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Project Number 18043.000.001

Preliminary Hydrological Assessment (Groundwater)

118 Montgomerie Road, Mangere, Auckland

Submitted to:
Goodman Nominee (NZ) Limited
Level 2, KPMG Centre
18 Viaduct Harbour Avenue
Auckland 1010

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Executive Summary

The following summarises the finding of a preliminary hydrogeological assessment of the property at 118 Montgomerie Road, Mangere, Auckland (herein referred to as 'the site'). This work has been carried out by ENGEO Ltd at the request of Goodman Nominee (NZ) Limited. It is a requirement that any user of this report review the document in its entirety, including all appendices.

Item	Summary Commentary
Groundwater Mapping, Flow, & Yield	Groundwater levels across the site are shallower than the depth of some open-channel drainage lines. Shallow seeps and groundwater discharge to existing channels is possible, and is likely two-way flow (i.e. in / out of drains / groundwater).
	No indication of groundwater springs was observed within the site. Springs associated with groundwater flows within the site are considered unlikely due to low topographic differences and hydraulic gradients, and necessary geomorphic relationships.
	The natural direction of groundwater was anticipated to be either directly south towards Oruarangi Creek or north towards the topographic low in the Waitomokia crater tuff-ring and the natural outflow to the Manukau Harbour. However, groundwater flow derived from onsite piezometer monitoring show that flow is predominantly towards the southeast, the same as the flow direction in the constructed drainages (c.1944) that discharge directly to the Oruarangi Creek.
	Measured groundwater level response indicates that natural recharge of rainfall into the volcanic aquifer is relatively low and is primarily maintained by constant leakage form the saturated alluvial material. Local abstraction bores targeting deeper Waitemata aquifer units indicates that the Waitomokia basalt aquifer is a low-yielding groundwater resource.
Groundwater Quality	*E. coli* levels in excess of Drinking Water Maximum Allowable Values (MAVs), and the presence of chlordanes in excess of MAV, precludes any potable use of groundwater without treatment. High dissolved iron (Fe) concentrations would constrain potential industrial use.
	Increasing electrical conductivity (EC) and differences in hydrogeochemistry towards the north of site indicate the presence of a calcium sulfate dominant saline wedge extending from the Manukau Harbour at depth below the site, with shallow groundwater being comparable to a saline / fresh water mixing zone and 'brackish' in nature.
	The overall quality of groundwater is considered to be poor, and not useable for either potable or industrial applications with appreciable treatment.
Offsite Connectivity	Due to the Oruarangi Creek groundwater divide and physical separation between the basalt aquifers it is considered improbable that site infiltration within Waitomokia supports spring discharge at Otuataua. Local hydraulic gradients and relative elevation differences between Waitomokia and Otuataua indicate that spring discharge originating from Waitomokia infiltration is likely to be submarine within the Manukau Harbour.
Development Impacts	Assuming the incorporation of peat recharge pits to prevent further consolidation settlement post-development (as outlined in Auckland Council GD07), no adverse effect on aquifer flows are anticipated.

1 Introduction

ENGEO Ltd was requested by Goodman Nominee (NZ) Limited to undertake a preliminary hydrological assessment (groundwater) of the property at 118 Montgomerie Road, Mangere, Auckland (herein referred to as 'the site'). This work has been carried out in accordance with our signed agreement dated 20 October 2022. The purpose of the assessment was to support a Master Planning process, as well as addressing queries raised by local iwi, for the proposed redevelopment of approximately 32 hectares of the site at 118 Montgomerie Road, Mangere.

Our assessment comprised:

- A desktop review of available geological and groundwater information (reports and maps) to develop a hydrogeological conceptual site model.
- A preliminary site walkover to:
    - Locate and confirm functionality of existing piezometers and locate visible springs.
    - Carry out groundwater quality field monitoring and collect of groundwater samples for laboratory analysis for potable water supply.
- Continuous monitoring of groundwater levels was undertaken at five minute intervals from 8 to 29 November 2022 in five existing piezometers across the site.
- Preparation of a groundwater contour map from monitoring data.
- High-level geomorphologic analyses to assess potential for groundwater seeps and springs and subsequent ground truthing field mapping.
- Laboratory analysis of water quality samples for:
    - Water type characterisation.
    - Comparison against potable water supply standards and environmental guidelines.
- Preliminary assessment (qualitative / semi-quantitative) of anticipated preloading effects on the underlying aquifer and groundwater regime.
- Preliminary assessment of potential groundwater impacts arising from site development.

The scope of work did not include collection or analyses of surface water samples, or the installation and monitoring of additional groundwater monitoring piezometers.

2 Site Description

The site at 118 Montgomerie Road is located on the Villa Maria winery / vineyard estate in Mangere, Auckland. The site consists of a total of approximately 42 ha of former agricultural land (closed vineyard area) and the winery and hospitality facilities which are still operating at the time of this report.

In total, the site is comprised of no less than eight land parcels (whole or in part) that extend across the Waitomokia volcanic crater. The most elevated portion of the site is along the crater rim which extends around the western, southern, and eastern boundaries. The Oruarangi Creek is located to the south of the site at the outer base of the crater rim. The average ground elevation across the vineyards is approximately 5.5 mRL, increasing to approximately 9.5 mRL around the winery, and flanked by the crest of the crater tuff ring that varies between approximately 13 and 20 mRL.

Primary access / egress is from Montgomerie Road to the east, descending via a paved driveway from the crater rim across the more-or-less level former vineyard area, to the winery near the western side of the site. One-way secondary access for heavy vehicles and site staff is from Oruarangi Road to the west, directly to the rear of the winery. A one-way secondary exit extends from the winery to the north back onto Oruarangi Road. Paddocks adjacent to the secondary exist are slightly elevated above the former vineyard area.

The cumulative site area is approximately horseshoe in shape, partially surrounding the IH Wedding & Sons quarry site to the north. The quarry occupies the location of the basalt rock cone itself (now quarried to be level with the vineyard).

Existing drainage lines on-site extend along the northern boundary, adjacent to the quarry, with a line extending south to the southern edge of the crater rim. A further drainage line flows from west to east along the southern edge of the crater rim, collecting from the north of the site, and discharges off-site near the south-eastern corner towards tributaries of the Oruarangi Creek. A constructed pond is located towards the south-western end of the vineyard area, adjacent to the winery facilities.

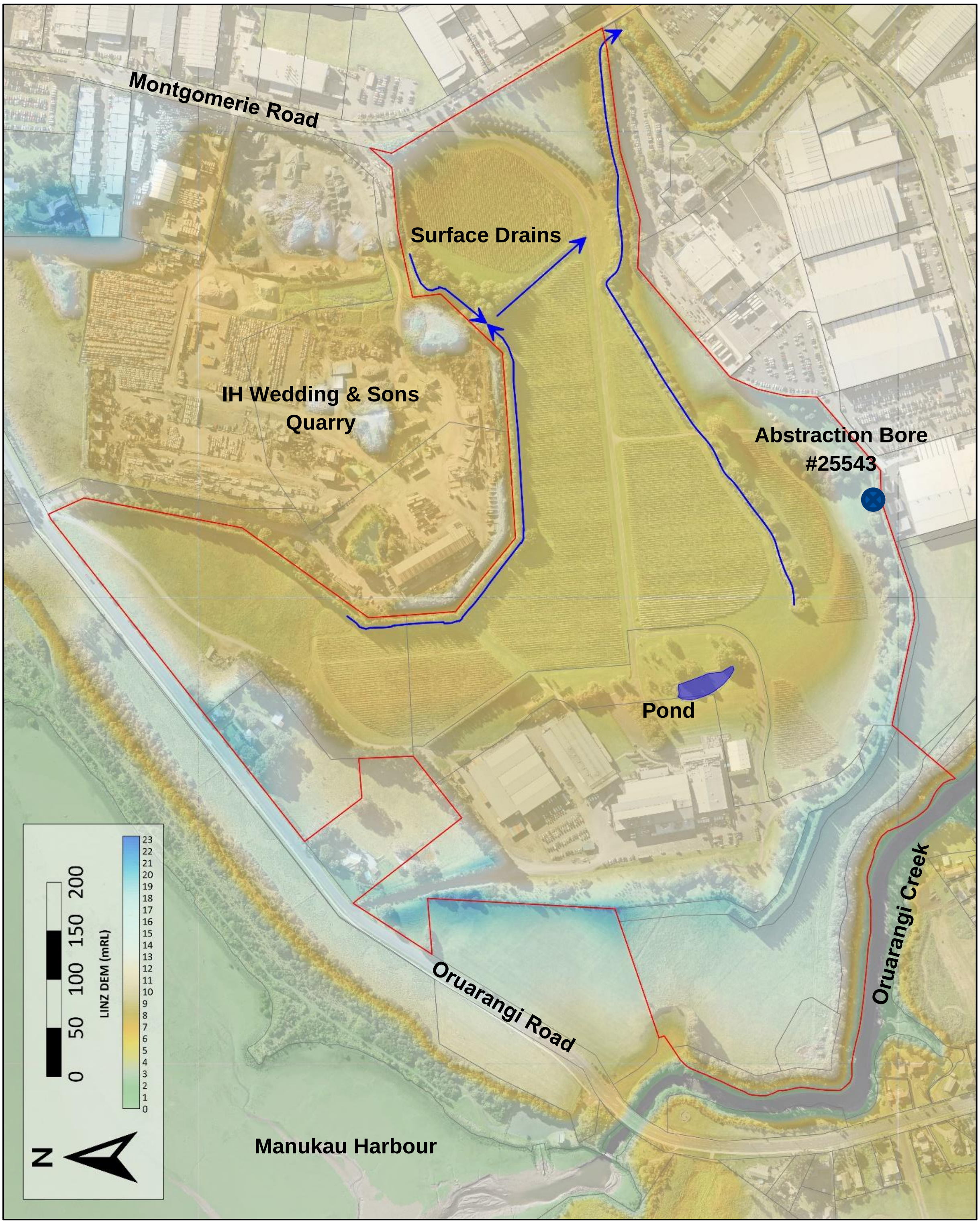
The Oruarangi Creek to the south and Manukau Harbour to the west represent Constant Head Boundaries for groundwater. Both are saline tidal environments, with the Oruarangi Creek and its tributaries expected to become increasingly brackish towards the southeast.

An existing groundwater abstraction bore is located midway along the southern site boundary. Reference to the drillers log available from the New Zealand Geotechnical Database[1] shows that the bore was completed by Drillwell Exploration NZ Ltd in 2001 (Permit #25543) and extend to a depth of 100.6 m. The drillers log indicates that volcanic tuff (crater ring) extended to approximately 12 m bgl, being underlain by alluvial deposits approximately 52 m bgl (base of Kaawa formation shell beds) and then Waitemata Group sandstone. The bore is cased to approximately 42 m bgl, with a static level water level at the time of 16.3 m bgl, being representative of deeper regional aquifer system.

General site features are shown in Figure 1.

[1] https://www.nzgd.org.nz/

Figure 1: General Site Layout



3 Previous Investigations & Assessments

Numerous previous site investigations have been carried out for the site. Recent reports carried out by ENGEO Ltd, and by other parties, and were reviewed for relevance as part of this assessment, are:

- ENGEO: Environmental Due Diligence Investigation - 350, 400, 470 Oruarangi Road, Mangere, Auckland; Our Reference 18043.000.000_03, Rev. 1, dated 16 March 2021.
- INITIA: Geotechnical Factual Report – Villa Maria; Reference P-000982-2 Rev 0, dated May 2022.
- INITIA: Villa Maria – Settlement Analyses Memo; Reference P-000982-2, dated May 2022.
- Te Kawerau Iwi Tiaki Trust: Cultural Impact Assessment (CIA) for Industrial Development of Waitomokia (Villa Maria Estate); Reference TKITT000072, dated October 2022.
- CFG Heritage: Waitomokia: Archaeological Assessment; Reference 22-1378, dated November 2022.

Additional reports, understood to have been supplied to the client by the vendor, and either referenced within the reports above, and / or reviewed in part for this assessment, are:

- Harrison Grierson Consultants: Geotechnical Investigation of 350 Oruarangi Road, 2000.
- CMW Geosciences: Geotechnical Investigations, 2019 & 2020.

Of particular relevance to our current assessment is the CIA prepared by Te Kawerau Iwi Tiaki Trust, which stated that:

> "Waitomokia is an important source of groundwater recharge on the peninsula and feeds the various springs around Ihumatao. Groundwater within the basin varies from 0.6 m to 1.5 m below ground level and could be perched or influenced by tidal force."

4 Published Geology

Reference to the GNS New Zealand Geological Web Map[2] (Figure 2) shows that the site straddles the crater and tuff ring of the Waitomokia volcanic centre, being part of the Auckland Volcanic Field (AVF) of the Kerikeri Volcanic Group. The crater is mapped as being partially filled with Holocene alluvium (Q1a; <14kya) of the Tauranga Group. Older Puketoka Formation alluvium (24kya to 2.0mya) of the Tauranga Group extends across the inland areas to the east and south of the site.

Lindsay & Leonard (2009)[3] indicate an approximate age for the Waitomokia centre of greater than 32kya (±6ky), being relative to the Pukeiti volcanic centre located in the north-eastern area of the Otuataua Stonefields Historic Reserve. No dating information for Waitomokia was presented, and the age is established as stratigraphic relationship only. Comparatively, the Otuataua volcanic centre further to the south-west has been dated as between 29kya (±10ky) to 36kya (±6ky).

[2] GNS, 2001; https://data.gns.cri.nz/geology/; Sheet 3 (Auckland) 1:250k Geological Map
[3] Lindsay & Leonard, 2009; Age of the Auckland Volcanic Field, IESE Report 1-2009.02

Figure 2: Local Geology (GNS)

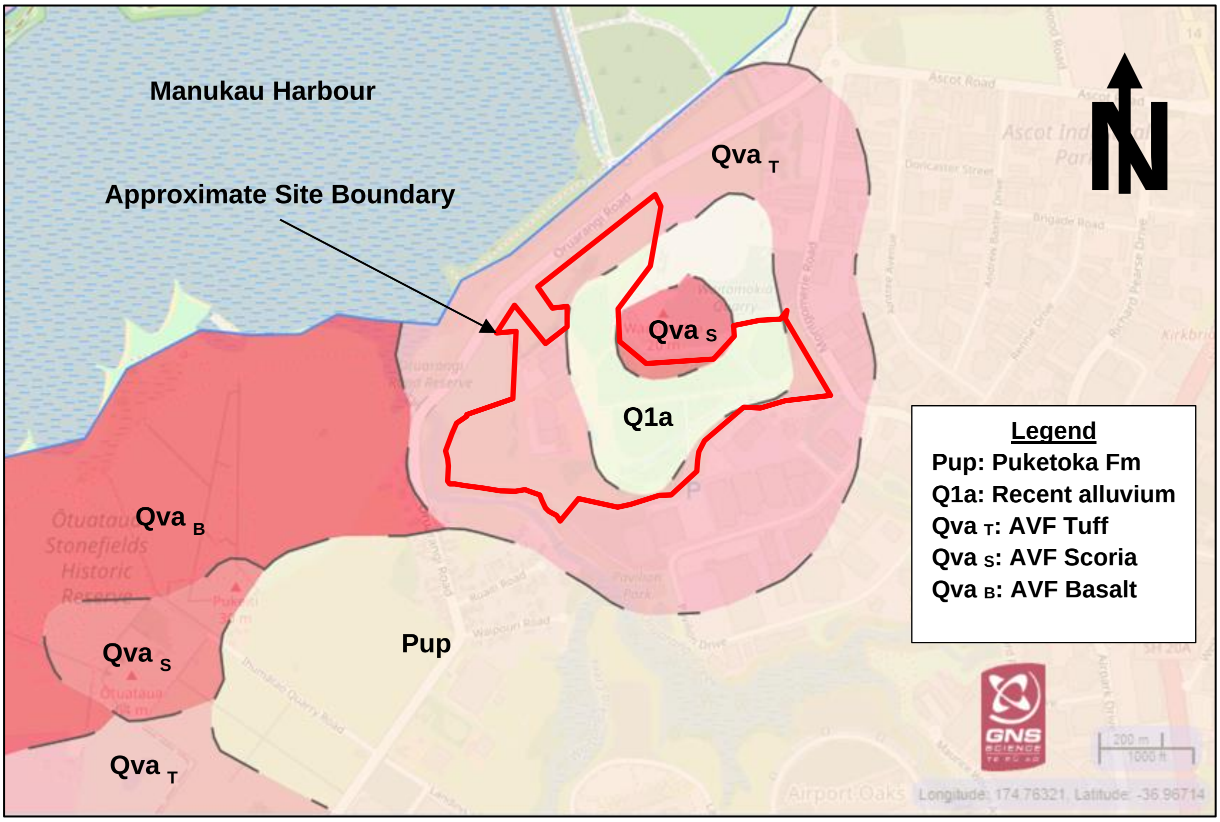
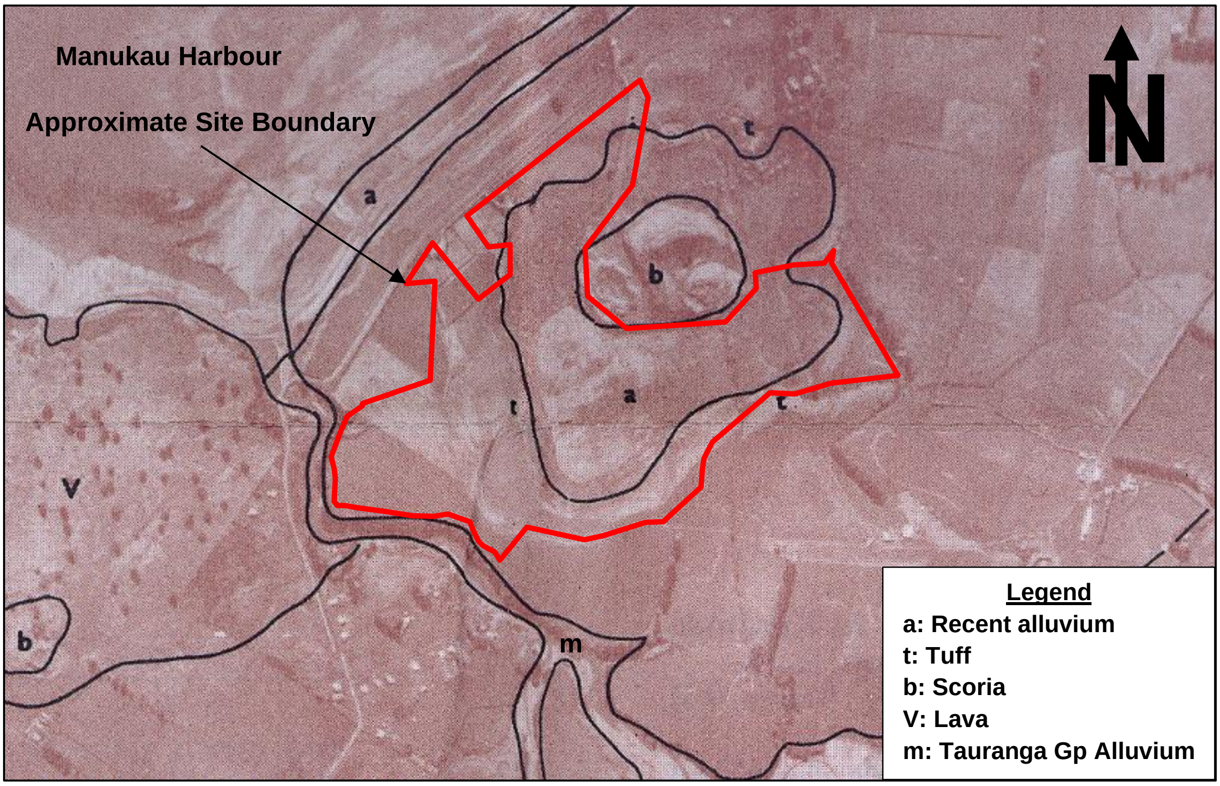


Figure 3: Local Geology (DSIR)



Further reference has been made to historic geologic maps prepared by the Department of Scientific and Industrial Research (DSIR[4]; predecessor to GNS) which presents finer detail on geological boundaries in relation to the site. Older mapping indicates the deposition of Tauranga Group Oruarangi Creek, inferred to indicate Puketoka Formation materials due to mapped differentiation from recent (i.e. Holocene) alluvial deposits.

Detailed descriptions of stratigraphy encountered within the site are presented in geotechnical reporting by Initia (Section 3) and are summarised as alluvial strata (including peat) overlying basalt rock across the entire vineyard area.

5 Field Investigation

ENGEO has undertaken the following field investigation works in 2022 as part of the assessment herein:

- 4 November: Initial site reconnaissance, locate/rehabilitate/flush existing piezometers
- 8 November: Installation of groundwater data-loggers for short-term monitoring programme, and collection of groundwater samples for laboratory water quality analyses.
- 29 November: Recovery of monitoring equipment and ground thruthing of numerically inferred (i.e. software projected) groundwater features.

5.1 Groundwater Monitoring

To support assessment of groundwater levels and flow within the site, short-term continuous monitoring of groundwater levels was undertaken from 8 to 29 November 2022. Monitoring was undertaken in piezometers installed by Initia in March 2022. Piezometer construction details are summarised in Table 1. Piezometer locations are shown in Figure 4. Measured groundwater elevation ranges are presented in Table 2 and Figure 5.

[4] DSIR, 1968; New Zealand Geological Survey Industrial Map Series; Sheet N42/8 (Mangere), Scale 1:25k

Table 1: Initia Piezometer Details

Location			Installation		
ID	Easting	Northing	Ground Level	Screened Interval	Screened Lithology
	NZTM		mRL		
BH102	1757794	5906157	6.2	1.2 to -0.8	AVF Basalt
BH106	1757478	5905879	5.7	1.7 to -0.3	AVF Basalt
BH108	1757370	5906014	6.0	2.0 to 0.0	Q1a Alluvium
BH110	1757366	5906227	6.9	2.9 to 0.9	Q1a Alluvium
BH112	1756973	5905788	12.8	8.8 to 6.8	Puketoka Fm.

Figure 4: Piezometer Locations

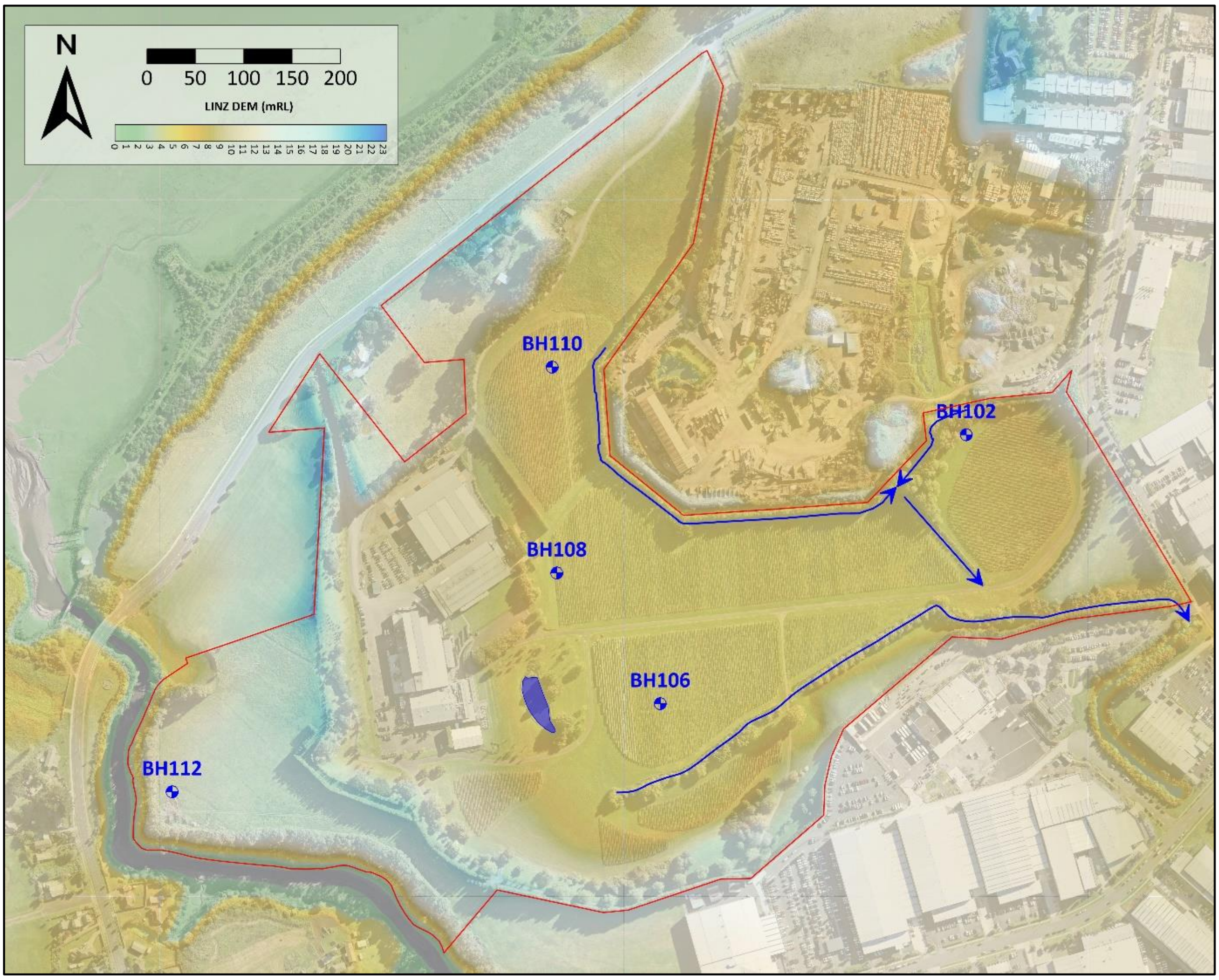


Table 2: Groundwater Monitoring Results

Location		Manual Groundwater Levels		
ID	Ground Level	4/11/2022	8/11/2022	29/11/2022
	mRL			
BH102	6.2	1.42	1.46	1.39
BH106	5.7	0.57	0.65	0.52
BH108	6.0	0.54	1.06	0.73
BH110	6.9	0.44	0.58	0.29
BH112	12.8	GWNE [1]	GWNE [1]	GWNE [1]

[1] GWNE: Groundwater Not Encountered

Figure 5: Groundwater Monitoring Results

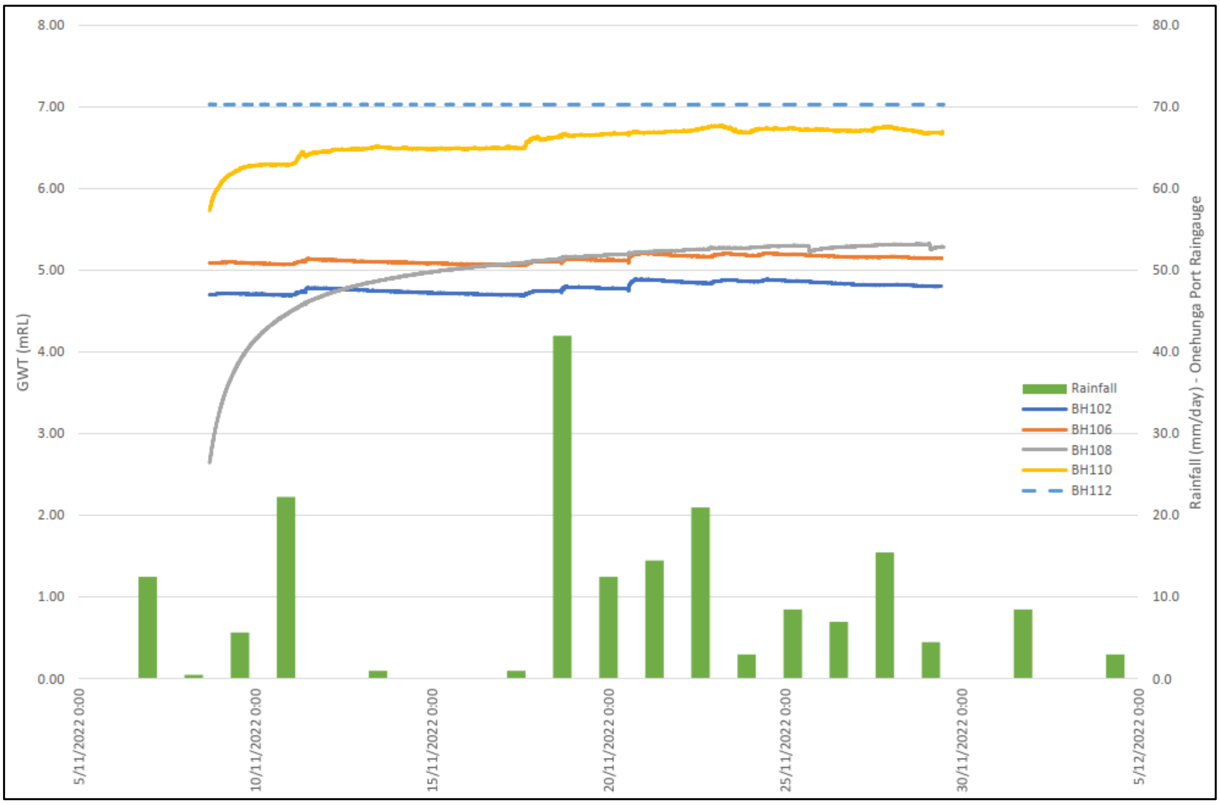


Figure Note: Groundwater Not Encountered for the full duration of continuous monitoring in BH112. Piezometer base elevation presented as dashed line for reference.

5.2 Groundwater Sampling

To support determination of groundwater types and intrinsic value, groundwater samples were collected from all piezometers except BH112, and submitted for laboratory analyses. BH112 was not sampled due to groundwater being below the depth of the piezometer.

Samples were collected using a low-flow Solinst Peristaltic pump and submitted to Eurofins laboratories for assessment of a wide range of both water quality markers and typical contaminants of concern. Field parameters were measured using a YSI ProPlus multiparameter meter. Recorded field parameters are presented in Table 3.

Samples were analysed for the following laboratory analytes:

- Cation & Anion Balance, including speciated alkalinity.
- Speciated Nitrogen.
- Heavy Metals, including total and dissolved Fe.
- Total Petroleum Hydrocarbons (TPH) / BTEX / Polycyclic Aromatic Hydrocarbons (PAH).
- Organochlorine & Organophosphorus Pesticides (OCP/OPP).
- *E. Coli.*

Table 3: Groundwater Sampling Field Parameters

Location ID	Temperature (˚C)	Dissolved Oxygen (%)	pH	SPC	Conductivity	General Fresh Water Limit
				µS/cm		
BH102	16.5	3	7.09	317	316	1,000
BH106	18.2	1.1	6.5	708	618	
BH108	18.3	2.8	6.53	559	487	
BH110	16.7	1.4	6.37	1,706	1,436	

5.3 Ground Truthing

Following initial site works, a more detailed site walkover was undertaken at the end of the groundwater monitoring period to review potential on-site groundwater features (springs, seeps).

Groundwater levels across the site are noted as being shallow, often within 1 m of ground level, and therefore shallower than the depth of some open-channel drainage lines within the site, indicating the potential for shallow seeps and groundwater discharge to the channels.

The known presence of volcanic springs further south at Otuataua Stonefields also indicates the potential for springs within or adjacent to the site. However, relative topographic differences (i.e. vineyard elevation c.5-6 mRL) and lack of discernible spring features within the site suggests that recharge within the Villa Maria estate likely discharges within the Manukau Harbour or Oruarangi Creek.

The detailed site walkover observed that open-channel water levels are equivalent to groundwater levels within nearby bores (both alluvial & volcanic screen bores) indicating that:

- The volcanic strata (i.e. jointed basalt rock) is a semi-confined aquifer, or effectively unconfined with 'leaky' alluvial burden.
- Collectively the basalt and alluvial materials are a shallow unconfined aquifer system.
- Two-way seepage occurs between the groundwater and surface water (i.e. open channel) regimes.

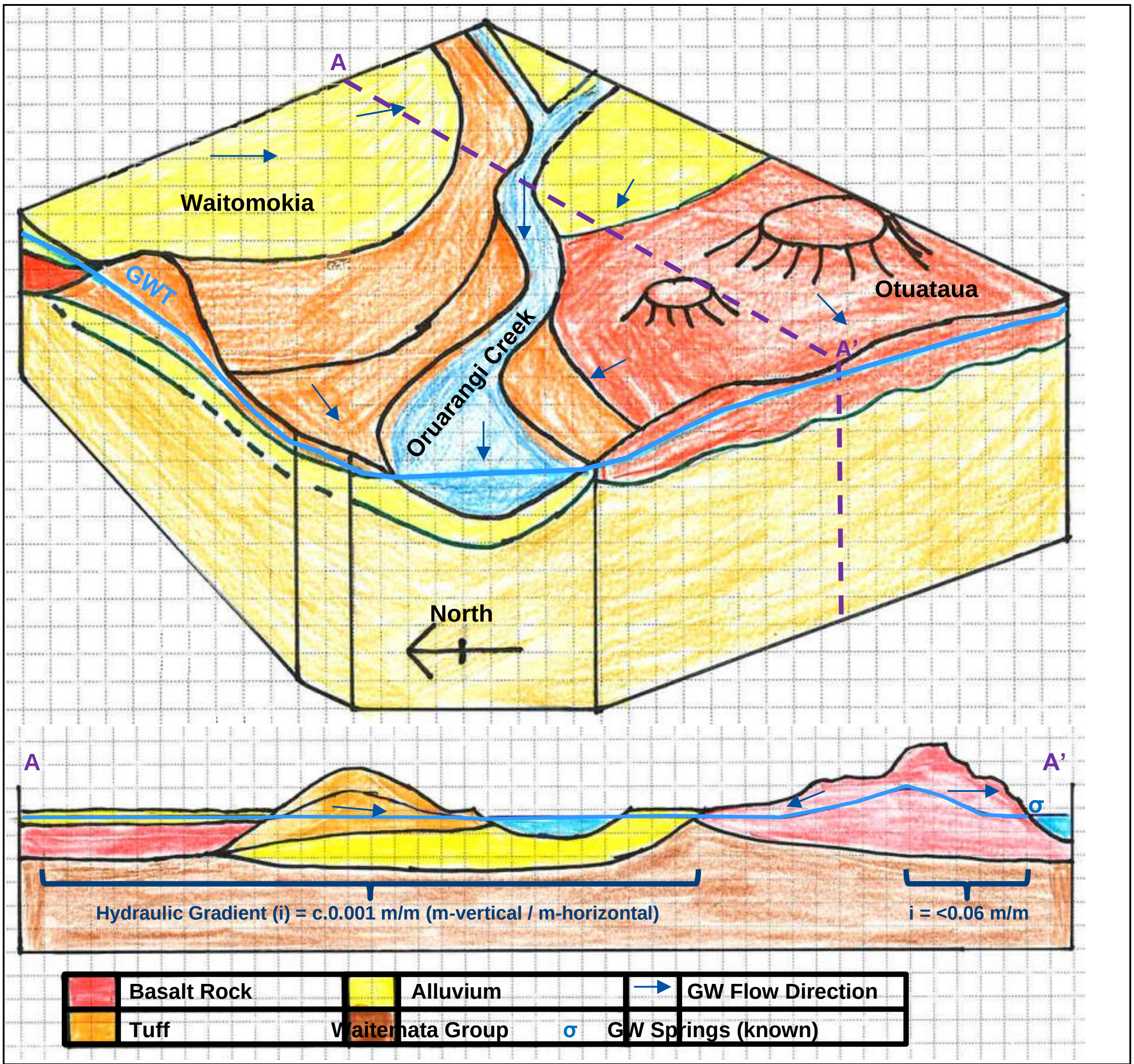
No evidence or indication of true groundwater springs was observed within the site. Springs are considered unlikely to be present due to lack of necessary topographic differences within the catchment to generate sufficient hydraulic gradients for spring discharge.

Qualitative surveillance of relative topography from outside the site indicate a low probability of any submarine spring outside of the site being located beyond Oruarangi Creek due to:

- Apparent insufficient stratigraphic connection between the Waitomokia and Otuataua volcanic areas (i.e. bisected by Oruarangi Creek, with no visible 'aquifer strata' at low tide).
- Negligible topographic difference between the Waitomokia crater (c.5.5 mRL; GWT c.4.5 mRL) and the Otuataua spring area (c.3.5 mRL) at a distance of approximately 1 km would indicate negligible flow potential (hydraulic gradient of 0.001m/m) compared to recharge of the Otuataua Spring from the Stonefields themselves (hydraulic gradient <0.06 m/m).

Our understanding of the stratigraphic, topographic, and hydrogeologic relationship between the Waitomokia and Otuataua volcanic areas is conceptually illustrated in Figure 6.

Figure 6: Waitomokia & Otuataua Conceptual Connectivity



6 Results and Technical Assessment

6.1 Laboratory Results

Laboratory analyses did not detect the presence of any TPH, PAH or BTEX compound, being common Contaminants of Concern (CoC) associated with quarrying and industrial activities, or OPP as commonly associated with agricultural activities. Full laboratory analyses are attached in Appendix 1.

A summary of general potability analytes is presented in Table 4.

Table 4: Laboratory Results - Groundwater Potability Analytes

Type	Analyte	Laboratory Results				Guideline Limits New Zealand Drinking Water Standards 2018	
		BH102	BH106	BH108	BH110	MAV [1]	Aesthetic
		Concentration (mg/L)					
Heavy Metals	Fe (Dissolved)	2.5	11	9.9	0.92		0.2
	Fe (Total)	2.9	11	11	14		
	As	MDL	MDL	0.008	0.005	0.01	
	Cd	MDL	MDL	MDL	MDL	0.004	
	Cr	0.001	0.004	0.003	0.004	0.05	
	Cu	0.003	MDL	0.006	0.015	2	1
	Pb	0.001	MDL	0.005	0.005	0.01	
	Hg	MDL	MDL	MDL	MDL	0.007	
	Ni	0.002	0.002	0.008	0.017	0.08	
	Zn	0.009	0.013	0.021	0.019		1.5
OCP	Chlordanes	MDL	MDL	MDL	0.0007	0.0002	
		Concentration (cfu/100mL)					
Biological	*E. coli*	120	12	3,500	1,270	100	

[1] MAV: Maximum Allowable Value for protection of Human Health

Underlined values exceed either Aesthetic or MAV values

Cation / Anion balance, carbonate and nitrogen speciation results (i.e. Water Type Analytes) are presented in Table 5. Water quality plots are presented in Figure 7 and Figure 8.

Table 5: Laboratory Results – Water-Type Analytes

Type	Analyte	Laboratory Results (mg/L)			
		BH102	BH106	BH108	BH110
Cations	Ca	25.1	39.7	46.3	200
	Mg	11.8	33.2	18.2	58.1
	K	7.4	6.6	10.7	15.5
	Na	30.2	33.6	42.1	141
Alkalinity	Bicarbonate (HCO_3 as $CaCO_3$)	<136	<194	<646	<136
	Carbonate (CO_3 as $CaCO_3$)	<2	<2	<2	<2
	Hydroxide (OH as $CaCO_3$)	0	0	0	0
	Total	136	194	646	136
Remaining Anions	Cl	93	33	80	93
	F	0.15	0.16	0.11	0.15
	Sulphate (as SO_4)	52.4	26.8	129	52.4
Hardness mg equivalent $CaCO_3$/L		236	191	738	236
Speciated Nitrogen	Ammonia (NH_3 as N)	0.61	4.85	12.5	0.61
	Nitrate (NO_3 as N)	0.01	0.01	0.1	0.01
	Nitrite (NO_2 as N)	0.01	0.01	0.01	0.01
	Total Nitrogen (as N)	1.28	5.63	14.7	1.28
	Total Kjeldahl Nitrogen (as N)	1.9	6.8	16.5	1.9

Figure 7: Schoeller Groundwater Plot

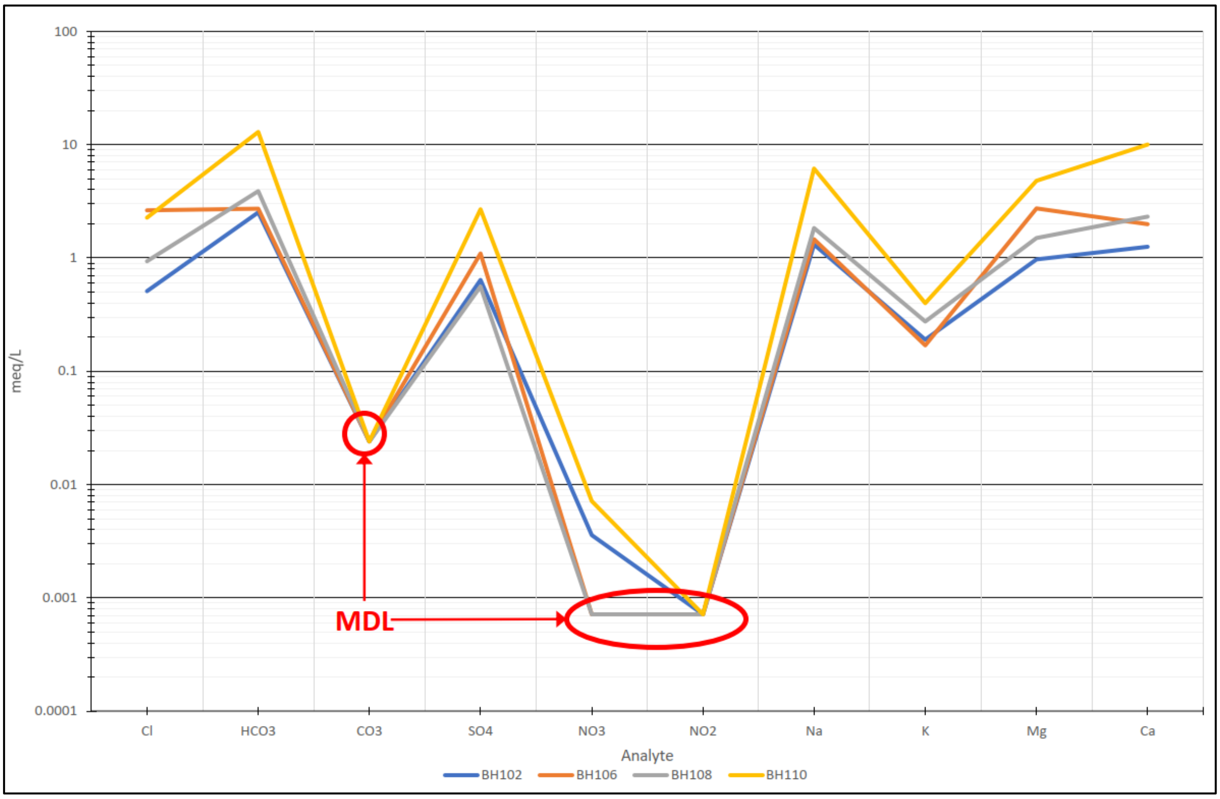
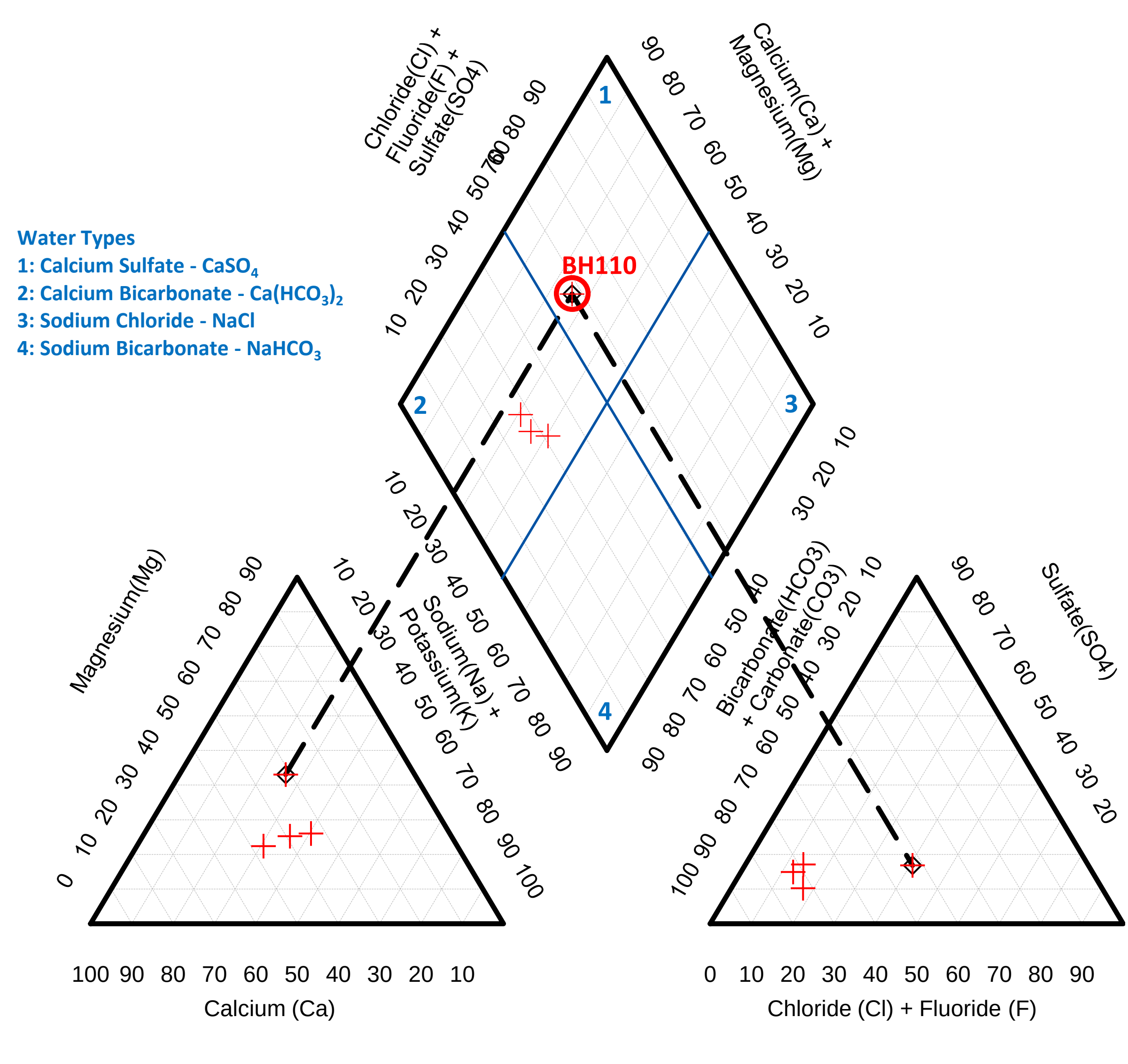


Figure 8: Piper Groundwater Plot



6.2 Groundwater Contours

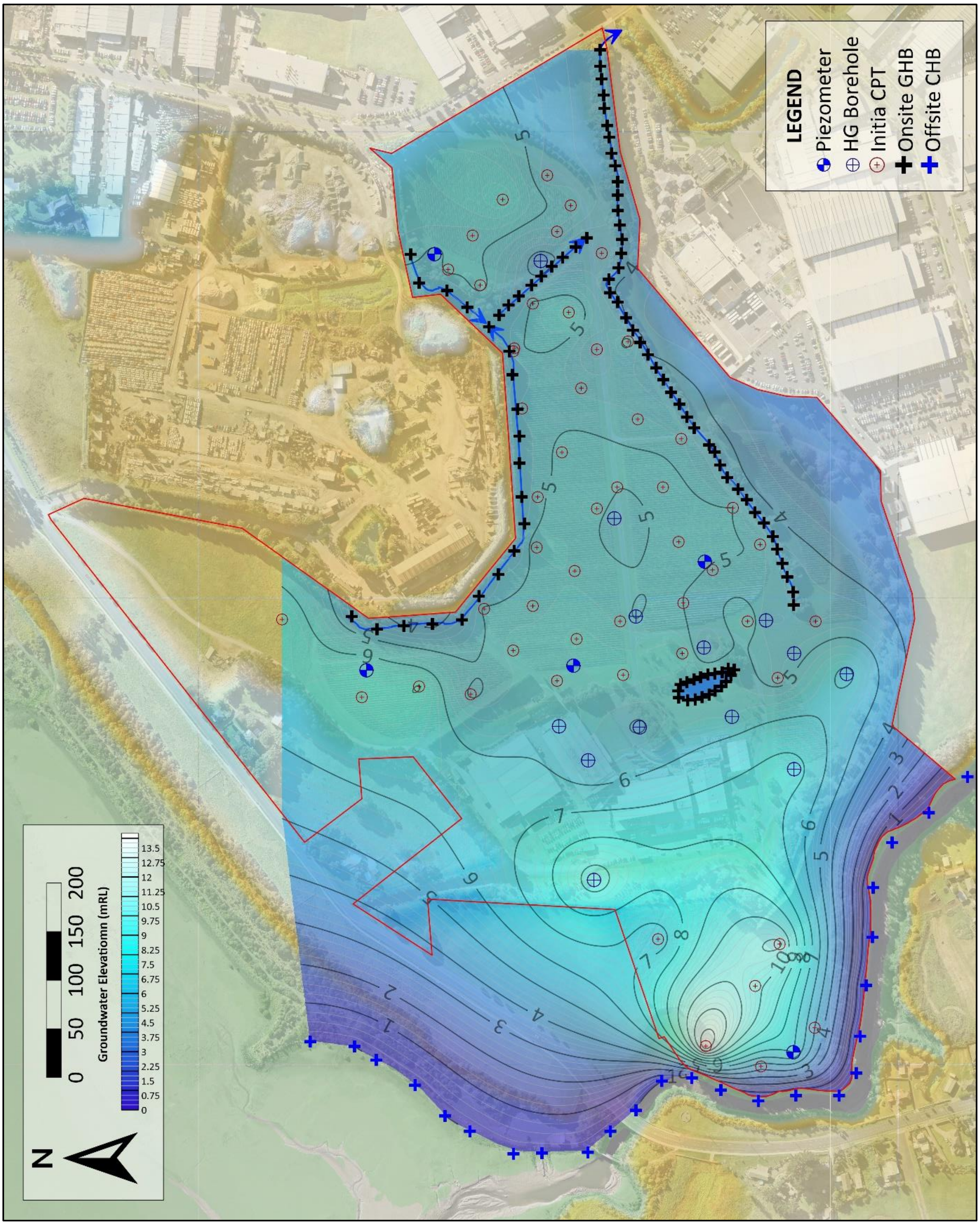
On the basis of the observed groundwater elevations (Figure 5 and Table 2), Groundwater Table (GWT) contours have been derived via the kriging geostatistical method and are shown in Figure 9 as elevation (mRL).

Due to the spatially restricted data set available from the current groundwater monitoring, additional groundwater static levels have incorporated from the following sources:

- 0.0 mRL Constant Head Boundary along the margin of the Manukau Harbour and the tidal zone of the Oruarangi Creek.
- Groundwater elevations from Initia CPTs and Harrison Grierson (HG) boreholes.

- General Head Boundaries, where surface water within on-site open drains and the pond are inferred to be at equilibrium with the groundwater regime.

Figure 9: Groundwater Contours



6.3 Hydraulic Conductivity

As part of the piezometer rehabilitation and groundwater monitoring, all of the existing piezometers previous installed by Initia were purged (i.e. emptied to base of standpipe) in order to flush out accumulated sediment.

Consequently, monitoring of groundwater levels has recorded prolonged recovery curves in the BH108 and BH110 piezometers, which we have analysed in accordance with slug testing well methodologies. Purging was undertaken in a rapid-manner, and in general accordance with standard ASTM D4044/D4044M. Both BH108 and BH110 are screened within the lower hydraulic conductivity (K) alluvial materials that confine/semi-confine the underlying jointed basalts.

The results of recovery test analyses are presented in Table 6 and are attached in Appendix 2.

Table 6: Derived Hydraulic Conductivities

Location	Screed Lithology	Hydraulic Conductivity (K; m/s)	
		Bouwer & Rice Solution Method	Hvorslev Solution Method
BH108	Alluvium (non-peat)	2.13×10^{-9}	2.75×10^{-9}
BH110		3.95×10^{-9}	5.11×10^{-9}
Method Average		**3.04×10^{-9}**	**3.93×10^{-9}**

No hydraulic testing of the underlying jointed basalt has been undertaken, however the properties of such materials across the AVF are well established. K values of 2.1×10^{-6} to 2.1×10^{-3} m/s, and 6.7×10^{-5} to 1.5×10^{-3} m/s are reported in the jointed basalts of the more expansive Onehunga and Western Springs aquifer systems[5].

It is however noted that fine grained material from the overlying low-conductivity alluvial materials is likely to have migrated into basalt jointing over time, reducing the *in situ* K of the basalt strata.

6.4 Historic Land Modification

Processed groundwater elevation data indicates that the direction of groundwater flow within the site is towards the southeast, following the constructed drainages that discharge to the Oruarangi Creek. From a higher-level topographic review perspective we estimate that the natural / prevailing direction of groundwater was anticipated to be either directly south towards Oruarangi Creek or, more likely, towards the north; being the topographic low in the Waitomokia crater tuff-ring and seemingly the natural outflow to the Manukau Harbour.

The presence of expansive alluvial deposits across the Waitomokia crater floor indicates however that pre-development surface water outflow was less than incipient rainfall, meaning that the area was likely a shallow wetland or bog in the geological past.

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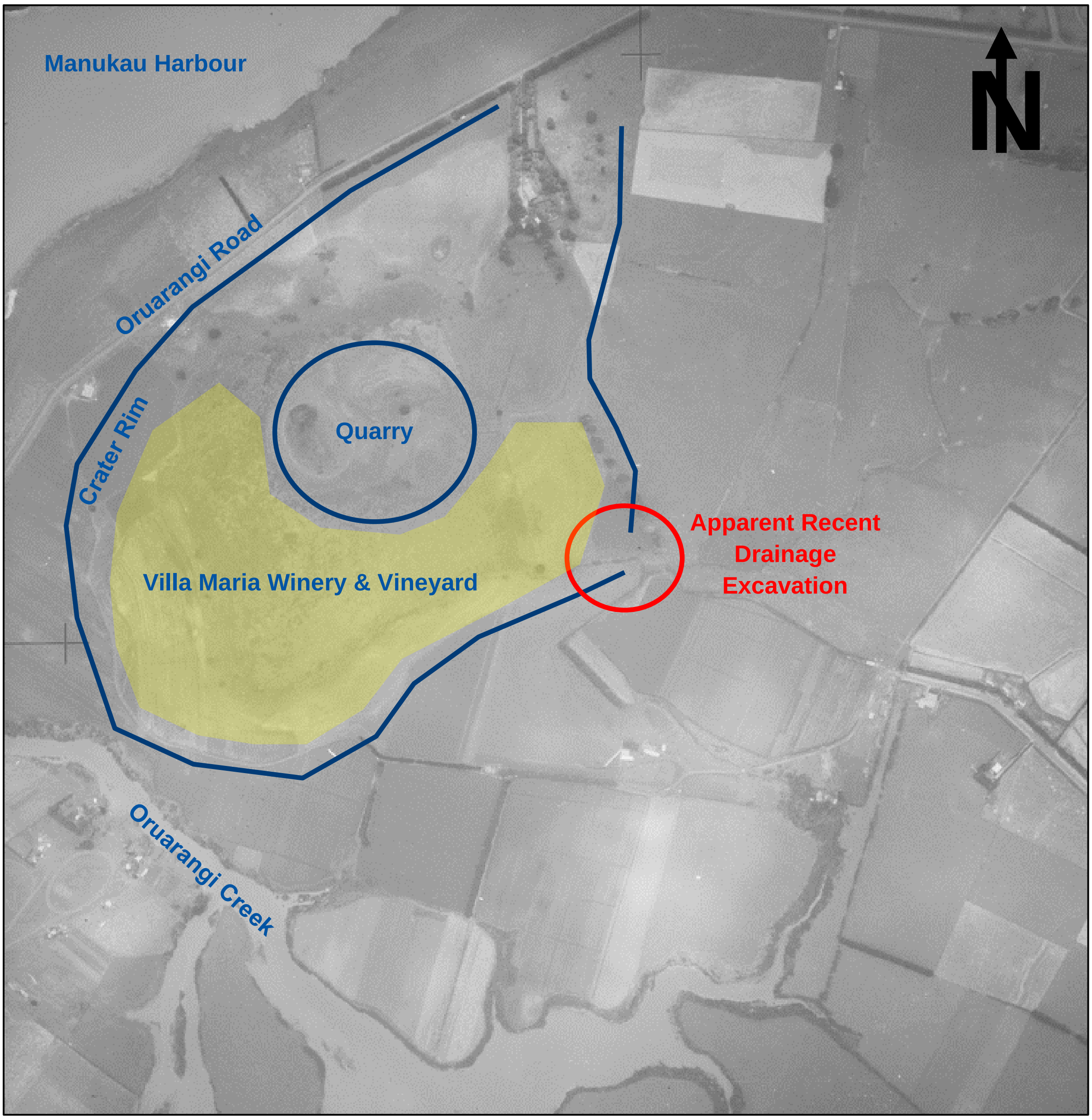
[5] Berry, 2007; Hydrogeological Characteristics and Numerical Modelling of the Western Springs and Onehunga Catchments

To understand what impact historic site development may have had on natural drainage, and consequently groundwater flow, preliminary stereoscopic analysis of historical stereo-pair aerial photographs was undertaken. Two consecutive photos (B4 & B5) from Crown aerial survey 622, dated 07 December 1944 and taken at an altitude of 6,600 feet (c. 2.0km) were obtained from RETROLENS[6]. An excerpt from photo 622_B4 is shown in Figure 10.

Figure 10: Historic Aerial Photograph 622_B4 – Waitomokia Volcanic Centre 1944

(Approximate Feature Locations)



[6] RETROLENS Historic Image Resource; https://retrolens.co.nz/

Aerial imagery indicates that prior to establishment of either the Villa Maria Estate, or the Wedding Quarry, the land use was pastoral. An incised cut is visible in the south-eastern corner of the crater rim, in the area where the current surface drains discharge, and appears to be of relatively 'recent' construction in 1944.

It is also noted that the visible extent of the Manukau Harbour is still 'open'. This section of the Manukau Harbour was progressively closed off by levees from the mid 1950s to establish 500 ha of biosolid waste ponds for the Mangere Treatment Plant to the north (Figure 11). The ponds themselves were removed during the early 2000s which reopened the Oruarangi Creek inlet.

Figure 11: Extent of Historic Coastal Impoundment

(Source: Auckland Council GeoMaps, 1996)

7 Discussion

7.1 Groundwater Quality & Hydrogeochemistry

Laboratory analyses for a wide suite of CoCs has identified little, if any, indicators of contaminants likely to have arisen from previous on-site land use.

Significant levels of *E. coli*, in excess of Drinking Water Maximum Allowable Values (MAVs) in 3 of 4 samples, and the presence of Chlordanes in excess of MAV in 1 of 4 samples, precludes any potable use of groundwater without significant treatment. The elevated levels of *E. coli* observed in the BH110 and BH108 is considered related the former biosolid oxidations ponds north of the site. Natural levels of *E. coli* in groundwater are typically in the order of <10 cfu/100 mL in the Auckland Region.

High Iron (Fe; both total and dissolved) levels in all groundwater samples are in excess of aesthetic drinking water guidelines. These Fe levels are not uncommon for a volcanic aquifer and would further constrain potential industrial use.

Increasing Electrical Conductivities (EC; Table 3) towards the north of site indicate the presence of a saline wedge extending from the Manukau Harbour at depth below the site. At the location of BH110 towards the northern end of the site, the observed EC values indicate that shallow groundwater is a saline / fresh water mixing zone and ‘brackish’ in nature.

Hydrogeochemistry plots (Figure 7 and Figure 8) indicate that groundwater within the area of BH110 towards the north is of a different ‘type” (i.e. Calcium Sulfate) than the rest of the site (Calcium Bicarbonate). Presence of a calcium sulfate water types and relative Sodium (Na) and Chloride (Cl) ions are considered to confirm saline wedge intrusion towards the north of the site.

When considered in conjunction with *E. Coli* concentrations (greatest towards the north) ENGEO consider that a significant portion of the groundwater regime within the site is influenced by flow into the site from a general north-westerly direction.

7.2 Conceptual Hydrogeology & Groundwater Modelling

At a wider catchment scale groundwater flow was expected to be predominantly towards the coast (i.e. towards the north and west). Groundwater table contours derived from a compiled data set however indicate that within the vineyard area groundwater flow predominantly mimics surface water drainage paths that discharge towards the southeast.

While groundwater flow that mimics surface water flow is not unexpected, review of further historical information indicates that the current drainage direction is highly modified from its ‘original’ geological state. This modification hinges on the apparent excavated drainage line through the southeast corner of the Waitomokia crater rim / tuff ring.

The timeframe for the original drainage modifications is unknown, however has occurred no later than the mid 1940s. It is likely that such drainage work was undertaken in conjunction with the original pastoral land clearance as the presence of alluvium across the Waitomokia is associated with a former crater lake wetland / bog / swamp. Given natural outfall from the crater would have been to the north, land use conversion would necessitate additional drainage, hence a new outfall to the southeast.

The extended period of level recovery in BH108 (purged 'dry' during installation) indicate low hydraulic conductivities in the alluvial mantle overlying the basalt aquifer. The barely discernible movement in groundwater levels in response to some significant rainfall events (>40mm/day) indicate that natural recharge of rainfall into the volcanic aquifer is relatively low and is primarily maintained by constant leakage form the saturated alluvial material.

Due to the downwards movement of groundwater from unconsolidated alluvial material into jointed basalt flows, siltation of the basalt aquifer is likely to have occurred to the extent that the aquifer yield under pumping is significantly reduced.

The presence of local abstraction bores targeting deeper Waitemata aquifer units (which are typically lower yielding sedimentary aquifer) indicates that the Waitomokia basalt aquifer is likely to be a low-yielding groundwater resource.

Although no tidal response was noted in any monitoring record, the apparent presence of a saline wedge (via osmosis) along the coastal margin and adjacent tidal reach of the Oruarangi Creek represent fixed groundwater boundaries (i.e. Constant Head, akin to static / immovable groundwater 'control points') in maintaining the groundwater levels within the site itself.

7.2.1 Spring Discharge

ENGEO has noted reference to potential recharge of groundwater from Waitomokia to the Otuataua / Ihumatao springs area to the southwest of the site.

Due to the Oruarangi Creek groundwater divide and physical separation between the basalt aquifers (i.e. direct connection between individual basalt flows has not been established), it is considered improbable that site infiltration supports any spring discharge at Otuataua.

Local hydraulic gradients and relative elevation differences indicate that any springs discharge originating from Waitomokia infiltration is likely to be submarine. However, we note that the Waitomokia groundwater regime may provide a buttressing effect against the adjacent Otuataua groundwater regime, reducing discharge from Otuataua towards Oruarangi Creek, and giving rise to greater outflow towards the Otuataua springs.

If direct connection between the systems beneath Oruarangi Creek was established, a decreased flow from Waitomokia could lead to a lower groundwater pressure along the northern edge of the Otuataua regime. In turn, this could reduce spring discharge along the northwest Otuataua springs area.

The Waitomokia groundwater regime is predominantly within the underlying basalt aquifer. Any landform modification within Waitomokia would only potentially affect the surficial alluvial materials which are currently a barrier to aquifer recharge due to the low hydraulic conductivity. Provided basalt aquifer recharge is maintained through engineering design as part of on-site stormwater management, no adverse effect on groundwater regimes would be anticipated.

8 Stakeholder Summary

8.1 Groundwater Resources

Laboratory analyses and subsequent review of hydrogeochemistry indicate that groundwater within the Waitomokia aquifer underlying the Villa Maria vineyard area is of poor quality, being unsuitable for potable use and of limited industrial use.

Overlying alluvial materials are of low hydraulic conductivity and partially confine the basalt aquifer. Due to the low hydraulic conductivity (up to five orders of magnitude lower than the basalt) rainfall recharge to the basalt aquifer is so low that responses to significant rainfall events is barely discernible. It is considered likely that recharge is mainly via steady leakage from the saturated alluvial materials, and natural recharge at hydraulic boundaries along the coastal margin and Oruarangi Creek.

Due to the low rates of apparent recharge, apparent semi-confined nature (both vertically and horizontally in two directions) the Waitomokia groundwater resources are unlikely to be considered economically viable for use due to the cost of establishing abstraction infrastructure and subsequent treatment.

Direct connection between the Waitomokia and Otuataua groundwater regimes has not been established. Indirect connection is circumspect, however may exist via a buttressing effect between aquifers.

No groundwater springs have been identified as being directly connected to the Waitomokia groundwater regime. Groundwater flux between the shallow alluvial materials and open channel drains is likely to be occurring, however is not considered a ‘natural’ occurrence as the drainage scheme itself is considered to be a historical modification in the early part of the 1900s.

Historically drainage modifications have significantly altered the Waitomokia groundwater regime, with the direction of flow being up to 180˚ from its original ‘geological’ direction.

The legacy of historic activities along the foreshore of the Manukau Harbour (Puketutu Island biosolid oxidation ponds) is evident in the presence of significant *E. coli* levels in groundwater.

8.2 Preloading Effects

As part of potential site development, preloading of alluvial materials has been proposed by the geotechnical engineer (Initia) to mitigate the effects of consolidation settlement on future buildings and services. Due to the incompressible nature of the basalt aquifer itself, preloading would only affect the overlying alluvial materials.

Preloading of alluvial material would, by nature, decrease the porosity and consequently the hydraulic permeability of the alluvium. At present the alluvium provides for slow recharge of the basalt. On the assumption that civil drainage works will incorporate peat recharge pits to prevent further consolidation settlement post-development (as outlined in Auckland Council GD07[7]) no adverse effect on aquifer flows are anticipated.

[7] Auckland Council, 2021: Stormwater Soakage and Groundwater Recharge in the Auckland Region - Guideline Document 2021/007 Version 1

In the absence of adverse effects on aquifer flows, no adverse effect on any naturally occurring Groundwater Dependant Ecosystem (GDE) are anticipated due to the existing highly modified nature of the local catchment.

9 Gap Analysis & Future Work

The analysis of groundwater levels is based on spatially limited temporal data, with a significant reliance on static levels from previous geotechnical investigations. While the result of groundwater level analyses accords with site observations and known activities, greater resolution in reporting would be needed to address any specific groundwater concerns or inform designs for groundwater level control.

10 Sustainability

We encourage you to consider sustainability when assessing the options available for your project. Where suitable for the project, we recommend prioritising the sustainable use of resources, using locally sourced materials where available, and installing in an environmentally friendly way (e.g., reduced carbon emissions and minimal contamination). If you would like to discuss these options further, ENGEO staff are available to offer suggestions.

11 Limitations

i. We have prepared this report in accordance with the brief as provided. This report has been prepared for the use of our client, Goodman Nominee (NZ) Limited, their professional advisers and the relevant Territorial Authorities in relation to the specified project brief described in this report. No liability is accepted for the use of any part of the report for any other purpose or by any other person or entity.

ii. The recommendations in this report are based on the ground conditions indicated from published sources, site assessments and subsurface investigations described in this report based on accepted normal methods of site investigations. Only a limited amount of information has been collected to meet the specific financial and technical requirements of the client's brief and this report does not purport to completely describe all the site characteristics and properties. The nature and continuity of the ground between test locations has been inferred using experience and judgement and it should be appreciated that actual conditions could vary from the assumed model.

iii. Subsurface conditions relevant to construction works should be assessed by contractors who can make their own interpretation of the factual data provided. They should perform any additional tests as necessary for their own purposes.

iv. This Limitation should be read in conjunction with the Engineering NZ/ACENZ Standard Terms of Engagement.

v. This report is not to be reproduced either wholly or in part without our prior written permission.

We trust that this information meets your current requirements. Please do not hesitate to contact the undersigned on (09) 972 2205 if you require any further information.

Report prepared by	Report reviewed by
	James Thurber
Sean Berry	**James Thurber, PG, CHg, CEG (California)**
Engineering Geologist / Hydrogeologist	Principal Hydrogeologist

APPENDIX 1:

Laboratory Analyses

Environment Testing

All tests reported herein have been performed in accordance with the laboratory's scope of accreditation

ENGEO Ltd
8 Greydene Place
Takapuna
Auckland 0622

Attention: **Vincent Pettinger**

Report **938764-W-V2**
Project name
Project ID 18043
Received Date Nov 08, 2022

Client Sample ID			**BH102**	**BH106**	**BH108**	**BH110**
Sample Matrix			**Water**	**Water**	**Water**	**Water**
Eurofins Sample No.			**K22-No0016218**	**K22-No0016219**	**K22-No0016220**	**K22-No0016221**
Date Sampled			**Nov 08, 2022**	**Nov 08, 2022**	**Nov 08, 2022**	**Nov 08, 2022**
Test/Reference	LOR	Unit				
Volatile Organics (NZ MfE)						
Naphthalene[N02]	0.01	mg/L	< 0.01	< 0.01	< 0.01	< 0.01
BTEX (NZ MfE)						
Benzene	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Toluene	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Ethylbenzene	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
m&p-Xylenes	0.002	mg/L	< 0.002	< 0.002	< 0.002	< 0.002
o-Xylene	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Xylenes - Total	0.003	mg/L	< 0.003	< 0.003	< 0.003	< 0.003
4-Bromofluorobenzene (surr.)	1	%	86	69	88	84
Total Petroleum Hydrocarbons (NZ MfE 1999)						
TPH-SG C7-C9	0.1	mg/L	< 0.1	< 0.1	< 0.1	< 0.1
TPH-SG C10-C14	0.2	mg/L	< 0.2	< 0.2	< 0.2	< 0.2
TPH-SG C15-C36	0.4	mg/L	< 0.4	< 0.4	< 0.4	< 0.4
TPH-SG C7-C36 (Total)	0.7	mg/L	< 0.7	< 0.7	< 0.7	< 0.7
Organochlorine Pesticides (NZ MfE)						
2.4'-DDD	0.0005	mg/L	< 0.0005	< 0.0005	< 0.0005	< 0.0005
2.4'-DDE	0.0005	mg/L	< 0.0005	< 0.0005	< 0.0005	< 0.0005
2.4'-DDT	0.0005	mg/L	< 0.0005	< 0.0005	< 0.0005	< 0.0005
4.4'-DDD	0.0005	mg/L	< 0.0005	< 0.0005	< 0.0005	< 0.0005
4.4'-DDE	0.0005	mg/L	< 0.0005	< 0.0005	< 0.0005	< 0.0005
4.4'-DDT	0.0005	mg/L	< 0.0005	< 0.0005	< 0.0005	< 0.0005
DDT + DDE + DDD (Total)*	0.0005	mg/L	< 0.0005	< 0.0005	< 0.0005	< 0.0005
a-HCH	0.0005	mg/L	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Aldrin	0.0005	mg/L	< 0.0005	< 0.0005	< 0.0005	< 0.0005
b-HCH	0.0005	mg/L	< 0.0005	< 0.0005	< 0.0005	0.0007
Chlordanes - Total	0.0005	mg/L	< 0.0005	< 0.0005	< 0.0005	0.0007
cis-Chlordane	0.0005	mg/L	< 0.0005	< 0.0005	< 0.0005	< 0.0005
d-HCH	0.0005	mg/L	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Dieldrin	0.0005	mg/L	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Endosulfan I	0.0005	mg/L	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Endosulfan II	0.0005	mg/L	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Endosulfan sulphate	0.0005	mg/L	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Endrin	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Endrin aldehyde	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Endrin ketone	0.0005	mg/L	< 0.0005	< 0.0005	< 0.0005	< 0.0005

Eurofins Environment Testing

Client Sample ID			BH102	BH106	BH108	BH110
Sample Matrix			Water	Water	Water	Water
Eurofins Sample No.			K22-No0016218	K22-No0016219	K22-No0016220	K22-No0016221
Date Sampled			Nov 08, 2022	Nov 08, 2022	Nov 08, 2022	Nov 08, 2022
Test/Reference	LOR	Unit				
Organochlorine Pesticides (NZ MfE)						
g-HCH (Lindane)	0.0005	mg/L	< 0.0005	< 0.0005	< 0.0005	0.0005
Heptachlor	0.0005	mg/L	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Heptachlor epoxide	0.0005	mg/L	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Hexachlorobenzene	0.0005	mg/L	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Methoxychlor	0.0005	mg/L	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Toxaphene	0.005	mg/L	< 0.005	< 0.005	< 0.005	< 0.005
trans-Chlordane	0.0005	mg/L	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Dibutylchlorendate (surr.)	0.0005	%	90	60	71	INT
Tetrachloro-m-xylene (surr.)	0.0005	%	103	83	98	64
Polycyclic Aromatic Hydrocarbons (NZ MfE)						
Acenaphthene	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Acenaphthylene	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Anthracene	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Benz(a)anthracene	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Benzo(a)pyrene	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Benzo(b&j)fluoranthene[N07]	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Benzo(g.h.i)perylene	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Benzo(k)fluoranthene	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Chrysene	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Dibenz(a.h)anthracene	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Fluoranthene	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Fluorene	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Indeno(1.2.3-cd)pyrene	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Naphthalene	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Phenanthrene	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Pyrene	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
p-Terphenyl-d14 (surr.)	1	%	90	89	107	63
2-Fluorobiphenyl (surr.)	1	%	54	INT	65	INT
Organophosphorus Pesticides						
Azinphos-methyl	0.002	mg/L	< 0.002	< 0.002	< 0.002	< 0.002
Bolstar	0.002	mg/L	< 0.002	< 0.002	< 0.002	< 0.002
Chlorfenvinphos	0.002	mg/L	< 0.002	< 0.002	< 0.002	< 0.002
Chlorpyrifos	0.02	mg/L	< 0.02	< 0.02	< 0.02	< 0.02
Chlorpyrifos-methyl	0.002	mg/L	< 0.002	< 0.002	< 0.002	< 0.002
Coumaphos	0.02	mg/L	< 0.02	< 0.02	< 0.02	< 0.02
Demeton-O	0.002	mg/L	< 0.002	< 0.002	< 0.002	< 0.002
Demeton-S	0.02	mg/L	< 0.02	< 0.02	< 0.02	< 0.02
Diazinon	0.002	mg/L	< 0.002	< 0.002	< 0.002	< 0.002
Dichlorvos	0.002	mg/L	< 0.002	< 0.002	< 0.002	< 0.002
Dimethoate	0.002	mg/L	< 0.002	< 0.002	< 0.002	< 0.002
Disulfoton	0.002	mg/L	< 0.002	< 0.002	< 0.002	< 0.002
EPN	0.002	mg/L	< 0.002	< 0.002	< 0.002	< 0.002
Ethion	0.002	mg/L	< 0.002	< 0.002	< 0.002	< 0.002
Ethoprop	0.002	mg/L	< 0.002	< 0.002	< 0.002	< 0.002
Ethyl parathion	0.002	mg/L	< 0.002	< 0.002	< 0.002	< 0.002
Fenamiphos	0.02	mg/L	< 0.02	< 0.02	< 0.02	< 0.02
Fenitrothion	0.002	mg/L	< 0.002	< 0.002	< 0.002	< 0.002
Fensulfothion	0.002	mg/L	< 0.002	< 0.002	< 0.002	< 0.002
Fenthion	0.002	mg/L	< 0.002	< 0.002	< 0.002	< 0.002

Environment Testing

Client Sample ID			BH102	BH106	BH108	BH110
Sample Matrix			Water	Water	Water	Water
Eurofins Sample No.			K22-No0016218	K22-No0016219	K22-No0016220	K22-No0016221
Date Sampled			Nov 08, 2022	Nov 08, 2022	Nov 08, 2022	Nov 08, 2022
Test/Reference	LOR	Unit				
Organophosphorus Pesticides						
Malathion	0.002	mg/L	< 0.002	< 0.002	< 0.002	< 0.002
Merphos	0.002	mg/L	< 0.002	< 0.002	< 0.002	< 0.002
Methyl parathion	0.002	mg/L	< 0.002	< 0.002	< 0.002	< 0.002
Mevinphos	0.002	mg/L	< 0.002	< 0.002	< 0.002	< 0.002
Monocrotophos	0.002	mg/L	< 0.002	< 0.002	< 0.002	< 0.002
Naled	0.002	mg/L	< 0.002	< 0.002	< 0.002	< 0.002
Omethoate	0.002	mg/L	< 0.002	< 0.002	< 0.002	< 0.002
Phorate	0.002	mg/L	< 0.002	< 0.002	< 0.002	< 0.002
Pirimiphos-methyl	0.02	mg/L	< 0.02	< 0.02	< 0.02	< 0.02
Profenofos	0.002	mg/L	< 0.002	< 0.002	< 0.002	< 0.002
Pyrazophos	0.002	mg/L	< 0.002	< 0.002	< 0.002	< 0.002
Ronnel	0.002	mg/L	< 0.002	< 0.002	< 0.002	< 0.002
Temephos	0.02	mg/L	< 0.02	< 0.02	< 0.02	< 0.02
Terbufos	0.002	mg/L	< 0.002	< 0.002	< 0.002	< 0.002
Tetrachlorvinphos	0.002	mg/L	< 0.002	< 0.002	< 0.002	< 0.002
Tokuthion	0.002	mg/L	< 0.002	< 0.002	< 0.002	< 0.002
Trichloronate	0.002	mg/L	< 0.002	< 0.002	< 0.002	< 0.002
Triphenylphosphate (surr.)	1	%	89	56	78	INT
Ammonia (as N)[N16]	0.01	mg/L	See Attached	See Attached	See Attached	See Attached
Chloride[N16]	1	mg/L	See Attached	See Attached	See Attached	See Attached
Fluoride[N16]	0.5	mg/L	See Attached	See Attached	See Attached	See Attached
Nitrate & Nitrite (as N)[N16]	0.05	mg/L	See Attached	See Attached	See Attached	See Attached
Nitrate (as N)[N16]	0.02	mg/L	See Attached	See Attached	See Attached	See Attached
Nitrite (as N)[N16]	0.02	mg/L	See Attached	See Attached	See Attached	See Attached
Sulphate (as SO4)[N16]	5	mg/L	See Attached	See Attached	See Attached	See Attached
Total Kjeldahl Nitrogen (as N)[N16]	0.2	mg/L	See Attached	See Attached	See Attached	See Attached
Total Nitrogen (as N)*[N16]	0.2	mg/L	-	-	-	-
Hardness mg equivalent CaCO3/L[N16]	5	mg/L	See Attached	See Attached	See Attached	See Attached
Iron (filtered)	0.05	mg/L	2.5	11	9.9	0.92
E. coli	0		See Attached	See Attached	See Attached	See Attached
Alkalinity (speciated)						
Bicarbonate Alkalinity (as CaCO3)[N16]	20	mg/L	See Attached	See Attached	See Attached	See Attached
Carbonate Alkalinity (as CaCO3)[N16]	20	mg/L	See Attached	See Attached	See Attached	See Attached
Hydroxide Alkalinity (as CaCO3)[N16]	20	mg/L	See Attached	See Attached	See Attached	See Attached
Total Alkalinity (as CaCO3)[N16]	20	mg/L	See Attached	See Attached	See Attached	See Attached
Heavy Metals						
Iron	0.05	mg/L	2.9	11	11	14
Alkali Metals						
Calcium[N16]	0.5	mg/L	See Attached	See Attached	See Attached	See Attached
Magnesium[N16]	0.5	mg/L	See Attached	See Attached	See Attached	See Attached
Potassium[N16]	0.5	mg/L	See Attached	See Attached	See Attached	See Attached
Sodium[N16]	0.5	mg/L	See Attached	See Attached	See Attached	See Attached
Metals M8 (NZ MfE)						
Arsenic	0.001	mg/L	< 0.001	< 0.001	0.008	0.005
Cadmium	0.0002	mg/L	< 0.0002	< 0.0002	< 0.0002	< 0.0002
Chromium	0.001	mg/L	0.001	0.004	0.003	0.004
Copper	0.001	mg/L	0.003	< 0.001	0.006	0.015

Client Sample ID			BH102	BH106	BH108	BH110
Sample Matrix			Water	Water	Water	Water
Eurofins Sample No.			K22-No0016218	K22-No0016219	K22-No0016220	K22-No0016221
Date Sampled			Nov 08, 2022	Nov 08, 2022	Nov 08, 2022	Nov 08, 2022
Test/Reference	LOR	Unit				
Metals M8 (NZ MfE)						
Lead	0.001	mg/L	0.001	< 0.001	0.005	0.005
Mercury	0.0001	mg/L	< 0.0001	< 0.0001	< 0.0001	< 0.0001
Nickel	0.001	mg/L	0.002	0.002	0.008	0.017
Zinc	0.005	mg/L	0.009	0.013	0.021	0.019

Sample History

Where samples are submitted/analysed over several days, the last date of extraction is reported.

If the date and time of sampling are not provided, the Laboratory will not be responsible for compromised results should testing be performed outside the recommended holding time.

Description	Testing Site	Extracted	Holding Time
BTEX (NZ MfE)	Auckland	Nov 15, 2022	14 Days
- Method: LTM-ORG-2010 TRH and BTEX in Soil and Water by GC FID and PT GCMS			
Total Petroleum Hydrocarbons (NZ MfE 1999)	Auckland	Nov 15, 2022	7 Days
- Method: LTM-ORG-2010 TRH and BTEX in Soil and Water by GC FID and PT GCMS			
Organochlorine Pesticides (NZ MfE)	Auckland	Nov 15, 2022	7 Days
- Method: LTM-ORG-2220 OCP & PCB in Soil and Water by GCMSMS			
Polycyclic Aromatic Hydrocarbons (NZ MfE)	Auckland	Nov 15, 2022	7 Days
- Method: LTM-ORG-2130 PAH and Phenols in Soil and Water by GC MSMS			
Organophosphorus Pesticides	Auckland	Nov 15, 2022	7 Days
- Method: LTM-ORG-2200 Organophosphorus Pesticides by GC-MS (USEPA 8081)			
Metals M8 (NZ MfE)	Auckland	Nov 15, 2022	28 Days
- Method: LTM-MET-3040 Metals in Waters, Soils & Sediments by ICP-MS			
Nitrogens (speciated)			
Ammonia (as N)	Melbourne	Nov 18, 2022	28 Days
- Method: LTM-INO-4200 Ammonia by Discrete Analyser			
Nitrate & Nitrite (as N)	Melbourne	Nov 18, 2022	28 Days
- Method: LTM-INO-4350 NO2 NO3 NOx in water by DA			
Nitrate (as N)	Melbourne	Nov 18, 2022	28 Days
- Method: LTM-INO-4350 NO2 NO3 NOx in water by DA			
Nitrite (as N)	Melbourne	Nov 18, 2022	2 Days
- Method: LTM-INO-4350 NO2 NO3 NOx in water by DA			
Total Kjeldahl Nitrogen (as N)	Melbourne	Nov 18, 2022	28 Days
- Method: APHA 4500-Norg B,D Total Kjeldahl Nitrogen by FIA			
Eurofins Suite B11F: Cl/SO4/Alkalinity/Total F			
Chloride	Melbourne	Nov 18, 2022	28 Days
- Method: LTM-INO-4090 Chloride by Discrete Analyser			
Fluoride	Melbourne	Nov 18, 2022	28 Days
- Method: in-house method LTM-INO-4390 Fluoride by Discrete Analyser			
Sulphate (as SO4)	Melbourne	Nov 18, 2022	28 Days
- Method: LTM-INO-4110 Sulfate by Discrete Analyser			
Alkalinity (speciated)	Melbourne	Nov 18, 2022	14 Days
- Method: LTM-INO-4250 Alkalinity by Electrometric Titration			
Eurofins Suite B11D: Na/K/Ca/Mg and Hardness			
Hardness mg equivalent CaCO3/L	Melbourne	Nov 18, 2022	28 Days
- Method: APHA 2340B Hardness by Calculation			
Alkali Metals	Melbourne	Nov 18, 2022	180 Days
- Method: LTM-MET-3010 Alkali Metals Sulfur Silicon Phosphorus by ICP-AES			
Iron (filtered)	Auckland	Nov 15, 2022	6 Months
- Method: LTM-MET-3040 Metals in Waters, Soils & Sediments by ICP-MS			
E. coli	Auckland	Nov 18, 2022	0 Day
- Method:			
Heavy Metals	Auckland	Nov 15, 2022	28 Days
- Method: LTM-MET-3040 Metals in Waters, Soils & Sediments by ICP-MS			

Company Name: ENGEO Ltd - NI
Address: 8 Greydene Place
Takapuna
Auckland 0622

Project Name:
Project ID: 18043

Order No.:
Report #: 938764
Phone: 0011 64 9 9722 205
Fax:

Received: Nov 8, 2022 1:44 PM
Due: Nov 11, 2022
Priority: 3 Day
Contact Name: Accounts Payable

Eurofins Analytical Services Manager : Karishma Patel

Sample Detail						Iron	Iron (filtered)	Eurofins Suite B10-NZ: TPH/BTEXN/PAH/OCP/OPP/M8 (NZ MfE)
Auckland Laboratory - IANZ# 1327						X	X	X
Christchurch Laboratory - IANZ# 1290								
External Laboratory								
No	**Sample ID**	**Sample Date**	**Sampling Time**	**Matrix**	**LAB ID**			
1	BH102	Nov 08, 2022		Water	K22-No0016218	X	X	X
2	BH106	Nov 08, 2022		Water	K22-No0016219	X	X	X
3	BH108	Nov 08, 2022		Water	K22-No0016220	X	X	X
4	BH110	Nov 08, 2022		Water	K22-No0016221	X	X	X
Test Counts						4	4	4

Internal Quality Control Review and Glossary

General

1. Laboratory QC results for Method Blanks, Duplicates, Matrix Spikes, and Laboratory Control Samples follows guidelines delineated in the National Environment Protection (Assessment of Site Contamination) Measure 1999, as amended May 2013 and are included in this QC report where applicable. Additional QC data may be available on request.
2. All soil/sediment/solid results are reported on a dry basis, unless otherwise stated.
3. All biota/food results are reported on a wet weight basis on the edible portion, unless otherwise stated.
4. Actual LORs are matrix dependant. Quoted LORs may be raised where sample extracts are diluted due to interferences.
5. Results are uncorrected for matrix spikes or surrogate recoveries except for PFAS compounds.
6. SVOC analysis on waters are performed on homogenised, unfiltered samples, unless noted otherwise.
7. Samples were analysed on an 'as received' basis.
8. Information identified on this report with blue colour, indicates data provided by customer that may have an impact on the results.
9. This report replaces any interim results previously issued.

Holding Times

Please refer to 'Sample Preservation and Container Guide' for holding times (QS3001).

For samples received on the last day of holding time, notification of testing requirements should have been received at least 6 hours prior to sample receipt deadlines as stated on the SRA.

If the Laboratory did not receive the information in the required timeframe, and regardless of any other integrity issues, suitably qualified results may still be reported.

Holding times apply from the date of sampling, therefore compliance to these may be outside the laboratory's control.

For VOCs containing vinyl chloride, styrene and 2-chloroethyl vinyl ether the holding time is 7 days however for all other VOCs such as BTEX or C6-10 TRH then the holding time is 14 days.

Units

mg/kg: milligrams per kilogram	**mg/L:** milligrams per litre	**µg/L:** micrograms per litre
ppm: parts per million	**ppb:** parts per billion	**%:** Percentage
org/100 mL: Organisms per 100 millilitres	**NTU:** Nephelometric Turbidity Units	**MPN/100 mL:** Most Probable Number of organisms per 100 millilitres

Terms

APHA	American Public Health Association
COC	Chain of Custody
CP	Client Parent - QC was performed on samples pertaining to this report
CRM	Certified Reference Material (ISO17034) - reported as percent recovery.
Dry	Where a moisture has been determined on a solid sample the result is expressed on a dry basis.
Duplicate	A second piece of analysis from the same sample and reported in the same units as the result to show comparison.
LOR	Limit of Reporting.
LCS	Laboratory Control Sample - reported as percent recovery.
Method Blank	In the case of solid samples these are performed on laboratory certified clean sands and in the case of water samples these are performed on de-ionised water.
NCP	Non-Client Parent - QC performed on samples not pertaining to this report, QC is representative of the sequence or batch that client samples were analysed within.
RPD	Relative Percent Difference between two Duplicate pieces of analysis.
SPIKE	Addition of the analyte to the sample and reported as percentage recovery.
SRA	Sample Receipt Advice
Surr - Surrogate	The addition of a like compound to the analyte target and reported as percentage recovery.
TBTO	Tributyltin oxide (*bis*-tributyltin oxide) - individual tributyltin compounds cannot be identified separately in the environment however free tributyltin was measured and its values were converted stoichiometrically into tributyltin oxide for comparison with regulatory limits.
TCLP	Toxicity Characteristic Leaching Procedure
TEQ	Toxic Equivalency Quotient or Total Equivalence
QSM	US Department of Defense Quality Systems Manual Version 5.4
US EPA	United States Environmental Protection Agency
WA DWER	Sum of PFBA, PFPeA, PFHxA, PFHpA, PFOA, PFBS, PFHxS, PFOS, 6:2 FTSA, 8:2 FTSA

QC - Acceptance Criteria

The acceptance criteria should be used as a guide only and may be different when site specific Sampling Analysis and Quality Plan (SAQP) have been implemented

RPD Duplicates: Global RPD Duplicates Acceptance Criteria is 30% however the following acceptance guidelines are equally applicable:

Results <10 times the LOR: No Limit

Results between 10-20 times the LOR: RPD must lie between 0-50%

Results >20 times the LOR : RPD must lie between 0-30%

NOTE: pH duplicates are reported as a range not as RPD

Surrogate Recoveries: Recoveries must lie between 20-130% for Speciated Phenols & 50-150% for PFAS

PFAS field samples that contain surrogate recoveries in excess of the QC limit designated in QSM 5.4 where no positive PFAS results have been reported have been reviewed and no data was affected.

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QC Data General Comments

1. Where a result is reported as a less than (<), higher than the nominated LOR, this is due to either matrix interference, extract dilution required due to interferences or contaminant levels within the sample, high moisture content or insufficient sample provided.
2. Duplicate data shown within this report that states the word "BATCH" is a Batch Duplicate from outside of your sample batch, but within the laboratory sample batch at a 1:10 ratio. The Parent and Duplicate data shown is not data from your samples.
3. pH and Free Chlorine analysed in the laboratory - Analysis on this test must begin within 30 minutes of sampling. Therefore, laboratory analysis is unlikely to be completed within holding time.Analysis will begin as soon as possible after sample receipt.
4. Recovery Data (Spikes & Surrogates) - where chromatographic interference does not allow the determination of recovery the term "INT" appears against that analyte.
5. For Matrix Spikes and LCS results a dash "-" in the report means that the specific analyte was not added to the QC sample.
6. Duplicate RPDs are calculated from raw analytical data thus it is possible to have two sets of data.

Quality Control Results

Test	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Method Blank							
Volatile Organics (NZ MfE)							
Naphthalene	mg/L	< 0.01			0.01	Pass	
Method Blank							
BTEX (NZ MfE)							
Benzene	mg/L	< 0.001			0.001	Pass	
Toluene	mg/L	< 0.001			0.001	Pass	
Ethylbenzene	mg/L	< 0.001			0.001	Pass	
m&p-Xylenes	mg/L	< 0.002			0.002	Pass	
o-Xylene	mg/L	< 0.001			0.001	Pass	
Xylenes - Total	mg/L	< 0.003			0.003	Pass	
Method Blank							
Total Petroleum Hydrocarbons (NZ MfE 1999)							
TPH-SG C7-C9	mg/L	< 0.1			0.1	Pass	
TPH-SG C10-C14	mg/L	< 0.2			0.2	Pass	
TPH-SG C15-C36	mg/L	< 0.4			0.4	Pass	
TPH-SG C7-C36 (Total)	mg/L	< 0.7			0.7	Pass	
Method Blank							
Organochlorine Pesticides (NZ MfE)							
2.4'-DDD	mg/L	< 0.0005			0.0005	Pass	
2.4'-DDE	mg/L	< 0.0005			0.0005	Pass	
2.4'-DDT	mg/L	< 0.0005			0.0005	Pass	
4.4'-DDD	mg/L	< 0.0005			0.0005	Pass	
4.4'-DDE	mg/L	< 0.0005			0.0005	Pass	
4.4'-DDT	mg/L	< 0.0005			0.0005	Pass	
a-HCH	mg/L	< 0.0005			0.0005	Pass	
Aldrin	mg/L	< 0.0005			0.0005	Pass	
b-HCH	mg/L	< 0.0005			0.0005	Pass	
Chlordanes - Total	mg/L	< 0.0005			0.0005	Pass	
cis-Chlordane	mg/L	< 0.0005			0.0005	Pass	
d-HCH	mg/L	< 0.0005			0.0005	Pass	
Dieldrin	mg/L	< 0.0005			0.0005	Pass	
Endosulfan I	mg/L	< 0.0005			0.0005	Pass	
Endosulfan II	mg/L	< 0.0005			0.0005	Pass	
Endosulfan sulphate	mg/L	< 0.0005			0.0005	Pass	
Endrin	mg/L	< 0.001			0.001	Pass	
Endrin aldehyde	mg/L	< 0.001			0.001	Pass	
Endrin ketone	mg/L	< 0.0005			0.0005	Pass	
g-HCH (Lindane)	mg/L	< 0.0005			0.0005	Pass	
Heptachlor	mg/L	< 0.0005			0.0005	Pass	
Heptachlor epoxide	mg/L	< 0.0005			0.0005	Pass	
Hexachlorobenzene	mg/L	< 0.0005			0.0005	Pass	
Methoxychlor	mg/L	< 0.0005			0.0005	Pass	
Toxaphene	mg/L	< 0.005			0.005	Pass	
trans-Chlordane	mg/L	< 0.0005			0.0005	Pass	
Method Blank							
Polycyclic Aromatic Hydrocarbons (NZ MfE)							
Acenaphthene	mg/L	< 0.001			0.001	Pass	
Acenaphthylene	mg/L	< 0.001			0.001	Pass	
Anthracene	mg/L	< 0.001			0.001	Pass	
Benz(a)anthracene	mg/L	< 0.001			0.001	Pass	
Benzo(a)pyrene	mg/L	< 0.001			0.001	Pass	

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Environment Testing

Test	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Benzo(b&j)fluoranthene	mg/L	< 0.001			0.001	Pass	
Benzo(g.h.i)perylene	mg/L	< 0.001			0.001	Pass	
Benzo(k)fluoranthene	mg/L	< 0.001			0.001	Pass	
Chrysene	mg/L	< 0.001			0.001	Pass	
Dibenz(a.h)anthracene	mg/L	< 0.001			0.001	Pass	
Fluoranthene	mg/L	< 0.001			0.001	Pass	
Fluorene	mg/L	< 0.001			0.001	Pass	
Indeno(1.2.3-cd)pyrene	mg/L	< 0.001			0.001	Pass	
Naphthalene	mg/L	< 0.001			0.001	Pass	
Phenanthrene	mg/L	< 0.001			0.001	Pass	
Pyrene	mg/L	< 0.001			0.001	Pass	
Method Blank							
Organophosphorus Pesticides							
Azinphos-methyl	mg/L	< 0.002			0.002	Pass	
Bolstar	mg/L	< 0.002			0.002	Pass	
Chlorfenvinphos	mg/L	< 0.002			0.002	Pass	
Chlorpyrifos	mg/L	< 0.02			0.02	Pass	
Chlorpyrifos-methyl	mg/L	< 0.002			0.002	Pass	
Coumaphos	mg/L	< 0.02			0.02	Pass	
Demeton-O	mg/L	< 0.002			0.002	Pass	
Demeton-S	mg/L	< 0.02			0.02	Pass	
Diazinon	mg/L	< 0.002			0.002	Pass	
Dichlorvos	mg/L	< 0.002			0.002	Pass	
Dimethoate	mg/L	< 0.002			0.002	Pass	
Disulfoton	mg/L	< 0.002			0.002	Pass	
EPN	mg/L	< 0.002			0.002	Pass	
Ethion	mg/L	< 0.002			0.002	Pass	
Ethoprop	mg/L	< 0.002			0.002	Pass	
Ethyl parathion	mg/L	< 0.002			0.002	Pass	
Fenamiphos	mg/L	< 0.02			0.02	Pass	
Fenitrothion	mg/L	< 0.002			0.002	Pass	
Fensulfothion	mg/L	< 0.002			0.002	Pass	
Fenthion	mg/L	< 0.002			0.002	Pass	
Malathion	mg/L	< 0.002			0.002	Pass	
Merphos	mg/L	< 0.002			0.002	Pass	
Methyl parathion	mg/L	< 0.002			0.002	Pass	
Mevinphos	mg/L	< 0.002			0.002	Pass	
Monocrotophos	mg/L	< 0.002			0.002	Pass	
Naled	mg/L	< 0.002			0.002	Pass	
Omethoate	mg/L	< 0.002			0.002	Pass	
Phorate	mg/L	< 0.002			0.002	Pass	
Pirimiphos-methyl	mg/L	< 0.02			0.02	Pass	
Profenofos	mg/L	< 0.002			0.002	Pass	
Pyrazophos	mg/L	< 0.002			0.002	Pass	
Ronnel	mg/L	< 0.002			0.002	Pass	
Temephos	mg/L	< 0.02			0.02	Pass	
Terbufos	mg/L	< 0.002			0.002	Pass	
Tetrachlorvinphos	mg/L	< 0.002			0.002	Pass	
Tokuthion	mg/L	< 0.002			0.002	Pass	
Trichloronate	mg/L	< 0.002			0.002	Pass	
Method Blank							
Iron (filtered)	mg/L	< 0.05			0.05	Pass	
LCS - % Recovery							
Volatile Organics (NZ MfE)							

Test	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Naphthalene	%	96			70-130	Pass	
LCS - % Recovery							
BTEX (NZ MfE)							
Benzene	%	83			70-130	Pass	
Toluene	%	70			70-130	Pass	
Ethylbenzene	%	114			70-130	Pass	
m&p-Xylenes	%	105			70-130	Pass	
o-Xylene	%	102			70-130	Pass	
Xylenes - Total	%	104			70-130	Pass	
LCS - % Recovery							
Total Petroleum Hydrocarbons (NZ MfE 1999)							
TPH-SG C7-C36 (Total)	%	101			70-130	Pass	
LCS - % Recovery							
Organochlorine Pesticides (NZ MfE)							
2.4'-DDD	%	121			70-130	Pass	
2.4'-DDE	%	112			70-130	Pass	
4.4'-DDD	%	110			70-130	Pass	
4.4'-DDE	%	116			70-130	Pass	
a-HCH	%	109			70-130	Pass	
Aldrin	%	108			70-130	Pass	
b-HCH	%	103			70-130	Pass	
Chlordanes - Total	%	114			70-130	Pass	
cis-Chlordane	%	115			70-130	Pass	
d-HCH	%	110			70-130	Pass	
Dieldrin	%	117			70-130	Pass	
Endosulfan I	%	115			70-130	Pass	
Endosulfan II	%	124			70-130	Pass	
Endosulfan sulphate	%	116			70-130	Pass	
Endrin	%	116			70-130	Pass	
Endrin aldehyde	%	104			70-130	Pass	
Endrin ketone	%	106			70-130	Pass	
Heptachlor	%	112			70-130	Pass	
Heptachlor epoxide	%	118			70-130	Pass	
Hexachlorobenzene	%	110			70-130	Pass	
Methoxychlor	%	117			70-130	Pass	
trans-Chlordane	%	114			70-130	Pass	
LCS - % Recovery							
Polycyclic Aromatic Hydrocarbons (NZ MfE)							
Acenaphthene	%	119			70-130	Pass	
Acenaphthylene	%	113			70-130	Pass	
Anthracene	%	116			70-130	Pass	
Benz(a)anthracene	%	117			70-130	Pass	
Benzo(a)pyrene	%	126			70-130	Pass	
Benzo(b&j)fluoranthene	%	105			70-130	Pass	
Benzo(g.h.i)perylene	%	91			70-130	Pass	
Benzo(k)fluoranthene	%	95			70-130	Pass	
Chrysene	%	117			70-130	Pass	
Dibenz(a.h)anthracene	%	98			70-130	Pass	
Fluoranthene	%	124			70-130	Pass	
Fluorene	%	121			70-130	Pass	
Indeno(1.2.3-cd)pyrene	%	102			70-130	Pass	
Naphthalene	%	117			70-130	Pass	
Phenanthrene	%	121			70-130	Pass	
Pyrene	%	107			70-130	Pass	

Test			Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
LCS - % Recovery									
Organophosphorus Pesticides									
Bolstar			%	115			70-130	Pass	
Chlorpyrifos			%	111			70-130	Pass	
Chlorpyrifos-methyl			%	118			70-130	Pass	
Demeton-O			%	95			70-130	Pass	
Diazinon			%	115			70-130	Pass	
Dichlorvos			%	105			70-130	Pass	
Dimethoate			%	110			70-130	Pass	
Ethion			%	117			70-130	Pass	
Ethoprop			%	110			70-130	Pass	
Ethyl parathion			%	115			70-130	Pass	
Fenitrothion			%	122			70-130	Pass	
Fensulfothion			%	105			70-130	Pass	
Fenthion			%	113			70-130	Pass	
Malathion			%	116			70-130	Pass	
Merphos			%	116			70-130	Pass	
Mevinphos			%	108			70-130	Pass	
Monocrotophos			%	92			70-130	Pass	
Naled			%	106			70-130	Pass	
Phorate			%	113			70-130	Pass	
Pirimiphos-methyl			%	117			70-130	Pass	
Profenofos			%	121			70-130	Pass	
Ronnel			%	102			70-130	Pass	
Temephos			%	119			70-130	Pass	
Terbufos			%	111			70-130	Pass	
Tokuthion			%	114			70-130	Pass	
Trichloronate			%	116			70-130	Pass	
LCS - % Recovery									
Iron (filtered)			%	98			80-120	Pass	
Test	**Lab Sample ID**	**QA Source**	**Units**	**Result 1**			**Acceptance Limits**	**Pass Limits**	**Qualifying Code**
Spike - % Recovery									
Volatile Organics (NZ MfE)				Result 1					
Naphthalene	K22-Oc0017166	NCP	%	74			70-130	Pass	
Spike - % Recovery									
BTEX (NZ MfE)				Result 1					
Toluene	K22-Oc0017166	NCP	%	71			70-130	Pass	
Ethylbenzene	K22-No0002351	NCP	%	82			70-130	Pass	
m&p-Xylenes	K22-No0002351	NCP	%	73			70-130	Pass	
o-Xylene	K22-No0002351	NCP	%	72			70-130	Pass	
Xylenes - Total	K22-No0002351	NCP	%	73			70-130	Pass	
Spike - % Recovery									
Organochlorine Pesticides (NZ MfE)				Result 1					
Chlordanes - Total	K22-No0015940	NCP	%	73			70-130	Pass	
cis-Chlordane	K22-No0015940	NCP	%	70			70-130	Pass	
Hexachlorobenzene	K22-No0008904	NCP	%	106			70-130	Pass	
trans-Chlordane	K22-No0015940	NCP	%	75			70-130	Pass	
Spike - % Recovery									
Organophosphorus Pesticides				Result 1					
Demeton-S	K22-No0008904	NCP	%	134			70-130	Fail	
Disulfoton	K22-No0008904	NCP	%	114			70-130	Pass	
Spike - % Recovery									
Total Petroleum Hydrocarbons (NZ MfE 1999)				Result 1					
TPH-SG C7-C36 (Total)	K22-No0016221	CP	%	77			70-130	Pass	

Test	Lab Sample ID	QA Source	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Spike - % Recovery									
Organochlorine Pesticides (NZ MfE)				Result 1					
2.4'-DDD	K22-No0016221	CP	%	79			70-130	Pass	
2.4'-DDE	K22-No0016221	CP	%	76			70-130	Pass	
2.4'-DDT	K22-No0016221	CP	%	111			70-130	Pass	
4.4'-DDD	K22-No0016221	CP	%	82			70-130	Pass	
4.4'-DDE	K22-No0016221	CP	%	78			70-130	Pass	
4.4'-DDT	K22-No0016221	CP	%	112			70-130	Pass	
a-HCH	K22-No0016221	CP	%	74			70-130	Pass	
Aldrin	K22-No0016221	CP	%	75			70-130	Pass	
b-HCH	K22-No0016221	CP	%	77			70-130	Pass	
d-HCH	K22-No0016221	CP	%	79			70-130	Pass	
Dieldrin	K22-No0016221	CP	%	78			70-130	Pass	
Endosulfan I	K22-No0016221	CP	%	76			70-130	Pass	
Endosulfan II	K22-No0016221	CP	%	83			70-130	Pass	
Endosulfan sulphate	K22-No0016221	CP	%	81			70-130	Pass	
Endrin	K22-No0016221	CP	%	77			70-130	Pass	
Endrin aldehyde	K22-No0016221	CP	%	89			70-130	Pass	
Endrin ketone	K22-No0016221	CP	%	83			70-130	Pass	
g-HCH (Lindane)	K22-No0016221	CP	%	100			70-130	Pass	
Heptachlor	K22-No0016221	CP	%	74			70-130	Pass	
Methoxychlor	K22-No0016221	CP	%	92			70-130	Pass	
Spike - % Recovery									
Polycyclic Aromatic Hydrocarbons (NZ MfE)				Result 1					
Acenaphthene	K22-No0016221	CP	%	86			70-130	Pass	
Acenaphthylene	K22-No0016221	CP	%	75			70-130	Pass	
Anthracene	K22-No0016221	CP	%	77			70-130	Pass	
Benz(a)anthracene	K22-No0016221	CP	%	106			70-130	Pass	
Benzo(a)pyrene	K22-No0016221	CP	%	91			70-130	Pass	
Benzo(b&j)fluoranthene	K22-No0016221	CP	%	110			70-130	Pass	
Benzo(g.h.i)perylene	K22-No0016221	CP	%	77			70-130	Pass	
Benzo(k)fluoranthene	K22-No0016221	CP	%	71			70-130	Pass	
Chrysene	K22-No0016221	CP	%	87			70-130	Pass	
Dibenz(a.h)anthracene	K22-No0016221	CP	%	75			70-130	Pass	
Fluoranthene	K22-No0016221	CP	%	80			70-130	Pass	
Fluorene	K22-No0016221	CP	%	79			70-130	Pass	
Indeno(1.2.3-cd)pyrene	K22-No0016221	CP	%	74			70-130	Pass	
Naphthalene	K22-No0016221	CP	%	83			70-130	Pass	
Phenanthrene	K22-No0016221	CP	%	76			70-130	Pass	
Pyrene	K22-No0016221	CP	%	79			70-130	Pass	
Spike - % Recovery									
Organophosphorus Pesticides				Result 1					
Azinphos-methyl	K22-No0016221	CP	%	130			70-130	Pass	
Bolstar	K22-No0016221	CP	%	88			70-130	Pass	
Chlorfenvinphos	K22-No0016221	CP	%	92			70-130	Pass	
Chlorpyrifos	K22-No0016221	CP	%	76			70-130	Pass	
Chlorpyrifos-methyl	K22-No0016221	CP	%	72			70-130	Pass	
Coumaphos	K22-No0016221	CP	%	94			70-130	Pass	
Demeton-O	K22-No0016221	CP	%	82			70-130	Pass	
Diazinon	K22-No0016221	CP	%	87			70-130	Pass	
Dichlorvos	K22-No0016221	CP	%	83			70-130	Pass	
Dimethoate	K22-No0016221	CP	%	79			70-130	Pass	
EPN	K22-No0016221	CP	%	102			70-130	Pass	
Ethion	K22-No0016221	CP	%	83			70-130	Pass	

Test	Lab Sample ID	QA Source	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Ethoprop	K22-No0016221	CP	%	79			70-130	Pass	
Ethyl parathion	K22-No0016221	CP	%	79			70-130	Pass	
Fenitrothion	K22-No0016221	CP	%	72			70-130	Pass	
Fensulfothion	K22-No0016221	CP	%	74			70-130	Pass	
Fenthion	K22-No0016221	CP	%	82			70-130	Pass	
Malathion	K22-No0016221	CP	%	86			70-130	Pass	
Merphos	K22-No0016221	CP	%	73			70-130	Pass	
Methyl parathion	K22-No0016221	CP	%	91			70-130	Pass	
Mevinphos	K22-No0016221	CP	%	82			70-130	Pass	
Naled	K22-No0016221	CP	%	90			70-130	Pass	
Phorate	K22-No0016221	CP	%	70			70-130	Pass	
Profenofos	K22-No0016221	CP	%	79			70-130	Pass	
Pyrazophos	K22-No0016221	CP	%	95			70-130	Pass	
Ronnel	K22-No0016221	CP	%	78			70-130	Pass	
Temephos	K22-No0016221	CP	%	97			70-130	Pass	
Terbufos	K22-No0016221	CP	%	72			70-130	Pass	
Tetrachlorvinphos	K22-No0016221	CP	%	86			70-130	Pass	
Tokuthion	K22-No0016221	CP	%	79			70-130	Pass	
Trichloronate	K22-No0016221	CP	%	72			70-130	Pass	

Test	Lab Sample ID	QA Source	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Duplicate									
Volatile Organics (NZ MfE)				Result 1	Result 2	RPD			
Naphthalene	K22-No0016218	CP	mg/L	< 0.01	< 0.01	<1	30%	Pass	
Duplicate									
BTEX (NZ MfE)				Result 1	Result 2	RPD			
Benzene	K22-No0016218	CP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Toluene	K22-No0016218	CP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Ethylbenzene	K22-No0016218	CP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
m&p-Xylenes	K22-No0016218	CP	mg/L	< 0.002	< 0.002	<1	30%	Pass	
o-Xylene	K22-No0016218	CP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Xylenes - Total	K22-No0016218	CP	mg/L	< 0.003	< 0.003	<1	30%	Pass	
Duplicate									
Total Petroleum Hydrocarbons (NZ MfE 1999)				Result 1	Result 2	RPD			
TPH-SG C7-C9	K22-No0016218	CP	mg/L	< 0.1	< 0.1	<1	30%	Pass	
TPH-SG C10-C14	K22-No0016218	CP	mg/L	< 0.2	< 0.2	<1	30%	Pass	
TPH-SG C15-C36	K22-No0016218	CP	mg/L	< 0.4	< 0.4	<1	30%	Pass	
TPH-SG C7-C36 (Total)	K22-No0016218	CP	mg/L	< 0.7	< 0.7	<1	30%	Pass	
Duplicate									
Organochlorine Pesticides (NZ MfE)				Result 1	Result 2	RPD			
2.4'-DDD	K22-No0016218	CP	mg/L	< 0.0005	< 0.0005	<1	30%	Pass	
2.4'-DDE	K22-No0016218	CP	mg/L	< 0.0005	< 0.0005	<1	30%	Pass	
2.4'-DDT	K22-No0016218	CP	mg/L	< 0.0005	< 0.0005	<1	30%	Pass	
4.4'-DDD	K22-No0016218	CP	mg/L	< 0.0005	< 0.0005	<1	30%	Pass	
4.4'-DDE	K22-No0016218	CP	mg/L	< 0.0005	< 0.0005	<1	30%	Pass	
4.4'-DDT	K22-No0016218	CP	mg/L	< 0.0005	< 0.0005	<1	30%	Pass	
a-HCH	K22-No0016218	CP	mg/L	< 0.0005	< 0.0005	<1	30%	Pass	
Aldrin	K22-No0016218	CP	mg/L	< 0.0005	< 0.0005	<1	30%	Pass	
b-HCH	K22-No0016218	CP	mg/L	< 0.0005	< 0.0005	<1	30%	Pass	
Chlordanes - Total	K22-No0016218	CP	mg/L	< 0.0005	< 0.0005	<1	30%	Pass	
cis-Chlordane	K22-No0016218	CP	mg/L	< 0.0005	< 0.0005	<1	30%	Pass	
d-HCH	K22-No0016218	CP	mg/L	< 0.0005	< 0.0005	<1	30%	Pass	
Dieldrin	K22-No0016218	CP	mg/L	< 0.0005	< 0.0005	<1	30%	Pass	
Endosulfan I	K22-No0016218	CP	mg/L	< 0.0005	< 0.0005	<1	30%	Pass	
Endosulfan II	K22-No0016218	CP	mg/L	< 0.0005	< 0.0005	<1	30%	Pass	

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Duplicate									
Organochlorine Pesticides (NZ MfE)				Result 1	Result 2	RPD			
Endosulfan sulphate	K22-No0016218	CP	mg/L	< 0.0005	< 0.0005	<1	30%	Pass	
Endrin	K22-No0016218	CP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Endrin aldehyde	K22-No0016218	CP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Endrin ketone	K22-No0016218	CP	mg/L	< 0.0005	< 0.0005	<1	30%	Pass	
g-HCH (Lindane)	K22-No0016218	CP	mg/L	< 0.0005	< 0.0005	<1	30%	Pass	
Heptachlor	K22-No0016218	CP	mg/L	< 0.0005	< 0.0005	<1	30%	Pass	
Heptachlor epoxide	K22-No0016218	CP	mg/L	< 0.0005	< 0.0005	<1	30%	Pass	
Hexachlorobenzene	K22-No0016218	CP	mg/L	< 0.0005	< 0.0005	<1	30%	Pass	
Methoxychlor	K22-No0016218	CP	mg/L	< 0.0005	< 0.0005	<1	30%	Pass	
trans-Chlordane	K22-No0016218	CP	mg/L	< 0.0005	< 0.0005	<1	30%	Pass	
Duplicate									
Polycyclic Aromatic Hydrocarbons (NZ MfE)				Result 1	Result 2	RPD			
Acenaphthene	K22-No0016218	CP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Acenaphthylene	K22-No0016218	CP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Anthracene	K22-No0016218	CP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Benz(a)anthracene	K22-No0016218	CP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Benzo(a)pyrene	K22-No0016218	CP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Benzo(b&j)fluoranthene	K22-No0016218	CP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Benzo(g.h.i)perylene	K22-No0016218	CP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Benzo(k)fluoranthene	K22-No0016218	CP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Chrysene	K22-No0016218	CP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Dibenz(a.h)anthracene	K22-No0016218	CP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Fluoranthene	K22-No0016218	CP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Fluorene	K22-No0016218	CP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Indeno(1.2.3-cd)pyrene	K22-No0016218	CP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Naphthalene	K22-No0016218	CP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Phenanthrene	K22-No0016218	CP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Pyrene	K22-No0016218	CP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Duplicate									
Organophosphorus Pesticides				Result 1	Result 2	RPD			
Azinphos-methyl	K22-No0016218	CP	mg/L	< 0.002	< 0.002	<1	30%	Pass	
Bolstar	K22-No0016218	CP	mg/L	< 0.002	< 0.002	<1	30%	Pass	
Chlorfenvinphos	K22-No0016218	CP	mg/L	< 0.002	< 0.002	<1	30%	Pass	
Chlorpyrifos	K22-No0016218	CP	mg/L	< 0.02	< 0.02	<1	30%	Pass	
Chlorpyrifos-methyl	K22-No0016218	CP	mg/L	< 0.002	< 0.002	<1	30%	Pass	
Coumaphos	K22-No0016218	CP	mg/L	< 0.02	< 0.02	<1	30%	Pass	
Demeton-O	K22-No0016218	CP	mg/L	< 0.002	< 0.002	<1	30%	Pass	
Demeton-S	K22-No0016218	CP	mg/L	< 0.02	< 0.02	<1	30%	Pass	
Diazinon	K22-No0016218	CP	mg/L	< 0.002	< 0.002	<1	30%	Pass	
Dichlorvos	K22-No0016218	CP	mg/L	< 0.002	< 0.002	<1	30%	Pass	
Dimethoate	K22-No0016218	CP	mg/L	< 0.002	< 0.002	<1	30%	Pass	
Disulfoton	K22-No0016218	CP	mg/L	< 0.002	< 0.002	<1	30%	Pass	
EPN	K22-No0016218	CP	mg/L	< 0.002	< 0.002	<1	30%	Pass	
Ethion	K22-No0016218	CP	mg/L	< 0.002	< 0.002	<1	30%	Pass	
Ethoprop	K22-No0016218	CP	mg/L	< 0.002	< 0.002	<1	30%	Pass	
Ethyl parathion	K22-No0016218	CP	mg/L	< 0.002	< 0.002	<1	30%	Pass	
Fenamiphos	K22-No0016218	CP	mg/L	< 0.02	< 0.02	<1	30%	Pass	
Fenitrothion	K22-No0016218	CP	mg/L	< 0.002	< 0.002	<1	30%	Pass	
Fensulfothion	K22-No0016218	CP	mg/L	< 0.002	< 0.002	<1	30%	Pass	
Fenthion	K22-No0016218	CP	mg/L	< 0.002	< 0.002	<1	30%	Pass	
Malathion	K22-No0016218	CP	mg/L	< 0.002	< 0.002	<1	30%	Pass	
Merphos	K22-No0016218	CP	mg/L	< 0.002	< 0.002	<1	30%	Pass	
Methyl parathion	K22-No0016218	CP	mg/L	< 0.002	< 0.002	<1	30%	Pass	
Mevinphos	K22-No0016218	CP	mg/L	< 0.002	< 0.002	<1	30%	Pass	

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Duplicate									
Organophosphorus Pesticides				Result 1	Result 2	RPD			
Monocrotophos	K22-No0016218	CP	mg/L	< 0.002	< 0.002	<1	30%	Pass	
Naled	K22-No0016218	CP	mg/L	< 0.002	< 0.002	<1	30%	Pass	
Omethoate	K22-No0016218	CP	mg/L	< 0.002	< 0.002	<1	30%	Pass	
Phorate	K22-No0016218	CP	mg/L	< 0.002	< 0.002	<1	30%	Pass	
Pirimiphos-methyl	K22-No0016218	CP	mg/L	< 0.02	< 0.02	<1	30%	Pass	
Profenofos	K22-No0016218	CP	mg/L	< 0.002	< 0.002	<1	30%	Pass	
Pyrazophos	K22-No0016218	CP	mg/L	< 0.002	< 0.002	<1	30%	Pass	
Ronnel	K22-No0016218	CP	mg/L	< 0.002	< 0.002	<1	30%	Pass	
Temephos	K22-No0016218	CP	mg/L	< 0.02	< 0.02	<1	30%	Pass	
Terbufos	K22-No0016218	CP	mg/L	< 0.002	< 0.002	<1	30%	Pass	
Tetrachlorvinphos	K22-No0016218	CP	mg/L	< 0.002	< 0.002	<1	30%	Pass	
Tokuthion	K22-No0016218	CP	mg/L	< 0.002	< 0.002	<1	30%	Pass	
Trichloronate	K22-No0016218	CP	mg/L	< 0.002	< 0.002	<1	30%	Pass	
Duplicate									
				Result 1	Result 2	RPD			
Iron (filtered)	K22-No0016218	CP	mg/L	2.5	2.5	<1	30%	Pass	

Comments

This report has been revised (V2-938764) to include analysis conducted by ELS, not reported in initial report.

Analysis of Alkalinity, Chloride, TKN, Nitrogen, Alkali metals, Ammonia Nitrogen, E. coli and Sulphate has been completed by Eurofins ELS, 22/30162.

Sample Integrity

Custody Seals Intact (if used)	N/A
Attempt to Chill was evident	No
Sample correctly preserved	No
Appropriate sample containers have been used	No
Sample containers for volatile analysis received with minimal headspace	Yes
Samples received within HoldingTime	Yes
Some samples have been subcontracted	No

Qualifier Codes/Comments

Code	Description
N16	Analysis performed by Eurofins Environment Testing Australia

Authorised by:

Karishma Patel	Analytical Services Manager
Michael Ritchie	Senior Analyst-Metal
Michael Ritchie	Senior Analyst-Organic
Michael Ritchie	Senior Analyst-Volatile

Michael Ritchie
Head of Semi Volatiles (Key Technical Personnel)

Final Report – this report replaces any previously issued Report

- Indicates Not Requested

* Indicates IANZ accreditation does not cover the performance of this service

Measurement uncertainty of test data is available on request or please click here.

Eurofins Environment Testing
New Zealand
35 O#Rorke Rd
Penrose
Auckland

Eurofins ELS Limited

Analytical Report

Report Number: 22/30162

Issue: 3
14 December 2022

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
22/30162-01	Water Sample		08/11/2022 00:00	09/11/2022 11:00	0

Notes: K22-No0016218

	Test	Result	Units	Test Date	Signatory
0052	Alkalinity - Total	126	g CaCO3/m³	14/11/2022	Jennifer Mont KTP
0061	Chloride	18	g/m³	15/11/2022	Jennifer Mont KTP
0071	Carbonate Alkalinity	< 2	g CaCO3/m³	15/11/2022	Jennifer Mont KTP
0072	Bicarbonate Alkalinity	126	g CaCO3/m³	15/11/2022	Jennifer Mont KTP
0083	Total Kjeldahl Nitrogen	< 0.8	g/m³	11/11/2022	Jennifer Mont KTP
0601	Fluoride	0.24	g/m³	15/11/2022	Divina Cunanan Lagazon KTP
0603	Nitrite - Nitrogen	< 0.01	g/m³	15/11/2022	Divina Cunanan Lagazon KTP
0605	Nitrate - Nitrogen	0.05	g/m³	15/11/2022	Divina Cunanan Lagazon KTP
0607	Sulphate	30.6	g/m³	15/11/2022	Divina Cunanan Lagazon KTP
0760	Ammonia Nitrogen	0.34	g/m³	15/11/2022	Divina Cunanan Lagazon KTP
2127	Total Nitrogen	0.58	g/m³	16/11/2022	Divina Cunanan Lagazon KTP
6043	Total Hardness	111	g CaCO3/m³	15/11/2022	Amitesh Kumar KTP
6610	Calcium - Total	25.1	g/m³	14/11/2022	Amitesh Kumar KTP
6620	Magnesium - Total	11.8	g/m³	14/11/2022	Amitesh Kumar KTP
6626	Potassium - Total	7.4	g/m³	14/11/2022	Amitesh Kumar KTP
6631	Sodium - Total	30.2	g/m³	14/11/2022	Amitesh Kumar KTP
M0104	E. coli	120	cfu/100mL	17/11/2022	Sunita Raju KTP
P1855	Aqueous Total Metal Digestion	Completed		12/11/2022	Weiwei Sun Analyst
P1859	Sample Filtration	Completed		12/11/2022	Emily Couper .

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
22/30162-02	Water Sample		08/11/2022 00:00	09/11/2022 11:00	0

Notes: K22-No0016219

	Test	Result	Units	Test Date	Signatory
0052	Alkalinity - Total	136	g CaCO3/m³	14/11/2022	Jennifer Mont KTP
0061	Chloride	93	g/m³	15/11/2022	Jennifer Mont KTP
0071	Carbonate Alkalinity	< 2	g CaCO3/m³	15/11/2022	Jennifer Mont KTP
0072	Bicarbonate Alkalinity	136	g CaCO3/m³	15/11/2022	Jennifer Mont KTP
0083	Total Kjeldahl Nitrogen	1.9	g/m³	11/11/2022	Jennifer Mont KTP
0601	Fluoride	0.15	g/m³	15/11/2022	Divina Cunanan Lagazon KTP
0603	Nitrite - Nitrogen	< 0.01	g/m³	15/11/2022	Divina Cunanan Lagazon KTP
0605	Nitrate - Nitrogen	< 0.01	g/m³	15/11/2022	Divina Cunanan Lagazon KTP
0607	Sulphate	52.4	g/m³	15/11/2022	Divina Cunanan Lagazon KTP
0760	Ammonia Nitrogen	0.61	g/m³	15/11/2022	Divina Cunanan Lagazon KTP
2127	Total Nitrogen	1.28	g/m³	15/11/2022	Divina Cunanan Lagazon KTP
6043	Total Hardness	236	g CaCO3/m³	15/11/2022	Amitesh Kumar KTP
6610	Calcium - Total	39.7	g/m³	14/11/2022	Amitesh Kumar KTP
6620	Magnesium - Total	33.2	g/m³	14/11/2022	Amitesh Kumar KTP
6626	Potassium - Total	6.6	g/m³	14/11/2022	Amitesh Kumar KTP
6631	Sodium - Total	33.6	g/m³	14/11/2022	Amitesh Kumar KTP
M0104	E. coli	12	cfu/100mL	17/11/2022	Sunita Raju KTP
P1855	Aqueous Total Metal Digestion	Completed		12/11/2022	Weiwei Sun Analyst
P1859	Sample Filtration	Completed		12/11/2022	Emily Couper .

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
22/30162-03	Water Sample		08/11/2022 00:00	09/11/2022 11:00	0

Notes: K22-No0016220

	Test	Result	Units	Test Date	Signatory
0052	Alkalinity - Total	194	g CaCO3/m³	15/11/2022	Gordon McArthur KTP
0061	Chloride	33	g/m³	15/11/2022	Jennifer Mont KTP
0071	Carbonate Alkalinity	< 2	g CaCO3/m³	15/11/2022	Jennifer Mont KTP
0072	Bicarbonate Alkalinity	194	g CaCO3/m³	15/11/2022	Jennifer Mont KTP
0083	Total Kjeldahl Nitrogen	6.8	g/m³	11/11/2022	Jennifer Mont KTP

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
22/30162-03	Water Sample		08/11/2022 00:00	09/11/2022 11:00	0

Notes: K22-No0016220

	Test	Result	Units	Test Date	Signatory
0601	Fluoride	0.16	g/m^3	15/11/2022	Divina Cunanan Lagazon KTP
0603	Nitrite - Nitrogen	< 0.01	g/m^3	15/11/2022	Divina Cunanan Lagazon KTP
0605	Nitrate - Nitrogen	< 0.01	g/m^3	15/11/2022	Divina Cunanan Lagazon KTP
0607	Sulphate	26.8	g/m^3	15/11/2022	Divina Cunanan Lagazon KTP
0760	Ammonia Nitrogen	4.85	g/m^3	15/11/2022	Divina Cunanan Lagazon KTP
2127	Total Nitrogen	5.63	g/m^3	15/11/2022	Divina Cunanan Lagazon KTP
6043	Total Hardness	191	g $CaCO3/m^3$	15/11/2022	Amitesh Kumar KTP
6610	Calcium - Total	46.3	g/m^3	14/11/2022	Amitesh Kumar KTP
6620	Magnesium - Total	18.2	g/m^3	14/11/2022	Amitesh Kumar KTP
6626	Potassium - Total	10.7	g/m^3	14/11/2022	Amitesh Kumar KTP
6631	Sodium - Total	42.1	g/m^3	14/11/2022	Amitesh Kumar KTP
M0104	E. coli	3,500	cfu/100mL	17/11/2022	Sunita Raju KTP
P1855	Aqueous Total Metal Digestion	Completed		12/11/2022	Weiwei Sun Analyst
P1859	Sample Filtration	Completed		12/11/2022	Emily Couper .

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
22/30162-04	Water Sample		08/11/2022 00:00	09/11/2022 11:00	0

Notes: K22-No0016221

	Test	Result	Units	Test Date	Signatory
0052	Alkalinity - Total	646	g $CaCO3/m^3$	15/11/2022	Gordon McArthur KTP
0061	Chloride	80	g/m^3	15/11/2022	Jennifer Mont KTP
0071	Carbonate Alkalinity	< 2	g $CaCO3/m^3$	15/11/2022	Jennifer Mont KTP
0072	Bicarbonate Alkalinity	646	g $CaCO3/m^3$	15/11/2022	Jennifer Mont KTP
0083	Total Kjeldahl Nitrogen	16.5	g/m^3	11/11/2022	Jennifer Mont KTP
0601	Fluoride	0.11	g/m^3	15/11/2022	Divina Cunanan Lagazon KTP
0603	Nitrite - Nitrogen	< 0.01	g/m^3	15/11/2022	Divina Cunanan Lagazon KTP
0605	Nitrate - Nitrogen	< 0.10	g/m^3	15/11/2022	Divina Cunanan Lagazon KTP
0607	Sulphate	129	g/m^3	15/11/2022	Divina Cunanan Lagazon KTP
0760	Ammonia Nitrogen	12.5	g/m^3	15/11/2022	Divina Cunanan Lagazon KTP
2127	Total Nitrogen	14.7	g/m^3	15/11/2022	Divina Cunanan Lagazon KTP
6043	Total Hardness	738	g $CaCO3/m^3$	15/11/2022	Amitesh Kumar KTP
6610	Calcium - Total	200	g/m^3	14/11/2022	Amitesh Kumar KTP
6620	Magnesium - Total	58.1	g/m^3	14/11/2022	Amitesh Kumar KTP
6626	Potassium - Total	15.5	g/m^3	14/11/2022	Amitesh Kumar KTP
6631	Sodium - Total	141	g/m^3	14/11/2022	Amitesh Kumar KTP
M0104	E. coli	1,270	cfu/100mL	17/11/2022	Sunita Raju KTP
P1855	Aqueous Total Metal Digestion	Completed		12/11/2022	Weiwei Sun Analyst
P1859	Sample Filtration	Completed		12/11/2022	Emily Couper .

Comments:

Sampled by customer using ELS approved containers.

All samples analysed as we receive them. Delivery was within the correct time and temperature conditions.

This report cancels and replaces report 22/30162-2. Please dispose of all previous versions.

Test Methodology:

Test	Methodology	Detection Limit
Alkalinity - Total	APHA Online Edition Method 2320 B	1 g $CaCO3/m^3$
Chloride	APHA Online Edition Method 4500-Cl B	1 g/m^3
Carbonate Alkalinity	APHA Online Edition Method 2320 B	2 g $CaCO3/m^3$
Bicarbonate Alkalinity	APHA Online Edition Method 2320 B	2 g $CaCO3/m^3$
Total Kjeldahl Nitrogen	APHA Online Edition 4500-N(org) C	0.8 g/m^3
Fluoride	Ion Chromatography following APHA 4110B.	0.02 g/m^3
Nitrite - Nitrogen	Ion Chromatography following APHA 4110B.	0.01 g/m^3
Nitrate - Nitrogen	Ion Chromatography following APHA 4110B.	0.01 g/m^3
Sulphate	Ion Chromatography following APHA 4110B.	0.02 g/m^3
Ammonia Nitrogen	Flow Injection Autoanalyser following APHA Online Edition Method 4500 NH3-H.	0.01 g/m^3
Total Nitrogen	Flow Injection Autoanalyser following APHA Online Edition Method 4500-NO3 I. Persulphate digestion based on APHA Online Edition 4500-N C	0.05 g/m^3
Total Hardness	ICP-MS following APHA Online Edition method 3125 (modified).	1 g $CaCO3/m^3$

Test	Methodology	Detection Limit
Calcium - Total	ICP-MS following APHA Online Edition method 3125 (modified)	0.1 g/m^3
Magnesium - Total	ICP-MS following APHA Online Edition method 3125 (modified)	0.1 g/m^3
Potassium - Total	ICP-MS following APHA Online Edition method 3125 (modified)	0.1 g/m^3
Sodium - Total	ICP-MS following APHA Online Edition method 3125 (modified)	0.1 g/m^3
E. coli	APHA 9222I:Online Edition	1 cfu/100mL
Aqueous Total Metal Digestion	Follows APHA Online Edition Method 3030E (modified) using nitric acid.	n/a
Sample Filtration	Sample filtered through 0.45 micron filter following APHA Online Edition Method 3030B.	n/a

Unless otherwise stated, all tests are performed in Wellington.
The laboratory is not responsible for the information provided by the customer which can affect the validity of the results, for example: sampling information such as date/time, field data etc.
"<" means that no analyte was found in the sample at the level of detection shown. Detection limits are based on a clean matrix and may vary according to individual sample.
For liquid samples g/m3 is the equivalent to mg/L and ppm, solid samples are reported as mg/kg which is equivalent to ppm.
Samples will be retained for a period of time, in suitable conditions appropriate to the analyses requested.

Report Released By
Rob Deacon

This laboratory is accredited by International Accreditation New Zealand and its reports are recognised in all countries affiliated to the International Laboratory Accreditation Co-operation Mutual Recognition Arrangement (ILAC-MRA). The tests reported have been performed in accordance with our terms of accreditation, with the exception of tests marked "not an accredited test", which are outside the scope of this laboratory's accreditation.

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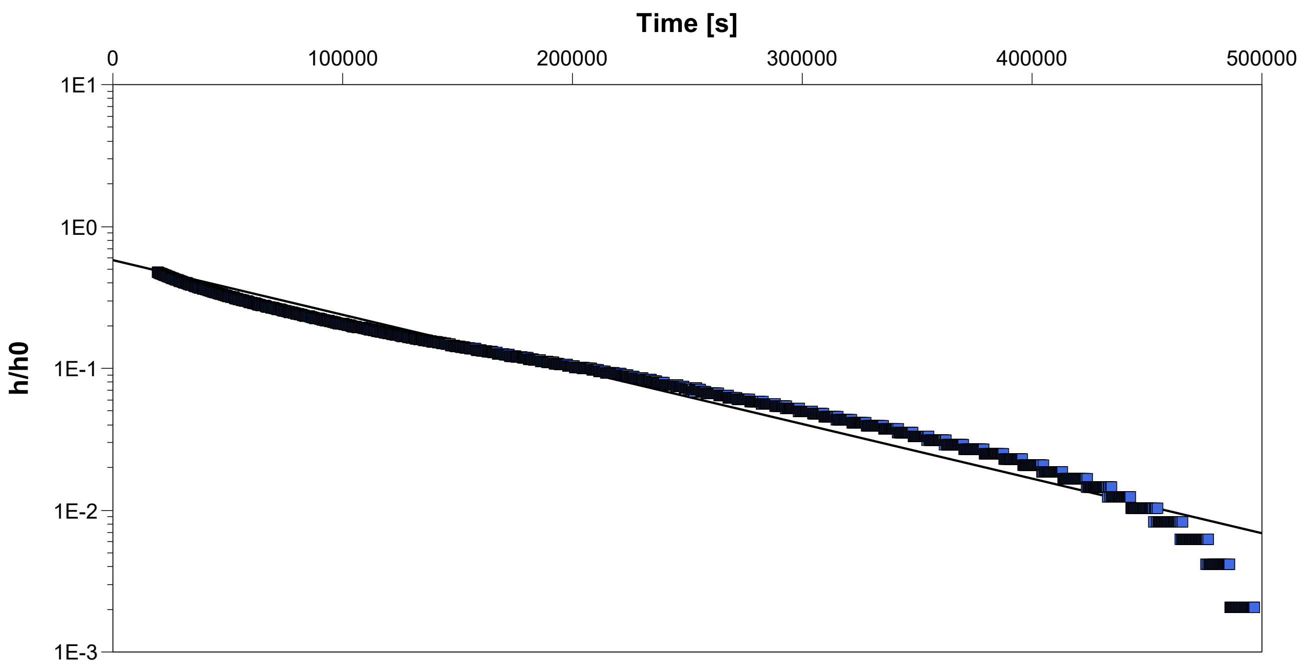
APPENDIX 2:

Rising Head Slug Test Results

	Slug Test Analysis Report
	Project: Villa Maria
	Number: 18043
	Client: Goodman

Location:	Slug Test: Recovery Test BH108	Test Well: BH108
Test Conducted by: SB		Test Date: 8/11/2022
Analysis Performed by: SB	Recovery1	Analysis Date: 21/12/2022
Aquifer Thickness: 6.00 m		

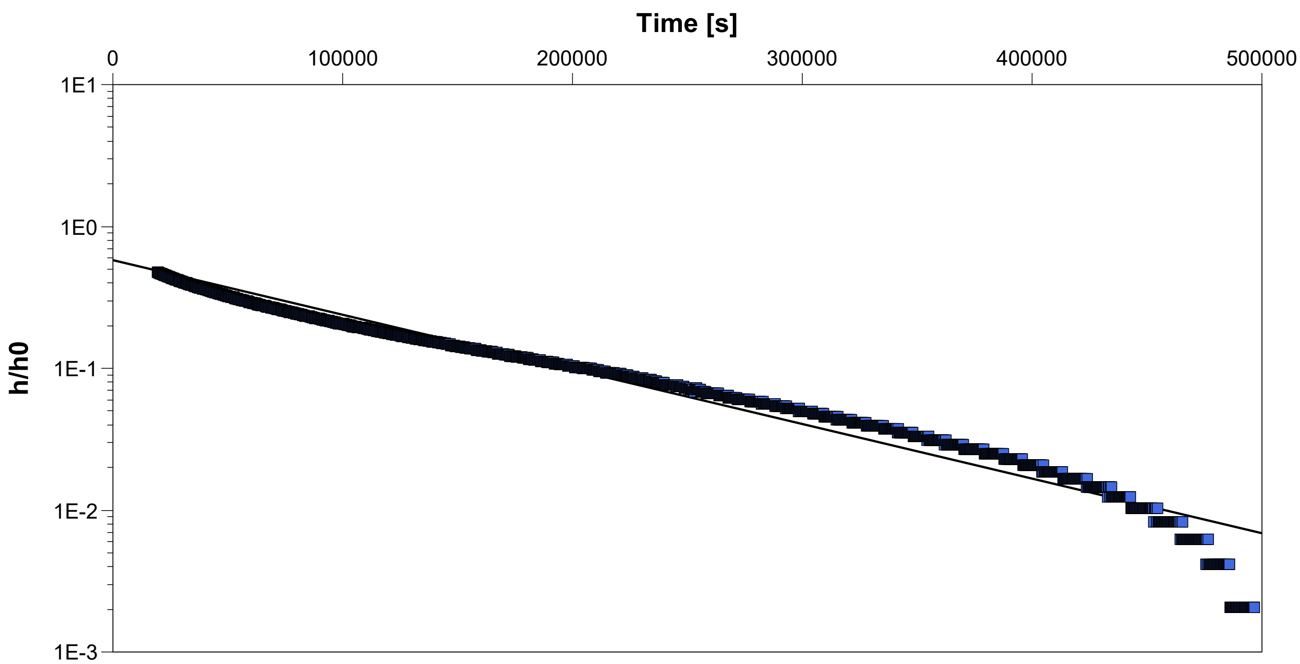


Calculation using Bouwer & Rice

Observation Well	Hydraulic Conductivity [m/s]	
BH108	2.13×10^{-9}	

	Slug Test Analysis Report
	Project: Villa Maria
	Number: 18043
	Client: Goodman

Location:	Slug Test: Recovery Test BH108	Test Well: BH108
Test Conducted by: SB		Test Date: 8/11/2022
Analysis Performed by: SB	Recovery2	Analysis Date: 21/12/2022
Aquifer Thickness: 6.00 m		

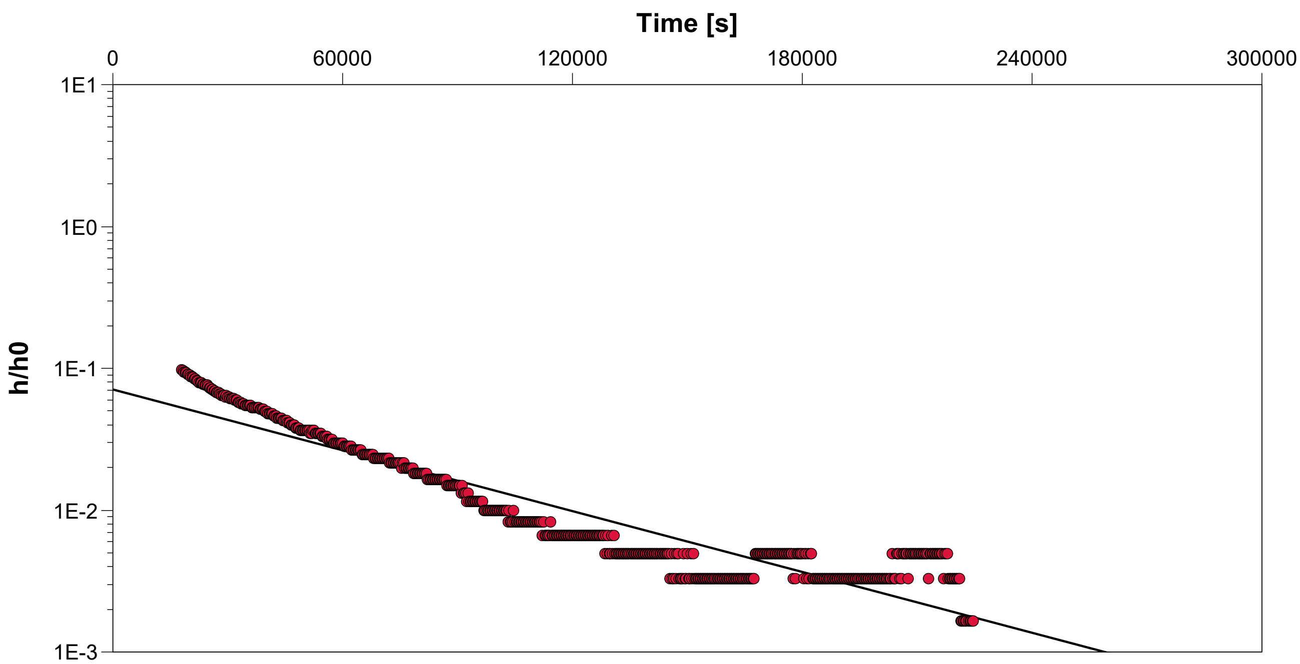


Calculation using Hvorslev

Observation Well	Hydraulic Conductivity [m/s]	
BH108	2.75×10^{-9}	

Slug Test Analysis Report	
Project: Villa Maria	
Number: 18043	
Client: Goodman	

Location:	Slug Test: Recoveryt Test BH110	Test Well: BH110
Test Conducted by: S Berry		Test Date: 8/11/2022
Analysis Performed by: SB	Recovery1	Analysis Date: 21/12/2022
Aquifer Thickness: 6.00 m		

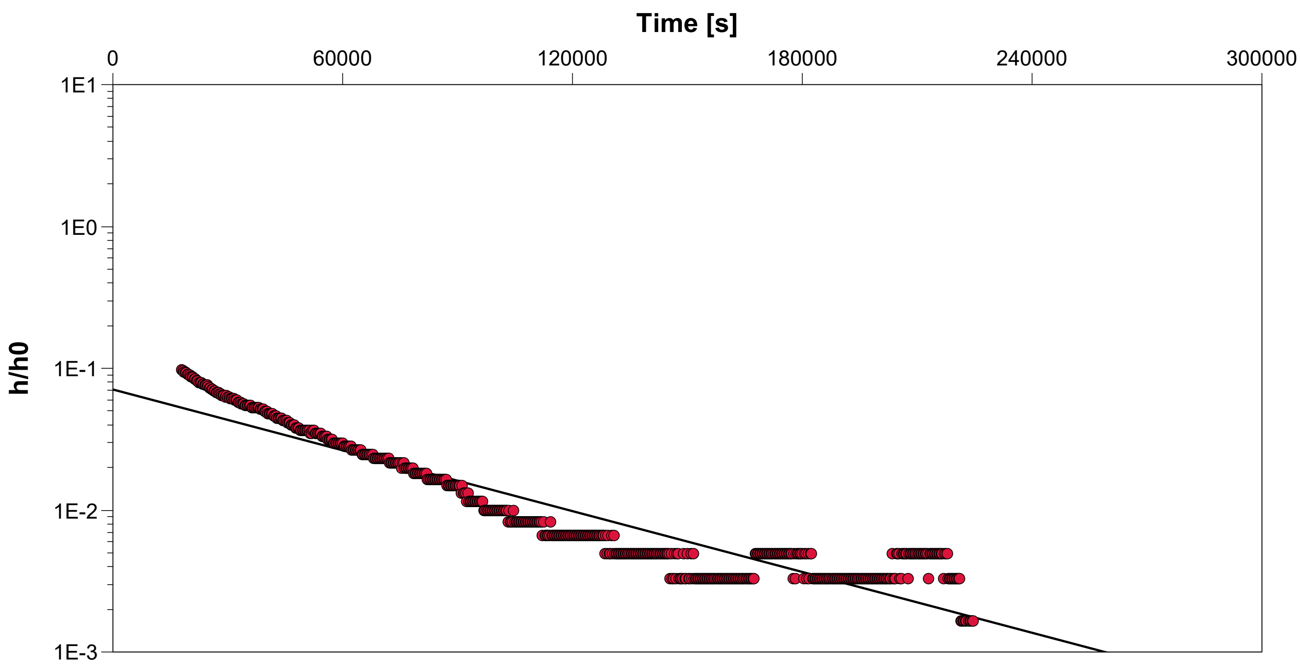


Calculation using Bouwer & Rice

Observation Well	Hydraulic Conductivity [m/s]	
BH110	3.95×10^{-9}	

Slug Test Analysis Report		
Project: Villa Maria		
Number: 18043		
Client: Goodman		

Location:	Slug Test: Recoveryt Test BH110	Test Well: BH110
Test Conducted by: S Berry		Test Date: 8/11/2022
Analysis Performed by: SB	Recovery2	Analysis Date: 21/12/2022
Aquifer Thickness: 6.00 m		



Calculation using Hvorslev

Observation Well	Hydraulic Conductivity [m/s]	
BH110	5.11×10^{-9}	