Groundwater Quantity State and Trends 2010

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Executive Summary

Marlborough's aquifers and their related springs or wetlands are at normal to high levels or flows for the current 2010/11 summer season. This reflects wetter than normal conditions during late 2010 along-with lower groundwater demand.

The state of most shallow aquifers remains stable over time. This shows that in recent times natural rates of recharge balance aquifer outputs of drainage and summer pumping.

The exception is the highly confined and low yielding Benmorven Aquifer, which experienced the largest falls in level following heavy use during the 1997/98 and 2000/02 droughts, and remains in a depleted state.

There is a small declining trend in unconfined Wairau Aquifer levels which is not significant at this stage, but its causes are being investigated to understand its interaction with the Wairau River and springs.

The monitoring record shows that impacts on other wells and the environment of current rates of pumping are minor, except during severe droughts. Under these conditions the symptoms are spring recession and the need to deepen wells.

These effects are in response to actual pumping rates that are likely to average only 50% of the consented allocation for grape plants, and slightly more for other crop types.

Demand on groundwater resources for the current crop regime is likely to have peaked as most of the irrigable flatland is planted.

If all the consented groundwater was actually used, it would cause larger seasonal falls in levels than those observed so far which may have unacceptable effects.

Contents

1. Introduction

This is the inaugural report to the Marlborough District Council (MDC) on the state and trends of the district's underground water resources.

Each year the Environmental Monitoring and Science group (ESM) of Marlborough District Council will formally report on the status of our economically and ecologically important aquifer systems. This compliments the earlier sister report on the state of and trends in groundwater quality that is produced in June of each year.

The Wairau Plain and Blenheim is completely dependant on groundwater for their economic prosperity, everyday drinking water needs, and the sense of wellbeing that groundwater fed springs provide residents. Without this natural reservoir of high quality groundwater, few of the agricultural activities or their associated processing industries would exist.

This is why monitoring its health is so important for the interests of all Marlburians. In higher rainfall catchments to the north, or the southern parts of the district where the geology doesn't support aquifers, there is less of a reliance on groundwater.

This report is a formal requirement of the MDC annual plan. It will be presented to the Council in spring each year prior to the upcoming summer irrigation season. Its purpose is to review the effect of both permitted and consented groundwater use during the previous summer season, and to describe the state of the main aquifer systems leading into the next summer, the time of highest water demand.

It is effectively the natural resource equivalent of a set of accounts or in other words a water budget for the coming season, and the balance for the previous summer season.

Future reports will document the volume of groundwater used as a percentage of the allocation on an aquifer by aquifer basis. When this information is compared to changes in spring flow or well level, it provides a clear picture of the cause and effect between consented use and aquifer state.

Every five years MDC staff will prepare a more comprehensive review of longer term trends in aquifer levels and spring flows in relation to abstraction and climate patterns, as new records become available. This fuller treatment has been incorporated in the current baseline report to set the scene.

For some aquifers, several decades of record now exist which is sufficient to provide a clear picture of their response to pumping and natural climatic extremes such as droughts. However for some of Marlborough's groundwater systems the record is still too short to be definitive about long-term patterns in their behaviour.

To explain the relative influence of natural versus man-made drivers on groundwater resources requires a detailed knowledge of both. The mechanics of how aquifers are recharged is well understood for uncomplicated systems which are close to the surface such as the Wairau or Rarangi Shallow Aquifers. However much remains to be learnt about the dynamics of the Deep Wairau or deeper Southern Valleys Aquifers.

While measured water use is growing as meter coverage expands through various processes, comprehensive records currently only exist for the Southern Valleys Aquifers. A full assessment of the water balance for each aquifer will have to wait until all consented users are metered, and there are records available for a range of seasonal conditions.

The focus of annual reporting in the future is likely to remain the Wairau Plain where the bulk of groundwater is used, and where most of the MDC regional groundwater monitoring network is focused. The regional location of the MDC well level recorder sites and their well reference number is shown in Figure 1.

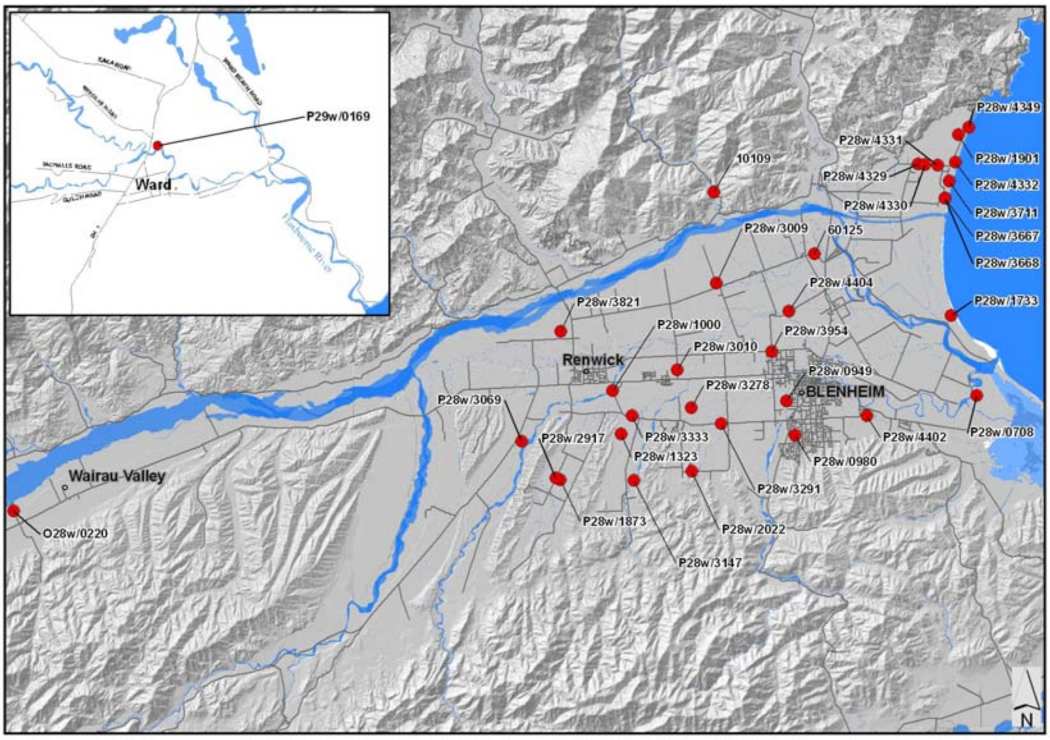

Figure 1: **Permanent MDC Regional Groundwater Level Monitoring Network**

The monitoring network is aligned to the aquifer systems underlying the Wairau Plain which are shown in Figure 2. The northern half of the plain is dominated by the relatively high yielding Wairau Aquifer which is coloured various shades of blue. The low yielding Southern Valleys Aquifers lie south of Middle Renwick Roads and are marked by the brighter colours.

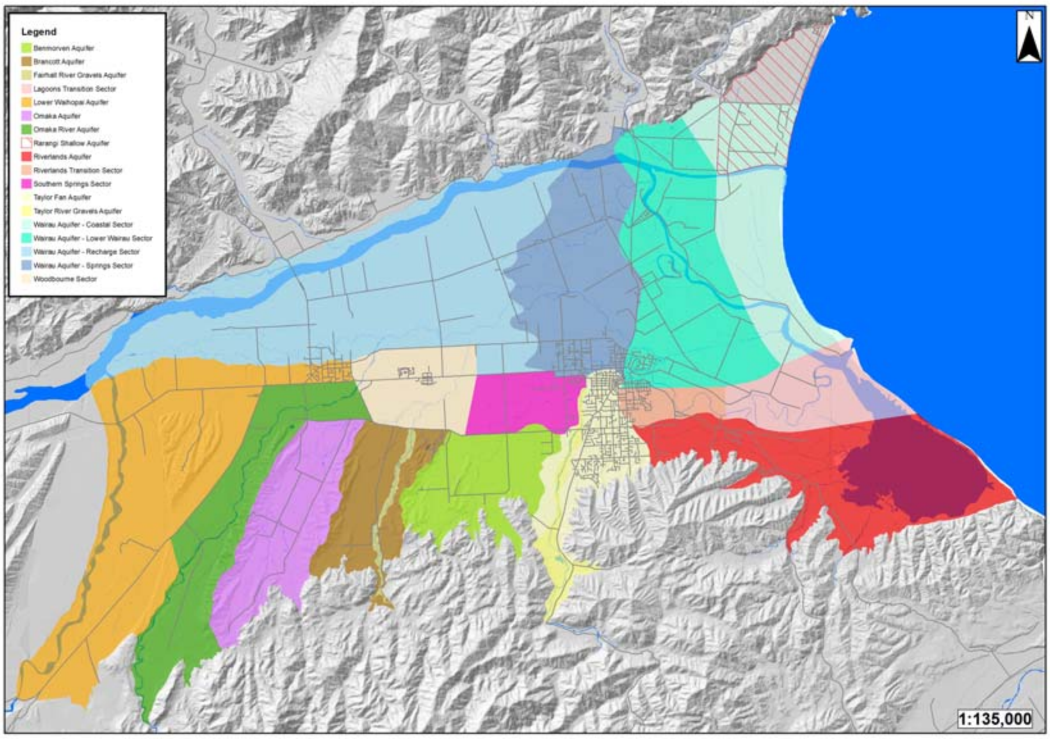

Figure 2 : Wairau Plain Aquifers 2010

2. Methodology

The aim of this document is to report on the volume of water stored underground in Marlborough's aquifers and how it is changing in relation to pumping or climate variability. Aquifer levels are the best indicator of the difference between aquifer inputs and outputs, but the flows of groundwater fed springs are increasingly becoming an important indice also.

Aquifer levels can either remain stable, be declining or rising over time. Where a change is constant and follows a pattern it is called a trend. Where a trend exists it is important to understand its cause and in particular whether it is natural or man-made. For example is it as a result of pumping, landuse change or climatic variability?

As is often the case in the real world, trends usually reflect a combination of factors and the primary driver can be difficult to isolate. For example catchment re-vegetation can have a similar effect on aquifer levels to a decrease in rainfall, or increased abstraction.

Trends are always a matter of scale and are sensitive to which years are included in an analysis. For example 2008 and 2010 have been relatively wet in Marlborough and most aquifers reflect this with lower demand and higher rates of natural recharge. This results in higher than average well or groundwater levels.

Long-term patterns in well or aquifer levels are commonly masked by seasonal variations. To make it easier to identify trends over decadal periods, the summer to winter cycle has been removed as part of this report in a process known as decomposition.

An example of this method is shown in Figure 3 for the Rarangi Shallow Aquifer well P28w/1901 where the raw record has been de-seasonalised and broken down into its components. The top row shows the observed well water level in metres above mean sea-level.

The next row down is the long-term seasonal component. This is then subtracted from the raw information to provide the de-seasonalised levels in the third row. The CENSUS method 1 in the statistical analysis package Statistica was used to decompose the well record. The bottom row shows what is left over and represents the random variation in well level records.

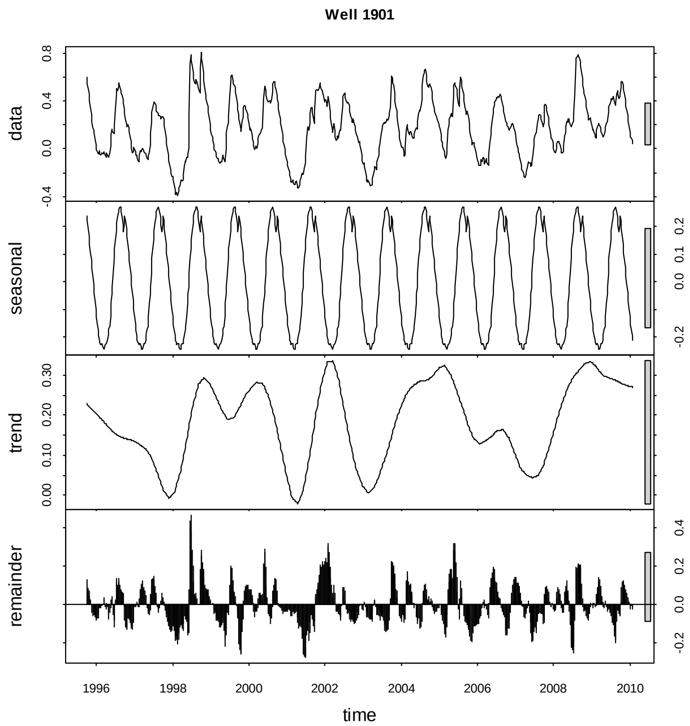

Figure 3: Time Series Decomposition Approach

The presence of a trend in aquifer levels is then determined by fitting a simple straight line through the de-seasonalised record. This is done by the statistical package to provide an objective assessment. Throughout this report the analysis of trends is presented in a standard format with the average daily aquifer elevations in grey, the de-seasonalised trace in red and the long-term trend line shown by the black line.

The way in which well or aquifer levels change over time is the net result of volumetric changes in aquifers. To make their interpretation meaningful requires an understanding of aquifer inputs and outputs, and how these have varied historically.

Climatic patterns such as rainfall or river flows are more difficult to define and beyond the scope of this report. To provide context for each aquifer or sub-sector, the consented demand, safe yield where it exists, district plan limit and actual use where it is available are tabled. This puts the aquifer state and trends in perspective.

For example if there are few stresses on an aquifer with average rates of recharge and low rates of pumping relative to consented allocation, well levels will be dominated by natural processes. Conversely high rates of pumping will generate seasonal falls in well levels. Generally speaking most of Marlborough's aquifers fall into the category of being underutilised but overallocated.

3. Aquifer level state and trends

Table 1 summarises the medium to long term trends in groundwater levels for each of the main aquifers systems. The response of the Southern Valleys Aquifers doesn't fit the normal definition of a trend because levels fell dramatically during droughts in 1997/98 and 2000/01, but have largely recovered since with the exception of the Benmorven Aquifer. In these cases the long-term net change is reported, not the short-term fall in aquifer level.

Aquifer	Monitoring well site and aquifer sector	Period of record	Long-term change in aquifer level or flow (metres)	Trend	Average annual rate of aquifer level change (mm/year)
Wairau Aquifer	Recharge sector well P28w/0398/3821 at Conders Bend Road	1982-2010	0.5	Small decline	18 mm/year
	Recharge sector Well P28w/3009 at Wratts Road	1996-2010	0.125	Very small decline	9 mm/year
	Spring sector Well P28w/3954 at Springlands	2002-2010	-	Slight rise	-
	Spring Creek flow at motorcamp	1996-2010	-	No change	-
	Coastal sector well P28w/1733 at Wairau Bar	1988-2010	0.05	• Very small level decline • Conductivity stable	2 mm/year

Aquifer	Monitoring well site and aquifer sector	Period of record	Long-term change in aquifer level or flow (metres)	Trend	Average annual rate of aquifer level change (mm/year)
	Coastal sector well P28w/3667 near Wairau Diversion	2000-2010	-	• No long-term level change but larger seasonal variability • Conductivity has fallen	-
Riverlands Aquifer	Well P28w/0708 at Lagoons	2002-2010	-	• No long-term level change but larger seasonal variability • Conductivity stable	-
	Well P28w/4402 at Alabama Road	2006-2010	Insufficient record for long-term trend analysis	Insufficient record for long-term trend analysis	-
Woodbourne Sector	Well P28w/594/3010 at Jacksons Road	1985-2010	1.25	Large decline	50 mm/year
Omaka River Aquifer	Deep layer well P28w/1000 at Godfrey Road	1981-2010	2.5	Large decline	86 mm/year
	Shallow layer well P28w/3069 at Spy Valley Wines	1997-2010	0.05	Small decline	4 mm/year
Taylor Fan Aquifer	Well P28w/0949 at Athletic Park	1977-2010	0.25	Small decline	8 mm/year
Rarangi Shallow Aquifer	Inland well P28w/1901 at Golf Club	1989-2010	-	No change	-
	Coastal well P28w/3711 at Bluegums	2001-2010	-	No change	-
	Coastal well 3668 at Hinepango Drive	2001-2010	-	No change	-
	Coastal well 4332 at Millennium Rock	2004-2010	Insufficient record to use for long-term trend analysis	Insufficient record to use for long-term trend analysis	-
	Coastal well P28w/4349 at northern coast	2004-2010	Insufficient record to use for long-term trend analysis	Insufficient record to use for long-term trend analysis	-
	Inland well P28w/4331 at wetland	2004-2010	Insufficient record to use for long-term trend analysis	Insufficient record to use for long-term trend analysis	-

Aquifer	Monitoring well site and aquifer sector	Period of record	Long-term change in aquifer level or flow (metres)	Trend	Average annual rate of aquifer level change (mm/year)
Brancott Aquifer	Well P28w/1323 at Montana Wines	1995-2010	No net change	Fully recovered from large seasonal falls in aquifer level during 1997/98 and 2000/01 droughts	-
Fairhall River Gravels Aquifer	Well P28w/3147 at Bints Ford	1997-2010	-	No change	-
Omaka Aquifer	Well P28w/1873 at Hawkesbury Road	1991-2010	No net change	Largely recovered from large seasonal falls in aquifer level during 1997/98 and 2000/01 droughts	-
Benmorven Aquifer	Well P28w/2022 at Morven Lane	1990-2010	7	Very large decline	350 mm/year
Deep Wairau Aquifer	Well P28w/3333 at Boulevard/New Renwick Road	1999-2010	1	Moderate decline	90 mm/year
	Well P28w/3291 at Benmorven Road/Middle Renwick road	1999-2010	2	Large decline	181 mm/year
	Well P28w/0980 at Hospital	1999-2010	2	Large decline	182 mm/year
	Well P28w/2917 at Hawkesbury Road	1996-2010	2.5	Large decline	180 mm/year
Wairau Valley Aquifer	Well O28w/0220 at Mill Road	2007-2010	Insufficient record to use for long-term trend analysis	Insufficient record to use for long-term trend analysis	Insufficient record to use for long-term trend analysis

Table 1 : Summary of Aquifer Level Trends

Because the period of record varies from site to site, the magnitude of any trend in aquifer level is only indicative and the average annual rate of change is also included. The largest changes have occurred in the Southern Valleys Aquifers followed by inland areas of the Wairau Aquifer. The reasons for this will be expanded on later in the report.

Overall changes in aquifer level for the Wairau Plain aquifers are mapped in Figure 4. Rising trends in aquifer level are marked blue with falling trends in red, and sites where there has been no change are shaded black. The magnitude of the change at each site is expressed in metres.

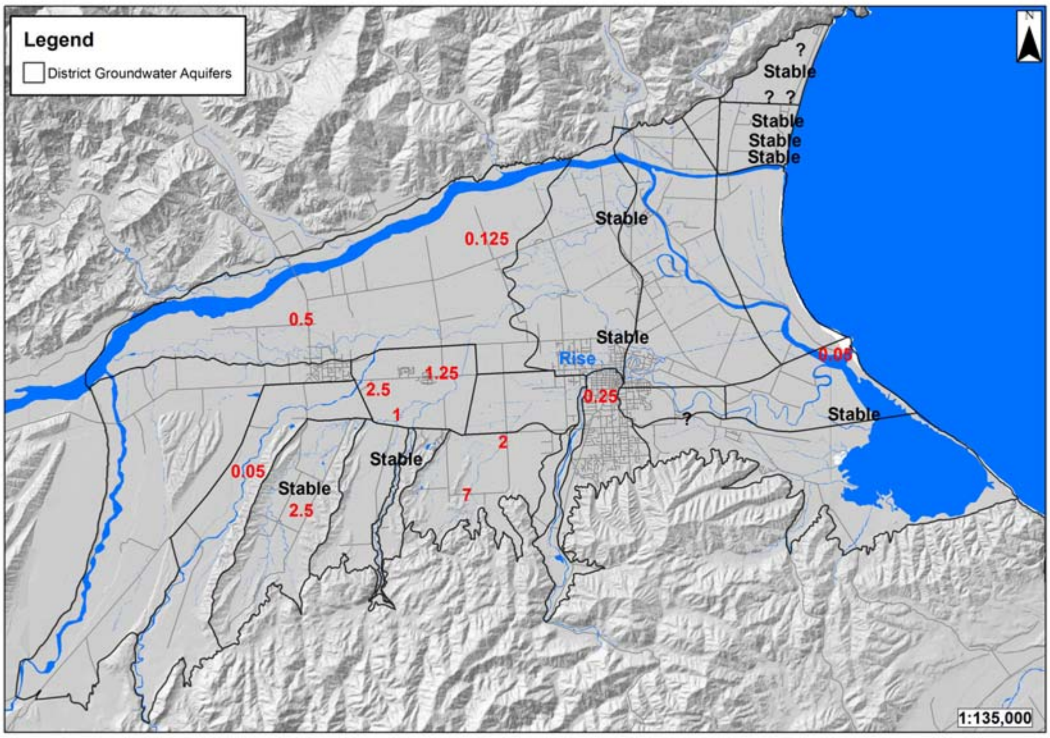

Figure 4 : **Long-term Wairau Plain Aquifer Level Changes**

Aquifer level patterns at a particular monitoring site also depend on their proximity to nearby pumping wells. Those closer to irrigation wells will experience larger changes in level than more isolated or passive sites.

No monitoring well is perfectly positioned to provide an independent measure of aquifer status. In the following sections the validity of observations from each individual monitoring well is discussed in terms of the length of record available, and how representative it is of the groundwater system it belongs to.

In the following sections the current state of each aquifer and any trends associated with it are discussed. The exceptions are the Lower Waihopai Aquifer, Wairau Valley and Flaxbourne River groundwater systems, where there is either insufficient record or no representative site available to provide a commentary at this stage. The boundaries of each of the main aquifer systems underlying the Wairau Plain are shown in Figure 2.

Some systems such as the Wairau Aquifer are so large they have been broken down into sectors represented by separate monitoring wells. In other cases such as for the Omaka River Aquifer, there are distinct vertical aquifer layers that require wells of differing depths to characterise their unique behaviour.

3.1. Wairau Aquifer

Introduction

The Wairau Aquifer is the highest yielding system in Marlborough and the main source of groundwater in the province by far. It underlies most of the northern Wairau Plain and is coloured various shades of blue in Figure 2. Not only does it provide most of the consented groundwater used by Wairau Plain residents, it also maintains the baseflow of the freshwater springs such as Spring Creek, and the drinking water for most rural residents.

Some of these groundwater fed springs are of high ecological importance and valued for their aesthetic qualities by the local community. This is especially true of the conspicuous and accessible Blenheim urban springs such as Fulton Creek which flows through Pollard Park, or Murphys Creek. The baseflow of the Taylor River below the High Street bridge in Blenheim is supplied by groundwater.

Because of its large size and varying characteristics, the Wairau Aquifer has been broken down into sectors with each being represented by a separate MDC monitoring well or wells. The current state of each sector and trends in local aquifer levels are described.

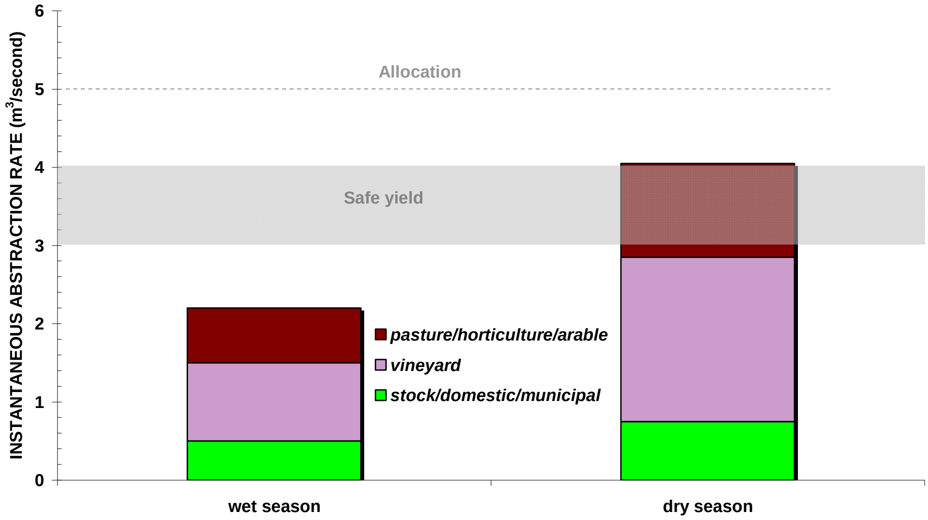

Figure 5 : Estimated Wairau Aquifer Abstraction Versus Allocation And Safe Yield

Trends in aquifer levels need to be interpreted in the context of climate variability and water demand. Variations in rainfall or river flows affect aquifer behaviour and are well documented by the MDC hydrological network, but groundwater pumping rates are not yet measured for all Wairau Aquifer consents.

A continuous and complete set of water meter records currently only exist for the Southern Valleys Aquifer systems. It was needed to manage water shortage issues dating back to the 1980s. A complete picture for the Wairau Aquifer will take at least another five years to become available to water planners. In lieu of this metered information rates of abstraction for wet and dry seasons have been estimated based on known rates of irrigation use (Figure 5).

Pumping rates were calculated for both dry and wet conditions to show the likely range in demand and were based on an area of land watered from the Wairau Aquifer of 12,000 hectares of vineyard and 2,000 hectares of crops or pasture. Irrigation rates used for the dry weather scenario were 1.5 mm/day for grape plants and 5 mm/day for field crops. During a wet season lower rates of 0.75 mm/day and 3 mm/day were used.

Total abstraction is predicted to be 2.2 m^3/second in a wet summer, and 4.05 m^3/second for a dry season (Figure 5). Abstraction for municipal or rural domestic use is the smallest component and is estimated to be relatively static in the range from 0.5 to 0.75 m^3/second. Demand for irrigation water is more sensitive to seasonal climatic conditions and is estimated to have a larger range of 1.7 and 3.3 m^3/second for the mix of crop types grown on the northern Wairau Plain in 2010.

These estimates of groundwater use compare to the consented rate of groundwater from the Wairau Aquifer of 5 m^3/second with a lesser rate used for domestic supply as of right. The sustainable limit is set at 4 m^3/second in the Wairau-Awatere Resource Management Plan (WARMP).

In reality the sustainable rate of abstraction will vary from season to season depending on the balance between demand and groundwater storage or recharge, relative to community expectations. The likely range is inferred by the grey shading in Figure 5.

If groundwater use does reach 4 m^3/second as predicted under dry conditions, and this is a fair reflection of the safe yield of the Wairau Aquifer, it is expected that there will be some noticeable environmental consequences. Have these been observed during the monitoring of well levels or spring flows to date?

It is likely that the widespread recession of spring headwaters during the 1998 and 2001 droughts was caused by levels of pumping of around 4 m^3/second. That this doesn't happen very frequently is probably an indication that abstraction is normally below this level in most seasons rather than the limit being too low.

3.1.1. Recharge sector

Introduction

The first Wairau Aquifer sector to be described is the western most area near Renwick where it receives the bulk of its recharge via natural losses of water from the Wairau River. It is referred to as the recharge sector. The close link between the two water bodies has long been known about and is obvious when river flows are compared against changes in the levels of well close to the channel.

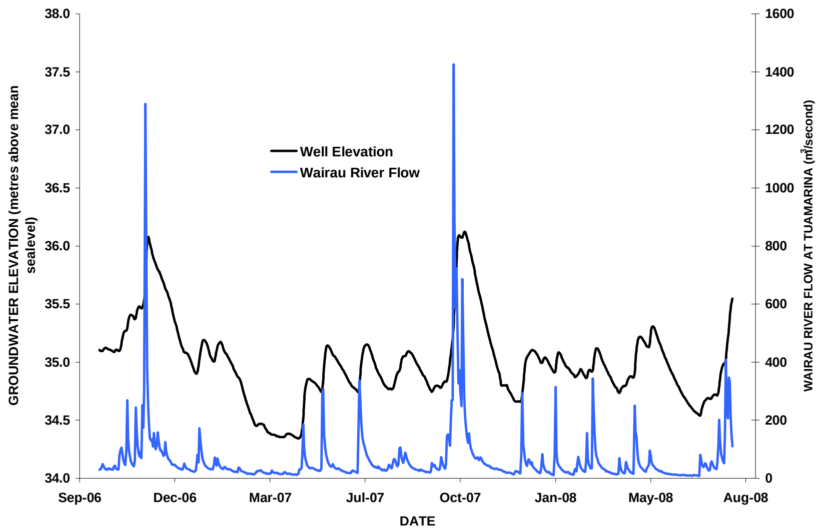

Figure 6 : Wairau Aquifer Response To Wairau River Flood Flows

Rises in well levels following Wairau River floods demonstrates the two water bodies are linked hydraulically as Figure 6 shows. It is important to preserve current rates of recharge in this upper aquifer area to supply downstream groundwater users as far afield as the Blenheim and Riverlands. Not all of the groundwater can be used as a residual is needed to maintain freshwater spring flows and the seawater interface at the Cloudy Bay coast.

Where are the monitoring sites and what do they represent?

Because the recharge area is so large and its properties vary spatially, several wells are used by the MDC to monitor its status. Monitoring well P28w/3821-398 is located near the intersection of Conders Bend Road and State Highway 6, and is twenty metres in depth.

It is the most significant of the MDC Wairau Aquifer monitoring sites due to its long length of stable record dating back to 1982 (Figure 7). But it is a short record compared to that of the Wairau River.

The second MDC monitoring well P28w/3009 representing the recharge sector is located at Wratts Road has been operating for 13 years. Not only does this site monitor Wairau River recharge processes, but also the way in which groundwater affects the headwaters and flow of Spring Creek.

How much groundwater has been allocated versus actual use?

Wairau Aquifer demand varies from year to year and within a single season, depending on the balance between rainfall and evapotranspiration. It also changes between locations depending on the soil water holding capacity and the crop being grown.

Because free draining soils are the dominant type in the recharge sector, groundwater use is likely to be slightly higher than areas with heavier soils further east. This will be offset by the relatively low irrigation water demand of grape plants which are the predominant irrigated crop.

The exact rate of abstraction for the Wairau Aquifer as a whole or its sub sectors has not yet been comprehensively measured, but it is likely to be around half of the crop guideline used to set the allocation rate in a normal season. This is based on knowledge of water use in areas where meters exist, the results of irrigation trials and modelling of vineyard micro-climates since 1994 by research scientists.

This underutilisation means the effects of pumping at the full allocated rate won't be apparent in the MDC aquifer level monitoring record yet, at least for sustained periods.

Category	Use
WARMP limit	A portion of the Wairau aquifer total of 346,000 m^3/day (4 m^3/s)
Number of consents	275
Irrigated area	-
Refined safe yield	-
Consented allocation	133,000 m^3/day (1,500 l/s)
Actual use	Estimated at 20% – 70 % of consented rate depending on crop type, seasonal conditions and soil type. Higher rate of use are likely on freer draining soils

Table 2 : Water Use Summary

Are there trends and what is causing them?

There is a long-term downwards trend in aquifer levels at well P28w/0398-3821 of around 0.5 metres since 1982, or on average 18 millimetres per year (Figure 7). This is a small decline in terms of the overall saturated aquifer thickness of twenty to thirty metres.

A drop in level with time is supported by the widespread deepening of wells that occurred during the 1998 and 2001 droughts. It is unlikely to affect the productivity of individual wells which are generally able to be deepened. Lower aquifer levels will theoretically increase the rate of recharge flows from the Wairau River up to a certain point.

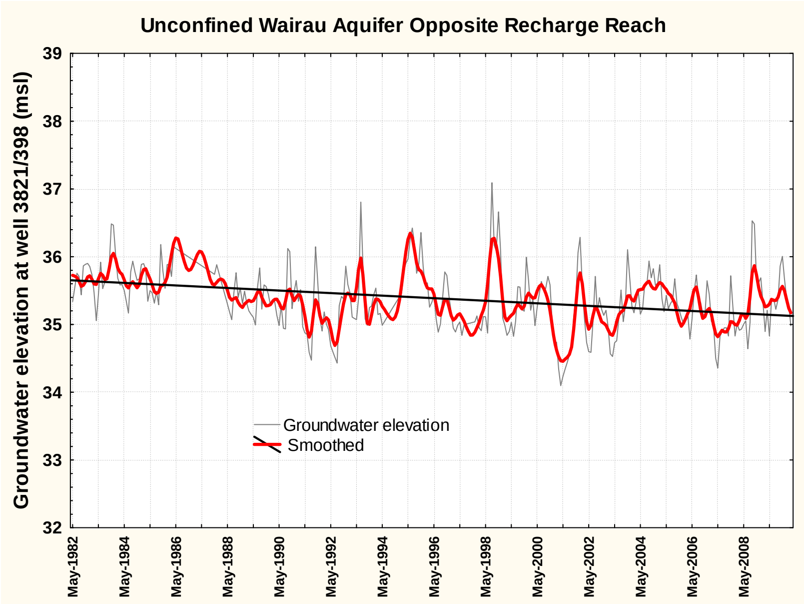

Figure 7 : Trends In Wairau Aquifer Level At Well P28w/0398-3821

At the second monitoring well P28w/3009 at the downstream end of the recharge sector, there is a smaller downwards trend of 0.125 metres since the site was established in 1996 (Figure 8). The average annual fall is smaller than further to the west, but could potentially have a more significant effect on the degree of spring headwaters recession due to the flatter water table slope at Wratts Road.

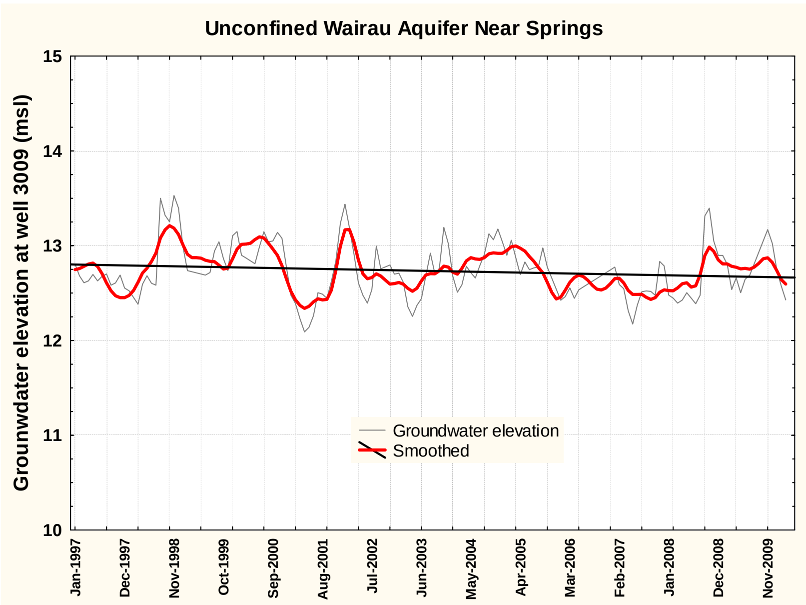

Figure 8 : Trends In Wairau Aquifer Level At Well P28w/3009

It is important for both the MDC and groundwater users to understand the reasons for the small but clear downwards trend in aquifer levels as it potentially affects many downstream well owners. There may be multiple factors. Increased consented demand on groundwater since the widespread introduction of irrigation in the early 1970s is almost certainly a contributing cause.

However demand had probably peaked in about 2001, by which time most of the land north-west of Renwick had been converted from mixed farming to vineyard, whereas aquifer levels are continuing to fall.

Increased groundwater abstraction is also expected to lead to lower levels in summer when demand is highest, not the observed long-term downwards trend. This is because the unconfined nature of the aquifer allows recharge water free entry, and as a consequence levels recover each winter or spring when pumping stops and Wairau River flows peak.

Part of the explanation is likely to be related to Wairau River processes because of the proximity of the monitoring wells to the Wairau River channel which is the source of most recharge water to the Wairau Aquifer. This may reflect changes in either catchment yield or channel processes.

It is likely that Wairau River flow has fallen over this period and as a consequence there is less aquifer recharge. However it must be recognised that from 2005, possibly earlier, the Wairau River flow records have been compromised by the increasing amount of abstraction direct from the Wairau River channel and it is difficult to be sure about patterns in river flow. The quantum of consented Wairau River abstraction is around 5 m^3/second at present.

Another reason for suspecting a Wairau River related explanation is that two of the lowest groundwater observations occurred in July 1991 and July 1992 when there would have been no irrigation pumping. The lower groundwater levels followed periods of five months of below average monthly river flows. This demonstrate the reliance of the Wairau Aquifer on continual top-ups of recharge water supplied by medium sized flood events to supplement the baseline leakage rate of 7 to 8 m^3/second.

Flow has been used in this report as the indicator of the rate of aquifer recharge, but Wairau River water elevation or stage as it is called, is more relevant because it is the difference in level between the two water bodies which is the prime driver. Unfortunately there isn't a continuous record of river stage at a single site so Wairau River flow near the bottom of the catchment at Tuamarina has been used instead.

It is unclear if the variability in Wairau River channel flow explains all of the observed fall in aquifer levels. While it is generally accepted that a hydraulic connection exists between the two water bodies, the process whereby the Wairau River channel loses water to groundwater is not yet fully understood. Furthermore there is no significant correlation with any single Wairau River flow parameter such as the median or mean annual low flow.

River management activities could potentially contribute to the long-term trend and are being studied as a follow-up to this report by Marlborough District Council staff. For example a fall in the elevation of Wairau River channel water relative to groundwater would reduce the gradient driving water into the aquifer and lessen the rate of recharge.

What is the aquifer state leading up to the 2010/011 summer?

Wairau Aquifer levels at both monitoring sites are currently high due to the recharge effect of heavy rain and large Wairau River flows in late 2010 (Figures 9 and 10).

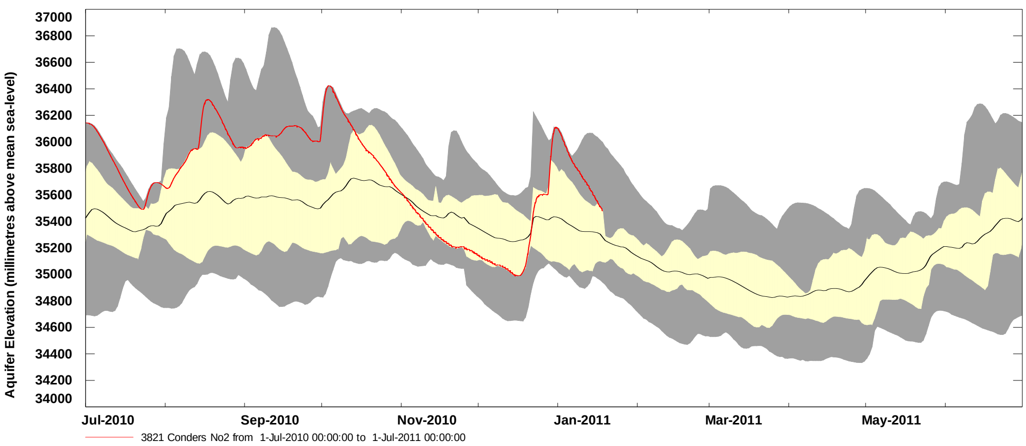

Figure 9 : Current Aquifer Status

Well levels are slowly falling as the aquifer drains from its peak on about New Years day, a process which directly mimics the natural recession of flow in the neighbouring Wairau River over the same period.

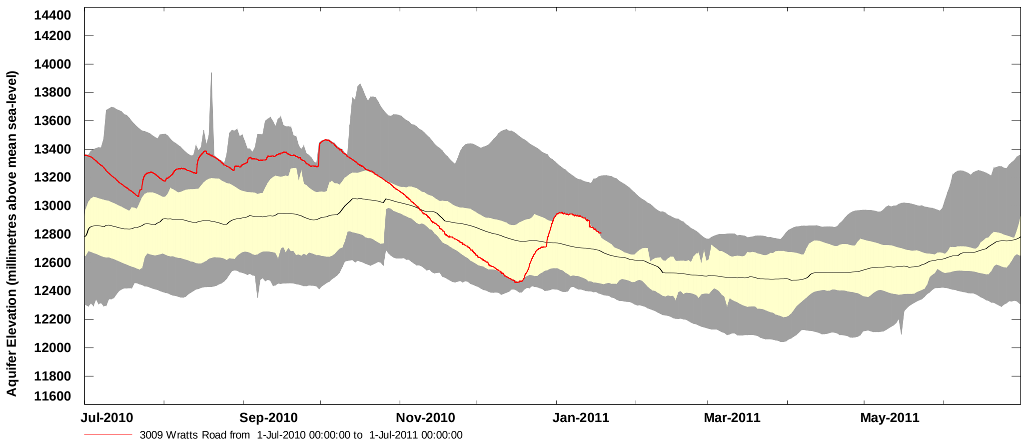

Figure 10 : Current Aquifer Status

3.1.2. Spring sector

Introduction

The Wairau Aquifer is hydraulically connected to the Wairau River and relies upon it for most of its recharge. The Wairau Aquifer in turn provides baseflow for the downstream belt of freshwater springs that rise through the middle of the Wairau Plain.

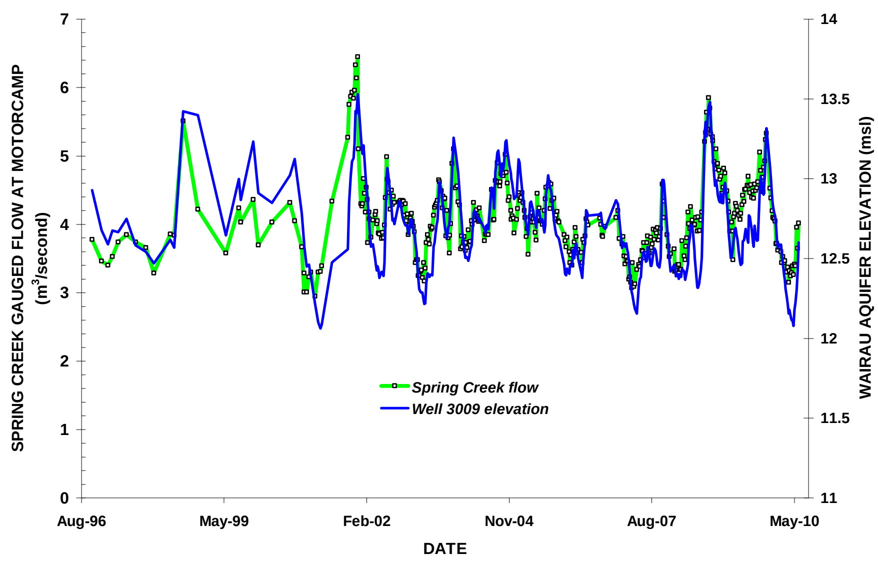

Figure 11 : Wairau Aquifer Elevation Versus Spring Creek Flow

The close match between Spring Creek flow and Wairau Aquifer elevation at the MDC well P28w/3009 at Wratts Road in Figure 11 demonstrates the close hydraulic link that exists between the two water bodies. Each of the squares represents an individual gauging of channel flow at the Motorcamp site by MDC staff.

Many of these groundwater fed springs are on private land, but those that are accessible are highly valued by the community for their scenic appeal and are also ecologically important. The springs are the only part of the aquifer that is visible and act as overflows for the aquifer. It is generally accepted that if their flows are maintained at acceptable levels, then at a regional scale the Wairau Aquifer is being sustainably managed.

Where are the monitoring sites and what do they represent?

Weekly manual measurements of flow are made at four of the major groundwater fed spring systems: Spring Creek, Murphys Creek, Doctors Creek and Fulton Creek by MDC staff. Spring Creek was used in this report to analyse the change in flow over time as it has the longest flow record starting in 1996, and is well understood in terms of its interaction with the Wairau Aquifer.

Flow is measured upstream of where each spring joins the Taylor River or Wairau River. However unlike a braided gravel river where flow can be monitoring continuously based on the depth of water in the channel, natural weed blooms makes this approach invalid for local springs and flow has to be gauged manually.

How much groundwater has been allocated versus actual use?

Because a well can be drilled virtually anywhere across the northern Wairau Plain and intercept groundwater, there have historically been very few consented takes of irrigation water direct from springs such as Spring Creek. However because spring flow is effectively groundwater, well pumping can have a significant effect on channel flow, particularly for wells close to the channel.

Category	Use
WARMP limit	Not defined separately from the larger Wairau Aquifer total of 346,000 m^3/day (4 m^3/day)
Number of consents	127
Irrigated area	1,744 ha out of a total land area of 3,064 ha
Refined safe yield	Currently being reviewed by MDC staff in conjunction with AQUALINC Research Ltd based on the effect of well pumping on spring flow and headwater recesssion
Consented allocation	96,061 m^3/day or 1,110 l/s
Actual use	Varies by individual consent from 20% – 100% of allocation depending on soil type, crop type and seasonal climatic conditions

Table 3 : Water Use Summary

There are two factors that affect water demand and differ from those in the upstream recharge area. Firstly, soils underlying this area are heavier and store water for longer meaning they don't require as much irrigation, all other factors being equal.

Secondly, there is a mix of irrigated crop types including pip fruit, vegetable and field crops in addition to grape plants and these have a higher water demand. Taking into account these factors, it is likely that groundwater abstraction overall is similar to elsewhere.

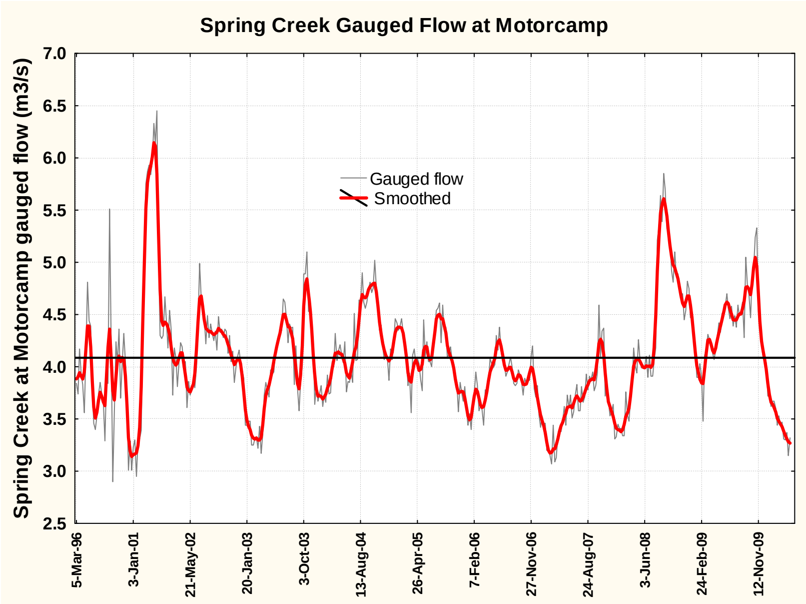

Figure 12 : Trends In Spring Creek Flow At Motorcamp

Are there trends and what is causing them?

Spring Creek flow is stable based on a moving average of the flow gaugings since 1996. It was expected that because spring flows are effectively an extension of the Wairau Aquifer, that their behaviour would mirror the slight downwards trend in groundwater levels over the same period.

One possible explanation for why Spring Creek flows are steady over the same time period is that the water level of Spring Creek has fallen since 2003. This would induce more water to drain from the associated aquifer, resulting in higher flows than would otherwise be the case.

What is the state of the springs leading up to the 2010/011 summer?

Spring Creek flow at the motor-camp was below the long-term average for spring, but has now risen in response to the large flood in the Wairau River in late December. The red diamonds in Figure 13 represent individual flow gaugings.

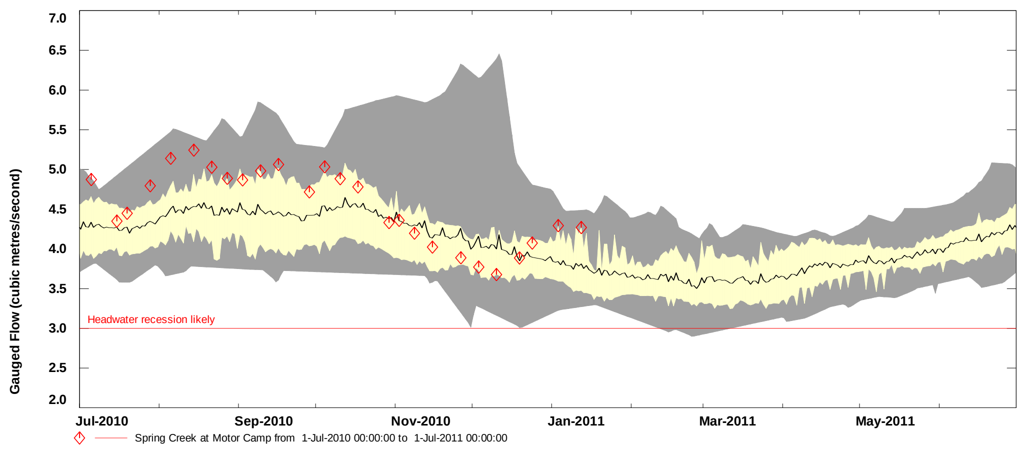

Figure 13 : Current Spring Creek Flow Status

No minimum flows have been set for Spring Creek or any of the other smaller springs at this stage. If flows fall below 3 m^3/second it is known from the experience during the 1997/98 and 2000/01 summer droughts that there would be significant recession in the position of the spring headwaters.

3.1.3. Blenheim sub-sector

Introduction

While the groundwater resources underlying Blenheim do not form a separate management sector or aquifer, their strategic importance as the source of Blenheim's municipal water supply and role in providing baseflow for the urban groundwater fed springs, warrants a detailed descrpition.

The geological structure of the Wairau Aquifer changes near Blenheim from being semi-confined in the western suburbs, to becoming fully confined east of Grove Road. As a result groundwater is forced to the surface to form springs such as Murphys Creek.

These springs contribute most of the channel flow of the Taylor River as it meanders through Blenheim during most summers. The flow of these ecologically and aesthetically important springs needs to be maintained which in turn depends on how the aquifer is managed.

Where are monitoring sites and what do they represent?

The MDC currently only operate a single monitoring site representing shallow groundwater beneath Blenheim. A deeper well is planned to monitor the confined aquifer where the town's drinking water is sourced from at a depth of 25 to 30 metres.

Well P28w/3954 is located near the intersection of Old Renwick Road with Murphys Road and represents the shallow groundwater feeding local springs. This well is 12 metres deep and was drilled in 2002 by MDC. It replaces a longstanding site nearby, but differences in well construction mean the two periods of record can't be combined.

Because a high proportion of groundwater leaves the aquifer through the network of natural springs, measuring their flow is a convenient way of monitoring the health of the aquifer over time. This is based on the principle that maintaining acceptable spring flows is likely to mean the Wairau Aquifer has sufficient groundwater in natural storage. MDC gauge the flow of Murphys Creek, Fulton Creek and Waterlea Creek each week.

How much groundwater has been allocated versus use?

Within the Blenheim urban area practically all of the consented groundwater use is for public supply. This represents the single largest water permit in the district at 43,200 m^3/day. While demand is highest in summer, around 10,000 m^3/day of groundwater is still used throughout the winter months as Figure 14 shows. For the period from 2000 to 2008, average daily water use varied from 10,000 up to 30,000 m^3/day.

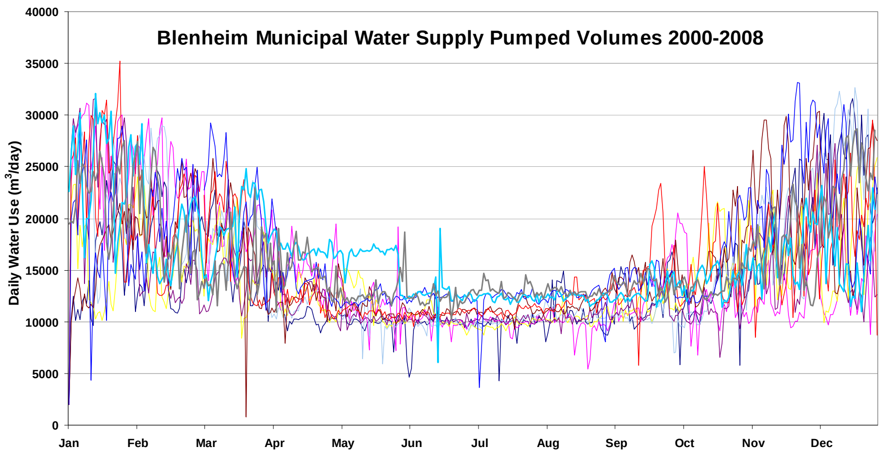

Figure 14 : Blenheim Public Water Supply Daily Use 2000 - 2008

During the peak summer demand period a higher proportion of allocation is used compared with a typical Wairau Plain grape irrigation water permit. For instance 20% to 60% of allocation is used by grape irrigators compared with 70% for municipal supply in Blenheim currently. This means that most of the effects of pumping from the municipal supply wellfields will already be apparent in the regional well monitoring network records and gaugings of spring flows.

Are there trends and what is causing them?

However the period of water level record available only dates from 2001 and is too short to be definitive about trends or longer term patterns yet (Figure 15). Aquifer levels have been stable or rising slightly over the short period of record available.

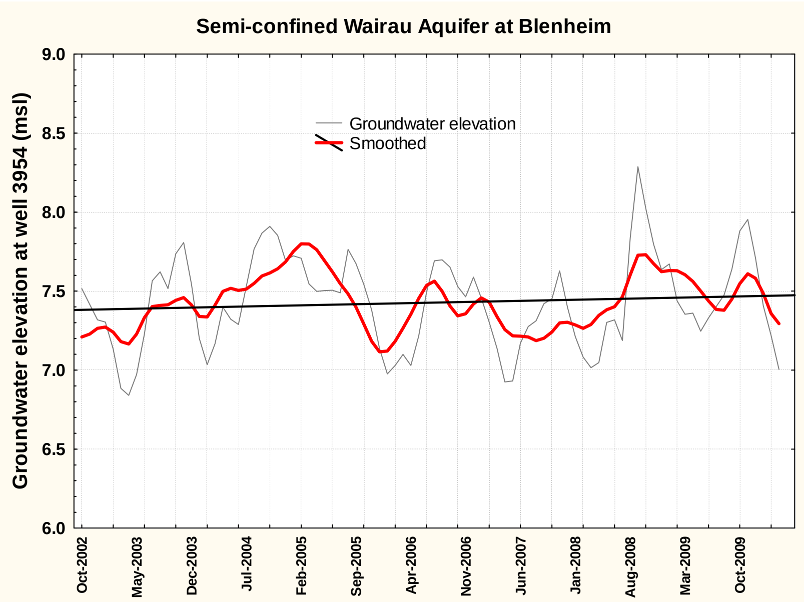

Figure 15 : Trends In Wairau Aquifer Level At Well P28w/3954

This upwards pattern reflects stable demand, above average rainfall in 2008 and 2010, together with the re-watering of the Gibson Creek/Upper Opawa River system which artificially recharges groundwater when it is operating. Not surprisingly this stable pattern is mimicked in the flow of the associated groundwater fed springs.

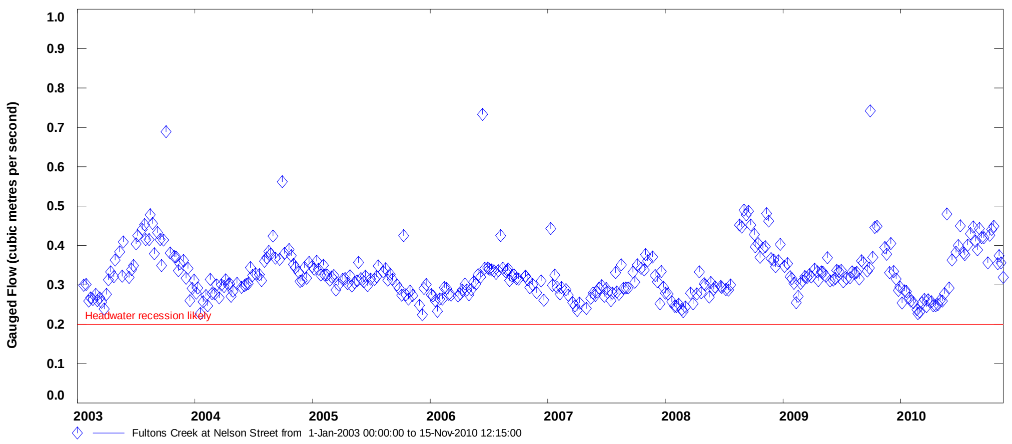

Figure 16 : Trends In Fulton Creek Flow Upstream Of The Taylor River

For example the flow of Fulton Creek and Waterlea Creek upstream of where they join the Taylor River over the past eight years is stable or rising as Figures 16 and 17 illustrate. Waterlea Creek runs from

Parker Street towards the Taylor River, and Fulton Creek rises in the western suburbs of Blenheim, before flowing through Pollard Park to the Taylor River.

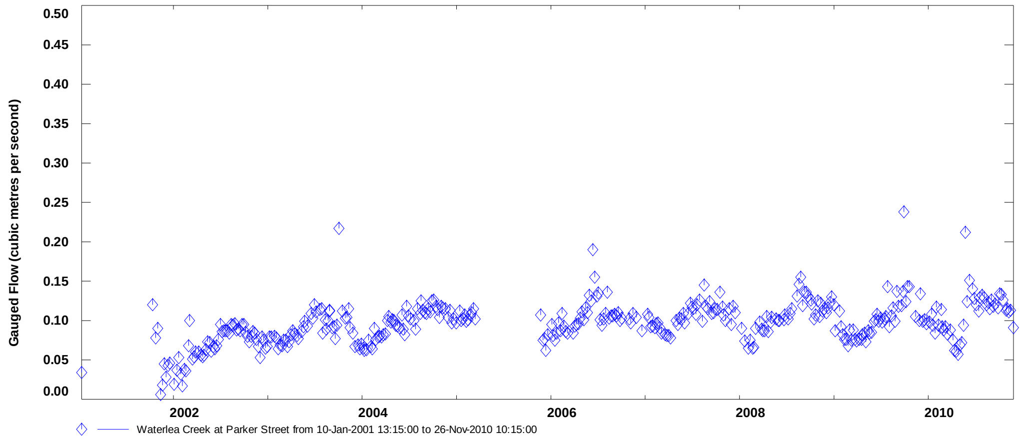

Figure 17 : Trends In Waterlea Creek Flow Upstream Of The Taylor River

Current urban spring flows appear to be acceptable to Blenheim residents and community groups based on the feedback received by MDC. There is no doubt that they are valued by Springland's residents, going on the number of complaints about headwater recession during the severe 1997/98 and 2000/01 droughts.

What is the aquifer state leading up to the 2010/11 summer?

Aquifer levels are above the average for this time of year and there are unlikely to be any shortages during the current summer season as the red line in Figure 18 shows. Because wells in this area are more distant from the Wairau River than those at Rapaura, proportionately more aquifer recharge originates as rainfall compared to river losses.

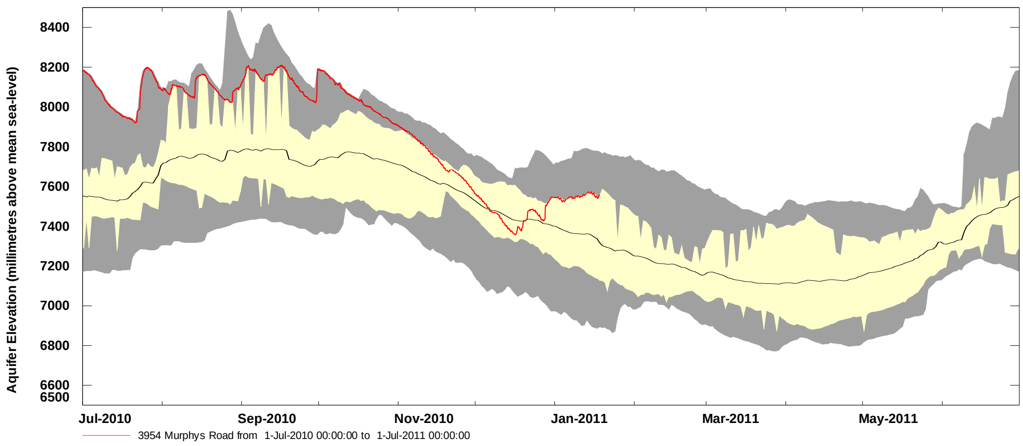

Figure 18 : Current Aquifer Status

Because spring flow is proportional to aquifer level, it is predictable that the current state of Waterlea Creek mirrors that of the Murphys Road well P28w/3954 (Figure 19). Interestingly the very recent gauged flow marked by the grey spike was caused by rainfall associated with the late December 2010 storm.

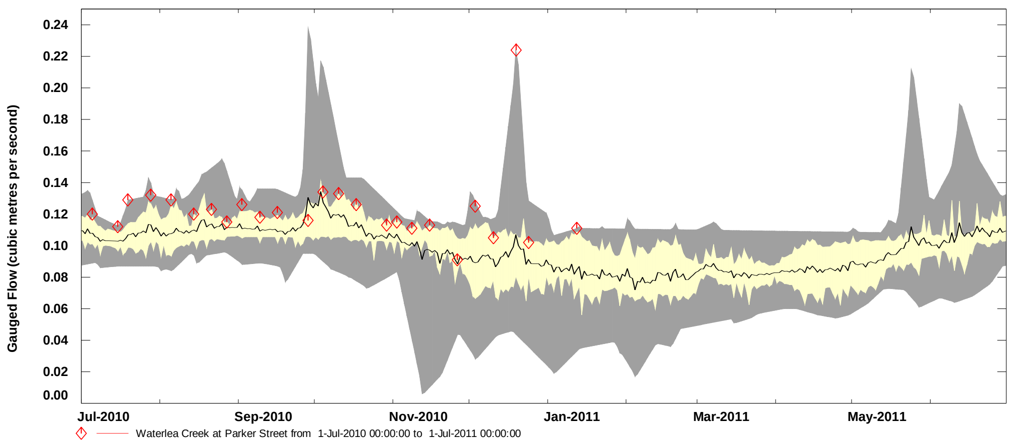

Figure 19 : Current Spring Status

3.1.4. Lower Wairau sector and Coastal sector

Introduction

Monitoring of the coastal border of the Wairau Aquifer has increased in importance over the past decade with the rise in consented groundwater demand from newly established vineyards and rural residential subdivisions. Potential aquifer management issues include seawater intrusion and maintaining the flow of groundwater fed coastal springs.

A separate coastal aquifer management sector was defined in 2001 and forms the corridor in Figure 2. The coastal sector of the Wairau Aquifer is defined as the area where pumping from wells can have a direct effect on groundwater levels at the coast.

However the cumulative effect of consented abstraction across a larger area extending as far inland as State Highway 1 is known to indirectly affect groundwater levels at the coast. The area between the SH1 and the coastal sector is referred to as the Lower Wairau sector of the Wairau Aquifer (Figure 2).

Due to the dynamic nature of local aquifers, a real time approach for monitoring local groundwater resources was adopted by the MDC in 2001 which relied on information provided by a network of sentinel wells along the Cloudy Bay coastline.

Continuous, automated measurements of aquifer level and groundwater salinity at these wells provide early warning of seawater intrusion and the mechanism for managing it. Seawater intrusion has not occurred to date.

Where are the monitoring sites and what do they represent?

Central areas are represented by the MDC monitoring well P28w/1733 which is located north of the Wairau River bar and within a few hundred metres of the coast. This longstanding site has been operating since 1988 and is commonly referred to as the Bar well.

Northern areas are represented by the MDC monitoring well P28w/3667 located at Hinepango Drive, just north of the Diversion, and has been operating for 10 years. This well is forty metres deep and was sited near the northern boundary of the Wairau Aquifer to monitor the effects of pumping in this boundary areas which is the most likely to experience issues.

There are currently no automated sites representing the Lower Wairau sector because of the lack of water management issues. Manual measurements are made at an MDC well in Morgans Road from time to time to provide background on the range in levels from a maximum in spring, to the minimum during summer when pumping is at its peak.

These sites are strategically important from a Wairau Plain scale because of their location at the downstream end of the Wairau Aquifer flow-path.

How much groundwater has been allocated versus actual use?

Rates of groundwater use vary significantly depending on soil type. Usage by vineyards on the free draining sandy soils located between Rarangi and the Wairau River mouth commonly reach 100% of allocation during dry mid summer conditions.

This means that with the exception of unexercised water permits, and uncertainty as to the effects during severe drought, that the full impact of pumping should be apparent in the existing monitoring record.

The degree of utilisation on the heavier inland soils is likely to be around 20% of allocation or less in a normal season for grape plants, and 80% or more for other crops such as peas, corn or pasture. This is one area of the Wairau Plain where these more traditional crops with higher irrigation demand still form a significant proportion of the crop area.

Groundwater demand is likely to be a relatively stable in the Lower Wairau sector, but there are several very large consents in the coastal area which have yet to be exercised and are predicted to cause aquifer levels to fall by a further one metre.

Category	Use
WARMP limit	Not defined separately from the larger Wairau Aquifer limit of 346,000 m^3/day (4 m^3/s.)
Number of consents	117
Irrigated area	-
Refined safe yield	*60,480 m^3/day
Consented allocation	100,030 m^3/day
Actual use	Varies by individual consent from 20% – 100% of allocation depending on soil type, crop type and seasonal climatic conditions

Table 4 : Water Use Summary

* *Coastal Aquifers Model and Aquifer Sustainability Assessment (Water matters Ltd 2010)*

A 2010 MDC commissioned modelling study defined the safe yield for this area to maintain coastal springs and avoid seawater intrusion of 60,480 m^3/day. This compares with the allocated total of 100,030 m^3/day. If on average 50% of allocation is pumped across both sectors then demand will be of the same order as the safe yield.

Are there trends and what is causing them?

There has only been a very small decline in aquifer levels in central areas since 1988 (Figure 20). This demonstrates that the effects of local and upstream pumping have been relatively minor. The zero at the base of the vertical axis is significant because it indicates mean sea-level.

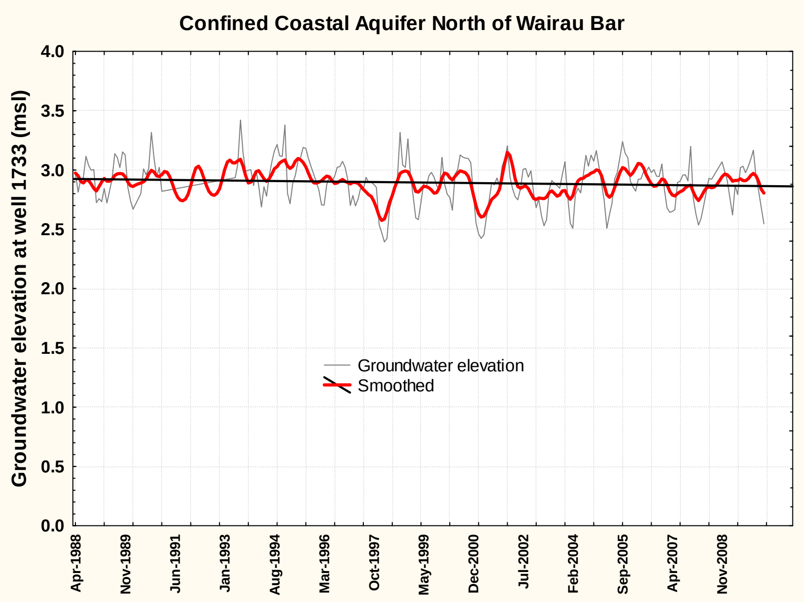

Figure 20 : Trends In Coastal Wairau Aquifer Level At Well P28w/1733

This area is subject to smaller seasonal variations in groundwater level than either northern coastal areas, or inland Wairau Aquifer areas for a number of reasons. Firstly, local consented rates of groundwater use have historically been relatively low. This means that pumping has not had a large direct effect on summer aquifer or well levels until very recently.

Secondly, the natural variation in aquifer levels is smaller at the coast because the sea acts as a boundary which all water must naturally drain to, and its presence moderates fluctuations in groundwater levels.

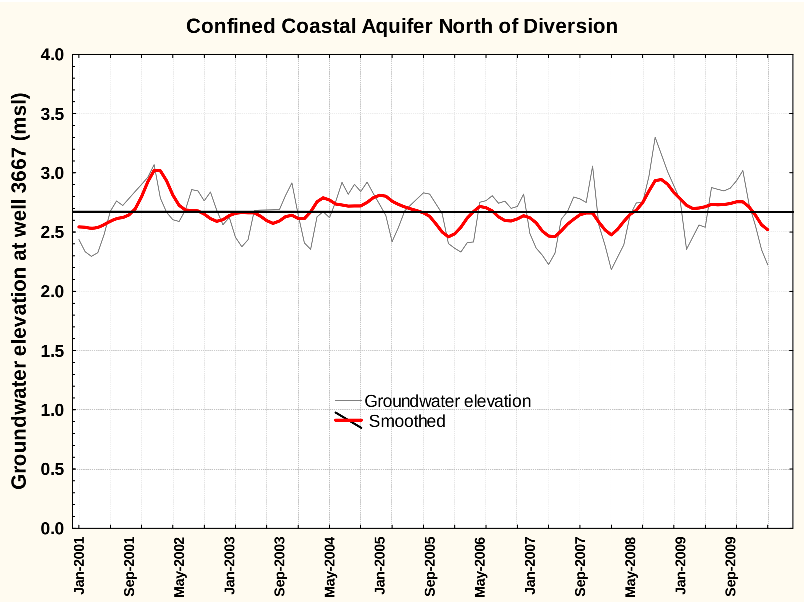

Figure 21 : Trends In Coastal Wairau Aquifer Level At Well P28w/3667

There has been little overall change in groundwater elevations in the northern coastal sector well P28w/3667 over the past decade (Figure 21). However there is a larger seasonal variation in more recent times as a greater proportion of consented abstraction is exercised. This means that aquifer levels fall further over summer when crops are irrigated, but in general levels are recovering by spring.

This is more clearly shown by comparing the variation in aquifer level with that of the more stable Bar well (P28w/1733) where historically groundwater use has been low. The divergence between the red and black traces in Figure 22 illustrates this. The difference between the summer levels represents the drop in groundwater levels caused by well pumping.

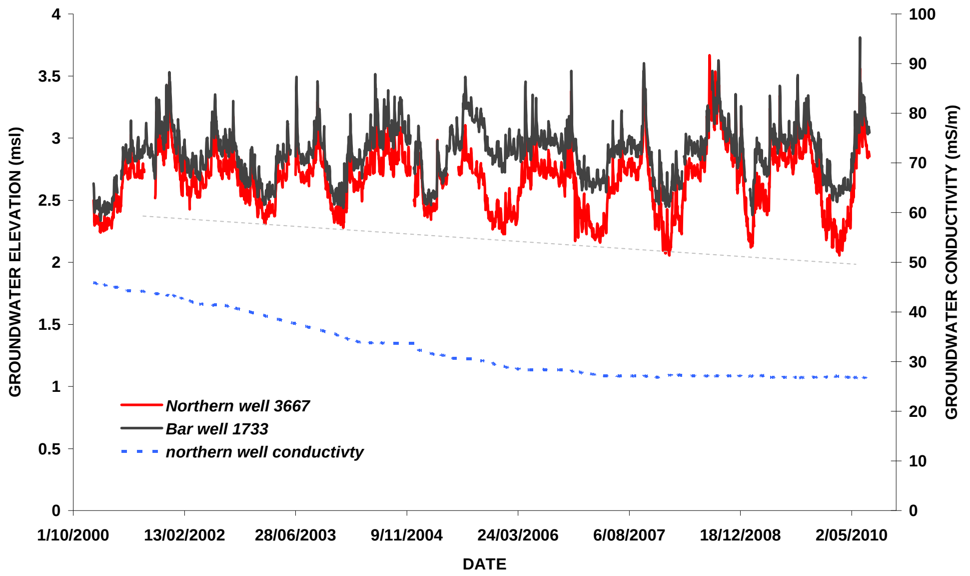

Figure 22 : Pumping Induced Changes In Groundwater Level And Conductivity

Interestingly groundwater conductivity shown by the dotted blue line is falling over time which indicates a lessening risk of seawater intrusion. This probably reflects younger more dilute groundwater being induced into the area by pumping from wells. The sentinel well network is doing its job by describing the relationship between pumping and changes in aquifer level.

What is the aquifer state leading up to the 2010/11 summer?

Aquifer levels at well P28w/3667 north of the Diversion are slightly above the long-term average for this time of year due to recharge from the December Wairau River flood event (Figure 23). The same pattern exists for the Bar well P28w/1733 as Figure 24 shows.

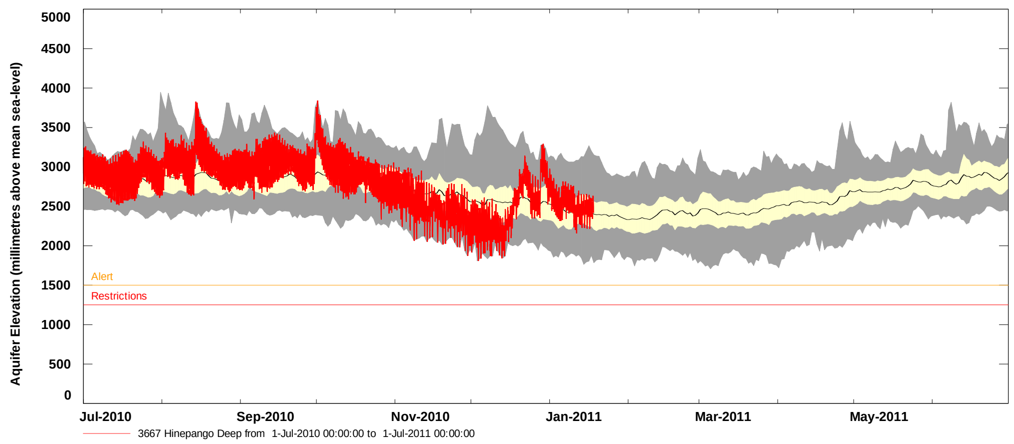

Figure 23 : Current Aquifer Status

The similarity in the most recent record shown by the red line shows that the same aquifer structure and recharge processes exist along the Cloudy Bay coast.

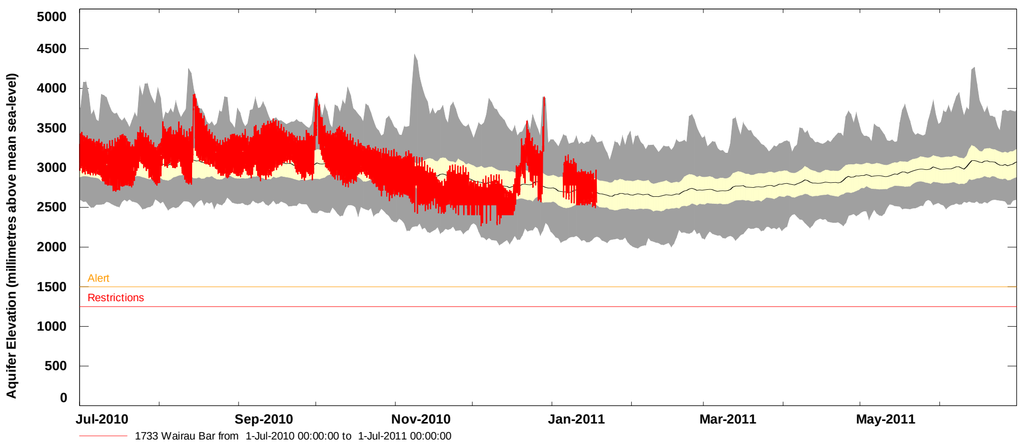

Figure 24 : Current Aquifer Status

At both locations aquifer levels are also well above the minimum safe elevation of 1.25 metres above mean sea level required to maintain the seawater interface in a safe position and marked by the red line. The oscillating levels in red are caused by the influence of the nearby ocean tides.

3.2. Riverlands Aquifer

Introduction

The Riverlands Aquifer lies to the south-east of Blenheim and receives recharge from a number of sources, principally the Wairau River, but also local runoff from the Wither Hills. Its southern margins are low yielding and potential issues include the sustainability of inland wells; and along its coastal margins, seawater intrusion.

It has only recently been defined as a separate aquifer system following a modelling study to assess its safe yield, and intensive hydrological investigations by MDC staff since 2004. The low lying topography and a confined aquifer structure cause natural artesian pressures to develop in some wells.

Where are the monitoring sites and what do they represent?

MDC operate two monitoring wells representing the two distinct areas making up the Riverlands Aquifer to represent the differing aquifer types and management issues. Only the coastal site (P28w/0708) located near the Lagoons currently has sufficient length of record for identifying the presence of trends, and then only for the last eight years. The second MDC monitoring well P28w/4402 at Alabama Road measures the status of inland parts of the Riverlands Aquifer, but was only drilled in 2004.

How much groundwater has been allocated versus actual use?

Almost twice the recently defined safe yield has been allocated through the consent process. This is offset by the low rate of actual use which is highly variable depending on the end use, but probably averages around 50% of allocation (Table 5).

The highest level of consent use is by the MDC water schemes supplying community drinking water schemes and food or industrial processing plants at the Cloudy Bay Business Park or Riverlands Estate. By comparison groundwater use for crop irrigation, especially for grape plants is a low proportion of their consented allowance. It is lower compared to elsewhere on the Wairau Plain due to the heavier soils at Riverlands which hold water for longer.

Category	Use
WARMP limit	Not defined separately from the larger Wairau Aquifer limit of 346,000 m^3/day (4 m^3/s.)
Number of consents	52
Irrigated area	-
Refined safe yield	*10,000 m^3/day
Consented allocation	28,000 m^3/day
Actual use	Varies by individual consent from 20% – 100% of allocation depending on soil type, crop type and seasonal climatic conditions

Table 5 : Water Use Summary

** Riverlands Groundwater Model and Aquifer Sustainability Assessment – Water Matters Ltd 2008*

No limits exist in the district plan for the Riverlands Aquifer, but a report commissioned by the MDC in 2008 recommended a ceiling of 10,000 m^3/day. This quantum of use will maintain the reliability of existing users and avoid seawater intrusion from occurring (Table 5). Consented allocation is still being taken up, especially by the MDC community water supply schemes and as a consequence summer levels are likely to fall further in the future until demand peaks.

Are there trends and what is causing them?

Overall aquifer levels at the Lagoon well P28w/0708 have been relatively stable based on the short period of record available since 2002, but as expected there is greater seasonal variability (Figure 25). Groundwater fluctuations are largest at the Alabama Road well (P28w/4402) due to nearby pumping effects as Figure 26 shows. The extent of these seasonal falls can again be quantified by comparing Riverlands Aquifer groundwater levels with the relatively stable record at the Bar well (1733) (Figure 26).

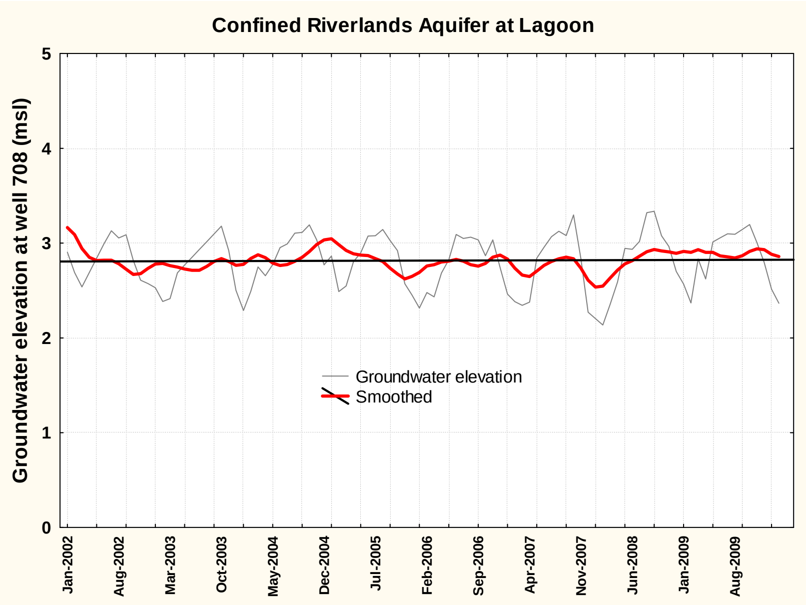

Figure 25 : Trends In Riverlands Aquifer Level At Lagoons Well P28w/0708

The divergence in the red and black lines in Figure 26 shows that consented groundwater abstraction is lowering aquifer and well levels by the order of several hundred millimetres each summer. However levels recover in spring while groundwater conductivity shown by the dashed blue line is not changing or may be trending downwards which is a good sign. There is no indication of groundwater becoming more saline due to increased pumping.

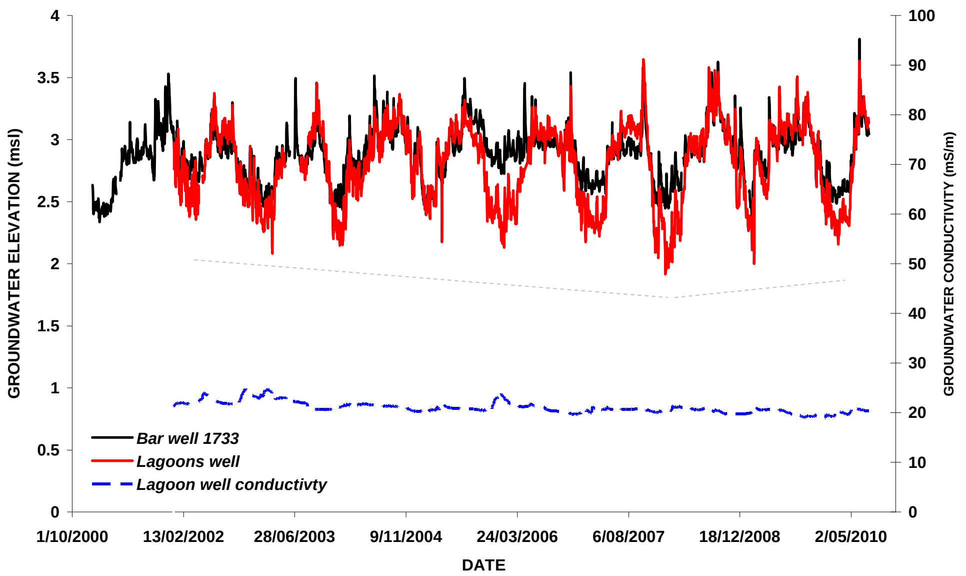

Figure 26: Pumping Induced Changes In Groundwater Level And Conductivity

A far longer period of level record which includes drought conditions and reflects peak groundwater demand is needed to be definitive about aquifer response to pumping.

What is the aquifer state leading up to the 2010/11 summer?

Aquifer levels are above average for both monitoring wells as Figures 27 and 28 show. The similarity in aquifer levels emphasises the common aquifer properties shared by both sites.

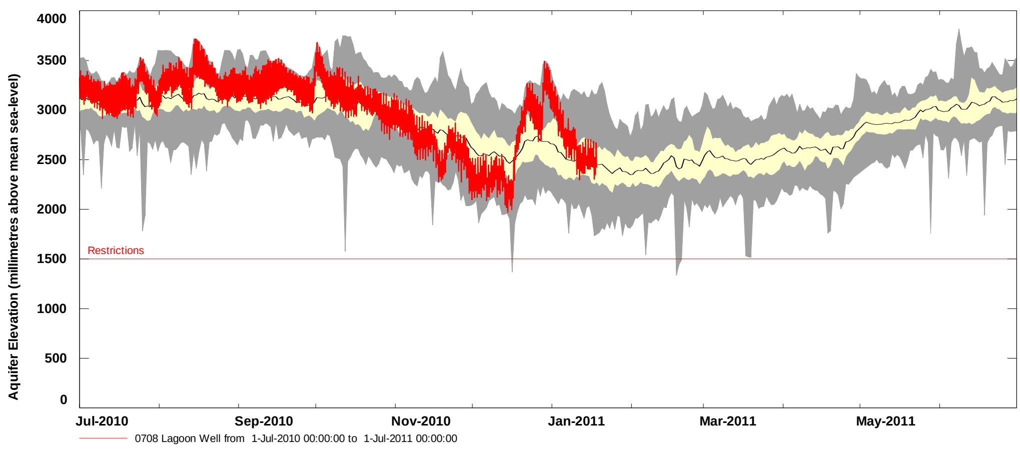

Figure 27 : Current Aquifer Status

Interestingly aquifer levels at the more inland site at Alabama Road are lower over summer than the Lagoon site which is closer to sea-level. This is caused by natural differences in aquifer permeability, especially south of Alabama/Hardings Road which naturally limits the rate of recharge.

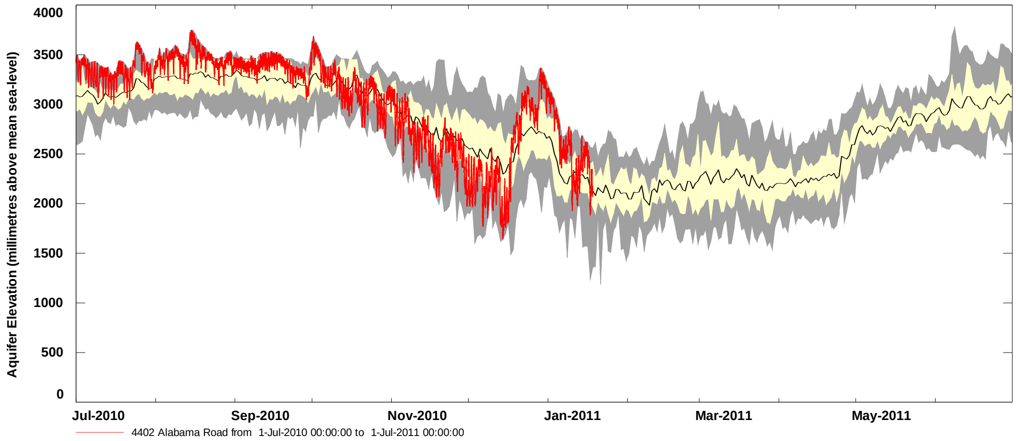

Figure 28 : Current Aquifer Status

3.3. Taylor River related aquifers

Introduction

Natural losses of Taylor River channel flow recharge a series of shallow to very deep aquifers underlying the southern suburbs of Blenheim. Rates of consented abstraction are falling due to declining agricultural demand and the expansion of the municipal water supply to new residential areas.

The naturally low yielding nature of these aquifers also makes them less attractive sources of water compared to other alternatives. Up until the late 1990s wells in this area contributed groundwater to the municipal supply, but these have been replaced by higher yield wells north of the Taylor River.

Because the Taylor River is naturally ephemeral, there are fewer ecological or downstream effects associated with groundwater use to account for compared to other Wairau Plain aquifers.

Where are the monitoring sites and what do they represent?

MDC operate two permanent wells to monitor the behaviour of local groundwater systems. The longstanding MDC monitoring well P28w/0949 at Athletic Park has been operating since 1977 and represents the Taylor Fan Aquifer. It is 22 metres in depth and represents shallow to medium depth wells supplying groundwater for crop irrigation and rural uses.

The second MDC monitoring well P28w/0980 is located in the grounds of Wairau Hospital where it represents deeper groundwater that is currently the oldest identified in New Zealand. Well P28w/0980 is 80 metres deep. While there is limited abstraction from this resource, it is being monitored to learn more about the dynamics of regional groundwater and the interaction between fossil groundwater and surface flows.

How much groundwater has been allocated versus actual use?

There are relatively few resource consents to take from groundwater and as a consequence changes in aquifer levels are largely driven by natural variations in recharge over time. There is a long term declining trend in catchment runoff which is known to reflect changes in upper catchment vegetation cover.

No limits on abstraction have been set in the WARMP. No new water permits have been granted in recent times and only then for harvesting of high channel flows. Actual use has probably declined in suburban areas and remained static for rural areas.

Are there trends and what is causing them?

There has been a small decline in Taylor Fan Aquifer levels of 250 millimetres over the past 33 years (Figure 29). This is likely to largely reflect a falling trend in Taylor River channel flow over time due to afforestation in the upper catchment, rather than increasing water demand as there has been limited conversion of land to irrigated agriculture. The seasonal falls corresponding to the 1997/98 and 2000/01 summer droughts are clear to see.

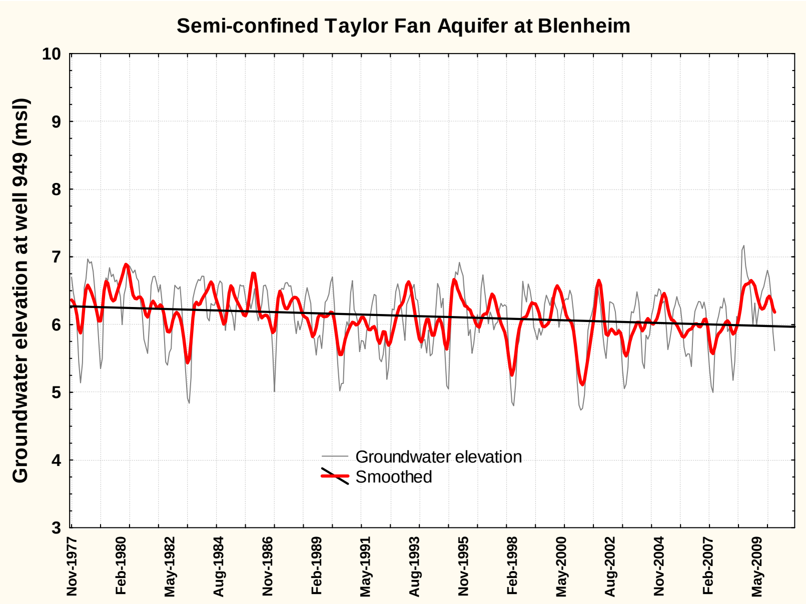

Figure 29 : Trends in Taylor Fan Aquifer Level At Well P28w/0949

There has been a net fall in groundwater levels at well P28w/0980 of two metres since records began in 1999. This pattern mimics the response of the nearby Benmorven Aquifer and demonstrates the sluggish rate of replenishment of deeper confined aquifers which are isolated from their surface sources of recharge. Trend analysis is further complicated by the gap in readings from 2005 to 2008.

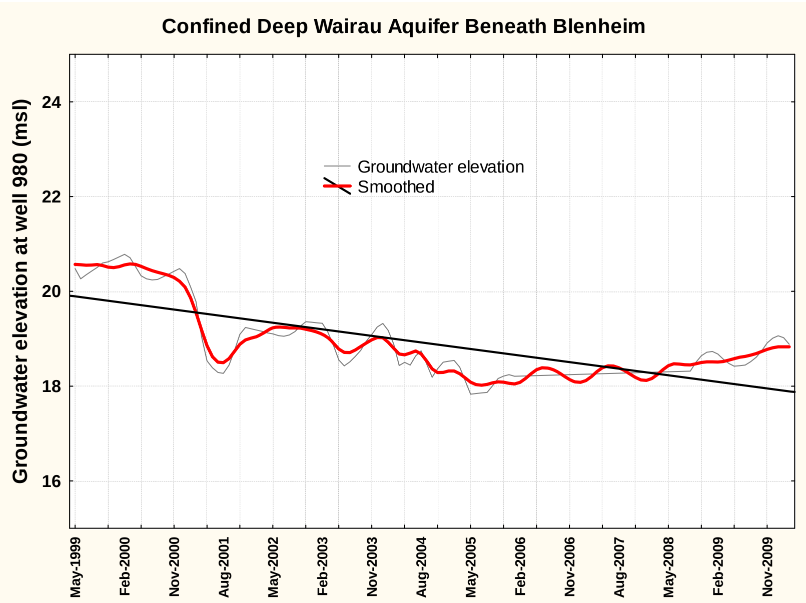

Figure 30 : Trends In Deep Wairau Aquifer Level At Well P28w/0980

What is the aquifer state leading up to the 2010/11 summer?

Medium depth groundwater levels are above average for this time of year which in turn reflects higher flows in the Taylor River, with more being lost to groundwater as recharge (Figure 31). Once the Taylor Fan gravels are fully recharged, the Taylor River flows in its channel to the sea.

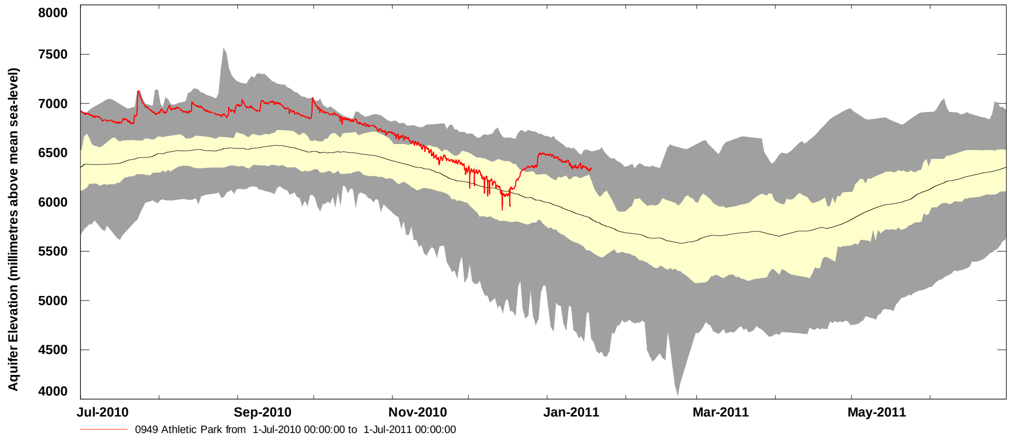

Figure 31 : Current Medium Depth Aquifer Status

Deep groundwater levels are below average for this time of year (Figure 32). Interestingly levels peak in January at this deep well when all other Marlborough aquifers reach their annual minima. This is thought to reflect sluggish groundwater flow through the deeper clay-bound strata which bear little resemblance to what is happening at the surface.

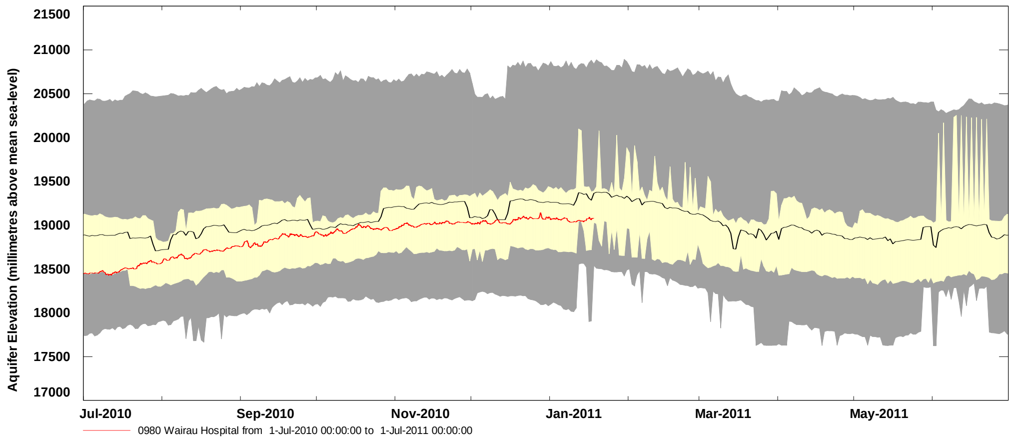

Figure 32 : Current Deep Aquifer Status

3.4. Omaka River Aquifer

Introduction

The next series of aquifers form part of the Southern Valleys Catchments suite of aquifers, all of which are low yielding compared to the Wairau Aquifer. The Omaka River Aquifer relies for its recharge on flow losses from the Omaka River.

All Omaka River flow is lost to groundwater in summer in the Hawkesbury Road area and apart from putting aside sufficient throughflow for downstream Woodbourne consents, there are no ecological low flows to account for.

Local aquifers can be broadly subdivided into either shallow riparian type systems which depend on flow in local rivers, or deeper aquifers that have greater storage, but take longer to recharge. A shallow unconfined aquifer exists in the middle parts of the catchment, with a deeper, semi-confined aquifer in its lower reaches around Woodbourne.

Sustainability of supply over summer is the primary water management issue dating back at least to the 1970s. All water resources in the catchment rely wholly on Omaka River flow. It follows that the status of the groundwater is very sensitive to changes in runoff which in turn depends on upper catchment land cover and climate.

Where are the monitoring sites and what do they represent?

MDC operate two wells to represent the two distinct aquifer layers. The more upstream well at Timara Wines (P28w/3069) represents the shallow aquifer surrounding the Omaka River channel. It is six metres deep and was established in 1997.

The second site (P28w/1000) is located in the lower reaches of the aquifer at Godfrey Road and represents the deeper aquifer layer. This well is eighteen metres deep and its level has been measured by MDC since 1980. In 2010 it was replaced by well 10231.

How much groundwater has been allocated versus actual use?

The WARMP limit of 170 l/s was fully taken up over a decade ago. To provide for further demand for water at the time by irrigators, harvesting of higher Omaka River flows was consented when they exceeded 400 l/s at the Tyntesfield Gorge.

Water permits with successively more restrictive water permits were issued by the Council, and no new water permits have been granted for several years. With the most of the flat land planted and developed and no new consents being issued, actual groundwater use should have peaked. The effects of consented abstraction should be relatively stable.

A review of actual use showed that in common with elsewhere in Marlborough, irrigation of grape plants which is the predominant crop, used significantly less than the MDC district plan guideline. To some extent this low use reflects the low yield of wells or water bearing layers.

The existing allocation limit was set in 1994 based on a forecast of the annual and 5 yearly Omaka River low flows. Sixteen years of flow record is now available from the Tyntesfield recorder site and it is being reviewed to determine the adequacy of the current district plan limit.

Category	Use
WARMP limit	14,688 m^3/day or 170 l/s This doesn’t include the harvesting of high channel flows when the Omaka River is at greater than 400 l/s
Number of consents	35
Irrigated area	Approximately 700 hectares out of the total irrigable flat-land area of about 2,680 hectares
Refined safe yield	The safe yield is being reviewed based on the flow record for the Omaka River
Consented allocation	Fully allocated
Actual use	Likely to vary depending on summer seasonal

	conditions from 20% – 60% for grape plants

Table 6 : Water Use Summary

Are there trends and what is causing them?

Ultimately all trends in both deep and shallow groundwater resources reflect the Omaka River flow regime. Since records began in 1997, shallow aquifer levels at well P28w/3069 have fallen by the small amount of 50 millimetres (Figure 33). Levels are stabilised by the proximity of Omaka River channel flows to this well. This means that pumping effects are short lived following a flood, which refills the shallow layer with channel water very quickly.

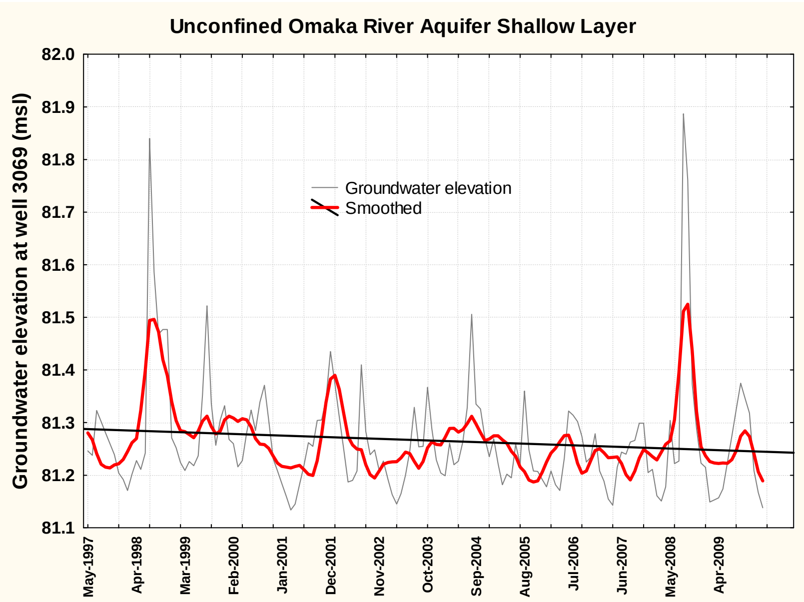

Figure 33 : Trends In Omaka River Aquifer Shallow Layer Level At Well P28w/3069

This contrasts with a large decline in deeper aquifer levels of 2.5 metres at the Godfrey Road well (P28w/1000) between 1980 and autumn 2010. The trend is not obvious to the eye in Figure 34 because it is reflected in lower average elevations rather than lower absolute levels. The main cause of this fall is declining catchment yield affecting Omaka River flows, but increased groundwater pumping since the 1980s is likely to be a contributing factor.

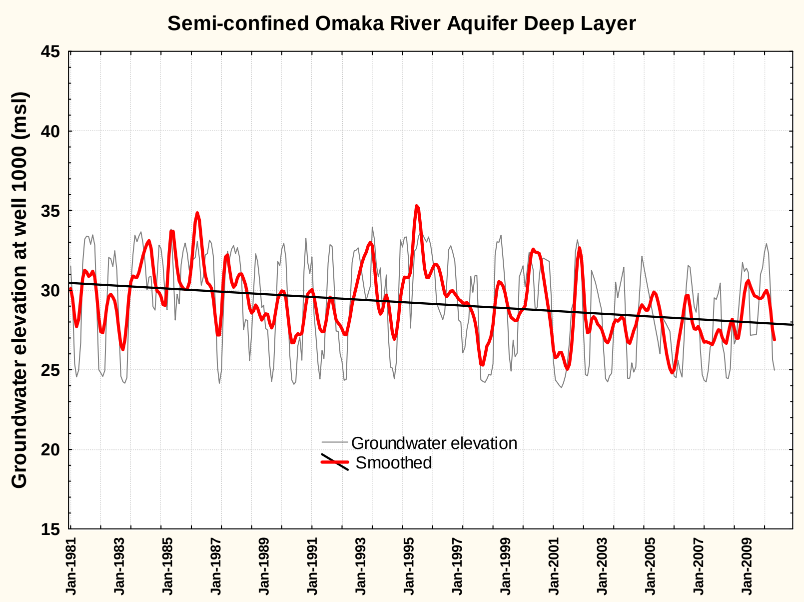

Figure 34 : Trends In Omaka Aquifer Deep Layer Level At Godfrey Road

Declining catchment runoff is a natural process because Tyntesfield Gorge is located upstream of where any consented abstraction occurs. While mean Omaka River flow followed a downwards trend between 1994 and 2008 at the Tyntesfield Gorge recorder site, it is now trending upwards again due to the wetter conditions experienced during 2008 and in mid 2010 (Figure 35).

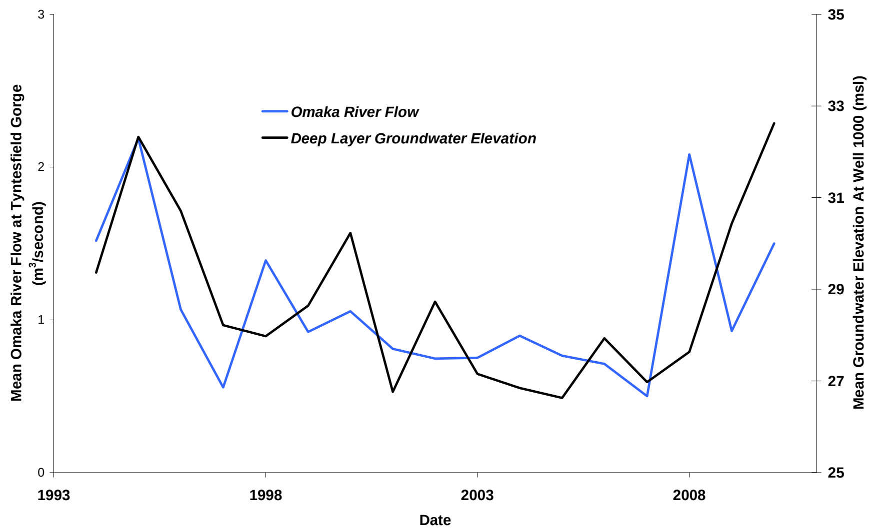

Figure 35 : Mean Omaka River Flow Versus Groundwater Elevation

The shift in patterns points to a climatic influence rather than the effects of land cover changes on runoff. Fewer medium sized Omaka River floods of 1 m^3/second magnitude, which are needed to recharge the deeper groundwater layers, may also be a contributing factor.

What is the aquifer state leading up to the 2010/11 summer?

Shallow aquifer levels are currently average for this time of year following the rejuvenating effect of the late December rain event. Aquifer levels were low throughout spring due to drier conditions (Figure 36).

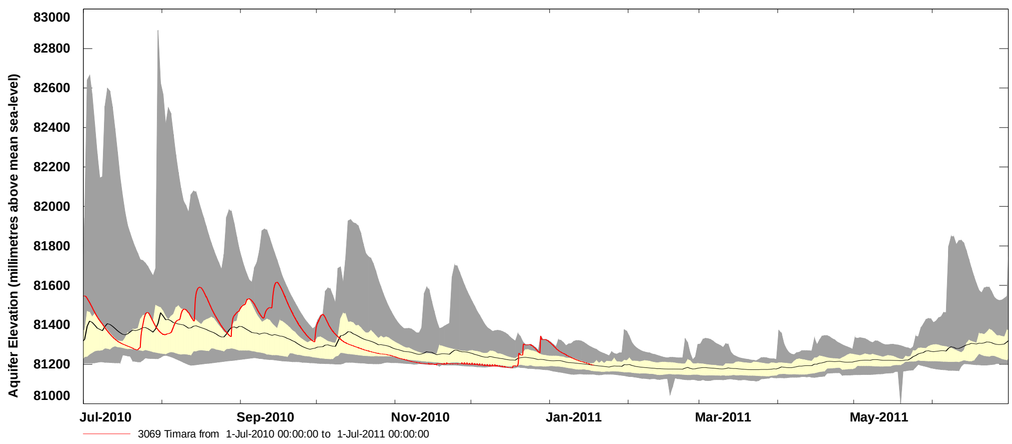

Figure 36 : Current Shallow Aquifer Status

The plot for the deeper layer well (P28w/1000) isn't available due to modifications, but spot measurements show levels are also above average and RNZAF Base Woodbourne should not experience water shortages this summer.

3.5. Woodbourne sector

Introduction

Woodbourne separates the relatively low yielding and highly committed Southern Valleys Catchments from the moderate to high yielding Wairau Aquifer to the north. Large seasonal variations in groundwater levels reflect the ephemeral nature of the Omaka River which provides much of the aquifer recharge. For example well levels can fluctuate by up to ten metres from winter to summer.

Because of the common source of recharge, Woodbourne is discussed in association with the Omaka River Aquifer. Historically water consents have been attributed to the Omaka River Aquifer, which is effectively an upstream extension of the Woodbourne sector. A separate Woodbourne sector was recently defined in recognition of its unique hydrological characteristics and its long history of water management issues.

Where is the monitoring site and what does it represent?

The current MDC monitoring well (P28w/3010) is situated mid-way along Jacksons Road and has been operating since 1997. Prior to this manual groundwater level measurements were made at the nearby well P28w/0594, and by the RNZAF at their tower well P28w/0662.

How much groundwater has been allocated versus actual use?

In common with most parts of the Wairau Plain it is likely that actual groundwater use is significantly less than the amount that has been allocated through the consent process. Actual use will vary depending on seasonal conditions with more in a dry year and less during a wet summer. Overall demand is likely to have peaked and won't increase significantly unless irrigated crop types change.

Category	Use
WARMP limit	The boundaries have been modified recently to reflect improvements in understanding. Previously the lower portion south of Middle Renwick Road formed part of the Omaka River Aquifer
Number of consents	25

Irrigated area	-
Refined safe yield	The safe yield is currently being revised as part of the hydrological review of the Omaka River flow record
Consented allocation	23,510 m^3/day
Actual use	Likely to reflect current trends of 20-60% of allocation for grape plants and a higher proportion for field crops

Table 7 : Water Use Summary

Are there trends and what is causing them?

The combined record for the Jackson Road wells P28w/3010 from 1997, and manual weekly measurements dating back to 1985 for the nearby well P28w/0594, are shown in Figure 37. A large fall in groundwater level of 1.25 metres occurred between 1985 and 2008.

Since this analysis was carried out in early 2010, the mean flow of the Omaka River has increased, and with it downstream recharge to the Woodbourne area. This highlights the sensitivity of well levels to the Omaka River and in turn the climate controlled runoff in the upper catchment.

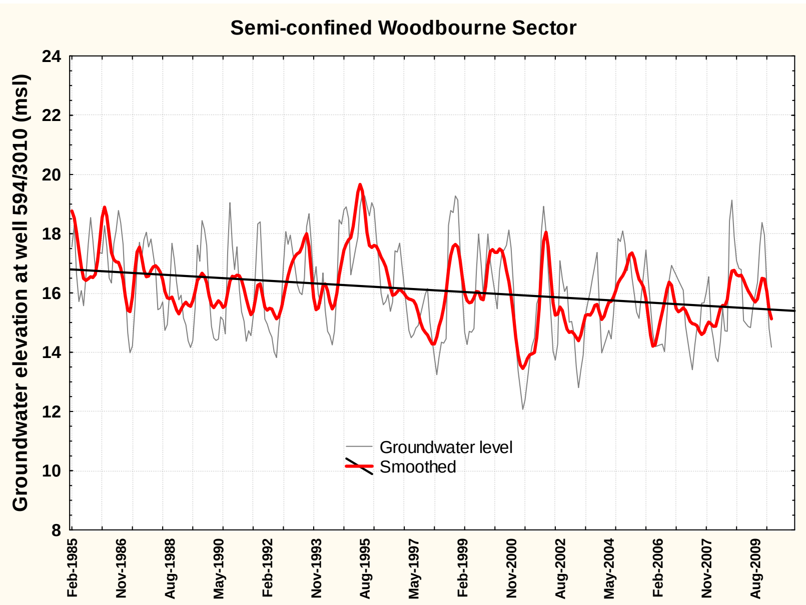

Figure 37 : Trends In Woodbourne Sector Level At Well P28w/0594-3010

A similar declining trend can be seen in aquifer levels at the Godfrey Road well (P28w/1000) slightly upstream in the Omaka River Aquifer. Both aquifers rely on the Omaka River for recharge and this implies that a major part of the downwards trend is due to less catchment runoff between 1996 and 2008. In other words a natural deficit rather than being related to consented use.

What is the aquifer state leading up to the 2010/11 summer?

Current Woodbourne Aquifer levels shown by the red line in Figure 38 have fluctuated from being below average in spring, to above average now following heavy rain and Omaka River flows in late 2010.

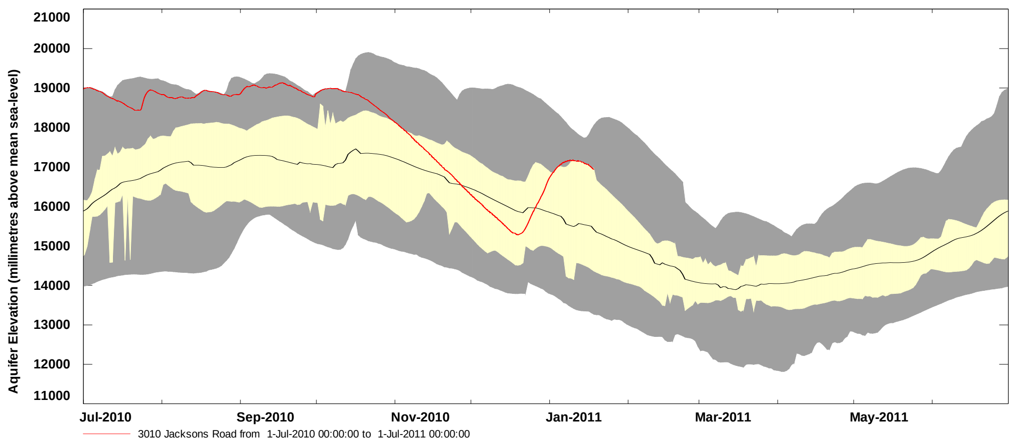

Figure 38 : Current Shallow Aquifer Status

3.6. Southern Springs sector

Introduction

The Southern Springs is the name given to the groundwater resources and their connected freshwater springs that occur west of Blenheim. It is bounded by Middle and New Renwick Roads, Woodbourne and the Taylor River in to the east.

In 2004 it was defined as a separate water management area to the Wairau Aquifer for two reasons. Firstly, in recognition of the valuable role groundwater plays in providing the summer baseflow of the lower reaches of the Taylor River through Blenheim.

Secondly, the Southern Springs Sector receives much of its recharge from the Southern Valleys catchments as opposed to the Wairau Aquifer. The lesser reliability of this source make them more vulnerable to overpumping and justifies a different management approach.

The largest surface waterway is Doctors Creek which represents a combination of upwelling groundwater and surface runoff from the Benmorven hill catchment. Large flood flows are generated by heavy rain such as in mid 2008. All other springs such as the Fairhall Co-op Drain, Camerons Creek, Old Fairhall River and Yelverton Stream represent wholly groundwater fed springs.

The area has excessively high soil water levels for agricultural purposes during the wetter months, but experiences shortages of channel flow in some summer seasons for maintaining the ecologically and aesthetically important Taylor River.

Where are the monitoring sites and what do they represent?

Because the bulk of groundwater exits the catchment as spring flow to the Taylor River, the state of the groundwater resource is focused on flow in Doctors Creek, rather than groundwater levels in wells as is normally the case. Maintaining spring flows at acceptable levels is the focus of management. Flow has been manually gauged each week since 2003, upstream of the Taylor River confluence by MDC staff for a number of reasons. These are to identify trends in catchment runoff, the effects of urbanisation or consented abstraction on spring flow, and to provide information for managing resource consent conditions (Figure 39).

How much groundwater has been allocated versus actual use?

Actual irrigation rates for grape plants are known to be low relative to other areas of the Wairau Plain because of the heavy soils locally. Actual irrigation water use for other crops such as pasture and maize is likely to be closer to their allocation guidelines.

Category	Use
WARMP limit	No limit defined
Number of consents	50
Irrigated area	-
Refined safe yield	The safe yield is currently being reviewed by MDC staff based on the updated flow record for Doctors Creek. It will also take into account the reliability of existing consents based on the approach documented in the 2010 AQUALINC 2010 report
Consented allocation	57,415 m^3/day (664 l/s)
Actual use	Varies by individual consent from zero to 60% of allocation depending on soil type, crop type and seasonal climatic conditions

Table 8 : Water Use Summary

Rates of groundwater pumping have fallen significantly since the Korere Farms dairy unit ceased operation in 2003 and water permits were transferred to lower demand crops such as grape plants or for rural residential supply. Because this large volume of water is now only partially used, summer flows in Doctors Creek will be higher all other factors being equal.

Are there trends and what is causing them?

The flow record for Doctors Creek upstream of the Taylor River is too short to draw any firm conclusions on trends at this stage (Figure 39). There are also a number of transient factors that have to accounted for including the wetter than normal conditions experienced in 2008 and 2010, together with conversion of dairy pasture to lower water demand uses. It is likely that wetter conditions explain the higher flows in spring, and the reduction in demand accounts for the higher average summer flows in recent seasons. The red line in Figure 39 is the environmental threshold of 150 litres/second designed to protect instream habitat. It hasn't been breached as frequently in recent summer irrigation seasons.

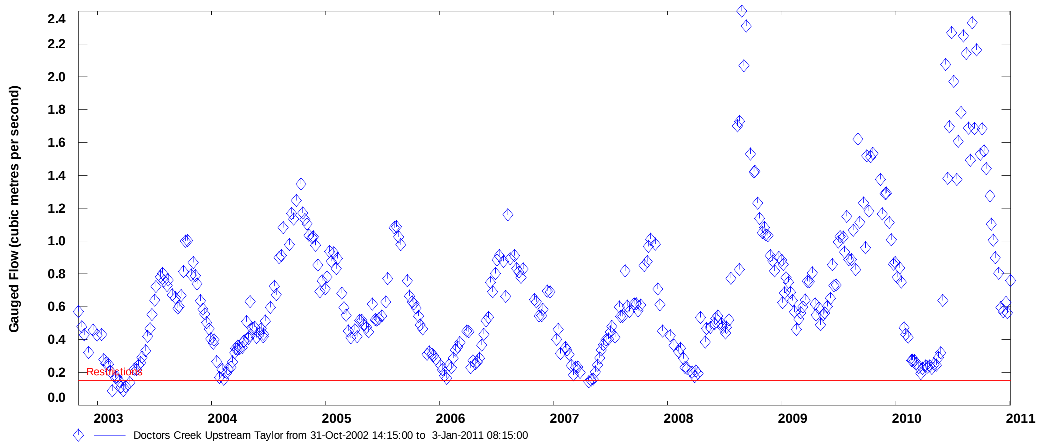

Figure 39 : Trends In Doctors Creek Flow Upstream Of The Taylor River

What is the aquifer state leading up to the 2010/11 summer?

The Southern Springs groundwater resource is likely to be near full capacity based on the high flows of its associated springs. This is illustrated by Figure 40 which shows that January flow of Doctors Creek before it joins the Taylor River upstream of the High Street bridge is above average at 795 litres/second.

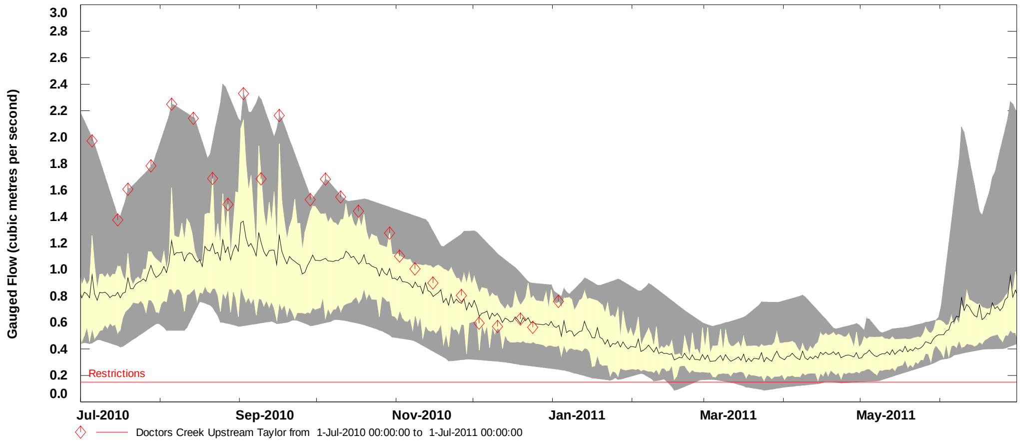

Figure 40 : Current Spring Status

3.7. Benmorven Aquifer

Introduction

The Benmorven Aquifer along with the neighbouring Brancott and Omaka systems form part of the low yielding and heavily committed Southern Valleys Catchments that lie along the southern edge of the Wairau Plain. The central water management issue is long-term sustainability of supply for well owners.

Groundwater is used for a broad range of applications including winery wash down, golf course irrigation, rural residential community drinking water schemes, crop irrigation and by small holders. Careful management has been needed in some seasons to ensure drinking water supplies aren't interrupted.

A fine balance exists between consented use and the natural rate of recharge for the Benmorven Aquifer. This is a function of its highly confined structure which naturally isolates it from the surface, slowing rates of recharge.

The safe yield has been refined over the past decade as more information has come to hand relating changes in aquifer levels to rates of abstraction. Active management has been required in some drier seasons to maintain minimum groundwater stocks.

A key component to the success of this voluntary approach has been seasonal quota as opposed to a daily limit. A bulk limit suits the way in which isolated aquifers receive an annual replenishment rather than daily top-ups, as is the case with the unconfined Wairau Aquifer.

Where are the monitoring sites and what do they represent?

The Benmorven Aquifer consists of a vertical series of water bearing layers extending down to depths of more than 100 metres, although most wells in the area tap the uppermost confined aquifer at depths of around 30 metres below the surface. This medium depth layer is represented by the long-standing MDC monitoring well P28w/2022 at Morven Lane, which has been operating since 1990.

The second MDC monitoring well P28w/3291 at Benmorven represents the Deep Wairau Aquifer which underlies and interacts with the Benmorven Aquifer. This site is located south of New Renwick Road near the intersection with Benmorven Road and has water level records dating from 1999.

How much groundwater has been allocated versus actual use?

The Deep Southern Valleys Aquifers are the only water resources in Marlborough where long-term and comprehensive records of groundwater use currently exist. Meters were first introduced in the mid 1980s to measure the impact of pumping on groundwater levels, and this information is now central to seasonal aquifer management.

For example knowledge of how pumping and recharge affect groundwater levels has allowed MDC staff to refine the safe yield from the original 1996 district plan limit of 1,700 m^3/day, to a nominal rate of around 1,000 m^3/day (Table 9).

Changes in Benmorven Aquifer levels have been shown to be most sensitive to consented abstraction and less so to rates of natural recharge. This finding along with the setting of natural limits has only been made possible through the availability of good hydrological information.

Annual groundwater use since 1985 is shown in Figure 41. The dashed line represents the upper limit of sustainable use. During the period when pumping exceeded this rate, aquifer and well levels were trending downwards.

The Deep Southern Valleys Aquifers are unique amongst Marlborough aquifers for having been driven hard in terms of their sustainable limits. The safe yield of all other aquifers relies on forecasts by computer models. There is no substitute for demonstrating the limits of the resource and verifying model predictions.

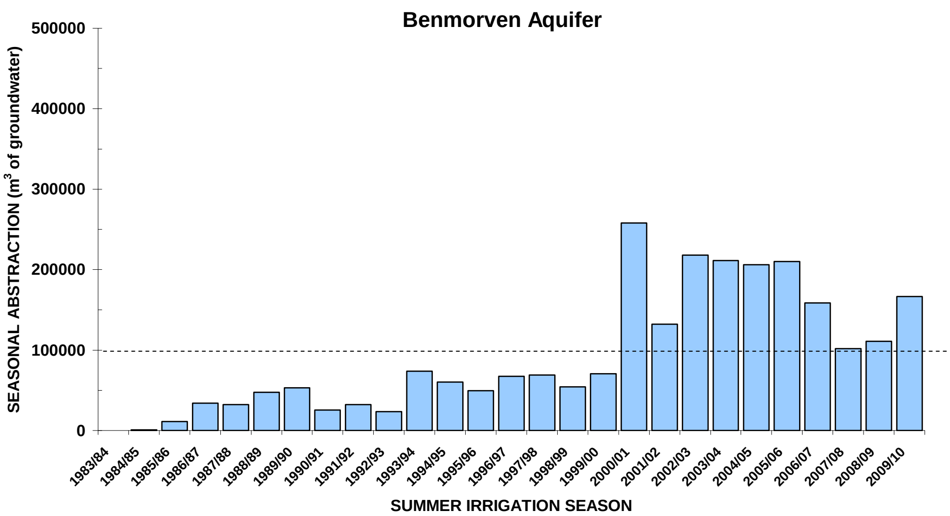

Figure 41 : Benmorven And Deep Wairau Aquifer Groundwater Use 1985-2010

The volume available to consent holders to pump will vary from season to season depending on the amount of groundwater stored in the aquifer. This will also reflect how much groundwater was pumped the previous summer season and the amount of spring recharge.

A formula exists that relates the bulk seasonal allocation or safe yield to the amount of groundwater above the community agreed threshold of 20 metres elevation. The safe yield is nominally set at 1,000 m^3/day based on the long-term behaviour of all three deep Southern Valleys Aquifer systems and their ability to rebound.

Category	Use
WARMP limit	1,700 m^3/day
Number of consents	10 consents for irrigation or food processing and several for rural residential community supply
Irrigated area	191 hectares
Refined safe yield	A nominal volume of 1,000 m^3/day or 100,000 m^3/season varying seasonally and depending on the free board above the minimum level of 20 metres elevation. If levels fall below this threshold then no groundwater may be available except for drinking/stock supply purposes
Consented allocation	2,641 m^3/day
Actual use	Up to 258,000 m^3 during 2000/01 drought season or an average rate of 2,580 m^3/day

Table 9 : Water Use Summary

Are there trends and what is causing them?

Aquifer levels have fallen by around 15 metres since 1990, but have stabilised as a result of reduced groundwater pumping. This was achieved through a combination of voluntary restrictions by consent holders, and the introduction of the SVIS in 2004.

The Benmorven Aquifer is over-allocated in some seasons but this wasn't apparent until a series of droughts resulted in much higher rates of pumping than had previously been experienced. The aquifer experienced a net fall of 7 metres (Figure 42) which represents a very large decline, and is the reason why the Benmorven Aquifer has been a focus of MDC monitoring activities since 1998.

Pumping is high relative to the low natural storage and recharge capacity of the system. Furthermore it has been slow to recover from the 2000/2001 drought compared to the neighbouring Brancott or Omaka Aquifer systems. This is a function of its confined structure which impedes the rate at which it naturally refills, despite the area experiencing record rainfall in mid 2008 and 2010.

This natural isolation from surface processes such as rainfall provides security from land use contamination, but also means the aquifer doesn't get recharged by recent rainfall.

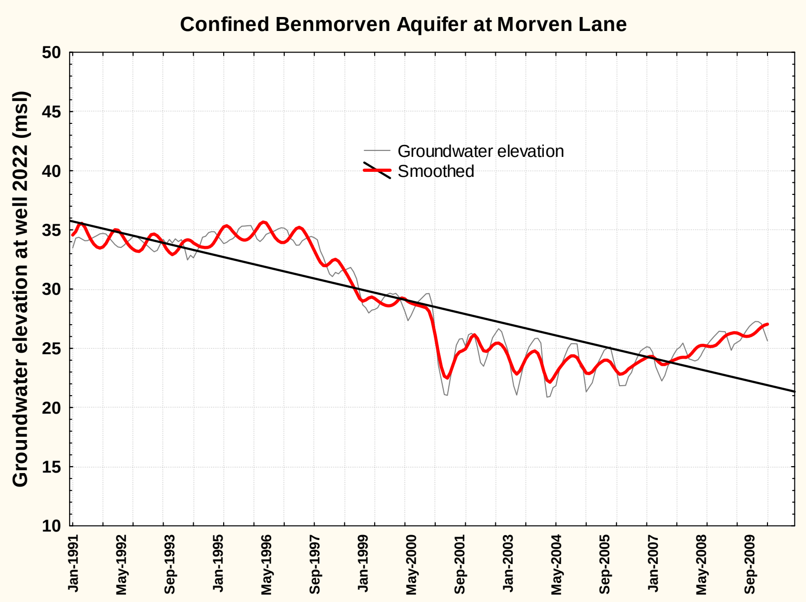

Figure 42 : Trends In Benmorven Aquifer Level At Well P28w/2022

Groundwater levels in the Deep Wairau Aquifer at Benmorven followed a similar pattern to those of the overlying Benmorven Aquifer layer, experiencing an overall fall of around 2 metres since 1999 (Figure 43). The similarity in the water level record and the seasonal effects of pumping between the two sites prove they are hydraulically linked.

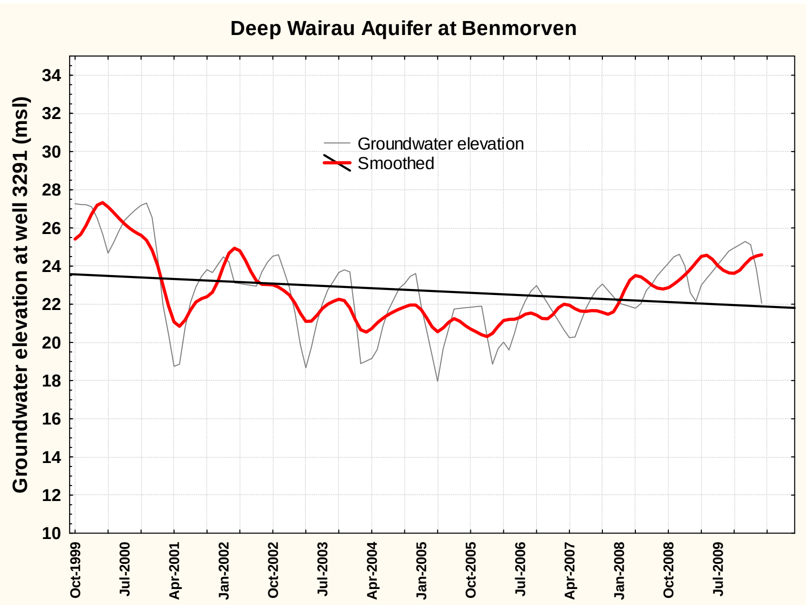

Figure 43 : Trends In Deep Wairau Aquifer Level At Well P28w/3291

What is the aquifer state leading up to the 2010/11 summer?

Benmorven Aquifer levels are currently six metres above the minimum threshold of twenty metres elevation as Figure 44 shows. Based on knowledge of the volume of groundwater this corresponds to, there is likely to be sufficient for water to meet demand for the current summer season.

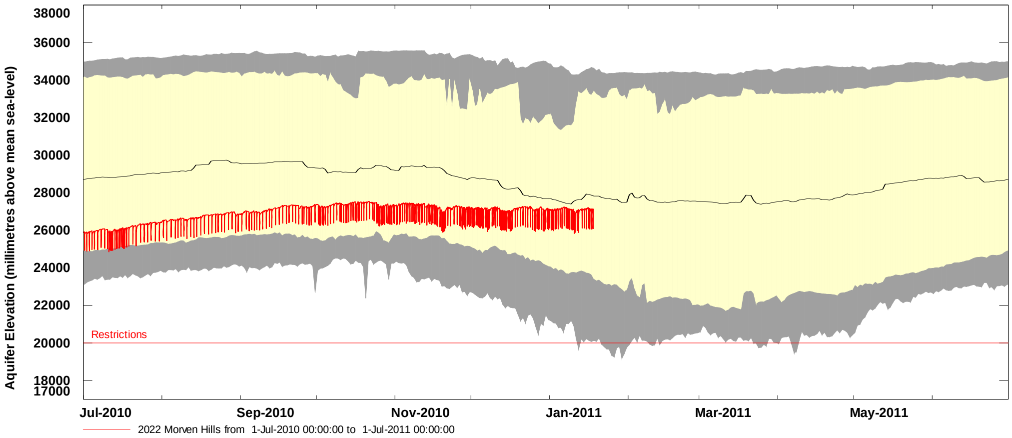

Figure 44 : Current Benmorven Aquifer Status

Not all of the groundwater free-board is available for use in a single summer in case there are droughts in successive years, and the SVIS is unavailable to water users. The state of the deeper aquifer layer represented by well P28w/3291 is similar to the shallower Benmorven Aquifer (Figure 45).

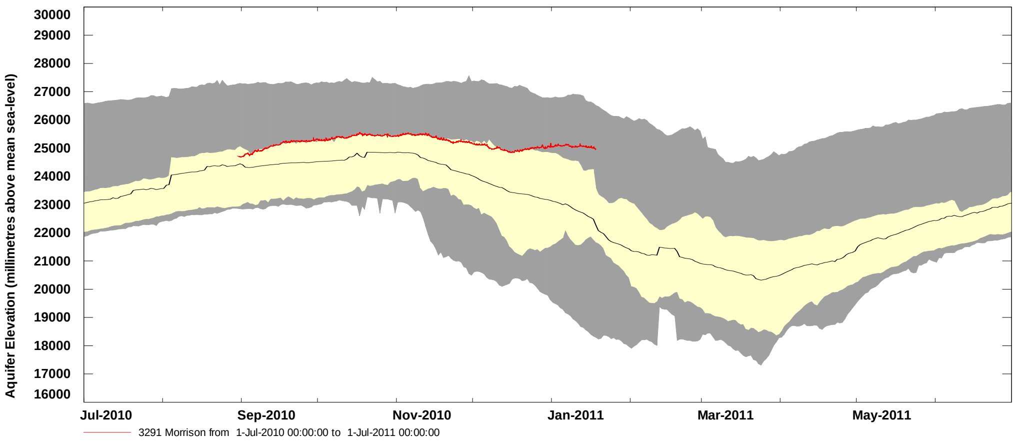

Figure 45 : Current Deep Wairau Aquifer Status

3.8. Fairhall River Gravels Aquifer

Introduction

Three groundwater systems exist beneath the Fairhall-Brancott Valley. The most significant volumetrically in terms of groundwater storage and the number of users it supplies is the medium depth Brancott Aquifer.

It is partially overlain by the Fairhall River Gravels Aquifer (FRGA) which is a riparian type groundwater system associated with the shallow gravels surrounding the channel and linked to Fairhall River flows. Underlying the Brancott are deeper layers extending to several hundreds of metres depth below the surface and belonging to the Deep Wairau Aquifer.

Due to its small size the FRGA doesn’t represent a significant natural reservoir, and relies on continual recharge from the Fairhall River to maintain well yields. As a consequence the FRGA drains quickly when Fairhall River flows are low and water demand is high.

The ephemeral nature of the Fairhall River means that it dries up naturally to near the foothills in most summers. Conversely it can also recover quickly in winter or spring when the Fairhall River flows again.

Where are the monitoring sites and what do they represent?

MDC operate two wells to monitor the behaviour of the three separate, but interconnected aquifer layers underlying the Fairhall-Brancott Valley. The Fairhall River Gravels Aquifer is represented by a 5 metre deep well P28w/3147, located close to the Fairhall River channel at Bints Ford, halfway between New Renwick Road and Wrekin Road.

How much groundwater has been allocated versus actual use?

The Wairau-Awatere Resource Management Plan specifies a daily limit of 800 m^3/day for the FRGA with a total of 626 m^3/day having been consented, along-with several smaller takes for domestic or stock use.

Category	Use
WARMP limit	800 m^3/day
Number of consents	5 for crop irrigation and 1 for community rural residential supply
Irrigated area	41 hectares
Refined safe yield	-
Consented allocation	626 m^3/day
Actual use	Similar low rates of usage expected as for other southern valleys aquifers of 20% to 60% of consented allocation

Table 10 : Water Use Summary

The FRGA has experienced shortages dating back many decades and actual demand on the resource is likely to have declined in recent years following the introduction of the Southern Valleys Irrigation Scheme (SVIS).

Are there trends and what is causing them?

The levels of wells tapping the shallow Fairhall River Gravels Aquifer have remained stable over the period of record from 1997 (Figure 46).

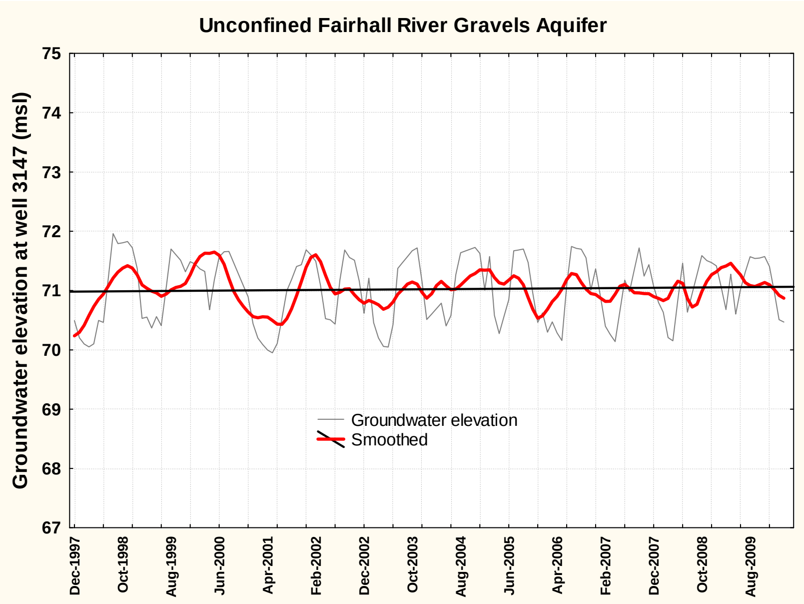

Figure 46 : Trends In Fairhall River Gravels Aquifer Level At Well P28w/3147

What is the aquifer state leading up to the 2010/11 summer?

Fairhall River Gravels Aquifer levels are above average for this time of year based on the thirteen years of record available, which includes two severe drought events (Figure 47). No water supply issues are expected through to the end of the summer season.

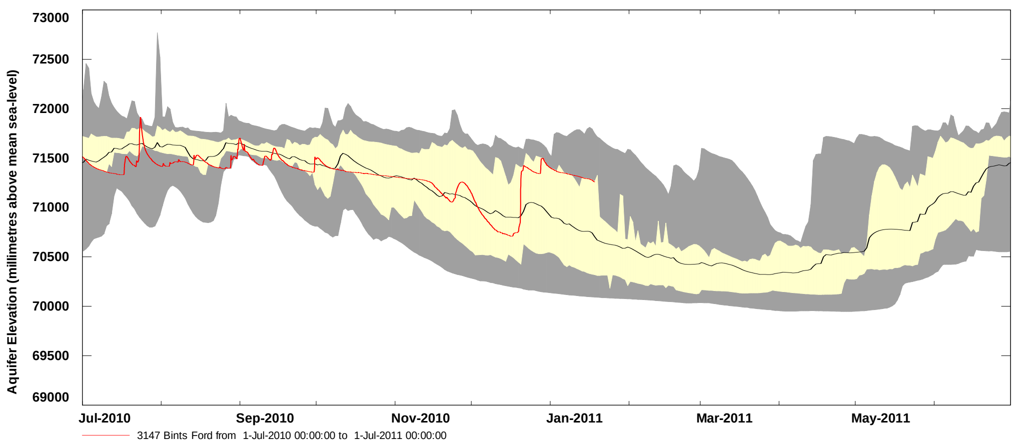

Figure 47 : Current Fairhall River Gravels Aquifer Status

3.9. Brancott Aquifer

Introduction

The Brancott Aquifer was introduced in the earlier section as the most significant groundwater resource beneath the Fairhall-Brancott Valley and the source of most consented water. This medium depth aquifer layer is tapped by wells that are around 30 metres or more in depth.

It is also partly underlain by the Deep Wairau Aquifer in the lower reaches of the valley near New Renwick Road at depths of around 150 metres below the surface. While this deeper layer supplies the smallest proportion of groundwater in terms of consented volume, all aquifer layers are indirectly connected. Water from the Fairhall River or the FRGA naturally leaks downwards to recharge the two deeper layers. The key management issue for all aquifer layers is sustainability of water supply from season to season.

Where are the monitoring sites and what do they represent?

The Brancott Aquifer monitoring well P28w/1323 has been operating since 1995 and is located in the middle reaches of the Fairhall-Brancott Valley at the Montana Wines Brancott Estate vineyard. The third MDC monitoring well in the area (P28w/3333), represents the Deep Wairau Aquifer and is also the deepest at 300 metres. It is located on the northern side of New Renwick Road.

How much groundwater has been allocated versus actual use?

With the introduction of SVIS it is likely that Brancott Aquifer groundwater demand has fallen. Historically the aquifer was heavily committed in many summer seasons. The SVIS was commissioned in 2004 and pumps water into the area from the Wairau River.

Category	Use
WARMP limit	3,000 m^3/day
Number of consents	18
Irrigated area	390 hectares
Refined safe yield	A nominal volume of 2,000 m^3/day or 200,000 m^3/season varying seasonally and depending on the free board above the minimum level of 36 metres elevation If levels fall below this threshold then no groundwater may be available except for drinking/stock supply purposes
Consented allocation	4,191 m^3/day
Actual use	Up to 400,000 m^3 during 2000/01 drought season or an average rate of 4,000 m^3/day

Table 11 : Water Use Summary

A clear picture exists of the safe yield of the Brancott Aquifer and its linked Deep Wairau Aquifer layer. Both have been pumped at close to their natural limits and detailed water meter records have been kept since the mid 1980s of the corresponding rate of abstraction.

A total daily volume of 4,191 m^3/day has been allocated in relation to the nominal safe yield of 2,000 m^3/day (Table 11). Pumping rates peaked during the 2000/01 summer drought season, as elsewhere in the Southern Valleys (Figure 48).

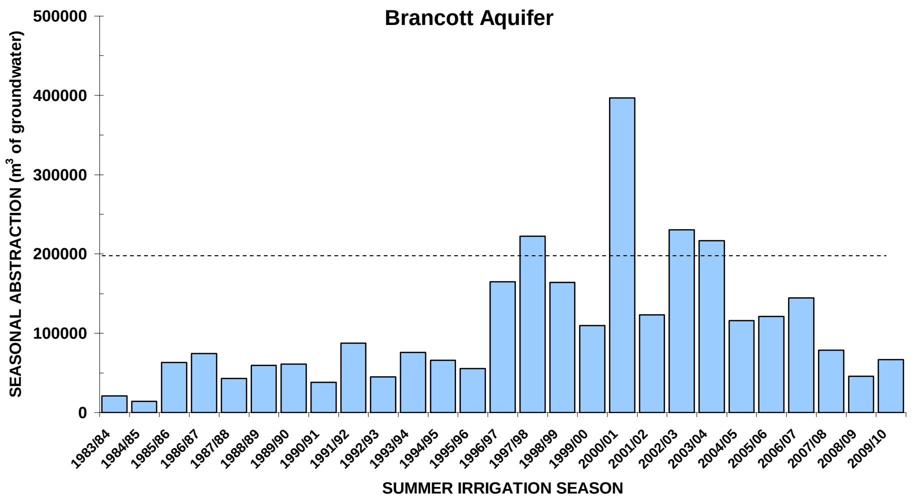

Figure 48 : Brancott And Deep Wairau Aquifer Groundwater Use 1985-2010

Are there trends and what is causing them?

The Brancott Aquifer experienced large falls in groundwater levels as a result of high demand and low rates of recharge during the past decade. Levels fell by around 7 metres, but have largely recovered following the introduction of the SVIS supplementary water supply scheme in 2004, and lower groundwater use (Figure 49). The Brancott Aquifer has recovered more quickly than the neighbouring Benmorven Aquifer because of its more open structure which allows it to naturally recharge at a faster rate providing there is sufficient rainfall and large Fairhall River flows in spring or winter.

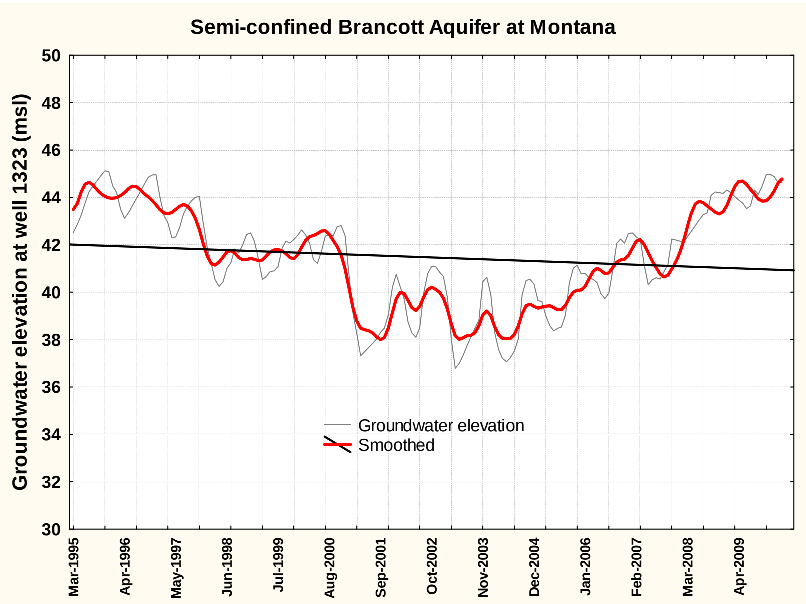

Figure 49 : Trends In Brancott Aquifer Level At Well P28w/1323

Levels in the underlying Deep Wairau Aquifer well (P28w/3333) have nearly recovered to their pre-drought state (Figure 50). The explanation for the recovery of such a deep reservoir is not perfectly understood yet. High rainfall and river flows are needed to saturate the intermediate gravel layers and allow recharge of the Brancott Aquifer or Deep Wairau Aquifer. High rainfall and river flows in 2008 and 2010 have contributed to the rebound.

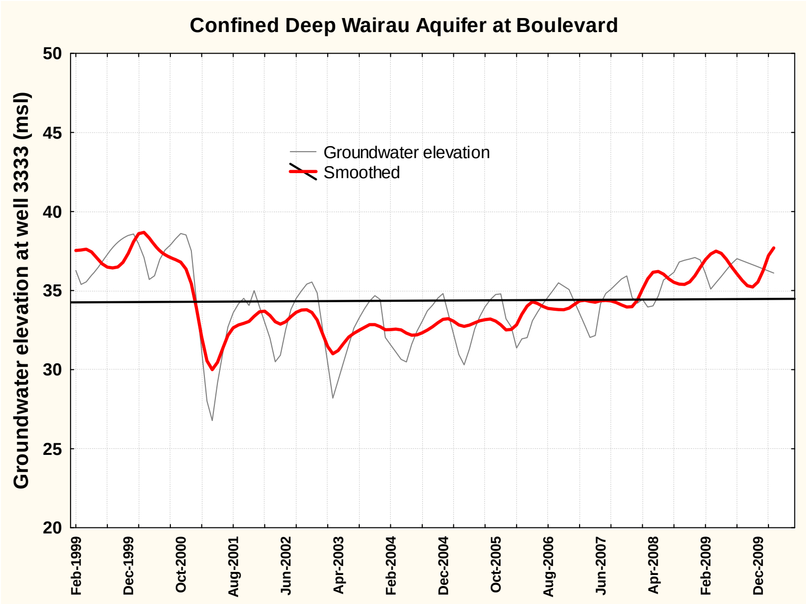

Figure 50 : Trends In Deep Wairau Aquifer Level At Well P28w/3333

What is the aquifer state leading up to the 2010/11 summer?

Brancott Aquifer levels are the highest since records began in 1995 with eight metres of free-board above the minimum level informally agreed to by water users and residents following the 2001 drought. There is sufficient groundwater stored in the Brancott to meet demand the remainder of the summer and for future seasons.

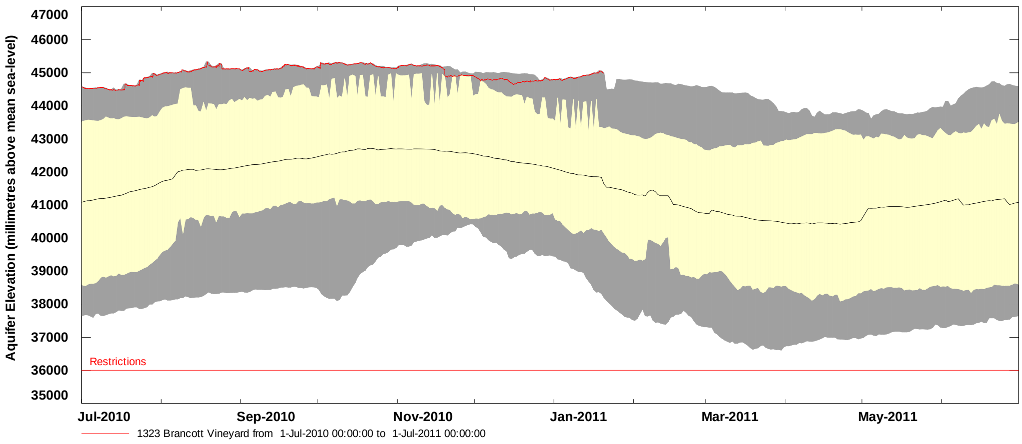

Figure 51 : Current Brancott Aquifer Status

The rise in Brancott Aquifer levels over the past decade represent a very large change in a well, but a modest difference in terms of the volume of groundwater storage because of the low water holding capacity of its clay-bound strata.

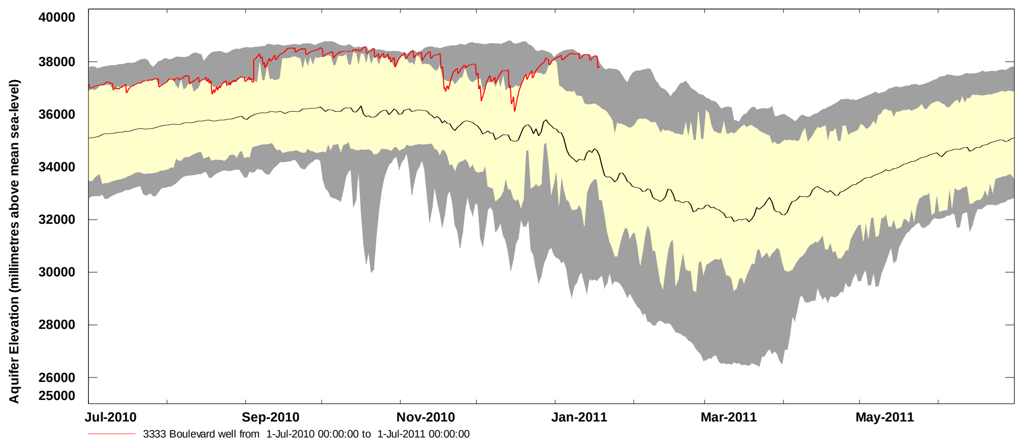

Figure 52 : Current Deep Wairau Aquifer Status

Above average levels also exist for the Deep Wairau Aquifer and this supports the notion of an interconnected Brancott Aquifer made-up of a sequence of water bearing layers. No shortages are expected with this layer for this summer period (Figure 52).

3.10. Omaka Aquifer

Introduction

The Omaka-Hawkesbury Valley is underlain by a series of low yielding water bearing layers similar to those forming the base of the neighbouring Brancott Valley. However there is less reliance on shallow groundwater because Mills/Ward Stream has lower late summer flows than the Fairhall River.

In this area groundwater is used almost exclusively for irrigation vineyards in summer. The Omaka Aquifer has a similar semi-confined structure to the Brancott Aquifer, meaning it responds reasonably quickly to recharge.

Where are the monitoring sites and what do they represent?

MDC monitors groundwater levels at two sites. Well P28w/1873 in Hawkesbury Road is 83 metres deep. It has been operating since 1991 and represents the medium depth Omaka Aquifer, the cluster of layers which are the source of most consented groundwater.

The Omaka Aquifer is also underlain by the Deep Wairau Aquifer in the Omaka-Hawkesbury Valley. MDC monitor groundwater levels in this deeper layer at well P28w/2917 which is currently the deepest well in Marlborough. These wells are located side by side but observe different aquifer layers.

How much groundwater has been allocated versus actual use?

A total daily take of 3,687 m^3/day has been allocated through the consents process. This exceeds the district plan limit of 1,900 m^3/day, and more importantly the safe yield of 2,000 m^3/day (Table 12). The Omaka Aquifer was pumped to near its natural limits during the 2000/01 drought. As more pumping and water level information has become available over time, the limits of the resource have become refined to a nominal daily rate of 2,000 m^3/day or 200,000 m^3/season (Table 12).

The same approach has been used in the Omaka Aquifer for setting seasonal allocations as in the neighbouring Brancott and Benmorven Aquifers. In this case the threshold of 73 metres is the highest because the Omaka-Hawkesbury Valley is the most elevated of the three Southern Valleys Aquifer systems.

Category	Use
WARMP limit	1,900 m^3/day
Number of consents	26
Irrigated area	339 hectares
Refined safe yield	A nominal volume of 2,000 m^3/day or 200,000 m^3/season varying seasonally and depending on the free board above the minimum level of 73 metres elevation If levels fall below this threshold then no groundwater may be available except for drinking/stock supply purposes
Consented allocation	3,687 m^3/day
Actual use	Up to 190,000 m^3 during 2000/01 drought season or a daily average of 1,900 m^3/day

Table 12 : Water Use Summary

In common with the other deeper groundwater layers of the Southern Valleys Aquifers, abstraction peaked during the 2000/2001 summer drought (Figure 53). Demand is a smaller proportion of the safe yield than for either the Brancott or Benmorven Aquifers.

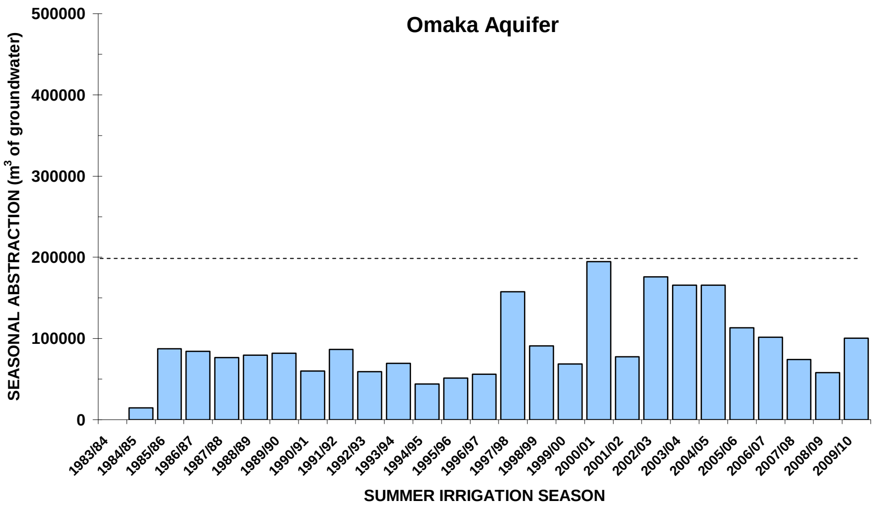

Figure 53 : Omaka And Deep Wairau Aquifer Groundwater Use 1985-2010

Are there trends and what is causing them?

Omaka Aquifer levels fell by up to ten metres because of high water demand during the 2000/01 drought, but have now largely recovered (Figure 54). This rebound largely reflects lower demand on groundwater resources following the introduction of the Southern Valleys Irrigation Scheme (SVIS) in 2004. This aquifer has a less confined structure than either the Benmorven or Brancott Aquifers, and recharges more rapidly than these systems.

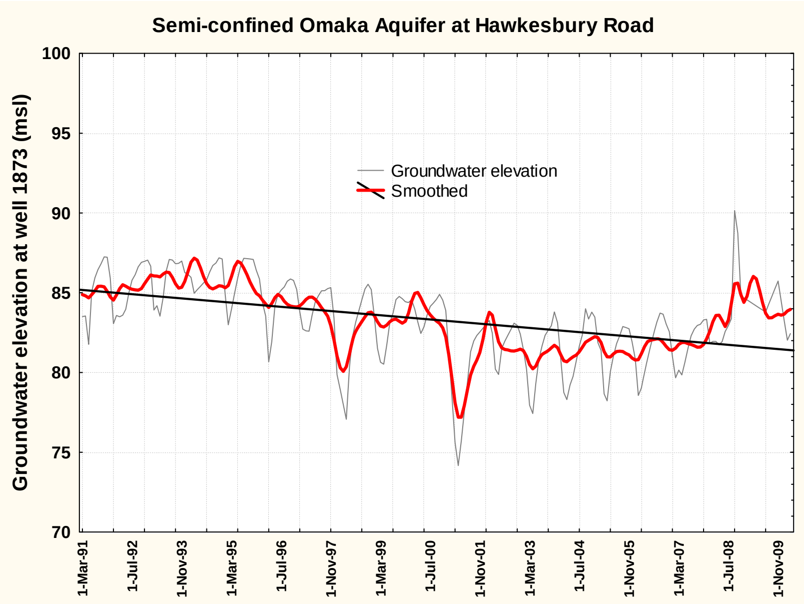

Figure 54 : Trends In Omaka Aquifer Levels At Well P28w/1873

Part of the variation in the water level at this well is caused by pumping at nearby irrigation wells. However the overall or long-term trend is generally consistent with Southern Valleys Aquifer patterns. The lowest level was experienced during the 2000/01 drought when groundwater demand peaked.

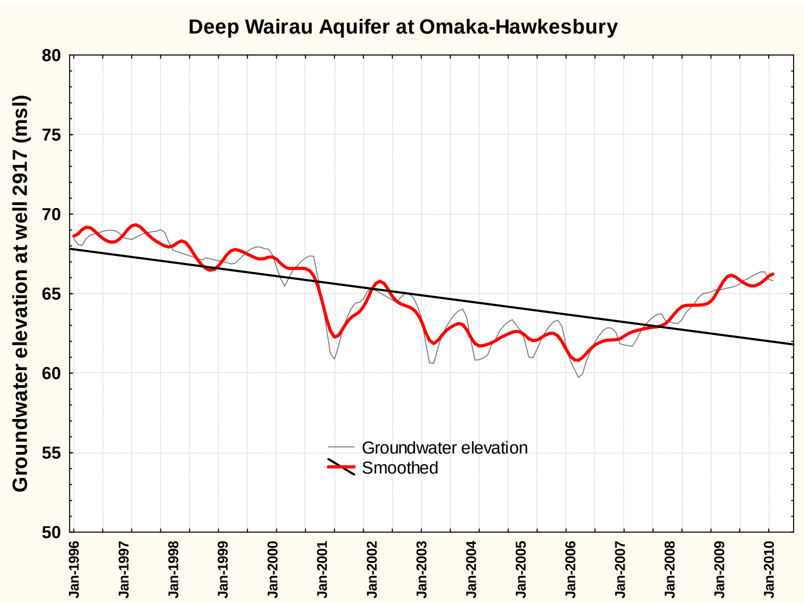

Figure 55 : Trends In Deep Wairau Aquifer Level At Well P28w/2917

Figure 55 shows that groundwater levels in the underlying deep Wairau Aquifer experienced a net decline of 2.5 metres as a result of high demand and lower rates of recharge over the past 14 years, but are now rebounding.

What is the aquifer state leading up to the 2010/11 summer?

Omaka Aquifer levels are well above the long-term average for this time of the season, and more than ten metres higher than they were during the height of the 2000/01 drought (Figure 56). As a consequence there is likely to be sufficient groundwater stored in the aquifer to supply demand for the coming summer season. Interestingly levels are not as high in relative terms as for the Brancott Aquifer.

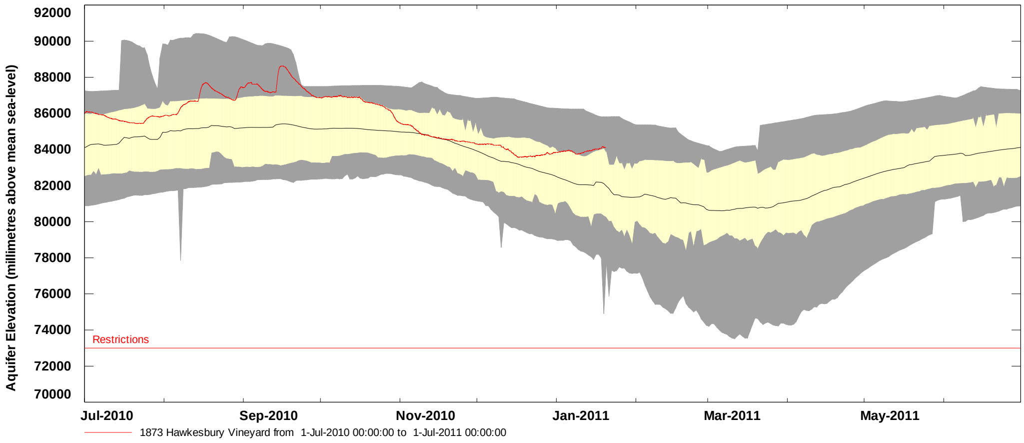

Figure 56 : Current Omaka Aquifer Status

Deep Wairau Aquifer levels are also above the long-term average and no issues with water supply are expected at this stage (Figure 57).

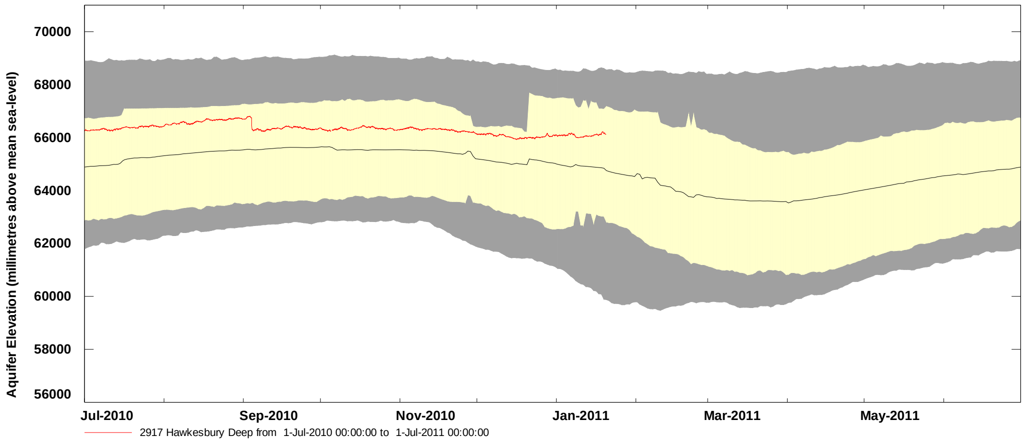

Figure 57 : Current Deep Wairau Aquifer Status

3.11. Rarangi Shallow Aquifer

Introduction

The Rarangi Shallow Aquifer (RSA) is a small coastal groundwater system formed on sand dunes at the Cloudy Bay coast north-east of Blenheim. There are seven MDC monitoring wells at Rarangi which represents the highest density for any aquifer area in Marlborough district. The high number of sites reflects the importance of groundwater to the local community, and the potential for water management issues such as seawater intrusion and depletion of groundwater fed wetlands to develop. Seawater intrusion has not been detected by the monitoring network since it was established in 2001.

Where are the monitoring sites and what do they represent?

Of the seven monitoring sites, four are located close to the sea and provide early warning of seawater intrusion. Three inland wells are used to monitor the localised effects of abstraction on the cluster of domestic wells near the intersection of Neal Road with Rarangi Road, and groundwater dependant wetlands. The longest standing monitoring well P28w/1901 at the Rarangi Golf Club course is located 400 metres inland from the coast and has been operating since 1989. Its purpose is to measure the long term variation of inland RSA levels.

How much groundwater has been allocated versus actual use?

There is no allocation limit in the district plan, but a value of 1,761 m^3/day has been proposed using the definition in the national environmental standard (NES) on ecological flows and water levels (Table 13).

Category	Use
WARMP limit	No limit specified
Number of consents	2
Refined safe yield	1,761 m^3/day
Consented allocation	750 m^3/day
Actual use	20% to 100% of consented allocation

Table 13 : Water Use Summary

Levels of groundwater pumping are likely to approach this limit in some drier summer seasons if the combined effects of the 300 or so wells used for domestic supply are taken into account. Some sections in the beach-front Edgewater subdivision have yet to be fully developed, and as a result coastal RSA levels are likely to fall further in the future. Elsewhere levels are likely to be relatively stable. Consented demand on RSA groundwater is likely to have peaked.

Are there trends and what is causing them?

A number of the sites show the same patterns and for the purposes of this report the records from just 3 sites are presented to provide an overview for the reader. While there appears to be a slight downwards trend at the longstanding well P28w/1901, the record is biased by the two years of missing record in the early to mid 1990s, and in reality levels are stable (Figure 58). The lowest levels shown by the grey line coincided with the 1997/98 and 2000/01 droughts.

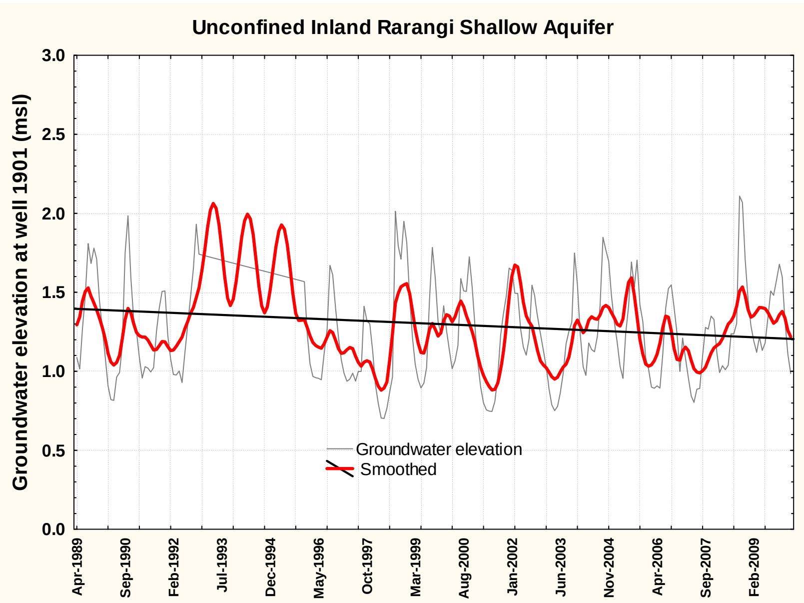

Figure 58 : Trends In Inland Rarangi Shallow Aquifer Level At Well P28w/1901

MDC well P28w/4331 is located one kilometre inland from the coast near Rarangi Road and was established in 2004 as an indicator of the status of the ecologically important groundwater fed wetlands. These wetlands are particularly valued for their flora.

Groundwater recharges the wetlands during drier parts of the year, while the reverse occurs in winter or spring when groundwater is replenished by high surface flows. High RSA groundwater elevations cause the related wetlands to expand while lower levels make it's area contract.

There is too short a period of record to be conclusive about trends at this stage, however levels were lower between 2004 and 2008 when consented groundwater pumping was higher. It follows that since 2008, Rarangi wetlands cover a larger area due to higher Rarangi Shallow Aquifer levels which drive them (Figure 59).

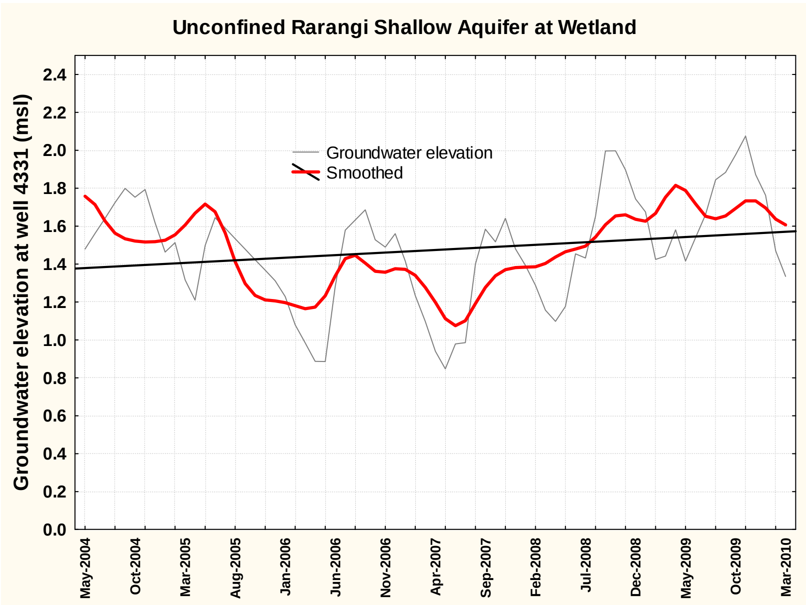

Figure 59 : Trends In Rarangi Shallow Aquifer Level At Hinepango-Pipitea Wetland Well P28w/4331

The second group of MDC monitoring wells at Rarangi are located along the seafront and were established in 2001 to provide early warning of seawater intrusion. The record at each of the coastal monitoring sites is identical with the exception of the northernmost well which because of its position closer to the sea, responds slightly differently.

Coastal Rarangi Shallow Aquifer levels have remained stable over time and their elevations are well above mean sea-level as Figure 60 shows for the lowest lying monitoring well P28w/3668. This well is located north of the Wairau Diversion channel opposite Hinepango Drive.

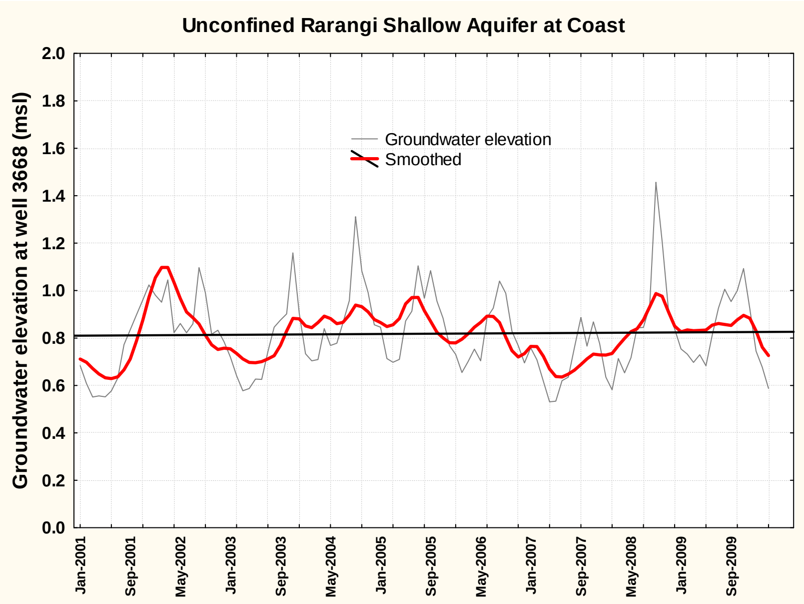

Figure 60 : Trends In Coastal Rarangi Shallow Aquifer Level At Well P28w/3668

What is the aquifer state leading up to the 2010/11 summer?

Inland aquifer levels which control the state of the wetlands are currently at record highs as the red line in Figure 61 shows. It follows that the wetland will be fully extended and in good health ecologically.

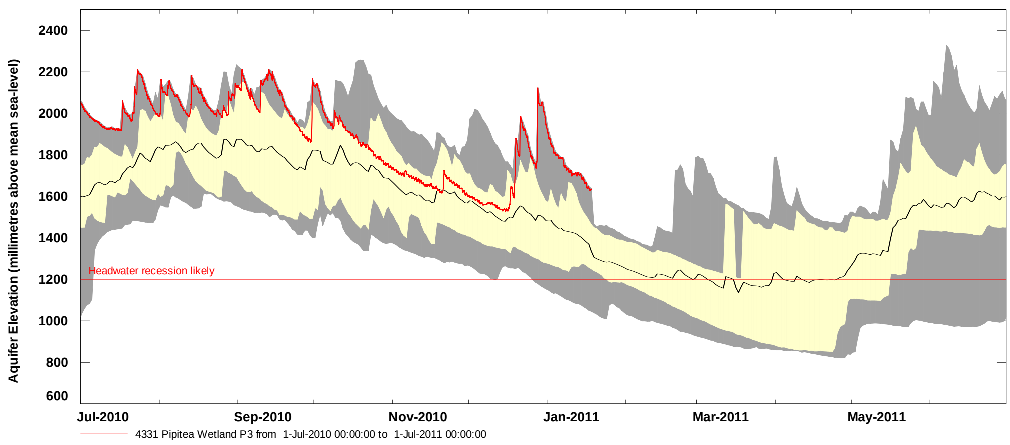

Figure 61 : Current Inland Rarangi Shallow Aquifer Status

Coastal RSA levels were below average for much of spring, but have been boosted by recent rain as the red line in Figure 62 shows.

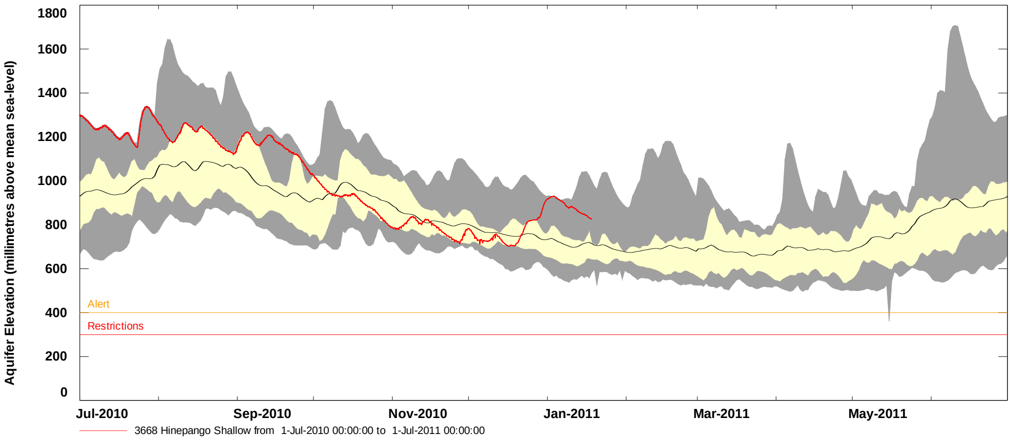

Figure 62 : Current Coastal Rarangi Shallow Aquifer Status

4. Conclusions

The MDC groundwater level monitoring network provides a representative picture of seasonal aquifer status and the long-term behaviour across all of Marlborough's main systems.

Trends and patterns in groundwater level vary from aquifer to aquifer. This reflects local differences in their physical makeup, and the balance between water demand and recharge.

Most aquifers and their groundwater fed springs or wetlands are at normal levels or flows during the 2010/11 summer season. This reflects the wetter than normal conditions during late 2010, and lower irrigation demand.

In terms of long-term trends in groundwater storage, the state of most shallow aquifers remains stable over time. This shows that natural rates of recharge balance summer drainage and pumping.

Deeper systems such as the Southern Valleys Aquifers are naturally slower to recharge because of their isolation from surface hydrological processes, and some are still recovering from heavy pumping during the 1998 or 2001 droughts. Of these the Benmorven Aquifer experienced the largest falls in level following heavy use and remains depleted today, along with parts of the associated Deep Wairau Aquifer.

Levels in the neighbouring Omaka and Brancott Aquifers also fell during this same period, but have now fully recovered. This is the result of lower groundwater demand since the introduction of the SVIS scheme in 2004, and the wetter conditions experienced by the province in 2008 and 2010.

There is a small declining trend in unconfined Wairau Aquifer levels which is not significant at this stage. Its causes are being investigated to improve understanding of groundwater interaction with the Wairau River and springs.

A major limitation on preparing a set of district water accounts is the lack of water consumption information. Pumping can potentially have a large effect on the status of an aquifer, particularly those with low yields. This paucity of information introduces uncertainty into the findings of this report as large parts of the water balance have to be estimated rather than measured.

The exceptions are the Southern Valleys Aquifers where water use records date back to the mid 1980s. This information has been applied in conjunction with trends in aquifer level to set sustainable limits for these systems. Deriving these limits would not have been possible without these comprehensive and accurate groundwater consumption records.

MDC is working towards universal metering of water permits as part of the national water measurement regulation. Within five years in Marlborough there will be sufficient coverage on differing soil types and for wet or dry seasons to characterise irrigation application rates.

For the remainder of the Wairau Plain, actual irrigation groundwater use for the predominant grape crop is estimated to be between 20 and 60 percent of consented allocation depending on seasonal conditions. Other irrigated crops such as pasture, vegetables or corn have a higher degree of utilisation.

These typically low rates of actual use mean that the full effects of consented abstraction have yet to be observed in the MDC monitoring record of well levels or spring flows, at least for sustained periods.

Because only the Southern Valleys Aquifers have been pumped at close to or above their physical limits, care is needed when interpreting Wairau Aquifer level patterns in relation to safe yield.

The monitoring record shows that current rates of pumping are sustainable and the impacts on other wells or the environment are acceptable, with the exception of severe drought conditions.

However if all the consented groundwater was actually used, it would cause larger seasonal falls in levels than those observed so far which may have unacceptable effects.