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122 Morven Ferry Road,
Arrow Junction

Prepared for Gibbons Developments Limited

Job No.: 2555087

Date: 17 March 2026

Revision: 4

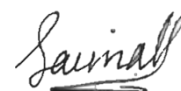
Geotechnical Assessment Report

Quality Control

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Signature:



Limitations

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Executive Summary

Kirk Roberts Consulting Engineers Ltd (Kirk Roberts) was engaged by Gibbons Developments Limited to undertake a site-specific geotechnical assessment for the proposed “Ridgeburn” subdivision at 122 Morven Ferry Road, Arrow Junction. The purpose of this report is to assess the suitability of the land for subdivision and development and to support a Resource Consent application in accordance with Section 106 of the Resource Management Act 1991.

The proposed development comprises a large-scale, staged subdivision including approximately 1,030 residential lots, a commercial and community village hub, associated infrastructure, and extensive open space and ecological restoration areas. The site extends over approximately 212 hectares and is located on gently undulating alluvial terraces and risers at the eastern toe of Morven Hill, sloping generally toward the Kowarau River.

This assessment is based on a comprehensive programme of desktop studies and site-specific geotechnical investigations undertaken by Kirk Roberts between May 2025 and January 2026. The investigations included test pits, Scala penetrometer testing, machine augers, deep boreholes, soakage testing for stormwater and wastewater disposal, groundwater observations, and engineering geological walkovers, including a rockfall assessment. Relevant previous geotechnical reports for adjacent land were also reviewed.

Subsurface conditions across the site generally comprise variable depths of topsoil and silty to sandy alluvial deposits overlying Haast Schist bedrock, which is locally shallow, particularly along ridgelines and toward Morven Hill. Deeper soil profiles are present within the eastern and southern alluvial terrace areas. Perched groundwater conditions were locally observed; however, regional groundwater is inferred to be at depth. These conditions are considered typical for the area and manageable through appropriate earthworks and drainage design.

A qualitative and quantitative assessment of natural hazards was undertaken, including consideration of liquefaction, lateral spreading, rockfall, slope instability, and seismic performance. Based on the ground conditions encountered, the site is assessed as having a low to negligible risk of liquefaction and lateral spreading. A site walkover and structural assessment of exposed schist outcrops indicate a low likelihood of rockfall affecting the proposed development, and further detailed rockfall modelling is not considered necessary.

Slope stability analyses were completed for the southern alluvial riser using numerical modelling under static and seismic loading conditions. The analyses indicate that, subject to appropriate development setbacks and adherence to recommended conditions, the proposed subdivision can be developed while achieving acceptable factors of safety for both serviceability and ultimate limit states. Deeper investigations and in-ground slope remediation is recommended to endorse the proposed development setback.

Stormwater soakage testing indicates variable infiltration rates across the site, with some areas exhibiting low soakage potential. These results should be incorporated into the detailed stormwater design, with allowance for appropriate factors of safety and alternative disposal or attenuation measures where required.

Overall, it is Kirk Roberts’ opinion that, from a geotechnical perspective, the site is suitable for the proposed subdivision, provided that the recommendations and limitations outlined in this report are implemented. This report is intended to support subdivision-level consenting only. Detailed design and building consent stages will require further site-specific geotechnical investigations and assessments.

1 Introduction

Kirk Roberts Consulting (Kirk Roberts) has been engaged by Gibbons Developments Limited (the client) to undertake site-specific investigations, assessments, and reporting for 122 Morven Ferry Road, Arrow Junction (the site).

The purpose of this investigation is to assess the geotechnical suitability of the land for a proposed subdivision called “Ridgeburn” consisting of 1,242 residential sections and associated retail and hospitality hub, subsequently to support a Land Use Consent Application

This report presents the results of our desktop study and site-specific geotechnical investigations that Kirk Roberts undertook from May 2025 through to January 2026.

1.1 Geotechnical Investigation Scope

The following scope of work is required:

- Conduct a thorough desktop review of available previous geotechnical reporting, site hazards, and groundwater information.
- Manage the Health and Safety of Kirk Roberts employees.
- Conduct a site walkover by an Engineering Geologist to review site conditions and the terrace riser.
- Conduct at least 12 machine excavated test pits to at least 2.0 m below the surface or effective refusal to determine subgrade soil composition and depth to rock.
- Conduct at least 12 Scala Penetrometer tests adjacent to each test pit to determine subsurface bearing capacity strength and high level CBR values.
- Provide rock fall review of Morven Hill, reviewing the presence of possible rock fall source areas, proximity to site and presence of any bounders on site (i.e., gullies, outcrops, rock bluffs/cliffs, any loose over-run rocks, measuring slope angles, etc).
- Digitise all field investigation data and provide a Site Investigation Plan.
- Review and incorporate previous geotechnical investigation data.
- Prepare a geotechnical cross-section through the terrace riser utilising inferred soil parameters and depth to rock.
- Prepare a slope stability model through the terrace riser utilising Slide2 by RocScience to provide development setbacks from any failure surfaces identified in the modelling.
- Conduct a review of the hazards identified on site in accordance with Section 106 of the Resource Management Act.
- Provide a Geotechnical Report detailing the results of the investigation, including subgrade conditions, setbacks from the terrace riser and possible rockfall areas. An assessment of additional hazards inclusive of settlement, liquefaction, and groundwater will be provided. Where a hazard is identified to affect the site, mitigation options will be provided with recommendations to be included as Conditions of Consent.

Note:

- Risk mitigation measures are limited only to those that would be warranted at the time of subdivision.
- The layout and nature of the future residential dwellings within the proposed subdivision may be subject to change. This report should not be used to support any future application for foundation design or Building Consent unless supported by further site-specific geotechnical investigation, assessment and reporting.
- This report assesses the land only within the proposed development area, not the condition of any structures or retaining walls at the site.

1.1.1 Additional Scopes

If the site was deemed to be a rockfall risk during the Geotechnical Investigation, a thorough rockfall assessment was to be completed with the following scope of work:

- Coordination with drone operator to finalise location of rockfall source areas.
- Access to neighbouring property to the west to determine boulder dimensions for rockfall modelling.

An additional option was recommended for Deep Geotechnical Investigations to assist with providing accurate inputs for the required slope stability modelling along the terrace riser.

1.2 Stormwater Pond and Swale Soakage Testing Scope

The following scope of work is required to conduct the site investigations within the proposed stormwater disposal ponds and swales for the proposed development:

- Coordinate excavator, water source, and site access.
- Conduct up to 15 x 150 mm boreholes and allow to pre-soak on Day 1.
- Conduct up to 15 soakage tests within 5.0 m deep x 150 mm diameter boreholes on Day 2 and 3.
- Provide logs of soils investigated and associated soakage rates.
- Provide a letter detailing the results of the investigation and any recommendations for the development.

1.3 Wastewater Investigation Scope

The following scope of work is required to conduct the site investigations within the wastewater disposal field for the proposed site:

- Coordinate excavator, water source and site access.
- Conduct 3 x soakage tests within 5.0 m x 150 mm diameter boreholes.
- Provide logs of soil investigated and associated soakage rates.
- Provide a letter detailing the results of the investigation and any recommendations for the development.

2 Reporting Requirements

A portion of the scope of this report is governed by the need to address requirements set out in the following documents:

- Resource Management Act (1991): S106 Natural Hazards;
- Ministry for the Environment (MfE) Resource Legislation Amendments 2017 – Fact sheet 10 New matters to consider for resource consents of designations;
- Ministry of Business, Innovation and Employment (MBIE) Guidelines¹: “Repairing and Rebuilding Houses Affected by the Canterbury Earthquakes; Part D – Subdivisions”.

3 Site Description

The proposed development spans over 12 parcels of land, being summarised in Table 1 and shown in Figure 1 below.

¹ Ministry of Business Innovation and Employment (MBIE) Guidance: Repairing and rebuilding houses affected by the Canterbury earthquakes, Version 3, December 2012

Table 1: Site Identification²

Address	Legal Description*	Area
122 Morven Ferry Road, Arrow Junction	Lot 4 DP 529201 Lot 2 DP 601937 Lot 3 DP 529201 Lot 5 DP 300661 Lot 4 DP 300661 Section 23 Block VIII Shotover SD Section 71 Block VIII Shotover SD Section 64 Block VIII Shotover SD Section 24 Block IX Shotover SD Section 25 Block IX Shotover SD Section 22 Block IX Shotover SD Section 21 Block IX Shotover SD	212 ha (approx.)

**All lots proposed to be included as part of the subdivision according to concept plans.*

The site is an approximately 212-hectare site at 122 Morven Ferry Road, between Arrowtown and the Kawarau River in the Queenstown Lakes District. The site is located on a gently undulating portion of land, on the eastern toe slopes of Morven Hill and district-wide contours indicate an overall decrease in elevation from west to east. Topographical plans provided by McKenzie and Co. titled “Doonholme Estate, 122 Morven Ferry Road, Arrow Junction, Queenstown” updated 19/01/26, indicates localised topographic variability is present, including low hills, mounds, and shallow depressions. These topographic plans are attached within Appendix A.

Review of recent aerial photography² indicates the site is currently developed with a standalone residential dwelling, associated gardens and driveways, and seven accessory buildings within a rural landholding. Ponds, minor streams, and water races conveying surface water and groundwater are present across the site (Figure 1).

The site is bounded to the east and west by similar rural properties comprising farmland and residential dwellings, with Morven Hill forming part of the western boundary. An alluvial embankment is present along the southern boundary within Lot 4 DP 300661 and Section 25 Block IX Shotover SD, providing access to the Kawarau River and accommodating a public walking trail. Site access is from the north-east via Morven Ferry Road, via an existing gravel accessway serving the dwelling and farm areas.

A review of the Queenstown Lakes District Council Map Navigator indicates no recorded wastewater or stormwater infrastructure within the site. A water supply main is present across the western corner of Lot 4 DP 529201.

² Queenstown Lakes District Council (QLDC) Map Navigator, data retrieved in January 2026 from <https://gis-qldc.hub.arcgis.com/>

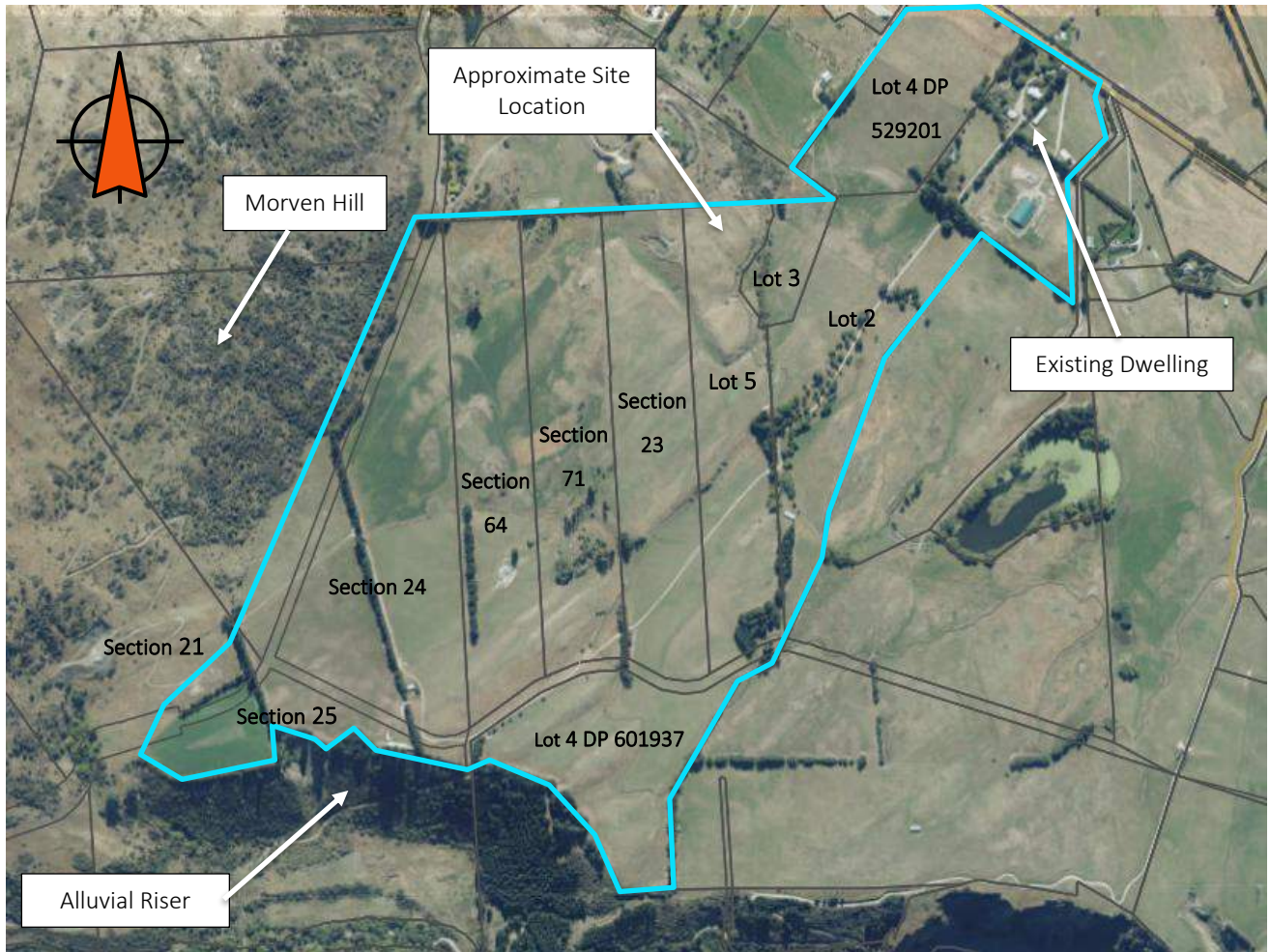


Figure 1: Approximate Site Location (source: ORC Map Navigator, 2026)

4 Proposed Development

Kirk Roberts was provided with a Subdivision Master Plan prepared by Gibbons Co titled “Ridgeburn – Arrowtown Junction”, provided in Appendix A. The development, named “Ridgeburn”, incorporates a mix of uses within a commercial village hub, including retail, shared working space, a daycare, and community facilities. Ridgeburn has been designed to integrate with a network of open space reserves and walking and cycling trails. Each neighbourhood includes access to local amenities and open space. Ridgeburn will be fully supported by on-site three waters infrastructure.

The Project is anticipated to be delivered over a six-year timeframe in six development phases and comprises of the following:

- 1,030 residential lots accommodating a total of 1,210 residential units across the site “House and Land” packages, with six lot size categories ranging from approximately 100 m² to greater than 1,000 m². This includes 180 affordable units consisting of a mix of single- and two-storey dwellings across six typologies (Types 1–6), representing a range of dwelling sizes.
- A commercial precinct located at the north-eastern corner of the site, providing approximately 17,420 m² commercial, retail, community and accommodation activities, including a supermarket, daycare, community hall/gym, workspace and retail uses, hospitality (woolshed bar and pizzeria), a pump station, and visitor accommodation/ workers accommodation.
- Approximately 32 hectares of reserve area, 103 hectares of Morven Hill and Kawareau Escarpment Native Restoration, green links and a mix of active and passive recreation areas.

It is understood that the existing dwelling and ancillary structures will be demolished and removed. Relocation of selected farm sheds is proposed for reuse as community facilities.

The subdivision layout includes a primary roading network with multiple secondary and tertiary roads branching from it. Engineering plans titled “Engineering Plan Approval” prepared by McKenzie and Co. indicated 11 stages of construction. These show a proposed layout for the roads and lots as well as stormwater, wastewater, and water supply plans. Approximate areas for wetlands and other features have been provided within these plans.

An initial earthworks report provided titled “Ridgeburn Earthworks Report” prepared by McKenzie and Co. dated 23/12/25. These indicated maximum estimated cut and fill depths of 10 m and 6 m respectively. The net cut volume is anticipated to be 644,182 m³, and net fill volumes of 581,860 m³. The total earthworks balance (cut and fill) is estimated to be 62,321 m³, assuming there are no spoils. A refined cut and fill plan titled “Ridgeburn Overall Resource Consent” prepared by McKenzie and Co. was provided following the initial Earthworks Report. This indicated a maximum cut and fill depth of 5 m and 6 m respectively. The deepest areas of fill can be found along the north-western boundary at the toe of Morven Hill. Cut is proposed to be extensive along the middle of the site, where a ridgeline is present consisting of shallow rock.

This is subject to change with further detailed design. The investigation results presented in this report are intended to inform the development of any appropriate changes required to cut and fill extents.

Relevant extracts from both the engineering report and earthworks report, as well as the latest cut and fill plan, can be found within Appendix A.

5 Desktop Investigation

5.1 Historic Aerial Images

Publicly available historical aerial photographs for the site have been sourced from the Retrolens - Historical Image Resource³ and Google Earth⁴. The imagery was reviewed to identify historical land use changes on the site and surrounding properties, as well as inform a geomorphological assessment.

Aerial photographs dating back to 1956 indicate the site has been predominantly used for farming, with this land use continuing through to November 2024. No evidence of bulk earthworks or significant land use changes was identified.

Along the alluvial riser near the southern extent of the site, an erosion feature is present in aerial photographs dating back to 1978. A review of this feature since that time shows that it has mainly remained the same.

5.2 Database Reviews

To supplement Kirk Roberts’ geotechnical investigation, a desktop review of the New Zealand Geotechnical Database⁵ (NZGD) and QLDC eDocs⁶ was undertaken.

NZGD records identify a water bore located approximately 60 m north of the property at 101 Morven Ferry Road. The bore, drilled by McNeill Drilling Co Ltd, encountered static groundwater at approximately 4.12 m below ground level (bgl), with stratigraphy comprising up to 0.5 m of topsoil over silty gravel and schist encountered at approximately 7.5 m bgl.

A review of the Otago Regional Council Bore Map⁷ indicates the nearest on-site bore is located at the north-west corner of the site, with lithological logs showing groundwater at approximately 1.11 m bgl. A further bore on the adjoining property to the west, approximately 30 m from the site boundary, does not record a static groundwater level. A bore on the adjacent property to the north records a static groundwater level of approximately 10.97 m bgl.

³ Retrolens, data retrieved in January 2026 from <https://retrolens.co.nz/>

⁴ Google Earth, data retrieved in January 2026 from <https://earth.google.com/web>

⁵ New Zealand Geotechnical Database (NZGD), data retrieved in January 2026 from <https://nzgd.org.nz/tenant/295/hierarchy/3563/level/1823/tag/Map>

⁶ Queenstown Lakes District Council eDocs, data retrieved in January 2026, from <https://edocs.qldc.govt.nz/>

⁷ Otago Regional Council – Wells Otago, data retrieved in January 2026 from <https://maps.orc.govt.nz/OtagoViewer232/?map=9869c74871aa4db390b6ffe2a49ac2c5>

A review of the GNS Science National Water Table Map⁸, which interpolates available bore data, indicates inferred groundwater levels of approximately 0.0–2.5 m bgl at the northern end of the site, decreasing southwards toward the Kawarau River to depths of approximately 40–80 m bgl.

The Council Bore Map and National Water Table Map are included in Appendix B. Relevant QLDC eDocs for neighbouring properties surrounding 122 Morven Ferry Road are discussed in Section 5.3.

5.3 Previous Reporting

The following documentation for a subdivision of the neighbouring farm into 7 allotments was found:

- A Geotechnical Report prepared by RDA Consulting titled “Morven Ferry DP Geotech” job number “50611” dated 13 September 2018.
- A Geotechnical Report prepared by GeoSolve Limited titled “Lots 2, 3 and 4 DP 397602 Morven Ferry Road, Queenstown”, job number “200108” dated 9 March 2020.
- A Geotechnical Completion Report prepared by GeoSolve Limited titled “RM171268 and RM200023 Geotechnical Completion Report Lot 4, Morven Ferry Road, Wakatipu”, job number “200108” dated 12 June 2023.

An initial geotechnical report by RDA Consulting for the neighbouring property documented 14 test pits and 31 Scala penetrometer tests. The shallow investigations encountered topsoil and silt overlying alluvial sand to depths of approximately 0.8 m to greater than 3.0 m below ground level (bgl). Haast Schist was encountered in 12 of the 14 test pits at depths ranging from approximately 0.6 m to greater than 3.2 m bgl. Groundwater seepage was observed in three test pits; however, this was attributed to an irrigation race traversing the property and was not considered representative of the regional groundwater table.

Review of geotechnical reports completed by GeoSolve Limited indicates a soil profile comprising up to 0.3 m of topsoil over approximately 0.4 m of loess, underlain by 0.2–1.2 m of glacial outwash deposits and greater than 1.1 m of glacial till, all overlying schist bedrock. Section 5.3 of the GeoSolve report concludes that, given the depth to regional groundwater and soil classifications, the site is not prone to liquefaction, with a low to negligible likelihood.

See Appendix B for relevant report extracts from both GeoSolve and RDA Consulting reports.

5.4 Kirk Roberts Geotechnical Letter, May 2025

Kirk Roberts previously issued an initial Geotechnical Review Letter in support of the Fast Track Consent Application titled “*Geotechnical Review for Proposed Development at Morven Ferry Road, Queenstown*” dated 15 April 2025. That review assessed available desktop information and concept development plans to characterise site conditions and identify additional investigation requirements for detailed design. Desktop data from neighbouring site investigations have been incorporated and expanded upon in this report.

5.4.1 Published Geology

We have reviewed the data published by GNS Science on the New Zealand Geology Web Map⁹ for the published subsurface geology beneath the site. The northern and southern portion of the site consists of River Deposits with a ridge of Schist through the central area. This is summarised in Table 2.

Table 2: Published geology

Geological group	Geological sub-group	Geological age	Description
OIS2 (Late Pleistocene) outwash deposits (Pakihi Supergroup)	Late Pleistocene River Deposits	0.012 – 0.017 million years	Generally unweathered, well sorted, loose, sandy to bouldery gravel forming large terraces and outwash plains.

⁸ GNS National Water Table interactive map, data retrieved in January 2026 from <https://www.gns.cri.nz/data-and-resources/gns-national-water-table-interactive-map/>

⁹ GNS Science – New Zealand Geology Web Map, date retrieved in January 2026 from <http://data.gns.cri.nz/geology/>

Aspiring Lithologic Association TZIV pelitic schist (Rakaia Terrane)	Basement (Eastern Province) Metamorphic Rocks	176.00 – 251.00 million years	Very well segregated and laminated; abundant pelitic and subordinate psammitic greyschist; minor greenschist and metachert; TZIV.
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These descriptions were generally confirmed by the geologies encountered during the geotechnical investigations by Kirk Roberts as well as previous investigations by GeoSolve Limited and RDA Consulting for the neighbouring site.

5.4.2 Faults

Review of the GNS Active Faults Database¹⁰ indicates that the closest GNS mapped active fault trace is the Cardrona Fault located approximately 10 km southeast of the site as shown in Figure 2. Therefore, the site is located outside the minimum 20.0 m fault avoidance zone recommended by the Ministry for the Environment¹¹.



Figure 2: GNS Fault Maps

5.4.3 Hazard Maps

The Queenstown Lakes District Council Hazard Map² indicate no natural hazard features associated with the subject site. A hazard map can be found within Appendix B.

5.5 Liquefaction Assessment

5.5.1 Area-Wide Liquefaction Hazard Assessment

A review of the ORC Map Navigator² found no relevant classifications for liquefaction for this site. A professional review of the ground conditions was undertaken to assess the liquefaction risk.

¹⁰ Geological and Nuclear Sciences (2004). Active Faults Database, data retrieved in January 2026 from <https://data.gns.cri.nz/af/>

¹¹ Planning for Development of Land on or Close to Active Faults: A Guideline to Assist Resource Management Planners in New Zealand (Published July 2003).

5.5.2 Site-Specific Liquefaction Hazard Assessment

Not all soils are susceptible to liquefaction. Generally, for liquefaction to occur, three preconditions need to be met¹²:

- Geologically young (less than 10,000 years old), loose sediments that are
- Fine-grained and non-cohesive (coarse silts and fine sands), and
- Saturated (below the water table).

If all three of these preconditions are met, then an assessment of the liquefaction hazard is required. Given the following:

- The site is underlain by a geological formation that is 176.00 – 251.00 million years old (schist) and 0.017 – 0.012 million years old (outwash deposits).
- The underlying soil profile is a mix of silty sands, sands, gravels, and completely weathered to highly weathered rock, at shallow depths in selected areas.
- The regional water table is expected to be at depth. Groundwater seepage is encountered in some areas but this is not expected to be a liquefaction risk.

It is our professional opinion that the risk of liquefaction at the site will be low to nil. The ground is predominantly underlain by rock or firm sediments.

5.6 Lateral Spread

Lateral spreading is not addressed by ORC Hazard maps, and site-specific assessment has been incorporated based on visual assessment of the site and standard geotechnical assessment methods.

Lateral spreading is a term applied to tracts of land that experience lateral displacement as a result of liquefaction of a layer below the surface. It is often observed near riverbanks, estuaries or on gentle slopes.

The risk of lateral spreading at a site is dependent on:

- The presence and height of a free face. Generally, the 'free face' that drives the lateral spreading is the riverbank or cliff.
- The thickness of liquefiable soil layers.
- The properties of the liquefiable soil such as the grain size and fines content.
- The earthquake characteristics such as the peak ground acceleration, magnitude and distance from the earthquake source.

As there is a low risk of the underlying soils liquefying, lateral spreading risk is considered very low to nil.

5.7 Importance Level

The proposed subdivision includes structures spanning multiple Importance Levels as defined by NZS 1170.0:2002, including Importance Level 1 (ancillary structures and sheds), predominantly Importance Level 2 (residential dwellings), Importance Level 3 (public buildings, daycares, supermarkets, accommodation, and telecommunications infrastructure), and Importance Level 4 (Transpower infrastructure). The final Importance Level of each development shall be confirmed by others.

5.8 Seismic Performance

Seismic design parameters are determined in accordance with NZS 1170.5, which defines site subsoil classes used to derive the seismic coefficient for elastic site spectra.

NZS 1170.5 Clause 3.1.3 defines five site subsoil classes, ranging from Class A (Strong Rock) to Class E (Very Soft Soil). Based on available information, the site is considered to comprise two subsoil classes for seismic design purposes: Class C – Shallow Soil and Class B – Rock. Class C conditions are associated with alluvial terraces and risers where soil depths locally exceed approximately 3.0 m, while Class B conditions are associated with ridgelines and areas of shallow bedrock across much of the site.

¹² Saunders, W. S. A., Berryman, K. R. 2012. "Just add water: when should liquefaction be considered in land use planning?", GNS Science Miscellaneous Series 47. 15p.

6 Site Investigations

6.1 Investigation Summary

A geotechnical investigation plan of the assessed field investigations is presented in Appendix C. A summary of geotechnical investigations is presented in Table 3 below.

Table 3: Summary of investigations

Investigation	Test type/code	Depth of test (m bgl)	Comments
Kirk Roberts, May 2025	Soakage Hand Augers (SK-4 and SK-5)	2.0	Target Depth Achieved
	Soakage Test Pits (TP-1/SK-1 to TP-3/SK-3)	3.3 – 4.6	Refusal on Dense Ground
Kirk Roberts, October 2025	Soakage Machine Augers (SK-01 to SK-11)	2.3 – 3.0	Target Depth Achieved / Refusal on Dense Ground
	Test Pits (TP-01 to TP-12)	1.0 – 1.8	Target Depth Achieved / Refusal on Dense Ground
	Scala Penetrometers (SP-02, SP-03, SP-04, SP-06, SP-08)	0.7 – 1.9	Target Depth Achieved / Refusal on Dense Ground
Kirk Roberts, December 2025	Machine Borehole (BH-01 to BH-04)	10.0	Target Depth Achieved
Kirk Roberts, January 2026	Hand Augers for Wastewater Assessment (WW-01 to WW-03)	0.1 – 0.5	Refusal on Dense Ground
	Rockfall Assessment	-	-

6.2 Geotechnical Investigation - Kirk Roberts, May 2025 to June 2025

An initial site investigation was undertaken on 5 May 2025 to supplement the Fast Track Letter referenced in Section 5.4. The investigation comprised five soakage tests, including three test pits and two hand augers.

Test pits were excavated within the alluvial terrace areas to depths of up to 5.0 m or until effective refusal. The encountered stratigraphy generally comprised a thick silt layer overlying fine- to coarse-grained SAND and gravelly SAND. TP-1 reached a maximum depth of 4.6 m bgl, while TP-2 and TP-3 terminated due to cobble obstruction and borehole collapse, respectively.

Hand auger investigations (HA-4/SK-4 and HA-5/SK-5) encountered gravelly and silty SAND and achieved the target depth of 2.0 m bgl. Groundwater seepage was not observed in any test pits or hand augers during this investigation.

An additional investigation was conducted to collect further data. Ten (10) machine augers at the base of test pits were conducted on 30 June 2025, to a target depth of 5.0 m. All refused on dense ground inferred to be the underlying schist throughout the site. No groundwater was encountered in this second initial investigation.

The investigation holes primarily contained gravelly SAND and SAND with soils containing silts within the upper 1.0 m in some areas.

6.3 Geotechnical Investigation - Kirk Roberts, October 2025 to December 2025

Further site-specific geotechnical investigations were undertaken by Kirk Roberts on 13 October 2025 and included test pits and Scala penetrometer testing, followed by soakage testing using machine augers between 14 and 16 October 2025. Deep boreholes within the alluvial terrace areas were logged on 10 December 2025, alongside ongoing groundwater monitoring and site walkovers.

All test pits and Scala penetrometer tests were advanced to a depth of 2.0 m bgl or until effective refusal, while machine augers were advanced to depths of up to 3.0 m bgl or until refusal.

6.3.1 Test Pits

Twelve (12) test pits were excavated across the site to provide representative coverage of subsurface conditions. Test pit locations and key findings are summarised below.

- **Western Site Area (toe of Morven Hill):** Test pits TP-04, TP-07, TP-10, and TP-12 generally encountered SAND, with local sandy GRAVEL and gravelly SAND to depths of up to 2.0 m bgl. TP-07, located along a ridgeline, encountered schist at approximately 1.0 m bgl, with groundwater seepage observed at approximately 1.1 m bgl.
- **Central Site Area:** Test pits TP-01, TP-03, TP-06, and TP-09 generally encountered shallow soil profiles due to ridgeline positioning, comprising gravelly SAND overlying schist bedrock. TP-01, located near Morven Ferry Road, achieved the target depth.
- **Eastern Site Area:** Test pits TP-02, TP-05, TP-08, and TP-11 encountered deeper soil profiles, with target depths achieved at all locations. The stratigraphy generally comprised topsoil over gravelly SAND. Groundwater seepage was encountered at TP-11 (approximately 1.2 m bgl) and TP-08 (approximately 1.8 m bgl), particularly toward the alluvial terrace areas.

6.3.2 Scala Penetrometers

Five (5) Scala penetrometer tests were completed adjacent to selected test pits (TP-02, TP-03, TP-04, TP-06, and TP-08) to assess geotechnical ultimate bearing capacity (GUBC). Results indicated increasing resistance with depth, with inferred GUBC values ranging from approximately 200 kPa in shallow soils to approximately 300 kPa where dense soils or shallow bedrock were encountered. Effective refusal depths ranged from approximately 0.7 m to 1.3 m bgl, with TP-03 indicating a GUBC of approximately 300 kPa immediately beneath the topsoil due to shallow rock.

6.3.3 Machine Augers

Machine-augered boreholes were advanced to assess soakage potential for proposed stormwater ponds and to supplement geological interpretation. These investigations indicated similar trends to the test pits, with deeper soil profiles toward the eastern portion of the site and shallower soils across central ridgelines. Encountered materials comprised gravelly sand, sandy gravel, and minor silt.

Soakage boreholes SK-01 and SK-11 achieved the target depth of 3.0 m bgl. Boreholes SK-02 to SK-10 terminated early due to dense ground or borehole instability associated with perched or seepage groundwater.

6.3.4 Machine Boreholes (Deep Investigations)

Additional machine-drilled boreholes were completed within the southern alluvial terrace area to assess depth to bedrock and inform ground and slope stability assessments. Four (4) boreholes were drilled to 10.0 m bgl and all achieved the target depth. BH-01 encountered predominantly SAND with layers of sandy GRAVEL, underlain by approximately 1.4 m of fine-grained SILT beneath topsoil. BH-02 comprised approximately 1.1 m of SILT overlying SAND, with GRAVEL encountered between approximately 4.0 m and 8.0 m bgl, grading back to fine- to medium-grained SAND at depth. Competent schist rock was not encountered in any of the deep boreholes.

6.4 Geotechnical Investigation - Kirk Roberts, January 2026

Kirk Roberts conducted a minor investigation on the 14th of January 2026. Wastewater boreholes were drilled along the proposed wastewater field on Morven Hill. Five (5) Hand Auger boreholes were drilled down to a maximum depth of 0.5 m. Additionally; an on-site risk assessment of rockfall was conducted to determine the need for extensive rockfall analysis and recommendations.

The shallow wastewater hand augers consisted of 0.1 – 0.3 m of topsoil overlying silty SAND, with effective refusal encountered between 0.2 – 0.5 m bgl within a gravel layer.

Further expansion on the results of the rockfall analysis can be found in Section 6.8 and details for the proposed wastewater system can be found within Section 8.

See Appendix C for site investigation plan and rockfall analysis observations. Wastewater investigation logs have been attached with the Wastewater Report located in Appendix F.

6.5 Soil Profile Summary

Subsurface ground conditions encountered in the exploratory investigations are summarised in Table 4. Detailed descriptions of the subsoil encountered at each location are provided in the appended investigation logs.

Subsoil conditions presented in this report have been interpolated between investigation locations and it is acknowledged that ground conditions may vary between test points. All test pits and machine auger investigations were undertaken at locations accessible to a 5-tonne excavator.

See attached detailed subsoil investigation logs in Appendix C and geological cross-sections in Appendix D.

Table 4 summarises the inferred average depths of subsurface soil units based on the site-specific exploratory investigations.

Table 4: Simplified Soil Profile

<u>Site-wide Soil Profiles</u>		
Layer (m bgl)	Description	Density
0.0 – 0.5	Topsoil	-
0.4 – 2.1	SILT	Medium dense
0.4 – 2.0	Gravelly SAND	Medium dense to very dense
0.3 – 5.0	SAND	Very loose to very dense
0.2 – 2.0	GRAVEL	Very loose to very dense
>0.9 m*	Schist	-
<u>Alluvial Terraces and Riser (southern end)</u>		
0.0 – 0.3	Topsoil	-
0.3 – 2.1 4.5 – 7.5**	SILT	No data available
2.7 – 9.0	GRAVEL	No data available
0.1 – 10.0	SAND	No data available
Not encountered	Schist	-

* With the exception of TP-03 (October 2025) conducted on the ridgeline, where schist was encountered at 0.3 m bgl.

**Outlier: deep silt layer within BH-03

6.6 Geotechnical Soil Parameters

Inferred soil parameters are presented in Table 5.

Table 5: Preliminary geotechnical soil design parameters for soils encountered during investigations*.

Inferred Design Parameter	Topsoil	SILT	SAND	GRAVEL	Schist
Bulk Unit Weight (kN/m ³)	8	12	14	19.5	27
Drained Effective Cohesion	0	0	0	0	40
Undrained Strength (kPa)	0	0	0	0	0

Inferred Design Parameter	Topsoil	SILT	SAND	GRAVEL	Schist
Internal Friction Angle (°)	20	24	27	35	34

**We utilised our experience and data published in textbooks to infer the above soil parameters.*

6.7 Groundwater Table

Groundwater seepage and inferred perched groundwater conditions were encountered during the October 2025 site investigations. Surface water ponding was also observed during site walkovers, particularly within flat terrace areas, existing ponds, and water races.

As noted in Section 5.2, a registered water bore located approximately 60 m across the road at 101 Morven Ferry Road, drilled by McNeill Drilling Co Ltd, recorded static groundwater at approximately 4.12 m below ground level (bgl).

In our professional opinion, regional groundwater is generally at depth due to the site elevation of approximately 380 m RL; however, perched groundwater tables are present across the site, as evidenced by field observations and subsurface investigations. Perched groundwater is expected to occur at the interface of permeable and less permeable soil layers, particularly during winter months and following periods of sustained rainfall.

Perched groundwater may be encountered during earthworks associated with access roads and building platform preparation. Management of perched groundwater is expected to be achieved through appropriate subsoil drainage measures, including drainage associated with retaining structures.

6.8 Rockfall Analysis

A rockfall assessment was undertaken to evaluate potential rockfall risk along Morven Hill and to determine whether detailed rockfall modelling was warranted. In January 2026, an Engineering Geologist completed a walkover of accessible rock outcrops, undertaking structural measurements and visual assessment of rock mass conditions.

See Table 6 below for structural measurements of exposed outcrops.

Table 6: Structural measurements of schist rock.

Feature Measured	Dip	Dip Direction
Foliation 27 – 234	41	218
	37	219
	38	220
	43	237
	42	226
	17	237
	31	288
	44	234
	12	248
	13	230
	6	205
	11	253
Joint Set 1 27 – 211	6	112
	17	149
	10	154
	31	218

Feature Measured	Dip	Dip Direction
	30	237
	12	225
	21	226
	18	250
	40	229
	27	212
	42	225
	39	237
	44	224
	40	225
	42	243
Joint Set 2 54 – 64	47	065
	56	058
	67	068
	55	074
	49	082
	52	053
	49	048
	58	072
	54	089
	55	053
	44	060
	49	067
	76	051
Outcrop Orientation	90	300

The assessment identified areas of superficial fractured rock at higher elevations with evidence of limited downslope mobilisation; however, no significant rockfall debris was observed at the toe of the slope or near the boundary of the proposed subdivision. Importantly, exposed outcrops generally comprised competent schist, with measured dip and dip directions indicating favourable kinematic conditions to deter rockfall initiation toward the site.

At lower elevations, a thin mantle of weathered schist overburden, typically up to approximately 0.5 m thick, was observed. This material appears prone to minor shallow slips only and does not present a significant rockfall hazard.

While dense vegetation cover and the scale of the site may have obscured isolated outcrops, the combination of field observations, competent rock conditions, and structural orientation indicates a low likelihood of rockfall affecting the proposed development. On this basis, further detailed rockfall modelling is not considered necessary.

See Appendix C for rockfall analysis locality map and supplementary stereonet. See Section 6.9 for annotated photographs of exposed outcrops.

6.9 Site Photographs



Photograph 1: 122 Morven Ferry Road, extent of site proposed for the Ridgeburn subdivision. Taken looking east from on top of Morven Hill, overlooking the current site area.



Photograph 2: Rock face on Morven Hill showing foliations and joint sets.



Photograph 3: Morven Hill, located on the western boundary of the proposed site.



Photograph 4: Ridgeline area down the middle of site.



Photograph 5: Geology found around site.

7 Stormwater Pond and Swale Soakage Testing

7.1 Introduction

Soakage testing was conducted as part of the scope for the construction of stormwater ponds and swales. Kirk Roberts conducted soakage testing following the Test Pit investigation in accordance with the Queenstown Lakes District Council Land Development and Subdivision Code of Practice 2025. The holes were drilled using a machine auger and logged for geology to assist with overall ground interpretations.

No stormwater disposal plans have been provided to Kirk Roberts however an investigation mark-up provided by McKenzie and Co detailed 11 stormwater ponds and associated swales to collect run-off.

7.2 Soakage Results

See Table 7 below for soakage rates and refer to Appendix E for soakage calculation sheets and proposed stormwater pond and swale locations. See for Appendix C soakage logs and locations.

Table 7: Soakage rates from onsite investigation by Kirk Roberts.

Investigation	Soakage Hole	Unfactored Soakage Rate (m ³ /hr-m ²)
Kirk Roberts May 2025	TP-1/SK-1	0.000
	TP-2/SK-2	0.007
	TP-3/SK-3	0.032
	HA-4/SK-4	0.043
	HA-5/SK-5	0.013
Kirk Roberts October 2025	SK-01	0.030
	SK-02	0.010
	SK-03	0.020
	SK-04	0.023
	SK-05	0.000
	SK-06	0.010
	SK-07	0.010
	SK-08	0.070
	SK-09	0.020
	SK-10	0.010
	SK-11	0.010

Soakage rates often have a Factor of Safety (FoS) applied to the soakage rate to give a Design Soakage Rate. Note that this was not applied within Table 7.

8 Wastewater Investigation

Kirk Roberts Consulting was engaged by Gibbons Developments Ltd to review available geotechnical information, undertake site investigations, and assess the suitability of land at 122 Morven Ferry Road, Arrow Junction for a proposed spray irrigation and dripline wastewater disposal system associated with the "Ridgeburn" subdivision. The work supports a Resource Consent application and follows Otago Regional Council precedent for spray irrigation systems in the Morven Hill area. A site investigation was completed in January 2026, including a desktop geology review, site walkover, and five hand-auger boreholes to characterise near-surface soils relevant to spray irrigation in accordance with AS/NZ 1547:2012. The

site comprises steep, undulating farmland rising from east to west, with the proposed disposal field located on Morven Hill for spray irrigation, as well as dripline areas spread out around the subdivision. The wastewater treatment plant is accessed via the proposed subdivision south of Morven Ferry Road.

Investigations identified shallow soils over schist bedrock across the upper half of Morven Hill. In contrast, the lower half of Morven Hill contains colluvial and topsoil deposits generally 0.3–0.5 m thick, locally up to approximately 1.0 m, overlying weathered schist. The soils were predominantly classified as Silty SAND (Category 3 under AS/NZ 1547:2012). Site characteristics, including adequate separation distances, deep groundwater levels, absence of flooding risk, and grassed north-facing slopes, are generally favourable. Overall, it is considered that Morven Hill provides suitable soil conditions and site characteristics for the proposed wastewater disposal system.

The complete report is provided in Appendix F.

9 Infrastructure

The site is underlain by Haast Schist, which is exposed at the ground surface in isolated locations and is overlain elsewhere by variable depths of soil. The thickness of soil cover is expected to vary across the site.

Based on the observed ground conditions, soils across the site are anticipated to be generally excavatable using suitably sized conventional excavators. However, where service trenches or other excavations encounter near surface or shallow Haast Schist, excavation may be more difficult and may require specialised excavation techniques, such as the use of rippers, hydraulic rock breakers, or, where appropriate and subject to the necessary approvals, controlled blasting.

At the time of reporting, the proposed alignment, depth, and extent of infrastructure services have not been provided to Kirk Roberts. Accordingly, the extent to which excavations may encounter Haast Schist cannot be confirmed. Allowance should therefore be made during detailed design and construction for the potential presence of rock along service alignments.

In accordance with Queenstown Lakes District Council (QLDC) subdivision requirements, service trench construction should comply with relevant QLDC Infrastructure Design Standards and NZS 4404, including provisions for trench stability, bedding, backfill, and compaction. Where Haast Schist or very shallow soil cover is encountered, trench design and construction methodology should be reviewed to ensure service performance is not adversely affected.

Should excavation conditions differ materially from those anticipated, or if extensive rock is encountered along service alignments, geotechnical review during construction is recommended to confirm the suitability of excavation methods, bedding, and backfill in accordance with QLDC requirements.

10 Slope Stability Analysis

Due to the sloping nature of the alluvial riser across the southern portion of the site, and the observed instability feature near the crest of this riser, stability of the site has been assessed based on numerical stability analyses carried out using specialist geotechnical software.

From the Subdivision concept plans, an approximate 30 m escarpment buffer from the riser has been proposed for the subdivision along the crest of the riser slope.

Cross Section A-A' and B-B' was generated based on a topographic survey provided by McKenzie and Co.

Both Cross Sections were analysed using computer modelling software Slide2 (2018) to determine the static and seismic stability of the slope using the GLE Morgenstern Price/Janbu method using non-planar modes of failure using worst case scenario techniques in soil or rock slopes.

For the analyses, effective stress soil parameters were selected in accordance with parameters commonly adopted by the geotechnical industry (i.e. based on lowest measured soil shear strengths) and based on our experience and in-situ testing within this site and similar terrain. A full table of effective stress parameters are included on the slope stability outputs.

10.1 Visual Stability Assessment

Considering the instability/erosion feature visible on aerial images at the crest of the southern riser, we have undertaken a visual assessment of this feature using desktop methods. Based on a predicted historical "Crest", and projecting a line across the observed head scarp, this feature has regressed some 50m (+/-10m) upslope from the estimated historical crest.

On this basis, a 30m setback from the crest is unlikely to be suitable to protect future developments from the observed hazard.

To provide a better outcome, and quantify a suitable slope setback, a detailed stability analysis using computer modelling has been undertaken.

10.2 Stability Modelling - Seismic Scenario

Slope stability at the site has been assessed in consideration to static loading conditions and based off two design seismic scenarios derived from "NZS1170 – Structure Design Actions". These scenarios represent the following design performance requirements:

- Serviceability Limit State (SLS) – to avoid damage that would prevent the structure from being used as originally intended, without repair.
- Ultimate Limit State (ULS) – to avoid collapse of the structural system.

It is assumed Building Importance Level 2 (IL2) dwellings will be constructed at site with a return period of 500 years.

The earthquake scenarios used in slope stability analyses are presented in Table 8 below, based on the NZTA Bridge Manual Rev 3, Addendum 6A Table 6A.1 and MBIE guidance documents and Module 1. Factor of safety requirements of 1.20 for SLS & 1.1 for ULS are based on the NZTA 9 recommendations.

For determining seismic coefficient in the Slide2 slope stability analyses, we utilise $0.5 * \text{PGA}$ (Peak ground acceleration) recommended from the Hynes-Griffin and Franklin paper to reflect the seismic forces in the software program.

Table 8: Seismic Parameters for Slope Stability Analysis

Parameters	Static Case	SLS Design Earthquake	ULS Design Earthquake
Annual Exceedance Probability (AEP)	N/A	1/25	1/500
Moment Magnitude (Mw)	N/A	6.5	6.5
Peak horizontal ground for Slide2 Assessment	N/A	0.10	0.41
PGA Coefficient for Slide2 Assessment	N/A	0.05g	0.21g
Factor of Safety (FOS) requirement	1.50	1.20	1.10

10.3 Slope Model Development

The following design information was utilised in the modelling to determine the slope stability of the site:

- The site topography:
 - Site contour data provided by McKenzie and Co.
 - Static and Earthquake scenarios as detailed above in Section 10.2 and Table 8.
- Geotechnical design parameters as detailed within Table 5. A current landslide seen on-site in the terraced area acted as a model for back-analysis of the parameters used for the GRAVEL layer within these models.
- Geology used in the model is based on current data available from the investigation coupled with visual assessments from site walkovers and desktop studies.
- The Slide2 model prepared with approximate loading areas for the development based on the provided 30.0 m setback.

Three different ground modelling scenarios were explored:

Current Ground Model:

The model represents current site conditions within the alluvial terrace area based on site investigations and walkover inspections completed to date. As rock depth has not been confirmed, the alluvial terraces have been conservatively modelled as gravel.

Potential Ground Model – Option 1: Deeper Investigations:

Deeper investigations could be conducted to create a more robust ground model. This model is a scenario that assumes an approximate rock depth of 10.0 m and is only an estimate based on the absence of rock in the investigations surrounding this area, which reached a maximum of 5.0 m above the riser and 10.0 m on the terraced areas. The purpose of this model is to present a potential scenario with an increase in FoS and decrease in displacement during a seismic event given deeper investigations are conducted to provide a more definitive rock depth. This can be considered a “Best Case” scenario to inform our sensitivity analysis.

Potential Ground Model – Option 2: Deeper Investigations + In-ground Remediation:

This model represents a scenario incorporating in-ground remediation in addition to the assumed deeper investigation. Palisade piles have been adopted as a potential option, with rock depth assumed at 10 m; however, confirmation of rock depth is required.

Options 1 and 2 are **indicative scenarios only**, based on preliminary assumptions, and would require further investigation and detailed design. The model will need to be updated to reflect the outcomes of any future deep investigations and/or remediation design.

10.4 Slope Stability Summary

Slope stability analysis was conducted through Cross Sections A-A' and B-B', aligning with the plan provided by McKenzie and Co. Refer to Kirk Roberts Slope Stability Transect Lines Plan located in Appendix D for respective transects.

Static, SLS and ULS slope stability scenarios were analysed in Slide2 and are detailed below in Table 9.

Table 9: Summary of earthquake scenarios used in the slope stability assessment.

Cross Section	Scenario	Minimum Factor of Safety Required	Setback from Terrace Edge at which minimum Factor of Safety is Achieved (m)	Factor of Safety Achieved within Proposed Building Area	Factor of Safety within Proposed 30m Setback Exceeds Minimum Required
A-A' Current Ground Model	Static	1.5	55.8	<1.5	No
	SLS Loading	1.2	49.1	<1.2	No
	ULS Loading	1.1	111.6	<1.1	No
B-B' Current Ground Model	Static	1.5	36.2	<1.5	No
	SLS Loading	1.2	23.1	>1.2	Yes
	ULS Loading	1.1	54.4	<1.1	No
A-A' Option 1 Model	Static	1.5	55.0	<1.5	No
	SLS Loading	1.2	28.5	>1.2	Yes – with the assumption of rock at 10m or less
	ULS Loading	1.1	91.4	<1.1	No
B-B' Option 1 Model	Static	1.5	48.5	<1.5	No
	SLS Loading	1.2	14.6	>1.2	Yes – with the assumption of rock at 10m or less
	ULS Loading	1.1	72.3	>1.1	No
A-A' Option 2 Model	Static	1.5	<30 m with adequate design	>1.5	Yes – with adequate design
	SLS Loading	1.2	<30 m with adequate design	>1.2	Yes – with adequate design
	ULS Loading	1.1	<30 m with adequate design	>1.1	Yes – with adequate design

B-B' Option 2 Model	Static	1.5	<30 m with adequate design	>1.5	Yes – with adequate design
	SLS Loading	1.2	<30 m with adequate design	>1.2	Yes – with adequate design
	ULS Loading	1.1	<30 m with adequate design	>1.1	Yes – with adequate design

10.5 Slope Stability Discussion

Evidence of slope instability was identified during the site walkover and desktop review, including Google Earth¹³ aerial imagery, which indicates a large historical landslide on the south-western side of the alluvial terrace. The original terrace edge is estimated to have been approximately 50 m (+/-10m) further south than its current position.

Gravel parameters adopted in the modelling were derived from observations of the existing landslide and professional judgement. Geological conditions may vary along the terrace due to limited subsurface information.

Current Ground Model:

The current ground model for Cross Section A-A' indicates significant instability across all scenarios. The results suggest that the existing 30 m setback is insufficient without further investigation and remediation, and the area constitutes a natural hazard under Section 106 of the RMA.

Cross Section B-B' shows similar instability under ULS conditions, with minimum setbacks of approximately 115 m and 60 m required for Cross Sections A-A' and B-B', respectively, to achieve the minimum Factor of Safety. Static and SLS cases showed only minor instability, likely due to the reduced terrace height and gentler slope geometry.

Potential Ground Model – Option 1: Deeper Investigations:

Assuming rock at 10 m bgl, the required setback remains greater than the proposed 30 m; however, the setback distance is reduced relative to the current ground model. Rock parameters have been conservatively adopted due to the unknown condition of the rock mass.

Potential Ground Model – Option 2: Deeper Investigations + In-ground Remediation:

With appropriately designed in-ground remediation, achieving the minimum Factor of Safety within the proposed 30 m setback may be feasible, subject to assessment of rock foliation and fracture conditions. Conservative rock parameters have been used in the modelling. Cross Section A-A' will require more robust stabilisation measures than Cross Section B-B'.

Palisade (soldier) piles shown in the modelling are indicative only. Alternative stabilisation options, such as shear keys, MSE walls, or other suitable ground improvement methods, may be adopted and will require detailed future modelling.

10.6 Conclusion

In summary, achieving the proposed 30 m setback shown in the concept plans will require further deep geotechnical investigations, together with the design of in-ground remediation for the southern alluvial terraces. A map using the ULS outputs has been prepared for illustrative purposes, indicating the following:

- **Green areas:** Achieve the minimum required Factor of Safety with no additional geotechnical investigation or design.
- **Yellow areas:** May achieve the minimum required Factor of Safety, subject to confirmation of rock at 10 m bgl or shallower through further investigation at the crest of the slope.
- **Red areas:** May achieve the minimum required Factor of Safety subject to confirmation of rock at 10 m bgl or shallower, together with in-ground remediation measures such as anchors.

Setback distances have been estimated from the modelling results. The map and all associated case outputs are provided in Appendix D.

¹³ Google Earth (2026), data retrieved January 2026, from <https://earth.google.com/>

10.7 Transpower Assets and Global Considerations

A Transpower transmission structure is located on the alluvial riser terrace to the south-east of the site, positioned on or near the crest of the slope. Given the proximity of this asset to the crest, and the potential influence of global slope stability on foundation performance under seismic loading, it is recommended that specific global slope stability analysis be undertaken through the footprint of this pylon. This assessment will be used to confirm slope stability and serviceability performance for the structure under both static and seismic conditions.

The remaining Transpower pylons within the vicinity of the site are understood to be founded on the lower alluvial terrace along the southern portion of the site, well removed from the crest of the slope. On this basis and given the more favourable topographic and geotechnical conditions in this area, no additional global slope stability analysis is considered necessary for these locations at this stage.

This approach is considered appropriate at a concept and feasibility level, subject to confirmation of ground conditions and final foundation details during detailed design.

In addition to the site-specific geotechnical and slope stability assessments undertaken by Kirk Roberts, it is noted that Transpower New Zealand Limited maintains its own hazard management and slope stability policies applicable to transmission structures and associated assets.

Accordingly, Transpower will be required to provide the developer with their relevant hazard, slope stability, and asset protection requirements for the transmission structures located within and adjacent to the site. These requirements should be reviewed and incorporated into the detailed design and construction planning, as necessary, to ensure that any works undertaken do not adversely affect the stability or long-term performance of Transpower assets.

Any additional analyses, setbacks, or mitigation measures identified by Transpower as part of their asset protection requirements shall be considered in addition to, and not in lieu of, the geotechnical assessments and recommendations provided within this report.

11 Groundwater Drawdown

Groundwater abstraction from the middle terraces located on the southern side of the site has been proposed to supply potable water for the development. As part of the Groundwater Take Assessment, Kirk Roberts has reviewed the existing Groundwater Take Assessment Report drafted by WGA titled *“Ridgeburn Groundwater Take Assessment of Effects”* referenced *“WGA252389”* dated 4 March 2026, to evaluate the potential effects of groundwater drawdown on the nearby Transpower pylons, including the potential for settlement based on the underlying geological conditions.

According to the report, two production bores (BH04 and BH05) were drilled and tested to assess potential groundwater drawdown effects associated with the proposed groundwater abstraction. Pumping tests indicate the bores can support a combined abstraction rate of approximately 23 L/s (2,006 m³/day), with the aquifers interpreted to be hydraulically connected to the Kowarau River.

Analytical modelling of long-term abstraction indicates groundwater drawdown within the upper gravel aquifer underlying the middle terrace of approximately 0.64–2.77 m at the western Transpower pylon and 0.72–1.57 m at the eastern Transpower pylon according to Table 9 within the report. The geology at the eastern pylon location has been confirmed through nearby subsurface investigations (BH04), which indicate clast-supported terrace gravels with low compressibility. While no investigation data is located directly adjacent to the western pylon, both pylons are situated on the same middle terrace at comparable elevations. Based on this geomorphic setting, it is reasonable to infer that similar geological conditions are present at the western pylon location.

Given the low compressibility of the terrace gravels, settlement resulting from the predicted lowering of the phreatic surface is expected to be less than minor (modelled by WGA to be approximately 0.001 m). Differential drawdown across the pylon foundations is modelled to be negligible, indicating minimal potential for differential settlement.

Based on our review of the Groundwater Take Assessment Report and the available geological information, Kirk Roberts considers the settlement estimates presented to be reasonable for the anticipated ground conditions. The predicted drawdown occurs within predominantly clast-supported terrace gravels, which are expected to exhibit low compressibility. On this basis, the magnitude of settlement associated with the lowering of the groundwater table is anticipated to be minor. Accordingly, the report’s conclusion that the potential for differential settlement at the nearby Transpower pylons is negligible is considered to be appropriate for the inferred site conditions. Report extracts can be found in Appendix B.

12 Bearing Capacity and Foundation Recommendations

12.1 In-Situ Bearing Capacity

Scala penetrometer tests were conducted to determine the Geotechnical Ultimate Bearing Capacity (GUBC) of the soils. Bearing strength within the SAND with some gravel underlying the site is expected to range between 200 - 300 kPa GUBC. Low bearing soils (soils with silt) were encountered within shallow depths in Machine Auger boreholes. For these areas, GUBC is expected to be 200-200 kPa.

Foundation design will be governed by the bearing capacity requirements of the foundation solution at the time of design.

Where cut earthworks exceed 1.0 m in depth along the western boundary, schist rock will generally be exposed and is expected to consistently provide 300 kPa GUBC. Additionally, where earthfill is proposed to be placed on site, the depth of earthfill placed will assist with increasing the available surface bearing capacity however where placed on low bearing natural soils, the effects of consolidation and associated settlement should be considered.

Frequent inspections and certification of earthworks and foundations by a suitably qualified geotechnical professional is recommended.

Scala penetrometers accompanied Test Pits (TP-02, TP-03, TP-04, TP-06, TP-08), with five (5) Scala Penetrometers in total:

- TP-02 yielded 300 kPa Geotechnical ultimate bearing capacity (GUBC) at 0.8 m bgl.
- TP-03 returned a 300 kPa GUBC directly underneath the 0.1 m topsoil layer due to shallow rock along the ridgeline.
- TP-04 yielded 300 kPa GUBC approximately 0.6 m bgl within the subgrade layer.
- TP-06 and TP-08 had a 300 kPa GUBC underneath the 0.3 m topsoil layer.

12.2 Foundation Recommendations

Based on the results of our site-specific investigations, desktop review, and the proposed development, the subgrade across the site is generally consistent with “Good Ground” in accordance with NZS3604:2011. The following methods are considered valid solutions:

- Shallow NZS3604:2011 timber piles.
- NZS3604:2011 concrete foundations.
- Concrete raft foundations by suppliers such as RibRaft, MAXRaft or other proprietary raft foundation providers.

Please note that Kirk Roberts did not undertake any design calculations to confirm the design requirements of the above options. The design requirements were provided as a guide only based on our general understanding of the site conditions and are not suitable for the final design.

It is expected that at the time of detailed design, site specific bearing capacity assessments will be conducted within each stage of the development to confirm and provide bearing capacity parameters to the structural engineer.

13 Excavation Recommendations

13.1 Excavation Overview

The earthworks associated with the proposed development are expected to comprise a combination of cut and fill to varying depths in order to achieve the required design levels. Based on the results of the Test Pit and Machine Auger investigations, the subgrade materials anticipated to be exposed within excavation areas comprise sand with gravels and highly weathered to completely weathered Haast Schist.

All unsuitable materials encountered within the earthworks and foundation excavations, including but not limited to uncontrolled fill, organic soils, and materials softened by exposure to water, should be undercut and replaced with engineered fill as required during construction. Any fill utilised to provide bearing support for foundations shall be placed and compacted in accordance with NZS 4431:2022, with appropriate compaction certification provided.

Where cut earthworks are proposed, the exposed materials shall be reviewed by a suitably qualified geotechnical professional to determine their suitability for reuse as engineered earthfill. It is anticipated that cut Haast Schist may be suitable for reuse as engineered fill, subject to screening to remove oversize particles and confirmation that grading and

durability requirements are met. Caution should be exercised with the finer-grained soils encountered on site, as these materials are susceptible to moisture content variations and may require moisture conditioning or blending to achieve satisfactory compaction.

All site-won materials proposed for reuse, as well as any imported fill materials, shall be supported by appropriate laboratory testing, including determination of compaction curves and optimum moisture content, prior to approval and use as engineered fill.

It is recommended that, upon excavation of the western and northern boundary areas, a geotechnical professional be engaged to observe and monitor trimming of the exposed slopes to assess the rock mass structure and joint sets. Based on these observations, refined recommendations can be provided regarding permanent batter angles for the exposed schist to ensure long-term stability of the rock faces.

13.2 Temporary and Permanent Batters

Where excavations encounter soil or rock, stability will be maintained by adhering to the temporary or permanent batter angles specified in Table 10. These measures are considered sufficient to mitigate the risk of slope instability during both the excavation and long-term phases of the project. Where necessary during the earthworks phase, the inspecting geo-professional shall provide stability monitoring and recommendations for both temporary and permanent soil slopes and batters. This is especially paramount for permanent rock face batters.

Table 10: Preliminary recommended temporary and permanent batters

Material Type	Temporary Batters (V:H)	Permanent Batters (V:H)
Topsoil/Uncontrolled Fill	1:2	1:3
Silty SAND/SAND	1:2	1:3
Schist	1:1	To Be Confirmed
Engineered Earthfill	1:1	1:2

Temporary and permanent batters are determined from previous local experience and will be subject to review based at time of construction if moisture ingress or unfavourable site conditions are present.

At the time of the earthwork's preparation on site, it is expected that all earthworks are conducted in accordance with NZS4431:2022 and the Queenstown Lakes District Council Land Development and Subdivision Code of Practice.

Topsoil and soils containing rootlets and decomposing wood fragments from deforestation should be adequately removed. In accordance with NZS4431:2022, the SAND with some gravel is generally suitable to be utilised as site won earthfill following preparation of laboratory testing confirming Maximum Dry Density, Optimum Moisture and Particle Size Distribution.

At the time of earthworks, the contractor and on-site geo-professional can review the suitability of blending the shallow silt with the underlying SAND with some gravels to limit the required cut to waste. The ratio of mixing will be determined via plateau testing and review of laboratory testing inclusive of Optimum Moisture.

A suitably qualified professional familiar with the contents of this reporting shall monitor the earthworks process and provide guidance as required.

14 Retaining Structures

At the time of preparing this reporting, the requirement for retaining was unknown.

Due to the presence of both shallow to deep soil on site and the outcropping Haast Schist, the below provides a number of suitable options, depending on the exposed subgrade within the retaining alignment.

Based on the anticipated ground conditions, the following retaining wall options are considered appropriate for different subgrade scenarios:

14.1 Shallow Soil Over Competent Rock

Where competent rock (e.g. Haast Schist) is encountered at shallow depth beneath the proposed wall footprint, gravity-type retaining wall systems are generally well suited. In these locations, walls may be founded directly on or socketed into rock, providing good resistance to sliding and overturning.

Suitable retaining wall options in areas of shallow rock include:

- Masonry block retaining walls, founded on rock or a shallow concrete footing bearing on rock
- Gravity walls, such as:
- Terramesh or mechanically stabilised earth (MSE) gravity systems
- Gabion basket walls

These systems are typically well suited where excavation into rock is feasible and where wall heights and geometry allow gravity resistance to be mobilised efficiently. The final wall type should consider constructability, drainage requirements, wall height, and architectural or landscaping constraints.

14.2 Deep Soil Conditions

In areas where deep soil profiles are present and competent rock is not encountered at shallow depth, cantilever retaining walls are generally more appropriate. These walls rely on embedded toe resistance and passive earth pressures within the soil mass and are typically founded on engineered fill or natural soil of suitable bearing capacity.

Suitable retaining wall options in deep soil locations include:

- Reinforced concrete cantilever retaining walls
- Potential use of reinforced soil systems, subject to available space and confirmation of soil strength parameters

These wall systems are better suited to locations where excavation into rock would be impractical or uneconomic and where sufficient embedment depth can be achieved to provide stability.

A suitably qualified engineer shall design all required retaining on site as required with provision of surcharges and consideration of drainage.

15 Natural Hazards Assessment

15.1 RMA 1991, S106 Assessment

A suitability assessment of the site for subdivision has been carried out in accordance with Section 106 of the Resource Management Act (RMA) 1991 and the Resource Legislation Amendments 2017 – Fact Sheet 10.

Our assessment, summarised in Table 11 is based on site observations and investigation results, a desktop review of the subject property and our knowledge of ground conditions in the Queenstown Lakes District.

Table 11: Assessment of hazards and their risk to new subdivision development

Hazard	Potential Susceptibility	
	Risk - Current	Risk - Post Development
Falling Debris	The site is located across the toe slopes of Morven Hill. However, rockfall analysis of Morven Hill determined no large rockfall debris identified, which would typically be expected if rockfall from those slopes had impacted the area. Structural measurements found the rock dipping mainly in a favourable direction, hence major rockfall is not expected. Shallow isolated rockfall may be possible however investigations indicate runout does not reach the development boundary. It should be noted that the investigation involved testing at discrete locations, so it is possible that subsurface rock blocks, if present, were not detected.	Low: Preliminary mapping and inspection of the rock faces was conducted as part of this assessment. Detailed rockfall assessment is not considered necessary at this stage. The risk of falling debris is considered low.
Volcanic and Geothermal Activity	The GNS database does not identify any active volcanoes within the South Island. Therefore, material damage arising from volcanic and geothermal activities is unlikely.	Low: No risk was identified.
Landslip	QLDC hazard maps² do not indicate any landslide activity within the subject site. The closest landslide risk areas are on the other side of the Kawarau River. The risk of landslides affecting the site is considered low. However, there was a landslip identified within the alluvial terraces. Further slips were not identified along the terraced areas from aerial imagery and hence could be isolated to a mechanism such as water scour for this particular area. An in-depth walkover of the entire terraced area was not conducted as part of this investigation.	Low (overall): No risk was identified. Moderate (alluvial terraces): Alluvial terraced area has a landslide currently present – historical images show this has not regressed over time and is now likely inactive. Other landslips not identified at this time. Careful management of stormwater flows away from this crest will be needed.
Inundation and Flood Risk	No documentation is available to suggest the site is at risk of inundation. The Queenstown Lakes District Council Map² indicates the site is not at risk of flooding.	Low: The risk from flooding and inundation is low. We recommend engaging a civil engineer to quantify any flood risk and provide flood mitigation advice if necessary. Stormwater run-off from roofs, driveways and hardstand should be appropriately managed and discharged appropriately.

Hazard	Potential Susceptibility	
	Risk - Current	Risk - Post Development
Soft Ground / Low Geotechnical Bearing Capacity	Soft ground implies a low geotechnical ultimate bearing capacity which impacts the structural foundation design. This issue can be mitigated by (1) specific engineering design of the foundation system allowing for low bearing capacity; and/or (2) ground improvement to increase the bearing capacity of the soils.	Low: Shallow rock and alluvial gravels present.
Site Subsoil Class	The site subsoil class impacts geotechnical and structural seismic loadings.	Low: RDA Consulting concluded that the site subsoil category for the neighbouring site in terms of NZS1170.5 Clause 3.1.3 is Class B (Rock) and Class C (shallow soils). Kirk Roberts investigations reiterated this point to be true for the subject site as well.
Groundwater	If the groundwater is within the proposed excavation depths, then water can flood excavations. This can result in damage and softening of founding soils. Groundwater can also exert buoyancy forces on embedded structures (e.g., foundations, manholes, pipes etc.) This issue can be mitigated by implementing dewatering measures, and specific engineering design to account for buoyancy effects.	Low to moderate: The site is elevated above surrounding areas, and the RDA Consulting Report indicates the local groundwater table. However, perched groundwater and groundwater seepage have been identified in the investigation for some areas, and should be mitigated accordingly at the advice of a Geo-professional at the time of construction.
Liquefaction Potential	Not all soils are susceptible to liquefaction. Generally, for liquefaction to occur, there is a need for three soil preconditions: ▪ Geologically young (less than ~10,000 years old), loose sediments, that are ▪ Fine-grained and non-cohesive (coarse silts and fine sands), and ▪ Saturated (below the water table)	Low: The site has shallow bedrock and the local groundwater table is expected to be greater than 10 m below existing ground level. Where there is deeper soils, these primarily consist of sands and gravels, which are not prone to liquefaction, hence liquefaction potential is low. Shallow perched water may be encountered within depressions on site.
Subsidence	The risk of liquefaction-induced settlement is expected to be negligible to low due to the absence of tunnelling voids, long term groundwater drawdown, carbonaceous soils that can lead to dissolution, organic soils that can lead to decomposition, and shrink-swell soils.	Low: Any future development will likely comprise the construction of residential dwellings and the likely degree of static settlement will not adversely affect this type of structure. Any filling greater than 0.5 m above existing ground levels should only be undertaken with input from a suitably qualified Geotechnical Engineer.
Immediate Static Settlement	Soils most prone to immediate static settlement are compressible soils which include: ▪ Soft cohesive soils (clays/silts); ▪ Loose sands; ▪ Peat/fibrous organic material; and ▪ Historic landfill.	Low: Soils underlying the site are unlikely susceptible to static settlement. All proposed earthfill shall be placed in accordance with NZS4431 and certified by a suitably qualified Engineer.
Long Term Consolidation Settlement	Consolidation settlement occurs in saturated soils with low permeability or Peat and can be triggered by (1) imposed building loads; or (2) groundwater	Low: The limited shallow investigation test results by RDA Consulting on a neighbouring site, along with the GNS

Hazard	Potential Susceptibility	
	Risk - Current	Risk - Post Development
	drawdown which is sometimes necessary for excavations. This type of settlement generally occurs over a long period of time.	Geology Web Map, indicate the site is underlain by sand and bedrock. Sand is known to be of medium to high permeability. Hence, long-term consolidation and creep settlements are not likely.
Expansive Soils	Expansive soils are those that experience notable volume change when soil moisture is altered (groundwater, drains roads etc.). Building damage due to volume changes associated with expansive soils can be reduced through proper foundation design.	Low: Expansive soils are not present on site.
Earthworks and Erosion Control	The site is flat to gently sloping. The final depth of cut and fill earthworks will depend on the final development plans.	Low to Medium: Depending on the required final excavation depth, site-specific earthworks controls and the staging of earthworks over drier months may be required to mitigate any risk. The impact of the future residential development erected within the site on the risk of erosion and sedimentation can be mitigated through best construction practices (protect exposed subgrade, silt fences, and the like).
Site Stability/Lateral Movement	The central and northern portions of the site is flat and level. The southern portion of the development is located across an alluvial terrace, with a riser down to the Kawarau River	Low: Slope stability through the central to northern portion of the development is low. Low to Medium: Slope stability analysis is required along the alluvial riser slope along the southern portion of the site.
Retaining Requirements	The proposed development plan does not include any retaining walls.	Low: Further assessment will be required once the proposed development plans are finalised and the foundation requirements are confirmed.
Foundation Options	Foundation options will depend on the structural design requirement and loading demands.	Low: - The foundations within the residential development are expected to be designed in accordance with NZS3604:2011. - The commercial buildings will require specific engineering design.
Earthquake	The risk of earthquake-induced damage from a geotechnical standpoint is low.	Low: The proposed subdivision is unlikely to worsen the current earthquake hazard at the site. The risk of earthquake damage can be mitigated through the design of an appropriate foundation system. Site-specific investigation and assessment will be required to confirm the design requirements for any future development. This should be undertaken as part of the Building Consent stage.
Fire	The site is serviced by the Queenstown and Arrowtown Fire Brigade Service.	Detailed fire risk assessment is beyond the scope of this report.

Hazard	Potential Susceptibility	
	Risk - Current	Risk - Post Development
Wind	The site is situated towards the east of Morven Hill, at the toe of the slope.	Detailed wind risk assessment is beyond the scope of this report.
Tsunami	The site is located outside the Otago Tsunami Evacuation Zones ¹⁴ . Therefore, the risk of material damage from a Tsunami is unlikely.	Detailed tsunami risk assessment is beyond the scope of this report.
Drought	Refer to services report.	Detailed drought risk assessment is beyond the scope of this report.

15.2 Natural Hazards Assessment Summary

Any proposed development will have to comply with relevant legislation, codes and standards. The future subdivision and development is likely to require significant fill or cut earthworks. Where earthworks are required, some areas are likely to expose fine grained soil that will be susceptible to erosion if left exposed to weathering for prolonged periods of time.

Erosion by wind, precipitation or inadequately discharged stormwater run-off should be controlled through best construction practices. Provided best practice methodologies are implemented during construction, it is our opinion that the development of the site will not result in the acceleration or worsening of these hazards.

Section 106 1(c) is not relevant to a geotechnical appraisal and therefore has not been considered in this report.

Providing the recommendations of this report are followed, then it is our opinion that the site will be geotechnically suitable for the proposed residential subdivision.

16 Conclusions

Kirk Roberts Consulting (Kirk Roberts) has been engaged by Gibbons Developments Limited (the client) to undertake site-specific investigations, assessment and reporting at 122 Morven Ferry Road, Arrow Junction.

The purpose of this investigation is to assess the geotechnical suitability of the site to support a Resource Consent for the land use, built development and subdivision of the project site to establish Ridgeburn.

Based on the findings of this investigation and assessment, the following can be concluded:

- Site investigations confirm variable alluvial soils over Haast Schist, with shallow bedrock common across ridgelines and deeper soils within terrace areas.
- Perched groundwater was locally observed; regional groundwater is inferred to be at depth and manageable through design.
- Liquefaction and lateral spreading risk is assessed as low to negligible.
- Rockfall risk from Morven Hill is assessed as low; detailed rockfall modelling is not required at this stage.
- Slope stability analyses identify constraints along the southern alluvial riser; achieving proposed setbacks may require further deep investigation and/or in-ground remediation in some areas.
- Stormwater soakage capacity is variable and should be addressed in detailed design with appropriate factors of safety.
- Soil categories for wastewater disposal has been assessed for Morven Hill and concluded mainly
- Subject to implementation of the recommendations in this report, the site is considered suitable for subdivision at a resource consent level.

¹⁴ Otago Tsunami Evacuation Zones, data retrieved on January 2026 from <https://www.arcgis.com/apps/webappviewer/index.html?id=4a6bc015e1a8447fba14e1ce3609cb25>

- Further site-specific geotechnical input will be required during detailed design, earthworks, and building consent stages.

17 Limitations

This report has been prepared at the specific instructions of our client in connection with the above project.

Whilst every care was taken during our desktop review, site investigation and interpretation of subsurface conditions, there may well be subsoil strata and features that were not detected.

It must be appreciated that the actual characteristics of the subsurface materials may vary significantly between adjacent test locations and sample intervals other than where observations, explorations and investigations have been made.

It should be noted that because of the inherent uncertainties in subsurface evaluations, changed or unanticipated subsurface conditions may occur that could affect total project cost and/or execution. Kirk Roberts Consulting does not accept responsibility for the consequences of significant variances in the conditions and the requirements for the execution of the works.

This report has been prepared to provide a preliminary assessment of the proposed development to assist with high level design elements. This report is not considered suitable to support the Building Consent application without further investigation/assessment once the final development plans are known for the proposed future hotel. This report is not intended to address the subdivision or earthworks of the original site. This report is not intended to assist with specific foundation design advice until specific assessments are provided within each development stage.

Only our client are entitled to rely upon this report, and then only for the purpose stated above. Kirk Roberts Consulting Engineers Ltd accepts no liability to anyone other than these parties in any way in relation to this report and the content of it and any direct or indirect effect this report may have. Kirk Roberts Consulting Engineers Ltd does not contemplate anyone else relying on this report or that it will be used for any other purpose.

Third parties: This report has been prepared for the sole use of our client, for the particular brief and on the terms and conditions agreed with our client. It may not be used or relied on (in whole or part) by anyone else, or for any other purpose, or in any other contexts, without our prior written agreement. We will not be liable for any loss, damage, cost, or expense incurred by such other persons.

Disciplines are limited to those stated: Although we are a multi-disciplinary organisation, we only provide input on each project from the particular disciplines engaged by our client and expressly stated in this document and our obligations are limited to the inputs expected from those specified disciplines. Please let us know if you would like to engage additional services or disciplines for your project.

Should anyone wish to discuss the content of this report with Kirk Roberts Consulting Engineers Ltd, they are welcome to contact us on 03 379 8600 and www.kirkroberts.co.nz.

Appendix A

Subdivision Concept Plans

1. Subdivision Master Plan by Gibbons Co.
2. Extracts from Earthworks Report by McKenzie & Co.
3. Extracts from Engineering Report by McKenzie & Co.
4. Cut and Fill Plan From Resource Consent Report by McKenzie & Co.
5. Topographic Plans





Legend

- Ponds and waterways
- Historic water race and 7m setback to edges
- Primary Rooding network
- Pedestrian / Cycle amenity network
- Secondary and tertiary rooding network
- Outstanding Natural Landscape (ONL) boundary
- Site boundary
- Escarpment edge and 30m setback
- 110kV Transmission lines (derived from Transpower GIS - Location TBC)

- Native dry shrubland management
- natural landscape planting areas
- Existing rocky outcrops with tussock planting

- 1 Ridgeburn Entrance
- 2 Retail and hospitality commercial hub
- 3 Affordable living units
- 4 Existing farm buildings
- 5 Lookout
- 6 Water race
- 7 Community node + playground
- 8 Development edge rural landscape buffer
- 9 Development edge Morven Ferry Rd landscape buffer
- 10 Development edge 30 escarpment buffer
- 11 Connection to twin rivers trail
- 12 Wetlands and stormwater management areas
- 13 Wastewater disposal area
- 14 Native dry shrubland areas of ecological restoration
- 15 Relocated farm shed / community node
- 16 Wastewater treatment plant - refer civil engineer

Note: This masterplan is indicative / conceptual only. All elements, including site layout, lot configuration, and house typologies, are subject to further design development, regulatory approvals, and stakeholder consultation.

RIDGEBURN
ARROWTOWN JUNCTION

Re-profiling and Material Relocation: The design focuses on re-profiling the existing ground primarily along the spines of the proposed sub-catchments. The cut material from these areas will be relocated for engineered filling along the periphery of stream zones, minimizing waste and optimizing resource use. By implementing these design strategies, the extent of earthworks has been minimized to the greatest extent practicable, balancing environmental, functional, and construction considerations. The detailed earthworks extent is illustrated in *Figure 3 – Overall Contour Plan*

The earthworks balance has been achieved by the following actions:

Bulk Cut – Fill

The amount of bulk cut material taken and final shaping from the site has been informed by the amount of fill material needed (including compaction factors) to facilitate flat lot platforms and transport corridors.

Topsoil Strip and Respread Philosophy

As identified by Kirk Roberts, the average topsoil depth across the site is approximately 100mm. The topsoil strip and respread philosophy is to minimise topsoil removal off site after the resspreading process is complete, and to place topsoil in thicker layers in landscaping areas to facilitate revegetation up to 300mm. Topsoil respread depths are proposed to be varied based on proposed land use at various locations within the site to maximise topsoil respread volumes on site.

A summary of the earthworks is included in Table 1 below.

Table 1: Earthworks

Area	Unit	Bulk	Assumptions
Earthworks area	m ²	806,003	Earthworks to be staged, not all open at once.
Net Cut Volume	m ³	644,182	Finish surface to existing topo level
Topsoil Strip Volume	m ³	83,000	Assumed 100mm deep topsoil across earthworks area
Maximum Cut Depth	m	10	
Net Fill Volume	m ³	581860	Finish surface to existing topo level
Topsoil Respread Volume	m ³	83,000	Assumed 100mm deep across earthworks area
Maximum Fill depth	m	6	
Clay Deficit/(surplus)	m ³	TBC	
Topsoil Deficit/(surplus)	m ³	TBC	There are several locations throughout site for excess topsoil to be disposed safely if required
Total Earthworks Balance (Cut + Fill)	m ³	62,321	Surplus volume assumes there is no spoils

4.6. WATERWAYS RECLAMATION

The design has been developed to ensure that there is no stream removal, thus there are no permanent streams being reclaimed as part of earthworks operations in any stage of the project. the two identified ephemeral streams will be realigned to better align with the development and will be enhanced further from their current form to meander to increase the length and replace the existing grass channels with native vegetation.

4.7. WATERWAYS MARGINS

Some filling is required in waterway margins, to form the batters. The margins have been defined as a 10m from the stream bank.

The total earthworks area and volumes are shown below in Table 2.

Table 2: Stream margin encroachment areas / volumes

	Area (m ²)	Volume (m ³)
Overall	32,079	92,438

4.8. WETLAND SETBACK AREA

The below table shows the extent of earthworks within the 10m wetland setback area.

Table 3: Wetland area encroachment areas / volumes

	Area (m ²)	Volume (m ³)
Overall	3938	15,712

4.9. STREAM WORKS

1. Earthworks will avoid works within streams, where possible. Earthworks within streams will be only for the following purposes – realign streams to create more natural alignment and enhance the environment. Also to cater for flows from the development.

Two of the ephemeral streams are to be realigned to integrate the stream alignments into the development for the future. The methodology for these realignments will be –

- 1) Carry out the works when there is no rain forecast and is in the dry season.
- 2) install bunds and erosion sediment controls around the area of the new stream.
- 3) excavate new channel alongside the existing channel
- 4) stabilise the new channel and install landscaping where possible.
- 5) Once stabilised, connect the existing stream at the inlet and outlet, to allow flows to be

divert the flows from the existing channel into the new channel alignment. As the existing channel has no permanent water, this will be done on a dry day.

- 6) Once the flow is diverted, erosion and sediment controls can be moved, and the existing channel can be filled in from upstream to downstream.
- 7) Stabilise and plant the filled in channel.

4.10. 10 DEGREE SLOPE

The area of earthworks across the project with slope above and below 10 degrees is shown in the table below.

Table 4 - Area of earthworks with varied slopes

	Slope above 10 degrees
Area of earthworks(m ²)	149,427

4.11. MAXIMUM DESIGN SLOPE

The area of earthworks across the project with maximum slopes shown in the table below.

Table 5 - Area of earthworks at maximum slopes

	1 in 2 slopes	1 in 3 slopes
Area of earthworks(m ²)	22,555	1,643

4.12.1% AEP FLOODPLAIN

The total volume of earthworks within the 1% AEP floodplain is shown in the table below. Note this is the taken from existing surface, to design surface. The volume of displaced water within the flood plain is not included in the below.

Table 6 - Volume of earthworks within 1% AEP floodplain

	Cut	Fill	Total
Volume of earthworks (m ³)	TBC	TBC	TBC

4.15.EARTHWORKS STAGING PLAN

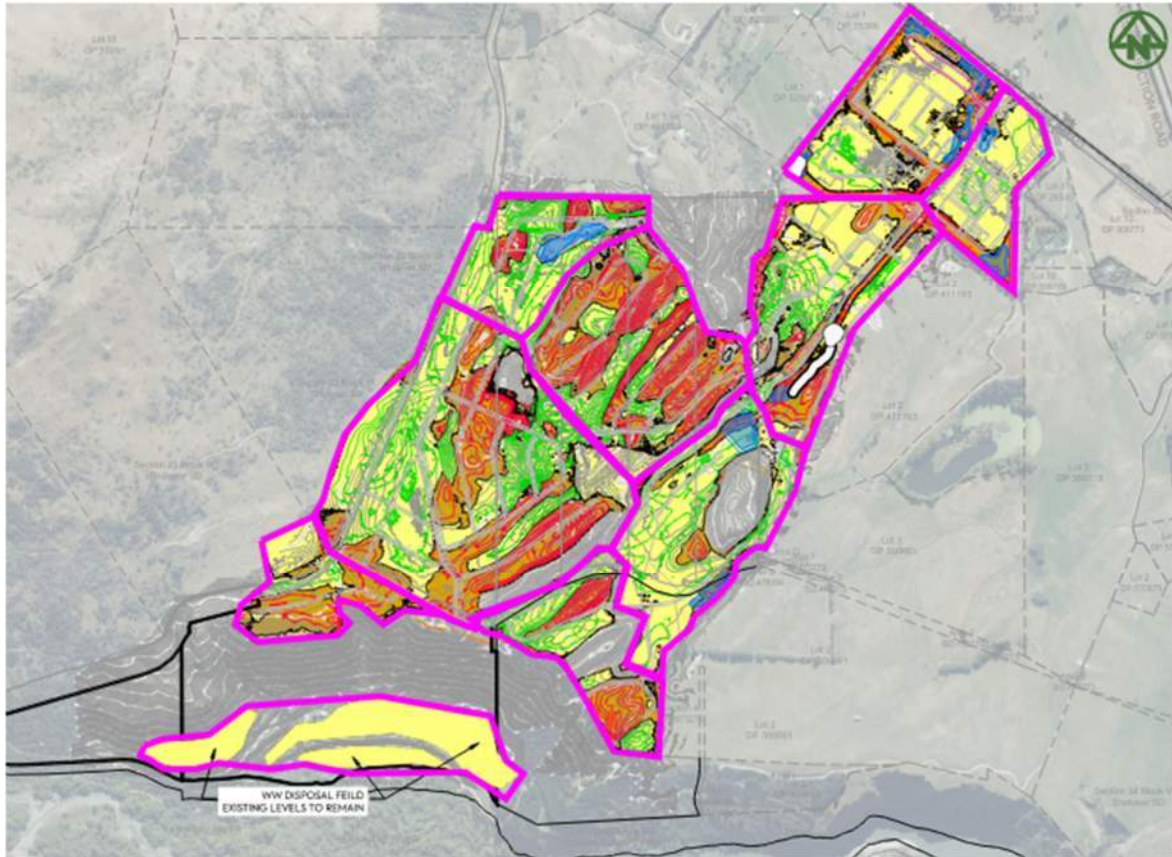
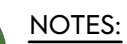


Figure 4 - Earthworks Staging



-
- The map illustrates the spatial distribution of 11 development stages in the Queenstown Lakes District. The stages are defined by colored boundaries and labels:
- STAGE A - AFFORDABLE DISTRICT** (Teal): Located in the northeast corner.
 - STAGE B - CENTRAL FIELDS** (Yellow): Adjacent to Stage A.
 - STAGE C - MIDLAND PADDOCKS** (Orange): Located to the east of Stage B.
 - STAGE D - CROWN RANGE ESTATES** (Light Yellow): Situated south of Stage C.
 - STAGE E - DOONHOLME VALLEY** (Red): A large central area.
 - STAGE F - MORVEN HILL** (Green): Located to the northwest of Stage E.
 - STAGE G - REMARKABLES RIDGE** (Brown): A large area to the west of Stage E.
 - STAGE H - KAWERAU RIVERVIEW** (Blue): Located at the southern edge, near the river.
 - STAGE J - QUEENSTOWN LOOKOUT** (Purple): Located at the southwest corner.
 - STAGE K - COMMERCIAL PRECINCT** (Pink): Located to the east of Stage K.
 - STAGE L - BUS** (Grey): Located at the top right corner.
- The map also shows various geographical features, including roads (solid and dashed lines), rivers (blue lines), and topographical contours (dashed lines). The stages are interconnected by a network of roads and paths.

A



MCKENZIE & CO.

A	FIRST ISSUE	EY	TDW	JK	29/10/25
REV	DESCRIPTION	DRN BY	CHK BY	APP BY	DATE

PLOT DATE 2025-12-22 13:56:31 WWW.MCKENZIEANDCO.CO.NZ THIS DRAWING IS SOLELY FOR USE BY THE CLIENT ON THIS PROJECT ONLY. NO LIABILITY IS ACCEPTED IN ITS USE BY ANY OTHER ENTITY OR FOR ANY OTHER PURPOSES.

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NOTES:

1. ALL WORK AND MATERIALS TO COMPLY WITH AT TRANSPORT DESIGN MANUAL STANDARDS. ANY AMBIGUITY BETWEEN ISSUED DRAWINGS AND CONCIL STANDARDS IS TO BE REPORTED TO THE ENGINEER FOR CLARIFICATION.
2. THE CONTRACTOR SHALL EXTEND ROAD CONSTRUCTION 2m PAST THE STAGE BOUNDARY FOR FUTURE INTERNAL SUBDIVISION CONNECTIONS.
3. ROAD SETOUT DATA SHOWN ON 300 SERIES DRAWINGS IS TO BE PROVIDED ELECTRONICALLY.
4. ALL ROAD MARKING AND ROAD SIGNAGE IS TO BE CONSTRUCTED AS PER TRANSIT NEW ZEALAND'S MANUAL OF SIGNS AND MARKINGS, AND AT TDM.
5. VEHICLE ACCESSWAYS FOR JOAL SHALL BE AS PER AT COMMERCIAL VEHICLE STANDARD DRAWINGS VX0201-VX0205. ALL OTHER VEHICILE CROSSINGS SHALL BE AS PER AT DRAWINGS VX0101-VX0105.
6. REFER TO LANDSCAPE ARCHITECTS PLANS FOR STREET TREE DETAILS. TREES SHOWN ON PLAN ARE INDICATIVE ONLY.
7. STREET LIGHTS SHOWN ON PLAN ARE INDICATIVE ONLY.

LEGEND:

SITE BOUNDARY	
WORKS BOUNDARY	
ROAD CENTRELINES & CHAINAGE	
PROPOSED CARRIAGEWAY	
PROPOSED ASPHALT PAVEMENT	
PROPOSED STANDARD FOOTPATH (BROOM FINISH)	
PROPOSED VEHICLE CROSSING	
INDICATIVE STREETLIGHTS	
PROPOSED STORMWATER TREATMENT RAINGARDEN	
INDICATIVE STREET TREES	
PROPOSED SPEED TABLE	
PROPOSED RECESSED PARKING BAY	

CLIENT: RIDGEBURN LTD

PROJECT: RIDGEBURN
122 MORVEN FERRY ROAD
ARROW JUNCTION
QUEENSTOWN

TITLE:

ROADING
PLAN
OVERALL

PURPOSE OF ISSUE:
RESOURCE CONSENT

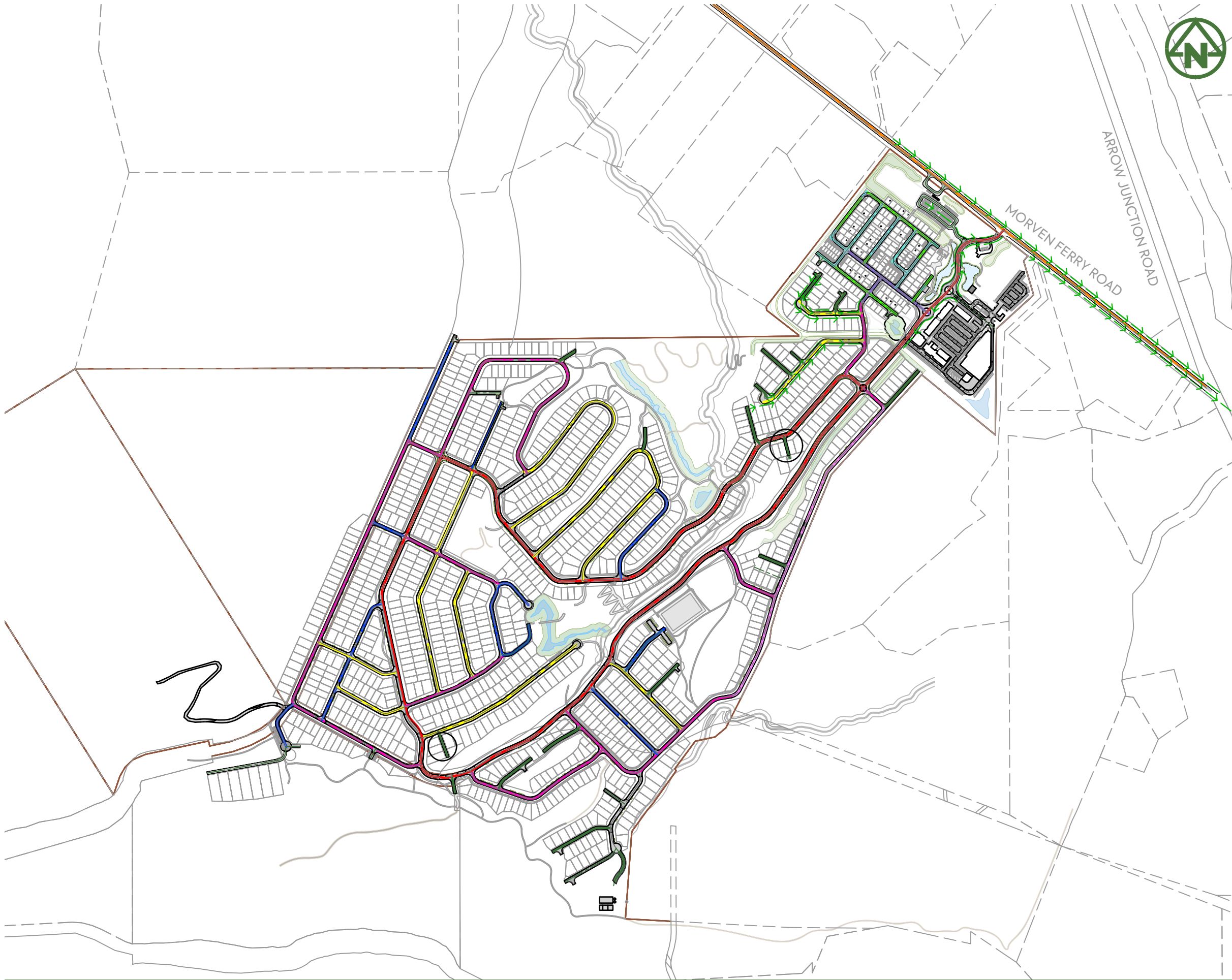
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NOTES:

1. ALL WORK AND MATERIALS COMPLY WITH QUEENSTOWN LAKE DISTRICT COUNCIL STANDARDS. ANY AMBIGUITY BETWEEN DRAWINGS AND COUNCIL STANDARDS ARE TO BE REPORTED TO THE ENGINEER FOR CLARIFICATION.
2. ROAD LAYOUTS SHOWN ON DRAWING 300.
3. SISD TAKEN FOR CAR OF THE 85TH PERCENTILE OPERATING AT A SPEED OF 50 kph.
4. SITE DISTANCE CRITERIA TAKEN AS ARTERIAL ROAD ROUNDABOUT.
5. SIGHT VISIBLTY DESIGN TO THE QUEENSTOWN LAKE DISTRICT COUNCIL CODE OF PRACTICE.
6. TREE TRUNKS WILL BE LESS THAN 200mm DIA AND DE-BRANCHED TO BE 2m ABOVE FINISHED GROUND LEVEL AND THIS WILL PROVIDE ADEQUATE SIGHTLINES FOR VEHICLES

LEGEND:

PROPOSED ROAD TYPE

MORVEN FERRY RD	
A1	
B1	
B1-C	
B2	
B2-C	
B3	
B3-C	

PROPOSED LANEWAY TYPE

C1	
C2	
C3	
C4	

PROPOSED CYCLE TRACK TYPE

D1	
----	--

CLIENT: RIDGEBURN LTD

PROJECT: RIDGEBURN
122 MORVEN FERRY ROAD
ARROW JUNCTION
QUEENSTOWN

TITLE: ROADING
HEIRARCHY
PLAN

PURPOSE OF ISSUE: RESOURCE CONSENT

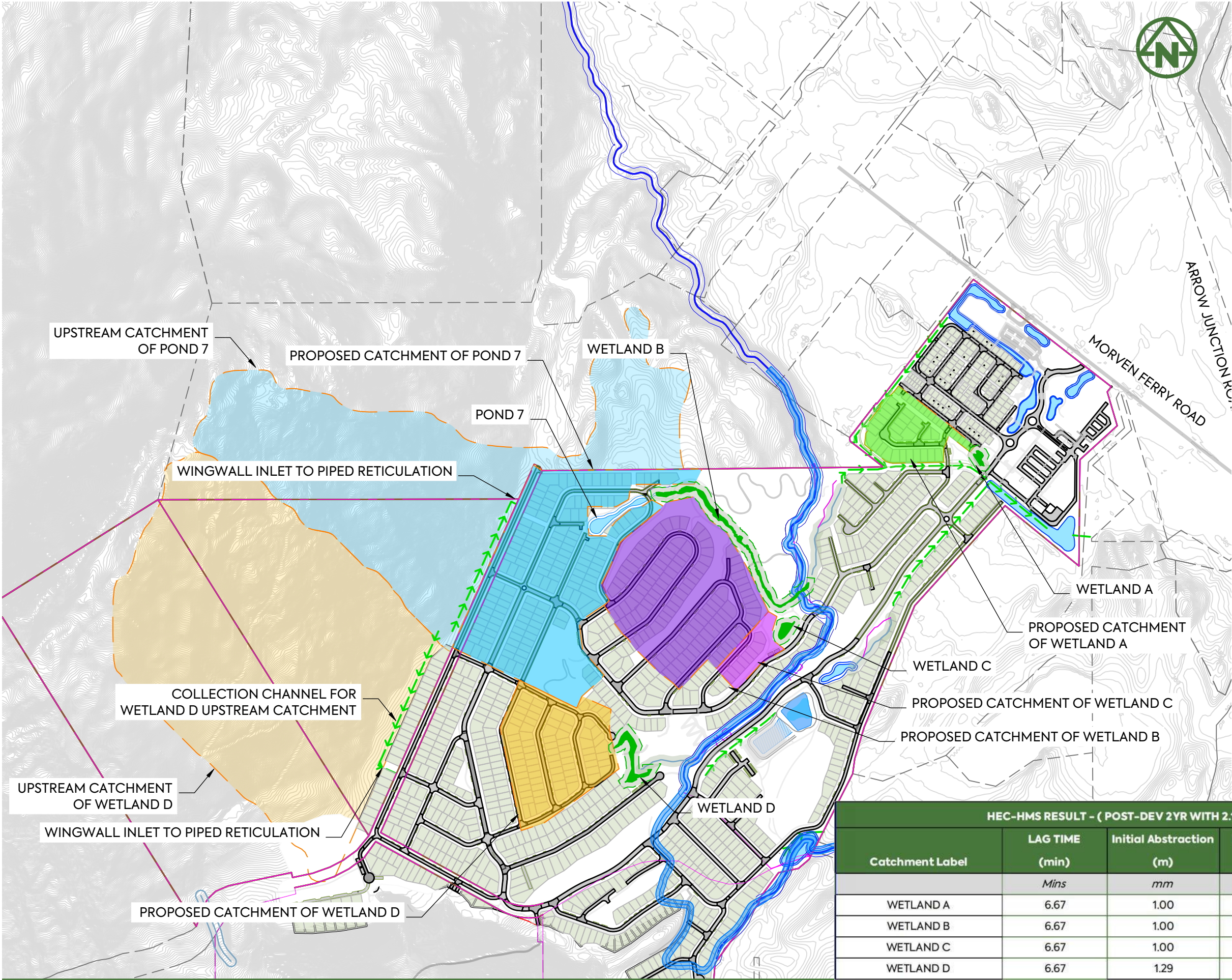
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DRAWING NO: 4048-O-3001

REV: B



B	UPDATED TRAFFIC COMMENTS	TDW	TDW	27/11/25	
A	FIRST ISSUE	MR	-	-	-
REV	DESCRIPTION	DRN BY	CHK BY	APP BY	DATE



NOTES

- 1. DATA RECEIVED FROM VIRIDIS ON 04/11/2025. REFER TO VIRIDIS DRAWING 10339-MAP2-3 FOR DETAILS.
- 2. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH THE ENGINEERING INFRASTRUCTURE AND SERVICING REPORT.
- 3. COORDINATE REFERENCE SYSTEM IS EPSG:2128 - NZGD2000 / MOUNT NICHOLAS 2000.
- 4. CATCHMENTS DELINEATED IN QGIS WERE USED TO COMPUTE EXISTING WETLAND FLOWS FOR PRE- AND POST-DEVELOPMENT USING TP108 HYDROLOGY PARAMETERS MODELLED IN HEC-HMS.

LEGEND:

SITE BOUNDARY	
PROPOSED LOT BOUNDARIES	
PROPOSED POST-DEVELOPMENT CATCHMENT BOUNDARY	
EXISTING CONTOUR (1.0m)	
PROPOSED CONTOUR (1.0m) MAJOR	22.0
PROPOSED CONTOUR (0.1m) MINOR	22.1
PROPOSED CARRIAGEWAY	
EXISTING CONSTRUCTED POND	
EXISTING WETLAND (10m setback)	
WATER RACE (7m setback)	
INTERMITTENT STREAM (10m setback)	
DRAIN (10m setback)	

HEC-HMS RESULT - (POST-DEV 2YR WITH 2.1 DEGREE CLIMATE CHANGE)					
Catchment Label	LAG TIME (min)	Initial Abstraction (m)	Weighted Curve Number	Catchment Flow (m3/s)	Percentage Change (%)
	Mins	mm	CN		
WETLAND A	6.67	1.00	86.00	0.18876	5%
WETLAND B	6.67	1.00	74.00	1.10764	10%
WETLAND C	6.67	1.00	86.00	0.04511	0.5%
WETLAND D	6.67	1.29	86.00	1.03325	0%

CLIENT: RIDGEBURN LTD

PROJECT: RIDGEBURN
122 MORVEN FERRY ROAD
ARROW JUNCTION
QUEENSTOWN

TITLE: STORMWATER
POST-DEVELOPMENT
WETLAND CATCHMENT PLAN
OVERALL SHEET 1

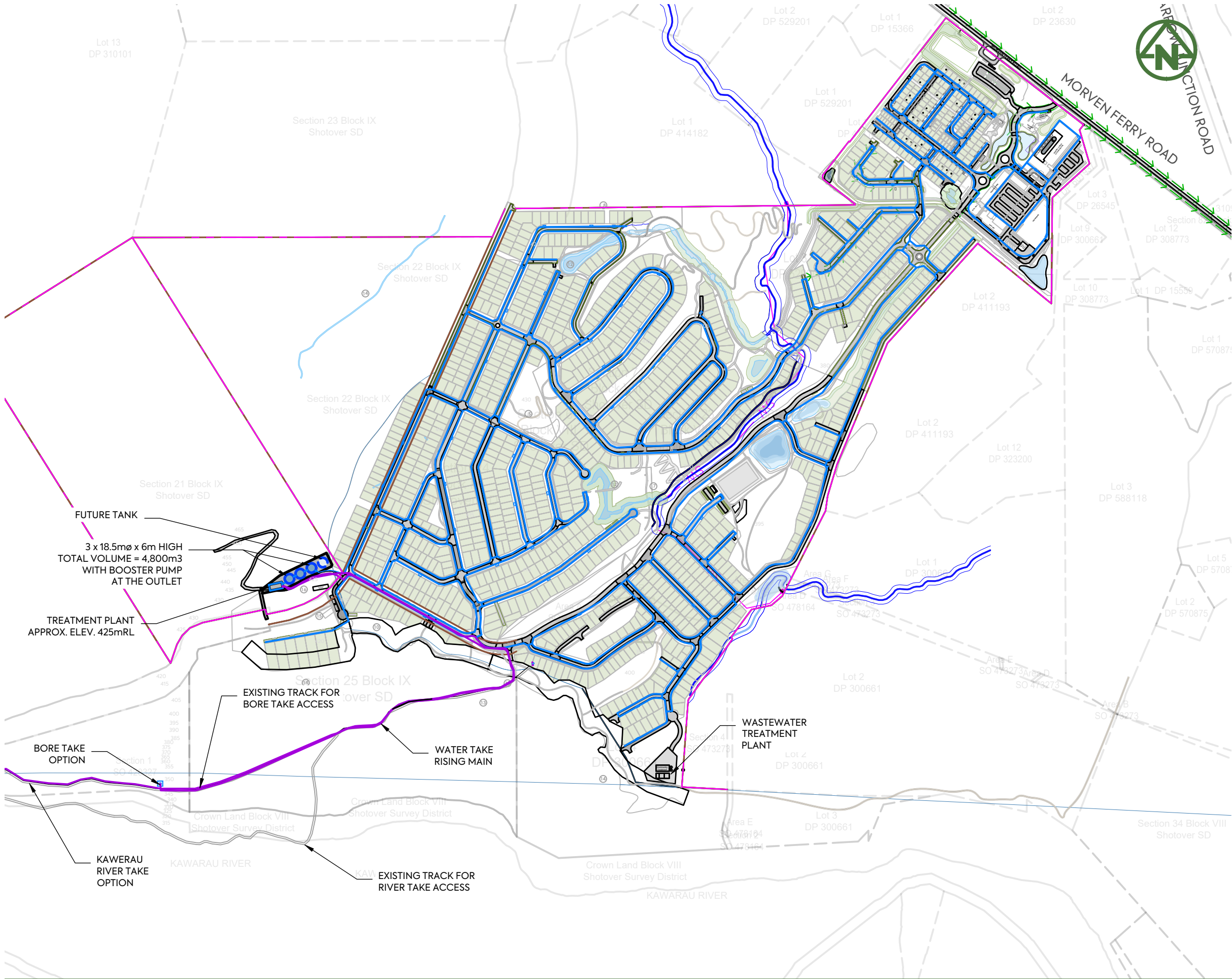
PURPOSE OF ISSUE: RESOURCE CONSENT

SCALE: 1:7500
DO NOT SCALE

DRAWING NO: 4048-0-4251

REV: A

A	FIRST ISSUE	EY	HS	JK	06/11/25
REV	DESCRIPTION	DRN BY	CHK BY	APP BY	DATE

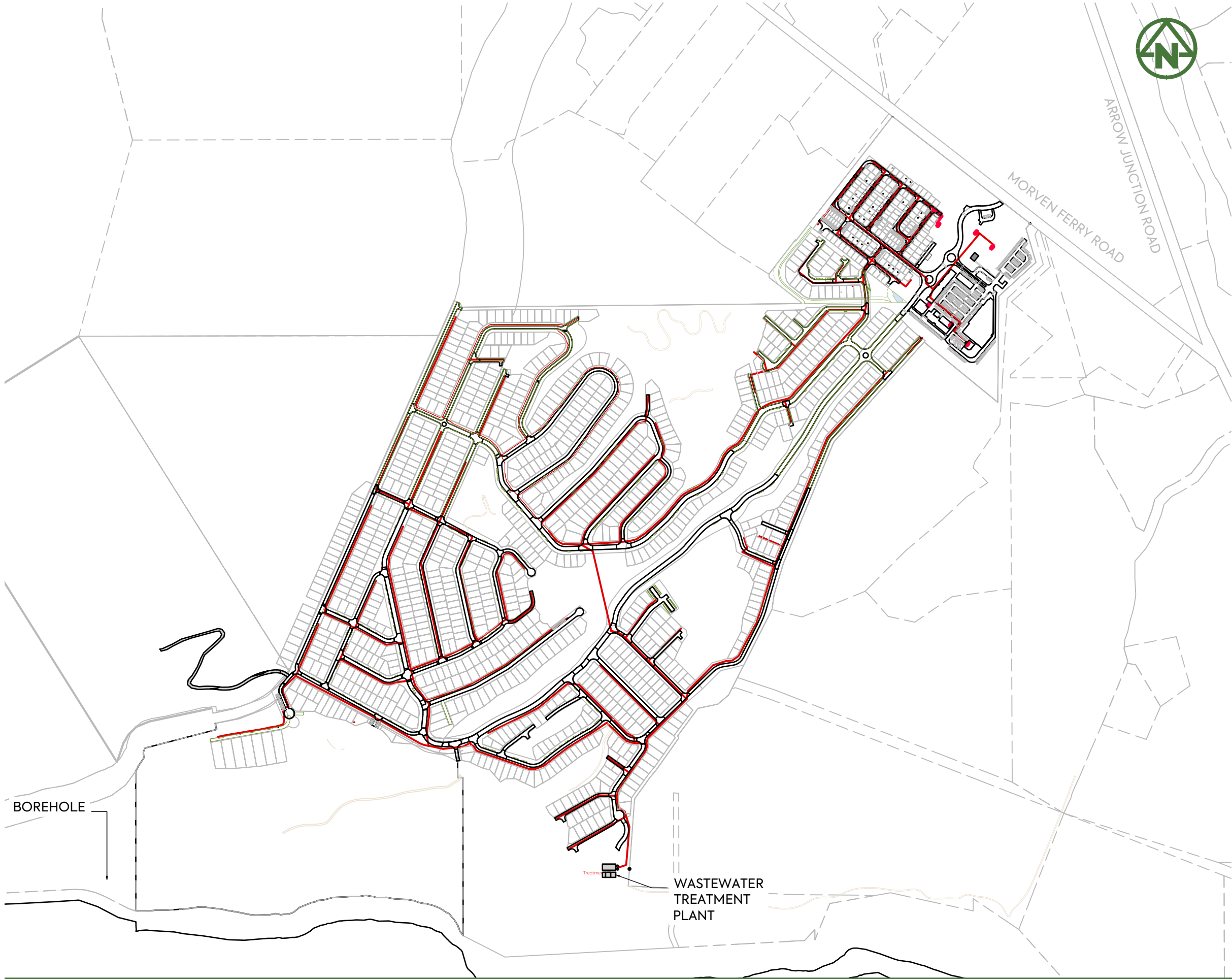




1. ALL WORKS AND MATERIALS TO COMPLY WITH QUEENSTOWN LAKE DISTRICT COUNCIL LAND DEVELOPMENT AND SUBDIVISION CODE OF PRACTICE.
2. ALL PIPES CROSSING UNDER CARRIAGEWAY/TRAFFIC AREAS TO BE HARDFILL BACKFILLED 1.0m BEYOND THE EXTENT OF CARRIAGEWAY. ALL PIPE CROSS OVERS ARE TO BE HARDFILL BACKFILLED 1.0m EITHER SIDE OF CROSS OVER.
3. THESE DRAWINGS DO NOT NECESSARILY SHOW ALL EXISTING SERVICES. IT IS THE RESPONSIBILITY OF THE CONTRACTOR TO ACCURATELY LOCATE AND PROJECT ALL EXISTING SERVICES DURING THE CONSTRUCTION PROCESS.
4. REFER TO DRAWING 4680 FOR OUTLET PROTECTION DETAILS
5. REFER TO DRAWINGS 4800 FOR CULVERT DETAILS.
6. REFER TO DRAWINGS 4600 FOR Q100 PRE- DEVELOPMENT CATCHMENTS.
7. REFER TO DRAWINGS 4650 FOR Q100 POST- DEVELOPMENT CATCHMENTS.

LEGEND:

SITE BOUNDARY	
PROPOSED BOUNDARIES	
PROPOSED STORMWATER CHANNEL	
PROPOSED TREATMENT SWALE	
PROPOSED STORMWATER POND	
EXISTING WETLAND (10m SETBACK)	
PROPOSED STORMWATER CULVERT	
PROPOSED STORMWATER PIPE	
EXISTING IRRIGATION WATER RACE	
PROPOSED PIPED IRRIGATION ROUTE	



NOTES:

- 1. ALL WORKS AND MATERIALS ARE TO COMPLY WITH QLDC LAND DEVELOPMENT AND SUBDIVISION CODE OF PRACTICE
- 2. ALL WORKS TO COMPLY WITH OTAGO REGIONAL COUNCIL
- 3. ALL LPS PIPES SHALL BE PE100 SDR11 PN16
- 4. ALL LPS PIPE SIZES ARE OD
- 5. LPS LATERALS FROM LPS TANK TO MAIN SHALL BE 40mm OD
- 6. THIS PLAN IS A PRELIMINARY DESIGN ONLY
- 7. THESE DRAWINGS DO NOT NECESSARILY SHOW ALL EXISTING SERVICES. IT IS THE RESPONSIBILITY OF THE CONTRACTOR TO ACCURATELY LOCATE AND PROTECT ALL EXISTING SERVICES DURING THE CONSTRUCTION PERIOD.

LEGEND:

- SITE BOUNDARY
- WORKS BOUNDARY
- EXISTING CONTOURS
- FINISHED CONTOURS
- PROPOSED LOW PRESSURE SEWER
- ZONE NUMBER / PIPE DIAMETER
- PROPOSED DISPOSAL FIELD

BOREHOLE

WASTEWATER TREATMENT PLANT



MCKENZIE & CO.

CLIENT: RIDGEBURN LTD

PROJECT: RIDGEBURN
122 MORVEN FERRY ROAD
ARROW JUNCTION
QUEENSTOWN

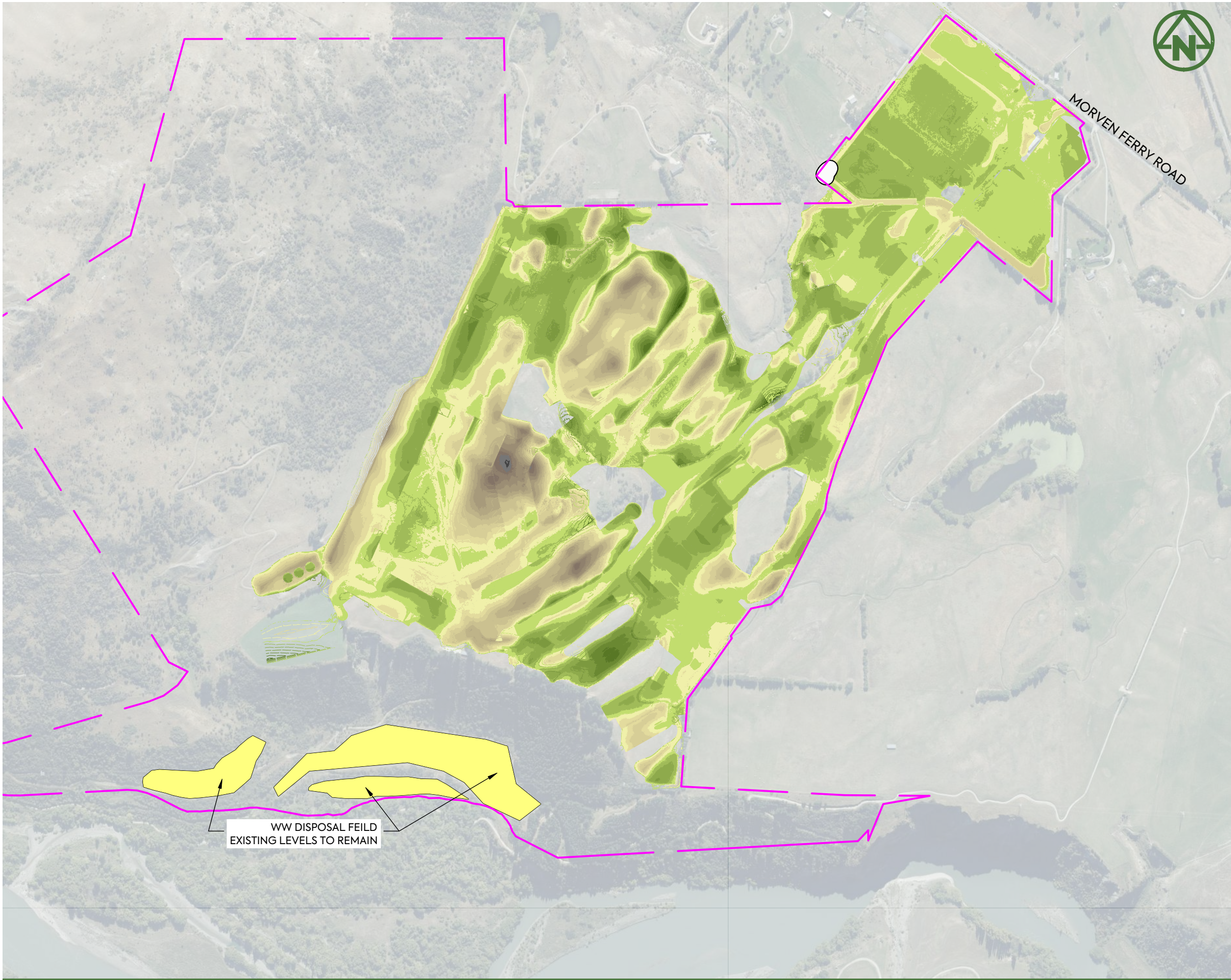
TITLE: WASTEWATER
PLAN
OVERALL

PURPOSE OF ISSUE: RESOURCE CONSENT

SCALE: 1:7500m @ A3
DO NOT SCALE

DRAWING NO: 4048-0-5000 REV: A

REV	DESCRIPTION	DRN BY	CHK BY	APP BY	DATE
A	FOR INFORMATION	MR	-	-	-



LEGEND:

SITE BOUNDARY

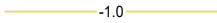
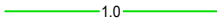
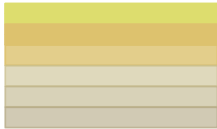
PROPOSED FILL
(0 to +1m)
(+1 to +2m)
(+2 to +3m)
(+3 to +4m)
(+4 to +5m)
(+5 to +6m)

PROPOSED CUT
(-1 to 0m)
(-2 to -1m)
(-3 to -2m)
(-4 to -3m)
(-5 to -4m)
(-6 to -5m)

PROPOSED FILL
(MAJOR CONTOUR)

PROPOSED CUT
(MAJOR CONTOUR)

CUT/FILL
(ZERO CONTOUR)



CLIENT:

RIDGEBURN LTD

PROJECT:

RIDGEBURN
122 MORVEN FERRY ROAD
ARROW JUNCTION
QUEENSTOWN

TITLE:

EARTHWORKS
CUT FILL
OVERALL

PURPOSE OF ISSUE:

RESOURCE CONSENT

SCALE:
1:7500m @ A3

DO NOT SCALE

DRAWING NO:

4048-0-2100

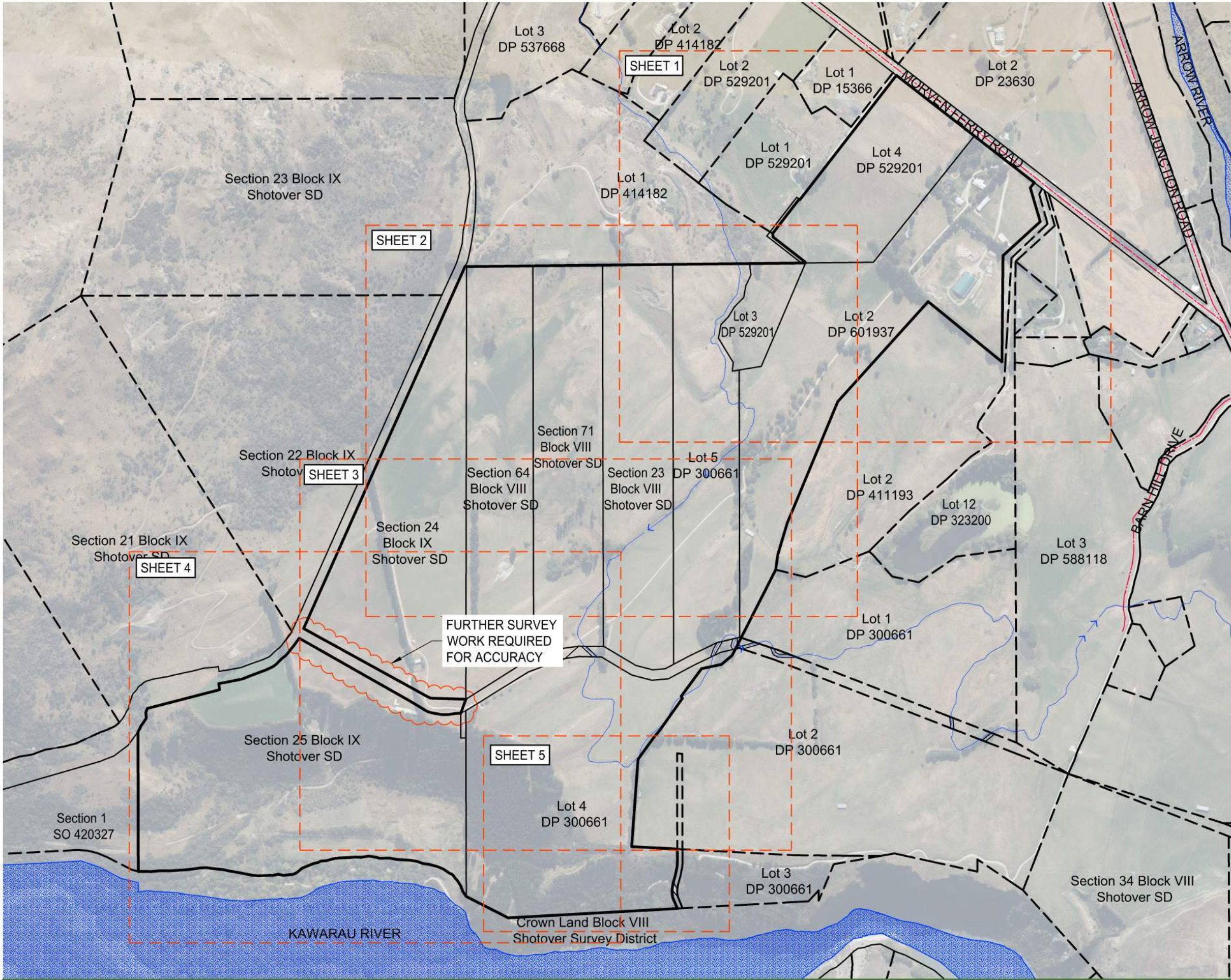
REV:

A



MCKENZIE & CO.

REV	DESCRIPTION	DRN BY	CHK BY	APP BY	DATE
A	FIRST ISSUE	MR	-	-	-

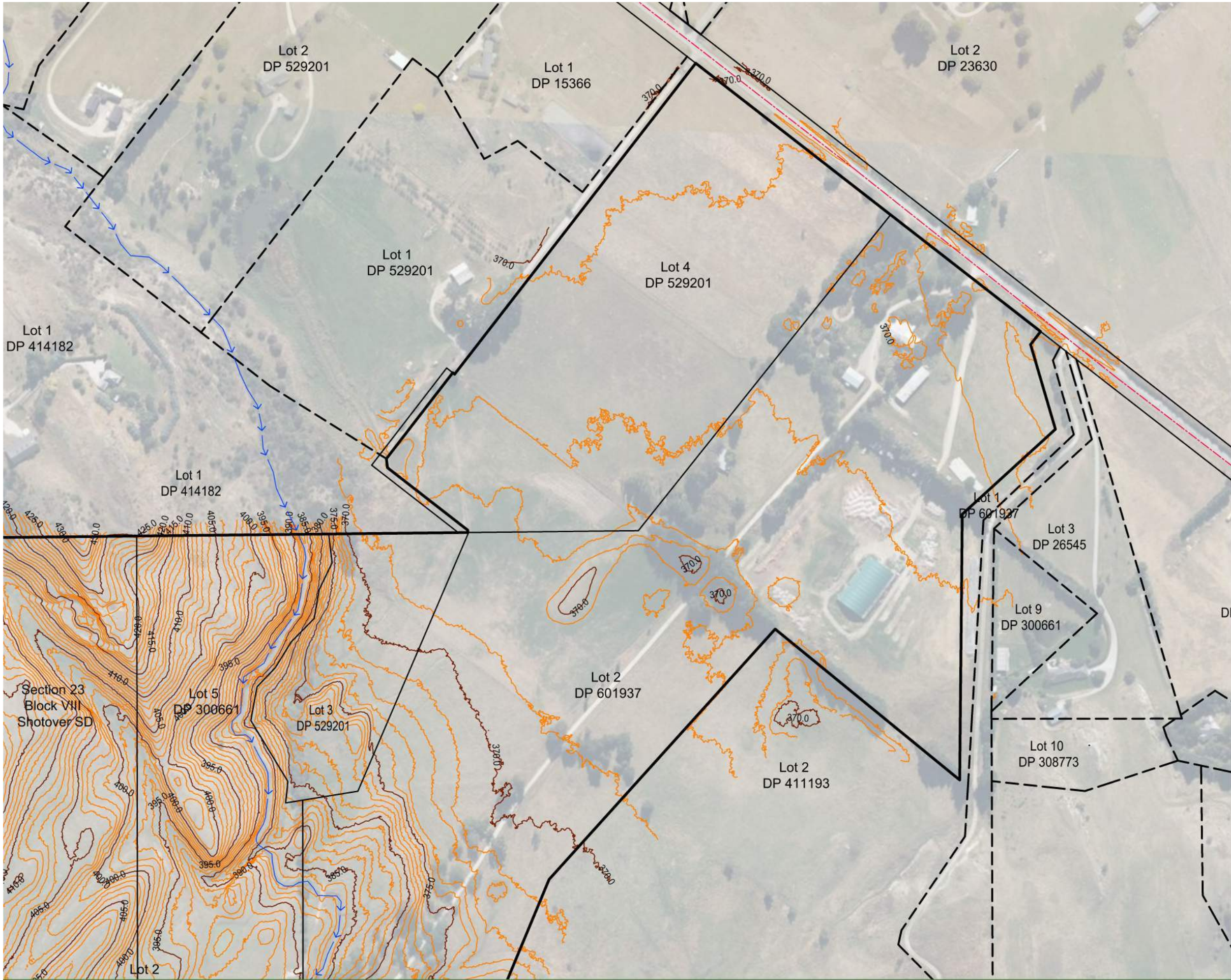


NOTES

- COORDINATES ARE IN TERMS OF MT NICHOLAS 2000.
ORIGIN OF COORDINATES
MARK: F6L9
815605.102 m N
435926.587 m E
- LEVELS ARE IN TERMS OF NEW ZEALAND VERTICAL DATUM 2016.
ORIGIN OF LEVELS
MARK: F6L9
R.L.: 365.116 m
- BOUNDARIES SHOWN ON THIS PLAN HAVE BEEN EXTRACTED FROM LAND INFORMATION NZ DCDB AND HAVE NOT BEEN SURVEYED. A BOUNDARY RETRACEMENT (REDEFINITION) SHOULD BE CARRIED OUT TO ESTABLISH EXACT BOUNDARY POSITIONS ON SITE.
- SOME LAYERS MAY HAVE BEEN SWITCHED OFF FOR CLARITY.
- DATA BY OTAGO REGIONAL COUNCIL AND LAND INFORMATION NEW ZEALAND IS LICENSED UNDER CC BY 3.0 NZ.
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- LEGAL DESCRIPTION
LOT 2 DP 601937, LOT 4 DP 529201, LOT 4 & 5 DP 300661, SECTION 24 & 25 BLOCK IX SHOTOVER SD AND SECTION 23, 64 & 71 BLOCK VIII SHOTOVER SD.
- THESE NOTES ARE AN INTEGRAL PART OF THIS PLAN.

LEGEND

- BOUNDARY (TSS CALC)
- ABBUTTALS (EXTRACT FROM LANDONLINE)
- MAJOR CONTOUR
- MINOR CONTOUR
- RIVER
- WATERWAY/ STREAM
- ROAD (EXTRACT FROM LANDONLINE)
- ROAD CENTRELINE



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LEGEND	
	BOUNDARY (TSS CALC)
	ABBUTTALS (EXTRACT FROM LANDONLINE)
	MAJOR CONTOUR
	MINOR CONTOUR
	RIVER
	WATERWAY/ STREAM
	ROAD (EXTRACT FROM LANDONLINE)
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- MAJOR CONTOUR
- MINOR CONTOUR
- RIVER
- WATERWAY/ STREAM
- ROAD (EXTRACT FROM LANDONLINE)
- ROAD CENTRELINE

CLIENT:

GIBBONS DEVELOPMENTS

PROJECT:

DOONHOME ESTATE
122 MORVEN FERRY ROAD
ARROW JUNCTION
QUEENSTOWN

TITLE:

TOPOGRAPHICAL SURVEY

PURPOSE OF ISSUE:

FOR INFORMATION ONLY

REV

DESCRIPTION

DRN BY

CHK BY

APP BY

DATE

C

UPDATED TOPO DRAWINGS

SH

SL

SL

19/01/26

B

INCLUDE LOT 3 DP 529201 ON BOUNDARY

MR

PC

PC

16/04/25

A

FIRST ISSUE

MR

PC

PC

25/03/25

SCALE:

1:3000

DO NOT SCALE

DRAWING NO.:

4035-0-012

REV:

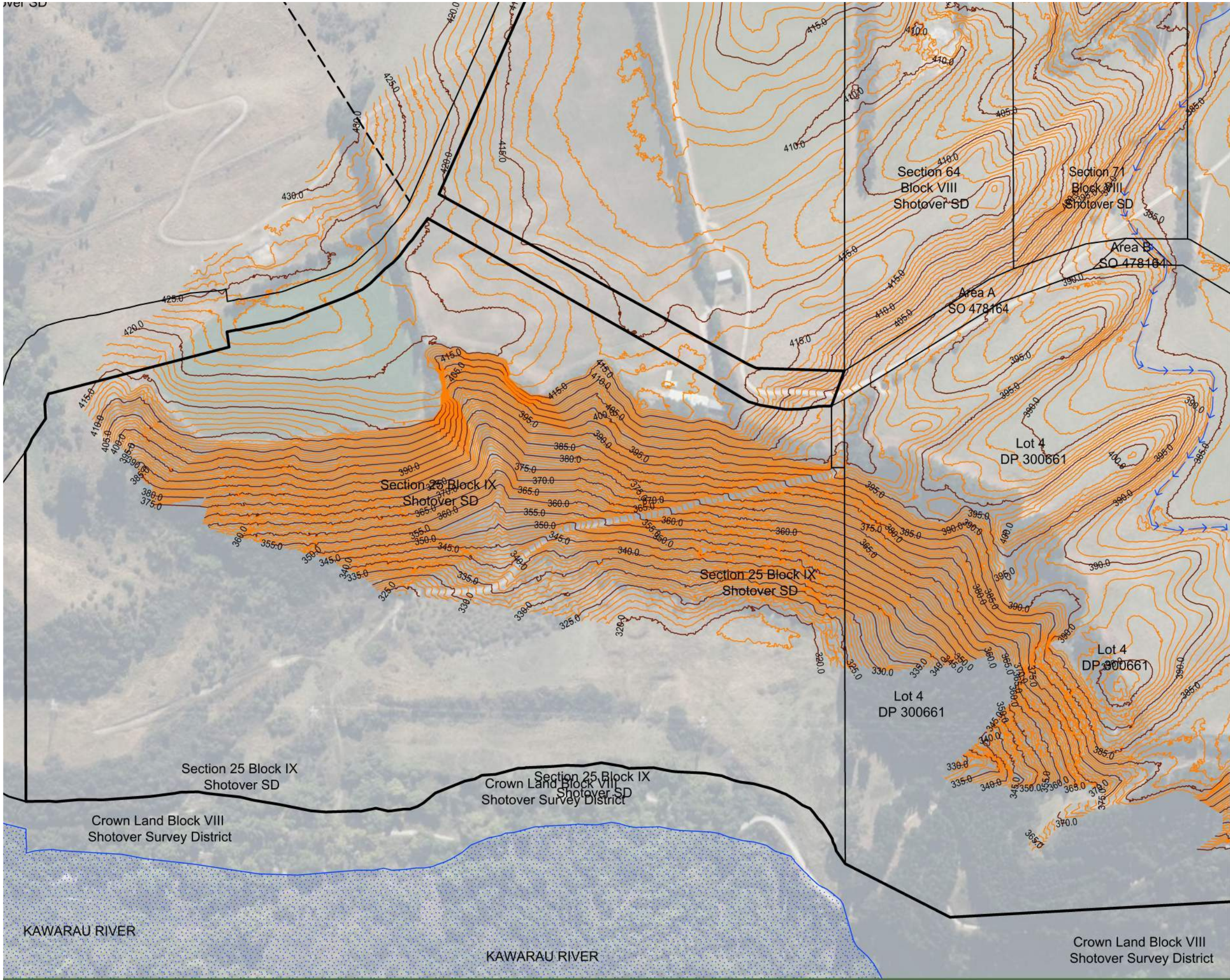
C

PLT DATE: 2026-01-19 17:07:10

WWW.MCKENZIEANDCO.CO.NZ

THIS DRAWING IS SOLELY FOR USE BY THE CLIENT ON THIS PROJECT ONLY. NO LIABILITY IS ACCEPTED IN ITS USE BY ANY OTHER ENTITY OR FOR ANY OTHER PURPOSE

C:\12DS\DATA\MCKFSOT\4035 122 MORVEN FERRY ROAD, ARROW JUNCTION - UAV FLIGHT_5470\05000: SURVEY\5030: DRAWINGS\4035-0-010.DWG

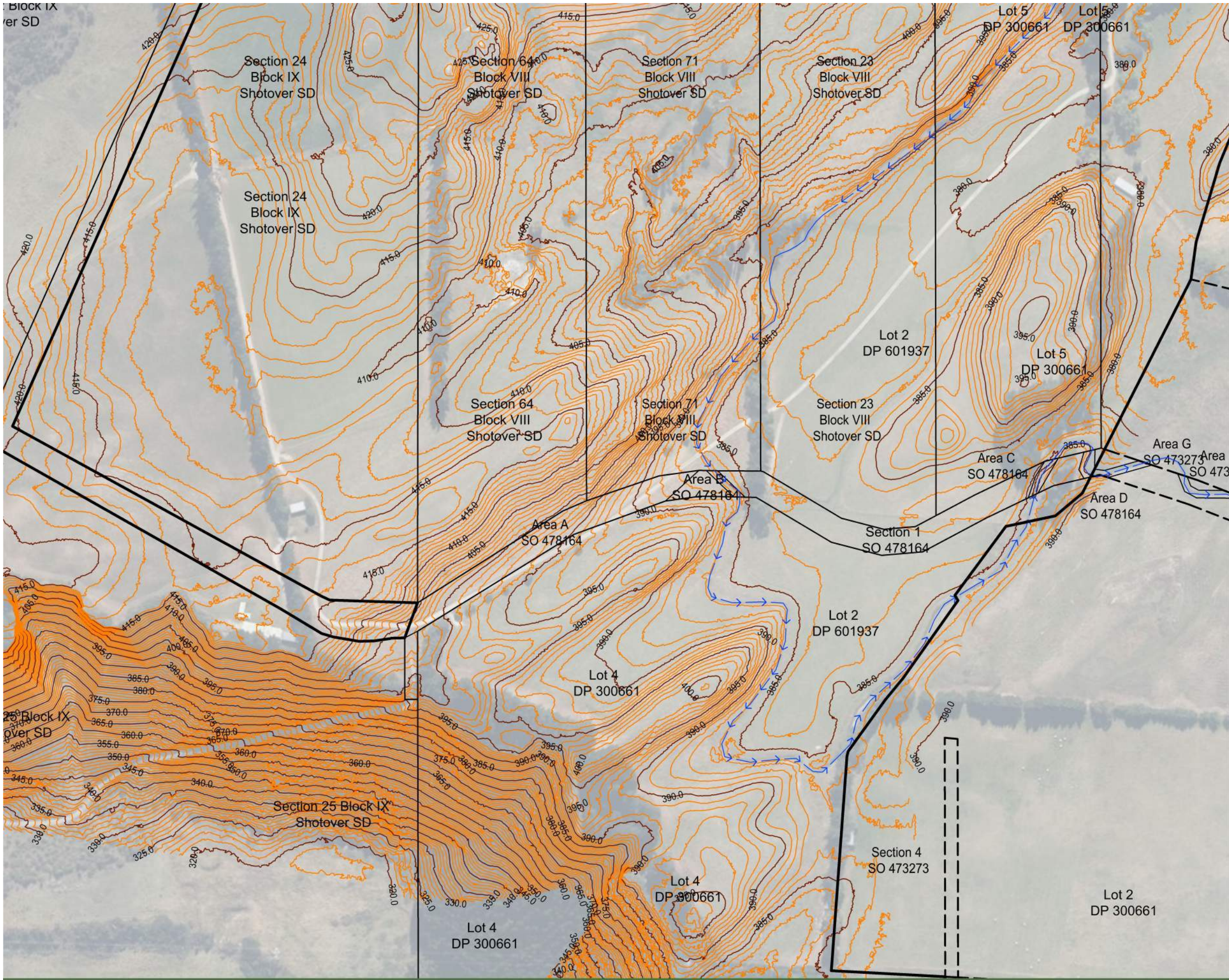


NOTES

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ORIGIN OF COORDINATES
MARK: F6L9
815605.102 m N
435926.587 m E
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- LEGAL DESCRIPTION
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- THESE NOTES ARE AN INTEGRAL PART OF THIS PLAN.

LEGEND

- BOUNDARY (TSS CALC)
- ABBUTTALS (EXTRACT FROM LANDONLINE)
- MAJOR CONTOUR
- MINOR CONTOUR
- RIVER
- WATERWAY/ STREAM
- ROAD (EXTRACT FROM LANDONLINE)
- ROAD CENTRELINE



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- LEVELS ARE IN TERMS OF NEW ZEALAND VERTICAL DATUM 2016.
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- MAJOR CONTOUR
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- RIVER
- WATERWAY/ STREAM
- ROAD (EXTRACT FROM LANDONLINE)
- ROAD CENTRELINE

C	UPDATED TOPO DRAWINGS	SH	SL	SL	19/01/26
B	INCLUDE LOT 3 DP 529201 ON BOUNDARY	MR	PC	PC	16/04/25
A	FIRST ISSUE	MR	PC	PC	25/03/25
REV	DESCRIPTION	DRN BY	CHK BY	APP BY	DATE



GIBBONS DEVELOPMENTS

DOONHOME ESTATE
122 MORVEN FERRY ROAD
ARROW JUNCTION
QUEENSTOWN

TOPOGRAPHICAL SURVEY

PURPOSE OF ISSUE:
FOR INFORMATION ONLY

SCALE:
1:3000
DO NOT SCALE

DRAWING NO.:
4035-0-013
REV: C



- ### LEGEND



	BOUNDARY (TSS CALC)
	ABBUTTALS (EXTRACT FROM LANDONLINE)
	MAJOR CONTOUR
	MINOR CONTOUR
	RIVER
	WATERWAY/ STREAM
	ROAD (EXTRACT FROM LANDONLINE)
	ROAD CENTRELINE

Crown Land Block VIII

GIBBONS DEVELOPMENTS

DOONHOME ESTATE
122 MORVEN FERRY ROAD
ARROW JUNCTION
QUEENSTOWN

TOPOGRAPHICAL SURVEY

FOR INFORMATION ONLY

DO NOT SCALE

DRAWING NO:

4035-0-015

REV:

C

C	UPDATED TOPO DRAWINGS	SH	SL	SL	19/01/26
B	INCLUDE LOT 3 DP 529201 ON BOUNDARY	MR	PC	PC	16/04/25
A	FIRST ISSUE	MR	PC	PC	25/03/25
REV	DESCRIPTION	DRN BY	CHK BY	APP BY	DATE



MCKENZIE & CO.

Appendix B

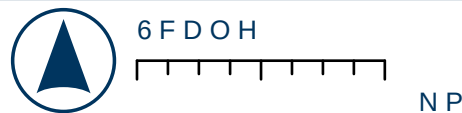
Desktop Study & Previous Reporting

1. Hazard Map
2. National Water Table Map
3. Report Extracts
4. Otago Regional Council Wells and Bore Map

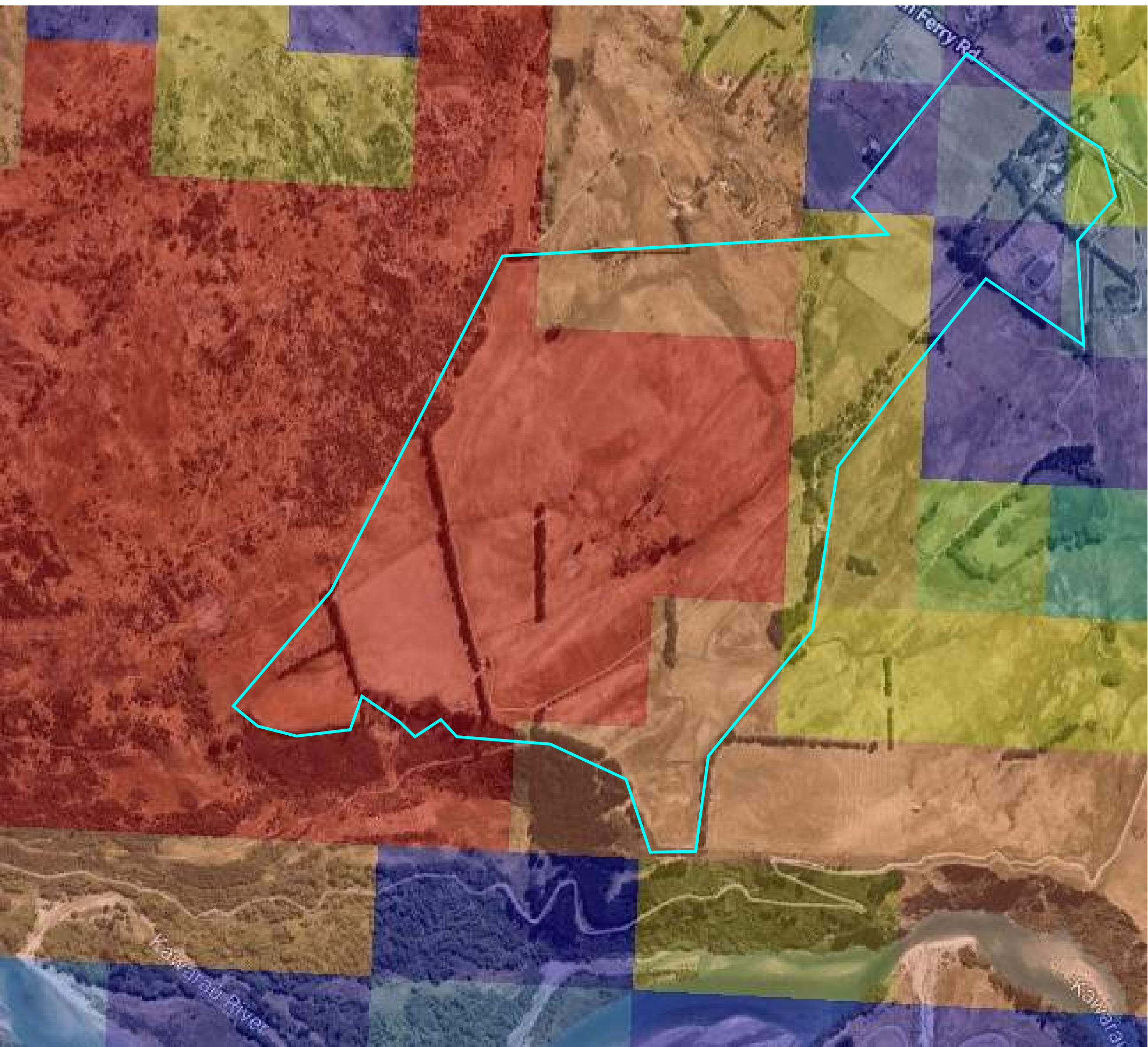




5RDGV *16 5HJLRQDO \$QDO\VLV
3DUFHOV DQG 3URSHUWLHV 2WDJR \$OOXYLDO)DQV 3URMHFW
\$FWLYH &RPSRVLWH /RFDWLRQ
DSSUR[LPDWH
)DXOWV *16
,QDFWLYH)DXOW /RFDWLRQ
DSSUR[LPDWH
1HZ =HDODQG +LOOVKDGH



7KH LQIRUPDWLRQ SURYLGHG RQ WKLV PDS LV LQWHQGHG
FRVLGHUDEOH HIIRUH KDV EHHQ PDGH WR HQVXUH WKDW
DFFXUDWH FXUUHQW DQG RWKHUZLVH DGHTXDWH LQ DOO
QRW DFFHSW DQ\ UHVSRQVLEOLW\ IRU FRQWHQW DQG VKL
ZLWK UHODWLRQ WR DQ\ FODLPV ZKDWVRHYHU DULVLQJ IU



LEGEND

Site Boundary (Approx.)

**Water table depth
(mbgl)**

- 0-0.5
- 0.5-2.5
- 2.5-5
- 5-10
- 10-20
- 20-40
- 40-80
- >80

NOTES

Location of Features are approximate only.

Site Plan sourced from Google Earth via the National Water Table interactive map by GNS, data retrieved January 2026.

TP13	0.0 – 0.2	-	-	-	0.2 - >0.6
TP14	0.0 – 0.3	0.3 – 1.3	-	1.3 – 1.7	1.7 – >1.9
- NOT ENCOUNTERED					
> UNIT EXTENTS BELOW DEPTH OF TEST PIT					

5.3. EXISTING FILL

No fill was encountered within the proposed building platforms across the site. Minor stock piles and excavated trench materials had been placed adjacent to each water course and man-made overland flow path. The trench material is not considered as engineered earthfill and has been clearly placed as stock piles and dumps

6. GROUNDWATER

Water inflows were observed in Test Pit 6, 12 and 14 on the down slope side of the irrigation race passing through the site. Vegetation within the depressions across site generally had greater vegetation due to the inflow from the irrigation race. The inflows were not part of the local groundwater table which was not encountered during our investigation.

It should be noted that fluctuations in the groundwater levels can occur as a result of seasonal variations, temperature, rainfall and other similar factors, the influence of which may not have been apparent at the time of investigation. As mentioned above, a shortage of rainfall meant the upper soils were relatively dry and no recent fluctuations in groundwater levels were observed within the test pits.

It is expected that minor seepage could be expected in the gravel horizons and locally typical perched levels are observed on the soil to rock contact. Perched groundwater or seepage is most likely during the winter months.

To ensure no seepage enters the proposed building platforms located below the existing irrigation race alignments, it is recommended that the race is either remediated where this seepage influences the building platforms and roading corridors; or drainage control works such as diversion swales or subsoil drains are installed to prevent this seepage affecting the building platforms. Lot 6 is shown to be directly adjacent to the irrigation race on the upslope side. Maintenance and clearing of the irrigation race is conducted by the company that owns the irrigation race, hence any works on the race will need to be approved and coordinated with them.

The weir located under the access road at the south west end of the pond is leaking around the sides of the weir. We have been advised these works are to be repaired to prevent further side bypass of flows around the weir.

A portion of Lot 3 is located across a depression along the north east boundary of the site which was saturated during our site investigation. A direct source of inflow was not observed however the irrigation race above the site would likely be seeping into the low-lying area also.

7. DISCUSSION AND RECOMMENDATIONS

7.1. SITE PREPARATION

Site preparation and earthworks suitable for structure and pavement support should consist of:

- Prior to the placement of any new structural fill, the proposed areas should be stripped to remove all vegetation, topsoil, root affected or other potentially deleterious material. Stripping is generally expected to be required to depths of about 0.2m to 0.5m;
- New site fill beneath structures should be compacted to a minimum density ratio of 95% Standard Compaction and within acceptable limits of Optimum Moisture Content; and if over 0.6m deep be certified in accordance with NZS4431.
- All new structural fill should be supported by properly designed and constructed retaining walls or else battered at 1V:2H or flatter and protected against erosion;
- Earthworks and landscaping fills not requiring certification should be in accordance with the recommendations of NZS 4431:1989 '*Earth Fill for Residential development*'. With particular emphasis on benching into steep slopes and appropriate drainage being installed.

7.2. EXCAVATION CONDITIONS

5.2. INTERPRETED SUBSURFACE CONDITIONS

The typical soil types encountered during the field investigations have been divided into five geotechnical units as summarised in Table 1. Geological Logs of the test pits are presented in Appendix B.

TABLE 1 – SUMMARY OF GEOLOGICAL UNITS AND SOIL TYPES

UNIT	SOIL TYPE	DESCRIPTION
1	Topsoil	TOPSOIL: SILT; dry; brown; organic; rootlets; very loose to medium dense.
2	Loess	SILT; light brown; massive; medium dense to dense.
3	Alluvial Silt	Sandy SILT with a trace of gravel and cobbles; moist; brown/grey; fine to coarse sand; fine to coarse, sub angular/rounded gravel; fine to medium sub angular/rounded cobbles; medium dense to dense.
4	Alluvial Sand	Silty, gravelly SAND/gravelly SAND; brown; fine to coarse sand; fine to coarse, angular to sub angular/rounded gravel; medium dense to dense.
5	Haast Schist	SCHIST; grey; highly weathered; laminated; very weak; fissile.

Table 2 contains a summary of the distribution of the above geotechnical units in each Test Pit location.

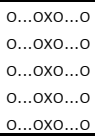
TABLE 2 – SUMMARY OF DISTRIBUTION OF GEOLOGICAL UNITS ENCOUNTERED AT TEST PIT LOCATIONS

TEST PIT LOCATION	DEPTH ENCOUNTERED BELOW EXISTING GROUND LEVEL (m)				
	UNIT 1	UNIT 2	UNIT 3	UNIT 4	UNIT 5
TP1	0.0 – 0.3	-	0.3 – 1.5	1.5 – >3.0	-
TP2	0.0 – 0.2	-	0.3 – 1.1	-	1.1 - >1.3
TP3	0.0 – 0.4	-	-	0.4 – 0.9	0.9 - >2.0
TP4	0.0 – 0.3	-	-	0.3 – 0.8	0.8 - >1.2
TP5	0.0 – 0.4	-	-	0.4 - 1.4	1.4 - >1.6
TP6	0.0 – 0.3	0.3 – 0.9	-	0.9 – 3.0	3.0 - >3.2
TP7	0.0 – 0.2	0.2 – 0.6	0.6 – 0.9	-	0.9 - >1.4
TP8	0.0 – 0.3	0.3 – 0.7	0.7 – 1.7	1.7 - >2.3	-
TP9	0.0 – 0.2	0.2 – 0.6	-	-	0.6 - >0.8
TP10	0.0 – 0.2	0.2 – 0.6	-	-	0.6 - >0.8
TP11	0.0 – 0.2	0.2 – 0.6	-	-	0.6 - >0.8
TP12	0.0 – 0.2	0.2 – 0.6	-	0.6 – 1.5	1.5 - >2.0

TP-1		TEST PIT LOG			RD Agritech ENGINEERED BY NATURE		
JOB NUMBER: 50611		PROJECT: Morven Ferry DP Geotech					
		LOCATION: Morven Ferry Road					
CO-ORDINATES:		HOLE STARTED: 29-Jan-18					
Refer Investigation Site Plan		HOLE FINISHED: 29-Jan-18					
ELEVATION:		m		OPERATOR: Declan			
DATUM:		COMPANY: C'n'R Earthworx			8 Tonne Excavator		
ENGINEERING DESCRIPTIONS					GEOLOGICAL		
STRENGTH TESTING	GROUNDWATER	SAMPLES	DEPTH (m)	GRAPHIC LOG	SOIL / ROCK CLASSIFICATION, PARTICLE SIZE CHARACTERISTICS,PLASTICITY, COLOUR, WEATHERING, SECONDARY AND MINOR COMPONENTS	MOISTURE CONDITION	SOIL / ROCK TYPE, ORIGIN, DEFECTS, STRUCTURE, FORMATION
			0.4	ψψψψψψ ψψψψψψ ψψψψψψ	SILT; brown; organic; rootlets; very loose to medium dense.	D	Topsoil
			0.8	..XXXOXXX.. 			

TP-2		TEST PIT LOG					
JOB NUMBER: 50611		PROJECT: Morven Ferry DP Geotech					
		LOCATION: Morven Ferry Road					
CO-ORDINATES: Refer Investigation Site Plan		HOLE STARTED: 29-Jan-18					
		HOLE FINISHED: 29-Jan-18					
ELEVATION: m		OPERATOR: Declan					
DATUM:		COMPANY: C'n'R Earthworx		8 Tonne Excavator			
ENGINEERING DESCRIPTIONS						GEOLOGICAL	
STRENGTH TESTING	GROUNDWATER	SAMPLES	DEPTH (m)	GRAPHIC LOG	SOIL / ROCK CLASSIFICATION, PARTICLE SIZE CHARACTERISTICS, PLASTICITY, COLOUR, WEATHERING, SECONDARY AND MINOR COMPONENTS	MOISTURE CONDITION	SOIL / ROCK TYPE, ORIGIN, DEFECTS, STRUCTURE, FORMATION
			0.4	φφφφφφφφ	SILT; brown; organic; rootlets; very loose to medium dense.	D	Topsoil
				φφφφφφφφ			
			0.8	..XXOXXX..	Sandy SILT with a trace of gravel and cobbles; brown/grey; fine to coarse sand; fine to coarse, sub angular/rounded gravel; fine to medium sub angular/rounded cobbles; medium dense to dense	M	Alluvial silt
				..XXOXXX..			
				..XXOXXX..			
				..XXOXXX..			
				..XXOXXX..			
				..XXOXXX..			
			1.2	\\\\\\\\\\\\\\\\	SCHIST; moderatley weathered; grey/brown; laminated; very weak; steeply inclined	D	Haast Schist
				\\\\\\\\\\\\\\\\			
			1.6		End of test pit, target depth encountered. No groundwater observed.		
			2.0				
2.4							
2.8							
3.2							
3.6							
4.0							
OTHER COMMENTS: Lot 1						Logged By: MJD	
						Checked Date: 27-Feb-18	
PHOTO REF.:						Sheet: 1 of 1	

TP-3		TEST PIT LOG		 ENGINEERED BY NATURE			
JOB NUMBER: 50611		PROJECT: Morven Ferry DP Geotech					
		LOCATION: Morven Ferry Road					
CO-ORDINATES: Refer Investigation Site Plan		HOLE STARTED: 29-Jan-18					
		HOLE FINISHED: 29-Jan-18					
ELEVATION: m		OPERATOR: Declan					
DATUM:		COMPANY: C'n'R Earthworx		8 Tonne Excavator			
ENGINEERING DESCRIPTIONS					GEOLOGICAL		
STRENGTH TESTING	GROUNDWATER	SAMPLES	DEPTH (m)	GRAPHIC LOG	SOIL / ROCK CLASSIFICATION, PARTICLE SIZE CHARACTERISTICS, PLASTICITY, COLOUR, WEATHERING, SECONDARY AND MINOR COMPONENTS	MOISTURE CONDITION	SOIL / ROCK TYPE, ORIGIN, DEFECTS, STRUCTURE, FORMATION
			0.4		SILT; brown; organic; rootlets; very loose to medium dense.	D	Topsoil
			0.8	o...oo...o o...oo...o o...oo...o o...oo...o	Gravelly SAND; grey; fine to coarse sand; fine to coarse, sub angular to angular gravel; medium dense to dense	M	Alluvial sand
			1.2		SCHIST; grey; highly weathered; laminated; very weak; fissile		Haast Schist
		1.6					
		2.0					
			2.4		End of test pit, target depth encountered. No groundwater observed.		
		2.8					
		3.2					
		3.6					
		4.0					
OTHER COMMENTS: Lot 2					Logged By: MJD Checked Date: 27-Feb-18		
PHOTO REF.:					Sheet: 1 of 1		

TP-4		TEST PIT LOG					
JOB NUMBER: 50611		PROJECT: Morven Ferry DP Geotech					
		LOCATION: Morven Ferry Road					
CO-ORDINATES:		HOLE STARTED: 29-Jan-18					
Refer Investigation Site Plan		HOLE FINISHED: 29-Jan-18					
ELEVATION: m		OPERATOR: Declan					
DATUM:		COMPANY: C'n'R Earthworx		8 Tonne Excavator			
ENGINEERING DESCRIPTIONS						GEOLOGICAL	
STRENGTH TESTING	GROUNDWATER	SAMPLES	DEPTH (m)	GRAPHIC LOG	SOIL / ROCK CLASSIFICATION, PARTICLE SIZE CHARACTERISTICS, PLASTICITY, COLOUR, WEATHERING, SECONDARY AND MINOR COMPONENTS	MOISTURE CONDITION	SOIL / ROCK TYPE, ORIGIN, DEFECTS, STRUCTURE, FORMATION
			0.4		SILT; brown; organic; rootlets; very loose to medium dense.	D	Topsoil
			0.8		Silty, gravelly SAND; grey; fine to coarse sand; fine to coarse, sub angular to angular gravel; medium dense to dense	M	Alluvial sand
			1.2		SCHIST; grey; highly weathered; laminated; very weak; fissile		Haast Schist
			1.6		End of test pit, target depth encountered. No groundwater observed.		
			2.0				
			2.4				
			2.8				
			3.2				
			3.6				
			4.0				
OTHER COMMENTS: Lot 2						Logged By: MJD	
						Checked Date: 27-Feb-18	
PHOTO REF.:						Sheet: 1 of 1	

TP-5		TEST PIT LOG					
JOB NUMBER: 50611		PROJECT: Morven Ferry DP Geotech					
		LOCATION: Morven Ferry Road					
CO-ORDINATES: Refer Investigation Site Plan		HOLE STARTED: 29-Jan-18					
		HOLE FINISHED: 29-Jan-18					
ELEVATION: m		OPERATOR: Declan					
DATUM:		COMPANY: C'n'R Earthworx		8 Tonne Excavator			
ENGINEERING DESCRIPTIONS							GEOLOGICAL
STRENGTH TESTING	GROUNDWATER	SAMPLES	DEPTH (m)	GRAPHIC LOG	SOIL / ROCK CLASSIFICATION, PARTICLE SIZE CHARACTERISTICS, PLASTICITY, COLOUR, WEATHERING, SECONDARY AND MINOR COMPONENTS	MOISTURE CONDITION	SOIL / ROCK TYPE, ORIGIN, DEFECTS, STRUCTURE, FORMATION
			0.4	ψψψψψψ ψψψψψψ ψψψψψψ ψψψψψψ	SILT; brown; organic; rootlets; very loose to medium dense.	D	Topsoil
			0.8	o...oo...o o...oo...o o...oo...o o...oo...o	Gravelly SAND; grey; fine to coarse sand; fine to coarse, sub angular to angular gravel ; medium dense to dense		Alluvial sand
			1.2	o...oo...o o...oo...o o...oo...o o...oo...o			
			1.6	\\\\\\\\\\\\ \\\\\\\\\\\\	SCHIST; grey; highly weathered; laminated; very weak; fissile		Haast Schist
			2.0		End of test pit, target depth encountered. No groundwater observed.		
			2.4				
			2.8				
			3.2				
			3.6				
			4.0				
OTHER COMMENTS: Lot 3						Logged By: MJD	
						Checked Date: 27-Feb-18	
PHOTO REF.:						Sheet: 1 of 1	

TP-6		TEST PIT LOG							
JOB NUMBER: 50611		PROJECT: Morven Ferry DP Geotech							
		LOCATION: Morven Ferry Road							
CO-ORDINATES: Refer Investigation Site Plan		HOLE STARTED: 29-Jan-18 HOLE FINISHED: 29-Jan-18							
ELEVATION: m		OPERATOR: Declan							
DATUM:		COMPANY: C'n'R Earthworx		8 Tonne Excavator					
ENGINEERING DESCRIPTIONS						GEOLOGICAL			
STRENGTH TESTING	GROUNDWATER	SAMPLES	DEPTH (m)	GRAPHIC LOG	SOIL / ROCK CLASSIFICATION, PARTICLE SIZE CHARACTERISTICS, PLASTICITY, COLOUR, WEATHERING, SECONDARY AND MINOR COMPONENTS	MOISTURE CONDITION	SOIL / ROCK TYPE, ORIGIN, DEFECTS, STRUCTURE, FORMATION		
			0.4	ψψψψψψ ψψψψψψ ψψψψψψ	SILT; brown; organic; rootlets; very loose to medium dense.	D	Topsoil		
			0.8	xxxxxxx xxxxxxx xxxxxxx xxxxxxx xxxxxxx	SILT; light brown; massive; medium dense to dense		Loess		
			1.2	o...oo...o o...oo...o o...oo...o o...oo...o o...oo...o	Gravelly SAND; grey; fine to coarse sand; fine to coarse, sub angular to angular gravel; medium dense to dense		Alluvial sand		
			1.6						
			2.0						
			2.4						
			2.8						
			3.2		///////// /////////	SCHIST; grey; highly weathered; laminated; very weak; fissile	W	Haast Schist	
				3.6		End of test pit, target depth encountered. Water inflow @ 3.0m on rock contact			
				4.0					
OTHER COMMENTS: Lot 3: Water inflow @ 3.0m minor						Logged By: MJD			
						Checked Date: 27-Feb-18			
PHOTO REF.:						Sheet: 1 of 1			

TP-7		TEST PIT LOG							
JOB NUMBER: 50611		PROJECT: Morven Ferry DP Geotech							
		LOCATION: Morven Ferry Road							
CO-ORDINATES: Refer Investigation Site Plan		HOLE STARTED: 29-Jan-18 HOLE FINISHED: 29-Jan-18							
ELEVATION: m		OPERATOR: Declan							
DATUM:		COMPANY: C'n'R Earthworx		8 Tonne Excavator					
ENGINEERING DESCRIPTIONS					GEOLOGICAL				
STRENGTH TESTING	GROUNDWATER	SAMPLES	DEPTH (m)	GRAPHIC LOG	SOIL / ROCK CLASSIFICATION, PARTICLE SIZE CHARACTERISTICS, PLASTICITY, COLOUR, WEATHERING, SECONDARY AND MINOR COMPONENTS	MOISTURE CONDITION	SOIL / ROCK TYPE, ORIGIN, DEFECTS, STRUCTURE, FORMATION		
			0.4	φφφφφφφφ φφφφφφφφ	SILT; brown; organic; rootlets; very loose to medium dense.	D	Topsoil		
				xxxxxxx xxxxxxx xxxxxxx xxxxxxx	SILT; light brown; massive; medium dense to dense		Loess		
			0.8	..xxxoxxx.. ..xxxoxxx.. ..xxxoxxx..	Sandy SILT with a trace of gravel and cobbles; brown/grey; fine to coarse sand; fine to coarse, sub angular/rounded gravel; fine to medium sub angular/rounded cobbles; medium dense to dense		Alluvial silt		
				//////// //////// //////// //////// ////////	SCHIST; grey; highly weathered; laminated; very weak; fissile		Haast Schist		
			1.2						
			1.6		End of test pit, target depth encountered. No groundwater observed.				
			2.0						
			2.4						
			2.8						
			3.2						
			3.6						
			4.0						
OTHER COMMENTS: Lot 4						Logged By: MJD			
						Checked Date: 27-Feb-18			
PHOTO REF.:						Sheet: 1 of 1			

TP-9		TEST PIT LOG							
JOB NUMBER: 50611		PROJECT: Morven Ferry DP Geotech							
		LOCATION: Morven Ferry Road							
CO-ORDINATES: Refer Investigation Site Plan		HOLE STARTED: 29-Jan-18							
		HOLE FINISHED: 29-Jan-18							
ELEVATION: m		OPERATOR: Declan							
DATUM:		COMPANY: C'n'R Earthworx			8 Tonne Excavator				
ENGINEERING DESCRIPTIONS							GEOLOGICAL		
STRENGTH TESTING	GROUNDWATER	SAMPLES	DEPTH (m)	GRAPHIC LOG	SOIL / ROCK CLASSIFICATION, PARTICLE SIZE CHARACTERISTICS, PLASTICITY, COLOUR, WEATHERING, SECONDARY AND MINOR COMPONENTS	MOISTURE CONDITION	SOIL / ROCK TYPE, ORIGIN, DEFECTS, STRUCTURE, FORMATION		
			0.4	φφφφφφφφ φφφφφφφφ	SILT; brown; organic; rootlets; very loose to medium dense.	D	Topsoil		
				xxxxxxx xxxxxxx xxxxxxx xxxxxxx	SILT; light brown; massive; medium dense to dense		Loess		
			0.8	//////// ////////	SCHIST; grey; highly weathered; laminated; very weak; fissile		Haast Schist		
				1.2		End of test pit, target depth encountered. No groundwater observed.			
			1.6						
			2.0						
			2.4						
			2.8						
			3.2						
			3.6						
			4.0						
			OTHER COMMENTS: Lot 5						Logged By: MJD
						Checked Date: 27-Feb-18			
PHOTO REF.:						Sheet: 1 of 1			

TP-10		TEST PIT LOG					
JOB NUMBER: 50611		PROJECT: Morven Ferry DP Geotech					
		LOCATION: Morven Ferry Road					
CO-ORDINATES: Refer Investigation Site Plan		HOLE STARTED: 29-Jan-18 HOLE FINISHED: 29-Jan-18					
ELEVATION: m		OPERATOR: Declan					
DATUM:		COMPANY: C'n'R Earthworx		8 Tonne Excavator			
ENGINEERING DESCRIPTIONS					GEOLOGICAL		
STRENGTH TESTING	GROUNDWATER	SAMPLES	DEPTH (m)	GRAPHIC LOG	SOIL / ROCK CLASSIFICATION, PARTICLE SIZE CHARACTERISTICS, PLASTICITY, COLOUR, WEATHERING, SECONDARY AND MINOR COMPONENTS	MOISTURE CONDITION	SOIL / ROCK TYPE, ORIGIN, DEFECTS, STRUCTURE, FORMATION
			0.4	φφφφφφφφ φφφφφφφφ	SILT; brown; organic; rootlets; very loose to medium dense.	D	Topsoil
				xxxxxxx xxxxxxx xxxxxxx xxxxxxx	SILT; light brown; massive; medium dense to dense		Loess
			0.8	//////// ////////	SCHIST; grey; highly weathered; laminated; very weak; fissile		Haast Schist
				1.2 1.6 2.0 2.4 2.8 3.2 3.6 4.0	End of test pit, target depth encountered. No groundwater observed. 		
			OTHER COMMENTS: Lot 5				
						Checked Date: 27-Feb-18	
PHOTO REF.:						Sheet: 1 of 1	

TP-11		TEST PIT LOG						
JOB NUMBER: 50611		PROJECT: Morven Ferry DP Geotech						
		LOCATION: Morven Ferry Road						
CO-ORDINATES: Refer Investigation Site Plan		HOLE STARTED: 29-Jan-18 HOLE FINISHED: 29-Jan-18						
ELEVATION: m		OPERATOR: Declan						
DATUM:		COMPANY: C'n'R Earthworx		8 Tonne Excavator				
ENGINEERING DESCRIPTIONS					GEOLOGICAL			
STRENGTH TESTING	GROUNDWATER	SAMPLES	DEPTH (m)	GRAPHIC LOG	SOIL / ROCK CLASSIFICATION, PARTICLE SIZE CHARACTERISTICS, PLASTICITY, COLOUR, WEATHERING, SECONDARY AND MINOR COMPONENTS	MOISTURE CONDITION	SOIL / ROCK TYPE, ORIGIN, DEFECTS, STRUCTURE, FORMATION	
			0.4	φφφφφφφφ φφφφφφφφ xxxxxxx xxxxxxx xxxxxxx xxxxxxx	SILT; brown; organic; rootlets; very loose to medium dense. SILT; light brown; massive; medium dense to dense	D	Topsoil	
			0.8	///////// /////////	SCHIST; brown/grey; highly weathered; laminated; very weak; fissile		Loess	
			1.2				Haast Schist	
			1.6		End of test pit, target depth encountered. No groundwater observed. 			
			2.0					
			2.4					
			2.8					
			3.2					
			3.6					
			4.0					
OTHER COMMENTS: Lot 6					Logged By: MJD Checked Date: 27-Feb-18			
PHOTO REF.:					Sheet: 1 of 1			

TP-12		TEST PIT LOG		 ENGINEERED BY NATURE					
JOB NUMBER: 50611		PROJECT: Morven Ferry DP Geotech							
		LOCATION: Morven Ferry Road							
CO-ORDINATES: Refer Investigation Site Plan		HOLE STARTED: 29-Jan-18 HOLE FINISHED: 29-Jan-18							
ELEVATION: m		OPERATOR: Declan							
DATUM:		COMPANY: C'n'R Earthworx		8 Tonne Excavator					
ENGINEERING DESCRIPTIONS						GEOLOGICAL			
STRENGTH TESTING	GROUNDWATER	SAMPLES	DEPTH (m)	GRAPHIC LOG	SOIL / ROCK CLASSIFICATION, PARTICLE SIZE CHARACTERISTICS, PLASTICITY, COLOUR, WEATHERING, SECONDARY AND MINOR COMPONENTS	MOISTURE CONDITION	SOIL / ROCK TYPE, ORIGIN, DEFECTS, STRUCTURE, FORMATION		
			0.4	φφφφφφφφ φφφφφφφφ	SILT; brown; organic; rootlets; very loose to medium dense.	D	Topsoil		
				xxxxxxx xxxxxxx xxxxxxx xxxxxxx	SILT; light brown; massive; medium dense to dense		Loess		
			0.8	o...oo...o o...oo...o o...oo...o o...oo...o o...oo...o o...oo...o o...oo...o o...oo...o	Gravelly SAND; grey; fine to coarse sand; fine to coarse, sub angular to angular gravel; medium dense to dense	M	Alluvial sand		
								1.2	
									1.6
								2.0	
			2.4		End of test pit, target depth encountered. Water inflow @ 2.0m				
			2.8						
			3.2						
			3.6						
			4.0						
			OTHER COMMENTS: Lot 6 - Adjacent to water race so water inflow is likely a result of this.						Logged By: MJD
						Checked Date: 27-Feb-18			
PHOTO REF.:						Sheet: 1 of 1			

TP-13		TEST PIT LOG						
JOB NUMBER: 50611		PROJECT: Morven Ferry DP Geotech						
		LOCATION: Morven Ferry Road						
CO-ORDINATES: Refer Investigation Site Plan		HOLE STARTED: 29-Jan-18						
		HOLE FINISHED: 29-Jan-18						
ELEVATION: m		OPERATOR: Declan						
DATUM:		COMPANY: C'n'R Earthworx		8 Tonne Excavator				
ENGINEERING DESCRIPTIONS						GEOLOGICAL		
STRENGTH TESTING	GROUNDWATER	SAMPLES	DEPTH (m)	GRAPHIC LOG	SOIL / ROCK CLASSIFICATION, PARTICLE SIZE CHARACTERISTICS,PLASTICITY, COLOUR, WEATHERING, SECONDARY AND MINOR COMPONENTS	MOISTURE CONDITION	SOIL / ROCK TYPE, ORIGIN, DEFECTS, STRUCTURE, FORMATION	
			0.4	φφφφφφφφ φφφφφφφφ	SILT; brown; organic; rootlets; very loose to medium dense.	D	Topsoil	
				\\\\\\\\\\\\\\\\ \\\\\\\\\\\\\\\\ \\\\\\\\\\\\\\\\ \\\\\\\\\\\\\\\\	SCHIST;grey; highly weathered; laminated; very weak; fissile		Haast Schist	
			0.8		End of test pit, target depth encountered. No groundwater observed.			
			1.2					
			1.6					
			2.0					
			2.4					
			2.8					
			3.2					
			3.6					
			4.0					
			OTHER COMMENTS: Lot 7					
						Checked Date: 27-Feb-18		
PHOTO REF.:						Sheet: 1 of 1		

TP-14		TEST PIT LOG							
JOB NUMBER: 50611		PROJECT: Morven Ferry DP Geotech							
		LOCATION: Morven Ferry Road							
CO-ORDINATES: Refer Investigation Site Plan		HOLE STARTED: 29-Jan-18 HOLE FINISHED: 29-Jan-18							
ELEVATION: m		OPERATOR: Declan							
DATUM:		COMPANY: C'n'R Earthworx			8Tonne Excavator				
ENGINEERING DESCRIPTIONS							GEOLOGICAL		
STRENGTH TESTING	GROUNDWATER	SAMPLES	DEPTH (m)	GRAPHIC LOG	SOIL / ROCK CLASSIFICATION, PARTICLE SIZE CHARACTERISTICS,PLASTICITY, COLOUR, WEATHERING, SECONDARY AND MINOR COMPONENTS	MOISTURE CONDITION	SOIL / ROCK TYPE, ORIGIN, DEFECTS, STRUCTURE, FORMATION		
			0.4	φφφφφφφφ φφφφφφφφ φφφφφφφφ xxxxxxxx xxxxxxxx xxxxxxxx xxxxxxxx xxxxxxxx xxxxxxxx xxxxxxxx xxxxxxxx xxxxxxxx xxxxxxxx	SILT; brown; organic; rootlets; very loose to medium dense.	D	Topsoil		
			0.8	SILT;light brown; massive; medium dense to dense	Loess				
			1.2						
			1.6	...Xo...oX... ...Xo...oX... ...Xo...oX... ...Xo...oX...	Silty, gravelly SAND; brown; fine to coarse sand; fine to coarse, angular to sub angular/rounded gravel; ; medium dense to dense	M	Alluvial sand		
			2.0	///////// /////////	SCHIST;brown/grey; highly weathered; laminated; very weak; fissile		Haast Schist		
			2.4		End of test pit, target depth encountered. No groundwater observed.				
			2.8						
			3.2						
			3.6						
			4.0						
			OTHER COMMENTS: Lot 7						Logged By: MJD
						Checked Date: 27-Feb-18			
PHOTO REF.:						Sheet: 1 of 1			

SCALA PENETROMETER RESULTS



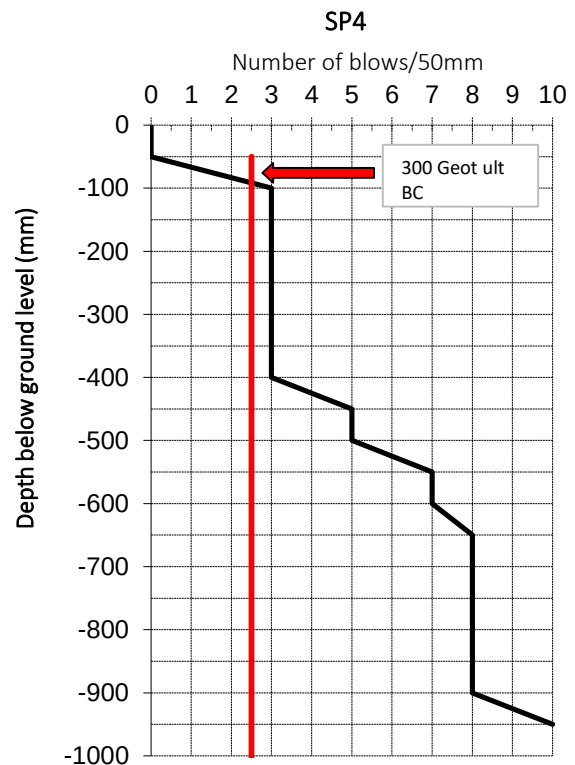
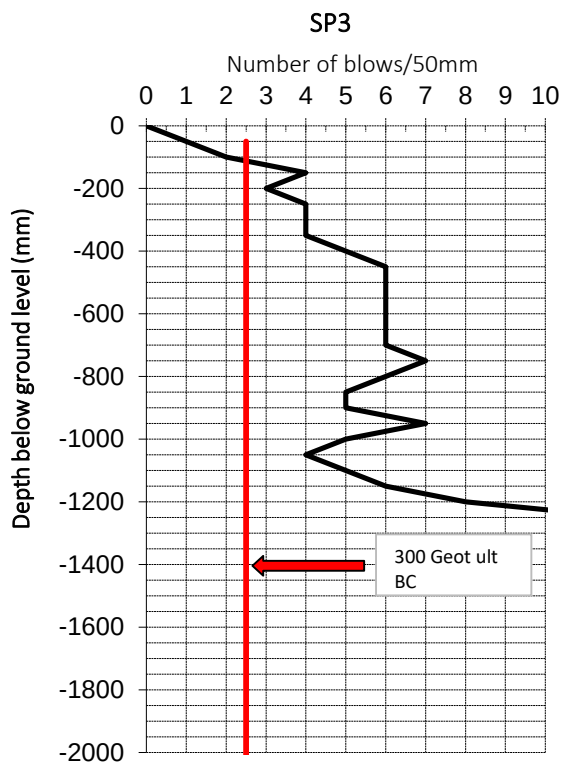
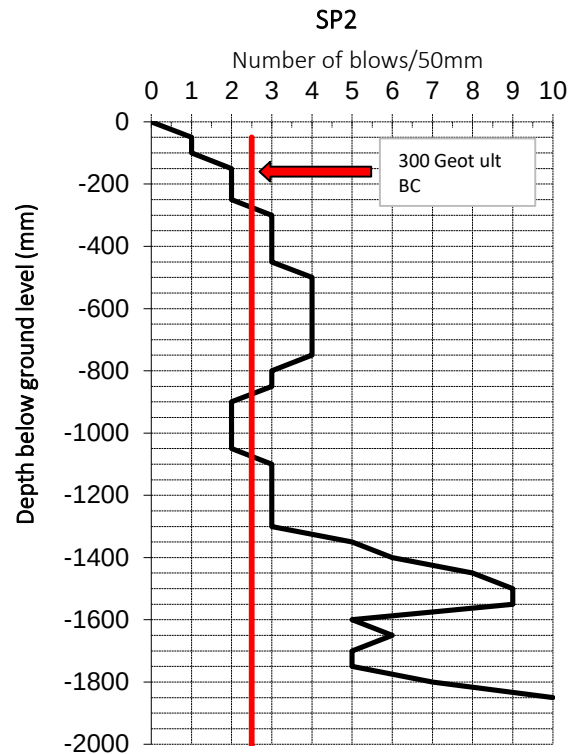
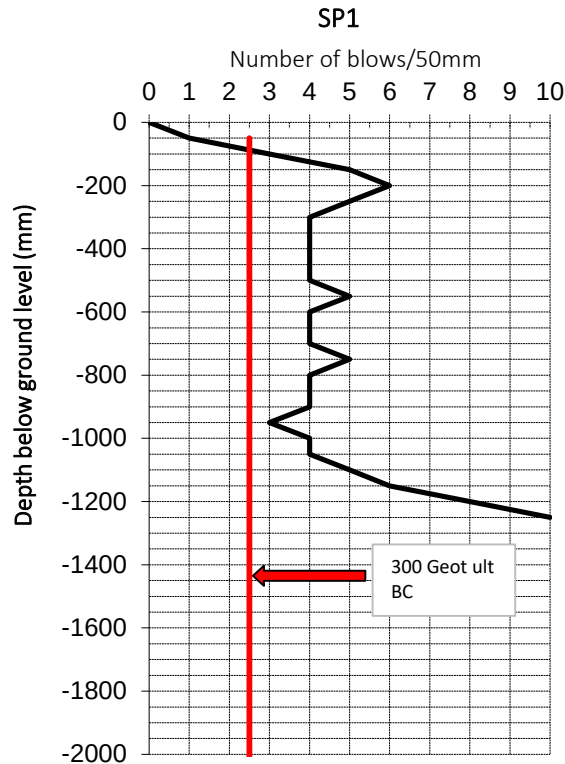
JOB NUMBER: 50611 PROJECT: Morven Ferry DP Geotech

LOCATION: MORVEN FERRY ROAD

CO-ORDINATES: mE DATE: 24-Jan-18

See attached plan mN OPERATOR: MJD & OMB

Note: No Friction correction has been applied to the field results. 5 Blows per 100mm is considered compliance with NZS3604 3.3.7

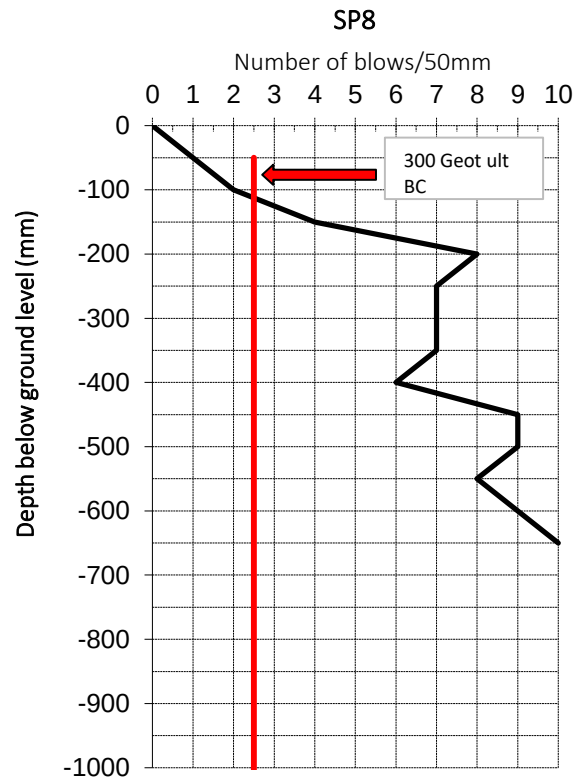
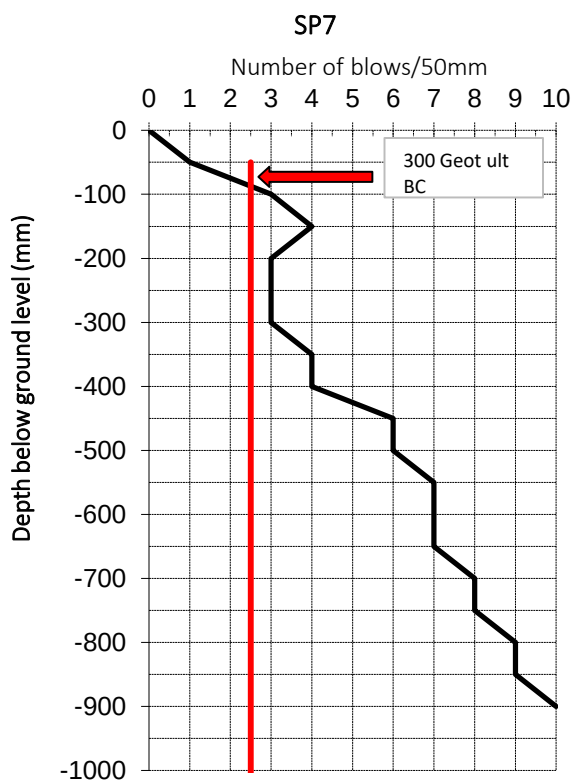
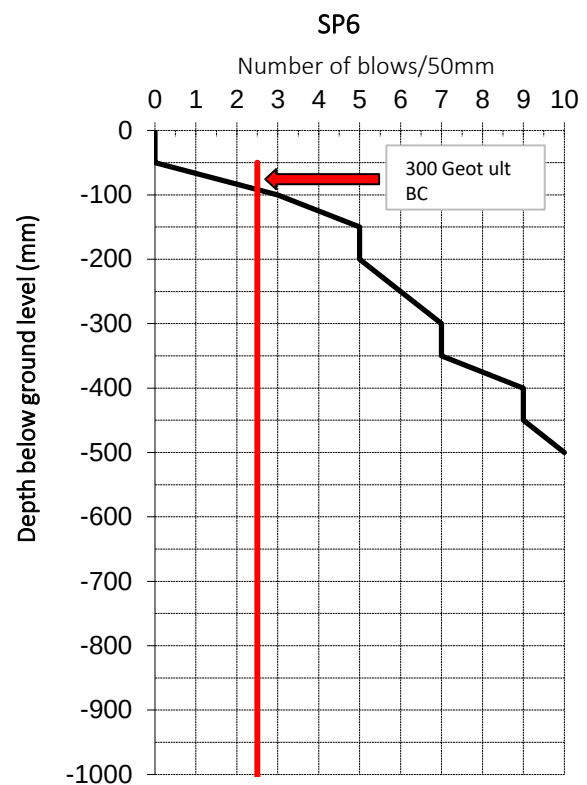
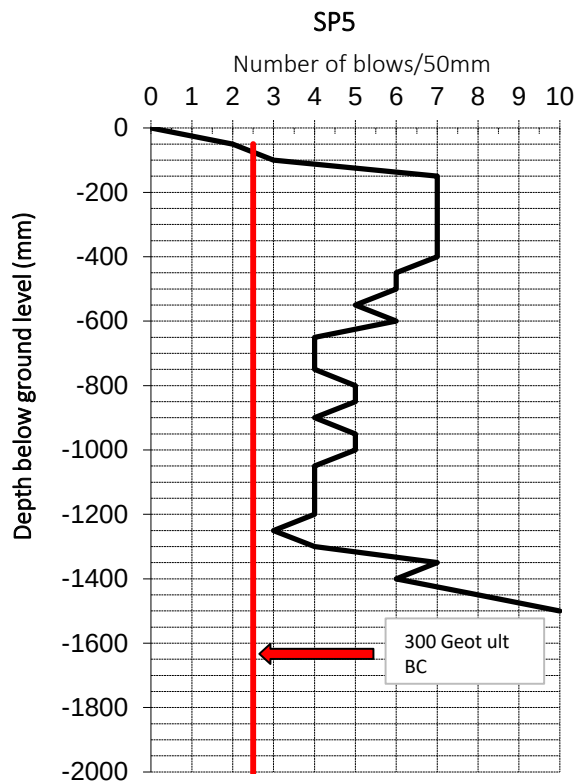


SCALA PENETROMETER RESULTS



JOB NUMBER:	50611	PROJECT:	Morven Ferry DP Geotech
		LOCATION:	MORVEN FERRY ROAD
CO-ORDINATES:	mE	DATE:	24-Jan-18
See attached plan	mN	OPERATOR:	MJD & OMB

Note: No Friction correction has been applied to the field results. 5 Blows per 100mm is considered compliance with NZS3604 3.3.7

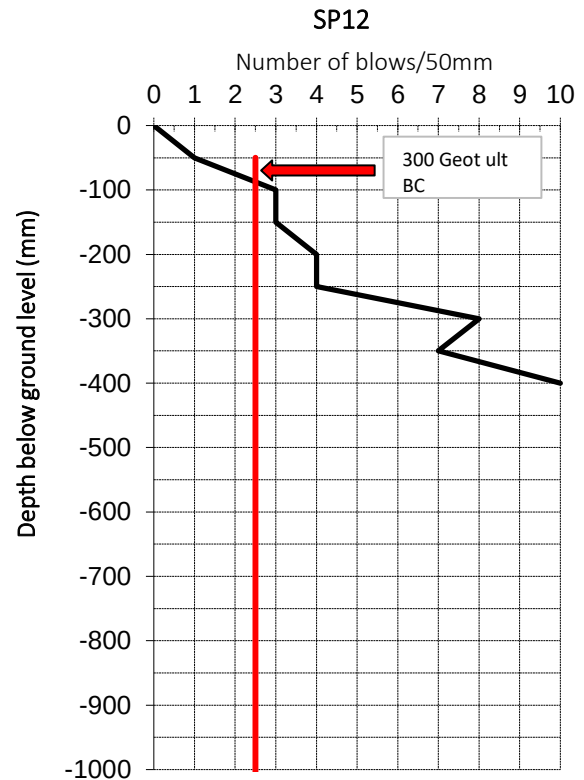
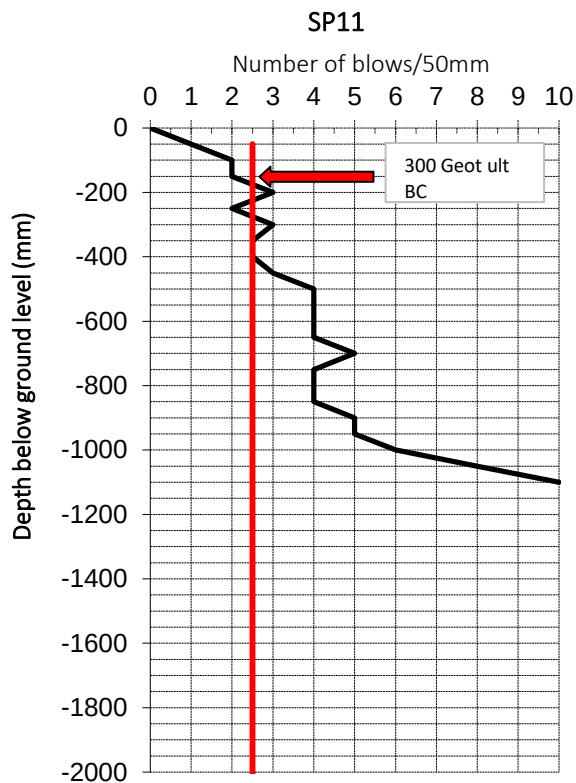
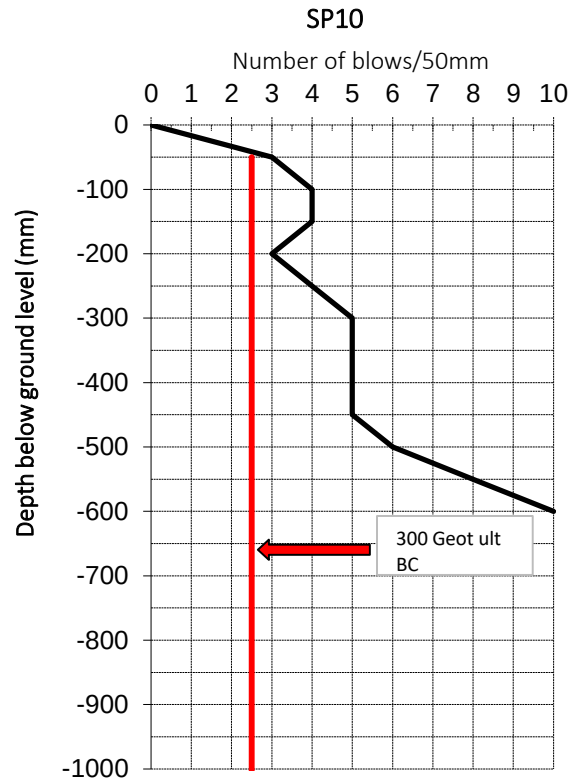
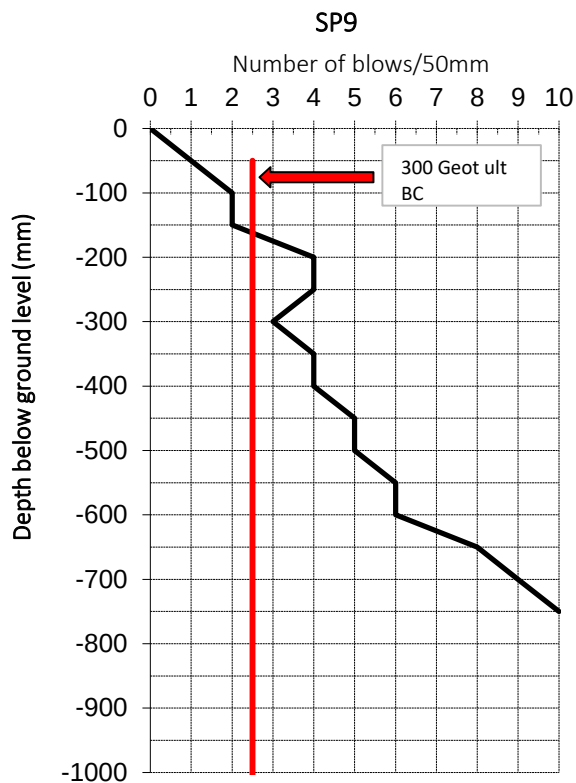


SCALA PENETROMETER RESULTS



JOB NUMBER:	50611	PROJECT:	Morven Ferry DP Geotech
		LOCATION:	MORVEN FERRY ROAD
CO-ORDINATES:	mE	DATE:	24-Jan-18
See attached plan	mN	OPERATOR:	MJD & OMB

Note: No Friction correction has been applied to the field results. 5 Blows per 100mm is considered compliance with NZS3604 3.3.7

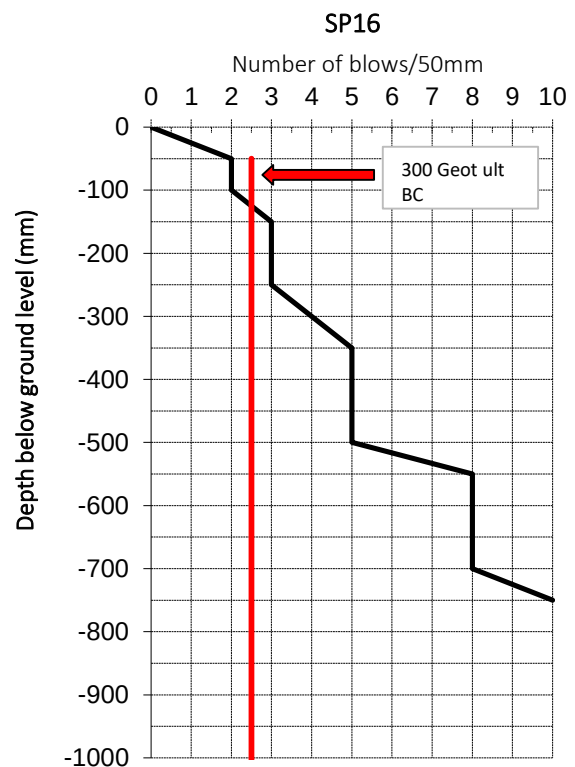
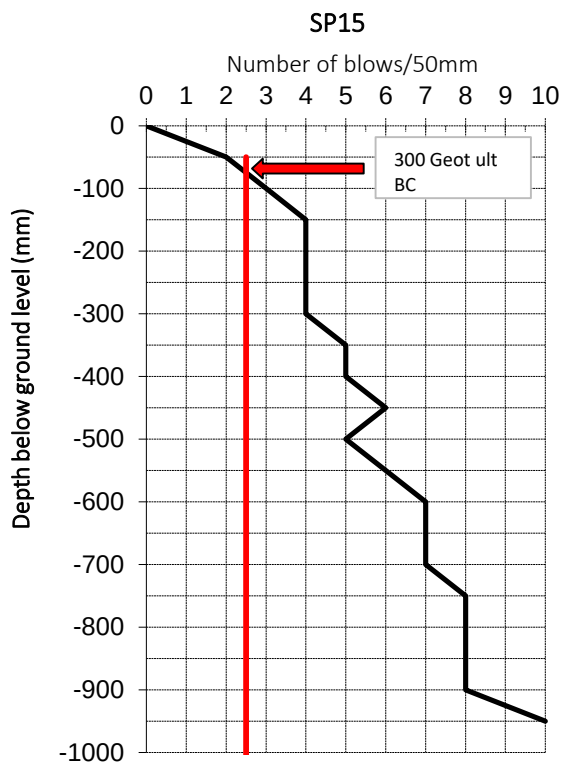
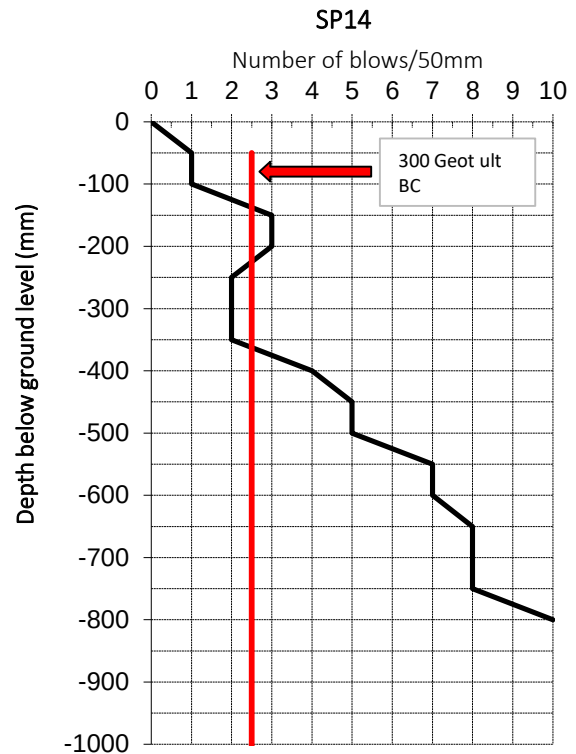
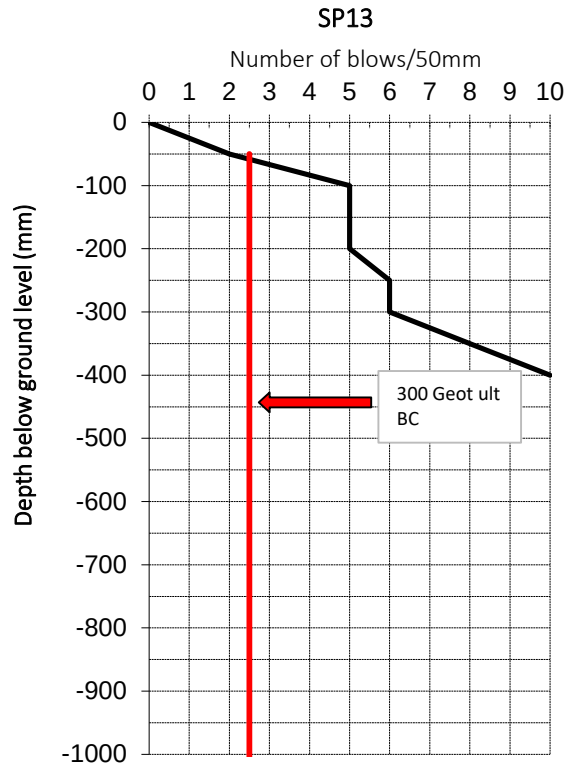


SCALA PENETROMETER RESULTS



JOB NUMBER: 50611	PROJECT: Morven Ferry DP Geotech
	LOCATION: MORVEN FERRY ROAD
CO-ORDINATES: mE	DATE: 24-Jan-18
See attached plan mN	OPERATOR: MJD & OMB

Note: No Friction correction has been applied to the field results. 5 Blows per 100mm is considered compliance with NZS3604 3.3.7

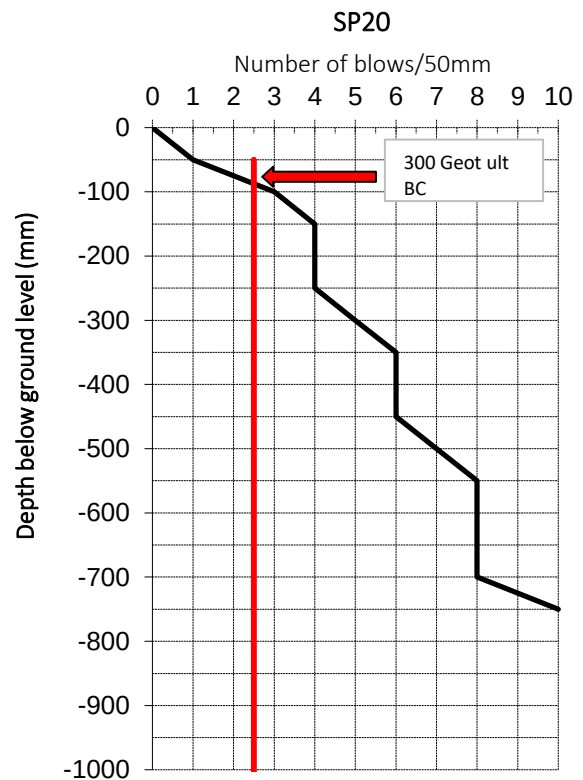
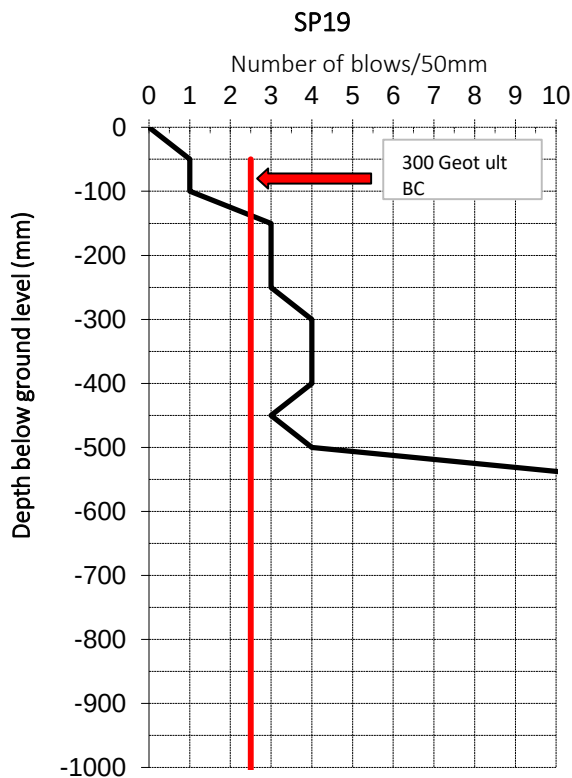
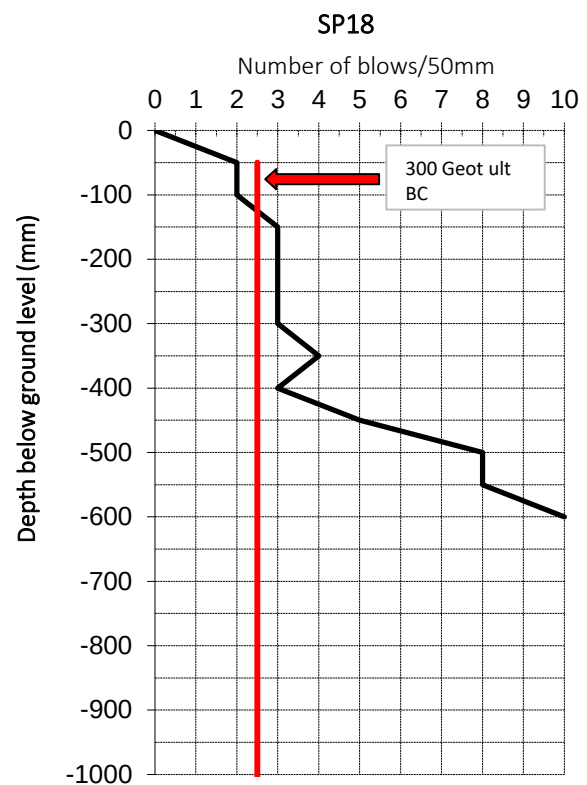
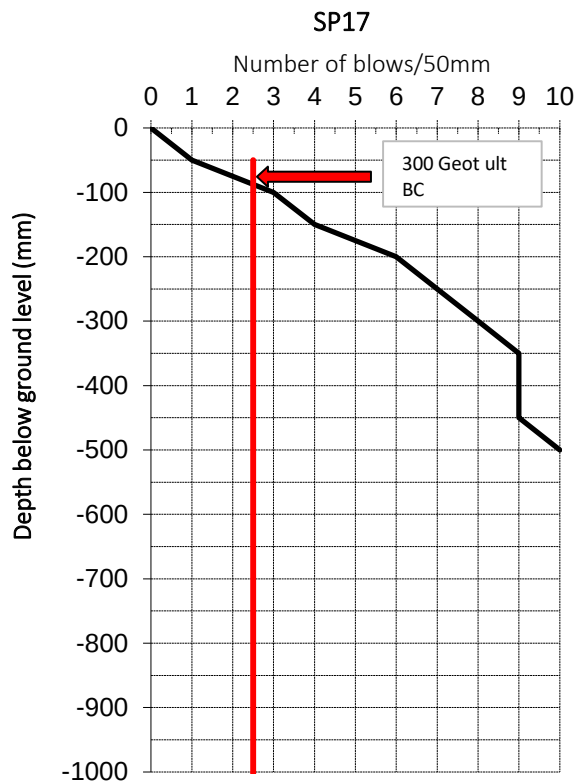


SCALA PENETROMETER RESULTS



JOB NUMBER:	50611	PROJECT:	Morven Ferry DP Geotech
		LOCATION:	MORVEN FERRY ROAD
CO-ORDINATES:	mE	DATE:	24-Jan-18
See attached plan	mN	OPERATOR:	MJD & OMB

Note: No Friction correction has been applied to the field results. 5 Blows per 100mm is considered compliance with NZS3604 3.3.7

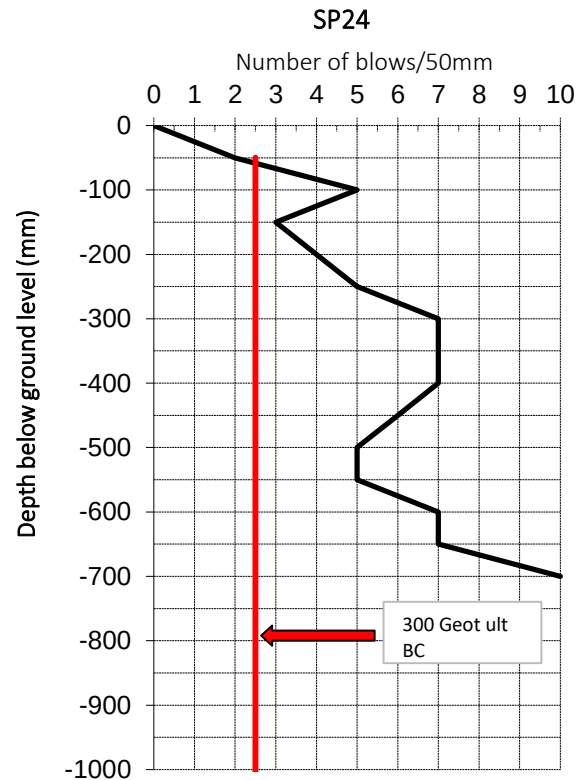
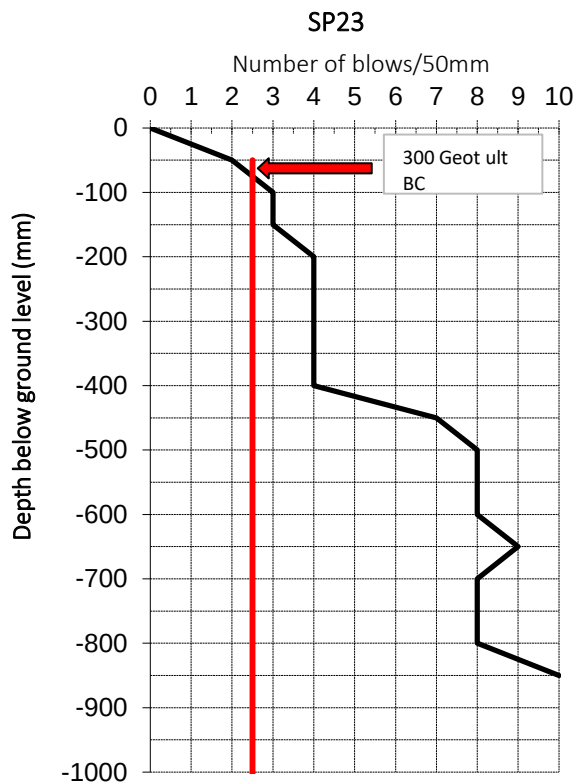
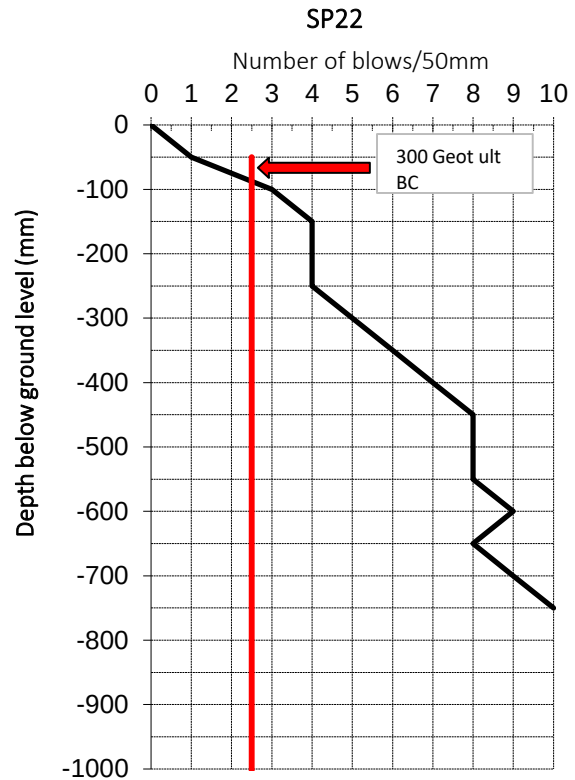
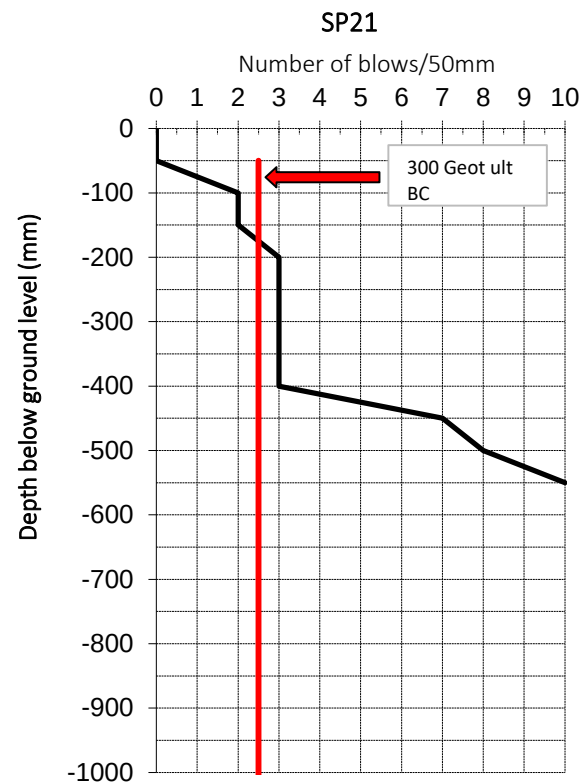


SCALA PENETROMETER RESULTS



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		LOCATION:	MORVEN FERRY ROAD
CO-ORDINATES:	mE	DATE:	24-Jan-18
See attached plan	mN	OPERATOR:	MJD & OMB

Note: No Friction correction has been applied to the field results. 5 Blows per 100mm is considered compliance with NZS3604 3.3.7



SCALA PENETROMETER RESULTS



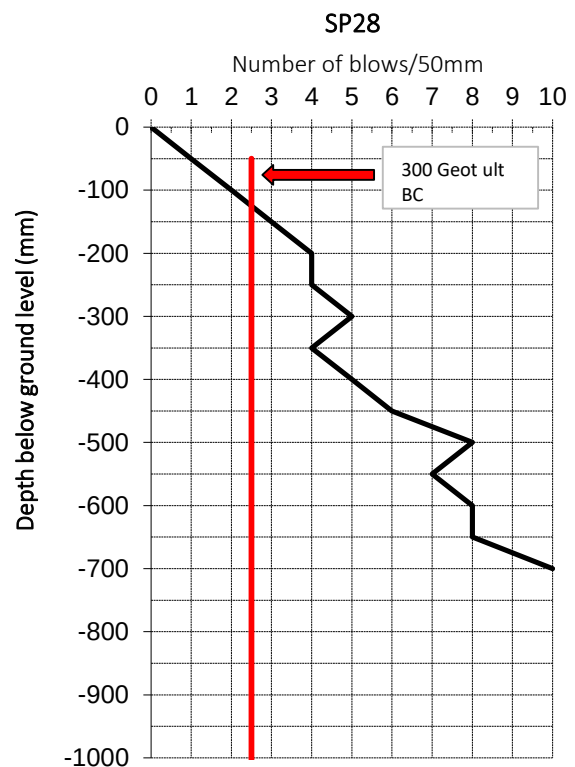
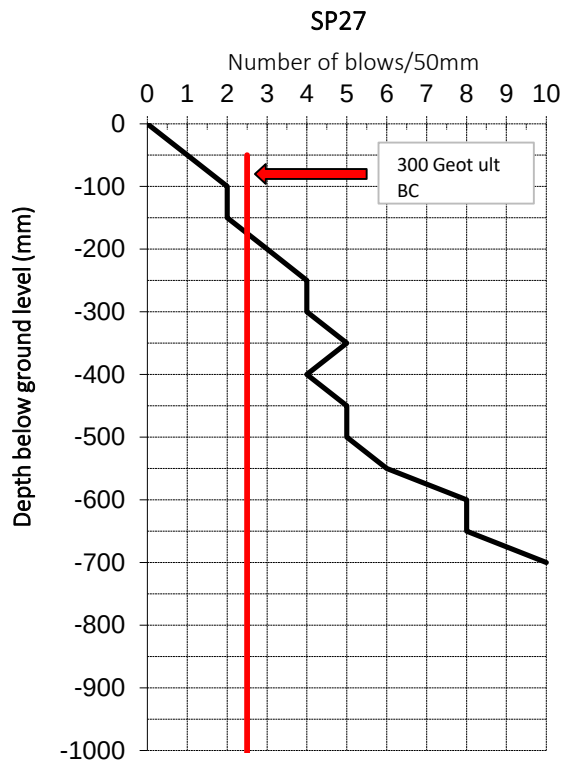
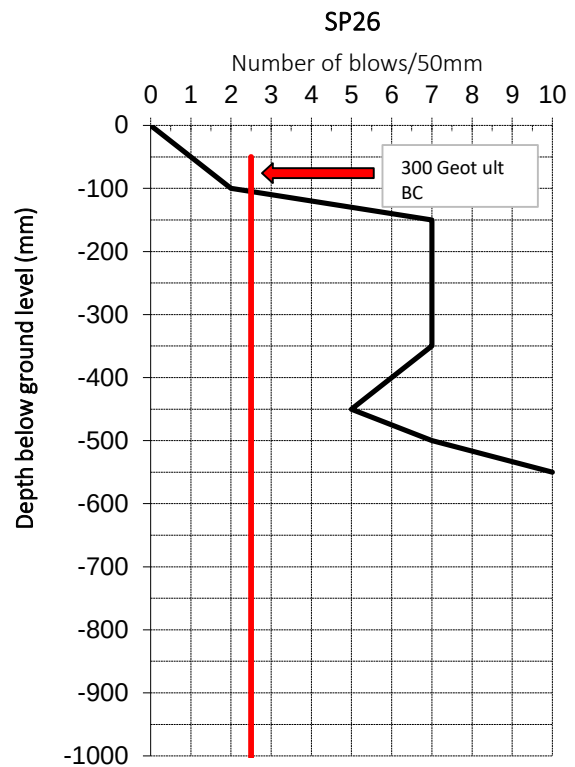
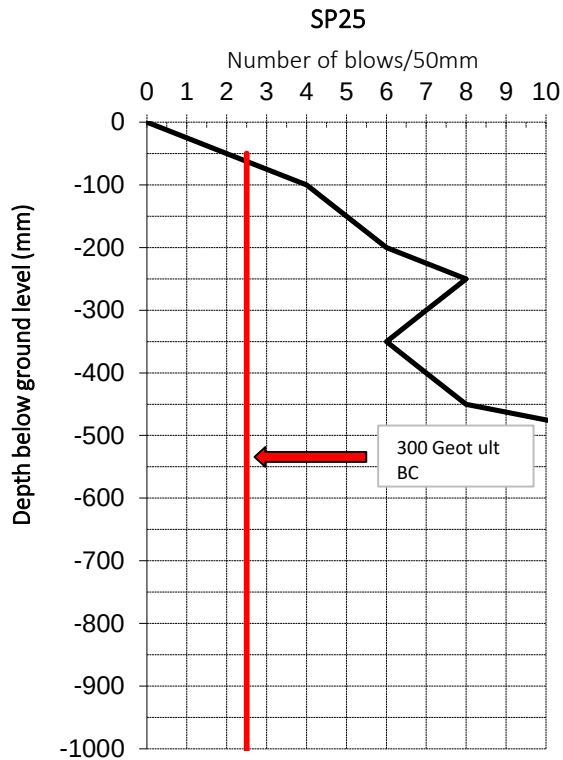
JOB NUMBER: 50611 PROJECT: Morven Ferry DP Geotech

LOCATION: MORVEN FERRY ROAD

CO-ORDINATES: mE DATE: 24-Jan-18

See attached plan mN OPERATOR: MJD & OMB

Note: No Friction correction has been applied to the field results. 5 Blows per 100mm is considered compliance with NZS3604 3.3.7

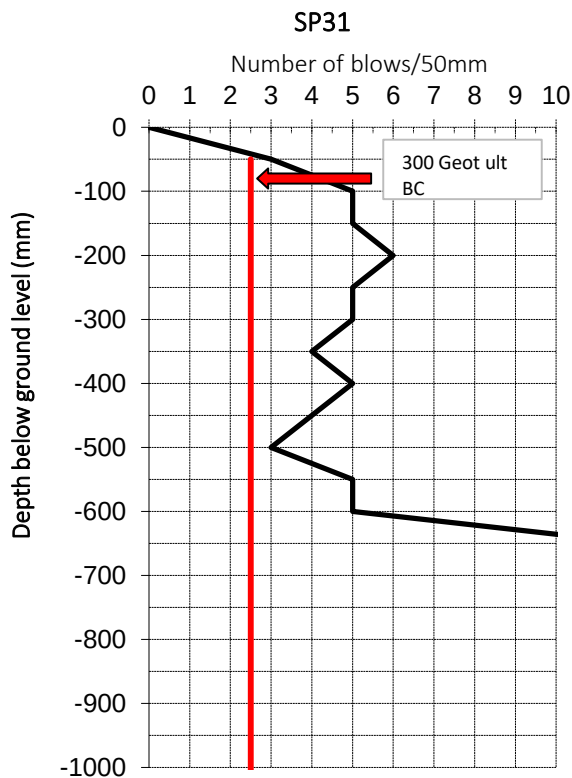
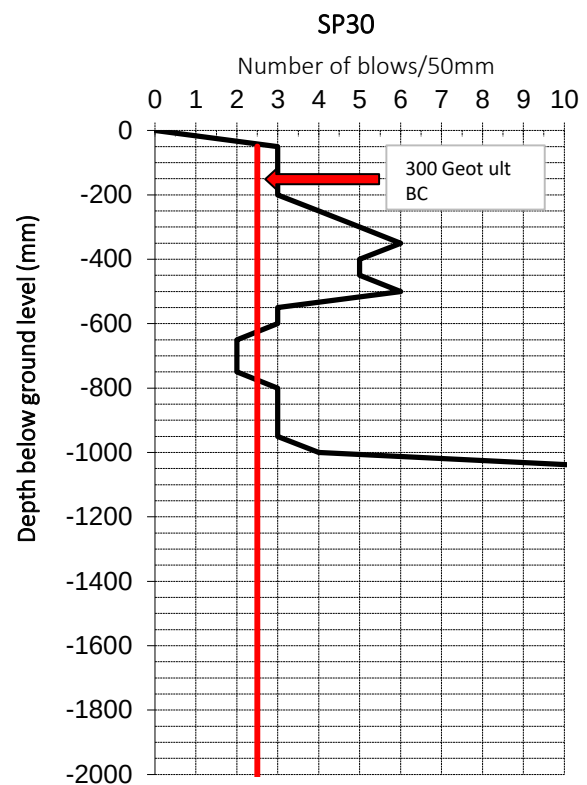
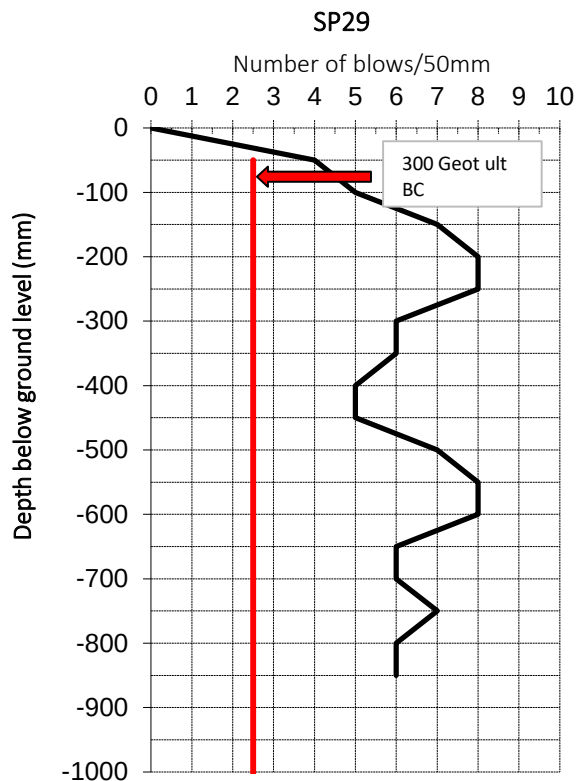


SCALA PENETROMETER RESULTS



JOB NUMBER:	50611	PROJECT:	Morven Ferry DP Geotech
		LOCATION:	MORVEN FERRY ROAD
CO-ORDINATES:	mE	DATE:	24-Jan-18
See attached plan	mN	OPERATOR:	MJD & OMB

Note: No Friction correction has been applied to the field results. 5 Blows per 100mm is considered compliance with NZS3604 3.3.7





4 Subsurface Conditions

4.1 Geological Setting

4.1.1 Regional Geology

The site is located in the Wakatipu basin, a feature formed predominantly by glacial advances. Published references indicate the last glacial event occurred in the region between 10,000 and 20,000 years ago. Glaciations have left deposits of glacial till, glacial outwash and lake sediment over ice-scoured bedrock. Post glacial times have been dominated by the erosion of the bedrock and glacial sediment, with deposition of alluvial gravel by local watercourses and lacustrine sediment during periods of high lake levels.

Active fault traces were not observed at the site or in the immediate vicinity, and the closest major active fault is the Nevis-Cardrona Fault system located within 5 km east of the proposed development. However, significant seismic risk exists in this region from potentially strong ground shaking, associated with the rupture of the Alpine Fault, located 80 km northwest from Queenstown along the West Coast of the South Island. There is a high probability that an earthquake with an expected magnitude of over M_w 8 will occur along the Alpine Fault in the next 50 years.

4.2 Stratigraphy

The subsurface soil and rock materials observed during the site investigation typically comprise:

- 0.3 m of topsoil, overlying;
- 0.2 to 0.4 m of loess, overlying;
- 0.2 to 1.2 m of glacial outwash deposit, overlying;
- 1.1 m+ of glacial till, overlying;
- Schist Bedrock.

Topsoil was observed on the surface of all test pits to a depth of 0.3 m, and comprises firm, organic SILT with trace of rootlets.

Loess was observed to underlie the topsoil in TP 2, 4 and 5 to depths of between 0.5 and 0.7 m. The loess comprises loose to medium dense, silty SAND with trace of rootlets.

Glacial outwash deposit was observed beneath the loess and topsoil in all test pits to depths of between 0.7 and 1.5 m. The glacial outwash deposit comprises loose to medium dense, silty SAND with trace of gravel, medium dense, gravelly SAND with minor silt, and medium dense, sandy GRAVEL with trace of silt.

Glacial till was observed to underlie the glacial outwash deposit in TP 1-4, and comprise medium dense, SAND and GRAVEL deposits with varying components of silt and cobbles. The base of the glacial till was not intercepted at the base of these test pits, which extended to a maximum depth of 2.2 m.

Schist bedrock was observed at the base TP 5 at a depth of 1.4 m, as well as in several outcrops in close proximity to the site. The schist bedrock comprises weak to moderately



strong, slightly to moderately weathered, pelitic SCHIST with foliation dipping between 30° and 40° to the west (250°-280°). The location of the schist outcrops is shown in Figure 1, Appendix A.

4.3 Groundwater

The regional groundwater table was not intercepted during test pit investigations at the site and is expected to lie at depth. Otago Regional Council (ORC) aquifer data indicates the depth to the regional ground water table to be approximately 20-30 m below current site levels.

Perched groundwater seepage was observed in TP 3 on the upper surface of the glacial till. Perched water horizons are common in this type of terrain being constrained by the low permeability glacial soils and rock, and the undulating topography. Perched seepages will be subject to variations in response to rainfall and may be encountered locally in shallow excavations completed in low lying areas.



5 Natural Hazards

5.1 Seismic

A risk of seismic activity has been identified for the region as a whole and appropriate allowance should be made for seismic loading during detailed design of the proposed building, foundations and associated earthworks.

A severe seismic risk is present in the region as discussed in Section 4.1 and appropriate allowance should be made for seismic loading during detailed design of the proposed buildings, foundations and associated earthworks.

5.2 Slope Stability

No deep seated, recent or active slope instability was observed during the site walkover, and no known mapped slope stability risks are present on the QLDC GIS system in the location of the proposed building platforms, or nearby areas.

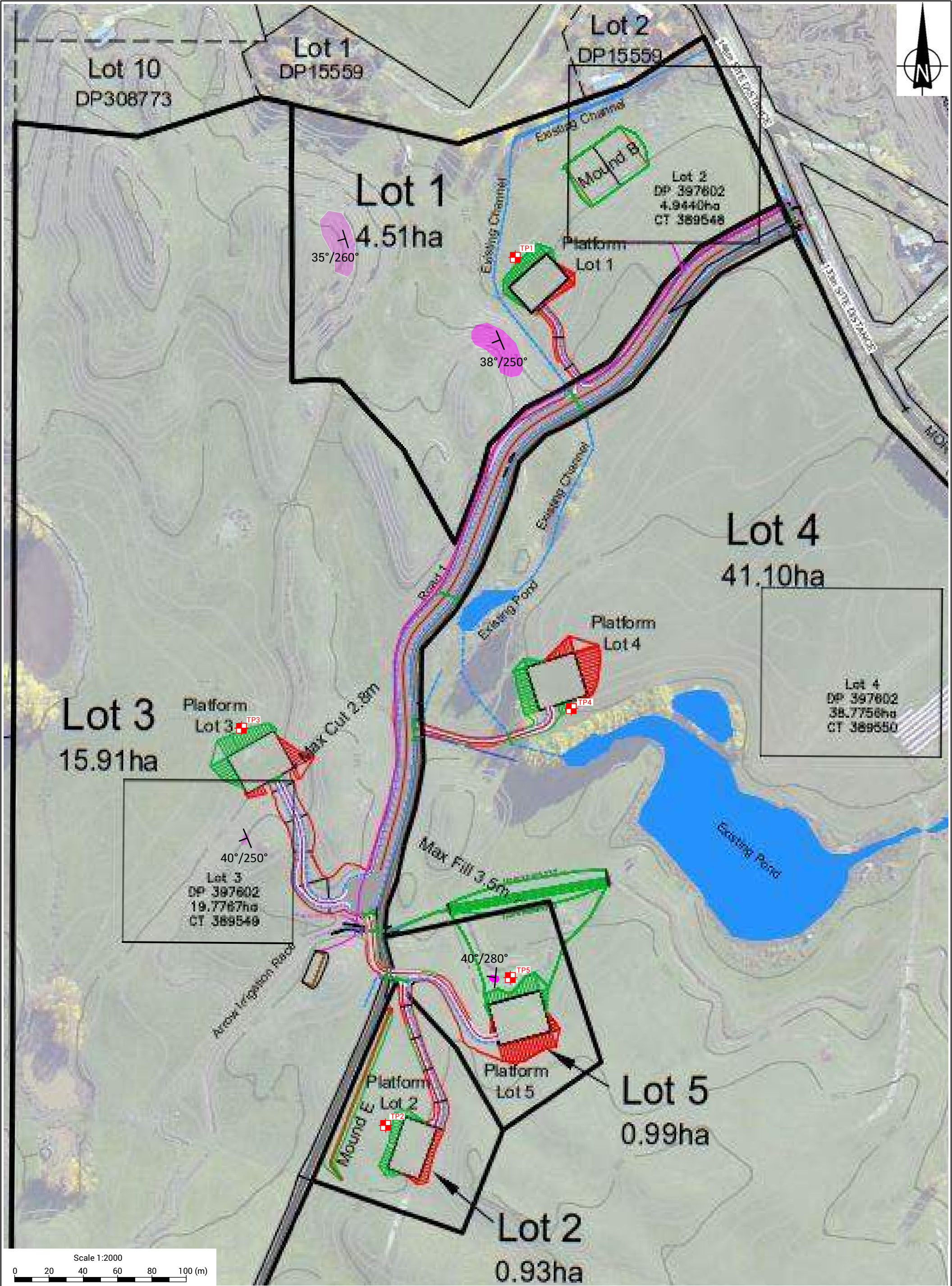
5.3 Liquefaction

The regional groundwater table is assessed to be at depth, and within the schist bedrock. Perched groundwater was identified on at Lot 3 only at a depth of 1.3 m. The soil types comprise medium dense, glacial outwash and glacial till deposits, with schist bedrock at relatively shallow depths. These materials are not considered to be susceptible to liquefaction.

We have assessed the liquefaction hazard for the site is considered to be consistent with a QLDC LIC 1 classification which is a nil to low liquefaction hazard, and no further assessment is considered necessary.

5.4 Other

No other natural hazards have been identified at the site or the immediate vicinity.

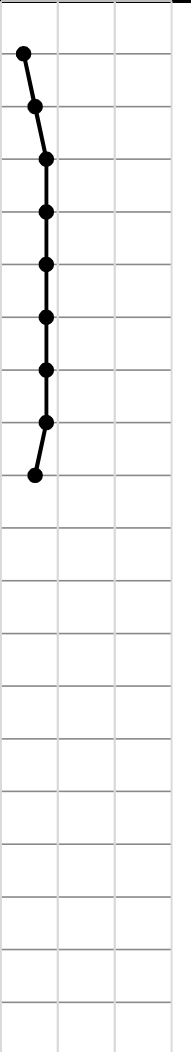
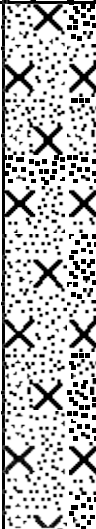


EXCAVATION LOG

EXCAVATION NUMBER:

TP 1

PROJECT:	Barn Hill Morven Ferry				JOB NUMBER:	200108
LOCATION:	See Site Plan			INCLINATION:		
EASTING:		mE	EQUIPMENT:	5.5 tonne excavator	OPERATOR:	Debbie
NORTHING:		mN	INFOMAP NO.		COMPANY:	Barn Hill Ltd
ELEVATION:		m	DIMENSIONS:		HOLE STARTED:	27-Feb-20
METHOD:			EXCAV. DATUM:		HOLE FINISHED:	27-Feb-20

DEPTH (m)	SOIL / ROCK TYPE	GRAPHIC LOG	DESCRIPTION	USCS GROUP	GROUNDWATER / SEEPAGE	SCALA PENETROMETER Blows per 100mm 0 5 10 15
0.3	TOPSOIL		Dark brown, organic SILT with trace of rootlets. Firm. Moist.		NO SEEPAGE	
1.3	GLACIAL OUTWASH DEPOSIT		Brown grey, silty SAND with trace of gravel. Sand is fine to coarse. Gravel is fine to coarse, subrounded to subangular. Loose to medium dense. Massive. Moist.			
2.0	GLACIAL TILL		Brown grey, sandy GRAVEL with minor cobbles and silt. Sand is fine to coarse. Gravel is fine to coarse, subrounded to angular. Cobbles are subrounded to angular (schist). Medium dense. Massive. Moist.			

Total Depth = 2 m

COMMENT: Test pit dry. Walls remained stable during excavation.

Logged By: MBS

Checked Date: 02.03.20

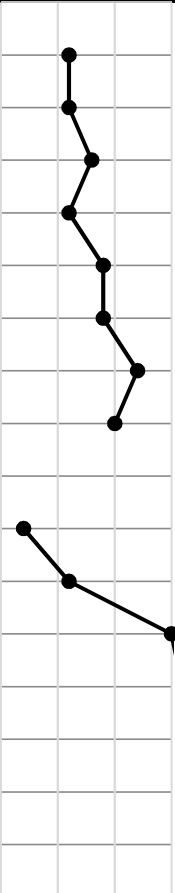
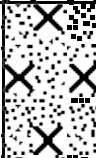
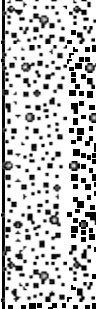
Sheet: 1 of 1

EXCAVATION LOG

EXCAVATION NUMBER:

TP 2

PROJECT:	Barn Hill Morven Ferry					JOB NUMBER:	200108
LOCATION:	See Site Plan						
INCLINATION:							
EASTING:		mE	EQUIPMENT:	5.5 tonne excavator	OPERATOR:	Debbie	
NORTHING:		mN	INFOMAP NO.		COMPANY:	Barn Hill Ltd	
ELEVATION:		m	DIMENSIONS:		HOLE STARTED:	27-Feb-20	
METHOD:			EXCAV. DATUM:		HOLE FINISHED:	27-Feb-20	

DEPTH (m)	SOIL / ROCK TYPE	GRAPHIC LOG	DESCRIPTION	USCS GROUP	GROUNDWATER / SEEPAGE	SCALA PENETROMETER Blows per 100mm 0 5 10 15
0.3	TOPSOIL		Dark brown, organic SILT with trace of rootlets. Firm. Dry.		NO SEEPAGE	
0.6	LOESS		Yellow brown, silty SAND with trace of rootlets. Sand is fine. Medium dense. Massive. Dry.			
1.1	GLACIAL OUTWASH DEPOSIT		Brown, sandy GRAVEL with trace of silt. Sand is fine to coarse. Gravel is fine to coarse, subrounded to angular. Medium dense. Bedded. Dry.			
1.7	GLACIAL TILL		Grey, gravelly SAND with minor silt. Sand is fine to coarse. Gravel is fine to coarse, subrounded to angular. Medium dense. Massive. Dry.			

Total Depth = 1.7 m

COMMENT: Test pit dry. Walls remained stable during excavation.

Logged By: MBS

Checked Date: 02.03.20

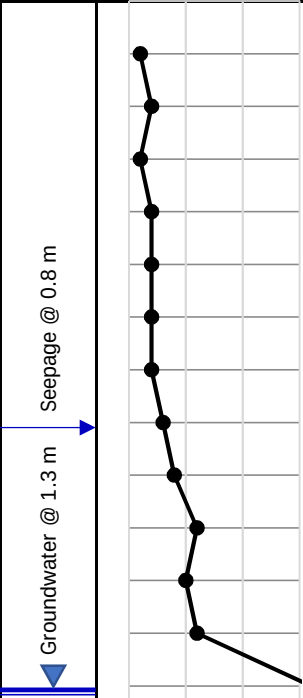
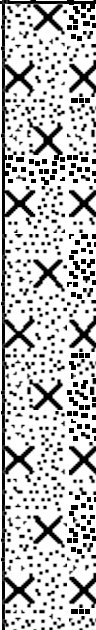
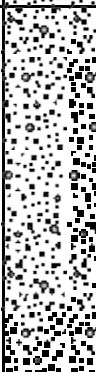
Sheet: 1 of 1

EXCAVATION LOG

EXCAVATION NUMBER:

TP 3

PROJECT:	Barn Hill Morven Ferry					JOB NUMBER:	200108
LOCATION:	See Site Plan						
INCLINATION:							
EASTING:		mE	EQUIPMENT:	5.5 tonne excavator	OPERATOR:	Debbie	
NORTHING:		mN	INFOMAP NO.		COMPANY:	Barn Hill Ltd	
ELEVATION:		m	DIMENSIONS:		HOLE STARTED:	27-Feb-20	
METHOD:			EXCAV. DATUM:		HOLE FINISHED:	27-Feb-20	

DEPTH (m)	SOIL / ROCK TYPE	GRAPHIC LOG	DESCRIPTION	USCS GROUP	GROUNDWATER / SEEPAGE	SCALA PENETROMETER Blows per 100mm 0 5 10 15
0.3	TOPSOIL		Dark brown, organic SILT with trace of rootlets. Firm. Moist.			
1.5	GLACIAL OUTWASH DEPOSIT		Brown grey, silty SAND with trace of gravel. Sand is predominantly fine with trace of medium to coarse. Gravel is fine to medium, subrounded to subangular. Loose. Medium dense from 0.8 m. Weak lamination. Moist. Wet from 0.8 m.			
2.2	GLACIAL TILL		Grey, silty gravelly SAND. Sand is fine to coarse. Gravel is fine to coarse, subrounded to subangular. Medium dense. Massive. Moist to wet.			

Total Depth = 2.2 m

COMMENT: Minor slumping from glacial outwash deposit. Perched groundwater at 1.3 m.

Logged By: MBS

Checked Date: 02.03.20

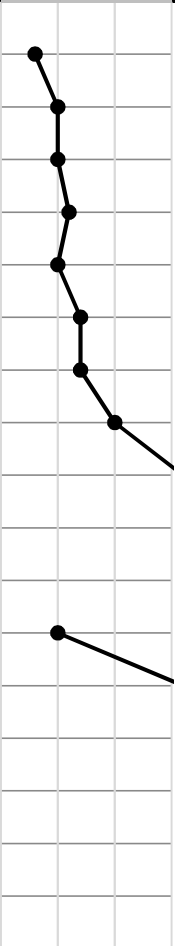
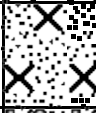
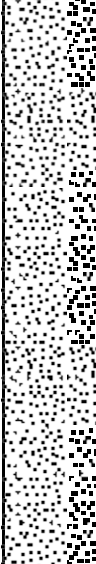
Sheet: 1 of 1

EXCAVATION LOG

EXCAVATION NUMBER:

TP 4

PROJECT:	Barn Hill Morven Ferry				JOB NUMBER:	200108
LOCATION:	See Site Plan			INCLINATION:		
EASTING:		mE	EQUIPMENT:	5.5 tonne excavator	OPERATOR:	Debbie
NORTHING:		mN	INFOMAP NO.		COMPANY:	Barn Hill Ltd
ELEVATION:		m	DIMENSIONS:		HOLE STARTED:	27-Feb-20
METHOD:			EXCAV. DATUM:		HOLE FINISHED:	27-Feb-20

DEPTH (m)	SOIL / ROCK TYPE	GRAPHIC LOG	DESCRIPTION	USCS GROUP	GROUNDWATER / SEEPAGE	SCALA PENETROMETER Blows per 100mm 0 5 10 15
0.3	TOPSOIL		Dark brown, organic SILT with trace of rootlets. Firm. Dry.		NO SEEPAGE	
0.5	LOESS		Yellow brown, silty SAND with trace of rootlets. Sand is fine. Medium dense. Massive. Dry.			
0.7	GLACIAL OUTWASH DEPOSIT		Grey brown, sandy GRAVEL with trace of silt. Sand is fine to coarse. Gravel is fine to coarse, subrounded to subangular. Medium dense. Bedded. Moist.			
1.8	GLACIAL TILL		Brown grey, SAND with minor silt and gravel. Sand is fine to medium. Gravel is fine to coarse, subrounded to subangular. Medium dense. Massive. Dry.			

Total Depth = 1.8 m

COMMENT: Test pit dry. Walls remained stable during excavation.

Logged By: MBS

Checked Date: 02.03.20

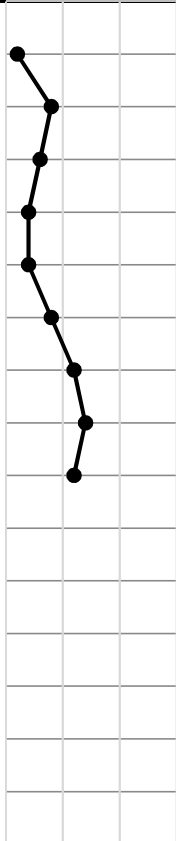
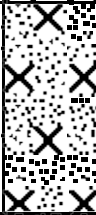
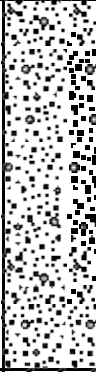
Sheet: 1 of 1

EXCAVATION LOG

EXCAVATION NUMBER:

TP 5

PROJECT:	Barn Hill Morven Ferry				JOB NUMBER:	200108
LOCATION:	See Site Plan			INCLINATION:		
EASTING:		mE	EQUIPMENT:	5.5 tonne excavator	OPERATOR:	Debbie
NORTHING:		mN	INFOMAP NO.		COMPANY:	Barn Hill Ltd
ELEVATION:		m	DIMENSIONS:		HOLE STARTED:	27-Feb-20
METHOD:			EXCAV. DATUM:		HOLE FINISHED:	27-Feb-20

DEPTH (m)	SOIL / ROCK TYPE	GRAPHIC LOG	DESCRIPTION	USCS GROUP	GROUNDWATER / SEEPAGE	SCALA PENETROMETER Blows per 100mm 0 5 10 15
0.3	TOPSOIL		Dark brown, organic SILT with trace of rootlets. Firm. Dry.		NO SEEPAGE	
0.7	LOESS		Yellow brown, silty SAND with trace of rootlets. Sand is fine. Loose to medium dense. Massive. Dry.			
1.4	GLACIAL OUTWASH DEPOSIT		Grey brown, gravelly SAND with minor silt. Sand is fine to coarse. Gravel is fine to coarse, subrounded to subangular. Medium dense. Bedded. Moist.			
1.6	SCHIST BEDROCK		Dark grey, pelitic SCHIST. Slightly to moderately weathered. Weak to moderately strong. Foliation dipping 30° to 280°.			

Total Depth = 1.6 m

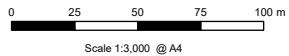
COMMENT: Test pit dry. Walls remained stable during excavation.

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Checked Date: 02.03.20

Sheet: 1 of 1

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Coordinate System: NZGD 2000 New Zealand Transverse Mercator

Disclaimer: While all reasonable care has been taken to ensure the information contained on this map is up to date and accurate, no guarantee is given that the information portrayed is free from error or omission. Any relevance placed on such information shall be at the risk of the user.

Note: The information shown on this map is a copyright of WGA 2026

LEGEND

- Pylon
- Drop Off
- Alluvial Fan
- Slope Break
- Hand Auger Hole
- Piezometer
- Water Supply Trail Bore

WGA

Figure 5

Geomorphological Sketch and Investigation
Locations for the Kaurau River Terraces

2.2 Local Aquifer Definition

The more northerly of the two water supply trial bores, BH04, was drilled on a terrace of the Kowarau River slightly to the north (outside) of the defined KARA. The KARA appears to be defined by the drop-off between the Middle and Lower Terraces (Figure 3 & Figure 5).

The Middle Terrace, where BH04 is constructed, has an elevation of approximately 318 mRL. The drillhole intersected topsoils and unconfined sandy gravels to a depth of 8.4 m below ground level (m BGL) (Table 2), which is consistent with piezometers constructed in this area (WGA, 2026a; Figure 5). Below 8.4 m BGL, silts and gravelly silts were intersected to a depth of 34.4 m BGL, with this unit interpreted as representing a confining layer. From 34.4 m to 38.8 m BGL silty gravels were intersected with 'large water flows' (Appendix A). Basement schist was intersected at 38.8 m depth, with little water flow generated from this unit. The silty gravels intersected from 34.4 m to 38.8 m depth in BH04 are expected to behave as a leaky confined aquifer with a thickness of approximately 4.4 m.

Table 2. Geological Log Summary for Production Bore BH04

Depth (m)		Description ⁽¹⁾	Hydrogeological Interpretation
From	To		
0.0	0.4	Topsoil	Aquifer
0.4	8.4	Brown Silty Gravels	
8.4	22.0	Blue Silts with Cobbles and Gravels	Aquitard
22.0	34.4	Blue Silts	
34.4	38.8	Silty Gravels	Aquifer
38.8	41.8	Schist	Aquitard

Note:

⁽¹⁾ Data from driller's bore log (Appendix A).

Prior to testing BH04, the static groundwater level was measured at about 8.9 m BGL. Conceptually, Production Bore BH04 is screened in a 4.4 m thick gravel aquifer that is underlain by impermeable (relative to the aquifer) schist bedrock and overlain by a 26 m thick leaky silt confining layer. Above the leaky confining layer is a more-permeable gravelly stratum forming an unconfined aquifer, which was mostly unsaturated at the time field investigations were undertaken (WGA 2026a). Piezometers installed within the upper unconfined river terrace aquifer have been tested using falling head infiltration tests (WGA 2026a). At its closest approach, the Kowarau River is approximately 330 m from BH04 (Figure 5), and it has an elevation of approximately 306 mRL at this point. The hydraulic gradient between BH04 and the river, assuming a direct hydraulic connection between the aquifer and the riverbed, is approximately 0.009 m/m. The hydraulic characteristics of the aquifer targeted by BH04 are documented in Section 3.

The more southerly of the two deep water supply trial bores, BH05, was drilled on an access track from the Lower Terrace to the river flood plain, at an elevation of approximately 307 mRL. Production Bore BH05 intersected topsoils and sandy gravels to a depth of 8.2 m BGL (Table 3). Below that depth, bands of silts and silt-bound gravels were intersected to a depth of 28.8 m BGL, with this unit interpreted as representing a leaky confining layer. Basement schist was intersected at 28.8 m BGL, and drilling continued to a depth of 102 m BGL. The schist intersected was apparently heavily fractured and produced substantial flows of water during the drilling. The driller's description of alternating hard and soft bands, together with substantial inflows of water, is rare for basement schist rock mass in Otago. The observed flows led to the driller leaving almost the entire schist section as open hole, with the overlying sediments cased off.

Table 3. Geological Log Summary for Production Bore BH05

Depth (m bgl)		Description ⁽¹⁾	Hydrogeological Interpretation	
From	To			
0.0	3.1	Topsoils and Gravels	Aquifer	
3.1	8.2	Sandy Gravels		
8.2	20.2	Blue Silts with Gravels	Aquitard	
20.2	28.8	Bands of Blue Silts and Gravels	Aquitard	Aquifer
28.8	30.9	Schist	Aquitard	
30.9	100.0	Schist with Soft Zones and Groundwater Flows	Aquifer	
100.0	102.0	Schist with Soft Fracture Zone		

Note:

⁽¹⁾ Data from driller's bore log (Appendix A)

Schist bedrock was intersected at approximately the same elevation in both Production Bores. The drillers log for BH05 does not indicate a significant gravel layer above the schist, unlike BH04 which targets a distinct 4.4 m thick layer of silty gravels. Instead, SouthDrill logged bands of silts and gravels in BH05 overlying the schist, which are interpreted to represent a mixture of aquitard and aquifer strata. The gravel aquifer targeted by BH04 and the gravels intersected by BH05 above the schist are expected to be hydraulically connected to the Kawarau River. By extension, the fractured schist intersected in BH05 is also expected to be hydraulically connected to the Kawarau River.

Prior to a constant rate pumping test being performed on BH05, the static groundwater level was measured at about 0.3 m below the top of casing, which is equivalent to approximately 308.3 m RL. At its closest approach, the Kawarau River is approximately 280 m from BH05 (Figure 5), and it has an elevation of approximately 306.5 mRL at this point. The lateral hydraulic gradient between BH05 and the river, assuming a direct hydraulic connection between the aquifer and the riverbed, is approximately 0.006 m/m.

Conceptually, BH05 is screened in heavily fractured zone of schist with a total exposed thickness in the drillhole of 73 m. The overlying 29 m of interbedded silts and gravels were cased off and are interpreted to constitute leaky silt confining layers interbedded with transmissive gravelly aquifer strata. Pumping test analyses documented in Section 3 suggest that the fractured schist is recharged from leakage and ultimately from the Kawarau River.

4 ASSESSMENT OF EFFECTS

4.1 Drawdown Effects

A drawdown assessment has been undertaken using the conservative range of expected aquifer parameters set out in Section 3.3 derived from the production bore and piezometer testing. The maximum water use scenario is considered to provide a conservative estimate of the potential effects of the proposed take. The maximum use scenario estimates drawdown due to pumping the production bores at the maximum combined abstraction rate of 23 L/s (2,006 m³/day) continuously for years across the long-term operation for the development supply (Table 8). Under this scenario, both production bores are expected to be pumping suitably below their respective capacities.

Table 8. Maximum Abstraction Rate Scenario

SCENARIO	BASIS	DAILY DEMAND (m ³)	FLOW RATE (L/s)
Maximum Use	BH04 and BH05 pumping at a combined 2,006 m ³ /day with continuous operation over years. BH04 at 3 L/s and BH05 at 20 L/s.	2,006	23

The Ward and Lough (2011) solution is applied for multi-well pumping forward drawdown and stream depletion projections. It is unlikely that the production bores will be pumped continuously at the maximum rate, therefore, the projections are expected to be a worst-case scenario for assessing potential drawdown effects.

There are no neighbouring bores according to the ORC database in the expected drawdown and groundwater source area for the production bores due to the Kwarau River hydraulic boundary effect, surrounding schist terrain, and absence of neighbouring supply bores on the relevant eastern section of the Kwarau Alluvial Ribbon Aquifer (refer Figure 1 and Figure 3). Therefore, no drawdown effects are expected on neighbouring bores and no further assessment of potential impacts on neighbouring bores is undertaken.

The results of the forward multi-well drawdown assessment under the maximum use scenario are tabulated below on Table 9 for the closest existing infrastructure being the two closest Transpower pylons with cement foundations set on the east middle and west middle river terrace. The locations of these two closest pylons are shown on Figure 5 in the context of the production bore locations. The modelled drawdown estimates provided on Table 9 are for the range of results across the range of expected parameters provided on Table 7. The modelled drawdown effects on Table 9 are the cumulative effect of both production bores under the maximum long-term use scenario.

Table 9. Modelled Drawdown Effects

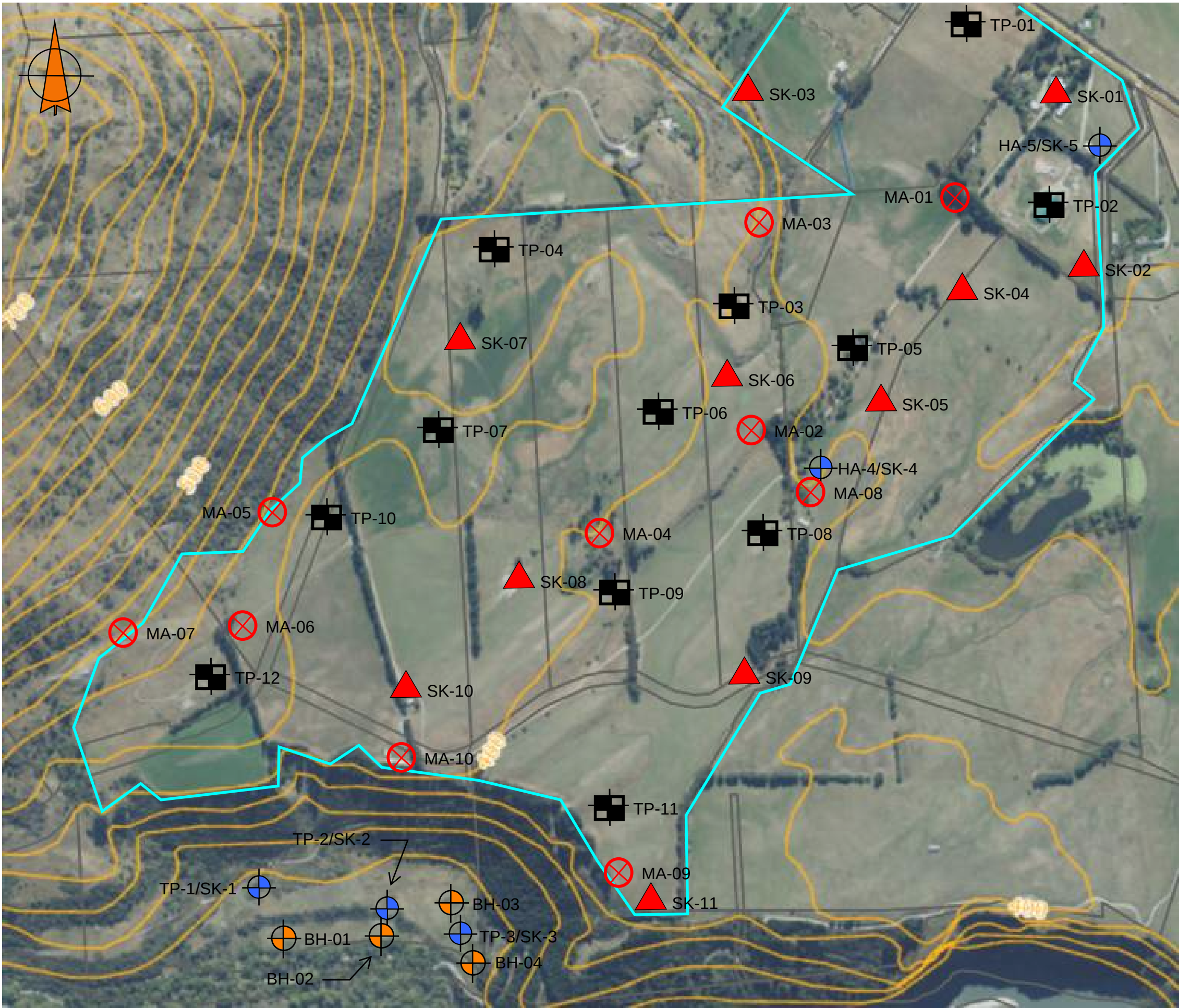
PYLON	BASIS	DRAWDOWN (m)
West middle river terrace	Long-term maximum use scenario. Drawdown is estimated within the upper unconfined Kwarau Alluvial Ribbon Aquifer as potential lowering of the phreatic surface within gravelly strata.	0.64 – 2.77
East middle river terrace		0.72 – 1.57

Appendix C

Site Plan & Site-specific Investigations

1. Site Investigation Plan
2. Hand Auger and Test Pit Logs – May 2025
3. Machine Auger Logs – June 2025
4. Soakage Logs – October 2025
5. Test Pit Logs – October 2025
6. Machine Boreholes – December 2025
7. Rockfall Analysis Locality Map and Stereonet – January 2026





LEGEND

-  Test Pit and Scala Penetrometer Locations, October 2025
-  Soakage Locations October 2025
-  Test Pit & Soakage Testing Locations, May 2025
-  Machine Borehole Testing Locations, December 2025
-  Machine Auger Locations, June 2025
-  Site Boundary

NOTES

Location of Features and Ground Investigation points are approximate only.
Aerial Image & Site Boundary Sourced from QLDC GIS, retrieved November

PROJECT: 2555087
CREATED BY: SSA
APPROVED BY: OB
DATE: November 2025

DWG NO: 001
REVISION: A
Scale: Not to Scale

Morven Ferry Road,
Arrow Junction

**GEOTECHNICAL INVESTIGATION
LOCATION PLAN**



TEST PIT RESULTS



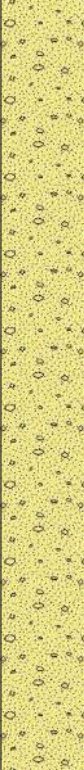
Client: Gibbons Developments Ltd
Site Address: Morven Ferry Road
Town/City: Queenstown

Job No.: 2555087
Test Pit No. TP-1
Scala Penetrometer:

Operator: MH
Logged By: MH
Logged Date: 05/05/25

Checked By: OB
Checked Date: 07/05/25

Date: 05/05/25
Weather: Fine
Datum:
Termination:

Geological Formation	Depth (m)	Elevation	Sample Description	Graphic	USCS	Dr	Water Table	Undrained Shear Strength Su (kPa)	Blows per 100 mm of Penetration																		
									1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
			Sandy silty TOPSOIL; dark brown. Moist; with rootlets.																								
	0.5	-0.5	Silty SAND, with some gravel, with trace cobbles; brownish grey. Medium dense, moist to wet, non-plastic, sand, fine to medium; gravel, fine to medium, subround to subangular.																								
	1.0	-1.0																									
	1.5	-1.5																									
	2.0	-2.0																									
	2.5	-2.5																									
	3.0	-3.0	SILT, with trace clay; brownish grey. Medium dense, moist, non-plastic.																								
	3.5	-3.5																									
	4.0	-4.0	SAND; brownish yellow. Medium dense, moist, sand, medium.																								
			Silty SAND, with trace gravel. Medium dense, moist, non-plastic, sand, fine to medium; gravel, fine, subround.																								
	4.5	-4.5	EOH: 4.60m																								

Remarks:
 Scala Penetrometer and Test Bore log tests give an indication of the ground condition at the location of the tests only. While they are representative of typical conditions across the site, they do not identify variations in the ground away from the test locations.
 Elevation datum sourced from council GIS LiDAR contours.

TEST PIT RESULTS



Client: Gibbons Developments Ltd
Site Address: Morven Ferry Road
Town/City: Queenstown

Job No.: 2555087
Test Pit No. TP-2
Scala Penetrometer:

Operator: MH
Logged By: MH
Logged Date: 05/05/25

Checked By: OB
Checked Date: 07/05/25

Date: 05/05/25
Weather: Fine
Datum:
Termination:

Geological Formation	Depth (m)	Elevation	Sample Description	Graphic	USCS	Dr	Water Table	Undrained Shear Strength Su (kPa)	Blows per 100 mm of Penetration																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																						
									1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																				
	0.5	-0.5	Sandy silty TOPSOIL; dark brown. Moist; with rootlets. Silty SAND, with some gravel, with trace cobbles; brownish grey. Medium dense, moist to wet, non-plastic, sand, fine to medium; gravel, fine to medium, subround to subangular.																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																												

Remarks:
 Scala Penetrometer and Test Bore log tests give an indication of the ground condition at the location of the tests only. While they are representative of typical conditions across the site, they do not identify variations in the ground away from the test locations.
 Elevation datum sourced from council GIS LiDAR contours.

TEST PIT RESULTS



Client: Gibbons Developments Ltd
Site Address: Morven Ferry Road
Town/City: Queenstown

Job No.: 2555087
Test Pit No. TP-3
Scala Penetrometer:

Operator: MH
Logged By: MH
Logged Date: 05/05/25

Checked By: OB
Checked Date: 07/05/25

Date: 05/05/25
Weather: Fine
Datum:
Termination:

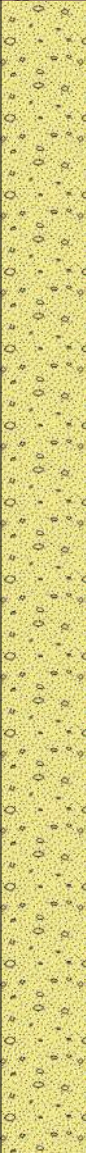
Geological Formation	Depth (m)	Elevation	Sample Description	Graphic	USCS	Dr	Water Table	Undrained Shear Strength Su (kPa)	Blows per 100 mm of Penetration																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																														
									1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																												
			Sandy silty TOPSOIL; dark brown. Moist; with rootlets.																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																				

Remarks:
 Scala Penetrometer and Test Bore log tests give an indication of the ground condition at the location of the tests only. While they are representative of typical conditions across the site, they do not identify variations in the ground away from the test locations.
 Elevation datum sourced from council GIS LiDAR contours.

HAND AUGER RESULTS



Client:	Gibbons Developments Ltd	Job No.:	2555087
Site Address:	Morven Ferry Road	Hand Auger No.	HA-4
Town/City:	Queenstown	Scala Penetrometer:	
Operator:	MH	Date:	05/05/25
Logged By:	MH	Weather:	Fine
Logged Date:	05/05/25	Datum:	
	Checked By: OB	Termination:	
	Checked Date: 07/05/25		

Geological Formation	Depth (m)	Elevation	Sample Description	Graphic	USCS	D _r	Water Table	Undrained Shear Strength S _u (kPa)	Blows per 100 mm of Penetration																		
			Sandy silty TOPSOIL; dark brown. Moist; with rootlets.						1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
			Gravelly SAND, with minor silt, with trace cobbles; light yellowish brown. Medium dense, dry to moist, non-plastic, sand, fine to medium; gravel, fine to coarse, subround.																								
	0.5	-0.5																									
	1.0	-1.0																									
	1.5	-1.5																									
	2.0	-2.0	EOH: 2.00m																								

Remarks:
 Scala Penetrometer and Test Bore log tests give an indication of the ground condition at the location of the tests only. While they are representative of typical conditions across the site, they do not identify variations in the ground away from the test locations.
 Elevation datum sourced from council GIS LiDAR contours.

HAND AUGER RESULTS



Client:	Gibbons Developments Ltd	Job No.:	2555087
Site Address:	Morven Ferry Road	Hand Auger No.	HA-5
Town/City:	Queenstown	Scala Penetrometer:	
Operator:	MH	Date:	05/05/25
Logged By:	MH	Weather:	Fine
Logged Date:	05/05/25	Checked By:	OB
		Checked Date:	07/05/25
		Datum:	
		Termination:	

Geological Formation	Depth (m)	Elevation	Sample Description	Graphic	USCS	D _r	Water Table	Undrained Shear Strength S _u (kPa)	Blows per 100 mm of Penetration																			
			Sandy silty TOPSOIL; dark brown. Moist; with rootlets.							1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
			Silty SAND, with some gravel; brown. Gravel, fine to medium, subround to subangular.																									
	0.5	-0.5																										
	1.0	-1.0																										
	1.5	-1.5																										
	2.0	-2.0	EOH: 2.00m																									

Remarks:
 Scala Penetrometer and Test Bore log tests give an indication of the ground condition at the location of the tests only. While they are representative of typical conditions across the site, they do not identify variations in the ground away from the test locations.
 Elevation datum sourced from council GIS LiDAR contours.

TEST PIT RESULTS


KIRK ROBERTS
CONSULTING

Client: Gibbons Developments Ltd
 Site Address: Morven Ferry Road
 Town/City: Queenstown

Job No.: 2555087
 Test Pit No. TP-MA-01
 Scala Penetrometer:

Operator: AA
 Logged By: AA
 Logged Date: 27/06/25

Checked By: OB
 Checked Date: 30/06/25

Date: 17/06/25
 Weather: Fine
 Datum: NZGD 2000
 Termination: Target Depth

Geological Formation	Depth (m)	Elevation	Sample Description	Graphic	USCS	Dr	Water Table	Undrained Shear Strength S_u (kPa)	Blows per 100 mm of Penetration																		
									1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
			Silty TOPSOIL (OL); dark brown. Moist.		OL																						
	0.5	-0.5	SILT (M); yellow brown. Moist, non-plastic.		M																						
	1.0	-1.0																									
	1.5	-1.5	Sandy GRAVEL (GS); grey. Moist, gravel, fineto coarse, subround to subangular; sand, fine to medium.		GS																						
	2.0	-2.0	SAND (S), with trace gravel; grey brown. Moist, sand, fineto medium; gravel, fineto medium, subround to subangular.																								
	2.3	-2.3	2.3m: End of Test Pit, Start of Machine Auger.																								
	2.5	-2.5	SAND (S); grey. Moist, sand, fine to medium.																								
	3.0	-3.0																									
	3.5	-3.5																									
	4.0	-4.0																									
	4.5	-4.5																									
	5.0	-5.0	EOH: 5.00m 5.0m: End of MA, Target Depth Achieved.																								

Remarks:
 Scala Penetrometer and Test Bore log tests give an indication of the ground condition at the location of the tests only. While they are representative of typical conditions across the site, they do not identify variations in the ground away from the test locations.
 Elevation datum sourced from council GIS LiDAR contours.

TEST PIT RESULTS


KIRK ROBERTS
CONSULTING

Client: Gibbons Developments Ltd
 Site Address: Morven Ferry Road
 Town/City: Queenstown

Job No.: 2555087
 Test Pit No. TP-MA-02
 Scala Penetrometer:

Operator: AA
 Logged By: AA
 Logged Date: 27/06/25
 Checked By: OB
 Checked Date: 30/06/25

Date: 17/06/25
 Weather: Fine
 Datum: NZGD 2000
 Termination: Target Depth

Geological Formation	Depth (m)	Elevation	Sample Description	Graphic	USCS	Dr	Water Table	Undrained Shear Strength S_u (kPa)	Blows per 100 mm of Penetration																		
									1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
			Silty TOPSOIL (OL), with some gravel; dark brown. Moist, non-plastic; gravel, fine to coarse, subround to subangular.		OL																						
	0.5	-0.5	Gravelly SAND (S), with minor cobbles and boulders, with tracesilt; grey brown with orangemottling. Sand, fine; gravel, fineto coarse, subround to subangular.																								
	1.0	-1.0																									
	1.5	-1.5																									
	2.0	-2.0	2.0m: End of Test Pits, Start of Machine Auger.																								
	2.5	-2.5			S																						
	3.0	-3.0	SAND (S), with some gravel; bluish grey. Moist, sand, fineto medium; gravel, fine to coarse, subround to subangular.																								
	3.5	-3.5	3.5m: Colour change to grey brown.																								
	4.0	-4.0	EOH: 4.10m																								
			4.1m: End of MA, Refusal on Gravel/ Inferred Rock.																								
	4.5	-4.5																									
	5.0	-5.0																									

Remarks:
 Scala Penetrometer and Test Bore log tests give an indication of the ground condition at the location of the tests only. While they are representative of typical conditions across the site, they do not identify variations in the ground away from the test locations.
 Elevation datum sourced from council GIS LiDAR contours.

TEST PIT RESULTS


KIRK ROBERTS
CONSULTING

Client: Gibbons Developments Ltd
 Site Address: Morven Ferry Road
 Town/City: Queenstown

Job No.: 2555087
 Test Pit No. TP-MA-03
 Scala Penetrometer:

Operator: AA
 Logged By: AA
 Logged Date: 27/06/25
 Checked By: OB
 Checked Date: 30/06/25

Date: 17/06/25
 Weather: Fine
 Datum: NZGD 2000
 Termination: Target Depth

Geological Formation	Depth (m)	Elevation	Sample Description	Graphic	USCS	D _r	Water Table	Undrained Shear Strength S _u (kPa)	Blows per 100 mm of Penetration																		
									1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
			Silty TOPSOIL (OL), with some gravel; dark brown. Moist, non-plastic; gravel, fine to coarse, subround to subangular.		OL																						
	0.5	-0.5	Silty SAND (SM), with some gravel; grey brown. Moist, non-plastic; gravel, fine to medium, subround to subangular.		SM																						
	1.0	-1.0	1.0m: With Orange Brown Mottling. 1.2m: With trace rock fragments.																								
	1.5	-1.5																									
	2.0	-2.0	EOH: 1.90m 1.9m: End of Test Pit. Rock Encountered.																								
	2.5	-2.5																									
	3.0	-3.0																									
	3.5	-3.5																									
	4.0	-4.0																									
	4.5	-4.5																									
	5.0	-5.0																									

Remarks:
 Scala Penetrometer and Test Bore log tests give an indication of the ground condition at the location of the tests only. While they are representative of typical conditions across the site, they do not identify variations in the ground away from the test locations.
 Elevation datum sourced from council GIS LiDAR contours.

TEST PIT RESULTS


KIRK ROBERTS
CONSULTING

Client: Gibbons Developments Ltd
 Site Address: Morven Ferry Road
 Town/City: Queenstown

Job No.: 2555087
 Test Pit No. TP-MA-04
 Scala Penetrometer:

Operator: AA
 Logged By: AA
 Logged Date: 27/06/25

Checked By: OB
 Checked Date: 30/06/25

Date: 17/06/25
 Weather: Fine
 Datum: NZGD 2000
 Termination: Target Depth

Geological Formation	Depth (m)	Elevation	Sample Description	Graphic	USCS	D _r	Water Table	Undrained Shear Strength S _u (kPa)	Blows per 100 mm of Penetration																		
									1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
	0.5	-0.5	Silty TOPSOIL (OL); dark brown. Moist, non-plastic.		OL																						
	1.0	-1.0	Silty SAND (SM); grey brown. Moist, non-plastic, sand, fine.		SM																						
	1.5	-1.5	1.0m: With some gravel, with minor cobbles and boulders. Gravel, fine to coarse, subround to subangular.																								
	2.0	-2.0	EOH: 2.00m 2.0m: End of Test Pit. Refusal on Bed Rock.																								
	2.5	-2.5																									
	3.0	-3.0																									
	3.5	-3.5																									
	4.0	-4.0																									
	4.5	-4.5																									
	5.0	-5.0																									

Remarks:
 Scala Penetrometer and Test Bore log tests give an indication of the ground condition at the location of the tests only. While they are representative of typical conditions across the site, they do not identify variations in the ground away from the test locations.
 Elevation datum sourced from council GIS LiDAR contours.

TEST PIT RESULTS


KIRK ROBERTS
CONSULTING

Client: Gibbons Developments Ltd
 Site Address: Morven Ferry Road
 Town/City: Queenstown

Job No.: 2555087
 Test Pit No. TP-MA-05
 Scala Penetrometer:

Operator: AA
 Logged By: AA
 Logged Date: 27/06/25

Checked By: OB
 Checked Date: 30/06/25

Date: 17/06/25
 Weather: Fine
 Datum: NZGD 2000
 Termination: Target Depth

Geological Formation	Depth (m)	Elevation	Sample Description	Graphic	USCS	D _r	Water Table	Undrained Shear Strength S _u (kPa)	Blows per 100 mm of Penetration																		
									1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
			Silty TOPSOIL (OL); dark brown. Moist, non-plastic.		OL																						
	0.5	-0.5	Silty SAND (SM); grey brown. Moist, non-plastic, sand, fine.		SM																						
	1.0	-1.0	SAND (S), with some rock fragments, grey. Sand, fine to medium.																								
	1.5	-1.5																									
	2.0	-2.0	2.0m: End of Test Pits, Start of Machine Auger.																								
	2.5	-2.5																									
	3.0	-3.0																									
	3.5	-3.5	3.5m: Light grey.																								
	4.0	-4.0	EOH: 4.00m 4.0m: End of MA. Refusal on Bed Rock.																								
	4.5	-4.5																									
	5.0	-5.0																									

Remarks:
 Scala Penetrometer and Test Bore log tests give an indication of the ground condition at the location of the tests only. While they are representative of typical conditions across the site, they do not identify variations in the ground away from the test locations.
 Elevation datum sourced from council GIS LiDAR contours.

TEST PIT RESULTS


KIRK ROBERTS
CONSULTING

Client: Gibbons Developments Ltd
 Site Address: Morven Ferry Road
 Town/City: Queenstown

Job No.: 2555087
 Test Pit No. TP-MA-06
 Scala Penetrometer:

Operator: AA
 Logged By: AA
 Logged Date: 27/06/25

Checked By: OB
 Checked Date: 30/06/25

Date: 17/06/25
 Weather: Fine
 Datum: NZGD 2000
 Termination: Target Depth

Geological Formation	Depth (m)	Elevation	Sample Description	Graphic	USCS	Dr	Water Table	Undrained Shear Strength S_u (kPa)	Blows per 100 mm of Penetration																		
									1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
			Silty TOPSOIL (OL); dark brown. Moist, non-plastic.		OL																						
	0.5	-0.5	SAND (S), with some rocks fragments, with trace silt; grey brown. Moist, sand, fine.																								
	1.0	-1.0	SAND (S), with some rock fragments, grey. Moist, sand, fine to medium.																								
	2.0	-2.0	2.3m: End of Test Pit, Start of Machine Auger.		S																						
	2.5	-2.5	SAND (S), with some rocks fragments and gravel; light grey. Sand, fine to medium; gravel, fine to medium, subround to subangular.																								
	3.0	-3.0																									
	3.5	-3.5																									
	4.0	-4.0	EOH: 3.90m 3.9m: End of MA, Hole collapsed due to dense Saturated Sand.																								
	4.5	-4.5																									
	5.0	-5.0																									

Remarks:
 Scala Penetrometer and Test Bore log tests give an indication of the ground condition at the location of the tests only. While they are representative of typical conditions across the site, they do not identify variations in the ground away from the test locations.
 Elevation datum sourced from council GIS LiDAR contours.

TEST PIT RESULTS


KIRK ROBERTS
CONSULTING

Client: Gibbons Developments Ltd
 Site Address: Morven Ferry Road
 Town/City: Queenstown

Job No.: 2555087
 Test Pit No. TP-MA-07
 Scala Penetrometer:

Operator: AA
 Logged By: AA
 Logged Date: 27/06/25

Checked By: OB
 Checked Date: 30/06/25

Date: 17/06/25
 Weather: Fine
 Datum: NZGD 2000
 Termination: Target Depth

Geological Formation	Depth (m)	Elevation	Sample Description	Graphic	USCS	D _r	Water Table	Undrained Shear Strength S _u (kPa)	Blows per 100 mm of Penetration																		
									1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
			Silty TOPSOIL (OL); dark brown. Moist, non-plastic.		OL																						
	0.5	-0.5	SAND (S), with some rocks fragments; grey. Moist, sand, fine to medium.																								
	1.0	-1.0																									
	1.5	-1.5																									
	2.0	-2.0																									
	2.5	-2.5	2.4m: End of Test Pit, Start of Machine Auger Hole.																								
	3.0	-3.0			S																						
	3.5	-3.5																									
	4.0	-4.0																									
	4.5	-4.5																									
	5.0	-5.0	EOH: 4.70m 4.7m: End of MA, Refusal on Inferred Gravels / Rocks																								

Remarks:
 Scala Penetrometer and Test Bore log tests give an indication of the ground condition at the location of the tests only. While they are representative of typical conditions across the site, they do not identify variations in the ground away from the test locations.
 Elevation datum sourced from council GIS LiDAR contours.

TEST PIT RESULTS


KIRK ROBERTS
CONSULTING

Client: Gibbons Developments Ltd
 Site Address: Morven Ferry Road
 Town/City: Queenstown

Job No.: 2555087
 Test Pit No. TP-MA-08
 Scala Penetrometer:

Operator: AA
 Logged By: AA
 Logged Date: 27/06/25

Checked By: OB
 Checked Date: 30/06/25

Date: 17/06/25
 Weather: Fine
 Datum: NZGD 2000
 Termination: Target Depth

Geological Formation	Depth (m)	Elevation	Sample Description	Graphic	USCS	D _r	Water Table	Undrained Shear Strength S _u (kPa)	Blows per 100 mm of Penetration																		
									1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
			Silty TOPSOIL (OL); dark brown. Moist, non-plastic.		OL																						
	0.5	-0.5	Sandy SILT (MS); grey with orange brown mottling. Moist, non-plastic.		MS																						
	1.0	-1.0	Gravelly SAND (S), with some cobbles and boulders. Sand, fine to medium; gravel, fine to coarse, subround to subangular.		S																						
	1.5	-1.5	EOH: 1.70m																								
	2.0	-2.0	1.7m: End of Test Pits, Refusal on Bed Rock.																								
	2.5	-2.5																									
	3.0	-3.0																									
	3.5	-3.5																									
	4.0	-4.0																									
	4.5	-4.5																									
	5.0	-5.0																									

Remarks:
 Scala Penetrometer and Test Bore log tests give an indication of the ground condition at the location of the tests only. While they are representative of typical conditions across the site, they do not identify variations in the ground away from the test locations.
 Elevation datum sourced from council GIS LiDAR contours.

TEST PIT RESULTS


KIRK ROBERTS
CONSULTING

Client: Gibbons Developments Ltd
 Site Address: Morven Ferry Road
 Town/City: Queenstown

Job No.: 2555087
 Test Pit No. TP-MA-09
 Scala Penetrometer:

Operator: AA
 Logged By: AA
 Logged Date: 27/06/25

Checked By: OB
 Checked Date: 30/06/25

Date: 17/06/25
 Weather: Fine
 Datum: NZGD 2000
 Termination: Target Depth

Geological Formation	Depth (m)	Elevation	Sample Description	Graphic	USCS	Dr	Water Table	Undrained Shear Strength Su (kPa)	Blows per 100 mm of Penetration																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																			
									1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																	
			Silty sandy TOPSOIL (OL); dark brown. Moist, non-plastic.		OL																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							</

Remarks:
 Scala Penetrometer and Test Bore log tests give an indication of the ground condition at the location of the tests only. While they are representative of typical conditions across the site, they do not identify variations in the ground away from the test locations.
 Elevation datum sourced from council GIS LiDAR contours.

TEST PIT RESULTS


KIRK ROBERTS
CONSULTING

Client: Gibbons Developments Ltd
 Site Address: Morven Ferry Road
 Town/City: Queenstown

Job No.: 2555087
 Test Pit No. TP-MA-10
 Scala Penetrometer:

Operator: AA
 Logged By: AA
 Logged Date: 27/06/25

Checked By: OB
 Checked Date: 30/06/25

Date: 17/06/25
 Weather: Fine
 Datum: NZGD 2000
 Termination: Target Depth

Geological Formation	Depth (m)	Elevation	Sample Description	Graphic	USCS	Dr	Water Table	Undrained Shear Strength Su (kPa)	Blows per 100 mm of Penetration																		
									1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
			Silty sandy TOPSOIL (OL); dark brown. Moist, non-plastic; with some tree roots.		OL																						
	0.5	-0.5	SAND (S); light grey. Moist, sand, fine to medium.																								
	1.0	-1.0			S																						
	1.5	-1.5	1.5m: With some gravel, with minor cobbles and boulders. Gravel, fine to coarse, subround to subangular.																								
	2.0	-2.0	Gravelly GLACIAL TILL (G), with some silt; grey. Very stiff to hard, dry to moist; gravel, fine to coarse, subround to subangular.		G																						
	2.5	-2.5	EOH: 2.40m																								
			2.4m: End of Test Pits, Too Dense to Auger.																								
	3.0	-3.0																									
	3.5	-3.5																									
	4.0	-4.0																									
	4.5	-4.5																									
	5.0	-5.0																									

Remarks:
 Scala Penetrometer and Test Bore log tests give an indication of the ground condition at the location of the tests only. While they are representative of typical conditions across the site, they do not identify variations in the ground away from the test locations.
 Elevation datum sourced from council GIS LiDAR contours.

HAND AUGER RESULTS


KIRK ROBERTS
CONSULTING

Client: Gibbons Developments Ltd
 Site Address: Morven Ferry Road
 Town/City: Queenstown

Job No.: 2555087
 Hand Auger No. HA-SK-01
 Scala Penetrometer:

Operator: SSA
 Logged By: SSA
 Logged Date: 14/10/25

Checked By: OMB
 Checked Date: 28/10/25

Date: 14/10/25
 Weather: Sunny/dry
 Datum: NZGD 2000
 Termination: Target Depth Achieved

Geological Formation		Depth (m)	Elevation	Sample Description	Graphic	USCS	D _r	Water Table	Undrained Shear Strength S _u (kPa)	Blows per 100 mm of Penetration																		
Topsoil				Sandy SILT; dark brown. Moist, non-plastic; sand, fine to medium; With trace rootlets.						1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Late Pleistocene River Deposits		0.5	-0.5	Gravelly SAND; dark brown. Moist, sand, fine to coarse; gravel, fine to medium, subangular to round.				Groundwater Not Encountered																				
		1.0	-1.0																									
		1.5	-1.5																									
		2.0	-2.0																									
		2.5	-2.5																									
		3.0	-3.0	End of Borehole.																								
		3.5	-3.5	EOH: 3.00m																								
		4.0	-4.0																									
		4.5	-4.5																									

Remarks:
 Scala Penetrometer and Test Bore log tests give an indication of the ground condition at the location of the tests only. While they are representative of typical conditions across the site, they do not identify variations in the ground away from the test locations.
 Elevation datum sourced from council GIS LiDAR contours.

KIRK ROBERTS
CONSULTING

Job No.:	2555087
Hand Auger No.	HA-SK-02
Scala Penetrometer:	

Date:	14/10/25
Weather:	Sunny/dry
Datum:	NZGD 2000
Termination:	Target Depth Achieved

[illegible]

Remarks:
Scala Penetrometer and Test Bore log tests give an indication of the ground condition at the location of the tests only. While they are representative of typical conditions across the site, they do not identify variations in the ground away from the test locations.
Elevation datum sourced from council GIS LiDAR contours.

HAND AUGER RESULTS


KIRK ROBERTS
CONSULTING

Client: Gibbons Developments Ltd
 Site Address: Morven Ferry Road
 Town/City: Queenstown

Job No.: 2555087
 Hand Auger No. HA-SK-03
 Scala Penetrometer:

Operator: SSA
 Logged By: SSA
 Logged Date: 14/10/25

Checked By: OMB
 Checked Date: 28/10/25

Date: 14/10/25
 Weather: Sunny/dry
 Datum: NZGD 2000
 Termination: terminated due to Collapse

Geological Formation		Depth (m)	Elevation	Sample Description	Graphic	USCS	D _r	Water Table	Undrained Shear Strength S _u (kPa)	Blows per 100 mm of Penetration																						
Topsoil	Late Pleistocene River Deposits			Sandy SILT; dark brown. Saturated, non-plastic; sand, fine to medium; With minor rootlets.							1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19			
		0.5	-0.5	Gravelly SAND. Saturated, sand, fine to coarse; gravel, fine to coarse, subangular to subround, completely weathered to highly weathered.																												
		2.0	-2.0	End of Borehole - Terminated due to Collpase. EOH: 1.70m																												
		2.5	-2.5																													
		3.0	-3.0																													
		3.5	-3.5																													
		4.0	-4.0																													
		4.5	-4.5																													

Remarks:
 Scala Penetrometer and Test Bore log tests give an indication of the ground condition at the location of the tests only. While they are representative of typical conditions across the site, they do not identify variations in the ground away from the test locations.
 Elevation datum sourced from council GIS LiDAR contours.

HAND AUGER RESULTS


KIRK ROBERTS
CONSULTING

Client: Gibbons Developments Ltd
 Site Address: Morven Ferry Road
 Town/City: Queenstown

Job No.: 2555087
 Hand Auger No. HA-SK-04
 Scala Penetrometer:

Operator: SSA
 Logged By: SSA
 Logged Date: 14/10/25

Checked By: OMB
 Checked Date: 28/10/25

Date: 14/10/25
 Weather: Sunny/dry
 Datum: NZGD 2000
 Termination: terminated due to Collapse

Geological Formation	Depth (m)	Elevation	Sample Description	Graphic	USCS	D _r	Water Table	Undrained Shear Strength S _u (kPa)	Blows per 100 mm of Penetration																		
Late Pleistocene River Deposits			Sandy SILT; dark brown. Moist, non-plastic; sand, fine to coarse; With minor rootlets.						1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
	0.5	-0.5	Gravelly SAND. Wet to saturated, sand, fine to coarse; gravel, fine to coarse, subangular to subround.																								
	1.0	-1.0	End of Borehole - Terminated due to Collapse EOH: 1.60m																								
	1.5	-1.5																									
	2.0	-2.0																									
	2.5	-2.5																									
	3.0	-3.0																									
	3.5	-3.5																									
	4.0	-4.0																									
	4.5	-4.5																									

Remarks:

Scala Penetrometer and Test Bore log tests give an indication of the ground condition at the location of the tests only. While they are representative of typical conditions across the site, they do not identify variations in the ground away from the test locations.
 Elevation datum sourced from council GIS LiDAR contours.

HAND AUGER RESULTS


KIRK ROBERTS
CONSULTING

Client: Gibbons Developments Ltd
 Site Address: Morven Ferry Road
 Town/City: Queenstown

Job No.: 2555087
 Hand Auger No. HA-SK-05
 Scala Penetrometer:

Operator: SSA
 Logged By: SSA
 Logged Date: 14/10/25

Checked By: OMB
 Checked Date: 28/10/25

Date: 14/10/25
 Weather: Sunny/dry
 Datum: NZGD 2000
 Termination: Refusal on Dense Ground

Geological Formation	Depth (m)	Elevation	Sample Description	Graphic	USCS	D _r	Water Table	Undrained Shear Strength S _u (kPa)	Blows per 100 mm of Penetration																		
Topsoil			Sandy SILT; dark brown. Moist, non-plastic; sand, fine to coarse; With trace rootlets.						1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Late Pleistocene River Deposits	0.5	-0.5	Gravelly SAND; dark brownish grey. Moist, sand, fine to coarse; gravel, fine to medium, subangular to subround.																								
	1.0	-1.0																									
	1.5	-1.5																									
	2.0	-2.0																									
Rakaia Terrane	2.5	-2.5	Sandy GRAVEL; dark grey. Moist to wet, gravel, fine to coarse, angular to subround, completely weathered to highly weathered, schist; sand, fine to coarse.																								
	2.5	-2.5	End of Borehole - Refusal on Dense Ground.																								
	3.0	-3.0	EOH: 2.30m																								
	3.5	-3.5																									
	4.0	-4.0																									
	4.5	-4.5																									

Remarks:
 Scala Penetrometer and Test Bore log tests give an indication of the ground condition at the location of the tests only. While they are representative of typical conditions across the site, they do not identify variations in the ground away from the test locations.
 Elevation datum sourced from council GIS LiDAR contours.

HAND AUGER RESULTS


KIRK ROBERTS
CONSULTING

Client: Gibbons Developments Ltd
 Site Address: Morven Ferry Road
 Town/City: Queenstown

Job No.: 2555087
 Hand Auger No. HA-SK-06
 Scala Penetrometer:

Operator: SSA
 Logged By: SSA
 Logged Date: 14/10/25

Checked By: OMB
 Checked Date: 28/10/25

Date: 14/10/25
 Weather: Sunny/dry
 Datum: NZGD 2000
 Termination: terminated due to Collapse

Geological Formation	Depth (m)	Elevation	Sample Description	Graphic	USCS	D _r	Water Table	Undrained Shear Strength S _u (kPa)	Blows per 100 mm of Penetration																		
									1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Topsoil			Sandy SILT; dark brown. Moist to saturated, non-plastic; sand, fine to medium; With trace rootlets.																								
Rakaia Terrane	0.5	-0.5	SAND, with minor gravel; dark grey. Moist to saturated, sand, fine to medium; gravel, fine to medium, angular to subround, completely weathered to highly weathered, schist.																								
	1.0	-1.0																									
	1.5	-1.5	End of Borehole - Termination due to Collapse. EOH: 1.20m																								
	2.0	-2.0																									
	2.5	-2.5																									
	3.0	-3.0																									
	3.5	-3.5																									
	4.0	-4.0																									
	4.5	-4.5																									

Remarks:
 Scala Penetrometer and Test Bore log tests give an indication of the ground condition at the location of the tests only. While they are representative of typical conditions across the site, they do not identify variations in the ground away from the test locations.
 Elevation datum sourced from council GIS LiDAR contours.

HAND AUGER RESULTS


KIRK ROBERTS
CONSULTING

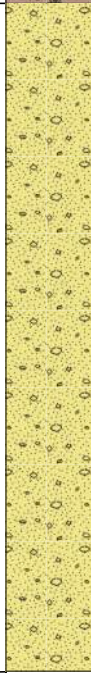
Client: Gibbons Developments Ltd
 Site Address: Morven Ferry Road
 Town/City: Queenstown

Job No.: 2555087
 Hand Auger No. HA-SK-07
 Scala Penetrometer:

Operator: SSA
 Logged By: SSA
 Logged Date: 14/10/25

Checked By: OMB
 Checked Date: 28/10/25

Date: 14/10/25
 Weather: Sunny/dry
 Datum: NZGD 2000
 Termination: Refusal on Dense Ground

Geological Formation		Depth (m)	Elevation	Sample Description	Graphic	USCS	D _r	Water Table	Undrained Shear Strength S _u (kPa)	Blows per 100 mm of Penetration																		
Topsoil	Rakaia Terrane			Sandy SILT; dark brown. Moist to wet, non-plastic; sand, fine to medium; With minor rootlets.						1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
		0.5	-0.5	Gravelly SAND; dark grey. Moist, sand, fine to medium; gravel, fine, angular to round, completely weathered to highly weathered.																								
		1.0	-1.0																									
		1.5	-1.5																									
		2.0	-2.0																									
		2.5	-2.5	End of Borehole - Refusal on Dense Ground.																								
		3.0	-3.0	EOH: 2.50m																								
		3.5	-3.5																									
		4.0	-4.0																									
		4.5	-4.5																									

Remarks:
 Scala Penetrometer and Test Bore log tests give an indication of the ground condition at the location of the tests only. While they are representative of typical conditions across the site, they do not identify variations in the ground away from the test locations.
 Elevation datum sourced from council GIS LiDAR contours.

HAND AUGER RESULTS


KIRK ROBERTS
CONSULTING

Client: Gibbons Developments Ltd
 Site Address: Morven Ferry Road
 Town/City: Queenstown

Job No.: 2555087
 Hand Auger No. HA-SK-08
 Scala Penetrometer:

Operator: SSA
 Logged By: SSA
 Logged Date: 14/10/25

Checked By: OMB
 Checked Date: 28/10/25

Date: 14/10/25
 Weather: Sunny/dry
 Datum: NZGD 2000
 Termination: Refusal on Dense Ground

Geological Formation	Depth (m)	Elevation	Sample Description	Graphic	USCS	Dr	Water Table	Undrained Shear Strength S_u (kPa)	Blows per 100 mm of Penetration																		
									1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Top soil			Sandy SILT; dark brown. Moist, non-plastic; sand, fine to coarse; With trace rootlets.																								
Rakaia Terrane	0.5	-0.5	SAND, with some gravel. Moist, sand, fine to medium; gravel, fine to medium, angular to subround, completely weathered to highly weathered, schist; Very weak to extremely weak rock.																								
	1.0	-1.0	End of Borehole - Refusal on Hard Ground.																								
			EOH: 0.60m																								
	1.5	-1.5																									
	2.0	-2.0																									
	2.5	-2.5																									
	3.0	-3.0																									
	3.5	-3.5																									
	4.0	-4.0																									
	4.5	-4.5																									

Remarks:
 Scala Penetrometer and Test Bore log tests give an indication of the ground condition at the location of the tests only. While they are representative of typical conditions across the site, they do not identify variations in the ground away from the test locations.
 Elevation datum sourced from council GIS LiDAR contours.

HAND AUGER RESULTS


KIRK ROBERTS
CONSULTING

Client: Gibbons Developments Ltd
 Site Address: Morven Ferry Road
 Town/City: Queenstown

Job No.: 2555087
 Hand Auger No. HA-SK-09
 Scala Penetrometer:

Operator: SSA
 Logged By: SSA
 Logged Date: 14/10/25

Checked By: OMB
 Checked Date: 28/10/25

Date: 14/10/25
 Weather: Sunny/dry
 Datum: NZGD 2000
 Termination: Refusal on Dense Ground

Geological Formation		Depth (m)	Elevation	Sample Description	Graphic	USCS	D _r	Water Table	Undrained Shear Strength S _u (kPa)	Blows per 100 mm of Penetration																					
Topsoil	Late Pleistocene River Deposits			Sandy SILT; dark brown. Moist, non-plastic; sand, fine to medium; With trace rootlets.						1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19			
		0.5	-0.5 <td>SAND, with some gravel; dark greyish brown. Moist to wet, sand, fine to coarse; gravel, fine to medium, angular to subround; With trace limonite staining.</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td>	SAND, with some gravel; dark greyish brown. Moist to wet, sand, fine to coarse; gravel, fine to medium, angular to subround; With trace limonite staining.																											
		1.0	-1.0 <td rowspan="5">End of Borehole - Refusal on Dense Ground EOH: 2.50m</td> <td rowspan="5"></td> <td rowspan="5"></td> <td rowspan="5"></td> <td rowspan="5">Groundwater Not Encountered</td> <td rowspan="5"></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td>	End of Borehole - Refusal on Dense Ground EOH: 2.50m				Groundwater Not Encountered																							
		1.5	-1.5 <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td>																												
		2.0	-2.0 <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td>																												
		2.5	-2.5 <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td>																												
		3.0	-3.0 <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td>																												
		3.5	-3.5 <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td>																												
		4.0	-4.0 <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td>																												
		4.5	-4.5 <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td>																												

Remarks:
 Scala Penetrometer and Test Bore log tests give an indication of the ground condition at the location of the tests only. While they are representative of typical conditions across the site, they do not identify variations in the ground away from the test locations.
 Elevation datum sourced from council GIS LiDAR contours.

HAND AUGER RESULTS


KIRK ROBERTS
CONSULTING

Client: Gibbons Developments Ltd
 Site Address: Morven Ferry Road
 Town/City: Queenstown

Job No.: 2555087
 Hand Auger No. HA-SK-10
 Scala Penetrometer:

Operator: SSA
 Logged By: SSA
 Logged Date: 14/10/25

Checked By: OMB
 Checked Date: 28/10/25

Date: 14/10/25
 Weather: Sunny/dry
 Datum: NZGD 2000
 Termination: Refusal on Dense Ground

Geological Formation	Depth (m)	Elevation	Sample Description	Graphic	USCS	D _r	Water Table	Undrained Shear Strength S _u (kPa)	Blows per 100 mm of Penetration																		
Topsoil			Silty SAND; dark brown. Moist to wet, non-plastic, sand, fine to coarse; with trace rootlets.						1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Late Pleistocene River Deposits	0.5	-0.5	SAND, with some gravel; dark greyish brown. Moist to wet, sand, fine to coarse; gravel, fine to medium, subangular to subround, completely weathered to highly weathered, schist.				Groundwater Not Encountered																				
	1.0	-1.0																									
	1.5	-1.5	End of Borehole - Refusal on Dense Ground.																								
	2.0	-2.0	EOH: 1.50m																								
	2.5	-2.5																									
	3.0	-3.0																									
	3.5	-3.5																									
	4.0	-4.0																									
	4.5	-4.5																									

Remarks:
 Scala Penetrometer and Test Bore log tests give an indication of the ground condition at the location of the tests only. While they are representative of typical conditions across the site, they do not identify variations in the ground away from the test locations.
 Elevation datum sourced from council GIS LiDAR contours.

HAND AUGER RESULTS


KIRK ROBERTS
CONSULTING

Client: Gibbons Developments Ltd
 Site Address: Morven Ferry Road
 Town/City: Queenstown

Job No.: 2555087
 Hand Auger No. HA-SK-11
 Scala Penetrometer:

Operator: SSA
 Logged By: SSA
 Logged Date: 14/10/25

Checked By: OMB
 Checked Date: 28/10/25

Date: 14/10/25
 Weather: Sunny/dry
 Datum: NZGD 2000
 Termination: Target Depth Achieved

Geological Formation		Depth (m)	Elevation	Sample Description	Graphic	USCS	D _r	Water Table	Undrained Shear Strength S _u (kPa)	Blows per 100 mm of Penetration																		
Topsoil				Sandy SILT; dark brown. Moist, non-plastic; sand, fine to medium; With minor rootlets.						1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Late Pleistocene River Deposits		0.5	-0.5	Silty SAND, with trace clay and gravel; dark brownish grey. Moist, non-plastic, sand, fine to medium; gravel, fine, angular to subround.																								
		1.0	-1.0																									
		1.5	-1.5																									
		2.0	-2.0																									
		2.5	-2.5																									
		3.0	-3.0	End of Borehole.																								
		3.5	-3.5	EOH: 3.00m																								
		4.0	-4.0																									
		4.5	-4.5																									

Remarks:
 Scala Penetrometer and Test Bore log tests give an indication of the ground condition at the location of the tests only. While they are representative of typical conditions across the site, they do not identify variations in the ground away from the test locations.
 Elevation datum sourced from council GIS LiDAR contours.

TEST PIT RESULTS


KIRK ROBERTS
CONSULTING

Client: Gibbons Developments Ltd
 Site Address: Morven Ferry Road
 Town/City: Queenstown

Job No.: 2555087
 Test Pit No. TP-TP-01
 Scala Penetrometer:

Operator: SSA
 Logged By: SSA
 Logged Date: 13/10/25

Checked By: OMB
 Checked Date: 28/10/25

Date: 13/10/25
 Weather: Overcast/slightly wet
 Datum: NZGD 2000
 Termination: Target Depth Achieved

Geological Formation	Depth (m)	Elevation	Sample Description	Graphic	USCS	D _r	Water Table	Undrained Shear Strength S _u (kPa)	Blows per 100 mm of Penetration																		
Topsoil	0.5	-0.5	SandySILT; dark brown. Moist, non-plastic; sand, fine; With trace rootlets.						1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Late Pleistocene River Deposits	1.0	-1.0	Gravelly SAND; dark greyish brown. Moist to wet, sand, fine to coarse; gravel, fine to coarse, subangular to round; With trace limonite staining.																								
	2.0	-2.0																									
	2.5	-2.5	End of Test Pit																								
	3.0	-3.0	EOH: 2.20m																								
	3.5	-3.5																									
	4.0	-4.0																									
	4.5	-4.5																									

Remarks:
 Scala Penetrometer and Test Bore log tests give an indication of the ground condition at the location of the tests only. While they are representative of typical conditions across the site, they do not identify variations in the ground away from the test locations.
 Elevation datum sourced from council GIS LiDAR contours.

SCALA PENETROMETER & TEST PIT RESULTS



Client:	Gibbons Developments Ltd	Job No.:	2555087
Site Address:	Morven Ferry Road	Test Pit No.	TP-TP-02
Town/City:	Queenstown	Scala Penetrometer:	SP-TP-02
Operator:	SSA	Date:	13/10/25
Logged By:	SSA	Weather:	Overcast/slightly wet
Logged Date:	13/10/25	Checked By:	OMB
		Checked Date:	28/10/25
		Datum:	NZGD 2000
		Termination:	Target Depth Achieved

Geological Formation	Depth (m)	Elevation	Sample Description	Graphic	USCS	D _r	Water Table	Undrained Shear Strength S _u (kPa)	Blows per 100 mm of Penetration																		
Topsoil			Sandy SILT; dark brown. Loose, moist, non-plastic; sand, fine to medium; With trace rootlets.						1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Late Pleistocene River Deposits	0.5	-0.5	SAND, with some gravel; dark greyish brown. Loose, moist, sand, fine to coarse; gravel, fine to medium, subangular to round.						2	3	2	2	3														
			Silty SAND, with minor gravel; dark brownish grey. Loose to very dense, moist, non-plastic, sand, fine; gravel, fine to medium, subangular to subround.						2	2	3																
	1.0	-1.0													7												
																			12								
																				15							
																					18						
																											20
	1.5	-1.5																									
	2.0	-2.0	End of Test Pit.																								
			EOH: 2.00m																								
	2.5	-2.5																									
	3.0	-3.0																									
	3.5	-3.5																									
	4.0	-4.0																									
	4.5	-4.5																									

Remarks:
 Scala Penetrometer and Test Bore log tests give an indication of the ground condition at the location of the tests only. While they are representative of typical conditions across the site, they do not identify variations in the ground away from the test locations.
 Elevation datum sourced from council GIS LiDAR contours.

SCALA PENETROMETER & TEST PIT RESULTS



Client:	Gibbons Developments Ltd	Job No.:	2555087
Site Address:	Morven Ferry Road	Test Pit No.	TP-TP-03
Town/City:	Queenstown	Scala Penetrometer:	SP-TP-03
Operator:	SSA	Date:	13/10/25
Logged By:	SSA	Weather:	Overcast/slightly wet
Logged Date:	13/10/25	Checked By:	OMB
		Checked Date:	28/10/25
		Datum:	NZGD 2000
		Termination:	Refusal on Dense Ground

Geological Formation	Depth (m)	Elevation	Sample Description	Graphic	USCS	Dr	Water Table	Undrained Shear Strength Su (kPa)	Blows per 100 mm of Penetration																		
									1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Topsoil			Sandy SILT; dark brown. Dense, moist, non-plastic; sand, fine; With trace rootlets.																11								
Rakaia Terrane			GRAVEL; dark grey streaked light grey; blocky. Very dense, dry to moist, gravel, fine to coarse, angular to subangular, completely weathered to highly weathered, schist; With trace limonite staining.																								
	0.5	-0.5	End of Test Pit - Refusal on Dense Ground																								20
	1.0	-1.0																									
	1.5	-1.5																									
	2.0	-2.0																									
	2.5	-2.5																									
	3.0	-3.0																									
	3.5	-3.5																									
	4.0	-4.0																									
	4.5	-4.5																									

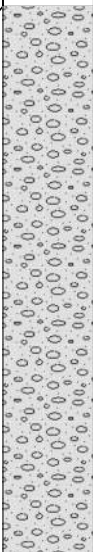
Remarks:
Scala Penetrometer and Test Bore log tests give an indication of the ground condition at the location of the tests only. While they are representative of typical conditions across the site, they do not identify variations in the ground away from the test locations.
Elevation datum sourced from council GIS LiDAR contours.

SCALA PENETROMETER & TEST PIT RESULTS



KIRK ROBERTS
CONSULTING

Client:	Gibbons Developments Ltd	Job No.:	2555087
Site Address:	Morven Ferry Road	Test Pit No.	TP-TP-04
Town/City:	Queenstown	Scala Penetrometer:	SP-TP-04
Operator:	SSA	Date:	13/10/25
Logged By:	SSA	Weather:	Overcast/slightly wet
Logged Date:	13/10/25	Datum:	NZGD 2000
Checked By:	OMB	Termination:	Target Depth Achieved
Checked Date:	28/10/25		

Geological Formation		Depth (m)	Elevation	Sample Description	Graphic	USCS	Dr	Water Table	Undrained Shear Strength Su (kPa)	Blows per 100 mm of Penetration																		
Topsoil	Rakaia Terrane									1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
		0.5	-0.5	Sandy SILT; dark brown. Very loose, moist to wet, non-plastic; sand, fine to medium; With trace rootlets. Sandy GRAVEL; dark brownish grey. Loose to dense, moist to saturated, wellgraded, gravel, fineto coarse, angular to subround, schist; sand, fine to coarse.				Groundwater Not Encountered		1	2	2	3	4	7		12	12	15	20								
		2.0	-2.0	End of Test Pit. EOH: 2.00m																								
		2.5	-2.5																									
		3.0	-3.0																									
		3.5	-3.5																									
		4.0	-4.0																									
		4.5	-4.5																									

TEST PIT RESULTS


KIRK ROBERTS
CONSULTING

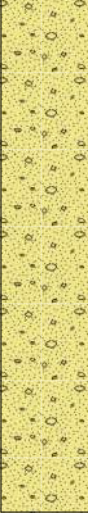
Client: Gibbons Developments Ltd
 Site Address: Morven Ferry Road
 Town/City: Queenstown

Job No.: 2555087
 Test Pit No. TP-TP-05
 Scala Penetrometer:

Operator: SSA
 Logged By: SSA
 Logged Date: 13/10/25

Checked By: OMB
 Checked Date: 28/10/25

Date: 13/10/25
 Weather: Overcast/slightly wet
 Datum: NZGD 2000
 Termination: Target Depth Achieved

Geological Formation		Depth (m)	Elevation	Sample Description	Graphic	USCS	D _r	Water Table	Undrained Shear Strength S _u (kPa)	Blows per 100 mm of Penetration																						
Topsoil				Sandy SILT; dark brown. Moist, non-plastic; sand, fine to medium; With trace rootlets.						1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19				
Late Pleistocene River Deposits		0.5	-0.5	Gravelly SAND; dark greyish brown. Moist, sand, fine to coarse; gravel, fine to coarse, subangular to round.				Groundwater Not Encountered																								
		1.0	-1.0																													
		1.5	-1.5																													
		2.0	-2.0	End of Test Pit.																												
		2.5	-2.5	EOH: 2.00m																												
		3.0	-3.0																													
		3.5	-3.5																													
		4.0	-4.0																													
		4.5	-4.5																													

Remarks:
 Scala Penetrometer and Test Bore log tests give an indication of the ground condition at the location of the tests only. While they are representative of typical conditions across the site, they do not identify variations in the ground away from the test locations.
 Elevation datum sourced from council GIS LiDAR contours.

SCALA PENETROMETER & TEST PIT RESULTS



Client:	Gibbons Developments Ltd	Job No.:	2555087
Site Address:	Morven Ferry Road	Test Pit No.	TP-TP-06
Town/City:	Queenstown	Scala Penetrometer:	SP-TP-06
Operator:	SSA	Date:	13/10/25
Logged By:	SSA	Weather:	Overcast/slightly wet
Logged Date:	13/10/25	Checked By:	OMB
		Checked Date:	28/10/25
		Datum:	NZGD 2000
		Termination:	Refusal on Dense Ground

Geological Formation	Depth (m)	Elevation	Sample Description	Graphic	USCS	D _r	Water Table	Undrained Shear Strength S _u (kPa)	Blows per 100 mm of Penetration
Topsoil			Sandy SILT; dark brown. Loose, moist, non-plastic; sand, fine to medium; With trace rootlets.						1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19
Rakaia Terrane	0.5	-0.5	Gravelly SAND; dark greyish brown streaked grey. Looseto very dense, sand, fine to coarse; gravel, fine to coarse, angular to subround, completely weathered, schist.				Groundwater Not Encountered		20
	1.0	-1.0							
	1.5	-1.5	GRAVEL; dark grey. Very dense, moist to wet, well graded, gravel, fine to coarse, angular to subround, completely weathered to highly weathered, schist; Very weak to weak..						
	2.0	-2.0	End of Test Pit - Refusal on Dense Ground						
			EOH: 1.60m						
	2.5	-2.5							
	3.0	-3.0							
	3.5	-3.5							
	4.0	-4.0							
	4.5	-4.5							

Remarks:
 Scala Penetrometer and Test Bore log tests give an indication of the ground condition at the location of the tests only. While they are representative of typical conditions across the site, they do not identify variations in the ground away from the test locations.
 Elevation datum sourced from council GIS LiDAR contours.

TEST PIT RESULTS


KIRK ROBERTS
CONSULTING

Client: Gibbons Developments Ltd
 Site Address: Morven Ferry Road
 Town/City: Queenstown

Job No.: 2555087
 Test Pit No. TP-TP-07
 Scala Penetrometer:

Operator: SSA
 Logged By: SSA
 Logged Date: 13/10/25

Checked By: OMB
 Checked Date: 28/10/25

Date: 13/10/25
 Weather: Overcast/slightly wet
 Datum: NZGD 2000
 Termination: Refusal on Dense Ground

Geological Formation		Depth (m)	Elevation	Sample Description	Graphic	USCS	D _r	Water Table	Undrained Shear Strength S _u (kPa)	Blows per 100 mm of Penetration																		
Topsoil	Rakaia Terrane			Sandy SILT; dark brown. Loose, moist, non-plastic; sand, fine to medium; With trace rootlets.						1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
		0.5	-0.5	Gravelly SAND; dark greyish brown mottled grey. Looseto dense, moist to wet, well graded, sand, fine to coarse; gravel, fine to coarse, angular to subround, schist; With tracelimonite.																								
		1.0	-1.0	Completely weathered to highly weathered, dark grey SCHIST. Very weak to weak. Recovered as fine to coarse GRAVEL. Angular to subrounded. Dense to Very dense. With trace limonite staining.																								
		1.5	-1.5	End of Test Pit - Refusal on Dense Ground.																								
				EOH: 1.40m																								
		2.0	-2.0																									
		2.5	-2.5																									
		3.0	-3.0																									
		3.5	-3.5																									
		4.0	-4.0																									
		4.5	-4.5																									

Remarks:
 Scala Penetrometer and Test Bore log tests give an indication of the ground condition at the location of the tests only. While they are representative of typical conditions across the site, they do not identify variations in the ground away from the test locations.
 Elevation datum sourced from council GIS LiDAR contours.

SCALA PENETROMETER & TEST PIT RESULTS



Client:	Gibbons Developments Ltd	Job No.:	2555087
Site Address:	Morven Ferry Road	Test Pit No.	TP-TP-08
Town/City:	Queenstown	Scala Penetrometer:	SP-TP-08
Operator:	SSA	Date:	13/10/25
Logged By:	SSA	Weather:	Overcast/slightly wet
Logged Date:	13/10/25	Datum:	NZGD 2000
Checked By:	OMB	Termination:	Target Depth Achieved
Checked Date:	28/10/25		

Geological Formation		Depth (m)	Elevation	Sample Description	Graphic	USCS	Dr	Water Table	Undrained Shear Strength Su (kPa)	Blows per 100 mm of Penetration																		
Topsoil	Rakaia Terrane			Sandy SILT; dark brown. Loose, moist, non-plastic; sand, fine to medium; With trace rootlets.						1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
		0.5	-0.5	Gravelly SAND; dark greyish brown. Loose to very dense, moist to saturated, sand, fine to coarse; gravel, fine to coarse, subangular to round.						2	2	2	5	6	6	6	7	9	7	6	12	12	15	20				
1.0		-1.0																										
1.5		-1.5																										
2.0		-2.0	1.8m: Groundwater seepage.																									
2.5		-2.5	End of Test Pit.																									
3.0		-3.0	EOH: 2.10m																									
3.5		-3.5																										
4.0		-4.0																										
4.5		-4.5																										

Remarks:
 Scala Penetrometer and Test Bore log tests give an indication of the ground condition at the location of the tests only. While they are representative of typical conditions across the site, they do not identify variations in the ground away from the test locations.
 Elevation datum sourced from council GIS LiDAR contours.

TEST PIT RESULTS


KIRK ROBERTS
CONSULTING

Client: Gibbons Developments Ltd
 Site Address: Morven Ferry Road
 Town/City: Queenstown

Job No.: 2555087
 Test Pit No. TP-TP-09
 Scala Penetrometer:

Operator: SSA
 Logged By: SSA
 Logged Date: 13/10/25

Checked By: OMB
 Checked Date: 28/10/25

Date: 13/10/25
 Weather: Overcast/slightly wet
 Datum: NZGD 2000
 Termination: Refusal on Dense Ground

Geological Formation		Depth (m)	Elevation	Sample Description	Graphic	USCS	D _r	Water Table	Undrained Shear Strength S _u (kPa)	Blows per 100 mm of Penetration																			
	Topsoil										1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
	Rakaia Terrane	0.5	-0.5	GRAVEL, with some sand; dark grey. Dry to moist, gravel, fine to coarse, angular to subround, completely weathered to highly weathered, schist; sand, fine to coarse.				Groundwater Not Encountered																					
		1.0	-1.0	End of Test Pit - Refusal on Dense Ground																									
				EOH: 0.90m																									
		1.5	-1.5																										
		2.0	-2.0																										
		2.5	-2.5																										
		3.0	-3.0																										
		3.5	-3.5																										
		4.0	-4.0																										
		4.5	-4.5																										

Remarks:
 Scala Penetrometer and Test Bore log tests give an indication of the ground condition at the location of the tests only. While they are representative of typical conditions across the site, they do not identify variations in the ground away from the test locations.
 Elevation datum sourced from council GIS LiDAR contours.

TEST PIT RESULTS


KIRK ROBERTS
CONSULTING

Client: Gibbons Developments Ltd
 Site Address: Morven Ferry Road
 Town/City: Queenstown

Job No.: 2555087
 Test Pit No. TP-TP-10
 Scala Penetrometer:

Operator: SSA
 Logged By: SSA
 Logged Date: 13/10/25

Checked By: OMB
 Checked Date: 28/10/25

Date: 13/10/25
 Weather: Overcast/slightly wet
 Datum: NZGD 2000
 Termination: Target Depth Achieved

Geological Formation	Topsoil	Late Pleistocene River Deposits	Depth (m)	Elevation	Sample Description	Graphic	USCS	Dr	Water Table	Undrained Shear Strength Su (kPa)	Blows per 100 mm of Penetration																		
											1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
			0.5	-0.5	Sandy SILT; dark brown. Moist, non-plastic; sand, fine to medium; With trace rootlets.																								
			1.0	-1.0	SAND, with some gravel; dark grey. Moist, well graded, sand, fine to coarse; gravel, fine to coarse, angular to round.																								
			1.5	-1.5																									
			2.0	-2.0	End of Test Pit.																								
			2.5	-2.5	EOH: 2.00m																								
			3.0	-3.0																									
			3.5	-3.5																									
			4.0	-4.0																									
			4.5	-4.5																									

Remarks:

Scala Penetrometer and Test Bore log tests give an indication of the ground condition at the location of the tests only. While they are representative of typical conditions across the site, they do not identify variations in the ground away from the test locations.
 Elevation datum sourced from council GIS LiDAR contours.

TEST PIT RESULTS


KIRK ROBERTS
CONSULTING

Client: Gibbons Developments Ltd
 Site Address: Morven Ferry Road
 Town/City: Queenstown

Job No.: 2555087
 Test Pit No. TP-TP-11
 Scala Penetrometer:

Operator: SSA
 Logged By: SSA
 Logged Date: 13/10/25

Checked By: OMB
 Checked Date: 28/10/25

Date: 13/10/25
 Weather: Overcast/slightly wet
 Datum: NZGD 2000
 Termination: Target Depth Achieved

Geological Formation		Depth (m)	Elevation	Sample Description	Graphic	USCS	D _r	Water Table	Undrained Shear Strength S _u (kPa)	Blows per 100 mm of Penetration																		
Topsoil	Late Pleistocene River Deposits									1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
		0.5	-0.5	Silty SAND; dark brown. Moist to wet, non-plastic, sand, fine to medium; With trace rootlets.																								
		1.0	-1.0	SAND, with trace gravel; dark greyish brown. Moist to wet, sand, fine to coarse; gravel, fine to medium, angular to subround.				Groundwater Not Encountered																				
		2.0	-2.0	End of Test Pit.																								
		2.5	-2.5	EOH: 2.00m																								
		3.0	-3.0																									
		3.5	-3.5																									
		4.0	-4.0																									
		4.5	-4.5																									

Remarks:
 Scala Penetrometer and Test Bore log tests give an indication of the ground condition at the location of the tests only. While they are representative of typical conditions across the site, they do not identify variations in the ground away from the test locations.
 Elevation datum sourced from council GIS LiDAR contours.

TEST PIT RESULTS


KIRK ROBERTS
CONSULTING

Client: Gibbons Developments Ltd
 Site Address: Morven Ferry Road
 Town/City: Queenstown

Job No.: 2555087
 Test Pit No. TP-TP-12
 Scala Penetrometer:

Operator: SSA
 Logged By: SSA
 Logged Date: 13/10/25

Checked By: OMB
 Checked Date: 28/10/25

Date: 13/10/25
 Weather: Overcast/slightly wet
 Datum: NZGD 2000
 Termination: Target Depth Achieved

Geological Formation	Depth (m)	Elevation	Sample Description	Graphic	USCS	D _r	Water Table	Undrained Shear Strength S _u (kPa)	Blows per 100 mm of Penetration																		
Topsoil			Sandy SILT; dark brown. Moist, non-plastic; sand, fine to coarse; With trace rootlets.						1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Late Pleistocene River Deposits	0.5	-0.5	SAND, with some gravel. Moist, sand, fine to coarse; gravel, fine to coarse, angular to round; With trace limonite staining.				Δ																				
	1.0	-1.0	1.2m: Groundwater seepage. 																								
	2.0	-2.0	End of Test Pit.																								
	2.5	-2.5	EOH: 2.00m																								
	3.0	-3.0																									
	3.5	-3.5																									
	4.0	-4.0																									
	4.5	-4.5																									

Remarks:
 Scala Penetrometer and Test Bore log tests give an indication of the ground condition at the location of the tests only. While they are representative of typical conditions across the site, they do not identify variations in the ground away from the test locations.
 Elevation datum sourced from council GIS LiDAR contours.

MACHINE BOREHOLE LOG



Client: Gibbons Developments Ltd
 Site Address: Morven Ferry Road
 Town/City: Queenstown
 Job No.: 2555087

Weather: Fine
 Borehole: BH-01
 Type:

Latitude: Longitude:
 Logged By: TJ Checked By: OB
 Logged Date: 10/12/25 Checked Date: 10/12/25

Date: Operator:
 Datum: NZGD 2000

Geological Formation	DESCRIPTION	GRAPHIC	DEPTH	ELEVATION	TCR (%)	SPT N-VALUE (Uncorrected)	SPT DATA (Uncorrected)	INSTALLATION
Topsoil	Silty sandy TOPSOIL; dark grey. Moist, non-plastic; sand, fine.							
	SILT, with some sand; dark grey. Moist, non-plastic; sand, fine.							
	SAND, with minor silt; dark grey. Moist, non-plastic; sand, fine.		1.0	1.0				
	Gravelly SAND; dark grey. Moist, sand, fine to coarse; gravel, fine, subround.		2.0	2.0				
	Sandy GRAVEL; grey. Moist, gravel, fine to medium, subround; sand, fine to coarse.		3.0	3.0				
			4.0	4.0				
	SAND, with minor gravel; brownish. Moist, sand, fine; gravel, fine to medium, subround.		5.0	5.0				

REMARKS
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 Elevation datum and coordinates sourced from council GIS LIDAR contours.

Water Level Measurements

MACHINE BOREHOLE LOG



Client: Gibbons Developments Ltd
Site Address: Morven Ferry Road
Town/City: Queenstown
Job No.: 2555087

Weather: Fine
Borehole: BH-01
Type:

Latitude: Longitude: OB
Logged By: TJ Checked By: OB
Logged Date: 10/12/25 Checked Date: 10/12/25
Date: Operator: Datum: NZGD 2000

Geological Formation	DESCRIPTION	GRAPHIC	DEPTH	ELEVATION	TCR (%)		SPT N-VALUE (Uncorrected)		SPT DATA (Uncorrected)	INSTALLATION
					25	75	10	20		
	[CONT] SAND, with minor gravel; brownish. Moist, sand, fine; gravel, fine to medium, subround.									
			6.0	6.0						
			7.0	7.0						
			8.0	8.0						
			9.0	9.0						
	SAND, with some gravel; grey. Moist, sand, fine to coarse; gravel, fine to medium, subround.									
			10.0	10.0						
	End of Borehole- Target Depth.									
	EOH: 10.00m									

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Elevation datum and coordinates sourced from council GIS LiDAR contours.

Water Level Measurements

MACHINE BOREHOLE LOG



Client: Gibbons Developments Ltd
Site Address: Morven Ferry Road
Town/City: Queenstown
Job No.: 2555087

Weather: Fine
Borehole: BH-02
Type:

Latitude: Longitude:
Logged By: TJ Checked By: OB
Logged Date: 10/12/25 Checked Date: 10/12/25
Date: Operator:
Datum: NZGD 2000

Geological Formation	DESCRIPTION	GRAPHIC	DEPTH	ELEVATION	TCR (%)	SPT N-VALUE (Uncorrected)	SPT DATA (Uncorrected)	INSTALLATION
Topsoil	Silty TOPSOIL, with minor sand; dark grey. Moist, non-plastic; sand, fine.							
	SILT, with minor sand; dark grey. Moist, non-plastic; sand, fine.							
	SAND, with some silt; dark grey. Moist, non-plastic, sand, fine to medium.							
	Gravelly SAND; light grey . Moist, sand, fine to medium; gravel, fine to medium, subround.							
	2.8m: SAND. Sand, coarse.							
	4.2m: Ground water.							
	GRAVEL, with minor sand; grey . Moist, gravel, fine to coarse, subround; sand, coarse.							

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Elevation datum and coordinates sourced from council GIS LIDAR contours.

Water Level Measurements

MACHINE BOREHOLE LOG



Client: Gibbons Developments Ltd
Site Address: Morven Ferry Road
Town/City: Queenstown
Job No.: 2555087

Weather: Fine
Borehole: BH-02
Type:

Latitude: Longitude:
Logged By: TJ Checked By: OB
Logged Date: 10/12/25 Checked Date: 10/12/25

Date: Operator:
Datum: NZGD 2000

Geological Formation	DESCRIPTION	GRAPHIC	DEPTH	ELEVATION	TCR (%)	SPT N-VALUE (Uncorrected)	SPT DATA (Uncorrected)	INSTALLATION
	[CONT] GRAVEL, with minor sand; grey . Moist, gravel, fine to coarse, subround; sand, coarse.		6.0	6.0	25 50 75	10 20 30 40		
	SAND; grey . Moist, sand, fine to medium.		8.0	8.0				
	9.5m: With minor gravel. Gravel, medium to coarse.		9.0	9.0				
	End of Borehole -Target Depth.		10.0	10.0				
	EOH: 10.00m							
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337 Saint Asaph Street, CHRISTCHURCH 8011								

MACHINE BOREHOLE LOG



Client: Gibbons Developments Ltd
 Site Address: Morven Ferry Road
 Town/City: Queenstown
 Job No.: 2555087

Weather: Fine
 Borehole: BH-03
 Type:

Latitude: Longitude:
 Logged By: TJ Checked By: OB
 Logged Date: 10/12/25 Checked Date: 10/12/25

Date: Operator:
 Datum: NZGD 2000

Geological Formation	DESCRIPTION	GRAPHIC	DEPTH	ELEVATION	TCR (%)	SPT N-VALUE (Uncorrected)	SPT DATA (Uncorrected)	INSTALLATION
Topsoil	Silty TOPSOIL, with minor sand; dark grey. Moist, non-plastic; sand, fine.							
	SILT, with minor sand; dark grey. Moist, non-plastic; sand, fine.							
	SAND; dark grey. Moist, sand, fine to medium.							
	Gravelly SAND; grey . Dry, sand, fine to coarse; gravel, fine, subangular.							
	Sandy GRAVEL; grey . Moist, gravel, fine to medium, subround; sand, fine to medium.							
	SILT, with minor sand; gark grey. Non-plastic; sand, fine.							

5.2m: With some gravel; brownish.
 Gravel, coarse.

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Weather: Fine
Borehole: BH-03
Type:

Date:
Operator:
Datum: NZGD 2000

Geological Formation	DESCRIPTION	GRAPHIC	DEPTH	ELEVATION	TCR (%)	SPT N-VALUE (Uncorrected)	SPT DATA (Uncorrected)	INSTALLATION
	[CONT] SILT, with minor sand; gark grey. Non-plastic; sand, fine.		6.0	6.0	25	10		
	Gravelly SILT; grey . Moist, non-plastic; gravel, fine to coarse, angular.		7.0	7.0	50	20		
	SAND; dark grey. Moist, sand, fine.		8.0	8.0	75	30		
			9.0	9.0		40		
	End of Borehole -Target Depth.		10.0	10.0				
	EOH: 10.00m							

Water Level Measurements

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Elevation datum and coordinates sourced from council GIS LiDAR contours.

Weather: Fine
Borehole: BH-04
Type:

Date:
Operator:
Datum: NZGD 2000

Geological Formation	DESCRIPTION	GRAPHIC	DEPTH	ELEVATION	TCR (%)	SPT N-VALUE (Uncorrected)	SPT DATA (Uncorrected)	INSTALLATION
Topsoil	Silty TOPSOIL, with minor sand; dark brown. Moist, non-plastic; sand, fine.				25 50 75	10 20 30 40		
	SILT, with minor sand; dark grey. Moist, non-plastic; sand, fine.		1.0	1.0				
	SAND; dark grey. Moist, sand, fine to coarse.		2.0	2.0				
	Gravelly SAND; grey. Moist, sand, fine to coarse; gravel, fine to medium, subangular to subround.		3.0	3.0				
			4.0	4.0				
			5.0	5.0				

Water Level Measurements

REMARKS
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Elevation datum and coordinates sourced from council GIS LiDAR contours.

MACHINE BOREHOLE LOG



Client: Gibbons Developments Ltd
 Site Address: Morven Ferry Road
 Town/City: Queenstown
 Job No.: 2555087

Weather: Fine
 Borehole: BH-04
 Type:

Latitude: Longitude:
 Logged By: TJ Checked By: OB
 Logged Date: 10/12/25 Checked Date: 10/12/25

Date:
 Operator:
 Datum: NZGD 2000

Geological Formation	DESCRIPTION	GRAPHIC	DEPTH	ELEVATION	TCR (%)	SPT N-VALUE (Uncorrected)	SPT DATA (Uncorrected)	INSTALLATION
	[CONT] Gravelly SAND; grey . Moist, sand, fine to coarse; gravel, fine to medium, subangular to subround.		6.0	6.0	25 50 75	10 20 30 40		
	Sandy gravelly SILT; light grey. Dry, non-plastic; sand, fine, gravel, fine to coarse, angular.		7.0	7.0				
	Sandy GRAVEL; dark grey. Moist, gravel, fine to coarse, subangular to subround; sand, fine to coarse.		8.0	8.0				
	Silty SAND, with minor gravel; dark grey. Moist, non-plastic, sand, fine; gravel, fine to medium.		9.0	9.0				
	End of Borehole - Target Depth.		10.0	10.0				
	EOH: 10.00m							

REMARKS
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 Elevation datum and coordinates sourced from council GIS LIDAR contours.

Water Level Measurements



Legend

Foliation

Joint Set 1

Joint Set 2

NOTES

Location of Features and Ground Investigation points are approximate only. 3D Aerial Image sourced from Google Earth, 2026. Measurements extracted from Clino app.

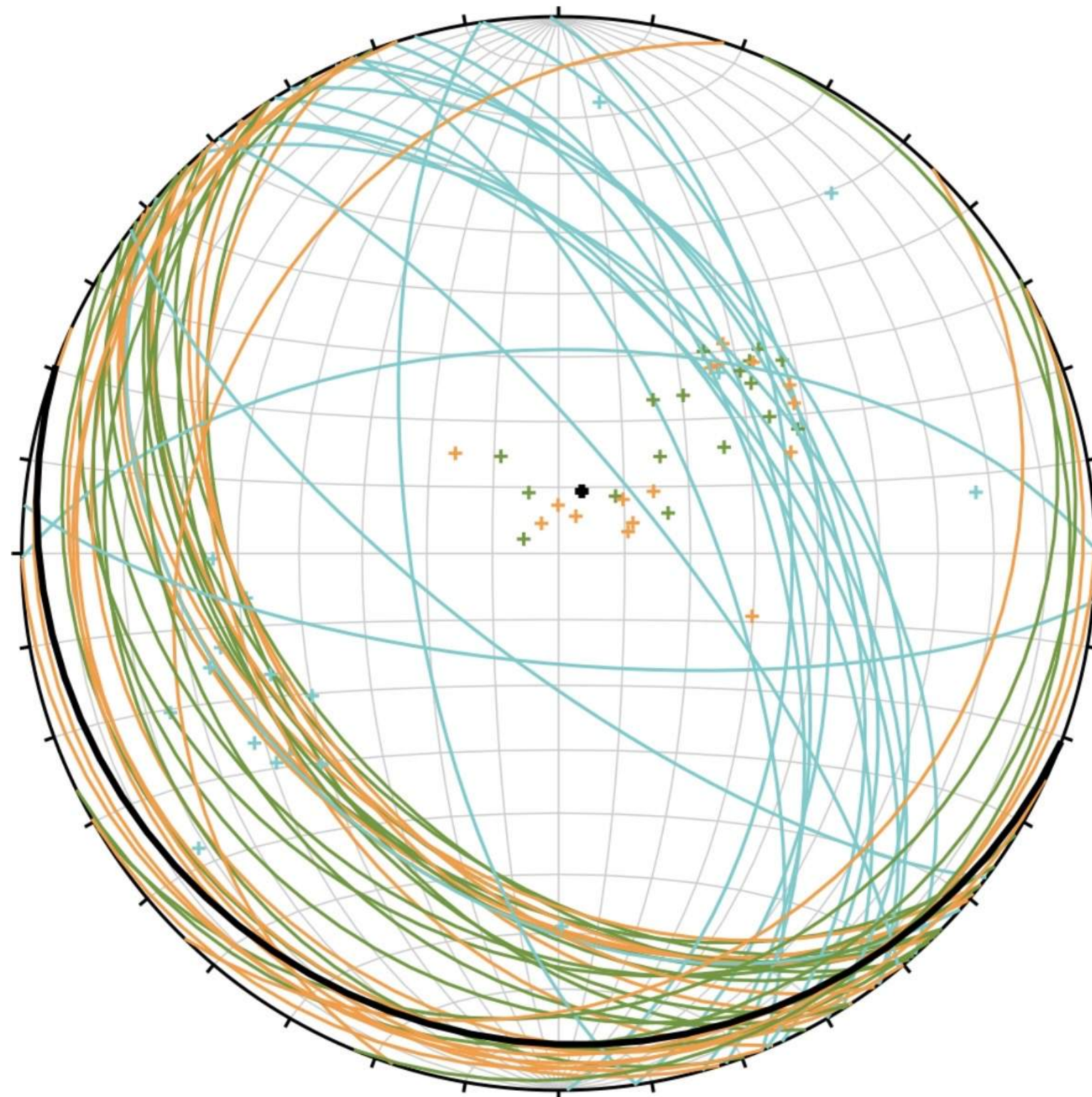
PROJECT: 2555087
CREATED BY: SSA
APPROVED BY: OB
DATE: December 2025

DWG NO: 001
REVISION: A
Scale: Not to Scale

122 Morven Ferry Road,
Arrow Junction

ROCK ANALYSIS LOCATION PLAN





MEAN: 10/201

Legend

- Foliation
- Joint Set 1
- Joint Set 2

NOTES

Location of Features and Ground Investigation points are approximate only. Stereonet extracted from Clino app.

PROJECT: 2555087
CREATED BY: SSA
APPROVED BY: OB
DATE: December 2025

DWG NO: 001
REVISION: A
Scale: Not to Scale

122 Morven Ferry Road,
Arrow Junction

STEREONET

