ENGEO Limited
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Project Number 20190.000.001

Groundwater Abstraction: Desktop Study

Forestry Road, Riverhead, Auckland

Submitted to:
Rangitoopuni Developments LP C/- Avant Group Limited
[redacted]

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Executive Summary

Rangitoopuni Developments LP seeks to establish a groundwater source to supplement potable supply for a proposed retirement village at Forestry Road, Riverhead. Demands include human consumption for the residents, Care Suite guests, and facilities staff, in addition to irrigation for communal facility landscaping. A 10% contingency has been incorporated to provide for unforeseen incidental use (facilities maintenance) and as a buffer against future changes in rainfall patterns.

The supplemental water supply will help meet demands during times of lower rainfall (summer months), drought, or unforeseen system failures. The assessment has determined that a maximum pumping rate of 1.3 L/s across 24 hours will be required for supplementary water supply. During a prolonged dry spells or drought periods a maximum drought pumping rate of 2.3 L/s across 24 hours will be required.

On the basis of averaged daily demands a total abstraction of 28,950 m^3 / annum is sought for allocation from the Lower Kaipara Waitematā aquifer in which the proposed bore will be located. The target aquifer is not listed as a High-Use Aquifer Management Area in the Auckland Unitary Plan and total allocation limits are not available. However, with respect to the aquifer footprint and quantum of existing users, sufficient volume is anticipated to be available for abstraction.

Lowering of the regional aquifer groundwater table for both the supplementary and drought pumping rates have been assessed and are considered to not adversely impact the closest existing bore at a distance of 1,250 m.

The target aquifer is the deeper regional confined system (below a depth of nominally 150 m) and is not connected hydraulically to the shallow unconfined system. As a result, the proposed abstraction does not represent appreciable potential for adverse impacts on either surface water features (wetlands, rivers etc.), or saline intrusion along the coastal margin.

A test bore is scheduled for Q2 2025 and will be used to confirm the anticipated performance and yield for groundwater abstraction. In the event that the yield is lower than anticipated, a second bore may be required, and would be located further north at a greater distance to any existing user.

All abstraction bores will be completed to requisite regulatory standards for water supply schemes and registered with Taumata Arowai as the regulatory authority, together with all relevant groundwater protection and safety plans.

1 Introduction

ENGEO Ltd was requested by Avant Group Limited on behalf of Rangitoopuni Developments LP to prepare a Groundwater Abstraction: Desktop Study Report for a proposed retirement village at Forestry Road, Riverhead, (herein referred to as 'the site', shown in Figure 1).

The purpose of this assessment is to support a fast-track resource consent application for the proposed retirement village within Stage 2 of the Riverhead Forest development. This work has been carried out in accordance with our signed agreement dated 19 February 2025.

The scope of the assessment was to investigate the viability of a groundwater supply bore and the potential effects of a groundwater take on other groundwater users and the environment. The desktop assessment scope has included the following:

- Literature search and review.
- Interrogation of publicly available databases and online portals, including New Zealand Geotechnical Database (NZGD).
- Review of local bore information from the Auckland Council geospatial database.
- Development of groundwater abstraction water budget for water supply to a proposed on-site water treatment plant.
- Identify and review potentially affected entities, including preliminary analyses of theoretical pumping rates on potential receivers.
- Preparation of this desktop study report.

Our scope of work does not include the installation of a test bore, however on the basis of the determined pumping requirements and anticipated well yields, an on-site test bore is being scheduled for Q2 2025.

2 Site Description

The site is situated north of the Auckland townships of Huapai, Kumeū, and Riverhead. The proposed retirement village and commercial retail buildings include the development of 32.3 hectares of the overall 173-hectare land parcel located in the south-eastern extent of the portion of Riverhead Forest accessed by Forestry Road from the southwest (legal description: LOT 1 DP 590677). The site was formerly covered by dense Pinus radiata plantations cultivated for commercial forestry, which have recently been harvested and replanted. It is now largely covered by young trees and shrubs. Within the site boundaries there are several unnamed gravel access roads.

The site is bordered to the south by large, predominantly cleared land parcels that contain residential dwellings, to the west by Deacon Road (a gravel road), and to the east by dense residential neighbourhoods in the Riverhead township. The surrounding land to the north consists of Pinus radiata plantations and pockets of native forest.

2.1 Topography

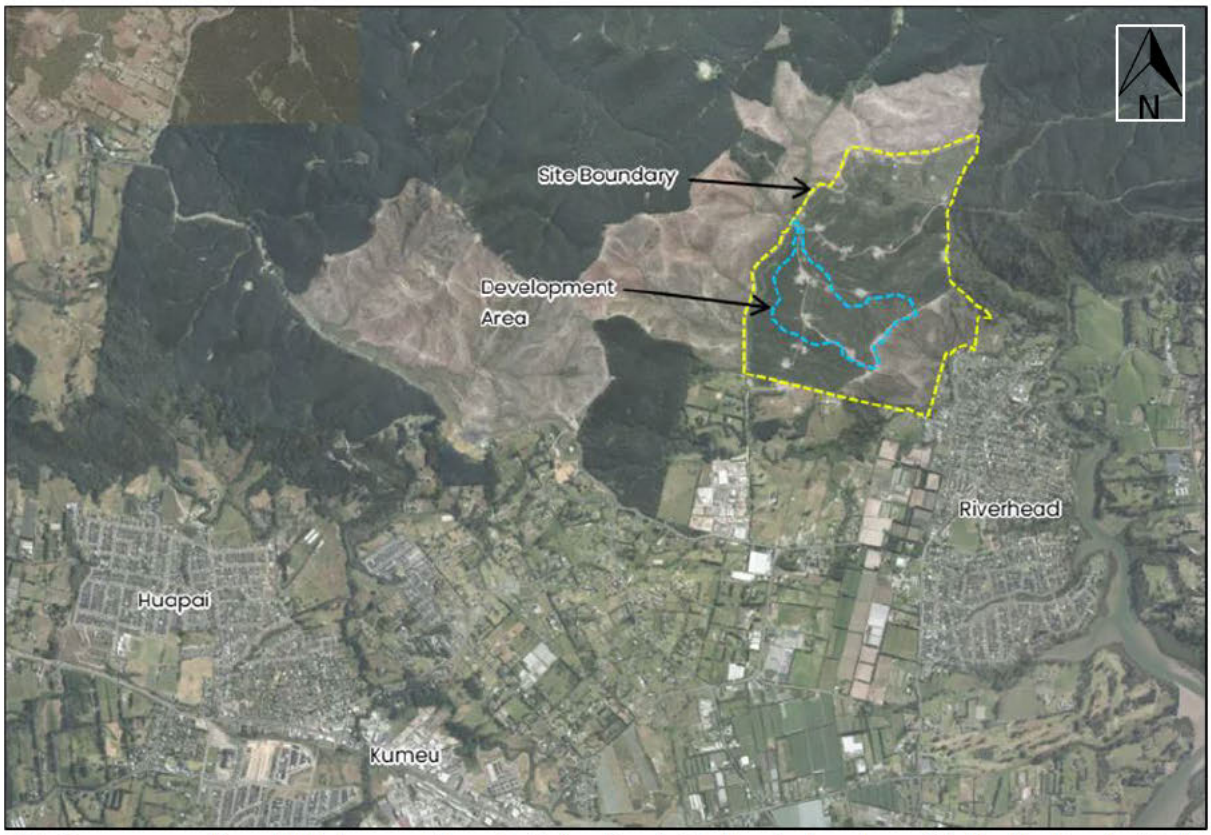
Elevations across the development area and to the west range from 90 m RL at the highest point down to 25 m RL along the gully which runs parallel to Forestry Road. Forestry Road then links up to Deacon Road providing access further north into the forest.

The eastern boundary of the development area is bounded by a break in slope in the opposite direction, which grades down to the east. The elevation changes across this slope from 90 m to 10 m RL.

Auckland Council GeoMaps depicts several tributaries across the site, which appear to be ephemeral at higher elevations, with permanent watercourses typically found in the lower-lying gullies. These tributaries flow westward toward an unnamed stream, continue south and eventually drain into the Wautaiti Stream located east of the site.

A site location plan is presented in Figure 1.

Figure 1: Site Location Plan



Note: Image sourced from LINZ. Image not to scale. Yellow line depicts the site boundary, while the blue line depicts the approximate development boundary.

3 Proposed Development

ENGEO have been provided with the following documentation which details the proposed residential development of the Retirement Village:

- Crosson Architects, 90% design for Resource Consent, Rangitoopuni Lifestyle Village, dated 21 March 2025, Revision 2, (unreferenced).
- Maven Associates Limited Proposed Earthworks Overview – Retirement Village, dated March 2025 (ref: 147007 rev. A, drawing no. C200- RV 0).
- Maven Associates Limited Proposed Accessway and Overview Plan – Retirement Village, dated March 2025 (ref: 147016 rev. A, drawing no. C300-0 to C300-14).
- GWE Consulting Engineers Ltd Technical Memo Rangitoopuni Retirement Village – Water Supply Servicing Strategy dated 26 March 2025

The Crosson Architects proposed scheme plan indicates that the site is to be developed to include 260 independent living units (villas) across four stages (Stages 1 to 4). The concept plan includes a proposed main 'spine' road that extends through the centre of the development. Several smaller arterial roads extend off and reconnect to the main road. Independent living units saddle both sides of the smaller arterial roads. The centre of the development includes a care building, amenities building, and wellness centre. Several planted 'green' areas are proposed across the development area including a small orchard area.

The Crosson Architects proposed scheme plan also shows that a commercial retail space is to be constructed northwest of the retirement village, however, has not been included in the water budget for groundwater supply.

3.1 Water Supply Scheme

Based on our discussions with the wastewater treatment and water treatment plant designers (GWE Consulting Engineers), we understand that the proposed treatment plants will likely be located towards the lower-lying northern end of development. As such, any future groundwater bore will practically be located in the same vicinity, with appropriate setbacks and well head protection in accordance with statutory requirements outlined by Taumata Arowai.

Additionally, due to the overall topography of the site and lower-lying rural areas to the south, locating future bores across the lower portion of the site reduces the depth required of any bore. Locating a bore at the southern end of the site would increase the well head elevation by approximately 65 m with no commensurate depth of penetration into the regional aquifer thereby increasing the required total bore depth. Locating bores to the north has the additional benefit of increasing the distance to both surrounding properties, existing groundwater takes, and coastal interfaces.

Information provided to ENGEO indicates that a total roof area of approximately 59,410 m² will be created by this development. Of this total roof area approximately 48,700 m² will be available for directing stormwater runoff to the water treatment plant with any supplementary supply requirement provided from groundwater abstraction. It is understood that the water treatment plant will have a minimum of 200 m³ of treated water storage, and 400 m³ of raw water storage.

4 Regional Geology

GNS Science maps the site and nearby area as being underlain by the geological units as presented in Figure A1.1 (Appendix 1).

Based on the GNS map (1:250,000), the site is underlain by East Coast Bays Formation (ECBF) of the Warkworth Subgroup (Waitematā Group). ECBF typically comprises alternating sandstone and mudstone with variable volcanic content and interbedded volcaniclastic grits. The upper horizons of the ECBF typically comprise residually weathered plastic silts and clays which gradually increase in strength with depth. Commonly a 'Transition Zone' comprised of dense sand and hard silts / clays separates the residually weathered soils and underlying competent bedrock. The weathering profile and layering thickness of the residually weathered soils can vary significantly depending on the geomorphological setting of the site.

Albany Conglomerate, also forming part of the Waitematā Group, is mapped running across the site approximately 250 – 400 m north of the development area, and in the south-eastern corner of the site. Albany Conglomerate typically comprises a well-cemented mixture of hard pebbles, cobbles, and boulders of igneous and metamorphic origin in highly lenticular beds. This geological unit commonly has a similar weathering profile to that of the ECBF (described above), however, based on its geological deposition it is typically less extensive and confined to 'narrow' lenses.

Several alluvial-derived geological units near the site ranging from Holocene to late Pliocene age are mapped south of the site as shown in Figure A1.1. Based on-site geomorphology, Holocene alluvial deposits are expected to be present within low lying areas of the site adjacent to overland flow paths, streams and / or rivers. Older middle Pleistocene to late Pliocene deposits may also be present within the site, however, these are likely to be at higher elevations relative to the younger alluvium. These alluvial formations typically comprise pumiceous mud, sand, and gravel with muddy peat and lignite. However, the Holocene alluvium is typically more compressible and consist of soft silts and clays and may include layers of organic materials.

5 Hydrogeology

The Waitematā aquifers occur within the Waitematā Group comprised of interbedded sandstones and mudstones and conglomerates beds. Thickness of the sandstone beds varies throughout the Auckland region, total thicknesses range from a few metres to over 1,000 m (Crowcroft & Smaill, 2001).

Waitematā aquifers are characterised by fine-grained sediment matrices with relatively low permeabilities, however the Waitematā Group includes fracturing, jointing, and faults that can improve local permeability. Horizontal permeability is significantly greater than vertical due to strong horizontal bedding and vertical constriction from mudstone horizons (White et al., 2020). Groundwater recharge rates are estimated around 4 – 76 mm/year (Earthtech, 2018).

In general, Waitematā Group aquifers are confined with transmissivities in the range of 1 to 250 m^2/day ($1.1e^{-5}$ to $2.9e^{-3}$ m^2/sec) but generally less than 100 m^2/day ($1.1e^{-3}$ m^2/sec), with storativity from 0.001 to 0.00001 ($1e^{-3}$ to $1e^{-5}$). Waitematā aquifers tend to be low yielding with typical yields of 30 – 300 m^3/day for a 100 mm diameter bore but can range from a few cubic meters per day to over 1,000 m^3/day (Crowcroft and Smaill, 2001).

Local aquifer transmissivities at bores 200 – 300 m deep, located 1.5 – 2.5 km south of the site, have been assessed in the order of 0.8 – 8 m^2 /day ($1e^{-5}$ to $9e^{-5}$ m^2 /sec), with hydraulic conductivities of $5e^{-8}$ to $4e^{-7}$ m^2/sec (Section 7.1.1).

Groundwater levels measured on site on 12 and 21 March 2025 as part of ENGEO geotechnical investigations ranged from 4.1 – 8.7 m below ground level (m bgl) in piezometers MBH02, MBH03, MBH05, and MBH06 (Figure A1 – 2), screening the upper Waitematā Group silts and sands to depths of 14 m bgl. Groundwater levels above mean sea level ranged from 72.2 m RL at piezometer MBH06 in the southeast of the site, to 42.3 m RL at MBH02 in the northwest. These groundwater levels are anticipated to be close to the summer groundwater low levels. Table 1 provides the groundwater levels and screen depths.

Table 1: Groundwater Monitoring (Shallow Unconfined System)

Borehole ID	Screened Interval (m bgl)	Groundwater depth (m bgl) [m RL]	
		12/03/2025	21/03/2025
MBH02	6.5 – 14	8.7 [42.3]	8.7 [42.3]
MBH03	2.0 – 8.0	4.7 [58.1]	4.8 [58.1]
MBH05	2.0 – 9.5	6.3 [50.9]	6.5 [50.7]
MBH06	2.0 – 12.0	4.1 [72.3]	4.2 [72.2]

Across the development area, the local shallow groundwater flows northwest with the topographic relief and surface water flow regimes. The deeper regional groundwater flow (at depths of more than 200 m bgl) however is expected to flow southeast towards the Riverhead Estuary and the head of the Waitematā Harbour.

Auckland Council monitor groundwater levels as part of the State of the Environment monitoring programme at Waitakere Road No 2 bore, screened from 78 – 150 m depth in the Waitematā Group aquifer, located approximately 4 km to the southwest of the site. Static groundwater levels are recorded as 18 m bgl (15 m RL) (Auckland Council Technical Publication 352, 2007) suggesting depth to groundwater may be deeper within the deeper aquifer systems. Figure 2 provides groundwater level data for this bore from 1998 – 2025 (Auckland Council Environmental Data Portal). Seasonal groundwater level fluctuations are approximately 15 – 20 m, however it is unknown the extent of groundwater abstraction in the area and potential effects on these groundwater levels. Regular pumping drawdown cycles can be seen in the more recent logger data.

Figure 2: Groundwater Levels – Waitakere Rd No. 2 Bore

The proposed taking and use of groundwater in the Auckland Region must meet the policies and rules of the Auckland Unitary Plan (AUP), specifically Section E2 water quantity, allocation and use. The taking and use of groundwater from aquifers must meet Appendix 3 - Aquifer Water Availability and Levels guidelines. An assessment against the objectives and policies of AUP Section E2 is included in Appendix 4.

The site is located within the Lower Kaipara Waitematā Aquifer Management Area as defined under the AUP, with the Kumeu East Waitematā Aquifer Management Area to the south and the Kumeu West Waitematā Aquifer Management Area to the southwest. The Lower Kaipara Waitematā Aquifer Management Areas is not separately listed within Table 1 Aquifer Water Availabilities with a water availability limit. With the confined nature of the Waitematā Group aquifers and the anticipated depth of proposed water take of around 200 – 300 m bgl, a connection to a surface water body is not likely, providing the water availability to be 65% of the average recharge as determined by the Auckland Council.

5.1 Groundwater Quality

The chemical composition of the Waitematā aquifers are broadly classified into two water types based on total hardness / total alkalinity (TH / TA) ratios, pH, silica, and total iron concentrations. Groundwater less than 200 m depth typically have a high TH / TA ratio and are hard calcium carbonate waters with near neutral pH, high total iron (>1.0 mg/l) and silica greater than 40 mg/l. Deeper groundwaters typically have a low TH / TA ratio, are soft sodium bicarbonate waters with pH >8.5, low total iron (< 0.2 mg/l) and silica concentrations less than 40 mg/l.

The Waitematā aquifer groundwater quality is monitored by Auckland Council as part of the National Groundwater Monitoring Programme and State of the Environment monitoring. Monitoring wells Waitakere Road shallow (Bore ID. 6475015), screened from 10 – 15 m below ground level (m bgl), and Waitakere Road deep (Bore ID. 6474003), open hole from 78 – 150 m bgl are located approximately 4 km southwest of the site.

The groundwater quality of the deeper 78 – 150 m deep bore is likely representative of the deeper aquifer groundwater quality at similar depths at the site. A summary of the median, minimum, and maximum values of the relevant groundwater quality data from this bore (1998 to 2024), sourced from State of the Environment reporting and the GNS Science Geothermal and Groundwater Database, is provided in Table 2. Where a data quality value exceeds the 2022 Drinking Water Standard and Drinking Water Notice guidelines, the value and the guideline are in bold.

Table 2: Groundwater Quality Kumeu Waitematā Aquifer (Depth 78 – 150 m bgl)

Parameter	Time Range Statistics					Standard / Guideline	
	Median 1998 – 2005 [1]	Median 2015 – 2019 [2]	Median 1996 – 2024 [3]	Minimum 1996 – 2024 [3]	Maximum 1996 – 2024 [3]	Drinking Water Standard Maximum Acceptable Value (DWS-MAV) [4]	Drinking Water Notice Aesthetic Value (DWN-AV) [5]
pH	7.6	7.5	7.4	**6**	8.5	-	7.0 - 8.5
Temperature (°C)	**18.9**	-	**18.8**	**15.5**	**20**	-	**≤ 15 °C**
TDS	435	-	756	756	756	-	≤ 1,000
Turbidity (NTU)	**11**	-	1.585	0.61	**1568**	-	**≤ 5 NTU**
Faecal Coliforms (cfu / 100 mL	< 1	-	-	-	-	-	-
E. coli (cfu / 100 mL)	< 1	-	-	-	-	< 1	-
Total Alkalinity as $CaCO_3$	282.8	-	-	-	-	-	-
Total Hardness as $CaCO_3$	**308.9**	-	-	-	-	-	**100 – 200**
Ammonia	-	0.3	0.31	0.24	0.47	-	≤ 1.5
Ammoniacal-N	0.270	-	0.27	0.005	0.41	-	-
Nitrate-N	<0.002	0.01	0.005	0.001	0.61	11.3	-
Calcium	76.4	-	77	8.5	87	-	-
Magnesium	28.3	-	29	5.8	32	-	-
Sodium	35.4	36	36	16	40.1	-	≤ 200
Potassium	1.7	-	1.7	1.3	2.1	-	-

Chloride	74.6	71	72	19.7	76	-	≤ 250
Sulphate	0.02	0.03	0.025	0.01	3	-	≤ 250
Aluminium	< 0.003	-	< 0.02 [6]	< 0.02 [6]	< 0.02 [6]	1	≤ 0.1
Antimony	-	-	< 0.001 [6]	< 0.001 [6]	< 0.001 [6]	0.02	-
Arsenic	< 0.0005	-	0.0028	0.0005	0.005	0.01	-
Barium	-	-	0.03 [6]	0.03 [6]	0.03 [6]	1.5	-
Boron	0.016	-	<0.05 [6]	<0.05 [6]	<0.05 [6]	2.4	-
Bromate	-	-	-	-	-	0.01	-
Bromide	-	-	0.22	0.02	0.33	-	-
Cadmium	-	-	< 0.001 [6]	< 0.001 [6]	< 0.001 [6]	0.004	-
Chromium (Total)	< 0.005	-	<0.0005 [6]	<0.0005 [6]	<0.0005 [6]	0.05	-
Copper	0.002	-	0.00038	0.00025	0.0005	2	≤ 1
Fluoride	0.050	-	0.04	0.012	0.16	1.5	-
Iron	**1.230**	**1.1** (soluble)	**1.1**	0.01	**1.5**	-	**≤ 0.3**
Lead	0.0001	-	0.0014	0.0002	0.0025	0.01	-
Lithium	0.0300	-	0.03 [6]	0.03 [6]	0.03 [6]	-	-
Manganese	**0.054**	**0.06** (soluble)	**0.055**	0.0025	**0.08**	0.4	**≤ 0.04**
Mercury	-	-	-	-	-	0.007	-
Nickel	< 0.005	-	< 0.001 [6]	< 0.001 [6]	< 0.001 [6]	0.08	-
Zinc	0.010	-	0.002 [6]	0.002 [6]	0.002 [6]	-	≤ 1.5

Table Notes:

1. State of the Environment Monitoring Groundwater Quality Data Report 1998-2005 (December 2007). Auckland Council TP 352. Waitakere Road No.2 Deep (Bore ID. 6474003)
2. Groundwater Quality State & Trends in Tamaki Makaurau / Auckland 2010-2019. State of Environment Reporting. Revised October 2021. Technical Report 2021/03-2 - Waitakere Road Deep (Bore ID. 6474003).
3. Geothermal and GroundWater Database. 2021 –. Release 3.1.26.115. Lower Hutt (NZ): GNS Science. [updated 2021 Nov 11; accessed 2021 Nov 13]. https://doi.org/10.21420/9QTA-4884
4. DWS-MAV – Water Services (Drinking Water Standards for New Zealand) Regulations 2022) - Maximum Acceptable Value
5. DWN-AV - Aesthetic Value for Drinking Water Notice 2022 - Aesthetic Value
6. Single value sampled on 22 November 2022

Overall, the Waitematā deep aquifer groundwater quality is good, meeting the Water Services (Drinking Water Standards for New Zealand) Regulations - Maximum Acceptable Values. The aesthetic values for groundwater quality are mostly met, excluding temperature, turbidity, total hardness, iron, and manganese.

The water quality of the Waitematā aquifers on-site (c.200 m depth) is expected to be similar to the groundwater quality in Table 2. With the appropriate water treatment, the groundwater quality is likely to be acceptable for drinking water supply.

5.2 Hydrogeological Conceptual Site Model

A geological model for the site has been developed incorporating the findings of the ENGEO Riverhead Stage 2 Retirement Village Geotechnical Investigation Report (GIR; dated 03.04.2025) combined with the topographic surface contour data to create a 3D geology ground model using the Leapfrog Works software. The creation of the model allows for visualisation of the borehole data in both 3D and 2D cross sections to support the geological conceptualisation of the site. Three geological cross sections showing the vertical separation between the shallow unconfined aquifer, and deeper confined (rock) aquifer are presented in the GIR and included in Appendix 1 for reference.

Based on this geological model and the geological and hydrogeological findings of this desktop study our preliminary conceptual site model in relation to groundwater resources is:

- The aquifer is a multi-layered, confined aquifer system within the thick sequences of Waitematā Group interbedded sandstone and siltstones and occasional conglomerate units. Flow is both primary and secondary porosity facture flow.
- Aquifer transmissivities are generally less than 100 m^2/day (1.1e^{-3} m^2/sec) but can be variable, with storativity ranging from 0.001 – 0.00001 (1e^{-3} – 1e^{-5}).
- Groundwater yields are typically low, requiring deep wells and long screen sections for appreciable abstraction. However, depending on geology encountered, yields can be highly variable.
- Groundwater levels of the deep (100 – 300 m) Waitematā aquifers are anticipated to be 15 – 20 m bgl with seasonal fluctuations potentially up to 15 – 20 m, although this may also be partly pumping induced.
- Regional groundwater level data and flow directions for the site are not available. Groundwater flow is anticipated to be southeast towards the Riverhead Estuary and the Waitematā Harbour.
- Groundwater quality of the Waitematā Group aquifers at depth is good, meets NZ Drinking Water Standards and most of the aesthetic values, but notably not total hardness, iron or manganese.

6 Water Budget

A water budget to compare water supply rates to anticipated demands was developed (Figure A1.3; Appendix 1).

6.1 Rainfall Supply

The primary source of potable water is planned to be the collection and distribution of rainwater from impermeable surfaces, specifically the roofs of site structures. The water supply from rainfall was calculated based on runoff collection from 49,000 m^2 of roof area planned to be connected into the network. The reticulated stormwater system is understood to be designed to accommodate a 95th percentile rainfall event, and so rainfall harvesting will be highly effective with little loss of average rainfall from within the supply catchment.

Rates of rainfall harvesting for monthly water supply requirements are based on average rainfall rates for each month (NIWA, 2021)[1], distributed across the number of days in a given month. The estimated supply ranges from 2,800 to 5,500 m^3 per month through the year, being a varying seasonal average of 101.6 to 178.5 m^3/day

6.2 Total Demand and Rainfall Deficit

Demands include human consumption for the residents, Care Suite guests, and facilities staff, in addition to irrigation for communal facility lawns and garden areas (8,058 m^2) and a small orchard (195 m^2). Human consumption was based on a minimum estimated use of 250 L/day for each of the 682 residents and 57 Care Suite guests, and 80 L/day for each of the 50 staff, for a total human consumption of approximately 188.8 m^3 /day.

The irrigation requirement of an orchard (calculated at 5.0 mm /day), plus the requirement for communal facility lawns / gardens (calculated at 3.5 mm /day), minus the estimated average rain preceding the need for reticulated irrigation, provides a variable average irrigation requirement between 7.7 m^3 /day in drier months to 0.1 m^3 /day in wetter months.

In addition to Human consumption and irrigation requirements, a 10% contingency has been incorporated to provide for any unforeseen incidental use (facilities maintenance) and as a buffer against future changes in rainfall patterns. It is noted that the adopted NIWA monthly rainfall averages predate the 2023 Auckland Anniversary storms, and that allowance for changing rainfall patterns (e.g. wetter winters, drier summers) is standard practice in private groundwater supply budgets.

Subtracting the average daily rainfall supply from the total residential and irrigation requirements, with the addition of a 10% contingency, yields an average groundwater supply requirement between 29.3 m^3/day (winter) and 114.5 m^3/day (summer).

Average rates are based on a statistical simplification of a uniform rainfall rate throughout an entire month. As a result, a maximum groundwater demand of 200 m^3/day is anticipated for drier periods during summer months where rainfall may be negligible for weeks at a time (e.g., relative drought conditions). The maximum groundwater pumping of 200 m^3 /day is the midpoint between the actual demand (average 191.7 m^3 /day across a full year) and total including the full 10% contingency (average 210.8 m^3 /day across a full year). The maximum rate therefore represents a reduced contingency under prolonged adverse weather conditions of approximately 5%.

[1] The Climate and Weather of Auckland, NIWA, 2nd Edition, 2021

6.3 Groundwater Abstraction Rates

To meet the demands of the community, an additional water source will need to be developed. Installation of one or more wells to meet the water demand during periods of shortfall is proposed. The supplemental water would help the network meet demands during times of lower rainfall (summer months), drought, or any unforeseen system failures. Based on the estimated monthly rainfall during a typical year, the highest shortfall month would require a supplemental volume of 115 m^3. This equates to a **maximum supplemental pumping rate of 2.6 L/s** over a 12-hour pumping day, being an average abstraction of **1.3 L/s across 24 hours**. The maximum supplemental rate corresponds to an 'average' February and would reduce through the year to as low as 0.7 L/s over a 12-hour pumping day in an 'average' July. The average supplemental rate across a full calendar year is in the order of 1.8 L/s over a 12-hour pumping day.

During a prolonged dry spell or drought period, when no rain can be collected, watering of site vegetation would need to be rationed by maintenance staff to ensure a maximum groundwater demand of no greater than 200 m^3/day. This equates to a **maximum drought pumping rate of 4.6 L/s** over a 12-hour pumping day, being 3.1 L/s over an extended 18-hour pumping day and an average abstraction of **2.3 L/s across 24 hours**. The maximum drought rate has been considered for a duration of up to 28 consecutive days.

6.4 Annual Abstraction and Resource Availability

Groundwater abstraction is considered a viable water source to maintain a minimum level of supply during months when the shortfall from rain collection is less than the maximum of 115 m^3, especially if abstraction is higher than the minimum recommended rate (2.6 L/s). This surplus can also assist the network in meeting the needs of the community during an emergency.

On the basis of averaged daily demands described above and shown in Appendix 1 for a supplementary groundwater supply a **total abstraction of 28,944 m^3 /annum is required**, rounded to 28,950 m^3 /annum. The Lower Kaipara Waitematā aquifer in which the proposed bore will be located is outside the area of the adjacent Kumeu Waitematā Aquifer which is a High-Use aquifer Management Area listed in Table D1.3.1 of the Auckland Unitary Plan. Current planning documents do not provide a total allocation limit for the Lower Kaipara Waitematā Aquifer, however at a total aquifer area in the order of 165 km^2 a total allocation in the same order as the 1.6 million m^3 /annum for the 132k m^2 Kumeu Waitematā Aquifer (combined East / West Zones) is anticipated.

Only 11 of the existing local bores are located within the Lower Kaipara Waitematā Aquifer. Conservatively, with many of these bores appearing to be operating as a Permitted Activity (i.e., limited to "reasonable domestic and stock water use" under s.14(b) of the Resource Management Act, 1991) local abstraction from the Lower Kaipara Aquifer is conservatively estimated to be no more than 110 m^3 /day (39,600 m^3 /annum).

On the balance of all available information, ENGEO considers that abstraction of the anticipated annual volume of groundwater from the Lower Kaipara Waitematā Aquifer will be within the available allocation and will not represent an adverse impact on the total availability of the groundwater resource for existing lawfully established groundwater.

7 Dewatering Impacts

7.1 Existing Groundwater Users

In order to assess the potential for adverse impacts on existing lawful groundwater users by the proposed development, a search of the Auckland Council bore permit database was undertaken. The search radius was set to 2 km, and based on a point at the southern end of the development area (i.e., closer to existing developed areas that the actual intended bore location).

A full list of bores identified from the Auckland Council database search is attached in Appendix 2. A plan showing the locations of these bores relative to the proposed bore location in shown in Figure A1.2 (Appendix 1). Several existing bores are located at a distance of approximately 1.5 km to the proposed bore, however one is located at a closer distance of approximately 1.25 km. This closest bore (ENGEO ID#138) is pre-1987, well-constructed to a depth of 120 m, however no recorded casing depth or static groundwater level is contained in the database search results. A current associated resource consent for abstraction associated with "industrial use including sawmill amenities" has been identified, however the quantum of the water take is not noted.

Although bore #138 is located within the Kumeu Waitematā Aquifer, not the Lower Kaipara Waitematā Aquifer, this location could still be impacted by site activities as the distinction between the two aquifers is primarily a management function and not reflective of a physical disconnection between the flow regimes. Bore #138 is considered to be the closest potential receiver to the proposed groundwater abstraction.

7.1.1 Existing Bore Data

To aid in the assessment of potential impacts from the proposed pumping, ENGEO has obtained well drilling records from the NZGD and reviewed the relevant development testing records. Of the ten drillers logs identified within the search area, three logs contained sufficient development test records to assess the well performance using the software AquiferTest Pro to determine a general range of hydraulic parameters for the local area relative to the intended abstraction depth. These well logs, and the associated analysis outputs from AquiferTest Pro are attached in Appendix 2. A summary of the test analyses is presented in Table 3. ENGEO has conservatively adopted a low range hydraulic conductivity of 5 x 10^{-8} m/s.

Table 3: AquiferTest Summary

ENGEO ID #	Address	Discharge Rate (m^3/hr)	Duration (hours)	Bore Depth	Static Water Level	Drawdown (m)	Hydraulic Conductivity (m/s)
				m bgl			
134	340 Riverhead Road	8.0	28	303.0	14.16	90	$7.69e^{-8}$
143	307 Riverhead Road	13.6	12	217.0	5.5	40	$4.08e^{-7}$
156	221 Riverhead Road	5.2	3	227.5	12.3	60	$5.17e^{-8}$

7.2 Environmental Receivers

7.2.1 Surface Water

Static groundwater levels in bores extended into the deeper aquifer system (bore depth >200 m) are greater than >10 m below ground level and represent the lower 'confined' aquifer. Static groundwater levels in shallower bore (generally <10 m depth) are in the range of 1 to 2 m below groundwater level and represent the shallow unconfined portion of the Waitematā Aquifer system.

The proposed abstraction is from the deeper regional Waitematā aquifer system and is not considered to be hydraulically connected to the shallow groundwater regime that is associated with potential surface water features such as streams and wetlands. As such, the abstraction of groundwater from deep bores such as that proposed does not represent an appreciable risk of impacting groundwater-dependant surface water features as the flow regimes are disconnected.

7.2.2 Saline Intrusion

As with the potential for impact on surface water features (Section 7.2.1), the coastal 'saline wedge' interface is within the shallow 'unconfined' portion of the Waitematā Aquifer system. As such, abstraction of groundwater at depth is not considered to represent appreciable potential for inducing saline intrusion which would degrade the quality of the aquifer.

It is also noted that several existing deep bores (>200 m depth) in the vicinity of the Riverhead township to the east are within 250 m of the coastal saline margin. ENGEO is unaware of any known saline intrusion issues in the Riverhead township area.

7.3 Anticipated Dewatering Impacts

ENGEO has assessed a range of pumping scenarios, for both the Maximum Supplementary and Maximum Drought pumping rates. Drawdown analyses have been undertaken using the Theis drawdown calculator developed by Environment Canterbury[2]. All calculation sheets are presented in Appendix 3. All analyses have been based on the following input criteria:

- Well Depth – 300 m
- Casing Depth – 100 m
- Hydraulic Conductivity – $5.0e^{-8}$ m/s
- Storativity – $1.0e^{-4}$

7.3.1 Supplementary Rate

As identified from the water budget, a maximum supplemental pumping rate of 2.6 L/s is anticipated over a 12-hour pumping day, being an average abstraction of 1.3 L/s across 24 hours. The anticipated drawdowns associated with averaged 24-hour rate are presented in Table 4.

Due to the nature of the Theis equation, it is not possible to assess a 12-hour pumping cycle (i.e., 12 hours 'on', 12 hours 'off') as the equation does not readily account for recovery of groundwater during the 'off' cycle, but rather continues pumping.

[2] Environment Canterbury [ECan] drawdown calculator, Dr Bruce Hunt, University of Canterbury, Christchurch, New Zealand

Therefore, the associated drawdown calculated on the basis of the 12-hour rate being continuous across 24 hours a day would be overly conservative. Nonetheless, the maximum rate is included in the appended analyses.

Table 4: Drawdown for Supplementary Groundwater Rate (1.3 L/s full day average)

Time (Days)	30	90	365
Radius (m)	Drawdown (m)		
50	56.410	67.758	82.236
250	23.700	34.657	48.986
500	11.096	20.924	34.797
750	5.289	13.509	26.660
1000	2.410	8.844	21.056
1250	1.024	5.762	16.878
1500	0.401	3.700	13.629
1750	0.143	2.329	11.040
2000	0.046	1.432	8.948
2250	0.014	0.858	7.243
2500	0.004	0.499	5.848
2750	0.001	0.282	4.705
3000	0.000	0.155	3.769

As noted in Section 0, the Maximum Supplementary Rate is based on an 'average February' and would typically only apply for up to one month duration before required abstractions rates decrease. Notwithstanding, application of this rate for up to three months would represent an extended dry summer period and would correspond to an anticipated 5.762 m of drawdown at the closest existing well (1,250 m distance). Due to the depth of that well, this magnitude of drawdown is unlikely to impact the existing well in a manner that prevents the ongoing lawful abstraction of groundwater by other users. At a distance of 1,500 m, the anticipated drawdown reduced to 3.7 m and would be unlikely to adversely impact any other existing users due to the significant depths of the existing wells. We also note that the Theis method calculation does not include natural recharge during the time period analysed and is therefore conservative.

7.3.2 Drought Rate

As identified from the water budget, maximum drought pumping rate of 4.6 L/s over a 12-hour pumping day, being an average abstraction of 2.3 L/s across 24 hours. The anticipated drawdowns associated with averaged 24-hour rate are presented in Table 5. As with calculations for the supplementary pumping rate, drawdowns have been calculated on the basis of the averaged 24-hour continuous rate, with the discrete 'full rates' appended.

Table 5: Drawdown for Drought Groundwater Rate (2.3 L/s full day average)

Time (Days)	7	14	28
Radius (m)	Drawdown (m)		
50	73.310	85.903	98.542
250	18.647	29.184	40.744
500	3.798	9.884	18.647
750	0.575	3.077	8.638
1000	0.059	0.816	3.798
1250	0.004	0.179	1.546
1500	0.000	0.032	0.575
1750	0.000	0.005	0.194
2000	-	0.001	0.059
2250	-	0.000	0.016
2500	-	0.000	0.004
2750	-	-	0.001
3000	-	-	0.000

As noted in Section 0, the Maximum Drought Rate is based on an adverse climate condition, and is not anticipated to be required for longer than one month. The application of this rate for up to 28 days would correspond to an anticipated 1.546 m of drawdown at the closest existing well (1,250 m distance). As with discussions regarding the extended Supplementary rate as presented in Section 7.3.1, drawdowns of the magnitude (being less than those previously discussed) are considered unlikely to impact any existing well in a manner that prevents the ongoing lawful abstraction of groundwater by other users.

8 Summary

ENGEO has undertaken a desktop assessment of potential impacts arising from abstraction of groundwater to support primarily potable water supply for the proposed development. Abstraction rates have been based on a site-specific water budget that accounts for rainfall harvesting and storage, however, has also considered 'worst case' conditions were ongoing dry weather (e.g., drought) requires a greater reliance on groundwater supply.

Hydraulic parameters have been adopted from a review of available groundwater information in nearby wells and used to assess dewatering anticipated to occur for a 300 m deep bore located at the northern end of the site.

On the basis of the presented analyses, the maximum depth of drawdown at the closest existing user is not considered to represent an adverse impact on their ability to exercise their own water right.

Adverse impacts on other users, surface water features, or saline intrusive are also not anticipated.

Both the maximum daily abstraction rate, and total annual abstraction volume, are considered to be available within the Lower Kaipara Waitematā aquifer that will be targeted by the bore.

A test bore is scheduled for Q2 2025 and will be used to confirm the anticipated performance and yield for groundwater abstraction. In the event the yield is lower than anticipated, a second bore may be required, and would be located further north at a greater distance to any existing user.

All abstraction bores (i.e., wells) constructed on-site will be completed to requisite standards for water supply schemes and well-head protection as outlined in regulatory guidelines from Taumata Arowai. The completed scheme will be registered with Taumata Arowai as the regulatory authority, together will all relevant safety plans.

9 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, Rangitoopuni Developments LP C/- Avant Group 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. Although this is not a hearing before the Environment Court, I record that I have read and agree to comply with the Environment Court's Code of Conduct for Expert Witnesses as specified in the Environment Court's Practice Note 2023. I confirm that this report is within my area of expertise, except where I state that I rely upon the evidence or reports of other expert witnesses lodged forming part of the project's application material. I have not omitted to consider any material facts known to me that might alter or detract from the opinions expressed.

iv. 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.

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

vi. 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

[redacted]

Senior Hydrogeologist

[redacted]

Engineering Geologist / Hydrogeologist

Report reviewed by

[redacted]

Principal

[redacted]

Principal Engineering Geologist

APPENDIX 1:

Figures

Figure A1.1 : Geology & Local Groundwater Bores

Groundwater Abstraction Assessment - Rangitoopuni RV

Prepared by: S. Berry Dated: 28.03.2025

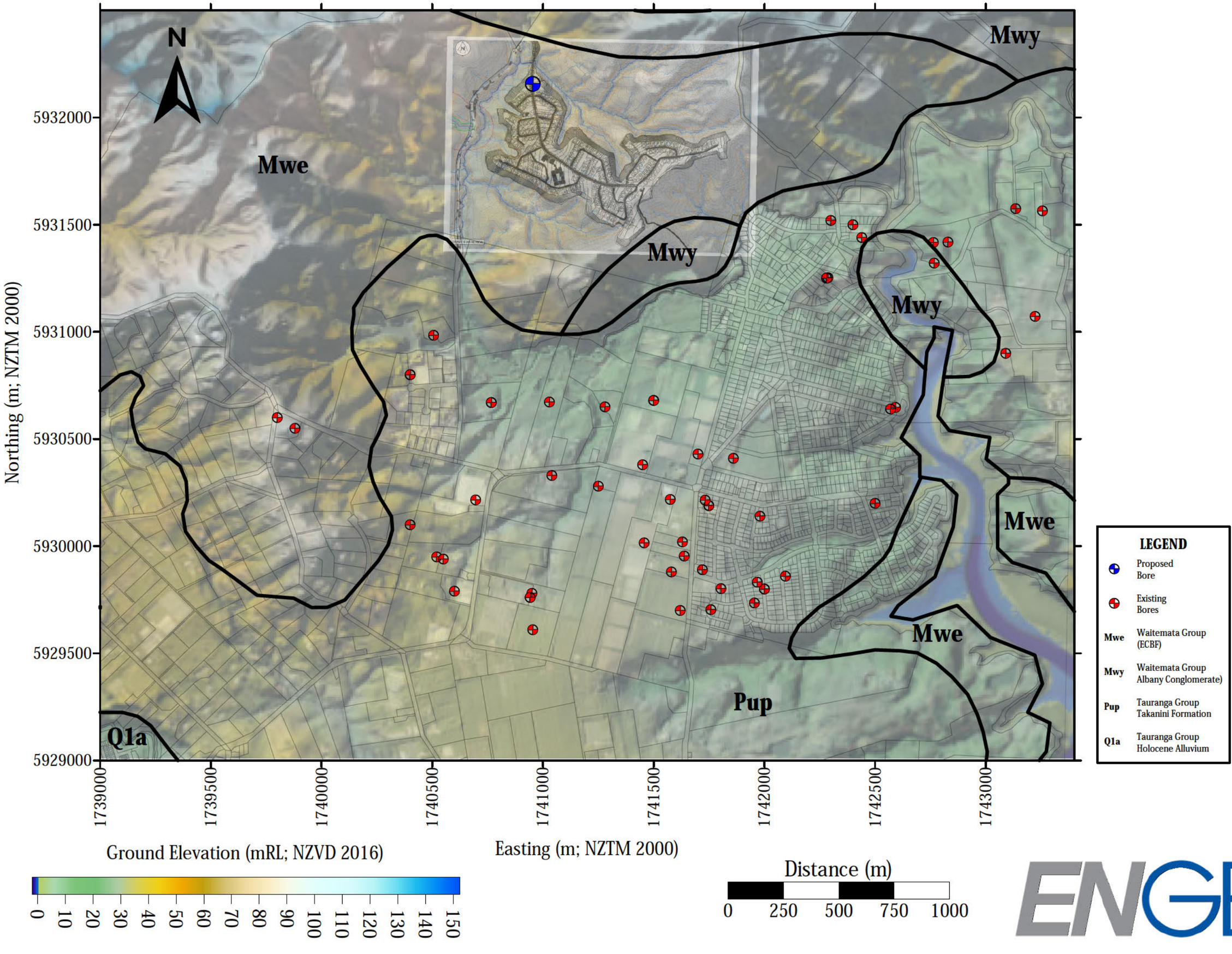


Figure A1.2 : Assessment of Effect Distances

Groundwater Abstraction Assessment - Rangitoopuni RV

Prepared by: S. Berry Dated: 28.03.2025

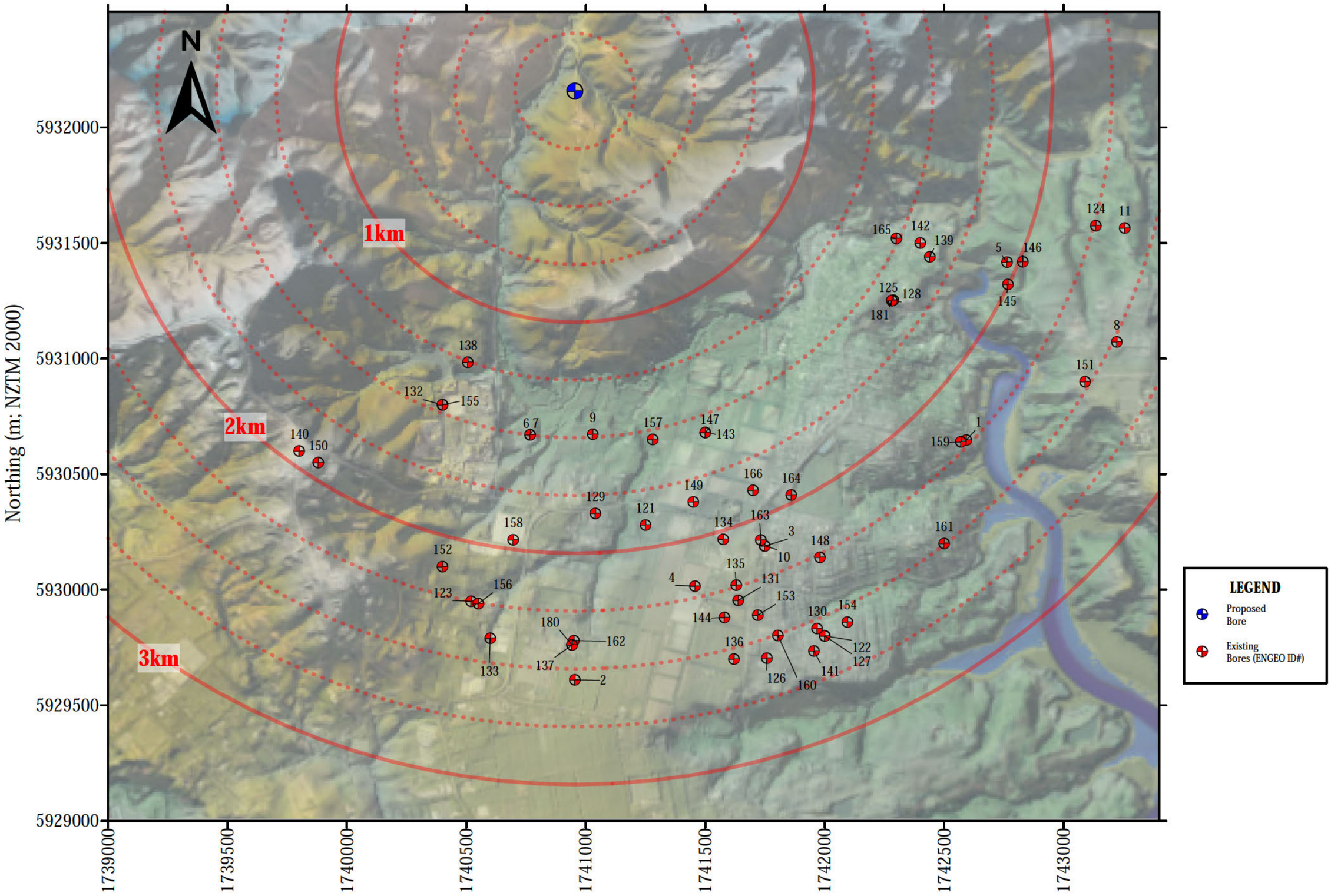


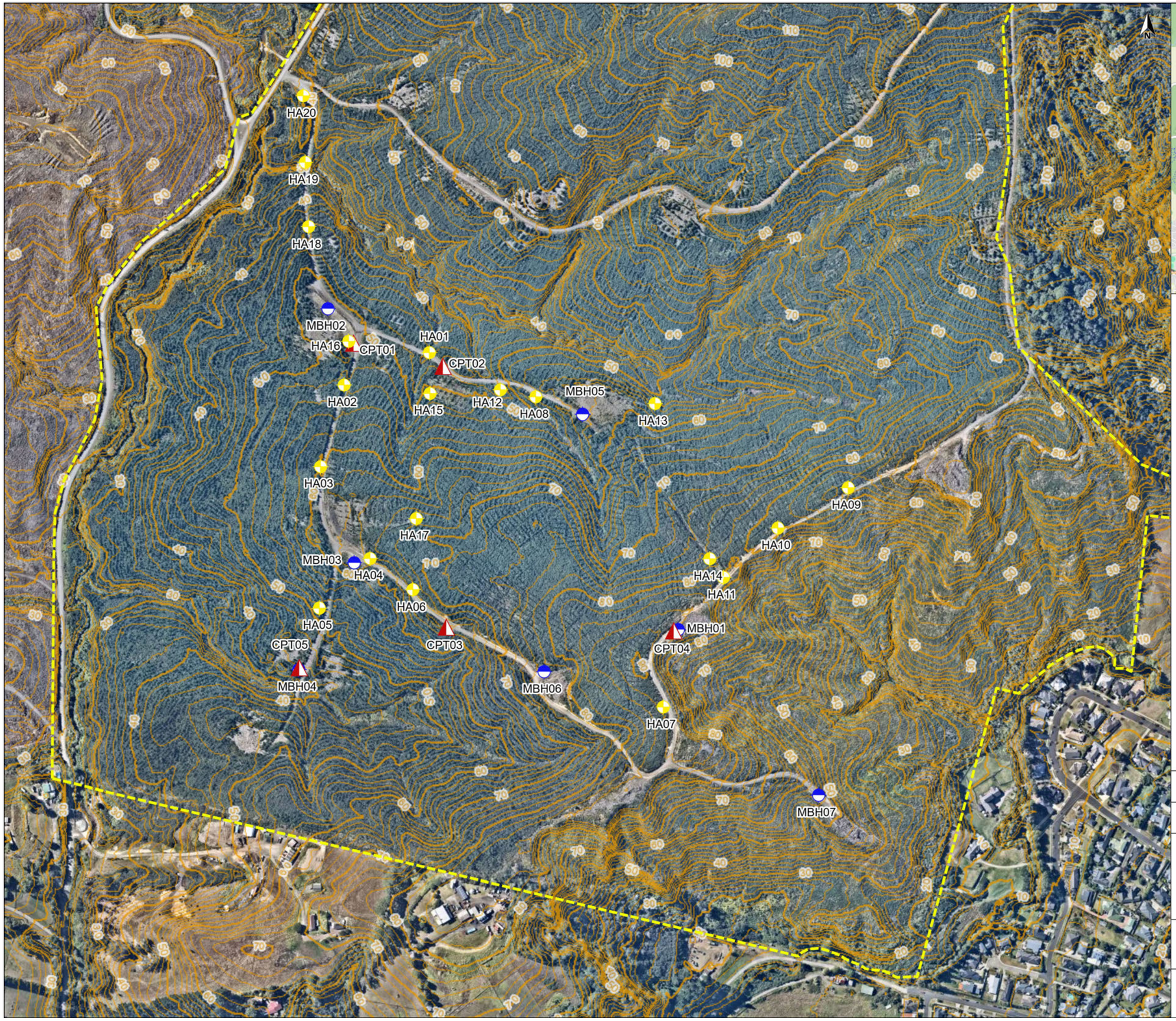
Figure A1.3 : Groundwater Supply Budget

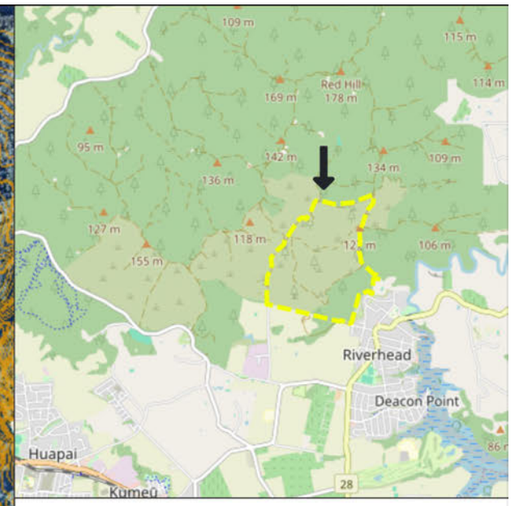
Groundwater Abstraction Assessment - Rangitoopuni RV

DEMAND			m3/day												Max daily
			Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	
Potable Demand (Domestic Water Supply)															
Residents: 250 L/d/pp for total #:	*682*		*170.5*	*170.5*	*170.5*	*170.5*	*170.5*	*170.5*	*170.5*	*170.5*	*170.5*	*170.5*	*170.5*	*170.5*	
Care Suite Guests: 250 L/d/pp for total #:	*57*		*14.3*	*14.3*	*14.3*	*14.3*	*14.3*	*14.3*	*14.3*	*14.3*	*14.3*	*14.3*	*14.3*	*14.3*	
Care Suite Staff: 80 L/d/pp for total #:	*50*		*4.0*	*4.0*	*4.0*	*4.0*	*4.0*	*4.0*	*4.0*	*4.0*	*4.0*	*4.0*	*4.0*	*4.0*	
Total Potable (m3/day; A)			188.8	*188.8*	*188.8*	*188.8*	*188.8*	*188.8*	*188.8*	*188.8*	*188.8*	*188.8*	*188.8*	*188.8*	188.8
Non-Potable Demand (Irrigation)															
Orchard	*Area (m2)*		*195*	*195*	*195*	*195*	*195*	*195*	*195*	*195*	*195*	*195*	*195*	*195*	
	Requirement (m3/day @5mm day)		*0.975*	*0.975*	*0.975*	*0.975*	*0.975*	*0.975*	*0.975*	*0.975*	*0.975*	*0.975*	*0.975*	*0.975*	
	Incipient RF (m3/day)		*0.5*	*0.5*	*0.6*	*0.6*	*0.5*	*0.7*	*0.9*	*0.9*	*0.7*	*0.6*	*0.6*	*0.7*	
	Watering requirement (m3/day; B1)		0.4	0.5	0.3	0.4	0.4	0.3	0.1	0.1	0.3	0.4	0.4	0.3	0.5
Lawn/Garden	*Area (m2; assumed)*		*8058*	*8058*	*8058*	*8058*	*8058*	*8058*	*8058*	*8058*	*8058*	*8058*	*8058*	*8058*	
	Requirement (m3/day @3.5mm day)		*28.2*	*28.2*	*28.2*	*28.2*	*28.2*	*28.2*	*28.2*	*28.2*	*28.2*	*28.2*	*28.2*	*28.2*	
	Incipient RF (m3/day)		*22.1*	*21.0*	*26.5*	*24.4*	*22.6*	*28.7*	*36.9*	*36.4*	*29.3*	*25.0*	*25.5*	*27.3*	
	Watering requirement (m3/day; B2)		6.1	7.2	1.7	3.8	5.6	0.0	0.0	0.0	0.0	3.2	2.7	0.9	7.2
Sub-Total (Demand; A + B = C)			195.3	196.4	190.8	192.9	194.8	189.0	188.8	188.8	189.0	192.4	191.8	190.0	196.4
Sub-Total (Budget Contingency; D)		10%	19.5	19.6	19.1	19.3	19.5	18.9	18.9	18.9	18.9	19.2	19.2	19.0	19.6
TOTAL DEMAND (C + D = E)			**214.8**	**216.1**	**209.9**	**212.2**	**214.2**	**207.9**	**207.7**	**207.7**	**207.9**	**211.6**	**211.0**	**209.0**	**216.1**
Rainfall Harvesting Supply															
Mean Rainfall (mm)	mm/month		Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	
			85.0	73.0	102.0	91.0	87.0	107.0	142.0	140.0	109.0	96.0	95.0	105.0	
Total Roof Area Catchment (m2)			48700	48700	48700	48700	48700	48700	48700	48700	48700	48700	48700	48700	
Runoff (m3/month)			3311.6	2844.1	3973.9	3545.4	3389.5	4168.7	5532.3	5454.4	4246.6	3740.2	3701.2	4090.8	
Days per month			31	28	31	30	31	30	31	31	30	31	30	31	
Average Runoff (m3/day)			106.8	101.6	128.2	118.2	109.3	139.0	178.5	175.9	141.6	120.7	123.4	132.0	
SUPPLY			m3/day												
			Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	
Rainfall; roof harvesting (m3/day; F) @		100%	106.8	101.6	128.2	118.2	109.3	139.0	178.5	175.9	141.6	120.7	123.4	132.0	
Groundwater Demand															**Max**
SUPPLEMENTAL GROUNDWATER DEMAND (m3/day; E - F = G)			**108.0**	**114.5**	**81.7**	**94.0**	**104.9**	**69.0**	**29.3**	**31.8**	**66.4**	**91.0**	**87.6**	**77.0**	**114.5**
							Design Pumping Rates		**Supplemental Supply**			Pumping (Hours)			12
												Max Rate (L/s)			**2.6**
									Drought 200 m3/day			Pumping (Hours)			12
												Rate (L/s)			**4.6**
SUPPLEMENTAL GROUNDWATER DEMAND (m3/month)			**3348**	**3205**	**2531**	**2820**	**3252**	**2069**	**907**	**985**	**1991**	**2820**	**2628**	**2387**	
			TOTAL ANNUAL SUPPLEMENTARY GROUNDWATER SUPPLY (m3/annum)												**28944**

ENGEO Project Number: 020190.000.001
ENGEO Project Name: Rangitopuni Riverhead Countryside
Prepared by: Rob MacCracken
Checked by: Sean Berry
Date: 28/03/2025

ENGEO





Legend

- Stage 2 Site Boundary
- Hand Auger Boreholes (ENGEO, 2025)
- Cone Penetration Tests (ENGEO, 2025)
- Machine Boreholes (ENGEO, 2025)

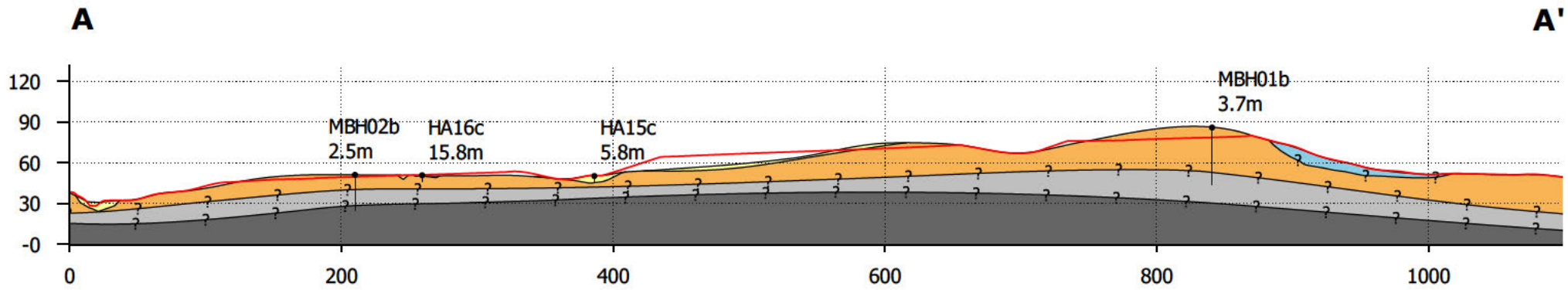
0 50 m 100 m

ENGEO

Produced by **Datanest.earth**

Title: Investigation Location Plan		
Client: Avant Group Ltd		Size: A3
Project: Stage 2 - Forestry Road, Riverhead	Drawn: JC	Figure No.: 1
Date: 20-03-2025	Checked: RB	
Proj No: 20190.000.003	Scale: 1:4800	Version: Final

Stage 2RV Geological Cross Section A-A'



Legend

Engineering Geological Model

- Colluvium
- Undifferentiated Takaanini Formation
- East Coast Bays Formation Residual Soil
- East Coast Bays Formation Transition Zone
- East Coast Bays Formation Rock

Surfaces

- Proposed Stage 2RV Surface

Scale: 1:4,300

Vertical exaggeration: 1x

0m 200m

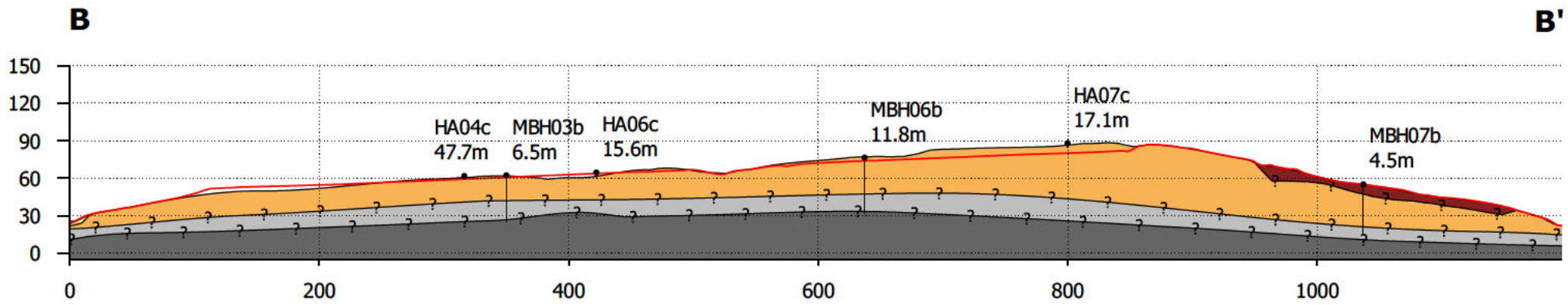
Location

A: 383324, 814887, 132

A': 384139, 814151, 132

Responsible dept.	Technical reference	Creator	Approved by	
ENGEO AKL	20190.000.001	Luke Mackinnon	Harrison Palmer	
Legal owner		**Document type**	**Document status**	
ENGEO		Conceptual Ground Model	Final	
		Title	**Identification number**	
		Rangitopuni Riverhead Stage 2RV Cross Section A-A'	20190.000.001_01	
			Rev. 01	**Date of issue** 21.03.2025 / **Sheet** 1

Stage 2RV Geological Cross Section B-B'



Legend

Engineering Geological Model

- Undifferentiated Takaanini Formation
- Albany Conglomerate
- East Coast Bays Formation Residual Soil
- East Coast Bays Formation Transition Zone
- East Coast Bays Formation Rock

Surfaces

- Proposed Stage 2RV Surface

Scale: 1:4,700

Vertical exaggeration: 1x

0m 200m

Location

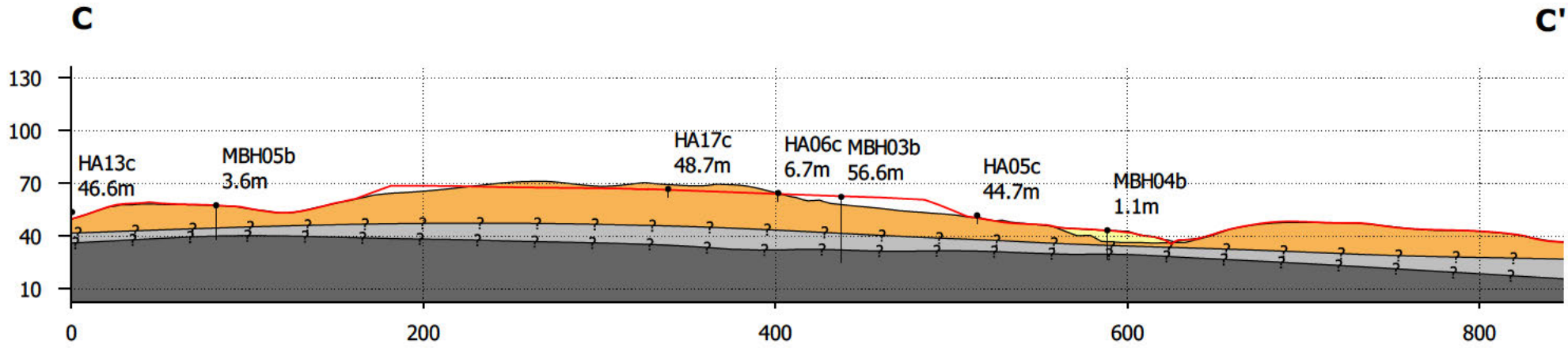
B: 383201, 814557, 150

B': 384273, 814027, 150

Responsible dept.	Technical reference	Creator	Approved by
ENGEO AKL	20190.000.001	Luke Mackinnon	Harrison Palmer

Legal owner	Document type	Document status
ENGEO	Conceptual Ground Model	Final
	Title: Rangitopuni Riverhead Stage 2RV Cross Section B-B'	**Identification number**: 20190.000.001_01
		Rev.: 01 / **Date of issue**: 21.03.2025 / **Sheet**: 1

Stage 2RV Geological Cross Section C-C'



Legend

Engineering Geological Model

- Undifferentiated Takaanini Formation
- East Coast Bays Formation Residual Soil
- East Coast Bays Formation Transition Zone
- East Coast Bays Formation Rock

Surfaces

- Proposed Stage 2RV Surface

Scale: 1:3,400

Vertical exaggeration: 1x

0m 200m

Location

C: 383883, 814655, 137

C': 383247, 814094, 137

Responsible dept.	Technical reference	Creator	Approved by
ENGEO AKL	20190.000.001	Luke Mackinnon	Harrison Palmer

Legal owner

ENGEO

Document type	Document status
Conceptual Ground Model	Final

Title	Identification number
Rangitopuni Riverhead Stage 2RV Cross Section C-C'	20190.000.001_01

Rev.	Date of issue	Sheet
01	21.03.2025	1

APPENDIX 2:

Bore Logs & Aquifer Test Analytic Review

Appendix 2: Compiled Auckland Council Search Results - "Bores and Takes spatial search"

(Results as received 12/Mar/2025)

NZTM			Auckland Council	Current	Historic				Date	Date	Total
Easting	Northing	#	Database Sheet	Consent Reference	Consent Number	File Reference	Bore ID	Consent Decription	Issued	Drilled	Depth (m)
1741260	5931550	0	Search Centre - 2km Radius								
1742592	5930648	1	BORE_AC	LUC60335953				Consent to drill and construct a new bore into the Kumeu Waitemata Sandstone Aquifer for the take and use of groundwater	20190411		
1740954	5929610	2	BORE_AC	LUC80309463				0	19980218		
1741749	5930189	3	BORE_AC	LUC60007412				The drilling of a bore	20150316		
1741457	5930016	4	BORE_AC	LUC60271274				To authorise the construction of one bore for irrigation purposes.	20130412		
1742763	5931417	5	BORE_AC	LUC80312758				To authorise the construction of a bore for stock purposes.	20100603		
1740767	5930670	6	BORE_AC	LUC60347586				Consent to drill and construct a new bore into the Lower Kaipara Waitemata Sandstone Aquifer for domestic and stock drink	20191114		
1740767	5930670	7	BORE_AC	LUC60347586				Consent to drill and construct a new bore into the Lower Kaipara Waitemata Sandstone Aquifer for domestic and stock drink	20191114		
1743223	5931072	8	BORE_AC	LUC80311945				To authorise the construction of a bore for irrigation of 5 ha of market garden.	20080411		
1741029	5930673	9	BORE_AC	LUC60316422				Permitted Activity - To authorise a replacement bore for stock and domestic supply.	20180309		
1741749	5930189	10	BORE_AC	LUC60007412				The drilling of a bore	20150316		
1743256	5931565	11	BORE_AC	LUC80308250				replacement of existing narrow diameter bore with deteriorated casing	20011018		
1741250	5930280	121	OAS_ALL_BORE				2232	Drilled pre-1987 for POOK MV by *** DRILLER UNKNOWN ***.		19831101	152
1742000	5929800	122	OAS_ALL_BORE				2254	Drilled pre-1987 for AIRBOURNE ORCHARDS by DRILLING SPECIALTIES LTD.		19770329	174
1740520	5929950	123	OAS_ALL_BORE				20902	Municipal supply for a lodge		0	0
1743135	5931575	124	OAS_ALL_BORE				2264	Drilled pre-1987 for LANGDON A by DRILLING SPECIALTIES LTD.		19750729	152
1742281	5931251	125	OAS_ALL_BORE		53406	C512-12-5836	30110	To take water to supply a school - replaces bore id 2255 (Drilled pre-1987 for AUCK ED BD RIVERHEAD by *** DRILLER UNKNOWN ***.)		20160707	201
1741758	5929704	126	OAS_ALL_BORE				23679	Drilled pre 1987 for MJ Jelas by driller unknown. Bore details from file applic form.		19830101	206
1742000	5929800	127	OAS_ALL_BORE				2253	Drilled pre-1987 for AIRBOURNE ORCHARDS by DRILLING SPECIALTIES LTD.		19770105	209
1742287	5931253	128	OAS_ALL_BORE				2255	superseded by new bore id no. 30110Drilled pre-1987 for AUCK ED BD RIVERHEAD by *** DRILLER UNKNOWN ***.		20000101	0
1741040	5930330	129	OAS_ALL_BORE				2229	Drilled pre-1987 for NEW ZEALAND FOREST SERVICE by PATTERSON R & CO.		19800101	220
1741968	5929832	130	OAS_ALL_BORE				21128	Pre permit bore. Location from file Ag 4506.		0	183
1741638	5929954	131	OAS_ALL_BORE				20904	Pre 1987. AG6424		19841201	181
1740400	5930800	132	OAS_ALL_BORE		21235	C512-12-2162*	20140	0		19980319	10
1740600	5929790	133	OAS_ALL_BORE				2217	Pre permit bore. Location from file Ag 6636.		0	167.6
1741575	5930218	134	OAS_ALL_BORE		41534	C512-12-5115	28862	To authorise the construction of one bore for irrigation purposes.		20120430	303
1741630	5930020	135	OAS_ALL_BORE				20905	Pre 1987. AG6418		0	106
1741620	5929700	136	OAS_ALL_BORE				21129	Pre permit bore. Location from file Ag 6407.		0	167.6
1740942	5929761	137	OAS_ALL_BORE		52998	C512-12-5234	29106	The construction of one replacement bore for irrigation purposes.		20140427	195
1740506	5930984	138	OAS_ALL_BORE				2218	Drilled pre-1987 for CARTER KUMEU LTD by *** DRILLER UNKNOWN ***.		20000101	120
1742440	5931440	139	OAS_ALL_BORE		10591	14/17/353	419	Construction of a 100mm dia. bore to approx. 150m depth, installation and full cement grouting of P.V.C. casing to approx. 70m.		19890920	142
1739800	5930600	140	OAS_ALL_BORE				2190	0		19890920	222
1741955	5929735	141	OAS_ALL_BORE				21126	Pre permit bore. Location from file Ag 4504.		19111101	183
1742400	5931500	142	OAS_ALL_BORE				2259	0		19890928	142
1741500	5930680	143	OAS_ALL_BORE		10473	14/17/235	301	Construction of a 100mm dia. bore to approx. 220m depth, installation and full cement grouting of steel casing to approx. 90m.		19881212	217
1741580	5929880	144	OAS_ALL_BORE				20903	0		19730101	182
1742767	5931321	145	OAS_ALL_BORE				2265	Drilled pre-1987 for ROSSER BM by ANDERSON GEORGE.		19321101	18
1742829	5931419	146	OAS_ALL_BORE		38028	C512-12-4651	23633	To authorise the construction of a bore for stock purposes.		0	0
1741500	5930680	147	OAS_ALL_BORE				2244	Drilled for J A King. same as bore ID 301		19881212	217
1741980	5930140	148	OAS_ALL_BORE				2251	Drilled pre-1987 for MURPHY PJ by *** DRILLER UNKNOWN ***.		20000101	0
1741450	5930380	149	OAS_ALL_BORE				2235	Drilled pre-1987 for WARD JC by MID NORTHERN DRILLING CO LTD.		0	218
1739880	5930550	150	OAS_ALL_BORE		10586	14/17/348	414	Construction of a 100mm dia. bore to approx. 220m depth, installation and full cement grouting of P.V.C. casing to approx. 60m.		19890825	222
1743090	5930900	151	OAS_ALL_BORE				21121	Pre permit bore. Location from file Ag 6971.		19850101	250
1740400	5930100	152	OAS_ALL_BORE		24905	C512-12-2685	21357	0		0	0
1741720	5929890	153	OAS_ALL_BORE				2252	Drilled pre-1987 for SABOURIN DJ by PATTERSON R & CO.		20000101	200
1742095	5929860	154	OAS_ALL_BORE				21127	Pre permit bore. Location from file Ag 4505.		0	243.8
1740400	5930800	155	OAS_ALL_BORE		21236	C512-12-2162*	20140	0		19980319	10
1740550	5929940	156	OAS_ALL_BORE		25724	C512-12-2784	21526	health lodge plus house ~ 25 people		20010919	227.5
1741280	5930650	157	OAS_ALL_BORE		10694	14/17/456	522	Construction of a 100mm dia. bore to approx. 200m depth and installation of steel casing to appropriate depth.		19900307	100
1740696	5930216	158	OAS_ALL_BORE				23738	Irrigation of 1.5H of flower crops and 4.5H of mixed orchard.		19850101	220
1742570	5930640	159	OAS_ALL_BORE				21115	Pre permit bore. Location from file Ag 7744. Supply a Tavern.		19400101	152.4
1741804	5929802	160	OAS_ALL_BORE				21125	Pre permit bore. Location from file Ag 4503.		0	60
1742500	5930200	161	OAS_ALL_BORE				2260	Drilled pre-1987 for WALKER E&JA by PATTERSON R & CO.		20000101	0
1740950	5929780	162	OAS_ALL_BORE				2211	Drilled pre-1987 for SLIECKER/MICHAEL by MID NORTHERN DRILLING CO LTD.		19760101	158
1741733	5930215	163	OAS_ALL_BORE		44233	C512-12-5557	29804	To authorise the construction of one bore for domestic purposes.		20150328	276
1741860	5930410	164	OAS_ALL_BORE		15096	C512-12-1759	5243	Public Amenities & Rugby Pavilion		19960531	252.6
1742300	5931520	165	OAS_ALL_BORE		10977	14/17/739	805	Remove existing casing, redrill to approx. 200m depth and installation of 100mm dia. steel casing to approx. 65m.		19920110	202
1741700	5930430	166	OAS_ALL_BORE				2240	Drilled pre-1987 for WHITE R by *** DRILLER UNKNOWN ***.		20000101	213
1740942	5929761	180	OAS_PA_BORE			C512-12-5234	29106	The construction of one replacement bore for irrigation purposes.			
1742281	5931251	181	OAS_PA_BORE			C512-12-5836	30110	To authorise the construction of a replacement bore forsupply to a school			

WELLDRILLERS CHRIS BROWN LTD

Mobile: 021 439791
AH: 09 424 8495
Email: WaterBores@xtra.co.nz

Customer	[redacted]
Address	340 Riverhead Road, Riverhead
City	Auckland

Permit #	41534	Bore ID	28862
Grid Reference	1741560mE, 5930166mN	Drilling Method	R/M
Purpose of Bore	Irrigation	Driller	Chris Brown
Date of Starting	20/04/2013	Date of Finishing	30/04/2013

BORE LOG

Depth from Surface		Description of Ground Passed Through
Top	Bottom	
0	4	Yellow Clay
4	7	Grey clay with Timber
7	13	Mudstone Soft
13	21	Sandstone Firm
21	303	Sandstone hard with some small gavels
		10% Water Loss @130
		5% Water Loss @ 283

WELL CONSTRUCTION

Depth of Bore:	303			(M)
Depth of Casing:	95.5			(M)
Diameter of Casing:	104			(mm)
Screens:				
Diameter(s):				
Interval(s):	From:		To:	
Slot Size & Type:				
Grouting:		Bags:	25	

PUMP TEST

Static Water Level:	14.160	
Method of Development:	Air	
Test Discharge:	8.0	(M^3/hr)
Drawdown level at Discharge:	90	(M)
Duration of Test:	28	Hours

Recommended Pump Depth:	95	(M)
Recommended Pump Volume:	8000	(ltrs p/hr)
Recommended Pump Type:	4"	

WATER QUALITY: (Basic on-site taste test)
Good to Taste

COMMENTS

Air Test @ 95m = 7000 LPH when drilled to 250m
Air Test @ 95m = 8000 LPH when drilled to 303m
Air Test start off 10000 LPH after 6 hours = 8000 and held for 24 hours

NZGD ID: 82546

The Manager,
Auckland Regional Water Board,
Auckland Regional Authority,
Private Bag,
AUCKLAND 1.
(Telephone No. 794-420)

Ground Water

301-10473

DRILLERS' LOG FORM

REGIONAL WATER BOARD
20 DEC 1988
A.R.A.

WELL OWNER [redacted]

ADDRESS [redacted]

DRILLING FIRM Kiwi Welldrillers Ltd

DRILLER J Allfrey

Date of Starting 12-12-88

LOCALITY Riverhead

MAP SHEET No. R 10

GRID REFERENCE 520924

WELL No. - JOB No. -

Date of Finishing 15-12-88

STRATA

Depth From Surface Top	Depth From Surface Bottom	Description of Ground Passed Through
0	2 m	Orenge Clay.
2m	3 m	Fine Sand Gray.
3m	40m	Med Sandstone with Fine Grit.
40m	48m	Fine Sandstone Mudstone
48m	50m	Sandstone Fine with. Seams Coal
50m	67m	Fine Sandstone.
67m	217m	Fine Sandstone Mudstone Hard Bars.

Copy on WATER ONLY 22/12/88.

BIP 235
GROUNDWATER A.R.W.B. RENEWAL.
W.R. No A3 86521 4 A3 880074
NAME SALHM KING
TECHNICAL FILES
22/12/88 9
ACTIONED
BORE LOG ✓
PUMP TEST
COMPUTER
WATER QUAL

Reduced Level of Well Site (m) -

Max. Drawdown (m) 40

At 227 (Litres/Min.)

Casing Diameter (cm) 10

Length (m) 83.

Screen Not Needed.

Pump Depth (m) 60

Static Water Level* (m) 5.50

Yield 300 (Litres/Min.)

Water Quality Good.

Hour Meter Reading 12 hour Air Test.

*or Artesian Head

Remarks Started with a 5% water loss at 93m. At 190m water loss was up to 25%.

FILED PK

NZGD ID: 82309

con 25724.

~~C512-12-2784~~

25724

KIWI WELLDRILLERS N.Z.

ISO 9002 CERTIFIED

KEVIN BROWN LTD.

MEMBER NZ DRILLERS FED

PH. 0800 822 822

BRANCHES:

BAY OF ISLANDS
WARKWORTH
GLENBROOK

PO BOX 400 OREWA
FAX 09 425 0228
[redacted]

BORE LOG FORM

[redacted]

Address 221 RIVERHEAD RD. KUMEU
PH. 09 412 7373
Grid Reference R10 509 916
Permit C512 12 2784

Driller PETER BECK
Drilling Method ROT.- MUD
Date of Finishing 19.9.2001
Purpose of Bore RESIDENTIAL HEALTH FACILITY

BORE LOG

Depth from Surface Top	Bottom	Description of Ground Passed Through
0..	3.0	SOFT STICKY ORANGE CLAY
3.0	9.0	SOFT STICKY GREY CLAY
9.0	12.0	SOFT ST. BLUE GREY CLAY
12.0	18.0	SOFT GREY SILTY CLAY
18.0	21.0	FIRM GREY CLAY
21.0	31.0	BLUE MOTTLED MUDSTONE
31.0	40.0	MED. GR. GREY SANDSTONE
40.0	45.0	FIRM GREY MUDSTONE
45.0	142.0	COARSE GREY HARD S/S
142.0	154.0	GREY COARSE S/S + GRAVELS
154.0	204.0	GREY COARSE SANDSTONE
204.0	227.5	MEDIUM GREY SANDSTONE

Consent Holder A & E BOATIE, HAPPY HEALTH LTD
Bore Permit No: C512-12-2784
Bore ID 21526
Water Permit No:
Date Consents D-base Updated 29/10/01
Date Bore Log D-base Updated 29/10/01
Airline Result (75% of Test)

WELL CONSTRUCTION

All measurements from the top of the casing

Depth of bore (M) 227.50
Depth of casing (M) 70.00
Diameter of Casing PVC 100 (mm)
Screens: N/R
From m to m
Slot size and type
Grouting 12 Bags

Pump Tests:

Method of development AIR INDUCTION
Static water level 12.30 m
Duration of test 3 HOURS
Max 5200 ltrs p/hr
Test discharge (m^3/hr) 5.2
Drawdown level 60 m
PUMP DEPTH 68.00 m
PUMP VOLUME up to 3000 ltrs p/hr
Type pump to suit construction of bore for client
100mm SUBMERSIBLE PUMP SET AT 68.00 m. FOR 3000 lph
Water Quality Basic on site taste test GOOD

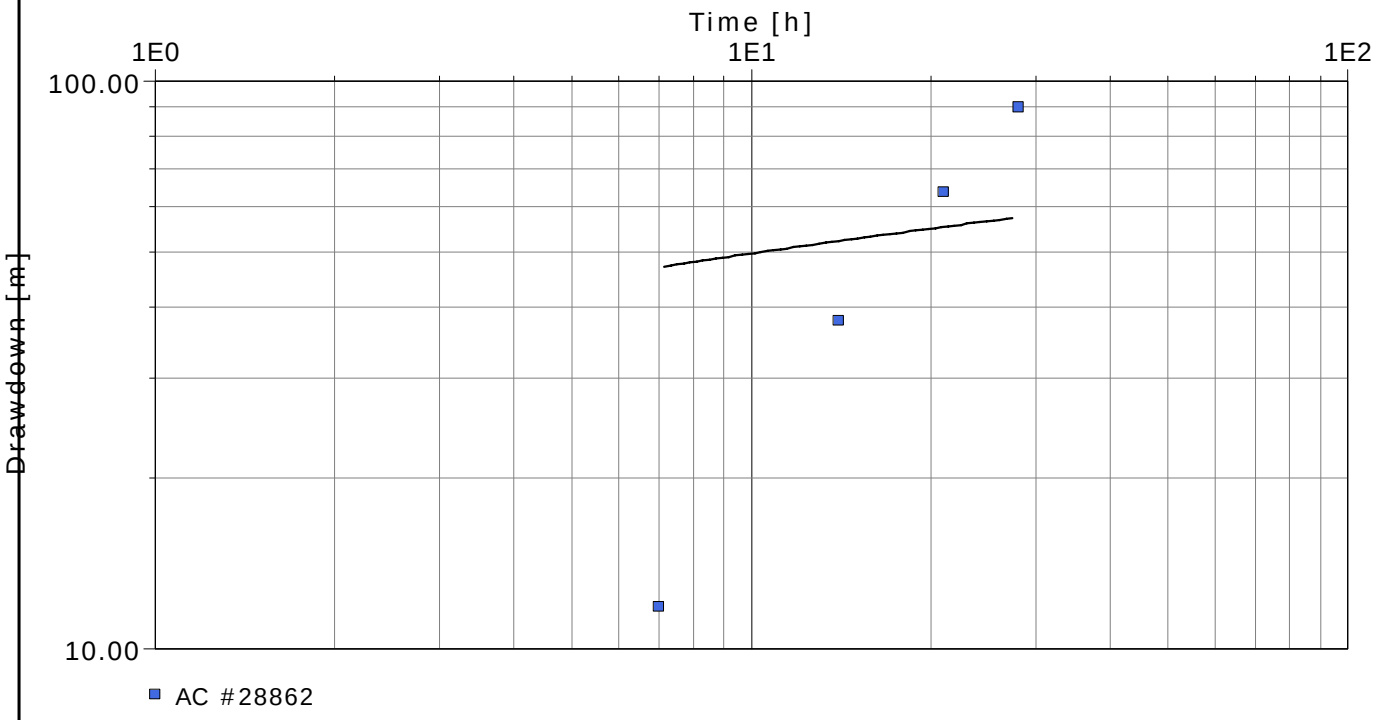
REMARKS

2% CIRCULATION LOSS @ 32m
5% CIRCULATION LOSS @ 142m 8% @ 227m
HIGH CIRCULATION LOSS @ 208m

NZGD ID: 80886

ENGEO	**Pumping Test Analysis Report**
	Project: Rangitoopuni RV
	Number: 020190.000.001
	Client: Rangitoopuni Developments LP

Location: Forestry Rd, Riverhead	Pumping Test: 340 Riverhead Road	Pumping Well: AC #28862
Test Conducted by: Welldrillers Chris Brown Ltd		Test Date: 4/20/2013
Analysis Performed by: S. Berry	Approximation Bore #28862	Analysis Date: 3/27/2025
Aquifer Thickness: 303.00 m	Discharge Rate: 8 [m³/h]	

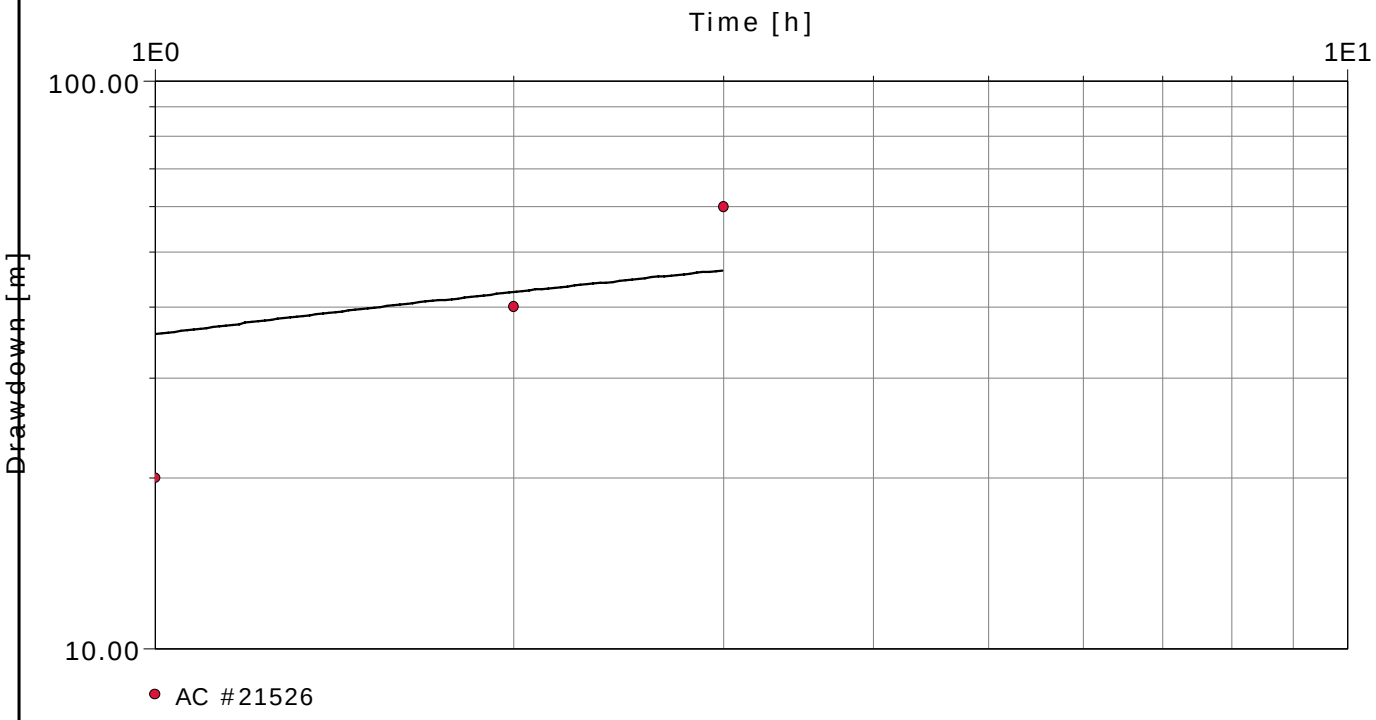


Calculation using Theis

Observation Well	Transmissivity [m²/s]	Hydraulic Conductivity [m/s]	Storage coefficient	Radial Distance to PW [m]	
AC #28862	2.33×10^{-5}	7.69×10^{-8}	9.90×10^{-1}	0.05	

ENGEO	**Pumping Test Analysis Report**
	Project: Rangitoopuni RV
	Number: 020190.000.001
	Client: Rangitoopuni Developments LP

Location: Forestry Rd, Riverhead	Pumping Test: 221 Riverhead Road	Pumping Well: AC #21526
Test Conducted by: Kiwi Welldrillers NZ		Test Date: 9/19/2001
Analysis Performed by: S. Berry	Approximation Bore #21526	Analysis Date: 3/27/2025
Aquifer Thickness: 227.50 m	Discharge Rate: 5.2 [m³/h]	

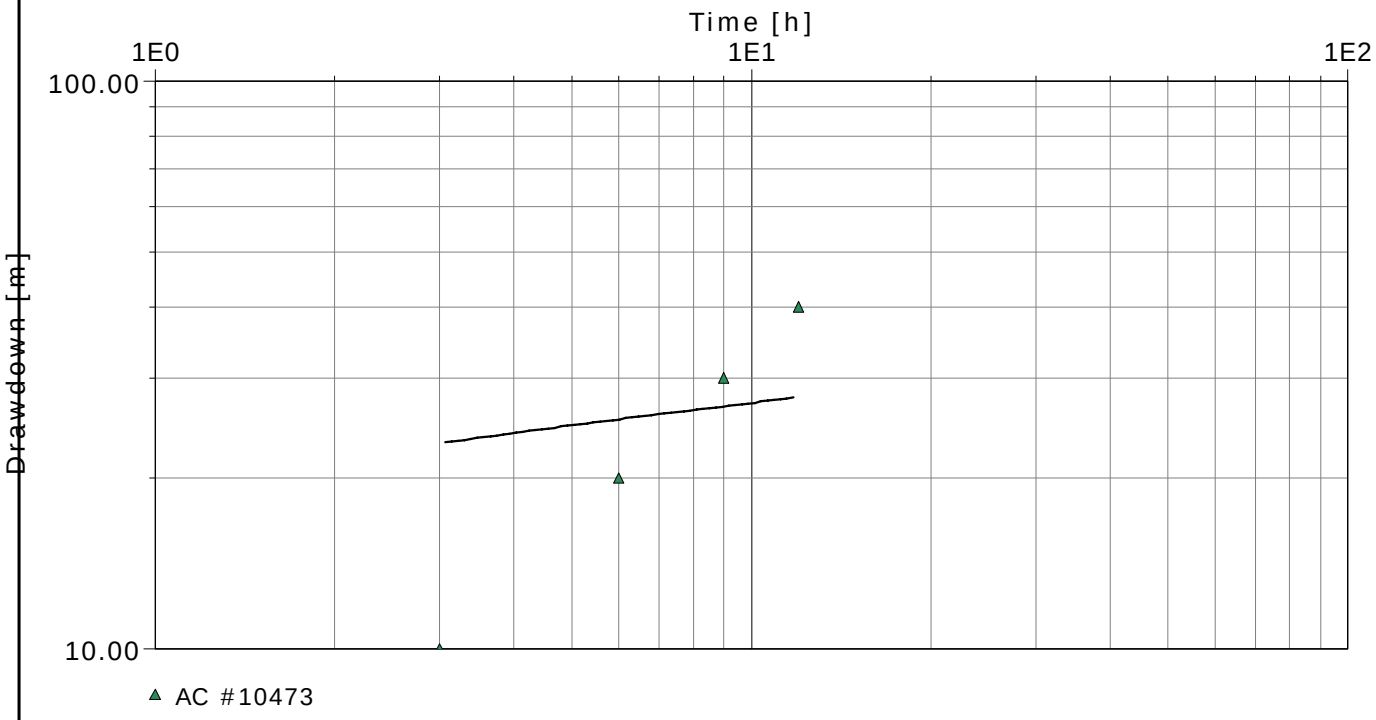


Calculation using Theis

Observation Well	Transmissivity [m²/s]	Hydraulic Conductivity [m/s]	Storage coefficient	Radial Distance to PW [m]	
AC #21526	1.18×10^{-5}	5.17×10^{-8}	9.90×10^{-1}	0.05	

ENGEO	**Pumping Test Analysis Report**
	Project: Rangitoopuni RV
	Number: 020190.000.001
	Client: Rangitoopuni Developments LP

Location: Forestry Rd, Riverhead	Pumping Test: 307 Riverhead Road	Pumping Well: AC #10473
Test Conducted by: Kiwi Welldrillers Ltd		Test Date: 12/15/1988
Analysis Performed by: S. Berry	Approximation Bore #10473	Analysis Date: 3/27/2025
Aquifer Thickness: 217.00 m	Discharge Rate: 13.62 [m³/h]	



Calculation using Theis

Observation Well	Transmissivity [m²/s]	Hydraulic Conductivity [m/s]	Storage coefficient	Radial Distance to PW [m]	
AC #10473	8.85×10^{-5}	4.08×10^{-7}	9.90×10^{-1}	0.05	

BOREHOLE LOG MBH01

Stage 2 Geotechnical Investigation
Forestry Road
Riverhead, Auckland
20190.000.001

Client : Rangitoopuni Developments **Core Diameter** : 64 mm
Date : 03-03-2025 **Energy Transfer Ratio** : 97.1%
Hole Depth : 42 m **Logged By/Reviewed By** : JM / HP
Drilling Method : Mud Rotary **Latitude** : -36.7505189
Drilling Contractor : McMillan Drilling Group Ltd **Longitude** : 174.5843713

Material	DESCRIPTION	Log Symbol	Strength	Depth (m BGL)	Elevation (mRL)	SPT N-Value / Vane Shear Strength	Sample Type	TCR (%)	RQD (%)	Defect Description	Moisture	Water Level	Piezometer Construction
F	[FILL] Clayey SILT with some organics; dark brown. Low plasticity. Organics are wood fragments.		N/A										
EAST COAST BAYS FORMATION	Clayey SILT with trace sand; light grey with pink and orange mottles. Low plasticity. 0.4 - 0.6 m - With pink streaks and minor fine to medium sand.		St	1	85	66/26 kPa							
	1.1 - 1.5 m - No recovery.	NR	N/A										
	Clayey SILT with some sand; light grey with pink and orange mottles. Low plasticity. Sand is fine to coarse.		St			1/1//1/1/2/2 N=6						▼	
	1.6 - 1.7 m - Becomes orange.	NR	N/A										
	1.8 - 1.95 m - No recovery.			2	84								
	Sandy SILT with trace clay; pinkish light grey. Low plasticity. Sand is fine to medium.		St								M		
	Clayey SILT with minor sand; light grey with orange mottles. Low plasticity. Sand is fine to medium.		St	3	83	0/1//1/1/2/2 N=6							
	3.75 - 4.1 m - With some fine to coarse sand.												
	4.1 m - With minor fine to medium sand and becomes light grey with pink and orange streaks.	NR	N/A	4	82								
	4.2 - 4.5 m - No recovery.												
	Sandy SILT with trace clay; orange with occasional light grey and pink mottles. Low plasticity. Sand is fine to coarse.		St	5	81	0/1//1/2/1/2 N=6							

Machine borehole met target depth at 42 m bgl
Dip test showed standing groundwater at 1.5 m [04/03/2025 15:00]
Coordaintes and elevation estimated using Auckland Council GeoMaps.

Strengths inferred from shear vane, SPT and tactile assessment.
N/A = Not Assessed; NR = No Recovery
F = Fill

GEOTECH MACHINE BOREHOLE - ROCK MBH06-07.GPJ NZ DATA TEMPLATE 2.GDT 23/03/25

BOREHOLE LOG MBH01

Stage 2 Geotechnical Investigation
Forestry Road
Riverhead, Auckland
20190.000.001

Client : Rangitoopuni Developments **Core Diameter** : 64 mm
Date : 03-03-2025 **Energy Transfer Ratio** : 97.1%
Hole Depth : 42 m **Logged By/Reviewed By** : JM / HP
Drilling Method : Mud Rotary **Latitude** : -36.7505189
Drilling Contractor : McMillan Drilling Group Ltd **Longitude** : 174.5843713

Material	DESCRIPTION	Log Symbol	Strength	Depth (m BGL)	Elevation (mRL)	SPT N-Value / Vane Shear Strength	Sample Type	TCR (%) 25 50 75	RQD (%) 25 50 75	Defect Description	Moisture	Water Level	Piezometer Construction
EAST COAST BAYS FORMATION	Sandy SILT with trace clay; orange with occasional light grey and pink mottles. Low plasticity. Sand is fine to coarse.		St										
	5.85 - 6 m - No recovery.	NR	N/A										
	Silty CLAY; light grey with pink and orange streaks. High plasticity.			6	80	0/2/2/1/3/3 N=9							
	6.8 - 6.95 m - With minor fine to medium sand.		VSt	7	79								
	Sandy SILT; orange with occasional dark orange staining. Low plasticity. Sand is fine to medium.					144/44 kPa							
						1/2/2/2/4/3 N=11							
				8	78						M		
	8.5 m - With light grey streaks and inclusions of silty CLAY (20 mm diameter).		VSt										
				9	77								
						1/2/2/2/3/3 N=10							
	Silty CLAY with trace sand; light grey with pink streaks. High plasticity.		VSt										
	Clayey SILT with some sand; orange with light grey mottles. Low plasticity.		VSt										
	Sandy SILT with trace clay; light pink with occasional light grey specks. Low plasticity. Sand is fine to coarse.												
	Interbedded with			10	76								
	Silty CLAY; light grey with pink and orange streaks. High plasticity. Beds are sub-horizontal to gently inclined, moderately thin to moderately thick, moderately widely spaced.		VSt			1/1/2/2/2/1 N=7							

Machine borehole met target depth at 42 m bgl
Dip test showed standing groundwater at 1.5 m [04/03/2025 15:00]
Coordaintes and elevation estimated using Auckland Council GeoMaps.

Strengths inferred from shear vane, SPT and tactile assessment.
N/A = Not Assessed; NR = No Recovery
F = Fill

GEOTECH MACHINE BOREHOLE - ROCK MBH06-07.GPJ NZ DATA TEMPLATE 2.GDT 23/03/25

BOREHOLE LOG MBH01

Stage 2 Geotechnical Investigation
Forestry Road
Riverhead, Auckland
20190.000.001

Client : Rangitoopuni Developments **Core Diameter** : 64 mm
Date : 03-03-2025 **Energy Transfer Ratio** : 97.1%
Hole Depth : 42 m **Logged By/Reviewed By** : JM / HP
Drilling Method : Mud Rotary **Latitude** : -36.7505189
Drilling Contractor : McMillan Drilling Group Ltd **Longitude** : 174.5843713

Material	DESCRIPTION	Log Symbol	Strength	Depth (m BGL)	Elevation (mRL)	SPT N-Value / Vane Shear Strength	Sample Type	TCR (%) 25 50 75	RQD (%) 25 50 75	Defect Description	Moisture	Water Level	Piezometer Construction
EAST COAST BAYS FORMATION	Sandy SILT with trace clay; light pink with occasional light grey specks. Low plasticity. Sand is fine to coarse. Interbedded with Silty CLAY; light grey with pink and orange streaks. High plasticity. Beds are sub-horizontal to gently inclined, moderately thin to moderately thick, moderately widely spaced.		VSt	11	75	1/1//2/2/2/1 N=7							
				12	74	1/2//1/3/3/3 N=10							
	Clayey SILT; light grey with pink and orange streaks. Low plasticity. Interbedded with Sandy SILT; light pink. Low plasticity. Sand is fine to coarse. Beds are moderately inclined, thin, closely spaced.		VSt	13	73								
	Sandy SILT with trace clay; pink with occasional light grey specks. Low plasticity. Sand is fine to coarse. Interbedded with Clayey SILT; light grey with pink streaks. Low plasticity. Beds are gently inclined, thin to moderately thin, moderately widely spaced.		VSt	14	72	144/44 kPa 1/2//2/2/2/3 N=9					M		
				15	71	2/2//3/3/4/4 N=14							
	16 - 16.2 m - Sandy SILT becomes grey.			16	70								

Machine borehole met target depth at 42 m bgl
Dip test showed standing groundwater at 1.5 m [04/03/2025 15:00]
Coordaintes and elevation estimated using Auckland Council GeoMaps.

Strengths inferred from shear vane, SPT and tactile assessment.
N/A = Not Assessed; NR = No Recovery
F = Fill

GEOTECH MACHINE BOREHOLE - ROCK MBH06-07.GPJ NZ DATA TEMPLATE 2.GDT 23/03/25

BOREHOLE LOG MBH01

Stage 2 Geotechnical Investigation
Forestry Road
Riverhead, Auckland
20190.000.001

Client : Rangitoopuni Developments **Core Diameter** : 64 mm
Date : 03-03-2025 **Energy Transfer Ratio** : 97.1%
Hole Depth : 42 m **Logged By/Reviewed By** : JM / HP
Drilling Method : Mud Rotary **Latitude** : -36.7505189
Drilling Contractor : McMillan Drilling Group Ltd **Longitude** : 174.5843713

Material	DESCRIPTION	Log Symbol	Strength	Depth (m BGL)	Elevation (mRL)	SPT N-Value / Vane Shear Strength	Sample Type	TCR (%) 25 50 75	RQD (%) 25 50 75	Defect Description	Moisture	Water Level	Piezometer Construction
EAST COAST BAYS FORMATION	Clayey SILT with trace sand; light grey with orange streaks. Low plasticity. Interbedded with Sandy SILT; light orange brown. Low plasticity. Sand is fine to medium. Beds are moderately inclined, thin, closely spaced to moderately widely spaced.		VSt - H	17	69	2/2//3/5/4/5 N=17							
	17.8 m - Sandy SILT becomes grey and thickly bedded.			18	68	3/3//5/6/6/8 N=25							
	Silty fine to coarse SAND; light brownish grey. Well graded.		MD	19	67						M		
	Clayey SILT; grey with dark grey streaks. Low plasticity.		H	20	66	3/4//5/6/8/9 N=28							
			VSt - H	21	65	2/3//3/4/6/5 N=18							

Machine borehole met target depth at 42 m bgl
Dip test showed standing groundwater at 1.5 m [04/03/2025 15:00]
Coordaintes and elevation estimated using Auckland Council GeoMaps.

Strengths inferred from shear vane, SPT and tactile assessment.
N/A = Not Assessed; NR = No Recovery
F = Fill

GEOTECH MACHINE BOREHOLE - ROCK MBH06-07.GPJ NZ DATA TEMPLATE 2.GDT 23/03/25

BOREHOLE LOG MBH01

Stage 2 Geotechnical Investigation
Forestry Road
Riverhead, Auckland
20190.000.001

Client : Rangitoopuni Developments **Core Diameter** : 64 mm
Date : 03-03-2025 **Energy Transfer Ratio** : 97.1%
Hole Depth : 42 m **Logged By/Reviewed By** : JM / HP
Drilling Method : Mud Rotary **Latitude** : -36.7505189
Drilling Contractor : McMillan Drilling Group Ltd **Longitude** : 174.5843713

Material	DESCRIPTION	Log Symbol	Strength	Depth (m BGL)	Elevation (mRL)	SPT N-Value / Vane Shear Strength	Sample Type	TCR (%) 25 50 75	RQD (%) 25 50 75	Defect Description	Moisture	Water Level	Piezometer Construction
EAST COAST BAYS FORMATION	Sandy SILT; light orange and dark reddish orange. Low plasticity. Sand is fine to coarse. Interbedded with Clayey SILT; grey. Low plasticity. Beds are sub-horizontal to gently inclined, very thin, very closely spaced.			22	64								
	22.65 m - Becomes light grey and clayey SILT beds become moderately thick to thick, moderately widely spaced.			23	63	3/4//5/6/7/8 N=26							
	23.7 - 24 m -With dark orange and light orange brown staining. 24 m - Becomes grey with orange and light brownish grey streaks.		VSt - H	24	62	4/3//4/6/7/8 N=25					M		
	25.35 - 25.5 m - Becomes light pinkish grey.			25	61	3/4//4/6/6/7 N=23							
	Silty fine to coarse SAND; pinkish orange. Well graded. 26.6 m - Becomes light greyish brown.		MD	26	60								
				27	59								

Machine borehole met target depth at 42 m bgl
Dip test showed standing groundwater at 1.5 m [04/03/2025 15:00]
Coordaintes and elevation estimated using Auckland Council GeoMaps.

Strengths inferred from shear vane, SPT and tactile assessment.
N/A = Not Assessed; NR = No Recovery
F = Fill

GEOTECH MACHINE BOREHOLE - ROCK MBH06-07.GPJ NZ DATA TEMPLATE 2.GDT 23/03/25

BOREHOLE LOG MBH01

Stage 2 Geotechnical Investigation
Forestry Road
Riverhead, Auckland
20190.000.001

Client : Rangitoopuni Developments **Core Diameter** : 64 mm
Date : 03-03-2025 **Energy Transfer Ratio** : 97.1%
Hole Depth : 42 m **Logged By/Reviewed By** : JM / HP
Drilling Method : Mud Rotary **Latitude** : -36.7505189
Drilling Contractor : McMillan Drilling Group Ltd **Longitude** : 174.5843713

Material	DESCRIPTION	Log Symbol	Strength	Depth (m BGL)	Elevation (mRL)	SPT N-Value / Vane Shear Strength	Sample Type	TCR (%) 25 50 75	RQD (%) 25 50 75	Defect Description	Moisture	Water Level	Piezometer Construction
EAST COAST BAYS FORMATION	Sandy SILT with trace clay; orange with dark orange staining. Low plasticity. Sand is fine to coarse. 27.25 - 27.35 m - Encountered trace fine, rounded limonite gravel.		H			3/4//6/7/10/10 N=33							
	Sandy SILT; light brownish grey. Low plasticity. Sand is fine to coarse. Interbedded with Clayey SILT; grey with dark grey streaks. Low plasticity. Beds are gently inclined to moderately inclined, moderately thin, moderately widely spaced. 28.5 - 28.7 m -With occasional orange staining.		H	28	28 58								
	29.75 - 29.8 m -Encountered lens of dark brown, fine SAND.		H	29	29 57						M		
	Clayey SILT; dark grey. Low plasticity. 30.5 m - Becomes light grey with dark grey streaks. 30.9 m - With orange streaks and staining.		H	30	30 56								
	Silty fine to medium SAND; orange. Well graded.		N/A	31	31 55								
	Clayey SILT; dark grey. Low plasticity. (Completely weathered SILTSTONE; extremely weak.) Interbedded with Silty fine to medium SAND; light and dark orange. Well graded. Beds are gently inclined, moderately thin, moderately widely spaced. 31.8 m - With gently inclined orange bands		H	32	32 54								

Machine borehole met target depth at 42 m bgl
Dip test showed standing groundwater at 1.5 m [04/03/2025 15:00]
Coordaintes and elevation estimated using Auckland Council GeoMaps.

Strengths inferred from shear vane, SPT and tactile assessment.
N/A = Not Assessed; NR = No Recovery
F = Fill

GEOTECH MACHINE BOREHOLE - ROCK MBH06-07.GPJ NZ DATA TEMPLATE 2.GDT 23/03/25

BOREHOLE LOG MBH01

Stage 2 Geotechnical Investigation
Forestry Road
Riverhead, Auckland
20190.000.001

Client : Rangitoopuni Developments **Core Diameter** : 64 mm
Date : 03-03-2025 **Energy Transfer Ratio** : 97.1%
Hole Depth : 42 m **Logged By/Reviewed By** : JM / HP
Drilling Method : Mud Rotary **Latitude** : -36.7505189
Drilling Contractor : McMillan Drilling Group Ltd **Longitude** : 174.5843713

Material	DESCRIPTION	Log Symbol	Strength	Depth (m BGL)	Elevation (mRL)	SPT N-Value / Vane Shear Strength	Sample Type	TCR (%) 25 50 75	RQD (%) 25 50 75	Defect Description	Moisture	Water Level	Piezometer Construction
	and sand beds become laminated to very thin. 32.8 - 33 m - No recovery.		H	33	53						M		
EAST COAST BAYS FORMATION	Silty fine to coarse SAND; dark orange and light orange brown. Well graded. (Completely weathered SANDSTONE; extremely weak.). Interbedded with Highly weathered, dark grey with moderately inclined, laminated to very thin orange bands and staining SILTSTONE; very weak. Beds are gently to moderately inclined, very thin to thin, extremley closely spaced to closely spaced, Fe staining along bedding contacts.		VD	34	52								
	Highly weathered, dark grey with gently inclined, laminated to very thin orange bands and staining SILTSTONE; very weak. 35.5 m - With gently inclined, very thin, extremely closely spaced to very closely spaced beds of light brownish grey, fine SAND.		VW	35	51					35.27-35.37 m: Driling induced bedding partings; gently inclined, extremley closely spaced to very closely spaced 35.45-35.97 m: Drilling induced bedding partings; closely spaced.	N/A		
			D										
	Silty fine to coarse SAND; light brownish grey. Well graded. (Completely weathered SANDSTONE; extremely weak.)			36	50					36.16 m: Bedding parting with Fe staining			
	Silty fine to coarse SAND; light brownish grey with orange staining. Well graded. (Completely weathered SANDSTONE; extremley weak.) Interbedded with Highly weathered, dark grey SILTSTONE; very weak. Beds are gently inclined, very thin to thin, very closely spaced to closely spaced, Fe staining along bedding contacts. 36.85 m - Sandstone beds become orange with dark orange staining. 37.2 - 37.5 m - No recovery.		VW	37	49					36.5-36.9 m: Drilling induced bedding partings; closely spaced. 36.7 m: Drilling induced bedding parting 36.9 m: Joint; gently inclined, stepped, planar, smooth, Fe staining			

Machine borehole met target depth at 42 m bgl
Dip test showed standing groundwater at 1.5 m [04/03/2025 15:00]
Coordaintes and elevation estimated using Auckland Council GeoMaps.

Strengths inferred from shear vane, SPT and tactile assessment.
N/A = Not Assessed; NR = No Recovery
F = Fill

BOREHOLE LOG MBH01

Stage 2 Geotechnical Investigation
Forestry Road
Riverhead, Auckland
20190.000.001

Client : Rangitoopuni Developments **Core Diameter** : 64 mm
Date : 03-03-2025 **Energy Transfer Ratio** : 97.1%
Hole Depth : 42 m **Logged By/Reviewed By** : JM / HP
Drilling Method : Mud Rotary **Latitude** : -36.7505189
Drilling Contractor : McMillan Drilling Group Ltd **Longitude** : 174.5843713

Material	DESCRIPTION	Log Symbol	Strength	Depth (m BGL)	Elevation (mRL)	SPT N-Value / Vane Shear Strength	Sample Type	TCR (%)	RQD (%)	Defect Description	Moisture	Water Level	Piezometer Construction
EAST COAST BAYS FORMATION	Silty fine to coarse SAND; light brownish grey with occasional orange staining. Well graded. (Completely weathered, SANDSTONE; extremley weak.) 38.35 - 38.5 m - With moderately inclined, thin to moderately thin, very closely spaced beds of highly weathered, dark grey SILTSTONE; very weak. 38.5 m - Becomes orange.		VW	38	48					38.5 m: Drilling induced bedding parting			
	39.65 - 39.85 m - With moderately inclined, thin to moderately thin, very closely spaced beds of highly weathered, dark grey SILTSTONE; very weak. 39.85 m - Becomes light brownish grey and siltstone beds become closely spaced to moderately widely spaced.		D	39	47					39.7 m: Bedding parting Drilling induced bedding parting with Fe staining	N/A		
	40.6 m - With orange staining.			40	46								
	40.9 - 41.25 m - With moderately inclined, thin to moderately thin, very closely spaced to closely spaced beds of highly weathered, dark grey SILTSTONE; very weak. 41.25 m - Becomes orange with dark orange, thinly laminated, moderately inclined bands.			41	45								
	41.7 m - With moderately inclined, thin to moderately thin, very closely spaced to closely spaced beds of highly weathered, dark grey SILTSTONE; very weak.			42	44								
	End of Hole Depth: 42 m Termination: met target depth												

Machine borehole met target depth at 42 m bgl
Dip test showed standing groundwater at 1.5 m [04/03/2025 15:00]
Coordaintes and elevation estimated using Auckland Council GeoMaps.

Strengths inferred from shear vane, SPT and tactile assessment.
N/A = Not Assessed; NR = No Recovery
F = Fill

GEOTECH MACHINE BOREHOLE - ROCK MBH06-07.GPJ NZ DATA TEMPLATE 2.GDT 23/03/25

BOREHOLE LOG MBH02

Stage 2 Geotechnical Investigation
Forestry Road
Riverhead, Auckland
20190.000.001

Client : Rangitoopuni Developments **Core Diameter** : 64 mm
Date : 21-02-2025 **Energy Transfer Ratio** : 93.9%
Hole Depth : 25.8 m **Logged By/Reviewed By** : JS / HP
Drilling Method : Mud Rotary **Latitude** : -36.7466927
Drilling Contractor : McMillan Drilling Group Ltd **Longitude** : 174.5791481

Material	DESCRIPTION	Log Symbol	Strength	Depth (m BGL)	Elevation (mRL)	SPT N-Value / Vane Shear Strength	Sample Type	TCR (%)	RQD (%)	Defect Description	Moisture	Water Level	Piezometer Construction
FILL	0 - 0.7 m: No Recovery (Inferred as below).	NR	N/A								N/A		
FILL	[FILL] Organic clayey SILT with minor roots and trace gravel; dark brown. Low plasticity; gravel is fine to medium, sub-angular to angular greywacke.		F-St		1 50						M		
FILL	[FILL] Clayey SILT with trace sand; brownish orange with grey streaks. Low plasticity; sand is fine to medium.		St										
EAST COAST BAYS FORMATION	Silty CLAY with trace sand; light grey with orange and dark pink streaks High plasticity; sand is fine.		St			75/34 kPa 1.1/1.1.2.2 N=6							
EAST COAST BAYS FORMATION	1.95-2.30: No Recovery.				2 49						N/A		
EAST COAST BAYS FORMATION	2.5 m: With minor fine to medium sand.												
EAST COAST BAYS FORMATION	Clayey SILT with minor sand; light grey with dark pink and orange streaks. Low plasticity; sand is fine to medium.		VSt		3 48	118/47 kPa 1.1/1.1.2.2 N=6					M		
EAST COAST BAYS FORMATION	3.45-3.70 m: With occasional dark brownish orange streaks (limonite staining).												
EAST COAST BAYS FORMATION	4.1 m: Lens of silty fine to coarse SAND with trace gravel; grey with white specks. Well graded; gravel is fine, sub-rounded hard siltstone clasts.	NR	N/A		4 47						N/A		
EAST COAST BAYS FORMATION	4.15-4.50 m: No Recovery.												
EAST COAST BAYS FORMATION	Silty CLAY; orange with pink and light grey streaks. High plasticity.		St			0.0/0.1.1.1 N=3					M		
EAST COAST BAYS FORMATION	4.85-4.95 m: Lens of clayey SILT with minor sand; light grey. Low plasticity; sand is fine to medium.				5 46								

Machine borehole met target depth at 25.8 m bgl.
Dip test showed standing water at 8.8 m depth on 18/02/2025 at 0800hrs.
Coordinates and Elevation estimated using Auckland Council GeoMaps.

Strengths inferred from shear vane, SPT and tactile assessment.
N/A = Not Applicable; NR = No Recovery; F = Fill.
AC = Albany Conglomerate

GEOTECH MACHINE BOREHOLE - ROCK MBH.GPJ NZ DATA TEMPLATE 2.GDT 23/03/25

BOREHOLE LOG MBH02

Stage 2 Geotechnical Investigation
Forestry Road
Riverhead, Auckland
20190.000.001

Client : Rangitoopuni Developments **Core Diameter** : 64 mm
Date : 21-02-2025 **Energy Transfer Ratio** : 93.9%
Hole Depth : 25.8 m **Logged By/Reviewed By** : JS / HP
Drilling Method : Mud Rotary **Latitude** : -36.7466927
Drilling Contractor : McMillan Drilling Group Ltd **Longitude** : 174.5791481

Material	DESCRIPTION	Strength	Depth (m BGL)	Elevation (mRL)	SPT N-Value / Vane Shear Strength	Sample Type	TCR (%)	RQD (%)	Defect Description	Moisture	Water Level
EAST COAST BAYS FORMATION	Clayey SILT with minor sand; light grey with orange and pink streaks. Low plasticity; sand is fine to medium.	VSt	6	45	0.1/2.1.2.2 N=7						
	6.05 m: With some fine to medium sand.										
AC	Sandy SILT with trace clay and gravel; bluish grey with white specks and black carbonaceous inclusions. Low plasticity; sand is fine to coarse; gravel is fine to medium, rounded to sub-rounded hard siltstone clasts. Chaotic fabric with discontinous lenses of silty clay.	VSt	7	44							
EAST COAST BAYS FORMATION	Clayey SILT with minor sand; grey with dark orange streaks. Low plasticity; sand is fine.				1.0/2.3.3.4 N=12						
	7.4 m: With some fine to coarse sand. Becomes dark orange.										
	7.95 m: With minor fine to medium sand.	VSt - H	8	43						M	
	8.30-8.35 m: With trace fine, sub-angular hard limonite concretions and dark brownish orange staining.										
	Silty fine to coarse SAND with trace clay; dark grey with dark orange staining. Well graded.	MD	9	42	2.2/4.4.5.6 N=19						
	Sandy SILT with minor clay; dark grey. Low plasticity; sand is fine to medium.	H	10	41							
	Silty fine to coarse SAND with trace clay; dark grey. Well graded.	MD			2.3/3.3.4.5 N=15						

Machine borehole met target depth at 25.8 m bgl.
Dip test showed standing water at 8.8 m depth on 18/02/2025 at 0800hrs.
Coordinates and Elevation estimated using Auckland Council GeoMaps.

Strengths inferred from shear vane, SPT and tactile assessment.
N/A = Not Applicable; NR = No Recovery; F = Fill.
AC = Albany Conglomerate

GEOTECH MACHINE BOREHOLE - ROCK MBH.GPJ NZ DATA TEMPLATE 2.GDT 23/03/25

BOREHOLE LOG MBH02

Stage 2 Geotechnical Investigation
Forestry Road
Riverhead, Auckland
20190.000.001

Client : Rangitoopuni Developments **Core Diameter** : 64 mm
Date : 21-02-2025 **Energy Transfer Ratio** : 93.9%
Hole Depth : 25.8 m **Logged By/Reviewed By** : JS / HP
Drilling Method : Mud Rotary **Latitude** : -36.7466927
Drilling Contractor : McMillan Drilling Group Ltd **Longitude** : 174.5791481

Material	DESCRIPTION	Log Symbol	Strength	Depth (m BGL)	Elevation (mRL)	SPT N-Value / Vane Shear Strength	Sample Type	TCR (%)	RQD (%)	Defect Description	Moisture	Water Level	Piezometer Construction
EAST COAST BAYS FORMATION	Silty fine to coarse SAND with trace clay; dark grey. Well graded.		MD	11	40	2.3/3.3.4.5 N=15							
	Clayey SILT; dark grey. Low plasticity. Interbedded with: Sandy SILT with minor clay; dark grey. Low plasticity; sand is fine to medium. Beds are sub-horizontal to gently inclined, thin, very closely spaced to closely spaced.		H	12	39								
	Silty fine to coarse SAND with trace clay; dark grey with occasional white specks. Well graded.		MD			3.4/4.5.5.5 N=19							
	12.9 m: With trace fine, sub-rounded to sub-angular hard sedimentary clasts. 13.2 m: Sand becomes fine to medium. 13.35-13.40 m: With black carbonaceous laminations and specks.			13	38								
	Silty fine to medium SAND with trace clay; dark grey with black carbonaceous laminations and specks. Poorly graded. Beds are sub-horizontal, moderately thin to moderately thick. Interbedded with: Clayey SILT; dark grey. Low plasticity. Beds are sub-horizontal, thin to moderately thin.		D	14	37	5.6/8.8.10.12 N=38					M		
	Clayey SILT; dark grey. Low plasticity. Interbedded with: Sandy SILT with minor clay; dark grey. Low plasticity; sand is fine to medium. Beds are sub-horizontal, very thin, very closely spaced.		H	15	36								
	Silty fine to coarse SAND; dark grey with occasional white specks. Well graded.		MD			4.4/5.5.5.9 N=24							
	15.85 m: Sand becomes fine to medium. White specks cease. 15.90-15.95 m: Lens of clayey SILT; dark grey. Low plasticity.			16	35								

Machine borehole met target depth at 25.8 m bgl.
Dip test showed standing water at 8.8 m depth on 18/02/2025 at 0800hrs.
Coordinates and Elevation estimated using Auckland Council GeoMaps.

Strengths inferred from shear vane, SPT and tactile assessment.
N/A = Not Applicable; NR = No Recovery; F = Fill.
AC = Albany Conglomerate

GEOTECH MACHINE BOREHOLE - ROCK MBH.GPJ NZ DATA TEMPLATE 2.GDT 23/03/25

BOREHOLE LOG MBH02

Stage 2 Geotechnical Investigation
Forestry Road
Riverhead, Auckland
20190.000.001

Client : Rangitoopuni Developments **Core Diameter** : 64 mm
Date : 21-02-2025 **Energy Transfer Ratio** : 93.9%
Hole Depth : 25.8 m **Logged By/Reviewed By** : JS / HP
Drilling Method : Mud Rotary **Latitude** : -36.7466927
Drilling Contractor : McMillan Drilling Group Ltd **Longitude** : 174.5791481

Material	DESCRIPTION	Log Symbol	Strength	Depth (m BGL)	Elevation (mRL)	SPT N-Value / Vane Shear Strength	Sample Type	TCR (%)	RQD (%)	Defect Description	Moisture	Water Level	Piezometer Construction
EAST COAST BAYS FORMATION	15.95 m: With occasional black carbonaceous laminations. Silty fine to coarse SAND; dark grey with occasional white specks. Well graded.		MD			4.6/7.7.8.8 N=30							
	Clayey SILT; dark grey. Low plasticity. Interbedded with: Silty fine to coarse SAND; dark grey with white specks. Well graded. Beds are sub-horizontal, very closely spaced to closely spaced.		H	17	34								
	Silty fine to medium SAND with trace clay; dark grey. Poorly graded. 17.9 m: Sand becomes fine to coarse.		MD	18	33	4.5/6.5.7.7 N=25					M		
	Clayey SILT with trace sand; dark grey with black carbonaceous inclusions. Low plasticity; sand is fine.		H	19	32	4.5/5.6.6.6 N=23							
	Silty fine to coarse SAND with trace clay; dark grey with occasional black carbonaceous laminations. Well graded.		D	20	31	5.5/7.8.8.10 N=33							
				21	30								

Machine borehole met target depth at 25.8 m bgl.
Dip test showed standing water at 8.8 m depth on 18/02/2025 at 0800hrs.
Coordinates and Elevation estimated using Auckland Council GeoMaps.

Strengths inferred from shear vane, SPT and tactile assessment.
N/A = Not Applicable; NR = No Recovery; F = Fill.
AC = Albany Conglomerate

GEOTECH MACHINE BOREHOLE - ROCK MBH.GPJ NZ DATA TEMPLATE 2.GDT 23/03/25

BOREHOLE LOG MBH02

Stage 2 Geotechnical Investigation
Forestry Road
Riverhead, Auckland
20190.000.001

Client : Rangitoopuni Developments **Core Diameter** : 64 mm
Date : 21-02-2025 **Energy Transfer Ratio** : 93.9%
Hole Depth : 25.8 m **Logged By/Reviewed By** : JS / HP
Drilling Method : Mud Rotary **Latitude** : -36.7466927
Drilling Contractor : McMillan Drilling Group Ltd **Longitude** : 174.5791481

Material	DESCRIPTION	Log Symbol	Strength	Depth (m BGL)	Elevation (mRL)	SPT N-Value / Vane Shear Strength	Sample Type	TCR (%) 25 50 75	RQD (%) 25 50 75	Defect Description	Moisture	Water Level	Piezometer Construction
	Silty fine to coarse SAND with trace clay; dark grey. Well graded. Interbedded with: Clayey SILT; dark grey. Low plasticity. [Highly weathered, dark grey SILTSTONE; extremely weak.] Beds are sub-horizontal, thin to moderately thin, closely spaced to moderately widely spaced.		D - VD	22	29	8.4/14.14.16.6 for 35 mm N=50+					M		
EAST COAST BAYS FORMATION	Moderately weathered, dark grey, fine to coarse SANDSTONE with occasional black carbonaceous laminations; very weak. Interbedded with: Slightly weathered, dark grey SILTSTONE; very weak. Beds are sub-horizontal to gently inclined, thin to moderately thin, closely spaced to moderately widely spaced.		VW	23 24 25	28 27 26	4.4/11.19.20 for 58 mm N=50+ 9.23/37.13 for 35 mm N=50+				23.25 m: Gently-inclined bedding parting; undulating, smooth, narrow. 23.35 m: Sub-horizontal joint; stepped, smooth, moderately narrow. 24.9 m: Gently-inclined joint; undulating, rough, narrow. 25 m: Gently-inclined bedding parting; undulating, smooth, narrow.	N/A		

End of Hole Depth: 25.8 m
Termination: met target depth

Machine borehole met target depth at 25.8 m bgl.
Dip test showed standing water at 8.8 m depth on 18/02/2025 at 0800hrs.
Coordinates and Elevation estimated using Auckland Council GeoMaps.

Strengths inferred from shear vane, SPT and tactile assessment.
N/A = Not Applicable; NR = No Recovery; F = Fill.
AC = Albany Conglomerate

GEOTECH MACHINE BOREHOLE - ROCK MBH.GPJ NZ DATA TEMPLATE 2.GDT 23/03/25

BOREHOLE LOG MBH03

Stage 2 Geotechnical Investigation
Forestry Road
Riverhead, Auckland
20190.000.001

Client : Rangitoopuni Developments
Date : 21-02-2025
Hole Depth : 37.5 m
Drilling Method : Mud Rotary
Drilling Contractor : McMillan Drilling Group Ltd
Core Diameter : 64 mm
Energy Transfer Ratio :
Logged By/Reviewed By : JS / HP
Latitude : -36.7497249
Longitude : 174.5795821

Material	DESCRIPTION	Log Symbol	Strength	Depth (m BGL)	Elevation (mRL)	SPT N-Value / Vane Shear Strength	Sample Type	TCR (%)	RQD (%)	Defect Description	Moisture	Water Level	Piezometer Construction
FILL	0.00-0.75 m: No Recovery (Inferred washout of gravelly material).	NR	N/A								N/A		
	[FILL] Silty CLAY with trace gravel; light orange-brown with dark orange mottles. High plasticity; gravel is fine, sub-angular greywacke.		VSt		62								
EAST COAST BAYS FORMATION	Silty CLAY; light grey with orange and dark pink streaks. High plasticity. Beds are sub-horizontal, moderately thin. Interbedded with: Clayey SILT with minor sand; light brownish orange. Low plasticity; sand is fine to medium. Beds are sub-horizontal, very thin to thin. 1.50-1.95 m: No Recovery.		F - St	1 2	61	2.2/2.2.2.1 N=7					M N/A		
	Clayey SILT with some sand; light grey with orange mottles. Low plasticity; sand is fine to medium.		St		60								
	Silty CLAY with minor sand; light grey with orange streaks. High plasticity; sand is fine to medium. 3.0 m: Becomes light grey with pink streaks.		VSt	3		0.1/1.1.1.1 N=4					M		
	Clayey SILT with minor sand; light grey with orange and pink streaks. Low plasticity; sand is fine to medium.		VSt		59								
	Silty CLAY trace sand; light grey with orange and pink streaks. High plasticity; sand is fine to medium. 4.4 m: With minor fine to medium sand.		VSt	4								▼	
	Clayey SILT with minor sand; light grey with pink and orange streaks. Low plasticity; sand is fine to medium.				58	0.0/1.1.1.2 N=5							
	4.95-5.10 m: Lens of silty CLAY; light grey with pink streaks. High plasticity.		VSt	5									

Machine borehole met target depth at 37.5 m bgl.
Dip test showed standing water at 4.35 m depth on 20/02/2025 at 0800hrs
N/A = Not Applicable; NR = No Recovery; F = Fill.
Strengths inferred from shear vane, SPT and tactile assessment.
Coordinates and Elevation estimated using Auckland Council GeoMaps.

GEOTECH MACHINE BOREHOLE - ROCK MBH.GPJ NZ DATA TEMPLATE 2.GDT 3/24/25

BOREHOLE LOG MBH03

Stage 2 Geotechnical Investigation
Forestry Road
Riverhead, Auckland
20190.000.001

Client : Rangitoopuni Developments
Date : 21-02-2025
Hole Depth : 37.5 m
Drilling Method : Mud Rotary
Drilling Contractor : McMillan Drilling Group Ltd
Core Diameter : 64 mm
Energy Transfer Ratio :
Logged By/Reviewed By : JS / HP
Latitude : -36.7497249
Longitude : 174.5795821

Material	DESCRIPTION	Log Symbol	Strength	Depth (m BGL)	Elevation (mRL)	SPT N-Value / Vane Shear Strength	Sample Type	TCR (%)	RQD (%)	Defect Description	Moisture	Water Level	Piezometer Construction
EAST COAST BAYS FORMATION	Clayey SILT with minor sand; light grey with pink and orange streaks. Low plasticity; sand is fine to medium. 5.5 m: With some fine to medium sand. Becomes orange with light grey streaks.		VSt	6	57								
	Clayey SILT; dark grey. Low plasticity. Beds are sub-horizontal; moderately thin to moderately thick. Intebedded with: Silty fine to coarse SAND with trace clay; dark grey. Well graded. Beds are sub-horizontal; thin to moderately thin.		VSt - H	7	56	0.1/1.1.2.2 N=6					M		
				8	55	0.1/1.2.2.2 N=7							
				9	54	0.1/2.2.2.3 N=9							
	9.45-9.80 m: No Recovery.			10	53						N/A		
					52	1.1/1.2.3.2 N=8					M		

Machine borehole met target depth at 37.5 m bgl.
Dip test showed standing water at 4.35 m depth on 20/02/2025 at 0800hrs.
N/A = Not Applicable; NR = No Recovery; F = Fill.
Strengths inferred from shear vane, SPT and tactile assessment.
Coordinates and Elevation estimated using Auckland Council GeoMaps.

GEOTECH MACHINE BOREHOLE - ROCK MBH.GPJ NZ DATA TEMPLATE 2.GDT 3/24/25

BOREHOLE LOG MBH03

Stage 2 Geotechnical Investigation
Forestry Road
Riverhead, Auckland
20190.000.001

Client : Rangitoopuni Developments
Date : 21-02-2025
Hole Depth : 37.5 m
Drilling Method : Mud Rotary
Drilling Contractor : McMillan Drilling Group Ltd
Core Diameter : 64 mm
Energy Transfer Ratio :
Logged By/Reviewed By : JS / HP
Latitude : -36.7497249
Longitude : 174.5795821

Material	DESCRIPTION	Log Symbol	Strength	Depth (m BGL)	Elevation (mRL)	SPT N-Value / Vane Shear Strength	Sample Type	TCR (%)	RQD (%)	Defect Description	Moisture	Water Level	Piezometer Construction
EAST COAST BAYS FORMATION	Clayey SILT; dark grey. Low plasticity. Beds are sub-horizontal; moderately thin to moderately thick. Intebedded with: Silty fine to coarse SAND with trace clay; dark grey. Well graded. Beds are sub-horizontal; thin to moderately thin.		VSt - H	11	51	1.1/1.2.3.2 N=8		25 50 75	25 50 75				
	Sandy SILT with minor clay; dark grey. Low plasticity; sand is fine to medium. Beds are sub-horizontal, moderately thin to moderately thick. Interbedded with: Clayey SILT with trace sand; dark grey. Low plasticity; sand is fine. Beds are sub-horizontal, thin to moderately thin		H	12	50	0.2/2.2.3.2 N=9					M		
				13	49	1.2/2.2.2.3 N=9							
				14	48								
	Silty fine to coarse SAND with trace clay; dark grey. Well graded.		L	15	47	0.2/2.1.2.3 N=8							
			H	16									

Machine borehole met target depth at 37.5 m bgl.
Dip test showed standing water at 4.35 m depth on 20/02/2025 at 0800hrs
N/A = Not Applicable; NR = No Recovery; F = Fill.
Strengths inferred from shear vane, SPT and tactile assessment.
Coordinates and Elevation estimated using Auckland Council GeoMaps.

GEOTECH MACHINE BOREHOLE - ROCK MBH.GPJ NZ DATA TEMPLATE 2.GDT 3/24/25

BOREHOLE LOG MBH03

Stage 2 Geotechnical Investigation
Forestry Road
Riverhead, Auckland
20190.000.001

Client : Rangitoopuni Developments
Date : 21-02-2025
Hole Depth : 37.5 m
Drilling Method : Mud Rotary
Drilling Contractor : McMillan Drilling Group Ltd
Core Diameter : 64 mm
Energy Transfer Ratio :
Logged By/Reviewed By : JS / HP
Latitude : -36.7497249
Longitude : 174.5795821

Material	DESCRIPTION	Log Symbol	Strength	Depth (m BGL)	Elevation (mRL)	SPT N-Value / Vane Shear Strength	Sample Type	TCR (%)	RQD (%)	Defect Description	Moisture	Water Level	Piezometer Construction
EAST COAST BAYS FORMATION	Clayey SILT; dark grey. Low plasticity. Beds are sub-horizontal, moderately thin to moderately thick. Interbedded with: Sandy SILT with some clay; dark grey. Low plasticity; sand is fine to medium. Beds are sub-horizontal, very thin to thin. 17.3 m: With black carbonaceous lamination.		H	17	46	0.3/3.3.3.4 N=13		25 50 75	25 50 75				
	Clayey SILT; dark grey with occasional black carbonaceous laminations. Low plasticity. Beds are sub-horizontal, thin to moderately thin. Interbedded with: Silty fine to coarse SAND with trace clay; dark grey. Well graded. Beds are sub-horizontal, thin to moderately thin.		H	18	45	2.2/3.3.3.5 N=14					M		
	Silty fine to coarse SAND; dark grey. Well graded. Beds are sub-horizontal to gently inclined, moderately thin to moderately thick. Interbedded with: Clayey SILT; dark grey. Low plasticity. Beds are sub-horizontal to gently inclined, very thin to thin. 19.50-19.95 m: No Recovery.		MD	19	44								
				20	43	1.1/3.3.4.4 N=14					N/A		
				21	42	2.3/4.4.5.5 N=18					M		

Machine borehole met target depth at 37.5 m bgl.
Dip test showed standing water at 4.35 m depth on 20/02/2025 at 0800hrs.
N/A = Not Applicable; NR = No Recovery; F = Fill.
Strengths inferred from shear vane, SPT and tactile assessment.
Coordinates and Elevation estimated using Auckland Council GeoMaps.

GEOTECH MACHINE BOREHOLE - ROCK MBH.GPJ NZ DATA TEMPLATE 2.GDT 3/24/25

BOREHOLE LOG MBH03

Stage 2 Geotechnical Investigation
Forestry Road
Riverhead, Auckland
20190.000.001

Client : Rangitoopuni Developments
Date : 21-02-2025
Hole Depth : 37.5 m
Drilling Method : Mud Rotary
Drilling Contractor : McMillan Drilling Group Ltd
Core Diameter : 64 mm
Energy Transfer Ratio :
Logged By/Reviewed By : JS / HP
Latitude : -36.7497249
Longitude : 174.5795821

Material	DESCRIPTION	Log Symbol	Strength	Depth (m BGL)	Elevation (mRL)	SPT N-Value / Vane Shear Strength	Sample Type	TCR (%)	RQD (%)	Defect Description	Moisture	Water Level	Piezometer Construction
EAST COAST BAYS FORMATION	Silty fine to coarse SAND; dark grey. Well graded. Beds are sub-horizontal to gently inclined, moderately thin to moderately thick. Interbedded with: Clayey SILT; dark grey. Low plasticity. Beds are sub-horizontal to gently inclined, very thin to thin.		MD	22	41			25 50 75	25 50 75				
				23	40	2.3/3.4.4.6 N=17							
				24	39								
			MD			3.4/4.4.5.5 N=18					M		
	25.40-25.45: With black carbonaceous laminations and specks.			25	38								
				26	37	4.5/5.6.7.7 N=25							
	26.5 m: With black carbonaceous laminations and specks.												
	Silty fine to coarse SAND with trace clay; dark grey with occasional black carbonaceous specks. Well graded.		MD	27	36								

Machine borehole met target depth at 37.5 m bgl.
Dip test showed standing water at 4.35 m depth on 20/02/2025 at 0800hrs
N/A = Not Applicable; NR = No Recovery; F = Fill.

Strengths inferred from shear vane, SPT and tactile assessment.
Coordinates and Elevation estimated using Auckland Council GeoMaps.

GEOTECH MACHINE BOREHOLE - ROCK MBH.GPJ NZ DATA TEMPLATE 2.GDT 3/24/25

BOREHOLE LOG MBH03

Stage 2 Geotechnical Investigation
Forestry Road
Riverhead, Auckland
20190.000.001

Client : Rangitoopuni Development **Core Diameter** : 64 mm
Date : 21-02-2025 **Energy Transfer Ratio** :
Hole Depth : 37.5 m **Logged By/Reviewed By** : JS / HP
Drilling Method : Mud Rotary **Latitude** : -36.7497249
Drilling Contractor : McMillan Drilling Group Ltd **Longitude** : 174.5795821

Material	DESCRIPTION	Log Symbol	Strength	Depth (m BGL)	Elevation (mRL)	SPT N-Value / Vane Shear Strength	Sample Type	TCR (%) 25 50 75	RQD (%) 25 50 75	Defect Description	Moisture	Water Level	Piezometer Construction
EAST COAST BAYS FORMATION	Silty fine to coarse SAND with trace clay; dark grey with occasional black carbonaceous specks. Well graded.		MD		35	3.2/3.5.6.6 N=20							
	Sandy SILT with trace clay; dark grey. Low plasticity; sand is fine to medium. Beds are sub-horizontal, moderately thin. Interbedded with: Clayey SILT with trace sand; dark grey with occasional black carbonaceous laminations. Low plasticity; sand is fine. Beds are sub-horizontal, very thin to thin.		MD	28									
	Silty fine to coarse SAND with trace clay; dark grey. Well graded. 29.25-29.55 m: With trace fine, sub-rounded to sub-angular hard sedimentary clasts.		MD	29	34	4.3/5.3.4.4 N=16					M		
				30	33	3.3/4.4.6.6 N=20							
				31	32	3.4/3.4.5.5 N=17							
				32	31								

Machine borehole met target depth at 37.5 m bgl.
Dip test showed standing water at 4.35 m depth on 20/02/2025 at 0800hrs
N/A = Not Applicable; NR = No Recovery; F = Fill.

Strengths inferred from shear vane, SPT and tactile assessment.
Coordinates and Elevation estimated using Auckland Council GeoMaps.

GEOTECH MACHINE BOREHOLE - ROCK MBH.GPJ NZ DATA TEMPLATE 2.GDT 3/24/25

BOREHOLE LOG MBH03

Stage 2 Geotechnical Investigation
Forestry Road
Riverhead, Auckland
20190.000.001

Client : Rangitoopuni Developments **Core Diameter** : 64 mm
Date : 21-02-2025 **Energy Transfer Ratio** :
Hole Depth : 37.5 m **Logged By/Reviewed By** : JS / HP
Drilling Method : Mud Rotary **Latitude** : -36.7497249
Drilling Contractor : McMillan Drilling Group Ltd **Longitude** : 174.5795821

Material	DESCRIPTION	Log Symbol	Strength	Depth (m BGL)	Elevation (mRL)	SPT N-Value / Vane Shear Strength	Sample Type	TCR (%)	RQD (%)	Defect Description	Moisture	Water Level	Piezometer Construction
EAST COAST BAYS FORMATION	Silty fine to coarse SAND with trace clay; dark grey. Well graded. 33.15-33.2 m: With black carbonaceous specks. 35.6-35.9 m: With trace fine, sub-rounded to sub-angular hard sedimentary clasts.		MD	33 34 35 36	30 29 28 27			25 50 75	25 50 75		M		
	Silty fine to coarse SAND; dark grey. Well graded. [Highly weathered, dark grey, fine to coarse SANDSTONE; extremely weak].		D	37	26								
	End of Hole Depth: 37.5 m Termination: met target depth												

Machine borehole met target depth at 37.5 m bgl.
Dip test showed standing water at 4.35 m depth on 20/02/2025 at 0800hrs
N/A = Not Applicable; NR = No Recovery; F = Fill.
Strengths inferred from shear vane, SPT and tactile assessment.
Coordinates and Elevation estimated using Auckland Council GeoMaps.

GEOTECH MACHINE BOREHOLE - ROCK MBH.GPJ NZ DATA TEMPLATE 2.GDT 3/24/25

BOREHOLE LOG MBH04

Stage 2 Geotechnical Investigation
Forestry Road
Riverhead, Auckland
20190.000.001

Client : Rangitoopuni Developments **Core Diameter** : 64 mm
Date : 06-03-2025 **Energy Transfer Ratio** : 97.1%
Hole Depth : 16.5 m **Logged By/Reviewed By** : JM / HP
Drilling Method : Mud Rotary **Latitude** : -36.7509991
Drilling Contractor : McMillan Drilling Group Ltd **Longitude** : 174.578719

Material	DESCRIPTION	Log Symbol	Strength	Depth (m BGL)	Elevation (mRL)	SPT N-Value / Vane Shear Strength	Sample Type	TCR (%)	RQD (%)	Defect Description	Moisture	Water Level	Piezometer Construction
TAKAANINI FORMATION	Clayey SILT; grey with orange mottles. Low plasticity. 0.4 m - With minor fine to medium sand.		H	0	44								
	Sandy SILT; grey with occasional orange mottles. Low plasticity. Sand is fine to coarse. 1 - 1.5 m - No recovery.		H	1	43	UTP 1/2//1/1/3/2 N=7							
	1.95 -3 m - No recovery.	NR	N/A	2	42						M		
	Sandy SILT with minor clay; dark grey. Low plasticity. Sand is fine to coarse. Interbedded with Silty CLAY; dark grey. High plasticity. Beds are sub-horizontal, moderately thin, moderately widely spaced. 4.3 - 4.35 m - Encountered organic CLAY.		F	3 4	41 40	0/0//0/0/2/1 N=3 37/22 kPa						▼	
	Silty CLAY with some organics; dark blackish grey. High plasticity. Organics are amorphous. 5.05 - 5.2 m - Encountered organic CLAY.		F	5	39	0/0//0/0/0/0 N=0							

Machine borehole met target depth at 16.5 m bgl
Dip test showed standing groundwater at 3.25 m bgl [05/03/2025 15:00]
Coordaintes and elevation estimated using Auckland Council GeoMaps.

Strengths inferred from shear vane, SPT and tactile assessment.
N/A = Not Assessed; NR = No Recovery
UTP = Unable to Penetrate

GEOTECH MACHINE BOREHOLE - ROCK MBH06-07.GPJ NZ DATA TEMPLATE 2.GDT 23/03/25

BOREHOLE LOG MBH04

Stage 2 Geotechnical Investigation
Forestry Road
Riverhead, Auckland
20190.000.001

Client : Rangitoopuni Developments **Core Diameter** : 64 mm
Date : 06-03-2025 **Energy Transfer Ratio** : 97.1%
Hole Depth : 16.5 m **Logged By/Reviewed By** : JM / HP
Drilling Method : Mud Rotary **Latitude** : -36.7509991
Drilling Contractor : McMillan Drilling Group Ltd **Longitude** : 174.578719

Material	DESCRIPTION	Log Symbol	Strength	Depth (m BGL)	Elevation (mRL)	SPT N-Value / Vane Shear Strength	Sample Type	TCR (%)	RQD (%)	Defect Description	Moisture	Water Level	Piezometer Construction
TAKAANINI FORMATION	Silty CLAY with some organics; dark blackish grey. High plasticity. Organics are amorphous. 5.5 - 5.25 m - Encountered organic CLAY.		F	6	38	32/15 kPa							
	Clayey SILT with minor sand and trace organics; dark grey. Low plasticity. Sand is fine to medium. Organics are amorphous.		F	7	37	0/0//0/0/0/1 N=1							
EAST COAST BAYS FORMATION	Silty fine to coarse SAND; dark grey. Well graded.		MD										
	7.25 - 7.5 m - No recovery.	NR	N/A										
	Sandy SILT with trace gravel; dark grey with bluish green specks. Low plasticity. Sand is fine to coarse; gravel is fine crushable, rounded siltstone clasts.		H	8	36	2/4//5/5/6/7 N=23					M		
	Clayey SILT with trace sand; dark grey with occasional black carbonaceous inclusions. Low plasticity. Sand is fine.		H	9	35	2/3//5/4/7/8 N=24							
	Sandy SILT with minor clay; dark grey. Low plasticity. Interbedded with Clayey SILT; dark grey. Low plasticity. Beds are gently inclined, moderately thin, moderately widely spaced.		H	10	34	4/4//7/8/9/14 N=38							

Machine borehole met target depth at 16.5 m bgl
Dip test showed standing groundwater at 3.25 m bgl [05/03/2025 15:00]
Coordaintes and elevation estimated using Auckland Council GeoMaps.

Strengths inferred from shear vane, SPT and tactile assessment.
N/A = Not Assessed; NR = No Recovery
UTP = Unable to Penetrate

GEOTECH MACHINE BOREHOLE - ROCK MBH06-07.GPJ NZ DATA TEMPLATE 2.GDT 23/03/25

BOREHOLE LOG MBH04

Stage 2 Geotechnical Investigation
Forestry Road
Riverhead, Auckland
20190.000.001

Client : Rangitoopuni Developments **Core Diameter** : 64 mm
Date : 06-03-2025 **Energy Transfer Ratio** : 97.1%
Hole Depth : 16.5 m **Logged By/Reviewed By** : JM / HP
Drilling Method : Mud Rotary **Latitude** : -36.7509991
Drilling Contractor : McMillan Drilling Group Ltd **Longitude** : 174.578719

Material	DESCRIPTION	Log Symbol	Strength	Depth (m BGL)	Elevation (mRL)	SPT N-Value / Vane Shear Strength	Sample Type	TCR (%)	RQD (%)	Defect Description	Moisture	Water Level	Piezometer Construction
			H	11	33	4/4//7/8/9/14 N=38					M		
EAST COAST BAYS FORMATION	Silty fine to coarse SAND; dark grey. Well graded. (Completely weathered SANDSTONE; extremely weak.)		D										
	Silty fine to coarse SAND; dark grey. Well graded. (Completely weathered, SANDSTONE; extremely weak.)		H										
	Interbedded with Clayey SILT; dark grey. Low plasticity. (Completely weathered, dark grey SILTSTONE; extremely weak. Beds are gently to moderately inclined, moderately thin, very closely spaced.)			12	32	5/12//12/16/17/ for 26 mm N=50+							
	Highly weathered, dark grey SILTSTONE; very weak. Interbedded with Silty fine to coarse SAND; dark grey. Well graded. (Completely weathered, SANDSTONE; extremely weak. Beds are moderately inclined, thin to moderately thin, extremely closely spaced to closely spaced.)		EW - VW	13	31					12.4-12.8 m: Drilling induced bedding partings; moderately inclined, smooth, planar, closely spaced			
	Moderately weathered, dark grey SILTSTONE; very weak. Interbedded with Moderately weathered, dark grey, fine to medium SANDSTONE; very weak. Beds are moderately inclined, thin, moderately widely spaced.		VW	14	30	7/29//46/4 for 6 mm N=50+				14.03-14.55 m: Drilling induced bedding partings; very closely spaced to closely spaced			
	16 m - Beds become very thin to thin and very closely spaced to closely spaced.			15	29	8/25//31/19 for 25 mm N=50+				15.75 m: Joint set; sub-vertical and sub-horizontal, planar, smooth 16.2 m: Joint; gently			
				16									

Machine borehole met target depth at 16.5 m bgl
Dip test showed standing groundwater at 3.25 m bgl [05/03/2025 15:00]
Coordaintes and elevation estimated using Auckland Council GeoMaps.

Strengths inferred from shear vane, SPT and tactile assessment.
N/A = Not Assessed; NR = No Recovery
UTP = Unable to Penetrate

GEOTECH MACHINE BOREHOLE - ROCK MBH06-07.GPJ NZ DATA TEMPLATE 2.GDT 23/03/25

BOREHOLE LOG MBH04

Stage 2 Geotechnical Investigation
Forestry Road
Riverhead, Auckland
20190.000.001

Client : Rangitoopuni Developments **Core Diameter** : 64 mm
Date : 06-03-2025 **Energy Transfer Ratio** : 97.1%
Hole Depth : 16.5 m **Logged By/Reviewed By** : JM / HP
Drilling Method : Mud Rotary **Latitude** : -36.7509991
Drilling Contractor : McMillan Drilling Group Ltd **Longitude** : 174.578719

Material	DESCRIPTION	Log Symbol	Strength	Depth (m BGL)	Elevation (mRL)	SPT N-Value / Vane Shear Strength	Sample Type	TCR (%) 25 50 75	RQD (%) 25 50 75	Defect Description	Moisture	Water Level	Piezometer Construction
		× ×	VW		28					inclined, planar, smooth, sand infill			

End of Hole Depth: 16.5 m
Termination: met target depth

Machine borehole met target depth at 16.5 m bgl
Dip test showed standing groundwater at 3.25 m bgl [05/03/2025 15:00]
Coordaintes and elevation estimated using Auckland Council GeoMaps.

Strengths inferred from shear vane, SPT and tactile assessment.
N/A = Not Assessed; NR = No Recovery
UTP = Unable to Penetrate

BOREHOLE LOG MBH05

Stage 2 Geotechnical Investigation
Forestry Road
Riverhead, Auckland
20190.000.001

Client : Rangitoopuni Developments **Core Diameter** : 64 mm
Date : 07-03-2025 **Energy Transfer Ratio** : 97.1%
Hole Depth : 19.5 m **Logged By/Reviewed By** : JM / HP
Drilling Method : Mud Rotary **Latitude** : -36.7480219
Drilling Contractor : McMillan Drilling Group Ltd **Longitude** : 174.5830162

Material	DESCRIPTION	Log Symbol	Strength	Depth (m BGL)	Elevation (mRL)	SPT N-Value / Vane Shear Strength	Sample Type	TCR (%)	RQD (%)	Defect Description	Moisture	Water Level	Piezometer Construction
FILL	[FILL] Fine to coarse GRAVEL with trace cobble and trace rootlets; dark grey. Well graded. Gravel and cobble are greywacke, angular.		N/A										
	[FILL] SILT with minor sand and trace gravel and trace organics; dark brown with occasional orange mottles. Low plasticity. Gravel is fine, angular greywacke. Organics are carbonaceous inclusions.		N/A		57								
	[FILL] SILT with minor clay and trace sand; light greyish brown with orange mottles. Low plasticity.		H			200+ kPa							
	0.5 - 1.5 m - No recovery.	NR	N/A	1	56								
UTF	SILT with minor sand and minor clay; light grey with orange mottles. Low plasticity. Sand is fine to medium.		VSt	2	55	1/0//1/2/2/1 N=6							
	Sandy SILT with trace clay; light grey with orange mottles. Low plasticity. Sand is fine to coarse.		St								M		
	2.65 - 3.0 m - No recovery.	NR	N/A	3	54	0/0//0/0/0/0 N=0						▼	
EAST COAST BAYS FORMATION	Sandy SILT with trace clay; light grey with orange mottles. Low plasticity. Sand is fine. Interbedded with SILT with minor sand and trace clay; orange. Low plasticity. Sand is fine. Beds are sub-horizontal, moderately thin to moderately thick and moderately widely spaced.		F - St	4	53								
	4.3 - 4.5 m - No recovery.	NR	N/A			74/37 kPa							
	SILT with some sand and minor clay; dark grey. Low plasticity. Sand is fine to medium.		St - VSt	5	52	0/2//2/2/2/3 N=9							

Machine borehole met target depth at 19.5 m bgl
Dip test showed standing groundwater at 3.4 m bgl [06/03/2025 15:00]
Coordaintes and elevation estimated using Auckland Council GeoMaps.

Strengths inferred from shear vane, SPT and tactile assessment.
N/A = Not Assessed; NR = No Recovery

GEOTECH MACHINE BOREHOLE - ROCK MBH06-07.GPJ NZ DATA TEMPLATE 2.GDT 23/03/25

BOREHOLE LOG MBH05

Stage 2 Geotechnical Investigation
Forestry Road
Riverhead, Auckland
20190.000.001

Client : Rangitoopuni Developments **Core Diameter** : 64 mm
Date : 07-03-2025 **Energy Transfer Ratio** : 97.1%
Hole Depth : 19.5 m **Logged By/Reviewed By** : JM / HP
Drilling Method : Mud Rotary **Latitude** : -36.7480219
Drilling Contractor : McMillan Drilling Group Ltd **Longitude** : 174.5830162

Material	DESCRIPTION	Log Symbol	Strength	Depth (m BGL)	Elevation (mRL)	SPT N-Value / Vane Shear Strength	Sample Type	TCR (%)	RQD (%)	Defect Description	Moisture	Water Level	Piezometer Construction
EAST COAST BAYS FORMATION	SILT with some sand and minor clay; dark grey. Low plasticity. Sand is fine to medium. 7.1 - 7.3 m - With some fine to coarse sand. 7.95 - 8.25 m - With some fine to coarse sand.		St - VSt	6 7 8	51 50 49	1/2//2/3/4/5 N=14 121/27 kPa 2/2//2/4/5/4 N=15					M		
	Sandy SILT with trace clay; dark grey. Low plasticity. Sand is fine to coarse. Interbedded with Clayey SILT with trace sand; dark grey. Low plasticity. Sand is fine. Beds are sub-horizontal to gently inclined, moderately thin, closely spaced to moderately widely spaced.		H	9 10	48 47	200+ kPa 3/3//5/5/5/5 N=20 UTP 3/3//5/7/8/10 N=30							

Machine borehole met target depth at 19.5 m bgl
Dip test showed standing groundwater at 3.4 m bgl [06/03/2025 15:00]
Coordaintes and elevation estimated using Auckland Council GeoMaps.

Strengths inferred from shear vane, SPT and tactile assessment.
N/A = Not Assessed; NR = No Recovery

GEOTECH MACHINE BOREHOLE - ROCK MBH06-07.GPJ NZ DATA TEMPLATE 2.GDT 23/03/25

BOREHOLE LOG MBH05

Stage 2 Geotechnical Investigation
Forestry Road
Riverhead, Auckland
20190.000.001

Client : Rangitoopuni Developments **Core Diameter** : 64 mm
Date : 07-03-2025 **Energy Transfer Ratio** : 97.1%
Hole Depth : 19.5 m **Logged By/Reviewed By** : JM / HP
Drilling Method : Mud Rotary **Latitude** : -36.7480219
Drilling Contractor : McMillan Drilling Group Ltd **Longitude** : 174.5830162

Material	DESCRIPTION	Log Symbol	Strength	Depth (m BGL)	Elevation (mRL)	SPT N-Value / Vane Shear Strength	Sample Type	TCR (%)	RQD (%)	Defect Description	Moisture	Water Level	Piezometer Construction
EAST COAST BAYS FORMATION	Silty fine to coarse SAND; dark grey. Well graded. Interbedded with Clayey SILT; dark grey. Low plasticity. (Completely weathered SILTSTONE; extremely weak.) Beds are gently inclined, thin to moderately thin, closely spaced.		D	11	46	3/3//5/7/8/10 N=30							
	Silty fine to coarse SAND; dark grey. Well graded.		VD	12	45	7/12//14/13/13/1 for 48 mm N=50+							
	Silty fine to coarse SAND; dark grey. Well graded. (Completely weathered SANDSTONE; extremley weak.) Interbedded with Moderately weathered, dark grey SILTSTONE; very weak. Beds are gently inclined to moderately inclined, thin, moderately widely spaced. 13.1 m - Siltstone beds become very widely spaced. 13.38 - 13.5 m - No recovery.		D - VD	13	44	10/14//16/18/1 for 64 mm N=50+				13.13 m: Drilling induced bedding parting with siltstone gravel infill	M		
				14	43								
	15.55 - 15.65 m - Siltstone beds become very closely spaced.			15	42	7/7//6/10/12/14 N=48				15.75 m: Drilling induced bedding parting			
	16 m - Siltstone beds become extremely closely spaced to closely spaced.			16						16 m: Drilling induced bedding parting			

Machine borehole met target depth at 19.5 m bgl
Dip test showed standing groundwater at 3.4 m bgl [06/03/2025 15:00]
Coordaintes and elevation estimated using Auckland Council GeoMaps.

Strengths inferred from shear vane, SPT and tactile assessment.
N/A = Not Assessed; NR = No Recovery

GEOTECH MACHINE BOREHOLE - ROCK MBH06-07.GPJ NZ DATA TEMPLATE 2.GDT 23/03/25

BOREHOLE LOG MBH05

Stage 2 Geotechnical Investigation
Forestry Road
Riverhead, Auckland
20190.000.001

Client : Rangitoopuni Developments **Core Diameter** : 64 mm
Date : 07-03-2025 **Energy Transfer Ratio** : 97.1%
Hole Depth : 19.5 m **Logged By/Reviewed By** : JM / HP
Drilling Method : Mud Rotary **Latitude** : -36.7480219
Drilling Contractor : McMillan Drilling Group Ltd **Longitude** : 174.5830162

Material	DESCRIPTION	Log Symbol	Strength	Depth (m BGL)	Elevation (mRL)	SPT N-Value / Vane Shear Strength	Sample Type	TCR (%) 25 50 75	RQD (%) 25 50 75	Defect Description	Moisture	Water Level	Piezometer Construction
			D - VD		41						M		
EAST COAST BAYS FORMATION	Highly weathered, dark grey, fine to medium SANDSTONE; very weak. Interbedded with Moderately weathered, dark grey, SILTSTONE; very weak. Beds are gently inclined, thin to moderately thin, very closely spaced.		VW	17	40	11/19//21/20/9 for 30 mm N=50+							
	Moderately weathered, dark grey SILTSTONE; very weak. Interbedded with Moderately weathered, dark grey fine to medium SANDSTONE; very weak. Beds are gently inclined, thin to moderately thin, closely spaced.		VW	18 19	39 38	13/37 for 51 mm N=50+				16.91-18.93 m: Bedding parting 19.01-19.04 m: Joint; moderately inclined, undulating, rough 19.04-19.29 m: Joint; slightly inclined, undulating, rough 19.29-19.33 m: Cross joint; moderately inclined, smooth, planar	N/A		

End of Hole Depth: 19.5 m
Termination: met target depth

Machine borehole met target depth at 19.5 m bgl
Dip test showed standing groundwater at 3.4 m bgl [06/03/2025 15:00]
Coordaintes and elevation estimated using Auckland Council GeoMaps.

Strengths inferred from shear vane, SPT and tactile assessment.
N/A = Not Assessed; NR = No Recovery

GEOTECH MACHINE BOREHOLE - ROCK MBH06-07.GPJ NZ DATA TEMPLATE 2.GDT 23/03/25

BOREHOLE LOG MBH06

Stage 2 Geotechnical Investigation
Forestry Road
Riverhead, Auckland
20190.000.001

Client : Rangitoopuni Developments **Core Diameter** : 64 mm
Date : 24-02-2025 **Energy Transfer Ratio** : 97.1%
Hole Depth : 45 m **Logged By/Reviewed By** : JM / HP
Drilling Method : Mud Rotary **Latitude** : -36.7510248
Drilling Contractor : McMillan Drilling Group Ltd **Longitude** : 174.5823707

Material	DESCRIPTION	Log Symbol	Strength	Depth (m BGL)	Elevation (mRL)	SPT N-Value / Vane Shear Strength	Sample Type	TCR (%)	RQD (%)	Defect Description	Moisture	Water Level	Piezometer Construction
F	[FILL] Fine to coarse GRAVEL with trace cobbles; grey. Well graded. Gravel is greywacke, sub-angular to angular.		N/A										
	[FILL] Gravelly SILT with trace rootlets; dark orange brown. Low plasticity. Gravel is fine, greywacke, sub-angular to angular.		N/A										
	SILT with some sand and trace clay; orange brown with occasional light grey streaks. Low plasticity. Sand is fine to medium.		VSt		76	133/30 kPa							
	0.5 - 1.5 m - No recovery.	NR	N/A	1									
EAST COAST BAYS FORMATION	Silty CLAY with minor sand; light grey with pink and orange streaks. High plasticity. Sand is fine.		St		75	1/1//1/1/1/2 N=5							
	Clayey SILT with some sand; light grey with pink mottles. Low plasticity. Sand is fine to coarse.		St	2	74	80/56 kPa							
	2.6 - 3.0 m - No recovery.	NR	N/A								M		
	Silty CLAY with minor sand; light grey with pink, orange and red streaks. High plasticity.		St - VSt	3	73	0/1//1/1/2/2 N=6							
	Clayey SILT with minor sand; light grey with pink mottles. Low plasticity. Sand is fine to medium. 4.25 - 4.5 m - No recovery. 4.55 m - 4.6 m - Encountered dark orange staining and with trace fine, sub-rounded to sub-angular limonite gravels. 4.8 - 4.95 m - No recovery.		St	4	72	1/1//1/0/1/1 N=3							
	Silty CLAY; light grey with pink and orange streaks. High plasticity.		St - VSt	5									

Machine borehole met target depth at 45 m bgl.
Dip test showed standing groundwater at 6.25 m bgl [28/02/2025 1200]
Coordaintes and elevation estimated using Auckland Council GeoMaps.

Strengths inferred from shear vane, SPT and tactile assessment.
N/A = Not Assessed; NR = No Recovery; F = Fill
UTF = Undifferentiated Takaanini Formation

GEOTECH MACHINE BOREHOLE - ROCK MBH06-07.GPJ NZ DATA TEMPLATE 2.GDT 23/03/25

BOREHOLE LOG MBH06

Stage 2 Geotechnical Investigation
Forestry Road
Riverhead, Auckland
20190.000.001

Client : Rangitoopuni Developments **Core Diameter** : 64 mm
Date : 24-02-2025 **Energy Transfer Ratio** : 97.1%
Hole Depth : 45 m **Logged By/Reviewed By** : JM / HP
Drilling Method : Mud Rotary **Latitude** : -36.7510248
Drilling Contractor : McMillan Drilling Group Ltd **Longitude** : 174.5823707

Material	DESCRIPTION	Strength	Depth (m BGL)	Elevation (mRL)	SPT N-Value / Vane Shear Strength	Defect Description	Moisture	Water Level
EAST COAST BAYS FORMATION	Clayey SILT with minor sand; brownish grey with sub-horizontal pink streaks. Low plasticity. Snad is fine to medium.	VSt	6	71	115/53 kPa 1/1//1/2/1/2 N=6			
	Silty fine to medium SAND; light brownish grey with orange streaks and staining. Well graded.	L						
	Clayey SILT with trace sand; light brownish grey with dark orange mottles. Low plasticity. Sand is fine.	VSt	7	70				
	Sandy SILT with minor clay; light brownish grey. Low plasticity. Sand is fine to medium. Interbedded with Silty fine to medium SAND; light brownish grey. Well graded. Beds are sub-horizontal, very thin to thin, moderately widely spaced.	VSt	8	69	177/41 kPa 2/2//3/4/5/6 N=18		M	
	Silty CLAY with trace sand; light brownish grey. High plasticity.	VSt		68				
	Sandy SILT with trace clay; light brownish grey. Low plasticity. Sand is fine to medium.	VSt	9		UTP 2/3//3/4/5/5 N=17			
	Clayey SILT with trace sand; dark grey. Low plasticity. Sand is fine. Interbedded with Silty fine to coarse SAND; dark grey. Well graded. Beds are gently inclined, laminated to very thin, very closely spaced. 9.45 m - Beds become moderately widely spaced.	H		67				
	Sandy SILT; light brownish grey. Low plasticity. Sand is fine to medium.	VSt	10					
		VSt		66	185/56 kPa 2/2//3/3/3/4 N=13			

Machine borehole met target depth at 45 m bgl.
Dip test showed standing groundwater at 6.25 m bgl [28/02/2025 1200]
Coordaintes and elevation estimated using Auckland Council GeoMaps.

Strengths inferred from shear vane, SPT and tactile assessment.
N/A = Not Assessed; NR = No Recovery; F = Fill
UTF = Undifferentiated Takaanini Formation

GEOTECH MACHINE BOREHOLE - ROCK MBH06-07.GPJ NZ DATA TEMPLATE 2.GDT 23/03/25

BOREHOLE LOG MBH06

Stage 2 Geotechnical Investigation
Forestry Road
Riverhead, Auckland
20190.000.001

Client : Rangitoopuni Developments **Core Diameter** : 64 mm
Date : 24-02-2025 **Energy Transfer Ratio** : 97.1%
Hole Depth : 45 m **Logged By/Reviewed By** : JM / HP
Drilling Method : Mud Rotary **Latitude** : -36.7510248
Drilling Contractor : McMillan Drilling Group Ltd **Longitude** : 174.5823707

Material	DESCRIPTION	Log Symbol	Strength	Depth (m BGL)	Elevation (mRL)	SPT N-Value / Vane Shear Strength	Sample Type	TCR (%)	RQD (%)	Defect Description	Moisture	Water Level	Piezometer Construction
EAST COAST BAYS FORMATION	Clayey SILT; light grey with orange streaks. Low plasticity. Interbedded with Silty fine to coarse SAND; orange. Well graded. Beds are gently inclined, laminated to very thin, very closely spaced.		VSt	11	65	2/2/3/3/3/4 N=13		25 50 75	25 50 75				
	12.2 - 12.25 m - Encountered orange staining and with trace fine, rounded limonite gravel.			12		1/5//4/2/3/3 N=12							
	Silty fine to coarse SAND; reddish pink with occasional orange streaks. Well graded.		MD		64								
	Clayey SILT with trace sand; light grey with orange streaks. Low plasticity. Interbedded with Sandy SILT; orange. Low plasticity. Sand is fine to coarse. Beds are gently inclined, laminated to very thin, closely spaced.		VSt	13	63						M		
	Silty fine to coarse SAND; orange and pink. Well graded. 13.65 m - Becomes light grey and interbedded with clayey silt; light grey. Low plasticity. Beds are undulating, gently inclined, thin, very closely spaced to closely spaced.		MD	14	62	2/3//4/5/5/5 N=19				14.02-14.1 m: Joint; moderately inclined, smooth, planar			
	Clayey SILT with trace sand; light grey. Low plasticity.		H	15	61	3/3//5/5/6/8 N=24							
				16									

Machine borehole met target depth at 45 m bgl.
Dip test showed standing groundwater at 6.25 m bgl [28/02/2025 1200]
Coordaintes and elevation estimated using Auckland Council GeoMaps.

Strengths inferred from shear vane, SPT and tactile assessment.
N/A = Not Assessed; NR = No Recovery; F = Fill
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GEOTECH MACHINE BOREHOLE - ROCK MBH06-07.GPJ NZ DATA TEMPLATE 2.GDT 23/03/25

BOREHOLE LOG MBH06

Stage 2 Geotechnical Investigation
Forestry Road
Riverhead, Auckland
20190.000.001

Client : Rangitoopuni Developments **Core Diameter** : 64 mm
Date : 24-02-2025 **Energy Transfer Ratio** : 97.1%
Hole Depth : 45 m **Logged By/Reviewed By** : JM / HP
Drilling Method : Mud Rotary **Latitude** : -36.7510248
Drilling Contractor : McMillan Drilling Group Ltd **Longitude** : 174.5823707

Material	DESCRIPTION	Log Symbol	Strength	Depth (m BGL)	Elevation (mRL)	SPT N-Value / Vane Shear Strength	Sample Type	TCR (%)	RQD (%)	Defect Description	Moisture	Water Level	Piezometer Construction
EAST COAST BAYS FORMATION	Silty fine to coarse SAND; pink with occasional orange streaks and light grey silty clay inclusions. Well graded.		MD	17	60	1/3//4/6/6/8 N=24							
	17.15 - 18 m - No recovery.	NR	N/A		59								
	Silty fine to coarse SAND; orange. Well graded.		MD	18	58	3/4//5/6/7/8 N=26							
	Sandy SILT; orange. Low plasticity. Sand is fine to medium.		VSt	19	57						M		
	Silty fine to coarse SAND; orange. Well graded.		MD	20	56	2/4//5/5/7/9 N=26							
	20.6 - 20.62 m - Encountered inclusion of light grey silty CLAY. 20.8 m - Becomes pink with orange streaks.			21	55	2/4//5/6/7/10 N=28							
	21.2 - 23.3 m - Encountered inclusions of grey silty CLAY (5 - 60 mm diameter).												

Machine borehole met target depth at 45 m bgl.
Dip test showed standing groundwater at 6.25 m bgl [28/02/2025 1200]
Coordaintes and elevation estimated using Auckland Council GeoMaps.

Strengths inferred from shear vane, SPT and tactile assessment.
N/A = Not Assessed; NR = No Recovery; F = Fill
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GEOTECH MACHINE BOREHOLE - ROCK MBH06-07.GPJ NZ DATA TEMPLATE 2.GDT 23/03/25

BOREHOLE LOG MBH06

Stage 2 Geotechnical Investigation
Forestry Road
Riverhead, Auckland
20190.000.001

Client : Rangitoopuni Developments **Core Diameter** : 64 mm
Date : 24-02-2025 **Energy Transfer Ratio** : 97.1%
Hole Depth : 45 m **Logged By/Reviewed By** : JM / HP
Drilling Method : Mud Rotary **Latitude** : -36.7510248
Drilling Contractor : McMillan Drilling Group Ltd **Longitude** : 174.5823707

Material	DESCRIPTION	Log Symbol	Strength	Depth (m BGL)	Elevation (mRL)	SPT N-Value / Vane Shear Strength	Sample Type	TCR (%)	RQD (%)	Defect Description	Moisture	Water Level	Piezometer Construction
EAST COAST BAYS FORMATION	Silty fine to coarse SAND; pink with orange streaks. Well graded. With irregular shaped inclusions of grey silty CLAY.		MD	22									
	Silty fine to coarse SAND; orange with light grey and dark orange steeply inclined to very steeply inclined streaks. Well graded. Fe staining along upper contact.		MD	23	54 53	3/2//5/5/6/7 N=23							
	23.5 m - Streaks cease.												
	Silty fine to coarse SAND; light pink. Well graded.		MD	24 25 26	52 51	2/4//5/6/7/9 N=27					M		
	24.8 - 24.83 m - Encountered, sub-horizontal, very thin lens of clayey SILT.					2/3//5/5/7/7 N=22							
	Sandy SILT with minor clay; orange with occasional light grey mottles. Low plasticity. Sand is fine.		VSt		50								
	Silty fine to coarse SAND; light pinkish grey with dark pink and red streaks. Well graded.		MD	27									

Machine borehole met target depth at 45 m bgl.
Dip test showed standing groundwater at 6.25 m bgl [28/02/2025 1200]
Coordaintes and elevation estimated using Auckland Council GeoMaps.

Strengths inferred from shear vane, SPT and tactile assessment.
N/A = Not Assessed; NR = No Recovery; F = Fill
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GEOTECH MACHINE BOREHOLE - ROCK MBH06-07.GPJ NZ DATA TEMPLATE 2.GDT 23/03/25

BOREHOLE LOG MBH06

Stage 2 Geotechnical Investigation
Forestry Road
Riverhead, Auckland
20190.000.001

Client : Rangitoopuni Developments **Core Diameter** : 64 mm
Date : 24-02-2025 **Energy Transfer Ratio** : 97.1%
Hole Depth : 45 m **Logged By/Reviewed By** : JM / HP
Drilling Method : Mud Rotary **Latitude** : -36.7510248
Drilling Contractor : McMillan Drilling Group Ltd **Longitude** : 174.5823707

Material	DESCRIPTION	Log Symbol	Strength	Depth (m BGL)	Elevation (mRL)	SPT N-Value / Vane Shear Strength	Sample Type	TCR (%)	RQD (%)	Defect Description	Moisture	Water Level	Piezometer Construction
EAST COAST BAYS FORMATION	Silty fine to coarse SAND; light pinkish grey with dark pink and red streaks. Well graded. 27.1 m - Light pink with steeply inclined pink streaks.		MD		49	2/4//4/5/6/7 N=22		25 50 75	25 50 75		M		
	Silty CLAY; dark grey. High plasticity.		VSt - H	28	28								
	Silty CLAY with trace sand; light grey. High plasticity. Interbedded with Sandy SILT; light grey. Low plasticity. Sand is fine to coarse. Beds are gently inclined, moderately thin, closely spaced.		VSt - H		48 29 47								
	Silty CLAY with trace sand; light grey with occasional orange streaks. High plasticity. Sand is fine.		VSt - H	30	30 46								
	Silty fine to coarse SAND; pink. Well graded.		MD										
	Clayey SILT with some fine to medium sand; light grey with pink and orange streaks. Low plasticity.		VSt - H	31	31 45								
	31.5 - 33 m - No Recovery.	NR	N/A	32	32								

Machine borehole met target depth at 45 m bgl.
Dip test showed standing groundwater at 6.25 m bgl [28/02/2025 1200]
Coordaintes and elevation estimated using Auckland Council GeoMaps.

Strengths inferred from shear vane, SPT and tactile assessment.
N/A = Not Assessed; NR = No Recovery; F = Fill
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GEOTECH MACHINE BOREHOLE - ROCK MBH06-07.GPJ NZ DATA TEMPLATE 2.GDT 23/03/25

BOREHOLE LOG MBH06

Stage 2 Geotechnical Investigation
Forestry Road
Riverhead, Auckland
20190.000.001

Client : Rangitoopuni Developments **Core Diameter** : 64 mm
Date : 24-02-2025 **Energy Transfer Ratio** : 97.1%
Hole Depth : 45 m **Logged By/Reviewed By** : JM / HP
Drilling Method : Mud Rotary **Latitude** : -36.7510248
Drilling Contractor : McMillan Drilling Group Ltd **Longitude** : 174.5823707

Material	DESCRIPTION	Log Symbol	Strength	Depth (m BGL)	Elevation (mRL)	SPT N-Value / Vane Shear Strength	Sample Type	TCR (%)	RQD (%)	Defect Description	Moisture	Water Level	Piezometer Construction
	31.5 - 33 m - No Recovery.	NR	N/A	33	44								
EAST COAST BAYS FORMATION	Sandy SILT with minor clay; pink with inclusions of light grey silty clay. Low plasticity. Sand is fine to medium.		VSt										
	Silty CLAY; light grey with pink streaks and pink inclusions of sandy silt. High plasticity.		VSt	34	43								
	Sandy SILT; orange. Low plasticity. Sand is fine to coarse.		VSt										
	Silty CLAY; light grey with dark orange Fe staining along upper contact. High plasticity.		VSt	35	42	147/42 kPa							
	Clayey SILT with some sand; light orange. Low plasticity. Sand is fine to coarse.		VSt										
	Silty CLAY with minor sand; grey with orange streaks. High plasticity. With inclusions of orange sandy silt.		VSt		41						M		
	Clayey SILT with trace sand; grey. Low plasticity. Interbedded with Sandy SILT with minor clay; grey. Low plasticity. Sand is fine to coarse. Beds are gently inclined, very thin to thin, closely spaced.		VSt	37	40								
					39								

Machine borehole met target depth at 45 m bgl.
Dip test showed standing groundwater at 6.25 m bgl [28/02/2025 1200]
Coordaintes and elevation estimated using Auckland Council GeoMaps.

Strengths inferred from shear vane, SPT and tactile assessment.
N/A = Not Assessed; NR = No Recovery; F = Fill
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GEOTECH MACHINE BOREHOLE - ROCK MBH06-07.GPJ NZ DATA TEMPLATE 2.GDT 23/03/25

BOREHOLE LOG MBH06

Stage 2 Geotechnical Investigation
Forestry Road
Riverhead, Auckland
20190.000.001

Client : Rangitoopuni Developments **Core Diameter** : 64 mm
Date : 24-02-2025 **Energy Transfer Ratio** : 97.1%
Hole Depth : 45 m **Logged By/Reviewed By** : JM / HP
Drilling Method : Mud Rotary **Latitude** : -36.7510248
Drilling Contractor : McMillan Drilling Group Ltd **Longitude** : 174.5823707

Material	DESCRIPTION	Log Symbol	Strength	Depth (m BGL)	Elevation (mRL)	SPT N-Value / Vane Shear Strength	Sample Type	TCR (%) 25 50 75	RQD (%) 25 50 75	Defect Description	Moisture	Water Level	Piezometer Construction
EAST COAST BAYS FORMATION	Sandy SILT; light orange brown. Low plasticity. Sand is fine to medium.		VSt - H	0	38								
	Clayey SILT with minor sand; grey with orange streaks and staining. Low plasticity. Sand is fine to medium.		H	0.6	38								
	Sandy SILT; dark grey. Low plasticity. Interbedded with Clayey SILT with trace sand; dark grey. Low plasticity. (Completely weathered, SILTSTONE; extremely weak).		H	1.2	37						M		
	Clayey SILT; dark grey. Low plasticity. (Completely weathered, SILTSTONE; extremely weak.) Interbedded with Sandy SILT; dark grey. Low plasticity. Sand is fine to coarse. Beds are gently inclined, thin, closely spaced.		H	3.2	35								
	Sandy SILT; dark grey. Low plasticity. Sand is fine to coarse. (Completely weathered, SANDSTONE; extremely weak.) Interbedded with Highly weathered, dark grey SILTSTONE; extremely weak. Beds are gently inclined, thin, closely spaced.		H	4.2	34								
				5	33								

Machine borehole met target depth at 45 m bgl.
Dip test showed standing groundwater at 6.25 m bgl [28/02/2025 1200]
Coordaintes and elevation estimated using Auckland Council GeoMaps.

Strengths inferred from shear vane, SPT and tactile assessment.
N/A = Not Assessed; NR = No Recovery; F = Fill
UTF = Undifferentiated Takaanini Formation

GEOTECH MACHINE BOREHOLE - ROCK MBH06-07.GPJ NZ DATA TEMPLATE 2.GDT 23/03/25

BOREHOLE LOG MBH06

Stage 2 Geotechnical Investigation
Forestry Road
Riverhead, Auckland
20190.000.001

Client : Rangitoopuni Developments **Core Diameter** : 64 mm
Date : 24-02-2025 **Energy Transfer Ratio** : 97.1%
Hole Depth : 45 m **Logged By/Reviewed By** : JM / HP
Drilling Method : Mud Rotary **Latitude** : -36.7510248
Drilling Contractor : McMillan Drilling Group Ltd **Longitude** : 174.5823707

Material	DESCRIPTION	Log Symbol	Strength	Depth (m BGL)	Elevation (mRL)	SPT N-Value / Vane Shear Strength	Sample Type	TCR (%) 25 50 75	RQD (%) 25 50 75	Defect Description	Moisture	Water Level	Piezometer Construction
EAST COAST BAYS FORMATION	Sandy SILT; dark grey. Low plasticity. Sand is fine to coarse. (Completely weathered, SANDSTONE; extremely weak.) Interbedded with Highly weathered, dark grey SILTSTONE; extremely weak. Beds are gently inclined, thin, closely spaced.		H	44	33						M		
	Highly weathered, dark grey SANDSTONE; very weak.		VW	45	32						N/A		

End of Hole Depth: 45 m
Termination: met target depth

Machine borehole met target depth at 45 m bgl.
Dip test showed standing groundwater at 6.25 m bgl [28/02/2025 1200]
Coordaintes and elevation estimated using Auckland Council GeoMaps.

Strengths inferred from shear vane, SPT and tactile assessment.
N/A = Not Assessed; NR = No Recovery; F = Fill
UTF = Undifferentiated Takaanini Formation

BOREHOLE LOG MBH07

Stage 2 Geotechnical Investigation
Forestry Road
Riverhead, Auckland
20190.000.001

Client : Rangitoopuni Developments **Core Diameter** : 64 mm
Date : 27-02-2025 **Energy Transfer Ratio** : 97.1%
Hole Depth : 40.5 m **Logged By/Reviewed By** : JM / HP
Drilling Method : Mud Rotary **Latitude** : -36.7524966
Drilling Contractor : McMillan Drilling Group Ltd **Longitude** : 174.5864613

Material	DESCRIPTION	Log Symbol	Strength	Depth (m BGL)	Elevation (mRL)	SPT N-Value / Vane Shear Strength	Sample Type	TCR (%)	RQD (%)	Defect Description	Moisture	Water Level	Piezometer Construction
ALBANY CONGLOMERATE	Silty fine to coarse GRAVEL; dark brown. Well graded. Gravel is greywacke, sub-angular to angular.		N/A										
	Clayey SILT with trace sand and trace gravel; orange brown. Low plasticity. Sand is fine. Gravel is fine crushable silt clasts.		St										
	SILT with minor sand and minor gravel and trace clay; orange brown. Low plasticity. Gravel is fine crushable silt clasts. 0.6 m - Becomes red and with minor fine to coarse sand.			1	54	96/18 kPa 1/1//1/2/1/2 N=6							
	3.05 - 3.2 m - Becomes dark orange.		St	2	53						M		
	Sandy SILT with trace gravel; orange with occasional pink staining. Low plasticity. Sand is fine to medium. Gravel is fine crushable silt clasts. 4.35 m - Sand becomes fine to coarse.			3	52	74/22 kPa 1/2//1/1/1/2 N=5							
			VSt - H	4	51	UTP 1/2//3/4/3/4 N=10							
			L	5	50								

Machine borehole met target depth at 37.5 m bgl.
Dip test showed standing groundwater at 6.05 m bgl [28/02/2025 1200]
Coordaintes and elevation estimated using Auckland Council GeoMaps.

Strengths inferred from shear vane, SPT and tactile assessment.
N/A = Not Assessed; NR = No Recovery
F = Fill

GEOTECH MACHINE BOREHOLE - ROCK MBH06-07.GPJ NZ DATA TEMPLATE 2.GDT 23/03/25

BOREHOLE LOG MBH07

Stage 2 Geotechnical Investigation
Forestry Road
Riverhead, Auckland
20190.000.001

Client : Rangitoopuni Developments **Core Diameter** : 64 mm
Date : 27-02-2025 **Energy Transfer Ratio** : 97.1%
Hole Depth : 40.5 m **Logged By/Reviewed By** : JM / HP
Drilling Method : Mud Rotary **Latitude** : -36.7524966
Drilling Contractor : McMillan Drilling Group Ltd **Longitude** : 174.5864613

Material	DESCRIPTION	Log Symbol	Strength	Depth (m BGL)	Elevation (mRL)	SPT N-Value / Vane Shear Strength	Sample Type	TCR (%) 25 50 75	RQD (%) 25 50 75	Defect Description	Moisture	Water Level	Piezometer Construction
ALBANY CONGLOMERATE	Silty fine to coarse SAND with trace gravel; orange. Well graded. Gravel is fine, crushable silt clasts.												
	5.45 - 6.0 m - No recovery.	NR	N/A										
	Sandy SILT with trace gravel; orange with occasional pink staining. Low plasticity. Sand is fine to medium. Gravel is fine crushable silt clasts.			6	6 49	1/1/1/2/2/2 N=7						▼	
	6.45 - 6.7 m - Disturbed during drilling, recovered as saturated SILT.												
	6.7 - 6.9 m - Becomes reddish pink with light grey and orange streaks.			7	7 48								
			St										
	7.4 - 7.5 m - Becomes reddish pink.					59/29 kPa 1/2/2/2/2/2 N=8							
	8.05 - 8.25 m - With minor clay and becomes pinkish red with light grey streaks.			8	8 47						M		
	Silty fine to coarse SAND; orange with light grey specks. Well graded.		L - MD										
	8.85 - 9 m - No recovery.	NR	N/A										
EAST COAST BAYS FORMATION	Sandy SILT; dark orange. Low plasticity. Sand is fine to coarse.			9	9 46	103/48 kPa 2/2/3/3/4/5 N=15							
			VSt										
				10	10 45								
	Silty CLAY; grey. High plasticity.		H			UTP							
	Sandy SILT; dark orange. Low plasticity. Sand is fine to coarse.		VSt			1/2/2/3/3/4 N=12							

Machine borehole met target depth at 37.5 m bgl.
Dip test showed standing groundwater at 6.05 m bgl [28/02/2025 1200]
Coordaintes and elevation estimated using Auckland Council GeoMaps.

Strengths inferred from shear vane, SPT and tactile assessment.
N/A = Not Assessed; NR = No Recovery
F = Fill

GEOTECH MACHINE BOREHOLE - ROCK MBH06-07.GPJ NZ DATA TEMPLATE 2.GDT 23/03/25

BOREHOLE LOG MBH07

Stage 2 Geotechnical Investigation
Forestry Road
Riverhead, Auckland
20190.000.001

Client : Rangitoopuni Developments **Core Diameter** : 64 mm
Date : 27-02-2025 **Energy Transfer Ratio** : 97.1%
Hole Depth : 40.5 m **Logged By/Reviewed By** : JM / HP
Drilling Method : Mud Rotary **Latitude** : -36.7524966
Drilling Contractor : McMillan Drilling Group Ltd **Longitude** : 174.5864613

Material	DESCRIPTION	Log Symbol	Strength	Depth (m BGL)	Elevation (mRL)	SPT N-Value / Vane Shear Strength	Sample Type	TCR (%)	RQD (%)	Defect Description	Moisture	Water Level	Piezometer Construction
EAST COAST BAYS FORMATION	Sandy SILT; dark orange. Low plasticity. Sand is fine to coarse.		VSt	11	44	1/2/2/3/3/4 N=12							
	Silty fine to coarse SAND; dark orange. Well graded.		MD										
	Sandy SILT; dark orange. Low plasticity. Sand is fine to coarse. 12 m - Becomes dark orange with light grey specks.		St - VSt	12	43	2/1//2/2/3/3 N=10							
				13	42								
	Sandy SILT; orange with light grey specks. Low plasticity. Sand is fine to coarse.		VSt	14	41	0/1//3/2/3/2 N=8					M		
				15	40	118/41 kPa 1/1//2/4/2/3 N=11							
			MD	16	39								

Machine borehole met target depth at 37.5 m bgl.
Dip test showed standing groundwater at 6.05 m bgl [28/02/2025 1200]
Coordaintes and elevation estimated using Auckland Council GeoMaps.

Strengths inferred from shear vane, SPT and tactile assessment.
N/A = Not Assessed; NR = No Recovery
F = Fill

GEOTECH MACHINE BOREHOLE - ROCK MBH06-07.GPJ NZ DATA TEMPLATE 2.GDT 23/03/25

BOREHOLE LOG MBH07

Stage 2 Geotechnical Investigation
Forestry Road
Riverhead, Auckland
20190.000.001

Client : Rangitoopuni Developments **Core Diameter** : 64 mm
Date : 27-02-2025 **Energy Transfer Ratio** : 97.1%
Hole Depth : 40.5 m **Logged By/Reviewed By** : JM / HP
Drilling Method : Mud Rotary **Latitude** : -36.7524966
Drilling Contractor : McMillan Drilling Group Ltd **Longitude** : 174.5864613

Material	DESCRIPTION	Log Symbol	Strength	Depth (m BGL)	Elevation (mRL)	SPT N-Value / Vane Shear Strength	Sample Type	TCR (%) 25 50 75	RQD (%) 25 50 75	Defect Description	Moisture	Water Level	Piezometer Construction
EAST COAST BAYS FORMATION	Silty fine to coarse SAND; dark grey. Well graded. Interbedded with Clayey SILT with minor sand; dark grey. Low plasticity. Beds are sub-horizontal to gently inclined, closely spaced to moderately widely spaced, thin to moderately thin.		MD	17	38	1/1//2/2/3/4 N=11							
	Silty fine to coarse SAND; dark grey. Well graded.		MD	18	37	2/2//3/4/4/6 N=17							
	Silty fine to coarse SAND; dark grey. Well graded. Interbedded with Clayey SILT; dark grey. Low plasticity. Beds are sub-horizontal, laminated to very thin and very closely spaced.		MD	19	36						M		
	Clayey SILT; dark grey. Low plasticity. Interbedded with Silty fine to coarse SAND; dark grey. Well graded. Beds are gently inclined, laminated to very thin, very closely spaced to closely spaced.		H	20	35	2/2//4/4/46 N=18							
	Sandy SILT; dark grey. Low plasticity. Sand is fine to medium.		H	21	34	3/3//4/5/6/6 N=21							

Machine borehole met target depth at 37.5 m bgl.
Dip test showed standing groundwater at 6.05 m bgl [28/02/2025 1200]
Coordaintes and elevation estimated using Auckland Council GeoMaps.

Strengths inferred from shear vane, SPT and tactile assessment.
N/A = Not Assessed; NR = No Recovery
F = Fill

GEOTECH MACHINE BOREHOLE - ROCK MBH06-07.GPJ NZ DATA TEMPLATE 2.GDT 23/03/25

BOREHOLE LOG MBH07

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Forestry Road
Riverhead, Auckland
20190.000.001

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Material	DESCRIPTION	Log Symbol	Strength	Depth (m BGL)	Elevation (mRL)	SPT N-Value / Vane Shear Strength	Sample Type	TCR (%) 25 50 75	RQD (%) 25 50 75	Defect Description	Moisture	Water Level	Piezometer Construction
EAST COAST BAYS FORMATION	Sandy SILT; dark grey. Low plasticity. Sand is fine to medium.		H										
	Sandy SILT; dark grey. Low plasticity. Sand is fine to medium. Interbedded with Clayey SILT with trace sand; dark grey. Low plasticity. (Completely weathered, SILTSTONE; extremely weak.) Beds are gently inclined, moderately thick, moderately widely spaced.		H	22 23 24	33 32 31	2/3//4/5/6/6 N=21 4/3//7/9/11/12 N=39					M		
	24.65 - 25.5 m - No recovery.	NR	N/A	25	30								
	Silty fine to coarse SAND; dark grey. Well graded.		MD - D			4/4//6/8/8/8 N=30							
	Clayey SILT; dark grey. Low plasticity.		H										
	Sandy SILT; light orange brown with light grey mottles. Low plasticity. Sand is fine to coarse.		H	26	29								
	Clayey SILT; dark grey with orange streaks. Low plasticity. Interbedded with Silty fine to coarse SAND; orange. Well graded. Beds are sub-horizontal to moderately inclined, moderately thin, closely spaced.		H	27	28								

Machine borehole met target depth at 37.5 m bgl.
Dip test showed standing groundwater at 6.05 m bgl [28/02/2025 1200]
Coordaintes and elevation estimated using Auckland Council GeoMaps.

Strengths inferred from shear vane, SPT and tactile assessment.
N/A = Not Assessed; NR = No Recovery
F = Fill

GEOTECH MACHINE BOREHOLE - ROCK MBH06-07.GPJ NZ DATA TEMPLATE 2.GDT 23/03/25

BOREHOLE LOG MBH07

Stage 2 Geotechnical Investigation
Forestry Road
Riverhead, Auckland
20190.000.001

Client : Rangitoopuni Developments **Core Diameter** : 64 mm
Date : 27-02-2025 **Energy Transfer Ratio** : 97.1%
Hole Depth : 40.5 m **Logged By/Reviewed By** : JM / HP
Drilling Method : Mud Rotary **Latitude** : -36.7524966
Drilling Contractor : McMillan Drilling Group Ltd **Longitude** : 174.5864613

Material	DESCRIPTION	Log Symbol	Strength	Depth (m BGL)	Elevation (mRL)	SPT N-Value / Vane Shear Strength	Sample Type	TCR (%)	RQD (%)	Defect Description	Moisture	Water Level	Piezometer Construction
EAST COAST BAYS FORMATION	Silty fine to coarse SAND; orange. Well graded.		H										
			MD			2/4//5/6/7/8 N=26							
	Interbedded with Clayey SILT; dark grey. Low plasticity. Beds are moderately inclined, very thin, very closely spaced.		H										
	Clayey SILT; dark grey with orange streaks. Low plasticity.		MD	28	28 27								
	Silty fine to coarse SAND; light brownish grey with orange staining. Well graded.												
	Sandy SILT; dark grey. Low plasticity. Sand is fine to coarse. Interbedded with Clayey SILT; dark grey. Low plasticity. Beds are gently inclined, moderately thin to moderately thick, moderately widely spaced.			29	29 26						M		
			H	30	30 25								
				31	31 24								
	31.85 m - With gently inclined, thin, very closely spaced lens of orange Sandy SILT with trace linonite gravel and hardpan limonite bands along bedding planes.			32	32 23								
	Clayey SILT; dark grey. Low plasticity.		H										

Machine borehole met target depth at 37.5 m bgl.
Dip test showed standing groundwater at 6.05 m bgl [28/02/2025 1200]
Coordaintes and elevation estimated using Auckland Council GeoMaps.

Strengths inferred from shear vane, SPT and tactile assessment.
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GEOTECH MACHINE BOREHOLE - ROCK MBH06-07.GPJ NZ DATA TEMPLATE 2.GDT 23/03/25

BOREHOLE LOG MBH07

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Forestry Road
Riverhead, Auckland
20190.000.001

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Hole Depth : 40.5 m **Logged By/Reviewed By** : JM / HP
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Material	DESCRIPTION	Log Symbol	Strength	Depth (m BGL)	Elevation (mRL)	SPT N-Value / Vane Shear Strength	Sample Type	TCR (%) 25 50 75	RQD (%) 25 50 75	Defect Description	Moisture	Water Level	Piezometer Construction
EAST COAST BAYS FORMATION	Clayey SILT; dark grey. Low plasticity.		H	33	22								
	33.25 m - Encountered some fine to coarse angular limonite gravel and hard pan limonite bands along bedding planes.		H										
	Clayey SILT; dark grey. Low plasticity.												
	Sandy SILT; dark grey. Low plasticity. Sand is fine to coarse.		H	34	21								
	Sandy SILT; dark grey. Sand is fine to coarse. Low plasticity. (Completely weathered, SANDSTONE; extremely weak.)		H	35	20						M		
	35.17 m - Encountered gently inclined black carbonaceous band.												
	Sandy SILT; dark grey. Low plasticity. (Highly weathered, SANDSTONE; extremely weak.)		H	36	19								
	Interbedded with												
	Moderately weathered, dark grey SILTSTONE; very weak. Beds are gently inclined, moderately thin, moderately widely spaced.												
	37.3 - 37.5 m - No Recovery.			37	18								

Machine borehole met target depth at 37.5 m bgl.
Dip test showed standing groundwater at 6.05 m bgl [28/02/2025 1200]
Coordaintes and elevation estimated using Auckland Council GeoMaps.

Strengths inferred from shear vane, SPT and tactile assessment.
N/A = Not Assessed; NR = No Recovery
F = Fill

GEOTECH MACHINE BOREHOLE - ROCK MBH06-07.GPJ NZ DATA TEMPLATE 2.GDT 23/03/25

BOREHOLE LOG MBH07

Stage 2 Geotechnical Investigation
Forestry Road
Riverhead, Auckland
20190.000.001

Client : Rangitoopuni Developments **Core Diameter** : 64 mm
Date : 27-02-2025 **Energy Transfer Ratio** : 97.1%
Hole Depth : 40.5 m **Logged By/Reviewed By** : JM / HP
Drilling Method : Mud Rotary **Latitude** : -36.7524966
Drilling Contractor : McMillan Drilling Group Ltd **Longitude** : 174.5864613

Material	DESCRIPTION	Log Symbol	Strength	Depth (m BGL)	Elevation (mRL)	SPT N-Value / Vane Shear Strength	Sample Type	TCR (%) 25 50 75	RQD (%) 25 50 75	Defect Description	Moisture	Water Level	Piezometer Construction
EAST COAST BAYS FORMATION	Sandy SILT; dark grey. Low plasticity. (Highly weathered, SANDSTONE; extremely weak.) Interbedded with Moderately weathered, dark grey SILTSTONE; very weak. Beds are gently inclined, moderately thin, moderately widely spaced.		H	38 39 40	17 16 15						M		

End of Hole Depth: 40.5 m
Termination: met target depth

Machine borehole met target depth at 37.5 m bgl.
Dip test showed standing groundwater at 6.05 m bgl [28/02/2025 1200]
Coordaintes and elevation estimated using Auckland Council GeoMaps.

Strengths inferred from shear vane, SPT and tactile assessment.
N/A = Not Assessed; NR = No Recovery
F = Fill

Drilling ID	Description	From	To	Accuracy
597	BROWN CLAYS	0	1	Metres
597	WHITE CLAY	1	3	Metres
597	GREY SILTS	3	14	Metres
597	INTERBEDDED SILTSTONE & SANDSTONE,OCCASIONAL PEAT AND WOOD FRAGMENTS ,	14	90	Metres
597	INTERBEBBED SANDSTONE/MUDSTONE	90	109	Metres
597	SANDSTONE WITH WATER-WORN FINE GRAVELS	109	140	Metres
597	INTERBEDDED SANDSTONE/MUDSTONE	140	150	Metres

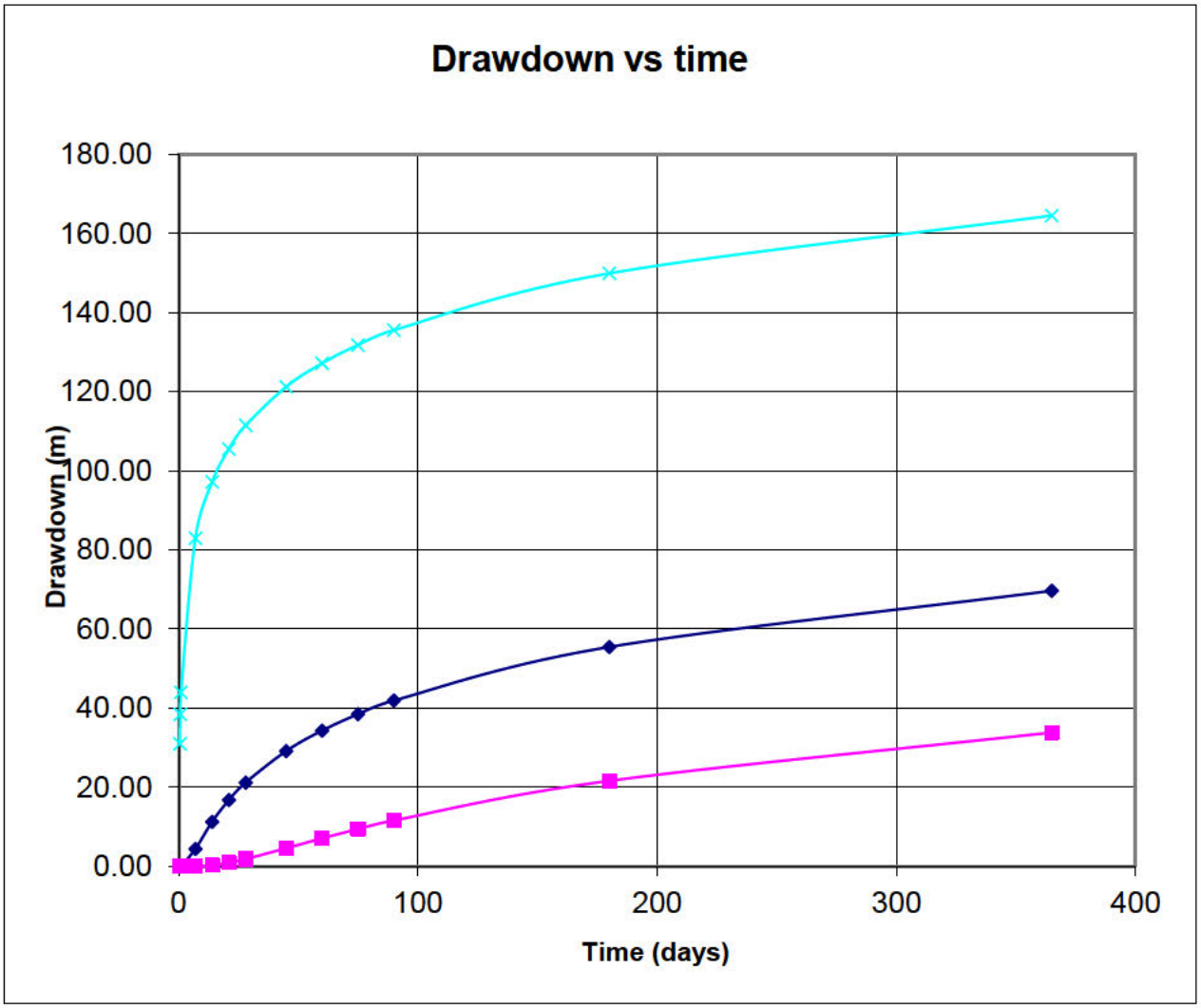
APPENDIX 3:

Theis Drawdown Calculations

Time-drawdown calculations using Theis equation

Aquifer parameters		
T	8.64E-01	m2/d
S	1.00E-04	
B		
Pumping rate		
Q	2.6	l/s

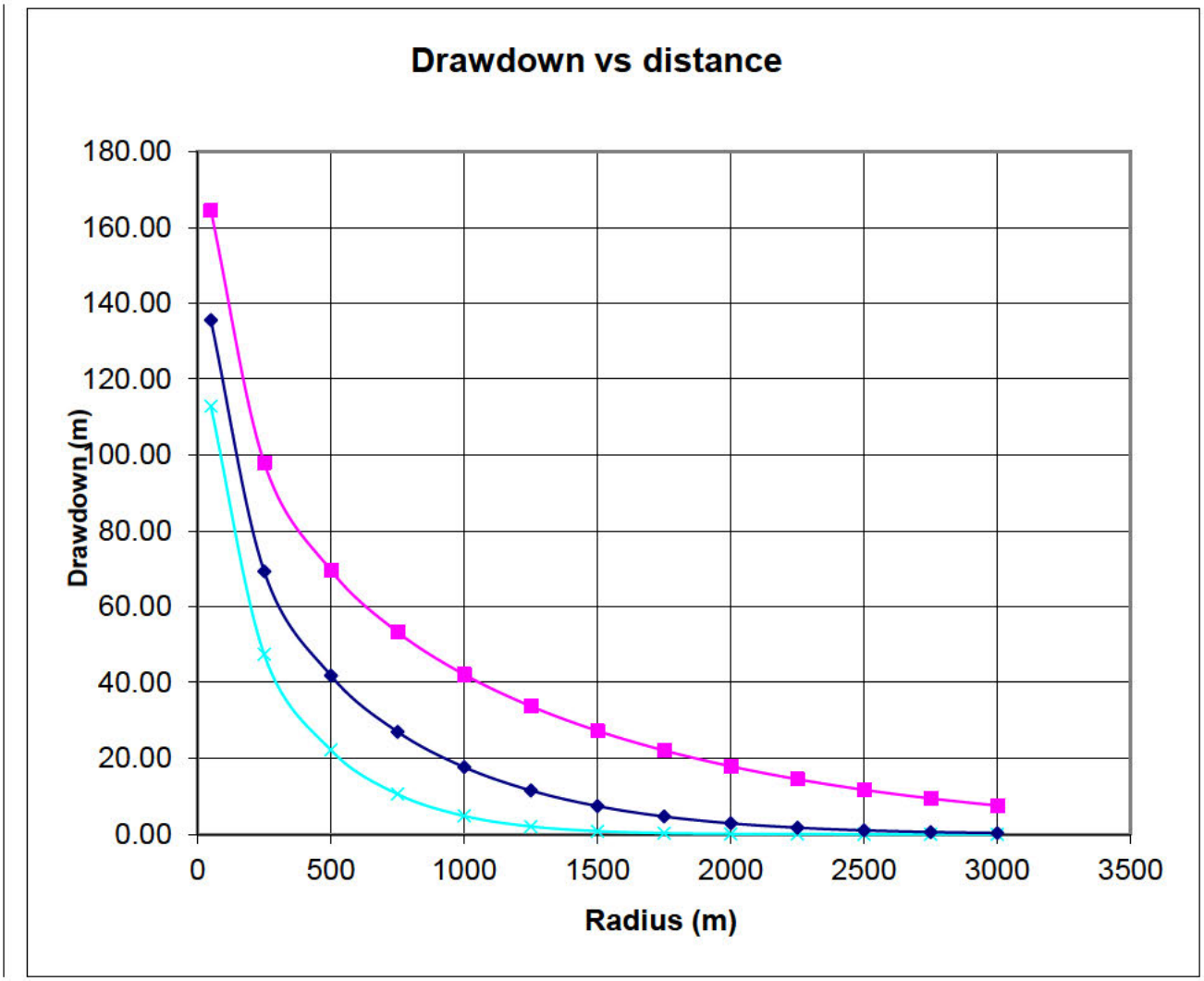
Radius (m)	50	500	1250
Time (days)	Drawdown (m)	Drawdown (m)	Drawdown (m)
0.5	30.945	0.000	-
0.75	38.394	0.000	-
1	43.868	0.002	-
7	82.873	4.293	0.004
14	97.107	11.173	0.202
21	105.461	16.665	0.820
28	111.395	21.079	1.748
45	121.192	29.074	4.504
60	127.136	34.250	6.996
75	131.748	38.394	9.348
90	135.516	41.848	11.523
180	149.850	55.383	21.531
365	164.472	69.594	33.755



Distance-drawdown calculations using Theis equation

Aquifer parameters		
T	0.864	m2/d
S	0.0001	
B		
Pumping rate		
Q	2.6	l/s

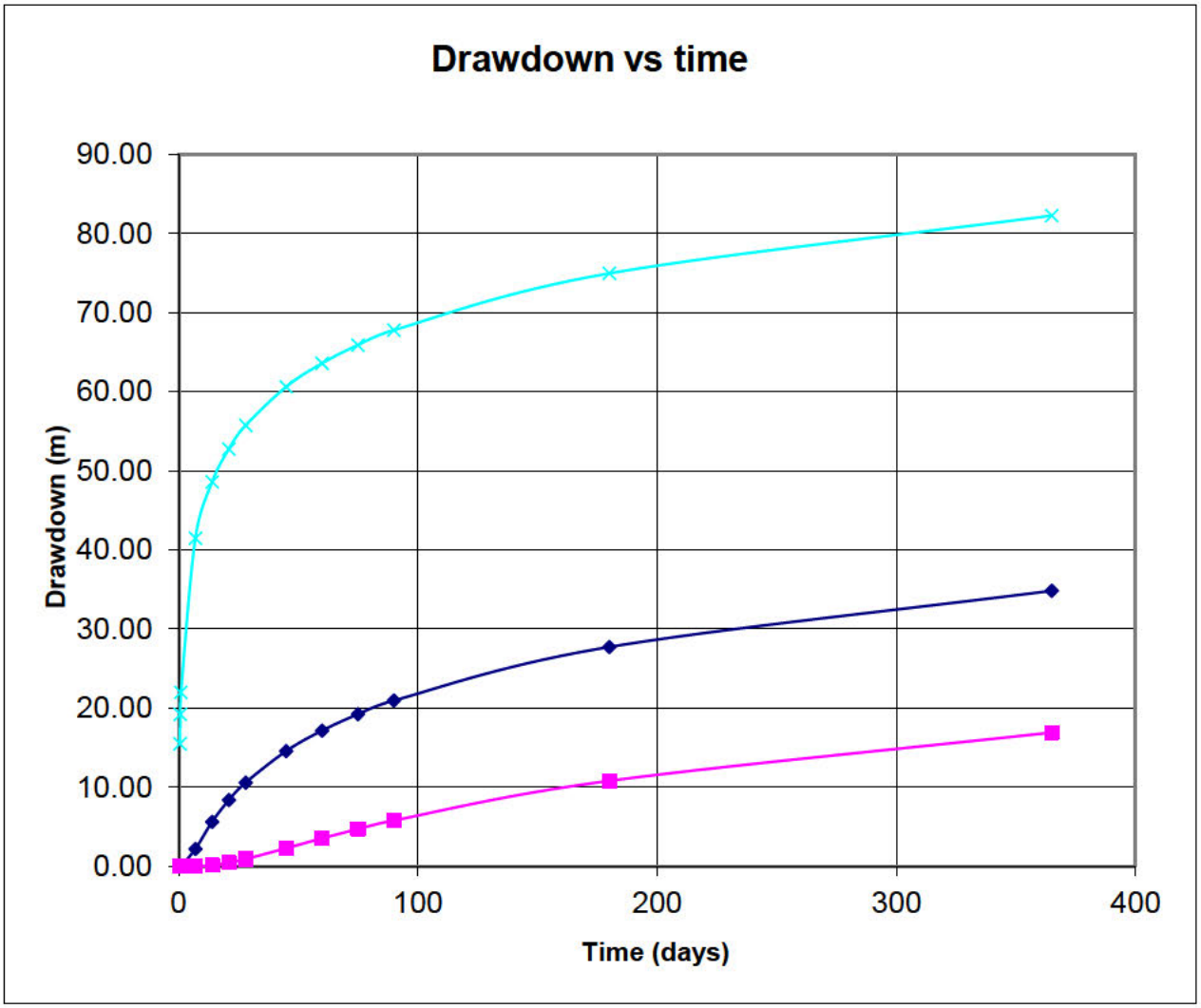
	Time (days)	30	90	365
	Radius (m)	Drawdown (m)	Drawdown (m)	Drawdown (m)
	50	112.819	135.516	164.472
	250	47.399	69.314	97.971
	500	22.191	41.848	69.594
	750	10.578	27.019	53.320
	1000	4.819	17.689	42.112
#138	1250	2.048	11.523	33.755
	1500	0.801	7.400	27.257
Creek	1750	0.286	4.658	22.080
	2000	0.093	2.864	17.896
Estuary	2250	0.027	1.715	14.486
	2500	0.007	0.999	11.696
	2750	0.002	0.564	9.410
	3000	0.000	0.309	7.539



Time-drawdown calculations using Theis equation

Aquifer parameters		
T	8.64E-01	m2/d
S	1.00E-04	
B		
Pumping rate		
Q	1.3	l/s

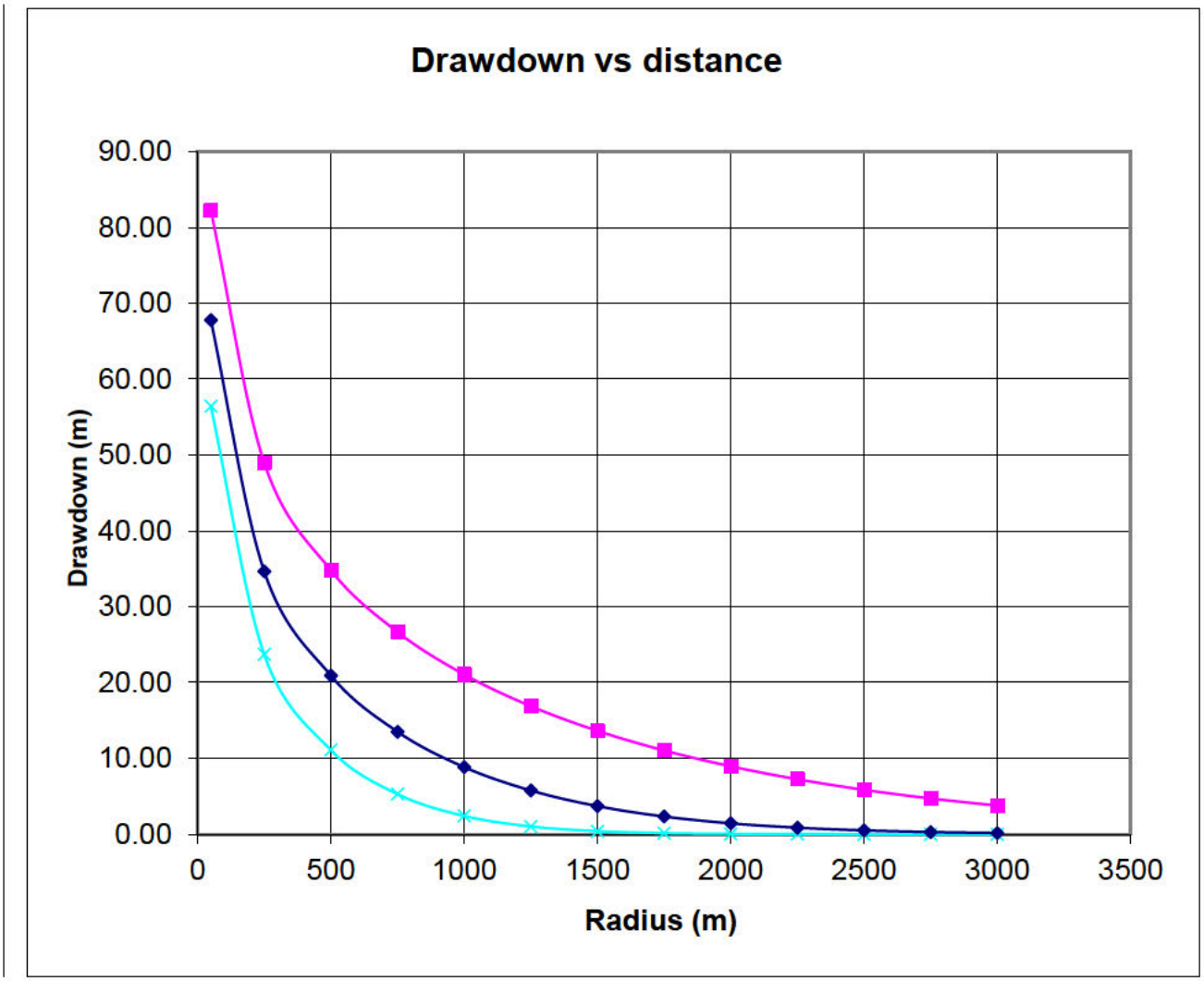
Radius (m)	50	500	1250
Time (days)	Drawdown (m)	Drawdown (m)	Drawdown (m)
0.5	15.473	0.000	-
0.75	19.197	0.000	-
1	21.934	0.001	-
7	41.436	2.147	0.002
14	48.554	5.586	0.101
21	52.730	8.333	0.410
28	55.698	10.540	0.874
45	60.596	14.537	2.252
60	63.568	17.125	3.498
75	65.874	19.197	4.674
90	67.758	20.924	5.762
180	74.925	27.691	10.765
365	82.236	34.797	16.878



Distance-drawdown calculations using Theis equation

Aquifer parameters		
T	0.864	m2/d
S	0.0001	
B		
Pumping rate		
Q	1.3	l/s

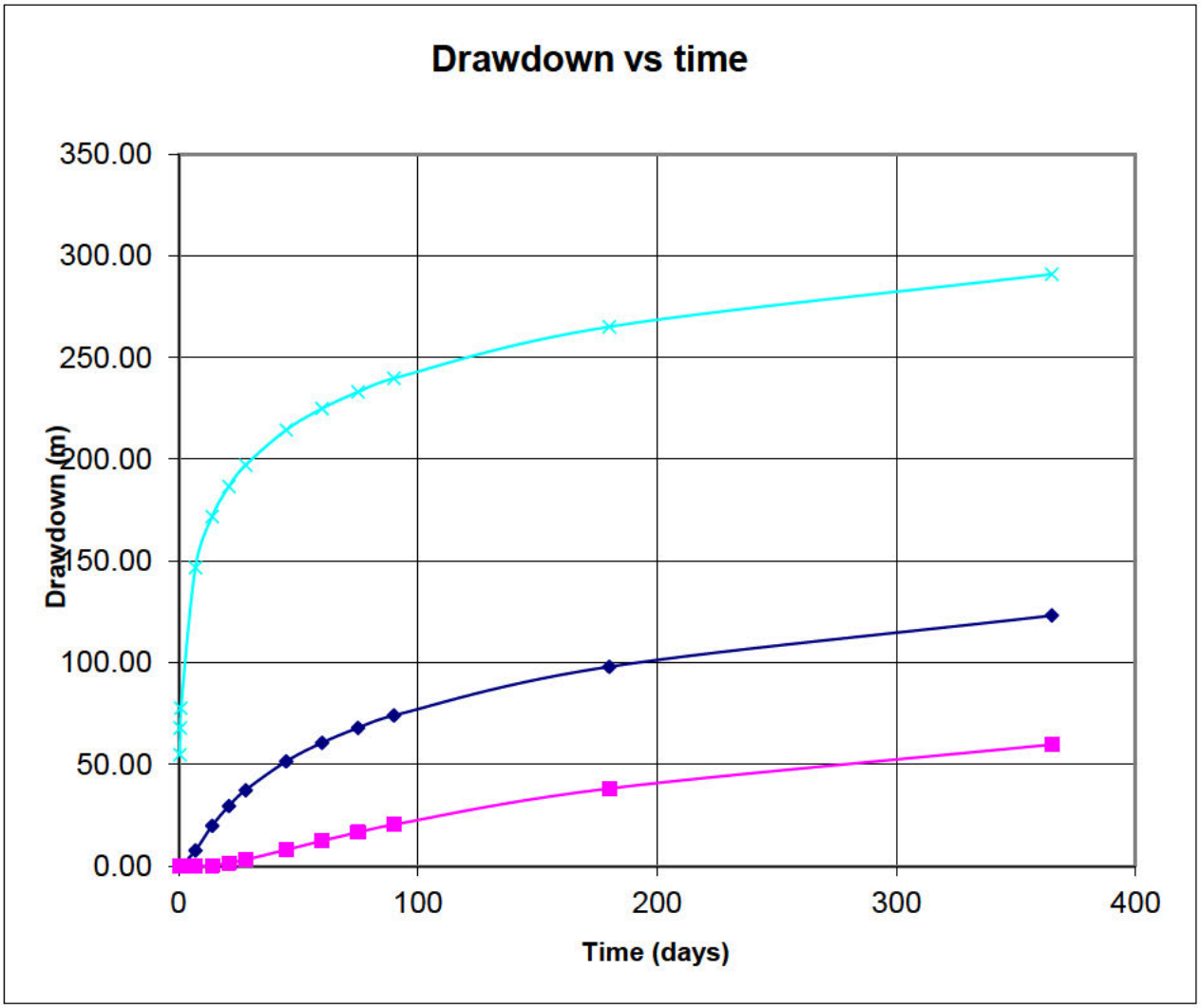
	Time (days)	30	90	365
	Radius (m)	Drawdown (m)	Drawdown (m)	Drawdown (m)
	50	56.410	67.758	82.236
	250	23.700	34.657	48.986
	500	11.096	20.924	34.797
	750	5.289	13.509	26.660
	1000	2.410	8.844	21.056
#138	1250	1.024	5.762	16.878
	1500	0.401	3.700	13.629
Creek	1750	0.143	2.329	11.040
	2000	0.046	1.432	8.948
Estuary	2250	0.014	0.858	7.243
	2500	0.004	0.499	5.848
	2750	0.001	0.282	4.705
	3000	0.000	0.155	3.769



Time-drawdown calculations using Theis equation

Aquifer parameters		
T	8.64E-01	m2/d
S	1.00E-04	
B		
Pumping rate		
Q	4.6	l/s

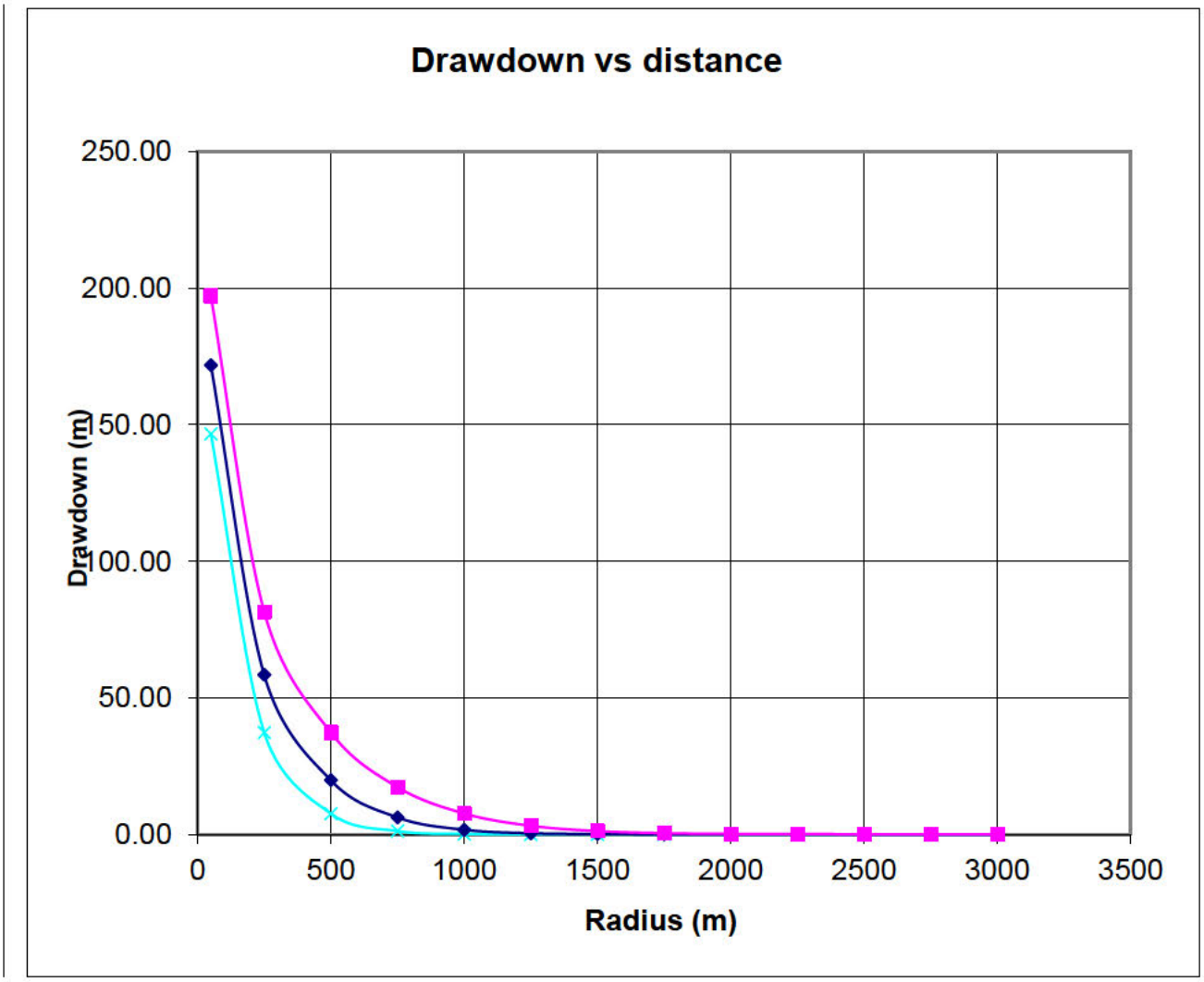
Radius (m)	50	500	1250
Time (days)	Drawdown (m)	Drawdown (m)	Drawdown (m)
0.5	54.749	0.000	-
0.75	67.928	0.000	-
1	77.613	0.003	-
7	146.621	7.596	0.008
14	171.805	19.767	0.357
21	186.585	29.485	1.451
28	197.084	37.294	3.092
45	214.416	51.438	7.968
60	224.932	60.597	12.378
75	233.092	67.928	16.539
90	239.760	74.039	20.387
180	265.118	97.985	38.093
365	290.989	123.128	59.721



Distance-drawdown calculations using Theis equation

Aquifer parameters		
T	0.864	m2/d
S	0.0001	
B		
Pumping rate		
Q	4.6	l/s

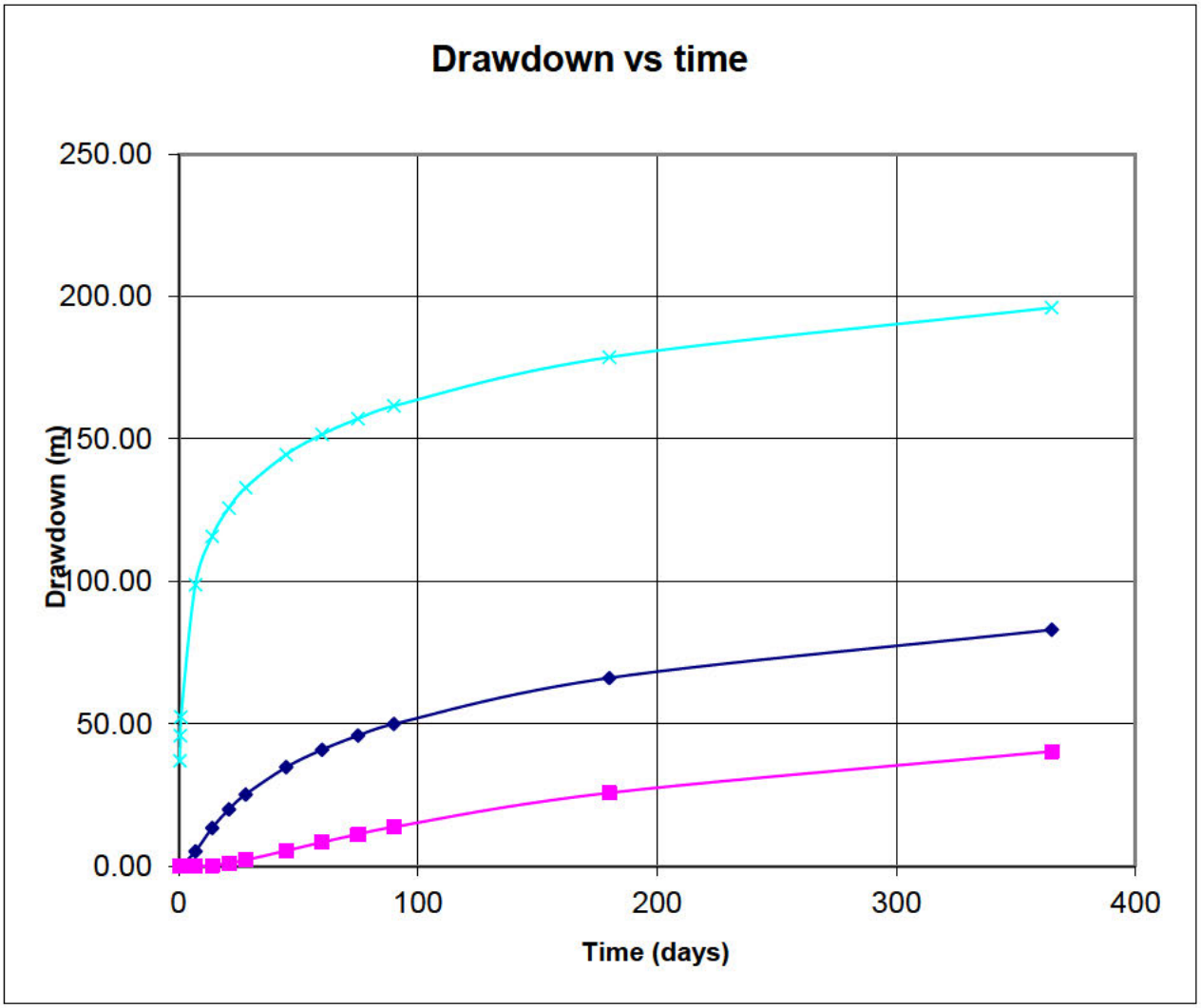
	Time (days)	7	14	28
	Radius (m)	Drawdown (m)	Drawdown (m)	Drawdown (m)
	50	146.621	171.805	197.084
	250	37.294	58.367	81.487
	500	7.596	19.767	37.294
	750	1.150	6.155	17.275
	1000	0.118	1.633	7.596
#138	1250	0.008	0.357	3.092
	1500	0.000	0.063	1.150
Creek	1750	0.000	0.009	0.388
	2000	-	0.001	0.118
Estuary	2250	-	0.000	0.032
	2500	-	0.000	0.008
	2750	-	-	0.002
	3000	-	-	0.000



Time-drawdown calculations using Theis equation

Aquifer parameters		
T	8.64E-01	m2/d
S	1.00E-04	
B		
Pumping rate		
Q	3.1	l/s

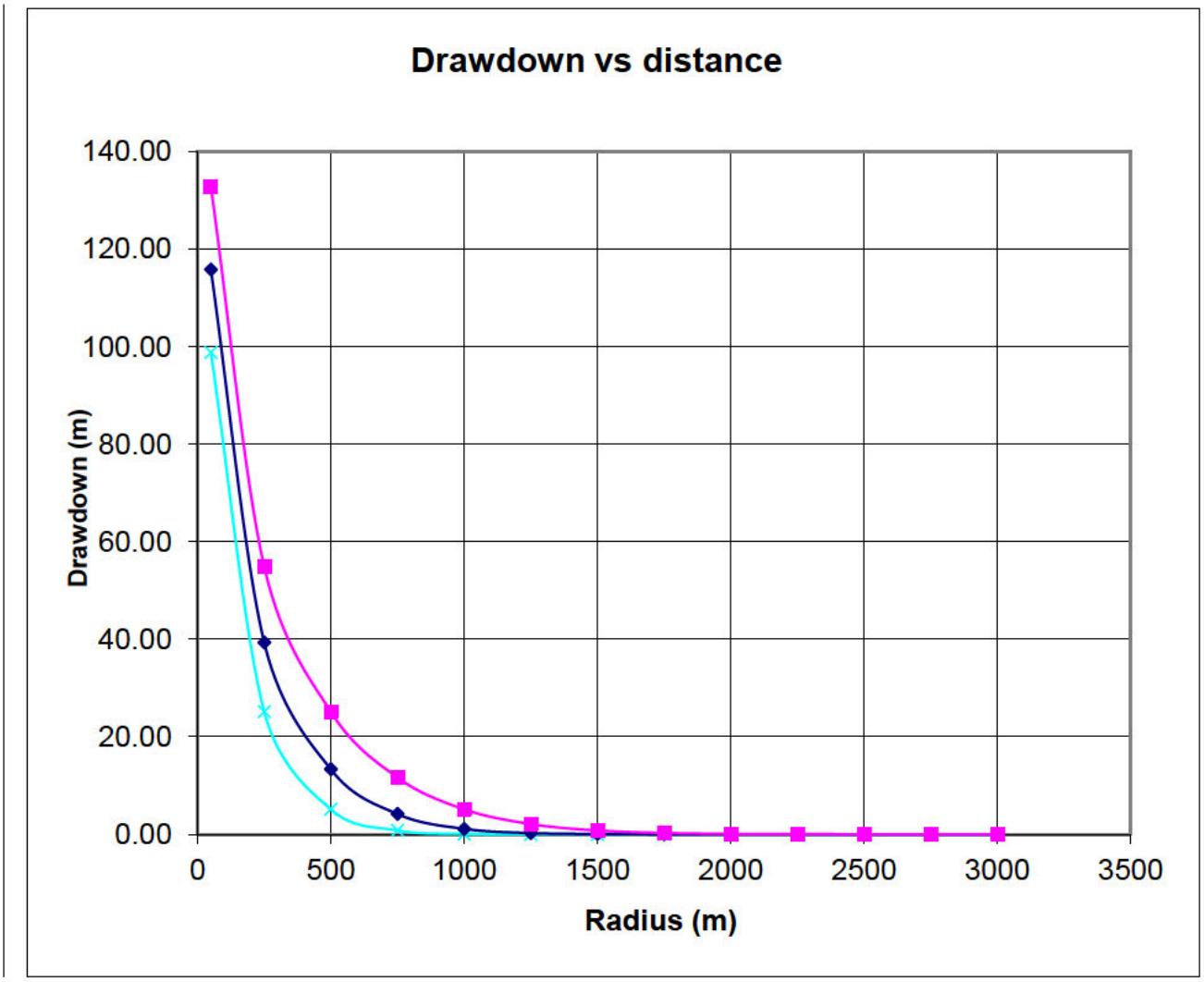
Radius (m)	50	500	1250
Time (days)	Drawdown (m)	Drawdown (m)	Drawdown (m)
0.5	36.896	0.000	-
0.75	45.778	0.000	-
1	52.304	0.002	-
7	98.810	5.119	0.005
14	115.782	13.322	0.241
21	125.742	19.870	0.978
28	132.818	25.133	2.084
45	144.498	34.665	5.370
60	151.585	40.837	8.341
75	157.084	45.778	11.146
90	161.577	49.896	13.739
180	178.667	66.033	25.672
365	196.101	82.978	40.247



Distance-drawdown calculations using Theis equation

Aquifer parameters		
T	0.864	m2/d
S	0.0001	
B		
Pumping rate		
Q	3.1	l/s

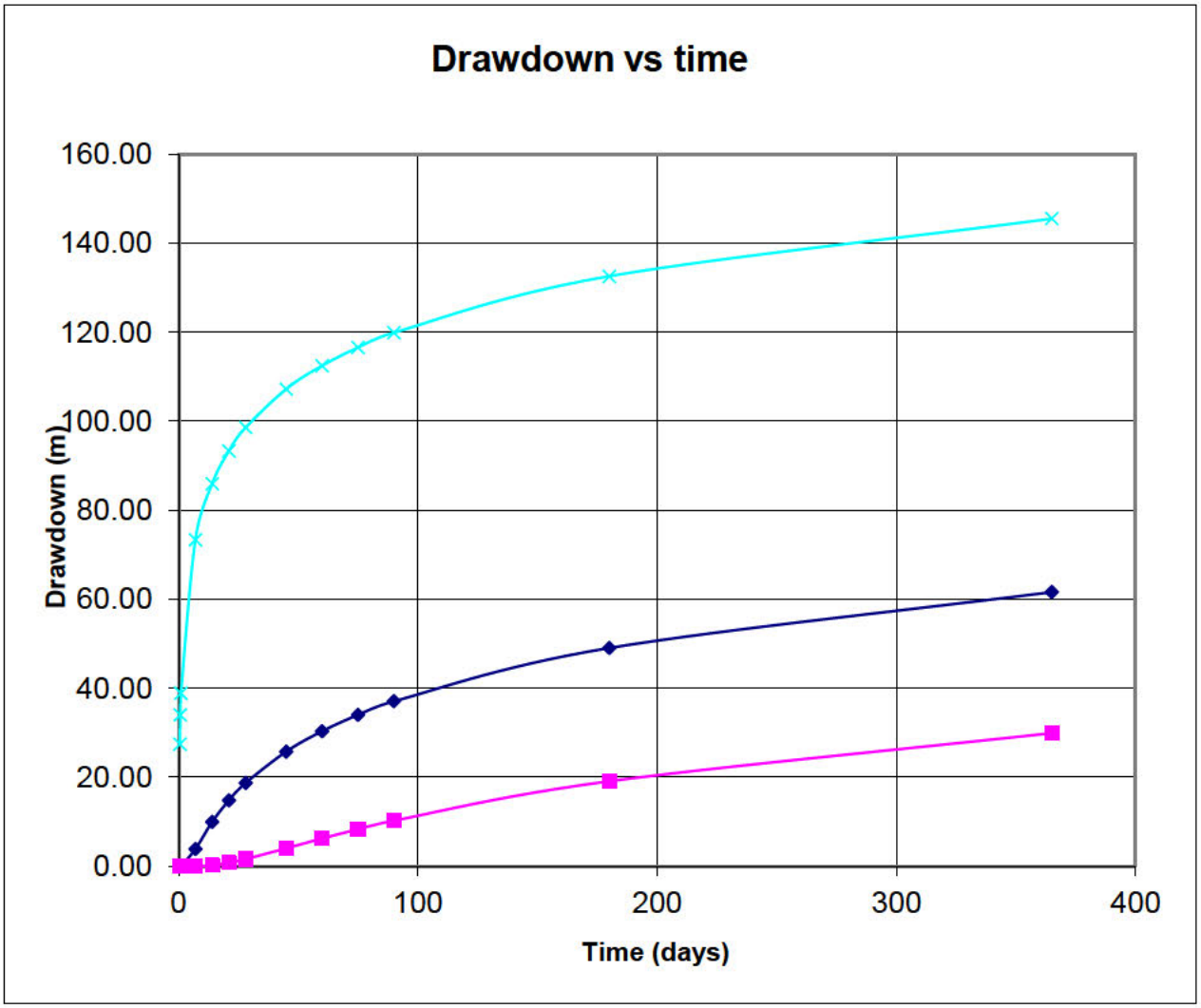
	Time (days)	7	14	28
	Radius (m)	Drawdown (m)	Drawdown (m)	Drawdown (m)
	50	98.810	115.782	132.818
	250	25.133	39.335	54.915
	500	5.119	13.322	25.133
	750	0.775	4.148	11.642
	1000	0.079	1.100	5.119
#138	1250	0.005	0.241	2.084
	1500	0.000	0.043	0.775
Creek	1750	0.000	0.006	0.261
	2000	-	0.001	0.079
Estuary	2250	-	0.000	0.022
	2500	-	0.000	0.005
	2750	-	-	0.001
	3000	-	-	0.000



Time-drawdown calculations using Theis equation

Aquifer parameters		
T	8.64E-01	m2/d
S	1.00E-04	
B		
Pumping rate		
Q	2.3	l/s

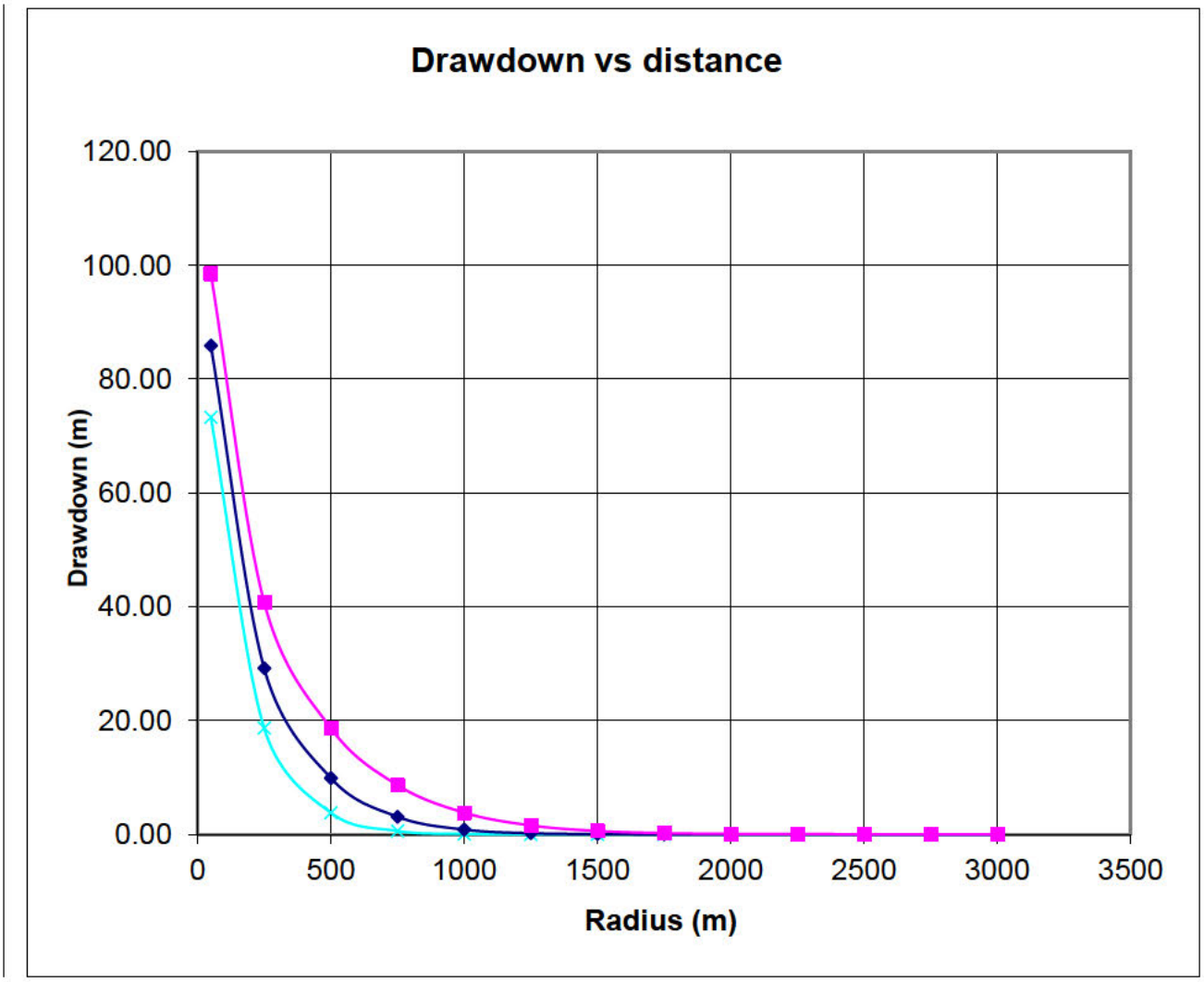
Radius (m)	50	500	1250
Time (days)	Drawdown (m)	Drawdown (m)	Drawdown (m)
0.5	27.375	0.000	-
0.75	33.964	0.000	-
1	38.806	0.002	-
7	73.310	3.798	0.004
14	85.903	9.884	0.179
21	93.292	14.743	0.726
28	98.542	18.647	1.546
45	107.208	25.719	3.984
60	112.466	30.298	6.189
75	116.546	33.964	8.269
90	119.880	37.020	10.194
180	132.559	48.992	19.047
365	145.494	61.564	29.861



Distance-drawdown calculations using Theis equation

Aquifer parameters		
T	0.864	m2/d
S	0.0001	
B		
Pumping rate		
Q	2.3	l/s

	Time (days)	7	14	28
	Radius (m)	Drawdown (m)	Drawdown (m)	Drawdown (m)
	50	73.310	85.903	98.542
	250	18.647	29.184	40.744
	500	3.798	9.884	18.647
	750	0.575	3.077	8.638
	1000	0.059	0.816	3.798
#138	1250	0.004	0.179	1.546
	1500	0.000	0.032	0.575
Creek	1750	0.000	0.005	0.194
	2000	-	0.001	0.059
Estuary	2250	-	0.000	0.016
	2500	-	0.000	0.004
	2750	-	-	0.001
	3000	-	-	0.000



APPENDIX 4:

AUP(OiP) Section E2
Objectives and Policies

1 May 2025

AUP(OiP) Section E2: Objectives and Policies
Forestry Road, Riverhead, Auckland

(Our Reference: 020190.000.001_10)

Table A4-1: AUP(OiP) Section E2

E2 Water quantity, allocation and use	
E2.2 Objectives	**ENGEO Review**
(1) Water in surface rivers and groundwater aquifers is available for use provided the natural values of water are maintained and established limits are not exceeded.	**Objective met** No reported abstraction limit and aquifer system not considered to be under stress.
(2) Water resources are managed within limits to meet current and future water needs for social, cultural and economic purposes.	**Objective met** Desktop assessment indicates groundwater abstraction is viable and is not likely to cause adverse impacts.
(3) Freshwater resources available for use are managed and allocated in order of priority to provide for domestic and municipal water supplies, animals, and economic development.	**Objective met** Abstraction requirements based on supplemental supply and limited potable use during drought conditions to support reasonable domestic use only. Requirement to restrict irrigation/landscaping demand during drought acknowledged in reporting.
(4) Water resources are managed to maximise the efficient allocation and efficient use of available water.	
(5) Mana Whenua values including the mauri of water, are acknowledged in the allocation and use of water.	
E2.3 Policies	**ENGEO Review**
(1) Manage the allocation of fresh water within the guidelines provided by Appendix 2 River and stream minimum flow and availability and Appendix 3 Aquifer water availabilities and levels and give priority to making freshwater available for the following uses (in descending order of priority): a. existing and reasonably foreseeable domestic and municipal water supply and animal drinking water requirements; b. existing lawfully established water users;	**Policy satisfied** No reported abstraction limit in Appendix 3 and aquifer system not considered to be under stress.

c. uses of water for which alternative water sources are unavailable or unsuitable; and d. all other uses.	
(2) Ensure allocations support the outcomes sought by relevant objectives and policies in B7.3 Freshwater systems.	N/A
(3) Manage the allocation of geothermal water, heat or energy within the guidelines provided by Appendix 3 Aquifer water availabilities and levels and give priority to making water, heat or energy available for (in descending order of priority): a. in accordance with tikanga Māori for the communal benefit of Mana Whenua of the area; b. existing lawfully established water uses; c. heating public pools; or d. all other uses.	N/A
(4) Promote the efficient allocation and use of freshwater and geothermal water by: a. requiring the amount of water taken and used to be reasonable and justifiable with regard to the intended use, and where appropriate: b. requiring consideration of water conservation and thermal efficiency methods; i. municipal water supplies are supported by a water management plan; ii. industrial and irrigation supplies implement best practice, in respect of the efficient use of water for that particular activity or industry; or iii. all takes (other than municipal water supplies from a dam) are limited to a maximum annual allocation based on estimated water requirements; c. facilitating the transfer of surface water take permits, provided the transfer is within the same surface water catchment and does not result in site-specific adverse effects; d. encouraging the shared use and management of water through water user groups or other arrangements where it results in an increased efficiency in the use and allocation of water; and e. providing for storage and harvesting of fresh water.	**Policy satisfied** Rainfall harvesting incorporated as practical to minimise groundwater demand. Abstraction required to water supply during periods of no/low rainfall.

(5) Manage the taking and use of surface water from rivers, streams and springs and taking and use of groundwater from aquifers to meet all of the following except where water allocation exceeds or is close to exceeding the guidelines (refer to Policy E2.3(10)): a. the minimum flow and availability guidelines in Table 1 River and stream minimum flow and availability in Appendix 2 River and stream minimum flow and availability are not exceeded; and b. the aquifer availability and groundwater levels in Table 1 Aquifer water availabilities and Table 2 Interim aquifer groundwater levels in Appendix 3 Aquifer water availabilities and levels are not exceeded.	**Policy satisfied** No reported abstraction limit in Appendix 3 and aquifer system not considered to be under stress.
(6) Require proposals to take and use water from lakes, rivers, streams, springs or wetlands to demonstrate all of the following: a. the taking of surface water from any river or stream is within the guideline in Table 1 River and stream minimum flow and availability in Appendix 2 River and stream minimum flow and availability, except in accordance with Policy E2.3(11); b. appropriate water levels and downstream flow regimes will be maintained, including: i. low flows in rivers and streams to protect in-stream values; ii. flow variability in rivers, streams and springs; iii. water levels and flows in wetlands ensure vegetation and habitat values of the wetland are protected throughout the year; iv. water levels in lakes maintain the ecological values and water quality of the lake and its shoreline stability, and enable recreational use; and v. existing lawfully established taking of water is not adversely affected; c. the taking of water will be at times of the day or year that will safeguard the identified freshwater values of the water body; d. intake structures will be designed, constructed, operated and maintained to avoid adverse effects on biota, including the entrainment and impingement of fish; and e. there are options for implementing water conservation measures in times of water shortage.	N/A

(7) Require all proposals to take and use groundwater from any aquifer to demonstrate that: a. the taking is within the water availabilities and levels for the aquifer in Table 1 Aquifer water availabilities and Table 2 Interim aquifer groundwater levels in Appendix 3 Aquifer water availabilities and levels, except in accordance with Policy E2.3(11), and meeting all of the following: i. recharge to other aquifers is maintained; and ii. aquifer consolidation and surface subsidence is avoided. b. the taking will avoid, remedy or mitigate adverse effects on surface water flows, including the following: i. base flow of rivers, streams and springs; and ii. any river or stream flow requirements and in particular the minimum stream flow and availability in Appendix 2 River and stream minimum flow and availability. c. the taking will avoid, remedy or mitigate adverse effects on terrestrial and freshwater ecosystem habitat; d. the taking will not cause saltwater intrusion or any other contamination; e. the taking will not cause adverse interference effects on neighbouring bores to the extent their owners are prevented from exercising their lawfully established water takes; f. Policy E2.3(7)(e) above will not apply in the following circumstances: i. where it is practicably possible to locate the pump intake at a greater depth within the affected bore; or ii. where it can be demonstrated that the affected bore accesses, or could access, groundwater at a deeper level within the same aquifer, if drilled or cased to a greater depth. g. the proposed bore is capable of extracting the quantity of groundwater applied for; and h. the proposal avoids, remedies or mitigates any ground settlement that may cause distress, including reducing the ability of an existing building or structure to meet the relevant requirements of the Building Act 2004 or the New Zealand Building Code, to any existing: i. buildings; ii. structures; or	**Policy satisfied** No reported abstraction limit in Appendix 3 and aquifer system not considered to be under stress. Desktop assessment indicates that dewatering effects are not anticipated to adversely impact identified receivers. Physical testing works to corroborate desktop assessment are underway.

iii. services including roads, pavements, power, gas, electricity, water and wastewater networks and fibre-optic cables.	
(8) Consider mitigation options, where there are significant adverse effects on the matters identified in policies E2.3(6) and (7) above, including any of the following: a. consideration of alternative locations, rates and timing of takes for both surface water and groundwater; b. use of alternative water supplies; c. use of water conservation methods when water shortage conditions apply d. provision for fish passage in rivers and streams; e. wetland creation or enhancement of existing wetlands; f. riparian planting; or g. consideration of alternative designs for groundwater dewatering proposals.	N/A
(9) Require proposals to take and use surface water and groundwater to monitor the effects of the take on the quality and quantity of the water resource and to: a. measure and record water use and rate of take; b. measure and record water flows and levels; c. sample and assess water quality and freshwater ecology; d. measure and record the movement of ground, buildings and other structures; and e. monitoring should be of a type and scale appropriate for the activity.	**Policy satisfied** Settlement and ecology effects not anticipated. Rate of groundwater take and volume to be recorded as required.
(10) Manage water availability, where water allocation exceeds or is close to exceeding the guidelines in Table 1 River and stream minimum flow and availability in Appendix 2 River and stream minimum flow and availability and Table 1 Aquifer water availabilities and Table 2 Interim aquifer groundwater levels in Appendix 3 Aquifer water availabilities and levels by: a. not granting new consent applications to take water except where provided for by Policy E2.3(11); b. reducing existing takes over time and phasing out any over allocation by: i. encouraging voluntary reductions in water allocations; and ii. reviewing existing consents to align water allocations to the actual historical use of water, for horticultural operators this will be averaged	N/A

across the full rotational cycle of the crops grown. c. exempting existing allocations for municipal water supply under Policy E2.3(10)(b)(ii) above from review where a water management plan demonstrates a necessary increase in abstraction to cater for planned urban growth; d. reviewing existing consents to require the efficient use of water; and e. accounting for takes expressly permitted in this Plan, or allowed under section 14(3)(b) of the Resource Management Act 1991.	
(11) Allow takes that exceed the guidelines in Table 1 River and stream minimum flow and availability in Appendix 2 River and stream minimum flow and availability and Table 1 Aquifer water availabilities and Table 2 Interim aquifer groundwater levels in Appendix 3 Aquifer water availabilities and levels in the following circumstances: a. For guidelines in Table 1 River and stream minimum flow and availability in Appendix 2 River and stream minimum flow and availability, when the river or stream flow is greater than the median flow, provided the total take does not exceed 10 per cent of the flow in the river or stream at the time of abstraction, and natural flow variability is maintained; or b. For all guidelines, where it is appropriately demonstrated in terms of the requirements of Policy of E2.3(6)(b) or Policy E2.3(7), that additional water is available for allocation.	N/A
(12) Consider the use of water shortage directions under section 329 of the Resource Management Act 1991 to impose temporary restrictions on water take, use, allocation, damming or diversion or discharge of contaminants into water in times of serious temporary water shortage, including where a river is at or below its Table 1 River and stream minimum flow and availability specified in Appendix 2 River and stream minimum flow and availability or groundwater levels are below the Table 2 Interim aquifer groundwater levels in Appendix 3 Aquifer water availabilities and levels having regard to the following priority uses: a. takes for firefighting purposes, allowed under section 14(3)(e) of the Resource Management Act 1991; b. takes expressly permitted in this Plan or allowed under section 14(3)(b) of the Resource Management Act 1991; c. consented or permitted takes for domestic and municipal water supply taken in accordance with a	N/A

water shortage management plan in any relevant Water Management Plan; d. takes for lifeline utilities, marae, residential accommodation and schools not connected to municipal water supply; e. takes for perishable food processing; or f. takes for irrigating water sensitive crops for human consumption.	
(13) When considering any application the Council must have regard to the following matters: a. the extent to which the change would adversely affect safeguarding the lifesupporting capacity of fresh water and of any associated ecosystem; and b. the extent to which it is feasible and dependable that any adverse effect on the life-supporting capacity of freshwater and of any associated ecosystem resulting from the change would be avoided.	N/A
(14) Policy E2.3(13) applies to: a. any new activity; and b. any change in the character, intensity or scale of any established activity that involves any taking, using, damming or diverting of freshwater or draining of any wetland which is likely to result in any more than minor adverse change in the natural variability of flows or level of any fresh water, compared to that which immediately preceded the commencement of the new activity or the change in the established activity (or in the case of a change in an intermittent or seasonal activity, compared to that on the last occasion on which the activity was carried out).	N/A
(15) Policies E2.3(13) and (14) do not apply to any application for consent first lodged before the National Policy Statement for Freshwater Management 2011 took effect on 1 July 2011.	N/A
(16) Develop catchment specific limits for freshwater quantity with Mana Whenua, through community engagement, scientific research and mātauranga Māori.	N/A
(17) Require resource consents granted to take, use or dam water and to discharge contaminants to land or freshwater to be for a duration and to include a condition setting the review date(s) of the consent, that will enable the concurrent processing or review of all consents/replacement applications, as a basis for a comprehensive and integrated assessment of water quality and water quantity issues in a specific catchment and/or aquifer system.	N/A

(18) Encourage the off-stream damming of water in preference to the damming of rivers or streams.	N/A
(19) Avoid damming water in the Natural Lake Management Areas Overlay, Wetland Management Areas Overlay and Natural Stream Management Areas Overlay other than where: a. these areas are in a Water Supply Management Areas Overlay and the damming is necessary for municipal water supply; b. the damming is necessary for the protection or maintenance of the natural values of the management area and there are no practicable alternative methods to achieve this protection; or c. the damming is necessary for managing hazards or the provision of infrastructure and there are no practicable alternatives to damming the water.	N/A
(20) Require proposals to dam a river to demonstrate the following: a. adverse effects on fish passage are avoided or remedied, where native fish and/or habitats actually or potentially exist upstream; b. appropriate water levels and downstream flow regimes will be maintained c. existing lawfully established upstream and downstream water uses are not adversely affected by the damming proposal, including those allowed by section 14(3)(b) of the Resource Management Act 1991; d. Mana Whenua values associated with the wetland, lake or river are identified and the effect of the proposal on these values are assessed and taken into account e. the design, construction, operation and maintenance of the dam avoids significant adverse effects and remedies or mitigates other effects f. if applicable, recognise the Vision and Strategy for the Waikato River in Schedule 2 of the Waikato-Tainui Raupatu Claims (Waikato River) Settlement Act 2010.	N/A
(21) Require proposals for new, change or replacement applications to dam a river or stream or dam water with an off-stream dam to undertake monitoring of a type and scale appropriate for the activity and its effects	N/A
(22) Require proposals to divert surface water to demonstrate the diversion will to the extent practicable avoid significant adverse effects and remedy or mitigate other adverse effects including where relevant, effects on:	N/A

a. existing lawfully established surface water takes including those allowed by section 14(3)(b) of the Resource Management Act 1991; b. existing buildings, structures and services; c. existing flood hazard risks; d. river bank stability; e. scheduled historic heritage places or scheduled sites and places of significance to Mana Whenua; f. people and communities; and g. the life supporting capacity of freshwater, ecosystem processes, and indigenous species and their ecosystems.	
(23) Require proposals to divert groundwater, in addition to the matters addressed in Policy E2.3(6) and (7) above, to ensure that: a. the proposal avoids, remedies or mitigates any adverse effects on: i. scheduled historic heritage places and scheduled sites and places of significance to Mana Whenua; and ii. people and communities b. the groundwater diversion does not cause or exacerbate any flooding; c. monitoring has been incorporated where appropriate, including: i. measurement and recording of water levels and pressures; and ii. measurement and recording of the movement of ground, buildings and other structures. d. mitigation has been incorporated where appropriate including: i. minimising the period where the excavation is open/unsealed; ii. use of low permeability perimeter walls and floors; iii. use of temporary and permanent systems to retain the excavation; or iv. re-injection of water to maintain groundwater pressures.	N/A: proposal is take and use of groundwater, not diversion

(24) Require proposals to drill holes or bores to demonstrate that the location, design and construction: a. complies with the New Zealand Standard on the Environmental Standard for Drilling of Soil and Rock (NZS 4411:2001); b. prevents contaminants from entering an aquifer; c. prevents cross-contamination between aquifers with different pressure, water quality or temperature; d. prevents leakage of groundwater to waste; e. avoids the destruction, damage or modification of any scheduled historic heritage place or scheduled sites and places of significance to Mana Whenua; and f. avoids disturbance of wetlands and significant ecological areas where practicable.	**Policy satisfied** Permit application for groundwater abstraction test bore in progress.
(25) Enable regionally significant mineral extraction activities (extraction within groundwater and dewatering) provided that significant adverse effects are managed through considering all of the relevant policies in this section.	N/A