Chapter 32: Lower Waihopai Aquifer

Introduction

The Lower Waihopai Aquifer underlies the lower reaches of the Waihopai River Valley, where it widens into a broad floodplain (Fig. 32.1). It also includes the land above the Renwick Terrace and the inland area surrounding the Delta Hill as far east as the Waihopai Valley Road, which forms the divide with the Omaka River. The Renwick Terrace separates the low yielding Lower Waihopai Aquifer from the high producing Wairau Aquifer.

Groundwater resources sufficient for irrigation purposes are limited in the area. Apart from stock or domestic uses, groundwater is not the primary source of water in the area. This reflects its relative scarcity in quantities sufficient for irrigation, especially under late summer conditions. There are also alternatives that are easier to access such as surface takes from the Waihopai River and due to the lack of local groundwater on the elevated terraces, most vineyards to the north and east of the Delta Hill pipe groundwater from the Wairau Aquifer.

As a result of the lesser reliance on groundwater in this area, fewer wells exist to describe subsurface conditions. As a consequence the hydrogeology of the area is not as well understood as other areas. This is not to say that attempts haven't been made to explore for water, but a history of poor yields has focused attention on easier options, especially for irrigating crops.

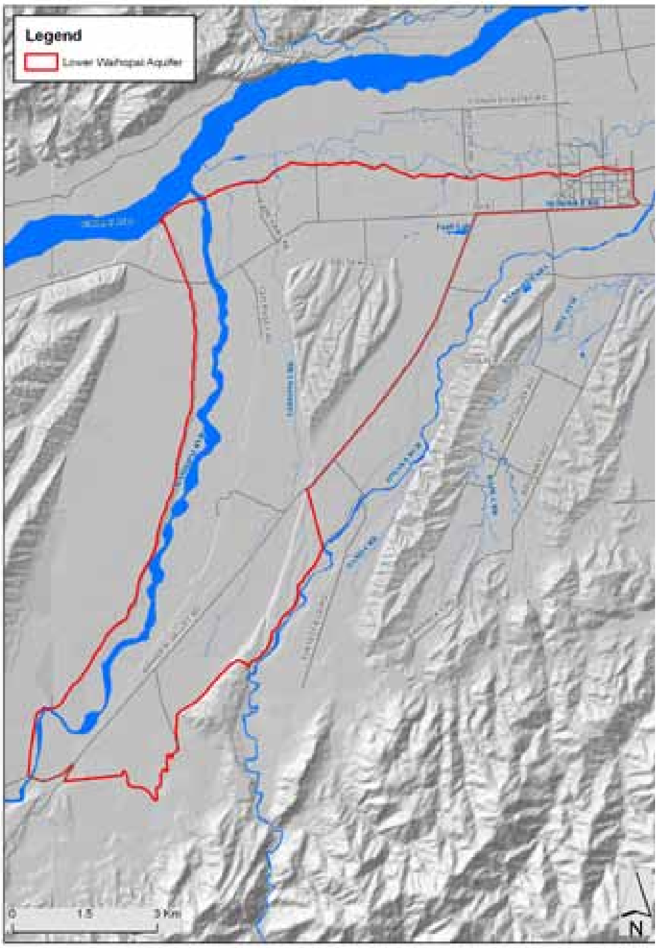

Figure 32.1: Lower Waihopai Aquifer boundary

Figure 32.2: Lower Waihopai looking south from Renwick (2009)

In the past this area has been semi-intensively farmed with the exception of the land to the north-east of the Delta which was cropped. Since the mid 1990s it has been converted to vineyard (Fig. 32.2). The conversion to vineyard has resulted in a corresponding increase in summer water demand. Due to the scarcity of local groundwater, very few vineyards have wells on their own properties.

Structural geology

A natural feature which affects groundwater flow patterns in the area is the Wairau Fault the main axis of which runs south of, but parallel to SH63. The fault

Figure 32.3: Fault associated wetlands

is defined at the surface by Fault Lake and a series of wetlands near the intersection of Waihopai Valley Road and the Grove Mill winery (Fig. 32.3). The fault cuts through Broadbridge Transport, before running eastwards and parallel to Middle Renwick Road to the south of Renwick.

The fault has a major influence on the distribution of shallow groundwater resources. In particular, the fault impedes flow and diverts it sideways to the east until there is sufficient build-up of water for it to break out northwards across the fault as a spring. Fault Lake near Grove Mill Wines on Waihopai Valley Road is an example of this.

Another important natural feature is the main Waihopai River terrace. The terrace separates the higher permeability gravels near the channel, from the elevated and lower yielding gravels (Fig. 32.4). The lower terrace gravels are an extension of the braided river channel material deposited over geological time (Fig. 32.5).

Groundwater systems

The largest quantities of groundwater discovered in the Lower Waihopai Aquifer exists at shallow depths. They are generally dependant on or closely linked to surface flows from the Waihopai River. Rainfall and drainage from the top terrace also contribute to recharge, but on a much smaller scale.

Deeper drilling has only located limited groundwater supplies, although large areas have yet to be investigated. Some deeper, low yielding irrigation wells do exist in the Fault Lake area where there are few alternatives for landowners who don't border rivers. Domestic or stock wells exist along the axis of the fault, but no wells are known to occur between the Renwick Terrace and SH63. Small quantities of groundwater may exist, but this source has not been pursued as shallow groundwater is available from the Wairau Aquifer on the lower terrace.

Shallow groundwater

While shallow groundwater is the most reliable source of supply, it is limited by the surface flow providing recharge and the limited storage within the gravels.

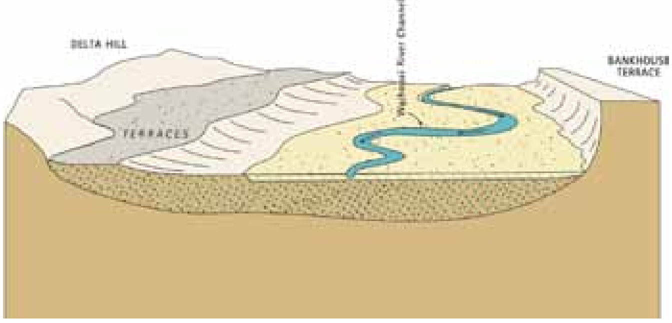

Figure 32.4: Lower Waihopai Aquifer conceptual model

Away from the Waihopai River gravels, the availability of groundwater appears to be very localised and variable.

Some shallow groundwater is found on the upper terraces where it is elevated above the Waihopai River. Its origin is uncertain but likely sources are rainfall, or runoff from further up the catchment.

On both the upper and lower terraces of the Waihopai River floodplain, infiltration galleries or shallow wells are commonly used to extract groundwater. They are better suited to accessing the thin water bearing layers than a conventional vertically screened well.

The dynamics of the upper terrace aquifers remains poorly understood, but their localised nature suggests they have limited storage and are likely to drain quickly in the absence of recharge.

Gibson Creek is a possible source of recharge on the upper terrace in wetter periods when high channel flows are likely to seep into the surrounding gravels. The reverse is likely in drier months when Gibson Creek behaves like a groundwater fed spring by receding from its headwaters first.

The upper terrace aquifers are hosted by a thin veneer of more permeable sediments overlying the claybound gravels forming the terraces (Fig. 32.6). The sediments can be split between the more permeable upper five metres of clays and gravels, which are likely to represent the primary water bearing layer, and the deeper cemented gravels which have poor prospects for supplying groundwater.

It is likely that wells receive recharge from the upper reaches of Gibson Creek when it is flowing, resulting in higher yields in spring compared to summer.

Deeper groundwater

Deeper wells in northern areas of the aquifer around the Wairau Fault are all low yielding by Wairau Aquifer

Figure 32.5: Lower Waihopai Aquifer terrace (NZGS)

Figure 32.6: Lower Waihopai Aquifer terrace

standards. They have transmissivity values of less than 50 m^2/day, which is consistent with those found elsewhere in the Southern Valleys Aquifers.

Two exceptionally deep wells were drilled in the southern part of the aquifer, on the eastern side of the Waihopai Valley Road near the catchment boundary with the Omaka River, in the late 1990s. Well 3313 was drilled to a depth of 230 metres and well 3314 to a depth of 284 metres. The yields of these two deep wells are very low even by Southern Valleys Catchment standards with transmissivities of 1 m^2/day and 4.3 m^2/day respectively. Multiple water bearing layers were found at a range of depths, but individually all were very low yielding. Well records show yields generally decrease with depth.

Recharge and flow patterns

Shallow groundwater receives recharge from a number of sources depending on its location. These include rainfall and seasonal leakage from the Waihopai River or Gibson Creek. The Waihopai River is known to lose around 300 l/s from its channel in the reach between Craiglochart Bridge and SH63. The water lost from the channel is likely to stay close to the river channel and recharge the surrounding riparian gravels.

The area north and east of Delta Hill is recharged by catchment runoff from the west which is modified and diverted by the Wairau Fault, before draining in the general direction of Renwick.

Deeper groundwater could potentially be recharged from a number of sources or even from another catchment. The subsurface geology doesn't necessarily reflect the ridgelines that define surface water drainage patterns.

Measurements made by the MDC at three locations along the length of the channel in late 2008 and early 2009, showed that flow in Gibsons Creek decreased as conditions became drier and receded downstream from its headwaters (Fig. 32.7).

Hydraulic properties

Very few aquifer tests are known to have been conducted in the area. One of these tests was carried out on infiltration gallery 4893 located on the upper terrace, approximately 200 metres west of the Delta hill in June 2009.

Values of aquifer transmissivity of 300 m^2/day and storativity of 0.14 were reported (PDP – 2009). Because testing was carried out during the wetter time of year, this transmissivity value is likely to represent the maximum that can be expected. Another aquifer test was conducted on the upper terrace at infiltration gallery 4793 in September 2009 and furnished a calculated transmissivity value of 235 m^2/day. These values are low and of the same order as for Southern Valleys Aquifer wells further east.

Transmissivity values are much higher in the more permeable gravels of the Waihopai River floodway. Testing of infiltration gallery 4012 on the lower terrace in November 2000 returned a relatively high transmissivity value of 2,448 m^2/day with a storativity of 0.17.

Groundwater chemistry

There are too few results to comprehensively describe the chemical composition of local groundwaters however, it is likely that shallow groundwater will have a similar composition to nearby streams, rivers or rainfall. The deeper groundwater is likely to be much older and as a result, more chemically evolved.

The chemical composition of shallow groundwater from well 3183, on the top terrace, and well 3118 on the lower terrace are similar although they contain higher proportions of sulphate and magnesium than the young groundwaters typical of the Wairau Plain aquifers (Fig. 32.8 and Fig. 32.9). This is likely to reflect the influence of local agricultural activities.

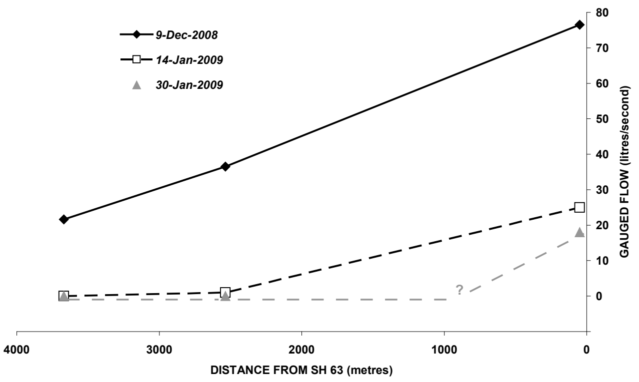

Figure 32.7: Extent of Gibson Creek channel

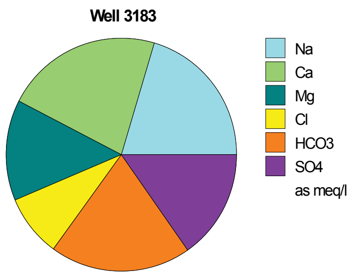

Figure 32.8: Well 3183 groundwater composition

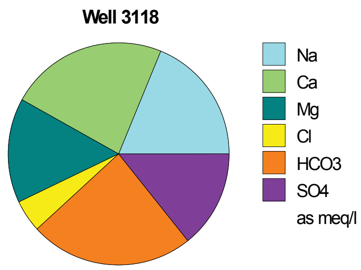

Figure 32.9: Well 3118 groundwater composition

Nitrate-Nitrogen

An issue for shallow wells in the vicinity of the fault and further north along the groundwater flowpath towards Renwick, is the presence of elevated nitrate-nitrogen concentrations. At times the levels in some wells approach the health guideline for drinking water. While some of the affected wells are in the Wairau Aquifer, the likely source of the nitrate is located in the Lower Waihopai Aquifer.

A survey of groundwater nitrate-nitrogen concentrations was carried out by the MDC in May 2002 at a number of wells. A range of values from natural background levels to elevated values were measured (Fig. 32.10). One of the sites affected was the Renwick municipal wellfield which consists of three wells oriented in a line extending north of the terrace.

Nitrate concentrations vary seasonally and normally peak in spring when higher rainfall leaches nitrates in the soil downwards to the water table. Levels in groundwater approach but have not exceeded, the maximum available value of 11.3 g/m^3 in the New Zealand Drinking Water Standards.

Figure 32.10: Nitrate-nitrogen distribution 2002

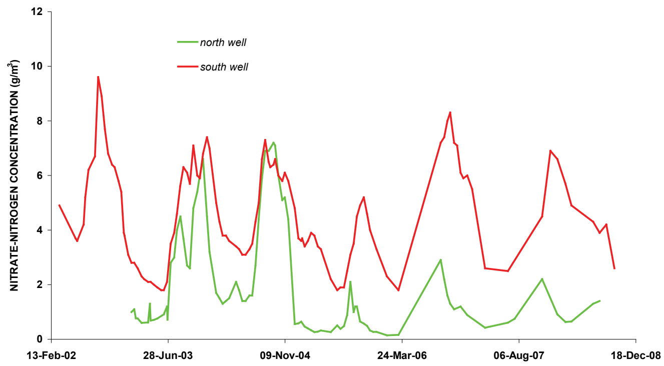

Figure 32.11: Renwick municipal wellfield nitrate-nitrogen levels

Concentrations of nitrate-nitrogen are lower in wells located further north in the Wairau Aquifer due to the greater diluting effect of Wairau River recharge water, and the lessening influence of runoff from the upper terrace. This pattern is evident in the range of concentrations across the most northern and southern wells forming the Renwick public water supply (Fig. 32.11).

The results of an analysis of nitrogen isotope ratios by the IGNS in 2004 showed the nitrogen is predominantly derived from agricultural and fertiliser sources, rather than human or animal waste. The most likely origin is local land-uses upgradient on the Delta terrace, and in particular historic fertiliser applications associated with cropping (IGNS - 2004). It is unclear whether this is an ongoing process or will taper off as the level of nutrients in the soil declines over time.

According to a report by Pattle Delamore Partners Ltd for the MDC in 2002, fertilisers in these heavier soils will be released more slowly due to their lower permeability. If this is the case high nutrient levels may persist well into the future.

Nitrate levels have declined in some wells on the lower terrace following the introduction of the Southern Valleys Irrigation Scheme in 2004. This is likely to be as a result of dilution caused by increased channel leakage from Gibson Creek.

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