

Auckland Region

**Long Term Baseline
Groundwater Chemistry Programme**

3yr Data Summary Report

**Auckland Regional Council
Working Report No. 95, October 2001**



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Executive Summary

The Long-Term Baseline (LTB) Groundwater Chemistry Programme has been set up by the Auckland Regional Council to establish and maintain a database of the groundwater quality of the primary aquifers within the Auckland Region.

The data is being collected to monitor the state of the region's aquifers by establishing the "typical" groundwater quality characteristics of the region's principal aquifers and through the identification of any long-term water quality trends.

The LTB Groundwater Chemistry Programme involves the sampling of groundwater from 24 bores installed within the primary aquifer types, which consist principally of basalts, sandstones, sands and shellbeds.

The sampling methodology has been developed to ensure consistency in sampling across the sites and throughout the duration of the programme. Sample analyses includes field analyses of pH, conductivity and temperature and laboratory analyses for the principal inorganic parameters, including selected heavy metals and nutrients.

The reporting of the LTB groundwater quality data, which commenced in January 1998, is scheduled for a five yearly term with the first principal report due in January 2003. The objective of this report is to provide a mid-term summary of the LTB groundwater data collected from January 1998 to July 2001.

Introduction

The Auckland Regional Council (ARC) Long-Term Baseline (LTB) Groundwater Chemistry Programme has been implemented to monitor the state of the region's aquifers. One of the functions of Regional Councils under Section 35 of the Resource Management Act, 1991 (RMA), is to gather information, monitor and keep records. In addition, under Section 30 of the RMA, Regional Councils are to control the use of land for the purpose of the maintenance and enhancement of the quality of water, in water bodies and coastal water.

Change in land use practices has a corresponding potential for a change in groundwater quality. Landuse changes between farmland, horticulture, market gardening and expanding residential and industrial subdivisions have the potential to affect water quality. Adverse changes in groundwater quality could result in a loss of a valuable commodity. Part of maintaining and enhancing groundwater quality is knowing the present, and preferably past, water quality of an aquifer, that is to have a groundwater quality database (LTB Groundwater Chemistry Programme).

The development and optimisation of the LTB Groundwater Chemistry Programme are described in detail in the two following ARC Working Reports:

- Methodology for a Long Term Baseline Ground Water Chemistry Programme, ARC Working Report No. 71, Auckland Regional Council, June 1997.
- Optimisation of the Long Term Groundwater Chemistry Programme, ARC Working Report No. 77, Auckland Regional Council, January 2000.

A brief summary of the LTB Groundwater Chemistry Programme is outlined in this report.

Objectives and Rationale

The primary objective of the LTB Groundwater Chemistry Programme is to establish and maintain a database of groundwater quality samples from the primary aquifers within the Auckland region and to gain a regional perspective of trends in groundwater quality.

It is important to realise that the purpose of baseline monitoring is not to seek areas of actively changing groundwater chemistry, rather it is to monitor long-term water quality of "typical" groundwater within a particular aquifer and to determine long-term water quality trends. This data may then be used to assess the impact of landuse practices on groundwater quality.

Where an aquifer is considered to be primarily unaffected by landuse practices, the LTB data can be particularly useful in establishing background groundwater quality for the area so that minimum groundwater remediation targets can be set.

Site Locations & Selection Criteria

The LTB Groundwater Chemistry Programme sites were selected based on areas of intensive land and groundwater use, the integrity of any existing boreholes, long term accessibility and particularly to ensure aquifer representativeness and a good geographic spread across the region's aquifers.

The predominant aquifers within the Auckland Region are comprised of basalt, sandstone, sand and shellbeds. It is not possible to sample all aquifers, hence those aquifers selected for baseline monitoring are those more heavily utilised or with high potential for their quality to be compromised. These include aquifers within:

- Waitemata Group (e.g. East Coast Bays Formation);
- Tauranga Group (e.g. Kaawa Formation);
- Franklin Volcanics (e.g. Pukekohe Hill); and,
- Auckland Volcanics (e.g. One Tree Hill).

Some stratified geological formations form aquifers of sufficient thickness such that groundwater in the upper and lower parts of the aquifer may have different quality (e.g. Waitemata Sandstones). It is therefore necessary to take samples from both the upper and lower parts of these aquifers.

The sampling bores used have thorough bore construction and lithological details to ensure that the bore penetrates only the target aquifer and that the overlying aquifers are excluded. The bores chosen are believed to be representative of their particular aquifer.

The LTB Groundwater Chemistry Programme is currently limited to sampling 24 sites. Figure 1 shows the location of the selected sampling sites across the Auckland Region and Table 1 lists the site names and aquifer types. Full site details are listed in Appendix 1.

Waitemata Group sandstones comprise the most widespread water bearing rock type in the region although these sediments are variable throughout the region. For this reason, the LTB Groundwater Chemistry Programme includes nine Waitemata bores.

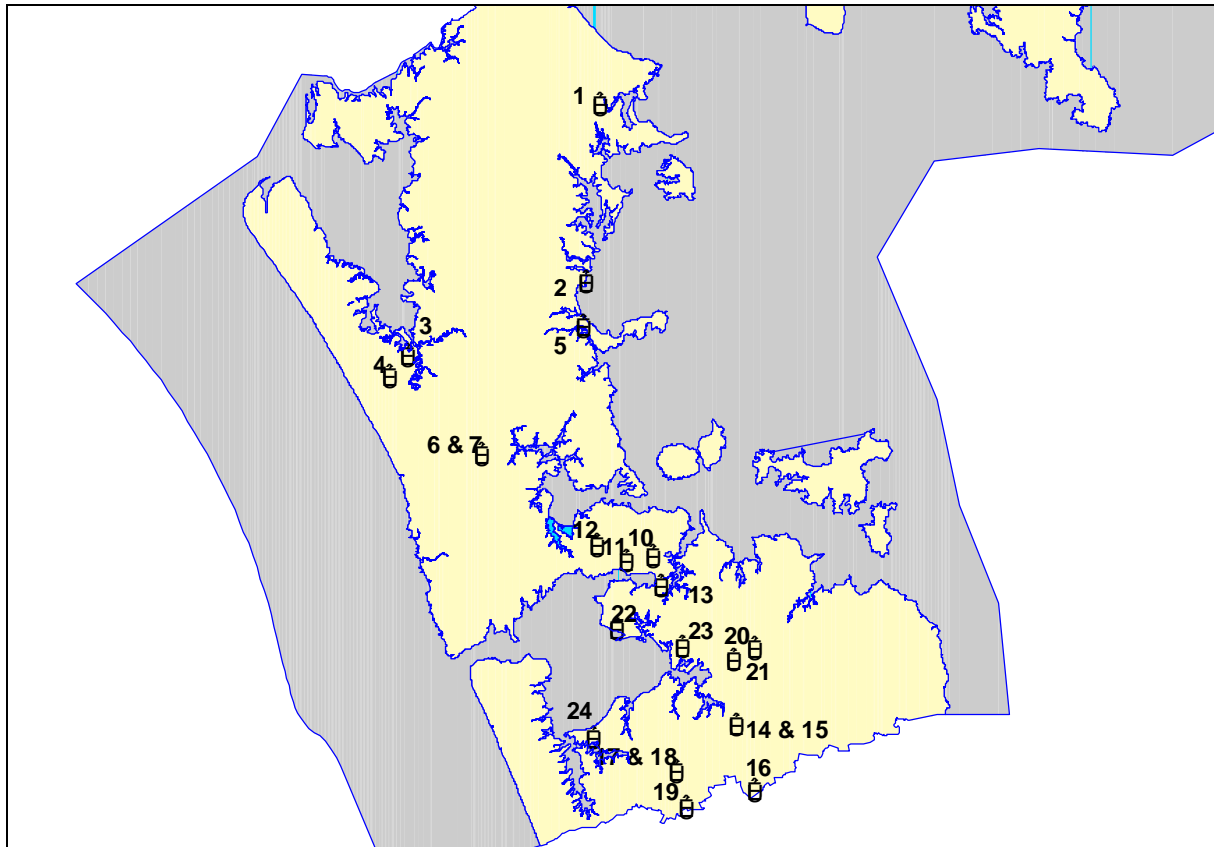


Figure 1: Long-Term Baseline Groundwater - Sampling Sites

Table 1

Key Site No.	Aquifer Type	Site Name / Area
1	Waitemata Sandstone	Quintals Road, Omaha
2	Geothermal - Waitemata Sandstone	Waiwera Thermal Park, Waiwera
3	Geothermal - Waitemata Sandstone	Parakai Thermal Pools, Parakai
4	Kaipara Sands (Pleistocene)	Rimmer Road, Helensville
5	Waitemata Sandstone	Chenery Road, Whangaparaoa
6	Shallow Waitemata Sandstone	Waitakere Road (shallow), Waitakere
7	Deep Waitemata Sandstone	Waitakere Road (deep), Waitakere
8	Kaawa Sands (Pliocene)	Ostrich Farm #2, Helvetia
9	Kaawa Shellbed (Pliocene)	Ostrich Farm #1, Helvetia
10	One Tree Hill Basalts	Central Park, Ellerslie
11	One Tree Hill Basalts	Tiwai Road, One Tree Hill
12	Three Kings Basalts	Watson Avenue, St Lukes
13	Mt Richmond Basalt	Mt Richmond Park, Otahuhu
14	Lower Sand (Pleistocene)	Fielding Road (sand), Drury
15	Drury Basalts	Fielding Road (basalt), Drury
16	Bombay Basalts	BP Bombay, Bombay
17	Shallow Pukekohe Basalts / Tephra	Rifle Range Road (shallow), Pukekohe
18	Deep Pukekohe Basalts	Rifle Range Road (deep), Pukekohe
19	Kaawa Shellbed (Pliocene)	Douglas Road, Pukekohe
20	Waitemata Sandstone / Limestone	Bullens Road, Clevedon
21	Waitemata Sandstone / Greywacke	Burnside Road, Clevedon
22	Mangere Sand (Pleistocene)	Amelia Earhart Avenue, Mangere
23	Waitemata Sandstone	Ford Motor Co., Wiri
24	Waitemata Sandstone	Seagrove Road, Karaka

Sampling Parameters

The aim of sampling groundwater for the LTB Groundwater Chemistry Programme is to obtain a representative sample of aquifer water chemistry. Samples are analysed in the field for temperature, electrical conductivity and turbidity. Samples are then analysed at the laboratory for a full list of inorganic parameters, major cations and anions, nutrients and selected heavy metals to achieve as complete an ion balance as possible. Synthetic organics are not a part of the LTB Groundwater Chemistry Programme.

Sampling Schedule

The LTB Groundwater Chemistry Programme operates on a 5-year schedule. The sampling frequency for the bores is summarised in Appendix 2. To achieve a sample size that will provide a statistically significant detection of trends, the optimum frequency for monitoring was determined as quarterly for all 5 years. This frequency includes some seasonal variation over a long time frame.

However, due to the slow groundwater flow within the less permeable sandstone aquifers, annual sampling is considered to be the most appropriate use of resources. The sampling schedule for these aquifers has therefore been designed as annual with one year of seasonal quarterly monitoring of each sandstone aquifer bore once during the 5-year schedule.

The anticipated minimum timeframe for this programme is 10 years. This would provide a statistically significant data set for trend analysis in the sandstone aquifers, and more data available for the aquifers sampled quarterly each year.

Additional sampling for other groundwater chemistry programmes is also undertaken within the standard sampling timetable. One such programme is the Institute of Geological and Nuclear Sciences (IGNS) National Groundwater Monitoring Programme. At present, six ARC LTB bores are being sampled quarterly for this programme. Groundwater samples are also taken for input to the Institute of Environmental Science and Research Ltd (ESR) National Pesticide Programme from some ARC LTB bores.

Sampling Procedure

The bores are sampled using a variety of pumping methods. Production pumps are installed in the Waiwera Thermal Park, the Parakai Thermal Pools, Chenery Road, Mount Richmond and BP Bombay bores. The production pumps are either privately owned, or owned by the local Territorial Authority.

ARC have installed, and own, sampling pumps for the Waitakere Road (deep), Ostrich Farm #1, Rifle Range Road (shallow), Rifle Range Road (deep), Douglas Road and Seagrove Road bores.

The Tiwai Road bore is sampled using a site dedicated bailer. At the Ford Motor Company bore, the sample is taken from artesian flow from a borehead valve.

The remaining 11 bores are sampled using a dedicated transportable Grundfos MP-1 groundwater sampling pump.

Static bore water levels are measured in the bore prior to sampling, which is used to calculate the required purging time. Sampling involves purging sufficient water from the bore to ensure a representative sample of water is obtained from the aquifer. Standing water in the bore prior to purging will be in equilibrium with atmospheric oxygen and the other chemical and physical parameters, such that the properties of the water standing in the bore are not those of the aquifer itself.

In-situ monitoring equipment for the measurement of pH, conductivity, dissolved oxygen and temperature was used during purging in the first sampling round of the programme. These measurements were then used for optimisation of the purging routine (ARC, 2000).

Water samples are taken after the minimum purging time has been reached and once the field measurements of temperature, pH and conductivity have stabilised.

Quality Assurance

To ensure that sampling is producing reproducible results, a quality assurance and quality control (QA/QC) system is used. This involves the analysis of two duplicate samples from each quarterly sampling round. These samples are collected from randomly selected bores and sent for analysis with no identification other than the sampling date and a unique number.

The laboratory used for the routine analysis of samples from the LTB Groundwater Chemistry Programme is Laboratory Services Ltd, a subsidiary of Watercare Services Ltd., Mangere. This laboratory is ISO and IANZ accredited and has its own rigorous internal QA/QC system.

Results

The results of the LTB Groundwater Chemistry Programme from January 1998 to July 2001 are summarised in Appendix 3. A statistical summary consisting of maximum, minimum and median values is also given. The data set is not yet sufficient to enable any statistically valid trends to be evaluated.

The principal aim of this report is to provide a mid-term summary of the groundwater chemistry data collected to date. Analysis and interpretation of this data will be completed in the year five report when sufficient data has been collected to allow confident identification of water quality trends (ARC, 1997).

Conclusion

This interim report presents the LTB Groundwater Chemistry Programme data collected from January 1998 to July 2001. The data is given in Appendix 3 and provides an initial characterisation of the groundwater chemistry of the principal aquifers of the Auckland region.

References

ARC, (1997) Methodology for a Long Term Baseline Ground Water Chemistry Programme, ARC Working Report No. 71, Auckland Regional Council.

ARC, (2000) Optimisation of the Long Term Groundwater Chemistry Programme, ARC Working Report No. 77, Auckland Regional Council.

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APPENDIX 1: Bores in Sampling Programme

1. Waitemata Sandstone

Site Name: **Quintals Road**
Bore Owner: Auckland Regional Council
Site Address: Quintals Road, Omaha
Grid Reference: R09: 665400
Tideda Number: 6437005

Bore Construction Details

Driller:
Date Drilled: Unknown
Bore Diameter: 200mm
Bore Depth: 129.6m
Casing Depth: 94m
Screen Depth: Open Hole
Elevation at top of casing: 14.22m
Aquifer: Waitemata Sandstones

2. Geothermal – Waitemata Sandstone

Site Name: **Waiwera Thermal Park**
Bore Owner: Auckland Regional Council
Site Address: Waiwera Thermal Park, Waiwera
Grid Reference: R10 634159
Tideda Number: 6457041

Bore Construction Details

Driller: Brown Brothers NZ Ltd
Date Drilled: 17 February 1982
Bore Diameter: 100 mm
Bore Depth: 407m
Casing Depth: 150m
Screen Depth: Open Hole
Elevation at top of casing: 3.244m
Aquifer: Fractured Waitemata Sandstones - geothermal

3. Geothermal – Waitemata Sandstone

Site Name: **Parakai Thermal Pools**
Bore Owner: Auckland Regional Council
Site Address: Parakai camping ground
Grid Reference: Q10 389037
Tideda Number: 6464009

Bore Construction Details

Driller: Unknown
Date Drilled: May 1984
Bore Diameter: 100mm
Bore Depth: 58m
Casing Depth: 45m
Screen Depth: 100mm from 17m-45m and 53mm from 45-58m
Elevation at top of casing: 3.39m
Aquifer: Fractured Waitemata Sandstone - geothermal

4. Kaipara Sands (Pleistocene)

Site Name: **Rimmer Road**
Bore Owner: Auckland Regional Council
Site Address: Rimmer Road, Helensville
Grid Reference: Q10 356009
Tideda Number: 6464089

Bore Construction Details

Driller: Kiwi Welldrillers NZ Kevin Brown Ltd
Date Drilled: 15 April 1997
Bore Diameter: 100 mm
Bore Depth: 63.5m
Casing Depth: 49.5m
Screen Depth: 49.5-61.5m
Elevation at top of casing: Unknown

Aquifer: Kaipara Sands

5. Waitemata Sandstone

Site Name: **Chenery Road**
Bore Owner: Rodney District Council
Site Address: Chenery Road, Whangaparaoa
Grid Reference: R10 626086
Tideda Number: 6467025

Bore Construction Details

Driller: Drillwell Exploration NZ Ltd
Date Drilled: 9 September 1986
Bore Diameter: 150 mm
Bore Depth: 500m
Casing Depth: 151 m
Screen Depth: Open hole
Elevation at top of casing: 37.33

Aquifer: Fractured Waitemata Sandstone

6. Shallow Waitemata Sandstone

Site Name: **Waitakere Road (shallow)**
Bore Owner: Auckland Regional Council
Site Address: Waitakere Road, Waitakere
Grid Reference: Q11 497898
Tideda Number: 6475015

Bore Construction Details

Driller: Drillwell Exploration NZ Ltd
Date Drilled: 16 June 1988
Bore Diameter: 100mm with 50mm screen
Bore Depth: 15.04m
Casing Depth: 10m
Screen Depth: 10-15.04m
Elevation at top of casing: 22.63m

Aquifer: Shallow Waitemata Sandstone

7. Deep Waitemata Sandstone

Site Name: **Waitakere Road (deep)**
Bore Owner: Auckland Regional Council
Site Address: Waitakere Road, Waitakere
Grid Reference: Q11 495898
Tideda Number: 6485070

Bore Construction Details

Driller: Drillwell Exploration NZ Ltd
Date Drilled: 19 May 1994
Bore Diameter: 100mm
Bore Depth: 150m
Casing Depth: 78m
Screen Depth: Open Hole
Elevation at top of casing: Unknown

Aquifer: Deep Waitemata Sandstone

8. Kaawa Sand (Pliocene)

Site Name: **Ostrich Farm #2**
Bore Owner: Auckland Regional Council
Site Address: Ostrich Farm Road, Helvetia
Grid Reference: R12 764468
Tideda Number: 7418023

Bore Construction Details

Driller: Brown Brothers NZ Ltd
Date Drilled: 20 November 1985
Bore Diameter: 80mm
Bore Depth: 47.6m
Casing Depth: 46m
Screen Depth: 46-47m
Elevation at top of casing: 27.42

Aquifer: Kaawa Sand

9. Kaawa Shellbed (Pliocene)

Site Name: **Ostrich Farm Road #1**
Bore Owner: Auckland Regional Council
Site Address: Ostrich Farm Road, Helvetia
Grid Reference: R12:764468
Tideda Number: 7418027

Bore Construction Details

Driller: Brown Brothers NZ Ltd
Date Drilled: 20 November 1985
Bore Diameter: 80mm
Bore Depth: 84 metres
Casing Depth: 68 metres
Screen Depth: 68 to 84 metres
Elevation at top of casing: 26.14 metres

Aquifer: Kaawa Shellbed

10. One Tree Hill Basalt

Site Name: **Central Park**
Bore Owner: Auckland Regional Council
Site Address: Central Park Industrial Offices, Ellerslie
Grid Reference: R11 715761
Tideda Number: 6498007

Bore Construction Details

Driller: Drillwell Exploration NZ Ltd
Date Drilled: 900322
Bore Diameter: 100mm
Bore Depth: 22.67m
Casing Depth: 12.96m
Screen Depth: 12.96-22
Elevation at top of casing: 23.23m

Aquifer: One Tree Hill Basalt

11. One Tree Hill Basalt

Site Name: **Tiwai Road**
Bore Owner: Auckland Regional Council
Site Address: Tiwai Road, One Tree Hill
Grid Reference: R11 692755
Tideda Number: 6497019

Bore Construction Details

Driller: Drillwell Exploration NZ Ltd
Date Drilled: 8 April 1997
Bore Diameter: 50mm
Bore Depth: 58.53m
Casing Depth: 46.53m
Screen Depth: 46.53-58.53m
Elevation at top of casing: Unknown

Aquifer: One Tree Hill Basalt

12. Three Kings Basalt

Site Name: **Watson Avenue**
Bore Owner: Auckland Regional Council
Site Address: Watson Avenue, St Lukes
Grid Reference: R11 653783
Tideda Number: 6487015

Bore Construction Details

Driller: Drillwell Exploration NZ Ltd
Date Drilled: 17 October 1996
Bore Diameter: 50mm
Bore Depth: 39m
Casing Depth: 32.5m
Screen Depth: 32.5-38.5m
Elevation at top of casing: 40.05m

Aquifer: Three Kings Basalt

13. Mt Richmond Basalt

Site Name: **Mt Richmond Park**
Bore Owner: Auckland City Council
Site Address: 645 Mt Wellington Highway, Otahuhu
Grid Reference: R11 744728
Tideda Number:

Bore Construction Details

Driller: Brown Brothers NZ Ltd
Date Drilled: 21 June 1995
Bore Diameter: 150mm
Bore Depth: 42.6m
Casing Depth: 30.27m
Screen Depth: 29.04-36.51m
Elevation at top of casing: Unknown

Aquifer: Mt Richmond Basalt

14. Lower Sand (Pleistocene)

Site Name: **Fielding Road (sand)**
Bore Owner: Auckland Regional Council
Site Address: Fielding Road, Drury
Grid Reference: R12 848523
Tideda Number: 7419007

Bore Construction Details

Driller: Drillwell Exploration NZ Ltd
Date Drilled: 20 March 1989
Bore Diameter: 100mm
Bore Depth: 64m
Casing Depth: 57m
Screen Depth: 57-64m
Elevation at top of casing: 19.72m

Aquifer: Pleistocene Sands (lower)

15. Drury Basalt

Site Name: **Fielding Road (basalt)**
Bore Owner: Auckland Regional Council
Site Address: Fielding Road, Drury
Grid Reference: R12 848523
Tideda Number: 7419009

Bore Construction Details

Driller: Drillwell Exploration NZ Ltd
Date Drilled: 31 March 1989
Bore Diameter: 150mm
Bore Depth: 46.7m
Casing Depth: 16.3m
Screen Depth: Open hole
Elevation at top of casing: 19.985m

Aquifer: Drury basalt (upper)

16. Bombay Basalt

Site Name: **BP Bombay**
Bore Owner: BP Oil NZ Ltd
Site Address: Mill Road, Bombay
Grid Reference: R12 864436
Tideda Number:

Bore Construction Details

Driller: Drillwell Exploration NZ Ltd
Date Drilled: 23 June 1996
Bore Diameter: 100mm
Bore Depth: 79.43m
Casing Depth: 62m
Screen Depth: Open hole
Elevation at top of casing: Unknown

Aquifer: Bombay Basalt

17. Shallow Pukekohe Basalt/ Tephra

Site Name: **Rifle Range Road (shallow)**
Bore Owner: Auckland Regional Council
Site Address: Rifle Range Road, Pukekohe
Grid Reference: R12 766426
Tideda Number: 7428105

Bore Construction Details

Driller: Pro-Drill NZ Ltd
Date Drilled: 25 April 1997
Bore Diameter: 50mm
Bore Depth: 42m
Casing Depth: 30m
Screen Depth: 30-42m
Elevation at top of casing: Unknown

Aquifer: Shallow Pukekohe Tephra/weathered basalt

18. Deep Pukekohe Basalt

Site Name: **Rifle Range Road (deep)**
Bore Owner: Auckland Regional Council
Site Address: Rifle Range Road, Pukekohe
Grid Reference: R12 766426
Tideda Number: 7428103

Bore Construction Details

Driller: Pro-Drill NZ Ltd
Date Drilled: June 1997
Bore Diameter: 50mm
Bore Depth: 90m
Casing Depth: 78m
Screen Depth: 78-90m
Elevation at top of casing: Unknown

Aquifer: Deep Pukekohe basalt

19. Kaawa Shellbed (Pliocene)

Site Name: **Douglas Road**
Bore Owner: Auckland Regional Council
Site Address: Douglas Road, Pukekohe
Grid Reference: R12 765411
Tideda Number: 7429013

Bore Construction Details

Driller: Drillwell Exploration NZ Ltd
Date Drilled: 29 September 1979
Bore Diameter: 100mm to 198.5m, 75mm to 254m
Bore Depth: 268.2m
Casing Depth: 254m
Screen Depth: 254-268m
Elevation at top of casing: 109.02m

Aquifer: Kaawa Shellbed

20. Waitemata Sandstone/ Limestone

Site Name: **Bullens Road**
Bore Owner: Auckland Regional Council
Site Address: Bullens Road, Clevedon
Grid Reference: R11 863607
Tideda Number: 7409011

Bore Construction Details

Driller: Drillwell Exploration NZ Ltd
Date Drilled: 10 June 1993
Bore Diameter: 100mm
Bore Depth: 75m
Casing Depth: 38.9
Screen Depth: Open hole
Elevation at top of casing: 34.66m

Aquifer: Sandstone/Limestone

21. Waitemata Sandstone/ Greywacke

Site Name: **Burnside Road**
Bore Owner: Auckland Regional Council
Site Address: Burnside Road, Clevedon
Grid Reference: R11 881619
Tideda Number: 7409001

Bore Construction Details

Driller: Drillwell Exploration NZ Ltd
Date Drilled: 10 July 1985
Bore Diameter: 100mm
Bore Depth: 169m
Casing Depth: 154.2m
Screen Depth: Open hole
Elevation at top of casing: 30.519m

Aquifer: Basal Waitemata onto greywacke

22. Mangere Sands (Pleistocene)

Site Name: **Amelia Earhart Avenue**
Bore Owner: Auckland Regional Council
Site Address: Amelia Earhart Place, Mangere
Grid Reference: R11 691675
Tideda Number: 6497017

Bore Construction Details

Driller: Pro-Drill NZ Ltd
Date Drilled: 26 April 1997
Bore Diameter: 50mm
Bore Depth: 50.6m
Casing Depth: 42.6m
Screen Depth: 42.6-48.6m
Elevation at top of casing: Unknown

Aquifer: Pleistocene Sand

23. Waitemata Sandstone

Site Name: **Ford Motor Company**
Bore Owner: Auckland Regional Council
Site Address: Lambie Drive, Wiri
Grid Reference: R11 768660
Tideda Number: 6498035

Bore Construction Details

Driller: Drillwell Exploration NZ Ltd
Date Drilled: 21 June 1993
Bore Diameter: 100mm
Bore Depth: 200m
Casing Depth: 60m
Screen Depth: Open hole
Elevation at top of casing: Unknown

Aquifer: Waitemata Sandstone

24. Waitemata Sandstone

Site Name: **Seagrove Road**
Bore Owner: Auckland Regional Council
Site Address: Seagrove Road, Karaka
Grid Reference: R12 663509
Tideda Number: 7417023

Bore Construction Details

Driller: Drillwell Exploration NZ Ltd
Date Drilled: 10 June 1991
Bore Diameter: 100mm
Bore Depth: 201m
Casing Depth: 97.80
Screen Depth: Open hole
Elevation at top of casing: 28.18m

Aquifer: Waitemata Sandstone

APPENDIX 2: Groundwater Sampling Schedule

APPENDIX 3: Groundwater Data