

# Groundwater Quality State and Trends 2011

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## Executive Summary

1. The quality of Marlborough groundwaters remains high and there have been no major changes from the initial state and trends report presented to MDC in 2010
2. MDC have established a stable network of survey wells that is representative of regional differences in natural water quality and land use impacts across Marlborough
3. A formal process exists for identifying and reporting changes in groundwater quality and providing feedback to influence policy or land use practices
4. Water quality information from key indicator wells will be added to the MDC website over the next year to provide the community with access to the raw data used for identifying the status of the resource and trends over time
5. Ongoing monitoring of groundwater quality is essential because of the value of the resource to residents for drinking, the economy and ecologically. The potential exists for groundwater quality to be quickly degraded because of the insecure type aquifers in many parts of the district
6. Longer records of the time scale of decades will isolate the influence of climate variability and the residual effects of past versus current land use on groundwater quality
7. Information collected today will answer the management questions of tomorrow



## Contents

Executive Summary .....	i
1. Introduction .....	4
1.1. Marlborough Groundwater Quality .....	4
1.2. Monitoring Methodology and Network .....	4
1.3. Methodology and Reporting .....	5
1.4. Sampling and Analysis Procedures .....	6
1.5. Water Quality Standards and Suitability Threshold .....	9
2. Groundwater Quality Status .....	9
2.1. Nitrate-Nitrogen .....	9
2.2. Ammoniacal Nitrogen .....	11
2.3. Chloride .....	11
2.4. pH .....	11
2.5. Manganese .....	12
2.6. Iron .....	12
2.7. Flouride .....	13
2.8. Sodium .....	13
2.9. Sulphate .....	14
2.10. Arsenic .....	14
2.11. Boron .....	15
3. Status Summary and Changes Over Time .....	16
4. Conclusions .....	16
5. References .....	16
6. Appendices .....	17

## 1. Introduction

Marlborough and especially the Wairau Plain is heavily dependant on underground water for its everyday existence and economic prosperity. All of the main settlements rely on groundwater for their public drinking water and many rural dwellers have water wells.

The Blenheim hinterland relies on groundwater as its prime source of freshwater for irrigating crops and wine processing. It also drives the baseflow of ecologically important and highly valued freshwater springs such as the Taylor River or Spring Creek.

The quality of groundwater is just as important as having enough of it in the right place at the right time. Groundwater is accorded the highest grading of any natural freshwater body because it is primarily used for human consumption. While potability standards remain the benchmark for freshwater quality, environmental and social criteria are also part of the formula.

There is growing awareness of the need to manage freshwater quality at a catchment scale given the connectivity of rivers with lowland springs and groundwater. With the exception of very old groundwater that is relatively isolated from other parts of the hydrological cycle, water quality should be preserved for the next stage in the continuum.

Generally speaking naturally occurring poor groundwater quality is associated with confined aquifers whereas human activities affect shallow, unconfined aquifers the most because they are more vulnerable to overlying landuses.

### 1.1. Marlborough Groundwater Quality

Marlborough groundwater quality is generally of a very high standard with some exceptions. This is especially true of the free-flowing aquifers which underlie the northern Wairau Plain. Because of the natural filtering effect of alluvial aquifers, groundwater is generally of higher quality than river waters, especially in terms of microbe levels.

Some local groundwaters are not of optimum quality due to natural processes and examples of this are the typically low pH waters beneath the northern Wairau Plain or hard water at Rarangi. Older groundwaters can be degraded through mineralisation which causes elevated levels of natural salts such as boron, chloride, iron, manganese and arsenic. Arsenic is the most harmful substance to human health found in Marlborough groundwaters and is mostly naturally occurring.

The focus in terms of poor groundwater quality caused by human activities is nutrients. They can come from septic tanks, agricultural fertilisers and the general effects of urbanisation or landuse intensification. The most common problem is elevated levels of nitrate-nitrogen linked to wells tapping unconfined aquifers.

Avoiding contamination through sound landuse practices is always preferable to fixing things later. However there is little that can be done about naturally occurring issues except treat water to reduce concentrations to acceptable levels, but this relies on an awareness that an issue exists.

The purpose of this report is to provide an annual update on the status of Marlborough groundwater quality. It is intended to inform the Marlborough District Council and community of regional scale risks that may affect them, and practices that can influence this valuable natural resource.

### 1.2. Monitoring Methodology and Network

To identify groundwater pollution issues, potential threats and to improve understanding of aquifer processes, the Marlborough District Council and its predecessors have actively monitored groundwater quality in some shape or form since the 1970s.



The programme has evolved over time to reflect the issues of the day and monitoring resources or staff levels. Major reviews occurred in 1998 when it became part of the national groundwater monitoring programme and again in 2004 when these standards were incorporated across all sites and the network was enlarged to its current size.

The core component of the programme which is reported on each year compares groundwater quality to national and local standards. This ranks its suitability for various uses and tracks changes from year to year. Every 5 years a more detailed assessment is made of whether groundwater quality is improving, deteriorating or staying the same along with the possible causes.

While the Marlborough District Council groundwater monitoring network covers a representative range of locations and threats to groundwater, it is primarily a regional scale tool and may not detect local spills or contamination issues. MDC still rely on reports from well owners to identify these smaller scale problems.

Most of the sites used for sampling groundwater are Marlborough District Council monitoring wells with a smaller number of privately owned wells. Dedicated sites are preferred because they provide security of tenure and continuity of information. The aim is to produce long term records of 50 years or more to identify any trends in groundwater quality in relation to land-uses or environmental changes.

In the past many different sites have been sampled rather than a fixed group. This provided a snapshot of groundwater chemistry, but not the uninterrupted record needed to see what if any trends exist. To ensure continuity of record, the current network will be maintained or added to, but no sites will be removed.

Geographically the focus has always been the Wairau Plain where the main population is located and the highest rates of groundwater use occur to support the most intensive land uses and largest settlements. The network has evolved over time and includes a reasonably representative series of aquifer types and land-uses, although areas like Rai Valley are not yet included.

### **1.3. Methodology and Reporting**

The methodology adopted by this report and in the future differs from previous MDC groundwater quality approaches. The emphasis is now on quantitatively assessing groundwater quality at a fixed number of monitoring sites.

Results will be reported on and formally presented to the Marlborough District Council in June of each year based on all records at a particular site updated with measurements from the last 12 months. Median values are used to assess the suitability or state of groundwater quality to even out seasonal or short-term fluctuations. Every 5 years there will be a more detailed analysis of trends in water quality over time.

Because pesticides and microbes are often either present or absent in groundwater their levels relative to safe thresholds is not as adequately defined by median values. A fairer method of describing the effect on water quality is still being worked out by MDC staff and will be incorporated in the 2012 report.

Bacteria are the only type of microbe measured by the MDC and their presence is surprisingly low at the sites sampled historically. This probably reflects natural attenuation processes, particularly in finer grained materials such as at Rarangi which in the past have been thought to be more vulnerable to land-use contaminants.

Pesticides are of high public interest but are not surveyed as often as other chemicals in groundwater because they can potentially be toxic in very small concentrations in groundwater and laboratory analyses at these low levels are very expensive. To narrow down the search, certain active ingredients known to be associated with Marlborough agricultural practices or crops are targeted for analysis.

Apart from isolated incidences, pesticides are not a major issue in Marlborough groundwaters and this was again demonstrated in the external ESR report on the 2010 National Pesticide Survey which did not detect pesticides at any of the 17 Marlborough well sites.

## 1.4. Sampling and Analysis Procedures

Monitoring involves taking samples of groundwater at a network of wells chosen to represent the main water supply aquifers, their vulnerability to pollution and the type of overlying land-use.

The overall monitoring programme is made-up of 5 separate surveys each with specific aims. The details of the 5 surveys are summarised in Table 1. The most frequently conducted survey is for state of the environment monitoring of general chemical parameters and is conducted each season.

It involves sampling 15 wells and analysing for a general range of metals, nutrients and commonly occurring constituents of Marlborough groundwaters. This is referred to as the Marlborough State of the Environment programme (MSOE). The location of the wells sampled is shown in Figure 1.

A further 8 well sites are sampled each season for a similar group of parameters as part of the National Groundwater Monitoring Programme (NGMP). Coordinated by the Crown Research Institute GNS Science Ltd and involving most regions of New Zealand, the results provide a national perspective of groundwater quality. These sites are also shown in Figure 1.

The information collected by the regions forms the basis for national state of the environment reports, the most recent of which was produced by the Ministry for the Environment in 2007. The Marlborough District Council first participated in the programme in 1998 and continues to support it. The mutual benefits to Marlborough district and New Zealand are a nationally consistent set of measurement and reporting guidelines.

**Table 1: MDC Monitoring Programme Details**

Survey	Number of wells sampled	Timing	Sampling Frequency
District state of the environment monitoring programme (MSOE)	15	Seasonally	4 times per year
National groundwater monitoring programme (NGMP)	8	Seasonally	4 times per year
Microbiological survey	14	Spring when potential leaching rates are highest and levels are likely to peak	Once each year
Coastal aquifer salinity survey	6	Summer when the potential for seawater intrusion is greatest	Once each year
National pesticide survey (NPS)	(17 every 4 years)	Spring when potential leaching rates are highest and levels are likely to peak	Once every 4 years
Marlborough pesticide survey (MPS)	(3 each year)		Once each year

As well as collecting information on the general constituents of groundwater MDC staff also measure levels of pesticides, microbes and the salinity of groundwater near the coast. These surveys are carried out at specific times of year when their concentration in groundwater is likely to peak. Microbes are surveyed for at 14 wells located in areas downstream of human settlement or in unconfined aquifers susceptible to landuse contamination (Figure 2).

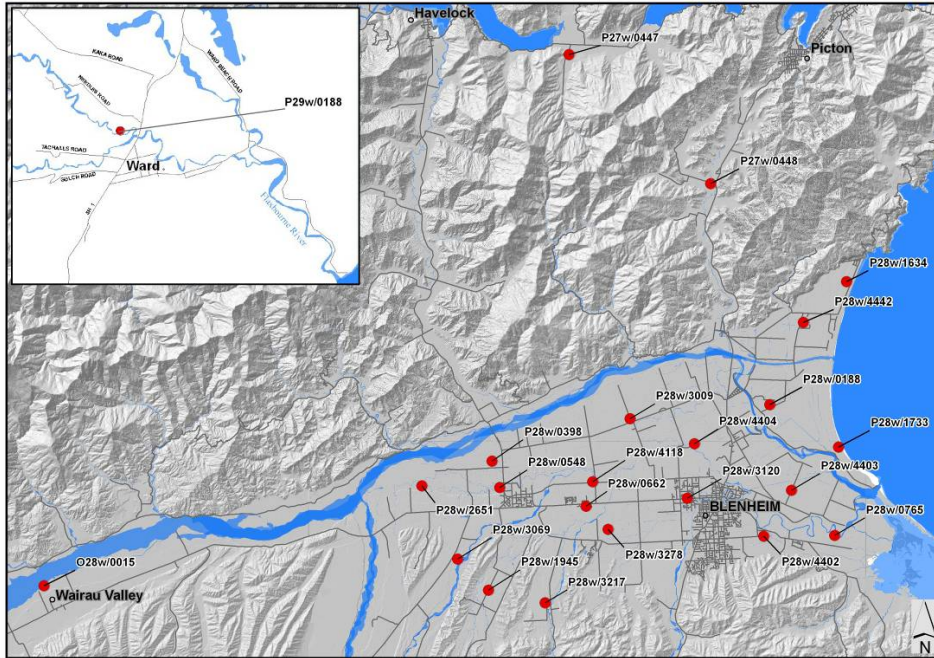


Figure 1 : Seasonal State of the Environment and NGMP Sampling Sites

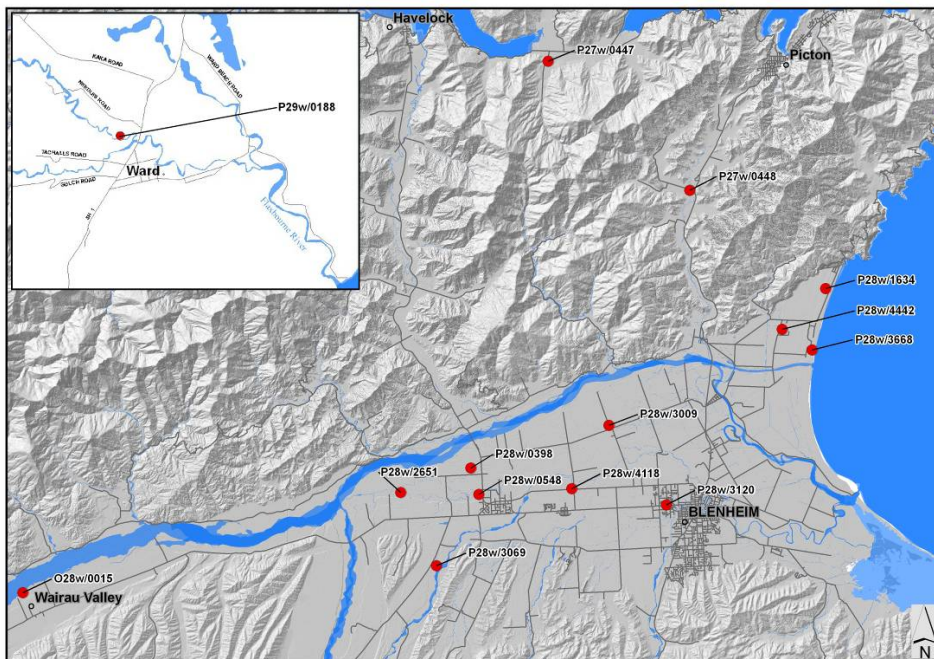
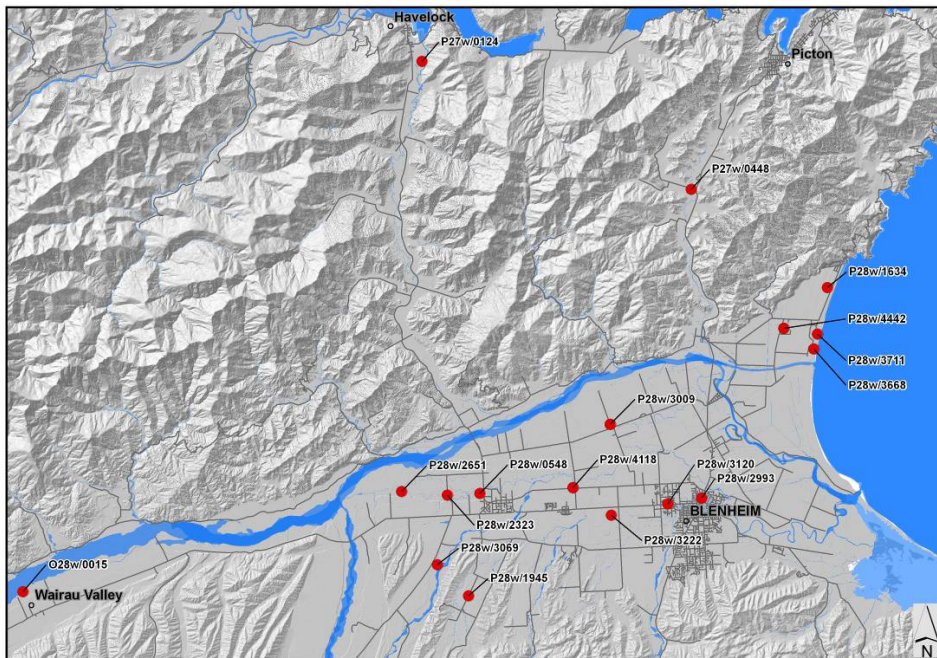


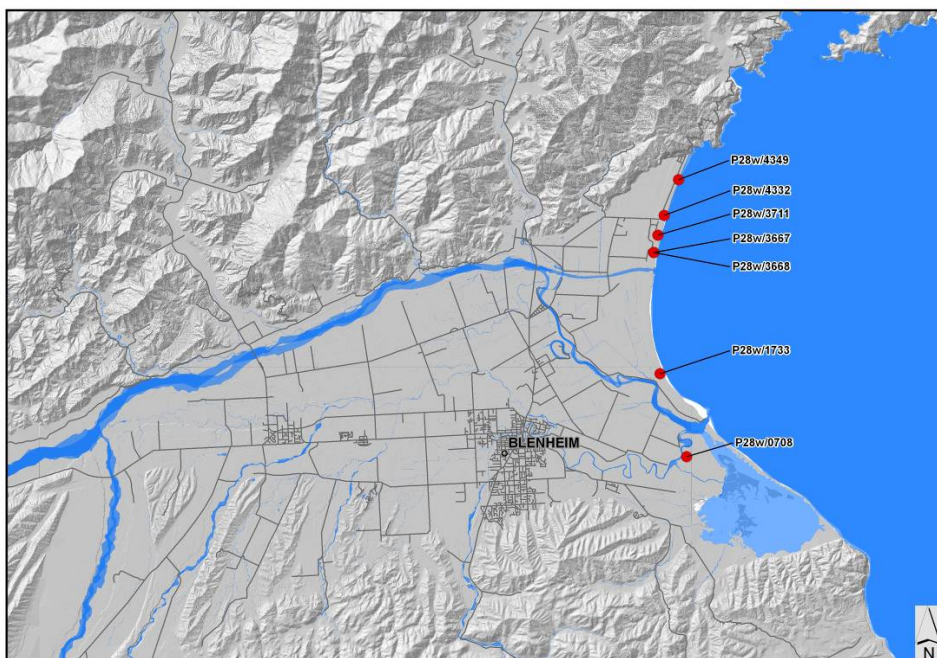
Figure 2 : Microbiological Sampling Sites

Pesticides are another special case of particular interest for the intensively farmed Wairau Plain. Council measures levels of a broad spectrum of pesticides at 3 sites each year and also participates in the National Pesticide Survey which involves collecting samples at 17 local wells every 4 years. It is coordinated by the crown research institute ESR Ltd. Sampling is focused on aquifers that are most vulnerable to landuse contamination and have high current or historic pesticide use (Figure 3).



**Figure 3 : Pesticide Sampling Sites**

The final special interest survey measures indicators of salinity at sentinel wells along the Cloudy Bay coast line in summer each year. Trends in these indicators provide early warning of an inland migration of the seawater interface. The locations of these coastal sites where laboratory calibration samples are taken are shown in Figure 4.



**Figure 4 : Coastal Salinity Sampling Sites**

## 1.5. Water Quality Standards and Suitability Threshold

Measuring the chemical or microbial makeup of groundwater is of little practical use unless it is compared to thresholds that indicate its fitness for a certain purpose. The primary measure of groundwater quality in New Zealand is its fitness for human consumption or its potability.

The Drinking Water Standards for New Zealand 2005 (DWSNZ 2005) were prepared by the Ministry of Health and specify the maximum allowable values of health significance for each of the common parameters in groundwater.

This document also contains guidelines to avoid aesthetic issues. These are not life threatening but cause nuisance problems depending on their concentrations such as staining, odours, smells or residues.

Ecological standards also exist to gauge the threat to the normal biological functioning of wetlands or surface waters connected to groundwater. These are specified in the ANZECC 2000 guidelines, or based on local scientific studies. These are used as a performance measure but are not formalised as rules in the district plan.

These are particularly relevant to nutrients such as sulphate and nitrate-nitrogen which are present in groundwater and are transferred to groundwater fed springs such as Spring Creek where it can cause weed blooms and affect the health of plants, animals or fish.

The graphs in Figure 5 colour code the 3 types of water quality threshold. Those of health significance (MAV) are shown as a solid red line, aesthetic guidelines are marked as a dashed red line (GV) and ecological protection guideline values (EPGV) are in green.

## 2. Groundwater Quality Status

The following section reviews the median values for each of the 11 parameters where human health, aesthetic or ecological thresholds exist at each monitoring sites and updated for the latest records since the initial SER report was produced in 2010.

The approach used to identify changes over time in groundwater quality involves comparing the median value for each parameter based on the entire length of record including the most recent measurements. So that the median value is sensitive to environmental changes the same start date is fixed for each parameter at each well site and these are listed in Table 2 at the back of the report.

Figure 5 show the water quality results used to compile the district wide summary. The graphs are arranged by parameter and split according to aquifer structure as this is the dominant influence on groundwater quality, its evolution and susceptibility to landuses. Each parameter has a pair of graphs representing the unconfined and confined well sites.

Concentrations or levels of each parameter are shown on the vertical axis in parts per million. In some cases where there are large ranges in value a logarithmic scale is used instead of a linear scale to see the detailed variation from well to well. The MDC well number identifying the site is shown along the bottom of the graph. The middle 50 percentile range is shaded grey with the median value marked by the horizontal red line. The black whiskers indicate the range of values measured at each site from the maximum to the minimum.

### 2.1. Nitrate-Nitrogen

Naturally occurring nitrate concentrations are generally considered to be 1 g/m<sup>3</sup> or less although in some cases the value may be closer to 3 g/m<sup>3</sup> which in turn exceeds the ecological threshold (Table 3 & Figure 5).

Nitrate-Nitrogen values are sensitive to aquifer structure and this explains the large range in values between unconfined and confined aquifers. The bulk of exceedences occur at sites representing unconfined aquifers reflecting their relative insecurity to surface activities.

Furthermore, while nutrient inputs from landuses may originally be the same, levels tend to become lower over time in confined aquifers due to natural denitrification processes. Conversely they persist for longer in unconfined type aquifers.

Five sites had nitrate concentrations that exceeded the lower ecological concentration of  $1.7 \text{ g/m}^3$  which can potentially affect the health of hydraulically connected springs or rivers. The  $1.7 \text{ g/m}^3$  threshold was derived by Environment Canterbury for similar types of aquifers and rivers to those which occur in Marlborough.

**Table 3 : Nitrate-Nitrogen**

Year	DWSNZ 2005	ECAN 2009*
	Maximum allowable value = $11.3 \text{ g/m}^3$	Ecological protection guideline value = $1.7 \text{ g/m}^3$
	Number of sites exceeding	Number of sites exceeding
2011	0	5

\* Guideline value for moderately disturbed systems (95% protection) Environment Canterbury Technical report No. R09/57 2009 : A review of nitrate toxicity to freshwater aquatic species

Notwithstanding this the median concentration across all 23 sites was below the maximum allowable value (MAV) of  $11.3 \text{ g/m}^3$  in the Drinking Water Standards and groundwater is safe to drink. The number of exceedences have fallen slightly from 6 to 5 since the last survey. There were lower levels at Wairau Valley and Woodbourne and a rise at Renwick.

Some sites representing unconfined aquifers have large seasonal fluctuations of more than  $10 \text{ g/m}^3$  such as wells 2651, 3069 and 1634. These variations reflect the seasonality of processes that generate or leach material from overlying landuses.

Well 3120 is the only site tapping a confined aquifer with elevated levels of nitrate. This is explained by its location in the western suburbs of Blenheim where the aquifer is only semi-confined and receives recharge water that has accumulated the maximum proportion of land-use runoff along its travel path from the Wairau River.

In most cases it remains uncertain whether elevated nitrate levels are a legacy of historical or current landuses. It is likely based on longer term records at some sites that levels are relatively stable and there has been no significant change associated with vineyard conversion since 1990.

Levels tend to peak in spring or winter when rainfall is highest which leaches fertilisers downwards to the water table. Levels are lower in the free flowing Wairau Aquifer due to dilution. Areas where potential problems may occur in the future are aquifers with lesser natural throughflow and diluting ability south of Middle Renwick Road in the southern valleys catchments in particular.

## 2.2. Ammoniacal Nitrogen

Ammoniacal nitrogen is the form of nitrogen present in oxygen depleted confined aquifers. The median value at no site exceeded either the human health limit or the ecological threshold (Table 4).

**Table 4 : Ammoniacal nitrogen**

Year	DWSNZ 2005	ANZECC 2000
	Guideline value = 1.5 g/m <sup>3</sup>	Trigger value** = 0.9 g/m <sup>3</sup>
	Number of sites exceeding	Number of sites exceeding
2011	0	0

\*\* Trigger value for ecosystem protection (95% level) specified in ANZECC 2000

The 2010 survey mistakenly indicated there were 3 transgressions of the trigger level of 0.9 g/m<sup>3</sup> for ecosystem protection whereas in fact there were none. Three groundwaters at Ward, Brancott and the Lower Wairau had median concentrations above 0.1 g/m<sup>3</sup> threshold indicating the presence of advanced chemical reducing conditions. Levels were much lower across all monitoring sites in unconfined aquifers.

## 2.3. Chloride

Chloride is largely a naturally occurring component of Marlborough groundwaters. Levels are within acceptable limits across all sites and median values have not changed significantly between 2010 and 2011 (Table 5 and Figure 5). The threshold is for aesthetic purposes in this case.

**Table 5 : Chloride**

Year	DWSNZ 2005
	Guideline = 250 g/m <sup>3</sup>
	Number of sites exceeding
2011	0

Higher levels are more common in older groundwaters or those close to the coast where marine sediments are naturally high in chloride such as at Rarangi. The highest median concentrations are found in groundwater from the Deep Wairau Aquifer and near Ward.

At depth below the Wairau Plain the confining layer capping the Wairau Aquifer and similar material at Ward is naturally high in sodium and chloride as a legacy of its marine origin. Both of these salts are easily dissolved in groundwater. The high value measured at the Woodbourne wells 662/3010 is an outlier and not representative of local groundwater quality.

## 2.4. pH

The pH of local groundwater is largely driven by natural processes with unconfined aquifers tending to have lower values and confined aquifers higher values. This is the expected pattern whereby natural chemical degradation processes in oxygen deficient confined aquifers produce bicarbonate which

increases pH. Conversely rainfall enriched in CO<sub>2</sub> has the opposite effect and pH falls as this water leaches through the soil down to the water table.

**Table 6 : pH**

Year	DWSNZ 2005
	Optimum range = 7 to 8.5
	Number of sites outside range
2011	13

Thirteen sites were outside the ideal range for water supply mostly due to naturally low pH in local unconfined aquifers (Table 6). This is the same number as for the 2010 report. Low pH is a common naturally occurring problem which is corrected for in the Renwick and Blenheim municipal water supply by adding lime to reduce the corrosion of water mains and household pipes or appliances.

## 2.5. Manganese

Along with iron, manganese is a naturally occurring constituent of groundwater. Elevated or high concentrations of manganese are mostly associated with confined aquifers which reflects longer residences times and as a consequence more water-rock interaction. Excessive levels of manganese is a common problem in many parts of Marlborough, but groundwater can be treated to make it safe to drink or prevent staining.

**Table 7 : Manganese**

Year	DWSNZ 2005	DWSNZ 2005
	Maximum allowable value = 0.4 g/m <sup>3</sup>	Guideline value = 0.04 g/m <sup>3</sup>
	Number of sites exceeding	Number of sites exceeding
2011	1	6

The updated median values for 2011 exceeded the human health limit of 0.4 g/m<sup>3</sup> at 1 site and the aesthetic guideline of 0.04 g/m<sup>3</sup> at 6 sites (Table 7). This high level occurred in groundwater at Ward and is caused by naturally occurring processes. The well owner has been told not to use the water for human consumption. Elevated levels of manganese were not only restricted to confined type aquifers but also the Rarangi Shallow Aquifer well 4442 which is thought to be linked to fossil wetlands.

## 2.6. Iron

Iron is a natural component of Marlborough groundwaters which generally only occurs in higher enough concentrations to cause aesthetic problems in confined aquifers where there is sluggish flow and depleted oxygen levels. Chemically iron behaves in a similar manner to manganese and high levels of one are likely to indicate the presence of the other.



**Table 8 : Iron**

Year	DWSNZ 2005
	Guideline value = 0.2 g/m <sup>3</sup>
	Number of sites exceeding
2011	5

Five sites exceeded the aesthetic guideline value for iron in both the 2010 and 2011 datasets (Table 8). All were associated with confined type aquifers except the MDC Wairau Valley public water supply well O28w/0015. While there are 5 sites with concentrations above the threshold, the consequences of drinking the groundwater are not life threatening and can be treated to avoid staining problems.

Groundwater samples have been filtered since 2004 so that only the dissolved fraction is measured in line with the national practice. As a consequence concentrations are generally lower for more recent surveys than historical records.

## 2.7. Flouride

Flouride is a naturally occurring component of groundwater that is increasingly being linked to aquifers influenced by leakage from geological faults such as at Wairau Valley.

**Table 9 : Fluoride**

Year	DWSNZ 2005
	Maximum allowable value = 1.5 g/m <sup>3</sup>
	Number of sites exceeding
2011	0

Concentrations are slightly higher in confined versus unconfined aquifers. There were no exceedences of the human health limit of 1.5 g/m<sup>3</sup> at any of the regional groundwater monitoring sites (Table 9).

## 2.8. Sodium

Sodium is largely a naturally occurring component of groundwater. This is demonstrated by the fact that levels are much higher from wells penetrating confined aquifers (Figure 5). Sodium is usually associated with chloride in groundwater.

**Table 10 : Sodium**

Year	DWSNZ 2005 Guideline value = 200 g/m <sup>3</sup>
	Number of sites exceeding
2011	0

No sites in either 2010 or 2011 had groundwater sodium levels above the aesthetic limit of 200 g/m<sup>3</sup> (Table 10). The highest concentrations were observed in groundwaters at Ward, Deep Wairau Aquifer and the Brancott Aquifer. Relative concentrations broadly follow groundwater age.

## 2.9. Sulphate

**Table 11 : Sulphate**

Year	DWSNZ 2005 Guideline value = 250 g/m <sup>3</sup>
	Number of sites exceeding
2011	0

Overall, sulphate concentrations are highest in unconfined aquifers indicating the influence of overlying landuses. One exception was higher values at Ward caused by the natural oxidation of sulphides in groundwater to produce sulphate. Sulphate levels across all sites are well below the aesthetic threshold for sulphate (Figure 5 & Table 11).

## 2.10. Arsenic

Levels of arsenic in groundwater have been reported on for the first time as part of this 2011 report. Concentrations were above the human health value of 0.01 g/ m<sup>3</sup> at 2 sites and in both cases the causes were natural.

Assuming the MDC monitoring network is representative of groundwater quality across the district, it is likely that other wells will potentially have similar concentrations (Table 12). Because MDC don't have a complete picture of the distribution of naturally occurring arsenic yet, well owners should have their water tested if their well is in a high risk area.

The risk factors for naturally high levels of arsenic are old or chemically reduced groundwaters which tend to mobilise it. Higher levels are most commonly linked with confined aquifers although they also occur at well 4442 tapping the Rarangi Shallow Aquifer which shows it can occur in a variety of types (Figure 5).

**Table 12 : Arsenic**

Year	DWSNZ 2005
	Maximum allowable value = 0.01 g/m <sup>3</sup>
	Number of sites exceeding
2011	2

## 2.11. Boron

Levels of boron in Marlborough groundwater have been reported on for the first time as part of this 2011 report. Boron in groundwater originates from natural interaction with minerals in local rocks such as the greywacke sandstone that predominates south of the Wairau River.

**Table 13 : Boron**

Year	DWSNZ 2005
	Maximum allowable value = 1.4 g/m <sup>3</sup>
	Number of sites exceeding
2011	0

Concentrations were well below the human health value of 1.4 g/m<sup>3</sup> at all sites. Samples from well 3278 which penetrates the Deep Wairau Aquifer at Fairhall and taps ancient, mineralised groundwater had elevated levels. There has commonly been a correlation between high levels of boron and arsenic in Marlborough groundwaters (Table 13).

### 3. Status Summary and Changes Over Time

Table 14 summarises the exceedances for median groundwater quality values for the 2010 and 2011 surveys. Because the median value across all measurements for a particular parameter is used there is unlikely to be large shifts relative to the thresholds.

Table 14 : Summary of Exceedances

Origin	Parameter	Number of exceedances			
		2010		2011	
		MAV	GV/EPGV	MAV	GV/EPGV
Predominantly natural	pH	-	13	-	13
	manganese	1	6	1	6
	iron	-	5	-	5
	ammoniacal-nitrogen	-	0/0	-	0/0
	sodium	-	0	-	0
	chloride	-	0	-	0
	fluoride	0	-	0	-
	arsenic	Not measured	Not measured	2	-
	boron	Not measured	Not measured	0	-
	Predominantly human	nitrate-nitrogen	0	6	0
sulphate		-	0	-	0

\*MAV : maximum acceptable value for human consumption

\*GV : guideline value for aesthetic purposes

\*EPGV : ecological protection guideline value

### 4. Conclusions

The quality of Marlborough groundwater remains high and there have only been minor changes in since the last report was prepared in mid 2010.

### 5. References

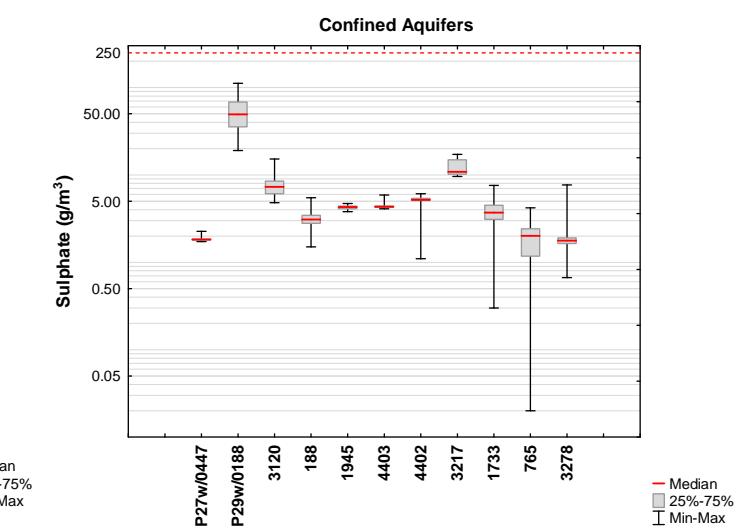
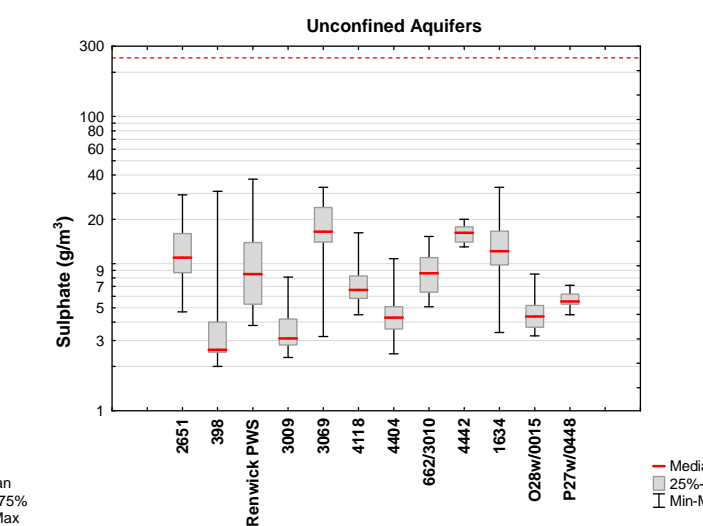
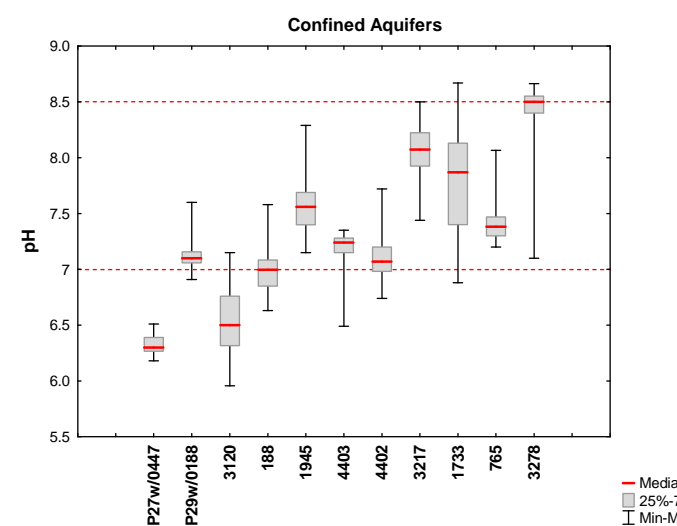
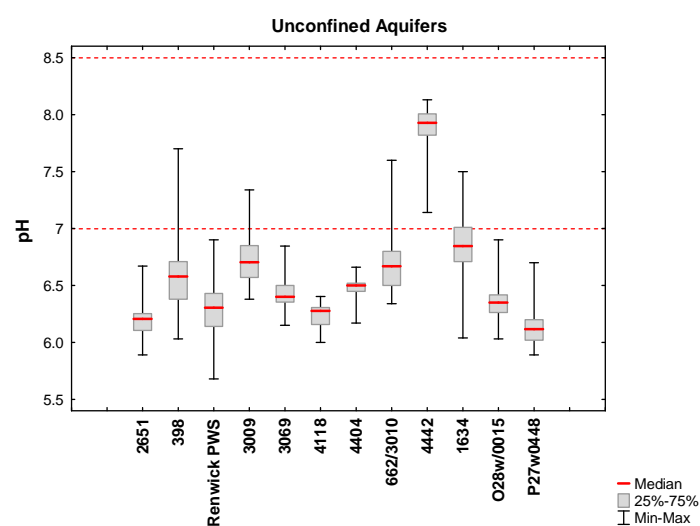
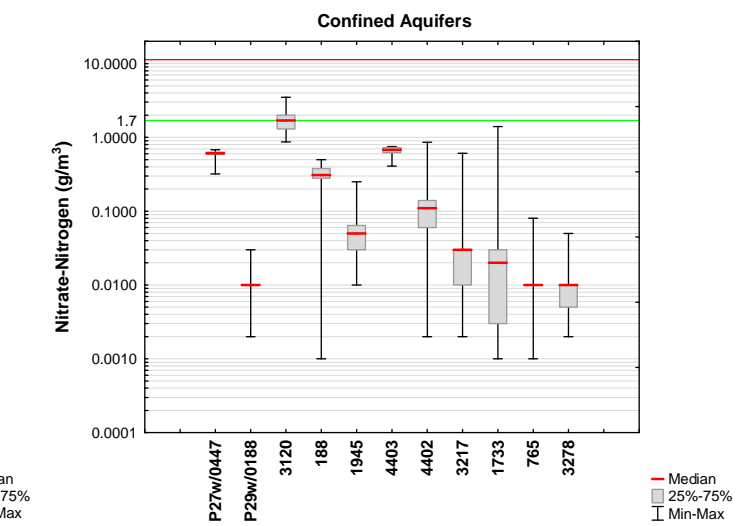
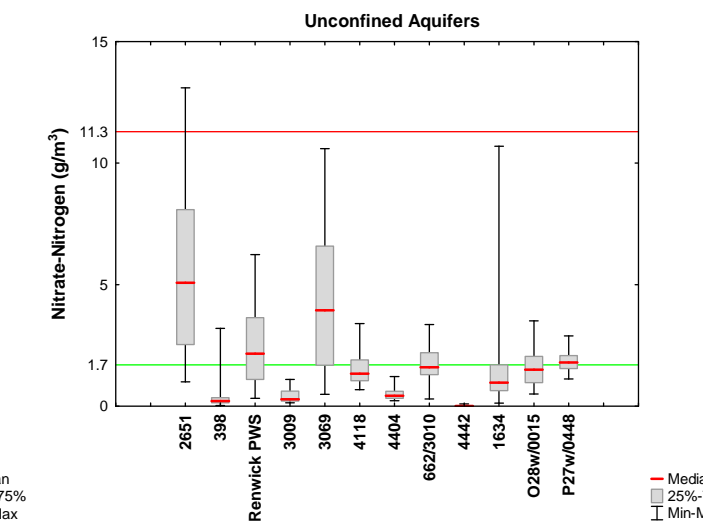
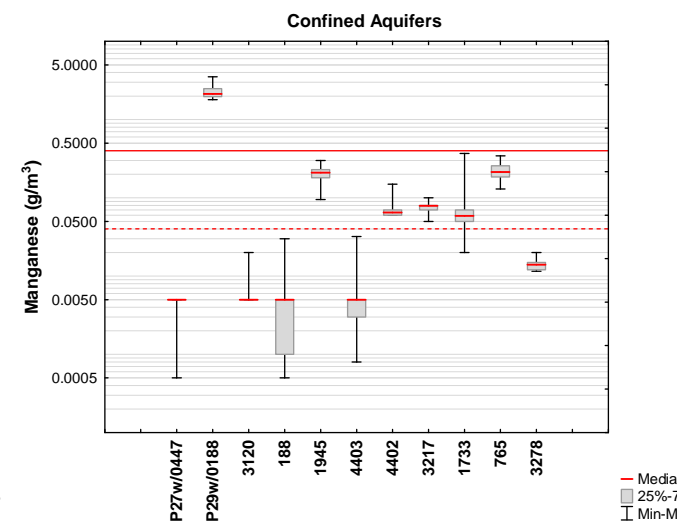
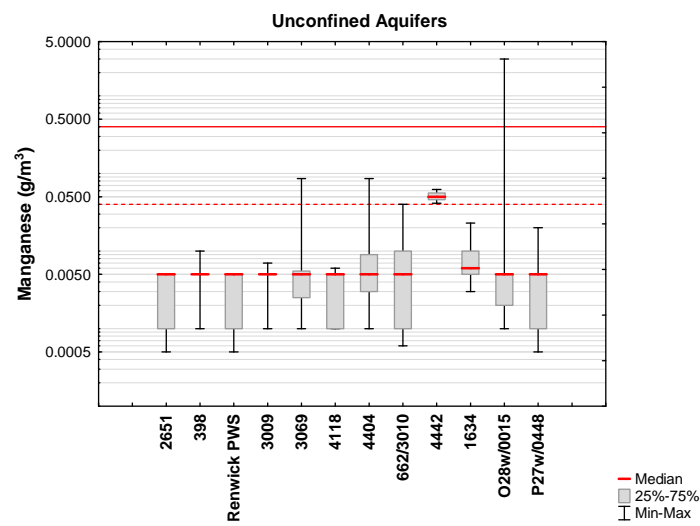
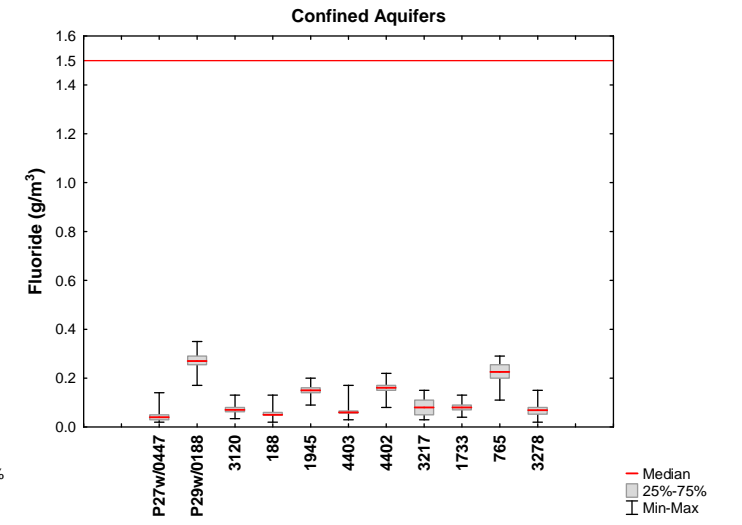
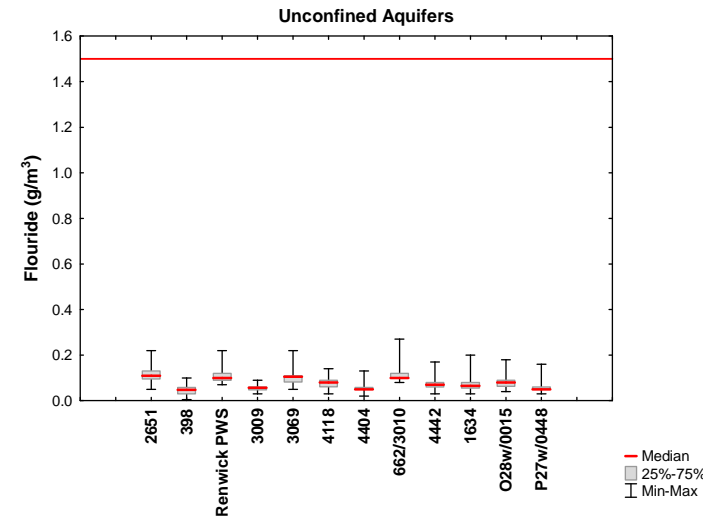
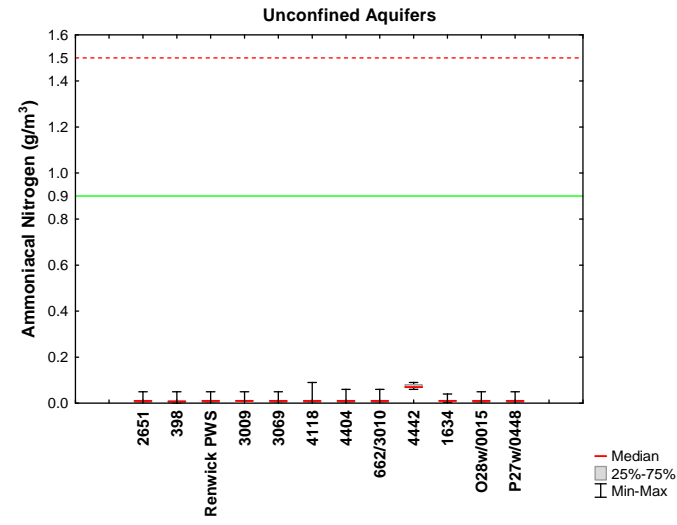
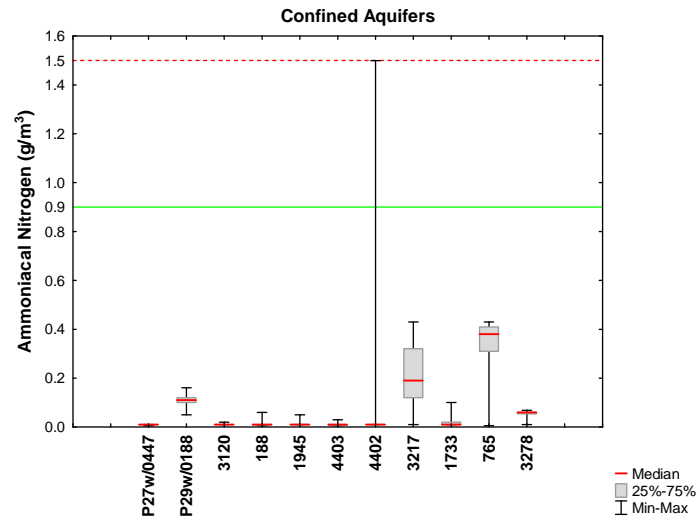
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## 6. Appendices



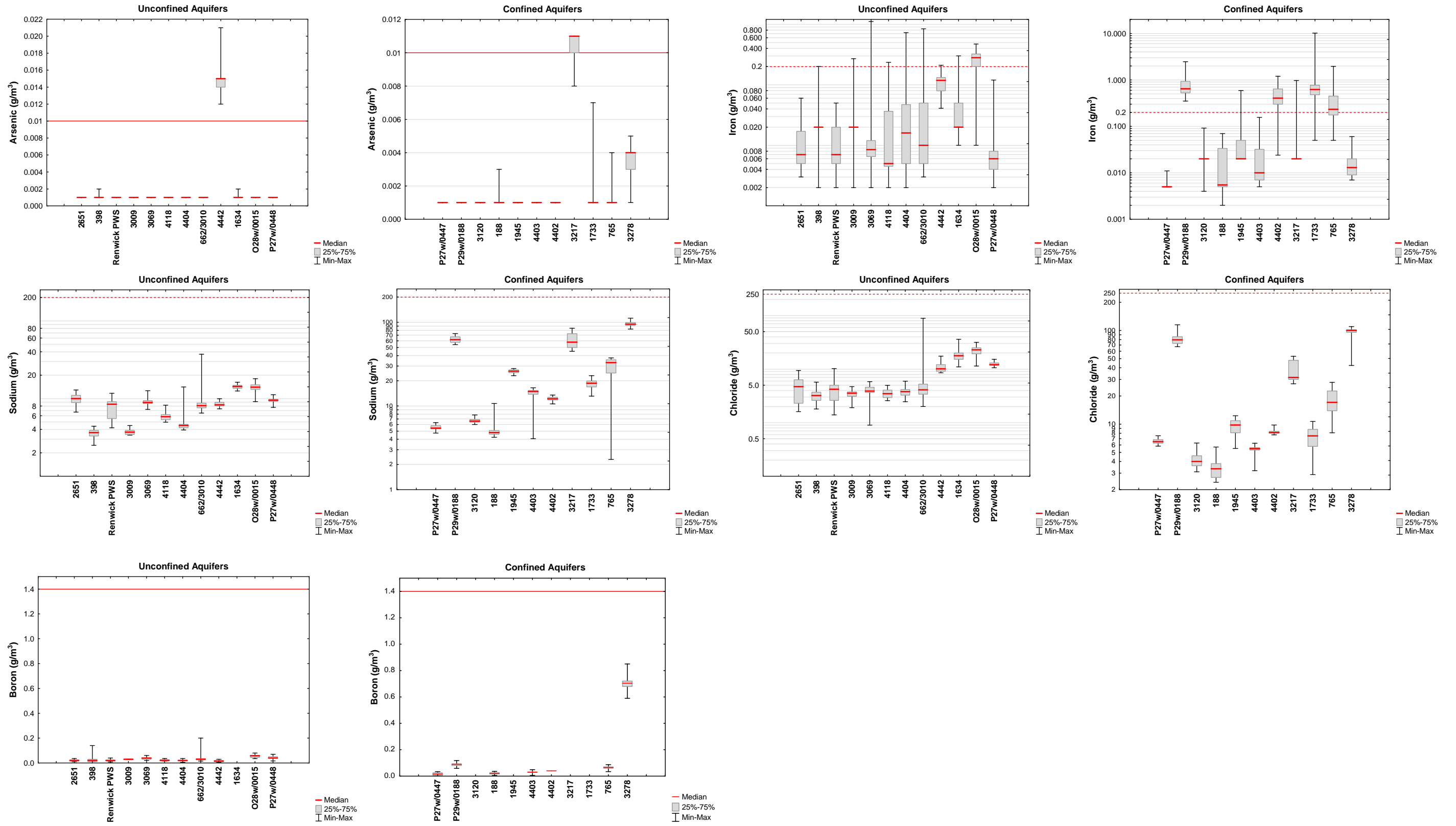


Figure 5 : Median Measured Values Versus Water Quality Standards

Table 2 : Dataset Start Dates

nitrogen as nitrate	chloride	pH	manganese	iron	nitrogen as ammonia	fluoride	sodium	sulphate	arsenic	boron	well
21/1/2003	21/1/2003	21/1/2003	21/1/2003	21/1/2003	21/1/2003	21/1/2003	21/1/2003	21/1/2003	21/1/2003	21/1/2003	3009
11/1/2005	11/1/2005	20/3/2005	11/1/2005	11/1/2005	20/4/2005	27/7/2005	11/1/2005	11/1/2005	11/1/2005	11/1/2005	4442
8/7/1997	8/7/1997	8/7/1997	8/7/1997	8/7/1997	8/7/1997	8/7/1997	8/7/1997	8/7/1997	21/1/2003	21/1/2003	3069
4/4/2002	4/4/2002	4/4/2002	4/4/2002	4/4/2002	4/4/2002	4/4/2002	4/4/2002	4/4/2002	4/4/2002	4/4/2002	O28w/15
21/3/1989	21/3/1989	21/3/1989	21/3/1989	21/3/1989	21/3/1989	11/5/1994	21/3/1989	21/3/1989	28/4/1998	-	1634
27/7/2004	27/7/2004	27/7/2004	27/7/2004	27/7/2004	27/7/2004	27/7/2004	27/7/2004	27/7/2004	27/7/2004	27/7/2004	4404
4/7/2000	4/7/2000	4/7/2000	4/7/2000	4/7/2000	28/5/2002	4/7/2002	4/7/2000	4/7/2000	28/1/2003	28/1/2003	2651
13/10/1981	13/10/1981	13/10/1981	13/10/1981	29/1/2003	13/10/1981	13/10/1981	13/10/1981	13/10/1981	29/1/2003	29/1/2003	P27w/448
7/5/1981	7/5/1981	7/5/1981	7/5/1981	7/5/1981	7/5/1981	30/1/2002	7/5/1981	7/5/1981	Exclude 1981 & 16/9/2004	15/1/2004	0398
19/1/2005	19/1/2005	19/1/2005	19/1/2005	19/1/2005	19/1/2005	27/7/2005	19/1/2005	19/1/2005	19/1/2005	19/1/2005	4118
20/4/2005	20/4/2005	20/4/2005	20/4/2005	20/4/2005	20/4/2005	25/7/2006	20/4/2005	20/4/2005	20/4/2005	20/4/2005	3010
11/8/1976	11/8/1976	11/8/1976	20/2/1980	16/10/1987	11/8/1976	11/8/1976	11/8/1976	11/8/1976	28/1/2003	8/11/1989	662
4/7/2000	4/7/2000	4/7/2000	4/7/2000	4/7/2000	20/4/2005	4/7/2000	4/7/2000	4/7/2000	20/4/2005	20/4/2005	1652
14/5/2008	14/5/2008	14/5/2008	14/5/2008	14/5/2008	14/5/2008	14/5/2008	14/5/2008	14/5/2008	14/5/2008	14/5/2008	548
29/1/2003	29/1/2003	29/1/2003	29/1/2003	29/1/2003	29/1/2003	29/1/2003	29/1/2003	29/1/2003	29/1/2003	29/1/2003	2333
7/3/2006	7/3/2006	7/3/2006	7/3/2006	7/3/2006	7/3/2006	7/3/2006	7/3/2006	7/3/2006	7/3/2006	7/3/2006	P27w/447
21/2/2006	21/2/2006	21/2/2006	21/2/2006	21/2/2006	21/2/2006	21/2/2006	21/2/2006	21/2/2006	21/2/2006	21/2/2006	P29w/188
6/11/2001	6/11/2001	6/11/2001	6/11/2001	6/11/2001	6/11/2001	6/11/2001	6/11/2001	6/11/2001	18/5/2010	-	3120
28/10/1987	28/10/1987	28/10/1987	28/10/1987	28/10/1987	28/10/1987	4/7/2000	28/10/1987	28/10/1987	9/11/2005	9/11/2005	188
29/3/1999	29/3/1999	29/3/1999	29/3/1999	29/3/1999	29/3/1999	22/6/1999	29/3/1999	29/3/1999	18/11/2008	-	1945
29/7/2004	29/7/2004	29/7/2004	29/7/2004	29/7/2004	29/7/2004	29/7/2004	29/7/2004	29/7/2004	29/7/2004	29/7/2004	4403
17/6/2004	17/6/2004	17/6/2004	17/6/2004	17/6/2004	17/6/2004	17/6/2004	17/6/2004	17/6/2004	17/6/2004	17/6/2004	4402
30/1/2001	30/1/2001	30/1/2001	30/1/2001	30/1/2001	30/1/2001	30/1/2001	30/1/2001	30/1/2001	18/11/2008	-	3217
27/10/1987	27/10/1987	27/10/1987	27/10/1987	27/10/1987	27/10/1987	23/6/1999	27/10/1987	27/10/1987	16/12/2003	-	1733
29/10/1987	29/10/1987	29/10/1987	29/10/1987	29/10/1987	29/10/1987	1/7/1997	29/10/1987	29/10/1987	8/3/2006	8/3/2006	765
13/5/1998	13/5/1998	13/5/1998	13/5/1998	13/5/1998	28/1/2003	5/7/2000	13/5/1998	13/5/1998	23/1/2003	13/5/1998	3278