Chapter 22: Woodbourne Sector

Introduction

The Woodbourne Sector is a historically important area in the groundwater management arena as it was the first intensively studied aquifer area of the Wairau Plain. Initial investigations in the early 1980s were sparked by competing demands between local groundwater users, and compounded by a series of summer droughts. At the time, new wells were being drilled by Montana Wines Ltd to supply their Brancott Estate vineyard in the Southern Valleys, and by the RNZAF as an alternative to their drought susceptible wells south of Middle Renwick Road.

The Woodbourne Sector straddles the boundary between the relatively water short Southern Valleys catchments, and the water abundant northern Wairau Plain (Fig. 22.1). This is a convergence zone where water from the Wairau River to the north meets the flow contributions from Southern Valleys Catchments to the south.

The boundary is defined in terms of the influence of the Omaka River flow on recharge or drainage, and the Omaka Fan deposits on well behaviour. Aquifer levels north of Middle Renwick Road are stabilised by relatively constant Wairau River flow losses. The characteristically large seasonal variation in well levels south of Middle Renwick Road reflects the ephemeral nature of the Omaka River, which drains the catchment to the south.

Groundwater systems

The geology of the area is a mixture of thin gravel layers, inter-bedded with claybound gravels and sands. Most of these sediments are likely to have been deposited by the Fairhall or Omaka Rivers. The low energy of these river systems explains the discontinuous and poorly sorted nature of the deposits, which in turn makes them poor host formations for aquifers. Sediments deposited by three low energy rivers form the Omaka Fan. This fan is less recognisable today because it has coalesced with gravels deposited by the Wairau River to the north, but it is a significant influence on groundwater flow patterns. The eastern edge of the fan is discernible as you travel along New Renwick Road, by the rise from Paynters Road to the Fairhall Cemetery.

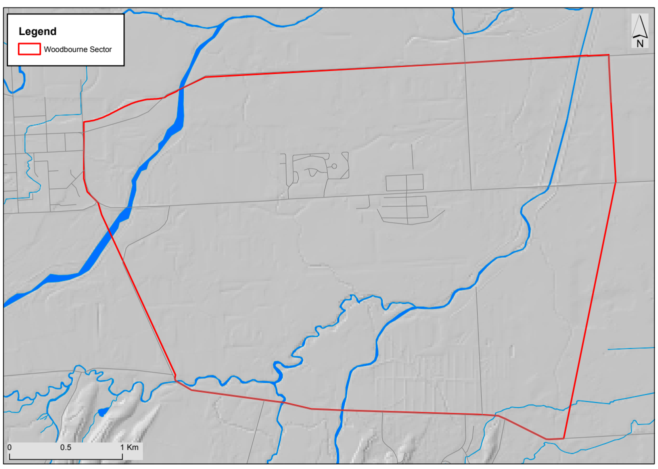

Figure 22.1: Woodbourne Sector

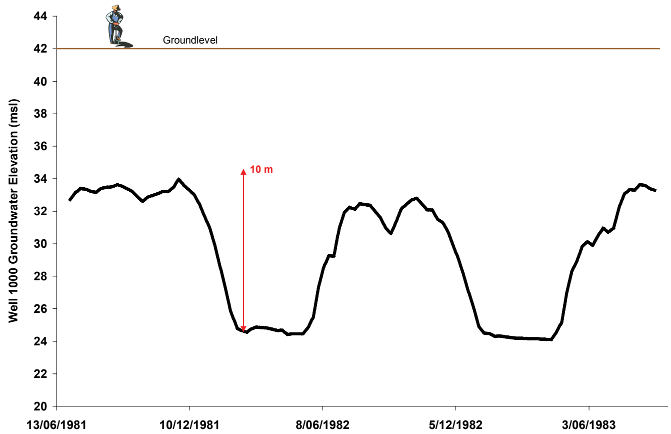

Figure 22.2: Godfrey Road well 1000 level variation

Investigations in the early 1980s demonstrated the stratified nature of water bearing layers beneath Woodbourne based on three distinct layers which were encountered at the RNZAF well 1106 located north of Middle Renwick Road, although there may be more at other locations. This is because the material forming these layers doesn't tend to be continuous over long distances. A very permeable formation between seven and nine metres depth was thought to be recharged from Omaka River water (MCRWB – 1981). The deeper strata were described as a succession of thin seams at depths of 11, 13 and 18 metres which were assumed to carry groundwater originating from the Wairau River. The upper strata are considerably more permeable than the lower strata.

Recharge and flow patterns

The Woodbourne sector is a dynamic aquifer by Wairau Plain standards, with conditions changing rapidly depending on the balance between recharge, drainage and pumping at any particular time. Symptomatic of this are characteristically large seasonal variations in aquifer or well levels of up to 10 metres between winter and summer (Fig. 22.2). This variability is largely a natural phenomena where aquifer drainage exceeds the rate of replenishment. As the ephemeral Omaka River dries and the river recedes southwards, its channel becomes disconnected and all flow is lost to groundwater. As recession continues the rate of recharge decreases and well levels drop. Localised pumping may also directly influence the variation in level at nearby wells.

It is generally early January before water levels begin their rapid decline and the rate and extent of decline are greatest in the south-western fringe areas. For example, the range in aquifer level at the more northern

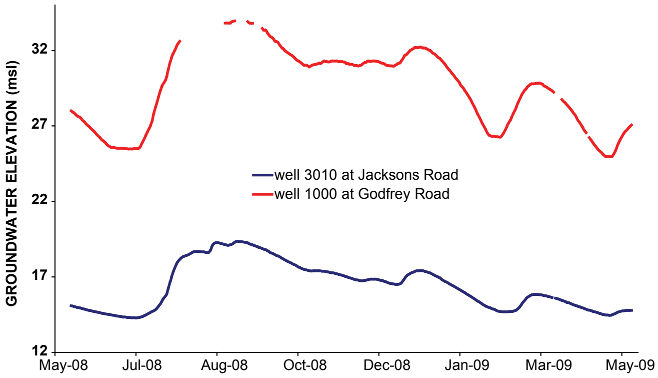

Figure 22.3: Woodbourne Sector well responses

MDC monitoring well 3010 at Jacksons Road is only half of the variation at MDC well 1000 in Godfrey Road (Fig. 22.3). The shape of the two hydrographs is very similar, showing the common influence of the Omaka River. Well levels may fall at rates of up to 200 millimetres per day during February and March.

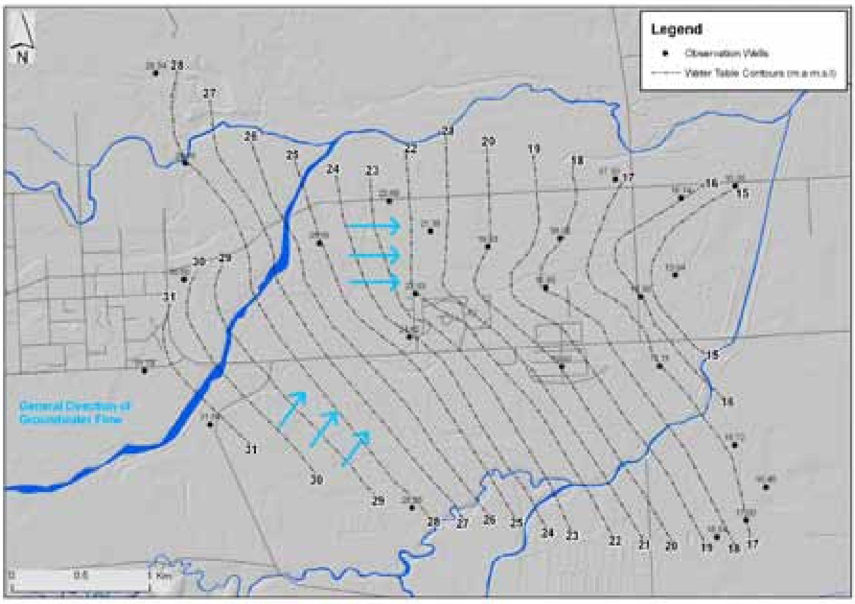

Figure 22.4: Woodbourne water table contours 12th November 1982

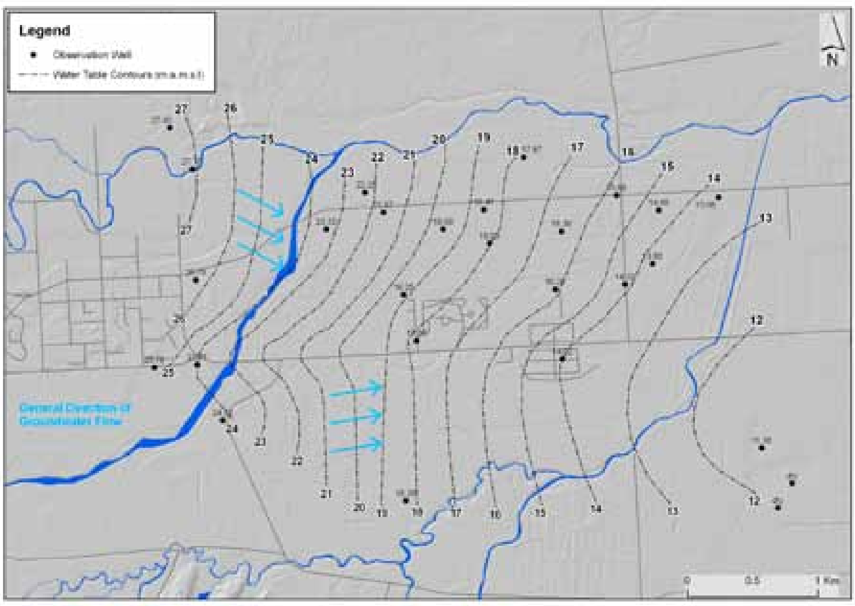

Figure 22.5: Woodbourne water table contours 10th March 1983

Due to the variability in recharge direction, recharge rate and aquifer yield vary from season to season. Groundwater levels are less constant than for other Wairau Plain aquifers which benefit from river recharge. These factors cause large shifts in groundwater flow direction.

Water table or piezometric contour maps show seasonal changes in groundwater flow patterns. During wetter months (Fig. 22.4) the flow directions indicated by the contours are markedly different from those for drier periods (Fig. 22.5). The water table is higher during winter and flow directions reflect the general contour of the land, which is from south-west to north-east. In other words the Woodbourne area is receiving much of its recharge from the Southern Valleys. The situation in March however tells a different story. Water table levels have fallen dramatically in this area and more significantly so has the shape of the contour lines. The source of the late summer recharge to the Woodbourne area is not from the south-west, but from the north-west with the Wairau River supplying this area as it has lost a large proportion of the southerly sourced contribution.

The winter to summer shift in flow direction is an example of how the Southern Valleys Aquifers contribute to the main Wairau Aquifer system, and vice versa depending on seasonal conditions. It is also a clear indication that recharge is not sustained during summer from the Southern Valleys Catchments.

Pumping can have an effect over a wide area. The effects of pumping generates crater shaped depressions below the surface on what would normally be a relatively smooth water table (Fig. 22.6). These then induce new groundwater to flow in from the surrounding area. Provided the capability of the system is such that these sinks do not grow and are manageable, there is no problem. Should the system capacity be overtaxed then the extension of these sinks is one of the first signs that the aquifer is under pressure.

Hydraulic properties

One of the most extensive aquifer tests ever conducted in Marlborough took place at Woodbourne in April 1981, when the performance of a RNZAF Base Woodbourne supply was assessed. Well

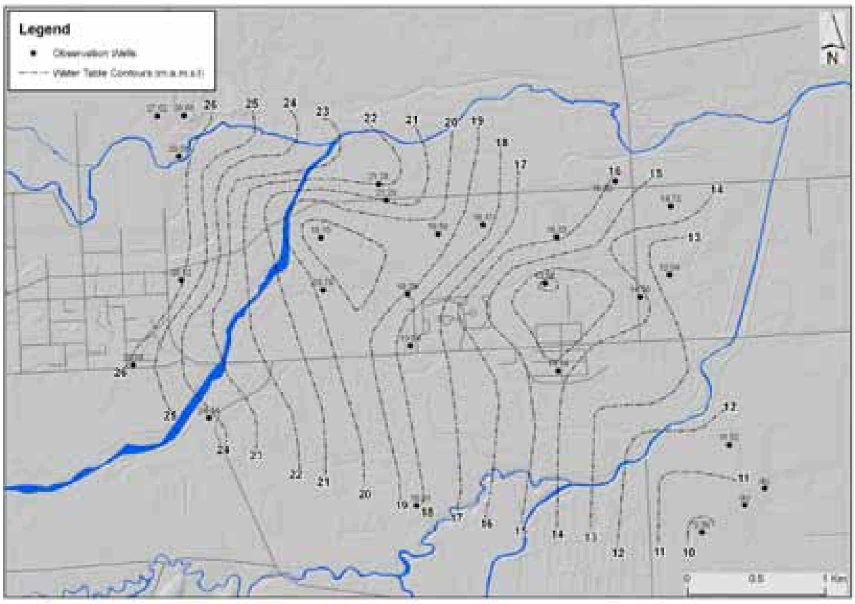

Figure 22.6: Woodbourne water table contours 7th March 1983

1106 was constructed to replace existing wells located at the base of the water tower, which had experienced severe water supply problems in March 1981.

Well 1106 is 22 metres deep and was pumped for a day starting on the 10th of April 1981 to establish its capacity. The MCRWB collaborated with the RNZAF on the test, which formed part of a wider investigation programme aimed at improving community understanding of the groundwater resource at Woodbourne. The test used two multi-layer observation wells to measure the response to pumping in individual strata. These observation wells were drilled at distances of 8 and 25 metres to the east of the pumping well in order to observe the fall in aquifer level during testing. Three separate tubes were inserted to measure each of the water bearing layers recognised during the drilling of well 1106 at 11, 13 and 18 metres depth (Fig. 22.7). This was to determine whether the three aquifer layers were hydraulically connected (Fig. 22.8).

Testing involved pumping well 1106 at a constant rate of 37 l/s while measuring the drawdown at these piezometers and various neighbouring wells around Woodbourne.

A series of tests were conducted at various sites in the area under a variety of climatic conditions to characterise the natural variation in aquifer hydraulic properties. Transmissivity values reflect the large natural variation in well levels and can vary by several orders of magnitude. Testing showed that each of the water bearing layers was connected, although the largest drawdowns occurred in the deeper layer corresponding to the screened depth of the pumped well 1106.

Aquifer transmissivity

The semi-confined structure of Woodbourne aquifers means that the large range in well levels is mirrored by seasonal changes in aquifer transmissivity. Larger variations are associated with more southerly wells which rely on losses from the ephemeral Omaka or Fairhall Rivers and are subject to the largest changes. For example, the measured range in transmissivity values at the RNZAF Base Woodbourne North well 662 went from a minimum of 162 m^2/day in February 1983, to a maximum of 7,095 m^2/day in September 1982. As a consequence, well 662 is capable of supplying far higher volumes of groundwater during wetter months compared to summer when in some seasons it is temporarily closed down and the more northerly well 1106 is used instead. This reflects the lessening influence of Omaka River recharge across the general Woodbourne area.

A more southerly located 25 metre deep irrigation supply well 1282, had a measured transmissivity value of 15,700 m^2/day in January 1984. This well was effectively dry in summer 1998. Its failure during the 1997/98 drought led to deeper exploration and ultimately the discovery of the Deep Wairau Aquifer.
Higher transmissivity values mean there is channel flow in the nearby Fairhall River providing recharge. As the seasonally ephemeral Fairhall River recedes southward, aquifer levels will fall and this will be reflected in lower transmissivity values and less groundwater produced for each metre well levels are lowered by pumping.

Figure 22.7: Multi-level observation well

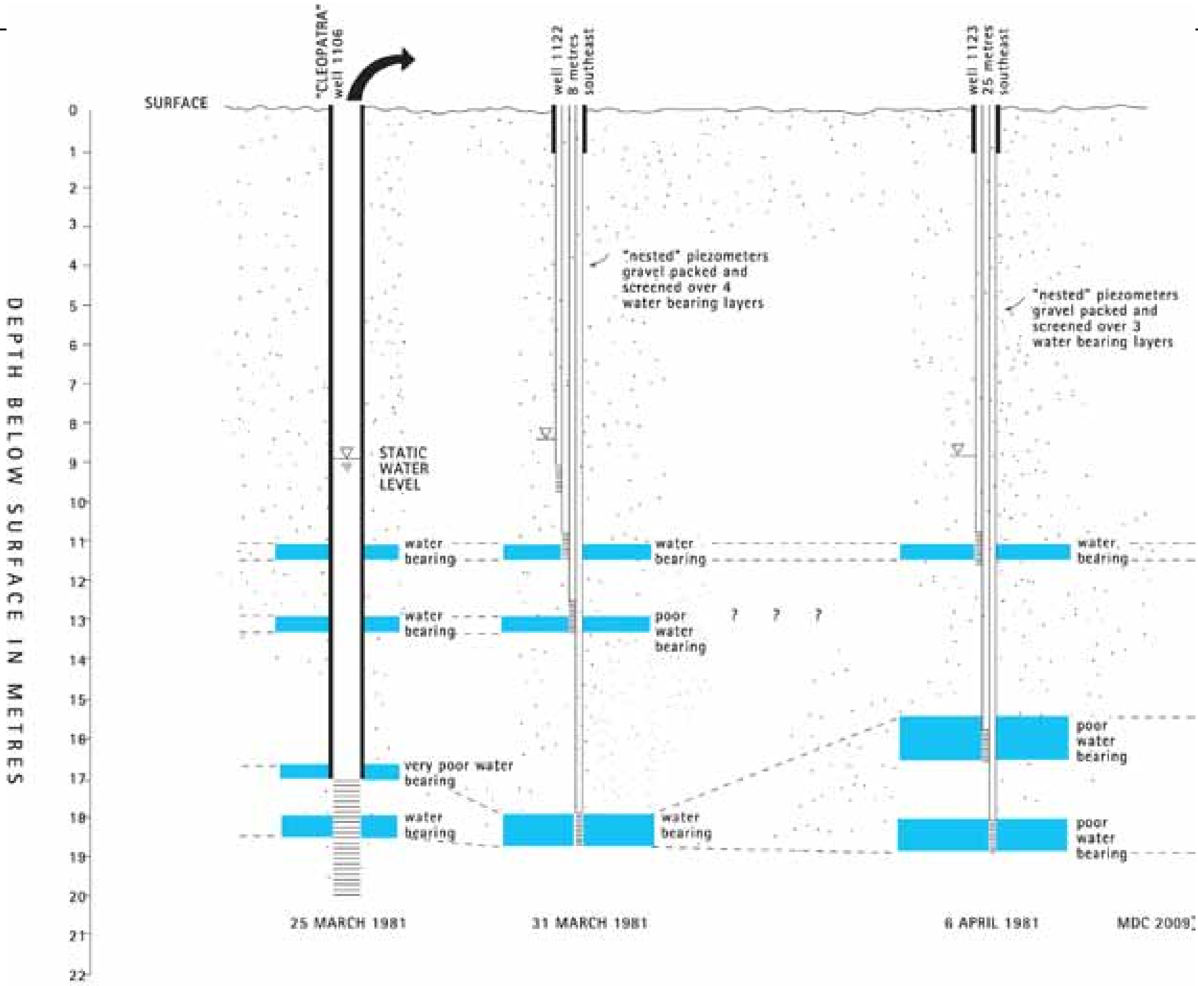

Figure 22.8: Woodbourne Sector stratification

A smaller measured range in transmissivity values of 2,413 to 3,063 m^2/day for the RNZAF Base Woodbourne Well 1106, reflects the smaller natural variation in well level on the northern edge of Woodbourne with the Wairau Aquifer, and the stabilising influence of Wairau River flows.

Groundwater chemistry

The chemical composition of groundwater from two Woodbourne wells has been sampled over many years by the MDC. They are chemically similar and represent the same dilute waters that dominate the shallower Wairau Plain aquifer systems (Fig. 22.9 and Fig. 22.10).

It is possible that the composition of the water may change seasonally depending on the dominant source of recharge water as water from the Southern Valleys Catchments is likely to have higher nutrient levels and be more mineralised than water recharged from the Wairau River.

References

Groundwater Consultants NZ Ltd, 1985. Fairhall Estate Groundwater Investigations Well Yields and Impacts, Job No. 116/3, Montana Wines Ltd

Marlborough Catchment and Regional Water Board, 1988. Water and Soil Resources of the Wairau. Volume 2

Marlborough Catchment and Regional Water Board, March 1981. Proposal for a 24 hour constant discharge test, with observation bores, at well 1106 – Base Woodbourne, File No. 186, 156/17

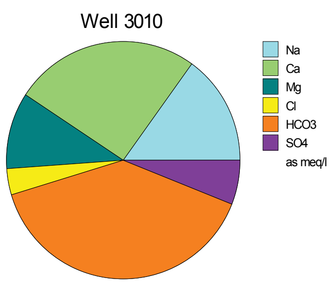

Figure 22.9: MDC Jackson Road well 3010 chemical composition

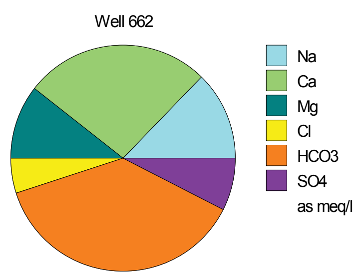

Figure 22.10: RNZAF Base Woodbourne well 662 chemical composition