

Environmental Management Group

Environmental Monitoring Section

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**Hawke's Bay Regional Council**  
**State of Environment**  
**Monitor Wells**  
**2003**

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July 2003  
EMI 0310

HBRC Plan Number 3266

## Table of Contents

1	Introduction .....	1
1.1	Purpose .....	2
1.2	Objectives .....	2
1.3	Terms Definitions .....	2
1.4	Data quality .....	3
1.5	Acknowledgement .....	3
2	History .....	4
2.1	Well numbering history .....	4
2.2	Water level history .....	6
2.3	Water quality history .....	9
3	Ground-water related databases .....	11
3.1	Wells database (Wellstor) .....	11
3.2	Water quality database (Puddle) .....	11
3.3	Water level database (TIDEDA) .....	11
3.4	Water level database (Hilltop) .....	11
4	Past and present records .....	12
4.1	Well locations .....	13
4.1.1	Wairoa District wells .....	14
4.1.2	Hastings-Napier District wells .....	15
4.1.3	Central Hawke's Bay District wells .....	17
5	Monitor well criteria .....	19
5.1	Optimal number of sites .....	19
5.2	Monitor criteria .....	19
5.2.1	Shared criteria .....	20
5.2.2	Water level wells .....	20
5.2.3	Water quality wells .....	20
6	2003 State of the Environment Wells .....	22
6.1	Wairoa District .....	23
6.2	Hastings-Napier District .....	25
6.3	Central Hawke's Bay District .....	27
7	Evaluation of 2003 monitor wells .....	29
7.1	Total well value .....	29
7.2	Shared criteria .....	30
7.3	Water level wells criteria .....	30
7.4	Water quality wells criteria .....	31
8	Proposed monitor well sites .....	32
8.1	Wairoa District .....	32
8.2	Hastings-Napier district .....	33
8.3	Central Hawke's Bay District .....	34

9	Procedures for the monitor well program.....	35
9.1	Common to all sites .....	35
9.1.1	Well number .....	35
9.1.2	Field verification.....	35
9.1.3	Site maintenance.....	36
9.2	Water level sites.....	36
9.2.1	Measurement period.....	36
9.2.2	Water level measurement .....	36
9.2.3	Data processing .....	36
9.2.4	Recorder installation criteria .....	36
9.2.5	Well retirement.....	37
9.3	Water quality sites.....	37
9.3.1	Sampling frequency .....	37
9.3.2	Standard sampling determinands .....	37
9.3.3	Data processing .....	37
9.3.4	Well retirement.....	37
9.4	Legal well easements .....	39
10	Recommendations.....	40

## Figures

Figure 1. Wellstor ground-water database evolution. ....	8
Figure 2. Distribution of past and present monitor wells. ....	12
Figure 3. Water quality of monitor wells. ....	12
Figure 4. Location of past and present monitor wells. ....	13
Figure 5. Past and present Mahia area wells, Wairoa District. ....	14
Figure 6. Past and present Wairoa area wells, Wairoa District. ....	14
Figure 7. Past and present eastern Hastings-Napier District wells. ....	15
Figure 8. Past and present western Hastings-Napier District wells. ....	16
Figure 9. Past and present eastern Central Hawke's Bay District wells. ....	17
Figure 10. Past and present western Central Hawke's Bay District wells. ....	18
Figure 11. Current monitor wells locations. ....	22
Figure 12. Current monitor wells monitoring. ....	22
Figure 13. Current monitor wells' depths (metres). ....	22
Figure 14. Distribution of current monitoring, Wairoa District. ....	23
Figure 15. Wairoa current monitor wells depths (metres). ....	23
Figure 16. 2003 Current Wairoa wells. ....	24
Figure 17. Distribution of current monitoring, Hastings-Napier district. ....	25
Figure 18. Hastings-Napier current monitor wells depths (metres). ....	25
Figure 19. 2003 Current Hastings-Napier wells. ....	26
Figure 20. Distribution of current monitoring, Central Hawke's Bay District. ....	27
Figure 21. Central Hawke's Bay current monitor wells depths (metres). ....	27
Figure 22. 2003 Current Central Hawke's Bay wells. ....	28
Figure 23. Distribution of total well rating points. ....	29
Figure 24. Distribution of shared well rating points. ....	30
Figure 25. Distribution of water level well rating points. ....	30
Figure 26. Distribution of water-quality well rating points. ....	31
Figure 27. Proposed wells, Wairoa District. ....	32
Figure 28. Proposed wells, Hastings-Napier District. ....	33
Figure 29. Proposed wells, Central Hawke's Bay District. ....	34

## Tables

Table 1. Well numbering history. ....	5
Table 2. History of the water level monitor well network. ....	7
Table 3. History of the water quality well network. ....	10
Table 4. Well criteria. ....	21
Table 5. Proposed new Wairoa monitor well. ....	32
Table 6. Proposed new Hastings-Napier monitor wells. ....	33
Table 7. Proposed new Central Hawke's Bay wells. ....	34
Table 8. Standard sampling determinands. ....	38
Table 9. Field-measured determinands. ....	38
Table 10. Past and present monitor wells. ....	43

## **Abstract**

Hawke's Bay Regional Council's State of the Environment wells are more closely scrutinised and interpreted than other Hawke's Bay wells. For this reason, all wells require maintenance and quality assurance to ensure optimal data.

This report establishes a long-term monitor well network to describe how aquifer conditions, water level and water quality, change with time. Monitor wells are to represent trends in background, natural, or unanticipated ground water changes. They are not intended to monitor for consent compliance, contamination, or anomalies.

Water levels describe the changing volume of the water resource and water quality suggests how useable it is. The monitor record measures the success of a ground-water management programme as well as to warn when problems develop.

The monitor-well network developed as opportunity developed with each well, rather than planned. There are 190 past and present monitor wells, of which water level has been measured in 158 wells and water quality sampled in 70 wells. There are 100 current sites, for which water level is measured at least once a month in 77 wells and water samples collected four times a year from 49 wells. Twenty six wells overlap as water level and water quality monitoring wells.

The median water-level record duration is 10 years; the longest period of record is 35 years (well 10371). The median water-quality record duration is 9 years; the longest duration is 29 years (wells 1674, 3781, 10212). Hawke's Bay ground water is predominantly a calcium-bicarbonate type.

A well-rating review based on monitoring criteria establishes a monitor well's value. The rating is to be used for deciding which wells to drop and add. The most valuable current well is well 3697, monitoring for water level and quality in south Hastings. Most monitor wells are 20- to 99-m deep and located in the Hastings - Napier district.

Standard methods are introduced for water level measurement and water quality sampling. Eight concluding recommendations are cited, including the need to establish one unique well number for each well and to encourage using this number to link Council databases.

## 1 Introduction

Hawke's Bay Regional Council monitored ground water at 100 wells in 2003. Of these, Council measured water level at least once a month in 77 wells and collected water samples four times a year from 49 wells. Both water level measurements and water quality samples collected at 26 wells. Data from these 100 wells are used to describe the state of the ground-water environment, such as in the State of the Environment report. The areas monitored are in Wairoa District, Hastings-Napier District, and Central Hawke's Bay District. In this report, Hastings District and Napier City are combined as Hastings-Napier District.

There are three fundamental questions regarding monitor wells.

1. Why monitor wells? Monitor wells, like monthly bank statements, tell us how our natural resource investment is progressing. Water levels describe the changing volume of the water resource and water quality suggests how useable it is. Both of these are integrated in their usefulness. For example, an aquifer may have much water but if the quality is unsafe, then it is not useful. Conversely, if the water quality is good but the aquifer is being depleted faster than is sustainable, then that is not a sustainable management program.

The longer the period of record, the greater the well's value. The monitor record measures the success of a ground-water management programme as well as to warn us when problems develop. It is not possible to distinguish a temporary drought from a long-term water-level decline without a historical context.

2. What do we monitor? Wells may monitor for natural conditions where there are no pumping wells or contamination, or they can monitor for human-affected conditions. Using the investment analogy, it is wise to diversify the monitoring program. For this reason, an optimal long-term monitor program would monitor for things such as:
  - areal distribution
  - different well depths
  - some wells in undeveloped areas for background (undisturbed) conditions
  - some wells in developing and developed areas for gauging the acceptability of changes
  - represent aquifers
  - ground-water trends
  - natural trends, unaffected by humans
  - human effects, but not anomalies

This report considers the long-term monitoring programme as distinct from short term monitoring. Short-term monitoring may be suited to specific and time-limited investigations, such as a study of the correlation of ground- and surface-water levels in a specific area or for consent monitoring.

- 3.

How much is a monitor well worth? . A monitor well is the sole-representative of an aquifer and area. A water level monitor well costs about \$2000 each year<sup>1</sup> to measure, archive data, and maintain the site and database (L. Withey, Hydrology team leader, June 2000, oral communication). Some wells cost as much as \$2500. Long-term wells such as 10371 near Flaxmere are therefore an \$80,000 water-resource management investment. This value does not include the increasing usefulness that an accumulated record gains with time for future application and interpretation. For these reasons, monitor wells and database maintenance are water-resource investments.

### **1.1 Purpose**

The general purpose of this report is to propose a monitor well network that would describe how aquifer conditions, water level and water quality, change with time. Monitor wells are to represent trends in background, natural, or unanticipated ground water changes. They are not intended to monitor for consent compliance, contamination, or anomalies.

### **1.2 Objectives**

The general objective is to establish an optimal ground-water-monitoring program for Hawke's Bay. Specific objectives include:

- Describe the evolution of the monitor well network.
- Identify Council ground-water related databases.
- Identify past and present monitor wells.
- Determine monitoring criteria.
- Describe the current monitor well network.
- Rate current monitor wells based on monitoring criteria.
- Identify where future monitor wells are needed.
- Recommend monitor well network maintenance and procedures.
- Recommend changes.

### **1.3 Terms Definitions**

In this report, wells are referred to by one or more of the following:

- 6-digit time-delimited data (TIDEDA) number (such as 402001) for a well with water-level data. This number is used in section 4 because some older wells lack a well number.
- 2- to 4-digit water quality site number (such as 229) for those wells for which water was sampled. This number is used in section 4 because some older wells lack a well number.
- 2- to 5-digit bore permit number (such as 1944), assigned by consent staff typically for a well-drilling consent. All current (2003) wells have this number and it is used to identify wells except in section 4.

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<sup>1</sup> The ground-water quantity project was budgeted for about \$136,000 in 2000-2001, including staff, maintenance, and plant expenses. This value divided by 71 monitor wells in that year results in about \$2,000 per well.

This report refers to various databases.

- Wellstor – well information, such as depth and location
- Daisy – consent information, such as consent number and location
- Puddle – water quality information, such as sampling date and location
- TIDEDA – water level information, such as used to plot hydrographs

The TIDEDA number is a database identification assigned by the National Institute of Water and Atmospheric Research Limited (NIWA). The water quality site number is assigned by Council staff. Hilltop software is gradually augmenting TIDEDA for data processing and display.

Wells are referred to with various terms in this report.

- 2003 wells – monitor network wells in June, 2003
- water level well network – water-level network before amalgamation into State of the Environment well network (July 2001)
- water quality well network – water quality network before amalgamation into State of the Environment network (July 2001)
- State of the Environment (SOE) wells – amalgamation of water level and water quality wells into single ground-water environmental monitoring network (July 2001)
- proposed wells – wells proposed to be drilled after July 2003 to give more complete aquifer representation
- consent monitoring wells – wells required as a consent condition to monitor effects, not background state of the environment

#### **1.4 Data quality**

The data given in this report are as reported from various Council databases, which have errors and inconsistencies. Some errors are specific, such as a wrong value for well depth. Other errors are general, such as inconsistencies in well number.

The most common source of data confusion has been caused by the lack of well numbers and inconsistent well numbers. Previous to this review, fewer than half the monitor wells had well number identifiers. In this report all State of the Environment monitor wells have well numbers.

#### **1.5 Acknowledgement**

Sevicke-Jones (1997) identified all regional monitor sites (rainfall, river, wells, etc.) as well as ground water sites. Hawke's Bay Regional Council data collection and data management staff provided much of the information to produce this report. Kim Coulson supplied original data and assisted with historical well information. Bob McIntyre provided history of the ground-water monitoring programme in Hawke's Bay. Field staff photographed well sites. Consultant Michael Broadbent provided history on how ground-water data was transferred from previous or external records. Council staff Pete Davis, Rebecca Larking, Karl van Turnhout, and Larry Withey reviewed the final draft.

## **2 History**

The monitor-well network developed with opportunity rather than planned. Some wells were retained following an investigation, some wells were damaged and removed, and some wells were drilled with the main objective to monitor water levels. There has not been a comprehensive review for well suitability to monitoring purposes.

### **2.1 Well numbering history**

The current consent-issued series began with well 1 issued on 17 September, 1970. The series numbers given in Table 1 (abstracted from unpublished report to Environmental Monitoring manager, 5/12/1997, Broadbent) are not certain; rather, they express the discontinuous nature of the current well numbering series.

There are three main numbers associated with wells:

- Well number is a non-legal well identification.
- Well permit number is a legal well identification, assigned by Council's environmental regulation section.
- Consent number is the legal reference number for permission to drill a well, assigned by Council's environmental regulation.

Well number in this report refers to either well number or well permit number.

Current well numbers in the 6000 - 9000 range were created to respond to either a duplicate well drilled on the same permit or two (or more) permits (from different issuing authorities) with the same permit number.

For example, Hawke's Bay Regional Council incorporated well permit numbers from pre-existing authorities, such as Napier City Council and Hastings City Council. Both councils likely had a well permit number 5. Hawke's Bay Regional Council had to register both wells with unique numbers. It therefore invented an arbitrary conversion factor to issue a new number to the second or third well that shared the same original well permit number. Napier well 5 may have been assigned as well 5 in the Hawke's Bay Regional Council system. Therefore, Hastings' well 5 would need a unique number and was assigned 6005 in the same system to avoid duplication.

Table 1. Well numbering history.

Series	Issued by	Comments	
1 - 500	Heretaunga Plains Underground Water Authority	Hawke's Bay Regional Council accepted these numbers in their database.	
501 - 2629	Hawke's Bay Regional Water Board	Hawke's Bay Regional Council accepted these numbers in their database.	
2701 - 5011 <b>CONTINUING</b>	Hawke's Bay Regional Council, environmental regulation	The most recent (1/7/2003) sequential-issued consent-issued number is 5011.	
6000 - 6500	Hawke's Bay Regional Council, environmental regulation	Duplicate well permit numbers from external sources given unique number by conversion	Original external well permit numbers 0 - 500 had 6000 added to result in 6000 - 6500 well numbers. This relationship is observed for many wells initially numbered 1 - 500.
6501 - 7000			Original external well permit number not known. No observable conversion number to result in 6501 - 7000 well numbers, but they did not originate from initial 6000-6500 permit numbers.
7000 - 8000			Original external well permit numbers 1 - 999 had 7000 added to result in 7001 - 7999 well numbers. This relationship is observed for many wells initially numbered 1 - 999.
8000 - 9000			Original external well permit numbers 1000 - 1999 had 7000 added to result in 8001 - 9999 well numbers. This relationship is observed for most wells initially numbered 1000 - 1999.
10000 - 12000	Hawke's Bay Regional Council, environmental regulation	Well numbers issued for New Zealand Geological Survey, Ministry of Works, and drillers' sites because there were no pre-existing consent well number.	
15000 - 15022 <b>CONTINUING</b>	Hawke's Bay Regional Council, Environmental Monitoring	Issued by ground-water staff for wells with no apparent consent number. This series started in 2002 with permission from Environmental Regulation. Current (28/7/2003) greatest number is 15033	

## **2.2 Water level history**

Water level monitor wells and their data records were maintained by several organisations, as summarised in Table 2. Data from these organisations evolved into more recent Wellstor computer databases as shown in Figure 1. Historical monitor wells are given in appendix A.

Those persons with current knowledge of the network history include: Kim Coulson, Pete Davis, Bob McIntyre (retired), and Larry Withey of Hawke's Bay Regional Council; Pat Grant (retired) of the Ministry of Works; Jeff Holland with the National Institute of Water and Atmospheric Research, Ltd.

The median length of well record for current wells is 10 years. The current monitor well with the longest period of record is well 10371 (TIDEDA 867001), 2 kilometres northwest of Flaxmere. Water levels have been measured there for 35 years, since the Ministry of Works began measurements in 1968.

Well numbers issued before about 1988 were assigned by original data sources such as Ministry of Works. After about 1988 they were assigned by Hawke's Bay Regional Council consents. In practice, the many well identifiers adopted over the years have caused inconsistencies in the database.

Database errors were caused by different organisations using different coordinate systems; transformation errors in grid origin, orientation, units, and projection system errors (Michael Broadbent, oral communication, January 2000). One well may have had several identifiers. For example, the well referred to as the Grassmere well had a TIDEDA number of 858009, a well number of 1412, a piezometric survey number of 1001, and perhaps more. Other identifiers include application number, water quality number, level number, old imperial number, etc.

**Table 2. History of the water level monitor well network.**

Year	Comments	Investigations	Administration
1938	The Soil Conservation and Rivers Control Act 1941 authorised the establishment of catchment boards in response to the Hawke's Bay Esk flood in 1938.		
1943	The Hawke's Bay Catchment Board was the third board to be established		Hawke's Bay Catchment Board
1954 (?)	Ground-water studies began in Hastings-Napier (Ministry of Works, 1974)	Hawke's Bay Catchment Board	
1962	Water level measurements in open pits began (Grant, 1972)	Hawke's Bay Catchment Board	
1965	First monitor well established, the "Curtis" well 10586; measured till at least 1972, referred to in Grant (1972)	Hawke's Bay Catchment Board	
1966	<ul style="list-style-type: none"> <li>Ministry of Works established their water and soil division in Hawke's Bay.</li> <li>The Hawke's Bay Catchment Board stopped maintaining wells and gave responsibility to Ministry of Works</li> </ul>	Ministry of Works	
1967	<ul style="list-style-type: none"> <li>The Water and Soil Act 1967 created authorities called the Regional water boards, administered by catchment authorities.</li> <li>Hawke's Bay Catchment Board renamed Hawke's Bay Catchment Board and Regional Water Board</li> <li>First recorder well noted (Grant, 1972)</li> <li>First noted well drilled, specifically for water level monitoring (Roys Hill well)</li> </ul>	Ministry of Works	Hawke's Bay Catchment Board and Regional Water Board
1972-1975	Increase in ground-water studies, several wells monitored; many investigation wells drilled; publications	Ministry of Works and Development	
1976	Name change: Ministry of Works, to Ministry of Works and Development	Ministry of Works and Development	
1979	Ministry of Works and Development began to return data collection duties and investigations to Hawke's Bay Catchment Board and Regional Water Board	Hawke's Bay Catchment Board and Regional Water Board	
1981-1982	New sites were initiated, specifically for water-level monitoring	Hawke's Bay Catchment Board and Regional Water Board	
1982-1983	Drought caused greater interest in the ground-water supply. Artificial recharge was proposed.	Hawke's Bay Catchment Board and Regional Water Board	
1984	Ground-water data began to be archived with computers	Hawke's Bay Catchment Board and Regional Water Board	
1989	Hawke's Bay Regional Council formed	Hawke's Bay Regional Council	Hawke's Bay Regional Council
1990-1991	Concentrated ground-water investigations	Hawke's Bay Regional Council	
2000-2003	Monitor well review	Hawke's Bay Regional Council	

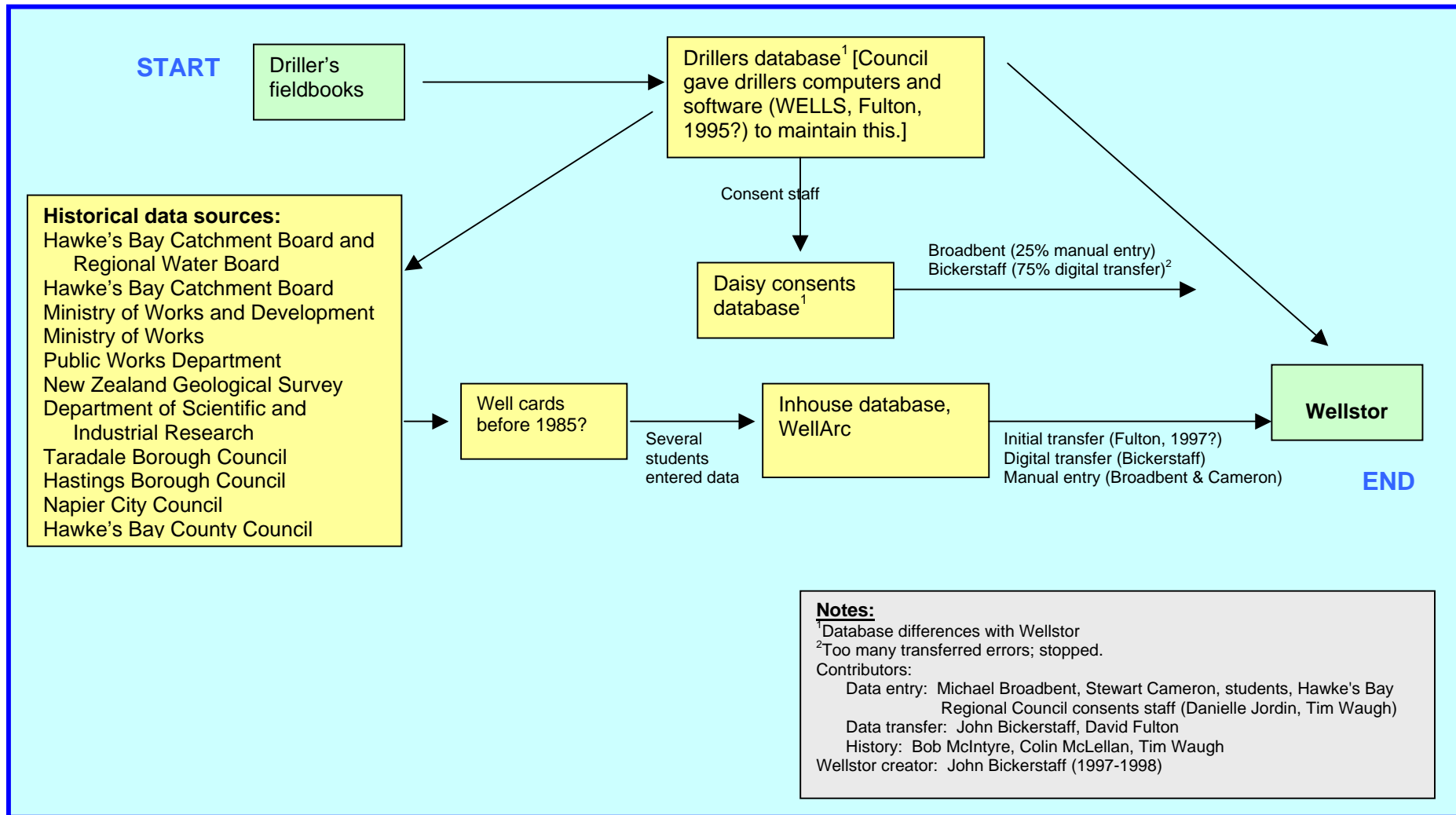


Figure 1. Wellstor ground-water database evolution.

### **2.3 Water quality history**

The Hawke's Bay Catchment Board collected ground-water quality data for investigations from 1974 - 1989. Table 3 summarises water quality monitoring to the present. The main objectives for data collection were to determine the unconfined aquifer boundary, evaluate and monitor contamination potential (such as from landfills, silage pits, septic tanks, and agricultural discharges), and advise on land use surrounding the Hastings-Napier unconfined aquifer (Dravid and Brown, 1997).

In 2003, Hawke's Bay Regional Council sampled 49 sites in the Wairoa area, Hastings-Napier, and Central Hawke's Bay. The median water-quality record duration is 9 years. Wells 1674, 3781, and 10212 have the longest record duration of 29 years, though data may not be continuous.

The monitor network required a review because many sample sites lacked critical relevant information or had unsatisfactory characteristics. Missing information includes well depth and well log information; unsatisfactory characteristics include insecure sample site with a potential to tampering. Such factors limit data confidence and interpretation.

**Table 3. History of the water quality well network.**

Year	Comments	Investigations	Administration
1974	Ground-water monitoring began in Hastings-Napier to evaluate the impact of land use on ground-water quality and potential nitrate leachate	Ministry of Works	Hawke's Bay Catchment Board and Regional Water Board
1974-1978	Ministry of Works completed unpublished report <i>The unconfined aquifer of the Heretaunga Plains groundwater system</i> and the Heretaunga Plains Groundwater Contamination Technical Committee is established	Ministry of Works and Development	
1979-1989	<ul style="list-style-type: none"> <li>▪ Regional landfills and timber treatment plants monitored</li> <li>▪ Recommendations made to city and district councils regarding land use practices to protect groundwater quality</li> </ul>	Hawke's Bay Catchment Board and Regional Water Board	
1989	Hawke's Bay Regional Council formed	Hawke's Bay Regional Council	Hawke's Bay Regional Council
1991-1994	Ground-water quality investigations of Roys Hill and Omaranui landfill sites	Hawke's Bay Regional Council	
1994-1997	<ul style="list-style-type: none"> <li>▪ Historical water-quality data reviewed and regional monitoring network established</li> <li>▪ Site specific ground-water quality investigation to evaluate land-use effects on ground-water quality</li> </ul>	Hawke's Bay Regional Council	
1997-2000	Monitor sites added in the Wairoa area and southern Central Hawke's Bay	Hawke's Bay Regional Council	
2000-2001	Monitor well review	Hawke's Bay Regional Council	

### **3 Ground-water related databases**

The ground-water databases exist to provide base data for interpretation. They should be practically complete, accurate, understandable to managers, in a form readily transferred to other applications and computer softwares, and it should be kept secure (archived).

#### **3.1 Wells database (Wellstor)**

Wellstor contains 5837 (28/7/2003) well records, typically for consented wells. Wellstor is described in Broadbent (1999) and expected to be updated in van Turnhout (2003).

Historically, a well number was issued when a well was consented. Well numbers have 1 - 5 digits. About half of Hawke's Bay wells are unconsented because they were drilled before consents were required. Therefore, there are about 4,000 Hawke's Bay wells without well numbers.

#### **3.2 Water quality database (Puddle)**

Puddle is the Hawke's Bay Regional Council water-quality database that stores surface- and ground-water quality data as well as site characteristics. There are 73 ground-water sites in Puddle (16/6/2003). Environmental Management Services, Ltd. (2001) describes the use of Puddle.

#### **3.3 Water level database (TIDEDA)**

Water level data for water-level monitor wells were stored from about 1982 in a software database designed by the National Institute of Water and Atmospheric Research, Limited (NIWA). All past monitor wells were assigned a 6- or 7-digit TIDEDA number. Water level measurements are stored in separate manual and recorder databases by this TIDEDA number. TIDEDA is useful for statistical operations.

#### **3.4 Water level database (Hilltop)**

Council began storing water level data in Hilltop software in 2002. Hilltop is useful for easy data management and integration with other data. This is to become the dominant database software though still using TIDEDA capabilities. Hilltop stores data by site name, not number.

## 4 Past and present records

Past and present wells are summarised and identified here so that they may be referenced in future investigations. There are past and present records for 190 monitor wells, of which water level has been measured in 158 wells (120 water-level only + 38 water level and water quality) and water quality sampled in 70 wells (32 water quality only + 38 water level and water quality). Pie chart numbers given in Figure 2 and throughout this report are well numbers.

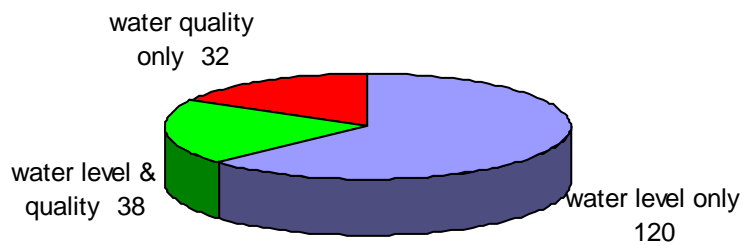


Figure 2. Distribution of past and present monitor wells.

Hawke's Bay ground-water quality is predominantly a calcium-bicarbonate type, based on samples collected from 48 monitor wells (Figure 3). Though calcium-bicarbonate is the most common ground-water type throughout the world, sodium water is less common in shallow ground waters.

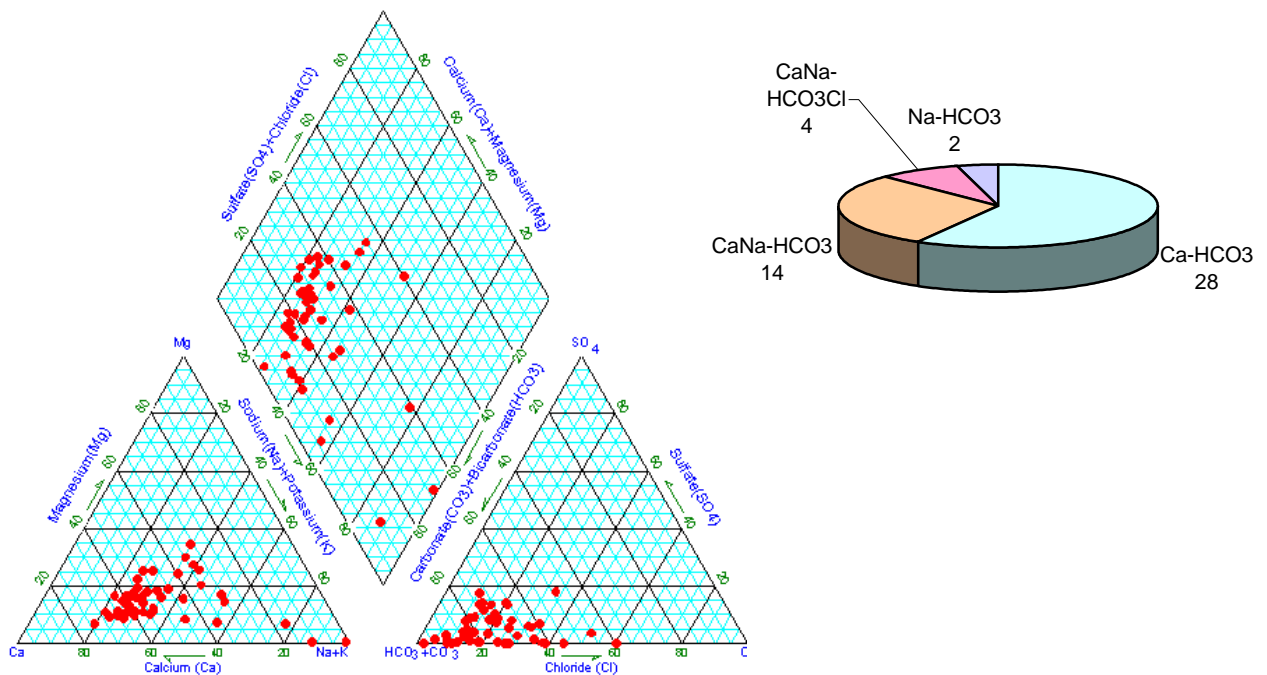


Figure 3. Water quality of monitor wells.

#### 4.1 Well locations

This report divides monitor areas into three areas: Wairoa District, Hastings District and Napier City, and Central Hawke's Bay. This report refers to Hastings District and Napier City, collectively, as Hastings-Napier District. Most past and present monitor wells are in Hastings-Napier district. Figure 4 summarises monitor areas by district. This report includes minor districts Taupo and Rangitikei, western Hawke's Bay, with Hastings-Napier district.

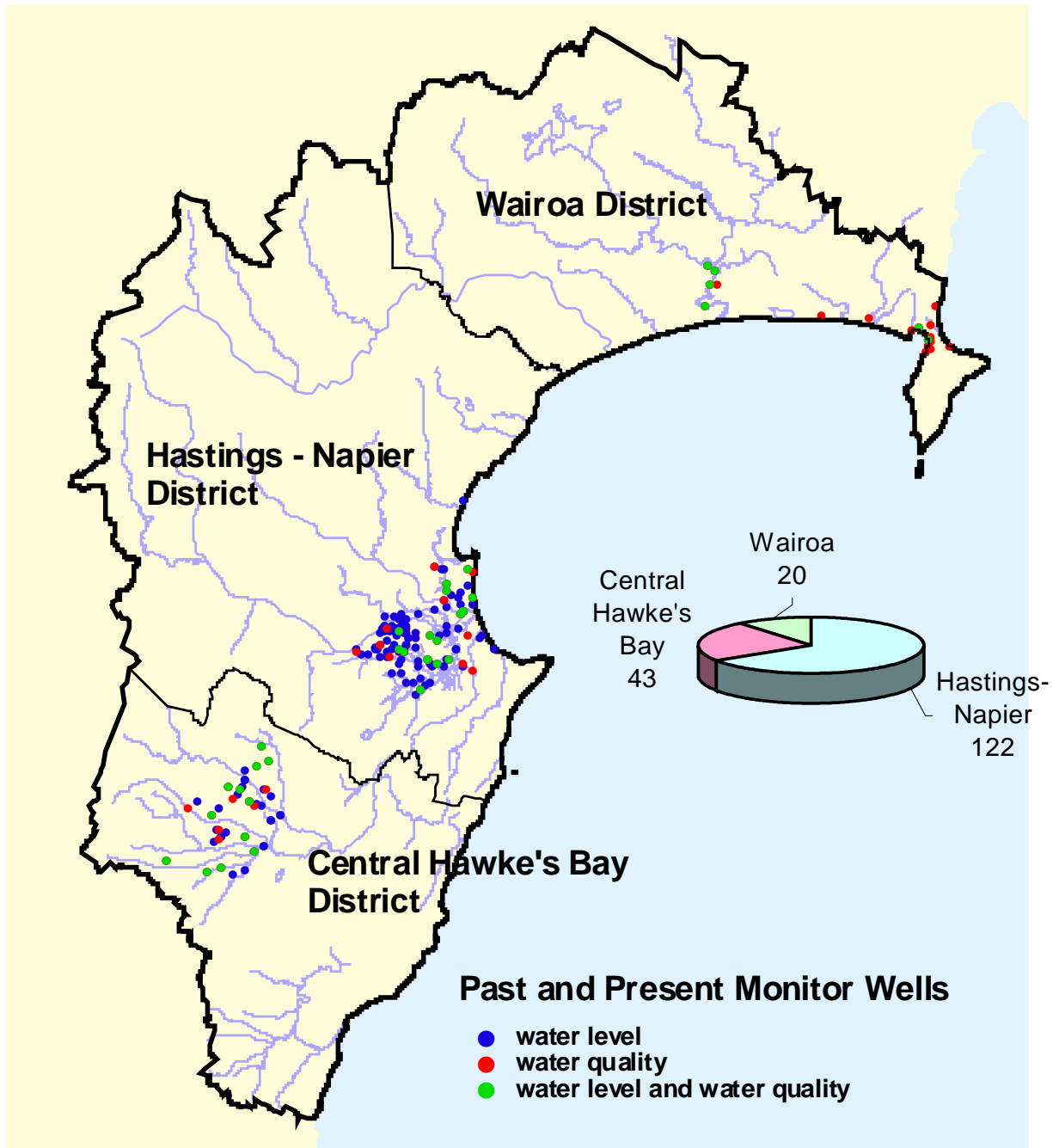


Figure 4. Location of past and present monitor wells.

#### 4.1.1 Wairoa District wells

Of the 190 past and present Hawke's Bay monitor wells, 20 are in Wairoa District. Wells, near Mahia and Wairoa have had water samples only collected until 2001. After that year, water level has also been measured in some wells.

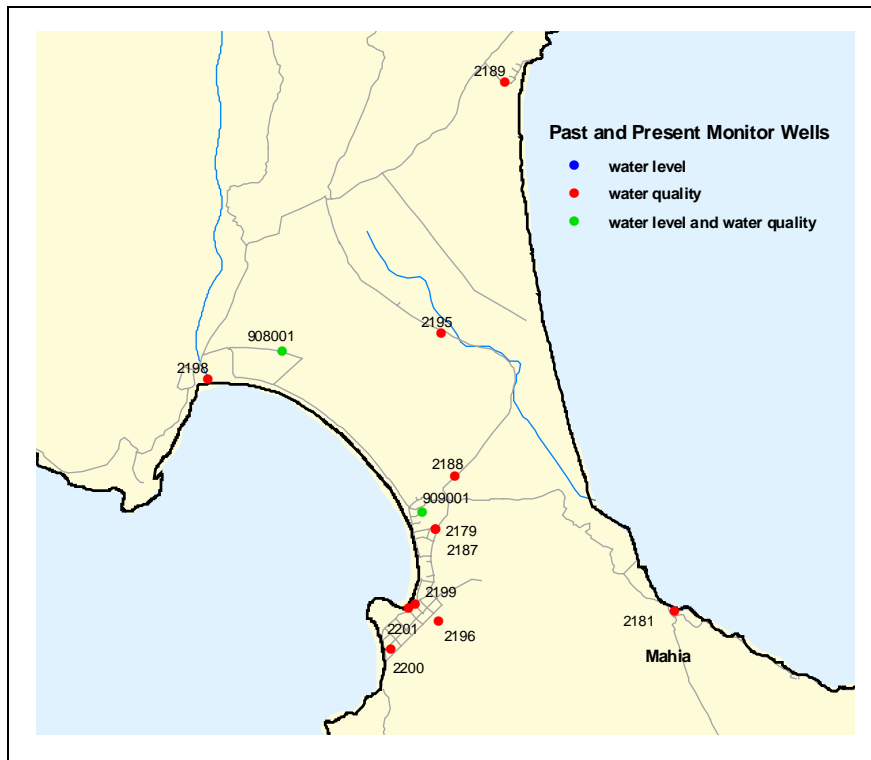


Figure 5. Past and present Mahia area wells, Wairoa District.

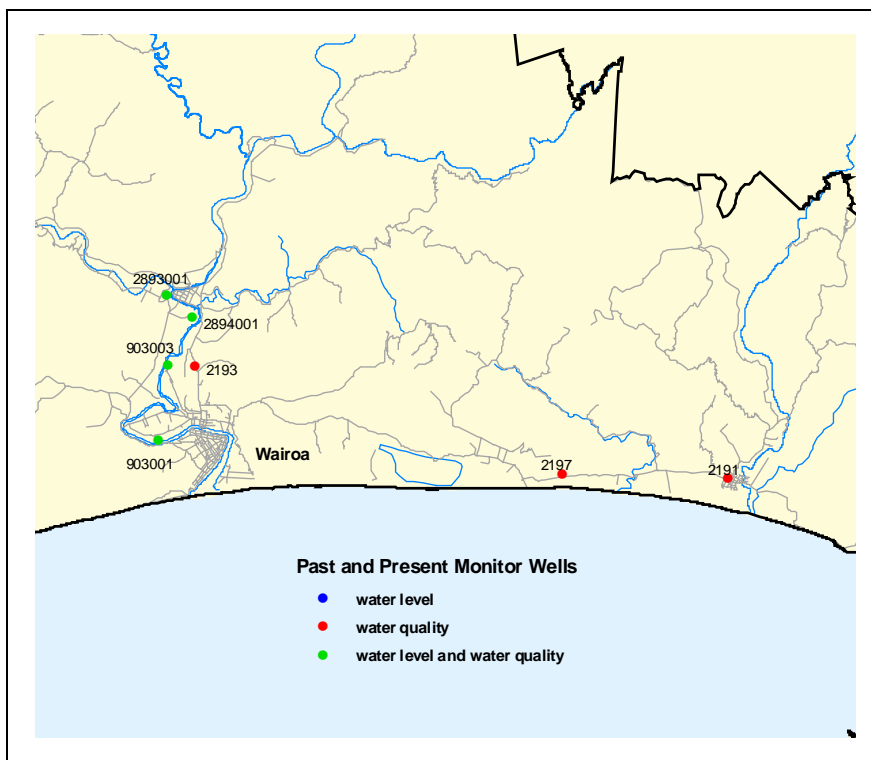


Figure 6. Past and present Wairoa area wells, Wairoa District.

### 4.1.2 Hastings-Napier District wells

Of the 190 past and present Hawke's Bay monitor wells, 125 are in Hastings-Napier district.

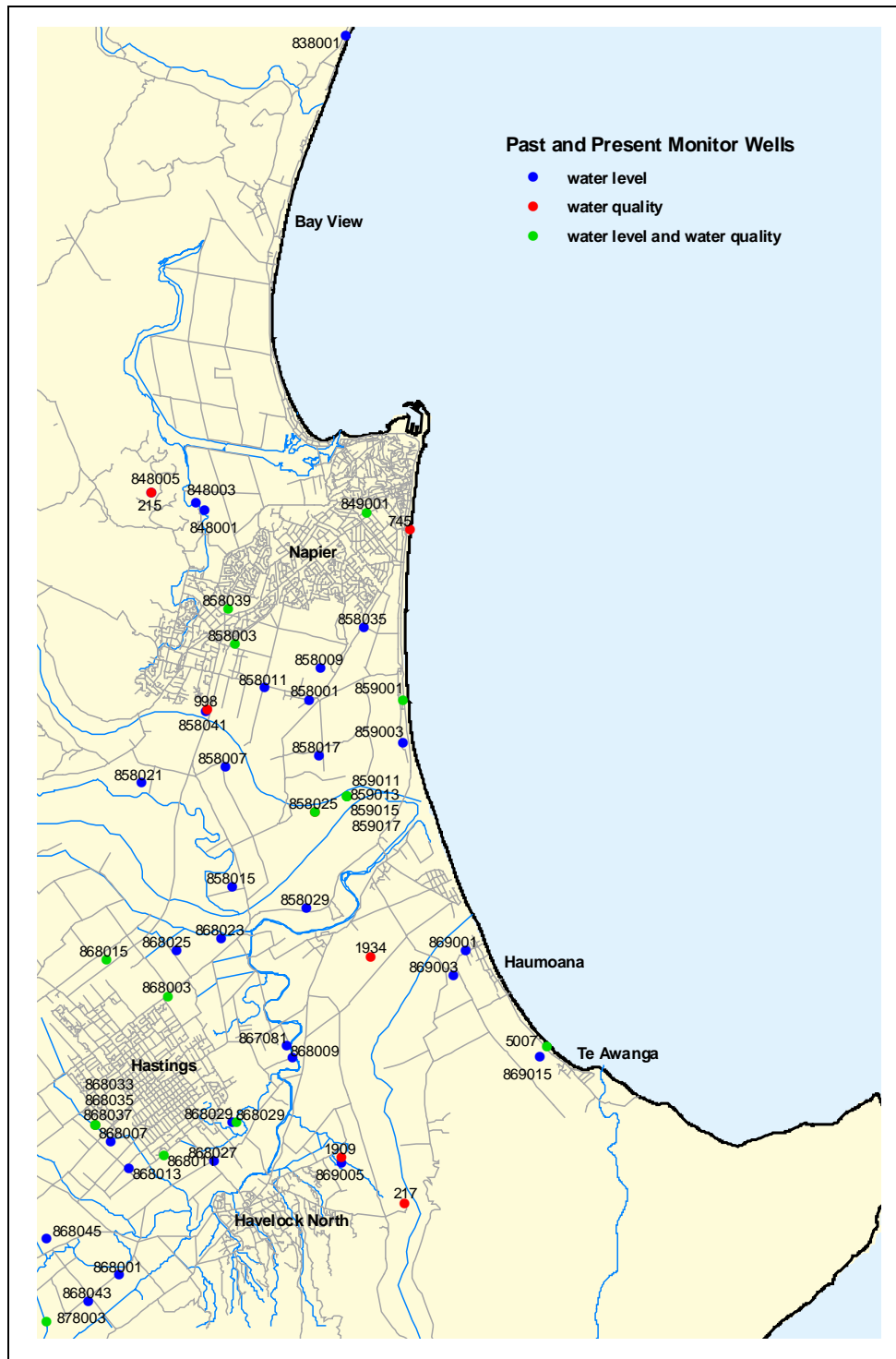


Figure 7. Past and present eastern Hastings-Napier District wells.

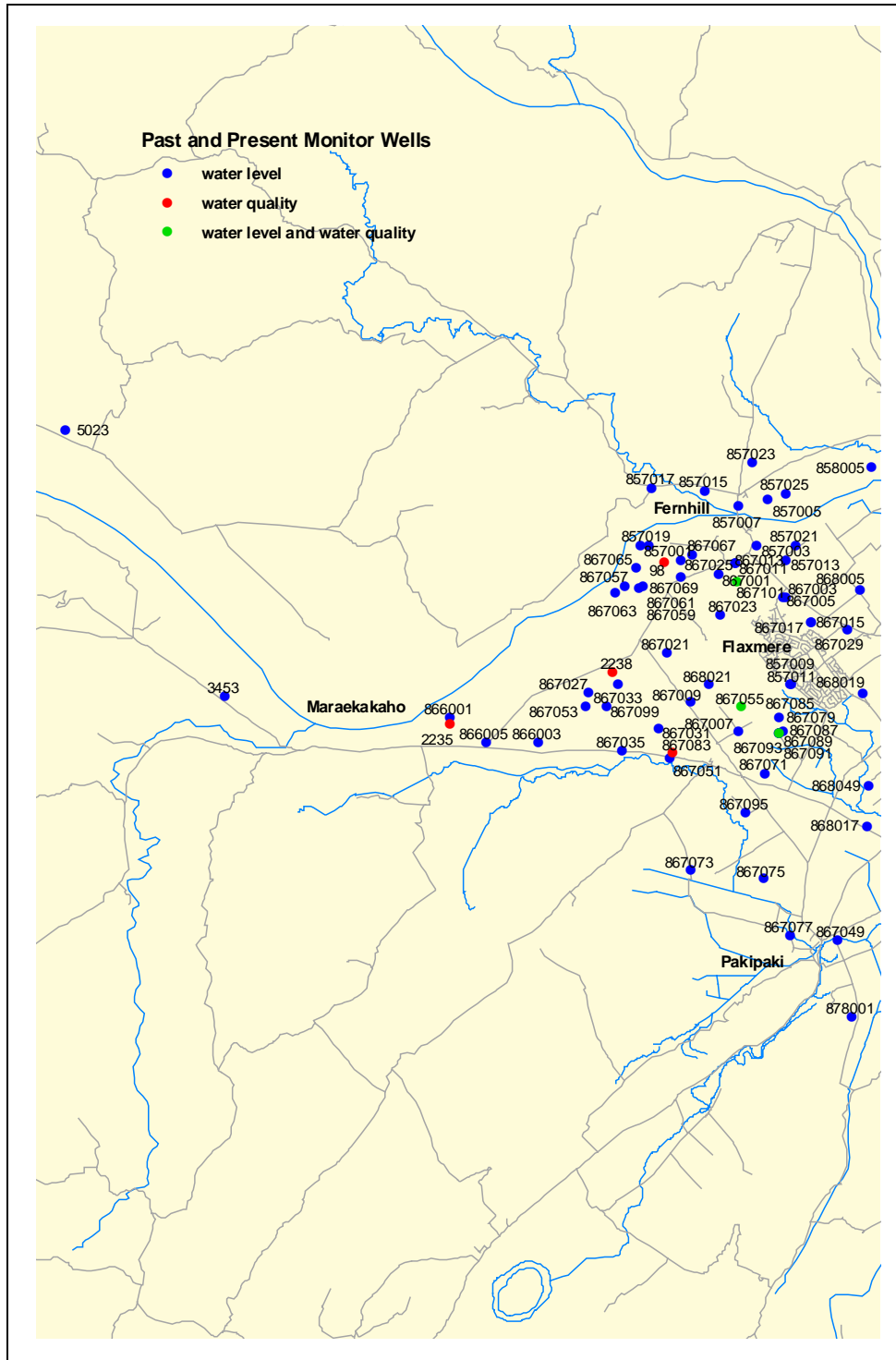


Figure 8. Past and present western Hastings-Napier District wells.

#### 4.1.3 Central Hawke's Bay District wells

Of the 190 past and present Hawke's Bay monitor wells, 45 are in Central Hawke's Bay District.

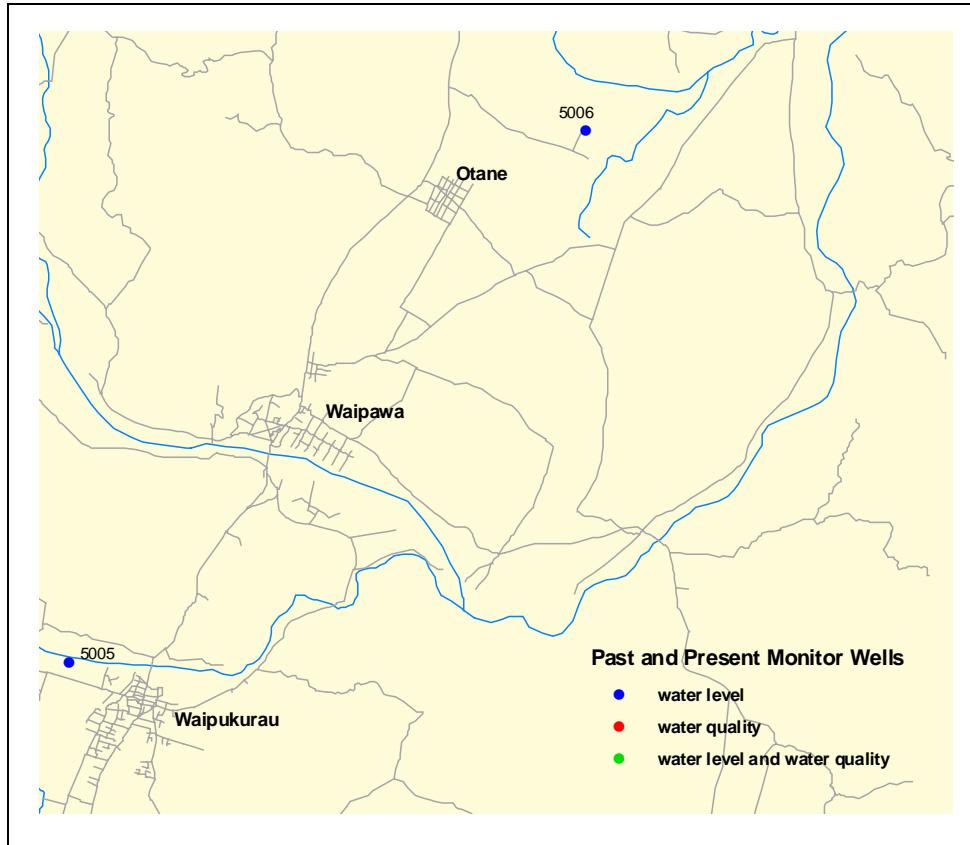


Figure 9. Past and present eastern Central Hawke's Bay District wells.

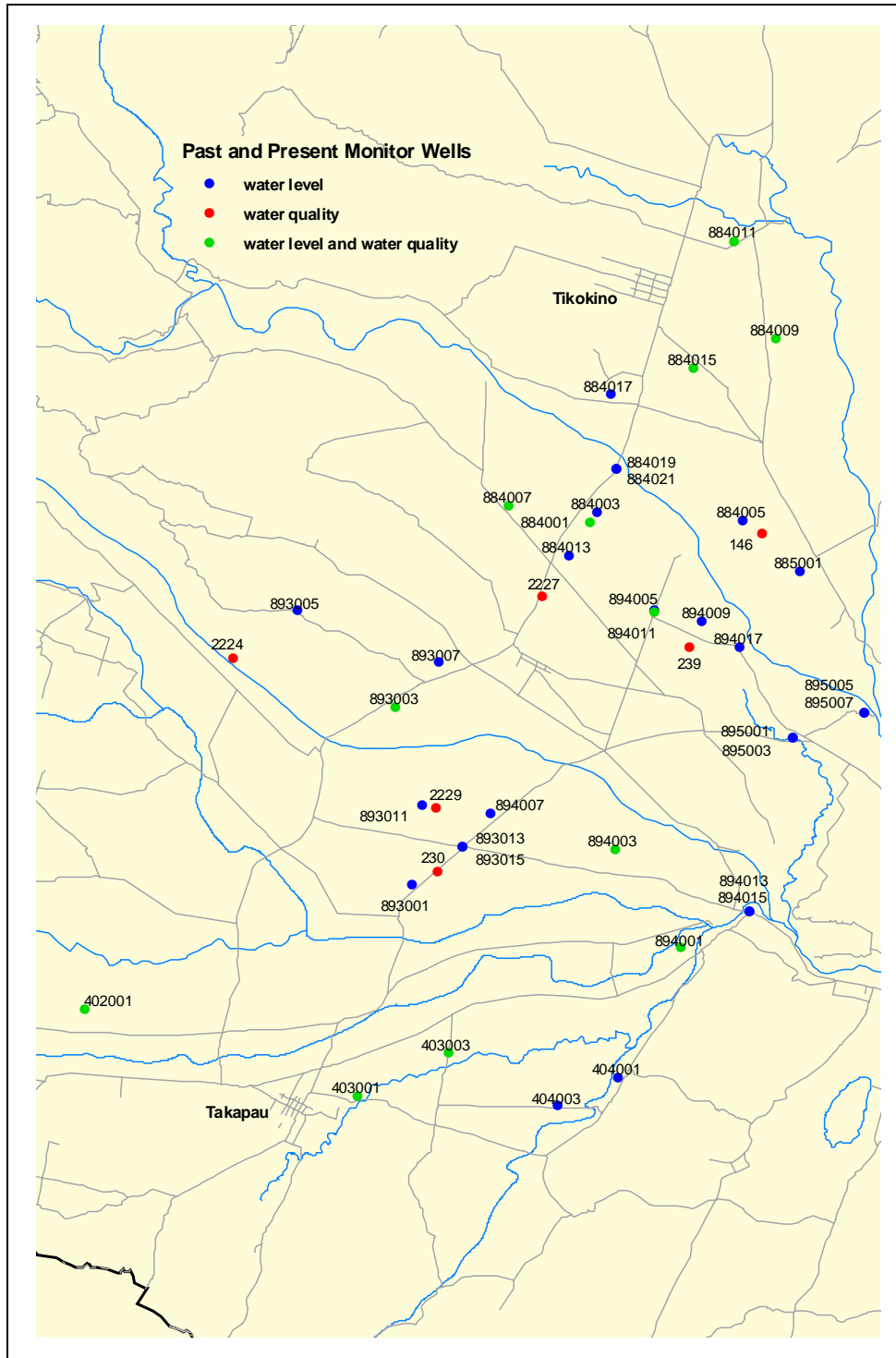


Figure 10. Past and present western Central Hawke's Bay District wells.

## 5 Monitor well criteria

A state of the environment monitor well should express aquifer conditions – not the delivery system such as a well and not the effects of individual consented wells on one another. Nearby pumping wells can affect water level measurements and pressure tanks can affect water quality. Additionally, there should be enough ground-water monitor sites to optimally represent regional aquifers without being too cumbersome to manage.

### 5.1 Optimal number of sites

Determining the optimal number of monitor wells is a balance of having enough wells to characterise Hawke's Bay aquifers and the staff number to maintain the wells and data. Too many wells would be cumbersome for staff to measure, maintain, and archive. Too few would not give a full enough basis from which to launch current and future ground-water investigations.

One method to determine an optimal number of monitor wells is to assume an even distribution over Hawke's Bay. That part of Hawke's Bay that is relevant is the relatively flat areas where aquifers are thicker and therefore more important to manage. Aquifers in hilly or mountain areas are discontinuous and any monitoring would be site specific rather than general. Therefore, the first step is to determine how much area is relatively flat.

Flat areas	km <sup>2</sup>
Wairoa	118
Hastings-Napier	300
Central Hawke's Bay	260
<b>Total</b>	<b>678</b>

Given an area of about 700 km<sup>2</sup>, about 80 evenly-spaced wells would ideally result in 1 well for every 9 km<sup>2</sup>. More simply, any site would be within 2 kilometres of a monitor well.

Additional wells at the same site allow monitoring vertical ground-water movement. It is useful to have either two wells of different depths near one another (within 100 metres) or two piezometers in the same well, sealed to different depths. An example of multiple piezometers at one site is Awatoto piezometers 15001, 15002, 15003, and 15022.

This 2-kilometre distance coincides with pumping well effects. A large production well may affect water levels up to about 2 kilometres radius, but not much more.

### 5.2 Monitor criteria

Some wells have more monitoring value than others. Decisions are sometimes needed to adopt a monitor well, retire a monitor well, or review the well network. To do this, criteria need to be identified to test the suitability of a monitor well. Criteria may include things such as whether the well itself is pumped, if water has been sampled, and record duration.

Table 4 gives well value ratings with 3 categories: shared characteristics for 6 points, water-level measurement characteristics for 16 points, and water quality characteristics for 10 points. There are 32 maximum points possible.

This criteria rating method objectively evaluates a well's value, total and use-specific, such as water level and water quality. For example, well 1944 given in appendix B warrants 4 points for shared criteria, 6 points for water level criteria, and 8 points for water quality for a 18-points total. Section 7 of this report summaries total point distribution for the monitor wells.

### **5.2.1 Shared criteria**

Water level and water quality wells both benefit by knowing well construction details and having a secure site that will not be disturbed over time. For example, it is important to know what the water-level represents, therefore, knowing the measured well depth warrants 2 points and the drilling log is worth 1 point. There are a maximum of 6 shared criteria points.

### **5.2.2 Water level wells**

Water level wells benefit from such things as long record, easy access, and unaffected data. For example, well 10371 has 35 years of water-level measurements and therefore receives 3 criteria points for record duration. But there is no well log so 0 points for that criteria. This well is also used for sampling water quality and this augments this well's total value. There are a maximum of 16 criteria points that rate a well's value for water-level use.

### **5.2.3 Water quality wells**

The criteria for water quality wells include factors that may affect the collected sample. For example, water that has passed through a pressure tank or insufficient well purging may contain greater residual chemical constituents such as iron and manganese than background ground water.

Water quality wells benefit from such things as long record, easy sampling, and no pressure tank. For example, well 1799 has 8 years of water sampling records for 1 criteria point and samples are direct from the well for 2 points. But water level is not measured in this well and this diminishes its total network value. There are a maximum of 10 criteria points that rate a well's value for water-quality use.

**Table 4. Well criteria.**

<b>Item</b>	<b>Comments</b>	<b>Value</b>
<b>Shared Criteria</b>		
Well depth	Useful for representing a specific aquifer.	2 = measured 1 = reported
Well log	Useful for describing aquifer.	1 = yes 0 = no
Ability to monitor	It is efficient to be able to monitor water level and quality in the same well. Casing must be at least 6-cm to sample, have pump, or flow to land surface.	2 = water level & quality 0 = water level or quality
Secure site	A secure site (such as locking cap) gives longer uninterrupted record.	1 = yes 0 = no
<b>Water Level Criteria</b>		
Proximal well of different depth	To describe potential vertical ground-water movement--100-m proximity.	2 = yes 0 = no
Distance to nearest monitor well	A remote monitor well is more valued for representing a larger area and providing background data before development.	3 (> 4 km) 2 (> 3 km) 1 (> 2 km) 0 (<2)
Record duration	Long-term record indicates how a current phenomenon fits into the greater context. For example, whether it is an isolated drought or a long-term water-level decline.	3 (> 26 years) 2 (> 16 years) 1 (> 6 years) 0 (<6 years)
Water level trend	Ground-water trend may require continued monitoring for interpretation, such as an early warning of a problem.	2 = >3m/10 yr 1 = 1-2m/10 yr 0 = little change ? = undetermined
Pump in well	A monitor well without a pump avoids water-level disturbance.	2 = no 0 = yes
Pumping affected	A well in an area where water is not pumped describes natural ground-water conditions – background data.	2 = no 1 = some 0 = significant
Easily accessed and measured	Difficult access and measurement slows down a well run and affects measurements.	2 = easy 1 = typical 0 = difficult
<b>Water Quality Criteria</b>		
Distance to nearest monitor well	A remote monitor well is more valued for representing a larger area and providing background data before development.	3 (> 4 km) 2 (> 3 km) 1 (> 2 km)
Record duration	A long-term record can indicate aquifer health and water-quality changes over time.	3 (> 20 years) 2 (> 10 years) 1 (> 5 years)
Sample point	Sampling nearer the aquifer source gives more accurate aquifer representation. Pipes, hoses, and sediment accumulation in tanks affect water samples.	2 = direct well 1 = hose/pipe 0 = tank pressure/store
Easily accessed and sampled	Difficult access for pump equipment and long purging times takes longer and affects results.	1 = easy 0 = hard
Portable pump required	Wells with pumps require less setup time and require less purging time.	1 = no 0 = yes

## 6 2003 State of the Environment Wells

There are 100 state of the environment wells; most are in Hastings-Napier district (Figure 11). Monitor type distribution is shown in Figure 12; depths monitored are shown in Figure 13. More wells now serve a dual purpose of water level and water quality monitoring, thereby increasing monitoring efficiency (more data from each well).

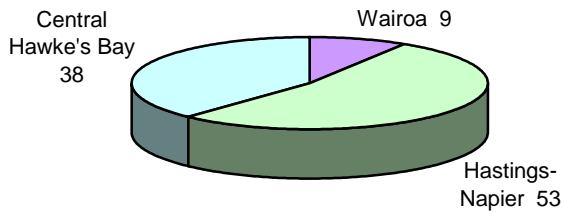


Figure 11. Current monitor wells locations.

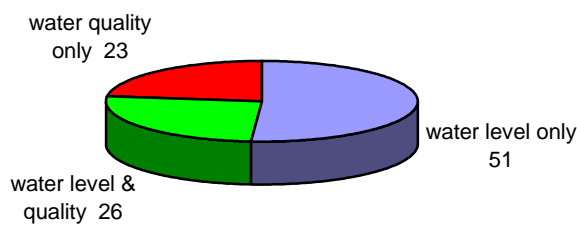


Figure 12. Current monitor wells monitoring.

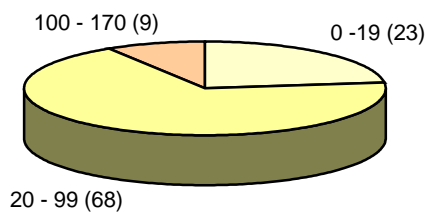


Figure 13. Current monitor wells' depths (metres).

### 6.1 Wairoa District

Of the 9 monitor wells in Wairoa District, water level is measured in 6 and water quality sampled in 9. Figure 14 shows what was monitored, Figure 15 shows depth monitored, and Figure 16 shows where it is monitored.

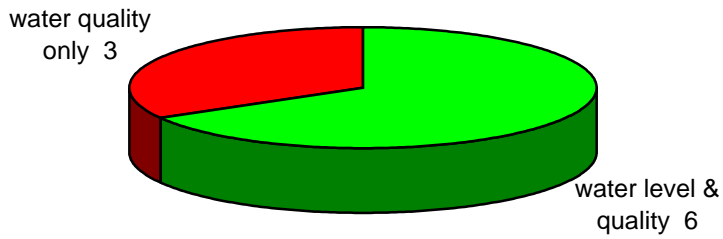


Figure 14. Distribution of current monitoring, Wairoa District.

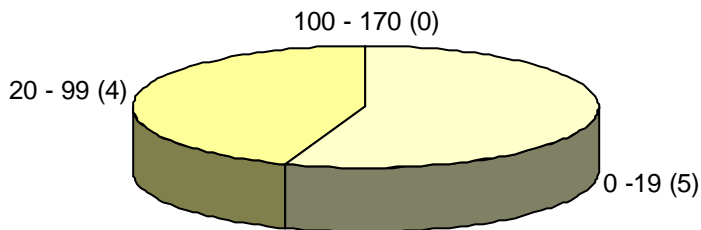


Figure 15. Wairoa current monitor wells depths (metres).

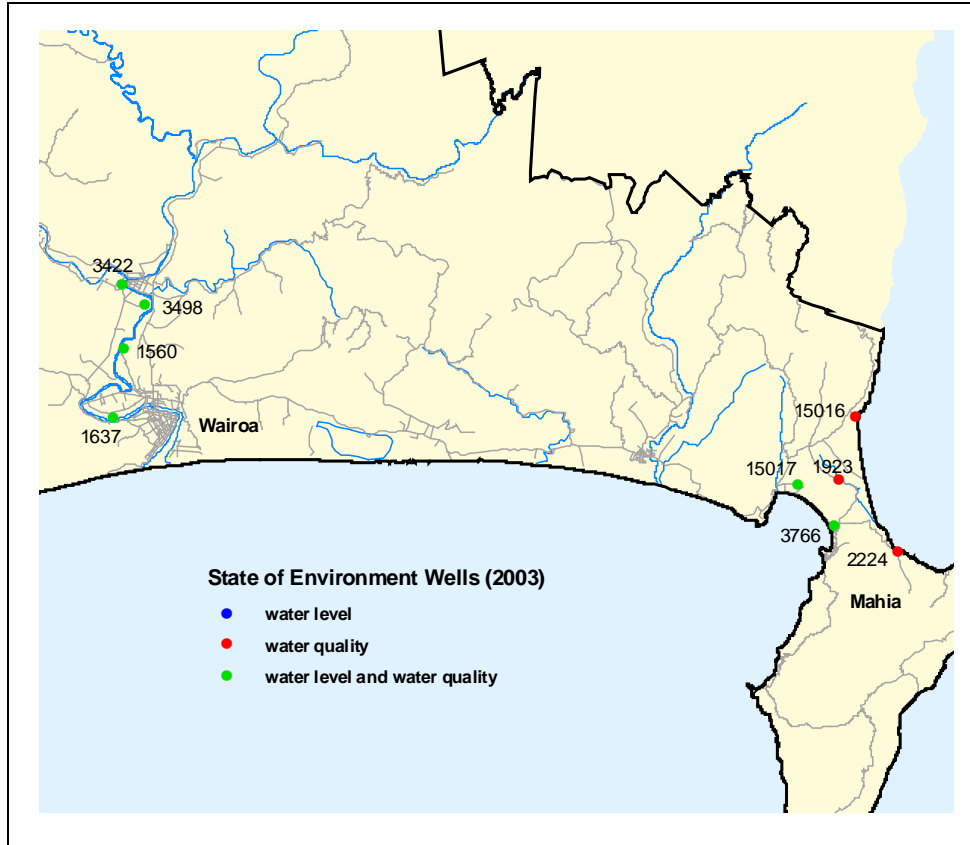


Figure 16. 2003 Current Wairoa wells.

## 6.2 Hastings-Napier District

Of the 53 monitor wells in Hastings and Napier district, water level is measured in 39 and water quality sampled in 27. Figure 19 shows what was monitored, Figure 18 shows depth monitored, and Figure 19 shows where it is monitored.

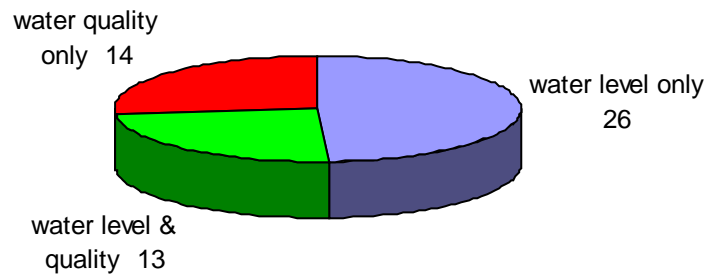


Figure 17. Distribution of current monitoring, Hastings-Napier district.

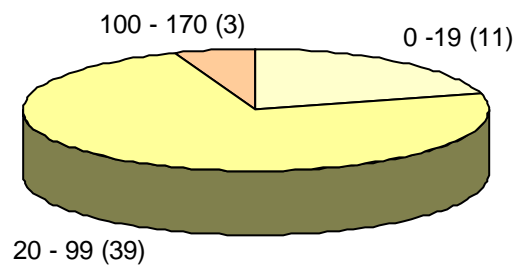


Figure 18. Hastings-Napier current monitor wells depths (metres).

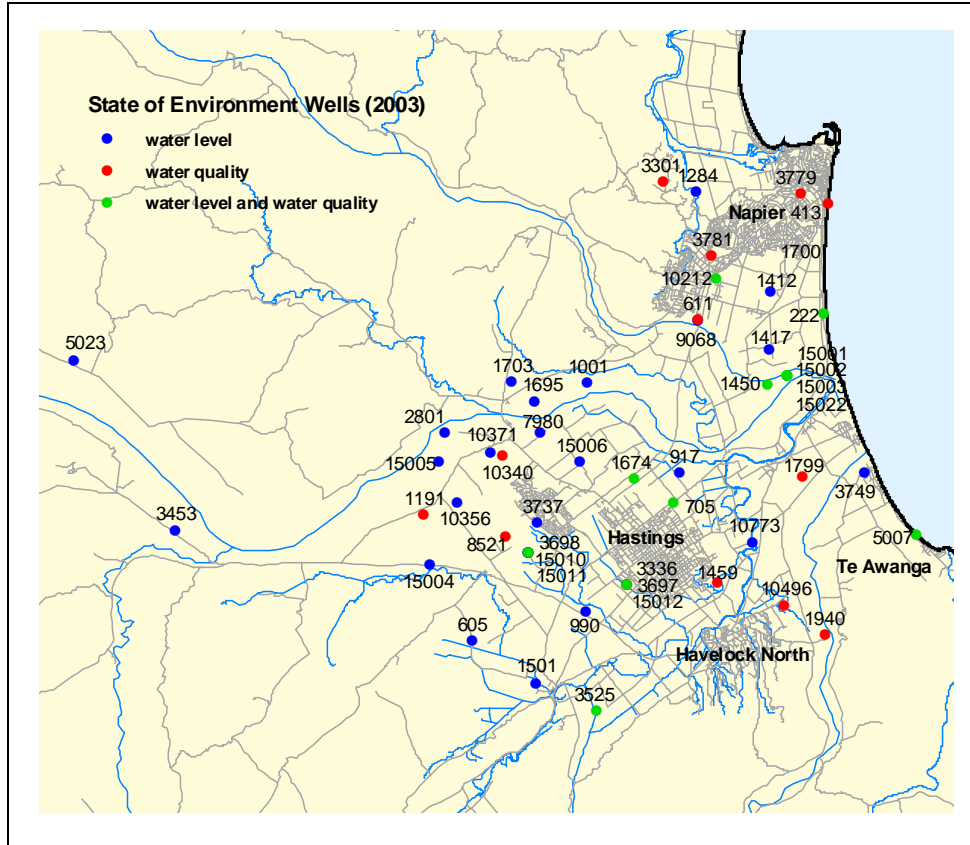


Figure 19. 2003 Current Hastings-Napier wells.

### 6.3 Central Hawke's Bay District

Of the 38 monitor wells in Central Hawke's Bay, water level is measured in 32 and water quality sampled in 13. Figure 20 shows what was monitored, Figure 21 shows depth monitored, and Figure 22 shows where it is monitored.

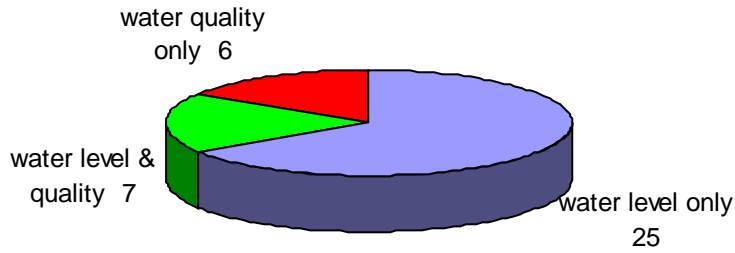


Figure 20. Distribution of current monitoring, Central Hawke's Bay District.

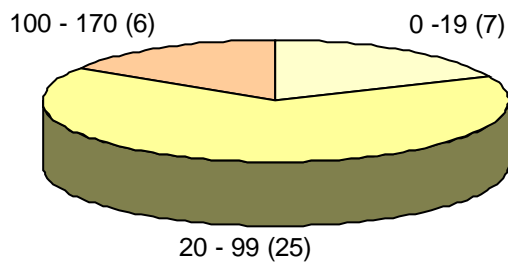


Figure 21. Central Hawke's Bay current monitor wells depths (metres).

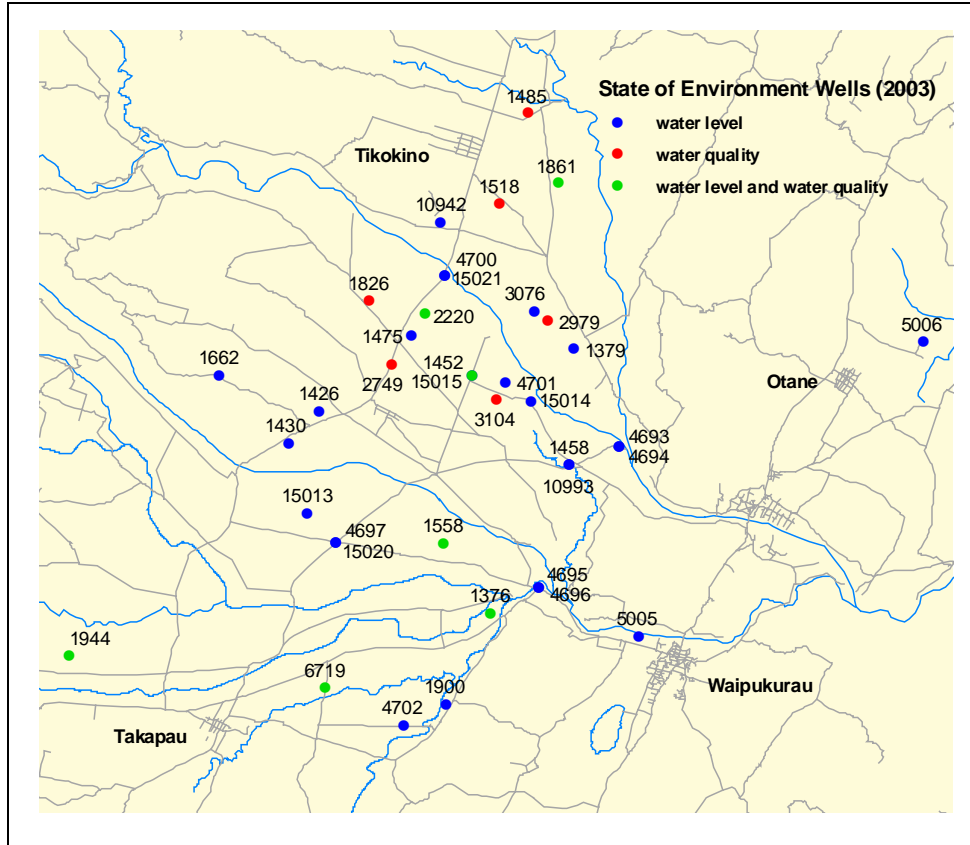


Figure 22. 2003 Current Central Hawke's Bay wells.

## 7 Evaluation of 2003 monitor wells

Appendix B reports monitor well attributes and each well's value for monitoring. This table and resulting rating is a means to objectively indicate a monitor well's value and is considered in conjunction with subjective experience.

A well's full value for monitoring is based on objective values. Section 7.1 gives a total well value based on section 5.2 criteria. Sections 7.2, 7.3, and 7.4 assign sub criteria values based on specific-use characteristics.

This report's objective was to assess each well for suitability to purpose. Though it is an incomplete assessment, it does provide a point of discussion for subjective values. These considerations are used to recommend the optimal monitor well network given in section 6.

### 7.1 Total well value

Total criteria points ranged from 6 to 22, median 10, with a maximum possible 32 points. Figure 23 shows how many wells received given points. For example, 9 wells received 10 points. Well 3697 (south Hastings), with 22 points, is clearly the most valuable well that monitors water level and water quality.

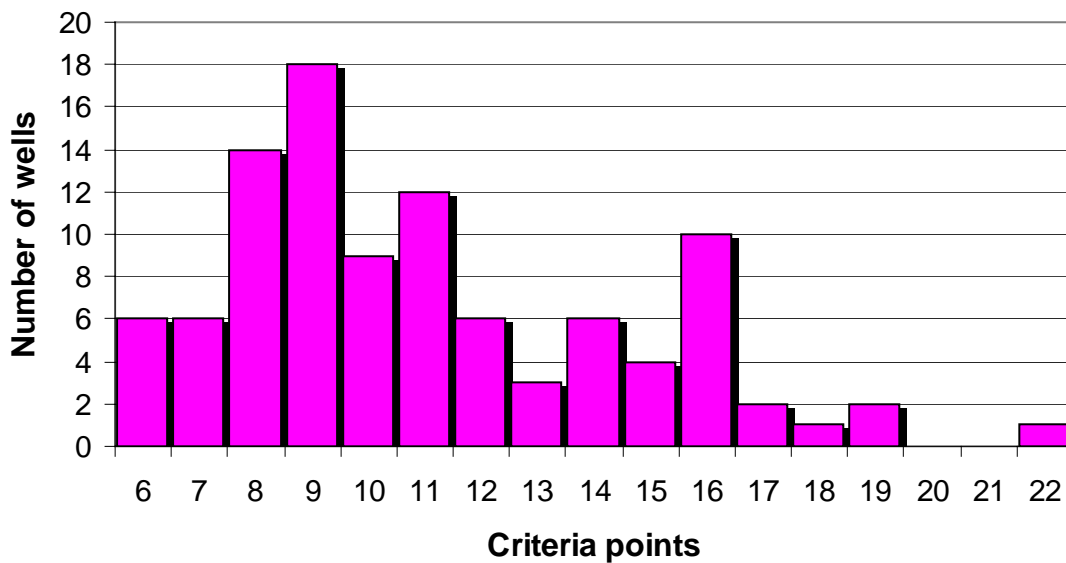


Figure 23. Distribution of total well rating points.

### 7.2 Shared criteria

Shared criteria points ranged from 2 to 5, median 4, with a maximum of 6 possible points.

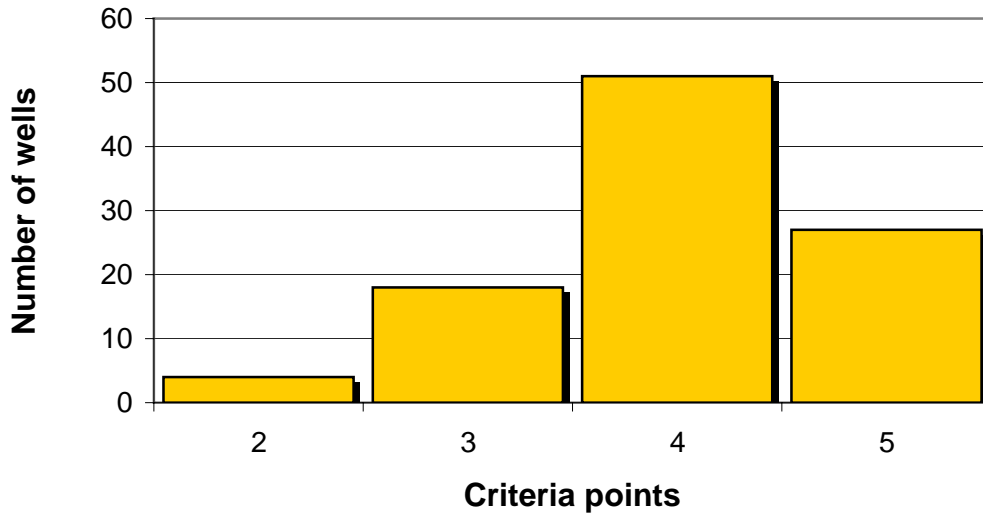


Figure 24. Distribution of shared well rating points.

### 7.3 Water level wells criteria

Water level criteria points ranged from 2 to 10, median 6, with a maximum possible 16 points. Wells 1458 (7 km west of Waipawa), 3453 (2 km northwest of Maraekakaho), 3697 (south Hastings), and 3749 (north Haumoana) are the most valuable water level wells.

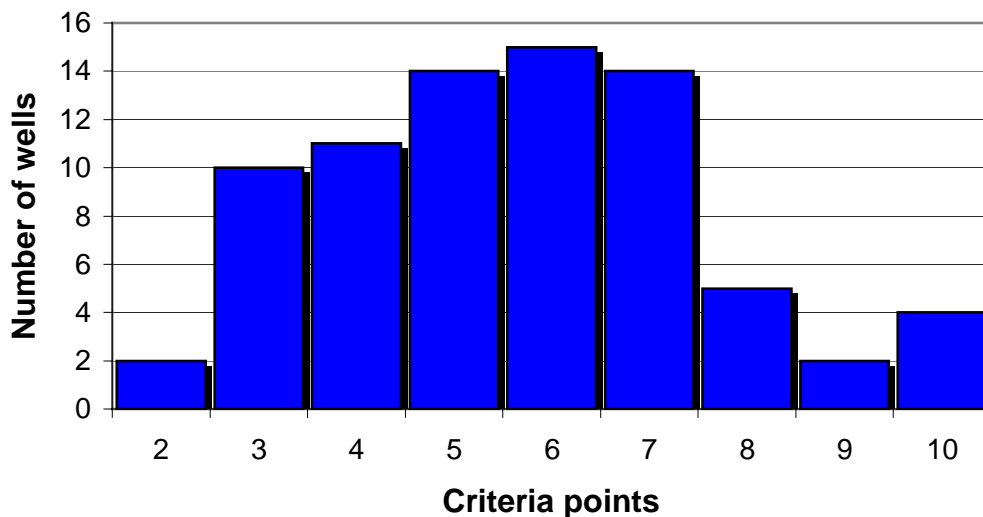


Figure 25. Distribution of water level well rating points.

#### 7.4 Water quality wells criteria

Water quality criteria points ranged from 2 to 8, median 5, with a maximum possible 10 points. Wells 1799 (east Whakatu), 1944 (6 km northwest of Takapau), and 3525 (2 km southeast of Pakipaki) are the most valuable water quality wells.

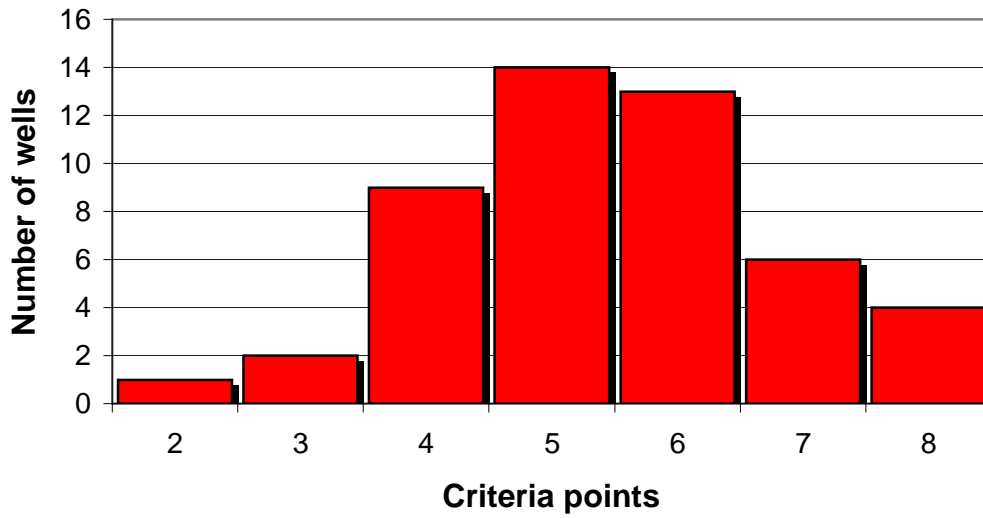


Figure 26. Distribution of water-quality well rating points.

## 8 Proposed monitor well sites

This section proposes those areas that need monitoring. Some areas of Hawke's Bay are being developed without the benefit of ground-water monitoring on which to base development plans. Towns such as Waipukarau have no base data for which to interpret changes. Ground water issues in such settlements may include suitability of septic tanks and localised water supply. Monitor wells give background values and represent land-use changes.

Proposed well sites in Table 5, Table 6, and Table 7 are rated by priority. Those with highest priority are in **bold**, medium are regular font, and low are in *italics*.

### 8.1 Wairoa District

Water quality was monitored in the Wairoa area previous to 2001, but not water levels. Subsequent to that year, 5 existing water quality wells began being measured for water levels. Additional water level sites may be considered for Mohaka and Nuhaka.

Table 5. Proposed new Wairoa monitor well

Area	Justification
<b>Mohaka</b>	Community or town without representation; gap in geographic distribution
<b>Nuhaka</b>	Community or town without representation; gap in geographic distribution

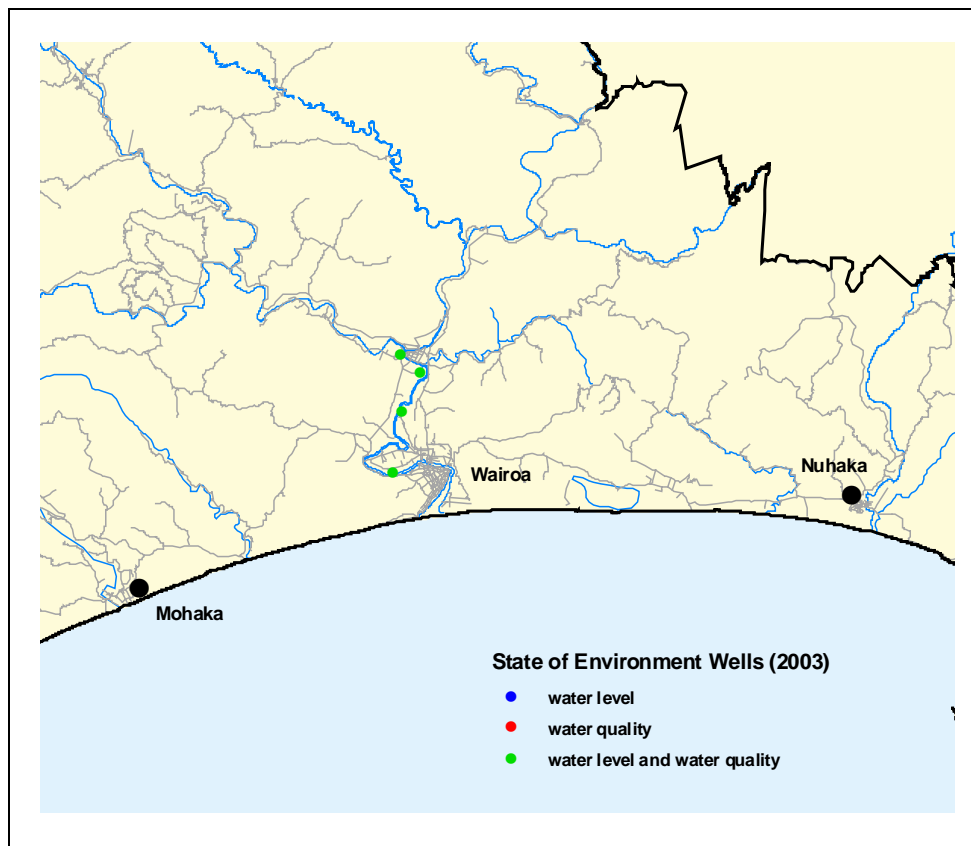


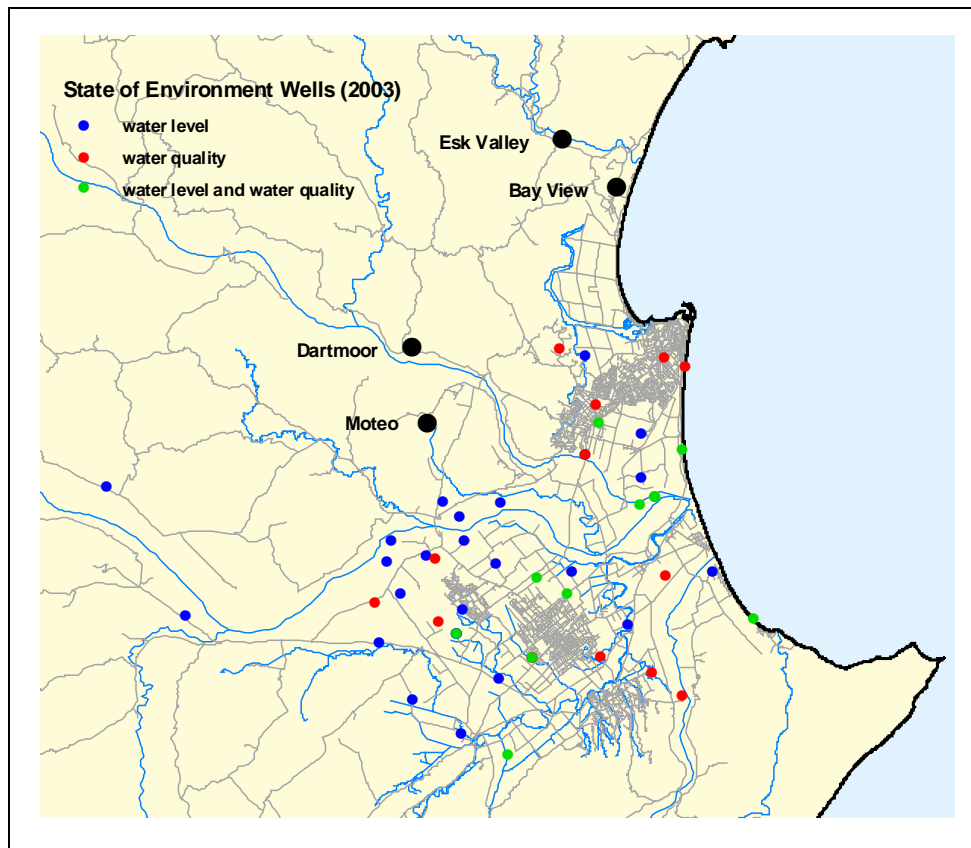
Figure 27. Proposed wells, Wairoa District.

## 8.2 Hastings-Napier district

The Hastings-Napier district has historically been the best represented for water-level monitoring in Hawke's Bay. Added sites would better distribute the water-level database. Proposed well sites are shown in Figure 28.

**Table 6. Proposed new Hastings-Napier monitor wells**

Area	Justification
Esk Valley	Community or town without representation; gap in geographic distribution
Bayview	Community or town without representation; gap in geographic distribution
Dartmoor	Gap in geographical distribution; wells related to minimum flows
Moteo	Drought sensitive; gap in geographical distribution



**Figure 28. Proposed wells, Hastings-Napier District.**

### 8.3 Central Hawke's Bay District

There is expected to be significant growth in ground-water development in Central Hawke's Bay with land use changes. Proposed new well sites are shown in Figure 29.

Table 7. Proposed new Central Hawke's Bay wells

Area	Justification
<b>Poukawa</b>	Community or town without representation; gap in geographic distribution
<i>Tikokino</i>	Community or town without representation; gap in geographic distribution
<i>Ongaonga</i>	Community or town without representation; gap in geographic distribution
<i>Upper Tukituki</i>	Gap in geographic distribution
Waipawa	Community or town without representation; gap in geographic distribution
Panui	Gap in geographic distribution; ground-water irrigation; dry river area
Mangatewai	Gap in geographic distribution
<b>Takapau</b>	Community or town without representation; gap in geographic distribution
Hatuma area	Community or town without representation; gap in geographic distribution

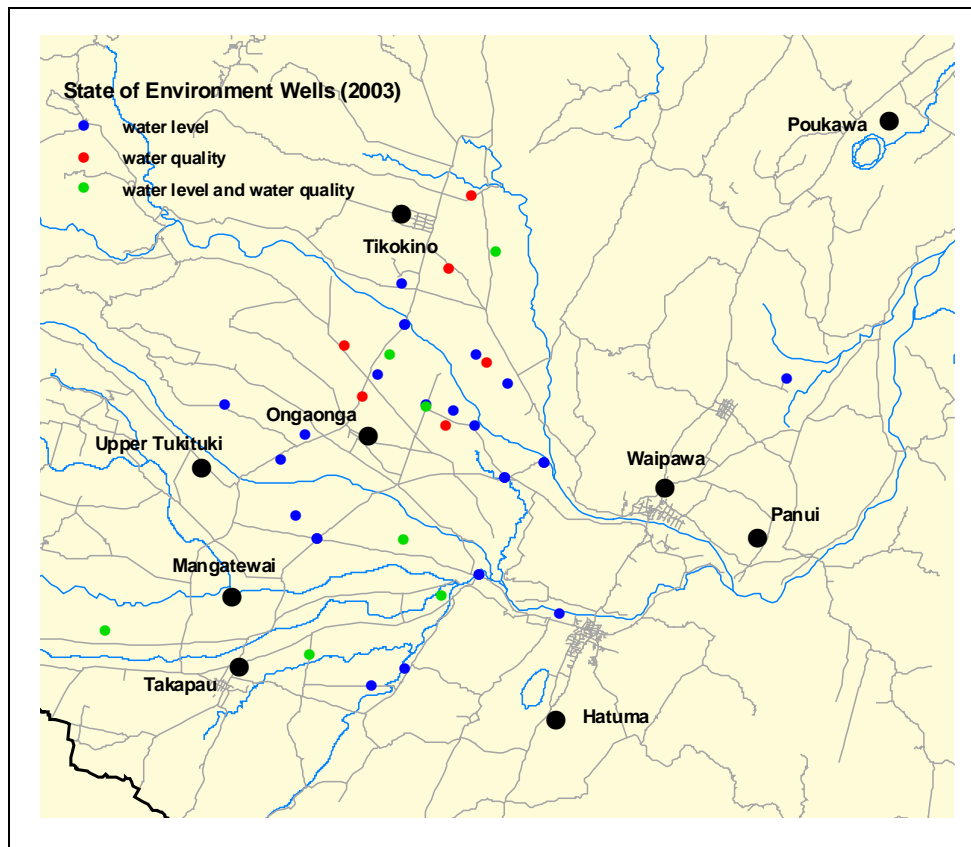


Figure 29. Proposed wells, Central Hawke's Bay District.

## 9 Procedures for the monitor well program

This section gives guidelines for measuring and archiving ground-water data. It proposes general recommendations but can not anticipate all field conditions and specific decision-making. Specific directives are to be published as Quality Assurance Procedures Manual by January 2004. The Quality Assurance Procedures Manual describes quality-assurance validation for monitoring activities, such as ground-water measurement.

It is expected these procedures may take several months to incorporate. The result will be standardised procedures that will remove uncertainty regarding the collection and accuracy of field data.

### 9.1 Common to all sites

Council's State of the Environment wells will be more closely scrutinised and interpreted than other Hawke's Bay wells. For this reason, all wells require maintenance and quality assurance to ensure optimal data from monitor wells. The monitor well network is to be reviewed every 5 years in association with the State of the Environment report.

#### 9.1.1 Well number

The well number is the only unique identifier for all Hawke's Bay wells for which there are records. The well number typically was assigned by consent staff when the well was permitted to be drilled. Other numbers were issued by other persons for non-consented wells, such as wells introduced to the database from external databases. Section 2 details history of well numbering series.

The well number's importance is greater than just well identification because it is more than a 2-dimensional land surface feature. Unlike a river identifier, a well number is specific to a 3-dimensional point. Because a well represents the hydrogeology at the well-screen depth, the well number represents that same depth, as well as map location. So that a water sample associated with well 1674 represents easting 2838641, northing 6170055, and elevation 32-38 m below land surface. A water level for that site represents that same 3-dimensional point. This elevation is typically below land surface.

#### 9.1.2 Field verification

There must be certainty that the well measured or sampled is consistent with well records--that water level data represents the well depth and location. Determine the following for all monitor wells.

- Measure well depth.
- Determine northing and easting by global positioning system (GPS) reading.
- Identify if a pump is in the well.
- Measure casing diameter--the actual well (typically steel or iron) that extends to the full depth.
- Measure the diameter of individual piezometer pipes [typically made of polyvinyl chloride (PVC)] within the well casing and their associated depths.
- Photograph the property entrance, well site, and well head.

These fundamental characteristics are the most useful to correctly identify a well. Having recorded these, the database can be made reliable for current and future investigation analysis.

### 9.1.3 Site maintenance

Note the exact measurement point with marks on the casing or written comments on the well summary form. One visit each year could be for maintenance, such as clearing the site of brush, re-photographing the site after an alteration, etc. Early summer may be the most convenient season for site maintenance.

## **9.2 Water level sites**

Water level measurements indicate changing aquifer volumes, though not directly specifying the cause. Field and office procedures can ensure that the interpreted data is valid.

### 9.2.1 Measurement period

All monitor wells within a ground-water basin should be measured within a small time period, such as one week. This is for having a synchronised database from which uniform comparisons may be made.

### 9.2.2 Water level measurement

The depth to water should be accurate to within 0.01 metre. Measurement value recorded should be relative to the measuring point, such as depth below the marked measuring point on the well casing. Where there is no casing or other obvious secure reference point, survey to a secure stake at the site for permanent reference point. Data is recorded on the measurement form, with date, time, and any comments.

### 9.2.3 Data processing

Data should be archived untreated (raw) because unmodified data is easier to quality assure. Any conversions, such as relative to land surface, are to be done subsequently as required by individual investigations. Water level data is to be quality-assured and posted to Council's web page (or other distribution method) within 5 days of measurement.

### 9.2.4 Recorder installation criteria

Ground water levels fluctuate less than surface water and monthly measurements are typically sufficient to describe trends. More frequent measurements may be useful in time-limited investigations but not for general monitoring.

Recorders may be used for background water-level monitoring in the following circumstances.

1. First year of a new well to determine if and how much it is affected by external factors such as pumping in nearby wells or tidal.
2. Telemetry for representative wells.
3. Difficult access where staff can not get to the site every month.
4. Secure and technically feasible site where items 1 - 3 apply.

### 9.2.5 Well retirement

Water level wells are to be reviewed for retirement where:

- 3 months or more of no measurement in one year.
- significantly affected by pumping.
- modification preventing measurement.
- plugged well screen or well opening.

## 9.3 Water quality sites

Water quality sampling indicates changing aquifer quality, though not directly specifying the cause. Field and office procedures can ensure that the interpreted data is valid.

### 9.3.1 Sampling frequency

Monitor well samples are collected and analysed four times a year. This frequency may be reduced in a future review of water-quality variability over time. Three years of sampling is enough to determine suitable sampling frequency.

### 9.3.2 Standard sampling determinands

Current standard sampling determinands for groundwater quality monitoring are given in Table 8. The table was compiled from information given in American Public Health Association, American Water Work Association, and Water Pollution (1998). Values for pH, specific conductance, and temperature change after collection and for this reason, should be measured in the field (Table 9).

### 9.3.3 Data processing

Data should be archived untreated (raw) because it is easier to quality assure. Any conversions done subsequently as required by individual investigations. Data is to be quality-assured and posted to Council's web page within 6 weeks of sampling.

### 9.3.4 Well retirement

Water quality wells are to be reviewed for retirement where the well has:

- no sample in one year.
- modification preventing or damaging measurement.
- Unsafe access or measurement
- plugged well screen or well opening.

**Table 8. Standard sampling determinands.**

<b>Parameter</b>	<b>Symbol</b>	<b>Reasons for monitoring</b>
ammoniacal nitrogen	NH <sub>4</sub> -N	Indicator of reducing vs. oxidising conditions which may be associated with leaching of fertilisers, dairy shed runoff and cropping.
bicarbonate (alkalinity)	HCO <sub>3</sub>	Indicator of hydrogeology and dairy shed effluent leaching into groundwater.
calcium	Ca	Indicator of hydrogeology and leaching of fertiliser into groundwater.
carbonate	CO <sub>3</sub>	Indicator of inorganic carbon and part of bicarbonate species. Related to hardness and alkalinity.
chloride	Cl	Indicator of seasonal variations associated with recharge and leaching of fertilisers into groundwater, salt water intrusion, contamination of animal or human waste.
conductivity lab	----	Indicator of ionic concentration of groundwater and correlates with the total dissolved solids
dissolved reactive phosphorous	PO <sub>4</sub>	Indicator of seasonal variations associated with recharge and leaching of fertilisers, contamination of animal or human waste
faecal coliforms	----	Indicator of contamination of animal or human waste.
iron	Fe	Indicator of hydrogeology, reducing-oxidising conditions (i.e. casing corrosion, iron bacteria) and aesthetic and health quality of groundwater.
magnesium	Mg	Indicator of hydrogeology and leaching of fertiliser into groundwater.
manganese	Mn	Indicator of hydrogeology, reducing-oxidising conditions and aesthetic and health quality of groundwater.
nitrate nitrogen	NO <sub>3</sub> -N	Indicator of seasonal variations associated with recharge and leaching of fertilisers, contamination from animal or human waste and cropping.
pH lab	----	Monitors seasonal variations associated with recharge and can be an indicator of changing water quality due to land use changes.
potassium	K	Indicator of hydrogeology and leaching of fertiliser into groundwater.
silica	SiO <sub>2</sub>	Indicator of hydrogeology and leaching of dairy shed runoff into groundwater.
sodium	Na	Indicator of season variations associated with recharge and leaching of fertilisers, contamination of animal or human waste, sea water intrusion
sulphate	SO <sub>4</sub>	Indicator of hydrogeology and leaching of fertiliser into groundwater.
total dissolved solids	TDS	Indicators of overall water quality, mineralisation and used for comparison of groundwater quality over time.
total hardness	as CaCO <sub>3</sub>	Indicator of hydrogeology and aesthetic quality of groundwater.
total organic carbon	TOC	Indicator of metal oxide reduction and increases associated with leachate contamination.

**Table 9. Field-measured determinands.**

<b>Parameter</b>	<b>Symbol</b>	<b>Reasons for field measurement.</b>
pH		Temperature dependent on aquifer conditions. It will vary from lab determination.
conductivity	µS/cm	Temperature and ion dependent on aquifer conditions. It will vary from lab determination.
water temperature	°C	Temperature dependent and will vary from lab measurement.

#### **9.4 Legal well easements**

Legal easements to access wells provide long-term security for site visits, well maintenance, and well protection; thereby preventing the current or future land owner closing or altering the site. It prevents land owner from pumping from the well, contrary to the well's intent and possibly lead to the public's perception that Council drilled a well for a private party.

Well access easements are recommended for the following:

1. Where well owner wants to end well access for one of Council's most valuable wells.
2. Council sells land surrounding a current most-valuable monitor well.
3. Someone "donates" a well determined to be valuable.

The above "valuable" is defined as any well that would rank within the upper 25% based on monitor well criteria Table 4. More simply, valuable means equivalent to our 25% most important monitor wells.

A standard easement form is given in appendix C.

## **10 Recommendations**

The ground-water monitor well network and the ground-water database are useful investments in ground-water management. The maintenance costs and usefulness justify conscientious management. This report suggests the following recommendations.

1. Encourage using the unique Council well number to transcend and link databases. Inconsistent well identifiers used by different people and offices have created many errors in cross-referencing the databases. Some of the current identifiers include water quality site, bore permit number, TIDEDA number, site name, map reference, consent number, well owner, and survey number.
2. First correct errors and inconsistencies in the monitor well database, then with this experience, gradually correct the full database. This would likely require several years. But until the database is corrected and verified our subsequent analyses and conclusions are vulnerable to scrutiny.
3. Review optimal water-quality sampling frequency after 3 years of data. Historical water-quality trends should be plotted to determine, based on annual fluctuations, if frequency can be reduced to less than four times a year.
4. Tag wells with a consent (well) number. This may be done by issuing a small metal disk, similar to a dog tag, with every well-drilling consent. Included with the tag would be instructions on how to attach the tag to the well casing or associated plumbing at the wellhead.
5. Slug test monitor wells for which this is possible, such as those without pumps. A slug test is done primarily to ensure the well is open to the aquifer (rather than a cistern) and provides a hydraulic conductivity value for the aquifer. A slug test is done by pouring water down a well and measuring recovery to the original level.
6. Existing site names need to be updated in Council databases Daisy, Hilltop, Puddle, Wellstor, etc. to include well number.
7. Establish 7 representative telemetry sites for Wairoa (1), Hastings (3), and Central Hawke's Bay (3). These would be used to monitor water levels in greater demand periods, such as summer.
8. As cited in section 9, the next review would be 2008.

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## Appendix A—Monitor Wells

Notes regarding tabled data.

- **Yellow shading** indicates current monitor well; unshaded indicates historical monitor wells.
- **Light blue** indicates the well needs a quality assurance review, such as a field visit to verify or refine the value. Eastings and northings given in black indicate the location was determined by hand-held geographical positioning system (GPS) meter or by the more accurate differential GPS survey. A hand held meter is typically accurate to within 5 metres and a differential survey typically is accurate within a metre.
- Information such as well location (easting and northing) for historical monitor wells in the following table is not necessarily the same data as in the ground-water database (Wellstor). Well numbers, easting and northing, and well depth should be regarded with caution. This table will likely be quality-assured and then used to update the ground-water database.
- TIDEDA = water-level database number; WQ = water quality; WL = water level.

Table 10. Past and present monitor wells.

Well	TIDEDA	WQ site	Site name	Easting	Northing	WL start	WL stop	WQ start	WQ stop
25	857017		Gunns	2830625	6173585	1982	1983		
113	868043		Elmlea Farm Ltd	2838147	6160704	1991	2000		
222	859001	753	Communitor Stn 222	2846786	6177188	1983		1982	
238	867009		Kilton Main	2831669	6167701	1968	1972		
244	868019		Oliver	2836399	6167951	1991	2000		
271	858011		Molenaar	2842979	6177520	1991	2000		
299	858029		Mackie (Farndon Rd)	2844132	6171463	1994	1994		
413		745	Aquarium Bore 413	2846954	6181866				1975
579	867071		Fireshed	2833722	6165775	1991	1991		
605	867073		Turamoe 605	2831677	6163103	1991			
611		998	Guppy Rd Depot 100m 611	2841389	6176923				1985
681	858021		Golden Del Ltd	2839591	6174906	1991	1991		
704	859003		Ammos-Phos	2846788	6176008	1991	1996		
705	868003	1795	Hawea 705	2840351	6169047	1983			1996
724	868023		Allenby	2841806	6170642	1994	1994		
913	858007		Gilligans	2841904	6175360	1992	2000		
915	868049		Omahuri	2836566	6165418	1991	1994		
917	868025		Bricklebank 917	2840569	6170336	1997			
938	869003		Woodham	2848144	6169638	1991	2000		
990	868017		Nu-Lands 990	2836519	6164318	1991			
995	868013		Silverdale 995	2839254	6164350	1991	2003		
1001	858005		Waima 1001	2836630	6174183	1992			
1025	868027		Collings	2841610	6164534	1994	1994		
1026	867033		Well NG8 (Sowersby)	2829694	6168220	1975	1987		
1053	858015		Solbaer Farm	2842113	6172056	1991	2000		
1083	868045		Koenders	2836993	6162425	1991	1995		
1129	869005		Te Mata 1129	2845086	6164471	1991	2003		
1191		2238	York's - SH50 1191	2829552	6168539				1997
1284	848003	156	Lagoon Farm No. 4 1284	2841331	6182394	1988			
1376	894001	226	Waipukurau Golf Club 1376	2806300	6129989	1992			1994
1379	885001		Glen Athol 1379	2809536	6140312	1992			
1381	403001	243	Oruawharo Rd	2797422	6125932	1992	1995	1994	2001
1402	894007		Eldorado Donalds 1402	2801050	6133686	1992	2003		
1412	858009		Grassmere 1412	2844516	6178079	1991			
1417	858017		Brookfields 1417	2844469	6175650	1991			
1426	893007		Forest Gate 1426	2799627	6137816	1992			
1429	893001		Lutz 1429	2798922	6131732	1992	2003		
1430	893003	233	Kindar 1430	2798457	6136599	1992			1994 2000
1450	858025	2617	Montana, Sissons Rd No.1 1450	2844366	6174136	1991			1994
1452	894005		Plantation Rd Office 1452	2805557	6139248	1992			
1458	895001		Punanui No.1 1458	2809352	6135743	1992			
1459	868029	203	St Georges Rd 1459	2842199	6165582	1991	1991		1994
1459	868029		Craufaud Orchard	2842100	6165600	1991	1991		
1475	884013		Thomsen 1475	2803192	6140763	1992			
1485	884011	220	Atherstone 1485	2807730	6149390	1992	2003		1994
1489		208	Montana, Sissons Rd No.2	2844366	6174133				1994 2001
1501	867077		Fatman 1501	2834408	6161309	1991			
1518	884015	236	Ingrams 1518	2806625	6145885	1996	2003		1975
1558	894003	231	Livingstone 1558	2804466	6132691	1992			1994
1560	903003	2186	Te Totara Farm 1560	2890631	6235279	2001			1997
1596	867075		Woodbury Farm	2833663	6162872	1991	2000		
1637	903001	2185	Waihirere Rd 1637	2890092	6231308	2001			1997
1659	867083	1652	Blackmore, Maraekakaho Rd.	2831193	6166325				1997 2000
1662	893005		Totaranui 1662	2795753	6139234	1992			

Hawke's Bay Regional Council State of the Environment Monitor Wells 2003

Well	TIDEDA	WQ site	Site name	Easting	Northing	WL start	WL stop	WQ start	WQ stop
1674	868015	205	Hillwell Orchards 1674	2838641	6170055	1991		1974	
1695	857025		Waima II 1695	2834301	6173428	1994			
1700	858035		Pedlow	2845718	6179174	1991	1991		
1703	857023		Loewcroft 1703	2833368	6174281	1995			
1799		1934	Hort Research 1799	2845885	6170137			1995	
1826	884007	224	Springhill 1826	2801559	6142134	1992	1995	1995	
1832	884003		Davenport	2803991	6141925	1988	1992		
1861	884009	221	Riddell 1861	2808905	6146692	1992		1994	
1900	404001		Hatuma 1900	2804551	6126435	1992			
1923		2195	Dickson 1923	2931751	6227734			1997	
1940		217	River Rd 1940	2846826	6163371			1994	
1944	402001	229	Springfield 1944	2789930	6128332	1992		1994	
2085	868007		D'Ath	2838765	6165058	1992	1996		
2220	884001	237	Te Papa No.2 2220	2803768	6141662	1988		1993	
2224		2181	Cappamore Lodge 2224	2935180	6223656			1997	
2401	869015		Wilken (Te Awanga)	2850532	6167416	1996	1996		
2749		2227	Meridith - SH 50 2749	2802473	6139623			1997	
2801	857019	2628	Fraser No.1 2801	2830517	6172020	1990			
2802	867067		Fraser No.3	2831719	6171754	1990	1992		
2803	867065		Fraser No.2	2830200	6171400	1990	1992		
2804	867069		Fraser No.4	2831429	6171117	1990	1994		
2979		146	Eastern Equities 2979	2808514	6141345			1993	
3076	884005		Feedlot 3076	2807961	6141704	1992			
3092		2224	Jensen, Tukituki Rd.	2793991	6137938			1997	1999
3104		239	Goldwater 3104	2806494	6138261			1993	
3148	867099		Coker No.2	2829369	6167615	1995	2000		
3301		215	Karl Poraiti 3301	2839879	6182855			1994	
3336	868033	154	Tollemache No.1 3336	2838342	6165518	1995	2003	1992	
3422	2893001	2176	Heighway - Ramuto Rd 3422	2890542	6238964	2001		1997	
3453	866007		Kereru Rd 3453	2818898	6167889	1994			
3498	2894001	2194	Aranui Rd 3498	2891877	6237783	2001		1997	
3525	878003	1733	Puke Puke 3525	2836995	6160097	1997		1995	
3697	868035	216	Tollemache No.2 3697	2838342	6165518	1994		1992	
3698	867087		Equestrian Park No.1 3698	2834092	6166866	1996			
3737	857009		Well 7D 3737	2834452	6168216	1974			
3749	869001		Richardson 3749	2848524	6170326	1981			
3766	909001	2183	Temure Cres 3766	2931471	6225119	2001		1997	
3774		2229	Murdoch	2799579	6133850			1997	2000
3779	849001	2236	Paxie - Vigor Brown St 3779	2845795	6182348	1995	1999	1997	
3781	858039	955	Anderson Park 3781	2841985	6179690	1995	2000	1974	
3852		230	Lutz, Fairfield Rd., No. 2	2799597	6132060			1994	2000
4693	895005		Stockade Road 4693	2811308	6136456	2003			
4694	895007		Stockade Road 4694	2811308	6136457	2003			
4695	894013		Ashcott Road 4695	2808146	6131016	2003			
4696	894015		Ashcott Road 4696	2808151	6131016	2003			
4697	893013		Burnside Road 4697	2800280	6132780	2002			
4700	884019		Waipawa River 4700	2804502	6143133	2003			
4701	894017		Swamp Road 4701	2807893	6138258	2003			
4702	404003		Station Road 4702	2802911	6125648	2003			
5005	895009		Waipukurau 5005	2812029	6129122	2003			
5006	886003		Drumpeel Road 5006	2823097	6140530	2003			
5007	869019		Clifton Road 5007	2850743	6167687	2003		2003	
5023	855007		Matapiro Rd.	2814766	6174863	2003			
6719	403003	235	Fraser Rd 6719	2799894	6127112	1992		1994	
7822	857015		Kupa	2832075	6173525	1972	1973		
7980	857021	2626	Burns 7980	2834578	6172026	1991			

Hawke's Bay Regional Council State of the Environment Monitor Wells 2003

Well	TIDEDA	WQ site	Site name	Easting	Northing	WL start	WL stop	WQ start	WQ stop
8380	868011	1045	Walsh - Norton Rd	2840210	6164671	1993	2000	1983	2001
8521	867055	1270	Flaxmere Golf Club 8521	2833073	6167589	1994	2000	1979	
9068	858041		Guppy Rd 50 mm 9068	2841366	6176871	1997			
10002	858001		Dumble	2844200	6177200	1975	1976		
10212	858003	959	Game Farm 10212	2842156	6178716	1981		1974	
10340	867101	2404	Well 1A 10340	2832934	6171037	1997	2000	1998	
10345	867011		Well OA	2832900	6171500	1973	1977		
10354	867023		Well 2D	2832500	6170100	1973	1974		
10356	867021		Well 2F 10356	2831027	6169052	1973			
10368	867007		Kamaka	2833000	6166900	1972	1979		
10369	867005		Twyford	2834200	6170600	1973	1979		
10371	867001		Substation 10371	2832439	6171204	1968			
10496		1909	Brookvale Rd 10496	2845092	6164640			1997	
10586	868001		Curtis	2839000	6161400	1982	1994		
10773	868009		GladePark 10773	2843756	6167354	1992			
10803	867015		Well 4G	2835000	6169900	1973	1978		
10805	857013		Well 2H	2834300	6171600	1973	1973		
10942	884017	2387	Kowhai Main 10942	2804350	6145182	1997			
10993	895003		Punanui No.2 10993	2809352	6135743	1992			
15001	859011	240	Awatoto No. 2 15001	2845228	6174527	1995		1994	
15002	859013	2134	Awatoto No. 3 15002	2845228	6174527	1995		1997	
15003	859015	2135	Awatoto No. 4 15003	2845228	6174527	1995		1995	
15004	867035	2629	Well NG7 15004	2829801	6166372	1975			
15005	867059		Artificial Recharge Bore No. 4 15005	2830250	6170833	1983			
15006	868005		Well 6k 15006	2836313	6170794	1990			
15009	867089		Equestrian Park No.2 15009	2834092	6166866	1996	2003		
15010	867091		Equestrian Park No.3 15010	2834092	6166866	1996			
15011	867093	153	Equestrian Park No.4 15011	2834092	6166866	1996		1991	
15012	868037	1582	Tollemache No.3 15012	2838342	6165518			1992	
15013	893011		Eldorado House 15013	2799186	6133898	1996			
15014	894009		Hudson 15014	2806864	6138936	1996			
15015	894011	1365	Plantation Rd 50 mm 15015	2805557	6139220	1996		1988	
15016		2189	Judges Parade 15016	2932689	6231386			1997	
15017	908001	2190	YMCA Rd 15017	2929419	6227467	2001		1997	
15020	893015		Burnside Road 15020	2800280	6132780	2002			
15021	884021		Waipawa River 15021	2804502	6143133	2003			
15022	859017	2136	Awatoto No. 5 15022	2845228	6174527	1995		1997	
		98	Roys Hill Control Bore	2830950	6171550			1990	1998
		2179	Gambel, Coast Rd.	2931669	6224850			1997	1997
		2187	Mahia fire station	2931669	6224850			1997	1997
		2188	Mahia Refuse Tip Monitoring Bore, Kaiwaitu Rd	2931955	6225631			1997	2001
		2191	Nuhaka Public Toilet	2920180	6229317			1997	2001
		2193	Wairoa Racing Club, SH38	2892068	6235179			1997	2001
		2196	Lochiel St	2931722	6223526			1997	2001
		2197	Opoho Coastal Garden, SH2	2911394	6229532			1997	2001
		2198	Opoutama Public Toilet	2928333	6227046			1997	2001
		2199	Mokotahi	2931388	6223756			1997	1997
		2200	Jane's, Taylors Bay	2931024	6223098			1997	2001
		2201	Boat Wash Bore, Mahia Beach	2931282	6223700			1997	2001
		2235	Glazebrook, Maraekakaho Rd.	2825100	6167100			1997	1999
	838001		Whirinaki	2845200	6195400	1981	1987		
	848001		Lagoon Bore No.6	2841100	6182600	1987	1987		
	848005		Karls - Poraiti Rd, no.1	2839880	6182859	1996	2000		
	857001		Roys Hill	2830300	6172000	1967	1979		
	857003		Fernhill	2833500	6172000	1972	1977		
	857005		Apatu	2833800	6173300	1972	1977		

*Hawke's Bay Regional Council State of the Environment Monitor Wells 2003*

Well	TIDEDA	WQ site	Site name	Easting	Northing	WL start	WL stop	WQ start	WQ stop
857007		Bridge End		2833000	6173100	1972	1977		
857011		Well 7D2		2834401	6168201	1974	1978		
866001		Wellwoods		2825100	6167300	1968	1986		
866003		Well NG4		2827500	6166600	1975	1979		
866005		Glazebrook		2826100	6166600	1994	1994		
867003		Twyford Farm (150mm)		2834300	6170600	1968	1973		
867013		Well OA2		2832901	6171501	1973	1974		
867017		Well 4G2		2835001	6169901	1973	1978		
867025		Saleyards		2831400	6171600	1970	1982		
867027		Well NG6		2828900	6168000	1975	1979		
867029		Omahu		2836000	6169700	1968	1971		
867031		Well NG10		2830800	6167000	1975	1977		
867049		Pakipaki		2835700	6161200	1975	1979		
867051		Well NG9		2831100	6166200	1975	1979		
867053		Morven Hills		2828800	6167600	1968	1970		
867057		AR2		2829900	6170900	1983	1987		
867061		AR5		2830400	6170900	1983	1986		
867063		AR1		2829600	6170700	1983	1994		
867079		Equestrian Park (8b)		2834200	6166900	1991	1991		
867081		Pesticide Study @ Apatu		2843600	6167700	1994	1995		
867085		Equestrian Lane - Pumpshed		2834100	6167300	1991	1991		
867095		Bateman		2833200	6164700	1991	1991		
868021		Pesticide Study @ Ngatarawa		2832200	6168200	1994	1995		
878001		McKenzie (Mutiny Rd)		2836100	6159100	1995	2000		

Appendix B—well evaluation

Well	Shared Criteria								Water Level Criteria										Water Quality Criteria								TOTAL POINTS	Comments									
	Well depth	Points	Well log	Points	Ability to monitor	Points	Secure site	Points	SHARED POINTS	Proximal well of different depth	Points	Distance to nearest monitor well (km)	Points	Record duration (years)	Points	Water level trend	Points	Pump in well	Points	Pumping affected	Points	Easily accessed and measured	Points	WATER LEVEL POINTS	Distance to nearest monitor well (km)	Points			Record duration (years)	Points	Sample Point	Points	Easily accessed and sampled?	Points	Portable pump required	Points	WATER QUALITY POINTS
222	r	1	y	1	wlwq	1	y	1	4	n	0	2.4	1	10	1	n	0	n	2	y+	0	y+	2	6	3.0	1	21	2	t	1	y	1	n	1	6	16	
413	r	1	y	1	wq	0	y	1	3															0	1.4	0	28	3	t	1	n	0	n	1	5	8	
605	r	1	y	1	wlwq	1	y	1	4	n	0	3.3	2	12	1	n	0	y	0	y	1	y	1	5											0	9	
611	r	1	y	1	wq	0	y	1	3															0	1.8	0	18	2	w	2	y	1	n	1	6	9	
705	r	1	y	1	wlwq	1	y	1	4	n	0	1.3	0	20	2	y	1	y	0	y+	0	y	1	4	2.0	0	7	1	w	2	n	0	n	1	4	12	
917	r	1	y	1	wlwq	1	y	1	4	n	0	1.3	0	6	0	y	1	y	0	y+	0	y+	2	3											0	7	
990	r	1	y	1	wlwq	1	y	1	4	n	0	2.2	1	12	1	n	0	y	0	y	1	y+	2	5											0	9	
1001	m	2	y	1	wlwq	1	y	1	5	n	0	2.4	1	11	1	n	0	y	0	n	2	y	1	5											0	10	
1191	r	1	y	1	wq	0	y	1	3															0	3.8	2	6	0	w	2	y	1	n	1	6	9	
1284	m	2	y	1	wlwq	1	y	1	5	?	0	3.8	2	15	1	n	0	n	2	n	2	y	1	8											0	13	Difficult measurement in crop season.
1376	r	1	y	1	wlwq	1	y	1	4	n	0	2.1	1	11	1	n	0	y	0	n	2	y+	2	6	3.4	2	9	1	h	1	y	1	n	1	6	16	Contact owner day before sampling.
1379	r	1	y	1	wlwq	1	y	1	4	n	0	2.1	1	11	1	n	0	y	0	y+	0	y	1	3											0	7	
1412	r	1	y	1	wlwq	1	y	1	4	n	0	2.4	1	12	1	n	0	y	0	y+	0	y	1	3											0	7	
1417	r	1	y	1	wlwq	1	y	1	4	n	0	1.4	0	12	1	n	0	y	0	y+	0	y	1	2											0	6	
1426	r	1	y	1	wlwq	1	y	1	4	n	0	1.7	0	11	1	y+	2	y	0	y+	0	n	0	3											0	7	
1430	r	1	y	1	wlwq	1	y	1	4	n	0	1.7	0	11	1	y	1	y	0	y+	0	y	1	3											0	7	
1450	r	1	y	1	wlwq	1	y	1	4	y	2	0.9	0	12	1	n	0	y	0	y	1	y+	2	6	1.0	0	9	1	w	2	y	1	n	1	5	15	
1452	m	2	y	1	wlwq	1	y	1	5	n	0	0.3	0	11	1	y	1	y	0	y	1	y+	2	5											0	10	
1458	m	2	y	1	wlwq	1	y	1	5	y	2	2.1	1	11	1	n	0	n	2	n	2	y+	2	10											0	15	
1459	r	1	y	1	wq	0	y	1	3															0	3.1	2	9	1	w	2	y	1	n	1	7	10	
1475	m	2	y	1	wlwq	1	y	1	5	n	0	1.1	0	11	1	y	1	y	0	y+	0	y	1	3											0	8	
1485	r	1	y	1	wq	0	y	1	3															0	2.9	1	9	1	w	2	y	1	n	1	6	9	Water level access limited by water level probe.
1501	r	1	y	1	wlwq	1	y	1	4	n	0	2.9	1	12	1	n	0	y	0	y	1	y	1	4											0	8	
1518	r	1	y	1	wq	0	y	1	3															0	2.5	1	20	2	w	2	y	1	n	1	7	10	
1558	m	2	y	1	wlwq	1	y	1	5	n	0	3.3	2	11	1	n	0	y	0	n	2	n	0	5	3.4	2	9	1	t	1	y	1	n	1	6	16	Tight bung hole prevents water level measurement.
1560	r	1	y	1	wlwq	1	y	1	4	n	0	2.8	1	2	0	y	1	y	0	n	2	y+	2	6	2.8	1	6	0	t	1	y	1	n	1	4	14	
1637	m	2	y	1	wlwq	1	n	0	4	n	0	4.0	3	2	0	n	0	y	0	n	2	y+	2	7	3.9	2	6	0	w	2	y	1	y	0	5	16	Well unlocked in front lawn.
1662	m	2	y	1	wlwq	1	y	1	5	n	0	3.8	2	11	1	n	0	y	0	n	2	n	0	5											0	10	
1674	r	1	y	1	wlwq	1	y	1	4	n	0	1.9	0	12	1	n	0	y	0	y	1	y	1	3	2.0	0	29	3	w	2	y	1	n	1	7	14	
1695	m	2	y	1	wlwq	1	y	1	5	n	0	1.3	0	9	1	n	0	y	0	n	2	y	1	4											0	9	
1703	r	1	y	1	wlwq	1	y	1	4	n	0	1.3	0	8	1	n	0	y	0	n	2	y+	2	5											0	9	
1799	r	1	y	1	wq	0	y	1	3															0	4.2	3	8	1	w	2	y	1	n	1	8	11	
1826	m	2	y	1	wq	0	y	1	4															0	2.4	1	9	1	w	2	y	1	n	1	6	10	
1861	m	2	y	1	wlwq	1	y	1	5	n	0	4.8	3	11	1	n	0	y	0	y+	0	y	1	5	2.5	1	9	1	w	2	y	1	n	1	6	16	
1900	r	1	n	0	wlwq	1	y	1	3	n	0	1.8	0	11	1	n	0	y	0	y	1	y	1	3											0	6	
1923	r	1	y	1	wq	0	y	1	3															0	2.2	1	6	0	h	1	n	0	n	1	3	6	No access to well head, dog problems.
1940	r	1	y	1	wq	0	y	1	3															0	2.2	1	6	0	w	2	y	1	n	1	5	8	
1944	r	1	y	1	wlwq	1	y	1	4	n	0	10.0	3	13	1	y	1	y	0	y+	0	y	1	6	10.0	3	9	1	w	2	y	1	n	1	8	18	
2220	m	2	y	1	wlwq	1	y	1	5	n	0	1.1	0	15	1	y	1	n	2	y+	0	y+	2	6	2.4	1	9	1	w	2	y	1	y	0	5	16	
2224	r	1	y	1	wq	0	y	1	3															0	4.1	3	6	0	t	1	y	1	n	1	6	9	Take sample from tap near sheds.
2749	m	2	y	1	wq	0	n	0	3															0	2.5	1	6	0	p	0	y	1	n	1	3	6	
2801	m	2	y	1	wlwq	1	y	1	5	n	0	1.2	0	13	1	n	0	n	2	n	2	y	1	6											0	11	
2979	m	2	y	1	wq	0	n	0	3															0	3.7	2	10	1	w	2	y	1	y	0	6	9	
3076	m	2	n	0	wlwq	1	y	1	4	n	0	2.1	1	11	1	n	0	n	2	y	1	n	0	5											0	9	
3104	r	1	y	1	wq	0	y	1	3															0	1.5	0	10	1	w	2	y	1	n	1	5	8	
3301	r	1	y	1	wq	0	y	1	3															0	6.0	3	9	1	p	0	n	0	n	1	5	8	Sample point from bottom pressure tank.
3336	m	2	y	1	wq	0	y	1	4															0	3.7	2	11	1	w	2	y	1	y	0	6	10	
3422	r	1	y	1	wlwq	1	y	1	4	n	0	1.8	0	2	0	y+	2	y	0	y+	0	y	1	3	1.7	0	6	0	p	0	y	1	n	1	2	9	Iron-metallic smell, not clear.
3453	m	2	y	1	wlwq	1	y	1	5	y	2	11.0	3	9	1	?	0	n	2	?	0	y+	2	10											0	15	

Well	Shared Criteria								Water Level Criteria										Water Quality Criteria										Comments										
	Well depth	Points	Well log	Points	Ability to monitor	Points	Secure site	Points	SHARED POINTS	Proximal well of different depth	Points	Distance to nearest monitor well (km)	Points	Record duration (years)	Points	Water level trend	Points	Pump in well	Points	Pumping affected	Points	Easily accessed and measured	Points	WATER LEVEL POINTS	Distance to nearest monitor well (km)	Points	Record duration (years)	Points		Sample Point	Points	Easily accessed and sampled?	Points	Portable pump required	Points	WATER QUALITY POINTS	TOTAL POINTS		
3498	r	1	n	0	wlq	1	y	1	3	n	0	1.8	0	2	0	y+	2	y	0	y+	0	y+	2	4	1.7	0	6	0	w	2	y	1	n	1	4	11			
3525	r	1	y	1	wlq	1	y	1	4	n	0	2.9	1	6	0	y	1	n	2	y+	0	y	1	5	5.5	3	8	1	w	2	y	1	n	1	8	17			
3697	m	2	y	1	wlq	1	y	1	5	y	2	2.2	1	9	1	n	0	n	2	n	2	y+	2	10	3.7	2	11	1	w	2	y	1	n	1	7	22			
3698	m	2	y	1	wlq	1	y	1	5	y	2	1.4	0	7	1	n	0	n	2	y+	0	y	1	6											0	11			
3737	m	2	y	1	wlq	1	y	1	5	n	0	1.4	0	29	3	n	0	n	2	n	2	y	1	8												0	13		
3749	r	1	n	0	wl	0	y	1	2	n	0	5.3	3	22	2	n	0	n	2	y	1	y+	2	10												0	12		
3766	m	2	n	0	wlq	1	y	1	4	n	0	3.1	2	5	0	y	1	y	0	n	2	n	0	5	2.6	1	6	0	w	2	y	1	n	1	5	14	Contact owner to turn on pump power.		
3779	r	1	n	0	wq	0	y	1	2															0	1.4	0	6	0	w	2	y	1	n	1	4	6			
3781	r	1	n	0	wq	0	y	1	2															0	0.8	0	29	3	w	2	y	1	n	1	7	9			
4693	m	2	y	1	wlq	1	y	1	5	y	2	2.0	0	1	0	?	0	n	2	?	0	y+	2	6												0	11		
4694	m	2	y	1	wlq	1	y	1	5	y	2	2.0	0	1	0	?	0	n	2	?	0	y+	2	6												0	11		
4695	r	1	y	1	wlq	1	y	1	4	y	2	2.1	1	1	0	?	0	n	2	?	0	y+	2	7												0	11		
4696	r	1	y	1	wlq	1	y	1	4	y	2	2.1	1	1	0	?	0	n	2	?	0	y+	2	7												0	11		
4697	r	1	y	1	wlq	1	y	1	4	n	0	1.6	0	1	0	?	0	n	2	y+	0	y+	2	4												0	8		
4700	r	1	y	1	wlq	1	y	1	4	y	2	1.6	0	1	0	?	0	n	2	?	0	y+	2	6												0	10		
4701	r	1	y	1	wlq	1	y	1	4	n	0	1.2	0	1	0	?	0	n	2	?	0	y+	2	4												0	8		
4702	r	1	y	1	wlq	1	y	1	4	n	0	1.8	0	1	0	?	0	n	2	?	0	y+	2	4												0	8		
5005	m	2	y	1	wlq	1	y	1	5	n	0	4.4	3	0	0	?	0	n	2	?	0	y+	2	7												0	12		
5006	m	2	y	1	wlq	1	y	1	5	n	0	12.4	3	0	0	?	0	n	2	?	0	y+	2	7												0	12		
5007	m	2	y	1	wlq	1	y	1	5	n	0	3.5	2	0	0	?	0	n	2	?	0	y+	2	6	5.8	3	0	0	w	2	y	1	y	0	6	17			
5023	m	2	y	1	wlq	1	y	1	5	n	0	16.3	3	0	0	?	0	n	2	?	0	y	1	6												0	11	Crownthorpe well, Matapiro Road	
6719	r	1	y	1	wlq	1	y	1	4	y	2	3.4	2	13	1	y+	2	y	0	y+	0	y+	2	9	7.2	3	9	1	w	2	y	1	n	1	8	21			
7980	m	2	y	1	wlq	1	y	1	5	n	0	1.4	0	12	1	n	0	n	2	n	2	y	1	6													0	11	
8521	m	2	y	1	wq	0	y	1	4															0	1.2	0	24	2	w	2	y	1	y	0	5	9			
9068	r	1	y	1	wlq	1	y	1	4	n	0	2.0	1	6	0	n	0	n	2	y	1	y	1	5												0	9		
10212	r	1	y	1	wlq	1	y	1	4	n	0	2.0	1	22	2	y+	2	n	2	y+	0	y	1	8	0.8	0	29	3	w	2	y	1	n	1	7	19			
10340	m	2	y	1	wq	0	y	1	4															0	3.6	2	5	0	w	2	y	1	y	0	5	9	Gate locked sometimes.		
10356	m	2	y	1	wlq	1	y	1	5	n	0	1.9	0	30	3	n	0	n	2	y	1	y	1	7												0	12		
10371	m	2	n	0	wlq	1	y	1	4	n	0	2.1	1	35	3	n	0	n	2	y	1	y	1	8												0	12		
10496	m	2	y	1	wq	0	y	1	4															0	2.2	1	6	0	w	2	y	1	y	0	4	8			
10773	r	1	y	1	wl	0	y	1	3	n	0	3.9	2	11	1	n	0	y	0	y	1	y	1	5												0	8		
10942	m	2	y	1	wlq	1	y	1	5	n	0	2.1	1	5	0	y	1	y	0	y+	0	y	1	3												0	8		
10993	r	1	y	1	wlq	1	y	1	4	y	2	2.1	1	11	1	n	0	n	2	n	2	y	1	9												0	13		
15001	m	2	n	0	wlq	1	y	1	4	y	2	0.9	0	8	1	n	0	n	2	y	1	y	1	7	1.0	0	9	1	w	2	y	1	n	1	5	16			
15002	m	2	n	0	wlq	1	y	1	4	y	2	0.9	0	8	1	n	0	n	2	y	1	y	1	7	1.0	0	8	1	w	2	y	1	n	1	5	16			
15003	m	2	n	0	wlq	1	y	1	4	y	2	0.9	0	8	1	n	0	n	2	y	1	y	1	7	1.0	0	8	1	w	2	y	1	n	1	5	16			
15004	m	2	y	1	wlq	1	y	1	5	n	0	2.9	1	28	3	y	1	n	2	y+	0	y+	2	9												0	14		
15005	m	2	n	0	wlq	1	y	1	4	n	0	1.2	0	20	2	n	0	n	2	y+	0	y	1	5												0	9		
15006	m	2	y	1	wlq	1	y	1	5	n	0	2.1	1	13	1	n	0	y	0	y	1	y	1	4												0	9		
15010	m	2	n	0	wlq	1	y	1	4	y	2	1.4	0	7	1	n	0	n	2	y	1	y	1	7												0	11		
15011	m	2	n	0	wlq	1	y	1	4	y	2	1.4	0	7	1	n	0	n	2	n	2	y	1	8	1.2	0	12	1	w	2	y	1	y	0	4	16			
15012	m	2	y	1	wq	0	y	1	4															0	3.7	2	11	1	w	2	y	1	y	0	6	10			
15013	m	2	n	0	wlq	1	y	1	4	n	0	1.6	0	7	1	n	0	?	0	y+	0	y	1	2												0	6		
15014	m	2	y	1	wlq	1	y	1	5	n	0	1.2	0	7	1	n	0	n	2	y	1	n	0	4												0	9		
15015	r	1	y	1	wl	0	y	1	3	y	2	0.3	0	7	1	n	0	n	2	y+	0	y+	2	7	1.5	0	5	0	w	2	y	1	n	1	4	14			
15016	r	1	n	0	wq	0	y	1	2															0	3.7	2	6	0	t	1	y	1	n	1	5	7	No well access; call Wairoa District Council for key.		
15017	m	2	n	0	wlq	1	y	1	4	n	0	3.1	2	2	0	n	0	y	0	n	2	y+	2	6	2.2	1	6	0	w	2	y	1	y	0	4	14			
15020	r	1	y	1	wlq	1	y	1	4	n	0	1.6	0	1	0	?	0	n	2	?	0	y+	2	4												0	8		
15021	r	1	y	1	wlq	1	y	1	4	y	2	1.6	0	1	0	?	0	n	2	?	0	n	0	4												0	8		
15022	m	2	n	0	wlq	1	y	1	4	y	2	0.9	0	8	1	n	0	n	2	y	1	y	1	7	1.0	0	6	0	w	2	y	1	n	1	4	15			

## Appendix C—Standard Legal Easement Form

# Standard Legal Easement Form

*for*  
**Council funded wells**  
*and/or*  
**ground-water monitoring easement**

**This standard document was created by example**, using the easement established for Hawke's Bay Regional Council's State of the Environment monitor well 15005 (867059, Artificial Recharge Bore No. 4). Source material from Council file 3/11/6 include 2 letters from Sainsbury, Logan & Williams.

- Unsigned easement in gross with specifications (15 December, 2000)
- Issued copy title Y2/284, including Deposited Plan 28426 (18 January, 2001)

The text of the above mentioned example was subsequently revised to simpler English for better understanding.

### EXPLANATION FOR THE FOLLOWING EASEMENT FORM

- ..... indicates information to be provided
- [Blue text indicates recommended standard text](#)

**TRANSFER**

Land Transfer Act 1952

If there is not enough space in any of the panels below, cross reference to and use the approved annexure schedule: no other format will be received

Land Registration District

Hawke's Bay

AN AGREEMENT BETWEEN

**Property owner** Surnames to be underlined

..... ("the Owner")

AND

HAWKE'S BAY REGIONAL COUNCIL ("the Council")

RELATING TO THE FOLLOWING PROPERTY

**Certificate of Title Number**      All or Part?      Area and legal description- Insert only when part or Stratum, GT

.....      .....      .....

**To create an easement or right of way:**

Monitoring well and Right of Way easement in gross pursuant to s122 Property Law Act 1952 (continued on annexure schedule.

For the following consideration

\$1.00

Operative Clause

For the above consideration (receipt of which is acknowledged) the Owner grants to the Council, an easement and right of way as described above over certificate(s) of title (certificate of title number) and the easement and right of way as described above is created.

Dated this ..... day of ..... 20....

Attestation

<p>_____</p> <p style="text-align: center;"><i>name(s) of Owner</i></p> <p>_____</p> <p>Signature or common seal of Owner</p>	<p>Signed in my presence by the Owner</p> <p>Signature of Witness</p> <p>_____</p> <p><b>Witness to complete in BLOCK letters</b> (unless typewritten or legibly stamped)</p> <p>Witness name</p> <p>Occupation</p> <p>Address</p>
---	--

Certified correct for the purposes of the Land Transfer Act of 1952

Certified that no conveyance duty is payable by virtue of Section 24(1) of the Stamp and Cheque Duties Act of 1971

\_\_\_\_\_

**Solicitor for the Council**

TRANSFER

Dated

.....

Page

of

Pages

Continuation of "Estate or Interest or Easement to be created"

The Hawke's Bay Regional Council (the Council) shall have the right of access to the ground water monitoring well ("the GMW") marked ..... on Deposited Plan ..... by right of way ("the GMW accessway") over that land in Certificate of Title ..... marked ..... on Deposited Plan ..... together with the additional rights and powers set out in the following clauses:

1. The Council shall have unrestricted right to use and maintain the GMW for ground water monitoring purposes pursuant to its function as a regional authority constituted under the Local Government Act 1974.
2. The Council shall have the unrestricted right to access the GMW, such GMW accessway to be sufficient to accommodate all vehicular well drilling equipment and other machinery as may be necessary to complete the well and for its servicing and maintenance.
3. The Council shall have the right to use any other part of the property of the Owner as may be reasonably necessary for any of the purposes in (1) and (2) above.
4. The Owner (which term includes their successors and assigns) shall not obstruct or prevent access to the GMW.
5. The Council shall maintain the GMW and the GMW access provided that the Council has the right to recover from the Owner any reasonable cost of repair to the GMW or the GMW accessway occasioned by wilful neglect or negligent act of the Owner, their agents, employees, contractors, permitted occupants, residents or invitees.
6. Any dispute arising over the use, maintenance or repair of the GMW or the GMW accessway shall be referred to arbitration. Such arbitration shall be undertaken by two arbitrators, one to be appointed by each party to the dispute, or to an umpire to be appointed by the arbitrators in accordance with the Arbitration Act 1996 (including the provisions of the Second Schedule).

The Hawke's Bay Regional Council hereby accepts the Grant of Easement/Right of Way

<p>..... Common Seal of Owner</p>	<p>Signed in by presence by the Owner by the affixing of its common seal in the presence of:</p> <p>..... Chairman</p> <p>..... General Manager</p>
---------------------------------------	---

If this Annexure Schedule is used as an expansion of an instrument, all signing parties and either their witnesses or their solicitors must put their signatures or initials here.

**SURVEY PLAN**

*showing*

**Well Location and Easement Access/Right of Way**