Monitoring Manual

Waikanae Borefield and Back-up Bores (PW1, PW5)

31 MARCH 2010

Prepared for

Kapiti Coast District Council

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URS

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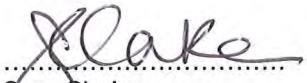

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This version of the Monitoring Manual supercedes that issued in July 2005, and includes well-specific trigger levels, based on borefield monitoring data collected over a 31 month period (October 2005 – April 2008).

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Introduction

This Manual details the monitoring requirements for the Waikanae Borefield and the back-up bores PW1 and PW5.

This version of the Monitoring Manual supercedes that issued in July 2005. This document includes well-specific trigger levels, based on borefield monitoring data collected over a 31 month period (October 2005 – April 2008).

1.1 The Waikanae Borefield

The Waikanae Borefield was constructed by Kapiti Coast District Council (KCDC) to provide a supplementary water supply to the primary water supply source, the Waikanae River. The Borefield comprises a network of six production wells in the Waikanae Groundwater Zone, abstracting groundwater from approximately 60-70 m depth. The water is pumped by submersible pumps via a raw water pipeline to the Waikanae Water Treatment Plant for treatment, prior to reticulation to the communities of Waikanae, Paraparaumu and Raumati, through the existing reticulation network. The Waikanae Borefield was officially commissioned in October 2005 and has been available for use as a supplementary supply since that time.

The production bores are listed in **Table 1-1**, and the borefield and pipeline array can be seen in **Figure 1-1**. Individual aerial photographs detailing the locations of each production well are contained in **Figure 1-2**.

Table 1-1 Wells in Borefield

	Production Wells	
Ngarara Branch	• K6 Wooden Bridge	Ngarara Road
	• K5 Nga Manu	Ngarara Road
	• K4 Cooper #1	Ngarara Road
Te Moana Branch	• Kb4 Landfill	Landfill access road, off Park Avenue
	• K10 Market Garden	Te Moana Road
	• K13 Huiawa	Huiawa Road
	Non-Production Wells	
	• Kb7 • K12 These bores were constructed during drilling for the Borefield and abstraction from these wells is permitted under the terms of the consent held by KCDC for the Borefield. Due to the low yield of these wells, they have not been connected to the raw water pipeline and there are no pumps installed in the wells. They may be connected in the future, if required.	
	• TW2, Rangihiroa Street. This bore was drilled in 1995/96 for use as a supplementary/back up supply, prior to construction of the Borefield. The production well is completed at 32-38 m below ground surface in the upper sections of the semi-confined aquifer (ie. this bore is shallower than those in the Borefield). Abstraction from TW2 is permitted under the terms of the consent held by KCDC for the Borefield, however there is currently no pipeline connection from TW2 to the raw water pipeline. The bore is therefore not currently used as part of the Borefield.	

Consent Conditions

Abstraction from the borefield is permitted by resource consent **WGN050025[25865]** granted by Greater Wellington Regional Council (GWRC), effective 1 July 2005, expiring 1 July 2025. Consent has been granted to abstract up to 23,000 m^3/day from any eight of the nine wells within the borefield. A copy of the consent is contained in **Appendix A**. Conditions 10 through 16 specify the monitoring and reporting requirements, namely:

10. a monitoring manual shall be prepared by KCDC and approved by GWRC
11. any changes to the monitoring manual shall be approved by GWRC
12. monitoring methods and procedures shall be approved by GWRC
13. if necessary, abstraction restrictions may be set by GWRC
14. wells shall be made available for monitoring
15. an annual report on the monitoring shall be submitted by KCDC each year
16. a detailed analysis of aquifer performance and bore use shall be prepared 10 years after granting of the consent (by Nov 2014).

This Manual fulfils the requirements of condition 10 of the consent, and sets out the procedures for complying with conditions 11 through 15.

1.2 Back-Up Bores – PW1 and PW5

PW1 and PW5 are located in Otaihanga (see **Figure 1-1**). They draw water from the same deep aquifer that the borefield taps. PW1 and PW5 have been retained as back-up bores to the Waikanae Borefield. The backup supply shall be used only:

- in extraordinary circumstances preventing full use of the supplementary supply from the Waikanae Borefield (eg. mechanical failure or damage from seismic events); or
- as a “bridging supply” until water metering is introduced to reduce demand below borefield supply capability (only required if the full expected yield is not realised from the Waikanae Borefield); or
- as required to commission and maintain the wells and on-site treatment facilities in a state of operational readiness.

The water from these bores would be treated locally at the wellhead and injected directly into the reticulation network. The pumps and control systems for the back-up bores are located locally at each wellhead.

Consent Conditions

Abstraction from the backup bores is permitted by resource consent **WGN050025[23852]** granted by Greater Wellington Regional Council (GWRC), effective 1 July 2005, expiring 1 July 2025. Consent has been granted to abstract up to 7,000 m^3/day in total from PW1 and PW5. A copy of the consent is contained in **Appendix A**. Conditions 10 through 15 specify the monitoring and reporting requirements, namely:

10. a monitoring manual shall be prepared by KCDC and approved by GWRC
11. any changes to the monitoring manual shall be approved by GWRC

12. monitoring methods and procedures shall be approved by GWRC
13. if necessary, abstraction restrictions may be set by GWRC
14. wells shall be made available for monitoring
15. an annual report on the monitoring shall be submitted by KCDC each year.

This Manual fulfils the requirements of condition 10 of the consent, and sets out the procedures for complying with conditions 11 through 15.

1.3 Purpose of Monitoring

Monitoring is required:

- to collect data to provide further knowledge and understanding of the aquifer characteristics and performance, and
- to monitor the effects of abstraction of water from the borefield and detect when trigger levels are reached so that action can be taken to remedy or mitigate those effects.

This Manual establishes a programme to monitor the potential effects on the environment that may be caused by the abstraction of groundwater, namely:

- Groundwater levels, to determine if any effects occur in shallow groundwater and surface water features, and to determine the effects on the deep aquifers from which water is being abstracted. This monitoring programme is described in Section 2.
- Saline intrusion in the deep aquifer, to determine the effects of the abstraction on the freshwater/ seawater interface. This monitoring programme is described in Section 3.

1.4 Trigger Levels

Trigger levels have been set in this Manual to alert the consent holder, KCDC, in the event that the unexpected monitoring results occur, and to identify trends that could result in adverse environmental effects, if left uncorrected.

In the absence of monitoring/production data, initial trigger levels were set for each of the monitored parameters, in the original monitoring manual (issued July 2005). A review was conducted in 2009, based on the 31 months of monitoring data reported upon in the 2006-2008 annual reports. Well-specific trigger levels were developed from that review, and agreed with GWRC (refer to letter of 24 September 2009, from URS to GWRC). This manual contains the well-specific Trigger Levels.

If a Trigger Level is reached, the data is looked at closely to see why the trigger level has been reached and whether it could possibly have been caused by operation of the borefield. The monitoring is reviewed to see if additional data should be gathered to enable further review. On the basis of that review, action may be taken to remedy or mitigate any effects that maybe occuring as a result of the abstraction.

1 Introduction

1.5 Responsibilities

The Borefield and back-up bores will be operated by KCDC, and KCDC will be responsible for implementing this Monitoring Manual. Data recording and review of the monitoring data may be undertaken by KCDC or Greater Wellington. KCDC are responsible for ensuring compliance with all the conditions of the resource consent.

1.6 Health and Safety

Any works and activities described in this document that are carried out on behalf of KCDC must be performed in accordance with an approved Health and Safety Plan.

1.7 Additional Reports

Background and design information for the borefield is contained in:

Waikanae Borefield Technical Report. URS New Zealand Limited. (Originally issued 27 July 2004; updated and re-issued November 2005).

Assessment of Environmental Effects Waikanae Borefield. URS New Zealand Limited. 26 July 2004

Monitoring Manual – Waikanae Borefield and Back-up Bores (PW1 and PW5). URS New Zealand Ltd. July 2005 (ref 42742443).

Revised trigger levels for monitoring of Waikanae Borefield. Letter from URS to GWRC, 24 September 2009 (ref 42749750).

Annual reports (as required by condition 15 of the consents) prepared to date by URS New Zealand Limited are as follows:

- *2006 Annual Report* (1 July 2005-31 March 2006)
- *2007 Annual Report* (1 April 2006-31 March 2007)
- *2008 Annual Report* (1 April 1007-30 April 2008) (13 month reporting period)
- *2009 Annual Report* (1 May 2008 – 31 March 2009) (11-month reporting period).

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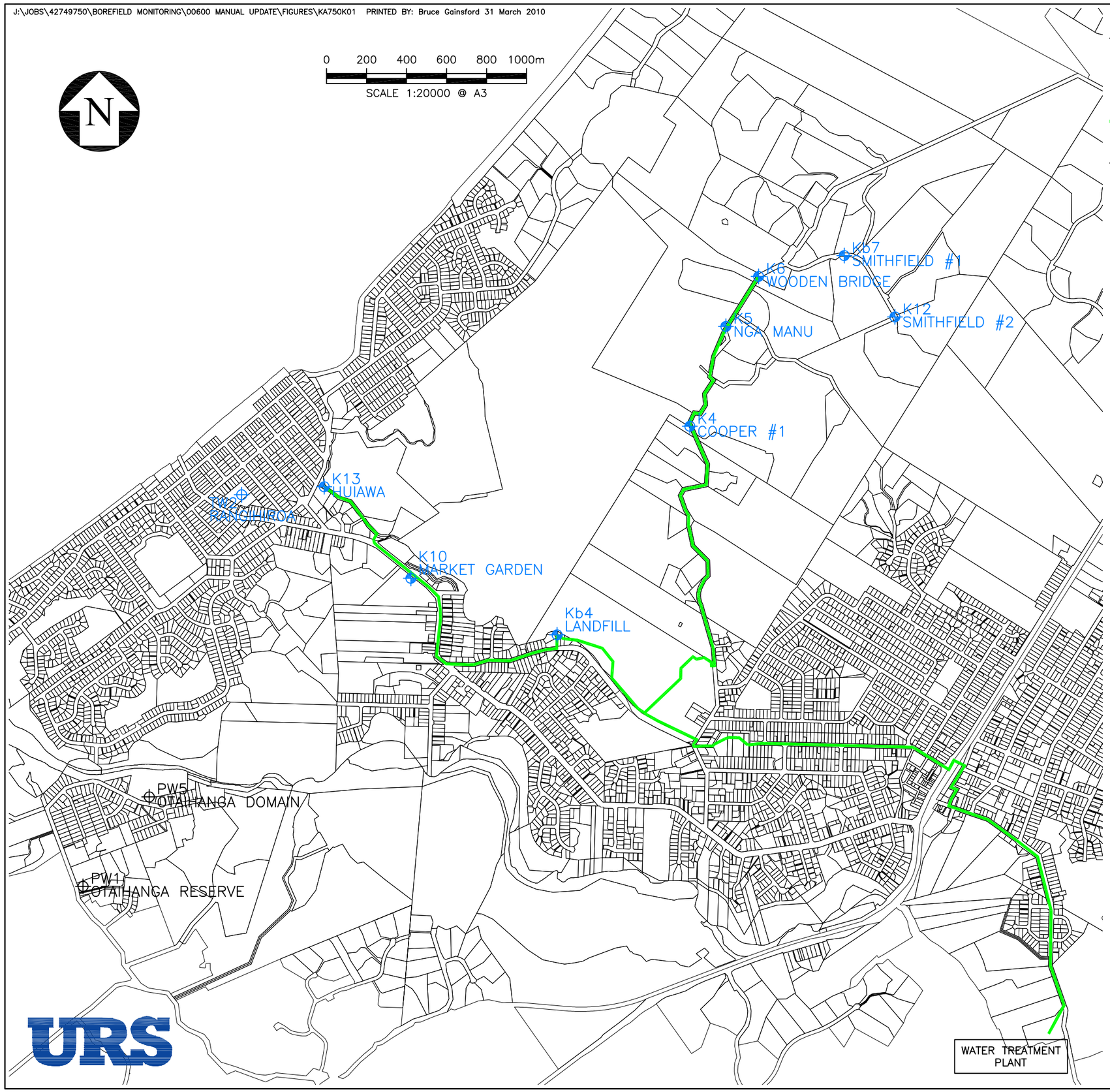

KEY

- BOREFIELD PRODUCTION WELL
- BACK–UP BORE
- RAW WATER PIPELINE ROUTE

NOTES

1. Kb7 & K12 HAVE BEEN COMPLETED AS PRODUCTION WELLS. DUE TO LOW YIELD FROM THESE WELLS, THEY ARE NOT CURRENTLY CONNECTED TO THE PIPELINE.
2. ABSTRACTION FROM TW2 IS PERMITTED FOR THE BOREFIELD, BUT THIS BORE IS NOT CURRENTLY CONNECTED TO THE RAW WATER PIPELINE.

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Client
KAPITI COAST DISTRICT COUNCIL
Project
WAIKANAE BOREFIELD SUPPLEMENTARY WATER SUPPLY
Report
WAIKANAE BOREFIELD MONITORING MANUAL
Title
BOREFIELD ARRAY

FIGURE 1-1

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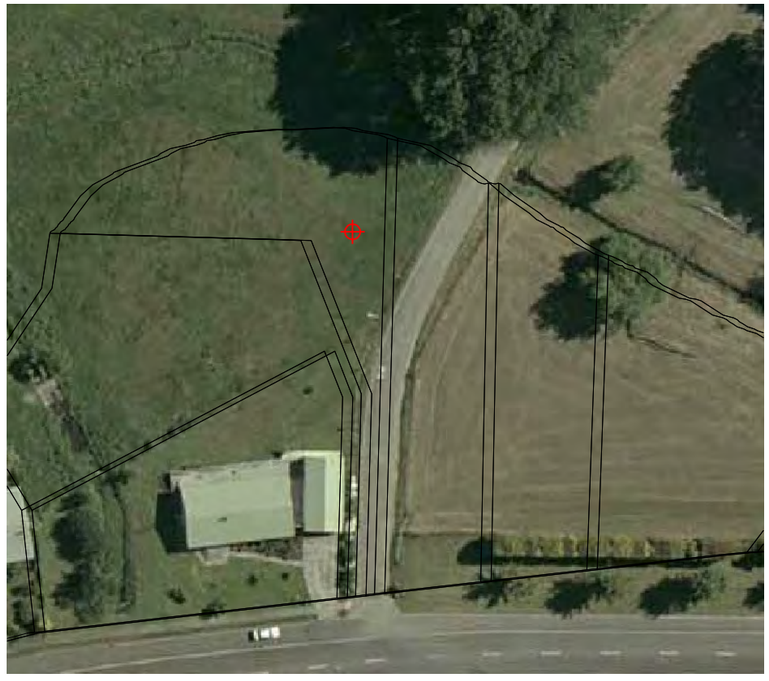
WELL SITE K13 - HUIAWA

WELL SITE K10 - MARKET GARDEN



WELL SITE Kb4 - LANDFILL

WELL SITE K4 - COOPER #1

KEY

- WELL LOCATION
- DEEP MONITORING WELL (>60m)
- MID–DEPTH MONITORING WELL (AROUND 40m)
- SHALLOW MONITORING WELL (<15m)
- MONITORING WELL DECOMMISSIONED

APPROXIMATE SCALE IN METRES.

0 10 20 30 40 50 60 70 80

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FIGURE 1-2 (a)

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WELL SITE K6 - WOODEN BRIDGE (TW3)

WELL SITE K5 - NGA MANU

KEY

- WELL LOCATION
- DEEP MONITORING WELL (>60m)
- MID–DEPTH MONITORING WELL (AROUND 40m)
- SHALLOW MONITORING WELL (<15m)
- MONITORING WELL DECOMMISSIONED

APPROXIMATE SCALE IN METRES.

0 10 20 30 40 50 60 70 80

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FIGURE 1-2 (b)

2

Monitoring of Groundwater Levels

An extensive network of groundwater monitoring wells is present throughout Waikanae, as shown on **Figure 2-1**, and available for monitoring purposes. The network includes monitoring wells that were established during the borefield drilling programme, and existing wells such as those established by GWRC. Details of the wells that were established during the borefield drilling programme are contained in **Appendix B**.

For the purposes of this manual, monitoring has been divided into that for shallow groundwater and surface water features, and that for the deeper aquifer.

2.1 Potential Effects

Effects of borefield on shallow groundwater and surface water features

As submitted in the resource consent application, abstraction of groundwater from the deeper aquifers that are the target of the borefield is not expected to have any measurable effect on mid-depth and shallow bores (less than approximately 40 m deep), that are used for either potable supply or for irrigation purposes. The lack of direct effect has been demonstrated by measuring water levels in adjacent (private) water supply wells and in monitoring wells during the pumping tests that were carried out on each production well. No pumping influences were observed in the shallow wells that were monitored during or following the pumping tests (URS, 2004 and 2005).

Effects of borefield on deep groundwater

Pumping from the deep aquifers will result in a reduction in water pressure, or drawdown, in those aquifers. The expected drawdown in the deep aquifers from which the water is being abstracted has been calculated based on pumping 25,500 m^3/day from up to 8 production wells and 7,800 m^3/day from the two back-up bores (PW1 and PW5) as shown in Table 2-1. These pumping rates exceed that for which consent has been granted, however it provides the most conservative, or "worst case" scenario for modelling purposes.

Figure 2-2 shows the calculated drawdown effect in the deeper aquifers for wells listed in **Table 2-1** pumping at the rates shown on that table.

The drawdown pattern shows two main zones of drawdown caused by the Borefield, mirroring the branches of the borefield array, namely: north Ngarara Road and the Waimeha Stream/Te Moana Road. In these zones, drawdown in the deep aquifer generally exceeds 4 m (away from the immediate vicinity of the bores being pumped). The wider-area drawdown is around 2 m and can be seen to extend over a relatively large area. This is a behaviour typical of confined aquifers such as that of the Waikanae Borefield.

There is only one (private) deep bore located within the drawdown zone of the borefield. That is a 68 m deep bore at the Parkwood Rest Home, used for grounds irrigation. Calculated drawdown from the proposed borefield pumping at this location is estimated to be 2-3 m.

Table 2-1 Pumping Rates used in numeric model to access drawdown effects

These pumping rates exceed that for which consent has been granted and provide a "worst case" scenario for modelling purposes. It is very unlikely that all wells would be pumped together at these flow rates.

Production Well		Expected Yield m^3/day
K12	Smithfield #2	850
Kb7	Smithfield #1	650
K6	Wooden Bridge	5000
K5	Nga Manu	3000
K4	Cooper #1	6000
Kb4	Landfill	3000
K10	Market Garden	2000
K13	Huiawa	5000
	Sub-Total Borefield	*25500*
PW1	Otaihanga Reserve	4800
PW5	Otaihanga Domain	3000
	Sub-Total Back-up Bores	*7,800*
	TOTAL	33,300

2.2 Objectives of Groundwater Level Monitoring

The consent application confirms that there are unlikely to be adverse environmental effects on existing groundwater users or on surface water features such as streams and wetlands. However monitoring will be implemented to confirm this and to gather additional data on the response of the aquifers.

The primary objective of the groundwater level monitoring is therefore to:

- Obtain background information on the groundwater systems in and around the borefield, to enable any changes caused by the abstraction to be identified.
- Measure how water levels (in the shallow groundwater) and water pressures (in the deep aquifer) around the Waikanae Borefield are affected by pumping from the borefield.

If analysis of the groundwater level data identifies that the borefield pumping is likely to adversely affect existing water supplies or water features (such as existing groundwater supply bores, surface springs or streams) then steps are to be taken by KCDC to limit, or mitigate, the effects to an acceptable level.

2.3 Monitoring Programme

Automatic monitoring locations shall be established at selected sites to monitor water levels in the shallow (unconfined) aquifer, and to monitor water pressures in the deep (confined) aquifers, from which groundwater is being abstracted.

The sites that have been selected as automatic monitoring locations are shown on **Figure 2-3** and described in Sections 2.4 and 2.5. These locations have been selected to provide information

2 Monitoring of Groundwater Levels

throughout the area that may potentially be affected by the borefield. This permanent network will allow a comprehensive picture of groundwater levels/pressure to be established over time, when the borefield is not operating as well as when the borefield is operating. This ensures that any background or seasonal trends can be identified, and separated from the effects of pumping from the borefield.

These sites are to be monitored continuously using a pressure transducer and automatic data logger in each well, with the readings telemetered to GWRC. The sites will be maintained by GWRC.

Note: Monitoring wells at all other locations, that do not form the permanent, automatic monitoring network, will be maintained to ensure that they are available if required in the future.

2.4 Shallow Groundwater Monitoring Programme

Table 2-2 Permanent Monitoring Locations - Shallow Groundwater and Wetlands

KCDC K6 Observation	Monitoring well established during borefield drilling programme, located adjacent to production well K6. (Referred to as TW3_obs in Borefield reports during construction and design).
GWRC Nga Manu	Monitoring location established in conjunction with Greater Wellington, in the Nga Manu Reserve wetlands
Te Harakeke 03	Existing shallow well established by Greater Wellington in wetland.
KCDC W1	Shallow monitoring well established adjacent landfill, to detect leachate. This well is approximately 25 m from the Kb4 production well.
Rangihiroa Street	Existing monitoring location established during the drilling of TW2, Rangihiroa Street. (Also referred to as TW2-MW3)
Waikanae CHP Shallow	Existing monitoring location, at the Christian Holiday Park.

The three monitoring wells located in or near to K6, Nga Manu and Te Harakeke monitor shallow groundwater and surface water levels in the important wetland areas to the north and west of Waikanae. These areas are outside of the reticulated water supply area and shallow (up to 40 m) bores are often used for potable supply.

Locations W1, Rangihiroa Street, and Waikanae CHP monitor the response of shallow groundwater as a result of pumping from wells located on the Te Moana branch of the pipeline.

2.4.1 Trigger Levels

Initially, trigger levels for shallow groundwater were set at 50% of the background for the well (based on running weekly average, with reference to control locations at Paraparaumu (Larch Grove and McLean Park)). The review of monitoring data collected over a 31 month period (October 2005 – April 2008) found it was appropriate to continue with this trigger level, but recommended well-specific water levels be set, given the data available. Individual trigger levels for shallow groundwater have therefore been derived equal to the lowest historic level minus 50% of the historic variation. These trigger level elevations (mm above mean sea level) are presented on **Table 2-3**.

It is important that any changes in shallow groundwater levels are assessed relative to regional changes. Therefore, in the event that water levels in any of the Waikanae monitoring wells fall below their respective trigger level, the first action should be to review the water level trend in the control locations at Mclean Park and Larch Grove, Paraparaumu.

2 Monitoring of Groundwater Levels

Table 2-3 Well-Specific Shallow Groundwater Trigger Levels

WELL NAME		GWRC Well reference number	Well screen depth, m bgl	Range (Oct 2005-April 2008) mm absl	Well-specific Trigger Level mm absl
As it appears on GWRC Database and in Annual Reports	Alternate name/as it appears in Borefield reports				
KCDC K6 Observation	TW3_obs	R26/6992	4-7	3610-2628	2140
GWRC Nga Manu	-	R26/6991	3.7-4.7	8317-7760	7480
KCDC W1	W1	R26/7025	2-4	5521-4808	4450
Rangihiroa Street	TW2-MW3	R26/6287	3-6	2646-1708	1240
Te Harakeke 03		R26/6886	5.5-6	3967-3125	2700
Waikanae CHP Shallow	WCHP	R26/6916	19-21	2620-2062	1780
Control Wells located in Paraparaumu					
Larch Grove	-	R26/6831	3.5-9.5		
Mclean Park	-	R26/6833	4.05-8.8		

2.5 Deep Groundwater Monitoring Programme

Table 2-4 Permanent Monitoring Locations - Deep Groundwater

K4, K5, K6, Kb4, K10 and K13 (Production Wells)	Water level in each production well is monitored continuously (even when pumps are not operating) and data provided to the control system. This water level data can be captured and downloaded for reporting and analysis.
KCDC Rutherford Drive (Sentinel #1)	Monitoring well established during borefield drilling programme
Taiata Street	Existing monitoring location, near TW2. (This location contains two observation wells: MW4/1 (screened at 33-36 m bgl) and MW4/2 (screened at 45-47 m bgl)).
Waikanae Park	Existing monitoring location established by GWRC, located on the corner of Waikanae Park.
Waikanae CHP Deep	Existing monitoring location, at the Christian Holiday Park.
Estuary	Existing monitoring location, near the Waikanae River estuary. (This location contains two observation wells: MW1/1 (screened at 52-53.5 m bgl) and MW1/2 (screened at 76-78 m bgl)).

There is only one known pre-existing bore, at Parkwood Rest Home (east of Ngarara Road), that taps the deep aquifers. Fewer permanent deep monitoring locations have therefore been established than for monitoring of the shallow groundwater systems. However, capturing data on the response of the deep aquifer will allow confirmation of the numerical model of aquifer behaviour, to replicate the aquifer responses during pumping. Thus, data from the production wells will be recorded, as well as data from five monitoring sites.

Data from the Estuary and Waikanae CHP will also be used to monitor the response of deep groundwater as a result of pumping from the backup bores PW1 and PW5, in the event that they are required.

2.5.1 Trigger Levels

Initially, trigger levels for the deep groundwater monitoring wells were set at 50% greater that the expected drawdown, as predicted in the resource consent application. The drawdown was calculated using a groundwater model, and assumed that all bores (both the six in the borefield and the two back-up bores) were pumping at full capacity abstracting 25,000 m^3/day from the Borefield and 7,800 m^3/day from the back-up bores, as described in Section 2.1.

From the review of monitoring data, there is good correlation between the predicted drawdown (shown in **Figure 2-2**) and the actual drawdown, considering that the predicted response was based on higher pumping rates from more wells than has actually occurred. There is some discrepancy between predicted and actual drawdowns around the back-up bores which are not fully utilised. Well-specific

2 Monitoring of Groundwater Levels

trigger levels have therefore been developed, equal to 50% greater than the expected drawdown, where the expected drawdown has been adjusted to account for the back up bores not being used. The revised trigger levels (mm above mean sea level) are presented in **Table 2-5**.

Table 2-5 Well-Specific Deep Groundwater Trigger Levels

WELL NAME		GWRC Well reference number	Well screen depth, m bgl	Elevation of static water level, mm amsl	Predicted Drawdown m	Deep Ground-water Trigger Level mm amsl
As it appears on GWRC Database and in this Report	As it appears in Borefield reports					
KCDC Rutherford Drive	Sentinel #1	R26/6378	110-122	2530	3	-1970
Taiata Street Shallow	TW2-MW4/1	R26/6673	33-36	1820	3.5	-3430
Taiata Street Deep	TW2-MW4/2	R26/6955	45-47	1810	3.5	-3440
Waikanae Park	GW-Waikanae Park	R26/6284	87-90	8770	2.5	5020
Waikanae CHP Deep	WCHP	R26/6594	71-74	2700	2	-300
Estuary Shallow	PW1-MW1/1	R26/6566	52-53.5	2070	1	570
Estuary Deep	PW1-MW1/2	R26/6956	76-78	2050	1	550

Flowcharts 1 and 2, **Appendix C**, describe the decision process associated with monitoring of groundwater levels, including the actions to be taken in the event that a trigger level is exceeded.

2.6 Review and Reporting

Monitoring results shall be reviewed:

- Annually, if there is no abstraction from the borefield*
- As required during abstraction

*Flushing the pipeline for maintenance purposes is not considered to be abstraction for monitoring purposes.

For the annual report, a plot of the groundwater level versus time is to be produced for all monitoring locations. Preliminary analysis of the data plots shall identify if unusual water level patterns have occurred during the period. Unusual water level changes would include:

- A sharp change in the water level trend, with the water level elevation falling below the trigger level
- A loss of yield from a production well accompanied by a change in water level.

2.7 Remediation and Mitigation

Flowchart 2, **Appendix C** summarises the actions to be taken in the event that unusual water levels are identified. The contingency plan for groundwater monitoring is as follows:

- Monitoring frequency is to be increased and investigations are to be undertaken to confirm the effect is due to borefield pumping and to confirm the extent of the effect.
- If adverse effects are likely, mitigation options are to be developed and agreed by KCDC, Greater Wellington and, if required, any affected parties.

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0 200 400 600 800 1000m

SCALE 1:20000 @ A3

N

SENTINEL #3

SENTINEL #1

TE HARAKEKE 01

KCDC K6 OBSERVATION

Kb11 END FARM ROAD

K7 SMITHFIELD #1

K6 WOODEN BRIDGE

K12 SMITHFIELD #2

K5 NGA MANU

TE HARAKEKE 02

SENTINEL #2 (SEE NOTE 1)

K4 COOPER #1

GWRC NGA MANU

TE HARAKEKE 03

Kb9 COOPER #2

TAIATA STREET

K13 HUIAWA

TW2 RANGIMEDA

K3 CEMETERY

K14 WAIMEA

K10 MARKET GARDEN

KCDCW1

Kb4 LANDFILL

K2 PARK

Kb3 PARK AVENUE

PW1-MW1 (ESTUARY)

WAIKANAE PARK

Kb1 MOTUITI RESERVE

WAIKANAE CHP

Kb2 RUSSEL RESERVE

PW5 OTAIHANGA DOMAIN

TW1 JIM COOK MEMORIAL PARK

PW1 OTAIHANGA RESERVE

WATER TREATMENT PLANT

URS

KEY

- BOREFIELD PRODUCTION WELL
- BACK-UP BORE
- DEEP MONITORING WELL (>50m)
- MID-DEPTH MONITORING WELL (AROUND 40m)
- SHALLOW MONITORING WELL (<15m)
- MONITORING WELL DECOMMISSIONED

NOTES

1. SENTINEL #2 (WAIKANAE GOLF CLUB) WAS DECOMMISSIONED FEBRUARY 2007.
2. Kb7, K12 AND TW2 ARE NOT CURRENTLY CONNECTED TO THE BOREFIELD RAW WATER PIPELINE. NO ABSTRACTION OCCURS FROM THESE WELLS.

Client
KAPITI COAST DISTRICT COUNCIL
Project
WAIKANAE BOREFIELD SUPPLEMENTARY WATER SUPPLY
Report
WAIKANAE BOREFIELD MONITORING MANUAL
Title
MONITORING WELL ARRAY

FIGURE 2-1

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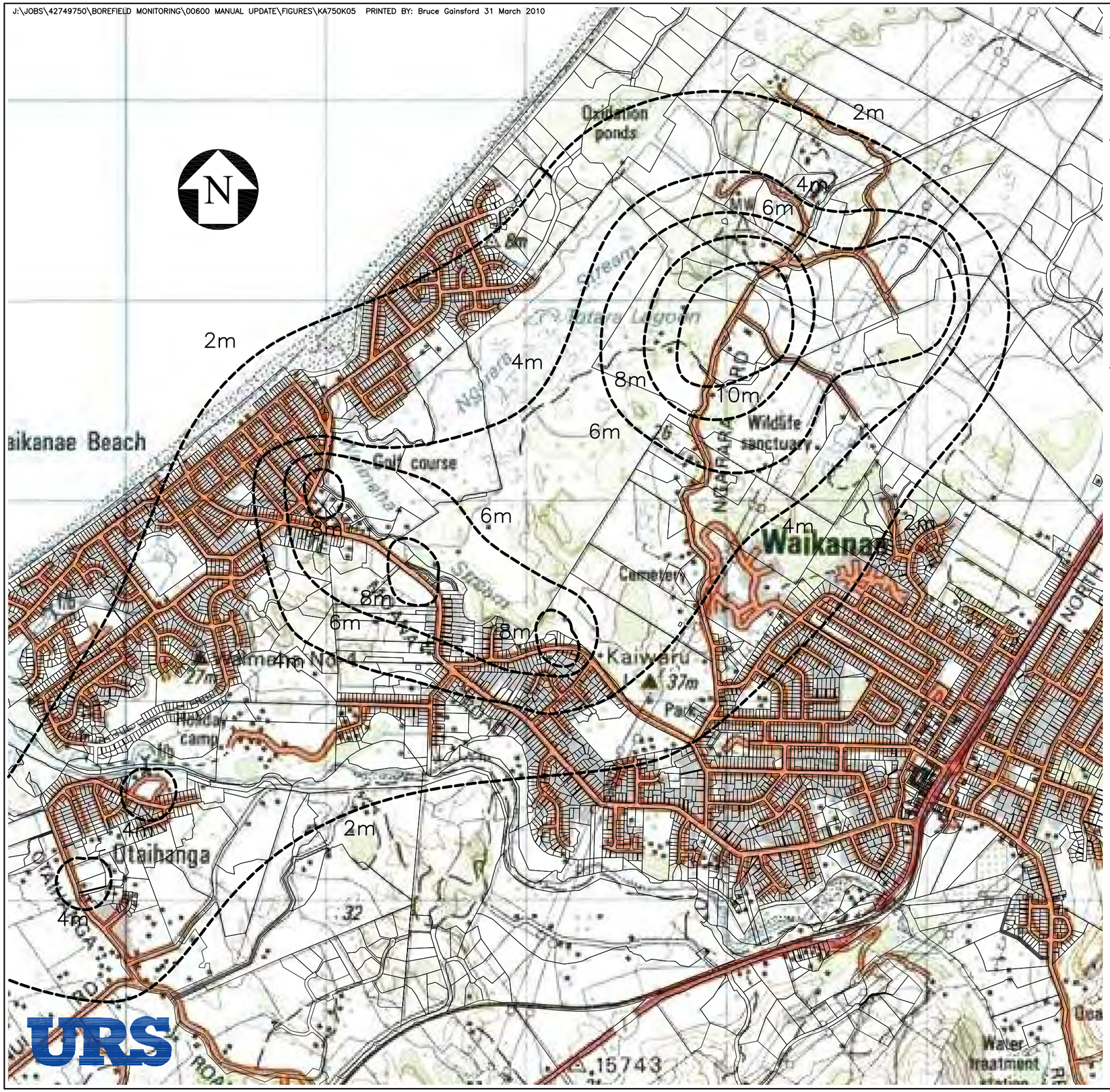


NOTES

CALCULATED DRAWDOWN (IN m) IN DEEP AQUIFER, AS A RESULT OF PUMPING FROM BOREFIELD (25,500m^3/day) AND FROM BACK–UP BORES PW1 & PW5 (7,800m^3/day).

KEY

- BOREFIELD PRODUCTION WELL
- DEEP MONITORING WELL (>60m)
- MID–DEPTH MONITORING WELL (AROUND 40m)
- SHALLOW MONITORING WELL (<15m)
- MONITORING WELL DECOMMISSIONED
- BACK–UP BORE

NOTES

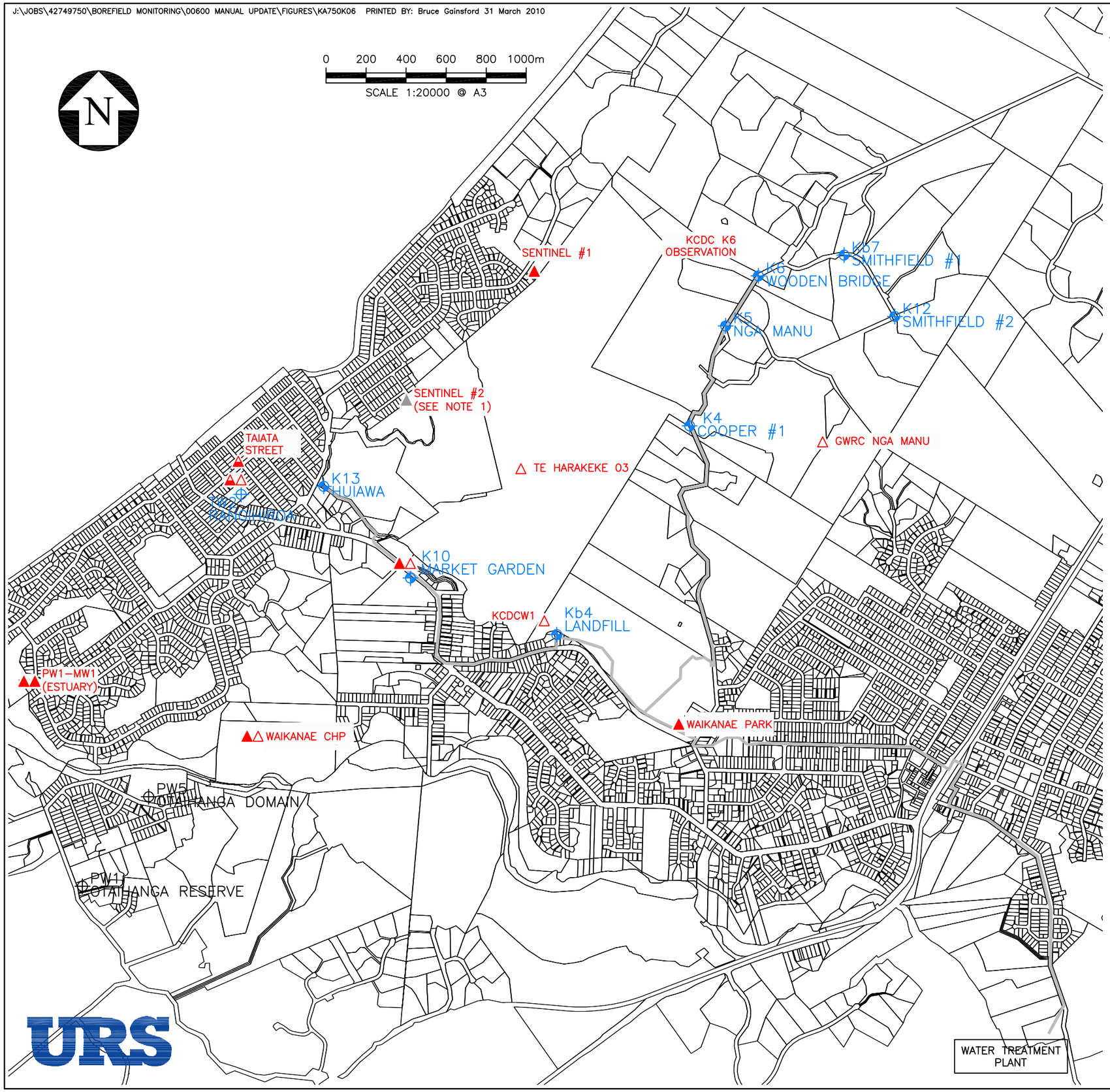
1. SENTINEL #2 (WAIKANAE GOLF CLUB) WAS DECOMMISSIONED FEBRUARY 2007.
2. Kb7, K12 AND TW2 ARE NOT CURRENTLY CONNECTED TO THE BOREFIELD RAW WATER PIPELINE. NO ABSTRACTION OCCURS FROM THESE WELLS.

URS

Client
KAPITI COAST DISTRICT COUNCIL
Project
WAIKANAE BOREFIELD SUPPLEMENTARY WATER SUPPLY
Report
WAIKANAE BOREFIELD MONITORING MANUAL
Title
PREDICTED DRAWDOWN IN DEEP AQUIFERS

FIGURE 2-2

J:\JOBS\42749750\BOREFIELD MONITORING\00600 MANUAL UPDATE\FIGURES\KA750K06 PRINTED BY: Bruce Gainsford 31 March 2010



KEY

- BOREFIELD PRODUCTION WELL
- BACK-UP BORE
- DEEP MONITORING WELL (>60m)
- MID-DEPTH MONITORING WELL (AROUND 40m)
- SHALLOW MONITORING WELL (<15m)
- MONITORING WELL DECOMMISSIONED
- PIPELINE ROUTE

Bore Name, as it appears on GWRC Database	*Bore Name, as it appears in Borefield reports*
Permanent Monitoring Locations - Shallow Groundwater	
KCDC K6 Observation	TW3_obs
GWRC Nga Manu	-
Te Harakeke 03	Te Harakeke 03
KCDC W1	W1
Rargihiroa Street	TW2-MW3
Waikanae CHP Shallow	WCHP
Larch Grove	-
WRCGolftech	-
Permanent Monitoring Locations - Deep Groundwater	
Waikanae Park	GW-Waikanae Park
KCDC Rutherford Drive	Sentinel #1
KCDC Waikanae Golf Club	Sentinel #2
Waikanae CHP Deep	WCHP
Estuary Deep	PW1-MW1/2
Estuary Shallow	PW1-MW1/1
Taiata Street Deep	TW2-MW4/2
Taiata Street Shallow	TW2-MW4/1
Permanent Monitoring Locations - Conductivity	
KCDC Rutherford Drive	Sentinel #1
KCDC Waikanae Golf Club	Sentinel #2
Estuary Deep	PW1-MW1/2
Estuary Shallow	PW1-MW1/1
Taiata Street Deep	TW2-MW4/2
Taiata Street Shallow	TW2-MW4/1

URS

Client
KAPITI COAST DISTRICT COUNCIL
Project
WAIKANAE BOREFIELD SUPPLEMENTARY WATER SUPPLY
Report
WAIKANAE BOREFIELD MONITORING MANUAL
Title
PERMANENT MONITORING LOCATIONS

FIGURE 2-3

3

Monitoring for Saline Intrusion

3.1 Potential Effects

As described in Section 2.1 the abstraction of water from the deeper aquifers results in a lowering in pressure in those aquifers, with the resultant movement of water laterally, towards the abstraction point. This effect could cause the seawater interface to move eastwards. The borefield has been placed inland to minimise risk from seawater intrusion and the contact of these aquifers with seawater is expected to be a considerable distance offshore.

As described in the AEE, on the basis of hydraulic data from the Ngarara Road tests, pumping for 90 days per year would only move the seawater interface landwards some 4 to 40 m before pumping stopped and pressures reversed. Little risk of seawater intrusion from pumping the borefield is therefore predicted, however "sentinel" wells were installed to monitor for early signs that the saltwater interface may be moving inland.

3.2 Objectives of Salinity Monitoring

The primary objective of the salinity monitoring is to:

- Measure salinity levels in the deeper aquifers between the borefield and the coast, to determine if the seawater interface is affected by pumping from the borefield and, if so, determine the effects of any such movement.

3.3 Monitoring Programme

Automatic monitoring locations have been established at selected sites, to monitor saline intrusion in the deep aquifer. Three "sentinel" wells were established specifically for this purpose as part of the drilling programme for the borefield. Construction details are contained in **Appendix B**.

Sentinel Well #2 (Waikanae Golf Club) was decommissioned in February, when the land was sold. Therefore Sentinel Well #1 has been adopted as a permanent monitoring well, along with the Taiata Street mid-depth wells, and the estuary wells (to monitor the effects of abstraction from PW1 and PW5).

The monitoring locations are listed in **Table 3-1** and shown on **Figure 2-3**.

Table 3-1 Permanent Monitoring Locations - Saline Intrusion

Sentinel #1 (Rutherford Drive)	Monitoring well established during borefield drilling programme
Taiata Street	Existing monitoring location, near TW2. (This location contains two observation wells: MW4/1 (screened at 33-36 m bgl) and MW4/2 (screened at 45-47 m bgl)).
Estuary	Existing monitoring location, near the Waikanae River estuary. (This location contains two observation wells: MW1/1 (screened at 52-53.5 m bgl) and MW1/2 (screened at 76-78 m bgl)).

These sites shall be established as permanent monitoring locations that will be monitored continuously, using a conductivity sensor and automatic data logger in each well. The readings will be

telemetered to Greater Wellington, and data from selected sites will be available on the internet. These sites will be maintained by Greater Wellington.

3.4 Trigger Levels

The initial trigger levels for conductivity in the deep aquifer were set at a 50% increase in conductivity over background (based on daily average). Data from the 2009 review indicated that, while variations do occur, the peak conductivity level for each well (based on the 7 day moving average to remove outliers) was fairly consistent. Therefore the revised trigger levels have been set at a value of 20% above the maximum 7 day moving average for each deep monitoring well.

These revised trigger levels are presented in Table 3.

Table 3-2 Well-Specific Deep Conductivity Trigger Levels

WELL NAME		GWRC Well reference number	Well screen depth, m bgl	Conductivity Max 7-day moving average, µS/cm	Proposed Trigger Level, µS/cm
As it appears on GWRC Database and in this Report	As it appears in Borefield reports				
KCDC Rutherford Drive	Sentinel #1	R26/6378	110-122	1250	1500
Taiata Street Shallow	TW2-MW4/1	R26/6673	33-36	358	430
Taiata Street Deep	TW2-MW4/2	R26/6955	45-47	2566	3080
Estuary Shallow	PW1-MW1/1	R26/6566	52-53.5	5960	7150
Estuary Deep	PW1-MW1/2	R26/6956	76-78	9831	11800

Flowcharts 3 and 4, **Appendix C**, describe the decision process associated with monitoring of saline intrusion, including the actions to be taken in the event that a trigger level is exceeded.

3.5 Review and Reporting

Monitoring results shall be reviewed:

- Annually, if there is no abstraction from the borefield*
- As required during abstraction

*Flushing the pipeline for maintenance purposes does not constitute abstraction for monitoring purposes.

For the annual report, a plot of the conductivity versus time is to be produced for all monitoring locations. Preliminary analysis of the data plots shall identify if unusual responses have occurred during the period. Unusual responses would include:

- A sharp increase in the conductivity level, exceeding trigger levels.

3.6 Remediation and Mitigation

Flowchart 4, **Appendix C** summarises the actions to be taken in the event that unusual salinity levels are identified. The contingency plan for saline monitoring is as follows:

- Monitoring is to be increased and investigations are to be undertaken to confirm the effect is due to borefield pumping and to confirm the extent of the effect.
- If adverse effects are likely, mitigation options to be developed and agreed by KCDC and Greater Wellington.

4

Reporting

To comply with condition 15 of resource consents WGN050025[25865] and [23852], an annual monitoring report is to be produced and issued to Greater Wellington that shall include the following:

a) A summary of monitoring results in accordance with Condition 10, including but not limited to review of data against agreed trigger levels;
b) (for the Borefield consent only WGN050025[23851]) reasons to support the use of the supplementary supply on more than 90 days in any 365-day period, if this occurs.

It is expected that the information provided in the report regarding the monitoring results (clause (a) above), will include:

- The data from monitoring undertaken during the previous year.
- For each production well: Daily total abstracted, maximum and average flowrate, running time
- For each permanent monitoring well: Water level/pressure, conductivity.
- Identification of any environmentally important trends in pumping behaviour.
- Interpretation and analysis of any change in groundwater profile over the previous year, any contingency actions that may have been taken during the year, predictions of future impacts on other bore users that may arise as a result of any trends that have been identified, and what contingency actions, if any, the consent holder proposes to take in response to those predictions.
- A review of trigger levels.

5

Maintenance of Monitoring Wells

Greater Wellington is responsible for maintaining all wells that form the permanent monitoring network (**Tables 2-2 and 2-3**).

KCDC are responsible for maintaining all other monitoring wells that are not part of the permanent monitoring network. These are monitoring wells at the following locations:

Kb1, Kb2, K2, K3, Kb9, Kb7, K12, Kb11, Kb3, K14 and Sentinel #3.

These shall be maintained operationally ready, in the event that they are required at any time to add into the network, or for specific, ad-hoc investigations.

A visual inspection of all permanent monitoring locations is to be undertaken during routine monitoring. If this inspection indicates that a monitoring well is unreliable, damaged or malfunctioning, then steps are to be taken to repair, relocate or decommission the monitoring site.

Alternatively, analysis of the monitoring data may identify a monitoring location that is unreliable or not representative. Re-measurement and a thorough inspection of this monitoring location shall be undertaken to ascertain the reliability of the data and the monitoring location, followed by the appropriate steps to repair, relocate or decommission the monitoring site.

If it is identified that a monitoring location requires remediation such as repairs or relocation, then these are to be implemented as soon as practicable and preferably before the next round of monitoring.

Annual maintenance shall include:

- Clearing cover and ensuring well is secure, with no ingress of water from surface.
- Removing any debris from within the manhole.
- Sounding to confirm depth of well. If necessary, well to be flushed.

A

Appendix A Resource Consents

Quality for Life

greater WELLINGTON
REGIONAL COUNCIL

Resource Consent

RESOURCE MANAGEMENT ACT 1991

Consent No. WGN050025 [25865]
Change of Conditions 1 and 3

Category: Water permit

Pursuant to sections 104B and 108, and subject to all the relevant provisions of the Resource Management Act 1991 and any regulations made thereunder, a consent in respect of a natural resource is hereby granted to:

Name	Kapiti Coast District Council		
Address	Private Bag 601, Paraparaumu		
Term of consent	Grant date: 4 November 2004	Effective: 1 July 2005	Expires: 1 July 2025
Purpose for which right is granted	To take and use a combined total of up to 23,000 m^3/day of groundwater from up to eight wells within the Waikanae borefield for the purposes of a supplementary public water supply for the communities of Waikanae, Paraparaumu and Raumati.		
Location	Waikanae borefield, Waikanae, at or about map references NZMS 260:R26;828.363 (K4), NZMS 260:R26;822.353 (Kb4), NZMS 260:R26;830.368 (K5), NZMS 260:R26;832.371 (K6), NZMS 260:R26;836.372 (Kb7), NZMS 260:R26;815.356 (K10), NZMS 260:R26;839.369 (K12) and NZMS 260:R26;810.361 (K13), and NZMS 260:R26;806.360 (TW2).		
Legal description of land	Road reserve (K4) (K5) (K6) (Kb7) (K10) (K12), Lot 25 DP 27407 (Kb4), Pt Lot 182 DP 6570 (K13), Pt Lot 111 DP 14131 (TW2).		
Volume/quantity/rate	23,000 m^3/day		
Conditions	1-18 as attached		

For and on behalf of
WELLINGTON REGIONAL COUNCIL

pp

Manager, Consents Management

Date: 15 March 2007

TELARC REGISTERED SUPPLIER

Summary of your rights and responsibilities

(Not part of the resource consent)

This resource consent gives you the right to use a public resource (e.g. water, air, the coastal marine area) in the manner specified in the consent.

You may exercise the resource consent how you see fit provided that you comply with all the conditions of your resource consent and all other laws of the land.

If you wish to change the way you operate under this resource consent or if you wish to alter or delete any consent conditions, please contact the Wellington Regional Council (hereafter referred to as Greater Wellington) prior to making the changes. You may need a formal variation to your resource consent conditions.

You may transfer your coastal, discharge, or water permit to any other person. So if you sell your operation please contact Greater Wellington and we will arrange the transfer. The service is free of charge.

If your resource consent application contained inaccurate or misleading information Greater Wellington may ask the Environment Court to cancel or alter the resource consent.

Your resource consent does not:

- provide any warranty of any structure or process;
- provide any guarantee that the resource will be available at all times;
- provide any right of access through or over public or private land;
- negate the need for any approvals necessary under other legislation.

You, as the holder(s) of this resource consent and your agents (including contractors and employees), are jointly and severally liable for compliance with the conditions of this consent. It's important that anyone operating on your behalf fully understands and complies with the conditions of the resource consent.

You are required to pay any relevant charges that are associated with the consent. Greater Wellington fixes these charges under section 36 of the Resource Management Act 1991. The Act allows you to comment on any proposed charges *prior to them being fixed*. Charges are usually fixed every three years. If you would like a copy of our current Resource Management Charging Policy please ask us.

You are required to allow Greater Wellington Enforcement Officers access to your site and operation at any reasonable time so that we can inspect your operation and confirm that it is complying with the resource consent.

Your resource consent will lapse if you do not exercise it within five years of the date it was granted (unless otherwise specified in the resource consent conditions). If this lapsing is going to be a problem for you please contact Greater Wellington before the lapse date.

If you stop using your resource consent for a continuous five-year period, Greater Wellington may cancel your resource consent. We will advise you in advance if we propose to cancel your consent. You also have the right to object to your consent being cancelled.

This consent is issued without prejudice to any claim that is lodged with the Waitangi Tribunal in relation to the customary ownership of natural resources, whether it be a claim that is pending hearing or whether it is a claim that is awaiting settlement by the Crown.

Conditions to Resource Consent WGN050025 [25865]

General conditions

1.[1] The location, design, implementation and operation of the take shall be in accordance with the application, and its associated plans and documents, lodged with the Wellington Regional Council on 4 August 2004, and additional information provided on 18 August 2004, 13 October 2004, 6 November 2006 and 19 February 2007.

2. In terms of Section 123(d) of the Resource Management Act 1991, the period for which this permit is granted is limited to twenty years from the date of granting.

Operational conditions

3.[2] The rate of groundwater abstracted from the production wells in the Waikanae borefield shall not exceed a combined total of 23,000 m^3/day. The Waikanae borefield includes any of the following production wells: K4, Kb4, K5, K6, Kb7, K10, K12, K13 and TW2.

Note: This permit allows for a maximum of eight wells to be abstracted from simultaneously only.

4. The supplementary supply shall be used only in the following circumstances:

- To provide water on days when limited water, or no water, can be taken from the Waikanae River;
- To provide water in the event that the Waikanae River supply or the Waikanae Water Treatment Plant is rendered unusable (e.g. in the event of a major flood when the river quality may be poor or the intake structure is damaged); or
- As required to commission and maintain the pipeline and wells in a state of operational readiness.

Use of the supplementary supply at any other time shall be at the discretion of the Manager, Consents Management, Wellington Regional Council.

5. The permit holder shall meter all abstractions from each individual well and the meters shall have an accuracy of +/- 5%.

6. The wells and their connection to the water reticulation system shall be designed so that excess water does not run to waste and backflow is prevented.

7. The permit holder shall take all practicable steps to ensure that leaks within the wellheads and pipeline are identified and repaired.

8. This permit shall be exercised in accordance with an Operations and Maintenance Manual which shall be prepared by the permit holder and submitted to the Manager, Consents Management, Wellington Regional Council for approval within three months of the date of granting of this permit. The manual is to include sections on:

- Type and capacity of the pumps in each well;
- Details of the well head and connection from the wells to pipeline;
- Pumping regimes;
- Measures taken to prevent aquifer contamination from surface sources (e.g. security of wellhead, backflow prevention);

---

[1],[2] Condition changes granted under section 127 of The Resource Management Act 1991 on 15 March 2007.

NAP 15/3/17

- Requirement, procedure and schedule for maintenance of pipeline and wells;
- Requirement and procedures for implementation of restrictions in abstraction (due to trigger levels set under Condition 10 being breached);
- Procedures for resumption of normal pumping rates;
- Procedures for notification to the Wellington Regional Council; and
- An operation log which will record information such as:

  (a) date and hours of operation of the take;
  (b) abstraction rates and volumes for each well;
  (c) total daily abstraction;
  (d) any changes in operational procedures;
  (e) any maintenance carried out; and
  (f) any unusual events which occur.

These operational logs shall be made available for inspection by the Wellington Regional Council at any time, and shall be sent to the Manager, Consents Management, Wellington Regional Council, on a three monthly basis.

9. Any changes to the Operational and Maintenance Manual shall be forwarded to the Manager, Consents Management, Wellington Regional Council, within one month of the change being made.

Monitoring conditions

10. This permit shall be exercised in accordance with a Monitoring Manual which shall be prepared by the permit holder and submitted to the Manager, Consents Management, Wellington Regional Council for approval within three months of the date of granting of this permit. The manual shall include:

- Monitoring of water levels in the shallow aquifer and Nga Manu Nature Reserve wetlands;
- Monitoring for interference or drawdown effects in the deep aquifer;
- Monitoring for seawater intrusion (electrical conductivity) in the 'sentinel' monitoring wells;
- Monitoring of water levels and electrical conductivity in the MW1/1 and MW1/2 monitoring wells;
- Monitoring methods, frequency and locations;
- Action levels, and the derivation of appropriate trigger levels to determine if changes in abstraction are required;
- Procedures for if/when any trigger levels are breached;
- Procedures and timing for notification to the Wellington Regional Council if any trigger levels are breached; and
- Frequency and method of reporting the monitoring information to the Wellington Regional Council.

11. Any changes to the Monitoring Manual shall be submitted to the Manager, Consents Management, Wellington Regional Council, for approval prior to the changes being implemented.

12. All monitoring methods and procedures shall be to the specific approval of the Manager, Consents Management, Wellington Regional Council.

13. Should the trigger levels determined under Condition 10 indicate it necessary, the permit holder shall comply with abstraction restrictions as directed by the Manager, Consents Management, Wellington Regional Council.

14. If so requested by the Manager, Consents Management, Wellington Regional Council, the permit holder shall make the wells available for the monitoring of water levels, water quality and seawater intrusion.

Reporting conditions

15. The permit holder shall prepare and submit an annual report to the Manager, Consents Management, Wellington Regional Council before 1 April each year. This annual report shall include:

(a) A summary of monitoring results in accordance with Condition 10, including but not limited to a review of data for trigger levels;

(b) Measures undertaken to investigate, implement and manage water conservation methods to reduce water demand on the Kapiti Coast, including the introduction of water meters, any increases in population, any reduction in peak daily water demand and the achieved results of these measures;

(c) Reasons to support the use of the supplementary supply on more than 90 days in any 365-day period, if this occurs. The consent holder shall notify the Manager, Consents Management, Wellington Regional Council before using the supplementary supply for more than 90 days in any 365-day period.

16. The permit holder shall submit a report to the Manager, Consents Management, Wellington Regional Council, ten years after the granting of this permit, which provides a detailed analysis including but not limited to available data on aquifer performance, bore use, river hydrology and environment.

Review conditions

17. The Wellington Regional Council may review any or all conditions of this permit by giving notice of its intention to do so pursuant to Section 128 of the Resource Management Act 1991, at any time within six months of the:

- The first anniversary of the date of granting;
- Every two years following the first anniversary of the date of granting thereafter.

Such a review shall be for any of the following purposes:

(a) To deal with any adverse effect on the environment which may arise from the exercise of the permit, including the rate of abstraction, and which it is appropriate to deal with at a later stage;

(b) to review the adequacy of any monitoring programme requirements, including trigger levels set under Condition 10, and if necessary to amend those requirements;

(c) to deal with any adverse effects from the results and analysis outlined in the ten-year report required by Condition 17.

18. In addition to Condition 17, the Wellington Regional Council may review any or all conditions of this permit by giving notice of its intention to do so pursuant to Section 128 of the Resource Management Act 1991, at any time within one year of amendments to the Regional Freshwater Plan for the Wellington Region (the Plan) becoming operative, to enable consistency of the permit with the Plan.

COPY

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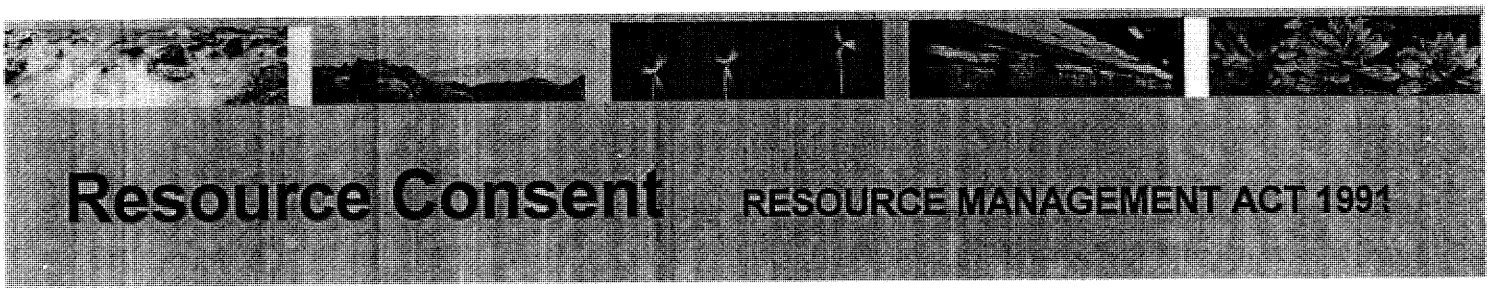
REGIONAL COUNCIL



Resource Consent

RESOURCE MANAGEMENT ACT 1991

Consent No. WGN050025 [23852]

Category: Water permit

Pursuant to sections 104B and 108, and subject to all the relevant provisions of the Resource Management Act 1991 and any regulations made thereunder, a consent in respect of a natural resource is hereby granted to:

Name	Kapiti Coast District Council		
Address	Private Bag 601, Paraparaumu		
Term of consent	Grant date: 4 November 2004	Effective: 1 July 2005	Expires: 1 July 2025
Purpose for which right is granted	To take and use a combined total of up to 7,000 m^3/day of groundwater from two wells (PW1 and PW5) for the purposes of a back-up public water supply for the communities of Waikanae, Paraparaumu and Raumati.		
Location	PW1, Otaihanga Recreation Reserve, Otaihanga, at or about map reference NZMS 260:R26;798.341 PW5, Otaihanga Domain, Otaihanga, at or about map reference NZMS 260:R26;801.345		
Legal description of land	Lot 21 DP 15740 (PW1), Lot 1 DP 15982 (PW5)		
Volume/quantity/rate	7,000 m^3/day		
Conditions	1-17 as attached		

For and on behalf of
WELLINGTON REGIONAL COUNCIL

Manager, Consents Management

Date: 14 December 2006

Summary of your rights and responsibilities

(Not part of the resource consent)

This resource consent gives you the right to use a public resource (e.g. water, air, the coastal marine area) in the manner specified in the consent.

You may exercise the resource consent how you see fit provided that you comply with all the conditions of your resource consent and all other laws of the land.

If you wish to change the way you operate under this resource consent or if you wish to alter or delete any consent conditions please contact the Wellington Regional Council (hereafter referred to as Greater Wellington) prior to making the changes. You may need a formal variation to your resource consent conditions.

You may transfer your coastal, discharge, or water permit to any other person. So if you sell your operation please contact Greater Wellington and we will arrange the transfer. The service is free of charge.

If your resource consent application contained inaccurate or misleading information Greater Wellington may ask the Environment Court to cancel or alter the resource consent.

Your resource consent does not:

- provide any warranty of any structure or process;
- provide any guarantee that the resource will be available at all times;
- provide any right of access through or over public or private land;
- negate the need for any approvals necessary under other legislation.

You, as the holder(s) of this resource consent and your agents (including contractors and employees) are jointly and severally liable for compliance with the conditions of this consent. It's important that anyone operating on your behalf fully understands and complies with the conditions of the resource consent.

You are required to pay any relevant charges that are associated with the consent. Greater Wellington fixes these charges, under section 36 of the Resource Management Act 1991. The Act allows you to comment on any proposed charges *prior to them being fixed.* Charges are usually fixed every three years. If you would like a copy of our current Resource Management Charging Policy please feel free to contact us.

You are required to allow Greater Wellington Enforcement Officers access to your site and operation at any reasonable time so that we are able to inspect your operation and confirm it is complying with the resource consent.

Your resource consent will lapse if you do not exercise it within five years of the date it was granted (unless otherwise specified in the resource consent conditions). If this lapsing is going to be a problem please contact Greater Wellington before the lapse date.

If you stop using your resource consent for a continuous five-year period, Greater Wellington may cancel your resource consent. We will advise you in advance if we propose to cancel your consent. You also have the right to object to your consent being cancelled.

This consent is issued without prejudice to any claim that is lodged with the Waitangi Tribunal in relation to the customary ownership of natural resources, whether it be a claim that is pending hearing or whether it is a claim that is awaiting settlement by the Crown.

Conditions to Resource Consent WGN050025 [23852]

General conditions

1. The location, design, implementation and operation of the take shall be in accordance with the application, and its associated plans and documents, lodged with the Wellington Regional Council on 4 August 2004, and additional information provided on 18 August 2004, and 13 October 2004.

2. In terms of Section 123(d) of the Resource Management Act 1991, the period for which this permit is granted is limited to twenty years from the date of granting.

Operational conditions

3. The rate of groundwater abstraction from the back-up wells (PW1 and PW5 wells) shall not exceed a combined total of 7,000 m^3/day.

4. The back-up supply shall be used only:

   - In extraordinary circumstances preventing full use of the supplementary supply from the Waikanae borefield (e.g. mechanical failure or damage from seismic events);
   - As a bridging supply until water metering is introduced to reduce demand below borefield supply capability (only required if the full expected yield is not realised from the Waikanae borefield); or
   - As required to commission and maintain the wells and on-site treatment facilities in a state of operational readiness.

   Use of the back-up supply at any other time shall be at the discretion of the Manager, Consents Management, Wellington Regional Council.

5. The permit holder shall meter all abstractions from each individual well and the meters shall have an accuracy of +/- 5%.

6. The wells and their connection to the water reticulation system shall be designed so that excess water does not run to waste and backflow is prevented.

7. The permit holder shall take all practicable steps to ensure that leaks within the PW1 and PW5 on-site treatment and storage system are identified and repaired.

8. This permit shall be exercised in accordance with an Operations and Maintenance Manual which shall be prepared by the permit holder and submitted to the Manager, Consents Management, Wellington Regional Council for approval within three months of the date of granting of this permit. The manual is to include sections on:

   - Type and capacity of the pumps in each well;
   - Details of the well head and connection from the wells to pipeline;
   - Pumping regimes;
   - Measures taken to prevent aquifer contamination from surface sources (e.g. security of wellhead, backflow prevention);
   - Requirement, procedure and schedule for maintenance of pipeline and wells;
   - Requirement and procedures for implementation of restrictions in abstraction (due to trigger levels set under Condition 10 being breached);

- Procedures for resumption of normal pumping rates;
- Procedures for notification to the Wellington Regional Council; and
- An operation log which will record information such as:

  (a) date and hours of operation of the take;
  (b) abstraction rates and volumes for each well;
  (c) total daily abstraction;
  (d) any changes in operational procedures;
  (e) any maintenance carried out; and
  (f) any unusual events which occur.

These operational logs shall be made available for inspection by the Wellington Regional Council at any time, and shall be sent to the Manager, Consents Management, Wellington Regional Council, on a three monthly basis.

9. Any changes to the Operational and Maintenance Manual shall be forwarded to the Manager, Consents Management, Wellington Regional Council, within one month of the change being made.

Monitoring conditions

10. This permit shall be exercised in accordance with a Monitoring Manual which shall be prepared by the permit holder and submitted to the Manager, Consents Management, Wellington Regional Council for approval within three months of the date of granting of this permit. The manual shall include:

- Monitoring of water levels in the shallow aquifer and Nga Manu Nature Reserve wetlands;
- Monitoring for interference or drawdown effects in the deep aquifer;
- Monitoring for seawater intrusion (electrical conductivity) in the 'sentinel' monitoring wells;
- Monitoring of water levels and electrical conductivity in the MW1/1 and MW1/2 monitoring wells;
- Monitoring methods, frequency and locations;
- Action levels, and the derivation of appropriate trigger levels to determine if changes in abstraction are required;
- Procedures for if/when any trigger levels are breached;
- Procedures and timing for notification to the Wellington Regional Council if any trigger levels are breached; and
- Frequency and method of reporting the monitoring information to the Wellington Regional Council.

11. Any changes to the Monitoring Manual shall be submitted to the Manager, Consents Management, Wellington Regional Council, for approval prior to the changes being implemented.

12. All monitoring methods and procedures shall be to the specific approval of the Manager, Consents Management, Wellington Regional Council.

13. Should the trigger levels determined under Condition 10 indicate it necessary, the permit holder shall comply with abstraction restrictions as directed by the Manager, Consents Management, Wellington Regional Council.

14. If so requested by the Manager, Consents Management, Wellington Regional Council, the permit holder shall make the wells available for the monitoring of water levels, water quality and seawater intrusion.

Reporting conditions

15. The permit holder shall prepare and submit an annual report to the Manager, Consents Management, Wellington Regional Council before 1 April each year. This annual report shall include:

  (a) A summary of monitoring results in accordance with Condition 10, including but not limited to a review of data for trigger levels; and

(b) Measures undertaken to investigate, implement and manage water conservation methods to reduce water demand on the Kapiti Coast, including the introduction of water meters, any increases in population, any reduction in peak daily water demand and the achieved results of these measures.

Review conditions

16. The Wellington Regional Council may review any or all conditions of this permit by giving notice of its intention to do so pursuant to Section 128 of the Resource Management Act 1991, at any time within six months of the:

- The first anniversary of the date of granting;
- Every two years following the first anniversary of the date of granting thereafter.

Such a review shall be for any of the following purposes:

(a) To deal with any adverse effect on the environment which may arise from the exercise of the permit, including the rate of abstraction, and which it is appropriate to deal with at a later stage;

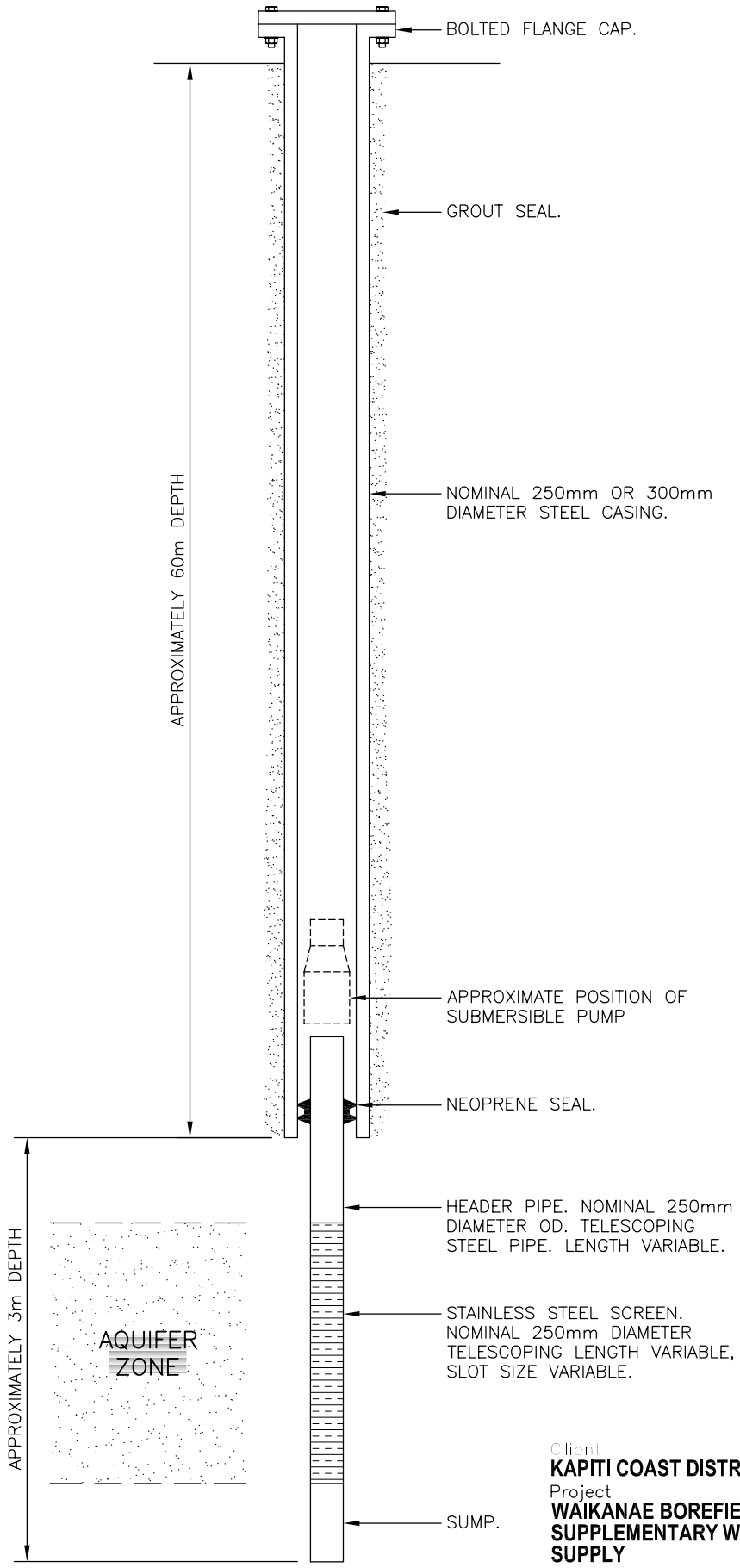
(b) to review the adequacy of any monitoring programme requirements, including trigger levels set under Condition 10, and if necessary to amend those requirements.

17. In addition to Condition 16, the Wellington Regional Council may review any or all conditions of this permit by giving notice of its intention to do so pursuant to Section 128 of the Resource Management Act 1991, at any time within one year of amendments to the Regional Freshwater Plan for the Wellington Region (the Plan) becoming operative, to enable consistency of the permit with the Plan.

B

Appendix B Well Construction Details

S:\Adv Jobs\48404 KCDC\005 Borefield\6400 Figures\KA005sk04
Rev A 16/07/04 RB



URS New Zealand
Engineering and Environmental Management

Client
KAPITI COAST DISTRICT COUNCIL
Project
WAIKANAE BOREFIELD SUPPLEMENTARY WATER SUPPLY
Report
WAIKANAE BOREFIELD TECHNICAL REPORT
Title
TYPICAL PRODUCTION WELL CONSTRUCTION
Figure No. **11** (NOT TO SCALE)

URS New Zealand

Project - Waikanae Borefield

Table 3: Well Construction Details

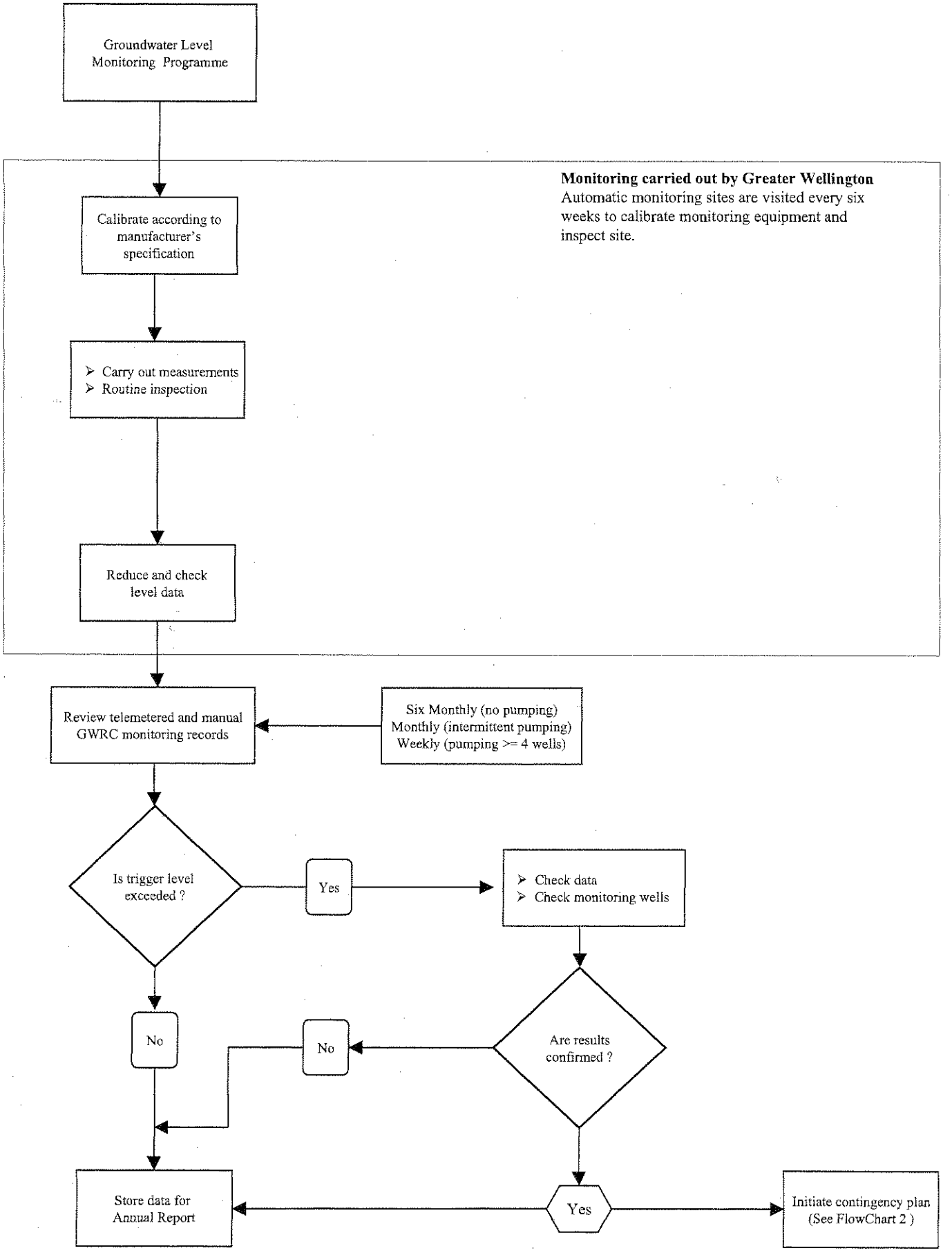
Well ID	K5	K5_obs	Jones	Hoverd	K4	K4_obs s	K4_obs d	Kb4	W1	K10	K10_obs s	K10_obs d	K13	K13_obs s	K13_obs d	TW2	TW2-MW1	TW2-MW2	TW2-MW3	TW2-MW4/1	TW2-MW4/2	K6	TW3_obs s	TW3_obs d
Well ID (other)	Nga Manu				Cooper			Landfill		Market Garden			Huiawa			Rangihiroa						Wooden Bridge		
Grid Reference	R26 830-368				R26 828-360			R26 822-353		R26 814-356			R26 809-360			R26 805-360						R26 832-372		
E	2683000				2682825			2682155		2681447			2680984			2680500						6037079		
N	6036842				6036334			6035306		6035591			6036044			6036000						2683151		
Well Type	production	monitoring	private	private	production	monitoring	monitoring	production	monitoring	production	monitoring	monitoring	production	monitoring	monitoring	production	monitoring	monitoring	monitoring	salinity obs.	salinity obs.	production	monitoring	monitoring
Distance to pumping well (m)	0	5	93	130	0	6	6	0	40	0	6	6	0	6	6	0	46.1	38.3	10.2	185	185	0	3	3
Well diameter (mm)	250	20	100	100	300	20	20	250		250	20	20	300	20	20	200	50	50	50	25	25	300	20	32
Depth drilled (m bgl)	103.50	12.00	?	?	74.20	6.00	82.00	92.50		123.00	123.00	123.00	78.60	123.00	123.00	91.00	38.00	39.00	6.00			66.28	12.00	-
Well Depth (m bgl)	100.27	12.00	28.50	21.30	74.20	-	-	74.00	approx 4	97.00	12.00	85.00	78.60	12.00	74.00	38.00						66.28	12.00	66.50
Casing length	68.43	8.00	?	?	65.00	2.00	78.00	67.00	2.00	64.00	10.00	80.00	2.60	10.00	70.00	32.00	32.00	33.00	3.00			62.00	10.00	64.00
Casing material	steel	pvc	steel	steel	steel	pvc	pvc	steel	pvc	steel	pvc	pvc	steel	pvc	pvc	steel	pvc	pvc	pvc			steel	pvc	pvc
Top of Header	66.76	-			66.00	-	-	64.25		60			72									61.78	-	-
Screen top (m bgs)	77.26	8.00	?	20.70	67.70	10	78	66	approx 2	60.00	10	80	74.60	10	70	32	32	33	3	33.00	45.00	64.25	10.0	64.0
Screen bottom (m bgs)	98.26	12.00	?	21.10	72.70	12	82	74	approx 4	97.00	12	85	78.60	12	74	38	38	39	6	36.00	47.00	66.25	12.0	66.5
Screen length (m bgs)	21.00	4.00	?	0.40	5.00	2.00	4.00	8	approx 2	37.00	2.00	5.00	4.00	2.00	4.00	6	6	6	3	3	2	2.0	2.0	2.5
Screen diameter (mm)	250 tele	20	?	?	300 tele	20	20	250 tele		250 tele	20	20	300 tele	20	20	-	-	-	-	-		300mm tele	20	32
Screen slot size (mm)	0.1	1.0	?	?	2.5	1.0	1.0	3		1.5	1.0	1.0	5.0	1.0	1.0	2.50	-	-	-	-		2.5	1	1
Screen type	wedgewire stainless	pvc	?	?	wedgewire stainless	pvc	pvc	wedgewire stainless		wedgewire stainless	pvc	pvc	wedgewire stainless	pvc	pvc	wedgewire stainless	pvc	pvc	pvc	pvc	pvc	wedgewire stainless	pvc	pvc
Well head	lockable flange & plate	lockable well cap	bolted pipe/pump	bolted pipe/pump	lockable flange & plate	lockable well cap	lockable well cap	lockable flange & plate	lockable well cap	lockable flange and plate	lockable well cap	lockable well cap	lockable flange and plate	lockable well cap	lockable well cap	lockable flange & plate	lockable well cap	lockable well cap	lockable well cap	lockable well cap	lockable well cap	lockable flange & plate	lockable well cap	lockable well cap
SWL (m bgl)	3.270	2.500	-	-	9.330	-	-	2.3	2.0	flowing artesian			1.500	-	-	1.100	1.040	2.500	1.450	-	-	0.86	1.10	-
RL ground (m, amsl)	6.93	6.93	-	-	11.79	11.79	11.79	6.26		3.49	3.49	3.49	2.59	2.59	2.59	3.33	3.16	4.63	3.33	4.525	4.525	4.31	4.31	4.31
RL top of casing (m, amsl)	7.66	6.93	-	-	11.98	11.79	11.79	6.86			11.79	11.79		2.59	2.59	3.96	3.5	4.94	3.6	4.464	4.464		-	-
RL water level (m, amsl)	3.66	4.43	-	-	2.65	-	-	4.56		artesian	8.30	8.30	1.09	-	-	2.86	2.46	2.44	2.15	1.94	1.95	3.45	3.21	-
Transmissivity (m^2/day)	132		-	-	495	-	-	470		90	-	-	175	-	-	1000	878.00	878.00	-	-	-	-	-	-
Storage co-efficient	0.00038	0.30	-	-	-			0.00005		-	-	-	-	-	-	0.00003	0.00008	0.00008	-	-	-	-	-	-
Comments			sounded to 28.5 m.										No pump test completed due to excessive sediment											

Table 3: Well Construction Details ...continued.

Well ID	Kb1_obs s	Kb1_obs m	Kb1_obs d	Kb2_obs s	Kb2_obs m	Kb2_obs d	Kb3_obs s	Kb3_obs d	Kb9_obs	Kb11_obs	K2_obs	K3_obs s	K3_obs m	K3_obs d	K14_obs s	K14_obs d	Kb7	Kb7_obs m	Kb7_obs d	K12	K12_obs s	K12_obs d	Sentinel 1	Sentinel 2	Sentinel 3
Well ID (other)	Motuiti Reserve			Russel Reserve			Park Avenue		Cooper	End Farm Road	Park	Cemetery			Waimea		Smithfield #1			Smithfield #2			Rutherford Drive	Golf Course	
Grid Reference	R26 837-347			R26 831-347			R26 825-350		R26 831-361	R26 837-376	R26 829-352	R26 829-356			R26 810-357		R26 836-372			R26 836-372			R26 814-365	R26 821-371	R26 825 376
E	2683100			2683100			2682500		2683100	2683700	2682900	2682900			2681000		2683600			2683600			2681400	2682100	2682500
N	6034700			6034700			6035000		6036100	6037600	6035200	6035600			6035700		6035700			6037200			6036500	6037100	6037600
Well Type	monitoring	monitoring	monitoring	monitoring	monitoring	monitoring	monitoring	pumping	monitoring	monitoring	monitoring	monitoring	monitoring	monitoring	pumping	monitoring	production	monitoring	monitoring	production	monitoring	monitoring	monitoring	monitoring	monitoring
Distance to pumping well (m)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	6	6	0	6	6	-	-	-
Well diameter (mm)	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	250	20	20	250	20	20	50	50	50
Depth drilled (m bgl)	40.50	40.50	53.00	40.50	40.50	74.00	12.00	91.00	89	105	104.50	40.00	40.00	79.20	123.00	123.00	83.00	97.00	97.00	76.80	99.00	99.00	122.50	118.20	123.00
Well Depth (m bgl)	10.00	40.50	49.00	10.70	40.50	74.00	12.00	86.00	74.0	80	65.50	10.00	40.00	73.00	12.00	82.00	81.78	58.50	73.00	75.80	10.00	72.00	122.50	118.00	102.00
Casing length	8.00	38.50	46.00	8.70	38.50	68.00	10.00	82.00	7	76	63.50	8.00	38.00	71.00	10.00	76.00	52.00	57.00	70.00	66.90	8.00	69.00	110.5	80	80
Casing material	pvc	pvc	pvc	pvc	pvc	pvc	pvc	pvc	pvc	pvc	pvc	pvc	pvc	pvc	pvc	pvc	steel	pvc	pvc	steel	pvc	pvc	pvc	pvc	pvc
Top of Header	-	-		-	-		-		-	-	-	-	-			-	48.5	-	-	65.7	-	-	-	-	-
Screen top (m bgs)	8.00	38.50	46.00	8.70	38.50	68.00	10.00	82	70	76	63.50	8.00	38.00	71.00	12.00	76	72.78	57	70	66.80	8.00	69.00	110.5	80.0	80.0
Screen bottom (m bgs)	10.00	40.50	49.00	10.70	40.50	74.00	12.00	86	74	80	65.50	10.00	40.00	73.00	10.00	82	81.78	58.5	73	75.80	10.00	72.00	122.5	118.0	102.0
Screen length (m bgs)	2.00	2.00	3.00	2.00	2.00	6.00	2.00	4.00	4.0	4.0	2.00	2.00	2.00	2.00	2.00	6.00	9.00	1.50	3.00	9.00	2.0	3.0	12.0	38.0	22.0
Screen diameter (mm)	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	250 tele	20	20	250 tele	20	20	50	50	50
Screen slot size (mm)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.3	1.0	1.0	0.3	1.0	1.0	1.0	1.0	1.0
Screen type	pvc	pvc	pvc	pvc	pvc	pvc	pvc	pvc	pvc	pvc	pvc	pvc	pvc	pvc	pvc	pvc	wedgewire stainless	pvc	pvc	wedgewire stainless	pvc	pvc	pvc	pvc	pvc
Well head	lockable well cap	lockable well cap	lockable well cap	lockable well cap	lockable well cap	lockable well cap	lockable well cap	lockable well cap	lockable well cap	lockable well cap	lockable well cap	lockable well cap	lockable well cap	lockable well cap	lockable well cap	lockable well cap	lockable flange & plate	lockable well cap	lockable well cap	lockable flange & plate	lockable well cap	lockable well cap	lockable well cap	lockable well cap	lockable well cap
SWL (m bgl)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	+1.5	-	-	-	-	-	-
RL ground (m, amsl)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-
RL top of casing (m, amsl)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-
RL water level (m, amsl)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-
Transmissivity (m^2/day)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	31	-	-	22	-	-			
Storage co-efficient	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			-			-	-	-
Comments																	Not used for pumping.			Not used for pumping.			Seawater intrusion wells.		

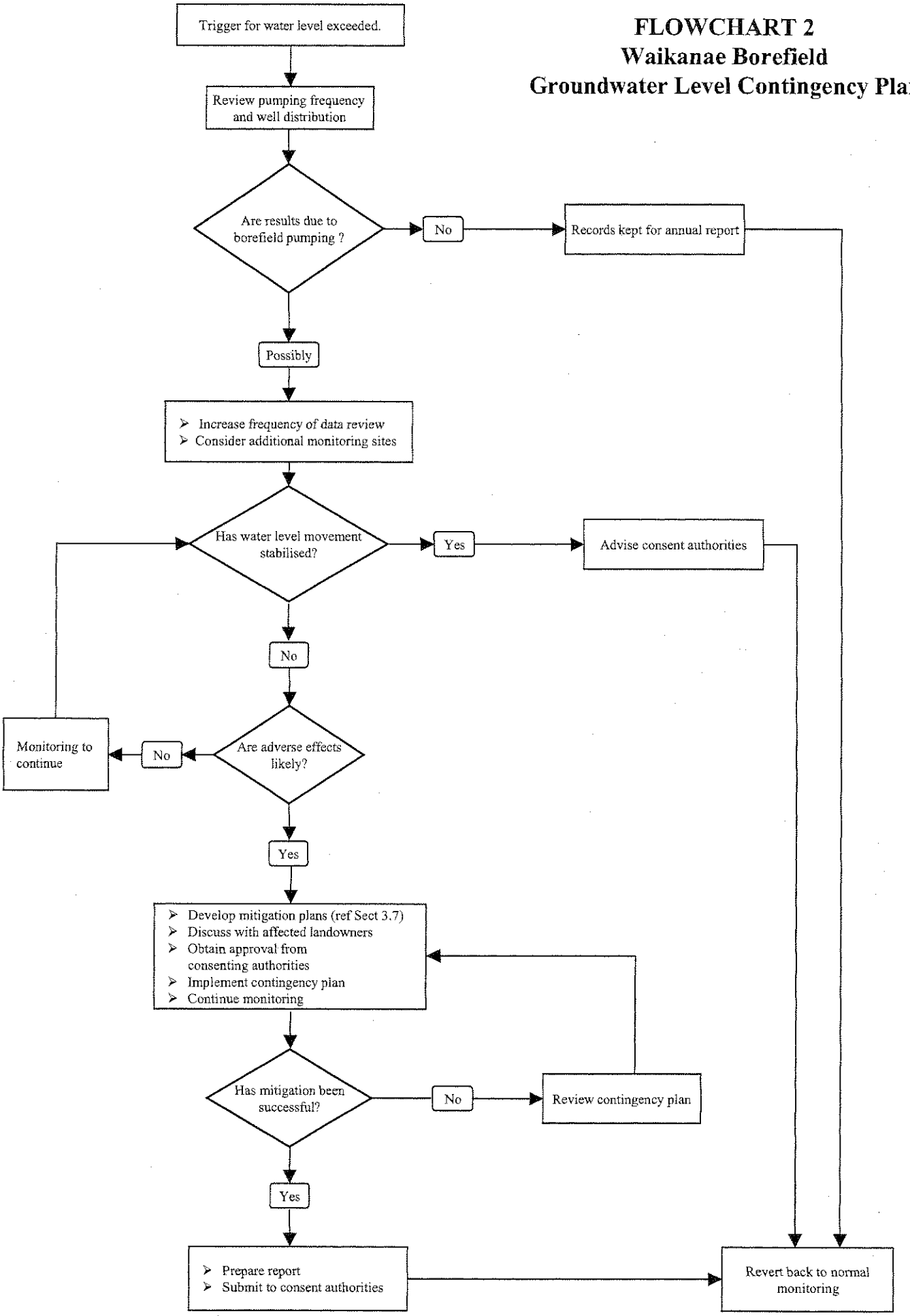
C

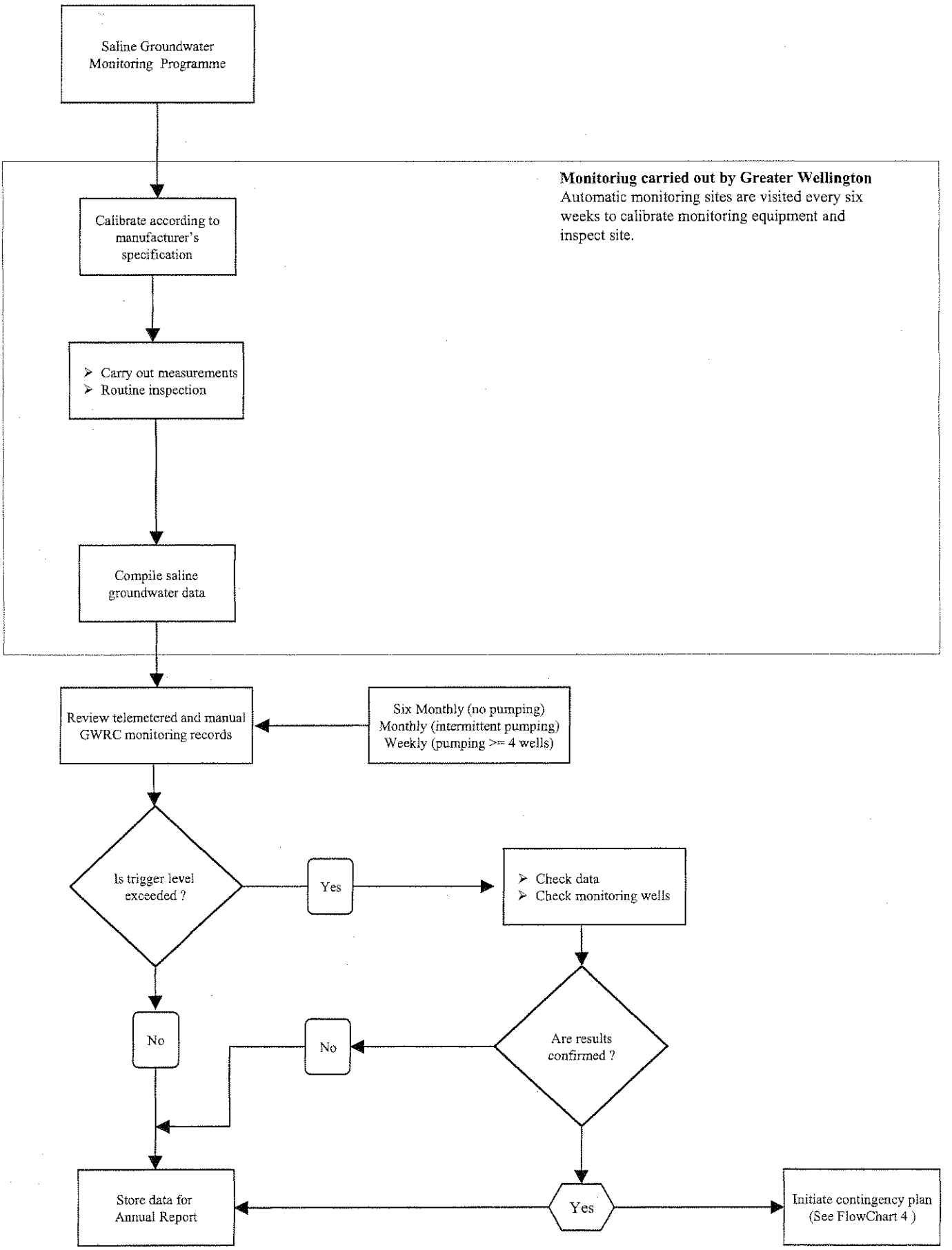
Appendix C Flowcharts



FLOWCHART 1
Waikanae Borefield
Monitoring of Groundwater Levels

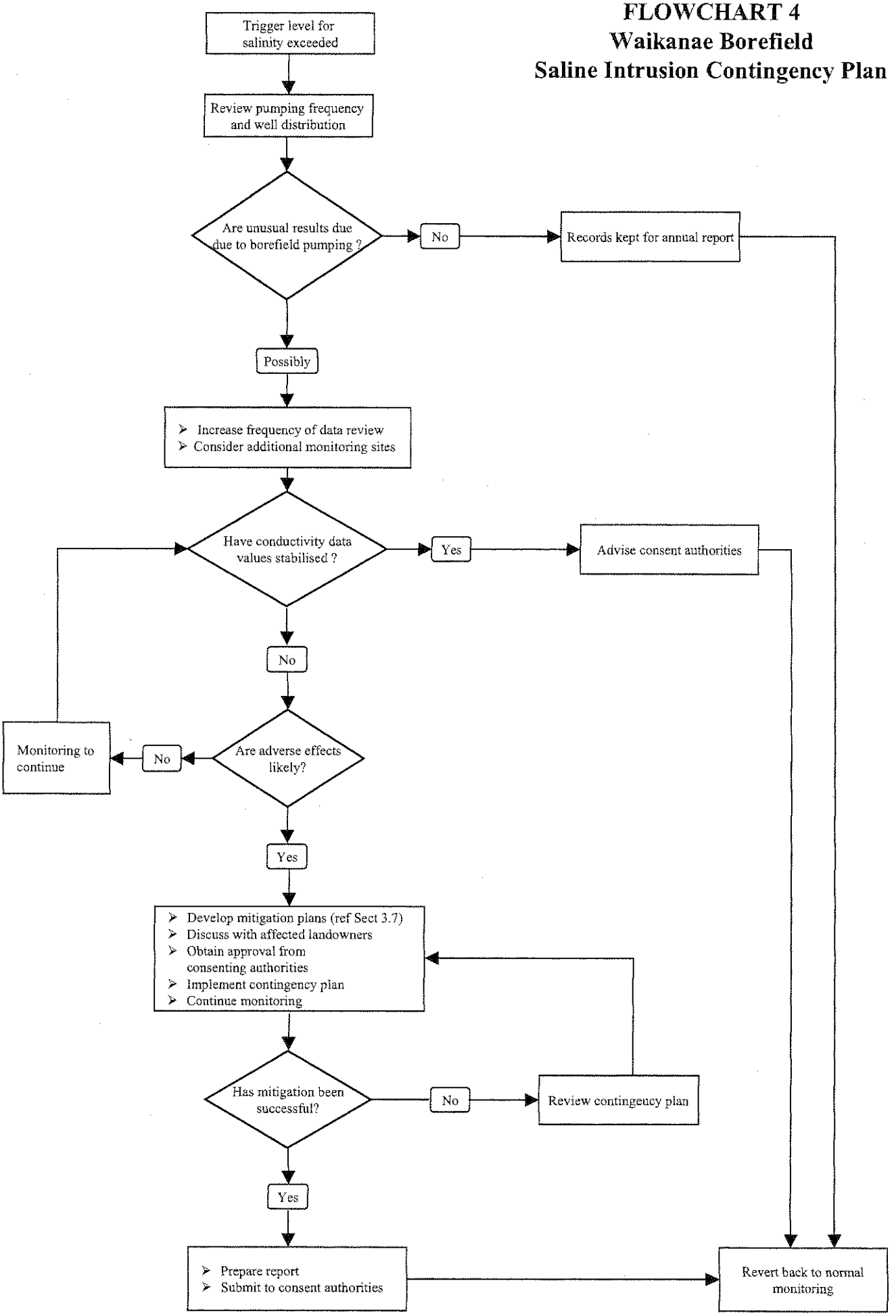
FLOWCHART 2
Waikanae Borefield
Groundwater Level Contingency Plan





FLOWCHART 3
Waikanae Borefield
Monitoring for Saline Intrusion

FLOWCHART 4
Waikanae Borefield
Saline Intrusion Contingency Plan



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