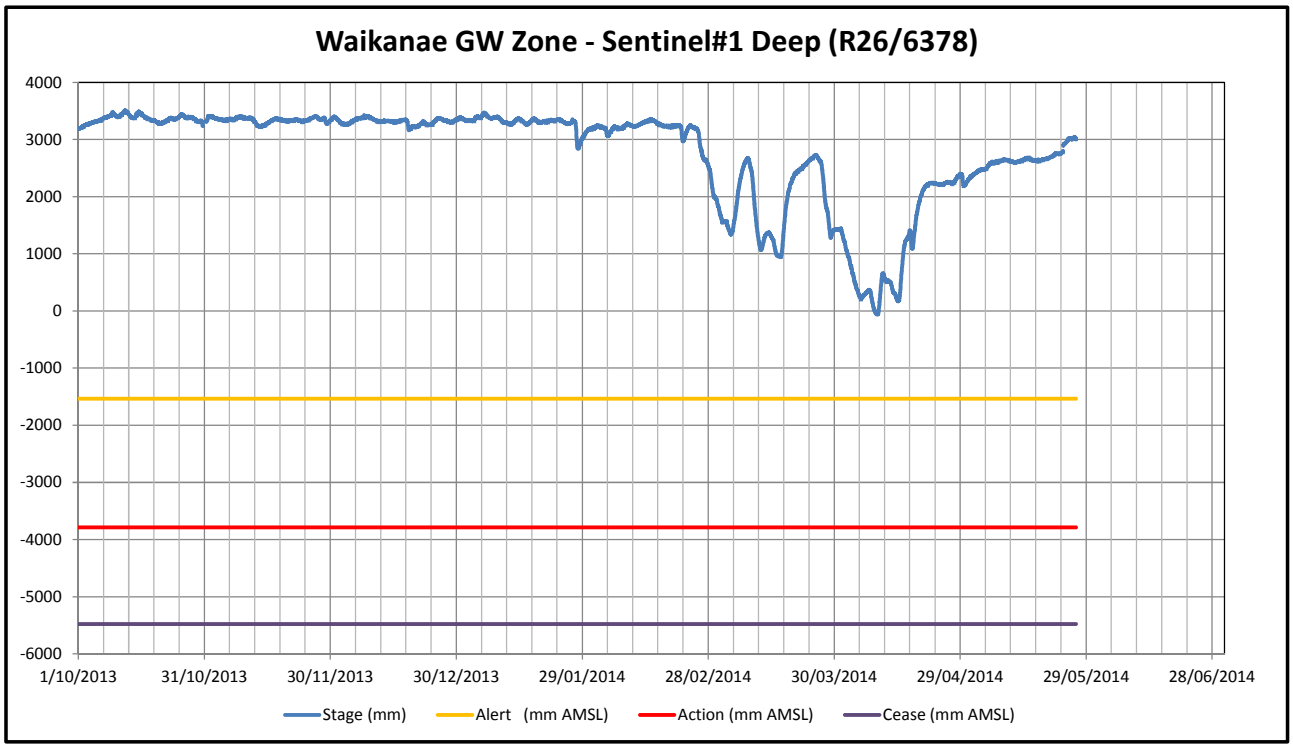


Figure C9: Water Levels in Sentinel#1 Deep Bore at Rutherford Drive (R26/6378) [Level data from GWRC, quality checked up to 4 April 2014 @ 09:45. Equipment removed on 26 May 2014 for borehead refurbishment]

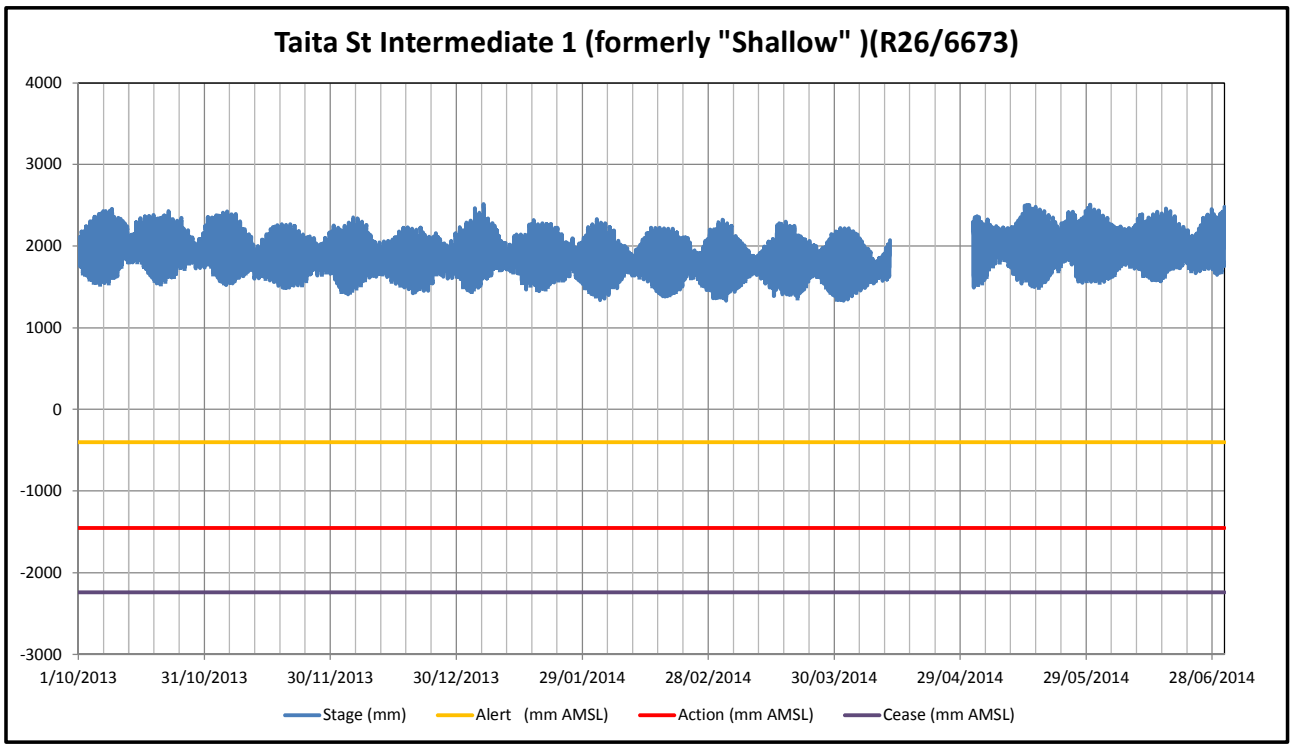


Figure C10: Water Levels in TW2-MW4/1 at Taiata St Intermediate 1 (formerly “Shallow”) (R26/6673) [Level data from GWRC, quality checked up to 27 March 2014 @ 12:45]

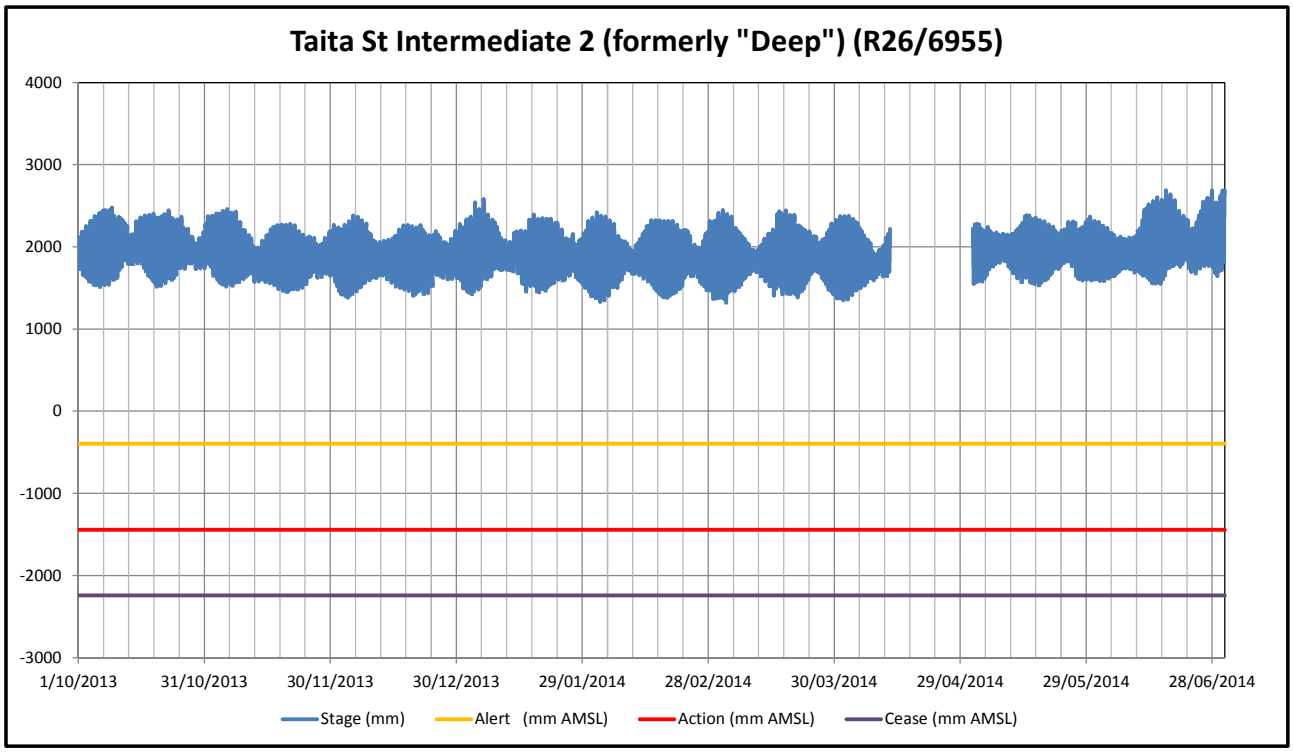


Figure C11: Water Levels in TW2-MW4/2 at Taiata Street Intermediate 2 (formerly “Deep”) (R26/6955) [Level data from GWRC]

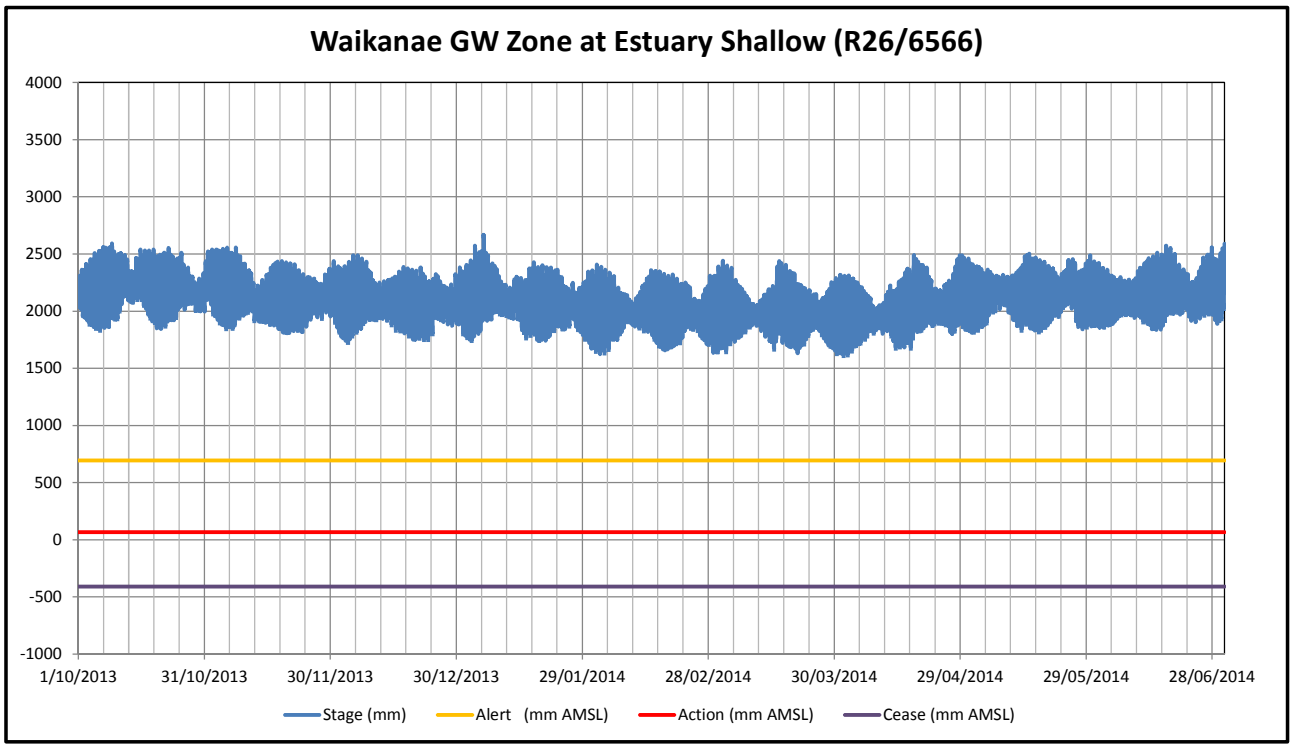


Figure C12: Water Levels in Old Estuary Shallow bore (R26/6566) [Level data from GWRC, quality checked up to 27 March 2014 @ 12:45]

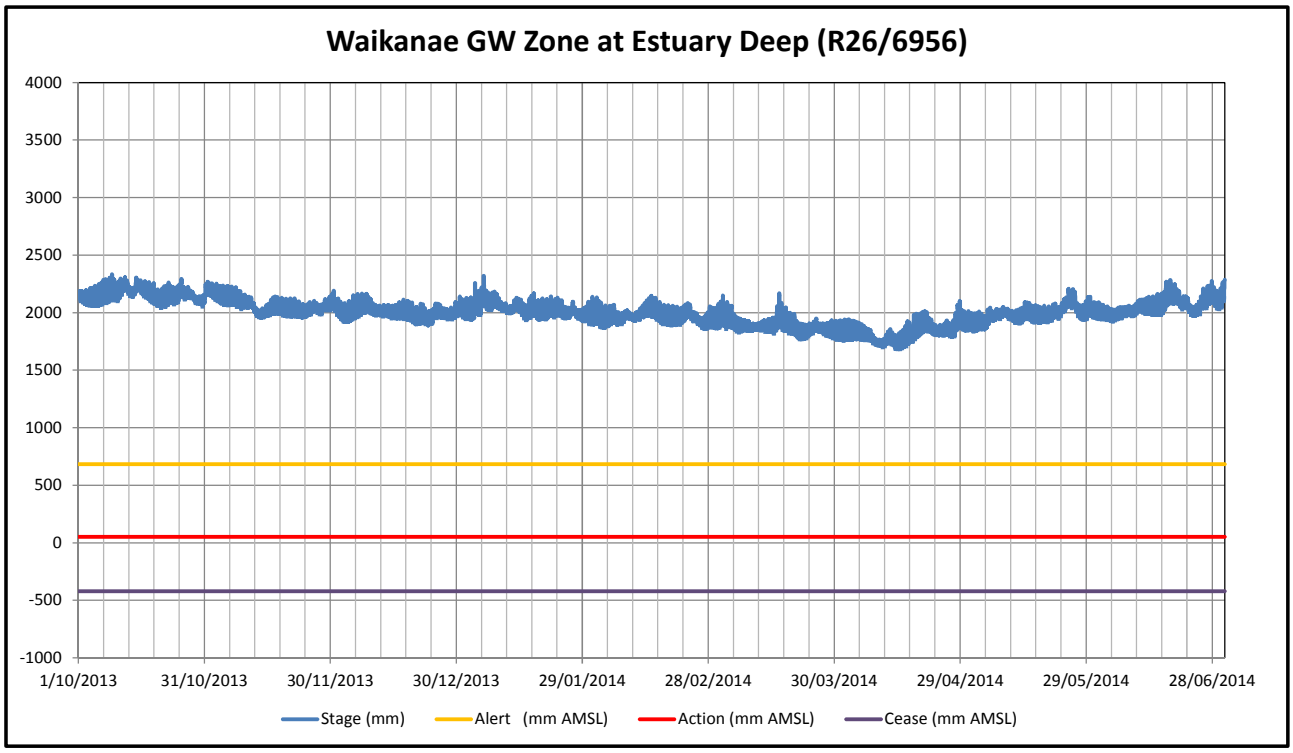


Figure C13: Water Levels in Old Estuary Deep Bore (R26/6956) [Level data from GWRC, quality checked up to 27 March 2014 @ 12:45]

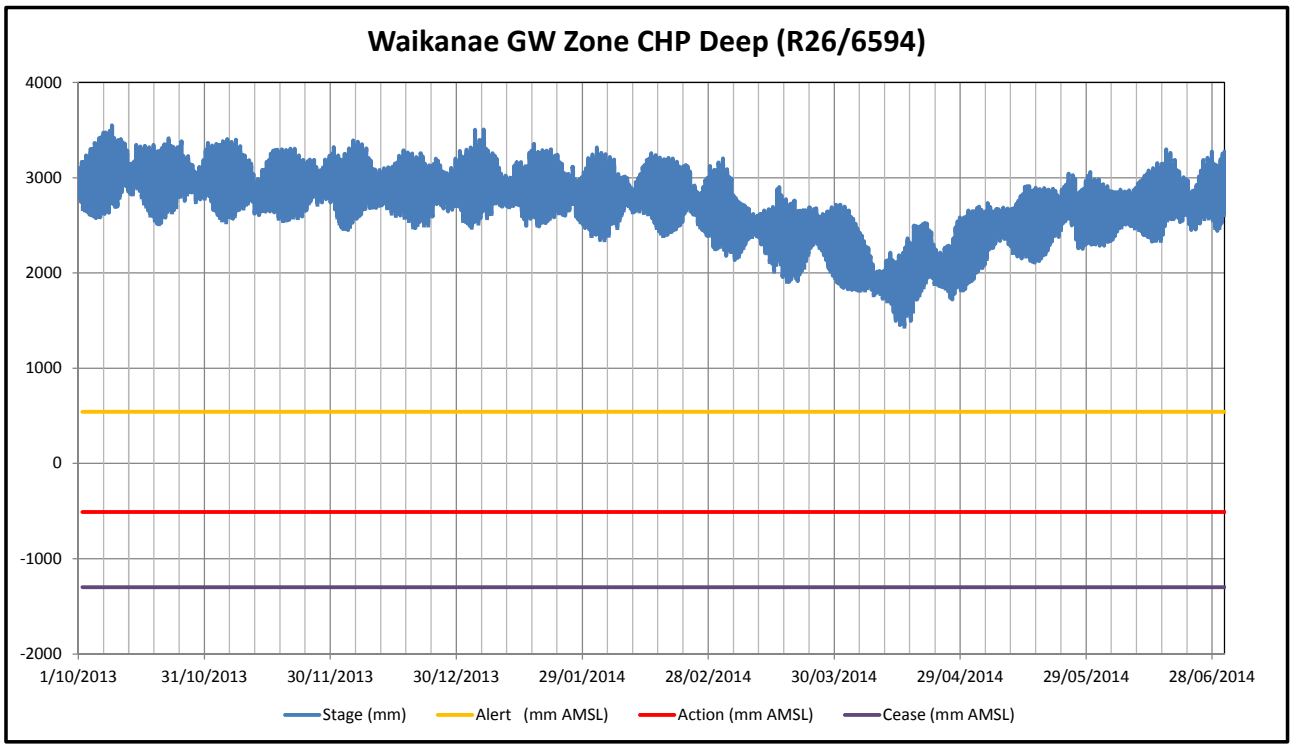


Figure C14: Water Levels in Waikanae CHP Deep Bore (R26/6594) [Level data from GWRC, quality checked up to 27 March 2014 @ 11:30]

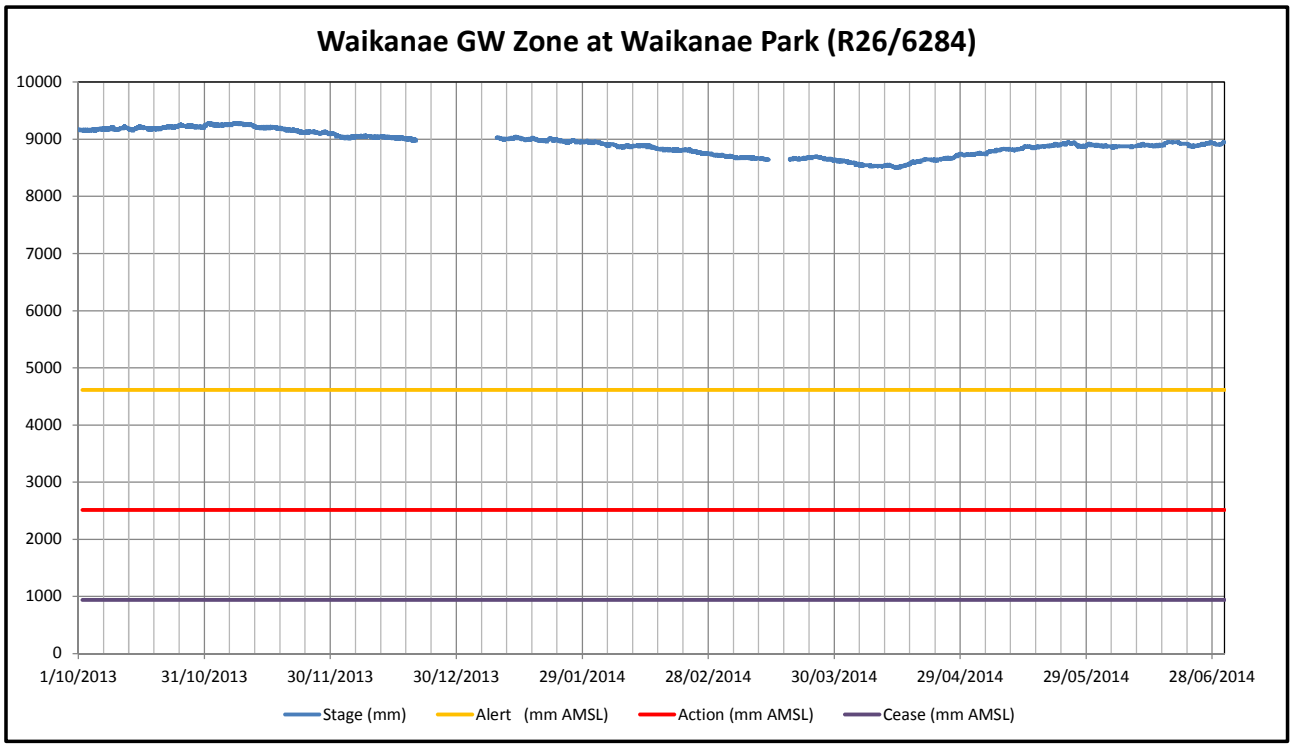


Figure C15: Water Levels in Waikanae Park Bore (R26/6284) [Level data from GWRC, quality checked up to 27 March 2014 @ 11:30]

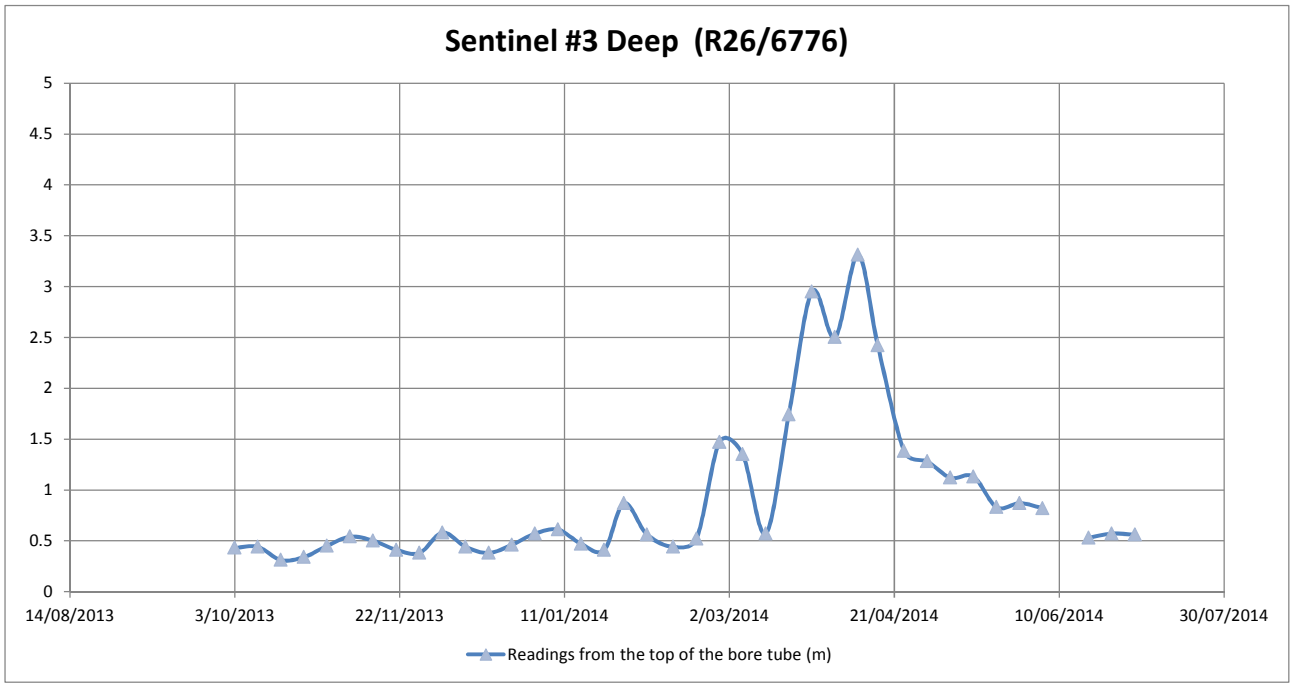


Figure C16: Water Levels in Sentinel#3 Deep Bore (R26/6776) [Council manual data]

C.3 Electrical Conductivity Monitoring

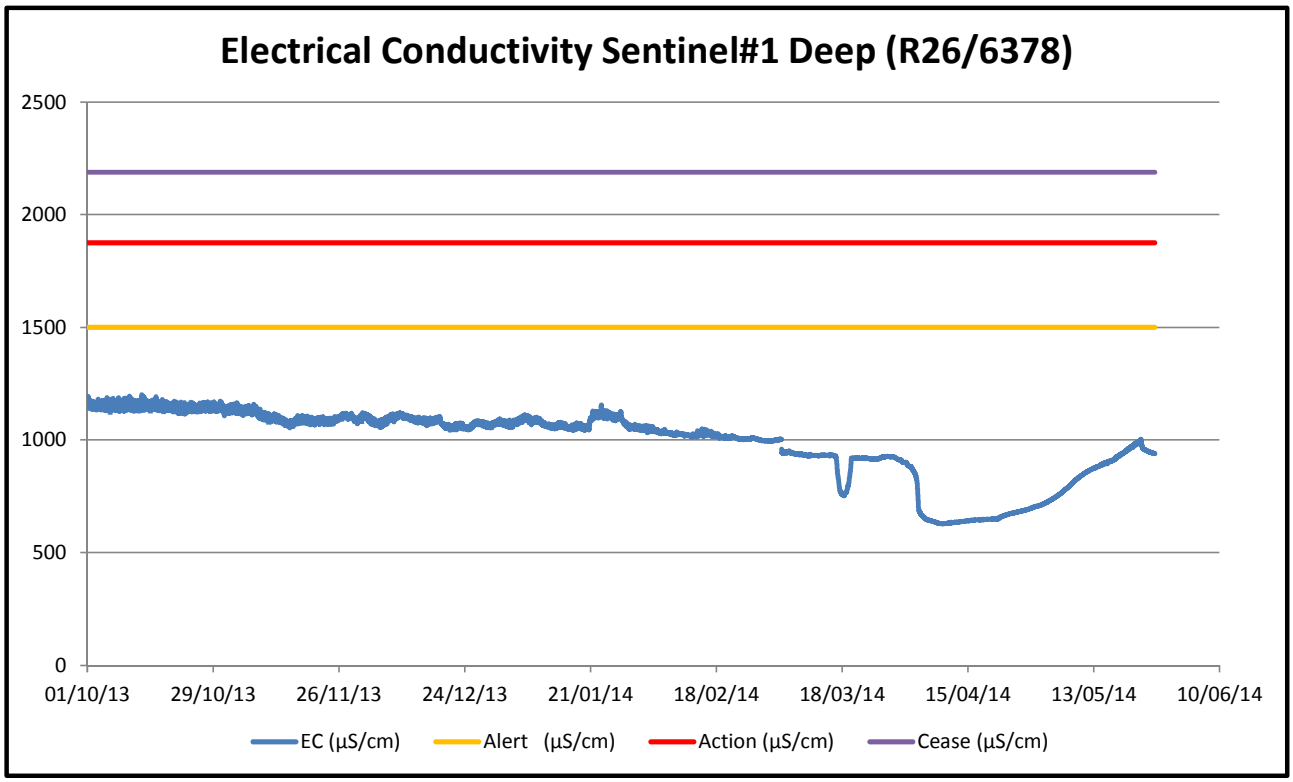


Figure C17: Electrical Conductivity in Sentinel #1 Deep at Rutherford Dr (R26/6284) [EC data from GWRC - all raw data. Equipment removed on 26 May 2014 for borehead refurbishment]

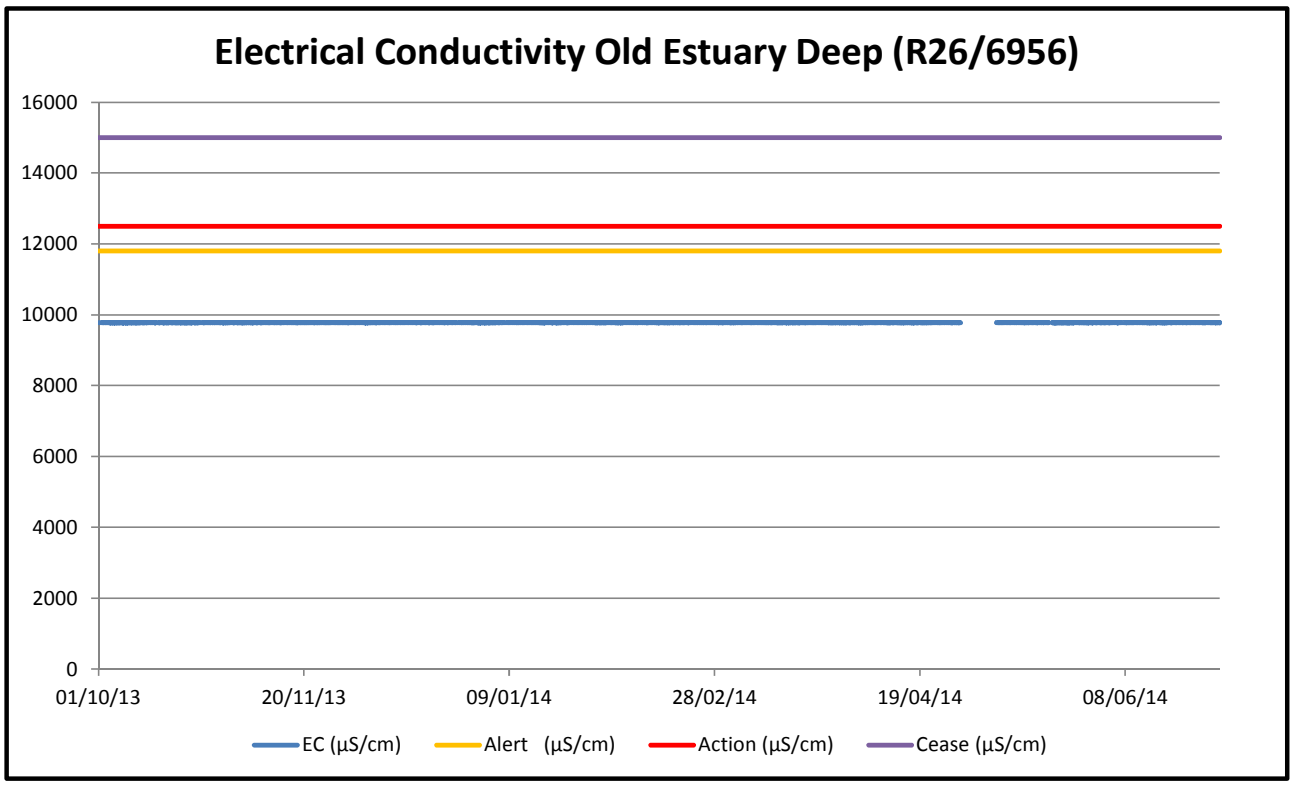


Figure C21: Electrical Conductivity at Old Estuary Deep (R26/6956) [EC data from GWRC - all raw data]

Appendix D

Bore Water Quality Summary

Table D.1 Bore Water Quality Summary (October 2013 – June 2014)

Bore		Temperature (field) (°C)	pH (field) -	pH (lab) -	Conductivity (field) mS/m	Conductivity (lab, @25°C) mS/m	Dissolved Oxygen (field) mg/L	Dissolved Oxygen (lab) g O_2/m^3	Total (NP) Organic Carbon g/m^3	Alkalinity - Total g $CaCO_3/m^3$	Total Dissolved Solids g/m^3	Bicarbonate g $CaCO_3/m^3$	Free CO2 g CO_2/m^3	Anion Sum meq/L	Cation Sum meq/L	Ion Balance %
KB4	Maximum	16.2	7.8	7.7	100.5	125	0.40	2.2	0.8	270	688	268	10	11.4	11.4	7.02
	Minimum	13.9	7.5	7.6	68.3	106	0.09	0.5	<0.3	195	582	194	8	9.6	9.8	0.49
	Average	14.7	7.6	7.7	80.4	116	0.19	0.9	0.3	211	637	209	8	10.3	10.7	1.97
	Number of Samples	9	4	8	4	9	4	9	9	9	9	9	9	9	9	9
K4	Maximum	15.2	7.6	7.5	53.9	53.1	0.40	0.8	1.1	117	292	117	9	4.7	4.9	2.83
	Minimum	14.3	7.3	7.4	43.4	50	0.10	<0.5	<0.5	111	275	111	7	4.4	4.5	0.14
	Average	14.7	7.5	7.4	48.6	52.1	0.19	0.5	0.8	114	286	114	8	4.5	4.7	1.48
	Number of Samples	5	4	5	4	5	4	5	5	5	5	5	5	5	5	5
K5	Maximum	16	7.9	8	89.8	110	0.40	0.9	0.9	255	604	253	5	10.1	10.5	7.14
	Minimum	15.1	7.6	8	60.7	97	0.06	<0.5	<0.5	217	535	215	4	8.7	8.9	0.06
	Average	15.5	7.8	8.0	73.5	105	0.19	0.6	0.5	240	579	238	5	9.4	10.0	3.20
	Number of Samples	9	4	9	4	9	4	9	9	9	9	9	9	9	9	9
K6	Maximum	16.2	7.7	7.7	96.2	113	0.49	2.1	0.9	289	622	288	14	10.4	11.4	7.77
	Minimum	15	7.5	7.6	73.7	109	0.12	<0.5	<0.3	205	598	204	8	9.2	10.0	1.29
	Average	15.4	7.6	7.7	84.0	111	0.34	1.0	0.4	271	609	270	11	9.9	10.6	3.56
	Number of Samples	9	4	9	4	9	4	9	9	9	9	9	9	9	9	9
K10	Maximum	15.5	7.4	7.6	46.3	80.4	0.40	0.7	1	227	442	226	14	7.3	7.7	6.37
	Minimum	15	7.4	7.5	46.3	78.9	0.40	0.6	<0.3	219	434	218	11	6.5	7.4	1.88
	Average	15.2	7.4	7.5	46.3	79.4	0.40	0.7	0.5	223	437	222	13	7.0	7.5	3.53
	Number of Samples	5	1	5	1	5	1	5	5	5	5	5	5	5	5	5

Bore		Fluoride g/m³	Chloride g/m³	Nitrite - Nitrogen g/m³	Bromide g/m³	Nitrate - Nitrogen g/m³	Sulphate g/m³	Ammonia Nitrogen g/m³	Total Hardness g $CaCO_3$/m³	Boron - Dissolved g/m³	Calcium - Dissolved g/m³	Iron - Dissolved g/m³	Magnesium - Dissolved g/m³	Manganese - Dissolved g/m³	Potassium - Dissolved g/m³	Sodium - Dissolved g/m³
KB4	Maximum	0.05	288	0.02	1.05	<0.01	2.07	0.38	152	0.616	39.5	<0.003	14.5	0.072	8.78	192
	Minimum	0.03	194	<0.01	0.73	<0.01	0.77	0.04	128	0.226	32.9	<0.003	11.1	0.021	5.98	117
	Average	0.04	243	0.01	0.90	<0.01	1.55	0.10	140	0.282	35.6	<0.003	12.4	0.032	7.07	170
	Number of Samples	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9
K4	Maximum	0.21	89	<0.01	0.30	<0.01	13.90	0.04	28	0.098	4.0	0.007	4.4	0.149	1.78	98.8
	Minimum	0.20	80	<0.01	0.27	<0.01	12.40	<0.01	25	0.086	3.6	<0.003	3.9	0.127	1.61	90.5
	Average	0.21	85	<0.01	0.29	<0.01	13.36	0.02	27	0.094	3.8	0.004	4.2	0.139	1.73	94.4
	Number of Samples	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
K5	Maximum	0.06	211	0.02	0.78	<0.01	0.58	0.34	141	0.484	31.2	0.027	16.0	0.062	9.58	178
	Minimum	0.05	168	<0.01	0.66	<0.01	0.43	0.25	105	0.379	24.3	<0.003	10.8	0.056	6.69	149
	Average	0.06	192	0.01	0.72	<0.01	0.51	0.30	124	0.435	28.3	0.011	13.0	0.058	7.78	167
	Number of Samples	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9
K6	Maximum	0.05	225	0.02	0.86	<0.01	1.50	0.44	151	0.674	35.1	<0.003	17.3	0.084	11.30	195
	Minimum	0.04	160	<0.01	0.70	<0.01	0.27	0.07	133	0.269	30.9	<0.003	12.1	0.024	6.43	160
	Average	0.04	192	0.01	0.74	<0.01	0.64	0.35	140	0.586	32.6	<0.003	14.3	0.072	9.16	174
	Number of Samples	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9
K10	Maximum	0.04	131	<0.01	0.51	<0.01	<0.02	0.25	173	0.170	48.3	<0.003	14.1	0.165	8.50	92.9
	Minimum	0.03	100	<0.01	0.49	<0.01	<0.02	0.22	164	0.155	45.8	<0.003	11.9	0.158	7.47	88.2
	Average	0.04	119	<0.01	0.50	<0.01	<0.02	0.23	170	0.162	47.0	<0.003	12.7	0.162	7.86	89.7
	Number of Samples	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5

Bore		Total Phosphorus g/m^3	Dissolved Reactive Phosphorus g/m^3	Total Nitrogen g/m^3	Arsenic - Dissolved g/m^3	Cadmium - Dissolved g/m^3	Chromium - Dissolved g/m^3	Copper - Dissolved g/m^3	Lead - Dissolved g/m^3	Nickel - Dissolved g/m^3	Zinc - Dissolved g/m^3
KB4	Maximum	0.063	0.072	0.35	0.001	0.0003	<0.001	0.0036	<0.001	0.0009	0.014
	Minimum	0.027	0.028	<0.05	<0.001	<0.0002	<0.001	0.0009	<0.0005	<0.0005	0.005
	Average	0.034	0.040	0.09	0.001	<0.0002	<0.001	0.0020	<0.0005	0.0004	0.008
	Number of Samples	9	9	9	9	9	9	9	9	9	9
K4	Maximum	0.098	0.099	0.06	<0.001	<0.0002	<0.001	0.0015	<0.0005	0.0005	0.009
	Minimum	0.090	0.090	<0.05	<0.001	<0.0002	<0.001	0.0007	<0.0005	<0.0005	0.004
	Average	0.095	0.097	<0.05	<0.001	<0.0002	<0.001	0.0011	<0.0005	0.0003	0.007
	Number of Samples	5	5	5	5	5	5	5	5	5	5
K5	Maximum	0.124	0.129	0.32	0.001	0.0003	<0.001	0.0093	0.0038	0.0007	0.019
	Minimum	0.084	0.075	0.29	<0.001	<0.0002	<0.001	<0.0005	<0.0005	<0.0005	<0.002
	Average	0.101	0.104	0.31	0.001	<0.0002	<0.001	0.0013	0.0007	0.00030	0.003
	Number of Samples	9	9	9	9	9	9	9	9	9	9
K6	Maximum	0.078	0.077	0.42	0.001	0.0003	<0.001	0.0063	<0.001	0.0025	0.013
	Minimum	0.028	0.038	<0.05	<0.001	<0.0002	<0.001	0.0010	<0.0005	<0.0005	<0.002
	Average	0.067	0.065	0.35	0.001	<0.0002	<0.001	0.0023	<0.0005	0.0008	0.008
	Number of Samples	9	9	9	9	9	9	9	9	9	9
K10	Maximum	0.068	0.062	0.26	0.001	0.0002	<0.001	0.0012	<0.001	0.0006	0.008
	Minimum	0.061	0.041	0.20	<0.001	<0.0002	<0.001	0.0005	<0.0005	<0.0005	0.005
	Average	0.064	0.055	0.24	0.001	<0.0002	<0.001	0.0009	<0.0005	<0.0005	0.006
	Number of Samples	5	5	5	5	5	5	5	5	5	5

Appendix E

Water Level Monitoring for Wetlands

D.1 Wetlands 1F

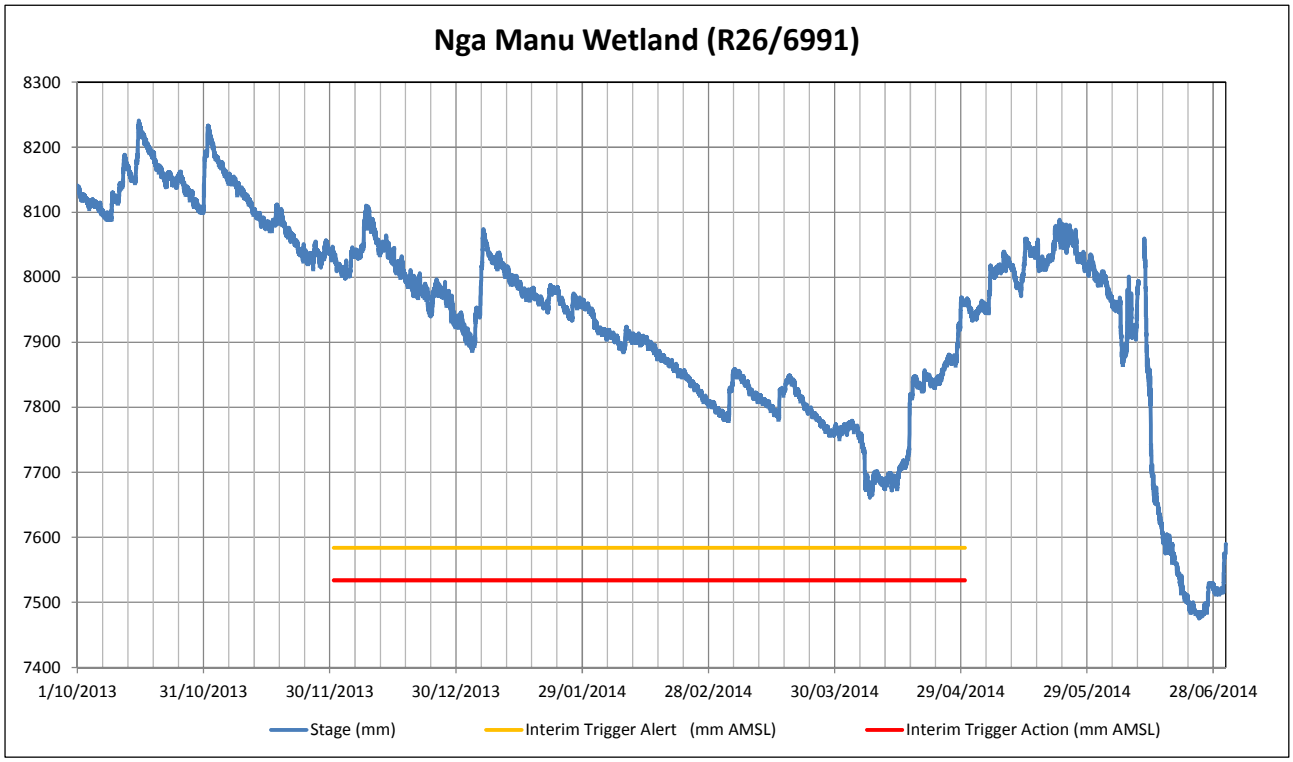


Figure E1: Water Levels in the vicinity of Nga Manu Wetland – Interim trigger levels [Level data from GWRC, quality checked up to 27 March 2014 @ 15:00]

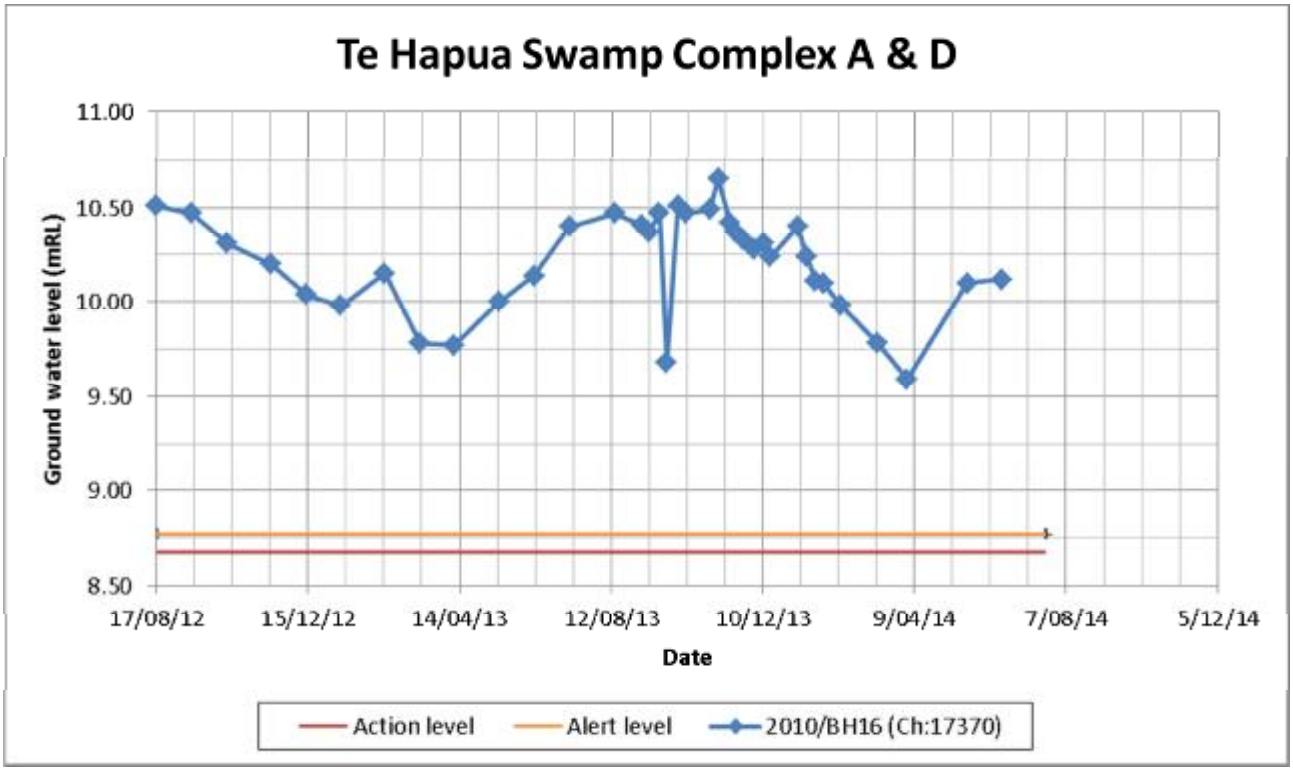


Figure E2: Water Levels in the broad vicinity of Te Hapua Swamp Complex A & D – M2PP Trigger levels

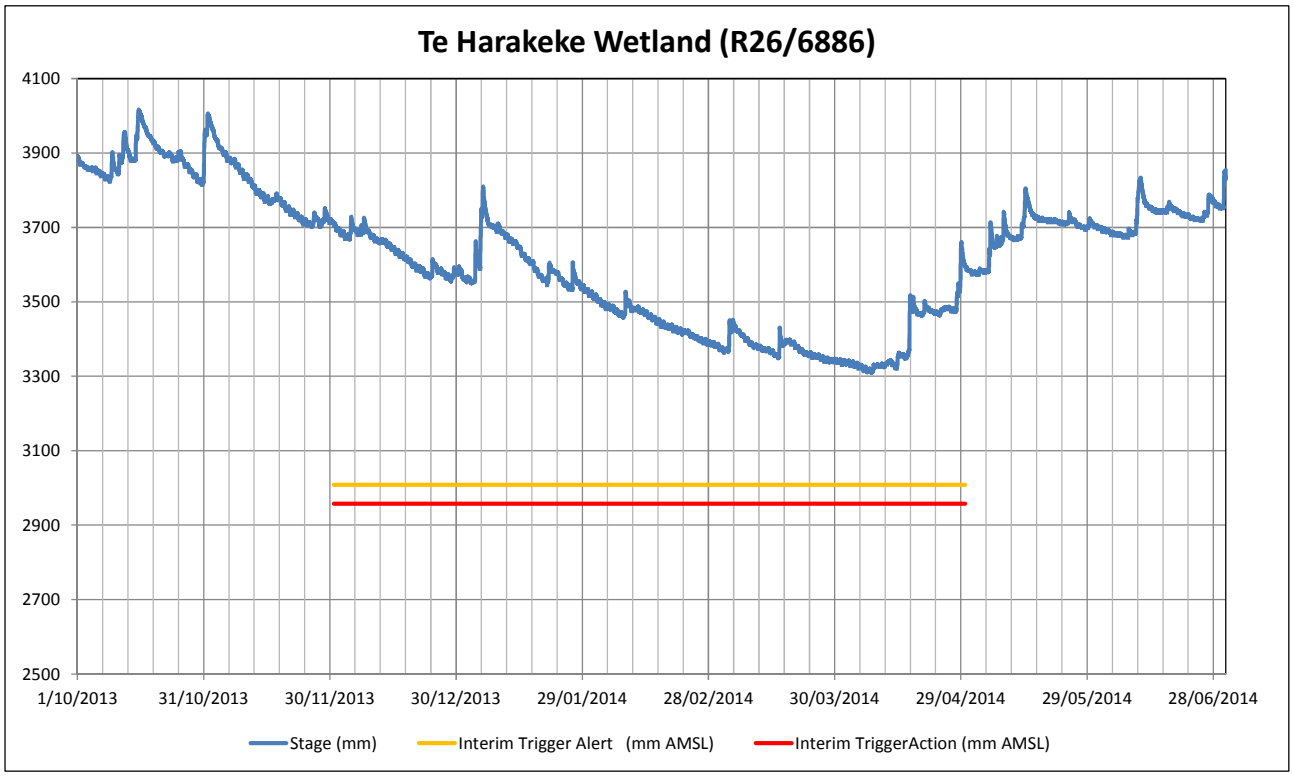
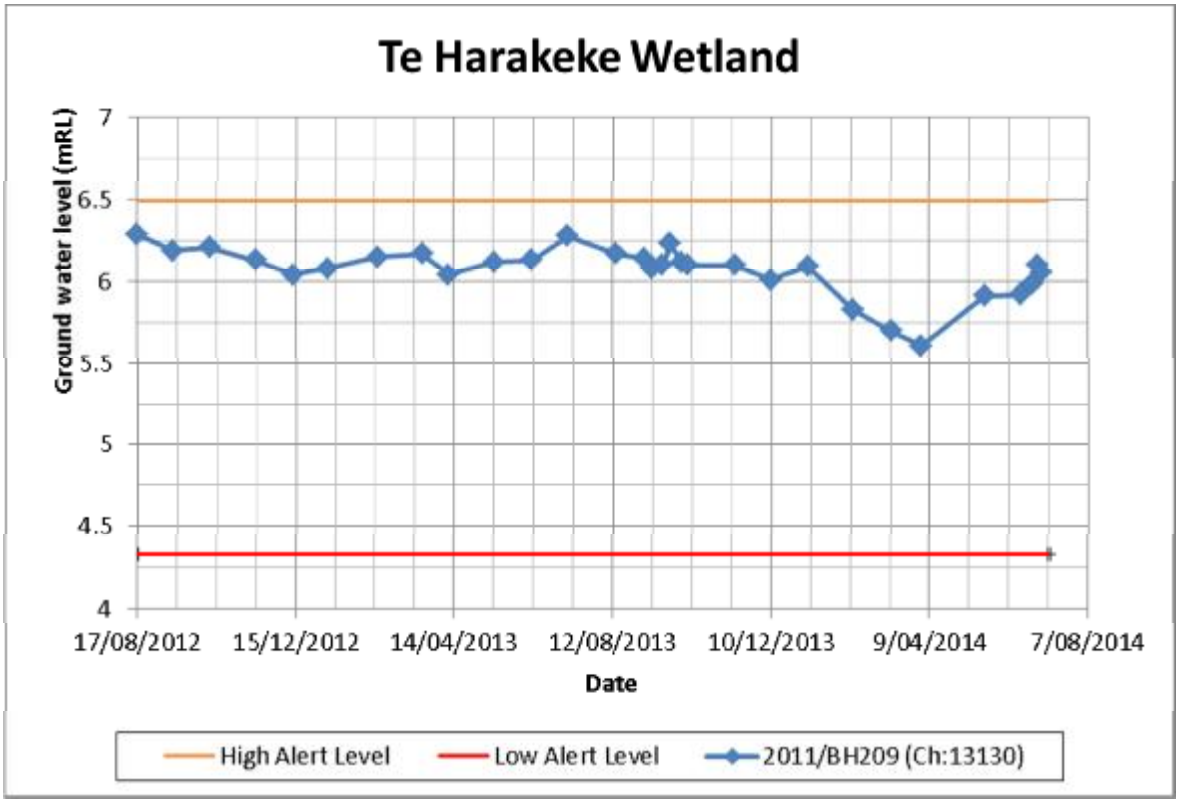


Figure E3: Water Levels in vicinity of Te Harakeke Wetland – Interim Trigger Levels [Level data from GWRC – Quality checked up to 4 April 2014 @ 09:00]



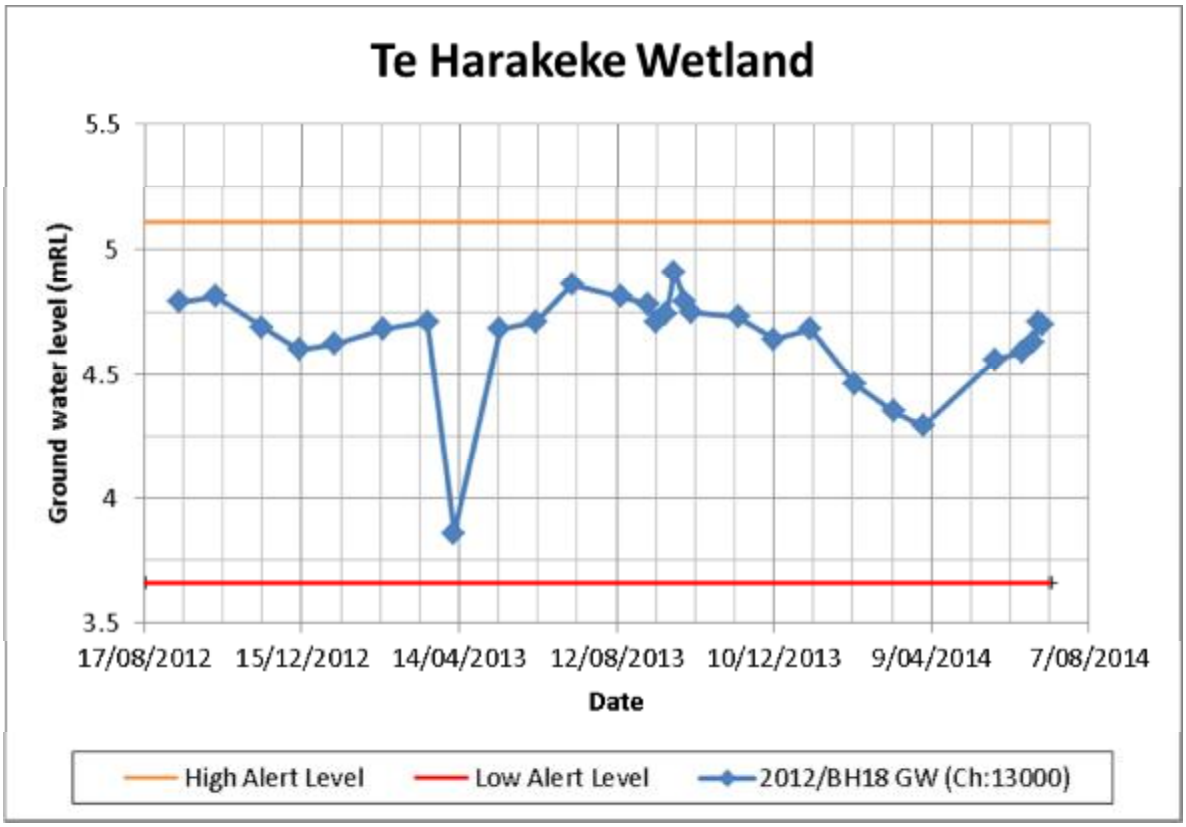


Figure E4: Water Levels in the vicinity of Te Harakeke Wetland – M2PP Trigger levels

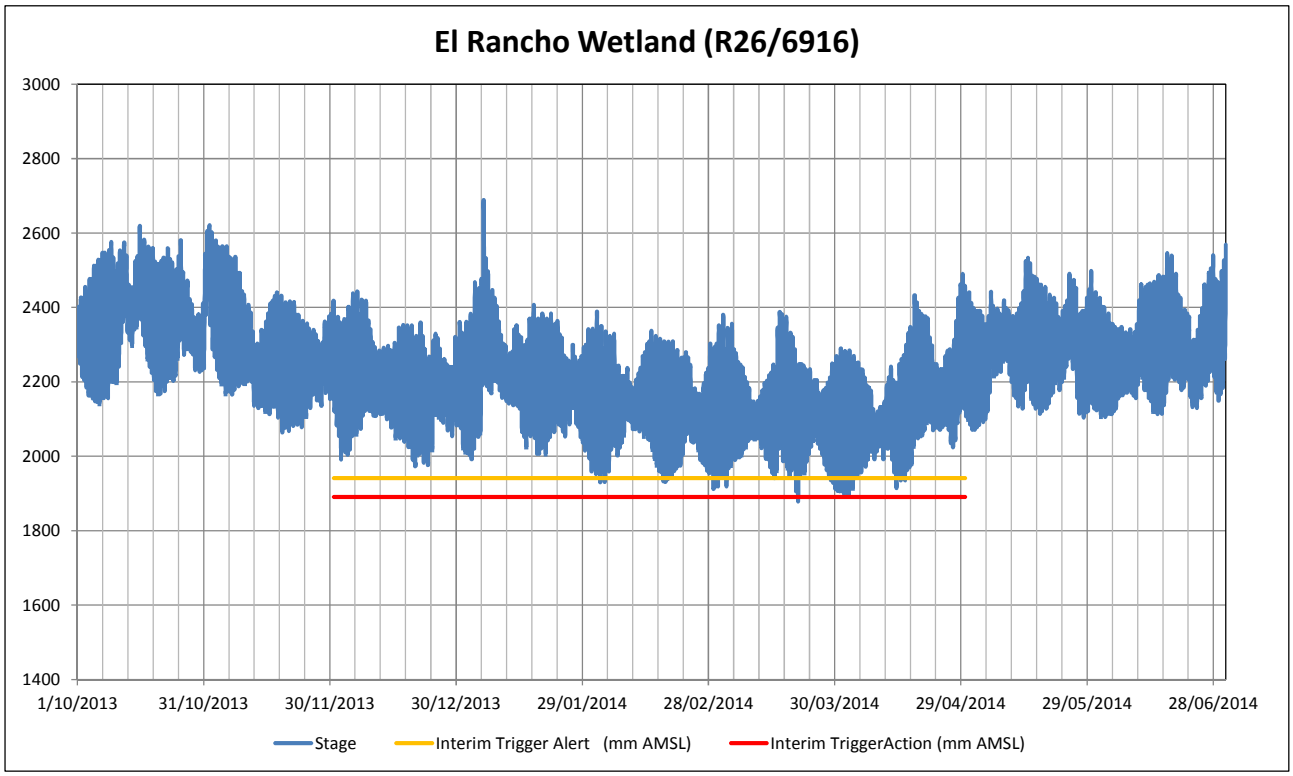
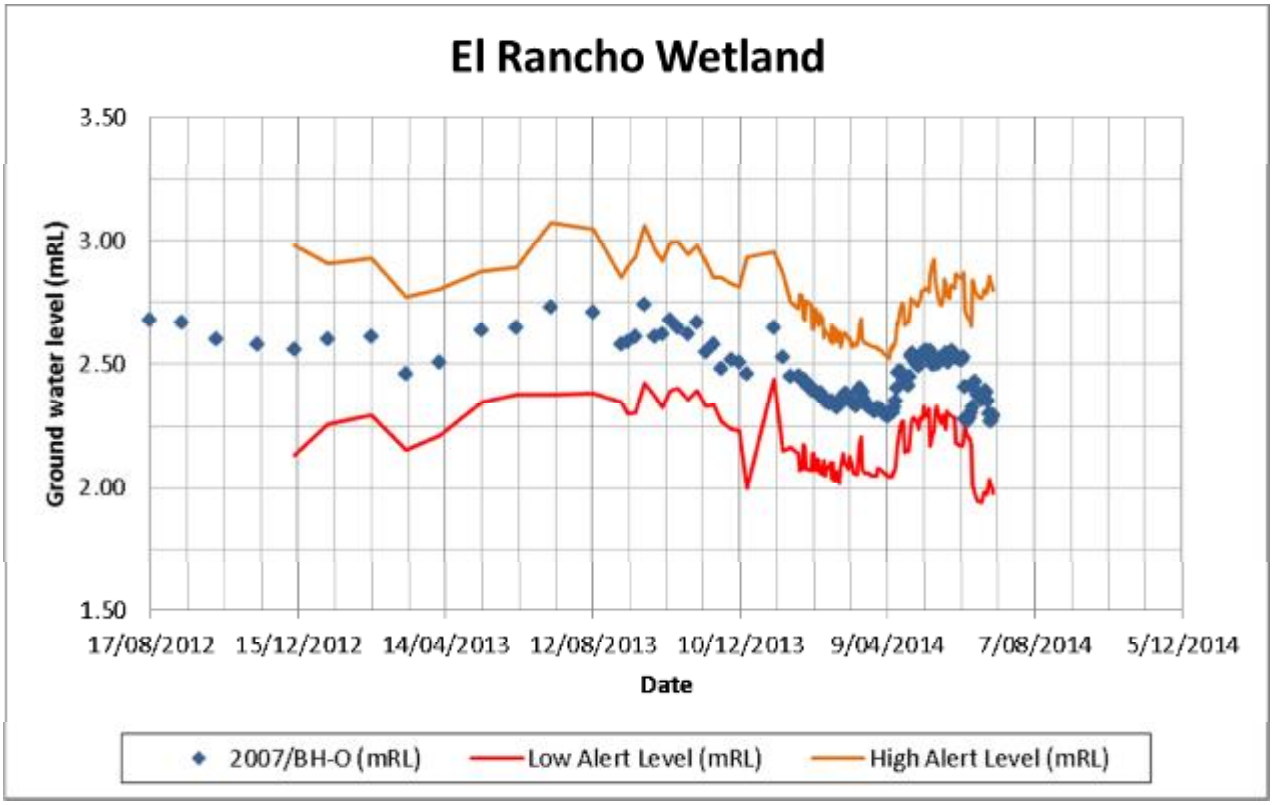


Figure E5: Water Levels in vicinity of El Rancho Wetland – Interim trigger levels



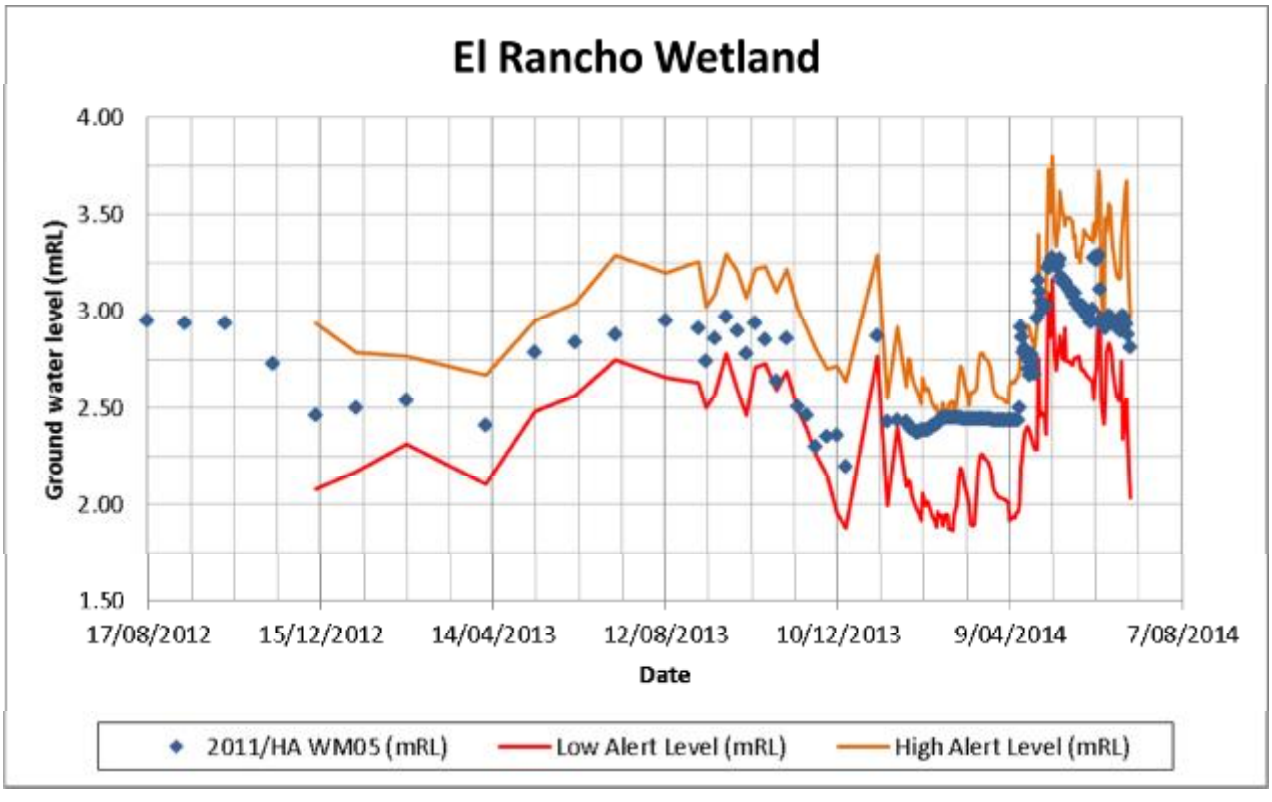


Figure E6: Water Levels in the vicinity of El Rancho Wetland – M2PP trigger levels

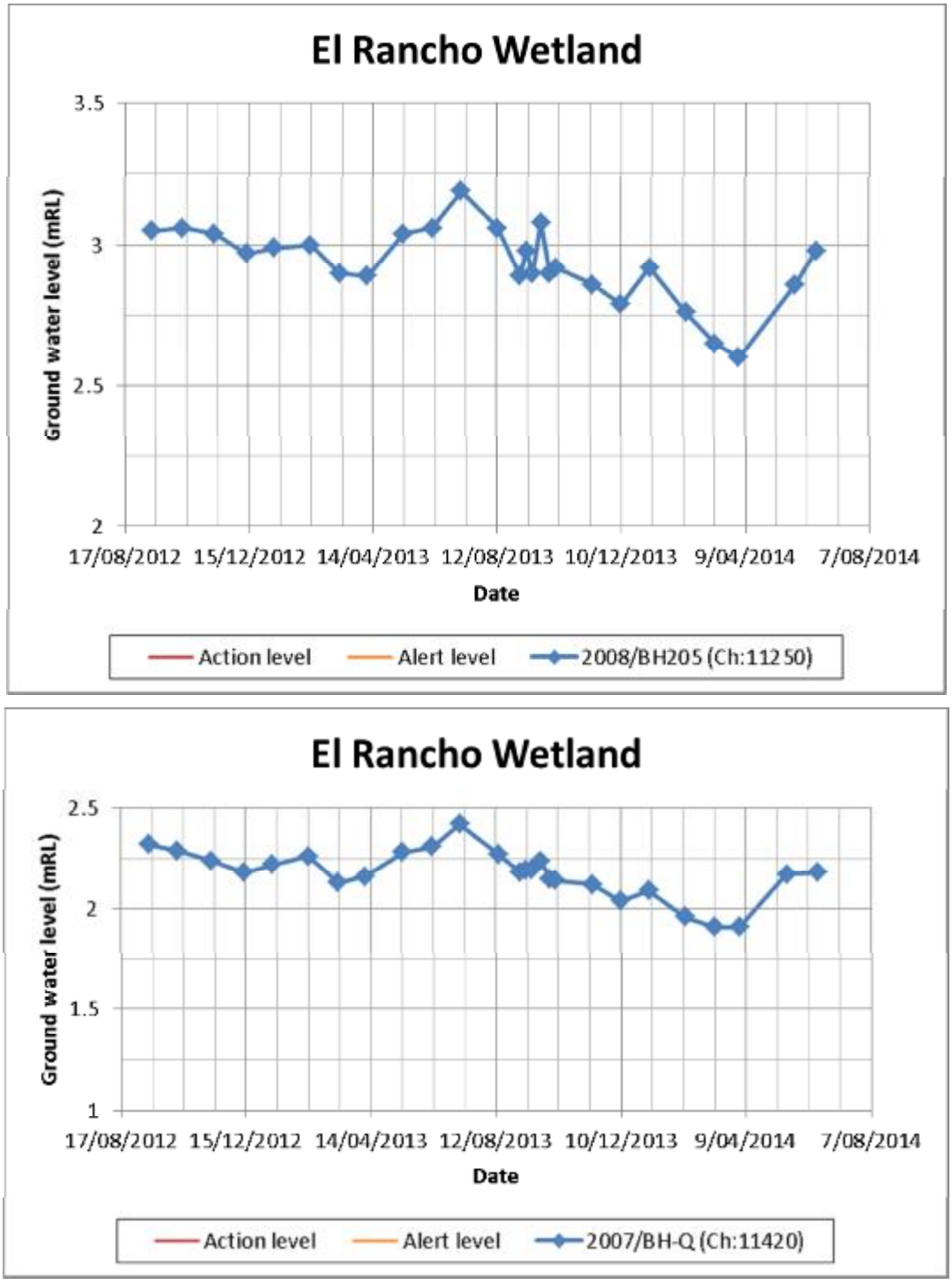
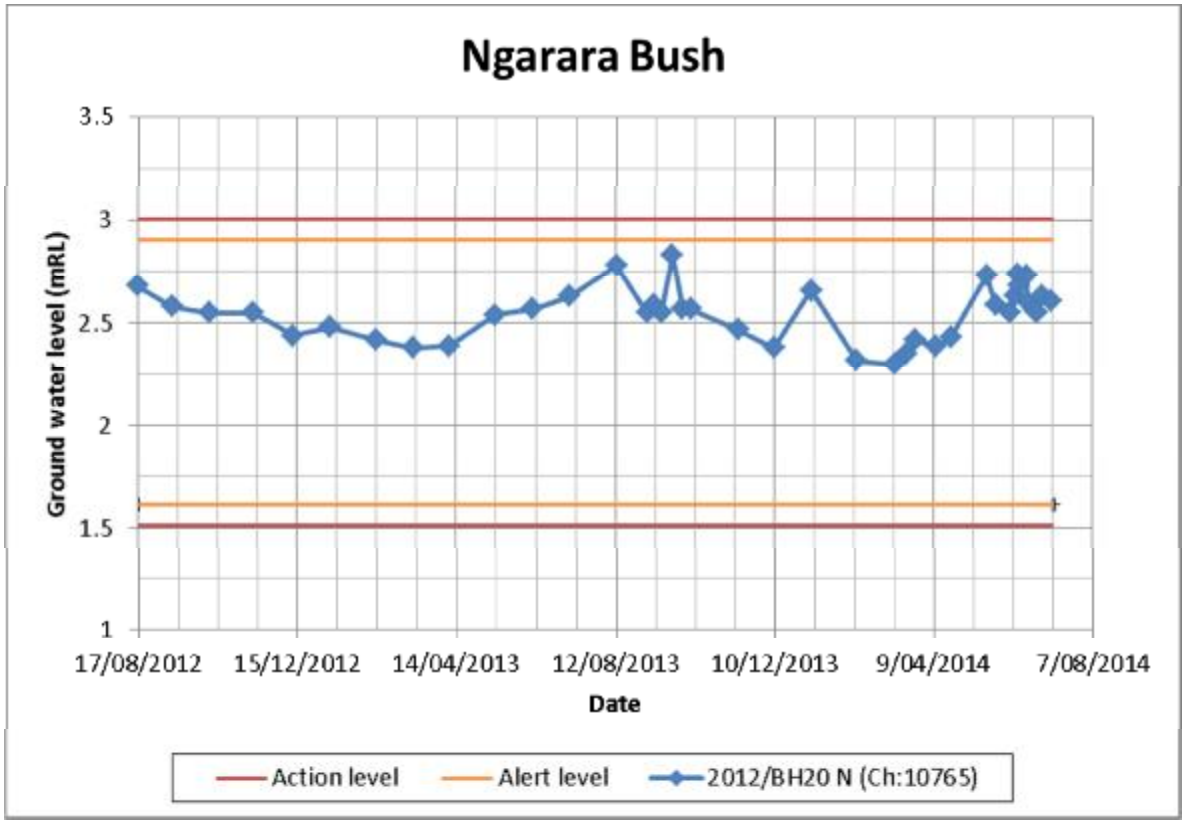


Figure E7: Water Levels in vicinity of El Rancho Wetland



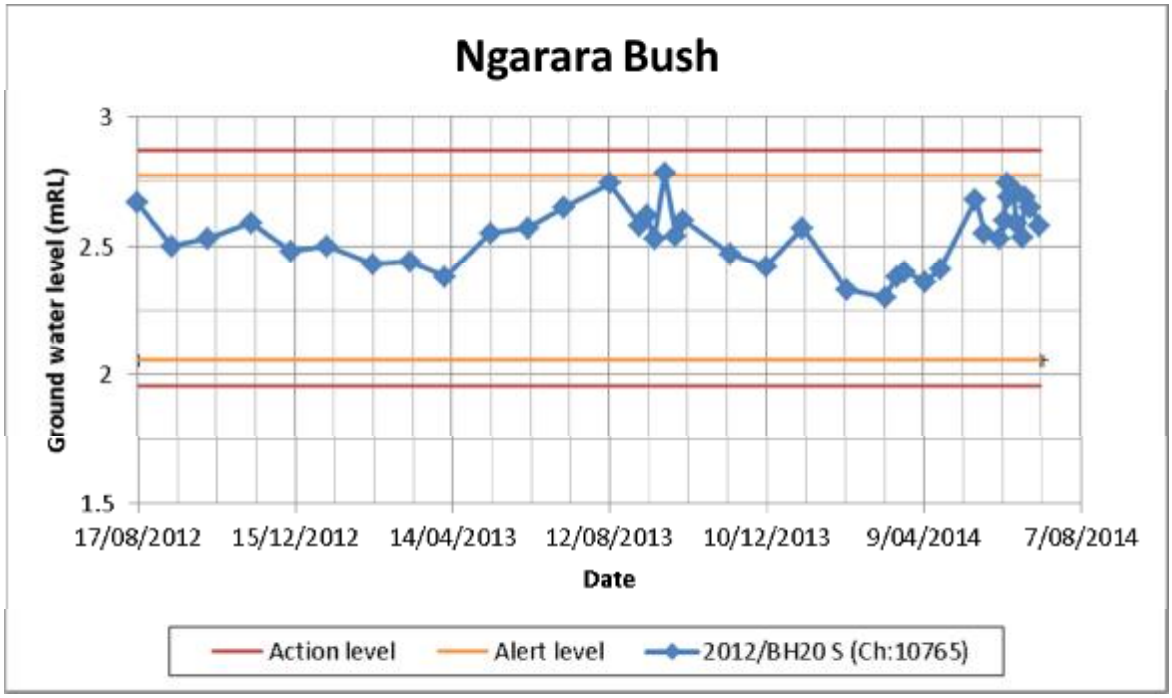


Figure E8: Water Levels in the vicinity of Ngarara Bush – M2PP trigger levels

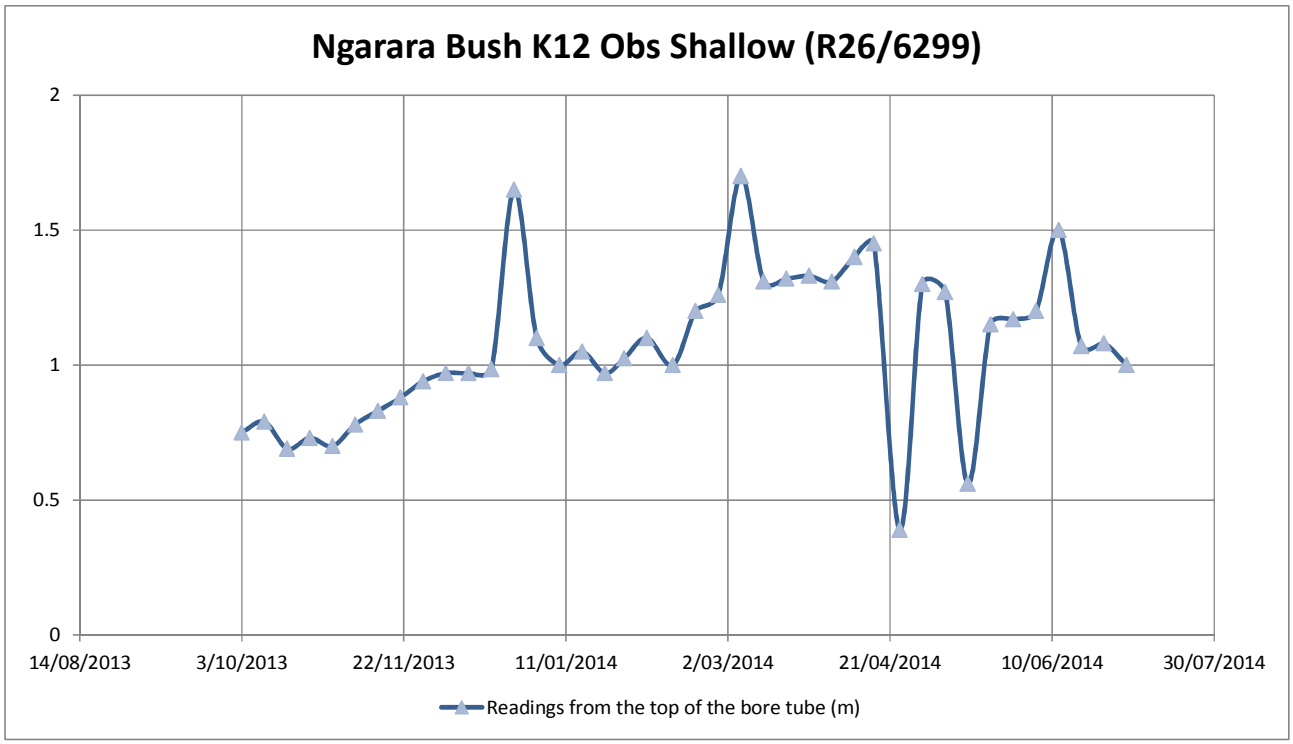
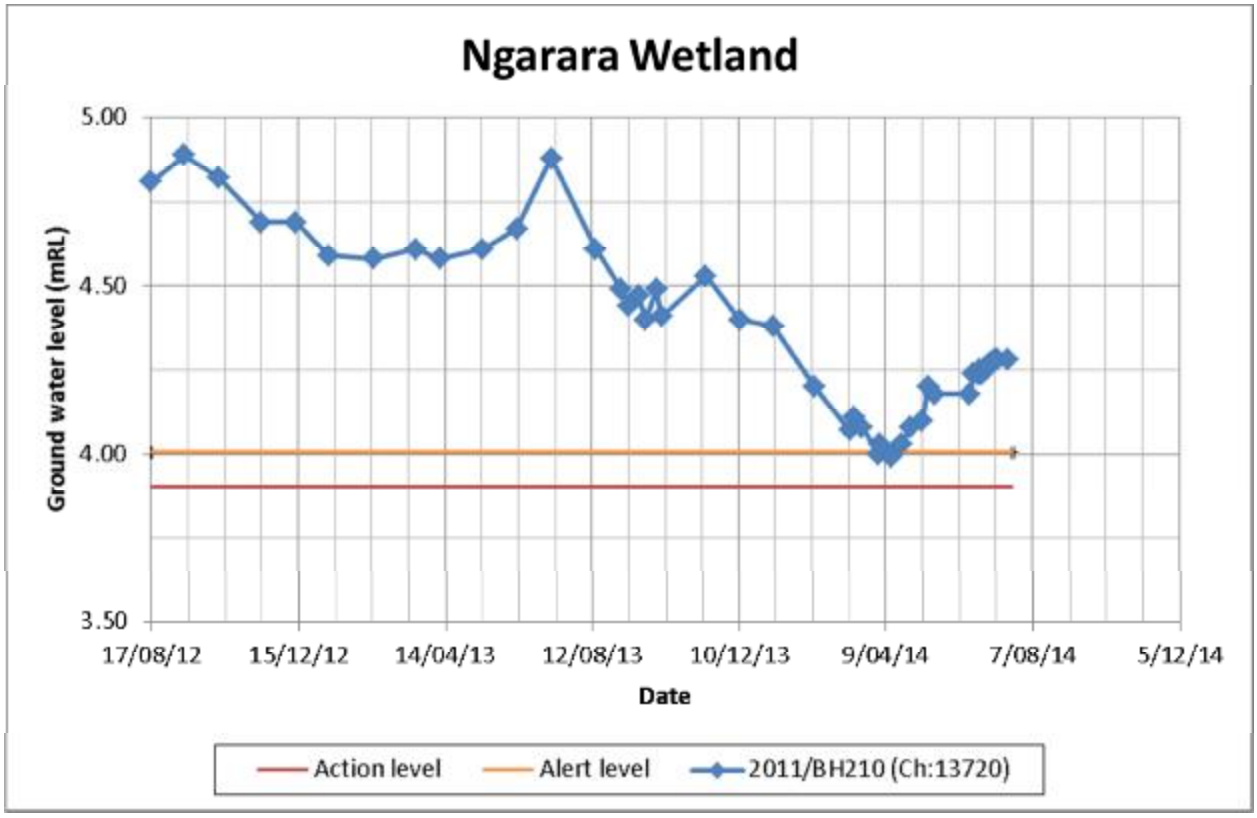


Figure E9: Water Levels in the Vicinity of Ngarara Bush



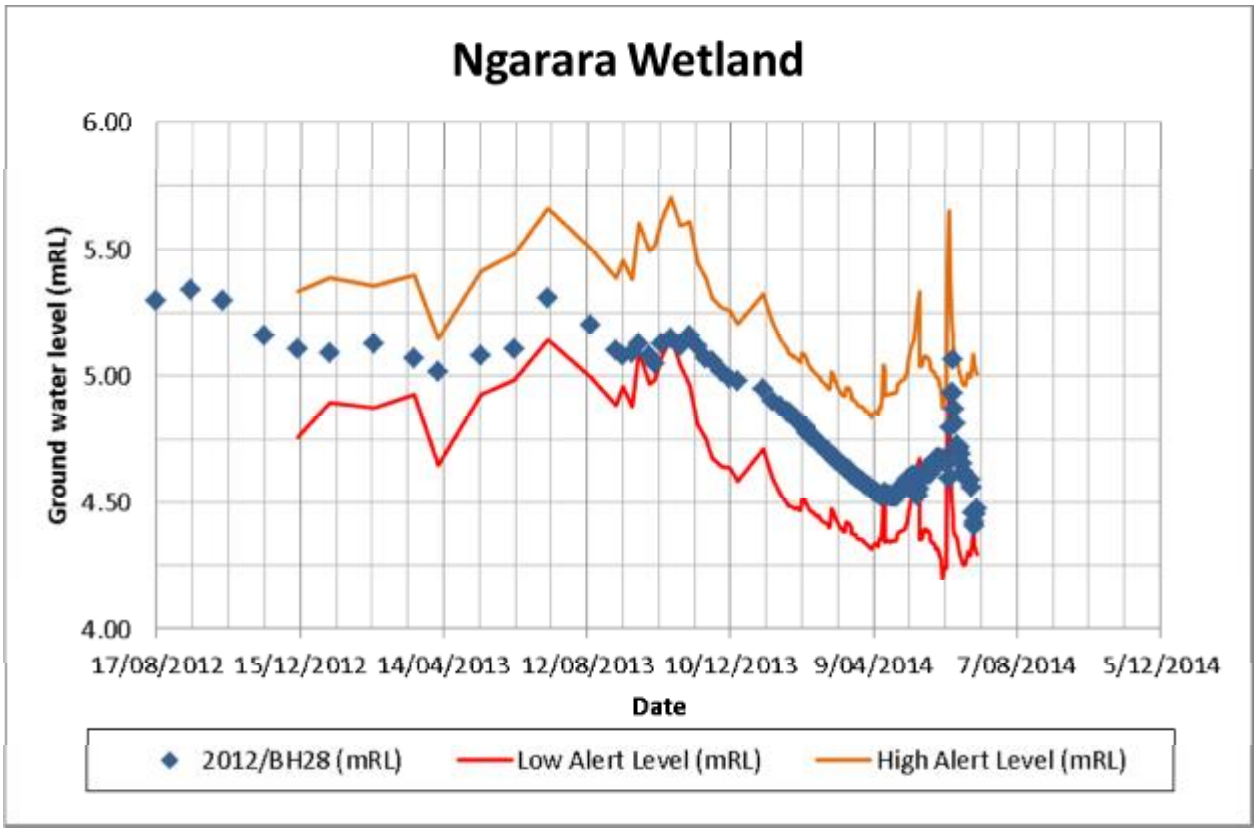
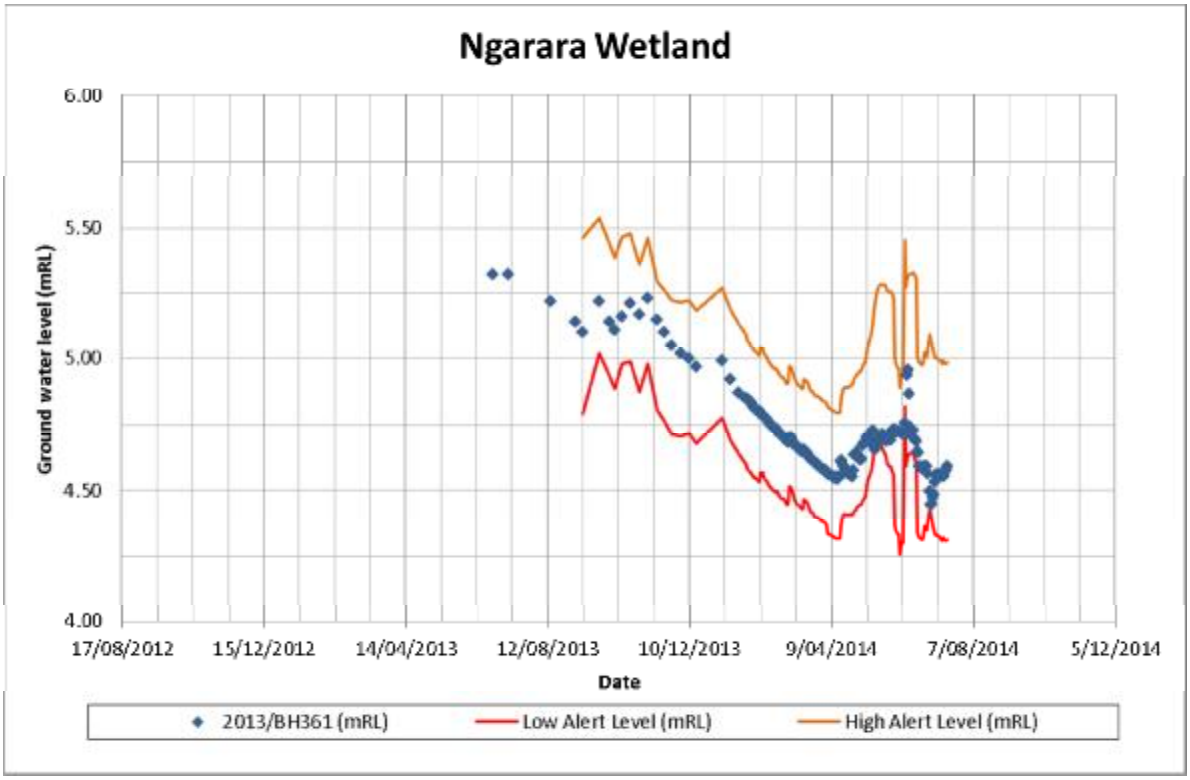


Figure E10: Water Levels in the vicinity of Ngarara Road Wetland – M2PP trigger levels



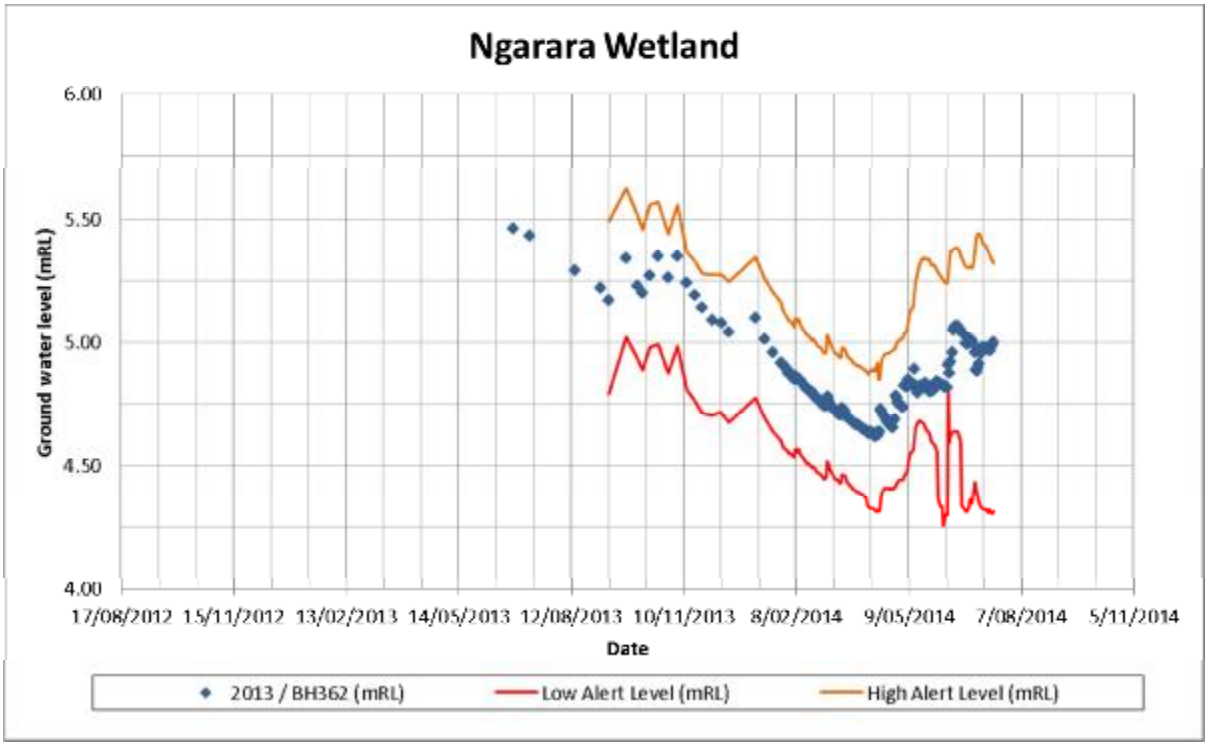
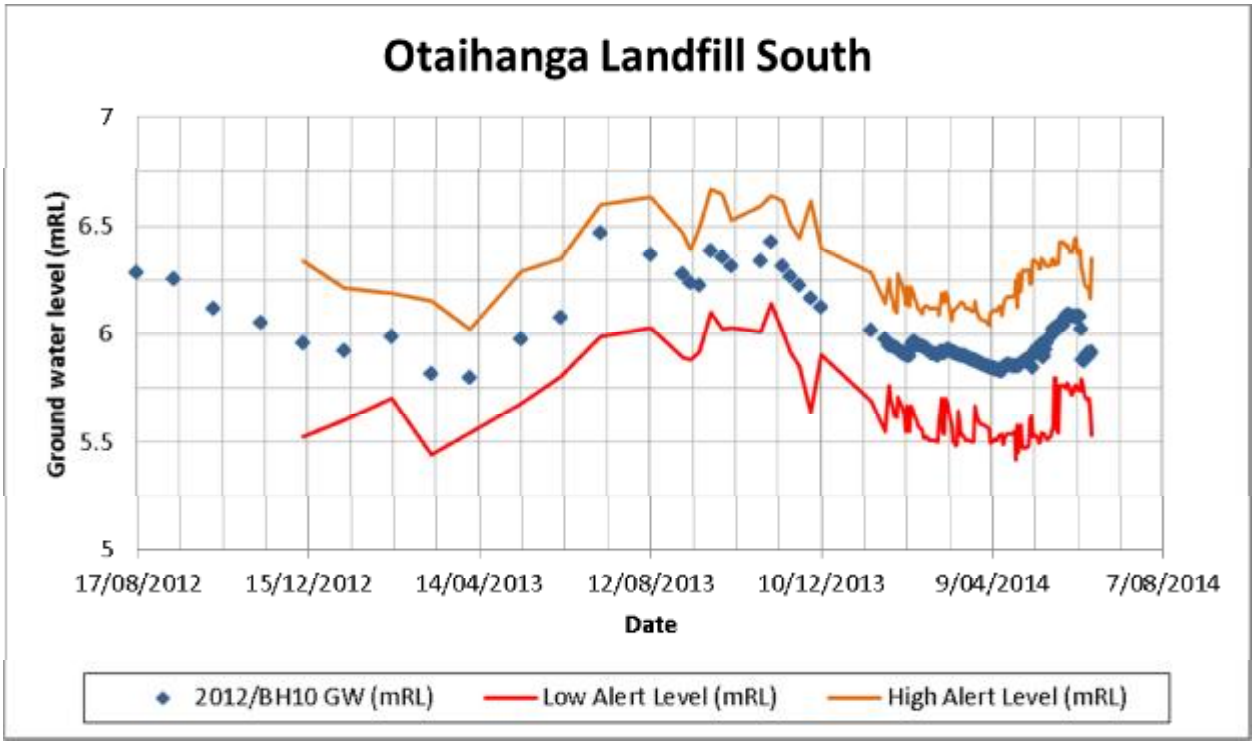


Figure E11: Water Levels in the vicinity of Ngarara Road Wetland – M2PP trigger levels



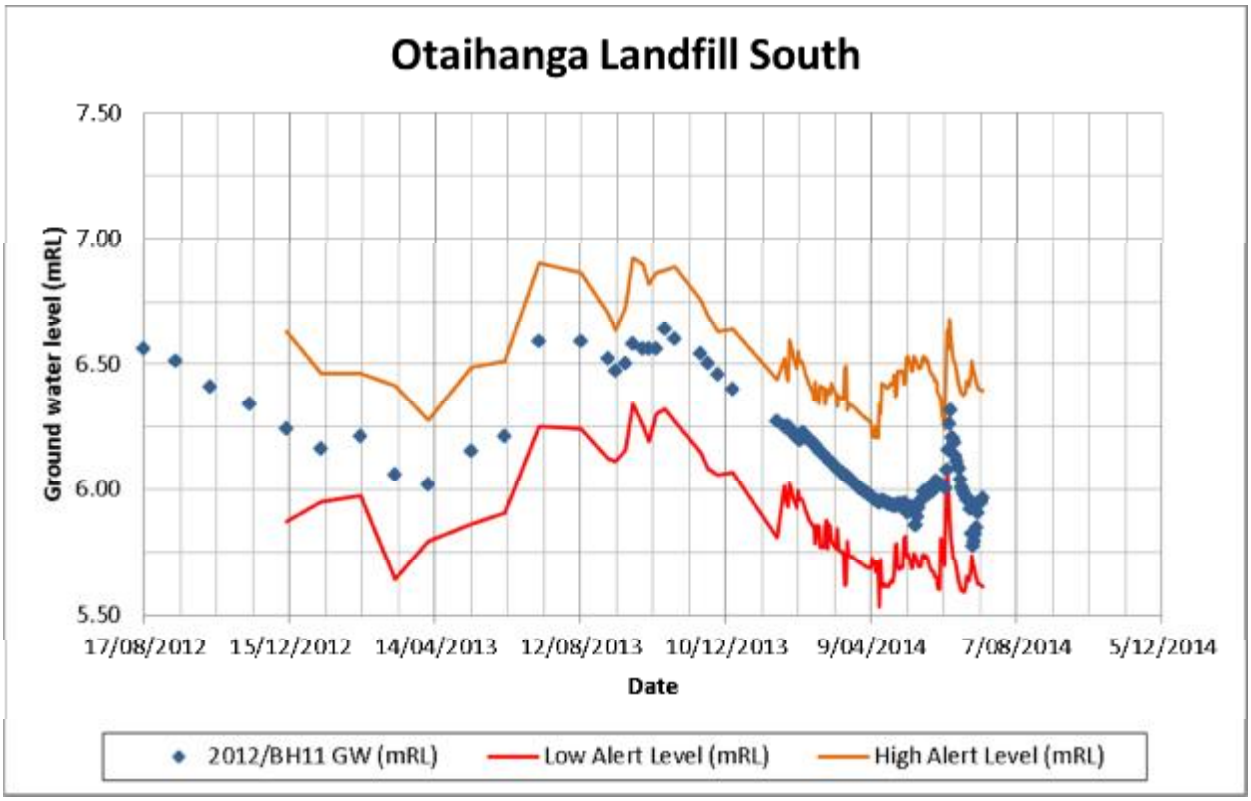
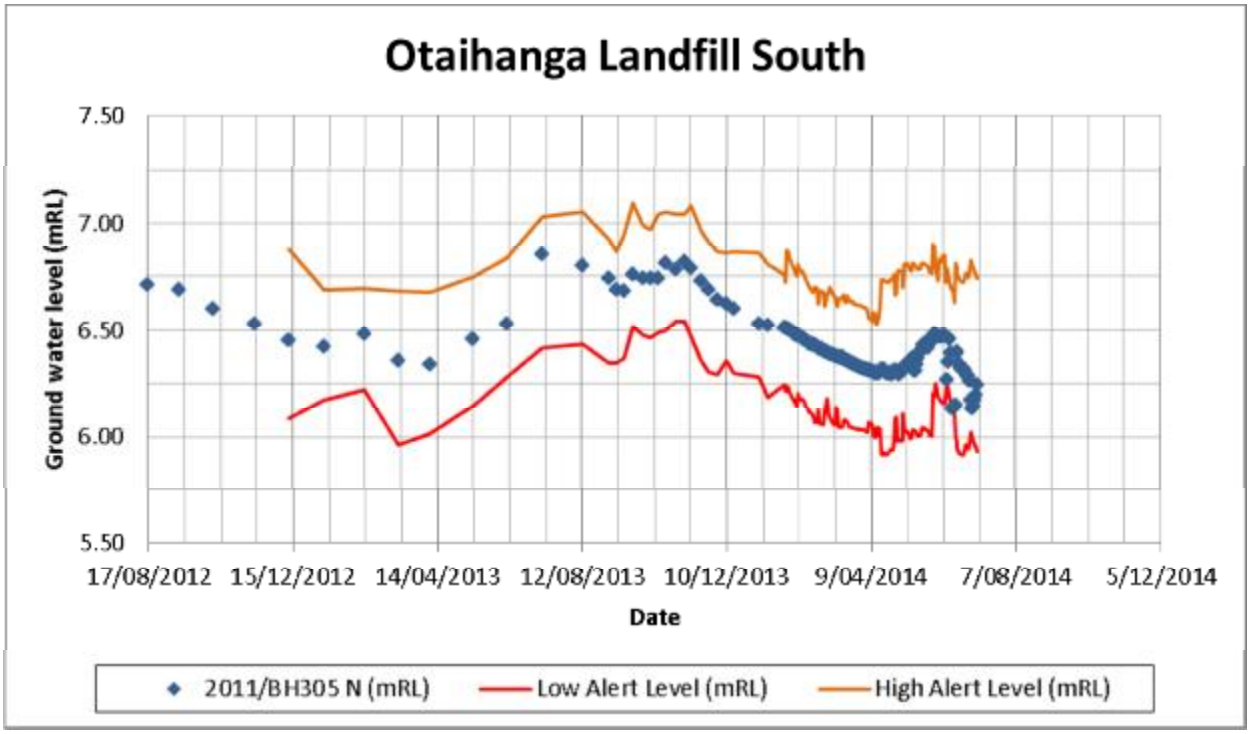


Figure E12: Water Levels in the vicinity of Otaihanga Landfill South – M2PP trigger levels



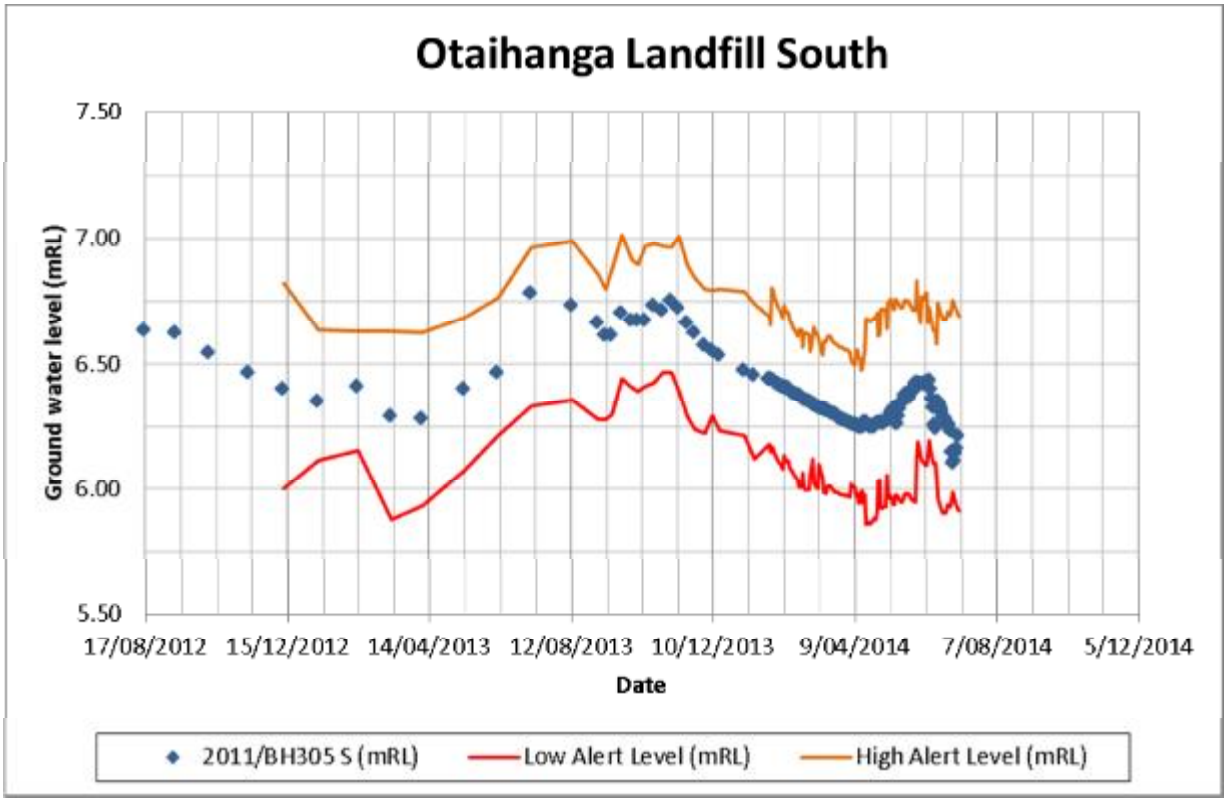
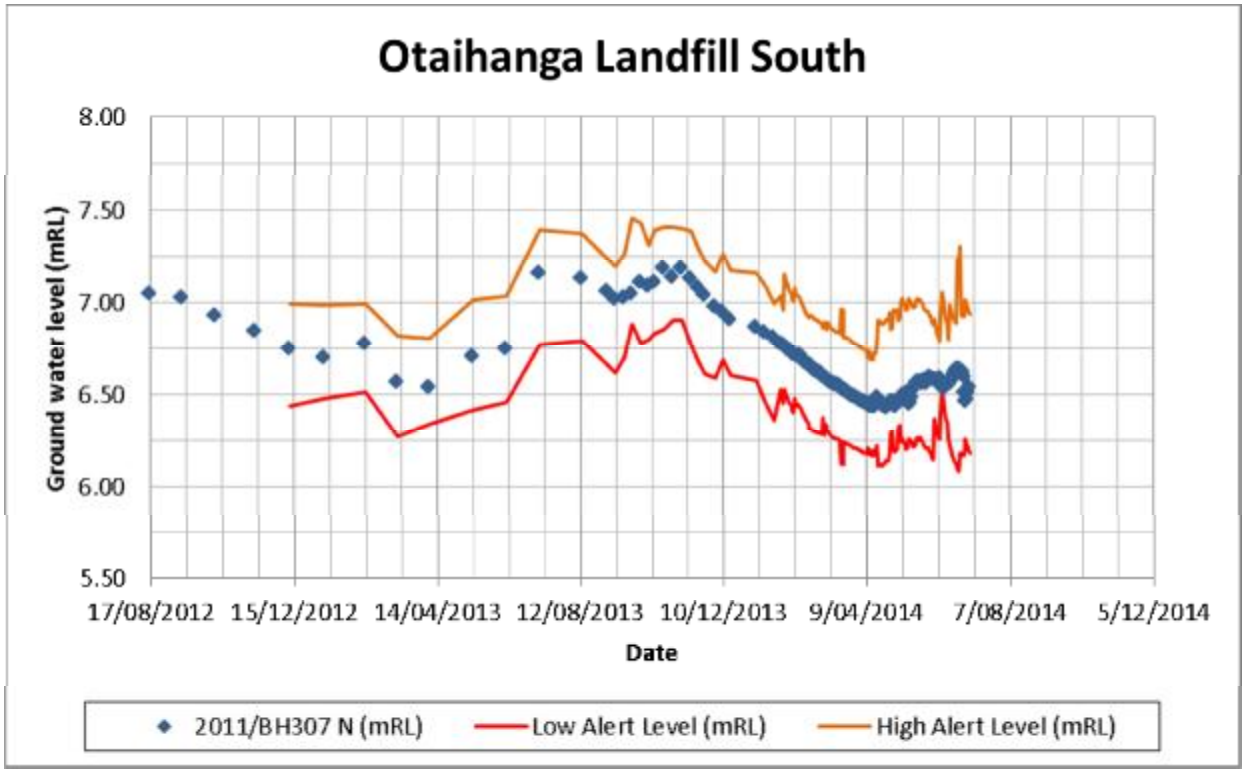


Figure E13: Water Levels in the vicinity of Otaihanga Landfill South – M2PP trigger levels



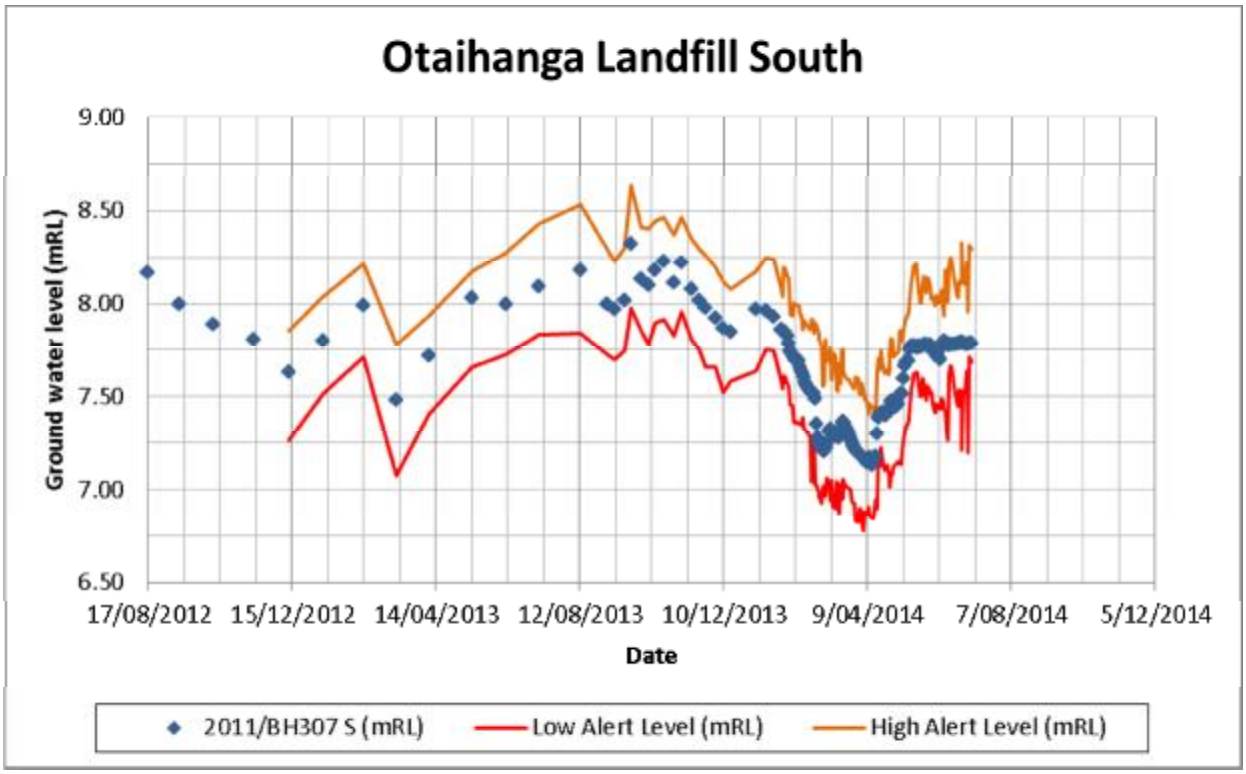


Figure E14: Water Levels in the vicinity of Otaihanga Landfill South – M2PP trigger levels

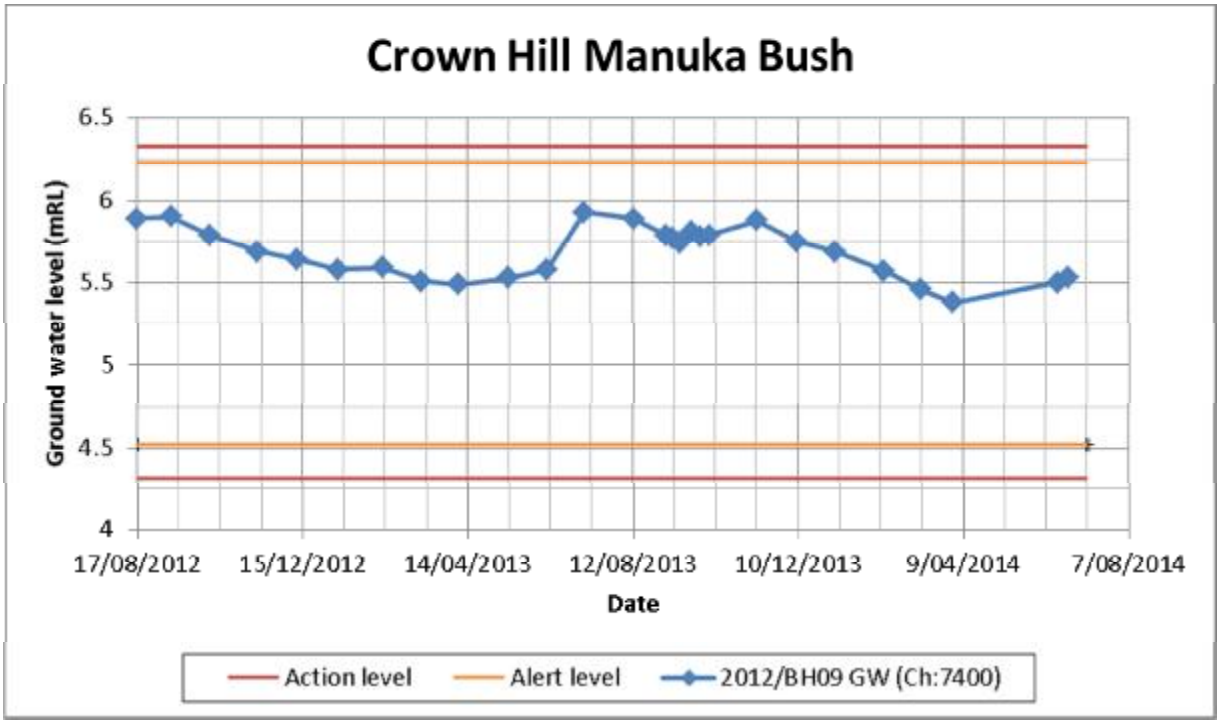


Figure E15: Water Levels in the vicinity of Crown Hill Manuka Bush – M2PP trigger levels

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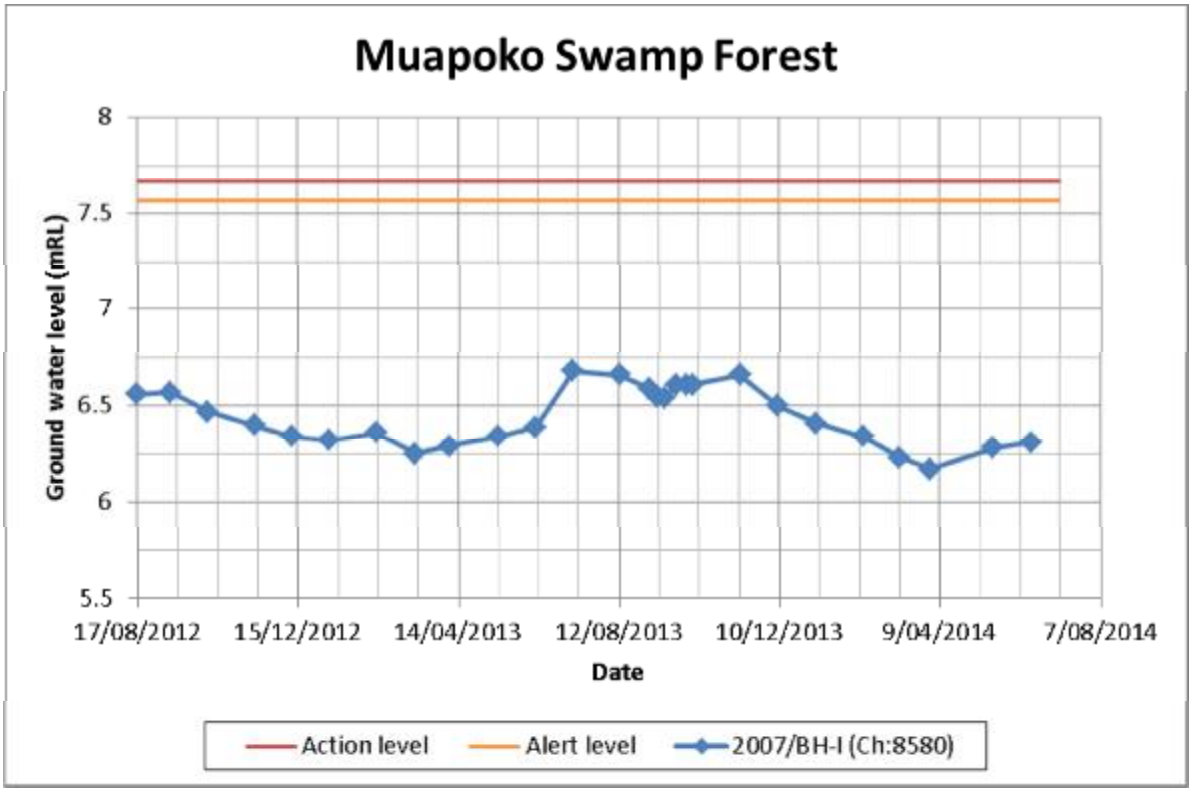
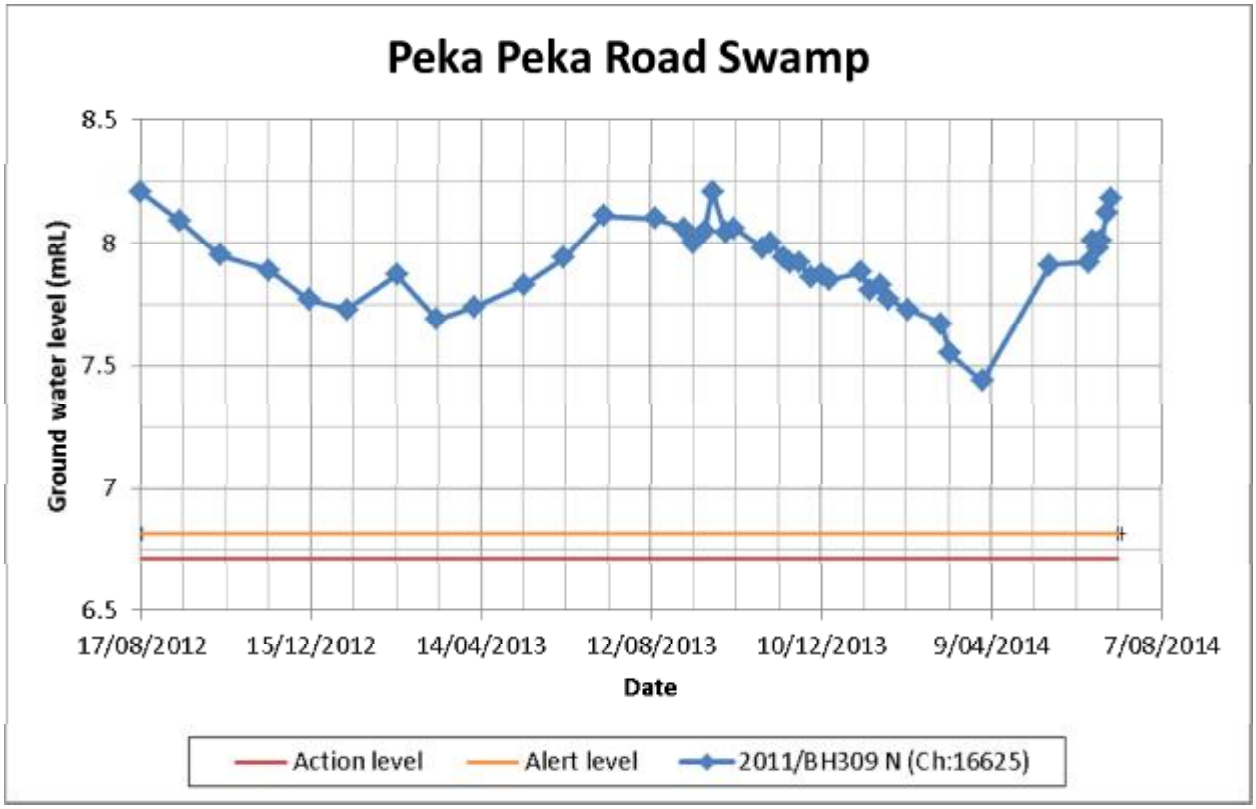


Figure E16: Water Levels in the vicinity of Muaupoko Swamp Forest - M2PP trigger levels



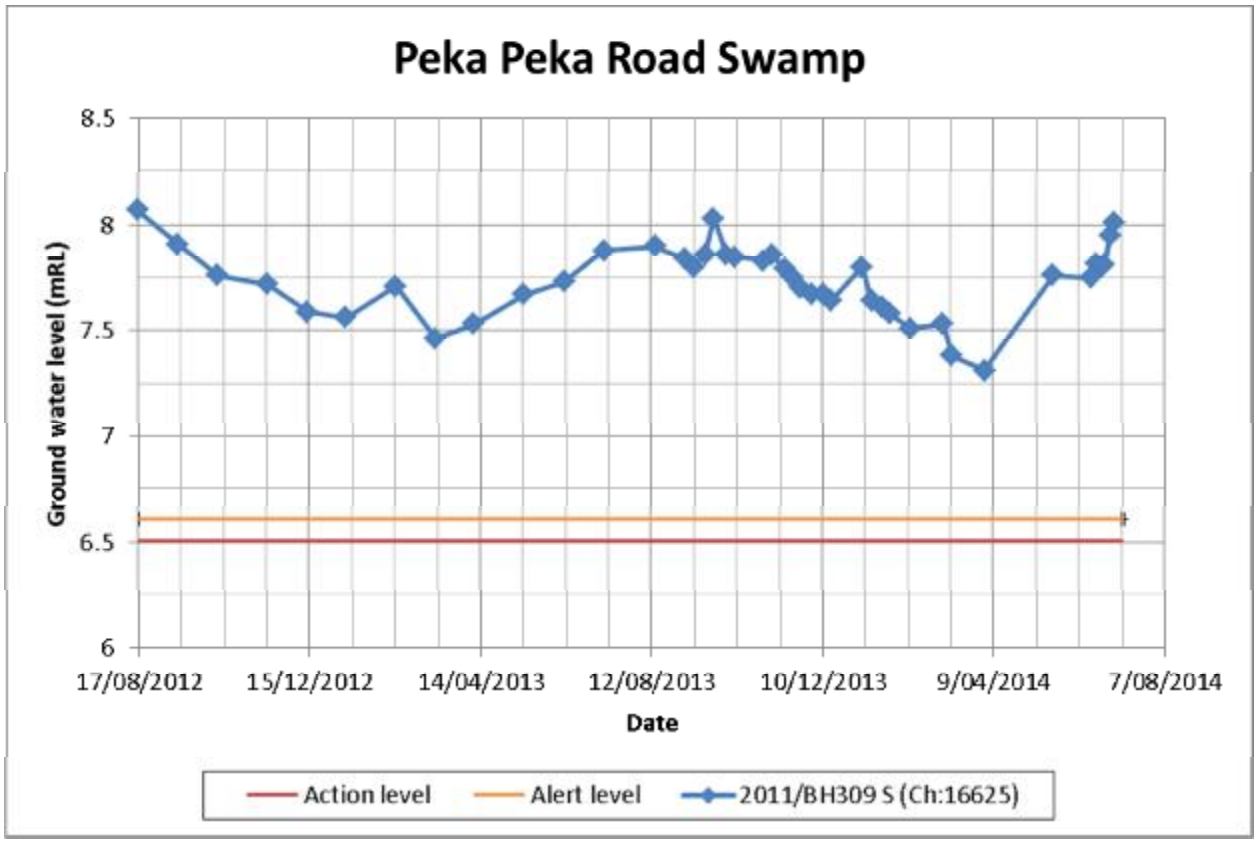
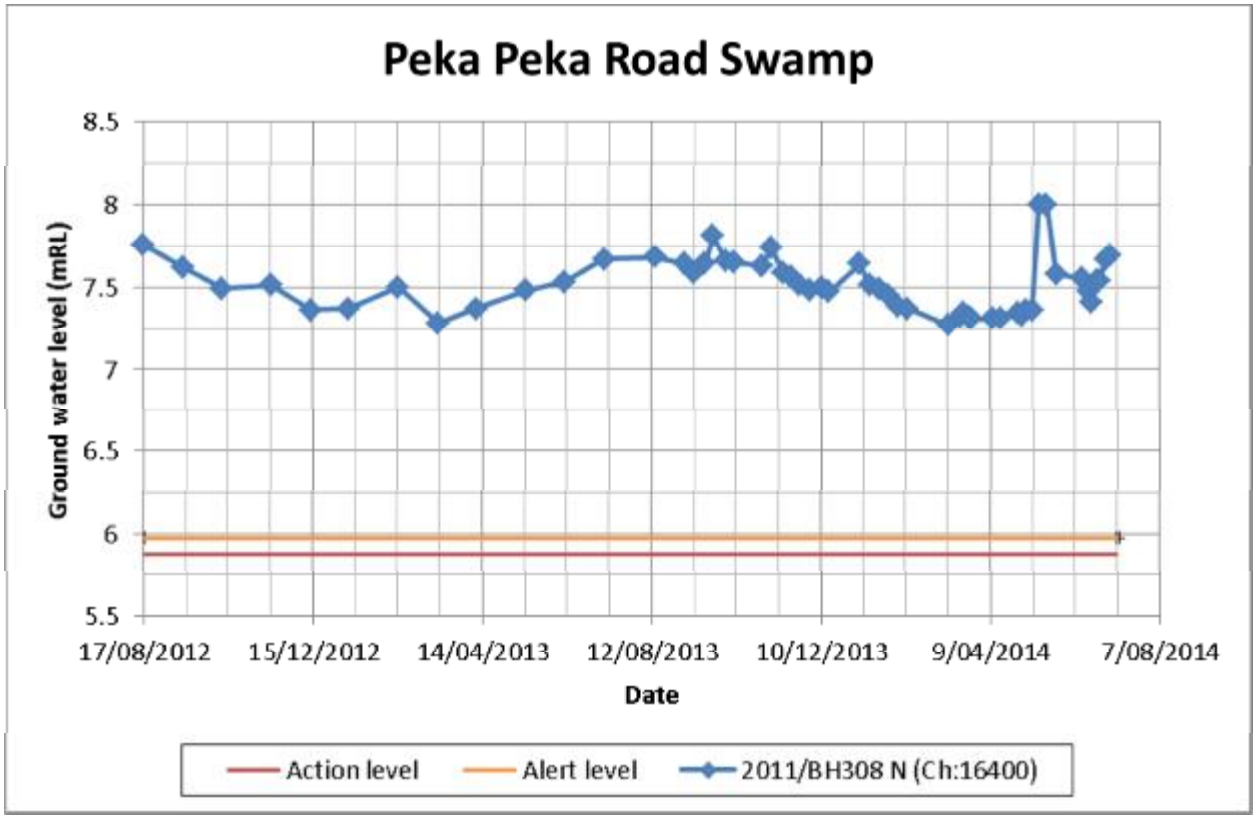


Figure E17: Water Levels in the vicinity of Peka Peka Road Swamp – M2PP trigger levels



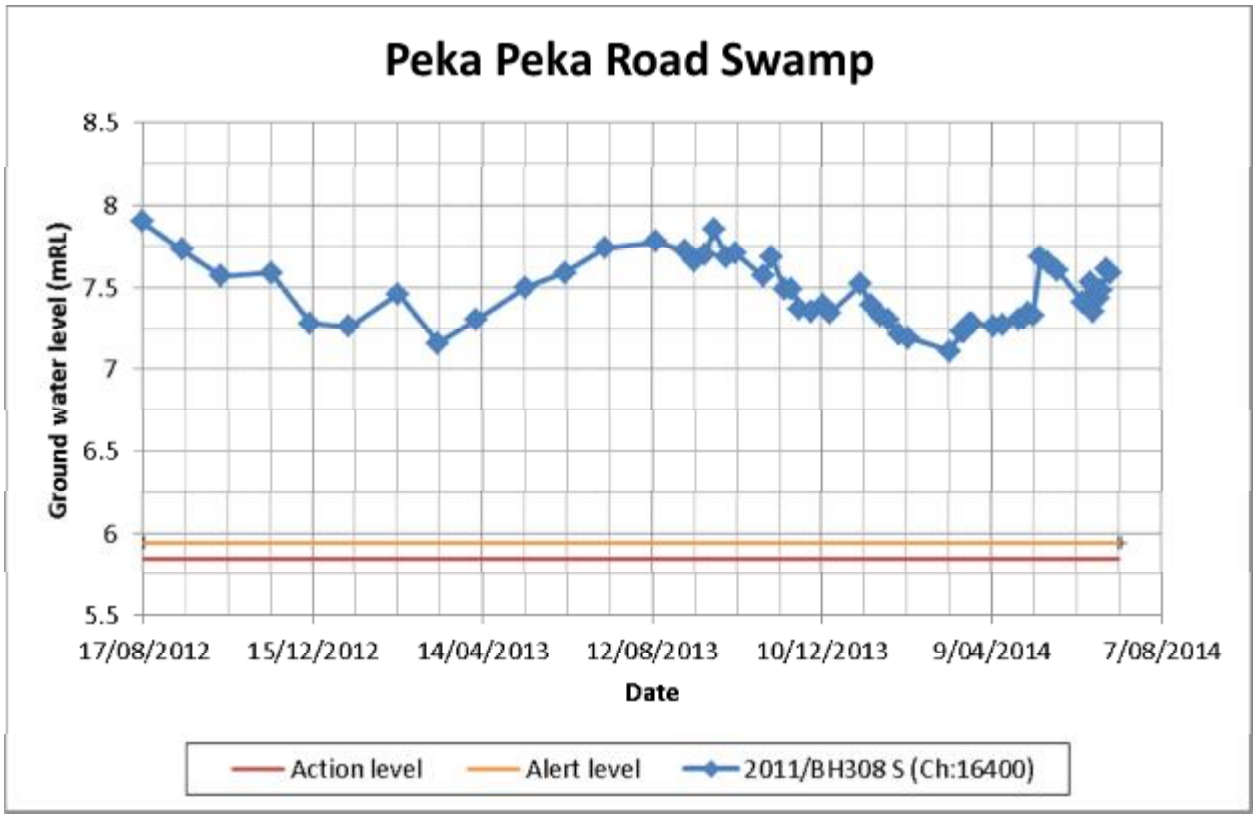


Figure E18: Water Levels in the vicinity of Peka Peka Road Swamp - M2PP trigger levels

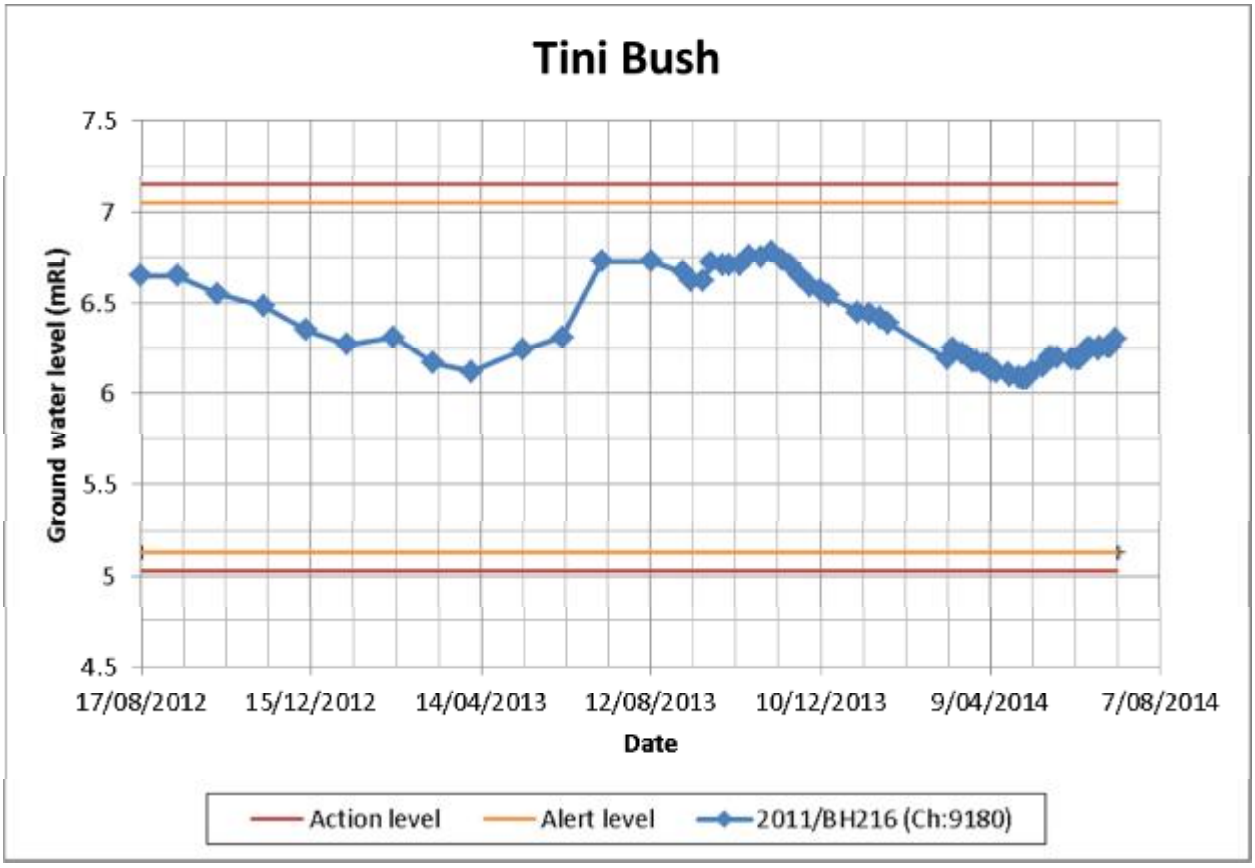
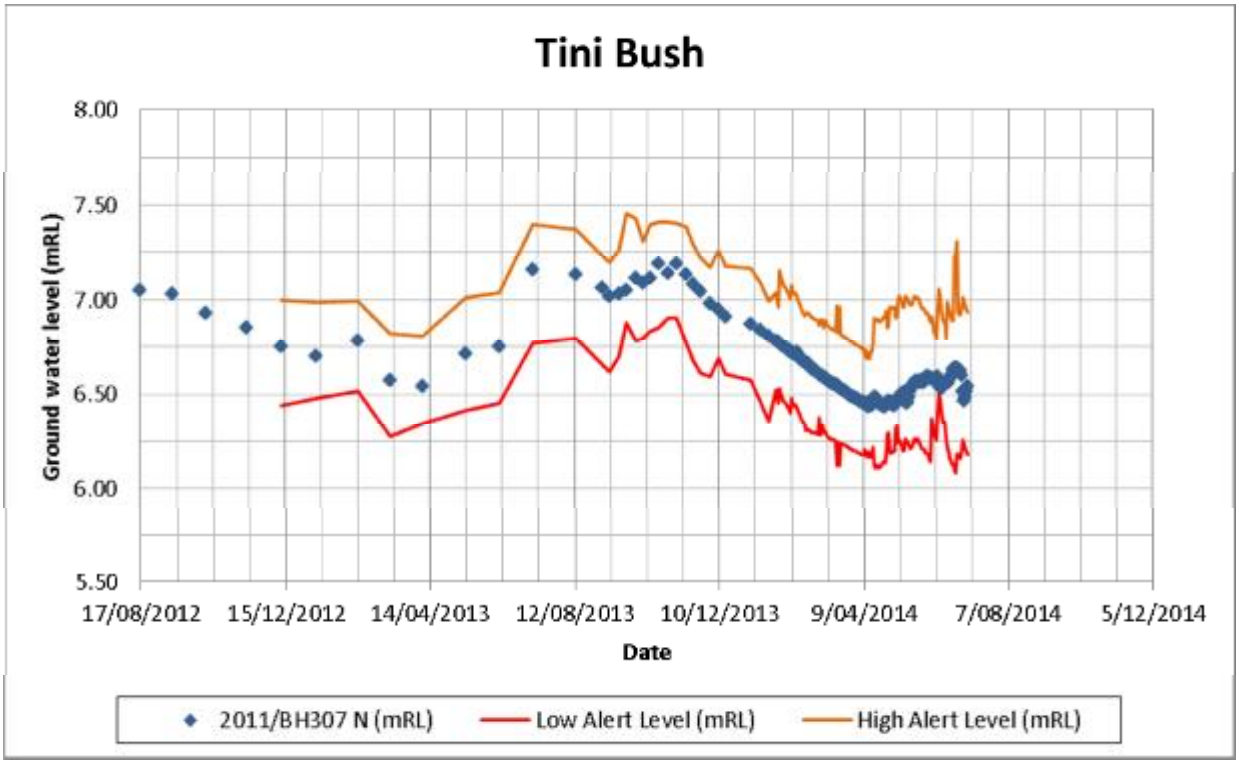


Figure E19: Water levels in the vicinity of Tini Bush - M2PP trigger levels



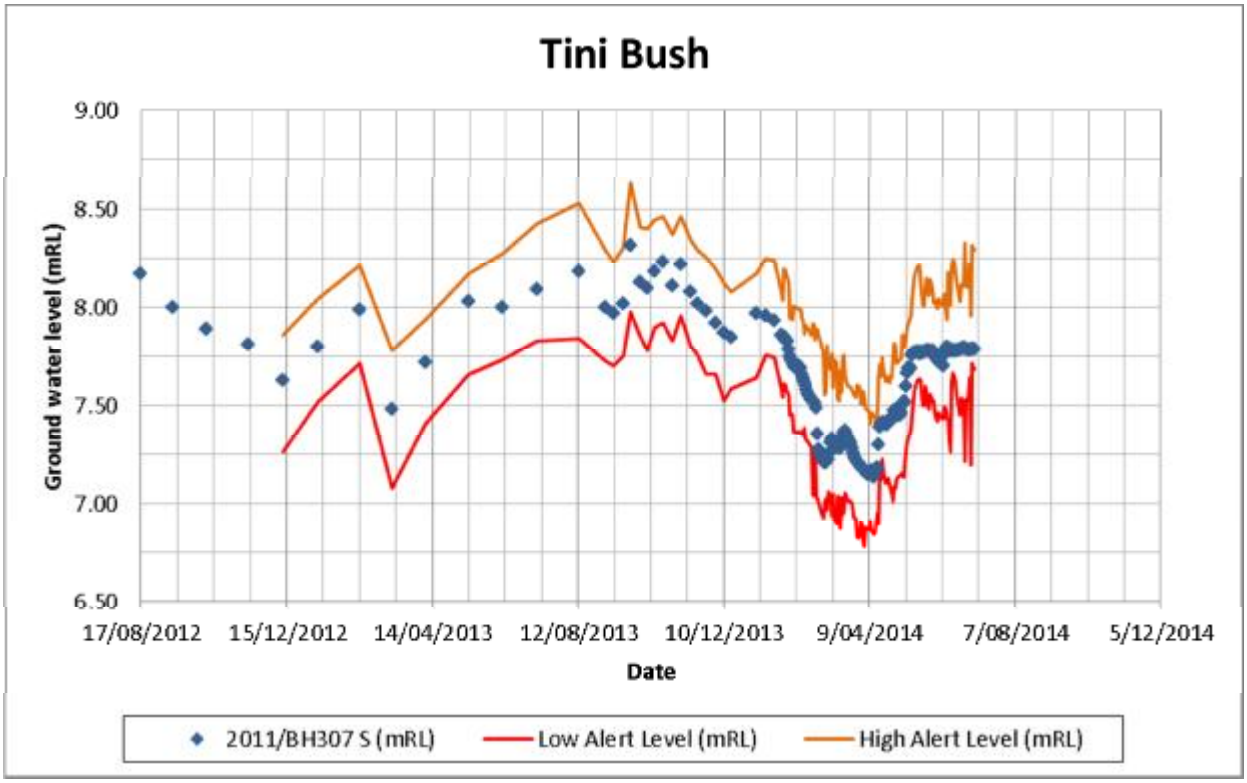
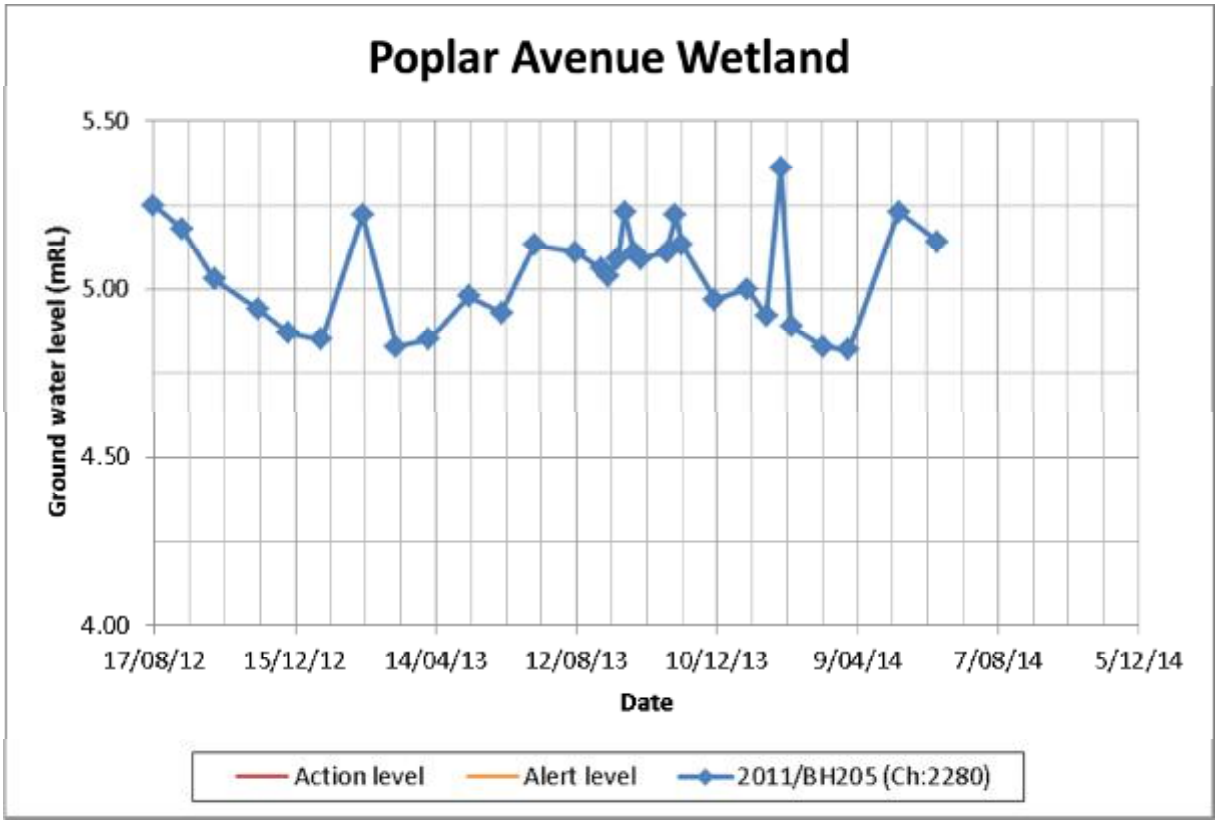


Figure E20: Water Levels in the vicinity of Tini Bush - M2PP trigger levels



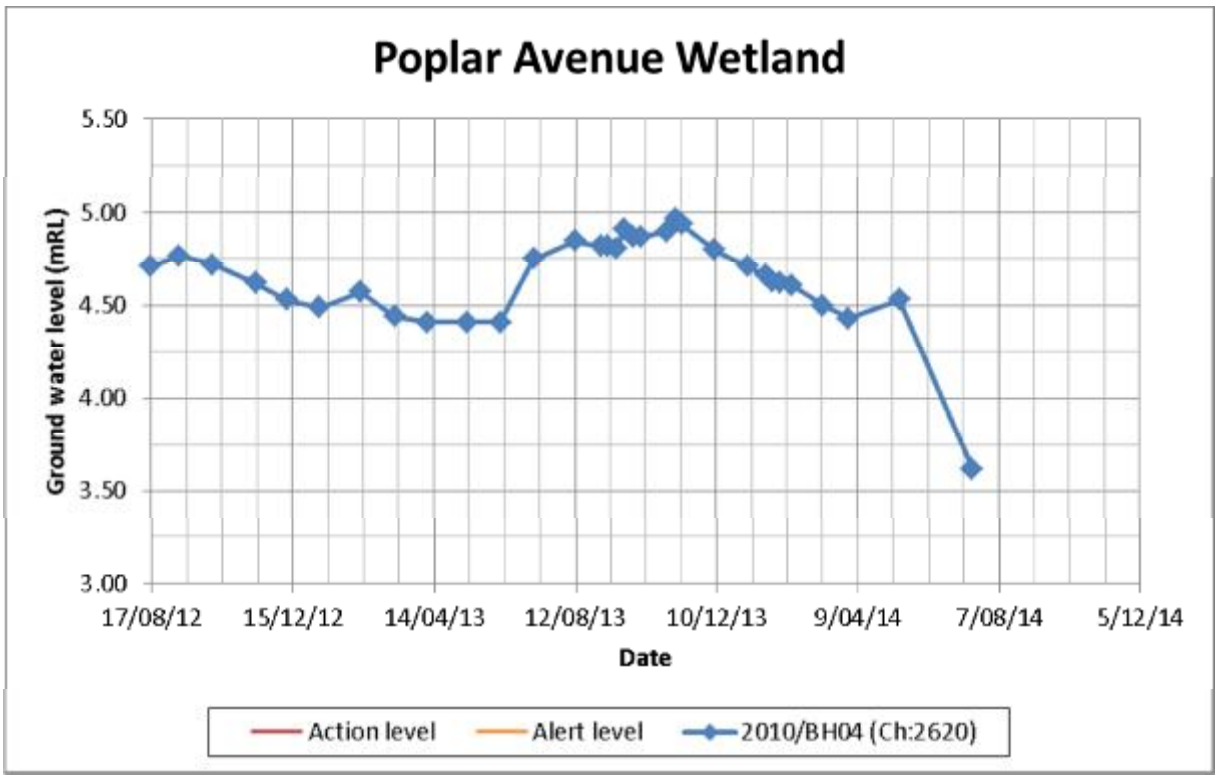


Figure E21: Water Levels in the vicinity of Poplar Avenue Wetland