STAFF REPORT

TO: Environment & Planning Subcommittee

FROM: Glenn Stevens, Resource Scientist (Water & Land)

REFERENCE: W218-2

SUBJECT: **2005 WAIMEA PLAINS GROUNDWATER NITRATE SURVEY - REPORT EP05/11/11 -** Report prepared for 16 November 2005 Meeting

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1. INTRODUCTION

Over 90 groundwater samples were collected from the Waimea Plains aquifers between 19 May and 4 August 2005 and tested for nitrate. Well owners have been informed of their results. This survey was the fourth such plains wide survey of groundwater nitrate concentrations. Previous surveys were undertaken in 1986, 1994, and 1999/2000. Contours of nitrate concentrations for the aquifers of the Waimea Plains are presented in Figures 1(a), (b), (c) and (d).

The most striking aspect to the data is the presence and persistence of areas of high nitrate concentration in the groundwater. Of all the bores sampled in the 2005 survey, 36% were above (i.e. did not comply with) the NZ drinking water standard of 11.3 g/m^3-N.

Groundwater from the Waimea Plains is widely used. By volume irrigation is the predominant use, however, many households rely on groundwater for drinking water supplies, and a significant portion of the Richmond Municipal Water Supply is sourced from a bore field adjacent to Lower Queen Street.

The elevated nitrate concentrations encountered in the groundwaters of the Waimea Plains do not meet the groundwater quality required by Policies 33.1.3 and 33.1.4 and Schedule 36.1B of the TRMP. These policies require that the groundwater and land resources of the Waimea Plains are managed so that the groundwater is not contaminated so as to make it unpalatable or unsuitable for consumption by humans after treatment (equivalent to coagulation, filtration and disinfection). Nitrate contamination of water can not be readily treated by coagulation, filtration or disinfection.

All previous nitrate surveys (allowing for the variable density of sample locations) have consistently identified three main areas of high nitrate concentrations. These are:

- Lower Confined Aquifer (LCA). Primarily in the middle parts of the aquifer (i.e. Ranzau Road to Lower Queen Street)

- Upper Confined Aquifer (UCA). Essentially along its length, though largely confined to the northeastern side, from near Aniseed Valley and Paton roads to State Highway 60.

- Appleby Gravel Unconfined Aquifer (AGUA) near State Highway 60 and Swamp Road.

Whilst previous surveys have identified high nitrate concentrations in the Hope Minor Confined and Unconfined Aquifers (HU aquifers), other than localised areas this was not the case for the 2005 survey. Whilst the HU aquifers show elevated nitrate concentrations overall, this aquifer system is the least used and has limited sampling points providing a poor statistical distribution. Potentially parts of the HU have high nitrate concentrations, particularly in the vicinity of bores WWD 159 and WWD 162 which show high nitrate concentrations in the underlying UCA, however there are no available bores to sample.

2. AQUIFER RECHARGE AREAS AND SOURCE AREAS OF NITRATE CONTAMINATION

The primary mechanism for nitrates entering the groundwater is via nitrates on the land surface and in soils leaching to the underlying groundwater with infiltrating rainfall and/or irrigation water, particularly in areas where aquifer recharge occurs.

In this respect some interrelationship exists between the three principal areas where elevated nitrate concentrations have been observed. Infiltration adjacent to the foot hills of the eastern hills (southwest of Richmond) provides recharge to the HU aquifers, the UCA and the LCA (although this is not the only source of recharge to the UCA and LCA).

The observed nitrate concentrations in the UCA are interpreted as entering the aquifer via the overlying HU aquifers in the vicinity of Paton and Aniseed Valley roads and migrating with groundwater flow along the aquifer. At the northern extent of the UCA (i.e. down gradient) in the vicinity of State Highway 60, the UCA is in direct hydraulic connection with the overlying AGUA. Groundwater is able to discharge (leak) from the UCA upwards into the overlying AGUA. Nitrate concentrations encountered in the AGUA in this area are elevated reflecting this input from the UCA. However, the results for the AGUA indicate that additional nitrate sources directly impacting the AGUA are also occurring.

The area where elevated nitrate concentrations occur in the LCA coincides with where the observed plume in the UCA crosses directly above the LCA (i.e. in the vicinity of Ranzau Road between Pugh Road and State Highway 6). This would suggest that excessive nitrogen inputs are, or have, occurred in the common recharge area. There is also the possibility of cross aquifer contamination occurring either by a natural connection and/or inadequate sealing of bores that penetrate both aquifers.

Consequently, the two predominant areas where nitrate contamination is observed to be occurring are the vicinity of:

- Aniseed Valley and Paton roads; and
- State Highway 60 and Swamp Road.

There are a number of other areas where elevated nitrate concentrations have been observed. These are interpreted as localised areas of contamination, typically based on data from a single bore, rather than a wider trend across the surrounding aquifer.

3. POTENTIAL SOURCES OF NITRATES

The extent that infiltrating rainfall and/or irrigation water results in the leaching of nitrates to groundwater is dependant on the nitrogen loading to the land and as well as the hydrogeological conditions present in the subsurface. Determining the specific causes and/or sources of nitrate contamination at the land surface was outside the scope of this survey. However, (in no particular order) possible nitrogen inputs include:

- discharge of domestic wastewater (particularly historical discharges where the level of treatment was not high);
- historic discharge of piggery wastes.
- discharge of dairy and or other animal effluent (milking shed, races and/or hard stand areas);
- increased animal stocking rates;
- fertiliser use associated with intensive land uses (horticulture, market gardening, dairying);
- inappropriate discharge of waste hydroponics water from glasshouse horticulture; and
- (in the case of the AUGA near State Highway 60) the discharge of groundwater with elevated nitrate concentrations from the underlying UCA.

It is likely that various combinations of these have contributed to the observed nitrate concentrations over time. It is also expected that the current nitrogen loadings have reduced from historical levels, primarily because:

- there are no longer any piggeries operating on the Waimea Plains;
- a general improvement in horticultural practises such as nutrient budgeting associated with fertiliser use and improved irrigation efficiency; and
- the placement of tighter controls on the discharge of wastewater and animal effluent so that there is a much higher level of treatment prior to discharge.

4. RECENT TRENDS

In general, the available data shows that nitrate concentrations, whilst high in places, are either decreasing or showing no appreciable change. There are two main areas where nitrate concentrations continue to show a gradual increase. These are in the LCA near the coast (i.e. vicinity of Lower Queen Street) and the AGUA near State Highway 60 and Swamp Road. Figures 2(a), (b), (c) and (d) show the trends over time for selected sites where suitable records are available. The locations of the sites are shown in Figures 1(a), (b), (c) and (d).

A key source area for nitrates entering the groundwater for both of these two areas is in the vicinity of Aniseed Valley and Paton roads. Whilst nitrate concentrations in bores from here (WWD 162 in particular) remain high, they appear to be showing a gradual decrease since the early 1990's. If this trend continues it is expected that a decrease "downstream" should also occur in time.

The observed nitrate concentrations indicate that contamination in the Aniseed Valley and Paton roads area has been occurring for a significant period of time (at least since the 1970's). Due to the processes of contaminant migration with groundwater, a significant lag time is expected between the nitrate concentrations observed in a bore and when the contamination occurred at the land surface in the recharge area.

The age of the groundwater in the confined aquifers increases with distance down gradient away from their recharge areas. As a consequence nitrate concentrations away from the recharge areas reflect land use activities that were occurring some time in the past.

The high, and in some places increasing, nitrates observed in the AGUA in the vicinity of State Highway 60 and Swamp Road is influenced by the discharge of groundwater with elevated nitrate concentrations from the underlying UCA. This results in relatively high "back ground" nitrate concentrations in this part of the AGUA. As a consequence, this part of the AGUA is particularly sensitive to additional nitrate inputs compared with other parts of the AGUA.

The extent that current land uses practises and discharges are continuing to result in nitrate entering the groundwater aquifers was not determined as part of this survey. However, the observed gradual decline in nitrate concentrations in the UCA in this area suggests that the particular land use practises and/or discharges that originally gave rise to the nitrate contamination are not presently occurring, or at least are not occurring to the same extent.

Nitrate concentrations will decrease naturally over time (assuming there are no further nitrogen inputs), however, such decreases will be slow and take a significant period of time.

5. OTHER AQUIFERS WITHIN TASMAN DISTRICT

Council has limited groundwater quality data for other aquifer systems within the District. These data and other anecdotal evidence suggest that it is likely that nitrate contamination does, or has, occurred elsewhere in the District, particularly where associated with areas of intensive land use. This line of enquiry is hoped to be followed up in the next financial year.

6. COUNCIL RESPONSE

A key response of the Council (and its predecessors) has been to undertake a number of comprehensive investigations into the distribution of nitrate concentrations in the Waimea Plains aquifers (this investigation being one of them). These have sought to identify and characterise the distribution of nitrate in the aquifers and to ascertain any trends over time.

Since the late 1990's Council has undertaken regular (typically quarterly) monitoring of groundwater quality of key bores throughout the District. These form part of Council's *State of the Environment Monitoring Programme* for groundwater. Some are also included in the Institute of Nuclear and Geological Sciences National Groundwater Monitoring Programme.

Another key response of the Council has been to progressively limit the discharge of potential nitrate sources occurring in the key aquifer recharge areas, primarily through the development of Part VI (Discharges) of the TRMP. In particular, the instigation of the Special Domestic Wastewater Disposal Area and the Waimea Aquifer Protection Area and their associated rules which requires higher levels of treatment prior to any discharges and in some cases prohibit discharges.

Council has continued to advocate and encourage improved land use and management practises and treatment of discharges so as to limit nitrates entering the groundwater. This has largely been undertaken in an ad hoc manner when and where the opportunity arises.

7. ADDITIONAL RESPONSE MEASURES

A number of key measures that should be undertaken by Council are included in the recommendations. However, in the longer term there are some additional measures that could also be undertaken, particularly if subsequent monitoring fails to show a continued improvement of the groundwater nitrate contamination. These include:

- Researching historic land use of the Waimea Plains with the aim of identifying areas of current or past land use with an elevated risk of groundwater nitrate contamination occurring;

- Investigating the nitrogen species and form present in soils in the key recharge areas where nitrate contamination is known to be occurring and areas of "high risk" land uses (see above point) so as to assess and characterise their potential for further leaching of nitrate to groundwater.

- Undertaking computer modelling of the fate and transport of nitrate in the Waimea Plains aquifer systems. This should allow the expected travel times and degradation rates to be quantified and the identification of the areas most sensitive to particular land uses. This could be particularly useful in determining the continued risk to the Richmond municipal water supply bores.

- Assessing bore security, particularly old abandoned bores, in key areas where cross aquifer contamination could be occurring.

- Greater monitoring of discharges in the key aquifer recharge areas, particularly those likely to contain nitrogen such as domestic and agricultural wastewater (this should include both those undertaken as a permitted activity or by resource consent).

- Reviewing nitrogen fertiliser use in key aquifer recharge areas, including Council's advocacy role as well as its regulatory approach to fertiliser use.

8. SUMMARY

This and previous groundwater nitrate investigations have clearly identified areas of elevated nitrate concentrations in the groundwaters of the Waimea Plains. Overall, it is considered that nitrate contamination is not getting any worse. However, in some places the nitrate concentrations remain high such that groundwater does not meet the NZ Drinking Water Standard. There are no practical treatment options for the removal of nitrate from groundwater.

One of the Council's statutory functions is to manage the natural resources within in the district. The Tasman Resource Management Plan contains various objectives and policies to guide the Council in the management of these natural resources. Currently some of these objectives and policies with respect to the groundwater resources of the Waimea Plains are not being adequately met.

Council has instigated a number of measures to address the nitrate contamination. Whilst the data collected to date (including this survey) appears to show that there has been some improvement, future monitoring is still required to confirm this trend.

9. RECOMMENDATIONS

That Council:

1. Receives the 2005 Waimea Plains Groundwater Nitrate Survey report and notes the findings;

2. Accepts the principle of monitoring nitrate concentrations and their distribution across the Waimea Plains every five years. In particular, to ensure that there is no increase in the current extent of nitrate contamination and to monitor any changes over time that may occur;

3. Notes a proposal will be submitted as a 2006 / 2007 budget request to conduct a preliminary survey of other groundwater aquifers in the District (such as the Moutere, Motueka Riwaka, and Golden Bay), particularly where intensive land use occurs.

4. Notes that staff will review land use in the Aniseed Valley – Paton roads area and in the vicinity of State Highway 60 and Swamp Road to identify likely sources of continued nitrate contamination of the aquifers.

5. Notes staff will report on options for managing the contamination risk in that part of the Appleby Gravel Unconfined Aquifer in the vicinity of State Highway 60 and Swamp Road.

6. Supports continued advocacy regarding good land use practises with respect to nitrogen inputs to land. This should include:

    - fertiliser use;
    - irrigation efficiency;
    - animal effluent and/or other discharges containing nitrogen;
    - operation and maintenance of domestic wastewater systems

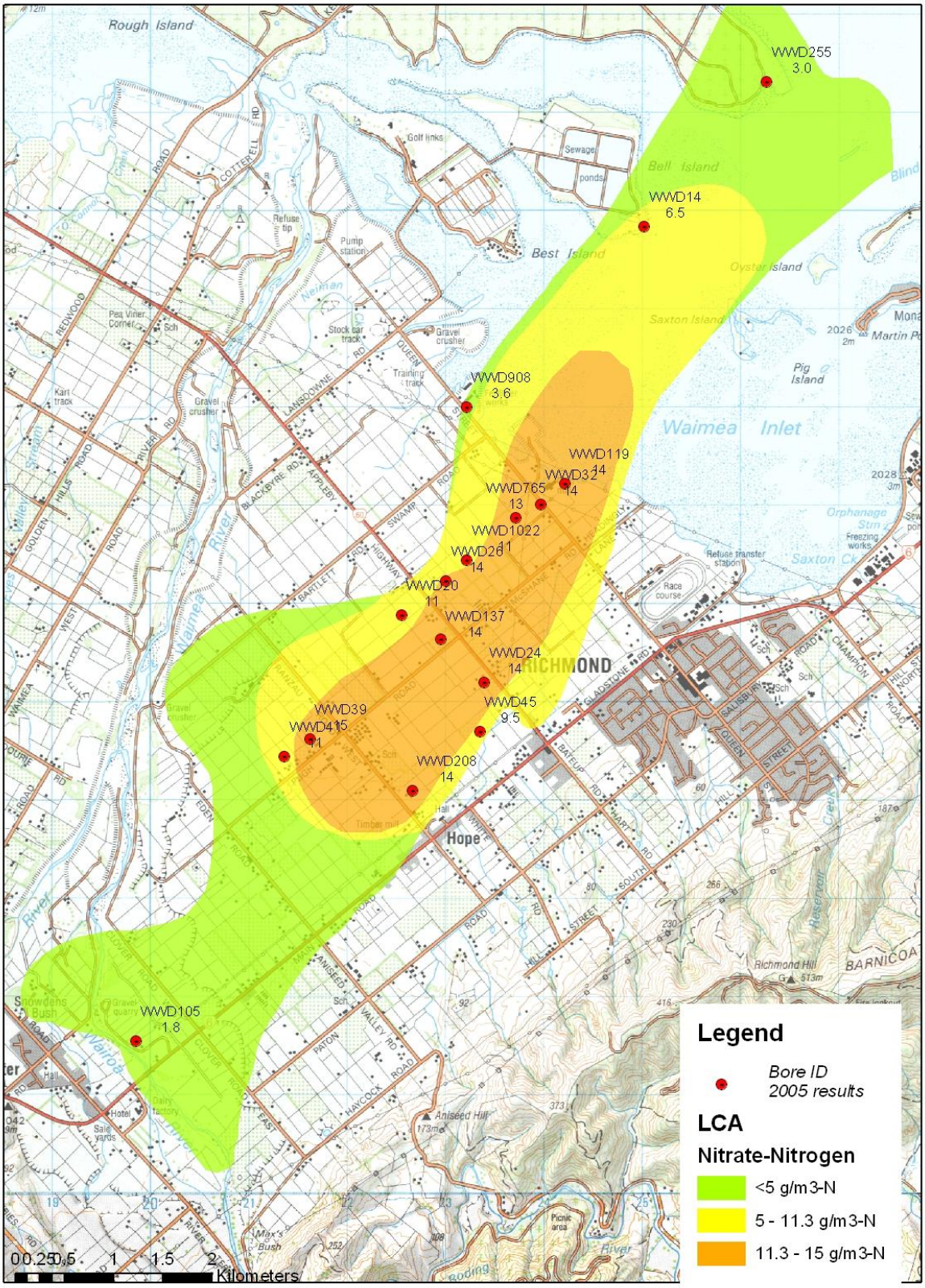

Figure 1(a): 2005 Groundwater Nitrate Survey
Lower Confined Aquifer

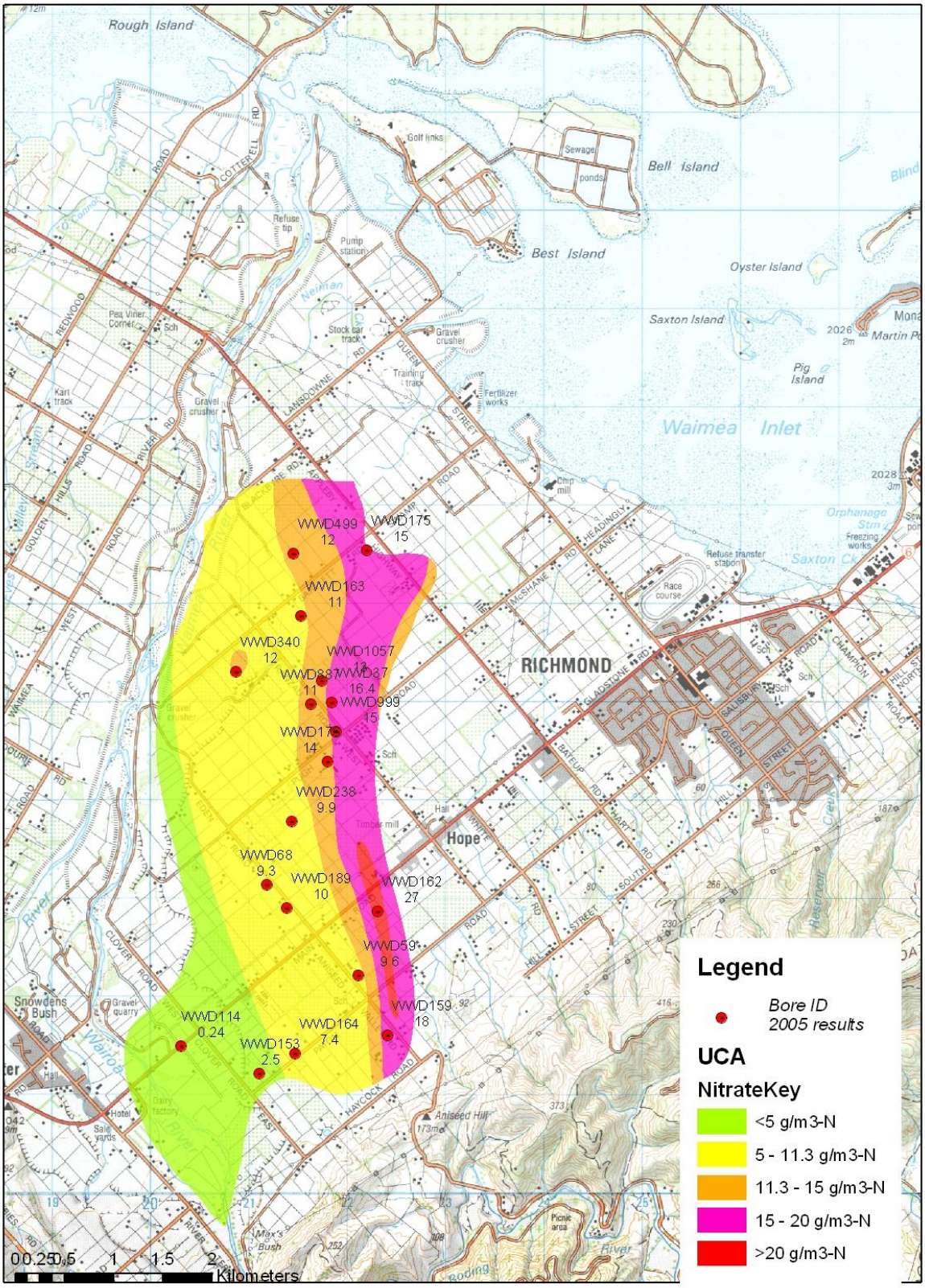

Figure 1(b): 2005 Groundwater Nitrate Survey
Upper Confined Aquifer

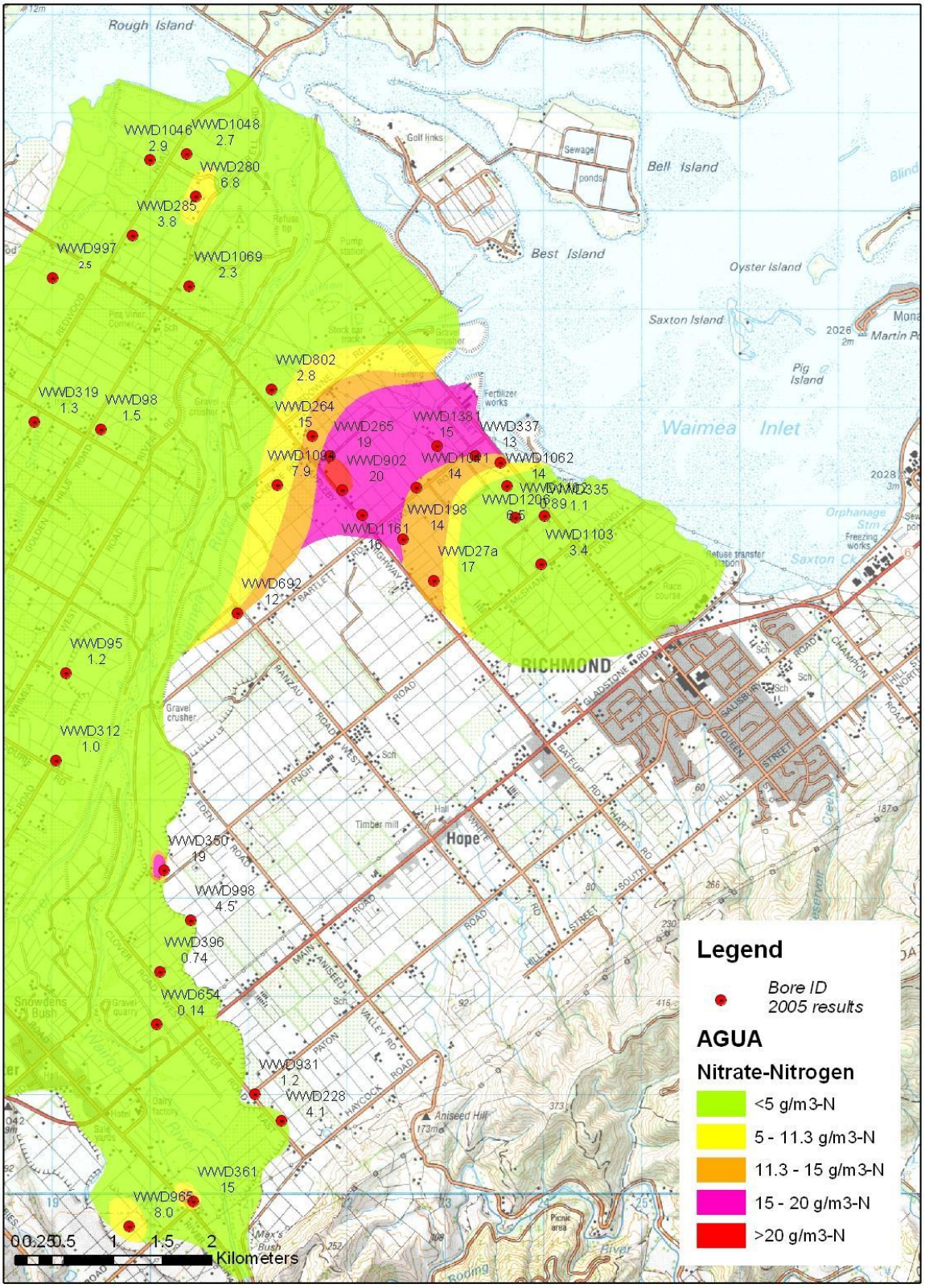

Figure 1(c): 2005 Groundwater Nitrate Survey
Appleby Gravel Unconfined Aquifer

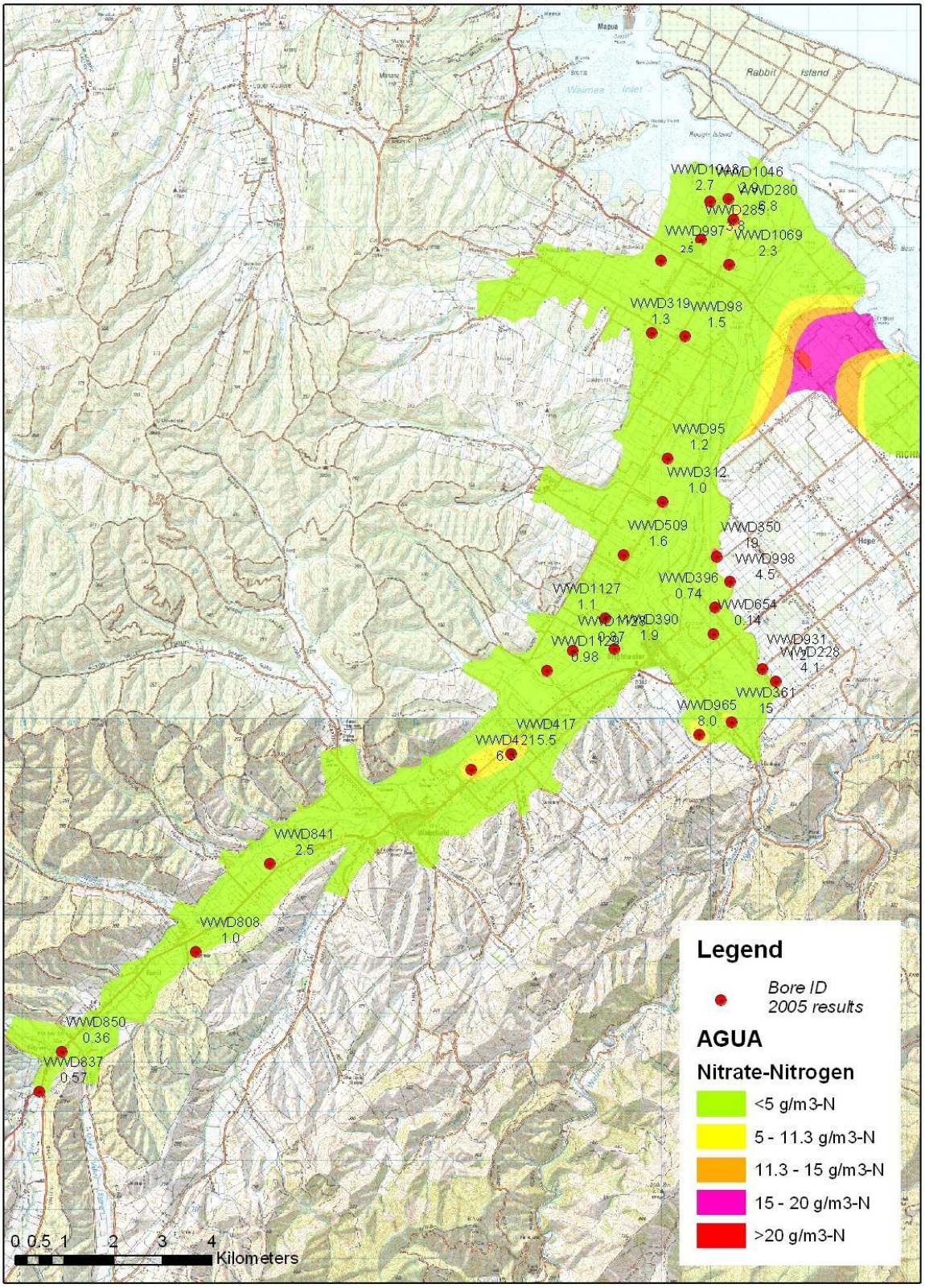

Figure 1(c): 2005 Groundwater Nitrate Survey
Appleby Gravel Unconfined Aquifer

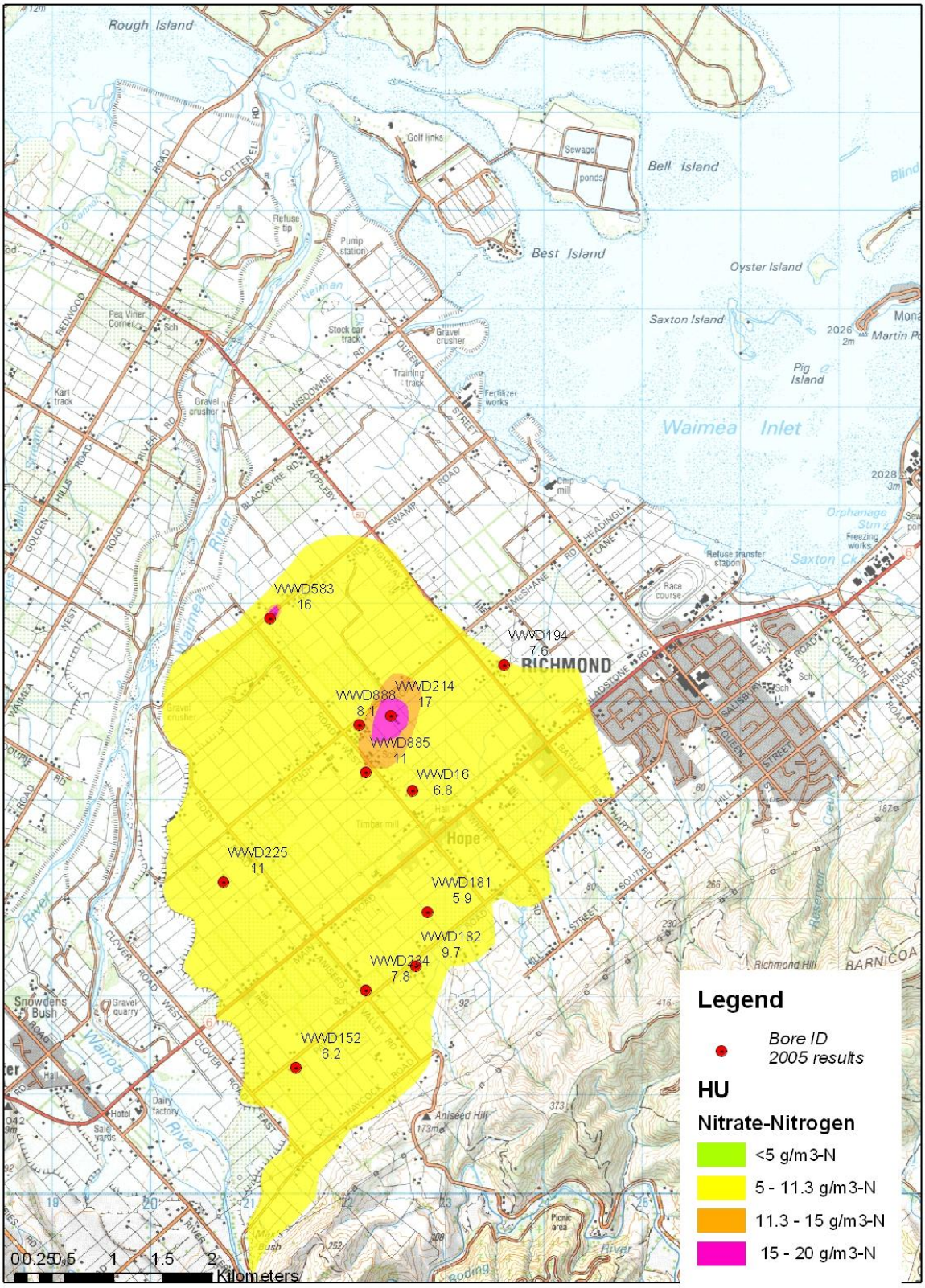

Figure 1(d): 2005 Groundwater Nitrate Survey
Hope Minor Confined and Unconfined Aquifers

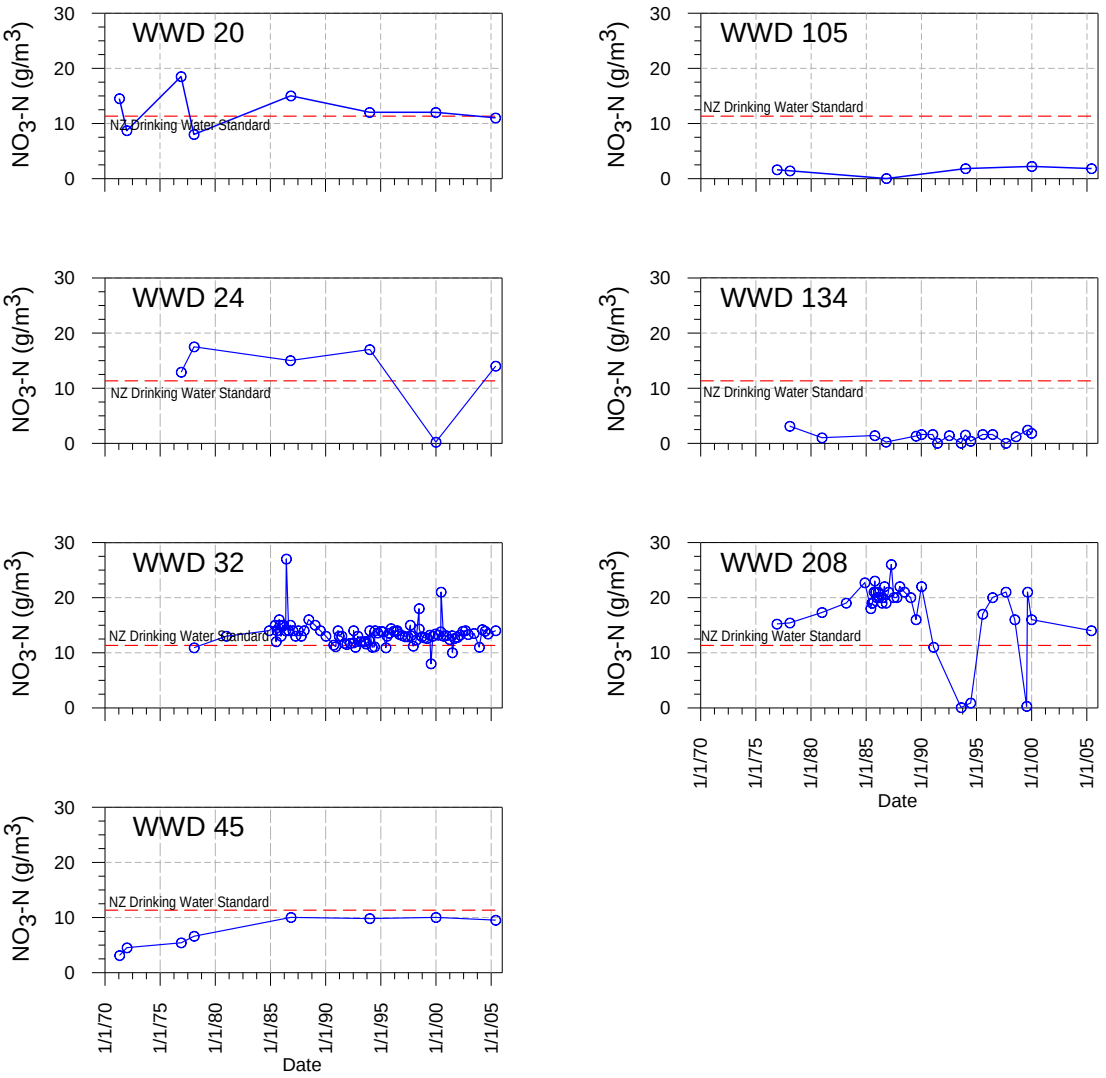

Figure 2(a) Measured groundwater nitrate concentrations over time. Lower Confined Aquifer.

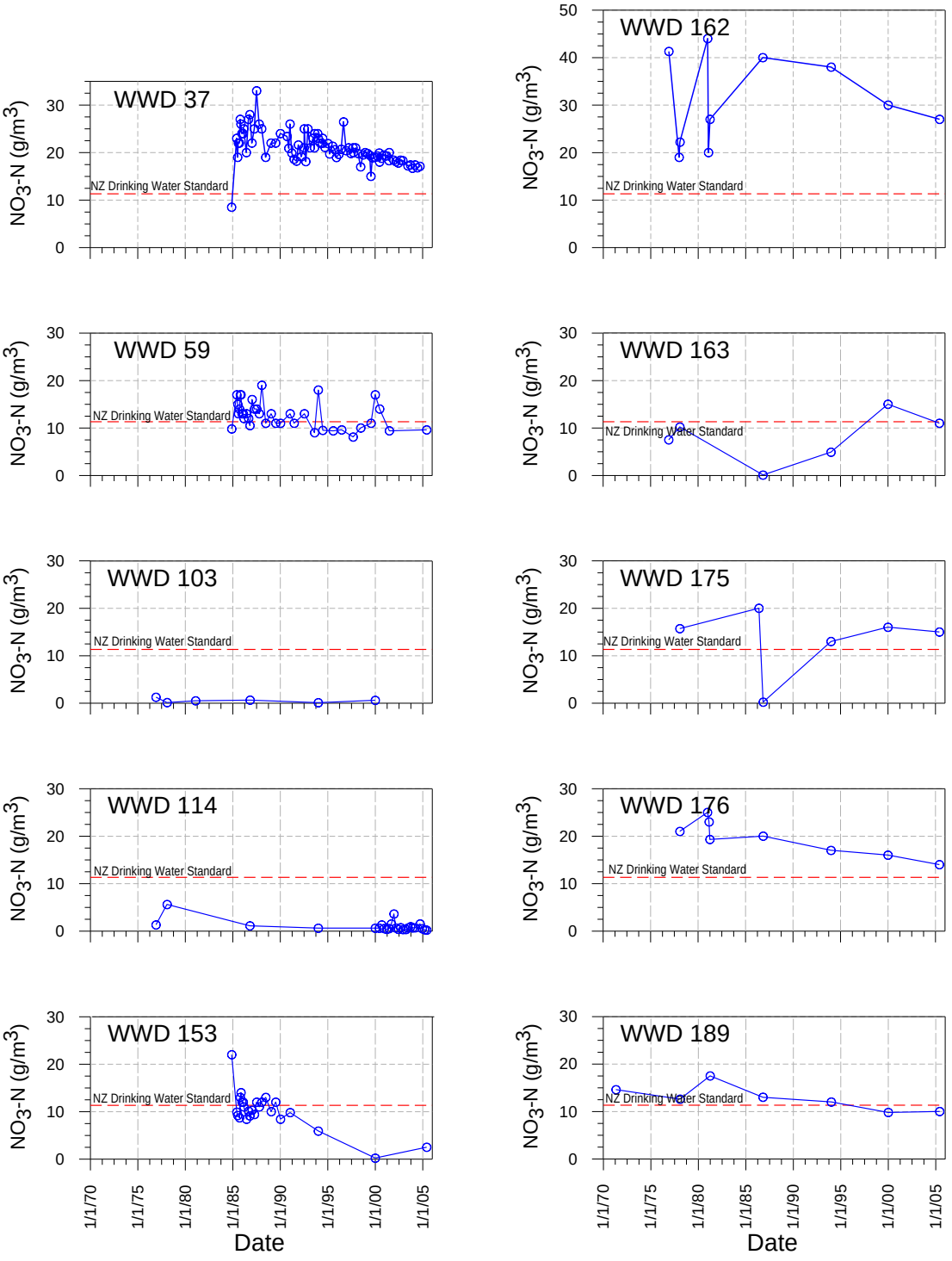

Figure 2(b) Measured groundwater nitrate concentrations over time. Upper Confined Aquifer.

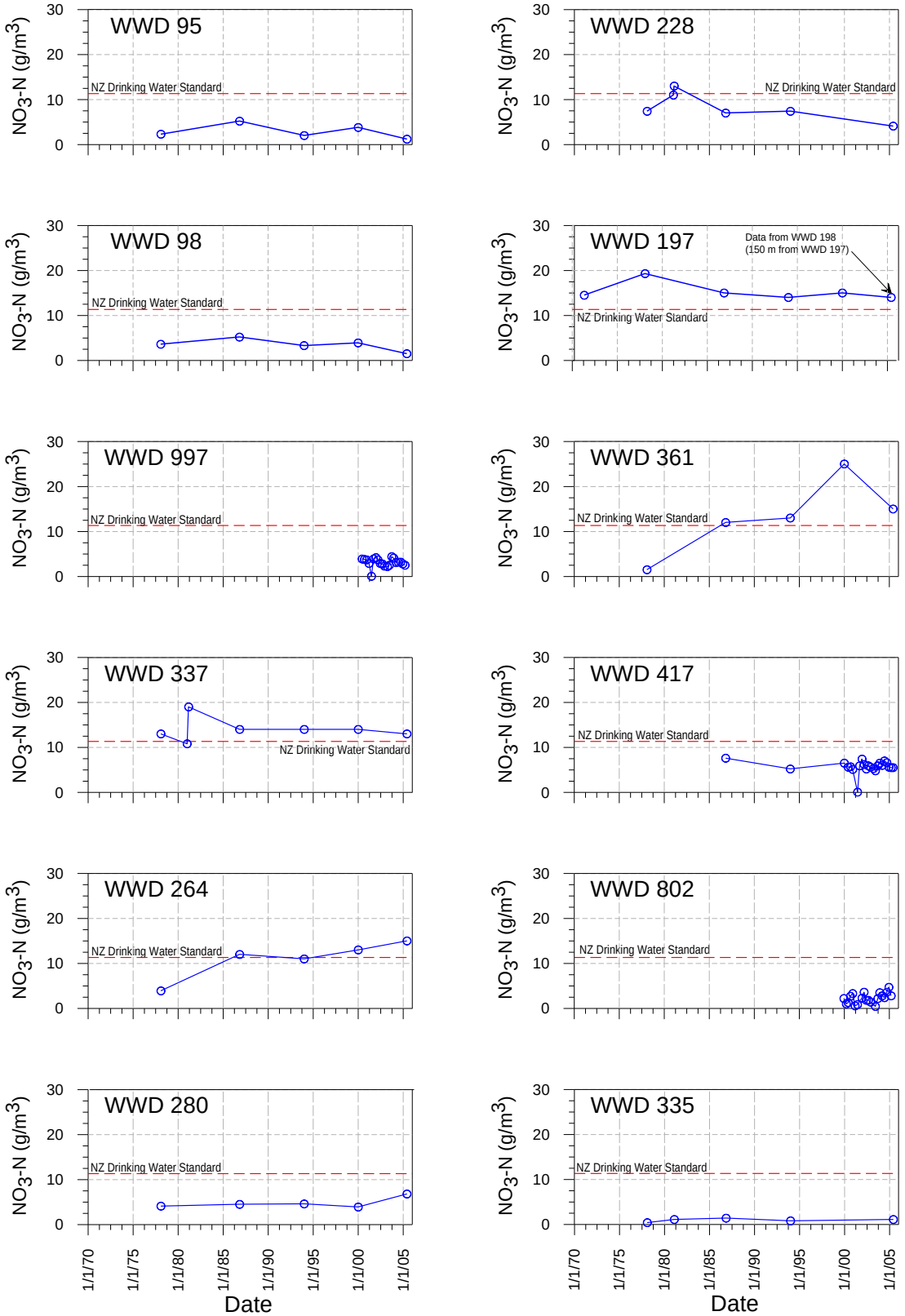

Figure 2(c) Measured groundwater nitrate concentrations over time. Appleby Gravel Unconfined Aquifer.

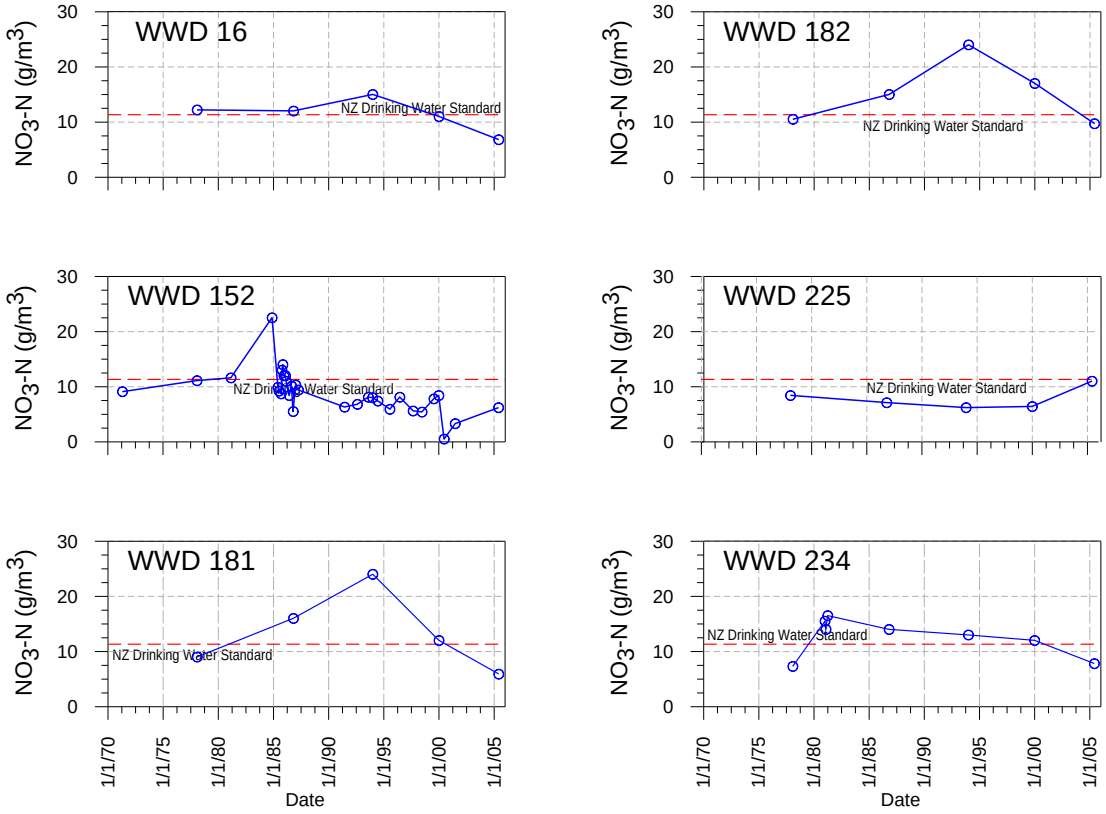

Figure 2(d) Measured groundwater nitrate concentrations over time. Hope Minor Confined and Unconfined Aquifers.

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