New Plymouth District Council
Mangapouri Cemetery
Monitoring Programme
Annual Report
2018-2019

Technical Report 2019-67

ISSN: 1178-1467 (Online)
Document: 2245542 (Word)
Document: 2352174 (Pdf)

Taranaki Regional Council
Private Bag 713
STRATFORD

November 2019

Executive summary

New Plymouth District Council (NPDC) operates the Mangapouri Cemetery (the Cemetery) located on Junction Road (SH3) between New Plymouth and Egmont Village, in the Waiwhakaiho Catchment. The Cemetery site is gated and includes an access road, landscaped greens, storage buildings and washroom facilities. This report covers the reporting period July 2018 to June 2019 and describes the monitoring programme implemented by the Taranaki Regional Council (the Council) to assess NPDC's environmental performance during the period under review. As the activity had not commenced during the reported period this report details the results of the baseline monitoring undertaken in relation to the site, and discusses the planned activities and any potential environmental impacts.

During the monitoring period, NPDC demonstrated an overall high level of environmental performance.

NPDC held one resource consent that allows for the discharge of contaminants into land where it may enter water. The consent included a total of 8 conditions setting out the requirements that they must satisfy.

The Cemetery opened to the public in May 2019. Prior to opening, baseline monitoring was carried out by Geosearch Limited (Geosearch) on behalf of NPDC. The baseline monitoring programme was undertaken for one year and commenced in February 2017. Monitoring included water quality sampling of the receiving waters (groundwater and surface water) and continuous groundwater level monitoring.

During the period under review, NPDC demonstrated a high level of environmental and administrative performance with the resource consent.

For reference, in the 2018-2019 year, consent holders were found to achieve a high level of environmental performance and compliance for 83% of the consents monitored through the Taranaki tailored monitoring programmes, while for another 13% of the consents, a good level of environmental performance and compliance was achieved.

This report includes recommendations to be implemented during the 2019–2020 monitoring period.

Table of contents

List of tables

List of figures

1 Introduction

1.1 Compliance monitoring programme reports and the Resource Management Act 1991

1.1.1 Introduction

This report is for the period July 2018 to June 2019 by the Taranaki Regional Council (the Council) describing the results of the baseline monitoring programme associated with the resource consent held by New Plymouth District Council (NPDC).

NPDC operate the Mangapouri Cemetery (the Cemetery) located on Junction Road (SH3) between New Plymouth and Egmont Village. NPDC held one resource consent authorising the discharge to land at the Cemetery during the reporting period. The consent includes a number of special conditions which set out specific requirements that NPDC must satisfy.

This report covers the results and findings of the baseline monitoring programme implemented by the Council in respect of the consent held by NPDC. The report also discusses the planned activities and any associated potential environmental impacts. This is the first report prepared by the Council to cover NPDC's discharges to land and their effects.

1.1.2 Structure of this report

Section 1 of this report is a background section. It sets out general information about:

- consent compliance monitoring under the *Resource Management Act 1991* (RMA) and the Council's obligations;
- the Council's approach to monitoring sites though annual programmes;
- the resource consent held by NPDC in the Waiwhakaiho Catchment;
- the nature of the monitoring programme in place for the period under review; and
- a description of the activities and operations conducted by NPDC at the Cemetery site.

Section 2 presents the results of monitoring during the period under review, including scientific and technical data.

Section 3 discusses the results, their interpretations, and their significance for the environment.

Section 4 presents recommendations to be implemented in the 2019-2020 monitoring year.

A glossary of common abbreviations and scientific terms, and a bibliography, are presented at the end of the report.

1.1.3 The Resource Management Act 1991 and monitoring

The RMA primarily addresses environmental 'effects' which are defined as positive or adverse, temporary or permanent, past, present or future, or cumulative. Effects may arise in relation to:

a. the neighbourhood or the wider community around an activity, and may include cultural and social-economic effects;
b. physical effects on the locality, including landscape, amenity and visual effects;
c. ecosystems, including effects on plants, animals, or habitats, whether aquatic or terrestrial;
d. natural and physical resources having special significance (for example recreational, cultural, or aesthetic); and

e. risks to the neighbourhood or environment.

In drafting and reviewing conditions on discharge permits, and in implementing monitoring programmes, the Council is recognising the comprehensive meaning of 'effects' inasmuch as is appropriate for each activity. Monitoring programmes are not only based on existing permit conditions, but also on the obligations of the RMA to assess the effects of the exercise of consents. In accordance with Section 35 of the RMA, the Council undertakes compliance monitoring for consents and rules in regional plans, and maintains an overview of the performance of resource users and consent holders. Compliance monitoring, including both activity and impact monitoring, enables the Council to continually re-evaluate its approach and that of consent holders to resource management and, ultimately, through the refinement of methods and considered responsible resource utilisation, to move closer to achieving sustainable development of the region's resources.

1.1.4 Evaluation of environmental and administrative performance

Besides discussing the various details of the performance and extent of compliance by NPDC, this report also assigns them a rating for their environmental and administrative performance during the period under review.

Environmental performance is concerned with actual or likely effects on the receiving environment from the activities during the monitoring year. Administrative performance is concerned with NPDC's approach to demonstrating consent compliance in site operations and management including the timely provision of information to Council (such as contingency plans and water take data) in accordance with consent conditions.

Events that were beyond the control of the consent holder and unforeseeable (that is a defence under the provisions of the RMA can be established) may be excluded with regard to the performance rating applied. For example loss of data due to a flood destroying deployed field equipment.

The categories used by the Council for this monitoring period, and their interpretation, are as follows:

Environmental Performance

High: No or inconsequential (short-term duration, less than minor in severity) breaches of consent or regional plan parameters resulting from the activity; no adverse effects of significance noted or likely in the receiving environment. The Council did not record any verified unauthorised incidents involving significant environmental impacts and was not obliged to issue any abatement notices or infringement notices in relation to such impacts.

Good: Likely or actual adverse effects of activities on the receiving environment were negligible or minor at most. There were some such issues noted during monitoring, from self reports, or in response to unauthorised incident reports, but these items were not critical, and follow-up inspections showed they have been dealt with. These minor issues were resolved positively, co-operatively, and quickly. The Council was not obliged to issue any abatement notices or infringement notices in relation to the minor non-compliant effects; however abatement notices may have been issued to mitigate an identified potential for an environmental effect to occur.

For example:

- High suspended solid values recorded in discharge samples, however the discharge was to land or to receiving waters that were in high flow at the time;
- Strong odour beyond boundary but no residential properties or other recipient nearby.

Improvement required: Likely or actual adverse effects of activities on the receiving environment were more than minor, but not substantial. There were some issues noted during monitoring, from self reports, or in response to unauthorised incident reports.

Cumulative adverse effects of a persistent minor non-compliant activity could elevate a minor issue to this level. Abatement notices and infringement notices may have been issued in respect of effects.

Poor: Likely or actual adverse effects of activities on the receiving environment were significant. There were some items noted during monitoring, from self reports, or in response to unauthorised incident reports. Cumulative adverse effects of a persistent moderate non-compliant activity could elevate an 'improvement required' issue to this level. Typically there were grounds for either a prosecution or an infringement notice in respect of effects.

Administrative performance

High: The administrative requirements of the resource consents were met, or any failure to do this had trivial consequences and were addressed promptly and co-operatively.

Good: Perhaps some administrative requirements of the resource consents were not met at a particular time, however this was addressed without repeated interventions from the Council staff. Alternatively adequate reason was provided for matters such as the no or late provision of information, interpretation of 'best practical option' for avoiding potential effects, etc.

Improvement required: Repeated interventions to meet the administrative requirements of the resource consents were made by Council staff. These matters took some time to resolve, or remained unresolved at the end of the period under review. The Council may have issued an abatement notice to attain compliance.

Poor: Material failings to meet the administrative requirements of the resource consents. Significant intervention by the Council was required. Typically there were grounds for an infringement notice.

For reference, in the 2018-2019 year, consent holders were found to achieve a high level of environmental performance and compliance for 83% of the consents monitored through the Taranaki tailored monitoring programmes, while for another 13% of the consents, a good level of environmental performance and compliance was achieved.

1.2 Process description

NPDC operate two main cemeteries, the Awanui and Te-Henui cemeteries, located in central New Plymouth. As both are running out of usable space the Mangapouri Cemetery was developed. The Cemetery opened to the public in May 2019 and the first internment was undertaken in July 2019.

The Cemetery accepts conventional single plot, natural burials and ashes. Each grave will be centered on an area of 10 m^2, which will result in 1,000 graves per hectare (ha). The first two areas available to the public are Area-A which is 0.8 ha in the north of the development, and Area-B which is 0.65 ha in the south and west of the development (Figure 1).

To avoid contamination of local surface and groundwater resources burials are required to occur at a minimum of 0.8 m above the high water table and internments will be spread out in time and space to reduce any risks associated with point source loading.

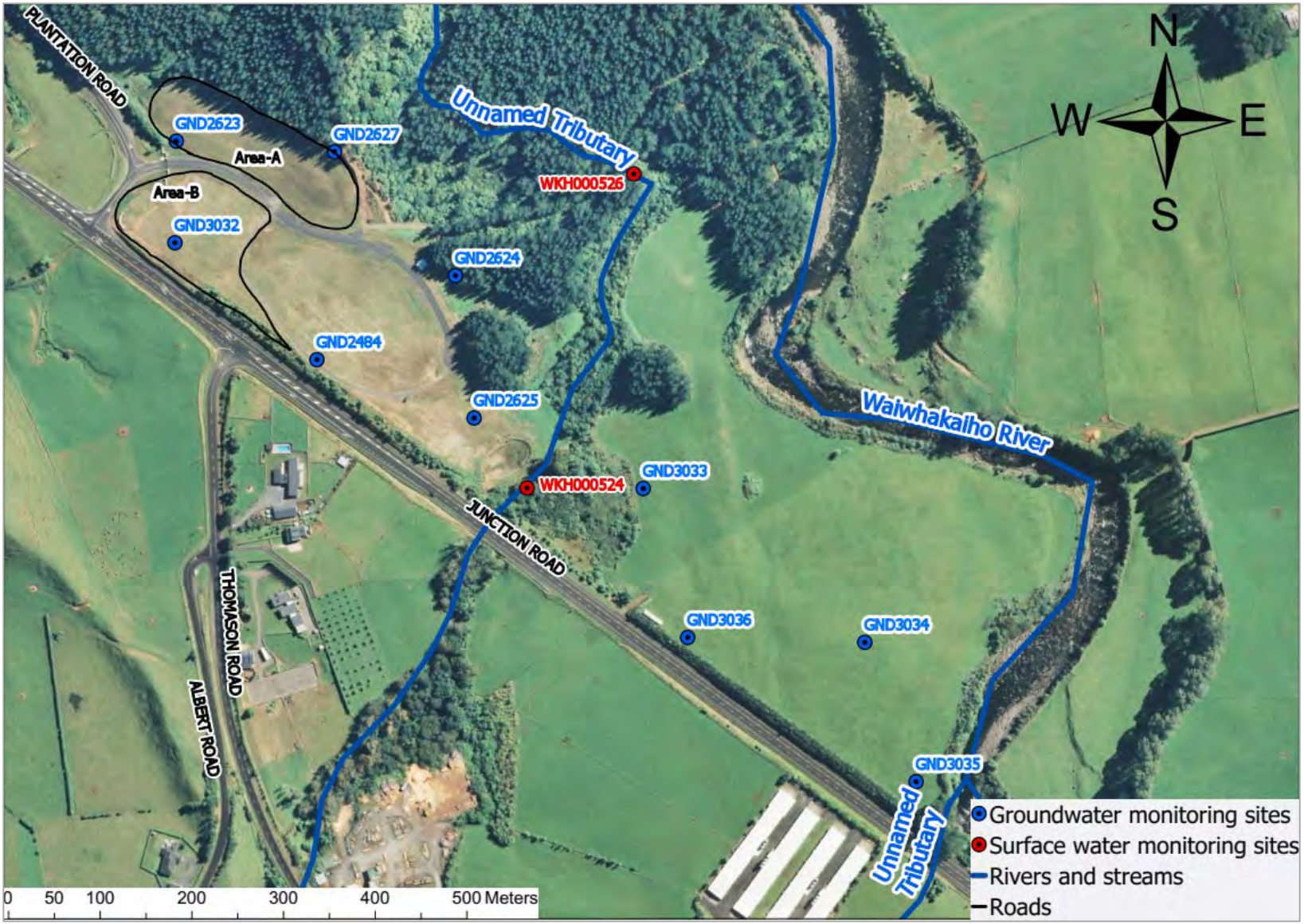


Figure 1 Mangapouri Cemetery location map

1.3 Resource consents

NPDC holds one discharge consent in relation to the Cemetery. The details of which are summarised in the table below (Table 1). A summary of the conditions attached to the permit are set out in Section 3 of this report.

A summary of the various consent types issued by the Council is included Appendix I, as is a copy of the permit held by NPDC that authorises their discharge to land.

Table 1 Summary of resource consents held by NPDC at the Mangapouri Cemetery

Consent number	Purpose	Granted	Review	Expires
Discharges of waste to land				
7882-1.1	To discharge contaminants into land at a cemetery in circumstances where they may enter water	09 Nov 2011	June 2020	01 Jun 2046

1.3.1 Extension of lapse condition

Consent 7882-1 was due to lapse on 31 December 2018. Prior to the lapse date NPDC applied to vary the consent to extend the lapse date, as the activity would not be given effect to by 31 December 2018. The lapse date was changed to of 31 December 2021 and the variation granted on 28 May 2018.

1.4 Monitoring programme

1.4.1 Introduction

Section 35 of the RMA sets obligations upon the Council to gather information, monitor, and conduct research on the exercise of resource consents within the Taranaki region. The Council is also required to assess the effects arising from the exercising of these consents and report upon them.

The Council may therefore make and record measurements of physical and chemical parameters, take samples for analysis, carry out surveys and inspections, conduct investigations, and seek information from consent holders.

The main environmental impacts associated with the internment of human remains is related to the degradation of human corpses. Degradation normally takes 10-12 years and it is estimated that more than half the pollutant load leaches within the first year, with loadings reducing by 50% each year thereafter (SEPA, 2015).

The main point source contamination issues related to cemeteries are the following (SEPA, 2015):

- Ammoniacal nitrogen resulting from the breakdown or organic products;
- Pathogens and organisms harmful to human health can be released into the environment if present;
- Formaldehyde, used in embalming fluids and coffin resins and glues is a biocide with toxic and carcinogenic properties;
- Mercury, present in amalgam in dental fillings, is a hazardous substance;
- Phosphates and metal concentrations in ground and surface water resources, present in cremated remains, can increase; and
- Phosphate from the decomposition of skeletal remains.

The baseline monitoring programme included the collection and analysis of a comprehensive suite of general water quality parameters and those contaminants specifically related to the degradation of human remains. The baseline data collected will allow for future comparisons to be made once the activity has commenced.

Baseline monitoring in relation to the Cemetery was undertaken by Geosearch, on behalf of NPDC, and the Council as outlined below.

1.4.2 Programme liaison and management

There is generally a significant investment of time and resources by the Council in:

- ongoing liaison with resource consent holders over consent conditions and their interpretation and application;
- in discussion over monitoring requirements;
- preparation of any consent reviews, renewals, or new consent applications;
- advice on the Council's environmental management strategies and the content of regional plans; and
- consultation on associated matters.

1.4.2.1 Review of NPDC's monitoring data

The monitoring data was provided quarterly to the Council for review to determine compliance with consent conditions.

1.4.2.2 Site inspections

No site inspections were undertaken during the reporting period as the activities had not commenced.

Once internments commence at the Cemetery ongoing site specific inspections will be undertaken. Inspections will include an overall visual inspection of the site and the manual collection of groundwater levels. The main points of interest will be to check for signs of water ponding or any sediment runoff into local waterways. The area will be surveyed for environmental effects.

1.4.2.3 Surface water quality monitoring

Baseline surface water quality samples were collected in an unnamed tributary of the Waiwhakaiho River, at one site upstream and one site downstream of the Cemetery. The samples were obtained during low flow and high flow conditions. The samples were submitted to Hill laboratories (Hills) for analysis. A Council Officer accompanied Geosearch during the first sampling round to assess and finalise sampling locations.

The location of surface water monitoring sites are displayed on Figure 1. A description of each site is provided in Table 2.

Table 2 Surface water monitoring site details

Site	Eastings	Northings	Description	Location
WKH000524	1697720	5667352	Unnamed tributary of the Waiwhakaiho River	On the cemetery side of Junction Road, downstream of the SH3 culvert
WKH000526	1697837	5667687	Unnamed tributary of the Waiwhakaiho River	320 m downstream of SH3 culvert

1.4.2.4 Groundwater quality monitoring

Ten groundwater monitoring sites were installed by NPDC at the Cemetery site to enable the collection of comprehensive groundwater quality and level data. Baseline monitoring was undertaken at six of the ten sites. The six sites monitored GND2623, GND2624, GND2625, GND2627, GND2484 and GND3032 are located on the western side of the unnamed tributary that intersects the Cemetery site (Figure 1). The western side of the site includes Area-A and Area-B the first two sections of the Cemetery available to the public for burials. The baseline groundwater sampling was undertaken quarterly and samples were submitted to Hills for analysis.

1.4.2.5 Groundwater level monitoring

Groundwater level data was collected using in-situ level loggers from six sites GND2623, GND2624, GND2625, GND2627 GND2484 and GND3032. Loggers recorded at 15 minute intervals and were downloaded quarterly.

The location of all groundwater monitoring sites are displayed on Figure 1 and the details of each site included in the baseline monitoring programme are summarised below in Table 3.

Table 3 Groundwater monitoring site details

Site code	id.	Eastings	Northings	bore depth (m)	Screen depth (m)
GND2623	MW1	1697453	5667700	8.0	1.2-8
GND2624	MW2	1697688	5667583	6.0	1.2-6
GND2625	MW3	1697703	5667463	5.6	1.6-5.6
GND2484*	MW4	1697570	5667514	8.0	1.2-8
GND2627	MW5	1697587	5667689	12.0	0-12
GND3032	MW6	1697454	5667601	8.0	4-8

**Note GND2484 is referred to as GND2626 in the burial report referenced in the following sections*

2 Results

2.1 Inspections

No inspections were undertaken during the reported period.

A Council Officer visited the site on two occasions during the initial setup of the baseline monitoring programme. The first visit on 21 February 2017 was to review the site prior to commencement of the groundwater baseline monitoring programme. The second on 24 August 2017 was to confirm the locations for the baseline surface water monitoring programme. No issues were identified during either site visit.

2.2 Provision of consent holder data

Groundwater levels and ground and surface water quality were provided quarterly for review and as required by consent conditions, a Burial Plan and Report were submitted more than three months prior to the first burial. The data provided by NPDC is summarised below.

2.2.1.1 Burial planning report

The Burial Plan and Report were submitted and reviewed by the Council upon receipt. The report was required to outline how NPDC would meet compliance with condition 3 of Consent 7882-1.1. Which requires NPDC to adopt the best practicable option, to avoid or minimise any adverse effects on the environment.

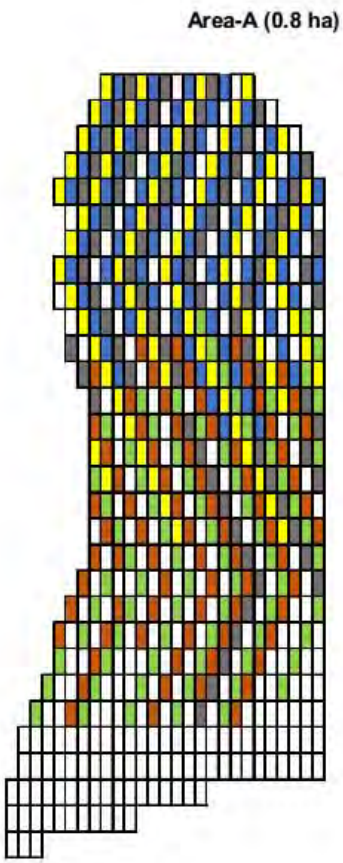
The Report included the Burial Plan for the first five years of internments. The Burial Plan was designed to enable the spreading of burials, in both time and location, in order to reduce point source loading of contaminants (Figure 2). The Report provided a map showing which areas were suitable for which type of burial to ensure that all burials will occur no deeper than 0.8 m above the seasonally high water table.

The Burial Plan established that for the first five years of operation only Area-A and Area-B would be utilised. The type of internment recommended for each area was determined using available groundwater level data and a 1 in 100 year high groundwater elevation scenario. The Burial Plan and Report are included as Appendix II.

2.3 Results of receiving environment baseline monitoring

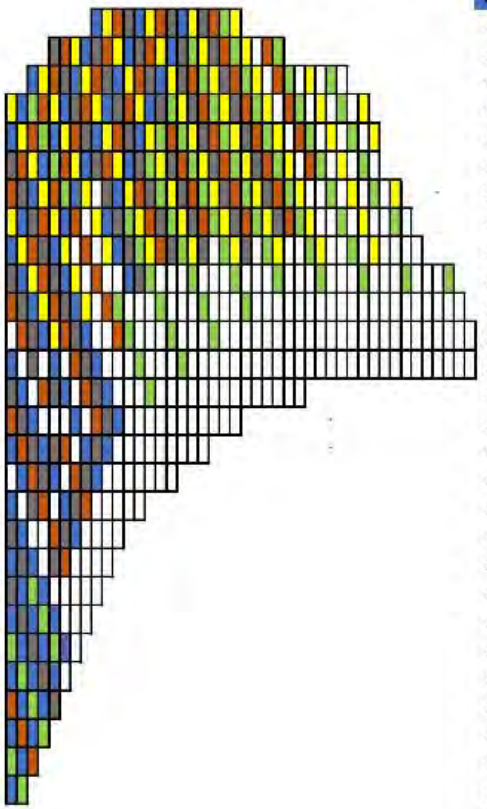
The baseline water quality monitoring programme commenced in February 2017 and was carried out for one year. Groundwater quality sampling was undertaken quarterly and surface water quality sampling was undertaken under high and low flow conditions. Groundwater level monitoring commenced in March 2017 and is ongoing.

The monitoring programme was designed to capture any seasonal changes in groundwater and surface water composition, and variation in groundwater levels, prior to commencement of activities. The following sections display and discuss the results.



Area-A (0.8 ha)

Number filled					Total available	Row number
Y1	Y2	Y3	Y4	Y5		
4	0	4	0	3	13	1
5	0	4	0	4	16	2
6	0	5	0	4	19	3
7	0	5	0	5	21	4
7	0	6	0	5	23	5
7	0	5	0	4	22	6
7	0	5	0	5	22	7
8	0	5	0	5	23	8
7	0	5	0	5	23	9
5	2	5	0	4	22	10
4	2	5	3	4	22	11
4	2	5	5	4	21	12
2	5	4	5	2	20	13
2	5	2	5	2	20	14
0	5	3	5	3	20	15
0	5	3	5	3	20	16
0	5	2	6	2	20	17
0	5	2	6	2	20	18
0	5	0	7	2	20	19
0	5	0	5	2	21	20
0	6	0	6	1	22	21
0	6	0	6	1	23	22
0	6	0	4	1	23	23
0	6	0	4	1	24	24
0	5	0	3	1	25	25
0	0	0	0	0	26	26
0	0	0	0	0	26	27
0	0	0	0	0	17	28
0	0	0	0	0	11	29
0	0	0	0	0	3	30
75	75	75	75	75	608	



Area-B (0.65 ha)

Number filled					Total available	Row number
Y1	Y2	Y3	Y4	Y5		
3	1	4	3	3	14	1
3	3	5	5	5	22	2
4	4	7	6	5	30	3
4	6	9	6	5	34	4
4	7	9	7	4	36	5
3	7	8	7	6	38	6
3	7	9	6	6	40	7
3	7	10	6	6	42	8
3	7	9	3	5	43	9
3	8	2	2	3	46	10
2	4	2	3	2	47	11
2	3	1	3	2	48	12
3	2	0	2	2	48	13
3	1	0	2	3	28	14
3	0	0	3	2	22	15
4	0	0	2	3	19	16
3	0	0	2	2	16	17
2	0	0	2	2	13	18
1	0	0	1	2	11	19
2	0	0	1	2	10	20
2	1	0	0	1	9	21
3	1	0	0	1	8	22
3	2	0	0	1	7	23
3	1	0	0	1	6	24
2	1	0	1	1	5	25
2	0	0	1	0	4	26
1	1	0	1	0	3	27
1	1	0	0	0	2	28
75	75	75	75	75	651	

Figure 2 Burial Plan for first five years of operation

2.3.1 Baseline surface water quality monitoring

Surface water samples were collected and analysed for an extensive suite of parameters during spring and summer flow conditions. Both sites, one upstream and one downstream, were located in the unnamed tributary of the Waiwhakaiho River that flows through the centre of the Cemetery site. The results of the baseline analysis carried out are set out below in Table 4.

Baseline results indicate no significant differences in water quality between the two sites. Some minor differences in some parameters can be seen between seasons. The summer samples exhibit higher total dissolved solids, carbonates and major cation and anions in both sites, when compared to the spring samples. The increases in these analytes are likely related to samples being made up of predominantly groundwater sourced baseflow during the drier summer months. In comparison during the spring when increases in nitrogen species can be seen, likely a consequence of rainfall runoff received in the tributary from the predominantly rural surroundings.

Table 4 Baseline surface water quality results

Parameter	Bore id	WKH000524 upstream		WKH000526 downstream	
Season	-	Spring	Summer	Spring	Summer
Sample date	Unit	05-Oct-17	31-Jan-18	05-Oct-17	31-Jan-18
Carbonate	g/m^3 CO_3	< 1.0	< 1.0	< 1.0	< 1.0
Bicarbonate	g/m^3 HCO_3	44	92	43	89
Total hardness	g/m^3 $CaCO_3$	43	74	43	73
Total alkalinity	g/m^3 $CaCO^3$	36	76	36	73
Total suspended solids	g/m^3	< 3	< 3	< 3	< 3
Total dissolved solids	g/m^3	95	146	108	153
Fluoride	g/m^3	< 0.05	< 0.05	< 0.05	< 0.05
Biological oxygen demand	g O_2/m^3	< 2	< 2	< 2	< 2
Total organic carbon	g/m^3	0.7	1.3	0.8	< 0.5
Escherichia coli	MPN / 100mL	> 200*	579	> 200*	140
Chemical oxygen demand	g O_2/m^3	< 6	< 6	< 6	< 6
Dissolved aluminium	g/m^3	0.009	0.028	0.006	0.005
Dissolved arsenic	g/m^3	< 0.0010	< 0.0010	< 0.0010	< 0.0010
Dissolved barium	g/m^3	0.028	0.024	0.027	0.021
Dissolved boron	g/m^3	0.013	0.009	0.012	0.01
Dissolved cadmium	g/m^3	< 0.00005	< 0.00005	< 0.00005	< 0.00005
Dissolved calcium	g/m^3	10.2	16	10.2	15.5
Dissolved chromium	g/m^3	< 0.0005	< 0.0005	0.0005	< 0.0005
Dissolved copper	g/m^3	< 0.0005	0.0007	< 0.0005	0.0008
Dissolved iron	g/m^3	0.65	0.58	0.36	0.34
Dissolved lead	g/m^3	< 0.00010	< 0.00010	< 0.00010	< 0.00010
Dissolved magnesium	g/m^3	4.3	8.2	4.4	8.3
Dissolved manganese	g/m^3	0.13	0.141	0.096	0.048
Dissolved mercury	g/m^3	< 0.00008	< 0.00008	< 0.00008	< 0.00008
Dissolved Nickel	g/m^3	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Dissolved potassium	g/m^3	2.9	3.5	2.9	3.7
Dissolved sodium	g/m^3	8.9	13.5	8.8	13.7
Dissolved zinc	g/m^3	0.0019	0.002	0.0015	< 0.0010

Parameter	Bore id	WKH000524 upstream		WKH000526 downstream	
Season	-	Spring	Summer	Spring	Summer
Sample date	Unit	05-Oct-17	31-Jan-18	05-Oct-17	31-Jan-18
Chloride	g/m^3	12.7	14.5	12.7	14.6
Ammoniacal nitrogen	g/m^3	0.057	0.04	0.037	< 0.010
Nitrite nitrogen	g/m^3 N	0.007	0.004	0.007	< 0.002
Nitrate & nitrite nitrogen	g/m^3 N	1.34	0.63	1.28	0.61
Total nitrogen	g/m^3	1.58	0.79	1.47	0.75
Nitrate nitrogen	g/m^3 N	1.33	0.63	1.27	0.61
Total kjeldahl nitrogen	g/m^3	0.24	0.17	0.19	0.14
Dissolved reactive phosphorus	g/m^3	< 0.004	0.005	< 0.004	0.011
Total phosphorus	g/m^3	0.016	0.029	0.013	0.022
Dissolved reactive silica	g/m^3 SiO_2	22	33	22	33
Sulphate	g/m^3	5.9	7.2	6	6.8
pH	pH	7.2	7.5	7.1	7.7
Electrical conductivity	mS/m	14	21.5	14	21.1
Formaldehyde	g/m^3	< 0.02	< 0.02	< 0.02	< 0.02

**Note results reported as >200 due to the lab method for clean water which has a top range of 200*

2.3.2 Baseline groundwater quality monitoring

Groundwater sampling was undertaken at quarterly intervals between February 2017 and November 2017 at five sites (GND2623, GND2624, GND2625, GND2484 and GND2627). Following installation of GND3032 in January 2019 an additional sample was also collected. Results are displayed in Table 5, Table 6 and Table 7.

Some minor variations in groundwater quality can be observed between bores. GND2624 and GND2625, which are the two shallowest bores, exhibit slightly higher electrical conductivity and ion concentrations than the other bores. The higher mineral concentrations indicate that the groundwater intercepted by these two bores may be older and more evolved. Results also point to a highly reducing environment at these two sites, which has led to a decrease in nitrates and an increase in iron and manganese concentrations.

The slight variations in analyte concentrations seen in each bore during the year are a result of seasonal fluctuations and sampling variability.

Table 5 Baseline groundwater quality results GND2623 and GND2624

Parameter	Bore id	GND2623				GND2624			
Sample date	Unit	27-Feb-17	26-May-17	28-Aug-17	16-Nov-17	27-Feb-17	26-May-17	28-Aug-17	16-Nov-17
Carbonate	g/m^3 CO_3	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Bicarbonate	g/m^3 HCO_3	47	52	47	59	102	124	119	107
Total hardness	g/m^3 $CaCO_3$	33	32	35	39	78	76	79	75
Total suspended solids	g/m^3	13	8	8	18	< 3	< 3	< 3	< 3
Total dissolved solids	g/m^3	100	86	89	106	163	166	167	161
Fluoride	g/m^3	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Total nitrogen	g/m^3	1.39	1.48	0.94	1.68	0.46	0.58	0.9	1.18
Nitrate nitrogen	g/m^3 N	1.32	1.45	0.91	1.62	0.007	0.019	< 0.002	0.6
Biological oxygen demand	g O_2/m^3	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2
Total organic carbon	g/m^3	0.9	< 0.5	< 0.5	< 1	< 0.5	0.9	1.5	< 1
Escherichia coli	MPN / 100mL	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
Chemical oxygen demand	g O_2/m^3	< 6	< 6	< 6	< 6	< 6	< 6	10	< 6
Dissolved aluminium	g/m^3	0.005	< 0.003	< 0.003	< 0.003	0.004	< 0.003	< 0.003	< 0.003
Dissolved arsenic	g/m^3	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010
Dissolved barium	g/m^3	0.0068	0.0077	0.0078	0.008	0.072	0.118	0.115	0.073
Dissolved boron	g/m^3	0.01	0.011	0.011	0.012	0.009	0.01	0.011	0.01
Dissolved cadmium	g/m^3	< 0.00005	< 0.00005	< 0.00005	< 0.00005	0.00011	0.0001	0.00012	0.0001
Dissolved calcium	g/m^3	8	7.7	8.4	9.6	17.8	17.5	17.5	16.9
Dissolved chromium	g/m^3	< 0.0005	< 0.0005	0.0005	0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Dissolved copper	g/m^3	< 0.0005	< 0.0005	0.001	0.0017	0.0011	0.0015	0.002	0.0014
Dissolved iron	g/m^3	< 0.02	< 0.02	< 0.02	< 0.02	0.1	2.8	1.69	0.07
Dissolved lead	g/m^3	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010
Dissolved magnesium	g/m^3	3.2	3.1	3.3	3.7	8.2	7.9	8.6	8.1
Dissolved manganese	g/m^3	0.001	0.0012	0.0014	0.0013	6.8	9.4	10.6	9.8
Dissolved mercury	g/m^3	< 0.00008	< 0.00008	< 0.00008	< 0.00008	< 0.00008	< 0.00008	< 0.00008	< 0.00008
Dissolved Nickel	g/m^3	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	0.0006
Dissolved potassium	g/m^3	1.34	1.53	1.53	1.63	3.4	4.1	4.9	3.8

Parameter	Bore id	GND2623				GND2624			
Sample date	Unit	27-Feb-17	26-May-17	28-Aug-17	16-Nov-17	27-Feb-17	26-May-17	28-Aug-17	16-Nov-17
Dissolved sodium	g/m^3	12.7	14.9	12.8	13.3	14.9	15.4	14.2	13.7
Dissolved zinc	g/m^3	0.0024	< 0.0010	< 0.0010	0.0018	0.007	0.0098	0.0073	0.0061
Chloride	g/m^3	9.2	8.7	8.9	8.6	19.9	16.9	21	22
Ammoniacal nitrogen	g/m^3	< 0.010	< 0.010	< 0.010	0.012	0.34	0.4	0.77	0.52
Nitrite nitrogen	g/m^3 N	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	0.018
Nitrate & nitrite nitrogen	g/m^3 N	1.32	1.45	0.91	1.62	0.008	0.019	< 0.002	0.62
Dissolved reactive phosphorus	g/m^3	0.012	0.01	0.008	0.011	< 0.004	< 0.004	< 0.004	< 0.004
Dissolved reactive silica	g/m^3 SiO_2	25	23	22	27	19	18.3	19.7	21
Sulphate	g/m^3	5	4.6	4.8	5.5	10.4	12.7	15.7	9.3
Total phosphorus	g/m^3	0.016	0.019	0.011	0.026	0.005	0.008	0.004	0.005
pH	pH	6.2	6.3	6.2	6.2	6.2	6	6.1	6.1
Electrical conductivity	mS/m	13	13.6	13.1	15.2	24.9	27.9	29.9	26.6
Total alkalinity	g/m^3 $CaCO^3$	39	43	39	48	84	102	98	88
Formaldehyde	g/m^3	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Total kjeldahl nitrogen	g/m^3	< 0.10	< 0.10	< 0.10	< 0.10	0.45	0.57	0.9	0.57

Table 6 Baseline groundwater quality results GND2625 and GND2484

Parameter	Bore id	GND2625				GND2484			
Sample date	Unit	27-Feb-17	26-May-17	28-Aug-17	16-Nov-17	27-Feb-17	26-May-17	28-Aug-17	16-Nov-17
Carbonate	g/m^3 CO_3	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Bicarbonate	g/m^3 HCO_3	73	88	98	92	36	39	36	39
Total hardness	g/m^3 $CaCO_3$	55	61	74	67	27	27	27	28
Total suspended solids	g/m^3	3	4	40	< 3	27	6	3	< 3
Total dissolved solids	g/m^3	111	120	129	133	85	69	81	79
Fluoride	g/m^3	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Total nitrogen	g/m^3	0.5	0.77	0.7	0.35	0.37	0.34	0.31	0.33
Nitrate nitrogen	g/m^3 N	< 0.002	< 0.002	< 0.002	< 0.002	0.34	0.29	0.29	0.28

Parameter	Bore id	GND2625				GND2484			
Sample date	Unit	27-Feb-17	26-May-17	28-Aug-17	16-Nov-17	27-Feb-17	26-May-17	28-Aug-17	16-Nov-17
Biological oxygen demand	g O_2/m^3	< 2	< 2	5	< 2	< 2	< 2	< 2	< 2
Total organic carbon	g/m^3	< 0.5	< 0.5	1.2	< 1	< 0.5	0.8	< 0.5	< 1
Escherichia coli	MPN / 100mL	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
Chemical oxygen demand	g O_2/m^3	< 6	< 6	10	< 6	< 6	< 6	< 6	< 6
Dissolved aluminium	g/m^3	< 0.003	< 0.003	< 0.003	< 0.003	0.013	< 0.003	0.004	< 0.003
Dissolved arsenic	g/m^3	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010
Dissolved barium	g/m^3	0.069	0.083	0.072	0.058	0.0061	0.0087	0.0079	0.009
Dissolved boron	g/m^3	0.013	0.014	0.016	0.012	0.008	0.009	0.008	0.009
Dissolved cadmium	g/m^3	0.00013	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005
Dissolved calcium	g/m^3	13.5	14.9	17.7	15.8	6.3	6.3	6.3	6.7
Dissolved chromium	g/m^3	< 0.0005	< 0.0005	< 0.0005	< 0.0005	0.0005	< 0.0005	0.0006	0.0005
Dissolved copper	g/m^3	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Dissolved iron	g/m^3	0.25	0.79	1.66	1.56	< 0.02	< 0.02	< 0.02	< 0.02
Dissolved lead	g/m^3	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010
Dissolved magnesium	g/m^3	5.3	5.7	7.3	6.8	2.7	2.7	2.8	2.8
Dissolved manganese	g/m^3	1.92	2.4	2.6	4.1	0.0012	0.0015	0.0022	0.0021
Dissolved mercury	g/m^3	< 0.00008	< 0.00008	< 0.00008	< 0.00008	< 0.00008	< 0.00008	< 0.00008	< 0.00008
Dissolved Nickel	g/m^3	< 0.0005	< 0.0005	< 0.0005	0.0006	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Dissolved potassium	g/m^3	4.1	4.6	4.4	4.2	1.13	1.25	1.18	1.22
Dissolved sodium	g/m^3	11	11.7	10.4	10.3	9.2	9.3	8.9	8.7
Dissolved zinc	g/m^3	0.007	0.0074	0.0045	0.0056	0.0033	0.0013	< 0.0010	0.0016
Chloride	g/m^3	13.4	11.7	9.9	12.6	8.1	7.1	7.6	7.5
Ammoniacal nitrogen	g/m^3	0.42	0.55	0.3	0.28	< 0.010	< 0.010	< 0.010	< 0.010
Nitrite nitrogen	g/m^3 N	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002
Nitrate & nitrite nitrogen	g/m^3 N	< 0.002	< 0.002	< 0.002	< 0.002	0.34	0.29	0.29	0.28
Dissolved reactive phosphorus	g/m^3	< 0.004	< 0.004	< 0.004	< 0.004	0.012	0.011	0.01	0.013
Dissolved reactive silica	g/m^3 SiO_2	21	22	22	22	25	24	25	26

Parameter	Bore id	GND2625				GND2484			
Sample date	Unit	27-Feb-17	26-May-17	28-Aug-17	16-Nov-17	27-Feb-17	26-May-17	28-Aug-17	16-Nov-17
Sulphate	g/m^3	9.8	9.6	6.3	12.1	6.3	6	5.7	6.1
Total phosphorus	g/m^3	0.006	0.018	0.055	0.005	0.019	0.029	0.012	0.013
pH	pH	6.2	6	6.3	6.2	6.3	6.4	6.2	6.2
Electrical conductivity	mS/m	18.7	20.4	21.1	21.7	10.4	10.3	10.4	10.5
Total alkalinity	g/m^3 $CaCO^3$	60	72	80	76	30	32	30	32
Formaldehyde	g/m^3	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Total kjeldahl nitrogen	g/m^3	0.5	0.77	0.7	0.35	< 0.10	< 0.10	< 0.10	< 0.10

Table 7 Baseline groundwater quality results GND2627 and GND3032

Parameter	Bore id	GND2627				GND3032
Sample date	Unit	27-Feb-17	26-May-17	28-Aug-17	16-Nov-17	31-Jan-19
Carbonate	g/m^3 CO_3	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Bicarbonate	g/m^3 HCO_3	46	37	37	40	134
Total hardness	g/m^3 $CaCO_3$	37	31	35	36	108
Total suspended solids	g/m^3	5	9	< 3	6	680
Total dissolved solids	g/m^3	112	79	91	103	200
Fluoride	g/m^3	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Total nitrogen	g/m^3	1.34	1.24	0.88	1.37	5.4
Nitrate nitrogen	g/m^3 N	1.3	1.22	0.79	1.3	5.1
Biological oxygen demand	g O_2/m^3	< 2	< 2	< 2	< 2	< 2
Total organic carbon	g/m^3	< 0.5	0.8	< 0.5	< 1	22
Escherichia coli	MPN / 100mL	< 1	< 1	< 1	< 1	< 1
Chemical oxygen demand	g O_2/m^3	< 6	< 6	< 6	< 6	< 6
Dissolved aluminium	g/m^3	< 0.003	0.042	< 0.003	< 0.003	0.006
Dissolved arsenic	g/m^3	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010
Dissolved barium	g/m^3	0.0092	0.0086	0.0088	0.0081	0.057
Dissolved boron	g/m^3	0.009	0.008	0.008	0.011	0.014

Parameter	Bore id	GND2627				GND3032
Sample date	Unit	27-Feb-17	26-May-17	28-Aug-17	16-Nov-17	31-Jan-19
Dissolved cadmium	g/m^3	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005
Dissolved calcium	g/m^3	6.6	5.5	5.7	6.3	31
Dissolved chromium	g/m^3	0.0006	< 0.0005	0.0008	0.0007	0.0022
Dissolved copper	g/m^3	< 0.0005	0.0012	0.0005	< 0.0005	0.0007
Dissolved iron	g/m^3	< 0.02	< 0.02	0.04	< 0.02	< 0.02
Dissolved lead	g/m^3	< 0.00010	0.00044	< 0.00010	< 0.00010	< 0.00010
Dissolved magnesium	g/m^3	5	4.3	4.9	4.9	7.7
Dissolved manganese	g/m^3	0.0015	0.0019	0.0035	0.001	0.085
Dissolved mercury	g/m^3	< 0.00008	< 0.00008	< 0.00008	< 0.00008	< 0.00008
Dissolved Nickel	g/m^3	< 0.0005	< 0.0005	< 0.0005	< 0.0005	0.0014
Dissolved potassium	g/m^3	0.76	0.67	0.66	0.84	1.83
Dissolved sodium	g/m^3	14.2	12.9	12.7	13.4	21
Dissolved zinc	g/m^3	0.0074	0.0012	0.003	0.0025	0.0079
Chloride	g/m^3	16.6	12.7	16	15	14.5
Ammoniacal nitrogen	g/m^3	< 0.010	< 0.010	< 0.010	< 0.010	0.016
Nitrite nitrogen	g/m^3 N	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002
Nitrate & nitrite nitrogen	g/m^3 N	1.3	1.22	0.79	1.3	5.1
Dissolved reactive phosphorus	g/m^3	0.005	< 0.004	0.005	0.005	< 0.004
Dissolved reactive silica	g/m^3 SiO_2	25	20	23	26	32
Sulphate	g/m^3	4.9	7.2	6.9	5.9	6.3
Total phosphorus	g/m^3	0.007	0.017	< 0.004	0.009	0.81
pH	pH	6.3	6.2	6.1	6.1	6.7
Electrical conductivity	mS/m	14.9	13	14	13.8	31.3
Total alkalinity	g/m^3 $CaCO^3$	38	31	30	33	110
Formaldehyde	g/m^3	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Total kjeldahl nitrogen	g/m^3	< 0.10	< 0.10	< 0.10	< 0.10	0.33

2.3.3 Baseline groundwater level monitoring

Groundwater level data was collected electronically at 15 minute intervals using in-situ level loggers. Data was downloaded quarterly.

A comparison with rainfall data collected in the nearby Waiwhakaiho at Egmont Village rainfall site is included as Figure 3. An assessment of the data confirms all groundwater levels respond to sustained periods of rainfall recharge.

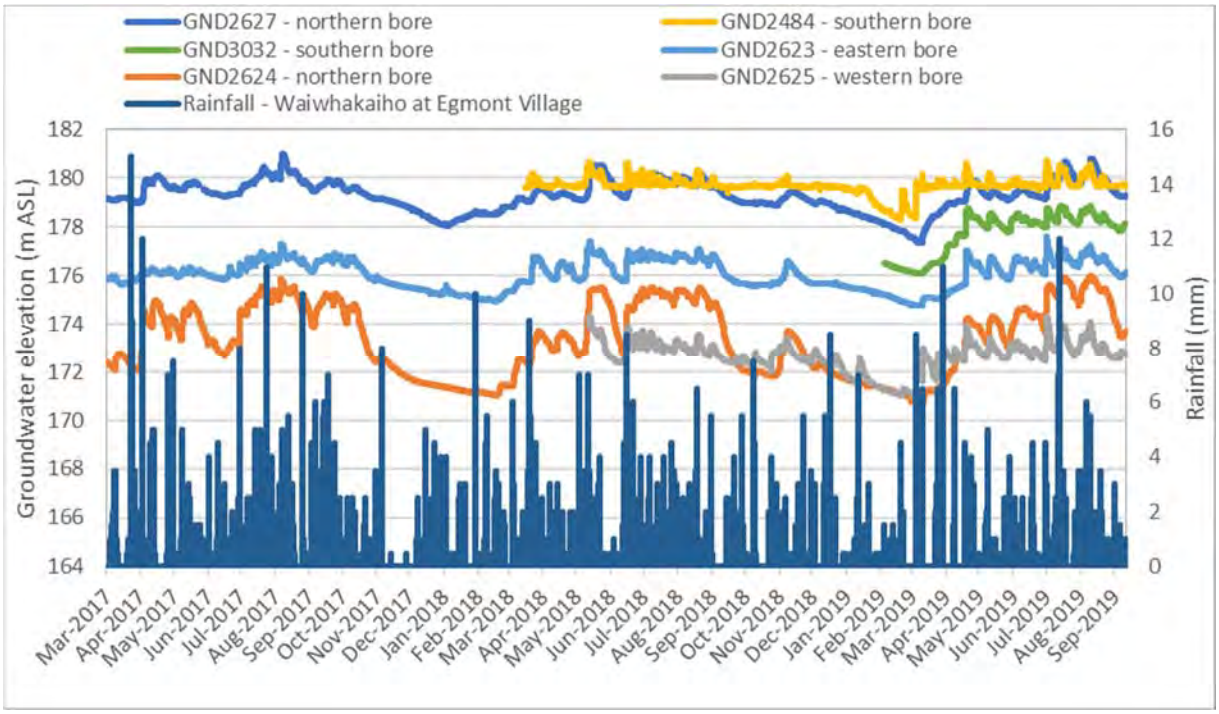


Figure 3 Baseline groundwater elevations in comparison to rainfall

A summary of the range of groundwater levels at the site and the minimum required depth to water for each type of internment are included in Table 8 below. The Table indicates that some areas are not suitable for some types of burials.

Table 8 Groundwater level range and burial type

Site code	Area	Conventional double burial	Conventional single burial	Natural grave	Water level range (m BMP)		Range	Continuous groundwater level data (15 min. interval)
		Minimum required depth to water (m BMP)			High	Low	(m)	Commenced
GND2627	north	2.8	2.0	1.8	1.44	5.11	3.67	4 Mar 2017
GND2624	north				0.20	5.44	5.24	4 Mar 2017
GND2625	east				0.98	4.33	3.35	14 May 2018
GND3032	south				2.83	5.65	2.82	7 Feb 2019
GND2484	south				2.72	5.18	2.46	19 Mar 2018
GND2623	west				2.49	5.35	2.86	4 Mar 2017

Groundwater level data is illustrated for all six monitored sites in Figure 3 to Figure 8 the minimum depth to water required for both conventional single burials (orange line) and natural burials (green line) have been added for reference.

An assessment of the data indicates that groundwater levels are high and fluctuate significantly in GND2624 and GND2627, ranging from <0.5 m BMP during the wetter months to >5 m BMP in the drier months (Figure 4 and Figure 5). GND2625 also exhibits high groundwater levels, fluctuating between <1 m BMP and >4 m BMP (Figure 6). Groundwater levels in GND2623, GND2484 and GND3032 are slightly more subdued and fluctuate to a lesser degree (Figure 7, Figure 8 and Figure 9). The greater fluctuations seen to the north and east may be a result of enhanced recharge, due to the close proximity of the forested hills to the north of the Cemetery.

Baseline groundwater level data indicates that Area-A and Area-B are not suitable for double plot stacked conventional burials which require internment to a minimum depth of 2 m BGL. Groundwater levels also indicate that the northern section and potentially the eastern section of Area-A are also not suitable for conventional single plot burials (1.2 m BGL) or natural graves (1 m BGL).

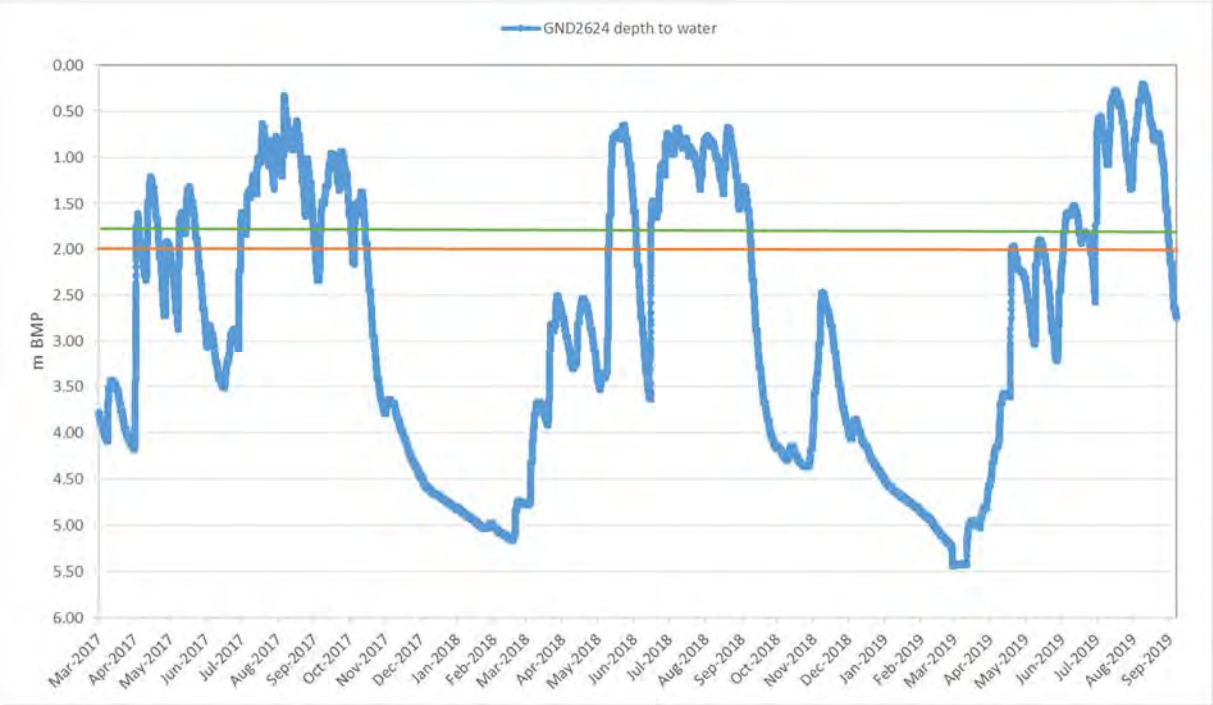


Figure 4 Baseline groundwater levels GND2624

Figure 5 Baseline groundwater levels GND2627

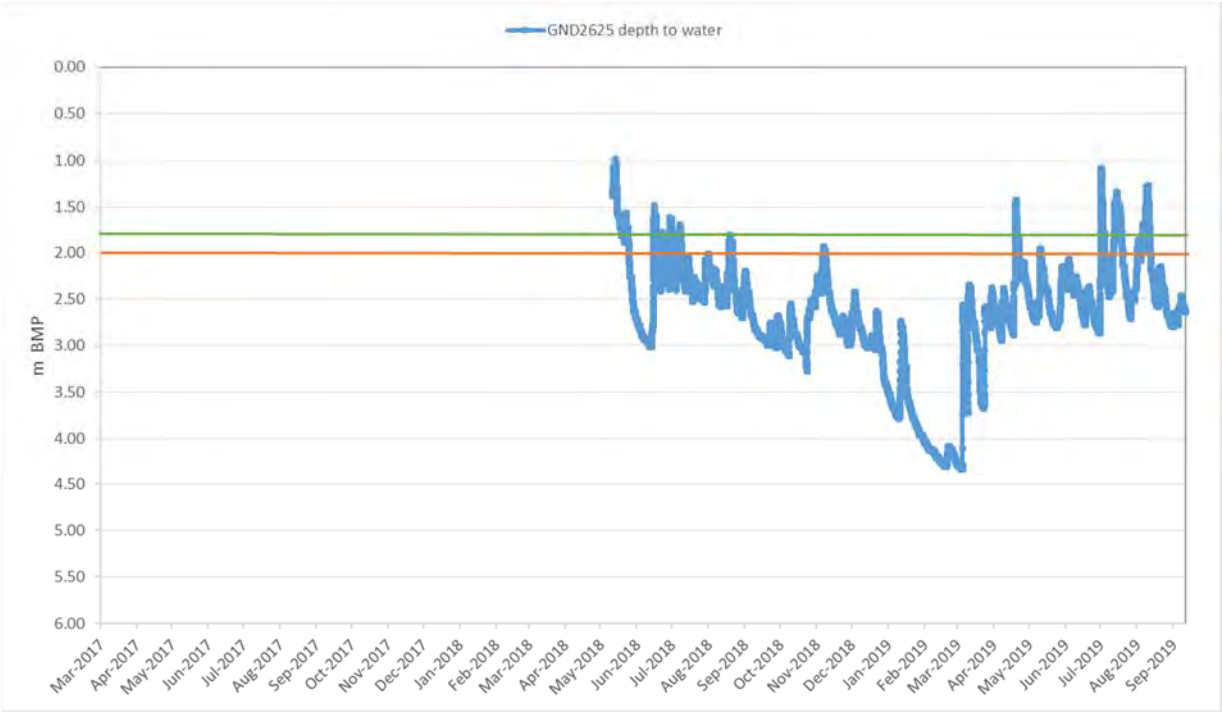


Figure 6 Baseline groundwater levels GND2625

Figure 7 Baseline groundwater levels GND2623

Figure 8 Baseline groundwater levels GND2484

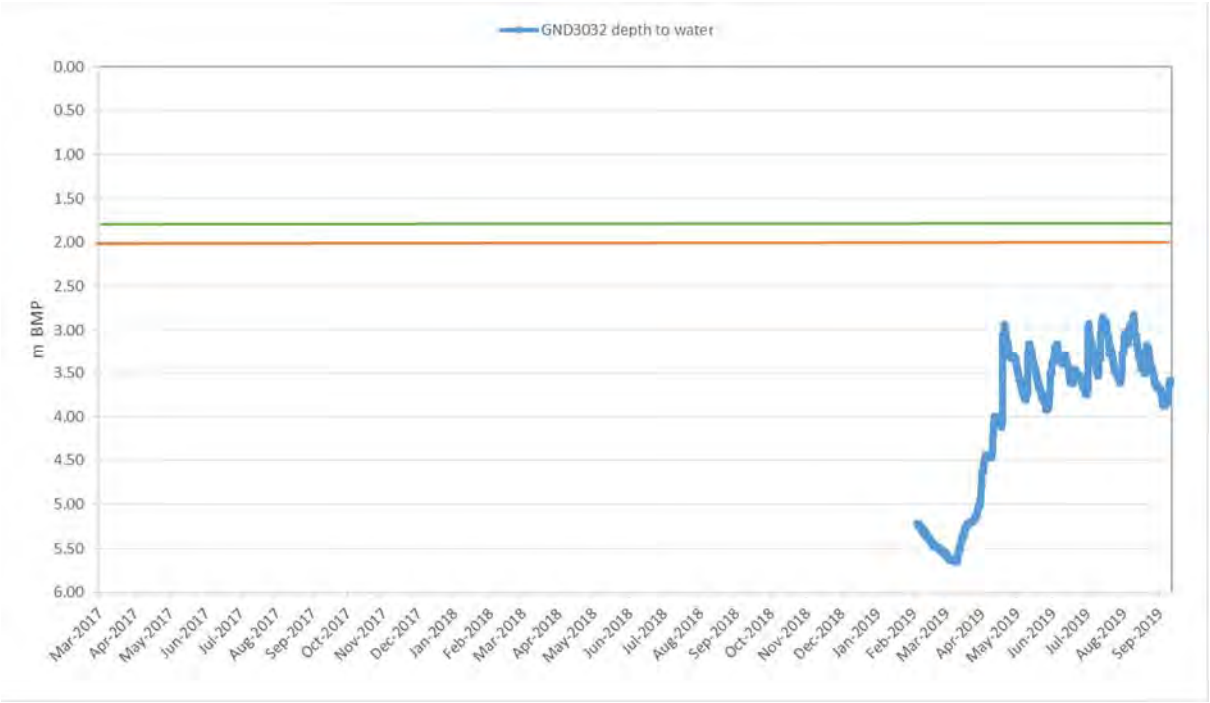


Figure 9 Baseline groundwater levels GND3032

2.4 Investigations, interventions and incidents

The monitoring programme for the year was based on what was considered to be an appropriate level of monitoring, review of data, and liaison with NPDC and or their representatives. During the year matters may arise which require additional activity by the Council, for example provision of advice and information, or investigation of potential or actual causes of non-compliance or failure to maintain good practices. A pro-active approach that in the first instance avoids issues occurring is favoured.

The Council operates and maintains a register of all complaints or reported and discovered excursions from acceptable limits and practices, including non-compliance with consents, which may damage the environment. The incident register includes events where NPDC concerned has itself notified the Council. The register contains details of any investigation and corrective action taken.

Complaints may be alleged to be associated with a particular site. If there is potentially an issue of legal liability, the Council must be able to prove by investigation that the identified company is indeed the source of the incident (or that the allegation cannot be proven).

In the 2018-2019 period, the Council was not required to undertake significant additional investigations and interventions, or record incidents, in association with the Company's conditions in resource consents or provisions in Regional Plans.

3 Discussion

3.1 Discussion of site performance

Visits to the site found it to be in good condition and being well managed. No complaints were received from the public in relation to the consent. The baseline monitoring programme was undertaken as required and data was provided to the Council for review as and when requested.

The groundwater and surface water baseline monitoring commenced in February 2017. The analytes sampled included a comprehensive suite of general water quality parameters and any contaminants related to the degradation of human remains. The monitoring programme also included the collection of groundwater level data from six bores. The data collected will allow for an in depth assessment of any variations in groundwater and surface water composition should the need arise in the future.

Surface water chemistry exhibited a distinct seasonal change. Groundwater composition in each bore remained relatively stable with only slight changes resulting from natural seasonal fluctuation and sampling variability. Groundwater composition differed slightly between bores due to depth and redox conditions.

An assessment of the groundwater level data concluded that groundwater levels fluctuate in response to rainfall and are slightly higher in the northern and eastern areas of the site close to the forested hills. The range of levels differs between bores with the greatest range (>5 m) seen in GND2624.

Groundwater levels indicated that Area-A and Area-B, the first areas available to the public, are both unsuitable for conventional double plots and that the northern and eastern areas of Area-A may also be unsuitable for conventional single and natural burials.

3.2 Environmental effects of exercise of consents

No internments occurred during the period being reported and no adverse environmental effects have been recorded by the Council in relation to development of the site.

Compliance with the conditions of NPDC's discharge consent during the review period is summarised below in Section 3.3.

3.3 Evaluation of performance

A tabular summary of the consent holder's compliance record for the year under review is set out in Table 9.

Table 9 Summary of performance for consent 7882-1.1

Purpose: ***To discharge contaminants into land at a cemetery in circumstances where they may enter water***		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
1. Burials to occur within designated areas	Review burial plan	Yes
2. Burials must occur more than 50 m from a surface water body	Review of burial plan	Yes
3. Best practicable option condition	Report and site inspections	Yes
4. Reporting provision	Receipt of report	Yes

Purpose: *To discharge contaminants into land at a cemetery in circumstances where they may enter water*		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
5. Provision of a report detailing how compliance with Condition 3 will be achieved	Receipt of report	Yes
6. Notification requirement	Receipt of notification	Yes
7. Lapse condition	Commencement of activity prior to lapse date	N/A
8. Optional review provision re environmental effects	Option not available. Next review date June 2020	N/A
Overall assessment of environmental performance in respect of this consent Overall assessment of administrative performance in respect of this consent		**High** **High**

During the year, NPDC demonstrated a high level of environmental and administrative performance with the resource consents as defined in Section 1.1.4.

3.4 Alterations to monitoring programmes for 2019-2020

In designing and implementing the monitoring programmes for air/water discharges in the region, the Council has taken into account:

- the extent of information already made available through monitoring or other means to date;
- its relevance under the RMA;
- the Council's obligations to monitor consented activities and their effects under the RMA;
- the record of administrative and environmental performances of the consent holder; and
- reporting to the regional community.

The Council also takes into account the scope of assessments required at the time of renewal of permits, and the need to maintain a sound understanding of industrial processes within Taranaki exercising resource consents.

It is proposed that for 2019-2020

1. THAT once internments begin the groundwater and surface water quality monitoring programme recommences; and
2. THAT groundwater level monitoring continues at 15 min intervals in all six bores.

It should be noted that the proposed programme represents a reasonable and risk-based level of monitoring for the site(s) in question. The Council reserves the right to subsequently adjust the programme from that initially prepared, should the need arise if potential or actual non-compliance is determined at any time during 2019-2020.

3.5 Exercise of optional review of consent

Resource consents 7882-1.1 provides for an optional review in June 2020. The review condition allows the Council to review the consent, for the purpose of ensuring that the conditions are adequate to deal with any adverse effects on the environment arising from the exercise of the resource consent, which were either not foreseen at the time the application was considered or which it was not appropriate to deal with at the time.

Based on the results of monitoring in the year under review, it is considered that there are no grounds that require a review to be pursued or grounds to exercise the review option on the consent.

4 Recommendations

1. THAT once internments begin the groundwater and surface water quality monitoring programme recommences; and
2. THAT groundwater level monitoring using in-situ electronic level loggers at 15 min intervals continues in all six bores.
3. THAT should there be issues with environmental or administrative performance in 2019-2020, monitoring may be adjusted to reflect any additional investigation or intervention as found necessary.
4. THAT the option for a review of resource consents in June 2020, as set out in the respective consent conditions not be exercised.

Glossary of common terms and abbreviations

The following abbreviations and terms may be used within this report:

Al*	Aluminium.
As*	Arsenic.
Biomonitoring	Assessing the health of the environment using aquatic organisms.
BOD	Biochemical oxygen demand. A measure of the presence of degradable organic matter, taking into account the biological conversion of ammonia to nitrate.
BODF	Biochemical oxygen demand of a filtered sample.
CBOD	Carbonaceous biochemical oxygen demand. A measure of the presence of degradable organic matter, excluding the biological conversion of ammonia to nitrate.
COD	Chemical oxygen demand. A measure of the oxygen required to oxidise all matter in a sample by chemical reaction.
Conductivity	Conductivity, an indication of the level of dissolved salts in a sample, usually measured at 25°C and expressed in µS/cm.
DO	Dissolved oxygen.
DRP	Dissolved reactive phosphorus.
E.coli	Escherichia coli, an indicator of the possible presence of faecal material and pathological micro-organisms. Usually expressed as colony forming units per 100 millilitre sample.
F	Fluoride.
FC	Faecal coliforms, an indicator of the possible presence of faecal material and pathological micro-organisms. Usually expressed as colony forming units per 100 millilitre sample.
g/m^3	Grams per cubic metre, and equivalent to milligrams per litre (mg/L). In water, this is also equivalent to parts per million (ppm), but the same does not apply to gaseous mixtures.
Incident	An event that is alleged or is found to have occurred that may have actual or potential environmental consequences or may involve non-compliance with a consent or rule in a regional plan. Registration of an incident by the Council does not automatically mean such an outcome had actually occurred.
Intervention	Action/s taken by Council to instruct or direct actions be taken to avoid or reduce the likelihood of an incident occurring.
Investigation	Action taken by Council to establish what were the circumstances/events surrounding an incident including any allegations of an incident.
Incident Register	The Incident Register contains a list of events recorded by the Council on the basis that they may have the potential or actual environmental consequences that may represent a breach of a consent or provision in a Regional Plan.
L/s	Litres per second.
m^3	Cubic Metres.
m BMP	Metres below measuring point
MPN	Most Probable Number. A method used to estimate the concentration of viable microorganisms in a sample.

mS/m	Millisiemens per metre.
µS/cm	Microsiemens per centimetre
NH_4	Ammonium, normally expressed in terms of the mass of nitrogen (N).
NH_3	Unionised ammonia, normally expressed in terms of the mass of nitrogen (N).
NNN	Nitrate and nitrate combined, expressed in terms of the mass of nitrogen (N).
NO_3	Nitrate, normally expressed in terms of the mass of nitrogen (N).
pH	A numerical system for measuring acidity in solutions, with 7 as neutral. Numbers lower than 7 are increasingly acidic and higher than 7 are increasingly alkaline. The scale is logarithmic i.e. a change of 1 represents a ten-fold change in strength. For example, a pH of 4 is ten times more acidic than a pH of 5.
Physicochemical	Measurement of both physical properties (e.g. temperature, clarity, density) and chemical determinants (e.g. metals and nutrients) to characterise the state of an environment.
Resource consent	Refer Section 87 of the RMA. Resource consents include land use consents (refer Sections 9 and 13 of the RMA), coastal permits (Sections 12, 14 and 15), water permits (Section 14) and discharge permits (Section 15).
Redox	Short for reduction-oxidation. A redox reaction is a chemical reaction that involves a transfer of electrons between two species. Groundwater can be reduced (low in oxygen) or oxidised (high in oxygen).
RMA	*Resource Management Act 1991* and including all subsequent amendments.
SS	Suspended solids.
Temp	Temperature, measured in °C (degrees Celsius).
Turb	Turbidity, expressed in NTU.
UI	Unauthorised Incident.
Zn*	Zinc.

*an abbreviation for a metal or other analyte may be followed by the letters 'As', to denote the amount of metal recoverable in acidic conditions. This is taken as indicating the total amount of metal that might be solubilised under extreme environmental conditions. The abbreviation may alternatively be followed by the letter 'D', denoting the amount of the metal present in dissolved form rather than in particulate or solid form.

For further information on analytical methods, contact a Science Services Manager.

Bibliography and references

Geosearch Limited 2018, Mangapouri Cemetery, pre-burial groundwater level and water quality assessment. 26 April 2018

Ministry of Health 2008, Drinking-Water Standards for New Zealand 2005 (Revised 2008) Wellington: Ministry of Health.

Scottish Environment Protection Agency (SEPA) 2015 Land Use Planning System SEPA Guidance Note, Guidance on assessing the impacts of Cemeteries on Groundwater - Version 3.

World Health Organisation 1998, The impacts of cemeteries om the environment and public health – An introductory briefing.

Environment Agency 2004, Assessing the groundwater pollution potential of cemetery developments.

Appendix I

Resource consent held by New Plymouth District Council

(For a copy of the signed resource consent
please contact the TRC Consents department)

Consent number	Purpose	Granted	Review	Expires or replaced
7882-1	To discharge contaminants into land at a cemetery in circumstances where they may enter water	09 Nov 2011	Not applicable	28 May 2018
7882-1.1	To discharge contaminants into land at a cemetery in circumstances where they may enter water	28 May 2018	June 2020	01 Jun 2046

Water abstraction permits

Section 14 of the RMA stipulates that no person may take, use, dam or divert any water, unless the activity is expressly allowed for by a resource consent or a rule in a regional plan, or it falls within some particular categories set out in Section 14. Permits authorising the abstraction of water are issued by the Council under Section 87(d) of the RMA.

Water discharge permits

Section 15(1)(a) of the RMA stipulates that no person may discharge any contaminant into water, unless the activity is expressly allowed for by a resource consent or a rule in a regional plan, or by national regulations. Permits authorising discharges to water are issued by the Council under Section 87(e) of the RMA.

Air discharge permits

Section 15(1)(c) of the RMA stipulates that no person may discharge any contaminant from any industrial or trade premises into air, unless the activity is expressly allowed for by a resource consent, a rule in a regional plan, or by national regulations. Permits authorising discharges to air are issued by the Council under Section 87(e) of the RMA.

Discharges of wastes to land

Sections 15(1)(b) and (d) of the RMA stipulate that no person may discharge any contaminant onto land if it may then enter water, or from any industrial or trade premises onto land under any circumstances, unless the activity is expressly allowed for by a resource consent, a rule in a regional plan, or by national regulations. Permits authorising the discharge of wastes to land are issued by the Council under Section 87(e) of the RMA.

Land use permits

Section 13(1)(a) of the RMA stipulates that no person may in relation to the bed of any lake or river use, erect, reconstruct, place, alter, extend, remove, or demolish any structure or part of any structure in, on, under, or over the bed, unless the activity is expressly allowed for by a resource consent, a rule in a regional plan, or by national regulations. Land use permits are issued by the Council under Section 87(a) of the RMA.

Coastal permits

Section 12(1)(b) of the RMA stipulates that no person may erect, reconstruct, place, alter, extend, remove, or demolish any structure that is fixed in, on, under, or over any foreshore or seabed, unless the activity is expressly allowed for by a resource consent, a rule in a regional plan, or by national regulations. Coastal permits are issued by the Council under Section 87(c) of the RMA.

Discharge Permit

Pursuant to the Resource Management Act 1991
a resource consent is hereby granted by the
Taranaki Regional Council

Name of Consent Holder:	New Plymouth District Council Private Bag 2025 New Plymouth 4342
Decision Date (Change):	28 May 2018
Commencement Date (Change):	28 May 2018 (Granted Date: 9 November 2011)

Conditions of Consent

Consent Granted:	To discharge contaminants into land at a cemetery in circumstances where they may enter water
Expiry Date:	1 June 2046
Review Date(s):	June 2020, June 2026, June 2032, June 2038
Site Location:	279 Junction Road, New Plymouth
Grid Reference (NZTM)	1697558E-5667612N
Catchment:	Waiwhakaiho

For General, Standard and Special conditions
pertaining to this consent please see reverse side of this document

General condition

a. The consent holder shall pay to the Taranaki Regional Council all the administration, monitoring and supervision costs of this consent, fixed in accordance with section 36 of the Resource Management Act 1991.

Special conditions

1. This consent authorises the discharge of contaminants to land associated with the burial of deceased persons at a cemetery. Subject to the other conditions of this consent, burials shall occur only in the areas identified as 'potential burial areas' on the plan titled 'Location of burial areas' attached to this document.

2. No burial shall occur within 50 metres of any surface water body.

3. The consent holder shall at all times adopt the best practicable option, as defined in section 2 of the Resource Management Act 1991, to prevent or minimise any actual or likely adverse effect on the environment associated with the discharge. The best practicable option includes, but is not limited to:

   a) ensuring graves are no deeper than 0.8 metres above the seasonally high watertable; and

   b) spreading the burials, in both time and location, to reduce point source loading of contaminants.

4. At least three months before the first burial, and at five-yearly intervals thereafter, the consent holder shall provide the Chief Executive, Taranaki Regional Council with a plan showing the specific areas where burials will occur.

5. The consent holder shall prepare a report that details how compliance with condition 3 will be achieved. The report shall be submitted for the approval of the Chief Executive, Taranaki Regional Council, acting in a certification capacity, at least three months before the first burial, and at five-yearly intervals thereafter.

6. The consent holder shall notify the Chief Executive, Taranaki Regional Council, in writing of the date that the cemetery will become operative, at least 1 month before. Notification shall include the consent number and a brief description of the activity consented and shall be emailed to worknotification@trc.govt.nz.

7. This consent shall lapse on 31 December 2021, unless the consent is given effect to before the end of that period or the Taranaki Regional Council fixes a longer period pursuant to section 125(1)(b) of the Resource Management Act 1991.

8. In accordance with section 128 and section 129 of the Resource Management Act 1991, the Taranaki Regional Council may serve notice of its intention to review, amend, delete or add to the conditions of this resource consent by giving notice of review during the month of June 2014 and/or June 2020 and/or 2026 and/or June 2032 and/or June 2038 and for the purpose of ensuring that the conditions are adequate to deal with any adverse effects on the environment arising from the exercise of this resource consent, which were either not foreseen at the time the application was considered or which it was not appropriate to deal with at the time.

Signed at Stratford on 28 May 2018

For and on behalf of
Taranaki Regional Council

_____

A D McLay
Director - Resource Management

Discharge Permit

Pursuant to the Resource Management Act 1991
a resource consent is hereby granted by the
Taranaki Regional Council

Name of Consent Holder:	New Plymouth District Council Private Bag 2025 NEW PLYMOUTH 4342
Decision Date:	9 November 2011
Commencement Date:	9 November 2011

Conditions of Consent

Consent Granted:	To discharge contaminants into land at a cemetery in circumstances where they may enter water at or about (NZTM) 1697558E-5667612N
Expiry Date:	1 June 2046
Review Date(s):	June 2014, June 2020, June 2026, June 2032, June 2038
Site Location:	279 Junction Road, New Plymouth
Legal Description:	Secs 21-22 SO 323897 Pt Secs 53, 55 & 161 Hua & Waiwhakaiho Hun Blk X Paritutu SD & BLK III Egmont SD & Sec 36 SO 323897 [general location of site]
Catchment:	Waiwhakaiho

For General, Standard and Special conditions
pertaining to this consent please see reverse side of this document

General condition

a. The consent holder shall pay to the Taranaki Regional Council all the administration, monitoring and supervision costs of this consent, fixed in accordance to section 36 of the Resource Management Act.

Special conditions

1. This consent authorises the discharge of contaminants to land associated with the burial of deceased persons at a cemetery. Subject to the other conditions of this consent, burials shall occur only in the areas identified as 'potential burial areas' on the plan titled 'Location of burial areas' attached to this document.

2. No burial shall occur within 50 metres of any surface water body.

3. The consent holder shall at all times adopt the best practicable option, as defined in section 2 of the Resource Management Act 1991, to prevent or minimise any actual or likely adverse effect on the environment associated with the discharge. The best practicable option includes, but is not limited to:

    a) ensuring graves are no deeper than 0.8 metres above the seasonally high watertable; and

    b) spreading the burials, in both time and location, to reduce point source loading of contaminants.

4. At least three months before the first burial, and at five-yearly intervals thereafter, the consent holder shall provide the Chief Executive, Taranaki Regional Council with a plan showing the specific areas where burials will occur.

5. The consent holder shall prepare a report that details how compliance with condition 3 will be achieved. The report shall be submitted for the approval of the Chief Executive, Taranaki Regional Council, acting in a certification capacity, at least three months before the first burial, and at five-yearly intervals thereafter.

6. The consent holder shall notify the Chief Executive, Taranaki Regional Council, in writing of the date that the cemetery will become operative, at least 1 month before. Notification shall include the consent number and a brief description of the activity consented and shall be emailed to worknotification@trc.govt.nz.

7. This consent shall lapse on 31 December 2018, unless the consent is given effect to before the end of that period or the Taranaki Regional Council fixes a longer period pursuant to section 125(1)(b) of the Resource Management Act 1991.

8. In accordance with section 128 and section 129 of the Resource Management Act 1991, the Taranaki Regional Council may serve notice of its intention to review, amend, delete or add to the conditions of this resource consent by giving notice of review during the month of June 2014 and/or June 2020 and/or 2026 and/or June 2032 and/or June 2038 and for the purpose of ensuring that the conditions are adequate to deal with any adverse effects on the environment arising from the exercise of this resource consent, which were either not foreseen at the time the application was considered or which it was not appropriate to deal with at the time.

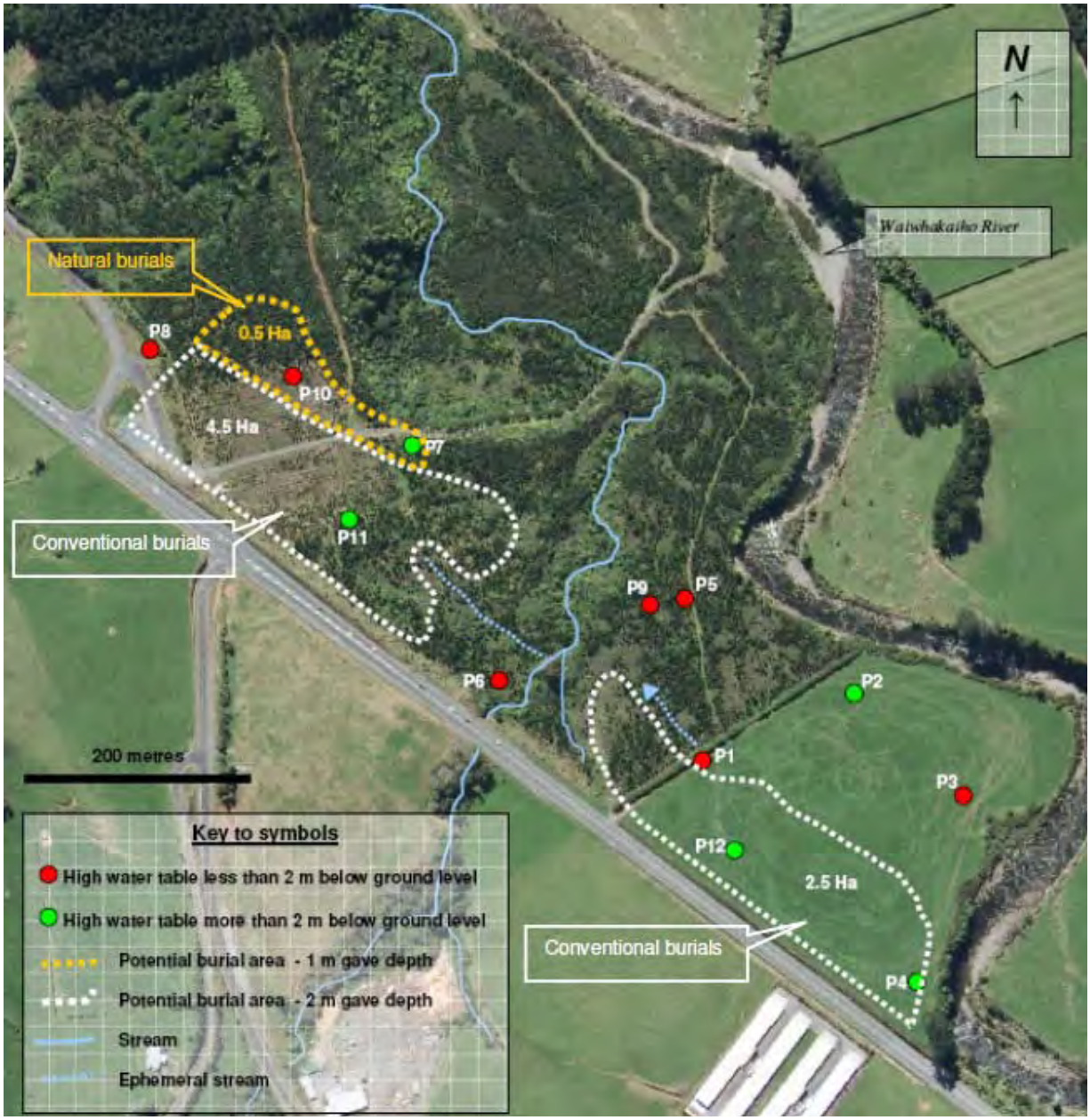
Signed at Stratford on 9 November 2011

For and on behalf of
Taranaki Regional Council

_____

Director-Resource Management

Location of burial areas



Appendix II

Mangapouri Cemetery
Burial Plan and Report

GEOSEARCH

- report

Mangapouri Cemetery, pre-burial groundwater level and water quality assessment

Prepared for New Plymouth District Council
By Karl Browne BSc, MSc
Geosearch Limited

26 April 2018

Revision history

Revision Nº	Prepared by	Description	Date
0	Karl Browne	Draft	15 February 2018
1	Karl Browne	Final	26 April 2018

Table of contents

Figures

Table of contents cont. **Page**

Photographs

Tables

Graphs

1. Introduction

New Plymouth District Council operates the newly established Mangapouri Cemetery, 7-km south-east of New Plymouth off SH3. The cemetery site covers a total area of 7.5 ha and comprises four discrete burial areas A to D (Figure 1). Area A and B will be the first two stages to open, while Area C and D will be opened in the future as demand dictates. At the date of this report no burials had taken place.

1.1 Purpose and scope of report

This report defines the location of the proposed burial areas within the cemetery site and presents the results and conclusions of pre-burial groundwater level and water quality monitoring to demonstrate compliance with resource consent conditions to discharge contaminants into land from a cemetery where they may enter water. The report includes the following information:

- A plan showing where burials will occur and how they will be spread in time and space;
- Verification that burial area A and B are more than 50 m away from and the nearest surface water body, the Mangapouri Stream;
- Contour plans for the 2017 seasonal groundwater level high and predicted 1:50-year and 1:100-year high levels with discussion on how groundwater levels will determine the type and depth of burial at the site;
- Baseline surface and ground water quality sampling results.

1.2 Previous work

Table 1 lists reports on previous work undertaken at the cemetery.

Table 1 Previous investigations

Report date	Author	Report title
Dec-07	Geosearch	Cemetery groundwater investigation phase I.
Feb-08	Geosearch	Cemetery groundwater investigation phase II.
Sep-08	Geosearch	Cemetery groundwater investigation phase III.
Feb-09	Geosearch	Groundwater levels at proposed cemetery.
Jan-14	Pattle Delamore & Partners	Groundwater investigation of proposed cemetery site (peer review).
Mar-17	GPR Geophysical Services & Taylor Patrick Surveyors	Geophysical & excavation investigation Mangapouri Cemetery.

2. Resource consent

NPDC holds consent 7882-1 "*to discharge contaminants into land at a cemetery in circumstances where they may enter water*". Consent conditions require the consent holder to prevent or minimize effects from the discharge, and prior to the first burial, provide a report that details how this will be achieved. Four conditions have specific requirements that aim to prevent or minimize effects:

Condition 2. "*No burial shall occur within 50 m of any surface water body*".

Condition 3. "*The consent holder shall adopt the best practicable option, as defined in Section 2 of the resource Management Act 1991, to prevent or minimise any actual or likely adverse effects on the environment associated with the discharge, including:*

a) Ensuring graves are no deeper than 0.8 m above the seasonally high water table; and
b) *Spreading burials in time and space to reduce point source loading of contaminants*".

Condition 4. "*At least three months before the first burial, and at five-yearly intervals thereafter, the consent holder shall provide the Chief Executive, Taranaki Regional Council, with a plan showing the specific areas where burials will occur.*

Condition 5. "*The consent holder shall prepare a report that details how compliance with condition 3 will be achieved. The report shall be submitted for the approval the Chief Executive, Taranaki Regional Council, acting in a certification capacity, at least three months before the first burial, and at five-yearly intervals thereafter*".

3. Burial type and depth

The cemetery will cater for both conventional and natural burials. Ashes will also be interred but these are chemically inert and of no concern here. Conventional burials will be either single or double plots dug to 1.2 m or 1.8 m standard depth, with the relative proportions depending on demand. Natural graves will be dug to 1 m depth.

Condition 3(a) of consent 7882-1 requires graves to be no deeper than 0.8 m above the seasonally high water table. Table 2 shows the highest groundwater level allowed under the consent below each grave type. As the water table is shallow under parts of the site, groundwater levels will largely dictate what type of burial can occur where. Ashes will be placed in burial areas where groundwater levels are too high for conventional or natural burials.

Table 2 Burial type and depth

Burial type	Plot type	Grave depth m	*Highest groundwater level below grave mBGL
Conventional	Double plot (stacked)	1.8	2.6
	Single plot	1.2	2.0
Natural	Single plot	1.0	1.8

*ref. condition 3(a) consent 7882.1

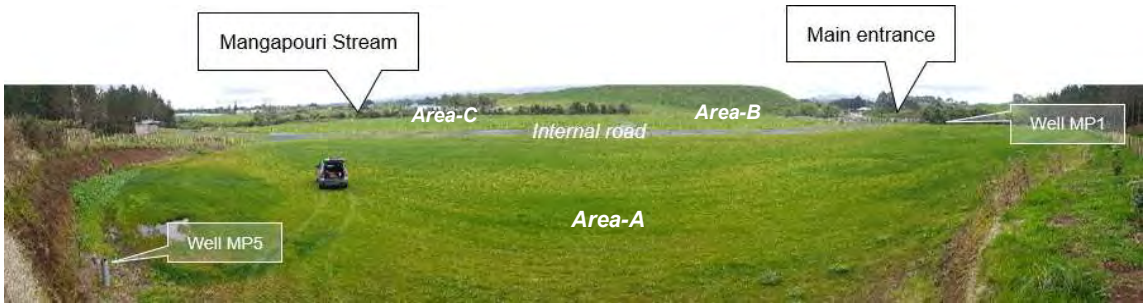
4. Burial area A and B

Figure 1 is an aerial photograph showing the layout of the burial areas in the northern part of the cemetery. The photo was taken in the 2017 summer. A surveyor's topographic plan showing the final as-built layout for Area-A is given in Appendix I. No surveyor's plan was available for Area-B at the date of this report.

Area A and B are bounded to the west by Plantation Rd and the main cemetery entrance, to the south by the Mangapouri Stream, and to the north and east by forested hills. The area is characterised by a broad, gently undulating, land surface with minimal topographic relief (Photos 1 & 2). The area is underlain by low-permeability volcanic ash and tephra (Geosearch 2008). The Mangapouri Stream runs through the cemetery site well to the south and east of Area-B (Figure 1).

Distance of burial areas to nearest surface water

The Mangapouri Stream is the nearest surface water body to Area-A and at its closest point is approximately 90 m down gradient (Figure 1).



Photograph 1 Panorama looking south-west over Area-A in foreground with Area-B beyond (Geosearch,13 October 2017)

Photograph 2 Panorama looking south over Area-B in foreground with Area-C beyond (Geosearch,14 April 2018)

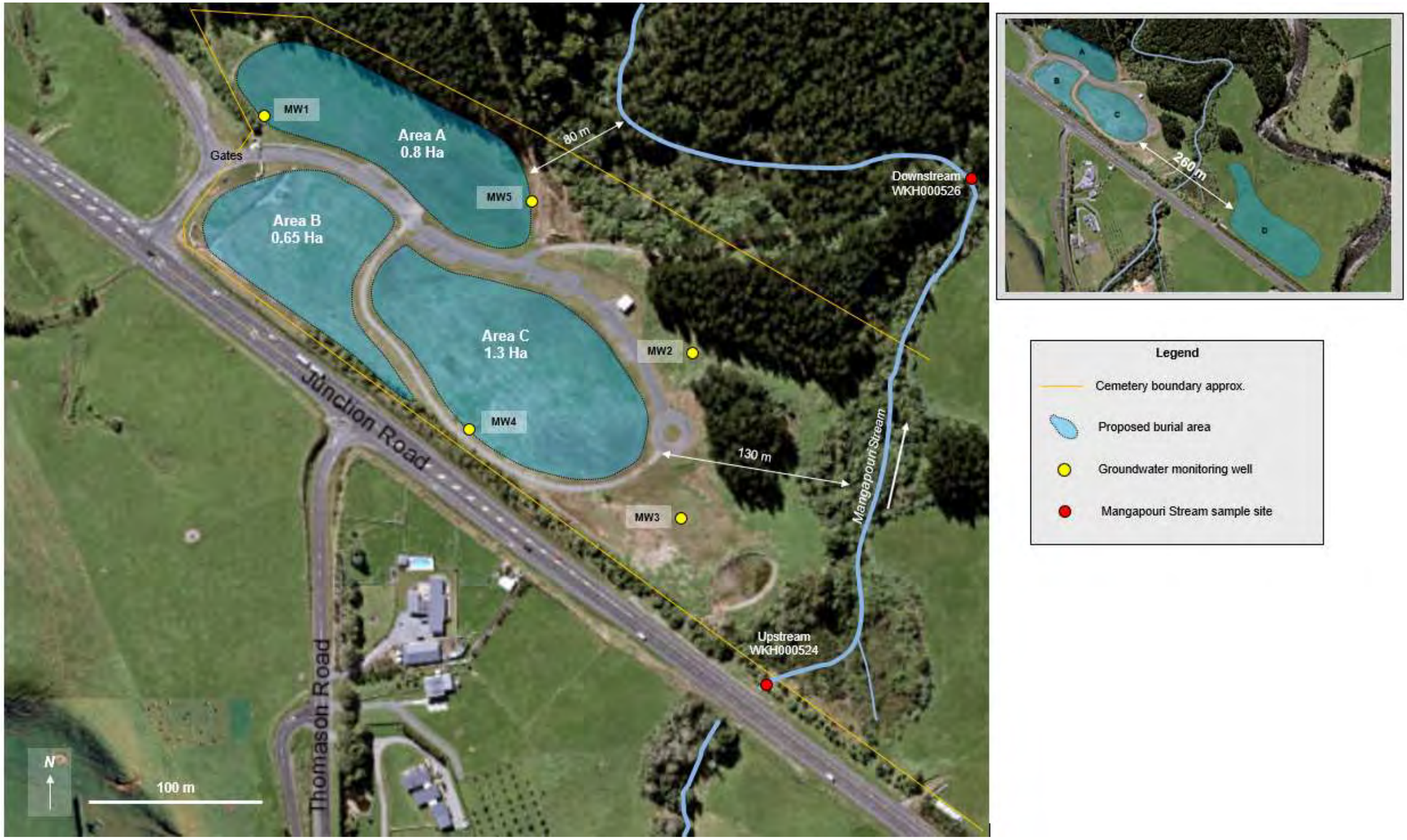


Figure 1 Mangapouri Cemetery and location of burial areas A to C *(Base photo NPDC Map Viewer. Photo summer 2017)*

5. Groundwater monitoring programme

Monitoring wells

During 2017 groundwater levels and water quality were monitored in five 50-mm diameter wells located in the northern part of the cemetery (Figure 1 and Table 3). The wells were installed in 2013 to replace those used in the 2008 monitoring lost during site development.

Table 3 Monitoring well details

Well	Location	Total depth m	Screen depth (m)	
			from	to
MW1	Down gradient	8	1.2	8
MW2	Well down gradient	6	1.2	6
MW3	Well down gradient	5.6	1.6	5.6
MW4	Up gradient	8	1.2	8
MW5	Up gradient	12	0	12

Groundwater levels

Water levels were measured manually in all wells at monthly intervals and electronically at 15-minute intervals in four wells using pressure-transducer dataloggers. Table 4 sets out the monitoring matrix. Results are given in Section 6.

Table 4 Groundwater level monitoring matrix

	MW1	MW2	MW3	MW4	MW5	Monitoring frequency	Data record	
							from	to
Manual gauging	√	√	√	√	√	Monthly	27 Feb-17	23 Jan-18
Datalogging	√	√	x	x	√	15-minute	4 Mar-17	23 Jan-18
	√	√	x	√	√		19 Mar-18	

Water quality

In 2017 prior to the commencement of burials, baseline water quality samples were collected from sites around the northern cemetery area for laboratory analysis (Figure 1). Table 5 records the type and frequency of sampling. Results are given in Section 8.

Table 5 Water sampling matrix

Sample type	Site name (TRC reference)	Sample date	Representative season	Hill Labs results report number
Groundwater	MW1 to MW5 (GND2623 to GND2627)	27-Feb-17	Summer	1730934
		26-May-17	Autumn	1782682
		28-Aug-17	Winter	1833101
		16-Nov-17	Spring	1878872
Surface water	WKH000524 Mangapouri upstream	5 Oct-17	Wet	1855903
	WKH000526 Mangapouri downstream	31 Jan-18	Dry	1917537

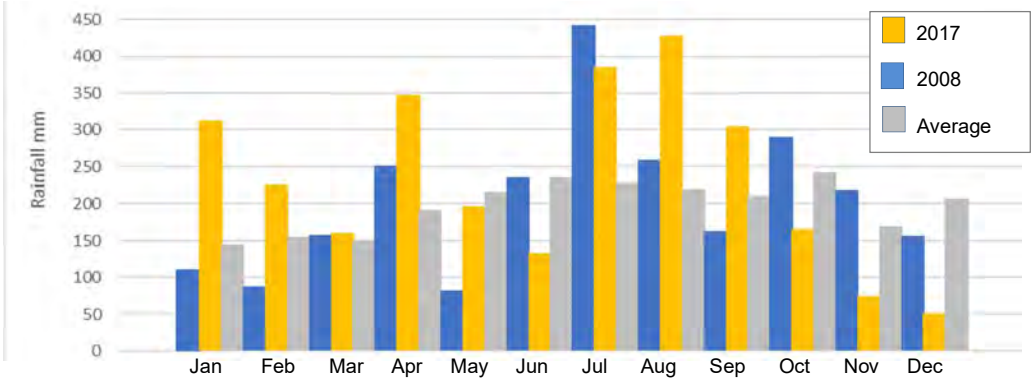
6. Groundwater monitoring results

6.1 Rainfall

Groundwater under the site is directly recharged by rainfall infiltration. Rainfall records for TRC's Egmont Village site were obtained for the 2017 monitoring period and presented in Table 6 and Graph 1 below. Figures are also given for 2008 when the previous groundwater level monitoring was carried out (Geosearch 2009).

Table 6 Monthly rainfall totals for 2008 and 2017 at Egmont Village (TRC)

Rainfall mm	2008	2017	Average
Jan	110	312.5	144.7
Feb	87.5	225	155.1
Mar	158	160	149.6
Apr	251	348	191.4
May	82.5	197	216.8
Jun	235.5	133	235.2
Jul	442.5	385.5	228.3
Aug	259	427.5	219.6
Sep	162.5	305	211.5
Oct	290.5	165	242.7
Nov	218.5	75	169.1
Dec	156.5	51	207.1
Total	**2,454**	**2,784.5**	**2,371.1**



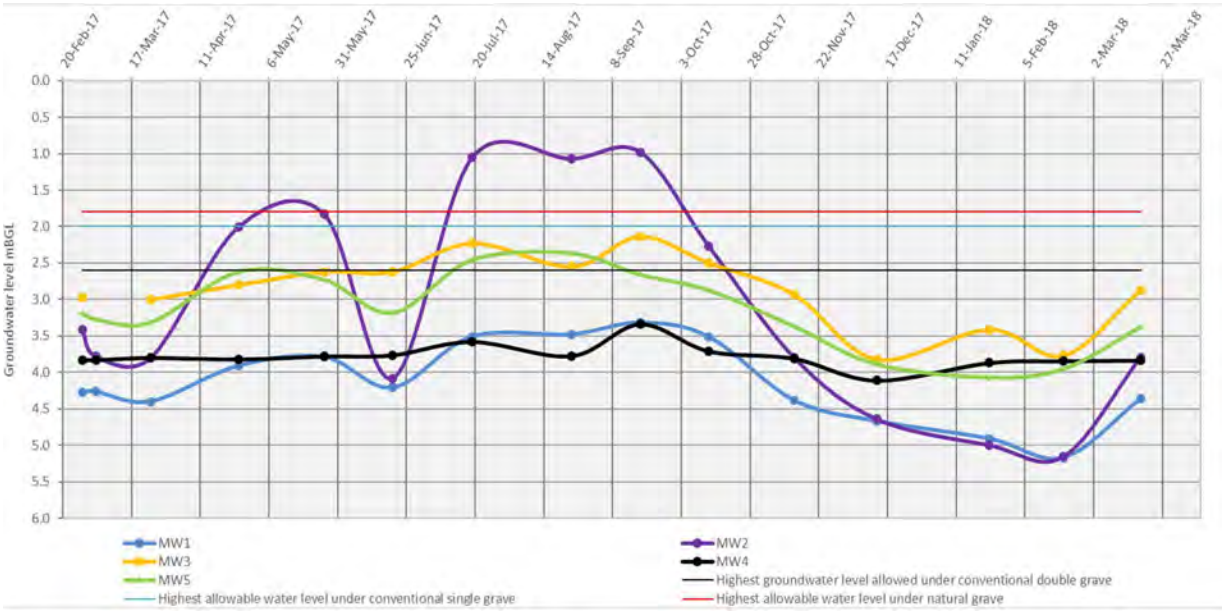
Graph 1 Monthly rainfall totals for 2008 and 2017 at Egmont Village (TRC)

6.2 Groundwater levels

Graph 2 plots groundwater levels measured monthly in the wells during 2017. Seasonal fluctuations occurred in all wells with a high in mid-winter to early spring and a low in summer-early-autumn. The three horizontal lines mark the highest groundwater level allowed under the consent (7882-1) below natural, single and double plot conventional graves (Table 2).

The water level fluctuated over a much larger range in some wells than others, suggesting aquifer recharge and discharge are not uniform across the site. Table 7 summarises the water level data.

Groundwater levels at the site are not influenced by tides or changes river level. We are satisfied the aquifer in the immediate area of the cemetery was not influenced by pumping during the monitoring period and for all practical purposes the water levels recorded were representative of natural conditions. It was therefore assumed that rises in groundwater levels were wholly due to recharge arriving at the water table and falls due to natural discharges.



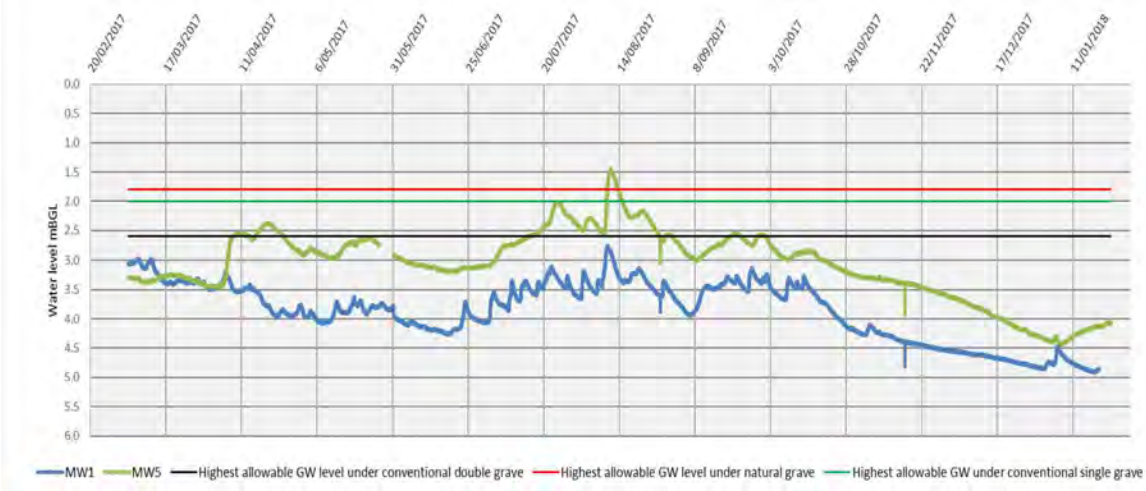
Graph 2 2017 groundwater levels under area A and B to Mangapouri Stream

Table 7 2017 groundwater levels

Level	MW1	MW2	MW3	MW4	MW5
Min mBGL	2.77	0.22	2.14	3.34	1.45
Max mBGL	4.90	4.84	3.82	4.11	4.43
Mean mBGL	3.86	2.62	2.78	3.77	3.08
Range m	2.13	4.62	1.68	0.77	2.98

Datalogger results

The loggers gave considerably more detail in the data and recorded a greater range than the manual measurements did for the same well. Graph 3 plots 2017 levels under Area-A recorded by the loggers.



Graph 3 2017 groundwater levels under Area-A

Graphs 2 and 3 show groundwater levels in 2017 rose above consented limits in MW2, MW3 and MW5, with the latter well at the east end of Area-A.

6.2.1 Groundwater level contour plans

Figures 2 to 4 are contour plans of the site showing the relationship between the burial areas and the groundwater high level surface. Plans are given for 2017 and estimated 50-year and 100-year high levels. The 100-year high was used in this report to assess compliance with consent 7882-1 over time, particularly with respect to consent condition 3(a).

The plans define what type of burial should occur where to maintain at least the minimum separation distance from groundwater and comply with the consent. Table 8 specifies groundwater depth ranges that accommodate the various burial types.

Table 8 Groundwater high and burial suitability

Zone	High groundwater level mBGL	Suitable for
1	>2.6	Double plot conventional graves to 1.8 m. Single plot conventional graves to 1.2 m. Natural graves to 1 m.
2	1.8-2.6	Single plot conventional graves to 1.2 m. Natural graves to 1 m.
3	>1.8	No burials.

2017 groundwater level

Figure 2 is a contour plan of 2017 groundwater levels under the burial areas. Levels were such that only half of Area-A (0.4 ha) would have been suitable for all burial types, while slightly less than half the area would have suited only natural burials to 1 m depth. All of Area-B (0.65 ha) would have suited all burial types.

Extreme groundwater levels

Figures 3 and 4 are contour plans of predicted 50-year and 100-year high groundwater levels under the burial areas, based on the rainfall totals in Table 9. Levels were estimated by multiplying the aquifer response to rainfall by the extreme monthly rainfall totals. Monthly rainfall totals were preferred over a shorter time frame as these will have more influence on groundwater levels.

Table 9 Monthly rainfall total ARI's Egmont Village

Event	Rainfall total in 1-2 month period (mm)
2017 actual	813 (7.1-yr ARI)
50-yr ARI	1,064
100-yr ARI	1,130

Plotting the burial areas on the contour plans produces three groundwater level zones. Zone 1 *(> 2.6 mBGL)* will suit burials to 1.8 m. Zone 2 *(1.8-2.6 mBGL)* will suit natural burials to 1 m, and conventional burials to 1.2 m depth above the 2 m contour. Zone 3 *(<1.8 mBGL)* is not suitable for burials.

Table 10 gives the area available for the three burial types in each zone under three groundwater level scenarios. The table shows for 2017, that burial area A & B would have provided a total of 1.05 ha suitable for full depth burials to 1.8 m. This area would reduce to 0.45 ha in a 50-year and 0.05 ha in a 100-year groundwater level high.

Table 10 Area available for burials

Area	Zone	Area ha		
		2017 high	50-yr high	100-yr high
A 0.8 ha	A1	0.4	0	0
	A2	0.3	0.5	0.6
	A3	0.1	0.3	0.2
B 0.65 ha	B1	0.65	0.45	0.05
	B2	0	0.2	0.6
	B3	0	0	0
C 1.3 ha	C1	0.6	0.4	0.1
	C2	0.6	0.7	0.9
	C3	0.1	0.25	0.95

No allowance was made in the predictions for climate change. A 10 % increase in the figures in Table 9 would make a 50-year a 100-year event. In any event, rainfall totals above those in Table 9 would raise groundwater levels and restrict burials further.

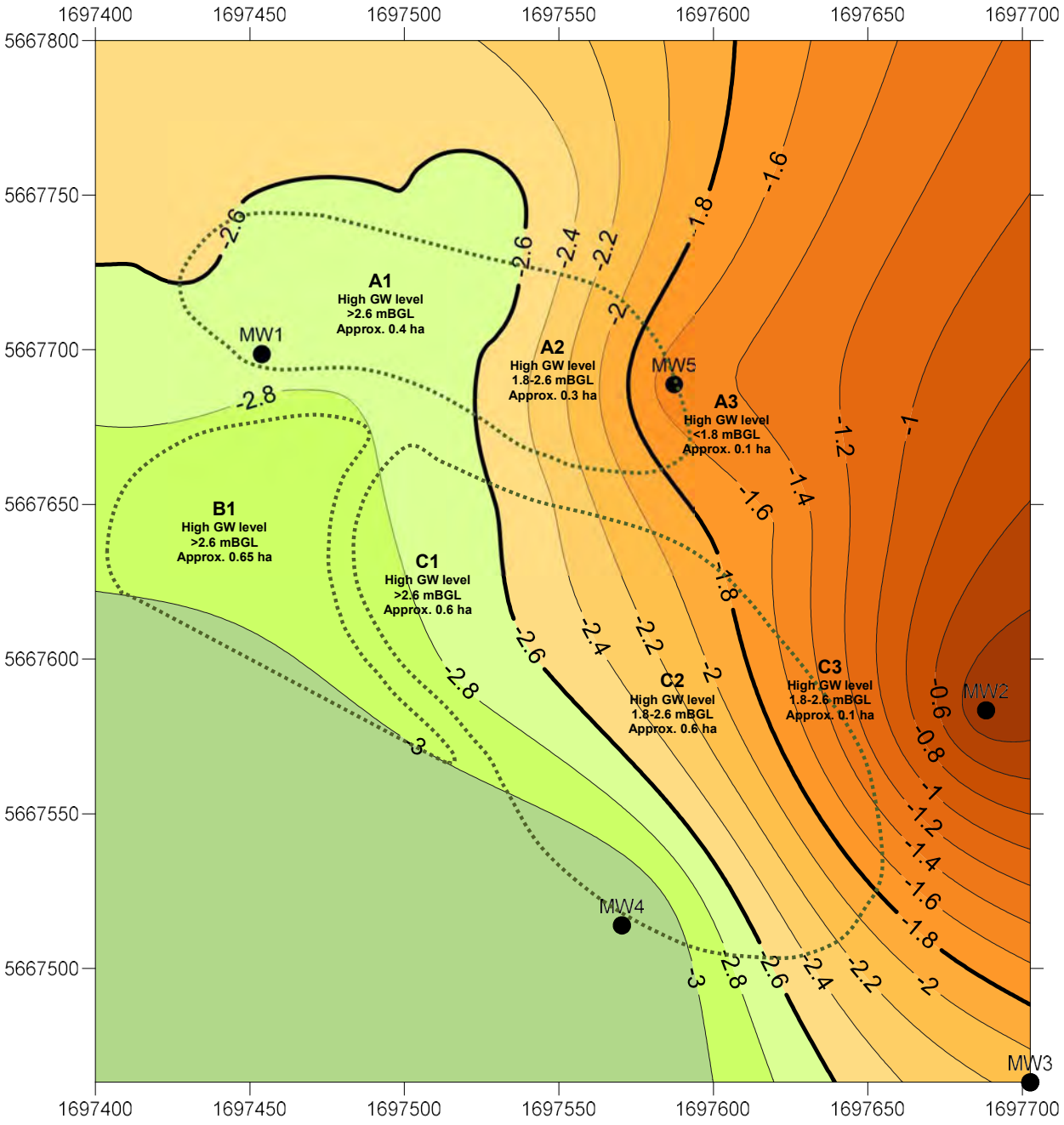


Figure 2 2017 high groundwater level under of burial areas A-C

Legend

Groundwater level contour mBGL

Burial area boundary

Monitoring well

50 m

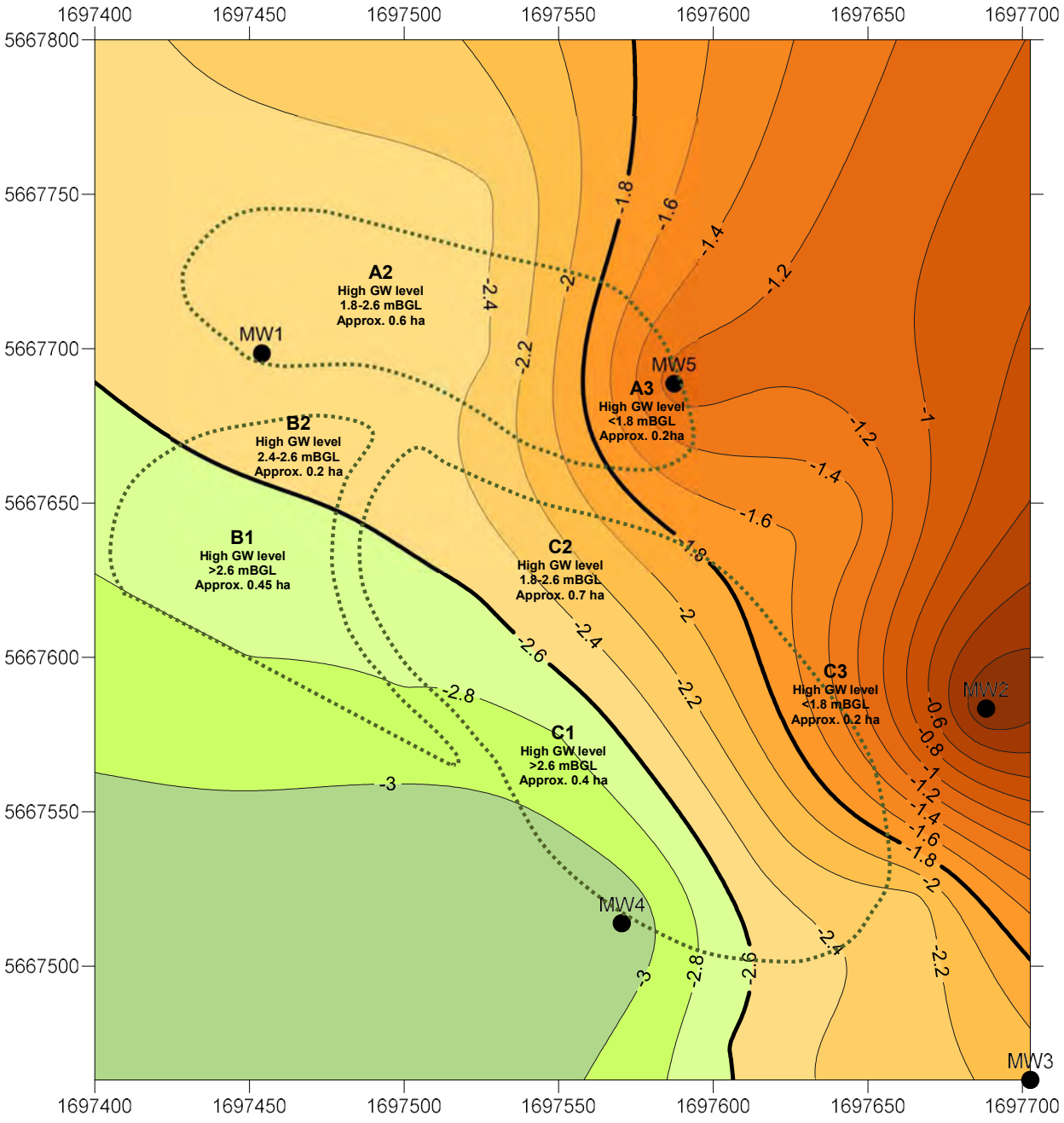
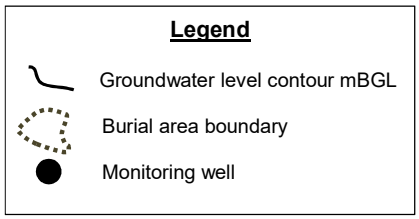
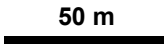


Figure 3 Estimated 1:50-year high groundwater level under of burial areas A-C





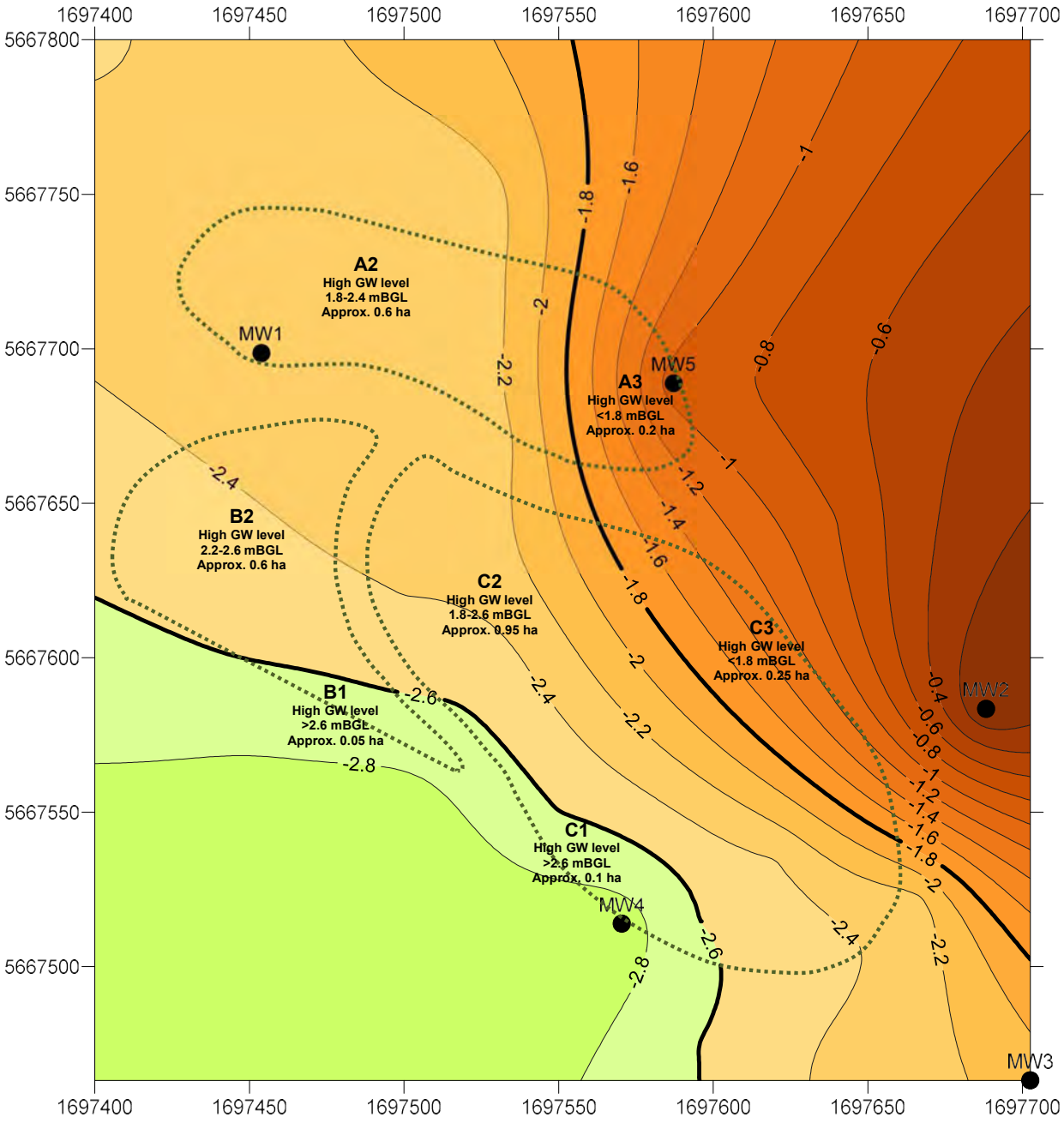
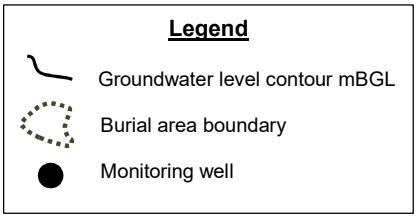
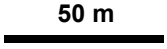


Figure 4 Estimated 1:100-year high groundwater level under of burial areas A-C





7. Spreading burials in time and space

NPDC will adopt the best practicable option to prevent or minimise actual or likely adverse effects on the environment associated with the discharges from graves. This includes spreading burials in time and space to reduce point source loading of contaminants. A burial rate of 150 /year was used here.

A chequered pattern of burials is proposed. Figure 5 shows how burials will be distributed in area A and B in the first five-years. Burials will be evenly distributed across both areas, with a higher density where groundwater is deepest and vice versa. There will be no burials where the high groundwater level is within 0.8 m of a grave base. The plans in Appendix IV give a breakdown of the proposed yearly burial pattern overlaid on 100-year high groundwater level surface contours.

Each grave site will be centred on an area of 10^2 m, consistent with planning design of 1,000 graves/ha. Area-A covers a total area of 0.8 ha, but the predicted 100-year groundwater level restricts burials to 0.6 ha (Figure 4). As such, Area-A could accommodate up to 608 plots laid out in 30 rows of 3 to 26. Area-B could accommodate up to 651 plots laid out in 28 rows of 2 to 48.

For consent compliance a grave base must be at least 0.8 m above the seasonally high groundwater level. Figure 4 and Table 10 suggest a 100-year high groundwater level would make area A and B only suitable for burials to a maximum depth of 1.2 m (natural and conventional single plot). Only a small part of Area-B is indicated to be suitable for full depth double plot burials to 1.8 m.

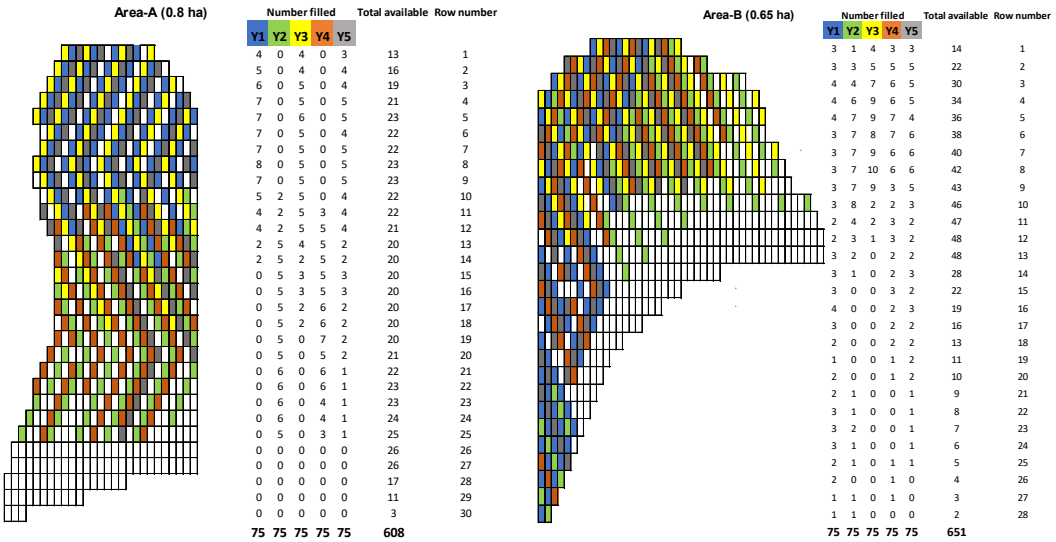


Figure 5 Burial pattern in area A and B for the first five-years of operation

8. Baseline water quality

Surface and ground water samples were dispatched on the day of collection to Hill laboratories for the analysis of:

- Major cations and anions
- Carbonate & bicarbonate
- Hardness & alkalinity
- Metals
- Nutrients
- Turbidity, suspended solids, electrical conductivity, & pH
- Fluoride
- Formaldehyde
- Carbonaceous & chemical oxygen demand
- Total organic carbon
- *E.* coli

Laboratory results are summarised in Tables 10 to 12 below. Field notes and laboratory results certificates are given in Appendices II and III.

Table 11 (groundwater) and Table 12 (surface water) summarise the results with reference to the NZ Drinking-water Standards 2005 (revised 2008) Guideline Values and Maximum Allowable Values (NZDWS); the Australian and New Zealand Environment and Conservation Council freshwater quality guidelines (ANZECC 2000, Tables 3.3.8, 3.3.10, 3.4.1 and 3.5.1); and the NZ Ministry for the Environment Microbiological Guidelines for Marine and Freshwater Recreational Areas (MfE 2003, Table E2). Laboratory results that exceeded the water quality standards and guidelines are highlighted in red text in Tables 11 and 12.

Groundwater

Exceedances for iron, manganese and barium occurred in two wells only, MW2 and MW3 (located well down gradient of Area-A). All the other groundwater results met the relevant standards, where applicable.

Surface water

Exceedances for iron, manganese, and *E. coli* occurred at both upstream and downstream sites on both sampling occasions. All the other surface water results met the relevant standards, where applicable.

Groundwater		MW1 (GND2623)				MW2 (GND2624)				MW3 (GND2625)				MW4 (GND2626)				MW5 (GND2627)			
Parameter	**Units**	27-Feb-17	26-May-17	28-Aug-17	16-Nov-17	27-Feb-17	26-May-17	28-Aug-17	16-Nov-17	27-Feb-17	26-May-17	28-Aug-17	16-Nov-17	27-Feb-17	26-May-17	28-Aug-17	16-Nov-17	27-Feb-17	26-May-17	28-Aug-17	16-Nov-17
Carbonate	g/m3 at 25°C	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Bicarbonate	g/m3 at 25°C	47	52	47	59	102	124	119	107	73	88	98	92	36	39	36	39	46	37	37	40
Total Hardness	g/m3 CaCO3	33	32	35	39	78	76	79	75	55	61	74	67	27	27	27	28	37	31	35	36
Total Alkalinity	g/m3 CaCO3	39	43	39	48	84	102	98	88	60	72	80	76	30	32	30	32	38	31	30	33
Total suspended solids	g/m3	13	8	8	18	< 3	< 3	< 3	< 3	3	4	40	< 3	27	6	3	< 3	5	9	< 3	6
Total dissolved solids	g/m3	100	86	89	106	163	166	167	161	111	120	129	133	85	69	81	79	112	79	91	103
Fluoride	g/m3	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
cBOD5	g O2/m3	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	5	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2
Total Organic Carbon	g/m3	0.9	< 0.5	< 0.5	< 1	< 0.5	0.9	1.5	< 1	< 0.5	< 0.5	1.2	< 1	< 0.5	0.8	< 0.5	< 1	< 0.5	0.8	< 0.5	< 1
Escherichia coli	MPN / 100mL	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
COD	g O2/m3	< 6	< 6	< 6	< 6	< 6	< 6	10	< 6	< 6	< 6	10	< 6	< 6	< 6	< 6	< 6	< 6	< 6	< 6	< 6
Dissolved Al	g/m3	0.005	< 0.003	< 0.003	< 0.003	0.004	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	0.013	< 0.003	0.004	< 0.003	< 0.003	0.042	< 0.003	< 0.003
Dissolved As	g/m3	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010
Dissolved Ba	g/m3	0.0068	0.0077	0.0078	0.008	0.072	0.118	0.115	0.073	0.069	0.083	0.072	0.058	0.0061	0.0087	0.0079	0.009	0.0092	0.0086	0.0088	0.0081
Dissolved B	g/m3	0.01	0.011	0.011	0.012	0.009	0.01	0.011	0.01	0.013	0.014	0.016	0.012	0.008	0.009	0.008	0.009	0.009	0.008	0.008	0.011
Dissolved Cd	g/m3	< 0.00005	< 0.00005	< 0.00005	< 0.00005	0.00011	0.0001	0.00012	0.0001	0.00013	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005
Dissolved Ca	g/m3	8	7.7	8.4	9.6	17.8	17.5	17.5	16.9	13.5	14.9	17.7	15.8	6.3	6.3	6.3	6.7	6.6	5.5	5.7	6.3
Dissolved Cr	g/m3	< 0.0005	< 0.0005	0.0005	0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	0.0005	< 0.0005	0.0006	0.0005	0.0006	< 0.0005	0.0008	0.0007
Dissolved Cu	g/m3	< 0.0005	< 0.0005	0.001	0.0017	0.0011	0.0015	0.002	0.0014	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	0.0012	0.0005	< 0.0005
Dissolved Fe	g/m3	< 0.02	< 0.02	< 0.02	< 0.02	0.1	2.8	1.69	0.07	0.25	0.79	1.66	1.56	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	0.04	< 0.02
Dissolved Pb	g/m3	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010	0.00044	< 0.00010	< 0.00010
Dissolved Mg	g/m3	3.2	3.1	3.3	3.7	8.2	7.9	8.6	8.1	5.3	5.7	7.3	6.8	2.7	2.7	2.8	2.8	5	4.3	4.9	4.9
Dissolved Mn	g/m3	0.001	0.0012	0.0014	0.0013	6.8	9.4	10.6	9.8	1.92	2.4	2.6	4.1	0.0012	0.0015	0.0022	0.0021	0.0015	0.0019	0.0035	0.001
Dissolved Hg	g/m3	< 0.00008	< 0.00008	< 0.00008	< 0.00008	< 0.00008	< 0.00008	< 0.00008	< 0.00008	< 0.00008	< 0.00008	< 0.00008	< 0.00008	< 0.00008	< 0.00008	< 0.00008	< 0.00008	< 0.00008	< 0.00008	< 0.00008	< 0.00008
Dissolved Ni	g/m3	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	0.0006	< 0.0005	< 0.0005	< 0.0005	0.0006	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Dissolved K	g/m3	1.34	1.53	1.53	1.63	3.4	4.1	4.9	3.8	4.1	4.6	4.4	4.2	1.13	1.25	1.18	1.22	0.76	0.67	0.66	0.84
Dissolved Na	g/m3	12.7	14.9	12.8	13.3	14.9	15.4	14.2	13.7	11	11.7	10.4	10.3	9.2	9.3	8.9	8.7	14.2	12.9	12.7	13.4
Dissolved Zn	g/m3	0.0024	< 0.0010	< 0.0010	0.0018	0.007	0.0098	0.0073	0.0061	0.007	0.0074	0.0045	0.0056	0.0033	0.0013	< 0.0010	0.0016	0.0074	0.0012	0.003	0.0025
Chloride	g/m3	9.2	8.7	8.9	8.6	19.9	16.9	21	22	13.4	11.7	9.9	12.6	8.1	7.1	7.6	7.5	16.6	12.7	16	15
Total Ammoniacal-N	g/m3	< 0.010	< 0.010	< 0.010	0.012	0.34	0.4	0.77	0.52	0.42	0.55	0.3	0.28	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
Nitrite-N	g/m3	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	0.018	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002
Nitrate-N+Nitrite-N	g/m3	1.32	1.45	0.91	1.62	0.008	0.019	< 0.002	0.62	< 0.002	< 0.002	< 0.002	< 0.002	0.34	0.29	0.29	0.28	1.3	1.22	0.79	1.3
Total Nitrogen	g/m3	1.39	1.48	0.94	1.68	0.46	0.58	0.9	1.18	0.5	0.77	0.7	0.35	0.37	0.34	0.31	0.33	1.34	1.24	0.88	1.37
Nitrate-N	g/m3	1.32	1.45	0.91	1.62	0.007	0.019	< 0.002	0.6	< 0.002	< 0.002	< 0.002	< 0.002	0.34	0.29	0.29	0.28	1.3	1.22	0.79	1.3
Total Kjeldhal-N	g/m3	< 0.10	< 0.10	< 0.10	< 0.10	0.45	0.57	0.9	0.57	0.5	0.77	0.7	0.35	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
DRP	g/m3	0.012	0.01	0.008	0.011	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004	0.012	0.011	0.01	0.013	0.005	< 0.004	0.005	0.005
Total Phosphorus	g/m3	0.016	0.019	0.011	0.026	0.005	0.008	0.004	0.005	0.006	0.018	0.055	0.005	0.019	0.029	0.012	0.013	0.007	0.017	< 0.004	0.009
Reactive Silica	g/m3 SiO2	25	23	22	27	19	18.3	19.7	21	21	22	22	22	25	24	25	26	25	20	23	26
Sulphate	g/m3	5	4.6	4.8	5.5	10.4	12.7	15.7	9.3	9.8	9.6	6.3	12.1	6.3	6	5.7	6.1	4.9	7.2	6.9	5.9
pH	pH Units	6.2	6.3	6.2	6.2	6.2	6	6.1	6.1	6.2	6	6.3	6.2	6.3	6.4	6.2	6.2	6.3	6.2	6.1	6.1
Electrical Conductivity	mS/m	13	13.6	13.1	15.2	24.9	27.9	29.9	26.6	18.7	20.4	21.1	21.7	10.4	10.3	10.4	10.5	14.9	13	14	13.8
Formaldehyde	g/m3	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02

Table 11 Baseline groundwater quality results - data

Groundwater		MW1 (GND2623)				MW2 (GND2624)				MW3 (GND2625)				MW4 (GND2626)				MW5 (GND2627)				NZDWS		ANZECC	
Parameter	Units	Min	Max	Mean	STD Dev	Min	Max	Mean	STD Dev	Min	Max	Mean	STD Dev	Min	Max	Mean	STD Dev	Min	Max	Mean	STD Dev	GV	MAV	[1]Low trigger value	Default trigger value
Carbonate	g/m3 at 25°C	< 1.0	< 1.0	< 1.0	-	< 1.0	< 1.0	< 1.0	-	< 1.0	< 1.0	< 1.0	-	< 1.0	< 1.0	< 1.0	-	< 1.0	< 1.0	< 1.0	-	-	-	-	-
Bicarbonate	g/m3 at 25°C	47	59	51	5.68	107	124	113	10.23	73	98	88	10.66	36	39	38	1.73	37	46	40	4.24	-	-	-	-
Total Hardness	g/m3 CaCO3	32	39	35	3.10	75	79	77	1.83	55	74	64	8.14	27	28	27	0.5	31	37	35	2.63	*< 200*	-	-	-
Total Alkalinity	g/m3 CaCO3	39	48	42.3	4.27	84	102	93	8.41	60	80	72	8.64	30	32	31	1.15	30	38	33	3.56	-	-	-	-
Total suspended solids	g/m3	8	18	12	4.79	< 3	< 3	< 3	-	<3	40	18	18.34	<3	27	12	11.59	<3	9	7	2.08	-	-	-	-
Total dissolved solids	g/m3	86	106	95	9.36	161	167	164	2.75	111	133	123	9.81	69	85	79	6.81	79	112	96	14.36	-	-	-	-
Fluoride	g/m3	< 0.05	< 0.05	< 0.05	-	< 0.05	< 0.05	< 0.05	-	< 0.05	< 0.05	< 0.05	-	< 0.05	< 0.05	< 0.05	-	< 0.05	< 0.05	< 0.05	-	-	*1.5*	-	-
cBOD5	g O2/m3	< 2	< 2	< 2	-	< 2	< 2	< 2	-	<2	5	2	1.73	< 2	< 2	< 2	-	< 2	< 2	< 2	-	-	-	-	-
Total Organic Carbon	g/m3	<0.5	< 1	0.9		< 0.5	1.5	1.2	0.42	<0.5	1.2	0.9	0.36	<1	0.8	0.5	0.24	< 0.5	0.8	0.8	-	-	-	-	-
Escherichia coli	MPN / 100mL	< 1	< 1	< 1	-	< 1	< 1	< 1	-	< 1	<1	< 1	-	< 1	< 1	< 1	-	< 1	< 1	< 1	-	-	< 1	-	*> 260* [2]
COD	g O2/m3	< 6	< 6	< 6	-	< 6	10	8	-	<0.6	10	8	2.31	< 6	< 6	< 6	-	< 6	< 6	< 6	-	-	-	-	-
Dissolved Al	g/m3	< 0.003	< 0.003	< 0.003	-	< 0.003	0.004	0.004	-	< 0.003	< 0.003	< 0.003	-	<0.003	0.013	0.005	0.01	< 0.003	0.042	0.001	0.02	*< 0.1*	-	-	-
Dissolved As	g/m3	< 0.0010	< 0.0010	< 0.0010	-	< 0.0010	< 0.0010	< 0.0010	-	< 0.0010	< 0.0010	< 0.0010	-	< 0.0010	< 0.0010	< 0.0010	-	< 0.0010	< 0.0010	< 0.0010	-	-	*0.01* [3]	-	-
Dissolved Ba	g/m3	0.0068	0.008	0.0076	0.0005	**0.072**	**0.118**	**0.095**	0.03	0.058	**0.083**	**0.0705**	0.01	0.009	0.0087	0.0079	0.001	0.0081	0.0092	0.0087	0.0005	-	*0.07* [3]	-	-
Dissolved B	g/m3	0.011	0.012	0.0115	0.0008	0.009	0.011	0.01	0.001	0.012	0.016	0.014	0.002	0.008	0.009	0.009	0.001	0.008	0.011	0.009	0.001	-	*1.4* [3]	-	-
Dissolved Cd	g/m3	< 0.00005	< 0.00005	< 0.00005	-	0.0001	0.00012	0.00011	0.00001	< 0.00005	< 0.00005	< 0.00005	-	< 0.00005	< 0.00005	< 0.00005	-	< 0.00005	< 0.00005	< 0.00005	-	-	*0.004* [3]	-	-
Dissolved Ca	g/m3	7.7	9.6	8.4	0.83	16.9	17.8	17.43	0.38	13.5	17.7	15.48	1.76	6.3	6.7	6.40	0.2	5.5	6.6	6.03	0.51	-		-	-
Dissolved Cr	g/m3	< 0.0005	0.0005	< 0.0005	-	< 0.0005	< 0.0005	< 0.0005	-	< 0.0005	< 0.0005	< 0.0005	-	< 0.0005	0.0006	0.0005	0.0001	< 0.0005	0.0008	0.0007	0.0001	-	*0.05* [3]	-	-
Dissolved Cu	g/m3	< 0.0005	0.0017	0.00135	0.0005	0.0011	0.002	0.0015	0.0004	< 0.0005	< 0.0005	< 0.0005	-	< 0.0005	< 0.0005	< 0.0005	-	< 0.0005	0.0012	0.0007	0.0005	*< 1* [3]	*2* [3]	-	-
Dissolved Fe	g/m3	< 0.02	< 0.02	< 0.02	-	0.07	**2.8**	**1.17**	1.33	**0.25**	**1.66**	**1.07**	0.67	< 0.02	< 0.02	< 0.02	-	< 0.0005	0.04	0.02	0.02	*< 0.2*	*< 0.2* [3]	-	-
Dissolved Pb	g/m3	< 0.00010	< 0.00010	< 0.00010	-	< 0.00010	< 0.00010	< 0.00010	-	< 0.00010	< 0.00010	< 0.00010	-	< 0.00010	< 0.00010	< 0.00010	-	< 0.00010	0.00044	0.0002	-	-	*0.01* [3]	-	-
Dissolved Mg	g/m3	3.1	3.7	3.3	0.26	7.9	8.6	8.2	0.29	5.3	7.3	6.3	0.93	2.7	2.8	2.8	0.06	4.3	5	4.8	0.32	-	-	-	-
Dissolved Mn	g/m3	0.001	0.0014	0.0013	0.0002	**6.8**	**10.6**	**9.15**	1.64	**1.92**	**4.1**	**2.76**	0.94	0.0012	0.0022	0.0018	0.0005	0.001	0.0035	0.0020	0.001	*< 0.04 (staining)* *< 0.10 (taste)*	*0.4*	-	-
Dissolved Hg	g/m3	< 0.00008	< 0.00008	< 0.00008	-	< 0.00008	< 0.00008	< 0.00008	-	< 0.00008	< 0.00008	< 0.00008	-	< 0.00008	< 0.00008	< 0.00008	-	< 0.00008	< 0.00008	< 0.00008	-	-	*0.007* [3]	-	-
Dissolved Ni	g/m3	< 0.0005	< 0.0005	< 0.0005	-	< 0.0005	0.0006	0.0006	0.0001	< 0.0005	0.0006	0.0005	0.0001	< 0.0005	< 0.0005	< 0.0005	-	< 0.0005	< 0.0005	< 0.0005	-	-	*0.08* [3]	-	-
Dissolved K	g/m3	1.34	1.63	1.51	0.12	3.4	4.9	4.05	0.64	4.1	4.6	4.3	0.22	1.13	1.25	1.20	0.05	0.66	0.84	0.73	0.08	-	-	-	-
Dissolved Na	g/m3	12.7	14.9	13.42	1.02	13.7	15.4	14.55	0.75	10.3	11.7	10.85	0.65	8.7	9.3	9.03	0.28	12.7	14.2	13.3	0.67	*< 200*	-	-	-
Dissolved Zn	g/m3	< 0.0010	0.0024	0.0021	0.0004	0.007	0.0098	0.0076	0.0016	0.0045	0.0074	0.0061	0.0013	<0.001	0.0033	0.0021	0.0011	0.0012	0.0074	0.0035	0.003	*1.5* [3]	-	-	-
Chloride	g/m3	8.6	9.2	8.9	0.26	16.9	22	19.95	2.21	9.9	13.4	11.9	1.5	7.1	8.1	7.6	0.41	12.7	16.6	15.1	1.72	*< 250*	-	-	-
Total Ammoniacal-N	g/m3	< 0.010	0.012	0.010		0.34	0.77	0.51	0.19	0.28	0.55	0.39	0.12	< 0.010	< 0.010	< 0.010	-	< 0.010	< 0.010	< 0.010	-	*< 1.2*	-		*0.021*
Nitrite-N	g/m3	< 0.002	< 0.002	< 0.002	-	< 0.002	0.018	0.018	0.008	< 0.002	< 0.002	< 0.002	-	< 0.002	< 0.002	< 0.002	-	< 0.002	< 0.002	< 0.002	-	-	*0.06* *0.91 (short term)*	-	-
Nitrate-N+Nitrite-N	g/m3	0.91	1.62	1.33	0.30	< 0.002	0.62	0.216	0.35	< 0.002	< 0.002	< 0.002	-	0.28	0.34	0.3	0.03	0.79	1.3	1.2	0.245	-	-	-	-
Total Nitrogen	g/m3	0.94	1.68	1.37	0.31	0.46	1.18	0.78	0.32	0.35	0.77	0.58	0.19	0.31	0.37	0.34	0.03	0.88	1.37	1.21	0.23	-	-		*0.614*
Nitrate-N	g/m3	0.91	1.62	1.325	0.30	< 0.002	0.6	0.209	0.34	< 0.002	< 0.002	< 0.002	-	0.28	0.34	0.30	0.03	0.79	1.3	1.15	0.24	-	*11.3*	-	-
Total Kjeldhal-N	g/m3	< 0.10	< 0.10	< 0.10	-	0.45	0.9	0.62	0.19	0.35	0.77	0.58	0.19	< 0.10	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	-	-	-	-	-
DRP	g/m3	0.008	0.012	0.010	0.002	< 0.004	< 0.004	< 0.004	-	< 0.004	< 0.004	< 0.004	-	0.01	0.012	0.012	0.001	< 0.004	0.005	0.005	0.0001	-	-	-	*0.01*
Total Phosphorus	g/m3	0.011	0.026	0.018	0.01	< 0.004	0.008	0.006	0.002	0.005	0.055	0.021	0.023	0.012	0.029	0.018	0.01	< 0.004	0.017	0.009	0.005	-	-	-	*0.033*
Reactive Silica	g/m3 SiO2	22	27	24.3	2.22	18.3	21	19.5	1.15	21	22	21.75	0.5	24	26	25	0.82	20	26	23.5	2.65	-	-	-	-
Sulphate	g/m3	4.6	5.5	5.0	0.39	9.3	15.7	12.0	2.83	6.3	12.1	9.5	2.39	5.7	6.3	6.0	0.25	4.9	7.2	6.2	1.04	-	-	-	-
pH	pH Units	6.2	6.3	6.225	0.05	6	6.2	6.1	0.08	6	6.3	6.2	0.13	6.2	6.4	6.3	0.1	6.1	6.3	6.2	0.1	*7.0-8.5*	-	-	-
Electrical Conductivity	mS/m	13	15.2	13.7	1.02	24.9	29.9	27.3	2.11	18.7	21.7	20.5	1.3	10.3	10.5	10.4	0.08	13	14.9	13.9	0.78	-	-	-	-
Formaldehyde	g/m3	< 0.02	< 0.02	< 0.02	-	< 0.02	< 0.02	< 0.02	-	< 0.02	< 0.02	< 0.02	-	< 0.02	< 0.02	< 0.02	-	< 0.02	< 0.02	< 0.02	-	-	-	-	-

[1] trigger value to protect 95% of freshwater species
[2] MfE microbiological water quality guidelines 2003
[3] MAV or GV for total concentration

Table 12 Baseline groundwater quality results - summary (red text indicates value exceeds relevant water quality standard or guideline)

Mangapouri Stream		WKH000524 upstream			WKH000526 downstream			NZDWS		ANZECC	
Parameter	Units	5-Oct-17	31-Jan-18	Mean	5-Oct-17	31-Jan-18	Mean	GV	MAV	[1]Low trigger value	Default trigger value
Carbonate	g/m3 at 25°C	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	-	-	-	-
Bicarbonate	g/m3 at 25°C	44	92	68	43	89	66	-	-	-	-
Total Hardness	g/m3 CaCO3	43	74	59	43	73	58	*< 200*	-	-	-
Total Alkalinity	g/m3 CaCO3	36	76	56	36	73	55	-	-	-	-
Total suspended solids	g/m3	< 3	< 3	< 3	< 3	< 3	< 3	-	-	-	-
Total dissolved solids	g/m3	95	146	121	108	153	131	-	-	-	-
Fluoride	g/m3	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	-	*1.5*	-	-
cBOD5	g O2/m3	< 2	< 2	< 2	< 2	< 2	< 2	-	-	-	-
Total Organic Carbon	g/m3	0.7	1.3	1	0.8	< 0.5	0.8	-	-	-	-
Escherichia coli	MPN / 100mL	**> 200**	**579**	**>400**	**> 200**	**140**	**>170**	-	< 1	-	*> 260* [2]
COD	g O2/m3	< 6	< 6	< 6	< 6	< 6	< 6	-	-	-	-
Dissolved Al	g/m3	0.009	0.028	0.019	0.006	0.005	0.006	*< 0.1*	-	-	-
Dissolved As	g/m3	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010	-	*0.01* [3]	-	-
Dissolved Ba	g/m3	0.028	0.024	0.026	0.027	0.021	0.024	-	*0.07* [3]	-	-
Dissolved B	g/m3	0.013	0.009	0.011	0.012	0.01	0.011	-	*1.4* [3]	-	-
Dissolved Cd	g/m3	< 0.00005	< 0.00005	< 0.0005	< 0.00005	< 0.00005	< 0.00005	-	*0.004* [3]	-	-
Dissolved Ca	g/m3	10.2	16	13.1	10.2	15.5	12.9	-		-	-
Dissolved Cr	g/m3	< 0.0005	< 0.0005	< 0.0005	0.0005	< 0.0005	0.0003	-	*0.05* [3]	-	-
Dissolved Cu	g/m3	< 0.0005	0.0007	0.0006	< 0.0005	0.0008	0.0004	*< 1* [3]	*2* [3]	-	-
Dissolved Fe	g/m3	**0.65**	**0.58**	**0.62**	**0.36**	**0.34**	**0.35**	*< 0.2*	*< 0.2* [3]	-	-
Dissolved PB	g/m3	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010	-	*0.01* [3]	-	-
Dissolved Mg	g/m3	4.3	8.2	6.3	4.4	8.3	6.4	-	-	-	-
Dissolved Mn	g/m3	**0.13**	**0.141**	**0.136**	**0.096**	**0.048**	**0.072**	*< 0.04 (staining)* *< 0.10 (taste)*	*0.4*	-	-
Dissolved Hg	g/m3	< 0.00008	< 0.00008	< 0.00008	< 0.00008	< 0.00008	< 0.00008	-	*0.007* [3]	-	-
Dissolved Ni	g/m3	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	-	*0.08* [3]	-	-
Dissolved K	g/m3	2.9	3.5	3.2	2.9	3.7	3.3	-	-	-	-
Dissolved Na	g/m3	8.9	13.5	11.2	8.8	13.7	11.3	*< 200*	-	-	-
Dissolved Zn	g/m3	0.0019	0.002	0.002	0.0015	< 0.0010	0.00013	*1.5* [3]	-	-	-
Chloride	g/m3	12.7	14.5	13.6	12.7	14.6	13.7	*< 250*	-	-	-
Total Ammoniacal-N	g/m3	0.057	0.04	0.049	0.037	< 0.010	0.002	*< 1.2*	-		*0.021*
Nitrite-N	g/m3	0.007	0.004	0.006	0.007	< 0.002	0.004	-	*0.91 (short term)*	-	-
Nitrate-N+Nitrite-N	g/m3	1.34	0.63	0.99	1.28	0.61	0.95	-	-	-	-
Total Nitrogen	g/m3	1.58	0.79	1.19	1.47	0.75	1.11	-	-		*0.614*
Nitrate-N	g/m3	1.33	0.63	0.98	1.27	0.61	0.94	-	*11.3*	-	-
Total Kjeldhal-N	g/m3	0.24	0.17	0.21	0.19	0.14	0.17	-	-	-	-
DRP	g/m3	< 0.004	0.005	0.005	< 0.004	0.011	0.006	-	-	-	*0.01*
Total Phosphorus	g/m3	0.016	0.029	0.023	0.013	0.022	0.018	-	-	-	*0.033*
Reactive Silica	g/m3 SiO2	22	33	28	22	33	28	-	-	-	-
Sulphate	g/m3	5.9	7.2	6.6	6	6.8	6.4	-	-	-	-
pH	pH Units	7.2	7.5	7.4	7.1	7.7	7.4	*7.0-8.5*	-	-	-
Electrical Conductivity	mS/m	14	21.5	17.8	14	21.1	17.6	-	-	-	-
Formaldehyde	g/m3	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	-	-	-	-

[1] trigger value to protect 95% of freshwater species

[2] MfE microbiological water quality guidelines 2003

[3] MAV or GV for total concentration

Table 13 Baseline surface water quality results - Mangapouri Stream

9. Summary and conclusions

- This pre-burial groundwater level and water quality assessment for the new Mangapouri Cemetery focusses on burial area A and B, the first two stages of the cemetery to open. Graves will be dug to standard depths of 1.8 m (conventional double), 1.2 m (conventional single), and 1 m (natural). Ashes will also be interred but are inert and of no environmental concern in this situation.

- Resource consent to discharge contaminants into land from burials at the cemetery requires the distance between the seasonally high groundwater level and the base of graves (unsaturated zone) to be no less than 0.8 m. Because the groundwater level varies across the site at any one time, and fluctuates over time, the grave depth and therefore type of burial, must be considered to comply with the consent.

- The groundwater surface under burial area A and B is deepest in the west and shallowest in the east. This relationship will hold regardless of rainfall patterns, provided the groundwater surface is not lowered by pumping or drainage.

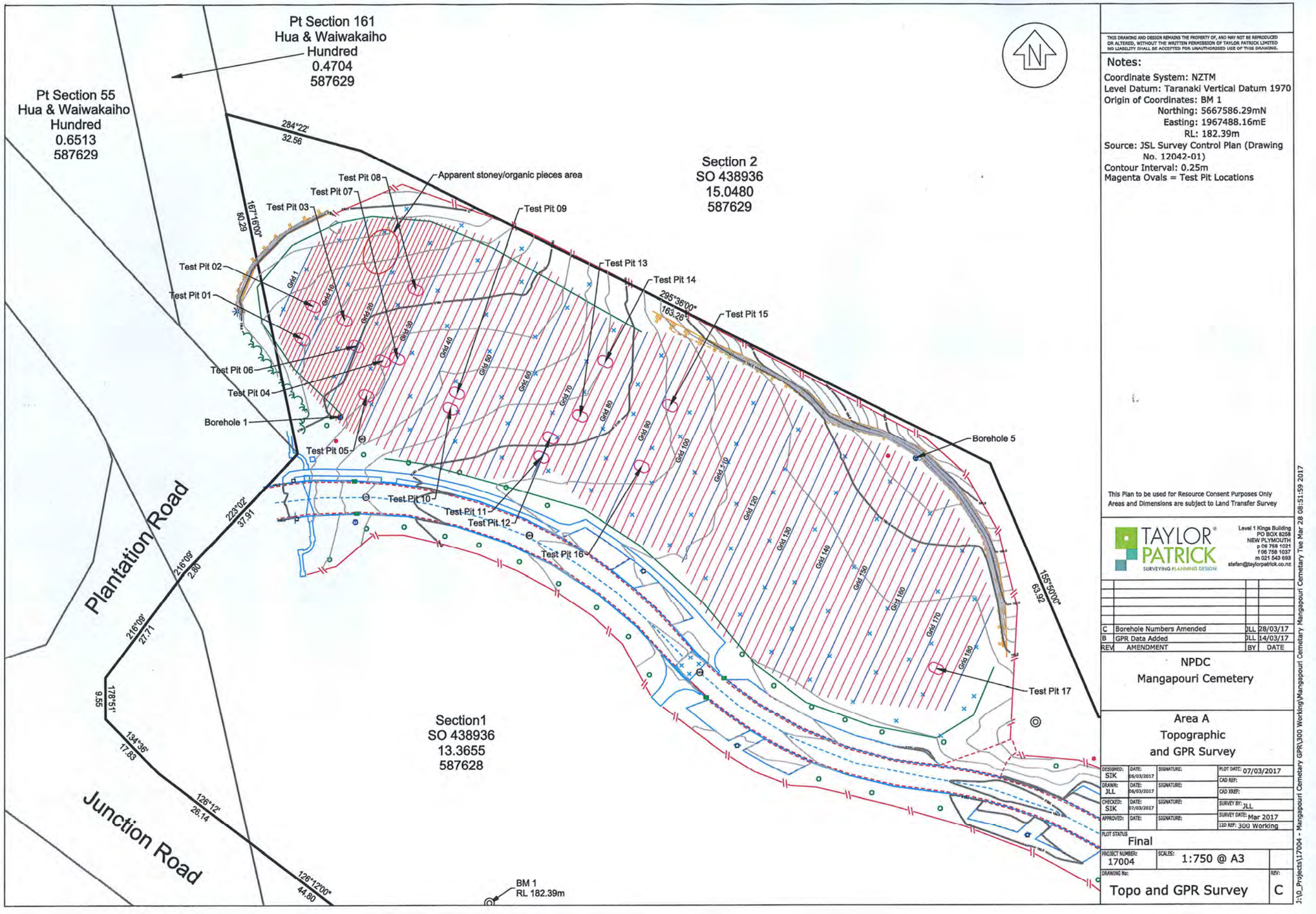
- The likelihood of achieving consent compliance around groundwater levels in the future was assessed against the estimated 100-year high groundwater level. The assessment indicated all of area A and most of area B would be suitable only for burials to a maximum depth of 1.2 m, and that double plot burials to 1.8 m would be restricted to a small part of Area-B.

- In a 100-year high groundwater scenario, area A and B would accommodate a total of approximately 1,259 burial plots, of which 1205 should be no deeper than 1.2 m. Area-B would accommodate approximately 54 burial plots to 1.8 m.

- Groundwater quality at the site was tested before any burials were carried out. Results indicate significant spatial variation in groundwater quality across the site, likely due to different groundwater flow paths, but otherwise were typical of shallow volcanic aquifers. The quality of water in the Mangapouri Stream was also tested and results were typical of smaller lower ring plain streams. No anomalous results were returned from the water sampling.

APPENDIX I

Area-A topographic & GPR survey plan



Notes:

Coordinate System: NZTM
Level Datum: Taranaki Vertical Datum 1970
Origin of Coordinates: BM 1
Northing: 5667586.29mN
Easting: 1967488.16mE
RL: 182.39m
Source: JSL Survey Control Plan (Drawing No. 12042-01)
Contour Interval: 0.25m
Magenta Ovals = Test Pit Locations

This Plan to be used for Resource Consent Purposes Only
Areas and Dimensions are subject to Land Transfer Survey

TAYLOR PATRICK
SURVEYING PLANNING DESIGN
Level 1 Kings Building
PO BOX 8258
NEW PLYMOUTH
p 06 758 1021
f 06 758 1037
m 021 543 693
stefan@taylorpatrick.co.nz

REV	AMENDMENT	BY	DATE
C	Borehole Numbers Amended	JLL	28/03/17
B	GPR Data Added	JLL	14/03/17

NPDC
Mangapouri Cemetery

Area A
Topographic
and GPR Survey

DESIGNED: SIK	DATE: 06/03/2017	SIGNATURE:	PLOT DATE: 07/03/2017
DRAWN: JLL	DATE: 06/03/2017	SIGNATURE:	CAD REF:
CHECKED: SIK	DATE: 07/03/2017	SIGNATURE:	CAD XREF:
APPROVED:	DATE:	SIGNATURE:	SURVEY BY: JLL
			SURVEY DATE: Mar 2017
			12D REF: 300 Working

PLOT STATUS: Final

PROJECT NUMBER:	SCALES:	
17004	1:750 @ A3	
DRAWING No:		REV:
Topo and GPR Survey		C

J:\10_Projects\17004 - Mangapouri Cemetery GPR\300 Working\Mangapouri Cemetary Mangapouri Cemetary Tue Mar 28 08:51:59 2017

APPENDIX II

Groundwater quality results

Hill Laboratories
TRIED, TESTED AND TRUSTED
R J Hill Laboratories Limited
1 Clyde Street Hamilton 3216
Private Bag 3205
Hamilton 3240 New Zealand
T 0508 HILL LAB (44 555 22)
T +64 7 858 2000
E mail@hill-labs.co.nz
W www.hill-laboratories.com

ANALYSIS REPORT

Client:	Geosearch Limited	Lab No:	1730934 SPv1
Contact:	K Browne	Date Received:	28-Feb-2017
	C/- Geosearch Limited	Date Reported:	14-Mar-2017
	PO Box 43	Quote No:	83792
	Oakura 4345	Order No:	
	TARANAKI	Client Reference:	Cemetery Groundwater
		Submitted By:	K Browne

Sample Type: Aqueous

Sample Name:		GHD 2623 27-Feb-2017 12:30 pm	GHD 2624 27-Feb-2017 3:15 pm	GHD 2625 27-Feb-2017 2:30 pm	GHD 2626 27-Feb-2017 1:40 pm	GHD 2627 27-Feb-2017 10:30 am
Lab Number:		1730934.1	1730934.2	1730934.3	1730934.4	1730934.5
Individual Tests						
Sum of Anions	meq/L	1.23	2.4	1.79	0.98	1.42
Sum of Cations	meq/L	1.25	2.5	1.80	0.97	1.37
pH	pH Units	6.2	6.2	6.2	6.3	6.3
Total Alkalinity	g/m³ as $CaCO_3$	39	84	60	30	38
Carbonate	g/m³ at 25°C	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Bicarbonate	g/m³ at 25°C	47	102	73	36	46
Total Hardness	g/m³ as $CaCO_3$	33	78	55	27	37
Electrical Conductivity (EC)	mS/m	13.0	24.9	18.7	10.4	14.9
Total Suspended Solids	g/m³	13	< 3	3	27	5
Total Dissolved Solids (TDS)	g/m³	100	163	111	85	112
Dissolved Aluminium	g/m³	0.005	0.004	< 0.003	0.013	< 0.003
Dissolved Barium	g/m³	0.0068	0.072	0.069	0.0061	0.0092
Dissolved Boron	g/m³	0.010	0.009	0.013	0.008	0.009
Dissolved Calcium	g/m³	8.0	17.8	13.5	6.3	8.6
Dissolved Iron	g/m³	< 0.02	0.10	0.25	< 0.02	< 0.02
Dissolved Magnesium	g/m³	3.2	8.2	5.3	2.7	5.0
Dissolved Manganese	g/m³	0.0010	6.8	1.92	0.0012	0.0015
Dissolved Mercury	g/m³	< 0.00008	< 0.00008	< 0.00008	< 0.00008	< 0.00008
Dissolved Potassium	g/m³	1.34	3.4	4.1	1.13	0.76
Dissolved Sodium	g/m³	12.7	14.9	11.0	9.2	14.2
Chloride	g/m³	9.2	19.9	13.4	8.1	16.6
Fluoride	g/m³	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Total Nitrogen	g/m³	1.39	0.46	0.50	0.37	1.34
Total Ammoniacal-N	g/m³	< 0.010	0.34	0.42	< 0.010	< 0.010
Nitrite-N	g/m³	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002
Nitrate-N	g/m³	1.32	0.007	< 0.002	0.34	1.30
Nitrate-N + Nitrite-N	g/m³	1.32	0.008	< 0.002	0.34	1.30
Total Kjeldahl Nitrogen (TKN)	g/m³	< 0.10	0.45	0.50	< 0.10	< 0.10
Dissolved Reactive Phosphorus	g/m³	0.012	< 0.004	< 0.004	0.012	0.005
Total Phosphorus	g/m³	0.016	0.005	0.006	0.019	0.007
Reactive Silica	g/m³ as SiO_2	25	19.0	21	25	25
Sulphate	g/m³	5.0	10.4	9.8	6.3	4.9
Carbonaceous Biochemical Oxygen Demand (cBOD5)	g O_2/m³	< 2	< 2	< 2	< 2	< 2
Chemical Oxygen Demand (COD)	g O_2/m³	< 6	< 6	< 6	< 6	< 6
Total Organic Carbon (TOC)	g/m³	0.9	< 0.5	< 0.5	< 0.5	< 0.5
Escherichia coli	MPN / 100mL	< 1	< 1	< 1	< 1	< 1

IANZ ACCREDITED LABORATORY

This Laboratory is accredited by International Accreditation New Zealand (IANZ), which represents New Zealand in the International Laboratory Accreditation Cooperation (ILAC). Through the ILAC Mutual Recognition Arrangement (ILAC-MRA) this accreditation is internationally recognised.
The tests reported herein have been performed in accordance with the terms of accreditation, with the exception of tests marked *, which are not accredited.

Sample Type: Aqueous						
Sample Name:		GHD 2623 27-Feb-2017 12:30 pm	GHD 2624 27-Feb-2017 3:15 pm	GHD 2625 27-Feb-2017 2:30 pm	GHD 2626 27-Feb-2017 1:40 pm	GHD 2627 27-Feb-2017 10:30 am
Lab Number:		1730934.1	1730934.2	1730934.3	1730934.4	1730934.5
Heavy metals, dissolved, trace As,Cd,Cr,Cu,Ni,Pb,Zn						
Dissolved Arsenic	g/m³	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010
Dissolved Cadmium	g/m³	< 0.00005	0.00011	0.00013	< 0.00005	< 0.00005
Dissolved Chromium	g/m³	< 0.0005	< 0.0005	< 0.0005	0.0005	0.0006
Dissolved Copper	g/m³	< 0.0005	0.0011	< 0.0005	< 0.0005	< 0.0005
Dissolved Lead	g/m³	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010
Dissolved Nickel	g/m³	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Dissolved Zinc	g/m³	0.0024	0.0070	0.0070	0.0033	0.0074
Formaldehyde in Water by DNPH & LCMSMS						
Formaldehyde	g/m³	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02

Analyst's Comments

Please interpret this result with caution as the sample was > 8 °C on receipt at the lab. The sample temperature is recommended by APHA to be less than 8 °C on receipt at the laboratory (but not frozen). However, it is acknowledged that samples that are transported quickly to the laboratory after sampling, may not have been cooled to this temperature.

SUMMARY OF METHODS

The following table(s) gives a brief description of the methods used to conduct the analyses for this job. The detection limits given below are those attainable in a relatively clean matrix. Detection limits may be higher for individual samples should insufficient sample be available, or if the matrix requires that dilutions be performed during analysis.

Sample Type: Aqueous			
Test	Method Description	Default Detection Limit	Sample No
Heavy metals, dissolved, trace As,Cd,Cr,Cu,Ni,Pb,Zn	0.45µm filtration, ICP-MS, trace level. APHA 3125 B 22nd ed. 2012.	0.00005 - 0.0010 g/m³	1-5
Formaldehyde in Water by DNPH & LCMSMS	DNPH derivatisation, extraction, LCMSMS	0.02 g/m³	1-5
Filtration, Unpreserved	Sample filtration through 0.45µm membrane filter.	-	1-5
Total Kjeldahl Digestion	Sulphuric acid digestion with copper sulphate catalyst.	-	1-5
Total Phosphorus Digestion	Acid persulphate digestion.	-	1-5
Total anions for anion/cation balance check	Calculation: sum of anions as mEquiv/L calculated from Alkalinity (bicarbonate), Chloride and Sulphate. Nitrate-N, Nitrite-N, Fluoride, Dissolved Reactive Phosphorus and Cyanide also included in calculation if available. APHA 1030 E 22nd ed. 2012.	0.07 meq/L	1-5
Total cations for anion/cation balance check	Sum of cations as mEquiv/L calculated from Sodium, Potassium, Calcium and Magnesium. Iron, Manganese, Aluminium, Zinc, Copper, Lithium, Total Ammoniacal-N and pH (H^+) also included in calculation if available. APHA 1030 E 22nd ed. 2012.	0.05 meq/L	1-5
pH	pH meter. APHA 4500-H^+ B 22nd ed. 2012. Note: it is not possible to achieve the APHA Maximum Storage Recommendation for this test (15 min) when samples are analysed upon receipt at the laboratory, and not in the field.	0.1 pH Units	1-5
Total Alkalinity	Titration to pH 4.5 (M-alkalinity), autotitrator. APHA 2320 B (Modified for alk <20) 22nd ed. 2012.	1.0 g/m³ as $CaCO_3$	1-5
Carbonate	Calculation: from alkalinity and pH, valid where TDS is not >500 mg/L and alkalinity is almost entirely due to hydroxides, carbonates or bicarbonates. APHA 4500-CO_2 D 22nd ed. 2012.	1.0 g/m³ at 25°C	1-5
Bicarbonate	Calculation: from alkalinity and pH, valid where TDS is not >500 mg/L and alkalinity is almost entirely due to hydroxides, carbonates or bicarbonates. APHA 4500-CO_2 D 22nd ed. 2012.	1.0 g/m³ at 25°C	1-5
Total Hardness	Calculation from Calcium and Magnesium. APHA 2340 B 22nd ed. 2012.	1.0 g/m³ as $CaCO_3$	1-5
Electrical Conductivity (EC)	Conductivity meter, 25°C. APHA 2510 B 22nd ed. 2012.	0.1 mS/m	1-5
Total Suspended Solids	Filtration using Whatman 934 AH, Advantec GC-50 or equivalent filters (nominal pore size 1.2 - 1.5µm), gravimetric determination. APHA 2540 D 22nd ed. 2012.	3 g/m³	1-5
Total Dissolved Solids (TDS)	Filtration through GF/C (1.2 µm), gravimetric. APHA 2540 C (modified; drying temperature of 103 - 105°C used rather than 180 ± 2°C) 22nd ed. 2012.	10 g/m³	1-5
Dissolved Aluminium	Filtered sample, ICP-MS, trace level. APHA 3125 B 22nd ed. 2012.	0.003 g/m³	1-5
Dissolved Barium	Filtered sample, ICP-MS, trace level. APHA 3125 B 22nd ed. 2012.	0.00010 g/m³	1-5

Sample Type: Aqueous			
Test	Method Description	Default Detection Limit	Sample No
Dissolved Boron	Filtered sample, ICP-MS, trace level. APHA 3125 B 22nd ed. 2012.	0.005 g/m³	1-5
Dissolved Calcium	Filtered sample, ICP-MS, trace level. APHA 3125 B 22nd ed. 2012.	0.05 g/m³	1-5
Dissolved Iron	Filtered sample, ICP-MS, trace level. APHA 3125 B 22nd ed. 2012.	0.02 g/m³	1-5
Dissolved Magnesium	Filtered sample, ICP-MS, trace level. APHA 3125 B 22nd ed. 2012.	0.02 g/m³	1-5
Dissolved Manganese	Filtered sample, ICP-MS, trace level. APHA 3125 B 22nd ed. 2012.	0.0005 g/m³	1-5
Dissolved Mercury	0.45µm filtration, bromine oxidation followed by atomic fluorescence. US EPA Method 245.7, Feb 2005.	0.00008 g/m³	1-5
Dissolved Potassium	Filtered sample, ICP-MS, trace level. APHA 3125 B 22nd ed. 2012.	0.05 g/m³	1-5
Dissolved Sodium	Filtered sample, ICP-MS, trace level. APHA 3125 B 22nd ed. 2012.	0.02 g/m³	1-5
Chloride	Filtered sample. Ferric thiocyanate colorimetry. Discrete Analyser. APHA 4500 Cl- E (modified from continuous flow analysis) 22nd ed. 2012.	0.5 g/m³	1-5
Fluoride	Direct measurement, ion selective electrode. APHA 4500-F- C 22nd ed. 2012.	0.05 g/m³	1-5
Total Nitrogen	Calculation: TKN + Nitrate-N + Nitrite-N. Please note: The Default Detection Limit of 0.05 g/m³ is only attainable when the TKN has been determined using a trace method utilising duplicate analyses. In cases where the Detection Limit for TKN is 0.10 g/m³, the Default Detection Limit for Total Nitrogen will be 0.11 g/m³.	0.05 g/m³	1-5
Total Ammoniacal-N	Filtered sample. Phenol/hypochlorite colorimetry. Discrete Analyser. (NH_4-N = NH_4+-N + NH_3-N). APHA 4500-NH_3 F (modified from manual analysis) 22nd ed. 2012.	0.010 g/m³	1-5
Nitrite-N	Automated Azo dye colorimetry, Flow injection analyser. APHA 4500-NO_3^- I 22nd ed. 2012 (modified).	0.002 g/m³	1-5
Nitrate-N	Calculation: (Nitrate-N + Nitrite-N) - NO2N, in-House.	0.0010 g/m³	1-5
Nitrate-N + Nitrite-N	Total oxidised nitrogen. Automated cadmium reduction, flow injection analyser. APHA 4500-NO_3^- I 22nd ed. 2012 (modified).	0.002 g/m³	1-5
Total Kjeldahl Nitrogen (TKN)	Total Kjeldahl digestion, phenol/hypochlorite colorimetry. Discrete Analyser. APHA 4500-N_{org} D. (modified) 4500 NH_3 F (modified) 22nd ed. 2012.	0.10 g/m³	1-5
Dissolved Reactive Phosphorus	Filtered sample. Molybdenum blue colorimetry. Discrete Analyser. APHA 4500-P E (modified from manual analysis) 22nd ed. 2012.	0.004 g/m³	1-5
Total Phosphorus	Total phosphorus digestion, ascorbic acid colorimetry. Discrete Analyser. APHA 4500-P B & E (modified from manual analysis) 22nd ed. 2012. Also modified to include the use of a reductant to eliminate interference from arsenic present in the sample. NWASCA, Water & soil Miscellaneous Publication No. 38, 1982.	0.004 g/m³	1-5
Reactive Silica	Filtered sample. Heteropoly blue colorimetry. Discrete analyser. APHA 4500-SiO_2 F (modified from flow injection analysis) 22nd ed. 2012.	0.10 g/m³ as SiO_2	1-5
Sulphate	Filtered sample. Ion Chromatography. APHA 4110 B 22nd ed. 2012.	0.5 g/m³	1-5
Carbonaceous Biochemical Oxygen Demand (cBOD5)	Incubation 5 days, DO meter, nitrification inhibitor added, dilutions, seeded. Analysed at Hill Laboratories - Microbiology; 1 Clow Place, Hamilton. APHA 5210 B (modified) 22nd ed. 2012.	2 g O_2/m³	1-5
Chemical Oxygen Demand (COD), trace level	Dichromate/sulphuric acid digestion in Hach tubes, colorimetry. Trace Level method. APHA 5220 D 22nd ed. 2012.	5 g O_2/m³	1-5
Total Organic Carbon (TOC)	Supercritical persulphate oxidation, IR detection, for Total C. Acidification, purging for Total Inorganic C. TOC = TC -TIC. APHA 5310 C (modified) 22nd ed. 2012.	0.5 g/m³	1-5
Escherichia coli	MPN count using Colilert , incubated at 35°C for 24 hours. Analysed at Hill Laboratories - Microbiology; 1 Clow Place, Hamilton. APHA 9223 B (2004), 22nd ed. 2012.	1 MPN / 100mL	1-5

These samples were collected by yourselves (or your agent) and analysed as received at the laboratory.

Samples are held at the laboratory after reporting for a length of time depending on the preservation used and the stability of the analytes being tested. Once the storage period is completed the samples are discarded unless otherwise advised by the client.

This report must not be reproduced, except in full, without the written consent of the signatory.

Peter Robinson MSc (Hons), PhD, FNZIC
Client Services Manager - Environmental

Hill Laboratories
TRIED, TESTED AND TRUSTED
R J Hill Laboratories Limited
1 Clyde Street Hamilton 3216
Private Bag 3205
Hamilton 3240 New Zealand
T 0508 HILL LAB (44 555 22)
T +64 7 858 2000
E mail@hill-labs.co.nz
W www.hill-laboratories.com

ANALYSIS REPORT

Client:	Geosearch Limited	Lab No:	1782682 SPv1
Contact:	K Browne	Date Received:	27-May-2017
	C/- Geosearch Limited	Date Reported:	13-Jun-2017
	PO Box 43	Quote No:	83792
	Oakura 4345	Order No:	
	TARANAKI	Client Reference:	Cemetery Groundwater
		Submitted By:	K Browne

Sample Type: Aqueous

Sample Name:		GND2623 15.4°C 26-May-2017 10:00 am	GND2624 14.8°C 26-May-2017 11:30 am	GND2625 14.9°C 26-May-2017 12:15 pm	GND2626 15.2°C 26-May-2017 1:10 pm	GND2627 13.8°C 26-May-2017 10:40 am
Lab Number:		1782682.1	1782682.2	1782682.3	1782682.4	1782682.5
Individual Tests						
Sum of Anions	meq/L	1.30	2.8	1.98	0.98	1.21
Sum of Cations	meq/L	1.33	2.8	2.0	0.97	1.21
pH	pH Units	6.3	6.0	6.0	6.4	6.2
Total Alkalinity	g/m³ as $CaCO_3$	43	102	72	32	31
Carbonate	g/m³ at 25°C	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Bicarbonate	g/m³ at 25°C	52	124	88	39	37
Total Hardness	g/m³ as $CaCO_3$	32	76	61	27	31
Electrical Conductivity (EC)	mS/m	13.6	27.9	20.4	10.3	13.0
Total Suspended Solids	g/m³	8	< 3	4	6	9
Total Dissolved Solids (TDS)	g/m³	86	166	120	69	79
Dissolved Aluminium	g/m³	< 0.003	< 0.003	< 0.003	< 0.003	0.042
Dissolved Barium	g/m³	0.0077	0.118	0.063	0.0087	0.0086
Dissolved Boron	g/m³	0.011	0.010	0.014	0.009	0.008
Dissolved Calcium	g/m³	7.7	17.5	14.9	6.3	5.5
Dissolved Iron	g/m³	< 0.02	2.8	0.79	< 0.02	< 0.02
Dissolved Magnesium	g/m³	3.1	7.9	5.7	2.7	4.3
Dissolved Manganese	g/m³	0.0012	9.4	2.4	0.0015	0.0019
Dissolved Mercury	g/m³	< 0.00008	< 0.00008	< 0.00008	< 0.00008	< 0.00008
Dissolved Potassium	g/m³	1.53	4.1	4.6	1.25	0.67
Dissolved Sodium	g/m³	14.9	15.4	11.7	9.3	12.9
Chloride	g/m³	8.7	16.9	11.7	7.1	12.7
Fluoride	g/m³	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Total Nitrogen	g/m³	1.48	0.58	0.77	0.34	1.24
Total Ammoniacal-N	g/m³	< 0.010	0.40	0.55	< 0.010	< 0.010
Nitrite-N	g/m³	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002
Nitrate-N	g/m³	1.45	0.019	< 0.002	0.29	1.22
Nitrate-N + Nitrite-N	g/m³	1.45	0.019	< 0.002	0.29	1.22
Total Kjeldahl Nitrogen (TKN)	g/m³	< 0.10	0.57	0.77	< 0.10	< 0.10
Dissolved Reactive Phosphorus	g/m³	0.010	< 0.004	< 0.004	0.011	< 0.004
Total Phosphorus	g/m³	0.019	0.008	0.018	0.029	0.017
Reactive Silica	g/m³ as SiO_2	23	18.3	22	24	20
Sulphate	g/m³	4.6	12.7	9.6	6.0	7.2
Carbonaceous Biochemical Oxygen Demand ($cBOD_5$)	g O_2/m³	< 2	< 2	< 2	< 2	< 2
Chemical Oxygen Demand (COD)	g O_2/m³	< 6	< 6	< 6	< 6	< 6
Total Organic Carbon (TOC)	g/m³	< 0.5	0.9	< 0.5	0.8	0.6
Escherichia coli	MPN / 100mL	< 1 #	< 1	< 1	< 1	< 1

IANZ ACCREDITED LABORATORY

This Laboratory is accredited by International Accreditation New Zealand (IANZ), which represents New Zealand in the International Laboratory Accreditation Cooperation (ILAC). Through the ILAC Mutual Recognition Arrangement (ILAC-MRA) this accreditation is internationally recognised.
The tests reported herein have been performed in accordance with the terms of accreditation, with the exception of tests marked #, which are not accredited.

Sample Type: Aqueous						
Sample Name:		GND2623 15.4°C 26-May-2017 10:00 am	GND2624 14.8°C 26-May-2017 11:30 am	GND2625 14.9°C 26-May-2017 12:15 pm	GND2626 15.2°C 26-May-2017 1:10 pm	GND2627 13.8°C 26-May-2017 10:40 am
Lab Number:		1782682.1	1782682.2	1782682.3	1782682.4	1782682.5
Heavy metals, dissolved, trace As,Cd,Cr,Cu,Ni,Pb,Zn						
Dissolved Arsenic	g/m³	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010
Dissolved Cadmium	g/m³	< 0.00005	0.00010	< 0.00005	< 0.00005	< 0.00005
Dissolved Chromium	g/m³	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Dissolved Copper	g/m³	< 0.0005	0.0015	< 0.0005	< 0.0005	0.0012
Dissolved Lead	g/m³	< 0.00010	< 0.00010	< 0.00010	< 0.00010	0.00044
Dissolved Nickel	g/m³	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Dissolved Zinc	g/m³	< 0.0010	0.0096	0.0074	0.0013	0.0012
Formaldehyde in Water by DNPH & LCMSMS						
Formaldehyde	g/m³	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02

Analyst's Comments

#1 Please interpret this microbiological result with caution as the sample was > 24 hours old at the time of testing in the laboratory. The sample is required to reach the laboratory with sufficient time to allow testing to commence within 24 hours of sampling.

SUMMARY OF METHODS

The following table(s) gives a brief description of the methods used to conduct the analyses for this job. The detection limits given below are those attainable in a relatively clean matrix. Detection limits may be higher for individual samples should insufficient sample be available, or if the matrix requires that dilutions be performed during analysis.

Sample Type: Aqueous			
Test	Method Description	Default Detection Limit	Sample No
Heavy metals, dissolved, trace As,Cd,Cr,Cu,Ni,Pb,Zn	0.45µm filtration, ICP-MS, trace level. APHA 3125 B 22nd ed. 2012.	0.00005 - 0.0010 g/m³	1-5
Formaldehyde in Water by DNPH & LCMSMS	DNPH derivatisation, extraction, LCMSMS	0.02 g/m³	1-5
Filtration, Unpreserved	Sample filtration through 0.45µm membrane filter.	-	1-5
Total Kjeldahl Digestion	Sulphuric acid digestion with copper sulphate catalyst.	-	1-5
Total Phosphorus Digestion	Acid persulphate digestion.	-	1-5
Total anions for anion/cation balance check	Calculation: sum of anions as mEquiv/L calculated from Alkalinity (bicarbonate), Chloride and Sulphate. Nitrate-N, Nitrite-N, Fluoride, Dissolved Reactive Phosphorus and Cyanide also included in calculation if available. APHA 1030 E 22nd ed. 2012.	0.07 meq/L	1-5
Total cations for anion/cation balance check	Sum of cations as mEquiv/L calculated from Sodium, Potassium, Calcium and Magnesium. Iron, Manganese, Aluminium, Zinc, Copper, Lithium, Total Ammoniacal-N and pH (H^+) also included in calculation if available. APHA 1030 E 22nd ed. 2012.	0.05 meq/L	1-5
pH	pH meter. APHA 4500-H^+ B 22nd ed. 2012. Note: It is not possible to achieve the APHA Maximum Storage Recommendation for this test (15 min) when samples are analysed upon receipt at the laboratory, and not in the field.	0.1 pH Units	1-5
Total Alkalinity	Titration to pH 4.5 (M-alkalinity), autotitrator. APHA 2320 B (Modified for alk <20) 22nd ed. 2012.	1.0 g/m³ as $CaCO_3$	1-5
Carbonate	Calculation: from alkalinity and pH, valid where TDS is not >500 mg/L and alkalinity is almost entirely due to hydroxides, carbonates or bicarbonates. APHA 4500-CO_2 D 22nd ed. 2012.	1.0 g/m³ at 25°C	1-5
Bicarbonate	Calculation: from alkalinity and pH, valid where TDS is not >500 mg/L and alkalinity is almost entirely due to hydroxides, carbonates or bicarbonates. APHA 4500-CO_2 D 22nd ed. 2012.	1.0 g/m³ at 25°C	1-5
Total Hardness	Calculation from Calcium and Magnesium. APHA 2340 B 22nd ed. 2012.	1.0 g/m³ as $CaCO_3$	1-5
Electrical Conductivity (EC)	Conductivity meter, 25°C. APHA 2510 B 22nd ed. 2012.	0.1 mS/m	1-5
Total Suspended Solids	Filtration using Whatman 934 AH, Advantec GC-50 or equivalent filters (nominal pore size 1.2 - 1.5µm), gravimetric determination. APHA 2540 D 22nd ed. 2012.	3 g/m³	1-5
Total Dissolved Solids (TDS)	Filtration through GF/C (1.2 µm), gravimetric. APHA 2540 C (modified; drying temperature of 103 - 105°C used rather than 180 ± 2°C) 22nd ed. 2012.	10 g/m³	1-5
Dissolved Aluminium	Filtered sample, ICP-MS, trace level. APHA 3125 B 22nd ed. 2012.	0.003 g/m³	1-5
Dissolved Barium	Filtered sample, ICP-MS, trace level. APHA 3125 B 22nd ed. 2012.	0.00010 g/m³	1-5

Sample Type: Aqueous			
Test	Method Description	Default Detection Limit	Sample No
Dissolved Boron	Filtered sample, ICP-MS, trace level. APHA 3125 B 22nd ed. 2012.	0.005 g/m³	1-5
Dissolved Calcium	Filtered sample, ICP-MS, trace level. APHA 3125 B 22nd ed. 2012.	0.05 g/m³	1-5
Dissolved Iron	Filtered sample, ICP-MS, trace level. APHA 3125 B 22nd ed. 2012.	0.02 g/m³	1-5
Dissolved Magnesium	Filtered sample, ICP-MS, trace level. APHA 3125 B 22nd ed. 2012.	0.02 g/m³	1-5
Dissolved Manganese	Filtered sample, ICP-MS, trace level. APHA 3125 B 22nd ed. 2012.	0.0005 g/m³	1-5
Dissolved Mercury	0.45µm filtration, bromine oxidation followed by atomic fluorescence. US EPA Method 245.7, Feb 2005.	0.00008 g/m³	1-5
Dissolved Potassium	Filtered sample, ICP-MS, trace level. APHA 3125 B 22nd ed. 2012.	0.05 g/m³	1-5
Dissolved Sodium	Filtered sample, ICP-MS, trace level. APHA 3125 B 22nd ed. 2012.	0.02 g/m³	1-5
Chloride	Filtered sample. Ferric thiocyanate colorimetry. Discrete Analyser. APHA 4500 Cl- E (modified from continuous flow analysis) 22nd ed. 2012.	0.5 g/m³	1-5
Fluoride	Direct measurement, ion selective electrode. APHA 4500-F- C 22nd ed. 2012.	0.05 g/m³	1-5
Total Nitrogen	Calculation: TKN + Nitrate-N + Nitrite-N. Please note: The Default Detection Limit of 0.05 g/m³ is only attainable when the TKN has been determined using a trace method utilising duplicate analyses. In cases where the Detection Limit for TKN is 0.10 g/m³, the Default Detection Limit for Total Nitrogen will be 0.11 g/m³.	0.05 g/m³	1-5
Total Ammoniacal-N	Filtered sample. Phenol/hypochlorite colorimetry. Discrete Analyser. (NH_4-N = NH_4+-N + NH_3-N). APHA 4500-NH_3 F (modified from manual analysis) 22nd ed. 2012.	0.010 g/m³	1-5
Nitrite-N	Automated Azo dye colorimetry, Flow injection analyser. APHA 4500-NO_2- I 22nd ed. 2012 (modified).	0.002 g/m³	1-5
Nitrate-N	Calculation: (Nitrate-N + Nitrite-N) - NO2N. In-House.	0.0010 g/m³	1-5
Nitrate-N + Nitrite-N	Total oxidised nitrogen. Automated cadmium reduction, flow injection analyser. APHA 4500-NO_3- I 22nd ed. 2012 (modified).	0.002 g/m³	1-5
Total Kjeldahl Nitrogen (TKN)	Total Kjeldahl digestion, phenol/hypochlorite colorimetry. Discrete Analyser. APHA 4500-N_{org} D. (modified) 4500 NH_3 F (modified) 22nd ed. 2012.	0.10 g/m³	1-5
Dissolved Reactive Phosphorus	Filtered sample. Molybdenum blue colorimetry. Discrete Analyser. APHA 4500-P E (modified from manual analysis) 22nd ed. 2012.	0.004 g/m³	1-5
Total Phosphorus	Total phosphorus digestion, ascorbic acid colorimetry. Discrete Analyser. APHA 4500-P B & E (modified from manual analysis) 22nd ed. 2012. Also modified to include the use of a reductant to eliminate interference from arsenic present in the sample. NWASCA, Water & soil Miscellaneous Publication No. 38, 1982.	0.004 g/m³	1-5
Reactive Silica	Filtered sample. Heteropoly blue colorimetry. Discrete analyser. APHA 4500-SiO_2 F (modified from flow injection analysis) 22nd ed. 2012.	0.10 g/m³ as SiO_2	1-5
Sulphate	Filtered sample. Ion Chromatography. APHA 4110 B 22nd ed. 2012.	0.5 g/m³	1-5
Carbonaceous Biochemical Oxygen Demand (cBOD5)	Incubation 5 days, DO meter, nitrification inhibitor added, dilutions, seeded. Analysed at Hill Laboratories - Microbiology; 1 Clow Place, Hamilton. APHA 5210 B (modified) 22nd ed. 2012.	2 g O_2/m³	1-5
Chemical Oxygen Demand (COD), trace level	Dichromate/sulphuric acid digestion in Hach tubes, colorimetry. Trace Level method. APHA 5220 D 22nd ed. 2012.	6 g O_2/m³	1-5
Total Organic Carbon (TOC)	Supercritical persulphate oxidation, IR detection, for Total C. Acidification, purging for Total Inorganic C. TOC = TC -TIC. APHA 5310 C (modified) 22nd ed. 2012.	0.5 g/m³	1-5
Escherichia coli	MPN count using Colilert , incubated at 35°C for 24 hours. Analysed at Hill Laboratories - Microbiology; 1 Clow Place, Hamilton. APHA 9223 B (2004), 22nd ed. 2012.	1 MPN / 100mL	1-5

These samples were collected by yourselves (or your agent) and analysed as received at the laboratory.

Samples are held at the laboratory after reporting for a length of time depending on the preservation used and the stability of the analytes being tested. Once the storage period is completed the samples are discarded unless otherwise advised by the client.

This report must not be reproduced, except in full, without the written consent of the signatory.

Ara Heron BSc (Tech)
Client Services Manager - Environmental

Hill Laboratories
TRIED, TESTED **AND TRUSTED**

R J Hill Laboratories Limited
28 Duke Street Frankton 3204
Private Bag 3205
Hamilton 3240 New Zealand

T 0508 HILL LAB (44 555 22)
T +64 7 858 2000
E mail@hill-labs.co.nz
W www.hill-laboratories.com

ANALYSIS REPORT

Client:	Geosearch Limited	Lab No:	1833101
Contact:	K Browne	Date Received:	29-Aug-2017
	C/- Geosearch Limited	Date Reported:	05-Sep-2017
	PO Box 43	Quote No:	83792
	Oakura 4345	Order No:	
	TARANAKI	Client Reference:	Cemetery Groundwater
		Submitted By:	K Browne

Sample Type: Aqueous

Sample Name:		GND2623 28-Aug-2017 9:00 am	GND2624 28-Aug-2017 10:00 am	GND2625 28-Aug-2017 10:20 am	GND2626 28-Aug-2017 10:50 am	GND2627 28-Aug-2017 9:40 am
Lab Number:		1833101.1	1833101.2	1833101.3	1833101.4	1833101.5
Individual Tests						
Sum of Anions	meq/L	1.19	2.9	2.0	0.95	1.26
Sum of Cations	meq/L	1.29	2.8	2.2	0.96	1.26
pH	pH Units	6.2	6.1	6.3	6.2	6.1
Total Alkalinity	g/m³ as $CaCO_3$	39	98	80	30	30
Carbonate	g/m³ at 25°C	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Bicarbonate	g/m³ at 25°C	47	119	98	36	37
Total Hardness	g/m³ as $CaCO_3$	35	79	74	27	35
Electrical Conductivity (EC)	mS/m	13.1	29.9	21.1	10.4	14.0
Total Suspended Solids	g/m³	8	< 3	40	3	< 3
Total Dissolved Solids (TDS)	g/m³	89	167	129	61	91
Dissolved Aluminium	g/m³	< 0.003	< 0.003	< 0.003	0.004	< 0.003
Dissolved Barium	g/m³	0.0078	0.115	0.072	0.0079	0.0088
Dissolved Boron	g/m³	0.011	0.011	0.016	0.008	0.008
Dissolved Calcium	g/m³	8.4	17.5	17.7	6.3	5.7
Dissolved Iron	g/m³	< 0.02	1.69	1.66	< 0.02	0.04
Dissolved Magnesium	g/m³	3.3	6.6	7.3	2.8	4.9
Dissolved Manganese	g/m³	0.0014	10.6	2.6	0.0022	0.0035
Dissolved Mercury	g/m³	< 0.00008	< 0.00008	< 0.00008	< 0.00008	< 0.00008
Dissolved Potassium	g/m³	1.53	4.9	4.4	1.18	0.66
Dissolved Sodium	g/m³	12.6	14.2	10.4	8.9	12.7
Chloride	g/m³	8.9	21	9.9	7.6	16.0
Fluoride	g/m³	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Total Nitrogen	g/m³	0.94	0.90	0.70	0.31	0.88
Total Ammoniacal-N	g/m³	< 0.010	0.77	0.30	< 0.010	< 0.010
Nitrite-N	g/m³	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002
Nitrate-N	g/m³	0.91	< 0.002	< 0.002	0.29	0.79
Nitrate-N + Nitrite-N	g/m³	0.91	< 0.002	< 0.002	0.29	0.79
Total Kjeldahl Nitrogen (TKN)	g/m³	< 0.10	0.90	0.70	< 0.10	< 0.10
Dissolved Reactive Phosphorus	g/m³	0.008	< 0.004	< 0.004	0.010	0.005
Total Phosphorus	g/m³	0.011	< 0.004	0.055	0.012	< 0.004
Reactive Silica	g/m³ as SiO_2	22	19.7	22	25	23
Sulphate	g/m³	4.6	15.7	6.3	5.7	6.9
Carbonaceous Biochemical Oxygen Demand ($cBOD_5$)	g O_2/m³	< 2	< 2	5	< 2	< 2
Chemical Oxygen Demand (COD)	g O_2/m³	< 6	10	10	< 6	< 6
Total Organic Carbon (TOC)	g/m³	< 0.5	1.5	1.2	< 0.5	< 0.5
Escherichia coli	MPN / 100mL	< 1	< 1	< 1	< 1	< 1

IANZ ACCREDITED LABORATORY

This Laboratory is accredited by International Accreditation New Zealand (IANZ), which represents New Zealand in the International Laboratory Accreditation Cooperation (ILAC). Through the ILAC Mutual Recognition Arrangement (ILAC-MRA) this accreditation is internationally recognised.
The tests reported herein have been performed in accordance with the terms of accreditation, with the exception of tests marked *, which are not accredited.

Sample Type: Aqueous						
Sample Name:		GND2623 28-Aug-2017 9:00 am	GND2624 28-Aug-2017 10:00 am	GND2625 28-Aug-2017 10:20 am	GND2626 28-Aug-2017 10:50 am	GND2627 28-Aug-2017 9:40 am
Lab Number:		1833101.1	1833101.2	1833101.3	1833101.4	1833101.5
Heavy metals, dissolved, trace As,Cd,Cr,Cu,Ni,Pb,Zn						
Dissolved Arsenic	g/m³	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010
Dissolved Cadmium	g/m³	< 0.00005	0.00012	< 0.00005	< 0.00005	< 0.00005
Dissolved Chromium	g/m³	0.0005	< 0.0005	< 0.0005	0.0006	0.0008
Dissolved Copper	g/m³	0.0010	0.0020	< 0.0005	< 0.0005	0.0005
Dissolved Lead	g/m³	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010
Dissolved Nickel	g/m³	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Dissolved Zinc	g/m³	< 0.0010	0.0073	0.0045	< 0.0010	0.0030
Formaldehyde in Water by DNPH & LCMSMS						
Formaldehyde	g/m³	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02

SUMMARY OF METHODS

The following table(s) gives a brief description of the methods used to conduct the analyses for this job. The detection limits given below are those attainable in a relatively clean matrix. Detection limits may be higher for individual samples should insufficient sample be available, or if the matrix requires that dilutions be performed during analysis.

Sample Type: Aqueous			
Test	Method Description	Default Detection Limit	Sample No
Heavy metals, dissolved, trace As,Cd,Cr,Cu,Ni,Pb,Zn	0.45µm filtration, ICP-MS, trace level. APHA 3125 B 22nd ed. 2012. Analysed at 1 Clyde Street, Hamilton	0.00005 - 0.0010 g/m³	1-5
Formaldehyde in Water by DNPH & LCMSMS	DNPH derivatisation, extraction, LCMSMS Analysis performed at 1 Clyde Street, Hamilton	0.02 g/m³	1-5
Filtration, Unpreserved	Sample filtration through 0.45µm membrane filter. Analysis performed at 1 Clyde Street, Hamilton.	-	1-5
Total Kjeldahl Digestion	Sulphuric acid digestion with copper sulphate catalyst.	-	1-5
Total Phosphorus Digestion	Acid persulphate digestion.	-	1-5
Total anions for anion/cation balance check	Calculation: sum of anions as mEquiv/L calculated from Alkalinity (bicarbonate), Chloride and Sulphate. Nitrate-N, Nitrite-N, Fluoride, Dissolved Reactive Phosphorus and Cyanide also included in calculation if available. APHA 1030 E 22nd ed. 2012.	0.07 meq/L	1-5
Total cations for anion/cation balance check	Sum of cations as mEquiv/L calculated from Sodium, Potassium, Calcium and Magnesium. Iron, Manganese, Aluminium, Zinc, Copper, Lithium, Total Ammoniacal-N and pH (H^+) also included in calculation if available. APHA 1030 E 22nd ed. 2012.	0.05 meq/L	1-5
pH	pH meter. APHA 4500-H^+ B 22nd ed. 2012. Note: it is not possible to achieve the APHA Maximum Storage Recommendation for this test (15 min) when samples are analysed upon receipt at the laboratory, and not in the field.	0.1 pH Units	1-5
Total Alkalinity	Titration to pH 4.5 (M-alkalinity), autotitrator. APHA 2320 B (Modified for alk <20) 22nd ed. 2012.	1.0 g/m³ as $CaCO_3$	1-5
Carbonate	Calculation: from alkalinity and pH, valid where TDS is not >500 mg/L and alkalinity is almost entirely due to hydroxides, carbonates or bicarbonates. APHA 4500-CO_2 D 22nd ed. 2012.	1.0 g/m³ at 25°C	1-5
Bicarbonate	Calculation: from alkalinity and pH, valid where TDS is not >500 mg/L and alkalinity is almost entirely due to hydroxides, carbonates or bicarbonates. APHA 4500-CO_2 D 22nd ed. 2012.	1.0 g/m³ at 25°C	1-5
Total Hardness	Calculation from Calcium and Magnesium. Analysed at 1 Clyde Street, Hamilton. APHA 2340 B 22nd ed. 2012.	1.0 g/m³ as $CaCO_3$	1-5
Electrical Conductivity (EC)	Conductivity meter, 25°C. APHA 2510 B 22nd ed. 2012.	0.1 mS/m	1-5
Total Suspended Solids	Filtration using Whatman 934 AH, Advantec GC-50 or equivalent filters (nominal pore size 1.2 - 1.5µm), gravimetric determination. Analysis performed at 1 Clyde Street, Hamilton. APHA 2540 D 22nd ed. 2012.	3 g/m³	1-5
Total Dissolved Solids (TDS)	Filtration through GF/C (1.2 µm), gravimetric. Analysis performed at 1 Clyde Street, Hamilton. APHA 2540 C (modified; drying temperature of 103 - 105°C used rather than 180 ± 2°C) 22nd ed. 2012.	10 g/m³	1-5
Dissolved Aluminium	Filtered sample, ICP-MS, trace level. Analysed at 1 Clyde Street, Hamilton. APHA 3125 B 22nd ed. 2012.	0.003 g/m³	1-5
Dissolved Barium	Filtered sample, ICP-MS, trace level. Analysed at 1 Clyde Street, Hamilton. APHA 3125 B 22nd ed. 2012.	0.00010 g/m³	1-5
Dissolved Boron	Filtered sample, ICP-MS, trace level. Analysed at 1 Clyde Street, Hamilton. APHA 3125 B 22nd ed. 2012.	0.005 g/m³	1-5

Sample Type: Aqueous			
Test	Method Description	Default Detection Limit	Sample No
Dissolved Calcium	Filtered sample, ICP-MS, trace level. Analysed at 1 Clyde Street, Hamilton. APHA 3125 B 22nd ed. 2012.	0.05 g/m³	1-5
Dissolved Iron	Filtered sample, ICP-MS, trace level. Analysed at 1 Clyde Street, Hamilton. APHA 3125 B 22nd ed. 2012.	0.02 g/m³	1-5
Dissolved Magnesium	Filtered sample, ICP-MS, trace level. Analysed at 1 Clyde Street, Hamilton. APHA 3125 B 22nd ed. 2012.	0.02 g/m³	1-5
Dissolved Manganese	Filtered sample, ICP-MS, trace level. Analysed at 1 Clyde Street, Hamilton. APHA 3125 B 22nd ed. 2012.	0.0005 g/m³	1-5
Dissolved Mercury	0.45µm filtration, bromine oxidation followed by atomic fluorescence. Analysed at 1 Clyde Street, Hamilton. US EPA Method 245.7, Feb 2005.	0.00008 g/m³	1-5
Dissolved Potassium	Filtered sample, ICP-MS, trace level. Analysed at 1 Clyde Street, Hamilton. APHA 3125 B 22nd ed. 2012.	0.05 g/m³	1-5
Dissolved Sodium	Filtered sample, ICP-MS, trace level. Analysed at 1 Clyde Street, Hamilton. APHA 3125 B 22nd ed. 2012.	0.02 g/m³	1-5
Chloride	Filtered sample. Ferric thiocyanate colorimetry. Discrete Analyser. Analysis performed at 1 Clyde Street, Hamilton. APHA 4500 Cl- E (modified from continuous flow analysis) 22nd ed. 2012.	0.5 g/m³	1-5
Fluoride	Direct measurement, ion selective electrode. Analysis performed at 1 Clyde Street, Hamilton. APHA 4500-F- C 22nd ed. 2012.	0.05 g/m³	1-5
Total Nitrogen	Calculation: TKN + Nitrate-N + Nitrite-N. Please note: The Default Detection Limit of 0.05 g/m³ is only attainable when the TKN has been determined using a trace method utilising duplicate analyses. In cases where the Detection Limit for TKN is 0.10 g/m³, the Default Detection Limit for Total Nitrogen will be 0.11 g/m³.	0.05 g/m³	1-5
Total Ammoniacal-N	Phenol/hypochlorite colourimetry. Flow injection analyser. (NH_4-N = NH_4^+-N + NH_3-N). Analysis performed at 1 Clyde Street, Hamilton. APHA 4500-NH_3 H (modified) 22nd ed. 2012.	0.010 g/m³	1-5
Nitrite-N	Automated Azo dye colorimetry, Flow injection analyser. Analysis performed at 1 Clyde Street, Hamilton. APHA 4500-NO_3^- I 22nd ed. 2012 (modified).	0.002 g/m³	1-5
Nitrate-N	Calculation: (Nitrate-N + Nitrite-N) - NO2N. In-House.	0.0010 g/m³	1-5
Nitrate-N + Nitrite-N	Total oxidised nitrogen. Automated cadmium reduction, flow injection analyser. Analysis performed at 1 Clyde Street, Hamilton. APHA 4500-NO_3^- I 22nd ed. 2012 (modified).	0.002 g/m³	1-5
Total Kjeldahl Nitrogen (TKN)	Total Kjeldahl digestion, phenol/hypochlorite colorimetry. Discrete Analyser. Analysis performed at 1 Clyde Street, Hamilton. APHA 4500-N_{org} D. (modified) 4500 NH_3 F (modified) 22nd ed. 2012.	0.10 g/m³	1-5
Dissolved Reactive Phosphorus	Filtered sample. Molybdenum blue colourimetry. Flow injection analyser. Analysis performed at 1 Clyde Street, Hamilton. APHA 4500-P G (modified), 22nd ed. 2012.	0.004 g/m³	1-5
Total Phosphorus	Total phosphorus digestion, ascorbic acid colorimetry. Discrete Analyser. Analysis performed at 1 Clyde Street, Hamilton. APHA 4500-P B & E (modified from manual analysis) 22nd ed. 2012. Also modified to include the use of a reductant to eliminate interference from arsenic present in the sample. NWASCA, Water & soil Miscellaneous Publication No. 38, 1982.	0.004 g/m³	1-5
Reactive Silica	Filtered sample. Heteropoly blue colorimetry. Discrete analyser. Analysis performed at 1 Clyde Street, Hamilton. APHA 4500-SiO_2 F (modified from flow injection analysis) 22nd ed. 2012.	0.10 g/m³ as SiO_2	1-5
Sulphate	Filtered sample. Ion Chromatography. Analysis performed at 1 Clyde Street, Hamilton. APHA 4110 B 22nd ed. 2012.	0.5 g/m³	1-5
Carbonaceous Biochemical Oxygen Demand (cBOD5)	Incubation 5 days, DO meter, nitrification inhibitor added, dilutions, seeded. Analysed at Hill Laboratories - Microbiology; 1 Clow Place, Hamilton. APHA 5210 B (modified) 22nd ed. 2012.	2 g O_2/m³	1-5
Chemical Oxygen Demand (COD), trace level	Dichromate/sulphuric acid digestion in Hach tubes, colorimetry. Trace Level method. Analysis performed at 1 Clyde Street, Hamilton. APHA 5220 D 22nd ed. 2012.	6 g O_2/m³	1-5
Total Organic Carbon (TOC)	Supercritical persulphate oxidation, IR detection, for Total C. Acidification, purging for Total Inorganic C. TOC = TC -TIC, APHA 5310 C (modified) 22nd ed. 2012.	0.5 g/m³	1-5
Escherichia coli	MPN count using Colilert , incubated at 35°C for 24 hours. Analysed at Hill Laboratories - Microbiology; 1 Clow Place, Hamilton. APHA 9223 B (2004), 22nd ed. 2012.	1 MPN / 100mL	1-5

These samples were collected by yourselves (or your agent) and analysed as received at the laboratory.

Samples are held at the laboratory after reporting for a length of time depending on the preservation used and the stability of the analytes being tested. Once the storage period is completed the samples are discarded unless otherwise advised by the client.

This report must not be reproduced, except in full, without the written consent of the signatory.

Graham Corban MSc Tech (Hons)
Client Services Manager - Environmental

Hill Laboratories
TRIED, TESTED AND TRUSTED
R J Hill Laboratories Limited
28 Duke Street Frankton 3204
Private Bag 3205
Hamilton 3240 New Zealand
T 0508 HILL LAB (44 555 22)
T +64 7 858 2000
E mail@hill-labs.co.nz
W www.hill-laboratories.com

ANALYSIS REPORT

Client:	Geosearch Limited	Lab No:	1878872 SPv1
Contact:	K Browne	Date Received:	17-Nov-2017
	C/- Geosearch Limited	Date Reported:	01-Dec-2017
	PO Box 43	Quote No:	83792
	Oakura 4345	Order No:	
	TARANAKI	Client Reference:	Cemetery Groundwater
		Submitted By:	K Browne

Sample Type: Aqueous

Sample Name:		GND2623 16-Nov-2017 10:10 am	GND2624 16-Nov-2017 11:20 am	GND2625 16-Nov-2017 12:00 pm	GND2626 16-Nov-2017 12:30 pm	GND2627 16-Nov-2017 11:00 am
Lab Number:		1878872.1	1878872.2	1878872.3	1878872.4	1878872.5
Individual Tests						
Sum of Anions	meq/L	1.44	2.6	2.1	1.00	1.29
Sum of Cations	meq/L	1.41	2.6	2.1	0.98	1.32
pH	pH Units	6.2	6.1	6.2	6.2	6.1
Total Alkalinity	g/m³ as $CaCO_3$	48	88	76	32	33
Carbonate	g/m³ at 25°C	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Bicarbonate	g/m³ at 25°C	59	107	92	39	40
Total Hardness	g/m³ as $CaCO_3$	39	75	67	28	36
Electrical Conductivity (EC)	mS/m	15.2	26.6	21.7	10.5	13.8
Total Suspended Solids	g/m³	18	< 3	< 3	< 3	6
Total Dissolved Solids (TDS)	g/m³	106	161	133	79	103
Dissolved Aluminium	g/m³	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003
Dissolved Barium	g/m³	0.0080	0.073	0.058	0.0090	0.0081
Dissolved Boron	g/m³	0.012	0.010	0.012	0.009	0.011
Dissolved Calcium	g/m³	9.6	16.9	15.8	6.7	6.3
Dissolved Iron	g/m³	< 0.02	0.07	1.56	< 0.02	< 0.02
Dissolved Magnesium	g/m³	3.7	8.1	6.8	2.8	4.9
Dissolved Manganese	g/m³	0.0013	9.8	4.1	0.0021	0.0010
Dissolved Mercury	g/m³	< 0.00008	< 0.00008	< 0.00008	< 0.00008	< 0.00008
Dissolved Potassium	g/m³	1.63	3.8	4.2	1.22	0.84
Dissolved Sodium	g/m³	13.3	13.7	10.3	8.7	13.4
Chloride	g/m³	8.6	22	12.6	7.5	15.0
Fluoride	g/m³	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Total Nitrogen	g/m³	1.68	1.16	0.35	0.33	1.37
Total Ammoniacal-N	g/m³	0.012	0.52	0.28	< 0.010	< 0.010
Nitrite-N	g/m³	< 0.002	0.018	< 0.002	< 0.002	< 0.002
Nitrate-N	g/m³	1.62	0.60	< 0.002	0.26	1.30
Nitrate-N + Nitrite-N	g/m³	1.62	0.62	< 0.002	0.26	1.30
Total Kjeldahl Nitrogen (TKN)	g/m³	< 0.10	0.57	0.35	< 0.10	< 0.10
Dissolved Reactive Phosphorus	g/m³	0.011	< 0.004	< 0.004	0.013	0.005
Total Phosphorus	g/m³	0.026	0.005	0.005	0.013	0.009
Reactive Silica	g/m³ as SiO_2	27	21	22	26	26
Sulphate	g/m³	5.5	9.3	12.1	6.1	5.9
Carbonaceous Biochemical Oxygen Demand ($cBOD_5$)	g O_2/m³	< 2	< 2	< 2	< 2	< 2
Chemical Oxygen Demand (COD)	g O_2/m³	< 6	< 6	< 6	< 6	< 6
Total Organic Carbon (TOC)	g/m³	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Escherichia coli	MPN / 100mL	< 1	< 1	< 1	< 1	< 1

IANZ ACCREDITED LABORATORY

This Laboratory is accredited by International Accreditation New Zealand (IANZ), which represents New Zealand in the International Laboratory Accreditation Cooperation (ILAC). Through the ILAC Mutual Recognition Arrangement (ILAC-MRA) this accreditation is internationally recognised.
The tests reported herein have been performed in accordance with the terms of accreditation, with the exception of tests marked *, which are not accredited.

Sample Type: Aqueous						
Sample Name:		GND2623 16-Nov-2017 10:10 am	GND2624 16-Nov-2017 11:20 am	GND2625 16-Nov-2017 12:00 pm	GND2626 16-Nov-2017 12:30 pm	GND2627 16-Nov-2017 11:00 am
Lab Number:		1878872.1	1878872.2	1878872.3	1878872.4	1878872.5
Heavy metals, dissolved, trace As,Cd,Cr,Cu,Ni,Pb,Zn						
Dissolved Arsenic	g/m³	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010
Dissolved Cadmium	g/m³	< 0.00005	0.00010	< 0.00005	< 0.00005	< 0.00005
Dissolved Chromium	g/m³	0.0005	< 0.0005	< 0.0005	0.0005	0.0007
Dissolved Copper	g/m³	0.0017	0.0014	< 0.0005	< 0.0005	< 0.0005
Dissolved Lead	g/m³	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010
Dissolved Nickel	g/m³	< 0.0005	0.0006	0.0006	< 0.0005	< 0.0005
Dissolved Zinc	g/m³	0.0018	0.0061	0.0056	0.0016	0.0025
Formaldehyde in Water by DNPH & LCMSMS						
Formaldehyde	g/m³	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02

SUMMARY OF METHODS

The following table(s) gives a brief description of the methods used to conduct the analyses for this job. The detection limits given below are those attainable in a relatively clean matrix. Detection limits may be higher for individual samples should insufficient sample be available, or if the matrix requires that dilutions be performed during analysis.

Sample Type: Aqueous			
Test	Method Description	Default Detection Limit	Sample No
Heavy metals, dissolved, trace As,Cd,Cr,Cu,Ni,Pb,Zn	0.45µm filtration, ICP-MS, trace level. APHA 3125 B 22nd ed. 2012.	0.00005 - 0.0010 g/m³	1-5
Formaldehyde in Water by DNPH & LCMSMS	DNPH derivatisation, extraction, LCMSMS	0.02 g/m³	1-5
Filtration, Unpreserved	Sample filtration through 0.45µm membrane filter.	-	1-5
Total Kjeldahl Digestion	Sulphuric acid digestion with copper sulphate catalyst.	-	1-5
Total Phosphorus Digestion	Acid persulphate digestion.	-	1-5
Total anions for anion/cation balance check	Calculation: sum of anions as mEquiv/L calculated from Alkalinity (bicarbonate), Chloride and Sulphate. Nitrate-N, Nitrite-N, Fluoride, Dissolved Reactive Phosphorus and Cyanide also included in calculation if available. APHA 1030 E 22nd ed. 2012.	0.07 meq/L	1-5
Total cations for anion/cation balance check	Sum of cations as mEquiv/L calculated from Sodium, Potassium, Calcium and Magnesium. Iron, Manganese, Aluminium, Zinc, Copper, Lithium, Total Ammoniacal-N and pH (H^+) also included in calculation if available. APHA 1030 E 22nd ed. 2012.	0.05 meq/L	1-5
pH	pH meter. APHA 4500-H^+ B 22nd ed. 2012. Note: it is not possible to achieve the APHA Maximum Storage Recommendation for this test (15 min) when samples are analysed upon receipt at the laboratory, and not in the field.	0.1 pH Units	1-5
Total Alkalinity	Titration to pH 4.5 (M-alkalinity), autotitrator. APHA 2320 B (Modified for alk <20) 22nd ed. 2012.	1.0 g/m³ as $CaCO_3$	1-5
Carbonate	Calculation: from alkalinity and pH, valid where TDS is not >500 mg/L and alkalinity is almost entirely due to hydroxides, carbonates or bicarbonates. APHA 4500-CO_2 D 22nd ed. 2012.	1.0 g/m³ at 25°C	1-5
Bicarbonate	Calculation: from alkalinity and pH, valid where TDS is not >500 mg/L and alkalinity is almost entirely due to hydroxides, carbonates or bicarbonates. APHA 4500-CO_2 D 22nd ed. 2012.	1.0 g/m³ at 25°C	1-5
Total Hardness	Calculation from Calcium and Magnesium. APHA 2340 B 22nd ed. 2012.	1.0 g/m³ as $CaCO_3$	1-5
Electrical Conductivity (EC)	Conductivity meter, 25°C. APHA 2510 B 22nd ed. 2012.	0.1 mS/m	1-5
Total Suspended Solids	Filtration using Whatman 934 AH, Advantec GC-50 or equivalent filters (nominal pore size 1.2 - 1.5µm), gravimetric determination. APHA 2540 D 22nd ed. 2012.	3 g/m³	1-5
Total Dissolved Solids (TDS)	Filtration through GF/C (1.2 µm), gravimetric. APHA 2540 C (modified; drying temperature of 103 - 105°C used rather than 180 ± 2°C) 22nd ed. 2012.	10 g/m³	1-5
Dissolved Aluminium	Filtered sample, ICP-MS, trace level. APHA 3125 B 22nd ed. 2012.	0.003 g/m³	1-5
Dissolved Barium	Filtered sample, ICP-MS, trace level. APHA 3125 B 22nd ed. 2012.	0.00010 g/m³	1-5
Dissolved Boron	Filtered sample, ICP-MS, trace level. APHA 3125 B 22nd ed. 2012.	0.005 g/m³	1-5
Dissolved Calcium	Filtered sample, ICP-MS, trace level. APHA 3125 B 22nd ed. 2012.	0.05 g/m³	1-5

Sample Type: Aqueous			
Test	Method Description	Default Detection Limit	Sample No
Dissolved Iron	Filtered sample, ICP-MS, trace level. APHA 3125 B 22nd ed. 2012.	0.02 g/m³	1-5
Dissolved Magnesium	Filtered sample, ICP-MS, trace level. APHA 3125 B 22nd ed. 2012.	0.02 g/m³	1-5
Dissolved Manganese	Filtered sample, ICP-MS, trace level. APHA 3125 B 22nd ed. 2012.	0.0005 g/m³	1-5
Dissolved Mercury	0.45µm filtration, bromine oxidation followed by atomic fluorescence. US EPA Method 245.7, Feb 2005.	0.00008 g/m³	1-5
Dissolved Potassium	Filtered sample, ICP-MS, trace level. APHA 3125 B 22nd ed. 2012.	0.05 g/m³	1-5
Dissolved Sodium	Filtered sample, ICP-MS, trace level. APHA 3125 B 22nd ed. 2012.	0.02 g/m³	1-5
Chloride	Filtered sample. Ferric thiocyanate colorimetry. Discrete Analyser. APHA 4500 Cl- E (modified from continuous flow analysis) 22nd ed. 2012.	0.5 g/m³	1-5
Fluoride	Direct measurement, ion selective electrode. APHA 4500-F⁻ C 22nd ed. 2012.	0.05 g/m³	1-5
Total Nitrogen	Calculation: TKN + Nitrate-N + Nitrite-N. Please note: The Default Detection Limit of 0.05 g/m³ is only attainable when the TKN has been determined using a trace method utilising duplicate analyses. In cases where the Detection Limit for TKN is 0.10 g/m³, the Default Detection Limit for Total Nitrogen will be 0.11 g/m³.	0.05 g/m³	1-5
Total Ammoniacal-N	Phenol/hypochlorite colourimetry. Flow injection analyser. (NH_4-N = NH_4^+-N + NH_3-N). APHA 4500-NH_3 H (modified) 22nd ed. 2012.	0.010 g/m³	1-5
Nitrite-N	Automated Azo dye colorimetry, Flow injection analyser. APHA 4500-NO_3^- I 22nd ed. 2012 (modified).	0.002 g/m³	1-5
Nitrate-N	Calculation: (Nitrate-N + Nitrite-N) - NO2N. In-House.	0.0010 g/m³	1-5
Nitrate-N + Nitrite-N	Total oxidised nitrogen. Automated cadmium reduction, flow injection analyser. APHA 4500-NO_3^- I 22nd ed. 2012 (modified).	0.002 g/m³	1-5
Total Kjeldahl Nitrogen (TKN)	Total Kjeldahl digestion, phenol/hypochlorite colorimetry. Discrete Analyser. APHA 4500-N_{org} D. (modified) 4500 NH_3 F (modified) 22nd ed. 2012.	0.10 g/m³	1-5
Dissolved Reactive Phosphorus	Filtered sample. Molybdenum blue colourimetry. Flow injection analyser. APHA 4500-P G (modified). 22nd ed. 2012.	0.004 g/m³	1-5
Total Phosphorus	Total phosphorus digestion, ascorbic acid colorimetry. Discrete Analyser. APHA 4500-P B & E (modified from manual analysis) 22nd ed. 2012. Also modified to include the use of a reductant to eliminate interference from arsenic present in the sample. NAWASCO, Water & soil Miscellaneous Publication No. 38, 1982.	0.004 g/m³	1-5
Reactive Silica	Filtered sample. Heteropoly blue colorimetry. Discrete analyser. APHA 4500-SiO_2 F (modified from flow injection analysis) 22nd ed. 2012.	0.10 g/m³ as SiO_2	1-5
Sulphate	Filtered sample. Ion Chromatography. APHA 4110 B 22nd ed. 2012.	0.5 g/m³	1-5
Carbonaceous Biochemical Oxygen Demand ($cBOD_5$)	Incubation 5 days, DO meter, nitrification inhibitor added, dilutions, seeded. Analysed at Hill Laboratories - Microbiology, 1 Clow Place, Hamilton. APHA 5210 B (modified) 22nd ed. 2012.	2 g O_2/m³	1-5
Chemical Oxygen Demand (COD), trace level	Dichromate/sulphuric acid digestion in Hach tubes, colorimetry. Trace Level method. APHA 5220 D 22nd ed. 2012.	5 g O_2/m³	1-5
Total Organic Carbon (TOC)	Supercritical persulphate oxidation, IR detection, for Total C. Acidification, purging for Total Inorganic C. TOC = TC -TIC. APHA 5310 C (modified) 22nd ed. 2012.	0.5 g/m³	1-5
Escherichia coli	MPN count using Colilert , incubated at 35°C for 24 hours. Analysed at Hill Laboratories - Microbiology, 1 Clow Place, Hamilton. APHA 9223 B (2004), 22nd ed. 2012.	1 MPN / 100mL	1-5

These samples were collected by yourselves (or your agent) and analysed as received at the laboratory.

Samples are held at the laboratory after reporting for a length of time depending on the preservation used and the stability of the analytes being tested. Once the storage period is completed the samples are discarded unless otherwise advised by the client.

This report must not be reproduced, except in full, without the written consent of the signatory.

Ara Heron BSc (Tech)
Client Services Manager - Environmental

GEOSEARCH

Weather:
27 Feb-17 Hot, dry & calm.
26 May-17 Cool, high overcast, light E wind
28 Aug-17 Light N with heavy showers
16 Nov-17 Warm with light NE wind & occ. showers

Groundwater sample record Mangapouri Cemetery monitoring well (MW1) GND2623, Plantation Rd, New Plymouth
*Surveyed location 1697453 E 5667698N
**Elevation GL at well 180.10 mAMSL

Sample id / date	Sample time	Photo	In-situ measurements						Sample point	Lab/ lab # (Hill)	Comments
			*Temp ºC	Condy mS/m	pH	DO Mg/L	REDOX Potential mV	Pumping WL mBGL			Mp = TOC inside well lid TOC = 600 mm AGL Well T.D dipped 8.7 mBMP (8.1 mBGL) ***PT installed in this well at 6.38 mBGL see gw level monitoring record***
GND2623 27 Feb-17	1230	y	15.4	12.1	6.2	5.88	94	4.27	Outlet peristaltic pump	1730934	Pre-burial baseline sample (Summer). 50mm ID PVC wellscreen 1-8 mBGL. Dedicated Teflon tube 5.1 mBGL. SWL = 4.11 mBGL. Water crystal clear, clean and odourless.
GND2623 26 May-17	10:00	y	15.4	13.6	5.5	3.68	148	4.29		1782682	Pre-burial baseline sample (Autumn). SWL = 3.79 mBGL. Water crystal clear, clean and odourless.
GND2623 28 Aug-17	9:00	y	14.6	13.1	6.5	5.67	142.4	3.87		1833101	Pre-burial baseline sample (Winter). SWL = 3.62 mBGL. Water crystal clear, clean and odourless.
GND2623 16 Nov-17	10:00	y	14.5	11.0	5.9	3.49	80.5	4.83		1878872	Pre-burial baseline sample (Spring). SWL = 4.42 mBGL. Water crystal clear, clean and odourless.

*Taylor Patrick Surveyors 29 Feb-17 **Taranaki Datum 1970

27 Feb-17 26 May-17 28 Aug-17 16 Nov-17

GEOSEARCH

Weather:
27 Feb-17 Hot, dry & calm.
26 May-17 Cool, high overcast, light E wind
28 Aug-17 Light N with heavy showers
16 Nov-17 Warm with light NE wind & occ. showers

Groundwater sample record Mangapouri Cemetery monitoring well (MW2) GND2624, Plantation Rd, New Plymouth
***Surveyed location 1697688E 5667583N**
**** Elevation GL at well 176.19 mASL**

y	Sample time	Photo	In-situ measurements						Sample point	Lab/ lab # (Hill)	Comments Mp = TOC inside well lid TOC = 650 mm AGL Well T.D dipped 6.59 mBMP (5.94 mBGL) ***PT installed in this well at 5.32 mBGL see gw level monitoring record***
			*Temp ^{0}C	Condy mS/m	pH	DO Mg/L	REDOX Potential mV	Pumping WL mBGL			
GND2624 27 Feb-17	15:20	y	15.4	23.7	5.6	3.4	79	-	Outlet peristaltic pump	1730934	Pre-burial baseline sample (Summer). 50mm ID PVC wellscreen 1.1-6 mBGL. Dedicated Teflon tube 5 mBGL. SWL = 3.41 mBGL. Water crystal clear, clean and odourless.
GND2624 26 May-17	11:30	y	14.8	28.7	5.7	0.88	114	2.00		1782682	Pre-burial baseline sample (Autumn). SWL = 1.83 mBGL. Water crystal clear, clean and odourless.
GND2624 28 Aug-17	10:00	y	14.2	28.4	5.9	8.57	127	1.64		1833101	Pre-burial baseline sample (Winter). SWL = 1.55 mBGL. Water crystal clear, clean and odourless.
GND2624 16 Nov-17	11:20	y	14.3	21.0	5.7	0.4	110.2	4.12		1878872	Pre-burial baseline sample (Spring). SWL = 2.92 mBGL. Water crystal clear, clean and odourless.

*Taylor Patrick Surveyors 1 Mar-17 **Taranaki Datum 1970

27 Feb-17 26 May-17 28 Aug-17 16 Nov-17

GEOSEARCH

Weather:
27 Feb-17 Hot, dry & calm.
26 May-17 Cool, high overcast, light E wind
28 Aug-17 Light N with heavy showers
16 Nov-17 Warm with light NE wind & occ. showers

Groundwater sample record Mangapouri Cemetery monitoring well (MW3) GND2625, Plantation Rd, New Plymouth
*Surveyed location 1697702 E 5667463 N
** Elevation GL at well 175.35 mASL

Sample id / date	Sample time	Photo	In-situ measurements						Sample point	Lab/ lab # (Hill)	Comments Mp = TOC inside well lid TOC = 770 mm AGL Well T.D dipped 5.45 mBMP (5.45 mBGL)
			*Temp ^{0}C	Condy mS/m	pH	DO Mg/L	REDOX Potential mV	Pumping WL mBGL			
GND2625 27 Feb-17	1430	y	15.6	18.0	5.73	2.95	24.2	-	Outlet peristaltic pump	1730934	Pre-burial baseline sample (Summer). 50mm ID PVC wellscreen 1.1-5 mBGL. Dedicated Teflon tube 4.5 mBGL. SWL = 2.97 mBGL. Water crystal clear, clean and odourless, with a few opaque specs (? Rust from rusted steel casing).
GND2625 26 May-17	12:15	y	14.9	20.5	5.74	0.43	5.9	2.72		1782682	Pre-burial baseline sample (Autumn). Upstand lengthened Mar-17. SWL = 2.58 mBGL. Water crystal clear, clean with strong foul odour (reduced).
GND2625 28 Aug-17	10:20	y	14.4	20.3	6.1	3.45	8.1	2.96		1833101	Pre-burial baseline sample (Winter). SWL = 2.78 mBGL. Water crystal clear, clean with strong foul odour (reduced).
GND2625 16 Nov-17	12:00	y	14.7	21.3	5.8	0.47	11.9	3.68		1878872	Pre-burial baseline sample (Spring). SWL = 2.98 mBGL. Water crystal clear, clean with strong foul odour (reduced).

*Taylor Patrick Surveyors 1 Mar-17 **Taranaki Datum 1970

27 Feb-17 26 May-17 28 Aug-17 16 Nov-17

GEOSEARCH

Weather:
27 Feb-17 Hot, dry & calm.
26 May-17 Cool, high overcast, light E wind
28 Aug-17 Light N with heavy showers
16 Nov-17 Warm with light NE wind & occ. showers

Groundwater sample record Mangapouri Cemetery monitoring well (MW4) GND2626, Plantation Rd, New Plymouth
***Surveyed location 1697570 E 5667513 N**
**** Elevation GL at well 183.47 mA SL**

Sample id / date	Sample time	Photo	In-situ measurements						Sample point	Lab/ lab # (Hill)	Comments Mp = TOC inside well lid TOC = 900 mm AGL Well T.D dipped 8.38 mBMP (7.48 mBGL)
			*Temp °C	Condy mS/m	pH	DO Mg/L	REDOX Potential mV	Pumping WL mBGL			
GND2626 27 Feb-17	13:40	y	15.4	6.0	5.92	7.4	102	4.72	Outlet peristaltic pump	1730934	Pre-burial baseline sample (Summer). 50mm ID PVC wellscreen 1.1-8 mBGL. Dedicated Teflon tube 6 mBGL. SWL = 3.83 mBGL. Water crystal clear, clean and odourless.
GND2626 26 May-17	13:10	y	15.2	10.39	5.74	6.5	11.2	4.57		1782682	Pre-burial baseline sample (Autumn). SWL = 3.78 mBGL. Water crystal clear, clean and odourless.
GND2626 28 Aug-17	10:50	y	14.4	10.4	5.9	9.57	27.3	4.47		1833101	Pre-burial baseline sample (Winter). SWL = 3.81 mBGL. Water crystal clear, clean and odourless.
GND2626 16 Nov-17	12:30	y	14.1	10.3	5.6	7.44	21.3	4.27		1878872	Pre-burial baseline sample (Spring). SWL = 3.82 mBGL. Water crystal clear, clean and odourless.

*Taylor Patrick Surveyors 1 Mar-17 **Taranaki Datum 1970

27 Feb-17 26 May-17 28 Aug-17 16 Nov-17

GEOSEARCH

Weather:
27 Feb-17 Hot, dry & calm
26 May-17 Cool, high overcast, light E wind
28 Aug-17 Light N with heavy showers
16 Nov-17 Warm with light NE wind & occ. showers

Groundwater sample record Mangapouri Cemetery monitoring well (MW5) GND2627, Plantation Rd, New Plymouth
***Surveyed location 1697587 E 5667689 N**
**** Elevation GL at well 182.46 mASL**

Sample id / date	Sample time	Photo	In-situ measurements						Sample point	Lab/ lab # (Hill)	Comments Mp = TOC inside well lid TOC = 780 mm AGL Well T.D dipped 11.29 mBMP (10.51 mBGL) ***PT installed in this well at 5.12 mBGL see gw level monitoring record***
			*Temp ^{0}C	Condy mS/m	pH	DO Mg/L	REDOX Potential mV	Pumping WL mBGL			
GND2627 27 Feb-17	10:30	y	14.4	9.0	5.8	6.91	101.4	3.82	Outlet peristaltic pump	1730934	Pre-burial baseline sample (Summer). 50mm ID PVC wellscreen 1.1-14 mBGL. Dedicated Teflon tube 5.2 mBGL. SWL = 3.19 mBGL. Water crystal clear, clean and odourless.
GND2627 26 May-17	10:40	y	13.8	12.96	5.48	8.26	146.2	3.57		1782682	Pre-burial baseline sample (Autumn). SWL = 2.73 mBGL. Water crystal clear, clean and odourless.
GND2627 28 Aug-17	9:40	y	13.6	13.3	5.81	9.6	135.1	2.97		1833101	Pre-burial baseline sample (Winter). SWL = 2.6 mBGL. Water crystal clear, clean and odourless.
GND2627 16 Nov-17	11:00	y	13.7	10.8	5.6	7.85	91.4	3.97		1878872	Pre-burial baseline sample (Spring). SWL = 3.38 mBGL. Water crystal clear, clean and odourless.

*Taylor Patrick Surveyors 1 Mar-17 **Taranaki Datum 1970

27 Feb-17 26 May-17 28 Aug-17 16 Nov-17

APPENDIX III

Surface water quality results

Mangapouri Stream

Hill Laboratories
TRIED, TESTED AND TRUSTED

R J Hill Laboratories Limited
28 Duke Street Frankton 3204
Private Bag 3205
Hamilton 3240 New Zealand

T 0508 HILL LAB (44 555 22)
T +64 7 858 2000
E mail@hill-labs.co.nz
W www.hill-laboratories.com

ANALYSIS REPORT

Client:	Geosearch Limited	Lab No:	1855903 SPv1
Contact:	K Browne	Date Received:	06-Oct-2017
	C/- Geosearch Limited	Date Reported:	19-Oct-2017
	PO Box 43	Quote No:	83792
	Oakura 4345	Order No:	
	TARANAKI	Client Reference:	Cemetery Groundwater
		Submitted By:	K Browne

Sample Type: Aqueous

Sample Name:		WKH000524 Upstream Temp=14.1°C 05-Oct-2017 1:20 pm	Mangapouri Downstream Temp=13.6°C 05-Oct-2017 2:00 pm			
Lab Number:		1855903.1	1855903.2			
Individual Tests						
Sum of Anions	meq/L	1.29	1.28	-	-	-
Sum of Cations	meq/L	1.36	1.35	-	-	-
pH	pH Units	7.2	7.1	-	-	-
Total Alkalinity	g/m³ as $CaCO_3$	36	36	-	-	-
Carbonate	g/m³ at 25°C	< 1.0	< 1.0	-	-	-
Bicarbonate	g/m³ at 25°C	44	43	-	-	-
Total Hardness	g/m³ as $CaCO_3$	43	43	-	-	-
Electrical Conductivity (EC)	mS/m	14.0	14.0	-	-	-
Total Suspended Solids	g/m³	< 3	< 3	-	-	-
Total Dissolved Solids (TDS)	g/m³	95	108	-	-	-
Dissolved Aluminium	g/m³	0.009	0.006	-	-	-
Dissolved Barium	g/m³	0.028	0.027	-	-	-
Dissolved Boron	g/m³	0.013	0.012	-	-	-
Dissolved Calcium	g/m³	10.2	10.2	-	-	-
Dissolved Iron	g/m³	0.65	0.36	-	-	-
Dissolved Magnesium	g/m³	4.3	4.4	-	-	-
Dissolved Manganese	g/m³	0.130	0.096	-	-	-
Dissolved Mercury	g/m³	< 0.00008	< 0.00008	-	-	-
Dissolved Potassium	g/m³	2.9	2.9	-	-	-
Dissolved Sodium	g/m³	8.9	8.8	-	-	-
Chloride	g/m³	12.7	12.7	-	-	-
Fluoride	g/m³	< 0.05	< 0.05	-	-	-
Total Nitrogen	g/m³	1.58	1.47	-	-	-
Total Ammoniacal-N	g/m³	0.057	0.037	-	-	-
Nitrite-N	g/m³	0.007	0.007	-	-	-
Nitrate-N	g/m³	1.33	1.27	-	-	-
Nitrate-N + Nitrite-N	g/m³	1.34	1.28	-	-	-
Total Kjeldahl Nitrogen (TKN)	g/m³	0.24	0.19	-	-	-
Dissolved Reactive Phosphorus	g/m³	< 0.004	< 0.004	-	-	-
Total Phosphorus	g/m³	0.016	0.013	-	-	-
Reactive Silica	g/m³ as SiO_2	22	22	-	-	-
Sulphate	g/m³	5.9	6.0	-	-	-
Carbonaceous Biochemical Oxygen Demand ($cBOD_5$)	g O_2/m³	< 2	< 2	-	-	-
Chemical Oxygen Demand (COD)	g O_2/m³	< 6	< 6	-	-	-
Total Organic Carbon (TOC)	g/m³	0.7	0.8	-	-	-

IANZ ACCREDITED LABORATORY

This Laboratory is accredited by International Accreditation New Zealand (IANZ), which represents New Zealand in the International Laboratory Accreditation Cooperation (ILAC). Through the ILAC Mutual Recognition Arrangement (ILAC-MRA) this accreditation is internationally recognised.
The tests reported herein have been performed in accordance with the terms of accreditation, with the exception of tests marked *, which are not accredited.

Sample Type: Aqueous						
Sample Name:		WKH000524 Upstream Temp=14.1°C 05-Oct-2017 1:20 pm	Mangapouri Downstream Temp=13.8°C 05-Oct-2017 2:00 pm			
Lab Number:		1855903.1	1855903.2			
Individual Tests						
Escherichia coli	MPN / 100mL	> 200	> 200	-	-	-
Heavy metals, dissolved, trace As,Cd,Cr,Cu,Ni,Pb,Zn						
Dissolved Arsenic	g/m³	< 0.0010	< 0.0010	-	-	-
Dissolved Cadmium	g/m³	< 0.00005	< 0.00005	-	-	-
Dissolved Chromium	g/m³	< 0.0005	0.0005	-	-	-
Dissolved Copper	g/m³	< 0.0005	< 0.0005	-	-	-
Dissolved Lead	g/m³	< 0.00010	< 0.00010	-	-	-
Dissolved Nickel	g/m³	< 0.0005	< 0.0005	-	-	-
Dissolved Zinc	g/m³	0.0019	0.0015	-	-	-
Formaldehyde in Water by DNPH & LCMSMS						
Formaldehyde	g/m³	< 0.02	< 0.02	-	-	-

SUMMARY OF METHODS

The following table(s) gives a brief description of the methods used to conduct the analyses for this job. The detection limits given below are those attainable in a relatively clean matrix. Detection limits may be higher for individual samples should insufficient sample be available, or if the matrix requires that dilutions be performed during analysis.

Sample Type: Aqueous			
Test	Method Description	Default Detection Limit	Sample No
Heavy metals, dissolved, trace As,Cd,Cr,Cu,Ni,Pb,Zn	0.45µm filtration, ICP-MS, trace level. APHA 3125 B 22nd ed. 2012.	0.00005 - 0.0010 g/m³	1-2
Formaldehyde in Water by DNPH & LCMSMS	DNPH derivatisation, extraction, LCMSMS Analysis performed at 1 Clyde Street, Hamilton	0.02 g/m³	1-2
Filtration, Unpreserved	Sample filtration through 0.45µm membrane filter.	-	1-2
Total Kjeldahl Digestion	Sulphuric acid digestion with copper sulphate catalyst.	-	1-2
Total Phosphorus Digestion	Acid persulphate digestion.	-	1-2
Total anions for anion/cation balance check	Calculation: sum of anions as mEquiv/L calculated from Alkalinity (bicarbonate), Chloride and Sulphate. Nitrate-N, Nitrite-N, Fluoride, Dissolved Reactive Phosphorus and Cyanide also included in calculation if available. APHA 1030 E 22nd ed. 2012.	0.07 meq/L	1-2
Total cations for anion/cation balance check	Sum of cations as mEquiv/L calculated from Sodium, Potassium, Calcium and Magnesium. Iron, Manganese, Aluminium, Zinc, Copper, Lithium, Total Ammoniacal-N and pH (H^+) also included in calculation if available. APHA 1030 E 22nd ed. 2012.	0.05 meq/L	1-2
pH	pH meter. APHA 4500-H^+ B 22nd ed. 2012. Note: It is not possible to achieve the APHA Maximum Storage Recommendation for this test (15 min) when samples are analysed upon receipt at the laboratory, and not in the field.	0.1 pH Units	1-2
Total Alkalinity	Titration to pH 4.5 (M-alkalinity), autotitrator. APHA 2320 B (Modified for alk <20) 22nd ed. 2012.	1.0 g/m³ as $CaCO_3$	1-2
Carbonate	Calculation: from alkalinity and pH, valid where TDS is not >500 mg/L and alkalinity is almost entirely due to hydroxides, carbonates or bicarbonates. APHA 4500-CO_2 D 22nd ed. 2012.	1.0 g/m³ at 25°C	1-2
Bicarbonate	Calculation: from alkalinity and pH, valid where TDS is not >500 mg/L and alkalinity is almost entirely due to hydroxides, carbonates or bicarbonates. APHA 4500-CO_2 D 22nd ed. 2012.	1.0 g/m³ at 25°C	1-2
Total Hardness	Calculation from Calcium and Magnesium. APHA 2340 B 22nd ed. 2012.	1.0 g/m³ as $CaCO_3$	1-2
Electrical Conductivity (EC)	Conductivity meter, 25°C, APHA 2510 B 22nd ed. 2012.	0.1 mS/m	1-2
Total Suspended Solids	Filtration using Whatman 934 AH, Advantec GC-50 or equivalent filters (nominal pore size 1.2 - 1.5µm), gravimetric determination. APHA 2540 D 22nd ed. 2012.	3 g/m³	1-2
Total Dissolved Solids (TDS)	Filtration through GF/C (1.2 µm), gravimetric. APHA 2540 C (modified; drying temperature of 103 - 105°C used rather than 180 ± 2°C) 22nd ed. 2012.	10 g/m³	1-2
Dissolved Aluminium	Filtered sample, ICP-MS, trace level. APHA 3125 B 22nd ed. 2012.	0.003 g/m³	1-2
Dissolved Barium	Filtered sample, ICP-MS, trace level. APHA 3125 B 22nd ed. 2012.	0.00010 g/m³	1-2

Sample Type: Aqueous			
Test	Method Description	Default Detection Limit	Sample No
Dissolved Boron	Filtered sample, ICP-MS, trace level. APHA 3125 B 22nd ed. 2012.	0.005 g/m³	1-2
Dissolved Calcium	Filtered sample, ICP-MS, trace level. APHA 3125 B 22nd ed. 2012.	0.05 g/m³	1-2
Dissolved Iron	Filtered sample, ICP-MS, trace level. APHA 3125 B 22nd ed. 2012.	0.02 g/m³	1-2
Dissolved Magnesium	Filtered sample, ICP-MS, trace level. APHA 3125 B 22nd ed. 2012.	0.02 g/m³	1-2
Dissolved Manganese	Filtered sample, ICP-MS, trace level. APHA 3125 B 22nd ed. 2012.	0.0005 g/m³	1-2
Dissolved Mercury	0.45µm filtration, bromine oxidation followed by atomic fluorescence. US EPA Method 245.7, Feb 2005.	0.00008 g/m³	1-2
Dissolved Potassium	Filtered sample, ICP-MS, trace level. APHA 3125 B 22nd ed. 2012.	0.05 g/m³	1-2
Dissolved Sodium	Filtered sample, ICP-MS, trace level. APHA 3125 B 22nd ed. 2012.	0.02 g/m³	1-2
Chloride	Filtered sample. Ferric thiocyanate colorimetry. Discrete Analyser. APHA 4500 Cl- E (modified from continuous flow analysis) 22nd ed. 2012.	0.5 g/m³	1-2
Fluoride	Direct measurement, ion selective electrode. APHA 4500-F- C 22nd ed. 2012.	0.05 g/m³	1-2
Total Nitrogen	Calculation: TKN + Nitrate-N + Nitrite-N. Please note: The Default Detection Limit of 0.05 g/m³ is only attainable when the TKN has been determined using a trace method utilising duplicate analyses. In cases where the Detection Limit for TKN is 0.10 g/m³, the Default Detection Limit for Total Nitrogen will be 0.11 g/m³.	0.05 g/m³	1-2
Total Ammoniacal-N	Phenol/hypochlorite colourimetry. Flow injection analyser. (NH_4-N = NH_4^+-N + NH_3-N). APHA 4500-NH_3 H (modified) 22nd ed. 2012.	0.010 g/m³	1-2
Nitrite-N	Automated Azo dye colorimetry, Flow injection analyser. APHA 4500-NO_3^- I 22nd ed. 2012 (modified).	0.002 g/m³	1-2
Nitrate-N	Calculation: (Nitrate-N + Nitrite-N) - NO2N. In-House.	0.0010 g/m³	1-2
Nitrate-N + Nitrite-N	Total oxidised nitrogen. Automated cadmium reduction, flow injection analyser. APHA 4500-NO_3^- I 22nd ed. 2012 (modified).	0.002 g/m³	1-2
Total Kjeldahl Nitrogen (TKN)	Total Kjeldahl digestion, phenol/hypochlorite colorimetry. Discrete Analyser. APHA 4500-N_{org} D. (modified) 4500 NH_3 F (modified) 22nd ed. 2012.	0.10 g/m³	1-2
Dissolved Reactive Phosphorus	Filtered sample. Molybdenum blue colourimetry. Flow injection analyser. APHA 4500-P G (modified). 22nd ed. 2012.	0.004 g/m³	1-2
Total Phosphorus	Total phosphorus digestion, ascorbic acid colorimetry. Discrete Analyser. APHA 4500-P B & E (modified from manual analysis) 22nd ed. 2012. Also modified to include the use of a reductant to eliminate interference from arsenic present in the sample. NWASCA, Water & soil Miscellaneous Publication No. 38, 1982.	0.004 g/m³	1-2
Reactive Silica	Filtered sample. Heteropoly blue colorimetry. Discrete analyser. APHA 4500-SiO_2 F (modified from flow injection analysis) 22nd ed. 2012.	0.10 g/m³ as SiO_2	1-2
Sulphate	Filtered sample. Ion Chromatography. APHA 4110 B 22nd ed. 2012.	0.5 g/m³	1-2
Carbonaceous Biochemical Oxygen Demand ($cBOD_5$)	Incubation 5 days, DO meter, nitrification inhibitor added, dilutions, seeded. Analysed at Hill Laboratories - Microbiology: 1 Clow Place, Hamilton. APHA 5210 B (modified) 22nd ed. 2012.	2 g O_2/m³	1-2
Chemical Oxygen Demand (COD), trace level	Dichromate/sulphuric acid digestion in Hach tubes, colorimetry. Trace Level method. APHA 5220 D 22nd ed. 2012.	6 g O_2/m³	1-2
Total Organic Carbon (TOC)	Supercritical persulphate oxidation, IR detection, for Total C. Acidification, purging for Total Inorganic C. TOC = TC -TIC. APHA 5310 C (modified) 22nd ed. 2012.	0.5 g/m³	1-2
Escherichia coli	MPN count using Colilert . Incubated at 35°C for 24 hours. Analysed at Hill Laboratories - Microbiology; 1 Clow Place, Hamilton. APHA 9223 B (2004), 22nd ed. 2012.	1 MPN / 100mL	1-2

These samples were collected by yourselves (or your agent) and analysed as received at the laboratory.

Samples are held at the laboratory after reporting for a length of time depending on the preservation used and the stability of the analytes being tested. Once the storage period is completed the samples are discarded unless otherwise advised by the client.

This report must not be reproduced, except in full, without the written consent of the signatory.

Graham Corban MSc Tech (Hons)
Client Services Manager - Environmental

Hill Laboratories
TRIED, TESTED AND TRUSTED
R J Hill Laboratories Limited
28 Duke Street Frankton 3204
Private Bag 3205
Hamilton 3240 New Zealand
T 0508 HILL LAB (44 555 22)
T +64 7 858 2000
E mail@hill-labs.co.nz
W www.hill-laboratories.com

ANALYSIS REPORT

Client:	Geosearch Limited	Lab No:	1917357
Contact:	K Browne	Date Received:	01-Feb-2018
	C/- Geosearch Limited	Date Reported:	14-Feb-2018
	PO Box 43	Quote No:	83792
	Oakura 4345	Order No:	
	TARANAKI	Client Reference:	Cemetery Groundwater
		Submitted By:	K Browne

Sample Type: Aqueous

Sample Name:		WKH000524 Mangapouri Upstream 31-Jan-2018 8:00 am	WKH000526 Mangapouri Downstream 31-Jan-2018 8:30 am			
Lab Number:		1917357.1	1917357.2			
Individual Tests						
Sum of Anions	meq/L	2.1	2.1	-	-	-
Sum of Cations	meq/L	2.2	2.2	-	-	-
pH	pH Units	7.5	7.7	-	-	-
Total Alkalinity	g/m³ as $CaCO_3$	76	73	-	-	-
Carbonate	g/m³ at 25°C	< 1.0	< 1.0	-	-	-
Bicarbonate	g/m³ at 25°C	92	89	-	-	-
Total Hardness	g/m³ as $CaCO_3$	74	73	-	-	-
Electrical Conductivity (EC)	mS/m	21.5	21.1	-	-	-
Total Suspended Solids	g/m³	< 3	< 3	-	-	-
Total Dissolved Solids (TDS)	g/m³	146	153	-	-	-
Dissolved Aluminium	g/m³	0.028	0.005	-	-	-
Dissolved Barium	g/m³	0.024	0.021	-	-	-
Dissolved Boron	g/m³	0.009	0.010	-	-	-
Dissolved Calcium	g/m³	16.0	15.5	-	-	-
Dissolved Iron	g/m³	0.56	0.34	-	-	-
Dissolved Magnesium	g/m³	8.2	8.3	-	-	-
Dissolved Manganese	g/m³	0.141	0.048	-	-	-
Dissolved Mercury	g/m³	< 0.00008	< 0.00008	-	-	-
Dissolved Potassium	g/m³	3.5	3.7	-	-	-
Dissolved Sodium	g/m³	13.5	13.7	-	-	-
Chloride	g/m³	14.5	14.6	-	-	-
Fluoride	g/m³	< 0.05	< 0.05	-	-	-
Total Nitrogen	g/m³	0.79	0.75	-	-	-
Total Ammoniacal-N	g/m³	0.04	< 0.010	-	-	-
Nitrite-N	g/m³	0.004	< 0.002	-	-	-
Nitrate-N	g/m³	0.63	0.61	-	-	-
Nitrate-N + Nitrite-N	g/m³	0.63	0.61	-	-	-
Total Kjeldahl Nitrogen (TKN)	g/m³	0.17	0.14	-	-	-
Dissolved Reactive Phosphorus	g/m³	0.005	0.011	-	-	-
Total Phosphorus	g/m³	0.029	0.022	-	-	-
Reactive Silica	g/m³ as SiO_2	33	33	-	-	-
Sulphate	g/m³	7.2	6.8	-	-	-
Carbonaceous Biochemical Oxygen Demand ($cBOD_7$)	g O_2/m³	< 2	< 2	-	-	-
Chemical Oxygen Demand (COD)	g O_2/m³	< 6	< 6	-	-	-
Total Organic Carbon (TOC)	g/m³	1.3	< 0.5	-	-	-

IANZ ACCREDITED LABORATORY

This Laboratory is accredited by International Accreditation New Zealand (IANZ), which represents New Zealand in the International Laboratory Accreditation Cooperation (ILAC). Through the ILAC Mutual Recognition Arrangement (ILAC-MRA) this accreditation is internationally recognised.
The tests reported herein have been performed in accordance with the terms of accreditation, with the exception of tests marked *, which are not accredited.

Sample Type: Aqueous						
Sample Name:		WKH000524 Mangapouri Upstream 31-Jan-2018 8:00 am	WKH000526 Mangapouri Downstream 31-Jan-2018 8:30 am			
Lab Number:		1917357.1	1917357.2			
Individual Tests						
Escherichia coli	MPN / 100mL	579	140	-	-	-
Heavy metals, dissolved, trace As,Cd,Cr,Cu,Ni,Pb,Zn						
Dissolved Arsenic	g/m³	< 0.0010	< 0.0010	-	-	-
Dissolved Cadmium	g/m³	< 0.00005	< 0.00005	-	-	-
Dissolved Chromium	g/m³	< 0.0005	< 0.0005	-	-	-
Dissolved Copper	g/m³	0.0007	0.0008	-	-	-
Dissolved Lead	g/m³	< 0.00010	< 0.00010	-	-	-
Dissolved Nickel	g/m³	< 0.0005	< 0.0005	-	-	-
Dissolved Zinc	g/m³	0.0020	< 0.0010	-	-	-
Formaldehyde in Water by DNPH & LCMSMS						
Formaldehyde	g/m³	< 0.02	< 0.02	-	-	-

Analyst's Comments

Please interpret this microbiological result with caution as the sample was > 24 hours old at the time of testing in the laboratory. The sample is required to reach the laboratory with sufficient time to allow testing to commence within 24 hours of sampling.

SUMMARY OF METHODS

The following table(s) gives a brief description of the methods used to conduct the analyses for this job. The detection limits given below are those attainable in a relatively clean matrix. Detection limits may be higher for individual samples should insufficient sample be available, or if the matrix requires that dilutions be performed during analysis.

Sample Type: Aqueous			
Test	Method Description	Default Detection Limit	Sample No
Heavy metals, dissolved, trace As,Cd,Cr,Cu,Ni,Pb,Zn	0.45µm filtration, ICP-MS, trace level. APHA 3125 B 22nd ed. 2012.	0.00005 - 0.0010 g/m³	1-2
Formaldehyde in Water by DNPH & LCMSMS	DNPH derivatisation, extraction, LCMSMS	0.02 g/m³	1-2
Filtration, Unpreserved	Sample filtration through 0.45µm membrane filter.	-	1-2
Total Kjeldahl Digestion	Sulphuric acid digestion with copper sulphate catalyst.	-	1-2
Total Phosphorus Digestion	Acid persulphate digestion.	-	1-2
Total anions for anion/cation balance check	Calculation: sum of anions as mEquiv/L calculated from Alkalinity (bicarbonate), Chloride and Sulphate. Nitrate-N, Nitrite-N, Fluoride, Dissolved Reactive Phosphorus and Cyanide also included in calculation if available. APHA 1030 E 22nd ed. 2012.	0.07 meq/L	1-2
Total cations for anion/cation balance check	Sum of cations as mEquiv/L calculated from Sodium, Potassium, Calcium and Magnesium. Iron, Manganese, Aluminium, Zinc, Copper, Lithium, Total Ammoniacal-N and pH (H^+) also included in calculation if available. APHA 1030 E 22nd ed. 2012.	0.05 meq/L	1-2
pH	pH meter. APHA 4500-H^+ B 22nd ed. 2012. Note: it is not possible to achieve the APHA Maximum Storage Recommendation for this test (15 min) when samples are analysed upon receipt at the laboratory, and not in the field. Samples and Standards are analysed at an equivalent laboratory temperature (typically 18 to 22 °C). Temperature compensation is used.	0.1 pH Units	1-2
Total Alkalinity	Titration to pH 4.5 (M-alkalinity), autotitrator. APHA 2320 B (Modified for alk <20) 22nd ed. 2012.	1.0 g/m³ as $CaCO_3$	1-2
Carbonate	Calculation: from alkalinity and pH, valid where TDS is not >500 mg/L and alkalinity is almost entirely due to hydroxides, carbonates or bicarbonates. APHA 4500-CO_2 D 22nd ed. 2012.	1.0 g/m³ at 25°C	1-2
Bicarbonate	Calculation: from alkalinity and pH, valid where TDS is not >500 mg/L and alkalinity is almost entirely due to hydroxides, carbonates or bicarbonates. APHA 4500-CO_2 D 22nd ed. 2012.	1.0 g/m³ at 25°C	1-2
Total Hardness	Calculation from Calcium and Magnesium. APHA 2340 B 22nd ed. 2012.	1.0 g/m³ as $CaCO_3$	1-2
Electrical Conductivity (EC)	Conductivity meter, 25°C. APHA 2510 B 22nd ed. 2012.	0.1 mS/m	1-2
Total Suspended Solids	Filtration using Whatman 934 AH, Advantec GC-50 or equivalent filters (nominal pore size 1.2 - 1.5µm), gravimetric determination. APHA 2540 D 22nd ed. 2012.	3 g/m³	1-2

Sample Type: Aqueous			
Test	Method Description	Default Detection Limit	Sample No
Total Dissolved Solids (TDS)	Filtration through GF/C (1.2 µm), gravimetric. APHA 2540 C (modified; drying temperature of 103 - 105°C used rather than 180 ± 2°C) 22nd ed. 2012.	10 g/m³	1-2
Dissolved Aluminium	Filtered sample, ICP-MS, trace level. APHA 3125 B 22nd ed. 2012.	0.003 g/m³	1-2
Dissolved Barium	Filtered sample, ICP-MS, trace level. APHA 3125 B 22nd ed. 2012.	0.00010 g/m³	1-2
Dissolved Boron	Filtered sample, ICP-MS, trace level. APHA 3125 B 22nd ed. 2012.	0.005 g/m³	1-2
Dissolved Calcium	Filtered sample, ICP-MS, trace level. APHA 3125 B 22nd ed. 2012.	0.05 g/m³	1-2
Dissolved Iron	Filtered sample, ICP-MS, trace level. APHA 3125 B 22nd ed. 2012.	0.02 g/m³	1-2
Dissolved Magnesium	Filtered sample, ICP-MS, trace level. APHA 3125 B 22nd ed. 2012.	0.02 g/m³	1-2
Dissolved Manganese	Filtered sample, ICP-MS, trace level. APHA 3125 B 22nd ed. 2012.	0.0005 g/m³	1-2
Dissolved Mercury	0.45µm filtration, bromine oxidation followed by atomic fluorescence. US EPA Method 245.7, Feb 2005.	0.00005 g/m³	1-2
Dissolved Potassium	Filtered sample, ICP-MS, trace level. APHA 3125 B 22nd ed. 2012.	0.05 g/m³	1-2
Dissolved Sodium	Filtered sample, ICP-MS, trace level. APHA 3125 B 22nd ed. 2012.	0.02 g/m³	1-2
Chloride	Filtered sample. Ion Chromatography. APHA 4110 B 22nd ed. 2012.	0.5 g/m³	1-2
Fluoride	Direct measurement, ion selective electrode. APHA 4500-F⁻ C 22nd ed. 2012.	0.05 g/m³	1-2
Total Nitrogen	Calculation: TKN + Nitrate-N + Nitrite-N. Please note: The Default Detection Limit of 0.05 g/m³ is only attainable when the TKN has been determined using a trace method utilising duplicate analyses. In cases where the Detection Limit for TKN is 0.10 g/m³, the Default Detection Limit for Total Nitrogen will be 0.11 g/m³.	0.05 g/m³	1-2
Total Ammoniacal-N	Phenol/hypochlorite colourimetry. Flow injection analyser. (NH_4-N = NH_4^+-N + NH_3-N). APHA 4500-NH_3 H (modified) 22nd ed. 2012.	0.010 g/m³	1-2
Nitrite-N	Automated Azo dye colorimetry, Flow injection analyser. APHA 4500-NO_3^- I 22nd ed. 2012 (modified).	0.002 g/m³	1-2
Nitrate-N	Calculation: (Nitrate-N + Nitrite-N) - NO2N. In-House.	0.0010 g/m³	1-2
Nitrate-N + Nitrite-N	Total oxidised nitrogen. Automated cadmium reduction, flow injection analyser. APHA 4500-NO_3^- I 22nd ed. 2012 (modified).	0.002 g/m³	1-2
Total Kjeldahl Nitrogen (TKN)	Total Kjeldahl digestion, phenol/hypochlorite colorimetry. Discrete Analyser. APHA 4500-N_{org} D. (modified) 4500 NH_3 F (modified) 22nd ed. 2012.	0.10 g/m³	1-2
Dissolved Reactive Phosphorus	Filtered sample. Molybdenum blue colourimetry. Flow injection analyser. APHA 4500-P G (modified). 22nd ed. 2012.	0.004 g/m³	1-2
Total Phosphorus	Total phosphorus digestion, ascorbic acid colorimetry. Discrete Analyser. APHA 4500-P B & E (modified from manual analysis) 22nd ed. 2012. Also modified to include the use of a reductant to eliminate interference from arsenic present in the sample. NAWASCO, Water & soil Miscellaneous Publication No. 38, 1982.	0.004 g/m³	1-2
Reactive Silica	Filtered sample. Heteropoly blue colorimetry. Discrete analyser. APHA 4500-SiO_2 F (modified from flow injection analysis) 22nd ed. 2012.	0.10 g/m³ as SiO_2	1-2
Sulphate	Filtered sample. Ion Chromatography. APHA 4110 B 22nd ed. 2012.	0.5 g/m³	1-2
Carbonaceous Biochemical Oxygen Demand ($cBOD_5$)	Incubation 5 days, DO meter, nitrification inhibitor added, dilutions, seeded. APHA 5210 B (modified) 22nd ed. 2012.	2 g O_2/m³	1-2
Chemical Oxygen Demand (COD), trace level	Dichromate/sulphuric acid digestion in Hach tubes, colorimetry. Trace Level method. APHA 5220 D 22nd ed. 2012.	6 g O_2/m³	1-2
Total Organic Carbon (TOC)	Supercritical persulphate oxidation, IR detection, for Total C. Acidification, purging for Total Inorganic C. TOC = TC -TIC. APHA 5310 C (modified) 22nd ed. 2012.	0.5 g/m³	1-2
Escherichia coli	MPN count using Colilert , incubated at 35°C for 24 hours. APHA 9223 B (2004), 22nd ed. 2012.	1 MPN / 100mL	1-2

These samples were collected by yourselves (or your agent) and analysed as received at the laboratory.

Samples are held at the laboratory after reporting for a length of time depending on the preservation used and the stability of the analytes being tested. Once the storage period is completed the samples are discarded unless otherwise advised by the client.

This report must not be reproduced, except in full, without the written consent of the signatory.

Ara Heron BSc (Tech)
Client Services Manager - Environmental

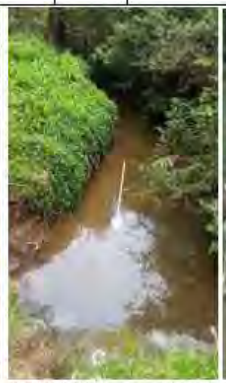
GEOSEARCH

Weather:
5 Oct-17 - Fine after recent rain. Overcast with light N wind.
31 Jan-18 – Fine, hot dry spell. Building NE to rain.

Surface water sample record Mangapouri Stream at cemetery, Plantation Rd, New Plymouth

Sample id / date	Sample time	Photo	In-situ measurements						Lab/ lab # (Hill)	Comments
			Temp °C	Specific cond. uS/cm	Cond. mS/m	pH	DO			
							Mg/L	%		
WKH000524 Mangapouri upstream 5 Oct-17	13:20	y	14.1	-	14.0	7.63	9.68	95.4	1855903	Pre-burial baseline sample wet season – upstream of cemetery (1 on photo below). Access site from culvert on downstream side of 5H3. Collect sample from downstream side of culvert crossing.
WKH000526 Mangapouri downstream 5 Oct-17	14:00	y	13.8	-	14.0	7.44	9.02	88.4		Pre-burial baseline sample wet season – downstream of cemetery (2 on photo below). Access site from vehicle track down to Waiwhakaiho River. Collect sample from upstream side of culvert crossing.
WKH000524 upstream 31 Jan-18	8:00	Y	18.9	0.214	18.93	7.17	8.25	88.7	1917357	Pre-burial baseline sample dry season – upstream of cemetery (1 photo below).
WKH000526 Mangapouri downstream 31 Jan-18	8:30	y	18.7	0.210	18.46	7.48	8.31	89.2		Pre-burial baseline sample dry season – downstream of cemetery (2 photo below).

1. WKH000524 Mangapouri u/s 5 Oct-17



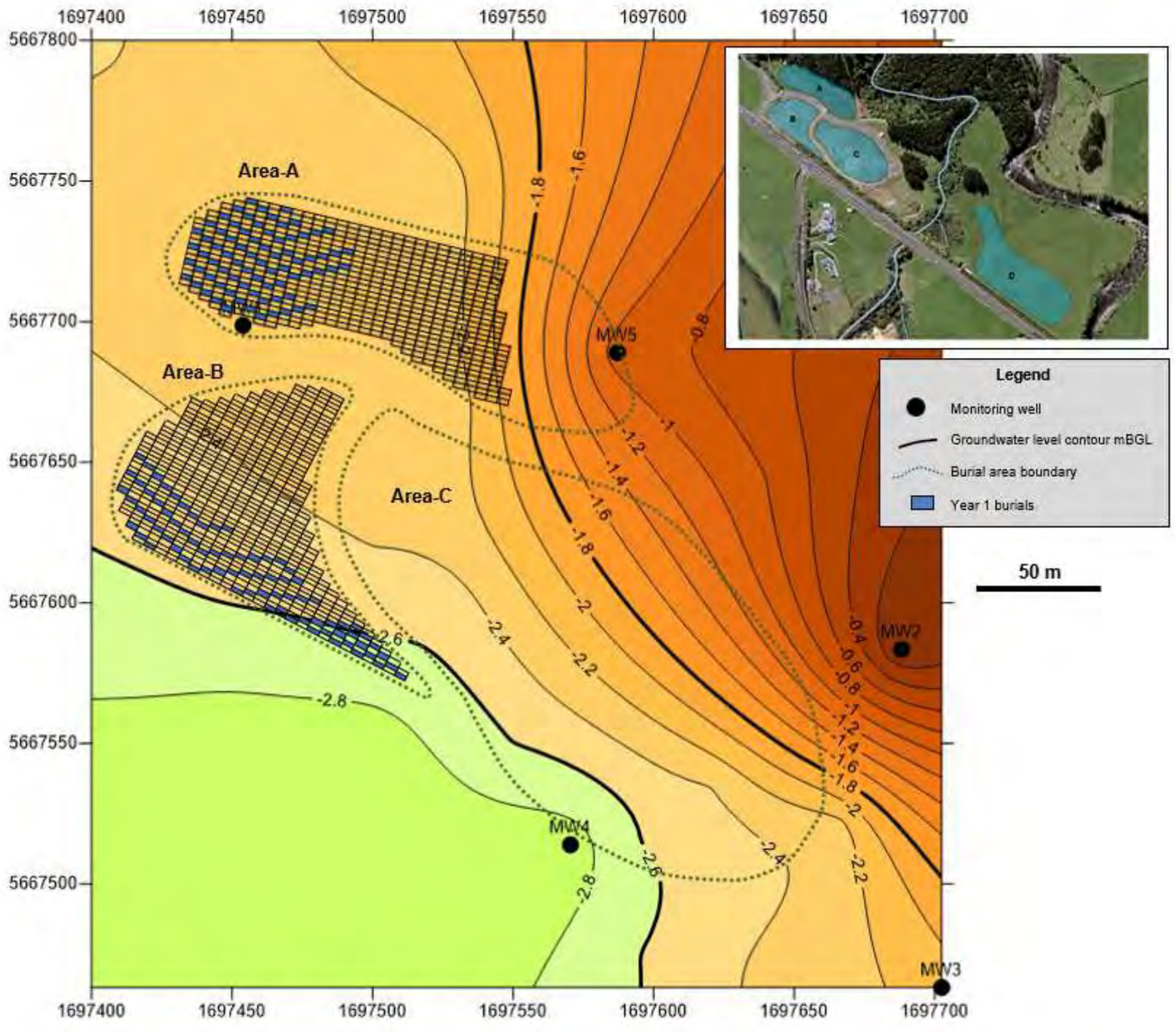
2. WKH000526 Mangapouri d/s 5 Oct-17

1. WKH000524 Mangapouri u/s 31 Jan-18

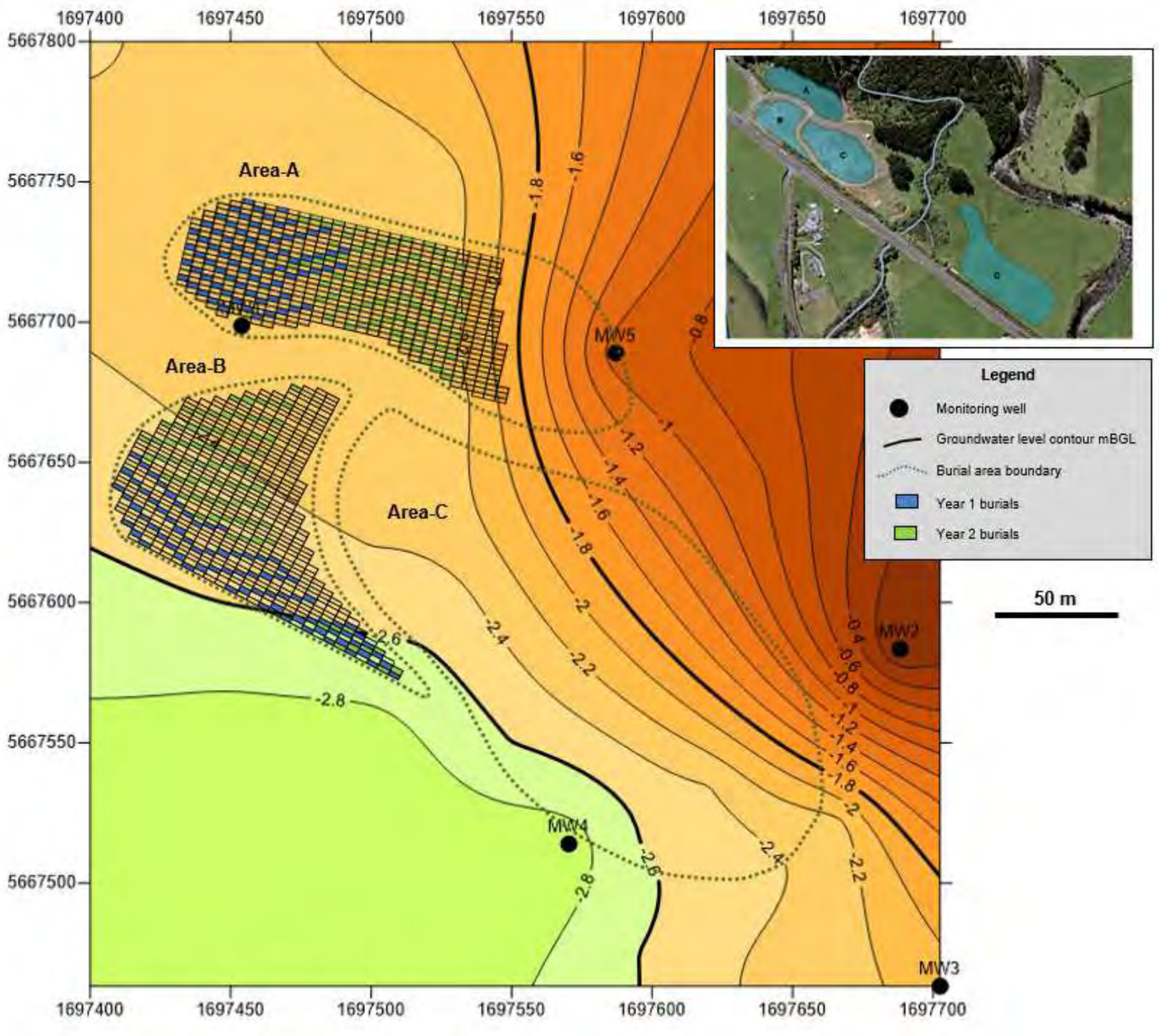
2 WKH000526 Mangapouri d/s 31 Jan-18

APPENDIX IV

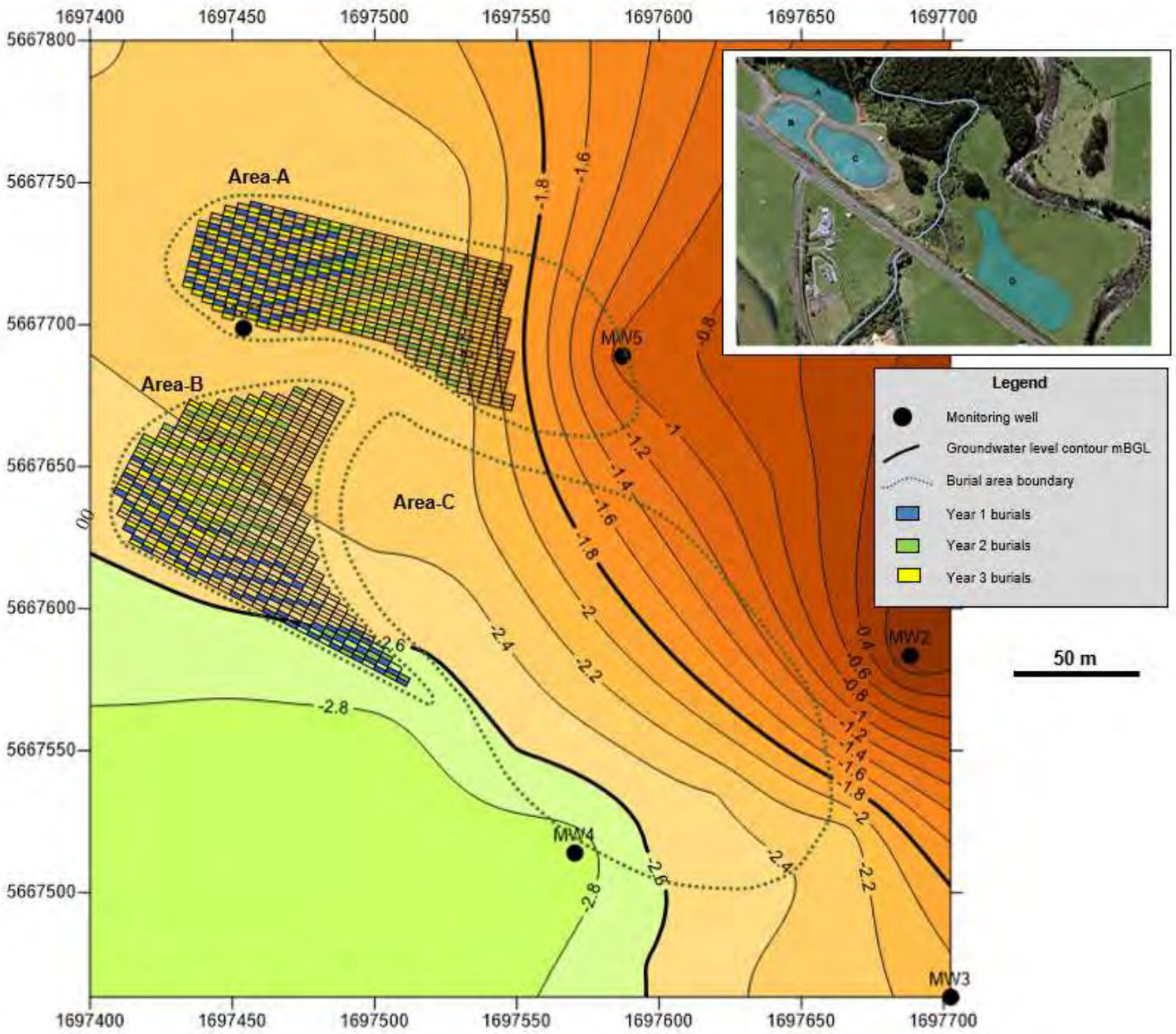
Burial pattern in area A & B for first five years



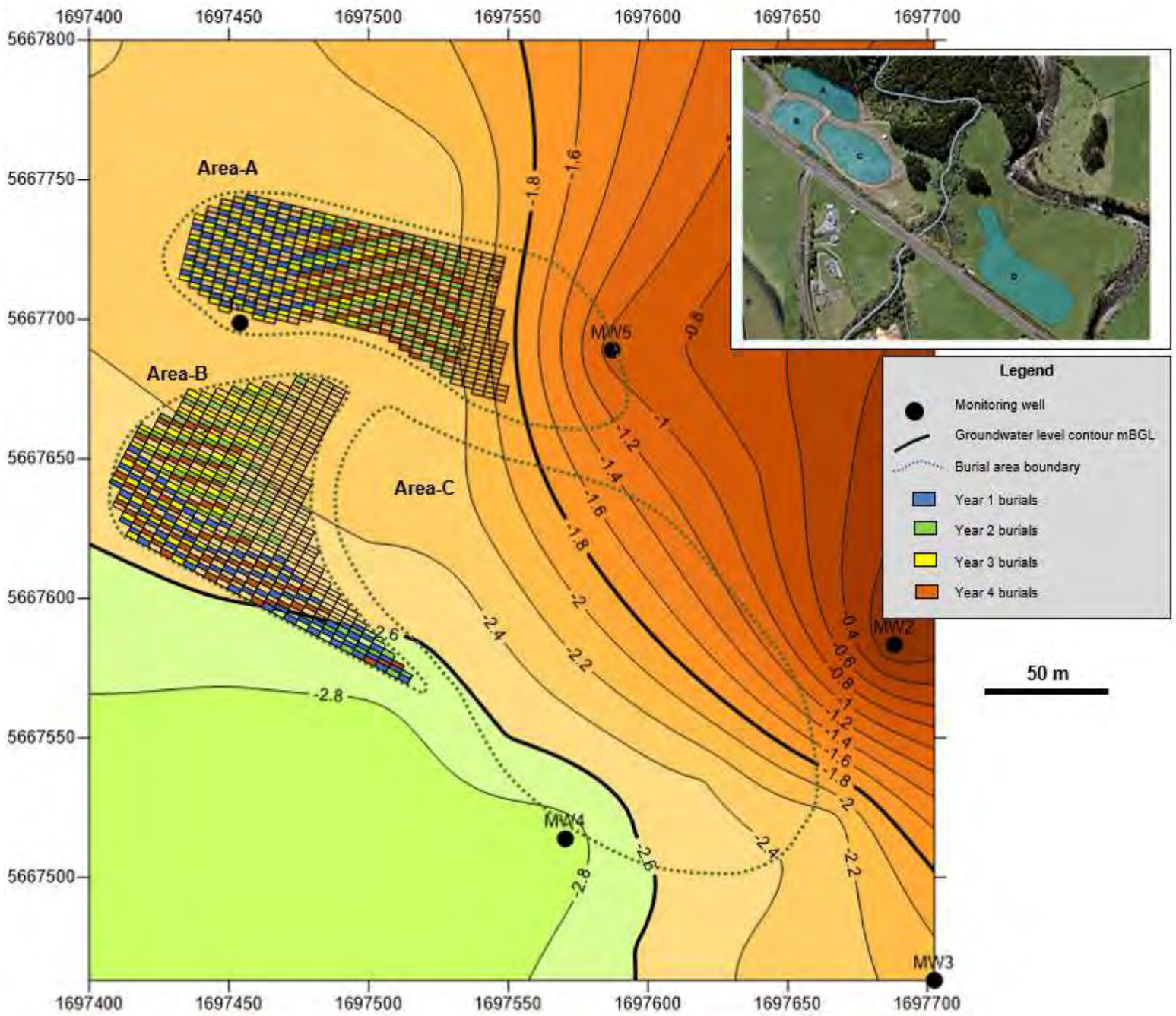
Year 1 pattern of burials in area A and B over predicted 100-year groundwater high level contours



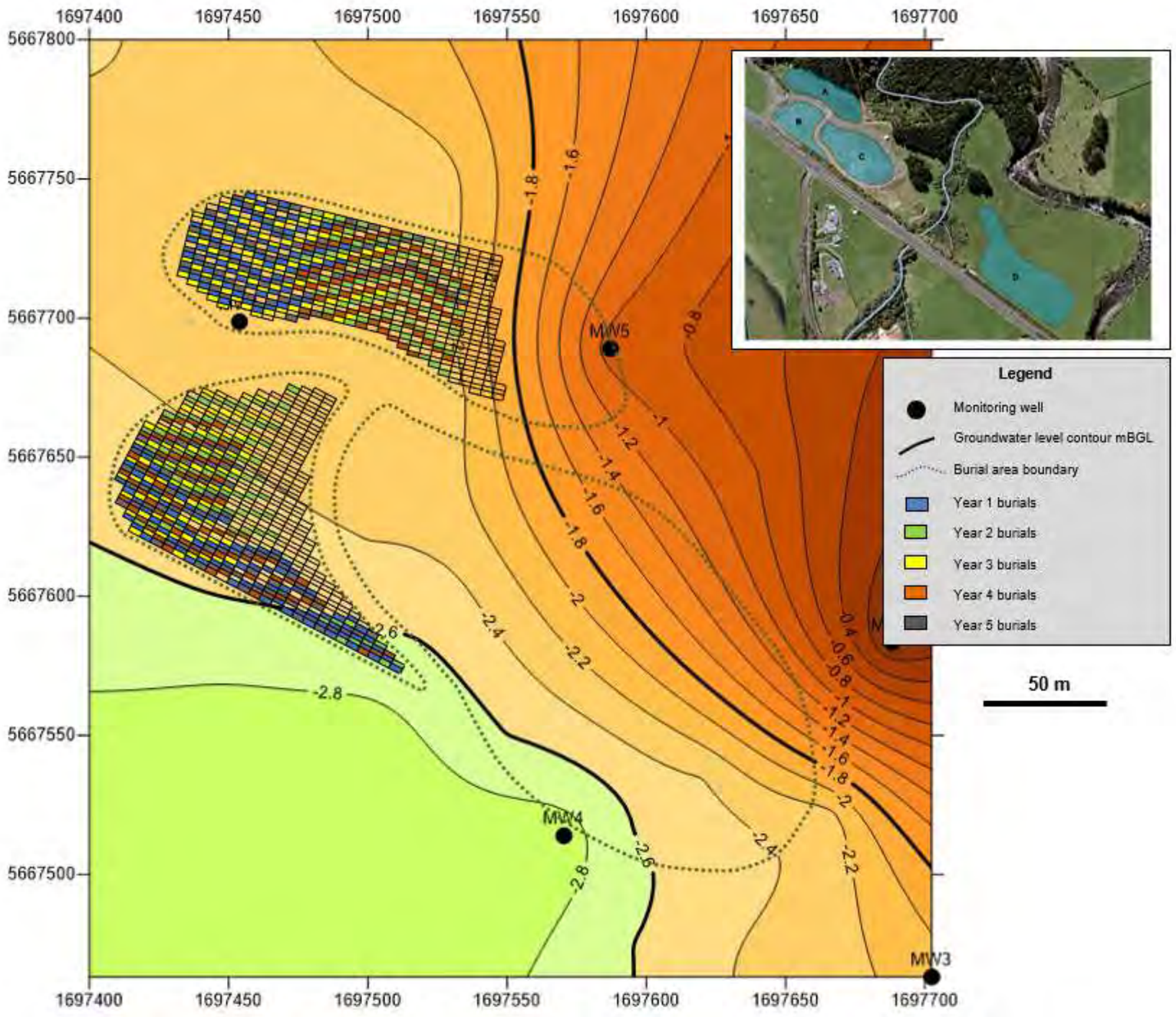
Year 2 pattern of burials in area A and B over predicted 100-year groundwater high level contours



Year 3 pattern of burials in area A and B over predicted 100-year groundwater high level contours



Year 4 pattern of burials in area A and B over predicted 100-year groundwater high level contours



Year 5 pattern of burials in area A and B over predicted 100-year groundwater high level contours

geosearch.co.nz

m 027 2424 333