WGA

TECHNICAL MEMORANDUM

PROJECT NO.: WGA250988

DOCUMENT NO: WGA250988-MM-HG-0001_C

DATE: 7 NOVEMBER 2025

COMPANY NAME	Gordon Litt Farms Limited
ATTENTION	Briar Belgrave
SUBJECT	Outline of Hydrogeological Assessment for Fast track

1. PROJECT OVERVIEW

Orchard Grove ('the site') is of irregular shape and is approximately 72 hectares, and is situated within the Waikato District, directly adjoining the territorial boundary of Hamilton City to the south.

The site consists of six parcels held in five Records of Title as identified in the Planning Memorandum prepared by Barker & Associates. The site can be accessed by Reynolds Road to the north, Resolution Drive to the east, Kay Road to the south, and Osborne Road to the west. Kay Road lies within the shared jurisdiction of Waikato District and Hamilton City Councils.

The Orchard Grove masterplan is shown in Figure 1. The proposal is for a staged and comprehensively designed residential development (including subdivision, earthworks and land use). The proposal includes subdivision to create residential lots, a small neighbourhood centre, open space and recreation areas, roading and walking and cycling facilities, three waters infrastructure, and all associated site and civil works.

Approval is required under the Resource Management Act 1991 from Waikato District Council and Waikato Regional Council and Wildlife Act 1953.

The majority of the development consists of low-lying, flat farmland. Existing drainage channels traverse the property, discharging to the Otama-ngenge stream that ultimately flows into the Waikato River. WGA understands that stormwater and wastewater are to be managed entirely on-site.

WGA understand that there are between 815 houses planned for the development. Therefore, based on the RITS (2.7 people per house, 260 L per person/day) the maximum daily water requirement for the residential development will be 572 m^3/day.

2. HYDROGEOLOGICAL INTRODUCTION

The hydrogeological assessment has been prepared to support the proposed development at Orchard Grove. It addresses the following activities that may interact with groundwater systems:

- The construction and ongoing operation of the stormwater management infrastructure
- General construction activities involving excavations below the water table
- The construction and ongoing operation of wastewater treatment and disposal Infrastructure
- The operation of production bores to supply domestic water for the development

The site is underlain by a shallow groundwater table that is hydraulically connected to nearby surface water features, including wetlands and streams. As a result, a detailed hydrogeological assessment is necessary to ensure the potential effects of the proposed urban development are appropriately understood and managed. Table 1 outlines the types of activities associated with infrastructure development that may impact groundwater and hydraulically connected surface water bodies.

The proposed activities are typical of land development projects in the Hamilton region. A range of standard monitoring and mitigation measures may be applied to manage potential effects, including the installation of groundwater monitoring bores, modifications to drainage design, reduced pumping rates and interventions to limit hydraulic connectivity in sensitive areas.

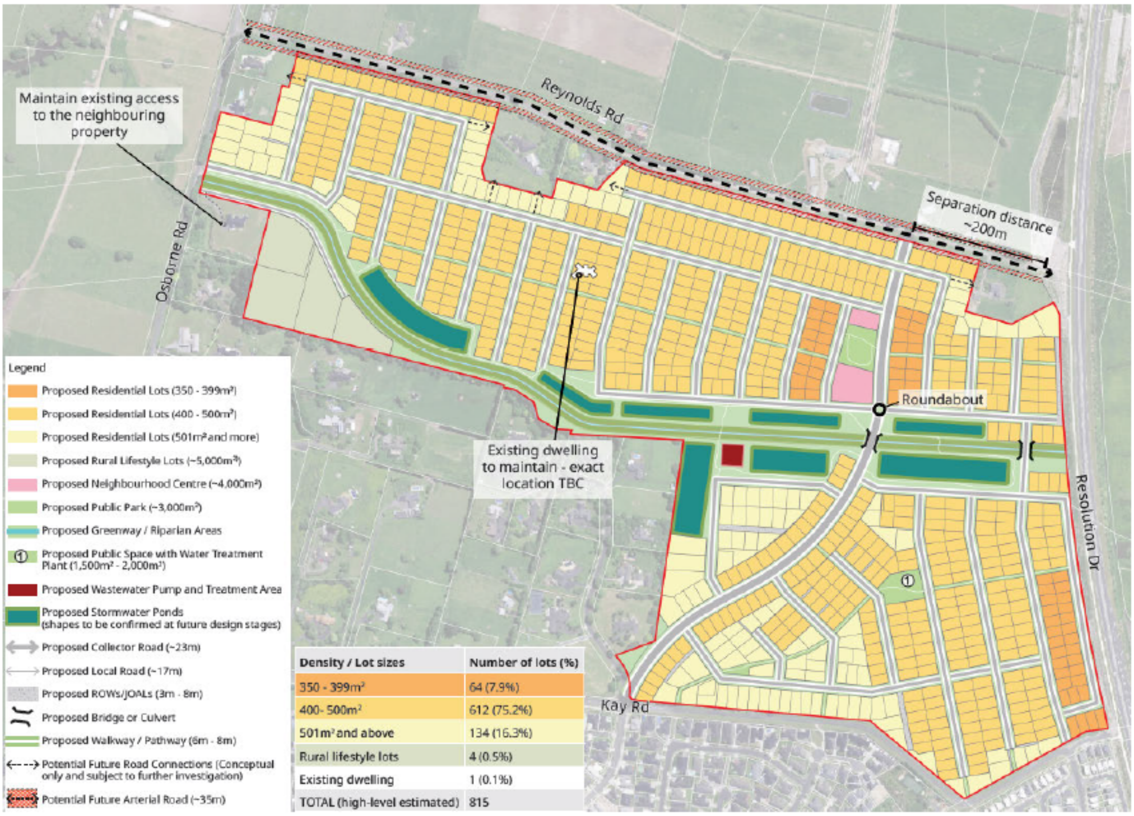

Figure 1: Proposed Site Masterplan

Table 1: Activities Which Require Resource Consent and Affect Hydrogeology

ACTIVITY	TECHNICAL ASSESSMENTS REQUIRED	CONSENTS
Stormwater Management Infrastructure		
Temporary and permanent diversion of surface water	Groundwater/hydrogeology, including effects on wetlands and settlement	Discretionary Activity under WRP Rule 3.6.4.13 Discretionary Activity under Regulation 54 of the NESFW
Permanent damming and diversion of groundwater (changes to groundwater flows resulting from the creation of the stormwater infrastructure)	Groundwater/hydrogeology, including effects on surface water bodies/wetlands, other groundwater users, mobilisation of contaminants, and settlement. The stormwater infrastructure may permanently lower the local water table, therefore requiring consent for a groundwater diversion.	Discretionary Activity under WRP Rule 3.6.4.13 Discretionary Activity under Regulation 54 of the NESFW
Temporary water takes during construction for dewatering/lowering of the groundwater table	Dewatering during construction to lower the groundwater table or maintain a dry environment within excavations may be undertaken using spears. The take will be classified as a groundwater take and will require an assessment of the effects on aquifer sustainability, other bore users, and surface water bodies (including wetlands), mobilisation of contaminants, ecological and cultural effects.	Controlled activity under WRP Rule 3.8.4.7 (drilling) Discretionary Activity under WRP Rule 3.3.4.24 (groundwater take)

ACTIVITY	TECHNICAL ASSESSMENTS REQUIRED	CONSENTS
Construction of specified infrastructure including earthworks and clean fill disposal	Groundwater/hydrogeology including effects on wetlands.	Discretionary Activity under Regulation 54 of the NESFW
Geotechnical and groundwater investigations	There will be a need to facilitate further groundwater and geotechnical investigation and monitoring to obtain additional information and to monitor the impact of the works on groundwater levels. This will occur prior to work, during work, and post-work.	Controlled Activity under WRP Rule 3.8.4.7 (drilling) Discretionary Activity under WRP Rule 3.3.4.24 (groundwater take) Controlled Activity under WRP Rule 3.6.8.2 (well and aquifer testing discharges)
Wastewater Treatment and Disposal Infrastructure		
Permanent damming and diversion of groundwater (changes to groundwater flows resulting from creation of the wastewater treatment and disposal infrastructure)	Groundwater/hydrogeology including effects on surface water bodies/wetlands, other groundwater users, mobilisation of contaminants, and settlement. The stormwater infrastructure may permanently lower the local water table, therefore requiring consent for a groundwater diversion.	Discretionary Activity under WRP Rule 3.6.4.13 Discretionary Activity under Regulation 54 of the NESFW
Temporary water takes during construction for dewatering/lowering of the groundwater table	Dewatering during construction to lower the groundwater table or maintain a dry environment within excavations may be undertaken using spears. The take will be classified as a groundwater take and will require an assessment of the effects on aquifer sustainability, other bore users, and surface water bodies (including wetlands), mobilisation of contaminants, ecological and cultural effects.	Controlled activity under WRP Rule 3.8.4.7 (drilling) Discretionary Activity under WRP Rule 3.3.4.24 (groundwater take)
Construction of specified infrastructure including earthworks and clean fill disposal	Groundwater/hydrogeology including effects on wetlands.	Discretionary Activity under Regulation 54 of the NESFW
Treatment and disposal of wastewater	The potential effects of discharging treated wastewater will need to be assessed. This required assessment will need to assess effects on surface water bodies/wetlands and other groundwater users.	Controlled Activity under WRP Rule 3.5.7.5
Drinking Water Infrastructure		
Abstraction of Groundwater for domestic water supply	Groundwater/hydrogeology, including effects on surface waterbodies/wetlands, and other groundwater users.	Controlled activity under WRP Rule Section 3.

3. HYDROGEOLOGICAL BACKGROUND

3.1 Regional Hydrogeology

The development is located within the Hamilton Basin, a large tectonic basin centred on Hamilton City with an area of approximately 2,000 km^2 and traversed by the Waikato River. The basin is infilled with Tauranga Group alluvial sediments deposited from the Pliocene through to the middle Holocene and overlain by late Holocene unconsolidated alluvial and colluvial sediments.

The Tauranga Group sediments reach a thickness of up to 300 m and comprise a mix of gravels, sands, silt, muds and peats of fluvial, lacustrine and distal ignimbritic origin.

The development is primarily underlain by the Hinuera Formation, which was deposited by braided river systems of the Waikato River. These systems were fed by large volumes of sediment from volcanism in the Taupo Volcanic Zone (Petch, 1987). The Hinuera Formation hosts the most extensively used aquifers in the Hamilton Basin. Within this formation, the most productive aquifers consist of well-sorted coarse sands and gravels. Discontinuous sequences of rhyolitic and pumiceous gravelly sands and gravels are interspersed with pumiceous silt, clay and peat layers. Lithological variability generally results in a number of zones of higher permeability within the formation rather than a single, continuous aquifer (Scholfield, 1972).

Regionally, the water table generally mirrors the topography of the basin, and groundwater flow is directed towards the Waikato and Waipa rivers. Groundwater discharges via incision into streams and rivers, which ultimately flow into these two major river systems before they exit the basin.

3.2 Local Hydrogeology

According to the Waikato Regional Council (WRC) database, approximately 133 bores are located within a three-kilometre radius of the development. Details of these bores are provided in Appendix A. In addition, the New Zealand Geotechnical Database (NZGD) identifies 13 geotechnical investigation sites within the vicinity of the development.

A review of available bore logs and geotechnical records indicates the local geology is characterised by alternating layers of sand, gravel, silt and clay, consistent with sedimentary sequences typical of the Hamilton Basin.

The northern and southern margins of the site are bound by low hills comprised of the Walton Group, which is characterised by low permeability, highly reworked tephra.

Groundwater levels recorded at the NZGD investigation sites typically range from 1.5 to 3 m below ground level.

3.3 Surface Water Bodies

The primary surface water feature on the site is an open drain that conveys water westward, joining the Otama-ngenge stream. This stream ultimately discharges into the Waikato River, approximately 2 km northwest of the development. The development is part of the Otama-ngenge Catchment, as defined by in the Waikato District Council’s Integrated Catchment Management Plans.

3.4 Wetlands

Wetland areas have been identified by Eco-Solutions (Ecological Solutions, 2025) in both the northeast and southeast corners of the site. In the north, wetlands are situated at the base of gently sloping hills, while in the south, they occur at the foot of steeper terrain. Satellite imagery indicates the southern wetlands are at least partially fed by groundwater seepage from the adjacent hillslopes.

3.5 Nearby Water Users

Data obtained from the WRC bore database indicates the presence of multiple bores in the area surrounding the development. Several of these bores are linked to active resource consents for groundwater abstraction.

Nearby bores range in depth from less than 10 m up and up to 60 m. Consented abstraction bores are used for agriculture, primarily to support dairy farming activities. These bores typically have maximum daily allocations ranging from 30 and 70 m^3, with bore depths commonly between 25 and 50 m.

4. KEY HYDROGEOLOGICAL EFFECTS TO BE ASSESSED

The hydrogeological assessment considers the following potential effects on groundwater arising from the proposed development activities:

Earthworks and Stormwater Infrastructure

- Groundwater seepage into temporary excavations and associated dewatering requirements.
- Localised groundwater drawdown resulting from dewatering, with potential effects on existing road infrastructure and sensitive environments such as wetlands (i.e., reduced groundwater levels affecting wetland hydrology).
- Management and potential effects of discharging dewatered groundwater.
- Groundwater mounding beneath soakage systems or constructed wetlands, which may alter local groundwater gradients.

Onsite Wastewater Treatment and Disposal

- Groundwater ingress into any temporary excavations and associated dewatering activities
- Potential effects from the infiltration or land application of treated wastewater

Water Supply Options from Groundwater

- Potential exploration drilling for a decentralised water supply system.
- Assessment of drawdown effects from any proposed take on nearby bores and surface water bodies.

5. METHODOLOGY FOR THE GROUNDWATER ASSESSMENT

WGA has experience modelling groundwater effects of the excavation work for nearby recent residential developments Rotokauri Rise and Rotokauri Greenway. Insights gained from these projects will inform the current assessment. In addition, WGA staff have played a key role in reviewing groundwater effects for the Waikato Expressway – Hamilton Section, further improving the team's understanding of local hydrogeological conditions.

5.1 Earthworks and Stormwater Network

WGA proposes to collaborate closely with geotechnical specialists and design engineers to build upon current groundwater knowledge and provide guidance for additional testing of the local hydraulic properties. Once the underlying local soil hydraulic properties are ascertained, WGA will then be able to assess the potential mounding effects of any planned soakage systems within the stormwater management network. Given the high groundwater levels and expected low permeability of the shallow soils, WGA proposes using the MOUNDSOLV software package developed by HydroSOLVE to assess potential groundwater mounding effects of the planned soakage systems.

Once local soil hydraulic properties are ascertained, the potential dewatering effects of any construction activities that require excavations below the water table can be assessed. WGA proposes to use a combination of analytical tools, such as trench models and pit models, to assess temporary and long-term groundwater drawdown as a result of any construction activities that require excavations below the water table. Additionally, WGA can build upon these models to undertake 2D finite element groundwater modelling if deemed required for excavations conducted in sensitive areas.

Once the mounding and groundwater drawdown risk has been analysed, WGA proposes that a monitoring plan will be developed to ensure any potential groundwater drawdown or mounding linked to potentially significant impacts can be detected and mitigated before these impacts arise.

Building upon this monitoring plan, mitigation measures will be developed and documented so that they may be put in place to reduce any calculated groundwater drawdown at the site both during the construction period and following completion of the earthworks, including, for example:

- Design, installation and monitoring of groundwater level measurement systems.
- Options to modify dewatering systems to reduce the magnitude and extent of groundwater drawdown.
- Optimise pumping rates and incorporate transient adjustments in pumping rates.
- Returning pumped water to the ground in areas where drawdown may lead to excessive ground settlement or other impacts.
- Reduction in hydraulic connections between groundwater and surface water bodies to reduce the effects of drawdown in sensitive areas.

5.2 Onsite Wastewater Treatment and Disposal Infrastructure

WGA proposes to assess the effects of the planned wastewater treatment and discharge facilities by undertaking attenuation modelling using microbial removal rates documented in Pang (2009). WGA proposes to use E. coli and rotavirus in the attenuation modelling as these are less likely to be removed by natural attenuation compared to other pathogens.

Once the groundwater quality risk from the wastewater treatment and discharge facilities has been assessed, WGA proposes that a monitoring plan will be developed to ensure groundwater is not affected by any wastewater discharge.

If excavations below the water table are required for the construction and operation of the wastewater treatment and disposal infrastructure, WGA will assess these using the same methods proposed for the dewatering associated with the stormwater infrastructure and detailed in Section 5.1. WGA propose that a similar groundwater monitoring plan be developed to ensure any potential groundwater drawdown or mounding linked to potentially significant impacts can be detected and mitigated before these impacts arise.

5.3 Onsite Water Supply Options

WGA has undertaken a high-level initial desktop assessment on possibilities for bore water supply to a potential suburban development area, together with comments on potential issues, constraints, and opportunities.

Our initial desktop assessment concluded that new water supply bores on site can provide drinking water during the development of the land parcels. Other bores in the area have achieved sufficiently high abstraction rates to satisfy the requirements of the development. For example, the Zealong Tea Estate, approximately 4 km from the development, is abstracting 1246m^3/day from a 138 m deep bore. Shallower bores nearby have lower abstraction rates, and it’s likely that a similarly shallow bore (<60 m deep) would not be able to provide sufficient water for the development without potentially affecting nearby bores. By targeting a deeper aquifer drawdown at nearby shallow bores would be minimized by vertical separation of the takes. WGA notes that water quality testing would be essential during exploration drilling as water quality issues such as high salinity have arisen in some water bores previously tested in the area.

WGA also understand that some water may be required during the construction phase for dust suppression and other construction-related activities. For this purpose, there are a number of existing bores on site that may be able to serve as temporary water supplies. Having investigated some of these bores and discussed their operation with the current farm manager, WGA notes that the amount of water they will be able to supply may be limited, especially during summer when the need for dust suppression is at its highest. Therefore, additional bores may be required for temporary supply.

In order to construct the required groundwater supply bores for the development, WGA proposes to use the following workflow for each of the bores outlined below:

Gather Background Site Information

- Carry out a desktop survey of the site to establish local lithological information and identify any factors that may affect, or be affected by, the proposed groundwater takes.

Drill Pilot Bore

- Drill a 75 mm pilot bore to inform the precise depth that the test bore and production bore will target.
- Collect and record underlying lithology.
- Determine from the underlying stratigraphy if the site is suitable or if another location is needed.

Construct Test Bore

- Drill a 100 mm test bore and carry out a production test.
- Collect a water sample during the production test and have it analysed.
- Decide if the target aquifer can provide the desired water volumes and quality or if the bore needs to be drilled into a deeper aquifer.

Construct Production Bore

- Drill and construct a production bore close to the test bore. The diameter of the production bore will be determined based on pump and water requirements.
- Undertake a stepped rate and constant rate pumping test on the production bore.
- Analyse the pumping test data and carry out forward projections to assess the effects of operating the production bore.

6. CONCLUSION

Based on WGA's experience and the information available to date, including regional hydrogeological data, site-specific assessments, and comparable nearby developments, there is no indication of any significant constraints that would prevent the proposed development from proceeding under a fast-track consenting process.

The potential effects on groundwater, such as drawdown during construction dewatering, mounding from soakage systems, and impacts from on-site wastewater discharge, are generally understood and can be appropriately managed.

WGA considers the potential adverse effects on the surrounding groundwater and surface water environment can be managed to an acceptable level.

7. QUALIFICATIONS AND EXPERIENCE

7.1 Clare Houlbrooke – Principal Hydrogeologist, Project Lead

Clare is a Principal Hydrogeologist (BSc, MSc (Hons) Earth Sciences) with more than 20 years' experience in hydrological resource investigations. Clare's focus is sustainable management of groundwater resources and connected surface water systems. Clare has worked in two regional councils as a Groundwater Scientist over a nine-year period, and as a consultant has continued to support regional councils with the review of groundwater-related resource consent applications, including reviewing the groundwater effects of the recently completed Waikato Expressway. Clare has been based in the Waikato for 11 years and has in-depth knowledge of the local hydrogeological conditions. She has prepared and presented evidence in regional council resource consent hearings and in Environment Court as an expert witness.

7.2 Brett Sinclair – Senior Principal Hydrogeologist, Project Reviewer

Brett is a Principal Hydrogeologist (BSc, MSc Geology) with more than 30 years' experience in hydrogeology, geology, water management, water quality assessment and environmental effects mitigation. He specialises in the evaluation, utilisation, management, and protection of groundwater resources and groundwater-dependent surface water resources. Brett provides specialist hydrogeological support for geotechnical assessments, including major civil infrastructure projects. He has undertaken numerous peer reviews of applications for site dewatering and infrastructure construction projects on behalf of regulatory authorities.

7.3 Catherine Howell – Senior Hydrogeologist, Technical Assessments

Catherine is a Hydrogeologist with a Masters in Groundwater Studies and over 15 years of experience in the United Kingdom, Australia and New Zealand. Catherine has gained experience in hydrogeological investigations through roles in both regulatory bodies and consultancy. Her hydrogeological assessment experience includes pump test analysis, regional-scale water assessments, water quality monitoring, and project management. Catherine has prepared a technical assessment of effects for other nearby construction works within the Rotokauri development area including effects of dewatering and soakage.

8. REFERENCES

Ecological Solutions. (2025). Orchard Grove Fast Track Referral Application Memorandum – Ecology.

Lowe, D.J. (2010). Introduction to the landscapes and soils of the Hamilton Basin. In: Lowe, D.J.; Neall, V.E., Hedley, M; Clothier, B.; Mackay, A. 2010. Guidebook for Pre-conference North Island, New Zealand “Volcanoes to Oceans” field tour (27-30 July). 19th World Soils Congress, International Union of Soil Sciences, Brisbane. Soil and Earth Sciences Occasional Publication No. 3, Massey University, Palmerston North, pp. 1.24-1.61.

Schofield JC. (1972). Groundwater of the Hamilton Lowland. New Zealand Geological Survey Bulletin No.89.

Pang, L. (2009). Microbial removal rates in subsurface media estimated from published studies of field experiments and large intact soil cores. Journal of Environmental Quality. 38, American Society of Agronomy, Crop Science Society of America, Soil Science Society pp. 1531–1559.

Yours Sincerely

Clare Houlbrooke
Principal Hydrogeologist
WALLBRIDGE GILBERT AZTEC

APPENDIX A NEARBY GEOTECHNICAL INVESTIGATION SITES AND BORES

APPENDIX A
NEARBY GEOTECHNICAL INVESTIGATION SITES AND BORES

Table A1: Nearby Investigation Sites from NZGD Database MAY 2025

WRC IDENTIFIER	DEPTH (m)	STATIC WATER LEVEL (m)
72_5001	4	42
69_1611		40
69_1282		40.2
72_6998		
72_8159	11.8	31.95
69_1588	2.1	10
72_6465		24
69_577	29.8	50.5
62_55		57
72_11735	0.6	0.85
69_775		5
72_11675		21.45
69_827		
69_826		
69_1500		
72_9482		25.94
72_9474		21
72_10232		7
72_11549		50
72_9355		20
72_8165		52.77
69_828		9.75
72_11637		57
72_8096		19.92
72_11673		8.5
72_10734	3	11
72_9356		45.45
72_11553		64.5
72_11685		30.45
72_6404		25
72_661	6	7.2
72_12208	5.5	8.5
72_10825	2	12
72_8166	3	24.45
72_12572		19.7
72_6397		51
69_1349	25.6	49
72_8160	8.1	32
72_9385	8.3	97.9
69_543		28
69_854		57.9
69_1732	12	24

WRC IDENTIFIER	DEPTH (m)	STATIC WATER LEVEL (m)
72_10163	20.6	49.5
72_5695		20.5
69_1856		46.9
69_845		40.8
72_5466	18	46.6
72_12662	11.8	31.95
72_9263		
72_10294	1.8	4.5
72_10298	1.8	4.5
72_10304	3.4	15.05
72_11616	32.3	67
69_601		46.5
69_1062		27
72_6988		
72_10257		8
72_5000	1	24
72_7227		21
69_1479		42
72_12622	18	114
69_1723		5
72_5694		19.95
72_6987		
72_6986		
72_7226		23
69_1912		44.5
72_5		35
69_542		28
72_1688	23	47
72_3489	21	58.5
72_9282		
72_9170		1,000
72_10156	5.7	60
72_5006	35	56
72_9280		30
72_9281		
72_11548		15.45
72_10701	10.66	32.35
72_11450	26.81	58.38
72_7271		20
72_3918	2	90.4
62_38		94.4
62_100	18.5	30
72_12199		46.5

WRC IDENTIFIER	DEPTH (m)	STATIC WATER LEVEL (m)
62_49		47.25
72_8093		30.45
72_7648		
69_2037		11.26
69_2038		1.93
69_2035		11.11
69_2041		11.21
69_2040		6.62
69_2033		2.03
69_2039		3.66
69_2034		3.46
69_2036		5.14
69_2032		2.03
72_3081		15
72_11111	27.8	101.5
72_2630	7.1	11
72_9593		20
72_2629	9	13.95
72_1303	0	50
72_7649		
72_4270	16.1	32
72_6364		51.8
72_11152		
72_2229	18	33
72_2349		27
72_5171	1.95	7
69_1428	2.1	4.55
69_1426	3	4.2
69_1427	2.3	5.2
72_9264		
72_6403		23
72_1996	12	30
72_6466		34
72_766	3.5	9.5
69_2009		1
69_2012		1
69_2010		2
69_2014		1
69_1425		1
69_2013		1.5
69_2011		1
69_2015		1
62_113		33.5

WRC IDENTIFIER	DEPTH (m)	STATIC WATER LEVEL (m)
72_9464		49.79
72_8157	17.4	26.22
72_9489		19.95
72_6985		
69_1418	7.9	10.3

Table A2: Nearby Investigation Sites from NZGD Database MAY 2025

NZGD ID:	INVESTIGATION TYPE	DEPTH (m)	STATIC WATER LEVEL (m)	GEOLOGICAL SUMMARY
73321	SCP	9.5	0.6	Interspersed layers of sandy silt, silty sand and clay
7322	SCP	7	0.9	Interspersed layers of sandy silt, silty sand and clay
140595	SCP	10.8	3.11	Interspersed layers of sandy silt, silty sand and clay.
150596	SCP	11.4	2.72	Interspersed layers of sandy silt, silty sand and clay.
142462	SCP	20	2.0	Interspersed layers of sandy silt, silty sand and clay
142463	SCP	20	2.6	Interspersed layers of sandy silt, silty sand and clay
142464	SCP	20	2.3	Interspersed layers of sandy silt, silty sand and clay
77263	Test Pit	6	Not encountered	0.2 m of SAND GRAVEL underlain by 5.8 m of Clayey SILT and SILT.
77264	Test Pit	5.5	5.5	0.5 m of silty sandy GRAVEL underlain by 2.6 m of Clayey SILT and SILT. This is further underlain by 1.5 m of pumiceous SAND.
77416	Test Pit	1.8	1.8	0.3 m of silty GRAVEL Fill underlain by 1.5 m of Reworked weathered volcanic ash
77417	Test Pit	1.6	Not encountered	0.3 m of silty GRAVEL Fill underlain by 1.3 m of Reworked weathered volcanic ash
77418	Test Pit	1.5	Not encountered	0.5 m of silty GRAVEL Fill underlain by 1 m of Lacustrine mud, silt and sand with interbedded peat
77419	Test Pit	1.8	1.8	0.5 m of silty GRAVEL Fill, underlain by 1.3 m Lacustrine mud, silt and sand