NERMN Groundwater Monitoring Report

Bay of Plenty Regional Council
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5 Quay Street
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Whakatane
NEW ZEALAND

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Bay of Plenty
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Cover Photo:
Installation of groundwater monitoring bore Lake Tikitapu. Photo by A Lovett, GNS Science.

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My thanks to all who have contributed to this report.

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Staff of the Document Specialist Team for format and management of this document.

How to read this report

This report has been constructed to read for both hard copy and electronic version. For electronic versions there are bookmarks embedded throughout the report that will link you to tables, maps and appendices referenced throughout the report. Click on the word and Ctrl+Click to follow link.

Executive summary

Bay of Plenty Regional Council (BOPRC) is required to undertake monitoring activities as part of its statutory responsibilities under the Resource Management Act 1991 (RMA). The monitoring data from the Natural Environment Regional Monitoring Network (NERMN) programme for groundwater has been collated and verified. This report provides an assessment of the groundwater level and groundwater quality of the aquifer systems we monitor.

The aquifer systems are informally named after the geological units they occur in. Aquifer systems are monitored for water quality and water level. However not all aquifers that are used are being monitored, or have only limited monitoring extent.

For the plains and low lying hill country the aquifer systems presently monitored are Tauranga Group sediments (river, estuary, marine); Volcanics like Waiteariki Ignimbrite; Aongatete Ignimbrite, and to a limited extent Mamaku Plateau Formation; Matahina Ignimbrite; and Minden Rhyolite/other volcanics. Those aquifers presently used but not monitored are Whitianga Group; Manawahe Volcano; Rotoiti Formation; and basement Greywacke.

For the Rotorua lake catchments the aquifer systems presently monitored are Mamaku Plateau Formation; Pokai and older volcanics; Pokai/Chimp Ignimbrite; and Tauranga Group sediments (lake sediments). The main focus of the lake monitoring is water quality in relation to land use and lake water quality.

Groundwater is part of the hydrological cycle and is therefore influenced by climatic change (Southern oscillation index; El Niño/La Niña). Rainfall partnered with the geology/soil type, topography and temperature can influence the amount of rainfall that percolates (recharges) to an aquifer system. Recharge to an aquifer system can be shown by a rise in bore water level.

Of the 54 water level monitoring bores assessed, 12 shows a decline in aquifer water level. These water level declines were localised and not widespread over the entire aquifer system. This indicates that use of groundwater in these areas exceeds that ability for the aquifer to recover before intensive pumping commences again.

There may be structural constraints within the aquifer at these locations that inhibits flow, so the effect in water level could be exaggerated because of the structural conditions. However without water use data or targeted hydraulic testing, the decline in water level cannot be determined.

Of the remaining 42 water level monitoring bores, water level is stable in 32 bores and increasing in 10. The stable trend indicates that groundwater use from the aquifer is sustainable; that in times of rest (no pumping) the aquifer can recover (replenished) so that recharge is meeting abstraction (use). The increasing trends probably indicate areas where over-use has occurred in the past.

It is considered that due to *Pseudomonas syringae pv. actinidiae* (Psa), climate change, land use change or maturity of crop, groundwater use has declined. Therefore less water is taken from the resource and the water level is able to recover to previous background levels. Water use data is crucial in understanding these trends. This information is lacking from the monitoring record.

Water quality data has been collected at varying intervals from 59 monitoring bores over the past twenty years. Presently 22 monitoring bores are used to provide water quality data. Twenty variables are assessed to determine any trend in water quality over time. Four of our bores are part of the National Groundwater Monitoring Program managed by GNS Science.

Groundwater quality in the region generally does not appear to be changing over time. Trend analysis found relatively few variables having statistically significant changes over time. However this can be due to the limited frequency of sampling, total number of samples and data gaps which can inhibit the ability to identify trends.

Groundwater quality concerns for the Bay of Plenty are:

- contamination by nutrients (nitrate, phosphate);
- contamination by microbial pathogens;
- risk of induced salt water intrusion;
- naturally elevated concentrations of iron, manganese, arsenic.

Aquifer properties of water level and groundwater quality have typically been seen as separate monitoring regimes. The importance of how each informs the other appears not to have been recognised. Only 15 of our monitoring bores have both water level and groundwater quality records. All others are either one or the other. This limits our ability to identify and understand any trends that may be present.

The findings of this report will be used to review and make recommendations to the NERMN groundwater monitoring programme. A review of the groundwater monitoring program is not within the scope of this report.

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Part 1: Introduction

1.1 Overview

The Resource Management Act 1991 (RMA) section 35(2)(a) requires Council to monitor the environment to enable Council to effectively carry out its functions. This report forms part of Bay of Plenty Regional Council (BOPRC) responsibility under the RMA. The Natural Environment Regional Monitoring Network (NERMN) groundwater was initiated July 1990 and continues today providing longevity of record on our groundwater systems. The program includes bores that were monitored as far back as 1983. For the purpose of this report water level data and groundwater quality data up to January 2012 has been used to assess the groundwater resources of the region.

1.2 Report purpose

The purpose of the report is to consider all the monitoring data to date that Council has collected for groundwater level and groundwater quality over the last twenty years or so to determine if there are any trends of concern that need to be addressed.

The purposes of monitoring groundwater resources of the region are:

- to provide data on the properties of the groundwater systems;
- this data can inform matters that need to be covered by regional policy;
- assist with the sustainable management of the resource; and
- identify trends in groundwater level and quality that may affect groundwater availability and potential use.

1.3 Report scope

The scope of this report is to provide information on how the groundwater levels and groundwater quality of the region have behaved over the past decades of monitoring record.

The scope of the report is not to answer how trends are to be managed, but to identify concerns that may need attention.

During the process of drawing this report together, gaps and some deficiencies in our monitoring have been identified. The scope of this report is not to deal with these matters, but to refer them to the formal review of the NERMN groundwater program to be undertaken in the near future.

1.4 Report outline

The report looks at the current groundwater monitoring regime and management structure in policy. It provides a brief overview of the groundwater systems in the region and climatic influence the groundwater resources. Assessment is made of groundwater level and groundwater quality data to identify trends. These trends and observations are discussed. Conclusions and recommendations are made.

Part 2: Groundwater monitoring and management in the Bay of Plenty region

2.1 Monitoring network overview

Coverage of the entire groundwater monitoring network is shown in Appendix 1, where maps detail the bore location and type of monitoring undertaken. The region has been divided into seven mapping areas in order to better manage the amount of data requiring assessment.

Bore and groundwater monitoring information are tabled in Appendix 2 and relate to the maps found in Appendix 1. The present monitoring network comprises 56 bores; 34 measure water level, 7 measure quality, 15 measure both water level and groundwater quality.

Assessment of groundwater quality data is tabled in Appendix 3, with comprehensive information sheets for each monitoring bore provided in Appendix 4 (in numerical order). This includes the geological profiles, graphed water level data and graphed groundwater quality data (chemistry) for each monitoring bore. Discussion of the data is held in Part 4 (groundwater level) and Part 5 (groundwater quality) of this report.

There are several groundwater systems throughout the region. Not all of these systems are monitored. Presently there are eight aquifers that are part of the monitoring program (Table 1); some are better represented than others. Historically Council has relied on the good will of bore owners for the use of their bores for monitoring purposes. This does not always coincide with even coverage of the groundwater systems in use. Over the past twenty year monitoring period several bores have been removed from the monitoring program for various reasons (bore collapse, access to bore denied).

2.2 Monitoring regime

Groundwater level is measured continuously for eight of our monitoring bores. This provides the best data record for assessment of the dynamics of our groundwater systems. All other bores have their water levels measured quarterly, however this is loosely observed and monitoring does not occur at the same time each year. The data from these bores does not provide as clear a picture of the climatic and pumping influence on a groundwater system as the continuously recorded bores.

Groundwater quality monitoring occurs on an annual basis. Again this is loosely observed and monitoring does not occur at the same time each year. This frequency of monitoring does not provide for robust trend analysis on groundwater quality over time. Presently water is analysed for major cations and anions. This can provide information on the source of the groundwater (the geology it has passed through and land use) and provide limited trend analysis for changes in the groundwater quality due to pumping influence.

2.3 Monitoring protocols and methodologies

2.3.1 Groundwater quality

Environmental Data Services staff follows the national protocol for State of the Environment groundwater sampling in New Zealand (MfE, 2006) for the collection of groundwater quality samples wherever possible.

This involves:

- calibrating all field instruments at least daily on the sample day;
- sampling from the source before holding tanks and filters;
- purging the bore of at least three times the volume of water contained;
- continued purging until Temperature, pH and Conductivity have been measured on at least 4 occasions (one purge apart); and
- the differences between the last two measurements are within the following limits: Temperature +-0.2°C, and Conductivity +-3%, and pH +-0.1 pH units.

Where this is not possible, it is noted why and the sampling procedure taken is detailed on the field sheet. Samples are chilled immediately and delivered to the BOPRC Laboratory on the same day and stored for analysis and/or distribution for analysis.

Presently water is analysed for major cations and anions; Alkalinity, Calcium, Chloride, Conductivity (ms/m), Fluoride, Iron, Potassium, Magnesium, Manganese, Sodium, Ammoniacal-N, Nitrate-N, pH, and Sulphate. In the past several other elements have been analysed for. These are listed on the front page of Appendix 3.

2.3.2 Groundwater level

Manual groundwater levels are measured from a known measure point. In some cases this level point has a reduced level, and in some cases this reduced level has been surveyed to Moturiki Datum. Where possible groundwater levels should not be measured within two days of rainfall, however as groundwater levels are measured quarterly, this is not always possible.

There is no provision to ensure the pump is off for at least 24 hours prior to the water level measurement being taken, to ensure that the static water level is measured. Most of th bores measured are privately owned production bores, some for domestic supply and others set up for irrigation programs. These takes are not interrupted for monitoring purposes. If the pump is on at the time of measurement it is noted on the field sheet. However it is not known the duration of time the pump has been off prior to the measurement. Therefore the reading could be the drawdown level of recovery rather than the static water level.

Telemetered groundwater levels are measured at least 15-minute intervals. Unless sooner due to issues, the site is visited at least every three months and a check is made of the recording sensor. If the recording sensors telemetered data is different to the manual measurement by more than +-3 mm, the raw data is adjusted to the manual reading, creating processed data. A rating is applied to the processed data to convert it to Moturiki Datum. Telemetered sites are survey levelled annually from at least two benchmarks to within +-3 mm. If there has been site movement greater than 3 mm within the year, the rating to apply Moturiki Datum is adjusted accordingly. When the Moturiki Datum for the area is updated by LINZ, BOPRC or other, the

rating is adjusted and backdated. Every few years (usually 3 to 5 years), the processed data is audited and checked externally.

2.4 Management of groundwater allocation and quality

Groundwater allocation and quality is currently managed under the

Bay of Plenty Regional Water and Land Plan (WLP), in particular Chapter 5: Water Quantity and Allocation. The RMA also provides permitted groundwater use for reasonable domestic and stock drinking water requirements under Section 14(3)(b).

Matters regarding the groundwater resource are set out in the WLP. In brief they are as follow:

- To allocate groundwater at a sustainable yield that avoids permanently or unsustainably lowering water levels, or degrading groundwater quality in aquifer systems, or streams/rivers where groundwater and surface water bodies are linked.
- Undertake surveys in areas of the region where water is at or near full allocation to identify water takes permitted under the RMA and WLP to establish an accurate water take record.
- Ensure the maintenance of high quality groundwater for recharge areas that contribute groundwater to aquifers that are pristine or used for public water supply, and to improve degraded groundwater quality where appropriate.
- Take appropriate action where there is significant adverse effect on groundwater quality, or there is a high risk that future development would adversely affect groundwater quality due to land use practices.
- Provide information to the public on the availability and quality of groundwater resources.
- Determine sustainable yields of groundwater systems.

The data from the NERMN groundwater program can be used to support some plan provisions in regard to allocation (water level) and groundwater quality. However we do not have the data to clarify impact due to abstraction pressure (allocation and actual use) on groundwater systems or related surface water systems.

Investigation of the groundwater resources of the Bay of Plenty is being carried out under the ‘Sustainable Water and Geothermal Programme’ of the Ten Year Plan. This work has been commissioned from GNS Science (GNS). Mass water balances are derived in these investigations to estimate the groundwater volumes available for allocation whilst ensuring surface waters are not compromised. In most areas groundwater and surface water are connected, with groundwater supplying the base flow for streams and rivers.

The groundwater allocation is provisionally set at no more than 35% of average annual recharge. This figure is taken from the Proposed National Environmental Standard on Ecological Flows and Water Level (the 'NES’). The NES is currently on-hold pending consideration of further advice to the NZ Government from the Land and Water Forum.

The groundwater available for allocation have been calculated against the NES to set an allocation volume for each groundwater catchment.

Actual groundwater use under resource consent is not recorded consistently across the region. Therefore an estimated actual groundwater use has been calculated. For this purpose the consented groundwater allocation is based on estimated actual use as follows:

- Frost protection water use for 30 days/year at the consented daily volume.
- Irrigation water use for five months/year at the consented daily volume.
- Municipal water use for 365 days/year at the consented daily volume

These figures help to inform consent and planning staff of areas in the region where potentially there are groundwater allocation concerns (see Map 10 and Map 11).

2.5 Current and future research and reporting

Evaluation of the groundwater resources of the Ōpōtiki area has recently been completed. Groundwater evaluation and conceptual models are presently under development for the greater Tarawera lakes catchment. The evaluation of the groundwater system of the Upper Rangitaiki is presently being scoped and will be initiated this year.

Two monitoring bores have been installed at Papamoa and Ōtamarākau for the purpose of measuring water level and corresponding groundwater quality change (Conductivity). The purpose is to identify any risk of salt water intrusion along the coast into freshwater aquifers if the groundwater levels decrease to a particular level due to pumping stress.

Three groundwater recharge monitoring stations (lysimeter) have been installed at existing BOPRC rainfall recorders. The three new sites complement the existing groundwater recharge monitoring station at Kaharoa. These sites are within groundwater catchments significant for rainfall recharge to extensive groundwater systems and groundwater catchments with high use. The monitoring stations are located at Kaharoa (Kaituna catchment), Mangorewa (Lower Kaituna catchment), Pongakawa (Pongakawa-Kaikokopo-Pokopoko-Wharere catchments), and Lower Kaimai (Wairoa catchment).

These sites will provide information to assess average annual rainfall recharge to the groundwater systems and under what climatic conditions does recharge occur. This data will help to inform groundwater allocation limits, which provisionally are set at 35% of average annual recharge (NES).

A drilling program has been initiated to develop a groundwater monitoring bore field at Oropi. The purpose is to intercept the three main groundwater systems that underlie this area and extend over large areas of the western Bay of Plenty providing a significant groundwater resource. The groundwater systems targeted are the Mamaku Formation, Waiteariki Ignimbrite and Aongatete Ignimbrite. The bore field will be set up with continuous water level monitoring and be regularly sampled for water quality (and possible isotope dating).

To help with assessing groundwater allocation staff have developed a numerical model to calculated estimated permitted takes under the RMA and WLP, for the region. This model has yet to be ‘ground truthed’ and tested, however work is progressing.

Considerable groundwater investigation has been undertaken in the greater Tarawera lake catchments to understand groundwater flow directions and groundwater quality in regard to anthropogenic impacts. This work is continuing with the development of a conceptual geological model and groundwater flow model and nutrient budget for better management of land use and potential impacts on groundwater quality and the lakes the groundwater discharges into.

Part 3: Groundwater systems

3.1 Hydrogeological overview

Groundwater is part of the hydrological cycle that is constrained by geology and influenced by climate (Figure 1). The groundwater systems of the Bay of Plenty region are predominantly found in volcanic deposits that form pumice gravel, sand and fractured rock layers that are capable of storing and releasing groundwater. There are also fluvial and marine deposits consisting of gravels and sands that can also provide a significant groundwater resource along the coastal areas of the region and within the Rangitaiki, Galatea, and Ōpōtiki plains.

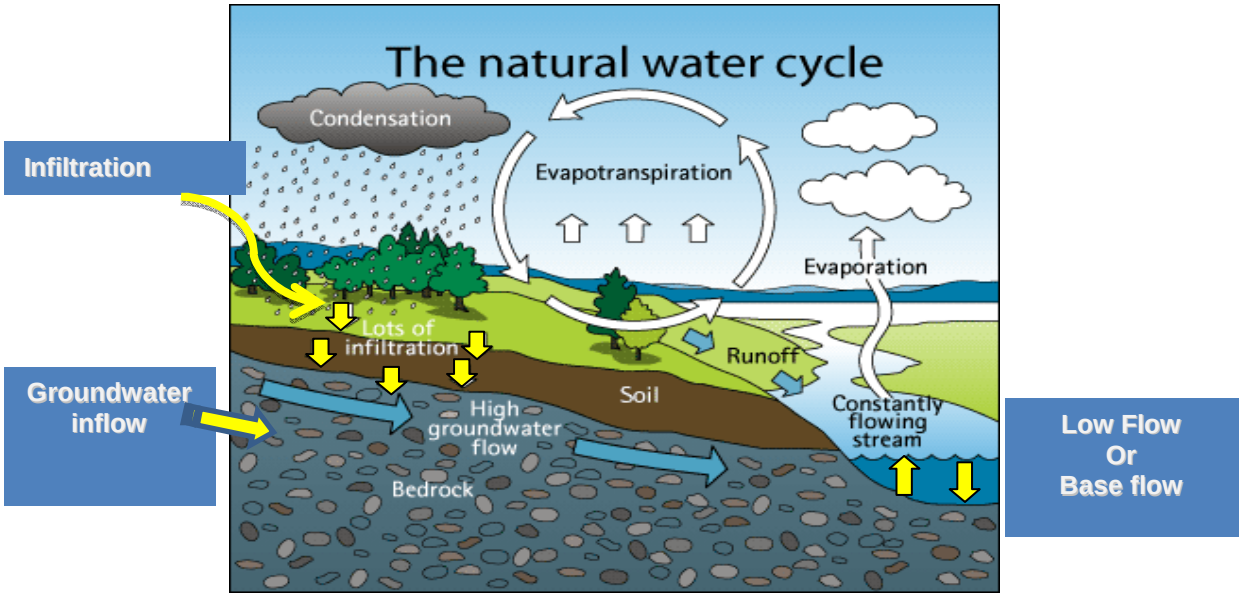


Figure 1 The natural water cycle

The groundwater resources are critically influenced by various pressures. These can include:

- Climatic conditions: rainfall and temperature.
- Allocation: consented and permitted abstractions.

  Anthropogenic effect: land use activities and practices.

3.1.1 Rainfall and climate

The Bay of Plenty region experiences a range of rainfall due to topography and aspect. Lower lying coastal areas typically have annual totals around 1200mm, whereas double this amount can often be recorded at inland elevated locations . It is this high country rainfall that helps to recharge and sustain the groundwater systems.

The amount of rainfall the Bay receives and where it occurs is dependent on global and local weather patterns. Apart from regular seasonal change the most important global effect on our climate is the El Niño -Southern Oscillation (ENSO) cycle. This climate fluctuation occurs at times of "ocean warming". The cycle has two situations which are referred to as El Niño and La Niña. They are both characterised by variable levels of winds and rainfall in different parts of New Zealand (NIWA 2010).

These cycles of climate are shown over the decades in Figure 2. This influences the temperatures experienced over New Zealand and the location and amount of rainfall that occurs. El Niño in New Zealand typically experiences cooler temperatures while rainfall is typically above normal in the south and west, but below normal in the north and east. For La Niña, New Zealand typically experiences warmer than normal seasons with above normal rainfall in northern and north-facing regions and below normal rain fall in southern and south-western areas (NIWA 2010).

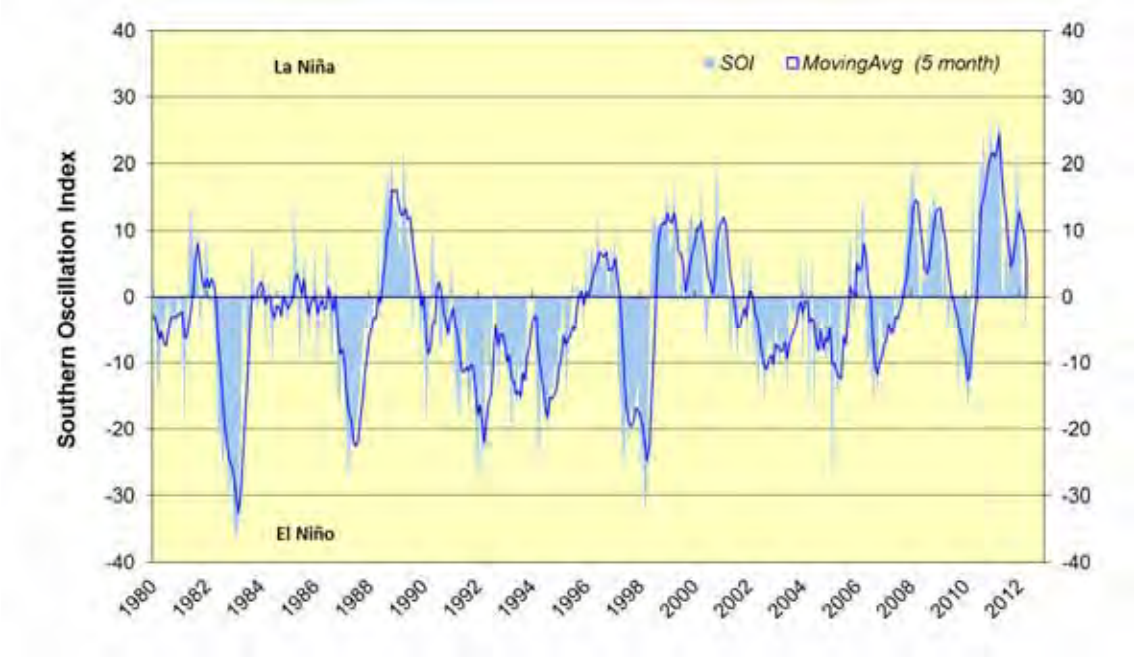


Figure 2 Southern oscillation Index

Other global weather patterns that impact on New Zealand climate are the Interdecadal Pacific Oscillation, a 20-30 year modulation in the behaviour of the ENSO cycle, and the Southern Annular Mode (SAM) that fluctuates every few weeks changing westerly wind direction and strength over New Zealand. A negative SAM situation is usually associated with unsettled and often wet conditions in parts of New Zealand.

3.1.2 Geology and aquifers

Rainfall recharges the groundwater systems. However the type of geology, soils and geomorphology also play a role in how much rainfall runs-off to surface water and how much percolates through the ground to the groundwater systems below.

Geology is the basis for identifying groundwater systems in the region. These geological units can be extensive covering large areas of the region. These units can be tens to hundreds of metres in thickness, and be gravel, sand or fracture rock.

For each monitoring bore the groundwater system can be identified by the geological unit, water level and groundwater quality. Identification can also be supported by isotope (signatures and age) and aquifer hydraulic properties (determined from pump testing data). The groundwater systems presently monitored in our region are listed in Table 1.

The groundwater systems occur in permeable geological units that are volcanic origin, with the exception of the Tauranga Group sediments; these being fluvial, marine or lake deposits that have generally been derived from the volcanic material.

Table 1 Groundwater systems presently monitored.

Groundwater system	Water level only	Groundwater quality only	Both water level and groundwater quality
Tauranga Group sediments	16	2	8
Waitеariki Ignimbrite	6	4	1
Aongatete Ignimbrite	5	0	1
Waitеariki/Aongatete Ignimbrite	6	0	0
Mamaku Plateau Formation	1	0	1
Whitianga Group	0	1	0
Pokai and older volcanics	0	0	1
Matahina Ignimbrite	0	0	1
Minden Rhyolite/other volcanics	0	0	2
Total	**34**	**7**	**15**

3.1.3 Conceptual model of groundwater systems - EarthVision

Investigation of the groundwater resources of the Bay of Plenty has been progressively carried out since 2006, beginning with the Rotorua Lake catchment. These investigations have been commissioned from GNS Science (GNS) and are foundation works to better understand the extent and depth of groundwater systems in the region. The conceptual geological models of groundwater systems are created in a model package called 'EarthVision' that is maintained by GNS.

To date conceptual models of the groundwater systems have been completed for the Western Bay of the Plenty area, the Lower Rangitaiki plains area, and Lake Rotorua catchment, and initiated for the Opotiki area and the greater Tarawera lakes catchment. The focus of the Western Bay, Rangitaiki and Opotiki work was on groundwater volumes and available allocation, whereas the focus for the Rotorua and Tarawera work is groundwater quality. The NERMN groundwater program plays an important role in understanding how the aquifer systems are behaving to abstraction pressure for parts of the region.

EarthVision is a 3-D model, so screenshots of the model a presented (Figures 3, 4 and 5) to show the versatility of the model and its ability to show groundwater extent and depth. These particular examples are from the sub-regional model of the western Bay of Plenty from Waihī to Maketu and back to the Rotorua lakes.

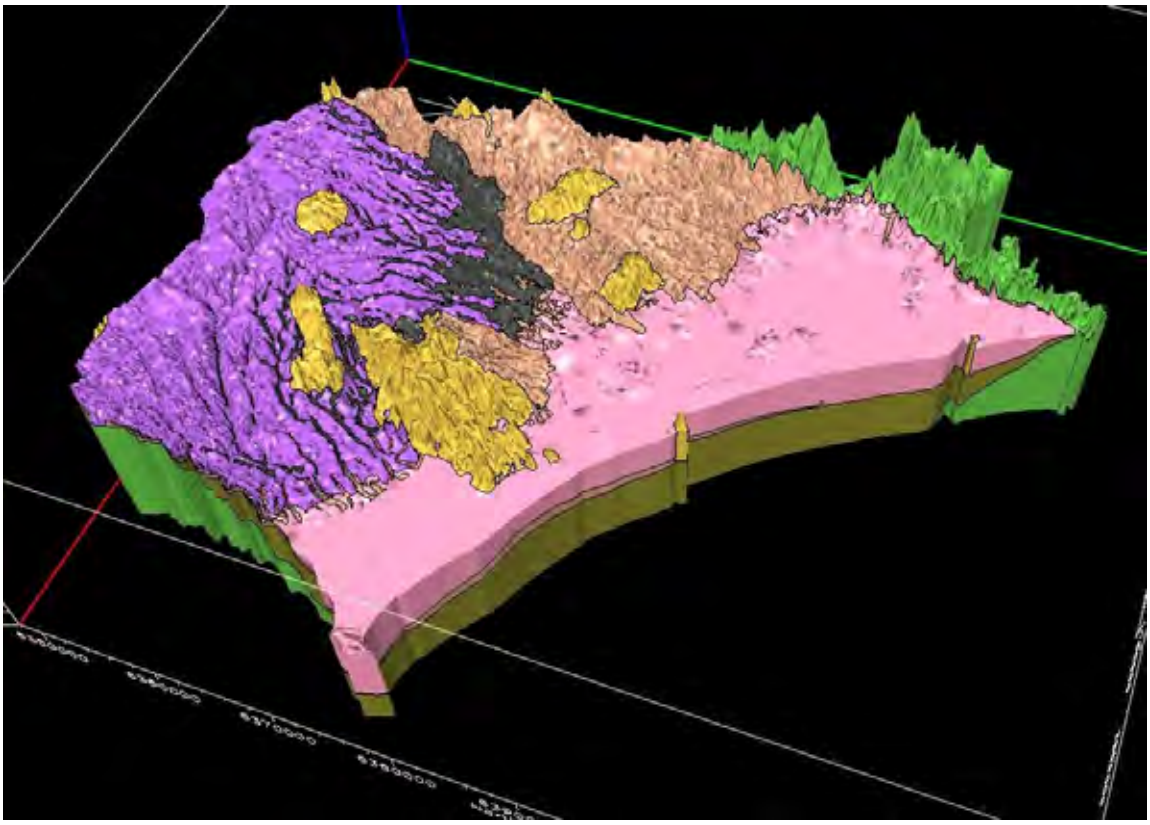


Figure 3 EarthVision 3-D western Bay of Plenty groundwater systems

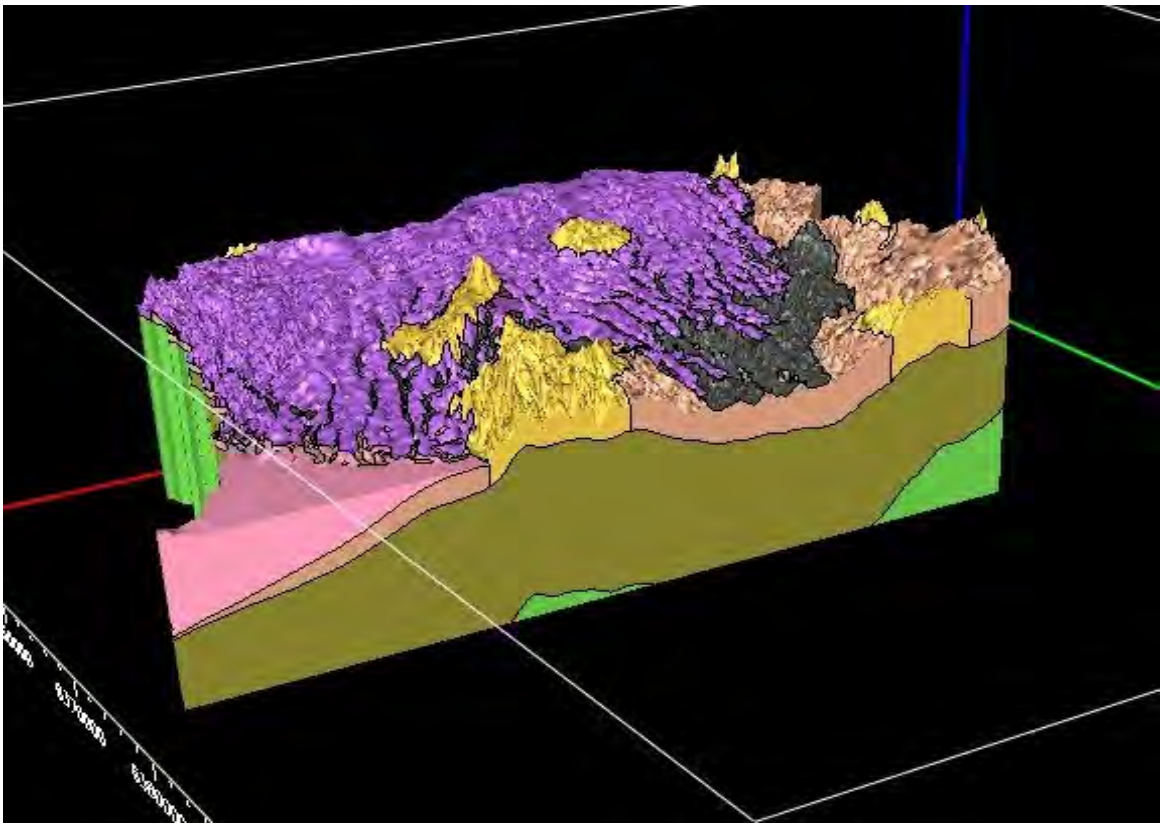


Figure 4: EarthVision cross-section western Bay of Plenty groundwater systems

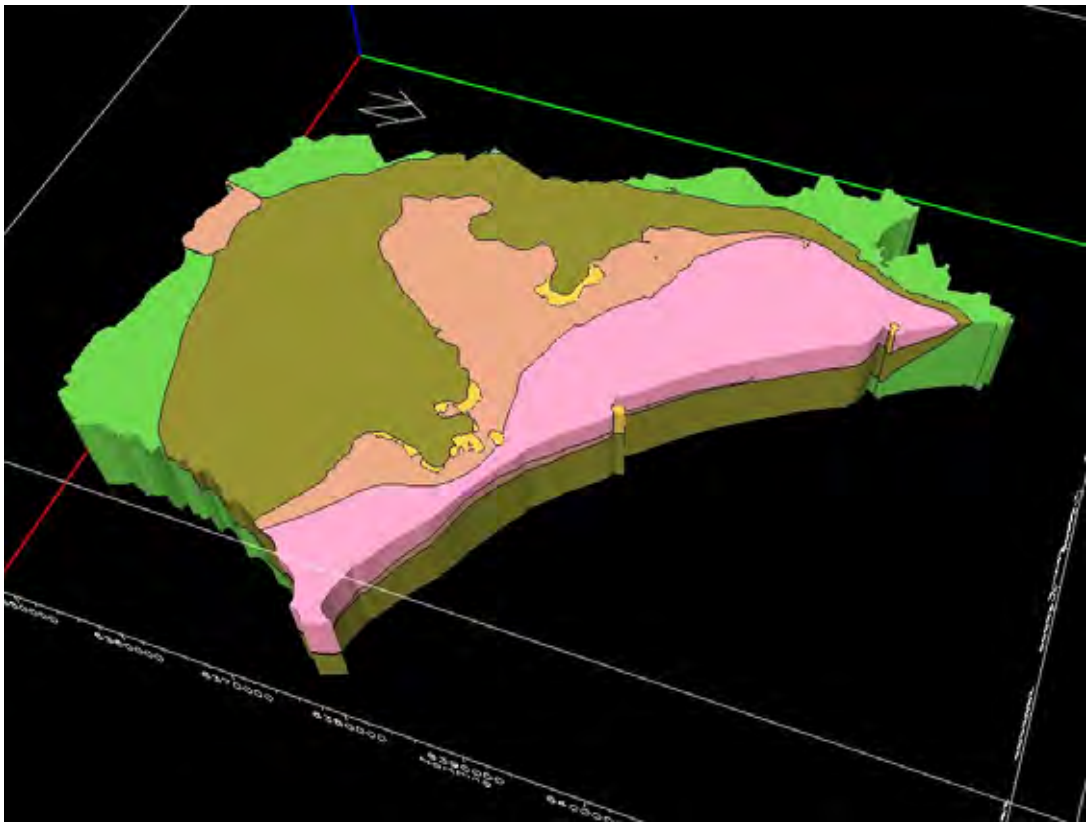


Figure 5 EarthVision plannar view western Bay of Plenty groundwater systems

Key for EarthVision groundwater systems:

Geological colour key	
	Tauranga Group sediments
	Mamaku Plateau Formation
	Pokai Formation (Waimakariri Ignimbrite)
	Waitеariki Ignimbrite
	Whitianga Group (Minden Rhyolite & Ōtawa Volcanics)
	Aongatete Ignimbrite
	Basement rock

3.1.4 Conceptual model of groundwater systems - Earth beneath our feet

The 3-D model has been adapted to a 2-D model so that the public can easily assess the groundwater information via the web. This adapted model is called Earth Beneath Our Feet. This is a webpage that is presently being developed by GNS. Simply enter your location, or select an area and the program will construct a geological profile (Figure 6) or cross-section (Figure 7) of the area you are interested in. Information about groundwater quality and potential yields are also being developed. The aim is to provide a useful tool for both staff and public to access information on groundwater systems in the region.

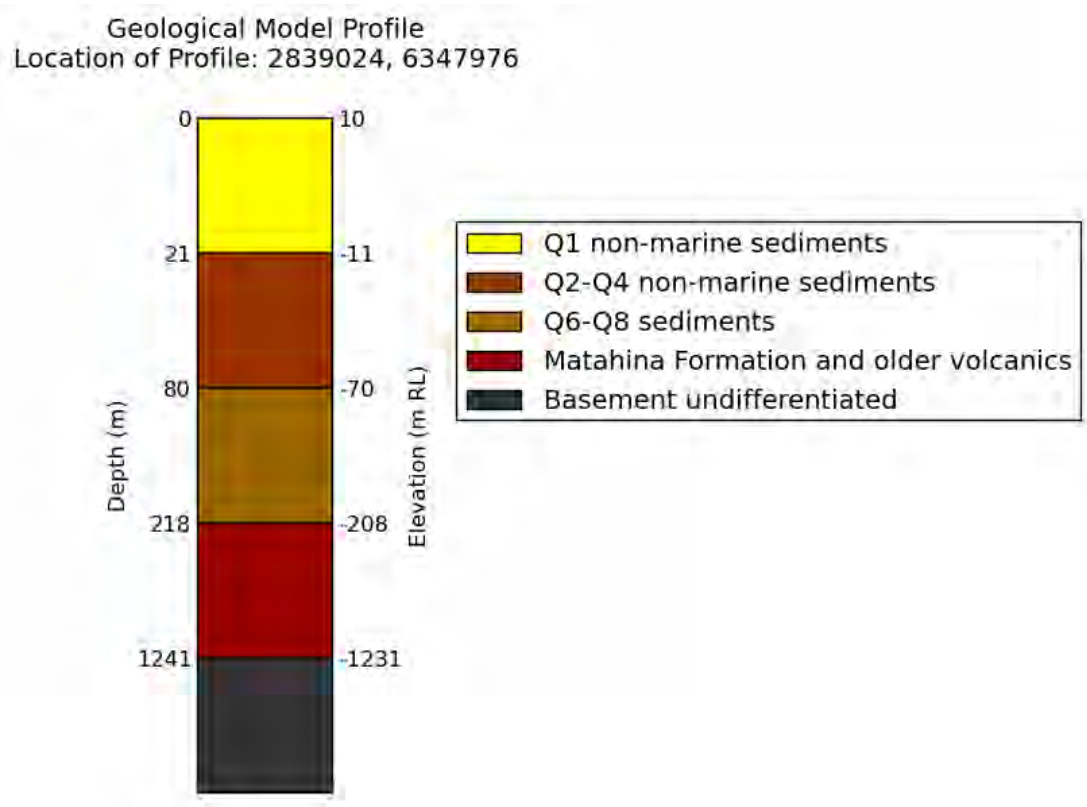


Figure 6 Profile at Otakiri - Rangitaiki Plains

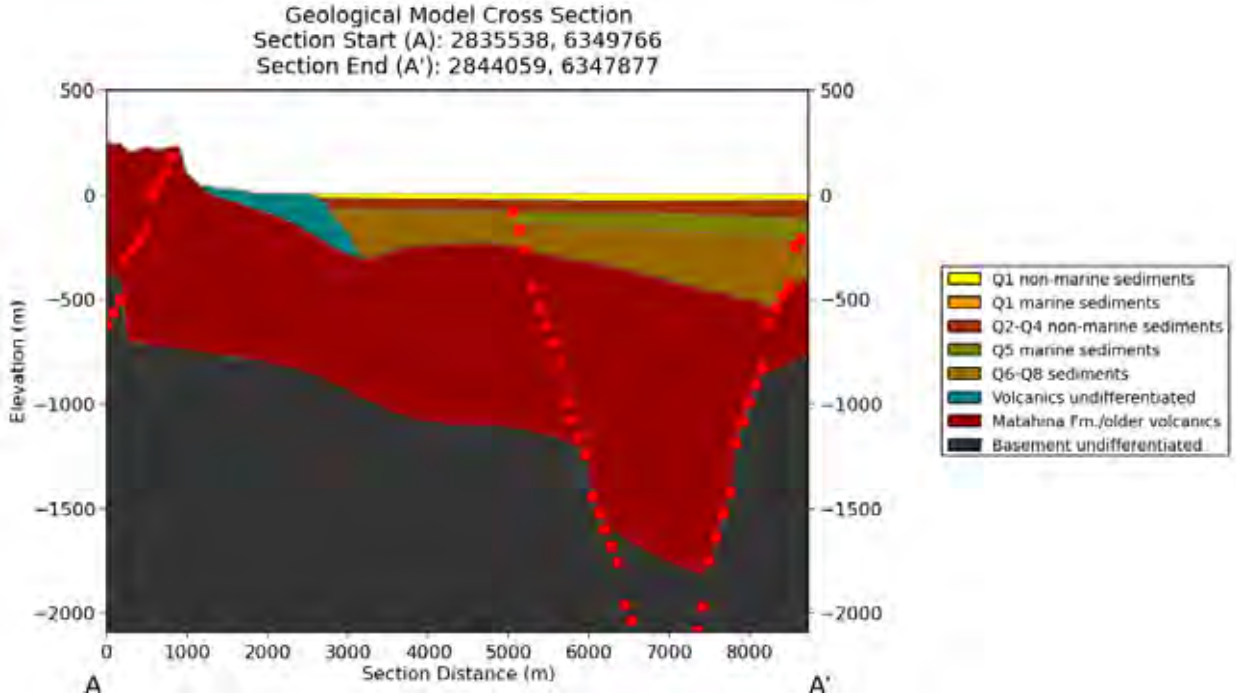


Figure 7 Cross-section through Otakiri - Rangitaiki Plains

3.1.5 Groundwater management areas

Presently the groundwater models have been developed in a sub-regional manner. Within each sub-region the areas have be divided into groundwater catchments (where surface water and groundwater are strongly connected) and groundwater zones (where groundwater is separated from the surface water in the area). Figure 8 is an illustration of the western Bay of Plenty sub-regional model showing the location of groundwater catchment boundaries (A) and coloured groundwater zones (B).

A B

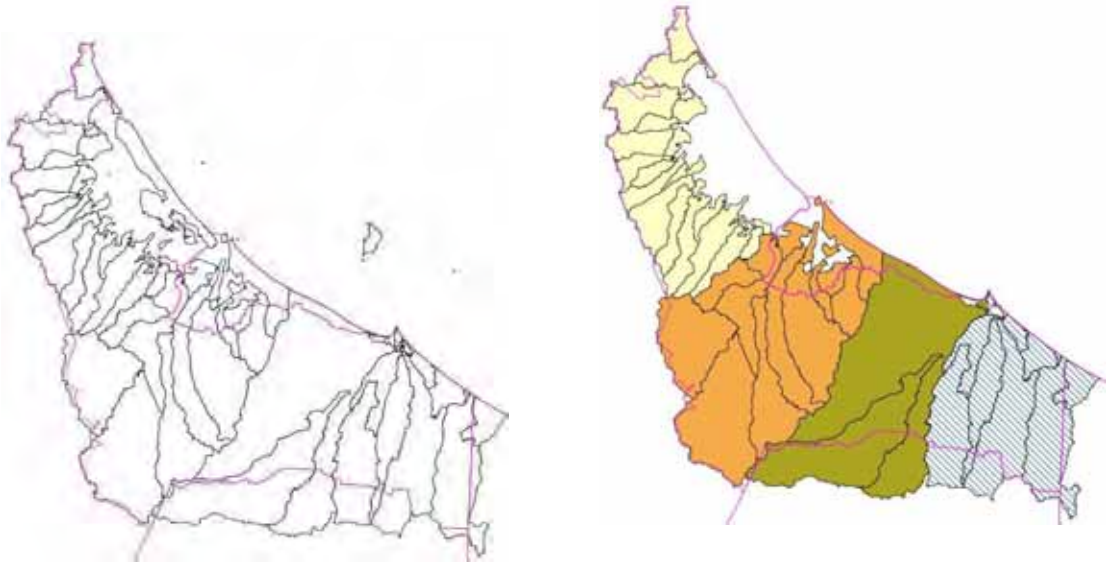
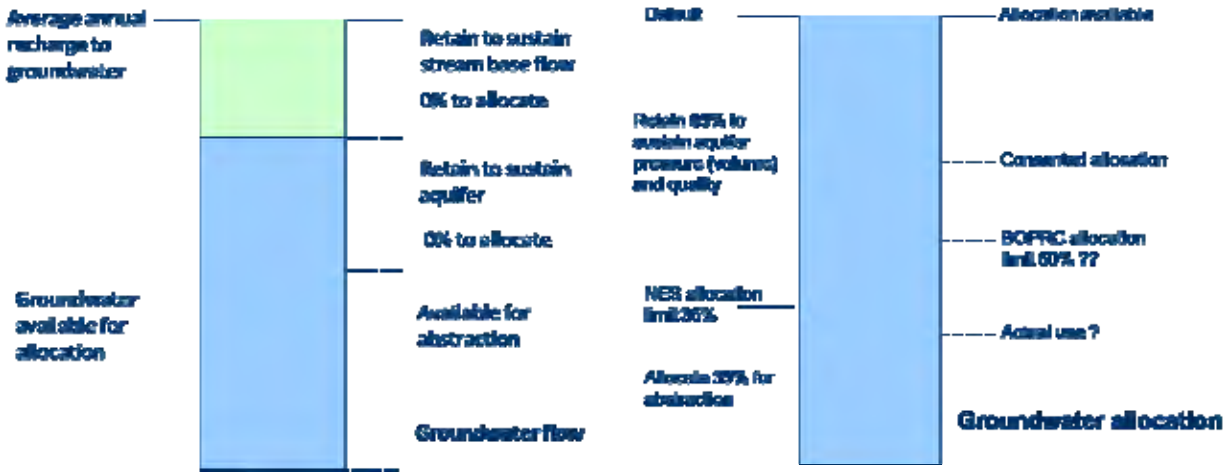


Figure 8 Groundwater catchments and groundwater zones for sub-regional model

For each of these groundwater catchments and zones groundwater available for allocation has been calculated. Groundwater flow and allocation considers three groundwater needs: to maintain spring flows (base flow) for streams, to maintain the aquifer itself (quality and water level), and provide water for use (abstraction). This is illustrated in Figure 9.



A: Groundwater flow B: Groundwater available for allocation

Figure 9 Concept of groundwater flow and allocation.

The present water level status of the monitoring bores has been mapped against the groundwater allocation status for the groundwater catchments/zones in Appendix 1 Map 10 and Map 11.

This is discussed in more detail in Part 4 of the report.

In order to better understand the volumes of groundwater actually being used requires a different approach to what we have presently. Under resource consent the allocation of groundwater can appear huge, however just because it is allocated does not mean that the resource is taken at its maximum allowable allocation on a daily or seasonal basis. The actual volumes used will vary with the climatic conditions experienced for that year and also the type of land use and practices that may now be in favour in the region.

Apart from attempting to estimate permitted use volumes for our groundwater catchments, it is crucial that actual use data is collected in a timely manner to effectively manage and allocate groundwater resources.

3.1.6 Pressures on the groundwater resource

To manage the groundwater resources, any take that exceeds volumes that are permitted under the RMA and WLP require resource consent from the Regional Council. This provides information on the amounts of water that have been legally allocated from a groundwater system.

Although the groundwater systems are extensive it is the actual and potential connection with surface water bodies that has dictated available allocation volumes from the groundwater systems. Groundwater allocation is now being considered in the framework of groundwater catchments, in keeping with surface water catchments.

It is only the confined groundwater systems (those that do not interact with surface water bodies above) that are dealt with differently as groundwater zones within the groundwater system.

Over the past 30 years land use and practices have changed and intensified. This can be illustrated by a regional overview of the amount of groundwater resources that have been approved under resource consent over the past decades. Figure 10 provides a snapshot of the volumes of groundwater allocated under resource consent at each decade 1980, 1990, 2000, and 2010. This broadly illustrates the changes in land use practices over the groundwater monitoring duration.

Resource consent is issued for a purpose. These are clumped into five categories: summer irrigation; frost protection; farm use; community/municipal; and commercial/industrial. Although these are not actual groundwater use figures they do show where the main pressure for groundwater is being driven from. In the 1980's most groundwater was being taken to develop the green kiwifruit industry in the region. As the vines matured less groundwater was needed.

However, by 2010 there had been a substantial shift in the kiwifruit industry with the introduction of Gold fruit that required irrigation to become established and continued irrigation for cropping. Gold fruit were also sensitive to frost, requiring protection. This saw a substantial increase in groundwater consents to provide security (an insurance) under which crops could be saved from inclement weather. Also over this time there was a boom in the dairy industry with the advent of pasture irrigation for sustained production and increased milk yields. Both frost protection and dairy irrigation require huge volumes of groundwater to meet the needs of the farmer.

Municipal supply has also increased its take from groundwater, as surface water became over-allocated based on the WLP policies. Groundwater is considered a secure supply of fresh water for growing communities, particularly in the Western Bay of Plenty.

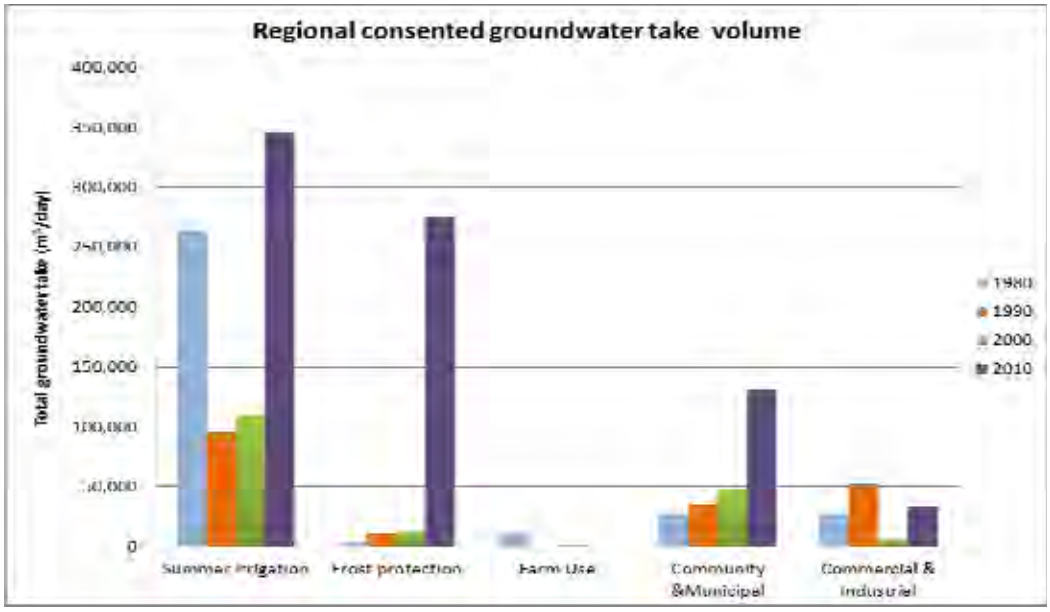


Figure 10 Consented groundwater take volume by purpose

3.2 Groundwater level

Long-term groundwater level monitoring records are valuable to help determine the behaviour of an aquifer; recharge zones, pumping impact, and flow direction. Other important data sets are rainfall, to identify climatic change and variance in recharge to groundwater systems, allocation and actual use data to determine the changes in water level on groundwater systems that are human induced. Typically groundwater is taken seasonally; irrigation in summer, heating in winter, frost protection in spring, the exceptions are municipal and commercial/industrial use, which is year round.

When the groundwater system is at rest the water level can determine how well the groundwater system recharges (replenishes) after intensive use. This data can identify trends of stress (depletion) on a groundwater system under certain pumping regimes (allocation and land use practices). It can show how the groundwater system responds to pumping stress and whether the allocation is sustainable.

Water level change in a groundwater system can influence groundwater quality. Abstraction can influence groundwater quality as pumping can change the flow directions and aquifer water levels. This provides for groundwater to flow from one area to another or from an aquifer to another (leakage), drawing varying quality of groundwater into areas. Leakage from other aquifers, or intercepting a recharge boundary i.e. a surface water source, may draw in better quality 'cleaner' water.

3.3 Groundwater quality

Groundwater is a large and reliable source of fresh water. In some areas the required volume of groundwater is available, however due to the quality of the water it may not be used. Groundwater quality needs to be monitored to identify high quality systems to be retained and deteriorated quality systems to be improved where possible.

For some groundwater systems the natural state will exclude them from use e.g. high iron or arsenic. However other groundwater systems can show human impacts to groundwater quality due to changes in water level (pumping) and/or impact from land use.

For some groundwater systems near the coast managing the water level of the system is necessary to avoid salt water intrusion from the sea into the fresh water groundwater system. Also a change in water level can draw poorer groundwater quality from one part of an aquifer into another.

Groundwater is largely replenished by rainfall; that is rainfall that percolates down through the soil to the groundwater system. Any soluble material on the ground surface can be moved into the groundwater systems by rainfall infiltration. Therefore managing land use in groundwater recharge areas is relevant to groundwater quality.

Part 4: Groundwater level assessment

4.1 Data management and trends

All monitoring bore data for water level has been verified, graphed and assessed. The primary purpose of this section is to identify any trends and pressures on the various groundwater systems. This will help assess if current allocation is sustainable; are the groundwater systems recovering from pumping stress.

4.1.1 Data quality

The majority of the bores monitored are done so on a manual basis. There are 48 manual water level monitoring sites. These bores are typically monitored every three months (four times per year). However this can occur at varying intervals over the years and is not consistent. The data collected over any year usually represents two lower and two higher water levels, for when the aquifer is under pumping stress and at rest (recovery) respectively. Pumping produces 'noise' in the data that needs to be assessed and removed where necessary, so the data is not skewed and causing a bias result.

Recording pumped levels is a problem in the water level monitoring program. Static water levels need to be recorded. This requires that the bore to be monitored is at rest for at least 24 hours before the water level is taken.

The limited data points that result from the manual water level monitoring program mean that seasonal variance and changes in static water levels are not clearly shown.

There are eight data-logged long term monitoring bores for water level; these are bore numbers 461, 2060, 2328, 2504, 2533, 2541, 2822, and 3043. These sites provide a frequent and continuous monitoring record of the fluctuations in water level during seasons and over years. These provide the most comprehensive water level data we have. However two of these bores (2328 and 2541) are actively pumped, therefore recording pumping water levels rather than static water levels.

Forty-nine of the monitoring bores are actively pumped at various volumes and therefore show pumping influence in the water level record. The monitoring bores also intercept aquifers that are pumped regularly either during summer (irrigation), autumn (frost protection) or winter (heating).

4.1.2 Approach to analysis

The pumped water level data influences the trend line of the static water level. For this reason the water level data required editing to remove outliers caused by pumping to gain a better understanding of the overall water level trend on the aquifer. The outliers were identified by visual/qualitative judgement. In Appendix 4 both graphs are presented; the raw data and edited data. Each bore has been surveyed to Moturiki datum and the data calculated to reduced level to standardise the data for assessment.

At least two high water level data points have been retained for each year. The trend line can then be applied (linear regression) without skewing the data. An example of how pumping can impact trend is shown at Bore 90 below.

The water level trend line for each bore has been assessed and put into three categories; stable, increase, decline. If the slope change is +/- 0.5m, over the duration of monitoring, then it is determined that there is a trend; + increase, - decline.

- **Stable**: there is fluctuation of the water levels over the years but the overall use does not exceed the ability for the aquifer to recover to background levels.
- **Increase**: could mean that the groundwater level had already been influenced by human impact prior to monitoring being initiated and we are now seeing a recovery on this system. Also there are periods where abstraction exceeds the ability of the aquifer to recover to background water levels. These sustained high use periods have caused the water levels to decline over time and not recover to background level. An increase trend is the recovery of the water levels to natural levels. This could be due to high rainfall years; land use change, and/or reduced abstraction.
- **Decline**: could mean that groundwater use exceeds recharge volumes for this aquifer. This can be influenced by low rainfall years; land use change, or high demand in localised areas.

The background water level is that recorded at the time monitoring began at the bore. Some aquifers had been in use for some years before any monitoring of water level began. So in some cases we are seeing a recovery of these systems to levels prior to when monitoring began e.g. Bore 729.

Water level trends have been derived for each bore. These are set out in stating whether the overall water level trend is stable, has increased or is in decline.

Table 2 key:

A:	Aongatete ignimbrite
W:	Waitearikiignimbrite
WA:	Waitearikiignimbrite
TGS:	Tauranga Group sediments
Q1:	Non-marine sediments (Tauranga Group)
Q1m:	Marine sediments (Tauranga Group)
Q2-Q4:	Non-marine sediments (Tauranga Group)
Q6-Q8:	Sediments (Tauranga Group)
Mnd:	Minden Rhyolite
Pk:	Pokai and other volcanics
Mmk:	Mamaku Plateau Formation
Mhn:	Matahina and other volcanics

Table 2 Summary of water level trends by aquifer

Bore	Aquifer	Status	Location	Data range	Duration	Water level change (m/year)	Water level change over duration (m)
51	A	Stable	Tauranga	1990 to 2011	21	-	-0.2
90*	A	Increase	Katikati	1986 to 2011	25	+0.32	+8.0
90	A	Decline	Katikati	1992 to 2011	19	-0.094	-1.8
93	A	Decline	Wairoa	1990 to 2011	21	-0.033	-0.7
94	W	Stable	Oturu	1990 to 2011	21	-	+0.4
851	W	Stable	Katikati	1987 to 2011	24	-	+0.2
1018	W	Stable	Maketu	1993 to 2011	18	-	-0.05
1386	A	Decline	Tauranga	1999 to 2011	13	-0.46	-6.0
1468	WA	Stable	Otumoetai	1995 to 2011	16	-	+0.48
1566	WA	Stable	Apata	1987 to 2011	24	-	+0.46
1670	W	Decline	Tauranga	1990 to 2011	21	-0.033	-0.70
1686	W	Stable	Waipapa	1990 to 2011	21	-	-0.3
2024	W	Stable	Te Puke	1990 to 2011	21	-	-0.05
2328	A	Increase	Katikati	1987 to 2011	24	+0.30	+7.2
2344	W	Stable	Waimapu	1990 to 2011	21	-	0
2533	WA	Stable	Te Puna	1990 to 2011	21	-	-0.08
2829	A	Decline	Athenree	1988 to 2011	23	-0.078	-1.8
2838	A	Increase	Katikati	1988 to 2011	23	+0.065	+1.5
3026	W	Increase	Te Puke	1990 to 2011	21	+0.095	+2
2519\2	?WA	Stable	Katikati	1986 to 2011	25	-	+0.2
2519\3	?WA	Stable	Katikati	1986 to 2011	25	-	+0.4
2520\3	?WA	Stable	Katikati	1986 to 2011	25	-	-
2521\1	?WA	Decline	Katikati	1990 to 2011	21	-0.104	-2.2
2521\3	?WA	Decline	Katikati	1986 to 2011	21	-0.138	-2.9
2522\3	?WA	Stable	Katikati	1986 to 2011	25	-	-
2523\2	?WA	Stable	Katikati	1986 to 2011	25	-	+0.25
1319	TGS	Stable	Galatea	1991 to 2011	20	-	-
1520	TGS	Stable	Maketu	1990 to 2011	21	-	-0.3
1535	TGS	Stable	Te Puke	1990 to 2011	21	-	+0.4
1690	TGS	Stable	Maketu	1990 to 2011	21	-	-0.42
2330	TGS	Stable	Katikati	1987 to 2011	24	-	-0.4
2504	TGS	Stable	Otumoetai	1983 to 2011	28	-	+0.35
2728	TGS	Stable	Te Puke	1990 to 2011	21	-	+0.3
2847	TGS	Stable	Maungatawa	1975 to 2009	35	-	-0.20
2913	TGS	Stable	Galatea	1990 to 2009	19	-	-0.25
3032	TGS	Increase	Waihī	1990 to 2011	21	+0.095	+2.0
3034	TGS	Stable	Maketu	1990 to 2011	21	-	+0.30
3036	TGS	Decline	Opotiki	1990 to 2011	21	0.038	-0.80
3038	TGS	Stable	Opotiki	1990 to 2011	21	-	-
3043	TGS	Stable	Maketu	1990 to 2011	21	-	+0.10
3301	TGS	Stable	Ohope	1996 to 2011	15	-	+0.40
3463	TGS	Stable	Otumoetai	1995 to 2011	16	-	+0.35
461	Q1	Stable	Rangitāiki Pl.	1988 to 2011	23	-	+0.005
845	Q6-Q8	Increase	Rangitāiki Pl.	1989 to 2011	22	-	+0.5
729	Q1m	Increase	Rangitāiki Pl.	1987 to 2011	24	-	+0.5
2060	Q2-Q4	Decline	Rangitāiki Pl.	1988 to 2011	23	-	-0.5
2541	Q6-Q8	Increase	Rangitāiki Pl.	1986 to 2011	25	+0.077	+2.0
410	Mnd	Stable	Paengaroa	1998 to 2011	13	-	-0.2
951	Mnd	Stable	Paengaroa	1990 to 2011	21	-	+0.25

Bore	Aquifer	Status	Location	Data range	Duration	Water level change (m/year)	Water level change over duration (m)
2822	Mnd	Decline	Pongakawa	1990 to 2011	21	-0.05	-1.1
1561	Mmk	Stable	Rotorua	1995 to2011	16	-	-0.2
3470	Mmk	Stable	Rotorua	1996 to 2011	15	-	+0.1
4005	Mmk	Increase	Rotorua	1995 to 2011	16	+0.03	+0.5
4006	Mmk	Stable	Rotorua	1995 to 2011	16	-	-0.2
3469	Pk	Increase	Rotorua	1996 to 2011	15	+0.1	+1.5
4007	Pk	Increase	Rotorua	1995 to 2011	16	+0.03	+0.5
2509	Mhn	Decline	Rangitāiki Pl.	1996 to 2011	15	-0.333	-5.0

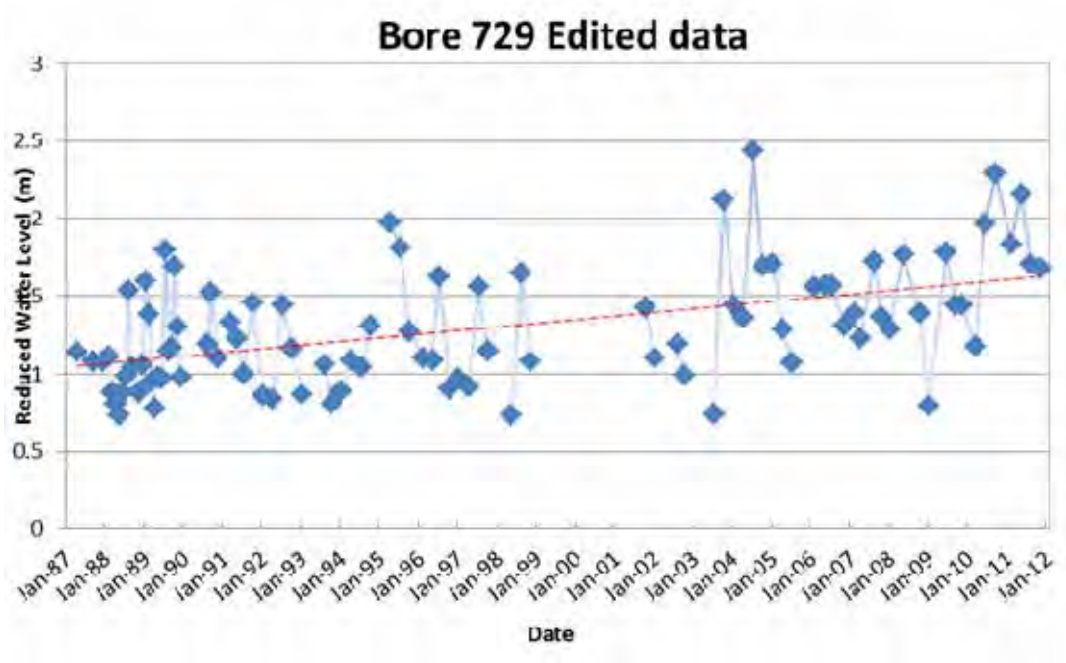
4.1.3 Bores with increasing water level trends

There are eleven monitoring bores that show an increasing water level trend (Bore 90 is included) over the monitoring duration. The overall water level trend is now higher than initial water level records. To help determine the reasons for an increase water level trend it is necessary to know abstraction volumes from a system. However no records of groundwater use have been kept. Groundwater was being abstracted prior to monitoring of the water levels began. Therefore we do not have a true background groundwater level, the static water level of the groundwater system prior to human impact by pumping. So the earliest record could be showing pumping effect. Therefore it is assumed that the increase water level trend is due to less groundwater being abstracted from these areas than previously.

Of the water level bores we monitor eleven show varying states of water level increase. These bores are within the Aongatete Ignimbrite (3), Waitеariki Ignimbrite (1), Mamaku Ignimbrite (1), Pokai Volcanics (2) and the Tauranga Group sediments (4). Examples of three of these water level trends are provided for bores 729, 2328 and 4005.

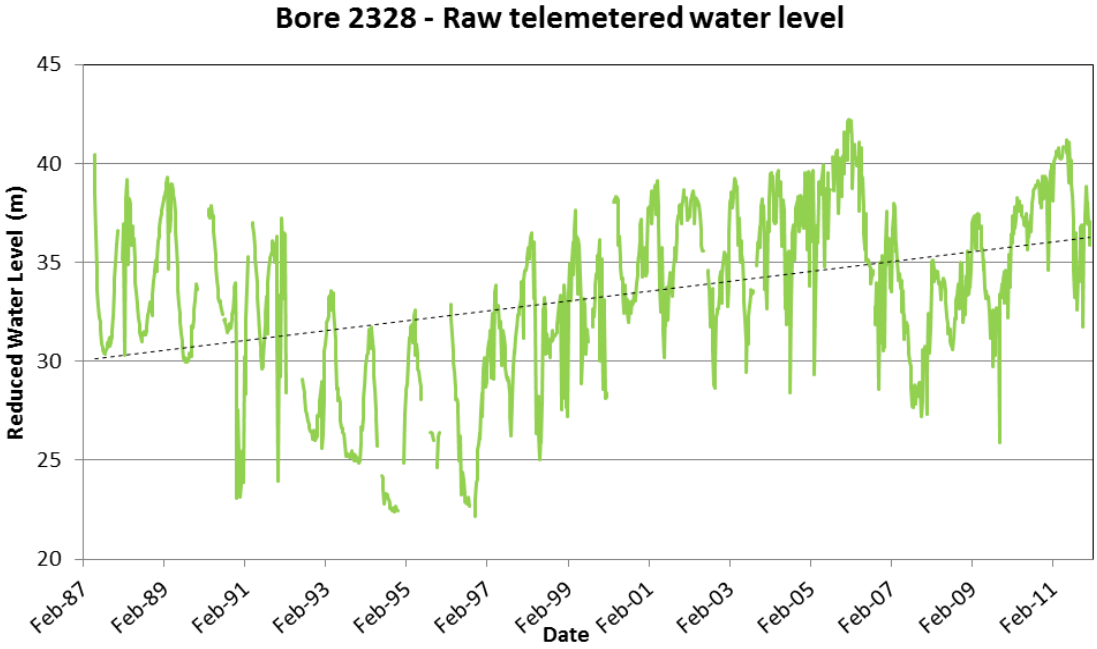
4.1.4 Bore 729 [page 124]

This bore intercepts the Tauranga Group sediments on the Whakatāne coastal plains and is 12.8 m deep. There appears to be an overall long term increasing water level trend of 0.02 m/year (0.5 m increase over 24 year period).



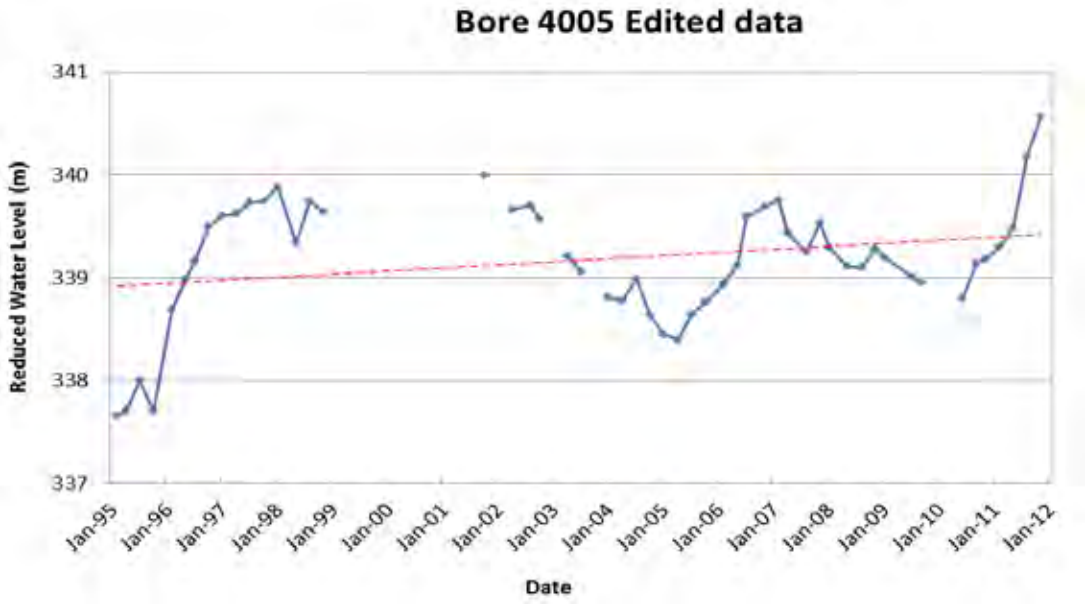
4.1.5 Bore 2328 [page 180]

This bore intercepts the Aongatete Ignimbrite near Katikati and is 454m deep. There appears to be an overall long term increasing water level trend of 0.30m/year (7.2m increase over 24 year period). This bore is also a production bore used for irrigation, so the extreme water level drops occur with pumping during the summer. This pumping effect provides a greater increase in water level trend than if it were not present.



4.1.6 **Bore 4005 [page 278]**

This bore intercepts the Mamaku Ignimbrite in the Rotorua lake catchment and is 180m deep. There appears to be an overall long term increasing water level trend of 0.03m/year (0.5m increase over 16 year period). The water use records for this aquifer are no known, but it is assumed that there was already a pumping effect on this data. The bore is used regularly to provide domestic supply all year round and irrigation in summer. Again it could be the pumping effect of this production bore that has skewed the data to show an overall increase in water level trend.



4.1.7 **Bores with declining water level trends**

Fluctuations in water level occur, however it is the over-all trend that is of interest; of particular concern is an overall declining trend. To help determine the reasons for a decline trend it is necessary to know abstraction volumes from a system. Although we can calculate the volumes for consented water takes, we are reliant on models to determine permitted take effects. Also the consented volumes are the maximum volumes rather than actual use. Just because consent provides for a set volume does not mean this total volume is used. Therefore it is assumed that the decline trend is due to use exceeding recharge.

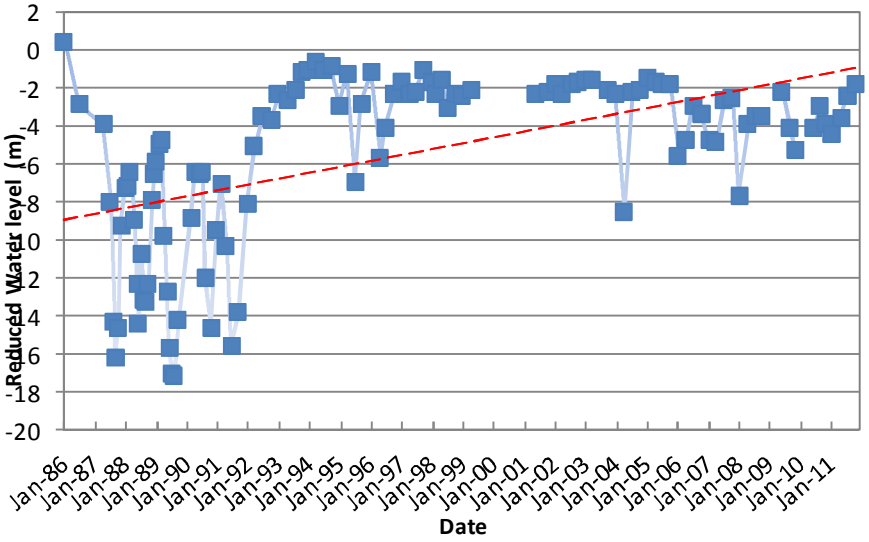
Of the water level bores we monitor eleven show varying states of water level decline. These bores are within the Aongatete Ignimbrite (5), Waitearikì Ignimbrite (2), Minden Rhyolite (1), Matahina Ignimbrite (1) and the Tauranga Group sediments (2).

4.1.8 **Bore 90 [page 104]**

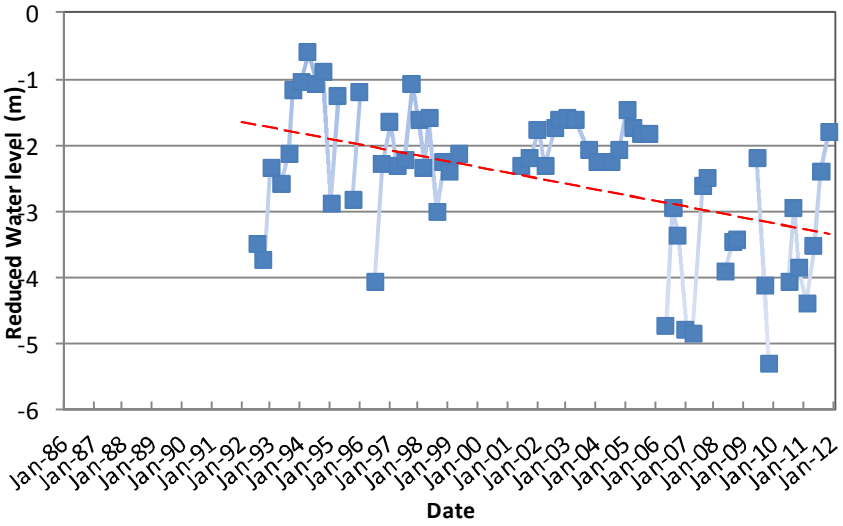
This bore intercepts the warm water of the Aongatete Ignimbrite aquifer in the Athenree area and is 329m deep. The highest water level recorded was in 1986 at the beginning of water level monitoring program (Graph A). Intensive pumping at the bore up to 1992 kept the overall water level down and recovery was only partial. However it appears as use decreased from 1992 that the water levels did recover, but not to the extent of the initial water level reading in 1986.

If the intensive pumping data is retained in the data record the over-all trend on the aquifer is increasing (Graph A). However if the pumping data is removed from 1987-1991 (retaining the initial 1986 level) then the water level shows an overall decline (Graph B). Background water levels have not been reached since 1994 with a steady groundwater level decline, particularly from winter 2005 to winter 2010. For Graph B there is a declining water level trend of 0.1m/year (1.8m drop over 19 year period).

Graph A: Bore 90 Raw Data



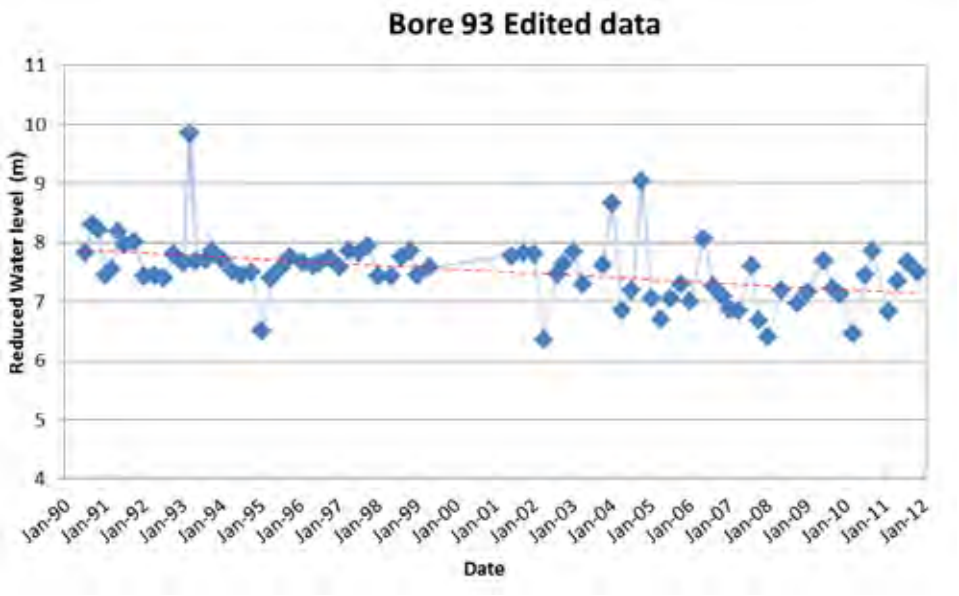
Graph B: Bore 90 Edited data



Bore 90 is near the coast and has a water level that is below sea level. This is a confined layer that extends out to sea. However the extent off shore is not known. It is recommended that groundwater quality monitoring is initiated at least twice annually for groundwater quality (particularly conductivity), to identify any risk of salt water intrusion.

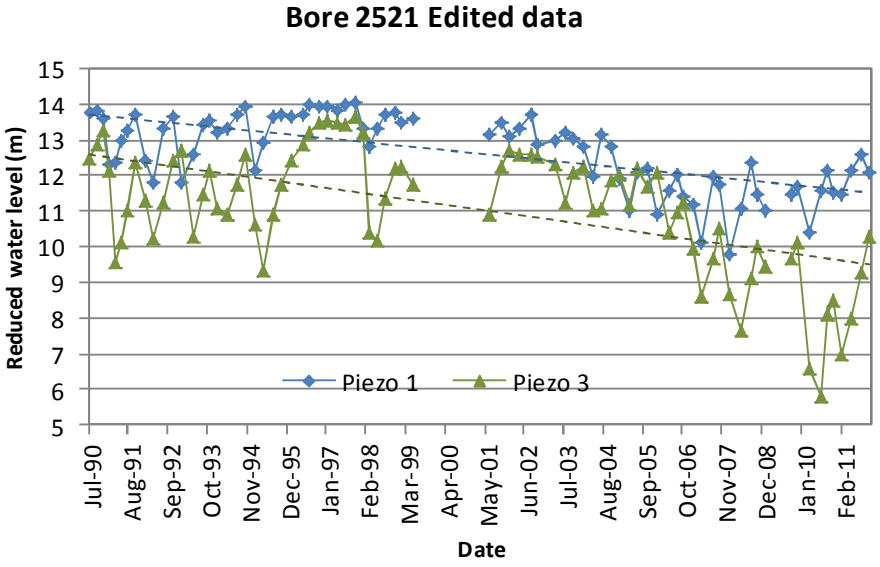
4.1.9 **Bore 93 [page 104]**

This bore intercepts the Aongatete Ignimbrite in the Te Puna area and is 460m deep. There appears to be an overall long term declining water level trend of 0.033m/year (0.7m drop over 21 year period).



4.1.10 **Bore 2521\1 [pages 205] and 2521\3 [page 209]**

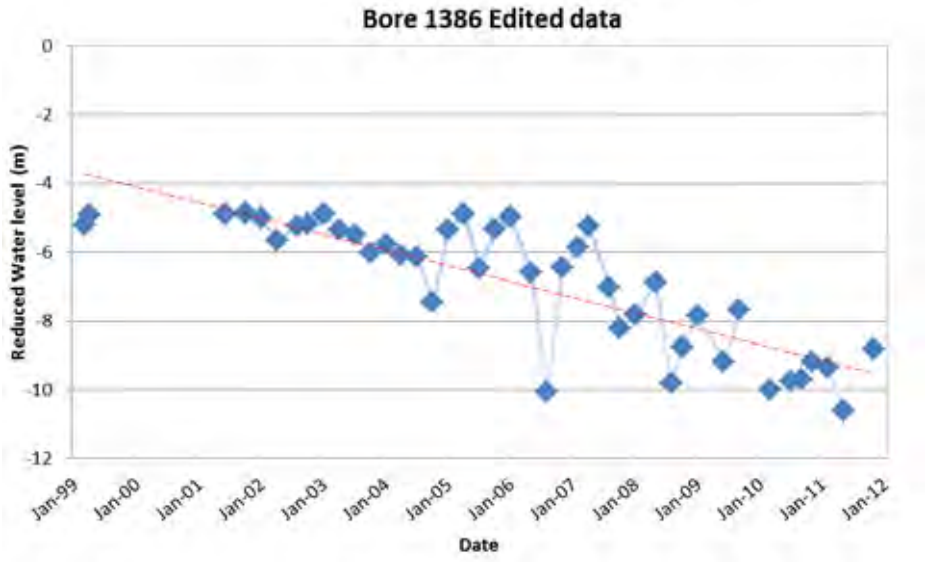
In the early 1980's several monitoring bores were installed north of Tauranga. Each bore intercepted several aquifers, and each aquifer was set with a piezo so that the separate aquifers could be monitored. However it is not known what piezo intercepts which aquifer. Few of these piezo remain functional and the data can be ambiguous. This bore is 157m deep and probably intercepts the Whaitereiki and/or Aongatete Ignimbrite aquifer system. There is an overall declining water level trend of 0.104m/year (2.2m drop over a 21 year period) and 0.138m/year (2.9m drop over a 21 year period) respectively for bore 2521/1 and 2521/3.



4.1.11 **Bore 1386 [page 142]**

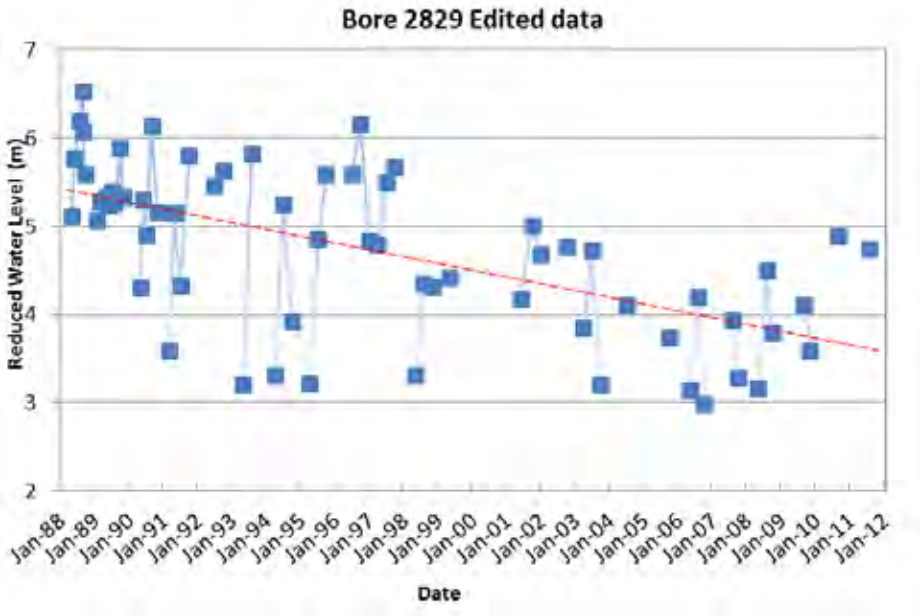
This bore intercepts warm water of the Aongatete Ignimbrite in the Tauranga city area and is 466m deep. There appears to be an overall long term declining water level trend of 0.46m/year (6m drop over 13 year period).The water permit for this bore states it is used for commercial heating. Drawdown tends to occur in the colder months.

Bore 1386 is inland of the coast but near the harbour. It has a water level that is below sea level. This is a confined layer that extends out to sea. It is recommended that groundwater quality monitoring is initiated at least twice annually for groundwater quality (particularly conductivity), to identify any risk of salt water intrusion.



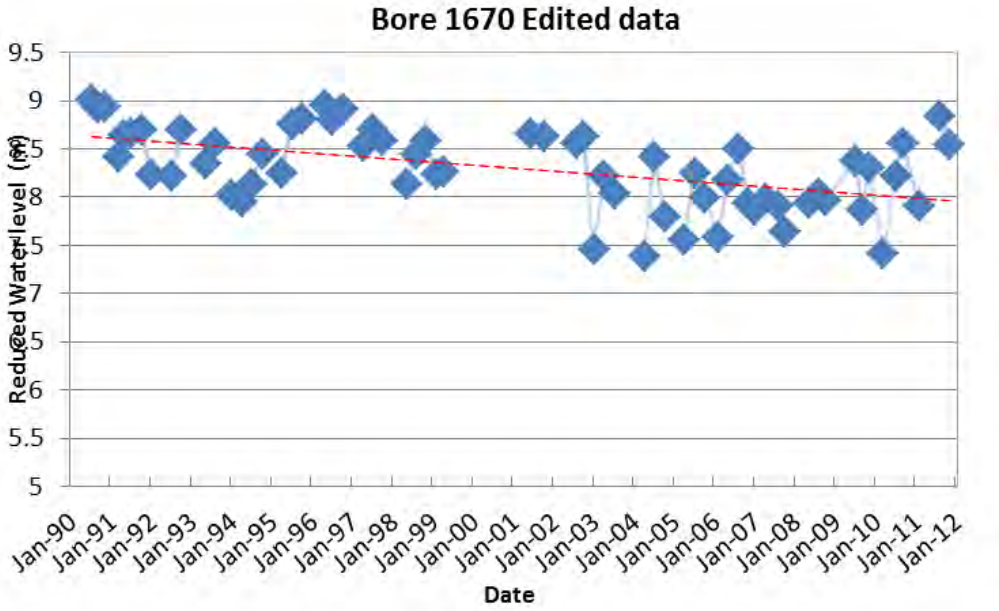
4.1.12 **Bore 2829 [page 227]**

This bore intercepts the warm water of Aongatete Ignimbrite in the Katikati area and is 216m deep. There appears to be a decline on groundwater levels since 1997. There is a declining water level trend of 0.078m/year (1.8m drop over a 23 year period).



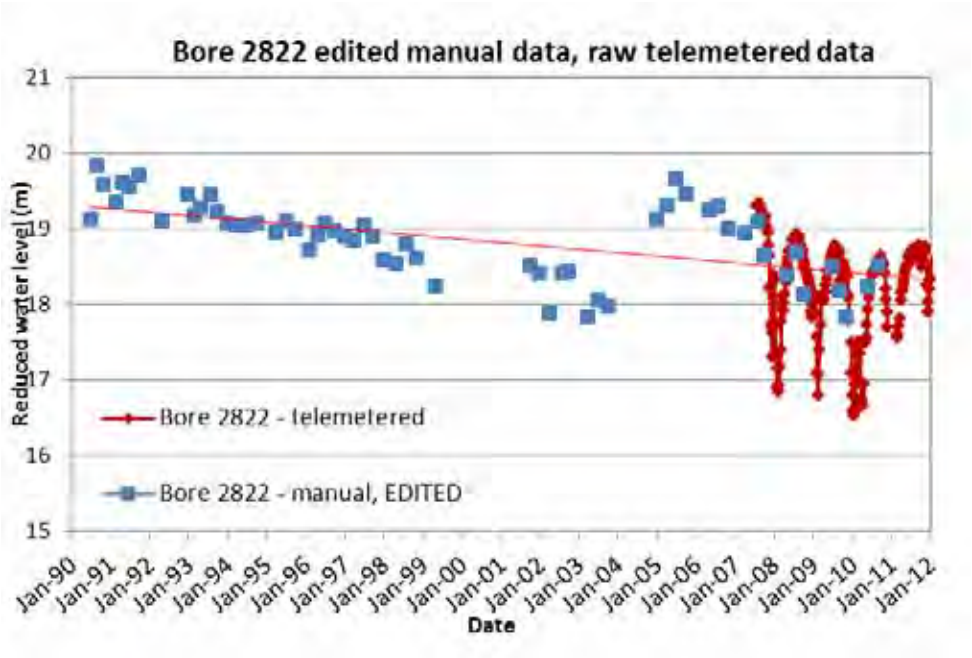
4.1.13 **Bore 1670 [page 160]**

This bore intercepts the Waitea riki Ignimbrite in the Tauranga city area and is 103m deep. There appears to be an overall long term declining water level trend of 0.033m/year (0.7m drop over a 21 year period).



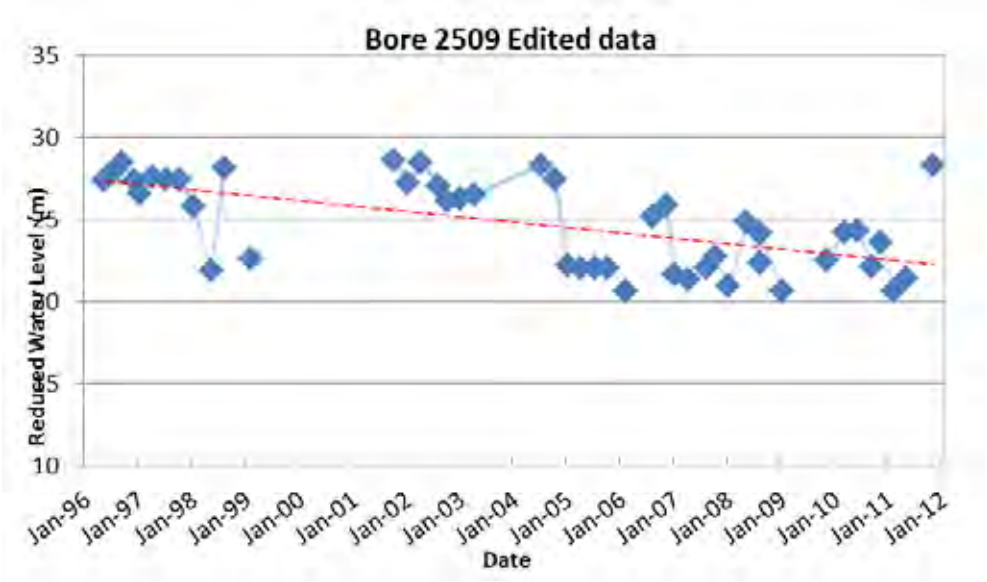
4.1.14 **Bore 2822 [page 223]**

This bore intercepts the Minden Rhyolite near Pongakawa and is 121m deep. The water levels were recorded manually until 2007 when the site was telemetered. The telemetered data provides more data and a clearer understanding of the overall drawdown on the aquifer system and its recharge levels over the years than what is provided for with the manually recorded data. There appears to be an overall long term declining water level trend of 0.05m/year (1.1m drop over 21 year period). This is not an extensive aquifer and is localised to this geological unit.



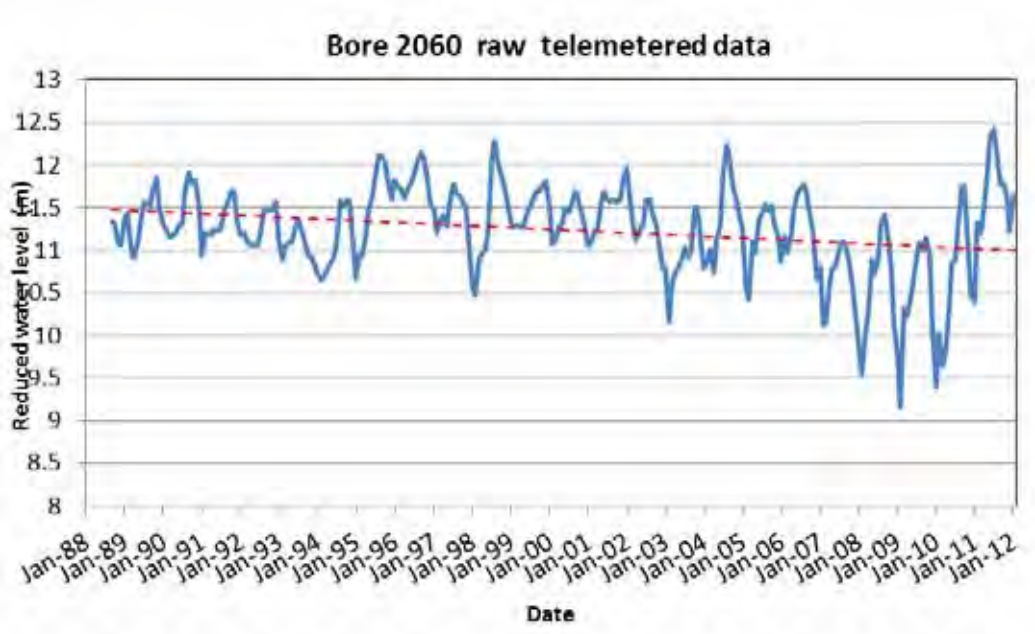
4.1.15 **Bore 2509 [page 198]**

This bore intercepts the Matahina and older volcanics on the Rangitaiki Plains and is 319m deep. A steady groundwater level decline occurs from 2004 to 2010, with a rise in groundwater levels in 2011. There is an overall declining water level trend of 0.3m/year (5m drop over a 15 year period).



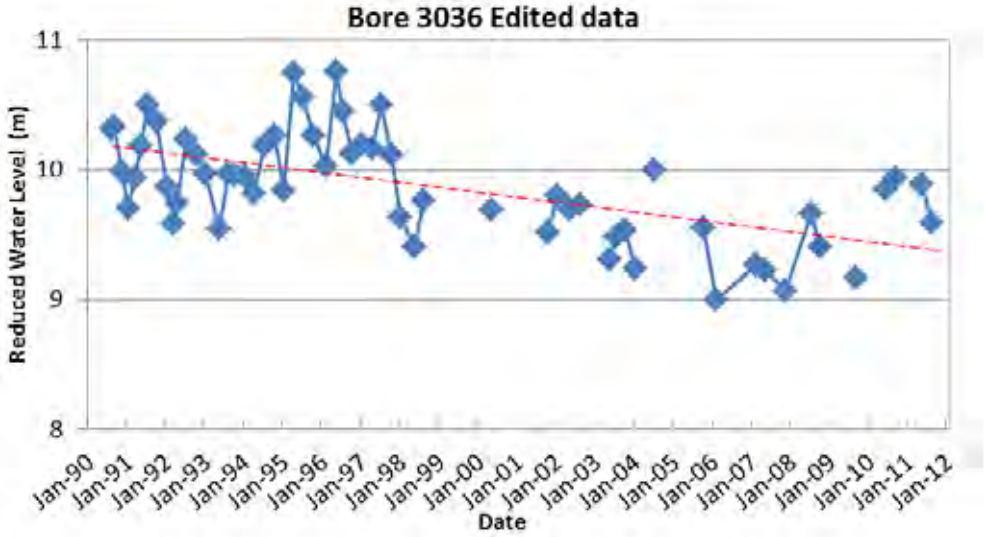
4.1.16 **Bore 2060 [page 170]**

This bore intercepts Tauranga Group sediments on the Rangitāiki Plains and is 61m deep. There appears to be an overall long term declining water level trend of 0.02m/year (0.5m drop over a 23 year period). However this comprehensive record also shows decline and recovery cycles between 1989-1995, 1998-2004, 2004-2011. These cycles could be related to climatic change (rainfall), land use change, or in later years the arrival of Psa in the region.



4.1.17 **Bore 3036 [page 245]**

This bore intercepts the Tauranga Group sediments near Opotiki and is 30m deep. This is the main aquifer for the Ōpōtiki Plains. There is an overall declining water level trend of 0.038m/year (0.80m drop over a 21 year period).



4.2 Discussion – factors influencing groundwater quantity

Eleven of the bores indicated a decline in groundwater levels relative to background levels. These bores are highlighted in Table 2. Seven of these are within the confined groundwater system of the Waitearikiand Aongatete Ignimbrites around the Tauranga Harbour. These show intensive use areas of the aquifer system. The entire aquifer however is not in decline. In the high use areas recharge cannot meet the volume of water being taken from the system.

The other decline groundwater trends are identified in localised unconfined, leaky or confined groundwater systems. These systems are the Tauranga Group sediments, Minden Rhyolite and Matahina aquifers respectively, of the Ōpōtiki Plains, Te Puke and Rangitāiki area. The remainder of the aquifer systems are either stable or showing an increase water level trend, due to recharge to the systems.

To put these trends in context with allocation status for the region see Map 10 and Map 11. Evaluation of the groundwater systems and preliminary water balance for the water resources have been completed for western Bay of Plenty and Rangitāiki Plains area. This work was commissioned from GNS Science. The reports calculated a rough volume of water available for allocation from the groundwater systems. This was off-set by estimated actual use based on consented use i.e. what is being taken from the groundwater for irrigation, frost protection, municipal/industrial/commercial use (this does not include any calculation for permitted takes). At present the WLP provides a general direction, but not a specific method on how to allocate the groundwater resource.

The Ministry for the Environment have had a draft proposed groundwater allocation systems since 2009, but this document has not progressed to an operative document and remains the Proposed National Environmental Standard on Ecological Flows and Water Levels (NES). This sets an allocation for groundwater of no more than 35% of average annual recharge or 15% of average annual recharge for shallow coastal aquifers (predominantly sand). However ‘coastal aquifer’ is not defined, therefore the 35% has been used as an allocation limit to assess allocation pressure in regard to consented use (estimated actual use).

Estimated actual use has been calculated for the groundwater systems for Western Bay of Plenty area and Rangitāiki Plains. How much of the groundwater resource that has been allocated is mapped against the 35% NES criteria. This identifies areas that are within allocation and those that are near full allocation (Map 10 and Map 11).

For Map 10 the Otumoetai and Kaituna catchments allocation is calculated as high, yet the monitoring bores are showing a stable trend (sustainable); pumping does not exceed recharge to the system. However for the Rangitāiki Plains decline trends are identified in catchment with allocation concerns.

For Map 11 for the groundwater zones of the Waiteariki/Aongatete ignimbrite aquifer the high allocation area is not showing decline and the medium to low allocation areas are showing decline trend in specific areas. This could be due to localised specific use and/or the structure of the geology in these areas affecting recharge.

For the majority of monitoring bores the water level recovers to above sea level. During pumping stress water levels can drop below sea level for period of time. When the pumping stress is off the aquifer we are seeing the water levels recover above sea level. There are three monitor bore where the background water level is below sea level. These are bores 90, 461 and 1386.

Two bores that show water level decline are bores 90 and 1386. Both bores draw groundwater from the geothermal resource that underlies the Tauranga harbour area.

For bores 90, 461 and 1386 groundwater quality sampling is recommended to identify any risk of salt water intrusion into the freshwater resource of the aquifer, and temperature monitoring for bores 90 and 1386 to determine any temperature loss with water level decline.

Rainfall recharge to unconfined groundwater systems typically is rapid. For other systems that are leaky (semi-confined, semi-unconfined) or confined the water level response from rainfall recharge can take days, weeks or months to show.

In Appendix 4 the telemetered bore data has also been plotted over residual monthly rainfall. The rainfall data used is from the closest rain gauge site to the bore Map 2. This was an attempt to assess any influence of rainfall on groundwater levels. These graphs are located on the information sheet for each of the telemetered bores (461, 2060, 2328, 2504, 2533, 2541, 2822, and 3043) in Appendix 4.

Human impact on the water level of the aquifer system is difficult to assess because the actual use (the annual or seasonal volume of water taken from an aquifer) is not recorded. Although estimated actual use has been calculated It can only be surmised why the water level of the systems behave the way they do.

To provide actual use (abstraction volumes) all consented water takes require a record of actual water use in real-time. This information coupled with rainfall, climate and hydraulic flow data will allow a better understanding and interpretation of the groundwater data and how the aquifer systems are behaving.

Part 5: Groundwater quality assessment

5.1 Data management and trends

Groundwater quality data has been collected from 59 monitoring bores over the years. Presently 22 monitoring bores are used to provide groundwater quality data. Only 15 of these also include water level data. However the water level and groundwater quality monitoring does not correspond to each other (undertaken at different times). Groundwater quality monitoring only occurs annually. Therefore no trend assessment can be done on the quality of the water, as to whether it changes under pumping stress and improves with recovery (recharge) or visa-versa.

5.1.1 Data quality

Twenty variables are assessed to determine any trend in groundwater quality over the entire monitoring regime. Four of our bores are presently part of the National Groundwater Monitoring Program managed by GNS Science (Bore numbers 2509, 3301, 4007, and 4364). No change to groundwater quality trend has been identified over the monitoring duration.

5.1.2 Approach to analysis

Groundwater quality has been assessed against Drinking Water Standards for New Zealand 2005 (revised 2008) (DWSNZ); ANZECC guidelines 2000; and anthropogenic nitrogen levels (Daughney & Reeves 2005). Although the standards and guidelines are not strictly applicable to ambient groundwater quality they serve as a reference for comparison and indicators of change.

In most cases the groundwater quality is within the maximum acceptable (MAV) or guideline value (GV) set in DWSNZ. The DWSNZ defines health-related maximum acceptable values (MAV) and aesthetic guideline values (GV). The ANZECC guidelines define trigger levels (TV) based on specified protection levels for aquatic ecosystems. This report uses TV that corresponds to the 95% protection level for freshwater ecosystems.

5.2 Groundwater quality

Maintaining good groundwater quality is crucial for the longevity of the fresh water resource. Regional concerns for groundwater quality relate to:

- contamination with nitrate and/or phosphate (nutrients);
- contamination with microbial pathogens;
- naturally elevated concentrations of iron, manganese, arsenic;
- risk of induced salt water intrusion.

Groundwater quality in the region generally does not appear to be changing over time. There is little evidence of trend. The frequency of sampling, total number of samples and data gaps may hinder the ability to recognise any annual (seasonal) or long term trends.

5.2.1 Key groundwater quality indicators

Over the years our groundwater systems have been analysed for various parameters. These are list in Appendix 3. Of these parameters some have been assigned limits based on health, environmental and aesthetic effects (Table A3-1, A3-2, A3-4).

Nitrate-nitrogen (NO_3-N) is monitored for health and environmental reasons. Work undertaken by Daughney & Reeves (2005) has provided figures for NO_3-N in groundwater to help determine status in regard to human impact:

- median concentration of 0.7g/m^3 for pristine oxidise groundwater
- median concentrations above 1.6g/m^3 probably indicate anthropogenic effects,
- median concentrations above 3.5g/m^3 indicate human impact on groundwater.

Nitrogen in oxygen-rich groundwater exists predominantly as NO_3-N, but under oxygen-poor conditions nitrogen is converted to ammoniacal-nitrogen (NH_4-N) by natural processes. The level of NH_4-N is useful as it shows whether the absence of NO_3-N is due to oxygen-poor water (conversion) or a lack of human or agricultural impact on groundwater quality. Low values of NO_3-N and greater values of NH_4-N, Fe and Mn indicate oxygen-poor groundwater. Thus nitrogen exists as NH_4-N rather than NO_3-N (Daughney & Reeves 2005).

Dissolved iron (Fe) can impart an unpleasant taste to drinking water, but is not a health or ecosystem risk. Fe can cause problems with staining and is precipitated on contact with surface oxygen, which can cause blockages in screen/pump works. Elevated concentrations of dissolved Fe in groundwater indicate oxygen-poor conditions, so complements NH_4-N to understand measured concentrations of NO_3-N.

Dissolved manganese (Mn) can impart an unpleasant taste to drinking water and cause staining. It can also be a risk to human health and freshwater ecosystems. Mn is soluble in oxygen-poor groundwater. Oxidised Fe and Mn can precipitate in the bore screen causing clogging. Before use the groundwater can be filtered to reduce the oxidised Fe and Mn from the water.

Eschericia coli (E. coli) are a species of bacteria that indicates the presence of faecal matter in groundwater. This can be due to lack of containment at bore head works or proximity to septic tank or dairy shed waste.

Electrical conductivity (conductivity) provides a measure of the total dissolved solids (TDS) concentration and provides a useful indicator of changes in quality, particularity with abstraction, like salt water intrusion and recharge.

5.2.2 Groundwater quality observations

To undertake trend analysis for groundwater quality requires at least quarterly data for several years. Due to the lack of monitoring frequency and inconsistency of sampling intervals trend analysis could not be performed for individual calendar years. Even the overall monitoring it is difficult to ascertain any changes in quality due to abstraction because to the lack of monitoring frequency and interval variation. Therefore medium and maximum have been considered in relation to standards, guidelines and trigger levels.

Groundwater quality data from the monitoring bores has been assessed and set out in tables (Appendix 3). The tables display the median and maximum figures for certain parameters against recognised standards, guidelines and trigger values.

In the tables the groundwater quality result is highlighted if the parameter exceeds a DWSNZ threshold or ANZECC TV. However this does not necessarily indicate a threat to human health, because some DWSNZ guidelines are purely aesthetic, and ANZECC TV do not necessarily lead to adverse ecological consequences in adjacent surface waters. Water treatment methods can often be employed to remove or reduce the concentration of the parameter of concern to meet health-related standards. Whereas groundwater discharging to a lake, stream, river, mixes with the surface water and can lead to dilution and a reduction of the contaminant concentration.

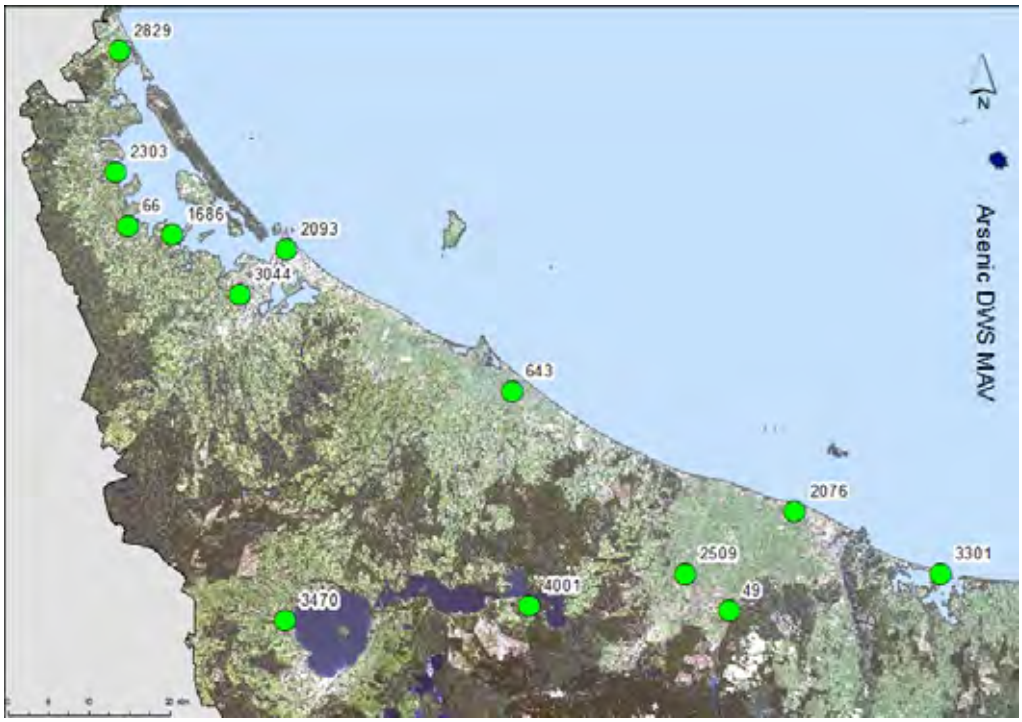
The median groundwater quality results for each bore have been assessed and tabled to show those with a tendency to exceed limits and guidelines. These bores and the parameters of concern are listed in Table 4 and shown on Maps 12 to 24.

Table 4 Bore with groundwater quality concerns

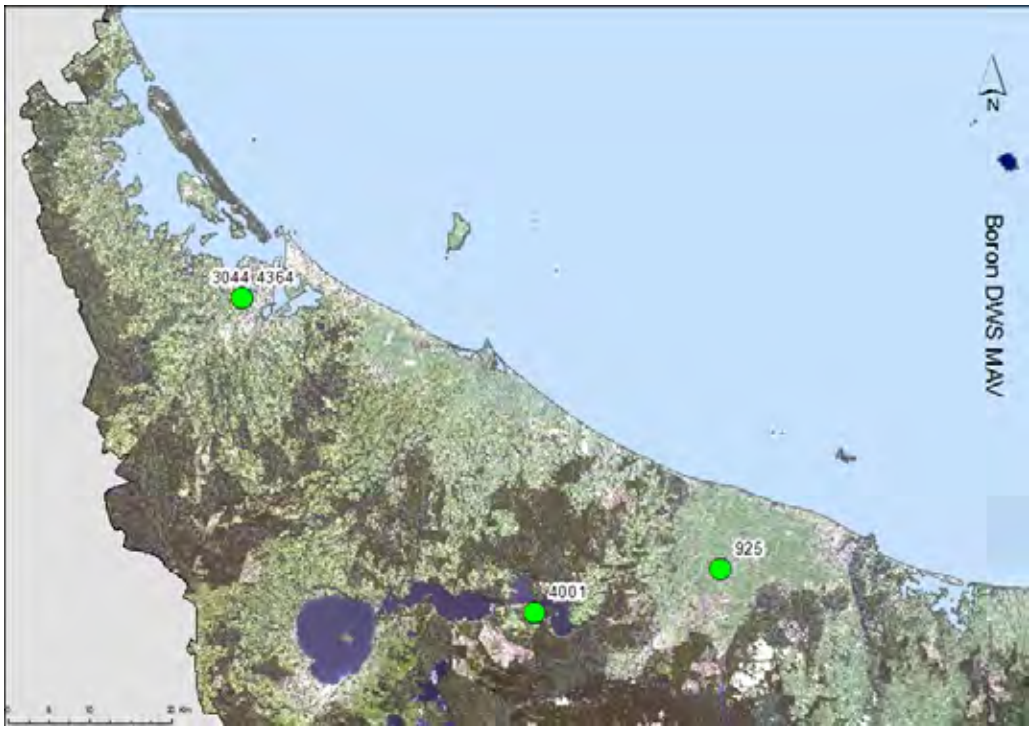
Above DWSNZ Health Related MAV	**Bore number**	**Map**
Arsenic	49, 66, 643, 1319, 1686, 2076, 2093, 2303, 2509, 2829, 3044, 3301, 3470, 4001	12
Boron	925, 3044, 4001, 4364	13
Manganese	410, 643, 925, 951, 1319, 1690, 2362, 2822, 3272, 3470, 4001, 4364,	14
ENT/FC	1, 49, 643, 3301, 3566	15
Ammoniacal-nitrogen	49, 466	16
Above DWSNZ Aesthetic Guideline	**Bore number**	
Aluminium	49, 1686, 2847	17
Hardness	49, 2707, 3272	18
Iron	1, 196, 410, 466, 490, 643, 845, 851, 925, 951, 1018, 1319, 1686, 1690, 2362, 2728, 2822, 2829, 2847, 3036, 3044, 3470, 4001, 4002, 4364,	19
Manganese	1, 49, 196, 410, 466, 490, 643, 845, 851, 925, 951, 1018, 1319, 1586, 1686, 1690 2303, 2362, 2728, 2822, 2847, 3036, 3044, 3272, 3470, 4001, 4002, 4364,	20
Sodium and Chloride	2093, 3044, 3272, 4001	21
Sulphate	3272	22
Above ANZECC TV	**Bore number**	
Ammoniacal-nitrogen	1, 2847, 3272, 3470	23
Anthropogenic nitrate effect	**Bore number**	
	3034, 3566, 4968	24

Also included in the groundwater quality analysis is a table of trace elements recorded Table A3-3. For data integrity and to determine accuracy of the groundwater quality results an Ion Balance data check was undertaken; Table A3-5 Major Ions and Table A3-6 Ion Balance of bore samples.

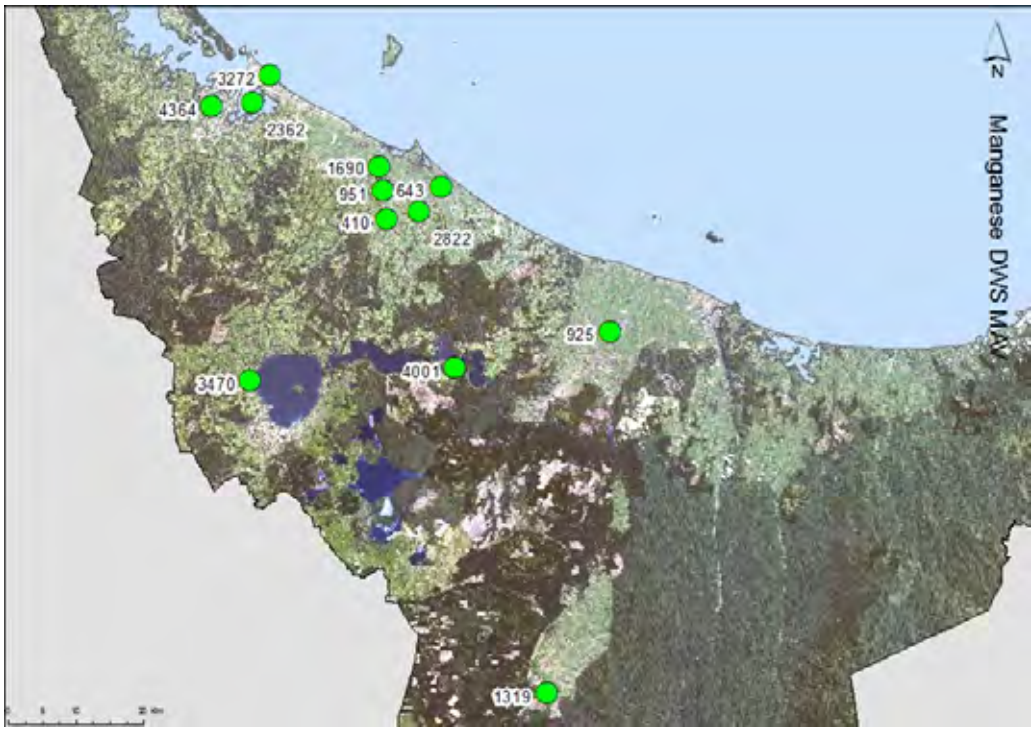
The review of outliers and charge balance (Table A3-6) errors indicates that data quality is generally acceptable; not greater than +/-10%. In general the bores are sampled on an annual basis. Some years no sample is collected. Therefore monitoring data is limited with regard to trend analysis. There could be quality changes occurring over the year (due to water level rise and fall) that are not shown due to low monitoring frequency. Time series plots of variables are produced for all bores to help visualise the data (Appendix 4).



Map 12



Map 13


3272
4364
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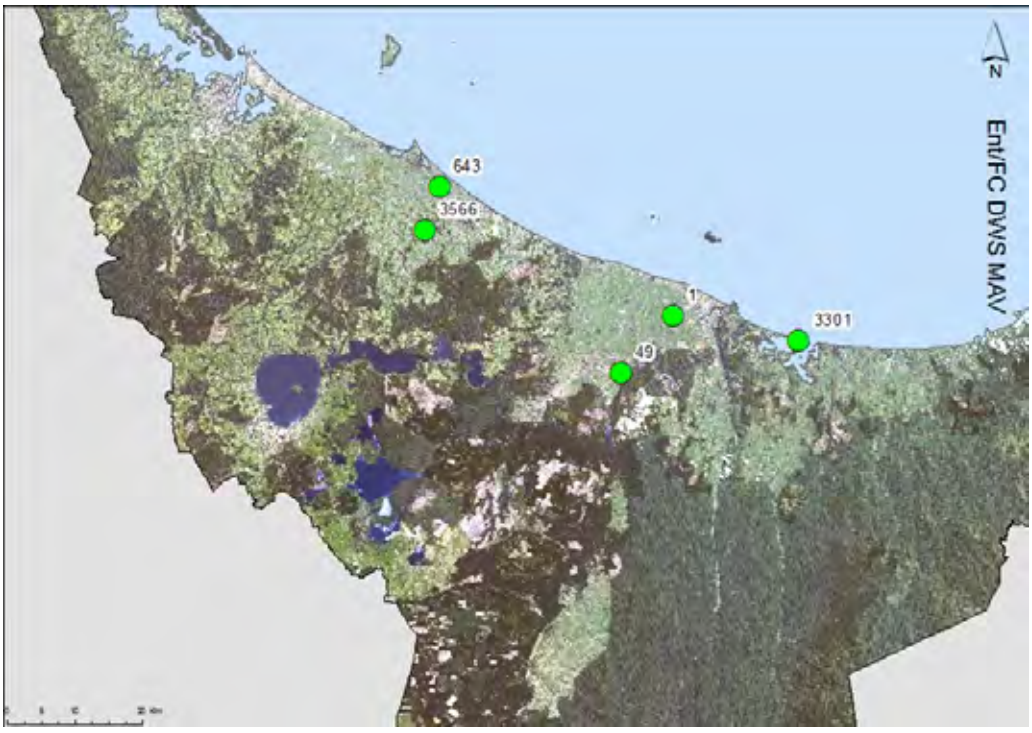
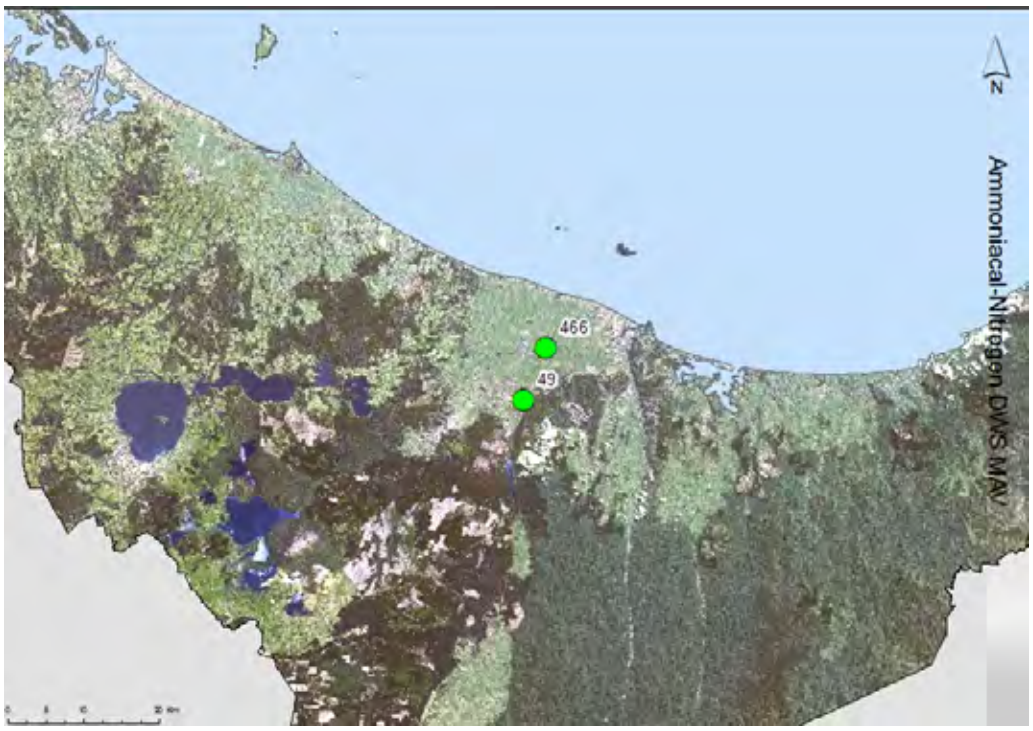
2822
925
4001
3470
1319
Manganese DWS MAV

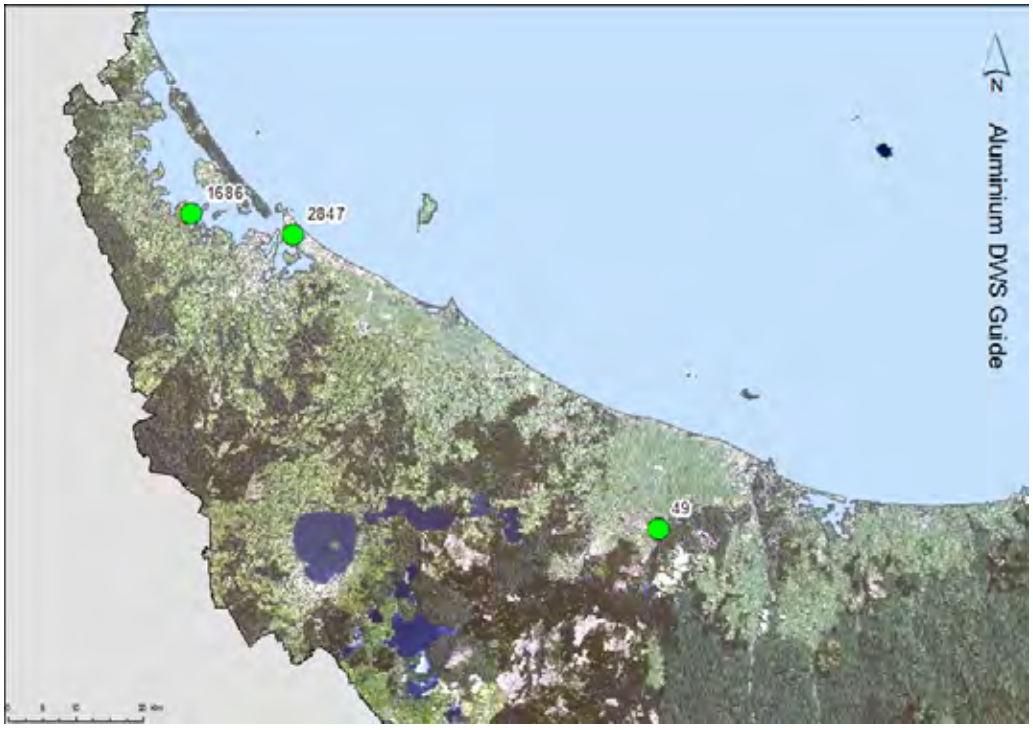
Map 14


643
3566
1
3301
49
Ent/FC DWS MAV

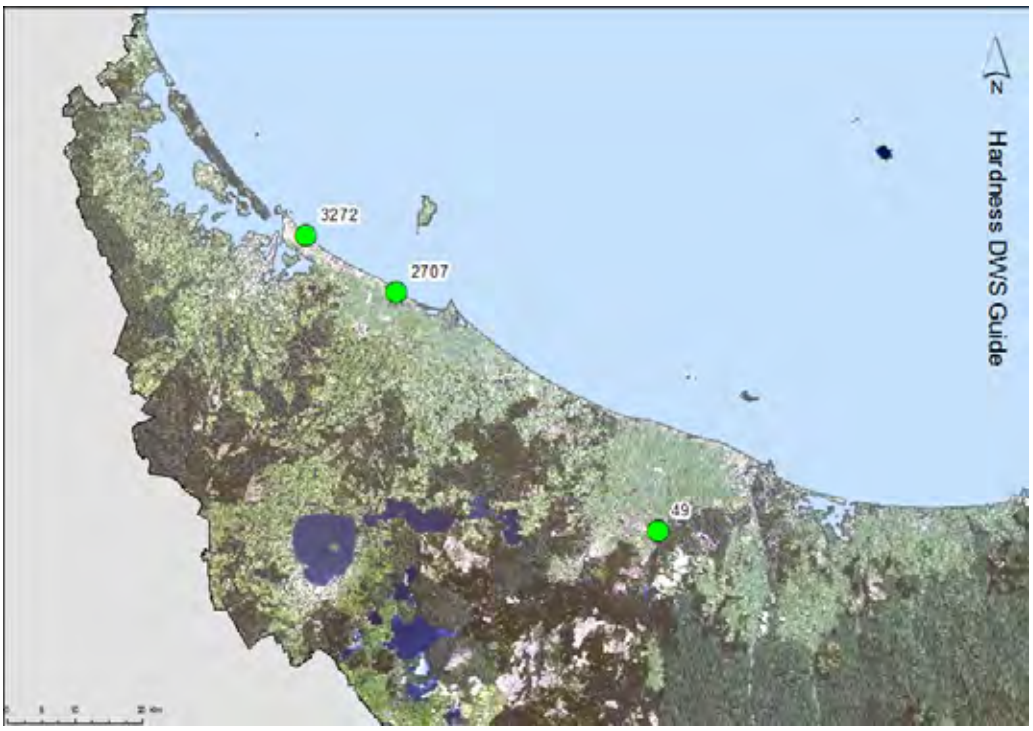
Map 15


N
Ammoniacal-Nitrogen DWS MAV
466
49

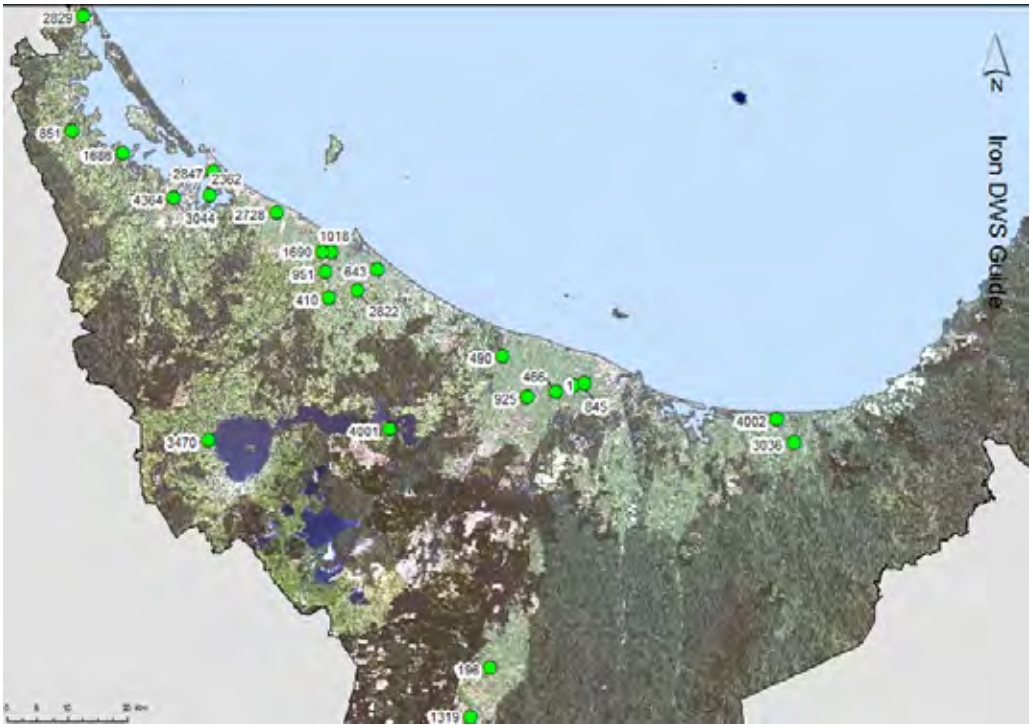
Map 16


N
Aluminium DWS Guide
1686
2847
49

Map 17


N
Hardness DWS Guide
3272
2707
49

Map 18


N
Iron DWS Guide
2829
851
1686
2847
2362
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3044
2728
1018
1690
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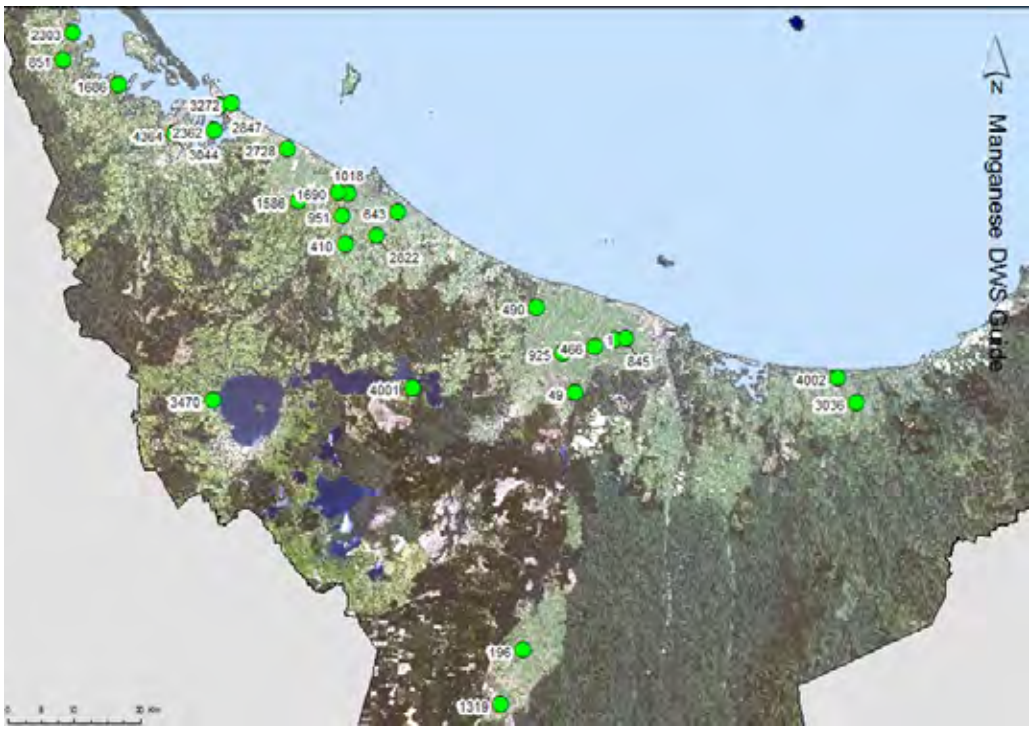
196
1319

Map 19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925
466
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4002
3036
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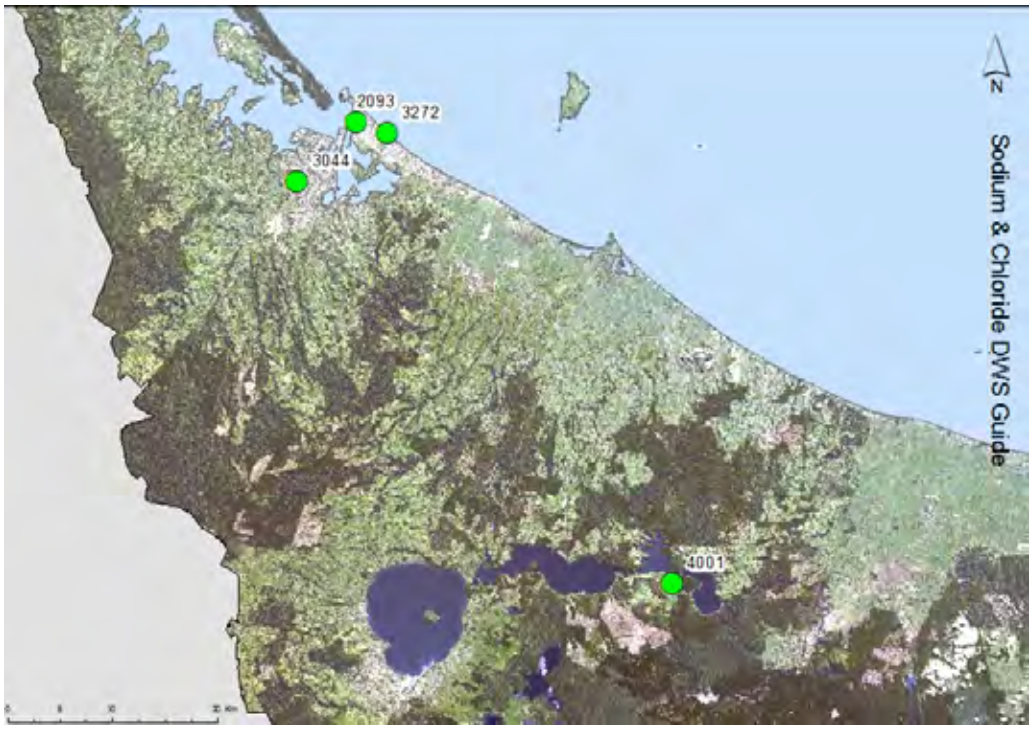
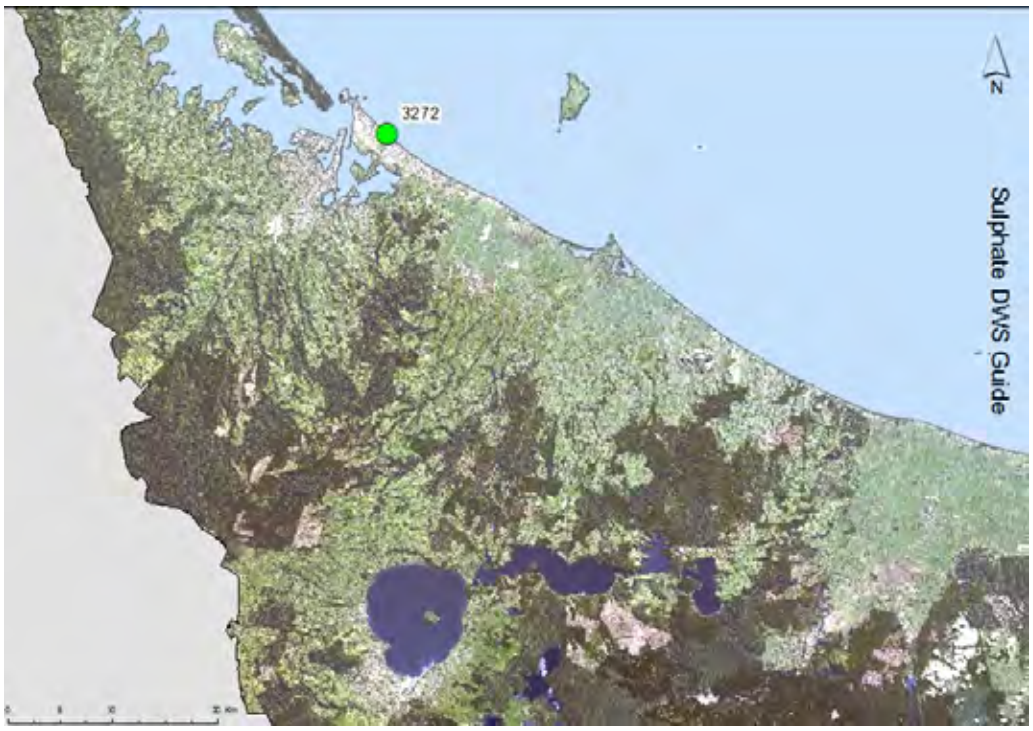
4001
3470
196
1310
N
Manganese DWS Guide

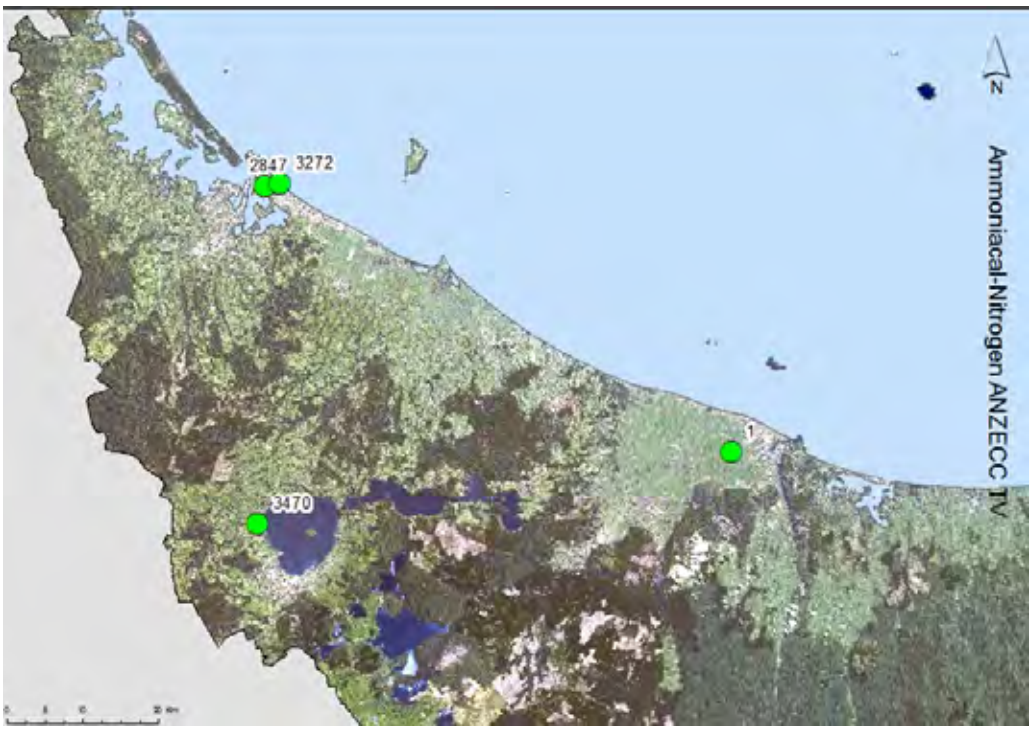
Map 20


2093
3272
3044
4001
N
Sodium & Chloride DWS Guide

Map 21

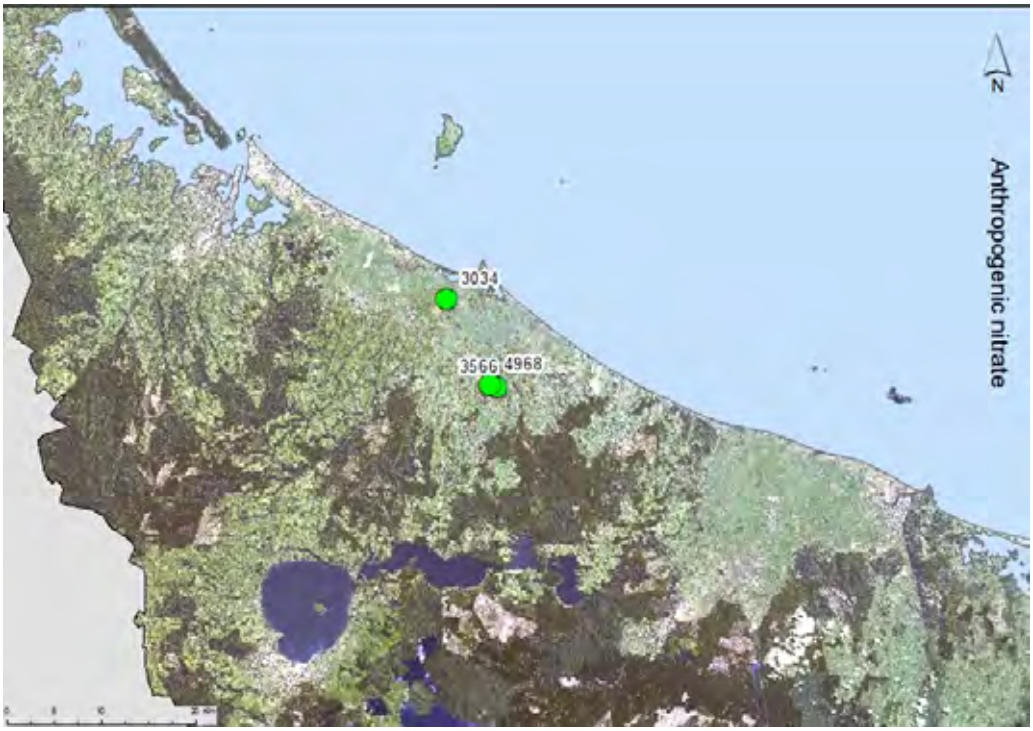

3272
N
Sulphate DWS Guide

Map 22


2847
3272
3470
1
N
Ammoniacal-Nitrogen ANZECC TV

Map 23

Map 24



5.2.3 Groundwater quality observations for bores with declining water level trends

With any water level drop there is the potential for water to move toward the lower water level area of the groundwater system. This means that the quality of the water moving into a low water level area could be the same, better or poorer in quality than what is already there. For declining water level bores (Table 3) that are not already part of the water quality monitoring regime, it is proposed that these bores are included in the water quality monitoring program to assess if there is any water quality change over time.

Table 3 Bore with declining water level trends and groundwater quality monitoring

Bore number	Aquifer	Water quality monitored	Groundwater quality trend
90	Aongatete Ignimbrite	No	
93	Aongatete Ignimbrite	No	
2521/1	Waitеariki/ Aongatete Ignimbrite	No	
2521/3	Waitеariki/ Aongatete Ignimbrite	No	
1386	Aongatete Ignimbrite	No	
2829	Aongatete Ignimbrite	Yes	Does not indicate groundwater quality decline.
1670	Waitеariki Ignimbrite	No	
2822	Minden Rhyolite	Yes	Does not indicate groundwater quality decline.
2509	Matahina Ignimbrite	Yes	Does not indicate groundwater quality decline.
2060	Tauranga Group sediments	No	
3036	Tauranga Group sediments	Yes	Does not indicate groundwater quality decline.

Part 6: Conclusions

6.1 Overview

Of the 54 water level monitoring bores assessed, 12 shows a decline in aquifer water level. These water level declines were localised and not widespread over the entire aquifer system. This indicates that use of groundwater in these areas exceeds that ability for the aquifer to recover before intensive pumping commences again.

There may be structural constraints within the aquifer at these locations that inhibits flow, so the effect in water level could be exaggerated because of the structural conditions. However without water use data (allocation) or targeted hydraulic testing, determination for the decline in water level can only be postulated.

Of the remaining 42 water level monitoring bores, the water level is stable in 32 bores and increasing in 10. The stable trend indicates that groundwater use from the aquifer is sustainable; that in times of rest (no pumping) the aquifer can recover (replenished) so that recharge is meeting abstraction (use). The increasing trends probably indicate areas where over-use has occurred in the past.

Groundwater quality data has been collected from 59 monitoring bores over the years. Presently 22 monitoring bores are used to provide groundwater quality data. Twenty variables are assessed to determine any trend in groundwater quality over time. Four of our bores are part of the National Groundwater Monitoring Program managed by GNS Science.

Groundwater quality in the region generally does not appear to be changing over time. Trend analysis found relatively few variables having statistically significant changes over time. However this can be due to the limited frequency of sampling, total number of samples and data gaps which can inhibit the ability to identify trends.

Aquifer properties of water level and groundwater quality have typically been seen as separate monitoring regimes. The importance of how each informs the other appears not to have been recognised. Only 15 of our monitoring bores have both water level and groundwater quality records. All others are either one or the other. This limits our ability to identify and understand any trends that may be present.

The findings of this report will be used to review and make recommendations to the NERMN groundwater monitoring programme. A review of the groundwater monitoring program is not within the scope of this report.

6.2 What is the monitoring telling us

Two separate monitoring regimes form the groundwater monitoring program; water level and groundwater quality. These regimes would better inform the state of the groundwater systems if they occurred sequentially and at regular intervals throughout the year.

The data available provides some information on the health of the groundwater systems. Apart from naturally occurring groundwater quality parameters (arsenic, iron/manganese) that can make the groundwater unsuitable for certain purposes (potable water), there are minor contamination concerns identified by nutrients, bacteria and increased conductivity (possible salt water intrusion). These tend to be localised and are not wide spread. To determine the actual reason for these contaminants would require further investigation of the containment of the bore, land use and bore management.

The water level of the groundwater systems can influence the movement of groundwater quality through an aquifer. However the monitoring regime does not presently provide for this.

The water level of the groundwater systems has in the past shown pumping stress. There have been periods where for many years the aquifer has maintained a decline water level trend, only to recover in recent years. It is not clear if this is due to better rainfall recharge to an area, less groundwater use, land use change or efficiency of resource use in recent times.

Those groundwater systems in decline tend to be in localised areas and do not extend over the entire aquifer. However the Tauranga Harbour deep aquifer is showing decline, particularly to the north and near Tauranga. Abstraction of groundwater exceeds the ability for the groundwater to recharge (flow) into these areas. It is also of concern due to the proximity to the coast, and that two bores have water levels that are below sea level (risk of salt water intrusion).

The monitoring program does not provide information on water use; what a consent holder is actually taking and what volumes are being abstracted under the permitted provisions of the RMA and WLP. Therefore it is not known what abstraction volumes cause decline water level trends, or how rainfall-recharge can offset this effect.

The taking of groundwater does not lower the water levels to where they are unsustainable or cause decrease in groundwater quality.

- Determine sustainable yields for groundwater systems.
- Investigate the linkages between groundwater and surface water where there are large abstractions of groundwater in the recharge areas of springs used for municipal water supply.

6.3 Further work

This report provides a comprehensive assessment of the current groundwater monitoring regime and an overview of the region.

This information will be used to inform a future review of the groundwater monitoring network to determine:

- which monitoring sites are of value - providing useful information
- what monitoring improvements are needed to the network
- provide direction on where information is required to fill information gaps
- identify areas that require further study.

Part 7: Recommendations

It is recommended that the groundwater monitoring regime be reviewed to better align monitoring objectives with the information necessary to assess the state of this resource over the region, and inform the implementation of the WLP.

It is suggested that the monitoring program be developed into modules for a specific purpose, with appropriate monitoring frequency and parameters to meet set objectives. Such modules could be:

- Groundwater system(s) water level and quality
- Tauranga geothermal
- Lake catchment groundwater
- Risk of salt water intrusion
- Recharge zones
- Surface water-Groundwater interaction

The modules can provide reasonable coverage over the region to ensure adequate information on the groundwater systems can be determined from the data.

At present monitoring of water level and groundwater quality are undertaken separately and at different intervals and frequency. This does not allow for any correlation to be made between changes in water level and change to water chemistry within the groundwater systems. This needs to be rectified to make better use of the data collected to provide information on the behaviour of the groundwater system under pumping stress and recharge (recovery).

Crucial data on water use and allocation is not readily available at present. This is a substantial gap in our information and inhibits our ability to understand and manage the groundwater resource. Support and resourcing is needed for Consents, Compliance and Data Services staff to allow information to be efficiently collected, stored and retrieved.

There is a separate groundwater program for geothermal groundwater in Rotorua. The groundwater program includes monitoring of bores that are geothermal within the Tauranga area. It is recommended that a monitoring module for these bores is developed and includes temperature measurements and temperature profiles. It is postulated that a decline in water level can also result in a decline in temperature. This needs to be monitored for assessment and management of the Tauranga geothermal resource.

At present there are three rainfall recharge monitoring stations that are gathering information on the infiltration of rain water through the soils to the groundwater systems (recharge). For the future the aim is to assess this data against water level over an aquifer system and actual use from the system to determine what influence pumping stress or climate has of the water levels of the system. The present assumption is that decline on the water levels of the groundwater systems are due to abstraction however it is not known what portion of this water drop is due also to climatic influences (changes in rainfall: El Niño/La Niña).

Data management, storage and retrieval require improvement. Presently it is dis-jointed and time consuming. The data required to undertake this NERMN groundwater assessment has been sourced from separate systems:

- Wells database
- Consents database
- LabStar (water quality database)

- HydroTel
- Archival hard files for groundwater quality and bore log data

Each of these data storage systems are managed separately, under different sections of Council. Verification of the data is slow and arduous. Data has been queried from the respective data storage systems and extracted into excel spreadsheets. Here it has been collated and verified where possible.

It is imperative that for Council to undertake its function effectively that data storage, management and retrieval is seamless. The systems at present are disseminated and clumsy for information retrieval and assessment of data.

Part 8: References

Australian and New Zealand Guidelines for Fresh and Marine Water Quality 2000; Australian and New Zealand Environmental Conservation Council (ANZECC guidelines).

Bay of Plenty Regional Council (2008). Operative Bay of Plenty Regional Water and Land Plan.

Daughney, C. J. and Reeves, R. (2005). Definition of hydrochemical facies in the New Zealand national groundwater monitoring Programme. Journal of Hydrology New Zealand Vol 44: 105-130.

Daughney, C. and Moreau-Fournier, M. (2011). Outputs from the National Groundwater Monitoring Programme (NGMP), July 2010 to June 2011. GNS Science Letter Report No. 2011/219LR.

Ministry for the Environment (2006). A national protocol for State of the Environment groundwater sampling in New Zealand. ME number: 781.

Ministry for the Environment (2009). Proposed National Environmental Standard on Ecological Flows and water Levels.

Ministry of Health (2005); Drinking water standards for New Zealand 2005 (Revised 2008).

NIWA, (2010). State of the Climate 2010 A snapshot of recent climate in New Zealand. NIWA Science & Technical Series No. 56.

NIWA, (Dec 2011). An updated climate change assessment for the Bay of Plenty Prepared for Bay of Plenty Regional Council.

White et. al. (2009); Groundwater resource investigations of the Western Bay of Plenty area stage 1 – conceptual geological and hydrological models and preliminary allocation assessment; GNS Science Consultancy Report 2008/240.

White et. al. (2009); Groundwater resource investigations of the Paengaroa-Matata area stage 1 – conceptual geological and hydrogeological models and preliminary allocation assessment; GNS Science Consultancy Report 2008/134.

White et. al. (2010): Groundwater resource investigations of the Rangitaiki Plains stage 1 – conceptual geological model, groundwater budget and preliminary groundwater allocation assessment; GNS Science International Consultancy Report 2010/113.

Appendices

Appendix 1 – Maps

Map 1 Regional distribution of NERMN groundwater bores

Map 2 NERMN water level bores and associated rainfall gauge sites

Map 3 Location of monitoring bores Western Bay of Plenty area

Map 4 Location of monitoring bores Tauranga area

Map 5 Location of monitoring bores Te Puke area

Map 6 Location of monitoring bores Rotorua area

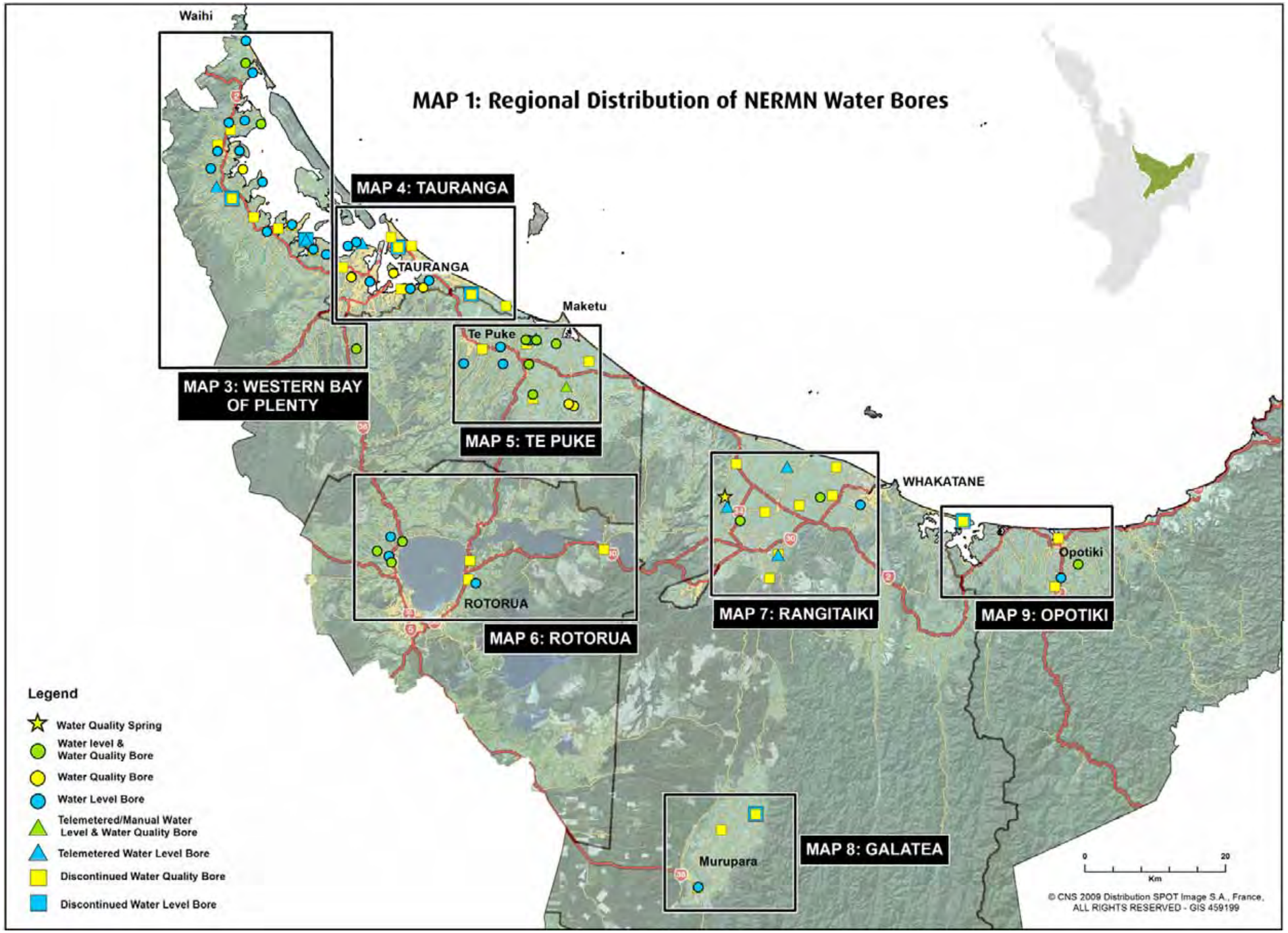
Map 7 Location of monitoring bores Rangitaiki Plains area

Map 8 Location of monitoring bores Galatea area

Map 9 Location of monitoring bores Ōpōtiki area

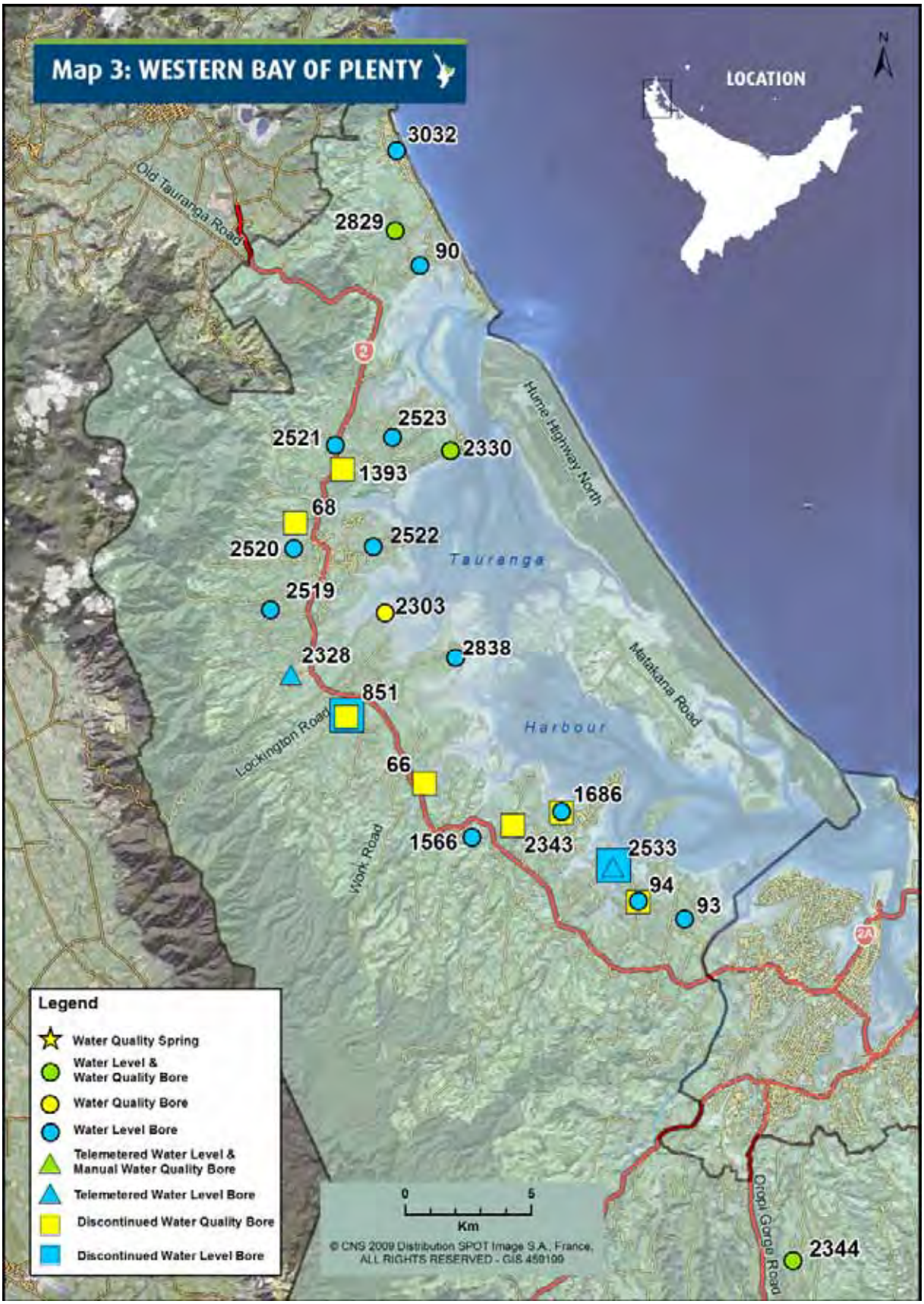
Map 10 NERMN groundwater level monitoring and allocation

Map 11 NERMN groundwater level monitoring and allocation Waitearikl/Aongatete Ignimbrite aquifer

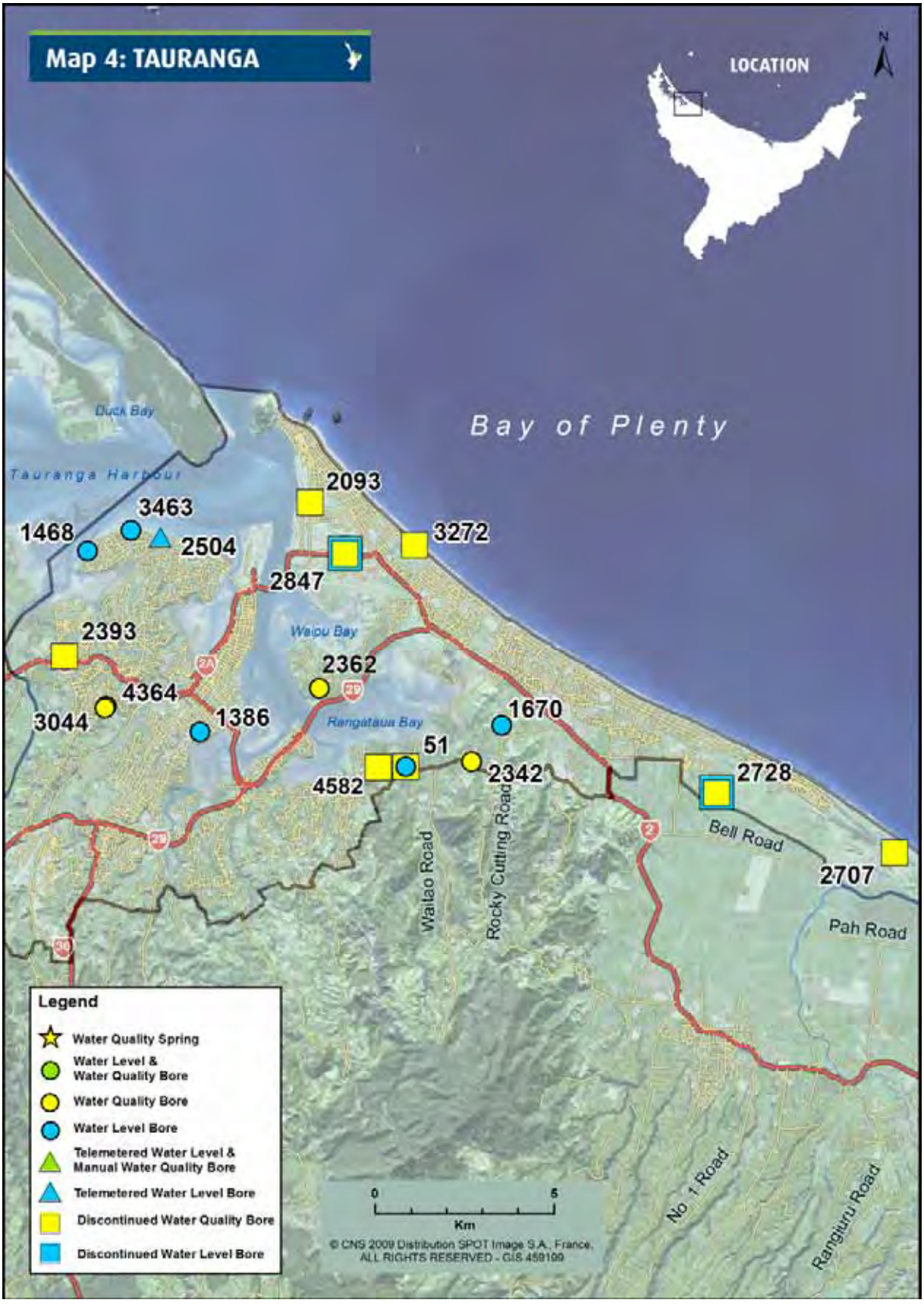


Map 1 *Regional distribution of NERMN groundwater bores*

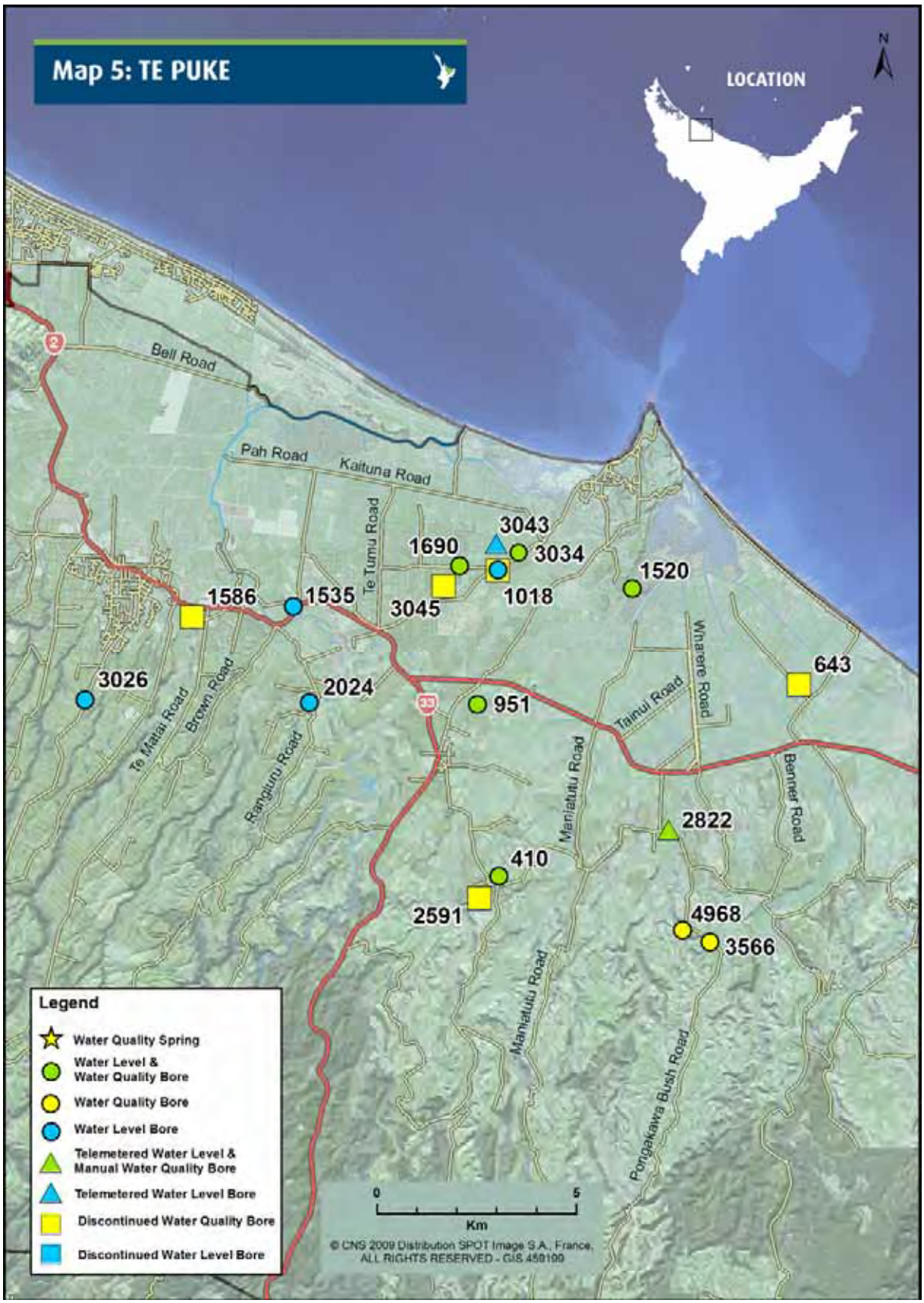
Map 2 *NERMN water level bores and associated rainfall gauge sites*



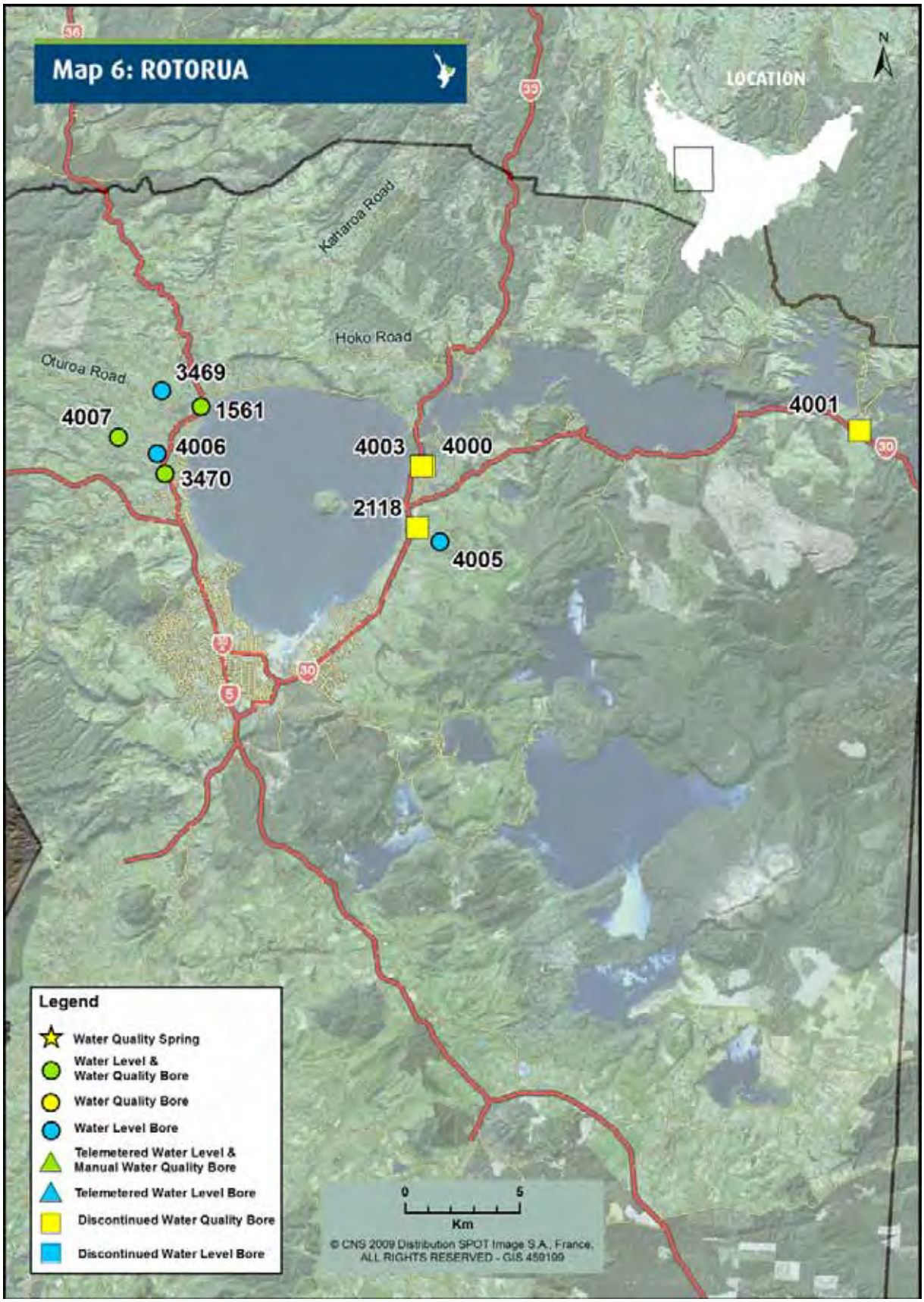
Map 3 Location of monitoring bores Western Bay of Plenty area



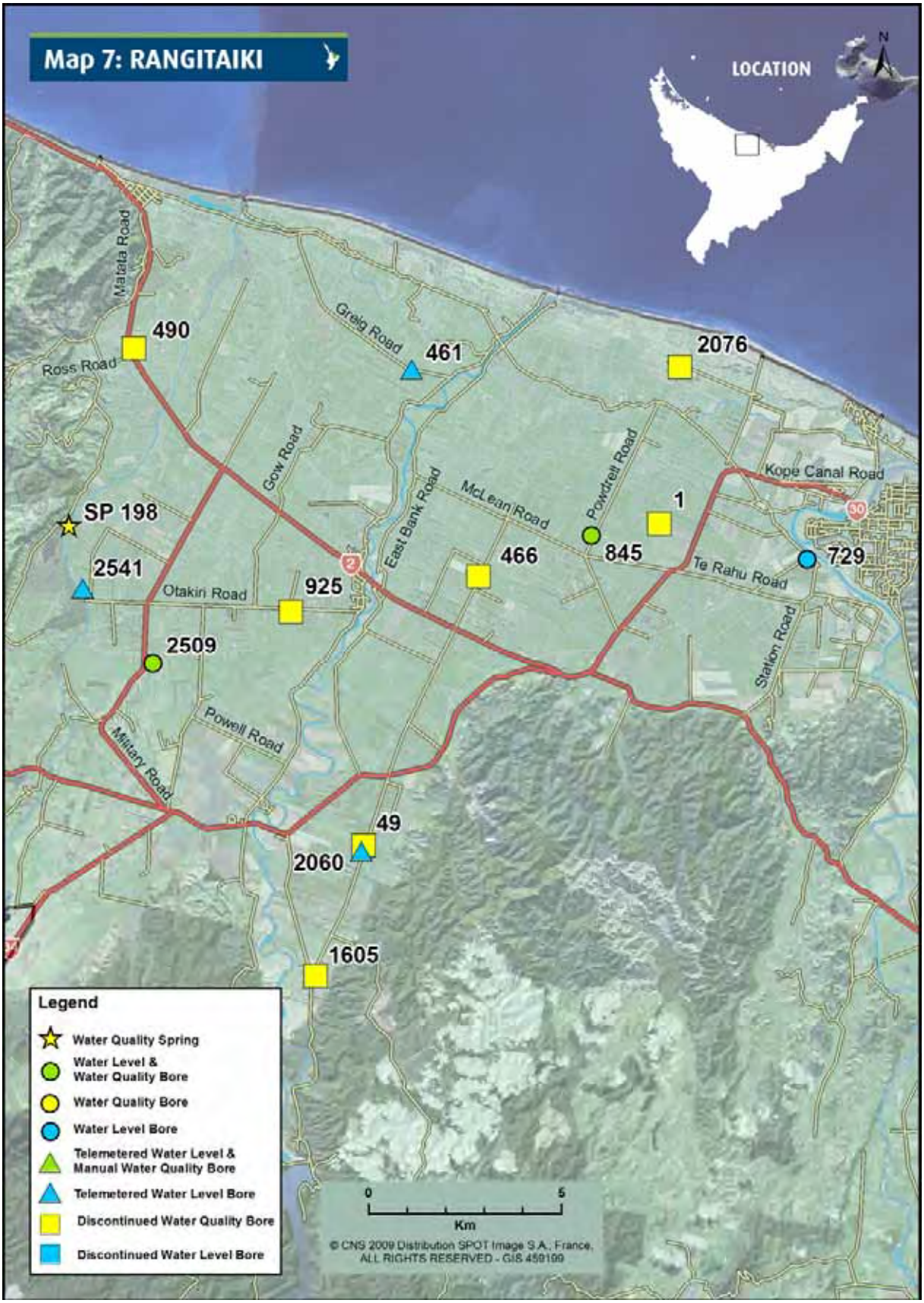
Map 4 Location of monitoring bores Tauranga area



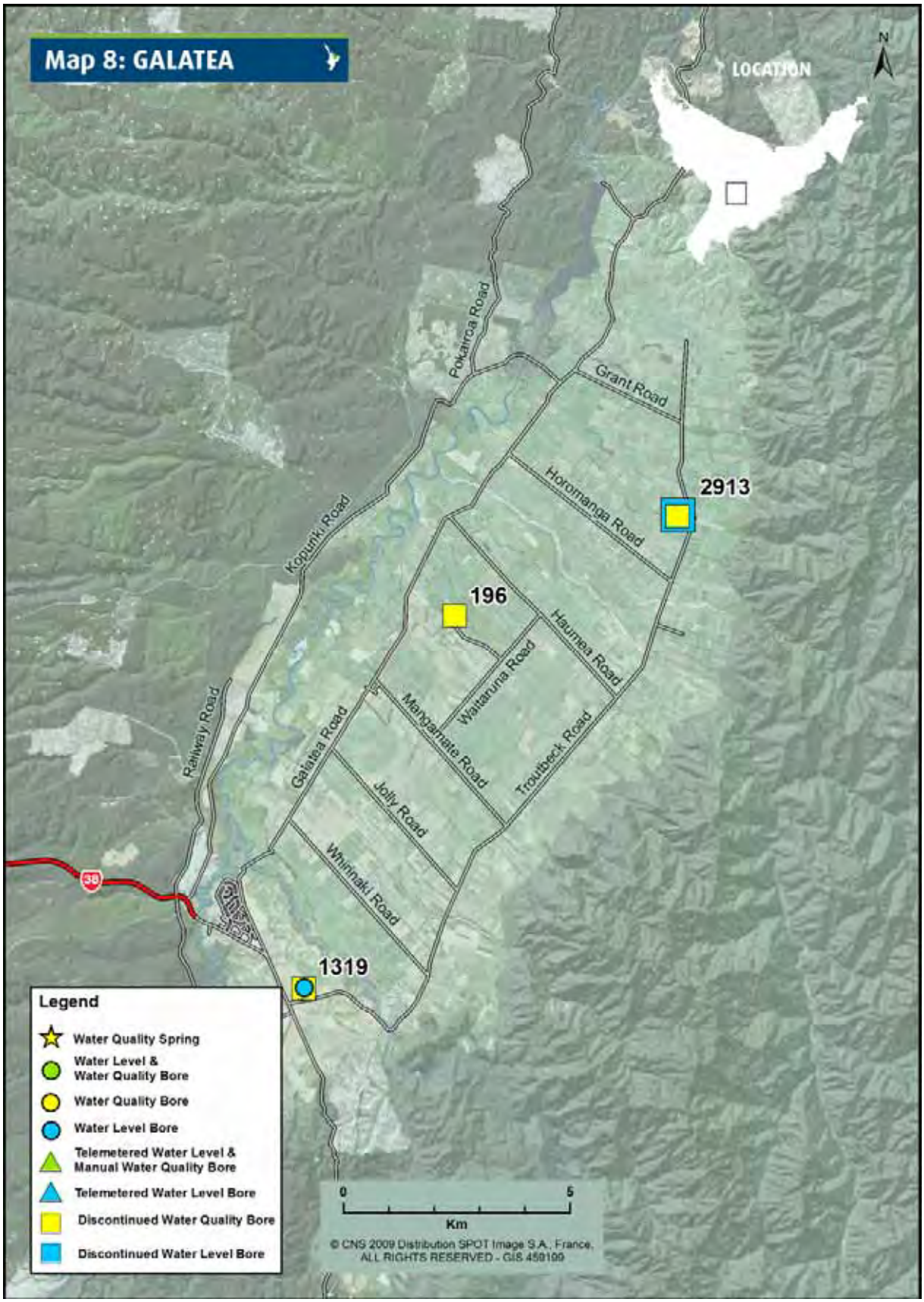
Map 5 Location of monitoring bores Te Puke area



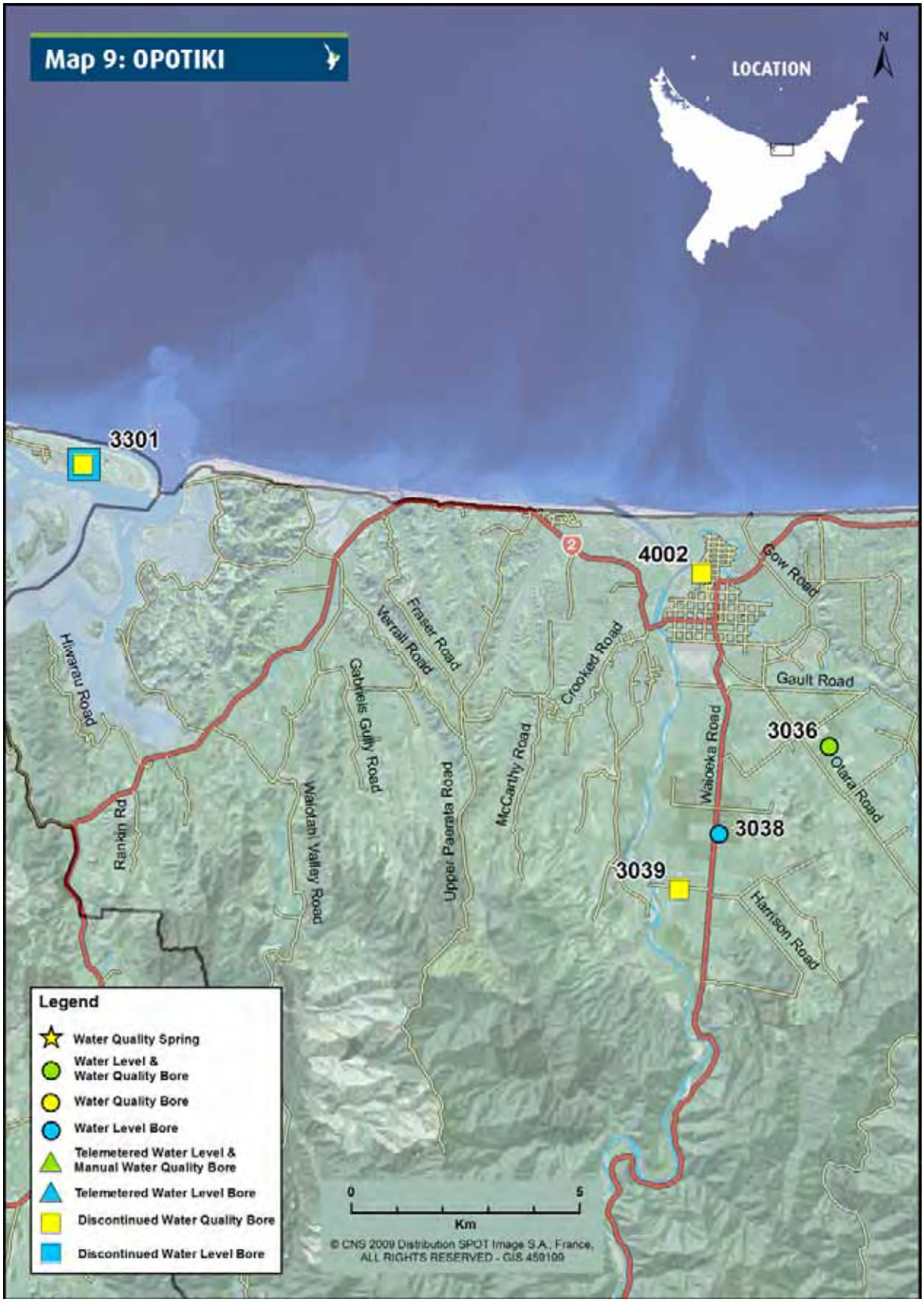
Map 6 Location of monitoring bores Rotorua area



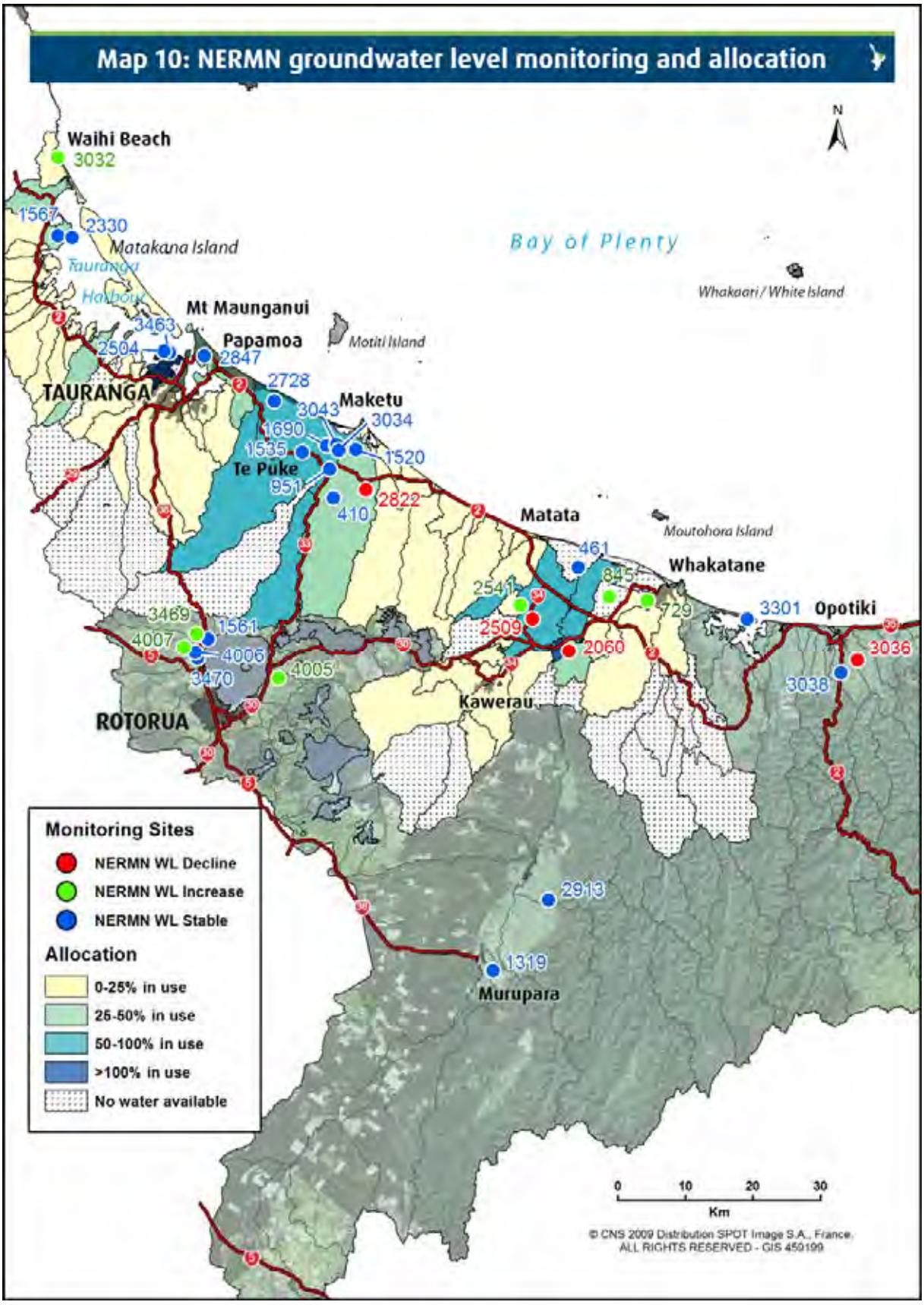
Map 7 Location of monitoring bores Rangitāiki Plains area



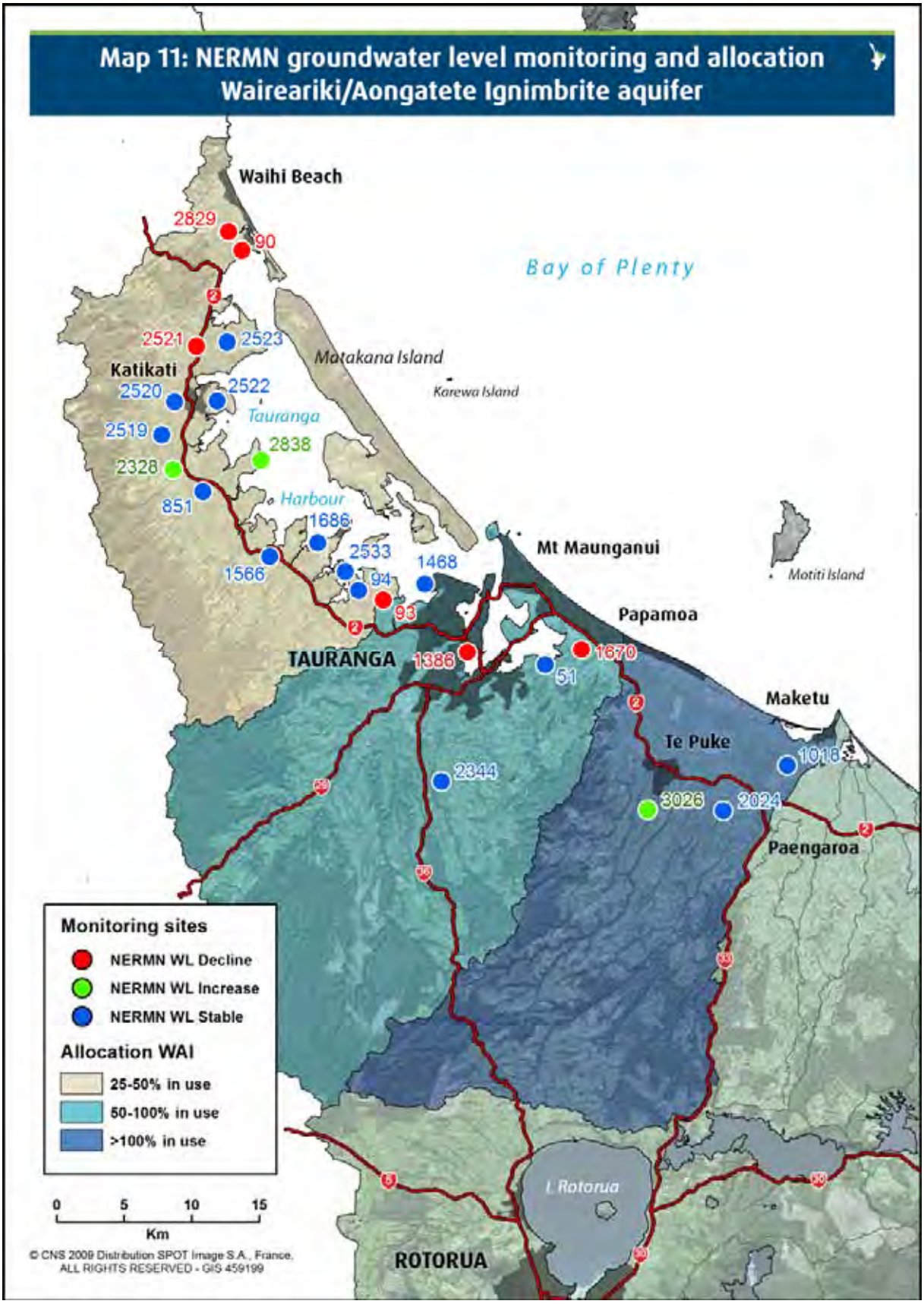
Map 8 Location of monitoring bores Galatea area



Map 9 Location of monitoring bores Ōpōtiki area



Map 10 NERMN groundwater level monitoring and allocation



Map 11 *NERMN groundwater level monitoring and allocation Waitearikl/ Aongatete Ignimbrite aquife*

Appendix 2 – Table of monitoring bores

Table A2 All NERMN monitoring bores – table key

Monitoring type	Symbol
NERMN current telemetered groundwater level bores	
NERMN current telemetered groundwater level and groundwater quality bore	
NERMN current combined groundwater level and groundwater quality bores	
NERMN current groundwater level bores	
NERMN current groundwater quality bores	
NERMN discontinued telemetered groundwater level bores	
NERMN discontinued groundwater level bores	
NERMN discontinued groundwater quality bores	
NERMN current water quality spring	

Table A2: All NERMN monitoring bores												
Map Area	**Bore number**	**Easting**	**Northing**	**Bore depth (m)**	**Static water level**	**Temp °C**	**Casing depth (m)**	**Reduced level of collar (m)**	**Groundwater Catchment or Zone**	**Aquifer**	**Bore use**	**Monitoring type**
Map 3 WBOP												
	66	2771800	6392300	618.7	5.5	34	199.9	16.20	WAI 1 zone	Aongatete	Irrigation	
	68	2766700	6402600	275.8	25	22	57	37.30	Tahawai WAI 1 zone	Aongatete	Irrigation	
	90	2771660	6412750	329.2	25.9	-	249.9	23.00	WAI 1 zone	Aongatete	Irrigation	
	93	2782075	6386903	460.2	18.3	-	350.5	26.051	WAI 1 zone	Aongatete	Irrigation	
	94	2780290	6387570	164.6	17.4	24	130.1	22.866	WAI 1 zone	Waitepriki	Irrigation/domestic	
	851	2768709	6394915	97.5	15.2	19	75.3	20.05	WAI 1 zone	Waitepriki	Irrigation	
	1393	2768559	6404732	326.2	33.5	41	247.5	55.20	WAI 1 zone	Aongatete	Irrigation/domestic	
	1566	2773663	6390116	163.1	0	-	85	41.166	WAI 1 zone	Waitepriki/Aongatete	Irrigation	
	1686	2777207	6391142	182.9	5.18	26	111.6	7.16	WAI 1 zone	Waitepriki	Irrigation	
	2303	2770212	6399012	262	-0.3	34	144.8	7.40	WAI 1 zone	Waitepriki	Irrigation	
	2328	2766513	6396560	454.2	0	-	246.89	21.237	WAI 1 zone	Aongatete	Irrigation	
	2330	2772801	6405433	118.87	33.53	18	65.53	31.843	Ongare/Tanners Point	Tauranga Group sediments	Irrigation	
	2343	2775286	6390637	153.9	17.07	18	98.45	27.569	WAI 1 zone	Waitepriki	Irrigation	
	2344	2786366	6373411	123.4	15.83	17	39.32	180.614	WAI 2 zone	Waitepriki	Irrigation	
	2519	2765671	6399135	452	0	-	-	50.406	WAI 1 zone?	Waitepriki/Aongatete?	Monitoring piezometers	
	2520	2766607	6401560	353	0	-	-	41.599	WAI 1 zone?	Waitepriki/Aongatete?	Monitoring piezometers	
	2521	2768240	6405650	157.4	0	-	-	36.474	WAI 1 zone?	Waitepriki/Aongatete?	Monitoring piezometers	
	2522	2769751	6401633	245.6	0	-	-	9.537	WAI 1 zone?	Waitepriki?	Monitoring piezometers	
	2523	2770510	6405965	196	0	-	-	37.94	Ongare/Tanners Point	Tauranga Group sediments?	Monitoring piezometers	
	2533	2779255	6389007	247.5	-	43	97.5	1.598	WAI 1 zone	Waitepriki/Anongatete	Irrigation	
	2829	2770619	6414114	216.41	0	35	-	28.098	WAI 1 zone	Aongatete	Irrigation	
	2838	2772680	6396970	304.8	-	-	-	7.6	WAI 1 zone	Waitepriki	Monitoring	
	3032	2770671	6417295	6	-	-	6	4.02	Waihi Beach	Tauranga Group sediments	Domestic	
Map 4 Tauranga												
	51	2794032	6382039	67	5.5	19	38.7	8.525	WAI 2 zone	Waitepriki	Irrigation	
	1386	2788282	6382004	466.3	23.8	-	335.3	26.444	WAI 2 zone	Aongatete	Commercial heating	
	1468	2785141	6388082	420.6	25.9	44	234.6	15.159	WAI 2 zone	Waitepriki /Aongatete	Domestic heating	
	1670	2796717	6383190	103.6	15.2	-	84.4	23.23	WAI 2 zone	Waitepriki	Irrigation	
	2093	2791360	6389420	6	0	17	-	4.22	Maungatawa area	Tauranga Group sediments	Monitoring bore	
	2342	2795869	6382168	194.5	29.87	22	78.33	23.036	WAI 2 zone	Whitianga Group	Domestic	
	2362	2791622	6384213	210.3	17.68	29	99.67	17.082	WAI 2 zone	Waitepriki	Irrigation/domestic	
	2393	2784480	6385120	146.3	29.26	28	128.02	30.23	WAI 2 zone	Waitepriki	Irrigation	
	2504	2787187	6388486	140	-	-	-	2.763	Otumoetai	Tauranga Group sediments	Monitoring	
	2707	2807700	6379630	10	4.5	15	8	11.8	Lower Kaituna (Plains)	Tauranga Group sediments	Irrigation	

Table A2: All NERMN monitoring bores												
Map Area	**Bore number**	**Easting**	**Northing**	**Bore depth (m)**	**Static water level**	**Temp °C**	**Casing depth (m)**	**Reduced level of collar (m)**	**Groundwater Catchment or Allocation Zone**	**Aquifer**	**Bore use**	**Monitoring type**
	2728	2802718	6381306	81	0	21	69	6.489	Lower Kaituna (Plains)	Tauranga Group sediments	Irrigation	
	2847	2792330	6387990	5.2	0	18	3.2	3.99	Maungatawa area	Tauranga Group sediments	Investigation bore	
	3044	2785661	6383715	244	-	44	-	38.68	WAI 2 zone	Waitemata	Swimming pool	
	3272	2794282	6388233	375	9	39	300	5.57	WAI 2 zone	Waitemata	Heating domestic/pool	
	3463	2786350	6388650	274.32	2.1	44	225.55	3.23	Otumoetai area	Tauranga Group sediments	Swimming Pool	
	4364	2785622	6383676	177	-	37	-	28.17	WAI 2 zone	Waitemata	Commercial	
	4582	2793910	6382080	350	0	26	-	1.71	WAI 2 zone	Aongatete	?	
Map 5 Te Puke												
	410	2811437	6366923	196.6	67.1	15	118	410	Kaikokopu - Pokopoko -Wharere	Minden Rhyolite & other volc.	Irrigation	
	643	2819490	6371720	9	1	15	7	0.2	Pukehina	Q1 non-marine sediments (TGS)	Agricultural	
	951	2811010	6371224	11 4	10.4	24	86.3	17.4	Kaikokopu - Pokopoko -Wharere	Mamaku Plateau Formation	Irrigation	
	1018	2811953	6374592	359	3.35	33	359	5.991	WAI 3 zone	Waitemata	Irrigation	
	1520	2814775	6374119	74	21.2	21	50	29.42	Kaikokopu - Pokopoko -Wharere	Q4 – Q8 sediments (TGS)	Irrigation	
	1535	2806837	6373680	32	0	-	19.81	9.023	Lower Kaituna (Plains)	Tauranga Group sediments	Domestic	
	1586	2804301	6373423	30.5	6	17	28	8.967	Lower Kaituna (Plains)	Tauranga Group sediments	Irrigation	
	1690	2810451	6374689	97.5	3	26	72.5	5.54	Lower Kaituna (Plains)	Tauranga Group sediments	Irrigation	
	2024	2807227	6371251	118.5	17.3	-	98	24.99	WAI 3 zone	Waitemata	Irrigation	
	2591	2811500	6366400	68.5	26	-	65	59.42	Kaikokopu - Pokopoko -Wharere	Mamaku Plateau Formation	Agricultural	
	2822	2816229	6368109	121.9	7.62	18	104.85	26.404	Kaikokopu - Pokopoko -Wharere	Minden Rhyolite & other volc	Irrigation	
	3026	2801617	6371318	103.6	0	-	-	100.298	WAI 3 zone	Waitemata	Horticultural	
	3034	2811950	6374614	8.5	-	18	-	6.194	Lower Kaituna (Plains)	Tauranga Group sediments	Irrigation	
	3043	2811922	6374862	10	-	18	-	3.748	Lower Kaituna (Plains)	Tauranga Group sediments	Agricultural	
	3045	2810600	6374200	5.48	4.5	15	-	8.31	Lower Kaituna (Plains)	Tauranga Group sediments	Irrigation/domestic	
	3566	2817258	6365278	122	28	-	70	59.9	Kaikokopu - Pokopoko -Wharere	Q4 – Q8 sediments (TGS)	Agricultural/domestic	
	4968	2816567	6365568	10	3.2	-	-	28.872	Kaikokopu - Pokopoko -Wharere	Q1 non-marine sediments (TGS)	Irrigation/frost	
Map 6 Rotorua												
	1561	2792914	6346012	73.1	15	12	63	300.033	Hamurana	Tauranga Group sediments	Irrigation	
	2118	2802240	6340950	24	4.5	12	19	294.55	Rotorua	Tauranga Group sediments	Irrigation	
	3469	2791219	6346703	124.66	54	-	80.16	355.786	Ngongotaha	Mamaku Plateau Formation	Irrigation	
	3470	2791341	6343091	-	-	12	-	286.35	Rotorua	Tauranga Group sediments	Irrigation/frost	
	4000	2802640	6343400	26	0	14	-	296.34	Rotorua	Tauranga Group sediments	Irrigation	
	4001	2821500	6345100	55	-	40	-	315	Rotoma	-	Swimming pool	
	4003	2802530	6343420	26	21.52	-	-	307.23	Rotorua	Tauranga Group sediments	Domestic	

Table A2: All NERMN monitoring bores												
Map Area	**Bore**	**Easting**	**Northing**	**Depth**	**Static water level (m)**	**Temp °C**	**Casing depth (m)**	**Reduced level of collar (m)**	**Groundwater catchment or Allocation Zone**	**Aquifer**	**Bore use**	**Monitoring type**
	4005	2803318	6340128	180	21	-	167	335.546	Rotorua	Tauranga Group sediments	Irrigation/domestic	●
	4006	2791006	6343963	85.3	18.3	-	-	305.214	Rotorua	Tauranga Group sediments	Irrigation	●
	4007	2789325	6344683	-	-	12	-	345.581	Ngongotaha	Pokai & older volcanics	Domestic/lifestyle block	●
Map 7 Rangitāiki												
	1	2854063	6352640	12.1	-	16	9.1	4.73	Kope Orini 1	Q1 non-marine sediments (TGS)	Agricultural	■
	49	2846400	6344300	36.2	0	-	36.2	13.37	Ngakauroa Stream	Q2 – Q4 non-marine sediments (TGS)	Irrigation	■
	Spring 198	2838752	6352574	28.5					Tumarau	Matahina and older volc.	Municipal	★
	461	2847653	6356639	12.5	0.92	-	9.24	-0.271	Old Rangitāiki Canal	Q1 marine sediments (TGS)	Irrigation	▲
	466	2849382	6351270	16.8	2.5	16	12.81	3.3	Reids Central Canal	Q1 marine sediments (TGS)	Irrigation	■
	490	2840440	6357180	73	-	14	57.13	6.19	Awakaponga	Q2 – Q4 non-marine sediments (TGS)	Irrigation	■
	729	2857889	6351701	12.8	-	-	9.8	2.57	Te Rāhu 2	Q1 marine sediments (TGS)	Irrigation	●
	845	2852293	6352320	173	0	28	161.6	4.077	Kope Orini 1	Q6 – Q8 sediments (TGS)	Irrigation	●
	925	2844517	6350358	32	-0.5	19	26.1	2.9	Awaiti Canal	Q2 – Q4 non-marine sediments (TGS)	Irrigation	■
	1605	2845160	6340930	61	7.8	16	51	20.616	Ngakauroa Stream	Matahina and older volcanic	Irrigation	■
	2060	2846350	6344147	61.3	0	-	55.6	13.61	Ngakauroa Stream	Q2 – Q4 non-marine sediments (TGS)	Domestic/agriculture	▲
	2076	2854600	6356700	-	-	19	-	6.09	Kope Orini 2	Tauranga Group sediments	Monitoring	■
	2509	2840923	6348991	319.5	0	18	295	10.082	Awaiti Canal	Matahina and older volcanic	Bottled drinking water	●
	2541	2839118	6350971	199	-18	-	160	8.159	Awaiti Canal	Q6-Q8 sediments (TGS)	Irrigation/frost/agricult	▲
Map 8 Galatea												
	196	2838400	6305100	19	1	14	13	166.76	Galatea	Tauranga Group sediments	Irrigation	■
	1319	2835070	6296819	51.8	0	15	39.6	198.36	Murupara	Tauranga Group sediments	Agricultural	●■
	2913	2843300	6307300	22	9.5	12	20	208.48	Galatea	Tauranga Group sediments	Agricultural	■■
Map 9 Ōpōtiki												
	3036	2888968	6342791	30	-	15	-	11.02	Opotiki	Tauranga Group sediments	Horticultural	●
	3038	2886554	6340885	12	1.5	18	-	9.44	Opotiki	Tauranga Group sediments	?	●
	3039	2885700	6339700	30	-	14	-	13.11	Opotiki	Tauranga Group sediments	?	■
	3301	2872660	6348980	12	0.8	15	6	10.58	Ohope	Tauranga Group sediments	Irrigation	■■
	4002	2886200	6346600	60	-	16	-	2.27	Opotiki	Tauranga Group sediments		■

Appendix 3 – Groundwater quality tables

Abbreviation	Parameter Category Name	Abbreviation	Parameter Category Name
Al	Aluminium	Mg	Magnesium
As	Arsenic	Mn	Manganese
B	Boron	Mo	Molybedenum
Ba	Barium	Na	Sodium
Br	Bromide	NH_4-N	Ammoniacal nitrogen
Ca	Calcium	Ni	Nickel
Cd	Cadmium	NNN	Nitrate-nitrite-nitrogen
Cl	Chloride	NO_2-N	Nitrite
Co	Cobalt	NO_3-N	Nitrate
Cond (mS/m)	Electrical conductivity	Pb	Lead
Cr	Chromium	pH	pH
Cs	Cesium	PO_4-P	Phosphate
Cu	Copper	Rb	Rubidium
DO	Dissolved oxygen	Sb	Antimony
DRP	Dissolved reactive phosphorus	Se	Selenium
E.coli	*Escherichia coli*	SiDR	Silica Dissolved Reactive
F	Fluoride	SiO_2	Silica
FC/Ent	*Faecal coliforms/Enterococci*	Sn	Tin
Fe	Iron	SO_4	Sulphate
Fe S/D	Iron soluble/dissolved	Sr	Strontium
Fe T/TR	Iron total/total recoverable	Temp	Temperature °C
HCO_3	Bicarbonate	Ti	Titanium
Hg	Mercury	TP	Total phosphorus
K	Potassium	U	Uranium
La	Lanthanum	V	Vanadium
Li	Lithium	Zn	Zinc

Table A3-1: Median Values - Health Related (DWSNZ - Maximum Acceptable Value) (g/m^3)

Map Area	Bore No	Sample size	As	B	Cd	Hg	Pb	Sb	Ba	Cr	Cu	F	Mn	U	Mo	NO_2-N	NO_3-N	ENT cfu/100mL	FC cfu/100mL
DWSNZ			0.01	1.40	0.004	0.007	0.01	0.02	0.7	0.05	2	1.5	0.4	0.02	0.07	3	11.3	1 in 100ml	1 in 100ml
Map 3 WBOP																			
	66	6	0.02015	0.7965	0.000015	0.00007	0.000655			0.0001	0.000555	0.35	0.026				0.0225		
	68	13	0.0030	0.0170	0.000025		0.00005			0.0007	0.0003	0.11	0.0003		0.0004				
	94	6	0.0042	0.0099	0.000005	0.00001	0.00014				0.00076	0.33	0.0084				0.679		
	851	10	0.0005	0.011	0.00002	0.00107	0.00007			0.000175	0.00025	0.09	0.136		0.0002	0.002	0.001		
	1393	15	0.0095	0.0545	0.000025	0.000065	0.00035	0.00035	0.02565	0.00067	0.0009	0.365	0.0039	0.000086	0.0016	0.001	0.022		
	1686	16	0.019	0.494	0.00006	0.00017	0.0017	0.0001	0.103	0.00025	0.00075	0.62	0.045	0.000115	0.0097	0.001	0.001		
	2303	18	0.03995	0.084	0.000025	0.00048	0.0001	0.0001	0.04605	0.00025	0.00045	0.45	0.06	0.00004	0.00085	0.001	0.001		
	2330	16	0.001	0.016	0.000025	0.00062	0.0004	0.0001	0.0931	0.00145	0.0011	0.06	0.01135	0.000027	0.0001	0.001	0.066		
	2343	13	0.0005	0.013	0.000025	0.000025	0.0002	0.0001	0.05425	0.00025	0.00025	0.055	0.00085	0.00001	0.0001	0.001	0.066		
	2829	17	0.013	0.121	0.000025	0.00057	0.000875	0.00015	0.0114	0.00025	0.0007	0.17	0.0137	0.000107	0.0016	0.001	0.149		
Map 4 Tauranga																			
	51	6	0.000555	0.0105	1.25E-05	0.00001	0.00262			0.0001	0.0035	0.21	0.0047				0.108		
	2093	7	0.022	0.056	0.00002		0.00092			0.0001	0.000525	0.065	0.003		0.0013	0.0025	1.58	0.5	0.5
	2342	18	0.0005	0.02	0.000025	0.000085	0.0002	0.0001	0.0422	0.00025	0.00025	0.075	0.00074	6.85E-05	0.0001	0.001	0.1095		
	2344	18	0.0005	0.012	0.000025	0.00004	0.000075	0.0001	0.0514	0.00025	0.000375	0.07	0.004	0.00001	0.0001	0.001	0.175		
	2362	17	0.004	0.078	0.000025	2.45E-05	0.00005	0.0001	0.06	0.00025	0.00025	0.21	0.551	0.00001	0.00046	0.001	0.019		
	2393	8	0.0038	0.145	1.25E-05	0.00001	0.00034			0.0001	0.0003	0.23	0.00025		0.0015	0.001	0.15		
	2707	17	0.0005	0.029	0.000025	0.000105	0.00005	0.0001	0.02625	0.00025	0.00025	0.03	0.03075	0.000108	0.0001	0.009	1.02		
	2728	15	0.01	0.099	0.000025	0.00262	0.0001	0.0001	0.294	0.00025	0.00025	0.06	0.26	0.00001	0.00155	0.001	0.02		
	2847	16	0.002	0.056	0.000025	0.00004	0.0002	0.0001	0.03925	0.00025	0.00025	0.06	0.0947	0.000049	0.0001	0.011	0.02	0.5	0.5
	3044	24	0.024	7.62	0.000025	0.00004	0.00005	0.000175	0.1375	0.00025	0.00028	1.3	0.231	0.00001	0.0038	0.001	0.001		
	3272	6	0.0005	0.68	5.25E-05	0.00004	0.0005	0.00055	0.112	0.0025	0.0012	0.07	9.21	0.000055	0.0022	0.005	0.525		
	4364	34	0.0067	2.85	0.000025		0.00005	0.0001	0.104	0.00025	0.00025	0.45	0.4975	0.00001	0.0025	0.001	0.01		
	4582	6	0.0005	0.02	0.000025		0.0002	0.0001	0.098	0.00025	0.00025	0.1	0.00545	0.000048	0.0001	0.001	0.104		
Map 5 Te Puke																			
	410	13	0.003	0.0415	0.000235	0.00004	0.0005	0.0001	0.28	0.00025	0.00045	0.27	4.9	0.00049	0.00105	0.001	0.009		
	643	11	0.0272	0.148	0.000045	0.000125	0.00028			0.000175	0.0076	0.33	10.965		0.0012	0.001	0.078	18	3.5
	951	16	0.01	0.183	0.000025	0.00009	0.00005	0.0001	0.0697	0.00025	0.00025	0.26	1.71	0.00001	0.0006	0.001	0.001		
	1018	11	0.0005	0.5015	0.00002	0.000215	0.00005			0.00025	0.00025	0.35	0.255		0.0007	0.001	0.0055		
	1520	17	0.00165	0.2315	0.000025	0.000085	0.00015	0.0001	0.209	0.00025	0.000425	0.13	0.00025	0.00059	0.0004	0.001	1.93		
	1586	14	0.0005	0.02	0.000025	0.000065	0.00005	0.0001	0.0742	0.00025	0.00025	0.135	0.13	0.00001	0.0001	0.001	0.257	0.5	0.5
	1690	17	0.0005	0.213	0.000025	0.00009	0.00005	0.0001	0.04255	0.00025	0.00025	0.3	0.601	0.00001	0.0005	0.001	0.029		
	2591	15	0.0170	0.030	0.000025		0.00005			0.00025	0.0003	0.13	0.001				0.0005		
	2822	17	0.004	0.214	0.000025	0.00177	0.00005	0.0001	0.2	0.00025	0.00025	0.395	0.9505	0.000039	0.0002	0.001	0.0085		
	3034	18	0.0005	0.095	0.000025	0.00017	0.00005	0.0001	0.095	0.00025	0.00025	0.14	0.025	0.00001	0.00015	0.001	6.05	1	0.5
	3045	43	0.0005	0.009	0.000025	0.0001	0.0003	0.0001	0.1285	0.00025	0.0028	0.12	0.01285	0.000032	0.0001	0.001	0.48	0.5	1
	3566	12	0.004	0.016	0.000025	0.000045	0.00005	0.000315	0.0274	0.00025	0.000375	0.13	0.0012	0.00001	0.0003	0.001	4.182	5.75	0.5
	4968	10	0.0013	0.015	0.000025	0.00004	0.00005	0.0001	0.073	0.00025	0.00025	0.145	0.00082	0.00002	0.00025	0.001	6.08		
Map 6 Rotorua																			
	1561	18	0.001	0.0087	0.000025	0.000025	0.00005	0.0001	0.01725	0.00025	0.0008	0.065	0.003	0.00001	0.0001	0.001	0.53		
	2118	9	0.008	0.013	0.000025	0.00004	0.00005	0.0001	0.00505	0.00025	0.00025	0.14	0.00355	0.00001	0.0001	0.002	2.27		0.5
	3470	12	0.28	0.0135	0.000025	0.00004	0.00005	0.0001	0.01175	0.00025	0.00025	0.29	1.25	0.00001	0.0001	0.001	0.0035		0.5
	4000	8	0.00065	0.007	0.00006	0.00019	0.00014			0.0001	0.0047	0.05	0.00245		0.0001	0.002	3.155	1	0.5
	4001	13	0.0855	2.255	0.000025	0.000395	0.00005	0.0001	0.196	0.00025	0.00025	0.55	2.92	0.00001	0.0003	0.006	0.0255		
	4003	5	0.0005	0.009	0.000025	0.00004	0.0002	0.0001	0.018	0.00025	0.000425	0.0575	0.0031	0.00003	0.0001	0.001	3.13		
	4007	40	0.0005	0.00775	0.000025	0.00004	0.00005	0.0001	0.032	0.00025	0.00025	0.025	0.0025	0.00001	0.0001	0.001	1.5		
Map 7 Rangitāiki																			
	1	42	0.0011	0.072	0.000025	0.00009	0.00005	0.0001	0.067	0.00025	0.00025	0.215	0.23	0.00005	0.0003	0.002	0.025	2	0.5
	49	7	0.0109	0.765	0.000045	0.00038	0.00112			0.0001	0.002	0.29	0.2925				0.363	20	93
	466	14	0.0005	0.081	0.000025	0.000075	0.00005	0.0001	0.01625	0.00025	0.00025	0.56	0.335	0.00001	0.0001	0.001	0.008	0.5	0.5
	490	16	0.0005	0.014	0.000025	0.000135	0.00005	0.0001	0.01985	0.00025	0.00025	0.18	0.126	0.00001	0.0001	0.001	0.01		
	845	19	0.0005	0.531	0.000025	0.000455	0.00005	0.0001	0.0625	0.00025	0.00025	0.57	0.129	0.00001	0.0001	0.001	0.0045		0.5
	925	12	0.0005	1.71	0.00002	0.00024	0.00005	0.0001	0.094	0.000425	0.00025	0.235	1.03	0.00001	0.0001	0.006	0.005		
	1605	11	0.001	0.0365	0.00002	0.000025	0.00005	0.0001	0.0068	0.00025	0.00025	0.18	0.00025	0.00001	0.0002	0.001	0.097		
	2076	15	0.017	0.027	0.000071	0.00039	0.00014	0.0028	0.02185	0.00025	0.0018	0.1	0.000695	0.00001	0.000325	0.001	1.89	0.5	0.5
	2509	46	0.013	0.024	0.000025	0.000025	0.00008	0.00036	0.0126	0.00025	0.00025	0.18	0.0025	0.000021	0.00095	0.001	0.18		0.5
	Spring 198	12	0.017	0.027	0.000025	0.00004	0.00005	0.0027	0.0304	0.00025	0.00025	0.1	0.00025	0.00001	0.00035	0.001	0.6405	8.25	0.5
Map 8 Galatea																			
	196	15	0.004	0.084	0.000025	0.00016	0.00005	0.0001	0.0465	0.00025	0.00025	0.27	0.4	0.00001	0.0003	0.001	0.0025	0.5	0.5
	1319	15	0.044	0.14	0.000025	0.00004	0.00005	0.0001	0.0335	0.00025	0.0005	0.33	0.77	0.00001	0.0012	0.001	0.025		
	2913	12	0.0005	0.0325	0.000025	0.000025	0.0002	0.0001	0.0289	0.00025	0.0011	0.23	0.00075	0.00001	0.0003	0.0015	0.231	0.5	0.5
Map 9 Ōpōtiki																			
	3036	17	0.002	0.0375	0.000025	0.00026	0.00005	0.0001	0.01535	0.00025	0.00025	0.19	0.2895	0.000024	0.0008	0.001	0.001		
	3039	15	0.0005	0.033	0.000025	0.000025	0.00005	0.0001	0.01125	0.00025	0.00025	0.07	0.00104	0.00001	0.0001	0.001	0.54		
	3301	38	0.011	0.034	0.000025	0.00004	0.00005	0.0001	0.0007	0.00025	0.000275	0.11	0.0025	0.00065	0.00028	0.005	2.4	2.75	0.5
	4002	15	0.002	0.053	0.000025	0.00014	0.00005	0.0001	0.0663	0.00025	0.00025	0.2	0.262	0.000265	0.0004	0.001	0.0055		

Table A3-2: Median Values - Aesthetic Value (DWSNZ - Guideline Values) (g/m^3)															
Map Area	**Bore No**	**Sample size**	**Temp**	**pH @25°C**	**pH**	**Al**	**Hardness**	**Cu**	**Fe S/D**	**Fe T/TR**	**Mn**	**Na**	**Zn**	**Cl**	**SO_4**
DWSNZ			Geothermal	7.0 - 8.5	7.0 - 8.5	0.1	200	1.0000	0.20	0.20	0.040	200.0	1.50	250.00	250.0
Map 3 WBOP															
	66	6	32.05	7.35	7.05	0.00725	11.8	0.000555	0.005	0.0465	0.026	64.3	0.299	35	2
	68	13	21.5	7.6	7.4	0.0015	74.42	0.00025	0.01	0.0255	0.00025	22.30	0.0621	8.8	1.8
	94	6	25	7.3	7.0	0.0019	28	0.00076		0.035	0.0084	31	0.024	16.4	2.65
	851	10	19.75	6.8	6.5	0.00225	40.3	0.00025	4.915	4.72	0.136	14.9	0.0427	10.5	2.17
	1393	15	26.9	7.9	7.75	0.027	1.4	0.0009	0.01	0.039	0.0039	34.9	0.035	9.45	1.54
	1686	16	27.15	7.66	7.415	0.4045	8.2	0.00075	0.3	0.74	0.045	73	0.0296	56.15	5
	2303	18	35.2	7.5	7.38	0.098	4.7	0.00045	0.095	0.052	0.06	106.5	0.0034	13	0.395
	2330	16	18.4	6.55	6.29	0.0041	25.7	0.0011	0.14	0.0345	0.01135	21	0.273	23.5	5
	2343	13	18.9	6.7	6.4	0.00195	18.5	0.00025	0.01	0.03	0.00085	13	0.303	10.25	2.25
	2829	17	31.2	8.4	8.25	0.073	1.8	0.0007	0.27	0.18	0.0137	49.9	0.0185	18.95	4
Map 4 Tauranga															
	51	6	19.8	6.65	6.45	0.0063	40.95	0.0035	0.07	0.58	0.0047	22	0.01	16.8	3.9
	2093	7	18.1	6.5	6.6	0.0015	75.9	0.000525	0.025	0.93	0.003	233	0.0027	310	32
	2342	18	22	7	6.83	0.0015	45.2	0.00025	0.01	0.035	0.00074	19.2	0.022	20.45	4.8
	2344	18	17.05	6.2	5.935	0.0175	12.6	0.000375	0.025	0.255	0.004	9.3	0.016	6.9	2.7
	2362	17	30.8	7	6.8	0.0015	30.3	0.00025	0.265	1.06	0.551	28.8	0.245	16.7	3.4
	2393	8	28.9	7.2	7.1	0.0015	32.7	0.0003	0.025	0.025	0.00025	33	0.0955	19.65	2.5
	2707	17	16.1	7.75	7.6	0.0015	268.85	0.00025	0.01	0.071	0.03075	95	0.0113	184	54.4
	2728	15	20	6.7	6.9	0.0015	53.7	0.00025	7.73	2.05	0.26	75.1	0.0815	84.3	9.8
	2847	16	20.25	5.85	6.15	0.242	28.4	0.00025	4.525	12.55	0.0947	17.8	0.335	19.3	19.5
	3044	24	42	7.5	7.57	0.003	55.6	0.00028	0.34	0.58	0.231	344.5	0.00565	580	0.25
	3272	6	32.5	6.8		0.007	3913.9	0.0012	12		9.21	4460	0.04	9790	995
	4364	34	36.65	7.3	7.48	0.0015	52.2	0.00025	0.45	0.585	0.4975	149	0.003	197	0.25
	4582	6	21.9	6.75		0.0015	41.3	0.00025	0.08		0.00545	23.5	0.399	22.3	3.4
Map 5 Te Puke															
	410	13	15.5	6.8	6.665	0.0015	32.1	0.00045	0.5	0.081	4.9	24	0.3635	10.2	6.6
	643	11	16.2	6.6	6.6	0.008	80.7	0.0076	8.755	6.13	10.965	59.25	0.003	28.1	14.4
	951	16	24.75	6.9	7	0.0015	109.4	0.00025	1.7	2.935	1.71	65	0.0081	22.25	0.25
	1018	11	32.4	6.7	6.5	0.0015	89.6	0.00025	1.8	3.305	0.255	105	0.149	40.55	0.9
	1520	17	22.8	6.7	6.5	0.0015	44.45	0.000425	0.01	0.0525	0.00025	62.9	0.0252	29.7	2.6
	1586	14	17.3	6.3	6.5	0.0015	16.7	0.00025	0.01	0.225	0.13	12.7	0.062	9.55	4.8
	1690	17	25	6.9	6.705	0.0015	75.8	0.00025	5.45	2.94	0.601	59	0.0115	19.6	0.25
	2591	15	18.3	7.3	7.175		157.38			2.93		31.9		14.9	3.9
	2822	17	18.1	6.6	6.52	0.0015	51.4	0.00025	4.6	3.78	0.9505	49.85	0.046	21	0.56
	3034	18	17.3	6.25	5.79	0.0085	11.4	0.00025	0.01	0.115	0.025	31.6	0.009	18.9	19.3
	3045	43	15.7	6.3	6.455	0.0015	54.75	0.0028	0.036	0.04	0.01285	23	0.045	35	8.7
	3566	12	16.3	6.65	6.935	0.0093	15.7	0.000375	0.0365		0.0012	15.2	0.024	8.4	1.85
	4968	10	16.2	6.45	6.195	0.006	20.65	0.00025	0.01		0.00082	16.75	0.018	14.55	8.4
Map 6 Rotorua															
	1561	18	13.65	6.6	6.25	0.0015	15.5	0.0008	0.025	0.08	0.003	9.7	0.091	4.95	1.3
	2118	9	14.2	6.5	6.61	0.0015	26	0.00025	0.01		0.00355	11.8	0.008	7.2	9.9
	3470	12	13.3	6.7	7.09	0.0015	12	0.00025	9.1		1.25	13	0.0094	4.2	0.25
	4000	8	15.4	6.35	6.25	0.00415	28.4	0.0047	0.025	0.045	0.00245	10.3	0.4615	9.4	8.9
	4001	13	39.2	5.8	5.6	0.004	68.2	0.00025	9.79	10.53	2.92	229	0.0125	315.5	40.4
	4003	5	14.5	6.75	7.4	0.0015	22.6	0.000425	0.01		0.0031	9.7	0.03	3.6	11.2
	4007	40	12.9	6.59	6.485	0.0015	15.9	0.00025	0.01	0.01	0.0025	9.97	0.01065	5.3	1.4
Map 7 Rangitāiki															
	1	42	16.7	7.27	7.38	0.008	108.2	0.00025	3.21	3.4	0.23	30.6	0.0105	22	29
	49	7	16	6.9	6.875	0.1706	329.3	0.002	0.08	9.585	0.2925	93	0.0214	36.4	0.35
	466	14	16.9	7.2	7.2	0.0015	194.1	0.00025	4.6	5.1	0.335	24.5	0.016	10.85	0.25
	490	16	14.3	6.9	7.23	0.0015	15.5	0.00025	1.255	1.915	0.126	15	0.0031	7.65	1.7
	845	19	28.5	7.4	7.2	0.0015	98.4	0.00025	0.48	1.02	0.129	100	0.0055	16.7	0.25
	925	12	19.05	6.05	6.1	0.0015	101.25	0.00025	26.7	8.29	1.03	83.65	0.0193	45.45	0.27
	1605	11	16.1	6.6	6.2	0.006	13.3	0.00025	0.01	0.055	0.00025	11.4	0.0092	8	3.2
	2076	15	19.7	7	6.8	0.00495	16.2	0.0018	0.01	0.03	0.000695	12.85	0.024	9.2	8.5
	2509	46	18.1	6.9	6.72	0.0165	13.2	0.00025	0.01	0.02	0.0025	11.7	0.0338	6.7	3.4
	Spring 198	12	17.05	6.8	6.315	0.0044	15.15	0.00025	0.01		0.00025	11.6	0.00425	8.8	8.1
Map 8 Galatea															
	196	15	14.9	6.75	6.9	0.0015	39.2	0.00025	5.21	0.895	0.4	11.15	0.014	5.7	2.65
	1319	15	15.8	7.3	7.1	0.0015	62.55	0.0005	0.66	0.675	0.77	23.05	0.0083	9.5	0.25
	2913	12	12.75	6.9	6.6	0.0015	33.6	0.0011	0.025	0.105	0.00075	8.45	0.026	6.35	4.8
Map 9 Ōpōtiki															
	3036	17	15.6	6.9	6.745	0.0015	59.9	0.00025	1.13	4.44	0.2895	15.3	0.039	12	0.945
	3039	15	14.9	6.65	6.3	0.0015	33.5	0.00025	0.0275	0.0495	0.00104	6.025	0.01	5.7	6.9
	3301	38	16	8.365	8.295	0.006	80.75	0.000275	0.01	0.03	0.0025	31	0.0005	39.5	10.6
	4002	15	16.4	7.1	7.1	0.0015	165.55	0.00025	0.63	1.19	0.262	102.5	0.004	188.5	26.3

Table A3-3: Median Values – Trace Elements (g/m^3)

			Field Variables		Silica	Trace elements												
Map Area	**Bore No**	**Sample size**	**DO**	**Cond. mS/m**	**Si**	**SiDR**	**Co**	**Cs**	**La**	**Li**	**Ni**	**Rb**	**Se**	**Sn**	**Sr**	**Ti**	V	**Br**
Map 3 WBOP																		
	66	6	1.05	36.2									0.0005					
	68	13	6	14.8			0.0001	0.0001	0.00005	0.0216	0.00025	0.0085	0.0005	0.00025	0.0358	0.000025	0.014	0.025
	94	6	3.45	19.8														
	851	10	3.25	16.35	80	85.3	0.0001			0.0057	0.0005		0.0005					
	1393	15	1.25	16.5	104	116.5	0.0001	0.0002	0.00005	0.0412	0.00025	0.0081	0.0005	0.00025	0.0024	0.000025	0.023	0.025
	1686	16	0.49	37.15	97	99.6	0.0001	0.000295	0.00005	0.094	0.00025	0.0089	0.0005	0.00025	0.01175	0.000025	0.0018	0.1175
	2303	18	0.655	48.5	114	31.5	0.0001	0.0027	0.00005	0.1225	0.00025	0.03	0.0005	0.00025	0.011	0.000025	0.00075	0.025
	2330	16	2.57	17.4	85	85.9	0.0001	0.000375	0.00005	0.0051	0.0005	0.0206	0.0005	0.00025	0.06005	0.000025	0.00175	0.1
	2343	13	7.65	10.6	66	66.9	0.0001	0.0002	0.00005	0.0082	0.000375	0.0101	0.0005	0.00025	0.0384	0.000025	0.002	0.025
	2829	17	5.98	23.4	67	73.85	0.0001	0.00012	0.000215	0.011	0.0005	0.00405	0.0005	0.00025	0.0022	0.000025	0.04	0.095
Map 4 Tauranga																		
	51	6	4.35	19.25									0.0005					
	2093	7	1.4	119.8	40.05		0.0001			0.0035	0.0005		0.0005					
	2342	18	7.47	19.59	86	91.5	0.0001	0.00005	0.00005	0.0136	0.00025	0.011	0.0005	0.00025	0.05685	0.000025	0.008	0.07
	2344	18	8.13	8.58	85	89.4	0.0001	0.00046	0.00005	0.0074	0.00025	0.0174	0.0005	0.00025	0.025	0.000025	0.0005	0.025
	2362	17	2.81	21	108	115	0.0001	0.0039	0.00005	0.03885	0.00025	0.019	0.0005	0.00025	0.0529	0.000025	0.0005	0.075
	2393	8	3.85	22.8	96.95		0.0001			0.0528	0.0005		0.0005					
	2707	17	4.1	103.85	34.3	36.2	0.0001	0.00005	0.00005	0.0052	0.00025	0.01145	0.0005	0.00025	0.6695	0.000025	0.0005	1.7
	2728	15	0.88	55.5	89	43.2	0.0002	0.00185	0.000085	0.0079	0.00025	0.02625	0.0005	0.00025	0.174	5.35E-05	0.0005	0.21
	2847	16	0.3	17.48	41	44.9	0.0002	0.00017	0.00038	0.00067	0.0005	0.00935	0.0005	0.00025	0.0298	0.000025	0.003	0.05
	3044	24	0.765	198.1	86.95	82.8	0.0001	0.0082	0.00005	0.533	0.00025	0.0706	0.0005	0.00075	0.069	0.00018	0.0005	1.49
	3272	6		2750	70.05	94	0.001	0.238	0.00005	1.26	0.0025	0.468	0.00875	0.001375	6.595	0.000138	0.00275	28
	4364	34	0.815	85.8	82	67.2	0.0001	0.0077	0.00005	0.2475	0.00025	0.04635	0.0005	0.00025	0.077	0.00016	0.0005	0.61
	4582	6		20.35	107		0.0001	0.000395	0.000075	0.0144	0.00025	0.01475	0.0005	0.00025	0.06615	0.000025	0.0023	0.09
Map 5 Te Puke																		
	410	13	4.66	20.5	76.5	76.3	0.000895	0.0002	0.00028	0.02865	0.00025	0.0193	0.0005	0.00025	0.0424	0.000025	0.0005	0.06
	643	11	0.4	43.5	73.1	73	0.0008			0.163	0.0005		0.0005					
	951	16	0.7	49.8	94.1	91.4	0.0001	0.000175	0.00005	0.13	0.00025	0.0138	0.0005	0.00025	0.1355	0.000025	0.00075	0.12
	1018	11	0.8	63.7	135	139	0.0001			0.2215	0.000375		0.0005					
	1520	17	5.225	38.1	97	55.95	0.0001	0.0015	0.00005	0.04605	0.00025	0.0254	0.0005	0.00025	0.08985	0.000025	0.0049	0.1
	1586	14	0.95	10.75	89.3	90.7	0.0001	0.00015	0.00005	0.0031	0.00025	0.0132	0.0005	0.00025	0.036	0.000025	0.0005	0.0475
	1690	17	0.295	42.2	97.5	58	0.0001	0.000075	0.00005	0.1005	0.00025	0.02325	0.0005	0.00025	0.15	0.000025	0.0005	0.08
	2591	15	7.7	28.8														
	2822	17	5.24	34.5	90.1	91.2	0.0006	0.00072	0.00005	0.195	0.00025	0.014	0.0005	0.00025	0.062	0.000025	0.0005	0.09
	3034	18	5.1	22.3	75.4	49.9	0.0001	0.00047	0.00011	0.0056	0.00025	0.019	0.0005	0.00025	0.0383	0.0001	0.00075	0.09
	3045	43	4.6	26	83.3	83.4	0.0001	0.0005	0.0002	0.0064	0.0005	0.02585	0.0005	0.00025	0.104	0.000025	0.00105	0.06
	3566	12	9.63	10	83	84.6	0.0001	0.00005	0.00005	0.013	0.00025	0.00057	0.0005	0.00025	0.0122	0.000025	0.0027	0.025
	4968	10	9.585	18.125	88.4	88.2	0.0001	0.00019	0.00005	0.0076	0.00025	0.01395	0.0005	0.00025	0.07265	0.000025	0.0016	0.07
Map 6 Rotorua																		
	1561	18	7.54	8.7	69.9	39.55	0.0001	0.00059	0.00005	0.013	0.00025	0.00635	0.0005	0.00025	0.02	0.000025	0.0005	0.025
	2118	9	8.46	12.385	78	44.35	0.0001	0.00195	0.00005	0.0216	0.00025	0.0079	0.0005	0.00025	0.0354	0.000025	0.0005	0.025
	3470	12	0.725	9.9	40	22.4	0.0001	0.00305	0.0001	0.0227	0.00025	0.0096	0.0005	0.00025	0.00765	0.000025	0.0005	0.05
	4000	8	8.8	13.2	82.6		0.0001			0.0038	0.0005		0.0005					
	4001	13	1	141	170.5	87.5	0.00059	0.0328	0.00005	1.605	0.00025	0.11	0.0005	0.00025	0.101	0.000025	0.002	1.155
	4003	5		10.78	83.8	84.1	0.0001	0.00005	0.00005	0.0046	0.0048	0.0078	0.0005	0.00025	0.043	0.000025	0.0005	0.025
	4007	40	8.45	8.6	66.5	41.1	0.0001	0.00038	0.00005	0.0118	0.00025	0.0061	0.0005	0.00025	0.02465	0.000025	0.0005	0.025
Map 7 Rangitāiki																		
	1	42	1.5	38.15	70.4	38.5	0.0001	0.00015	0.00015	0.01275	0.00085	0.0163	0.0005	0.00025	0.11	0.000025	0.0005	0.025
	49	7	0.275	88.55									0.0005					
	466	14	1.05	49.85	71.3	72.8	0.0001	0.00016	0.00005	0.03425	0.00025	0.0094	0.0005	0.00025	0.342	0.000025	0.00075	0.08
	490	16	1.35	10.4	78	80.45	0.0001	0.00005	0.00005	0.0223	0.00025	0.0044	0.0005	0.00025	0.0225	0.000025	0.0005	0.05
	845	19	1.01	61.7	98.95	96.6	0.0001	0.00005	0.00005	0.227	0.00025	0.0065	0.0005	0.00025	0.214	0.000025	0.00075	0.07
	925	12	0.3	68.9	107	59.25	0.0001	0.0025	0.00005	0.42	0.00025	0.017	0.0005	0.00025	0.18	0.000025		0.13
	1605	11	2.4	9.2	76.8	85	0.0001	0.00005	0.00005	0.00765	0.000375	0.0002	0.0005	0.00025	0.0299	0.000025	0.003	
	2076	15	7	10.745	70.6	73.3	0.0001	0.0049	0.00005	0.0229	0.000375	0.012	0.0005	0.00025	0.0279	0.000025	0.0005	0.025
	2509	46	8.2	8.95	85	71.5	0.0001	0.0017	0.00005	0.0223	0.00025	0.01245	0.0005	0.00025	0.016	0.000025	0.0041	0.025
	Spring198	12	7.51	10.1	73.15	74.7	0.0001	0.0044	0.00005	0.021	0.00025	0.013	0.0005	0.00025	0.028	0.000025	0.0005	0.025
Map 8 Galatea																		
	196	15	2.36	14.4	59.2	41.65	0.0001	0.00005	0.00005	0.0103	0.00025	0.00645	0.0005	0.00025	0.1495	0.000025	0.0005	0.025
	1319	15	3.1	22.8	64.6	40.9	0.0001	0.00005	0.00005	0.0138	0.00025	0.0017	0.0005	0.00025	0.203	0.000025	0.0005	0.06
	2913	12	9.6	11.25	43	43.9	0.0001	0.00005	0.00005	0.008	0.00025	0.00025	0.0005	0.00025	0.109	0.000025	0.001	0.025
Map 9 Ōpōtiki																		
	3036	17	2.6	20.85	33.5	27.6	0.0001	0.00005	0.00005	0.00375	0.00025	0.000315	0.0005	0.00025	0.175	0.000025	0.0005	0.06
	3039	15	5.2	10.2	23.95	39.05	0.0001	0.00005	0.00005	0.0015	0.00025	0.00105	0.0005	0.00025	0.07815	0.000025	0.0005	0.025
	3301	38	3.5	29.5	35.45	36.5	0.0001	0.00005	0.00005	0.0068	0.00025	0.0019	0.0005	0.00025	0.0725	0.000025	0.0061	0.13
	4002	15	4.65	86.7	42.05	18.65	0.0001	0.00005	0.00005	0.021	0.00025	0.00415	0.0005	0.00025	0.4435	0.000025	0.0005	0.86

Table A3-4: Median Values – Nutrients (g/m^3)									
Map Area	Bore No	Sample size	DRP	NH_4-N	NNN	NO_2-N	NO_3-N	PO_4-P	TP
DWSNZ 2005 (revised 2008)				1.50			11.30		
ANZECC TV for direct toxicity to an aquatic organism				0.90			7.20		
Anthropogenic nitrate levels*							3.50		
Possible anthropogenic effect*							1.6		
Map 3 WBOP									
	66	6	0.12	0.14	0.01		0.02	0.11	0.12
	68	13	0.11	0.005	0.06	0.001	0.05	0.14	0.11
	94	6	0.11	0.01	0.38		0.68	0.14	0.11
	851	10	0.13	0.03	0.00	0.00	0.00	0.05	0.13
	1393	15	0.16	0.01	0.01	0.00	0.02	0.08	0.17
	1686	16	0.22	0.01	0.00	0.00	0.00	0.20	0.22
	2303	18	2.70	0.50	0.00	0.00	0.00	3.70	2.60
	2330	16	0.02	0.01	0.08	0.00	0.07	0.05	0.02
	2343	13	0.06	0.01	0.09	0.00	0.07		0.06
	2829	17	0.22	0.01	0.16	0.00	0.15	0.17	0.22
Map 4 Tauranga									
	51	6	0.17	0.01	0.13	0.00	0.11	0.89	0.18
	2093	7	0.03	0.09	2.58	0.00	1.58	0.05	0.04
	2342	18	0.08	0.01	0.11	0.00	0.11	0.09	0.08
	2344	18	0.02	0.01	0.20	0.00	0.18	0.05	0.02
	2362	17	0.21	0.13	0.02	0.00	0.02	0.22	0.29
	2393	8	0.09	0.01	0.21	0.00	0.15	0.11	0.10
	2707	17	0.02	0.01	4.11	0.01	1.02	0.05	0.02
	2728	15	0.02	0.49	0.00	0.00	0.02	0.05	0.03
	2847	16	0.02	1.40	0.00	0.01	0.02	0.05	0.03
	3044	24	0.09	0.21	0.00	0.00	0.00	0.05	0.10
	3272	6	0.01	1.06	0.02	0.01	0.53		0.05
	4364	34	0.14	0.02	0.00	0.00	0.01	0.09	0.14
	4582	6	0.11	0.04	0.07	0.00	0.10		0.16
Map 5 Te Puke									
	410	13	0.01	0.07	0.01	0.00	0.01	0.06	0.01
	643	11	0.41	0.11	0.01	0.00	0.08	0.05	0.42
	951	16	0.09	0.16	0.00	0.00	0.00	0.05	0.32
	1018	11	0.14	0.11	0.01	0.00	0.01	0.05	0.19
	1520	17	0.09	0.01	2.12	0.00	1.93	0.07	0.09
	1586	14	0.03	0.02	1.72	0.00	0.26	0.05	0.04
	1690	17	0.06	0.21	0.01	0.00	0.03	0.05	0.20
	2591	15	0.06	0.04	0.05		0.00		0.10
	2822	17	0.14	0.03	0.01	0.00	0.01	0.05	0.24
	3034	18	0.14	0.01	7.20	0.00	6.05	0.22	0.16
	3045	43	0.02	0.01	0.38	0.00	0.48	0.02	0.03
	3566	12	0.23	0.01	0.08	0.00	4.18		0.24
	4968	10	0.16	0.01	8.30	0.00	6.08		0.16
Map 6 Rotorua									
	1561	18	0.08	0.01	0.60	0.00	0.53	0.22	0.09
	2118	9	0.15	0.01	2.31	0.00	2.27		0.15
	3470	12	0.37	0.98	0.01	0.00	0.00		0.67
	4000	8	0.05	0.01	2.90	0.00	3.16	1.70	0.03
	4001	13	0.22	0.38	0.01	0.01	0.03	0.62	0.24
	4003	5	0.04	0.02	2.22	0.00	3.13		0.04
	4007	40	0.08	0.01	1.45	0.00	1.50	0.09	0.08
Map 7 Rangitāiki									
	1	42	0.17	1.00	0.04	0.00	0.03	0.08	0.48
	49	7	0.31	1.92	0.02		0.36	0.05	1.33
	466	14	0.03	3.50	0.00	0.00	0.01	0.24	1.08
	490	16	0.10	0.09	0.01	0.00	0.01	0.38	0.22
	845	19	0.55	0.47	0.00	0.00	0.00	0.30	0.61
	925	12	0.22	0.61	0.01	0.01	0.01	0.05	0.27
	1605	11	0.12	0.01	0.12	0.00	0.10	0.11	0.13
	2076	15	0.08	0.01	0.51	0.00	1.89	0.21	0.07
	2509	46	0.11	0.01	0.19	0.00	0.18	0.10	0.11
	Spring 198	12	0.07	0.01	0.63	0.00	0.64		0.07
Map 8 Galatea									
	196	15	0.30	0.11	0.00	0.00	0.00	0.16	0.50
	1319	15	1.32	0.53	0.06	0.00	0.03	0.65	1.43
	2913	12	0.07	0.01	0.39	0.00	0.23	0.07	0.08
Map 9 Ōpōtiki									
	3036	17	0.11	0.12	0.01	0.00	0.00	0.05	0.18
	3039	15	0.02	0.01	0.50	0.00	0.54	0.05	0.02
	3301	38	0.13	0.01	2.02	0.01	2.40	0.11	0.12
	4002	15	0.02	0.07	0.00	0.00	0.01	0.05	0.09

Table A3-5: Median Values - Major Ions									
			Cations (g/m^3)				Anions (g/m^3)		
Map Area	Bore No	Sample size	Ca	Mg	K	Na	HCO3	Cl	SO4
Map 3 WBOP									
	66	6	2.9	1.1	5.4	64.3	128.283	35	2
	851	10	6.59	5.75	4.14	14.9	79.727	10.5	2.17
	1393	15	0.34	0.13	2.7	34.9	83.082	9.45	1.54
	1686	16	1.215	1.27	3.74	73	114.68	56.15	5
	2303	18	1.03	0.6235	12.2	106.5	284.26	13	0.395
	2330	16	5.96	2.5	5.5	21	51.972	23.5	5
	2343	13	4.605	1.63	3	13	42.7	10.25	2.25
	2829	17	0.28	0.309	3.7	49.9	102.48	18.95	4
Map 4 Tauranga									
	51	6	8.615	4.585	3.6	22	82.045	16.8	3.9
	2093	7	25	2.94	7.7	233	92.72	310	32
	2342	18	8.5	6	4.1	19.2	74.603	20.45	4.8
	2344	18	2.73	1.43	4.98	9.3	34.099	6.9	2.7
	2362	17	6.78	3.2	5.085	28.8	94.306	16.7	3.4
	2393	8	5.24	4.5	5.2	33	100.101	19.65	2.5
	2707	17	81.55	14.8	6.07	95	157.38	184	54.4
	2728	15	14	4.5	10.8	75.1	148.84	84.3	9.8
	2847	16	7.155	2.53	5.565	17.8	57.645	19.3	19.5
	3044	24	12.2	7.175	13	344.5	275.11	580	0.25
	3272	6	546	616	267	4460	104.615	9790	995
	4364	34	9.6	7	6.8	149	136	197	0.25
	4582	6	8.45	4.92	4.1	23.5	83.387	22.3	3.4
Map 5 Te Puke									
	410	13	7.55	3.2	3.5	24	101.26	10.2	6.6
	643	11	15.9	10.22	5.68	59.25	234.85	28.1	14.4
	951	16	28.6	10.1	3	65	294.63	22.25	0.25
	1018	11	16.2	11.5	8.8	105	346.48	40.55	0.9
	1520	17	8.38	6.58	7.6	62.9	179.34	29.7	2.6
	1586	14	3.17	2.08	3.7	12.7	35.563	9.55	4.8
	1690	17	17	8.045	6.815	59	236.68	19.6	0.25
	2591	15	11.5	10.7	4.2	31.9	157.38	14.9	3.9
	2822	17	8.06	7.705	4.19	49.85	180.56	21	0.56
	3034	18	3.595	1.68	6.7	31.6	45.262	18.9	19.3
	3045	43	13	5.8	9.3	23	67	35	8.7
	3566	12	4.01	1.465	0.515	15.2	44.896	8.4	1.85
	4968	10	7.54	3	5.4	16.75	27.511	14.55	8.4
Map 6 Rotorua									
	1561	18	3.145	2	2.66	9.7	39.894	4.95	1.3
	2118	9	6.42	2.4	2.95	11.8	34.038	7.2	9.9
	3470	12	2.285	1.5	1.9	13	50.691	4.2	0.25
	4000	8	7.19	2.25	5.8	10.3	30.866	9.4	8.9
	4001	13	14.3	7.9	21.1	229	188.49	315.5	40.4
	4003	5	5.43	2.2	4.22	9.7	31.476	3.6	11.2
	4007	40	3.2	1.9	1.7	9.97	31.842	5.3	1.4
Map 7 Rangitāiki									
	1	42	27	11	3.8	30.6	157	22	29
	49	7	105	11.4	9.7	93	537.41	36.4	0.35
	466	14	69	5.12	3.8	24.5	309.88	10.85	0.25
	490	16	2.84	2.05	1.805	15	50.142	7.65	1.7
	845	19	23	10.1	4.9	100	384.3	16.7	0.25
	925	12	24.415	9.54	3.8	83.65	358.741	45.45	0.27
	1605	11	2.56	1.58	2.9	11.4	35.38	8	3.2
	2076	15	4.14	1.44	3.36	12.85	33.001	9.2	8.5
	2509	46	2.8	1.51	2.8	11.7	35	6.7	3.4

Table A3-5: Median Values - Major Ions									
			Cations (g/m^3)				Anions (g/m^3)		
Map Area	**Bore No**	**Sample size**	**Ca**	**Mg**	**K**	**Na**	**HCO3**	**Cl**	**SO4**
	Spring 198	12	3.63	1.5	3.455	11.6	30.378	8.8	8.1
Map 8 Galatea									
	196	15	8.17	4.61	2.6	11.15	60.756	5.7	2.65
	1319	15	13.95	6.675	3.72	23.05	126.88	9.5	0.25
	2913	12	7.77	3.4	2.39	8.45	49.593	6.35	4.8
Map 9 Ōpōtiki									
	3036	17	14	6.93	2.265	15.3	111.02	12	0.945
	3039	15	9.285	2.51	1.18	6.025	41.968	5.7	6.9
	3301	38	17.7	10.8	3.6	31	97	39.5	10.6
	4002	15	44.45	13	7.8	102.5	126.88	188.5	26.3

Table A3-6: Ion Balance of Bore Samples with Complete Major Ions (milliequivelents)														
Bore No	Collect Date	Ca	K	Mg	Na	Total Cations	Cl	SO4	HCO3	Total anions	Cations-anions	Cations + anions	Difference	%
1	1993	1.65	0.08	1.05	1.40	4.18	0.52	0.33	3.24	4.09	0.09	8.36	0.01	1.07
1	1994	1.55	0.09	0.95	1.30	3.89	0.42	0.33	3.12	3.88	0.01	7.77	0.00	0.12
1	1997	1.21	0.16	0.81	2.82	4.99	0.71	0.38	4.38	5.47	-0.48	9.99	-0.05	-4.79
1	1997	1.62	0.11	1.04	1.30	4.07	0.68	0.54	2.74	3.96	0.11	8.13	0.01	1.36
1	1997	1.44	0.10	0.97	1.36	3.87	0.73	0.60	2.67	4.01	-0.14	7.73	-0.02	-1.82
1	1998	1.45	0.09	0.90	1.21	3.65	0.75	0.62	2.62	3.99	-0.34	7.30	-0.05	-4.71
1	1998	1.58	0.10	0.95	1.33	3.96	0.73	0.58	2.61	3.92	0.04	7.92	0.01	0.50
1	1998	1.65	0.10	1.01	1.44	4.19	0.76	0.60	2.64	4.00	0.19	8.38	0.02	2.24
1	1998	1.55	0.09	0.95	1.39	3.98	0.68	0.62	2.57	3.87	0.11	7.96	0.01	1.32
1	1998	1.60	0.10	0.94	1.39	4.02	0.68	0.62	2.61	3.91	0.12	8.05	0.01	1.45
1	1999	0.94	0.10	0.58	1.00	2.62	0.47	0.41	1.67	2.55	0.07	5.23	0.01	1.27
1	1999	1.45	0.10	0.94	1.39	3.88	0.62	0.62	2.59	3.83	0.04	7.75	0.01	0.54
1	1999	1.40	0.10	0.91	1.39	3.80	0.59	0.60	2.57	3.77	0.03	7.60	0.00	0.40
1	2000	1.30	0.09	0.86	1.35	3.59	0.56	0.60	2.47	3.64	-0.05	7.19	-0.01	-0.68
1	2000	1.25	0.09	0.83	1.30	3.47	0.56	0.56	2.47	3.60	-0.13	6.95	-0.02	-1.84
1	2000	1.20	0.09	0.82	1.30	3.42	0.56	0.60	2.52	3.69	-0.27	6.83	-0.04	-3.93
1	2002	1.24	0.10	0.79	1.29	3.42	0.67	0.73	2.32	3.72	-0.30	6.83	-0.04	-4.44
1	2003	1.25	0.10	0.75	1.17	3.27	0.56	0.69	2.08	3.33	-0.05	6.54	-0.01	-0.83
1	2004	1.23	0.10	0.77	1.27	3.37	0.62	0.78	2.14	3.54	-0.16	6.75	-0.02	-2.42
1	2006	0.67	0.26	0.44	1.14	2.50	0.72	1.33	0.48	2.53	-0.03	5.00	-0.01	-0.69
1	2007	0.65	0.26	0.43	0.99	2.33	0.85	1.12	0.40	2.38	-0.05	4.65	-0.01	-1.08
1	2009	0.65	0.29	0.44	0.74	2.12	0.59	1.04	0.36	1.99	0.13	4.25	0.03	3.05
68	1991	0.25	0.08	0.20	0.91	1.44	0.36	0.04	1.30	1.70	-0.26	2.87	-0.09	-9.08
68	1992	0.21	0.04	0.16	1.05	1.46	0.24	0.04	1.22	1.50	-0.04	2.92	-0.01	-1.29
68	1993	0.24	0.06	0.20	0.98	1.48	0.24	0.04	1.22	1.50	-0.02	2.95	-0.01	-0.78
68	1994	0.33	0.05	0.19	0.96	1.52	0.21	0.04	1.25	1.50	0.02	3.05	0.01	0.80
68	1996	0.31	0.05	0.02	0.90	1.28	0.20	0.03	1.29	1.53	-0.25	2.55	-0.10	-9.86
68	1997	0.25	0.05	0.19	0.92	1.41	0.24	0.04	1.20	1.47	-0.07	2.81	-0.02	-2.44
68	1998	0.27	0.05	0.18	0.96	1.46	0.28	0.01	1.20	1.48	-0.03	2.92	-0.01	-0.88
68	2002	0.25	0.05	0.19	0.98	1.48	0.26	0.04	1.24	1.54	-0.06	2.95	-0.02	-2.07
68	2004	0.26	0.05	0.21	1.00	1.51	0.25	0.05	1.24	1.54	-0.03	3.02	-0.01	-0.90
68	2005	0.25	0.05	0.20	1.00	1.49	0.27	0.06	1.21	1.53	-0.04	2.99	-0.01	-1.34
68	2006	0.27	0.05	0.20	1.00	1.52	0.25	0.05	1.20	1.49	0.03	3.04	0.01	0.85
68	2007	0.25	0.05	0.19	0.94	1.42	0.25	0.04	1.22	1.51	-0.08	2.85	-0.03	-2.95
196	1991	0.33	0.07	0.31	0.41	1.12	0.16	0.10	1.00	1.26	-0.14	2.24	-0.06	-6.46
196	1993	0.20	0.03	0.47	0.44	1.15	0.13	0.05	0.94	1.12	0.03	2.30	0.01	1.40
196	1994	0.35	0.05	0.32	0.39	1.11	0.11	0.06	0.95	1.12	-0.01	2.22	-0.01	-0.62
196	1996	0.32	0.05	0.33	0.41	1.11	0.12	0.06	1.00	1.18	-0.06	2.23	-0.03	-2.85
196	1997	0.31	0.05	0.33	0.43	1.12	0.14	0.06	0.98	1.19	-0.07	2.24	-0.03	-2.99
196	1998	0.38	0.05	0.39	0.49	1.31	0.16	0.02	0.98	1.16	0.15	2.62	0.06	5.79
196	2004	0.61	0.09	0.48	0.65	1.84	0.22	0.02	1.66	1.90	-0.06	3.68	-0.02	-1.76
196	2005	0.44	0.07	0.39	0.68	1.58	0.23	0.08	1.38	1.69	-0.10	3.17	-0.03	-3.25
196	2006	0.61	0.11	0.45	0.63	1.79	0.27	0.06	1.78	2.11	-0.33	3.57	-0.09	-9.11
196	2008	0.47	0.07	0.37	0.52	1.44	0.19	0.03	1.38	1.60	-0.16	2.87	-0.06	-5.73
196	2009	0.50	0.07	0.40	0.52	1.50	0.20	0.04	1.17	1.41	0.09	3.00	0.03	3.06
410	1997	0.37	0.09	0.28	1.06	1.80	0.28	0.14	1.64	2.06	-0.26	3.60	-0.07	-7.15
410	1998	0.38	0.08	0.28	1.04	1.79	0.29	0.08	1.70	2.07	-0.28	3.58	-0.08	-7.83
410	2002	0.37	0.09	0.28	1.10	1.85	0.32	0.14	1.68	2.14	-0.29	3.70	-0.08	-7.80
410	2004	0.41	0.19	0.33	0.86	1.78	0.30	0.14	1.70	2.14	-0.35	3.57	-0.10	-9.88
410	2005	0.34	0.09	0.22	1.08	1.73	0.27	0.10	1.63	2.00	-0.27	3.46	-0.08	-7.80
410	2006	0.39	0.09	0.27	1.12	1.87	0.31	0.14	1.65	2.09	-0.22	3.74	-0.06	-5.91
410	2008	0.38	0.09	0.26	1.09	1.82	0.31	0.14	1.72	2.18	-0.36	3.64	-0.10	-9.86
410	2009	0.38	0.09	0.26	1.04	1.77	0.28	0.13	1.61	2.02	-0.25	3.54	-0.07	-7.16
410	2010	0.35	0.08	0.24	1.04	1.72	0.28	0.15	1.66	2.09	-0.37	3.43	-0.11	-10.85
410	2011	0.38	0.08	0.26	1.00	1.72	0.29	0.14	1.66	2.09	-0.37	3.45	-0.11	-10.59
466	1991	3.54	0.12	0.39	1.00	5.06	0.35	0.04	5.22	5.60	-0.54	10.12	-0.05	-5.35
466	1992	3.93	0.16	0.43	1.21	5.74	0.27	0.00	5.08	5.35	0.39	11.48	0.03	3.36
466	1993	4.38	0.12	0.44	1.43	6.36	0.31	0.01	5.04	5.35	1.01	12.72	0.08	7.92
466	1994	3.24	0.09	0.41	1.09	4.84	0.27	0.00	4.86	5.13	-0.29	9.67	-0.03	-3.03
466	1996	3.59	0.09	0.42	1.07	5.17	0.29	0.01	5.16	5.45	-0.28	10.34	-0.03	-2.70
466	1997	3.37	0.09	0.41	1.05	4.93	0.28	0.00	5.02	5.30	-0.37	9.86	-0.04	-3.71
466	1998	3.16	0.09	0.41	1.05	4.72	0.29	0.01	4.98	5.28	-0.57	9.43	-0.06	-5.99
466	2002	3.12	0.10	0.36	0.97	4.56	0.32	0.01	5.22	5.55	-0.99	9.12	-0.11	-10.83
466	2004	3.41	0.10	0.45	1.15	5.11	0.30	0.01	5.08	5.39	-0.28	10.22	-0.03	-2.70
466	2006	3.66	0.10	0.44	1.06	5.26	0.33	0.01	5.42	5.75	-0.49	10.52	-0.05	-4.69
466	2007	3.41	0.10	0.43	1.11	5.04	0.33	0.01	5.06	5.39	-0.35	10.09	-0.03	-3.43
466	2008	3.44	0.10	0.42	1.13	5.10	0.31	0.01	5.08	5.39	-0.30	10.19	-0.03	-2.93
466	2009	3.69	0.09	0.44	1.04	5.27	0.31	0.01	5.24	5.55	-0.28	10.53	-0.03	-2.70
490	1992	0.15	0.04	0.16	0.67	1.02	0.15	0.02	0.96	1.13	-0.10	2.05	-0.05	-5.02
490	1993	0.16	0.04	0.18	0.80	1.18	0.23	0.01	0.88	1.12	0.07	2.37	0.03	2.79
490	1994	0.21	0.04	0.17	0.63	1.05	0.18	0.02	0.87	1.08	-0.02	2.11	-0.01	-1.09
490	1997	0.16	0.04	0.19	0.63	1.01	0.21	0.03	0.82	1.06	-0.05	2.02	-0.02	-2.36
490	2002	0.14	0.05	0.17	0.65	1.01	0.22	0.04	0.82	1.08	-0.07	2.01	-0.04	-3.70
490	2004	0.14	0.05	0.17	0.67	1.03	0.25	0.04	0.78	1.08	-0.05	2.05	-0.02	-2.34
490	2005	0.14	0.05	0.17	0.66	1.01	0.31	0.06	0.82	1.19	-0.18	2.03	-0.09	-8.68
490	2006	0.14	0.05	0.17	0.64	1.00	0.24	0.04	0.80	1.07	-0.08	1.99	-0.04	-3.84
490	2007	0.14	0.05	0.17	0.69	1.05	0.22	0.04	0.80	1.05	0.00	2.10	0.00	-0.01
490	2009	0.13	0.05	0.16	0.65	1.00	0.19	0.04	0.82	1.06	-0.06	2.00	-0.03	-2.91
643	1991	0.85	0.23	0.99	2.61	4.67	0.60	0.38	3.88	4.85	-0.18	9.34	-0.02	-1.95
643	1992	1.33	0.23	1.23	2.43	5.22	1.05	0.93	3.88	5.86	-0.64	10.44	-0.06	-6.13

Table A3-6: Ion Balance of Bore Samples with Complete Major Ions (milliequivelents)														
Bore No	Collect Date	Ca	K	Mg	Na	Total Cations	Cl	SO4	HCO3	Total anions	Cations-anions	Cations + anions	Difference	%
643	1993	0.69	0.14	0.75	2.75	4.33	0.79	0.21	3.80	4.80	-0.46	8.67	-0.05	-5.35
643	1994	0.71	0.13	0.64	2.61	4.09	0.56	0.13	3.54	4.23	-0.14	8.19	-0.02	-1.67
643	1996	0.69	0.14	0.76	2.48	4.06	0.67	0.22	3.82	4.71	-0.64	8.13	-0.08	-7.89
643	1997	0.93	0.16	1.00	2.86	4.96	0.96	0.71	4.06	5.73	-0.78	9.91	-0.08	-7.86
643	1998	0.84	0.15	0.92	2.54	4.46	0.91	0.54	3.92	5.37	-0.91	8.92	-0.10	-10.21
643	2004	0.74	0.14	0.65	2.41	3.95	0.91	0.18	3.32	4.42	-0.46	7.90	-0.06	-5.88
845	1991	1.20	0.13	0.91	4.70	6.93	0.49	0.02	6.92	7.43	-0.50	13.87	-0.04	-3.60
845	1992	1.34	0.11	0.91	5.55	7.92	0.45	0.00	6.34	6.79	1.12	15.83	0.07	7.10
845	1994	1.40	0.13	0.86	4.48	6.87	0.42	0.00	6.38	6.80	0.07	13.74	0.00	0.49
845	1997	1.13	0.13	0.85	3.93	6.03	0.49	0.01	6.32	6.82	-0.79	12.07	-0.07	-6.54
845	1998	1.13	0.12	0.83	4.00	6.08	0.48	0.01	6.30	6.79	-0.71	12.15	-0.06	-5.88
845	2002	1.06	0.14	0.78	4.35	6.33	0.55	0.01	4.58	5.13	1.19	12.66	0.09	9.43
845	2004	1.11	0.13	0.82	4.57	6.63	0.47	0.01	6.28	6.75	-0.12	13.26	-0.01	-0.90
845	2005	1.03	0.12	0.76	4.44	6.35	0.51	0.02	6.22	6.74	-0.39	12.71	-0.03	-3.08
845	2006	1.10	0.12	0.77	4.21	6.20	0.47	0.01	6.18	6.66	-0.46	12.39	-0.04	-3.71
845	2007	1.21	0.12	0.86	5.57	7.76	0.47	0.01	6.42	6.89	0.86	15.51	0.06	5.57
845	2008	1.15	0.13	0.77	4.35	6.40	0.48	0.01	6.24	6.72	-0.32	12.80	-0.03	-2.53
845	2009	1.15	0.12	0.81	4.35	6.43	0.45	0.01	6.16	6.62	-0.19	12.86	-0.01	-1.49
845	2010	1.05	0.12	0.77	4.31	6.24	0.45	0.01	6.14	6.60	-0.36	12.47	-0.03	-2.89
845	2012	1.15	0.13	0.88	4.61	6.76	0.47	0.01	7.50	7.98	-1.21	13.53	-0.09	-8.97
851	1991	0.32	0.14	0.48	0.65	1.59	0.32	0.04	1.54	1.91	-0.31	3.19	-0.10	-9.75
851	1992	0.32	0.11	0.47	0.79	1.69	0.29	0.04	1.46	1.80	-0.10	3.39	-0.03	-3.05
851	1993	0.37	0.11	0.49	0.71	1.69	0.28	0.04	1.28	1.60	0.08	3.38	0.02	2.50
851	1994	0.39	0.10	0.47	0.43	1.39	0.28	0.05	1.30	1.64	-0.25	2.78	-0.09	-8.89
851	1996	0.30	0.09	0.44	0.57	1.40	0.27	0.05	1.34	1.65	-0.25	2.80	-0.09	-8.92
851	1997	0.32	0.10	0.48	0.60	1.50	0.30	0.06	1.38	1.73	-0.24	2.99	-0.08	-7.86
851	1998	0.33	0.10	0.47	0.65	1.55	0.30	0.01	1.28	1.59	-0.03	3.11	-0.01	-1.08
851	2004	0.34	0.11	0.51	0.65	1.60	0.32	0.06	1.24	1.62	-0.02	3.21	-0.01	-0.54
925	1993	1.35	2.84	0.85	2.81	7.85	1.47	0.01	5.80	7.28	0.57	15.69	0.04	3.62
925	1994	1.30	0.10	0.77	3.74	5.90	0.90	0.00	5.72	6.62	-0.72	11.80	-0.06	-6.11
925	2004	1.29	0.10	0.82	4.00	6.21	1.30	0.01	6.04	7.35	-1.13	12.43	-0.09	-9.12
925	2009	1.30	0.10	0.82	3.83	6.05	1.30	0.01	5.96	7.26	-1.22	12.09	-0.10	-10.07
951	1991	1.55	0.11	0.82	2.78	5.26	0.60	0.02	4.84	5.46	-0.20	10.52	-0.02	-1.87
951	1993	1.57	0.06	0.87	2.72	5.22	0.58	0.01	4.68	5.26	-0.04	10.45	0.00	-0.36
951	1994	1.55	0.06	0.83	2.74	5.18	0.51	0.00	4.74	5.25	-0.07	10.36	-0.01	-0.63
951	1996	1.35	0.06	0.79	2.56	4.76	0.56	0.05	4.78	5.39	-0.62	9.53	-0.07	-6.55
951	1997	1.39	0.06	0.79	2.52	4.77	0.61	0.00	4.58	5.19	-0.42	9.53	-0.04	-4.45
951	1998	1.41	0.07	0.89	2.62	4.99	0.63	0.01	4.58	5.22	-0.23	9.98	-0.02	-2.28
951	2002	1.44	0.07	0.88	2.94	5.33	0.69	0.01	4.86	5.55	-0.22	10.67	-0.02	-2.06
951	2004	1.33	0.07	0.80	3.03	5.23	0.63	0.01	4.56	5.19	0.04	10.46	0.00	0.36
951	2005	0.80	0.14	1.26	3.85	6.05	1.34	0.09	5.12	6.55	-0.50	12.10	-0.04	-4.15
951	2006	0.89	0.15	1.24	3.87	6.15	1.42	0.13	5.02	6.57	-0.42	12.30	-0.03	-3.41
951	2008	1.45	0.08	0.79	2.87	5.18	0.68	0.01	4.86	5.54	-0.36	10.37	-0.03	-3.44
951	2010	1.70	0.08	0.89	2.83	5.49	0.68	0.01	5.48	6.16	-0.67	10.98	-0.06	-6.09
951	2011	1.45	0.08	0.75	2.83	5.10	0.68	0.01	5.06	5.74	-0.64	10.21	-0.06	-6.25
1018	1991	0.60	0.36	0.79	5.00	6.75	1.22	0.04	5.92	7.17	-0.43	13.50	-0.03	-3.15
1018	1992	0.14	0.29	0.83	4.77	6.03	1.17	0.00	5.74	6.91	-0.88	12.06	-0.07	-7.32
1018	1993	0.79	0.27	0.93	4.66	6.65	1.11	0.01	5.68	6.80	-0.16	13.30	-0.01	-1.18
1018	1994	0.97	0.24	0.91	4.57	6.68	0.79	0.00	5.66	6.45	0.23	13.36	0.02	1.72
1018	1996	0.80	0.21	0.95	3.98	5.94	1.05	0.02	5.70	6.77	-0.83	11.89	-0.07	-6.94
1018	1997	0.81	0.21	0.97	3.77	5.76	1.11	0.02	5.50	6.63	-0.87	11.52	-0.08	-7.52
1018	1998	0.85	0.23	1.07	4.44	6.58	1.18	0.01	5.64	6.83	-0.24	13.17	-0.02	-1.82
1018	2004	0.81	0.22	1.00	4.61	6.64	1.16	0.02	5.68	6.86	-0.21	13.29	-0.02	-1.59
1018	2005	0.81	0.22	1.02	4.57	6.62	1.28	0.09	5.48	6.85	-0.23	13.23	-0.02	-1.77
1319	1991	0.70	0.14	0.50	0.96	2.30	0.03	0.02	2.20	2.25	0.06	4.60	0.01	1.20
1319	1993	0.39	0.10	0.69	1.19	2.37	0.28	0.01	2.04	2.33	0.04	4.73	0.01	0.83
1319	1994	0.73	0.09	0.52	0.96	2.29	0.19	0.00	2.08	2.28	0.02	4.58	0.00	0.35
1319	1996	0.72	0.09	0.53	0.95	2.30	0.28	0.01	2.16	2.45	-0.15	4.59	-0.03	-3.31
1319	1997	0.61	0.09	0.52	0.91	2.13	0.26	0.00	2.00	2.26	-0.13	4.26	-0.03	-3.02
1319	1998	0.70	0.09	0.59	1.08	2.45	0.28	0.01	2.04	2.33	0.13	4.91	0.03	2.59
1319	2003	0.69	0.10	0.56	0.99	2.34	0.31	0.01	2.27	2.58	-0.24	4.68	-0.05	-5.15
1319	2004	0.68	0.10	0.57	1.03	2.38	0.27	0.01	2.06	2.33	0.05	4.76	0.01	1.07
1319	2005	0.68	0.10	0.56	1.02	2.36	0.32	0.04	2.08	2.43	-0.07	4.72	-0.02	-1.59
1319	2006	0.69	0.09	0.55	1.00	2.34	0.28	0.01	2.08	2.36	-0.02	4.68	-0.01	-0.53
1319	2008	0.75	0.10	0.55	1.09	2.49	0.27	0.01	2.24	2.51	-0.03	4.97	-0.01	-0.51
1319	2009	0.70	0.09	0.54	1.00	2.34	0.25	0.00	2.06	2.31	0.03	4.67	0.01	0.65
1393	1991	0.01	0.11	0.01	1.48	1.61	0.21	0.07	1.34	1.62	0.00	3.23	0.00	-0.15
1393	1992	0.01	0.06	0.01	1.65	1.73	0.24	0.03	1.32	1.59	0.14	3.45	0.04	4.03
1393	1993	0.12	0.07	0.06	1.40	1.66	0.25	0.05	1.29	1.58	0.08	3.31	0.02	2.34
1393	1994	0.03	0.07	0.01	1.44	1.54	0.11	0.02	1.29	1.42	0.13	3.09	0.04	4.06
1393	1996	0.01	0.06	0.01	1.41	1.49	0.22	0.03	1.37	1.62	-0.12	2.99	-0.04	-4.16
1393	1997	0.00	0.06	0.00	1.52	1.59	0.26	0.03	1.40	1.69	-0.10	3.18	-0.03	-3.21
1393	1998	0.01	0.06	0.01	1.59	1.66	0.29	0.02	1.36	1.67	-0.01	3.32	0.00	-0.23
1393	2004	0.01	0.07	0.01	1.58	1.68	0.28	0.01	1.44	1.73	-0.04	3.36	-0.01	-1.32
1393	2005	0.02	0.08	0.01	1.64	1.75	0.32	0.05	1.48	1.84	-0.09	3.49	-0.03	-2.69
1393	2006	0.02	0.08	0.01	1.77	1.89	0.28	0.04	1.47	1.78	0.10	3.77	0.03	2.69
1393	2007	0.02	0.09	0.01	1.84	1.96	0.30	0.03	1.53	1.86	0.09	3.91	0.02	2.40
1393	2008	0.02	0.07	0.01	1.48	1.58	0.28	0.04	1.32	1.64	-0.06	3.16	-0.02	-1.87
1393	2008	0.25	0.05	0.18	0.96	1.44	0.25	0.04	1.25	1.53	-0.09	2.88	-0.03	-3.23
1520	1991	0.27	0.28	0.40	1.87	2.83	0.75	0.04	1.94	2.73	0.10	5.66	0.02	1.73

Table A3-6: Ion Balance of Bore Samples with Complete Major Ions (milliequivelents)														
Bore No	Collect Date	Ca	K	Mg	Na	Total Cations	Cl	SO4	HCO3	Total anions	Cations-anions	Cations + anions	Difference	%
1520	1992	0.38	0.18	0.47	2.11	3.14	0.69	0.03	2.30	3.01	0.13	6.28	0.02	2.02
1520	1993	0.50	0.20	0.63	2.54	3.87	0.85	0.04	2.94	3.83	0.04	7.73	0.00	0.46
1520	1994	0.40	0.17	0.37	1.78	2.72	0.48	0.05	1.85	2.38	0.35	5.45	0.06	6.34
1520	1996	0.31	0.18	0.40	1.65	2.54	0.70	0.06	1.81	2.57	-0.03	5.08	-0.01	-0.66
1520	1997	0.37	0.19	0.50	1.69	2.75	0.76	0.07	2.06	2.89	-0.14	5.49	-0.03	-2.54
1520	1998	0.56	0.24	0.68	2.82	4.30	0.91	0.04	3.40	4.35	-0.05	8.59	-0.01	-0.59
1520	2004	0.42	0.22	0.56	3.19	4.38	0.90	0.05	3.32	4.27	0.11	8.77	0.01	1.25
1520	2005	0.42	0.20	0.56	3.07	4.25	0.93	0.12	3.16	4.21	0.04	8.50	0.00	0.47
1520	2006	0.54	0.22	0.68	3.44	4.88	0.98	0.05	3.96	4.99	-0.11	9.76	-0.01	-1.12
1520	2007	0.43	0.19	0.59	2.90	4.11	0.84	0.06	2.94	3.83	0.28	8.22	0.03	3.37
1520	2008	0.40	0.19	0.49	2.83	3.91	0.82	0.06	2.74	3.62	0.29	7.83	0.04	3.74
1520	2009	0.60	0.21	0.76	3.22	4.79	0.96	0.05	3.63	4.64	0.15	9.57	0.02	1.58
1520	2010	0.39	0.18	0.53	2.65	3.75	0.85	0.06	2.96	3.87	-0.11	7.51	-0.02	-1.53
1520	2011	0.42	0.16	0.52	2.44	3.53	0.82	0.07	2.78	3.67	-0.14	7.06	-0.02	-1.93
1520	2012	0.42	0.19	0.60	3.09	4.31	0.87	0.06	3.62	4.56	-0.25	8.62	-0.03	-2.91
1561	1991	0.15	0.10	0.13	0.41	0.80	0.21	0.08	0.68	0.97	-0.17	1.60	-0.11	-10.93
1561	1992	0.14	0.07	0.15	0.38	0.75	0.04	0.03	0.70	0.77	-0.02	1.49	-0.01	-1.49
1561	1993	0.10	0.07	0.16	0.39	0.72	0.16	0.02	0.62	0.80	-0.08	1.45	-0.05	-5.23
1561	1994	0.18	0.06	0.15	0.38	0.78	0.10	0.02	0.66	0.78	0.00	1.56	0.00	0.11
1561	1996	0.15	0.06	0.16	0.40	0.77	0.14	0.03	0.63	0.80	-0.04	1.54	-0.02	-2.28
1561	1997	0.15	0.07	0.16	0.42	0.80	0.13	0.03	0.62	0.78	0.02	1.60	0.01	1.05
1561	1998	0.15	0.07	0.17	0.43	0.81	0.14	0.01	0.65	0.81	0.00	1.62	0.00	0.19
1561	2003	0.16	0.07	0.16	0.43	0.82	0.16	0.03	0.65	0.84	-0.01	1.65	-0.01	-0.81
1561	2004	0.16	0.07	0.18	0.47	0.87	0.14	0.03	0.70	0.87	0.01	1.75	0.00	0.43
1561	2005	0.14	0.06	0.16	0.41	0.78	0.15	0.03	0.64	0.81	-0.04	1.55	-0.02	-2.34
1561	2006	0.16	0.07	0.17	0.42	0.81	0.17	0.02	0.66	0.86	-0.05	1.63	-0.03	-2.84
1561	2008	0.17	0.07	0.16	0.43	0.84	0.14	0.03	0.68	0.85	-0.01	1.68	-0.01	-0.70
1561	2009	0.17	0.07	0.17	0.43	0.84	0.13	0.03	0.65	0.81	0.02	1.67	0.01	1.47
1561	2010	0.16	0.07	0.16	0.42	0.81	0.13	0.03	0.68	0.84	-0.03	1.61	-0.02	-1.96
1561	2011	0.16	0.07	0.17	0.42	0.82	0.13	0.03	0.64	0.80	0.02	1.64	0.01	1.22
1561	2012	0.16	0.07	0.18	0.45	0.87	0.14	0.02	0.85	1.01	-0.14	1.74	-0.08	-7.81
1586	1991	0.15	0.11	0.15	0.48	0.89	0.23	0.13	0.56	0.92	-0.03	1.79	-0.02	-1.55
1586	1992	0.15	0.09	0.15	0.55	0.94	0.24	0.02	0.58	0.85	0.10	1.88	0.05	5.14
1586	1993	0.15	0.07	0.15	0.52	0.89	0.24	0.12	0.62	0.98	-0.09	1.78	-0.05	-4.95
1586	1994	0.21	0.09	0.16	0.54	1.01	0.21	0.11	0.70	1.01	-0.01	2.01	0.00	-0.26
1586	1996	0.15	0.09	0.16	0.50	0.90	0.20	0.10	0.62	0.92	-0.02	1.80	-0.01	-0.88
1586	1997	0.16	0.09	0.17	0.54	0.95	0.26	0.13	0.54	0.93	0.02	1.90	0.01	1.00
1586	1998	0.16	0.09	0.18	0.58	1.01	0.28	0.08	0.59	0.95	0.07	2.03	0.03	3.35
1586	2002	0.15	0.09	0.16	0.53	0.93	0.29	0.10	0.59	0.98	-0.05	1.86	-0.03	-2.65
1586	2004	0.23	0.14	0.23	0.84	1.44	0.67	0.10	0.47	1.23	0.21	2.88	0.07	7.22
1586	2005	0.19	0.13	0.18	0.77	1.27	0.48	0.11	0.53	1.13	0.15	2.54	0.06	5.72
1586	2007	0.20	0.13	0.19	0.75	1.26	0.47	0.07	0.51	1.06	0.21	2.53	0.08	8.22
1586	2008	0.20	0.12	0.18	0.74	1.24	0.45	0.08	0.48	1.01	0.22	2.48	0.09	9.07
1605	1991	0.12	0.10	0.11	0.43	0.77	0.28	0.05	0.58	0.91	-0.14	1.54	-0.09	-8.86
1605	1992	0.13	0.02	0.13	0.49	0.77	0.21	0.06	0.58	0.85	-0.08	1.54	-0.05	-5.21
1605	1993	0.14	0.08	0.15	0.62	0.99	0.24	0.04	0.57	0.85	0.13	1.97	0.07	6.83
1605	1994	0.17	0.07	0.13	0.49	0.87	0.21	0.07	0.60	0.88	-0.02	1.73	-0.01	-1.02
1605	1997	0.12	0.07	0.13	0.51	0.84	0.22	0.07	0.56	0.85	-0.01	1.67	-0.01	-0.74
1605	1998	0.12	0.07	0.12	0.49	0.79	0.22	0.04	0.55	0.82	-0.02	1.59	-0.01	-1.37
1605	2004	0.13	0.08	0.14	0.54	0.88	0.24	0.07	0.58	0.88	0.00	1.76	0.00	-0.23
1605	2006	0.14	0.09	0.14	0.55	0.92	0.23	0.07	0.58	0.87	0.05	1.84	0.03	2.67
1686	1991	0.06	0.15	0.10	3.31	3.62	1.57	0.13	1.96	3.66	-0.04	7.24	-0.01	-0.52
1686	1993	0.14	0.20	0.17	3.88	4.41	1.79	0.09	1.85	3.73	0.67	8.81	0.08	7.62
1686	1996	0.06	0.10	0.11	3.01	3.27	1.53	0.09	1.92	3.53	-0.26	6.54	-0.04	-4.01
1686	1997	0.06	0.10	0.11	3.15	3.42	1.59	0.10	1.86	3.55	-0.13	6.85	-0.02	-1.86
1686	2002	0.06	0.10	0.11	3.59	3.86	1.62	0.11	1.88	3.60	0.26	7.72	0.03	3.34
1686	2004	0.06	0.10	0.12	3.24	3.53	1.57	0.11	1.82	3.51	0.02	7.05	0.00	0.31
1686	2005	0.06	0.09	0.11	3.14	3.41	1.59	0.15	1.23	2.97	0.43	6.81	0.06	6.34
1686	2006	0.06	0.09	0.10	3.15	3.41	2.15	0.11	1.84	4.10	-0.70	6.81	-0.10	-10.21
1686	2007	0.06	0.10	0.10	3.09	3.35	1.63	0.11	1.81	3.55	-0.20	6.69	-0.03	-3.05
1686	2008	0.06	0.09	0.10	3.18	3.42	1.38	0.11	1.89	3.38	0.04	6.85	0.01	0.64
1686	2010	0.05	0.08	0.09	2.83	3.05	1.30	0.09	1.90	3.28	-0.23	6.10	-0.04	-3.78
1686	2011	0.05	0.09	0.10	3.13	3.38	1.66	0.10	1.84	3.60	-0.23	6.75	-0.03	-3.37
1686	2012	0.06	0.09	0.10	3.31	3.57	1.58	0.10	2.14	3.82	-0.26	7.13	-0.04	-3.62
1690	1991	0.90	0.23	0.73	2.57	4.42	0.61	0.02	4.18	4.80	-0.38	8.85	-0.04	-4.27
1690	1992	0.87	0.15	0.66	2.76	4.43	0.46	0.01	3.94	4.41	0.02	8.87	0.00	0.26
1690	1993	0.95	0.27	0.75	2.71	4.69	0.53	0.01	3.96	4.50	0.19	9.38	0.02	2.03
1690	1994	1.05	0.15	0.72	2.57	4.48	0.39	0.00	3.98	4.37	0.11	8.97	0.01	1.21
1690	1996	0.84	0.16	0.68	2.34	4.01	0.50	0.02	4.06	4.57	-0.56	8.02	-0.07	-7.02
1690	1997	0.84	0.16	0.67	2.34	4.01	0.52	0.00	3.84	4.36	-0.35	8.01	-0.04	-4.40
1690	1998	0.83	0.16	0.69	2.48	4.16	0.55	0.01	3.80	4.36	-0.20	8.32	-0.02	-2.43
1690	2004	0.85	0.17	0.67	2.68	4.38	0.55	0.01	3.86	4.41	-0.03	8.76	0.00	-0.37
1690	2005	0.80	0.17	0.62	2.48	4.07	0.74	0.02	3.94	4.70	-0.63	8.15	-0.08	-7.67
1690	2007	0.90	0.19	0.67	2.79	4.55	0.57	0.01	3.78	4.35	0.19	9.09	0.02	2.12
1690	2008	0.85	0.19	0.53	2.61	4.18	0.56	0.01	3.78	4.35	-0.17	8.36	-0.02	-1.99
1690	2009	0.85	0.18	0.56	2.57	4.15	0.54	0.01	3.78	4.32	-0.17	8.30	-0.02	-2.07
1690	2010	0.77	0.18	0.53	2.48	3.96	0.55	0.01	3.88	4.44	-0.48	7.92	-0.06	-6.01
1690	2011	0.83	0.17	0.53	2.48	4.02	0.59	0.01	3.88	4.48	-0.46	8.04	-0.06	-5.69
2076	1991	0.47	0.10	0.43	0.57	1.57	0.56	0.25	0.58	1.39	0.18	3.13	0.06	5.66
2076	1992	0.53	0.06	0.42	0.63	1.64	0.47	0.18	0.86	1.51	0.12	3.27	0.04	3.69

Table A3-6: Ion Balance of Bore Samples with Complete Major Ions (milliequivelents)														
Bore No	Collect Date	Ca	K	Mg	Na	Total Cations	Cl	SO4	HCO3	Total anions	Cations-anions	Cations + anions	Difference	%
2076	1993	0.47	0.07	0.39	0.67	1.61	0.50	0.17	0.66	1.34	0.27	3.21	0.08	8.37
2076	1997	0.20	0.09	0.11	0.47	0.88	0.23	0.13	0.50	0.87	0.01	1.75	0.01	0.69
2076	1998	0.19	0.08	0.11	0.47	0.85	0.22	0.12	0.52	0.86	-0.02	1.69	-0.01	-1.06
2076	2004	0.19	0.09	0.12	0.55	0.95	0.26	0.16	0.54	0.96	-0.01	1.91	0.00	-0.28
2076	2006	0.20	0.09	0.12	0.54	0.95	0.26	0.19	0.51	0.95	0.00	1.90	0.00	-0.15
2076	2007	0.21	0.08	0.12	0.55	0.97	0.26	0.19	0.52	0.96	0.01	1.94	0.00	0.46
2076	2008	0.22	0.09	0.12	0.57	0.99	0.25	0.19	0.52	0.97	0.02	1.98	0.01	1.16
2076	2009	0.20	0.08	0.12	0.57	0.96	0.25	0.18	0.49	0.92	0.04	1.93	0.02	2.11
2093	1991	2.10	0.43	0.59	10.13	13.26	11.40	0.52	1.02	12.94	0.32	26.52	0.01	1.22
2093	1996	0.84	0.19	0.17	9.61	10.82	7.31	0.73	2.18	10.22	0.60	21.63	0.03	2.76
2093	1997	0.62	0.16	0.11	8.44	9.33	6.49	1.46	1.52	9.46	-0.14	18.65	-0.01	-0.74
2093	1998	1.57	0.24	0.24	13.88	15.93	14.02	0.67	1.61	16.30	-0.36	31.86	-0.01	-1.14
2303	1991	0.04	0.56	0.04	5.13	5.78	0.34	0.02	5.42	5.78	0.00	11.56	0.00	0.01
2303	1992	0.03	0.40	0.02	6.48	6.94	0.38	0.02	5.06	5.46	1.48	13.87	0.11	10.67
2303	1993	0.04	0.47	0.03	4.77	5.31	0.38	0.01	4.86	5.25	0.06	10.63	0.01	0.61
2303	1994	0.09	0.39	0.03	4.96	5.48	0.37	0.00	5.10	5.47	0.01	10.95	0.00	0.06
2303	1996	0.07	0.25	0.06	3.88	4.26	0.30	0.01	4.36	4.67	-0.41	8.52	-0.05	-4.82
2303	1997	0.05	0.22	0.05	3.44	3.77	0.34	0.00	4.12	4.46	-0.69	7.53	-0.09	-9.19
2303	1998	0.05	0.24	0.05	3.94	4.28	0.34	0.08	4.20	4.62	-0.34	8.56	-0.04	-3.94
2303	2004	0.99	0.23	0.01	1.12	2.35	0.66	0.15	1.54	2.35	0.01	4.70	0.00	0.13
2303	2005	0.05	0.36	0.04	4.70	5.15	0.46	0.02	4.40	4.88	0.27	10.30	0.03	2.64
2303	2006	0.05	0.41	0.03	5.13	5.63	0.39	0.02	5.08	5.48	0.15	11.26	0.01	1.29
2303	2007	0.05	0.34	0.04	4.74	5.17	0.39	0.01	4.88	5.27	-0.10	10.35	-0.01	-0.92
2303	2008	0.07	0.26	0.06	4.31	4.69	0.37	0.01	4.22	4.59	0.10	9.38	0.01	1.05
2303	2009	0.08	0.32	0.05	4.78	5.24	0.56	0.08	4.74	5.38	-0.15	10.48	-0.01	-1.39
2303	2010	0.16	0.23	0.09	3.65	4.13	0.34	0.01	3.90	4.25	-0.12	8.26	-0.01	-1.42
2303	2011	0.09	0.30	0.06	4.57	5.02	0.36	0.01	4.58	4.95	0.08	10.04	0.01	0.76
2303	2012	0.24	0.20	0.11	3.65	4.21	0.38	0.01	4.54	4.93	-0.72	8.41	-0.09	-8.56
2330	1991	0.30	0.19	0.19	0.83	1.51	0.62	0.10	0.90	1.62	-0.11	3.02	-0.04	-3.74
2330	1992	0.25	0.14	0.18	0.97	1.54	0.65	0.02	0.86	1.53	0.02	3.09	0.01	0.51
2330	1993	0.37	0.14	0.19	0.91	1.61	0.69	0.12	0.92	1.73	-0.12	3.22	-0.04	-3.83
2330	1994	0.61	0.14	0.20	0.87	1.81	0.39	0.08	1.06	1.53	0.28	3.62	0.08	7.78
2330	1996	0.28	0.13	0.21	0.83	1.46	0.61	0.10	0.82	1.53	-0.07	2.92	-0.02	-2.49
2330	1997	0.28	0.14	0.21	0.87	1.51	0.67	0.12	0.78	1.56	-0.06	3.01	-0.02	-1.94
2330	1998	0.30	0.14	0.22	0.91	1.57	0.66	0.08	0.78	1.52	0.04	3.14	0.01	1.42
2330	2002	0.29	0.14	0.22	0.95	1.60	0.72	0.11	0.88	1.71	-0.11	3.20	-0.03	-3.44
2330	2004	0.28	0.03	0.13	0.32	0.77	0.30	0.04	0.46	0.79	-0.03	1.53	-0.02	-1.71
2330	2005	1.19	0.19	0.02	0.96	2.35	0.76	0.16	1.65	2.57	-0.21	4.71	-0.05	-4.56
2330	2006	0.30	0.15	0.22	0.92	1.59	0.67	0.10	0.84	1.62	-0.02	3.18	-0.01	-0.78
2330	2007	0.30	0.14	0.22	0.90	1.56	0.70	0.11	0.84	1.65	-0.09	3.12	-0.03	-2.83
2330	2008	0.29	0.14	0.21	0.91	1.55	0.71	0.10	0.87	1.68	-0.12	3.11	-0.04	-4.01
2330	2011	0.28	0.14	0.22	0.91	1.56	0.65	0.11	0.82	1.58	-0.02	3.12	-0.01	-0.80
2342	1991	0.45	0.16	0.49	0.83	1.94	0.54	0.09	1.30	1.93	0.00	3.87	0.00	0.12
2342	1992	0.45	0.10	0.50	0.87	1.92	0.54	0.02	1.22	1.78	0.14	3.85	0.04	3.71
2342	1993	0.37	0.11	0.53	0.92	1.94	0.58	0.10	1.25	1.93	0.01	3.87	0.00	0.25
2342	1994	0.49	0.10	0.49	0.82	1.91	0.59	0.11	1.25	1.95	-0.05	3.81	-0.01	-1.23
2342	1996	0.41	0.10	0.48	0.77	1.76	0.56	0.11	1.25	1.92	-0.15	3.52	-0.04	-4.38
2342	1997	0.44	0.10	0.51	0.85	1.90	0.56	0.10	1.22	1.88	0.02	3.79	0.01	0.55
2342	1998	0.42	0.11	0.48	0.86	1.87	0.58	0.06	1.21	1.86	0.01	3.74	0.00	0.34
2342	2002	0.40	0.10	0.43	0.78	1.71	0.64	0.10	1.22	1.96	-0.24	3.43	-0.07	-7.13
2342	2004	0.41	0.11	0.49	0.84	1.85	0.58	0.10	1.23	1.90	-0.05	3.71	-0.01	-1.40
2342	2005	0.41	0.11	0.48	0.82	1.83	0.62	0.13	1.23	1.97	-0.15	3.65	-0.04	-4.03
2342	2006	0.43	0.11	0.50	0.87	1.91	0.60	0.10	1.23	1.93	-0.02	3.82	-0.01	-0.52
2342	2007	0.44	0.11	0.52	0.87	1.94	0.57	0.10	1.21	1.87	0.07	3.87	0.02	1.77
2342	2008	0.42	0.11	0.46	0.87	1.86	0.59	0.10	1.22	1.91	-0.05	3.72	-0.01	-1.39
2342	2009	0.42	0.10	0.49	0.83	1.84	0.56	0.09	1.22	1.87	-0.03	3.69	-0.01	-0.79
2342	2010	0.38	0.10	0.44	0.80	1.73	0.56	0.10	1.22	1.88	-0.15	3.45	-0.04	-4.44
2342	2011	0.42	0.09	0.46	0.76	1.73	0.56	0.10	1.22	1.88	-0.15	3.46	-0.04	-4.48
2342	2012	0.40	0.10	0.48	0.84	1.83	0.59	0.13	1.45	2.18	-0.35	3.65	-0.10	-9.64
2343	1991	0.22	0.11	0.13	0.57	1.03	0.25	0.04	0.74	1.02	0.01	2.06	0.00	0.31
2343	1992	0.23	0.08	0.13	0.68	1.12	0.29	0.03	0.70	1.02	0.10	2.24	0.05	4.59
2343	1993	0.24	0.07	0.12	0.62	1.06	0.27	0.05	0.90	1.22	-0.16	2.13	-0.07	-7.47
2343	1996	0.22	0.08	0.13	0.51	0.94	0.23	0.04	0.71	0.99	-0.04	1.89	-0.02	-2.37
2343	1997	0.23	0.08	0.14	0.56	1.01	0.28	0.05	0.66	0.98	0.03	2.02	0.01	1.50
2343	1998	0.22	0.08	0.14	0.56	1.01	0.30	0.04	0.67	1.01	-0.01	2.01	0.00	-0.38
2343	2002	0.23	0.08	0.14	0.57	1.02	0.30	0.05	0.70	1.05	-0.03	2.03	-0.02	-1.59
2343	2004	0.23	0.08	0.14	0.59	1.04	0.31	0.06	0.69	1.06	-0.02	2.09	-0.01	-0.79
2343	2006	0.23	0.08	0.13	0.54	0.98	0.30	0.04	0.69	1.03	-0.05	1.95	-0.03	-2.51
2343	2007	0.23	0.08	0.15	0.57	1.03	0.29	0.05	0.70	1.04	-0.01	2.06	-0.01	-0.58
2344	1991	0.14	0.17	0.11	0.48	0.90	0.21	0.10	0.60	0.90	-0.01	1.80	0.00	-0.30
2344	1993	0.14	0.14	0.10	0.44	0.82	0.17	0.04	0.56	0.76	0.05	1.64	0.03	3.34
2344	1994	0.18	0.12	0.12	0.37	0.79	0.11	0.03	0.60	0.74	0.05	1.58	0.03	3.27
2344	1996	0.13	0.11	0.12	0.38	0.75	0.17	0.05	0.56	0.79	-0.04	1.49	-0.03	-2.76
2344	1997	0.14	0.13	0.13	0.42	0.82	0.20	0.06	0.54	0.80	0.02	1.63	0.01	1.04
2344	1998	0.14	0.13	0.13	0.43	0.83	0.20	0.02	0.55	0.77	0.06	1.65	0.03	3.46
2344	2002	0.13	0.13	0.12	0.41	0.79	0.19	0.06	0.56	0.81	-0.02	1.59	-0.01	-1.02
2344	2004	0.13	0.13	0.12	0.40	0.78	0.20	0.05	0.54	0.79	-0.01	1.57	-0.01	-0.52
2344	2005	0.11	0.12	0.11	0.38	0.71	0.20	0.06	0.55	0.81	-0.10	1.43	-0.07	-6.72
2344	2006	0.14	0.13	0.12	0.40	0.79	0.19	0.06	0.66	0.91	-0.12	1.57	-0.08	-7.60
2344	2007	0.13	0.12	0.12	0.39	0.76	0.20	0.06	0.56	0.81	-0.06	1.51	-0.04	-3.76

Table A3-6: Ion Balance of Bore Samples with Complete Major Ions (milliequivelents)														
Bore No	Collect Date	Ca	K	Mg	Na	Total Cations	Cl	SO4	HCO3	Total anions	Cations-anions	Cations + anions	Difference	%
2344	2008	0.13	0.13	0.12	0.40	0.78	0.21	0.06	0.65	0.92	-0.14	1.55	-0.09	-9.11
2344	2009	0.13	0.12	0.12	0.40	0.77	0.17	0.06	0.53	0.76	0.01	1.54	0.00	0.49
2344	2010	0.13	0.13	0.12	0.41	0.79	0.17	0.06	0.48	0.72	0.07	1.58	0.05	4.57
2344	2011	0.13	0.12	0.12	0.40	0.77	0.17	0.06	0.54	0.77	0.00	1.55	0.00	0.10
2344	2012	0.13	0.13	0.12	0.45	0.83	0.18	0.06	0.65	0.88	-0.05	1.67	-0.03	-2.84
2362	1993	0.35	0.13	0.26	1.26	1.99	0.45	0.06	1.55	2.06	-0.06	3.99	-0.02	-1.54
2362	1994	0.43	0.13	0.26	1.22	2.04	0.39	0.07	1.58	2.04	0.00	4.08	0.00	-0.07
2362	1996	0.32	0.13	0.26	1.20	1.90	0.43	0.09	1.59	2.11	-0.20	3.81	-0.05	-5.33
2362	1997	0.34	0.13	0.28	1.27	2.02	0.46	0.07	1.54	2.07	-0.05	4.04	-0.01	-1.24
2362	1998	0.35	0.14	0.29	1.30	2.08	0.47	0.08	1.55	2.11	-0.03	4.16	-0.01	-0.61
2362	2002	0.31	0.13	0.23	1.16	1.83	0.54	0.07	1.54	2.14	-0.32	3.65	-0.09	-8.69
2362	2004	0.33	0.14	0.27	1.37	2.11	0.48	0.06	1.70	2.24	-0.13	4.22	-0.03	-3.10
2362	2005	0.33	0.13	0.27	1.16	1.89	0.61	0.10	1.51	2.22	-0.34	3.77	-0.09	-8.91
2362	2006	0.34	0.13	0.28	1.25	1.99	0.48	0.07	1.52	2.07	-0.07	3.99	-0.02	-1.83
2362	2008	0.34	0.13	0.26	1.26	1.99	0.48	0.08	1.50	2.06	-0.07	3.98	-0.02	-1.73
2362	2009	0.33	0.13	0.27	1.26	1.99	0.45	0.06	1.53	2.05	-0.06	3.99	-0.01	-1.43
2362	2010	0.32	0.13	0.26	1.35	2.07	0.45	0.06	1.44	1.95	0.12	4.13	0.03	2.84
2362	2011	0.33	0.12	0.25	1.17	1.87	0.56	0.08	1.52	2.16	-0.29	3.74	-0.08	-7.83
2362	2012	0.34	0.13	0.29	1.26	2.02	0.46	0.05	1.85	2.36	-0.34	4.04	-0.09	-8.52
2393	1991	0.23	0.19	0.35	1.52	2.30	0.54	0.02	1.70	2.26	0.03	4.59	0.01	0.66
2393	1992	0.06	0.15	0.36	1.30	1.87	0.57	0.00	1.68	2.25	-0.37	3.75	-0.10	-10.00
2393	1993	0.28	0.14	0.39	1.43	2.24	0.54	0.05	1.62	2.21	0.02	4.47	0.01	0.55
2393	1994	0.34	0.13	0.37	1.44	2.27	0.45	0.05	1.64	2.14	0.13	4.54	0.03	2.94
2393	1996	0.26	0.13	0.36	1.34	2.08	0.50	0.06	1.64	2.20	-0.12	4.17	-0.03	-2.79
2393	1997	0.27	0.13	0.38	1.46	2.24	0.65	0.06	1.58	2.29	-0.04	4.49	-0.01	-0.96
2393	1998	0.26	0.13	0.39	1.47	2.26	0.61	0.06	1.60	2.27	-0.01	4.52	0.00	-0.17
2509	1991	0.14	0.09	0.12	0.40	0.76	0.21	0.07	0.56	0.85	-0.09	1.52	-0.06	-5.75
2509	1992	0.14	0.07	0.12	0.47	0.80	0.14	0.04	0.68	0.85	-0.05	1.60	-0.03	-3.25
2509	1993	0.22	0.08	0.14	0.56	1.00	0.18	0.05	0.56	0.79	0.21	1.99	0.11	10.62
2509	1994	0.18	0.07	0.12	0.45	0.82	0.17	0.07	0.55	0.80	0.02	1.64	0.01	1.35
2509	1997	0.13	0.07	0.12	0.49	0.81	0.19	0.07	0.56	0.82	0.00	1.63	0.00	-0.25
2509	1997	0.16	0.08	0.14	0.49	0.87	0.18	0.11	0.57	0.86	0.00	1.74	0.00	0.24
2509	1997	0.14	0.07	0.12	0.50	0.83	0.19	0.07	0.57	0.83	0.00	1.66	0.00	0.21
2509	1998	0.14	0.07	0.12	0.47	0.79	0.19	0.04	0.56	0.79	0.00	1.58	0.00	-0.21
2509	1998	0.14	0.07	0.13	0.49	0.84	0.18	0.06	0.59	0.83	0.01	1.68	0.01	0.62
2509	1998	0.15	0.07	0.14	0.52	0.89	0.19	0.07	0.57	0.84	0.05	1.78	0.03	2.88
2509	1998	0.15	0.07	0.13	0.53	0.88	0.18	0.07	0.59	0.84	0.04	1.77	0.02	2.39
2509	1998	0.15	0.07	0.13	0.53	0.89	0.19	0.07	0.57	0.84	0.05	1.78	0.03	2.83
2509	1999	0.14	0.08	0.13	0.53	0.88	0.19	0.07	0.57	0.83	0.04	1.75	0.03	2.53
2509	1999	0.14	0.08	0.13	0.52	0.88	0.19	0.07	0.57	0.83	0.04	1.75	0.02	2.31
2509	2000	0.14	0.07	0.13	0.51	0.85	0.19	0.07	0.57	0.83	0.02	1.70	0.01	1.09
2509	2000	0.13	0.07	0.12	0.50	0.83	0.19	0.07	0.57	0.83	0.00	1.66	0.00	-0.25
2509	2000	0.14	0.08	0.12	0.50	0.85	0.19	0.07	0.59	0.85	0.00	1.69	0.00	-0.28
2509	2002	0.14	0.07	0.13	0.51	0.85	0.20	0.07	0.56	0.84	0.02	1.71	0.01	1.07
2509	2004	0.13	0.06	0.12	0.52	0.83	0.21	0.07	0.56	0.84	-0.01	1.66	-0.01	-0.64
2509	2006	0.14	0.07	0.12	0.47	0.80	0.20	0.07	0.57	0.83	-0.03	1.61	-0.02	-1.92
2509	2008	0.13	0.07	0.22	0.48	0.90	0.19	0.07	0.57	0.83	0.07	1.81	0.04	4.14
2509	2009	0.13	0.07	0.13	0.54	0.87	0.19	0.07	0.58	0.84	0.03	1.75	0.02	1.84
2509	2010	0.12	0.07	0.11	0.49	0.79	0.18	0.07	0.58	0.82	-0.03	1.58	-0.02	-2.18
2509	2011	0.13	0.07	0.12	0.52	0.84	0.18	0.06	0.56	0.81	0.03	1.68	0.02	1.82
2509	2012	0.13	0.07	0.12	0.51	0.83	0.17	0.07	0.67	0.92	-0.08	1.67	-0.05	-4.84
2707	1991	3.54	0.13	0.82	1.09	5.58	1.25	0.52	2.92	4.69	0.90	11.17	0.08	8.03
2707	1993	3.98	0.10	1.20	1.19	6.47	3.74	0.65	2.44	6.84	-0.37	12.93	-0.03	-2.85
2707	1994	4.29	0.11	1.23	1.30	6.94	2.48	0.69	2.58	5.75	1.19	13.89	0.09	8.60
2707	1996	4.02	0.13	1.07	2.68	7.90	4.54	0.75	2.36	7.65	0.26	15.81	0.02	1.62
2707	1997	3.53	0.14	1.04	3.12	7.83	5.19	1.33	1.88	8.40	-0.57	15.66	-0.04	-3.65
2707	1998	5.34	0.18	1.89	5.00	12.41	8.63	1.44	2.30	12.37	0.04	24.82	0.00	0.18
2707	2002	4.12	0.19	1.70	8.70	14.71	10.46	1.27	2.36	14.10	0.61	29.42	0.02	2.07
2707	2004	6.19	0.26	2.77	10.96	20.18	15.51	1.41	2.93	19.86	0.32	40.36	0.01	0.79
2707	2006	2.54	0.15	1.15	6.74	10.58	6.91	0.99	2.46	10.36	0.22	21.17	0.01	1.05
2707	2007	6.29	0.23	2.70	11.05	20.27	15.57	1.39	2.84	19.80	0.47	40.54	0.01	1.15
2707	2008	4.34	0.22	2.06	10.00	16.63	12.41	1.29	2.98	16.68	-0.06	33.25	0.00	-0.17
2707	2009	1.50	0.16	1.07	3.26	5.99	3.67	0.81	1.19	5.66	0.33	11.98	0.03	2.72
2728	1991	1.90	0.31	0.71	2.78	5.69	1.68	0.19	4.14	6.01	-0.32	11.39	-0.03	-2.78
2728	1992	0.05	0.15	0.02	1.20	1.43	0.64	0.01	0.86	1.51	-0.08	2.85	-0.03	-2.90
2728	1993	1.26	0.29	0.67	3.78	6.00	2.38	0.33	3.54	6.25	-0.25	12.00	-0.02	-2.07
2728	1994	0.45	0.30	0.33	4.83	5.91	2.45	0.54	2.18	5.17	0.74	11.83	0.06	6.24
2728	1996	0.32	0.30	0.24	3.92	4.78	3.24	0.50	1.98	5.72	-0.94	9.56	-0.10	-9.85
2728	1998	0.26	0.28	0.16	3.47	4.16	2.82	0.01	1.68	4.51	-0.35	8.32	-0.04	-4.24
2728	2004	1.46	0.27	0.66	3.27	5.66	1.70	0.20	3.76	5.67	0.00	11.32	0.00	-0.02
2728	2005	1.57	0.24	0.66	2.69	5.16	1.65	0.26	3.98	5.88	-0.73	10.32	-0.07	-7.03
2728	2006	1.68	0.25	0.68	2.84	5.45	1.65	0.20	3.92	5.77	-0.32	10.91	-0.03	-2.91
2728	2007	1.77	0.25	0.75	2.85	5.63	1.39	0.17	4.06	5.62	0.00	11.25	0.00	0.03
2728	2008	0.70	0.28	0.37	3.83	5.18	2.43	0.44	2.50	5.36	-0.18	10.36	-0.02	-1.78
2728	2009	0.22	0.26	0.08	2.65	3.22	2.48	0.10	1.20	3.78	-0.57	6.43	-0.09	-8.80
2822	1991	0.36	0.14	0.64	2.00	3.15	0.64	0.08	2.76	3.49	-0.34	6.30	-0.05	-5.32
2822	1992	0.37	0.09	0.59	2.29	3.35	0.47	0.02	2.78	3.26	0.09	6.71	0.01	1.35
2822	1993	0.42	0.11	0.67	2.14	3.35	0.55	0.01	2.86	3.42	-0.07	6.70	-0.01	-1.02
2822	1994	0.52	0.10	0.63	2.22	3.47	0.51	0.01	3.14	3.66	-0.19	6.95	-0.03	-2.67
2822	1996	0.39	0.11	0.62	2.04	3.16	0.54	0.03	3.14	3.71	-0.55	6.33	-0.09	-8.67

Table A3-6: Ion Balance of Bore Samples with Complete Major Ions (milliequivelents)														
Bore No	Collect Date	Ca	K	Mg	Na	Total Cations	Cl	SO4	HCO3	Total anions	Cations-anions	Cations + anions	Difference	%
2822	1997	0.38	0.10	0.61	2.07	3.16	0.54	0.01	2.92	3.48	-0.31	6.33	-0.05	-4.93
2822	1998	0.38	0.10	0.61	2.02	3.11	0.56	0.01	3.02	3.59	-0.48	6.21	-0.08	-7.76
2822	2002	0.40	0.11	0.66	2.16	3.33	0.62	0.01	2.92	3.54	-0.21	6.67	-0.03	-3.14
2822	2004	0.40	0.11	0.64	2.21	3.35	0.60	0.01	2.90	3.50	-0.15	6.70	-0.02	-2.23
2822	2005	0.41	0.11	0.66	2.18	3.37	0.65	0.04	2.94	3.64	-0.27	6.74	-0.04	-3.98
2822	2006	0.40	0.11	0.63	2.15	3.30	0.66	0.01	3.06	3.74	-0.44	6.59	-0.07	-6.67
2822	2008	0.42	0.11	0.62	2.22	3.37	0.62	0.01	2.94	3.56	-0.20	6.73	-0.03	-2.94
2822	2009	0.42	0.11	0.67	2.26	3.46	0.59	0.01	3.02	3.63	-0.16	6.93	-0.02	-2.35
2822	2010	0.37	0.10	0.58	2.17	3.23	0.62	0.01	2.96	3.58	-0.36	6.46	-0.06	-5.53
2822	2011	0.41	0.10	0.63	2.09	3.23	0.59	0.01	3.12	3.72	-0.50	6.46	-0.08	-7.69
2829	1991	0.01	0.12	0.02	2.17	2.32	0.46	0.07	1.74	2.27	0.05	4.64	0.01	0.98
2829	1992	0.01	0.25	0.02	2.60	2.87	0.51	0.06	1.72	2.29	0.59	5.74	0.10	10.19
2829	1993	0.15	0.09	0.03	2.21	2.48	0.53	0.08	1.70	2.32	0.16	4.97	0.03	3.28
2829	1994	0.02	0.09	0.02	2.04	2.18	0.28	0.05	1.70	2.03	0.15	4.36	0.04	3.51
2829	1996	0.01	0.10	0.03	1.98	2.12	0.46	0.07	1.71	2.24	-0.12	4.24	-0.03	-2.80
2829	1997	0.01	0.09	0.01	1.96	2.07	0.52	0.08	1.66	2.26	-0.19	4.15	-0.05	-4.54
2829	1998	0.01	0.09	0.02	2.07	2.20	0.57	0.10	1.63	2.31	-0.11	4.40	-0.02	-2.42
2829	2004	0.02	0.11	0.04	2.17	2.35	0.58	0.09	1.66	2.33	0.02	4.69	0.00	0.46
2829	2005	0.02	0.09	0.03	2.07	2.21	0.61	0.13	1.67	2.41	-0.21	4.41	-0.05	-4.73
2829	2006	0.01	0.09	0.02	2.21	2.34	0.54	0.09	1.66	2.29	0.05	4.68	0.01	1.13
2829	2007	0.01	0.10	0.03	2.20	2.34	0.56	0.09	1.68	2.33	0.01	4.69	0.00	0.31
2829	2008	0.01	0.10	0.03	2.13	2.27	0.56	0.08	1.70	2.34	-0.07	4.54	-0.02	-1.61
2829	2010	0.01	0.09	0.02	2.31	2.43	0.52	0.07	1.68	2.27	0.16	4.86	0.03	3.28
2829	2011	0.01	0.09	0.03	2.13	2.27	0.54	0.08	1.65	2.27	-0.01	4.53	0.00	-0.15
2829	2012	0.01	0.10	0.03	2.22	2.36	0.54	0.07	2.00	2.61	-0.25	4.72	-0.05	-5.35
2847	1992	1.42	0.26	0.76	2.00	4.43	1.89	0.95	0.98	3.82	0.61	8.86	0.07	6.89
2847	1993	1.43	0.34	0.77	1.48	4.01	1.84	1.91	0.91	4.65	-0.64	8.02	-0.08	-7.97
2847	1994	0.28	0.12	0.12	0.53	1.05	0.28	0.48	0.45	1.21	-0.16	2.10	-0.08	-7.78
2847	1996	1.69	0.36	0.90	1.91	4.85	2.27	2.67	0.67	5.60	-0.75	9.70	-0.08	-7.78
2847	1997	1.64	0.36	0.87	2.07	4.94	2.48	2.17	0.98	5.63	-0.69	9.88	-0.07	-6.98
2847	1998	0.33	0.15	0.20	0.85	1.52	0.37	0.33	1.01	1.71	-0.19	3.05	-0.06	-6.12
2847	2004	0.30	0.14	0.17	0.70	1.32	0.25	0.07	1.16	1.47	-0.15	2.64	-0.06	-5.83
2847	2004	0.45	0.10	0.47	1.10	2.12	0.58	0.10	1.47	2.15	-0.03	4.24	-0.01	-0.65
2847	2006	0.39	0.12	0.21	0.59	1.32	0.19	0.05	1.16	1.41	-0.09	2.63	-0.03	-3.44
2847	2007	0.29	0.10	0.17	0.47	1.03	0.29	0.32	0.51	1.12	-0.09	2.07	-0.04	-4.14
2847	2008	0.30	0.09	0.16	0.43	0.98	0.28	0.48	0.39	1.15	-0.18	1.96	-0.09	-8.93
2847	2009	0.20	0.05	0.09	0.30	0.64	0.18	0.21	0.33	0.72	-0.08	1.28	-0.06	-5.88
2913	1991	0.37	0.07	0.27	0.34	1.05	0.25	0.10	0.82	1.17	-0.12	2.10	-0.06	-5.80
2913	1993	0.26	0.08	0.26	0.34	0.94	0.16	0.07	0.79	1.02	-0.08	1.88	-0.04	-4.19
2913	1994	0.43	0.05	0.28	0.30	1.06	0.13	0.09	0.88	1.10	-0.03	2.13	-0.02	-1.55
2913	1996	0.38	0.06	0.26	0.33	1.02	0.14	0.09	0.79	1.03	0.00	2.04	0.00	-0.18
2913	1997	0.38	0.06	0.28	0.35	1.07	0.17	0.11	0.80	1.08	-0.01	2.15	0.00	-0.38
2913	1998	0.40	0.06	0.27	0.38	1.11	0.19	0.06	0.81	1.06	0.05	2.22	0.02	2.22
2913	2004	0.39	0.06	0.28	0.37	1.10	0.17	0.11	0.78	1.06	0.04	2.19	0.02	1.81
2913	2005	0.41	0.06	0.29	0.43	1.20	0.21	0.14	0.83	1.18	0.02	2.41	0.01	0.89
2913	2006	0.44	0.06	0.30	0.39	1.20	0.19	0.11	0.85	1.15	0.05	2.40	0.02	1.96
3034	1991	0.05	0.18	0.01	2.91	3.16	0.85	0.25	1.92	3.02	0.14	6.31	0.02	2.16
3034	1993	0.08	0.19	0.03	3.13	3.43	0.59	0.42	1.85	2.85	0.58	6.86	0.08	8.40
3034	1994	0.32	0.31	0.12	3.74	4.50	0.59	0.25	3.04	3.88	0.62	9.00	0.07	6.89
3034	1997	0.13	0.16	0.08	1.77	2.14	0.38	0.44	1.00	1.81	0.33	4.29	0.08	7.76
3034	1998	0.15	0.19	0.11	2.07	2.52	0.47	0.65	1.07	2.18	0.34	5.05	0.07	6.73
3034	2004	0.21	0.15	0.17	1.31	1.84	0.55	0.47	0.71	1.74	0.10	3.69	0.03	2.84
3034	2005	0.21	0.16	0.15	1.37	1.89	0.90	0.50	0.56	1.95	-0.06	3.79	-0.02	-1.57
3034	2006	0.26	0.14	0.19	1.10	1.68	0.62	0.64	0.54	1.80	-0.12	3.36	-0.04	-3.63
3034	2008	0.28	0.18	0.18	1.17	1.82	0.68	0.65	0.30	1.62	0.20	3.64	0.05	5.41
3036	1991	0.70	0.09	0.52	0.65	1.96	0.27	0.04	1.82	2.13	-0.17	3.92	-0.04	-4.27
3036	1993	0.70	0.57	0.50	0.54	2.31	0.35	0.02	1.57	1.94	0.36	4.61	0.08	7.87
3036	1994	0.66	0.06	0.47	0.62	1.82	0.26	0.01	1.60	1.86	-0.05	3.63	-0.01	-1.32
3036	1996	0.59	0.06	0.44	0.60	1.69	0.32	0.03	1.60	1.95	-0.26	3.38	-0.08	-7.60
3036	1998	0.48	0.04	0.31	0.47	1.31	0.35	0.06	1.08	1.49	-0.19	2.62	-0.07	-7.15
3036	2003	0.70	0.05	0.57	0.65	1.98	0.36	0.02	1.77	2.16	-0.18	3.95	-0.05	-4.64
3036	2004	0.72	0.06	0.57	0.57	1.92	0.41	0.04	1.54	1.98	-0.06	3.83	-0.02	-1.67
3036	2005	0.64	0.05	0.54	0.71	1.95	0.41	0.07	1.64	2.13	-0.18	3.89	-0.05	-4.61
3036	2006	0.77	0.06	0.62	0.72	2.16	0.34	0.02	1.87	2.23	-0.07	4.31	-0.02	-1.60
3036	2007	0.84	0.06	0.70	0.82	2.43	0.67	0.01	1.93	2.61	-0.19	4.86	-0.04	-3.83
3036	2008	0.80	0.06	0.60	0.74	2.20	0.34	0.01	1.92	2.28	-0.08	4.39	-0.02	-1.78
3036	2009	0.80	0.06	0.64	0.78	2.28	0.31	0.02	1.97	2.30	-0.02	4.56	0.00	-0.38
3036	2010	0.72	0.05	0.58	0.68	2.03	0.32	0.01	1.88	2.20	-0.17	4.06	-0.04	-4.22
3036	2011	0.72	0.05	0.58	0.68	2.04	0.30	0.02	1.88	2.20	-0.16	4.08	-0.04	-3.96
3039	1991	0.49	0.06	0.21	0.24	1.01	0.16	0.08	0.74	0.99	0.02	2.01	0.01	1.02
3039	1994	0.39	0.03	0.17	0.20	0.79	0.11	0.12	0.62	0.85	-0.06	1.59	-0.04	-3.66
3039	1996	0.46	0.03	0.21	0.24	0.94	0.12	0.13	0.69	0.94	0.00	1.89	0.00	0.06
3039	1997	0.51	0.03	0.23	0.27	1.04	0.16	0.16	0.70	1.03	0.01	2.07	0.01	0.50
3039	1998	0.43	0.02	0.19	0.25	0.90	0.14	0.12	0.62	0.88	0.02	1.80	0.01	0.99
3039	2003	0.44	0.03	0.19	0.25	0.92	0.19	0.17	0.73	1.10	-0.18	1.83	-0.10	-9.79
3039	2004	0.53	0.03	0.24	0.30	1.10	0.17	0.20	0.84	1.21	-0.11	2.20	-0.05	-4.99
3039	2005	0.50	0.03	0.23	0.29	1.04	0.19	0.21	0.69	1.09	-0.04	2.09	-0.02	-2.03
3039	2006	0.46	0.03	0.20	0.26	0.96	0.16	0.16	0.62	0.93	0.02	1.91	0.01	1.27
3039	2008	0.46	0.03	0.20	0.26	0.95	0.17	0.14	0.65	0.96	-0.02	1.90	-0.01	-0.80
3039	2009	0.42	0.03	0.19	0.26	0.89	0.13	0.15	0.59	0.87	0.03	1.79	0.01	1.40

Table A3-6: Ion Balance of Bore Samples with Complete Major Ions (milliequivelents)														
Bore No	Collect Date	Ca	K	Mg	Na	Total Cations	Cl	SO4	HCO3	Total anions	Cations-anions	Cations + anions	Difference	%
3044	1991	0.75	0.49	0.60	16.96	18.80	16.64	0.11	4.52	21.27	-2.47	37.60	-0.07	-6.58
3044	1993	0.62	0.38	0.61	10.27	11.88	6.67	0.01	3.02	9.69	2.18	23.75	0.09	9.19
3044	1996	0.42	0.21	0.43	10.22	11.28	8.26	0.01	2.34	10.62	0.66	22.56	0.03	2.95
3044	1997	0.75	0.32	0.62	18.14	19.83	16.50	0.01	4.66	21.17	-1.34	39.66	-0.03	-3.37
3044	1998	0.61	0.26	0.55	13.44	14.86	12.72	0.01	3.80	16.53	-1.67	29.72	-0.06	-5.62
3044	2004	0.54	0.26	0.56	11.31	12.66	9.76	0.03	3.06	12.85	-0.19	25.32	-0.01	-0.74
3044	2005	0.74	0.34	0.60	17.49	19.17	18.42	0.05	4.50	22.97	-3.80	38.34	-0.10	-9.91
3044	2006	0.70	0.30	0.59	19.31	20.90	14.70	0.02	4.10	18.82	2.09	41.80	0.05	4.99
3044	2007	0.77	0.35	0.54	20.84	22.50	18.33	0.01	5.04	23.38	-0.89	44.99	-0.02	-1.97
3044	2008	0.39	0.25	0.30	15.22	16.17	11.28	0.01	3.70	14.99	1.17	32.34	0.04	3.63
3044	2009	1.00	0.45	0.58	31.10	33.13	28.21	0.01	7.60	35.81	-2.68	66.25	-0.04	-4.05
3044	2010	0.99	0.48	0.53	31.32	33.32	29.05	0.01	7.46	36.52	-3.20	66.63	-0.05	-4.80
3044	2011	1.05	0.50	0.61	33.49	35.65	30.46	0.01	7.50	37.97	-2.31	71.30	-0.03	-3.25
3044	2012	1.00	0.47	0.55	33.06	35.08	30.18	0.01	8.94	39.13	-4.05	70.16	-0.06	-5.77
3045	1992	0.12	0.25	0.44	0.91	1.73	0.97	0.00	1.10	2.07	-0.34	3.46	-0.10	-9.96
3045	1993	0.61	0.24	0.44	0.93	2.22	0.79	0.10	1.06	1.95	0.27	4.44	0.06	6.13
3045	1996	0.60	0.21	0.43	0.90	2.15	0.90	0.07	1.18	2.16	-0.01	4.29	0.00	-0.20
3045	1997	0.67	0.24	0.49	0.97	2.37	1.13	0.11	1.14	2.39	-0.02	4.74	0.00	-0.37
3045	1997	0.73	0.25	0.53	0.98	2.49	1.16	0.07	1.20	2.42	0.07	4.98	0.01	1.36
3045	1997	0.71	0.24	0.53	1.00	2.48	1.18	0.13	1.15	2.46	0.03	4.97	0.01	0.51
3045	1998	0.65	0.24	0.51	1.02	2.42	1.16	0.08	1.09	2.34	0.08	4.83	0.02	1.62
3045	1998	0.69	0.25	0.51	1.04	2.49	1.13	0.16	1.08	2.37	0.12	4.98	0.02	2.39
3045	1998	0.70	0.24	0.51	1.09	2.54	1.16	0.18	1.08	2.42	0.12	5.07	0.02	2.31
3045	1998	0.73	0.24	0.51	1.04	2.52	1.10	0.17	1.10	2.37	0.15	5.05	0.03	2.97
3045	1998	0.75	0.24	0.51	1.04	2.54	1.16	0.19	1.13	2.47	0.07	5.09	0.01	1.38
3045	1999	0.65	0.25	0.49	1.09	2.48	1.07	0.18	1.10	2.35	0.12	4.95	0.03	2.51
3045	1999	0.60	0.24	0.48	1.09	2.40	1.04	0.19	1.10	2.33	0.08	4.81	0.02	1.60
3045	2000	0.61	0.24	0.46	1.04	2.36	1.02	0.19	1.10	2.31	0.05	4.71	0.01	1.05
3045	2000	0.57	0.23	0.45	1.00	2.25	0.99	0.20	1.10	2.29	-0.04	4.50	-0.01	-0.78
3045	2000	0.56	0.23	0.40	1.04	2.24	0.93	0.25	1.18	2.36	-0.12	4.48	-0.03	-2.72
3045	2002	0.60	0.24	0.43	0.95	2.21	1.00	0.39	1.10	2.49	-0.28	4.42	-0.06	-6.30
3045	2003	0.62	0.23	0.46	1.00	2.31	0.85	0.36	1.00	2.21	0.10	4.62	0.02	2.16
3045	2004	0.59	0.23	0.44	0.96	2.23	0.89	0.40	1.07	2.36	-0.13	4.46	-0.03	-2.96
3045	2006	0.66	0.22	0.44	0.90	2.22	0.91	0.55	0.97	2.43	-0.21	4.44	-0.05	-4.78
3045	2007	0.72	0.24	0.50	0.96	2.41	0.89	0.59	1.00	2.47	-0.06	4.82	-0.01	-1.24
3045	2008	0.70	0.24	0.53	1.04	2.51	0.87	0.54	1.03	2.44	0.07	5.02	0.01	1.37
3045	2009	0.65	0.22	0.49	1.00	2.36	0.87	0.54	0.98	2.40	-0.03	4.72	-0.01	-0.72
3272	1997	27.25	6.83	50.69	194.00	278.76	276.14	20.72	1.62	298.48	-19.71	557.53	-0.04	-3.54
3272	1998	0.45	0.10	0.04	2.85	3.45	2.78	0.04	0.85	3.68	-0.23	6.90	-0.03	-3.32
3272	2004	27.59	7.39	51.59	217.92	304.50	298.99	22.28	1.95	323.21	-18.71	609.01	-0.03	-3.07
3272	2006	28.89	7.06	55.54	234.89	326.38	287.70	21.24	1.80	310.75	15.64	652.76	0.02	2.40
3272	2008	25.45	6.14	41.97	173.99	247.54	234.11	18.11	1.75	253.98	-6.44	495.09	-0.01	-1.30
3301	1996	0.99	0.10	1.00	1.36	3.45	1.45	0.25	1.64	3.34	0.12	6.91	0.02	1.70
3301	1997	1.00	0.09	1.05	1.30	3.44	1.53	0.26	1.54	3.33	0.12	6.89	0.02	1.67
3301	1997	1.06	0.10	1.07	1.39	3.63	1.69	0.30	1.66	3.66	-0.03	7.26	0.00	-0.36
3301	1997	0.97	0.09	1.05	1.37	3.48	1.33	0.24	1.60	3.16	0.33	6.97	0.05	4.69
3301	1998	0.90	0.09	0.93	1.24	3.16	1.27	0.21	1.64	3.12	0.04	6.32	0.01	0.62
3301	1998	0.96	0.10	1.01	1.35	3.43	1.21	0.24	1.66	3.10	0.32	6.85	0.05	4.71
3301	1998	1.03	0.10	1.05	1.44	3.61	1.33	0.25	1.64	3.22	0.39	7.21	0.05	5.40
3301	1998	0.96	0.09	1.01	1.44	3.51	1.33	0.25	1.62	3.20	0.31	7.01	0.04	4.38
3301	1998	0.97	0.09	0.95	1.39	3.41	1.18	0.28	1.64	3.10	0.30	6.82	0.04	4.47
3301	1999	0.91	0.09	0.91	1.44	3.35	1.13	0.27	1.69	3.08	0.27	6.70	0.04	3.97
3301	1999	0.90	0.10	0.89	1.44	3.32	1.13	0.29	1.66	3.07	0.25	6.64	0.04	3.78
3301	1999	0.90	0.10	0.90	1.39	3.29	1.13	0.26	1.64	3.03	0.26	6.57	0.04	3.98
3301	2000	0.85	0.09	0.82	1.35	3.11	1.04	0.22	1.61	2.87	0.24	6.22	0.04	3.84
3301	2000	0.75	0.08	0.76	1.30	2.89	1.07	0.21	1.54	2.82	0.07	5.78	0.01	1.24
3301	2000	0.81	0.09	0.73	1.30	2.94	1.10	0.20	1.56	2.86	0.08	5.89	0.01	1.42
3301	2002	0.65	0.09	0.66	1.14	2.54	1.07	0.19	1.48	2.74	-0.20	5.08	-0.04	-3.85
3301	2003	0.71	0.09	0.71	1.13	2.64	0.90	0.17	1.46	2.53	0.11	5.27	0.02	2.02
3301	2004	0.69	0.08	0.71	1.19	2.68	0.98	0.17	1.46	2.61	0.06	5.35	0.01	1.17
3301	2006	0.66	0.08	0.62	1.07	2.43	0.90	0.14	1.42	2.46	-0.03	4.87	-0.01	-0.58
3301	2007	0.68	0.07	0.64	1.07	2.47	0.89	0.13	1.41	2.43	0.04	4.94	0.01	0.77
3301	2008	0.70	0.08	0.69	1.13	2.60	0.87	0.13	1.44	2.45	0.15	5.20	0.03	2.86
3301	2009	0.65	0.08	0.67	1.13	2.52	0.79	0.13	1.48	2.40	0.12	5.04	0.02	2.44
3301	2010	0.61	0.08	0.57	1.09	2.35	0.90	0.13	1.40	2.43	-0.09	4.69	-0.02	-1.87
3470	1997	0.11	0.05	0.13	0.52	0.82	0.10	0.00	0.82	0.93	-0.11	1.63	-0.07	-6.76
3470	2003	0.11	0.05	0.13	0.54	0.83	0.13	0.01	0.86	0.99	-0.16	1.66	-0.10	-9.73
3470	2003	0.11	0.07	0.11	0.32	0.61	0.15	0.03	0.43	0.61	0.00	1.23	0.00	-0.02
3470	2004	0.12	0.05	0.14	0.52	0.83	0.11	0.01	0.80	0.92	-0.08	1.66	-0.05	-5.04
3470	2005	0.09	0.05	0.10	0.59	0.83	0.12	0.01	0.81	0.94	-0.11	1.65	-0.07	-6.53
3470	2006	0.12	0.04	0.11	0.66	0.93	0.14	0.01	0.96	1.10	-0.17	1.86	-0.09	-9.38
3470	2008	0.11	0.05	0.12	0.57	0.85	0.13	0.01	0.84	0.98	-0.12	1.70	-0.07	-7.30
3470	2009	0.12	0.05	0.12	0.57	0.85	0.10	0.01	0.91	1.02	-0.16	1.71	-0.10	-9.58
3470	2010	0.08	0.05	0.09	0.57	0.79	0.11	0.01	0.82	0.94	-0.15	1.58	-0.09	-9.38
3566	2004	0.19	0.01	0.13	0.68	1.01	0.24	0.04	0.77	1.04	-0.03	2.01	-0.02	-1.69
3566	2005	0.20	0.01	0.12	0.67	1.01	0.22	0.03	0.75	1.00	0.01	2.01	0.00	0.41
3566	2006	0.19	0.01	0.12	0.65	0.98	0.24	0.04	0.75	1.02	-0.05	1.95	-0.02	-2.50
3566	2007	0.27	0.12	0.20	0.69	1.28	0.39	0.11	0.65	1.15	0.13	2.55	0.05	4.97
3566	2008	0.19	0.01	0.12	0.65	0.97	0.22	0.04	0.84	1.11	-0.14	1.95	-0.07	-6.95

Table A3-6: Ion Balance of Bore Samples with Complete Major Ions (milliequivelents)														
Bore No	Collect Date	Ca	K	Mg	Na	Total Cations	Cl	SO4	HCO3	Total anions	Cations-anions	Cations + anions	Difference	%
3566	2009	0.19	0.01	0.12	0.65	0.97	0.22	0.03	0.73	0.98	-0.01	1.94	-0.01	-0.60
3566	2010	0.18	0.01	0.11	0.64	0.93	0.22	0.03	0.74	0.99	-0.05	1.87	-0.03	-2.85
3566	2011	0.17	0.01	0.10	0.62	0.91	0.23	0.04	0.70	0.97	-0.06	1.82	-0.03	-3.13
3566	2012	0.18	0.01	0.12	0.65	0.97	0.25	0.02	0.86	1.13	-0.16	1.93	-0.08	-8.46
4000	1991	0.32	0.17	0.16	0.43	1.08	0.43	0.04	0.50	0.97	0.12	2.17	0.05	5.40
4000	1992	0.08	0.16	0.19	0.48	0.90	0.26	0.19	0.46	0.90	0.00	1.80	0.00	-0.10
4000	1996	0.38	0.13	0.19	0.45	1.15	0.27	0.20	0.51	0.99	0.16	2.29	0.07	7.06
4000	1997	0.36	0.13	0.18	0.43	1.11	0.28	0.21	0.46	0.95	0.16	2.21	0.07	7.01
4000	1998	0.39	0.15	0.20	0.49	1.24	0.32	0.15	0.51	0.98	0.25	2.47	0.10	10.18
4001	1996	0.71	0.50	0.64	10.22	12.07	8.15	0.81	3.14	12.10	-0.03	24.15	0.00	-0.13
4001	1997	0.72	0.52	0.65	9.83	11.72	9.08	0.84	3.06	12.98	-1.26	23.44	-0.05	-5.38
4001	2003	0.71	0.54	0.64	10.79	12.68	10.61	1.00	3.08	14.68	-2.00	25.37	-0.08	-7.87
4001	2004	0.74	0.57	0.72	11.27	13.29	9.11	0.85	3.22	13.18	0.12	26.58	0.00	0.44
4001	2006	0.76	0.54	0.77	10.44	12.51	8.72	0.84	2.98	12.54	-0.03	25.01	0.00	-0.12
4001	2009	0.70	0.49	0.65	9.57	11.40	8.74	0.90	2.94	12.58	-1.18	22.81	-0.05	-5.16
4002	1991	2.20	0.24	1.07	4.31	7.81	5.32	0.52	2.08	7.92	-0.11	15.62	-0.01	-0.69
4002	1993	6.10	7.70	1.88	1.62	17.30	16.16	1.37	2.64	20.16	-2.87	34.59	-0.08	-8.30
4002	1996	0.88	0.10	0.49	2.46	3.94	2.14	0.22	1.91	4.27	-0.33	7.88	-0.04	-4.22
4002	1997	2.35	0.21	1.08	4.61	8.25	5.98	0.65	2.00	8.63	-0.38	16.49	-0.02	-2.32
4002	1998	2.43	0.20	1.19	5.00	8.82	6.54	0.69	2.12	9.35	-0.53	17.63	-0.03	-3.02
4002	2004	1.05	0.12	0.50	3.55	5.22	3.67	0.01	0.94	4.61	0.61	10.44	0.06	5.81
4002	2005	0.25	0.07	0.08	2.45	2.85	2.99	0.02	0.17	3.18	-0.33	5.70	-0.06	-5.74
4002	2006	2.24	0.19	1.09	4.87	8.38	6.04	0.65	1.94	8.63	-0.24	16.77	-0.01	-1.44
4002	2007	2.90	0.23	1.46	6.00	10.58	7.05	0.87	2.20	10.12	0.47	21.17	0.02	2.21
4002	2008	3.69	0.31	1.48	7.83	13.31	10.44	1.00	2.48	13.92	-0.60	26.62	-0.02	-2.27
4002	2009	1.95	0.19	0.91	4.78	7.82	4.80	0.48	2.19	7.46	0.36	15.65	0.02	2.31
4003	2003	0.30	0.11	0.19	0.43	1.02	0.15	0.26	0.48	0.88	0.13	2.04	0.07	6.59
4003	2004	0.27	0.11	0.18	0.42	0.98	0.12	0.23	0.50	0.85	0.13	1.95	0.06	6.43
4003	2006	0.27	0.11	0.16	0.41	0.94	0.10	0.21	0.53	0.84	0.11	1.89	0.06	5.66
4003	2008	0.27	0.11	0.18	0.42	0.98	0.10	0.23	0.53	0.86	0.12	1.96	0.06	5.99
4007	1996	0.14	0.03	0.14	0.40	0.72	0.14	0.03	0.54	0.71	0.01	1.43	0.00	0.50
4007	1997	0.16	0.04	0.16	0.44	0.80	0.14	0.03	0.52	0.69	0.11	1.60	0.07	6.93
4007	1997	0.18	0.05	0.16	0.41	0.80	0.14	0.03	0.51	0.68	0.11	1.59	0.07	7.18
4007	1997	0.15	0.04	0.16	0.43	0.78	0.15	0.03	0.51	0.68	0.09	1.55	0.06	5.92
4007	1998	0.17	0.05	0.16	0.42	0.79	0.19	0.01	0.49	0.69	0.10	1.59	0.06	6.48
4007	1998	0.18	0.05	0.16	0.43	0.82	0.15	0.03	0.51	0.69	0.13	1.64	0.08	8.04
4007	1998	0.18	0.04	0.17	0.46	0.85	0.17	0.02	0.51	0.71	0.15	1.71	0.09	8.65
4007	1998	0.16	0.04	0.16	0.45	0.81	0.17	0.03	0.51	0.71	0.10	1.62	0.06	6.04
4007	1998	0.17	0.04	0.16	0.45	0.82	0.15	0.03	0.52	0.70	0.11	1.63	0.07	7.00
4007	1999	0.16	0.04	0.16	0.45	0.81	0.14	0.03	0.52	0.69	0.12	1.62	0.07	7.22
4007	1999	0.16	0.05	0.16	0.44	0.81	0.14	0.03	0.51	0.68	0.13	1.62	0.08	7.92
4007	1999	0.16	0.05	0.16	0.44	0.81	0.15	0.03	0.51	0.68	0.13	1.62	0.08	7.83
4007	2000	0.16	0.04	0.16	0.43	0.79	0.15	0.03	0.51	0.69	0.10	1.58	0.07	6.59
4007	2000	0.15	0.04	0.15	0.43	0.77	0.15	0.03	0.52	0.70	0.07	1.55	0.05	4.52
4007	2000	0.14	0.04	0.15	0.43	0.77	0.15	0.03	0.52	0.71	0.06	1.53	0.04	4.03
4007	2002	0.15	0.05	0.15	0.42	0.78	0.17	0.03	0.52	0.72	0.06	1.55	0.04	3.55
4007	2004	0.15	0.04	0.16	0.47	0.81	0.16	0.02	0.56	0.74	0.07	1.62	0.04	4.23
4007	2006	0.17	0.05	0.16	0.43	0.81	0.16	0.03	0.52	0.72	0.09	1.61	0.06	5.67
4007	2008	0.16	0.04	0.15	0.43	0.79	0.15	0.03	0.63	0.82	-0.03	1.58	-0.02	-1.60
4007	2009	0.16	0.04	0.16	0.43	0.79	0.15	0.03	0.54	0.73	0.07	1.59	0.04	4.37
4007	2010	0.15	0.04	0.14	0.42	0.76	0.14	0.03	0.54	0.71	0.04	1.51	0.03	2.77
4007	2011	0.15	0.04	0.14	0.44	0.78	0.14	0.03	0.54	0.72	0.06	1.56	0.04	4.08
4007	2012	0.15	0.04	0.15	0.43	0.77	0.12	0.03	0.69	0.83	-0.06	1.54	-0.04	-4.21
4364	1996	0.43	0.16	0.51	6.05	7.15	4.54	0.01	2.28	6.83	0.32	14.29	0.02	2.21
4364	1997	0.46	0.17	0.57	6.48	7.67	5.61	0.00	2.18	7.80	-0.13	15.34	-0.01	-0.83
4364	1997	0.48	0.18	0.61	6.39	7.66	5.58	0.01	2.23	7.82	-0.16	15.32	-0.01	-1.05
4364	1998	0.49	0.16	0.56	5.79	6.99	5.70	0.01	2.18	7.89	-0.89	13.99	-0.06	-6.39
4364	1998	0.52	0.19	0.63	6.96	8.30	5.50	0.01	2.20	7.70	0.60	16.60	0.04	3.59
4364	1998	0.51	0.17	0.62	6.79	8.09	5.87	0.01	2.20	8.07	0.02	16.18	0.00	0.14
4364	1998	0.51	0.18	0.61	6.92	8.22	5.61	0.01	2.23	7.85	0.37	16.43	0.02	2.24
4364	1998	0.53	0.18	0.62	6.92	8.24	5.64	0.01	2.23	7.88	0.37	16.48	0.02	2.22
4364	1999	0.51	0.17	0.63	6.92	8.22	5.50	0.01	2.23	7.73	0.49	16.45	0.03	2.98
4364	1999	0.48	0.18	0.59	7.05	8.30	5.75	0.00	2.25	8.00	0.30	16.60	0.02	1.80
4364	1999	0.48	0.18	0.58	6.79	8.03	5.53	0.01	2.23	7.76	0.27	16.07	0.02	1.68
4364	2000	0.48	0.18	0.60	6.44	7.69	5.42	0.00	2.20	7.62	0.08	15.39	0.01	0.50
4364	2000	0.46	0.16	0.56	6.92	8.10	5.78	0.00	2.25	8.03	0.07	16.21	0.00	0.45
4364	2000	0.44	0.18	0.57	6.61	7.80	5.56	0.00	2.28	7.84	-0.04	15.60	0.00	-0.26
4364	2003	0.47	0.19	0.56	6.22	7.45	5.53	0.00	2.20	7.73	-0.29	14.89	-0.02	-1.92
4364	2004	0.47	0.18	0.57	6.66	7.88	5.70	0.01	2.22	7.92	-0.04	15.75	0.00	-0.29
4364	2006	0.47	0.17	0.55	6.13	7.32	5.56	0.01	2.10	7.66	-0.34	14.65	-0.02	-2.30
4364	2007	0.48	0.17	0.59	6.13	7.38	5.25	0.01	1.96	7.21	0.17	14.75	0.01	1.14
4364	2008	0.50	0.17	0.61	6.52	7.80	5.36	0.01	2.16	7.52	0.28	15.61	0.02	1.79
4364	2009	0.47	0.17	0.58	6.09	7.30	5.08	0.01	2.20	7.28	0.02	14.60	0.00	0.13
4364	2010	0.45	0.17	0.53	5.92	7.06	5.16	0.02	2.18	7.36	-0.30	14.12	-0.02	-2.11
4364	2011	0.46	0.16	0.55	5.92	7.09	5.19	0.01	2.16	7.35	-0.26	14.18	-0.02	-1.85
4364	2012	0.49	0.17	0.57	5.57	6.79	4.68	0.01	2.40	7.09	-0.30	13.59	-0.02	-2.19
4582	1997	0.41	0.09	0.43	1.04	1.97	0.53	0.08	1.48	2.09	-0.12	3.94	-0.03	-3.03
4582	1998	0.42	0.10	0.40	1.02	1.95	0.63	0.04	1.26	1.93	0.02	3.90	0.01	0.57
4582	2005	0.39	0.11	0.40	0.99	1.90	0.78	0.14	1.20	2.12	-0.22	3.79	-0.06	-5.83
4582	2006	0.42	0.11	0.41	1.02	1.96	0.66	0.07	1.28	2.01	-0.04	3.92	-0.01	-1.11

Table A3-6: Ion Balance of Bore Samples with Complete Major Ions (milliequivelents)														
Bore No	Collect Date	Ca	K	Mg	Na	Total Cations	Cl	SO4	HCO3	Total anions	Cations-anions	Cations + anions	Difference	%
4582	2008	0.42	0.10	0.38	1.00	1.91	0.59	0.05	1.46	2.10	-0.19	3.82	-0.05	-5.03
4968	2002	0.20	0.01	0.12	0.66	0.99	0.23	0.03	0.88	1.15	-0.16	1.97	-0.08	-8.12
4968	2007	0.21	0.01	0.13	0.68	1.03	0.28	0.04	0.72	1.04	-0.01	2.06	-0.01	-0.65
4968	2008	0.29	0.13	0.20	0.70	1.31	0.39	0.14	0.53	1.07	0.24	2.62	0.09	9.09
4968	2012	0.26	0.12	0.21	0.72	1.31	0.32	0.23	0.48	1.02	0.29	2.62	0.11	10.93
2118	1997	0.31	0.07	0.19	0.49	1.06	0.14	0.20	0.58	0.91	0.15	2.12	0.07	6.96
2118	1998	0.32	0.07	0.19	0.50	1.08	0.14	0.15	0.60	0.89	0.19	2.16	0.09	8.91
2118	2003	0.31	0.07	0.18	0.49	1.07	0.21	0.26	0.54	1.00	0.06	2.13	0.03	2.96
2118	2004	0.32	0.08	0.20	0.50	1.09	0.18	0.23	0.56	0.96	0.13	2.19	0.06	5.90
2118	2005	0.30	0.07	0.18	0.51	1.07	0.19	0.26	0.56	1.01	0.06	2.14	0.03	2.66
2118	2006	0.36	0.08	0.21	0.52	1.17	0.20	0.21	0.57	0.98	0.20	2.35	0.08	8.35
2118	2009	0.41	0.08	0.24	0.52	1.26	0.25	0.21	0.54	0.99	0.27	2.52	0.11	10.60
SP198	1997	0.18	0.09	0.12	0.49	0.88	0.25	0.17	0.46	0.88	0.00	1.76	0.00	-0.03
SP198	1998	0.17	0.08	0.11	0.48	0.84	0.23	0.15	0.46	0.84	0.00	1.68	0.00	0.16
SP198	2002	0.17	0.09	0.12	0.50	0.88	0.26	0.19	0.51	0.96	-0.08	1.76	-0.04	-4.44
SP198	2004	0.18	0.09	0.13	0.52	0.91	0.25	0.17	0.52	0.94	-0.02	1.83	-0.01	-1.29
SP198	2005	0.18	0.09	0.13	0.51	0.90	0.26	0.20	0.49	0.95	-0.05	1.80	-0.03	-3.02
SP198	2006	0.19	0.09	0.13	0.50	0.91	0.25	0.16	0.48	0.90	0.00	1.81	0.00	0.20
SP198	2007	0.19	0.09	0.13	0.54	0.95	0.26	0.17	0.50	0.93	0.02	1.90	0.01	1.27
SP198	2008	0.19	0.09	0.12	0.57	0.97	0.24	0.18	0.54	0.96	0.00	1.94	0.00	0.17
SP198	2009	0.18	0.08	0.12	0.48	0.87	0.24	0.17	0.48	0.89	-0.02	1.74	-0.01	-0.99
SP198	2010	0.17	0.08	0.11	0.50	0.87	0.24	0.20	0.50	0.94	-0.07	1.75	-0.04	-3.88
SP198	2012	0.18	0.09	0.13	0.52	0.93	0.25	0.15	0.60	1.00	-0.08	1.85	-0.04	-4.09
49	1991	5.24	0.28	1.32	4.05	10.88	1.10	0.02	10.24	11.36	-0.48	21.77	-0.02	-2.18
49	1994	4.54	0.21	0.85	3.87	9.47	0.87	0.00	8.98	9.85	-0.39	18.93	-0.02	-2.05
2591	1991	0.65	0.26	0.91	1.35	3.16	0.53	0.08	2.58	3.19	-0.03	6.32	-0.01	-0.51
2591	1992	0.36	0.08	0.77	1.39	2.60	0.37	0.05	2.68	3.10	-0.51	5.19	-0.10	-9.75
2591	1993	0.57	0.11	0.88	1.53	3.09	0.42	0.08	2.52	3.02	0.07	6.18	0.01	1.10
66	1991	0.14	0.14	0.09	1.39	1.76	0.41	0.04	1.40	1.86	-0.10	3.52	-0.03	-2.72
66	1992	0.14	0.10	0.09	1.85	2.19	0.42	0.04	1.28	1.73	0.45	4.37	0.10	10.33
66	1993	0.12	0.11	0.06	2.80	3.09	1.15	0.07	1.97	3.18	-0.09	6.18	-0.01	-1.38
66	1994	0.26	0.16	0.09	3.13	3.65	0.99	0.08	2.24	3.31	0.34	7.29	0.05	4.65
66	1996	0.44	0.68	0.14	12.61	13.86	4.63	0.02	8.38	13.03	0.84	27.73	0.03	3.02
94	1991	0.29	0.08	0.42	1.39	2.19	0.39	0.06	1.66	2.12	0.07	4.38	0.02	1.68
94	1993	0.21	0.08	0.40	1.30	2.00	0.46	0.05	1.59	2.10	-0.09	4.00	-0.02	-2.35
94	1994	0.31	0.06	0.19	1.57	2.13	0.62	0.07	1.45	2.14	-0.01	4.25	0.00	-0.30
51	1992	0.41	0.10	0.35	1.16	2.02	0.47	0.25	1.34	2.07	-0.04	4.05	-0.01	-1.07
51	1993	0.45	0.09	0.39	0.96	1.89	0.45	0.06	1.33	1.84	0.05	3.79	0.01	1.33
51	1994	0.49	0.09	0.38	0.96	1.92	0.51	0.08	1.35	1.94	-0.02	3.84	0.00	-0.44
51	1996	0.41	0.09	0.38	0.94	1.81	0.48	0.09	1.34	1.91	-0.10	3.62	-0.03	-2.67

Table A3-7: Maximum Values - Health Related (DWSNZ - Maximum Acceptable Value) (g/m^3)

Map Area	Bore No	Sample size	As	B	Cd	Hg	Pb	Sb	Ba	Cr	Cu	F	Mn	U	Mo	NO2	NO3	ENT cfu/100mL	FC cfu/100mL
DWSNZ			0.01	1.40	0.004	0.007	0.01	0.02	0.7	0.05	2	1.5	0.4	0.02	0.07	3	11.3	1 in 100ml	1 in 100ml
Map 3 WBOP																			
	66	6	0.0328	1.56	0.00002	0.00007	0.00072			0.0001	0.0006	0.67	0.03				0.045		
	68	13	0.003	0.02	0.00016	0.00009	0.0002	0.0001	0.0366	0.006	0.0003	0.35	0.0005	0.00008	0.0004	0.001	0.179		
	94	6	0.0042	0.01	0.000005	0.00001	0.00014				0.00076	0.35	0.0084				0.693		
	851	10	0.0005	0.01	0.000025	0.0021	0.0001			0.00025	0.0004	0.35	0.16		0.0002	0.002	0.001		
	1393	15	0.013	0.08	0.000071	0.00009	0.0006	0.0004	0.0486	0.0017	0.0016	0.46	0.0079	0.00009	0.0023	0.001	0.053		
	1686	16	0.02	0.62	0.0028	0.0003	0.0023	0.0001	0.13	0.00025	0.059	0.74	0.083	0.00012	0.0104	0.001	0.004		
	2303	18	0.074	0.16	0.0005	0.00092	0.0003	0.0001	0.049	0.0005	0.0017	0.72	0.093	0.000076	0.0009	0.004	0.011		
	2330	16	0.003	0.03	0.000025	0.00004	0.0031	0.0001	0.098	0.0031	0.0021	0.11	0.027	0.00003	0.0001	0.001	0.086		
	2343	13	0.0006	0.04	0.0012	0.00004	0.00038	0.0001	0.0721	0.00025	0.0111	0.35	0.004	0.00001	0.0001	0.009	0.11		
	2829	17	0.016	0.16	0.00006	0.0011	0.0011	0.0002	0.0572	0.00052	0.001	0.35	0.023	0.00012	0.0024	0.001	0.457		
Map 4 Tauranga																			
	2093	7	0.024	0.09	0.0013	0.00074	0.0018	0.0035	0.027	0.00025	0.0035	0.79	0.0375	0.00001	0.0013	0.003	3.14	5	3
	2342	18	0.001	0.03	0.000081	0.00013	0.0008	0.0001	0.0457	0.0006	0.012	0.35	0.0072	0.00008	0.0001	0.001	0.266		
	2344	18	0.0005	0.02	0.00005	0.00004	0.00065	0.0001	0.057	0.00025	0.0007	0.35	0.04	0.00001	0.0001	0.001	0.25		
	2362	17	0.005	0.09	0.000025	0.00004	0.0002	0.0001	0.0623	0.00025	0.0006	0.35	0.66	0.00001	0.0007	0.001	0.208		
	2393	8	0.004	0.15	0.00002	0.00001	0.0005			0.0001	0.0005	0.35	0.005		0.0015	0.001	0.2		
	2707	17	0.002	0.06	0.0021	0.00017	0.0008	0.0001	0.082	0.00025	0.0006	0.35	0.0955	0.00015	0.00022	0.015	9.9	11	0.5
	2728	15	0.018	0.13	0.0016	0.00004	0.0006	0.0001	0.36	0.00025	0.00025	0.23	0.538	0.00001	0.0018	0.001	0.02		
	2847	16	0.0071	0.08	0.0002	0.00025	0.00068	0.0001	0.0528	0.0009	0.0008	0.35	0.29	0.00008	0.0001	0.021	1.34	10	39
	3044	24	0.074	30.00	0.000125	0.00053	0.005	0.0005	0.18	0.00125	0.0025	3	0.54	0.00005	0.0099	0.001	0.155		
	3272	6	0.005	0.92	0.00008	0.00004	0.0006	0.001	0.114	0.0025	0.005	0.09	10.8	0.0001	0.0027	0.009	1.02		
	4364	34	0.033	13.80	0.000025		0.00025	0.000175	0.143	0.0015	0.0015	0.54	0.57	0.00001	0.004	0.001	0.07		
	4582	6	0.001	0.02	0.00008		0.0003	0.0001	0.102	0.00025	0.00025	0.13	0.0276	0.000056	0.0002	0.001	0.123		
Map 5 Te Puke																			
	410	13	0.004	0.08	0.00039	0.00004	0.0023	0.0001	0.287	0.00025	0.0029	0.33	6.17	0.00051	0.0012	0.002	0.09		
	643	11	0.039	0.16	0.00007	0.00021	0.0006			0.00025	0.14	0.41	15.4		0.0012	0.001	0.96	27	91
	951	16	0.012	0.80	0.000025	0.00014	0.00005	0.0001	0.0884	0.00025	0.00025	0.35	2.01	0.00001	0.0012	0.011	0.034		
	1018	11	0.0006	0.58	0.000025	0.00039	0.0004	0	0	0.0005	0.00096	0.41	0.295		0.0007	0.001	6.848		
	1520	17	0.003	0.27	0.000025	0.00013	0.0004	0.0001	0.241	0.00025	0.0012	0.35	0.0048	0.00088	0.00043	0.001	2.38		
	1586	14	0.0012	0.05	0.00007	0.00009	0.0002	0.0001	0.079	0.0011	0.001	0.35	0.247	0.00001	0.0006	0.001	0.458	0.5	33
	1690	17	0.002	0.24	0.0005	0.00014	0.0012	0.0001	0.0496	0.0005	0.0127	0.37	0.727	0.00001	0.0009	0.001	0.448		
	2591	13										0.35					0.0005		
	2822	17	0.0063	0.34	0.000025	0.0035	0.0001	0.0001	0.205	0.00025	0.0031	0.44	1.1	0.00004	0.0003	0.008	0.245		
	3034	18	0.00054	0.21	0.00014	0.0003	0.00022	0.0001	0.14	0.00025	0.0021	3.5	0.325	0.00001	0.0005	0.001	7.81	100	3
	3045	43	0.0025	0.02	0.000025	0.00016	0.0007	0.000175	0.144	0.0015	0.011	0.35	0.12	0.000049	0.0001	0.001	3.65	46	174
	3566	12	0.005	0.06	0.000083	0.00005	0.0001	0.0004	0.0772	0.00025	7.5	0.22	0.035	0.00003	0.0004	0.001	11.5	11	0.5
	4968	10	0.005	0.08	0.00013	0.00004	0.0008	0.0004	0.0965	0.00025	0.0035	0.17	0.017	0.000035	0.00037	0.001	9.04		
Map 6 Rotorua																			
	1561	18	0.001	0.03	0.000025	0.00004	0.00005	0.0001	0.0441	0.00025	0.0016	0.08	0.0148	0.000021	0.0001		0.648		
	2118	9	0.009	0.02	0.000065	0.00004	0.0017	0.000175	0.0316	0.00025	0.0025	0.16	0.0112	0.00001	0.0002	0.002	2.3		0.5
	3470	12	0.386	0.05	0.000025	0.00004	0.0001	0.0001	0.0339	0.00025	0.0155	0.34	1.64	0.00001	0.0001	0.005	0.545		0.5
	4000	8	0.00087	0.01	0.00007	0.00019	0.00063			0.0001	0.0059	0.35	0.0036		0.0001	0.003	4.31	1	0.5
	4001	13	0.92	2.54	0.0001	0.00075	0.0002	0.0001	0.202	0.00028	0.0005	0.79	3.43	0.00001	0.0004	0.011	0.936		
	4003	5	0.0005	0.01	0.000025	0.00004	0.0004	0.0001	0.0474	0.00025	0.0013	0.09	0.0067	0.000035	0.0002	0.001	3.13		
	4007	40	0.0025	0.02	0.000025	0.00004	0.0006	0.000175	0.0799	0.0015	0.0015	6	0.01	0.00001	0.0001	0.007	2.7		
Map 7 Rangitāiki																			
	1	42	0.003	0.31	0.00007	0.00014	0.00025	0.0005	0.0726	0.0015	0.0015	0.63	0.27	0.00006	0.0004	0.026	3.6	120	22
	49	7	0.021	1.17	0.00007	0.00038	0.0022			0.0001	0.0038	0.35	0.335				0.703	20	93
	466	14	0.0012	0.09	0.002	0.00011	0.00005	0.0001	0.024	0.00025	0.00025	11.4	0.39	0.00001	0.0001	0.001	0.214	1	2
	490	16	0.0013	0.03	0.000025	0.00023	0.00015	0.0001	0.0522	0.00025	0.0006	0.9	0.21	0.00001	0.0001	0.001	0.082		
	845	19	0.0005	0.56	0.000025	0.00004	0.00044	0.0001	0.0772	0.0005	0.00025	0.6	0.146	0.00001	0.0001		0.0005		0.5
	925	12	0.0005	1.90	0.00042	0.00044	0.016	0.0001	0.094	0.0015	0.0009	44.9	1.1	0.00001	0.0001	0.018	0.045		
	1605	11	0.0012	0.04	0.000025	0.00004	0.0002	0.0001	0.0068	0.0004	0.0006	0.9	0.0003	0.00001	0.0002	0.001	0.13		
	2076	15	0.021	0.04	0.0013	0.00074	0.00105	0.0035	0.027	0.00025	0.0035	0.79	0.002	0.00001	0.0004	0.001	3.14	1	0.5
	2509	46	0.017	0.04	0.000025	0.00004	0.0006	0.0005	0.0413	0.0015	0.0015	0.8	0.01	0.000026	0.0011	0.001	0.211		0.5
	SP198	12	0.018	0.034	0.000073	0.00004	0.00005	0.0033	0.0366	0.00025	0.0009	9.3	0.0048	0.000022	0.00047	0.008	0.836	16	2
Map 8 Galatea																			
	196	15	0.011	0.19	0.000025	0.00028	0.0023	0.0001	0.08	0.00025	0.035	0.35	0.783	0.00001	0.0007	0.001	0.015	0.5	13
	1319	15	0.049	0.20	0.0018	0.00004	0.0002	0.0001	0.0482	0.00025	0.0006	0.39	1.02	0.00001	0.0013	0.002	0.097	1	0.5
	2913	12	0.0005	0.06	0.000025	0.00004	0.00055	0.0001	0.0395	0.00025	0.0034	0.35	0.0043	0.00001	0.00032	0.002	0.39	0.5	1
Map 9 Ōpōtiki																			
	3036	17	0.006	0.05	0.000025	0.00048	0.0005	0.0001	0.0396	0.00025	0.0006	0.8	1.84	0.00003	0.00085	0.001	0.01		
	3039	15	0.0005	0.04	0.000025	0.00004	0.00005	0.0001	0.0313	0.00025	0.0005	0.8	0.0059	0.00001	0.0001	0.001	0.79		
	3301	38	0.0115	0.04	0.000025	0.00004	0.00005	0.000175	0.0094	0.00025	0.0368	37.8	0.018	0.00071	0.0003	0.013	4.6	110	2
	4002	15	0.006	0.07	0.000025	0.00024	0.00008	0.0001	0.085	0.00025	0.00025	0.8	0.384	0.0004	0.00052	0.001	0.046		

Table A3-8: Maximum Values - Aesthetic Value (DWSNZ - Guideline Values) (g/m^3)															
Map Area	**Bore No**	**Sample size**	**Temp**	**pH @25C**	**pH**	**Al**	**Hardness**	**Cu**	**Fe S/D**	**Fe T/TR**	**Mn**	**Na**	**Zn**	**Cl**	**SO4**
DWSNZ			Geothermal	7.0 - 8.5	7.0 - 8.5	0.1	200	1.0000	0.20	0.20	0.040	200.0	1.50	250.00	250.0
Map 3 WBOP															
	66	6	39.7	7.7	7.3	0.01	28.90	0.0006	0.01	0.40	0.030	290.0	0.46	164.00	3.9
	68	13	22.3	7.9	7.5	0.01	26.00	0.0003	0.03	1.00	0.001	24.2	0.23	12.80	2.9
	94	6	27	8.2	7.2	0.02	35.90	0.0008		0.50	0.008	36.0	0.02	23.00	3.2
	851	10	20.5	6.9	6.8	0.00	43.30	0.0004	7.32	6.80	0.160	18.1	0.07	11.50	3.0
	1393	15	29.3	8.1	7.8	0.14	21.90	0.0016	0.04	2.00	0.008	42.3	0.09	11.20	3.5
	1686	16	28.3	7.9	7.48	0.65	133.60	0.0590	0.74	3.40	0.083	89.3	0.11	76.20	7.4
	2303	18	37.5	8	7.4	0.18	20.60	0.0017	0.13	0.80	0.093	148.9	0.06	20.00	4.0
	2330	16	23	8.8	6.28	0.01	60.80	0.0021	0.68		0.027	25.8	1.20	26.80	7.6
	2343	13	23.2	7.7	6.5	0.01	20.80	0.0111	0.07	1.20	0.004	15.6	0.45	12.80	3.3
	2829	17	32.2	8.8	8.48	0.10	9.00	0.0010	0.59	2.20	0.023	59.7	0.03	21.80	6.4
Map 4 Tauranga															
	2093	7	22.5	8	7.09	0.01	135.00	0.0035	0.10	2.20	0.038	319.0	1.34	497.00	70.0
	2342	18	22.5	7.5	7.2	0.05	49.60	0.0120	0.03	0.20	0.007	21.2	0.12	22.80	6.4
	2344	18	20.4	6.5	6.54	0.34	63.00	0.0007	0.13	0.90	0.040	11.0	2.60	78.00	4.6
	2362	17	32.4	7.5	7	0.00	34.80	0.0006	0.47	1.56	0.660	31.5	0.54	38.30	4.9
	2393	8	29.5	7.5	7.1	0.00	35.60	0.0005	0.03	0.80	0.005	35.0	0.16	22.90	3.0
	2707	17	16.6	7.9	7.7	0.01	514.90	0.0006	0.05	0.80	0.096	274.0	0.06	794.00	92.1
	2728	15	22	7.3	6.91	0.01	126.50	0.0003	26.00		0.538	88.0	2.40	111.00	23.1
	2847	16	22.8	6.2	6.4	0.53	129.80	0.0008	12.70	17.30	0.290	47.5	1.14	88.00	128.0
	3044	24	50	7.9	7.67	0.02	79.30	0.0025	0.55	0.70	0.540	770.0	0.03	1080.00	5.4
	3272	6	36	8.1		0.02	4240.40	0.0050	15.10	0.00	10.800	5400.0	0.20	10600.00	1070.0
	4364	34	42.8	7.9	7.83	0.01	64.80	0.0015	0.65	0.71	0.570	444.0	0.10	521.00	1.0
	4582	6	26.7	6.9		0.00	42.40	0.0003	1.30		0.028	23.9	1.20	27.50	6.8
Map 5 Te Puke															
	410	13	15.9	7.2	7.01	0.01	37.20	0.0029	3.37	0.08	6.170	26.0	4.25	11.20	7.2
	643	11	16.7	6.8	6.7	0.01	128.60	0.1400	10.80	7.82	15.400	65.7	0.04	37.20	44.9
	951	16	54.7	7.5	7.2	0.01	242.20	0.0003	21.00	5.50	2.010	150.0	0.06	50.40	6.3
	1018	11	34.1	6.9	6.5	0.01	96.60	0.0010	3.99	4.10	0.295	115.0	0.20	45.50	4.3
	1520	17	23.7	7.2	6.9	0.01	68.10	0.0012	0.04	0.50	0.005	79.0	0.14	34.90	5.7
	1586	14	17.8	6.6	6.5	0.01	23.30	0.0010	0.03	0.40	0.247	19.2	0.27	23.60	6.4
	1690	17	27.1	7.5	7.2	0.00	88.60	0.0127	19.70	3.30	0.727	64.1	0.07	26.30	0.9
	2591	13	18.3	7.7	7.65	0.00	78.00	0.0000		7.70		35.1		18.70	4.0
	2822	17	18.5	7.1	7.1	0.01	57.70	0.0031	7.10	4.16	1.100	52.7	0.18	23.50	4.0
	3034	18	22.4	6.9	6.6	0.05	23.40	0.0021	2.75	0.26	0.325	86.0	0.22	31.80	31.0
	3045	43	16.5	6.6	6.92	0.18	63.20	0.0110	0.08	0.14	0.120	2322.8	0.07	74.10	28.1
	3566	12	17	7.2	7.24	0.03	44.40	7.5000	0.06		0.035	19.2	0.09	19.50	10.9
	4968	10	17.1	7.3	6.28	0.01	42.40	0.0035	1.03		0.017	25.9	1.17	21.60	11.1
Map 6 Rotorua															
	1561	18	16.1	6.9	6.88	0.00	17.90	0.0016	0.16		0.015	10.7	0.15	6.10	1.6
	2118	9	15.5	6.7	6.61	0.00	35.50	0.0025	0.03		0.011	13.6	0.02	8.80	12.6
	3470	12	14.2	6.8	7.9	0.00	13.20	0.0155	12.10		1.640	15.2	0.03	5.30	1.6
	4000	8	16	6.7	6.3	0.01	34.30	0.0059	0.03	0.20	0.004	12.6	0.76	15.10	10.1
	4001	13	40.8	6.3	5.61	0.01	77.40	0.0005	11.10	35.90	3.430	259.0	0.03	606.00	47.9
	4003	5	15	7	7.4	0.00	24.90	0.0013	0.04		0.007	10.5	0.14	5.20	12.4
	4007	40	13.6	7	7.06	0.01	19.40	0.0015	0.10	0.01	0.010	10.7	0.06	6.70	1.7
Map 7 Rangitāiki															
	1	42	20	7.6	7.93	0.03	170.50	0.0015	6.70	4.00	0.270	2728.9	0.08	69.10	64.1
	49	7	16.1	7.1	6.9	0.34	717.10	0.0038	0.08	10.28	0.335	250.0	0.04	41.30	1.0
	466	14	17.5	7.5	7.25	0.01	242.00	0.0003	6.80	6.44	0.390	32.8	0.03	12.30	1.8
	490	16	15.9	7.2	7.6	0.07	19.50	0.0006	1.60	4.60	0.210	18.4	0.03	11.00	15.0
	845	19	29.5	7.8	7.42	0.01	103.90	0.0003	0.70		0.146	128.0	0.23	18.00	0.9
	925	12	20.1	6.3	6.6	0.00	110.20	0.0009	56.50	40.40	1.100	109.6	2.69	100.00	1.9
	1605	11	16.7	7.1	6.2	0.01	15.30	0.0006	0.03	0.60	0.000	14.2	0.04	9.80	4.1
	2076	15	22.5	8	7.09	0.01	48.80	0.0035	0.10	2.20	0.002	15.4	1.34	38.00	11.8
	2509	46	19.3	7.7	7.25	0.10	18.10	0.0015	4.86	0.90	0.010	1110.7	0.13	7.60	5.3
	SP198	12	17.9	6.9	6.67	0.006	16.1	0.0009	0.025		0.0048	13	0.02	9.3	9.8
Map 8 Galatea															
	196	15	15.6	7.4	7	0.02	60.00	0.0350	10.20	3.66	0.783	15.6	0.06	9.40	5.0
	1319	15	16.2	7.6	7.28	0.01	68.50	0.0006	0.77	1.40	1.020	27.3	0.02	11.30	1.7
	2913	12	14.3	7.3	6.6	0.00	37.90	0.0034	0.06	0.70	0.004	10.0	0.05	8.90	6.8
Map 9 Ōpōtiki															
	3036	17	16.1	7.4	7.19	0.01	77.70	0.0006	12.80	6.01	1.840	64.0	0.83	23.80	3.6
	3039	15	16	7	6.6	0.01	39.80	0.0005	0.10	0.40	0.006	19.9	0.05	6.70	10.1
	3301	38	16.8	8.7	8.7	0.02	107.10	0.0368	0.04	0.09	0.018	2625.5	0.01	3237.60	14.4
	4002	15	16.7	7.4	7.13	0.01	400.60	0.0003	6.74	1.33	0.384	180.0	0.05	572.90	65.6

Table A3-9: Maximum Values – Nutrients (g/m^3)									
Map Area	Bore No	Sample size	DRP	NH_4-N	NNN	NO_2-N	NO_3-N	PO_4-P	TP
DWSNZ 2005 (revised 2008)				1.5			11.30		
ANZECC TV for direct toxicity to an aquatic organism				0.90			7.20		
Map 3 WBOP									
	66	6	0.14	0.28	0.03	0.00	0.05	0.11	0.14
	68	13	0.15	0.16	0.07	0.00	0.18	0.14	0.13
	94	6	0.13	0.03	0.56	0.00	0.69	0.17	0.29
	851	10	0.16	0.05	0.02	0.00	0.00	0.05	0.14
	1393	15	0.37	0.04	0.08	0.00	0.05	0.11	0.39
	1686	16	0.26	0.03	0.02	0.00	0.00	0.22	0.23
	2303	18	3.22	0.57	0.33	0.00	0.01	3.70	3.21
	2330	16	0.18	0.04	0.30	0.00	0.09		0.03
	2343	13	0.08	0.02	0.09	0.01	0.11		0.09
	2829	17	0.28	0.02	2.60	0.00	0.46	0.21	0.31
Map 4 Tauranga									
	51	6	0.19	0.02	0.13	0.00	0.15	0.89	0.12
	2093	7	0.40	2.12	4.86	0.00	3.14	0.38	0.41
	2342	18	0.11	0.03	0.12	0.00	0.27	0.13	0.08
	2344	18	0.05	0.02	0.22	0.00	0.25	0.05	0.29
	2362	17	0.28	0.17	0.02	0.00	0.21	0.25	0.52
	2393	8	0.12	0.01	0.22	0.00	0.20	0.11	0.12
	2707	17	0.02	0.03	9.90	0.02	9.90	0.05	0.04
	2728	15	0.03	1.07	0.02	0.00	0.02		0.04
	2847	16	0.20	4.78	0.13	0.02	1.34	0.05	0.18
	3044	24	0.13	0.49	0.01	0.00	0.16	0.05	0.17
	3272	6	0.09	1.33	1.02	0.01	1.02		0.11
	4364	34	0.15	0.17	0.01	0.00	0.07	0.11	0.15
	4582	6	0.17	0.05	0.12	0.00	0.12		0.20
Map 5 Te Puke									
	410	13	0.03	0.12	0.07	0.00	0.09	0.06	0.03
	643	11	0.50	1.30	0.05	0.00	0.96	0.05	0.52
	951	16	0.30	0.31	0.02	0.01	0.03	0.05	0.35
	1018	11	0.21	0.15	0.04	0.00	6.85	0.05	0.22
	1520	17	0.17	0.02	2.67	0.00	2.38	0.08	0.16
	1586	14	0.10	0.15	3.40	0.00	0.46	0.05	0.06
	1690	17	0.20	0.34	0.02	0.00	0.45	0.05	0.23
	2591	13	0.06	0.06	0.05		0.00		0.12
	2822	17	0.27	0.05	0.02	0.01	0.25	0.05	0.26
	3034	18	0.22	0.07	13.30	0.00	7.81	0.23	0.22
	3045	43	0.06	0.03	2.09	0.00	3.65	0.05	0.09
	3566	12	0.26	0.02	11.50	0.00	11.50		0.26
	4968	10	0.25	0.03	10.60	0.00	9.04		0.25
Map 6 Rotorua									
	1561	18	0.10	0.02	0.64		0.65		0.10
	2118	9	0.16	0.03	5.28	0.00	2.30		0.18
	3470	12	0.87	2.89	0.55	0.01	0.55		0.95
	4000	8	0.06	0.02	3.53	0.00	4.31	3.30	0.04
	4001	13	0.25	0.42	0.04	0.01	0.94	1.20	0.27
	4003	5	0.06	0.03	3.13	0.00	3.13		0.05
	4007	40	0.24	1.50	2.28	0.01	2.70	0.10	0.55
Map 7 Rangitāiki									
	1	42	0.39	1.25	6.44	0.03	3.60	0.18	0.63
	49	7	0.91	4.50	0.49		0.70	0.05	3.48
	466	14	0.42	4.10	0.02	0.00	0.21	0.44	1.20
	490	16	0.17	0.11	0.04	0.00	0.08	0.38	0.67
	845	19	0.65	0.49	0.00		0.00		0.64
	925	12	0.29	0.90	0.05	0.02	0.05	0.05	0.28
	1605	11	0.14	0.01	0.15	0.00	0.13	0.17	0.14
	2076	15	0.40	0.05	3.14	0.00	3.14	0.38	0.41
	2509	46	0.13	0.02	0.21	0.00	0.21	0.19	0.21
	SP198	12	0.106	0.031	0.705	0.008	0.836		0.09
Map 8 Galatea									
	196	15	0.82	0.45	0.04	0.00	0.02	0.27	2.34
	1319	15	1.50	0.65	0.15	0.00	0.10	1.20	1.60
	2913	12	0.10	0.05	0.75	0.00	0.39	0.10	0.10
Map 9 Ōpōtiki									
	3036	17	0.75	0.28	2.82	0.00	0.01	0.05	0.78
	3039	15	0.04	0.06	0.90	0.00	0.79	0.05	0.03
	3301	38	0.14	0.08	3.91	0.01	4.60	0.11	0.18
	4002	15	0.09	0.13	3.42	0.00	0.05	0.05	0.11

Appendix 4 – Individual bore information sheets

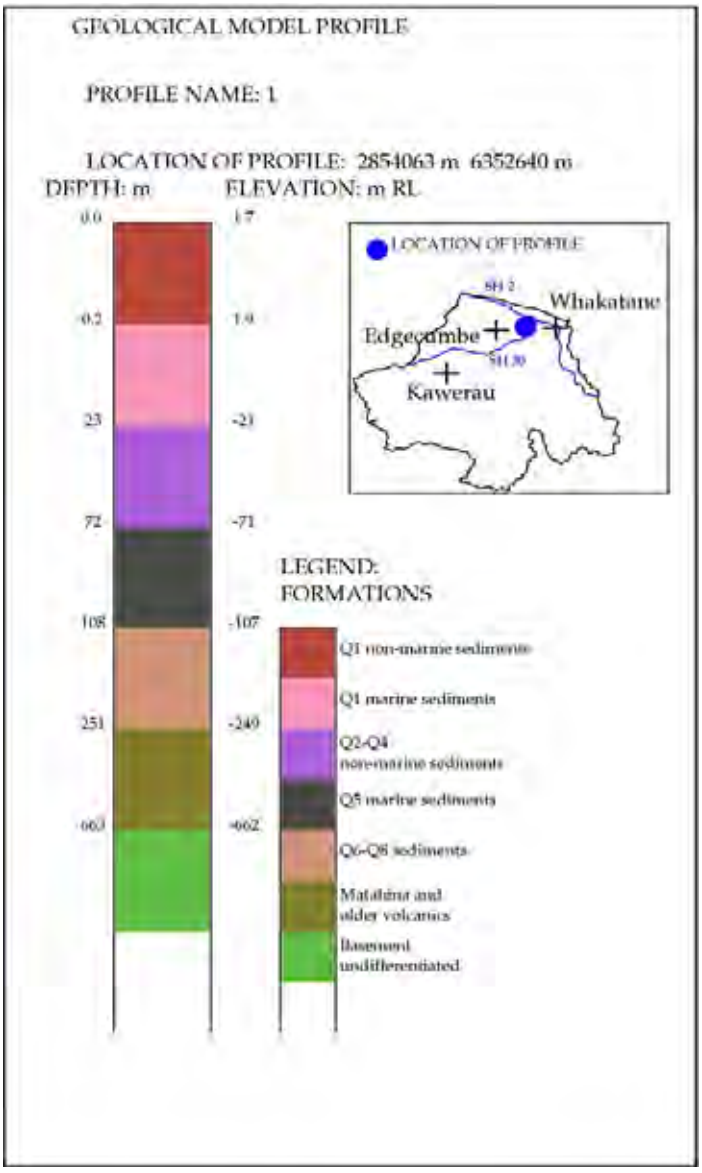
All bore information sheets are presented in numerical order and have:

- An information table
- Geological profile from Earth Beneath Our Feet (where available)
- Water level graphs (all have raw and edited data)
- Groundwater quality graphs (3)

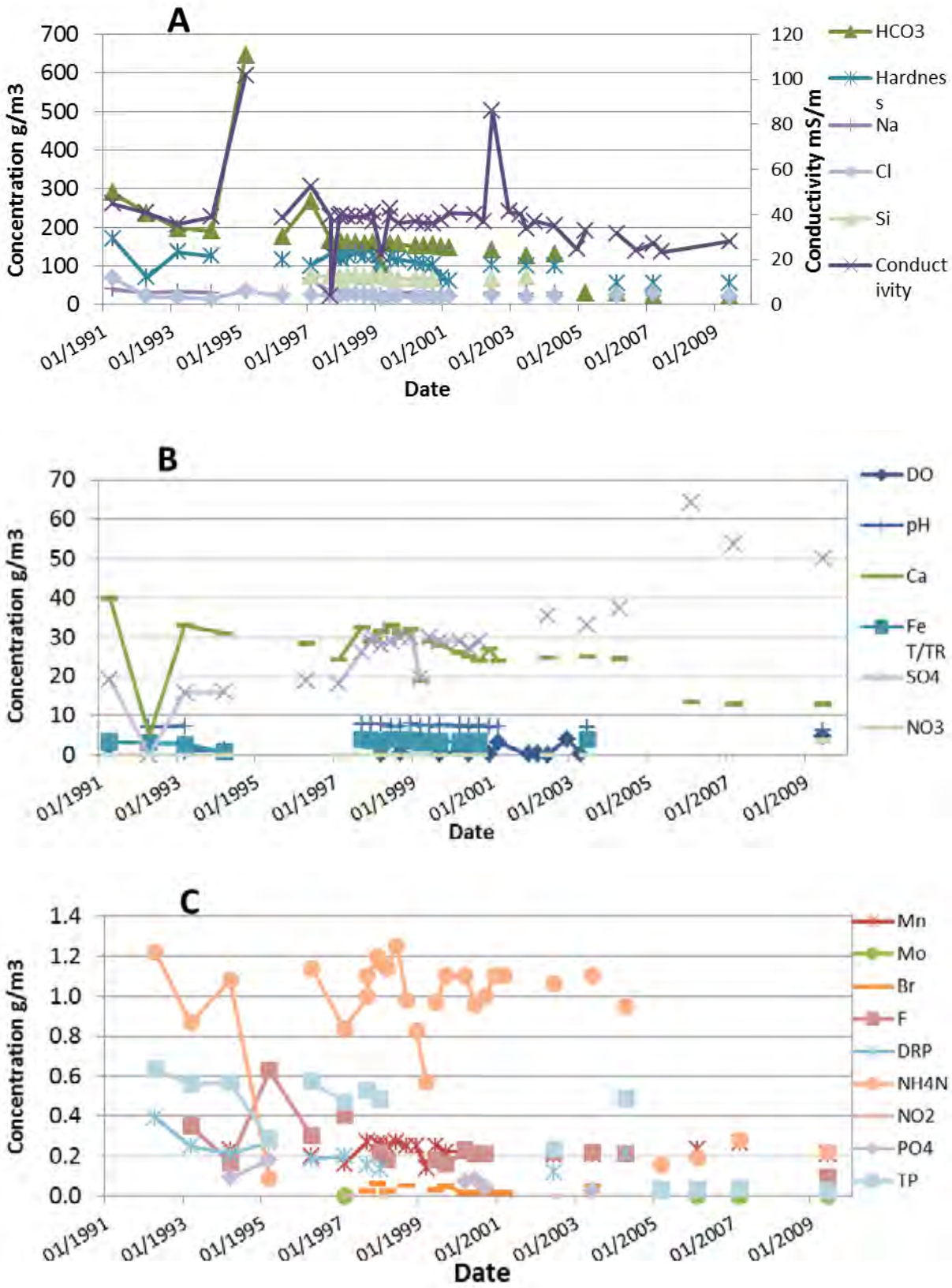
Earth Beneath Our Feet provides a generic representation of the stratigraphic groundwater systems. The elevations are not to scale and may be +/- several metres. The drillers bore log information is maintained in the Regional Council Wells Database.

Bore 1 Information			
Monitoring type	Water quality	**Depth (m)**	12.1
Name	Van Beek	**Casing Depth (m)**	9.1
Bore use	Dairy Shed Water	**Screen/open hole**	Screened
Easting	285 4063	**Temperature**	10.6°C
Northing	635 2640	**Catchment**	Kope Orini 1
Bore log	Complete	**Aquifer**	Tauranga Group sediment
Monitoring period	**Water level**		
	Water quality	1991 to 2009	**LabStar:** BOP180046

Bore 1 geological profile (EBOF)

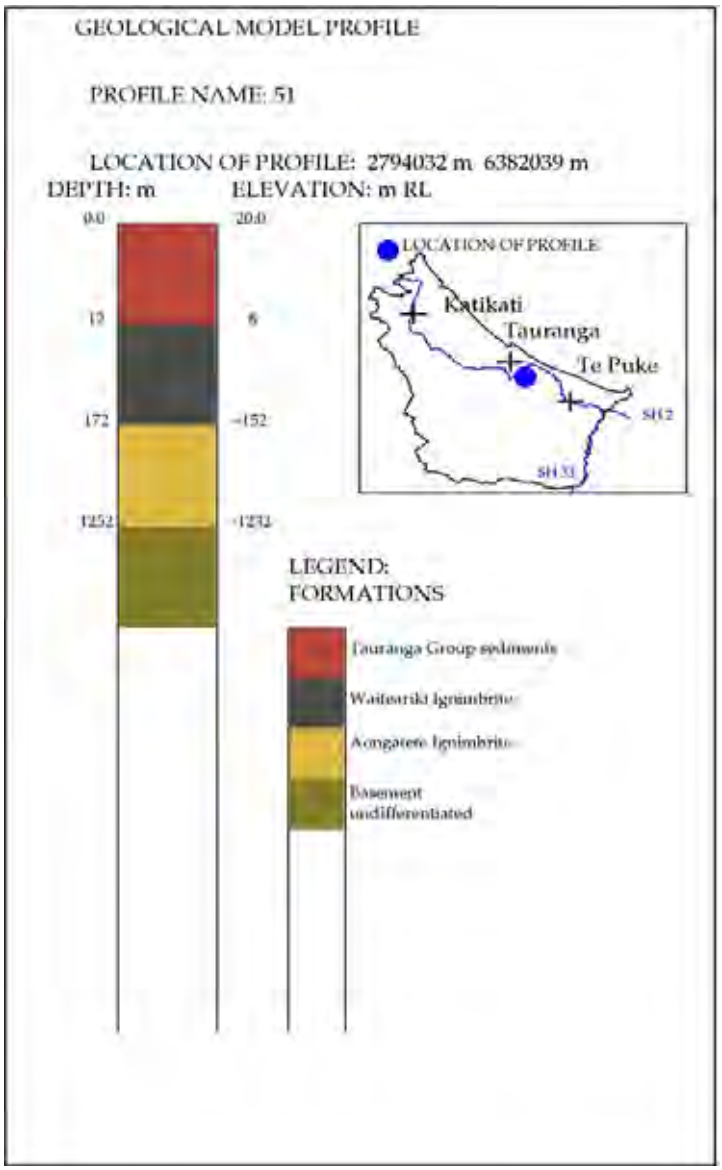


Bore 1 water quality graphs

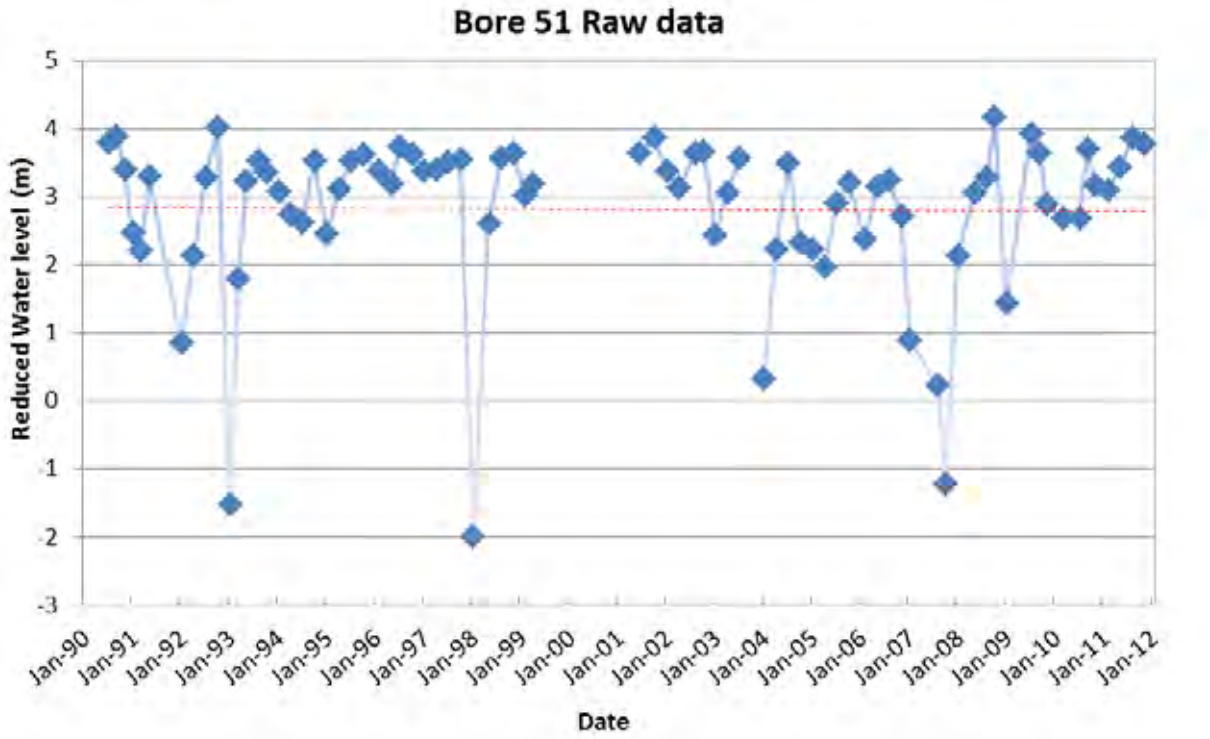


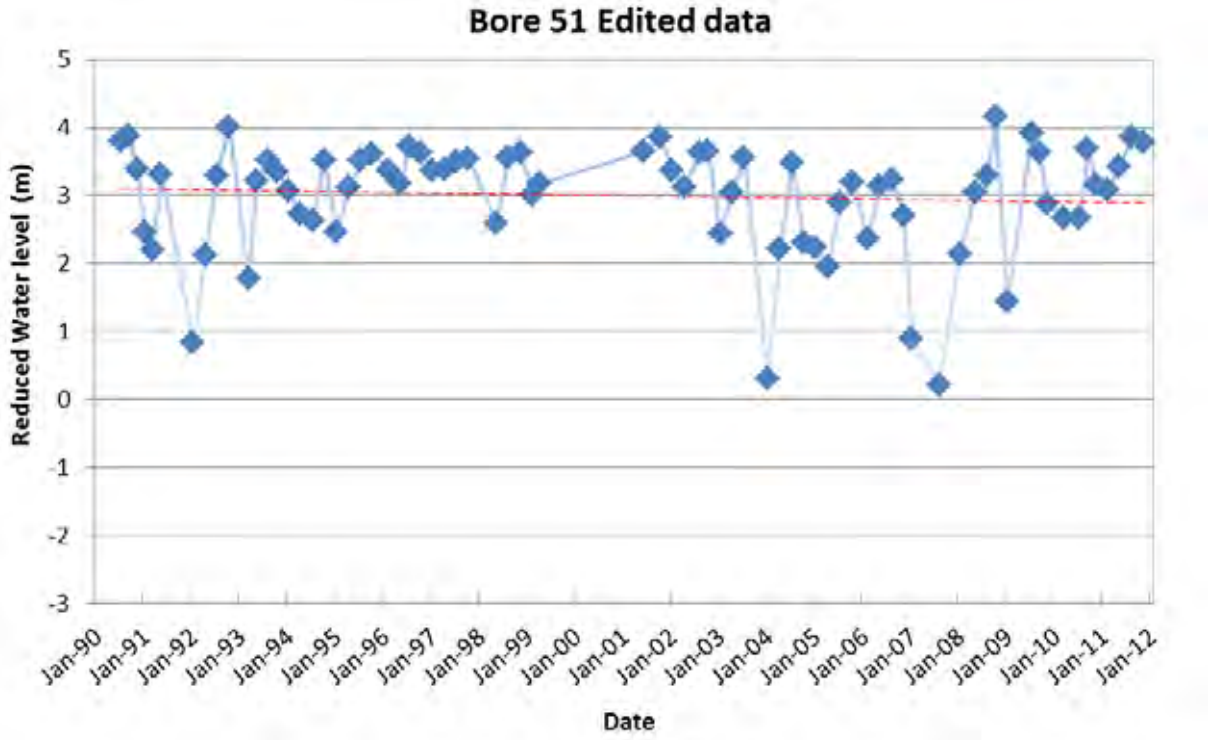
Bore 51 Information			
Monitoring type	Water level & Water quality	**Depth (m)**	67
Name	Ngāpeke Orchard	**Casing Depth (m)**	38.7
Bore use	Irrigation	**Screen/open hole**	Open hole
Easting	279 4032	**Temperature**	19°C
Northing	638 2039	**Catchment**	WAI 2 zone
Bore log	Complete	**Aquifer**	Waitekariki
Monitoring period	**Water level**	1990 to 2011	
	Water quality	1990 to 1996	**LabStar:** BOP180038

Bore 51 geological profile (EBOF)



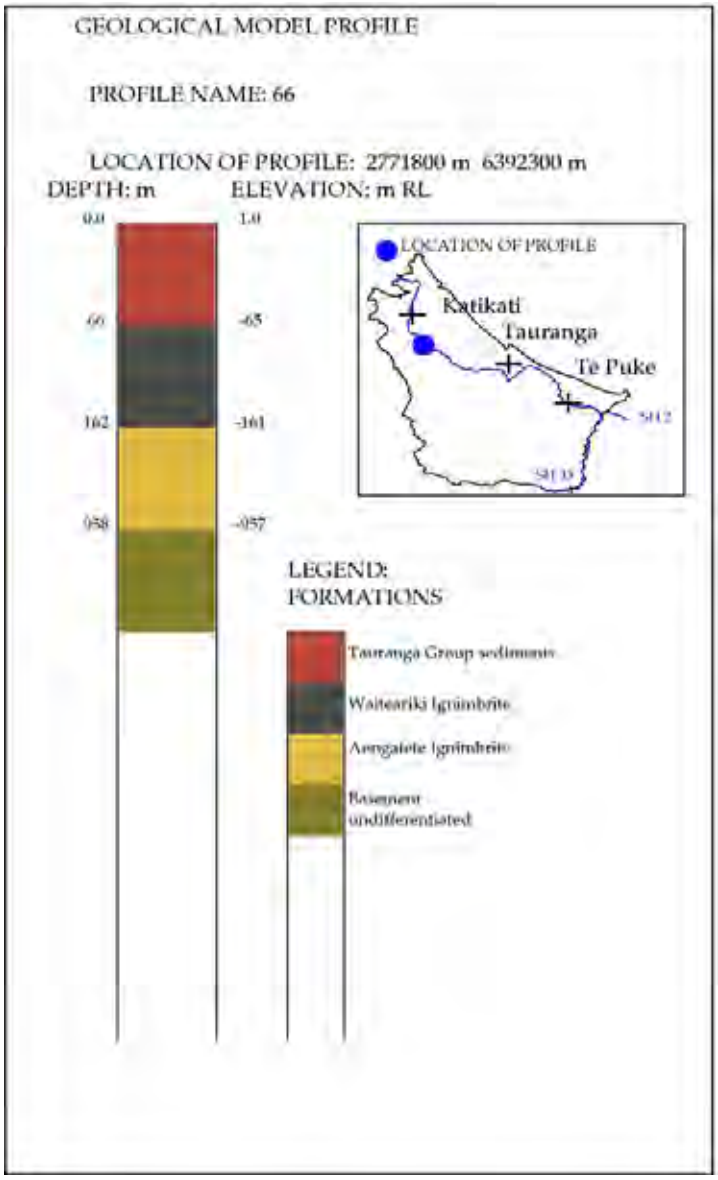
Bore 51 water level graphs



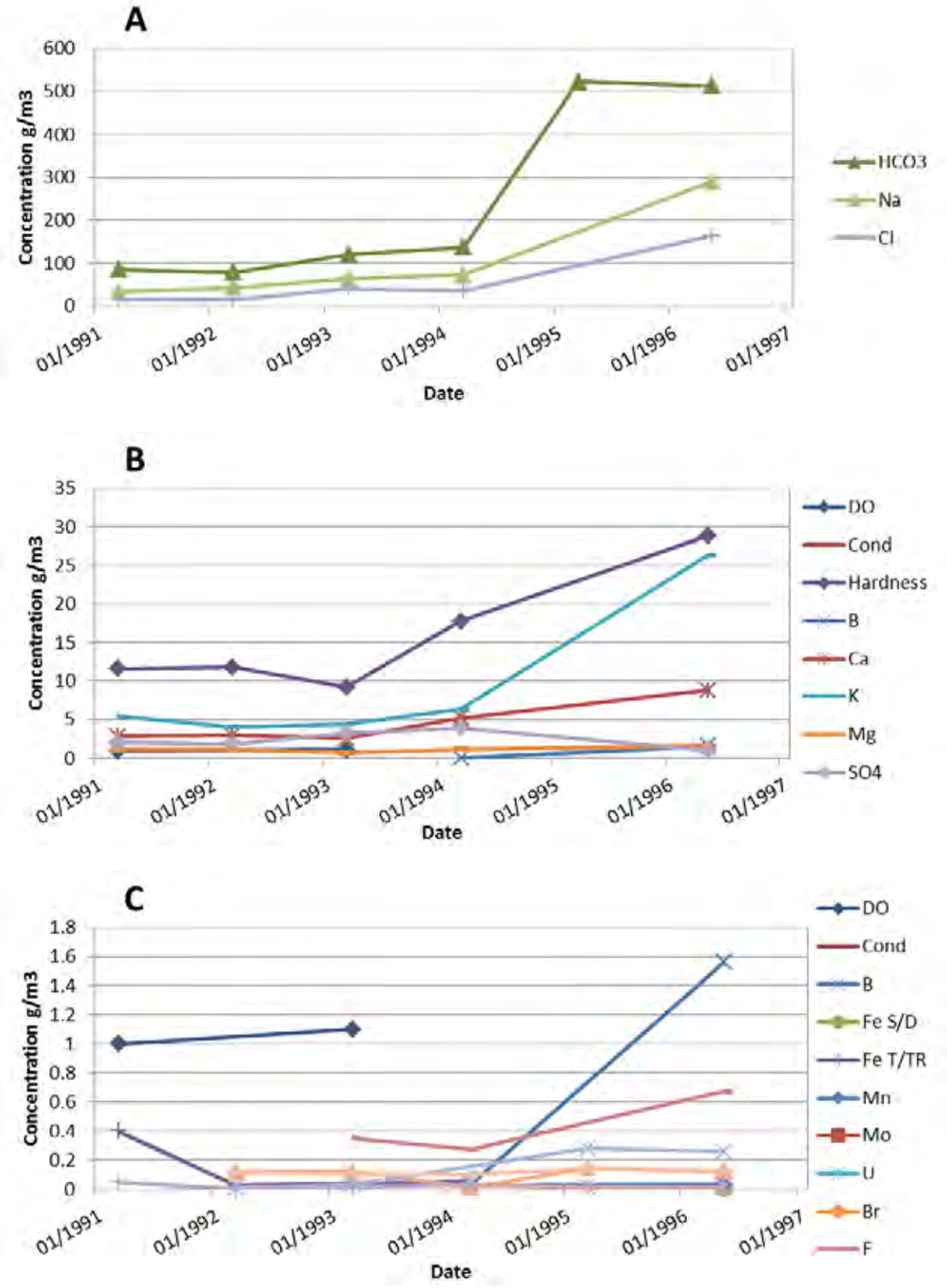


Bore 66 Information			
Monitoring type	Water quality	**Depth (m)**	618.7
Name	Ferrer Family Trust	**Casing Depth (m)**	199.9
Bore use	Irrigation	**Screen/open hole**	Unknown
Easting	277 1800	**Temperature**	34°C
Northing	639 2300	**Catchment**	WAI1 (zone)
Bore log	Partial	**Aquifer**	Aongatete (WAI)
Monitoring period	**Water level**		
	Water quality	1991 to 1996	**LabStar:** BOP180021

Bore 66 geological profile (EBOF)

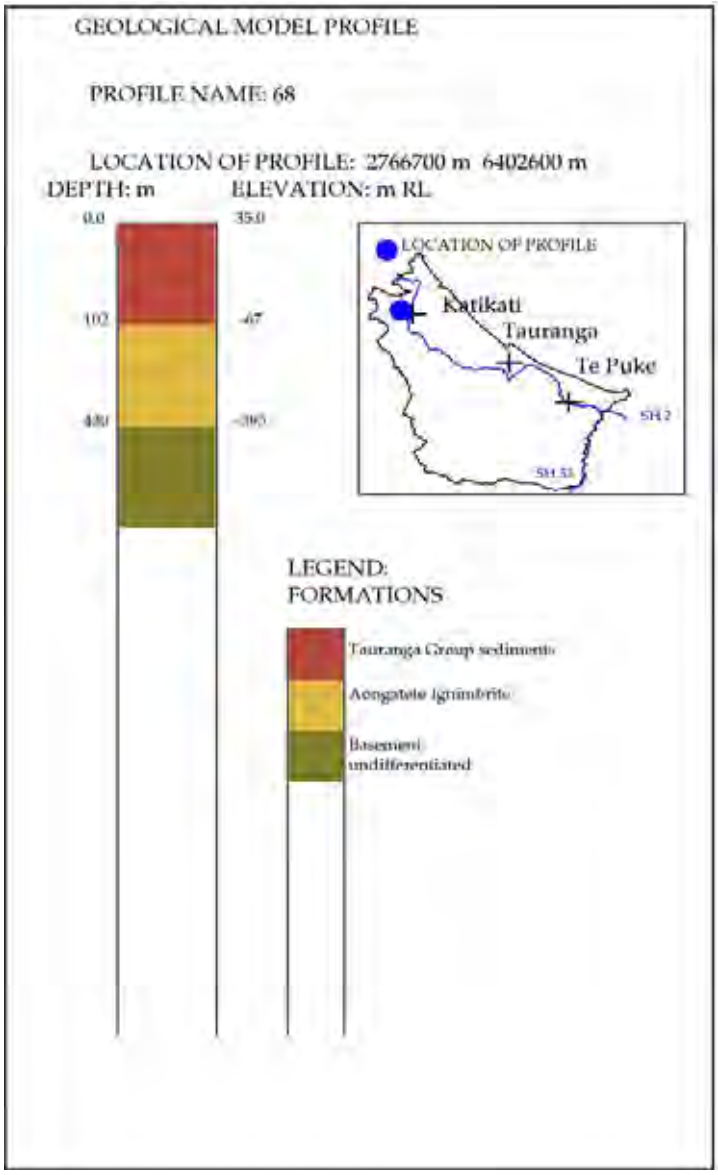


Bore 66 water quality graphs

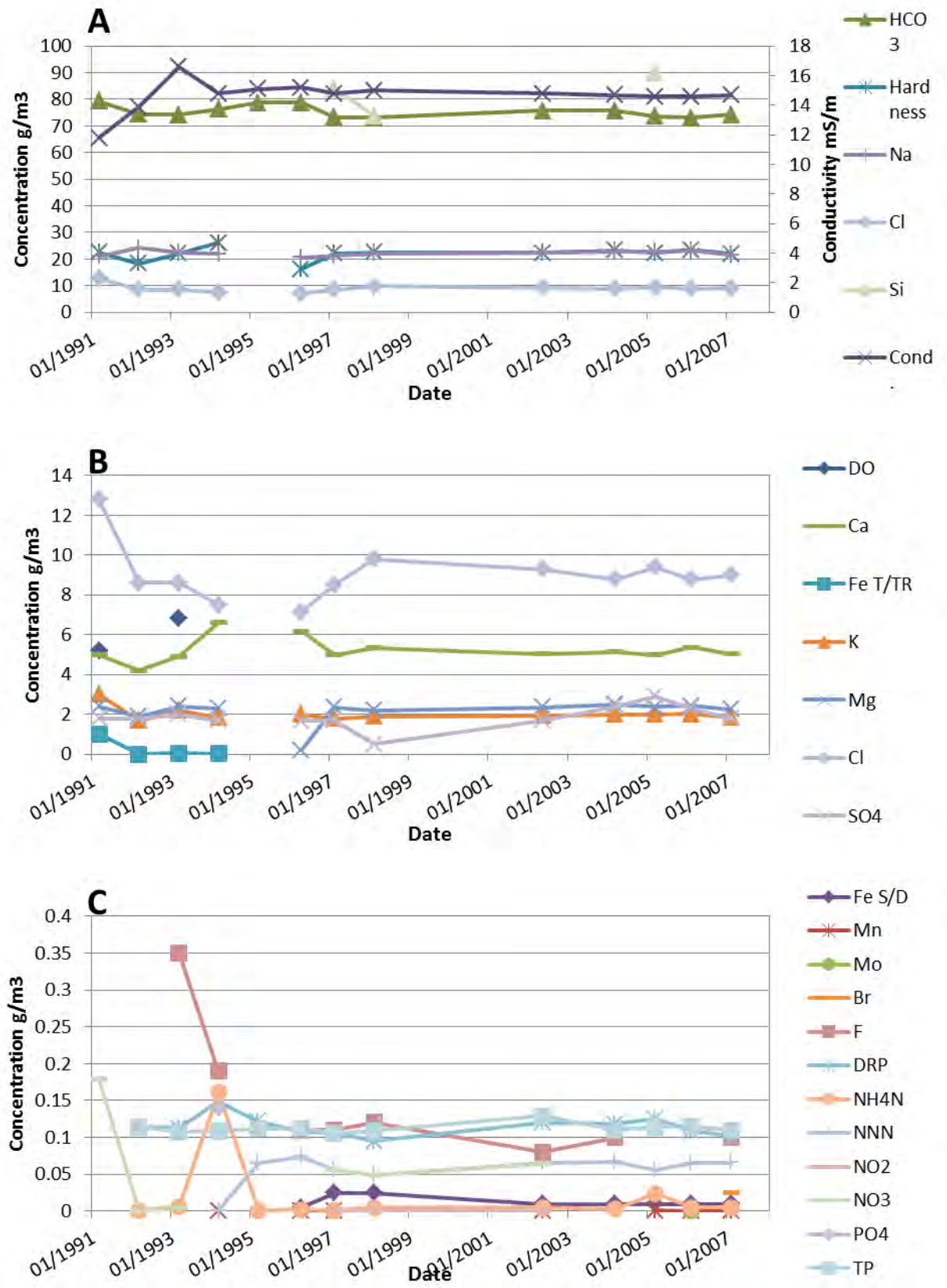


Bore 68 Information			
Monitoring type	Water quality	**Depth (m)**	275.8
Name	Hacking	**Casing Depth (m)**	57
Bore use	Irrigation/domestic	**Screen/open hole**	Unknown
Easting	276 8559	**Temperature**	22°C
Northing	640 4732	**Catchment**	WAI1 (zone)
Bore log	Partial	**Aquifer**	Aongatete (WAI)
Monitoring period	**Water level**		
	Water quality	1991 to 2008	**LabStar:** BOP180018

Bore 68 geological profile (EBOF)

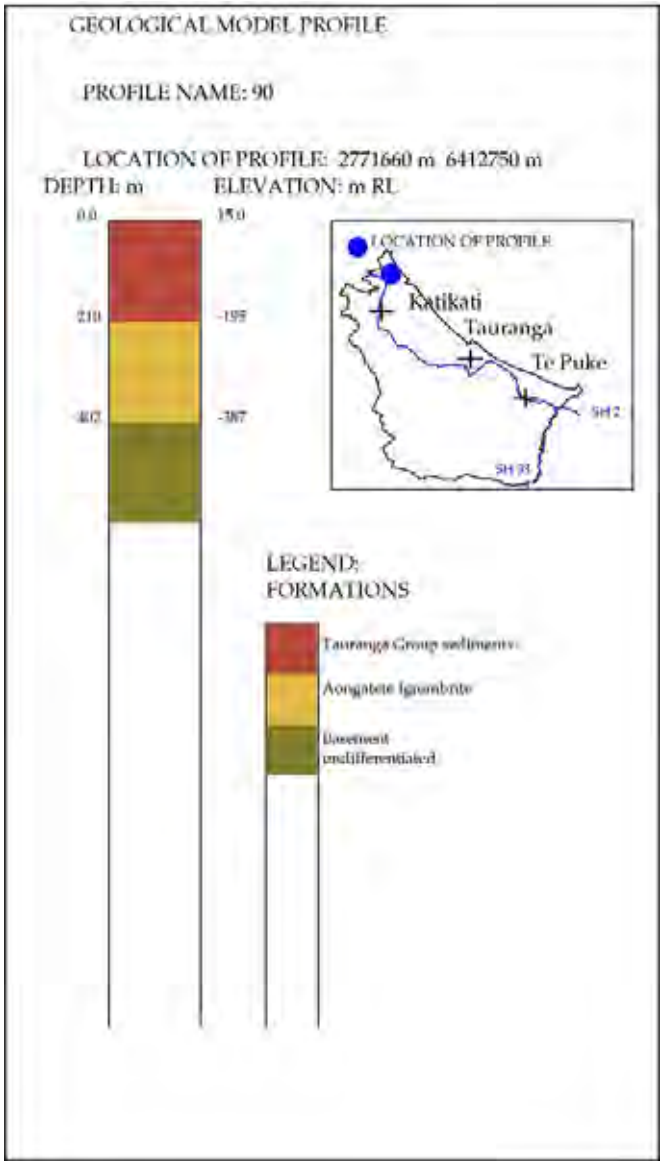


Bore 68 water quality graphs

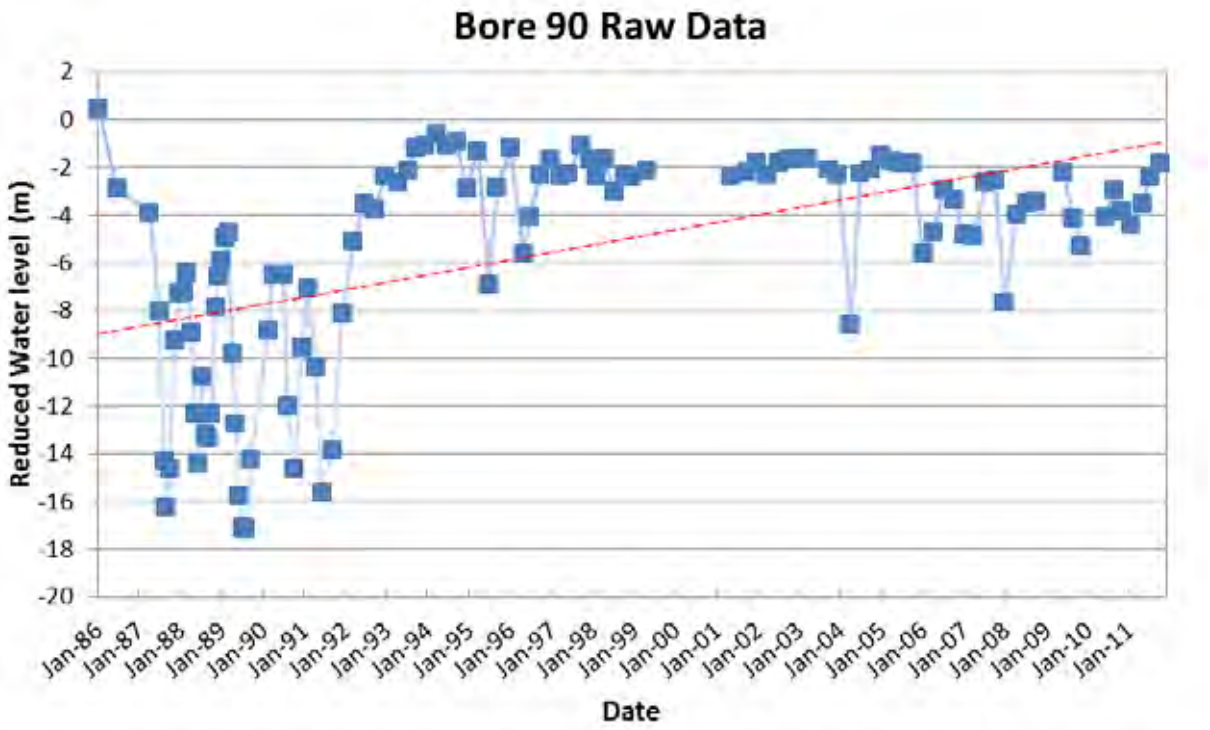


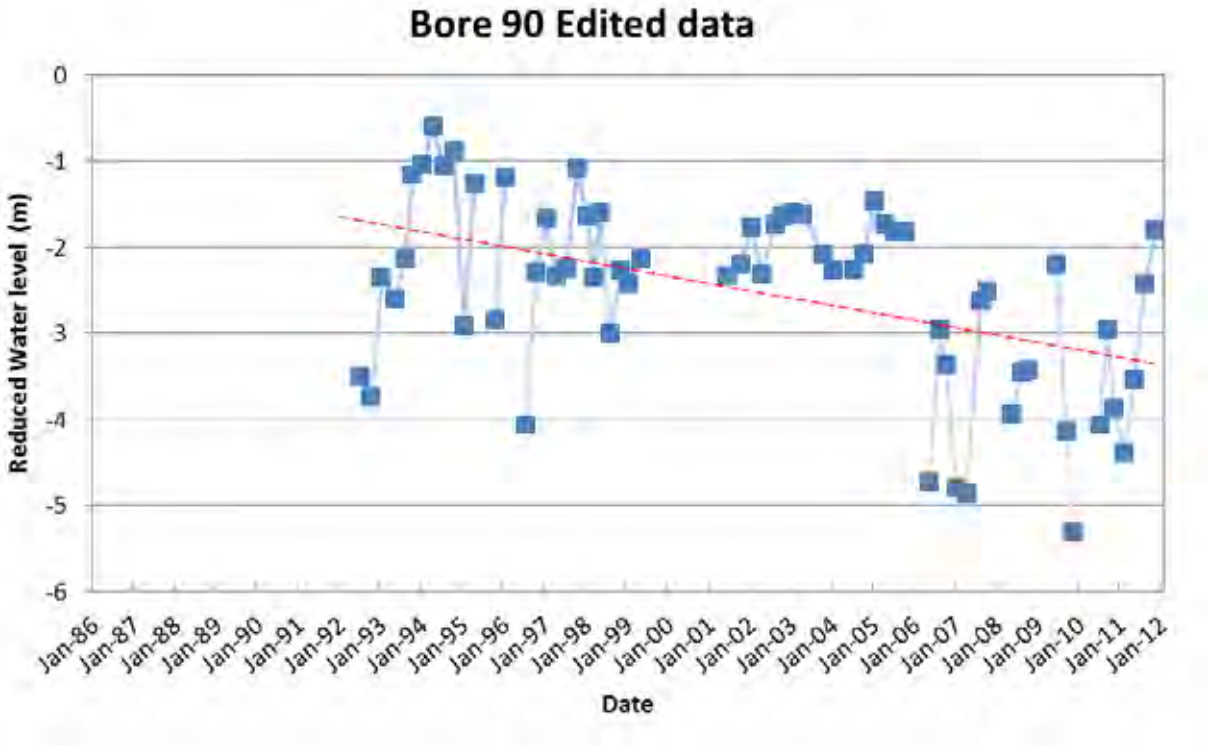
Bore 90 Information			
Monitoring type	Water level	**Depth (m)**	329.2
Name	Stevenson	**Casing Depth (m)**	250
Bore use	Irrigation	**Screen/open hole**	Open hole
Easting	277 1660	**Temperature**	Geothermal
Northing	641 2750	**Catchment**	Katikati
Bore log	Complete	**Aquifer**	Aongatete (WAI)
Monitoring period	**Water level**	1986 – 2011	
	Water quality	–	

Bore 90 geological profile (EBOF)



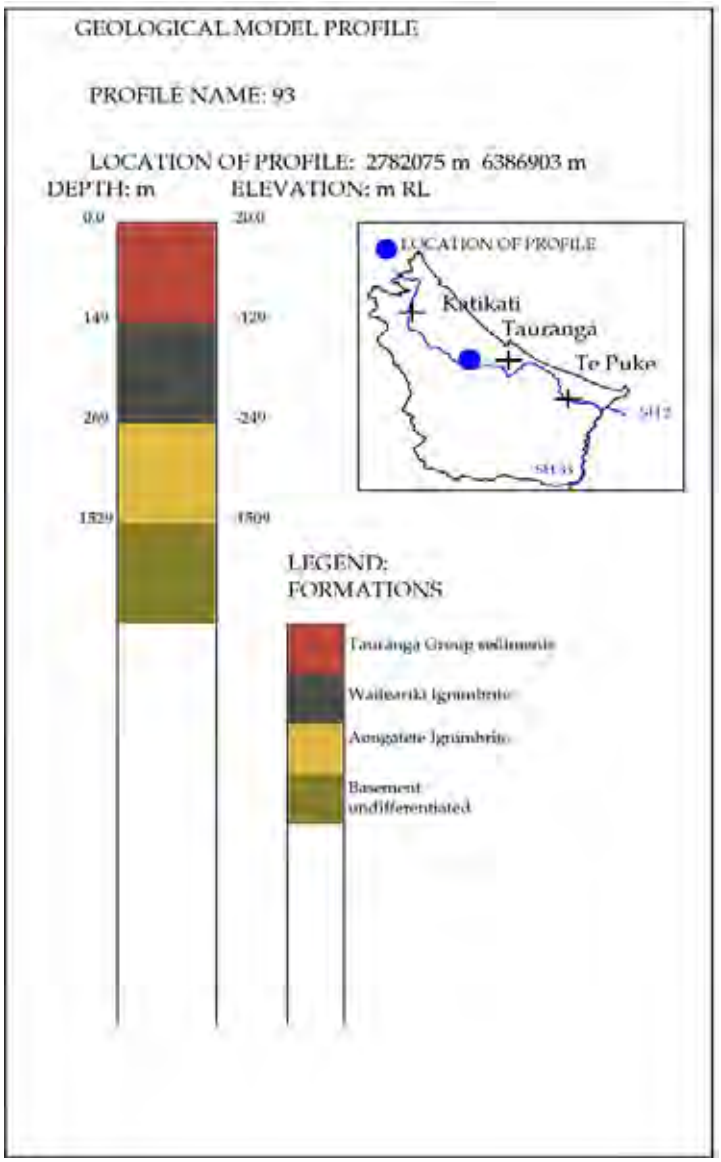
Bore 90 water level graphs



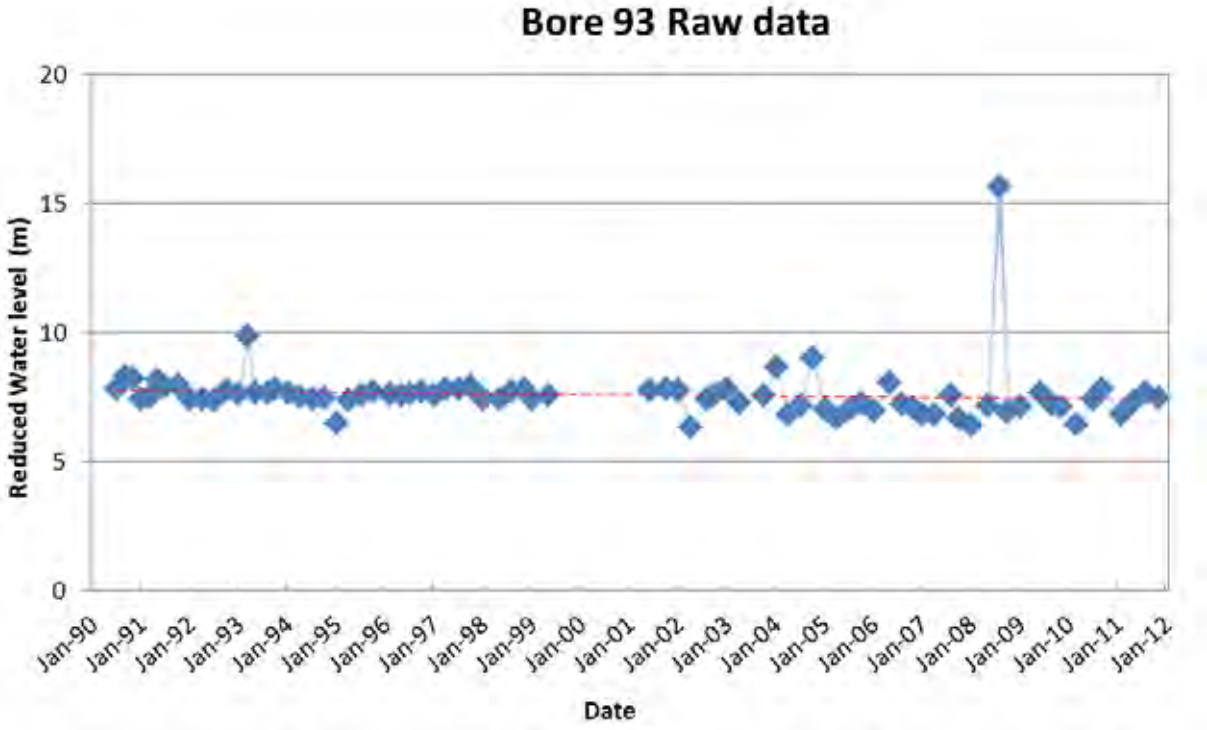


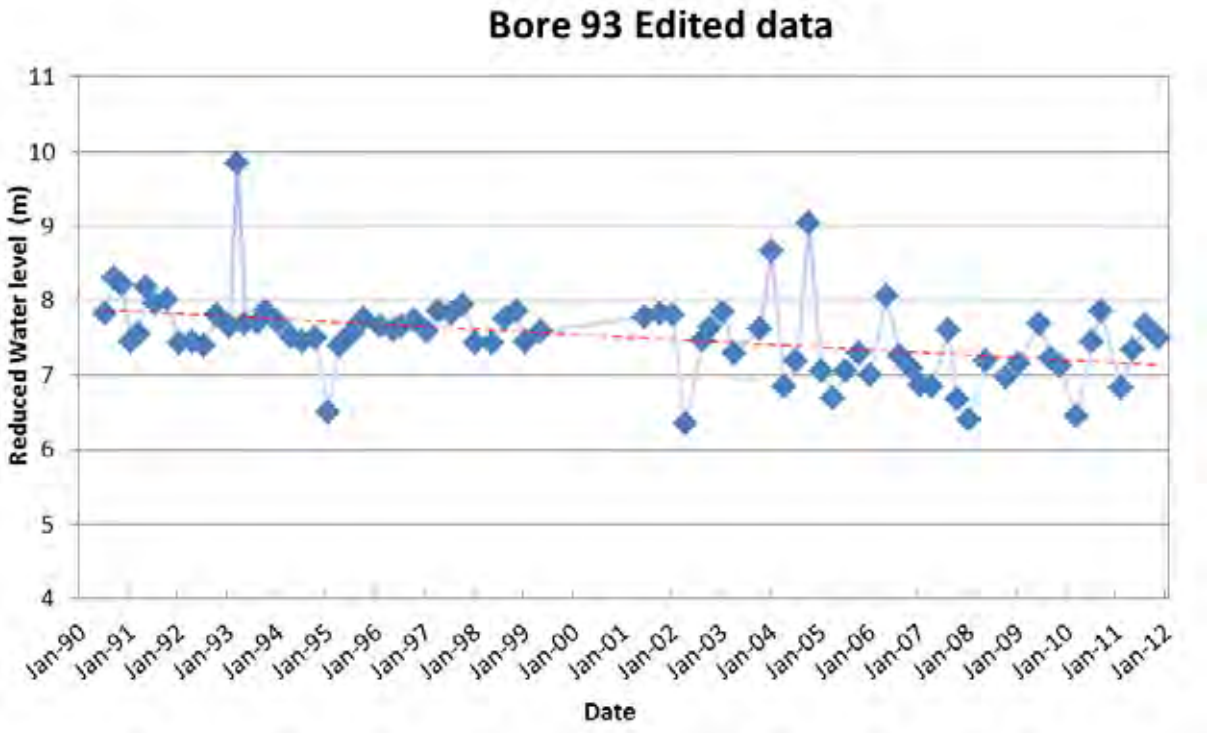
Bore 93 Information			
Monitoring type	Water level	**Depth (m)**	460.2
Name	Lowes	**Casing Depth (m)**	350.5
Bore use	Irrigation	**Screen/open hole**	Open hole
Easting	278 2075	**Temperature**	Unknown
Northing	638 6903	**Catchment**	Wairoa
Bore log	Complete	**Aquifer**	Aongatete (WAI)
Monitoring period	**Water level**	1990 to 2011	
	Water quality	-	

Bore 93 geological profile (EBOF)



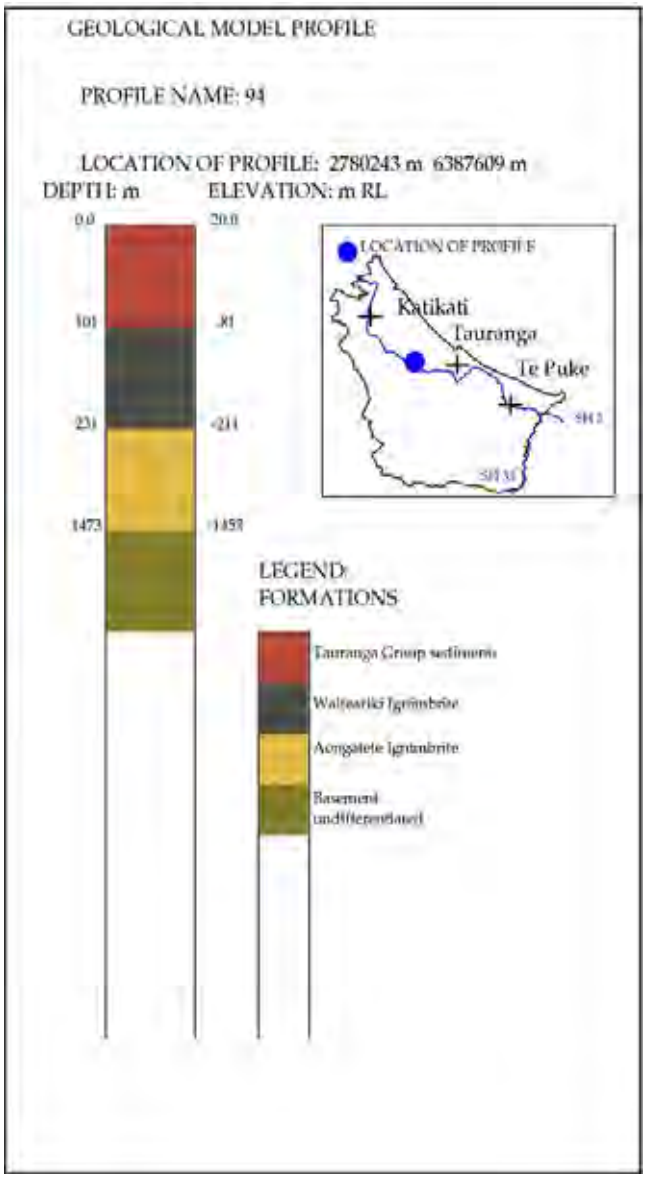
Bore 93 water level graphs



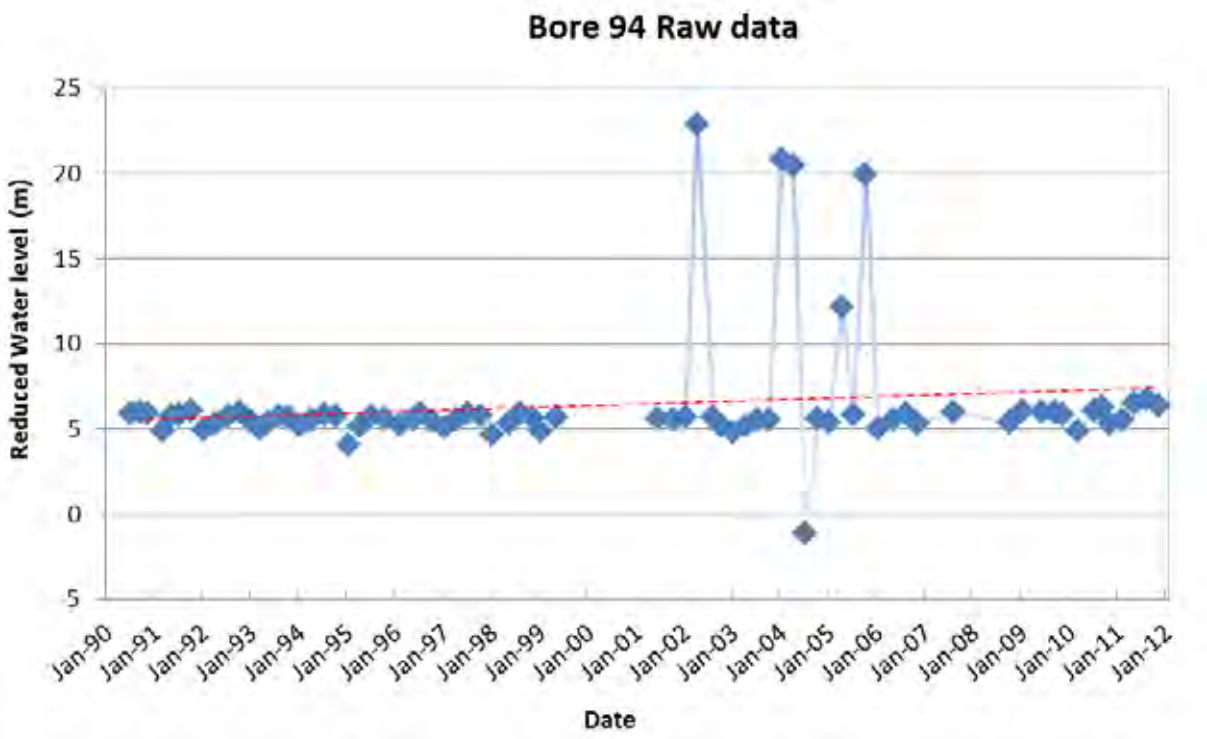


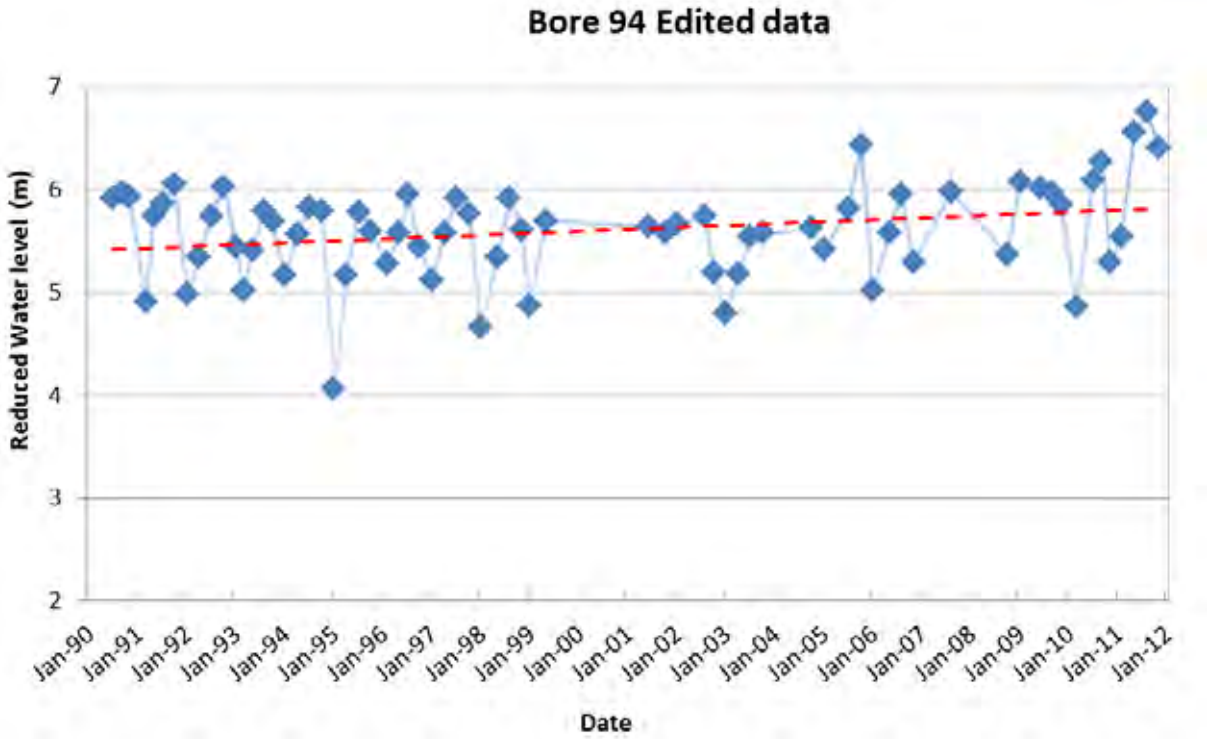
Bore 94 Information			
Monitoring type	Water level	**Depth (m)**	164.6
Name	Cain	**Casing Depth (m)**	130.1
Bore use	Irrigation/Domestic	**Screen/open hole**	
Easting	278 0243	**Temperature**	24.3
Northing	638 7609	**Catchment**	Oturu
Bore log	Complete	**Aquifer**	Waitetariki (WAI)
Monitoring period	**Water level**	1990 to 2011	
	Water quality	1991 to 1995	**LabStar:** BOP180023

Bore 94 geological profile (EBOF)

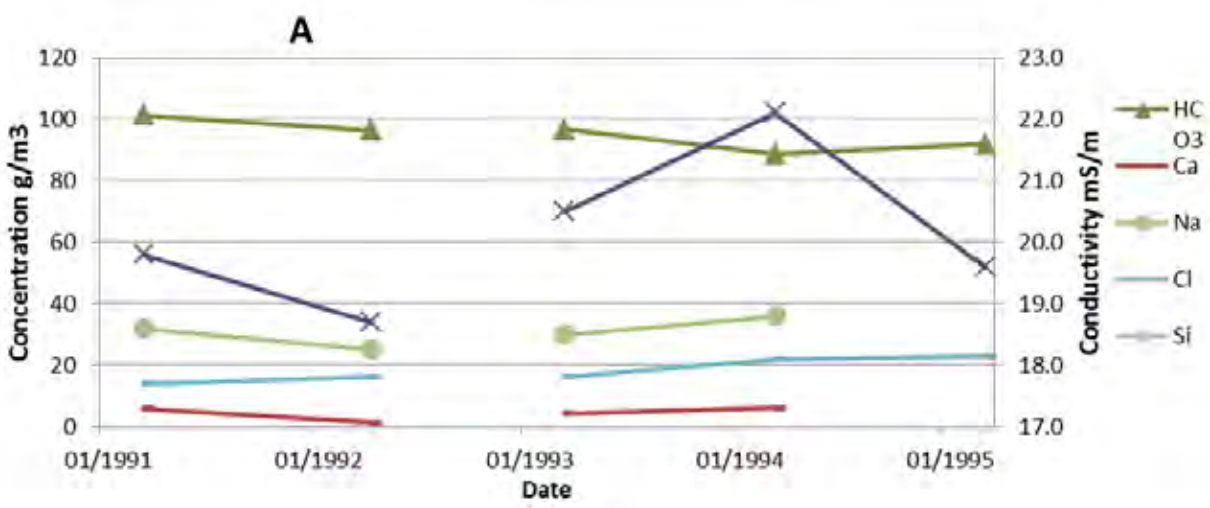


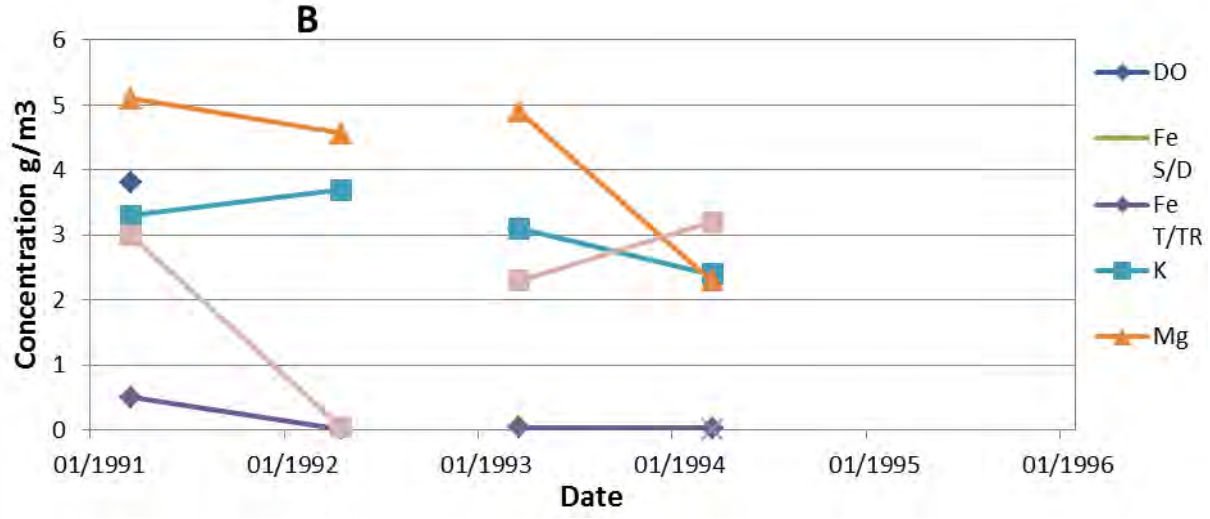
Bore 94 water level graphs

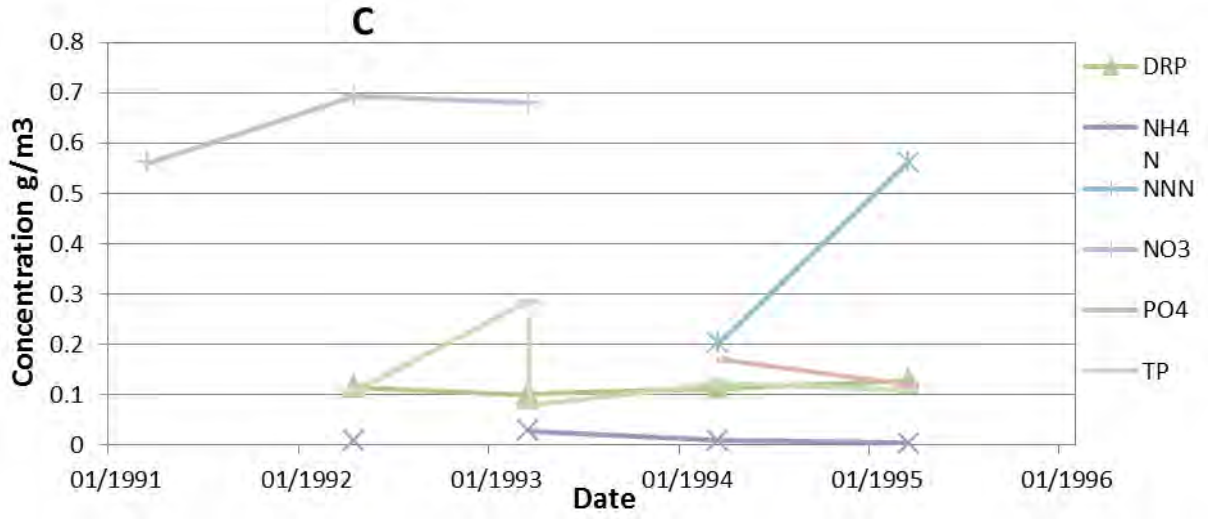




Bore 94 water quality graphs



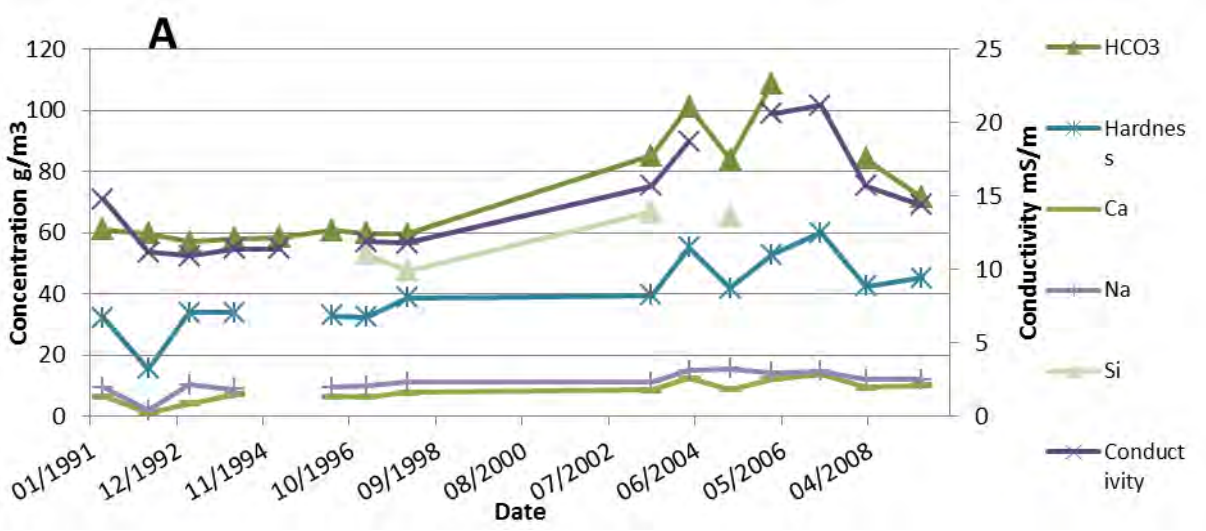


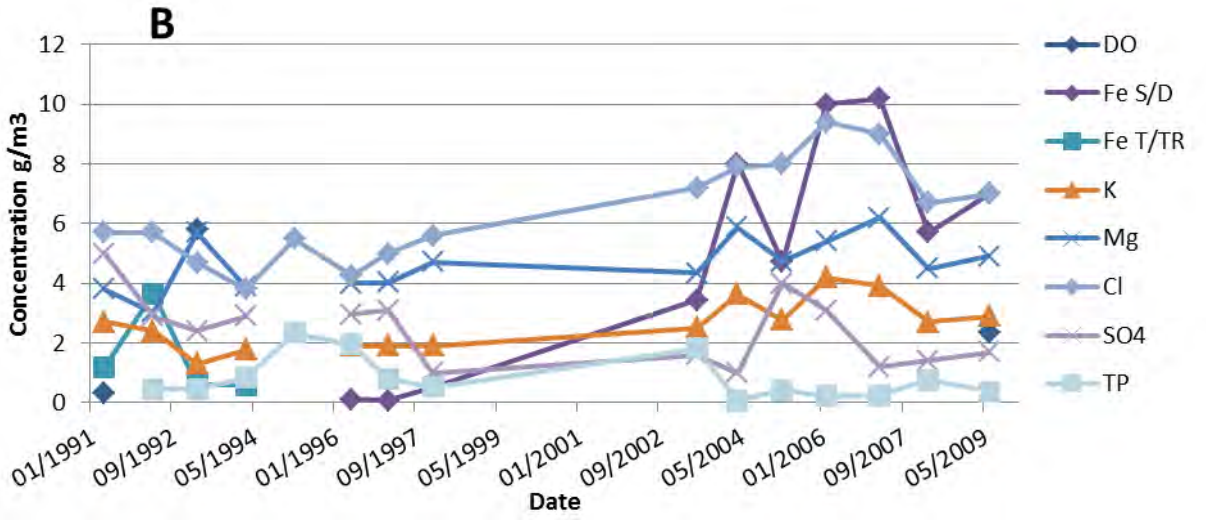


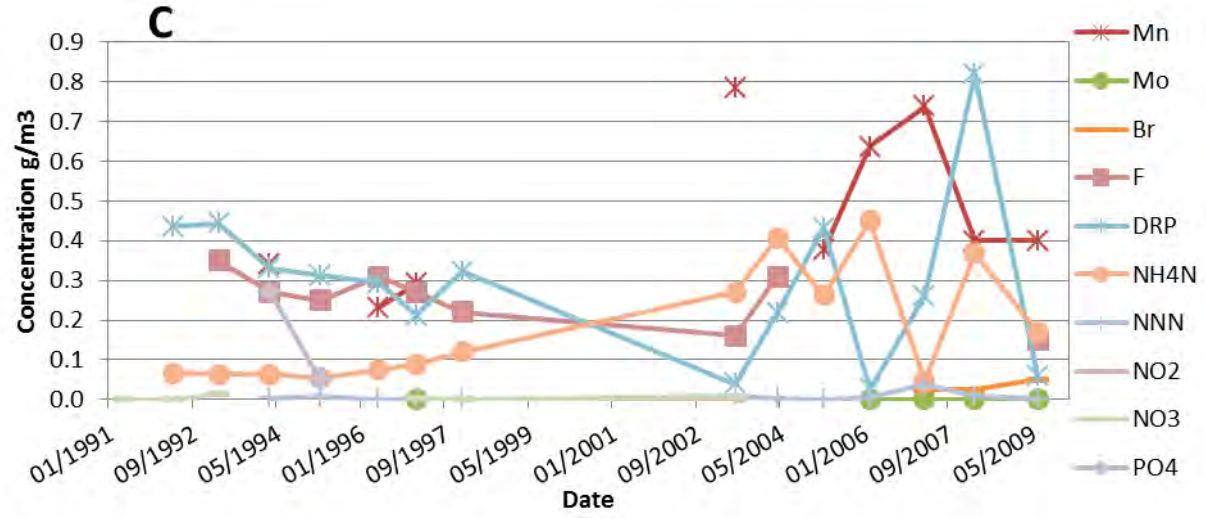
Bore 196 Information			
Monitoring type	Water quality	**Depth (m)**	19
Name	Taylor	**Casing Depth (m)**	13
Bore use	Irrigation	**Screen/open hole**	Unknown
Easting	283 8400	**Temperature**	14.6°C
Northing	630 5100	**Catchment**	Galatea
Bore log	Complete	**Aquifer**	Unknown
Monitoring period	**Water level**		
	Water quality	1991 to 2009	**LabStar:** BOP180033

The Earth Beneath our Feet model is not currently available for this region.

Bore 196 water quality graphs

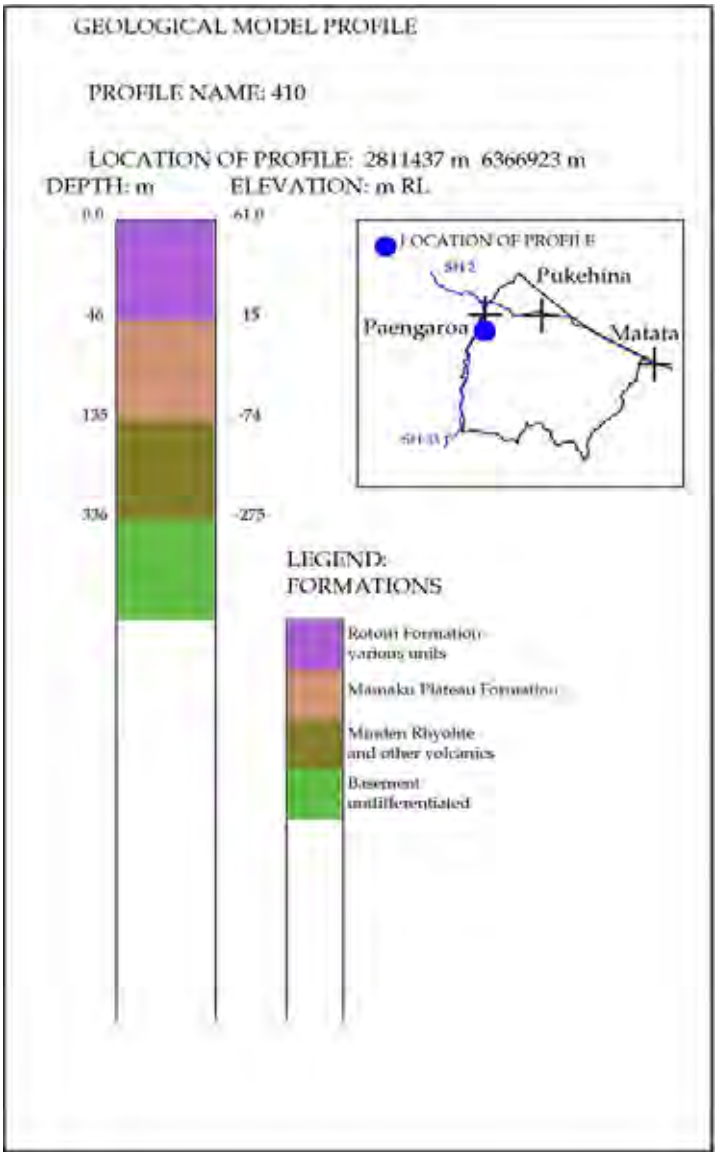




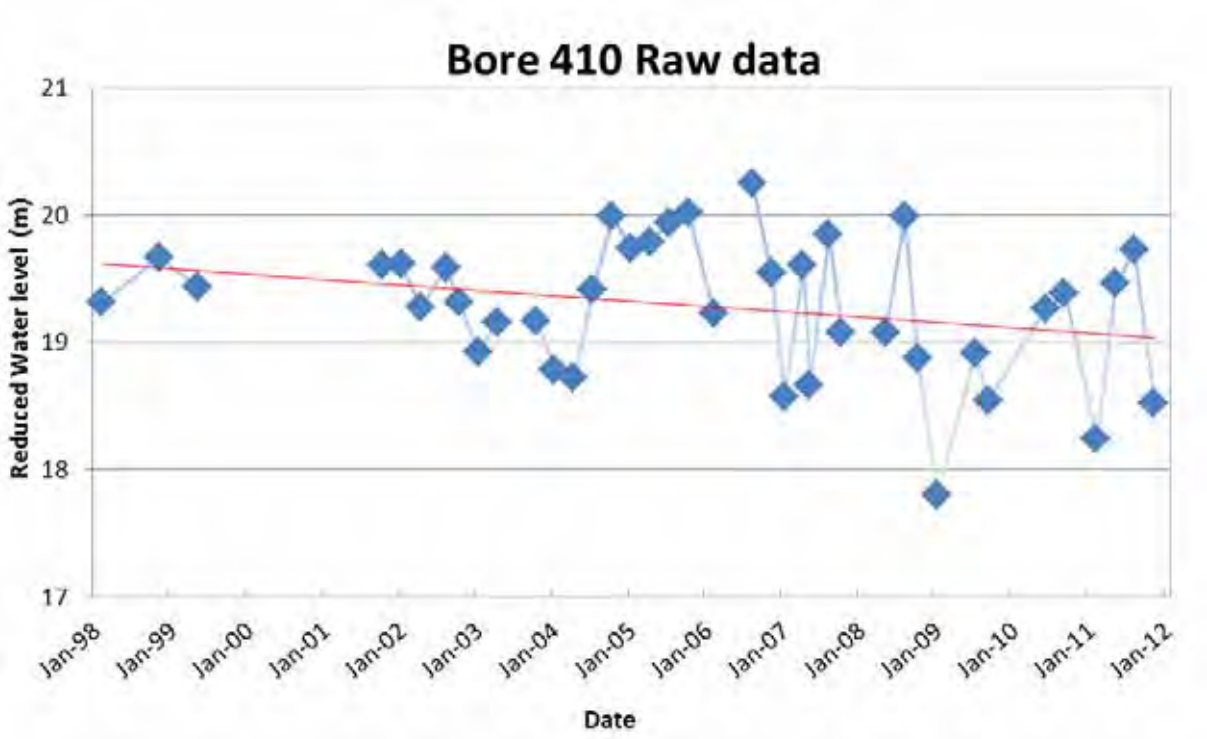


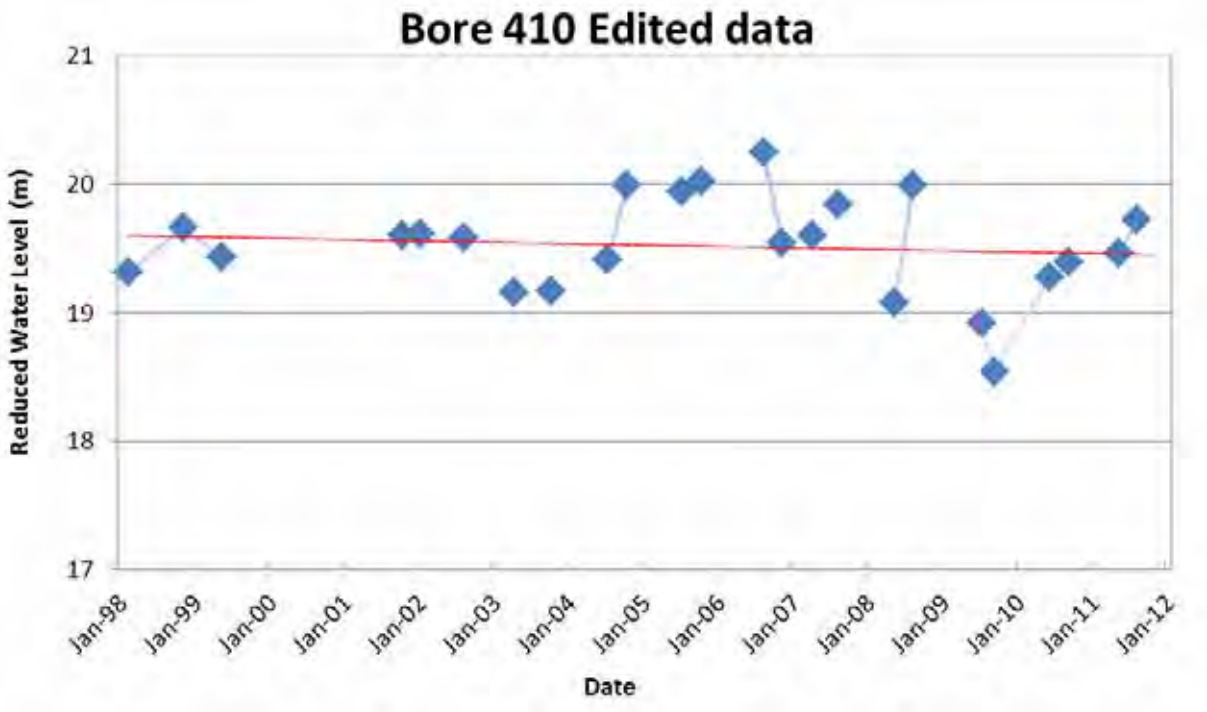
Bore 410 Information			
Monitoring type	Water level & Water quality	**Depth (m)**	196.6
Name	Bowyer	**Casing Depth (m)**	118
Bore use	Irrigation	**Screen/open hole**	Open hole
Easting	281 1437	**Temperature**	15.3°C
Northing	636 6923	**Catchment**	Kaikokopu-Pokopoko-Wharere
Bore log	Complete	**Aquifer**	Minden Rhyolite and other volcanics
Monitoring period	**Water level**	1998 to 2011	
	Water quality	1994 to 2011	**LabStar:** BOP180051

Bore 410 geological profile (EBOF)

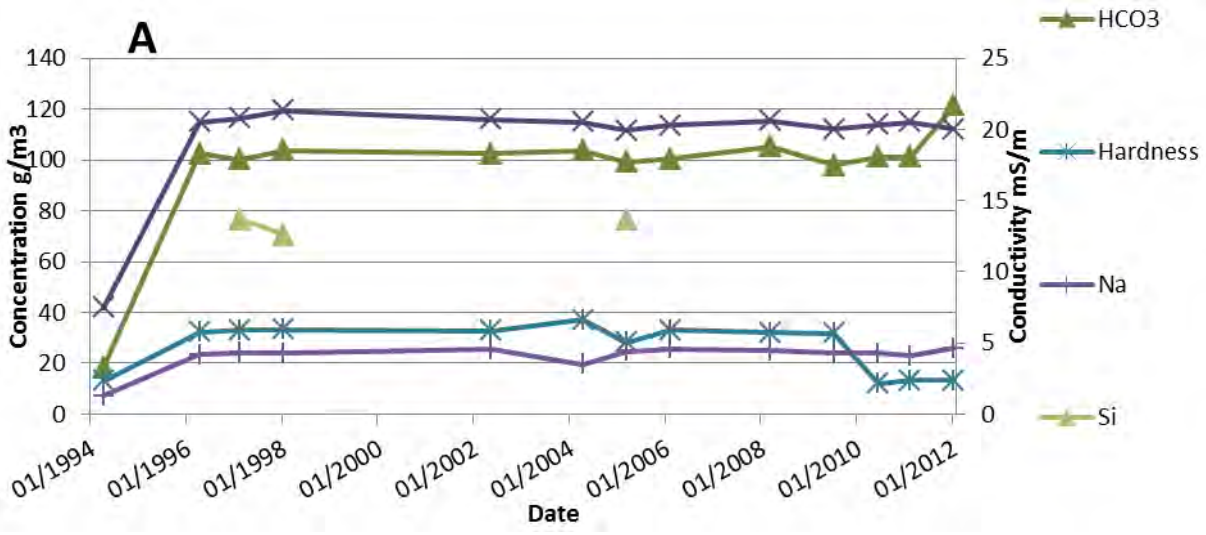


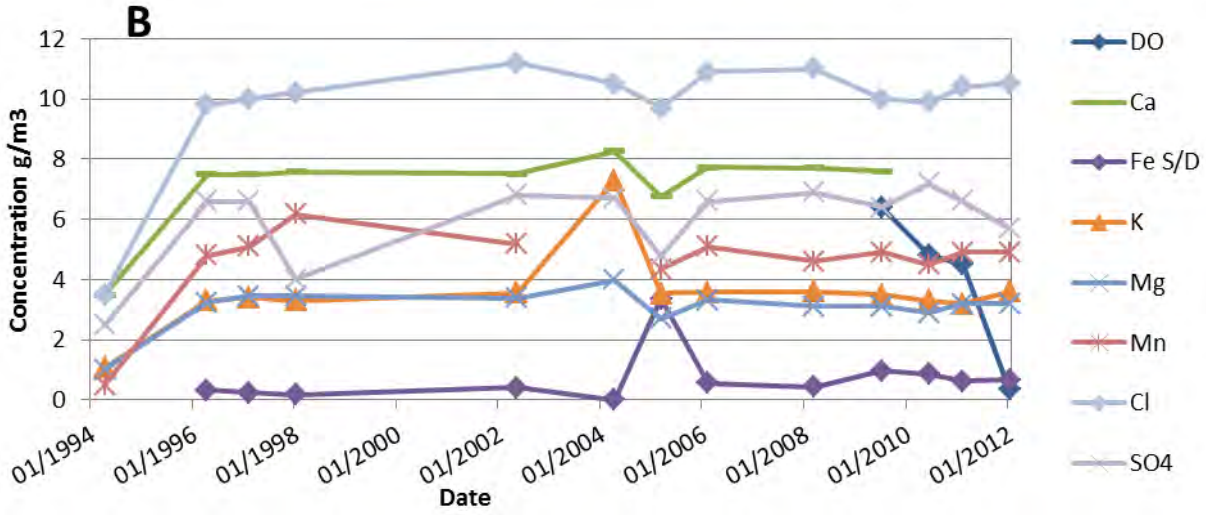
Bore 410 water level graphs

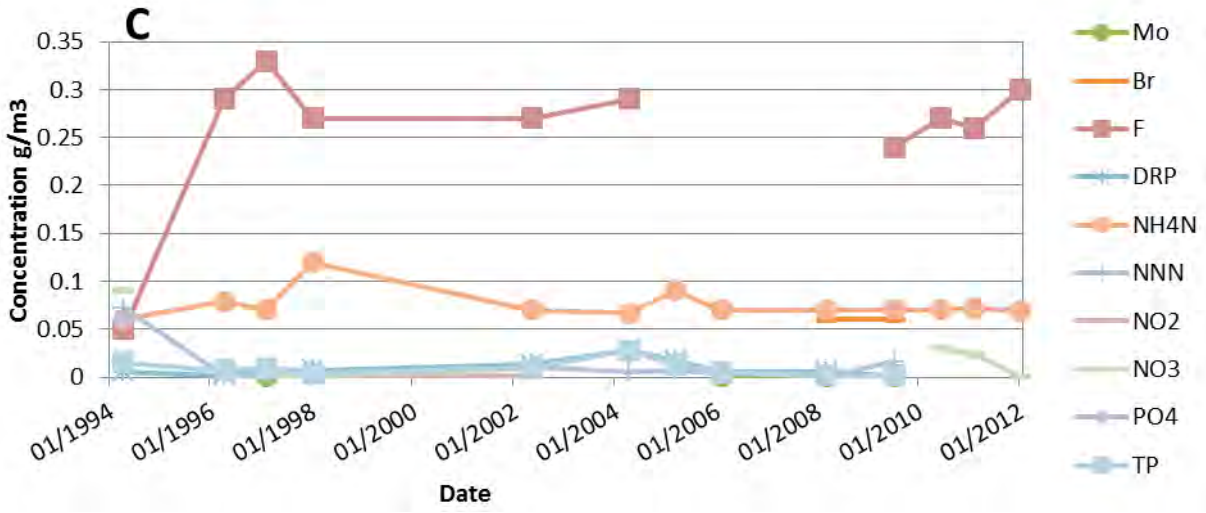




Bore 410 water quality graphs

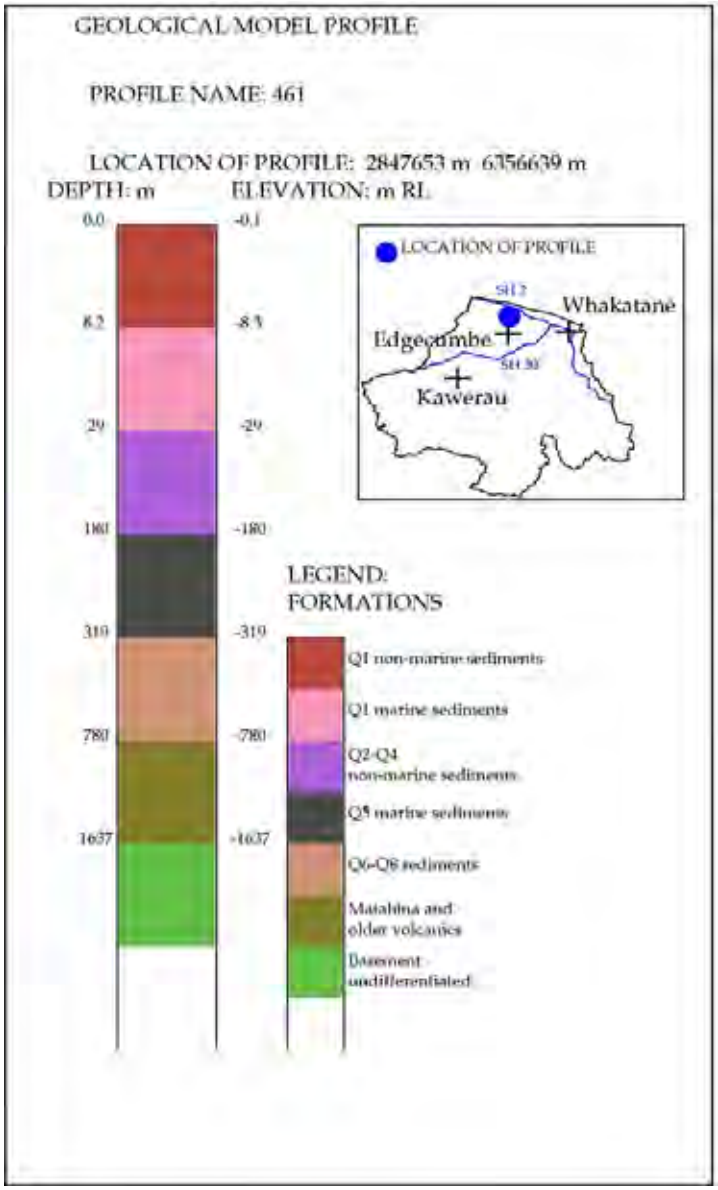


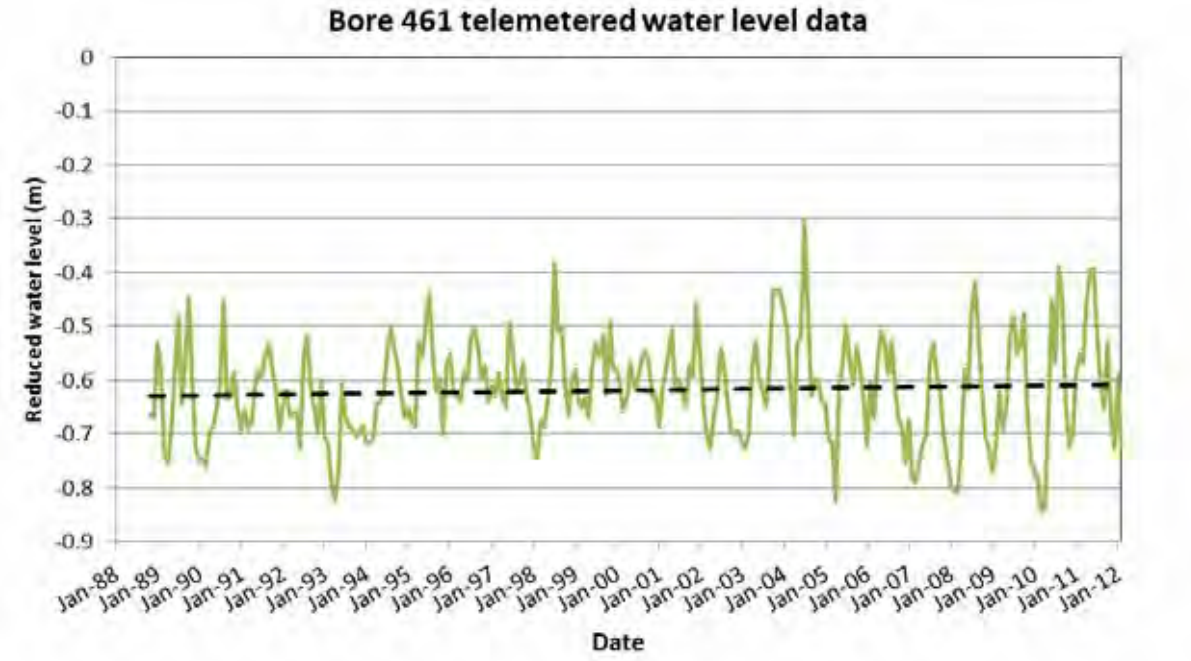


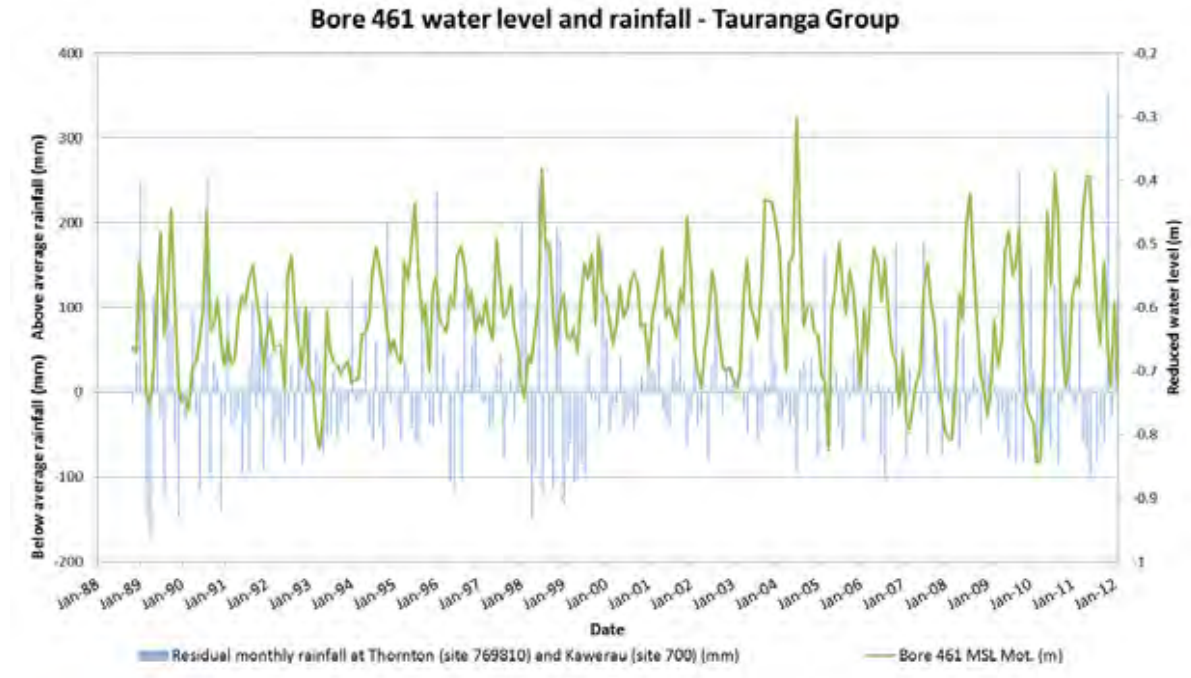


Bore 461 Information			
Monitoring type	Telemetered Water level	**Depth (m)**	12.5
Name	Byford	**Casing Depth (m)**	9.24
Bore use	Irrigation	**Screen/open hole**	screened
Easting	284 7653	**Temperature**	Unknown
Northing	635 6639	**Catchment**	
Bore log	Complete	**Aquifer**	Tauranga sediments
Monitoring period	**Water level**	1988 to 2011	
	Water quality	-	

Bore 461 geological profile (EBOF)

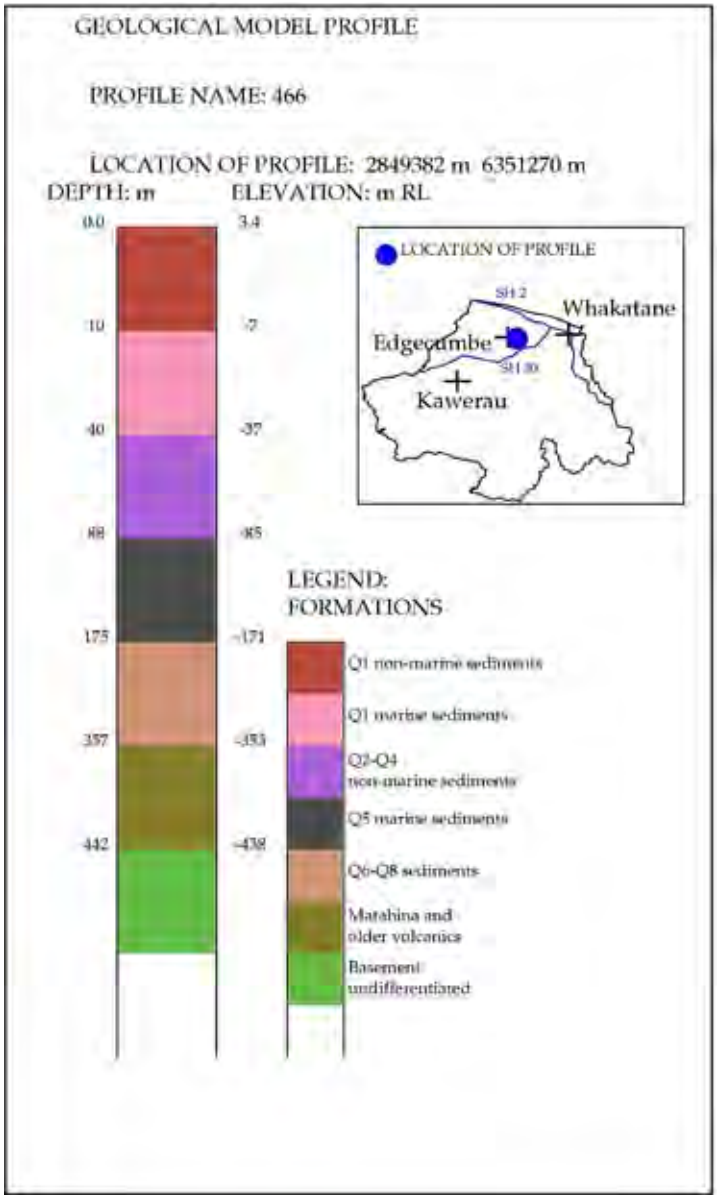



Bore 461 telemetered water level data
Reduced water level (m)
0
-0.1
-0.2
-0.3
-0.4
-0.5
-0.6
-0.7
-0.8
-0.9
Jan-88 Jan-89 Jan-90 Jan-91 Jan-92 Jan-93 Jan-94 Jan-95 Jan-96 Jan-97 Jan-98 Jan-99 Jan-00 Jan-01 Jan-02 Jan-03 Jan-04 Jan-05 Jan-06 Jan-07 Jan-08 Jan-09 Jan-10 Jan-11 Jan-12
Date

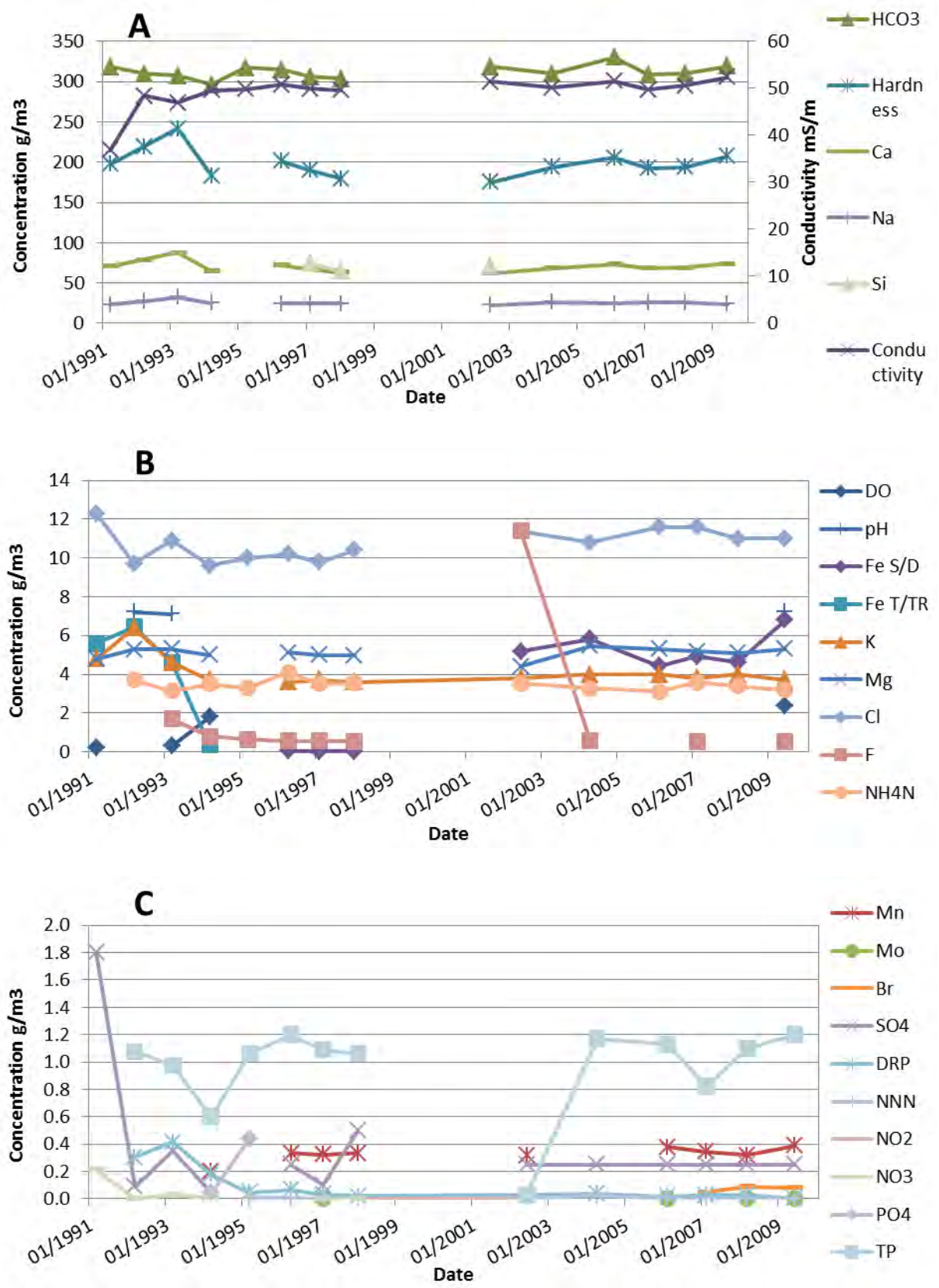

Bore 461 water level and rainfall - Tauranga Group
Below average rainfall (mm) Above average rainfall (mm)
400
300
200
100
0
-100
-200
-0.2
-0.3
-0.4
-0.5
-0.6
-0.7
-0.8
-0.9
-1
Reduced water level (m)
Jan-88 Jan-89 Jan-90 Jan-91 Jan-92 Jan-93 Jan-94 Jan-95 Jan-96 Jan-97 Jan-98 Jan-99 Jan-00 Jan-01 Jan-02 Jan-03 Jan-04 Jan-05 Jan-06 Jan-07 Jan-08 Jan-09 Jan-10 Jan-11 Jan-12
Date
Residual monthly rainfall at Thornton (site 769810) and Kawerau (site 700) (mm)
Bore 461 MSL Mot. (m)

Bore 466 Information			
Monitoring type	Water quality	**Depth (m)**	16 .8
Name	Rogers	**Casing Depth (m)**	12.81
Bore use	Irrigation	**Screen/open hole**	Screened
Easting	284 9382	**Temperature**	16.8°C
Northing	635 1270	**Catchment**	
Bore log	Complete	**Aquifer**	Tauranga sediment
Monitoring period	**Water level**		
	Water quality	1991 to 2009	**LabStar:** BOP180006

Bore 466 geological profile (EBOF)

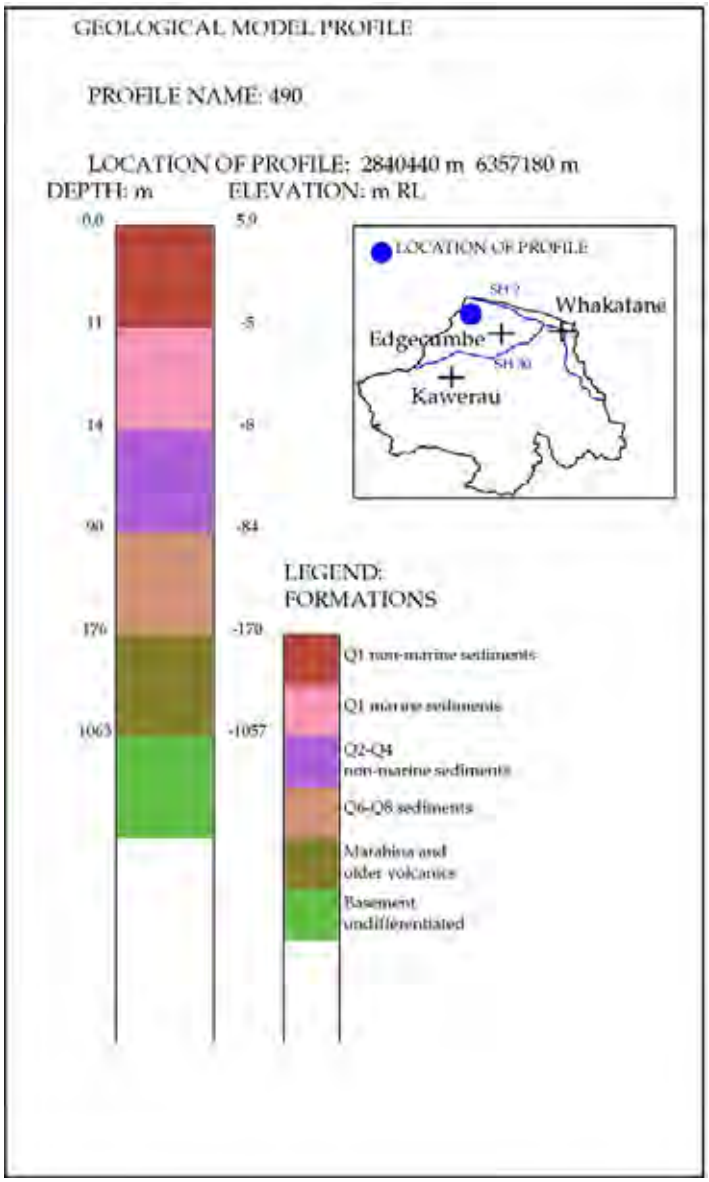


Bore 466 water quality graphs

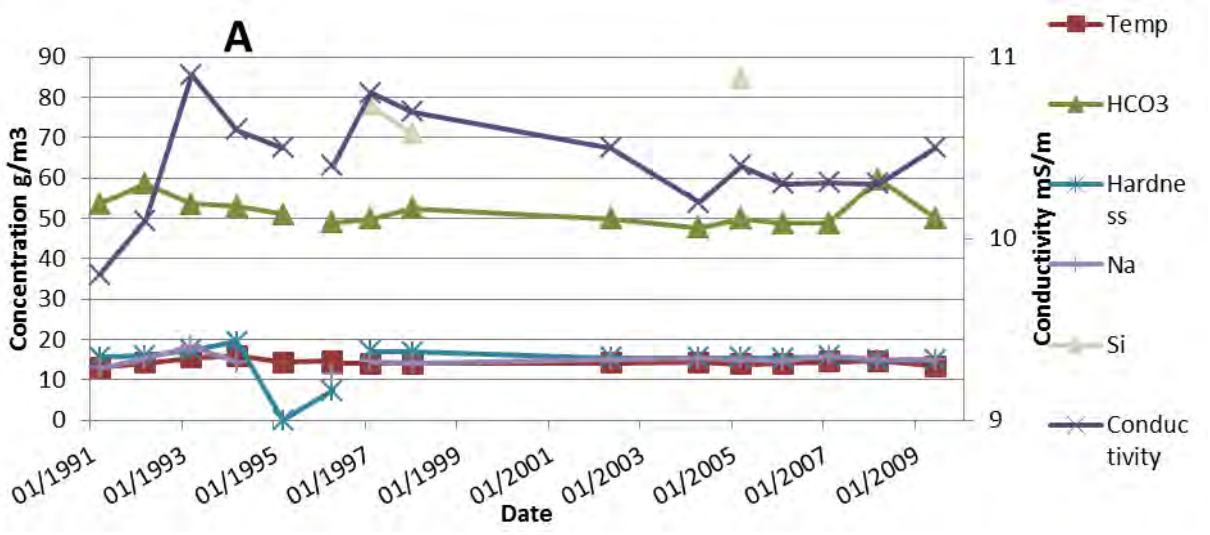


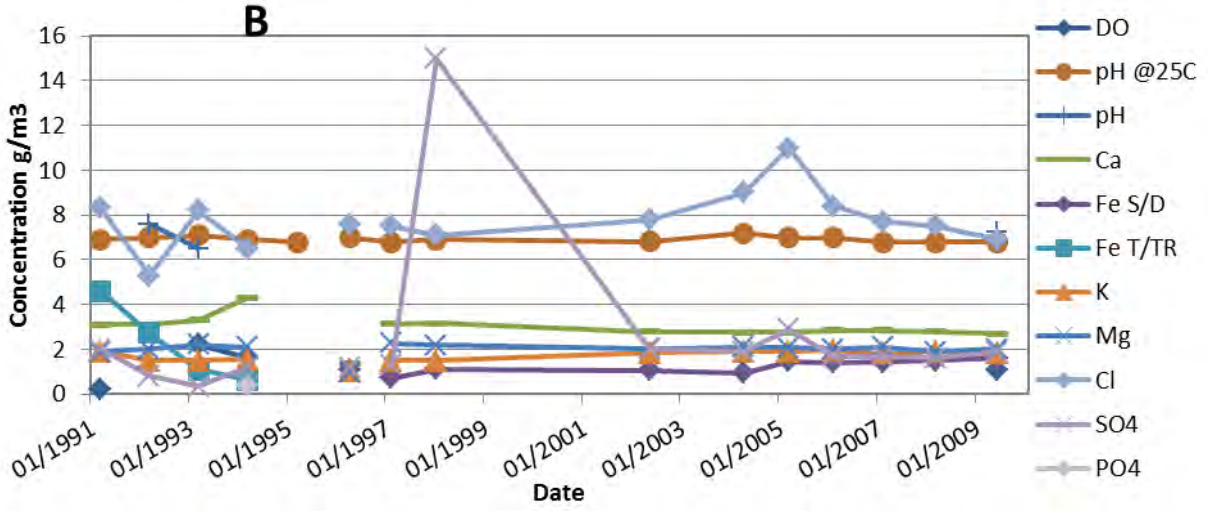
Bore 490 Information			
Monitoring type	Water quality	**Depth (m)**	73
Name	Muller	**Casing Depth (m)**	57.13
Bore use	Irrigation	**Screen/open hole**	
Easting	284 0440	**Temperature**	14°C
Northing	635 7180	**Catchment**	
Bore log	Complete	**Aquifer**	Tauranga sediments
Monitoring period	**Water level**		
	Water quality	1991 to 2009	**LabStar:** BOP180003

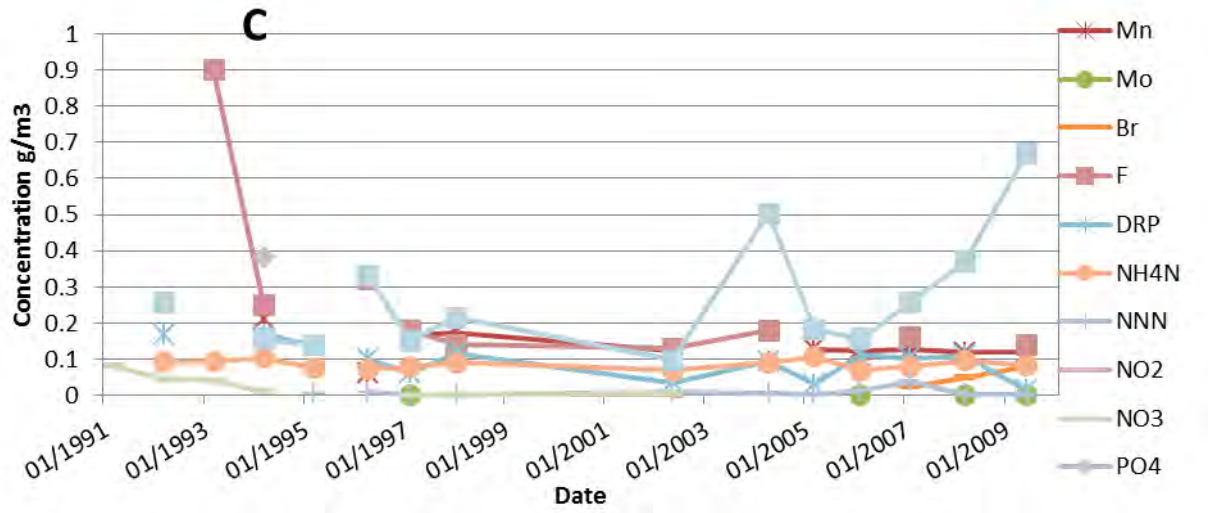
Bore 490 geological profile (EF)



Bore 490 water quality graphs

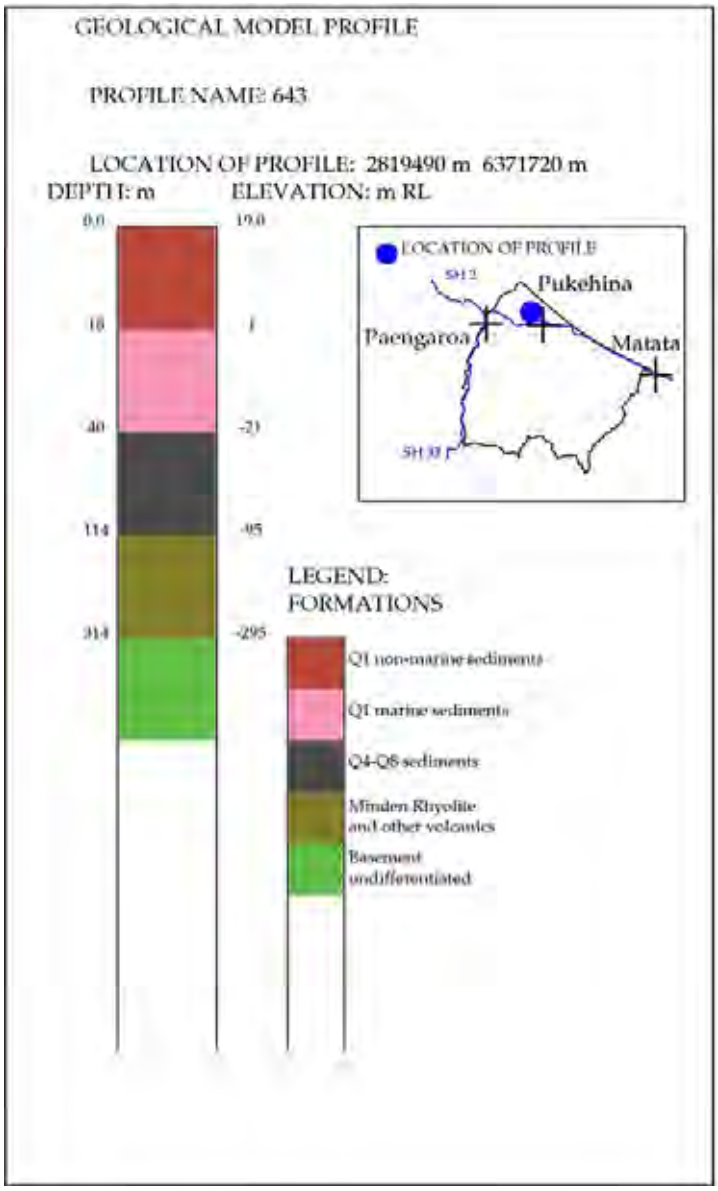




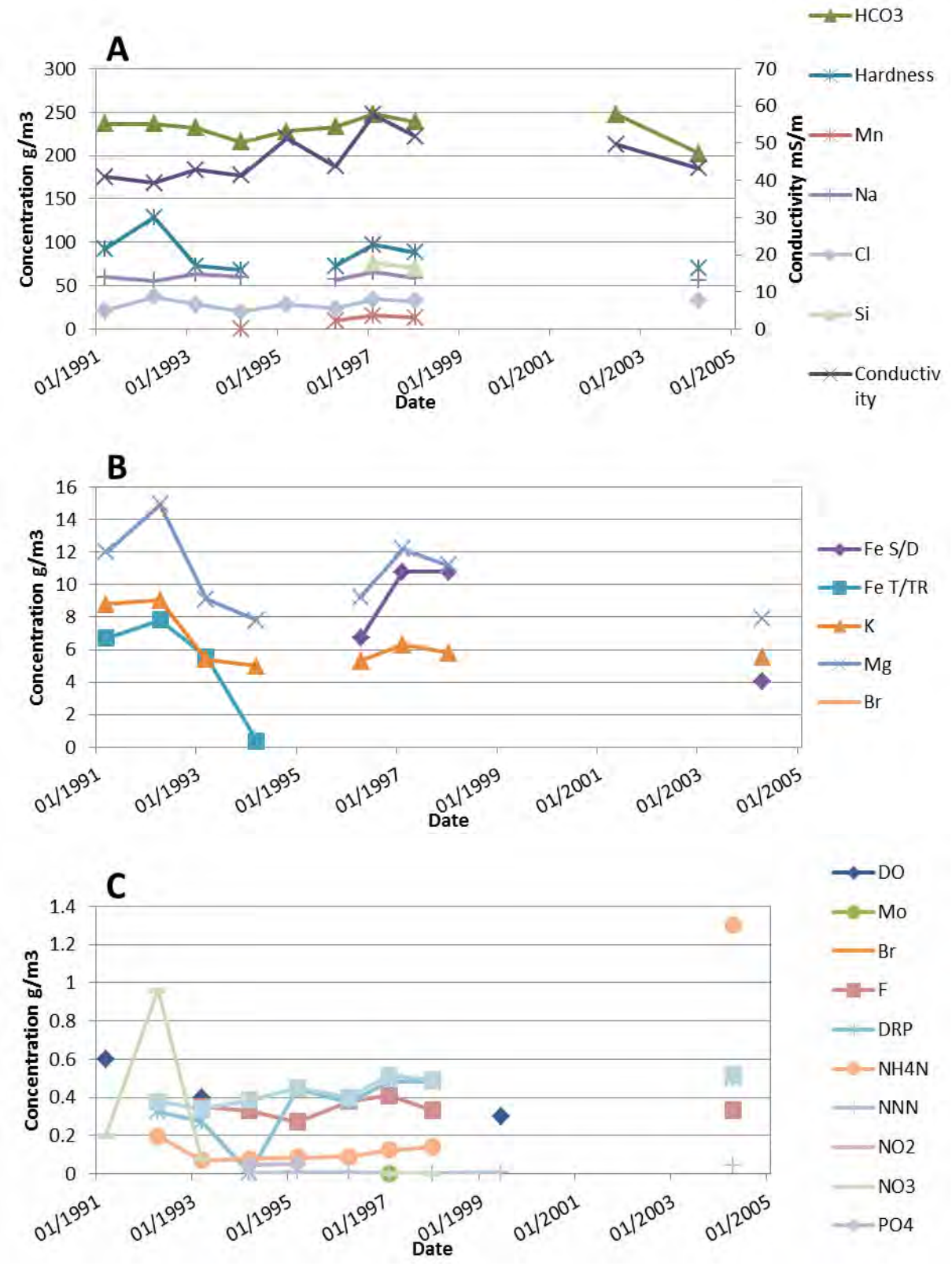


Bore 643 Information			
Monitoring type	Water quality	**Depth (m)**	9
Name	Watts	**Casing Depth (m)**	7
Bore use	Irrigation	**Screen/open hole**	screened
Easting	2819490	**Temperature**	15°C
Northing	6371720	**Catchment**	Pukehina
Bore log	partial	**Aquifer**	Tauranga sediments
Monitoring period	**Water level**	-	
	Water quality	1991 to 2004	**LabStar:** BOP180008

Bore 643 geological profile (EBOF)

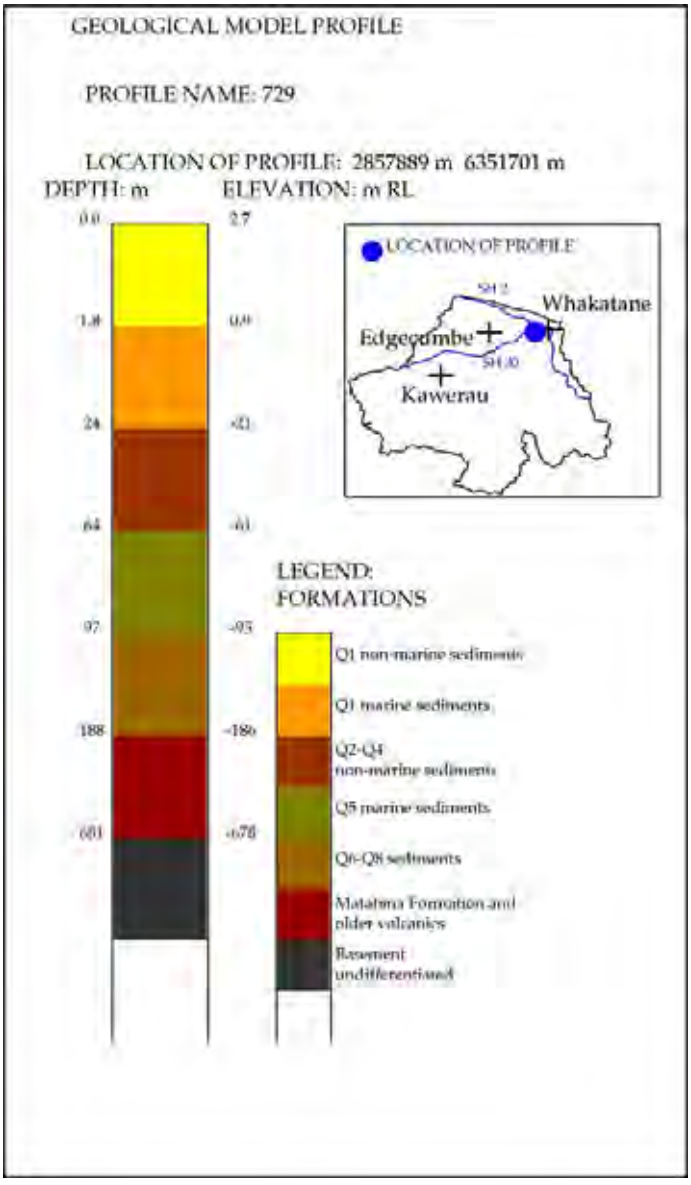


Bore 643 water quality graphs

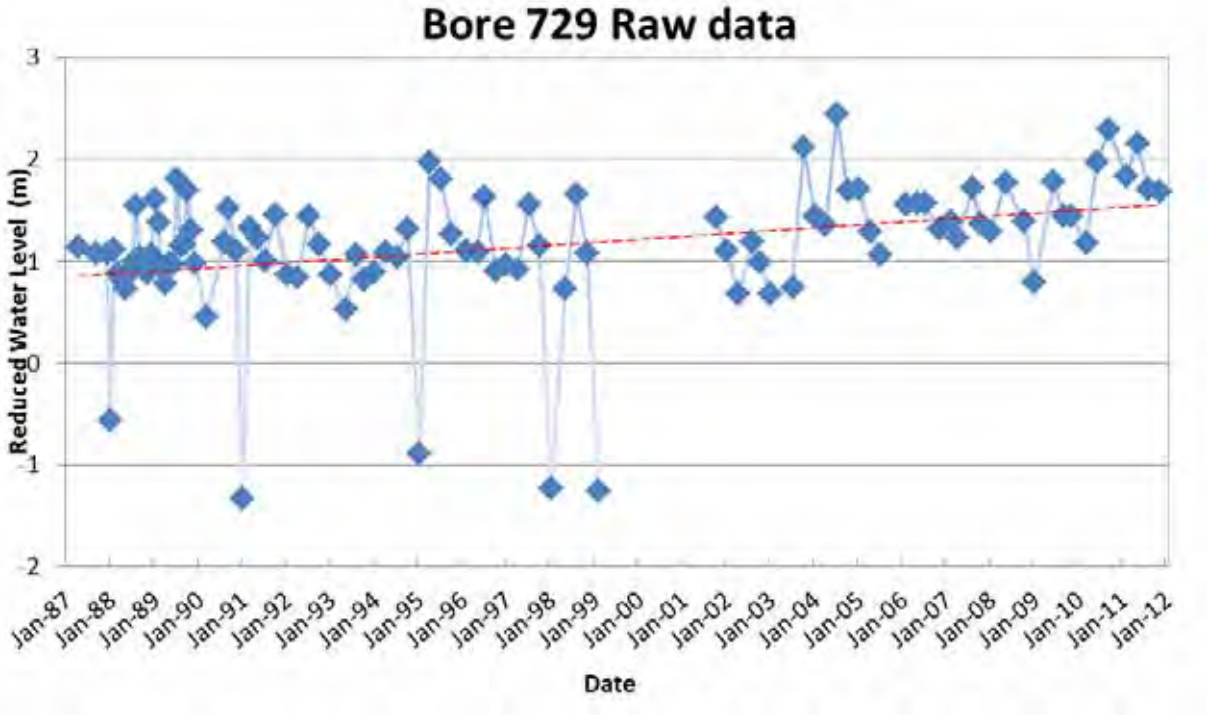


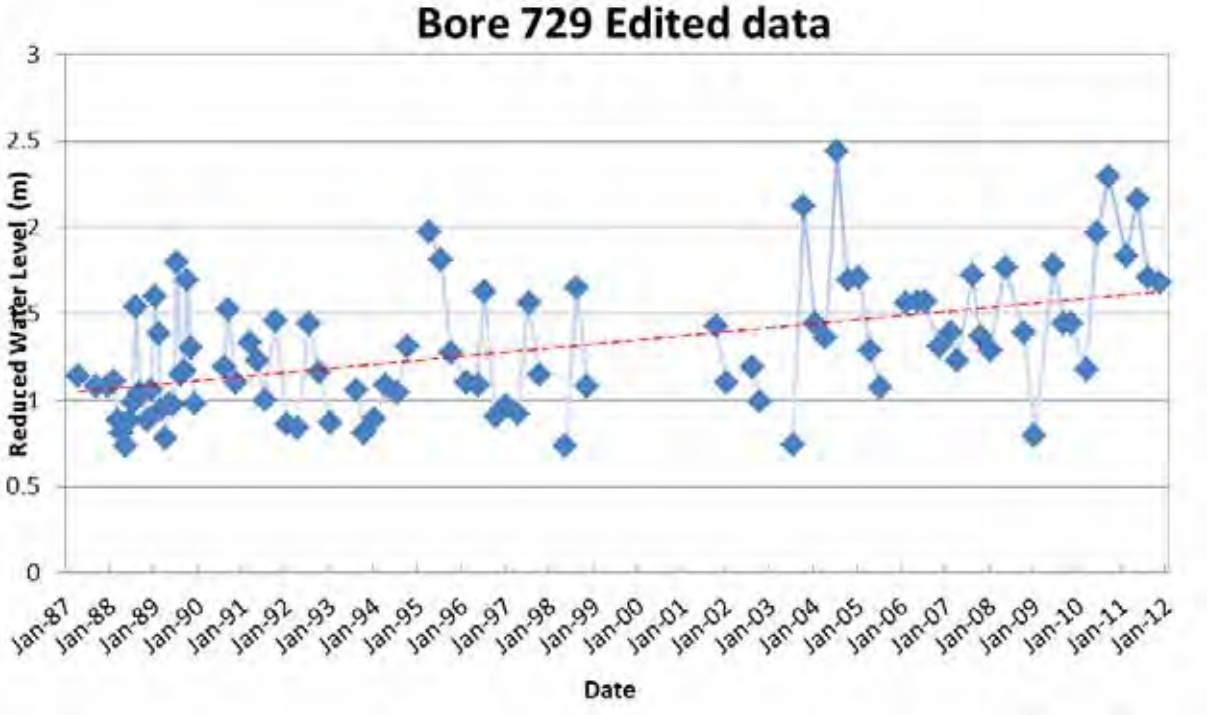
Bore 729 Information			
Monitoring type	Water level	**Depth (m)**	12.8
Name.	Schlepers	**Casing Depth (m)**	9.8
Bore use	Irrigation	**Screen/open hole**	Screened
Easting	285 7889	**Temperature**	Unknown
Northing	635 1701	**Catchment**	Whakatane
Bore log	Complete	**Aquifer**	Tauranga sediments
Monitoring period	**Water level**	1987 to 2011	
	Water quality		

Bore 729 geological profile (EBOF)



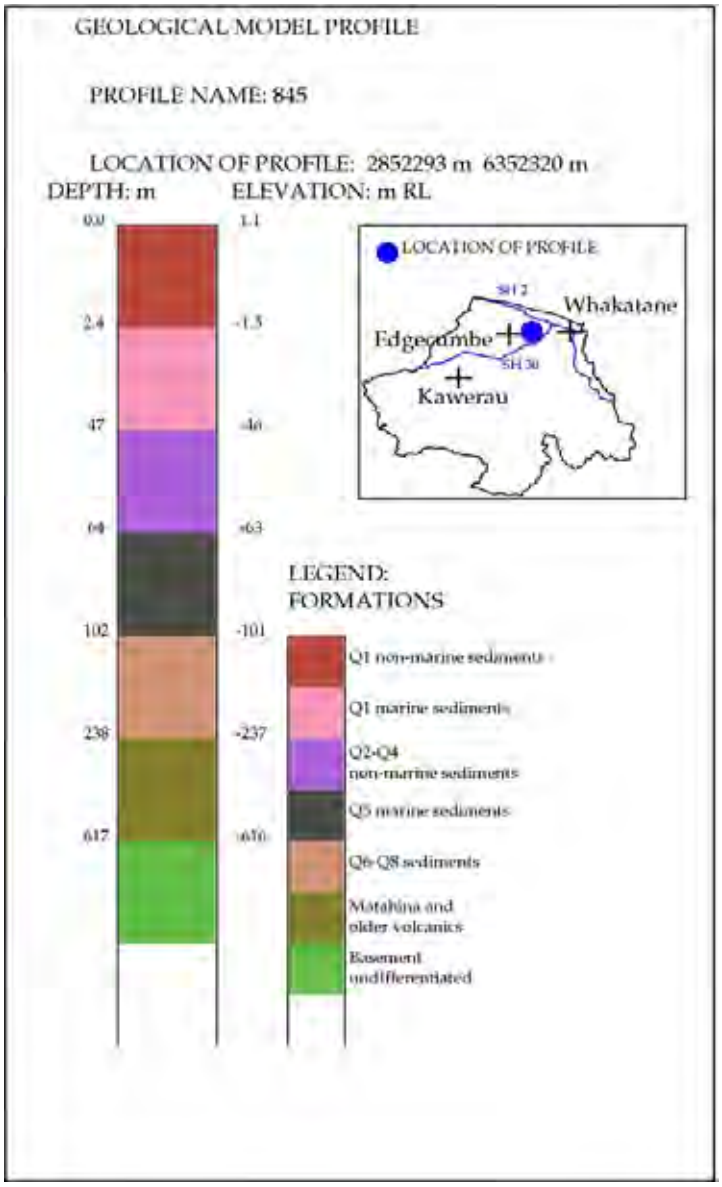
Bore 729 water level graphs



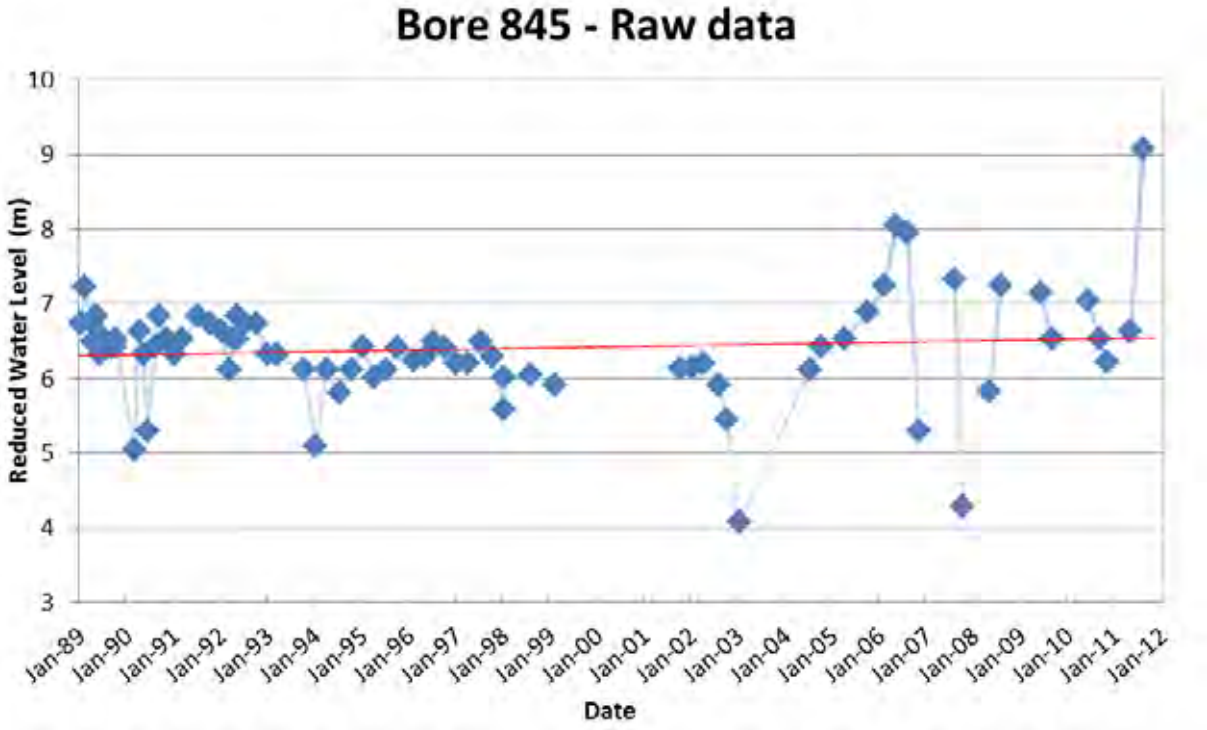


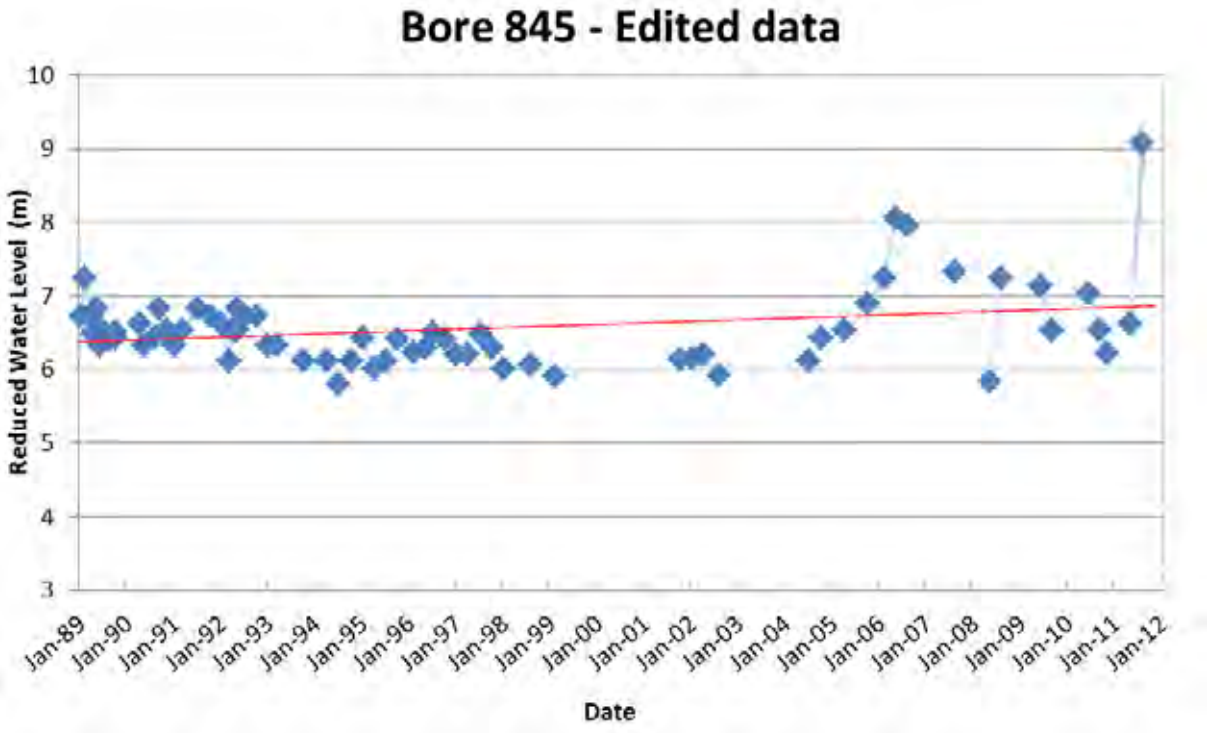
Bore 845 Information			
Monitoring type	Water level	**Depth (m)**	173
Name	Bonner	**Casing Depth (m)**	161.6
Bore use	Irrigation	**Screen/open hole**	From 161 to 173
Easting	285 2293	**Temperature**	28.1°C
Northing	635 2320	**Catchment**	Awakeri
Bore log	Complete	**Aquifer**	Tauranga sediments
Monitoring period	**Water level**	1989 to 2011	
	Water quality		

Bore 845 geological profile (EBOF)



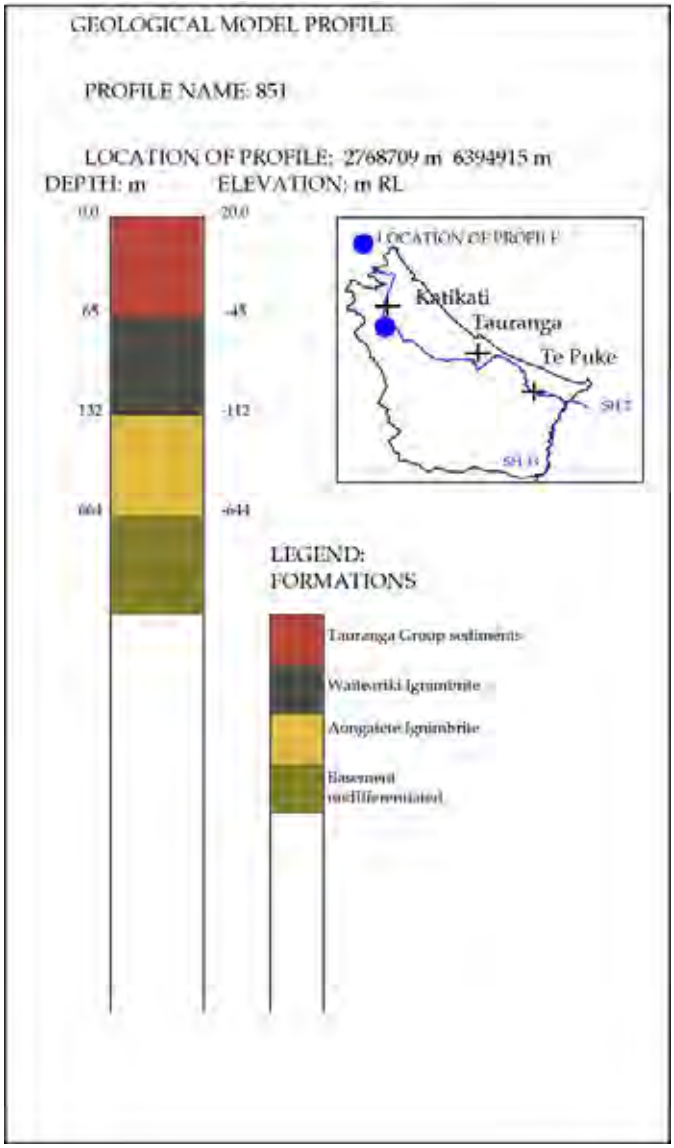
Bore 845 water level graphs



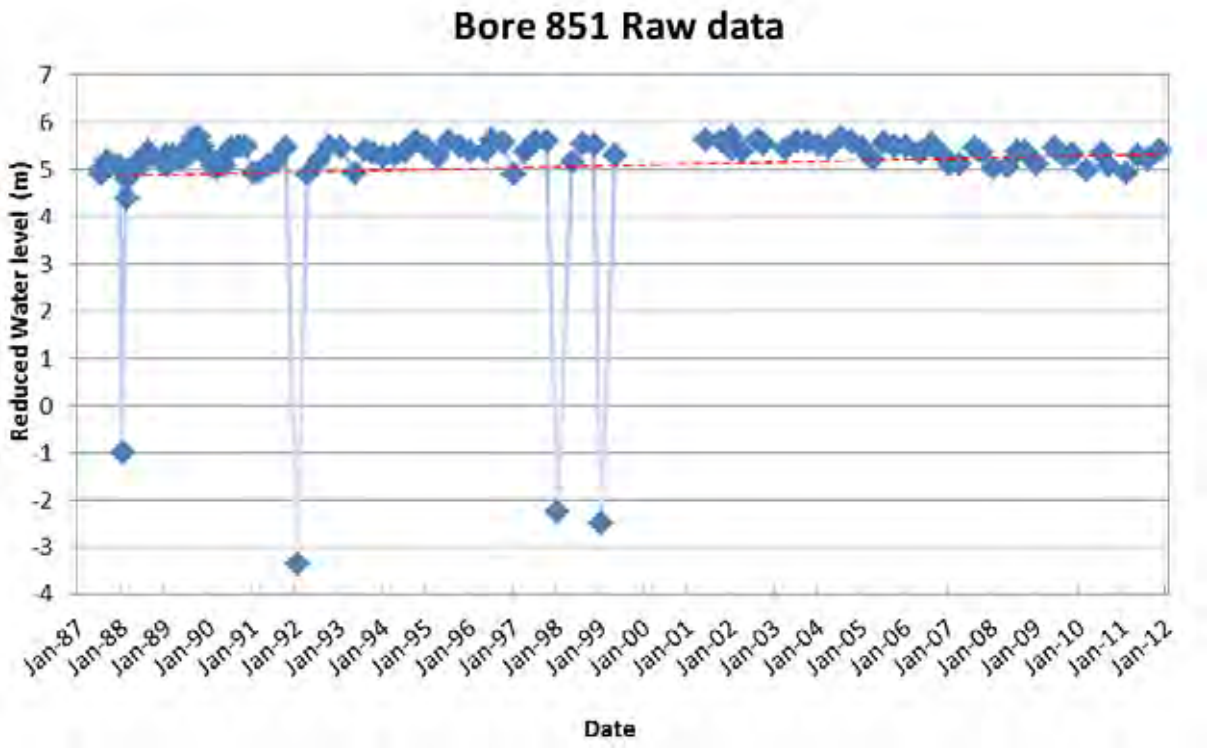


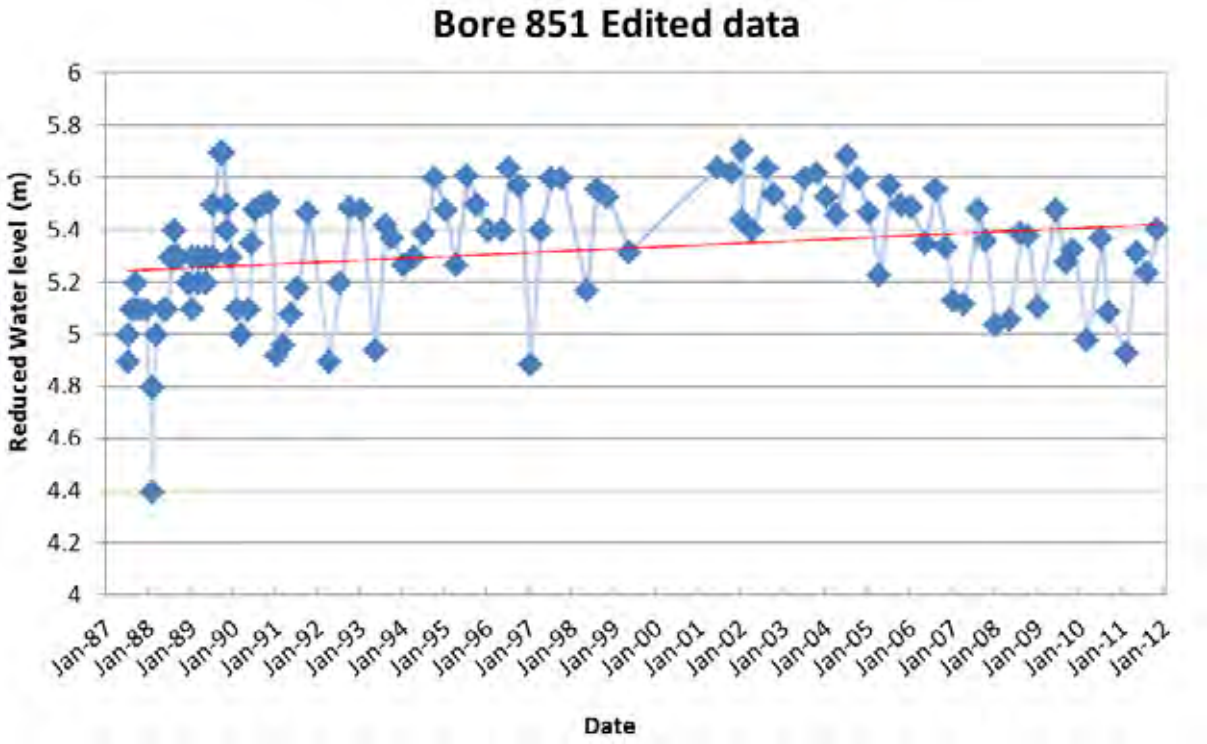
Bore 851 Information			
Monitoring type	Water level and Water quality	**Depth (m)**	97.5
Name	Cook	**Casing Depth (m)**	75.3
Bore use	Irrigation	**Screen/open hole**	screened
Easting	2768709	**Temperature**	19.6°C
Northing	6394915	**Catchment**	Aongatete
Bore log	Complete	**Aquifer**	Waitekariki (WAI)
Monitoring period	**Water level**	1987 to 2011	
	Water quality	1991 to 2004	**LabStar:** BOP180020

Bore 851 geological profile (EBOF)

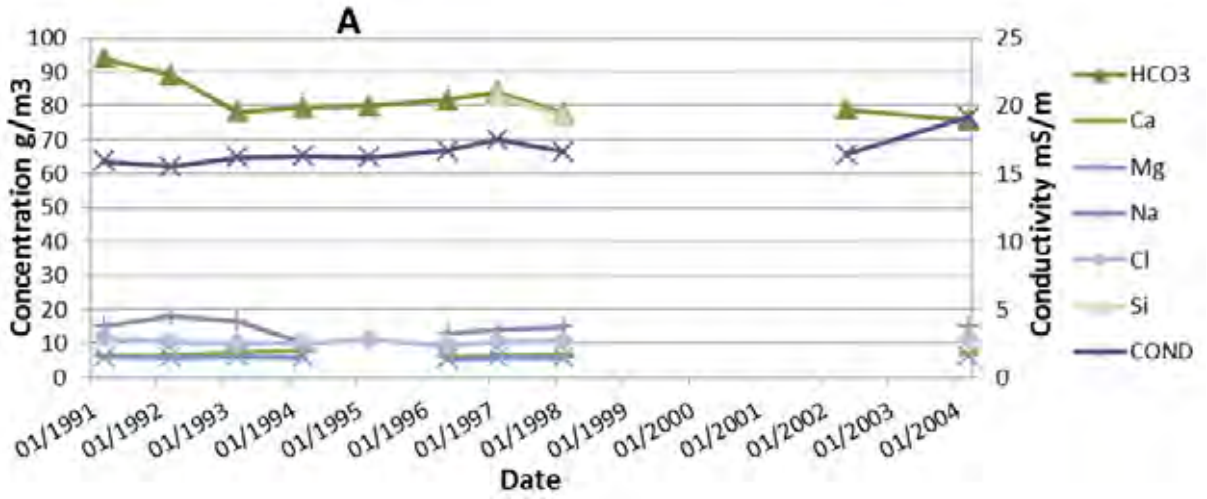


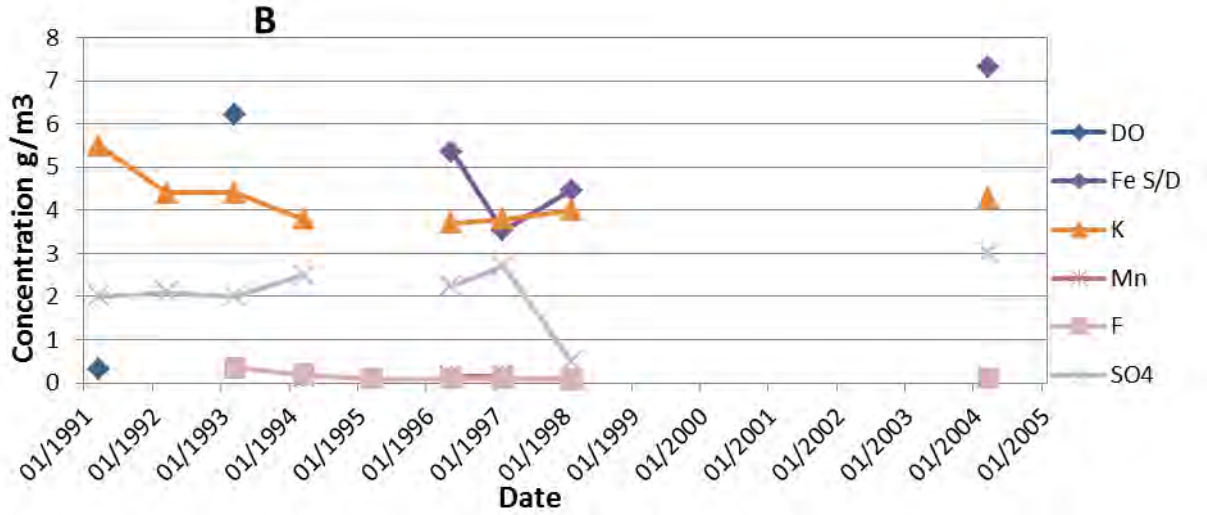
Bore 851 water level graphs

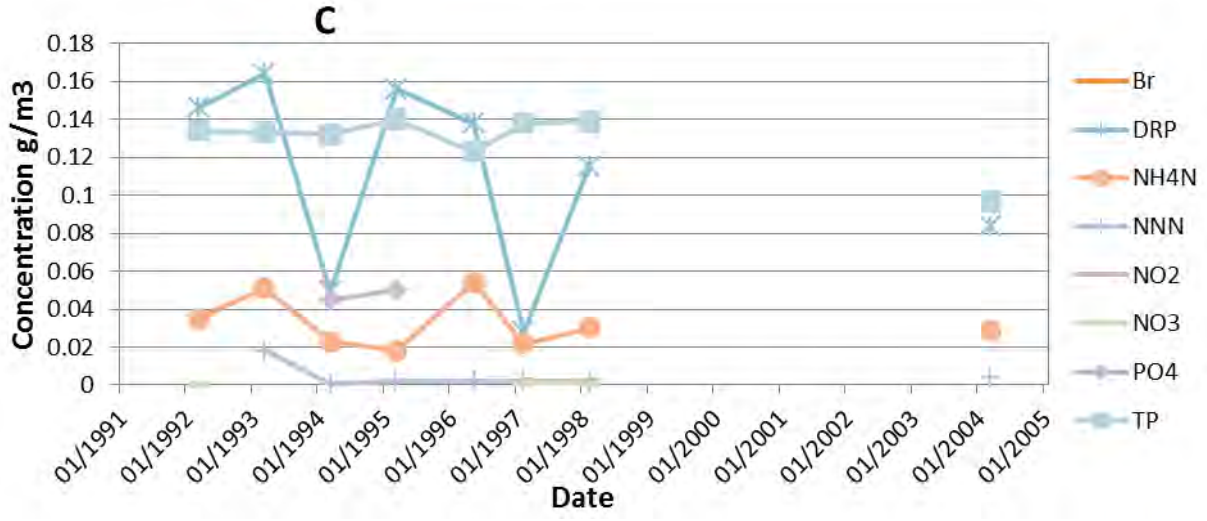




Bore 851 water quality graphs

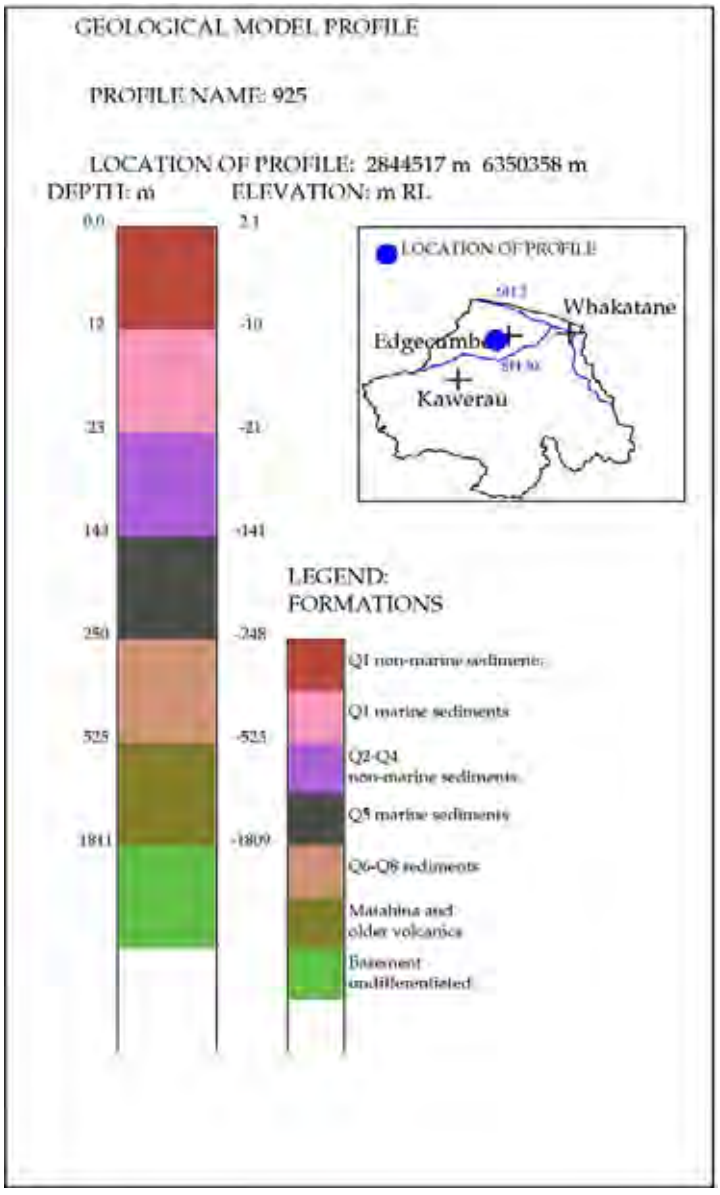




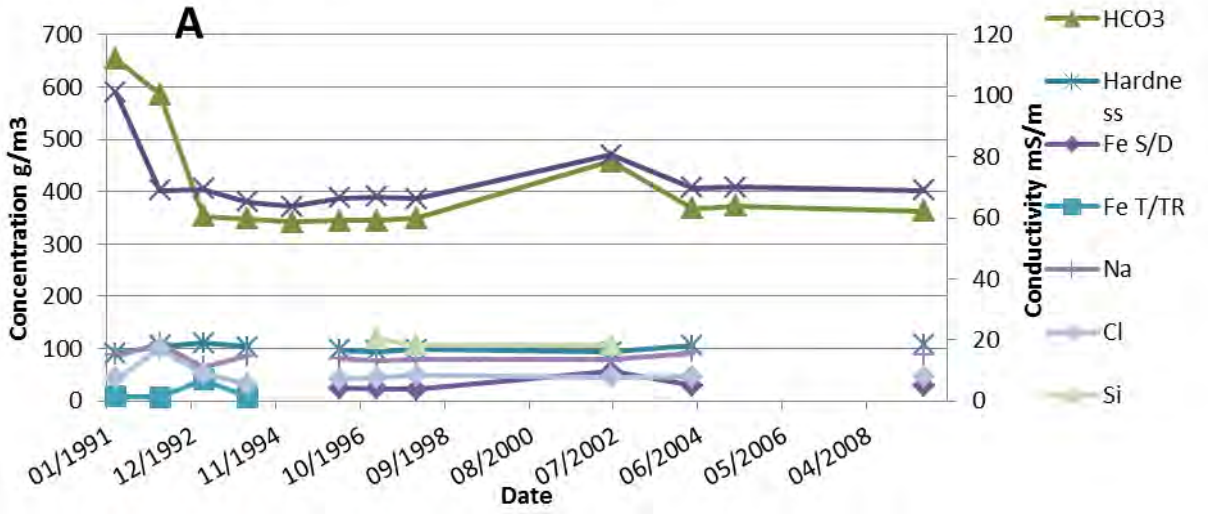


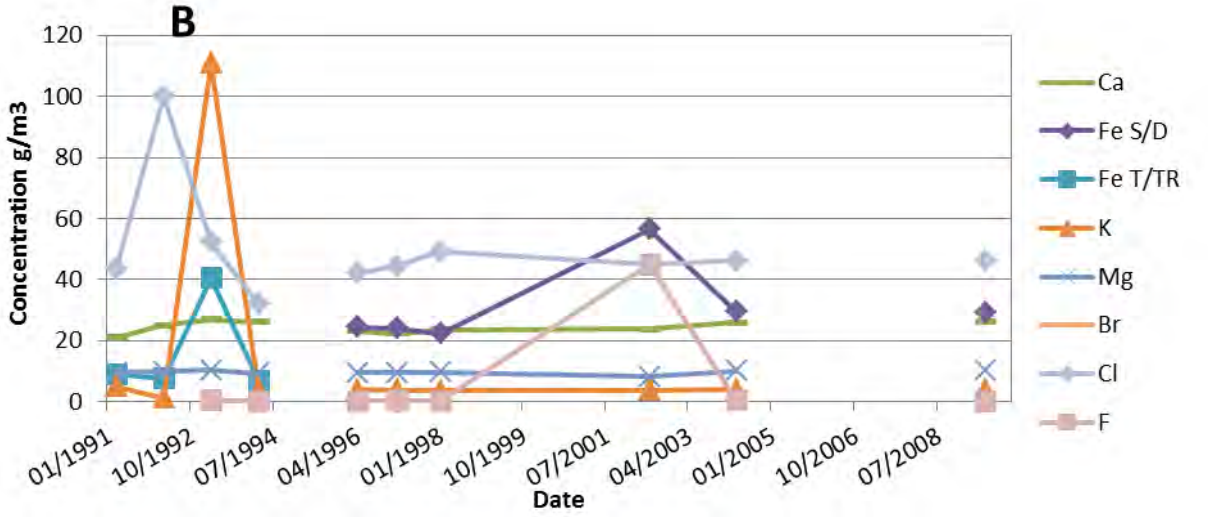
Bore 925 Information			
Monitoring type	Water quality	**Depth (m)**	32
Name	Mayes	**Casing Depth (m)**	26.1
Bore use	Irrigation	**Screen/open hole**	Screened
Easting	284 4517	**Temperature**	19.6°C
Northing	635 0358	**Catchment**	Awaiti Canal
Bore log	Complete	**Aquifer**	Tauranga sediments
Monitoring period	**Water level**		
	Water quality	1991 to 2009	**LabStar:** BOP180014

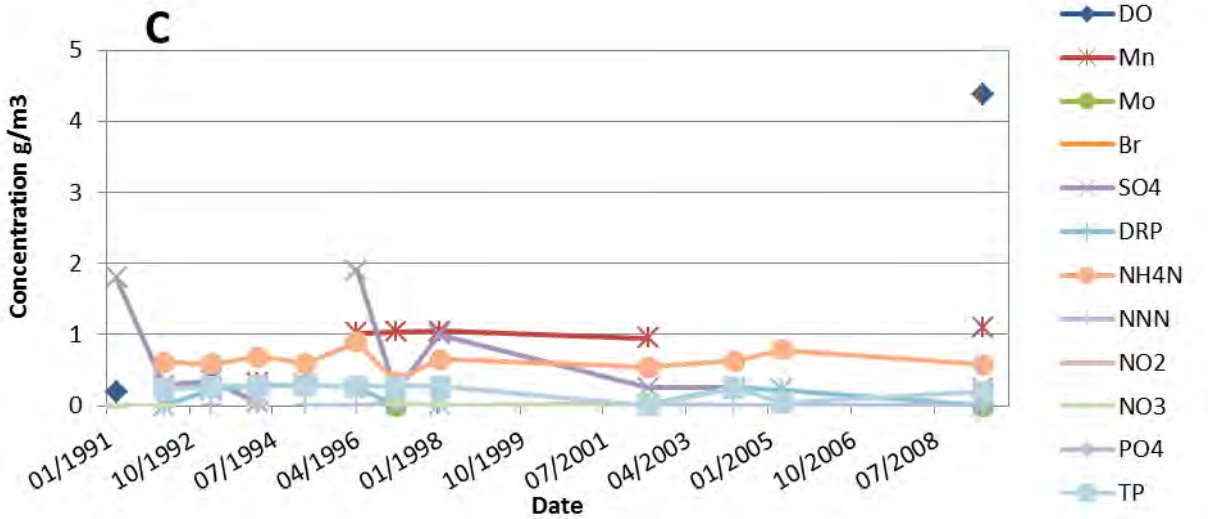
Bore 925 geological profile (EBOF)



Bore 925 water quality graphs

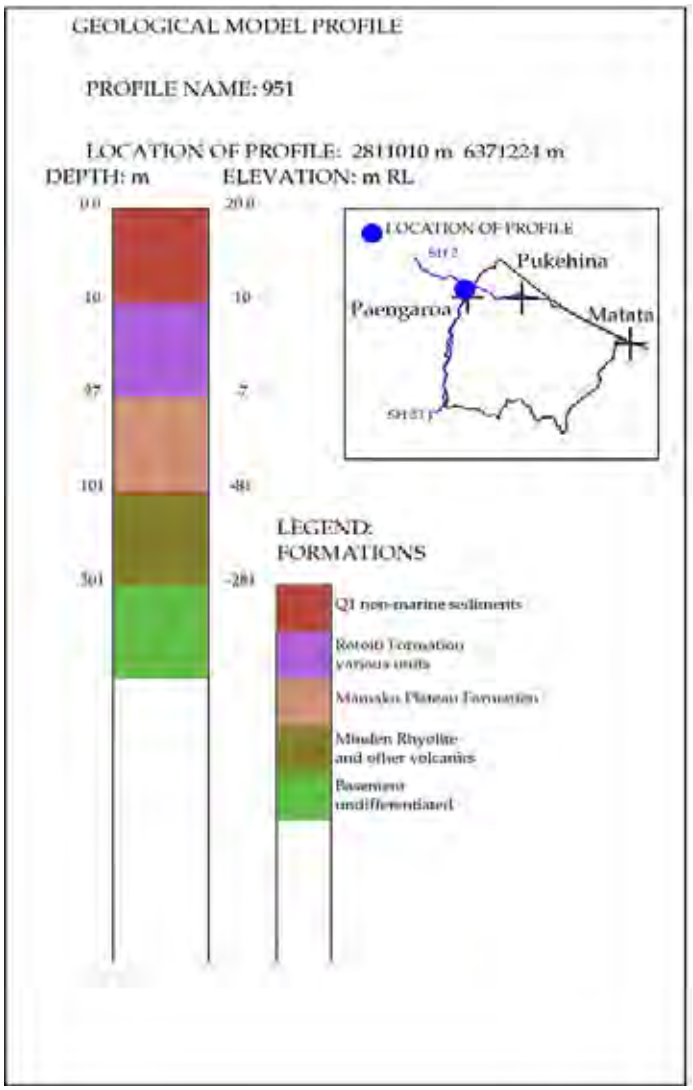




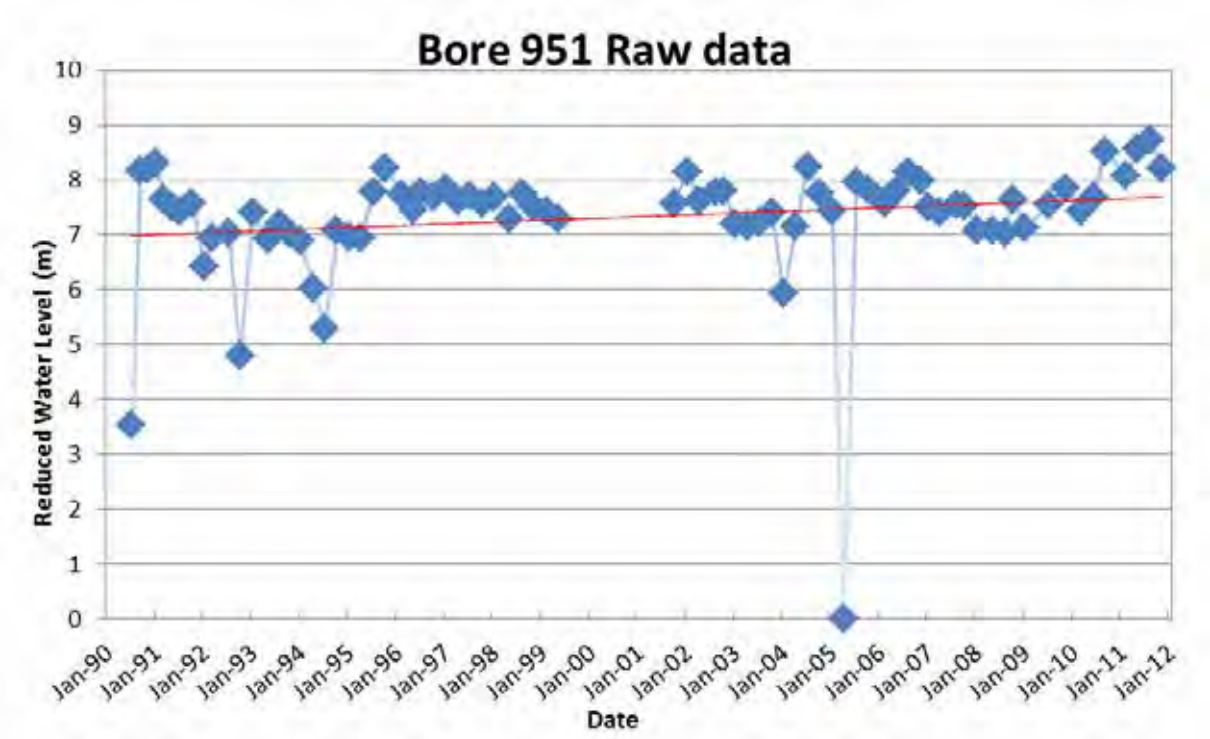


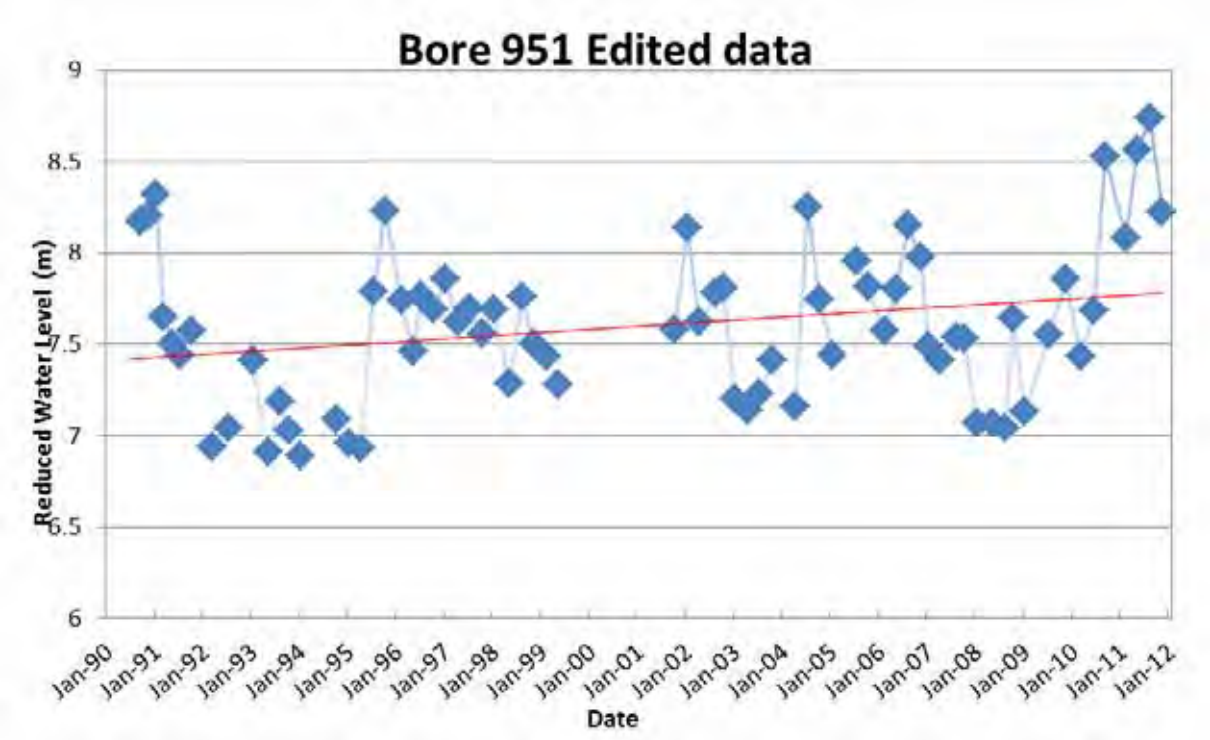
Bore 951 Information			
Monitoring type	Water level and Water quality	**Depth (m)**	114
Name	Paengaroa North K Trust	**Casing Depth (m)**	86.3
Bore use	Irrigation	**Screen/open hole**	From 86 to 114
Easting	281 1010	**Temperature**	24.8°C
Northing	637 1224	**Catchment**	Kaikokopu-Pokopoko-Wharere
Bore log	Complete	**Aquifer**	Mamaku Plateau Formation
Monitoring period	**Water level**	1990 to 2011	
	Water quality	1991 to 2011	**LabStar No.:**BOP180035

Bore 951 geological profile (EBOF)

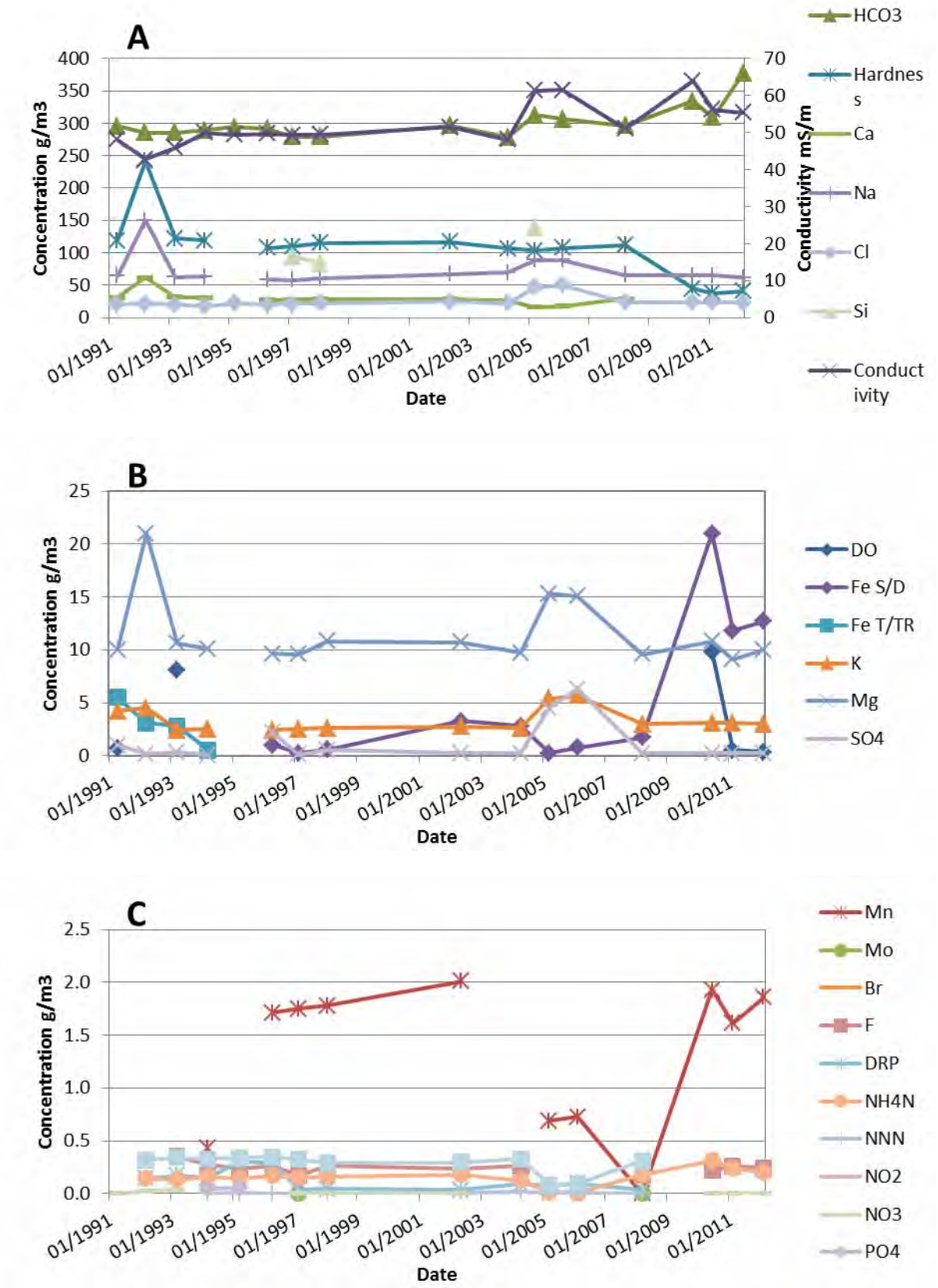


Bore 951 water level graphs



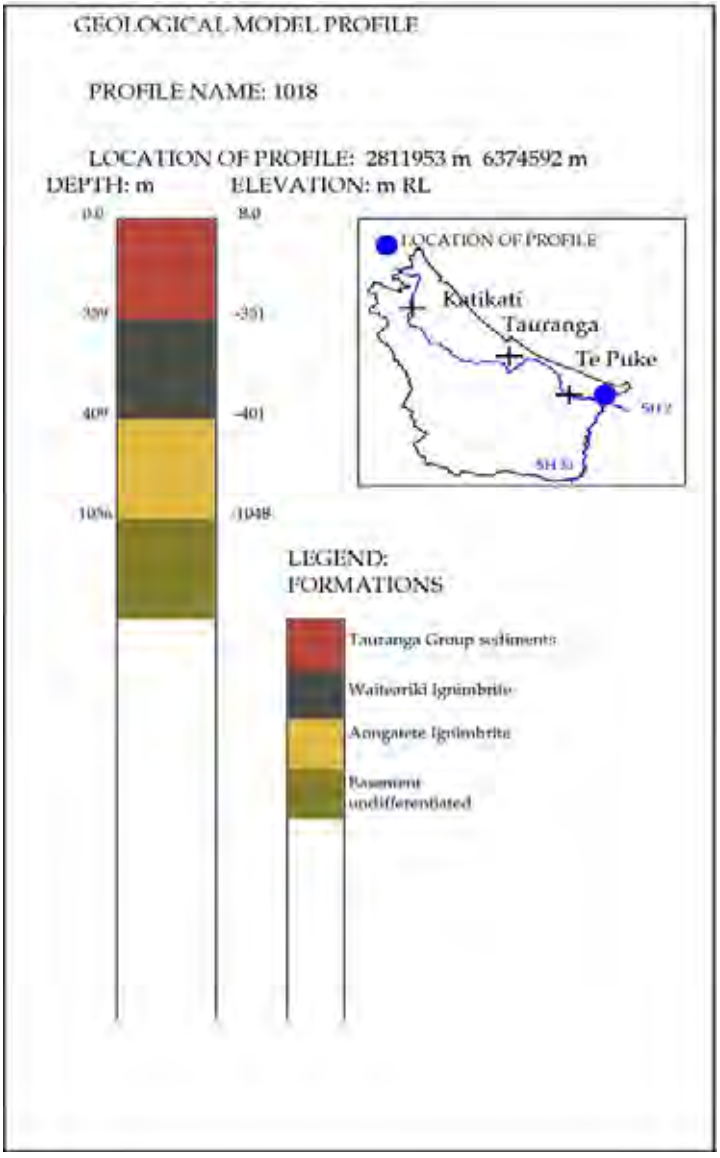


Bore 951 water quality graphs

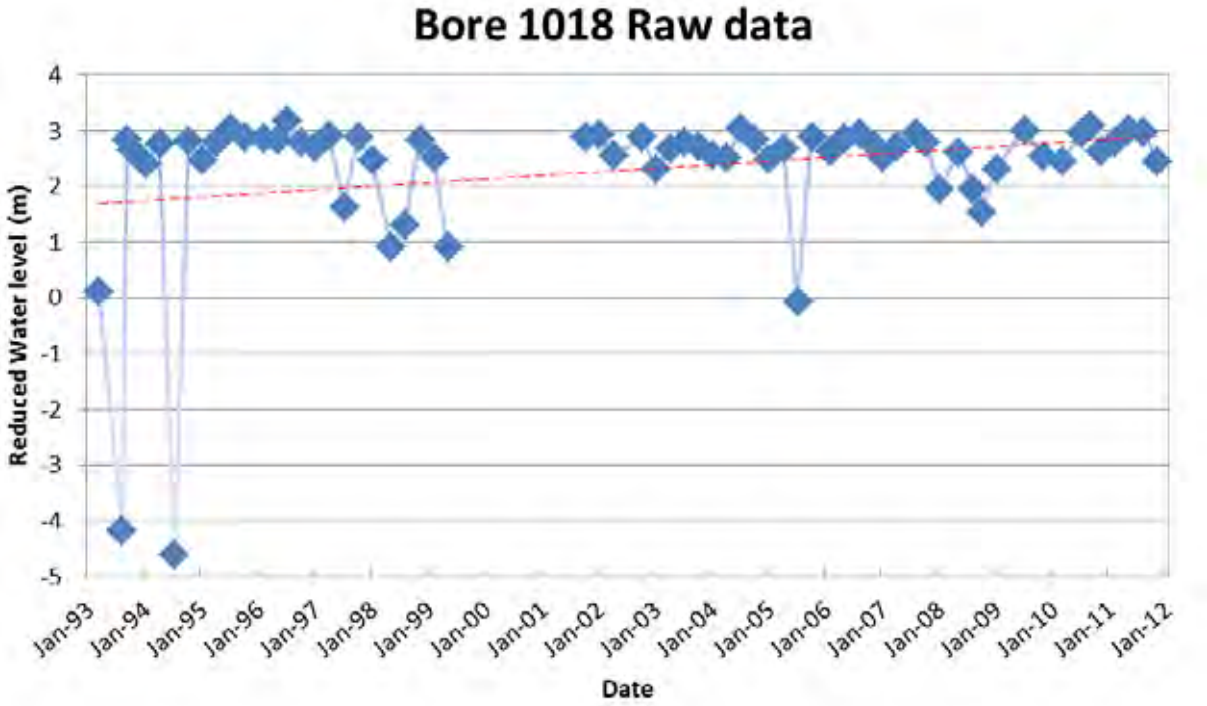


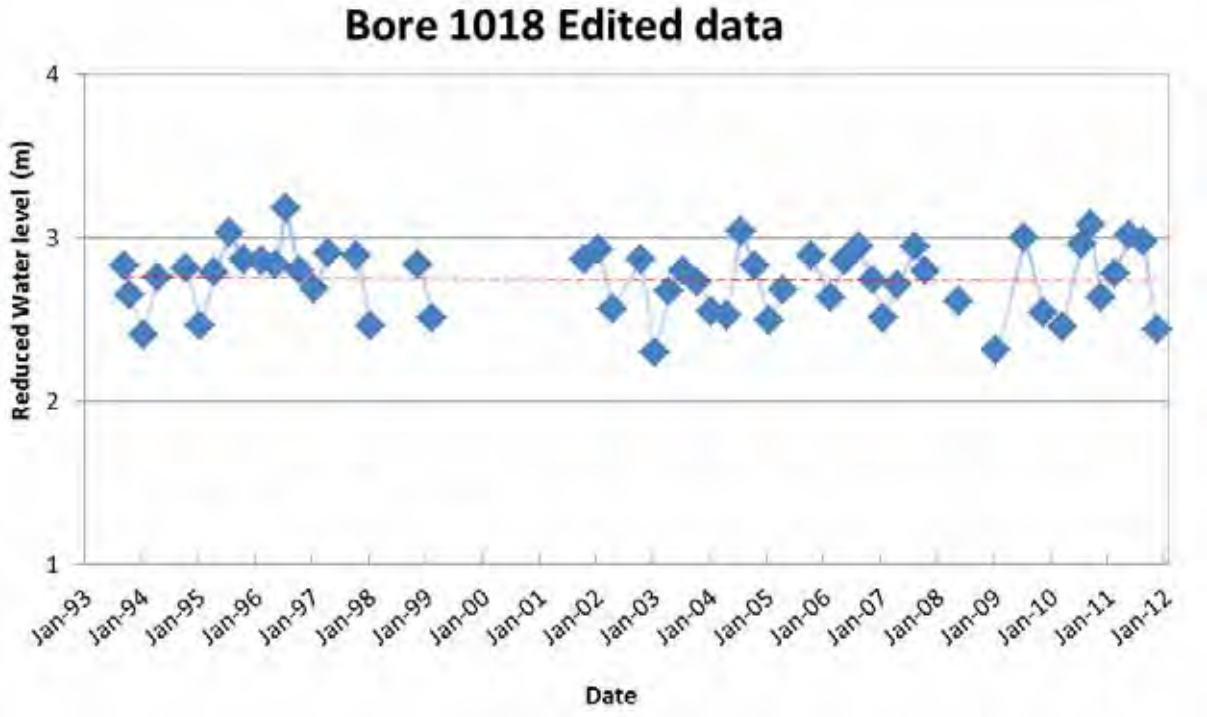
Bore 1018 Information			
Monitoring type	Water level & Water quality	**Depth (m)**	359
Name	Brawn	**Casing Depth (m)**	359
Bore use	Irrigation	**Screen/open hole**	Open hole
Easting	281 1953	**Temperature**	33°C
Northing	637 4592	**Catchment**	Lower Kaituna
Bore log	Partial	**Aquifer**	Waiteariki
Monitoring period	**Water level**	1993 to 2011	
	Water quality	1991 to 2005	**LabStar:** BOP180044

Bore 1018 geological profile (EBOF)

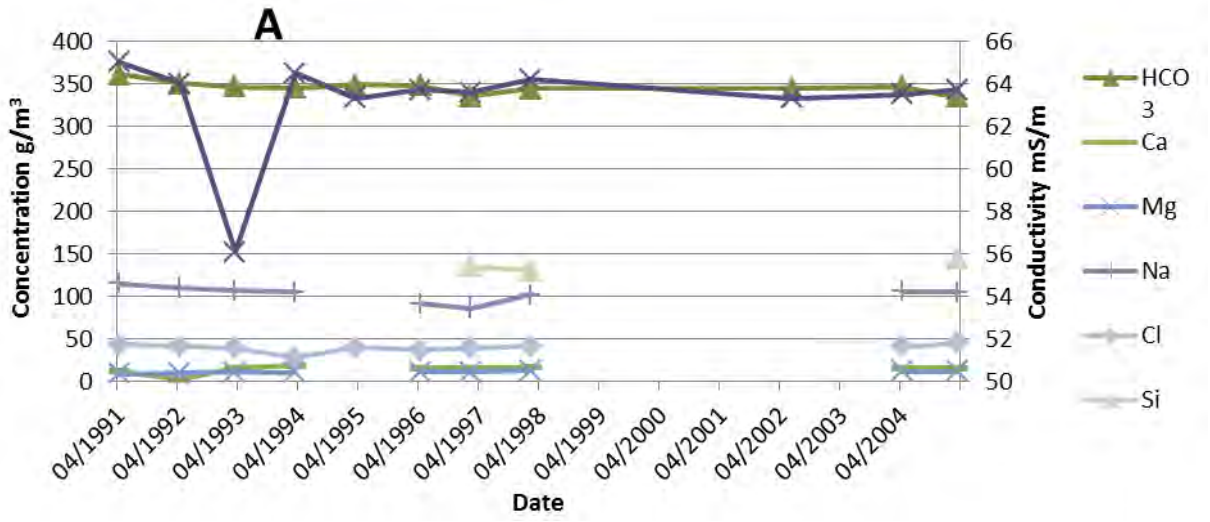


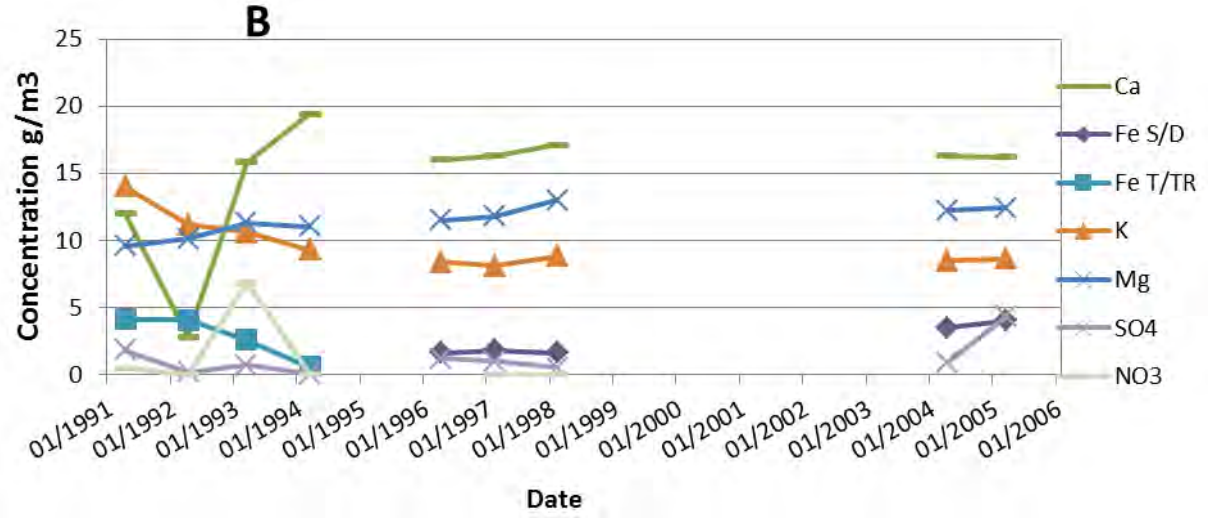
Bore 1018 water level graphs

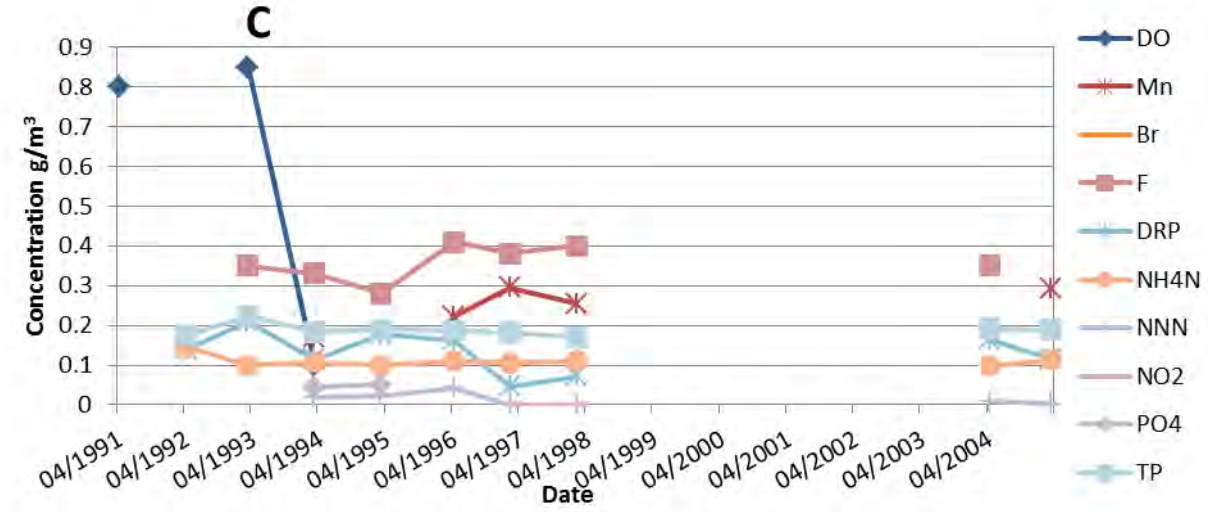




Bore 1018 water quality graphs



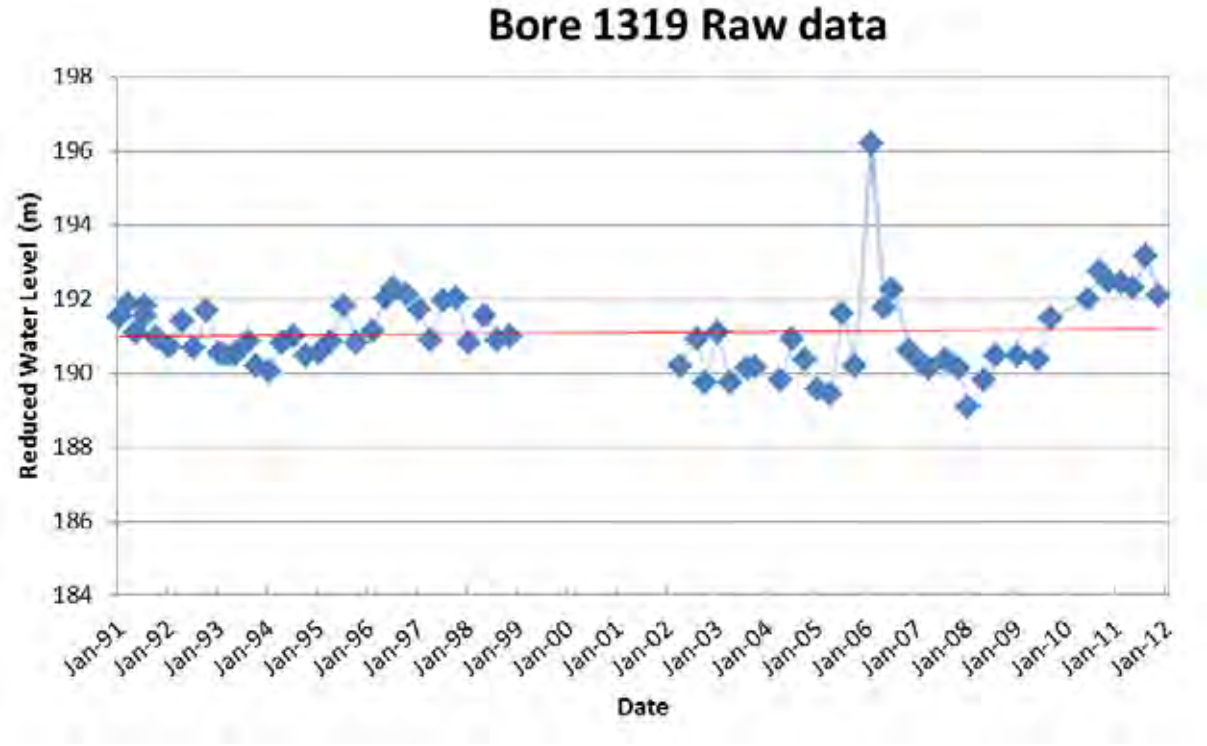


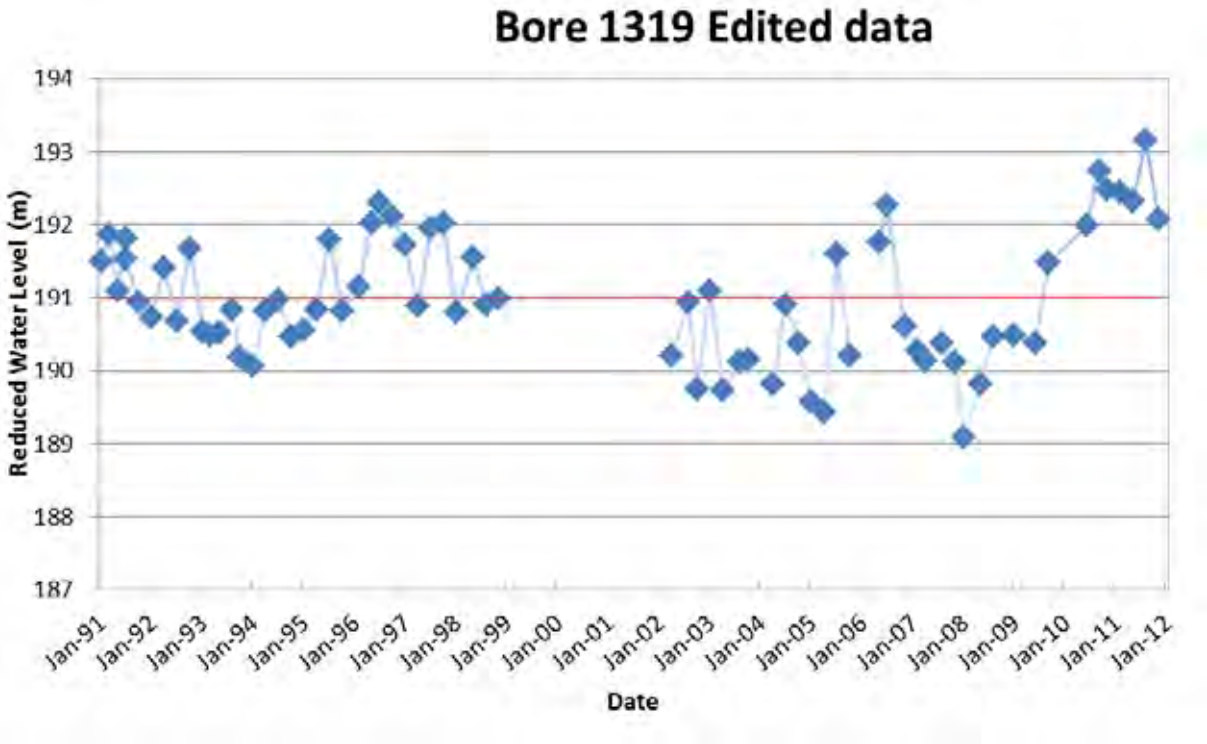


Bore 1319 Information			
Monitoring type	Water level and Water quality	**Depth (m)**	51.8
Name	Ngāti Manawa Tribal Lands	**Casing Depth (m)**	39.6
Bore use	Agricultural	**Screen/open hole**	Unknown
Easting	283 5070	**Temperature**	15.6°C
Northing	629 6819	**Catchment**	Galatea
Bore log	Complete	**Aquifer**	Unknown
Monitoring period	**Water level**	1991 to 2011	
	Water quality	1991 to 2009	**LabStar:** BOP180034

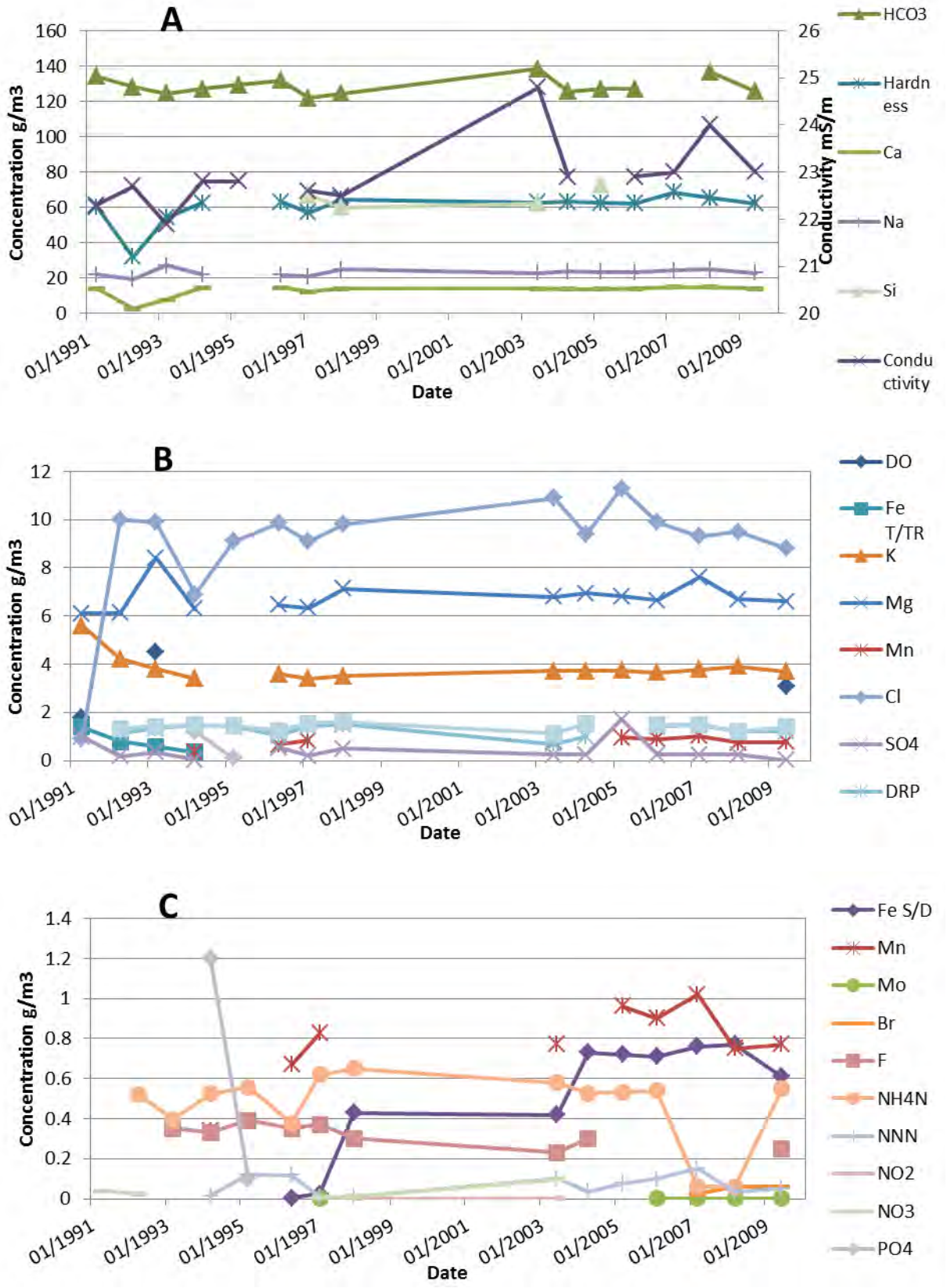
The Earth Beneath our Feet model is not currently available for this region.

Bore 1319 water level graphs



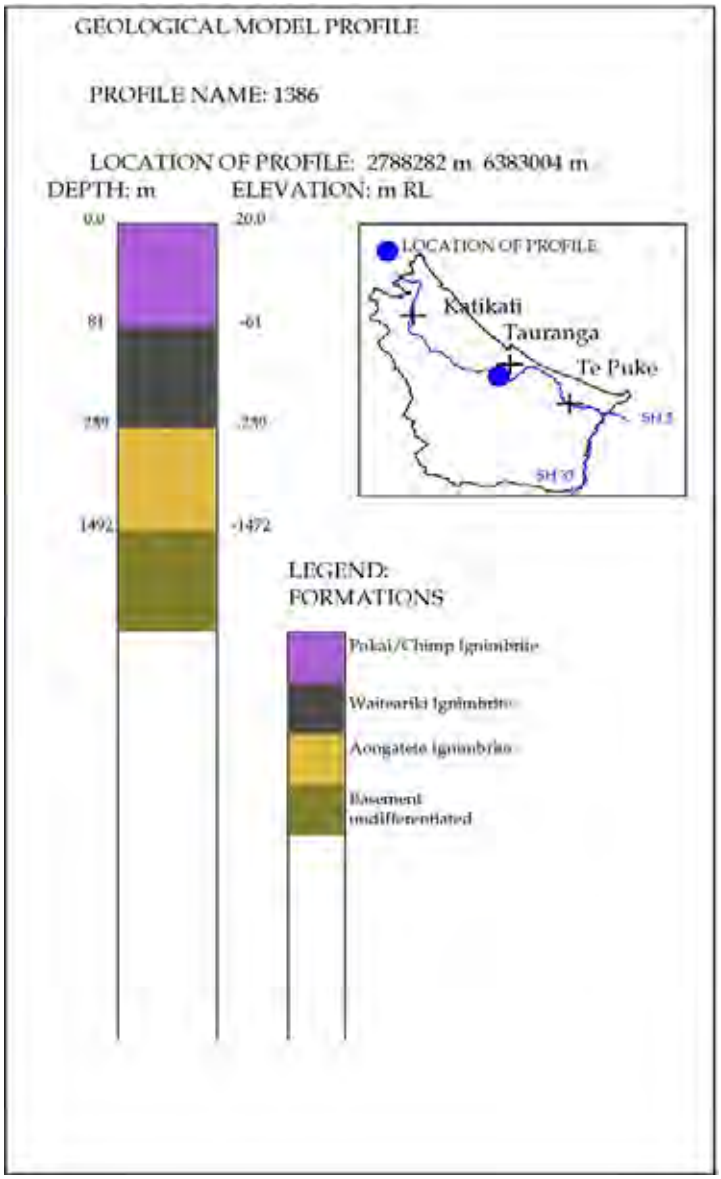


Bore 1319 water quality

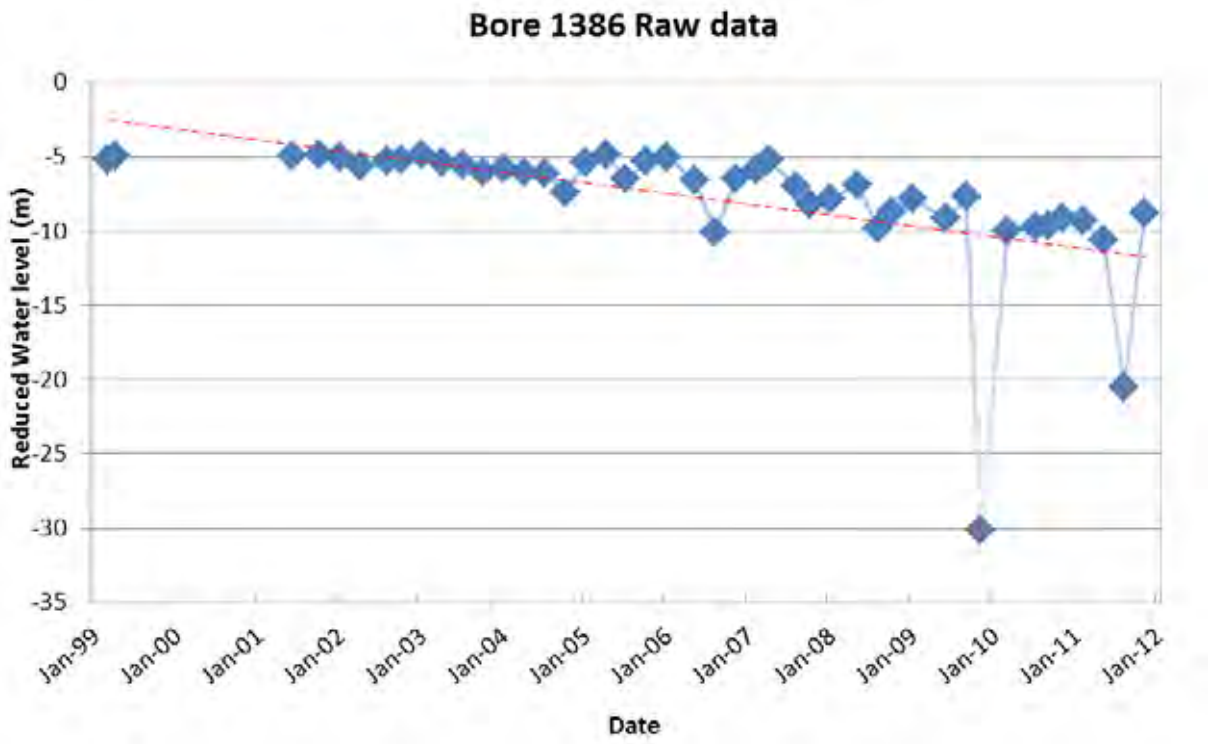


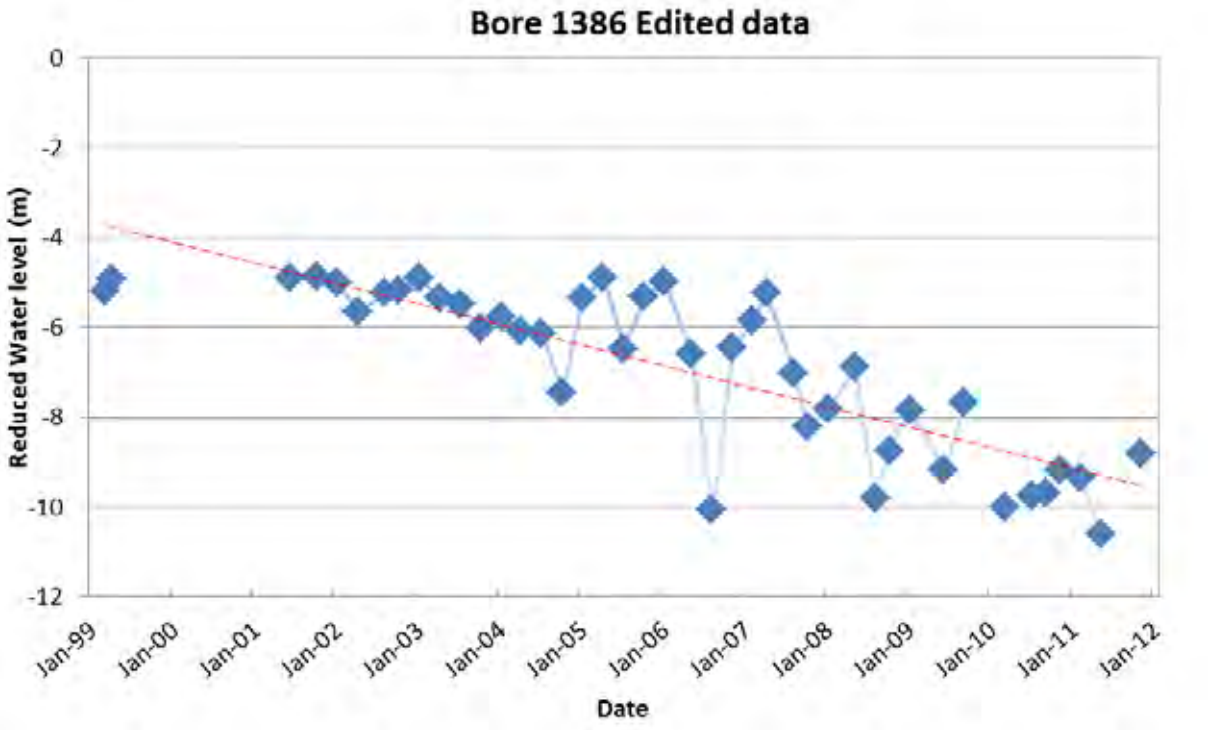
Bore 1386 Information			
Monitoring type	Water level	**Depth (m)**	466.3
Name	STBJ Investments	**Casing Depth (m)**	335.3
Bore use	Commercial heating	**Screen/open hole**	Open hole
Easting	278 8282	**Temperature**	Geothermal
Northing	638 3004	**Catchment**	WAI 2 (zone)
Bore log	Complete	**Aquifer**	Aongatete
Monitoring period	**Water level**	1999 to 2011	
	Water quality	-	

Bore 1386 geological profile (EBOF)



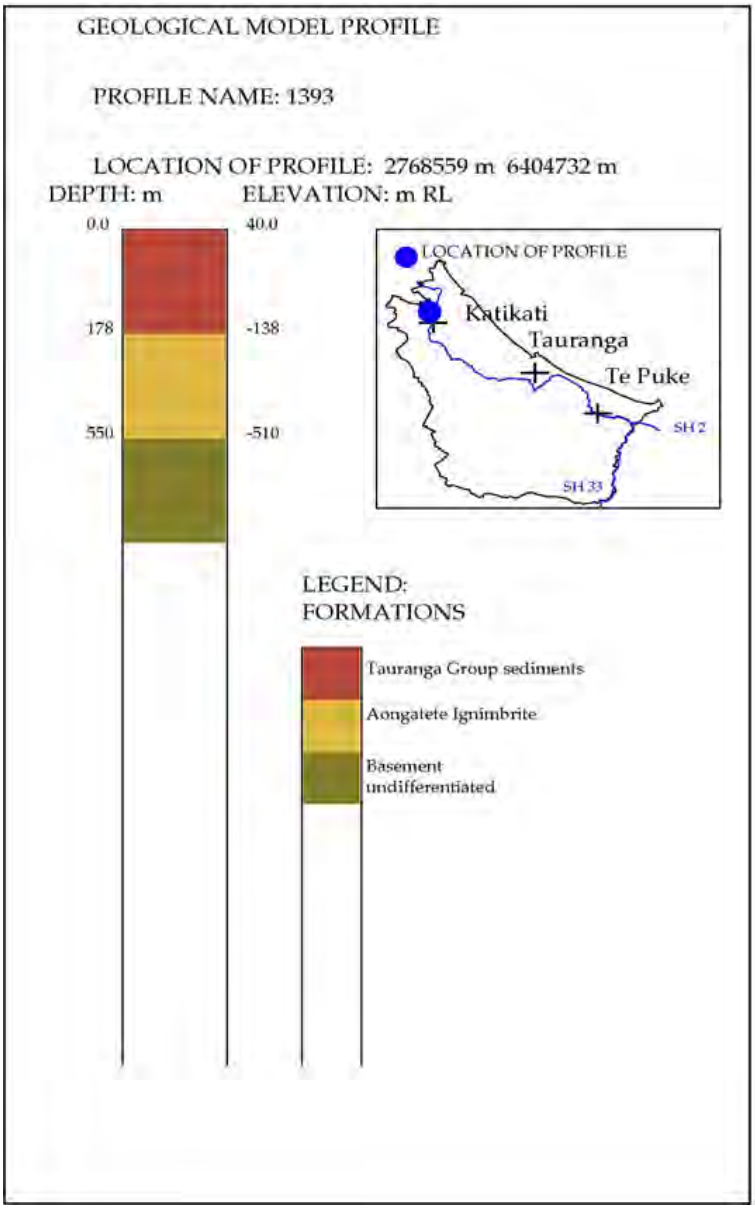
Bore 1386 water level graphs



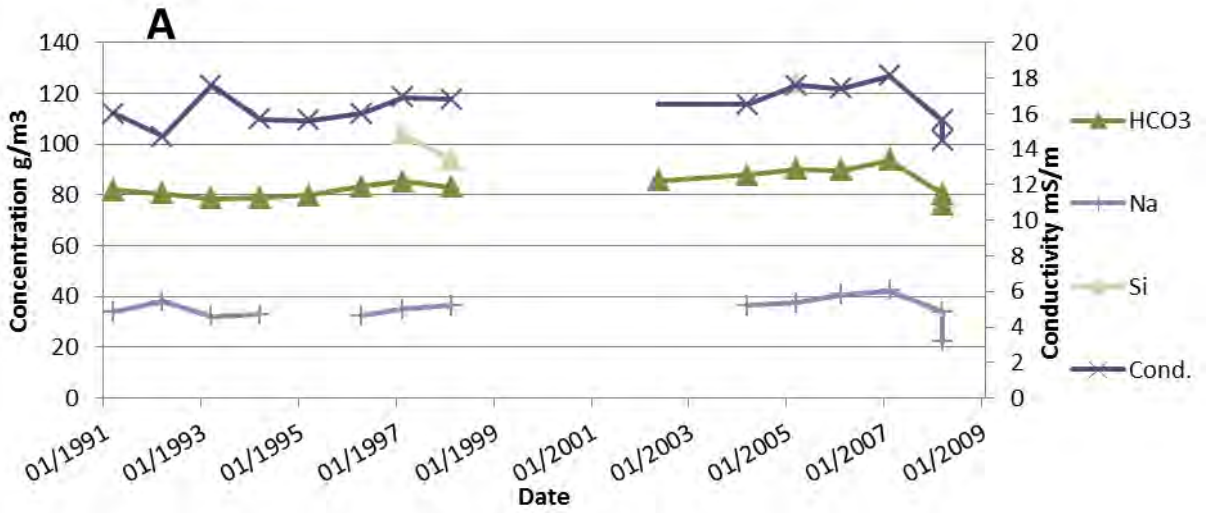


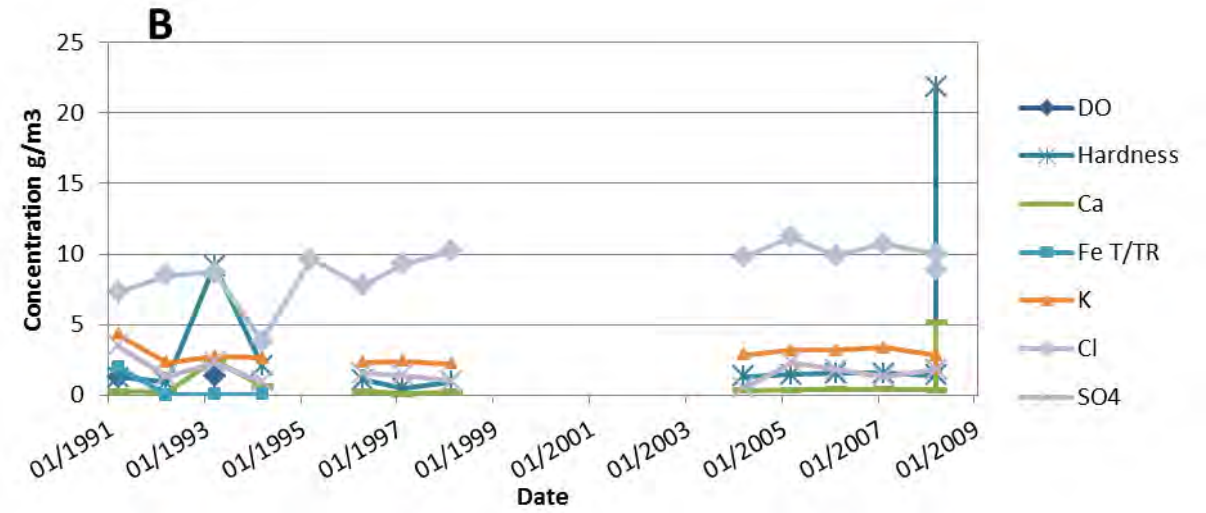
Bore 1393 Information			
Monitoring type	Water quality	**Depth (m)**	326.2
Name	Babington	**Casing Depth (m)**	247.5
Bore use	Irrigation/domestic	**Screen/open hole**	Unknown
Easting	276 8559	**Temperature**	41°C
Northing	640 4732	**Catchment**	WAI 1 zone
Bore log	Complete	**Aquifer**	Aongatete (WAI)
Monitoring period	**Water level**		
	Water quality	1991 to 2008	**LabStar:** BOP180017

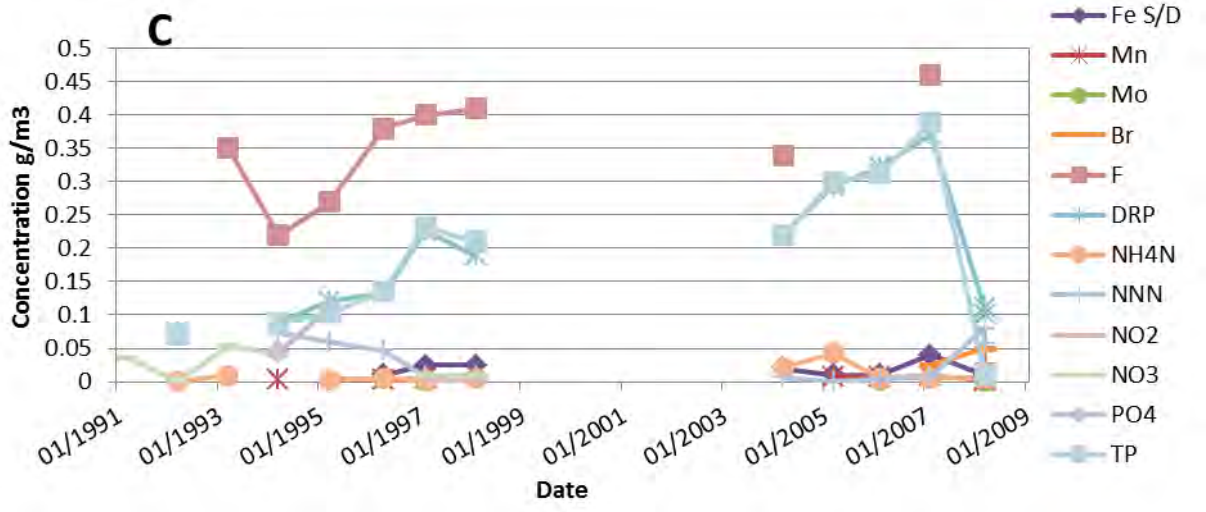
Bore 1393 geological profile (EBOF)



Bore 1393 water quality

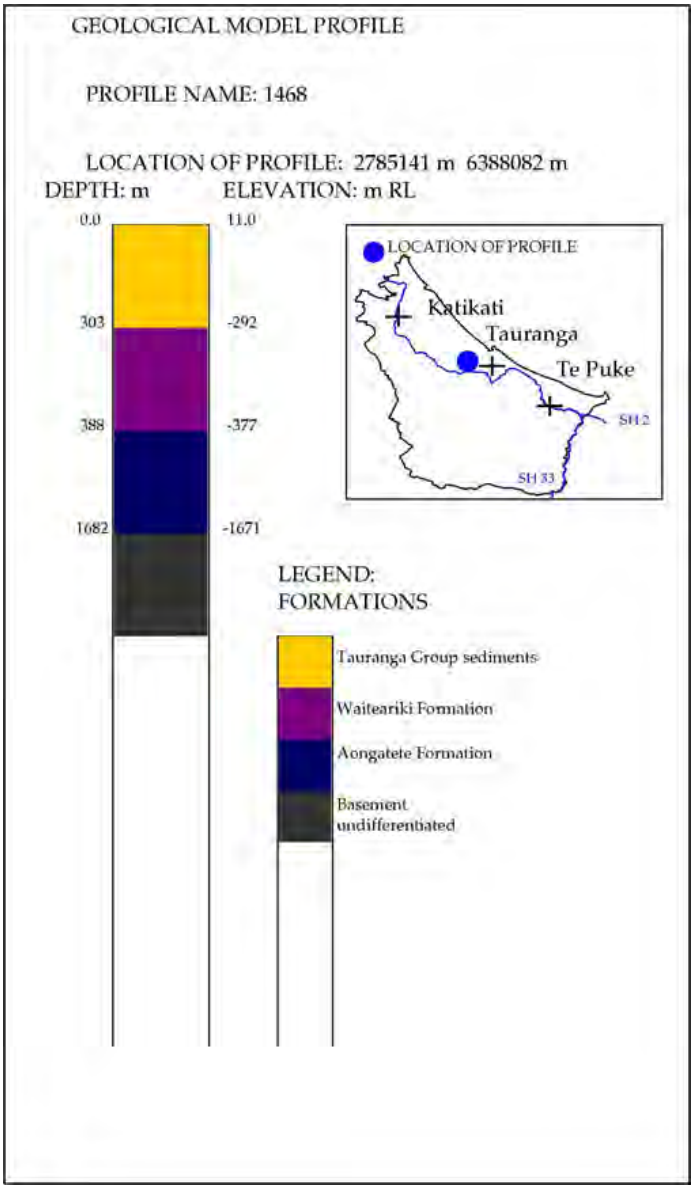




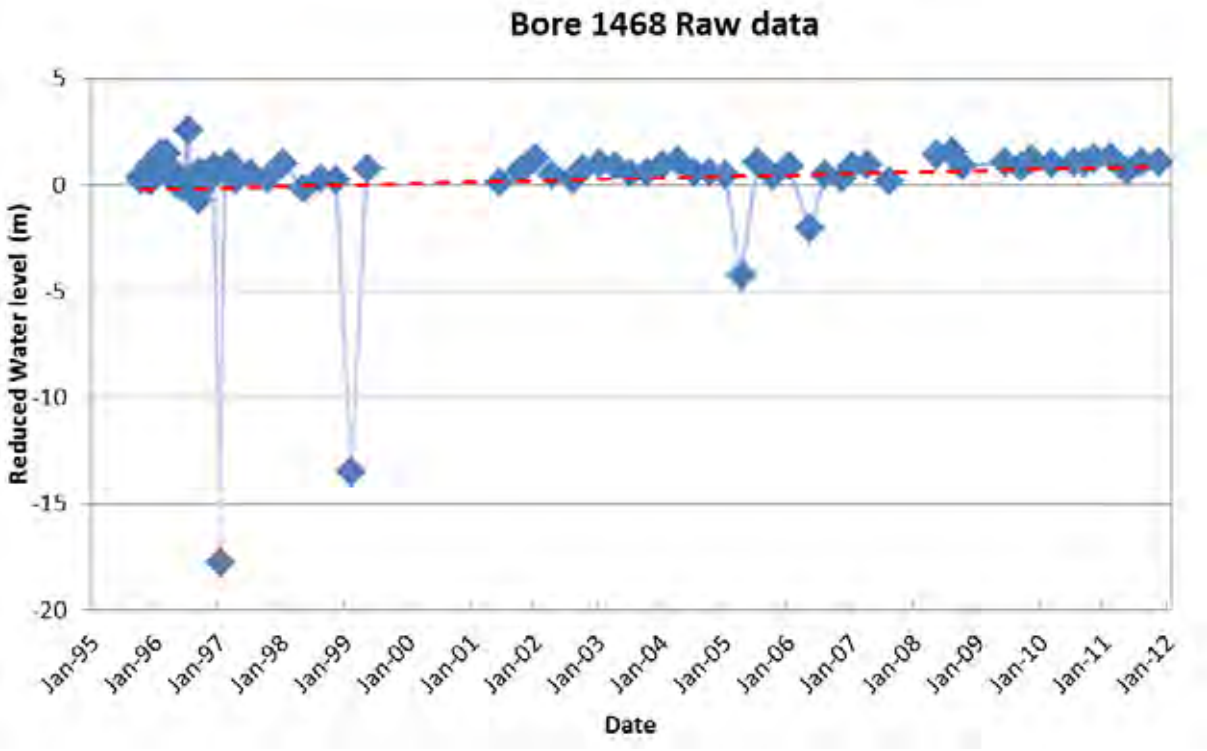


Bore 1468 Information			
Monitoring type	Water level	**Depth (m)**	420.6
Name	Haddad	**Casing Depth (m)**	234.6
Bore use	Domestic heating	**Screen/open hole**	Open hole
Easting	278 5141	**Temperature**	44.5
Northing	638 8082	**Catchment**	Otumoetai
Bore log	Complete	**Aquifer**	Aongatete/Waitearikiki (WAI)
Monitoring period	**Water level**	1995 to 2011	
	Water quality	-	

Bore 1468 geological profile (EBOF)



Bore 1468 water level graphs


Bore 1468 Raw data
Reduced Water level (m)
5
0
-5
-10
-15
-20
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
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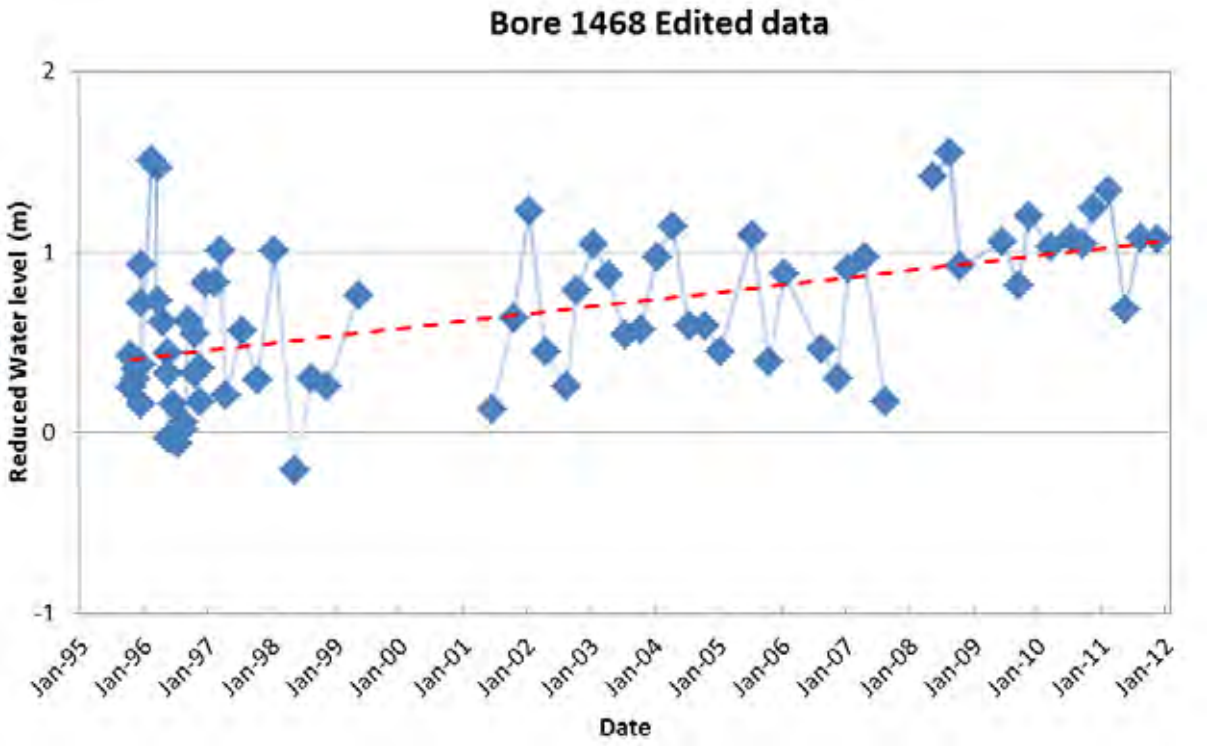
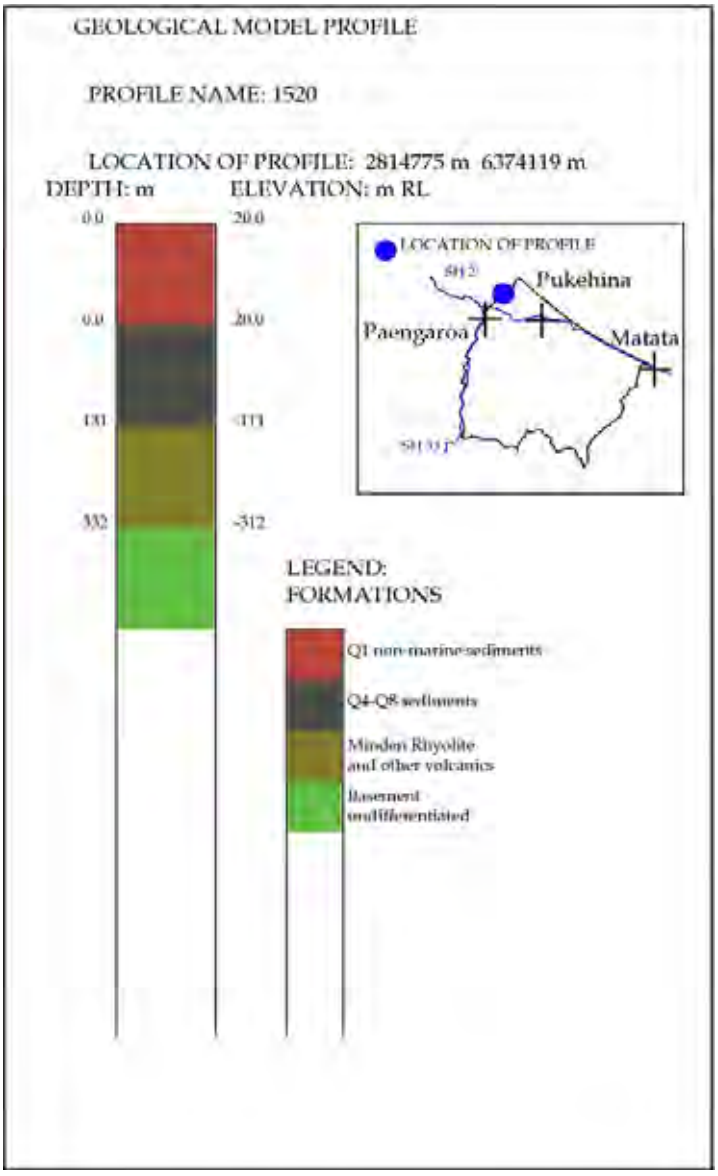
Jan-10
Jan-11
Jan-12
Date

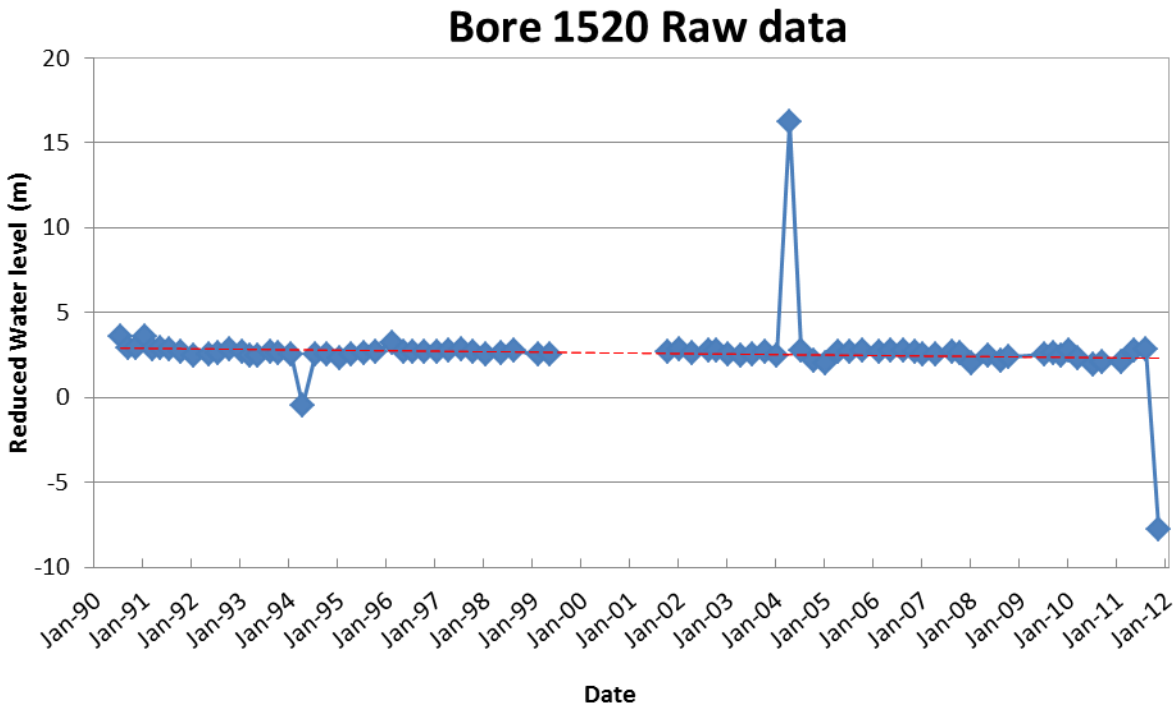

Bore 1468 Edited data
Reduced Water level (m)
2
1
0
-1
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
Jan-09
Jan-10
Jan-11
Jan-12
Date

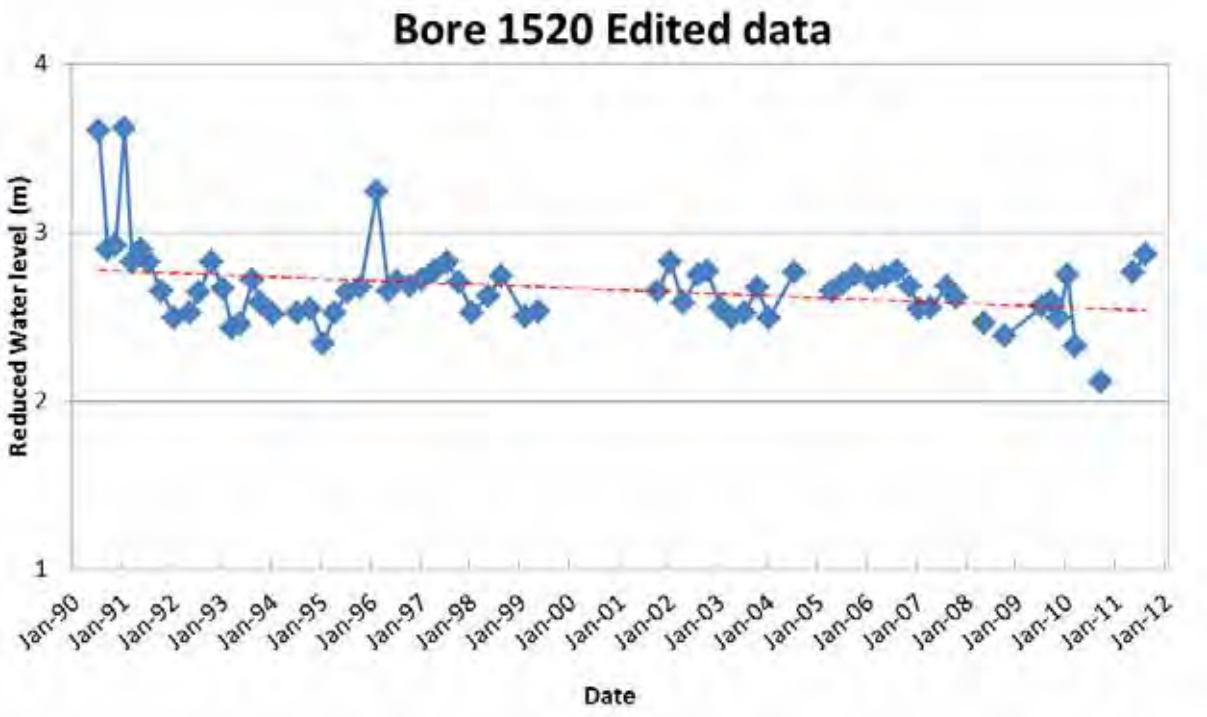
Bore 1520 Information			
Monitoring type	Water level & Water quality	**Depth (m)**	74
Name	Tapsell	**Casing Depth (m)**	50
Bore use	Unknown	**Screen/open hole**	Screened
Easting	281 4775	**Temperature**	21.9°C
Northing	637 4119	**Catchment**	Kaikokopu
Bore log	Complete	**Aquifer**	Tauranga sediments
Monitoring period	**Water level**	1990 to 2011	
	Water quality	1991 to 2011	**LabStar:** BOP180036

Bore 1520 geological profile (EBOF)

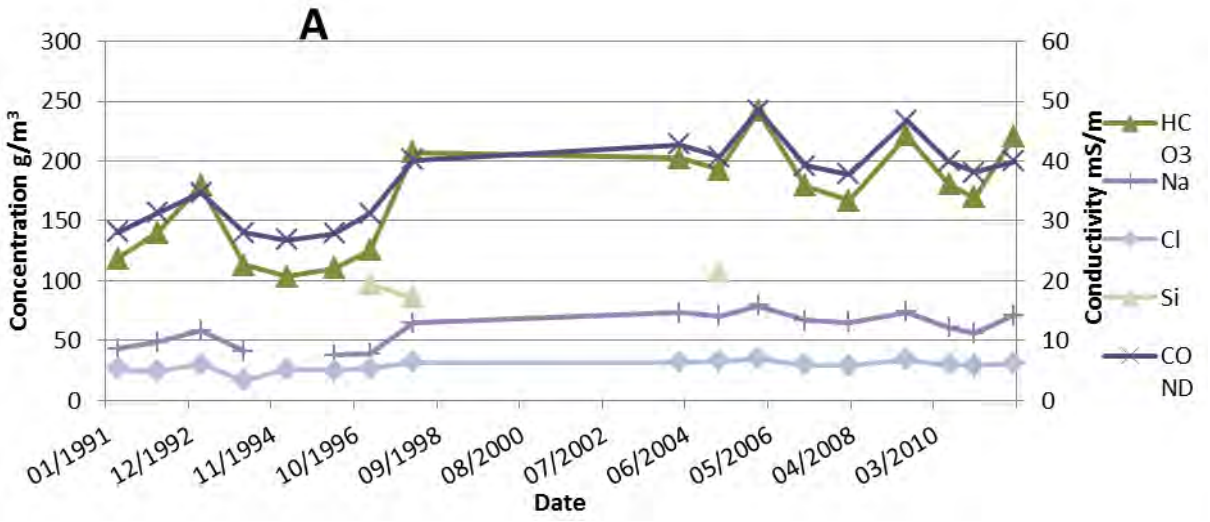


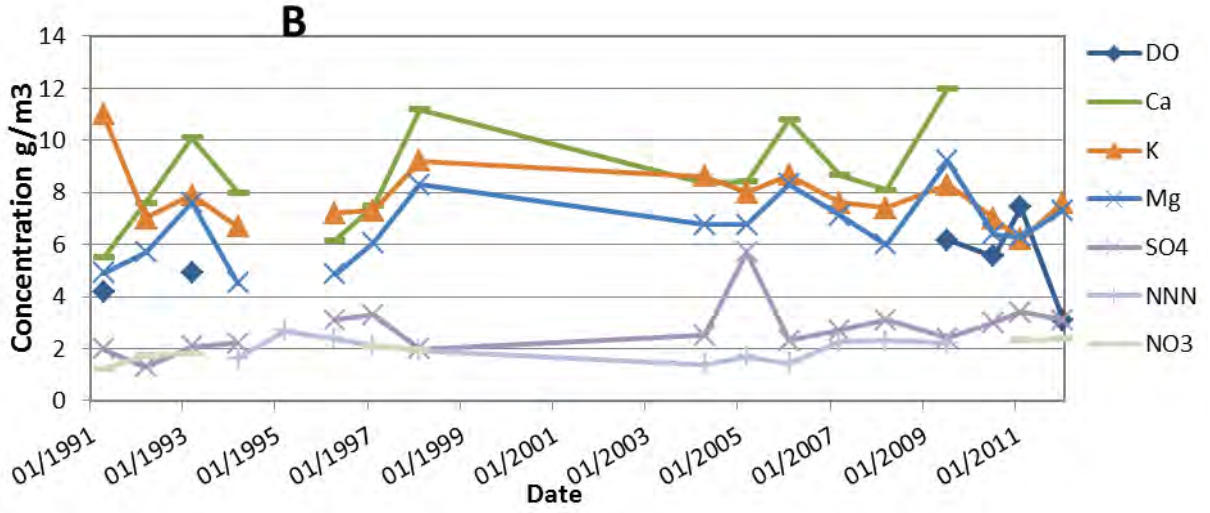
Bore 1520 water level graphs

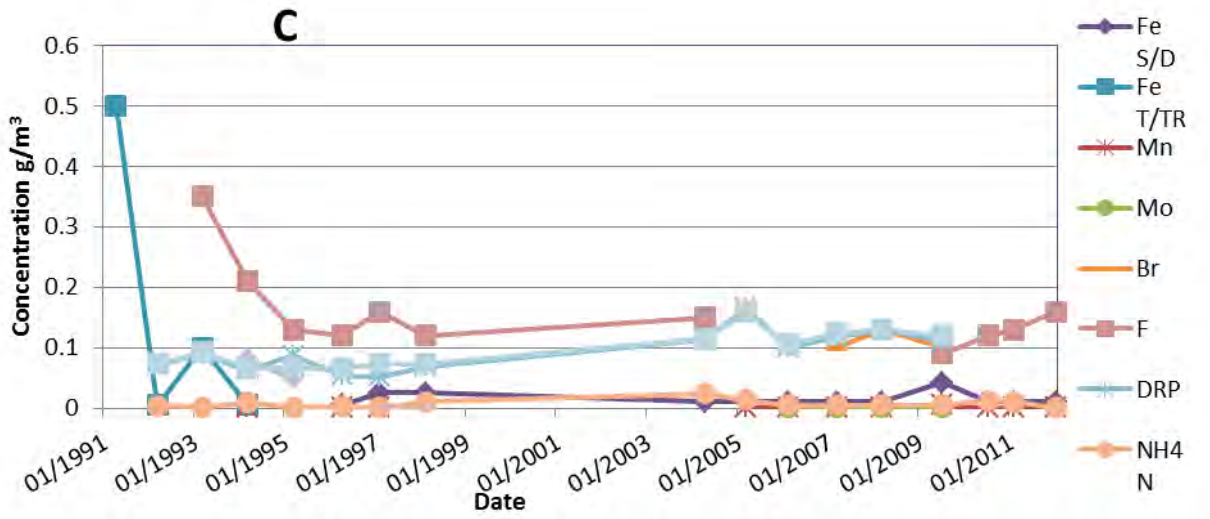




Bore 1520 water quality

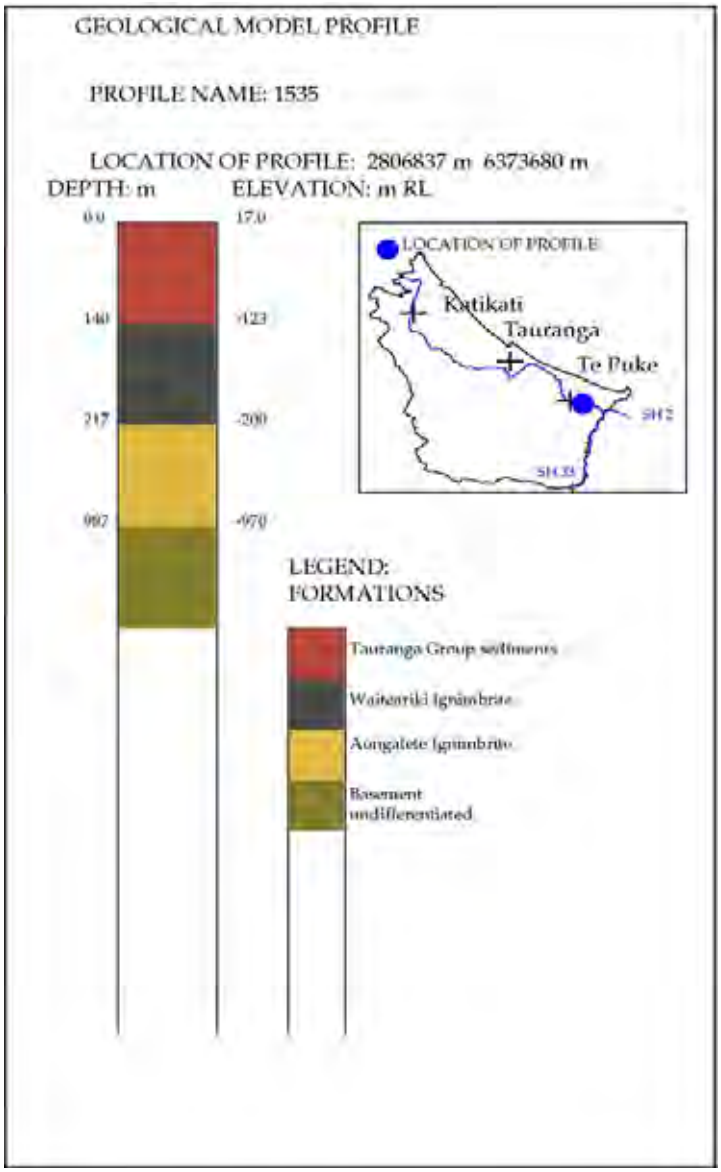




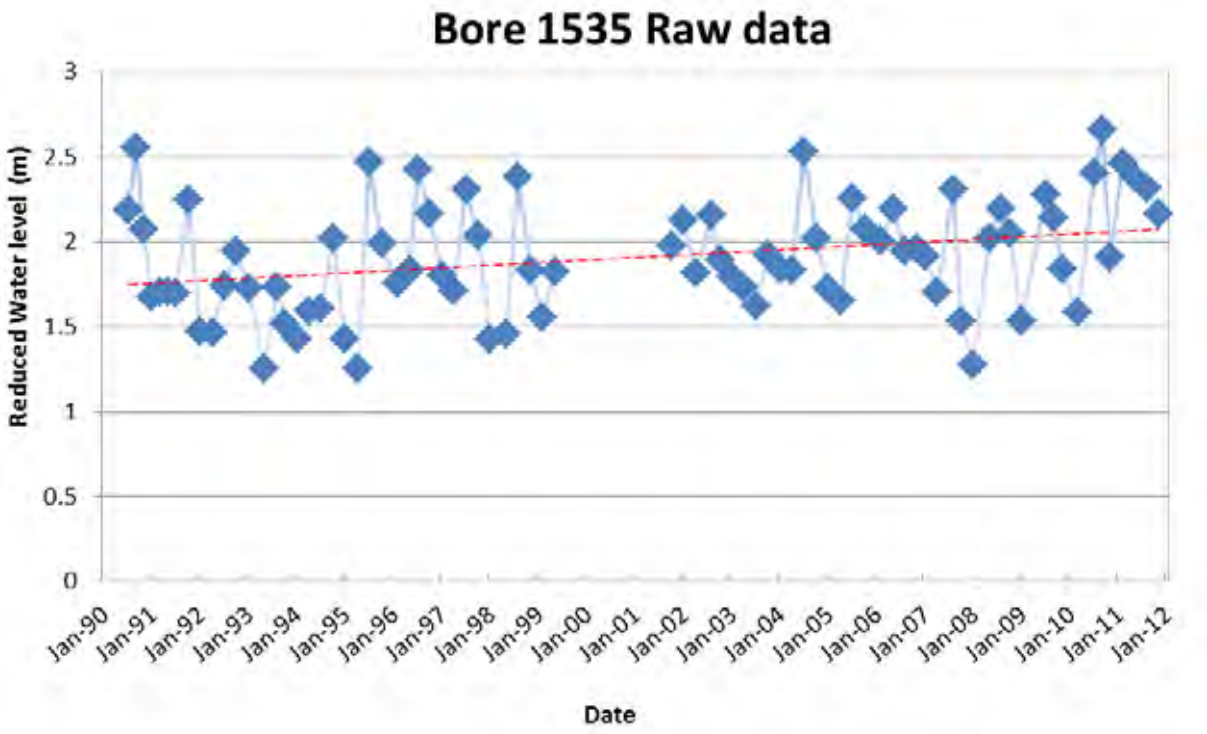


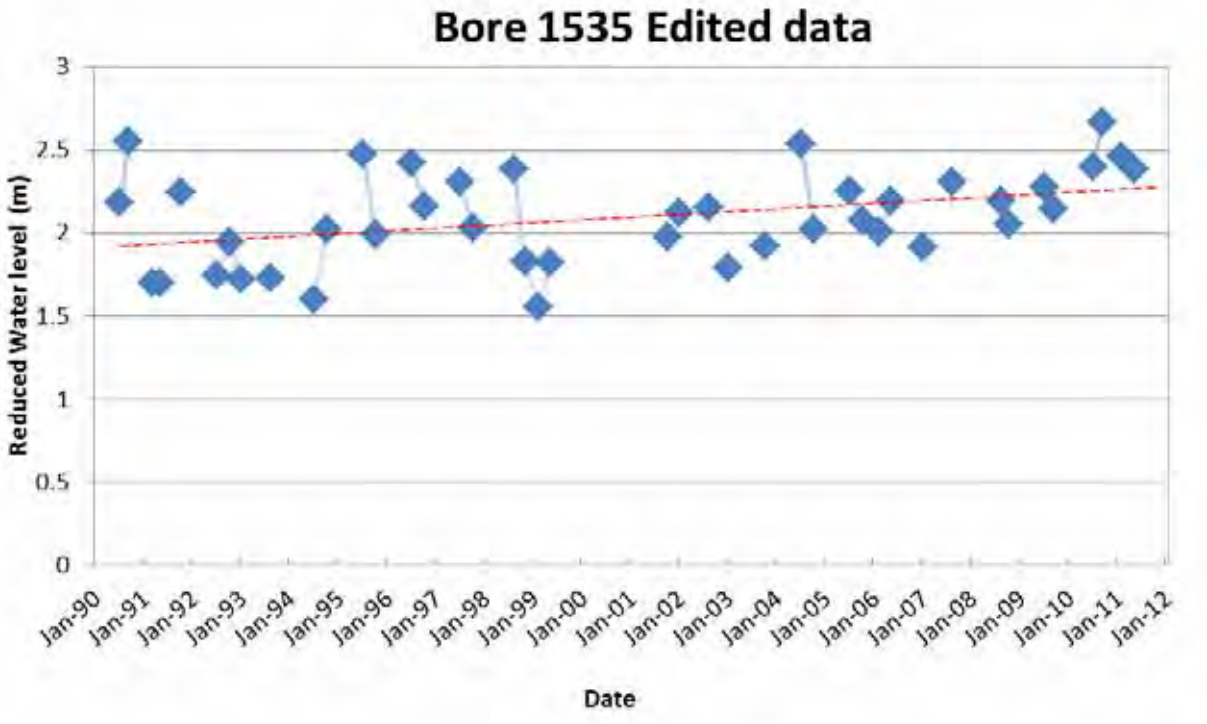
Bore 1535 Information			
Monitoring type	Water level	**Depth (m)**	32
Name	Tuhurangi Marae Ladies Committee	**Casing Depth (m)**	19.81
Bore use	Unknown	**Screen/open hole**	Screened
Easting	280 6837	**Temperature**	Unknown
Northing	637 3680	**Catchment**	Lower Kaituna
Bore log	Complete	**Aquifer**	Tauranga sediments
Monitoring period	**Water level**	1990 to 2011	
	Water quality	-	

Bore 1535 geological profile (EBOF)



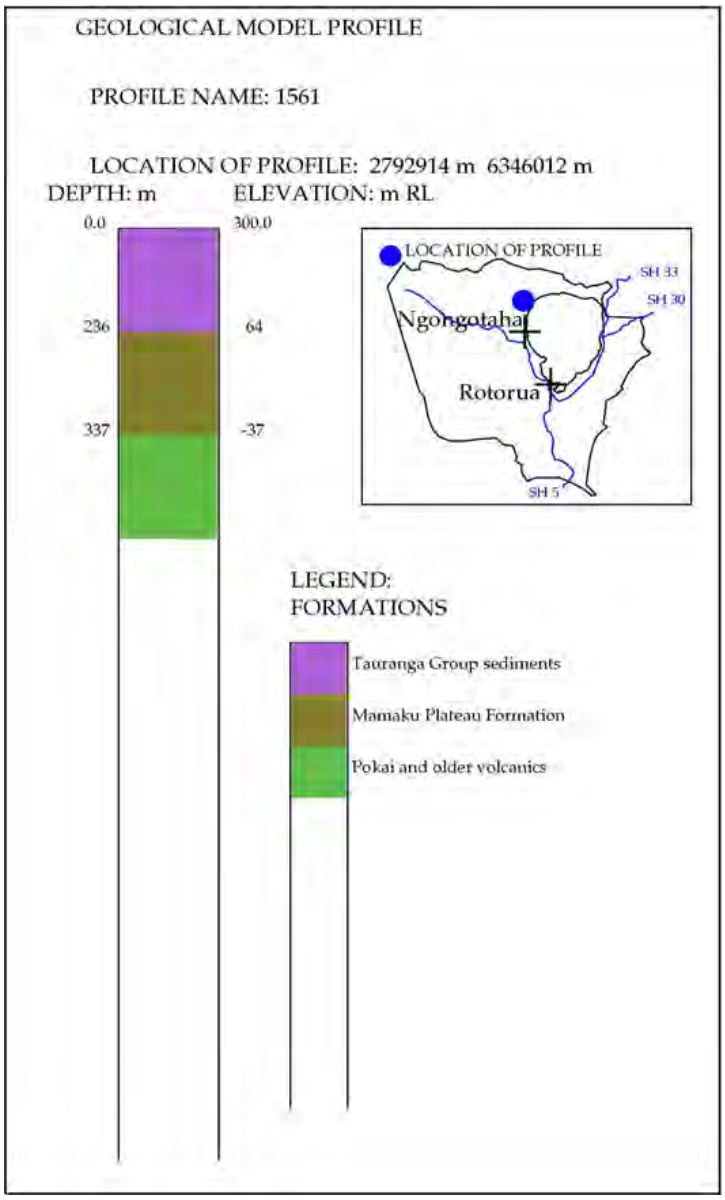
Bore 1535 water level graphs



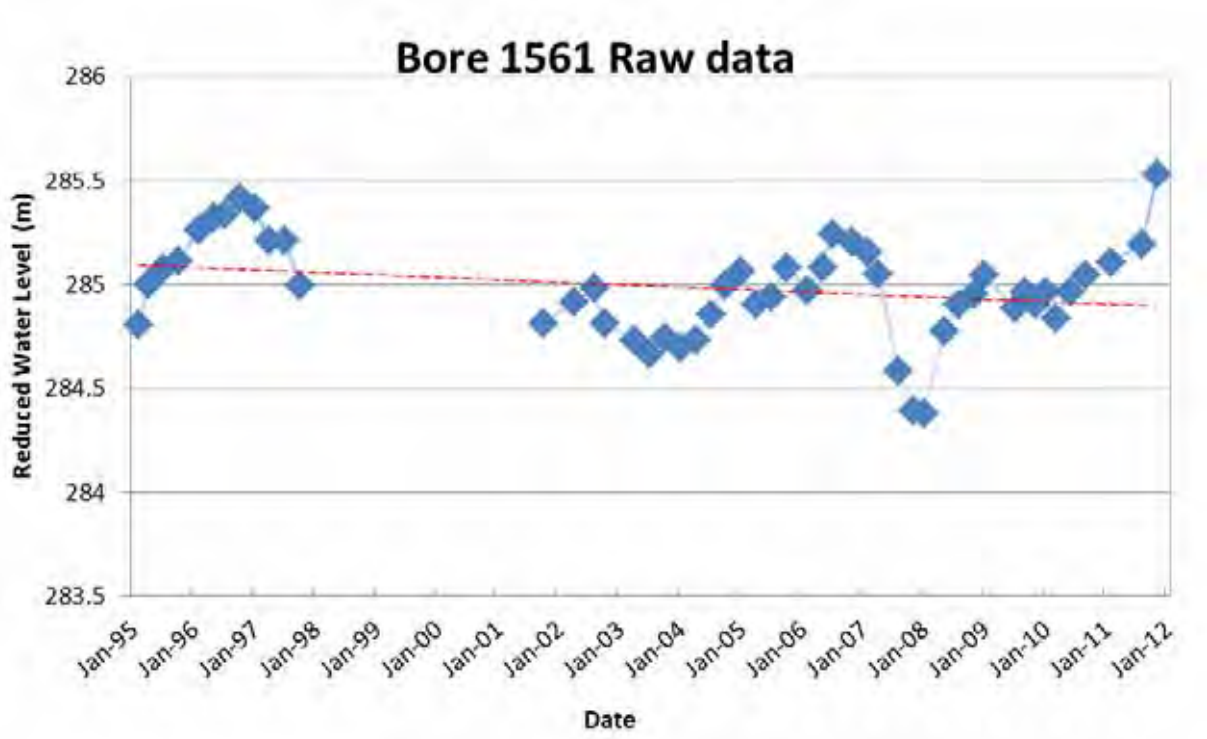


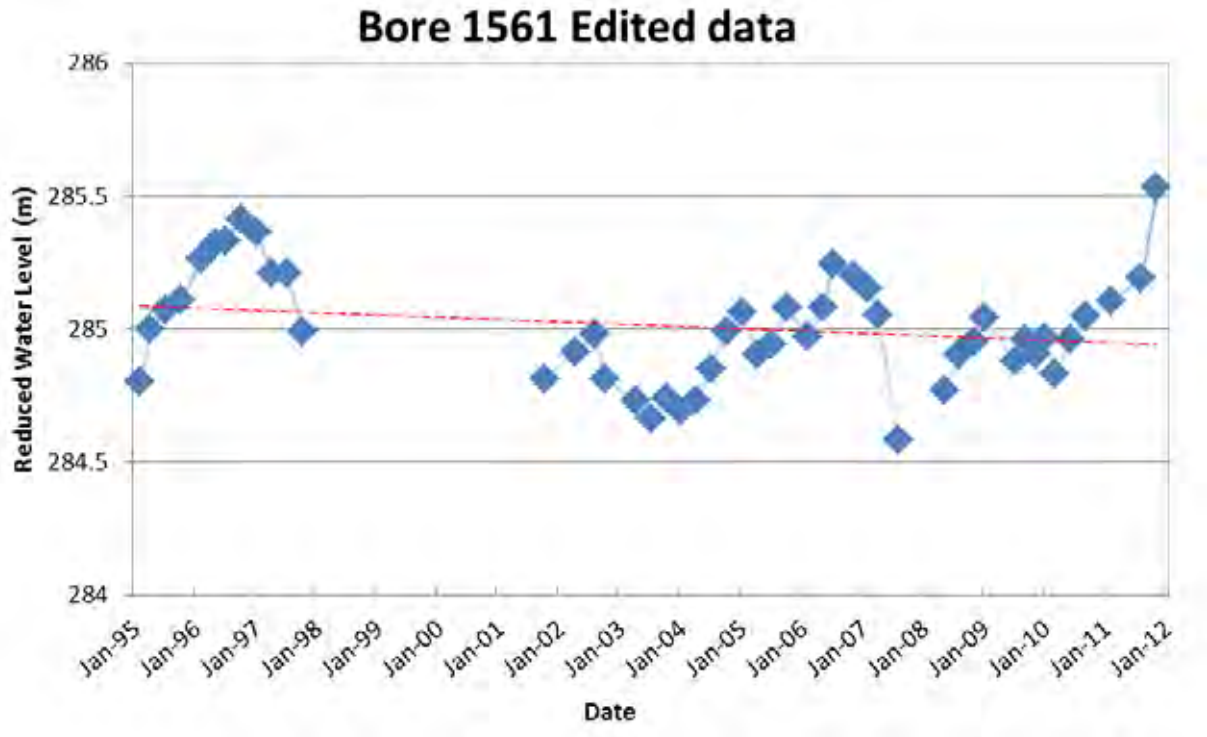
Bore 1561 Information			
Monitoring type	Water level & Water quality	**Depth (m)**	73.1
Name	Dunroamin Nursery	**Casing Depth (m)**	63
Bore use	Irrigation	**Screen/open hole**	Open hole
Easting	279 2914	**Temperature**	12.8
Northing	634 6012	**Catchment**	Awahou Point (Lake Rotorua)
Bore log	Complete	**Aquifer**	Tauranga sediments
Monitoring period	**Water level**	1995 - 2011	
	Water quality	1991 - 2011	**LabStar:** BOP180049

Bore 1561 geological profile (EBOF)

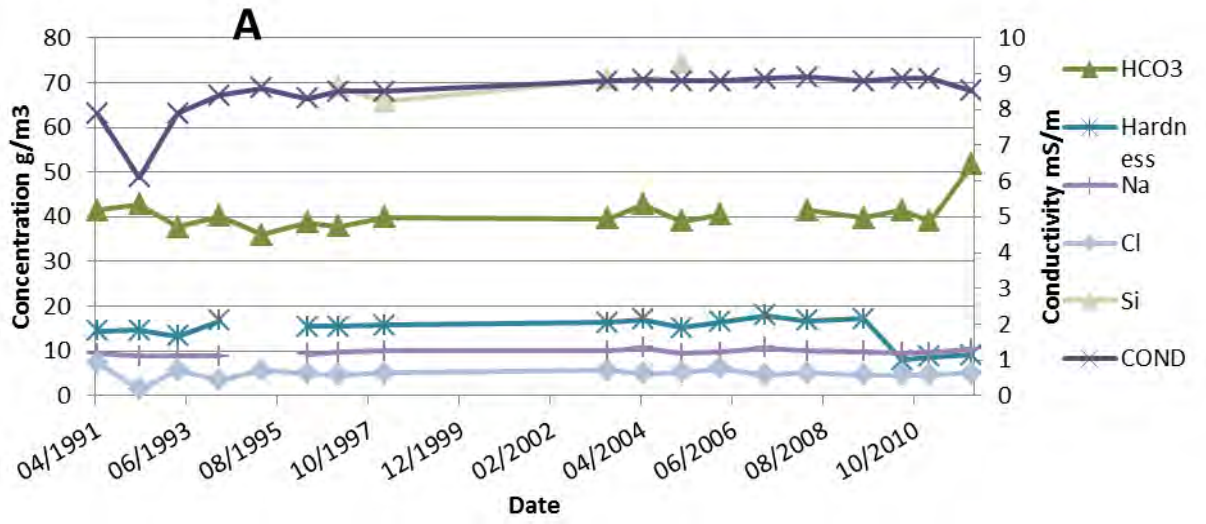


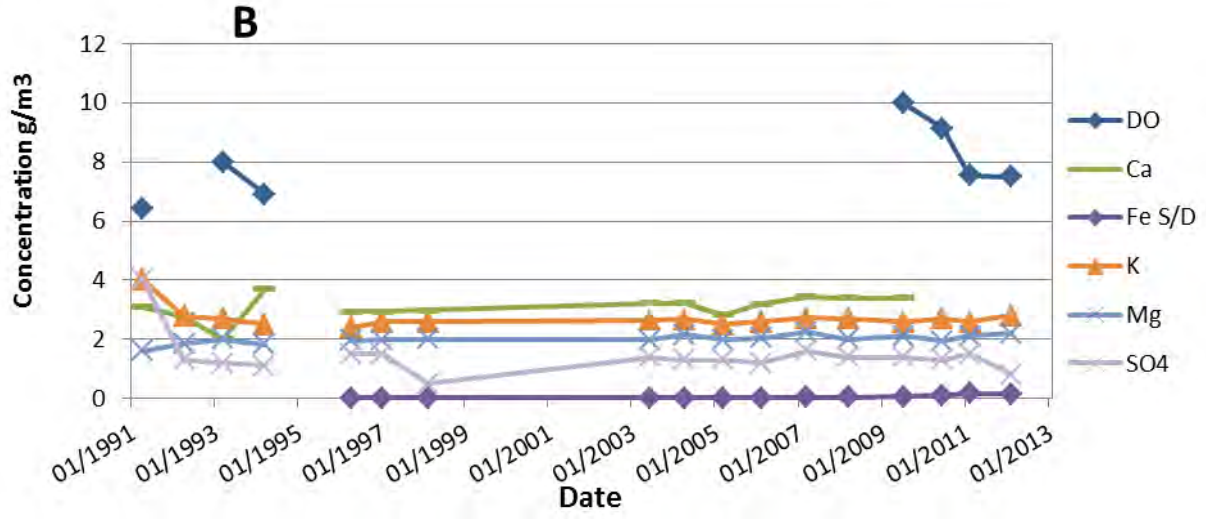
Bore 1561 water level graphs

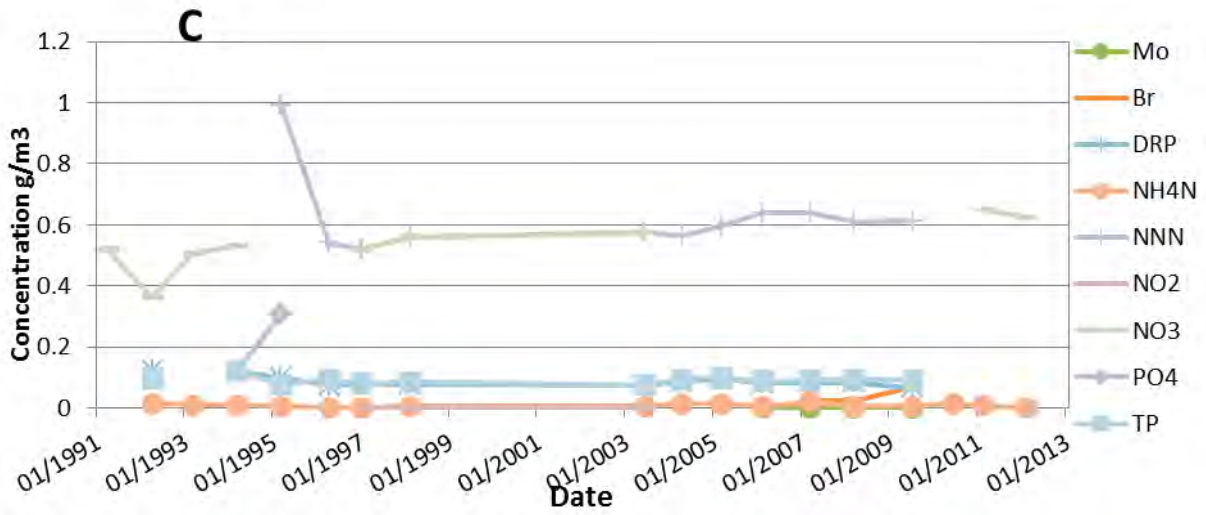




Bore 1561 water quality graphs

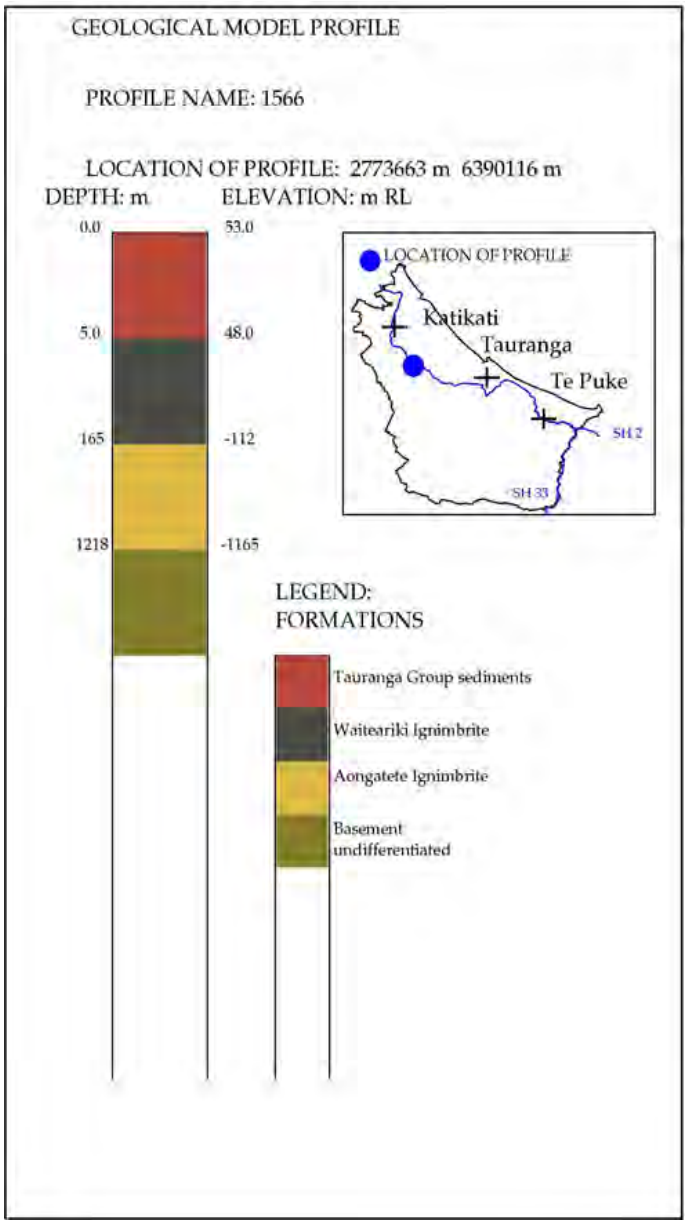




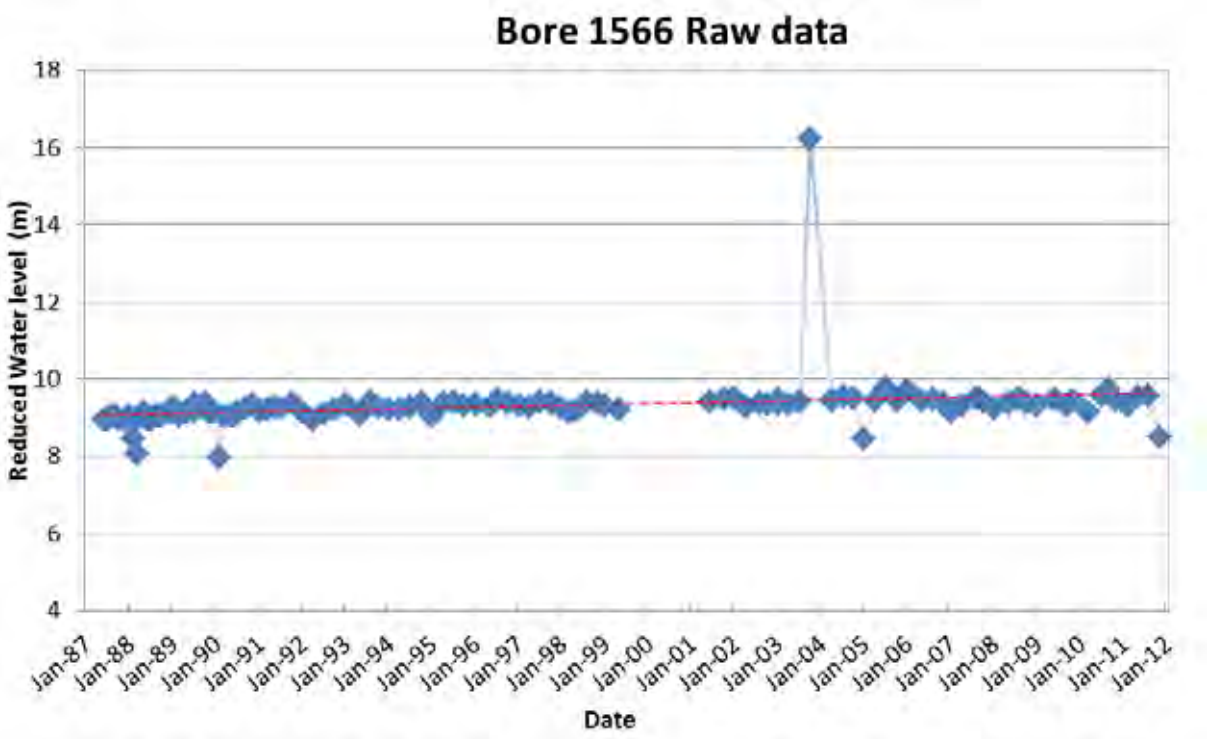


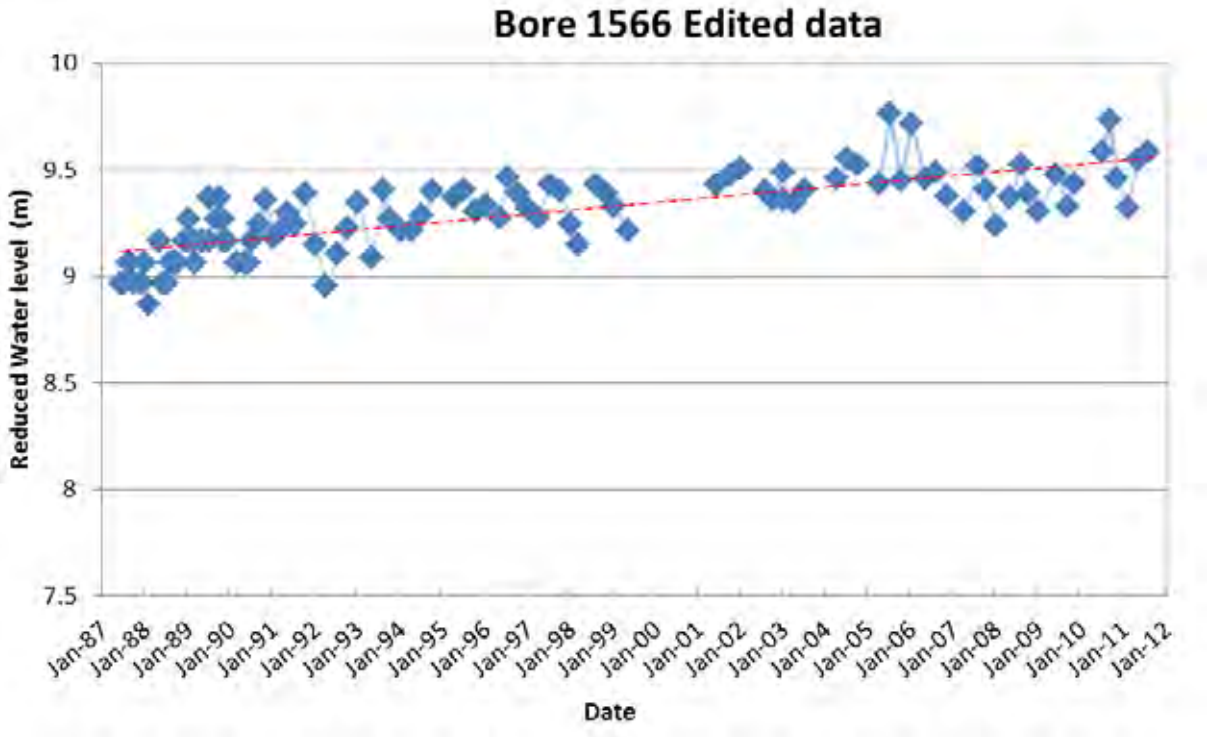
Bore 1566 Information			
Monitoring type	Water level	**Depth (m)**	163.1
Name	Turntable Orchard	**Casing Depth (m)**	85
Bore use	Irrigation	**Screen/open hole**	Open hole
Easting	2773663	**Temperature**	Unknown
Northing	6390116	**Catchment**	Apata
Bore log	Complete	**Aquifer**	Waitea riki/Aongatete (WAI)
Monitoring period	**Water level**	1987 to 2011	
	Water quality		

Bore 1566 geological profile (EBOF)



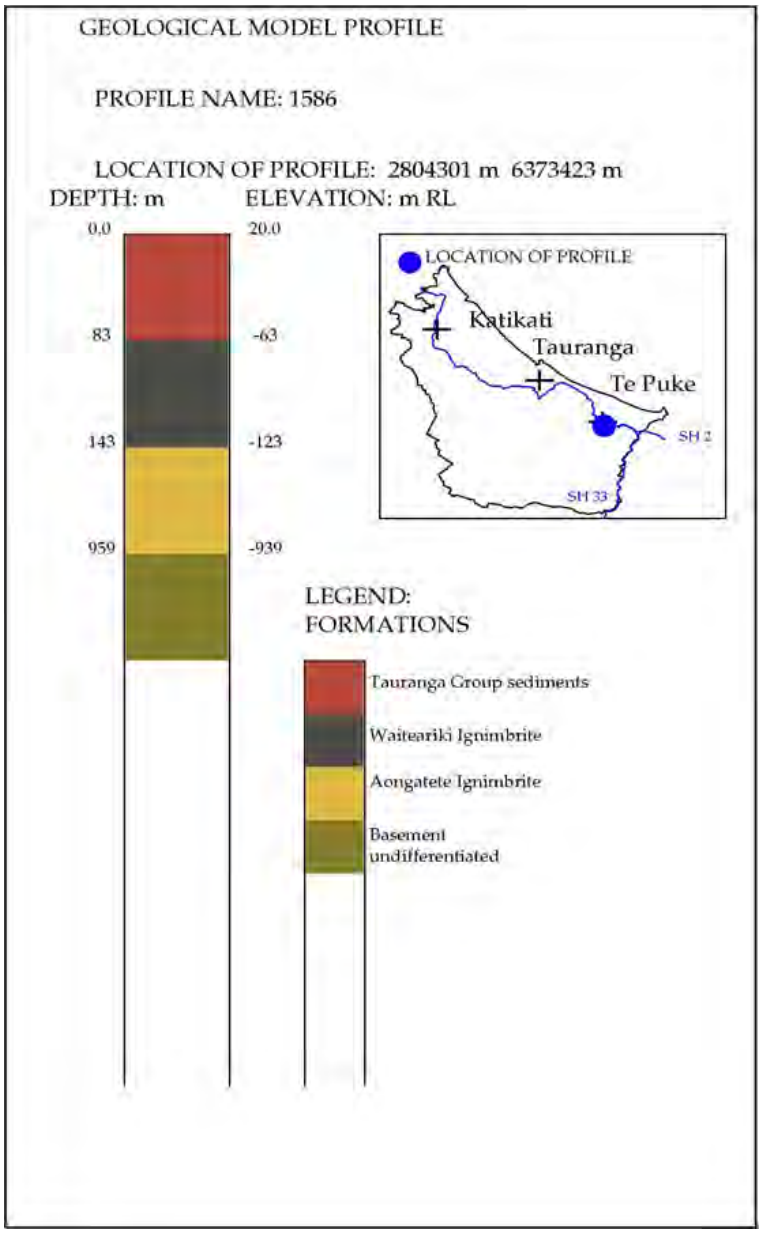
Bore 1566 water level graphs



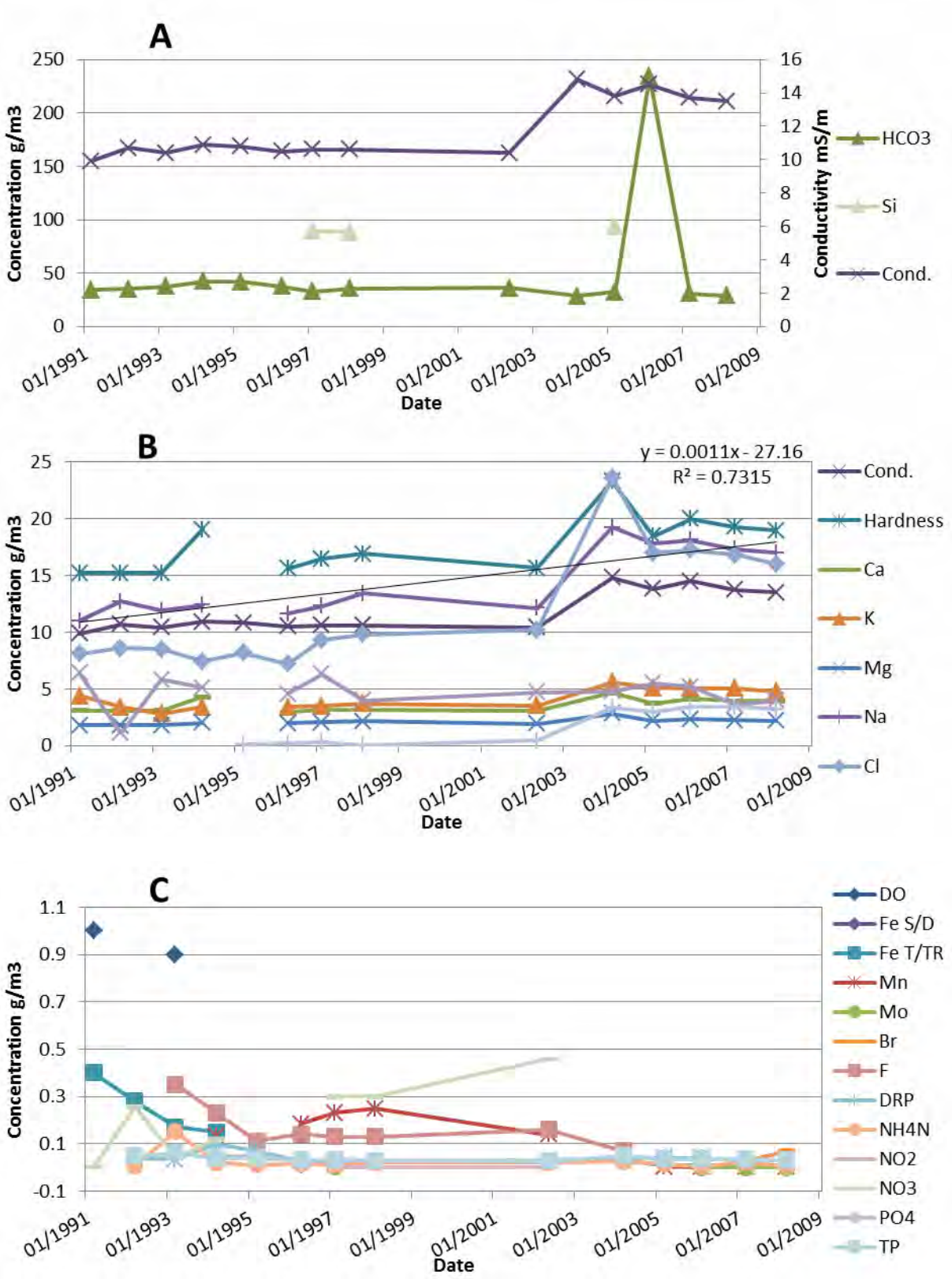


Bore 1586 Information			
Monitoring type	Water quality	**Depth (m)**	30.5
Name	Yates	**Casing Depth (m)**	28
Bore use	Irrigation	**Screen/open hole**	From 27 to 30
Easting	280 4301	**Temperature**	17°C
Northing	637 3423	**Catchment**	Lower Kaituna (Plains)
Bore log	Complete	**Aquifer**	Tauranga sediments
Monitoring period	**Water level**		
	Water quality	1994 to 2011	**LabStar:** BOP180011

Bore 1586 geological profile (EBOF)

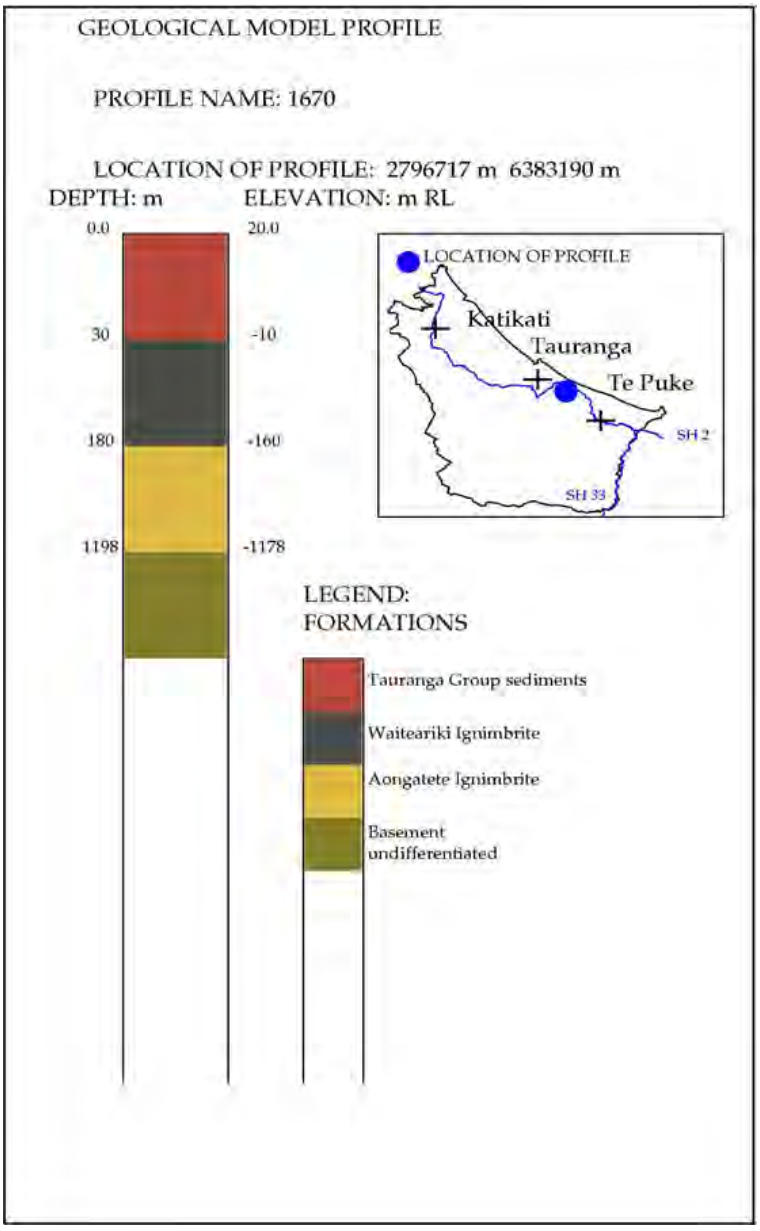


Bore 1586 water quality graphs

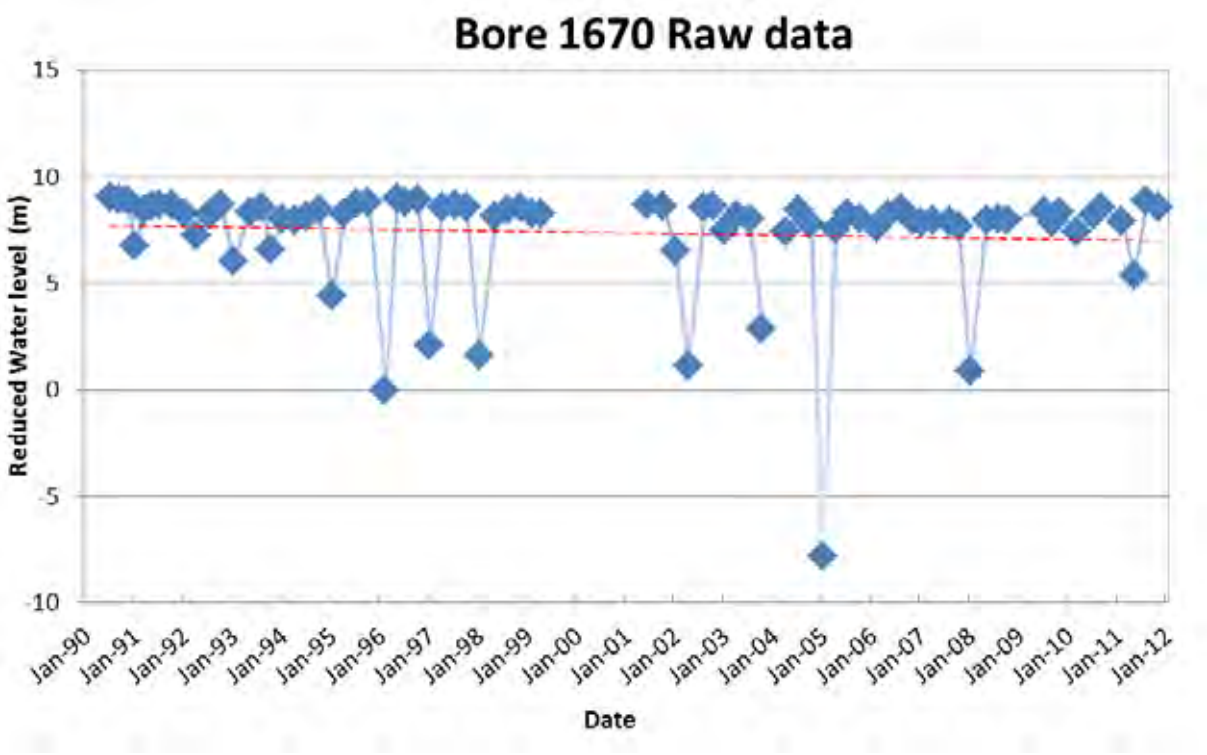


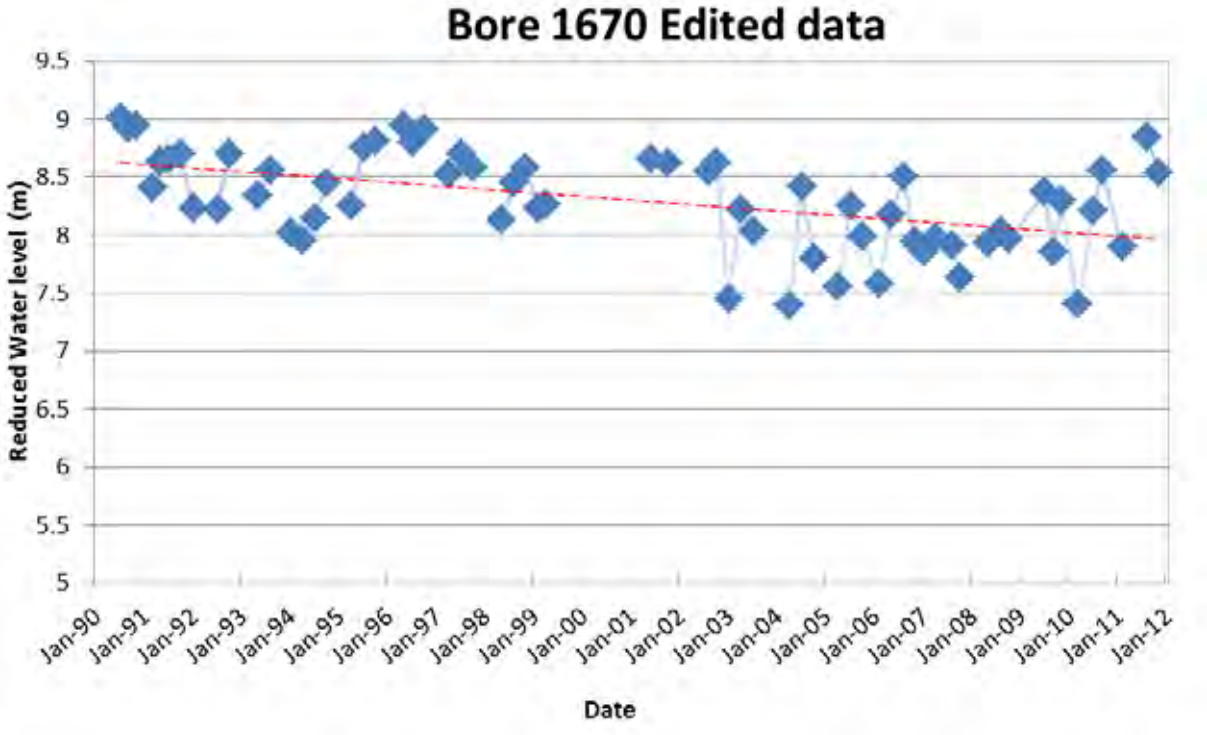
Bore 1670 Information			
Monitoring type	Water level	**Depth (m)**	103.6
Name	Te Hua Whenua Trust	**Casing Depth (m)**	84.4
Bore use	Irrigation	**Screen/open hole**	Open hole
Easting	279 6717	**Temperature**	Unknown
Northing	638 3190	**Catchment**	WAI 2 zone
Bore log	Partial	**Aquifer**	Waitekariki (WAI)
Monitoring period	**Water level**	1990 to 2011	
	Water quality		

Bore 1670 geological profile (EBOF)



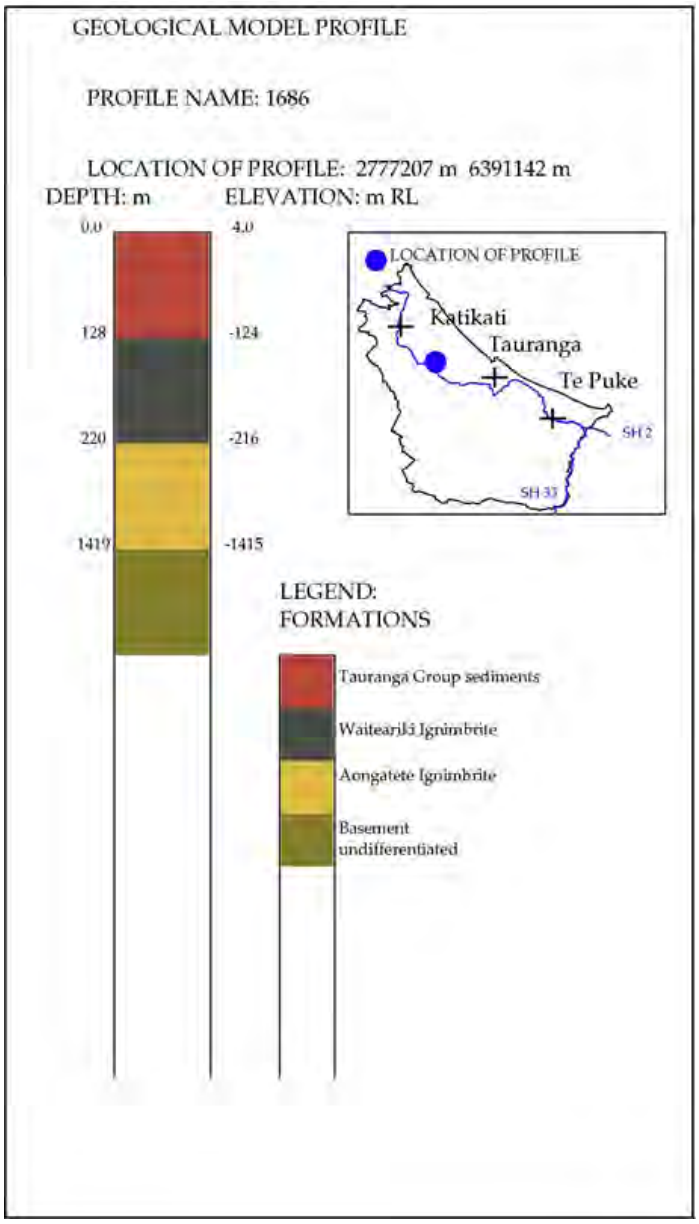
Bore 1670 water level graphs



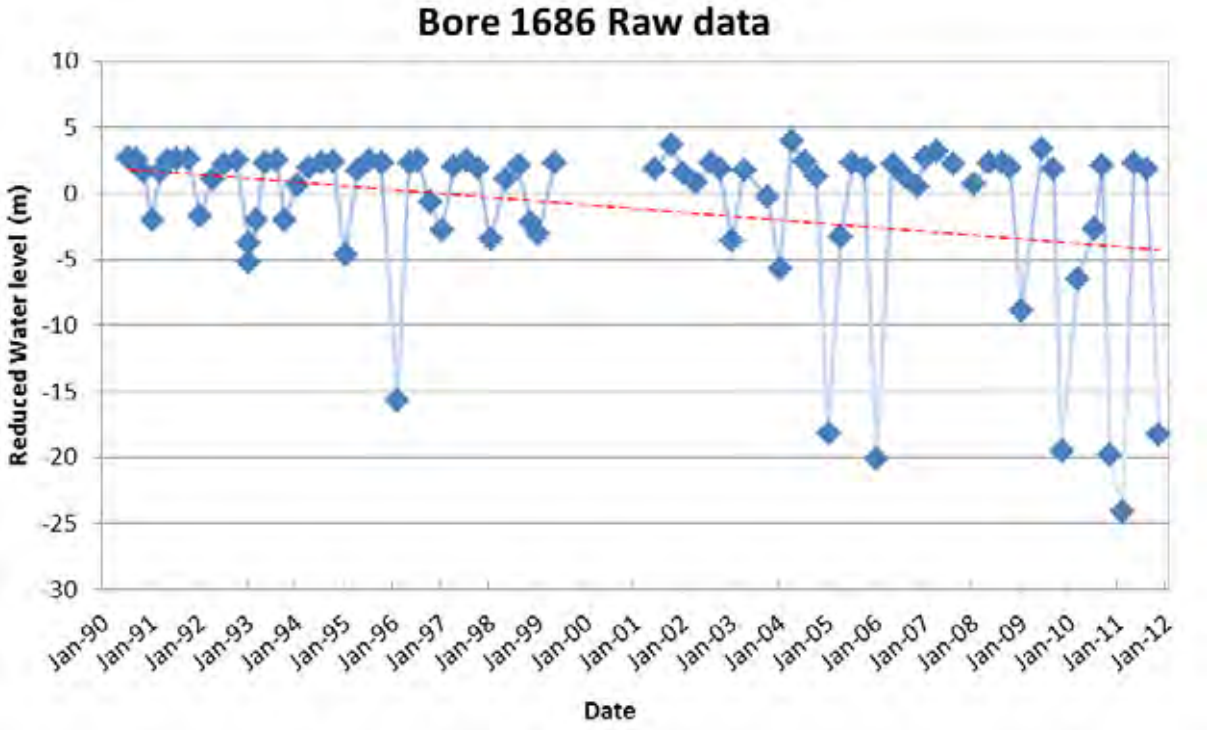


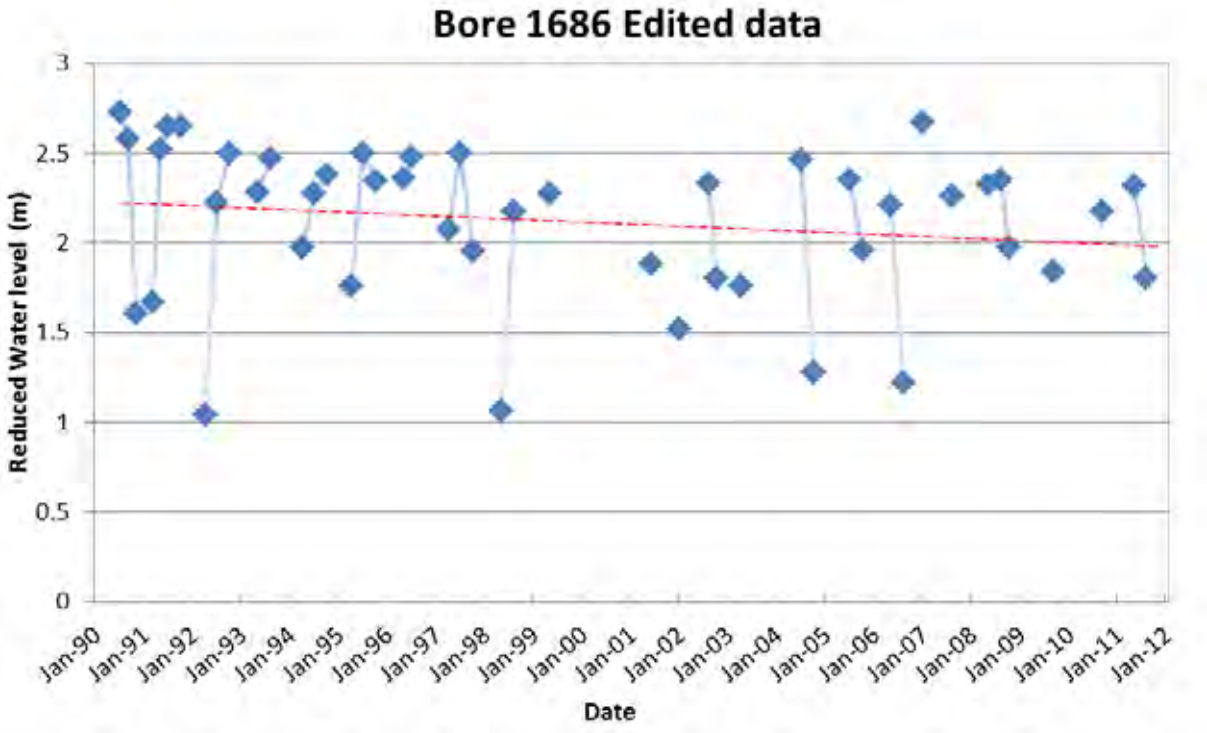
Bore 1686 Information			
Monitoring type	Water level & Water quality	**Depth (m)**	182.9
Name	Western Bay Golf Club	**Casing Depth (m)**	111.6
Bore use	Irrigation	**Screen/open hole**	
Easting	277 7207	**Temperature**	26.7
Northing	639 1142	**Catchment**	Waipapa
Bore log	Complete	**Aquifer**	Waitemata (WAI)
Monitoring period	**Water level**	1990 to 2011	
	Water quality	1991 to 2011	**LabStar:** BOP180027

Bore 1686 geological profile (EBOF)

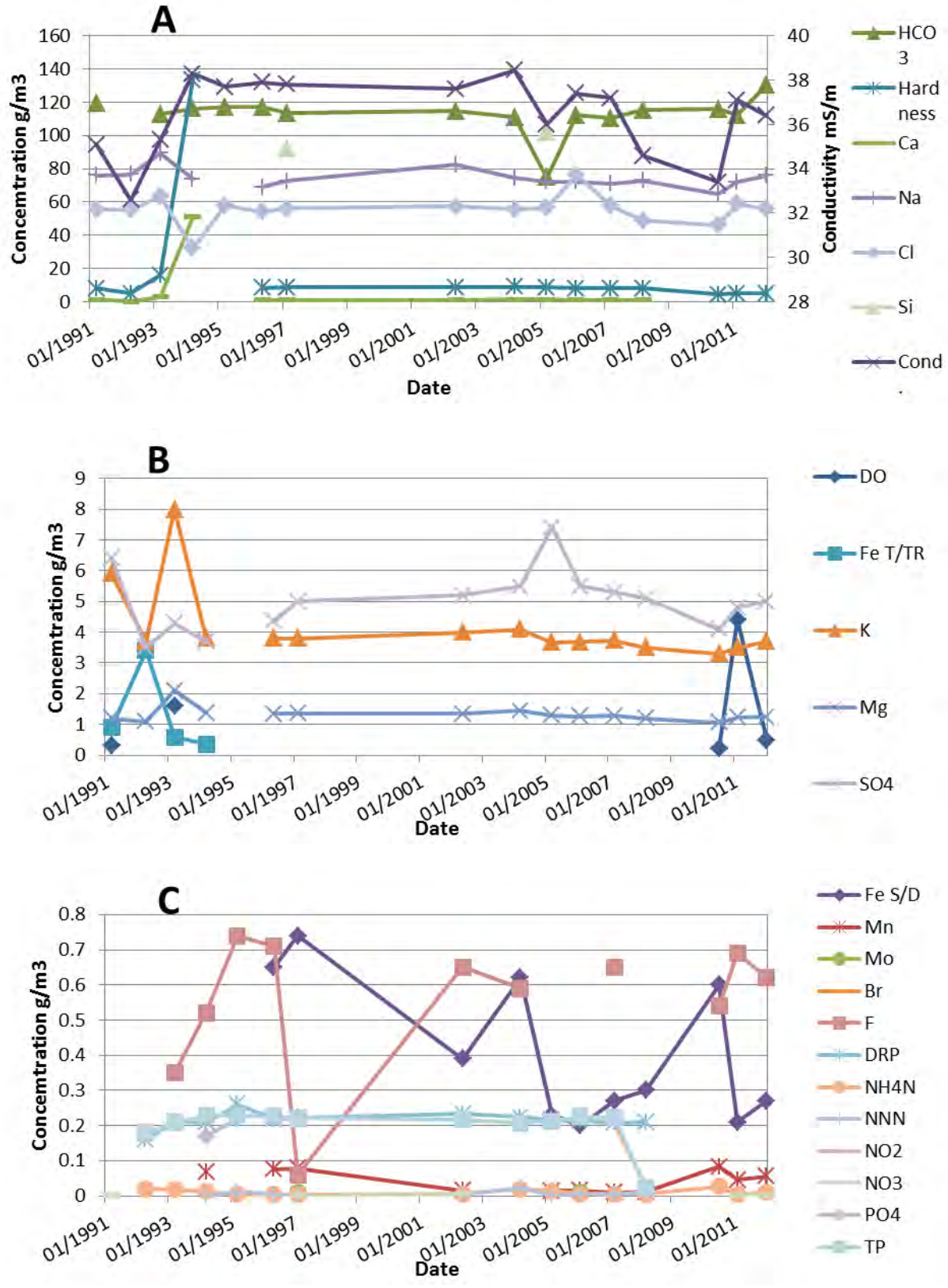


Bore 1686 water level graphs



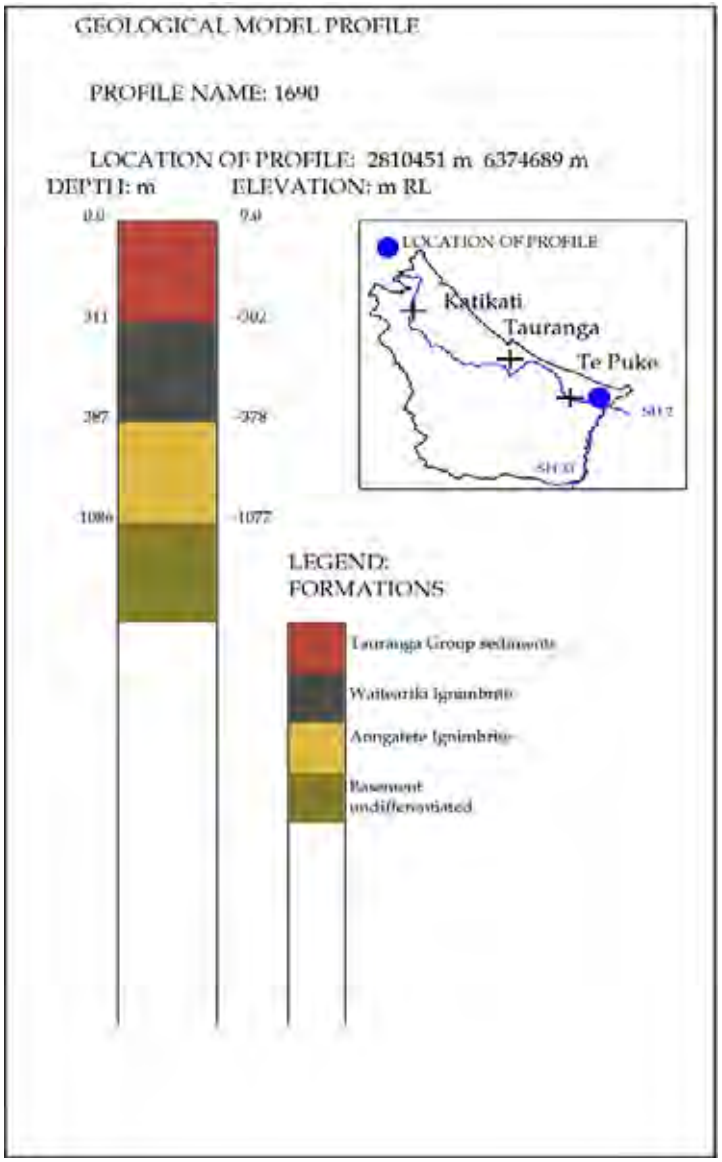


Bore 1686 water quality graphs

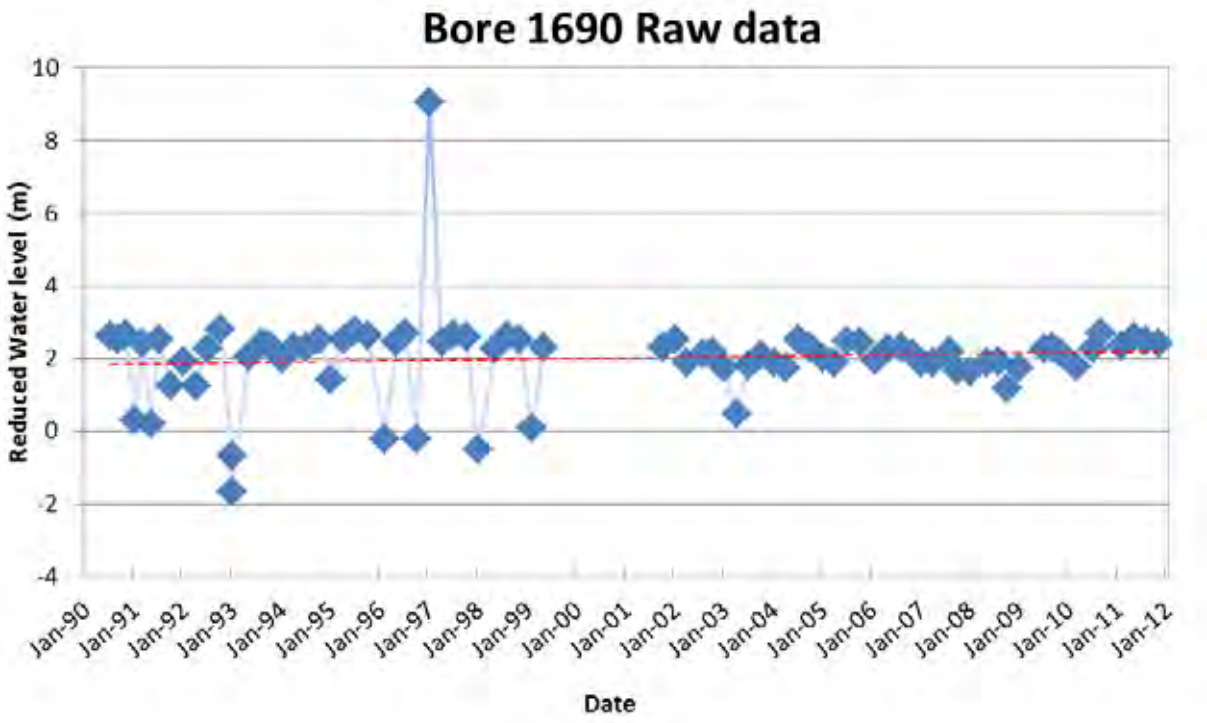


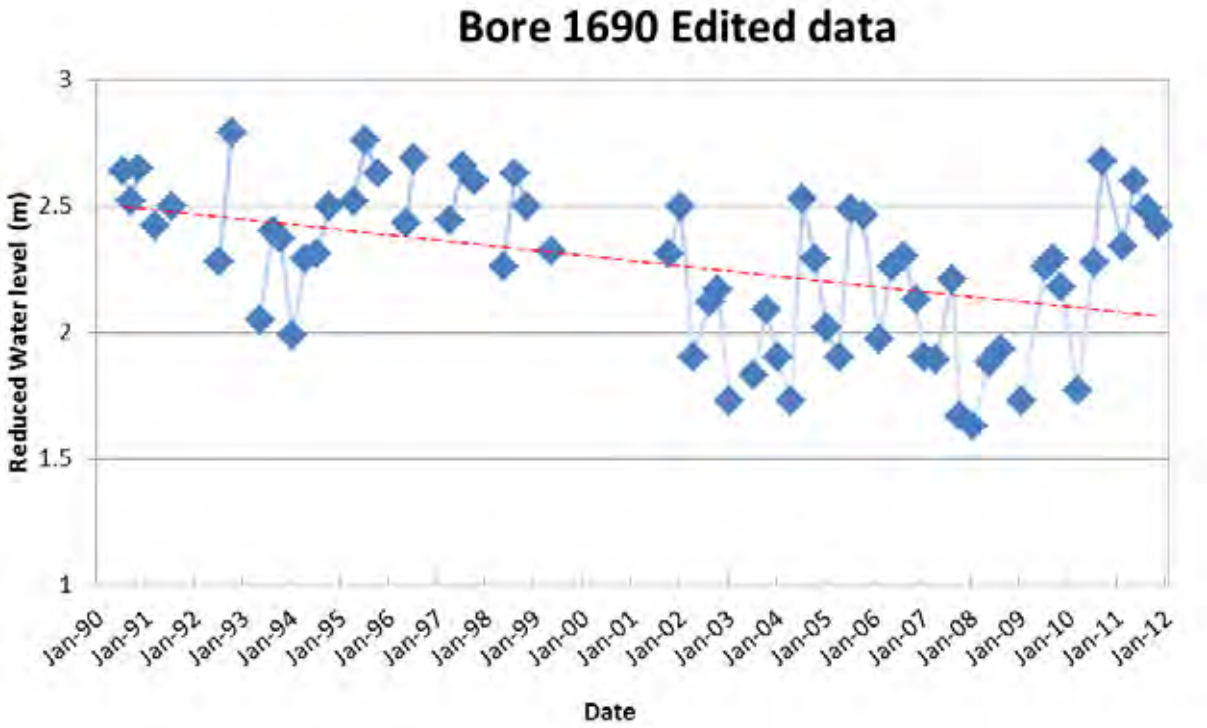
Bore 1690 Information			
Monitoring type	Water level & Water quality	**Depth (m)**	97.5
Name	Mangatarata orchards	**Casing Depth (m)**	72.5
Bore use	Irrigation	**Screen/open hole**	Open hole
Easting	281 0451	**Temperature**	26.5°C
Northing	637 4681	**Catchment**	Lower Kaituna
Bore log	Complete	**Aquifer**	Tauranga sediments
Monitoring period	**Water level**	1990 to 2011	
	Water quality	1991 to 2011	**LabStar:** BOP180013

Bore 1690 geological profile (EBOF)

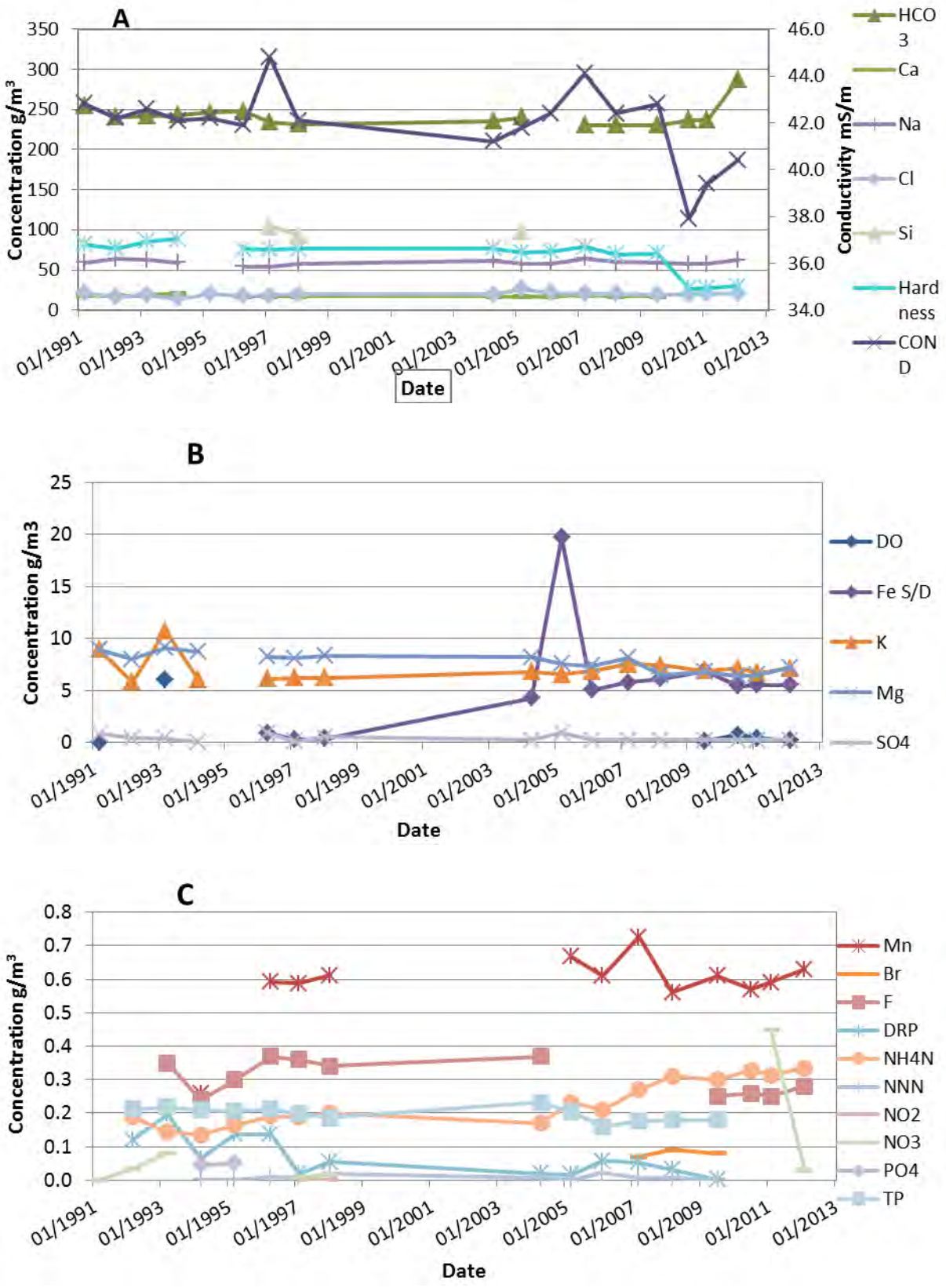


Bore 1690 water level graphs



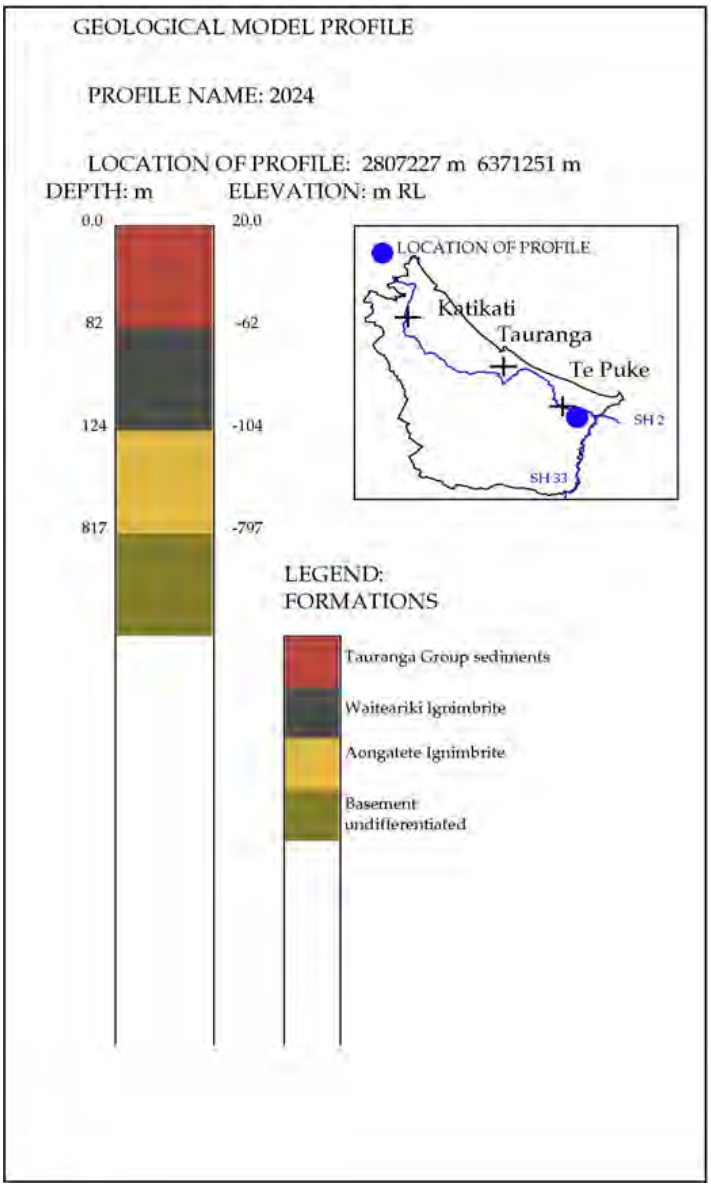


Bore 1690 water quality graphs

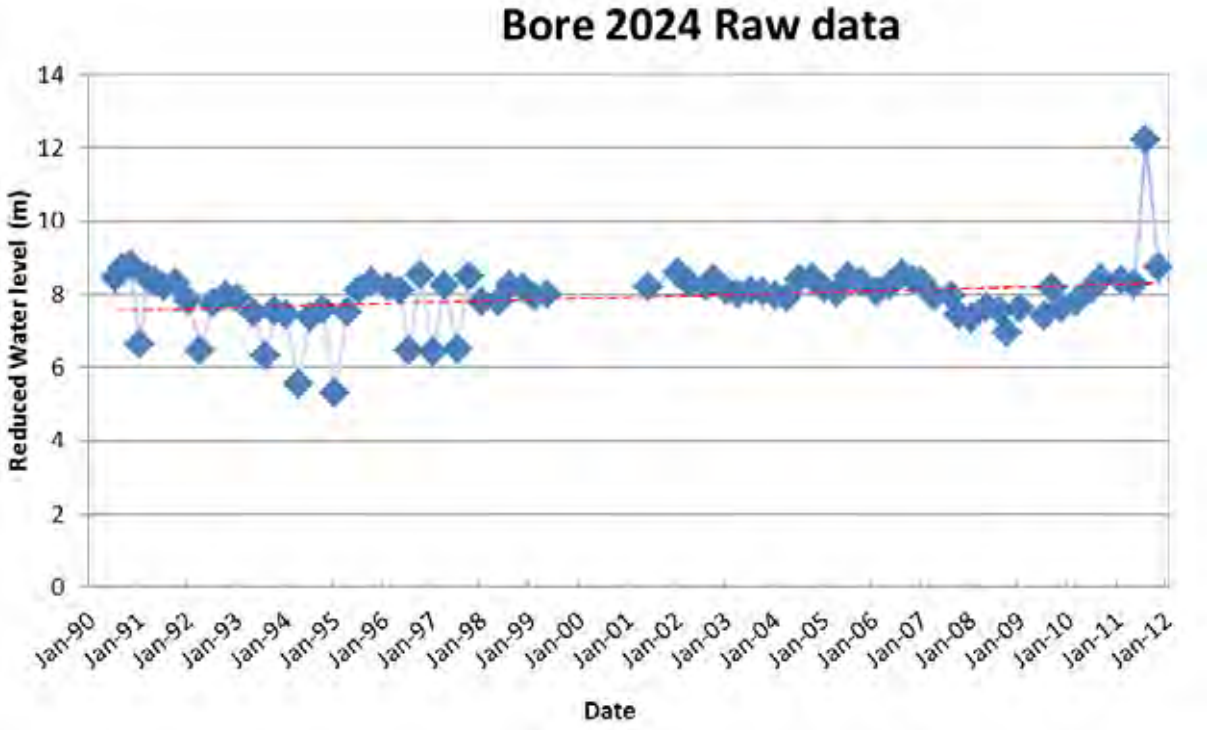


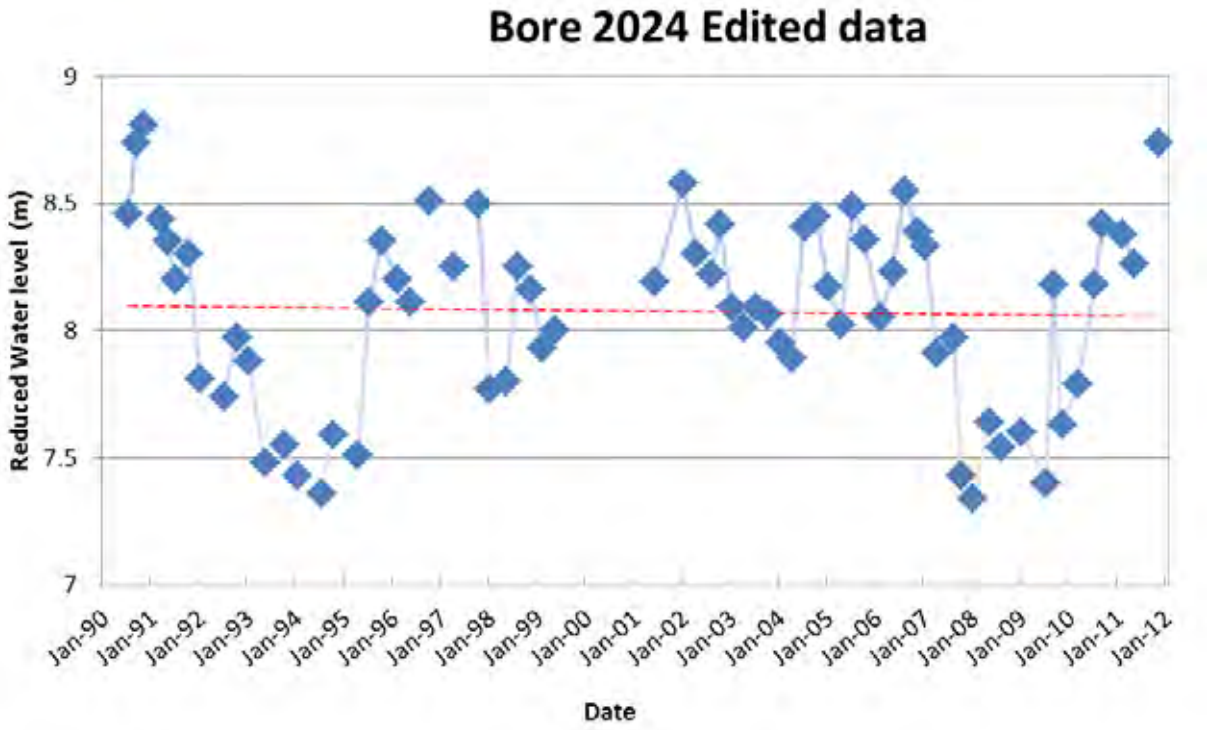
Bore 2024 Information			
Monitoring type	Water level	**Depth (m)**	118.5
Name	Eleos	**Casing Depth (m)**	98
Bore use	Irrigation	**Screen/open hole**	Open hole
Easting	280 7227	**Temperature**	Unknown
Northing	637 1251	**Catchment**	Lower Kaituna
Bore log	Complete	**Aquifer**	Waitekariki
Monitoring period	**Water**	1990 to 2011	
	Water quality	-	

Bore 2024 geological profile (EBOF)



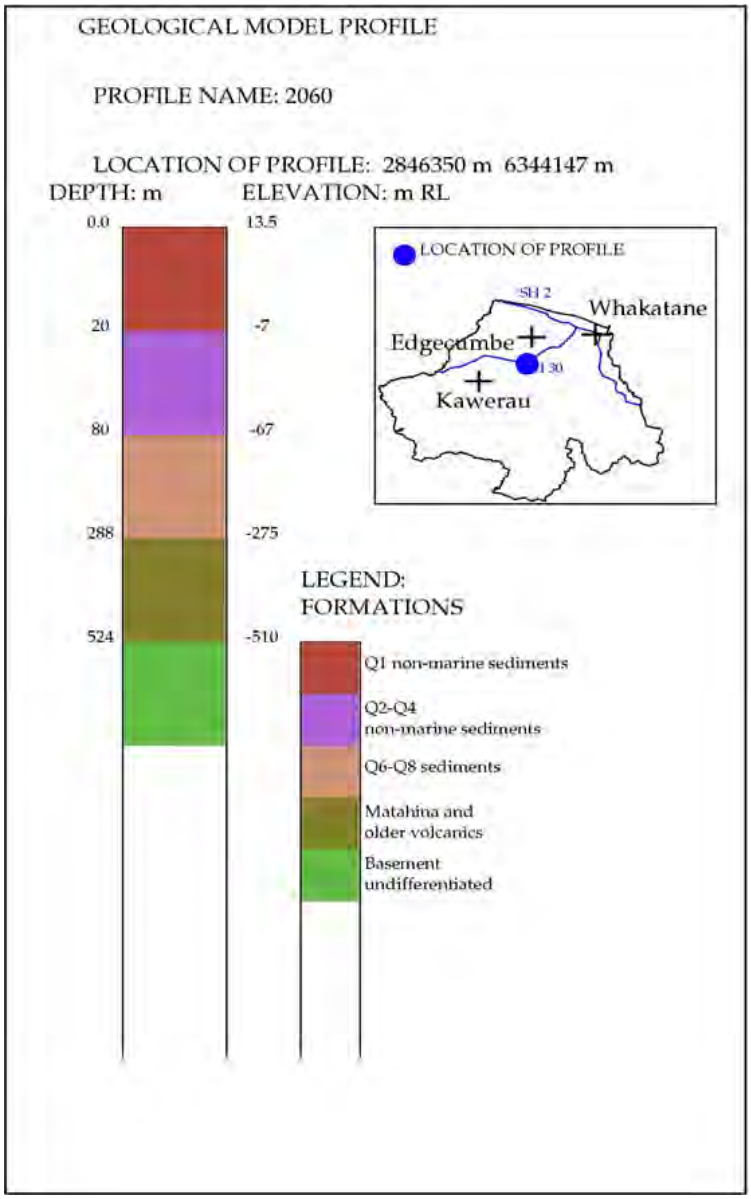
Bore 2024 water level graphs

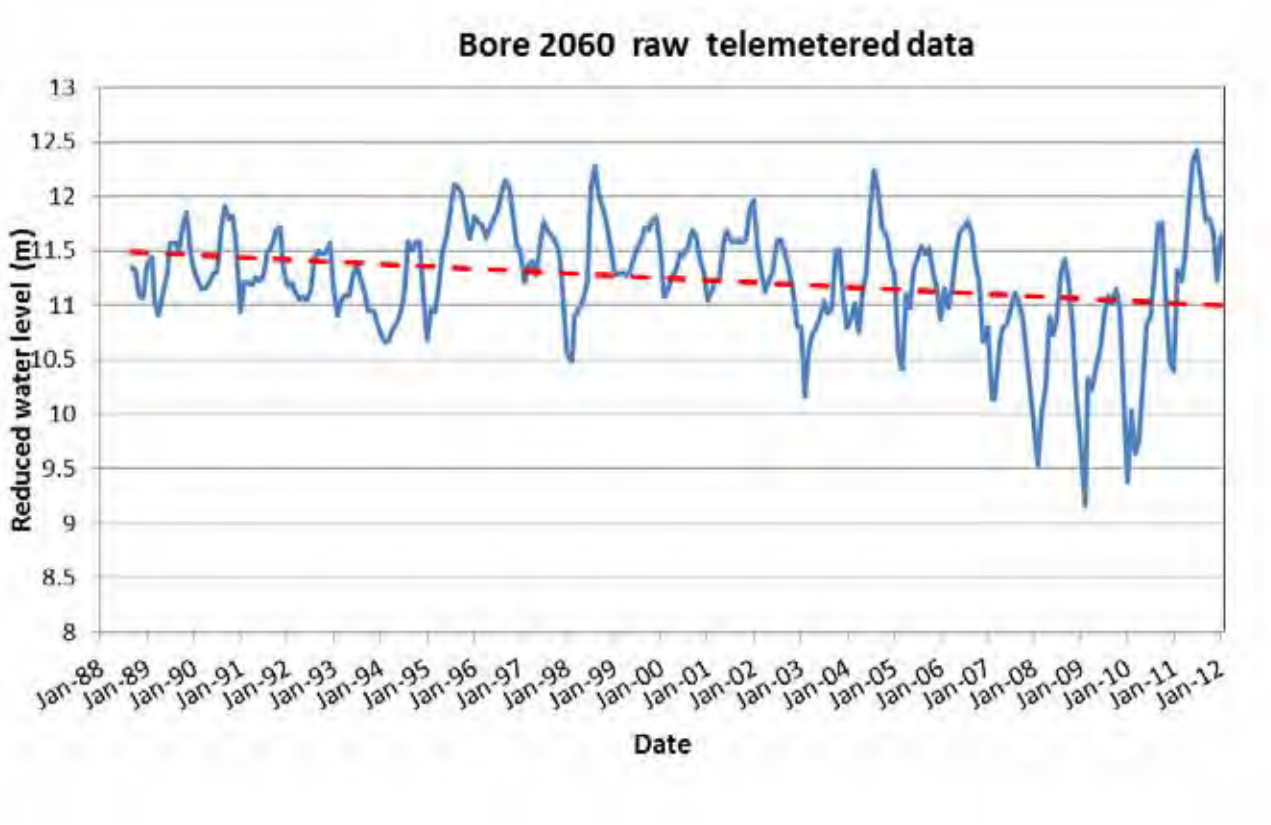




Bore 2060 Information			
Monitoring type	Telemetered Water level	**Depth (m)**	61.3
Name	Signal	**Casing Depth (m)**	55.6
Bore use	Unknown	**Screen/open hole**	From 61.3 to 55.6
Easting	284 6350	**Temperature**	Unknown
Northing	634 4147	**Catchment**	Ngakauroa Stream
Bore log	Complete	**Aquifer**	Tauranga sediments
Monitoring period	**Water level**	1988 to 2011	
	Water quality		

Bore 2060 geological profile (EBOF)




Bore 2060 raw telemetered data
Reduced water level (m)
13
12.5
12
11.5
11
10.5
10
9.5
9
8.5
8
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
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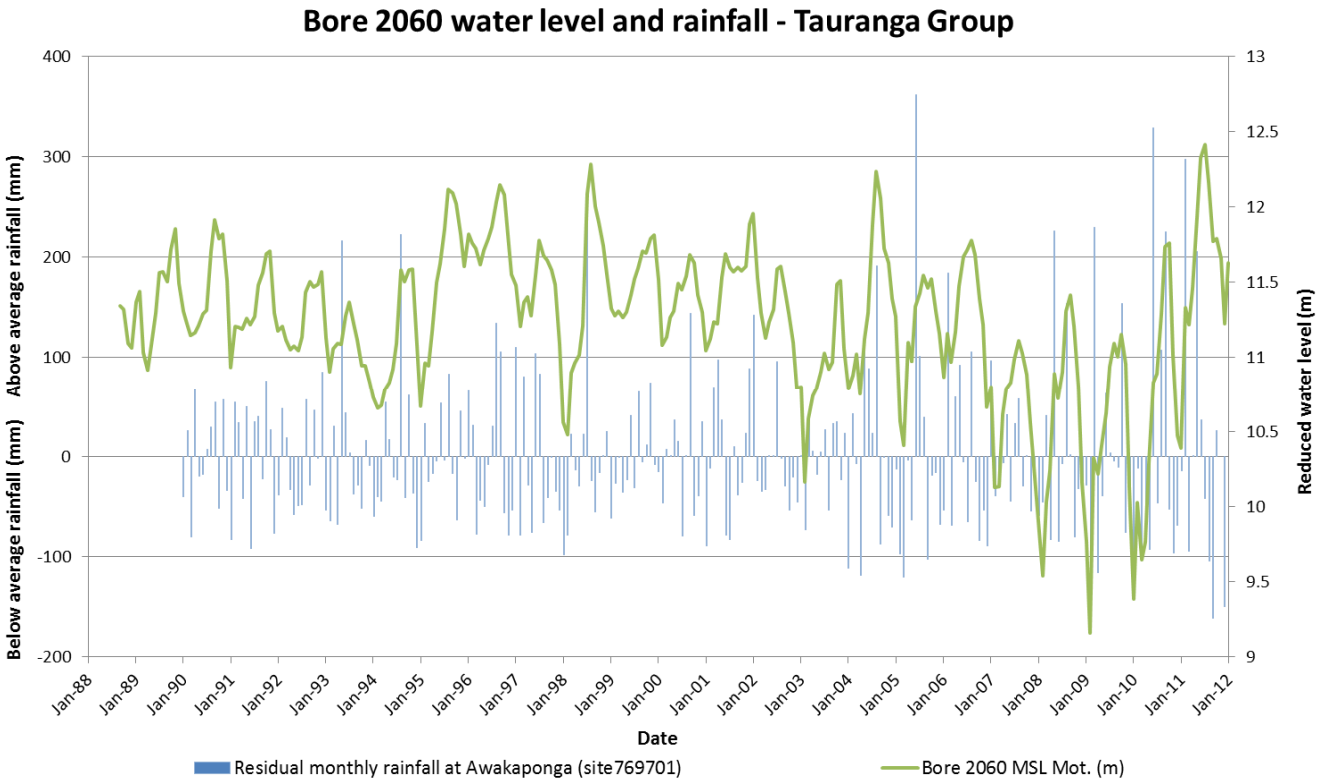
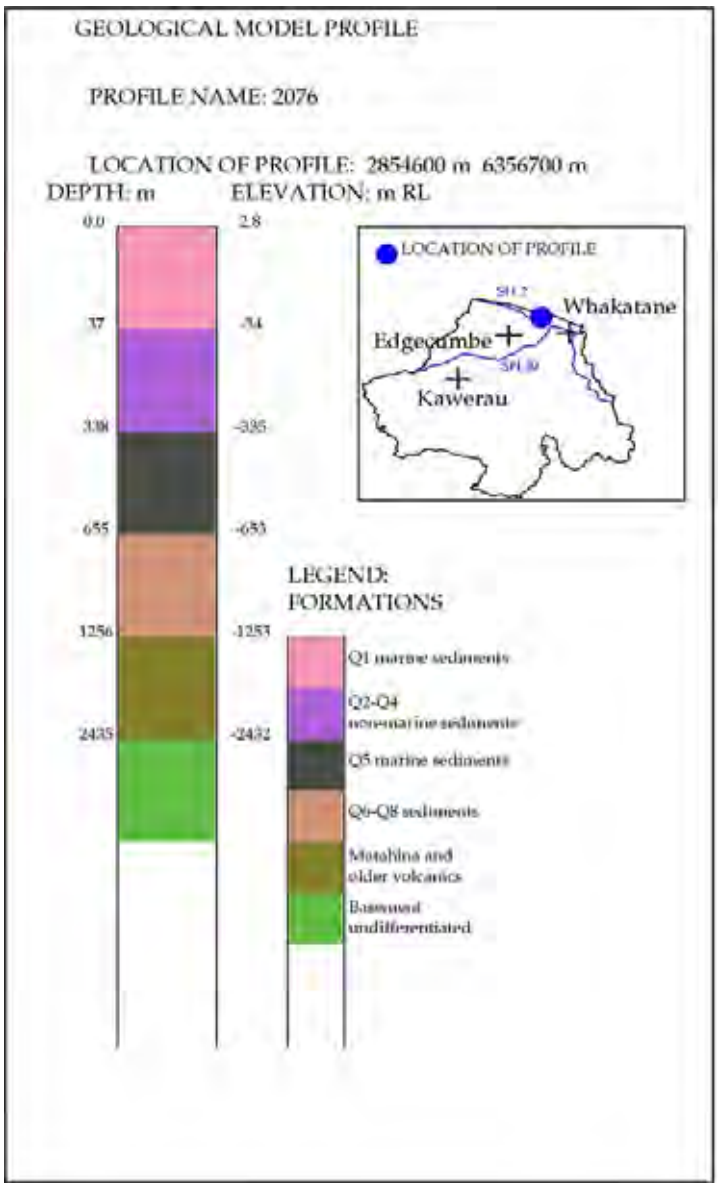
Jan-10
Jan-11
Jan-12
Date

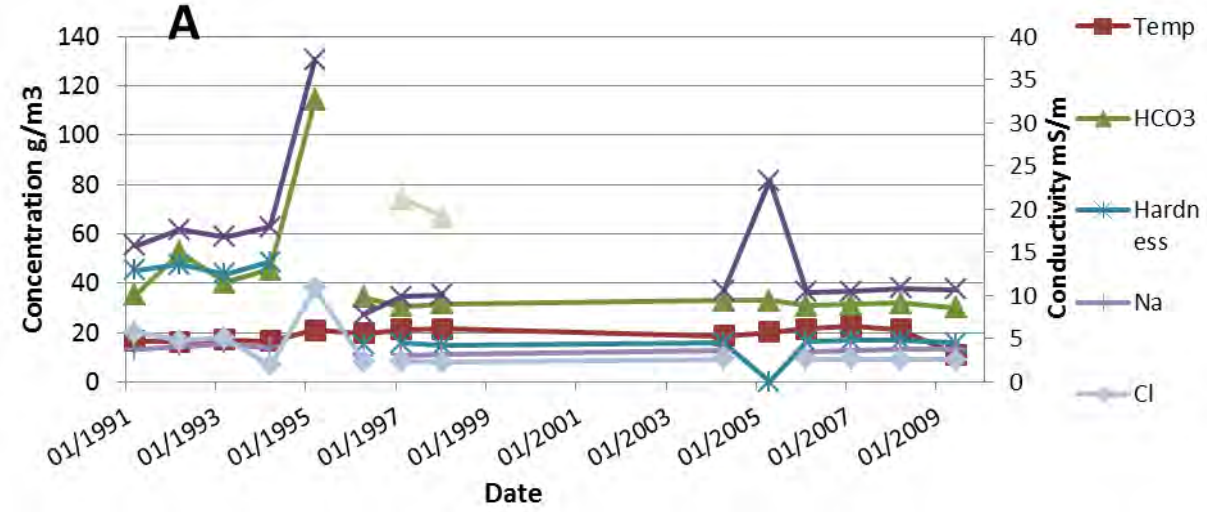

Bore 2060 water level and rainfall - Tauranga Group
Above average rainfall (mm)
Below average rainfall (mm)
400
300
200
100
0
-100
-200
13
12.5
12
11.5
11
10.5
10
9.5
9
Reduced water level (m)
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
Jan-09
Jan-10
Jan-11
Jan-12
Date
Residual monthly rainfall at Awakaponga (site769701)
Bore 2060 MSL Mot. (m)

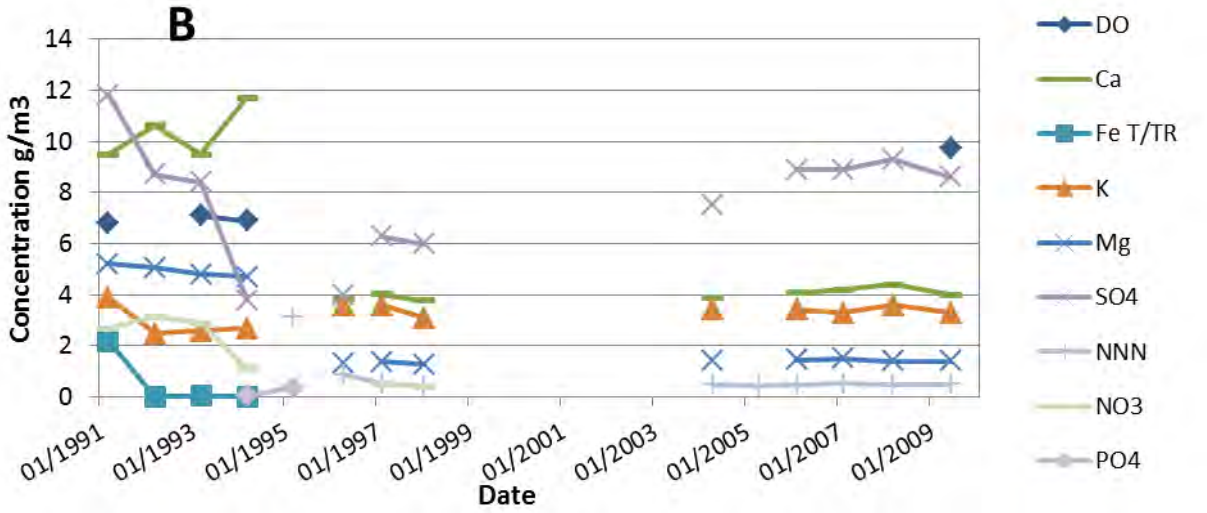
Bore 2076 Information			
Monitoring type	Water quality	**Depth (m)**	Unknown
Name	Whakatane airport	**Casing Depth (m)**	Unknown
Bore use	Unknown	**Screen/open hole**	Unknown
Easting	285 4600	**Temperature**	19.6°C
Northing	635 6700	**Catchment**	Kope Orini 2
Bore log	–	**Aquifer**	Unknown
Monitoring period	**Water level**		
	Water quality	1991 to 2009	**LabStar:** BOP180001

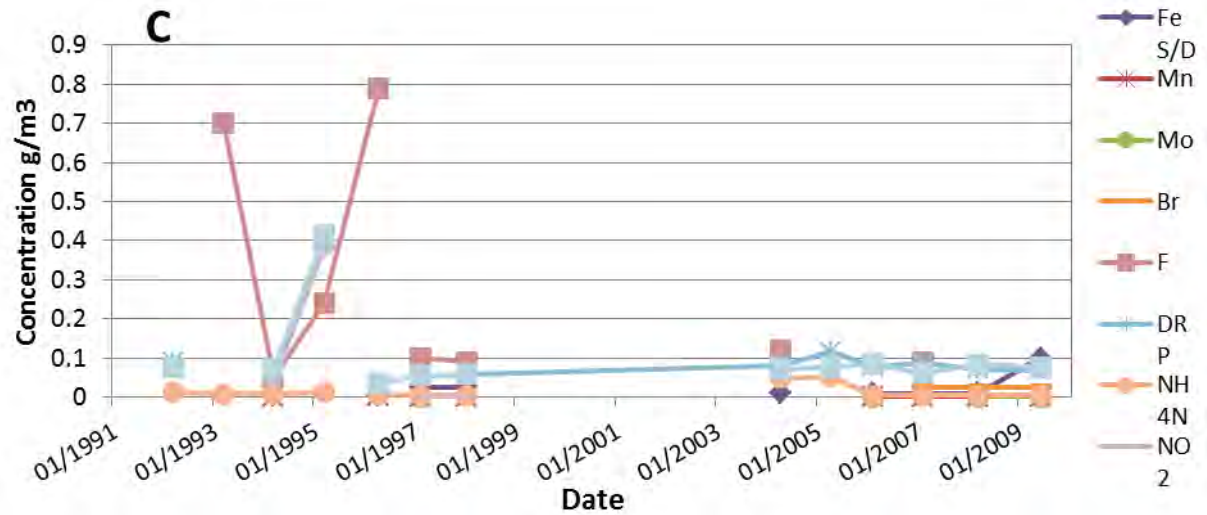
Bore 2076 geological profile (EBOF)



Bore 2076 water quality

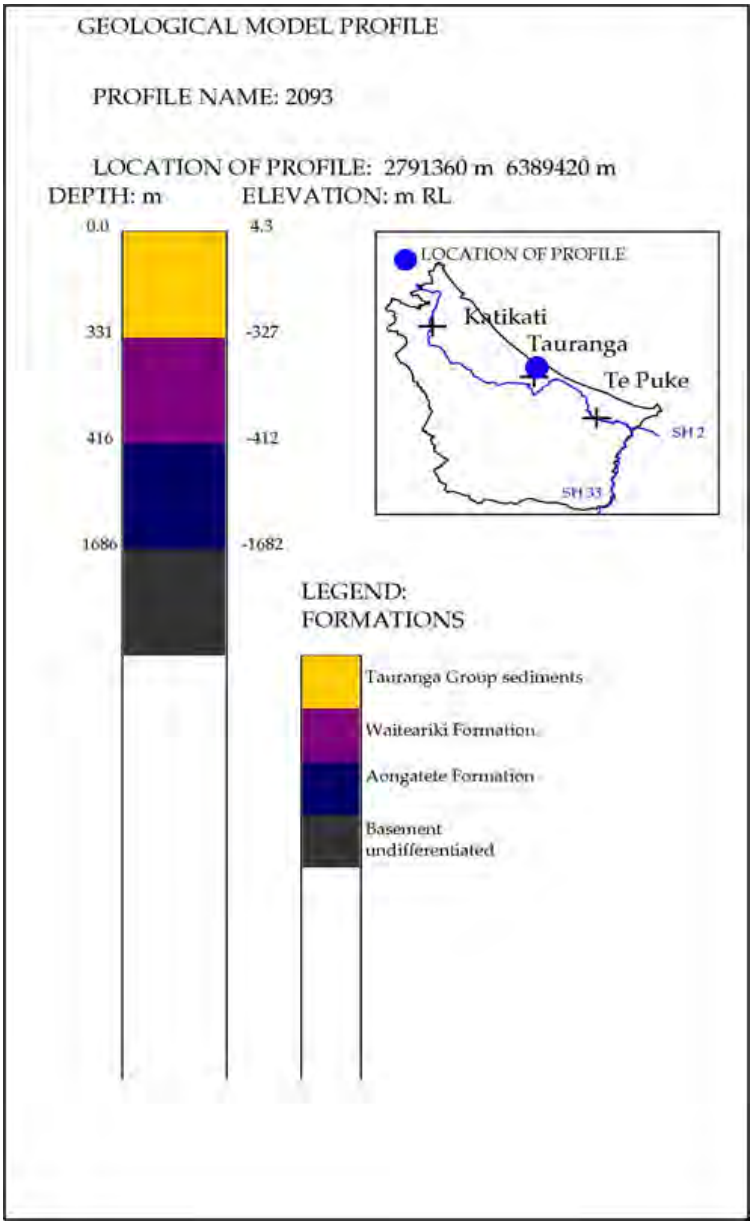




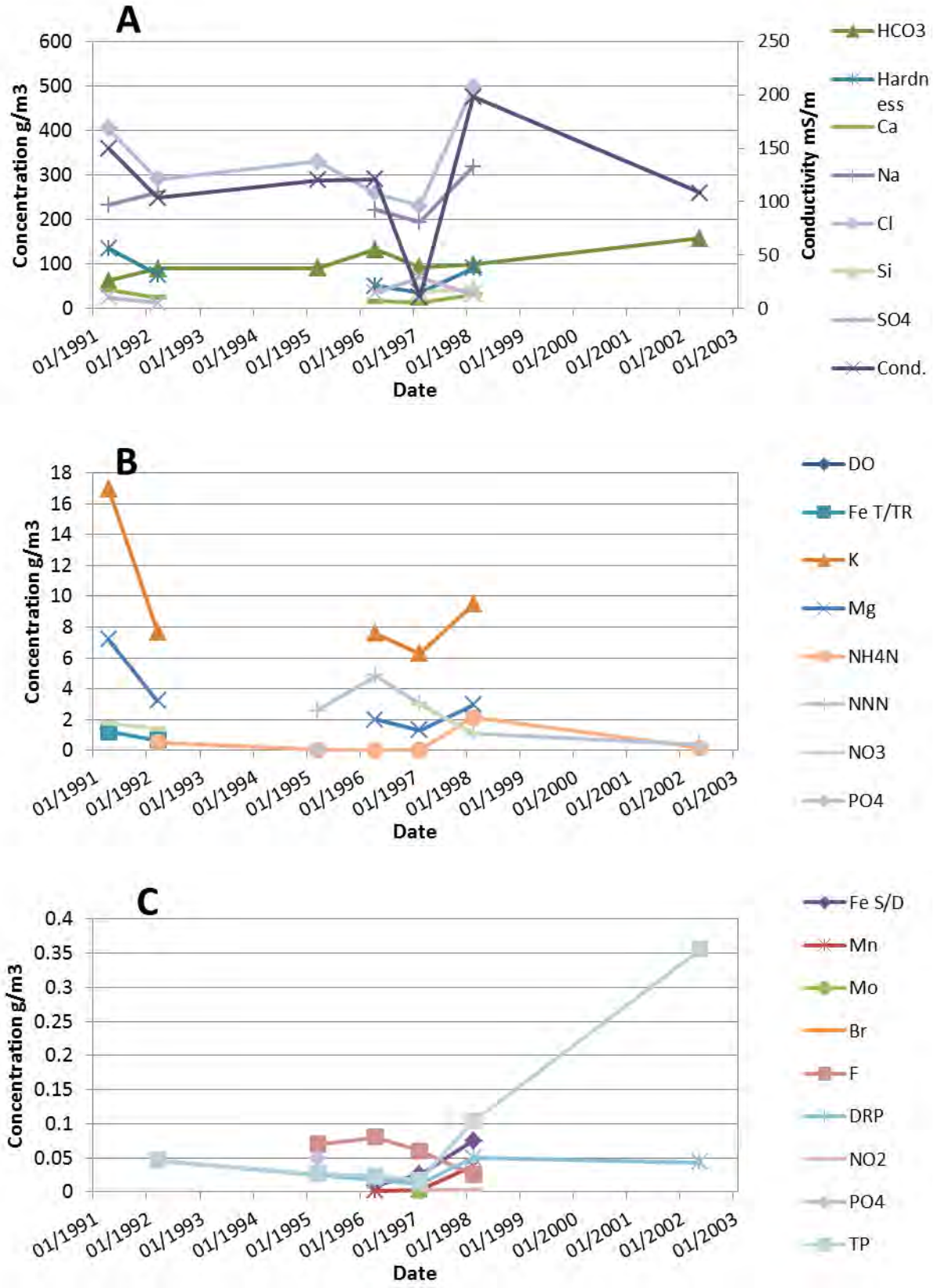


Bore 2093 Information			
Monitoring type	Water quality	**Depth (m)**	6
Name	Dominion Salt Works	**Casing Depth (m)**	Unknown
Bore use	Monitoring	**Screen/open hole**	Unknown
Easting	279 1360	**Temperature**	17.4°C
Northing	638 9420	**Catchment**	Maungatawa Area
Bore log	-	**Aquifer**	Tauranga sediments
Monitoring period	**Water level**		
	Water quality	1991 to 2002	**LabStar:** BOP180040

Bore 2093 geological profile (EBOF)

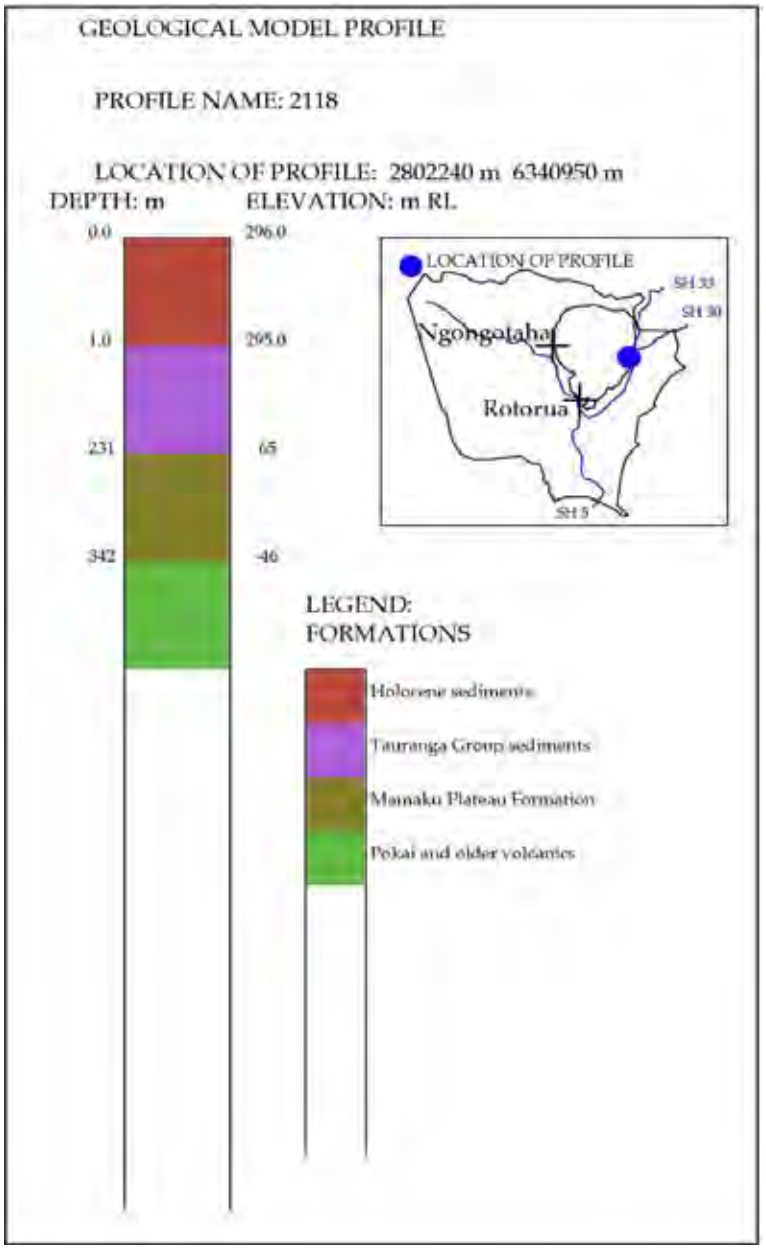


Bore 2093 water quality graphs

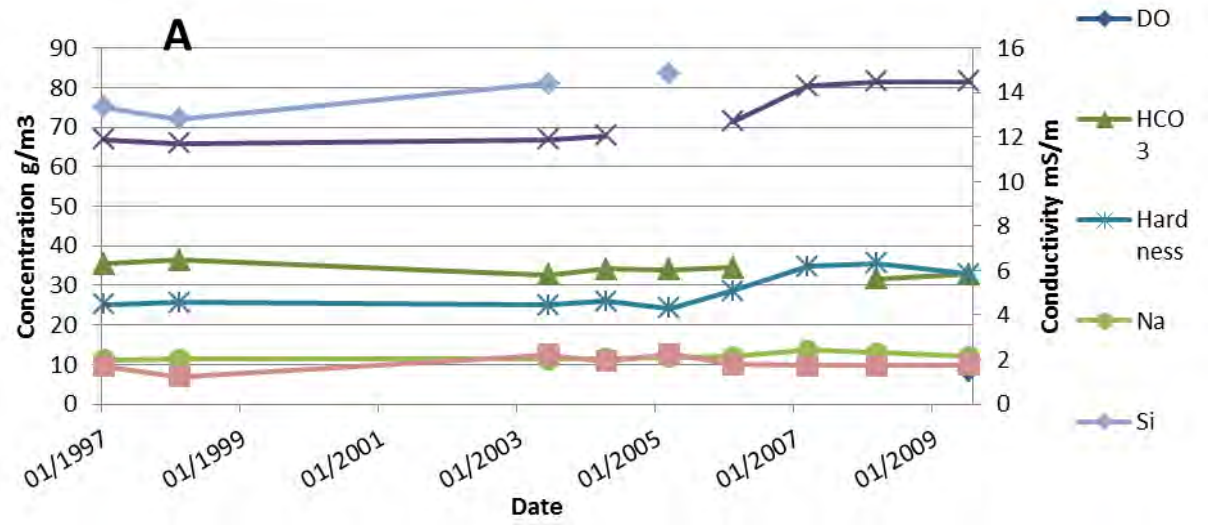


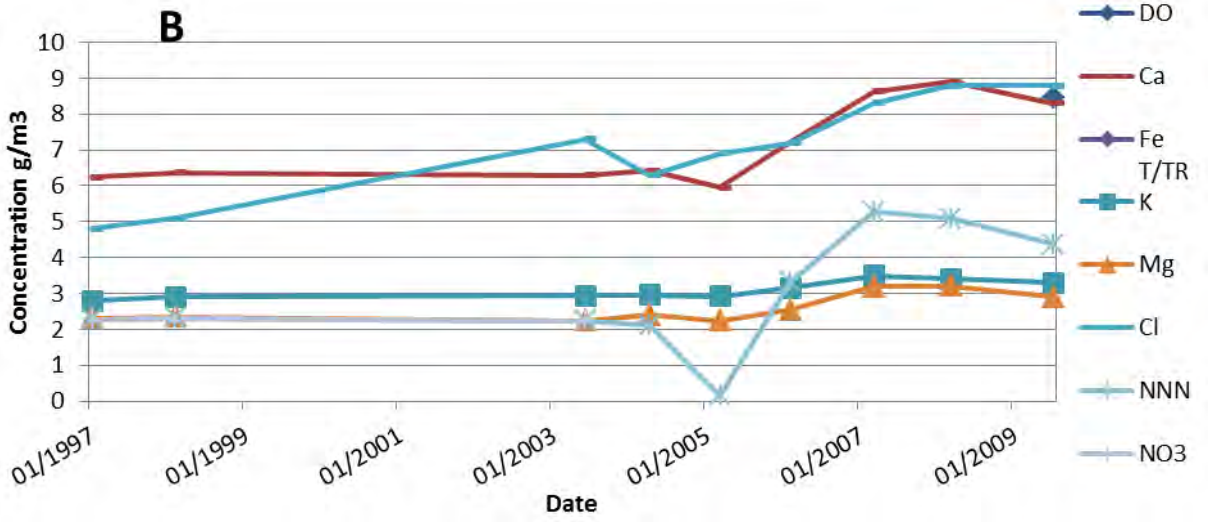
Bore 2118 Information			
Monitoring type	Water quality	**Depth (m)**	24
Name	Te Ngae Nursery	**Casing Depth (m)**	19
Bore use	Irrigation	**Screen/open hole**	From 19 to 22
Easting	280 2240	**Temperature**	12°C
Northing	634 0950	**Catchment**	Rotokawa Area
Bore log	Complete	**Aquifer**	Tauranga sediments
Monitoring period	**Water level**		
	Water quality	1997 to 2009	**LabStar:** BOP180065

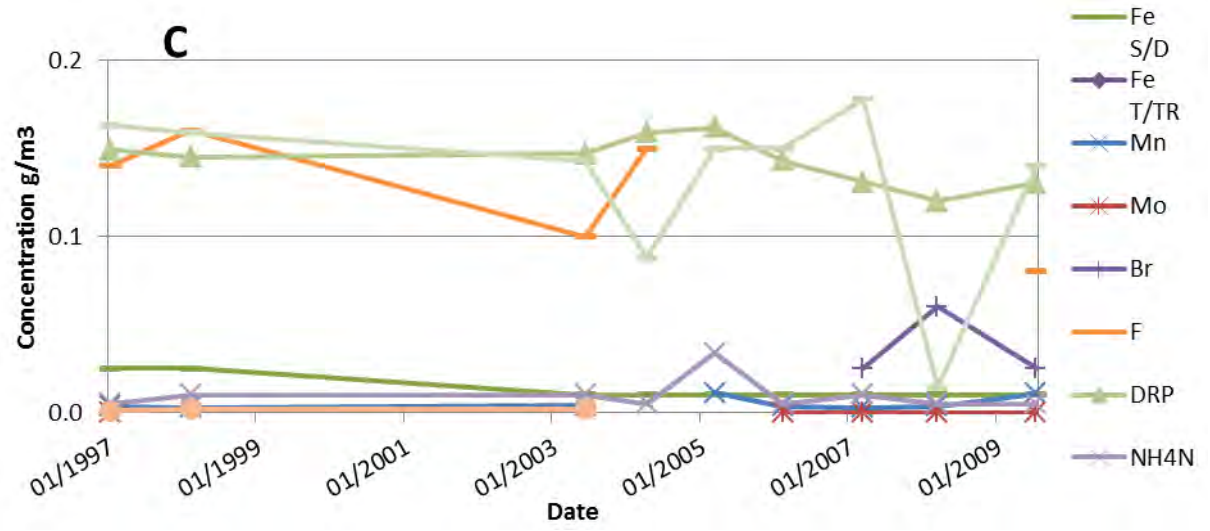
Bore 2118 geological profile (EBOF)



Bore 2118 water quality graphs

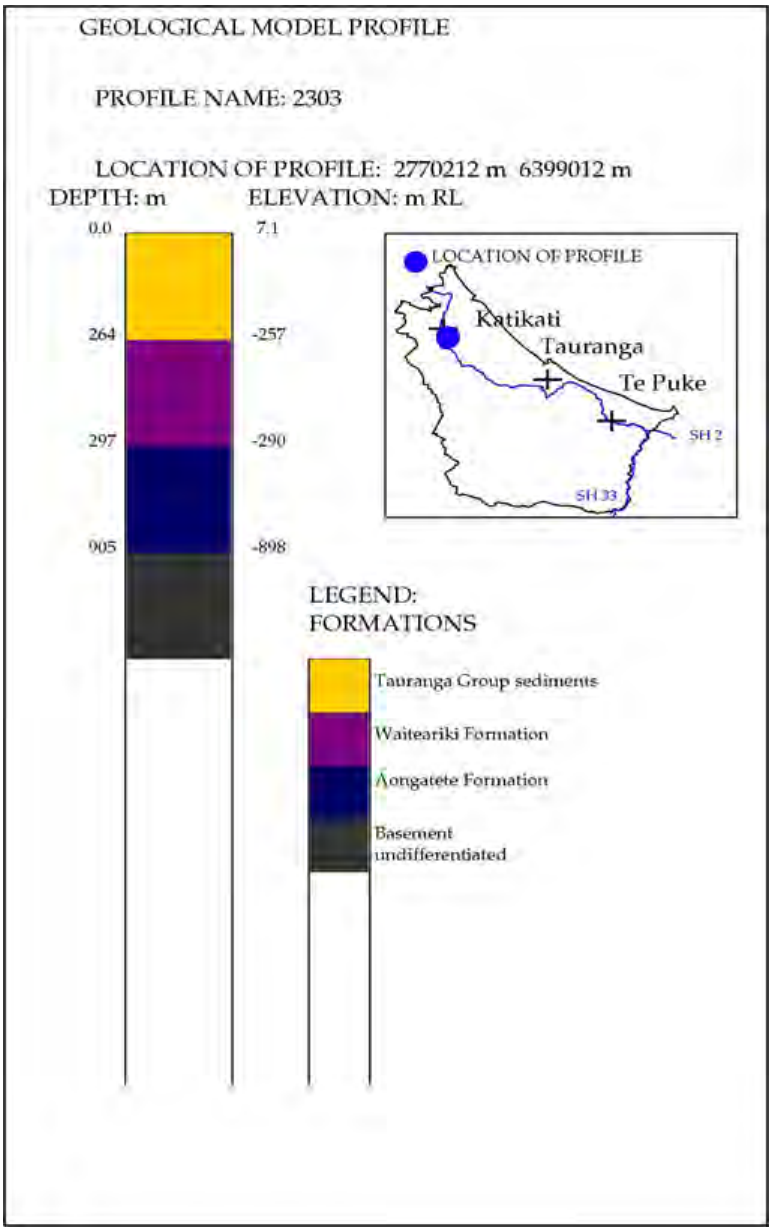




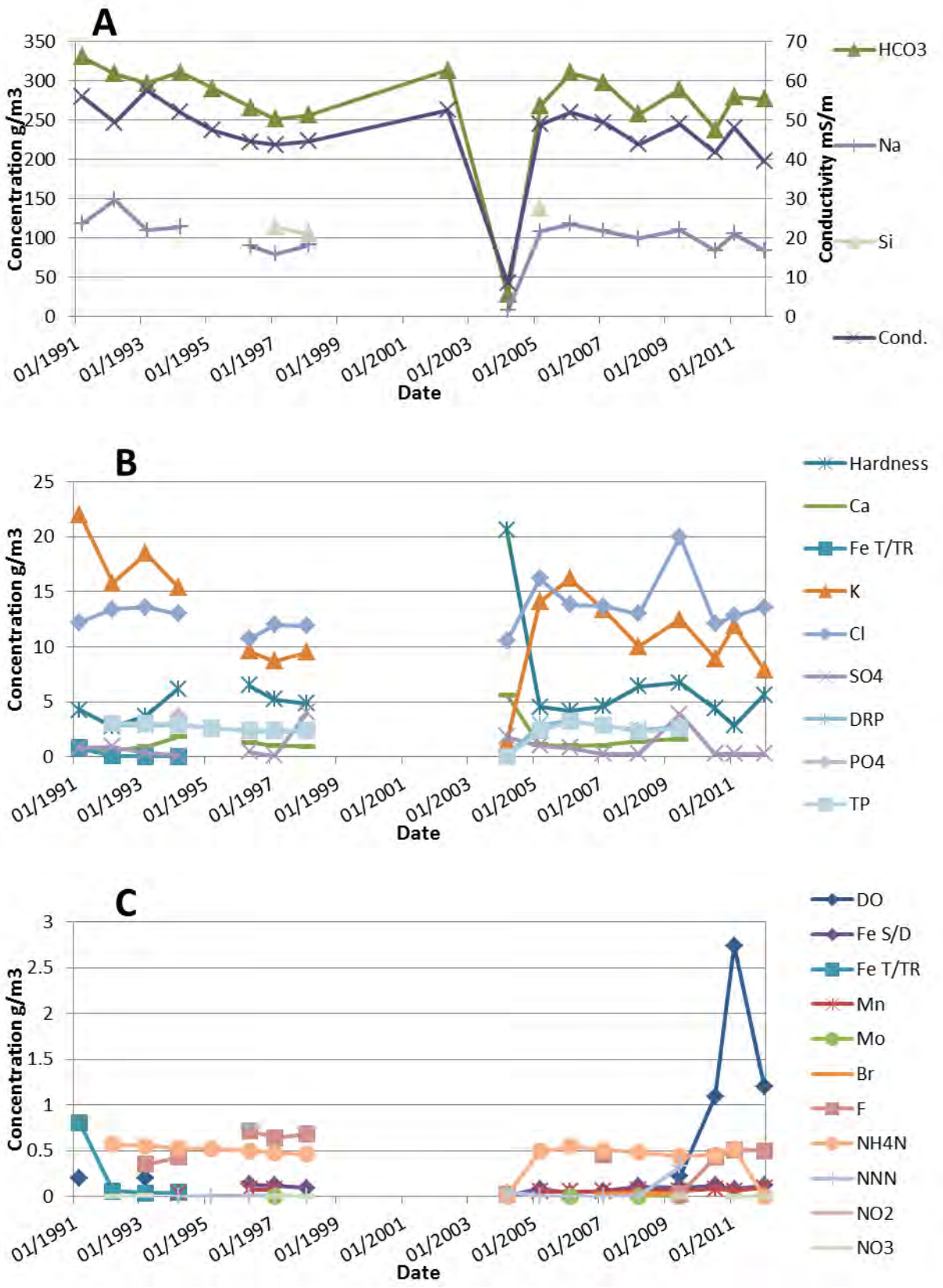


Bore 2303 Information			
Monitoring type	Water quality	**Depth (m)**	262
Name	Harris	**Casing Depth (m)**	144.8
Bore use	Irrigation	**Screen/open hole**	Unknown
Easting	277 0212	**Temperature**	34°C
Northing	639 9012	**Catchment**	WAI1 (zone)
Bore log	Complete	**Aquifer**	Waitekariki (WAI)
Monitoring period	**Water level**		
	Water quality	1991 to 2011	**LabStar:** BOP180019

Bore 2303 geological profile (EBOF)

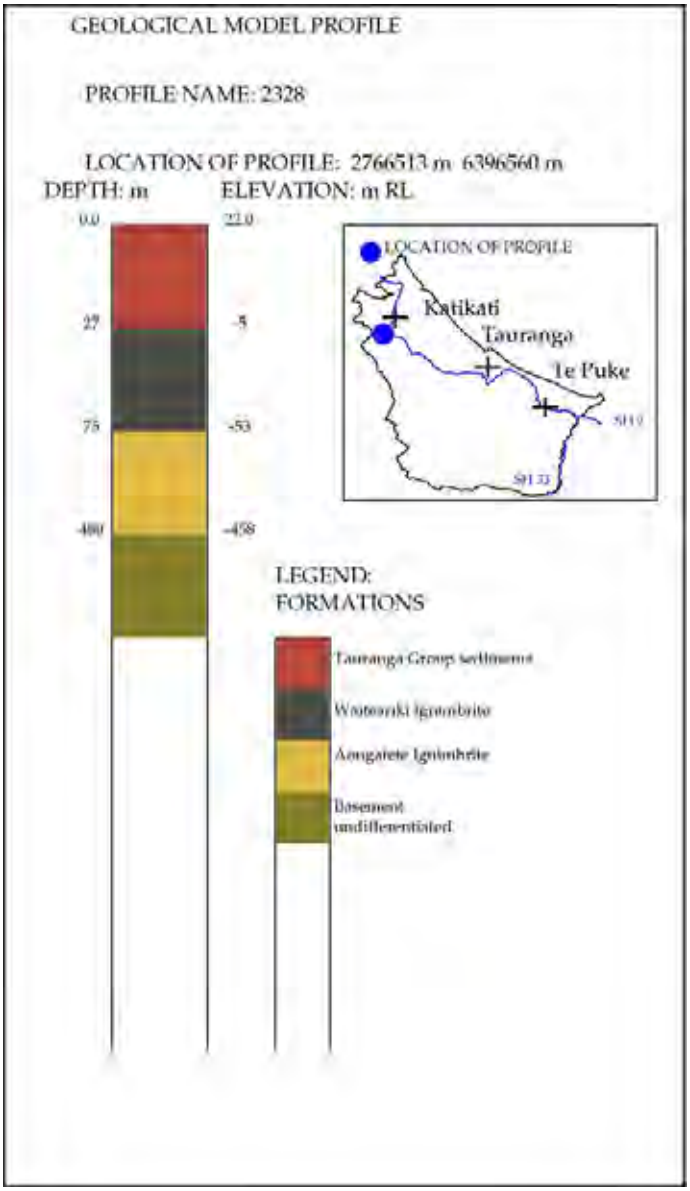


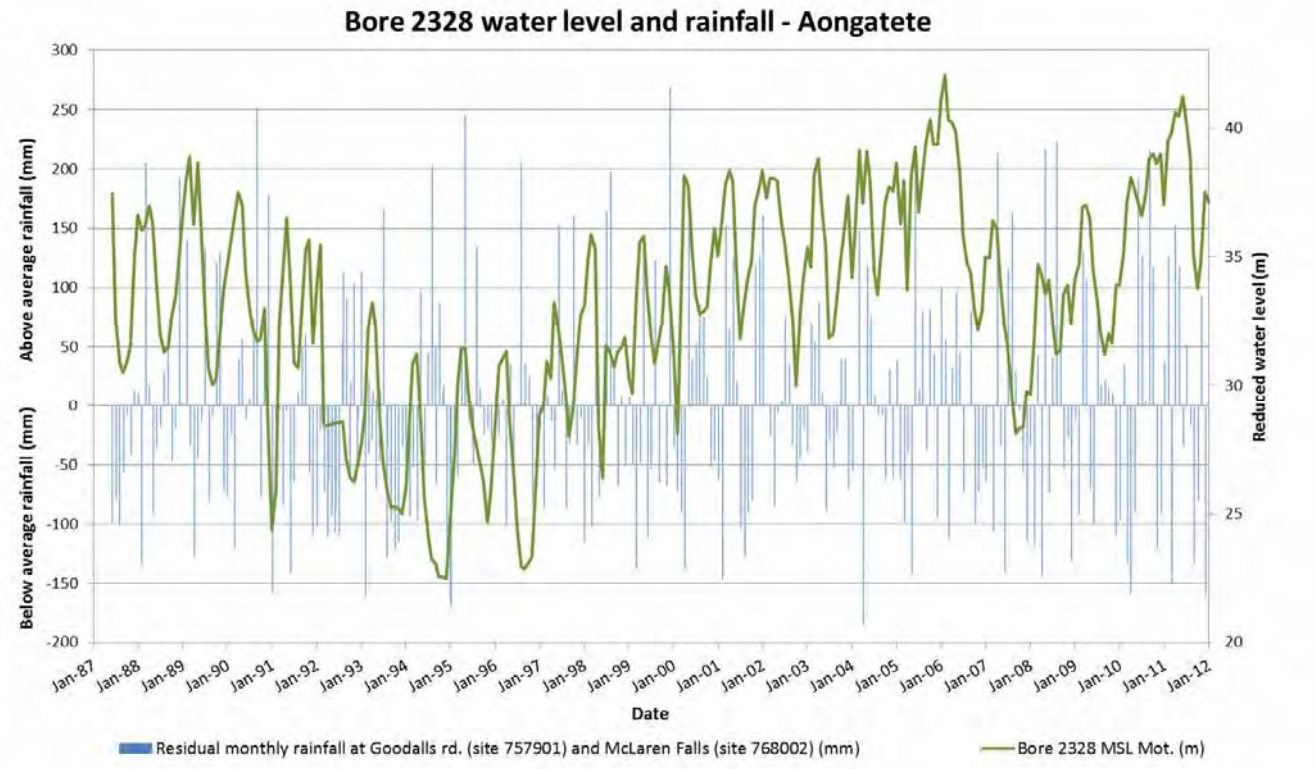
Bore 2303 water quality graphs

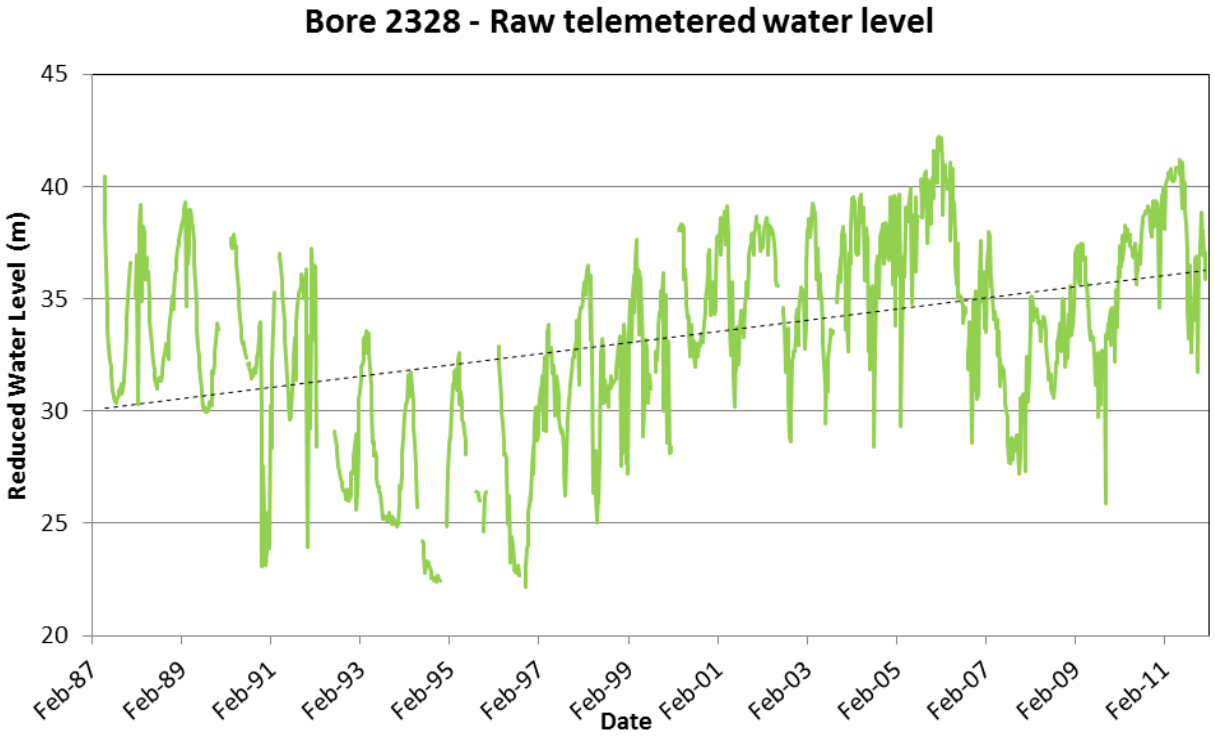


Bore 2328 Information			
Monitoring type	Water level	**Depth (m)**	454.2
Name	Duncan	**Casing Depth (m)**	246.89
Bore use	Irrigation	**Screen/open hole**	Open hole
Easting	2766513	**Temperature**	Unknown
Northing	6396560	**Catchment**	Te Mania
Bore log	Complete	**Aquifer**	Aongatete (WAI)
Monitoring period	**Water level**	1987 to 2011	
	Water quality	-	

Bore 2328 geological profile (EBOF)

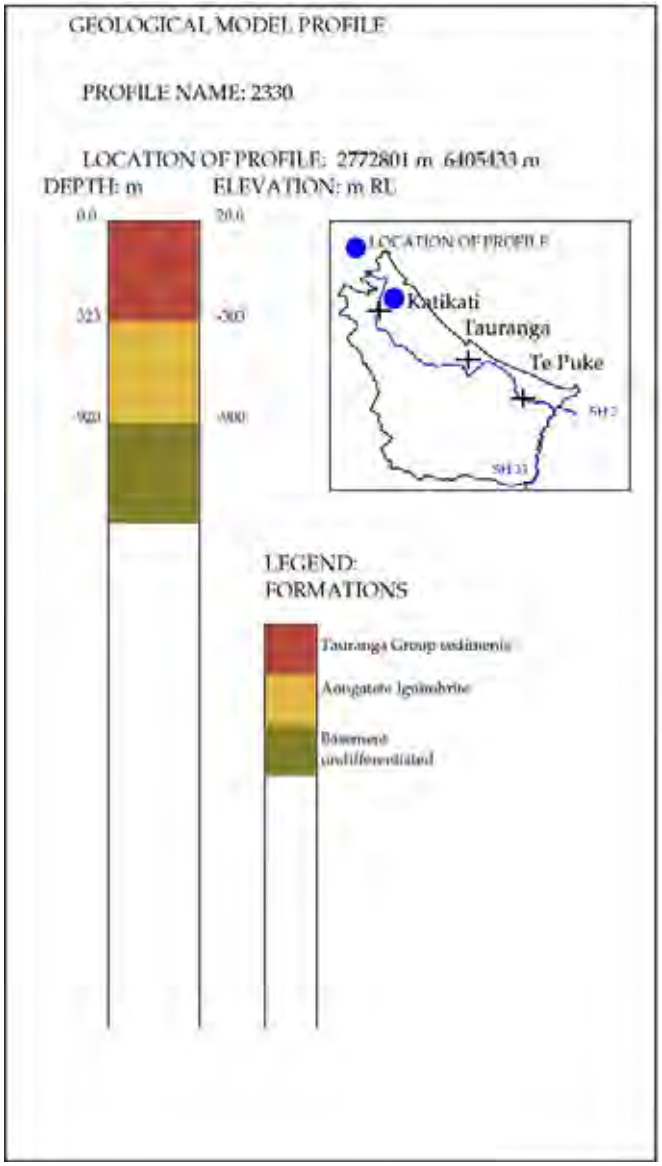



Bore 2328 water level and rainfall - Aongatete
Above average rainfall (mm)
Below average rainfall (mm)
Reduced water level (m)
Date
Residual monthly rainfall at Goodalls rd. (site 757901) and McLaren Falls (site 768002) (mm)
Bore 2328 MSL Mot. (m)

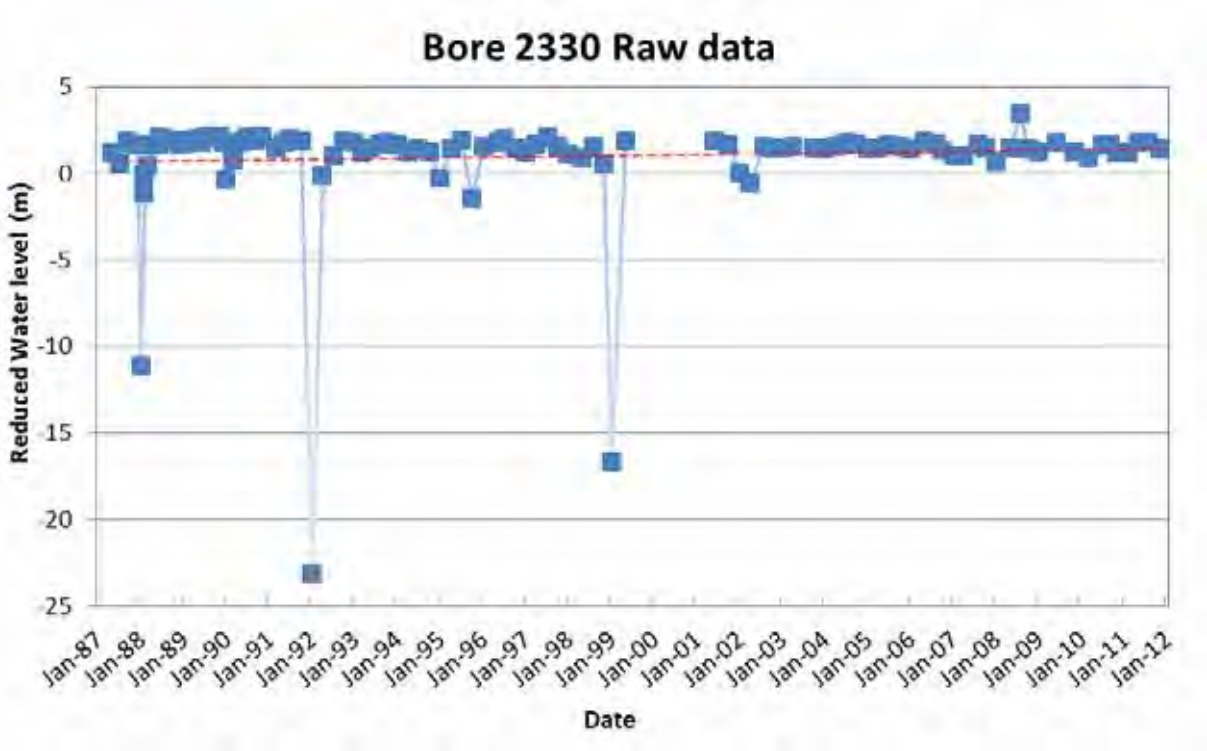

Bore 2328 - Raw telemetered water level
Reduced Water Level (m)
Date

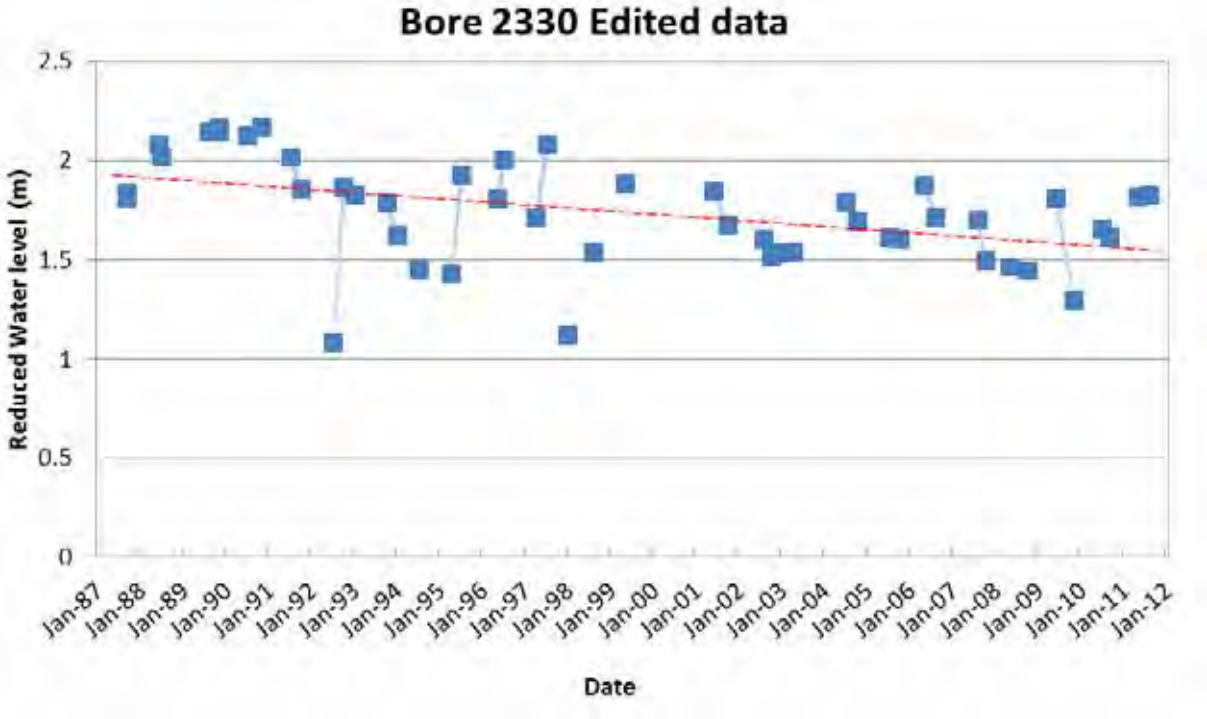
Bore 2330 Information			
Monitoring type	Water level and Water quality	**Depth (m)**	118.9
Name	Noble	**Casing Depth (m)**	55.53
Bore use	Irrigation	**Screen/open hole**	Unknown
Easting	277 2801	**Temperature**	18.3
Northing	640 5433	**Catchment**	Ongare/Tanners Point
Bore log	Complete	**Aquifer**	Tauranga sediments
Monitoring period	**Water level**	1984 – 2011	
	Water quality	1991 - 2011	**LabStar:** BOP180016

Bore 2330 geological profile (EBOF)



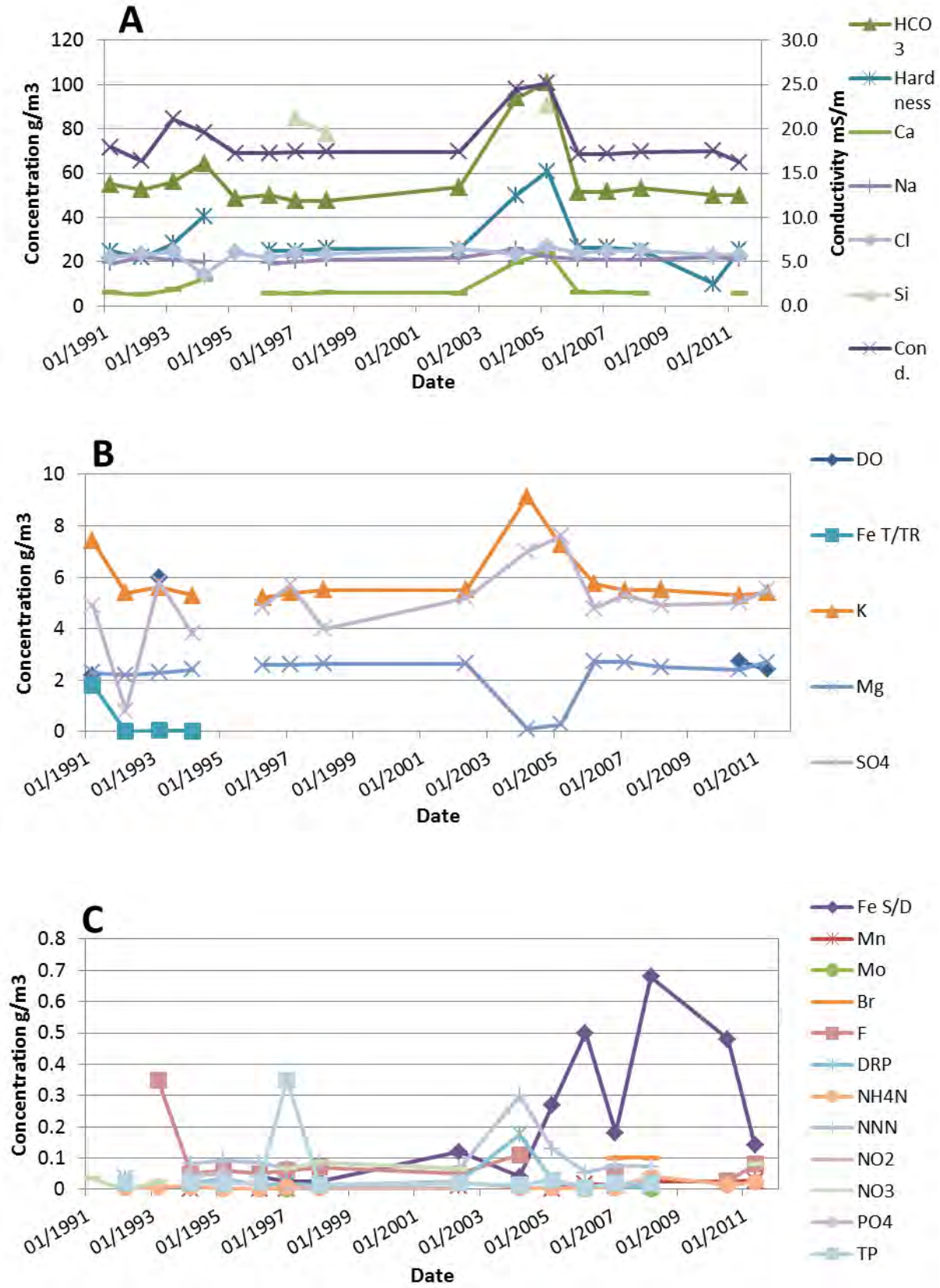
Bore 2330 water level graphs





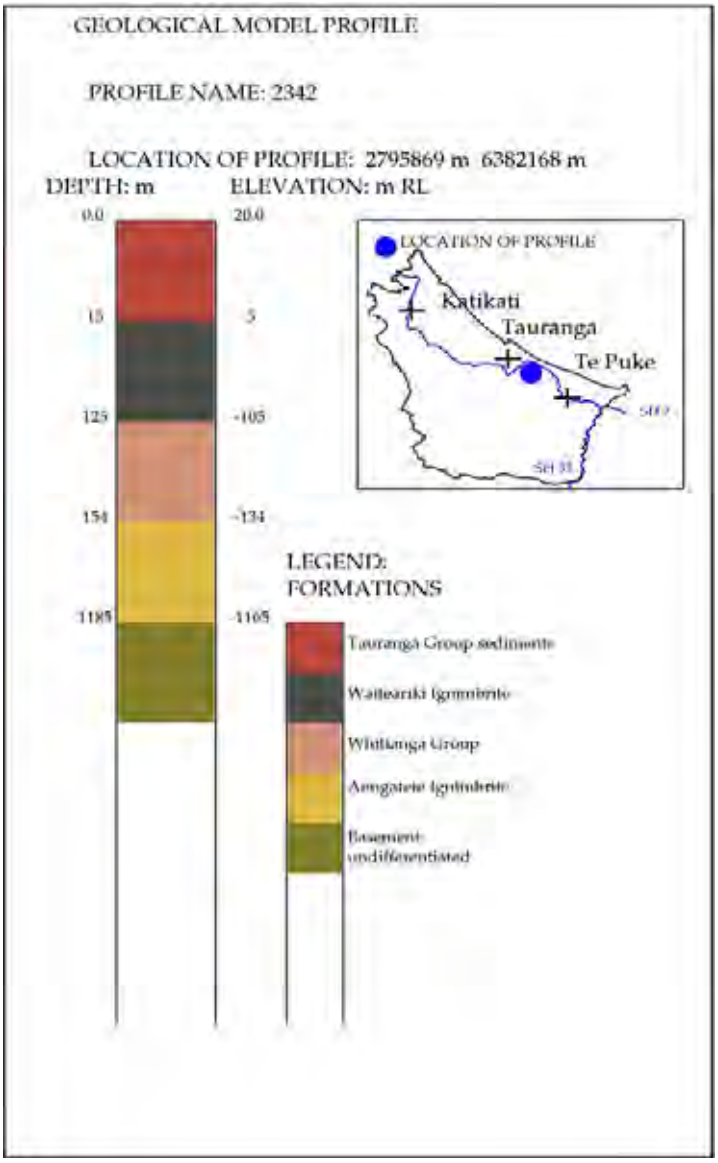
- Edited by removing the two (of generally four) lowest data values per year.

Bore 2330 water quality graphs

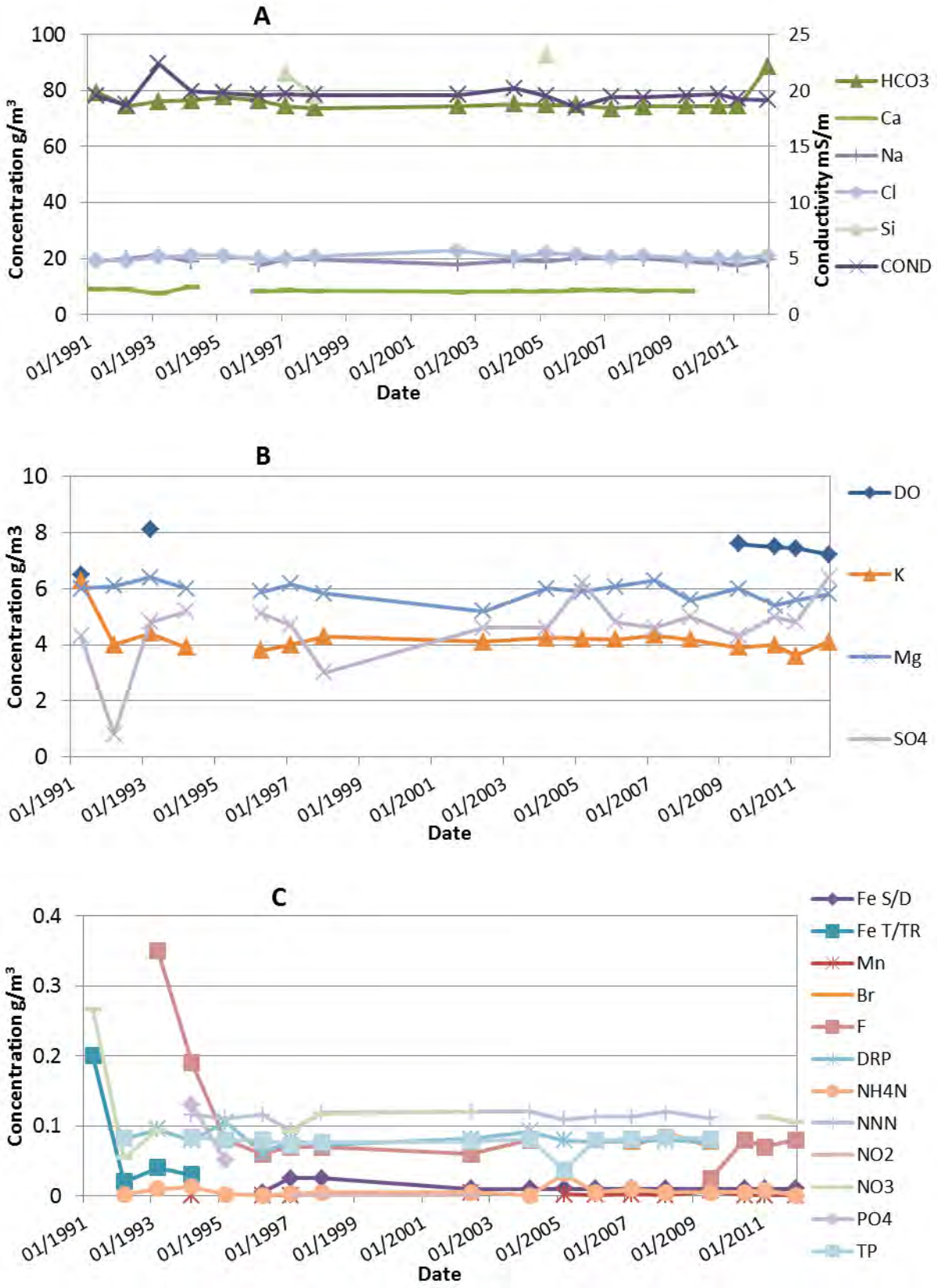


Bore 2342 Information			
Monitoring type	Water quality	**Depth (m)**	194.5
Name	Faith Bible College	**Casing Depth (m)**	78.33
Bore use	Unknown	**Screen/open hole**	Open hole
Easting	279 5869	**Temperature**	22°C
Northing	638 2168	**Catchment**	Welcome Bay
Bore log	Complete	**Aquifer**	Aongatete (WAI)
Monitoring period	**Water level**		
	Water quality	1991 to 2011	**LabStar:** BOP180037

Bore 2342 geological profile (EBOF)

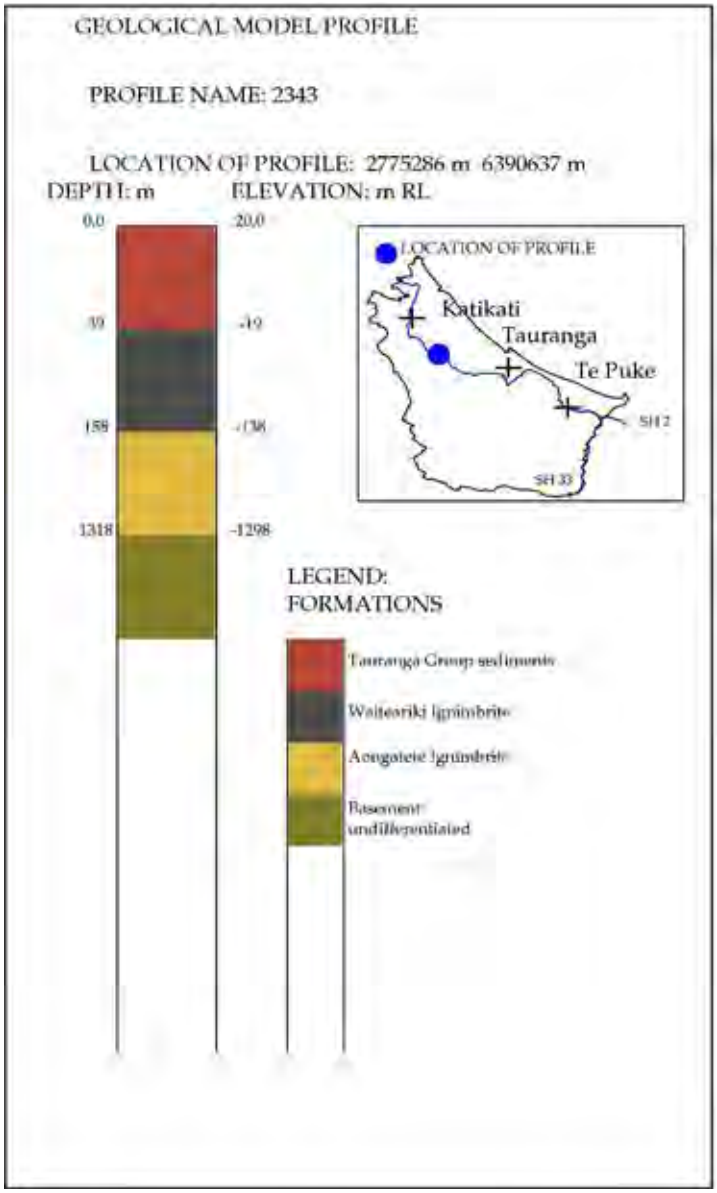


Bore 2342 water quality graphs

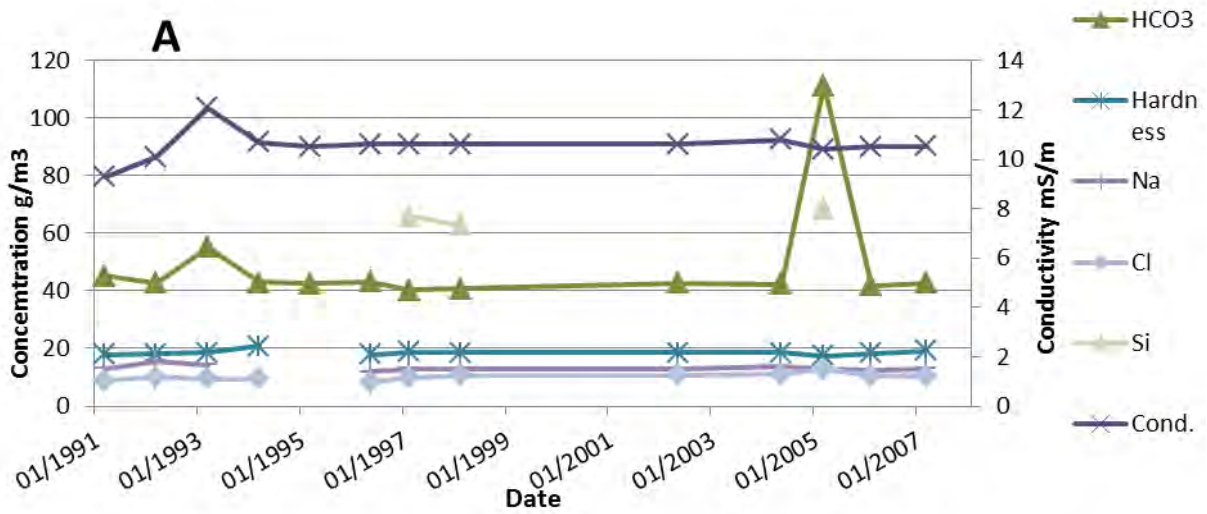


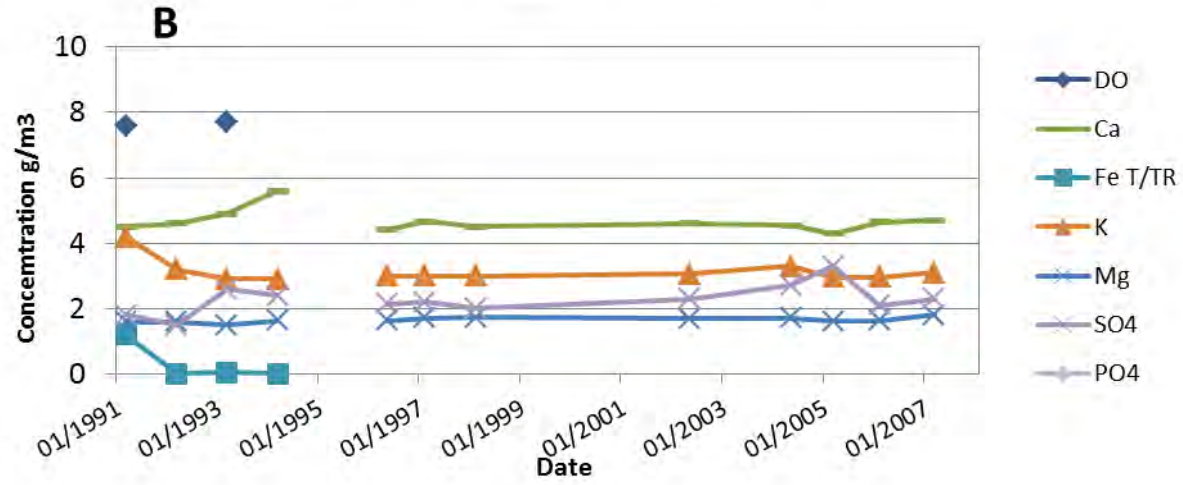
Bore 2343 Information			
Monitoring type	Water quality	**Depth (m)**	153.9
Name	Ronald	**Casing Depth (m)**	98.45
Bore use	Irrigation	**Screen/open hole**	
Easting	277 5286	**Temperature**	18.7°C
Northing	639 0637	**Catchment**	WAI 1 zone
Bore log	Complete	**Aquifer**	Waitieariki (WAI)
Monitoring period	**Water level**		
	Water quality	1991 to 2007	**LabStar:** BOP180022

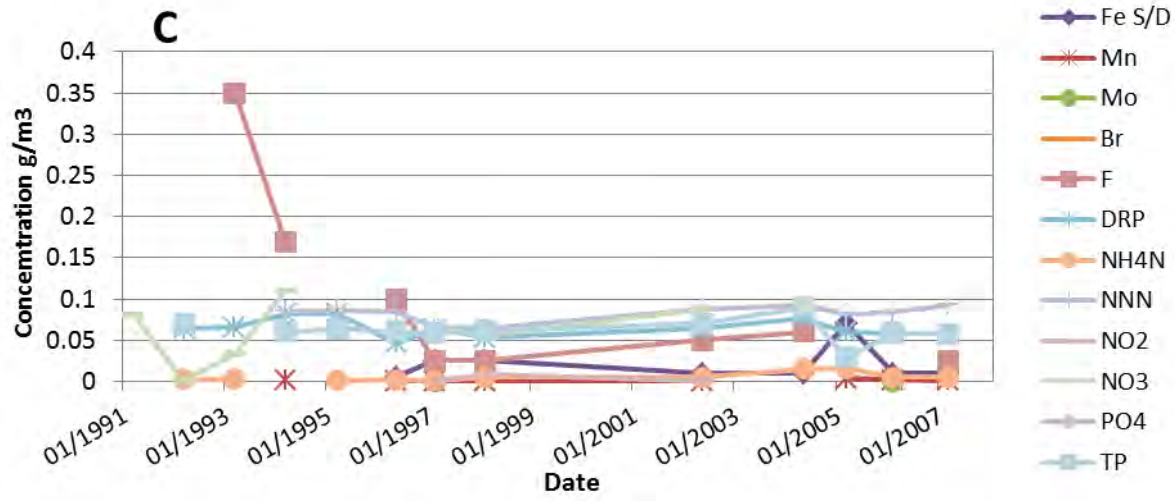
Bore 2343 geological profile (EBOF)



Bore 2343 water quality graphs

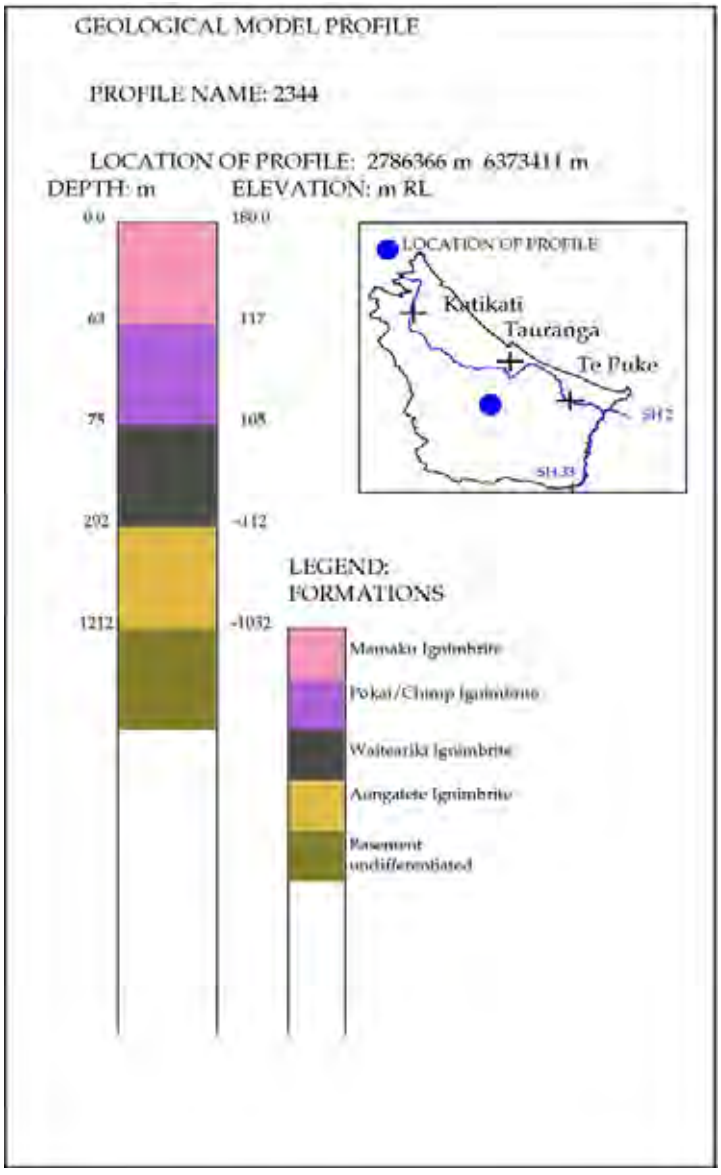




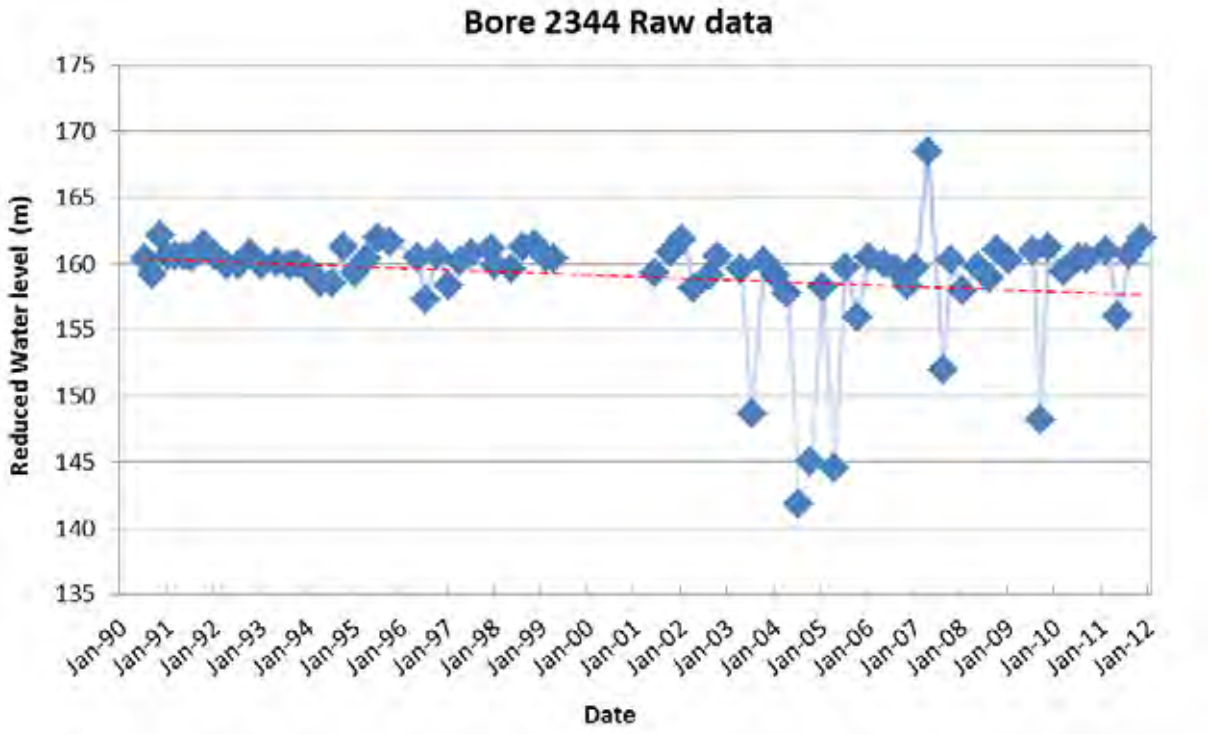


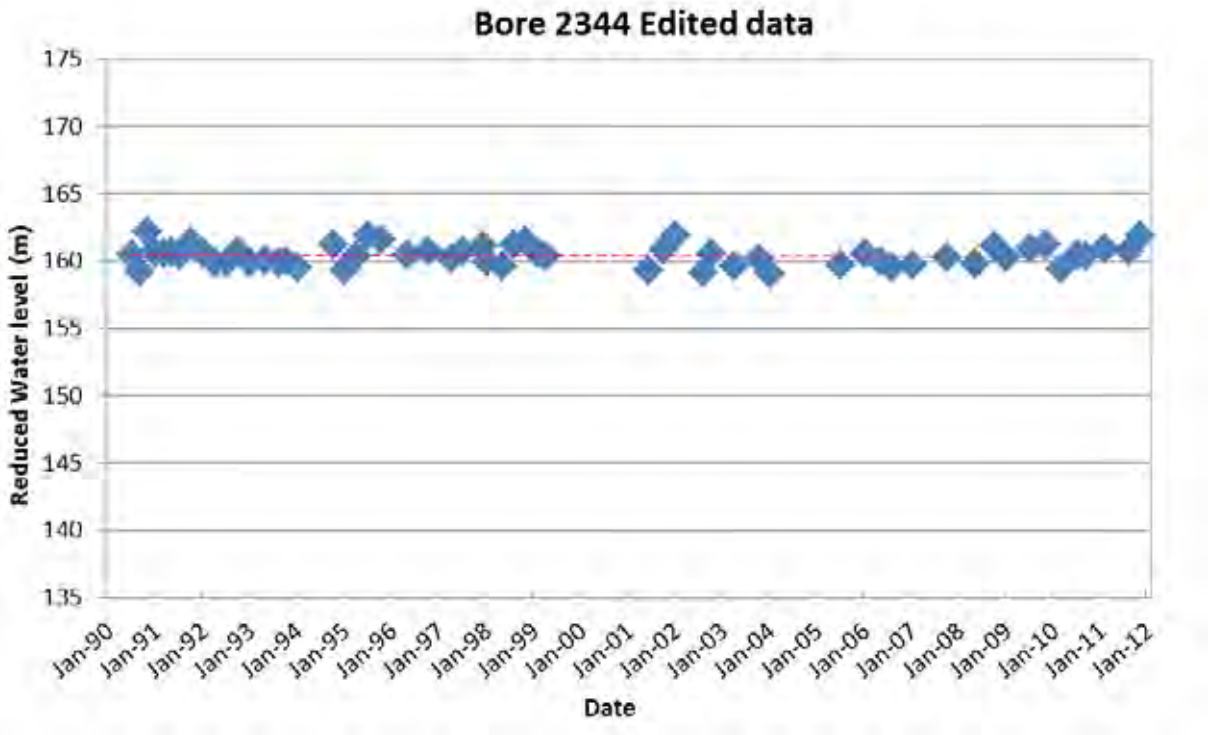
Bore 2344 Information			
Monitoring type	Water level	**Depth (m)**	123.4
Name	Waimapu Packhouse and Coolstore	**Casing Depth (m)**	39.32
Bore use	Irrigation	**Screen/open hole**	Open hole
Easting	278 6366	**Temperature**	17°C
Northing	637 3411	**Catchment**	Waimapu
Bore log	Complete	**Aquifer**	Waitetariki (WAI)
Monitoring period	**Water level**	1990 to 2011	
	Water quality	1991 to 2011	**LabStar:** BOP180028

Bore 2344 geological profile (EBOF)

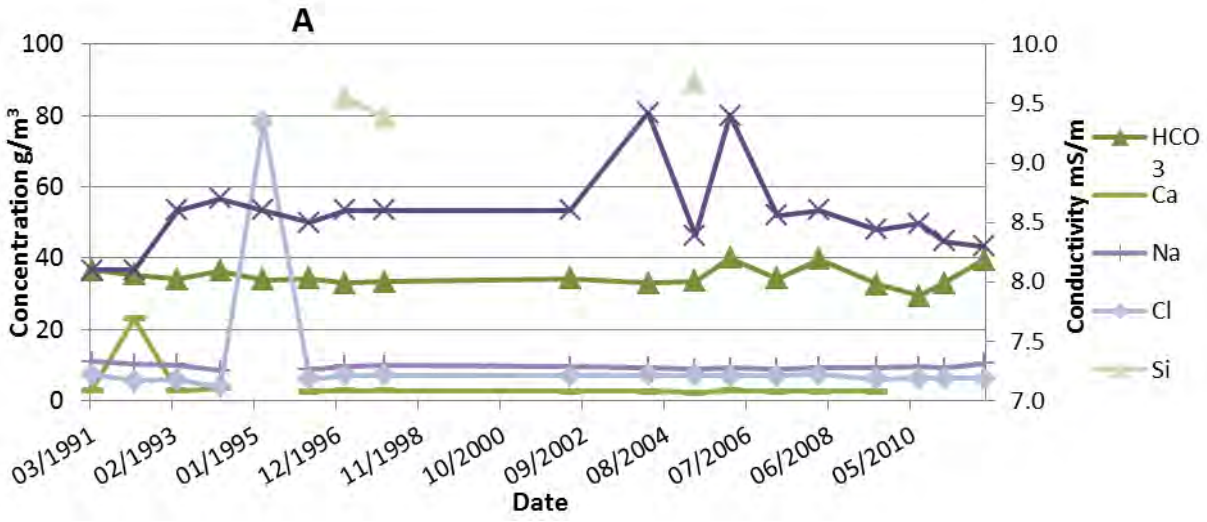


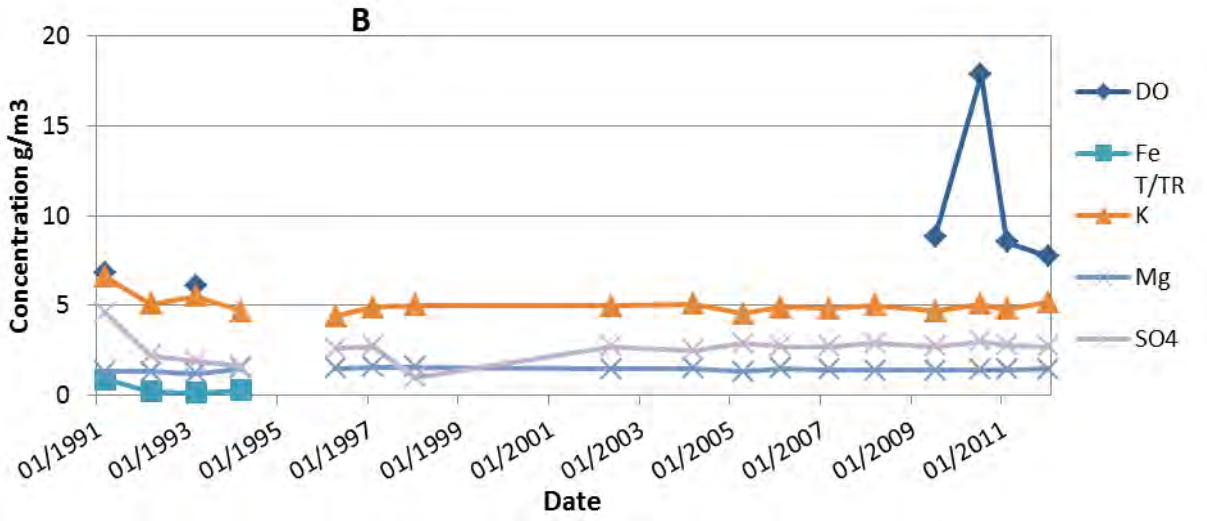
Bore 2344 water level graphs

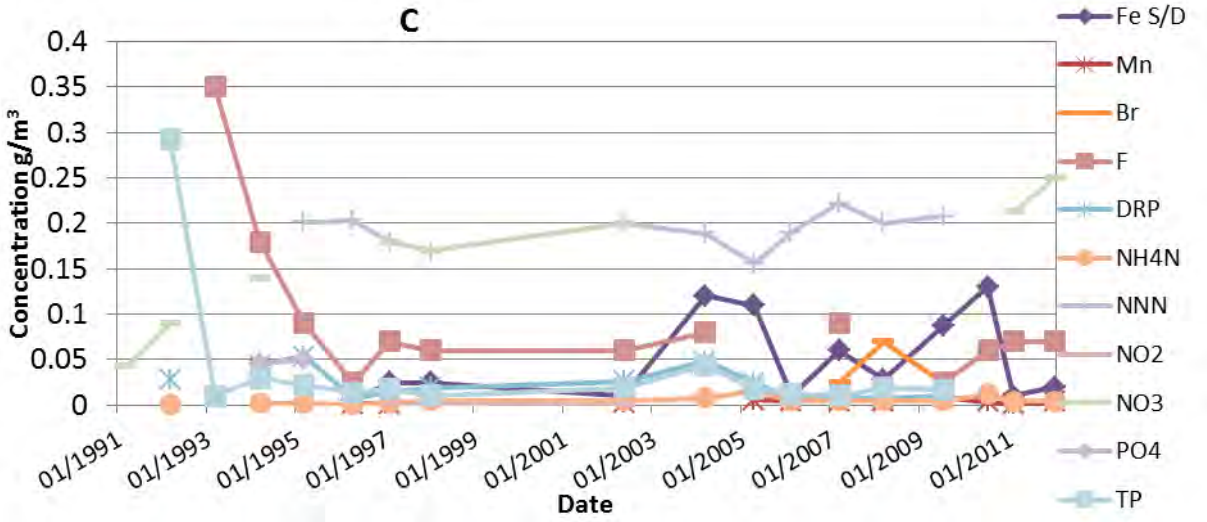




Bore 2344 water quality graphs

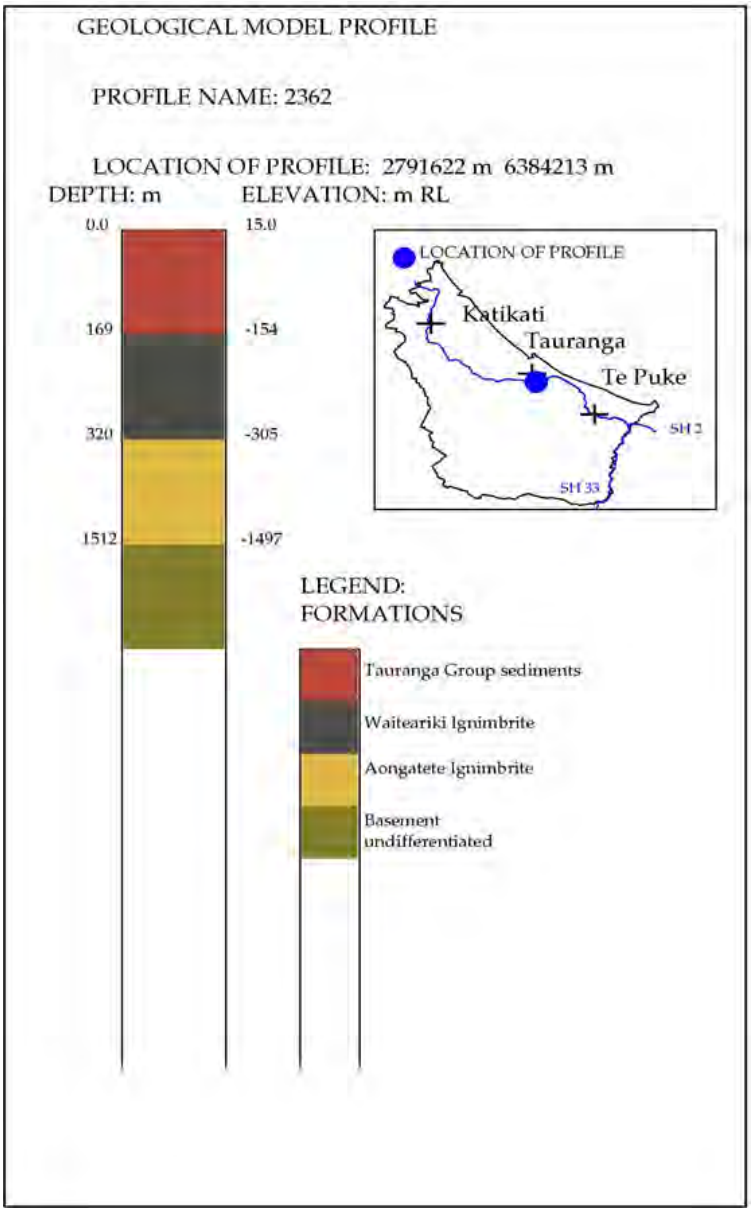




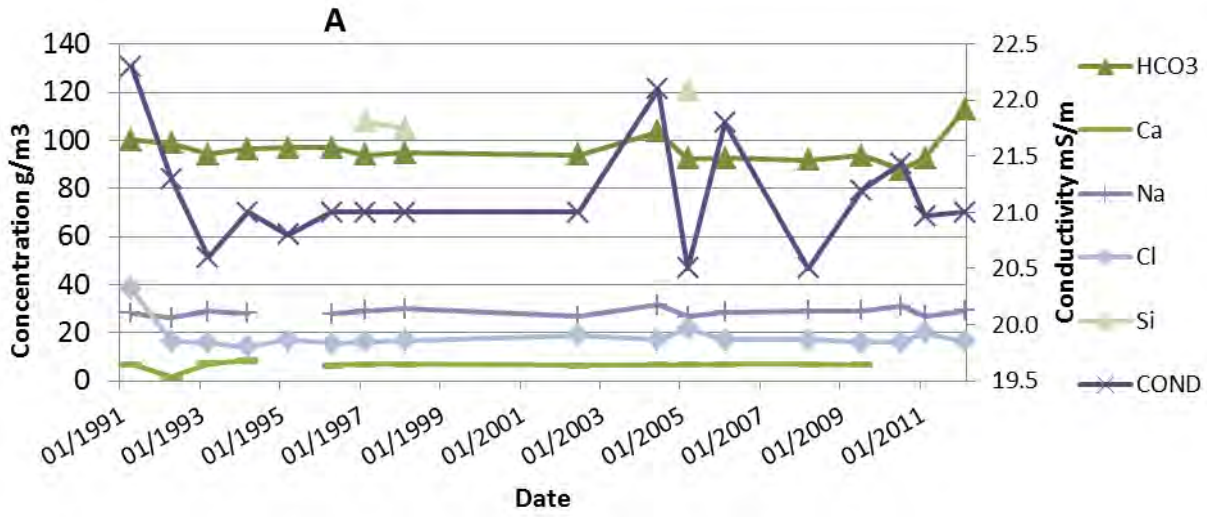


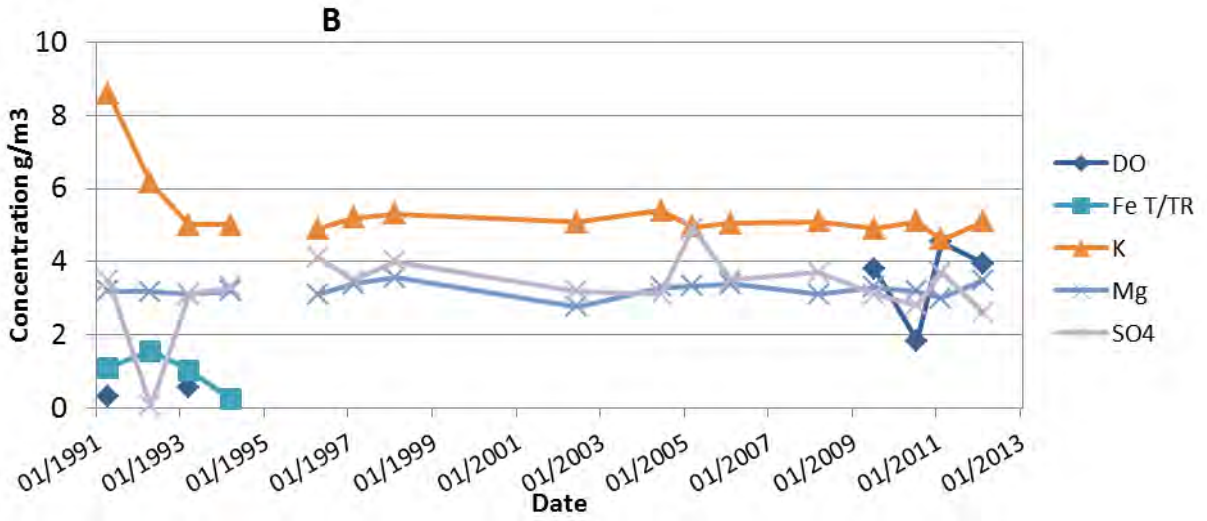
Bore 2362 Information			
Monitoring type	Water quality	**Depth (m)**	210.3
Name	Bell	**Casing Depth (m)**	99.67
Bore use	Irrigation/Domestic	**Screen/open hole**	Open hole
Easting	279 1622	**Temperature**	29.9
Northing	638 4213	**Catchment**	WAI 2 zone
Bore log	Complete	**Aquifer**	Waitekariki
Monitoring period	**Water level**		
	Water quality	1991 to 2011	**LabStar:** BOP180041

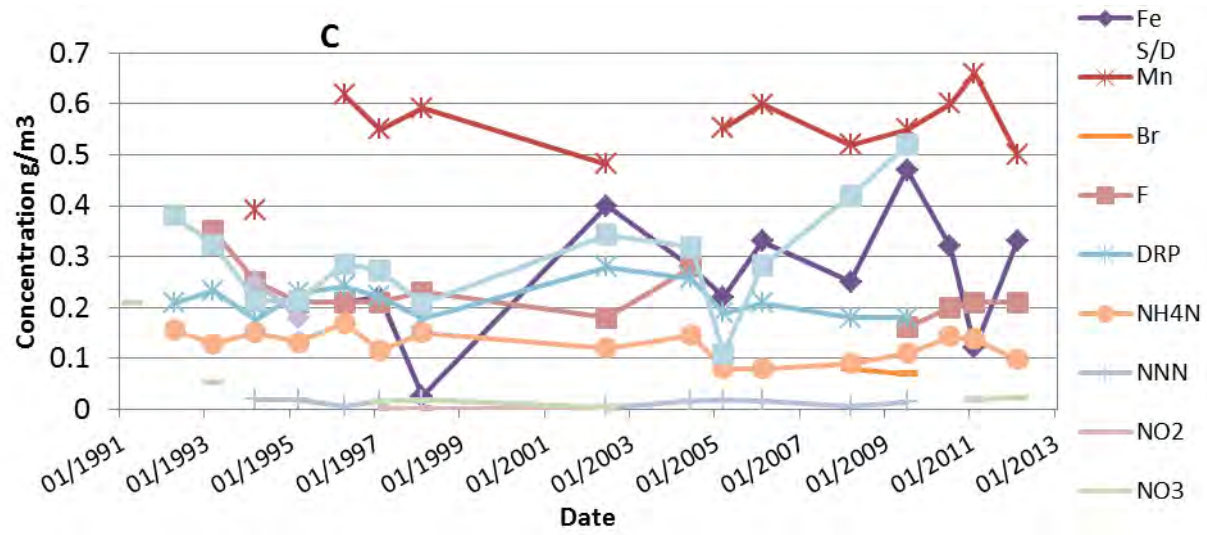
Bore 2362 geological profile (EBOF)



Bore 2362 water quality

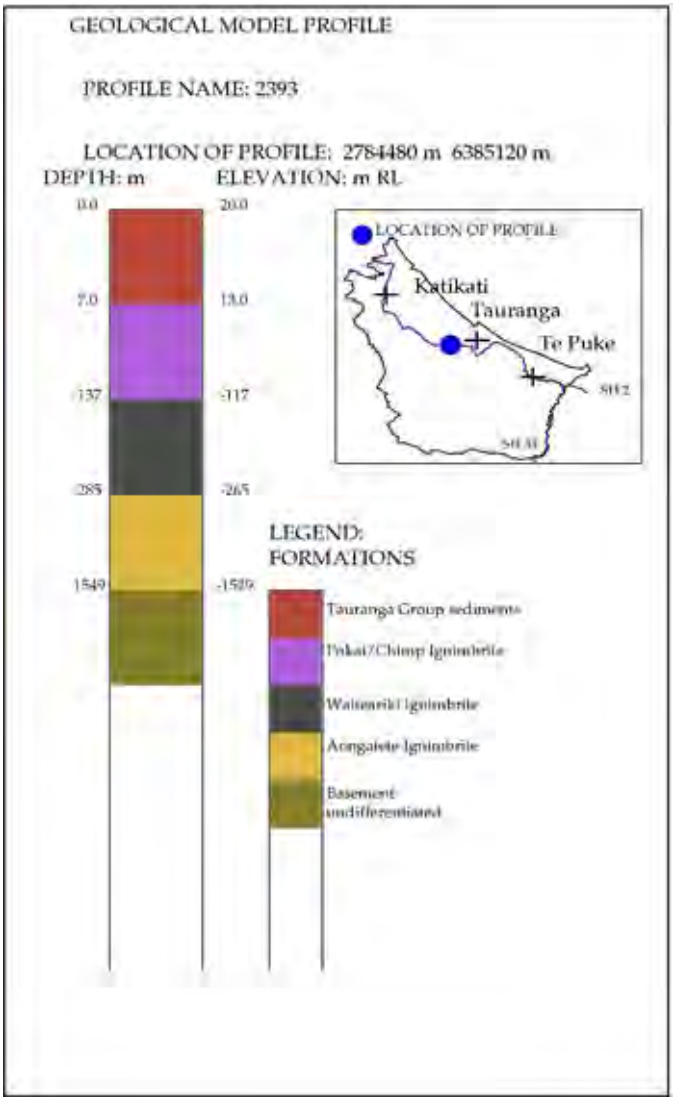




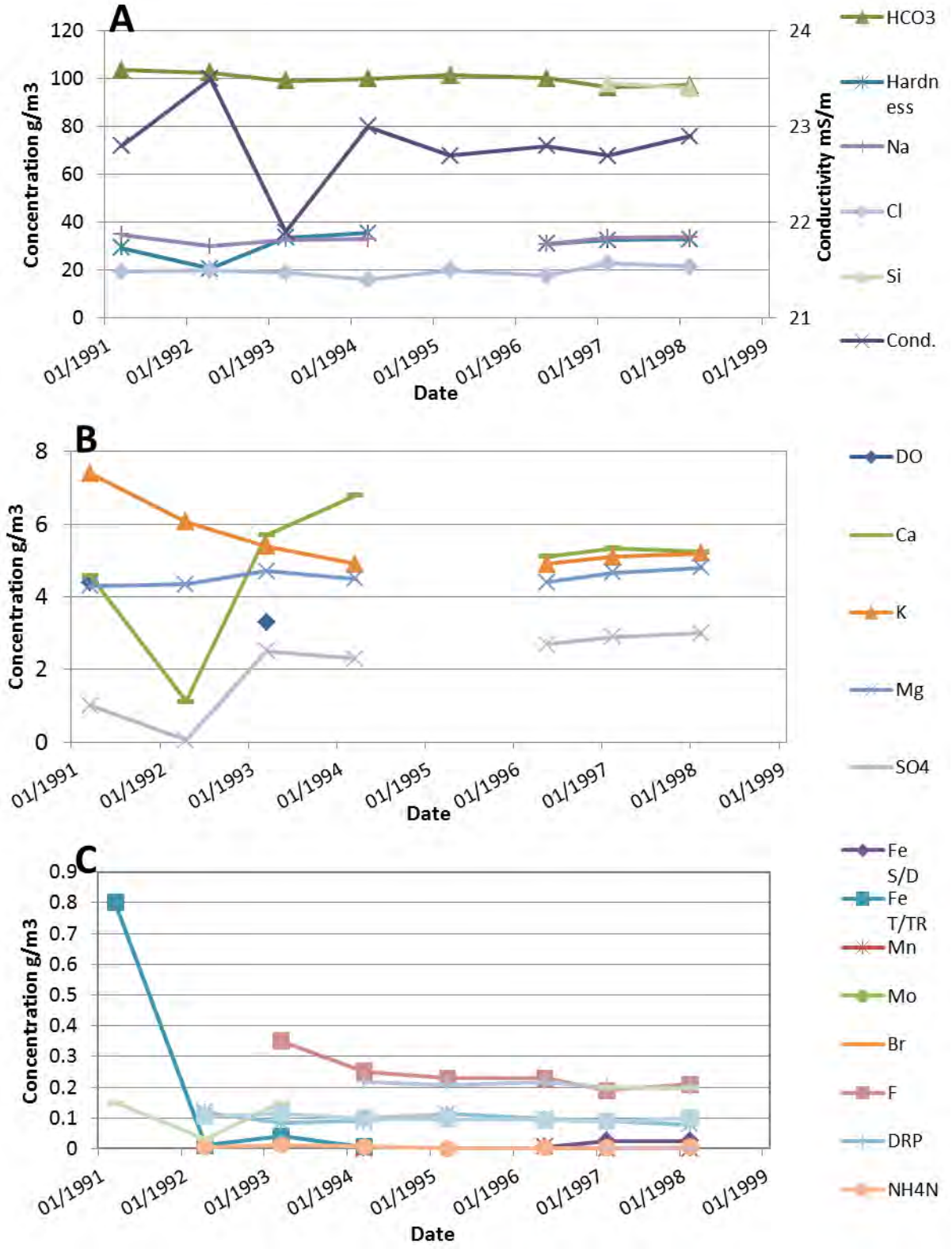


Bore 2393 Information			
Monitoring type	Water quality	**Depth (m)**	146.3
Name	Thompson	**Casing Depth (m)**	128.02
Bore use	Irrigation	**Screen/open hole**	Unknown
Easting	276 8559	**Temperature**	28.8°C
Northing	640 4732	**Catchment**	WAI 2 (zone)
Bore log	Partial	**Aquifer**	Pokai Chimp Ignimbrite/Waitearikl
Monitoring period	**Water level**		
	Water quality	1991 to 1999	**LabStar:** BOP180026

Bore 2393 geological profile (EBOF)

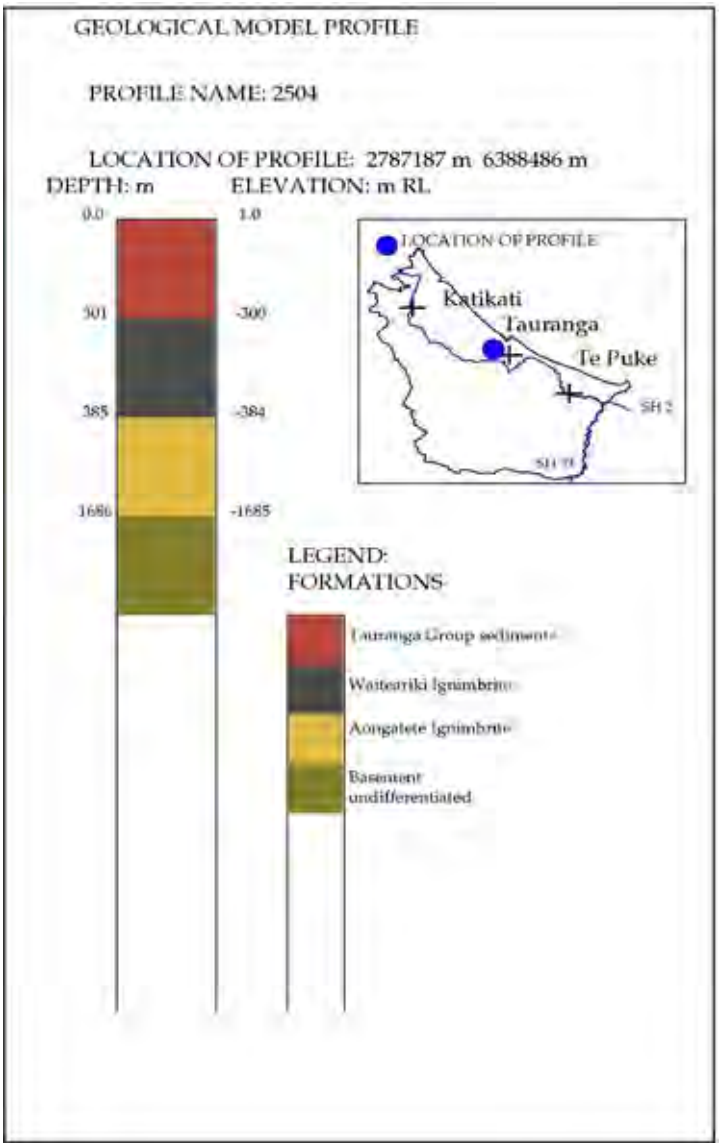


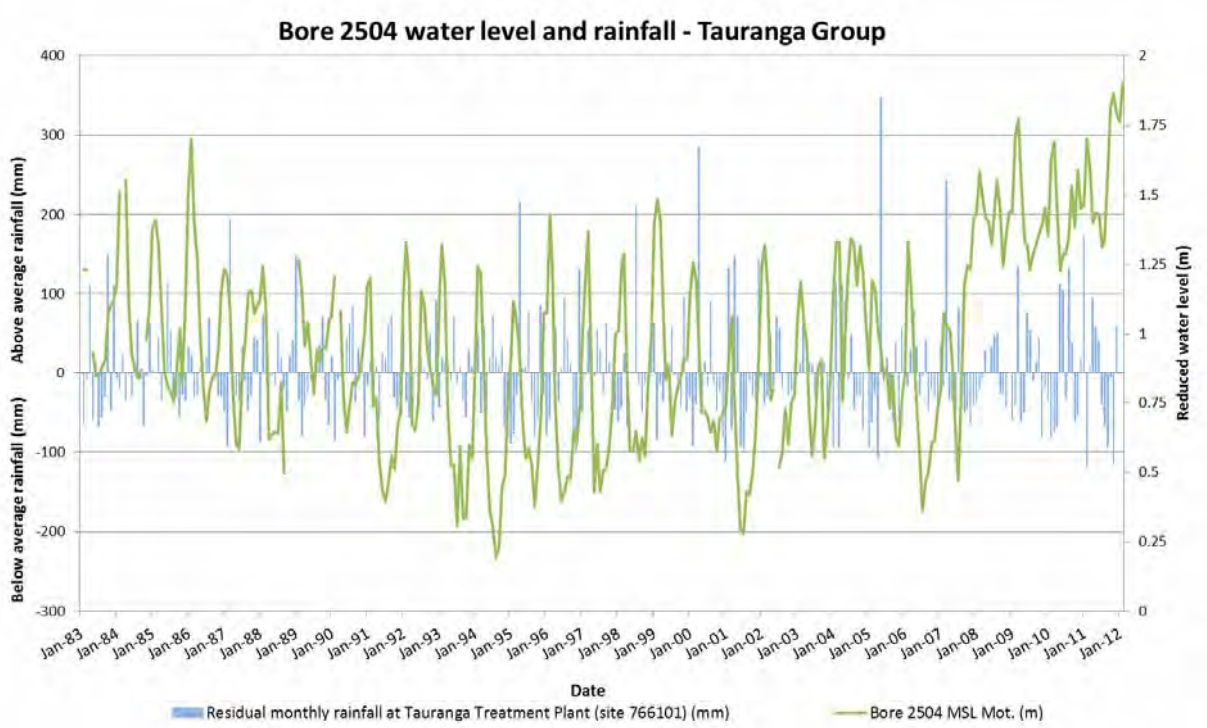
Bore 2393 water quality graphs

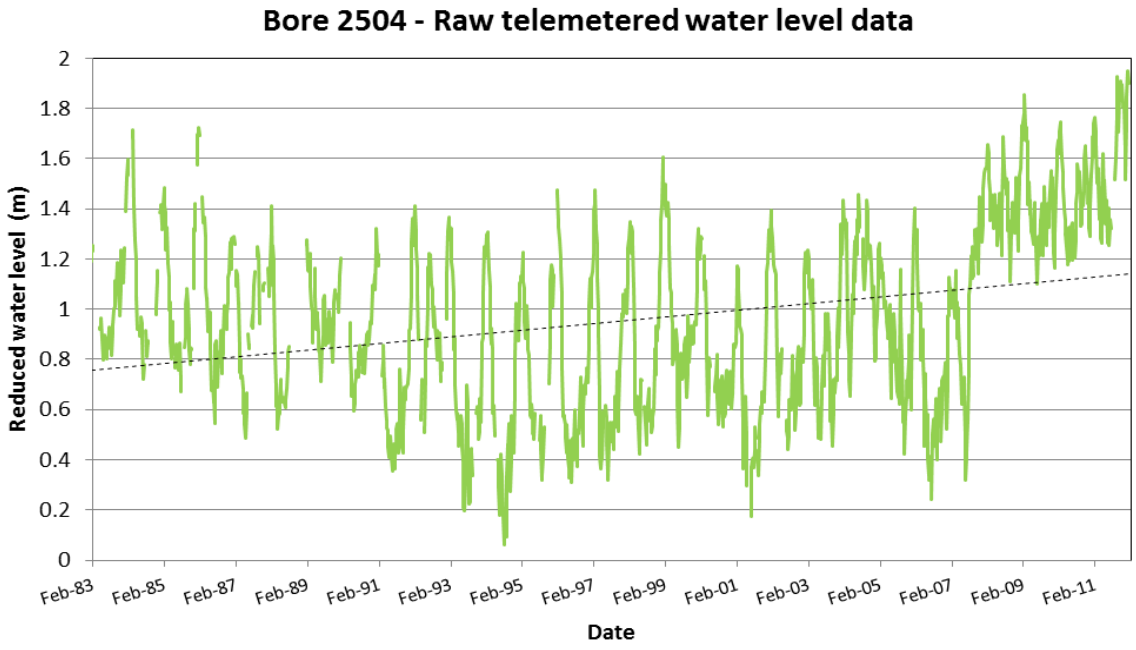


Bore 2504 Information			
Monitoring type	Water level	**Depth (m)**	140
Name	Beach Road Reserve	**Casing Depth (m)**	-
Bore use	Monitoring	**Screen/open hole**	-
Easting	278 7187	**Temperature**	Geothermal
Northing	638 8486	**Catchment**	Otumoetai
Bore log	Complete	**Aquifer**	Tauranga sediments
Monitoring period	**Water level**	1983 to 2011	
	Water quality	-	

Bore 2504 geological profile (EBOF)

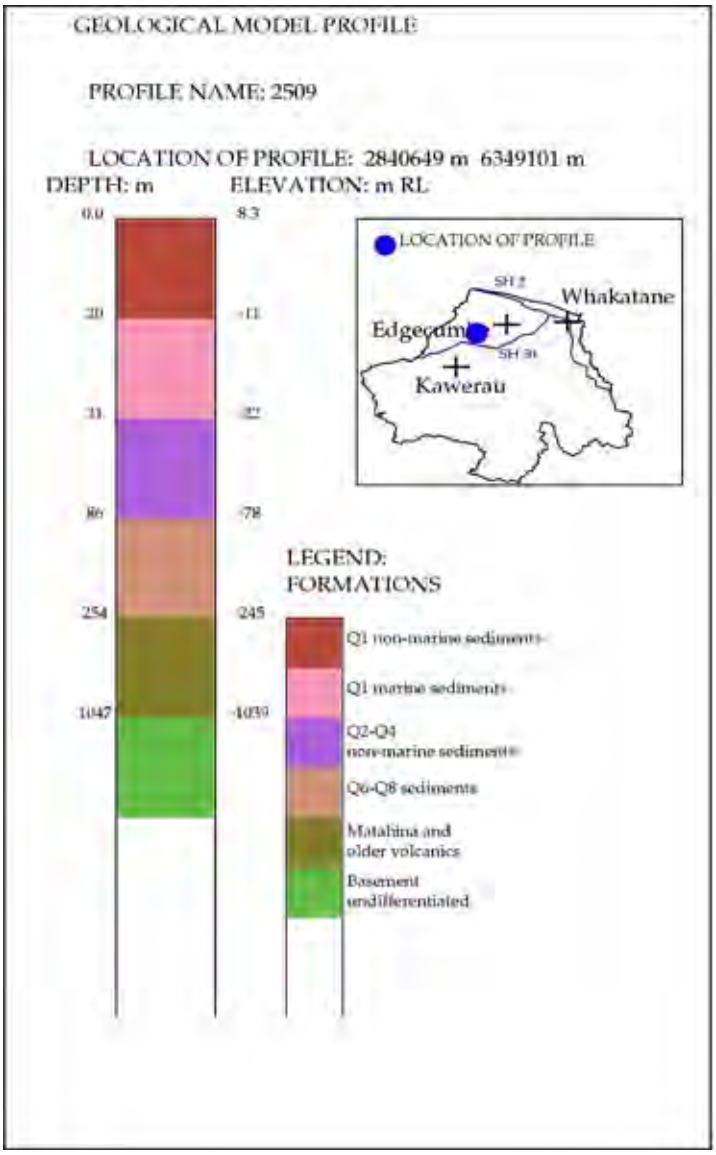



Bore 2504 water level and rainfall - Tauranga Group
Above average rainfall (mm)
Below average rainfall (mm)
Reduced water level (m)
Date
Residual monthly rainfall at Tauranga Treatment Plant (site 766101) (mm)
Bore 2504 MSL Mot. (m)

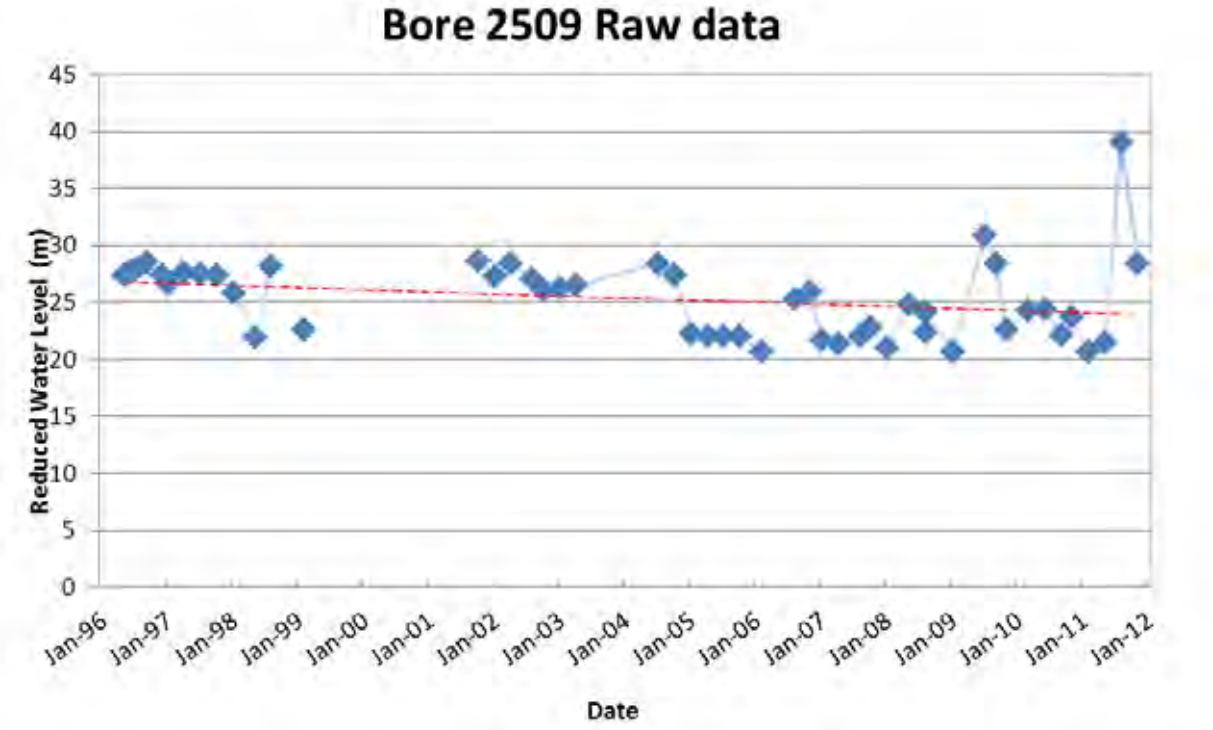

Bore 2504 - Raw telemetered water level data
Reduced water level (m)
Date

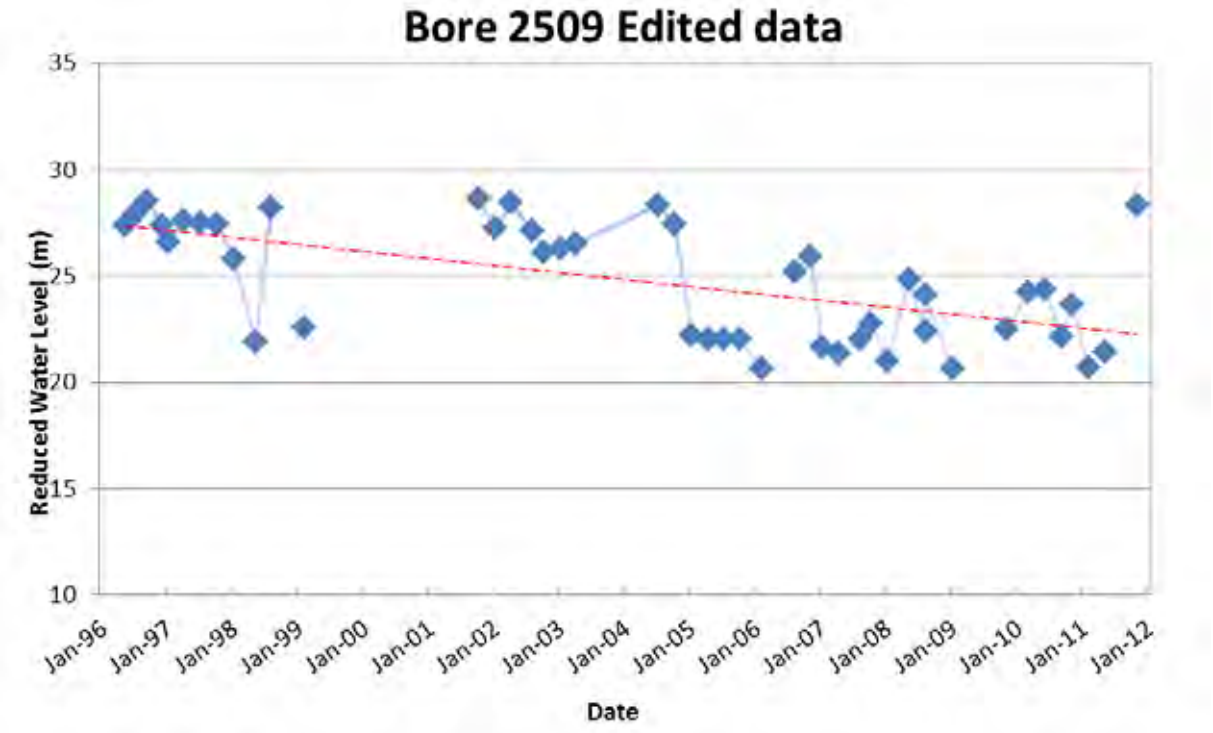
Bore 2509 Information			
Monitoring type	Water level & Water quality	**Depth (m)**	319.5
Name	Eternal springs	**Casing Depth (m)**	295
Bore use	Bottled water	**Screen/open hole**	Open hole
Easting	284 0649	**Temperature**	18.8°C
Northing	634 9101	**Catchment**	Awaiti Canal
Bore log	Complete	**Aquifer**	Matahina and older volcanics
Monitoring period	**Water level**	1996 to 2011	
	Water quality	1991 to 2011	**LabStar:** BOP180004

Bore 2509 geological profile (EBOF)

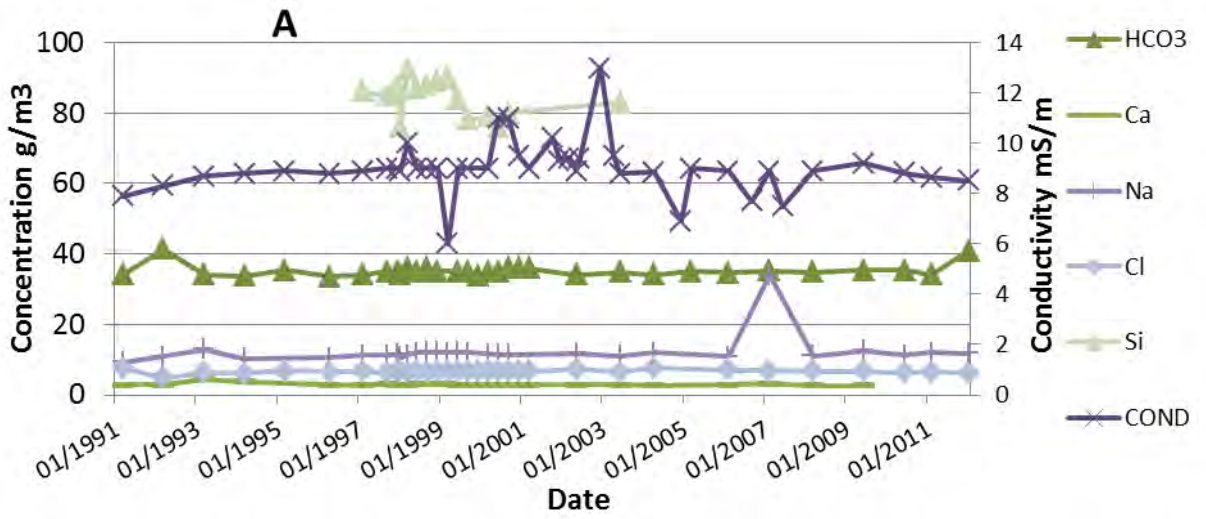


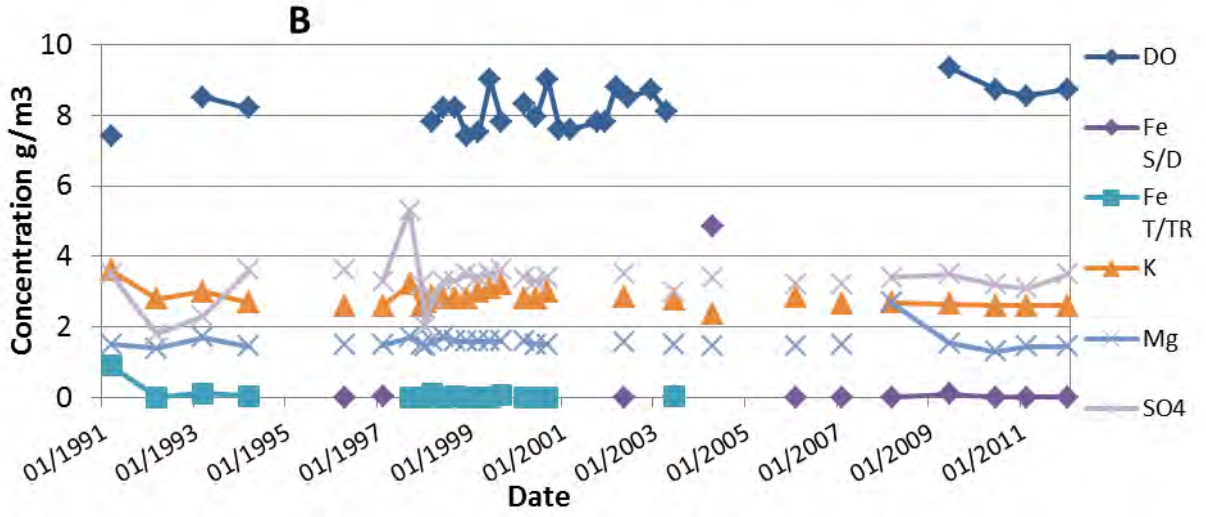
Bore 2509 water level graphs

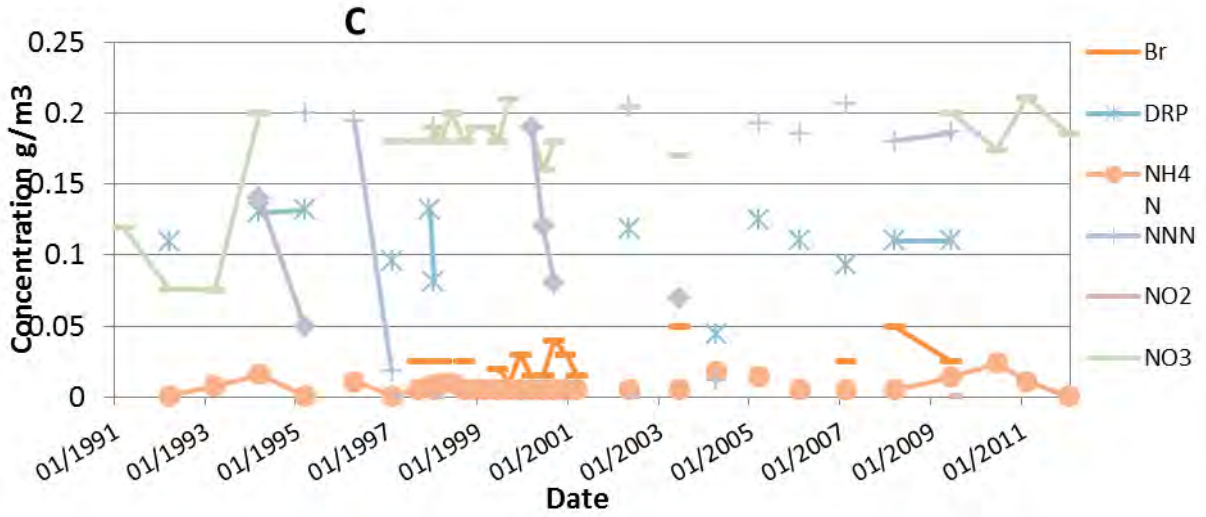




Bore 2509 water quality graphs

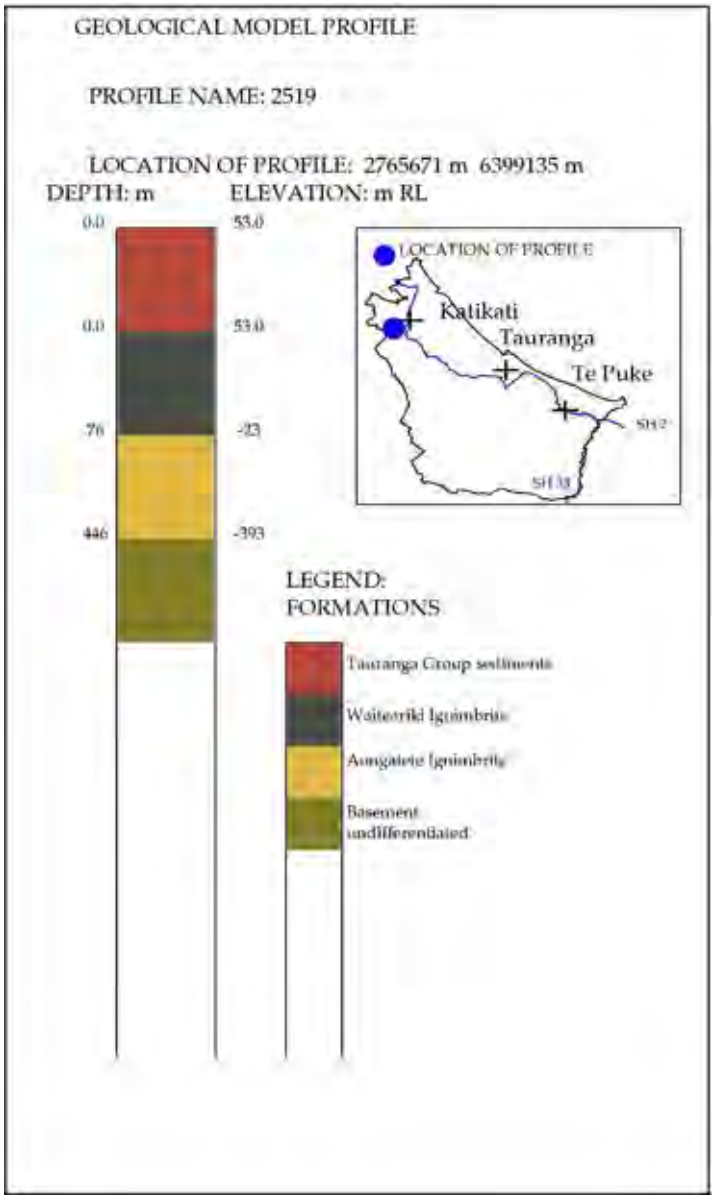


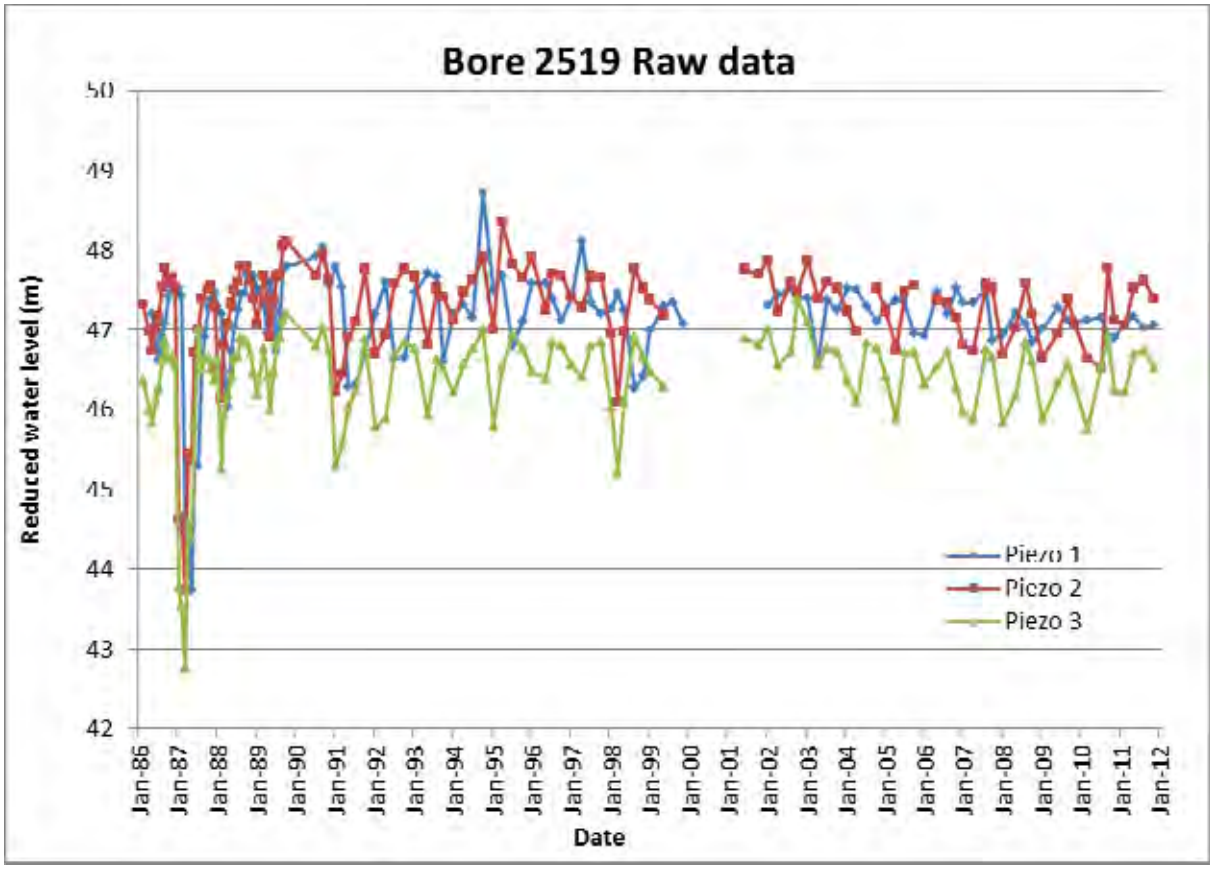


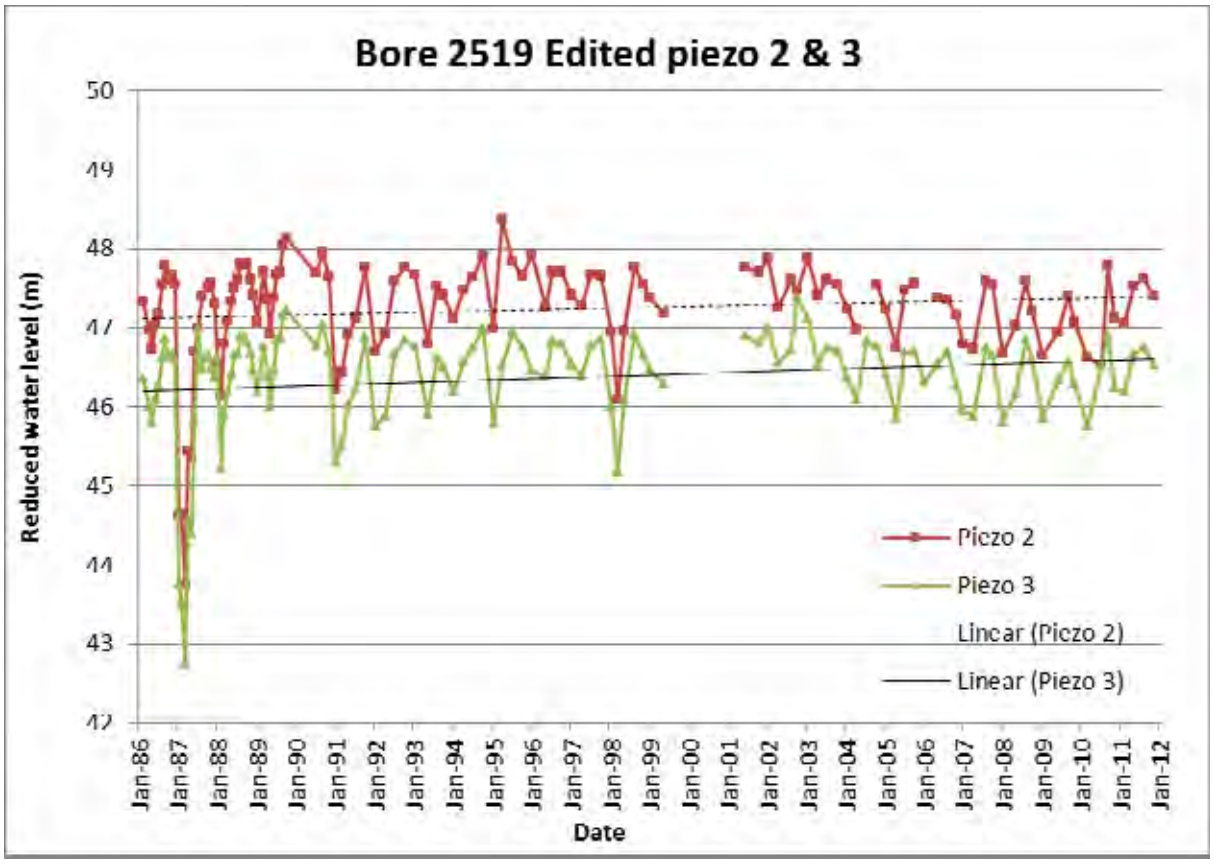


Bore 2519 Information			
Monitoring type	Water level	**Depth (m)**	452
Name	BOPRC	**Casing Depth (m)**	Unknown
Bore use	Monitoring	**Screen/open hole**	Unknown
Easting	276 5671	**Temperature**	Unknown
Northing	639 9135	**Catchment**	WAI 1 zone
Bore log	Complete	**Aquifer**	Aongatete
Monitoring period	**Water level**	1986 to 2011	
	Water quality	-	

Bore 2519 geological profile (EBOF)

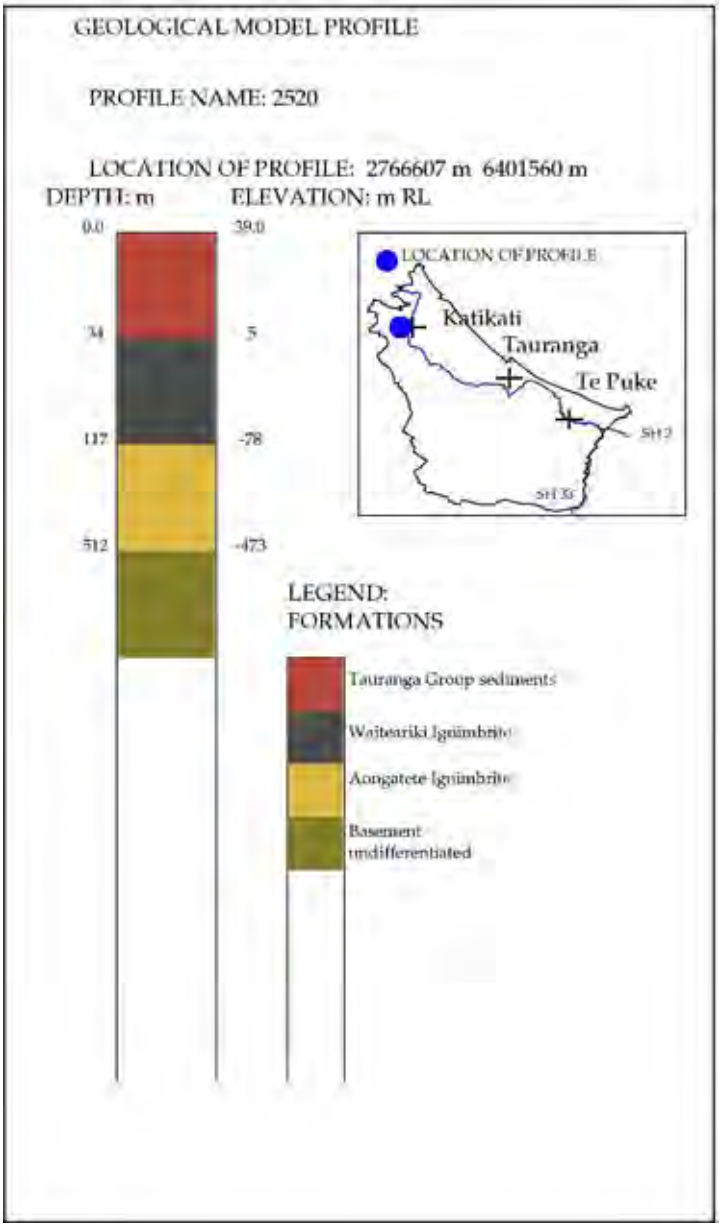


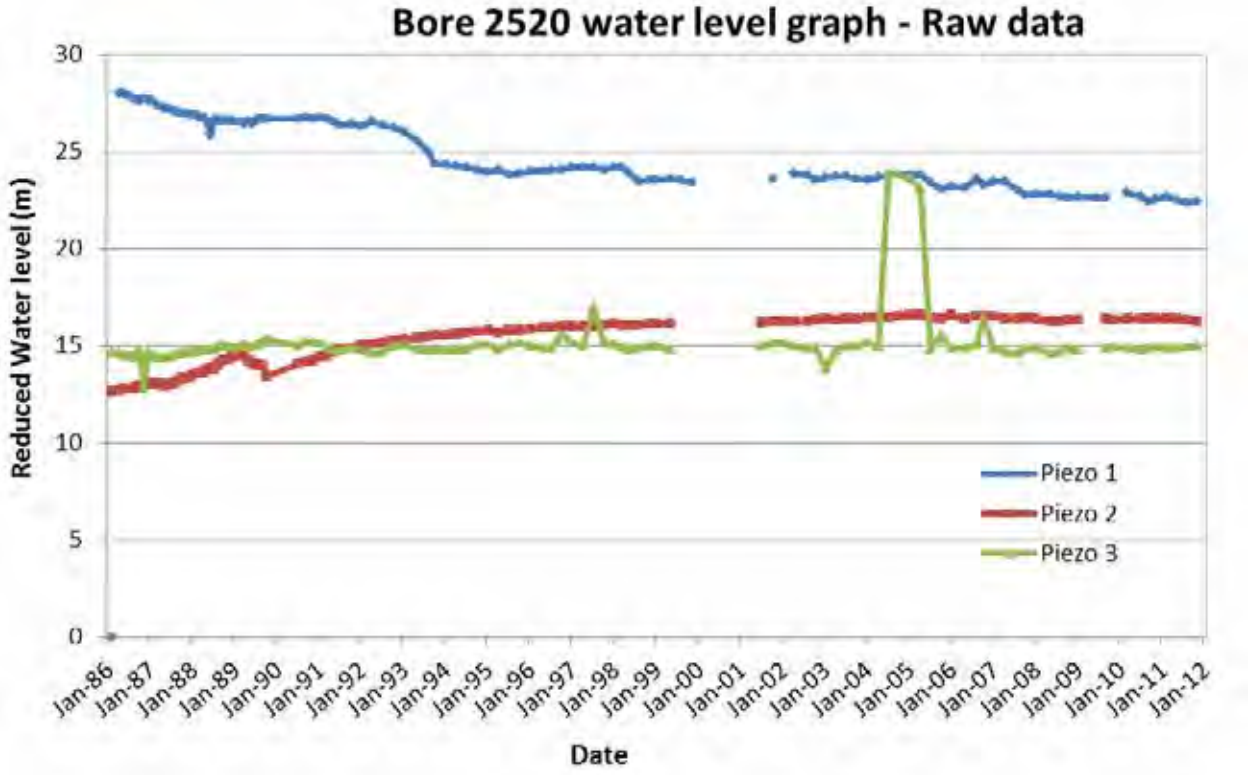

Bore 2519 Raw data
Reduced water level (m)
50
49
48
47
46
45
44
43
42
Jan-86
Jan-87
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
Jan-09
Jan-10
Jan-11
Jan-12
Date
Piezo 1
Piezo 2
Piezo 3

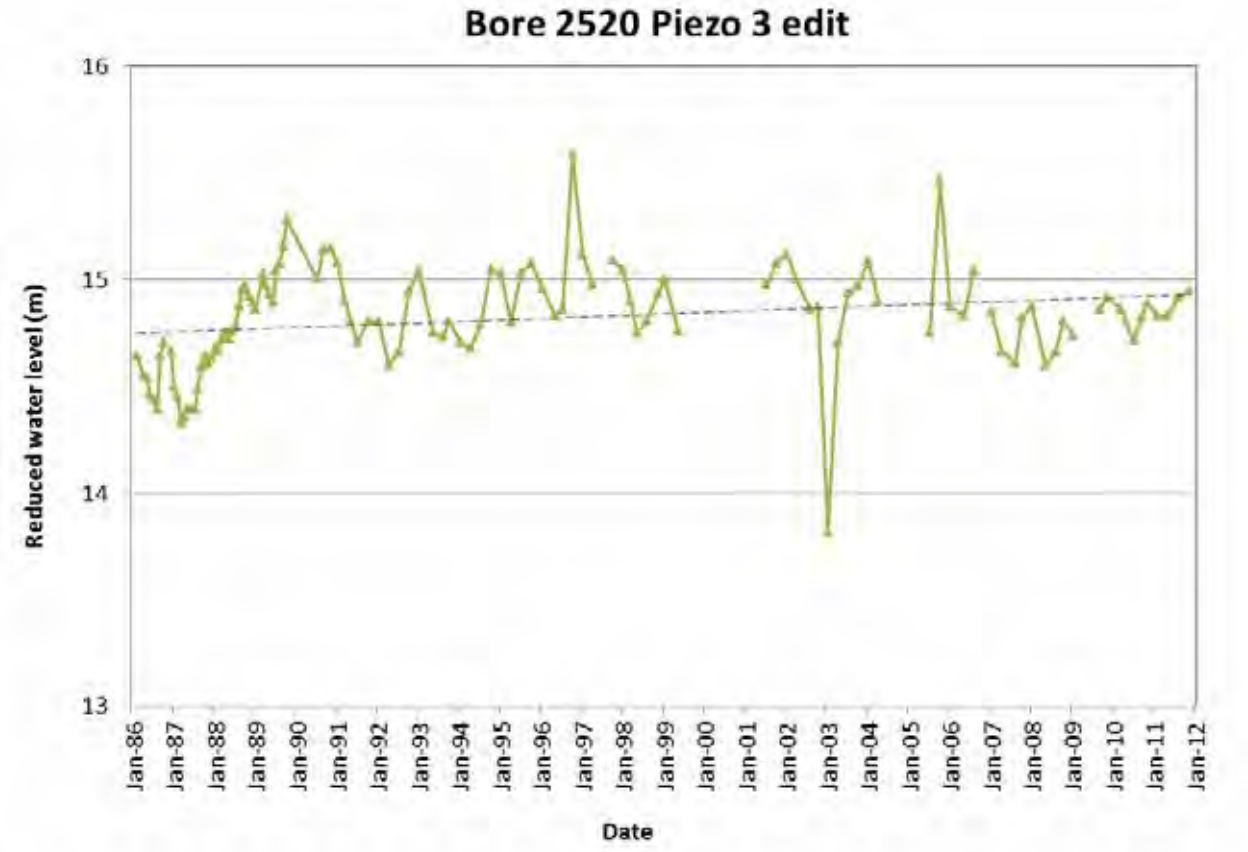

Bore 2519 Edited piezo 2 & 3
Reduced water level (m)
50
49
48
47
46
45
44
43
42
Jan-86
Jan-87
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
Jan-09
Jan-10
Jan-11
Jan-12
Date
Piezo 2
Piezo 3
Linear (Piezo 2)
Linear (Piezo 3)

Bore 2520 Information			
Monitoring type	Water level	**Depth (m)**	353
Name	BOPRC	**Casing Depth (m)**	Unknown
Bore use	Monitoring	**Screen/open hole**	Unknown
Easting	276 9751	**Temperature**	Unknown
Northing	6401633	**Catchment**	WAI 1 zone
Bore log	Complete	**Aquifer**	Aongatete
Monitoring period	**Water level**	1986 to 2011	
	Water quality	-	

Bore 2520 geological profile (EBOF)

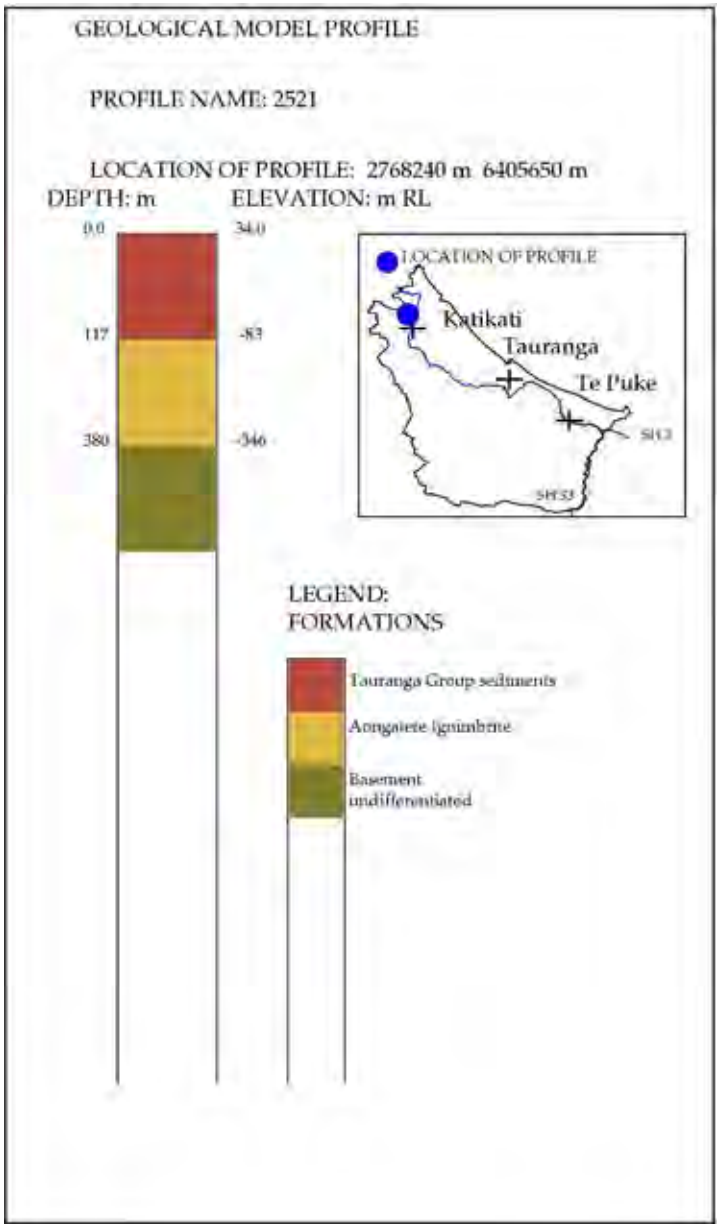


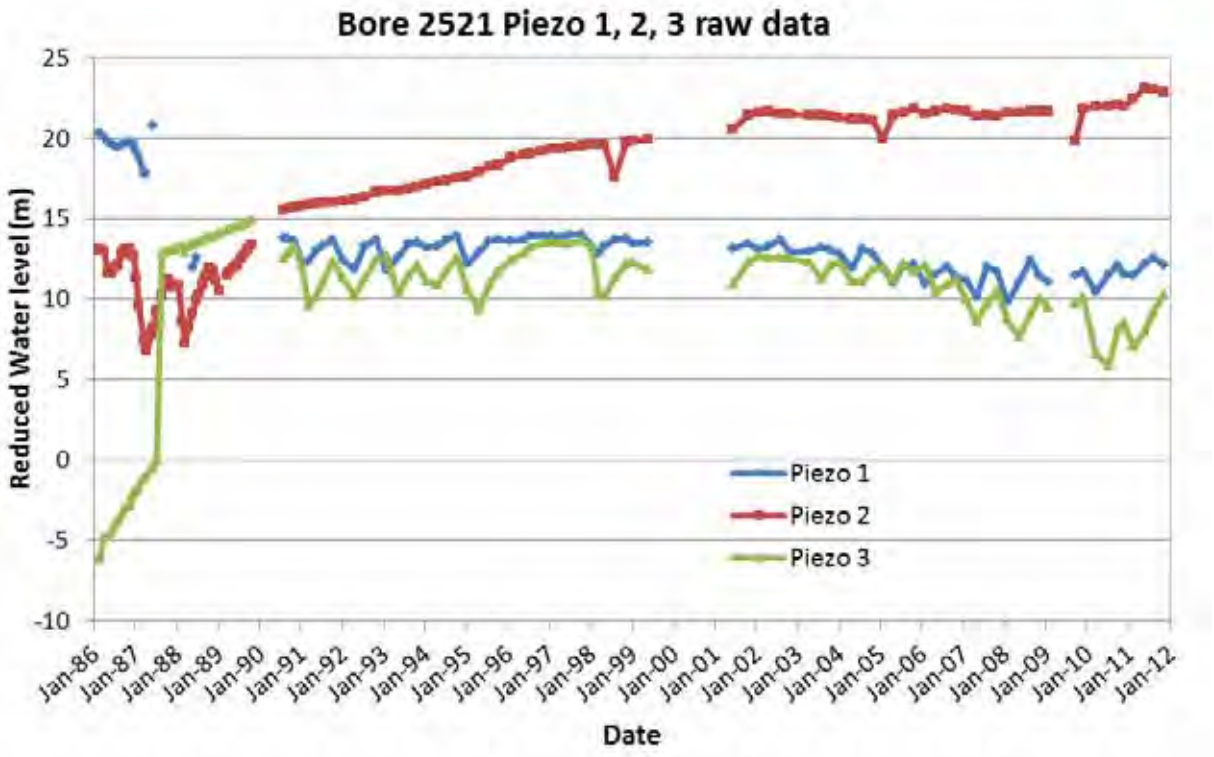

Bore 2520 water level graph - Raw data
Reduced Water level (m)
30
25
20
15
10
5
0
Piezo 1
Piezo 2
Piezo 3
Jan-86
Jan-87
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
Jan-09
Jan-10
Jan-11
Jan-12
Date

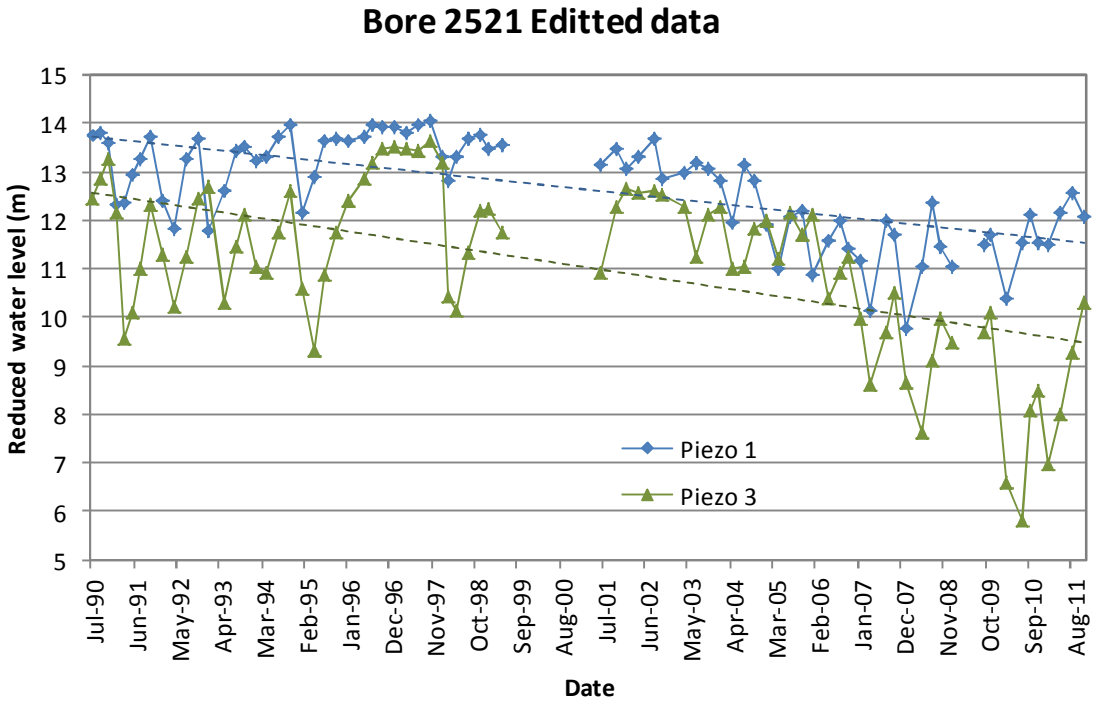

Bore 2520 Piezo 3 edit
Reduced water level (m)
16
15
14
13
Jan-86
Jan-87
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
Jan-09
Jan-10
Jan-11
Jan-12
Date

Bore 2521 Information			
Monitoring type	Water level	**Depth (m)**	157.4
Name	BOPRC	**Casing Depth (m)**	Unknown
Bore use	Investigation bore	**Screen/open hole**	Unknown
Easting	276 8240	**Temperature**	Unknown
Northing	640 5650	**Catchment**	WAI 1 zone
Bore log	Complete	**Aquifer**	Aongatete
Monitoring period	**Water level**	1986 - 2011	
	Water quality	-	

Bore 2521 geological profile (EBOF)

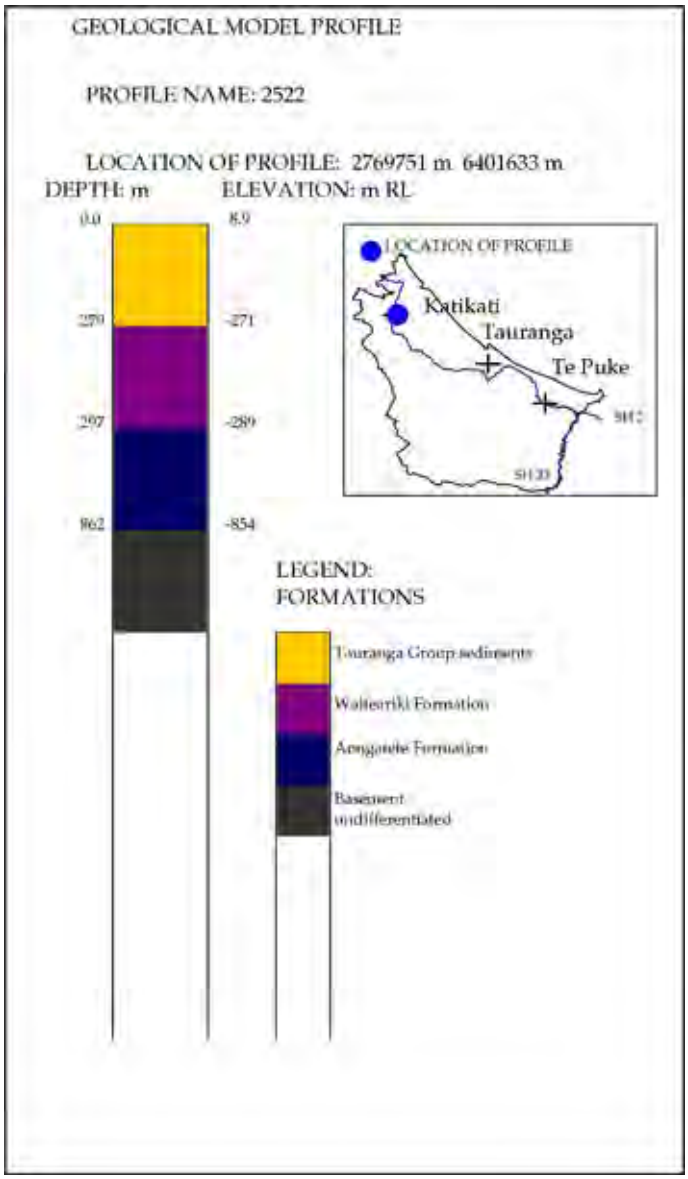


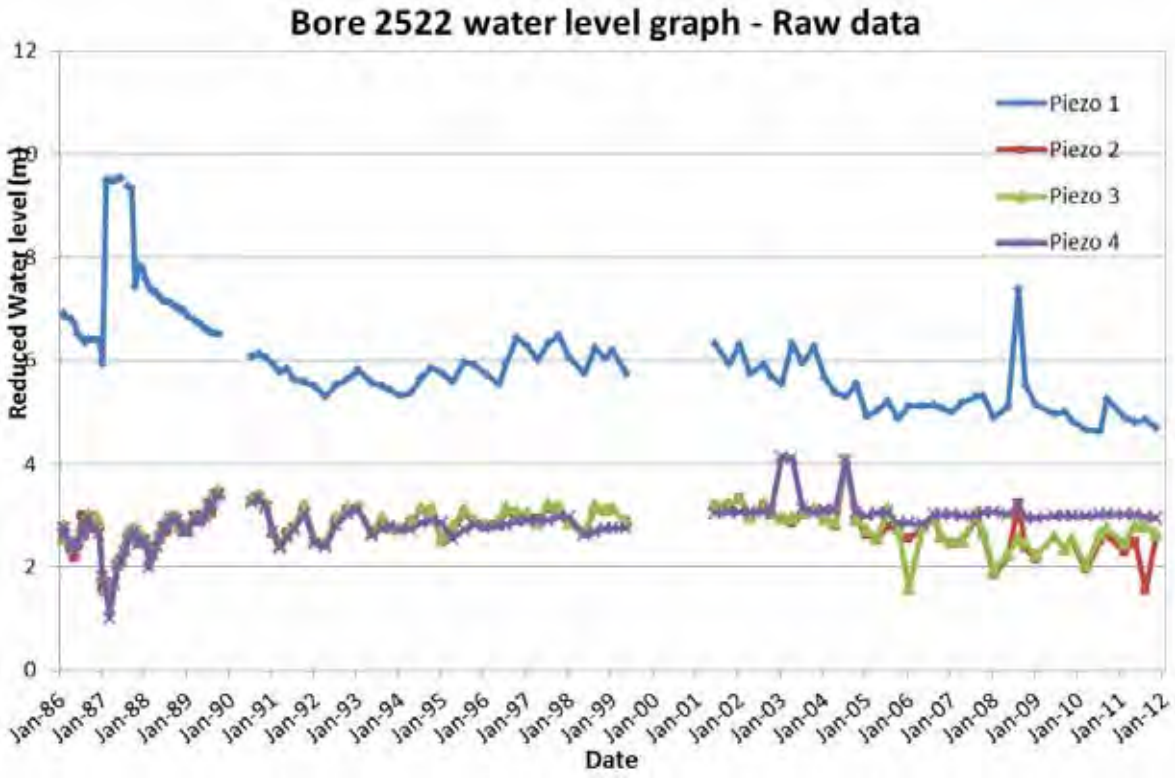

Bore 2521 Piezo 1, 2, 3 raw data
Reduced Water level (m)
25
20
15
10
5
0
-5
-10
Piezo 1
Piezo 2
Piezo 3
Jan-86
Jan-87
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
Jan-09
Jan-10
Jan-11
Jan-12
Date

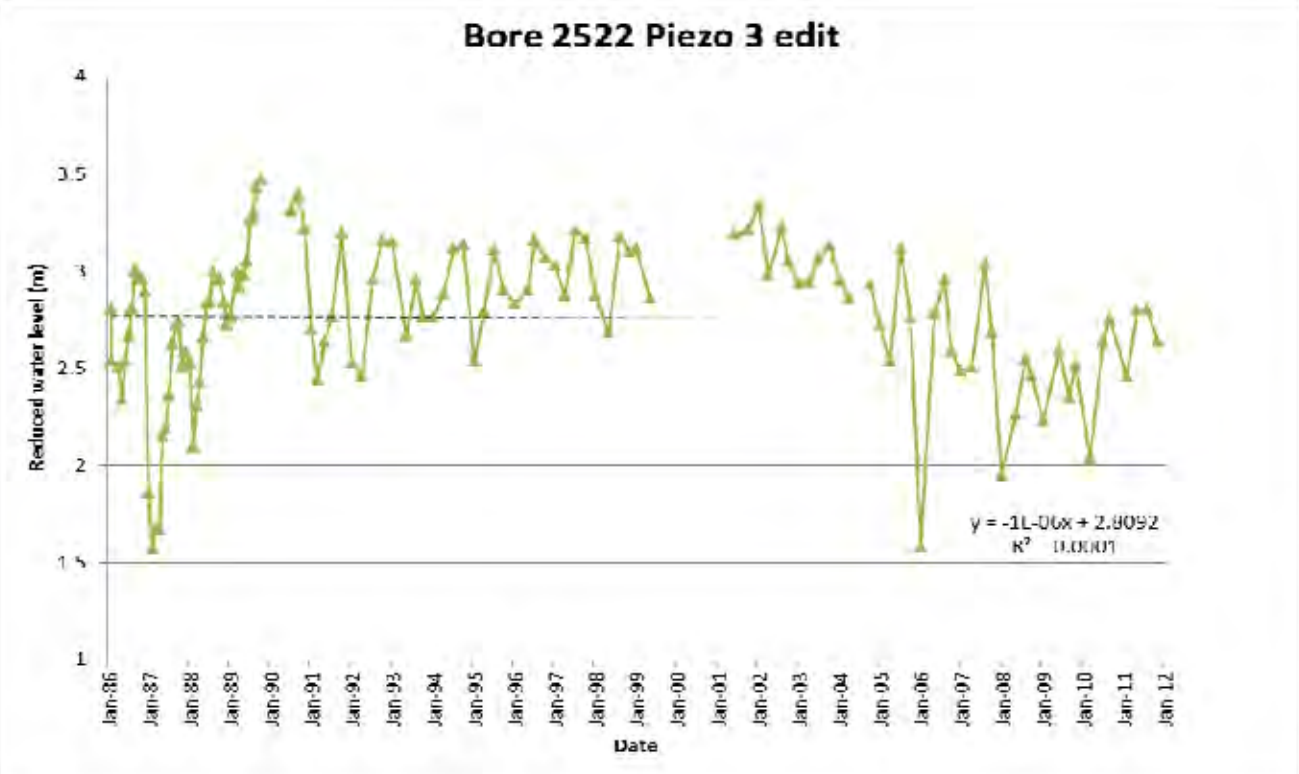

Bore 2521 Editted data
Reduced water level (m)
15
14
13
12
11
10
9
8
7
6
5
Piezo 1
Piezo 3
Jul-90
Jun-91
May-92
Apr-93
Mar-94
Feb-95
Jan-96
Dec-96
Nov-97
Oct-98
Sep-99
Aug-00
Jul-01
Jun-02
May-03
Apr-04
Mar-05
Feb-06
Jan-07
Dec-07
Nov-08
Oct-09
Sep-10
Aug-11
Date

Bore 2522 Information			
Monitoring type	Water level	**Depth (m)**	245.6
Name	BOPRC	**Casing Depth (m)**	Unknown
Bore use	Monitoring	**Screen/open hole**	Unknown
Easting	276 9751	**Temperature**	Unknown
Northing	640 1633	**Catchment**	WAI 1 zone
Bore log	Complete	**Aquifer**	Waitieariki
Monitoring period	**Water**	1986 to 2011	
	Water quality	-	

Bore 2522 geological profile (EBOF)

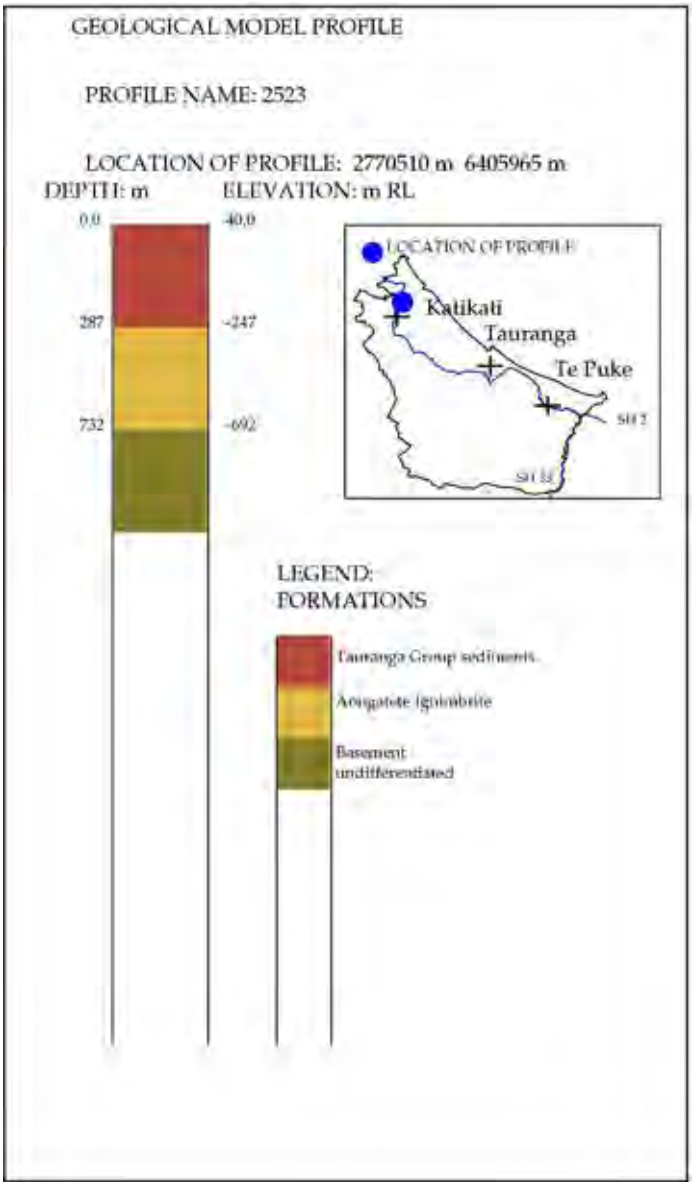



Bore 2522 water level graph - Raw data
Reduced Water level (m)
Date
Piezo 1
Piezo 2
Piezo 3
Piezo 4
0
2
4
6
8
10
12
Jan-86
Jan-87
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
Jan-09
Jan-10
Jan-11
Jan-12

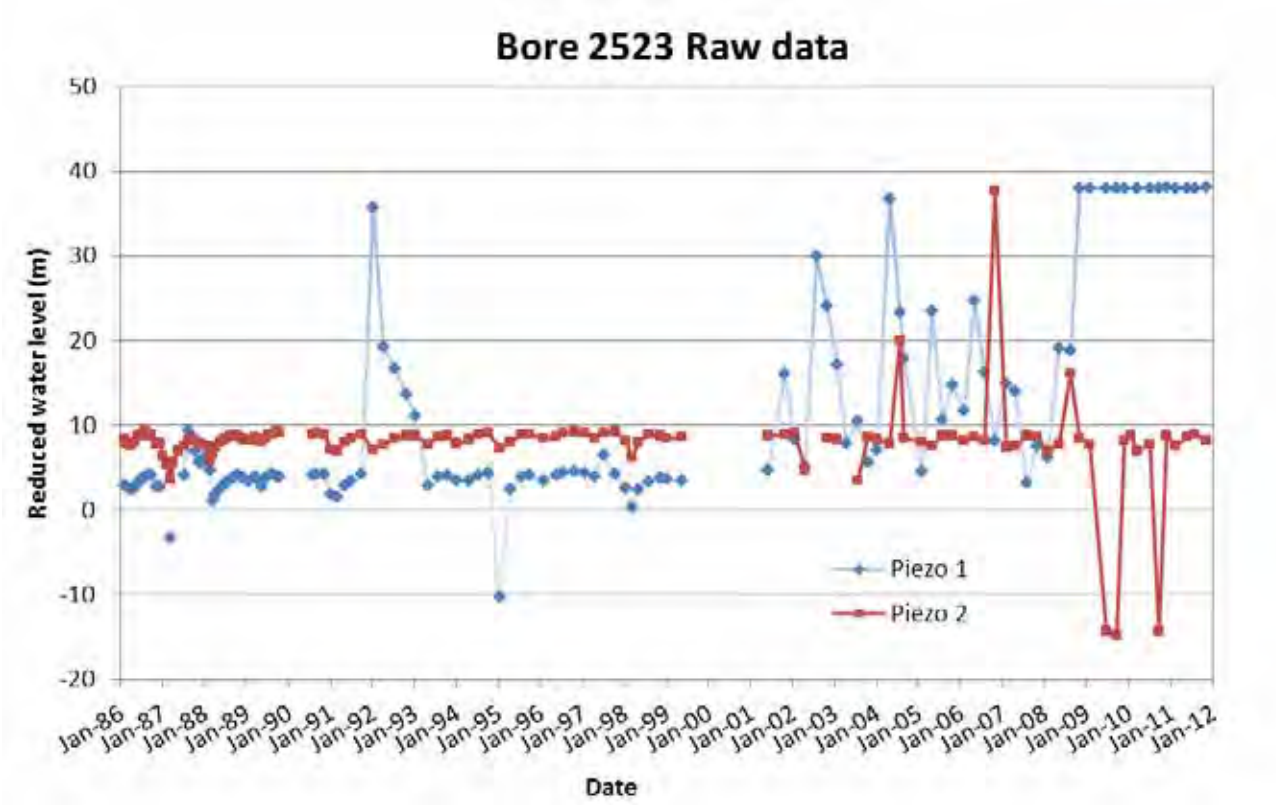

Bore 2522 Piezo 3 edit
Reduced water level (m)
Date
1
1.5
2
2.5
3
3.5
4
y = -1E-06x + 2.8092
Jan-86
Jan-87
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
Jan-09
Jan-10
Jan-11
Jan-12

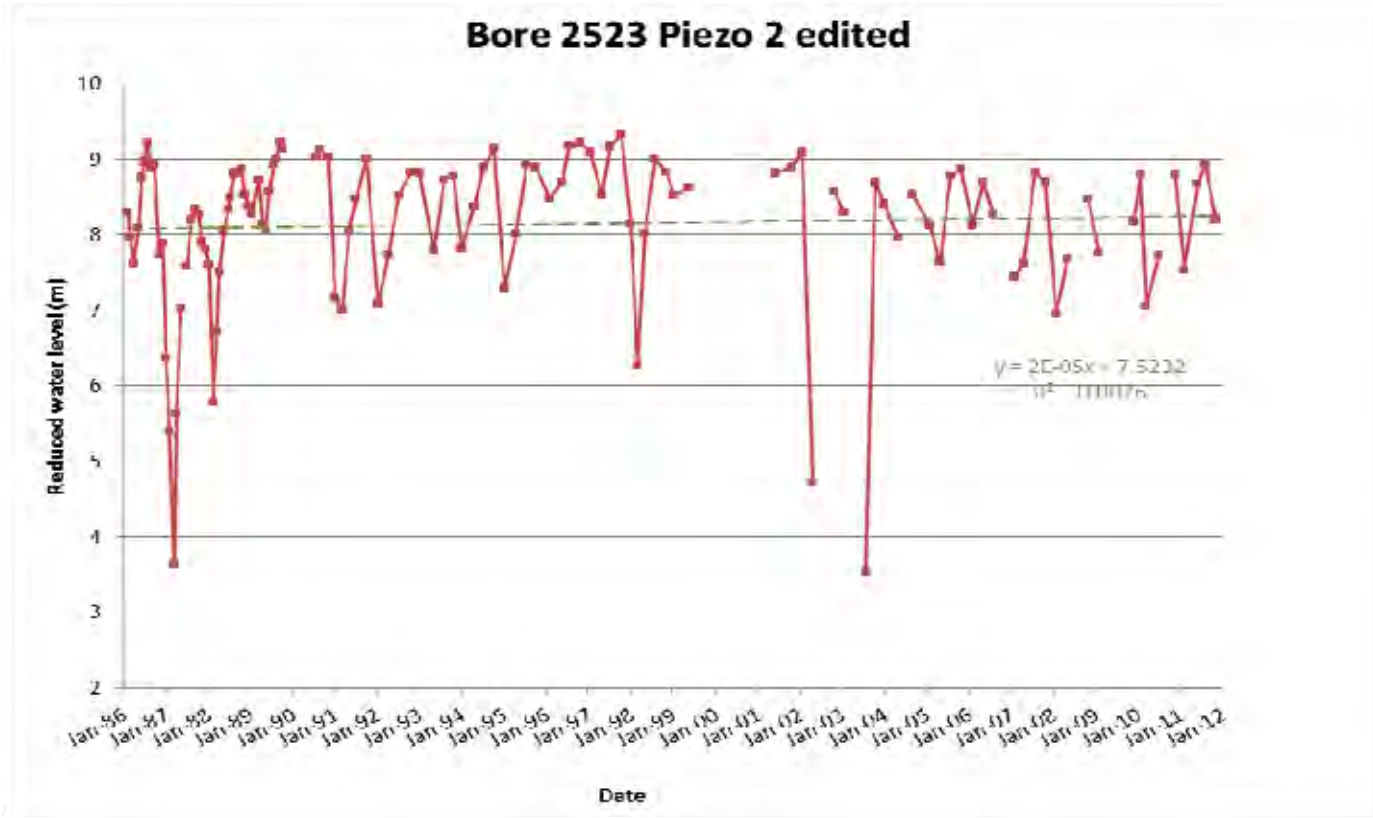
Bore 2523 Information			
Monitoring type	Water level	**Depth (m)**	196
Name	BOPRC	**Casing Depth (m)**	Unknown
Bore use	Investigation bore	**Screen/open hole**	Unknown
Easting	277 0510	**Temperature**	Unknown
Northing	640 5965	**Catchment**	Katikati
Bore log	Complete	**Aquifer**	Tauranga sediments
Monitoring period	**Water level**	1984 - 2011	
	Water quality	–	

Bore 2523 geological profile (EBOF)



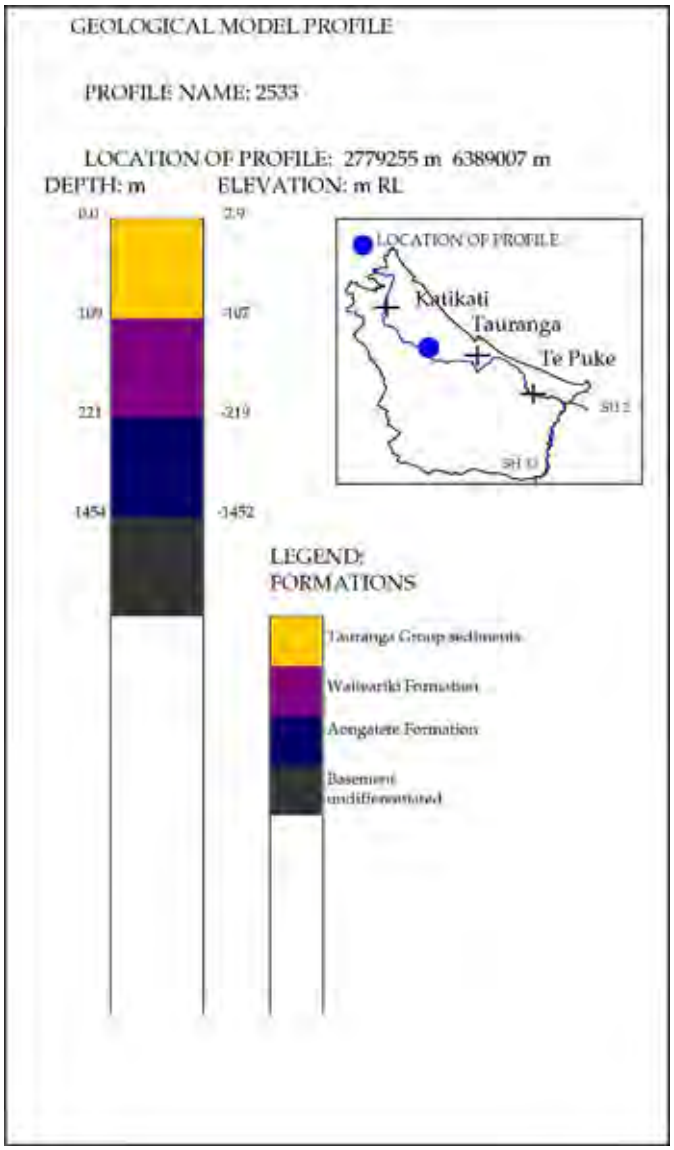
Bore 2523 water level graphs

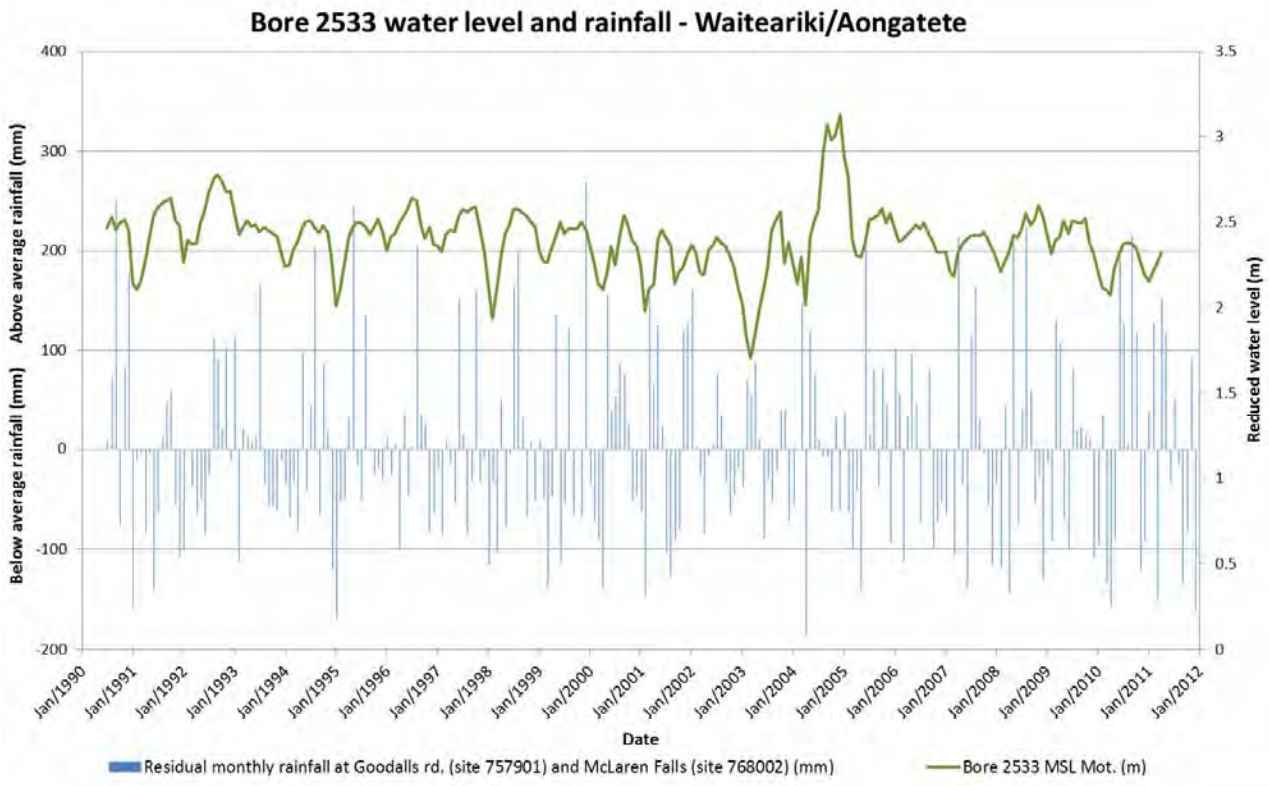


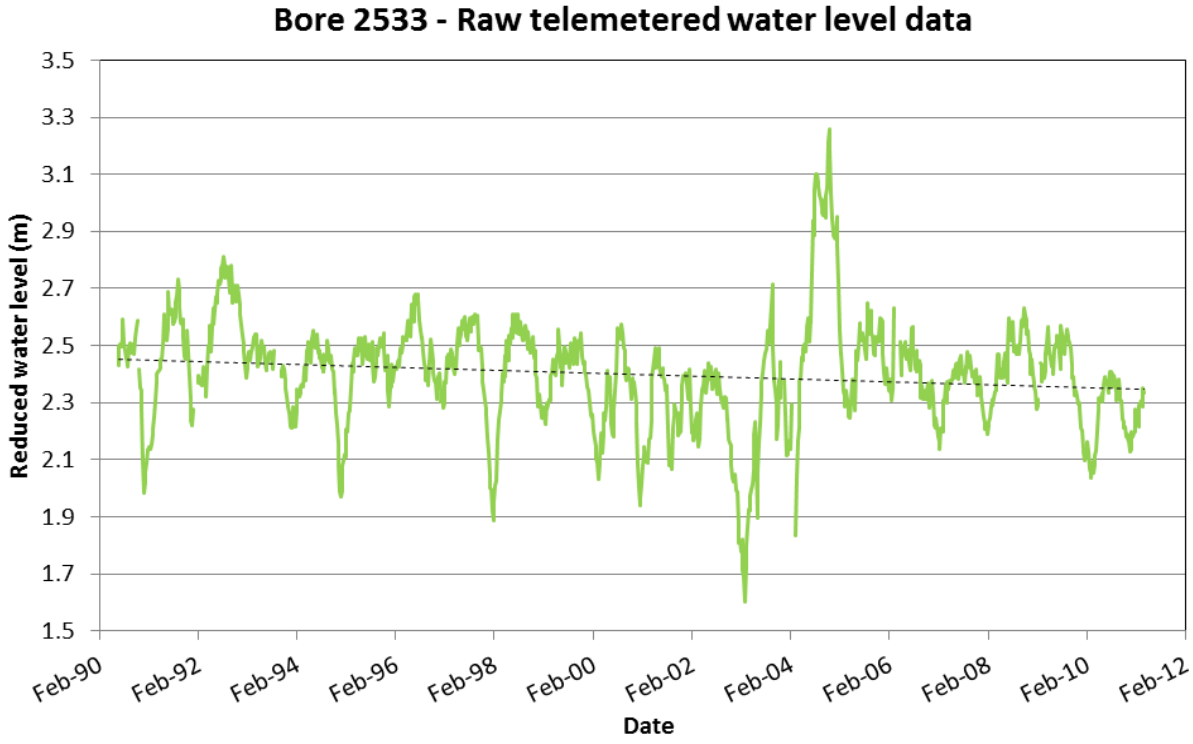


Bore 2533 Information			
Monitoring type	Water level	**Depth (m)**	247.5
Name	Edmonds	**Casing Depth (m)**	97.5
Bore use	Irrigation	**Screen/open hole**	
Easting	277 9255	**Temperature**	43.3
Northing	638 9007	**Catchment**	WAI 1 zone
Bore log	Complete	**Aquifer**	Waitekariki/Aongatete
Monitoring period	**Water level**	1990 to 2011	
	Water quality	-	

Bore 2533 geological profile (EBOF)

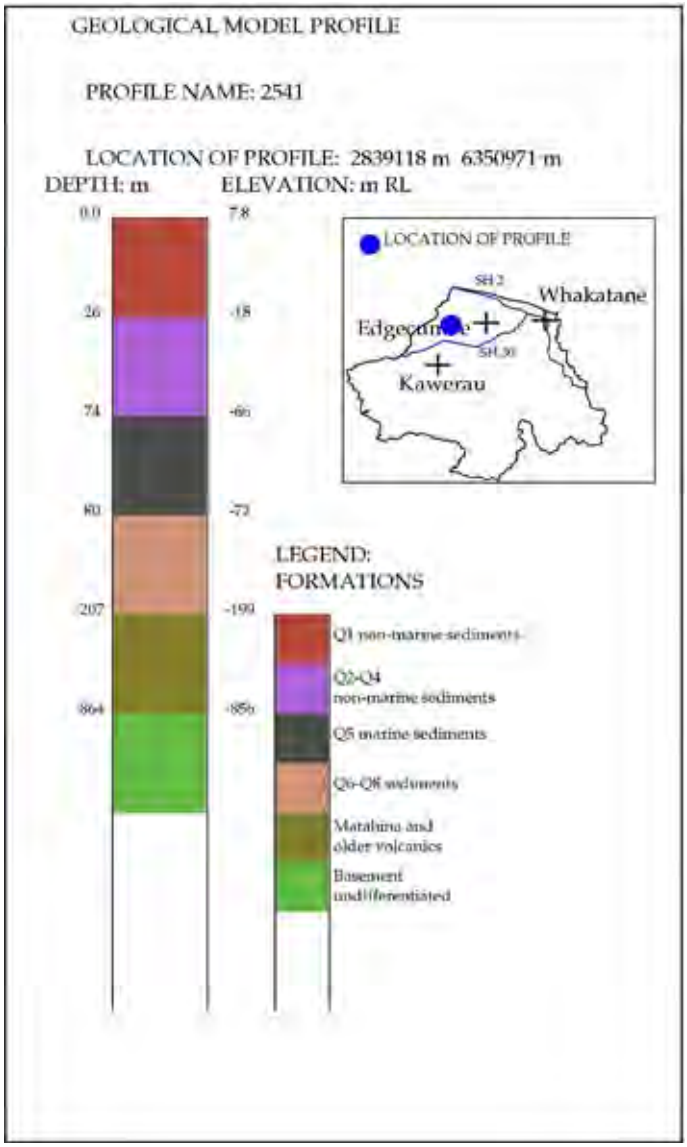


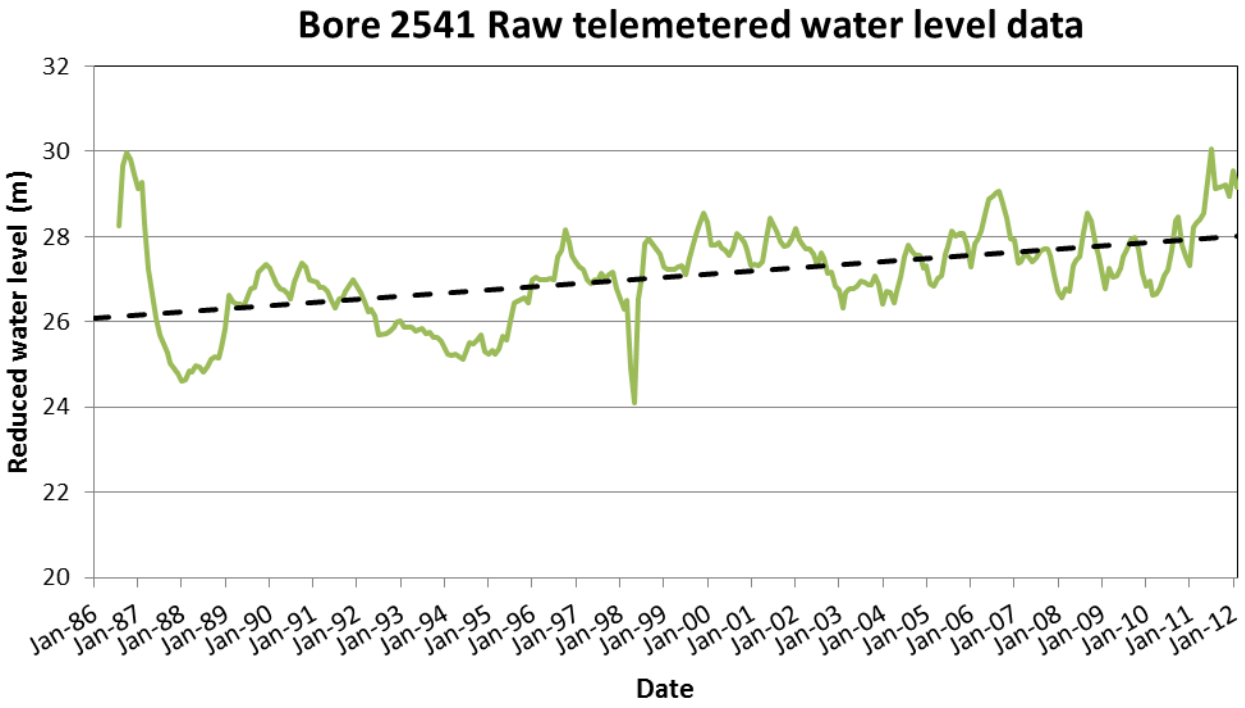

Bore 2533 water level and rainfall - Waitearikl/Aongatete
Above average rainfall (mm)
Below average rainfall (mm)
Reduced water level (m)
Date
Residual monthly rainfall at Goodalls rd, (site 757901) and McLaren Falls (site 768002) (mm)
Bore 2533 MSL Mot. (m)

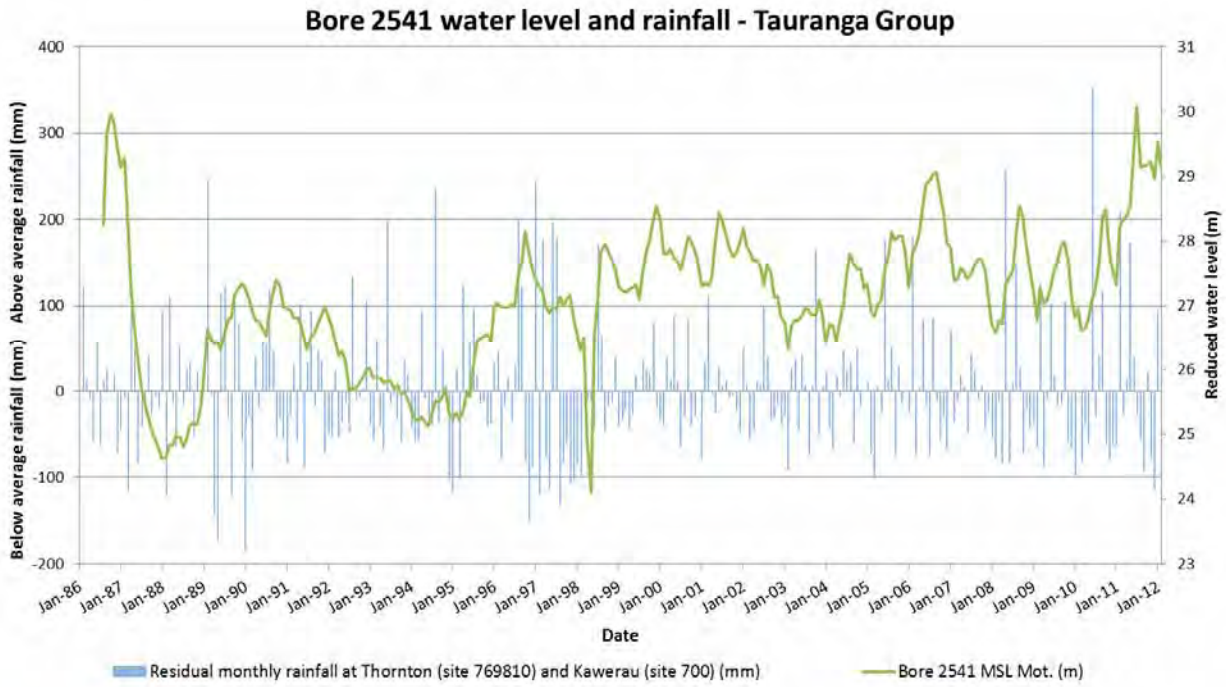

Bore 2533 - Raw telemetered water level data
Reduced water level (m)
Date

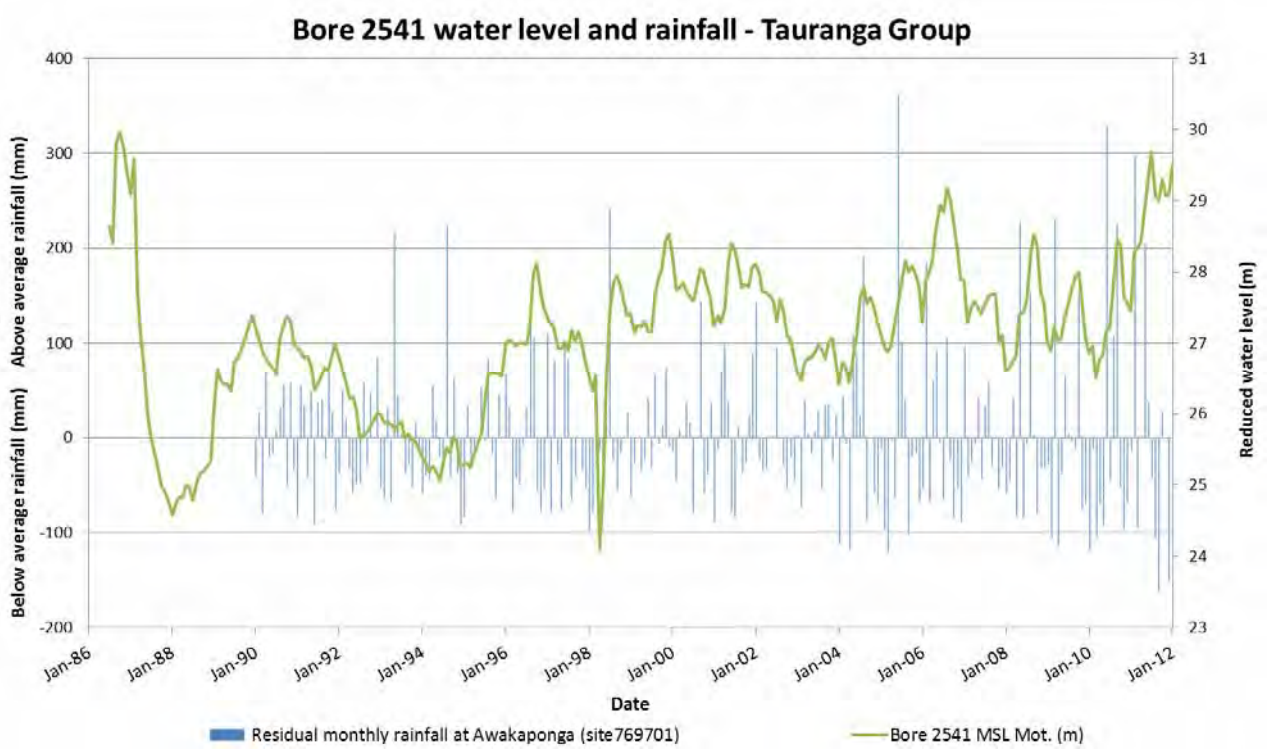
Bore 2541 Information			
Monitoring type	Telemetered Water level	**Depth (m)**	199
Name	Zink	**Casing Depth (m)**	160
Bore use	Irrigation/Frost/Agricultural	**Screen/open hole**	Open hole
Easting	283 9118	**Temperature**	Unknown
Northing	635 0971	**Catchment**	Awaiti Canal
Bore log	Complete	**Aquifer**	Tauranga sediments
Monitoring period	**Water level**	1986 to 2011	
	Water quality		

Bore 2541 geological profile (EBOF)



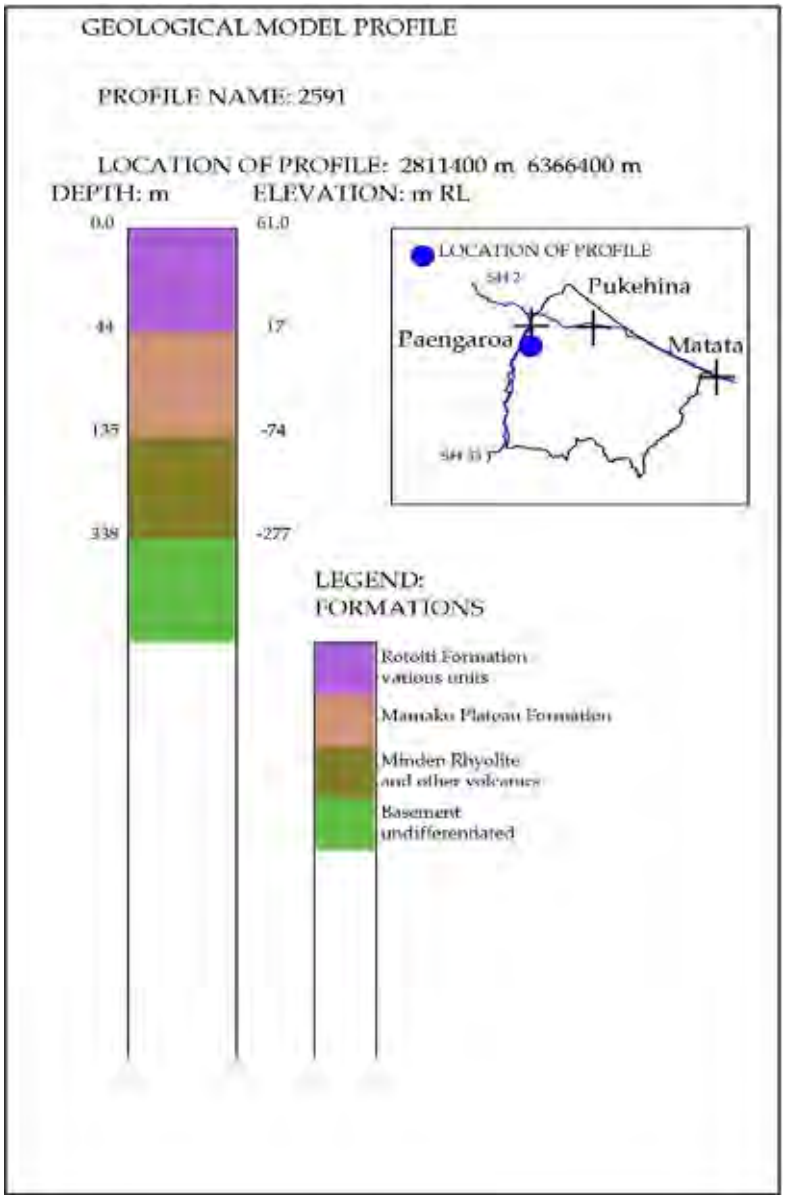

Bore 2541 Raw telemetered water level data
Reduced water level (m)
32
30
28
26
24
22
20
Jan-86 Jan-87 Jan-88 Jan-89 Jan-90 Jan-91 Jan-92 Jan-93 Jan-94 Jan-95 Jan-96 Jan-97 Jan-98 Jan-99 Jan-00 Jan-01 Jan-02 Jan-03 Jan-04 Jan-05 Jan-06 Jan-07 Jan-08 Jan-09 Jan-10 Jan-11 Jan-12
Date


Bore 2541 water level and rainfall - Tauranga Group
Above average rainfall (mm)
Below average rainfall (mm)
400
300
200
100
0
-100
-200
31
30
29
28
27
26
25
24
23
Reduced water level (m)
Jan-86 Jan-87 Jan-88 Jan-89 Jan-90 Jan-91 Jan-92 Jan-93 Jan-94 Jan-95 Jan-96 Jan-97 Jan-98 Jan-99 Jan-00 Jan-01 Jan-02 Jan-03 Jan-04 Jan-05 Jan-06 Jan-07 Jan-08 Jan-09 Jan-10 Jan-11 Jan-12
Date
Residual monthly rainfall at Thornton (site 769810) and Kawerau (site 700) (mm)
Bore 2541 MSL Mot. (m)

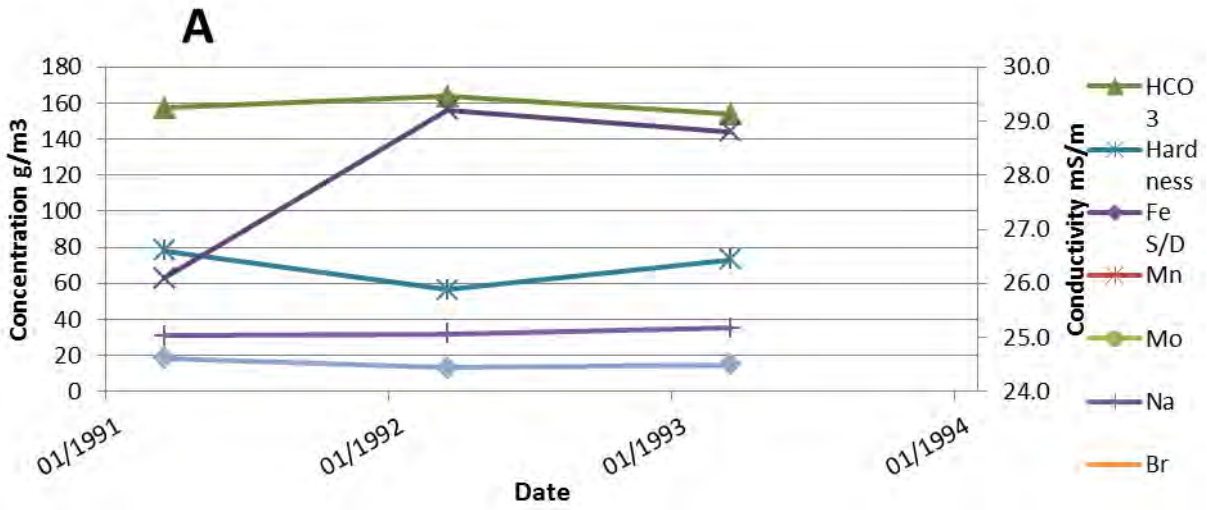

Bore 2541 water level and rainfall - Tauranga Group
Above average rainfall (mm)
Below average rainfall (mm)
Reduced water level (m)
400
300
200
100
0
-100
-200
31
30
29
28
27
26
25
24
23
Jan-86
Jan-88
Jan-90
Jan-92
Jan-94
Jan-96
Jan-98
Jan-00
Jan-02
Jan-04
Jan-06
Jan-08
Jan-10
Jan-12
Date
Residual monthly rainfall at Awakaponga (site769701)
Bore 2541 MSL Mot. (m)

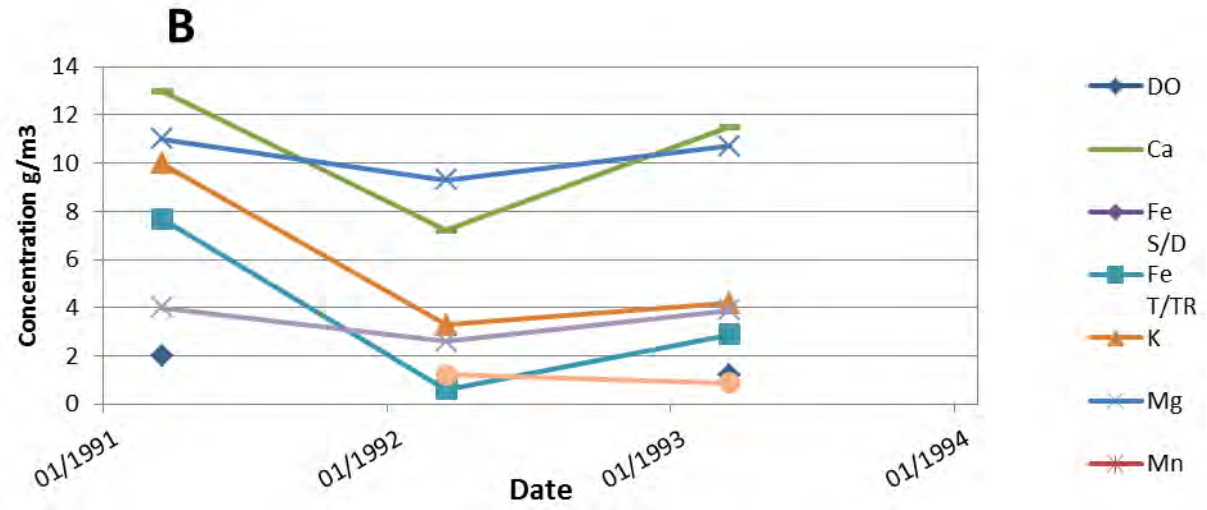
Bore 2591 Information			
Monitoring type	Water quality	**Depth (m)**	68.5
Name	Roberts	**Casing Depth (m)**	65
Bore use	Domestic	**Screen/open hole**	65.5 to 68.5
Easting	281 1500	**Temperature**	18°C
Northing	636 6400	**Catchment**	Kaikokopu-Pokopoko-Wharere
Bore log	Complete	**Aquifer**	Mamaku Plateau Formation
Monitoring period	**Water level**	-	
	Water quality	1991 to 1993	**LabStar:** BOP180010

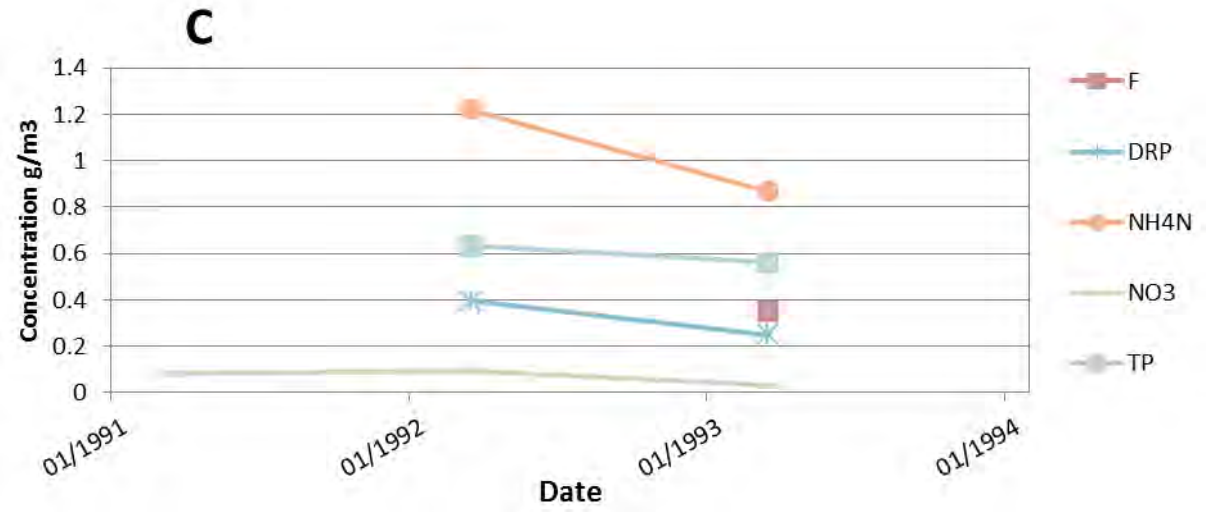
Bore 2591 geological profile (EBOF)



Bore 2591 water quality graphs

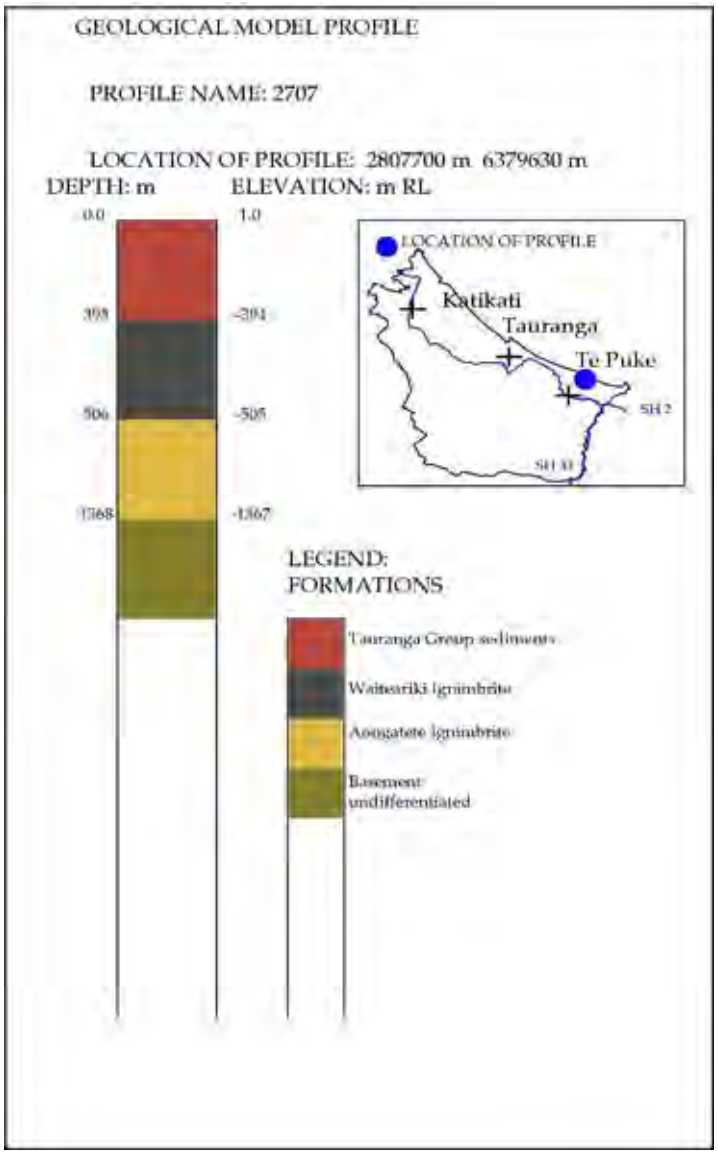

A
Concentration g/m3
180
160
140
120
100
80
60
40
20
0
30.0
29.0
28.0
27.0
26.0
25.0
24.0
Conductivity mS/m
01/1991
01/1992
01/1993
01/1994
Date
HCO3
Hardness
Fe S/D
Mn
Mo
Na
Br


B
Concentration g/m3
14
12
10
8
6
4
2
0
01/1991
01/1992
01/1993
01/1994
Date
DO
Ca
Fe S/D
Fe T/TR
K
Mg
Mn

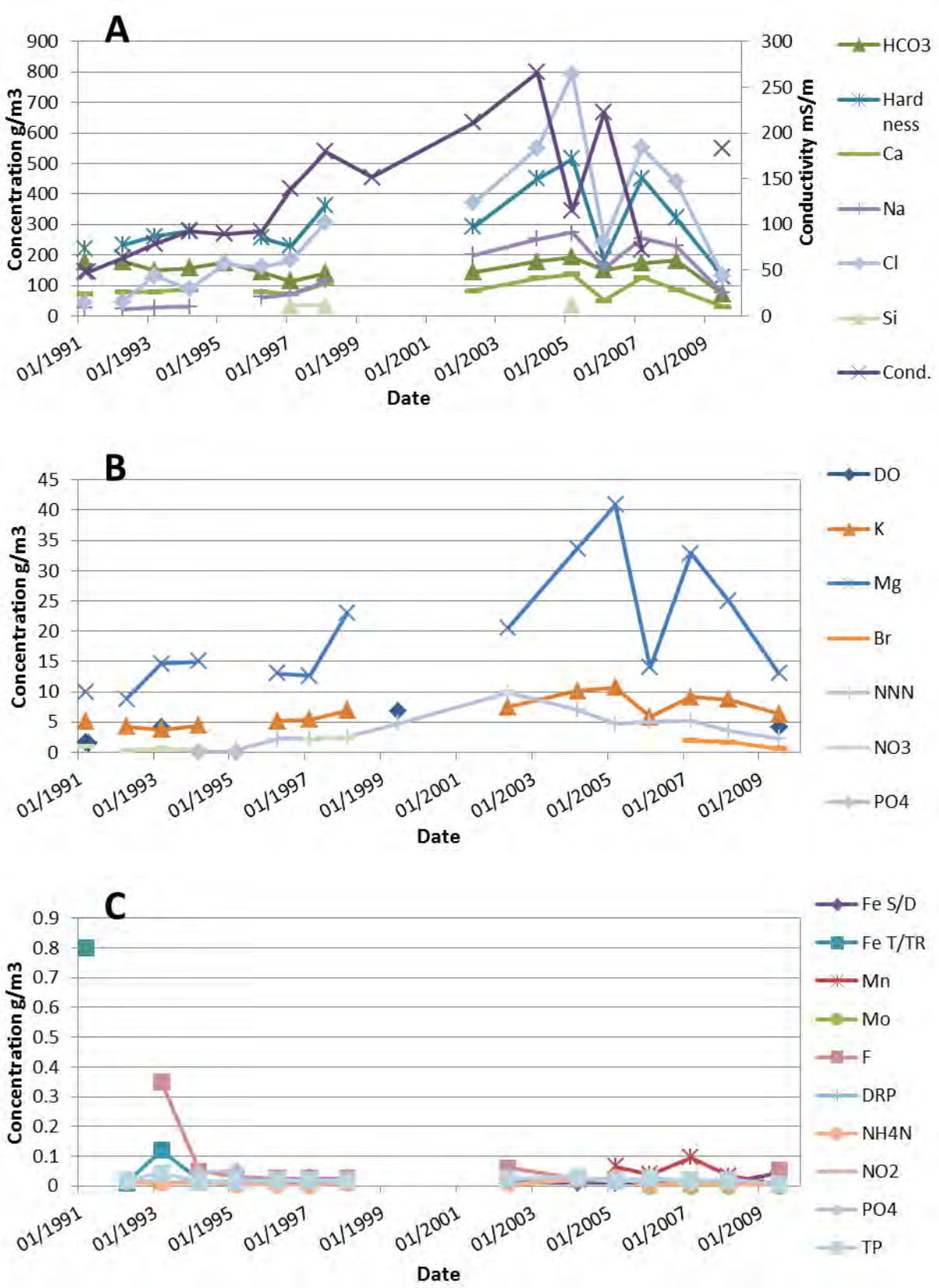

C
Concentration g/m3
1.4
1.2
1
0.8
0.6
0.4
0.2
0
01/1991
01/1992
01/1993
01/1994
Date
F
DRP
NH4N
NO3
TP

Bore 2707 Information			
Monitoring type	Water quality	**Depth (m)**	10
Name	Hickson	**Casing Depth (m)**	8
Bore use	Irrigation/domestic	**Screen/open hole**	Screened
Easting	280 7700	**Temperature**	15°C
Northing	637 9630	**Catchment**	Lower Kaituna (Plains)
Bore log	Complete	**Aquifer**	Tauranga sediments
Monitoring period	**Water level**	1990 to 2009	
	Water quality	1991 to 2009	**LabStar:** BOP180024

Bore 2707 geological profile (EBOF)

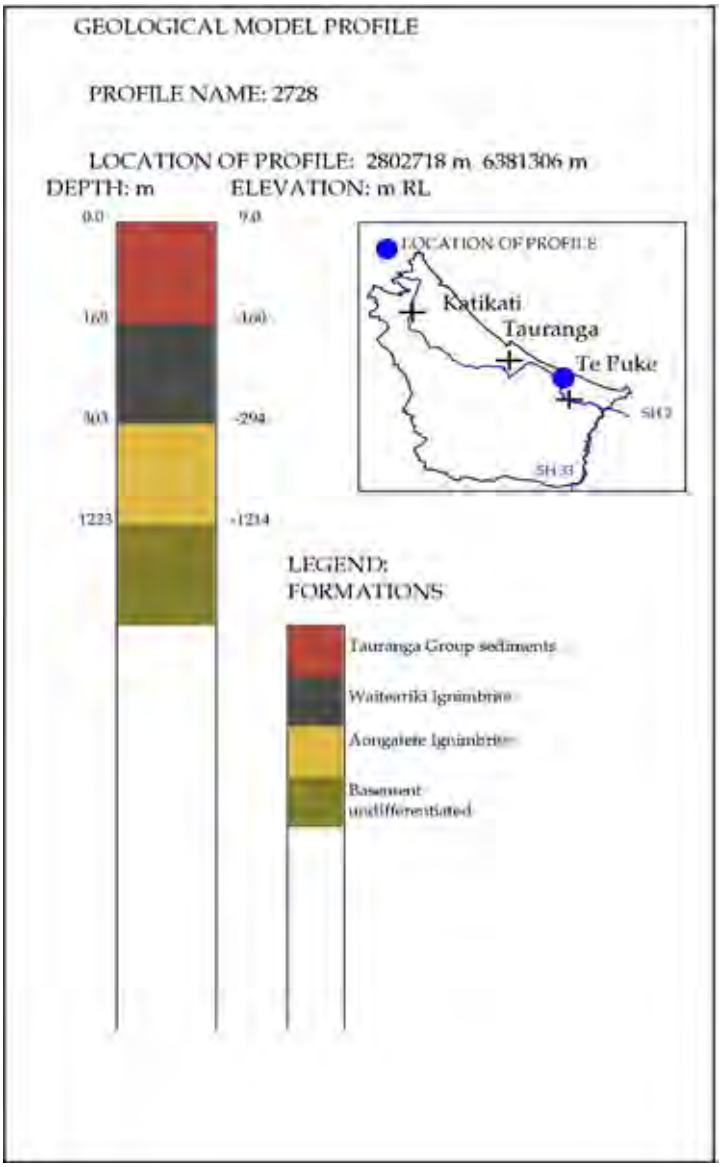


Bore 2707 water quality graphs

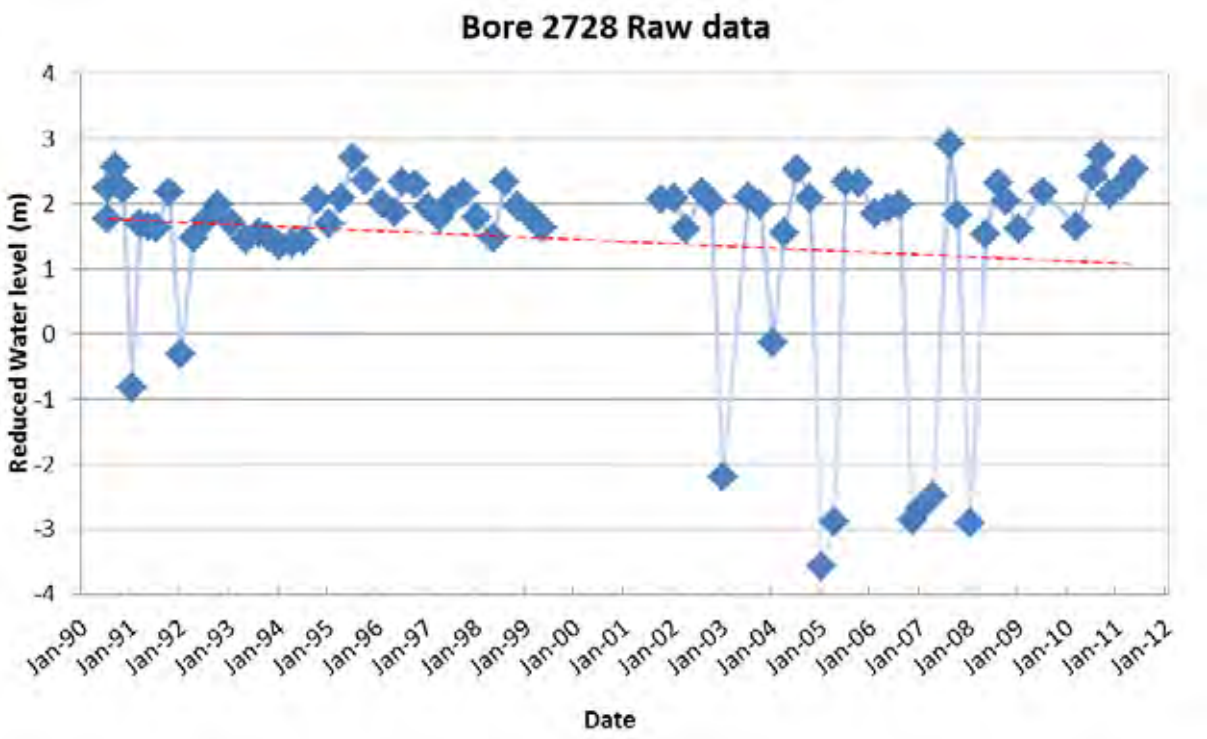


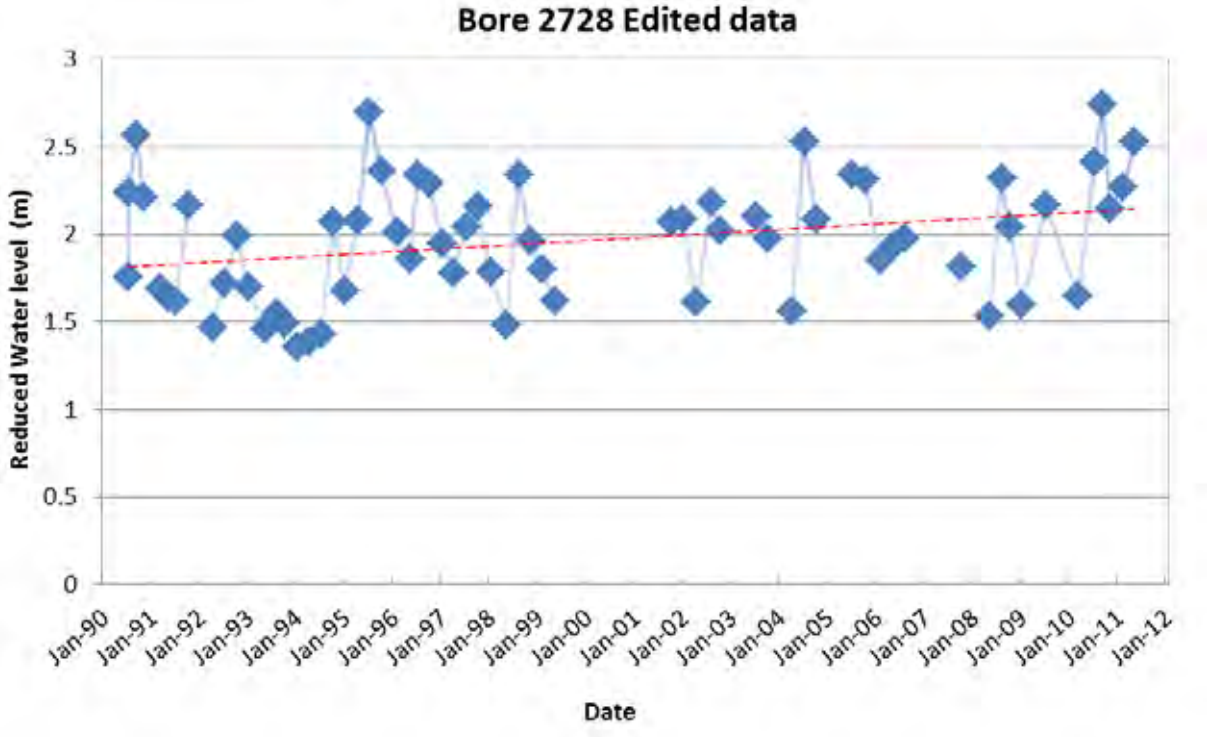
Bore 2728 Information			
Monitoring type	Water level & Water quality	**Depth (m)**	81
Name	Fulton Hogan	**Casing Depth (m)**	69
Bore use	Irrigation	**Screen/open hole**	69 to 81
Easting	280 2718	**Temperature**	21.7°C
Northing	638 1306	**Catchment**	Lower Kaituna
Bore log	Complete	**Aquifer**	Tauranga sediments
Monitoring period	**Water level**	1990 to 2011	
	Water quality	1991 to 2009	**LabStar:** BOP180018

Bore 2728 geological profile (EBOF)

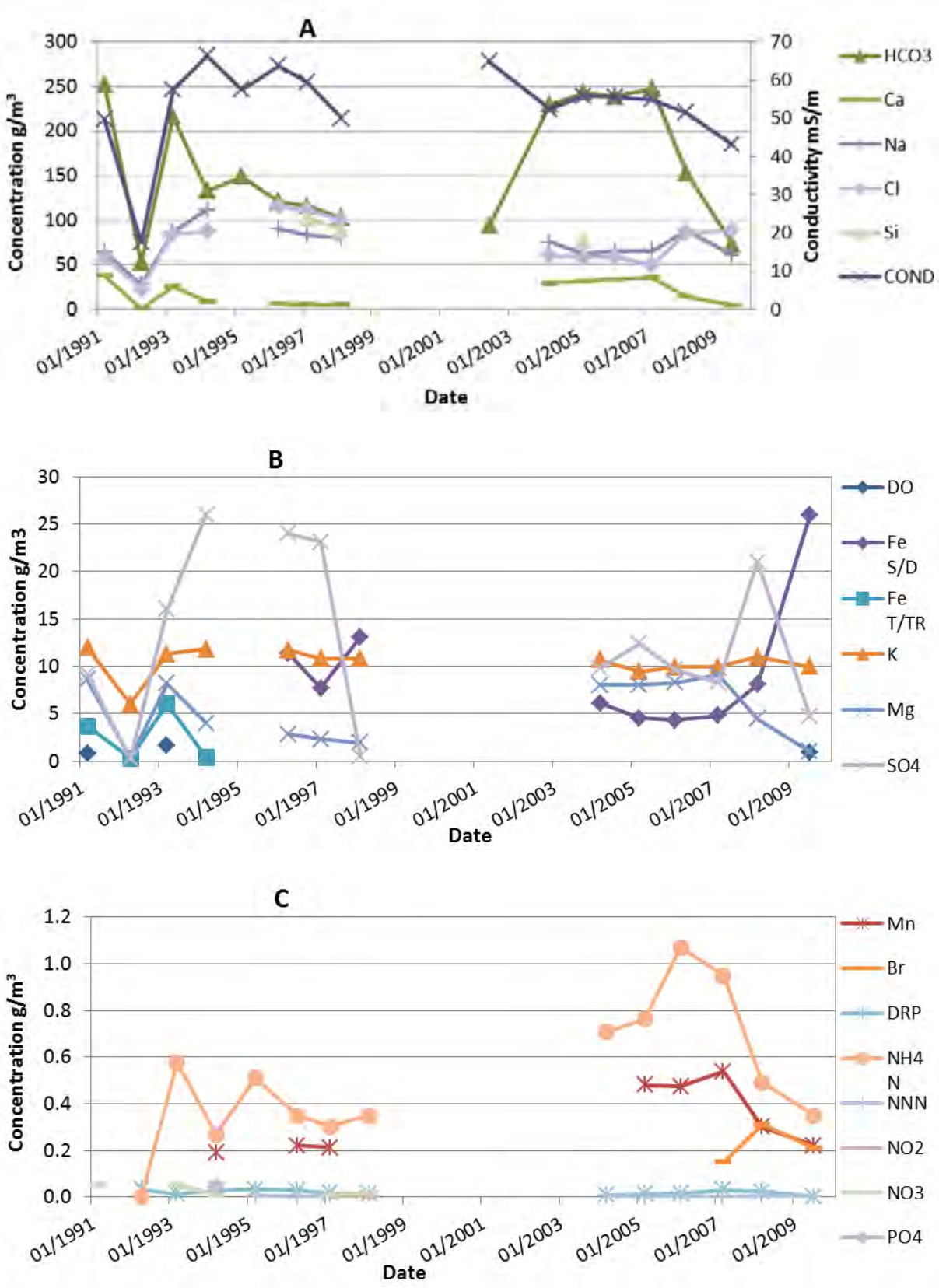


Bore 2728 water level graphs



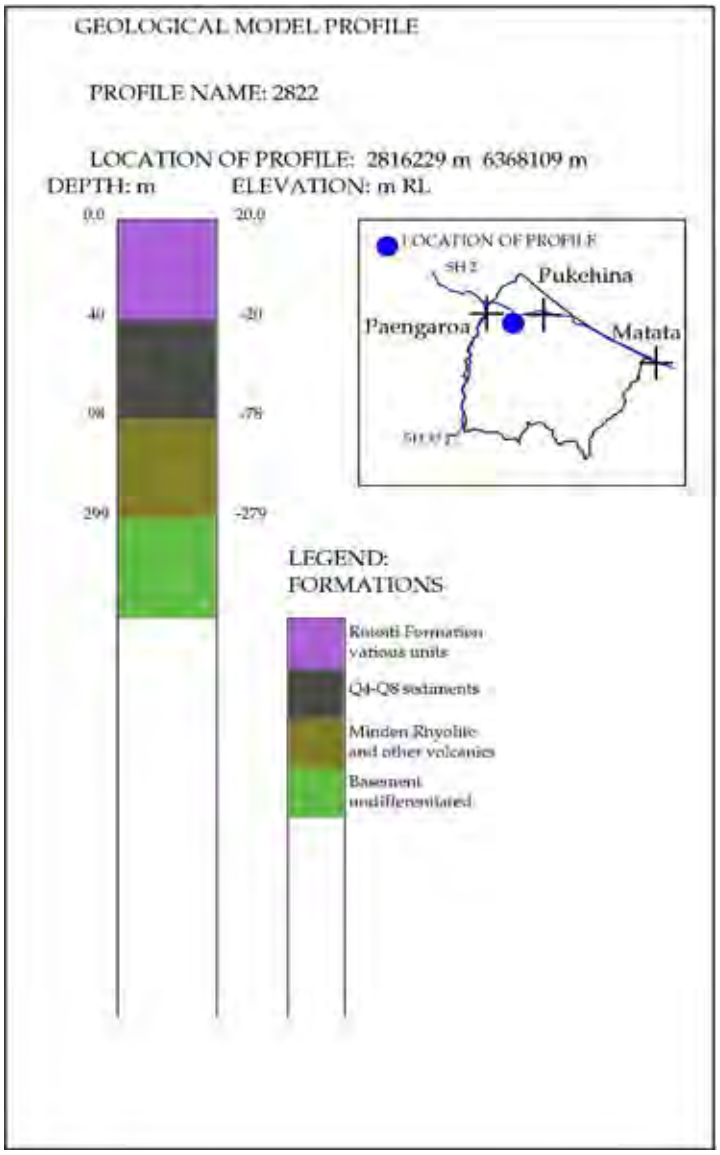


Bore 2728 water quality

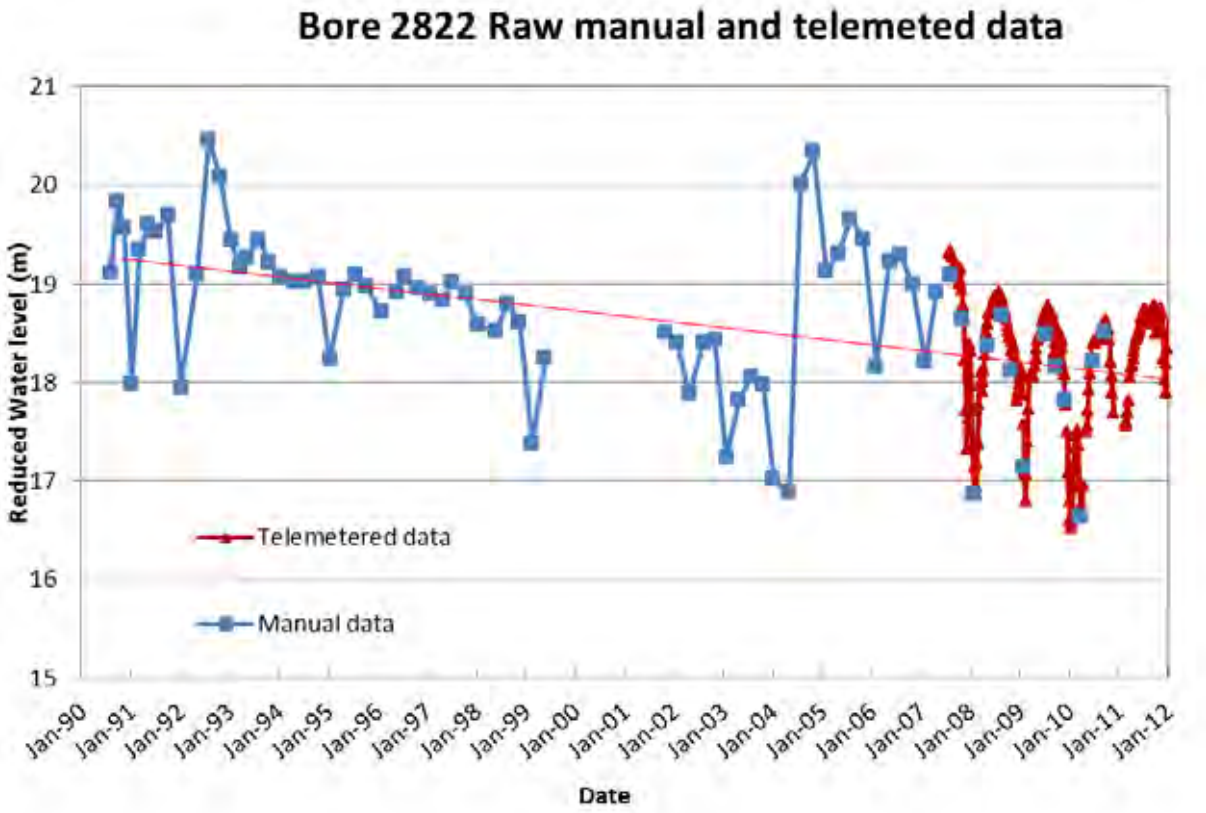


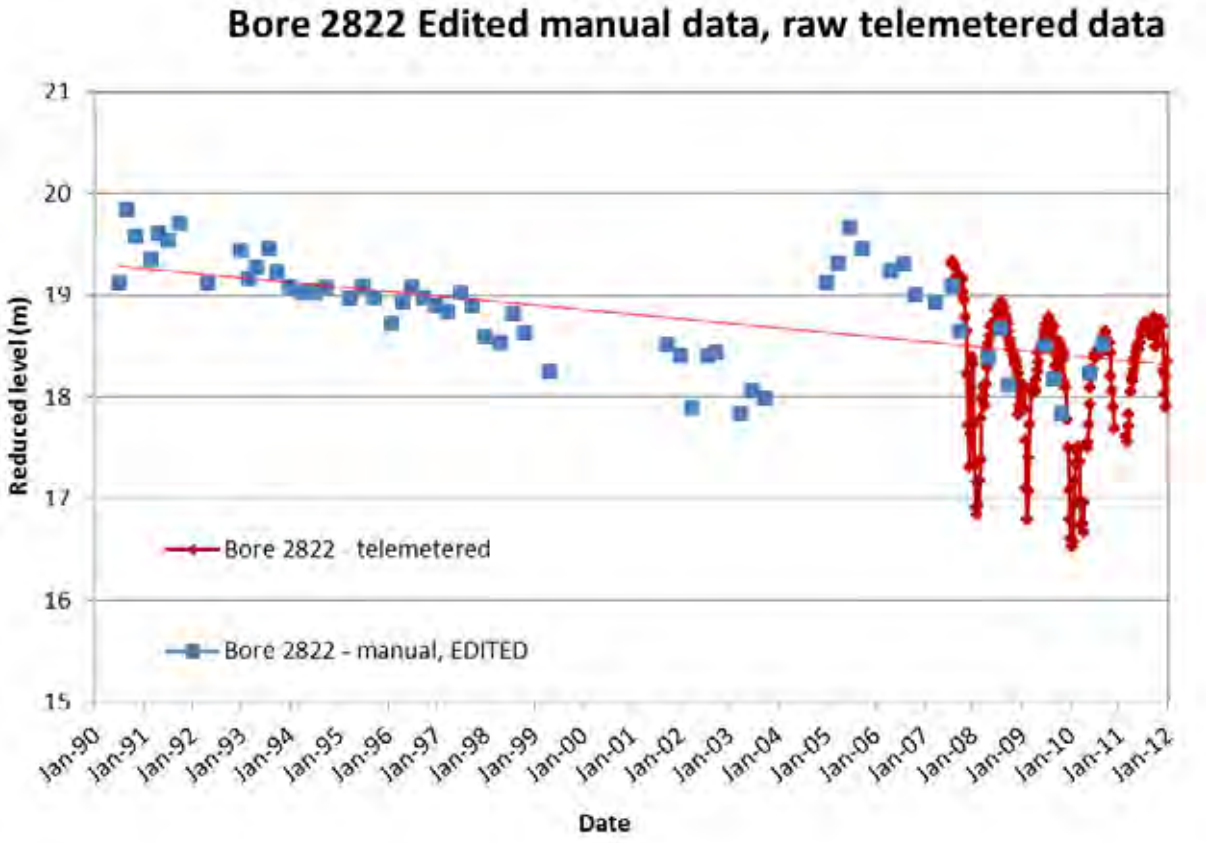
Bore 2822 Information			
Monitoring type	Water level & Water quality	**Depth (m)**	121.9
Name	Winters	**Casing Depth (m)**	104.85
Bore use	Irrigation	**Screen/open hole**	Open hole
Easting	281 6229	**Temperature**	18.1°C
Northing	636 8109	**Catchment**	Wharere (Pongakawa)
Bore log	Complete	**Aquifer**	Minden Rhyolite
Monitoring period	**Water**	1990 to 2011	
	Water quality	1991 to 2011	**LabStar:** BOP180044

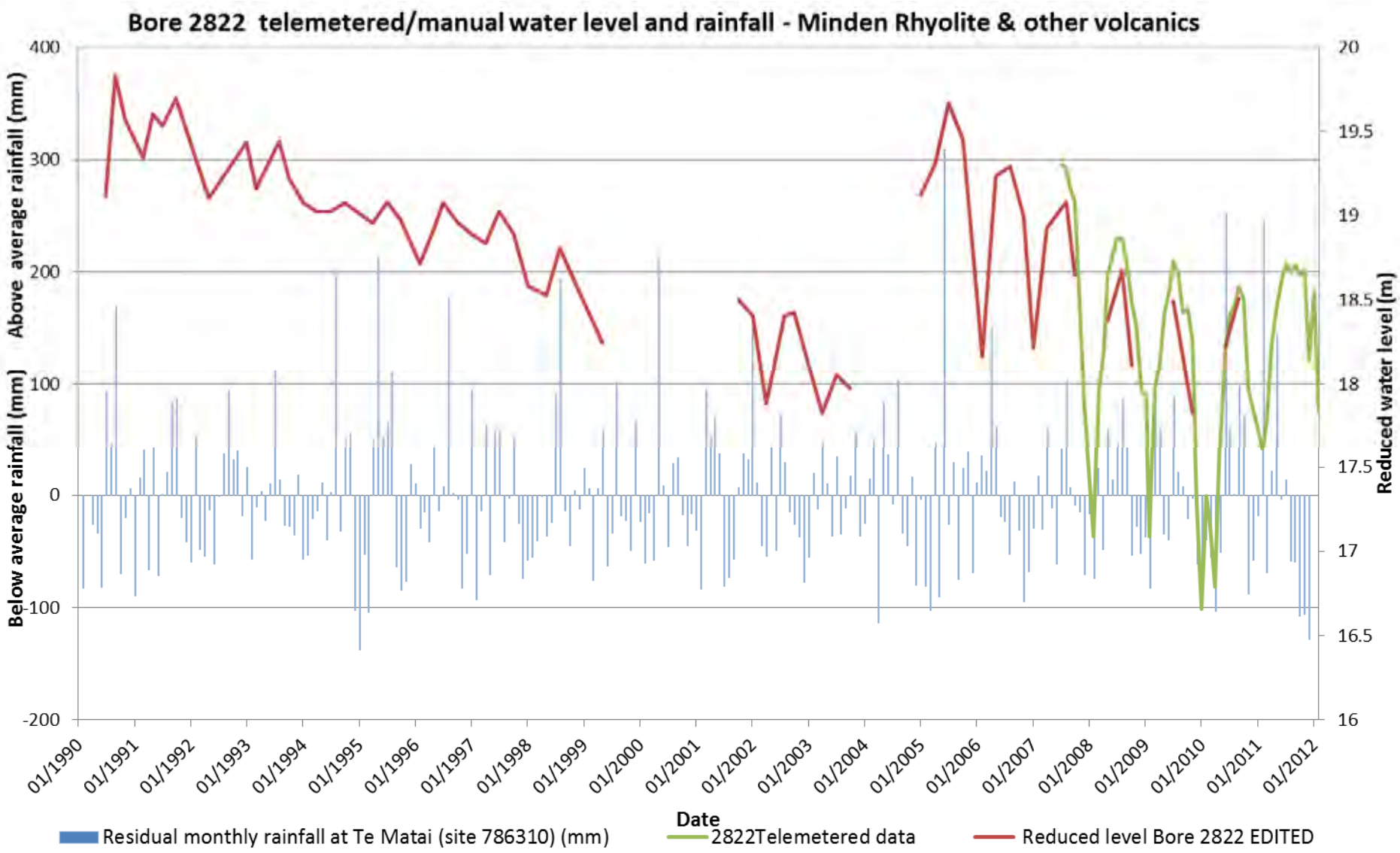
Bore 2822 geological profile (EBOF)



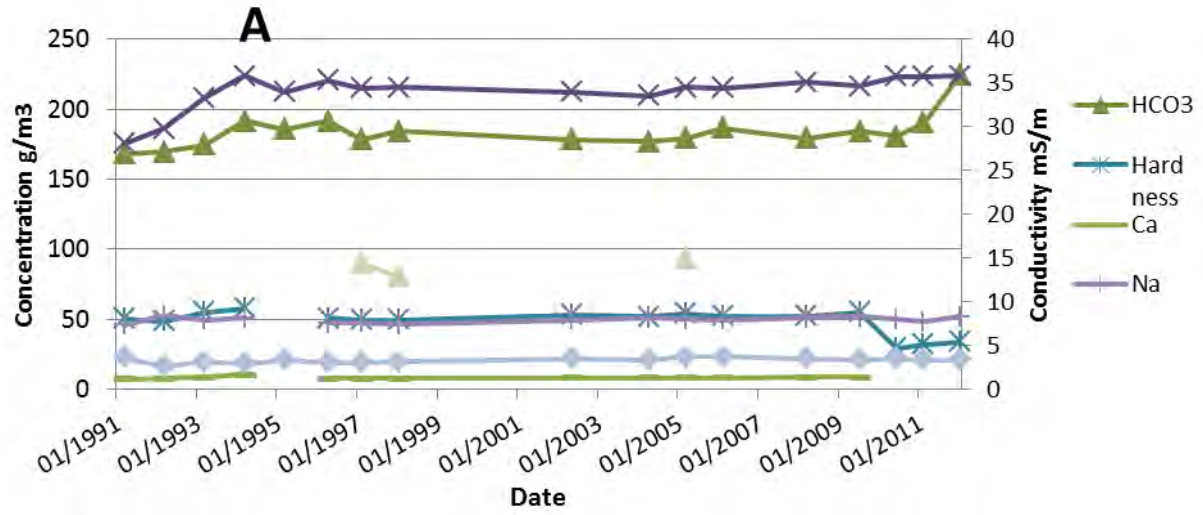
Bore 2822 water level graphs

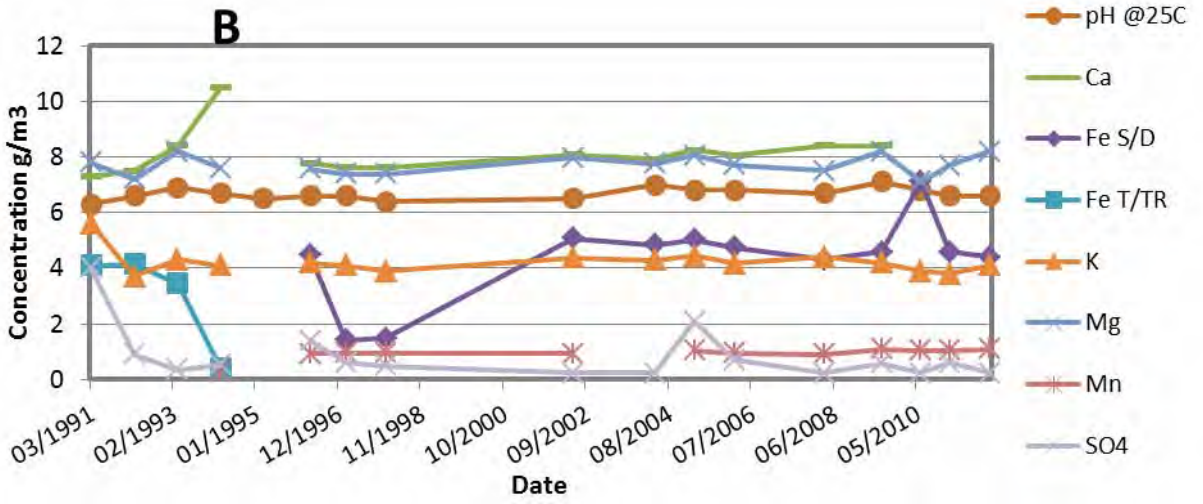


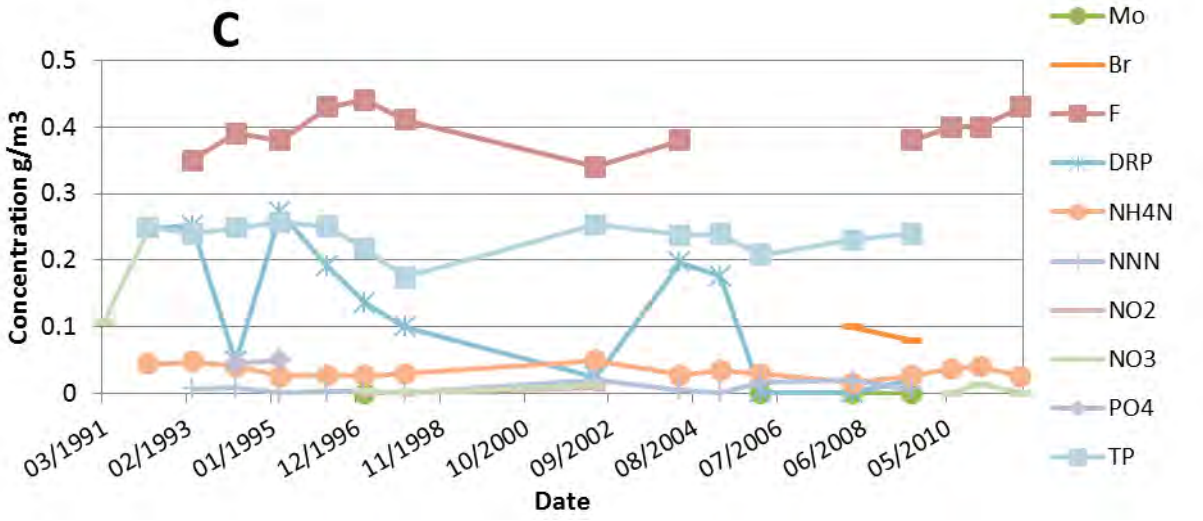



Bore 2822 telemetered/manual water level and rainfall - Minden Rhyolite & other volcanics
Above average rainfall (mm)
Below average rainfall (mm)
Reduced water level (m)
400
300
200
100
0
-100
-200
20
19.5
19
18.5
18
17.5
17
16.5
16
01/1990
01/1991
01/1992
01/1993
01/1994
01/1995
01/1996
01/1997
01/1998
01/1999
01/2000
01/2001
01/2002
01/2003
01/2004
01/2005
01/2006
01/2007
01/2008
01/2009
01/2010
01/2011
01/2012
Date
Residual monthly rainfall at Te Matai (site 786310) (mm)
2822Telemetered data
Reduced level Bore 2822 EDITED

Bore 2822 water quality graphs

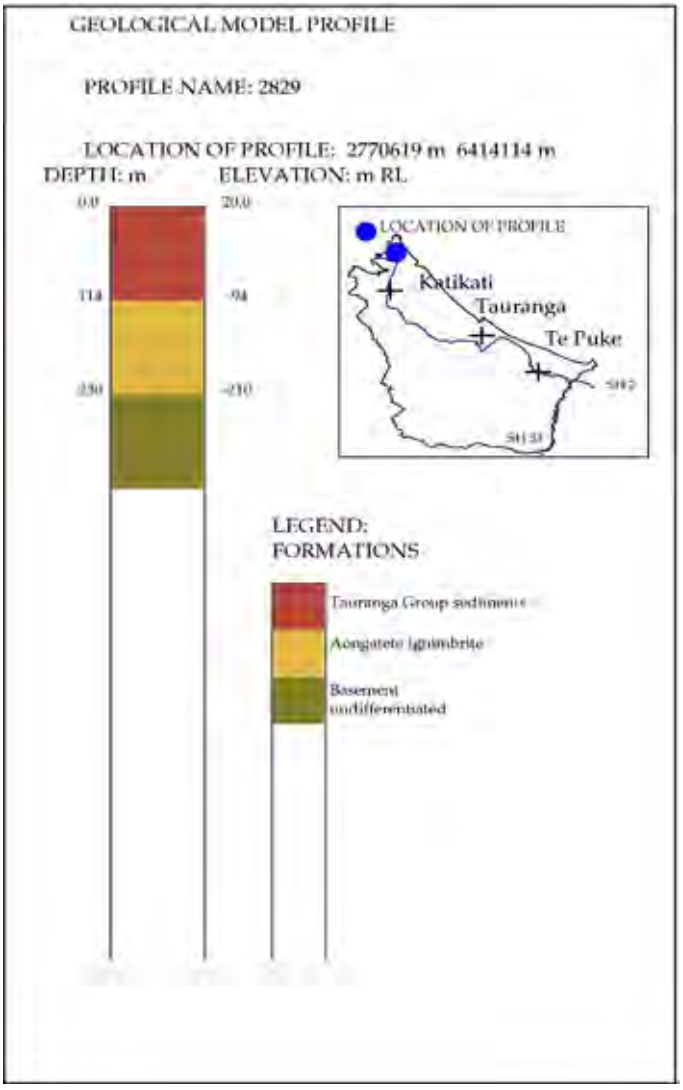




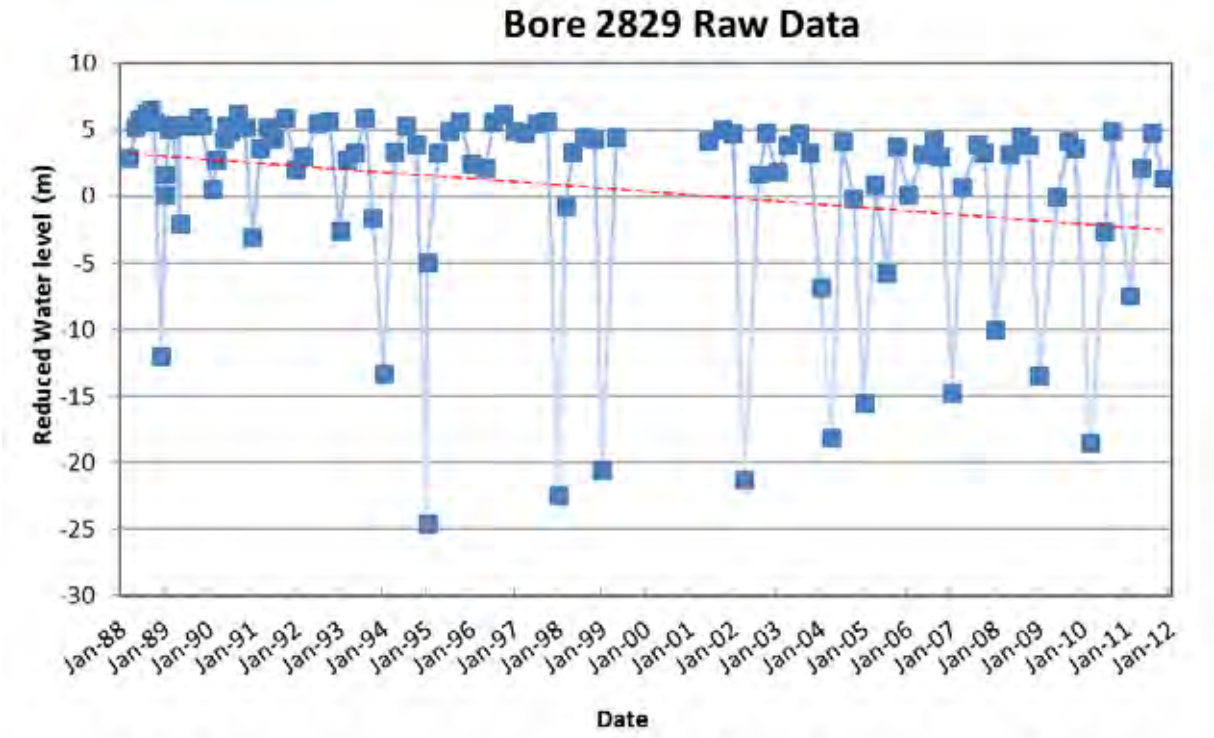


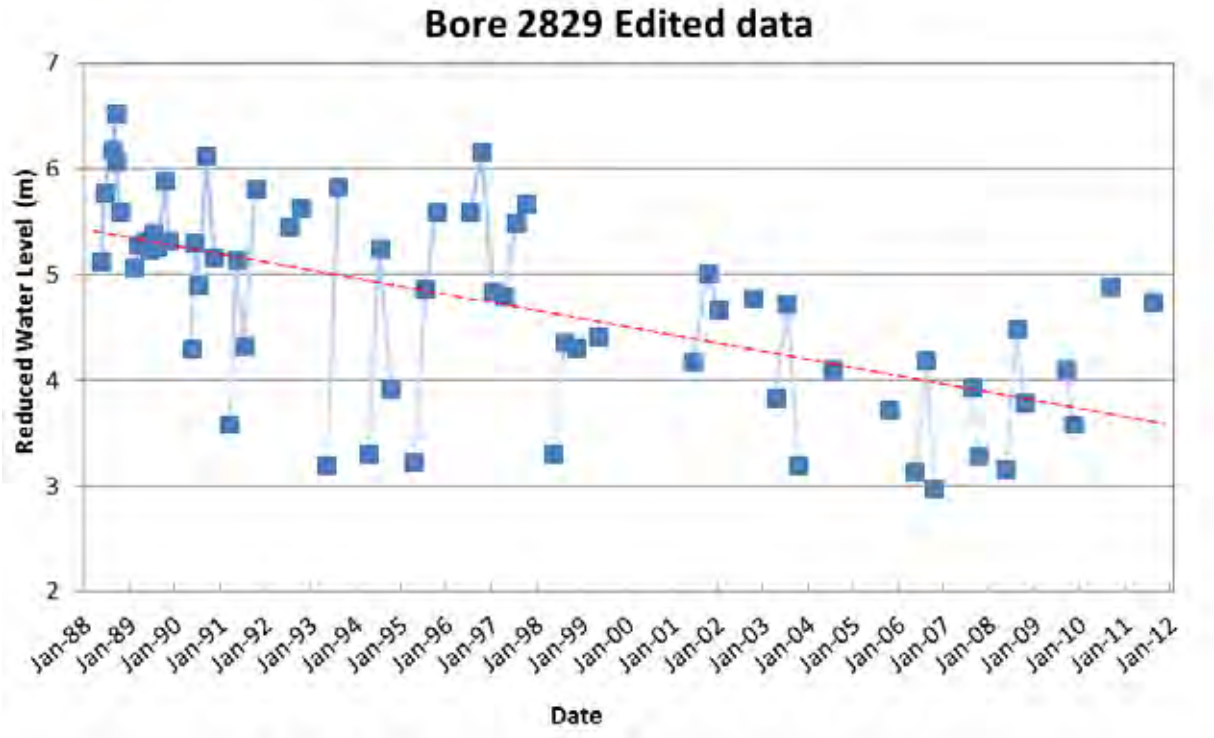
Bore 2829 Information			
Monitoring type	Water level & Water quality	**Depth (m)**	304.8
Name	Bagshaw	**Casing Depth (m)**	No casing
Bore use	Irrigation	**Screen/open hole**	Open hole
Easting	2772680	**Temperature**	35°C
Northing	6396970	**Catchment**	Waihī Beach
Bore log	Complete	**Aquifer**	Aongatete (WAI)
Monitoring period	**Water level**	1988 - 2011	
	Water quality	1991 - 2011	**LabStar:** BOP180015

Bore 2829 geological profile (EBOF)

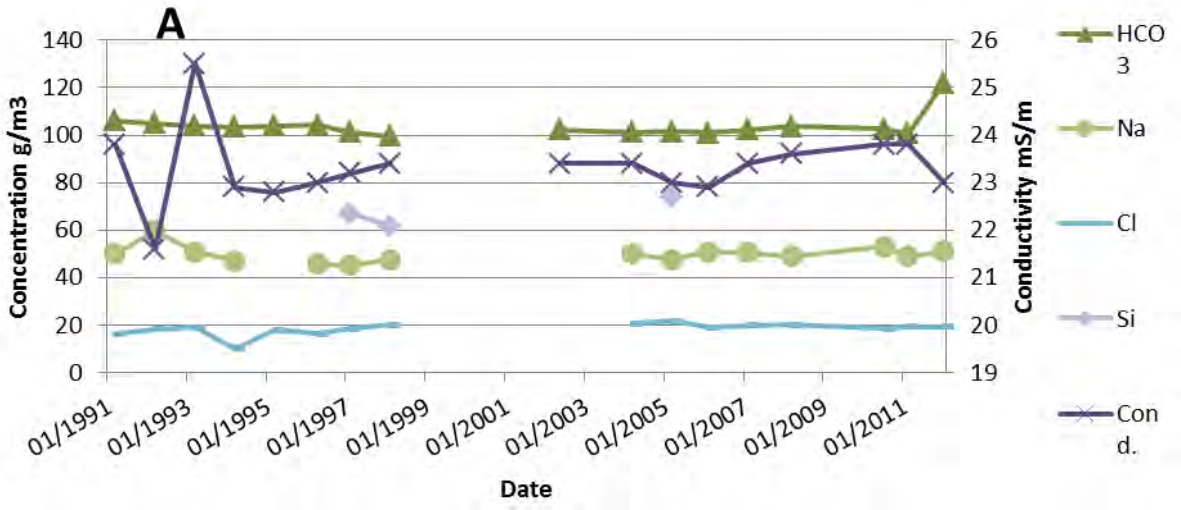


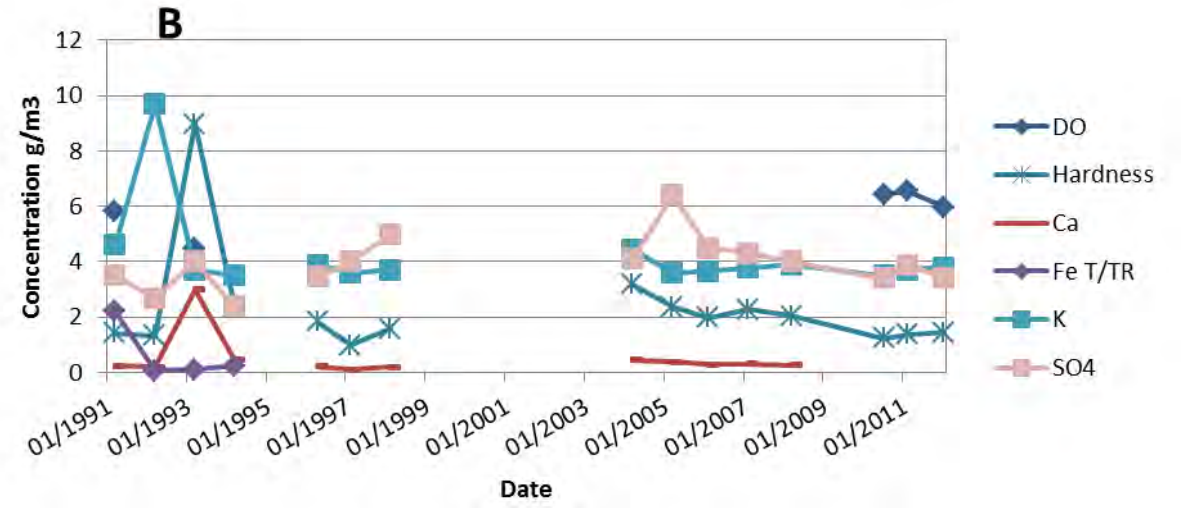
Bore 2829 water level

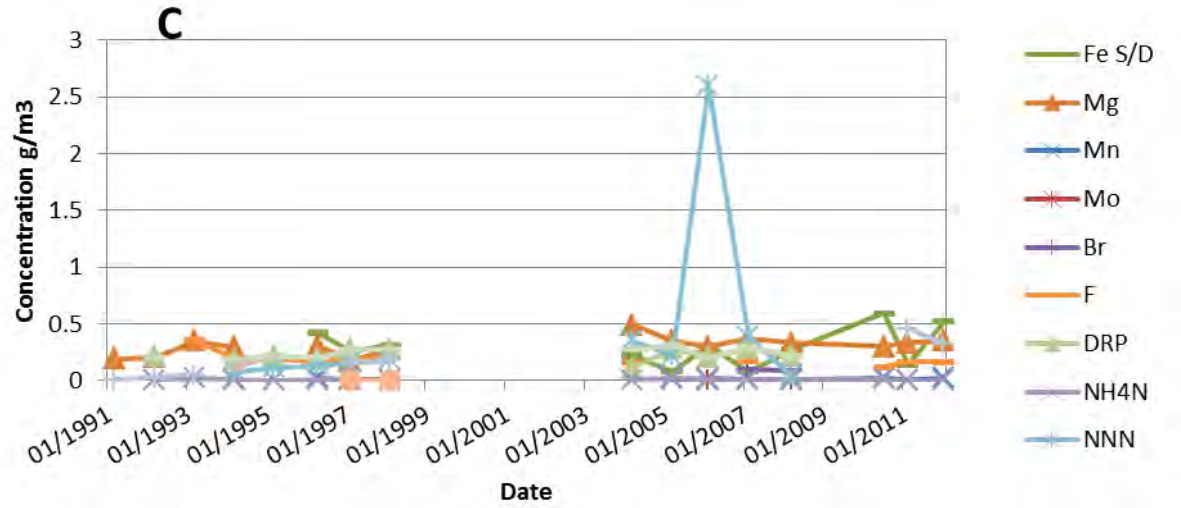




Bore 2829 water quality

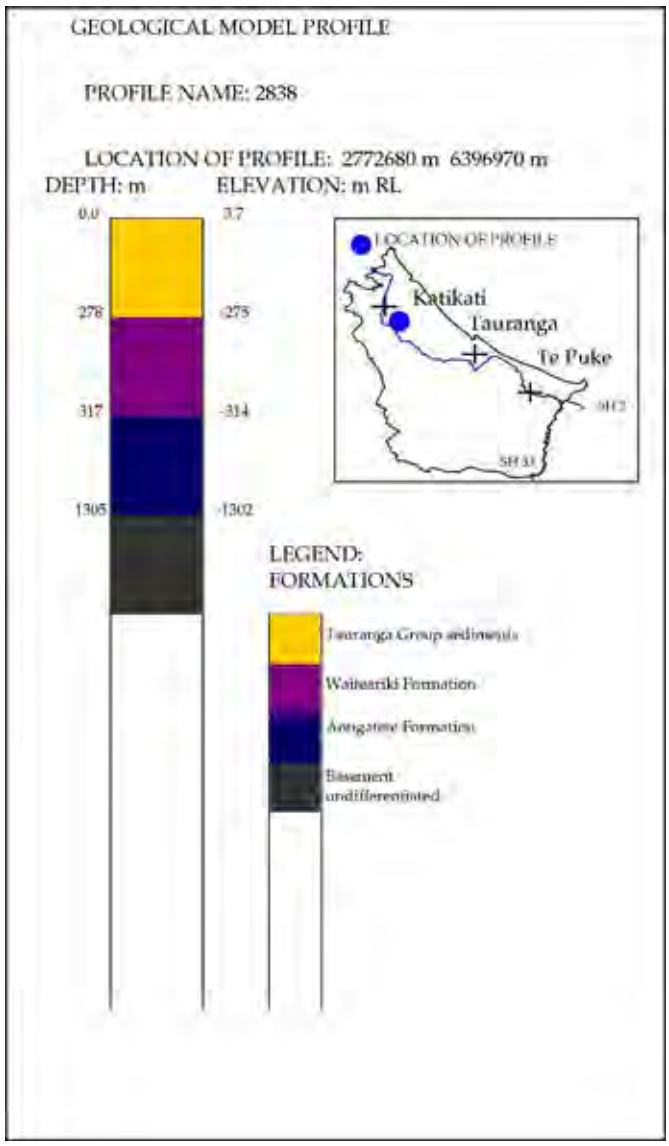




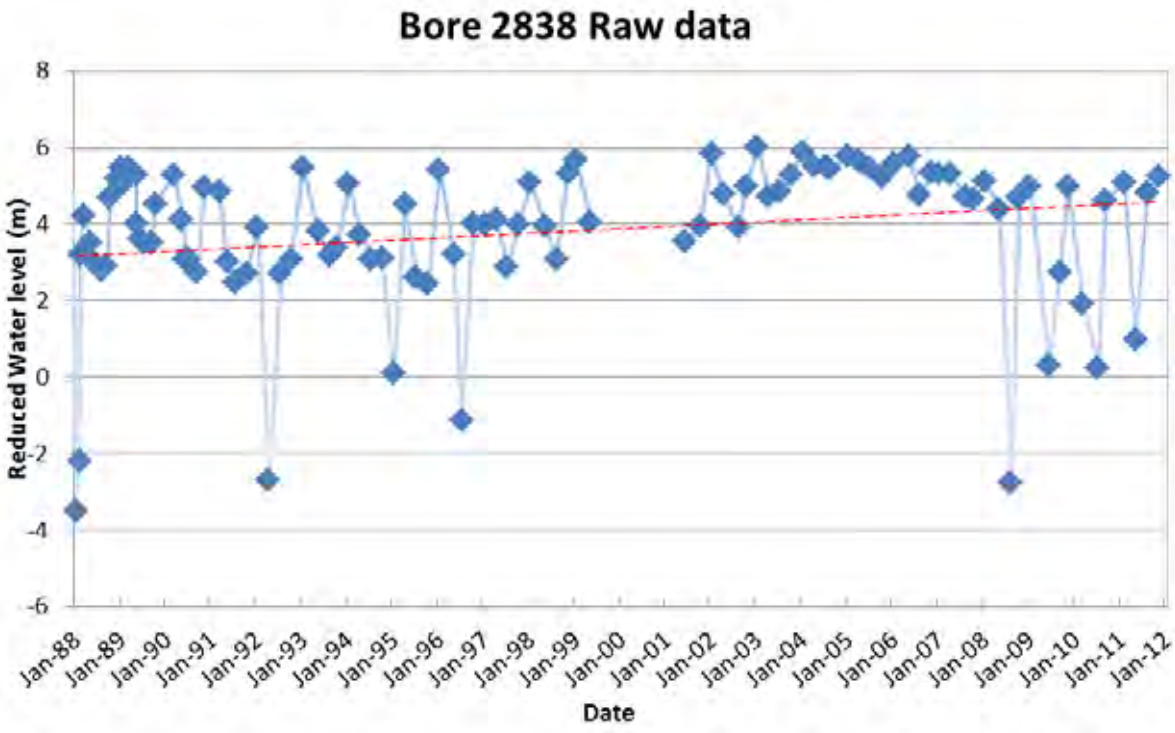


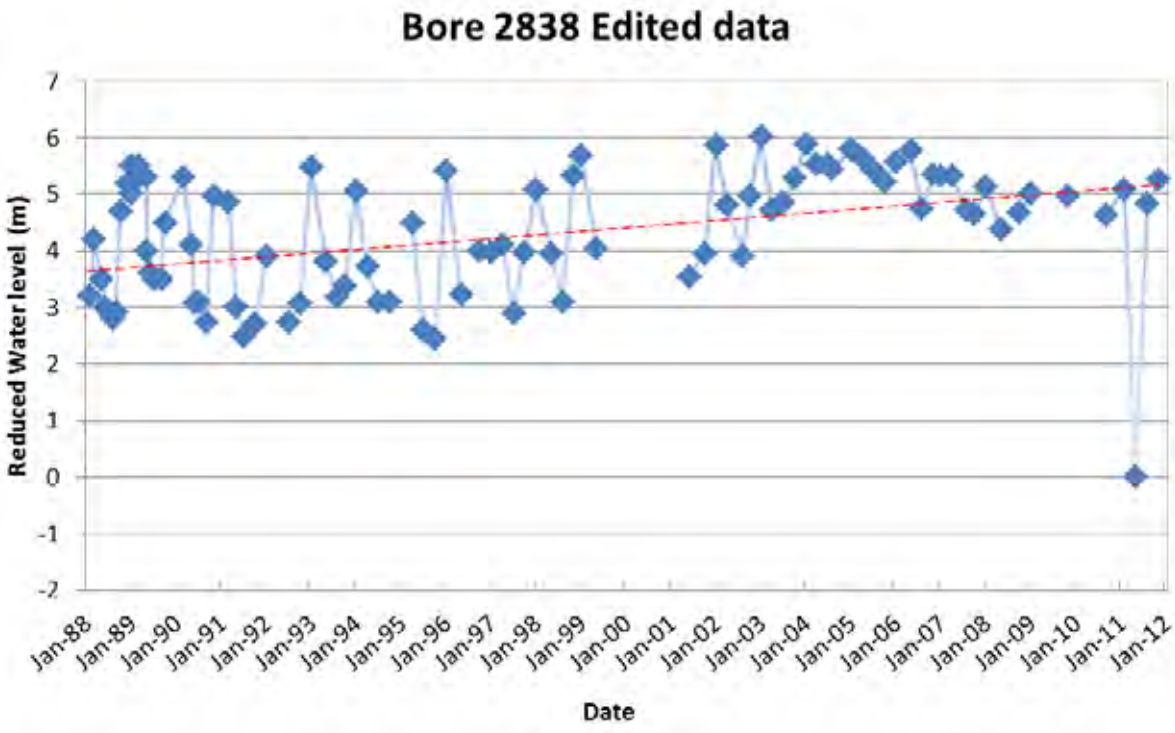
Bore 2838 Information			
Monitoring type	Water level	**Depth (m)**	304.8
Name	Higgs	**Casing Depth (m)**	No casing
Bore use	Monitoring	**Screen/open hole**	Open hole
Easting	277 2680	**Temperature**	Geothermal
Northing	639 6970	**Catchment**	WAI 1 zone
Bore log	Complete	**Aquifer**	Aongatete (WAI)
Monitoring period	**Water level**	1988 - 2011	
	Water quality	-	

Bore 2838 geological profile (EBOF)



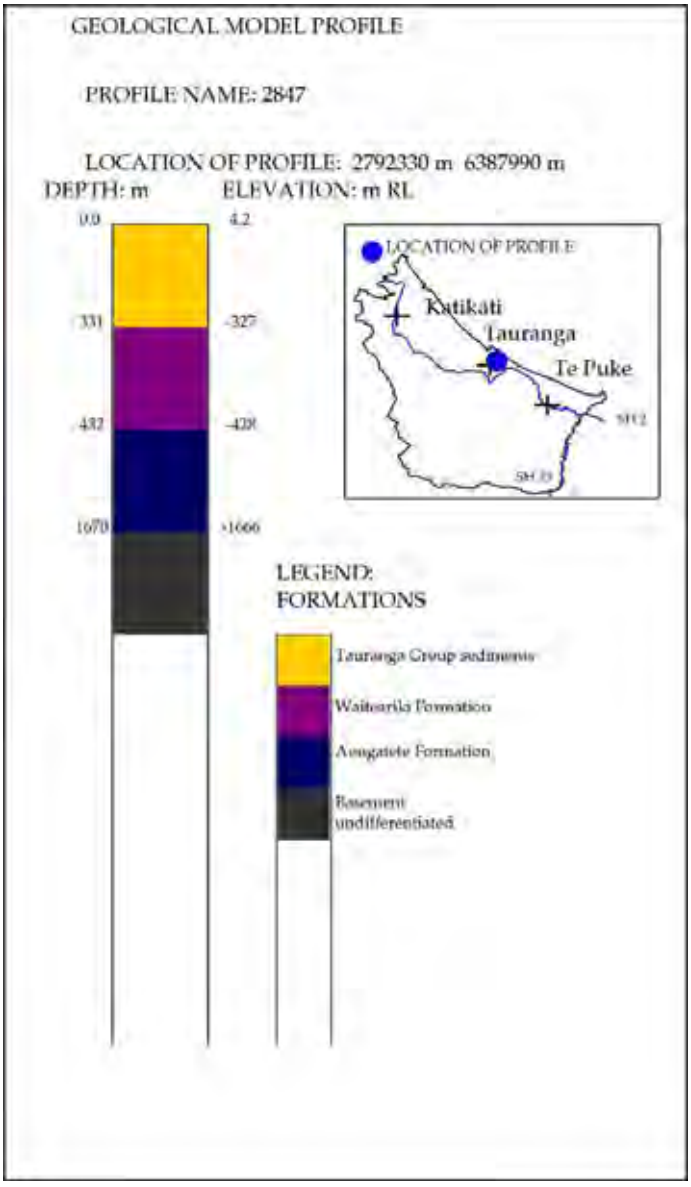
Bore 2838 water level graphs



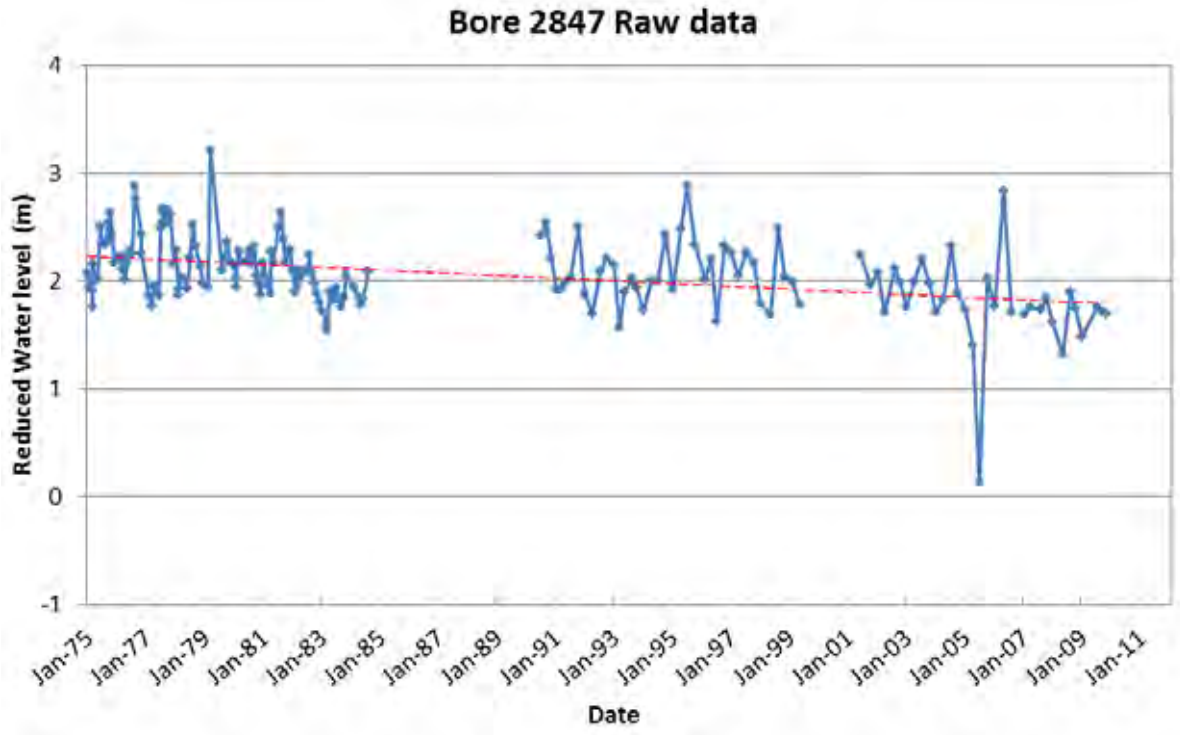


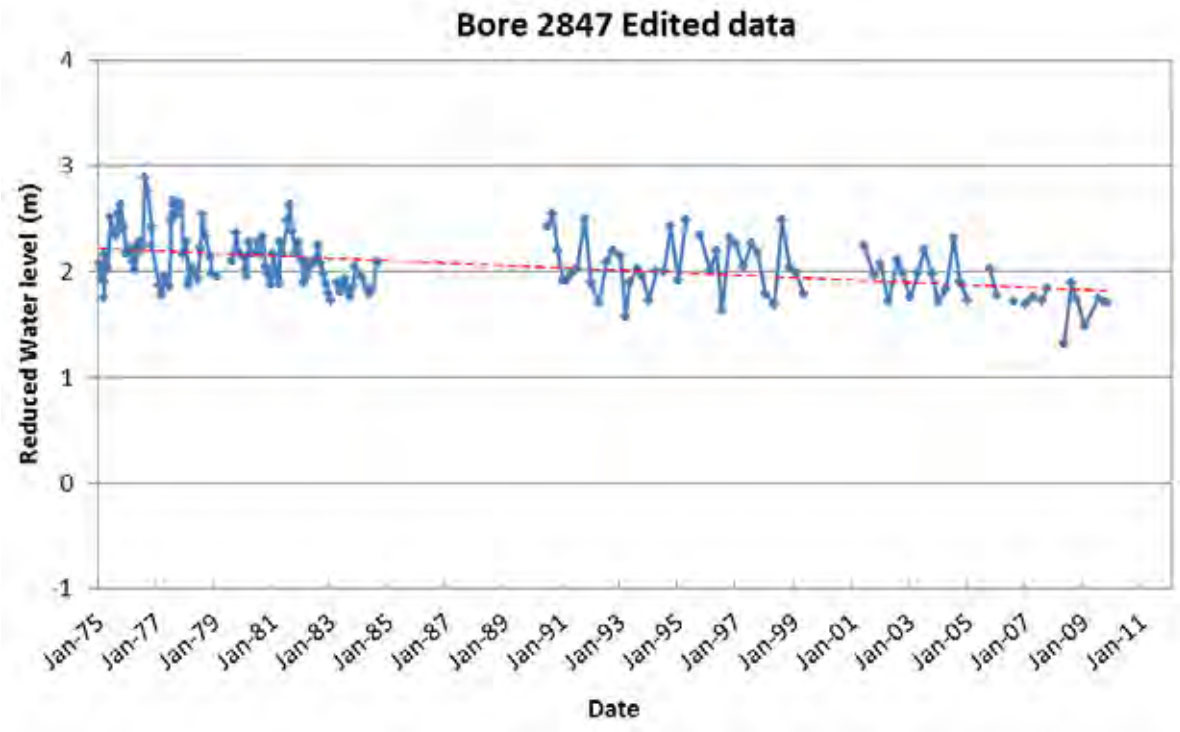
Bore 2847 Information			
Monitoring type	Water level & Water quality	**Depth (m)**	5.2
Name	BOPRC	**Casing Depth (m)**	3.2
Bore use	Monitoring	**Screen/open hole**	Open hole
Easting	279 2330	**Temperature**	18.4°C
Northing	638 7990	**Catchment**	Maungatawa
Bore log	Complete	**Aquifer**	Tauranga sediments
Monitoring period	**Water level**	1975 to 2011	
	Water quality	1991 to 2009	**LabStar:** BOP180039

Bore 2847 geological profile (EBOF)

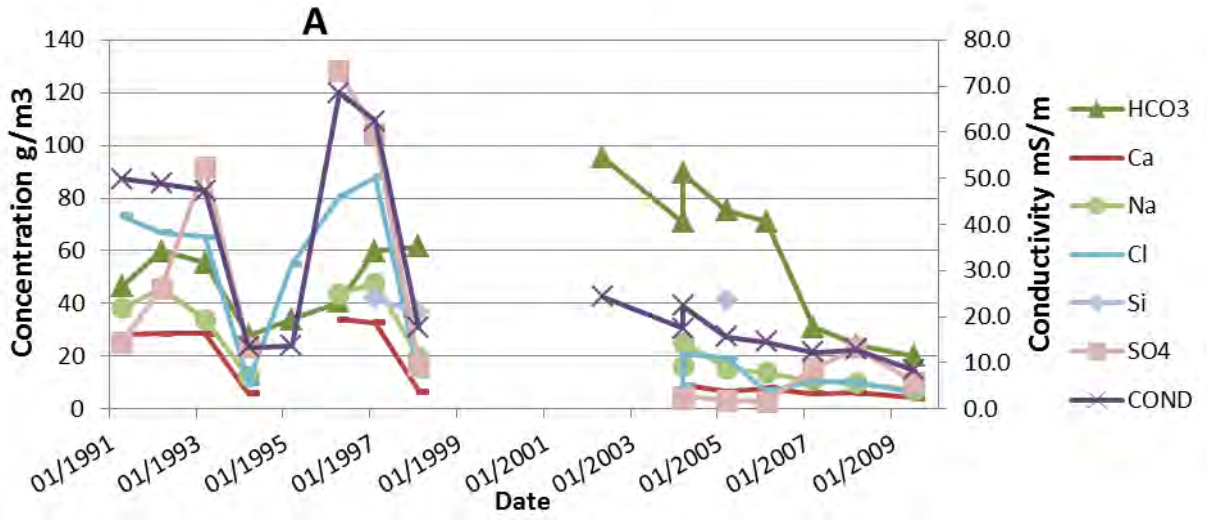


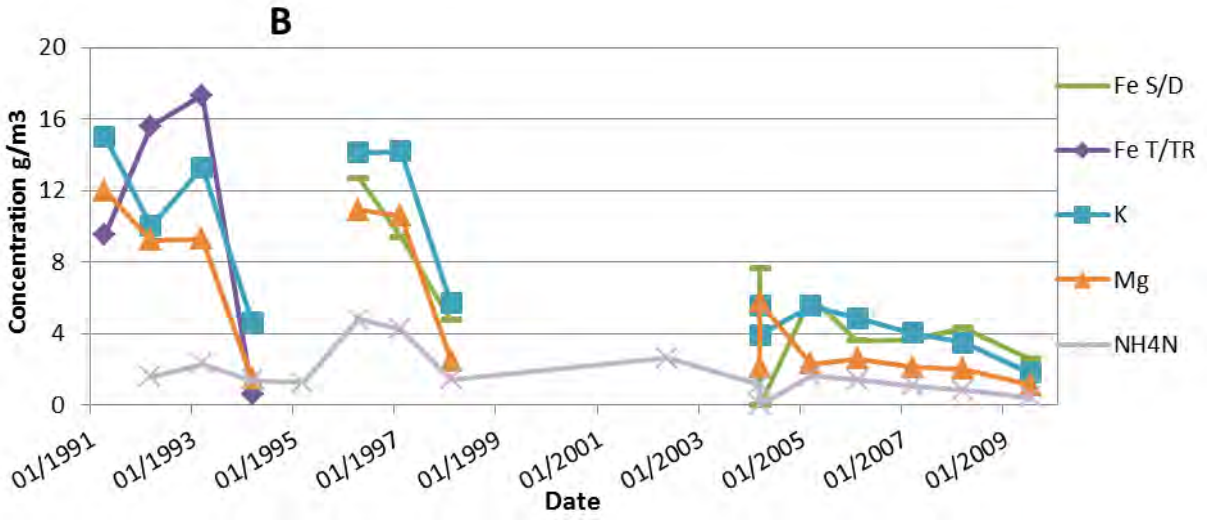
Bore 2847 water level graphs

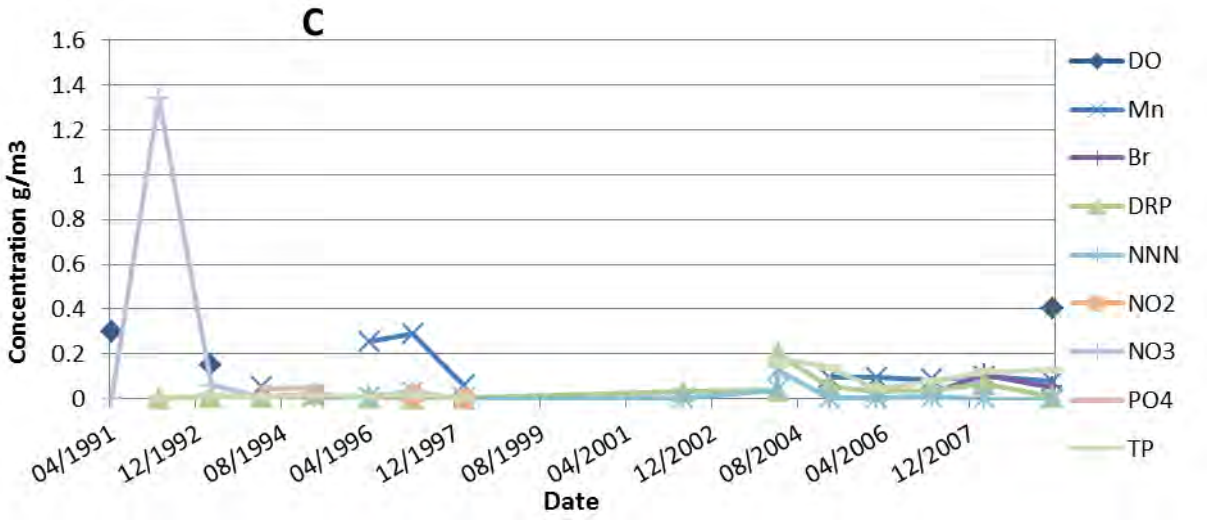




Bore 2847 water quality



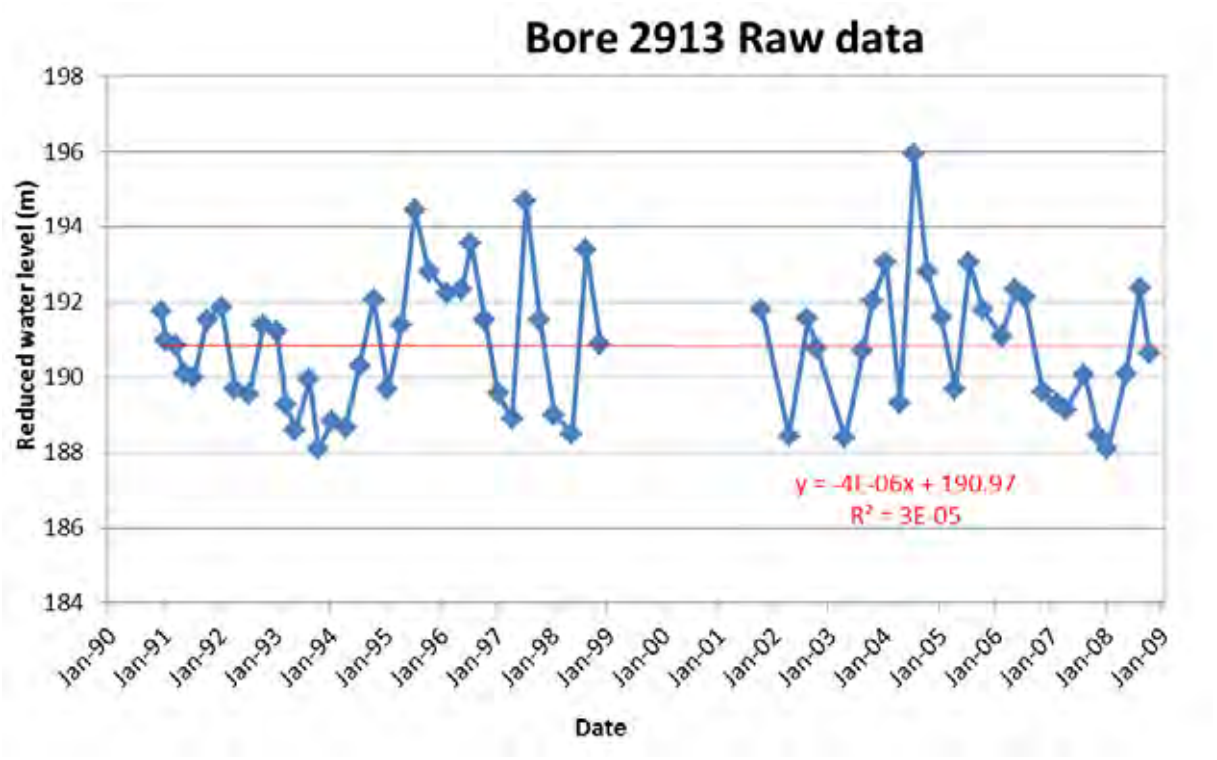


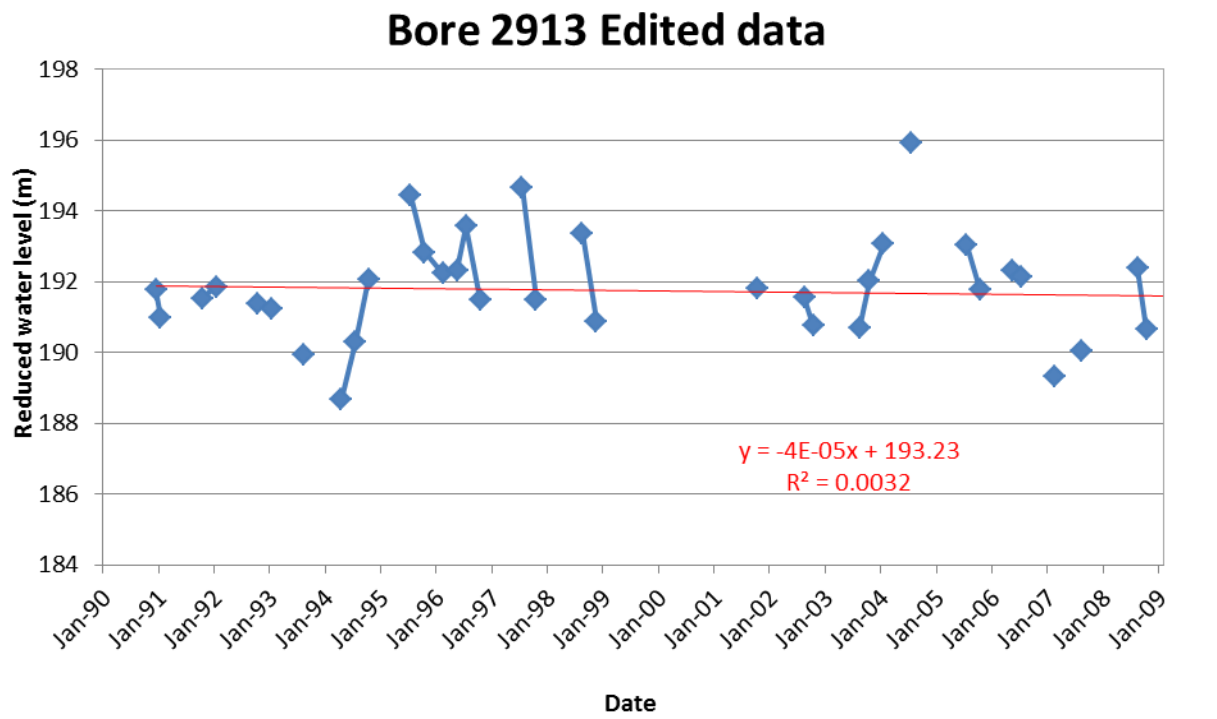


Bore 2913 Information			
Monitoring type	Water quality	**Depth (m)**	22
Name	Muller	**Casing Depth (m)**	20
Bore use	Agricultural	**Screen/open hole**	Screened
Easting	284 3300	**Temperature**	12.7°C
Northing	630 7300	**Catchment**	Galatea
Bore log	Complete	**Aquifer**	Tauranga Group sediments
Monitoring period	**Water level**	1990 to 2009	
	Water quality	1991 to 2007	**LabStar:** BOP180032

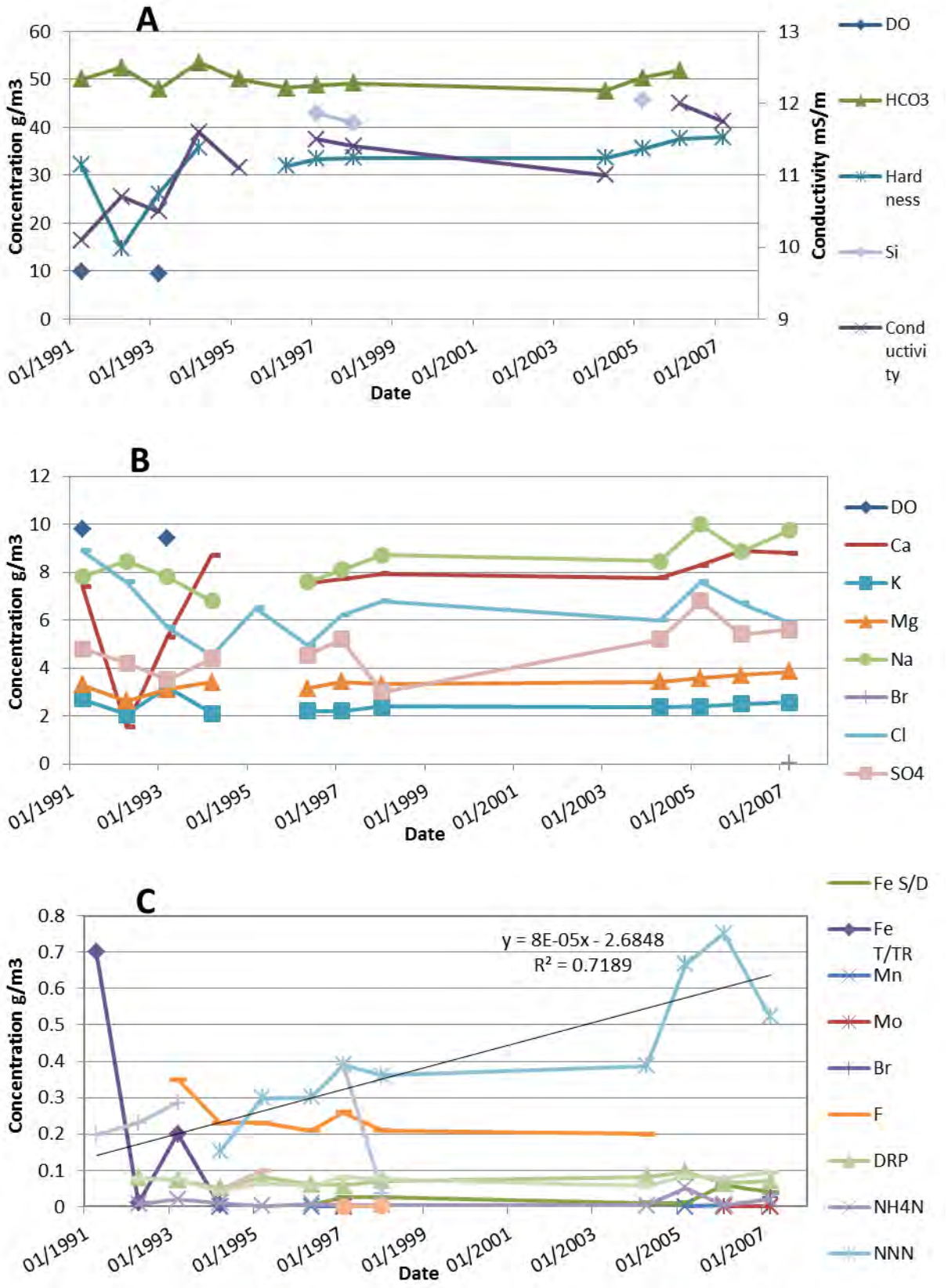
The Earth Beneath our Feet model is not currently available for this region.

Bore 2913 water level graphs



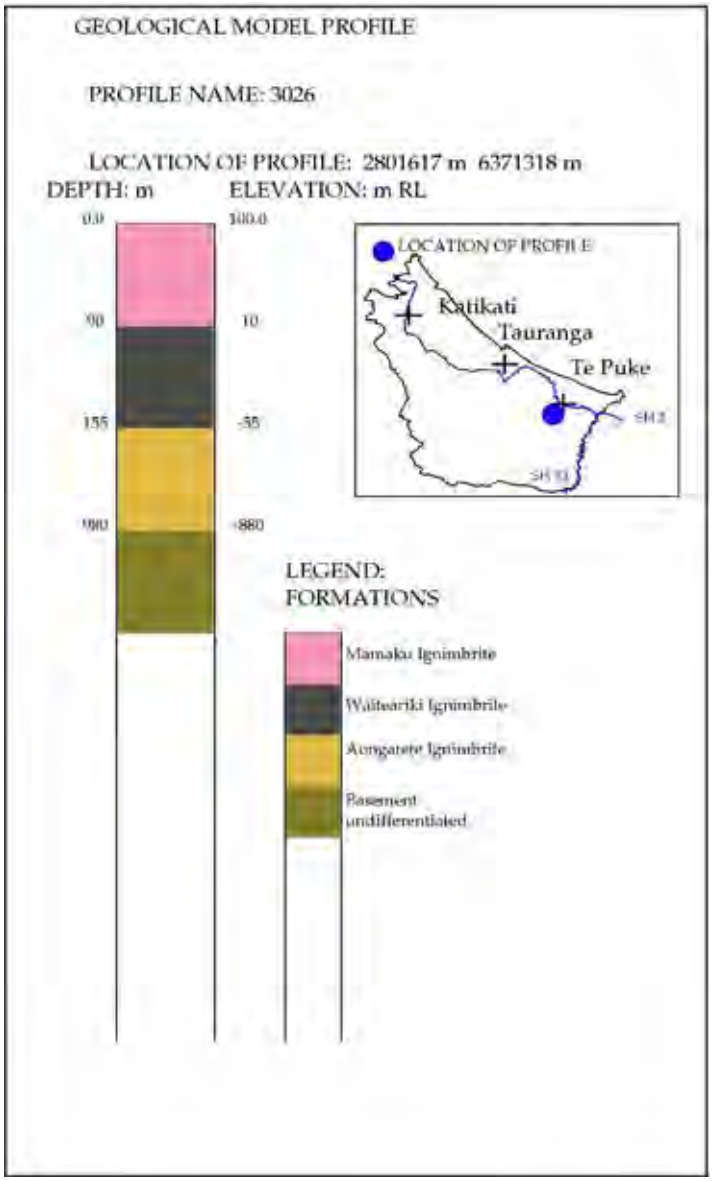


Bore 2913 water quality graphs

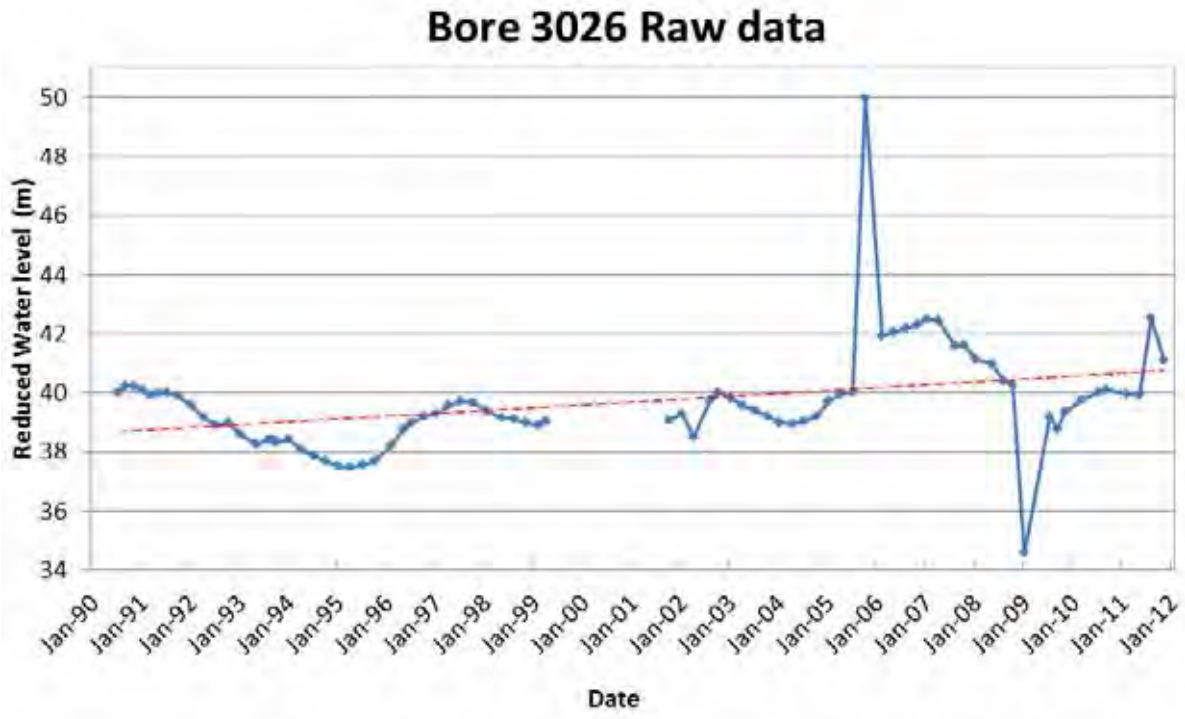


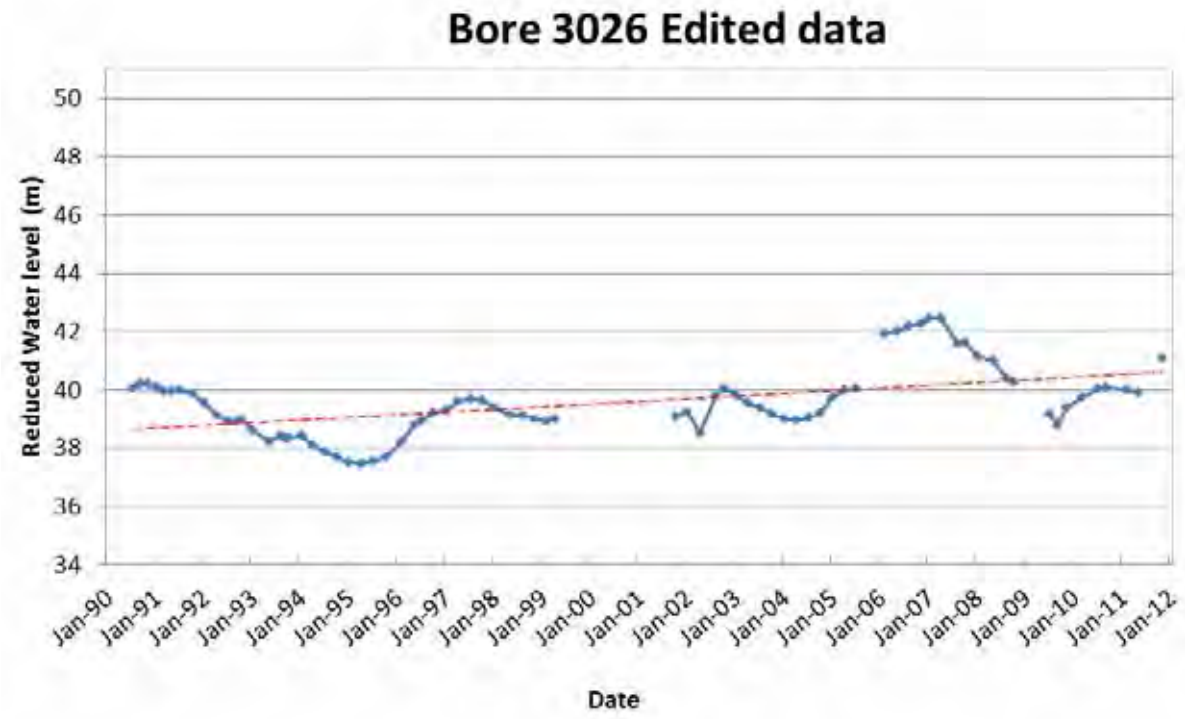
Bore 3026 Information			
Monitoring type	Water level	**Depth (m)**	103.6
Name	Norfork Trust	**Casing Depth (m)**	Unknown
Bore use	Unknown	**Screen/open hole**	Open hole
Easting	280 1617	**Temperature**	Geothermal
Northing	637 1318	**Catchment**	Lower Kaituna
Bore log	Complete	**Aquifer**	Waiteariki
Monitoring period	**Water level**	1990 to 2011	
	Water quality	-	

Bore 3026 geological profile (EBOF)



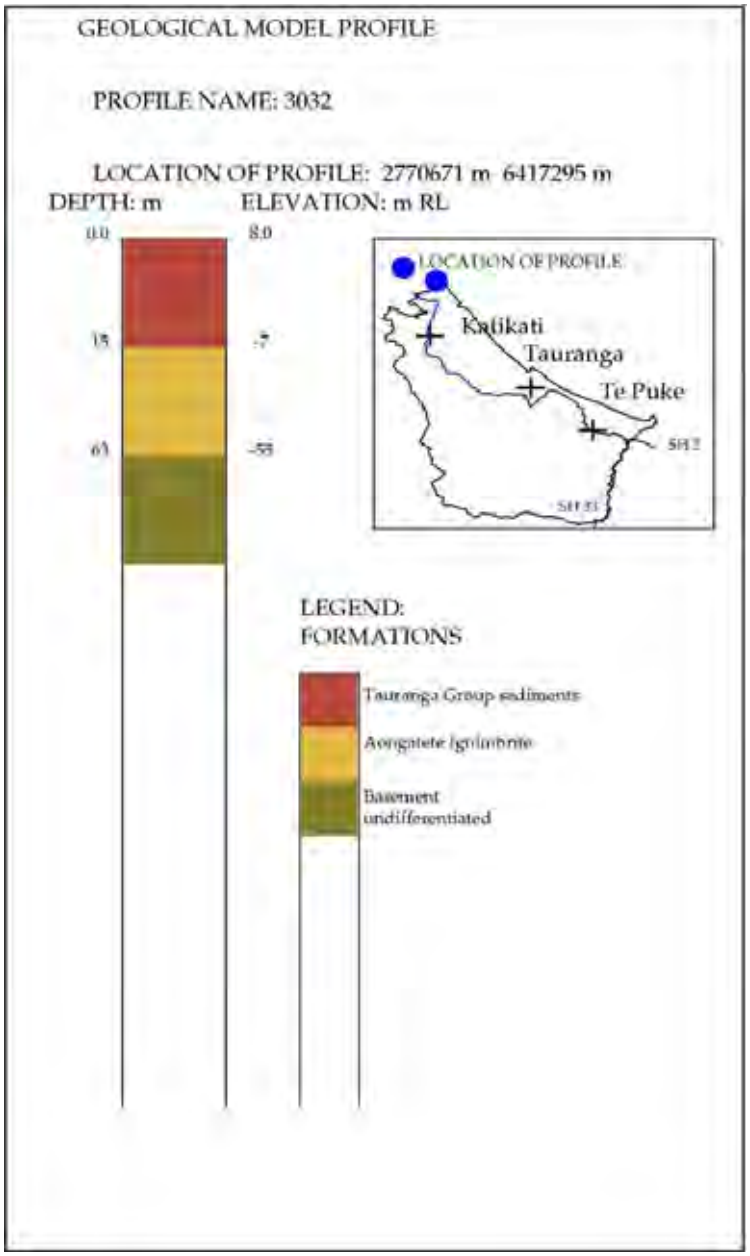
Bore 3026 water level graphs



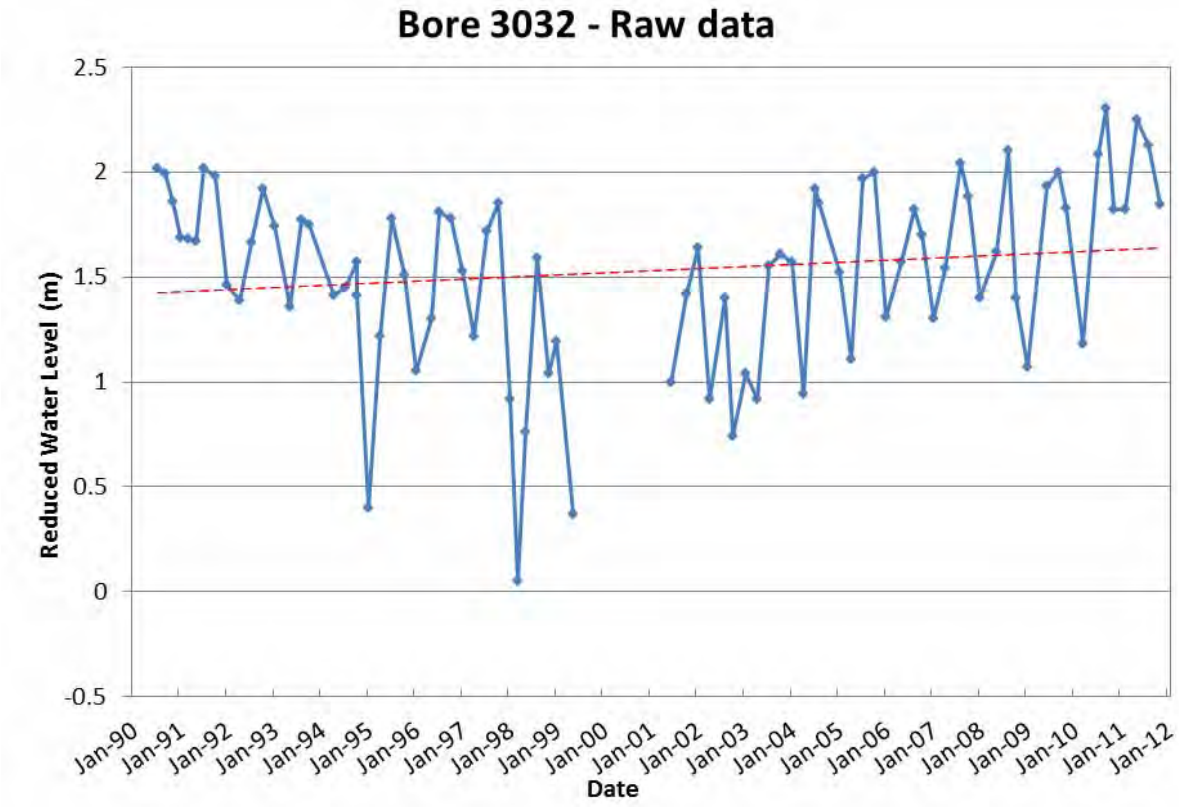


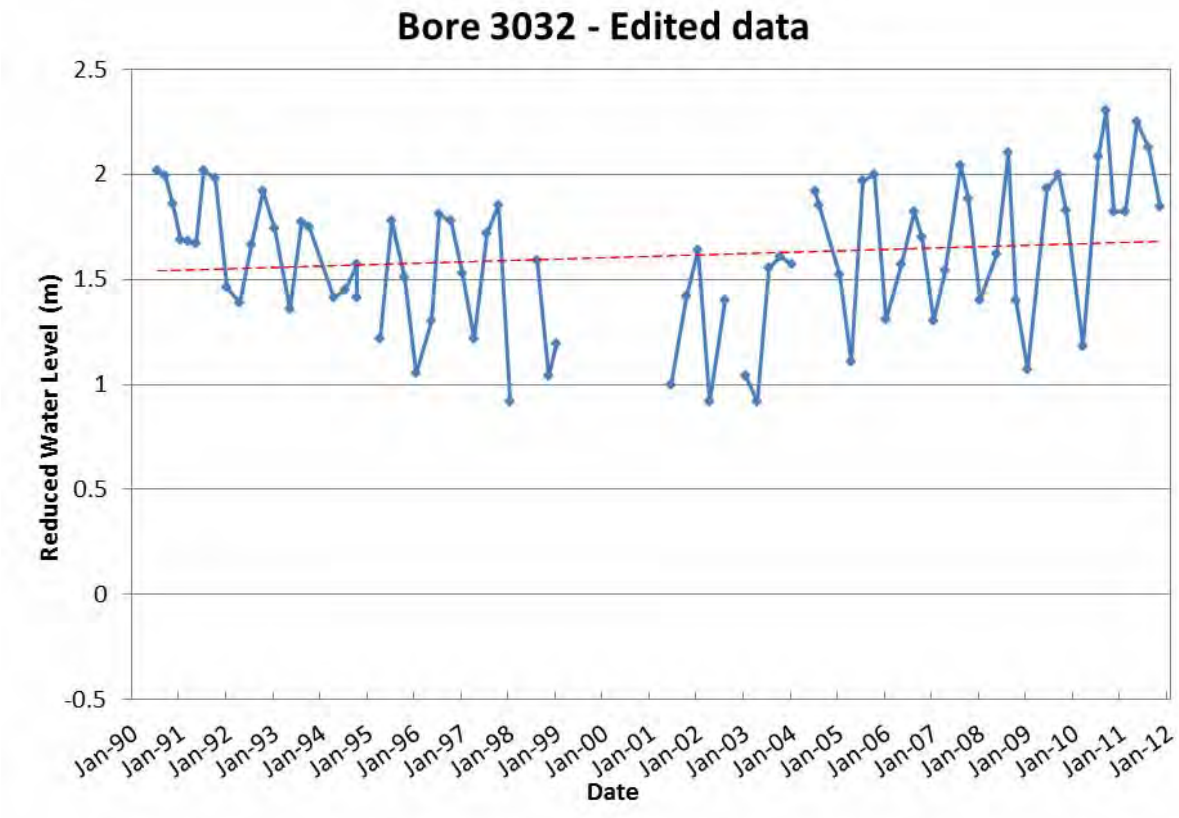
Bore 3032 Information			
Monitoring type	Water level	**Depth (m)**	6
Name	Lockyer	**Casing Depth (m)**	6
Bore use	Irrigation/Domestic	**Screen/open hole**	Unknown
Easting	277 0671	**Temperature**	Unknown
Northing	641 7295	**Catchment**	Waihī Beach
Bore log	-	**Aquifer**	Tauranga sediments
Monitoring period	**Water level**		
	Water quality		

Bore 3032 geological profile (EBOF)



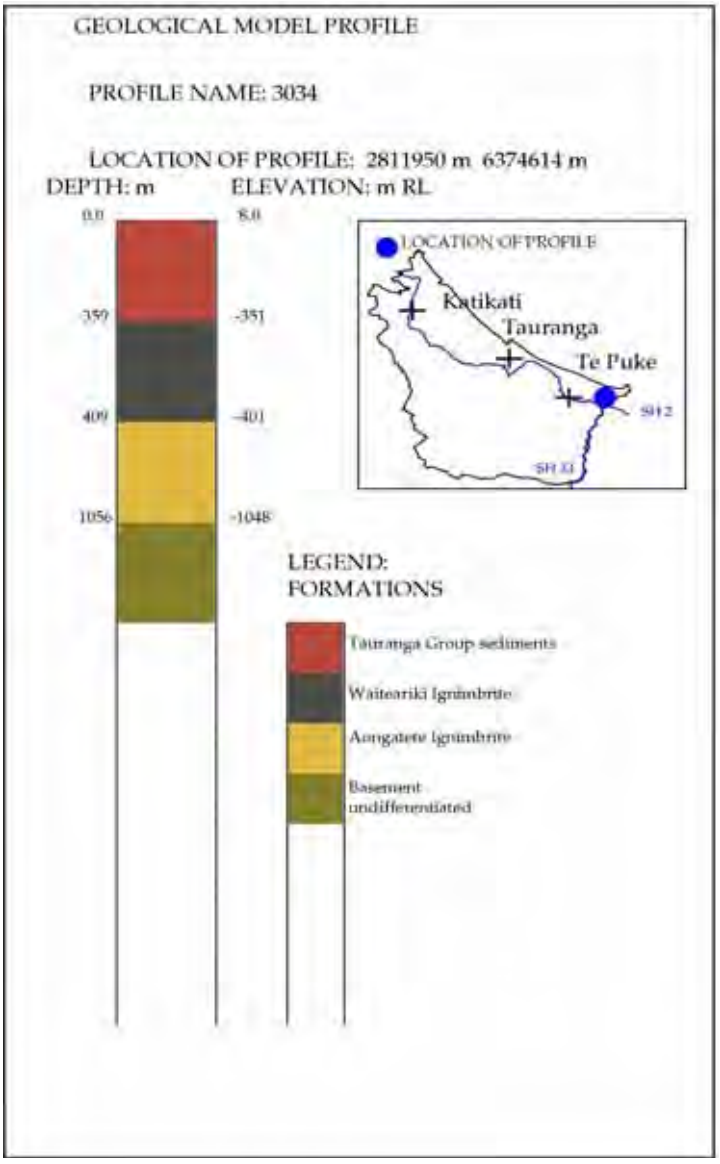
Bore 3032 water level graphs



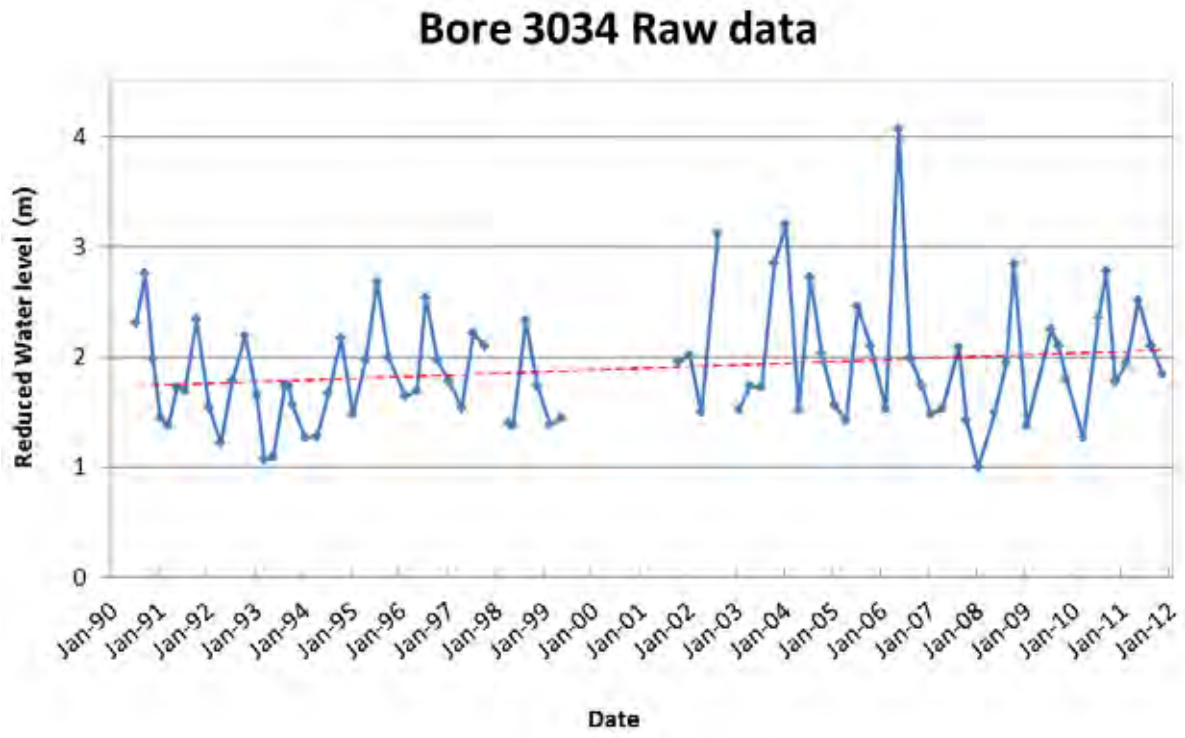


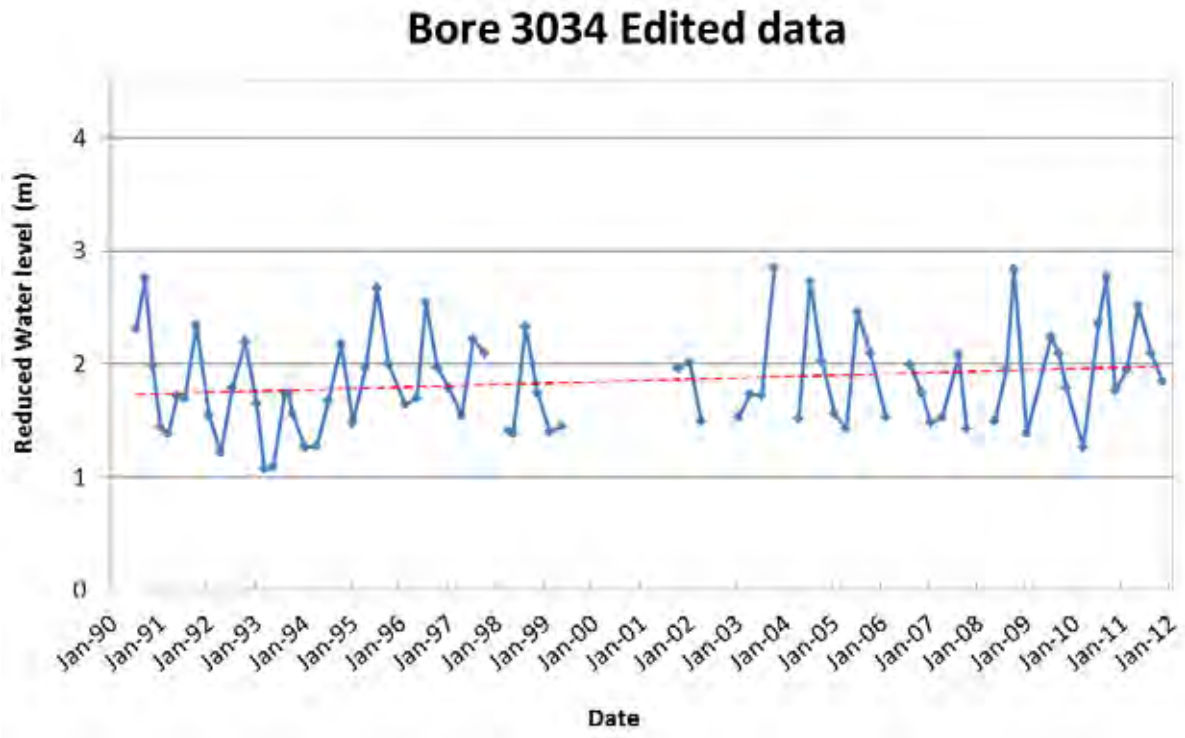
Bore 3034 Information			
Monitoring type	Water level & Water quality	**Depth (m)**	8.5
Name	Brawn	**Casing Depth (m)**	Unknown
Bore use	Irrigation	**Screen/open hole**	Open hole
Easting	281 1950	**Temperature**	18.2°C
Northing	637 4614	**Catchment**	Maketu
Bore log	Complete	**Aquifer**	Tauranga sediments
Monitoring period	**Water level**	1990 to 2011	
	Water quality	1991 to 2011	**LabStar:** BOP180015

Bore 3034 geological profile (EBOF)

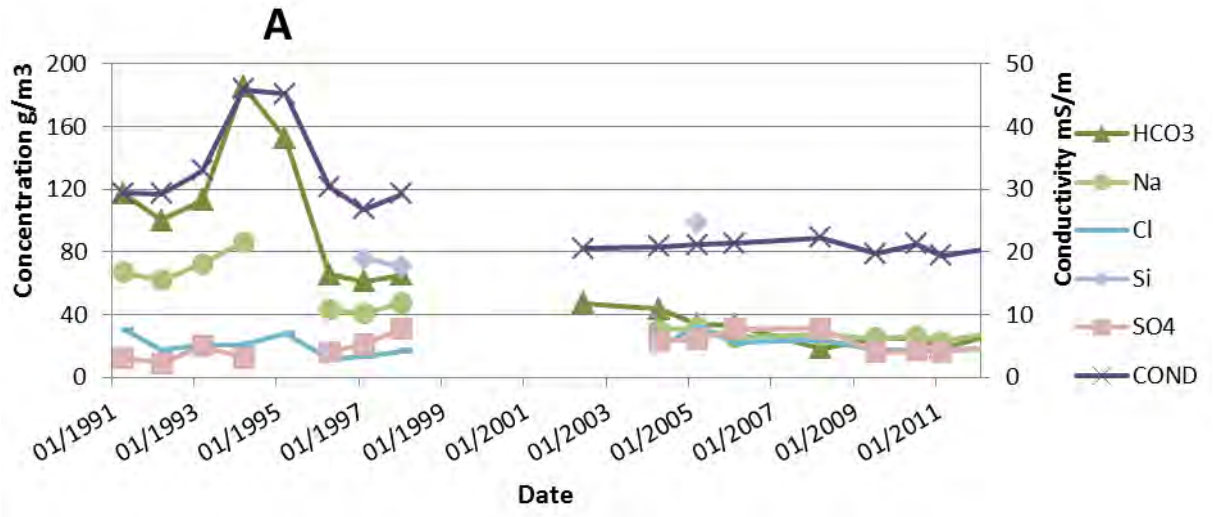


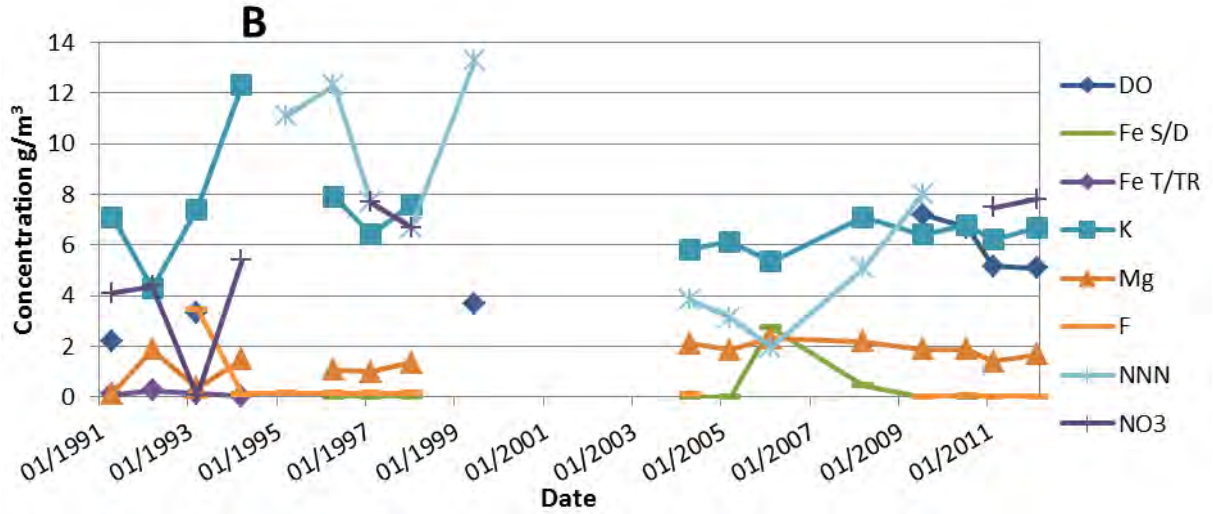
Bore 3034 water level graphs

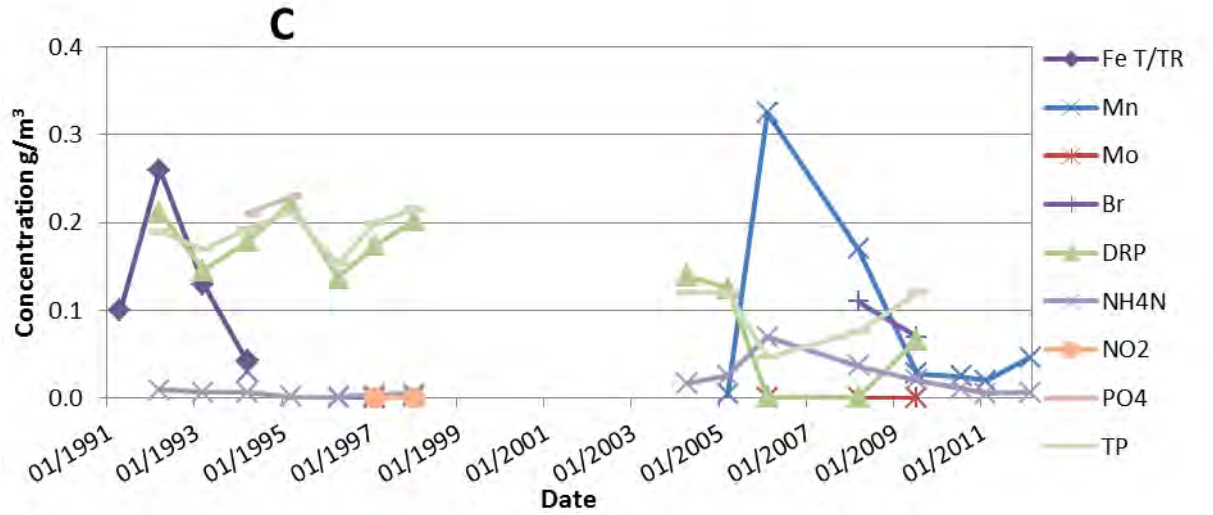




Bore 3034 water quality graphs



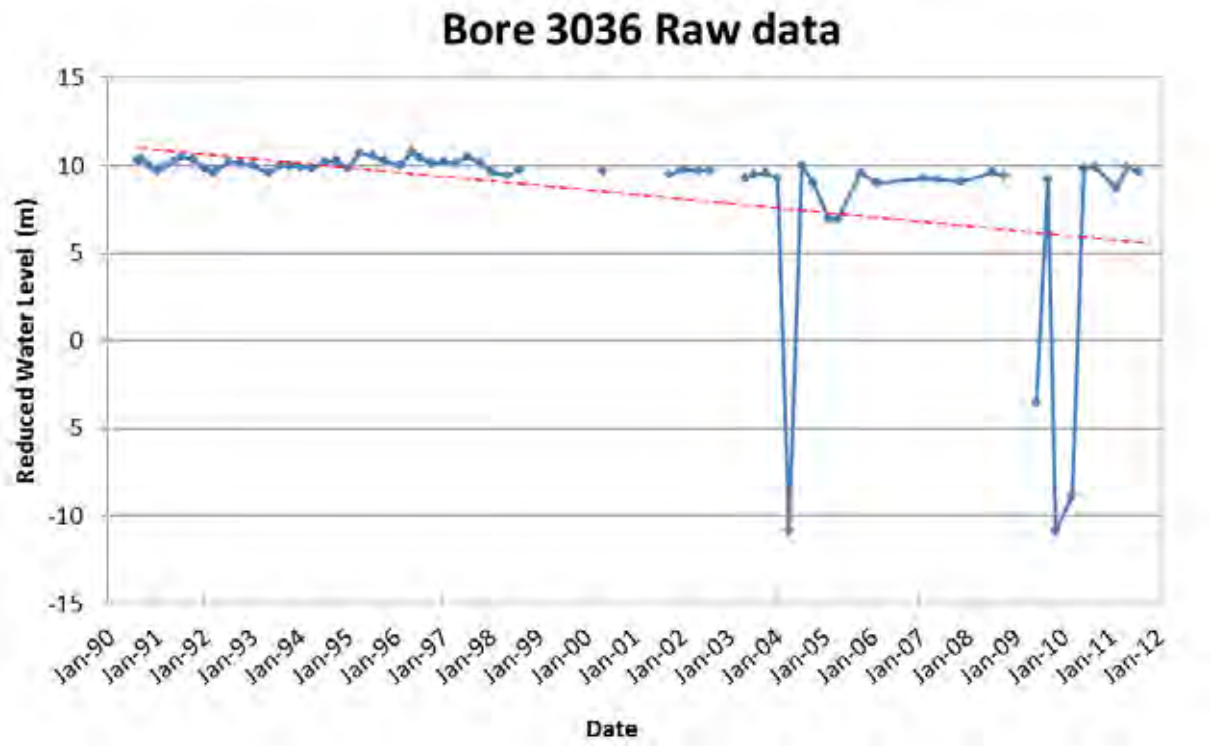


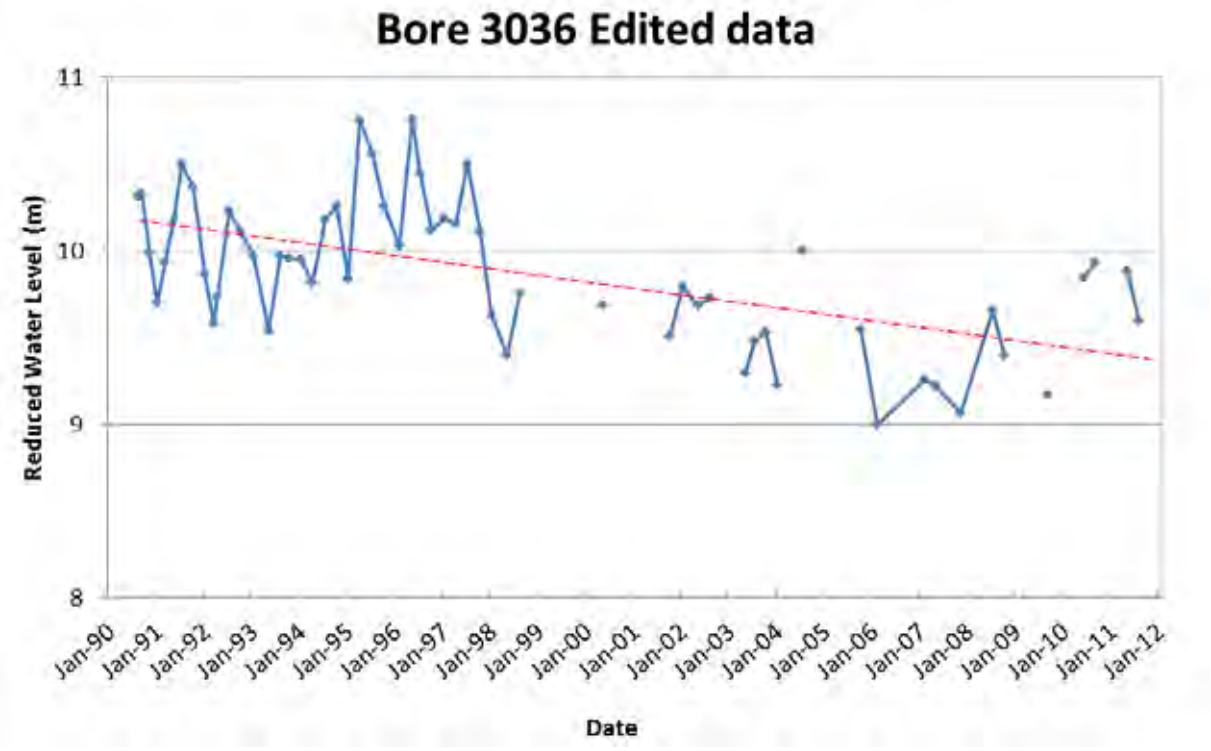


Bore 3036 Information			
Monitoring type	Water level & Water quality	**Depth (m)**	30
Name	Brooklyn Farms Ltd	**Casing Depth (m)**	Unknown
Bore use	Unknown	**Screen/open hole**	Unknown
Easting	288 8968	**Temperature**	15.6°C
Northing	634 2791	**Catchment**	Opotiki Plains
Bore log	-	**Aquifer**	Tauranga sediments
Monitoring period	**Water level**	1990 to 2011	
	Water quality	1991 to 2011	**LabStar:** BOP180030

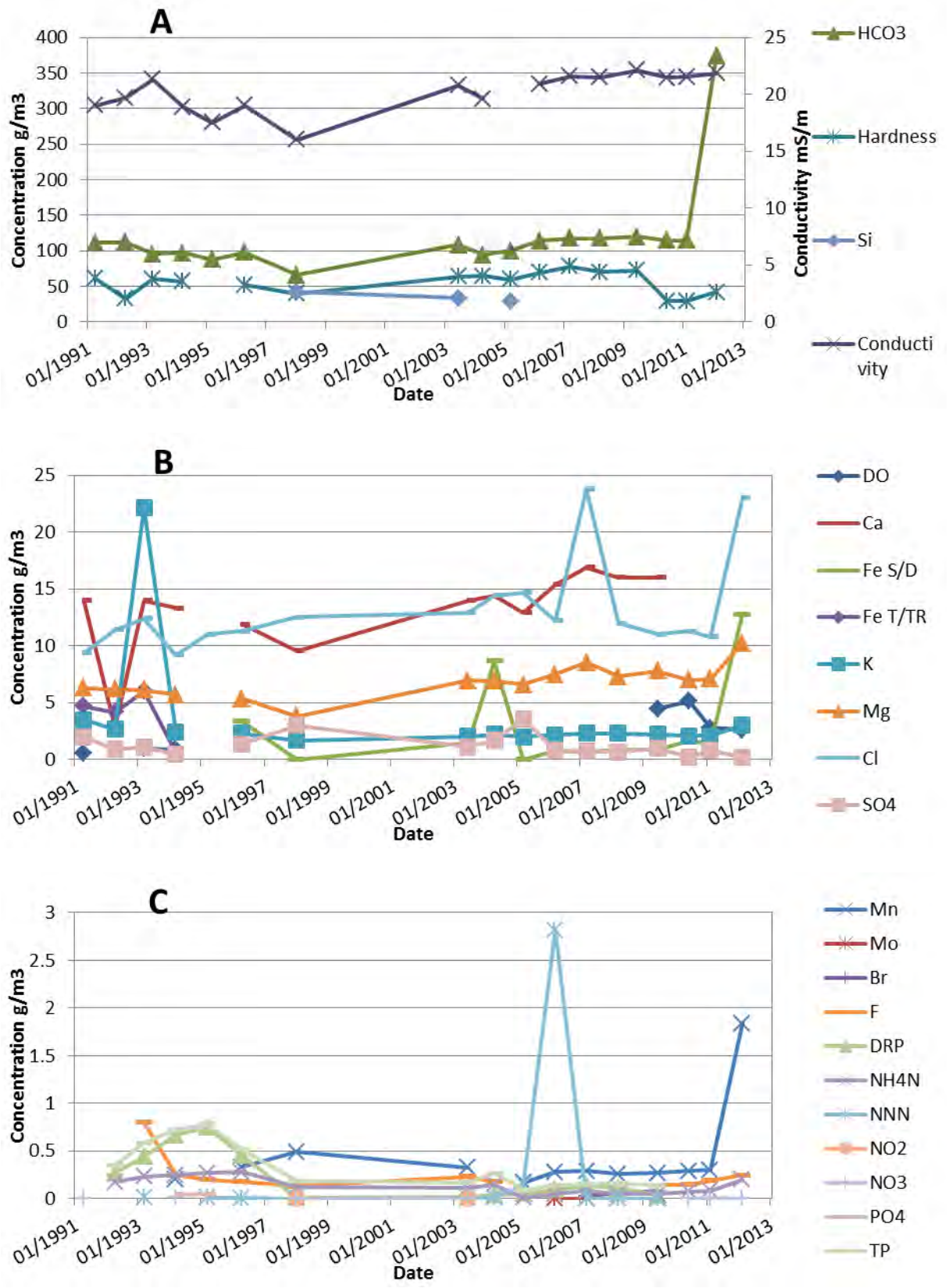
The Earth Beneath our Feet model is not currently available for this region.

Bore 3036 water level graphs





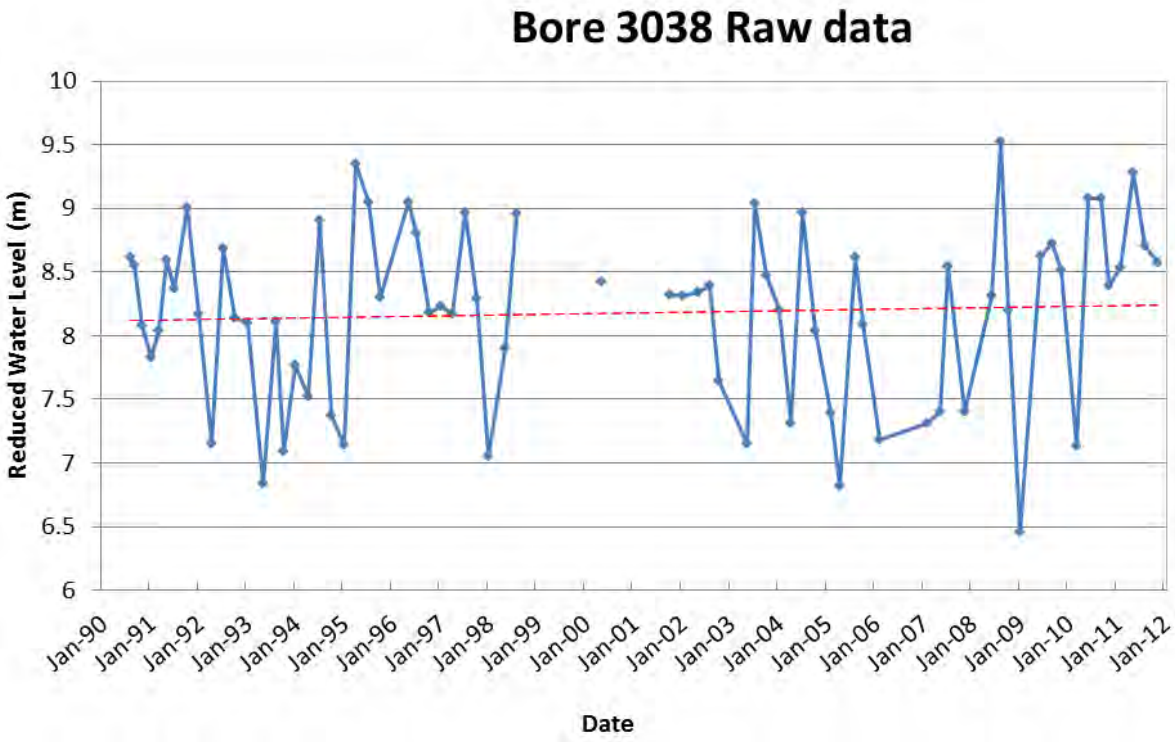
Bore 3036 water quality graphs

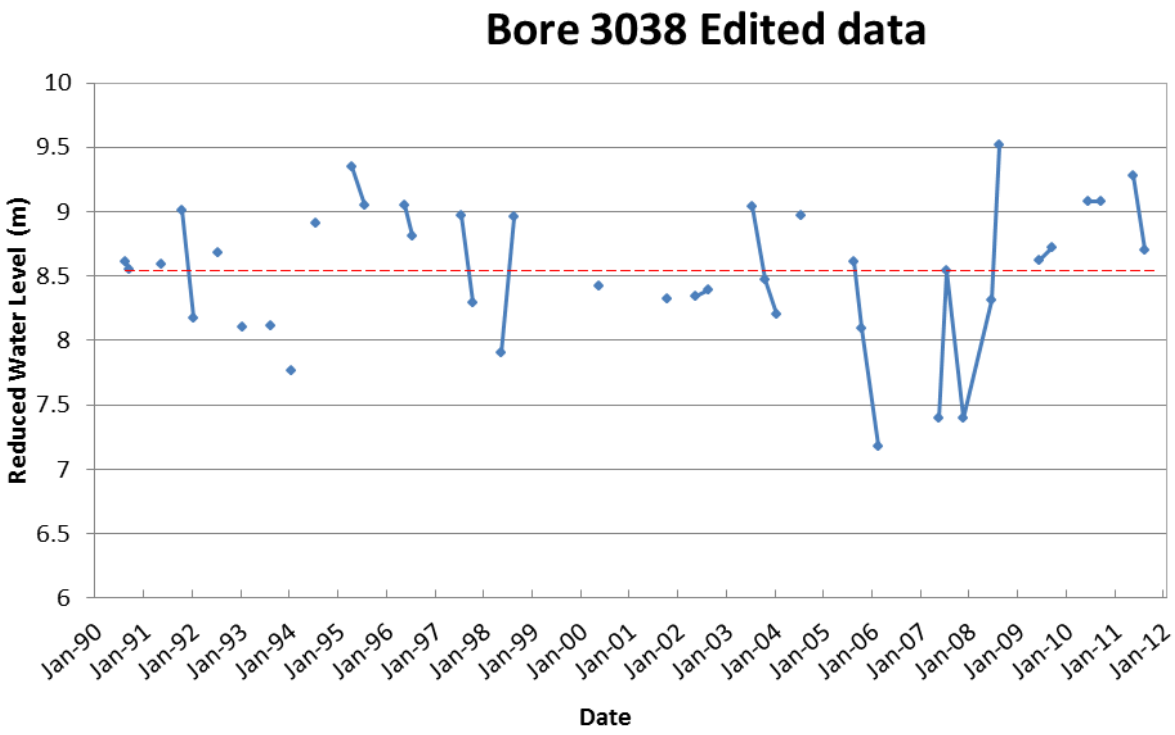


Bore 3038 Information			
Monitoring type	Water level	**Depth (m)**	12
Name	Young	**Casing Depth (m)**	Unknown
Bore use	Unknown	**Screen/open hole**	Unknown
Easting	288 6554	**Temperature**	18.2°C
Northing	634 0885	**Catchment**	Opotiki Plains
Bore log	-	**Aquifer**	Tauranga sediments
Monitoring period	**Water level**	1990 to 2011	
	Water quality		

The Earth Beneath our Feet model is not currently available for this region.

Bore 3038 water level graphs

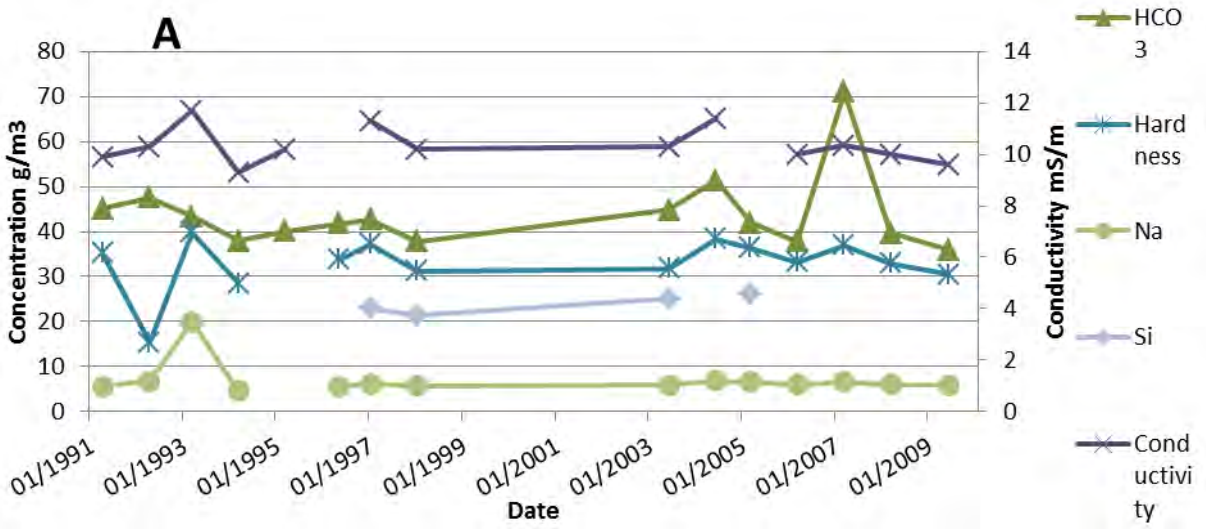


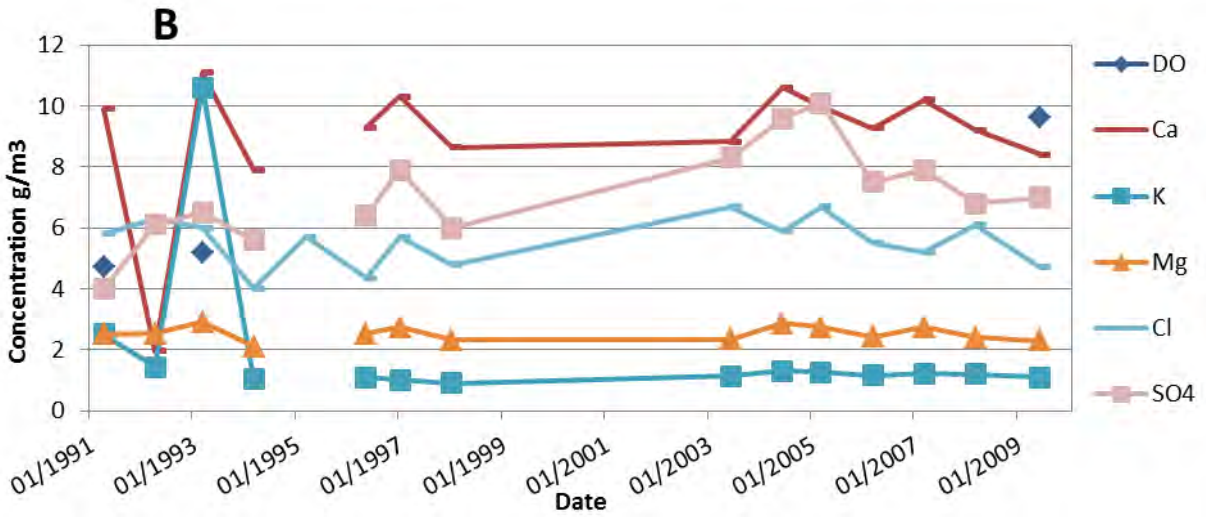


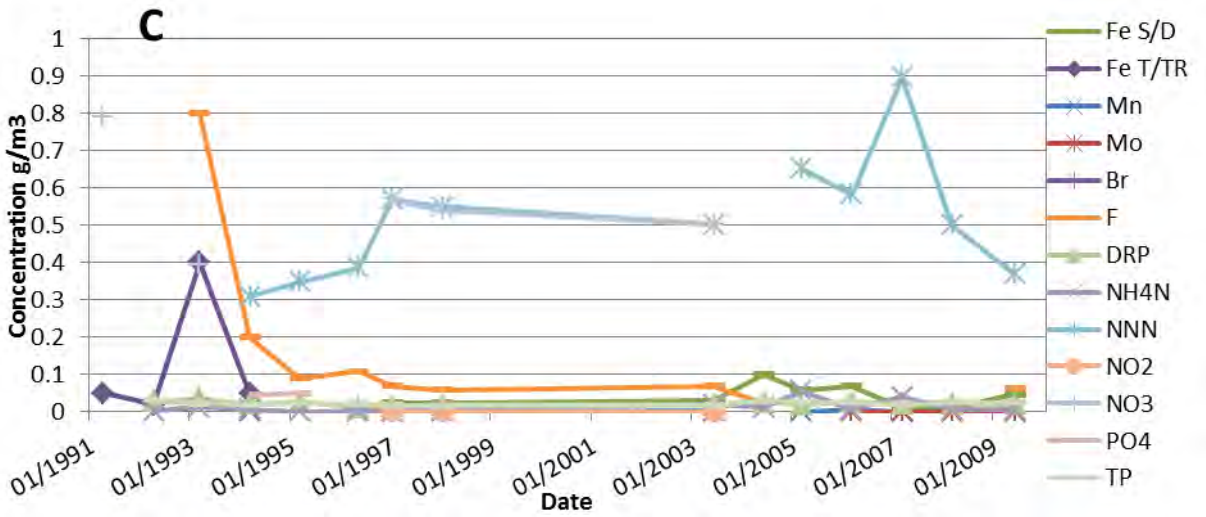
Bore 3039 Information			
Monitoring type	Water quality	**Depth (m)**	30
Name	Riverloch Farms Ltd	**Casing Depth (m)**	Unknown
Bore use	Unknown	**Screen/open hole**	Unknown
Easting	288 5700	**Temperature**	14.8°C
Northing	633 9700	**Catchment**	Opotiki Plains
Bore log	-	**Aquifer**	Tauranga sediments
Monitoring period	**Water level**		
	Water quality	1991 to 2009	**LabStar:** BOP180031

The Earth Beneath our Feet model is not currently available for this region.

Bore 3039 water quality graphs

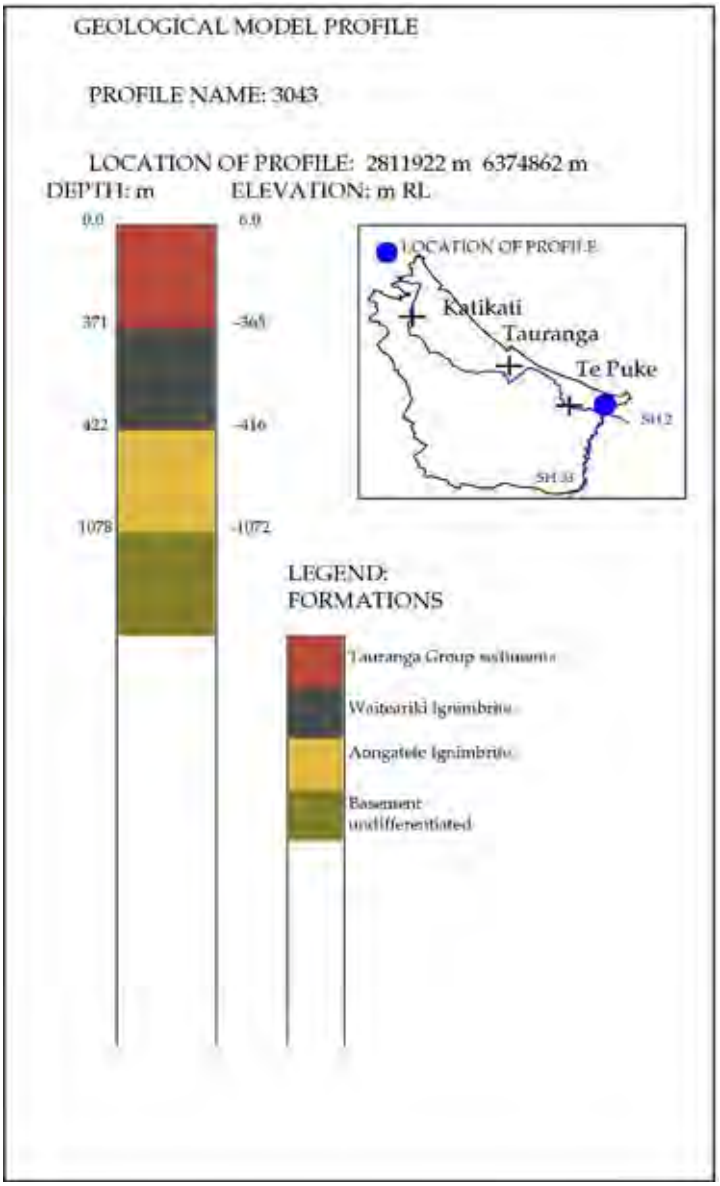


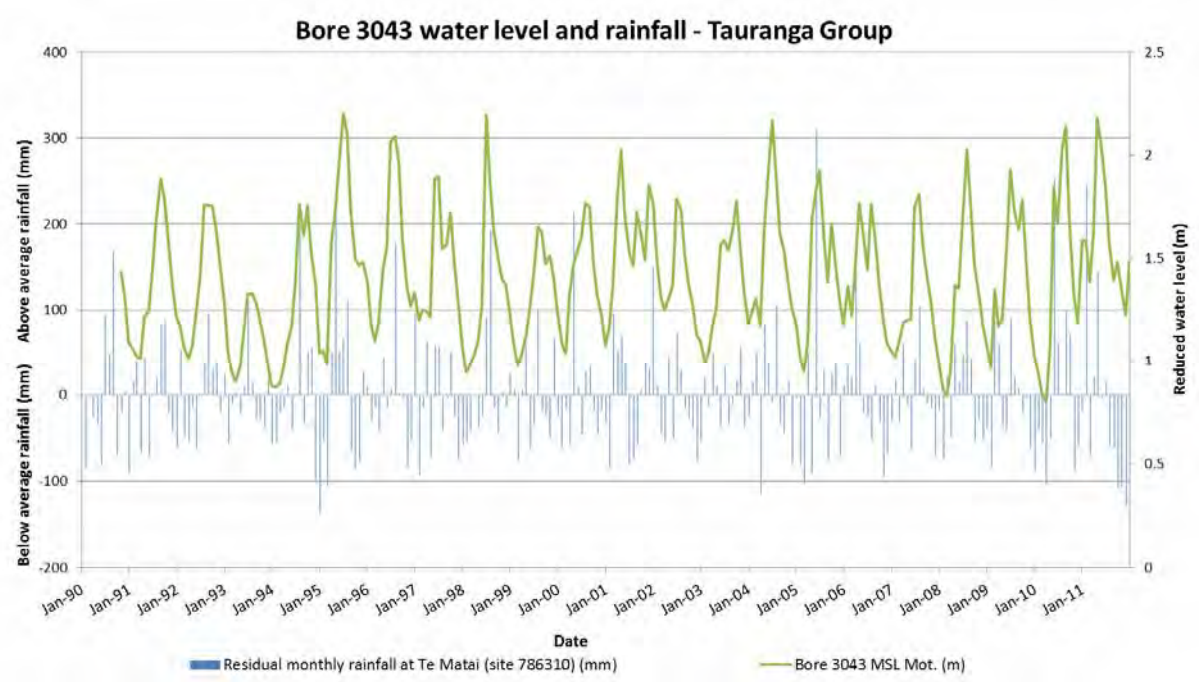


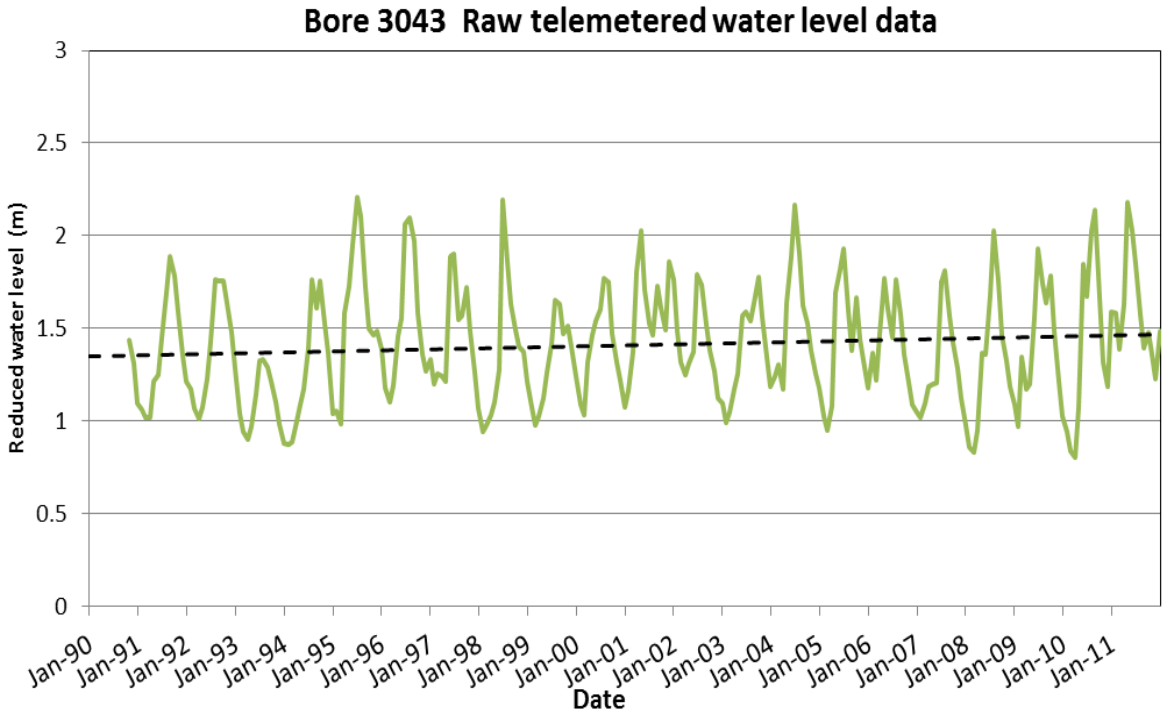


Bore 3043 Information			
Monitoring type	Telemetered Water level	**Depth (m)**	10
Name	Stewart	**Casing Depth (m)**	Unknown
Bore use	Agricultural	**Screen/open hole**	Open hole
Easting	281 1922	**Temperature**	18.9°C
Northing	637 4862	**Catchment**	Maketu
Bore log	–	**Aquifer**	Tauranga sediments
Monitoring period	**Water level**	1990 to 2011	
	Water quality	-	

Bore 3043 geological profile (EBOF)

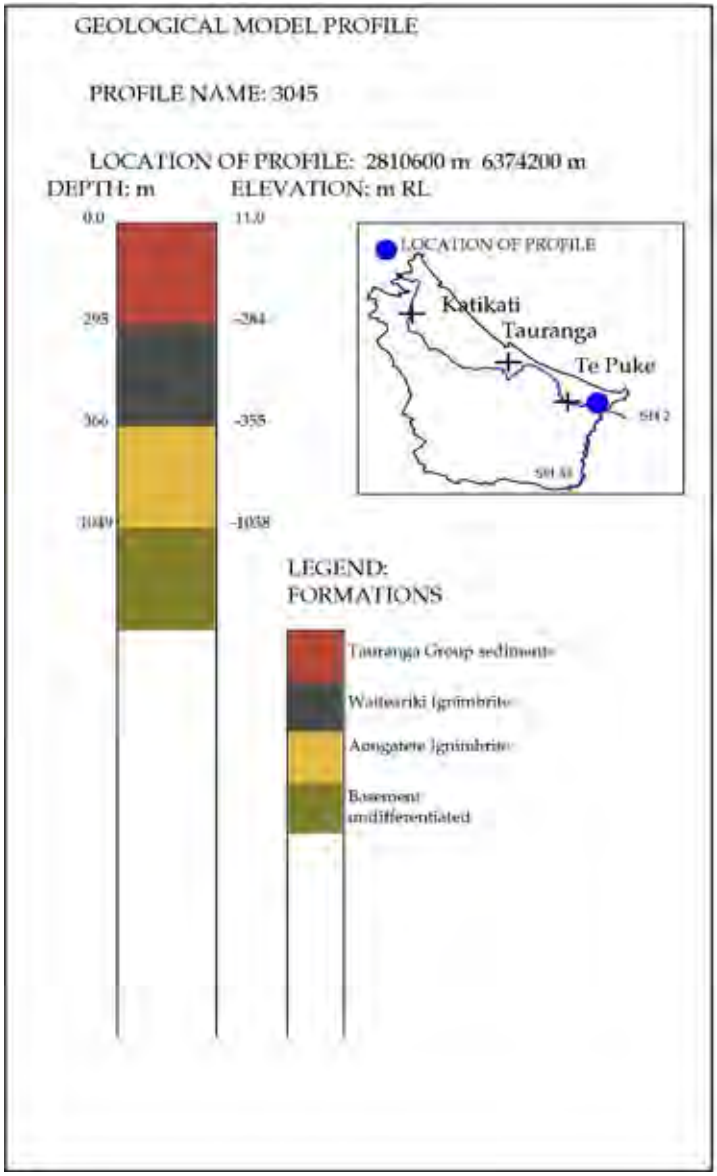



Bore 3043 water level and rainfall - Tauranga Group
Above average rainfall (mm)
Below average rainfall (mm)
Reduced water level (m)
Date
Residual monthly rainfall at Te Matai (site 786310) (mm)
Bore 3043 MSL Mot. (m)

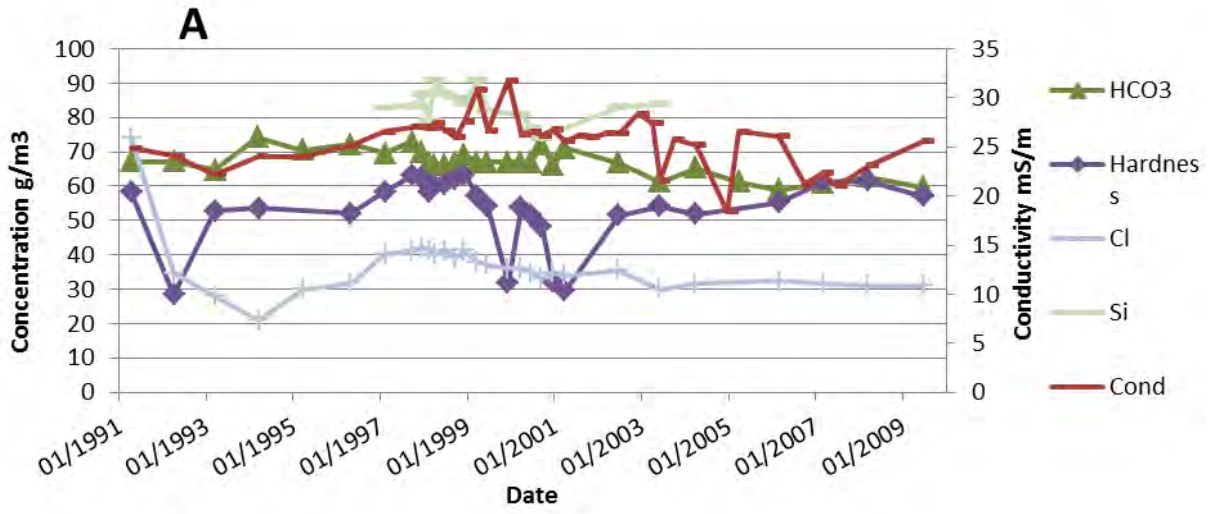

Bore 3043 Raw telemetered water level data
Reduced water level (m)
Date

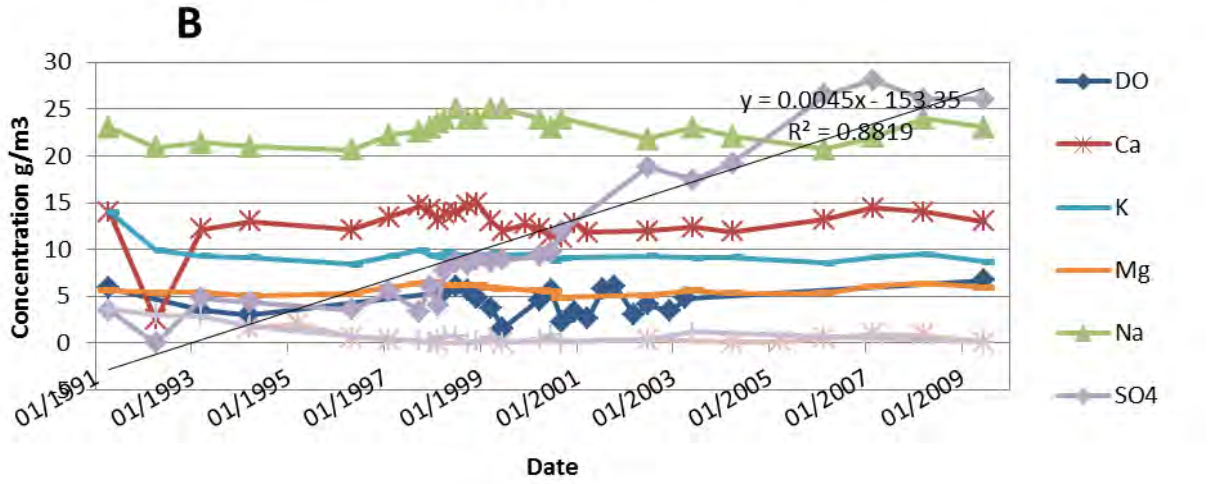
Bore 3045 Information			
Monitoring type	Water quality	**Depth (m)**	5.48
Name	Joyce Family Trust	**Casing Depth (m)**	-
Bore use	Irrigation/domestic	**Screen/open hole**	Unknown
Easting	281 0600	**Temperature**	15°C
Northing	637 4200	**Catchment**	Lower Kaituna (Plains)
Bore log	Partial	**Aquifer**	Tauranga sediments
Monitoring period	**Water level**		
	Water quality	1991 to 2009	**LabStar:** BOP180045

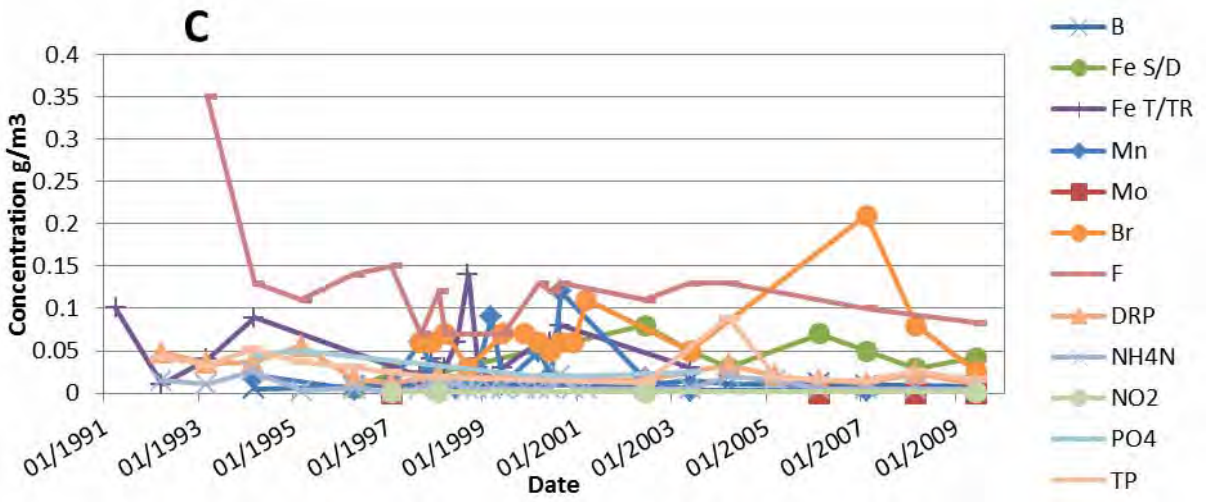
Bore 3045 geological profile (EBOF)



Bore 3045 water quality graphs

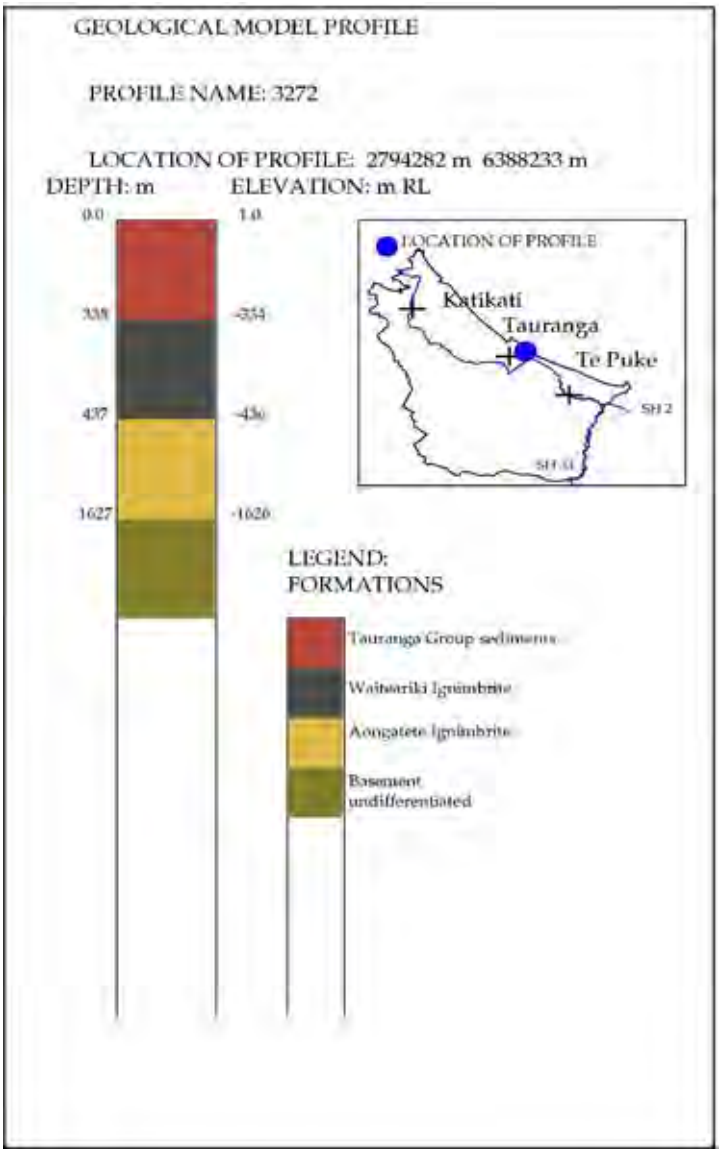




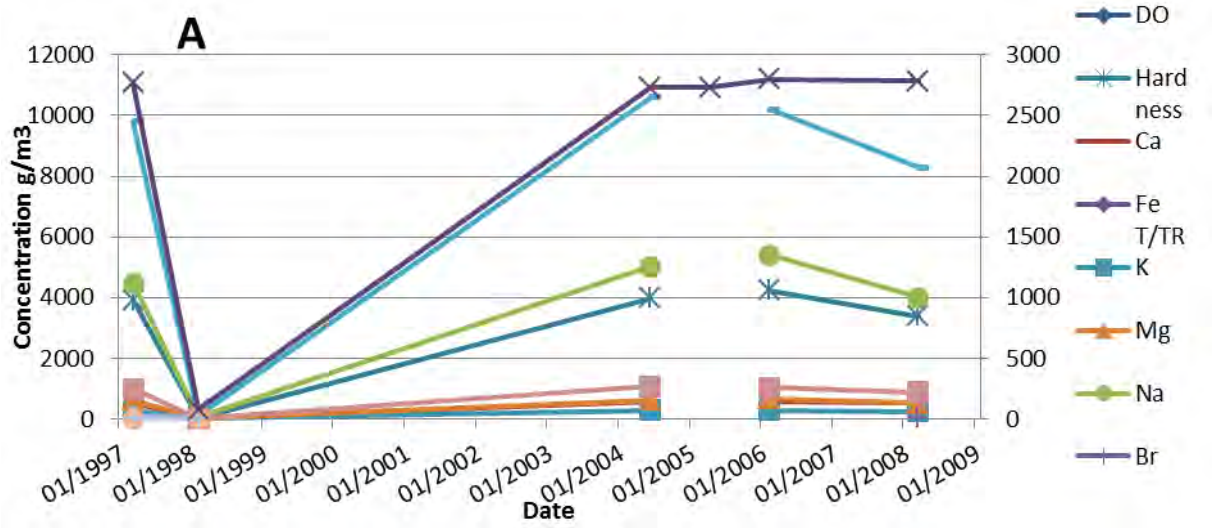


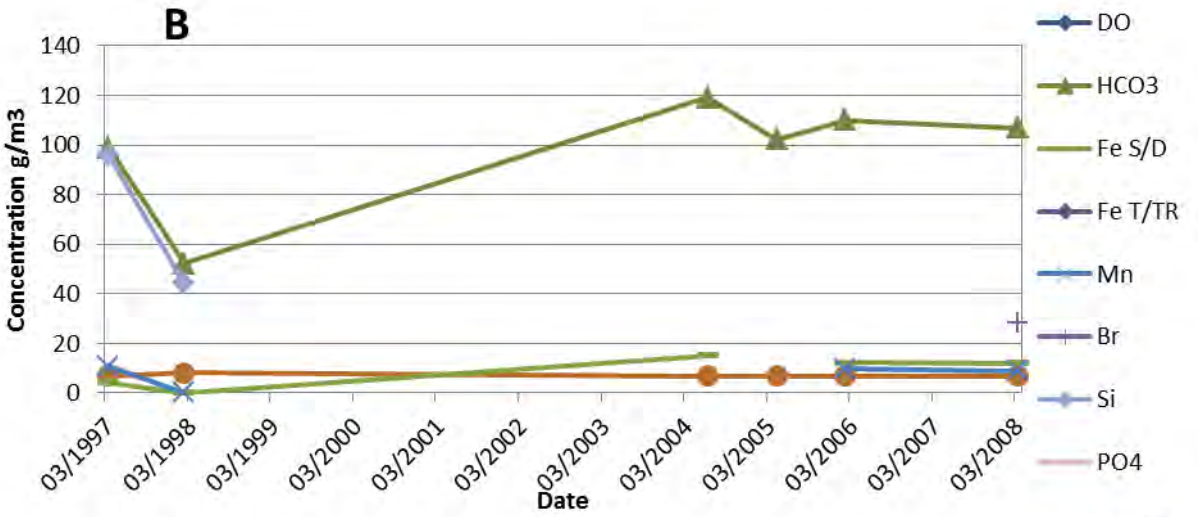
Bore 3272 Information			
Monitoring type	Water quality	**Depth (m)**	375
Name	Drake	**Casing Depth (m)**	300
Bore use	Irrigation/domestic	**Screen/open hole**	Unknown
Easting	276 8559	**Temperature**	39°C
Northing	640 4732	**Catchment**	WAI 2 (zone)
Bore log	Complete	**Aquifer**	Waiteariki
Monitoring period	**Water level**	1996 to 2009	
	Water quality	1997 to 2008	**LabStar:** BOP180068

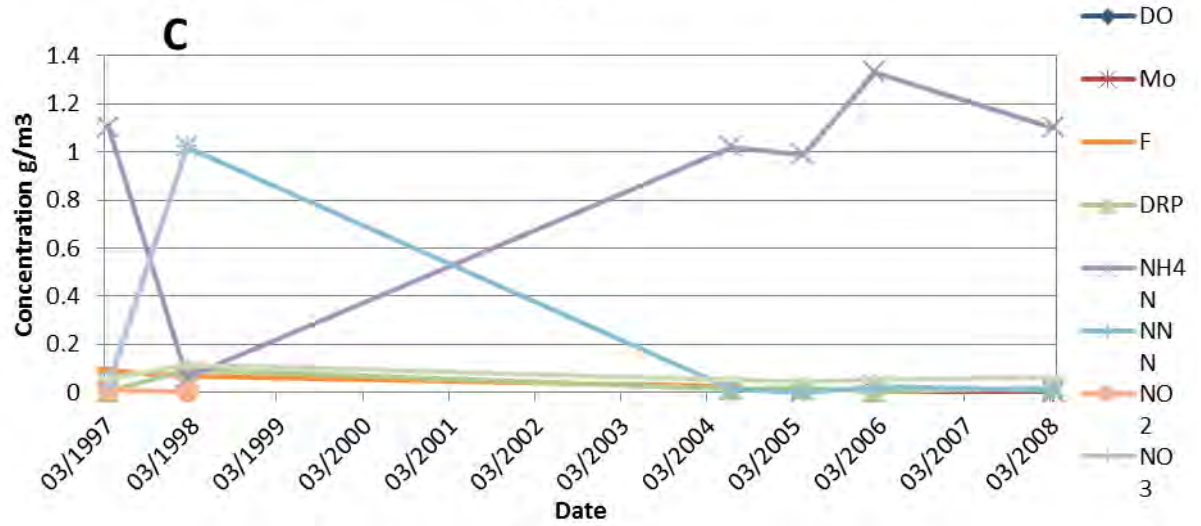
Bore 3272 geological profile (EBOF)



Bore 3272 water quality graphs



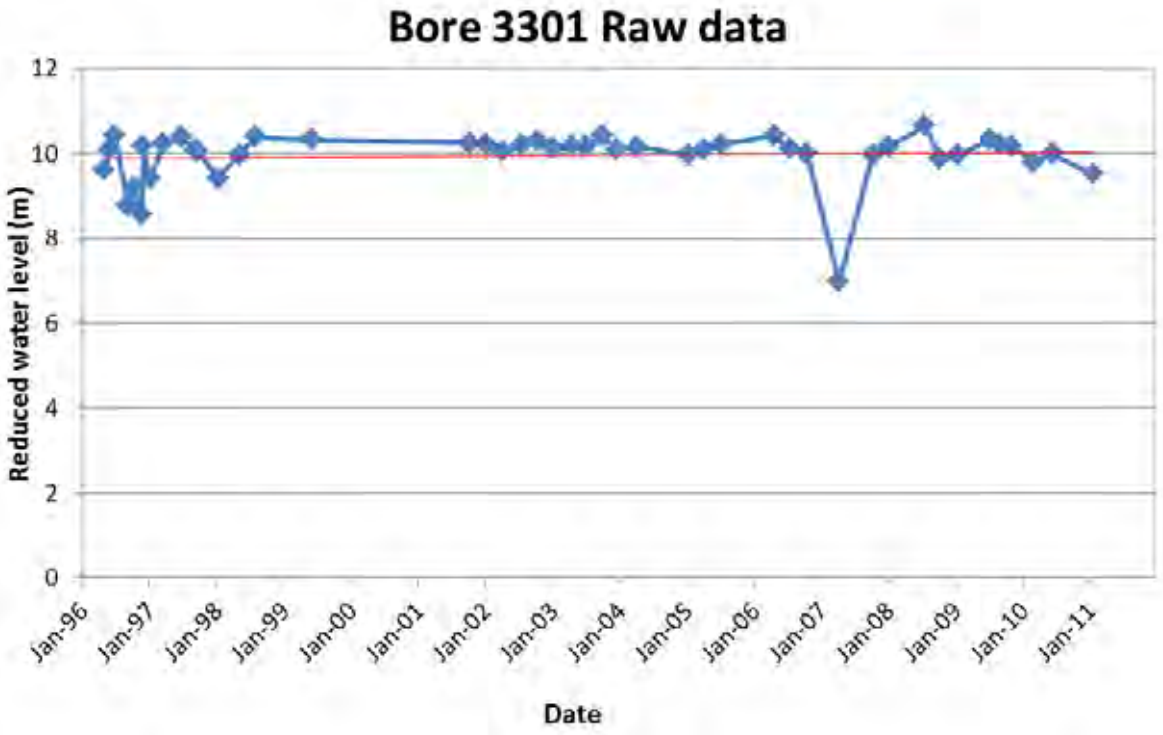


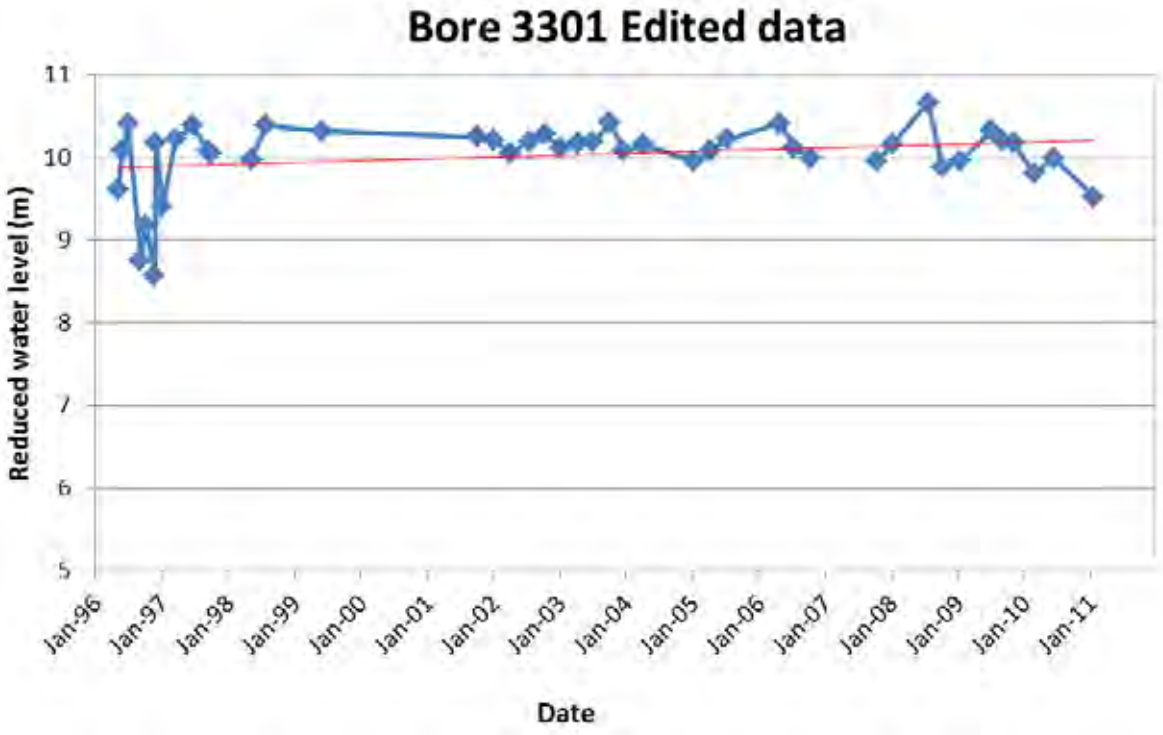


Bore 3301 Information			
Monitoring type	Water quality	**Depth (m)**	12
Name	Ōhope Golf Club	**Casing Depth (m)**	6
Bore use	Irrigation	**Screen/open hole**	Screened
Easting	287 2660	**Temperature**	15.6°C
Northing	634 8980	**Catchment**	Opotiki Plains
Bore log	Complete	**Aquifer**	Tauranga sediments
Monitoring period	**Water level**	1996 to 2011	
	Water quality	1996 to 2010	**LabStar:** BOP180063

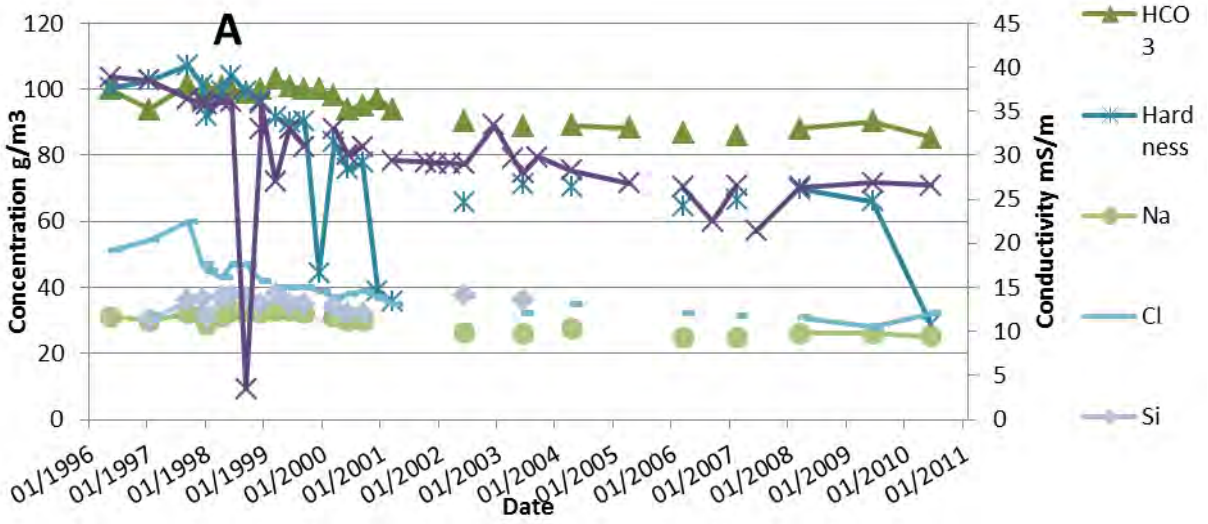
The Earth Beneath our Feet model is not currently available for this region.

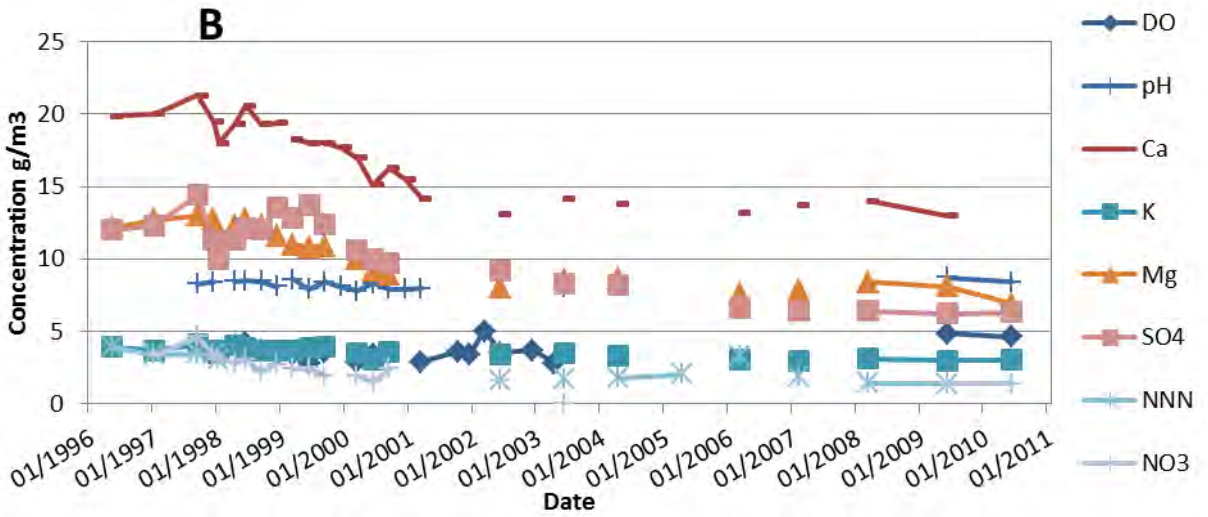
Bore 3301 water level graphs

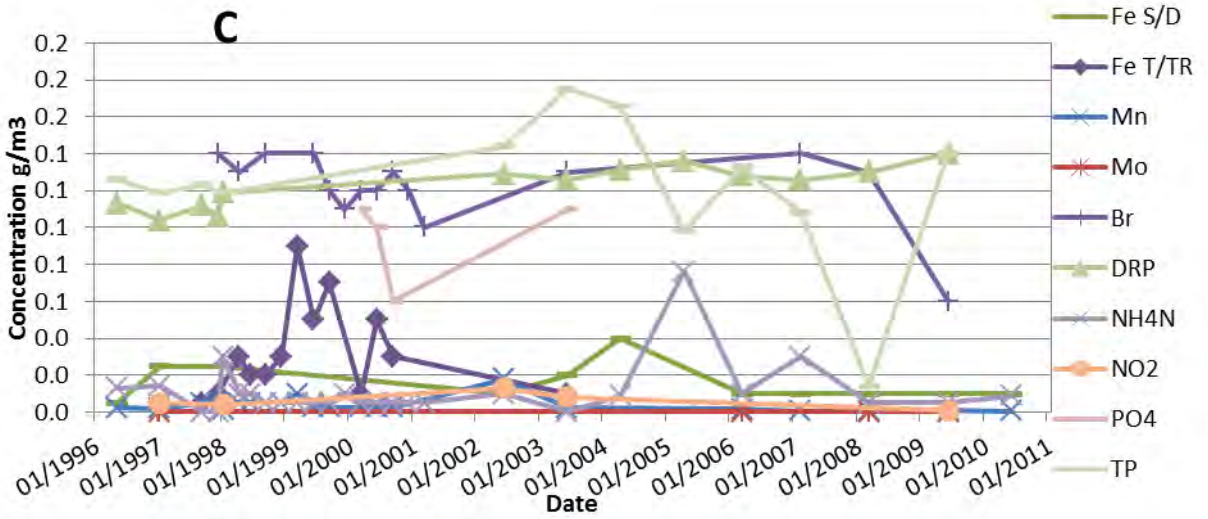




Bore 3301 water quality graphs

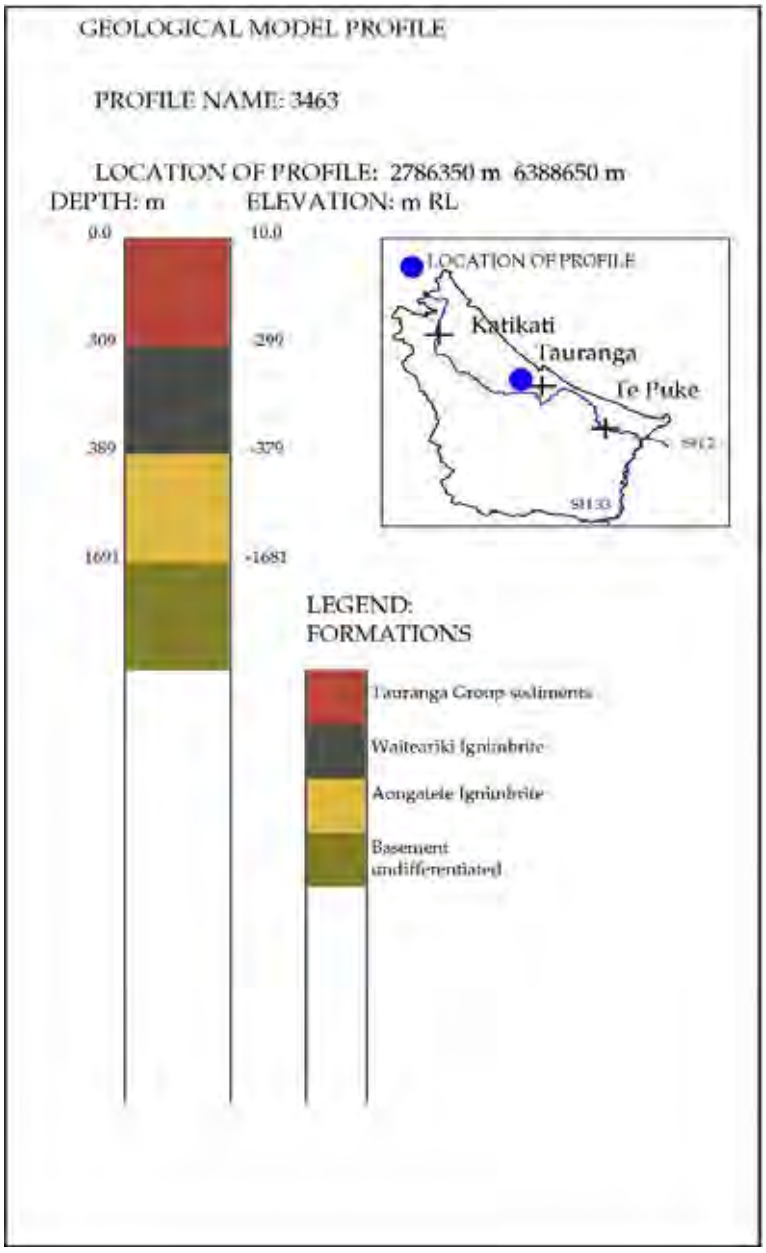




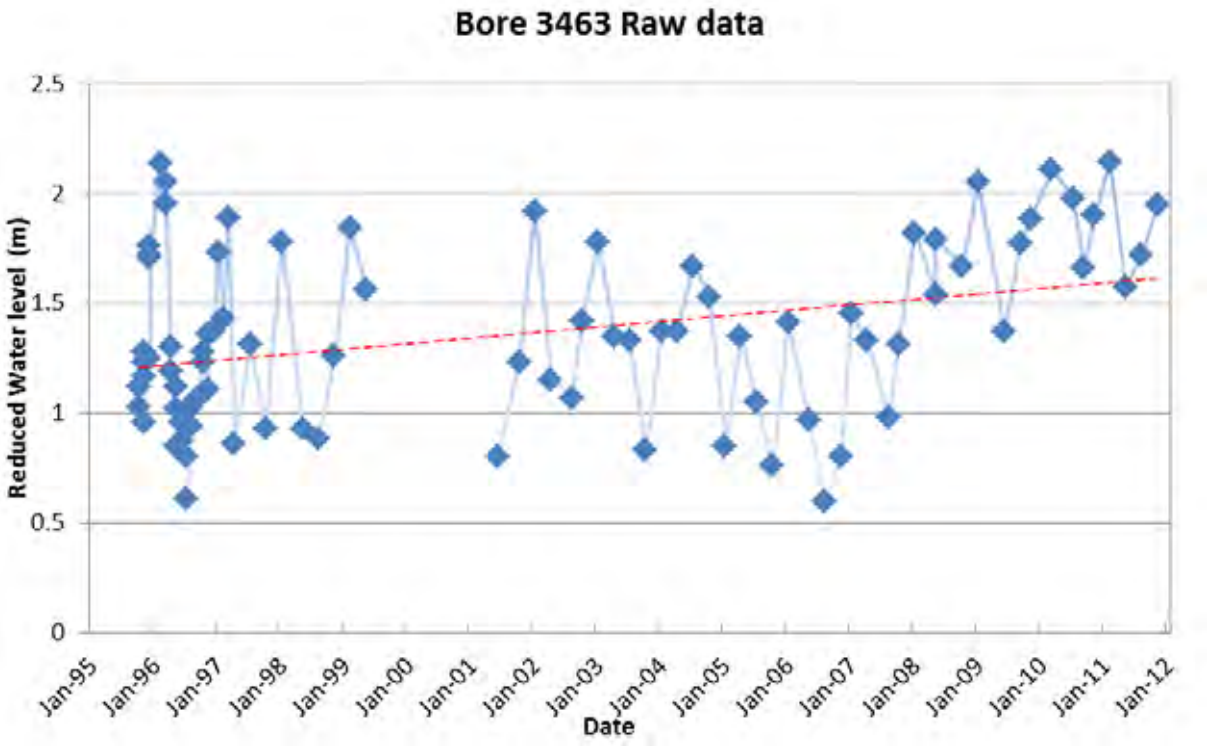


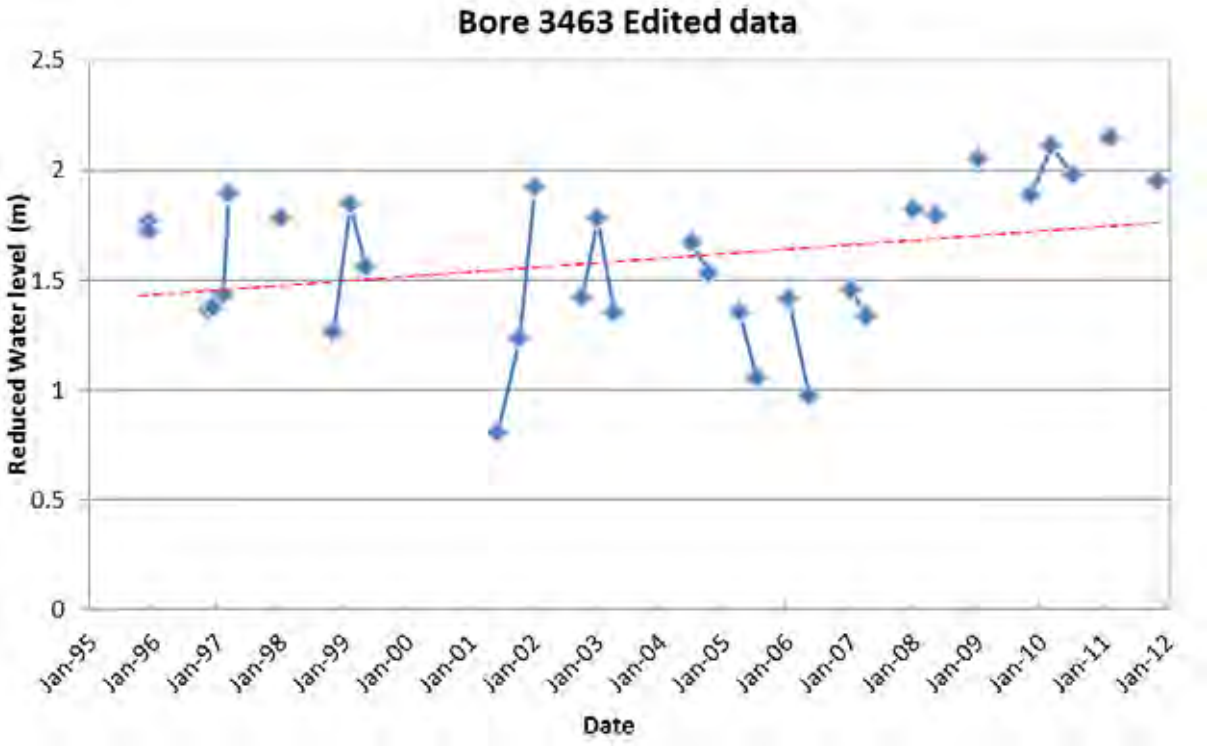
Bore 3463 Information			
Monitoring type	Water level	**Depth (m)**	274.32
Name	McIntosh	**Casing Depth (m)**	255.55
Bore use	Swimming pool	**Screen/open hole**	Open hole
Easting	278 6350	**Temperature**	44
Northing	638 8650	**Catchment**	Otumoetai
Bore log	-	**Aquifer**	Tauranga sediments
Monitoring period	**Water level**	1995 to 2011	
	Water quality	-	

Bore 3463 geological profile (EBOF)



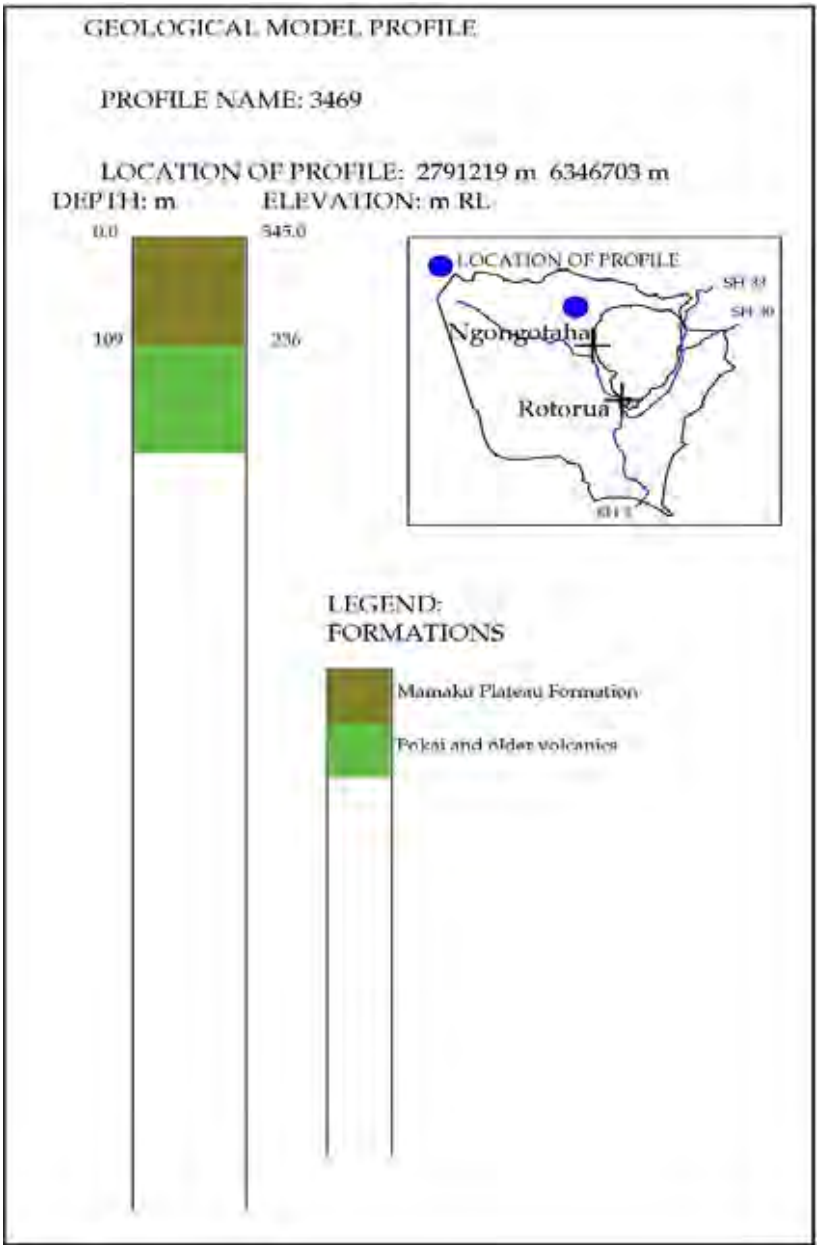
Bore 3463 water level graphs



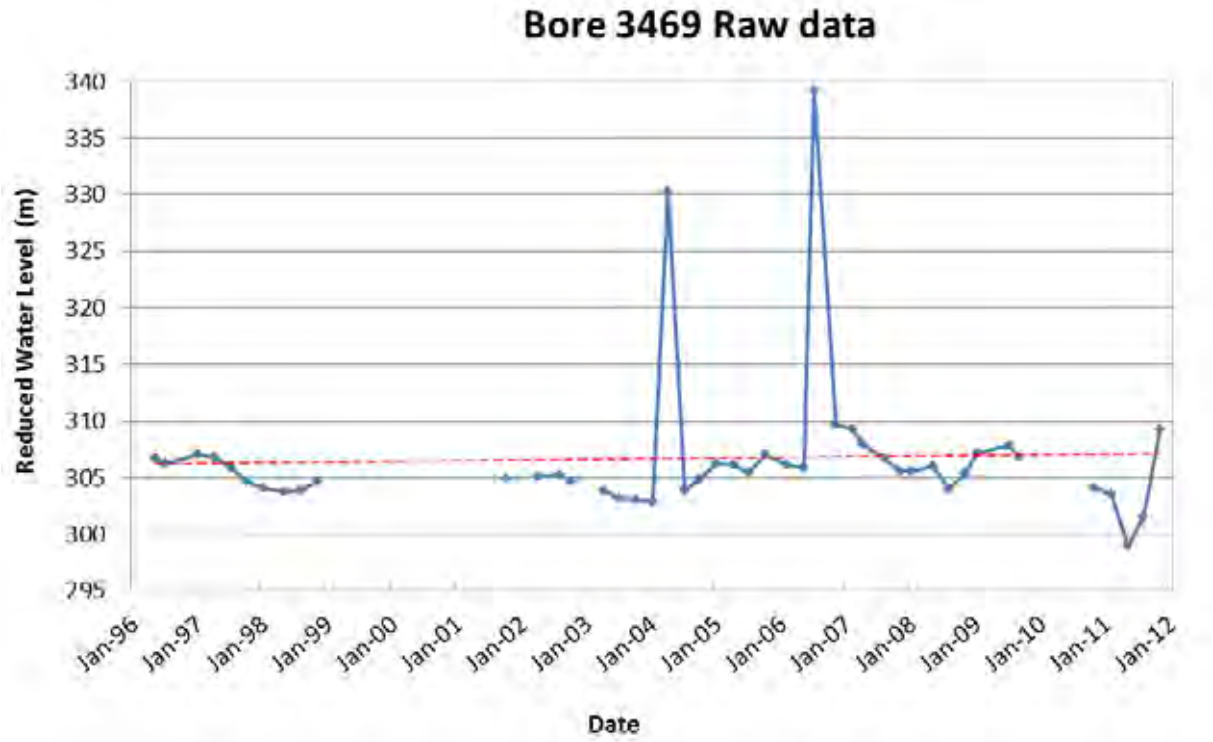


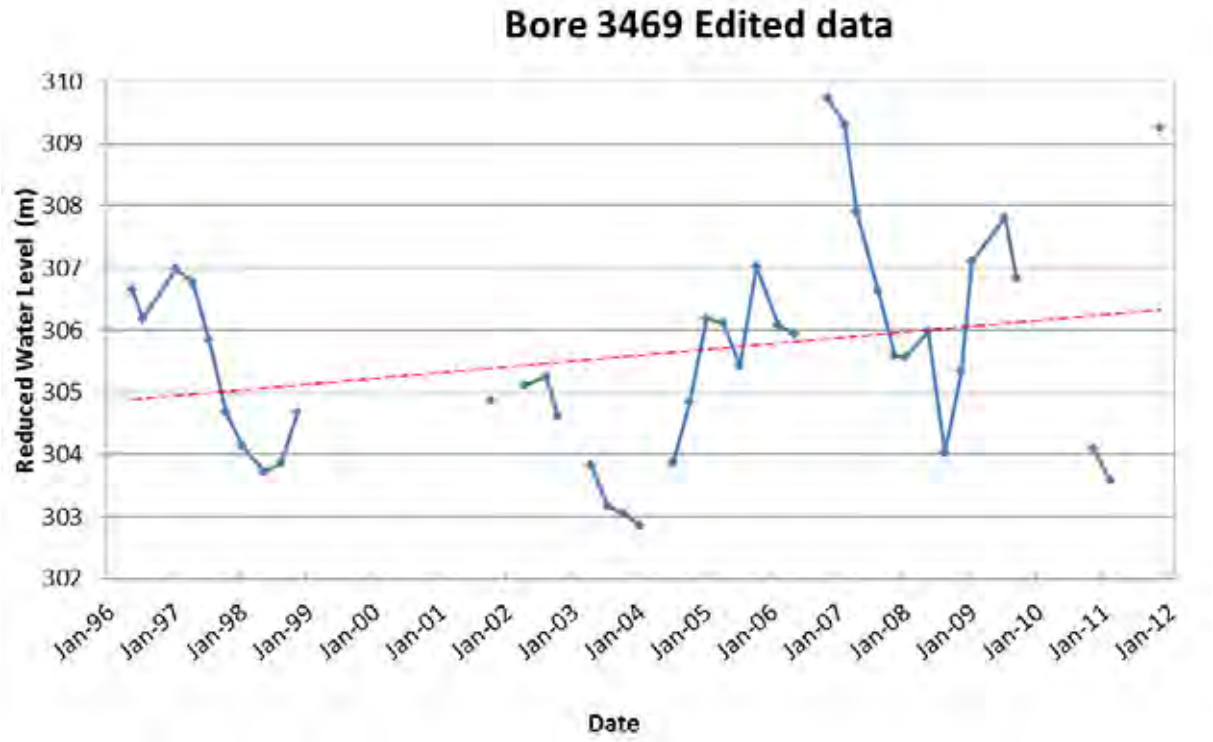
Bore 3469 Information			
Monitoring type	Water level	**Depth (m)**	124.66
Name	Nelson	**Casing Depth (m)**	80.16
Bore use	Irrigation	**Screen/open hole**	Open hole
Easting	279 1219	**Temperature**	Unknown
Northing	634 6703	**Catchment**	Awahou (Lake Rotorua)
Bore log	Complete	**Aquifer**	Mamaku/Pokai Chimp volcanics
Monitoring period	**Water level**	1996 to 2011	
	Water quality		

Bore 3469 geological profile (EBOF)



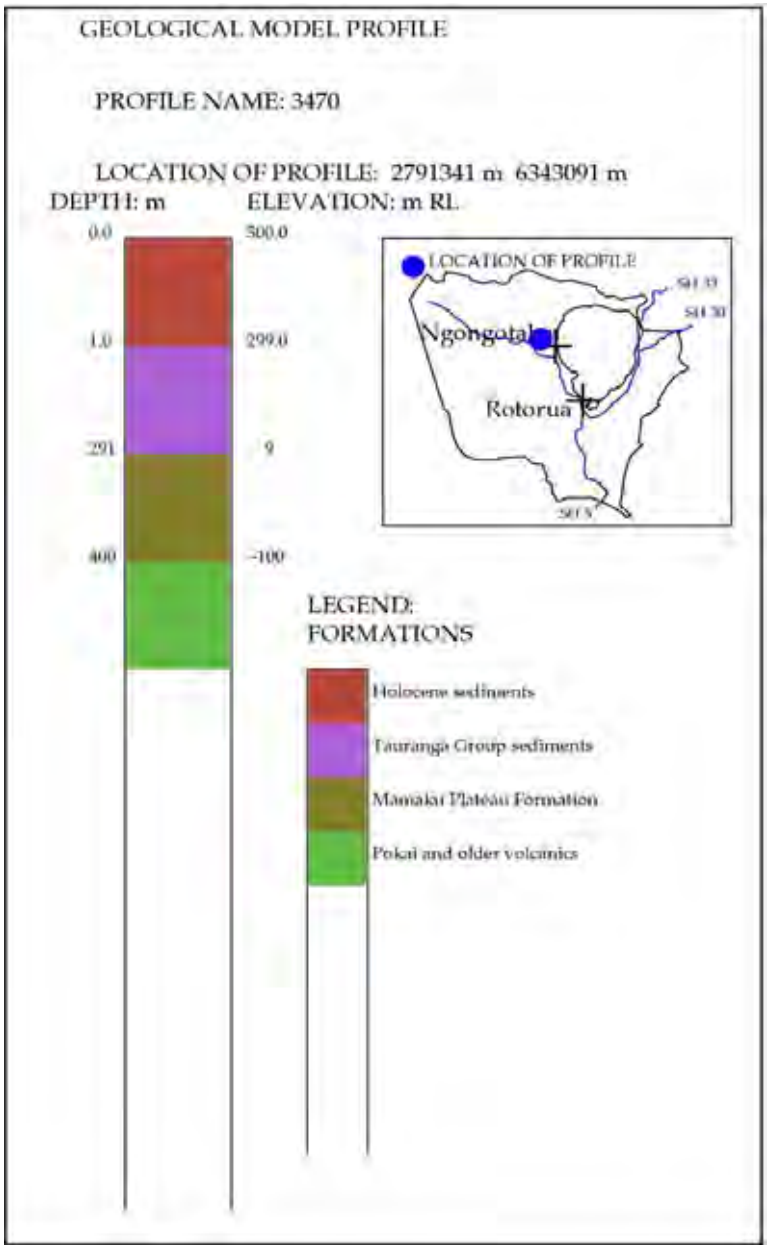
Bore 3469 water level graphs



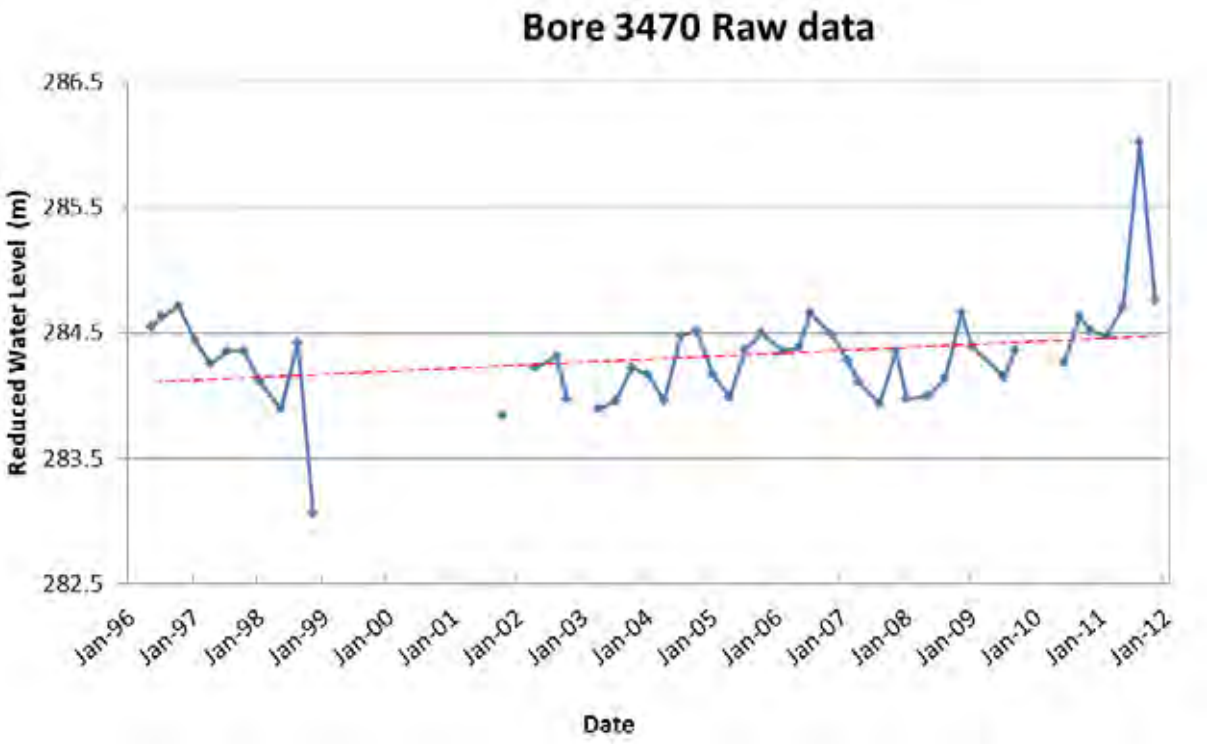


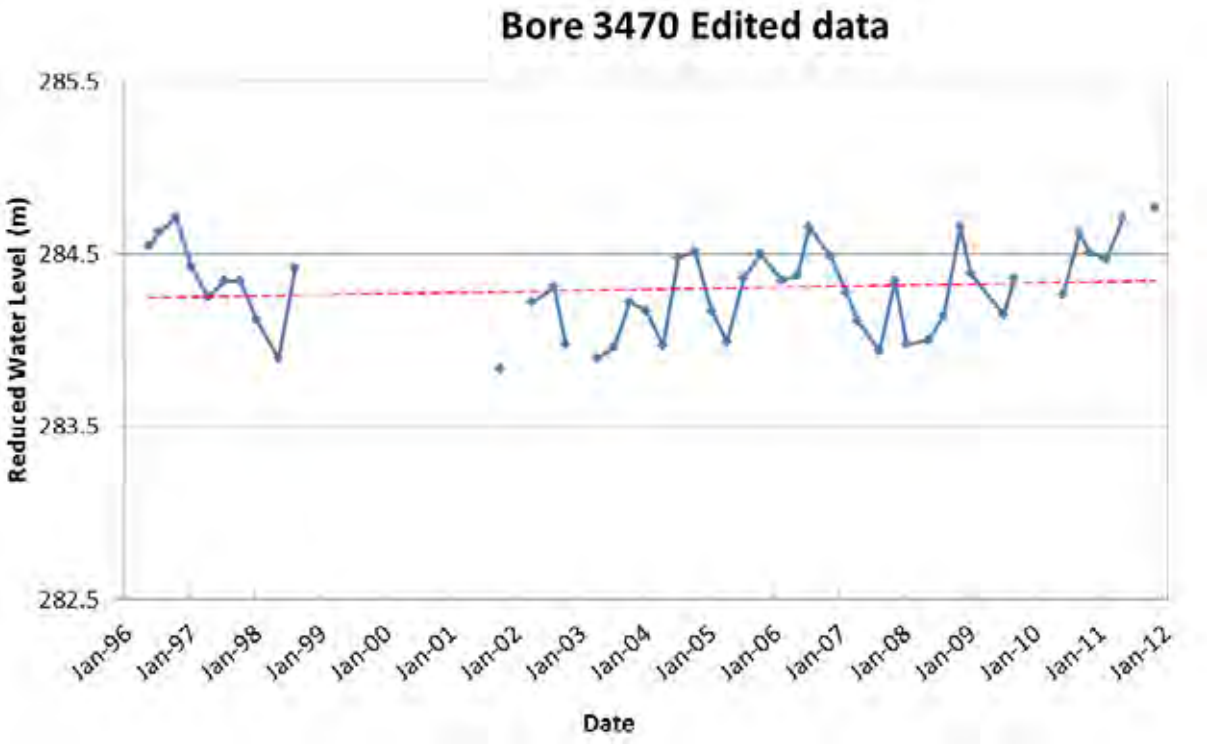
Bore 3470 Information			
Monitoring type	Water level & Water quality	**Depth (m)**	Unknown
Name	Lepper	**Casing Depth (m)**	Unknown
Bore use	Irrigation/Frost protection	**Screen/open hole**	Unknown
Easting	279 1341	**Temperature**	12.7°C
Northing	634 3091	**Catchment**	Waitetī (Lake Rotorua)
Bore log	-	**Aquifer**	Tauranga sediment
Monitoring period	**Water level**	1996 to 2011	
	Water quality	1997 to 2011	**LabStar:** BOP180067

Bore 3470 geological profile (EBOF)

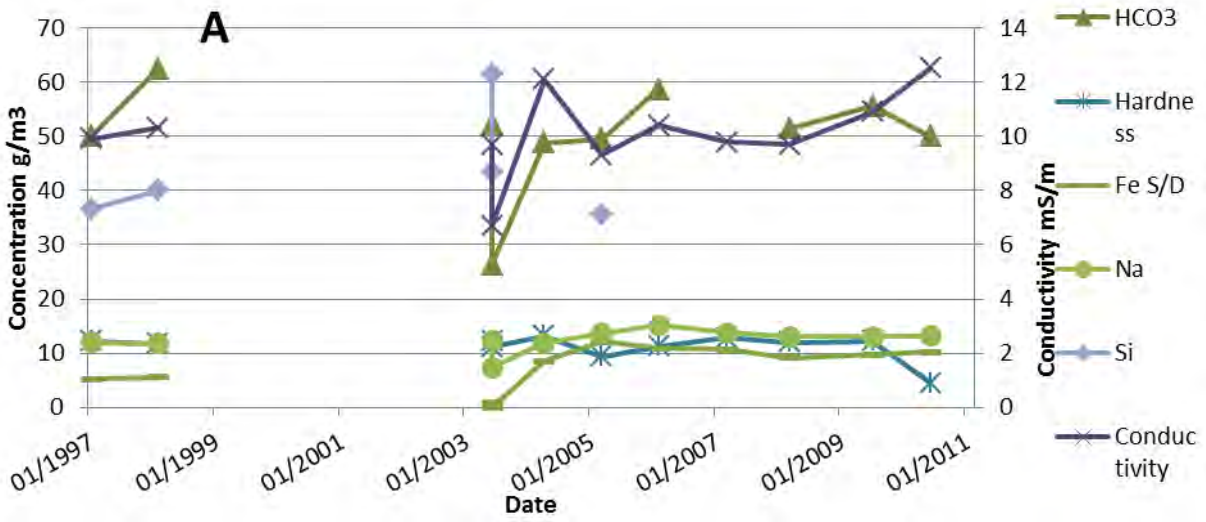


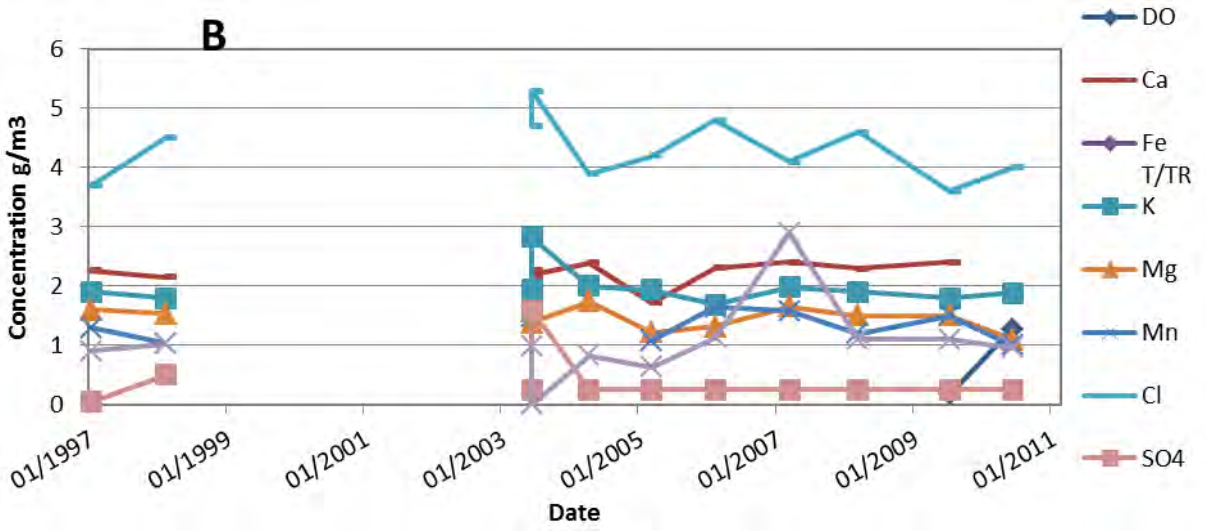
Bore 3470 water level graphs

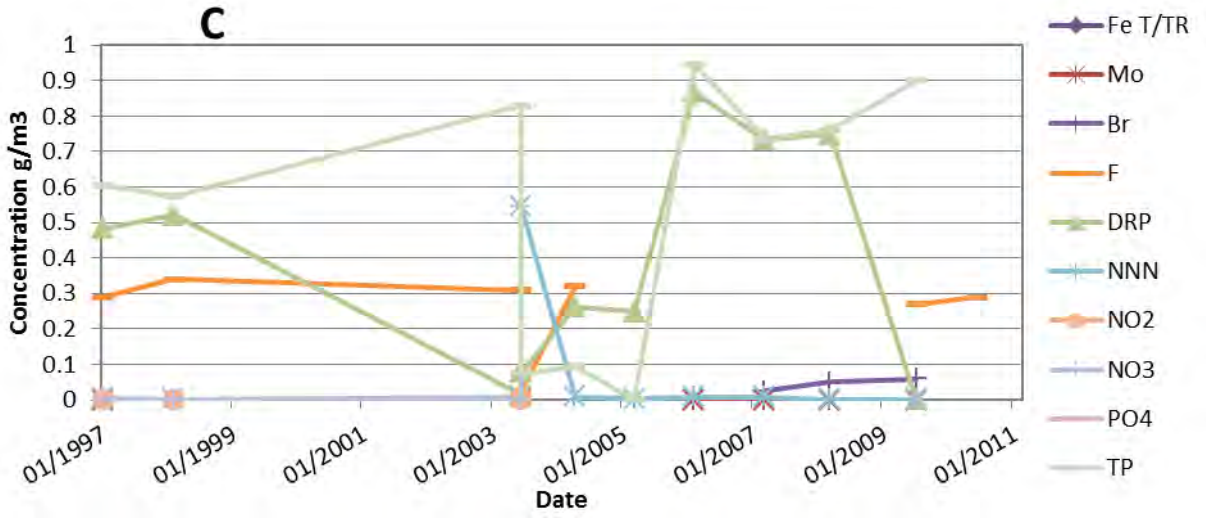




Bore 3470 water quality graphs

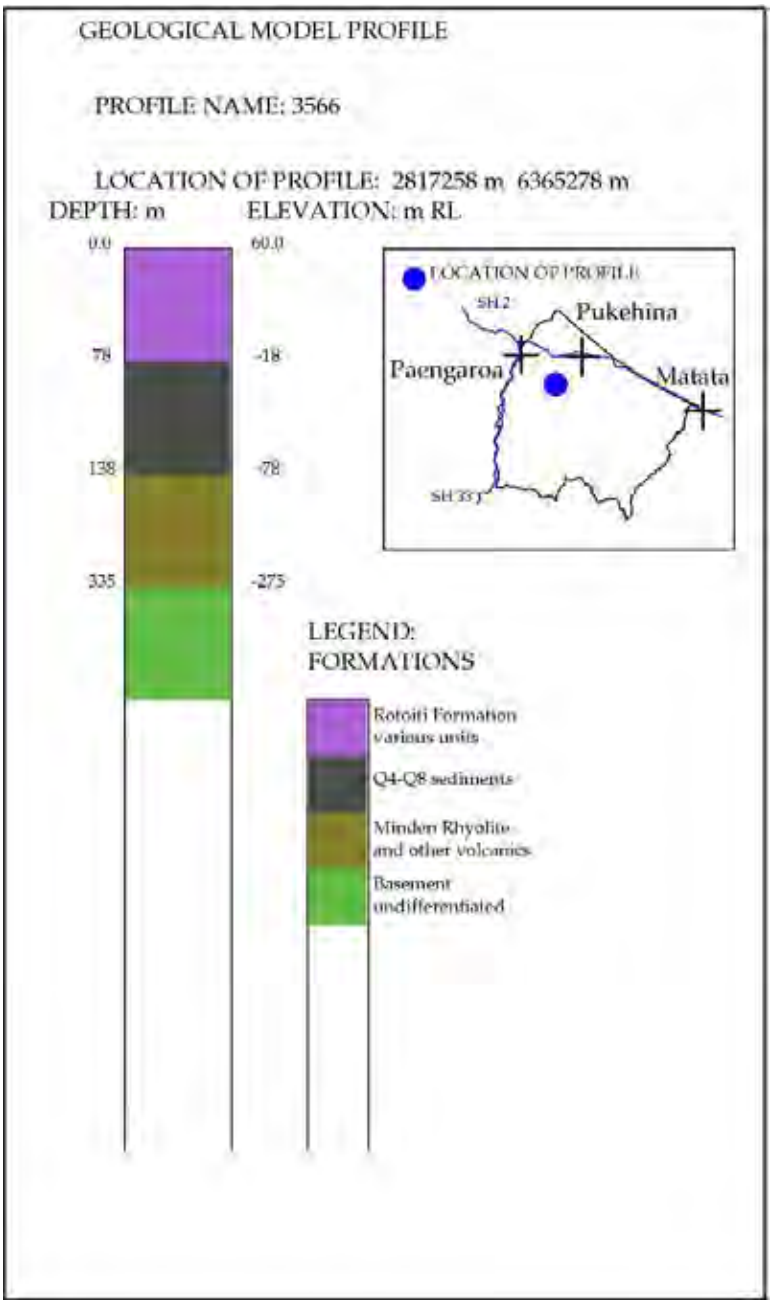




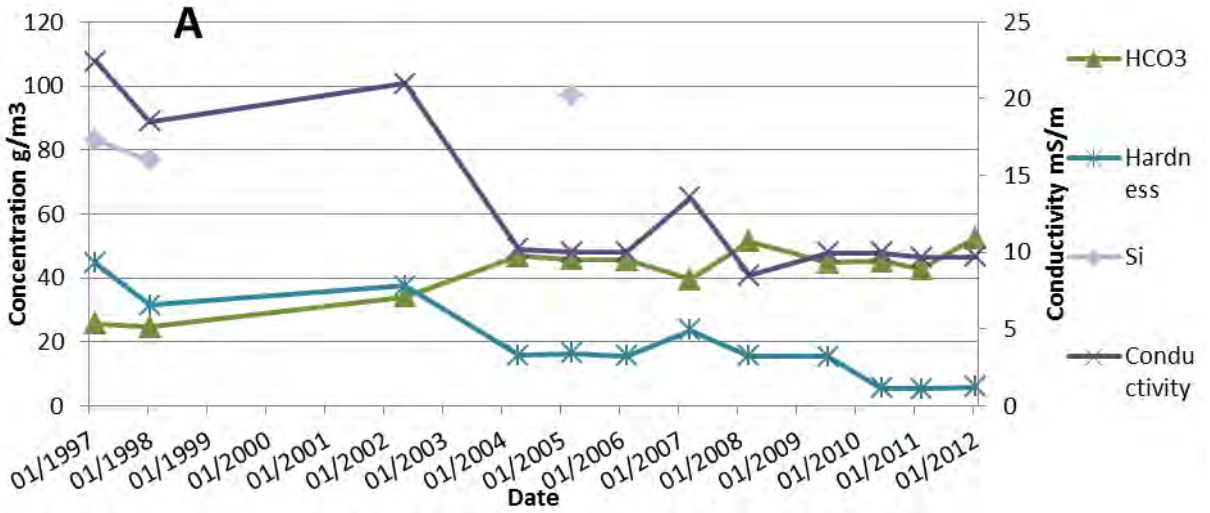


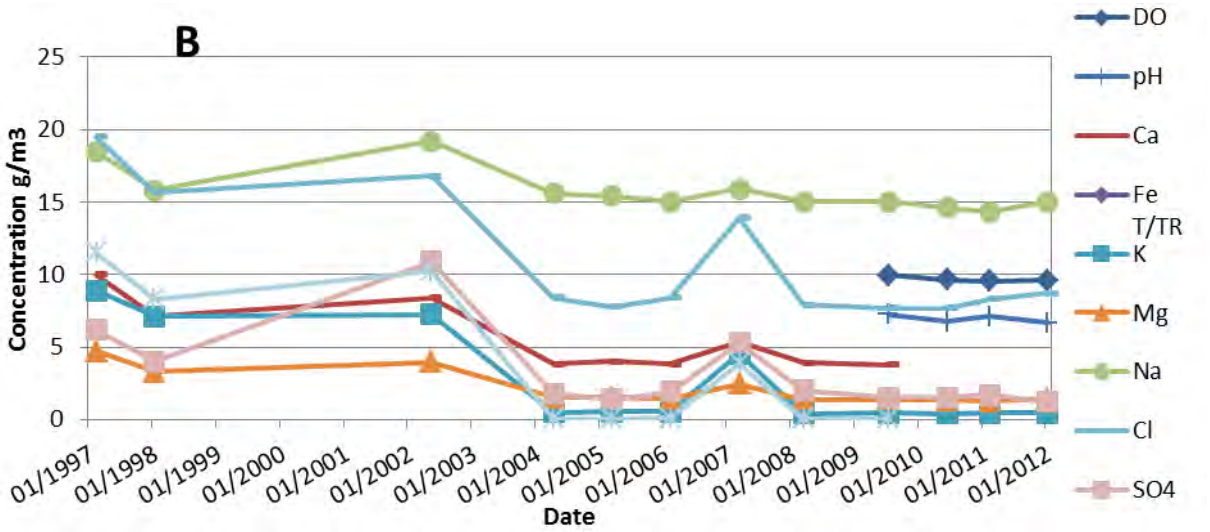
Bore 3566 Information			
Monitoring type	Water quality	**Depth (m)**	122
Name	Thacker	**Casing Depth (m)**	70
Bore use	Agricultural/Domestic	**Screen/open hole**	From 88? to 122
Easting	281 7258	**Temperature**	Cold water
Northing	636 5278	**Catchment**	Kaikokopu-Pokopoko-Wharere
Bore log	-	**Aquifer**	Tauranga sediments
Monitoring period	**Water level**	-	
	Water quality	1997 - 2011	**LabStar:** BOP180070

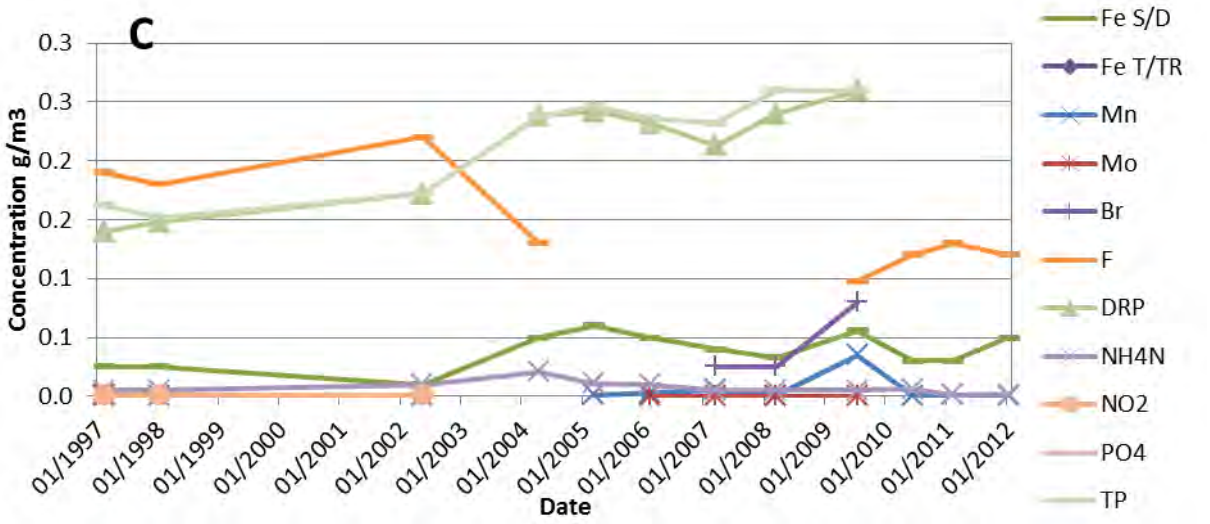
Bore 3566 geological profile (EBOF)



Bore 3566 water quality graphs

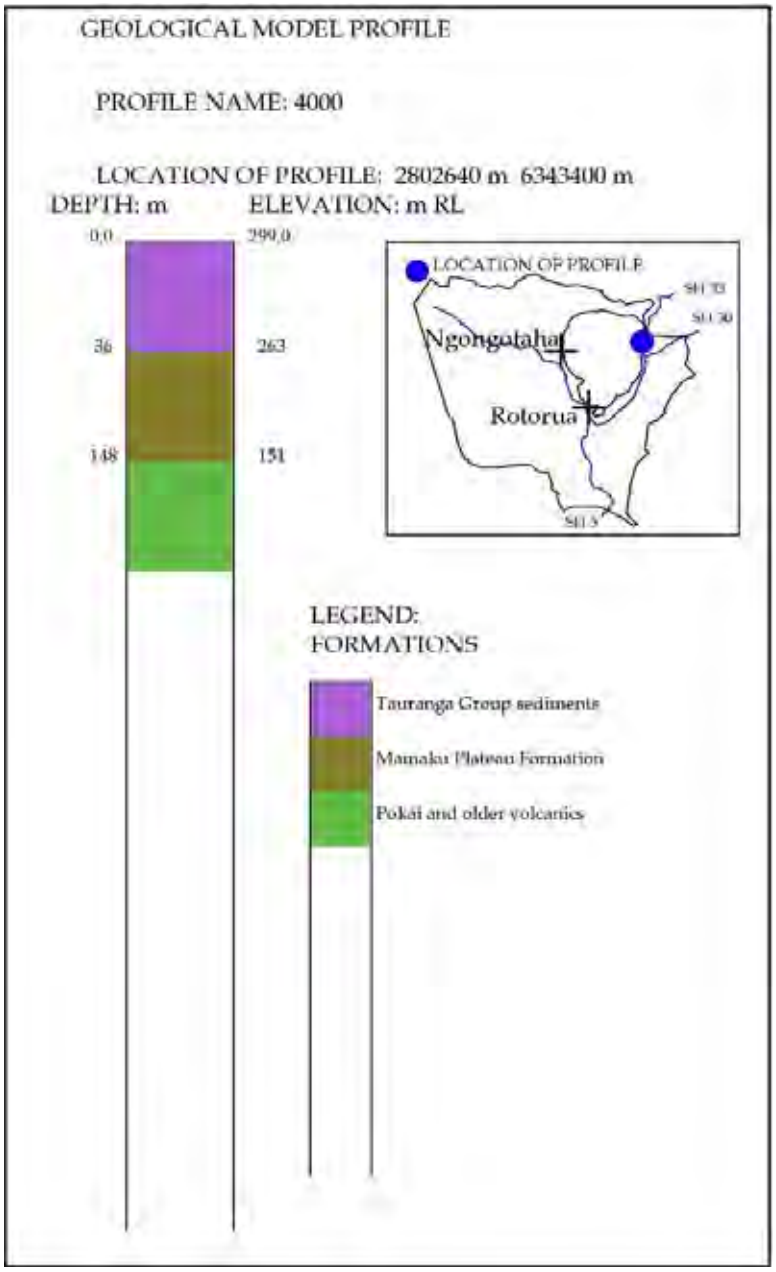




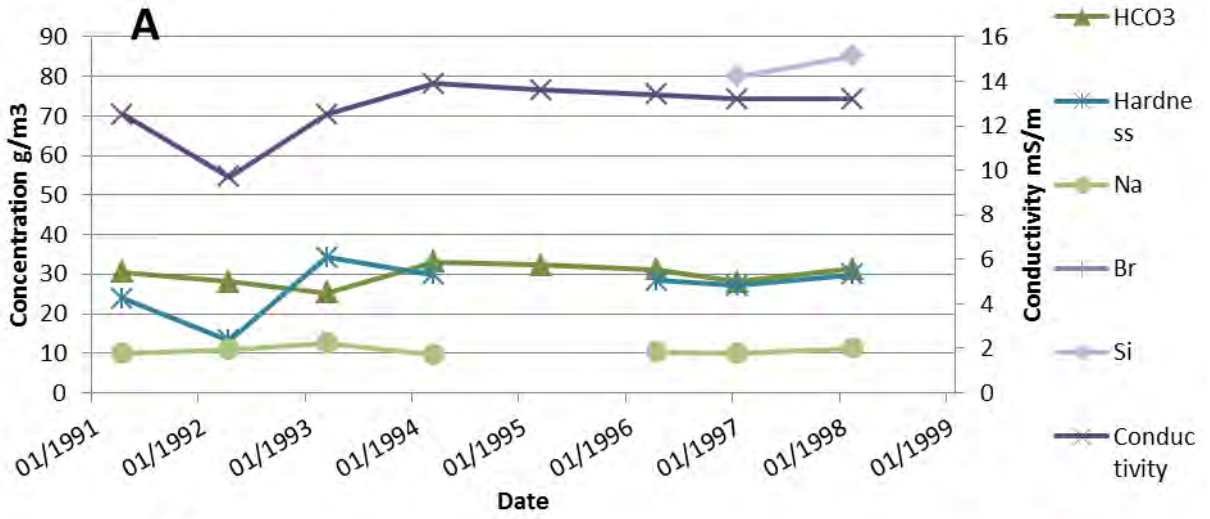


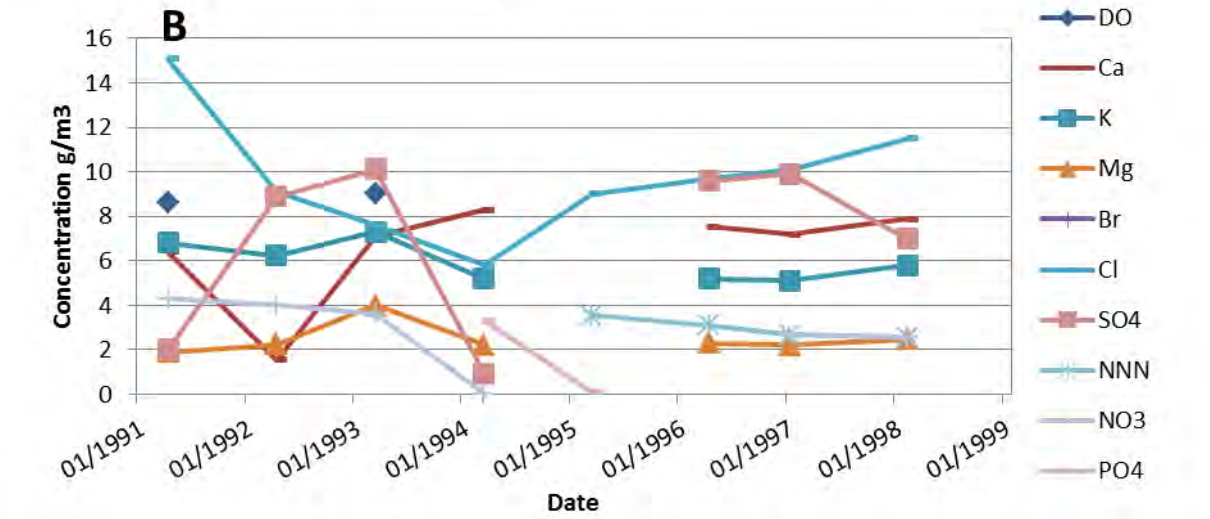
Bore 4000 Information			
Monitoring type	Water quality	**Depth (m)**	26
Name	Ludgate Hill	**Casing Depth (m)**	Unknown
Bore use	Irrigation	**Screen/open hole**	Unknown
Easting	2802640	**Temperature**	14°C
Northing	6343400	**Catchment**	Lake Rotorua
Bore log	–	**Aquifer**	Tauranga sediments
Monitoring period	**Water level**	-	
	Water quality	1991 to 1998	

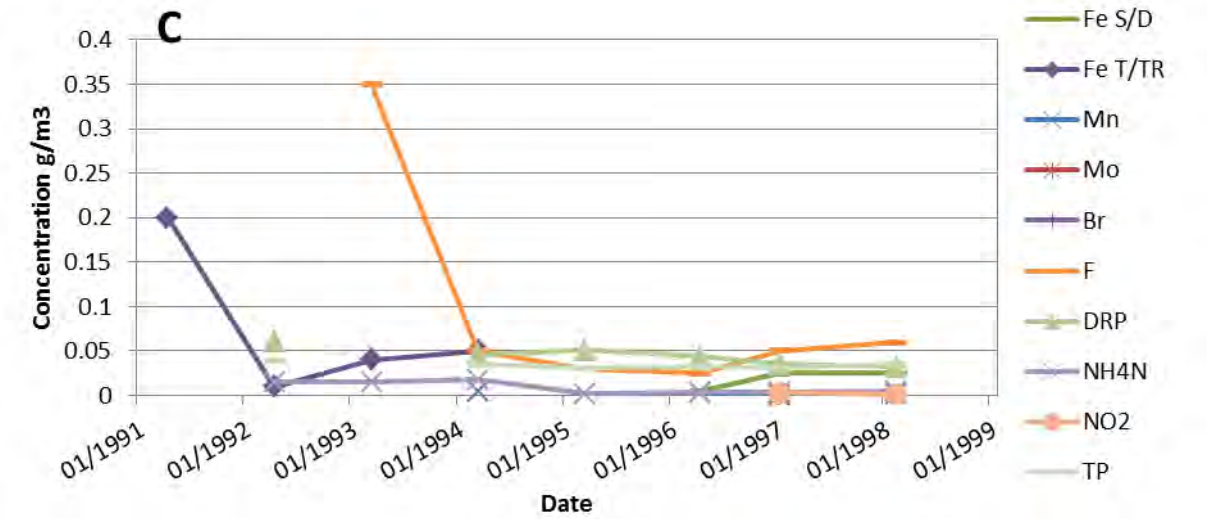
Bore 4000 geological profile (EBOF)



Bore 4000 water quality graphs



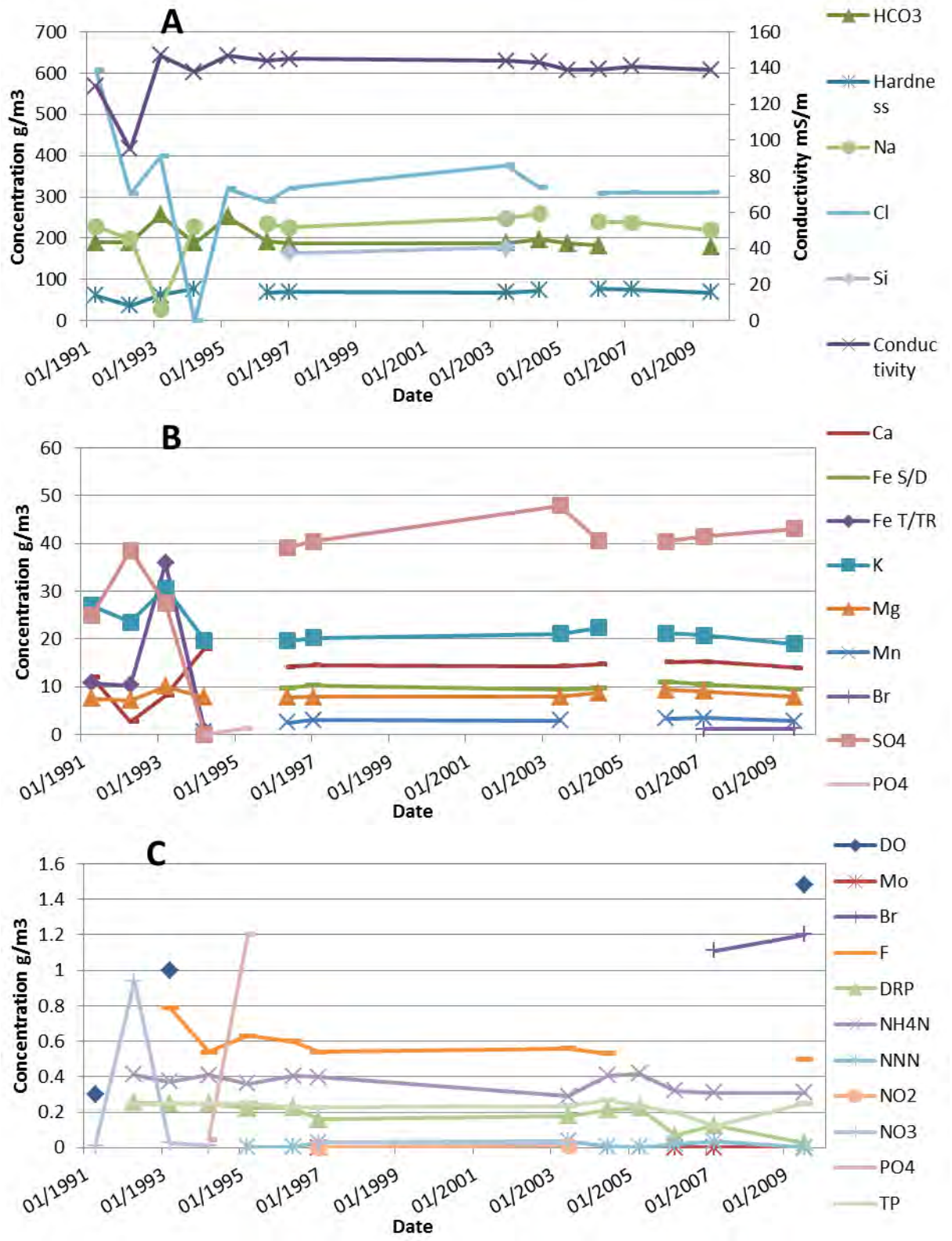




Bore 4001 Information			
Monitoring type	Water quality	**Depth (m)**	55
Name	Rotomā Holiday Camp	**Casing Depth (m)**	Unknown
Bore use	Swimming pool	**Screen/open hole**	Unknown
Easting	282 1500	**Temperature**	40°C
Northing	634 5100	**Catchment**	Lake Rotoehu
Bore log	–	**Aquifer**	Tauranga sediments
Monitoring period	**Water level**	-	
	Water quality	1991 to 2009	

The Earth Beneath our Feet model is not currently available for this bore.

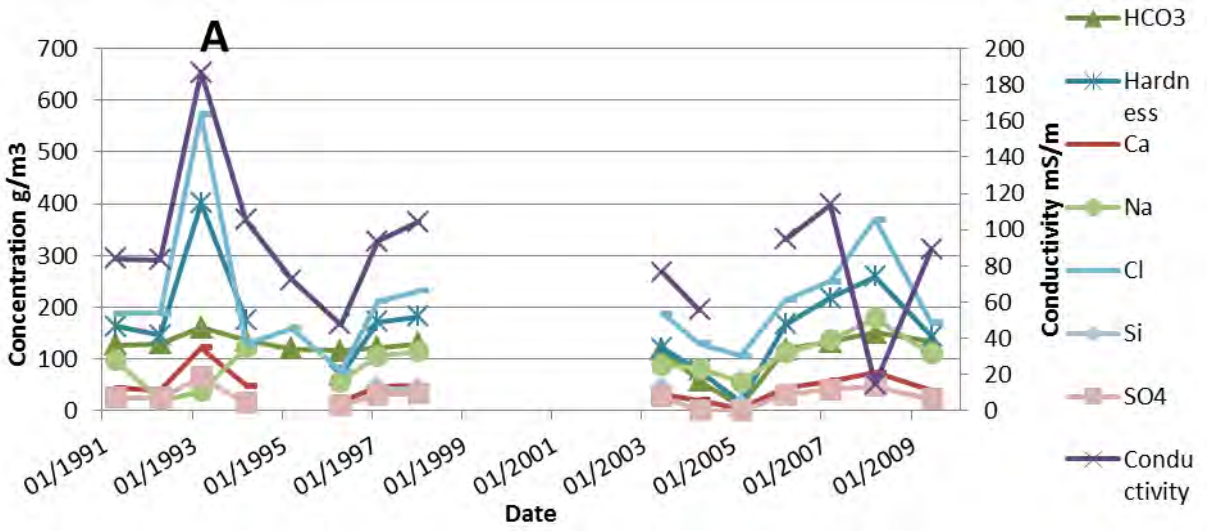
Bore 4001 water quality graphs

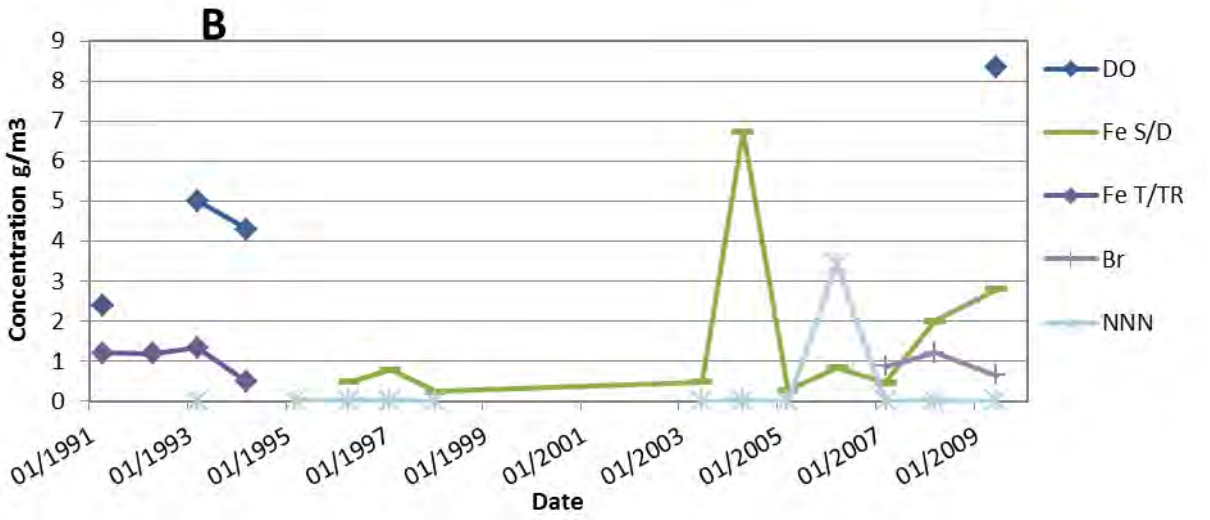


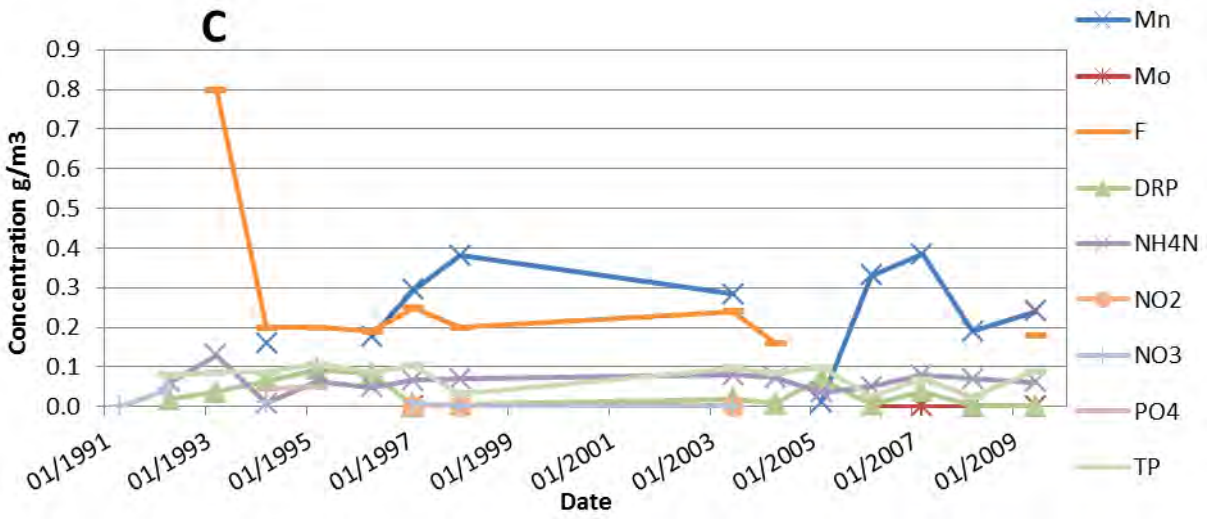
Bore 4002 Information			
Monitoring type	Water quality	**Depth (m)**	60
Name	Ōpōtiki Holiday Park	**Casing Depth (m)**	Unknown
Bore use	Unknown	**Screen/open hole**	Unknown
Easting	288 6200	**Temperature**	16.5°C
Northing	634 6600	**Catchment**	Opotiki Plains
Bore log	-	**Aquifer**	Tauranga Group Sediments
Monitoring period	**Water level**		
	Water quality	1991 to 2009	**LabStar:** BOP180029

The Earth Beneath our Feet model is not currently available for this region.

Bore 4002 water quality graphs

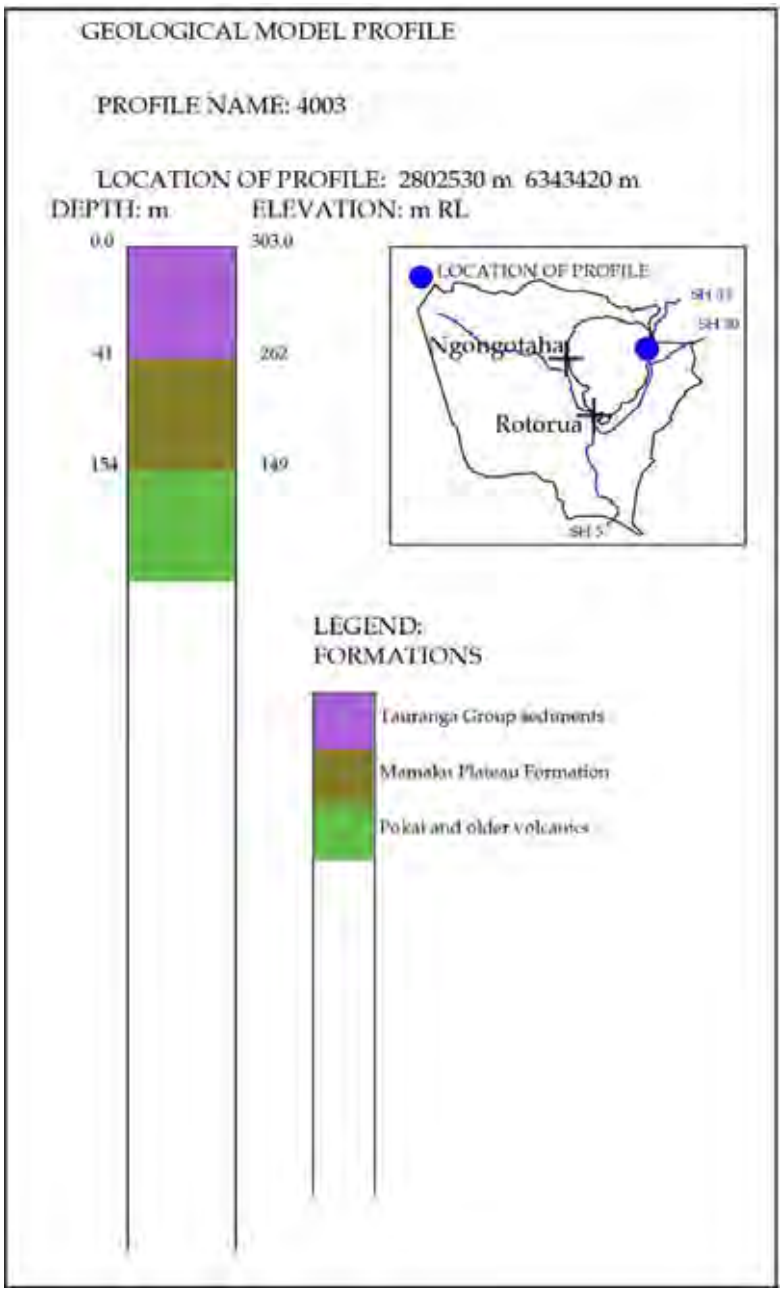




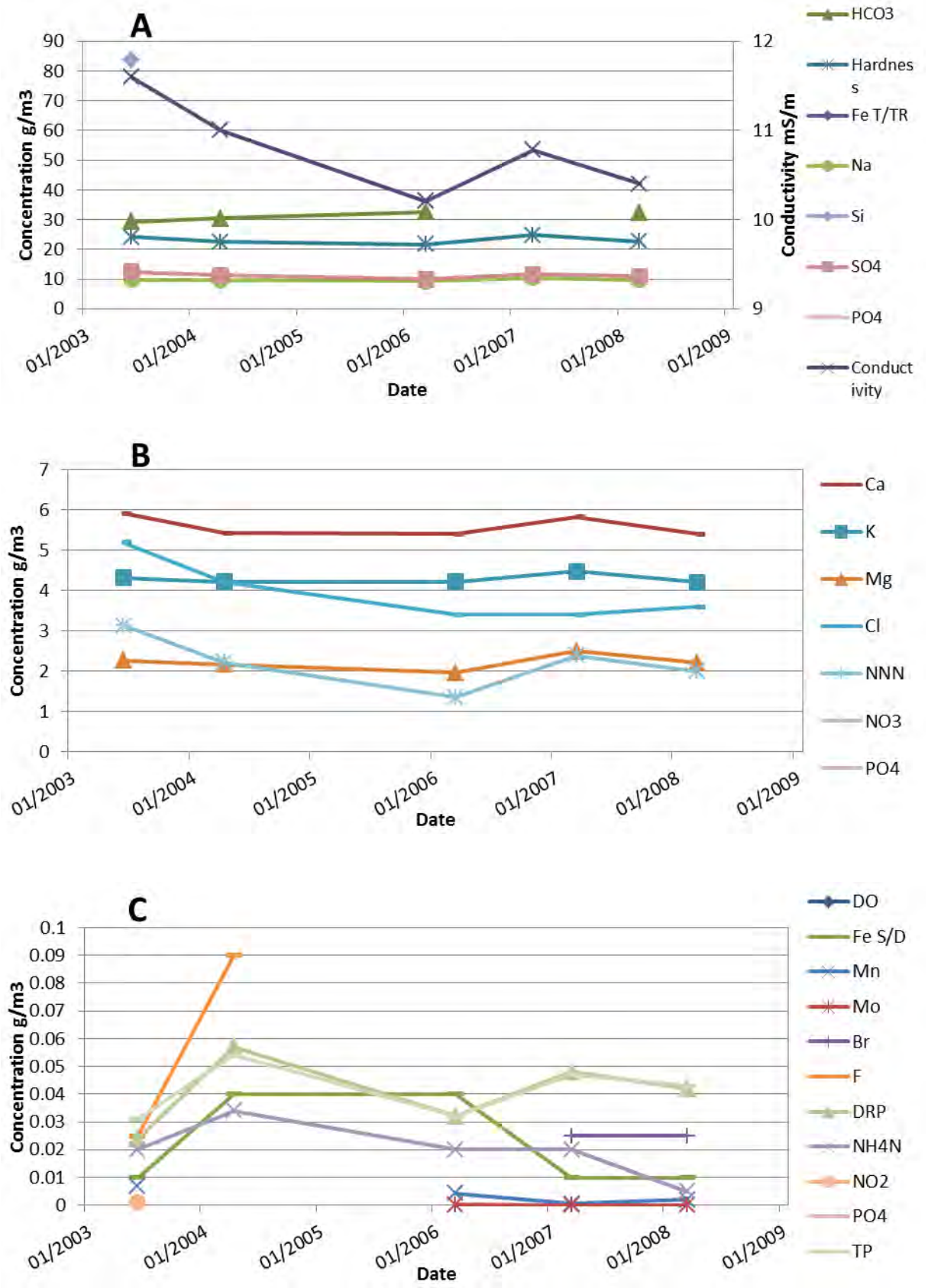


Bore 4003 Information			
Monitoring type	Water quality	**Depth (m)**	26
Name	Ludgate Hill	**Casing Depth (m)**	Unknown
Bore use	Domestic	**Screen/open hole**	Unknown
Easting	280 2530	**Temperature**	Unknown
Northing	634 3420	**Catchment**	Lake Rotorua
Bore log	–	**Aquifer**	Tauranga sediments
Monitoring period	**Water level**	-	
	Water quality	2003 to 2008	

Bore 4003 geological profile (EBOF)

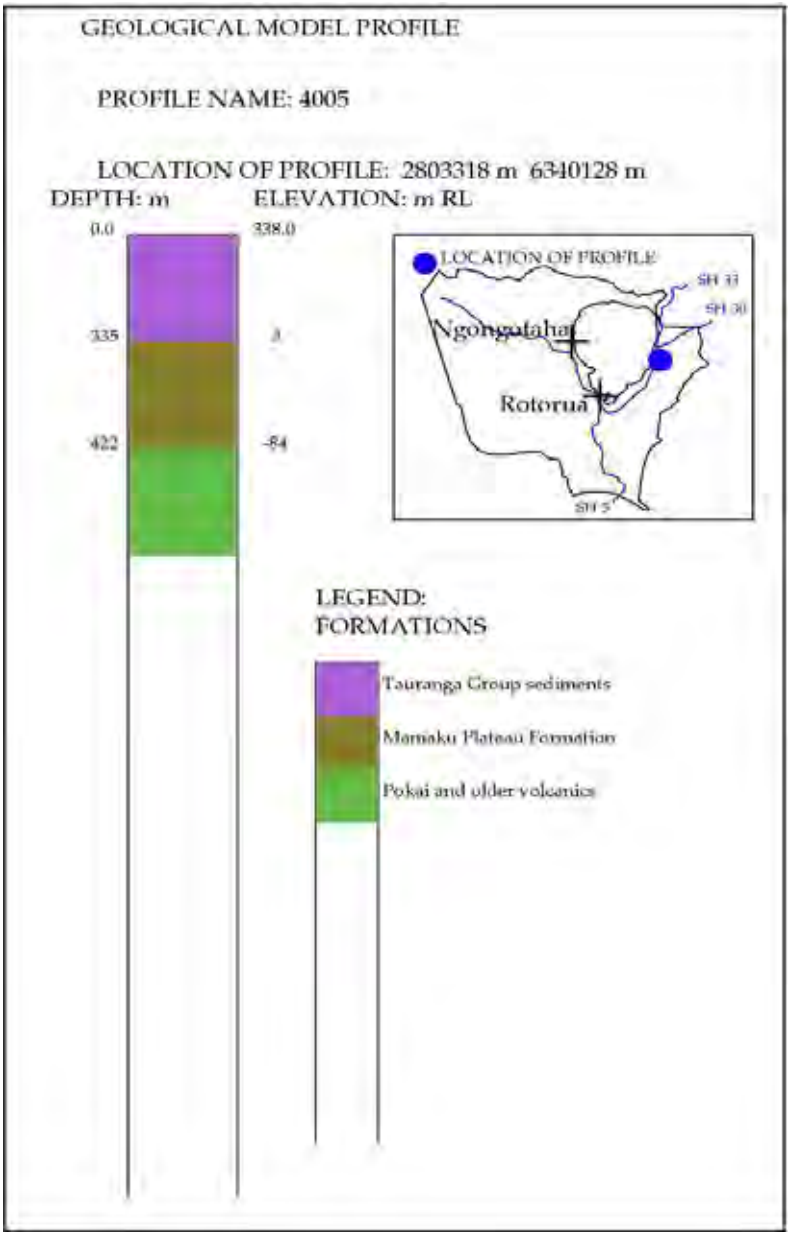


Bore 4003 water quality graphs

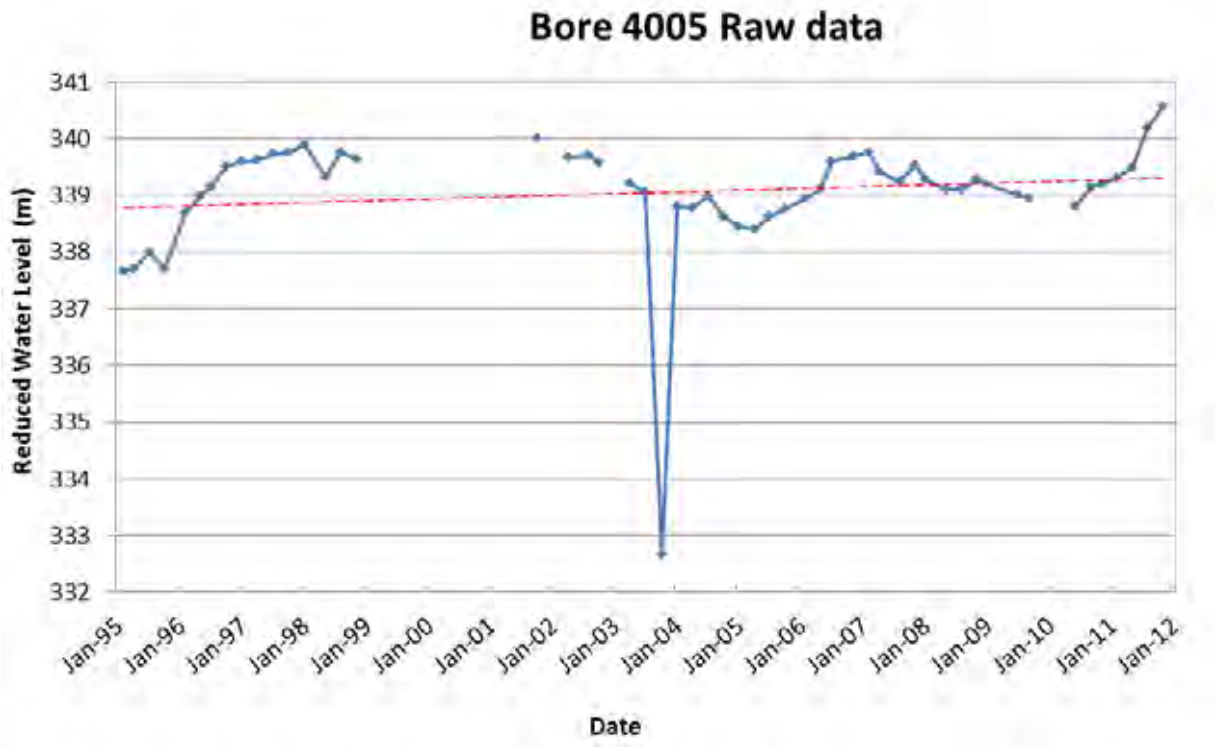


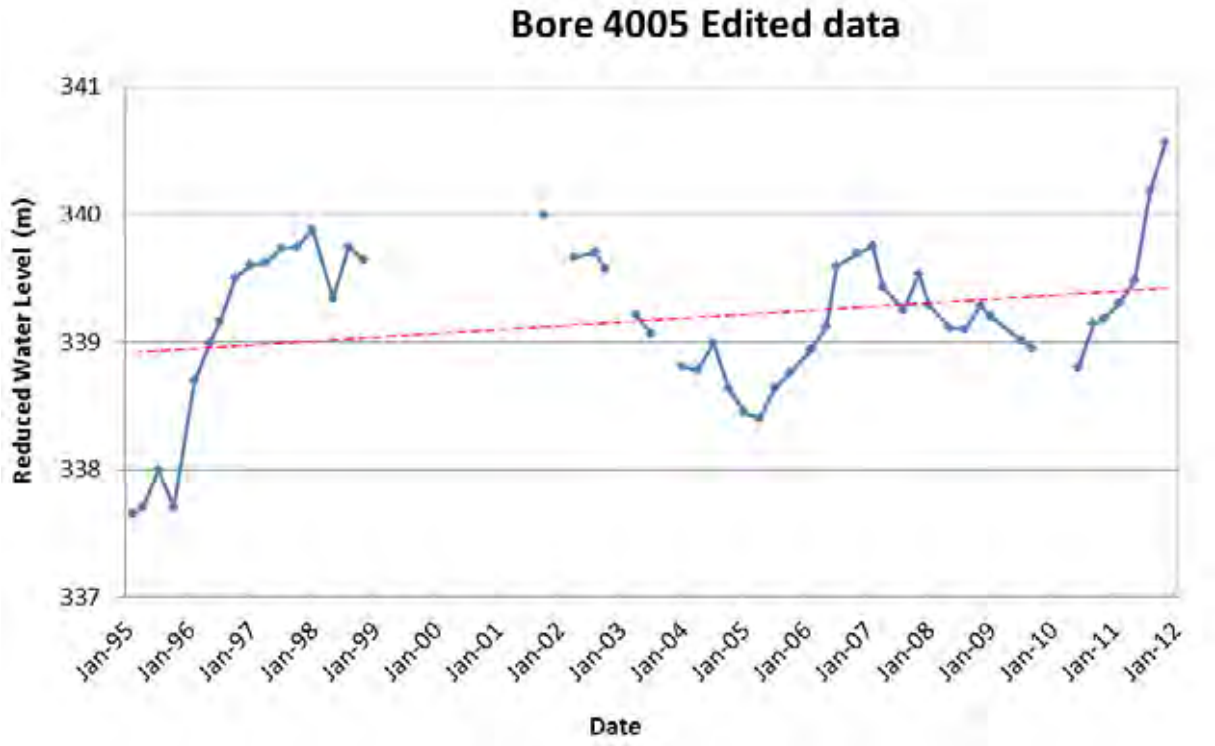
Bore 4005 Information			
Monitoring type	Water level	**Depth (m)**	180
Name	Geiss	**Casing Depth (m)**	167
Bore use	Irrigation/domestic	**Screen/open hole**	Unknown
Easting	280 3318	**Temperature**	Unknown
Northing	634 0128	**Catchment**	Rotokawa (Lake Rotorua)
Bore log	–	**Aquifer**	Tauranga sediments
Monitoring period	**Water level**	1995 to 2011	
	Water quality	-	

Bore 4005 geological profile (EBOF)



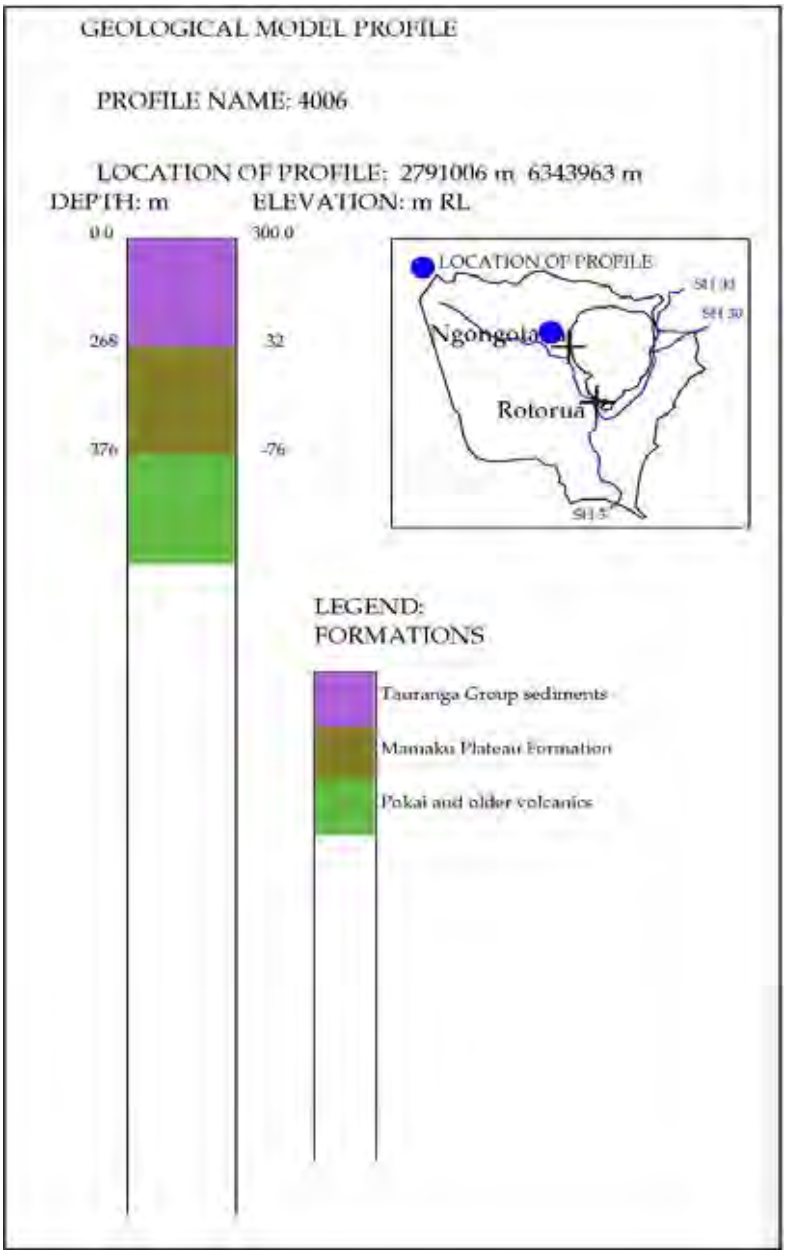
Bore 4005 water level graphs



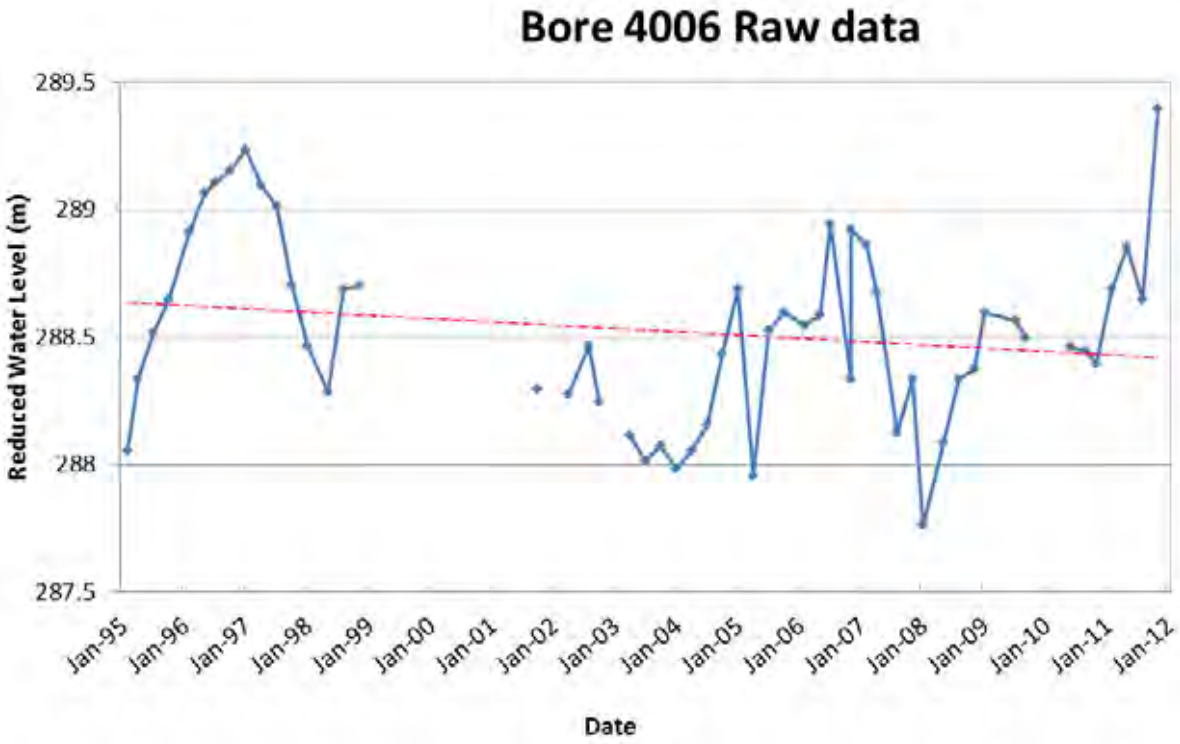


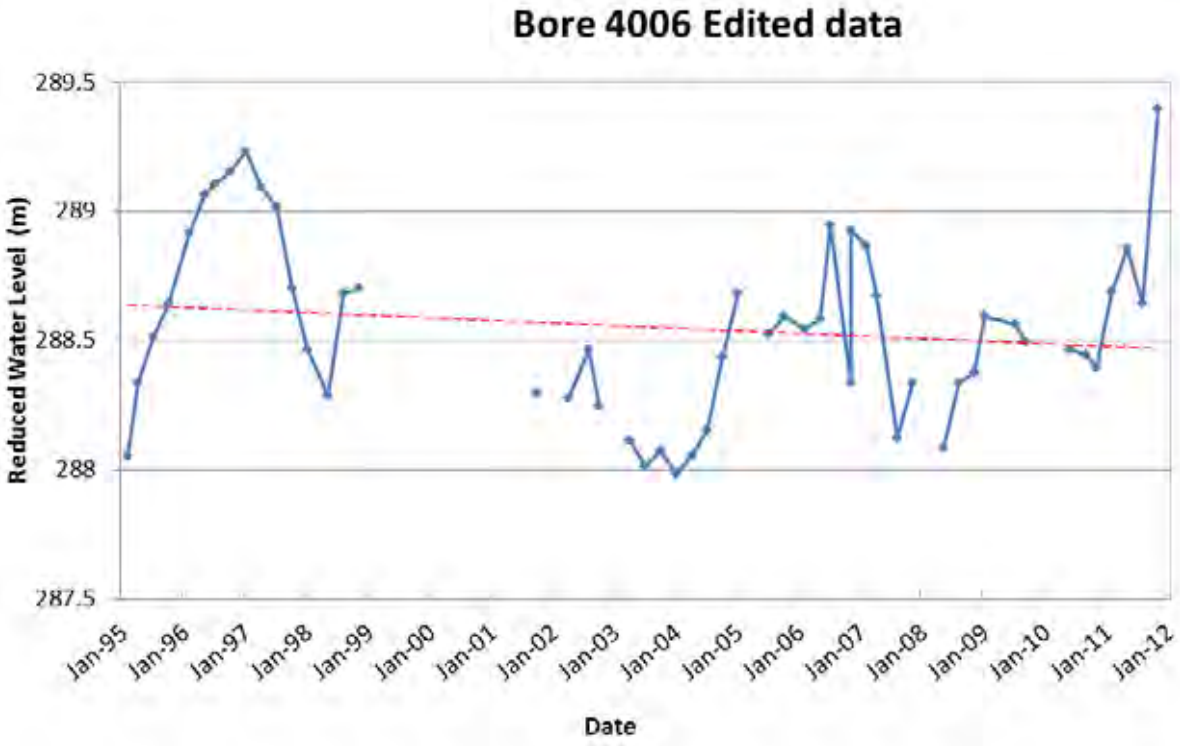
Bore 4006 Information			
Monitoring type	Water level	**Depth (m)**	85.3
Name	Field	**Casing Depth (m)**	Unknown
Bore use	Irrigation	**Screen/open hole**	Unknown
Easting	279 1006	**Temperature**	Unknown
Northing	634 3963	**Catchment**	Waimehia (Lake Rotorua)
Bore log	-	**Aquifer**	Tauranga sediments
Monitoring period	**Water level**	1995 to 2011	
	Water quality		

Bore 4006 geological profile (EBOF)



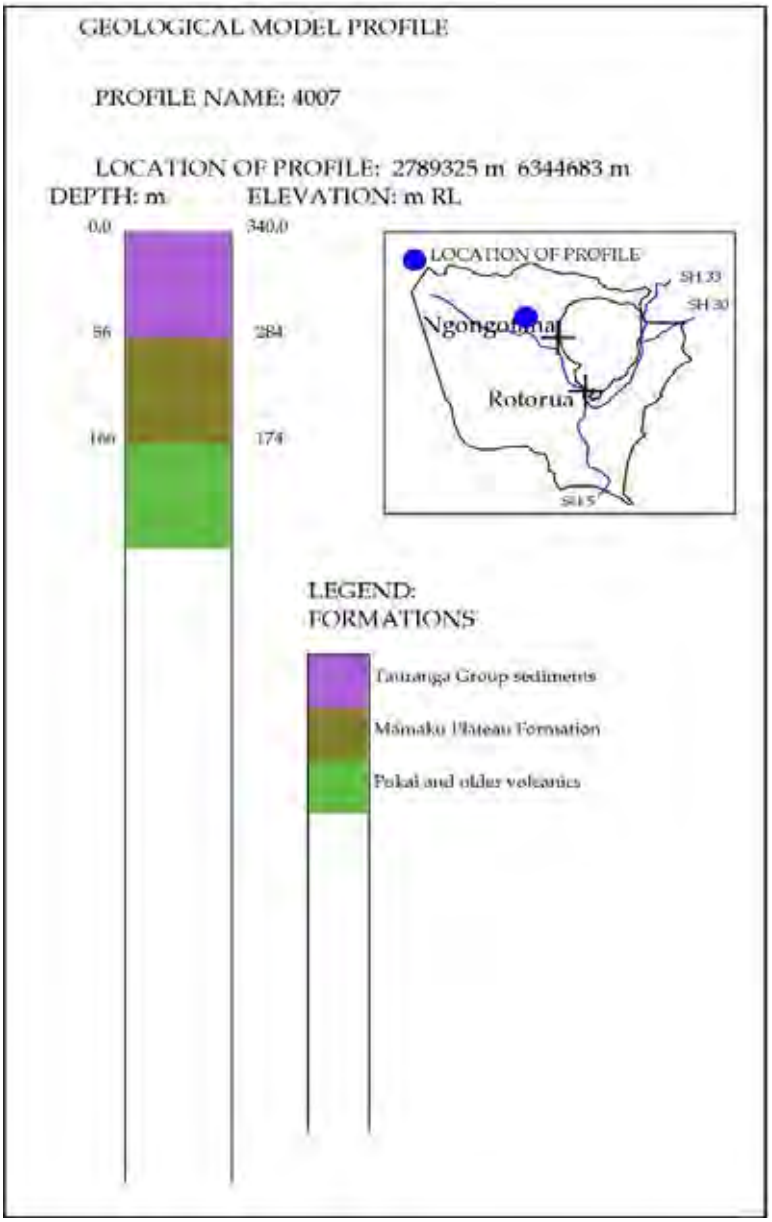
Bore 4006 water level graphs



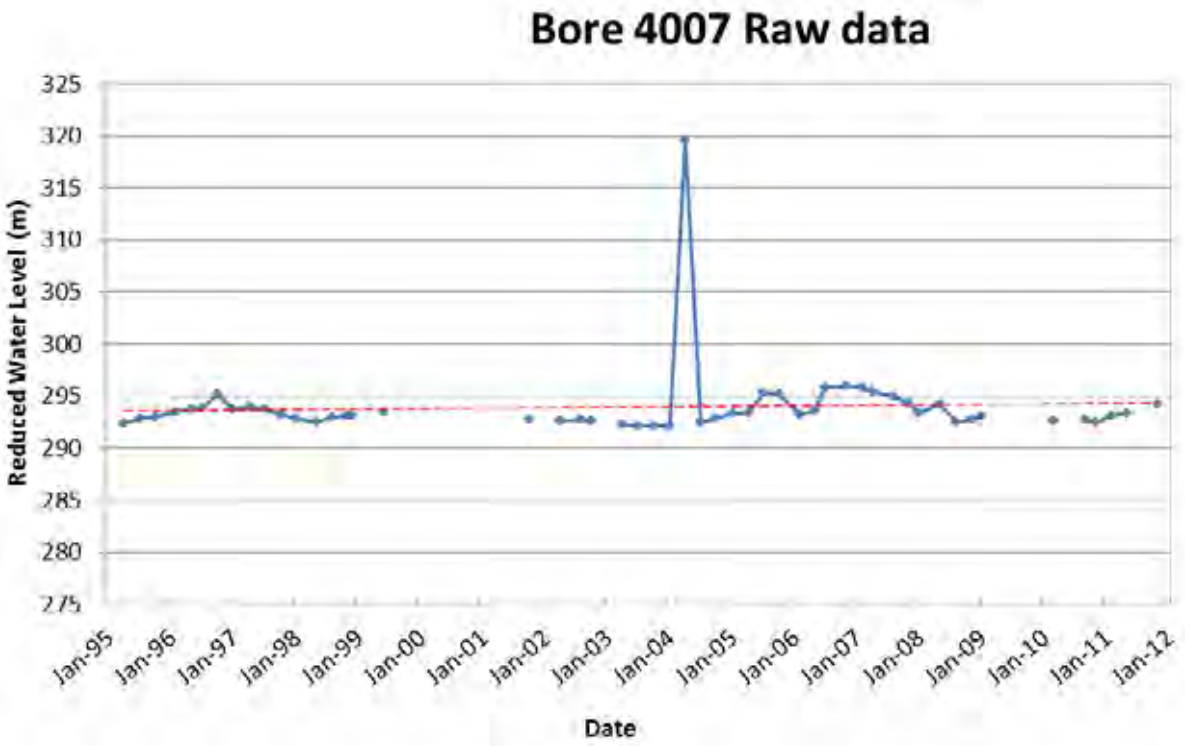


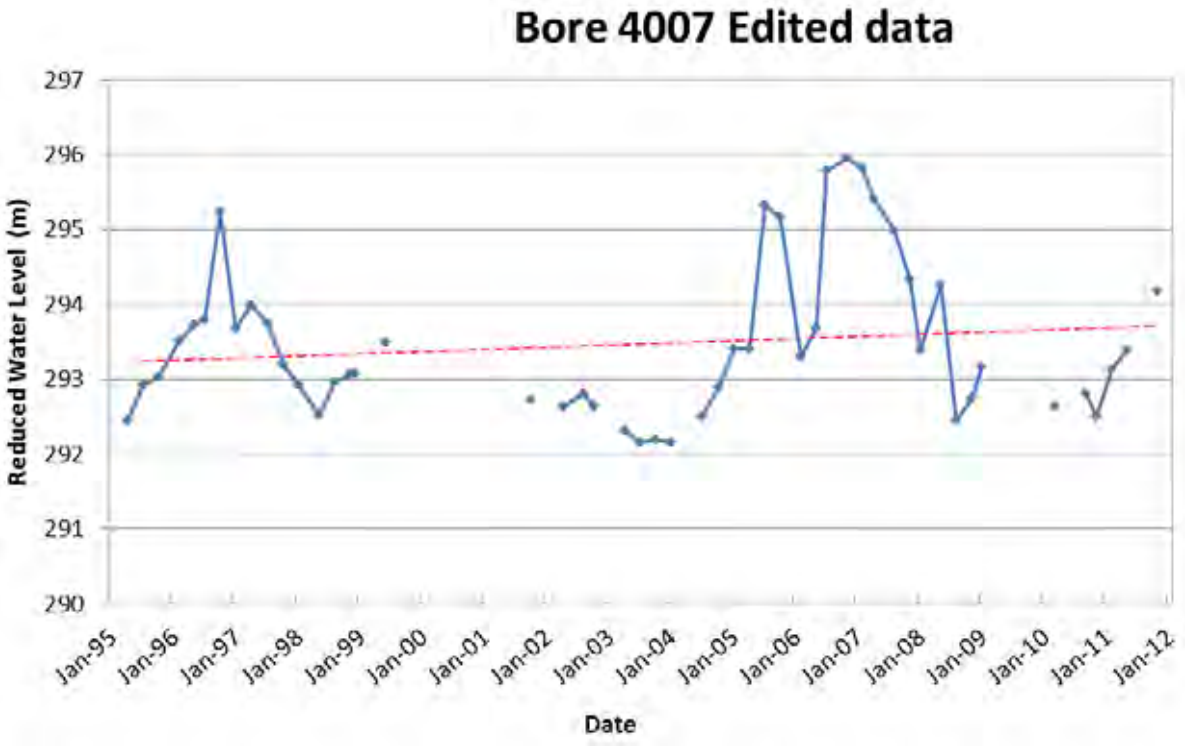
Bore 4007 Information			
Monitoring type	Water level & Water quality	**Depth (m)**	Unknown
Name	Pemberton	**Casing Depth (m)**	Unknown
Bore use	Lifestyle block/Domestic	**Screen/open hole**	Open hole
Easting	278 9325	**Temperature**	12.7°C
Northing	634 4683	**Catchment**	Waimehia (Lake Rotorua)
Bore log	-	**Aquifer**	Pokai and other volcanics
Monitoring period	**Water level**	1995 to 2011	
	Water quality	1996 to 2011	**LabStar:** BOP180061

Bore 4007 geological profile (EBOF)

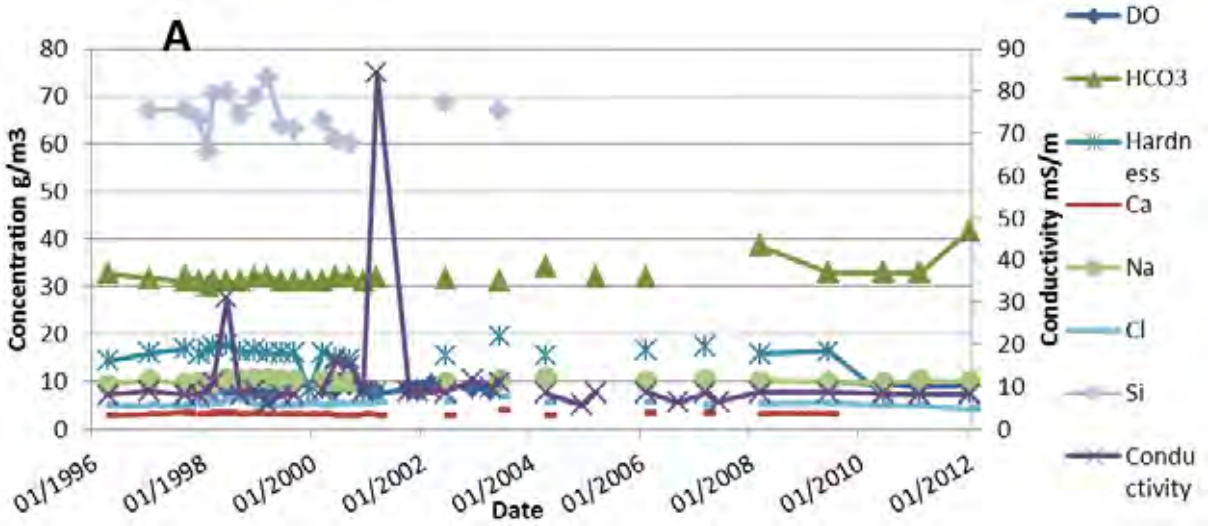


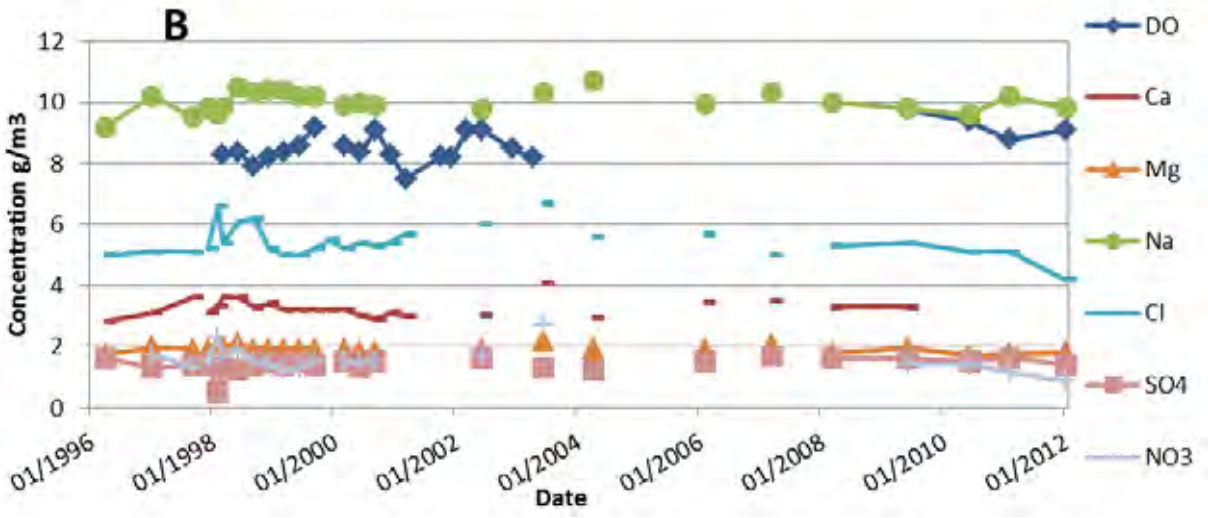
Bore 4007 water level graphs

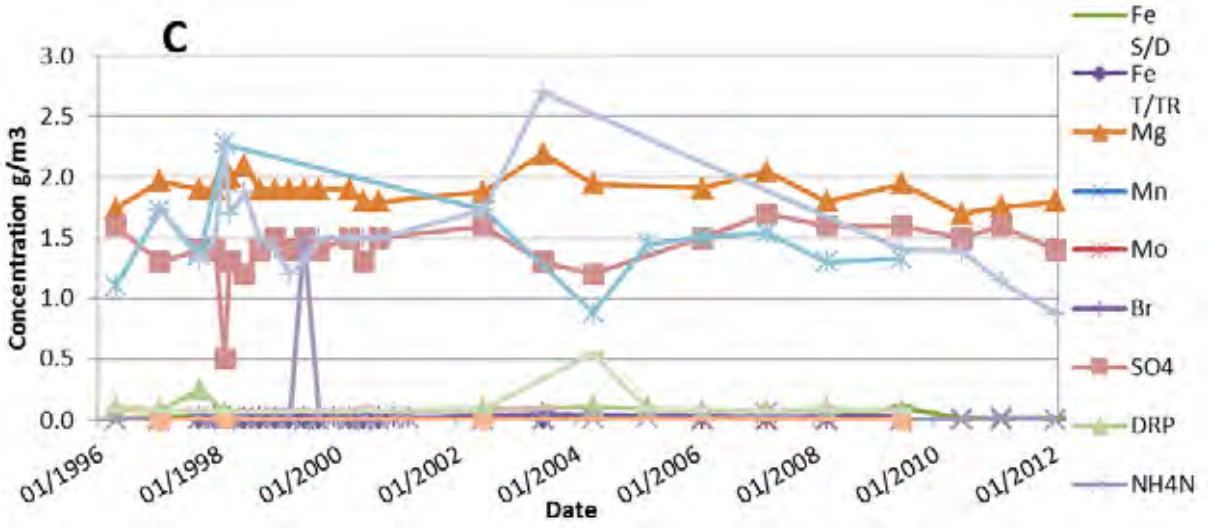




Bore 4007 water quality graphs

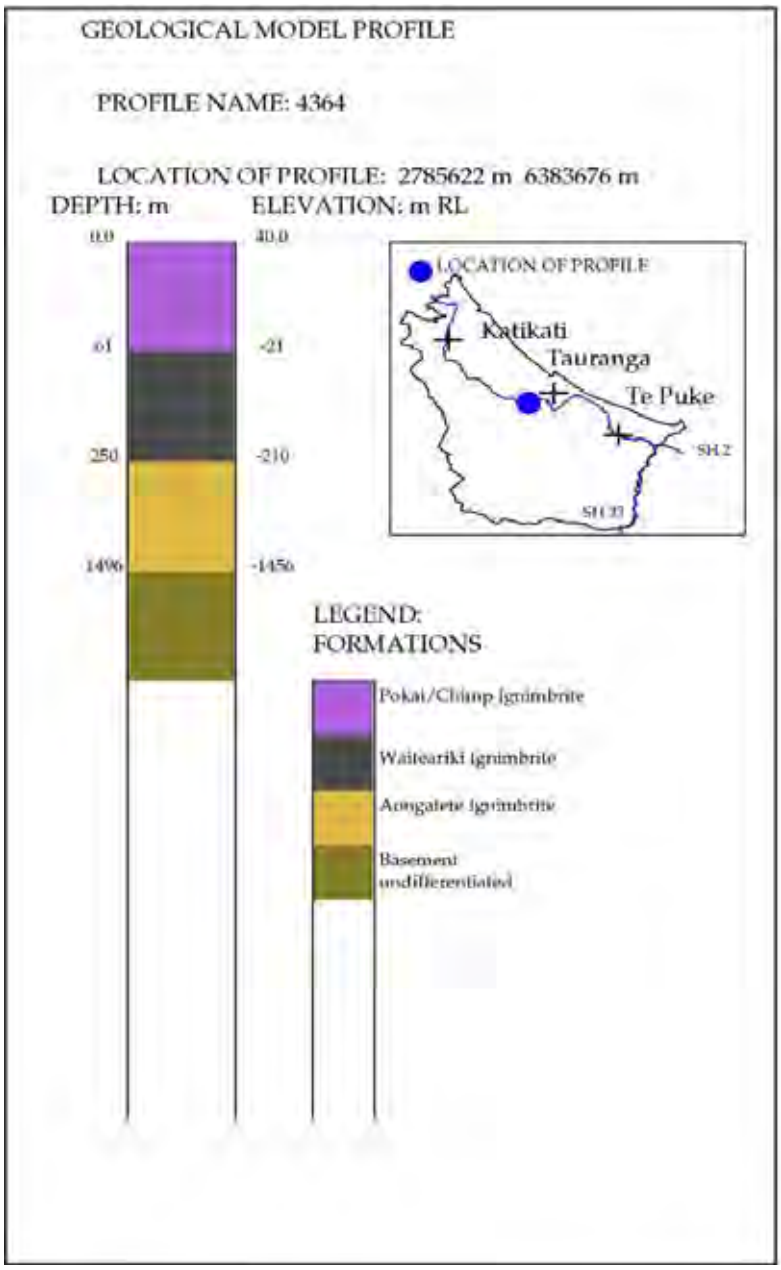




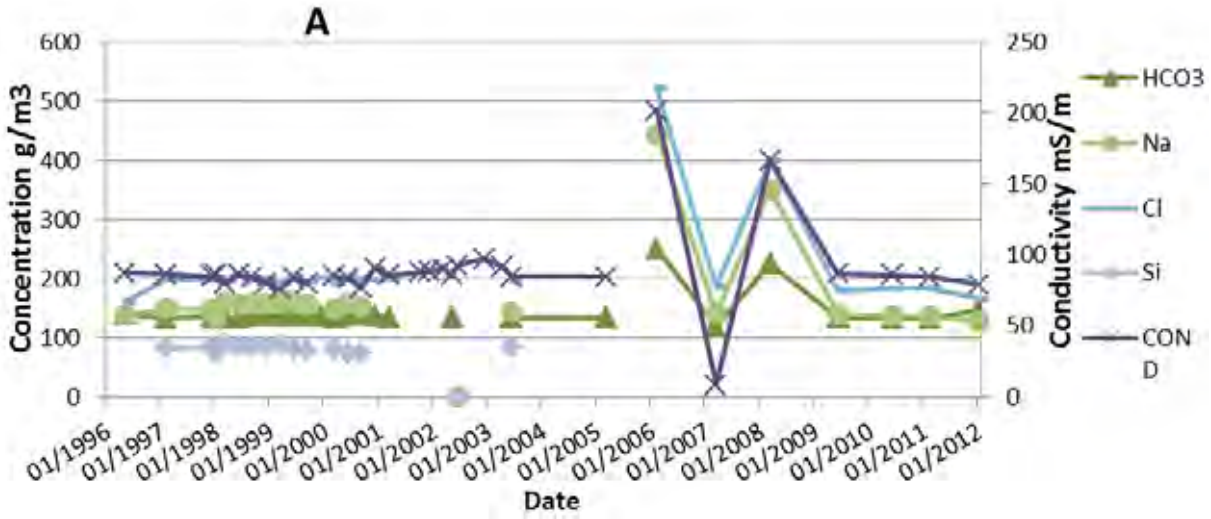


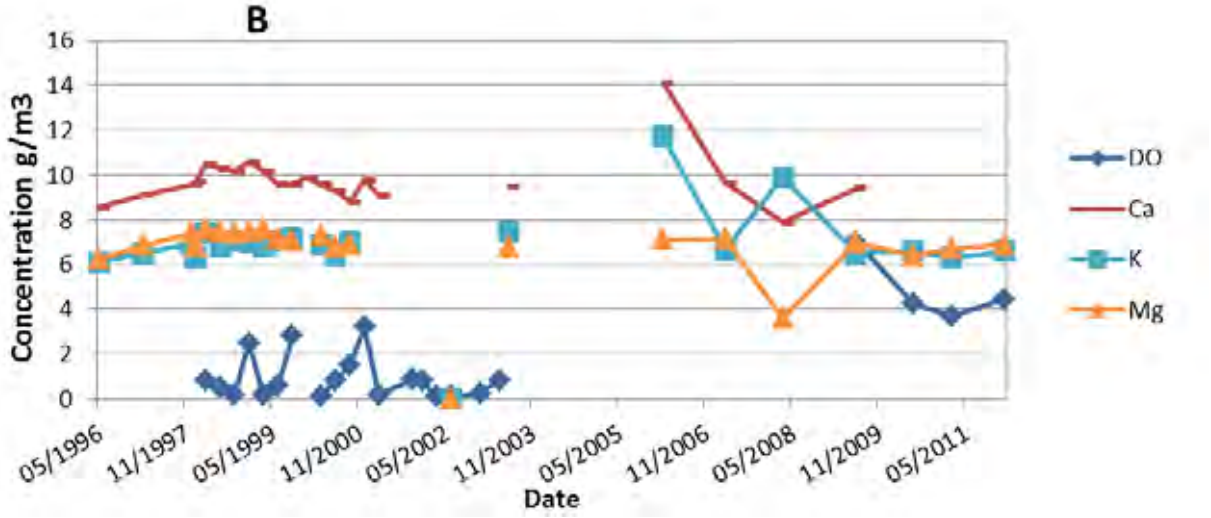
Bore 4364 Information			
Monitoring type	Water quality	**Depth (m)**	177
Name	Fernland Spa	**Casing Depth (m)**	-
Bore use	Commercial	**Screen/open hole**	Open hole
Easting	278 5622	**Temperature**	37.4
Northing	638 3676	**Catchment**	
Bore log	Complete	**Aquifer**	Waitekariki (WAI)
Monitoring period	**Water level**		
	Water quality	1996 to 2011	**LabStar:** BOP180062

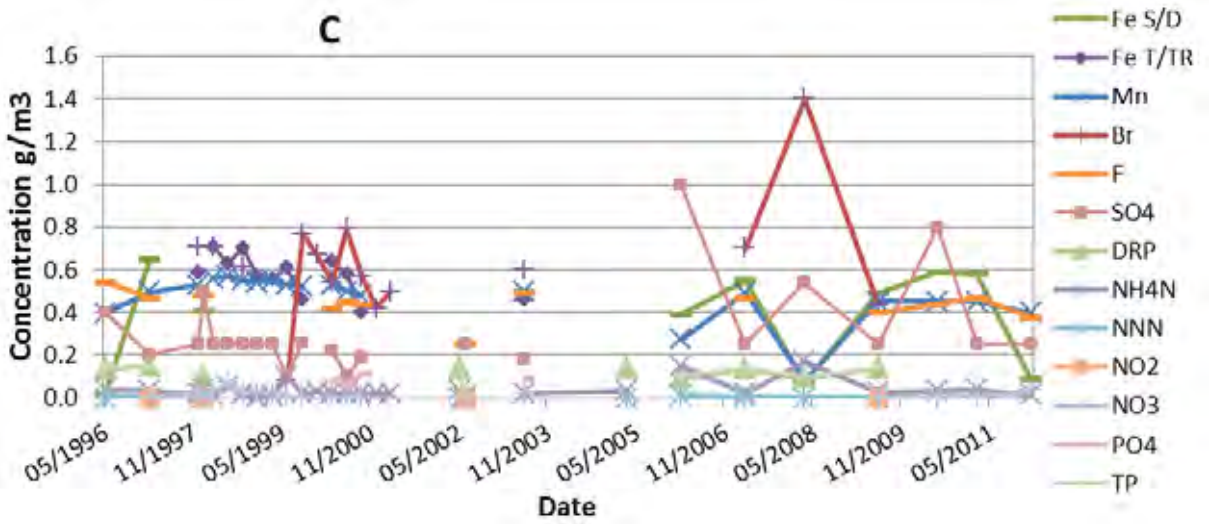
Bore 4364 geological profile (EBOF)



Bore 4364 water quality

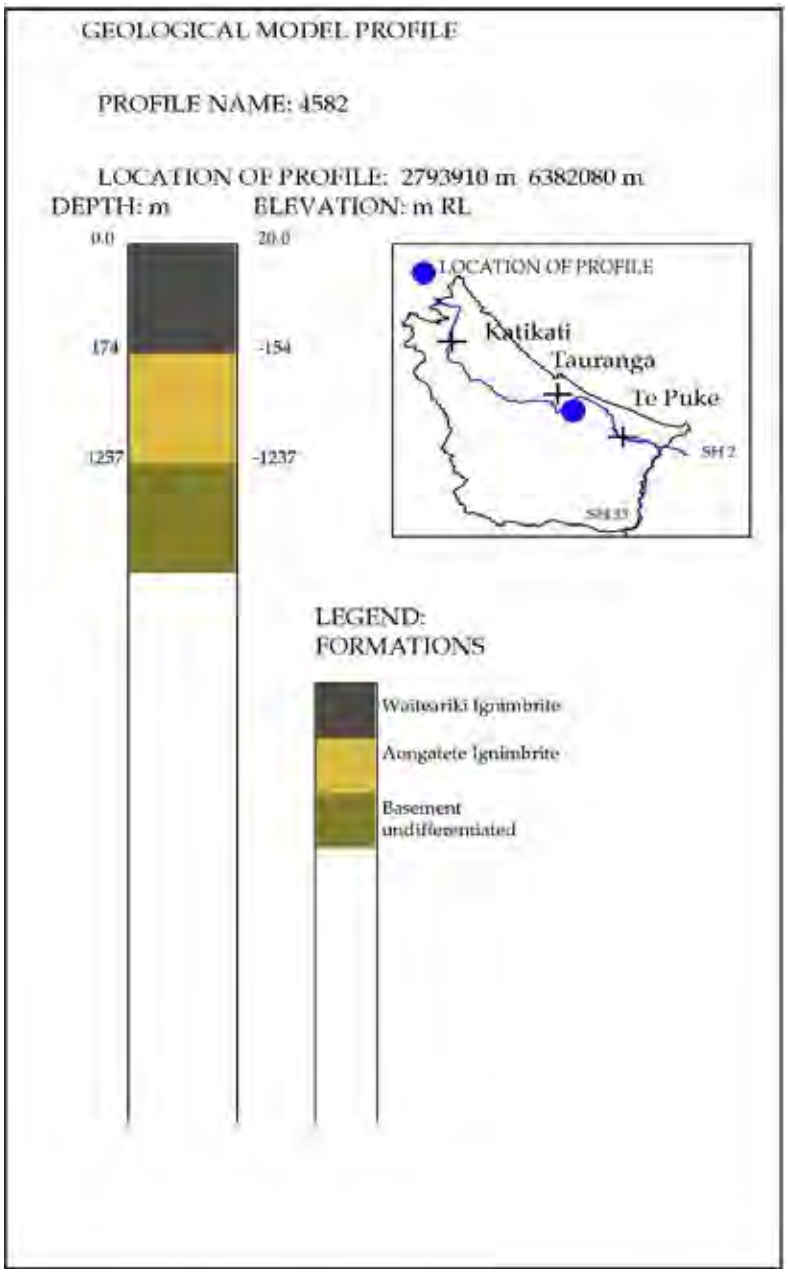




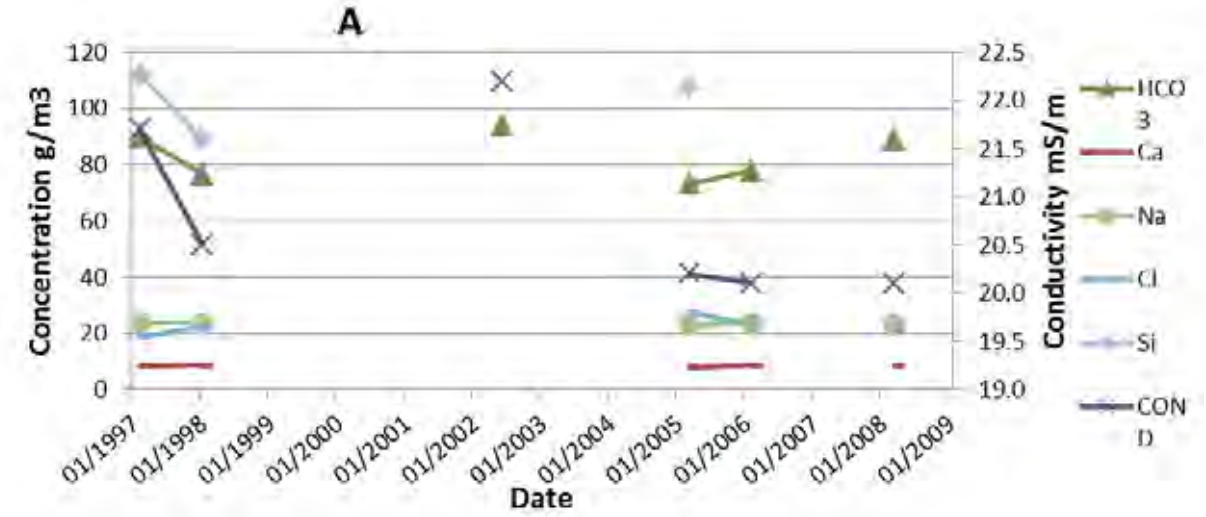


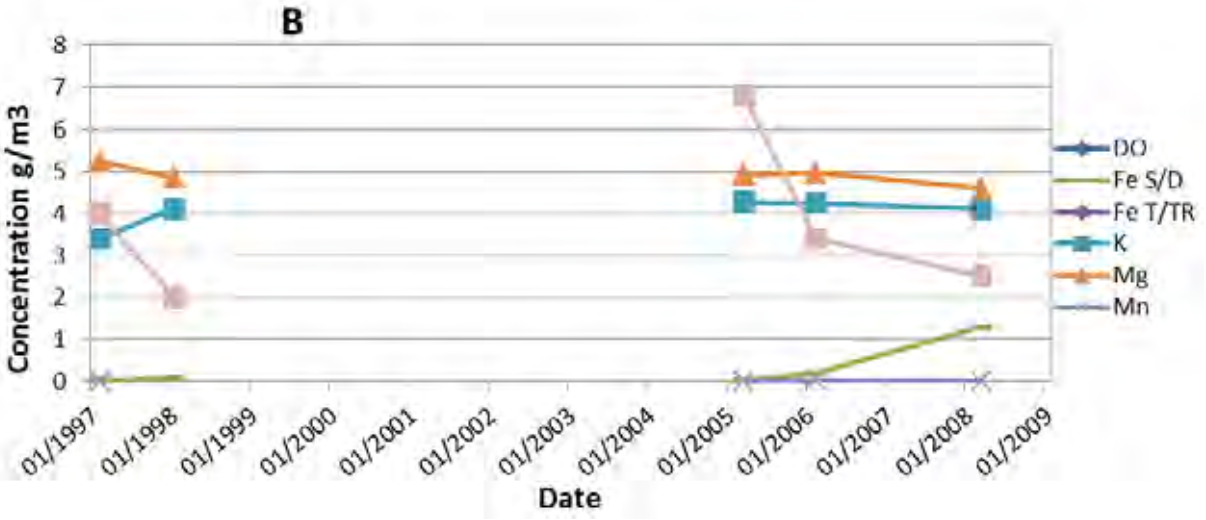
Bore 4582 Information			
Monitoring type	Water quality	**Depth (m)**	350
Name	MacLean	**Casing Depth (m)**	Unknown
Bore use	Unknown	**Screen/open hole**	Open hole
Easting	279 3910	**Temperature**	26.7°C
Northing	638 2080	**Catchment**	Welcome Bay
Bore log	–	**Aquifer**	Aongatete (WAI)
Monitoring period	**Water level**		
	Water quality	1997 to 2008	**LabStar:** BOP180069

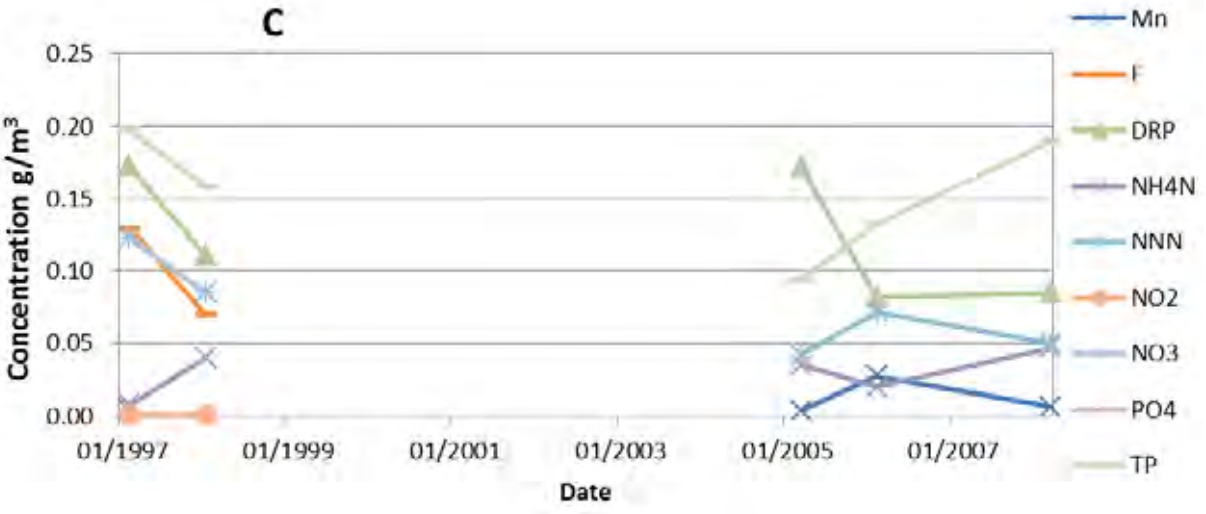
Bore 4582 geological profile (EBOF)



Bore 4582 water quality graphs

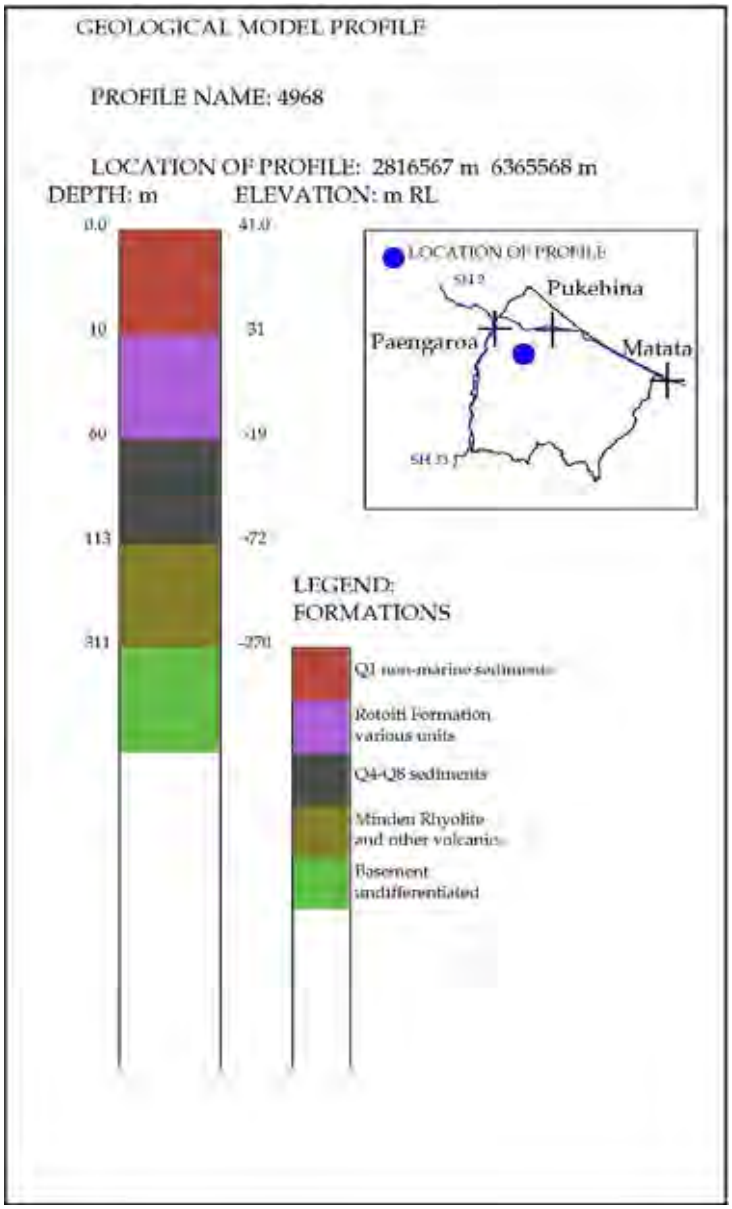






Bore 4968 Information			
Monitoring type	Water quality	**Depth (m)**	10
Name	Wharenui Green Ltd.	**Casing Depth (m)**	unknown
Bore use	Irrigation/frost	**Screen/open hole**	unknown
Easting	2816567	**Temperature**	-
Northing	6365568	**Catchment**	Kaikokopu-Pokopoko-Wharere
Bore log	-	**Aquifer**	Tauranga sediments
Monitoring period	**Water level**	-	
	Water quality	2002 to 2011	**LabStar:** BOP180406

Bore 4968 geological profile (EBOF)



Bore 4968 water quality graphs