REPORT

Tonkin+Taylor

Geotechnical assessment report for

Proposed Maitahi Village Subdivision
Kaka Valley, Nelson

Prepared for
CCKV Maitai Dev Co Lp
Prepared by
Tonkin & Taylor Ltd
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Appendix F Slug Test and infiltration assessment results

Client summary

Tonkin & Taylor Ltd have undertaken this assessment under the terms and conditions of our Letter of Engagement with CCKV Maitai Dev Co Lp, dated 31 October 2019 and our approved Variation VO2 dated 20 April 2023.

This report has been prepared to support an application for resource consent for earthworks and subdivision development.

This geotechnical report provides comprehensive site investigations and assessments relating to a proposed earthworks and subdivision development at 7 Ralphine Way, Kākā Valley, Maitai, Nelson. The scope of the report covers geological, geomorphological, and geo-hydrological aspects of the site. It also presents an analysis of the inherent geotechnical risks and outlines recommendations for mitigating these risks.

The proposed subdivision involves the creation of 184 residential allotments (including one large lot for future development), one allotment for commercial use, along with roads to vest, reserve to vest, and also allotments to vest for utility / infrastructure purposes.

The geology of the site includes generally hard and strong bedrock of the Botanical Hill Formation, Grampian Formation, and Kākā Formation and weaker Wakapuaka Phyllonite. Within the Kākā Stream floodplain geologically young river alluvium and fan gravels overlie bedrock.

The data collected from site investigations such as geomorphological mapping, test pit excavations, drilled boreholes, and groundwater monitoring, contributes to the understanding of site conditions. Collectively, these informed the development of engineering geological models that show the inferred soil, rock and groundwater characteristics within each of seven sub areas.

Consideration is given to the nature of geotechnical hazards, their likelihood of occurrence, and their potential impacts. These include seismic shaking hazard, slope instability, and rock fall and erosion. Geotechnical hazard mitigation options are considered with a variety of measures identified, such as ground improvement works where weaker soil is excavated and replaced with engineered fill, slope instability mitigation using retaining walls, earth bunds and barriers and planting, and installation of rock bolts and mesh on high cut slopes in rock.

Detailed design of slope geotechnical hazard mitigation should be undertaken as part of the detailed design process. The design objective to reduce the potential risk to residential and commercial lots to a low level, normally considered acceptable for development, is feasible for the proposed development. These proposed mitigation strategies will significantly lower geotechnical risks after earthworks completion.

Drawing from all the detailed assessments and considerations, the report proposes a wide array of recommendations that can be incorporated into resource consent conditions for earthworks and subdivision. These include the need for experienced Geo-professional oversight throughout the design and construction stages of the project.

When considering Section 106 of the Resource Management Act and based on the investigations and the assessment of risks undertaken for this report, we consider that there will not be a significant risk of geotechnical hazards arising from or affecting the subdivision. This is provided that the recommended conditions that require geotechnical hazards to be mitigated through design and construction works as outlined in Section 7 of the report, are included as conditions of resource consents.

1 Introduction

1.1 General

This report presents Tonkin & Taylor Ltd's (T+T) opinion as to the suitability of land for earthworks and subdivision development at 7 Ralphine Way in Kākā Valley, Maitai, Nelson. T+T have undertaken investigations of an area referred to as the "Site" which is shown in Figure 1.1 that encompasses, and extends beyond, the area of approximately 66 ha where approximately 600,000 m^3 of earthworks is proposed to create 184 residential allotments (including one large lot for future development), one allotment for commercial use, along with roads to vest, reserve to vest, and also allotments to vest for utility / infrastructure purposes. The balance land (zoned rural) containing Kākā Hill will remain in one large title at the end of the subdivision and development process.

Tonkin & Taylor Ltd (T+T) was engaged by CCKV Maitai Dev Co Lp (CCKV) to undertake geotechnical site investigations and to provide a geotechnical assessment for the earthworks and proposed subdivision development. The investigations were undertaken to ascertain ground conditions and identify any geotechnical development constraints for the site.

We have undertaken this assessment under the terms and conditions of our Letter of Engagement with CCKV Maitai Dev Co Lp, dated 31 October 2019 and our approved Variation VO2 dated 20 April 2023.

This report has been written for CCKV Matai Dev Co Lp to be supplied with their applications for subdivision and application for earthworks resource consents to The Environmental Protection Agency's (EPA) panel consideration under the Fast-Track Approvals Act 2024.

The site is located along the floor of Kākā Valley and on the adjacent hill slopes to the west and east.

Our investigations have identified areas of the proposed subdivision which are generally suitable for residential and commercial development. However, there are areas where slope instability risk will require slope stability mitigation work to provide access and to make the proposed lots suitable for development. We consider that it is feasible to undertake works to create a subdivision.

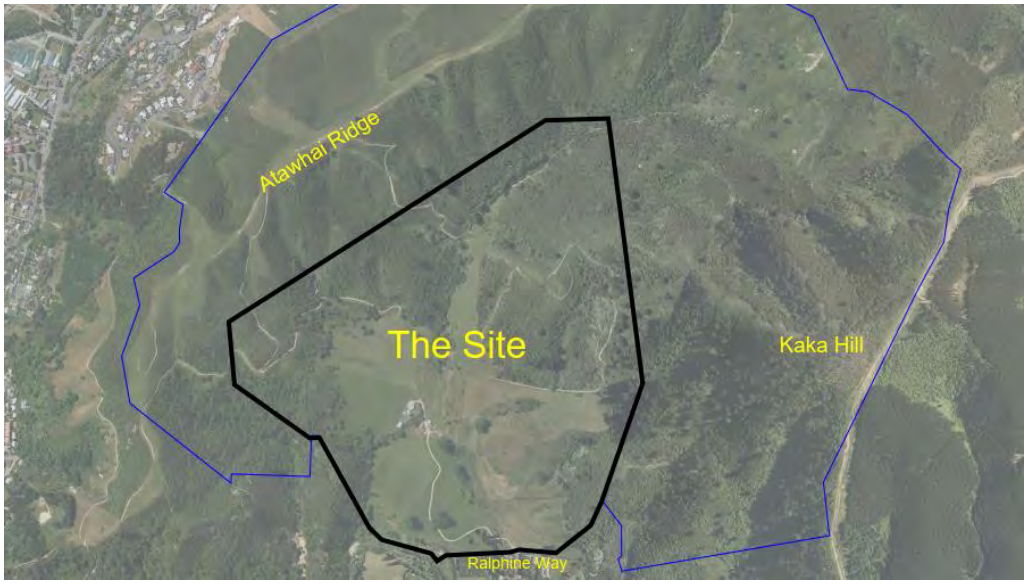


Figure 1.1: Investigation area

1.2 Report structure

This report is set out in sections to describe the geological geomorphological and geo-hydrological aspects of the Site to assist the Environmental Protection Agency's (EPA) panel consideration of the suitability of the land for earthworks and subdivision.

Section 1 provides an introduction and background to the current earthworks and subdivision proposal.

Section 2 describes the physical setting of the land within the Site and introduces seven sub areas within the Site where geology and geomorphology are generally distinct.

Section 3 outlines the proposed earthworks and subdivision to create residential the residential and commercial lots, road formations and other subdivision infrastructure.

Section 4 describes the bedrock geology of the Site, the investigations that have been carried out for the proposed development, the range of bedrock and soil materials encountered in investigations, and the groundwater and geomorphological (including slope instability) aspects of the Site that are relevant in considering the feasibility of the proposed earthworks and residential and commercial lots.

In Section 5 the investigation data is interpreted. The subsurface conditions are interpolated from the fixed investigation and observation locations to develop an engineering geology model. This model is shown in plans and cross sections and is described in the text. Geotechnical hazards that should be considered as part of the proposed development are outlined in this section.

In Section 6 consideration is given the geotechnical risks that exists within the Site. This is relevant to consideration of the proposed development with regard to Section 106 of the Resource Management Act (1991). The existing (hypothetical) geotechnical risk is first considered in its pre-existing state without modifications to the landform by the proposed earthworks. Earthworks design considerations to avoid, remedy and/or mitigate risk are outlined and a further geotechnical risk assessment is made based on the earthworks being completed and incorporating the recommended geotechnical hazard risk mitigation works.

Section 7 provides our opinion as to whether the proposed residential lots will satisfy the Section 106 criteria with respect to the risk posed by geotechnical natural hazards and makes recommendations for conditions to be applied to the earthworks and subdivision consents to avoid remedy and/or mitigate significant risk from geotechnical natural Hazards.

1.3 Background

T+T have previously provided a geotechnical 'Geology and Geotechnical Hazards 'report (T+T ref: 1012397.v3) for the subdivision area dated March 2021. That report was prepared to support the application for the proposed Private Plan Change Request for the Maitahi and Bayview land associated with or bordering the current proposed residential/commercial development. That proposed plan change (PPC28) is now operative and includes Schedule X 'Maitahi Bayview Structure Plan.

The report concluded that the area covered by Schedule X, without landform modification comprises specific areas of low, moderate and high geotechnical risk. Areas of low risk were assessed as suitable for residential development, areas of moderate risk were considered suitable for development following mitigation via geotechnical input during subdivision design.

The areas previously assessed as having high geotechnical risk were identified to have potential geotechnical constraints to development that may or may not be feasible to mitigate for residential development.

Further investigations have been undertaken in 2022 and 2023 as part of the assessment document in this report which have enabled the risk zonation plan to be updated and for feasible measures to be identified to avoid remedy or mitigate significant risk.

2 Site description

2.1.1 Location

The proposed Site is located in Kākā Valley which forms a tributary of the Maitai/Maitahi River, located on the northern side of the Maitai/Maitahi River 2.3 km east of the centre of Nelson. It is accessed via Maitai Valley Road and Ralphine Way (T+T Figures 1012397.1000-GT-F01 and -F02 Appendix A). Geographical features described in this report are labelled on these figures.

The Site comprises a land area of approximately 66 ha and is currently used as pastoral farmland. There is an existing residential homestead and various farm storage sheds near the centre of the Site on the true right of the valley.

2.1.2 Sub-area designation

To assist in describing the variations in geology and geomorphology within the proposed earthworks and subdivision development area we have subdivided the Site into seven areas as set out below and shown on T+T Figure 1012397.1000-GT-F03 in Appendix A:

- **Area 1 – Kākā Lower Reach**
- **Area 2 – Eastern slopes**
- **Area 3 – Eastern debris fan**
- **Area 4 – Kākā Middle Reach**
- **Area 5 – Lower West Valley fan and terrace**
- **Area 6 – West Valley slopes**
- **Area 7 – Kākā Upper Reach**

This report addresses geotechnical aspects of the proposed development. Surface water, drainage and flooding are covered the stormwater report (T+T ref:1012397.1000 titled Stormwater Assessment Report dated February 2025).

2.1.3 Topography

2.1.3.1 Area 1 – Kākā Lower Reach

This area comprises the lower reach of Kākā Stream, which discharges to the Maitai/Maitahi River at the south-western corner of a very gently south-west sloping flood plain at a low elevation above the northern bank of the Maitai/Maitahi River channel. The lower valley floor is very gently sloping to the south-west and is bounded to the north-east and north-west by moderately inclined slopes that rise to elevates terraces.

2.1.3.2 Area 2 – Eastern slopes

This area comprises two moderately inclined westerly plunging ridges separated by a gully with moderately inclined side slopes. Land becomes steeply inclined upslope of the eastern property boundary above approximate RL 250 m towards the main ridge line and Kākā Hill.

2.1.3.3 Area 3 – Eastern debris fan

This area comprises an ancient debris fan and narrow gully source area (Gully 16) extending upslope to approximately RL 380 m. The downslope, western portion, of the fan and the fan lateral slopes above Gullies 14 and 17 are moderately inclined. The broad crest of the fan is gently inclined below RL 60 m and becomes progressively steeper upslope, to the east of this contour. The slope is steep to very steep upslope of RL 120 m and within Gully 16.

2.1.3.4 Area 4 – Kākā Middle Reach

This area includes elevated terraces and Kākā Stream low level terraces adjacent to the Kākā Stream channel. The area extends upstream (north) from the Eastern Debris Fan to the northern extent of the proposed residential lots on the upper terrace (TTL1) and on the eastern side (true left) of Kākā Stream. It comprises moderately to steeply inclined slopes that are generally south-west to north-west facing that flank the gently to moderately inclined terrace surface. Steeply west to south-west plunging shallow gullies drain the slope to the east of the Area.

2.1.3.5 Area 5 – Lower West Valley fan and terrace

This area comprises a gently sloping south-east facing fan surfaces at the toe of the western slope that progrades onto an alluvial terrace TTR2, elevated above the western side of Kākā Stream. The existing farm dwelling is located on this terrace.

2.1.3.6 Area 6 – West Valley slopes

This area comprises moderate to steeply inclined south to south-east to north-east facing slopes and numerous spurs and erosion gullies that lie to the north and west of Area 5. The northern and north-west part end of the slope above terrace TTR2 is moderately inclined (14°) up to a Farm Track that climbs through the Site and up to the Atawhai Hills Ridge. Upslope of the Farm Track the slope steepens and varies from moderately steep to steep. The south-western portion of Area 6 rises steeply up from the Area 5 Terrace surface. The slopes are dissected by a dendritic pattern of shallow gullies.

2.1.3.7 Area 7 – Kākā Upper Reach

Area 7 includes land to the east of the Kākā Stream. It comprises a gently sloping terrace and the toe of the moderately to steeply inclined hillslope that rises to the east. The terrace slope is covered by several moderately inclined fan deposits that prograde beyond incipient gullies which drain the eastern slopes. The largest fan is located near the northern end of the upper reach and is downslope of a large and deep gully, Gully 9, that drains a portion of the slopes below the south-west ridge of Kākā Peak.

3 Proposed development

The Maitahi Village (Project) is a fully integrated and comprehensive subdivision and development that will provide for a range of housing needs, within an enhanced cultural, ecological, landscape and recreational setting in close proximity to Nelson City.

This project has been planned and seeks to achieve the objectives and outcomes that were carefully planned within Schedule X of the Nelson Resource Management Plan (NRMP), in accordance with the *Maitahi Bayview Structure Plan.* These bespoke provisions were part of Plan Change 28, recommended for approval by an Independent Hearing Panel, adopted by Council in September 2022, and then approved by the Environment Court in November 2024.

The Project includes the following components:

1 The proposed subdivision involves the creation of 184 residential allotments (including one large lot for future development), one allotment for commercial use, along with roads to vest, reserve to vest, and also allotments to vest for utility / infrastructure purposes. The balance land (zoned rural) containing Kākā Hill will remain in one large title at the end of the subdivision and development process.

2 Two of the residential allotments to be created are to be sold to Arvida for the development of a retirement village containing 192 residential units, a care facility containing 36 beds, and the full range of communal facilities such as a Residents Clubhouse and Pavillion.

3 Development of the commercial site for the cultural base for Ngati Koata (Te Whare or Koata), containing offices, meeting rooms, function and event spaces, and a commercial kitchen.

There are a total of 11 subdivision stages (Stages 1-11), with one additional stage (Stage 0) proposed as a part of undertaking an initial boundary adjustment between the applicant's title (NL11A/1012) and that adjoining title owned by Bayview Nelson Limited (RT 1039028). The planned ecological, cultural and recreational outcomes will be developed progressively at each stage. A comprehensive description of these fully integrated components of the development are provided in the Application and supporting technical reports and plans.

3.1 Proposed earthworks

The extent and scale of the proposed earthworks are shown Davis Ogilvie and Partners (DOP) drawings in Appendix B. Drawing 39470 Sheet C001 Rev. P5 titled 'Engineering Design Overall Plan' and dated 01/24 and issued 04/02/25 shows the extent of cut and fill and the proposed lots.

Earthworks will be required for the construction of the access road extension of Ralphine Way, the creation of subdivision roading and other infrastructure, the realignment of Kākā Stream, creation of flood mitigation and stormwater treatment infrastructure, creation of a temporary reservoir site, creation of building platforms, creation of construction stage erosion and sediment control works and construction stage access, including haul roads and for slope instability mitigation works.

It is intended that there will be a balance of cut and fill earthworks, with all excavated rock and soil being retained on site and used beneficially for roading, three waters infrastructure, flood mitigation works and the creation of allotments. Fill not required for the lots to be created as part of this subdivision will be placed under engineering management and control to form a stable landform within Area 7 to allow for potential future residential lots or other land use. The fill in Area 7 has been designed to accommodate a maximum potential volume in a stable landform that is greater than the resource consent volume estimates indicate is required. This allows for a contingency in the fill storage. If the contingency storage is not required the finished levels may be lower than indicated on the drawings.

DOP drawing titled Preliminary Earthworks, Overall Earthworks Plan - Volumes'(ref: C100 Rev P8 dated 01/24) included in Appendix B shows a phasing plan and provides cut and fill volumes for each phase of works. Four earthworks phases and a future road phase are shown on the drawings as set out below:

- Phase 1A and 1C works comprise the eastern slope and the Arvida development while Phase 1B comprises the lower reach Kākā Stream realignment and bridge.
- Phase 2 comprises the Lower West Valley fan and terrace area.
- Phase 3A and 3B comprise the Western slope area.
- Phase 4 is works to form the Middle Kākā Reach area.
- The Upper Reach Valley Fill areas are intended to support excess fill material from Phases 1 to 3 to allow for future residential development and the upstream valley fill is a contingency area for fill disposal and have provision for disposal of low level contaminated soils if required within a specially designed containment cell.
- The Future Road works extends from the western end of Phase 3A up to the Atawhai Ridge.

It is envisaged that earthworks Phases 1 to 4 will be undertaken in conjunction with subdivision Stages 1 and 2. DOP preliminary estimate of cut and fill quantities for bulk earthworks as set out in **Error! Reference source not found.** below. Based on our experience in earthworks we consider that these estimated could vary by -10% to +20% and not that the contingency volume will be largely be taken up through bulking (increasing in volume) of cut volumes via the excavation process.

Table 3.1: DOP preliminary estimates of cut and fill

Phase	Cut (m^3)	Fill (m^3)	Cut/fill balance (m^3)	Comment
Phase 1	371,870	267,180	104,690	Surplus to Valley fill Area. Balance 87,580 $m^3$to Phase 4.
Phase 2	72,770	25,480	47,290	Surplus to Valley fill Area
Phase 3	155,150	92,020	63,130	Surplus to Valley Fill Area
Phase 4	420	88,000	- 87,580	Deficit to come from Phase 1.
Valley Fill* Area	1,320	142,240	-140,920	Will have additional 1,4710 m^3 minimum reserve capacity.
Valley Fill Contingency Area	0	49,440	-49440	Surplus Fill volumes will include some fill not suitable for use as certified fill.
Column Totals	**601,530**	**664,360**	**62,830**	Balance does not allow for bulking of cut material

*Maximum design volume for Valley Fill Area, stockpile capacity assumes cut will be cut to a surplus fill stockpile.

The surplus fill from Phases 1 to 3 excavations will be placed as controlled engineered fill in the 'Upper Reach Valley Fill Areas' with provision made for a separate stockpile for topsoil and any fill material that is unsuitable to place as engineered fill for later respreading as landscape fill.

The provided estimates indicate that up to 62,830 m^3 of additional capacity. This is likely to be taken up by the increase in soil volume placed as fill due to bulking of cut material. If the contingency storage is not required the finished levels may be lower than indicated on the drawings.

The values provided above are an estimate. As detailed design progresses a more accurate cut and fill volume estimate will be developed with an aim to minimise cuts where access grades permit and by beneficial use of remaining surplus fill for landscape enhancement and stability mitigation.

4 Description an assessment of Site conditions

4.1 Geology and faulting

The New Zealand Geological survey, Dun Mountain 1:50,000 scale geology map[1] shows five basement rock types ***Botanical Hill Formation, Wakapuaka Phyllonite, Grampian Formation and Kākā Formation*** predominate within the Site, Figure 4.1. Apart from the Wakapuaka Phyllonite, these basement rocks are principally strong to very strong breccia, tuff and tuffaceous sandstone. Kākā Formation is noticeably stronger than other rocks. The Wakapuaka Phyllonite varies from a strong to weak rock and has led to more subdued topography and more evidence of ancient slope instability than other mapped basement rocks.

In addition to basement bedrock, geologically young river alluvium and fan gravels are mapped within the lower, mid and upper reaches of the Kākā Valley.

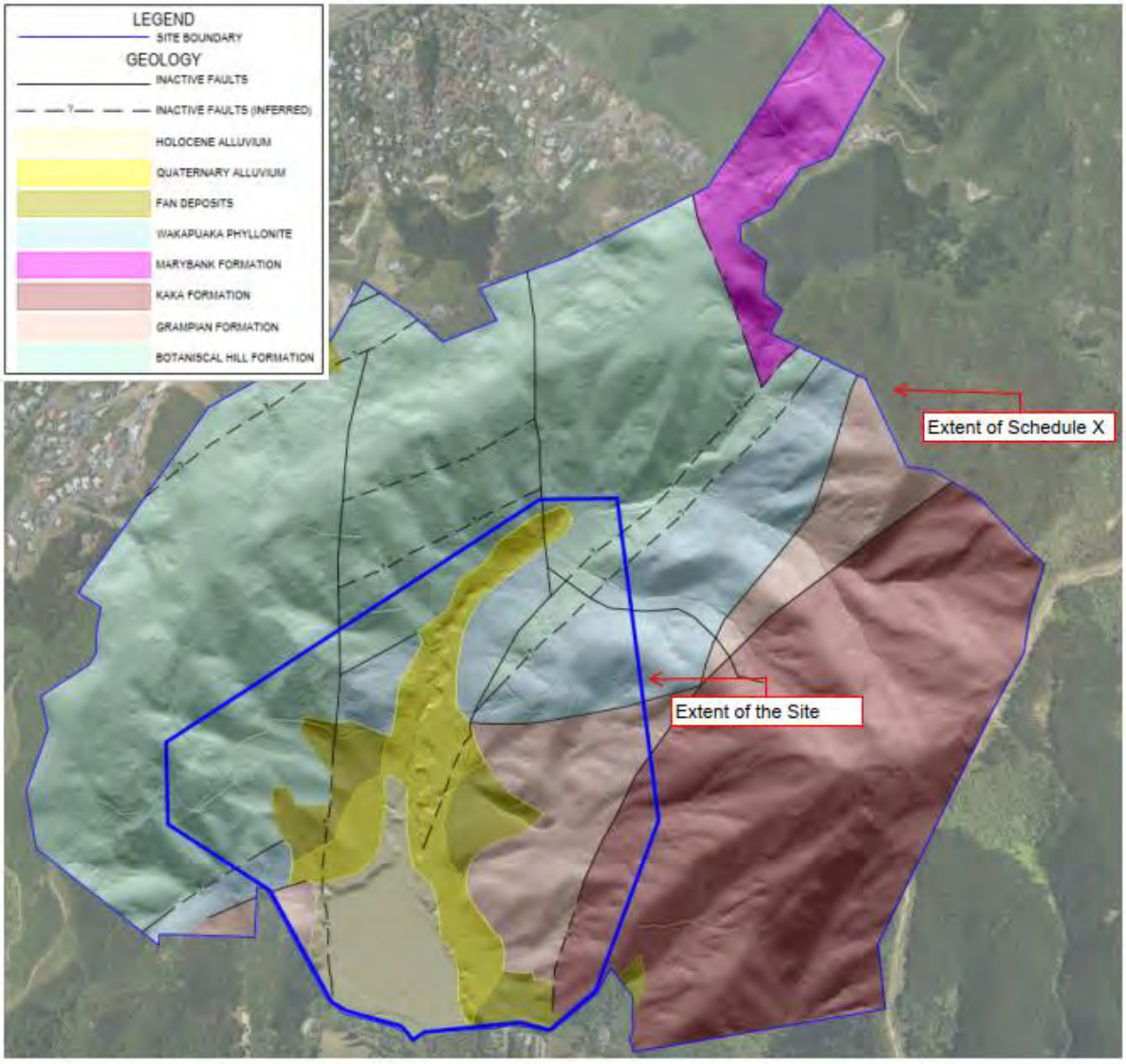


Figure 4.1: Geology of the Site (sourced from Johnston, M.R. 1981[2])

[1] Johnston, M.R. 1981 Geological Map of New Zealand 1:50,000 Sheet 027 AS Dun Mountain. Lower Hutt: New Zealand Geological Survey.

We have also reviewed the more recent 2021 'Revised Geological Map of the Nelson-Richmond Urban Area[2]. This map does not show the individual unit formations of the Drumduan and Brook Street Terranes but shows a similar distribution for the bedrock geology and younger alluvium and fan deposits that is shown in Figure 4.1 above.

There is exposure of weathered bedrock in many farm track excavations on the Site. These outcrop locations are shown on T+T Figure 1012379.1000-GT-F03 and further description of the main exposures is given is Section 4.1.2. Based on our review of published maps and inspections of outcrops we comment on the bedrock geology as follows

- The rock observed in cut batter and in outcrop around the site area comprises moderately to highly weathered, weak to moderately strong rock, it is blocky, with closely to moderately spaced joint sets. The highly and highly to moderately weathered and closely jointed rock displayed a susceptibility to small, localised ravelling type instability.
- Surface soil deposits, consisting of colluvium, alluvium, fan deposits and residual soil, overlie bedrock. They are products of bedrock weathering, erosion and shallow mass movement formed predominantly during the Pleistocene epoch.
- The active Flaxmore Fault is part of the Waimea Flaxmore Fault system is mapped approximately 670 m to the north-west, beyond the northern most part of the Site.
- The active Waimea Fault is mapped approximately 2.3 kilometres to the south-east of the Site and east of Ralphine Way.
- The Waimea/Flaxmore Fault system has been assigned a return period by others of about 6,000 years[3].
- The inactive Delaware Fault runs south-west to north-east through the property, the trace of the fault defines the contact between Botanical Hill Formation, Wakapuaka Phyllonite and Grampian Formation.

4.1.1 Geotechnical investigations

Site investigations have been ongoing since 2019 and involved programmes of:

- Geomorphological mapping
- 66 test pit excavations
- 14 drilled boreholes
- Logging of outcrop in track cuts
- Ground water monitoring via 14 piezometers and four standpipes

Copies of our investigation logs are presented in Appendix C. The locations of our subsurface investigations are shown on T+T Figures 1012397.1000-GT-F01 and F02 (Appendix A).

Between 2019 and 2023 investigations identified areas of stable land where bedrock was identified at or very near to ground surface level, some localised evidence of past (geological age and minor areas of recent (historical) shallow slope instability, ancient debris fans, areas of deep alluvium and the presence of shallow groundwater within the lower elevations of the Site. These geotechnical aspects are discussed below.

[2] Johnston M.R, Ghisetti f., Wopereis P. (2021) Revised Geological Map of the Nelson- Richmond Urban Area, V3
[3] Johnston & Nicol, GNS Consultancy Report 2013/186.

4.1.2 Subsurface conditions

Figure 4.1 shows the distribution of geological bedrock formations based on published geological maps. and are described below along with our assessment of the rock based on our subsurface investigations.

4.1.2.1 Existing track cuts and rock outcrop

A network of farm tracks and a pylon maintenance track have been established across the site area in the past and expose soil and rock. Rock outcrop was also observed in the mid and upstream reaches of Kākā Stream and in Gullies 6, 14, 15, 16 and 17.

The locations of rock exposure in tracks are shown on T+T Figure 1012397.1000-GT-F03 and rock and soil exposure observations are summarised below.

Grampian Formation

Grampian Formation (GF) of the Brook Street Volcanics Group (BVG) is Permian in age (oldest deposits encountered). This formation presented as predominantly highly to moderately weathered weak to moderately strong siltstone / sandstone units (track cuts and outcrop on mid to upper Eastern Slopes) and locally as a highly weathered extremely weak, volcanoclastic breccia (BH1/2023 to BH3/2023) on the south side of the Debris Fan and on the mid to lower part of the Eastern Slope. The Pylon Track upslope of the East Fan revealed very weak highly weathered and moderately strong to strong moderately weathered Grampian Formation siltstone and fine sandstone rock, typically < 1.0 m of colluvium and residual soil overlies the bedrock along the length of the track, except in the vicinity of the Gully 16 mouth immediately upslope of the fan where a debris flow deposit up to 2.0 m high is exposed and bedrock is not visible.

Wakapuaka Phyllonite

The Wakapuaka Phyllonite member of the Brook Street Volcanics Group is mapped to be present at shallow depth underlying the saddle between the Southern Spur (labelled on T+T Figure 1012397.1001-GT-F02) and Area 3 West valley slopes, and also forms the Northern Knoll (labelled on T+T Figure 1012397.1001-GT-F01). Wakapuaka Phyllonite is a fault sheared Late Cretaceous age unit that separates older Grampian Formation rock from younger Botanical Hill Formation rock. TP17 was excavated on the knoll, the results of the excavation were inconclusive, with material presenting as a highly weathered, angular silty-Gravel with minor clay.

Rock exposure in the track cut up towards and within Gully 6 revealed highly weathered to moderately weathered Wakapuaka Phyllonite. The Phyllonite presented as either weak steeply dipping siltstone and breccia in the road cut or as metamorphosed foliated moderately strong siltstone. Exposure in the bed of Gully 6 revealed metamorphosed phyllonite rock displaying localised areas of mineral layer separation and incipient foliation.

The rock mass is typically slightly to moderately weathered, and moderately strong to strong. Where incipient foliation was present the rock displays a higher grade of weathering and anisotropic strength characteristics.

Observation of a Farm Track cut batter on the western side of Kākā Hill exposed a volcaniclastic breccia in the cut. A 1987 journal paper by Johnston, Raine and Watters [4], describes the Wakapuaka Phyllonite in this area as comprising red schistose rock. This description is similar to the descriptions we have provided in test pits TP23-22 and TP24-22. Rock exposure in the Kākā Stream exposes Botanical Hill Formation siltstone dipping steeply towards the south-east (*Photograph 4.1*). Based on

[4] Journal of the Royal Society of New Zealand, Volume 17, Number3, 1987, pp 275 – 301. 'Drumduan Group of East Nelson, New Zealand: plant bearing Jurassic arc rocks metamorphosised during terrane interaction (Johnston M.R, Raine J.I. and Watters W. A.)

our site observations the Wakapuaka Phylonite/ Botanical Hill Formation contact passes between the track cut and the stream bed in Gully 14.

Photograph 4.1: Botanical Hill Formation siltstone in the stream downslope of the western slopes of Kākā Hill, in Gully 14.

Botanical Hill Formation

The Botanical Hill Formation (BHF) of the Drumduan Group is of Jurassic Age and is present on the Southern Spur, on the alluvial terrace (TTR1) on the Western slope above the existing farm dwelling and in the stream within Gully 6 downslope of the western slopes of Kākā Hill (*Photograph 4.1*). This unit comprised poorly bedded sequences of volcanoclastic breccia and was identified in Outcrop in recent shallow headscarps on the southeast side of the Debris Fan and in Borehole BH 4/2023. Exposure in the Farm Track above Gully 6 revealed moderately strong to strong Botanical Hill Formation rock.

Kaka Formation

Kaka Formation underlies the extern extent of the site, upslope of where development is proposed and underlies Kaka Hill. The formation consists of breccia and altered tuff and varies from highly weathered strong rock to very strong slightly weathered rock. No investigations within the Site encountered Kaka Formation bedrock although boulders locally exposed on the Fan surface in Area 3, and in test pits into the fan encountered Kaka Formation derived cobbles and boulders.

Quaternary Alluvium

Quaternary alluvium deposits are present along the length of Kākā Stream, within its major tributaries and have also been identified in test pit and drillhole excavations on the alluvial terraces above the present-day valley floor. The alluvium typically presents as alternating layers of coarse rounded – subrounded sandy-Gravel with cobbles and fine to medium sandy-Gravel or

gravelly-Sand. Sub-rounded to sub-angular boulders are present in the stream bed above the northern end of the site area.

In addition to the mapped geology we have identified the following soils that overly bedrock and alluvium.

Fan deposits

A large and geologically old debris fan has been identified within Area 3. The location of the fan is shown on T+T Figure 10012397.1000-GT-F03. Other younger fan deposits are also evident, typically downslope of gullies.

The East Fan deposit in Area 3 is comprised of predominantly loose to moderately well packed angular silty-Gravel or gravelly-Silt, and layers of soft to firm Clayey-Silt. The fan deposits are layered, slope parallel and where large cobbles, and boulders.

Test pits indicate that fan deposits across the Site are generally up to at least 3.0 m thick. However, we note that where the test pit logs show 'terminated on rock'. It is possible that this may have been a large boulder (e.g. TP35-23 and TP36-23). In BH03, progressively below 6.4 m depth, the core becomes more competent and displays rock structure and is highly weathered, we consider this to be the top of insitu rock. Above 6.4 m the core is more disturbed and has lengths of soft soil between intact rock lengths that we interpret as debris flow material. We note that rock is exposed in the stream channel on the northern margin of the fan and in the head of the erosion Gully on the southern side of the fan, the exposures of the rock head indicate a possible depth of up to 7 m depth.

Shallow landslide, and colluvium

The steeply sloping ground on the valley side slopes including within erosion gullies and ephemeral water courses is mantled with colluvium, derived from slope erosion and mass movement processes that have occurred from time to time over tens to hundreds of thousands of years as the slope profiles have evolved. Areas of shallow landslide deposits are shown on T+T Figure 1012397.1000–GT-F03. These areas include pre-historic and/or geological age earthflow deposits that are generally less than 4.0 m thick as encountered in test pits TP19 and TP21 located in hummocky ground below the Gullies 6 and 7, and also recent shallow translational earth slides and debris/ earth flows (generally less than 1.2 m thick) that on developed on steeper (> 30°) portions of hill slopes during the August 2022 rainstorm event (e.g. as visible in aerial photographs taken in September 2022).

Residual Soils

Residual soils are those derived from in-situ weathering of underlying bedrock. They are encountered primarily along the prominent spurs and ridgelines of the Western and Eastern Slopes. These deposits range from less than 0.5 m to 2.0 m thick and are typically less than 1.0 m thick.

4.2 Geomorphology

The general geomorphology of the site, based on observations made on our site walkovers, and inspection of aerial photography and LiDAR Digital Elevation Models (DEM), is described in Section 4.2.1.

Key geomorphological features within specific sub-areas are described in Section 4.2.2.

4.2.1 General Slope morphology

The natural undisturbed landforms (excluding areas affected by track cuts, etc.) within the Site, where development is mainly proposed have a rounded profile as distinct to the sharper edged

ridges evident at higher elevations. There is no evidence that there have been significant changes to the Site geomorphology over periods of many tens of thousands of years other that localised shallow slope instability.

The track cut batters have typically been cut with a face angle between 50° and 90°. In general, existing track cuts in rock have only experienced minor fretting. Where localised batter failures have occurred, this has been mostly in areas containing thicker colluvium and residual soil profiles or in very weak highly to completely weathered rock such as occurred during the August 2022 rainstorm event.

4.2.1.1 Boulders and scree

Many small boulders and some large boulders were observed on the slope near to the toe of the moderate to gently inclined slopes on the east and west side of the valley and at various locations on the steeper slopes above, within and beyond the Site. T+T Figure 1012397.1000-GT-F03 shows the main areas of boulder accumulation.

4.2.1.1.1 Boulders on Eastern Slope

Boulders varied in size from 0.4 m (mean diameter) up to 1.2 m (intermediate axis) (*Photograph 4.2*) and are estimated range of mass approximately 200 kg and 2,600 kg per boulder. Boulders coalesced along the Farm Track at the northern side of the Debris Fan within Gully 14 appear to have been side cast as part of track development.

Photograph 4.2: Example of a large boulder on the slope

Other boulders appear to be rock roll from natural processes. The largest boulders seen were upslope of the mid-level power line track on the Eastern Slope, these boulders had come to rest in an area of natural slope break within the gully.

Where Gully 16 steepens (approximately 250 m upstream of the pylon track), fewer boulders were observed to be visible on the slope surface most were partially buried within the hummocky surface topography of the gully floor (*Photograph 4.3*).

Photograph 4.3: Example of boulder encased in hummocky debris

Upslope of the scarp area and below the Kākā Hill ridge the slope surface was covered in cobble sized scree deposits (*Photograph 4.4*).

Photograph 4.4: Scree slope below the Kākā Hill ridge

4.2.1.1.2 Boulders on Western Slope

Cobbles and boulders that varied in size from 0.3 m up to 0.6 m wide along the intermediate axis (*Photograph 4.5*) and boulder mass is estimated to vary between approximately 50 kg and 450 kg. Boulders are present in two primary locations on the western slope, these are:

- Along the outlet channels downslope of mouth of Gullies 5 and 6 on the downslope side of the Farm Track (T+T Figure 1012397.1000-GT-F03). The source of these boulders appears to be either landslide or flood debris derived from the two gullies which culminate in this general location. As the boulders are primarily located downslope of the track it is also possible that some of these boulders may be the result of side cast fill generated as part of track development.

Photograph 4.5: Example of one of the larger boulders in the runout zone of Gullies 5 and 6

- A boulder garden concentration of the true left of Gully 5 and directly upslope of the track (*Photograph 4.6* below).

Photograph 4.6: Boulder Garden on true right of Gully 5

We note that the run-out zone for these gullies contained predominantly cobble sized clasts with occasional boulders.

4.2.1.2 Slope instability features

4.2.1.2.1 Geomorphic indicators of past slope instability

The site geomorphology provides evidence that historic slope instability has occurred at locations within the Site. The slope instability indicators typically comprise:

- Ancient scarp features forming the where very steep slopes existing at the upslope end of the main erosion gullies.
- Arcuate depressions on the hillslopes outside of the main gullies.
- Hummocky ground associated with the above gully features.
- The East Fan deposit.
- Boulder fields associated with the East Fan; and
- Boulder fields associated with Gullies 5 and 6.

These features are readily identified in the LiDAR DEM and aerial photographs and confirmed by walkover survey. The specific locations of areas where there is evidence of slope instability are shown on T+T Figure 10012397.1000-GT-F03.

4.2.1.2.2 2022 Rainstorm instability

An extreme rainfall event occurred over three days from midday Wednesday 17 August 2022 to early morning Saturday 20 August 2022 when 245.5 mm of rain was recorded at the nearby Nelson City Council rain gauge at Founders Park. Based on NIWA, HIRDs website this is equivalent to a rainfall event with an annual recurrence interval in excess of 250 years. This rainfall event culminated a three month very wet period when three times the average rainfall was recorded in Nelson.

The location of these recent landslides are shown on T+T Figure 10012397.1000-GT-F03. These landslides were shallow regolith failures that typically occurred within the upper 1.4 m of the soil profile. No deep seated or large volume landslides were initiated by the August 2022 rainstorm event within or adjacent to the Site.

Thirty-eight shallow landslides have been identified within the proposed area to be developed. At least eight of these occurred on land that had been modified by unengineered works (such as track cutting) associated with past farming activities. Observed damage affected approximately 1% of the proposed area to be developed and 80% of that damage was limited to the deposition of < 0.3 m of fluidised debris on existing ground.

4.2.2 Geomorphological characteristics of sub areas within the Site

Specific geomorphology and engineering geological characteristics of the seven areas identified in Section 2.1.2 are described below. The extent of the Areas 1 to 7 are shown on T+T Figure 1012397.1000-GT-F01 and Figure 1012397.1000-GT-F02. Geomorphic and Engineering geology features are shown on T+T Figure 1012397.1000-GT-F03.

4.2.2.1 Area 1 - Kākā Lower Reach

The Kākā Stream flows north – south through the area and has a narrow well-defined channel and has steeply incised banks. Downstream of the farm dwelling the stream turns to flow towards the east before swinging towards the toe of the western slope. This alignment appears to be man-made

and there is evidence of the overbank deposits from periods when the stream has broken out of the formed channel (including recent sand and gravels deposited during the rainfall event in August 2022.

The lower reach is characterised by a broad very gently inclined, aggradation surface and by almost flat ground near to Maitai/Maitahi River. When inspected in Summer months there was no surface flow in the Kākā Stream within the lower reach.

The broad valley floor has been formed by downcutting Alluvial terraces, that are now preserved in Areas 3 and 5 to the east and west of both sides of the valley floor (*Photograph 4.7*) and periodic infilling by flood derived sediment from the Maitai/Maitahi River and Kākā Stream over the last 1,000 to 20,000 years. The terraces occur at two elevations and are thought to have been formed by aggradation processes within the last 150,000 years when the climate was significantly different to that which exists today.

Photograph 4.7: View West to East Example of remnant stream terraces near the toe of the Debris Fan (Area 3) and below the Western Slopes in Area 5.

4.2.2.2 Area 2 – Eastern slopes

This area contains the west facing slopes at the south end of the Site. The gentle inclined slope below approximately RL 30 m is an alluvial terrace. Fan and colluvium apron deposits partly blanket the terrace. Moderately to steep slopes that rise above the terrace are rounded in form and show only rare evidence of past slope instability. Track excavations and test pits indicate a residual soil profile is generally preserved. Three areas of ancient and recent slope instability are indicated on T+T Figure 1012397.1000-GT-F03. One small shallow earth slide is located in an area the lots are

proposed. These are shallow soil/debris slides/flows originating on steep slopes to the east of the proposed residential lots. Thin deposits of soil derived from the shallow landslides are present in places where residential lots are proposed.

4.2.2.3 Area 3 – Eastern debris fan

This area contains an ancient debris fan that has been formed from a series of debris flows originating from the very steep slopes immediately below the summit of Kākā Hill located to the East of the Site and debris flows originating within Gully 16. Many small and large boulders that are partially embedded in soil are present on the downslope part of the fan.

The fan is characterised by a deep soil weathering profile and the toe of the fan has been truncated by past geological erosion and the subsequent deposition of alluvium deposits that form terrace TTL1. The fan has also been incised by erosion gullies on its northern (Gully 14) and southern sides (Gullies 15 and 17). This indicates that the fan was formed by geological processes that occurred many 10s of thousands of years ago.

Geologically young and recent slope forming processes are evident within Gully 16 and adjacent very steep slopes to the East, and upslope of proposed residential lots. These include:

- Localised shallow landslide scarps that appear to have been reactivated from time to time in the past.
- Open tension cracks.
- Hummocky and irregular surface topography.
- Large cobbles and boulders within the gully floor.
- A mantle of scree mantle and absence of an organic soil layer.

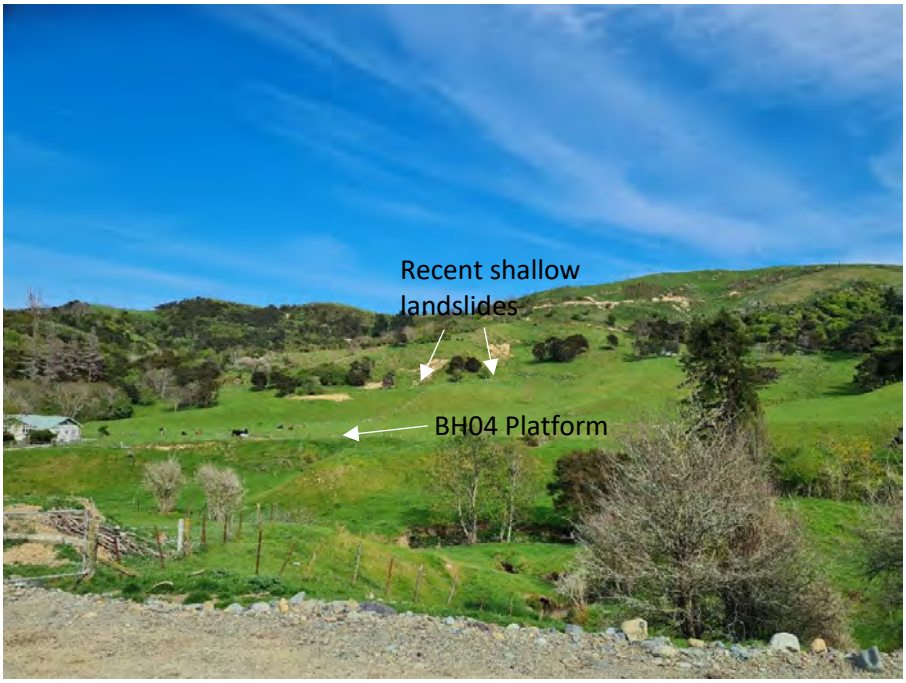
It is possible some of the boulders that now lie on the surface to the Fan are a result of boulder roll from Gully 16 within the last 10,000 years.

4.2.2.4 Area 4 - Kākā Middle Reach

This area includes elevated terraces on the eastern side of Kākā Stream and fan deposits that locally overlie the terrace. There is no evidence of recent or ancient slope instability having developed on the terrace surface although there is some recently deposited soil and debris that flowed onto the terraces from shallow landslides that have originated in the past, (including in August 2022) within shallow gullies on the steep slopes east of Area 4.

4.2.2.5 Area 5 – Lower West Valley fan and terrace

This area contains a flat lying to gently inclined (to the south and east) alluvial terrace where the farm dwelling is located (*Photograph 4.8*) The terrace surface merges into fan surfaces and gently rounded spurs to the West These slopes are largely free of any evidence of slope instability except near the southern end of the areas where a very this (0.1 m) deposit of silt has been deposited from rainfall erosion of debris from three shallow landslides originating in Area 6 during the August 2022 rainfall event. Minor subdued hummocky ground in this area and locally in the floor of each of the gullies that extend into Area 5 from the west indicate past (pre-historic) episodes of soil deposition likely due to erosion during major rainfall events.



Photograph 4.8: View of Area 5 and 6.

4.2.2.6 Area 6 – West Valley slopes

This area contains moderately to steeply inclined east facing slopes. The Western Slopes comprise typical spur and gully topography and the following geomorphic features are present:

- There are extensive areas of steep stable slopes.
- Old arcuate features near to the heads of the gullies and on steep side slopes.
- Creep terracettes.
- Hummocky ground is typically present in the floor of gullies.
- Developing shallow coalescing fan deposits are present at the mouths of the gullies downslope of the Farm Track.
- There is emergent groundwater (a spring) present in Gully 6 upslope of the development.
- Recent shallow earthslides - earthflows are located within Gullies 2 and 3 and Gully 8.
- Debris run-out tails are visible on the slope within Gullies 2, 3, 5 and 6 from the recent August 2022 landslides.
- Boulder roll deposits are present in Gullies 5 and 6.

4.2.2.7 Area 7 – Kākā Upper Reach

This area continues upstream from Area 4 to the northern most extent of the Site. It includes the upstream continuation of gently to moderately inclined terraces blanketed by fan surfaces described in Area 4. To the east the slopes rise steeply. The eastern slopes above this area are incised by two steepling plunging moderately incised gullies, Gullies 10 and 11, and the very deeply incised Gully 9. Each of these gullies have steep to very steep slopes several recent shallow landslides are evident following the August 2022 rainfall event. Each gully displays evidence of ancient shallow landslides and the recent landslide scars are coincident with older scarp features. Soil from those landslides has been eroded from the headscarp areas and has in places flowed along the floor of the gullies to be deposited on the terrace and fan surfaces. Significant surface water flood flows during the August 2022 rainfall event have eroded a portion of the fan surface downslope of the Gully 9.

There is also evidence of open slope earthslides between Gully 10 and Gully 11. Unlike the Gully instability the open slope landslides have not resulted in evacuation of disturbed ground and deposition of debris on the lower slopes. However, open tension cracks are evident across the slope arising from minor downslope movement during the August 2022 rainfall event.

4.3 Groundwater

Twelve standpipe piezometers have been installed in boreholes across the site, and we have noted groundwater encountered during our test pit investigations and surface water in site walkovers. Our observations are described below:

Area 1 – Kākā Lower Reach: Kākā Stream flows through this area. Six piezometers have been installed, plus three additional split-level piezometers, to monitor the groundwater levels. The piezometers were monitored between April 2023 and February 2024 Groundwater characteristics are summarised below:

- Groundwater levels are responsive to heavy rainfall, and water levels increased by up to 1.3 m during an intense rainfall event in May 2023.
- There was a lowering in the groundwater level in all of the piezometers of up to 0.3 m during January and February 2024.
- Groundwater has been consistently observed at the ground surface level across the lower reach, particularly on the western margin near the toe of the steep, bush covered hill to the west of the Site. The ground surface was noticeably drier in January and February 2024 and no flow was observed in Kākā Stream during this period.
- It has been reported (N Donaldson/D Andrews, April 2023) that Kākā Stream dries up regularly approximately mid-way across the lower reach in the height of summer.

Area 2 – Eastern slopes: Three piezometers were installed on the prominent spur immediately to the south of the Eastern debris fan within colluvium and disturbed bedrock (BH01_0723, BH1A_0723 and BH02_0723). Groundwater measurements indicated that a shallow, perched groundwater is locally present within the colluvium and residual soil deposits from 6.45 m depth at the BH01and BH01A location. The permanent groundwater table for both BH01 and BH02 locations varies seasonally between 11.03 m and 18 m depth.

A further shallow piezometer was installed in BH07_0723 to 4.0 m depth at the mouth of Gully 18 within sandstone. Groundwater was not recorded during drilling or in or subsequent the piezometer monitoring.

TP6, excavated in proximity to BH07_0723 was excavated through 2.4 m of fan deposits terminating in moderately weathered sandstone at 2.8 m depth and did not encounter groundwater. TP03-22, excavated upstream in Gully 18, at approximate RL 50 m encountered seepage at 3.0 m depth within moderately weathered sandstone.

Area 3 – Eastern debris fan: Piezometers were installed in the debris fan deposits and the adjacent spur to the south within colluvium and/disturbed bedrock (BH03_0723 and BH05_0723). They indicated that a shallow, perched groundwater is locally present within the fan deposits and that groundwater in these deposits varies from approximately 1.7 m depth to more than 6.5 m below ground surface. A copy of the piezometer data chart is presented in Appendix E.

Area 4 – Kākā Middle Reach

Groundwater seepages have been encountered in a number of locations in the shallow test pits in this area. Groundwater is likely to be near the ground surface at the base of the steeply inclined hill to the east and taper down to emerge in the Kākā Stream bed. No emergent groundwater (i.e. springs) has been observed.

Area 5 – Lower West Valley fan and terrace

Test pits excavated in this area have encountered groundwater seepages within fan deposits that overly the Quaternary alluvial terrace (TTR1). Groundwater levels are expected to be lower toward the downslope flanking slope of the alluvial terrace, tapering down to the surface level of the Area 1 at the toe of the terrace slope. However, at times of inspection no emerging groundwater was observed.

Area 6 – West Valley slopes

Shallow test pits in this area typically did not encounter groundwater, though some seepages have been noted in test pits that were excavated close to mapped outcrop of the Wakapuaka Phyllonite. We have noted on our walkovers that the vegetation along the floor of the gullies is more lush than vegetation on adjacent spurs but have not observed emergent groundwater. Gully 6 has flowing water that emerges at a spring immediately upslope of the Farm Track. A small dam has been constructed to capture this water.

Area 7 – Kākā Upper Reach

No piezometers were installed within this area. Shallow test pits TP18-22 to TP24-22 and TP26-22 to TP27-22 (inclusive) that were excavated to between 1.5 m and 4.8 m depth in February and early March2022 (Summer) generally did not encounter groundwater. In TP 25, located in the Floor of Gully 9 upslope of the Site, a minor seepage was encountered at the interface of colluvium and residual soil but adjacent soil was described as dry. An area of minor seepage was also identified at 1.0 m depth in TP22-22 within residually weathered Wakapuaka Phyllonite.

5 Engineering geological and geotechncial assessment

Recommendations and opinions expressed in this report are based on recent subsurface investigations listed in Appendix C. The nature and continuity of subsurface conditions away from the test locations are inferred and it must be appreciated that the actual conditions may vary from the assumed model.

5.1 Engineering geological model

The surface and subsurface conditions are shown in plan view on T+T Figure 1012397.1000-GT-F03. Cross Sections presented in T+T Figures 1012397.1000-GT-F10 to F22 show the assumed engineering geological model for each of Areas 1 to 7. A summary of inferred engineering geology is provided below.

Area 1 – Kākā Lower Reach

The engineering geological model for this area is shown in Cross-section A1 in T+T Figure 1012397.1000-GT-F15 and at the eastern extent of Cross sections S3 and S4 in T+T Figures 1012397.1000-GT-F-12 and F-13 (attached in Appendix A) and the typical soil and rock sequence is described in **Table 5.1** below.

Table 5.1: Area 1 typical soil and rock sequence

Unit	Depth to top of layer (m)	Description
Holocene and Quaternary Alluvium	0	Interbedded layers typically ≤1 m thick, but occasionally thicker, comprising gravel, gravelly silt, silty gravel, clayey silt and sand.
	1.2 to 5.0	Interbedded layers typically >1m thick, but occasionally thinner, typically comprising gravel, silty/sandy gravel, and sand. Occasional layers of clayey silt.
	4.5 to 9.7+	Cobbles and boulders
Weathered Grampian Formation sandstone/siltstone	5.2 to 10.5+	Mudstone and sandstone layers

The landform will be modified by filling to create residential lots and locally by excavation for the Kākā Stream realignment and for stormwater mitigation works.

Area 2 – Eastern slopes

The engineering geological model for this area is shown on Cross sections A1, A3, A4 and A5 in T+T Figures 1012397.1000-GT-F15 and F17 – -F19 (attached in Appendix A).

Table 5.2 below summarises the typical soil and rock sequence.

Table 5.2: Area 2 typical soil and rock sequence

Unit	Depth to top of layer (m)	Description
Colluvium (present on the upper slope, mid-slope, and lower slope).	0	Silty clayey gravel with some cobbles. Shallow in the upper parts of the slope, thickening to approx. 5 m near the base of the slope. The colluvium interface with the alluvium in Area 1, at the base of the slope, is variable. In some locations, colluvium has run out over the alluvial surface, in others the alluvium is likely to truncate the colluvium.
Holocene and Quaternary Alluvium (only present near the base of the slope, and extending out onto the Area 1 flood plain)**.**	0 to 4.0	Interbedded layers typically >1m thick, but occasionally thinner, typically comprising gravel, silty/sandy gravel, and sand. Occasional layers of clayey silt.
Bedrock comprising weathered Grampian Formation downslope of bedrock contact at approx. RL 50 m, and Kākā Formation upslope of the contact.	<1 m to 8 m+ at the toe of the slope	Weathered Grampian Formation comprises siltstone and sandstone layers. Kākā Formation comprises moderately weathered, strong tuff.

The proposed earthworks involve mainly cutting into stable bedrock to form roads and building platforms. Some filling will take place on the above the terrace surface and to infill two gullies

Area 3 – Eastern debris fan

The engineering geological model is shown on Cross section A2 in T+T Figure 1012397.1000-GT-F16 (attached in Appendix A) and the typical soil and sock sequence is described in Table 5.3 below.

Table 5.3: Area 3 typical engineering geological model

Unit	Depth to top of layer (m)	Description
Fan deposits comprising colluvial soil (present on the upper slope, mid-slope, and lower slope.)	0	Silty clayey gravel with some cobbles. Shallow in the upper parts of the slope, thickening to approx. 9 m near the base of the slope. The colluvium interfaces with the alluvium in Area 1, at the base of the slope.
Holocene and Quaternary Alluvium (only present near the base of the slope, and extending out onto the Area 1 flood plain.)	0	Interbedded layers typically >1 m thick, but occasionally thinner, typically comprising gravel, silty/sandy gravel, and sand. Occasional layers of clayey silt.
Bedrock comprising weathered Grampian Formation downslope of bedrock contact at approx. RL 165 m, and Kākā Formation upslope of the contact.	<1 m to potentially 10 m+ at the toe of the slope.	Weathered Grampian Formation comprises siltstone and sandstone layers. Kākā Formation comprises moderately weathered, strong tuff.

Proposed earthworks involve mainly cutting in the lower part of the area to provide for roads and residential and commercial lots. It is proposed to retain the cut slopes formed for the commercial

lots. In the upslope part of the area some fill is to be placed to create building platforms. Cutting, to form a debris channel, and filling, to provide a debris protection bund, will be undertaken upslope of residential lots for slope instability mitigation. A platform will be formed at RL 123 m, upslope of proposed lots, for a temporary water reservoir.

Area 4 – Kākā Middle Reach

The engineering geological model for this area is shown in Cross sections A6 and A7 in T+T Figures 1012397.1000-GT-F20 and -F21 (attached in Appendix A). The typical soil and rock sequence is described in Table 5.4 below.

Table 5.4: Area 4 typical soil and rock sequence

Unit	Depth to top of layer (m)	Description
Colluvium and residual soil (present on the upper slope, mid-slope, and lower slope).	0	Silty clayey gravel with some cobbles. Shallow in the upper parts of the slope, thickening to approx. 9 m near the base of the slope. The colluvium interfaces with the alluvium in Area 1, at the base of the slope.
Holocene and Quaternary Alluvium (only present near the base of the slope, and extending out onto the Area 1 flood plain)**.**	0 to 4.0	Interbedded layers typically >1 m thick, but occasionally thinner, typically comprising gravel, silty/sandy gravel, and sand. Occasional layers of clayey silt.
Bedrock comprising weathered Grampian Formation.	<1 m to 12 m at the toe of the slope	Weathered Grampian Formation comprises siltstone and sandstone layers.

Filling is proposed to raise ground level and to create building platforms.

Area 5 – Lower West Valley fan and terraces

The engineering geological model for this area is shown in Cross sections S3, S4 and S5 in T+T Figures 1012397.1000-GT-F12 – F14 (attached in Appendix A) and the typical soil and rock sequence is described in Table 5.5 below.

Table 5.5: Area 5 typical soil and rock sequence

Unit	Depth to top of layer (m)	Description
Holocene and Quaternary Alluvium	0	Silty clayey gravel with some cobbles. Shallow in the upper parts of the slope, thickening to approx. 9 m near the base of the slope.
Bedrock comprising weathered Grampian Formation	<1 m to 20 m at the south-eastern side of this area.	Weathered Grampian Formation comprises siltstone and sandstone layers.

Earthworks will involve a combination of cutting on the western half of the Area and filling on the eastern half to create near flat building platforms and also filling to create a crossing of Kākā Stream.

Area 6 – West Valley slopes

The engineering geological model for this area is shown in Cross sections S1, S2, S3, S4 and S5 in T+T Figures 1012397.1000-F10 – -F14 (attached in Appendix A) and the typical soil and rock sequence is shown in Table 5.6 below.

Table 5.6: Area 6 typical soil and rock sequence

Unit	Depth to top of layer (m)	Description
Holocene and Quaternary Alluvium	0	Silty clayey gravel with some cobbles. Shallow in the upper parts of the slope, thickening to approx. 9 m near the base of the slope.
Bedrock comprising weathered Grampian Formation	<1 m to >10 m at the central portion of this area,	Weathered Grampian Formation comprises siltstone and sandstone layers.
Bedrock comprising weathered Wakapuaka Phyllonite – Northern Knoll – Southern Spur areas	<1 m to >10 m	Varies, includes weak steeply dipping siltstone and breccia and foliated moderately strong siltstone,

Earthworks include excavations up to 11 metres deep for form up to 25 m high moderately steep cut batters for Road 1 and cuts and fills of lesser height to form building platforms.

Area 7 – Kākā Upper Reach

The engineering geological model for this area is shown in Cross sections A6, A7 and A8 in T+T Figures 1012397.1000-GT-F20 to -F22 (attached in Appendix A) and is described in Table 5.7 below.

Table 5.7: Area 7 typical engineering geological model

Unit	Depth to top of layer (m)	Description
Fan deposits and colluvium	0	Clayey silty-Gravel with some cobbles and small boulders. The colluvium mantles the alluvium at the mouth of the gullies.
Holocene and Quaternary Alluvium	0 – 0.6 m	Interbedded layers typically >1 m thick, but occasionally thinner, typically comprising gravel, silty/sandy gravel, and sand. Occasional layers of clayey silt.
Bedrock comprising Kākā Formation Breccia	0 to >5.0 m	Bedrock not encountered in test pits but present in Kākā Stream. Dark grey, slightly weathered, Strong to very-strong Siltstone.
Bedrock comprising Wakapuaka Phyllonite	0- 1m	Very weak, highly weathered, red-brown Phyllite recovered as a Gravelly -Silt, angular, fine to coarse, with green-grey volcanic clasts. Locally extremely weak.

This area is to be filled to enable building platforms to be formed and to provide a stable gentle to moderately inclined landform for potential future residential lots.

5.2 Geotechnical hazards

Common geotechnical hazards that are prevalent across the site are described in Sections 5.2.1to 5.2.3 below.

5.2.1 Seismic shaking hazard

5.2.1.1 2022 National Seismic Hazard Model (NSHM) update

In October 2022, GNS Science released the revised National Seismic Hazard Model (NSHM)[5]. This represents the latest scientific knowledge of earthquake hazard in New Zealand and is an important factor for understanding and managing earthquake risk in the built environment.

While the NSHM will inform future design standards, it does not provide information that can be directly applied in design applications. Consequently, the current minimum compliance pathway within the Building Code has not changed[6]. However, important updates to Building Code compliance documents that will be informed by the NSHM are expected to be released between 2023 and 2025.

We have undertaken an initial appraisal of the implications of the 2022 NSHM for consideration of concept geotechnical design. It is uncertain how the updated NSHM will be reflected in future design standards, however it is possible that the code minimum seismic design loadings will increase in some situations.

Seismic hazard models carry an inherent amount of uncertainty, but more important is the uncertainty in what shaking a particular site or building will be subject to during its actual life. This depends on which specific earthquakes actually occur over that time. Therefore, designers and building owners are strongly encouraged to focus on resilient design practices, rather than the specific code minimum demand[7].

5.2.1.2 Seismic site subsoil class

We have assessed the soil profile at the site in accordance with Section 3.1.3 of NZS1170.5:2004. While the exact depth to rock varies across the site, test pit excavations and drill holes in the area indicate mid and up-slope areas of the site with less than 3 m of soil overlying competent rock, and other parts of the site, e.g. near to the toe of the debris fan and along the valley floor where soil (silts, sand and gravel) thickness varies from >3.0 m up to approximately >11 m depth. The site subsoil classes are therefore assessed to be either Class B – Weak Rock or Class C– Shallow Soil, depending upon the location of interest.

We note that the 2022 NSHM update is based entirely on shear wave velocity over the top 30 m of the soil profile (Vs30), as opposed to site subsoil Classes A to E as defined in NZS 1170.5. Therefore,

5 https://nshm.gns.cri.nz/

6 Current relevant compliance documents to meet *Clause B1: Structure* of the Building Code are as shown in Verification Method B1/VM1. For structural seismic design this is *NZS 1170.5:2004 – Structural Design Actions Part 5: Earthquake Actions – New Zealand.* For geotechnical design, although not directly referenced in B1/VM1, the Section 175 MBIE/NZGS guidance document *Earthquake Geotechnical Engineering Practice: Module 1 (November 2021)* is to be continued to be used for seismic design loadings.

7 NZSEE, SESOC, NZGS (August 2022). *Earthquake Design for Uncertainty: Advisory.* Revision 1. https://www.nzsee.org.nz/db/PUBS/Earthquake-Design-for-Uncertainty-Advisory_Rev1_August-2022-NZSEE-SESOC-NZGS.pdf

future updates to design standards may also move away from the existing site subsoil class system to a more site-specific assessment. This could also lead to changes in design loadings.

5.2.1.3 Ground shaking hazard

Ground motion parameters for geotechnical design of slopes, earth structures, retaining walls, and liquefaction triggering calculations are presented in Table 5.8 below. Parameters from MBIE/NZGS guidance documents are provided[8], as well as values from the GNS 2022 National Seismic Hazard Model (NSHM)[9]. The ground shaking characteristics that may occur at the site in a strong earthquake are unavoidably uncertain. Uncertainty in ground motion parameters for slopes, earth structures, retaining walls, and liquefaction should be managed by good design. Both sets of parameters should be considered during detailed design and the subdivision earthworks detailed accordingly to achieve acceptable levels of risk.

Table 5.8: Design earthquake parameters

Earthquake return period	Comments	MBIE/NZGS Module 1 values for design		2022 GNS NSHM values	
		M	PGA (g)	M	PGA (g)
1 in 25 years	Typical Serviceability Limit State (SLS) EQ event.	6.1	0.10	7.5	0.08-0.10
1 in 100 years		6.1	0.20	7.5	0.20-0.23
1 in 500 years	Typical Ultimate Limit State (ULS) EQ event for IL2 structures (i.e. residential houses).	6.1	0.41	7.5	0.46-0.49
1 in 1,000 years	Typical Ultimate Limit State (ULS) EQ event for IL3 structures.	6.1	0.53	7.5	0.63-0.65

5.2.2 Slope instability

Aerial photographs, LiDAR imagery, site observations and our subsurface investigations have identified that that the majority of land within the proposed subdivision is not subject to slope instability.

The most significant slope instability features in Kākā Valley are dominated by translational soil slide/debris flows (generally less than 2 m deep although locally up to approximately 6 m deep) within the gullies (e.g. the Eastern Debris Fan). These areas are limited in extent and mainly associated with slopes steeper than 30° within the headscarp areas and flatter slopes that have been disturbed by past land management, including cutting tracks.

Our assessment has identified a landslide derived geologically old debris fan deposit – the East Fan. It appears to predate Late Quaternary age terraces and may therefore be in the order of 10s of thousands to more than 100,000 years of years old. We have assessed the source area for the debris deposit and identified an area where a smaller volume debris flow could occur (potentially triggered by an earthquake generated on the Waimea Fault to the east of the site).

[8] MODULE 1: Overview of the guidelines - Earthquake geotechnical engineering practice (building.govt.nz)
[9] NZ NSHM (gns.cri.nz)

5.2.2.1 Rock fall

Our investigations at the site identified a potential rock fall hazard for the site because of observations of boulders and rock debris being present on the slope. Specifically on the slope above the proposed residential allotments and the commercial lot on the east side of the valley, and lots downslope of Gullies 5 and 6 on the west side of the valley.

Our rockfall assessment was carried out in terms of Chapter 2 of MBIE's national guidance document 'Rockfall: Design considerations for passive protection structures' – October 2016. We have also carried out preliminary rockfall modelling in accordance with the guideline to inform suitable rockfall mitigation for the site. However, we note that there are some inherent uncertainties associated with this modelling as outlined below:

The Rocfall software programme uses mathematics and basic mechanics to model a natural process. The behaviour of falling rocks can be unpredictable. For example, observations in the Port Hills, Christchurch suggested boulders could deviate up to 30° along their path, principally due to boulder shape. This is not captured in our 2D preliminary analysis but should be considered in assessing the necessary Rockfall Protection Structure length during detailed design.

5.2.2.1.1 Eastern Fan rock fall risk assessment

We have observed boulders with an estimated weight range 20 kg to 2,600 kg lying on vegetation or embedded at shallow depth in topsoil/debris upslope of the proposed Lots.

Based on observations of batter fritter, the debris lying on the inside shoulder of the Pylon Track, the width of the track bench, the gradient of the slope above the bench and the large boulders observed on the slope face we consider that it is unlikely that rock roll from the Pylon Track batter failure and ongoing fritter will affect the proposed building sites under heavy or extended rainfall and high frequency seismic events.

Based on the boulders observed to be resting on or near surface within Gully 11 upslope of the Pylon Track; we consider it possible that boulders currently resting on portions of the slope exceeding 24° will roll in a large seismic event (e.g. ≥ 1:500-year return event) and have the potential to reach the residential and commercial allotments. The potential consequence[10] of a boulder of approximately 200 kg to 2,400 kg impacting the proposed building platforms is uncertain and dependant on the impact velocity of the boulder when it strikes the platform. Provision will be required for design and construction of a debris protection bund or barrier fence upslope of the proposed lots. The rockfall bund or barrier will require specific analysis at the detailed design stage. For the largest boulders it would be feasible to break these up via either mechanical expansion or blasting. This would reduce the consequence and risk currently posed by the largest boulders on site.

5.2.2.1.2 Western slopes rock fall assessment risk assessment

We have observed boulders with an estimated weight range of 50 kg to 450 kg lying on the ground surface or partially embedded in topsoil upslope of the proposed lots and in recent debris run out tails from the August 2022 rainstorm event.

These boulders are concentrated in the area encompassing Gullies 5 and 6 and the run-out paths appear to be constrained around the gully centre lines.

There is evidence of side cast fill along the outside shoulder of the Farm Track and we consider it probable that some boulders will be present within the sidecast fill.

Small, localised batter failures and fretting have occurred at various locations along the length of the Farm Track. Our observations indicate that the fretting and slumps appear to have been mostly

[10] Risk assessed in terms of NZ Geomechanics Practice Note Guidelines for Landslide Risk management 2007.

contained within the track table drain. We consider it possible that under the right circumstances individual boulders may roll over the track and onto the slope below. Run out distances are expected to be constrained by the quickly flattening slope gradient downslope towards the Farm Dwelling alluvial terrace.

Based on the boulders observed to be resting on or near surface within the vicinity of Gullies 5 and 6 upslope of the Farm Track; we consider it possible that boulders currently resting on portions of the slope exceeding 24° will roll in a large seismic event (e.g. ≥ 1:500-year return event) and have the potential to reach the residential allotments below. Provision will be required for design and construction of a debris protection bund or barrier fence upslope of the proposed new access road. The rockfall bund or barrier will require specific analysis at the detailed design stage. Existing side cast fill should be removed as part of subdivision earthworks.

5.2.3 Sub-area geotechnical hazards

This section outlines the geotechnical hazards and risks that we have identified in each sub-area. Subdivision design considerations and recommendations for development, that will be required to reduce the risks associated with the hazards to acceptable levels for development, are described in Section 6.

5.2.3.1 Area 1 – Kākā Lower Reach

Pre-development geotechnical hazards and the associated risks to the development that we have identified include:

- Soft/loose alluvial soils are present in the upper 1.4 to 5 m depth of the flood plain. These soils could cause settlement of the proposed fill platform and heavy structures.
- High groundwater levels and ponded surface water over the flood plain. This could increase instability risk of temporary excavations, and damage exposed subgrades. Additionally, the groundwater level is responsive to heavy rainfall, and lowering of the groundwater level has been measured during the peak of summer, in January and February 2024. This could affect the proposed stream realignment and the new channel will have to be designed accordingly.
- During moderate to strong earthquakes, liquefaction is likely to occur in discontinuous, spatially isolated layers or pockets of the loose alluvial soils. If left untreated this is likely to cause ground damage including total and differential surface settlement, ground cracking, and instability of sloping ground around the perimeter of the proposed fill.

5.2.3.2 Area 2 – Eastern slopes

Pre-development geotechnical hazards and the associated risks to the development that we have identified include:

- Areas of historic shallow landslides and weak near-surface soils on the moderate to steeply inclined hill slopes. If left untreated, landslides could remobilise, or this could cause instability of fill batters and natural slopes under elevated groundwater or seismic conditions.
- Areas where debris flow have occurred in the valleys, causing inundation at the valley mouths. If left untreated future debris flows in these areas could impact and damage buildings and infrastructure
- Shallow groundwater levels near the toe of the slopes. If left untreated, this could cause slope instability and wetting of the development area.

5.2.3.3 Area 3 – Eastern debris fan

Pre-development geotechnical hazards and the associated risks to the development that we have identified include:

- Shallow landslides could occur in the gullies and steep sided spurs from the mid-slope area up to the fan source area. If left untreated debris from these types of landslides could travel/be washed down the fan area and impact buildings and infrastructure.
- Large deep-seated (>3 m seep) soil and rock slides that have the potential to be triggered by large earthquakes within Gully 16 upslope of the Site. Debris runout from earth/rock slides on these slopes has the potential to reach the area proposed for residential lots.
- Boulders are present on the slope in the area upslope of the pylon track. There is potential for boulders to become unstable during a strong earthquake and to roll down the slope and impact the area proposed for residential lots.

5.2.3.4 Area 4 – Kākā Middle Reach

Pre-development geotechnical hazards and the associated risks to the development that we have identified include:

- Debris inundation from shallow landslides and weak near-surface soils on the moderate to steeply inclined hill slopes.
- Scour across the alluvial terrace in the development area due to gully stormwater flows.

5.2.3.5 Area 5 – Lower West Valley fan and terraces

Pre-development geotechnical hazards and the associated risks to the development that we have identified include:

- Shallow instability within the sides of gullies upslope of this area, and there it is possible for debris run out into the area downslope of Gullies 2, 3 and 6 where lots are proposed.
- There is isolate shallow instability around the edge of the alluvial terrace slope on the south-eastern side of this area. There is potential, although unlikely, that any infrastructure constructed on the crest of the terrace slope could be subject to loss of foundation support.

5.2.3.6 Area 6 – West Valley slopes

Pre-development geotechnical hazards and the associated risks to the development that we have identified include:

- Wakapuaka Phyllonite bedrock in this area contains locally extremely weak rock with multiple rock defects the overlying soils contain clays and there is a possibility of shallow earth slides/flows on moderately steep slopes.
- Shallow landslides within the colluvial soils within Gullies 2, 3 and 6 are likely under elevated groundwater arising from extreme rainfall events.
- There are very steep rock slopes within Gullies 5 and 6 that have given rise to rock fall and rock roll in the past. Further rock fall and rock roll is likely under seismic triggering and unlikely under rainfall events.

5.2.3.7 Area 7 – Kākā Upper Reach

Pre-development geotechnical hazards and the associated risks posed to the development area that we have identified include.

- Local stream bank slumping and erosion is likely within the Kākā Stream affecting alluvial slopes up to about the Q100 flood level is possible.
- Flood debris (silt, gravel and vegetation) inundation within the Kākā stream flood plain is possible arising from flood events.
- It is almost certain that there will be further shallow soil and debris slides within the shallow incised gullies above this area and it is likely that some portions of the area will be subject to debris inundation arising from upslope instability.
- It is likely that the flow channel within fan deposit downstream of Gully 9 will experience further erosion by flood waters discharging from the gully catchment.

6 Subdivision risk and design considerations

The earthworks and lot layout for the subdivision has been iteratively developed with input from multiple professionals and the developers. Large areas of land are to remain in their natural state and or enhanced by shrub and tree vegetation. As part of the planning process for subdivision decisions have been made to avoid residential development on steep to very steep slopes where there is an elevated risk of slope instability and where it is considered unfeasible to remedy or mitigate slope instability risks.

Within the areas now proposed for residential and commercial development and where associated earthworks are proposed to enable that development consideration has been given as part of this assessment to the design and layout of earthworks and lots to ensure that geotechnical hazards are avoided, remedied and/or mitigated. The process that has been followed is set out in the following sections.

6.1 Geotechnical risk considerations for residential development

As part of the earthworks and lot layout planning for the subdivision we have assessed the geotechnical hazards that exist at the site and the risk those hazards would present to roads, services and residential building development on the proposed lots. This is to inform our Section 106 assessment. We have also considered the potential hazards that have potential to arise as a result of earthworks.

We have undertaken this risk assessment in general accordance with the Australian Geomechanics Society (AGS) “Practise Note Guidelines for Landslide Risk Management 2007”. This is a qualitative assessment tool. We have considered the geotechnical risks within the context of the RMA and Building Act and in doing so have assessed the likelihood of hazards occurring within a 50 to 100-year time span. In assessing risk, we have considered the likelihood of various slope instability events that can arise from natural triggering events such as rainstorms and earthquakes, and we have considered the consequences to residential land and dwellings arising from slope instability scenarios.

We note that the AGS document advises that Low risk is generally acceptable to regulators. Moderate risk may be tolerated, but requires investigation, planning and implementation of treatment and/or management options to reduce the risk to low. High risk is normally considered unacceptable without treatment. This is somewhat different to the requirements of the RMA as discussed in Section 4.

We have undertaken this assessment in two parts. Firstly, considering the land prior to any earthworks, and secondly to consider the land as proposed to be developed with earthworks and additional slope instability mitigation measures.

6.1.1 Pre-development geotechnical risk

T+T Figure titled ‘Pre-development Geotechnical Risk Plan’ Figure 1012397.1000-GT-F50 attached in Appendix A, illustrates our assessment of the geotechnical risk that exists if residential development was to take place without earthworks and without specific risk mitigation measures being undertaken for the development. The Figure divides the Site into areas of low, moderate and high geotechnical risk. Table 6.1 below summarises the development suitability and likely mitigation requirements for each risk rating level.

There is no intention to develop the Site without earthworks and without geotechnical risk mitigation.

Table 6.1: Geotechnical risk rating descriptions

Existing Risk Rating	Development suitability/Ground mitigation work
Low	Suitable for development; minor restrictions. Good engineering practices suitable for hillside development required subject to specific investigation and design (SID) for building development. Risk after development normally acceptable.
Moderate	Suitable for development, moderate restrictions. Sensitive to changes in ground profile, drainage and vegetation. Risk after development generally no higher than normally tolerated. Building development to be subject to specific investigation and design. Mitigation work including ground improvement and drainage required.
High	Unsuitable for building development unless geotechnical mitigation works are carried out. Some restriction on type of development likely. Mitigation work including ground improvement by weak soil undercut and replacement, drainage and planting, debris bund construction required.

6.1.2 Risk mitigation options

Implementing risk mitigation measures as part of design and construction of residential subdivisions is best practise. T+T Figure 1012397.1000-GT-F50 identifies that some of the proposed residential lots are in areas that have the potential to be subject to geotechnical hazards and that present a High and Moderate geotechnical risk. The earthworks landform design has been developed in consideration of the risks associated with the hazards and the earthworks, as proposed, will mitigate many geotechnical hazards.

The Figure identifies where specific geotechnical hazard mitigation works should be designed and constructed to further enhance the beneficial effects of the designed landform and to provide hazard mitigation to lots and infrastructure.

Mitigation measures that are proposed for inclusion in earthworks detailed design and construction as shown on T+T Figure 1012397.1000-GT-60 include the following:

1 Utilise fill placement to provide stabilising buttress to the toe of existing slopes.
2 Sub-excavating weak subsurface soils and replacement with engineered fill.
3 Remove an/or stabilise weak soils of upslope and downslope of earthworks areas.
4 Review the geotechnical design all cut slopes in rock and soil and either flatten cut batters, over excavate and replace with engineered buttress fill or install rock bolts and mesh if unfavourable rock conditions are revealed in high cuts.
5 Design and construct retaining walls areas of permanent cut in the commercial lot and for the residential access road on the East Fan.
6 Utilise designated planting areas to improve the stability of the slopes.
7 Construct debris impact protection bunds or catch fences where debris inundation by landslides upslope of lots has been identified.
8 Installation of subsoil drains where seepage is encountered and install drainage blankets where high groundwater levels are anticipated.
9 Geotechnical inspection, monitoring and review of earthworks a by a Geo-professional during construction.

We note that subsoil drains are an essential good practice. However, they are not to be relied upon as a sole measure to improve long term slopes stability and care will need to be taken to ensure the use of subsoil drains does not adversely affect the natural groundwater regime.

Specific works to be undertaken as part of the proposed earthworks for each sub-area are discussed in Section 6.2.

Specific geotechnical design and construction monitoring and review by the project Geo-professional will be required for the earthworks and slope instability mitigation works and all works will require regular geotechnical inspection. This is a normal requirement of NZS 4404: 2010 and NZS 4431: 2022.

On completion of earthworks, geotechnical review should be carried out of the completed works, and the Geo-Professional should make recommendations for future lot owners to follow (via consent notices) to ensure that the land stability is maintained.

6.2 Sub-area subdivision design considerations.

The following outlines the specific geotechnical hazard mitigation required in each sub area as generally highlighted on TT Figure 1012397.1000-GT-60.

6.2.1 Area 1 – Kākā Lower Reach

6.2.1.1 Kākā Stream realignment

It is proposed to realign the lower reach of Kākā Stream to follow a new naturized corridor generally on the western side of the lower reach. To reduce the frequency of the stream drying up, and ensure it remains saturated for as much time as practicable, the proposed stream alignment will be cut down below current ground level to intercept groundwater and follow the base of the hill around to the south, finally discharging into the Maitai/Maitahi River at a location similar to where the existing stream confluence. The existing and proposed stream alignments are shown on *Figure* 6.1 below.

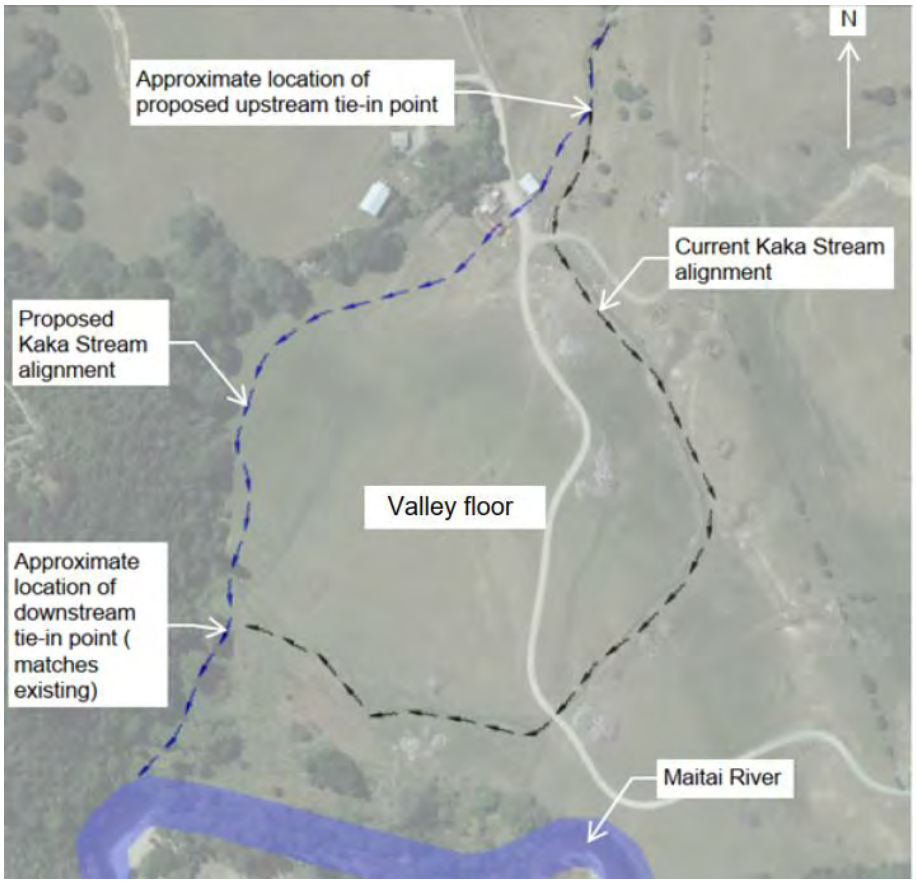


Figure 6.1: Existing and proposed Kākā Stream alignment

The proposed stream alignment is shown in more detail on T+T Figure 1012397.1000-GW-110, and typical sections are shown on T+T Figures 1012397.1000-GW-111 and -112 in Appendix A. The proposed stream invert will be at a lower level that the existing channel and is in response to planned enhancement of freshwater values.

Our groundwater modelling for the flood plain (described in Appendix D) shows that the lower invert level of the stream, which is predominantly at or below the groundwater level, will remain water bearing for more of the year than the current alignment. It is recognised that under future dry climatic extremes that there is potential (lower potential than at present) that groundwater levels could lower, and the stream bed may become partially dry for short periods of time. Further information is provided in Appendix D.

6.2.1.2 Area 1 – Kākā Lower Reach, earthworks and building foundations

Earthworks to create building platforms in this area will include placing typically up to 4.5 m of fill to build up the area above flood levels. Localised cuts up to a maximum 2.0 m depth are proposed on the eastern part of the area where land levels are higher.

The investigations have identified that there is a limited liquefaction hazard within alluvial soils beneath the lower reach, where some isolated and discontinuous soil layers are likely to liquefy during moderate to strong earthquakes (refer Appendix D). Ground strengthening works will need to be carried out in the vicinity of the proposed fill face, to limit earthquake and liquefaction induced building platform ground damage to tolerable levels. Suitable measures could include undercutting weak/soft soils around the toe of the fill and reinforcing the sloping face of the fill with geogrid. Provided these works are appropriately designed and constructed, residential development could be carried out using readily available TC2 foundation concepts.

Additional testing could be carried out during construction to identify/refine areas where liquefaction is not expected to occur. These areas could then be developed using regular foundation details with no liquefaction mitigation measures.

Ground underlying heavy multistorey commercial, industrial, or community buildings will need to be investigated, and foundations subsequently designed by experienced engineer practising in geotechnical engineering.

6.2.2 Area 2 – Eastern slopes earthworks and building foundations

Earthworks to create building platforms and roads in this area will include cuts typically between 2 to 10 m high and fills typically between 1 to 5 m height in the valleys. Localised areas of deeper cuts (up to 20 m) and fills (up to 14.6 m) are present. A retaining structure in the order of 1.5 m high will be required to locally retain the toe of the reprofiled slope.

Where filling is required, each fill will require specific geotechnical design with provision for underfill subsoil drainage. Geotechnical inspection and undercutting of weak colluvial deposits and shallow landslides will be required prior to fill placement. Fill platforms in the gullies and on the moderate to steeply inclined slopes will need to be keyed into competent bedrock.

Unstable ground identified within undeveloped gullies where slope instability is likely or possible and will possibly inundate developed areas will need specific stabilisation or mitigation, or the development will need to be protected with debris bunds, barriers or fences.

Large cuts in this area will generally be formed in competent bedrock. Smaller cuts are likely to daylight colluvial soils. Weak colluvial soils and localised weakened or disturbed rock areas may be encountered that will need to be stabilised by sub-excavation and replacement with good fill, or installation of palisade poles. Where deep cuts intersect the natural groundwater table, surface

drains, subsoil drains and drainage blankets will be required to intercept and direct water away from residential and commercial development.

Provision should be made to flatten the top of cut slopes where inspection reveals the rock is classified as highly or completely weathered. This is typically within 3 m of the top of the rock surface. As a result the crest of cut batters may extend further upslope than the design contours indicate.

Following initial excavation of the cut batter adjacent to Road 1 ground water seepage may be evident near the toe of the slope. Seepage areas should be identified and to avoid seepage nuisance horizontal drains can be drilled into the rock face to assist drainage. Provision should also be made for subsoil drains to be installed as part of road constructions and to keep groundwater below the depth of influence beneath building foundations.

Upslope areas that have been subject to recent slope instability should be planted with tree and shrub vegetation.

6.2.3 Area 3 – Eastern debris fan

A cut is proposed along the toe of the fan deposit to form the split-level commercial development. The base of the cut will be into rock. However, the debris fan deposits will be exposed in the face of the cut. Provision will need to be made for specific geotechnical review of this cut as works proceed and geotechnical input provided for detailed design of slope instability stability measures. Split level Mechanically Stabilised Earth (MSE) retaining walls up to 15 m high will be required to stabilise this landform. These walls will need to be undercut and founded on competent bedrock and will require geogrid extending into the backfill. The backfill will require significant drainage metal, subsoil pipes, and surface swale drains as the cut will intercept the natural groundwater table. Bedrock is expected at shallow depth near the top of this cut, however colluvial soils above rock will need to be undercut and a buttress of good fill will be required to stabilise colluvial soils above bedrock.

Additional earthworks will be required to form the road to building platforms higher up the hillslope, and also up to the temporary reservoir at approximately RL 124 m. The road will traverse several gullies and ridges. Fill placed in these gullies will need to be stabilised by keying the fill into competent bedrock. Where road cuts daylight adversely dipping defects in bedrock local stabilisation measures may be required, which would include rock bolts.

A debris bund or barrier will be required on the northern side of the uphill road to deflect any landslide debris that may flow downslope fan source area to the steep sided gully 16 upslope of the proposed lots. Fill for the debris bund will need to be keyed into competent bedrock, or placed above a shear key to prevent the bund from destabilising the road cut.

The full upslope extent of the bund should be reviewed at the time of detailed design.

6.2.4 Area 4 – Kākā Middle Reach

Earthworks to create building platforms and roads in this area will include placing fill generally up to 10 m thick. Geotechnical inspection and undercutting of weak alluvial and colluvial deposits will be required prior to fill placement.

A debris bund, fence or barrier will be required at the base of the steeply inclined hill slope on the eastern side of this area, below areas of potential future instability that have been identified, to protect building sites from debris runout from shallow slope failures.

6.2.5 Area 5 – Lower West Valley fan and terraces

Earthworks to create building platforms and roads in this area will include cuts up to approximately 10 m deep at the western extent and fills up to 5 m thick on the eastern extent above the alluvial terrace face.

Where filling is required, geotechnical inspection and undercutting of weak colluvial deposits will be required prior to fill placement. The fill face will need to be constructed at a stable angle, and either set back, battered, or stabilised with geogrid or palisade poles to avoid destabilising the downslope alluvial terrace slope.

The cut batters on the western side of the area are likely to expose both strong rock and weak soils, some of which are landslide derived. These cut batters will need inspection by the Geo-professional during excavation and provision should be made to over excavate weak soils and replace with engineered fill.

Areas of concentrated seepage are also likely to be encountered in the cut batter. Provision should be made for either installation of trench subsoil drains or drilling of horizontal drains to enhance drainage of these areas.

6.2.6 Area 6 – West Valley slopes

This area includes earthworks to form building platforms and roads. Wakapuaka Phyllonite is present in this area and is may locally be a extremely weak rock that weathers to produce clay rich.

Where filling is required to form roads and lots, and fill in gullies, geotechnical inspection and undercutting of weak colluvial deposits will be required prior to fill placement. Suitable rock to found fill on is typically expected at shallow depths. Geogrid stabilisation is likely to be required for fills steeper than 2H:1V. Fill that is proposed to be constructed on moderately sloping ground will need to be well keyed well into the underlying bedrock. All fill will require specific geotechnical design.

Recent landslides to the north of the northern knoll will need to be excavated, with all landslide derived and weak soils removed and engineered fill placed to enable lots to be formed in this area. Similar landslide treatment will be required to remediate recent landslides located near to the turning head on Road 10.

Where cutting is required to form roads and lots, cut faces will need to be inspected for the presence of adversely orientated defects within the Wakapuaka Phyllonite. Locally the cut batters may need to be flattened which will extend the batter crest uphill and/or and local stabilisation measures may be required that could include installing rock bolts and mesh.

Upslope of Road 1, in the vicinity of Gullies 5 and 6, debris bunds, barriers or fences will be required to contain debris from shallow landslides originating within the gullies, and potential to protect the road and downslope lats from boulder roll.

6.2.7 Area 7 – Kākā Upper Reach

The toe of fill slopes will locally extend close to the Q100 ARI flood level in Kākā Stream. The toe portions of the fill slopes should be constructed in rockfill with an outer layer of armour stone to protect the slope from erosion in times of extreme flood events.

The fill will abut moderately steep to steep hillside slopes where there is evidence of recent slope instability. Provision will be required to construct debris barriers along the fill - natural slope interface or to install debris catch fences downslope of landslide source area to protect lots from landslide debris inundation.

It is proposed that a portion of the Valley fill contingency disposal area at the upstream extent of Area 7 is set aside for the construction of a geo-membrane lined containment cell of approximately 12 m x 20 m in plan dimensions to accommodate a small volume of low-level concentration contaminated soil. This lower portion of the slope (above extreme flood levels) has been identified as having a low geotechnical risk and area is suitable for such a cell as it is underlain by a residually bedrock and there is no evidence for the presence of high groundwater or seepage emanating from the rock. Specific geotechnical design will be required, including clay and geo-membrane liners and drainage details.

6.2.8 Subdivision servicing risk assessment

Three waters subdivision servicing to the subdivision, including water supply and stormwater detention and has been designed by T+T and are summarised in T+T report titled 'CCKV Stormwater Assessment Report Maitahi Village, Kākā Valley, Nelson' ref. 1012397.1000 v3 dated February 2025. Pipe services within the subdivision have been designed by DOP and is summarized in DOP's report titled 'Servicing Report Maitahi Village, 7 Ralphine Way, Nelson ref: 39470 dated 31 January 2025.

Risk profiles for pipe systems and other services infrastructure such as stormwater detention ponds differs from residential properties. In considering the potential risk of geotechnical hazards to three waters infrastructure we have utilized the risk criteria assessment process followed Nelson City Council (NCC) dated July 2016 (A1545157) which we understand was adopted by NCC on 10 August 2017.

In carrying out this assessment we have considered the effects of events (i.e., rainfall and seismic shaking) with a recurrence interval that would normally be catered for in design of infrastructure in accordance with NCC's Land Development Manual.

Permanent services routes have been selected to avoid areas of higher geotechnical risk, i.e., away from areas of upslope or downslope steep or unstable natural ground. Services corridors are largely positioned within areas where earthworks are proposed, in roads in on residential sections.

6.2.8.1 Potable water reservoir and maintenance road

DOP Drawing titled 'Engineering Design Overall Water & Services Plan' (ref: 3940, Dwg C300 RevP2) shows a temporary potable water reservoir is proposed to be located at RL 123 in Area 3. The reservoir platform will be cut into a small spur directly to the north of Gully 16 so as to avoid slope instability hazards that have been identified in Gully 16. Detailed design of the cut batter and observation by a Geo-professional will allow any localised rock fall from the batter to be mitigated by scaling loose rocks and/or installing rock bolts to secure loose blocks. A low risk is therefore assessed for the reservoir.

The access track to the reservoir will be traversing a slope where debris flow and rock fall hazard has been identified. Due to the short-term need for access to the reservoir (assumed to be approximately 10 years) and the rare likelihood rating that the track will be inundated, the associated risk is assessed to be Low.

6.2.8.2 Flood risk to bridge fixed piped services

Three waters piped services are proposed to be fixed to the proposed bridge crossing over Kākā Stream. The proposed elevation of the underside of the bridge is between RL 28 m to 28.4 m. T+T's report titled 'CCKV Stormwater Assessment Report Maitahi Village, Kākā Valley, Nelson' (ref;1012397.1000 v3 and dated February 2025) has assessed a 1% AEP RCP8.5 2130 flood event to have a maximum water level of RL 24.6 m. Allowing for 0.6 m of freeboard (required by the NTLDM) this provides between 2.8 m and 3.2 m of available space to fix the pipes above flood level.

Based on the above we consider there to be a rare likelihood of piped services fixed to the bridge being adversely affected by flood waters and subsequently the associated consequence is expected to be Insignificant as services are not expected to be affected by design flood events.

6.2.8.3 Bridge abutments

The bridge on Road 1 is located upstream of the flood plain alluvial deposits. As part of the detailed design for the bridge we expect the abutments will be detailed to mitigate slope and foundation hazard risks in accordance with Waka Kotahi Bridge Manual (3rd edition) and the Nelson Tasman Land Development Manual (2020).

6.2.8.4 Stormwater overland flow paths

Stormwater swales

Stormwater design considerations and preliminary design of the overland flow paths and associated swales and culverts are covered in Section 5 of T+T's Stormwater Assessment report.

The main risk posed to the development from the overland flow paths is scour of receiving surface swales due to the large flows, steep gradients and subsequent high flow velocities. The stormwater report has categorised the channels the proposes to mitigate the identified scour risk by:

- Use of rip rap rock lining of the swales.
- Specific engineer design to dissipate energy and reduce force (at detailed design stage) for very steep channels with gradients in excess of 40% (these areas have been identified as chutes in the stormwater report). These chutes have been identified predominantly where the swales discharge into Kākā Stream.

We consider that provided the proposed engineer design solutions are carried out; that the likelihood of stormwater induced scour affecting subdivision infrastructure to be unlikely. We also assess that the consequence should scour occur to be insignificant to minor, requiring minor remedial work to channel lining/ outfalls and potential short term temporary localised environmental impact.

6.2.8.5 Culverts

A secondary risk is culvert blockage from debris flows generated in the upper catchment, in particular for Culvert 2 that is located at the downstream end of the proposed Eastern Debris Fan debris protection bund. Clearance of the debris bund after any future event is a long-term maintenance requirement for the subdivision. The stormwater design has proposed the following design controls to reduce the likelihood and consequence of blockage for Culvert 2:

- Shape road to allow for overtopping and concrete line that section of road.
- Secondary scruffy dome intake.
- Oversize the pipe.
- Construction of a maintenance track to allow excavator access to clear debris from the intake.
- Concrete headwalls and energy dissipation structures.

We note that except for the 'concrete lined road section' these controls are proposed for all culverts assessed to be potentially affected by future debris flows.

Provided that the identified controls are constructed, and that regular maintenance of the debris bind is carried out we consider the likelihood of debris flow blockage of the culvert(s) to be unlikely and the consequence to be insignificant to minor. Consequence is expected to comprise minor works to clear debris from in and around the intakes and behind the debris bund, if overtopped

some road sweeping and maintenance around the area the breaching flows return to the OFP or designed conveyancing system. Environmental impacts are expected to be localised and short term.

6.2.8.6 Seismic induced flotation/ differential settlement of inground services

Measures that have been identified to mitigate liquefaction risk within Area 1 will result in a low level of risk to piped services within the residential lots and roads in this Area.

Pipework that services stormwater devices on the alluvial flood plain will need to be detailed to accommodate (without loss of function) the small-scale differential settlements that are possible under moderate to large earthquakes.

6.2.9 Design standards

We have considered the impact of proposed earthworks, and mitigation works with regard to the risk of geotechnical hazards to residential development, infrastructure and to the environment, and consider that if the recommendations contained in this report are adhered to, the geotechnical hazard risk to the proposed services corridors and permanent stormwater detention ponds is Low, (i.e., a level that is normally considered acceptable by key stakeholders).

The creation of residential lots under the RMA is undertaken on a risk-based approach. The RMA does not prescribe specific design standards. The RMA does not prescribe a specific factor of safety (FoS) that slopes should have in order for the subdivision to be consented.

Detailed design for each stage of works should be based on Best Practise.

The Nelson Tasman Land Development Manual sets out the design standards required for infrastructure construction in Nelson. It references and is supported by multiple New Zealand Standards. Retaining walls and other structures should be designed in accordance with the New Zealand Building Code. Building consents may be required for structures classified as buildings under the Building Act (1991). The Waka Kotahi Bridge Manual (3rd edition) provides guidance relating to appropriate design factors of safety of slopes and provides a method for evaluating the seismic performance of earth fills under seismic loadings. Best practise is to assess seismic performance of slopes using multiple techniques.

Best practise for assessing the response of land to earthquake induced liquefaction, liquefaction triggering and the potential ground surface damage are described in MBIE/GNS Earthquake Engineering Geotechnical Practise Modules 1 to 4 and recommend appropriate foundation types can be derived from the 3rd edition MBIE Technical Guidance developed following the Canterbury Earthquake Sequence[11].

In designing debris bunds and barriers, it is appropriate to quantify potential debris source volumes and travel velocities. Best practise design guidance described in the MBIE, Rockfall, Design Considerations for passive protection structures[12], and Hong Kong Geo Report No. 104, Review of Natural Terrain Landslide Debris-resisting Barrier Design[13] can be utilised.

An assessment of flood hazards posed by Kākā Stream and the Maitai/Maitahi River has been covered separately in T+T stormwater report titled 'CCKV Stormwater Assessment Report Maitahi Village, Kākā Valley, Nelson' (ref;1012397.1000 v3 and dated February 2025).

[11] Repairing and rebuilding houses affected by the Canterbury earthquakes | Building Performance
[12] Rockfall: Design considerations for passive protection structures (building.govt.nz)
[13] GEO Report No. 104 (cedd.gov.hk)

6.3 Post-development geotechnical hazard zonation

We have considered the beneficial impact of proposed earthworks, and mitigation options outlined in Section 6.2, on the stability of the final landform and the residual risk to infrastructure, including proposed residential and commercial lots, on completion of proposed works.

T+T Figure titled 'Post-Development Geotechnical Risk Plan', Figure 1012397.1000-GT-F60 (attached in Appendix A) shows the modified residential land development risk zonation that can be achieved based on the proposed earthworks and the recommended geotechnical hazard mitigation works contained in this report. We consider that if the recommendations contained in this report are adhered as part of design and construction it is feasible to reduce the existing slope instability risk to building platforms on lots to a Low level. We note that a low residual risk is normally considered acceptable by key stakeholders.

7 RMA Section 106 considerations

We assess that the geotechnical aspects of the earthworks, proposed lots and infrastructure within the Sites is suitable for subdivision development. This includes the land areas with an existing Medium and High risk of geotechnical hazards, provided adequate mitigation and/or remediation work as outlined in this report is undertaken as part of the subdivision development process.

Section 106 of the Resource Management Act states that a consent authority may refuse to grant a subdivision consent, or may grant a subdivision consent subject to conditions, if it considers that there is a significant risk from natural hazards. It states that an assessment of the risk from natural hazards requires a combined assessment of:

a the likelihood of natural hazards occurring (whether individually or in combination); and

b the material damage to land in respect of which the consent is sought, other land, or structures that would result from natural hazards; and

c any likely subsequent use of the land in respect of which the consent is sought that would accelerate, worsen, or result in material damage of the kind referred to in (b) above.

As part of our investigations, we have identified potential geotechnical hazards. We have considered the potential for geotechnical hazards to be to be triggered by rainstorm and earthquake events or from activities that may be undertaken on the land. We have assessed the likelihood of various slope instability scenarios and the material damage to land and structures that may arise. We have undertaken this assessment for the proposed final landform on which the lots will be formed, and with geotechnical mitigation measures in place as recommended in this report.

We note that from a planning point of view, a High risk may be considered **significant** and a Medium risk, without appropriate measures to avoid, remedy or mitigate the risk may also be potentially viewed as significant.

In Section 6 we have identified a number of measures that can be implemented as part of detailed design and construction to avoid, remedy or mitigate potentially significant risks. The implementation of these measures will require geotechnical input during the detailed design and construction stages.

Following the implementation of the earthworks design and construction stages, in accordance with our recommendations in Section 7, we consider that the modified risk rating will be as shown in T+T Figure 10012397.1000-GT-F70, attached in Appendix A.

Based on the assessment of risks undertaken for this report and with provision for resource consent conditions to be set that require geotechnical hazards to be mitigated through design and construction works we consider that there will not be a significant risk of geotechnical hazards arising from or affecting the subdivision.

We note that there may be some areas of potential Moderate and High risk on some lots at the 224 certification stage if lot owners undertake inappropriate development. We anticipate that the accompanying geotechnical statement of suitability to be provided with the 224 Application will make further recommendations regarding the location of dwellings on the lots and the way in which the land is developed by lot owners to achieve and maintain a Low level of residual risk. It would be appropriate for any ongoing requirement for future lot owners to be formulated at the 224 certification stage via consent notices.

7.1 Recommendations and proposed resource consent conditions

Recommendations are made in the following two sections to provide methodologies and practises that can achieve successful earthworks and subdivision development within the Site. These recommendations draw from the assessment and opinions provided in the preceding sections of this report where the prefix “should” is provided in context of professional opinion regarding actions to achieve desired actions. The recommended wording below has been structured to allow integration with other conditions to be volunteered and included in resource consents to be issued. As consent conditions need to confirm actions to be complied with the prefix “shall” is used below instead of “should”.

7.1.1 Subdivision earthworks

1 The investigation, design and specification for earthworks shall be carried out or reviewed by an experienced Geo-professional as defined in NZS 4404:2010 Land development and subdivision infrastructure.

2 The Geo-professional shall be retained to inspect and monitor the progress of construction works and shall keep a record of exposed site conditions prior to filling and/or topsoiling. The Contractor undertaking the works shall report immediately to the Geo-professional if soft, wet or weak ground conditions are encountered.

3 Subdivision earthworks shall include construction of slope instability mitigation works as generally identified on T+T Drawings 10012397.1000 – GT–F60 and an such other risk mitigation works that the Geo-professional considers to be necessary, based on detailed design and construction observations.

4 On satisfactory completion of earthworks the Geo-professional shall submit an earthworks completion report and Statement of Professional Opinion as to suitability of the land for building construction and include any recommendations for the building development on the lots.

5 All earth fill that will support lightweight structures shall be designed and constructed in accordance with NZS4431:2022 Engineering fill construction for lightweight structures.

6 The investigation and design of excavations in excess of 1.2 m deep shall be carried out by or reviewed by a Geo-professional experienced in hillslope development. The effect of all excavations on global stability should be assessed.

7 The investigation and design of fills in excess of 1.0 m high or any fill on ground sloping at more than 3H:1V shall be carried out or reviewed by a Geo-professional experienced in hillslope design. The effect of filling on global stability shall be assessed.

8 The investigation and design of retaining walls shall be carried out or reviewed by a Chartered Professional Engineer practicing in geotechnical engineering. All walls are to be adequately drained.

9 The investigation and design of debris fences and barriers shall be carried out by or under the supervision of a Geo-professional.

10 The proposed development shall ensure consideration is given to designating certain areas within and upslope of the subdivision for stability planting and all disturbed areas shall be stabilised progressively to minimise the risk of soil erosion.

11 Prior to commencing construction the Contractor shall prepare (or have prepared by a Geo-professional) an erosion and sediment Control plan (DESCP) in accordance with the Nelson Tasman Erosion and Sediment Control Guidelines, that specifies measures to avoid adverse offsite effects arising from land disturbance and earthworks construction. The DESCP shall be reviewed by the Geo-professional who shall advise the Contractor whether the proposed controls are appropriate for the prevailing ground conditions.

12 Prior to commencing construction the Contractor shall prepare a Construction Management Plan (CMP) for the approval of the Geo-professional. The CMP should include copies of approved designs and specifications provided by the earthworks designer, a programme and sequencing plan for the works, names and contact details of the Contractor's site representatives, a copy of the approved DESCP, a copy of the inspection schedule provided by the Geo-professional. A copy of the CMP shall be held on Site and be updated regularly as works proceed.

7.1.2 Subdivision Consent

1 The Geo-professional who is engaged to monitor and inspect the earthworks shall be retained to provide statements of suitability for residential development at the 224 certification stage.

2 The detailed design of all subdivision services shall be reviewed by the Geo-professional identified in Condition 1 who shall specify appropriate slope instability mitigation measures as part of the detailed design process. This shall include verification of all secondary flow routes and detailing of erosion protection measures to mitigate adverse effects of stormwater conveyance across natural ground and engineered ground.

3 The Geo-Professional identified in Condition 1 shall undertake regular inspections of the ground conditions exposed during construction of the water, wastewater and stormwater infrastructure and shall advise the Contractor of measures to take to mitigate geotechnical hazards that are identified.

4 On satisfactory completion of earthworks the Geo-Professional shall submit a geotechnical completion report and Statement of Professional Opinion as to suitability of the land for Building Construction and include any recommendations for the building to ensure that future development on the lots does not adversely affect slope stability as required by NZS4404:2010.

- The certification shall define the area within proposed lots that is suitable for building where there is no significant risk from geotechnical natural hazards and shall list development conditions pertaining to the lot to maintain the stability of the lot. Any such conditions shall be included in consent notices for each lot.

5 On completion of construction, the Geo-professional shall review the geotechnical risk to the water, wastewater and stormwater infrastructure in accordance with the Nelson City Council risk criteria July 2016 (A1545157) and provide a statement of professional opinion of the level geotechnical risk to the pipe network.

6 All retaining structures shall comply with the requirements of the Building Code.

7 All infrastructure development shall be undertaken in accordance with the requirements of the Nelson Tasman Land Development Manual (2020).

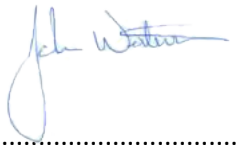
8 Applicability

This report has been prepared for the exclusive use of our client CCKV Maitai Dev Co Lp, with respect to the particular brief given to us and it may not be relied upon in other contexts or for any other purpose, or by any person other than our client, without our prior written agreement.

We understand and agree that our client will submit this report as part of an application for resource consent and that Nelson City Council as the consenting authority will use this report for the purpose of assessing that application.

Tonkin & Taylor Ltd
Environmental and Engineering Consultants

Report prepared by:



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John Westerson
Engineering Geologist

Authorised for Tonkin & Taylor Ltd by:

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Mark Foley
Project Director

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Dan Andrews
Geotechnical Engineer

5-Feb-25
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Appendix A T+T Figures

- **1012397.1000-GT-F01 Site Investigation Location Plan 1/2**
- **1012397.1000-GT-F02 Site Investigation Location Plan 2/2**
- **1012397.1000-GT-F03 Engineering Geology Plan**
- **1012397.1000-GT-F10 Inferred Engineering Geological Section S1**
- **1012397.1000-GT-F11 Inferred Engineering Geological Section S2**
- **1012397.1000-GT-F12 Inferred Engineering Geological Section S3**
- **1012397.1000-GT-F13 Inferred Engineering Geological Section S4**
- **1012397.1000-GT-F14 Inferred Engineering Geological Section S5**
- **1012397.1000-GT-F15 Inferred Engineering Geological Section A1**
- **1012397.1000-GT-F16 Inferred Engineering Geological Section A2**
- **1012397.1000-GT-F17 Inferred Engineering Geological Section A3**
- **1012397.1000-GT-F18 Inferred Engineering Geological Section A4**
- **1012397.1000-GT-F19 Inferred Engineering Geological Section A5**
- **1012397.1000-GT-F20 Inferred Engineering Geological Section A6**
- **1012397.1000-GT-F21 Inferred Engineering Geological Section A7**
- **1012397.1000-GT-F22 Inferred Engineering Geological Section A8**
- **1012397.1000-GT-F50 Pre-Development Geotechnical Risk Plan**
- **1012397.1000-GT-F60 Geotechnical Hazard Mitigation Recommendations**
- **1012397.1000-GT-F70 Post-Development Geotechnical Risk Plan**

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LEGEND

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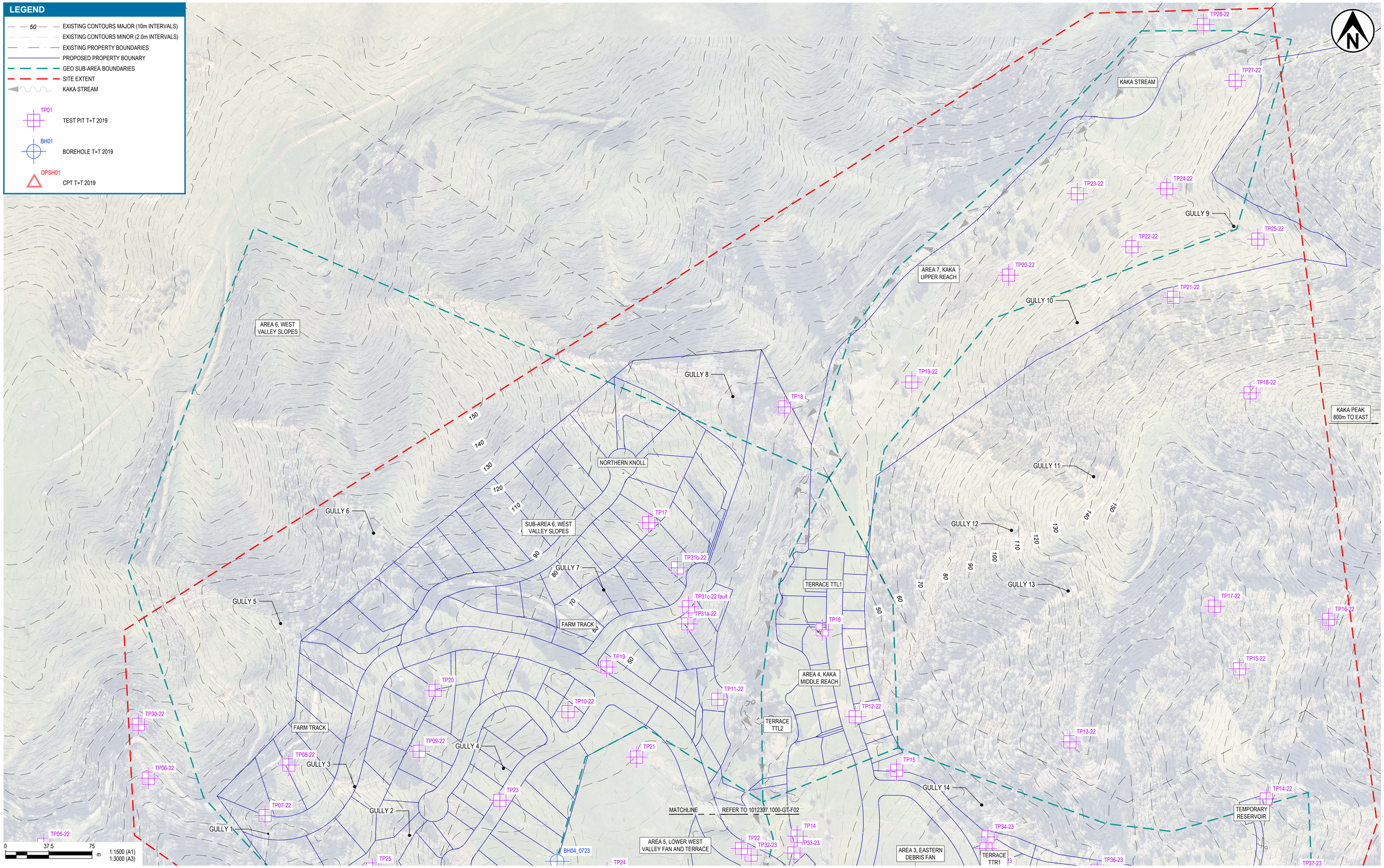
- EXISTING CONTOURS MINOR (2.0m INTERVALS)
- EXISTING PROPERTY BOUNDARIES
- PROPOSED PROPERTY BOUNARY
- GEO SUB-AREA BOUNDARIES
- SITE EXTENT
- KAKA STREAM
- TP01 — TEST PIT T+T 2019
- BH01 — BOREHOLE T+T 2019
- DPSH01 — CPT T+T 2019



NOTES:
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3. NOT ALL GEOMORPHOLOGY FEATURES BEYOND THE 'EXTENT OF MAPPING FOR THIS REPORT' BOUNDARY ARE SHOWN.
4. LOT BOUNDARIES SOURCED FROM DAVIS OGILVIE SURVEYORS, DATED 27/01/2025.

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DESIGNED	JXWW	FEB.25	FIGURE STATUS
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DESIGN CHECKED	BYMU	FEB.25	PROJECT PHASE
FIGURE CHECKED	BYMU	FEB.25	

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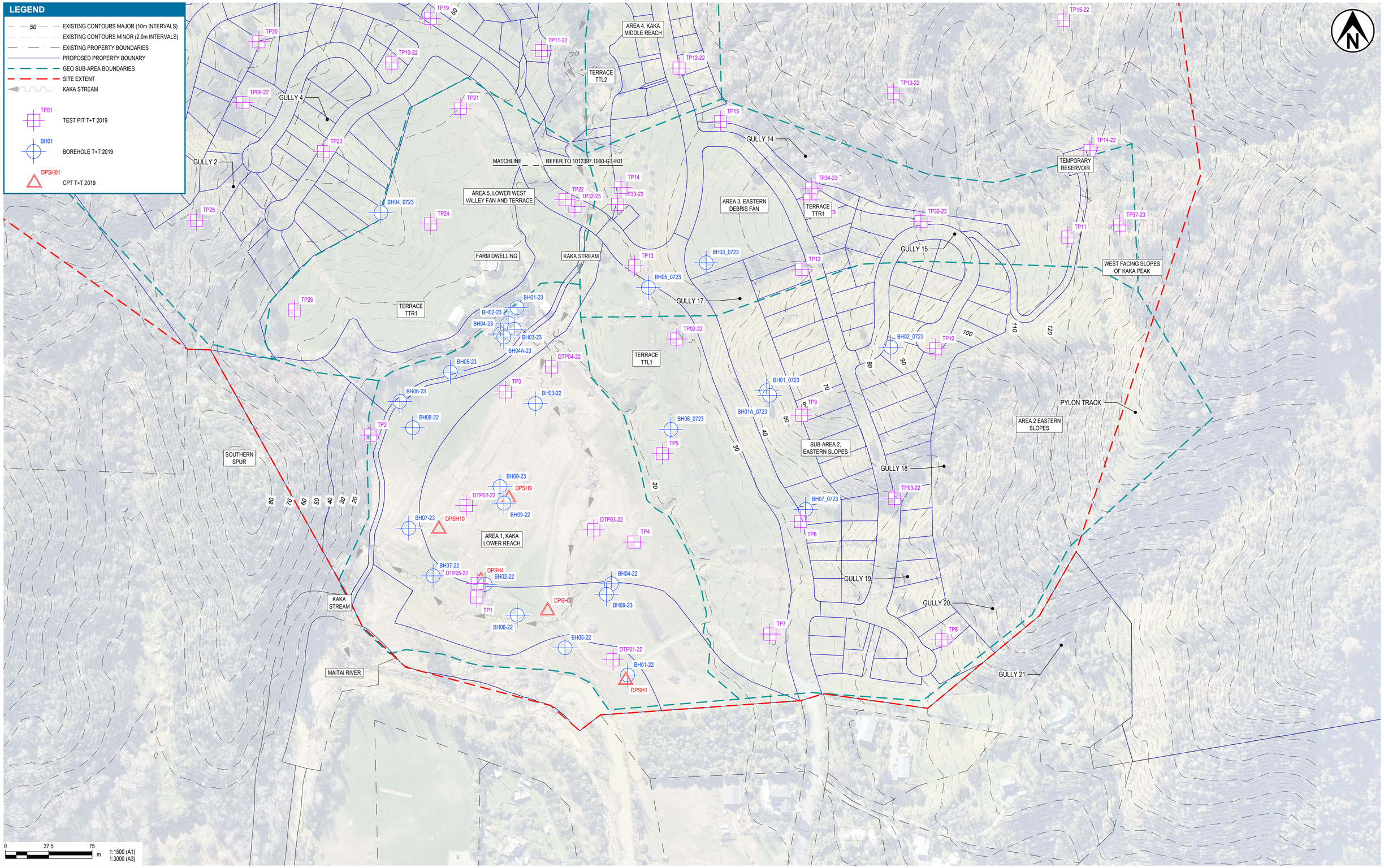
CLIENT **CCKV MAITAI DEV CO LP**

PROJECT **KAKA SUBDIVISION, MAITAI VALLEY, NELSON**

TITLE MAITAHI SUBDIVISION
SITE INVESTIGATION PLAN - SHEET 1

SCALE (A1) 1:1500 FIG No. 1012937.1000-GT-F01 REV 1

C:\12dSynergy\data\ALBTCAD\Maitahi Resource Consent Design_1359\CAD\FIG\1012397.1000-GT-F01_F02.dwg 2025-Feb-05 2:59:36 pm Plotted By: DFL



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DESIGN CHECKED	BYMU	FEB.25
FIGURE CHECKED	BYMU	FEB.25

FIGURE STATUS
RESOURCE CONSENT ISSUE
PROJECT PHASE

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CLIENT **CCKV MAITAI DEV CO LP**

PROJECT **KAKA SUBDIVISION, MAITAI VALLEY, NELSON**

TITLE MAITAHI SUBDIVISION
SITE INVESTIGATION PLAN - SHEET 2

SCALE (A1) 1:1500 FIG No. 1012937.1000-GT-F02 REV 1

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LEGEND

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- EXISTING PROPERTY BOUNDARIES
- PROPOSED LOT BOUNDARY
- SITE EXTENT
- RECENT LANDSLIDE SCARP
- DEGRADED LANDSLIDE SCARP
- TENSION CRACK
- AREA DISPLAYING EVIDENCE OF PRE-HISTORIC/GEOLOGICAL AGE INSTABILITY
- RECENT LANDSLIDE AREA
- BOULDERS NOTED ON GROUND SURFACE
- AREAS OF HUMMOCKY GROUND
- AREAS OF REEDS
- ROCK OUTCROPS
- TP01 TEST PIT LOCATION
- BH01 BOREHOLE LOCATION
- DPSH01 CPT TEST LOCATION
- INFERRED FAULT LINE

KAKA PEAK SOUTH-WEST RIDGE

0 62.5 125 m

1:2500 (A1)
1:5000 (A3)

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4. LOT BOUNDARIES SOURCED FROM DAVIS OGILVIE SURVEYORS, DATED 27/01/2025.

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FIGURE CHECKED	DJA	FEB.25

FIGURE STATUS
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CLIENT **CCKV MAITAI DEV CO LP**

PROJECT **KAKA SUBDIVISION, MAITAI VALLEY, NELSON**

TITLE MAITAHI SUBDIVISION
ENGINEERING GEOLOGY PLAN

SCALE (A1) 1:2500 FIG No. 1012937.1000-GT-F03 REV 1

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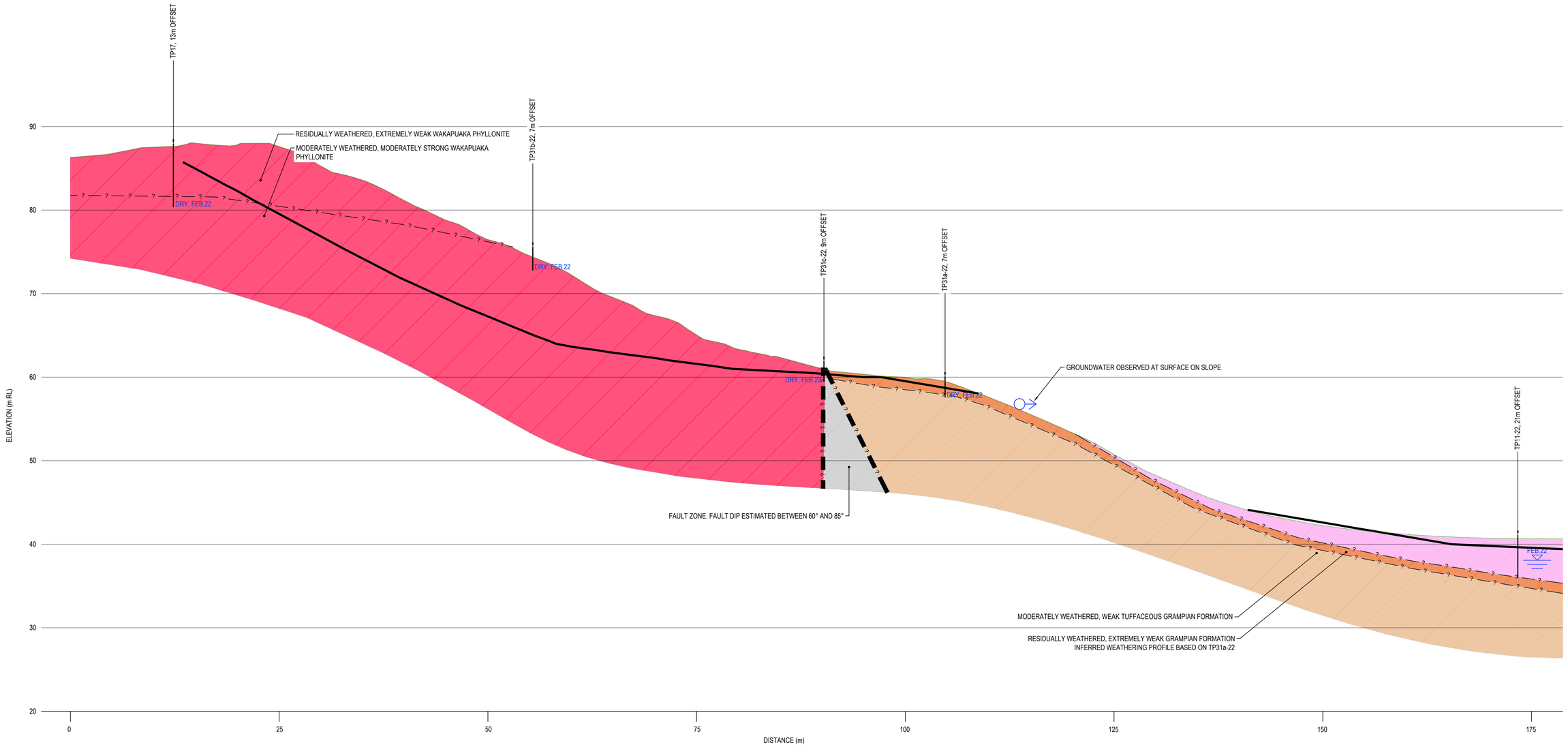

S1 / F03 CROSS SECTION

HORIZONTAL SCALE 1:250
VERTICAL SCALE 1:250

LEGEND

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- DESIGN GROUND LEVEL (D.O. JAN. 24)
- INFERRED FAULTS
- INFERRED CONTACTS
- DATE — INVESTIGATION LOCATIONS (DEPTHS APPROXIMATE)
- DRY, DATE — WATER LEVEL
- SEEPAGE
- WAKAPUAKA PHYLLONITE
- UPPER ALLUVIUM
- BURIED TOPSOIL
- LOWER ALLUVIUM
- KAKA FORMATION
- GRAMPIAN FORMATION
- FAN DEPOSITS
- BOTANICAL HILL FORMATION
- COLLUVIUM DEPOSITS
- RESIDUAL SOIL

0 6.25 12.5 m
1:250 (A1)
1:500 (A3)

NOTES:
1. UNITS ARE IN METRES UNLESS STATED OTHERWISE.
2. LEVELS TO NZVD 2016
3. ENGINEERING GEOLOGICAL MODELS ARE INFERRED FROM THE SURFACE CONDITIONS, MAPPED GEOLOGY, AND DISCRETE SUBSURFACE INVESTIGATION LOCATIONS. IT MUST BE APPRECIATED THAT GROUND CONDITIONS AWAY FROM THE INVESTIGATION LOCATIONS MAY VARY FROM CONDITIONS SHOWN HERE.
4. PROPOSED GROUND SURFACE PROVIDED BY DAVIS OGILVIE LTD.

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CLIENT **CCKV MAITAI DEV CO LP**

PROJECT **KAKA SUBDIVISION, MAITAI VALLEY, NELSON**

TITLE MAITAHI SUBDIVISION
INFERRED ENGINEERING GEOLOGICAL SECTION S1

SCALE (A1) 1:250 FIG No. 1012937.1000-GT-F10 REV 1

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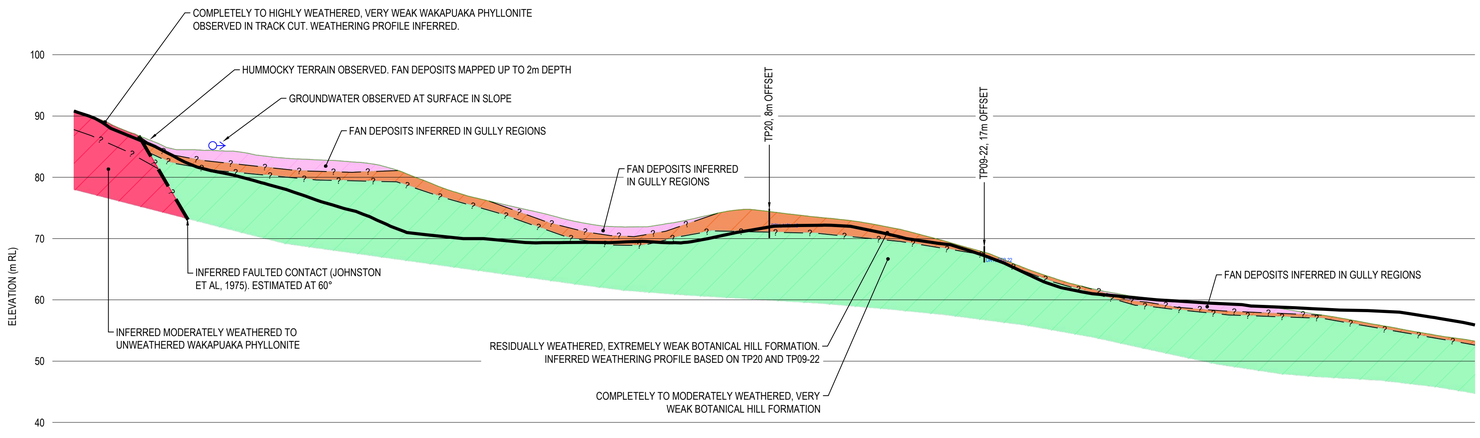

S2 / F03 CROSS SECTION

HORIZONTAL SCALE 1:500
VERTICAL SCALE 1:500

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1:500 (A1)
1:1000 (A3)

LEGEND

- LIDAR 2021 EXISTING SURFACE
- DESIGN GROUND LEVEL (D.O. JAN. 24)
- INFERRED FAULTS
- INFERRED CONTACTS
- DATE — INVESTIGATION LOCATIONS (DEPTHS APPROXIMATE)
- DRY, DATE — WATER LEVEL
- SEEPAGE
- WAKAPUAKA PHYLLONITE
- UPPER ALLUVIUM
- BURIED TOPSOIL
- LOWER ALLUVIUM
- KAKA FORMATION
- GRAMPIAN FORMATION
- FAN DEPOSITS
- BOTANICAL HILL FORMATION
- COLLUVIUM DEPOSITS
- RESIDUAL SOIL

NOTES:
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4. PROPOSED GROUND SURFACE PROVIDED BY DAVIS OGILVIE LTD.

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FIGURE CHECKED	DJA	FEB.25

FIGURE STATUS: RESOURCE CONSENT ISSUE
PROJECT PHASE

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APPROVED DATE

CLIENT **CCKV MAITAI DEV CO LP**

PROJECT **KAKA SUBDIVISION, MAITAI VALLEY, NELSON**

TITLE MAITAHI SUBDIVISION
INFERRED ENGINEERING GEOLOGICAL SECTION S2

SCALE (A1) 1:500 FIG No. 1012937.1000-GT-F11 REV 1

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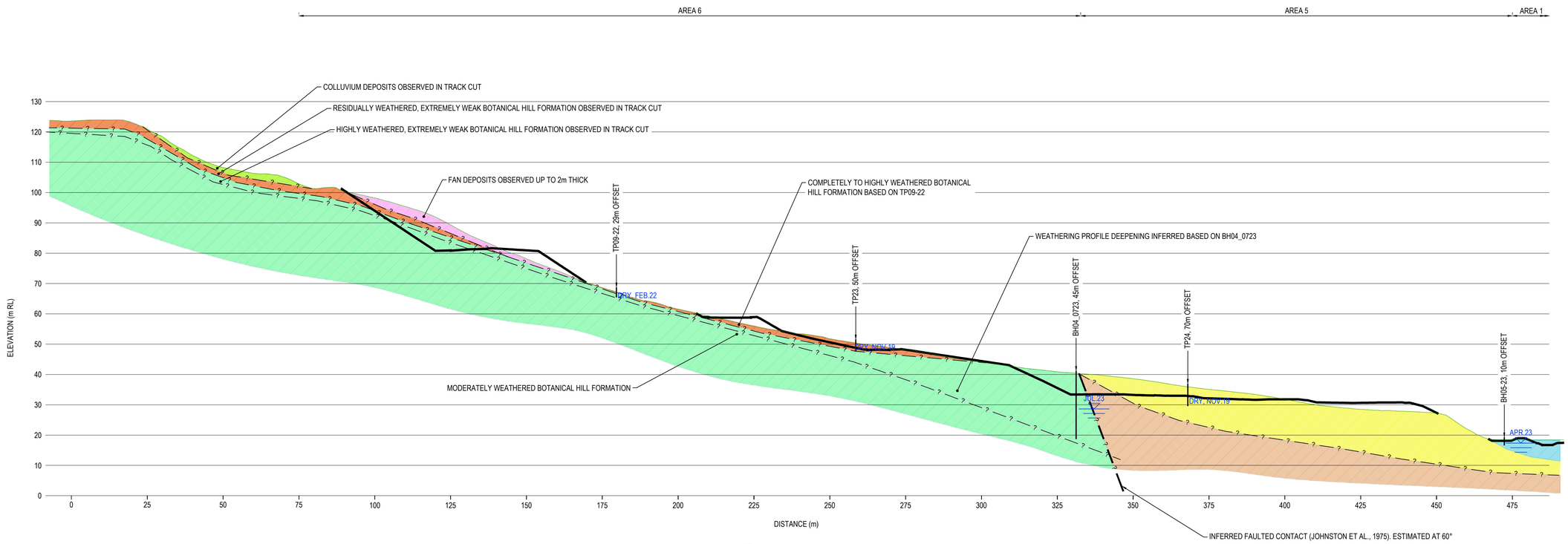

S3 / F03 CROSS SECTION
HORIZONTAL SCALE 1:750
VERTICAL SCALE 1:750

LEGEND

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- DESIGN GROUND LEVEL (D.O. JAN. 24)
- INFERRED FAULTS
- INFERRED CONTACTS
- DATE — INVESTIGATION LOCATIONS (DEPTHS APPROXIMATE)
- DRY, DATE — WATER LEVEL
- SEEPAGE
- WAKAPUAKA PHYLLONITE
- UPPER ALLUVIUM
- BURIED TOPSOIL
- LOWER ALLUVIUM
- KAKA FORMATION
- GRAMPIAN FORMATION
- FAN DEPOSITS
- BOTANICAL HILL FORMATION
- COLLUVIUM DEPOSITS
- RESIDUAL SOIL

0 18.75 37.5 m
1:750 (A1)
1:1500 (A3)

NOTES:
1. UNITS ARE IN METRES UNLESS STATED OTHERWISE.
2. LEVELS TO NZVD 2016
3. ENGINEERING GEOLOGICAL MODELS ARE INFERRED FROM THE SURFACE CONDITIONS, MAPPED GEOLOGY, AND DISCRETE SUBSURFACE INVESTIGATION LOCATIONS. IT MUST BE APPRECIATED THAT GROUND CONDITIONS AWAY FROM THE INVESTIGATION LOCATIONS MAY VARY FROM CONDITIONS SHOWN HERE.
4. PROPOSED GROUND SURFACE PROVIDED BY DAVIS OGILVIE LTD.

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DESIGNED	JXWW	FEB.25
DRAWN	DFL	FEB.25
DESIGN CHECKED	MRF	FEB.25
FIGURE CHECKED	DJA	FEB.25

FIGURE STATUS
RESOURCE CONSENT ISSUE
PROJECT PHASE

NOT FOR CONSTRUCTION

THIS DRAWING IS NOT TO BE USED FOR CONSTRUCTION PURPOSES UNLESS SIGNED AS APPROVED

APPROVED DATE

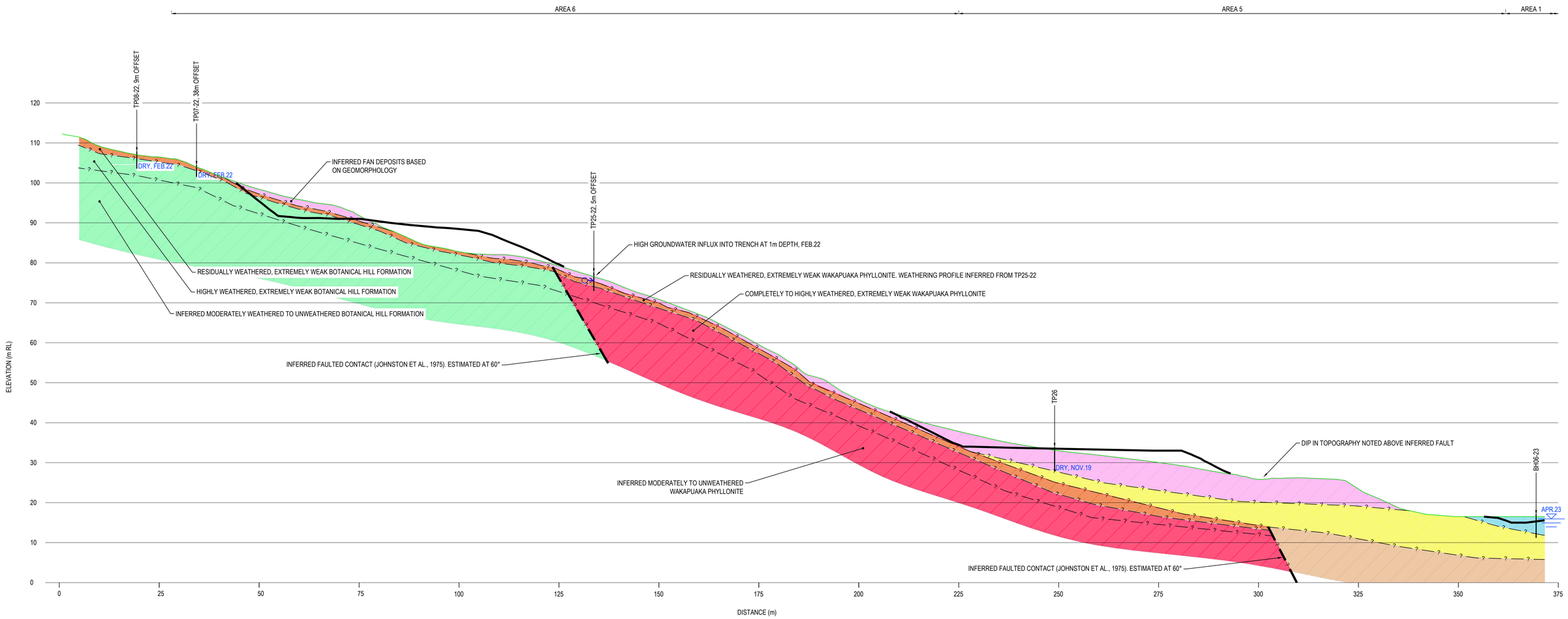
CLIENT **CCKV MAITAI DEV CO LP**

PROJECT **KAKA SUBDIVISION, MAITAI VALLEY, NELSON**

TITLE MAITAHI SUBDIVISION
INFERRED ENGINEERING GEOLOGICAL SECTION S3

SCALE (A1) 1:750 FIG No. 1012937.1000-GT-F12 REV 1

C:\12dSynergy\data\ALBTCAD\Maitahi Resource Consent Design_1359\CAD\FIG\1012397.1000-GT-F20.dwg 2025-Feb-04 7:02:58 pm Plotted By: DFL



S4 CROSS SECTION

F03

HORIZONTAL SCALE 1:500
VERTICAL SCALE 1:500

LEGEND

- LIDAR 2021 EXISTING SURFACE
- DESIGN GROUND LEVEL (D.O. JAN. 24)
- INFERRED FAULTS
- INFERRED CONTACTS
- DATE — INVESTIGATION LOCATIONS (DEPTHS APPROXIMATE)
- DRY, DATE — WATER LEVEL
- SEEPAGE
- WAKAPUAKA PHYLLONITE
- UPPER ALLUVIUM
- BURIED TOPSOIL
- LOWER ALLUVIUM
- KAKA FORMATION
- GRAMPIAN FORMATION
- FAN DEPOSITS
- BOTANICAL HILL FORMATION
- COLLUVIUM DEPOSITS
- RESIDUAL SOIL

0 12.5 25 m
1:500 (A1)
1:1000 (A3)

NOTES:
1. UNITS ARE IN METRES UNLESS STATED OTHERWISE.
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3. ENGINEERING GEOLOGICAL MODELS ARE INFERRED FROM THE SURFACE CONDITIONS, MAPPED GEOLOGY, AND DISCRETE SUBSURFACE INVESTIGATION LOCATIONS. IT MUST BE APPRECIATED THAT GROUND CONDITIONS AWAY FROM THE INVESTIGATION LOCATIONS MAY VARY FROM CONDITIONS SHOWN HERE.
4. PROPOSED GROUND SURFACE PROVIDED BY DAVIS OGILVIE LTD.

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DESIGNED	JXWW	FEB.25
DRAWN	DFL	FEB.25
DESIGN CHECKED	MRF	FEB.25
FIGURE CHECKED	DJA	FEB.25

FIGURE STATUS
RESOURCE CONSENT ISSUE
PROJECT PHASE

NOT FOR CONSTRUCTION

THIS DRAWING IS NOT TO BE USED FOR CONSTRUCTION PURPOSES UNLESS SIGNED AS APPROVED

APPROVED DATE

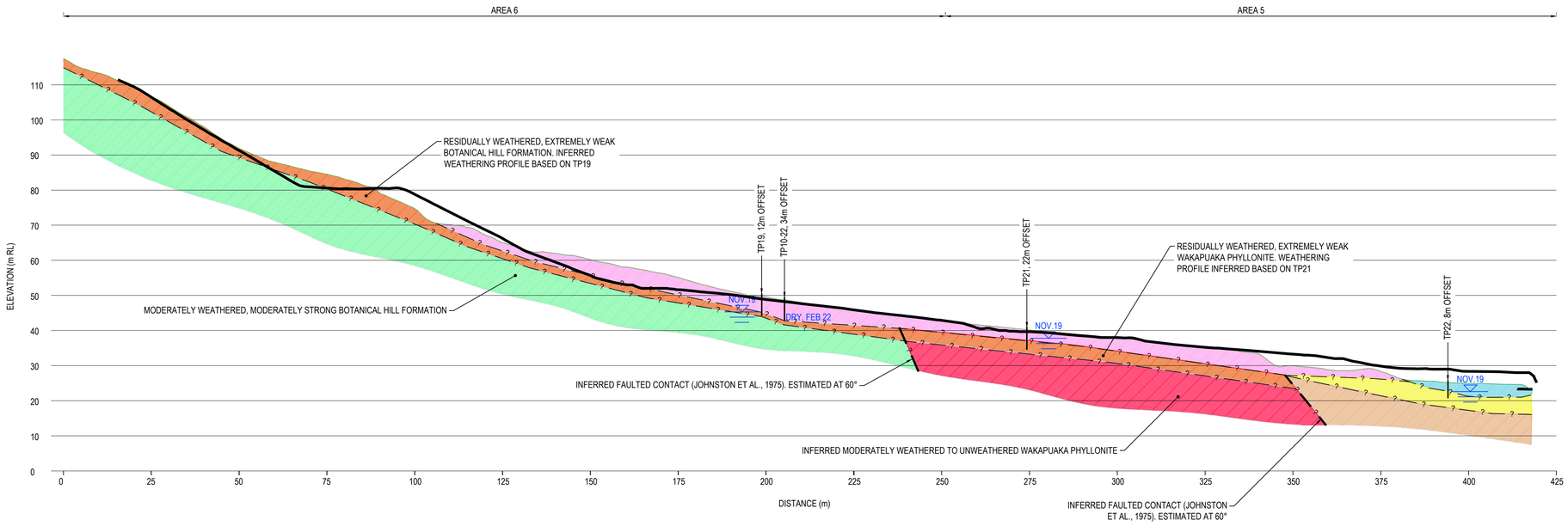
CLIENT **CCKV MAITAI DEV CO LP**

PROJECT **KAKA SUBDIVISION, MAITAI VALLEY, NELSON**

TITLE MAITAHI SUBDIVISION
INFERRED ENGINEERING GEOLOGICAL SECTION S4

SCALE (A1) 1:500 FIG No. 1012937.1000-GT-F13 REV 1

C:\12dSynergy\data\ALBTCAD\Maitahi Resource Consent Design_1359\CAD\FIG\1012397.1000-GT-F20.dwg 2025-Feb-04 7:02:47 pm Plotted By: DFL



S5 CROSS SECTION
F03

HORIZONTAL SCALE 1:750
VERTICAL SCALE 1:750

LEGEND

- LIDAR 2021 EXISTING SURFACE
- DESIGN GROUND LEVEL (D.O. JAN. 24)
- INFERRED FAULTS
- INFERRED CONTACTS
- INVESTIGATION LOCATIONS (DEPTHS APPROXIMATE)
- WATER LEVEL
- SEEPAGE
- WAKAPUAKA PHYLLONITE
- UPPER ALLUVIUM
- BURIED TOPSOIL
- LOWER ALLUVIUM
- KAKA FORMATION
- GRAMPIAN FORMATION
- FAN DEPOSITS
- BOTANICAL HILL FORMATION
- COLLUVIUM DEPOSITS
- RESIDUAL SOIL

0 18.75 37.5 m
1:750 (A1)
1:1500 (A3)

NOTES:
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4. PROPOSED GROUND SURFACE PROVIDED BY DAVIS OGILVIE LTD.

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DESIGNED	JXWW	FEB.25
DRAWN	DFL	FEB.25
DESIGN CHECKED	MRF	FEB.25
FIGURE CHECKED	DJA	FEB.25

FIGURE STATUS
RESOURCE CONSENT ISSUE
PROJECT PHASE

NOT FOR CONSTRUCTION

THIS DRAWING IS NOT TO BE USED FOR CONSTRUCTION PURPOSES UNLESS SIGNED AS APPROVED

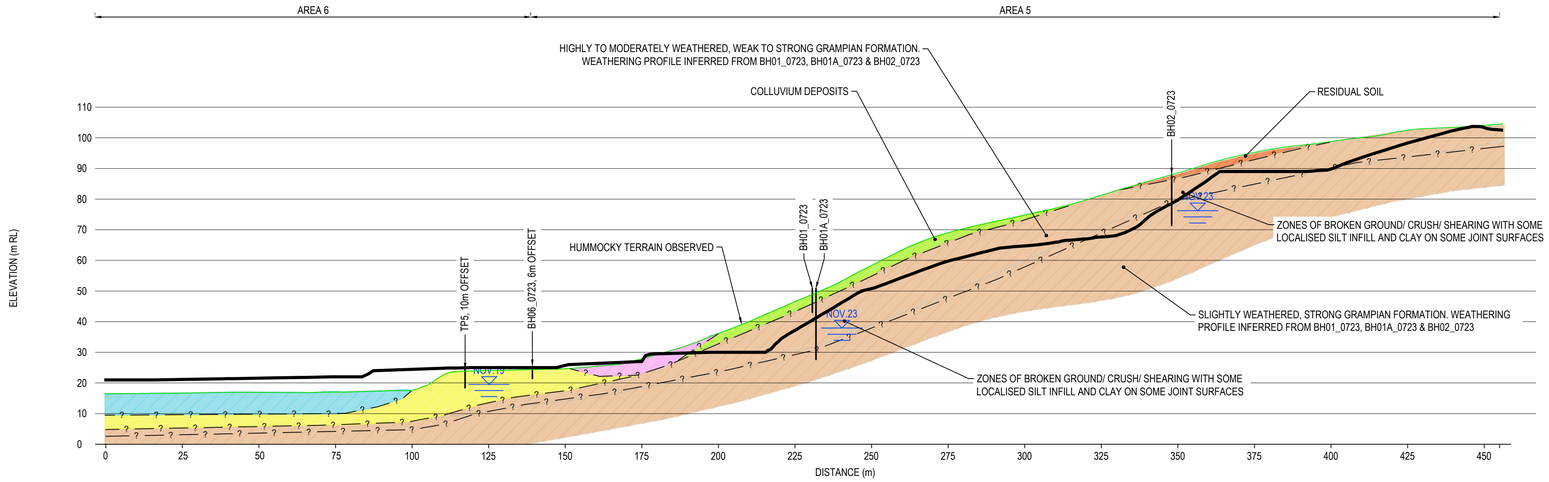
APPROVED DATE

CLIENT **CCKV MAITAI DEV CO LP**

PROJECT **KAKA SUBDIVISION, MAITAI VALLEY, NELSON**

TITLE MAITAHI SUBDIVISION
INFERRED ENGINEERING GEOLOGICAL SECTION S5

SCALE (A1) 1:750 FIG No. 1012937.1000-GT-F14 REV 1



A1 / F03 CROSS SECTION
HORIZONTAL SCALE 1:1000
VERTICAL SCALE 1:1000

LEGEND

- LIDAR 2021 EXISTING SURFACE
- DESIGN GROUND LEVEL (D.O. JAN. 24)
- INFERRED FAULTS
- INFERRED CONTACTS
- DATE — INVESTIGATION LOCATIONS (DEPTHS APPROXIMATE)
- DRY, DATE — WATER LEVEL
- SEEPAGE
- WAKAPUAKA PHYLLONITE
- UPPER ALLUVIUM
- BURIED TOPSOIL
- LOWER ALLUVIUM
- KAKA FORMATION
- GRAMPIAN FORMATION
- FAN DEPOSITS
- BOTANICAL HILL FORMATION
- COLLUVIUM DEPOSITS
- RESIDUAL SOIL

0 25 50 m
1:1000 (A1)
1:2000 (A3)

NOTES:
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DESIGNED	JXWW	FEB.25	FIGURE STATUS
DRAWN	DFL	FEB.25	RESOURCE CONSENT ISSUE
DESIGN CHECKED	MRF	FEB.25	PROJECT PHASE
FIGURE CHECKED	DJA	FEB.25	

NOT FOR CONSTRUCTION

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APPROVED DATE

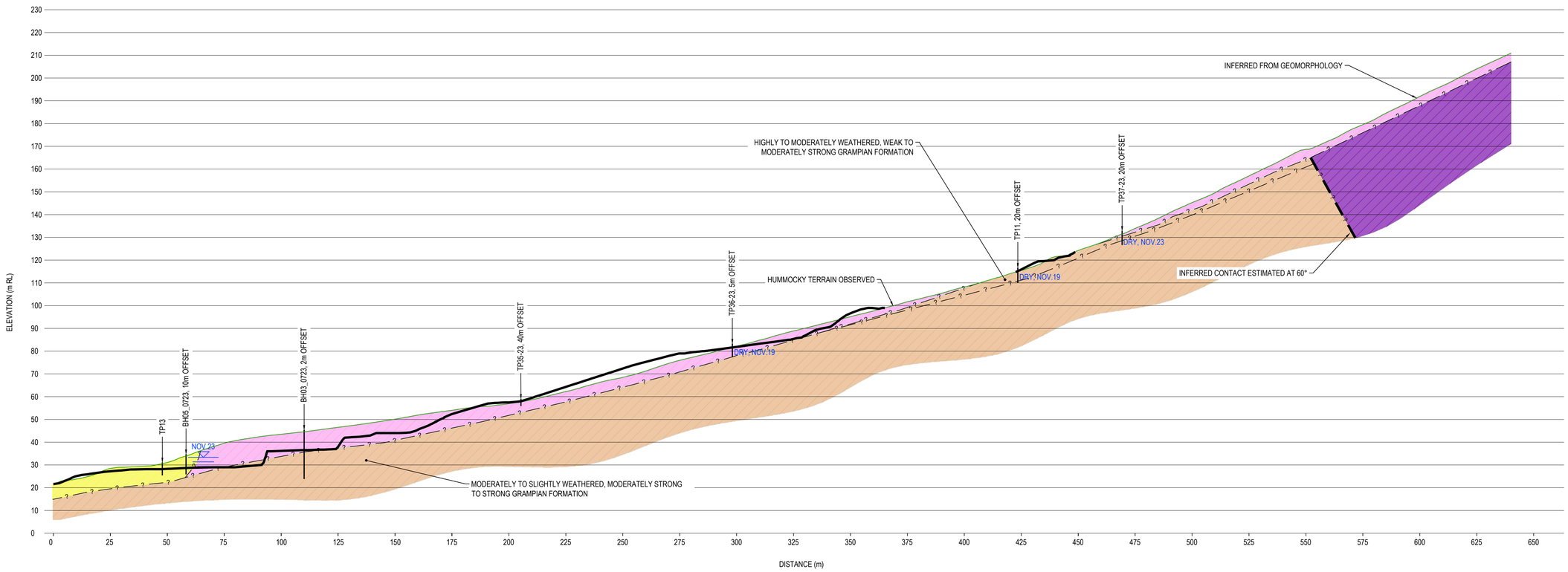
CLIENT **CCKV MAITAI DEV CO LP**

PROJECT **KAKA SUBDIVISION, MAITAI VALLEY, NELSON**

TITLE MAITAHI SUBDIVISION
INFERRED ENGINEERING GEOLOGICAL SECTION A1

SCALE (A1) 1:1000 FIG No. 1012937.1000-GT-F15 REV 1

C:\12dSynergy\data\ALBTCAD\Maitahi Resource Consent Design_1359\CAD\FIG\1012397.1000-GT-F20.dwg 2025-Feb-04 7:03:08 pm Plotted By: DFL



A2 CROSS SECTION
F03

HORIZONTAL SCALE 1:1000
VERTICAL SCALE 1:1000

0 25 50 m
1:1000 (A1)
1:2000 (A3)

LEGEND

- LIDAR 2021 EXISTING SURFACE
- DESIGN GROUND LEVEL (D.O. JAN. 24)
- INFERRED FAULTS
- INFERRED CONTACTS
- DATE — INVESTIGATION LOCATIONS (DEPTHS APPROXIMATE)
- DRY, DATE — WATER LEVEL
- SEEPAGE
- WAKAPUAKA PHYLLONITE
- UPPER ALLUVIUM
- BURIED TOPSOIL
- LOWER ALLUVIUM
- KAKA FORMATION
- GRAMPIAN FORMATION
- FAN DEPOSITS
- BOTANICAL HILL FORMATION
- COLLUVIUM DEPOSITS
- RESIDUAL SOIL

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DESIGNED	JXWW	FEB.25	FIGURE STATUS
DRAWN	DFL	FEB.25	RESOURCE CONSENT ISSUE
DESIGN CHECKED	MRF	FEB.25	PROJECT PHASE
FIGURE CHECKED	DJA	FEB.25	

NOT FOR CONSTRUCTION

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APPROVED DATE

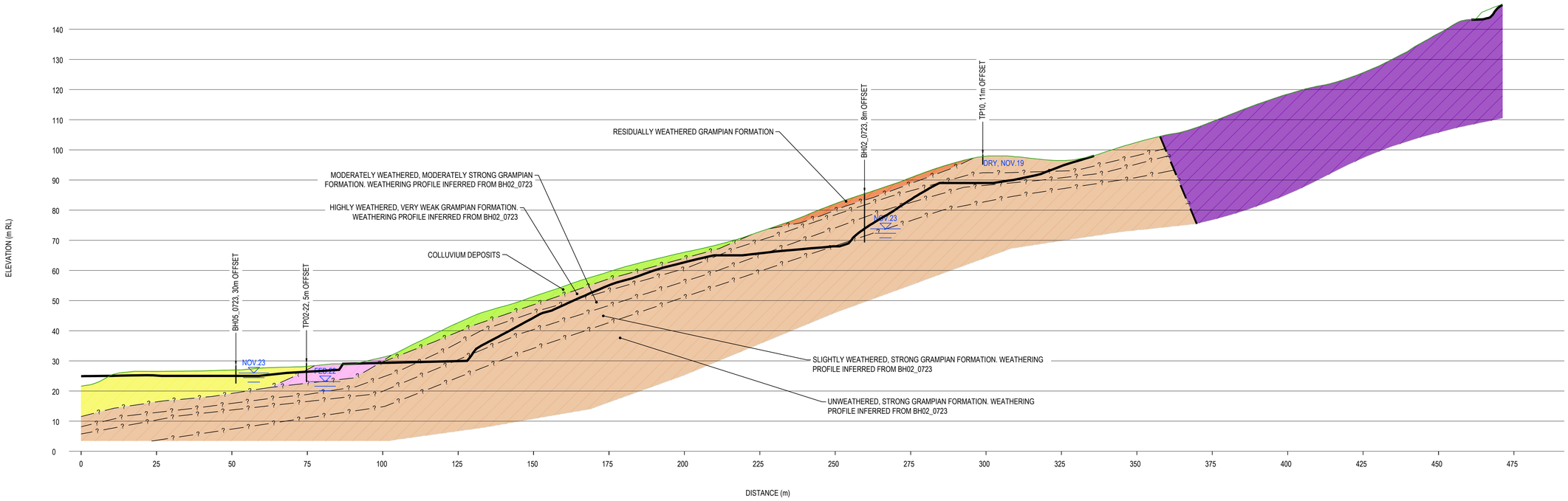
CLIENT **CCKV MAITAI DEV CO LP**

PROJECT **KAKA SUBDIVISION, MAITAI VALLEY, NELSON**

TITLE MAITAHI SUBDIVISION
INFERRED ENGINEERING GEOLOGICAL SECTION A2

SCALE (A1) 1:1000 FIG No. 1012937.1000-GT-F16 REV 1

C:\12dSynergy\data\ALBTCAD\Maitahi Resource Consent Design_1359\CAD\FIG\1012397.1000-GT-F20.dwg 2025-Feb-04 7:03:11 pm Plotted By: DFL



A3 CROSS SECTION

F03

HORIZONTAL SCALE 1:750
VERTICAL SCALE 1:750

0 18.75 37.5 m
1:750 (A1)
1:1500 (A3)

LEGEND

- LIDAR 2021 EXISTING SURFACE
- DESIGN GROUND LEVEL (D.O. JAN. 24)
- INFERRED FAULTS
- INFERRED CONTACTS
- DATE — INVESTIGATION LOCATIONS (DEPTHS APPROXIMATE)
- DRY, DATE — WATER LEVEL
- SEEPAGE
- WAKAPUAKA PHYLLONITE
- UPPER ALLUVIUM
- BURIED TOPSOIL
- LOWER ALLUVIUM
- KAKA FORMATION
- GRAMPIAN FORMATION
- FAN DEPOSITS
- BOTANICAL HILL FORMATION
- COLLUVIUM DEPOSITS
- RESIDUAL SOIL

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NOTES:
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4. PROPOSED GROUND SURFACE PROVIDED BY DAVIS OGILVIE LTD.

DESIGNED	JXWW	FEB.25
DRAWN	DFL	FEB.25
DESIGN CHECKED	MRF	FEB.25
FIGURE CHECKED	DJA	FEB.25

FIGURE STATUS
RESOURCE CONSENT ISSUE
PROJECT PHASE

NOT FOR CONSTRUCTION

THIS DRAWING IS NOT TO BE USED FOR CONSTRUCTION PURPOSES UNLESS SIGNED AS APPROVED

APPROVED DATE

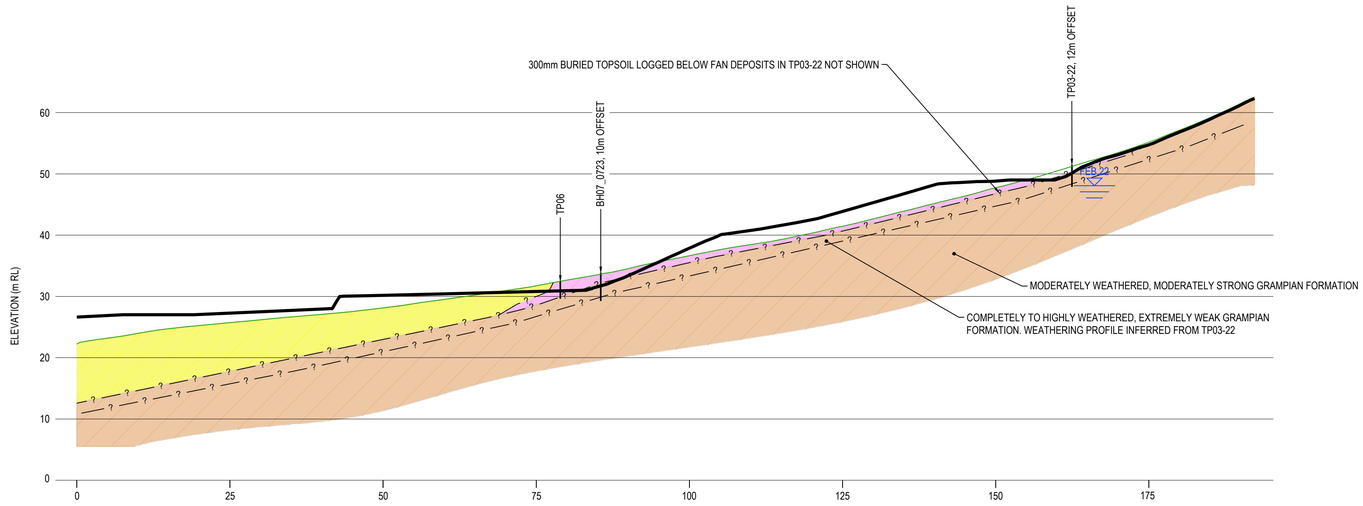
CLIENT **CCKV MAITAI DEV CO LP**

PROJECT **KAKA SUBDIVISION, MAITAI VALLEY, NELSON**

TITLE MAITAHI SUBDIVISION
INFERRED ENGINEERING GEOLOGICAL SECTION A3

SCALE (A1) 1:750 FIG No. 1012937.1000-GT-F17 REV 1

C:\12dSynergy\data\ALBTCAD\Maitahi Resource Consent Design_1359\CAD\FIG\1012397.1000-GT-F20.dwg 2025-Feb-04 7:03:24 pm Plotted By: DFL



A4 CROSS SECTION
F03

HORIZONTAL SCALE 1:500
VERTICAL SCALE 1:500

LEGEND

- LIDAR 2021 EXISTING SURFACE
- DESIGN GROUND LEVEL (D.O. JAN. 24)
- INFERRED FAULTS
- INFERRED CONTACTS
- DATE — INVESTIGATION LOCATIONS (DEPTHS APPROXIMATE)
- DRY, DATE — WATER LEVEL
- SEEPAGE
- WAKAPUAKA PHYLLONITE
- UPPER ALLUVIUM
- BURIED TOPSOIL
- LOWER ALLUVIUM
- KAKA FORMATION
- GRAMPIAN FORMATION
- FAN DEPOSITS
- BOTANICAL HILL FORMATION
- COLLUVIUM DEPOSITS
- RESIDUAL SOIL

0 12.5 25 m
1:500 (A1)
1:1000 (A3)

NOTES:
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3. ENGINEERING GEOLOGICAL MODELS ARE INFERRED FROM THE SURFACE CONDITIONS, MAPPED GEOLOGY, AND DISCRETE SUBSURFACE INVESTIGATION LOCATIONS. IT MUST BE APPRECIATED THAT GROUND CONDITIONS AWAY FROM THE INVESTIGATION LOCATIONS MAY VARY FROM CONDITIONS SHOWN HERE.
4. PROPOSED GROUND SURFACE PROVIDED BY DAVIS OGILVIE LTD.

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DESIGNED	JXWW	FEB.25	FIGURE STATUS
DRAWN	DFL	FEB.25	RESOURCE CONSENT ISSUE
DESIGN CHECKED	MRF	FEB.25	PROJECT PHASE
FIGURE CHECKED	DJA	FEB.25	

NOT FOR CONSTRUCTION

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APPROVED DATE

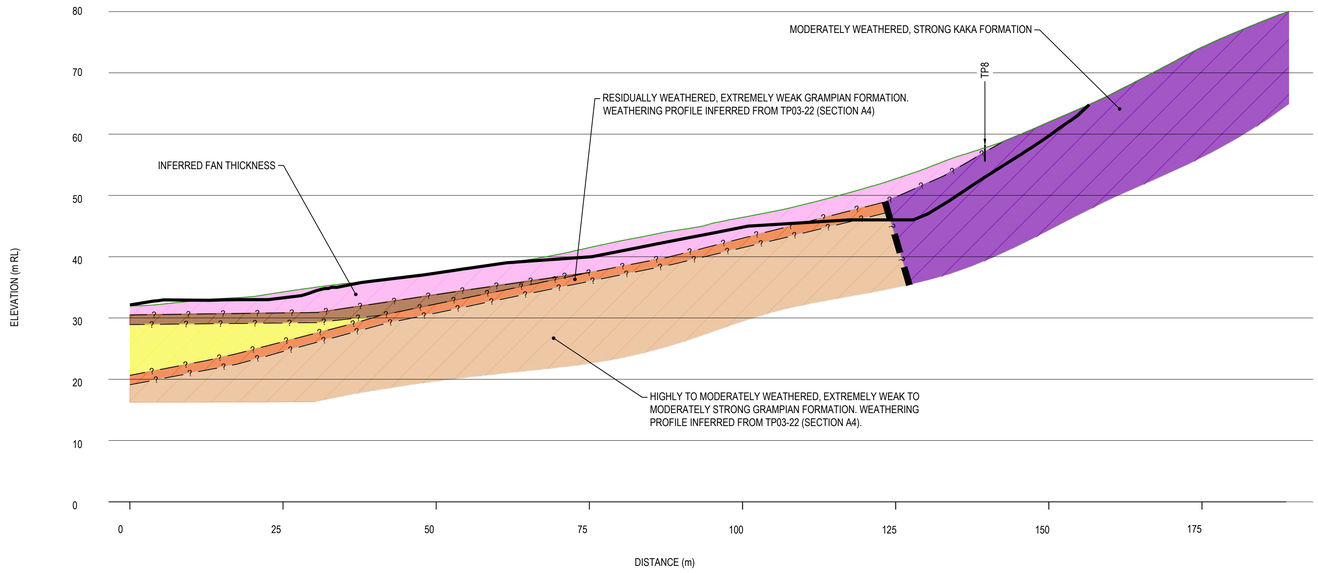
CLIENT **CCKV MAITAI DEV CO LP**

PROJECT **KAKA SUBDIVISION, MAITAI VALLEY, NELSON**

TITLE MAITAHI SUBDIVISION
INFERRED ENGINEERING GEOLOGICAL SECTION A4

SCALE (A1) 1:500 FIG No. 1012937.1000-GT-F18 REV 1

C:\12dSynergy\data\ALBTCAD\Maitahi Resource Consent Design_1359\CAD\FIG\1012397.1000-GT-F20.dwg 2025-Feb-04 7:03:03 pm Plotted By: DFL



A5 / F03 **CROSS SECTION**
HORIZONTAL SCALE 1:500
VERTICAL SCALE 1:500

LEGEND

- LIDAR 2021 EXISTING SURFACE
- DESIGN GROUND LEVEL (D.O. JAN. 24)
- INFERRED FAULTS
- INFERRED CONTACTS
- DATE — INVESTIGATION LOCATIONS (DEPTHS APPROXIMATE)
- DRY, DATE — WATER LEVEL
- SEEPAGE
- WAKAPUAKA PHYLLONITE
- UPPER ALLUVIUM
- BURIED TOPSOIL
- LOWER ALLUVIUM
- KAKA FORMATION
- GRAMPIAN FORMATION
- FAN DEPOSITS
- BOTANICAL HILL FORMATION
- COLLUVIUM DEPOSITS
- RESIDUAL SOIL

0 12.5 25 m
1:500 (A1)
1:1000 (A3)

NOTES:
1. UNITS ARE IN METRES UNLESS STATED OTHERWISE.
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4. PROPOSED GROUND SURFACE PROVIDED BY DAVIS OGILVIE LTD.

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DESIGNED	JXWW	FEB.25	FIGURE STATUS
DRAWN	DFL	FEB.25	RESOURCE CONSENT ISSUE
DESIGN CHECKED	MRF	FEB.25	PROJECT PHASE
FIGURE CHECKED	DJA	FEB.25	

NOT FOR CONSTRUCTION

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APPROVED DATE

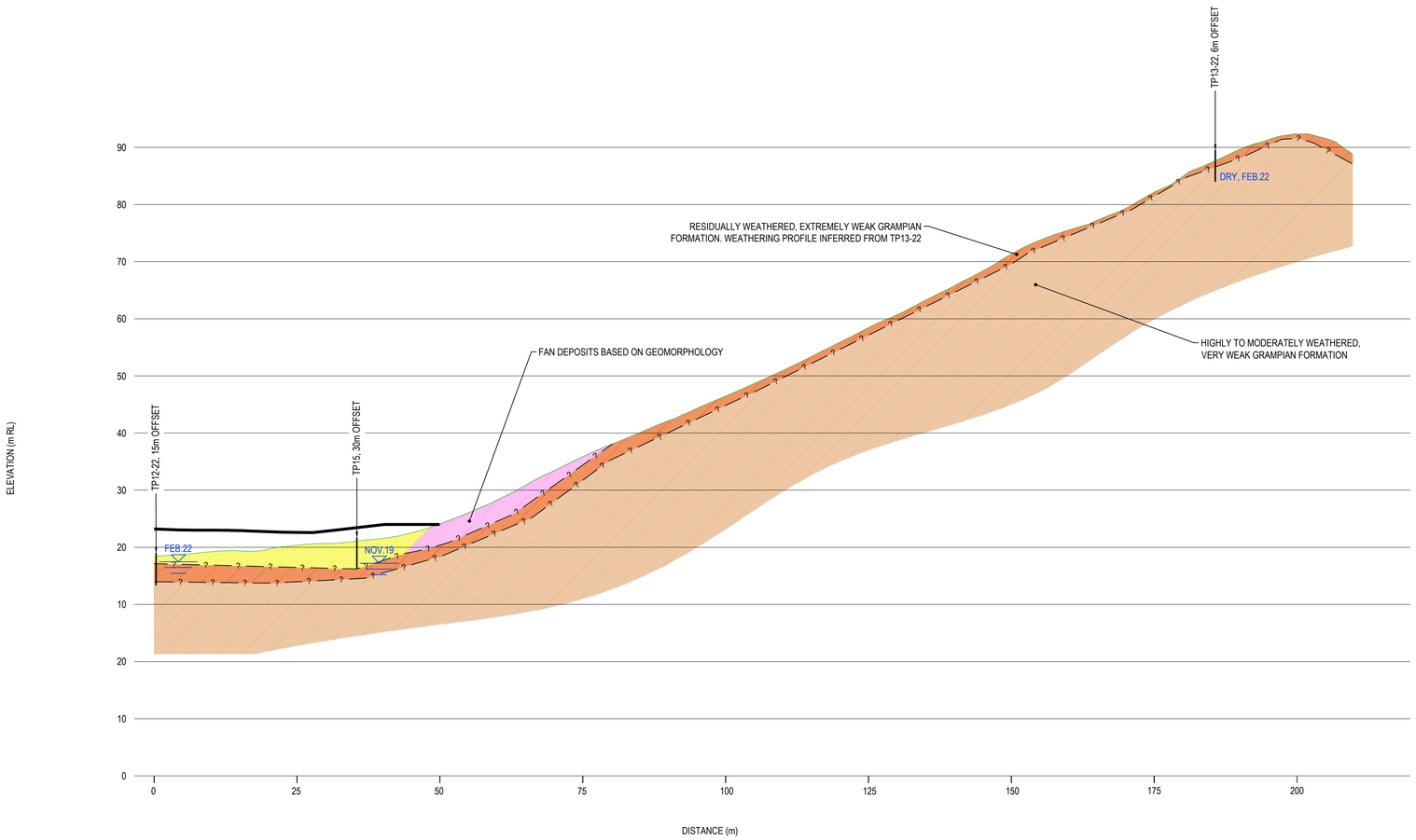
CLIENT **CCKV MAITAI DEV CO LP**

PROJECT **KAKA SUBDIVISION, MAITAI VALLEY, NELSON**

TITLE MAITAHI SUBDIVISION
INFERRED ENGINEERING GEOLOGICAL SECTION A5

SCALE (A1) 1:500 FIG No. 1012937.1000-GT-F19 REV 1

C:\12dSynergy\data\ALBTCAD\Maitahi Resource Consent Design_1359\CAD\FIG\1012397.1000-GT-F20.dwg 2025-Feb-04 7:03:17 pm Plotted By: DFL



A6 F03 **CROSS SECTION**
HORIZONTAL SCALE 1:500
VERTICAL SCALE 1:500

LEGEND

- LIDAR 2021 EXISTING SURFACE
- DESIGN GROUND LEVEL (D.O. JAN. 24)
- INFERRED FAULTS
- INFERRED CONTACTS
- DATE — INVESTIGATION LOCATIONS (DEPTHS APPROXIMATE)
- DRY, DATE — WATER LEVEL
- SEEPAGE
- WAKAPUAKA PHYLLONITE
- UPPER ALLUVIUM
- BURIED TOPSOIL
- LOWER ALLUVIUM
- KAKA FORMATION
- GRAMPIAN FORMATION
- FAN DEPOSITS
- BOTANICAL HILL FORMATION
- COLLUVIUM DEPOSITS
- RESIDUAL SOIL

0 12.5 25 m
1:500 (A1)
1:1000 (A3)

NOTES:
1. UNITS ARE IN METRES UNLESS STATED OTHERWISE.
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4. PROPOSED GROUND SURFACE PROVIDED BY DAVIS OGILVIE LTD.

DESIGNED	JXWW	FEB.25	FIGURE STATUS
DRAWN	DFL	FEB.25	RESOURCE CONSENT ISSUE
DESIGN CHECKED	MRF	FEB.25	PROJECT PHASE
FIGURE CHECKED	DJA	FEB.25	

NOT FOR CONSTRUCTION

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APPROVED DATE

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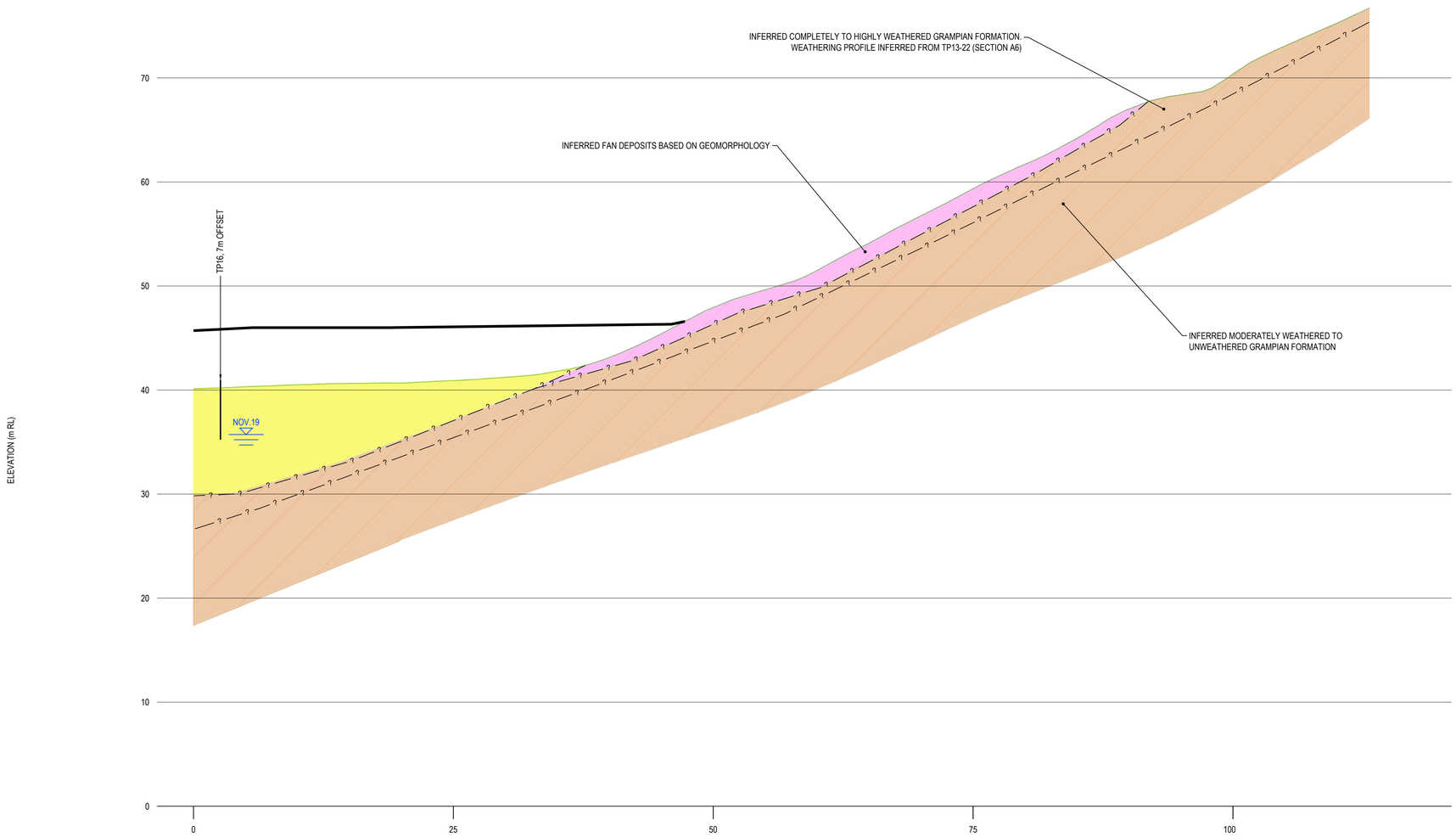
CLIENT **CCKV MAITAI DEV CO LP**

PROJECT **KAKA SUBDIVISION, MAITAI VALLEY, NELSON**

TITLE MAITAHI SUBDIVISION
INFERRED ENGINEERING GEOLOGICAL SECTION A6

SCALE (A1) 1:500 FIG No. 1012937.1000-GT-F20 REV 1

C:\12dSynergy\data\ALBTCAD\Maitahi Resource Consent Design_1359\CAD\FIG\1012397.1000-GT-F20.dwg 2025-Feb-04 7:03:20 pm Plotted By: DFL



A7 / F03 CROSS SECTION
HORIZONTAL SCALE 1:250
VERTICAL SCALE 1:250

0 6.25 12.5 m
1:250 (A1)
1:500 (A3)

LEGEND

- LIDAR 2021 EXISTING SURFACE
- DESIGN GROUND LEVEL (D.O. JAN. 24)
- INFERRED FAULTS
- INFERRED CONTACTS
- DATE — INVESTIGATION LOCATIONS (DEPTHS APPROXIMATE)
- DRY, DATE — WATER LEVEL
- SEEPAGE
- WAKAPUAKA PHYLLONITE
- UPPER ALLUVIUM
- BURIED TOPSOIL
- LOWER ALLUVIUM
- KAKA FORMATION
- GRAMPIAN FORMATION
- FAN DEPOSITS
- BOTANICAL HILL FORMATION
- COLLUVIUM DEPOSITS
- RESIDUAL SOIL

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NOTES:
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4. PROPOSED GROUND SURFACE PROVIDED BY DAVIS OGILVIE LTD.

DESIGNED	JXWW	FEB.25	FIGURE STATUS
DRAWN	DFL	FEB.25	RESOURCE CONSENT ISSUE
DESIGN CHECKED	MRF	FEB.25	PROJECT PHASE
FIGURE CHECKED	DJA	FEB.25	

NOT FOR CONSTRUCTION

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APPROVED DATE

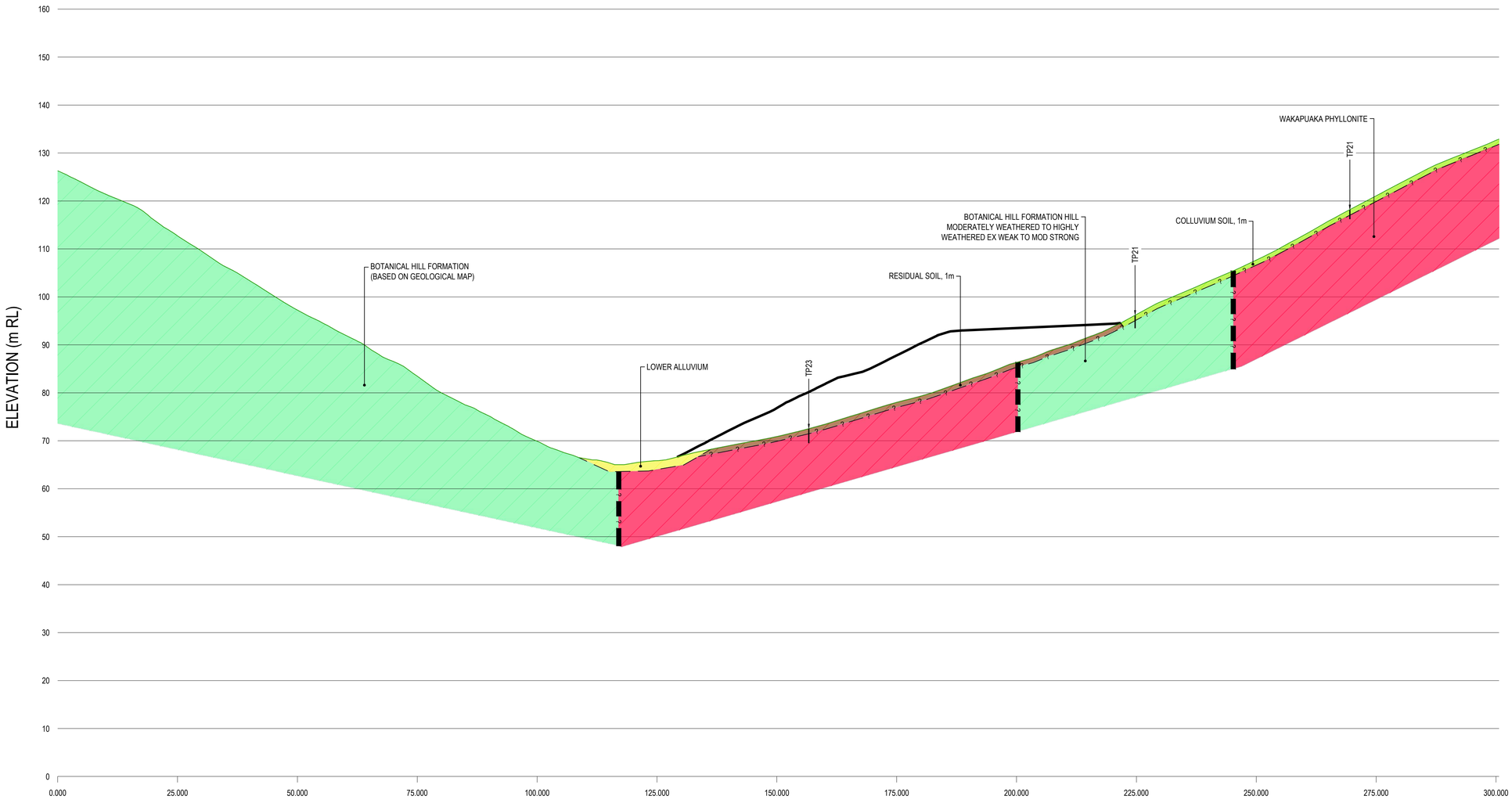
CLIENT **CCKV MAITAI DEV CO LP**

PROJECT **KAKA SUBDIVISION, MAITAI VALLEY, NELSON**

TITLE MAITAHI SUBDIVISION
INFERRED ENGINEERING GEOLOGICAL SECTION A7

SCALE (A1) 1:250 FIG No. 1012937.1000-GT-F21 REV 1

C:\12dSynergy\data\ALBTCAD\Maitahi Resource Consent Design_1359\CAD\FIG\1012397.1000-GT-F20.dwg 2025-Feb-04 7:02:48 pm Plotted By: DFL



A8 F03 **CROSS SECTION**
HORIZONTAL SCALE 1:500
VERTICAL SCALE 1:500

0 6.25 12.5 m
1:250 (A1)
1:500 (A3)

LEGEND

- LIDAR 2021 EXISTING SURFACE
- DESIGN GROUND LEVEL (D.O. JAN. 24)
- INFERRED FAULTS
- INFERRED CONTACTS
- DATE — INVESTIGATION LOCATIONS (DEPTHS APPROXIMATE)
- DRY, DATE — WATER LEVEL
- SEEPAGE
- WAKAPUAKA PHYLLONITE
- UPPER ALLUVIUM
- BURIED TOPSOIL
- LOWER ALLUVIUM
- KAKA FORMATION
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- FAN DEPOSITS
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- COLLUVIUM DEPOSITS
- RESIDUAL SOIL

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3. ENGINEERING GEOLOGICAL MODELS ARE INFERRED FROM THE SURFACE CONDITIONS, MAPPED GEOLOGY, AND DISCRETE SUBSURFACE INVESTIGATION LOCATIONS. IT MUST BE APPRECIATED THAT GROUND CONDITIONS AWAY FROM THE INVESTIGATION LOCATIONS MAY VARY FROM CONDITIONS SHOWN HERE.
4. PROPOSED GROUND SURFACE PROVIDED BY DAVIS OGILVIE LTD.

DESIGNED	JXWW	FEB.25	FIGURE STATUS
DRAWN	DFL	FEB.25	RESOURCE CONSENT ISSUE
DESIGN CHECKED	MRF	FEB.25	PROJECT PHASE
FIGURE CHECKED	DJA	FEB.25	

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APPROVED DATE

CLIENT **CCKV MAITAI DEV CO LP**

PROJECT **KAKA SUBDIVISION, MAITAI VALLEY, NELSON**

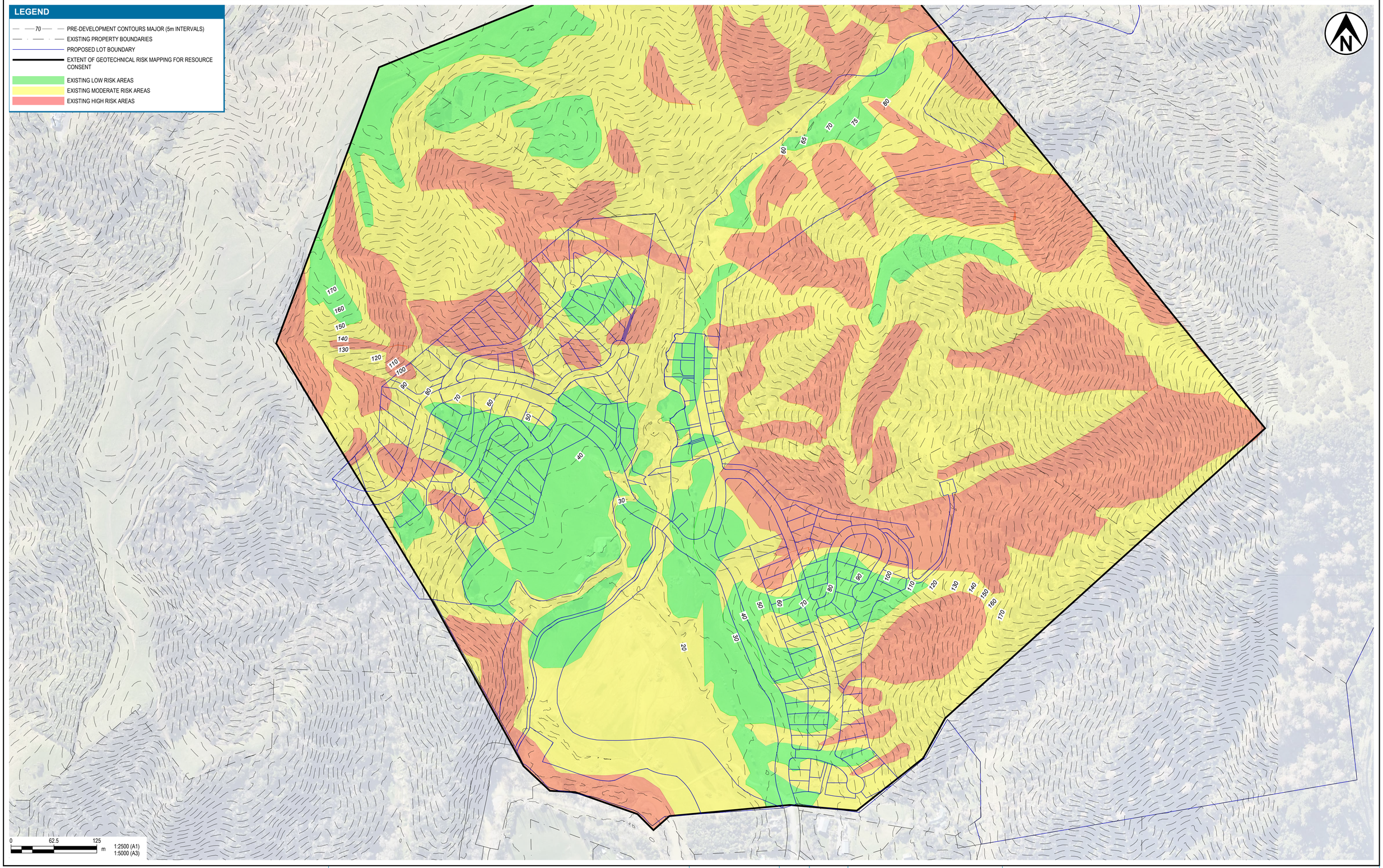
TITLE MAITAHI SUBDIVISION
INFERRED ENGINEERING GEOLOGICAL SECTION A8

SCALE (A1) 1:500 FIG No. 1012937.1000-GT-F22 REV 1

C:\12dSynergy\data\ALBTCAD\Maitahi Resource Consent Design_1359\CAD\FIG\1012397.1000-GT-F50.dwg 2025-Feb-04 6:29:11 pm Plotted By: DFL

LEGEND

- 70 — PRE-DEVELOPMENT CONTOURS MAJOR (5m INTERVALS)
- EXISTING PROPERTY BOUNDARIES
- PROPOSED LOT BOUNDARY
- EXTENT OF GEOTECHNICAL RISK MAPPING FOR RESOURCE CONSENT
- EXISTING LOW RISK AREAS
- EXISTING MODERATE RISK AREAS
- EXISTING HIGH RISK AREAS



NOTES:
1. UNITS ARE IN METRES UNLESS STATED OTHERWISE.
2. EXISTING CONTOURS AND PROPERTY BOUNDARIES SOURCED FROM TOP OF THE SOUTH MAPS <HTTPS://WWW.TOPOFTHESOUTHMAPS.CO.NZ/> AND MADE AVAILABLE UNDER A CREATIVE COMMONS ATTRIBUTION 4.0 INTERNATIONAL LICENSE.

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DESIGNED	JXWW	FEB.25	FIGURE STATUS
DRAWN	DFL	FEB.25	RESOURCE CONSENT ISSUE
DESIGN CHECKED	MRF	FEB.25	PROJECT PHASE
FIGURE CHECKED	DJA	FEB.25	

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APPROVED DATE

CLIENT **CCKV MAITAI DEV CO LP**

PROJECT **KAKA SUBDIVISION, MAITAI VALLEY, NELSON**

TITLE MAITAHI SUBDIVISION
PRE-DEVELOPMENT GEOTECHNICAL RISK PLAN

SCALE (A1) 1:2500 FIG No. 1012937.1000-GT-F50 REV 1

C:\12dSynergy\data\ALBTCAD\Maitahi Resource Consent Design_1359\CAD\FIG\1012397.1000-GT-F60.dwg 2025-Feb-04 6:28:53 pm Plotted By: DFL

LEGEND

- EXISTING PROPERTY BOUNDARIES
- PROPOSED LOT BOUNDARY
- EXTENT OF MAPPING FOR THIS REPORT
- PROPOSED DEBRIS BUND, BARRIER OR FENCE
- PROPOSED DEBRIS BUND, BARRIER OR FENCE
- PROPOSED RETAINING WALL
- RECENT LANDSLIDE SCARP
- DEGRADED LANDSLIDE SCARP
- TENSION CRACK
- AREA DISPLAYING EVIDENCE OF HISTORICAL INSTABILITY
- RECENT LANDSLIDE AREA
- BOULDERS NOTED ON GROUND SURFACE
- AREAS OF HUMMOCKY GROUND
- AREAS OF REEDS
- ROCK OUTCROPS

EXCAVATE AND REPLACE LANDSLIDE DEBRIS OR INSTALL SHEAR KEY TO STABILISE GROUND PRIOR TO FILLING

EXCAVATE AND REPLACE LANDSLIDE DEBRIS OR INSTALL SHEAR KEY TO STABILISE GROUND PRIOR TO FILLING

EXCAVATE AND REPLACE LANDSLIDE DEBRIS

FILL BATTERS STEEPER THAN 2H:1V TO BE REINFORCED WITH GEOGRID

EXCAVATE AND REPLACE LANDSLIDE DEBRIS AND INSTALL DRAINAGE

THIS FILL SLOPE WILL REQUIRE MECHANICAL STABILISATION OVER ITS ENTIRE HEIGHT

DEBRIS BUND, BARRIER OR FENCE

EXCAVATE AND REPLACE REPLACE LANDSLIDE DEBRIS, BOULDERS AND HUMMOCKY GROUND AND INSTALL SUBSOIL DRAINAGE

DEBRIS BUND, BARRIER OR FENCE

EXCAVATE AND REPLACE WEAK SOILS AND INSTALL SUBSOIL DRAINAGE

DEBRIS BUND, BARRIER OR FENCE

EXCAVATE AND REPLACE LANDSLIDE DEBRIS AND HUMMOCKY GROUND AND INSTALL SUBSOIL DRAINAGE

EXCAVATE AND REPLACE LANDSLIDE DEBRIS

DEBRIS BUND

EXCAVATE TO FORM DEBRIS FLOW

ROCK CUTS WITHIN WEST VALLEY SLOPES AREA TO BE INSPECTED BY THE GEO-PROFESSIONAL FOR ADVERSELY DIPPING DEFECTS. ANY POTENTIALLY UNSTABLE BLOCKS IDENTIFIED TO BE TRIMMED BACK AT STABLE ANGLE OR ROCK BOLTED

COMMERCIAL AREA TERRACE RETAINING WALLS. EXCAVATE TO INSITU ROCK AND BUILD UP WITH MECHANICALLY STABILISED EARTH (MSE) RETAINING WALLS WITH SUBSURFACE DRAINAGE AND SURFACE SWALES.

DEBRIS BUND

EXCAVATE AND REPLACE WEAK SOILS AND INSTALL SUBSOIL DRAINAGE

EXCAVATE AND REPLACE LANDSLIDE DEBRIS AND HUMMOCKY GROUND AND INSTALL SUBSOIL DRAINAGE

EXCAVATE AND REPLACE LANDSLIP / FAN DEBRIS, BOULDERS AND HUMMOCKY GROUND ON SOUTH SIDE OF PROPOSED DEBRIS BUND

EXCAVATE AND REPLACE LANDSLIDE DEBRIS

RETAINING WALL AND DRAINAGE

EXCAVATE AND REPLACE HUMMOCKY GROUND

DEBRIS BARRIER

UNDERCUT AND REPLACE WEAK SOILS NEAR THE TOP OF THE FILL. REINFORCE FILL FACE WITH GEOGRID AND USE TC2 FOUNDATIONS IN AREAS THAT COULD BE AFFECTED BY LIQUEFACTION.

DEBRIS BUND

EXCAVATE AND REPLACE LANDSLIDE DEBRIS AND INSTALL DRAINAGE

EXCAVATE AND REPLACE LANDSLIDE DEBRIS AND INSTALL SUBSOIL DRAINAGE

GENERAL GEOTECHNICAL STABILISATION WORKS:

- AREAS ON RECENT LANDSLIDE DEBRIS, HUMMOCKY GROUND, WEAK SATURATED GROUND WITHIN LOTS TO BE UNDERCUT DOWN TO GOOD GROUND AND BACKFILLED. BACKFILL TO COMPRISE ENGINEERED FILL UNDER BUILDING PLATFORMS. SUBSOIL DRAINS ARE TO BE INSTALLED TO PICK UP GROUNDWATER AND DISCHARGE TO KAKA STREAM OF THE PERMANENT STORMWATER SYSTEM.
- ROCK CUTS ARE TO BE INSPECTED BY THE GEO-PROFESSIONAL FOR ADVERSELY DIPPING DEFECTS. ANY POTENTIALLY UNSTABLE BLOCKS IDENTIFIED ARE TO BE TRIMMED BACK AT STABLE ANGLE OR ROCK BOLTED.
- EARTHFILL BATTERS STEEPER THAN 2H:1V WILL NEED TO BE REINFORCED WITH GEOGRID. FILL SLOPES DEIGNED STEEPER THAN 2H:1V AND NOT EXCEEDING 1.5H: 1V CAN BE CONSTRUCTED WITH APPROVED ROCKFILL. ALL FILL SLOPES STEEPER THAN 1.5H:1V WILL REQUIRE MECHANICAL STABILISATION.
- BOULDERS UPSLOPE OF LOTS WILL NEED TO BE REMOVED TO A SAFE AREA, OR PROTECTIVE BUNDS OR DEBRIS FENCES WILL BE REQUIRED TO PROTECT BUILDING SITES - UPPER CUT SLOPES ABOVE BUILDING SITES WILL REQUIRE THE TOP PORTION OF THE CUT TO BE BATTERED BACK OR REINFORCED TO REDUCE THE RISK OF FAILURES ABOVE BUILDING SITES.
- ALL CUT SLOPES IN SOIL STEEPER THAT 2H:1V WILL REQUIRE MECHANICAL REINFORCEMENT OR WHERE FEASIBLE SHOULD BE CUT BACK TO 2H:1V.
- CUT SLOPES STEEPER THAN 30 DEGREES ABOVE BUILDING SITES WILL NEED TO BE ASSESSED BY THE GEO-PROFESSIONAL AND WILL REQUIRE PROVISION FOR STABILISATION POTENTIALLY INCLUDING LOCAL ROCK REINFORCEMENT (I.E. ROCK BOLTS, SHOTCRET.E), AND DEBRIS FENCES OR BUNDS TO REDUCE THE RISK OF DEBRIS IMPACTING BUILDINGS.

0 62.5 125 m

1:2500 (A1)
1:5000 (A3)

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NOTES:

1. UNITS ARE IN METRES UNLESS STATED OTHERWISE.
2. EXISTING CONTOURS AND PROPERTY BOUNDARIES SOURCED FROM TOP OF THE SOUTH MAPS <HTTPS://WWW.TOPOFTHESOUTHMAPS.CO.NZ/> AND MADE AVAILABLE UNDER A CREATIVE COMMONS ATTRIBUTION 4.0 INTERNATIONAL LICENSE.
3. NOT ALL GEOMORPHOLOGY FEATURES BEYOND THE 'EXTENT OF MAPPING FOR THIS REPORT' BOUNDARY ARE SHOWN.
4. LOT BOUNDARIES AND PROPOSED CONTOURS SOURCED FROM DAVIS OGILVIE SURVEYORS, DATED JAN. 2025.
5.

DESIGNED	JXWW	FEB.25	FIGURE STATUS
DRAWN	DFL	FEB.25	RESOURCE CONSENT ISSUE
DESIGN CHECKED	MRF	FEB.25	PROJECT PHASE
FIGURE CHECKED	DJA	FEB.25	

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APPROVED DATE

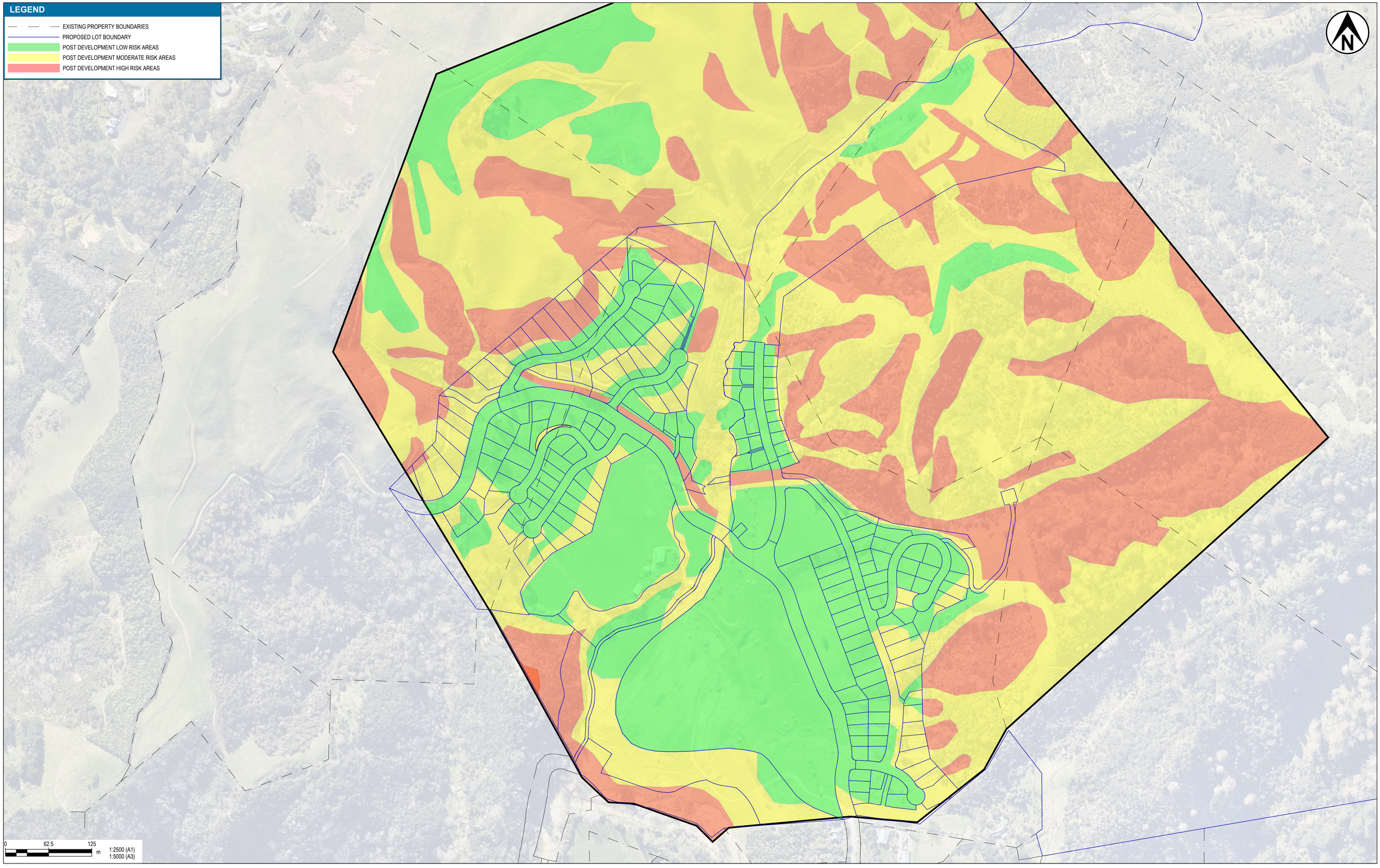
CLIENT **CCKV MAITAI DEV CO LP**

PROJECT **KAKA SUBDIVISION, MAITAI VALLEY, NELSON**

TITLE MAITAHI SUBDIVISION
GEOTECHNICAL HAZARD MITIGATION RECOMMENDATIONS

SCALE (A1) 1:2500 FIG No. 1012937.1000-GT-F60 REV 1

C:\12dSynergy\data\ALBTCAD\Maitahi Resource Consent Design_1359\CAD\FIG\1012397.1000-GT-F70.dwg 2025-Feb-04 6:29:56 pm Plotted By: DFL



NOTES:
1. UNITS ARE IN METRES UNLESS STATED OTHERWISE.
2. TO ACHIEVE THE POST DEVELOPMENT RISK AREAS SHOWN HERE, THE RECOMMENDATIONS IN THE REPORT AND WORKS INDICATED ON THE FIGURE 1012397.1000-GT04, GEOTECHNICAL DEVELOPMENT RECOMMENDATIONS, WILL BE REQUIRED.
2. EXISTING PROPERTY BOUNDARIES SOURCED FROM TOP OF THE SOUTH MAPS <HTTPS://WWW.TOPOFTHESOUTHMAPS.CO.NZ/> AND MADE AVAILABLE UNDER A CREATIVE COMMONS ATTRIBUTION 4.0 INTERNATIONAL LICENSE.

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DESIGNED	JXWW	FEB.25
DRAWN	DFL	FEB.25
DESIGN CHECKED	MRF	FEB.25
FIGURE CHECKED	DJA	FEB.25

FIGURE STATUS
RESOURCE CONSENT ISSUE
PROJECT PHASE

NOT FOR CONSTRUCTION

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APPROVED DATE

CLIENT **CCKV MAITAI DEV CO LP**

PROJECT **KAKA SUBDIVISION, MAITAI VALLEY, NELSON**

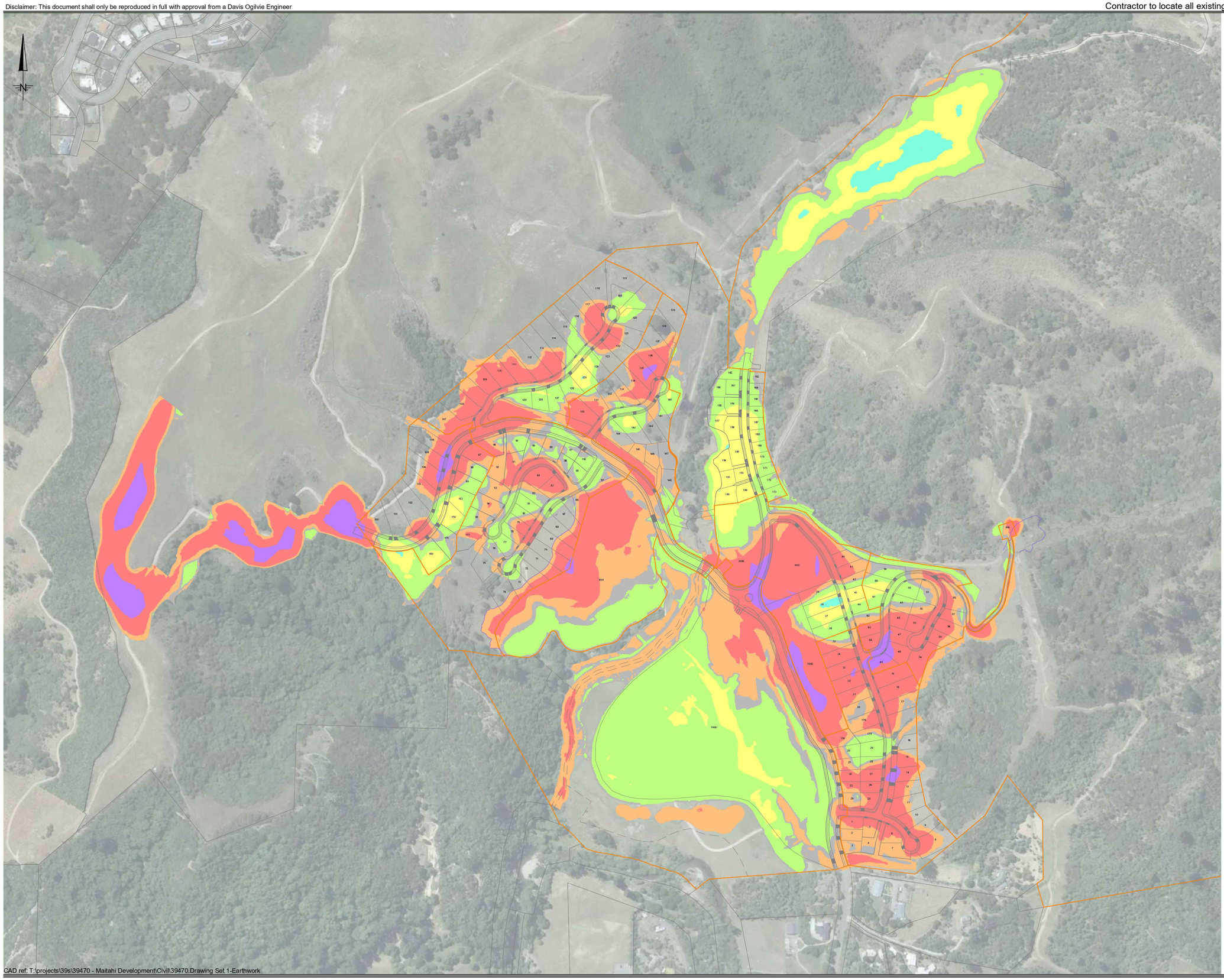
TITLE MAITAHI SUBDIVISION
POST-DEVELOPMENT GEOTECHNICAL RISK PLAN

SCALE (A1) 1:2500 FIG No. 1012937.1000-GT-F70 REV 1

Appendix B Davis Ogilvie and Partners drawings

- **C001 Overall Earthworks Plan**
- **C100 Overall Earthworks Plan – Volumes**
- **C200 Engineering Design – Overall Drainage Plan**
- **C300 Engineering Design – Overall Water & Services Plan**
- **C400 Engineering Design – Overall Roading Plan**

Contractor to locate all existing services & verify all dimensions before commencing work



Rev.	Date	Reason	Approved
P1	7/02/24	Issued for Information	RB
P2	24/09/24	Issued for Information	RB
P3	22/11/24	Issued for Information	RB
P4	31/01/25	Issued for Information	RB
P5	4/02/25	Issued for information	RB

FOR INFORMATION

NOTE : Additional excavation and filling may be undertaken beyond the area shown at the direction of the Geo-Professional to allow access to and construction of slope instability mitigation works, construction of temporary haul roads, to allow trimming of cut batters to merge with adjacent ground profiles for landscape enhancement and temporary works for erosion and sediment control.

CAD ref: T:\projects\39s\39470 - Maitahi Development\Civil\39470.Drawing Set 1-Earthwork

DAVIS OGILVIE
ENGINEERS / SURVEYORS / PLANNERS
Davis Ogilvie & Partners Limited
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MAITAHI DEVELOPMENT
NELSON

PRELIMINARY EARTHWORKS
OVERALL EARTHWORKS PLAN

Design	Drawn	QA Check	Dwg No.
BVB	CR	JB	C001
Scale @ A1	Date	Job No.	Rev.
1:2500	01/24	39470	P5

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Rev.	Date	Reason	Approved
P3	20/03/24	Updated EW Zones	
P4	10/04/24	Issued for Information	RB
P5	25/09/24	Issued for information	RB
P6	22/11/24	Issued for Information	RB
P7	31/01/25	Issued for Information	RB
P8	4/02/25	Issued for Information	RB

FOR INFORMATION

LOCATION PLAN
NTS

Valley fill Contingency

Disposal Area:

Area:	10,650 m²
Fill Volume:	49,440 m³

Phase 3:

Area:	93,770 m²
Cut Volume:	155,150 m³
Fill Volume:	92,020 m³

Surplus to Valley Fill area

63,130 m³

Phase 3A:

Area:	50,570 m²
Cut Volume:	85,920 m³
Fill Volume:	56,640 m³

Phase 3B:

Area:	43,200 m²
Cut Volume:	69,230 m³
Fill Volume:	35,380m³

Valley Fill Area:

Area:	29,020 m²
Cut Volume:	1,320 m³
Fill Volume:	142,240 m³

Future Road:

Area:	35,100 m²
Cut Volume:	220,800 m³
Fill Volume:	2,000 m³

Phase 4:

Area:	18,670 m²
Cut Volume:	420 m³
Fill Volume:	88,000 m³

Phase 2 Earthworks:

Area:	41,870 m²
Cut Volume:	72,770m³
Fill Volume:	25,480 m³

Surplus to Valley Fill area

47,290m³

Phase 1 Earthworks:

Area:	191,450 m²
Cut Volume:	371,870 m³
Fill Volume:	267,180 m³

Surplus Cut to Phase 4

87,580m³

Surplus cut to Valley fill area

17,110m³

Phase 1A

Area:	151,190 m²
Cut Volume:	279,830 m³
Fill Volume:	253,570 m³

Phase 1B

Area:	20,960 m²
Cut Volume:	15,160 m³
Fill Volume:	7,660m³

Phase 1C

Area:	19,300 m²
Cut Volume:	76,880 m³
Fill Volume:	5,950 m³

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Surface Analysis: Elevation Ranges

Number	Color	Minimum Elevation (m)	Maximum Elevation (m)	2D Area (m²)	Volume (m)
1		-19.856	-10.000	15063.9	30707.6
2		-10.000	-2.000	109063.7	438059.8
3		-2.000	0.000	74592.4	318332.5
4		0.000	1.000	38911.2	163279.8
5		1.000	5.000	111869.4	359376.8
6		5.000	10.000	32165.2	68395.1
7		10.000	14.600	1999.7	2318.7

Overall Earthworks :
(Excluding Future road)

Area:	376,980 m²
Cut Volume:	601,830 m³
Fill Volume:	666,720 m³
Net (Surplus)*	64,900 m³

* Note - Net fill surplus is made up of additional fill volume that can be accommodated within Valley Fill Area. Fill Volumes within this area to be reduced to suit..

CAD ref: T:\projects\39s\39470 - Maitahi Development\Civil\39470.Drawing Set 1-Earthwork

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MAITAHI DEVELOPMENT
NELSON

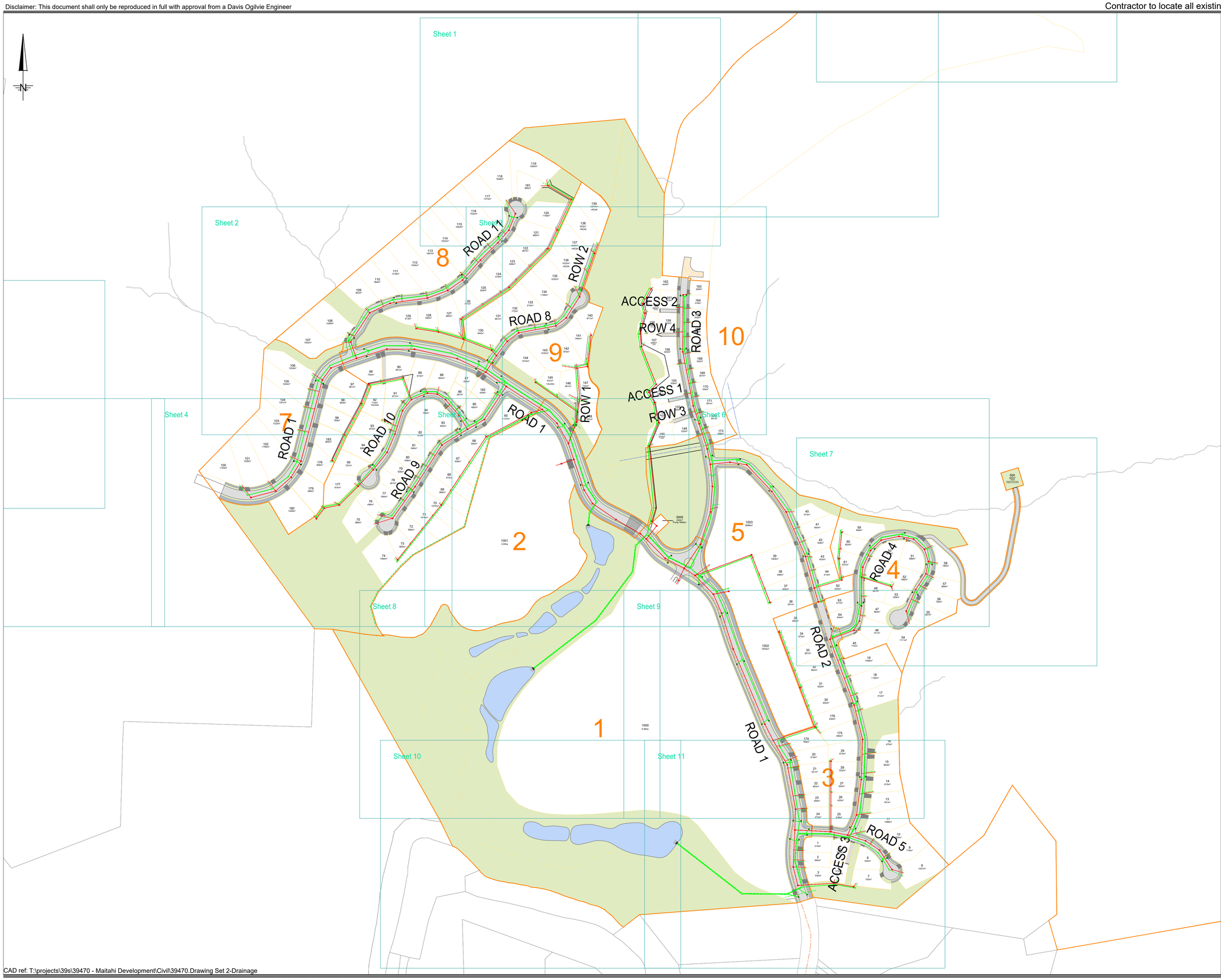
PRELIMINARY EARTHWORKS
OVERALL EARTHWORKS PLAN - VOLUMES

Design	Drawn	QA Check	Dwg No.
BVB	CR	JB	C100
Scale @ A1	Date	Job No.	Rev.
1:2,000 (m)	01/24	39470	P8

Contractor to locate all existing services & verify all dimensions before commencing work

Rev.	Date	Reason	Approved
P1	15/12/23	Issued for Information	DB
P2	5/04/24	Issued for Information	RB
P3	31/01/25	Issued for information	RB

FOR INFORMATION



CAD ref: T:\projects\39s\39470 - Maitahi Development\Civil\39470.Drawing Set 2-Drainage

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MAITAHI DEVELOPMENT
NELSON

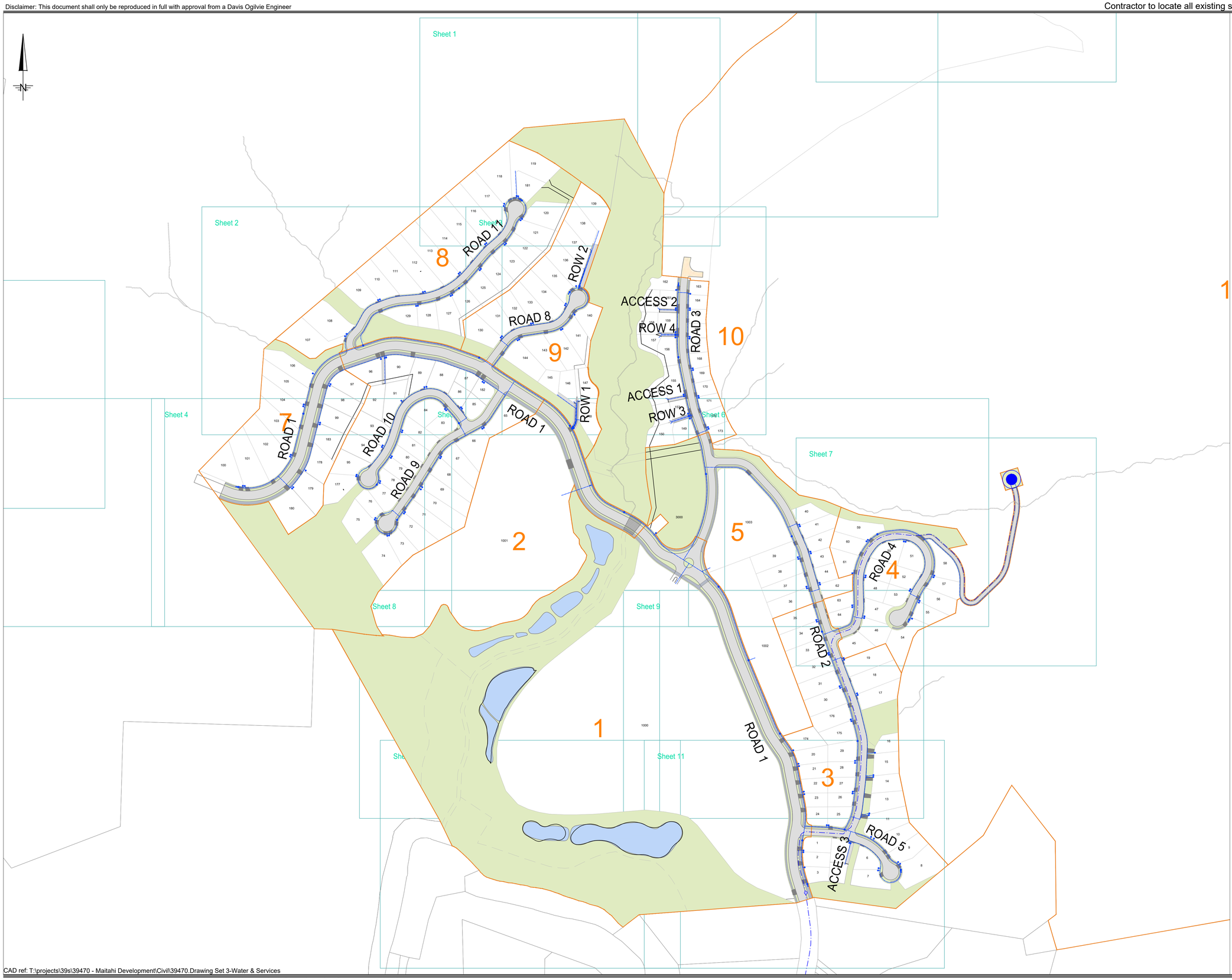
ENGINEERING DESIGN
OVERALL DRAINAGE PLAN

Design	Drawn	QA Check	Dwg No.
BVB	CR	DB	C200
Scale @ A1	Date	Job No.	Rev.
1:2,000 (m)	12/23	39470	P3

Contractor to locate all existing services & verify all dimensions before commencing work

Rev.	Date	Reason	Approved
P1	15/12/23	Issued for Information	DB
P2	31/01/25	Issued for Information	RB

FOR INFORMATION



CAD ref: T:\projects\39s\39470 - Maitahi Development\Civil\39470.Drawing Set 3-Water & Services

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MAITAHI DEVELOPMENT
NELSON

ENGINEERING DESIGN
OVERALL WATER & SERVICES PLAN

Design	Drawn	QA Check	Dwg No.
BVB	CR	DB	C300
Scale @ A1	Date	Job No.	Rev.
1:2,000 (m)	12/23	39470	P2

Contractor to locate all existing services & verify all dimensions before commencing work

Rev.	Date	Reason	Approved
P1	15/12/23	Issued for Information	RB
P2	10/04/24	Issued for Information	RB
P3	15/04/24	Issued for Information	RB
P4	15/01/25	Issued for Information	RB
P5	31/01/25	Issued for Information	RB

FOR INFORMATION

CAD ref: T:\projects\39s\39470 - Maitahi Development\Civil\39470.Drawing Set 4-Roading

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MAITAHI DEVELOPMENT
NELSON

ENGINEERING DESIGN
OVERALL ROADING PLAN

Design	Drawn	QA Check	Dwg No.
BVB	CR	DB	C400
Scale @ A1	Date Started	Job No.	Rev.
1:2,000 (m)	12/23	39470	P5

Appendix C Ground investigation log sheets

- **Borehole Logs BH01-0723 to BH09-0723**
- **Borehole Logs BH01-22 to BH09-22**
- **Test pit excavations DTP01-22 to DTP05-22**
- **Test pit excavations TP02-22 to TP28-22 and TP29-22 to TP31c-22**
- **Test pit excavations TP32-23 to TP37-23**
- **Test pit excavations TP1 (2019) to TP26 (2019)**
- **Engineering Log Terminology Sheets 1 & 2**

BOREHOLE LOG

Tonkin+Taylor

BOREHOLE No.: BH01_0723

SHEET: 1 OF 5

PROJECT: Maitahi
JOB No.: 1012397.1000.1000
LOCATION: Kaka Valley

CO-ORDINATES: 5431321 mN, 1626162 mE (NZTM2000)
DIRECTION: 0°
ANGLE FROM HORIZ.: -90°

R.L. GROUND: 48m
R.L. COLLAR:
DATUM: NZVD2016
SURVEY: Map or aerial photograph

DRILLED BY: Dylan
LOGGED BY: ANCO
CHECKED: JXWW
START DATE: 03/07/2023
FINISH DATE: 07/07/2023
CONTRACTOR: CW Drilling

GEOLOGICAL UNIT	MATERIAL DESCRIPTION (SOIL: Classification, colour, consistency / density, moisture, plasticity; ROCK: Weathering, colour, fabric, name, strength, cementation)
Colluvium Deposits	*0.00m:* Clayey SILT, some gravel; Orange -brown and grey, massive. Very soft to soft, moist, non-plastic to low plasticity. Gravel, sub-angular, highly weathered, sandstone, Tuffaceous. (TUFF).
Grampian Formation	*1.50m:* Moderately weathered, Brownish -green grey, TUFF. Moderately strong to strong, medium grained, porphyritic, limonite staining. Minor lithics. Numerous fractures.. (UNDIFFERENTIATED VOLCANICS). *1.87m:* Clay seam *1.95 - 1.98m:* Quartz? vein *2.10 - 3.59m:* Fault zone? *2.15 - 3.27m:* Minor lithics possibly increasing with depth. "Apple - green" coloured mineral locally present. Some silica / quartz. Occasional quartz veinlet *2.20 - 3.55m:* Clay on some joint surfaces *3.27 - 3.59m:* PARTIAL CORE LOSS - Suspect fines washed out Moderately weathered. Weak to moderately strong. Broken ground. Fault Zone?. *3.59 - 4.20m:* PARTIAL CORE LOSS - Suspect fines washed out Moderately weathered, Orange - brown. Weak to moderately strong. Broken ground / brecciated. Fault Zone?. *4.20m:* Slightly weathered, Brownish grey, SANDSTONE. Strong, fine to medium grained. Interbedded with fine siltstone and mudstone beds and re-healed fracture zones. *4.55m:* Slightly to moderately weathered, Dark -grey, broken, clayey MUDSTONE. Weak to moderately strong, fine grained. Broken ground (crushed), fractured, brecciated. Localised zones of clay gouge with rock fragments (Faulted?).

Sampling Method	Core Recovery (%)	RL (m)	Depth (m)	RQD (%)	Description & Additional Observations
HQ3	93	47	0.5		
		46	1.5		*1.60m:* J, ST, R, *1.70m:* J, ST, SM
HQ3	96		2.0	33	*1.87m:* J, ST, SM, Clay veneer *1.87m:* Clay seam *1.95m:* Quartz vein *2.10m:* J, ST, SM, Some clay; orange-brown *2.00m:* Rod spin *2.20m:* J, ST, R, Minor clay
HQ3	90	45	2.5	33	*2.35m:* J, ST, R *2.36m:* J, ST, SM *2.40m:* J, ST, SM *2.50m:* J, ST, SM *2.51m:* J, ST, SM *2.55m:* J, ST, SM *2.56m:* J, ST, SM *2.57m:* J, ST, SM *2.80m:* J, ST, SM *2.81m:* J, ST, SM, Some clay; orange-brown *2.85m:* J, ST, SM *2.86m:* J, ST, SM
HQ3	92	44	3.5	49	*3.27m:* Fg, ST, SM, Clay gouge with fine rock fragments
HQ3	73		4.0	0	*3.53m:* J, UN, SM, Some clay *3.59m:* Fg, ST, R, Clay gouge and rock fragments
HQ3	100			93	*4.16m:* Fg, ST, R, Clay gouge and rock fragments
HQ3	87	43	4.5	0	*4.40m:* J, ST, SM *4.47m:* J, ST, SM *4.55 - 6.00m:* Fault Zone? *4.67m:* Fg, ST, SM, Clay gouge with rock fragments *4.75m:* J, ST, SM *4.76m:* J, PL, SM
HQ3	90			0	*4.77m:* Fg, ST, SM, Clay gouge and rock

Water Level / Fluid Loss (%): 06/07/2023
Casing: HQ
Installation: Box 0.00-2.70m
Core Box No

COMMENTS: Weather fine / overcast/ windy

Hole Depth 22m

Scale 1:25

Rev.: A

TTNZ_20230523 - General Log - 29/02/2024 5:25:39 pm - Produced with Core-GS by GeRoc

BOREHOLE LOG

Tonkin+Taylor

BOREHOLE No.: BH01_0723

SHEET: 2 OF 5

PROJECT: Maitahi
JOB No.: 1012397.1000.1000
LOCATION: Kaka Valley

CO-ORDINATES: 5431321 mN, 1626162 mE (NZTM2000)
DIRECTION: 0°
ANGLE FROM HORIZ.: -90°

R.L. GROUND: 48m
R.L. COLLAR:
DATUM: NZVD2016
SURVEY: Map or aerial photograph

DRILLED BY: Dylan
LOGGED BY: ANCO
CHECKED: JXWW
START DATE: 03/07/2023
FINISH DATE: 07/07/2023
CONTRACTOR: CW Drilling

GEOLOGICAL UNIT	MATERIAL DESCRIPTION	Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK MASS DISCONTINUITIES: Defect Log	Fracture Spacing (mm)	RQD (%)	Description & Additional Observations	Water Level / Fluid Loss (%)	Casing	Installation	Core Box No
	SOIL: Classification, colour, consistency / density, moisture, plasticity ROCK: Weathering, colour, fabric, name, strength, cementation	UW SW MW HW CW DW RS	VS+ S MS M W VW DW								2000 600 200 60 20			25 50 75			
Grampian Formation	[CONT] *4.55m:* Slightly to moderately weathered, Dark -grey, broken, clayey MUDSTONE. Weak to moderately strong, fine grained. Broken ground (crushed), fractured, brecciated. Localised zones of clay gouge with rock fragments (Faulted?).			HQ3	90							0	fragments *5.00m:* Fg, ST, SM, Clay gouge *5.10m:* J, ST, R *5.11m:* J, ST, SM				
	5.10 - 5.80m: Strongly crushed, highly fractured and brecciated. *5.45 - 6.00m:* PARTIAL CORE LOSS - Suspect fines washed out.			HQ3	100 / 80							0	*5.30m:* Loss of return. Water pressure increasing				Box 2 [70-5.20m]
	5.80 - 6.00m: Highly fractured, crushed with some clay. Loss of return and increased water pressure through this zone. Fault Zone? .			HQ3	64		42	5.5				0	*5.80m:* J, ST, SM *5.81m:* Fg, ST, R, Clay gouge with rock fragments				
	6.00m: Slightly weathered, Light brown-grey, bedded, SILTSTONE. Strong, fine grained. Some fine mudstone beds. Highly fractured with possible fault zones locally, and some healed fractures throughout. Bedding.							6.0					*6.17m:* J, UN, SM				
	6.65 - 7.10m: PARTIAL CORE LOSS - Suspect soft material washed out Slightly weathered. Weak to moderately strong. Broken ground. Highly crushed. Fault Zone?.			HQ3	95		41	6.5				15	*6.42m:* J, ST, SM *6.50m:* J, ST, SM *6.51m:* J, ST, SM *6.60m:* J, ST, SM				
	7.10 - 7.50m: PARTIAL CORE LOSS - Suspect fines washed out Slightly weathered, Light brown grey. Broken ground.			HQ3	67			7.0				0					
	7.50m: Moderately weathered, Dark -orange brown, broken, MUDSTONE. Weak , fine grained. Highly fractured (crushed?).			HQ3	94		40	7.5				0	*7.40m:* J, PL, SM		HQ		Box 5.20-7.70m
	8.35m: Slightly weathered, Greyish -brown, SANDSTONE. Strong.			HQ3	43			8.0				0					
	8.40 - 8.70m: Clayey SILT; Orange brown. Soft to firm, moist, non-plastic. Suspect some re-drill. Fault zone?.											28	*8.35m:* Bit becoming blocked, pulled rods to clean bit				
	8.70 - 9.00m: PARTIAL CORE LOSS - Suspect fines washed out.			HQ3	17		39	8.5				0	*8.70m:* J, ST, SM *8.70m:* "Finger catcher" added to bit to help recovery				
	9.00 - 9.65m: PARTIAL CORE LOSS - Suspect fines washed out Slightly weathered, Orange -brown. Strong, fine grained. Broken ground.			HQ3	80			9.0				0	*9.00 - 9.25m:* High water pressure				
	9.25 - 9.65m: Broken ground.			HQ3	73		38	9.5				18	*9.25m:* J, ST, SM				
	9.60 - 10.10m: Clay on some joint surfaces												*9.60m:* J, ST, SM, Minor clay; white				
	9.65m: Slightly weathered, Bluish -grey, MUDSTONE. Strong, fine grained. Numerous healed fractures.			HQ3	94							43	*9.70m:* J, ST, SM, Trace clay; white				

COMMENTS: Weather fine / overcast/ windy

Hole Depth 22m

Scale 1:25

Rev.: A

BOREHOLE LOG

Tonkin+Taylor

BOREHOLE No.: BH01_0723

SHEET: 3 OF 5

PROJECT: Maitahi
JOB No.: 1012397.1000.1000
LOCATION: Kaka Valley

CO-ORDINATES: 5431321 mN, 1626162 mE (NZTM2000)
DIRECTION: 0°
ANGLE FROM HORIZ.: -90°

R.L. GROUND: 48m
R.L. COLLAR:
DATUM: NZVD2016
SURVEY: Map or aerial photograph

DRILLED BY: Dylan
LOGGED BY: ANCO
CHECKED: JXWW
START DATE: 03/07/2023
FINISH DATE: 07/07/2023
CONTRACTOR: CW Drilling

GEOLOGICAL UNIT	MATERIAL DESCRIPTION (SOIL: Classification, colour, consistency / density, moisture, plasticity; ROCK: Weathering, colour, fabric, name, strength, cementation)	Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m) / Depth (m)	Graphic Log	ROCK MASS DISCONTINUITIES: Defect Log / Fracture Spacing (mm) / RQD (%) / Description & Additional Observations	Water Level / Fluid Loss (%)	Casing	Installation	Core Box No
Grampian Formation	[CONT] *9.65m:* Slightly weathered, Bluish -grey, MUDSTONE. Strong, fine grained. Numerous healed fractures.			HQ3	94		37 / 10.5		RQD 43: *10.00m:* J, ST, SM; *10.01m:* J, ST, SM, Some clay; orange-brown; *10.02m:* J, ST, SM, Some clay; orange-brown; *10.25m:* J, ST, R, Minor clay; white; *10.40m:* J, ST, R, Some clay; orange-brown; *10.50m:* J, PL, SM, Some clay				Box 7.70-10.60m
	10.60 - 11.35m: PARTIAL CORE LOSS - Suspect fines washed out.			HQ3	47		11.0		RQD 0: *10.60m:* J, ST, R, Some clay; *10.65 - 10.30m:* Mixed muds used. Ground becoming softer				
	11.20 - 11.35m: Clayey gravelly SILT; Grey - brown. Soft to firm. At 70 degrees to core axis. Fault zone? . *11.35 - 11.90m:* Local quartz? vein.			HQ3	91		36 / 11.5		RQD 27: *11.20m:* Fg, Highly crushed				
	11.90 - 12.10m: CORE LOSS.			HQ3	75		12.0		RQD 0				
	12.10 - 12.95m: PARTIAL CORE LOSS - Suspect fines washed out.			HQ3	82		35 / 12.5		RQD 35		HQ		
	12.95m: CORE LOSS.			HQ3	0		13.0		RQD 0: *12.95 - 13.30m:* Core Loss				
Grampian Formation	*13.30m:* Unweathered to slightly weathered, Light grey, bedded, SANDSTONE. Strong, fine grained. Interbedded dark grey mudstone. Breccia locally present - cemented. Occasional quartz veins. Bedding.			HQ3	33		34 / 13.5		RQD 0: *13.60 - 13.75m:* Decreasing rotation				
	13.75 - 13.85m: PARTIAL CORE LOSS - Suspect fines washed out.			HQ3	50				RQD 0: *13.75 - 13.85m:* Water pressure increased; *13.85m:* B, Mudstone beds				Box 10.60-14.00m
	14.00 - 16.05m: Slightly weathered, White - grey. Moderately strong, fine grained. With fine inter- beds of siltstone and discontinuous lenses of mudstone. Occasional quartz veins.			HQ3	102		33 / 14.5		RQD 56: *14.10m:* J, ST, SM; *14.25m:* J, ST, R, Minor FeSt; *14.60m:* J, ST, R, Minor FeSt; *14.70m:* J, ST, R, Srong FeSt; *14.80m:* J, ST, R, FeSt; *14.90m:* J, ST, SM, FeSt				

COMMENTS: Weather fine / overcast/ windy

Hole Depth 22m

Scale 1:25

Rev.: A

BOREHOLE LOG

Tonkin+Taylor

BOREHOLE No.: BH01_0723

SHEET: 4 OF 5

PROJECT: Maitahi
JOB No.: 1012397.1000.1000
LOCATION: Kaka Valley

CO-ORDINATES: 5431321 mN, 1626162 mE (NZTM2000)
DIRECTION: 0°
ANGLE FROM HORIZ.: -90°

R.L. GROUND: 48m
R.L. COLLAR:
DATUM: NZVD2016
SURVEY: Map or aerial photograph

DRILLED BY: Dylan
LOGGED BY: ANCO
CHECKED: JXWW
START DATE: 03/07/2023
FINISH DATE: 07/07/2023
CONTRACTOR: CW Drilling

GEOLOGICAL UNIT | MATERIAL DESCRIPTION (SOIL: Classification, colour, consistency / density, moisture, plasticity; ROCK: Weathering, colour, fabric, name, strength, cementation) | Rock Weathering | Rock Strength | Sampling Method | Core Recovery (%) | Testing | RL (m) | Depth (m) | Graphic Log | ROCK MASS DISCONTINUITIES: Defect Log | Fracture Spacing (mm) | RQD (%) | Description & Additional Observations | Water Level / Fluid Loss (%) | Casing | Installation | Core Box No

Grampian Formation

[CONT] *13.30m:* Unweathered to slightly weathered, Light grey, bedded, SANDSTONE. Strong, fine grained. Interbedded dark grey mudstone. Breccia locally present - cemented. Occasional quartz veins. Bedding.

15.25 - 15.55m: Clay on some joint surfaces

16.05 - 16.60m: Slightly weathered, Greenish -grey. Moderately strong. With some finer beds of siltstone and mudstone. Highly fractured in places.

16.60m: Slightly weathered, Dark grey black, MUDSTONE. Strong, fine grained. Very fine quartz? veins throughout.

16.75 - 16.90m: Clayey SILT; Greenish -grey. Very soft. Clay gouge - Fault Zone?.
16.90 - 17.10m: Unweathered, Greenish -grey and light grey. Weak to moderately strong, choritized. Fractured. Re-cemented / re-healed fault zone? .

Sampling Method: HQ3
Core Recovery (%): 102, 94, 95, 100, 97, 97
RL (m): 32, 31, 30, 29, 28
Depth (m): 15.5, 16.0, 16.5, 17.0, 17.5, 18.0, 18.5, 19.0, 19.5
RQD (%): 56, 0, 26, 43, 8, 56, 54

15.15m: J, ST, R, Minor FeSt
15.25m: J, ST, R, Clay; orange-brown. FeSt
15.50m: J, ST, SM, Minor clay; FeSt
15.65m: J, ST, R, Broken ground
15.80m: J, ST, R, Broken ground
16.00 - 16.60m: Slowed rotation
16.08m: J, ST, SM, FeSt. Minor quartz
16.35m: Fg, ST, SM, Clay gouge with rock fragments
16.64m: J, ST, SM
16.70m: J, ST, SM
16.77m: Fg, ST, SM, Clay gouge
16.82m: Fg, ST, SM, Clay gouge
18.37m: J, ST, SM
18.97m: J, ST, SM
19.37m: J, ST, SM, Broken ground
19.66m: J, ST, SM
19.72m: Fg, ST, SM, Clay gouge
19.75m: Fg, ST, SM, Clay and rock fragments
19.80m: J, ST, SM
19.85m: J, ST, SM

Casing: HQ
Box 14.00-16.30m
Box 16.30-18.65m

COMMENTS: Weather fine / overcast/ windy

Hole Depth 22m

Scale 1:25

Rev.: A

BOREHOLE LOG

Tonkin+Taylor

BOREHOLE No.: BH01_0723

SHEET: 5 OF 5

PROJECT: Maitahi
JOB No.: 1012397.1000.1000
LOCATION: Kaka Valley

CO-ORDINATES: 5431321 mN, 1626162 mE (NZTM2000)
DIRECTION: 0°
ANGLE FROM HORIZ.: -90°

R.L. GROUND: 48m
R.L. COLLAR:
DATUM: NZVD2016
SURVEY: Map or aerial photograph

DRILLED BY: Dylan
LOGGED BY: ANCO
CHECKED: JXWW
START DATE: 03/07/2023
FINISH DATE: 07/07/2023
CONTRACTOR: CW Drilling

GEOLOGICAL UNIT	MATERIAL DESCRIPTION (SOIL: Classification, colour, consistency / density, moisture, plasticity; ROCK: Weathering, colour, fabric, name, strength, cementation)	Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m) / Depth (m)	Graphic Log	ROCK MASS DISCONTINUITIES: Defect Log / Fracture Spacing (mm) / RQD (%) / Description & Additional Observations	Water Level / Fluid Loss (%)	Casing	Installation	Core Box No
Grampian Formation	[CONT] *16.60m:* Slightly weathered, Dark grey black, MUDSTONE. Strong, fine grained. Very fine quartz? veins throughout.			HQ3	97		27 / 20.5		*20.17m:* J, ST, SM *20.27m:* J, ST, SM *20.35m:* J, ST, SM *20.50m:* J, ST, SM RQD 54		HQ		Box 18.65-21.10m
				HQ3	100		26 / 21.0 / 21.5		*21.20m:* J, ST, SM *21.43m:* J, ST, SM *21.56m:* J, ST, SM *21.66m:* J, ST, SM *21.90m:* J, ST, SM RQD 48				Box 21.10-22.00m
	22m: END OF BOREHOLE. Target depth.						25 / 22.5 / 23.0 / 24 / 23.5 / 24.0 / 23 / 24.5						

COMMENTS: Weather fine / overcast/ windy

Hole Depth 22m

Scale 1:25

Rev.: A

TTNZ_20230523 - General Log - 29/02/2024 5:25:40 pm - Produced with Core-GS by GeRoc

CORE PHOTOS

BOREHOLE No.: **BH01_0723**

PROJECT: Maitahi	LOCATION: Kaka Valley	JOB No.: 1012397.1000.1000
CO-ORDINATES: 5431321 mN (NZTM2000) 1626162 mE R.L.: 48m DATUM: NZVD2016	DRILL TYPE: Hanjin D8 METHOD: Rotary cored	HOLE STARTED: 03/07/2023 HOLE FINISHED: 07/07/2023 DRILLED BY: CW Drilling LOGGED BY: ANCO CHECKED: JXWW

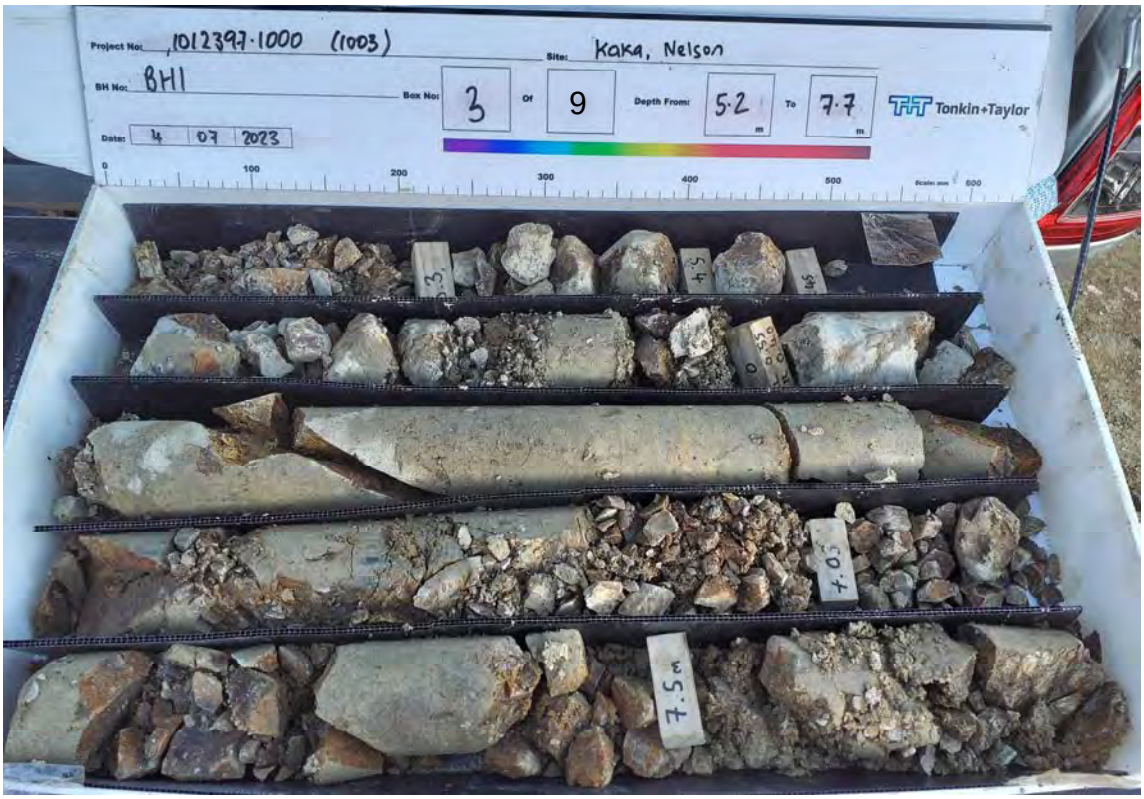
0.00-2.70m

2.70-5.20m

CORE PHOTOS

BOREHOLE No.: **BH01_0723**

PROJECT: Maitahi	LOCATION: Kaka Valley	JOB No.: 1012397.1000.1000
CO-ORDINATES: 5431321 mN (NZTM2000) 1626162 mE R.L.: 48m DATUM: NZVD2016	DRILL TYPE: Hanjin D8 METHOD: Rotary cored	HOLE STARTED: 03/07/2023 HOLE FINISHED: 07/07/2023 DRILLED BY: CW Drilling LOGGED BY: ANCO CHECKED: JXWW



5.20-7.70m

7.70-10.60m

CORE PHOTOS

BOREHOLE No.: **BH01_0723**

PROJECT: Maitahi	LOCATION: Kaka Valley	JOB No.: 1012397.1000.1000
CO-ORDINATES: 5431321 mN (NZTM2000) 1626162 mE R.L.: 48m DATUM: NZVD2016	DRILL TYPE: Hanjin D8 METHOD: Rotary cored	HOLE STARTED: 03/07/2023 HOLE FINISHED: 07/07/2023 DRILLED BY: CW Drilling LOGGED BY: ANCO CHECKED: JXWW

10.60-14.00m

14.00-16.30m

CORE PHOTOS

BOREHOLE No.: **BH01_0723**

PROJECT: Maitahi	LOCATION: Kaka Valley	JOB No.: 1012397.1000.1000
CO-ORDINATES: 5431321 mN (NZTM2000) 1626162 mE R.L.: 48m DATUM: NZVD2016	DRILL TYPE: Hanjin D8 METHOD: Rotary cored	HOLE STARTED: 03/07/2023 HOLE FINISHED: 07/07/2023 DRILLED BY: CW Drilling LOGGED BY: ANCO CHECKED: JXWW

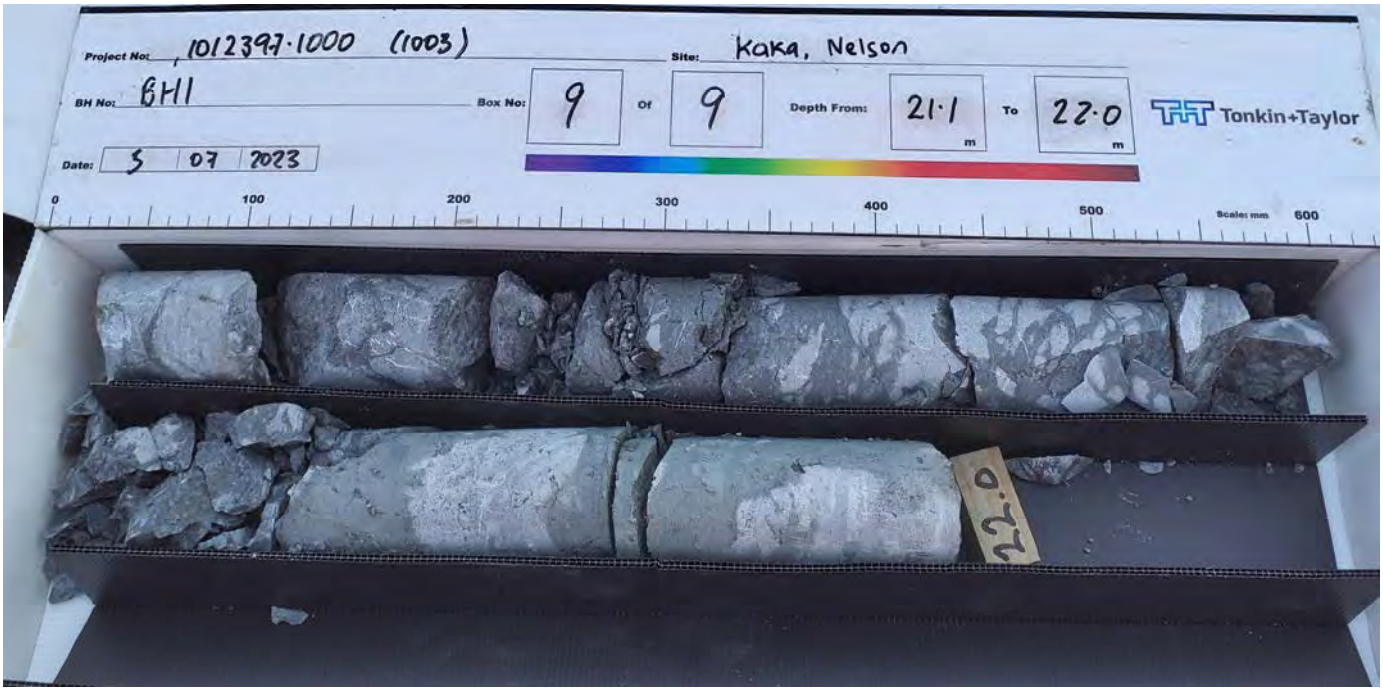
16.30-18.65m

18.65-21.10m

CORE PHOTOS

BOREHOLE No.: **BH01_0723**

PROJECT: Maitahi	LOCATION: Kaka Valley	JOB No.: 1012397.1000.1000
CO-ORDINATES: 5431321 mN (NZTM2000) 1626162 mE R.L.: 48m DATUM: NZVD2016	DRILL TYPE: Hanjin D8 METHOD: Rotary cored	HOLE STARTED: 03/07/2023 HOLE FINISHED: 07/07/2023 DRILLED BY: CW Drilling LOGGED BY: ANCO CHECKED: JXWW



21.10-22.00m

BOREHOLE LOG

Tonkin+Taylor

BOREHOLE No.: BH01-22

SHEET: 1 OF 4

PROJECT: Maitahi
JOB No.: 1012397.1000.1000
LOCATION: Kaka Valley

CO-ORDINATES: 5431074 mN, 1626042 mE (NZTM2000)
DIRECTION: 180°
ANGLE FROM HORIZ.: -90°

R.L. GROUND: 16m
R.L. COLLAR: 17m
DATUM: NZVD2016
SURVEY: Handheld GPS

DRILLED BY: Matt and Mason
LOGGED BY: AMHO
CHECKED: SAPR
START DATE: 21/03/2022
FINISH DATE: 22/03/2022
CONTRACTOR: ProDrill

GEOLOGICAL UNIT	MATERIAL DESCRIPTION (SOIL: Classification, colour, consistency / density, moisture, plasticity; ROCK: Weathering, colour, fabric, name, strength, cementation)	Depth (m)	RL (m)	Sampling Method	Core Recovery (%)	Testing
TSoil	*0.00m:* Clayey SILT, trace rootlets; Dark Brown. Firm, moist, low plasticity. (TOPSOIL).	0				
Alluvial Deposits	*0.30m:* SILT, some sand, minor clay; Orange Brown. Stiff, dry, low plasticity. Sand, fine.	0.3				
	0.75m: Sandy SILT, some gravel, minor clay; Brown. Firm, moist, non-plastic. Sand, fine to coarse; gravel, fine to medium.	0.75		SNC	100	
	0.85m: Gravelly fine to coarse SAND, some silt; Brown. Medium dense, moist, well graded. Gravel, fine to coarse, sub-angular to angular.	0.85				
	1.50m: Sandy fine to coarse GRAVEL, some silt; Brown. Loose, wet, well graded. Gravel, sub-angular to angular; sand, fine to coarse.	1.5	15	SPT	100	2/2// 3/4/5/4 N=16
	1.75m: Sandy fine to coarse GRAVEL, minor silt; Brownish Grey. Dense, moist, well graded. Gravel, sub-angular to angular; sand, fine to coarse.	1.75		SNC	100	
	3.00m: Sandy fine GRAVEL, some silt; Brown. Dense, moist, well graded. Gravel, sub-rounded; sand, fine to coarse.	3	13	SPT	100	8/6// 6/5/5/4 N=20
	3.95m: Gravelly fine to coarse SAND, some silt; Grey. Dense, moist. Gravel, fine.	3.95	12	SNC	100	
	4.40m: Sandy fine to medium GRAVEL, minor silt; Grey. Medium dense, moist. Gravel, sub-rounded to sub-angular; sand, fine to coarse.	4.4		SPT	100	3/4// 3/2/3/7 N=15

ROCK MASS DISCONTINUITIES: Defect Log; Fracture Spacing (mm); RQD (%); Description & Additional Observations

Water Level / Fluid Loss (%): 23/03/2022, 19.8m

Casing; Installation: Box 0.00-2.80m

Core Box No

COMMENTS:

Hole Depth 19.84m

Scale 1:25

Rev.: A

TTNZ_20220309 - General Log - 29/02/2024 5:25:47 pm - Produced with Core-GS by GeRoc

BOREHOLE LOG

Tonkin+Taylor

BOREHOLE No.: BH01-22

SHEET: 2 OF 4

PROJECT: Maitahi
JOB No.: 1012397.1000.1000
LOCATION: Kaka Valley

CO-ORDINATES: 5431074 mN, 1626042 mE (NZTM2000)
DIRECTION: 180°
ANGLE FROM HORIZ.: -90°

R.L. GROUND: 16m
R.L. COLLAR: 17m
DATUM: NZVD2016
SURVEY: Handheld GPS

DRILLED BY: Matt and Mason
LOGGED BY: AMHO
CHECKED: SAPR
START DATE: 21/03/2022
FINISH DATE: 22/03/2022
CONTRACTOR: ProDrill

GEOLOGICAL UNIT	MATERIAL DESCRIPTION (SOIL: Classification, colour, consistency / density, moisture, plasticity; ROCK: Weathering, colour, fabric, name, strength, cementation)	Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m) / Depth (m)	Graphic Log	ROCK MASS DISCONTINUITIES: Defect Log / Fracture Spacing (mm) / RQD (%) / Description & Additional Observations	Water Level / Fluid Loss (%)	Casing	Installation	Core Box No
Alluvial Deposits	[CONT] *4.40m:* Sandy fine to medium GRAVEL, minor silt; Grey. Medium dense, moist. Gravel, sub-rounded to sub-angular; sand, fine to coarse.			SNC	100		5.5						
	5.55m: Gravelly fine to coarse SAND, some silt; Brownish Grey. Medium dense, moist, well graded. Gravel, fine, sub-rounded to sub-angular.			SPT	100	4/7// 8/7/8/6 N=29	6.0						Box 2.80-6.00m
	6.95m: Silty fine SAND, some gravel; Greenish Brown. Medium dense, moist, poorly graded. Gravel, fine to medium, sub-rounded to sub-angular.			SNC	100		6.5						
	7.70m: Sandy fine to coarse GRAVEL, some silt; Brown. Medium dense, moist. Gravel, sub-rounded to sub-angular; sand, fine to coarse.			SPT	100	2/3// 5/5/5/6 N=21	7.0				19.8m		
				SNC	100		7.5						
				SPT	100	2/3// 5/5/3/4 N=17	8.0						Box 6.00-9.00m
	9.70m: Medium SAND; Brown. Medium dense, moist, poorly graded.			SNC	100		8.5						
							9.0						
							9.5						

COMMENTS:

Hole Depth 19.84m

Scale 1:25

Rev.: A

BOREHOLE LOG

Tonkin+Taylor

BOREHOLE No.: BH01-22

SHEET: 3 OF 4

PROJECT: Maitahi
JOB No.: 1012397.1000.1000
LOCATION: Kaka Valley

CO-ORDINATES: 5431074 mN, 1626042 mE (NZTM2000)
DIRECTION: 180°
ANGLE FROM HORIZ.: -90°

R.L. GROUND: 16m
R.L. COLLAR: 17m
DATUM: NZVD2016
SURVEY: Handheld GPS

DRILLED BY: Matt and Mason
LOGGED BY: AMHO
CHECKED: SAPR
START DATE: 21/03/2022
FINISH DATE: 22/03/2022
CONTRACTOR: ProDrill

GEOLOGICAL UNIT	MATERIAL DESCRIPTION (SOIL: Classification, colour, consistency / density, moisture, plasticity; ROCK: Weathering, colour, fabric, name, strength, cementation)	Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m) / Depth (m)	Graphic Log	ROCK MASS DISCONTINUITIES: Defect Log / Fracture Spacing (mm) / RQD (%) / Description & Additional Observations	Water Level / Fluid Loss (%)	Casing	Installation	Core Box No
Alluvial Deposits	[CONT] *9.70m:* Medium SAND; Brown. Medium dense, moist, poorly graded.												
	10.10m: Gravelly fine to coarse SAND, some silt; Brown. Medium dense, moist, well graded. Gravel, fine to medium, sub-rounded to angular.			SNC	100								
				SPT	100	6/8// 6/5/6/5 N=22	10.5						
				SNC	100		11.0						
				SPT	100	15/12// 11/8/6/5 N=30	11.5						
				SNC	100		12.0						Box 9.00-12.20m
	12.60m: Gravelly fine to coarse SAND, some silt; Brown. Medium dense, moist, well graded. Gravel, fine, sub-rounded to angular.						12.5				19.8m		
				SNC	100		13.0						
				SPT	100	17/33// for70mm N>=50 Refusal	13.5						
	13.95m: Gravelly fine to coarse SAND, minor silt; Grey. Very dense, moist. Gravel, fine to coarse, sub-angular to angular.						14.0						
	14.10m: Gravelly fine to coarse SAND, minor silt; Brown. Dense, moist. Gravel, fine to coarse, sub-angular to angular.			SNC	100		14.5						Box 12.20-14.35m

COMMENTS:

Hole Depth 19.84m

Scale 1:25

Rev.: A

BOREHOLE LOG

Tonkin+Taylor

BOREHOLE No.: BH01-22

SHEET: 4 OF 4

PROJECT: Maitahi
JOB No.: 1012397.1000.1000
LOCATION: Kaka Valley

CO-ORDINATES: 5431074 mN, 1626042 mE (NZTM2000)
DIRECTION: 180°
ANGLE FROM HORIZ.: -90°

R.L. GROUND: 16m
R.L. COLLAR: 17m
DATUM: NZVD2016
SURVEY: Handheld GPS

DRILLED BY: Matt and Mason
LOGGED BY: AMHO
CHECKED: SAPR
START DATE: 21/03/2022
FINISH DATE: 22/03/2022
CONTRACTOR: ProDrill

GEOLOGICAL UNIT	MATERIAL DESCRIPTION (SOIL: Classification, colour, consistency / density, moisture, plasticity; ROCK: Weathering, colour, fabric, name, strength, cementation)	Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m) / Depth (m)	Graphic Log	ROCK MASS DISCONTINUITIES: Defect Log / Fracture Spacing (mm) / RQD (%) / Description & Additional Observations	Water Level / Fluid Loss (%)	Casing	Installation	Core Box No
Alluvial Deposits	[CONT] *14.10m:* Gravelly fine to coarse SAND, minor silt; Brown. Dense, moist. Gravel, fine to coarse, sub-angular to angular.			SNC	100								
				SPT	100	6/11/ 8/11/13/16 N=48	15.5						
	15.70m: Sandy fine to coarse GRAVEL, minor silt; Grey. Dense, moist, well graded. Gravel, up to 60mm, sub-angular to angular; sand, fine to coarse.						16.0						
	16.25m: Silty fine SAND, some gravel, trace clay; Brown. Medium dense, moist, well graded. Gravel, fine.			SNC	100		16.5						
	16.55m: Silty fine SAND, some gravel, trace clay; Brown. Dense, dry, well graded. Gravel, fine.												
	16.75m: Sandy fine to coarse GRAVEL, minor silt; Brown. Dense, saturated, well graded. Gravel, sub-rounded to angular; sand, fine to coarse.			SPT	100	8/11/ 11/13/13/12 N=49	17.0						
	17.70m: Fine SAND, some silt, minor gravel; Grey. Dense, dry, well graded. Gravel, fine to medium, sub-angular.			SNC	16		17.5						Box 14.35-17.75m
	18.10m: Fine SAND, some gravel, minor silt; Grey. Very dense, dry, well graded. Gravel, fine to medium, sub-angular.						18.0						
	18.35m: Gravelly fine to coarse SAND, trace silt; Grey. Very dense, moist, well graded, disturbed. Gravel, fine to medium.				8	50 for 50mm N>=50	18.5						
	19.35m: Silty fine SAND, some gravel; Grey. Very dense, moist, well graded. Gravel, fine, angular.			SNC	100		19.0				19.8m		
	19.84m: Target depth					50 for 35mm N>=50	19.5						Box 17.75-19.84m

COMMENTS:

Hole Depth 19.84m

Scale 1:25

Rev.: A

TTNZ_20220309 - General Log - 29/02/2024 5:25:48 pm - Produced with Core-GS by GeRoc

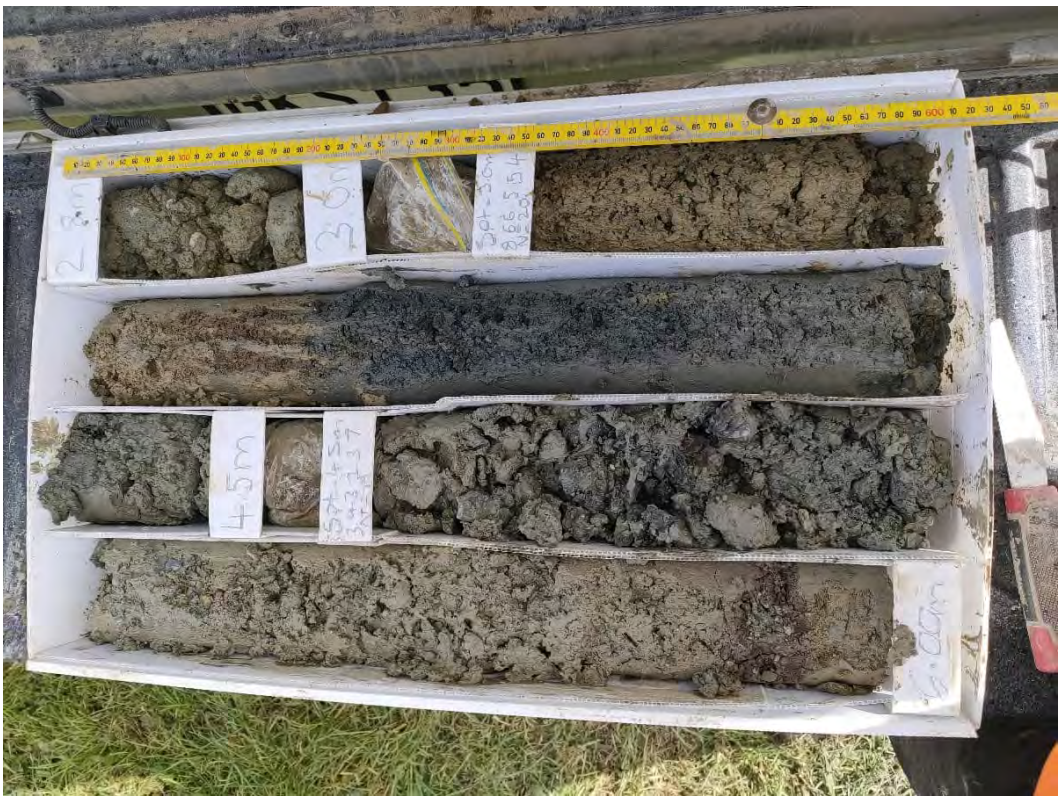
Tonkin+Taylor

CORE PHOTOS

BOREHOLE No.: **BH01-22**

PROJECT: Maitahi	LOCATION: Kaka Valley	JOB No.: 1012397.1000.1000
CO-ORDINATES: 5431074 mN (NZTM2000) 1626042 mE R.L.: 16m DATUM: NZVD2016	DRILL TYPE: Sonic drill METHOD: Sonic core drilling	HOLE STARTED: 21/03/2022 HOLE FINISHED: 22/03/2022 DRILLED BY: ProDrill LOGGED BY: AMHO CHECKED: SAPR

0.00-2.80m



2.80-6.00m

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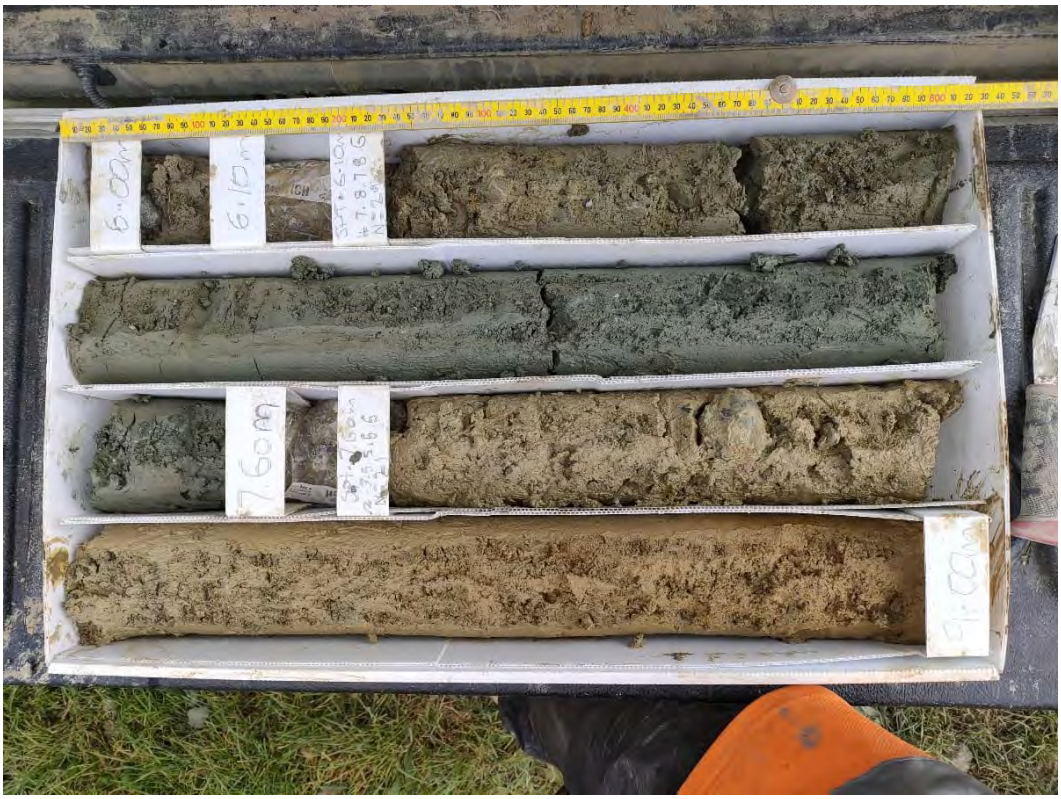
CORE PHOTOS

BOREHOLE No.: **BH01-22**

PROJECT: Maitahi	LOCATION: Kaka Valley	JOB No.: 1012397.1000.1000
CO-ORDINATES: 5431074 mN (NZTM2000) 1626042 mE R.L.: 16m DATUM: NZVD2016	DRILL TYPE: Sonic drill METHOD: Sonic core drilling	HOLE STARTED: 21/03/2022 HOLE FINISHED: 22/03/2022 DRILLED BY: ProDrill LOGGED BY: AMHO CHECKED: SAPR



6.00-9.00m

9.00-12.20m

CORE PHOTOS

BOREHOLE No.: **BH01-22**

SHEET: 3 OF 4

PROJECT: Maitahi	LOCATION: Kaka Valley	JOB No.: 1012397.1000.1000
CO-ORDINATES: 5431074 mN (NZTM2000) 1626042 mE R.L.: 16m DATUM: NZVD2016	DRILL TYPE: Sonic drill METHOD: Sonic core drilling	HOLE STARTED: 21/03/2022 HOLE FINISHED: 22/03/2022 DRILLED BY: ProDrill LOGGED BY: AMHO CHECKED: SAPR

12.20-14.35m

14.35-17.75m

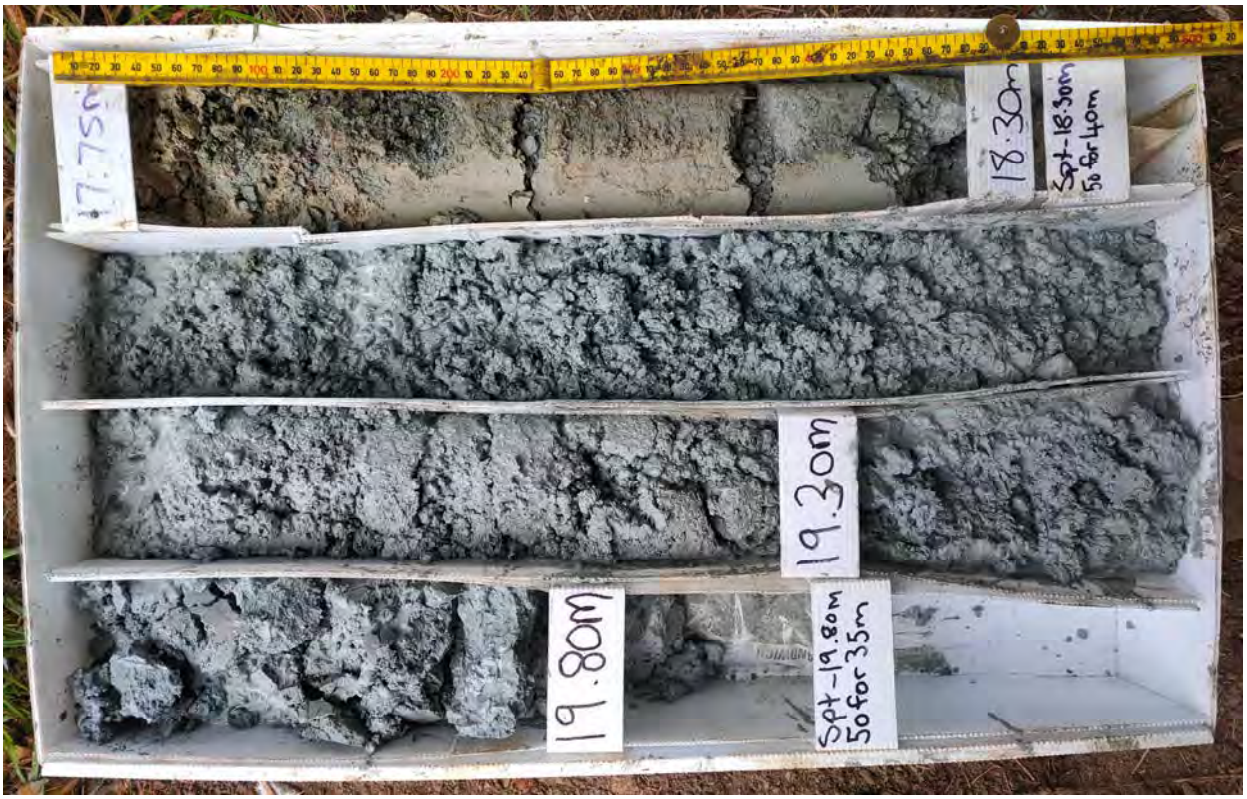
Tonkin+Taylor

CORE PHOTOS

BOREHOLE No.: **BH01-22**

SHEET: 4 OF 4

PROJECT: Maitahi	LOCATION: Kaka Valley	JOB No.: 1012397.1000.1000
CO-ORDINATES: 5431074 mN (NZTM2000) 1626042 mE R.L.: 16m DATUM: NZVD2016	DRILL TYPE: Sonic drill METHOD: Sonic core drilling	HOLE STARTED: 21/03/2022 HOLE FINISHED: 22/03/2022 DRILLED BY: ProDrill LOGGED BY: AMHO CHECKED: SAPR



17.75-19.84m

BOREHOLE LOG

Tonkin+Taylor

BOREHOLE No.: BH01-23

SHEET: 1 OF 1

PROJECT: Maitahi
JOB No.: 1012397.1000.1000
LOCATION: Kaka Valley

CO-ORDINATES: (NZTM2000) 5431392.84 mN, 1625946.01 mE
DIRECTION: 180°
ANGLE FROM HORIZ.: -90°

R.L. GROUND: 20.46m
R.L. COLLAR: 20.46m
DATUM: NZVD2016
SURVEY: Handheld GPS

DRILLED BY: Dylan
LOGGED BY: DJA
CHECKED: MRF
START DATE: 13/04/2023
FINISH DATE: 13/04/2023
CONTRACTOR: CW Drilling

GEOLOGICAL UNIT	DESCRIPTION OF CORE SOIL: Classification, colour, consistency / density, moisture, plasticity ROCK: Weathering, colour, fabric, name, strength, cementation
Fill	*0.00m:* SILT, some organics, minor gravel; Dark brown. Moist, low plasticity. Gravel, medium, sub-rounded. Cobbles noted on surrounding sheep pen surface.
Alluvial Deposits	*0.80m:* SILT, some organics and some gravel; Brown . Moist, low plasticity. Gravel, sub-angular, grey and white, platey.
	1.00m: Silty fine to medium GRAVEL; Light brown . Moist. Gravel, sub-angular, grey and white, platey.
	1.20m: SILT; Light brown. Moist, low plasticity.
	1.40m: Silty fine GRAVEL; Light brown . Dry. Gravel, grey and white, platey.
	1.60m: Medium to coarse GRAVEL, minor silt; Brown.. Dry. Gravel, light grey.
	2.20m: Silty fine GRAVEL; Light brown . Moist.
	2.50m: Fine to medium GRAVEL, minor silt; Greyish blue. Wet. Gravel, sub-rounded.
	3.6m: END OF BOREHOLE. Target depth.

Rock Weathering: UW, SW, MW, HW, CW
Rock Strength: ES, VS, S, MS, W, VW, EW
Sampling Method: PR
Core Recovery (%): 0
Testing
RL (m) / Depth (m): 20, 19, 18, 17 / 1, 2, 3, 4, 5
Graphic Log
ROCK DEFECTS: Defect Log; Fracture Spacing (mm): 2000, 600, 200, 60, 20; RQD (%); Description & Additional Observations
Fluid Loss (%): 25, 50, 75
Water Level: 13/04/2023
Casing
Installation: Box 1; 0.00-3.60m
Core Box No

COMMENTS:

Hole Depth 3.6m

Scale 1:30

Rev.: A

CORE PHOTOS

BOREHOLE No.: **BH01-23**

SHEET: 1 OF 1

PROJECT: Maitahi	LOCATION: Kaka Valley	JOB No.: 1012397.1000.1000
CO-ORDINATES: 5431392.84 mN (NZTM2000) 1625946.01 mE R.L.: 20.46m DATUM: NZVD2016	DRILL TYPE: Concentric DRILL METHOD: PR	HOLE STARTED: 13/04/2023 HOLE FINISHED: 13/04/2023 DRILLED BY: CW Drilling LOGGED BY: DJA CHECKED: MRF

0.00-3.60m

BOREHOLE LOG

BOREHOLE No.: BH01A_0723

SHEET: 1 OF 2

PROJECT: Maitahi
JOB No.: 1012397.1000.1000
LOCATION: Kaka Valley

CO-ORDINATES: 5431317 mN 1626165 mE (NZTM2000)
DIRECTION: 0°
ANGLE FROM HORIZ.: -90°

R.L. GROUND: 48m
R.L. COLLAR:
DATUM: NZVD2016
SURVEY: Map or aerial photograph

DRILLED BY: Dylan
LOGGED BY: ANCO
CHECKED: JXWW
START DATE: 06/07/2023
FINISH DATE: 07/07/2023
CONTRACTOR: CW Drilling

GEOLOGICAL UNIT: Grampian Formation

MATERIAL DESCRIPTION

SOIL: Classification, colour, consistency / density, moisture, plasticity
ROCK: Weathering, colour, fabric, name, strength, cementation

0.00 - 0. 60m: NOT LOGGED. Open barrel.

0. 60m: Orange -brown mix ed with minor blue-grey, broken, SANDSTONE.

0.60 - 1. 20m: CORE LOSS - Suspect washed out Highly weathered, Orange - brown mixed with some light blue - grey, clayey . Very weak to weak. Highly fractured .

1.20 - 1. 67m: PARTIAL CORE LOSS - Suspect fines washed out Highly weathered, Orange -brown, clayey . Weak to moderately strong, fine to medium grained, limonite staining. Grain size increasing with depth. Highly fractured .

1.67 - 2. 40m: Highly weathered, clayey . Weak, fine to medium grained, limonite staining Clayey SILT. Soft, moist to wet, non-plastic. Strongly fractured.

2. 40m: CORE LOSS - Suspect washed out Highly weathered, Orange -brown mix ed with some bluish - grey , clayey MUDSTONE. Weak to moderately strong. With interbedded siltstone and some coarser grained sandstone.

3. 00m: CORE LOSS - Suspect washed out Moderately weathered, Orange - brown mix ed with some bluish - grey, MUDSTONE. Moderately strong, fine grained.

3. 40m: PARTIAL CORE LOSS - Suspect fines washed out clayey gravelly SILT. Soft to firm. Gravel, sandstone / mudstone. Lower contact at 45 degrees to core axis.

4. 20m: Slightly weathered, Orange - brown mix ed with some bluish - grey, SANDSTONE. Strong, limonite staining. - pervasive on fractures.

4.50 - 5. 65m: PARTIAL CORE LOSS - Suspect fines washed out.

Sampling Method	Core Recovery (%)	RL (m)	Depth (m)	RQD (%)	Description & Additional Observations
OB	0			0	
HQ3	78	47	0.5	16	
			1.0		
HQ3	100	46	1.5	0	*1.42m:* J, ST, SM
			2.0		*2.00m:* J, ST, R *2.01m:* J, ST, R *2.25m:* J, ST, SM
HQ3	50	45	2.5	0	
HQ3	67		3.0	3	
HQ3	80	44	3.5	20	
HQ3	86		4.0	45	*4.20m:* , ST, R, Contact
HQ3	87	43	4.5	35	*4.80m:* J, ST, SM

Water Level / Fluid Loss (%): 07/07/2023
Casing: HQ
Installation: Box 0.00-3.55m
Core Box No

COMMENTS:

Hole Depth 7m

Scale 1:25

Rev.: A

BOREHOLE LOG

Tonkin+Taylor

BOREHOLE No.: BH01A_0723

SHEET: 2 OF 2

PROJECT: Maitahi
JOB No.: 1012397.1000.1000
LOCATION: Kaka Valley

CO-ORDINATES: 5431317 mN 1626165 mE (NZTM2000)
DIRECTION: 0°
ANGLE FROM HORIZ.: -90°

R.L. GROUND: 48m
R.L. COLLAR:
DATUM: NZVD2016
SURVEY: Map or aerial photograph

DRILLED BY: Dylan
LOGGED BY: ANCO
CHECKED: JXWW
START DATE: 06/07/2023
FINISH DATE: 07/07/2023
CONTRACTOR: CW Drilling

GEOLOGICAL UNIT	MATERIAL DESCRIPTION (SOIL: Classification, colour, consistency / density, moisture, plasticity; ROCK: Weathering, colour, fabric, name, strength, cementation)	Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m) / Depth (m)	Graphic Log	ROCK MASS DISCONTINUITIES: Defect Log / Fracture Spacing (mm) / RQD (%) / Description & Additional Observations	Water Level / Fluid Loss (%)	Casing	Installation	Core Box No
Grampian Formation	*4.95m:* PARTIAL CORE LOSS - Suspect fines washed out Slightly weathered, Greenish - grey, SANDSTONE. Moderately strong. Interbedded with finer siltstone / mudstone. Strongly fractured / broken ground.			HQ3	87		42 / 5.5		RQD 35 *4.95m:* Fg, ST, SM *5.25m:* J, ST, SM *5.26m:* J, UN, SM *5.27m:* J, ST, SM		HQ		
	5.60m: Greenish - grey mixed with some brown, tuffaceous SANDSTONE. *5.60 - 5.65m:* Highly weathered. Weak. Clayey SILT (fault zone?). *5.65 - 5.75m:* Slightly weathered, Greenish - grey. Strong. *5.75 - 5.80m:* Moderately weathered, Greenish -grey and brown, clayey. Weak, medium grained.			HQ3	100				RQD 0 *5.60m:* F, ST, R *5.75m:* J, ST, SM *5.77m:* Fg, ST, R				
	5.80 - 7.00m: Moderately weathered, tuffaceous. Strong.			HQ3	95		41 / 6.5		RQD 48 *5.95m:* J, ST, SM *6.00m:* J, ST, SM *6.13m:* J, ST, SM *6.14m:* Iz, ST, R *6.17m:* J, ST, SM *6.37m:* J, ST, SM *6.62m:* J, ST, R *6.67m:* J, ST, SM *6.90m:* J, ST, R *6.91m:* J, ST, R				Box 3.55-6.30m Box 6.30-7.00m
	7m: END OF BOREHOLE. Target depth.						40 / 7.5 39 / 8.5 38 / 9.5		*6.92m:* J, ST, SM *6.95m:* J, ST, SM *7.00m:* J, ST, SM				

COMMENTS:

Hole Depth 7m

Scale 1:25

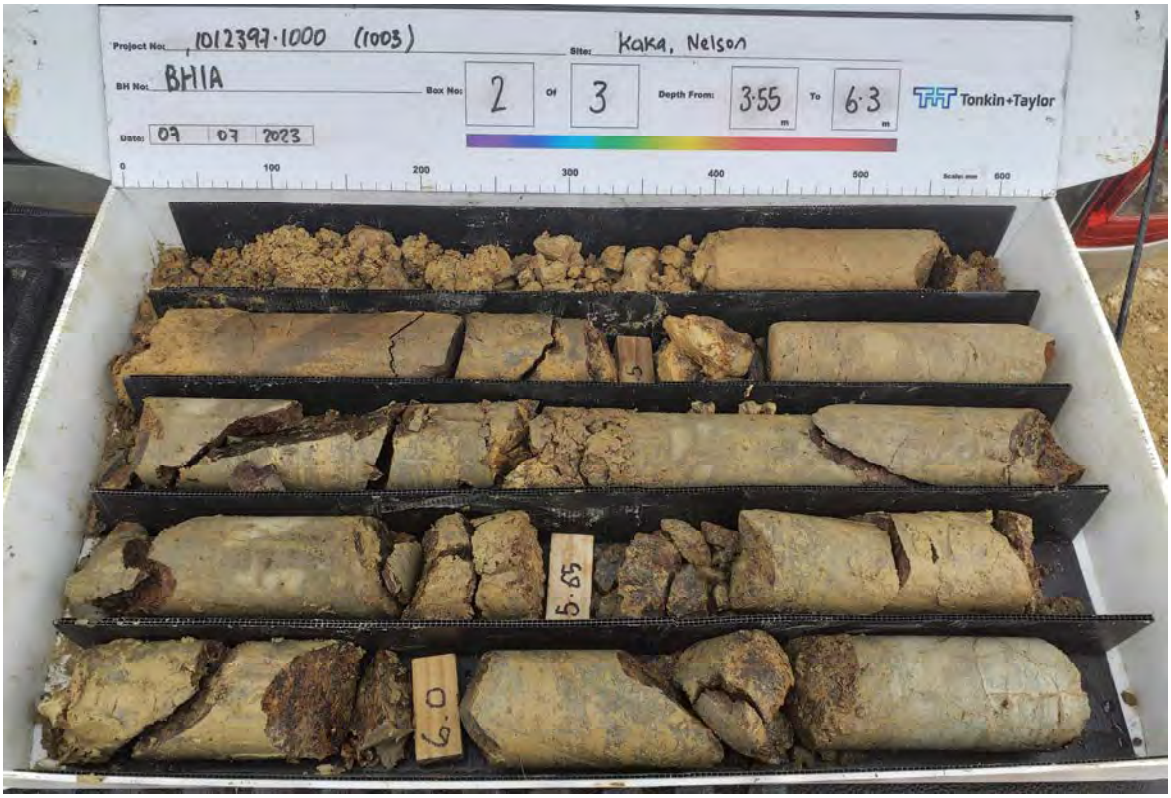
Rev.: A

CORE PHOTOS

BOREHOLE No.: **BH01A_0723**

PROJECT: Maitahi	LOCATION: Kaka Valley	JOB No.: 1012397.1000.1000
CO-ORDINATES: 5431317 mN (NZTM2000) 1626165 mE R.L.: 48m DATUM: NZVD2016	DRILL TYPE: Hanjin D8 METHOD: Rotary cored	HOLE STARTED: 06/07/2023 HOLE FINISHED: 07/07/2023 DRILLED BY: CW Drilling LOGGED BY: ANCO CHECKED: JXWW

0.00-3.55m



3.55-6.30m

CORE PHOTOS

BOREHOLE No.: **BH01A_0723**

PROJECT: Maitahi	LOCATION: Kaka Valley	JOB No.: 1012397.1000.1000
CO-ORDINATES: 5431317 mN (NZTM2000) 1626165 mE R.L.: 48m DATUM: NZVD2016	DRILL TYPE: Hanjin D8 METHOD: Rotary cored	HOLE STARTED: 06/07/2023 HOLE FINISHED: 07/07/2023 DRILLED BY: CW Drilling LOGGED BY: ANCO CHECKED: JXWW

6.30-7.00m

BOREHOLE LOG

Tonkin+Taylor

BOREHOLE No.: BH02_0723

SHEET: 1 OF 4

PROJECT: Maitahi
JOB No.: 1012397.1000.1000
LOCATION: Kaka Valley

CO-ORDINATES: 5431359 mN, 1626270 mE (NZTM2000)
DIRECTION: 0°
ANGLE FROM HORIZ.: -90°

R.L. GROUND: 85m
R.L. COLLAR:
DATUM: NZVD2016
SURVEY: Map or aerial photograph

DRILLED BY: Dylan
LOGGED BY: ANCO
CHECKED: JXWW
START DATE: 10/07/2023
FINISH DATE: 13/07/2023
CONTRACTOR: CW Drilling

GEOLOGICAL UNIT	MATERIAL DESCRIPTION (SOIL: Classification, colour, consistency / density, moisture, plasticity; ROCK: Weathering, colour, fabric, name, strength, cementation)	Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m) / Depth (m)	Graphic Log	ROCK MASS DISCONTINUITIES: Defect Log	Fracture Spacing (mm)	RQD (%)	Description & Additional Observations	Water Level / Fluid Loss (%)	Casing	Installation	Core Box No
Colluvium Deposits	*0.00m:* Clayey SILT, minor organics; Orange -brown. Soft, moist, low plasticity. *1.25 - 1.30m:* Firm. Rootlets.			HQ3	100		84									
Grampian Formation	*1.30m:* Highly to completely weathered, Orange -brown greyish white, SANDSTONE. Very weak to weak. *1.50 - 1.80m:* PARTIAL CORE LOSS - Suspect fines washed out.			HQ3	88						75					
	1.80m: Highly weathered, Orange - brown bluish grey, indistinctly bedded, SANDSTONE. Weak, fine grained. Inter-bedded with mudstone / siltstone.						83									
	2.30m: Moderately weathered, Orange -brown, SANDSTONE. Moderately strong, medium to coarse grained.			HQ3	100						75	*2.25m:* J, 30-70°, ST, R *2.27m:* J, PL, SM *2.50m:* J, ST, SM		HQ		Box 0.00-2.80m
	3.25m: Moderately weathered, Orange -brown greyish brown, bedded, SANDSTONE. Moderately strong. Inter-bedded with siltstone and finer mudstone. Bedding.			HQ3	100		82				42	*3.00m:* Water pressure 100 -125 Psi *3.07m:* J, ST, R *3.14m:* J, ST, SM *3.25m:* J, ST, SM *3.40m:* BF, ST, SM				
	3.50m: Moderately weathered, Dark grey mixed with minor orange-brown, MUDSTONE. Moderately strong, fine grained. *3.50m:* Clay on bedding surface *3.80 - 4.00m:* PARTIAL CORE LOSS - Suspect fines washed out, Brownish - grey. Broken ground.			HQ3	100						90	*3.50m:* B, ST, R, minor clay *3.50m:* Water pressure dropping; talk increasing				
				HQ3	75						0					
	4.00m: Moderately weathered, Brownish - grey, SANDSTONE. Moderately strong, medium grained. *4.20 - 4.60m:* PARTIAL CORE LOSS - Suspect fines washed out Moderately weathered, Brownish - grey. Moderately strong, fine grained. With closely spaced recemented fractures - healed fracture? / fault zone? Locally brecciated.			HQ3	95		81				23					
	4.60m: CORE LOSS Moderately weathered, Brownish -grey, broken, SANDSTONE. Moderately strong, fine grained. Interbedded sandstone - siltstone and mudstone.			HQ3	50						0					

COMMENTS: Weather fine / windy. Wet overnight

Hole Depth 16.5m

Scale 1:25

Rev.: A

BOREHOLE LOG

Tonkin+Taylor

BOREHOLE No.: BH02_0723

SHEET: 2 OF 4

PROJECT: Maitahi
JOB No.: 1012397.1000.1000
LOCATION: Kaka Valley

CO-ORDINATES: 5431359 mN, 1626270 mE (NZTM2000)
DIRECTION: 0°
ANGLE FROM HORIZ.: -90°

R.L. GROUND: 85m
R.L. COLLAR:
DATUM: NZVD2016
SURVEY: Map or aerial photograph

DRILLED BY: Dylan
LOGGED BY: ANCO
CHECKED: JXWW
START DATE: 10/07/2023
FINISH DATE: 13/07/2023
CONTRACTOR: CW Drilling

GEOLOGICAL UNIT	MATERIAL DESCRIPTION (SOIL: Classification, colour, consistency / density, moisture, plasticity; ROCK: Weathering, colour, fabric, name, strength, cementation)	Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m) / Depth (m)	Graphic Log	ROCK MASS DISCONTINUITIES: Defect Log / Fracture Spacing (mm) / RQD (%) / Description & Additional Observations	Water Level / Fluid Loss (%)	Casing	Installation	Core Box No
Grampian Formation	[CONT] *4.60m:* CORE LOSS Moderately weathered, Brownish -grey, broken, SANDSTONE. Moderately strong, fine grained. Interbedded sandstone - siltstone and mudstone.			HQ3	50				RQD 0				Box 2.80-5.30m
	5.30m: Moderately weathered, Brownish-yellow -grey, broken, SANDSTONE. Moderately strong, fine to coarse grained.			HQ3	100		5.5		RQD 50				
	5.40 - 5.55m: PARTIAL CORE LOSS - Suspect fines washed out. Broken ground.			HQ3	90				RQD 80 *5.60m:* J, ST, R				
	5.90 - 5.97m: Clayey gravelly SILT; orange brown. Wet. Gravel, sandstone. Rock fragments. Fault zone?.						6.0		*5.90m:* J, PL, R *5.95m:* Fg, ST, R				
	6.00 - 6.70m: CORE LOSS - Suspect washed out.			HQ3	36				RQD 0				
				HQ3	100		6.5						
	7.20 - 7.85m: CORE LOSS - Suspect washed out.			HQ3	50		7.0		RQD 28 *6.90m:* J, PL, R				
				HQ3	71				RQD 0				
	8.05 - 8.10m: Clayey gravelly SILT; orange brown. Soft to firm. Gravel, moderately to highly weathered, mudstone. Fault zone?.						7.5						
	8.10m: Slightly weathered, Dark -grey orange-brown, MUDSTONE. Strong.						8.0		RQD 0 *7.90m:* J, ST, R *8.00m:* J, ST, R *8.10m:* Fg, ST, R,				
				HQ3	100		8.5		RQD 69				Box 5.30-8.45m
	9.00 - 9.20m: PARTIAL CORE LOSS - Suspect fines washed out.			HQ3	75		9.0		RQD 0 *9.20m:* F, UN *9.30m:* J, ST, R				
	9.40m: Clay on joint surface								*9.38m:* J, ST, R, some clay; light green				
	9.67 - 10.90m: Orange - brown. Limonite staining.			HQ3	100		9.5		RQD 53 *9.60m:* J, PL, R *9.67 - 10.90m:* Colour change *9.70m:* J, ST, R *9.85m:* J, ST, R		HQ		

COMMENTS: Weather fine / windy. Wet overnight

Hole Depth 16.5m

Scale 1:25

Rev.: A

BOREHOLE LOG

Tonkin+Taylor

BOREHOLE No.: BH02_0723

SHEET: 3 OF 4

PROJECT: Maitahi
JOB No.: 1012397.1000.1000
LOCATION: Kaka Valley

CO-ORDINATES: 5431359 mN, 1626270 mE (NZTM2000)
DIRECTION: 0°
ANGLE FROM HORIZ.: -90°

R.L. GROUND: 85m
R.L. COLLAR:
DATUM: NZVD2016
SURVEY: Map or aerial photograph

DRILLED BY: Dylan
LOGGED BY: ANCO
CHECKED: JXWW
START DATE: 10/07/2023
FINISH DATE: 13/07/2023
CONTRACTOR: CW Drilling

GEOLOGICAL UNIT	MATERIAL DESCRIPTION (SOIL: Classification, colour, consistency / density, moisture, plasticity; ROCK: Weathering, colour, fabric, name, strength, cementation)	Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m) / Depth (m)	Graphic Log	ROCK MASS DISCONTINUITIES: Defect Log / Fracture Spacing (mm) / RQD (%)	Description & Additional Observations	Water Level / Fluid Loss (%)	Casing	Installation	Core Box No
Grampian Formation	[CONT] *8.10m:* Slightly weathered, Dark -grey orange-brown, MUDSTONE. Strong.			HQ3	100		10.5			*9.95m:* B, PL				Box 8.45-10.80m
	10.90m: Slightly weathered, Greenish-grey, SANDSTONE. Strong, fine to medium grained. Interbedded with dark-grey, very fine mudstone. Bedding is fine 3mm-			HQ3	100		11.0			*11.00m:* J, ST, SM		HQ		
							11.5			*11.45m:* J, ST, SM *11.60m:* J, PL, SM *11.75m:* J, ST, SM				
							12.0			*12.20m:* B, PL *12.40m:* J, ST, R, *12.60m:* J, PL, SM				
	13.30 - 13.35m: Limonite staining. - strong. Broken ground.			HQ3	100		12.5			*13.30m:* J, ST, R *13.45m:* J, ST, R *13.60m:* B, PL, SM				Box 10.80-13.60m
	14.15 - 14.45m: PARTIAL CORE LOSS - Suspect fines washed out.			HQ3	100		13.0			*14.05m:* J, ST, SM				
	14.45 - 15.10m: Some fine (2mm) quartz? veins. Re-cemented fracture / fault zone?			HQ3	83		13.5			*14.47m:* may have lost core here *14.35m:* J, ST, R *14.45m:* J, ST, SM *14.46m:* B *14.50m:* J, ST, SM *14.60m:* J, ST, SM *14.61m:* B, UN, SM *14.67m:* J, ST, SM *14.68m:* J, UN, SM				
				HQ3	100		14.0							
							14.5							

COMMENTS: Weather fine / windy. Wet overnight

Hole Depth 16.5m

Scale 1:25

Rev.: A

BOREHOLE LOG

Tonkin+Taylor

BOREHOLE No.: BH02_0723

SHEET: 4 OF 4

PROJECT: Maitahi
JOB No.: 1012397.1000.1000
LOCATION: Kaka Valley

CO-ORDINATES: 5431359 mN, 1626270 mE (NZTM2000)
DIRECTION: 0°
ANGLE FROM HORIZ.: -90°

R.L. GROUND: 85m
R.L. COLLAR:
DATUM: NZVD2016
SURVEY: Map or aerial photograph

DRILLED BY: Dylan
LOGGED BY: ANCO
CHECKED: JXWW
START DATE: 10/07/2023
FINISH DATE: 13/07/2023
CONTRACTOR: CW Drilling

GEOLOGICAL UNIT	MATERIAL DESCRIPTION (SOIL: Classification, colour, consistency / density, moisture, plasticity; ROCK: Weathering, colour, fabric, name, strength, cementation)	Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m) / Depth (m)	Graphic Log	ROCK MASS DISCONTINUITIES: Defect Log	Fracture Spacing (mm)	RQD (%)	Description & Additional Observations	Water Level / Fluid Loss (%)	Casing	Installation	Core Box No
Grampian Formation	[CONT] *10.90m:* Slightly weathered, Greenish-grey, SANDSTONE. Strong, fine to medium grained. Interbedded with dark-grey, very fine mudstone. Bedding is fine 3mm-			HQ3	100						52					
	15.70 - 15.90m: Disseminated fine pyrite						15.5									
	15.90m: Unweathered to slightly weathered, Greenishgrey, SANDSTONE. Strong, fine to medium grained, pyritized. Rare dark red mineral.			HQ3	93		69 16.0				42			HQ		Box 13.60-16.30m
	16.5m: END OF BOREHOLE. Target depth.						16.5									
							68 17.0									
							17.5									
							67 18.0									
							18.5									
							66 19.0									
							19.5									

COMMENTS: Weather fine / windy. Wet overnight

Hole Depth 16.5m

Scale 1:25

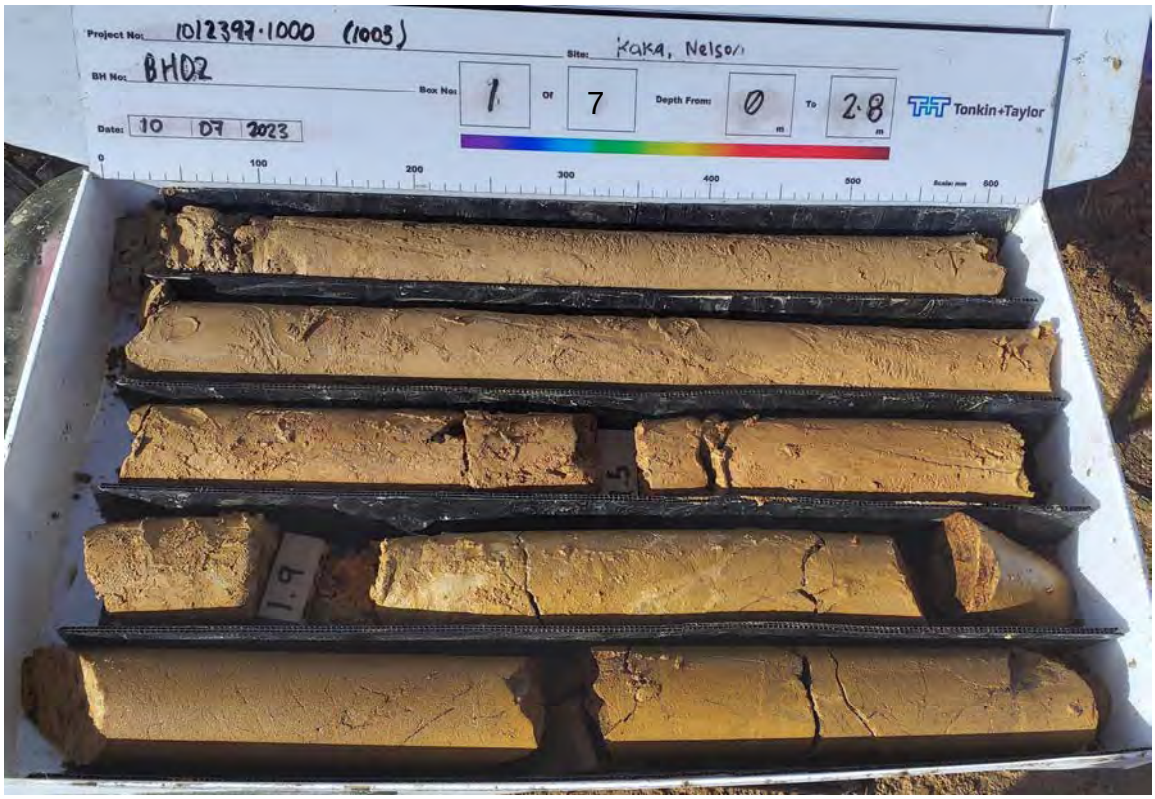
Rev.: A

TTNZ_20230717 - General Log - 29/02/2024 5:26:11 pm - Produced with Core-GS by GeRoc

CORE PHOTOS

BOREHOLE No.: **BH02_0723**

PROJECT: Maitahi	LOCATION: Kaka Valley	JOB No.: 1012397.1000.1000
CO-ORDINATES: 5431359 mN (NZTM2000) 1626270 mE R.L.: 85m DATUM: NZVD2016	DRILL TYPE: Hanjin D8 METHOD: Rotary cored	HOLE STARTED: 10/07/2023 HOLE FINISHED: 13/07/2023 DRILLED BY: CW Drilling LOGGED BY: ANCO CHECKED: JXWW



0.00-2.80m

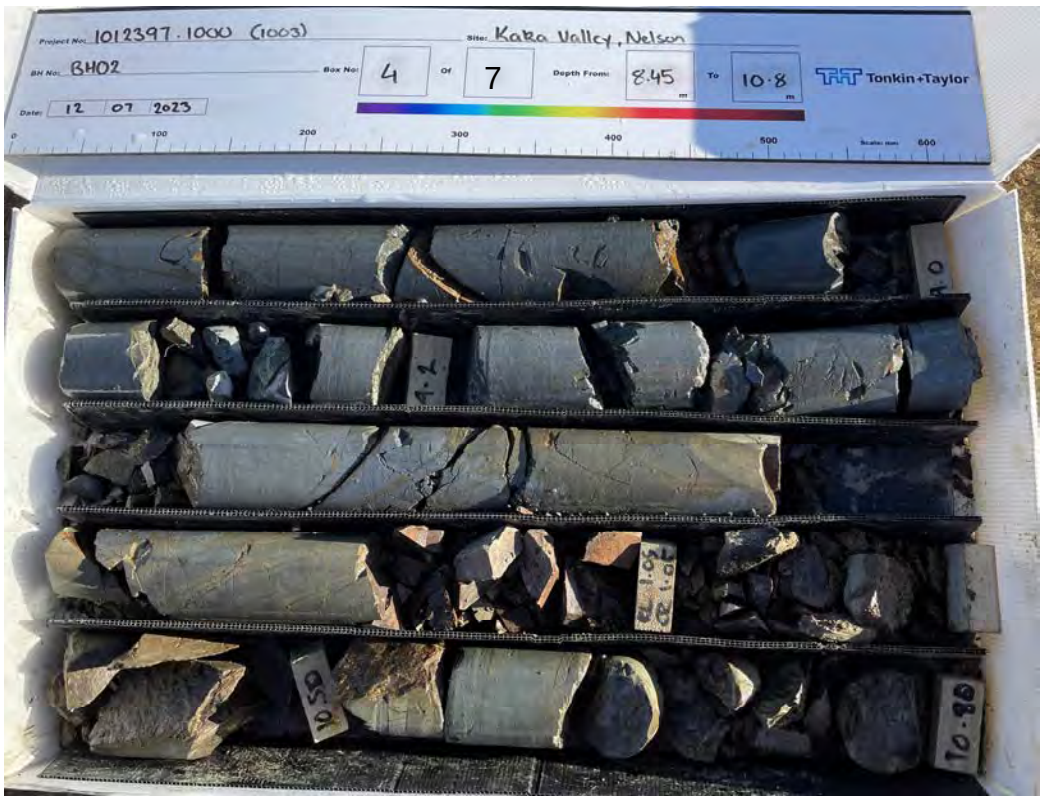
2.80-5.30m

CORE PHOTOS

BOREHOLE No.: **BH02_0723**

PROJECT: Maitahi	LOCATION: Kaka Valley	JOB No.: 1012397.1000.1000
CO-ORDINATES: 5431359 mN (NZTM2000) 1626270 mE R.L.: 85m DATUM: NZVD2016	DRILL TYPE: Hanjin D8 METHOD: Rotary cored	HOLE STARTED: 10/07/2023 HOLE FINISHED: 13/07/2023 DRILLED BY: CW Drilling LOGGED BY: ANCO CHECKED: JXWW

5.30-8.45m

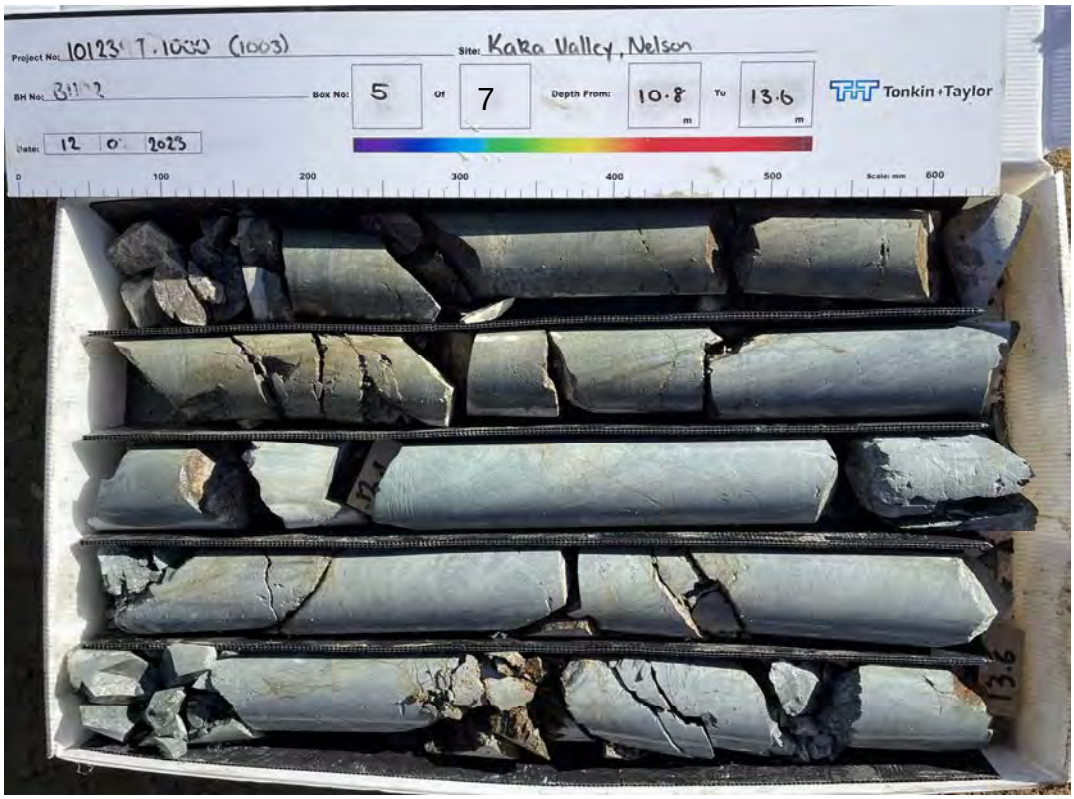


8.45-10.80m

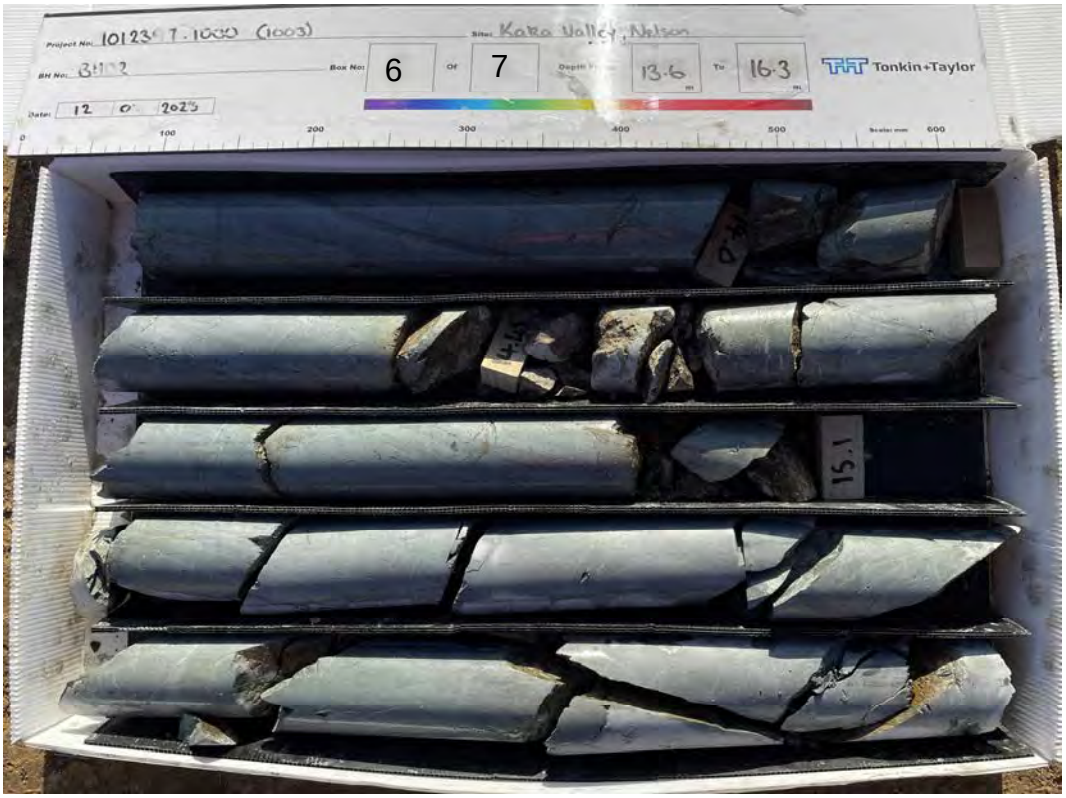
CORE PHOTOS

BOREHOLE No.: **BH02_0723**

PROJECT: Maitahi	LOCATION: Kaka Valley	JOB No.: 1012397.1000.1000
CO-ORDINATES: 5431359 mN (NZTM2000) 1626270 mE R.L.: 85m DATUM: NZVD2016	DRILL TYPE: Hanjin D8 METHOD: Rotary cored	HOLE STARTED: 10/07/2023 HOLE FINISHED: 13/07/2023 DRILLED BY: CW Drilling LOGGED BY: ANCO CHECKED: JXWW



10.80-13.60m

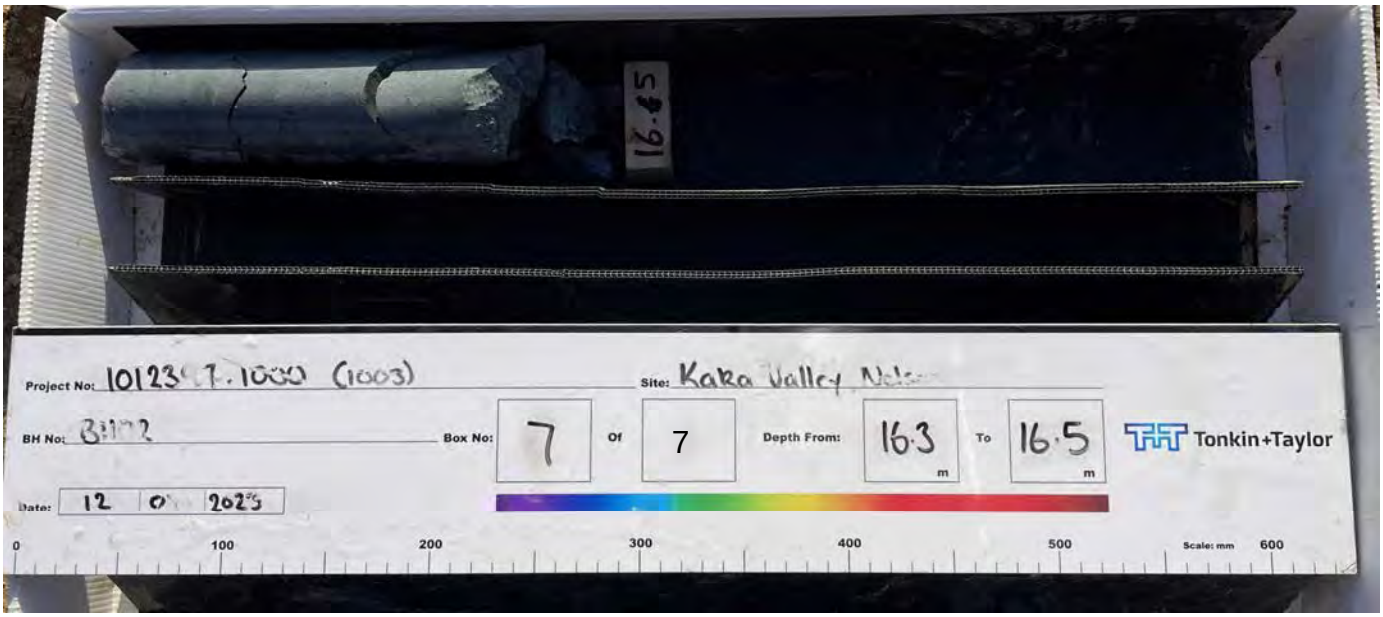


13.60-16.30m

CORE PHOTOS

BOREHOLE No.: **BH02_0723**

PROJECT: Maitahi	LOCATION: Kaka Valley	JOB No.: 1012397.1000.1000
CO-ORDINATES: 5431359 mN (NZTM2000) 1626270 mE R.L.: 85m DATUM: NZVD2016	DRILL TYPE: Hanjin D8 METHOD: Rotary cored	HOLE STARTED: 10/07/2023 HOLE FINISHED: 13/07/2023 DRILLED BY: CW Drilling LOGGED BY: ANCO CHECKED: JXWW



16.30-16.50m

BOREHOLE LOG

Tonkin+Taylor

BOREHOLE No.: BH02-22

SHEET: 1 OF 3

PROJECT: Maitahi
JOB No.: 1012397.1000.1000
LOCATION: Kaka Valley

CO-ORDINATES: 5431153 mN, 1625918 mE (NZTM2000)
DIRECTION: 180°
ANGLE FROM HORIZ.: -90°

R.L. GROUND: 16m
R.L. COLLAR:
DATUM: NZVD2016
SURVEY: Handheld GPS

DRILLED BY: Mason and Matt
LOGGED BY: AMHO
CHECKED: SAPR
START DATE: 22/03/2022
FINISH DATE: 23/03/2022
CONTRACTOR: ProDrill

GEOLOGICAL UNIT	MATERIAL DESCRIPTION (SOIL: Classification, colour, consistency / density, moisture, plasticity; ROCK: Weathering, colour, fabric, name, strength, cementation)	Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m) / Depth (m)	Graphic Log	ROCK MASS DISCONTINUITIES: Defect Log / Fracture Spacing (mm) / RQD (%) / Description & Additional Observations	Water Level / Fluid Loss (%)	Casing	Installation	Core Box No
TSoil	*0.00m:* SILT, some clay; Dark Brown. Stiff, moist, low plasticity. (TOPSOIL).												
Alluvial Deposits	*0.40m:* Gravelly fine to coarse SAND, minor silt; Light Brown. Medium dense, moist, well graded. Gravel, fine to medium, up to 20mm, rounded to sub-rounded.			SNC	77								
	1.00 - 1.15m: Gravel, fine to coarse, up to 60mm.												
	1.15m: CORE LOSS - Suspect loose granular material dropped out of barrel.												
	1.50m: Gravelly fine to coarse SAND, minor silt; Light Brown. Medium dense, moist, well graded. Gravel, fine to coarse, up to 60mm, sub-rounded to angular.			SPT	100	3/5// 5/3/5/5 N=18							
				SNC	100								
				SPT	100	4/7// 3/4/2/3 N=12							
	3.30m: Sandy fine to medium GRAVEL, minor silt; Light Brown. Medium dense, moist, well graded. Gravel, up to 10mm, sub-rounded to sub-angular; sand, fine to coarse.												
	3.65m: Clayey SILT, trace organic flecks; Grey. Stiff, moist, high plasticity, moderately sensitive.			SNC	100								
				SPT	100	0/0// 0/1/2/3 N=6							
	4.80m: Gravelly fine to coarse SAND; Grey. Loose, wet, well graded. Gravel, fine to coarse, up to 20mm, sub-rounded to												

Rock Weathering: XW, SW, MW, HW, CW, RS
Rock Strength: VS, S, MS, M, W, VW, EW
RL (m): 15, 14, 13, 12
Depth (m): 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5
Defect Log / Fracture Spacing (mm): 2000, 600, 200, 60, 20
Water Level / Fluid Loss (%): 25, 50, 75
24/03/2022
Box 0.00-3.45m

COMMENTS:

Hole Depth 12.5m

Scale 1:25

Rev.: A

TTNZ_20220309 - General Log - 29/02/2024 5:26:18 pm - Produced with Core-GS by GeRoc

BOREHOLE LOG

BOREHOLE No.: BH02-22

SHEET: 2 OF 3

Tonkin+Taylor

PROJECT: Maitahi
JOB No.: 1012397.1000.1000
LOCATION: Kaka Valley

CO-ORDINATES: 5431153 mN, 1625918 mE (NZTM2000)
DIRECTION: 180°
ANGLE FROM HORIZ.: -90°

R.L. GROUND: 16m
R.L. COLLAR:
DATUM: NZVD2016
SURVEY: Handheld GPS

DRILLED BY: Mason and Matt
LOGGED BY: AMHO
CHECKED: SAPR
START DATE: 22/03/2022
FINISH DATE: 23/03/2022
CONTRACTOR: ProDrill

GEOLOGICAL UNIT	MATERIAL DESCRIPTION (SOIL: Classification, colour, consistency / density, moisture, plasticity; ROCK: Weathering, colour, fabric, name, strength, cementation)	Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m) / Depth (m)	Graphic Log	ROCK MASS DISCONTINUITIES: Defect Log	Fracture Spacing (mm)	RQD (%)	Description & Additional Observations	Water Level / Fluid Loss (%)	Casing	Installation	Core Box No
Alluvial Deposits	sub-angular. *5.05m:* Fine to medium SAND, minor silt; Grey. Medium dense, moist, uniformly graded.															
	5.50m: Gravelly fine to coarse SAND, minor silt; Grey. Medium dense, moist, well graded. Gravel, fine to coarse, up to 60mm, sub-rounded to angular.			SNC	100											
	5.80m: Gravelly fine to medium SAND, some silt; Grey mottled orange. Dense, moist, well graded. Gravel, fine to medium, up to 20mm, sub-rounded to sub-angular.			SPT	100	7/11// 8/9/6/9 N=32	10 / 6.0									
	6.55m: Gravelly fine to coarse SAND, minor silt; Greyish brown. Medium dense, moist, well graded. Gravel, fine to coarse, up to 30mm, sub-rounded to sub-angular.			SNC	100		6.5									Box 3.45-6.55m
	6.90m: Gravelly fine to coarse SAND, minor silt; Greyish brown. Medium dense, moist, well graded. Gravel, fine to coarse, up to 60mm, sub-rounded to sub-angular.						9 / 7.0									
	7.40m: Gravelly fine to coarse SAND, some silt; brown. Dense, moist, well graded. Gravel, fine to medium, up to 20mm, sub-rounded to sub-angular.			SPT	100	12/17// 18/10/11/11 for 65mm N=50	7.5									
	7.80m: Gravelly fine to coarse SAND, trace silt; Reddish brown. Very dense, moist, well graded. Gravel, fine to medium, up to 20mm, sub-rounded to sub-angular.						8 / 8.0									
	8.10m: Silty fine GRAVEL, some sand; Brown. Dense, moist, well graded. Gravel, up to 10mm, rounded to sub-rounded; sand, fine to medium.			SNC	100		8.5									
	8.60m: Gravelly fine to medium SAND, some silt; Brown. Dense, dry, well graded.						7 / 9.0									
	9.45m: CORE LOSS - Obstruction (recovered) in front of barrel.			SPT	100	17/17// 23/19/8 for 35 mm N=50	9.5									Box 6.55-9.40m
	9.70m: BOULDERS; grey. Hard, dry. Boulders, unweathered, strong, sandstone.			RC	84											

COMMENTS:

Hole Depth 12.5m

Scale 1:25

Rev.: A

BOREHOLE LOG

Tonkin+Taylor

BOREHOLE No.: BH02-22

SHEET: 3 OF 3

PROJECT: Maitahi
JOB No.: 1012397.1000.1000
LOCATION: Kaka Valley

CO-ORDINATES: 5431153 mN, 1625918 mE (NZTM2000)
DIRECTION: 180°
ANGLE FROM HORIZ.: -90°

R.L. GROUND: 16m
R.L. COLLAR:
DATUM: NZVD2016
SURVEY: Handheld GPS

DRILLED BY: Mason and Matt
LOGGED BY: AMHO
CHECKED: SAPR
START DATE: 22/03/2022
FINISH DATE: 23/03/2022
CONTRACTOR: ProDrill

GEOLOGICAL UNIT	MATERIAL DESCRIPTION (SOIL: Classification, colour, consistency / density, moisture, plasticity; ROCK: Weathering, colour, fabric, name, strength, cementation)	Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m) / Depth (m)	Graphic Log	ROCK MASS DISCONTINUITIES: Defect Log / Fracture Spacing (mm) / RQD (%) / Description & Additional Observations	Water Level / Fluid Loss (%)	Casing	Installation	Core Box No
Alluvial Deposits	*10.00m:* Fine to coarse GRAVEL, some sand; Grey mottled orange. Very loose, dry, uniformly graded. Gravel, up to 60mm, rounded to sub-rounded; sand, fine to coarse.												
Grampian Formation	*10.40m:* Highly weathered, Greenish grey, tuffaceous MUDSTONE. Weak, well cemented.			RC	84		10.5		*10.41m:* B, 20°, PL, SM *10.45m:* B, 5°, UN, SM *10.50-10.55m:* B, 10°, UN, R				
	10.75m: Highly weathered, Grey, tuffaceous MUDSTONE. Very weak, well cemented.						11.0		*10.65-10.80m:* J, 5-70°, UN, SM *10.85-11.10m:* BZ, 5-60°, UN, R				
	11.45m: Moderately weathered, Grey, tuffaceous SANDSTONE. Moderately strong, well cemented.			RC	100		11.5		*11.20m:* B, 20°, PL, SM *11.26m:* B, 10°, UN, SM *11.37-11.60m:* J, 80°, PL, SM				Box 9.10-11.65m
	11.80m: Moderately weathered, Grey, sheared, tuffaceous MUDSTONE. Extremely weak, well cemented. Recovered as: Sandy fine GRAVEL; Grey. Very loose, moist, uniformly graded. Gravel, up to 5mm, sub-angular to angular; sand, fine to coarse.						12.0		*11.80-12.25m:* BZ, 5-70°, UN, SM				Box 11.65-12.50m
	12.05m: Moderately weathered, Grey, sheared, tuffaceous SANDSTONE. Weak, well cemented.												
	12.25m: Moderately weathered, Grey, tuffaceous SANDSTONE. Moderately strong, well cemented.						12.5		*12.40-12.50m:* BZ, UN, SM				
	12.5m: Target depth						13.0						
							13.5						
							14.0						
							14.5						

COMMENTS:

Hole Depth 12.5m

Scale 1:25

Rev.: A

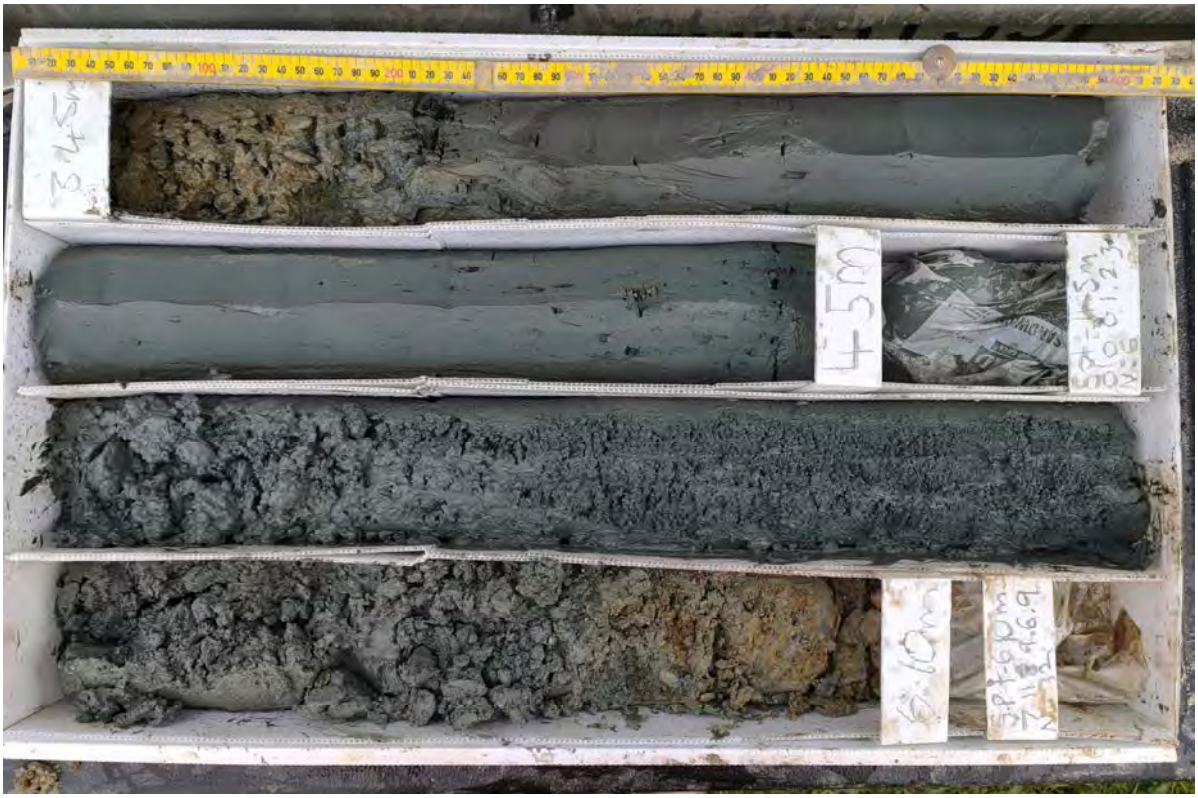
Tonkin+Taylor

CORE PHOTOS

BOREHOLE No.: **BH02-22**

PROJECT: Maitahi	LOCATION: Kaka Valley	JOB No.: 1012397.1000.1000
CO-ORDINATES: 5431153 mN (NZTM2000) 1625918 mE R.L.: 16m DATUM: NZVD2016	DRILL TYPE: Sonic drill METHOD: Sonic core drilling	HOLE STARTED: 22/03/2022 HOLE FINISHED: 23/03/2022 DRILLED BY: ProDrill LOGGED BY: AMHO CHECKED: SAPR

0.00-3.45m



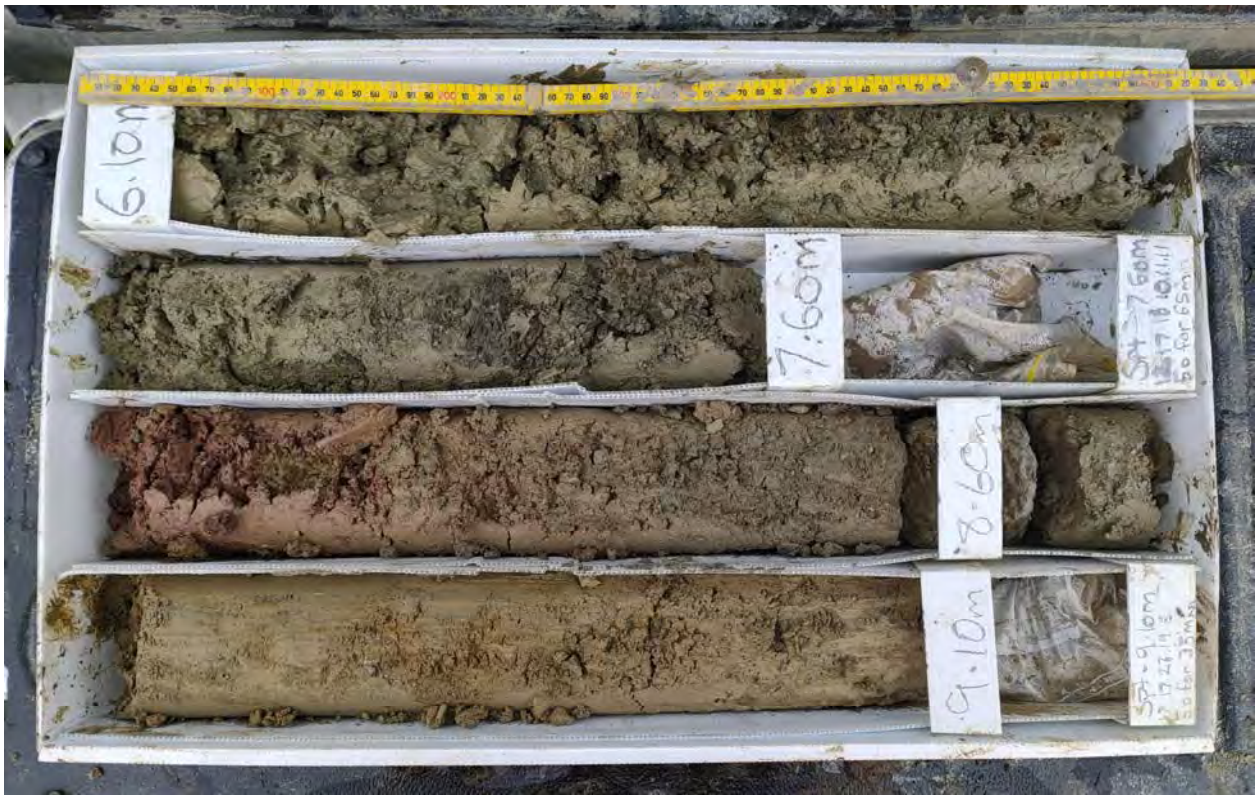
3.45-6.55m

Tonkin+Taylor

CORE PHOTOS

BOREHOLE No.: **BH02-22**

PROJECT: Maitahi	LOCATION: Kaka Valley	JOB No.: 1012397.1000.1000
CO-ORDINATES: 5431153 mN (NZTM2000) 1625918 mE R.L.: 16m DATUM: NZVD2016	DRILL TYPE: Sonic drill METHOD: Sonic core drilling	HOLE STARTED: 22/03/2022 HOLE FINISHED: 23/03/2022 DRILLED BY: ProDrill LOGGED BY: AMHO CHECKED: SAPR



6.55-9.40m

9.10-11.65m

CORE PHOTOS

BOREHOLE No.: **BH02-22**

SHEET: 3 OF 3

PROJECT: Maitahi	LOCATION: Kaka Valley	JOB No.: 1012397.1000.1000
CO-ORDINATES: 5431153 mN (NZTM2000) 1625918 mE R.L.: 16m DATUM: NZVD2016	DRILL TYPE: Sonic drill METHOD: Sonic core drilling	HOLE STARTED: 22/03/2022 HOLE FINISHED: 23/03/2022 DRILLED BY: ProDrill LOGGED BY: AMHO CHECKED: SAPR

11.65-12.50m

BOREHOLE LOG

Tonkin+Taylor

BOREHOLE No.: BH02-23

SHEET: 1 OF 1

PROJECT: Maitahi
JOB No.: 1012397.1000.1000
LOCATION: Kaka Valley

CO-ORDINATES: (NZTM2000) 5431379.37 mN 1625938.35 mE
DIRECTION: 180°
ANGLE FROM HORIZ.: -90°

R.L. GROUND: 20.35m
R.L. COLLAR:
DATUM: NZVD2016
SURVEY: Handheld GPS

DRILLED BY: Dylan
LOGGED BY: FEOH
CHECKED: MRF
START DATE: 17/04/2023
FINISH DATE: 17/04/2023
CONTRACTOR: CW Drilling

GEOLOGICAL UNIT	DESCRIPTION OF CORE SOIL: Classification, colour, consistency / density, moisture, plasticity ROCK: Weathering, colour, fabric, name, strength, cementation
TSoil	*0.00m:* SILT, minor organics; Dark brown. Moist to wet, low plasticity.
Alluvial Deposits	*0.40m:* Gravelly SILT; Light brown. Moist to wet, low plasticity. Gravel, medium, sub-rounded.
	1.00m: Fine to coarse GRAVEL, minor silt; Light brown grey. Dry. Gravel, sub-rounded to sub-angular.
	1.50m: Silty sandy fine to medium GRAVEL; Light brown grey. Dry. Gravel, sub-rounded; sand, fine. *1.90 - 2.50m:* Coarse gravel and sand *2.40 - 2.50m:* Grey
	2.50m: Silty fine to coarse GRAVEL, trace organics and trace clay and trace sand; Grey . Wet. Gravel, sub-rounded to sub-angular; organics , rootlets.
	2.90m: Fine to coarse GRAVEL, trace clay and trace silt and trace sand; Grey . Wet. Gravel, sub-rounded to sub-angular.

Rock Weathering: UW SW MW HW EW
Rock Strength: ES VS S MS W VW EW
Sampling Method
Core Recovery (%)
Testing
RL (m) / Depth (m): 20 (0), 19 (1), 18 (2), 17 (3), 16 (4), 15 (5)
Graphic Log
ROCK DEFECTS: Defect Log; Fracture Spacing (mm): 2000 600 200 60 20; RQD (%); Description & Additional Observations
Fluid Loss (%): 25 50 75
Water Level: 17/04/2023
Casing
Installation: Box 1, 0.00-3.50m
Core Box No

COMMENTS:

Hole Depth 3.5m

Scale 1:30

Rev.: A

CORE PHOTOS

BOREHOLE No.: **BH02-23**

SHEET: 1 OF 1

PROJECT: Maitahi	LOCATION: Kaka Valley	JOB No.: 1012397.1000.1000
CO-ORDINATES: 5431379.37 mN (NZTM2000) 1625938.35 mE R.L.: 20.35m DATUM: NZVD2016	DRILL TYPE: Concentric DRILL METHOD: PR	HOLE STARTED: 17/04/2023 HOLE FINISHED: 17/04/2023 DRILLED BY: CW Drilling LOGGED BY: FEOH CHECKED: MRF

0.00-3.50m

Tonkin+Taylor

DRAFT

BOREHOLE LOG

BOREHOLE No.: BH03_0723

SHEET: 1 OF 4

PROJECT: Maitahi

JOB No.: 1012397.1000.1000

LOCATION: Kaka Valley

CO-ORDINATES: 5431432 mN 1626110 mE (NZTM2000)

DIRECTION: 0°

ANGLE FROM HORIZ.: -90°

R.L. GROUND: 44m

R.L. COLLAR:

DATUM: NZVD2016

SURVEY: Map or aerial photograph

DRILLED BY: Dylan

LOGGED BY: ANCO

CHECKED: JXWW

START DATE: 17/07/2023

FINISH DATE: 19/07/2023

CONTRACTOR: CW Drilling

GEOLOGICAL UNIT	MATERIAL DESCRIPTION	Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK MASS DISCONTINUITIES: Defect Log	Fracture Spacing (mm)	RQD (%)	Description & Additional Observations	Water Level / Fluid Loss (%)	Casing	Installation	Core Box No
	SOIL: Classification, colour, consistency / density, moisture, plasticity ROCK: Weathering, colour, fabric, name, strength, cementation	XW SW MW HW CW DW RS	VS+ S MS W VW WW								2000 600 200 60 20			25 50 75			
Grampian Formation	*0.00m:* Greenish - brown orange - brown, volcaniclastic BRECCIA. Extremely weak. Has the properties of Clayey gravelly SILT. Very soft. Non-plastic to low plasticity. .			HQ3	100							100			HQ		
	0.30m: Grading from brownish - green - grey to orange - brown																
	0.60 - 0. 80m: Clayey gravelly SILT. Soft, low plasticity. Polymict volcanic breccia? Matrix supported. Finning with depth.																
	0.80 - 1. 35m: Gravelly SILT, some clay; Orange -brown blue- grey. Mediumdense. Gravel, up to 60mm, sub-angular.			HQ3	96		43	1									
	1.35 - 1. 60m: PARTIAL CORE LOSS - Suspect fines washed out clayey SILT, some sand and some gravel. Soft, low plasticity. Sand, fine to coarse.																
	1.60 - 1. 65m: Highly weathered, Greenish - brown, TUFF. Weak to moderately strong, coarse grained, porph yritic.																
	1.65 - 2. 23m: Gravelly SILT, some clay and some cobbles; Orange - brown green grey. Firm to stiff, low plasticity. Gravel, sub-rounded to sub-angular; cobbles, up to 200mm, sub-rounded to sub-angular. Matrix supported, volcaniclastic breccia? Breccia clasts are commonly-tuffaceous; with some minor quartz and possible sandstone? .			HQ3	100		42	2									
	2.23 - 2. 51m: Clayey SILT. Soft, low plasticity.												*2.30m:* Water pressure increasing				
	2.51 - 2. 90m: Sandy gravelly SILT, some clay. Firm to stiff. Gravel, sub-angular.												*2.50m:* Bit becoming blocked				
	2.90 - 3. 00m: Highly weathered, Light grey orange - brown. Moderately strong, limonite staining. Fractured.																Box 0.00-2.80m
	3.10 - 3. 35m: Highly weathered, Orange - brown greenish - brown, tuffaceous . Moderately strong, limonite staining. Volcanic Tuff?.			HQ3	60		41	3									
	3.35 - 6. 40m: CORE LOSS - Suspect washed out clayey SILT, some gravel. Soft, low plasticity. Gravel, coarse, sub-angular. Broken ground.																
	3.90 - 4. 45m: Gravelly SILT, some clay; White -grey grey mixed with minor reddish -grey. Very stiff. Gravel, sub-angular, Matrix supported. Volcanic Tuff?.			HQ3	108		40	4									
	4.45 - 4. 60m: CORE LOSS - Suspect washed out gravelly SILT, some clay and some cobbles; Greenish - grey - orange brown. Soft, non-plastic to low plasticity. Cobbles, volcanic tuff with some quartz.			HQ3	75												
				HQ3	24		39	5									
				HQ3	43												Box 2.80-6.00m

COMMENTS: Weather fine.

Hole Depth 20m

Scale 1:30

Rev.: A

Tonkin+Taylor

DRAFT

BOREHOLE LOG

BOREHOLE No.: BH03_0723

SHEET: 2 OF 4

PROJECT: Maitahi
JOB No.: 1012397.1000.1000
LOCATION: Kaka Valley

CO-ORDINATES: 5431432 mN, 1626110 mE (NZTM2000)
DIRECTION: 0°
ANGLE FROM HORIZ.: -90°

R.L. GROUND: 44m
R.L. COLLAR:
DATUM: NZVD2016
SURVEY: Map or aerial photograph

DRILLED BY: Dylan
LOGGED BY: ANCO
CHECKED: JXWW
START DATE: 17/07/2023
FINISH DATE: 19/07/2023
CONTRACTOR: CW Drilling

GEOLOGICAL UNIT	MATERIAL DESCRIPTION (SOIL: Classification, colour, consistency / density, moisture, plasticity; ROCK: Weathering, colour, fabric, name, strength, cementation)	Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK MASS DISCONTINUITIES: Defect Log	Fracture Spacing (mm)	RQD (%)	Description & Additional Observations	Water Level / Fluid Loss (%)	Casing	Installation	Core Box No
Grampian Formation	[CONT] *0.00m:* Greenish - brown orange - brown, volcaniclastic BRECCIA. Extremely weak. Has the properties of Clayey gravelly SILT. Very soft. Non-plastic to low plasticity. .			HQ3	75												
	6.40 - 6.75m: Very stiff																
	6.75 - 7.15m: Gravelly SILT. Soft to firm. Gravel, slightly to moderately weathered.			HQ3	100		37	7									
	7.15 - 7.20m: Moderately weathered, Green - grey, tuffaceous. Strong, coarse grained. *7.20 - 7.50m:* Gravelly SILT. Soft to firm.																
	7.50 - 7.70m: Soft																
	7.70 - 8.00m: Highly weathered, Orange - brown grey, broken, volcaniclastic? BRECCIA. Weak. *7.75 - 7.95m:* Moderately weathered, Greenish - grey, volcaniclastic? TUFF. Moderately strong. *8.00 - 8.35m:* Moderately weathered, Blue - green grey, volcaniclastic TUFF. Moderately strong, medium grained, porphyritic. Dark green mineral / phenocyrst.			HQ3	97		36	8									
	8.35 - 8.40m: Firm *8.40 - 9.10m:* Clayey gravelly SILT, some cobbles. Soft, matrix supported. Cobbles, sub-angular, highly weathered, tuff.																
	9.00 - 9.10m: Stiff *9.10 - 9.30m:* Very soft						35	9					*9.30m:* Drill string dropped - softer ground		HQ		Box 6.00-9.60m
	9.30 - 9.40m: Stiff *9.40 - 9.50m:* Soft *9.50 - 9.75m:* Soft to firm			HQ3	82												
	9.75 - 9.93m: Moderately weathered, Greenish -grey, TUFF. Strong, coarse grained, porphyritic. Dacitic? .																
	10.00 - 10.10m: CORE LOSS - Suspect washed out Slightly weathered, Greenish grey, tuffaceous . Strong, medium grained. *10.10 - 10.40m:* Clayey SILT, some gravel; Orange - brown . Soft, non-plastic. Volcanic tuff?. *10.40 - 10.55m:* Moderately weathered, Brownish green grey, TUFF. Moderately strong.			HQ3	74		34	10				23					
	10.55m: Gravelly SILT, some clay; Orange - brown. Soft, non-plastic. Fault zone.												*10.50m:* B				
	10.70m: Slightly weathered, Light bluish grey, SANDSTONE. Strong, fine to medium grained. Interbedded with fine mudstone. Numerous fine fractures with minor limonite staining. .			HQ3	86							48	*10.70m:* Fg, ST, SM *10.95m:* J, ST, R *11.00m:* J, ST, SM				
	11.45m: Gravelly SILT; Brownish -grey. Soft, non-plastic. Fault zone?.						33	11									
	11.60m: Slightly weathered, Dark grey, MUDSTONE. Moderately strong to strong, fine grained. *11.73 - 11.80m:* Gravelly SILT, minor clay; Dark grey. Soft, non-plastic. Fault zone?.			HQ3	100							15	*11.60m:* Fg, ST, SM *11.80m:* F, ST, SM *11.85m:* J, ST, R				

COMMENTS: Weather fine.

Hole Depth 20m

Scale 1:30

Rev.: A

Tonkin+Taylor

DRAFT

BOREHOLE LOG

BOREHOLE No.: BH03_0723

SHEET: 3 OF 4

PROJECT: Maitahi
JOB No.: 1012397.1000.1000
LOCATION: Kaka Valley

CO-ORDINATES: 5431432 mN 1626110 mE (NZTM2000)
DIRECTION: 0°
ANGLE FROM HORIZ.: -90°

R.L. GROUND: 44m
R.L. COLLAR:
DATUM: NZVD2016
SURVEY: Map or aerial photograph

DRILLED BY: Dylan
LOGGED BY: ANCO
CHECKED: JXWW
START DATE: 17/07/2023
FINISH DATE: 19/07/2023
CONTRACTOR: CW Drilling

GEOLOGICAL UNIT	MATERIAL DESCRIPTION (SOIL: Classification, colour, consistency / density, moisture, plasticity; ROCK: Weathering, colour, fabric, name, strength, cementation)	Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK MASS DISCONTINUITIES: Defect Log	Fracture Spacing (mm)	RQD (%)	Description & Additional Observations	Water Level / Fluid Loss (%)	Casing	Installation	Core Box No
Grampian Formation	[CONT] *11.60m:* Slightly weathered, Darkgrey, MUDSTONE. Moderately strong to strong, fine grained.			HQ3	74							0	*12.10m:* J, ST, SM *12.11m:* J, ST, SM		HQ		Box 9.60-12.70m
	11.80 - 14.20m: Strong. Bedding. Fine fractures (healed).			HQ3	96		31	13				78	*12.75m:* Rod Spin *12.80m:* J, ST, SM *12.95m:* J, ST, R *13.00m:* J, ST, R *13.15m:* J, ST, SM *13.20m:* J, ST, SM *13.30m:* J, ST, R *13.40m:* J, ST, SM				
				HQ3	100		30	14				57	*13.50m:* J, ST, R *13.60m:* J, ST, R *13.70m:* J, ST, R *13.71m:* J, ST, SM *13.80m:* B *14.05m:* J, ST, SM				
	14.20m: CORE LOSS - Suspect washed out COBBLES; Light grey . Cobbles, sub-rounded. Fines lost?.			HQ3	25							0					
	15.00m: PARTIAL CORE LOSS - Suspect fines washed out Slightly weathered, Light grey, SANDSTONE. Moderately strong, medium grained. FeSt on joint surfaces. Last 100mm broken ground. . *15.20m:* Clay seam *15.55 - 16.38m:* Zone of broken ground. Fault zone?			HQ3	70		29	15				30	*15.00m:* B *15.07m:* J, ST, R *15.00m:* Water out top of hole when roads pulled *15.20m:* Iz, ST, SM, clay seam				
	15.65m: Slightly weathered, Dark -light grey, SANDSTONE. Strong. Interbedded with mudstone, bedding is fine. Locally brecciated. Many fractures. .			HQ3	100		28	16				35	*15.60m:* J, ST, R *15.70m:* J, ST, R *15.75m:* J, ST, R *15.76m:* J, ST, R *15.90m:* J, ST, R *16.00m:* J, ST, SM *16.05m:* J, ST, SM *16.10m:* B, UN, SM *16.20m:* J, ST, SM *16.30m:* J, ST, SM *16.31m:* J, ST, SM				Box 12.70-15.80m
				HQ3	100		27	17				50	*16.60m:* J, ST, SM *16.85m:* J, ST, SM *17.05m:* J, ST, SM *17.20m:* J, ST, SM *17.25m:* J, ST, SM				Box 15.80-17.50m
				HQ3	100							64	*17.50m:* J, ST, R *17.70m:* J, ST, R *17.80m:* J, ST, R				

COMMENTS: Weather fine.

Hole Depth 20m

Scale 1:30

Rev.: A

Tonkin+Taylor

DRAFT

BOREHOLE LOG

BOREHOLE No.: BH03_0723

SHEET: 4 OF 4

PROJECT: Maitahi

JOB No.: 1012397.1000.1000

LOCATION: Kaka Valley

CO-ORDINATES: 5431432 mN, 1626110 mE (NZTM2000)

DIRECTION: 0°

ANGLE FROM HORIZ.: -90°

R.L. GROUND: 44m

R.L. COLLAR:

DATUM: NZVD2016

SURVEY: Map or aerial photograph

DRILLED BY: Dylan

LOGGED BY: ANCO

CHECKED: JXWW

START DATE: 17/07/2023

FINISH DATE: 19/07/2023

CONTRACTOR: CW Drilling

GEOLOGICAL UNIT	MATERIAL DESCRIPTION (SOIL: Classification, colour, consistency / density, moisture, plasticity; ROCK: Weathering, colour, fabric, name, strength, cementation)	Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m) / Depth (m)	Graphic Log	ROCK MASS DISCONTINUITIES: Defect Log / Fracture Spacing (mm) / RQD (%) / Description & Additional Observations	Water Level / Fluid Loss (%)	Casing	Installation	Core Box No
Grampian Formation	[CONT] *15.65m:* Slightly weathered, Dark -light grey, SANDSTONE. Strong. Interbedded with mudstone, bedding is fine. Locally brecciated. Many fractures. .			HQ3	97		25 / 19		*18.10m:* J, ST, SM *18.20m:* J, ST, R		HQ		
	18.60 - 18.90m: Clay seams								*18.60m:* J, ST, SM *18.70m:* J, ST, R *18.80m:* J, ST, SM, Minor clay				
	19.20 - 19.50m: Broken ground								*19.00m:* J, ST, SM *19.10m:* J, ST, SM *19.20m:* J, ST, SM				
				HQ3	108		24 / 20		RQD 46 *19.80m:* J, ST, R *19.85m:* J, ST, R *19.90m:* J, ST, SM *19.95m:* J, ST, R RQD 28				Box 17.50-20.00m
	20m: END OF BOREHOLE. Target depth.						23 / 21						
							22 / 22						
							21 / 23						

COMMENTS: Weather fine.

Hole Depth 20m

Scale 1:30

Rev.: A

TTNZ_20230717 - General Log - 29/02/2024 5:26:30 pm - Produced with Core-GS by GeRoc

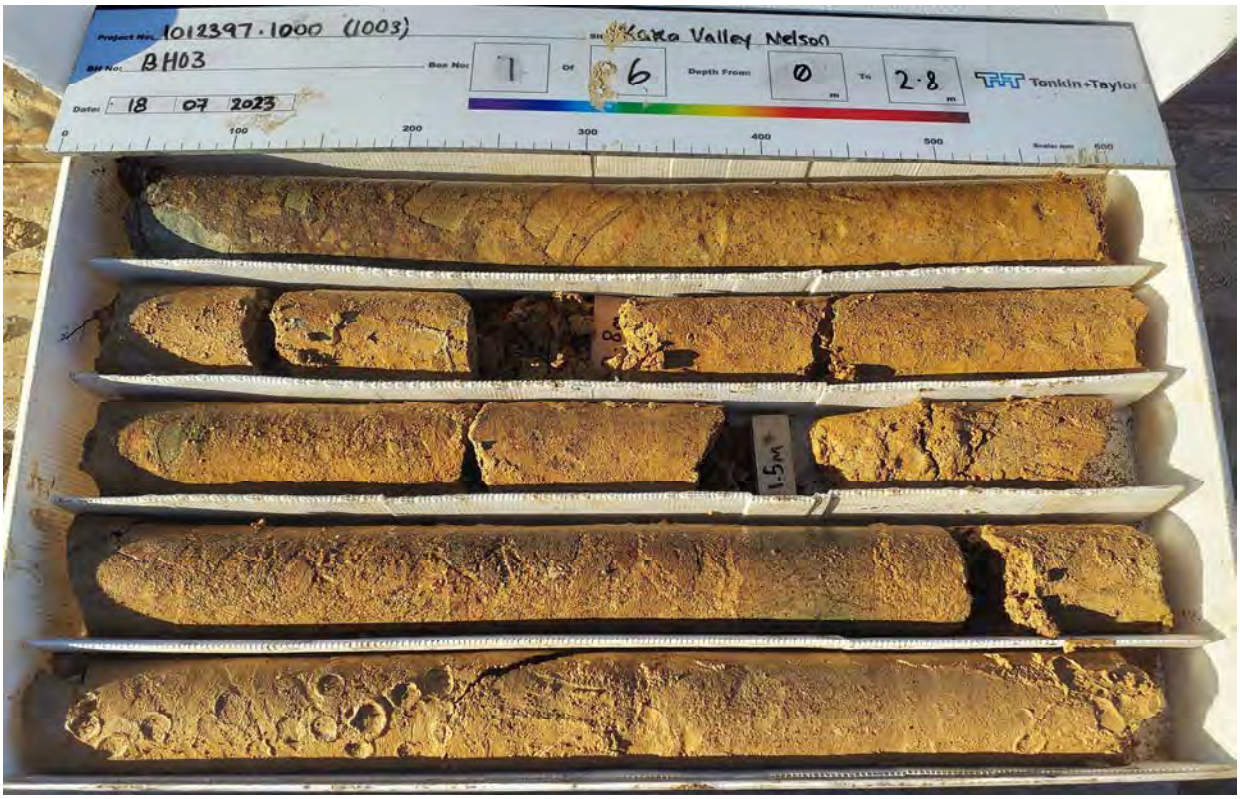
DRAFT

Tonkin+Taylor

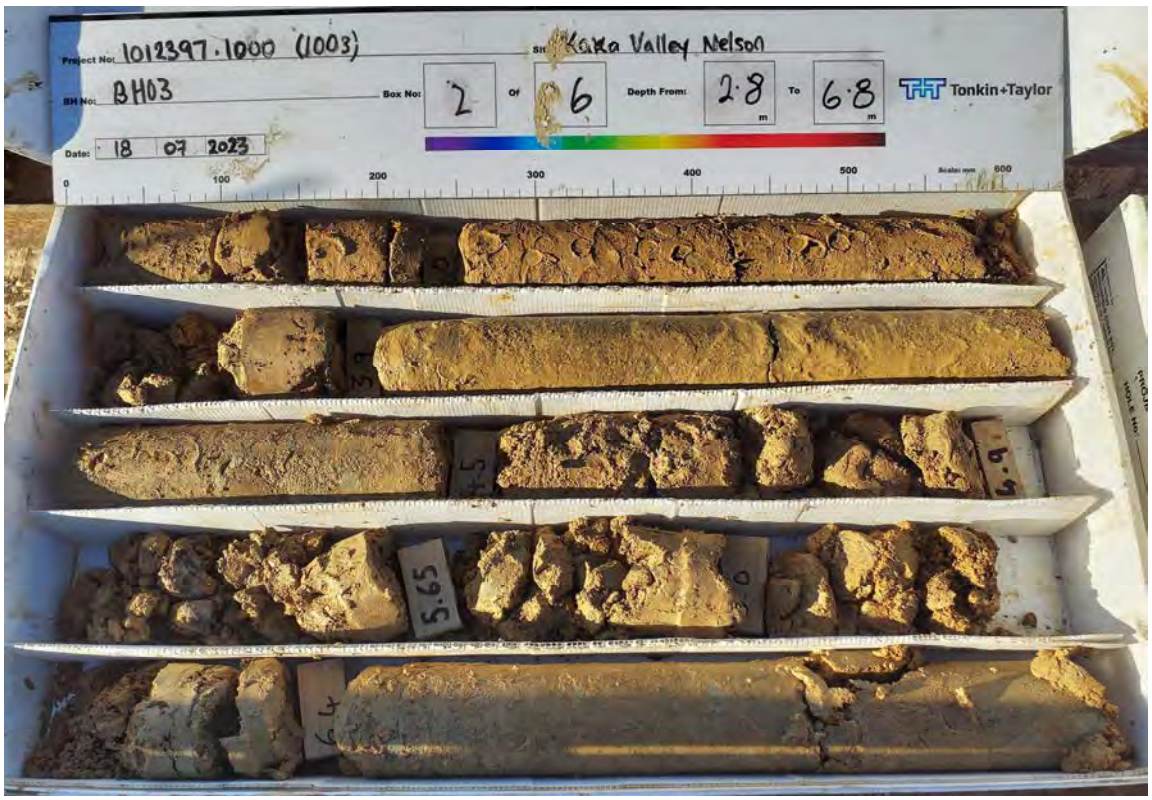
CORE PHOTOS

BOREHOLE No.: **BH03_0723**

PROJECT: Maitahi	LOCATION: Kaka Valley	JOB No.: 1012397.1000.1000
CO-ORDINATES: 5431432 mN (NZTM2000) 1626110 mE R.L.: 44m DATUM: NZVD2016	DRILL TYPE: Hanjin D8 METHOD: Rotary cored	HOLE STARTED: 17/07/2023 HOLE FINISHED: 19/07/2023 DRILLED BY: CW Drilling LOGGED BY: ANCO CHECKED: JXWW



0.00-2.80m



2.80-6.00m

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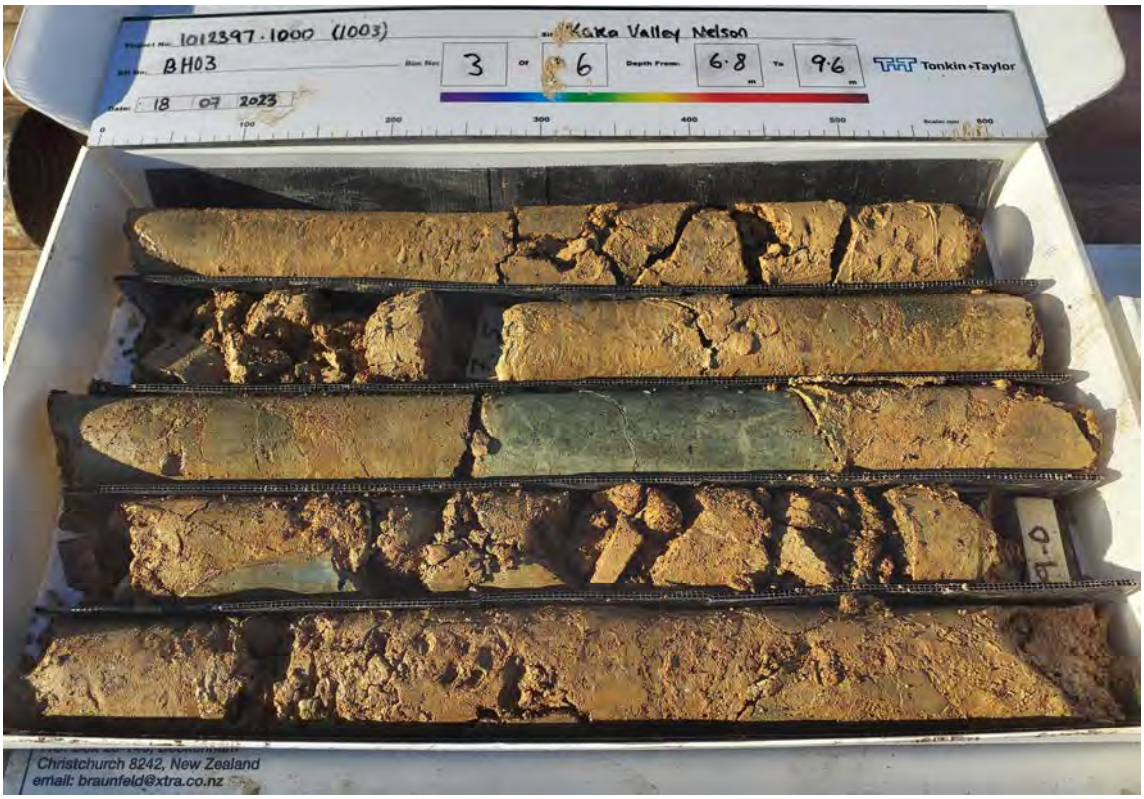
CORE PHOTOS

BOREHOLE No.: **BH03_0723**

PROJECT: Maitahi	LOCATION: Kaka Valley	JOB No.: 1012397.1000.1000
CO-ORDINATES: 5431432 mN (NZTM2000) 1626110 mE R.L.: 44m DATUM: NZVD2016	DRILL TYPE: Hanjin D8 METHOD: Rotary cored	HOLE STARTED: 17/07/2023 HOLE FINISHED: 19/07/2023 DRILLED BY: CW Drilling LOGGED BY: ANCO CHECKED: JXWW



6.00-9.60m

9.60-12.70m

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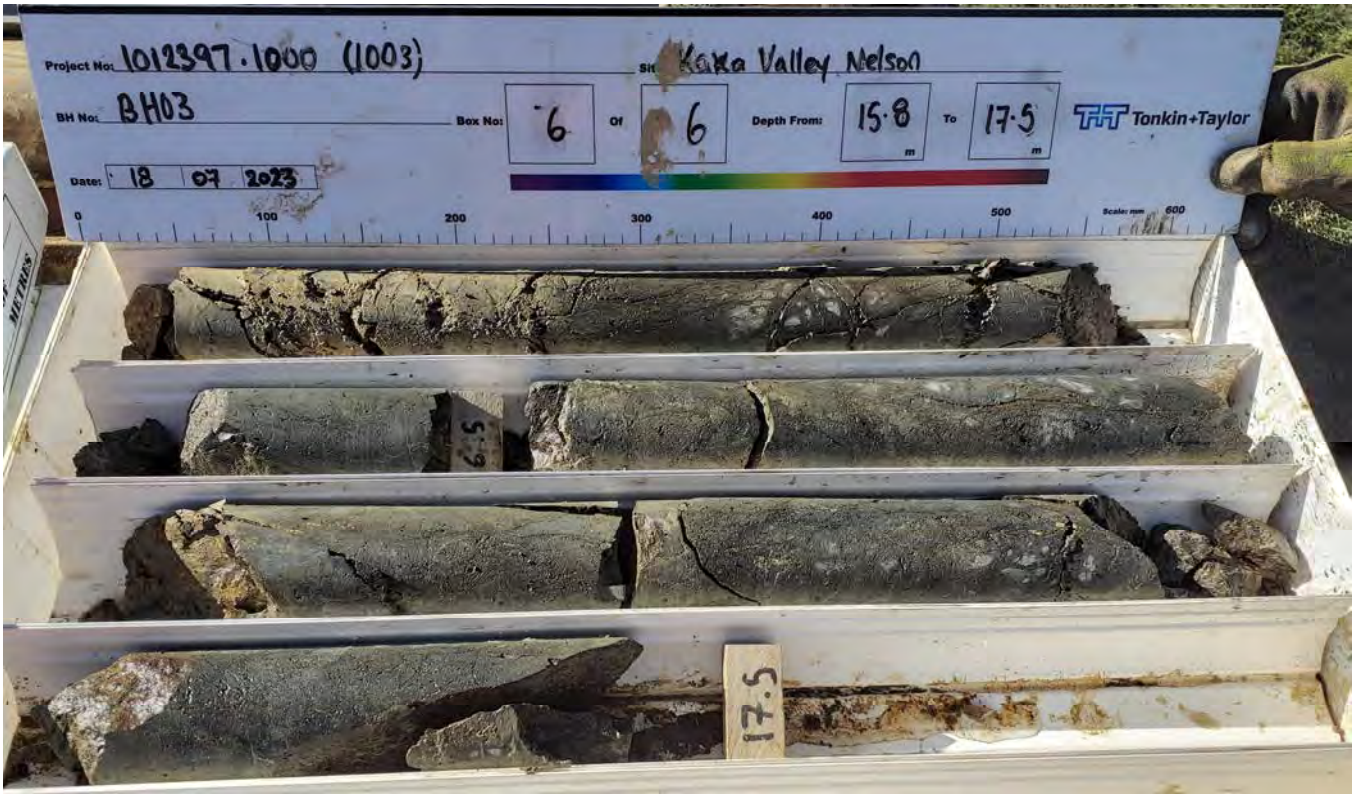
CORE PHOTOS

BOREHOLE No.: **BH03_0723**

PROJECT: Maitahi	LOCATION: Kaka Valley	JOB No.: 1012397.1000.1000
CO-ORDINATES: 5431432 mN (NZTM2000) 1626110 mE R.L.: 44m DATUM: NZVD2016	DRILL TYPE: Hanjin D8 METHOD: Rotary cored	HOLE STARTED: 17/07/2023 HOLE FINISHED: 19/07/2023 DRILLED BY: CW Drilling LOGGED BY: ANCO CHECKED: JXWW

12.70-15.80m



15.80-17.50m

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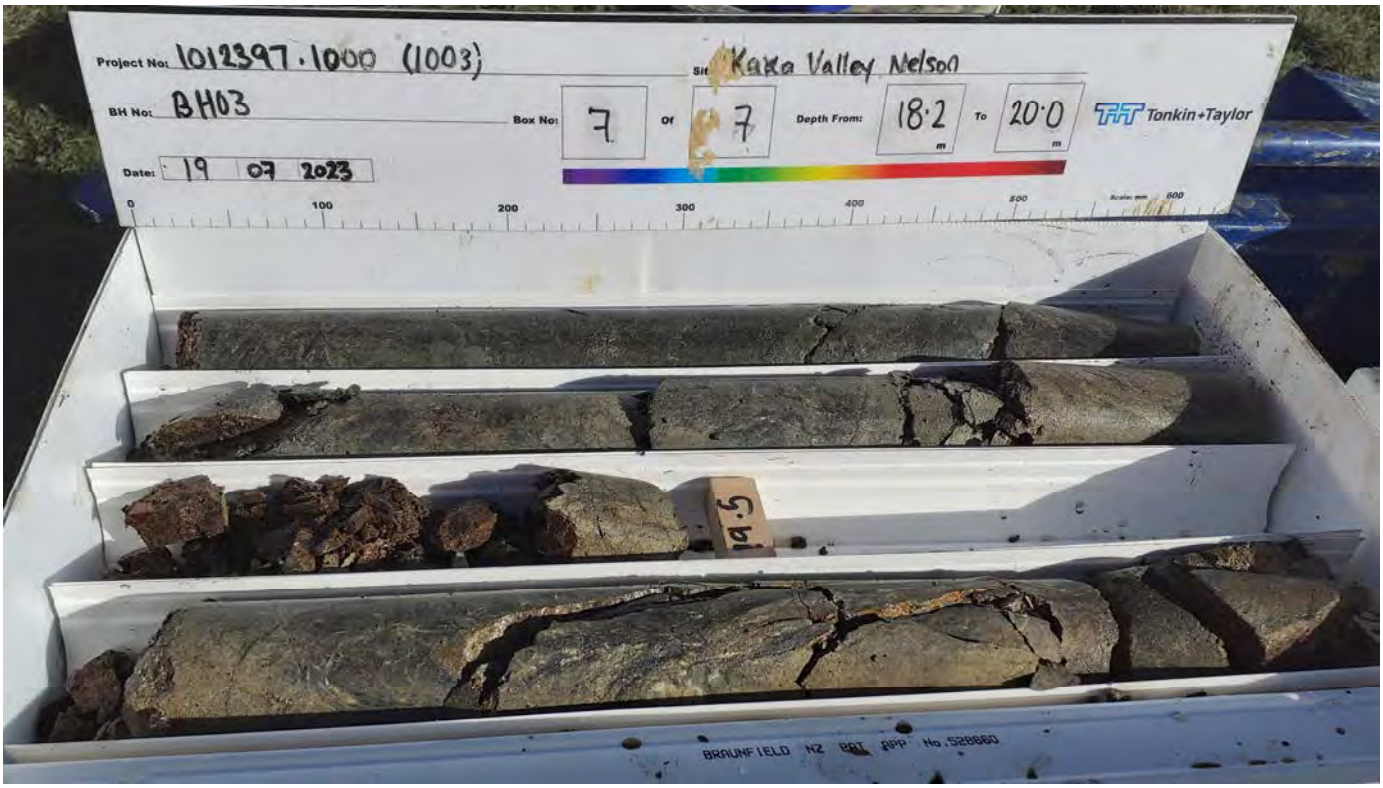
CORE PHOTOS

BOREHOLE No.: **BH03_0723**

PROJECT: Maitahi	LOCATION: Kaka Valley	JOB No.: 1012397.1000.1000
CO-ORDINATES: 5431432 mN (NZTM2000) 1626110 mE R.L.: 44m DATUM: NZVD2016	DRILL TYPE: Hanjin D8 METHOD: Rotary cored	HOLE STARTED: 17/07/2023 HOLE FINISHED: 19/07/2023 DRILLED BY: CW Drilling LOGGED BY: ANCO CHECKED: JXWW



17.50-20.00m

BOREHOLE LOG

Tonkin+Taylor

BOREHOLE No.: BH03-22

SHEET: 1 OF 4

PROJECT: Maitahi
JOB No.: 1012397.1000.1000
LOCATION: Kaka Valley

CO-ORDINATES: 5431310 mN, 1625962 mE (NZTM2000)
DIRECTION: 180°
ANGLE FROM HORIZ.: -90°

R.L. GROUND: 16m
R.L. COLLAR:
DATUM: NZVD2016
SURVEY: Handheld GPS

DRILLED BY: Mason and Matt
LOGGED BY: AMHO
CHECKED: SAPR
START DATE: 23/03/2022
FINISH DATE: 24/03/2022
CONTRACTOR: ProDrill

GEOLOGICAL UNIT	MATERIAL DESCRIPTION (SOIL: Classification, colour, consistency / density, moisture, plasticity; ROCK: Weathering, colour, fabric, name, strength, cementation)	Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m) / Depth (m)	Graphic Log	ROCK MASS DISCONTINUITIES: Defect Log / Fracture Spacing (mm) / RQD (%) / Description & Additional Observations	Water Level / Fluid Loss (%)	Casing	Installation	Core Box No
TSoil	*0.00m:* SILT, some sand, trace organics; dark brown. Stiff, moist, non-plastic. Sand, fine; organics, rootlets.												
Alluvial Deposits	*0.40m:* Sandy SILT, some gravel; dark brown. Stiff, moist, non-plastic. Sand, fine to coarse; gravel, fine to medium, sub-rounded to sub-angular.												
	0.60m: Silty fine to coarse SAND, some gravel; brown. Medium dense, moist. Gravel, fine to medium, sub-rounded to sub-angular.			SNC	100								
	1.50m: Gravelly fine to coarse SAND, some silt; brown. Medium dense, moist. Gravel, fine to medium, sub-rounded to angular.			SPT / SNC	100 / 100	1/1// 2/3/4/2 N=11							
	2.80m: Silty fine to coarse SAND, some gravel; brown. Medium dense, wet. Gravel, fine to medium, sub-rounded to angular.			SPT / SNC	100 / 100	4/6// 3/3/4/2 N=12							
	3.40m: Gravelly fine to coarse SAND, minor silt; grey. Medium dense, wet. Gravel, fine to medium, sub-angular to angular.			SNC	100								
	4.20m: Clayey SILT, trace organics; grey. Stiff, moist, high plasticity. Organics, carbonaceous material.												
	4.50m: Sandy fine to coarse GRAVEL, minor silt; grey. Dense, moist. Gravel, sub-rounded to angular; sand, fine to coarse.			SPT	100	6/8// 5/9/9/10 N=33							

Water Level: 23/03/2022

Box 0.00-3.00m

COMMENTS:

Hole Depth 15.5m

Scale 1:25

Rev.: C

BOREHOLE LOG

Tonkin+Taylor

BOREHOLE No.: BH03-22

SHEET: 2 OF 4

PROJECT: Maitahi
JOB No.: 1012397.1000.1000
LOCATION: Kaka Valley

CO-ORDINATES: 5431310 mN, 1625962 mE (NZTM2000)
DIRECTION: 180°
ANGLE FROM HORIZ.: -90°

R.L. GROUND: 16m
R.L. COLLAR:
DATUM: NZVD2016
SURVEY: Handheld GPS

DRILLED BY: Mason and Matt
LOGGED BY: AMHO
CHECKED: SAPR
START DATE: 23/03/2022
FINISH DATE: 24/03/2022
CONTRACTOR: ProDrill

GEOLOGICAL UNIT	MATERIAL DESCRIPTION (SOIL: Classification, colour, consistency / density, moisture, plasticity; ROCK: Weathering, colour, fabric, name, strength, cementation)	Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m) / Depth (m)	Graphic Log	ROCK MASS DISCONTINUITIES: Defect Log / Fracture Spacing (mm) / RQD (%) / Description & Additional Observations	Water Level / Fluid Loss (%)	Casing	Installation	Core Box No
Alluvial Deposits	[CONT] *4.50m:* Sandy fine to coarse GRAVEL, minor silt; grey. Dense, moist. Gravel, sub-rounded to angular; sand, fine to coarse.			SNC	100		5.5						
	5.15m: Fine to coarse GRAVEL, minor sand, trace silt; grey. Dense, moist. Gravel, sub-rounded to angular; sand, fine to coarse.												
	5.35m: Gravelly fine to coarse SAND, some silt; reddish grey. Medium dense, wet. Gravel, fine to medium, sub-angular to angular.												
	5.55m: Fine to coarse SAND, some silt, minor gravel; brown. Medium dense, moist. Gravel, fine to medium, sub-rounded to angular.						10						Box 3.00-6.10m
				SPT	100	4/6// 7/6/8/8 N=29	6.0						
	6.40m: Silty fine to coarse SAND, some gravel; brown. Medium dense, moist. Gravel, fine to medium, sub-rounded to angular.						6.5						
	6.95m: Gravelly fine to coarse SAND, minor silt; grey. Dense, moist. Gravel, fine, sub-rounded to angular.			SNC	100		9						
	7.05m: Gravelly fine to coarse SAND, minor silt; brown. Dense, moist. Gravel, fine, sub-rounded to angular.						7.0						
	7.70m: Gravelly fine to coarse SAND, some silt; brown. Medium dense, moist. Gravel, fine to medium, sub-rounded to angular.						7.5						
				SPT	100	4/7// 6/6/7/6 N=24	8						
				SNC	100		8.0						
							8.5						
							7						
				SPT	100	7/6// 6/5/13/15 N=39	9.0						
	9.35m: Silty fine to coarse SAND, some gravel; brown. Medium dense, wet. Gravel, fine to medium, sub-rounded to angular.						9.5						Box 6.10-9.55m
	9.70m: Gravelly fine to coarse SAND, some silt; brown. Medium dense, moist. Gravel, fine to medium, sub-rounded to angular.			SNC	100								

COMMENTS:

Hole Depth 15.5m

Scale 1:25

Rev.: C

BOREHOLE LOG

Tonkin+Taylor

BOREHOLE No.: BH03-22

SHEET: 3 OF 4

PROJECT: Maitahi
JOB No.: 1012397.1000.1000
LOCATION: Kaka Valley

CO-ORDINATES: 5431310 mN 1625962 mE (NZTM2000)
DIRECTION: 180°
ANGLE FROM HORIZ.: -90°

R.L. GROUND: 16m
R.L. COLLAR:
DATUM: NZVD2016
SURVEY: Handheld GPS

DRILLED BY: Mason and Matt
LOGGED BY: AMHO
CHECKED: SAPR
START DATE: 23/03/2022
FINISH DATE: 24/03/2022
CONTRACTOR: ProDrill

GEOLOGICAL UNIT	MATERIAL DESCRIPTION SOIL: Classification, colour, consistency / density, moisture, plasticity ROCK: Weathering, colour, fabric, name, strength, cementation	Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m) / Depth (m)	Graphic Log	ROCK MASS DISCONTINUITIES: Defect Log	Fracture Spacing (mm)	RQD (%)	Description & Additional Observations	Water Level / Fluid Loss (%)	Casing	Installation	Core Box No
Alluvial Deposits	[CONT] *9.70m:* Gravelly fine to coarse SAND, some silt; brown. Medium dense, moist. Gravel, fine to medium, sub-rounded to angular.			SNC	100		10.5									
	10.25m: Silty fine to coarse SAND, some gravel; brown. Dense, moist. Gravel, fine to medium, sub-rounded to angular.															
	10.45m: Gravelly fine to coarse SAND, some silt; brown. Very dense, moist. Gravel, fine to coarse, sub-rounded to angular.			SPT	100	11/39// for 75mm N=50										
	10.75m: Gravelly fine to coarse SAND, some silt; greyish brown. Very dense, wet. Gravel, fine to medium, sub-rounded to angular.						11.0									
	10.95m: Silty fine to coarse SAND, some gravel; greyish brown. Very dense, moist. Gravel, fine to coarse, sub-rounded to angular.															
	11.20m: Gravelly fine to coarse SAND, some silt; grey. Very dense, moist. Gravel, fine to coarse, sub-rounded to angular.															
	11.40m: Gravelly fine to coarse SAND, some silt; brown. Medium dense, moist. Gravel, fine to medium, sub-rounded to angular.			SNC	100		11.5									
	11.70m: Sandy fine to coarse GRAVEL, minor silt; brown. Very dense, moist. Gravel, sub-rounded to angular; sand, fine to coarse.															
	12.50m: Fine to coarse GRAVEL, some sand, minor silt; brown. Very dense, moist. Gravel, sub-rounded to angular; sand, fine to coarse.			SPT	100	7/12// 5/16/18/11 for 25mm N=50	12.0									
	12.75m: Gravelly fine to coarse SAND, some silt; brown. Very dense, wet. Gravel, fine to medium, sub-rounded to angular.															
	12.95m: Fine to coarse GRAVEL, some sand, minor silt; brown. Very dense, moist. Gravel, sub-rounded to angular; sand, fine to coarse.						12.5									
Grampian Formation	*13.10m:* Completely weathered, light grey, tuffaceous SANDSTONE. Extremely weak, fine to coarse grained. Recovered as: Gravelly fine to coarse SAND, minor silt; light grey. Very dense, dry. Gravel, fine to coarse, sub-rounded to angular.			SNC	100		13.0									
	13.70m: Highly weathered, dark grey, tuffaceous SANDSTONE. Weak, fine to medium grained.			SPT	100	30/20// for 30mm N=50	13.5									
	14.70m: Moderately weathered, dark grey, tuffaceous SANDSTONE. Moderately strong, fine to medium grained.			PQ3	100		14.0					*14.00-14.15m:* BZ, 5-75°, UN, R *14.30m:* J, 25°, ST, R *14.40m:* J, 5°, PL, R *14.50m:* J, 7°, UN, R *14.60m:* J, 7°, PL, R *14.70m:* J, 12°, CU, R *14.90-14.95m:* BZ, 5-20°, IR, R				Box 9.55-12.20m Box 12.20-15.00m

COMMENTS:

Hole Depth 15.5m

Scale 1:25

Rev.: C

TTNZ_20220309 - General Log - 29/02/2024 5:26:39 pm - Produced with Core-GS by GeRoc

BOREHOLE LOG

BOREHOLE No.: BH03-22

SHEET: 4 OF 4

PROJECT: Maitahi
JOB No.: 1012397.1000.1000
LOCATION: Kaka Valley

CO-ORDINATES: 5431310 mN, 1625962 mE (NZTM2000)
DIRECTION: 180°
ANGLE FROM HORIZ.: -90°

R.L. GROUND: 16m
R.L. COLLAR:
DATUM: NZVD2016
SURVEY: Handheld GPS

DRILLED BY: Mason and Matt
LOGGED BY: AMHO
CHECKED: SAPR
START DATE: 23/03/2022
FINISH DATE: 24/03/2022
CONTRACTOR: ProDrill

GEOLOGICAL UNIT	MATERIAL DESCRIPTION (SOIL: Classification, colour, consistency / density, moisture, plasticity; ROCK: Weathering, colour, fabric, name, strength, cementation)	Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m) / Depth (m)	Graphic Log	ROCK MASS DISCONTINUITIES: Defect Log	Fracture Spacing (mm)	RQD (%)	Description & Additional Observations	Water Level / Fluid Loss (%)	Casing	Installation	Core Box No
Grampian Formation	[CONT] *14.70m:* Moderately weathered, dark grey, tuffaceous SANDSTONE. Moderately strong, fine to medium grained.			PQ3	100							*15.00m:* J, 7°, UN, R *15.15-15.20m:* BZ, 5-35°, IR, R *15.30m:* J, 15°, UN, R *15.45-15.50m:* BZ, 5-75°, UN, R				Box 15.00-15.50m
	15.5m: Target depth						15.5 / 0 / 16.0 / 16.5 / -1 / 17.0 / 17.5 / -2 / 18.0 / 18.5 / -3 / 19.0 / 19.5									

COMMENTS:

Hole Depth 15.5m

Scale 1:25

Rev.: C

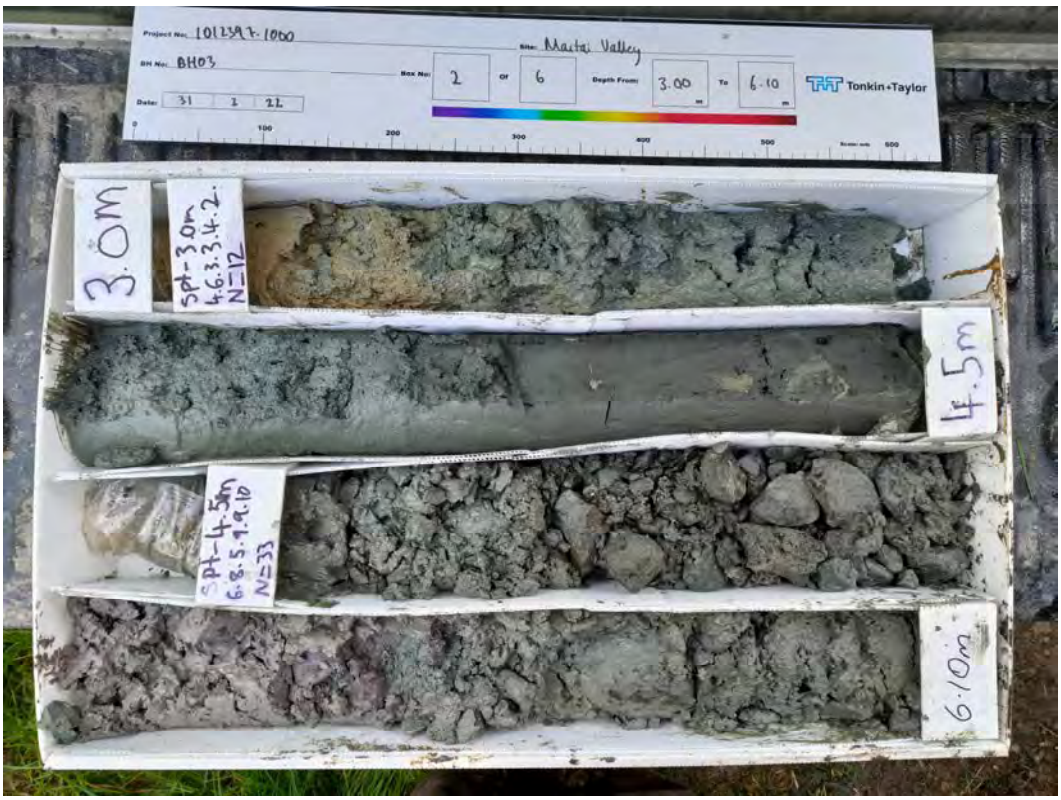
TTNZ_20220309 - General Log - 29/02/2024 5:26:39 pm - Produced with Core-GS by GeRoc

CORE PHOTOS

BOREHOLE No.: **BH03-22**

PROJECT: Maitahi	LOCATION: Kaka Valley	JOB No.: 1012397.1000.1000
CO-ORDINATES: 5431310 mN (NZTM2000) 1625962 mE R.L.: 16m DATUM: NZVD2016	DRILL TYPE: Sonic drill METHOD: Rotary cored	HOLE STARTED: 23/03/2022 HOLE FINISHED: 24/03/2022 DRILLED BY: ProDrill LOGGED BY: AMHO CHECKED: SAPR

0.00-3.00m



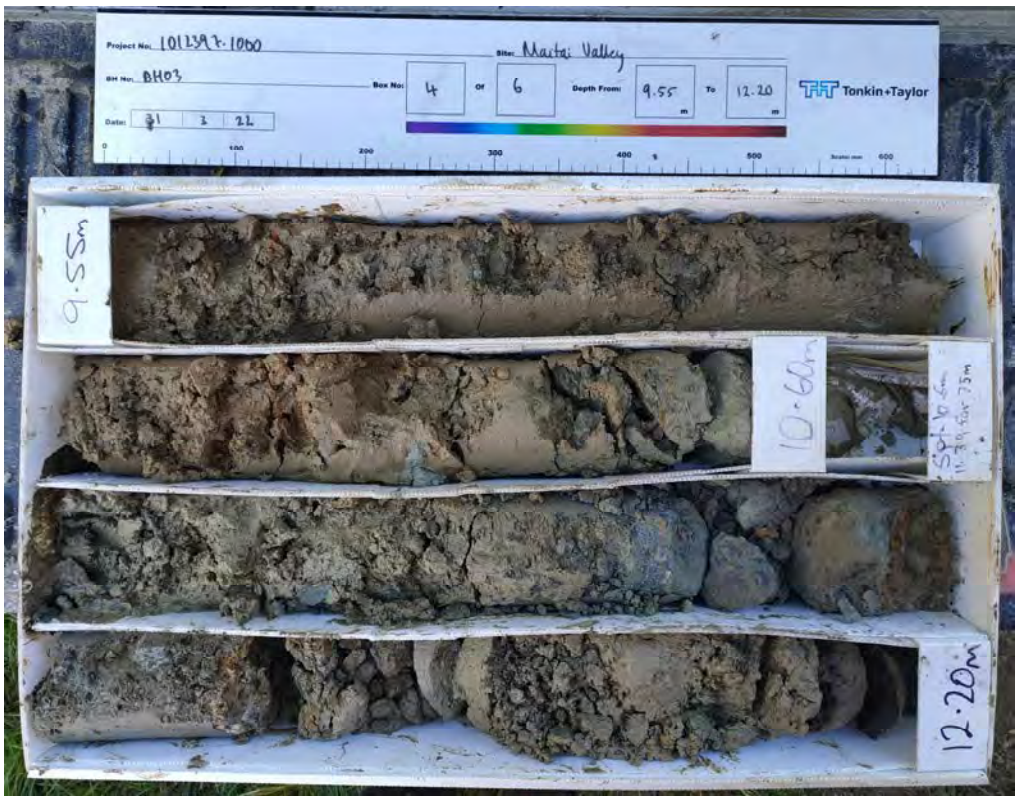
3.00-6.10m

CORE PHOTOS

BOREHOLE No.: **BH03-22**

PROJECT: Maitahi	LOCATION: Kaka Valley	JOB No.: 1012397.1000.1000
CO-ORDINATES: 5431310 mN (NZTM2000) 1625962 mE R.L.: 16m DATUM: NZVD2016	DRILL TYPE: Sonic drill METHOD: Rotary cored	HOLE STARTED: 23/03/2022 HOLE FINISHED: 24/03/2022 DRILLED BY: ProDrill LOGGED BY: AMHO CHECKED: SAPR

6.10-9.55m



9.55-12.20m

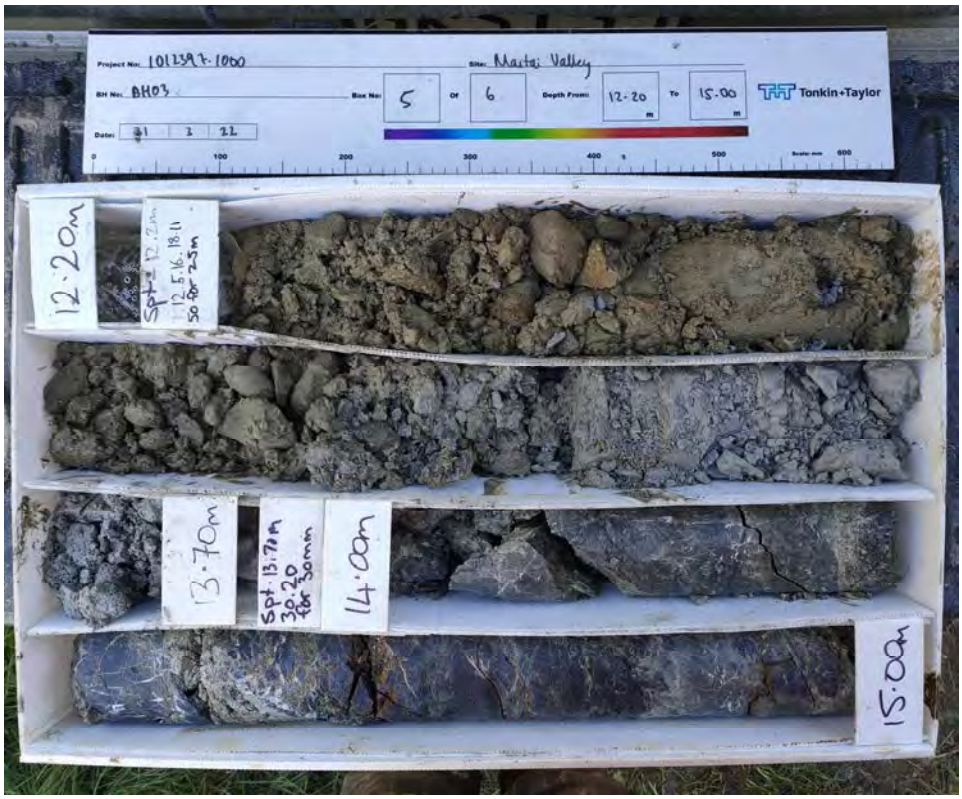
Tonkin+Taylor

CORE PHOTOS

BOREHOLE No.: **BH03-22**

SHEET: 3 OF 3

PROJECT: Maitahi	LOCATION: Kaka Valley	JOB No.: 1012397.1000.1000
CO-ORDINATES: 5431310 mN (NZTM2000) 1625962 mE R.L.: 16m DATUM: NZVD2016	DRILL TYPE: Sonic drill METHOD: Rotary cored	HOLE STARTED: 23/03/2022 HOLE FINISHED: 24/03/2022 DRILLED BY: ProDrill LOGGED BY: AMHO CHECKED: SAPR



12.20-15.00m

15.00-15.50m

BOREHOLE LOG

BOREHOLE No.: BH03-23

SHEET: 1 OF 1

PROJECT: Maitahi
JOB No.: 1012397.1000.1000
LOCATION: Kaka Valley

CO-ORDINATES: 5431374.08 mN, 1625943.56 mE (NZTM2000)
DIRECTION:
ANGLE FROM HORIZ.: -90°

R.L. GROUND: 20.35m
R.L. COLLAR:
DATUM: NZVD2016
SURVEY: Handheld GPS

DRILLED BY: Dylan
LOGGED BY: FEOH
CHECKED: MRF
START DATE: 17/04/2023
FINISH DATE: 17/04/2023
CONTRACTOR: CW Drilling

GEOLOGICAL UNIT	DESCRIPTION OF CORE (SOIL: Classification, colour, consistency / density, moisture, plasticity; ROCK: Weathering, colour, fabric, name, strength, cementation)
Alluvial Deposits	*0.00m:* Silty fine to medium GRAVEL, some sand; Dark brown. Moist. Gravel, sub-rounded to sub-angular.
	0.90m: SILT, minor gravel, trace sand; brown. Moist, non-plastic. Gravel, medium to coarse, sub-rounded to sub-angular; sand, medium to coarse.
	1.00 - 1.20m: Some gravel.
	1.20 - 1.80m: Minor gravel.
	1.80m: Fine GRAVEL; grey. Moist to wet. Gravel, sub-rounded to sub-angular.
	2.10 - 2.30m: Fine to medium GRAVEL, some silt.
	2.30m: Fine to coarse GRAVEL, minor sand; grey. Moist to wet. Gravel, sub-rounded to sub-angular.
	2.60 - 3.50m: Silty; brown.
	3.5m: END OF BOREHOLE. Target depth.

Rock Weathering: UW, SW, MW, HW, EW
Rock Strength: ES, VS, S, MS, W, VW, EW
Sampling Method
Core Recovery (%)
Testing
RL (m) / Depth (m): 20 (0), 19 (1), 18 (2), 17 (3), 16 (4), 15 (5)
Graphic Log
ROCK DEFECTS: Defect Log; Fracture Spacing (mm): 2000, 600, 200, 60, 20; RQD (%); Description & Additional Observations
Fluid Loss (%): 25, 50, 75
Water Level: DRY 17/04/2023
Casing
Installation
Core Box No

COMMENTS:

Hole Depth 3.5m

Scale 1:30

Rev.: A

BOREHOLE LOG

Tonkin+Taylor

BOREHOLE No.: BH04_0723

SHEET: 1 OF 5

PROJECT: Maitahi

JOB No.: 1012397.1000.1000

LOCATION: Kaka Valley

CO-ORDINATES: 5431475 mN, 1625828 mE (NZTM2000)

DIRECTION: 0°

ANGLE FROM HORIZ.: -90°

R.L. GROUND: 45m

R.L. COLLAR:

DATUM: NZVD2016

SURVEY: Map or aerial photograph

DRILLED BY: Dylan and Todd

LOGGED BY: ANCO

CHECKED: JXWW

START DATE: 20/07/2023

FINISH DATE: 21/07/2023

CONTRACTOR: CW Drilling

GEOLOGICAL UNIT	MATERIAL DESCRIPTION (SOIL: Classification, colour, consistency / density, moisture, plasticity; ROCK: Weathering, colour, fabric, name, strength, cementation)	Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK MASS DISCONTINUITIES: Defect Log	Fracture Spacing (mm)	RQD (%)	Description & Additional Observations	Water Level / Fluid Loss (%)	Casing	Installation	Core Box No
Botanical Hill Formation	*0.00m:* Highly weathered, Orange - brown , volcaniclastic BRECCIA. Extremely weak (soft), matrix supported. Has property of clayey - gravelly SILT, well graded. Low plasticity. Gravel up to 200mm - subrounded to subangular. Some localised clasts are moderately - slightly weathered, strong.			HQ3	97		44	0.5							HQ		
	0.65 - 1.00m: Clayey- gravelly SILT. Firm. Gravel, fine, subrounded to sub-angular.																
	1.00 - 1.30m: Gravelly SILT, some clay: Orange - brown mixed with some grey. Firm. Gravel, up to 30mm, sub-angular, polymict. Clast supported volcaniclastic breccia.							1.0					*1.00m:*				
	1.30 - 1.50m: Grading to clayey SILT, some gravel. Soft. Gravel, sub-rounded to angular. Matrix supported breccia																
	1.50 - 1.75m: Clayey gravelly SILT. Soft						43	1.5									
	1.75 - 2.30m: PARTIAL CORE LOSS - Suspect finer material washed out. Cobbly. Cobbles up to 60mm, sub-rounded to sub-angular, highly weathered. Clasts locally with smooth edges, some limonite staining.			HQ3	96			2.0									
	2.30 - 2.80m: Clayey SILT. Soft, low plasticity.						42	2.5									
	2.80 - 2.95m: CORE LOSS - suspect finer material washed out. Very soft.			HQ3	60												Box 0.00-3.00m
	2.95 - 3.15m: Soft							3.0					*2.95m:* Water pressure increasing				
	3.15 - 3.20m: CORE LOSS - suspect finer material washed out. Clayey SILT. Very soft, non- plastic. *3.20 - 3.60m:* PARTIAL CORE LOSS - suspect fine washed out. Clayey SILT. Some gravel. Soft, non-plastic. Gravel is sub - rounded			HQ3	76		41	3.5									
	3.60 - 3.70m: Clayey SILT. Very soft, low plasticity.																
	3.70 - 4.05m: CORE LOSS - suspect fines washed out. Clayey gravelly SILT. Soft. Broken ground. Breccia with large clasts of rock.							4.0					*4.00m:* Rod spin				
	4.05 - 4.15m: PARTIAL CORE LOSS - suspect fines washed out. Firm. Large clasts. *4.15 - 4.25m:* PARTIAL CORE LOSS - suspect fines washed out. Clayey SILT, some sand and some gravel. *4.25 - 4.50m:* Clayey gravelly SILT. Firm.			HQ3	89												
	4.50 - 6.80m: Clayey-gravelly SILT. Soft, non-plastic to low plasticity. Gravel up to 60mm, sub-rounded to sub-angular, sandstone and volcanic tuff.			HQ3	98		40	4.5									

COMMENTS: Weather fine / very windy.

Hole Depth 22m

Scale 1:25

Rev.: A

TTNZ_20230717 - GeneralLog - 29/02/2024 5:26:59 pm - Produced with Core-GS by GeRoc

BOREHOLE LOG

Tonkin+Taylor

BOREHOLE No.: BH04_0723

SHEET: 2 OF 5

PROJECT: Maitahi
JOB No.: 1012397.1000.1000
LOCATION: Kaka Valley

CO-ORDINATES: 5431475 mN, 1625828 mE (NZTM2000)
DIRECTION: 0°
ANGLE FROM HORIZ.: -90°

R.L. GROUND: 45m
R.L. COLLAR:
DATUM: NZVD2016
SURVEY: Map or aerial photograph

DRILLED BY: Dylan and Todd
LOGGED BY: ANCO
CHECKED: JXWW
START DATE: 20/07/2023
FINISH DATE: 21/07/2023
CONTRACTOR: CW Drilling

GEOLOGICAL UNIT	MATERIAL DESCRIPTION (SOIL: Classification, colour, consistency / density, moisture, plasticity; ROCK: Weathering, colour, fabric, name, strength, cementation)	Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m) / Depth (m)	Graphic Log	ROCK MASS DISCONTINUITIES: Defect Log / Fracture Spacing (mm) / RQD (%) / Description & Additional Observations	Water Level / Fluid Loss (%)	Casing	Installation	Core Box No
Botanical Hill Formation	[CONT] *0.00m:* Highly weathered, Orange - brown, volcaniclastic BRECCIA. Extremely weak (soft), matrix supported. Has property of clayey - gravelly SILT, well graded. Low plasticity. Gravel up to 200mm - subrounded to subangular. Some localised clasts are moderately - slightly weathered, strong.			HQ3	98		39 / 5.5		*5.00m:* Core dilating in the tube		HQ		Box 3.00-6.00m
	6.80 - 6.87m: Highly weathered, SANDSTONE. Strong. *6.87 - 7.30m:* PARTIAL CORE LOSS - suspect fines washed out. Clayey gravelly SILT; orange - brown, mixed with blue-grey. Soft.			HQ3	90		38 / 6.5						
	7.30 - 7.50m: PARTIAL CORE LOSS - suspect fines washed out. Soft. Broken.						37 / 7.5						
	7.50 - 8.90m: Clayey gravelly SILT. Soft, non- plastic. Gravel up to 30mm, sub-rounded to sub-angular, sandstone, tuff and some quartz, smooth edges on clasts.			HQ3	100		36 / 8.5						Box 6.00-8.75m
	8.90 - 9.00m: PARTIAL CORE LOSS - suspect fines washed out. Soft. Broken ground. *9.00 - 9.80m:* Grading to clayey cobbly SILT. Soft. Cobbles, up to 60mm, sandstone / tuff.						35 / 9.5						
	9.80 - 10.00m: Very soft to soft.			HQ3	99								

COMMENTS: Weather fine / very windy.

Hole Depth 22m

Scale 1:25

Rev.: A

BOREHOLE LOG

Tonkin+Taylor

BOREHOLE No.: BH04_0723

SHEET: 3 OF 5

PROJECT: Maitahi

JOB No.: 1012397.1000.1000

LOCATION: Kaka Valley

CO-ORDINATES: 5431475 mN, 1625828 mE (NZTM2000)

DIRECTION: 0°

ANGLE FROM HORIZ.: -90°

R.L. GROUND: 45m

R.L. COLLAR:

DATUM: NZVD2016

SURVEY: Map or aerial photograph

DRILLED BY: Dylan and Todd

LOGGED BY: ANCO

CHECKED: JXWW

START DATE: 20/07/2023

FINISH DATE: 21/07/2023

CONTRACTOR: CW Drilling

GEOLOGICAL UNIT	MATERIAL DESCRIPTION (SOIL: Classification, colour, consistency / density, moisture, plasticity; ROCK: Weathering, colour, fabric, name, strength, cementation)	Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m) / Depth (m)	Graphic Log	ROCK MASS DISCONTINUITIES: Defect Log / Fracture Spacing (mm) / RQD (%)	Description & Additional Observations	Water Level / Fluid Loss (%)	Casing	Installation	Core Box No
Botanical Hill Formation	[CONT] *0.00m:* Highly weathered, Orange - brown , volcaniclastic BRECCIA. Extremely weak (soft), matrix supported. Has property of clayey - gravelly SILT, well graded. Low plasticity. Gravel up to 200mm - subrounded to subangular. Some localised clasts are moderately - slightly weathered, strong.			HQ3	99		34 / 10.5			*10.10m:* B		HQ		
	10.00 - 10.10m: Highly weathered, Orange - brown, whitesh, tuffaceous . Strong. *10.10 - 11.15m:* Clayey gravelly SILT, some cobbles; some greenish grey. Soft to firm. Cobbles are sub-angular, highly weathered, sandstone / tuff and minor quartz. Some lithics.													
	11.15 - 11.20m: Highly weathered, Orange - brown, VOLCANIC BRECCIA. Strong. *11.20 - 11.25m:* Sandy gravelly SILT. Soft. Sand is fine. *11.25 - 11.90m:* Clayey gravelly SILT, some cobbles. Soft to firm. Gravel, up to 50mm, coarse tuff / sandstone. Some quartz; cobbles, sub-angular, moderately to highly weathered. Upward fining. Matrix supported.			HQ3	100		33 / 11.5							Box 8.75-11.65m
	11.90 - 12.00m: Dark grey - blue - grey - brown, TUFF. Strong, fine grained. With healed fractures. *12.00 - 12.45m:* Soft.						32 / 12.5							
	12.45 - 12.90m: Clayey gravelly SILT, some cobbles; Orange - brown dark grey mixed with some reddish - brown. Firm to stiff. Gravel, up to 50mm, sub-angular; cobbles, highly weathered.			HQ3	100				66					
	12.90 - 13.00m: Highly weathered, Orange - brown, tuffaceous SANDSTONE. Strong. *13.00 - 13.40m:* Soft to firm.						31 / 13.5							
	13.40 - 13.50m: Highly weathered, Orange - brown , tuffaceous SANDSTONE. Strong, medium grained. Limonite stained. . *13.50 - 13.80m:* Stiff.													
	13.80 - 13.90m: Soft. *13.90 - 14.90m:* Stiff.			HQ3	100		30 / 14.5		66					Box 11.65-14.50m
	14.90 - 15.85m: Clayey gravelly SILT, some cobbles; Orange - brown. Soft to firm. Cobbles, sub-rounded to sub-angular, highly weathered, polymict.													

COMMENTS: Weather fine / very windy.

Hole Depth 22m

Scale 1:25

Rev.: A

BOREHOLE LOG

Tonkin+Taylor

BOREHOLE No.: BH04_0723

SHEET: 4 OF 5

PROJECT: Maitahi
JOB No.: 1012397.1000.1000
LOCATION: Kaka Valley

CO-ORDINATES: 5431475 mN, 1625828 mE (NZTM2000)
DIRECTION: 0°
ANGLE FROM HORIZ.: -90°

R.L. GROUND: 45m
R.L. COLLAR:
DATUM: NZVD2016
SURVEY: Map or aerial photograph

DRILLED BY: Dylan and Todd
LOGGED BY: ANCO
CHECKED: JXWW
START DATE: 20/07/2023
FINISH DATE: 21/07/2023
CONTRACTOR: CW Drilling

GEOLOGICAL UNIT	MATERIAL DESCRIPTION	Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m) / Depth (m)	Graphic Log	ROCK MASS DISCONTINUITIES: Defect Log	Fracture Spacing (mm)	RQD (%)	Description & Additional Observations	Water Level / Fluid Loss (%)	Casing	Installation	Core Box No
Botanical Hill Formation	[CONT] *0.00m:* Highly weathered, Orange - brown, volcaniclastic BRECCIA. Extremely weak (soft), matrix supported. Has property of clayey - gravelly SILT, well graded. Low plasticity. Gravel up to 200mm - subrounded to subangular. Some localised clasts are moderately - slightly weathered, strong.	HW SW MW SW CW RS	VS+ S MS W MW MW	HQ3	100		29 / 15.5			2000 600 200 60 20	66		25 50 75	HQ		Box 14.50-17.30m
	15.85 - 16.00m: Slightly weathered, Light grey - brown, volcaniclastic VOLCANIC BRECCIA Very strong.															
	16.00 - 16.45m: Soft						16.0					*16.00m:* B				
	16.45 - 16.55m: Highly weathered, White-grey, TUFF. Strong. Broken ground.						28 / 16.5					*16.40m:* B				
	16.55 - 17.00m: Clayey gravelly SILT, some cobbles. Stiff, poorly graded. Cobbles, sub-rounded, highly weathered											*16.50m:* B				
	17.00 - 17.45m: Grading to clayey cobbly SILT. Stiff. Cobbles, volcanic tuff.			HQ3	100		17.0				56					
	17.45 - 17.50m: Soft *17.50 - 17.70m:* Gravelly cobbly SILT, some clay. Stiff. Gravel, volcanic rich; cobbles, up to 60mm.						27 / 17.5					*17.50m:* B				
	17.70 - 18.20m: Gravelly cobbly SILT, some clay. Soft. Gravel, sub-rounded to sub-angular, moderately to highly weathered; cobbles, up to 60mm, sub-rounded to sub-angular, moderately to highly weathered, coarse grained tuff rich, some quartz, clasts mostly subangular.						18.0									
	18.20 - 18.30m: Stiff															
	18.30 - 18.85m: Firm			HQ3	100		18.5				41					
	18.70m: Milky white quartz															
	18.85 - 18.90m: Soft *18.90 - 19.90m:* Soft to firm						26									
				HQ3	87		19.0				50	*19.00m:* Water pressure increasing				
							25 / 19.5									
				HQ3	97						53					
	19.90m: Highly weathered, Orange - brown, volcaniclastic															

COMMENTS: Weather fine / very windy.

Hole Depth 22m

Scale 1:25

Rev.: A

BOREHOLE LOG

Tonkin+Taylor

BOREHOLE No.: BH04_0723

SHEET: 5 OF 5

PROJECT: Maitahi
JOB No.: 1012397.1000.1000
LOCATION: Kaka Valley

CO-ORDINATES: 5431475 mN, 1625828 mE (NZTM2000)
DIRECTION: 0°
ANGLE FROM HORIZ.: -90°

R.L. GROUND: 45m
R.L. COLLAR:
DATUM: NZVD2016
SURVEY: Map or aerial photograph

DRILLED BY: Dylan and Todd
LOGGED BY: ANCO
CHECKED: JXWW
START DATE: 20/07/2023
FINISH DATE: 21/07/2023
CONTRACTOR: CW Drilling

GEOLOGICAL UNIT	MATERIAL DESCRIPTION (SOIL: Classification, colour, consistency / density, moisture, plasticity; ROCK: Weathering, colour, fabric, name, strength, cementation)	Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m) / Depth (m)	Graphic Log	ROCK MASS DISCONTINUITIES: Defect Log	Fracture Spacing (mm)	RQD (%)	Description & Additional Observations	Water Level / Fluid Loss (%)	Casing	Installation	Core Box No
Botanical Hill Formation	BRECCIA. Very weak to weak, moderately cemented, matrix supported. (UNDIFFERENTIATED VOLCANICS).			HQ3	97		24 / 20.5				53	*20.15m:* B *20.25m:* J *20.30m:* J *20.35m:* J *20.40m:* J		HQ		Box 17.30-20.10m
	20.55 - 20.75m: Soft															
	20.75 - 20.95m: Soft. Broken ground.															
	20.95 - 21.85m: Very stiff.			HQ3	97		23 / 21.5				67					Box 20.10-22.00m
	21.85 - 22.00m: Weak.															
	22m: END OF BOREHOLE. Target depth.						22 / 22.5 21 / 23.5 20 / 24.5									

COMMENTS: Weather fine / very windy.

Hole Depth 22m

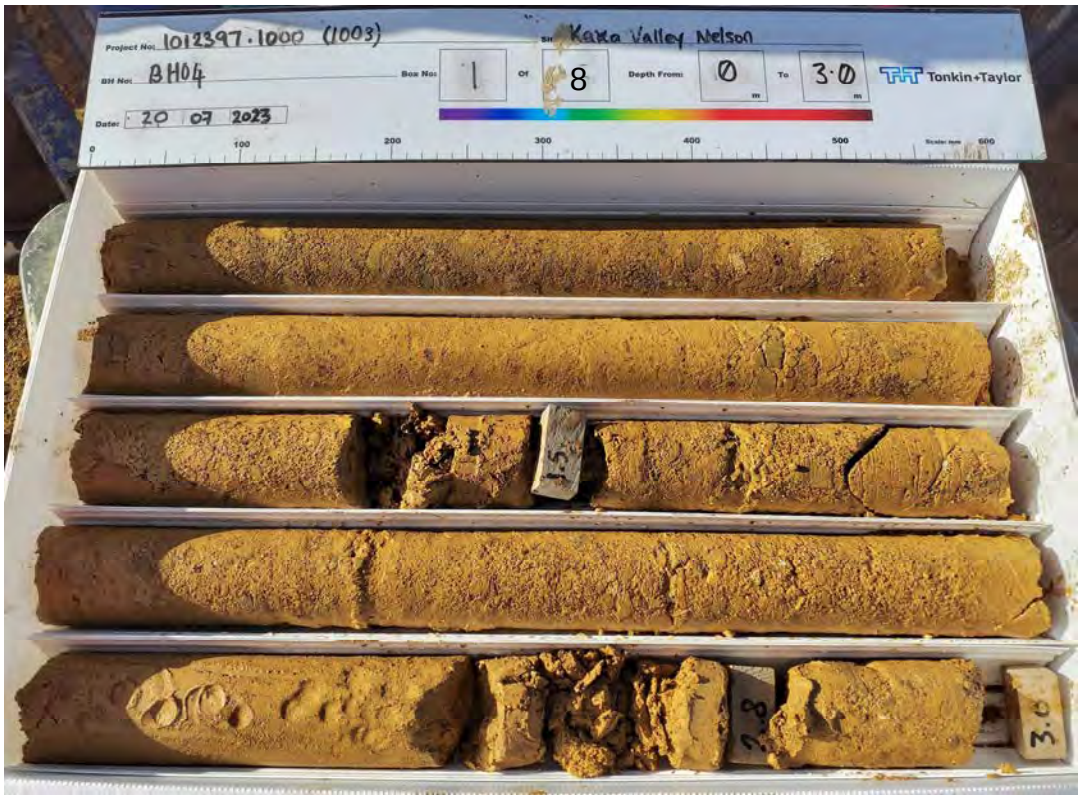
Scale 1:25

Rev.: A

CORE PHOTOS

BOREHOLE No.: **BH04_0723**

PROJECT: Maitahi	LOCATION: Kaka Valley	JOB No.: 1012397.1000.1000
CO-ORDINATES: 5431475 mN (NZTM2000) 1625828 mE R.L.: 45m DATUM: NZVD2016	DRILL TYPE: Hanjin D8 METHOD: Rotary cored	HOLE STARTED: 20/07/2023 HOLE FINISHED: 21/07/2023 DRILLED BY: CW Drilling LOGGED BY: ANCO CHECKED: JXWW



0.00-3.00m

3.00-6.00m

CORE PHOTOS

BOREHOLE No.: **BH04_0723**

PROJECT: Maitahi	LOCATION: Kaka Valley	JOB No.: 1012397.1000.1000
CO-ORDINATES: 5431475 mN (NZTM2000) 1625828 mE R.L.: 45m DATUM: NZVD2016	DRILL TYPE: Hanjin D8 METHOD: Rotary cored	HOLE STARTED: 20/07/2023 HOLE FINISHED: 21/07/2023 DRILLED BY: CW Drilling LOGGED BY: ANCO CHECKED: JXWW

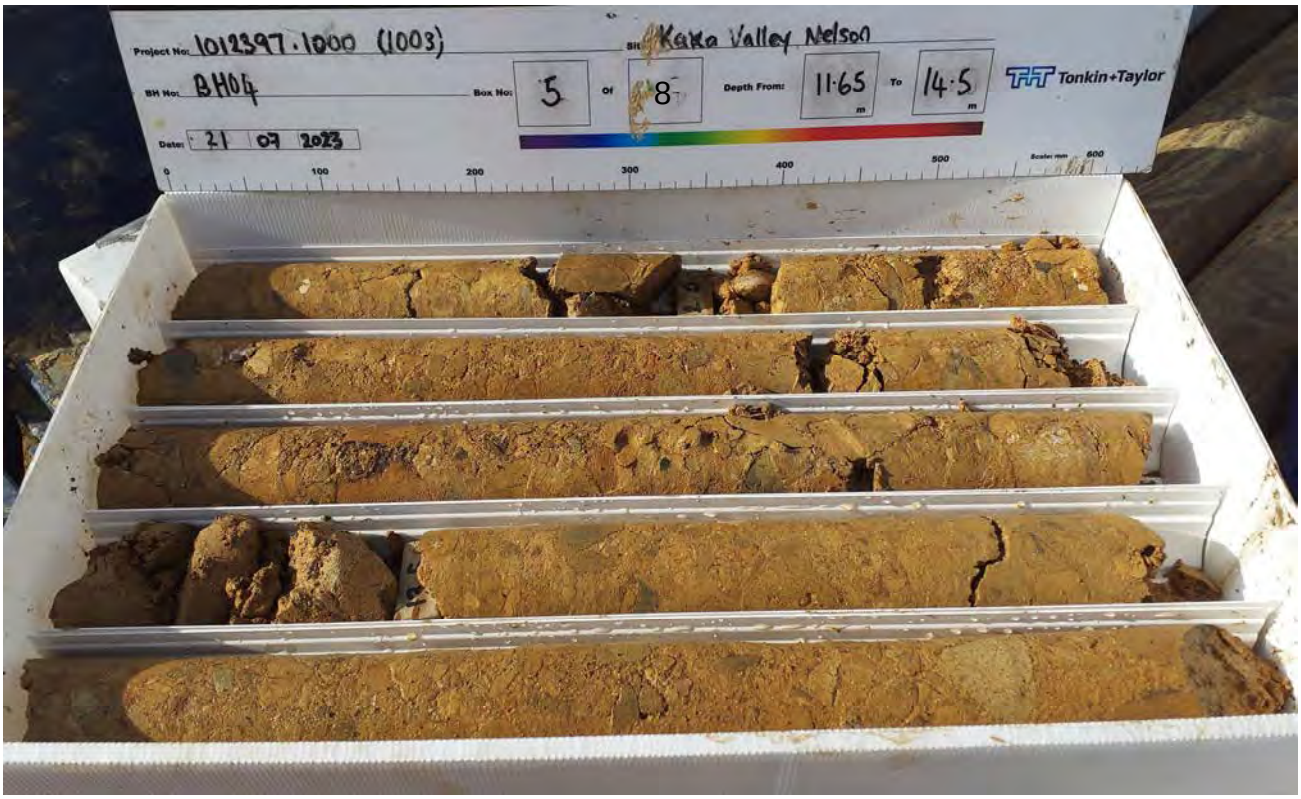
6.00-8.75m

8.75-11.65m

CORE PHOTOS

BOREHOLE No.: **BH04_0723**

PROJECT: Maitahi	LOCATION: Kaka Valley	JOB No.: 1012397.1000.1000
CO-ORDINATES: 5431475 mN (NZTM2000) 1625828 mE R.L.: 45m DATUM: NZVD2016	DRILL TYPE: Hanjin D8 METHOD: Rotary cored	HOLE STARTED: 20/07/2023 HOLE FINISHED: 21/07/2023 DRILLED BY: CW Drilling LOGGED BY: ANCO CHECKED: JXWW



11.65-14.50m

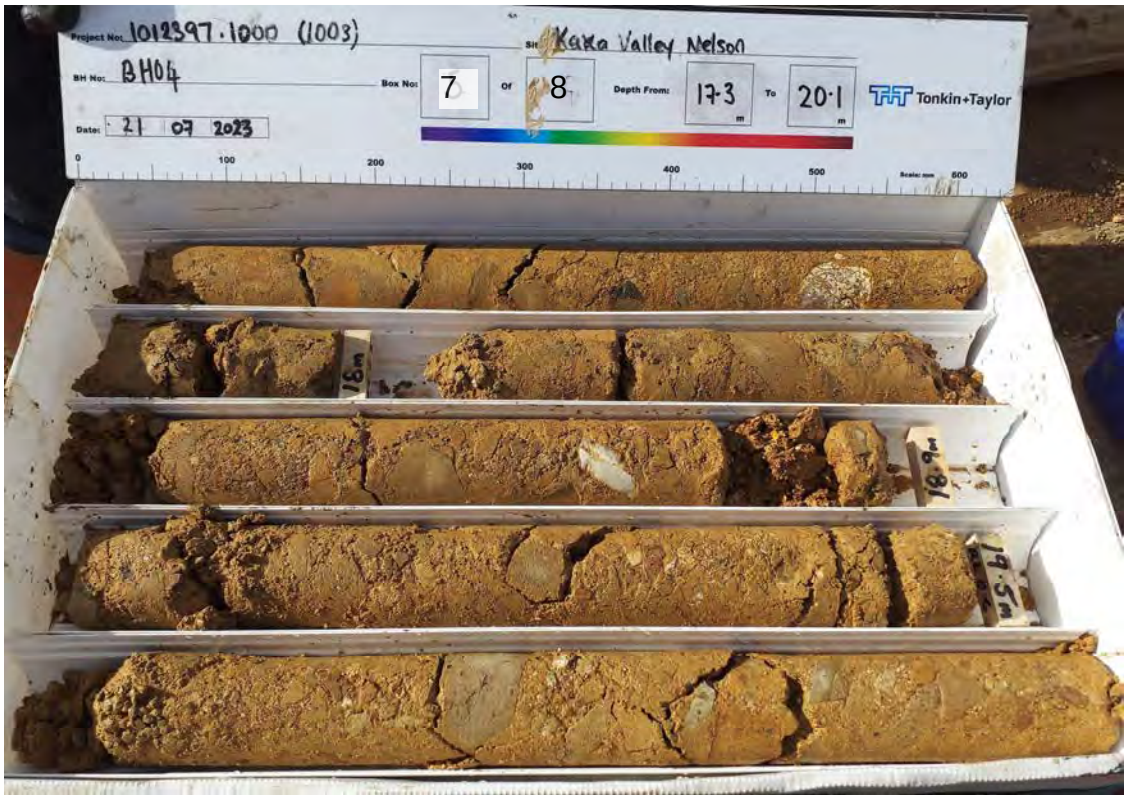
14.50-17.30m

Tonkin+Taylor

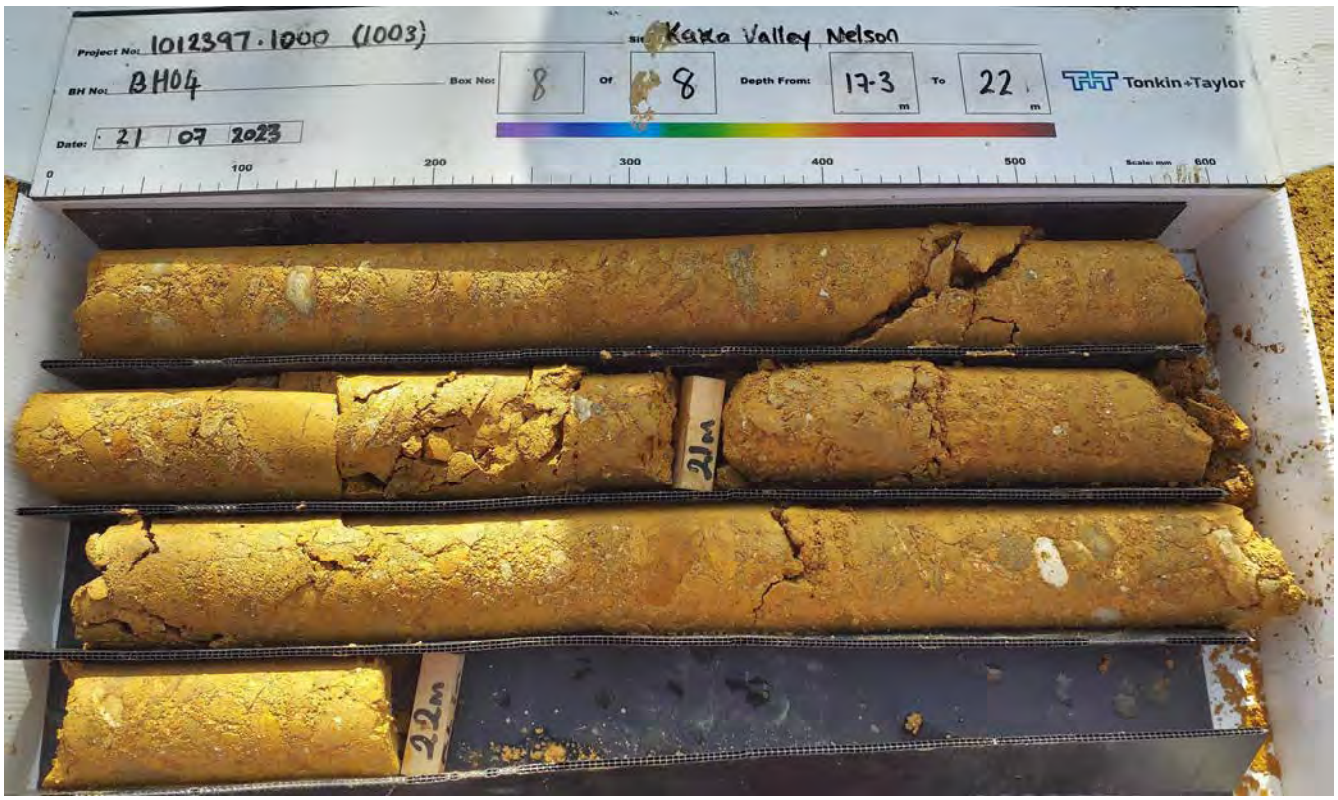
CORE PHOTOS

BOREHOLE No.: **BH04_0723**

PROJECT: Maitahi	LOCATION: Kaka Valley	JOB No.: 1012397.1000.1000
CO-ORDINATES: 5431475 mN (NZTM2000) 1625828 mE R.L.: 45m DATUM: NZVD2016	DRILL TYPE: Hanjin D8 METHOD: Rotary cored	HOLE STARTED: 20/07/2023 HOLE FINISHED: 21/07/2023 DRILLED BY: CW Drilling LOGGED BY: ANCO CHECKED: JXWW



17.30-20.10m



20.10-22.00m

BOREHOLE LOG

Tonkin+Taylor

BOREHOLE No.: BH04-22

SHEET: 1 OF 3

PROJECT: Maitahi
JOB No.: 1012397.1000.1000
LOCATION: Kaka Valley

CO-ORDINATES: 5431154 mN, 1626028 mE (NZTM2000)
DIRECTION: 180°
ANGLE FROM HORIZ.: -90°

R.L. GROUND: 16m
R.L. COLLAR:
DATUM: NZVD2016
SURVEY: Handheld GPS

DRILLED BY: Matt and Mason
LOGGED BY: AMHO
CHECKED: SAPR
START DATE: 25/03/2022
FINISH DATE: 25/03/2022
CONTRACTOR: ProDrill

GEOLOGICAL UNIT	MATERIAL DESCRIPTION (SOIL: Classification, colour, consistency / density, moisture, plasticity; ROCK: Weathering, colour, fabric, name, strength, cementation)	Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK MASS DISCONTINUITIES: Defect Log	Fracture Spacing (mm)	RQD (%)	Description & Additional Observations	Water Level / Fluid Loss (%)	Casing	Installation	Core Box No
TSoil	*0.00m:* SILT, some clay, minor sand, trace organics; Dark Brown. Stiff, moist, low plasticity. (TOPSOIL).																
Alluvial Deposits	*0.35m:* Sandy SILT; Brown Mottled Orange. Stiff, dry, non-plastic. Sand, fine.																
	0.70m: Silty fine to medium SAND, some gravel; Grey. Medium dense, moist. Gravel, fine, rounded to sub-rounded.			SNC	100			0.5									
	1.25m: Gravelly fine to coarse SAND, some silt; Grey. Medium dense, moist. Gravel, fine to coarse, rounded to sub-rounded.			SPT	100	2/2// 1/2/3/2 N=8	15	1.0									
	1.95m: Gravelly fine to coarse SAND, minor silt; Brown. Medium dense, wet. Gravel, fine to coarse, rounded to sub-rounded.							1.5									
	2.40m: Gravelly fine to coarse SAND, minor silt; Grey. Medium dense, wet. Gravel, fine to coarse, sub-rounded to sub-angular.			SNC	100		14	2.0						24/03/2022			
	3.30m: Clayey SILT, trace sand; Bluish Grey. Stiff, moist, high plasticity, insensitive.			SPT	100	5/10// 10/8/5/4 N=27	13	2.5									
	3.70m: Silty fine to coarse SAND, some gravel; Bluish Grey. Dense, moist, well graded. Gravel, fine to medium, sub-angular.							3.0									
	3.95m: Silty fine to coarse SAND, some gravel; Purple Grey. Dense, moist, well graded. Gravel, fine to coarse, sub-rounded to sub-angular.			SNC	100		12	3.5									
	4.50m: COBBLES, minor gravel; Grey. Dense, dry, gap graded. Cobbles, up to 150mm, sub-rounded to sub-angular, sandstone; gravel, coarse, up to 60mm, sub-rounded to sub-angular.			SNC	100	50 for 50mm N=50		4.0 4.5									Box 0.00-3.00m

COMMENTS:

Hole Depth 14m

Scale 1:25

Rev.: A

BOREHOLE LOG

Tonkin+Taylor

BOREHOLE No.: BH04-22

SHEET: 2 OF 3

PROJECT: Maitahi
JOB No.: 1012397.1000.1000
LOCATION: Kaka Valley

CO-ORDINATES: 5431154 mN 1626028 mE (NZTM2000)
DIRECTION: 180°
ANGLE FROM HORIZ.: -90°

R.L. GROUND: 16m
R.L. COLLAR:
DATUM: NZVD2016
SURVEY: Handheld GPS

DRILLED BY: Matt and Mason
LOGGED BY: AMHO
CHECKED: SAPR
START DATE: 25/03/2022
FINISH DATE: 25/03/2022
CONTRACTOR: ProDrill

GEOLOGICAL UNIT	MATERIAL DESCRIPTION (SOIL: Classification, colour, consistency / density, moisture, plasticity; ROCK: Weathering, colour, fabric, name, strength, cementation)	Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m) / Depth (m)	Graphic Log	ROCK MASS DISCONTINUITIES: Defect Log / Fracture Spacing (mm) / RQD (%) / Description & Additional Observations	Water Level / Fluid Loss (%)	Casing	Installation	Core Box No
Alluvial Deposits	[CONT] *4.50m:* COBBLES, minor gravel; Grey. Dense, dry, gap graded. Cobbles, up to 150mm, sub-rounded to sub-angular, sandstone; gravel, coarse, up to 60mm, sub-rounded to sub-angular.												
Grampian Formation	*5.10m:* Completely weathered, grey, tuffaceous SANDSTONE. Extremely weak. Recovered as: Silty fine to coarse SAND, some gravel; Grey. Dense, wet, well graded. Gravel, fine to coarse, sub-rounded to sub-angular.			SNC	100		5.5						
	6.25m: Completely weathered, brown, tuffaceous SANDSTONE. Extremely weak. Recovered as: Gravelly fine to coarse SAND, some silt; Brown. Medium dense, wet, well graded. Gravel, fine to coarse, sub-rounded to sub-angular.			SPT	100	6/12/ 9/7/13/13 N=42	6.0						
	6.90m: Completely weathered, grey, tuffaceous SANDSTONE. Extremely weak. Recovered as: Gravelly fine to coarse SAND, some silt; Brownish grey. Medium dense, moist, well graded. Gravel, fine to medium, sub-rounded to sub-angular.			SNC	100		6.5						Box 3.00-6.55m
	7.10m: Highly weathered, grey, tuffaceous SANDSTONE. Extremely weak (very soft). Recovered as: Silty fine to coarse SAND, minor gravel; Grey. Medium dense, moist, well graded.						7.0						
	7.30m: Highly weathered, grey, tuffaceous SANDSTONE. Extremely weak. Recovered as: Gravelly fine to coarse SAND, minor silt; Grey. Medium dense, moist, well graded. Gravel, fine to coarse, sub-rounded to sub-angular.					50 for 40mm N=50	7.5						
	7.50m: Highly weathered, grey, tuffaceous SANDSTONE. Very weak. Recovered as: Fine to coarse GRAVEL, some sand, minor silt; Grey. Dense, moist, well graded. Gravel, sub-rounded to angular; sand, fine to coarse.						8.0						
	7.70m: Highly weathered, grey, tuffaceous SANDSTONE. Extremely weak. Recovered as: Gravelly fine to coarse SAND, minor silt; Grey. Medium dense, wet, well graded. Gravel, fine to coarse, sub-rounded to sub-angular.			SNC	100		8.5						
	7.90m: Highly weathered, grey, tuffaceous SANDSTONE. Extremely weak. Recovered as: Fine to coarse SAND, minor gravel, trace silt; Grey. Medium dense, moist, uniformly graded. Gravel, fine.												Box 6.55-8.80m
	8.30m: Highly weathered, grey, tuffaceous SILTSTONE. Extremely weak. Recovered as: SILT, some sand, minor clay; Grey. Stiff, moist, low plasticity. Sand, fine.						9.0						
	9.00m: Highly weathered, grey, tuffaceous SANDSTONE. Extremely weak. Recovered as: Gravelly fine to coarse SAND, some silt; Grey. Loose, moist, uniformly graded. Gravel, fine to medium, sub-rounded to sub-angular, highly weathered, very weak, mudstone.			SPT	100	7/43/ for65mm N=50	9.5						
	9.70m: Highly weathered, light grey, tuffaceous SANDSTONE. Extremely weak. Recovered as: Gravelly fine to coarse SAND; Light Grey. Loosely packed, dry, uniformly graded. Gravel, fine to medium, sub-rounded to sub-angular, highly weathered,			SNC	100								

COMMENTS:

Hole Depth 14m

Scale 1:25

Rev.: A

BOREHOLE LOG

Tonkin+Taylor

BOREHOLE No.: BH04-22

SHEET: 3 OF 3

PROJECT: Maitahi
JOB No.: 1012397.1000.1000
LOCATION: Kaka Valley

CO-ORDINATES: 5431154 mN, 1626028 mE (NZTM2000)
DIRECTION: 180°
ANGLE FROM HORIZ.: -90°

R.L. GROUND: 16m
R.L. COLLAR:
DATUM: NZVD2016
SURVEY: Handheld GPS

DRILLED BY: Matt and Mason
LOGGED BY: AMHO
CHECKED: SAPR
START DATE: 25/03/2022
FINISH DATE: 25/03/2022
CONTRACTOR: ProDrill

GEOLOGICAL UNIT	MATERIAL DESCRIPTION (SOIL: Classification, colour, consistency / density, moisture, plasticity; ROCK: Weathering, colour, fabric, name, strength, cementation)	Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m) / Depth (m)	Graphic Log	ROCK MASS DISCONTINUITIES: Defect Log / Fracture Spacing (mm) / RQD (%) / Description & Additional Observations	Water Level / Fluid Loss (%)	Casing	Installation	Core Box No
Grampian Formation	extremely weak, sandstone.												
	9.90m: Moderately weathered, grey, tuffaceous SANDSTONE. Extremely weakGravelly fine to coarse SAND, some silt; Grey. Dense, moist, uniformly graded. Gravel, fine to medium, sub-rounded to sub-angular, highly weathered, very weak, mudstone.			SNC	100								
	10.20m: Moderately weathered, light grey, tuffaceous SANDSTONE. Extremely weak. Recovered as: Gravelly fine to coarse SAND; Light Grey. Loosely packed, dry, uniformly graded. Gravel, fine to medium, sub-rounded to sub-angular, highly weathered, extremely weak, sandstone.					50 for 50mm N>=50	10.5						
	10.45m: Moderately weathered, grey, tuffaceous SANDSTONE. Very weak. Recovered as: Gravelly fine to coarse SAND, some silt; Grey. Dense, moist, uniformly graded. Gravel, fine to medium, sub-rounded to sub-angular, highly weathered, very weak, mudstone.			SNC	100		11.0						Box 8.80-11.00m
	10.60m: Moderately weathered, grey, tuffaceous SANDSTONE. Very weak. Recovered as: Sandy fine to coarse GRAVEL, some silt; Grey. Very dense, moist, uniformly graded. Gravel, sub-rounded to sub-angular, moderately weathered, weak, sandstone; sand, fine to coarse.			SNC	100		11.5						
	11.00m: Moderately weathered, grey, tuffaceous SANDSTONE. Weak. Recovered as: Silty fine to coarse SAND, some gravel; Grey. Dense, moist, well graded. Gravel, fine to medium.			HQ3	100		12.0		*11.80-11.90m:* J, 5-75°, UN, SM *11.95-12.05m:* J, 5°, UN, SM *12.10m:* J, 25°, UN, SM *12.20m:* B, 5°, PL, SM *12.30m:* J, 30°, UN, SM *12.35m:* J, 30°, UN, SM				
	11.40m: Slightly weathered, Light Grey, tuffaceous SANDSTONE. Moderately strong, well cemented.						12.5		*12.50m:* J, 25°, UN, R *12.65m:* J, UN, SM *12.75m:* J, 10°, UN, SM				
							13.0		*12.95m:* J, 15°, UN, R *13.15m:* J, 20°, PL, R *13.30m:* J, 10°, PL, R				
				HQ3	100		13.5		*13.36-13.60m:* J (x4), 5-70°, UN, R *13.70m:* J, 10°, IR, R *13.71-14.00m:* J, 80°, UN, SM *13.80-14.00m:* J (x10), 5-75°, UN, R				Box 11.00-14.00m
	14m: Target depth						14.0						
							14.5						

COMMENTS:

Hole Depth 14m

Scale 1:25

Rev.: A

TTNZ_20220309 - General Log - 29/02/2024 5:27:09 pm - Produced with Core-GS by GeRoc

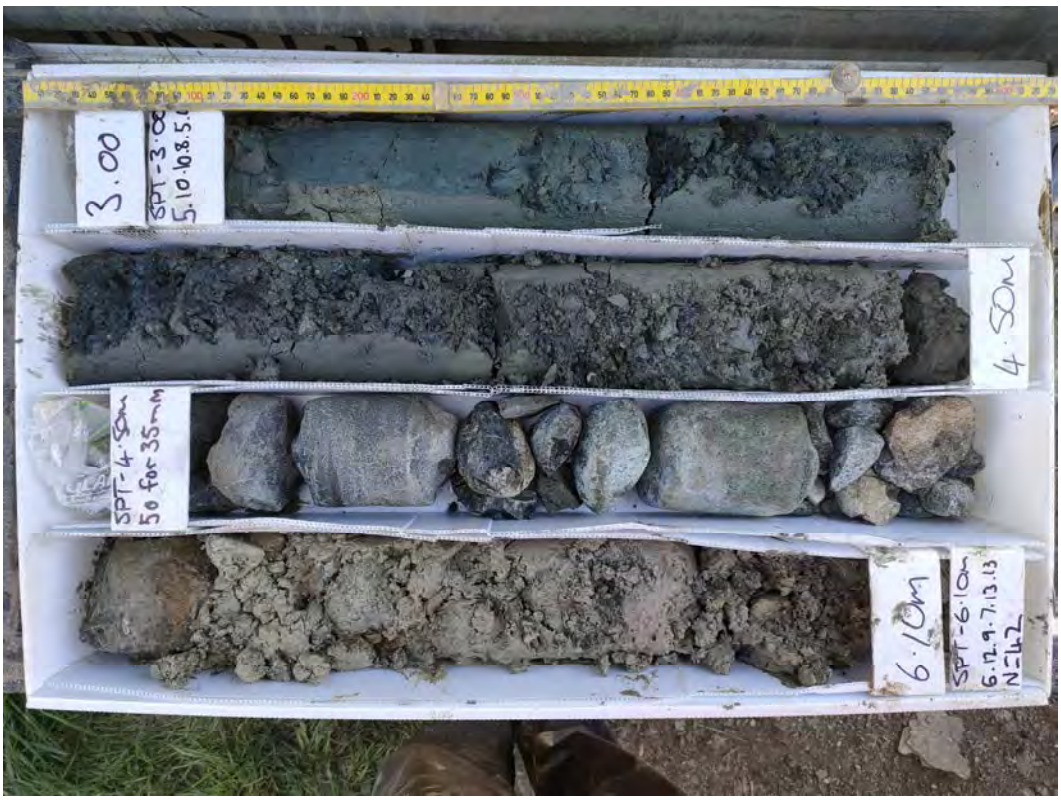
CORE PHOTOS

BOREHOLE No.: **BH04-22**

SHEET: 1 OF 3

PROJECT: Maitahi	LOCATION: Kaka Valley	JOB No.: 1012397.1000.1000
CO-ORDINATES: 5431154 mN (NZTM2000) 1626028 mE R.L.: 16m DATUM: NZVD2016	DRILL TYPE: Sonic drill METHOD: Sonic core drilling	HOLE STARTED: 25/03/2022 HOLE FINISHED: 25/03/2022 DRILLED BY: ProDrill LOGGED BY: AMHO CHECKED: SAPR

0.00-3.00m



3.00-6.55m

Tonkin+Taylor

CORE PHOTOS

BOREHOLE No.: **BH04-22**

PROJECT: Maitahi	LOCATION: Kaka Valley	JOB No.: 1012397.1000.1000
CO-ORDINATES: 5431154 mN (NZTM2000) 1626028 mE R.L.: 16m DATUM: NZVD2016	DRILL TYPE: Sonic drill METHOD: Sonic core drilling	HOLE STARTED: 25/03/2022 HOLE FINISHED: 25/03/2022 DRILLED BY: ProDrill LOGGED BY: AMHO CHECKED: SAPR

6.55-8.80m

8.80-11.00m

Tonkin+Taylor

CORE PHOTOS

BOREHOLE No.: **BH04-22**

PROJECT: Maitahi	LOCATION: Kaka Valley	JOB No.: 1012397.1000.1000
CO-ORDINATES: 5431154 mN (NZTM2000) 1626028 mE R.L.: 16m DATUM: NZVD2016	DRILL TYPE: Sonic drill METHOD: Sonic core drilling	HOLE STARTED: 25/03/2022 HOLE FINISHED: 25/03/2022 DRILLED BY: ProDrill LOGGED BY: AMHO CHECKED: SAPR

11.00-14.00m

BOREHOLE LOG

Tonkin+Taylor

BOREHOLE No.: BH04-23

SHEET: 1 OF 1

PROJECT: Maitahi
JOB No.: 1012397.1000.1000
LOCATION: Kaka Valley

CO-ORDINATES: 5431369.95 mN, 1625931.75 mE (NZTM2000)
DIRECTION:
ANGLE FROM HORIZ.: -90°

R.L. GROUND: 19.43m
R.L. COLLAR:
DATUM: NZVD2016
SURVEY: Handheld GPS

DRILLED BY: Dylan
LOGGED BY: FEOH
CHECKED: MRF
START DATE: 17/04/2023
FINISH DATE: 17/04/2023
CONTRACTOR: CW Drilling

GEOLOGICAL UNIT	DESCRIPTION OF CORE SOIL: Classification, colour, consistency / density, moisture, plasticity ROCK: Weathering, colour, fabric, name, strength, cementation
Alluvial Deposits	*0.00m:* Silty SAND, minor gravel; brown. Dry to moist. Gravel, fine to medium, sub-rounded.
	0.30m: SILT, trace gravel; dark brown. Dry to moist, low plasticity. Gravel, fine to medium, sub-rounded. *0.60 - 0.90m:* Light brown.
	0.90m: Gravelly SILT; light brown. Moist, low plasticity. Gravel, fine to medium, rounded to sub-rounded, grey brown. *1.10 - 1.20m:* Silty GRAVEL. *1.20 - 1.30m:* SILT, minor gravel.
	1.30m: Fine GRAVEL, some silt; orange brown. Moist. Gravel, sub-rounded to sub-angular. *1.60 - 1.90m:* Medium GRAVEL. Wet. Gravel, sub-rounded.
	1.90m: Silty fine to coarse GRAVEL, trace clay; grey brown. Wet. Gravel, sub-rounded.
	4m: END OF BOREHOLE. Target depth.

Rock Weathering: UW, SW, MW, HW, EW
Rock Strength: ES, VS, S, MS, W, VW, EW
Sampling Method
Core Recovery (%)
Testing
RL (m) / Depth (m): 19, 18, 17, 16, 15, 14 / 1, 2, 3, 4, 5
Graphic Log
ROCK DEFECTS: Defect Log; Fracture Spacing (mm): 2000, 600, 200, 60, 20; RQD (%); Description & Additional Observations
Fluid Loss (%): 25, 50, 75
Water Level: DRY 17/04/2023
Casing
Installation: Box 1, 0.00-4.00m
Core Box No

COMMENTS:

Hole Depth 4m

Scale 1:30

Rev.: A

CORE PHOTOS

BOREHOLE No.: **BH04-23**

SHEET: 1 OF 1

PROJECT: Maitahi	LOCATION: Kaka Valley	JOB No.: 1012397.1000.1000
CO-ORDINATES: 5431369.95 mN (NZTM2000) 1625931.75 mE R.L.: 19.43m DATUM: NZVD2016	DRILL TYPE: Concentric DRILL METHOD: PR	HOLE STARTED: 17/04/2023 HOLE FINISHED: 17/04/2023 DRILLED BY: CW Drilling LOGGED BY: FEOH CHECKED: MRF

0.00-4.00m

BOREHOLE LOG

BOREHOLE No.: BH04A-23

SHEET: 1 OF 1

PROJECT: Maitahi
JOB No.: 1012397.1000.1000
LOCATION: Kaka Valley

CO-ORDINATES: (NZTM2000) 5431367.37 mN 1625934.52 mE
DIRECTION:
ANGLE FROM HORIZ.: -90°

R.L. GROUND: 19.43m
R.L. COLLAR:
DATUM: NZVD2016
SURVEY: Handheld GPS

DRILLED BY: Dylan
LOGGED BY: FEOH
CHECKED: MRF
START DATE: 17/04/2023
FINISH DATE: 17/04/2023
CONTRACTOR: CW Drilling

GEOLOGICAL UNIT	DESCRIPTION OF CORE SOIL: Classification, colour, consistency / density, moisture, plasticity ROCK: Weathering, colour, fabric, name, strength, cementation
Alluvial Deposits	*0.00m:* Silty SAND, minor gravel; brown. Dry to moist. Gravel, fine to medium, sub-rounded.
	0.30m: SILT, trace gravel; dark brown. Dry to moist, low plasticity. Gravel, fine to medium, sub-rounded. *0.60 - 0.90m:* Light brown.
	0.90m: Gravelly SILT; light brown. Moist, low plasticity. Gravel, fine to medium, rounded to sub-rounded, grey brown. *1.10 - 1.20m:* Silty GRAVEL. *1.20 - 1.30m:* SILT, minor gravel.
	1.30m: Fine GRAVEL, some silt; orange brown. Wet. Gravel, sub-rounded to sub-angular. *1.60 - 2.00m:* Medium GRAVEL. Gravel, sub-rounded.
	2m: END OF BOREHOLE. Target depth.

Rock Weathering: UW, SW, MW, HW, EW
Rock Strength: ES, VS, S, MS, W, VW, EW
Sampling Method
Core Recovery (%)
Testing
RL (m) / Depth (m): 19, 18, 17, 16, 15, 14 / 1, 2, 3, 4, 5
Graphic Log
ROCK DEFECTS: Defect Log; Fracture Spacing (mm): 2000, 600, 200, 60, 20; RQD (%); Description & Additional Observations
Fluid Loss (%): 25, 50, 75
Water Level: DRY 17/04/2023
Casing
Installation
Core Box No

COMMENTS:

Hole Depth 2m

Scale 1:30

Rev.: A

BOREHOLE LOG

BOREHOLE No.: BH05_0723

SHEET: 1 OF 1

PROJECT: Maitahi
JOB No.: 1012397.1000.1000
LOCATION: Kaka Valley

CO-ORDINATES: 5431410 mN, 1626060 mE (NZTM2000)
DIRECTION: 0°
ANGLE FROM HORIZ.: -90°

R.L. GROUND: 31m
R.L. COLLAR:
DATUM: NZVD2016
SURVEY: Map or aerial photograph

DRILLED BY: Dylan
LOGGED BY: ANCO
CHECKED: JXWW
START DATE: 14/08/2023
FINISH DATE: 14/08/2023
CONTRACTOR: CW Drilling

GEOLOGICAL UNIT	MATERIAL DESCRIPTION (SOIL: Classification, colour, consistency / density, moisture, plasticity; ROCK: Weathering, colour, fabric, name, strength, cementation)	Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m) / Depth (m)	Graphic Log	ROCK MASS DISCONTINUITIES: Defect Log / Fracture Spacing (mm) / RQD (%)	Description & Additional Observations	Water Level / Fluid Loss (%)	Casing	Installation	Core Box No
Top	*0.00m:* Top soil									*0.00 - 0.30m:* Drillers log				
Alluvial Deposits	*0.30m:* Large gravels									*0.30 - 1.00m:* Drillers log				
	1.00m: Clayey SILT; Dark brown. Grading into gravels.			RO	0		30 / 1			*1.00 - 4.00m:* Drillers log		HQ		
							29 / 2							
							28 / 3							
	4m: END OF BOREHOLE. Target depth.						27 / 4				DRY 14/08/2023			
							26 / 5							

COMMENTS: Weather fine

Hole Depth 4m

Scale 1:30

Rev.: A

BOREHOLE LOG

Tonkin+Taylor

BOREHOLE No.: BH05-22

SHEET: 1 OF 3

PROJECT: Maitahi
JOB No.: 1012397.1000.1000
LOCATION: Kaka Valley

CO-ORDINATES: 5431098 mN, 1625988 mE (NZTM2000)
DIRECTION: 180°
ANGLE FROM HORIZ.: -90°

R.L. GROUND: 16m
R.L. COLLAR:
DATUM: NZVD2016
SURVEY: Handheld GPS

DRILLED BY: Matt and Mason
LOGGED BY: AMHO
CHECKED: SAPR
START DATE: 28/03/2022
FINISH DATE: 28/03/2022
CONTRACTOR: ProDrill

GEOLOGICAL UNIT	MATERIAL DESCRIPTION (SOIL: Classification, colour, consistency / density, moisture, plasticity; ROCK: Weathering, colour, fabric, name, strength, cementation)	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)
TSoil	*0.00m:* SILT, minor sand; Dark Brown. Stiff, moist, non-plastic. Sand, fine.					
Alluvial Deposits	*0.30m:* SILT, minor sand, trace gravel; Dark Brown. Stiff, dry, non-plastic. Sand, fine; gravel, fine to medium.					
	0.50m: SILT, some clay; Greyish Brown Mottled Orange. Stiff, moist, low plasticity.					
	0.60m: SILT, some clay, trace organics; Brown. Firm, wet, low plasticity.					
	0.70m: Clayey SILT, trace sand; Orange Brown. Stiff, moist, high plasticity, insensitive.					
	0.90m: Silty fine to coarse SAND, some gravel; Greyish Brown. Dense, moist, well graded. Gravel, fine, sub-rounded.	HANDEX50	100		15	1.0
	1.50m: Gravelly fine to coarse SAND, some silt; Greyish Brown. Dense, moist, well graded. Gravel, fine to medium, sub-rounded to sub-angular.	SPT	100	5/8// 4/4/5/6 N=19	14	2.0
		SNC	100			2.5
	3.00m: Gravelly fine to coarse SAND, minor silt; Grey. Very dense, wet, well graded. Gravel, fine to medium, sub-rounded to angular.		0	7/23// 50 for 20mm N=50	13	3.0
	3.60m: Sandy fine to medium GRAVEL, some silt; Brownish Grey. Dense, moist, well graded. Gravel, sub-rounded to angular; sand, fine to coarse.	SNC	100			3.5
	3.90m: Silty fine to medium GRAVEL, some sand; Grey. Dense, moist, well graded. Gravel, rounded to sub-angular; sand, fine to coarse.				12	4.0
	4.50m: Silty fine to coarse GRAVEL, some sand; Brownish Grey. Very dense, moist, well graded. Gravel, sub-rounded to sub-angular; sand, fine to coarse.		0	8/28// 50 for 50mm N=50		4.5
		SNC	100			

Rock Weathering: UW, SW, MW, HW, CW, RS
Rock Strength: VS+, S, MS, M, W, VW, EW

ROCK MASS DISCONTINUITIES

Defect Log	Fracture Spacing (mm) (2000, 600, 200, 60, 20)	RQD (%)	Description & Additional Observations

Water Level / Fluid Loss (%): 25, 50, 75
28/03/2022

Casing: 10.6m

Installation: Box 0.00-3.00m

Core Box No

COMMENTS:

Hole Depth 10.6m

Scale 1:25

Rev.: B

TTNZ_20220309 - General Log - 29/02/2024 5:27:27 pm - Produced with Core-GS by GeRoc

BOREHOLE LOG

Tonkin+Taylor

BOREHOLE No.: BH05-22

SHEET: 2 OF 3

PROJECT: Maitahi
JOB No.: 1012397.1000.1000
LOCATION: Kaka Valley

CO-ORDINATES: 5431098 mN, 1625988 mE (NZTM2000)
DIRECTION: 180°
ANGLE FROM HORIZ.: -90°

R.L. GROUND: 16m
R.L. COLLAR:
DATUM: NZVD2016
SURVEY: Handheld GPS

DRILLED BY: Matt and Mason
LOGGED BY: AMHO
CHECKED: SAPR
START DATE: 28/03/2022
FINISH DATE: 28/03/2022
CONTRACTOR: ProDrill

GEOLOGICAL UNIT	MATERIAL DESCRIPTION (SOIL: Classification, colour, consistency / density, moisture, plasticity; ROCK: Weathering, colour, fabric, name, strength, cementation)	Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK MASS DISCONTINUITIES: Defect Log	Fracture Spacing (mm)	RQD (%)	Description & Additional Observations	Water Level / Fluid Loss (%)	Casing	Installation	Core Box No
Alluvial Deposits	[CONT] *4.50m:* Silty fine to coarse GRAVEL, some sand; Brownish Grey. Very dense, moist, well graded. Gravel, sub-rounded to sub-angular; sand, fine to coarse.			SNC	100		10	5.5							10.6m		Box 3.00-5.40m
	5.25m: Silty fine to coarse SAND, some gravel; Grey. Dense, moist, well graded. Gravel, fine to medium, sub-rounded to sub-angular.																
	5.40m: Sandy SILT, some gravel, minor clay; Reddish Grey. Stiff, moist, low plasticity. Sand, fine; gravel, medium to coarse.																
	5.55m: Medium to coarse GRAVEL; Reddish Grey. Loose, dry, uniformly graded. Gravel, sub-angular to angular. Interbedded with: Gravelly fine to coarse SAND, minor silt; Grey . Medium dense, moist, well graded. Gravel, fine to medium, sub-rounded to sub-angular.																
	5.70m: Sandy SILT, minor clay; Brown. Firm, moist, low plasticity.			SPT	100	12/6// 7/8/10/6 N=31		6.0									
	6.55m: Silty fine to medium SAND; Brown. Medium dense, moist.			SNC	100		9	6.5									
	7.00m: Fine to medium SAND, some silt, minor gravel; Brown. Medium dense, wet, poorly graded. Gravel, fine.							7.0									
	7.15m: Silty fine to coarse SAND, some gravel; Greyish brown. Dense, moist, well graded. Gravel, fine to coarse.																
	7.60m: Silty fine to coarse SAND, some gravel; brown. Medium dense, wet, well graded. Gravel, fine to coarse.			SPT	100	2/7// 7/8/7/6 N=28		7.5									
	8.20m: Silty fine to coarse SAND, some gravel; brown. Dense, moist, well graded. Gravel, fine to medium, sub-rounded to sub-angular.			SNC	100		8	8.0									
	8.50m: Gravelly fine to coarse SAND, some silt; brown. Medium dense, saturated, well graded. Gravel, fine to coarse.							8.5									Box 5.40-8.80m
	8.80m: Silty fine to coarse SAND, some gravel; brown Mottled Orange. Medium dense, moist, well graded. Gravel, fine to medium, sub-rounded to sub-angular.																
	9.05m: Clayey SILT, trace sand; Brown. Firm, wet, medium plasticity. Sand, fine.			SPT	100	11/13// 10/10/15/6 N=41	7	9.0									
	9.25m: Silty fine to coarse SAND, some gravel; Greyish brown. Medium dense, moist, well graded. Gravel, fine to medium, sub-rounded to sub-angular.																
	9.60m: Silty fine to coarse SAND, some gravel; brown. Loose, wet, well graded. Gravel, fine to medium, sub-rounded to sub-angular.			SNC	100			9.5									
	9.90m: Gravelly fine to coarse SAND, some silt; brown.																

COMMENTS:

Hole Depth 10.6m

Scale 1:25

Rev.: B

BOREHOLE LOG

BOREHOLE No.: BH05-22

SHEET: 3 OF 3

PROJECT: Maitahi	CO-ORDINATES: 5431098 mN (NZTM2000) 1625988 mE	R.L. GROUND: 16m
JOB No.: 1012397.1000.1000	DIRECTION: 180°	R.L. COLLAR:
LOCATION: Kaka Valley	ANGLE FROM HORIZ.: -90°	DATUM: NZVD2016
		SURVEY: Handheld GPS

DRILLED BY: Matt and Mason
LOGGED BY: AMHO
CHECKED: SAPR
START DATE: 28/03/2022
FINISH DATE: 28/03/2022
CONTRACTOR: ProDrill

GEOLOGICAL UNIT	MATERIAL DESCRIPTION (SOIL: Classification, colour, consistency / density, moisture, plasticity; ROCK: Weathering, colour, fabric, name, strength, cementation)	Rock Weathering (UW SW MW HW CW DW RS)	Rock Strength (VS+ S MS M W VW EW)	Sampling Method	Core Recovery (%)	Testing	RL (m) / Depth (m)	Graphic Log	ROCK MASS DISCONTINUITIES: Defect Log	Fracture Spacing (mm) (2000 600 200 60 20)	RQD (%)	Description & Additional Observations	Water Level / Fluid Loss (%) (25 50 75)	Casing	Installation	Core Box No
Alluvial Deposits	Medium dense, moist, well graded. Gravel, fine to medium, sub-rounded to sub-angular.			SNC	100		10.5							10.6m		Box 8.80-10.60m
	10.6m: Target depth						11.0 (5) 11.5 12.0 (4) 12.5 13.0 (3) 13.5 14.0 (2) 14.5									

COMMENTS:

Hole Depth 10.6m

Scale 1:25

Rev.: B

TTNZ_20220309 - General Log - 29/02/2024 5:27:27 pm - Produced with Core-GS by GeRoc

CORE PHOTOS

BOREHOLE No.: **BH05-22**

SHEET: 1 OF 2

PROJECT: Maitahi	LOCATION: Kaka Valley	JOB No.: 1012397.1000.1000
CO-ORDINATES: 5431098 mN (NZTM2000) 1625988 mE R.L.: 16m DATUM: NZVD2016	DRILL TYPE: Sonic drill METHOD: Sonic core drilling	HOLE STARTED: 28/03/2022 HOLE FINISHED: 28/03/2022 DRILLED BY: ProDrill LOGGED BY: AMHO CHECKED: SAPR

0.00-3.00m

3.00-5.40m

Tonkin+Taylor

CORE PHOTOS

BOREHOLE No.: **BH05-22**

PROJECT: Maitahi	LOCATION: Kaka Valley	JOB No.: 1012397.1000.1000
CO-ORDINATES: 5431098 mN (NZTM2000) 1625988 mE R.L.: 16m DATUM: NZVD2016	DRILL TYPE: Sonic drill METHOD: Sonic core drilling	HOLE STARTED: 28/03/2022 HOLE FINISHED: 28/03/2022 DRILLED BY: ProDrill LOGGED BY: AMHO CHECKED: SAPR

5.40-8.80m

8.80-10.60m

BOREHOLE LOG

BOREHOLE No.: BH05-23

SHEET: 1 OF 1

Tonkin+Taylor

PROJECT: Maitahi
JOB No.: 1012397.1000.1000
LOCATION: Kaka Valley

CO-ORDINATES: 5431337.00 mN, 1625888.30 mE (NZTM2000)
DIRECTION:
ANGLE FROM HORIZ.: -90°

R.L. GROUND: 18.10m
R.L. COLLAR:
DATUM: NZVD2016
SURVEY: Handheld GPS

DRILLED BY: Dylan
LOGGED BY: FEOH
CHECKED: SCON
START DATE: 14/04/2023
FINISH DATE: 14/04/2023
CONTRACTOR: CW Drilling

GEOLOGICAL UNIT	DESCRIPTION OF CORE SOIL: Classification, colour, consistency / density, moisture, plasticity ROCK: Weathering, colour, fabric, name, strength, cementation
TSoil	*0.00m:* SILT, some organics and some gravel; dark brown. Moist, low plasticity. Gravel, fine to medium, sub-rounded. (TOPSOIL).
Alluvial Deposits	*0.50m:* Fine to medium GRAVEL, some silt; greyish brown. Moist. Gravel, sub-rounded to sub-angular. *0.60 - 1.00m:* Becomes more silty. *0.90 - 1.00m:* Gravel becomes more coarse.
	1.00m: Fine to coarse GRAVEL, trace silt; greyish brown. Saturated. Gravel, sub-rounded to sub-angular.
	1.40m: Gravelly SILT, trace clay; grey and brown. Wet, medium to high plasticity. Gravel, fine to coarse, sub-rounded to sub-angular. *1.50 - 1.90m:* Moist.
	1.90m: Silty fine to medium GRAVEL, trace clay; grey. Moist. Gravel, sub-rounded to sub-angular. *2.10 - 2.50m:* Gravel becomes fine. *2.40 - 2.50m:* Wet.
	2.5m: END OF BOREHOLE. Target depth.

Rock Weathering: UW, SW, MW, HW, EW
Rock Strength: ES, VS, S, MS, H, VH, EH
Sampling Method
Core Recovery (%)
Testing
RL (m) / Depth (m): 18/0, 17/1, 16/2, 15/3, 14/4, 13/5
Graphic Log: TS, TS
ROCK DEFECTS: Defect Log; Fracture Spacing (mm): 2000, 600, 200, 60, 20; RQD (%); Description & Additional Observations
Fluid Loss (%): 25, 50, 75
Water Level: 14/04/2023
Casing
Installation
Core Box No

COMMENTS:

Hole Depth 2.5m

Scale 1:30

Rev.: A

BOREHOLE LOG

BOREHOLE No.: BH06_0723

SHEET: 1 OF 1

PROJECT: Maitahi

JOB No.: 1012397.1000.1000

LOCATION: Kaka Valley

CO-ORDINATES: 5431287 mN, 1626079 mE (NZTM2000)

DIRECTION: 0°

ANGLE FROM HORIZ.: -90°

R.L. GROUND: 25m

R.L. COLLAR:

DATUM: NZVD2016

SURVEY: Map or aerial photograph

DRILLED BY: Dylan

LOGGED BY: ANCO

CHECKED: JXWW

START DATE: 14/09/2023

FINISH DATE: 14/09/2023

CONTRACTOR: CW Drilling

GEOLOGICAL UNIT	MATERIAL DESCRIPTION (SOIL: Classification, colour, consistency / density, moisture, plasticity; ROCK: Weathering, colour, fabric, name, strength, cementation)	Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m) / Depth (m)	Graphic Log	ROCK MASS DISCONTINUITIES: Defect Log / Fracture Spacing (mm) / RQD (%)	Description & Additional Observations	Water Level / Fluid Loss (%)	Casing	Installation	Core Box No
TSoil	*0.00m:* Brown. Top soil.									*0.00 - 0.50m:* Drillers Log				
Alluvial Deposits	*0.50m:* Clayey SILT; Yellowish brown.									*0.50 - 0.70m:* Drillers Log				
	0.70m: GRAVEL; Yellowish -brown.									*0.70 - 2.00m:* Drillers Log				
	2.00m: Silty GRAVEL; Orange - brown. Soft to firm, moist, low plasticity.			RO	0							HQ		
	2.80m: Clayey gravelly SILT; Orange - brown grey. Moist, low plasticity.													
	4m: END OF BOREHOLE. Target depth.										DRY 14/09/2023			

COMMENTS: Weather fine.

Hole Depth 4m

Scale 1:30

Rev.: A

BOREHOLE LOG

Tonkin+Taylor

BOREHOLE No.: BH06-22

SHEET: 1 OF 3

PROJECT: Maitahi
JOB No.: 1012397.1000.1000
LOCATION: Kaka Valley

CO-ORDINATES: 5431126 mN, 1625946 mE (NZTM2000)
DIRECTION: 180°
ANGLE FROM HORIZ.: -90°

R.L. GROUND: 15m
R.L. COLLAR:
DATUM: NZVD2016
SURVEY: Handheld GPS

DRILLED BY: Kortni
LOGGED BY: MIBU
CHECKED: SAPR
START DATE: 26/05/2022
FINISH DATE: 26/05/2022
CONTRACTOR: McMillan

GEOLOGICAL UNIT	MATERIAL DESCRIPTION (SOIL: Classification, colour, consistency / density, moisture, plasticity; ROCK: Weathering, colour, fabric, name, strength, cementation)	Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m) / Depth (m)	Graphic Log	ROCK MASS DISCONTINUITIES: Defect Log / Fracture Spacing (mm) / RQD (%) / Description & Additional Observations	Water Level / Fluid Loss (%)	Casing	Installation	Core Box No
TSoil	*0.00m:* SILT, some gravel, trace sand; Dark Brownish Orange, homogeneous (no textural variation). Soft to firm, dry, low plasticity. Gravel, fine, up to 10mm, sub-angular to angular; sand, fine to medium.						15 / 0						
	0.60m: CORE LOSS - Obstruction (recovered) in front of barrel.			SNC50	43		0.5						
Alluvial Deposits	*1.40m:* Silty fine to coarse GRAVEL, some cobbles, minor sand; Light Brownish Grey, massive. Medium dense, moist, uniformly graded. Gravel, up to 60mm, rounded to sub-angular, strong to extremely strong, blue and white, Augite tuff; cobbles, up to 100mm, rounded to sub-rounded, unweathered, strong to extremely strong, blue and white; sand, fine to coarse, sub-rounded to angular.			SPT50	78	3/2// 2/2/6/6 N=16	14 / 1.0						
	2.45 - 2.75m: Light Blue Grey.			SNC50	100		13 / 2.0						
				SPT50	67	6/6// 6/7/7/8 N=28	12 / 3.0			26/05/2022			Box 0.00-3.24m
	3.37 - 10.97m: Wet.			SNC50	100		11 / 4.0						
	4.00 - 4.15m: Gravelly SILT; Reddish Orange. Soft, wet, low plasticity, dilatant. Gravel, fine to coarse, rounded to sub-rounded, unweathered to slightly weathered, blue.			SPT50	78	16/24// 16/17/12/15 N=60	4.5						
				SNC50	100								

COMMENTS:

Hole Depth 10.97m

Scale 1:25

Rev.: B

BOREHOLE LOG

Tonkin+Taylor

BOREHOLE No.: BH06-22

SHEET: 2 OF 3

PROJECT: Maitahi
JOB No.: 1012397.1000.1000
LOCATION: Kaka Valley

CO-ORDINATES: 5431126 mN, 1625946 mE (NZTM2000)
DIRECTION: 180°
ANGLE FROM HORIZ.: -90°

R.L. GROUND: 15m
R.L. COLLAR:
DATUM: NZVD2016
SURVEY: Handheld GPS

DRILLED BY: Kortni
LOGGED BY: MIBU
CHECKED: SAPR
START DATE: 26/05/2022
FINISH DATE: 26/05/2022
CONTRACTOR: McMillan

GEOLOGICAL UNIT	MATERIAL DESCRIPTION (SOIL: Classification, colour, consistency / density, moisture, plasticity; ROCK: Weathering, colour, fabric, name, strength, cementation)	Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m) / Depth (m)	Graphic Log	ROCK MASS DISCONTINUITIES: Defect Log	Fracture Spacing (mm)	RQD (%)	Description & Additional Observations	Water Level / Fluid Loss (%)	Casing	Installation	Core Box No
Alluvial Deposits	[CONT] *1.40m:* Silty fine to coarse GRAVEL, some cobbles, minor sand; Light Brownish Grey, massive. Medium dense, moist, uniformly graded. Gravel, up to 60mm, rounded to sub-angular, strong to extremely strong, blue and white, Augite tuff; cobbles, up to 100mm, rounded to sub-rounded, unweathered, strong to extremely strong, blue and white; sand, fine to coarse, sub-rounded to angular. *5.25 - 7.80m:* Very dense.			SNC	100		10 / 5.5									
				SPT50	78	11/16// 11/11/9/10 N=41	9 / 6.0									Box 3.24-5.36m
				SNC50	100		6.5									
				SPT50	67	5/8// 10/14/25/11 N=60	8 / 7.0									Box 5.36-7.48m
				SNC50	100		7.5									
				SPT50	100	8/6// 8/14/12/12 N=46	7 / 8.0									Box 7.48-9.32m
				SNC50	100		8.5									
							6 / 9.0									
							9.5									

COMMENTS:

Hole Depth 10.97m

Scale 1:25

Rev.: B

TTNZ_20220309 - General Log - 29/02/2024 5:27:42 pm - Produced with Core-GS by GeRoc

BOREHOLE LOG

Tonkin+Taylor

BOREHOLE No.: BH06-22

SHEET: 3 OF 3

PROJECT: Maitahi
JOB No.: 1012397.1000.1000
LOCATION: Kaka Valley

CO-ORDINATES: 5431126 mN, 1625946 mE (NZTM2000)
DIRECTION: 180°
ANGLE FROM HORIZ.: -90°

R.L. GROUND: 15m
R.L. COLLAR:
DATUM: NZVD2016
SURVEY: Handheld GPS

DRILLED BY: Kortni
LOGGED BY: MIBU
CHECKED: SAPR
START DATE: 26/05/2022
FINISH DATE: 26/05/2022
CONTRACTOR: McMillan

GEOLOGICAL UNIT	MATERIAL DESCRIPTION (SOIL: Classification, colour, consistency / density, moisture, plasticity; ROCK: Weathering, colour, fabric, name, strength, cementation)	Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m) / Depth (m)	Graphic Log	ROCK MASS DISCONTINUITIES: Defect Log	Fracture Spacing (mm)	RQD (%)	Description & Additional Observations	Water Level / Fluid Loss (%)	Casing	Installation	Core Box No
Alluvial Deposits	[CONT] *1.40m:* Silty fine to coarse GRAVEL, some cobbles, minor sand; Light Brownish Grey, massive. Medium dense, moist, uniformly graded. Gravel, up to 60mm, rounded to sub-angular, strong to extremely strong, blue and white, Augite tuff; cobbles, up to 100mm, rounded to sub-rounded, unweathered, strong to extremely strong, blue and white; sand, fine to coarse, sub-rounded to angular.			SNC	100		5									
				SPT50	78	5/9// 11/11/12/17 N=51	10.5									Box 9.32-10.52m
	10.97m: Target depth						11.0									
							11.5									
							12.0									
							12.5									
							13.0									
							13.5									
							14.0									
							14.5									

COMMENTS:

Hole Depth 10.97m

Scale 1:25

Rev.: B

Tonkin+Taylor

CORE PHOTOS

BOREHOLE No.: **BH06-22**

PROJECT: Maitahi	LOCATION: Kaka Valley	JOB No.: 1012397.1000.1000
CO-ORDINATES: 5431126 mN (NZTM2000) 1625946 mE R.L.: 15m DATUM: NZVD2016	DRILL TYPE: Sonic Drill METHOD: Sonic core drilling	HOLE STARTED: 26/05/2022 HOLE FINISHED: 26/05/2022 DRILLED BY: McMillan LOGGED BY: MIBU CHECKED: SAPR

0.00-3.24m

3.24-5.36m

Tonkin+Taylor

CORE PHOTOS

BOREHOLE No.: **BH06-22**

SHEET: 2 OF 3

PROJECT: Maitahi	LOCATION: Kaka Valley	JOB No.: 1012397.1000.1000
CO-ORDINATES: 5431126 mN (NZTM2000) 1625946 mE R.L.: 15m DATUM: NZVD2016	DRILL TYPE: Sonic Drill METHOD: Sonic core drilling	HOLE STARTED: 26/05/2022 HOLE FINISHED: 26/05/2022 DRILLED BY: McMillan LOGGED BY: MIBU CHECKED: SAPR

5.36-7.48m

7.48-9.32m

CORE PHOTOS

BOREHOLE No.: **BH06-22**

SHEET: 3 OF 3

PROJECT: Maitahi	LOCATION: Kaka Valley	JOB No.: 1012397.1000.1000
CO-ORDINATES: 5431126 mN (NZTM2000) 1625946 mE R.L.: 15m DATUM: NZVD2016	DRILL TYPE: Sonic Drill METHOD: Sonic core drilling	HOLE STARTED: 26/05/2022 HOLE FINISHED: 26/05/2022 DRILLED BY: McMillan LOGGED BY: MIBU CHECKED: SAPR

9.32-10.52m

BOREHOLE LOG

BOREHOLE No.: BH06-23

SHEET: 1 OF 1

PROJECT: Maitahi
JOB No.: 1012397.1000.1000
LOCATION: Kaka Valley

CO-ORDINATES: (NZTM2000) 5431311.46 mN 1625844.56 mE
DIRECTION:
ANGLE FROM HORIZ.: -90°

R.L. GROUND: 16.82m
R.L. COLLAR:
DATUM: NZVD2016
SURVEY: Handheld GPS

DRILLED BY: Dylan
LOGGED BY: FEOH
CHECKED: SCON
START DATE: 18/04/2023
FINISH DATE: 18/04/2023
CONTRACTOR: CW Drilling

GEOLOGICAL UNIT	DESCRIPTION OF CORE SOIL: Classification, colour, consistency / density, moisture, plasticity ROCK: Weathering, colour, fabric, name, strength, cementation
Alluvial Deposits	*0.00m:* Gravelly SILT, some organics; greyish brown. Moist, low plasticity. Gravel, fine, sub-rounded to sub-angular.
	1.00m: Silty fine to coarse GRAVEL; grey. Moist. Gravel, sub-rounded to sub-angular; silt, light brown.
	1.50m: Gravelly SILT; light brown. Moist, low plasticity. Gravel, fine, sub-rounded to sub-angular. *1.80 - 1.90m:* Grey.
	1.90m: Fine to coarse GRAVEL, some silt; light brownish grey. Moist. Gravel, sub-rounded to sub-angular. *2.20 - 2.60m:* Dry.
	2.60m: Drilling continued in search for rock but was not logged.
	4.50 - 4.65m: Sandy layer. *4.65 - 5.50m:* Alluvial gravels becoming coarse.
	5.5m: END OF BOREHOLE

Rock Weathering: UW SW MW HW EW
Rock Strength: ES VS S MS W VW EW
Sampling Method
Core Recovery (%)
Testing
RL (m) / Depth (m): 16 (1), 15 (2), 14 (3), 13 (4), 12 (5), 11
Graphic Log
ROCK DEFECTS: Defect Log; Fracture Spacing (mm): 2000 600 200 60 20; RQD (%); Description & Additional Observations
Fluid Loss (%): 25 50 75
Water Level: 18/04/2023
Casing
Installation
Core Box No

COMMENTS:

Hole Depth 5.5m

Scale 1:30

Rev.: A

BOREHOLE LOG

BOREHOLE No.: BH07_0723

SHEET: 1 OF 1

PROJECT: Maitahi
JOB No.: 1012397.1000.1000
LOCATION: Kaka Valley

CO-ORDINATES: 5431218 mN, 1626196 mE (NZTM2000)
DIRECTION: 0°
ANGLE FROM HORIZ.: -90°

R.L. GROUND: 33m
R.L. COLLAR:
DATUM: NZVD2016
SURVEY: Map or aerial photograph

DRILLED BY: Dylan
LOGGED BY: ANCO
CHECKED: JXWW
START DATE: 15/08/2023
FINISH DATE: 15/08/2023
CONTRACTOR: CW Drilling

GEOLOGICAL UNIT	MATERIAL DESCRIPTION (SOIL: Classification, colour, consistency / density, moisture, plasticity; ROCK: Weathering, colour, fabric, name, strength, cementation)	Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK MASS DISCONTINUITIES: Defect Log	Fracture Spacing (mm)	RQD (%)	Description & Additional Observations	Water Level / Fluid Loss (%)	Casing	Installation	Core Box No
Top	*0.00m:* Brown. Topsoil.												*0.00 - 0.30m:* Drillers Log				
Colluvium	*0.30m:* Clayey silty GRAVEL; Brown.												*0.30 - 1.00m:* Drillers Log				
Grampian Formation	*1.00m:* Brown - to light grey, SANDSTONE.			AH	0		32	1					*1.00 - 4.00m:* Chip logging - appears strong		HQ		
							31	2									
							30	3									
	4m: END OF BOREHOLE. Target depth.						29	4									
							28	5									

COMMENTS: Weather fine.

Hole Depth 4m

Scale 1:30

Rev.: A

BOREHOLE LOG

Tonkin+Taylor

BOREHOLE No.: BH07-22

SHEET: 1 OF 3

PROJECT: Maitahi
JOB No.: 1012397.1000.1000
LOCATION: Kaka Valley

CO-ORDINATES: 5431160 mN, 1625873 mE (NZTM2000)
DIRECTION: 180°
ANGLE FROM HORIZ.: -90°

R.L. GROUND: 15m
R.L. COLLAR:
DATUM: NZVD2016
SURVEY: Handheld GPS

DRILLED BY: Paul
LOGGED BY: ABOT
CHECKED: SAPR
START DATE: 13/06/2022
FINISH DATE: 14/06/2022
CONTRACTOR: McMillan Drilling

GEOLOGICAL UNIT	MATERIAL DESCRIPTION (SOIL: Classification, colour, consistency / density, moisture, plasticity; ROCK: Weathering, colour, fabric, name, strength, cementation)	Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK MASS DISCONTINUITIES: Defect Log	Fracture Spacing (mm)	RQD (%)	Description & Additional Observations	Water Level / Fluid Loss (%)	Casing	Installation	Core Box No
TSoil	*0.00m:* SILT, trace organics and trace sand; Dark Brown. Soft to firm, moist, non-plastic to low plasticity, insensitive.																
Alluvial Deposits	*0.60m:* SILT; Light brown with orange mottle. Firm to stiff, moist, non-plastic to low plasticity, insensitive.			SNC	100		14	0.5									
	1.40m: CORE LOSS - Suspect loose granular material dropped out of barrel.			SPT	0	6/8// 5/4/5/4 N=18	13	1.5									
	2.10m: Cobbly fine to coarse GRAVEL, some sand; Bluish Grey. Loosely packed, wet. Gravel, rounded to angular.			SNC	65		12	2.5									Box 0.00-2.92m
	2.55m: Sandy fine and coarse GRAVEL, some silt and some cobbles; Light Brownish Grey. Tightly packed, wet. Sand, medium.																
	2.75m: Cobbly fine to coarse GRAVEL, some sand; Bluish Grey. Loosely packed, wet. Gravel, rounded to angular.			SPTC	0	18/9// 15/16/11/8 N>=50 Solid Cone		3.0									
	3.57m: Silty medium to coarse GRAVEL, some sand and some cobbles; Light Brownish Grey. Tightly packed, wet.						11	3.5									
	3.80m: Cobbly fine to coarse GRAVEL, some sand; Bluish Grey. Loosely packed, wet. Gravel, rounded to angular.			SNC	100												
	3.90m: Silty medium to coarse GRAVEL, some sand and some cobbles; Light Brownish Grey. Tightly packed, saturated.							4.0									
	4.44m: Cobbly fine to coarse GRAVEL, some sand; Bluish Grey. Loosely packed, wet. Gravel, rounded to angular.			SPTC	0	3/9// 15/5/6/7 N=33 Solid Cone	10	4.5									

COMMENTS:

Hole Depth 10.92m

Scale 1:25

Rev.: A

TTNZ_20220309 - General Log - 29/02/2024 5:27:58 pm - Produced with Core-GS by GeRoc

BOREHOLE LOG

Tonkin+Taylor

BOREHOLE No.: BH07-22

SHEET: 2 OF 3

PROJECT: Maitahi
JOB No.: 1012397.1000.1000
LOCATION: Kaka Valley

CO-ORDINATES: 5431160 mN, 1625873 mE (NZTM2000)
DIRECTION: 180°
ANGLE FROM HORIZ.: -90°

R.L. GROUND: 15m
R.L. COLLAR:
DATUM: NZVD2016
SURVEY: Handheld GPS

DRILLED BY: Paul
LOGGED BY: ABOT
CHECKED: SAPR
START DATE: 13/06/2022
FINISH DATE: 14/06/2022
CONTRACTOR: McMillan Drilling

GEOLOGICAL UNIT	MATERIAL DESCRIPTION (SOIL: Classification, colour, consistency / density, moisture, plasticity; ROCK: Weathering, colour, fabric, name, strength, cementation)	Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m) / Depth (m)	Graphic Log	ROCK MASS DISCONTINUITIES: Defect Log / Fracture Spacing (mm) / RQD (%) / Description & Additional Observations	Water Level / Fluid Loss (%)	Casing	Installation	Core Box No
Alluvial Deposits	[CONT] *4.44m:* Cobbly fine to coarse GRAVEL, some sand; Bluish Grey. Loosely packed, wet. Gravel, rounded to angular.												
	5.06m: CORE LOSS - Suspect loose granular material dropped out of barrel.												
	5.96m: Sandy fine to medium GRAVEL, trace silt; Light Brown. Loosely packed, wet.			SPTC	0	14/14// 15/8/9/20 N>=50 Solid Cone	6.0						Box 2.92-6.26m
	6.26m: Sandy fine to coarse GRAVEL, some cobbles; Bluish grey. Loosely packed, wet.												
	6.56m: Silty fine to coarse GRAVEL, some sand, minor cobbles; Light Brown. Medium dense to dense, saturated. Sand, medium.			SNC	100		6.5 / 7.0						
	7.48m: Silty fine to coarse GRAVEL, some sand, minor cobbles; Light Light Brown. Medium dense to dense, saturated. Sand, medium.			SPTC	0	10/18// 20/20/15/5 for 25mm N>=50 Solid Cone	7.5						
				SNC	100		8.0 / 8.5						Box 6.26-8.38m
	8.95m: Medium to coarse GRAVEL, trace silt; Grey . Very dense, saturated. Gravel, sub-rounded to sub-angular; silt covering gravels. Fines washed away.				0	26/34// for75mm N=60 Solid Cone	9.0						
				SNC	93		9.5						
	9.60m: Sandy fine to medium GRAVEL, minor silt. Very dense, saturated. Sand, medium to coarse.												
	9.90m: Silty medium SAND, minor gravel and minor cobbles;												

COMMENTS:

Hole Depth 10.92m

Scale 1:25

Rev.: A

BOREHOLE LOG

BOREHOLE No.: BH07-22

SHEET: 3 OF 3

PROJECT: Maitahi
JOB No.: 1012397.1000.1000
LOCATION: Kaka Valley

CO-ORDINATES: 5431160 mN, 1625873 mE (NZTM2000)
DIRECTION: 180°
ANGLE FROM HORIZ.: -90°

R.L. GROUND: 15m
R.L. COLLAR:
DATUM: NZVD2016
SURVEY: Handheld GPS

DRILLED BY: Paul
LOGGED BY: ABOT
CHECKED: SAPR
START DATE: 13/06/2022
FINISH DATE: 14/06/2022
CONTRACTOR: McMillan Drilling

GEOLOGICAL UNIT	MATERIAL DESCRIPTION (SOIL: Classification, colour, consistency / density, moisture, plasticity; ROCK: Weathering, colour, fabric, name, strength, cementation)	Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m) / Depth (m)	Graphic Log	ROCK MASS DISCONTINUITIES: Defect Log	Fracture Spacing (mm)	RQD (%)	Description & Additional Observations	Water Level / Fluid Loss (%)	Casing	Installation	Core Box No
Alluvial Deposits	Light brown. Very dense, saturated. Gravel, fine to medium.			SNC	100	10/26// 26/14/15/5 for 10mm N=60 Solid Cone	4 10.5									Box 8.38-10.52m
	10.92m: Target depth				0		11.0, 3 11.5, 12.0, 2 12.5, 13.0, 1 13.5, 14.0, 0 14.5									

COMMENTS:

Hole Depth 10.92m

Scale 1:25

Rev.: A

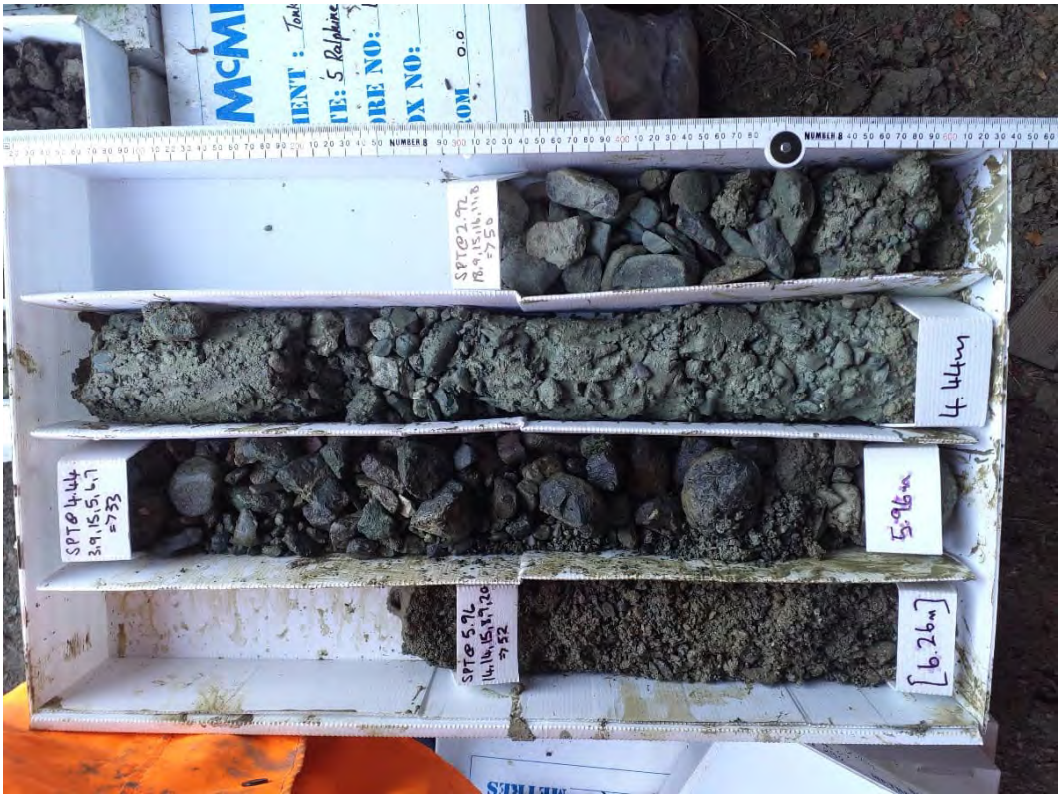
CORE PHOTOS

BOREHOLE No.: **BH07-22**

SHEET: 1 OF 2

PROJECT: Maitahi	LOCATION: Kaka Valley	JOB No.: 1012397.1000.1000
CO-ORDINATES: 5431160 mN (NZTM2000) 1625873 mE R.L.: 15m DATUM: NZVD2016	DRILL TYPE: Sonic drill METHOD: Sonic core drilling	HOLE STARTED: 13/06/2022 HOLE FINISHED: 14/06/2022 DRILLED BY: McMillan Drilling LOGGED BY: ABOT CHECKED: SAPR

0.00-2.92m



2.92-6.26m

Tonkin+Taylor

CORE PHOTOS

BOREHOLE No.: **BH07-22**

SHEET: 2 OF 2

PROJECT: Maitahi	LOCATION: Kaka Valley	JOB No.: 1012397.1000.1000
CO-ORDINATES: 5431160 mN (NZTM2000) 1625873 mE R.L.: 15m DATUM: NZVD2016	DRILL TYPE: Sonic drill METHOD: Sonic core drilling	HOLE STARTED: 13/06/2022 HOLE FINISHED: 14/06/2022 DRILLED BY: McMillan Drilling LOGGED BY: ABOT CHECKED: SAPR

6.26-8.38m

8.38-10.52m

BOREHOLE LOG

BOREHOLE No.: BH07-23

SHEET: 1 OF 1

PROJECT: Maitahi
JOB No.: 1012397.1000.1000
LOCATION: Kaka Valley

CO-ORDINATES: (NZTM2000) 5431201.70 mN 1625852.20 mE
DIRECTION:
ANGLE FROM HORIZ.: -90°

R.L. GROUND: 15.00m
R.L. COLLAR:
DATUM: NZVD2016
SURVEY: Handheld GPS

DRILLED BY: Dylan
LOGGED BY: FEOH
CHECKED: SCON
START DATE: 19/04/2023
FINISH DATE: 19/04/2023
CONTRACTOR: CW Drilling

GEOLOGICAL UNIT	DESCRIPTION OF CORE SOIL: Classification, colour, consistency / density, moisture, plasticity ROCK: Weathering, colour, fabric, name, strength, cementation	Rock Weathering (UW SW MW HW EW)	Rock Strength (ES VS S MS W VW EW)	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK DEFECTS: Defect Log	Fracture Spacing (mm) (2000 600 200 60 20)	RQD (%)	Description & Additional Observations	Fluid Loss (%) (25 50 75)	Water Level	Casing	Installation	Core Box No
TSoil	*0.00m:* SILT, some sand; dark brown. Moist, low plasticity. (TOPSOIL).								TS									
Alluvial Deposits	*0.60m:* SILT, some clay; brown. Moist, medium plasticity. *1.00 - 1.70m:* Light brown.						14	1										
	1.70m: Silty fine to medium GRAVEL, minor sand; greyish brown. Wet. Gravel, sub-rounded to sub-angular; sand, coarse. *2.20 - 2.50m:* Silt becomes absent.						13	2							19/04/2023			
	2.5m: END OF BOREHOLE. Target depth.						12	3										
							11	4										
							10	5										

COMMENTS:

Hole Depth 2.5m

Scale 1:30

Rev.: A

BOREHOLE LOG

BOREHOLE No.: BH08-22

SHEET: 1 OF 3

Tonkin+Taylor

PROJECT: Maitahi
JOB No.: 1012397.1000.1000
LOCATION: Kaka Valley

CO-ORDINATES: 5431289 mN 1625856 mE (NZTM2000)
DIRECTION:
ANGLE FROM HORIZ.: -90°

R.L. GROUND: 16m
R.L. COLLAR:
DATUM: NZVD2016
SURVEY: Handheld GPS

DRILLED BY: Kortni
LOGGED BY: ABOT
CHECKED: SAPR
START DATE: 26/05/2022
FINISH DATE: 26/05/2022
CONTRACTOR: McMillan

GEOLOGICAL UNIT	MATERIAL DESCRIPTION (SOIL: Classification, colour, consistency / density, moisture, plasticity; ROCK: Weathering, colour, fabric, name, strength, cementation)
Top	*0.00m:* Sandy SILT, some rootlets; Dark Brown. Very loose to loose, moist, non-plastic. Sand, fine. (TOPSOIL).
Alluvial Deposits	*0.20m:* SILT, trace gravel; Light brown, mottled orange. Soft to firm, moist, non-plastic to low plasticity. Gravel, medium.
	0.90m: Gravelly SILT; light brown, mottled orange. Soft to firm, dry to moist, low plasticity. Gravel, fine to coarse, sub-rounded to sub-angular.
	1.20m: CORE loss no recovery
	1.40m: Sandy GRAVEL, some cobbles; Bluish grey. Dense, moist to wet.
	1.72m: CORE loss no recovery
	2.92m: Silty GRAVEL, some cobbles; light brown. Medium dense, wet to saturated.
	3.84m: CORE loss no recovery
	4.44m: SILT; Light bluish grey. Very soft to soft, wet, medium to high plasticity.

Rock Weathering: UW SW MW HW CW DW RS
Rock Strength: VS+ S MS M W VW EW
Sampling Method / Core Recovery (%): 0 0 0
Testing: 6/8// 11/12/10/6 N=39; 3/4// 3/4/10/12 N=29; 6/2// 2/1/0/1 N=4
RL (m): 15 14 13 12
Depth (m): 0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5
Graphic Log
ROCK MASS DISCONTINUITIES: Defect Log; Fracture Spacing (mm): 2000 600 200 60 20; RQD (%); Description & Additional Observations
Water Level / Fluid Loss (%): 25 50 75
Casing
Installation
Core Box No: Box 0.00-2.92m

COMMENTS:

Hole Depth 10.52m

Scale 1:25

Rev.: B

BOREHOLE LOG

BOREHOLE No.: BH08-22

SHEET: 2 OF 3

PROJECT: Maitahi
JOB No.: 1012397.1000.1000
LOCATION: Kaka Valley

CO-ORDINATES: 5431289 mN, 1625856 mE (NZTM2000)
DIRECTION:
ANGLE FROM HORIZ.: -90°

R.L. GROUND: 16m
R.L. COLLAR:
DATUM: NZVD2016
SURVEY: Handheld GPS

DRILLED BY: Kortni
LOGGED BY: ABOT
CHECKED: SAPR
START DATE: 26/05/2022
FINISH DATE: 26/05/2022
CONTRACTOR: McMillan

GEOLOGICAL UNIT	MATERIAL DESCRIPTION (SOIL: Classification, colour, consistency / density, moisture, plasticity; ROCK: Weathering, colour, fabric, name, strength, cementation)	Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m) / Depth (m)	Graphic Log	ROCK MASS DISCONTINUITIES: Defect Log / Fracture Spacing (mm) / RQD (%) / Description & Additional Observations	Water Level / Fluid Loss (%)	Casing	Installation	Core Box No
Alluvial Deposits	[CONT] *4.44m:* SILT; Light bluish grey. Very soft to soft, wet, medium to high plasticity.												
	5.04m: Silty sandy fine to coarse GRAVEL, some cobbles; light brown. Medium dense, wet to saturated. Sand, medium.												
	5.66m: Medium to coarse SAND, minor gravel; Light brown. Medium dense, wet to saturated.												
	6.36m: Silty fine to coarse GRAVEL, minor cobbles, trace sand; Light Brown. Dense to very dense, wet to saturated. Gravel, sub-rounded to sub-angular; sand, medium to coarse.				0	1/1// 2/4/4/6 N=16	10						Box 2.92-5.36m
					0	15/14// 14/19/17/10 N>=50	9 / 8 / 7						Box 5.36-7.48m
					0	55/5// N>=50							Box 7.48-9.32m

RL (m): 5.5, 6.0, 6.5, 7.0, 7.5, 8.0, 8.5, 9.0, 9.5
Depth (m): 10, 9, 8, 7

COMMENTS:

Hole Depth 10.52m

Scale 1:25

Rev.: B

TTNZ_20220309 - General Log - 29/02/2024 5:28:07 pm - Produced with Core-GS by GeRoc

BOREHOLE LOG

BOREHOLE No.: BH08-22

SHEET: 3 OF 3

Tonkin+Taylor

PROJECT: Maitahi
JOB No.: 1012397.1000.1000
LOCATION: Kaka Valley

CO-ORDINATES: 5431289 mN, 1625856 mE (NZTM2000)
DIRECTION:
ANGLE FROM HORIZ.: -90°

R.L. GROUND: 16m
R.L. COLLAR:
DATUM: NZVD2016
SURVEY: Handheld GPS

DRILLED BY: Kortni
LOGGED BY: ABOT
CHECKED: SAPR
START DATE: 26/05/2022
FINISH DATE: 26/05/2022
CONTRACTOR: McMillan

GEOLOGICAL UNIT	MATERIAL DESCRIPTION (SOIL: Classification, colour, consistency / density, moisture, plasticity; ROCK: Weathering, colour, fabric, name, strength, cementation)	Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m) / Depth (m)	Graphic Log	ROCK MASS DISCONTINUITIES: Defect Log	Fracture Spacing (mm)	RQD (%)	Description & Additional Observations	Water Level / Fluid Loss (%)	Casing	Installation	Core Box No
Alluvial Deposits	[CONT] *6.36m:* Silty fine to coarse GRAVEL, minor cobbles, trace sand; Light Brown. Dense to very dense, wet to saturated. Gravel, sub-rounded to sub-angular; sand, medium to coarse.						10.5									Box 9.32-10.52m
	10.52m: Target depth				0	40/20// N>=50	11.0									
							11.5									
							12.0									
							12.5									
							13.0									
							13.5									
							14.0									
							14.5									

COMMENTS:

Hole Depth 10.52m

Scale 1:25

Rev.: B

Tonkin+Taylor

CORE PHOTOS

BOREHOLE No.: **BH08-22**

PROJECT: Maitahi	LOCATION: Kaka Valley	JOB No.: 1012397.1000.1000
CO-ORDINATES: 5431289 mN (NZTM2000) 1625856 mE R.L.: 16m DATUM: NZVD2016	DRILL TYPE: Geoprobe 8140LS METHOD: Sonic core drilling	HOLE STARTED: 26/05/2022 HOLE FINISHED: 26/05/2022 DRILLED BY: McMillan LOGGED BY: ABOT CHECKED: SAPR

0.00-2.92m

2.92-5.36m

CORE PHOTOS

BOREHOLE No.: **BH08-22**

PROJECT: Maitahi	LOCATION: Kaka Valley	JOB No.: 1012397.1000.1000
CO-ORDINATES: 5431289 mN (NZTM2000) 1625856 mE R.L.: 16m DATUM: NZVD2016	DRILL TYPE: Geoprobe 8140LS METHOD: Sonic core drilling	HOLE STARTED: 26/05/2022 HOLE FINISHED: 26/05/2022 DRILLED BY: McMillan LOGGED BY: ABOT CHECKED: SAPR

5.36-7.48m

7.48-9.32m

Tonkin+Taylor

CORE PHOTOS

BOREHOLE No.: **BH08-22**

SHEET: 3 OF 3

PROJECT: Maitahi	LOCATION: Kaka Valley	JOB No.: 1012397.1000.1000
CO-ORDINATES: 5431289 mN (NZTM2000) 1625856 mE R.L.: 16m DATUM: NZVD2016	DRILL TYPE: Geoprobe 8140LS METHOD: Sonic core drilling	HOLE STARTED: 26/05/2022 HOLE FINISHED: 26/05/2022 DRILLED BY: McMillan LOGGED BY: ABOT CHECKED: SAPR

9.32-10.52m

BOREHOLE LOG

BOREHOLE No.: BH08-23

SHEET: 1 OF 1

PROJECT: Maitahi	CO-ORDINATES: 5431237.80 mN, 1625931.20 mE (NZTM2000)	R.L. GROUND: 16.70m
JOB No.: 1012397.1000.1000	DIRECTION:	R.L. COLLAR:
LOCATION: Kaka Valley	ANGLE FROM HORIZ.: -90°	DATUM: NZVD2016
		SURVEY: Handheld GPS
DRILLED BY: Dylan		
LOGGED BY: SIMV		
CHECKED: SCON		
START DATE: 19/04/2023		
FINISH DATE: 19/04/2023		
CONTRACTOR: CW Drilling		

GEOLOGICAL UNIT	DESCRIPTION OF CORE SOIL: Classification, colour, consistency / density, moisture, plasticity ROCK: Weathering, colour, fabric, name, strength, cementation	Rock Weathering (XW, SW, MW, HW, FW)	Rock Strength (ES, VS, S, MS, W, VW, EW)	Sampling Method	Core Recovery (%)	Testing	RL (m) / Depth (m)	Graphic Log	ROCK DEFECTS: Defect Log	Fracture Spacing (mm) (2000, 600, 200, 60, 20)	RQD (%)	Description & Additional Observations	Fluid Loss (%) (25, 50, 75)	Water Level	Casing	Installation	Core Box No
TSoil	*0.00m:* SILT; dark brown. Moist, low plasticity. (TOPSOIL).						16 / 0	TS									
Alluvial Deposits	*0.60m:* SILT, some clay; blackish brown. Moist, low plasticity. *0.70 - 0.90m:* Greyish brown. *0.90 - 2.20m:* Brown.						1										
	2.20m: SILT, some gravel, minor fibrous organics (rootlets); brownish bluish grey. Moist, low plasticity. Gravel, fine, sub-rounded to sub-angular.						15 / 2										
	2.40m: Fine to medium GRAVEL, some organics (rootlets) and some silt; grey. Wet. Gravel, sub-rounded to sub-angular. *2.60 - 2.90m:* Rootlets absent *2.90 - 4.50m:* Trace rootlets. *3.00 - 3.40m:* Minor silt. *3.40 - 4.00m:* Some silt. Wet. *4.00 - 4.50m:* Saturated.						14 / 3							19/04/2023			
	4.5m: END OF BOREHOLE. Target depth.						13 / 4										
							12 / 5										
							11										

COMMENTS:

Hole Depth 4.5m

Scale 1:30

Rev.: A

BOREHOLE LOG

Tonkin+Taylor

BOREHOLE No.: BH09-22

SHEET: 1 OF 3

PROJECT: Maitahi
JOB No.: 1012397.1000.1000
LOCATION: Kaka Valley

CO-ORDINATES: 5431223 mN, 1625935 mE (NZTM2000)
DIRECTION:
ANGLE FROM HORIZ.: -90°

R.L. GROUND: 16m
R.L. COLLAR:
DATUM: NZVD2016
SURVEY: Handheld GPS

DRILLED BY: Paul
LOGGED BY: ABOT
CHECKED: SAPR
START DATE: 31/05/2022
FINISH DATE: 31/05/2022
CONTRACTOR: McMillan

GEOLOGICAL UNIT	MATERIAL DESCRIPTION (SOIL: Classification, colour, consistency / density, moisture, plasticity; ROCK: Weathering, colour, fabric, name, strength, cementation)	Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK MASS DISCONTINUITIES: Defect Log	Fracture Spacing (mm)	RQD (%)	Description & Additional Observations	Water Level / Fluid Loss (%)	Casing	Installation	Core Box No
TSoil	*0.00m:* SILT, some rootlets and some sand; Dark Brown. Soft to firm, moist, non-plastic. (TOPSOIL).																
Alluvial Deposits	*0.40m:* SILT, minor sand; light brown, mottled orange. Soft to firm, moist, low plasticity. Sand, fine to medium.			RC	100			0.5									
	1.10m: Gravelly SILT, trace cobbles; light brown. Medium dense, wet, low plasticity. Gravel, fine to coarse, rounded to sub-angular.						15	1.0									
	1.40m: Gravelly SILT; light brown. Medium dense, wet, non-plastic. Gravel, fine to coarse. Fines potentially washed out during drilling process.				0	4/2// 4/3/3/5 N=15 Solid Cone		1.5									Box 0.00-1.70m
	2.05m: Silty fine to coarse GRAVEL; light brown. Medium dense, wet. Gravel, sub-rounded to sub-angular.			RC	100		14	2.0									
	2.92m: Gravelly SILT; light brown. Dense, wet to saturated, low to medium plasticity. Gravel, fine to coarse, sub-rounded to sub-angular.				0	14/11// 16/11/9/8 N=44 Solid Cone	13	3.0									
	3.32m: Gravelly SILT; light brown. Very dense, wet to saturated. Gravel, fine to coarse, sub-rounded to sub-angular.			RC	100			3.5									Box 1.70-3.82m
	4.40m: Fine to coarse GRAVEL, some cobbles. Very dense, wet. Gravel, sub-rounded to sub-angular.				0	4/10// 20/10/13/11 N>=50 Solid Cone	12	4.0									
	4.74m: Gravelly SILT; Light brown. Very dense, wet to saturated. Gravel, fine to coarse, sub-rounded to sub-angular.							4.5									

COMMENTS:

Hole Depth 10.6m

Scale 1:25

Rev.: B

TTNZ_20220309 - General Log - 29/02/2024 5:28:16 pm - Produced with Core-GS by GeRoc

BOREHOLE LOG

Tonkin+Taylor

BOREHOLE No.: BH09-22

SHEET: 2 OF 3

PROJECT: Maitahi
JOB No.: 1012397.1000.1000
LOCATION: Kaka Valley

CO-ORDINATES: 5431223 mN, 1625935 mE (NZTM2000)
DIRECTION:
ANGLE FROM HORIZ.: -90°

R.L. GROUND: 16m
R.L. COLLAR:
DATUM: NZVD2016
SURVEY: Handheld GPS

DRILLED BY: Paul
LOGGED BY: ABOT
CHECKED: SAPR
START DATE: 31/05/2022
FINISH DATE: 31/05/2022
CONTRACTOR: McMillan

GEOLOGICAL UNIT	MATERIAL DESCRIPTION (SOIL: Classification, colour, consistency / density, moisture, plasticity; ROCK: Weathering, colour, fabric, name, strength, cementation)	Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m) / Depth (m)	Graphic Log	ROCK MASS DISCONTINUITIES: Defect Log / Fracture Spacing (mm) / RQD (%) / Description & Additional Observations	Water Level / Fluid Loss (%)	Casing	Installation	Core Box No
Alluvial Deposits	[CONT] *4.74m:* Gravelly SILT; Light brown. Very dense, wet to saturated. Gravel, fine to coarse, sub-rounded to sub-angular.												
	5.04m: SILT, some gravel; Light bluish grey. Soft to firm, wet, medium plasticity. Gravel, fine to medium.												
	5.66m: Gravelly SILT, trace sand; Light bluish grey. Soft to firm, wet, low to medium plasticity. Gravel, fine to medium; sand, fine to medium.												
	5.96m: Gravelly medium to coarse SAND; Light brown. Medium dense, wet to saturated. Gravel, medium to coarse, sub-rounded to sub-angular. Some sands have liquefied during transportation of core.				0	3/3// 3/4/3/5 N=15 Solid Cone	10 / 6.0						
	6.26m: Silty fine to coarse GRAVEL, some cobbles; Light brown. Medium dense to dense, wet to saturated. Gravel, sub-rounded to sub-angular.			RC	100		9 / 7.0						Box 3.82-5.96m
	8.38 - 8.58m: Less fines present more cobbles present				0	14/9// 10/8/7/14 N=39 Solid Cone	8 / 8.0						Box 5.96-7.78m
				RC	100								
Alluvial Deposits	*9.00m:* Core loss no recovery				0	6/6// 7/6/5/6 N=24 Solid Cone	7 / 9.0						
	9.60m: Silty fine to coarse GRAVEL, some cobbles; Light brown. Dense to very dense, wet to saturated. Gravel, sub-rounded to sub-angular.												

COMMENTS:

Hole Depth 10.6m

Scale 1:25

Rev.: B

TTNZ_20220309 - General Log - 29/02/2024 5:28:17 pm - Produced with Core-GS by GeRoc

BOREHOLE LOG

BOREHOLE No.: BH09-22

SHEET: 3 OF 3

PROJECT: Maitahi
JOB No.: 1012397.1000.1000
LOCATION: Kaka Valley

CO-ORDINATES: 5431223 mN, 1625935 mE (NZTM2000)
DIRECTION:
ANGLE FROM HORIZ.: -90°

R.L. GROUND: 16m
R.L. COLLAR:
DATUM: NZVD2016
SURVEY: Handheld GPS

DRILLED BY: Paul
LOGGED BY: ABOT
CHECKED: SAPR
START DATE: 31/05/2022
FINISH DATE: 31/05/2022
CONTRACTOR: McMillan

GEOLOGICAL UNIT	MATERIAL DESCRIPTION (SOIL: Classification, colour, consistency / density, moisture, plasticity; ROCK: Weathering, colour, fabric, name, strength, cementation)	Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m) / Depth (m)	Graphic Log	ROCK MASS DISCONTINUITIES: Defect Log	Fracture Spacing (mm)	RQD (%)	Description & Additional Observations	Water Level / Fluid Loss (%)	Casing	Installation	Core Box No
Alluvial Deposits	[CONT] *9.60m:* Silty fine to coarse GRAVEL, some cobbles; Light brown. Dense to very dense, wet to saturated. Gravel, sub-rounded to sub-angular.						10.5									Box 7.78-10.60m
	10.6m: Target depth				0	35/15// 34/20/6 for 0 mm N>=50 Solid Cone	11.0									
							11.5									
							12.0									
							12.5									
							13.0									
							13.5									
							14.0									
							14.5									

COMMENTS:

Hole Depth 10.6m

Scale 1:25

Rev.: B

TTNZ_20220309 - General Log - 29/02/2024 5:28:17 pm - Produced with Core-GS by GeRoc

Tonkin+Taylor

CORE PHOTOS

BOREHOLE No.: **BH09-22**

PROJECT: Maitahi	LOCATION: Kaka Valley	JOB No.: 1012397.1000.1000
CO-ORDINATES: 5431223 mN (NZTM2000) 1625935 mE R.L.: 16m DATUM: NZVD2016	DRILL TYPE: Geoprobe 8140LS METHOD: Sonic core drilling	HOLE STARTED: 31/05/2022 HOLE FINISHED: 31/05/2022 DRILLED BY: McMillan LOGGED BY: ABOT CHECKED: SAPR

0.00-1.70m

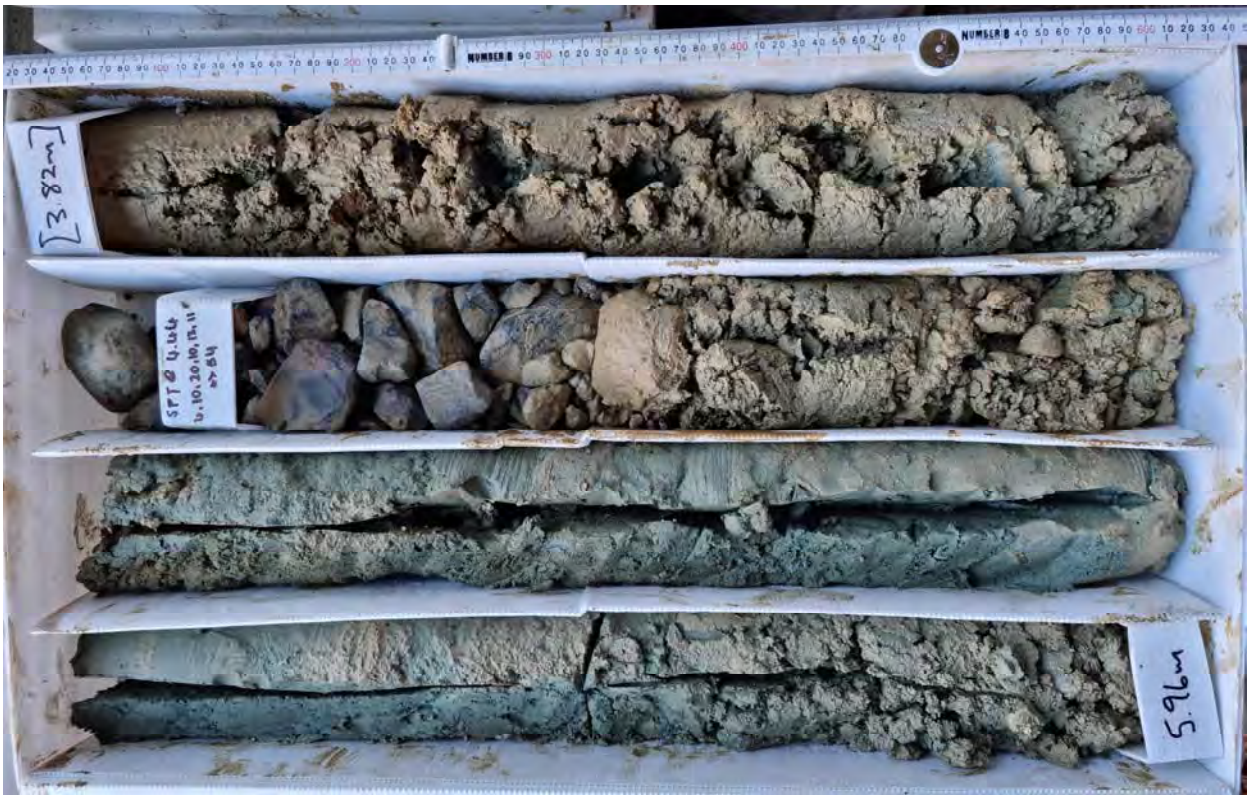
1.70-3.82m

Tonkin+Taylor

CORE PHOTOS

BOREHOLE No.: **BH09-22**

PROJECT: Maitahi	LOCATION: Kaka Valley	JOB No.: 1012397.1000.1000
CO-ORDINATES: 5431223 mN (NZTM2000) 1625935 mE R.L.: 16m DATUM: NZVD2016	DRILL TYPE: Geoprobe 8140LS METHOD: Sonic core drilling	HOLE STARTED: 31/05/2022 HOLE FINISHED: 31/05/2022 DRILLED BY: McMillan LOGGED BY: ABOT CHECKED: SAPR



3.82-5.96m

5.96-7.78m

CORE PHOTOS

BOREHOLE No.: **BH09-22**

SHEET: 3 OF 3

PROJECT: Maitahi	LOCATION: Kaka Valley	JOB No.: 1012397.1000.1000
CO-ORDINATES: 5431223 mN (NZTM2000) 1625935 mE R.L.: 16m DATUM: NZVD2016	DRILL TYPE: Geoprobe 8140LS METHOD: Sonic core drilling	HOLE STARTED: 31/05/2022 HOLE FINISHED: 31/05/2022 DRILLED BY: McMillan LOGGED BY: ABOT CHECKED: SAPR

7.78-10.60m

BOREHOLE LOG

BOREHOLE No.: BH09-23

SHEET: 1 OF 1

PROJECT: Maitahi	CO-ORDINATES: 5431144.50 mN, 1626023.40 mE (NZTM2000)	R.L. GROUND: 16.70m
JOB No.: 1012397.1000.1000	DIRECTION:	R.L. COLLAR:
LOCATION: Kaka Valley	ANGLE FROM HORIZ.: -90°	DATUM: NZVD2016
		SURVEY: Handheld GPS

DRILLED BY: Dylan
LOGGED BY: SIMV
CHECKED: SCON
START DATE: 19/04/2023
FINISH DATE: 19/04/2023
CONTRACTOR: CW Drilling

GEOLOGICAL UNIT	DESCRIPTION OF CORE (SOIL: Classification, colour, consistency / density, moisture, plasticity; ROCK: Weathering, colour, fabric, name, strength, cementation)	Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m) / Depth (m)	Graphic Log	ROCK DEFECTS: Defect Log	Fracture Spacing (mm)	RQD (%)	Description & Additional Observations	Fluid Loss (%)	Water Level	Casing	Installation	Core Box No
TSoil	*0.00m:* SILT, some organics; brown. Moist, low plasticity.																
Alluvial Deposits	*0.60m:* Sandy SILT, some gravel; light brown. Dry, non-plastic. Sand, coarse; gravel, fine.																
	0.80m: Gravelly fine to coarse SAND, some silt; brownish grey. Dry. Gravel, fine to medium, sub-rounded to sub-angular.																
	1.50m: Sandy fine to medium GRAVEL; grey. Moist. Gravel, sub-rounded; sand, fine to coarse.																
	2.00 - 2.20m: Some sand. Sand, coarse.																
	2.20 - 2.30m: Minor sand. Wet. Sand, coarse.																
	2.30 - 2.50m: Saturated.													19/04/2023			Box 1, 0.00-2.50m
	2.5m: END OF BOREHOLE. Target depth.																

COMMENTS:

Hole Depth 2.5m

Scale 1:30

Rev.: A

CORE PHOTOS

BOREHOLE No.: **BH09-23**

SHEET: 1 OF 1

PROJECT: Maitahi	LOCATION: Kaka Valley	JOB No.: 1012397.1000.1000
CO-ORDINATES: 5431144.50 mN (NZTM2000) 1626023.40 mE R.L.: 16.70m DATUM: NZVD2016	DRILL TYPE: Concentric DRILL METHOD: PR	HOLE STARTED: 19/04/2023 HOLE FINISHED: 19/04/2023 DRILLED BY: CW Drilling LOGGED BY: SIMV CHECKED: SCON

0.00-2.50m

EXCAVATION LOG

Excavation Id.: **DTP01-22**

SHEET: 1 OF 1

PROJECT: Maitahi	LOCATION: Kaka Valley		JOB No.: 1012397.1000.1000
CO-ORDINATES: 5431087.73 mN (NZTM2000) 1626029.15 mE	EXPOSURE METHOD: TP	EXCAV. STARTED: 15/02/2022	
	EQUIPMENT: 20T Excavator	EXCAV. FINISHED: 15/02/2022	
R.L.: 16.00m	OPERATOR: Bill	LOGGED BY: AMHO	
DATUM: NZVD2016	DIMENSIONS: 4m by 1.5m	CHECKED BY: SCON	

EXCAVATION TESTS | ENGINEERING DESCRIPTION | GEOLOGICAL

PENETRATION	SUPPORT	WATER	SAMPLES, TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	SOIL NAME, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, SECONDARY AND MINOR COMPONENTS	MOISTURE / WEATHERING CONDITION	STRENGTH/DENSITY CLASSIFICATION	ESTIMATED SHEAR STRENGTH (kPa)	DEFECTS, STRUCTURE, COMMENTS	UNIT
1 2 3											10 25 50 100 200		
		15/02/2022			15	1	TS	*0.00m:* SILT, some sand, minor clay, trace organics; dark brown. Stiff, moist, non-plastic. Sand, fine; organics, rootlets. (TOPSOIL).	M	St			TSoil
								0.35m: Sandy SILT; brown. Stiff, moist, non-plastic. Sand, fine.		D			
								0.65m: Fine to medium SAND, minor silt; brown. Dense, moist, poorly graded.		MD			
								0.75m: Silty fine SAND, trace clay; brown. Medium dense, moist, poorly graded.		St			
								0.85m: SILT, some clay, trace organics; brown. Stiff, moist, low plasticity. Organics, carbonaceous material.	W	MD			
					14	2		*1.30m:* Sandy fine to coarse GRAVEL, some cobbles, trace silt; brown. Medium dense, wet, well graded. Gravel, rounded; sand, fine to coarse; cobbles, up to 100mm, rounded.	S				
	Pit walls unstable				13	3		*2.00m:* Gravelly COBBLES, some boulders, minor sand, trace silt; brown. "Medium dense", saturated, well graded. Cobbles, up to 100mm, rounded to sub-rounded; gravel, fine to coarse, rounded; boulders, up to 350mm, rounded to sub-rounded; sand, fine to coarse.					Alluvial Deposits
					12	4							
					11	5							
								5.7m: END OF INVESTIGATION					

SKETCH / PHOTO:

COMMENTS:

Hole Depth 5.7m

Scale 1:50

Rev.: A

Tonkin+Taylor

EXCAVATION LOG

Excavation Id.: **DTP02-22**

SHEET: 1 OF 1

PROJECT: Maitahi		LOCATION: Kaka Valley	JOB No.: 1012397.1000.1000
CO-ORDINATES: (NZTM2000)	5431221.29 mN 1625901.96 mE	EXPOSURE METHOD: TP	EXCAV. STARTED: 15/02/2022
		EQUIPMENT: 20T Excavator	EXCAV. FINISHED: 15/02/2022
R.L.:	16.00m	OPERATOR: Bill	LOGGED BY: AMHO
DATUM:	NZVD2016	DIMENSIONS: 4m by 1.5m	CHECKED BY: SCON

EXCAVATION TESTS | ENGINEERING DESCRIPTION | GEOLOGICAL

PENETRATION	SUPPORT	WATER	SAMPLES, TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	SOIL NAME, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, SECONDARY AND MINOR COMPONENTS	MOISTURE / WEATHERING CONDITION	STRENGTH/DENSITY CLASSIFICATION	ESTIMATED SHEAR STRENGTH (kPa)	DEFECTS, STRUCTURE, COMMENTS	UNIT
1 2 3											10 25 50 100 200		
	Pit walls unstable	15/02/2022			15	1	TS	*0.00m:* SILT, some sand, minor clay; dark brown. Stiff, moist, non-plastic. Sand, fine. (TOPSOIL).	M	St			TSoil
								0.40m: SILT, some clay; grey mottled orange. Very stiff, moist, medium plasticity.		VSt			Alluvial Deposits
								1.10m: Sandy SILT, some clay; brown. Very stiff, moist, low plasticity. Sand, fine.					
								1.40m: Fine to medium SAND; brown. Medium dense, moist.		MD			
					14	2		*1.60m:* Silty fine to medium SAND, minor clay; brown. Medium dense, moist, non-plastic.					
								2.00m: COBBLES, some gravel and some boulders, minor silt. "Medium dense", saturated. Cobbles, up to 200mm, rounded to sub-rounded; gravel, fine to coarse, rounded to sub-rounded; boulders, up to 400mm, rounded to sub-rounded.	S				
					13	3							
					12	4							
								4.5m: END OF INVESTIGATION					
					11	5							

SKETCH / PHOTO:

COMMENTS:

Hole Depth 4.5m

Scale 1:50

Rev.: A

EXCAVATION LOG

Excavation Id.: **DTP03-22**

SHEET: 1 OF 1

PROJECT: Maitahi	LOCATION: Kaka Valley	JOB No.: 1012397.1000.1000
CO-ORDINATES: 5431200.30 mN (NZTM2000) 1626012.49 mE	EXPOSURE METHOD: TP	EXCAV. STARTED: 15/02/2022
	EQUIPMENT: 20T Excavator	EXCAV. FINISHED: 15/02/2022
R.L.: 16.00m	OPERATOR: Bill	LOGGED BY: AMHO
DATUM: NZVD2016	DIMENSIONS: 3m by 1.2m	CHECKED BY: SCON

EXCAVATION TESTS | ENGINEERING DESCRIPTION | GEOLOGICAL

PENETRATION	SUPPORT	WATER	SAMPLES, TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	SOIL NAME, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, SECONDARY AND MINOR COMPONENTS	MOISTURE / WEATHERING CONDITION	STRENGTH/DENSITY CLASSIFICATION	ESTIMATED SHEAR STRENGTH (kPa)	DEFECTS, STRUCTURE, COMMENTS	UNIT
	Pit walls unstable	15/02/2022 ▼	deepTP03 @ 4.00m		15	1		*0.00m:* Clayey SILT, some sand; dark brown. Stiff, moist, low plasticity. Sand, fine. (TOPSOIL).	M	St			Top
								0.25m: Silty CLAY; greyish brown. Stiff, moist, high plasticity.					
								0.45 - 0.65m: CLAY; grey mottled red. Firm, high plasticity.					
								0.70m: SILT, some sand, minor clay; grey. Soft, moist, low plasticity.	W	S			
								0.80m: Clayey SILT; grey. Soft, wet, high plasticity.		MD			
								1.00m: Fine to medium SAND; grey. "Medium dense", wet, poorly graded.					
								1.45m: Silty CLAY; bluish grey. Firm, wet, high plasticity, sensitive.		F			
					14	2		*2.00m:* Gravelly COBBLES, some boulders, minor sand, trace organics; grey. "Medium dense", wet. Cobbles, up to 200mm, rounded to sub-rounded; gravel, fine to coarse; boulders, up to 350mm, rounded to sub-rounded; sand, fine to coarse; organics, branches.		MD			Alluvial Deposits
					13	3							
					12	4		*4.00m:* Sandy SILT, some clay, trace organics; greyish blue. Firm, wet, low plasticity, sensitive. Organics, branches.		F			
										MD			
								4.25m: Gravelly COBBLES, some boulders, minor sand, trace organics; grey. "Medium dense", wet. Cobbles, up to 200mm, rounded to sub-rounded; gravel, fine to coarse; boulders, up to 350mm, rounded to sub-rounded; sand, fine to coarse; organics, branches.					
					11	5		4.6m: END OF INVESTIGATION					

SKETCH / PHOTO:

COMMENTS:

Hole Depth 4.6m

Scale 1:50

Rev.: A

EXCAVATION LOG

Excavation Id.: **DTP04-22**

SHEET: 1 OF 1

PROJECT: Maitahi	LOCATION: Kaka Valley	JOB No.: 1012397.1000.1000
CO-ORDINATES: 5431341.43 mN (NZTM2000) 1625975.88 mE	EXPOSURE METHOD: TP	EXCAV. STARTED: 15/02/2022
	EQUIPMENT: 20T Excavator	EXCAV. FINISHED: 15/02/2022
R.L.: 16.00m	OPERATOR: Bill	LOGGED BY: AMHO
DATUM: NZVD2016	DIMENSIONS: 4m by 1.5m	CHECKED BY: SCON

EXCAVATION TESTS | ENGINEERING DESCRIPTION | GEOLOGICAL

PENETRATION	SUPPORT	WATER	SAMPLES, TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	SOIL NAME, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, SECONDARY AND MINOR COMPONENTS	MOISTURE / WEATHERING CONDITION	STRENGTH/DENSITY CLASSIFICATION	ESTIMATED SHEAR STRENGTH (kPa)	DEFECTS, STRUCTURE, COMMENTS	UNIT
1 2 3											10 25 50 100 200		
	Pit walls unstable	15/02/2022	DeepTP04 @ 4.40m		15 14 13 12 11	1 2 3 4 5		*0.00m:* Sandy SILT, minor clay; dark brown. Stiff, moist, low plasticity. (TOPSOIL). *0.20m:* Sandy fine to coarse GRAVEL, some cobbles; brown. Tightly packed, moist. Gravel, rounded to sub-rounded; sand, fine to coarse; cobbles, up to 100mm, rounded to sub-rounded. *0.45m:* SILT, some sand, minor clay; dark brown. Firm, moist, low plasticity. *0.65m:* Fine to coarse SAND, some gravel, minor silt; brown. "Dense", moist. Gravel, fine to coarse. *0.85m:* SILT, some sand, minor clay, trace organics; dark brown. Firm, wet, non-plastic. *1.05m:* Sandy fine to coarse GRAVEL, minor cobbles; light brown. Tightly packed, wet. Gravel, sub-rounded to sub-angular; sand, fine to coarse; cobbles, up to 200mm, sub-rounded to sub-angular. *1.20 - 4.20m:* Saturated. *4.20m:* Silty CLAY, trace organics; bluish grey. Firm, moist, high plasticity. Organics, branches. *4.80m:* Sandy fine to coarse GRAVEL, some cobbles, minor silt, trace boulders; bluish grey. "Loose", saturated, well graded. Gravel, rounded to sub-angular; sand, fine to coarse; cobbles, up to 200mm, sub-rounded to sub-angular; boulders, up to 350mm, sub-rounded. 5.2m: END OF INVESTIGATION	M W S M S	St F D F L			Top Alluvial Deposits

SKETCH / PHOTO:

COMMENTS:

Hole Depth 5.2m

Scale 1:50

Rev.: A

EXCAVATION LOG

Excavation Id.: **DTP05-22**

SHEET: 1 OF 1

PROJECT: Maitahi	LOCATION: Kaka Valley	JOB No.: 1012397.1000.1000

CO-ORDINATES: (NZTM2000)	5431153.87 mN 1625911.50 mE	EXPOSURE METHOD:	TP	EXCAV. STARTED:	15/02/2022
		EQUIPMENT:	20T Excavator	EXCAV. FINISHED:	15/02/2022
R.L.:	16.00m	OPERATOR:	Bill	LOGGED BY:	AMHO
DATUM:	NZVD2016	DIMENSIONS:	3m by 1.5m	CHECKED BY:	SCON

EXCAVATION TESTS | ENGINEERING DESCRIPTION | GEOLOGICAL

PENETRATION (1 2 3)	SUPPORT	WATER	SAMPLES, TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	SOIL NAME, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, SECONDARY AND MINOR COMPONENTS	MOISTURE / WEATHERING CONDITION	STRENGTH/DENSITY CLASSIFICATION	ESTIMATED SHEAR STRENGTH (kPa) (10 25 50 100 200)	DEFECTS, STRUCTURE, COMMENTS	UNIT
	Pit walls unstable	15/02/2022			15	1	TS	*0.00m:* SILT, some sand, trace [set a composition]; dark brown. Stiff, moist. Sand, fine; organics, rootlets. [TOPSOIL]. *0.30m:* Sandy SILT, minor clay; dark brown. Stiff, moist, low plasticity. *0.65m:* Clayey SILT, minor organics; light greyish brown. Firm, moist, medium plasticity, insensitive. *0.70m:* Silty fine to coarse SAND, some gravel, minor clay; brown. "Dense", moist, well graded. Gravel, fine to medium, rounded to sub-rounded. *0.90m:* Sandy fine to coarse GRAVEL, some silt; brown. "Medium dense", moist, well graded. Gravel, rounded to sub-rounded; sand, fine to coarse.	M	St D MD			Top Alluvial Deposits
					14	2		*1.20m:* Sandy fine to coarse GRAVEL, some cobbles; brown. "Medium dense", moist, well graded. Gravel, rounded to sub-rounded; sand, fine to coarse; cobbles, up to 150mm, rounded to sub-angular.	S				
					13	3		*1.50m:* Gravelly COBBLES, some boulders; brown. "Medium dense", moist, well graded. Cobbles, up to 200mm, rounded to sub-angular; gravel, fine to coarse, rounded to sub-rounded; boulders, up to 350mm, rounded to sub-angular. *1.80m:* Gravelly COBBLES, some boulders; brown. "Medium dense", saturated, well graded. Cobbles, up to 200mm, rounded to sub-angular; gravel, fine to coarse, rounded to sub-rounded; boulders, up to 350mm, rounded to sub-angular.					
					12	4		*4.00m:* Sandy fine to medium GRAVEL; brown. "Medium dense", saturated, well graded. Gravel, rounded to sub-rounded; sand, fine to coarse. *4.20m:* Gravelly COBBLES, some boulders; brown. "Medium dense", saturated, well graded. Cobbles, up to 200mm, rounded to sub-angular; gravel, fine to coarse, rounded to sub-rounded; boulders, up to 350mm, rounded to sub-angular.					
					11	5		*4.90m:* Gravelly SILT, some sand; light brown. Stiff, non-plastic. Gravel, fine to coarse, rounded to sub-rounded; sand, fine to coarse. 5m: END OF INVESTIGATION		St			

SKETCH / PHOTO:

COMMENTS:

Hole Depth 5m

Scale 1:50

Rev.: A

EXCAVATION LOG

Excavation Id.: **TP02-22**

SHEET: 1 OF 1

PROJECT: Maitahi	LOCATION: Kaka Valley		JOB No.: 1012397.1000.1000
CO-ORDINATES: (NZTM2000) 5431366 mN 1626084 mE	METHOD: Trial pit/trench	EXCAV. STARTED: 15/02/2022	
	EQUIPMENT: 20T Excavator	EXCAV. FINISHED: 15/02/2022	
R.L.: 30m	OPERATOR: Bill	LOGGED BY: AMHO	
DATUM: NZVD2016	DIMENSIONS: 3.5m by 1.2m	CHECKED BY: SCON	

EXCAVATION TESTS | ENGINEERING DESCRIPTION | GEOLOGICAL

PENETRATION	SUPPORT	WATER	SAMPLES, TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	SOIL NAME, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, SECONDARY AND MINOR COMPONENTS	WEATHERING CLASSIFICATION	MOISTURE CLASSIFICATION	CONSISTENCY / DENSITY CLASSIFICATION	ESTIMATED SOIL SHEAR STRENGTH (Su, kPa)	DEFECTS, STRUCTURE, COMMENTS	UNIT
1 2 3	Pit walls stable	15/02/2022			29 28 27 26 25 24	0 1 2 3 4 5	T S	*0.00m:* Clayey SILT; dark brown. Stiff, moist, low plasticity. (TOPSOIL). *0.30m:* Silty CLAY; reddish brown. Firm, moist, high plasticity, sensitive. *0.70m:* Clayey SILT, trace organics; bluish grey. Stiff, moist, high plasticity. Organics, branches. *1.90m:* Sandy fine to coarse GRAVEL, some cobbles, minor silt; light brown. Dense, moist, well graded. Gravel, sub-rounded to sub-angular; sand, fine to coarse; cobbles, up to 100mm, sub-rounded to sub-angular. *4.80m:* Silty fine to coarse GRAVEL, some clay, minor cobbles; light bluish grey. "Dense", moist. Gravel, sub-angular to angular; cobbles, up to 200mm, angular. 5.1m: END OF INVESTIGATION		M	St F St D 'D'	VS 12 S 25 F 50 St 100 VSt 200 H		Top Alluvial Deposits Fan Deposits

SKETCH / PHOTO:

COMMENTS:

Hole Depth 5.1m

Scale 1:50

Rev.: A

EXCAVATION LOG

Excavation Id.: **TP03-22**

SHEET: 1 OF 1

Tonkin+Taylor

PROJECT: Maitahi	LOCATION: Kaka Valley		JOB No.: 1012397.1000.1000
CO-ORDINATES: (NZTM2000) 5431228 mN 1626273 mE	METHOD: Trial pit/trench	EXCAV. STARTED: 17/02/2022	
	EQUIPMENT: 20T Excavator	EXCAV. FINISHED: 17/02/2022	
R.L.: 49m	OPERATOR: Bill	LOGGED BY: AMHO	
DATUM: NZVD2016	DIMENSIONS: 3m by 1m	CHECKED BY: SCON	

EXCAVATION TESTS | ENGINEERING DESCRIPTION | GEOLOGICAL

PENETRATION	SUPPORT	WATER	SAMPLES, TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	SOIL NAME, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, SECONDARY AND MINOR COMPONENTS	WEATHERING CLASSIFICATION	MOISTURE CLASSIFICATION	CONSISTENCY / DENSITY CLASSIFICATION	ESTIMATED SOIL SHEAR STRENGTH (Su, kPa)	DEFECTS, STRUCTURE, COMMENTS	UNIT
1 2 3	Pit walls stable	17/02/2022			48 47 46 45 44 43	1 2 3 4 5	TS	*0.00m:* SILT, minor clay, trace rootlets and trace gravel; dark brown. Firm, moist, low plasticity. Gravel, medium to coarse, sub-angular to angular. (TOPSOIL). *0.20m:* SILT, some clay, trace gravel; orangish brown. Stiff, moist, low plasticity. Gravel, coarse, angular. *0.30m:* SILT, some clay, trace organics (decomposed) and trace gravel; dark brown. Stiff, moist, low plasticity. Gravel, fine, angular. (BURIED TOPSOIL). *0.60m:* Gravelly SILT, some sand, minor clay. Soft, wet, non-plastic. Gravel, fine to medium, angular; sand, fine to coarse. (RESIDUAL SOIL). *1.20m:* Completely weathered, brown, SANDSTONE. Extremely weak. Recovered as: Gravelly SILT, some sand and some cobbles, trace clay. Firm, moist, non-plastic. Gravel, fine to coarse, angular; sand, fine to coarse; cobbles, up to 150mm, angular. *1.50m:* Highly weathered, brown, SANDSTONE. Extremely weak. Recovered as: Silty GRAVEL, some sand and some cobbles; brown. "Dense", moist. Cobbles, up to 150mm. *2.10m:* Moderately weathered, brown, SANDSTONE. Moderately strong. Recovered as: Cobbly fine to coarse GRAVEL, some sand, minor silt; brown. "Dense", moist. Sand, coarse. 3.1m: END OF INVESTIGATION	CW HW MW	M W	F St S EW MS	VS S F St M S H 12 25 50 100 200 400		Top Colluvium Grampian Formation

SKETCH / PHOTO:

COMMENTS:

Hole Depth 3.1m

Scale 1:50

Rev.: A

EXCAVATION LOG

Excavation Id.: **TP05-22**

SHEET: 1 OF 1

PROJECT: Maitahi		LOCATION: Kaka Valley		JOB No.: 1012397.1000.1000	
CO-ORDINATES: (NZTM2000)	5431490 mN 1625383 mE	METHOD:	Trial pit/trench	EXCAV. STARTED:	22/02/2022
		EQUIPMENT:	20T Excavator	EXCAV. FINISHED:	22/02/2022
R.L.:	132m	OPERATOR:	Bill	LOGGED BY:	AMHO
DATUM:	NZVD2016	DIMENSIONS:	4m by 0.8m	CHECKED BY:	SCON

EXCAVATION TESTS | ENGINEERING DESCRIPTION | GEOLOGICAL

PENETRATION	SUPPORT	WATER	SAMPLES, TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	SOIL NAME, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, SECONDARY AND MINOR COMPONENTS	WEATHERING CLASSIFICATION	MOISTURE CLASSIFICATION	CONSISTENCY / DENSITY CLASSIFICATION	ESTIMATED SOIL SHEAR STRENGTH (Su, kPa)	DEFECTS, STRUCTURE, COMMENTS	UNIT
1 2 3					132	0	TS	*0.00m:* Sandy SILT, some gravel; dark brown. Stiff, moist, non-plastic. Sand, fine to coarse; gravel, fine to medium, sub-angular to angular. (TOPSOIL).		M	St	VS 12 S 25 F 50 St 100 VSt 200 H		Top
									CW		EW			
					131	1		*0.30m:* Completely weathered, light brown, tuffaceous BRECCIA. Extremely weak. Recovered as: Sandy SILT, some gravel. Stiff, moist, non-plastic. Sand, fine to coarse; gravel, fine to coarse, sub-angular to angular.						
					130	2		*2.00m:* Completely weathered, light brown, tuffaceous BRECCIA. Extremely weak. Recovered as: SILT, some gravel, minor clay. Stiff, moist, low plasticity. Gravel, fine to medium, sub-angular to angular.						
					129	3								
	Pit walls stable				128	4		*4.10m:* Highly weathered, light brown, tuffaceous BRECCIA. Extremely weak. Recovered as: Sandy SILT, some gravel, minor cobbles and minor boulders. Stiff, moist, low plasticity. Sand, fine to coarse; gravel, fine to coarse, sub-angular to angular; cobbles, up to 200mm; boulders, up to 350mm.	HW					
		22/02/2022			127	5		5.7m: END OF INVESTIGATION						Botanical Hill Formation

SKETCH / PHOTO:

COMMENTS:

Hole Depth 5.7m

Scale 1:50

Rev.: A

EXCAVATION LOG

Excavation Id.: **TP06-22**

SHEET: 1 OF 1

PROJECT: Maitahi	LOCATION: Kaka Valley		JOB No.: 1012397.1000.1000
CO-ORDINATES: (NZTM2000) 5431547 mN 1625474 mE	METHOD: Trial pit/trench	EXCAV. STARTED: 22/02/2022	
	EQUIPMENT: 20T Excavator	EXCAV. FINISHED: 22/02/2022	
R.L.: 118m	OPERATOR: Bill	LOGGED BY: AMHO	
DATUM: NZVD2016	DIMENSIONS: 3.5m by 0.8m	CHECKED BY: SCON	

EXCAVATION TESTS | ENGINEERING DESCRIPTION | GEOLOGICAL

PENETRATION	SUPPORT	WATER	SAMPLES, TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	SOIL NAME, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, SECONDARY AND MINOR COMPONENTS	WEATHERING CLASSIFICATION	MOISTURE CLASSIFICATION	CONSISTENCY / DENSITY CLASSIFICATION	ESTIMATED SOIL SHEAR STRENGTH (Su, kPa)	DEFECTS, STRUCTURE, COMMENTS	UNIT
1 2 3	Pit walls stable	DRY 22/02/2022			117 116 115 114 113	1 2 3 4 5	TS T	*0.00m:* SILT, some sand, trace rootlets and trace clay; dark brown. Stiff, moist, non-plastic. Sand, fine. (TOPSOIL). *0.30m:* SILT, some gravel, minor sand, trace clay; light brown. Stiff, moist, non-plastic. (RESIDUAL SOIL). *0.70m:* Highly weathered, light brown, heavily jointed, tuffaceous BRECCIA. Moderately strong. Recovered as: Silty fine to coarse GRAVEL, some sand, minor cobbles, trace clay; light brown. Medium dense, dry. Cobbles, up to 100mm. *2.80m:* Moderately weathered, light brown, heavily jointed, tuffaceous BRECCIA. Strong. Recovered as: Silty fine to coarse GRAVEL, some sand, minor cobbles, trace clay and trace boulders; light brown. "Dense", dry. Gravel, sub-angular to angular; cobbles, up to 200mm, sub-angular to angular; boulders, up to 250mm, sub-angular to angular. 3.3m: END OF INVESTIGATION	HW MW	M	St MS S	VS S F St VSt H 12 25 50 100 200 400		Top Botanical Hill Formation

SKETCH / PHOTO:

COMMENTS:

Hole Depth 3.3m

Scale 1:50

Rev.: A

EXCAVATION LOG

Excavation Id.: **TP07-22**

SHEET: 1 OF 1

PROJECT: Maitahi	LOCATION: Kaka Valley		JOB No.: 1012397.1000.1000
CO-ORDINATES: (NZTM2000) 5431515 mN 1625575 mE	METHOD: Trial pit/trench	EXCAV. STARTED: 22/02/2022	
	EQUIPMENT: 20T Excavator	EXCAV. FINISHED: 22/02/2022	
R.L.: 95m	OPERATOR: Bill	LOGGED BY: AMHO	
DATUM: NZVD2016	DIMENSIONS: 2.5m by 0.8m	CHECKED BY: SCON	

EXCAVATION TESTS | ENGINEERING DESCRIPTION | GEOLOGICAL

PENETRATION	SUPPORT	WATER	SAMPLES, TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	SOIL NAME, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, SECONDARY AND MINOR COMPONENTS	WEATHERING CLASSIFICATION	MOISTURE CLASSIFICATION	CONSISTENCY / DENSITY CLASSIFICATION	ESTIMATED SOIL SHEAR STRENGTH (Su, kPa)	DEFECTS, STRUCTURE, COMMENTS	UNIT
1 2 3												VS 12 S 25 F 50 St 100 VSt 200 H		
	Pit walls stable	DRY 22/02/2022			94	1	TS	*0.00m:* Sandy SILT, trace organics and rootlets and trace clay; dark brown. Stiff, moist, non-plastic. (TOPSOIL).		M	St			Top
								0.25m: Gravelly SILT, some sand, minor clay; light brown. Stiff, moist, low plasticity. Gravel, up to 60mm, sub-angular to angular; sand, coarse, sub-angular to angular. (RESIDUAL SOIL).	HW		S			Botanical Hill Formation
								0.65m: Highly weathered, light brown, highly fractured, tuffaceous BRECCIA. Strong. Recovered as: Cobbly GRAVEL, some sand, minor silt; light brown. "Dense", dry.						
					93	2		1.7m: END OF INVESTIGATION						
					92	3								
					91	4								
					90	5								
					89									

SKETCH / PHOTO:

COMMENTS:

Hole Depth 1.7m

Scale 1:50

Rev.: A

EXCAVATION LOG

Excavation Id.: **TP08-22**

SHEET: 1 OF 1

PROJECT: Maitahi	LOCATION: Kaka Valley		JOB No.: 1012397.1000.1000
CO-ORDINATES: (NZTM2000) 5431559 mN 1625596 mE	METHOD: Trial pit/trench	EXCAV. STARTED: 22/02/2022	
	EQUIPMENT: 20T Excavator	EXCAV. FINISHED: 22/02/2022	
R.L.: 105m	OPERATOR: Bill	LOGGED BY: AMHO	
DATUM: NZVD2016	DIMENSIONS: 3.5m by 0.8m	CHECKED BY: SCON	

EXCAVATION TESTS | ENGINEERING DESCRIPTION | GEOLOGICAL

PENETRATION	SUPPORT	WATER	SAMPLES, TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	SOIL NAME, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, SECONDARY AND MINOR COMPONENTS	WEATHERING CLASSIFICATION	MOISTURE CLASSIFICATION	CONSISTENCY / DENSITY CLASSIFICATION	ESTIMATED SOIL SHEAR STRENGTH (Su, kPa)	DEFECTS, STRUCTURE, COMMENTS	UNIT
1 2 3	Pit walls stable	DRY 22/02/2022			104	1	TS	*0.00m:* SILT, minor sand, trace clay and trace gravel; dark brown. Stiff, moist, non-plastic. Gravel, fine to medium. (TOPSOIL).		M	St	VS 12 S 25 F 50 St 100 VSt 200 H		Top
								0.25m: Silty fine to coarse GRAVEL, some sand; light brown. Medium dense, moist. Gravel, sub-angular to angular, highly weathered. (RESIDUAL SOIL).			MD			
					103	2		*1.05m:* Highly weathered, light brown, heavily jointed, tuffaceous BRECCIA. Extremely weak. Recovered as: Sandy GRAVEL, minor silt, trace cobbles; light brown. "Dense", dry. Gravel, sub-angular to angular, highly weathered; cobbles, up to 200mm, highly weathered.	HW		EW		*1.05 - 3.7m:* Density increases with depth	Botanical Hill Formation
					102	3								
					101	4		3.7m: END OF INVESTIGATION						
					100	5								

SKETCH / PHOTO:

COMMENTS:

Hole Depth 3.7m

Scale 1:50

Rev.: A

EXCAVATION LOG

Excavation Id.: **TP09-22**

SHEET: 1 OF 1

PROJECT: Maitahi	LOCATION: Kaka Valley		JOB No.: 1012397.1000.1000
CO-ORDINATES: (NZTM2000) 5431571 mN 1625709 mE	METHOD: Trial pit/trench	EXCAV. STARTED: 22/02/2022	
	EQUIPMENT: 20T Excavator	EXCAV. FINISHED: 22/02/2022	
R.L.: 67m	OPERATOR: Bill	LOGGED BY: AMHO	
DATUM: NZVD2016	DIMENSIONS: 2m by 0.8m	CHECKED BY: SCON	

EXCAVATION TESTS | ENGINEERING DESCRIPTION | GEOLOGICAL

PENETRATION	SUPPORT	WATER	SAMPLES, TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	SOIL NAME, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, SECONDARY AND MINOR COMPONENTS	WEATHERING CLASSIFICATION	MOISTURE CLASSIFICATION	CONSISTENCY / DENSITY CLASSIFICATION	ESTIMATED SOIL SHEAR STRENGTH (Su, kPa)	DEFECTS, STRUCTURE, COMMENTS	UNIT
1 2 3	Pit walls stable	DRY 22/02/2022			66 65 64 63 62 61	1 2 3 4 5	TS T	*0.00m:* SILT, some sand, minor clay, trace rootlets; dark brown. Stiff, moist, non-plastic.		M	St	VS S F St VSt H 12 25 50 100 200		Top
								0.30m: Sandy SILT, minor clay, trace gravel; light brown. Very stiff, dry, low plasticity. Sand, fine to coarse. (RESIDUAL SOIL).		D	VSt			Botanical Hill Formation
								0.70m: Completely weathered, light brown, tuffaceous BRECCIA. Very weak. Recovered as: Sandy SILT, some gravel, minor clay; light brown. Stiff, moist, low plasticity. Gravel, fine to coarse, angular.	CW		VW			
								1.10m: Highly weathered, grey brown, tuffaceous BRECCIA. Very weak. Recovered as: Cobbly fine to coarse GRAVEL, some sand, minor silt; light brown and grey. Loose to medium dense, dry. Gravel, sub-angular to angular; cobbles, up to 100mm, angular.	HW					
								1.60m: Moderately weathered, grey brown, tuffaceous BRECCIA. Very weak, heavily fractured. Recovered as: Gravelly COBBLES, minor sand; light brown. "Dense", dry, oxidation staining. Cobbles, up to 200mm, sub-angular to angular; gravel, fine to coarse, sub-angular to angular.	MW					
								1.75m: END OF INVESTIGATION						

SKETCH / PHOTO:

COMMENTS:

Hole Depth 1.75m

Scale 1:50

Rev.: A

EXCAVATION LOG

Excavation Id.: **TP10-22**

SHEET: 1 OF 1

PROJECT: Maitahi	LOCATION: Kaka Valley		JOB No.: 1012397.1000.1000
CO-ORDINATES: (NZTM2000) 5431605 mN 1625838 mE	METHOD: Trial pit/trench	EXCAV. STARTED: 23/02/2022	
	EQUIPMENT: 20T Excavator	EXCAV. FINISHED: 23/02/2022	
R.L.: 47m	OPERATOR: Bill	LOGGED BY: AMHO	
DATUM: NZVD2016	DIMENSIONS: 4m by 1m	CHECKED BY: SCON	

EXCAVATION TESTS | ENGINEERING DESCRIPTION | GEOLOGICAL

PENETRATION	SUPPORT	WATER	SAMPLES, TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	SOIL NAME, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, SECONDARY AND MINOR COMPONENTS	WEATHERING CLASSIFICATION	MOISTURE CLASSIFICATION	CONSISTENCY / DENSITY CLASSIFICATION	ESTIMATED SOIL SHEAR STRENGTH (Su, kPa)	DEFECTS, STRUCTURE, COMMENTS	UNIT
1 2 3	Pit walls stable	DRY 23/02/2022	Sample @ 3.50m		47 46 45 44 43 42	1 2 3 4 5	TS	*0.00m:* SILT, some sand, minor gravel; dark brown. Firm, moist, non-plastic. Sand, fine; gravel, fine to medium, sub-angular to angular. (TOPSOIL). *0.25m:* SILT, some sand and some gravel, minor cobbles; brown. Stiff, moist, non-plastic. Gravel, fine to coarse, sub-angular to angular; cobbles, up to 100mm, sub-angular to angular. *0.60m:* Gravelly SILT, some cobbles, minor clay; brown. Stiff, moist, non-plastic. Gravel, sub-angular to angular, iron staining; cobbles, up to 150mm, sub-angular to angular, iron staining. *3.20m:* Clayey SILT, minor sand and minor gravel, trace cobbles; greenish grey. Firm, moist, high plasticity. Sand, sub-rounded to angular; gravel, fine to coarse, sub-rounded to angular; cobbles, up to 150mm, coarsening with depth. 5.4m: END OF INVESTIGATION		M	F / St / F	VS S F St H		Top / Fan Deposits

SKETCH / PHOTO:

COMMENTS:

Hole Depth 5.4m

Scale 1:50

Rev.: A

EXCAVATION LOG

Excavation Id.: **TP11-22**

SHEET: 1 OF 1

PROJECT: Maitahi	LOCATION: Kaka Valley		JOB No.: 1012397.1000.1000
CO-ORDINATES: (NZTM2000) 5431616 mN 1625967 mE	METHOD: Trial pit/trench	EXCAV. STARTED: 23/02/2022	
	EQUIPMENT: 20T Excavator	EXCAV. FINISHED: 23/02/2022	
R.L.: 38m	OPERATOR: Bill	LOGGED BY: AMHO	
DATUM: NZVD2016	DIMENSIONS: 4m by 1m	CHECKED BY: SCON	

EXCAVATION TESTS | ENGINEERING DESCRIPTION | GEOLOGICAL

PENETRATION	SUPPORT	WATER	SAMPLES, TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	SOIL NAME, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, SECONDARY AND MINOR COMPONENTS	WEATHERING CLASSIFICATION	MOISTURE CLASSIFICATION	CONSISTENCY / DENSITY CLASSIFICATION	ESTIMATED SOIL SHEAR STRENGTH (Su, kPa)	DEFECTS, STRUCTURE, COMMENTS	UNIT
1 2 3	Pit walls stable	23/02/2022			38	0	TS	*0.00m:* SILT, some sand, minor clay, trace organics; dark brown. Stiff, moist, low plasticity. (TOPSOIL).		M	St	VS 12 S 25 F 50 St 100 VSt 200 H		Top
								0.30m: Silty fine GRAVEL, some sand; light brown. Medium dense, moist. Gravel, sub-angular to angular; sand, fine to coarse, sub-angular to angular.			MD			
								0.60m: SILT, some clay, trace gravel; light brown. Stiff, moist, low plasticity. Gravel, fine to medium, sub-angular.			St			
					37	1		*0.80m:* Sandy SILT, some gravel, minor clay; light brown. Very stiff, dry, non-plastic. Sand, fine; gravel, fine to medium, sub-angular to angular, grey.		D	VSt			
					36	2		*1.90m:* Silty fine to coarse GRAVEL, some sand, minor clay; light brownish grey. "Medium dense", wet. Gravel, sub-angular to angular, highly weathered; sand, fine to coarse.		W	'MD'			Fan Deposits
					35	3		*3.10m:* Sandy fine to coarse GRAVEL, some silt, minor clay, trace cobbles; orangish brown. "Dense", wet. Gravel, sub-angular to angular, highly weathered, weak, greenish grey, (volcanic-olivine crystals present); sand, fine to coarse; cobbles, up to 150mm.			'D'			
					34	4								
					33	5		4.7m: END OF INVESTIGATION						

SKETCH / PHOTO:

COMMENTS:

Hole Depth 4.7m

Scale 1:50

Rev.: A

EXCAVATION LOG

Excavation Id.: **TP12-22**

SHEET: 1 OF 1

PROJECT: Maitahi		LOCATION: Kaka Valley		JOB No.: 1012397.1000.1000	
CO-ORDINATES: (NZTM2000)	5431600 mN 1626086 mE	METHOD:	Trial pit/trench	EXCAV. STARTED:	16/02/2022
		EQUIPMENT:	20T Excavator	EXCAV. FINISHED:	16/02/2022
R.L.:	40m	OPERATOR:	Bill	LOGGED BY:	AMHO
DATUM:	NZVD2016	DIMENSIONS:	4m by 1m	CHECKED BY:	SCON

EXCAVATION TESTS | ENGINEERING DESCRIPTION | GEOLOGICAL

PENETRATION	SUPPORT	WATER	SAMPLES, TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	SOIL NAME, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, SECONDARY AND MINOR COMPONENTS	WEATHERING CLASSIFICATION	MOISTURE CLASSIFICATION	CONSISTENCY / DENSITY CLASSIFICATION	ESTIMATED SOIL SHEAR STRENGTH (Su, kPa)	DEFECTS, STRUCTURE, COMMENTS	UNIT
1 2 3	Pit walls stable	16/02/2022			39 38 37 36 35 34	0 1 2 3 4 5	TS	*0.00m:* SILT, some sand, minor clay; dark brown. Stiff, moist, non-plastic. Sand, fine. (TOPSOIL). *0.25m:* Sandy SILT, some clay; light brown. Stiff, moist, low plasticity. Sand, fine to coarse. *0.85m:* SILT, some clay; light brown. Hard, dry, low plasticity. *1.15m:* SILT, some clay, trace gravel; light brown. Very stiff, dry, low plasticity. Gravel, coarse, rounded to sub-rounded. (RESIDUAL SOIL). *4.00m:* Highly weathered, light brown, SANDSTONE. Moderately strong. Recovered as: Gravelly COBBLES, some silt, minor clay; light brown. "Dense", dry. 5m: END OF INVESTIGATION	HW	M D	St H VSt MS	VS 12 S 25 F 50 St 100 VSt 200 H		Top Alluvial Deposits Grampian Formation

SKETCH / PHOTO:

COMMENTS:

Hole Depth 5m

Scale 1:50

Rev.: A

EXCAVATION LOG

Excavation Id.: **TP13-22**

SHEET: 1 OF 1

PROJECT: Maitahi	LOCATION: Kaka Valley		JOB No.: 1012397.1000.1000
CO-ORDINATES: (NZTM2000) 5431579 mN 1626272 mE	METHOD: Trial pit/trench	EXCAV. STARTED: 16/02/2022	
	EQUIPMENT: 20T Excavator	EXCAV. FINISHED: 16/02/2022	
R.L.: 111m	OPERATOR: Bill	LOGGED BY: AMHO	
DATUM: NZVD2016	DIMENSIONS: 3m by 1m	CHECKED BY: SCON	

EXCAVATION TESTS | ENGINEERING DESCRIPTION | GEOLOGICAL

PENETRATION	SUPPORT	WATER	SAMPLES, TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	SOIL NAME, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, SECONDARY AND MINOR COMPONENTS	WEATHERING CLASSIFICATION	MOISTURE CLASSIFICATION	CONSISTENCY / DENSITY CLASSIFICATION	ESTIMATED SOIL SHEAR STRENGTH (Su, kPa)	DEFECTS, STRUCTURE, COMMENTS	UNIT
1 2 3	Pit walls stable	DRY 16/02/2022			110	0	TS	*0.00m:* Sandy SILT, minor clay, trace organics; dark brown. Stiff, dry, low plasticity. Sand, fine to coarse, rounded to sub-angular; organics, rootlets. (TOPSOIL).		D	St	VS 12 S 25 F 50 St 100 VSt 200 H		Top
								0.15m: Silty fine to coarse GRAVEL, minor clay; light brown. Medium dense, moist. Gravel, rounded to sub-rounded. (RESIDUAL SOIL).	CW	M	MD			
					109	1		*0.35m:* Completely weathered, light brown, blocky, SANDSTONE. Very weak, fine to coarse grained. Recovered as: Cobbly fine to coarse GRAVEL, some sand; light brown. Medium dense, moist. Sand, fine to coarse.	HW		VW			
					108	2		*1.25m:* Highly weathered, light brown, blocky, SANDSTONE. Very weak, fine to coarse grained. Recovered as: Gravelly COBBLES, some sand; light brown. "Medium dense", moist. Cobbles, up to 100mm, rounded to sub-angular; gravel, fine to coarse, rounded to sub-rounded; sand, fine to coarse.						Grampian Formation
					107	3		*2.40m:* Moderately weathered, light brown, blocky, SANDSTONE. Weak, fine to coarse grained. Recovered as: Gravelly COBBLES, some boulders; light brown. "Medium dense", moist. Cobbles, up to 200mm, rounded to sub-angular; gravel, fine to coarse, rounded to sub-rounded; boulders, up to 350mm, rounded to sub-angular.	MW		W			
					106	4		3.8m: END OF INVESTIGATION						
					105	5								

SKETCH / PHOTO:

COMMENTS:

Hole Depth 3.8m

Scale 1:50

Rev.: A

EXCAVATION LOG

Excavation Id.: **TP14-22**

SHEET: 1 OF 1

PROJECT: Maitahi	LOCATION: Kaka Valley		JOB No.: 1012397.1000.1000
CO-ORDINATES: (NZTM2000) 5431529 mN 1626442 mE	METHOD: Trial pit/trench	EXCAV. STARTED: 17/02/2022	
	EQUIPMENT: 20T Excavator	EXCAV. FINISHED: 17/02/2022	
R.L.: 130m	OPERATOR: Bill	LOGGED BY: AMHO	
DATUM: NZVD2016	DIMENSIONS: 2.5m by 1m	CHECKED BY: SCON	

EXCAVATION TESTS | ENGINEERING DESCRIPTION | GEOLOGICAL

PENETRATION	SUPPORT	WATER	SAMPLES, TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	SOIL NAME, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, SECONDARY AND MINOR COMPONENTS	WEATHERING CLASSIFICATION	MOISTURE CLASSIFICATION	CONSISTENCY / DENSITY CLASSIFICATION	ESTIMATED SOIL SHEAR STRENGTH (Su, kPa)	DEFECTS, STRUCTURE, COMMENTS	UNIT
1 2 3	Pit walls stable	DRY 17/02/2022			129	1	TS	*0.00m:* Sandy SILT, minor gravel, trace organics; dark brown. Stiff, dry, non-plastic. Sand, fine to coarse; gravel, fine; organics, rootlets. (TOPSOIL).	HW	D	St	VS 12 S 25 F 50 St 100 VSt 200 H		Top
								0.15m: Highly weathered, brown, blocky, SANDSTONE. Very weak. Recovered as: Silty COBBLES, some gravel, minor sand; brown. Medium dense, dry, well graded. Cobbles, up to 150mm, angular, highly weathered; gravel, fine to coarse, angular; sand, fine to coarse.			VW			Grampian Formation
					128	2		1.5m: END OF INVESTIGATION						
					127	3								
					126	4								
					125	5								
					124									

SKETCH / PHOTO:

COMMENTS:

Hole Depth 1.5m

Scale 1:50

Rev.: A

EXCAVATION LOG

Excavation Id.: **TP15-22**

SHEET: 1 OF 1

PROJECT: Maitahi	LOCATION: Kaka Valley		JOB No.: 1012397.1000.1000
CO-ORDINATES: (NZTM2000) 5431642 mN 1626419 mE	METHOD: Trial pit/trench	EXCAV. STARTED: 17/02/2022	
	EQUIPMENT: 20T Excavator	EXCAV. FINISHED: 17/02/2022	
R.L.: 127m	OPERATOR: Bill	LOGGED BY: AMHO	
DATUM: NZVD2016	DIMENSIONS: 4m by 1.5m	CHECKED BY: SCON	

EXCAVATION TESTS | ENGINEERING DESCRIPTION | GEOLOGICAL

PENETRATION	SUPPORT	WATER	SAMPLES, TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	SOIL NAME, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, SECONDARY AND MINOR COMPONENTS	WEATHERING CLASSIFICATION	MOISTURE CLASSIFICATION	CONSISTENCY / DENSITY CLASSIFICATION	ESTIMATED SOIL SHEAR STRENGTH (Su, kPa)	DEFECTS, STRUCTURE, COMMENTS	UNIT
1 2 3	Pit walls stable	DRY 17/02/2022			126 125 124 123 122	1 2 3 4 5	TS	*0.00m:* SILT, some sand, minor clay; dark brown. Stiff, moist, non-plastic. Sand, fine. (TOPSOIL). *0.15m:* Highly weathered, light brown, SANDSTONE. Extremely weak. Recovered as: Silty fine SAND, some gravel, minor cobbles; light brown. Dense, dry. Gravel, fine to coarse, angular; cobbles, up to 100mm, angular, highly weathered. *1.75m:* Highly weathered, light brown, blocky, SANDSTONE. Extremely weak. Recovered as: Fine to coarse GRAVEL, some cobbles, minor silt, trace sand; light brown. "Dense", dry. Gravel, angular; cobbles, up to 150mm, angular; sand, fine to coarse. 3.5m: END OF INVESTIGATION	HW EW	M	St	VS 12 S 25 F 50 St 100 VSt 200 H		Top Grampian Formation

SKETCH / PHOTO:

COMMENTS:

Hole Depth 3.5m

Scale 1:50

Rev.: A

EXCAVATION LOG

Excavation Id.: **TP16-22**

SHEET: 1 OF 1

PROJECT: Maitahi	LOCATION: Kaka Valley		JOB No.: 1012397.1000.1000
CO-ORDINATES: 5431685 mN (NZTM2000) 1626496 mE	METHOD: Trial pit/trench	EXCAV. STARTED: 16/02/2022	
	EQUIPMENT: 20T Excavator	EXCAV. FINISHED: 16/02/2022	
R.L.: 157m	OPERATOR: Bill	LOGGED BY: AMHO	
DATUM: NZVD2016	DIMENSIONS: 3m by 0.8m	CHECKED BY: SCON	

EXCAVATION TESTS | ENGINEERING DESCRIPTION | GEOLOGICAL

PENETRATION	SUPPORT	WATER	SAMPLES, TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	SOIL NAME, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, SECONDARY AND MINOR COMPONENTS	WEATHERING CLASSIFICATION	MOISTURE CLASSIFICATION	CONSISTENCY / DENSITY CLASSIFICATION	ESTIMATED SOIL SHEAR STRENGTH (Su, kPa)	DEFECTS, STRUCTURE, COMMENTS	UNIT
1 2 3	Pit walls stable	DRY 16/02/2022			156	1	TS T	*0.00m:* SILT, some sand, minor clay; dark brown. Stiff, moist, non-plastic. (TOPSOIL).		M	St	VS 12 S 25 F 50 St 100 VSt 200 H		Top
								0.30m: SILT, some clay. Stiff, moist, low plasticity. (RESIDUAL SOIL).						
								0.70 - 0.75m: COBBLES; light brown.						
								0.80m: Completely weathered, light brown, SANDSTONE. Very weak. Recovered as: SILT, some clay, minor sand. Very stiff, moist, low plasticity.	CW		VW			
					155	2		*1.20m:* Completely weathered, light brown, SANDSTONE. Moderately strong. Recovered as: Silty fine to coarse GRAVEL, some cobbles, minor clay; light brown. "Very dense", dry. Gravel, sub-angular to angular; cobbles, up to 150mm, sub-angular to angular, moderately weathered.			MS			Grampian Formation
					154	3								
					153	4		*4.00m:* Highly weathered, light brown, SANDSTONE. Moderately strong. Recovered as: Cobbly fine to coarse GRAVEL, some silt, minor clay; light brown. "Very dense", dry. Gravel, sub-angular to angular, highly weathered; cobbles, up to 200mm, sub-angular to angular, highly weathered.	HW					
					152	5		4.3m: END OF INVESTIGATION						
					151									

SKETCH / PHOTO:

COMMENTS:

Hole Depth 4.3m

Scale 1:50

Rev.: A

EXCAVATION LOG

Excavation Id.: **TP17-22**

SHEET: 1 OF 1

PROJECT: Maitahi	LOCATION: Kaka Valley	JOB No.: 1012397.1000.1000
CO-ORDINATES: (NZTM2000) 5431696 mN 1626397 mE	METHOD: Trial pit/trench	EXCAV. STARTED: 17/02/2022
	EQUIPMENT: 20T Excavator	EXCAV. FINISHED: 17/02/2022
R.L.: 123m	OPERATOR: Bill	LOGGED BY: AMHO
DATUM: NZVD2016	DIMENSIONS: 3m by 0.8m	CHECKED BY: SCON

EXCAVATION TESTS | ENGINEERING DESCRIPTION | GEOLOGICAL

PENETRATION	SUPPORT	WATER	SAMPLES, TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	SOIL NAME, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, SECONDARY AND MINOR COMPONENTS	WEATHERING CLASSIFICATION	MOISTURE CLASSIFICATION	CONSISTENCY / DENSITY CLASSIFICATION	ESTIMATED SOIL SHEAR STRENGTH (Su, kPa)	DEFECTS, STRUCTURE, COMMENTS	UNIT
1 2 3	Pit walls stable	17/02/2022			123	0	TS	*0.00m:* SILT, some clay, trace organics; dark brown. Stiff to very stiff, moist, low plasticity. Organics, rootlets. [TOPSOIL].		M	St-VSt	VS 12 S 25 F 50 St 100 VSt 200 H		Top
								0.25m: SILT, some clay, minor sand; light brown. Firm, moist, low plasticity. Sand, fine. (RESIDUAL SOIL).			F			
					122	1		*0.70m:* Completely weathered, light brown, SANDSTONE. Very weak. Recovered as: Sandy SILT, trace gravel. Loose, moist, non-plastic. Sand, fine to medium; gravel, medium to coarse, angular.	CW		VW			Grampian Formation
					121	2		*2.20m:* Completely weathered, light brown, SANDSTONE. Extremely weak. Recovered as: Gravelly SILT, some sand. Firm, wet, non-plastic. Gravel, fine to coarse, angular; sand, fine to coarse.			EW			
					120	3		3.3m: END OF INVESTIGATION						
					119	4								
					118	5								

SKETCH / PHOTO:

COMMENTS:

Hole Depth 3.3m

Scale 1:50

Rev.: A

EXCAVATION LOG

Excavation Id.: **TP18-22**

SHEET: 1 OF 1

PROJECT: Maitahi	LOCATION: Kaka Valley		JOB No.: 1012397.1000.1000
CO-ORDINATES: (NZTM2000) 5431881 mN 1626428 mE	METHOD: Trial pit/trench	EXCAV. STARTED: 24/02/2022	
	EQUIPMENT: 20T Excavator	EXCAV. FINISHED: 24/02/2022	
R.L.: 170m	OPERATOR: Bill	LOGGED BY: AMHO	
DATUM: NZVD2016	DIMENSIONS: 3m by 0.8m	CHECKED BY: SCON	

EXCAVATION TESTS | ENGINEERING DESCRIPTION | GEOLOGICAL

PENETRATION	SUPPORT	WATER	SAMPLES, TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	SOIL NAME, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, SECONDARY AND MINOR COMPONENTS	WEATHERING CLASSIFICATION	MOISTURE CLASSIFICATION	CONSISTENCY / DENSITY CLASSIFICATION	ESTIMATED SOIL SHEAR STRENGTH (Su, kPa)	DEFECTS, STRUCTURE, COMMENTS	UNIT
1 2 3	Pit walls stable	DRY 23/02/2022			170	0	TS	*0.00m:* SILT, some sand, minor clay; dark brown. Firm, moist, low plasticity. [TOPSOIL]		M	F			TS
								0.30m: Sandy SILT, some gravel, minor clay. Very stiff, moist, low plasticity. (RESIDUAL SOIL). [WAKAPUAKA PHYLLONITE]	CW		VSt			
					169	1		*0.55m:* Completely weathered, grey, PHYLLITE. Very weak. Recovered as: SILT, some clay, minor sand. Very stiff, moist, medium plasticity.	HW		VW			
								0.80m: Highly weathered, light brown, heavily jointed, PHYLLITE. Moderately strong to strong. Recovered as: Sandy GRAVEL, some cobbles, minor silt, trace clay. Tightly packed, dry.			MS-S			Wakapuaka Phyllonite
					168	2		*2.50m:* Moderately weathered, light brown, heavily jointed, PHYLLITE. Strong. Recovered as: Cobbly fine to coarse GRAVEL, some sand, minor silt, trace clay. Very dense, dry. Gravel, sub-angular to angular, moderately weathered, strong, grey; cobbles, up to 200mm; sand, fine to coarse, sub-angular to angular.	MW		S			
					167	3		3.2m: END OF INVESTIGATION						
					166	4								
					165	5								

SKETCH / PHOTO:

COMMENTS:

Hole Depth 3.2m

Scale 1:50

Rev.: A

EXCAVATION LOG

Excavation Id.: **TP19-22**

SHEET: 1 OF 1

PROJECT: Maitahi	LOCATION: Kaka Valley		JOB No.: 1012397.1000.1000
CO-ORDINATES: 5431890 mN (NZTM2000) 1626135 mE	METHOD: Trial pit/trench	EXCAV. STARTED: 23/02/2022	
	EQUIPMENT: 20T Excavator	EXCAV. FINISHED: 23/02/2022	
R.L.: 57m	OPERATOR: Bill	LOGGED BY: AMHO	
DATUM: NZVD2016	DIMENSIONS: 2.5m by 0.8m	CHECKED BY: SCON	

EXCAVATION TESTS | ENGINEERING DESCRIPTION | GEOLOGICAL

PENETRATION	SUPPORT	WATER	SAMPLES, TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	SOIL NAME, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, SECONDARY AND MINOR COMPONENTS	WEATHERING CLASSIFICATION	MOISTURE CLASSIFICATION	CONSISTENCY / DENSITY CLASSIFICATION	ESTIMATED SOIL SHEAR STRENGTH (Su, kPa)	DEFECTS, STRUCTURE, COMMENTS	UNIT
1 2 3	Pit walls stable	DRY 23/02/2022			56 55 54 53 52 51	1 2 3 4 5	TS	*0.00m:* SILT, some clay, trace organics; dark brown. Firm, moist, low plasticity. [TOPSOIL] *0.30m:* Highly weathered, light greyish brown, PHYLLITE. Extremely weak. Recovered as: Sandy SILT. Stiff, moist, non-plastic. Sand, coarse. [WAKAPUAKA PHYLLONITE] *0.55m:* Highly weathered, grey mottled orange, PHYLLITE. Very weak. Recovered as: SILT, some clay, minor gravel. Stiff, moist, medium plasticity. Gravel, medium, sub-angular to angular, highly weathered. *2.10m:* Highly weathered, light brown, PHYLLITE. Very weak. Recovered as: Gravelly SILT, some sand and some cobbles, trace clay. Stiff, moist, non-plastic. Gravel, fine to coarse, sub-angular to angular, highly weathered, greenish grey fine grained volcanic rock; sand, fine to coarse; cobbles, up to 200mm, greenish grey fine grained volcanic rock. 3.6m: END OF INVESTIGATION	HW	M	F EW VW	VS S F St VSt H 12 25 50 100 200		TS Wakapuaka Phyllonite

SKETCH / PHOTO:

COMMENTS:

Hole Depth 3.6m

Scale 1:50

Rev.: A

EXCAVATION LOG

Excavation Id.: **TP20-22**

SHEET: 1 OF 1

PROJECT: Maitahi	LOCATION: Kaka Valley		JOB No.: 1012397.1000.1000
CO-ORDINATES: (NZTM2000) 5431983 mN 1626219 mE	METHOD: Trial pit/trench	EXCAV. STARTED: 23/02/2022	
	EQUIPMENT: 20T Excavator	EXCAV. FINISHED: 23/02/2022	
R.L.: 72m	OPERATOR: Bill	LOGGED BY: AMHO	
DATUM: NZVD2016	DIMENSIONS: 3m by 0.8m	CHECKED BY: SCON	

EXCAVATION TESTS | ENGINEERING DESCRIPTION | GEOLOGICAL

PENETRATION	SUPPORT	WATER	SAMPLES, TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	SOIL NAME, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, SECONDARY AND MINOR COMPONENTS	WEATHERING CLASSIFICATION	MOISTURE CLASSIFICATION	CONSISTENCY / DENSITY CLASSIFICATION	ESTIMATED SOIL SHEAR STRENGTH (Su, kPa)	DEFECTS, STRUCTURE, COMMENTS	UNIT
1 2 3	Pit walls stable	DRY 23/02/2022			72	0		*0.00m:* Sandy SILT, minor gravel; dark brown. Stiff, moist, non-plastic. Sand, fine to coarse; gravel, fine to coarse, sub-angular to angular. [TOPSOIL]		M	St	VS 12 S 25 F 50 St 100 VSt 200 H		TS
								0.25m: SILT, some sand, minor gravel, trace clay. Stiff, moist, non-plastic. Sand, fine; gravel, fine to coarse, angular. (RESIDUAL SOIL). [WAKAPUAKA PHYLLONITE]						
					71	1		*1.05m:* Completely weathered, light brown, PHYLLITE. Extremely weak. Recovered as: Gravelly SILT, some sand, trace clay. Hard, dry, non-plastic. Gravel, fine to coarse, sub-angular to angular, highly weathered, grey; sand, fine.	CW		EW			
					70	2		*2.10m:* Completely weathered, light brown, PHYLLITE. Extremely weak. Recovered as: Clayey SILT. Hard, dry, high plasticity.						Wakapuaka Phyllonite
					69	3								
					68	4		*4.10m:* Completely weathered, light brown, PHYLLITE. Extremely weak. Recovered as: Clayey SILT, minor gravel. Hard, dry, high plasticity. Gravel, coarse, angular, highly weathered, extremely weak.						
					67	5		4.8m: END OF INVESTIGATION						

SKETCH / PHOTO:

COMMENTS:

Hole Depth 4.8m

Scale 1:50

Rev.: A

EXCAVATION LOG

Excavation Id.: **TP21-22**

SHEET: 1 OF 1

PROJECT: Maitahi	LOCATION: Kaka Valley		JOB No.: 1012397.1000.1000
CO-ORDINATES: 5431964 mN (NZTM2000) 1626362 mE	METHOD: Trial pit/trench	EXCAV. STARTED: 22/02/2022	
	EQUIPMENT: 20T Excavator	EXCAV. FINISHED: 22/02/2022	
R.L.: 118m	OPERATOR: Bill	LOGGED BY: AMHO	
DATUM: NZVD2016	DIMENSIONS: 3m by 0.8m	CHECKED BY: SCON	

EXCAVATION TESTS | ENGINEERING DESCRIPTION | GEOLOGICAL

PENETRATION	SUPPORT	WATER	SAMPLES, TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	SOIL NAME, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, SECONDARY AND MINOR COMPONENTS	WEATHERING CLASSIFICATION	MOISTURE CLASSIFICATION	CONSISTENCY / DENSITY CLASSIFICATION	ESTIMATED SOIL SHEAR STRENGTH (Su, kPa)	DEFECTS, STRUCTURE, COMMENTS	UNIT
1 2 3	Pit walls stable	DRY 22/02/2022			118	0	TS	*0.00m:* SILT, some sand, minor clay, trace rootlets; dark brown. Stiff, dry, low plasticity. Sand, fine. [TOPSOIL]		D	St	VS 12 S 25 F 50 St 100 VSt 200 H		TS
								0.30m: Completely weathered, brown, PHYLLITE. Extremely weak. Recovered as: Sandy SILT, some gravel, trace clay; brown. Stiff, dry, low plasticity. Sand, fine to coarse; gravel, fine to coarse. [WAKAPUAKA PHYLLONITE]	CW HW		EW			Wakapuaka Phyllonite
					117	1		*0.50m:* Highly weathered, light brown, heavily jointed, PHYLLITE. Extremely weak. Recovered as: Sandy fine to coarse GRAVEL, some silt, minor cobbles, trace clay. Stiff, dry, low plasticity. Gravel, sub-angular to angular, moderately weathered, strong; sand, fine to coarse; cobbles, up to 150mm.						
					116	2		2.2m: END OF INVESTIGATION						
					115	3								
					114	4								
					113	5								

SKETCH / PHOTO:

COMMENTS:

Hole Depth 2.2m

Scale 1:50

Rev.: A

EXCAVATION LOG

Excavation Id.: **TP22-22**

SHEET: 1 OF 1

PROJECT: Maitahi	LOCATION: Kaka Valley		JOB No.: 1012397.1000.1000
CO-ORDINATES: (NZTM2000) 5432008 mN 1626326 mE	METHOD: Trial pit/trench	EXCAV. STARTED: 23/02/2022	
	EQUIPMENT: 20T Excavator	EXCAV. FINISHED: 23/02/2022	
R.L.: 96m	OPERATOR: Bill	LOGGED BY: AMHO	
DATUM: NZVD2016	DIMENSIONS: 2.5m by 0.8m	CHECKED BY: SCON	

EXCAVATION TESTS | ENGINEERING DESCRIPTION | GEOLOGICAL

PENETRATION	SUPPORT	WATER	SAMPLES, TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	SOIL NAME, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, SECONDARY AND MINOR COMPONENTS	WEATHERING CLASSIFICATION	MOISTURE CLASSIFICATION	CONSISTENCY / DENSITY CLASSIFICATION	ESTIMATED SOIL SHEAR STRENGTH (Su, kPa)	DEFECTS, STRUCTURE, COMMENTS	UNIT
1 2 3	Pit walls stable	DRY 23/02/2022			95 94 93 92 91 90	0 1 2 3 4 5	TS	*0.00m:* SILT, some sand, minor clay, trace rootlets and trace gravel; dark brown. Stiff, moist, non-plastic. Gravel, coarse, sub-rounded to sub-angular. (TOPSOIL). *0.30m:* Gravelly SILT, some sand, trace clay. Stiff, moist, low plasticity. Gravel, fine to coarse, moderately weathered, strong; sand, fine to coarse. (RESIDUAL SOIL). *0.50m:* Completely weathered, grey mottled orange, tuffaceous BRECCIA. Extremely weak. Recovered as: Clayey SILT, minor gravel. Stiff, dry, high plasticity. Gravel, medium to coarse, sub-angular, highly weathered, moderately strong. *1.30m:* Highly weathered, light brown, heavily jointed, tuffaceous BRECCIA. Moderately strong. Recovered as: Sandy fine to coarse GRAVEL, some cobbles, minor silt, trace boulders. Dense, dry. Gravel, sub-angular to angular, moderately weathered, moderately strong; sand, fine to coarse; cobbles, up to 200mm; boulders, up to 350mm. 2.7m: END OF INVESTIGATION	CW HW	M	St EW MS	VS S F St VSt H 12 25 50 100 200 400		Top Botanical Hill Formation

SKETCH / PHOTO:

COMMENTS:

Hole Depth 2.7m

Scale 1:50

Rev.: A

EXCAVATION LOG

Excavation Id.: **TP23-22**

SHEET: 1 OF 1

PROJECT: Maitahi	LOCATION: Kaka Valley	JOB No.: 1012397.1000.1000
CO-ORDINATES: (NZTM2000) 5432054 mN 1626279 mE	METHOD: Trial pit/trench	EXCAV. STARTED: 23/02/2022
	EQUIPMENT: 20T Excavator	EXCAV. FINISHED: 23/02/2022
R.L.: 73m	OPERATOR: Bill	LOGGED BY: AMHO
DATUM: NZVD2016	DIMENSIONS: 2.5m by 0.8m	CHECKED BY: SCON

EXCAVATION TESTS | ENGINEERING DESCRIPTION | GEOLOGICAL

PENETRATION	SUPPORT	WATER	SAMPLES, TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	SOIL NAME, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, SECONDARY AND MINOR COMPONENTS	WEATHERING CLASSIFICATION	MOISTURE CLASSIFICATION	CONSISTENCY / DENSITY CLASSIFICATION	ESTIMATED SOIL SHEAR STRENGTH (Su, kPa)	DEFECTS, STRUCTURE, COMMENTS	UNIT
1 2 3	Pit walls stable	DRY 23/02/2022			72	0	TS	*0.00m:* Sandy SILT, minor gravel, trace organics and trace clay; dark brown. Stiff, moist, non-plastic. Gravel, medium to coarse, sub-rounded to sub-angular. [TOPSOIL]		M	St	VS S F St VSt H 12 25 50 100 200		TS
								0.25m: Sandy SILT, minor gravel, trace clay. Stiff, moist, low plasticity. Gravel, fine to coarse, sub-angular. (RESIDUAL SOIL). [WAKAPUAKA PHYLLONITE]						Wakapuaka Phyllonite
					71	1		*0.85m:* Completely weathered, light brown, PHYLLITE. Extremely weak. Recovered as: Clayey SILT, some gravel. Stiff, moist, high plasticity. Gravel, fine to coarse, sub-angular to angular.	CW		EW			
								1.10m: Completely weathered, light brown, PHYLLITE. Extremely weak. Recovered as: Sandy fine to coarse GRAVEL, some silt, minor cobbles, trace boulders. Dense, moist. Gravel, sub-angular to angular; sand, sub-angular to angular; cobbles, up to 200mm.						
					70	2		1.9m: END OF INVESTIGATION						
					69	3								
					68	4								
					67	5								

SKETCH / PHOTO:

COMMENTS:

Hole Depth 1.9m

Scale 1:50

Rev.: A

EXCAVATION LOG

Excavation Id.: **TP24-22**

SHEET: 1 OF 1

PROJECT: Maitahi	LOCATION: Kaka Valley		JOB No.: 1012397.1000.1000
CO-ORDINATES: (NZTM2000) 5432058 mN 1626356 mE	METHOD: Trial pit/trench	EXCAV. STARTED: 01/03/2022	
	EQUIPMENT: 20T Excavator	EXCAV. FINISHED: 01/03/2022	
R.L.: 84m	OPERATOR: Bill	LOGGED BY: AMHO	
DATUM: NZVD2016	DIMENSIONS: 2.5m by 0.8m	CHECKED BY: SCON	

EXCAVATION TESTS | ENGINEERING DESCRIPTION | GEOLOGICAL

PENETRATION	SUPPORT	WATER	SAMPLES, TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	SOIL NAME, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, SECONDARY AND MINOR COMPONENTS	WEATHERING CLASSIFICATION	MOISTURE CLASSIFICATION	CONSISTENCY / DENSITY CLASSIFICATION	ESTIMATED SOIL SHEAR STRENGTH (Su, kPa)	DEFECTS, STRUCTURE, COMMENTS	UNIT
1 2 3	Pit walls stable	DRY 01/03/2022			84	0	TS	*0.00m:* Sandy SILT, trace organics and trace gravel; dark brown. Stiff, moist, non-plastic. [TOPSOIL]		M	St	VS 12 S 25 F 50 St 100 VSt 200 H		TS
								0.20m: SILT, some gravel. Stiff, dry, low plasticity. Gravel, sub-angular to angular. (RESIDUAL SOIL). [WAKAPUAKA PHYLLONITE]	CW	D	EW			Wakapuaka Phyllonite
					83	1		*0.55m:* Completely weathered, light brown, PHYLLITE. Extremely weak. Recovered as: Silty fine to coarse GRAVEL, some sand, trace cobbles; light brown. Dense. Gravel, sub-angular to angular, moderately weathered, strong; sand, fine to coarse, sub-angular to angular; cobbles, sub-angular to angular, moderately weathered, strong.						
					82	2		*1.20m:* Completely weathered, light brown, PHYLLITE. Extremely weak. Recovered as: Cobbly fine to coarse GRAVEL, some silt and some sand, minor boulders. Dense, dry. Gravel, sub-angular to angular, moderately weathered, strong; sand, fine to coarse; boulders, up to 350mm, sub-angular to angular, moderately weathered, strong.						
					81	3		1.5m: END OF INVESTIGATION						
					80	4								
					79	5								

SKETCH / PHOTO:

COMMENTS:

Hole Depth 1.5m

Scale 1:50

Rev.: A

EXCAVATION LOG

Excavation Id.: **TP25-22**

SHEET: 1 OF 1

PROJECT: Maitahi		LOCATION: Kaka Valley		JOB No.: 1012397.1000.1000	
CO-ORDINATES: (NZTM2000)	5432014 mN 1626435 mE	METHOD:	Trial pit/trench	EXCAV. STARTED:	01/03/2022
		EQUIPMENT:	20T Excavator	EXCAV. FINISHED:	01/03/2022
R.L.:	106m	OPERATOR:	Bill	LOGGED BY:	AMHO
DATUM:	NZVD2016	DIMENSIONS:	2.5m by 0.8m	CHECKED BY:	SCON

EXCAVATION TESTS | ENGINEERING DESCRIPTION | GEOLOGICAL

PENETRATION	SUPPORT	WATER	SAMPLES, TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	SOIL NAME, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, SECONDARY AND MINOR COMPONENTS	WEATHERING CLASSIFICATION	MOISTURE CLASSIFICATION	CONSISTENCY / DENSITY CLASSIFICATION	ESTIMATED SOIL SHEAR STRENGTH (Su, kPa)	DEFECTS, STRUCTURE, COMMENTS	UNIT
1 2 3	Pit walls stable	01/03/2022			105 104 103 102 101 100	0 1 2 3 4 5		*0.00m:* Sandy SILT, minor clay; dark brown. Stiff, moist, non-plastic. Sand, fine. [TOPSOIL] *0.30m:* Sandy fine to coarse GRAVEL, minor cobbles, trace silt; brown. Tightly packed, dry. Gravel, sub-angular to angular, moderately weathered, moderately strong; sand, fine to coarse; cobbles, up to 150mm. [COLLUVIUM] *0.60m:* Clayey SILT, some gravel, minor sand, trace cobbles; greyish brown mottled orange. Stiff, dry, medium plasticity. Gravel, fine to coarse, angular, moderately weathered, moderately strong; sand, fine to coarse; cobbles, up to 100mm, angular, moderately weathered, moderately strong. (RESIDUAL SOIL). *0.80m:* Completely weathered, greyish brown, PHYLLITE. Extremely weak. Recovered as: Silty fine to coarse GRAVEL, some sand, minor cobbles, trace clay; greyish brown. Dense, moist. Gravel, sub-angular to angular, slightly weathered, strong; sand, fine to coarse, sub-angular to angular; cobbles, up to 200mm, sub-angular to angular, slightly weathered, strong. [WAKAPUAKA PHYLLONITE] *1.10m:* Highly weathered, greyish brown, PHYLLITE. Extremely weak. Recovered as: Cobbly fine to coarse GRAVEL, some sand, minor silt, trace clay and trace boulders. Dense, wet. Gravel, cobbles and boulders, sub-angular to angular, slightly weathered, strong; cobbles, up to 200mm; sand, fine to coarse, sub-angular to angular; boulders, up to 400mm. 3.9m: END OF INVESTIGATION	CW HW	M D	St TP St EW	VS 12 S 25 F 50 St 100 VSt 200 H		TS COLL Wakapuaka Phyllonite

SKETCH / PHOTO:

COMMENTS:

Hole Depth 3.9m

Scale 1:50

Rev.: A

EXCAVATION LOG

Excavation Id.: **TP26-22**

SHEET: 1 OF 1

PROJECT: Maitahi	LOCATION: Kaka Valley		JOB No.: 1012397.1000.1000
CO-ORDINATES: 5431972 mN (NZTM2000) 1626586 mE	METHOD: Trial pit/trench	EXCAV. STARTED: 01/03/2022	
	EQUIPMENT: 20T Excavator	EXCAV. FINISHED: 01/03/2022	
R.L.: 148m	OPERATOR: Bill	LOGGED BY: AMHO	
DATUM: NZVD2016	DIMENSIONS: 3m by 0.8m	CHECKED BY: SCON	

EXCAVATION TESTS | ENGINEERING DESCRIPTION | GEOLOGICAL

PENETRATION	SUPPORT	WATER	SAMPLES, TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	SOIL NAME, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, SECONDARY AND MINOR COMPONENTS	WEATHERING CLASSIFICATION	MOISTURE CLASSIFICATION	CONSISTENCY / DENSITY CLASSIFICATION	ESTIMATED SOIL SHEAR STRENGTH (Su, kPa)	DEFECTS, STRUCTURE, COMMENTS	UNIT
1 2 3	Pit walls stable	DRY 01/03/2022			147	0		*0.00m:* Sandy SILT, minor gravel; dark brown. Stiff, moist, non-plastic. Sand, fine to coarse; gravel, fine. [TOPSOIL]		M	St	VS 12 S 25 F 50 St 100 VSt 200 H		TS
								0.30m: Clayey SILT, some sand, minor gravel; Light brown. Stiff, dry, medium plasticity. Sand, fine to coarse; gravel, fine to coarse, angular, moderately strong. (RESIDUAL SOIL). [WAKAPUAKA PHYLLONITE]		D				
					146	1		*0.80m:* Completely weathered, light brown, PHYLLITE. Extremely weak. Recovered as: Sandy SILT, some clay, minor gravel. Stiff, dry, non-plastic. Sand, fine to coarse; gravel, fine to coarse, angular, moderately strong.	CW		EW			
					145	2		*2.00m:* Highly weathered, grey, heavily jointed, PHYLLITE. Strong. Recovered as: Cobbly fine to coarse GRAVEL, some sand, minor silt, trace boulders; grey. Very dense, dry. Gravel, angular, moderately weathered, strong; cobbles, up to 200mm, angular, moderately weathered, strong; boulders, up to 350mm, angular, moderately weathered, strong.	HW		S			Wakapuaka Phyllonite
					144	3		2.8m: END OF INVESTIGATION						
					143	4								
					142	5								

SKETCH / PHOTO:

COMMENTS:

Hole Depth 2.8m

Scale 1:50

Rev.: A

EXCAVATION LOG

Excavation Id.: **TP27-22**

SHEET: 1 OF 1

PROJECT: Maitahi	LOCATION: Kaka Valley		JOB No.: 1012397.1000.1000
CO-ORDINATES: (NZTM2000) 5432152 mN 1626415 mE	METHOD: Trial pit/trench	EXCAV. STARTED:	23/02/2023
	EQUIPMENT: 20T Excavator	EXCAV. FINISHED:	23/02/2022
R.L.: 89m	OPERATOR: Bill	LOGGED BY:	AMHO
DATUM: NZVD2016	DIMENSIONS: 4m by 1.5m	CHECKED BY:	ASCO

EXCAVATION TESTS | ENGINEERING DESCRIPTION | GEOLOGICAL

PENETRATION	SUPPORT	WATER	SAMPLES, TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	SOIL NAME, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, SECONDARY AND MINOR COMPONENTS	WEATHERING CLASSIFICATION	MOISTURE CLASSIFICATION	CONSISTENCY / DENSITY CLASSIFICATION	ESTIMATED SOIL SHEAR STRENGTH (Su, kPa)	DEFECTS, STRUCTURE, COMMENTS	UNIT
1 2 3	Pit walls stable	DRY 23/02/2022			88 87 86	1 2	TS	*0.00m:* SILT, some sand, minor clay, trace organics; dark brown. Stiff, moist, non-plastic. [TOPSOIL] *0.30m:* SILT, some clay, minor gravel; Light brown. Stiff, moist, low plasticity. (RESIDUAL SOIL). [WAKAPUAKA PHYLLONITE] *0.65m:* Clayey SILT; light grey motled orange. Stiff, moist, low plasticity. (RESIDUAL SOIL). *0.70m:* Completely weathered, greyish brown, PHYLLITE. Extremely weak. Recovered as: SILT, some clay, minor gravel, trace sand. Hard, dry, low plasticity. Gravel, fine to coarse, sub-angular to angular; sand, fine to coarse. *2.10m:* Highly weathered, greyish brown, PHYLLITE. Very weak. Recovered as: Sandy fine to coarse GRAVEL, some silt and some cobbles, trace clay. Dense, moist. Sand, fine to coarse; cobbles, up to 200mm.	M CW HW	St EW VW	VS S F St VSt H 12 25 50 100 200		TS Wakapuaka Phyllonite
					85 84 83	3 4 5		2.8m: END OF INVESTIGATION						

SKETCH / PHOTO:

COMMENTS:

Hole Depth 2.8m

Scale 1:50

Rev.: A

EXCAVATION LOG

Excavation Id.: **TP28-22**

SHEET: 1 OF 1

PROJECT: Maitahi	LOCATION: Kaka Valley		JOB No.: 1012397.1000.1000
CO-ORDINATES: (NZTM2000) 5432200 mN 1626388 mE	METHOD: Trial pit/trench	EXCAV. STARTED: 23/02/2022	
	EQUIPMENT: 20T Excavator	EXCAV. FINISHED: 23/02/2022	
R.L.: 86m	OPERATOR: Bill	LOGGED BY: AMHO	
DATUM: NZVD2016	DIMENSIONS: 4m by 1.5m	CHECKED BY: SCON	

EXCAVATION TESTS | ENGINEERING DESCRIPTION | GEOLOGICAL

PENETRATION	SUPPORT	WATER	SAMPLES, TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	SOIL NAME, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, SECONDARY AND MINOR COMPONENTS	WEATHERING CLASSIFICATION	MOISTURE CLASSIFICATION	CONSISTENCY / DENSITY CLASSIFICATION	ESTIMATED SOIL SHEAR STRENGTH (Su, kPa)	DEFECTS, STRUCTURE, COMMENTS	UNIT
1 2 3	Pit walls stable	DRY 23/02/2022			86	0	TS	*0.00m:* SILT, some sand, minor clay, trace organics; dark brown. Firm, moist, low plasticity. Sand, fine. (TOPSOIL?).		M	F			Top
								0.30m: Silty SAND, some gravel, trace clay; grey. Medium dense, wet.		W	MD			
						1		*0.65m:* SILT, some sand and some gravel, minor clay; grey mottled orange. Stiff, wet, low plasticity.			St			
					85			*1.20m:* Sandy fine to coarse GRAVEL, some silt; light greyish brown. Loose, wet. Gravel, sub-rounded to sub-angular; sand, fine to coarse.			L			Colluvium Deposits
					84	2								
					83	3								
					82	4		*4.00m:* Sandy fine to coarse GRAVEL, some cobbles, minor silt; light greyish brown. Loose, wet. Gravel, sub-rounded to sub-angular, moderately to highly weathered; sand, fine to coarse; cobbles, up to 200mm.						
					81	5		4.4m: END OF INVESTIGATION						

SKETCH / PHOTO:

COMMENTS:

Hole Depth 4.4m

Scale 1:50

Rev.: A

EXCAVATION LOG

Excavation Id.: **TP30-22**

SHEET: 1 OF 1

PROJECT: Maitahi		LOCATION: Kaka Valley		JOB No.: 1012397.1000.1000	
CO-ORDINATES: (NZTM2000)	5431594 mN 1625465 mE	METHOD:	Trial pit/trench	EXCAV. STARTED:	22/02/2022
		EQUIPMENT:	20T Excavator	EXCAV. FINISHED:	22/02/2022
R.L.:	135m	OPERATOR:	Bill	LOGGED BY:	AMHO
DATUM:	NZVD2016	DIMENSIONS:	4m by 1.5m	CHECKED BY:	SCON

EXCAVATION TESTS | ENGINEERING DESCRIPTION | GEOLOGICAL

PENETRATION	SUPPORT	WATER	SAMPLES, TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	SOIL NAME, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, SECONDARY AND MINOR COMPONENTS	WEATHERING CLASSIFICATION	MOISTURE CLASSIFICATION	CONSISTENCY / DENSITY CLASSIFICATION	ESTIMATED SOIL SHEAR STRENGTH (Su, kPa)	DEFECTS, STRUCTURE, COMMENTS	UNIT
1 2 3							TS	*0.00m:* SILT, some sand, minor clay, trace organics; dark brown. Stiff, moist, low plasticity. (TOPSOIL).		M	St	VS 12 S 25 F 50 St 100 VSt 200 H		Top
	Pit walls stable	DRY 22/02/2022			134			*0.20m:* SILT, some clay, minor sand, trace gravel; light brown. Stiff, moist, low plasticity. Gravel, fine to coarse, sub-angular to angular, volcanic, greenish. (RESIDUAL SOIL).			MD			
					133	1		*0.55m:* Silty fine to coarse GRAVEL, some sand, trace clay; light brown. Medium dense, moist. Gravel, sub-angular to angular, volcanic, greenish. (RESIDUAL SOIL).			St			
					132	2		*1.10m:* SILT, some clay, minor gravel; light brown. Stiff, moist, non-plastic. (RESIDUAL SOIL).	CW		EW			Botanical Hill Formation
					131	3		*1.40m:* Completely weathered, dark reddish brown, heavily jointed, tuffaceous BRECCIA. Extremely weak. Recovered as: Cobbly fine to coarse GRAVEL, some sand, minor silt; reddish brown. Tightly packed, moist, oxidised staining. Gravel, sub-angular to angular, highly weathered, volcanic, greenish; cobbles, up to 60mm.						
					130	4		3.5m: END OF INVESTIGATION						
					129	5								

SKETCH / PHOTO:

COMMENTS:

Hole Depth 3.5m

Scale 1:50

Rev.: A

EXCAVATION LOG

Excavation Id.: **TP31a-22**

SHEET: 1 OF 1

PROJECT: Maitahi	LOCATION: Kaka Valley		JOB No.: 1012397.1000.1000
CO-ORDINATES: (NZTM2000) 5431681 mN 1625941 mE	METHOD: Trial pit/trench	EXCAV. STARTED: 25/02/2022	
	EQUIPMENT: 20T	EXCAV. FINISHED: 25/02/2022	
R.L.: 2m	OPERATOR: Bill	LOGGED BY: RH	
DATUM: ELLIPSOID	DIMENSIONS: 31m by 2m	CHECKED BY: SCON	

EXCAVATION TESTS | ENGINEERING DESCRIPTION | GEOLOGICAL

PENETRATION	SUPPORT	WATER	SAMPLES, TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	SOIL NAME, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, SECONDARY AND MINOR COMPONENTS	WEATHERING CLASSIFICATION	MOISTURE CLASSIFICATION	CONSISTENCY / DENSITY CLASSIFICATION	ESTIMATED SOIL SHEAR STRENGTH (Su, kPa)	DEFECTS, STRUCTURE, COMMENTS	UNIT
1 2 3					1	1	TS	*0.00m:* Gravelly SILT, minor sand; dark brown. Very soft, moist, non-plastic. *0.15m:* CLAY, some silt, minor gravel; light yellowish brown. Firm, moist, medium plasticity. (RESIDUAL SOIL).		M	VS / F	VS 12 25 50 100 200 H	*0.0 - 2.0m:* 31a	Top
	Pit walls stable				0	2		*1.00m:* Moderately weathered, light brown, blocky, tuffaceous SILTSTONE. Weak. Annealed fractures with black oxidisation. Bedding typically thin to moderately thin.	MW		W		*1.6 - 1.6m:* Base of trench varied showing that rock weathering and strength varies	Grampian Formation
					-1	3		2m: Refusal						
					-2	4								
					-3	5								
					-4									

SKETCH / PHOTO:

COMMENTS: Aim to locate mapped fault

Hole Depth 2m

Scale 1:50

Rev.: A

EXCAVATION LOG

Excavation Id.: **TP31b-22**

SHEET: 1 OF 1

PROJECT: Maitahi		LOCATION: Kaka Valley		JOB No.: 1012397.1000.1000	
CO-ORDINATES: (NZTM2000)	5431729 mN 1625932 mE	METHOD:	Trial pit/trench	EXCAV. STARTED:	25/02/2022
		EQUIPMENT:	20T	EXCAV. FINISHED:	25/02/2022
R.L.:	2m	OPERATOR:	Bill	LOGGED BY:	RH
DATUM:	ELLIPSOID	DIMENSIONS:	31m by 2m	CHECKED BY:	SCON

EXCAVATION TESTS					ENGINEERING DESCRIPTION						GEOLOGICAL	
PENETRATION (1 2 3)	SUPPORT	WATER	SAMPLES, TESTS	SAMPLES	RL (m) / DEPTH (m)	GRAPHIC LOG	SOIL NAME, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, SECONDARY AND MINOR COMPONENTS	WEATHERING CLASSIFICATION	MOISTURE CLASSIFICATION	CONSISTENCY / DENSITY CLASSIFICATION	ESTIMATED SOIL SHEAR STRENGTH (Su, kPa) (VS 12 25 50 100 200 H)	DEFECTS, STRUCTURE, COMMENTS	UNIT
	Pit walls stable				1 / 1 0 / 2 -1 / 3 -2 / 4 -3 / 5 -4	TS	*0.00m:* SILT, some gravel; Dark Brown. Very soft, moist, non-plastic. *0.10m:* Moderately weathered, greenish grey, bedded, blocky, SANDSTONE. Moderately strong. Joints and bedding are weathered with orange- brown to dark brown oxidation. Bedding. 1.5m: Refusal	MW	M	VS MS	VS		Top Whakapuaka Phyollonite

SKETCH / PHOTO:

COMMENTS: Trench. Also refer to 31a

Hole Depth 1.5m

Scale 1:50

Rev.: A

EXCAVATION LOG

Excavation Id.: **TP31c-22 fault**

SHEET: 1 OF 1

PROJECT: Maitahi		LOCATION: Kaka Valley		JOB No.: 1012397.1000.1000	
CO-ORDINATES: (NZTM2000)	5431696 mN 1625942 mE	METHOD:	Trial pit/trench	EXCAV. STARTED:	25/02/2022
		EQUIPMENT:	20T	EXCAV. FINISHED:	25/02/2022
R.L.:	2m	OPERATOR:	Bill	LOGGED BY:	RH
DATUM:	ELLIPSOID	DIMENSIONS:	31m by 2m	CHECKED BY:	SCON

EXCAVATION TESTS					ENGINEERING DESCRIPTION					GEOLOGICAL	
PENETRATION (1 2 3)	SUPPORT	WATER	SAMPLES, TESTS	SAMPLES	RL (m) / DEPTH (m)	GRAPHIC LOG	SOIL NAME, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, SECONDARY AND MINOR COMPONENTS	WEATHERING CLASSIFICATION	MOISTURE CLASSIFICATION	CONSISTENCY / DENSITY CLASSIFICATION	ESTIMATED SOIL SHEAR STRENGTH (Su, kPa) (VS 12 25 50 100 200 H)	DEFECTS, STRUCTURE, COMMENTS	UNIT
	Pit walls stable	DRY 25/02/2022			1 / 1 0 / 2 -1 / 3 -2 / 4 -3 / 5 -4		*0.00m:* Highly weathered, light brown to light grey, sheared and blocky, SILTSTONE. Very weak. Lenses of highly plastic clay (fault gorge). Fault zone is approximately 1.5m wide. Zone appears generally vertical in trench. 1.5m: Refusal	HW		VW			

SKETCH / PHOTO:

COMMENTS:

Hole Depth 1.5m

Scale 1:50

Rev.: A

EXCAVATION LOG

Excavation Id.: **TP32-23**

SHEET: 1 OF 1

PROJECT: Maitahi	LOCATION: Kaka Valley		JOB No.: 1012397.1000.1000
CO-ORDINATES: (NZTM2000) 5431481 mN 1625996 mE	METHOD: Trial pit/trench	EXCAV. STARTED: 27/11/2023	
	EQUIPMENT: 22T Excavator	EXCAV. FINISHED: 27/11/2023	
R.L.: 26m	OPERATOR: Ching	LOGGED BY: ANCO	
DATUM: NZVD2016	DIMENSIONS: 10m by 1.2m	CHECKED BY: JXWW	

EXCAVATION TESTS | ENGINEERING DESCRIPTION | GEOLOGICAL

PENETRATION	SUPPORT	WATER	SAMPLES, TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	SOIL NAME, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, SECONDARY AND MINOR COMPONENTS	WEATHERING CLASSIFICATION	MOISTURE CLASSIFICATION	CONSISTENCY / DENSITY CLASSIFICATION	ESTIMATED SOIL SHEAR STRENGTH (Su, kPa)	DEFECTS, STRUCTURE, COMMENTS	UNIT
1 2 3	Nil	27/11/2023 water inflow			25 24 23 22 21 20	0 1 2 3 4 5	TS TS TS	*0.00m:* Gravelly SILT, some organic; Dark brown. Very soft to soft, dry, non-plastic to low plasticity. *0.30m:* Gravelly SILT; Yellowish - orange - brown to brown. Soft, dry to moist, non-plastic to low plasticity. Gravel, sub-angular, moderately to highly weathered. *0.40m:* Organics sandy SILT; Yellowish - grey mixed with minor dark grey. Soft, dry to moist, non-plastic to low plasticity. *0.70m:* Silty GRAVEL; Reddish - brown. Loosely packed, dry. Gravel, sub-rounded to sub-angular. Appears to be localized (discontinuous lense). *1.00m:* Organic clayey SILT; Dark brown. Very soft to soft, dry to moist, non-plastic to low plasticity. *1.10m:* Clayey sandy SILT; Greenish - grey. Soft to firm, dry to moist, non-plastic to low plasticity. *1.50m:* Organic SILT; Dark brown. Soft to firm, dry to moist, non-plastic to low plasticity. *1.70m:* Gravelly SILT; Orange brown. Loose to medium dense, dry to moist. Localised zones of low plasticity. *2.20m:* Gravelly cobbly SILT; Dark brown. Loose to medium dense, dry to moist. Cobbles, up to 200 mm. Localised zones of low plasticity. *2.50m:* Silty GRAVEL; Orange - brown. Loose to medium dense, moist to wet. Gravel, sub-rounded to sub-angular. Wet - some caving. *3.00m:* Clayey gravelly SILT, some organics and some sand; Greyish blue. Soft to firm, wet, low plasticity. Gravels appear to be coarsing with depth.		D D-M D D-M M-W W	VS-S S LP VS-S-F L-MD S-F		*0.0 - 2.5m:* Stable *2.5m:* Caving	Alluvial Deposits
								5m: Machine limit					*5.0m:* Water pooling in base of test pit	

SKETCH / PHOTO:

COMMENTS:

Hole Depth 5m

Scale 1:50

Rev.: A

EXCAVATION LOG

Excavation Id.: **TP33-23**

SHEET: 1 OF 1

PROJECT: Maitahi	LOCATION: Kaka Valley	JOB No.: 1012397.1000.1000
CO-ORDINATES: (NZTM2000) 5431482 mN 1626033 mE	METHOD: Trial pit/trench	EXCAV. STARTED: 27/11/2023
	EQUIPMENT: 22T Excavator	EXCAV. FINISHED: 27/11/2023
R.L.: 31m	OPERATOR: Ching	LOGGED BY: ANCO
DATUM: NZVD2016	DIMENSIONS: 10m by 1.2m	CHECKED BY: JXWW

EXCAVATION TESTS | ENGINEERING DESCRIPTION | GEOLOGICAL

PENETRATION	SUPPORT	WATER	SAMPLES, TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	SOIL NAME, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, SECONDARY AND MINOR COMPONENTS	WEATHERING CLASSIFICATION	MOISTURE CLASSIFICATION	CONSISTENCY / DENSITY CLASSIFICATION	ESTIMATED SOIL SHEAR STRENGTH (Su, kPa)	DEFECTS, STRUCTURE, COMMENTS	UNIT
1 2 3	Nil	DRY 27/11/2023			30 29 28 27 26	1 2 3 4 5	TS T	*0.00m:* Organic SILT; Dark brown - brown. Soft, dry, non-plastic to low plasticity. *0.40m:* Sandy gravelly SILT; Orange - brown. Soft to firm, dry to moist, non-plastic to low plasticity. *2.50m:* Sandy gravelly SILT, some cobbles; Orange - grey -brown mixed with some blue-green-grey. Soft to firm, moist, low plasticity. Gravel, sub-angular. *5.00m:* Gravel size appears to be increasing with depth 5m: Machine limit		D D-M M	S S-F	VS 12 S 25 F 50 St 100 VSt 200 H	*0.0 - 5.0m:* Stable	TSoil Alluvial Deposits

SKETCH / PHOTO:

COMMENTS:

Hole Depth 5m

Scale 1:50

Rev.: A

EXCAVATION LOG

Excavation Id.: **TP34-23**

SHEET: 1 OF 1

PROJECT: Maitahi	LOCATION: Kaka Valley		JOB No.: 1012397.1000.1000
CO-ORDINATES: (NZTM2000) 5431496 mN 1626201 mE	METHOD: Trial pit/trench	EXCAV. STARTED: 27/11/2023	
	EQUIPMENT: 22T Excavator	EXCAV. FINISHED: 27/11/2023	
R.L.: 60m	OPERATOR: Ching	LOGGED BY: ANCO	
DATUM: NZVD2016	DIMENSIONS: 5m by 1.2m	CHECKED BY: JXWW	

EXCAVATION TESTS | ENGINEERING DESCRIPTION | GEOLOGICAL

PENETRATION	SUPPORT	WATER	SAMPLES, TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	SOIL NAME, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, SECONDARY AND MINOR COMPONENTS	WEATHERING CLASSIFICATION	MOISTURE CLASSIFICATION	CONSISTENCY / DENSITY CLASSIFICATION	ESTIMATED SOIL SHEAR STRENGTH (Su, kPa)	DEFECTS, STRUCTURE, COMMENTS	UNIT
1 2 3	Nil	DRY 27/11/2023			59	1	TS	*0.00m:* Organics clayey SILT, some boulders; brown mixed with some darker brown. Soft, dry, non-plastic to low plasticity.		D	S	VS S F St VSt H 12 25 50 100 200	*0.0 - 1.2m:* Caving	Top
								0.30m: Clayey gravelly SILT, some boulders; Yellowish - orange brown. Loose to medium dense, dry. Boulders, up to 3000mm, rounded to sub-angular, slightly weathered, strong, sandstone, greenish - grey tuffaceous. Locally - low plasticity in matrix material.			L-MD		*0.3m:* Boulders maybe pushed down (side cast) from the track construction?	Fan Deposits
					58			*1.20m:* Unweathered to slightly weathered, Greenish grey, tuffaceous SANDSTONE. Moderately strong to strong, fine to coarse grained, porphyritic.	UW-SW		MS-S		*1.2 - 1.5m:* Boulder?	
						2		1.5m: Machine limit						
					57	3								
					56	4								
					55	5								
					54									

SKETCH / PHOTO:

COMMENTS:

Hole Depth 1.5m

Scale 1:50

Rev.: A

EXCAVATION LOG

Excavation Id.: **TP35-23**

SHEET: 1 OF 1

PROJECT: Maitahi	LOCATION: Kaka Valley		JOB No.: 1012397.1000.1000
CO-ORDINATES: (NZTM2000) 5431486 mN 1626200 mE	METHOD: Trial pit/trench	EXCAV. STARTED: 27/11/2023	
	EQUIPMENT: 22T Excavator	EXCAV. FINISHED: 27/11/2023	
R.L.: 60m	OPERATOR: Ching	LOGGED BY: ANCO	
DATUM: NZVD2016	DIMENSIONS: 10m by 1.2m	CHECKED BY: JXWW	

EXCAVATION TESTS | ENGINEERING DESCRIPTION | GEOLOGICAL

PENETRATION	SUPPORT	WATER	SAMPLES, TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	SOIL NAME, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, SECONDARY AND MINOR COMPONENTS	WEATHERING CLASSIFICATION	MOISTURE CLASSIFICATION	CONSISTENCY / DENSITY CLASSIFICATION	ESTIMATED SOIL SHEAR STRENGTH (Su, kPa)	DEFECTS, STRUCTURE, COMMENTS	UNIT
1 2 3												VS 12 S 25 F 50 St 100 VSt 200 H		
	Nil	DRY 27/11/2023				0.5		*0.00m:* Clayey SILT, some organics; Dark brown to light brown. Very soft to soft, dry, non-plastic to low plasticity.		D	VS-S		*0.0 - 1.1m:* Caving	TSoil
								0.20m: Gravelly SILT; Brown - grey. Loose to medium dense, dry to moist. Gravel, sub-angular. Locally - low plasticity in matrix.		D-M	L-MD			
					59	1.0		*0.60m:* Gravelly bouldery SILT, some clay and some cobbles; Brownish grey. Loose to medium dense, dry. Boulders, rounded; cobbles, rounded to sub-angular. Caving.		D				
						1.5		*1.10m:* Clayey gravelly SILT; Orange - brown. Soft to firm, dry to moist, low plasticity. Gravel, sub-rounded to sub-angular.		D-M	S-F		*1.1 - 2.7m:* Stable	Fan Deposits
					58	2.0								
						2.5		*2.60m:* Slightly to moderately weathered, Orange - brown blue - grey, SANDSTONE. Moderately strong to strong.	SW-[illegible]		MS-S			
					57	3.0		2.7m: Machine limit						

SKETCH / PHOTO:

COMMENTS:

Hole Depth 2.7m

Scale 1:27

Rev.: A

EXCAVATION LOG

Excavation Id.: **TP36-23**

SHEET: 1 OF 1

PROJECT: Maitahi	LOCATION: Kaka Valley		JOB No.: 1012397.1000.1000
CO-ORDINATES: (NZTM2000) 5431467 mN 1626296 mE	METHOD: Trial pit/trench	EXCAV. STARTED: 27/11/2023	
	EQUIPMENT: 22T Excavator	EXCAV. FINISHED: 27/11/2023	
R.L.: 83m	OPERATOR: Ching	LOGGED BY: ANCO	
DATUM: NZVD2016	DIMENSIONS: 10m by 1.2m	CHECKED BY: JXWW	

EXCAVATION TESTS | ENGINEERING DESCRIPTION | GEOLOGICAL

PENETRATION	SUPPORT	WATER	SAMPLES, TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	SOIL NAME, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, SECONDARY AND MINOR COMPONENTS	WEATHERING CLASSIFICATION	MOISTURE CLASSIFICATION	CONSISTENCY / DENSITY CLASSIFICATION	ESTIMATED SOIL SHEAR STRENGTH (Su, kPa)	DEFECTS, STRUCTURE, COMMENTS	UNIT
1 2 3	Nil	DRY; 27/11/2023			82	0.5		*0.00m:* SILT, some organics and some clay; Dark brown. Soft, dry, non-plastic to low plasticity.		D	S	VS 12 S 25 F 50 St 100 VSt 200 H	*0.0 - 0.6m:* Caving	TSoil
								0.35m: Cobbly bouldery SILT, some clay and some sand; Orange - brown. Soft to firm, dry to moist, low plasticity. Boulders, sub-rounded to sub-angular, slightly weathered, strong to very strong, blue brown.		D-M	S-F		*0.6 - 1.0m:* Boulder? *0.6 - 3.1m:* Stable	
								0.60m: Slightly to moderately weathered, brownish - blue - grey, SANDSTONE - boulder. Strong to very strong.						
					81	1.0 / 1.5		*1.00m:* Gravelly bouldery SILT, some clay; Orange - brown. Soft to firm, moist, low plasticity. Gravel, sub-rounded to sub-angular; boulders, sub-rounded to sub-angular, sandstone.		M	S-F			Fan Deposits
					80	2.0 / 2.5								
						3.0		*3.00m:* Slightly to moderately weathered, Brownish blue-grey, SANDSTONE. Moderately strong to strong.	SW-		MS-			
					79	3.5		3.1m: Machine limit						

SKETCH / PHOTO:

COMMENTS:

Hole Depth 3.1m

Scale 1:33

Rev.: A

EXCAVATION LOG

Excavation Id.: **TP37-23**

SHEET: 1 OF 1

PROJECT: Maitahi	LOCATION: Kaka Valley	JOB No.: 1012397.1000.1000
CO-ORDINATES: 5431464 mN (NZTM2000) 1626468 mE	METHOD: Trial pit/trench	EXCAV. STARTED: 27/11/2023
	EQUIPMENT: 22T Excavator	EXCAV. FINISHED: 27/11/2023
R.L.: 133m	OPERATOR: Ching	LOGGED BY: ANCO
DATUM: NZVD2016	DIMENSIONS: 5m by 1.2m	CHECKED BY: JXWW

EXCAVATION TESTS | ENGINEERING DESCRIPTION | GEOLOGICAL

PENETRATION	SUPPORT	WATER	SAMPLES, TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	SOIL NAME, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, SECONDARY AND MINOR COMPONENTS	WEATHERING CLASSIFICATION	MOISTURE CLASSIFICATION	CONSISTENCY / DENSITY CLASSIFICATION	ESTIMATED SOIL SHEAR STRENGTH (Su, kPa)	DEFECTS, STRUCTURE, COMMENTS	UNIT
1 2 3	Nil	DRY 27/11/2023			132	0		*0.00m:* Gravelly cobbly SILT, minor clay; Orange - brown. Firm to stiff, dry to moist, low plasticity.		D-M	F-St	VS 12 S 25 F 50 St 100 VSt 200 H	*0.0 - 3.0m:* Stable	Fan Deposits
					131	1		*0.80m:* Tuffaceous SANDSTONE. Medium to coarse grained, porphyritic.	MW-HW		W-MS			Grampian Formation
					130	2		*0.80 - 2.00m:* Moderately to highly weathered, Orange - brown to dark brown mixed with some greenish - grey. Weak to moderately strong.						
					129	3		*2.00 - 3.00m:* Slightly to moderately weathered, Blue - brown grey to greenish - grey , tuffaceous . Strong.	SW-MW		S			
					128	4		3m: Machine limit						
					127	5								

SKETCH / PHOTO:

COMMENTS:

Hole Depth 3m

Scale 1:50

Rev.: A

EXCAVATION LOG

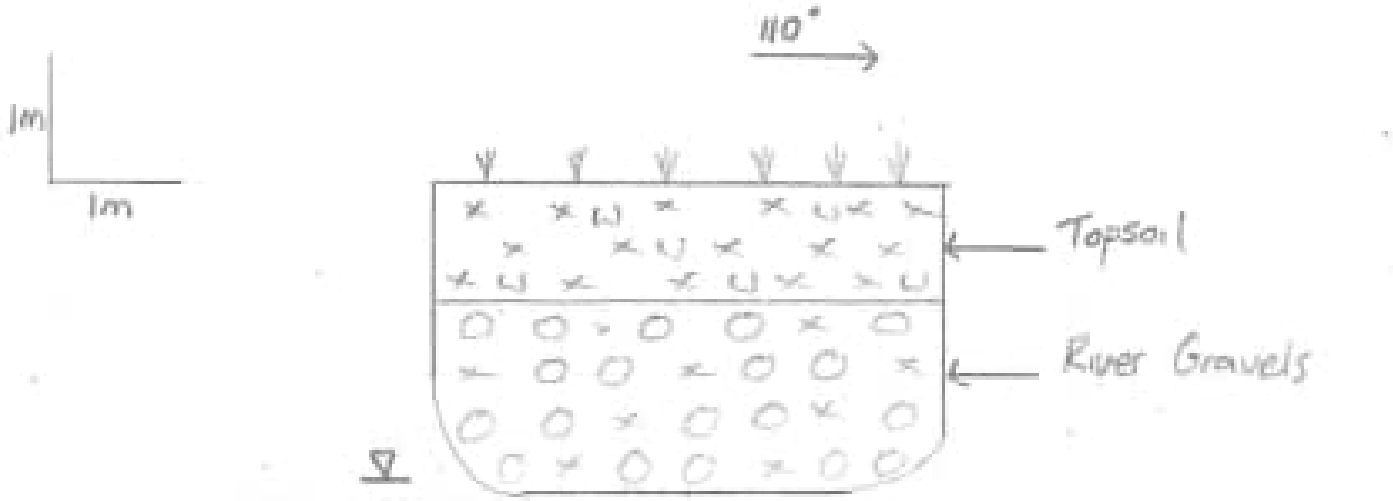
Excavation Id.: **TP1**

SHEET: 1 OF 1

PROJECT: Kaka Hill Subdivision	LOCATION: Kaka Hill Subdivision		JOB No.: 1012397.0000
CO-ORDINATES: (NZTM2000) 5431142.12 mN 1625911.12 mE	EXPOSURE METHOD: TP	EXCAV. STARTED: 06/11/2019	
	EQUIPMENT: 20 T Excavator	EXCAV. FINISHED: 06/11/2019	
R.L.: 15.60m	OPERATOR: Tony	LOGGED BY: SAPR	
DATUM: NZVD2016	DIMENSIONS: 4m by 1.2m	CHECKED BY: MJL	

EXCAVATION TESTS					ENGINEERING DESCRIPTION						GEOLOGICAL	
PENETRATION	SUPPORT	WATER	SAMPLES, TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	SOIL NAME, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, SECONDARY AND MINOR COMPONENTS	MOISTURE / WEATHERING CONDITION	STRENGTH/DENSITY CLASSIFICATION	ESTIMATED SHEAR STRENGTH (kPa)	DEFECTS, STRUCTURE, COMMENTS	UNIT
1 2 3	Whole testpit wall collapse	06/11/2019 ▼			15	0.5	TS	SILT; dark brown. Soft, dry, low plasticity. Contains organics	D	S	10 25 50 100 200		Topsoil
					14	1.0 1.5 2.0		Silty Gravelly COBBLE with some boulders and minor clay; dark brown. Moderately tightly packed, moist to wet, well graded. Gravel, cobbles and boulders are sub-rounded to rounded.	M W	MD			Alluvial Deposits
					13	2.5		2.4m: Collapse					
					12	3.0 3.5							
					11	4.0 4.5							

SKETCH / PHOTO:



COMMENTS:

Hole Depth 2.4m

Scale 1:42

Rev.: B

EXCAVATION LOG

Excavation Id.: **TP2**

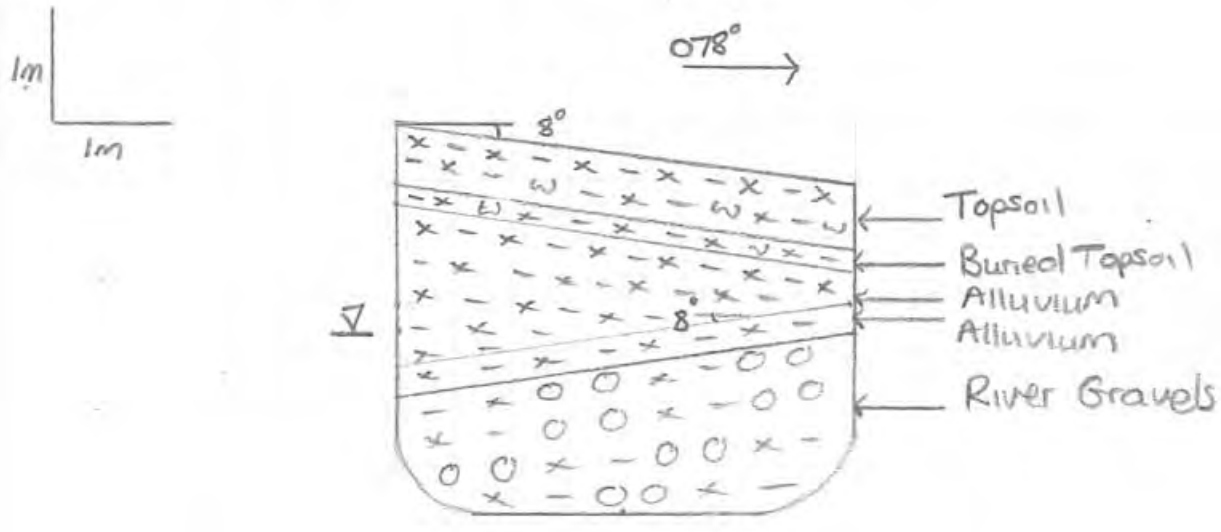
SHEET: 1 OF 1

PROJECT: Kaka Hill Subdivision	LOCATION: Kaka Hill Subdivision		JOB No.: 1012397.0000
CO-ORDINATES: (NZTM2000) 5431282.41 mN 1625819.34 mE	EXPOSURE METHOD: TP	EXCAV. STARTED: 06/11/2019	
	EQUIPMENT: 20 T Excavator	EXCAV. FINISHED: 06/11/2019	
R.L.: 15.90m	OPERATOR: Tony	LOGGED BY: SAPR	
DATUM: NZVD2016	DIMENSIONS: 4m by 1.2m	CHECKED BY: MJL	

EXCAVATION TESTS | ENGINEERING DESCRIPTION | GEOLOGICAL

PENETRATION	SUPPORT	WATER	SAMPLES, TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	SOIL NAME, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, SECONDARY AND MINOR COMPONENTS	MOISTURE CONDITION	WEATHERING	STRENGTH/DENSITY CLASSIFICATION	ESTIMATED SHEAR STRENGTH (kPa)	DEFECTS, STRUCTURE, COMMENTS	UNIT
1 2 3								Clayey SILT; dark brown. Firm, moist, low plasticity. Contains organics.	M		F	10 25 50 100 200		Topsoil
	Whole test pit wall collapse	08/11/2019 Seepage			15	0.5	TS	Clayey SILT; blackish dark brown. Firm, moist, low plasticity, Contains organics.						
						1.0	TS	Silty CLAY; light grey with orange mottle. Firm, moist, high plasticity. Contains rootlets						
						1.5		Silty CLAY; light bluish grey. Firm, moist, high plasticity.						Alluvial Deposits
					14	2.0		Clayey silty GRAVEL with some cobbles; light bluish grey. Moderately tightly packed, wet, well graded. Gravel subrounded to rounded.	S		MD			
						2.5		Clayey silty gravelly COBBLES; light brown. Moderately tightly packed, wet, well graded. Gravel and cobbles subrounded to rounded.						
					13	3.0								
						3.5		3.4m: Collapse						
					12	4.0								
						4.5								
					11									

SKETCH / PHOTO



COMMENTS:

Hole Depth 3.4m

Scale 1:42

Rev.: B

EXCAVATION LOG

Excavation Id.: **TP3**

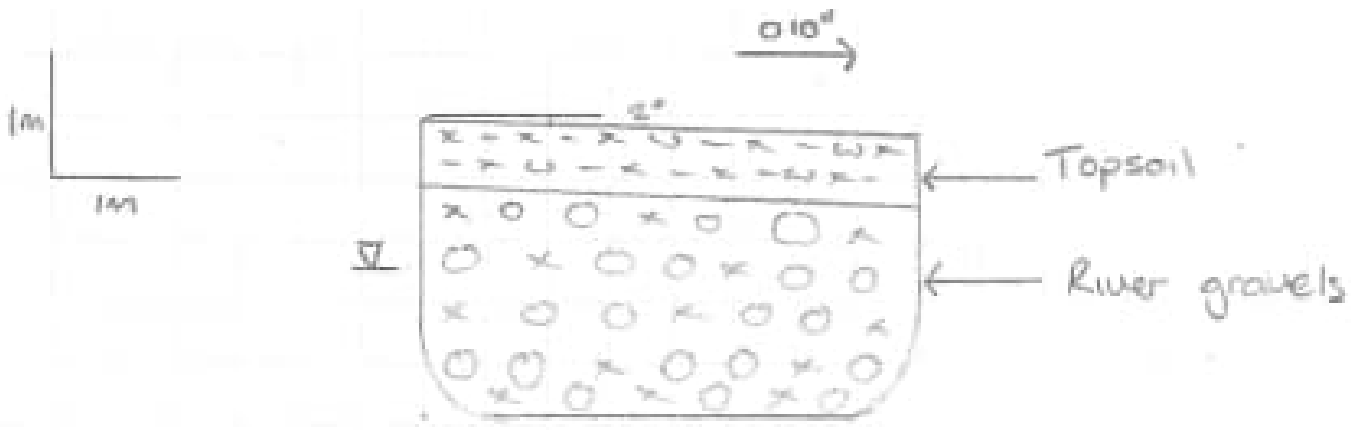
SHEET: 1 OF 1

PROJECT: Kaka Hill Subdivision	LOCATION: Kaka Hill Subdivision		JOB No.: 1012397.0000
CO-ORDINATES: (NZTM2000) 5431319.85 mN 1625935.82 mE	EXPOSURE METHOD: TP	EXCAV. STARTED: 06/11/2019	
	EQUIPMENT: 20 T Excavator	EXCAV. FINISHED: 06/11/2019	
R.L.: 18.00m	OPERATOR: Tony	LOGGED BY: SAPR	
DATUM: NZVD2016	DIMENSIONS: 4m by 1.2m	CHECKED BY: MJL	

EXCAVATION TESTS | ENGINEERING DESCRIPTION | GEOLOGICAL

PENETRATION	SUPPORT	WATER	SAMPLES, TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	SOIL NAME, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, SECONDARY AND MINOR COMPONENTS	MOISTURE \ WEATHERING CONDITION	STRENGTH/DENSITY CLASSIFICATION	ESTIMATED SHEAR STRENGTH (kPa)	DEFECTS, STRUCTURE, COMMENTS	UNIT
1 2 3	Whole test pit wall collapse	06/11/2019			17	0.5	TS	Clayey SILT; dark brown. Firm, moist, low plasticity. Contains organics.	M	F	10 25 50 100 200		TSoil
					16	1.0		Silty gravelly COBBLES with minor sand and clay and local boulders; light greyish brown. Moderately tightly packed, wet. Gravel subrounded to rounded.	W	MD			Alluvial Deposits
					15	1.5							
					14	2.0							
						2.5		2.4m: Collapse					
						3.0							
						3.5							
						4.0							
						4.5							

SKETCH / PHOTO:



COMMENTS:

Hole Depth 2.4m

Scale 1:42

Rev.: B

EXCAVATION LOG

Excavation Id.: **TP4**

SHEET: 1 OF 1

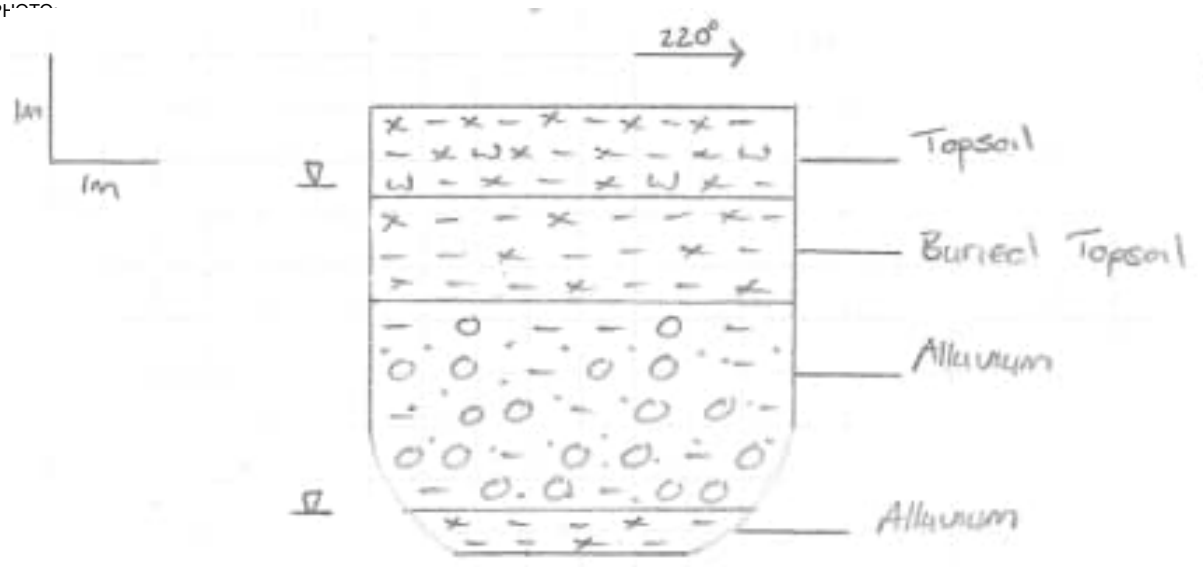
PROJECT: Kaka Hill Subdivision	LOCATION: Kaka Hill Subdivision	JOB No.: 1012397.0000

CO-ORDINATES: (NZTM2000)	5431189.73 mN 1626047.35 mE	EXPOSURE METHOD:	TP	EXCAV. STARTED:	06/11/2019
		EQUIPMENT:	20 T Excavator	EXCAV. FINISHED:	06/11/2019
R.L.:	16.60m	OPERATOR:	Tony	LOGGED BY:	SAPR
DATUM:	NZVD2016	DIMENSIONS:	4m by 1.2m	CHECKED BY:	MJL

EXCAVATION TESTS | ENGINEERING DESCRIPTION | GEOLOGICAL

PENETRATION	SUPPORT	WATER	SAMPLES, TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	SOIL NAME, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, SECONDARY AND MINOR COMPONENTS	MOISTURE / WEATHERING CONDITION	STRENGTH/DENSITY CLASSIFICATION	ESTIMATED SHEAR STRENGTH (kPa)	DEFECTS, STRUCTURE, COMMENTS	UNIT
1 2 3	Whole test pit wall collapse	06/11/2019 Seepage 06/11/2019			16 15 14 13 12	0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5	TS TS	Clayey SILT; dark brown. Soft, moist to wet, low plasticity. Contains organics.	M	S	10 25 50 100 200		Topsoil
								Silty CLAY; orangy brown. Firm, wet, high plasticity. Contains organics.	W	F			Colluvium Deposits
								Clayey sandy GRAVEL; light bluish grey. Moderately tightly packed, wet, well graded. Contains rootlets, Gravel sub-rounded to rounded. 2.3 - 3.8m: Gravel content increases and some cobbles, minor boulders.		MD D			Alluvial Deposits
								Silty CLAY; light bluish grey. Firm, wet, high plasticity.		F			
								4.2m: Collapse					

SKETCH / PHOTO



COMMENTS:

Hole Depth 4.2m

Scale 1:42

Rev.: B

Tonkin+Taylor

EXCAVATION LOG

Excavation Id.: **TP5**

SHEET: 1 OF 1

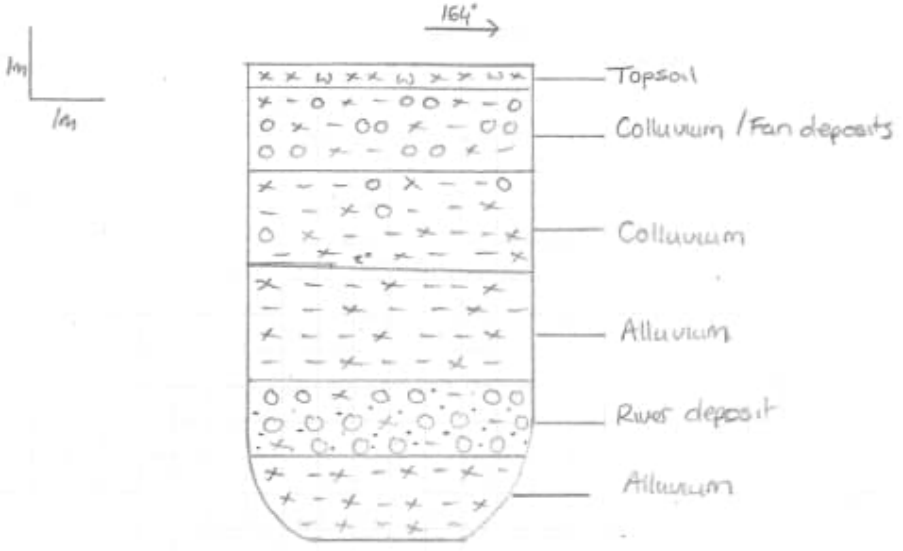
PROJECT: Kaka Hill Subdivision	LOCATION: Kaka Hill Subdivision	JOB No.: 1012397.0000

CO-ORDINATES: (NZTM2000) 5431266.28 mN 1626071.97 mE	EXPOSURE METHOD: TP	EXCAV. STARTED: 08/11/2019	
	EQUIPMENT: 20 T Excavator	EXCAV. FINISHED: 08/11/2019	
R.L.: 23.70m	OPERATOR: Tony	LOGGED BY: SAPR	
DATUM: NZVD2016	DIMENSIONS: 4m by 1.2m	CHECKED BY: MJL	

EXCAVATION TESTS | ENGINEERING DESCRIPTION | GEOLOGICAL

PENETRATION	SUPPORT	WATER	SAMPLES, TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	SOIL NAME, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, SECONDARY AND MINOR COMPONENTS	MOISTURE / WEATHERING CONDITION	STRENGTH/DENSITY CLASSIFICATION	ESTIMATED SHEAR STRENGTH (kPa)	DEFECTS, STRUCTURE, COMMENTS	UNIT
1 2 3	None-Stable	08/11/2019 Seepage			23	0		SILT; dark brown. Soft, dry, low plasticity	D	S	10 25 50 100 200		Top
								Clayey silty GRAVEL; orangy brown. Moderately tightly packed, dry, well graded. Gravel subrounded.		MD			
					22	1		Silty CLAY with some gravel; creamy grey with orange mottle. Firm, moist, high plasticity.	M	F			
					21	2		Silty CLAY; light greyish blue. Soft, moist, high plasticiy. Contains rootlets.		S			Alluvial Deposits
					20	3							
					19	4		Sandy GRAVEL with some silt and clay and local cobble; light greyish brown. Moderately tightly packed, wet, well graded. Gravel sub-rounded to rounded.	W	MD			
					18	5		Silty CLAY; light blusih grey. Firm, moist, high plasticity. Contains rootlets.	M	F			
					17	6		6.6m: Machine limit					
					16	7							

SKETCH / PHOTO:



COMMENTS:

Hole Depth 6.6m

Scale 1:67

Rev.: B

Tonkin+Taylor

EXCAVATION LOG

Excavation Id.: **TP6**

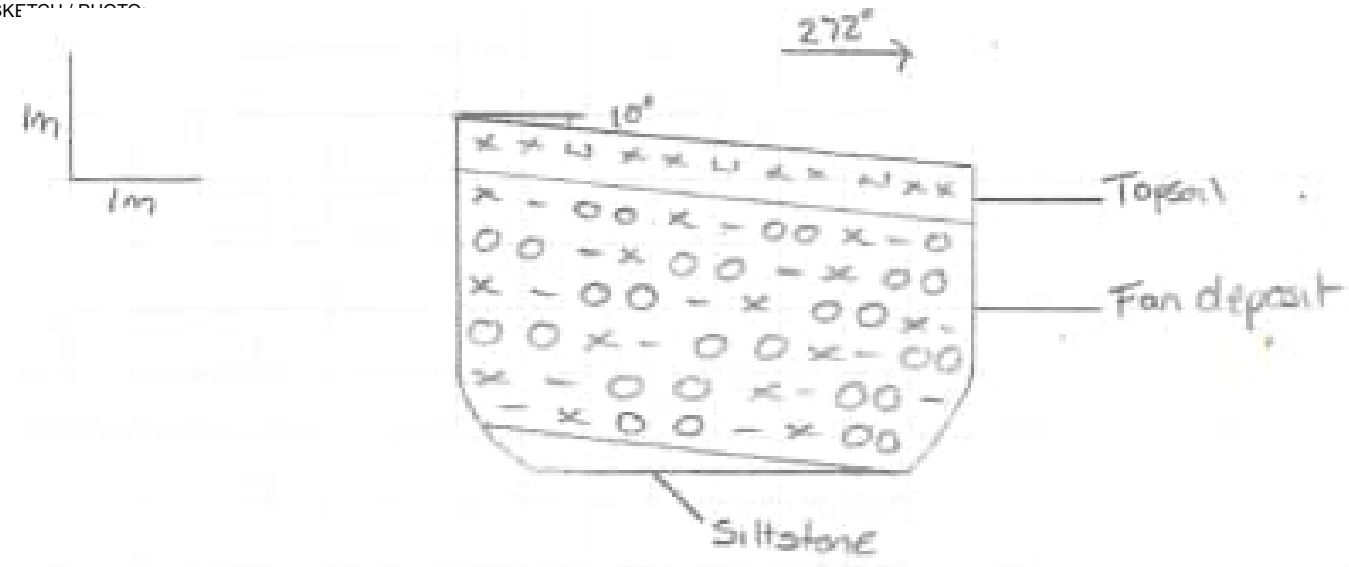
SHEET: 1 OF 1

PROJECT: Kaka Hill Subdivision		LOCATION: Kaka Hill Subdivision	JOB No.: 1012397.0000
CO-ORDINATES: (NZTM2000)	5431207.53 mN 1626191.71 mE	EXPOSURE METHOD: TP EQUIPMENT: 20 T Excavator	EXCAV. STARTED: 07/11/2019 EXCAV. FINISHED: 07/11/2019
R.L.:	32.00m	OPERATOR: Tony	LOGGED BY: SAPR
DATUM:	NZVD2016	DIMENSIONS: 4m by 1.2m	CHECKED BY: MJL

EXCAVATION TESTS | ENGINEERING DESCRIPTION | GEOLOGICAL

PENETRATION	SUPPORT	WATER	SAMPLES, TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	SOIL NAME, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, SECONDARY AND MINOR COMPONENTS	MOISTURE \ WEATHERING CONDITION	STRENGTH/DENSITY CLASSIFICATION	ESTIMATED SHEAR STRENGTH (kPa)	DEFECTS, STRUCTURE, COMMENTS	UNIT
1 2 3	None-Stable	DRY 07/11/2019			31 30 29 28	0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5	TS	SILT; dark brown. Soft, dry, low plasticity. Contains organics.	D	S	10 25 50 100 200		TSoil
								Silty clayey GRAVEL with some cobbles and boulders; orangy brown. Moderately tightly packed, moist. Gravel, sub-rounded to sub-angular clasts of tuff and mudstone.	M	MD			Fan Deposits
								Moderately weathered; dark brownish grey, laminated SILTSTONE. Weak, highly fractured. Excavates as 20-60 mm angular clasts, local 100 mm.					BotHillFm
								2.8m: Machine limit					

SKETCH / PHOTO



COMMENTS:

Hole Depth 2.8m

Scale 1:42

Rev.: A

EXCAVATION LOG

Excavation Id.: **TP7**

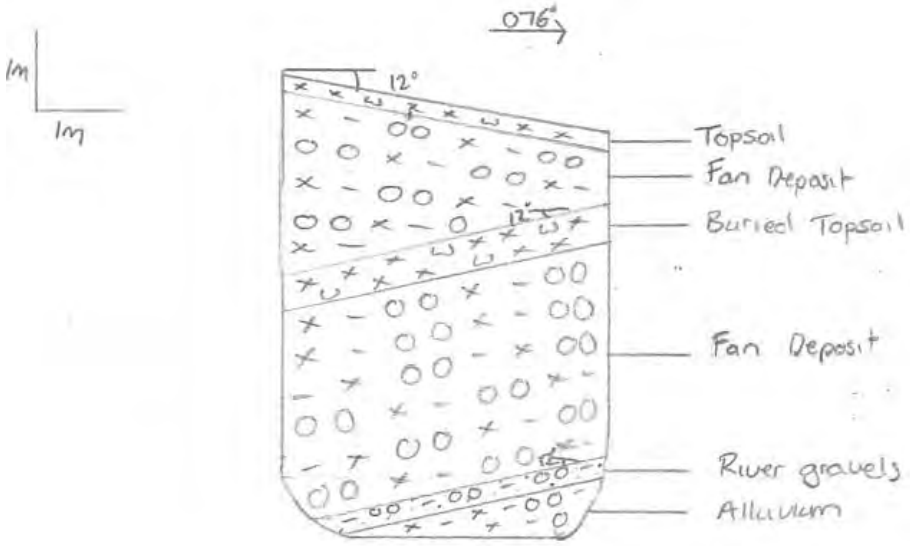
SHEET: 1 OF 1

PROJECT: Kaka Hill Subdivision	LOCATION: Kaka Hill Subdivision		JOB No.: 1012397.0000
CO-ORDINATES: (NZTM2000) 5431110.00 mN 1626165.00 mE	EXPOSURE METHOD: TP	EXCAV. STARTED: 07/11/2019	
	EQUIPMENT: 20 T Excavator	EXCAV. FINISHED: 07/11/2019	
R.L.: 29.70m	OPERATOR: Tony	LOGGED BY: SAPR	
DATUM: NZVD2016	DIMENSIONS: 4m by 1.2m	CHECKED BY: MJL	

EXCAVATION TESTS | ENGINEERING DESCRIPTION | GEOLOGICAL

PENETRATION	SUPPORT	WATER	SAMPLES, TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	SOIL NAME, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, SECONDARY AND MINOR COMPONENTS	MOISTURE CONDITION	WEATHERING	STRENGTH/DENSITY CLASSIFICATION	ESTIMATED SHEAR STRENGTH (kPa)	DEFECTS, STRUCTURE, COMMENTS	UNIT
1 2 3	Non-Stable	07/11/2019 Seepage			29	1		SILT; dark brown. Soft, dry, low plasticity. Contains rootlets.	D		S	10 25 50 100 200		Top
								Silty clayey GRAVEL with some cobbles; orangy brown. Moderately tightly packed, dry, well graded. Gravel sub-rounded tuff.			MD			Fan Deposits
					28	2	TS	SILT; dark brown. Firm, dry, low plasticity. Contains organics.			F			TSoil
					27	3		Silty clayey GRAVEL with some cobbles; orangy brown. Moderately tightly packed, moist, well graded. Gravel sub rounded tuff.	M		MD			Alluvial Deposits
					26	4								
					25	5		Sandy clayey GRAVEL with some cobbles; light bluish grey. Moderately tightly packed, wet, well graded. Gravel sub-rounded.	W					
								Silty CLAY with some gravel; light bluish grey. Firm, wet, moderate plasticity.			F			
					24	6		5.7m: Machine limit						
					23	7								
					22									

SKETCH / PHOTO:



COMMENTS:

Hole Depth 5.7m

Scale 1:67

Rev.: B

EXCAVATION LOG

Excavation Id.: **TP8**

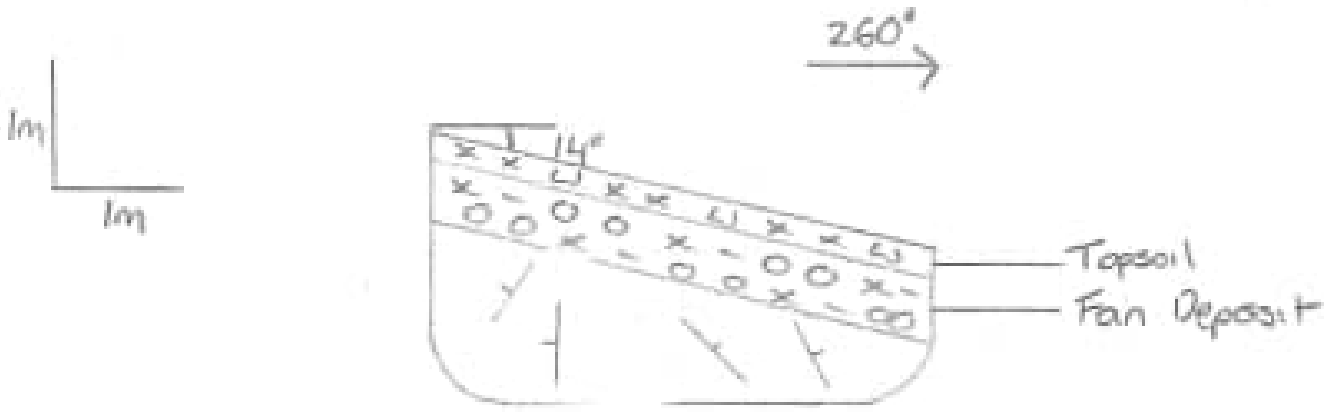
SHEET: 1 OF 1

PROJECT: Kaka Hill Subdivision	LOCATION: Kaka Hill Subdivision		JOB No.: 1012397.0000
CO-ORDINATES: (NZTM2000) 5431105.00 mN 1626314.00 mE	EXPOSURE METHOD: TP	EXCAV. STARTED: 07/11/2019	
	EQUIPMENT: 20 T Excavator	EXCAV. FINISHED: 07/11/2019	
R.L.: 56.80m	OPERATOR: Tony	LOGGED BY: SAPR	
DATUM: NZVD2016	DIMENSIONS: 4m by 1.2m	CHECKED BY: MJL	

EXCAVATION TESTS | ENGINEERING DESCRIPTION | GEOLOGICAL

PENETRATION	SUPPORT	WATER	SAMPLES, TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	SOIL NAME, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, SECONDARY AND MINOR COMPONENTS	MOISTURE / WEATHERING CONDITION	STRENGTH/DENSITY CLASSIFICATION	ESTIMATED SHEAR STRENGTH (kPa)	DEFECTS, STRUCTURE, COMMENTS	UNIT
1 2 3	None-Stable	DRY 07/11/2019			56	0.5		SILT; dark brown. Firm, dry, low plasticity. Contains organics.	D	F	10 25 50 100 200		Top
								Silty clayey GRAVEL with some cobbles; orangy brown. Moderately tightly packed, moist, well graded. Gravel, sub-rounded to sub-angular clasts of tuff.	M	MD			FanDepst
					55	1.0 1.5 2.0		Moderately weathered, light greeny grey TUFF. Strong, 4 joint sets (52/34,50/358, 48/216, 40/316). Excavates as 60-200 mm angular clasts.					Kaka Formation
					54	2.5 3.0 3.5		2.2m: Machine limit					
					53	4.0							
					52	4.5							

SKETCH / PHOTO:



COMMENTS:

Hole Depth 2.2m

Scale 1:42

Rev.: A

EXCAVATION LOG

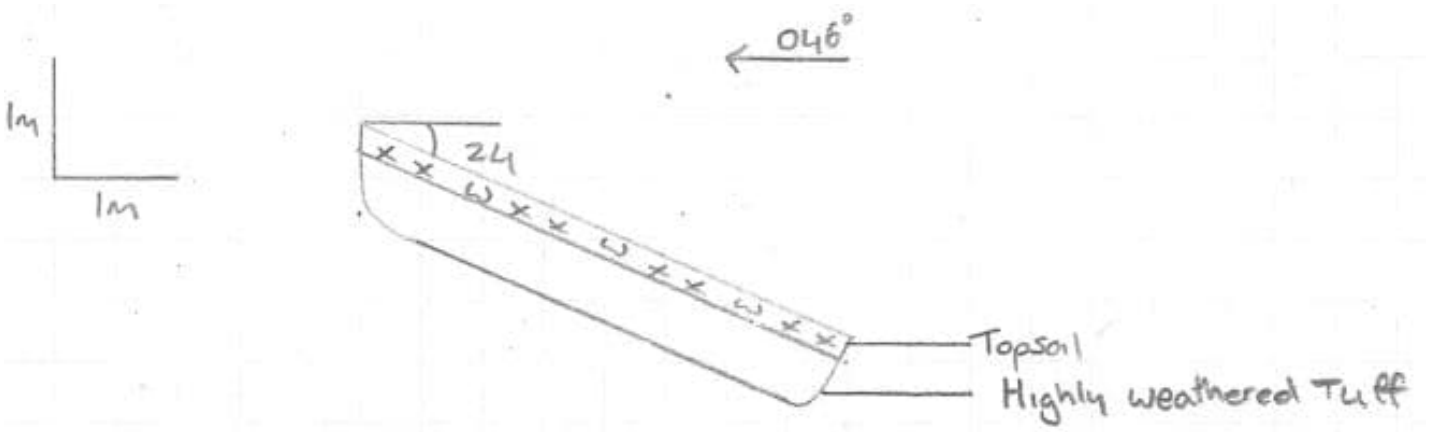
Excavation Id.: **TP9**

SHEET: 1 OF 1

PROJECT: Kaka Hill Subdivision	LOCATION: Kaka Hill Subdivision		JOB No.: 1012397.0000
CO-ORDINATES: (NZTM2000) 5431299.59 mN 1626192.49 mE	EXPOSURE METHOD: TP	EXCAV. STARTED: 06/11/2019	
	EQUIPMENT: 20 T Excavator	EXCAV. FINISHED: 06/11/2019	
R.L.: 56.40m	OPERATOR: Tony	LOGGED BY: SAPR	
DATUM: NZVD2016	DIMENSIONS: 4m by 1.2m	CHECKED BY: MJL	

EXCAVATION TESTS					ENGINEERING DESCRIPTION						GEOLOGICAL	
PENETRATION	SUPPORT	WATER	SAMPLES, TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	SOIL NAME, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, SECONDARY AND MINOR COMPONENTS	MOISTURE / WEATHERING CONDITION	STRENGTH/DENSITY CLASSIFICATION	ESTIMATED SHEAR STRENGTH (kPa)	DEFECTS, STRUCTURE, COMMENTS	UNIT
1 2 3											10 25 50 100 200		
	None-Stable	DRY 06/11/2019			56	0.5		SILT; dark brown. Firm, dry, low plasticity. Contains organics.	D	F			Top
								Highly weathered, light greeny grey TUFF. Moderately strong, 2 joint sets (58/258, 58/42). Excavating as 40-200 mm angular blocks.					GrmpinFm
								0.7m: Machine limit					
					55	1.0							
						1.5							
						2.0							
					54	2.5							
						3.0							
					53	3.5							
						4.0							
					52	4.5							

SKETCH / PHOTO:



COMMENTS:

Hole Depth 0.7m

Scale 1:42

Rev.: A

EXCAVATION LOG

Excavation Id.: **TP10**

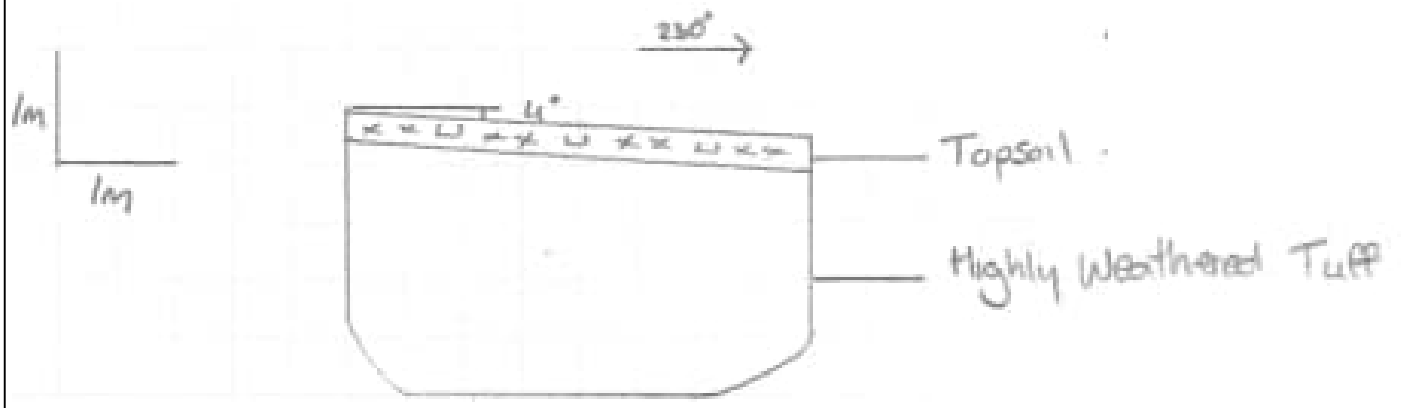
SHEET: 1 OF 1

PROJECT: Kaka Hill Subdivision	LOCATION: Kaka Hill Subdivision		JOB No.: 1012397.0000
CO-ORDINATES: (NZTM2000) 5431357.19 mN 1626308.64 mE	EXPOSURE METHOD: TP	EXCAV. STARTED: 06/11/2019	
	EQUIPMENT: 20 T Excavator	EXCAV. FINISHED: 06/11/2019	
R.L.: 97.80m	OPERATOR: Tony	LOGGED BY: SAPR	
DATUM: NZVD2016	DIMENSIONS: 4m by 1.2m	CHECKED BY: MJL	

EXCAVATION TESTS | ENGINEERING DESCRIPTION | GEOLOGICAL

PENETRATION	SUPPORT	WATER	SAMPLES, TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	SOIL NAME, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, SECONDARY AND MINOR COMPONENTS	MOISTURE / WEATHERING CONDITION	STRENGTH/DENSITY CLASSIFICATION	ESTIMATED SHEAR STRENGTH (kPa)	DEFECTS, STRUCTURE, COMMENTS	UNIT
1 2 3	None- Stable	DRY 07/11/2019			97	0.5		SILT; dark brown, Firm, dry, low plasticity. Contains organics.	D	F	10 25 50 100 200		Top
						1.0		Highly weathered, light greeny grey TUFF. Moderately strong, 3 joints (56 south, 44 south-west, 52 north-east). Excavates as 40-200 mm angular blocks.					
					96	1.5							Grampian Formation
						2.0							
						2.5		2.5m: Machine limit					
					95	3.0							
						3.5							
					94	4.0							
						4.5							
					93								

SKETCH / PHOTO:



COMMENTS:

Hole Depth 2.5m

Scale 1:42

Rev.: A

Tonkin+Taylor

EXCAVATION LOG

Excavation Id.: **TP11**

SHEET: 1 OF 1

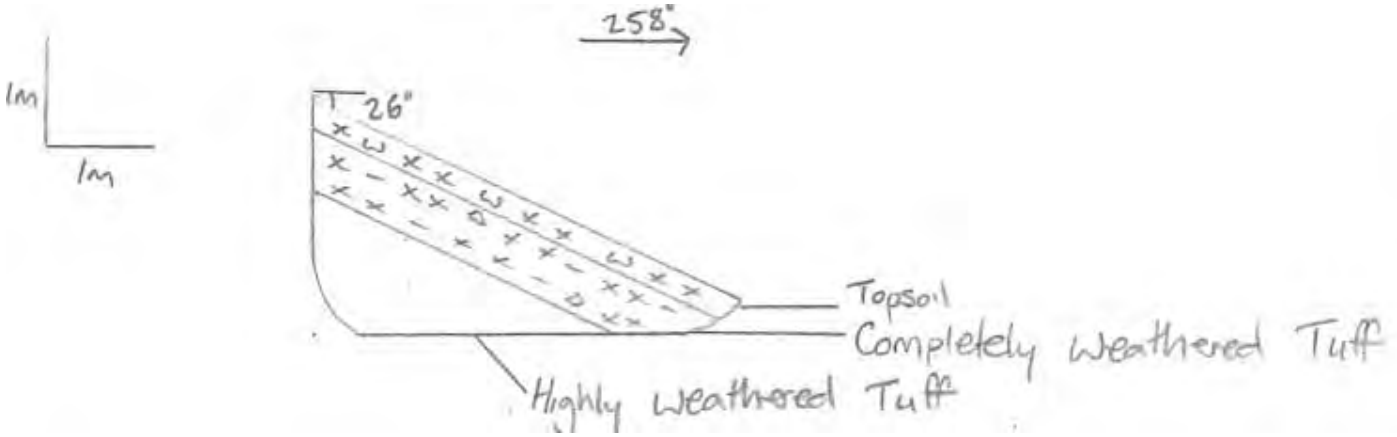
PROJECT: Kaka Hill Subdivision	LOCATION: Kaka Hill Subdivision	JOB No.: 1012397.0000

CO-ORDINATES: (NZTM2000)	5431453.95 mN 1626423.16 mE	EXPOSURE METHOD:	TP	EXCAV. STARTED:	06/11/2019
		EQUIPMENT:	20 T Excavator	EXCAV. FINISHED:	06/11/2019
R.L.:	116.30m	OPERATOR:	Tony	LOGGED BY:	SAPR
DATUM:	NZVD2016	DIMENSIONS:	4m by 1.2m	CHECKED BY:	MJL

EXCAVATION TESTS | ENGINEERING DESCRIPTION | GEOLOGICAL

PENETRATION	SUPPORT	WATER	SAMPLES, TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	SOIL NAME, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, SECONDARY AND MINOR COMPONENTS	MOISTURE \ WEATHERING CONDITION	STRENGTH/DENSITY CLASSIFICATION	ESTIMATED SHEAR STRENGTH (kPa)	DEFECTS, STRUCTURE, COMMENTS	UNIT
1 2 3											10 25 50 100 200		
	None-Stable	DRY 06/11/2019			116	0.5	TS	SILT; dark brown. Firm, dry, low plasticity. Contains organics.	D	F			
								Completely weathered, light brown TUFF, Extremely weak.Recovered as clayey SILT with some gravel. Stiff, dry, low plasticity. Gravel sub-angular.					
					115	1.0		Highly weathered, light greeny grey, TUFF. Moderately strong. Excavates s 40-200 mm angular blocks, local 400 mm.					Grampian Formation
						1.5							
					114	2.0		2.2m: Machine limit					
						2.5							
					113	3.0							
						3.5							
					112	4.0							
						4.5							

SKETCH / PHOTO:



COMMENTS:

Hole Depth 2.2m

Scale 1:42

Rev.: B

EXCAVATION LOG

Excavation Id.: **TP12**

SHEET: 1 OF 1

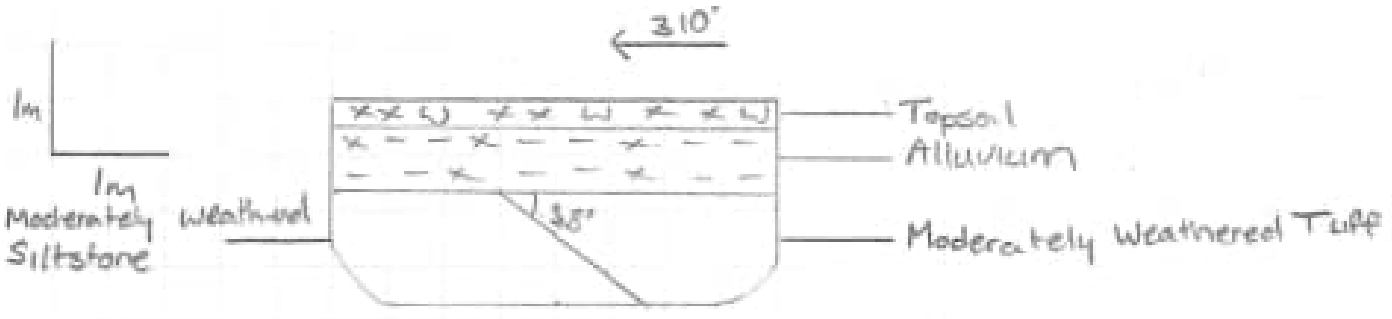
PROJECT: Kaka Hill Subdivision	LOCATION: Kaka Hill Subdivision	JOB No.: 1012397.0000

CO-ORDINATES: (NZTM2000)	5431426.00 mN 1626192.79 mE	EXPOSURE METHOD:	TP	EXCAV. STARTED:	06/11/2019
		EQUIPMENT:	20 T Excavator	EXCAV. FINISHED:	06/11/2019
R.L.:	47.80m	OPERATOR:	Tony	LOGGED BY:	SAPR
DATUM:	NZVD2016	DIMENSIONS:	4m by 1.2m	CHECKED BY:	MJL

EXCAVATION TESTS | ENGINEERING DESCRIPTION | GEOLOGICAL

PENETRATION	SUPPORT	WATER	SAMPLES, TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	SOIL NAME, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, SECONDARY AND MINOR COMPONENTS	MOISTURE / WEATHERING CONDITION	STRENGTH/DENSITY CLASSIFICATION	ESTIMATED SHEAR STRENGTH (kPa)	DEFECTS, STRUCTURE, COMMENTS	UNIT
1 2 3	None-Stable	08/11/2019 Seepage			47 46 45 44 43	0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5		SILT, dark brown, soft, moist, low plasticity. Contains organics. Silty CLAY, dark brown to black. Firm, moist, moderate plasticity. Contains organics. To north of 38°/130° contact is a moderately weathered, dark grey SILTSTONE. Weak, excavates as 20-60 mm angular clasts. To south of 38°/130° contact is a moderately weathered light greeny grey TUFF. Moderately strong, excavates as 60-200 mm angular blocks. 1.8m: Machine limit	M	S F	10 25 50 100 200		Top Alluvial Deposits Grampian Formation

SKETCH / PHOTO:



COMMENTS: Water ponded at surface.

Hole Depth 1.8m

Scale 1:42

Rev.: A

EXCAVATION LOG

Excavation Id.: **TP13**

SHEET: 1 OF 1

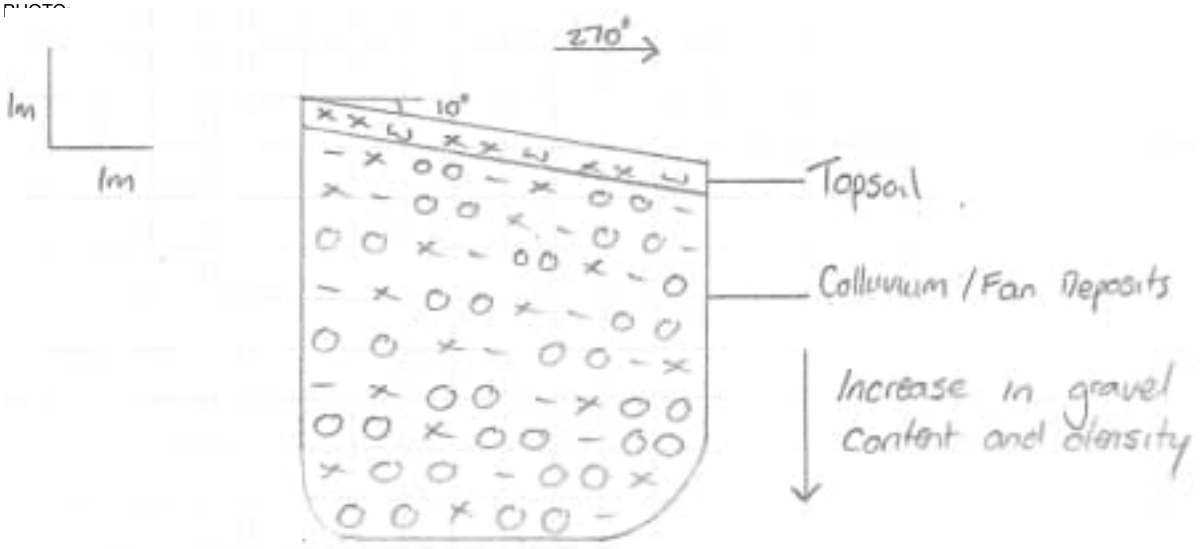
PROJECT: Kaka Hill Subdivision	LOCATION: Kaka Hill Subdivision	JOB No.: 1012397.0000

CO-ORDINATES: (NZTM2000)	5431429.00 mN 1626048.00 mE	EXPOSURE METHOD:	TP	EXCAV. STARTED:	07/11/2019
		EQUIPMENT:	20 T Excavator	EXCAV. FINISHED:	07/11/2019
R.L.:	30.20m	OPERATOR:	Tony	LOGGED BY:	SAPR
DATUM:	NZVD2016	DIMENSIONS:	4m by 1.2m	CHECKED BY:	MJL

EXCAVATION TESTS | ENGINEERING DESCRIPTION | GEOLOGICAL

PENETRATION (1 2 3)	SUPPORT	WATER	SAMPLES, TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	SOIL NAME, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, SECONDARY AND MINOR COMPONENTS	MOISTURE \ WEATHERING CONDITION	STRENGTH/DENSITY CLASSIFICATION	ESTIMATED SHEAR STRENGTH (kPa) (10 25 50 100 200)	DEFECTS, STRUCTURE, COMMENTS	UNIT
	None-Stable	DRY 07/11/2019			30	0	TS	SILT, dark brown. Firm, dry, low plasticity. Contains organics.	D	F			TSoil
						0.5		Clayey silty GRAVEL with some cobbles and boulders; orangy brown. Moderately tightly packed, dry, well graded. Gravel sub-rounded to sub-angular clasts of tuff.		MD			Alluvial Deposits
					29	1.0							
						1.5							
					28	2.0							
						2.5							
					27	3.0		3.2 - 4.4m: Gravel and cobble content increases and becomes tightly packed.					
						3.5							
					26	4.0							
						4.5		4.4m: Machine limit					

SKETCH / PHOTO



COMMENTS:

Hole Depth 4.4m

Scale 1:42

Rev.: B

EXCAVATION LOG

Excavation Id.: **TP14**

SHEET: 1 OF 1

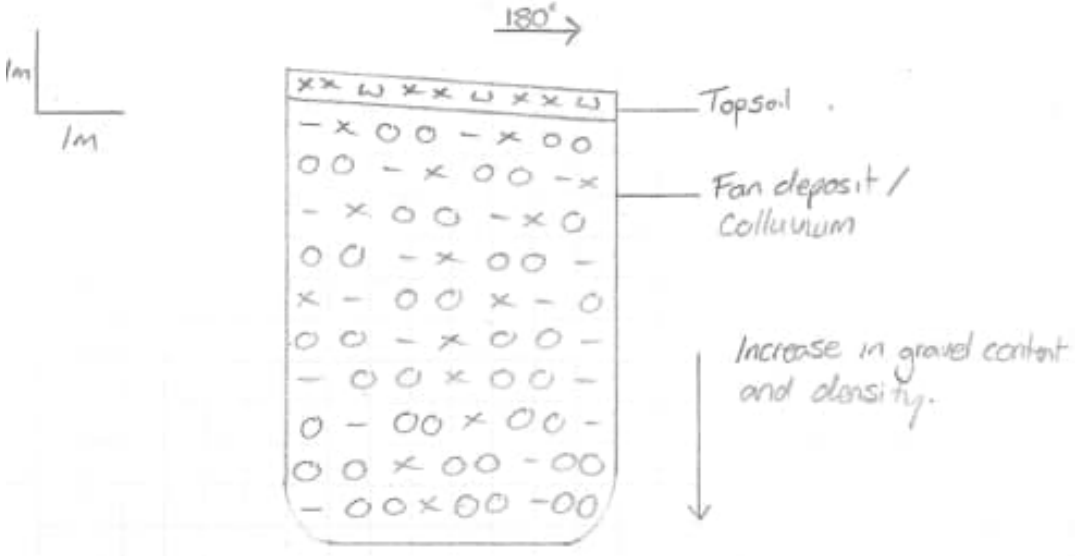
PROJECT: Kaka Hill Subdivision	LOCATION: Kaka Hill Subdivision	JOB No.: 1012397.0000

CO-ORDINATES: (NZTM2000)	5431497.00 mN 1626036.00 mE	EXPOSURE METHOD:	TP	EXCAV. STARTED:	07/11/2019
		EQUIPMENT:	20 T Excavator	EXCAV. FINISHED:	07/11/2019
R.L.:	32.50m	OPERATOR:	Tony	LOGGED BY:	SAPR
DATUM:	NZVD2016	DIMENSIONS:	4m by 1.2m	CHECKED BY:	MJL

EXCAVATION TESTS | ENGINEERING DESCRIPTION | GEOLOGICAL

PENETRATION	SUPPORT	WATER	SAMPLES, TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	SOIL NAME, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, SECONDARY AND MINOR COMPONENTS	MOISTURE / WEATHERING CONDITION	STRENGTH/DENSITY CLASSIFICATION	ESTIMATED SHEAR STRENGTH (kPa)	DEFECTS, STRUCTURE, COMMENTS	UNIT
1 2 3					32	0		SILT; dark brown. Soft, dry, low plasticity. Contains organics.	D	S	10 25 50 100 200		Top
	None-Stable	DRY 07/11/2019			31	1		Clayey silty GRAVEL with some cobbles and boulders; orangy brown. Moderately tightly packed, dry, well graded. Gravel sub-rounded to sub-angular.		MD			
					30	2							
					29	3		3.3 - 5.7m: Increase in gravel and cobble content and grades to tightly packed.		D			Alluvial Deposits
					28	4							
					27	5							
					26	6		5.7m: Machine limit					
					25	7							

SKETCH / PHOTO:



COMMENTS:

Hole Depth 5.7m

Scale 1:67

Rev.: B

EXCAVATION LOG

Excavation Id.: **TP15**

SHEET: 1 OF 1

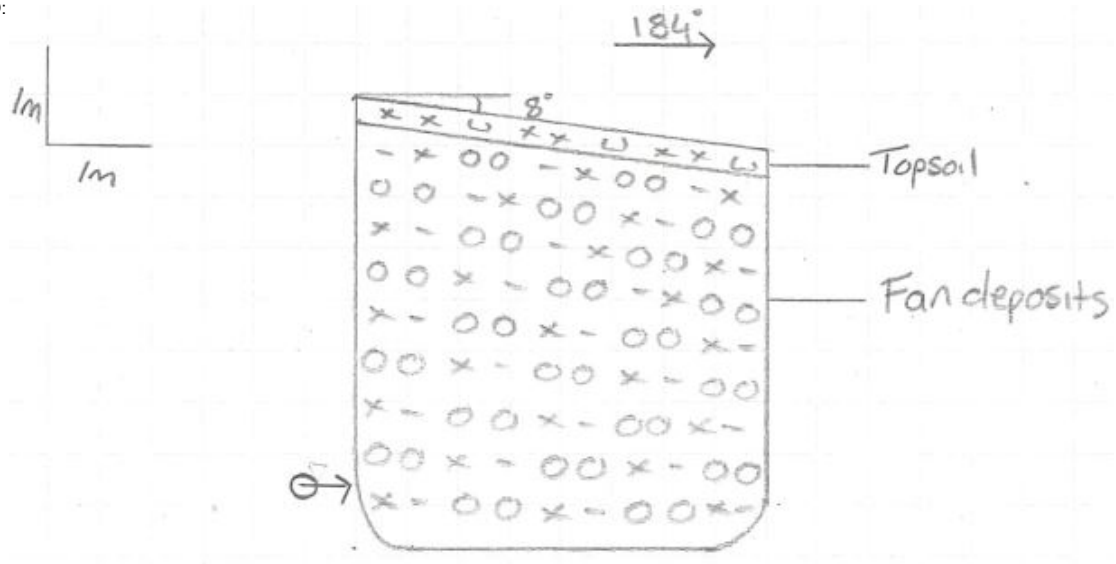
PROJECT: Kaka Hill Subdivision	LOCATION: Kaka Hill Subdivision	JOB No.: 1012397.0000

CO-ORDINATES: (NZTM2000)	5431554.12 mN 1626122.18 mE	EXPOSURE METHOD:	TP	EXCAV. STARTED:	06/11/2019
		EQUIPMENT:	20 T Excavator	EXCAV. FINISHED:	06/11/2019
R.L.:	41.50m	OPERATOR:	Tony	LOGGED BY:	SAPR
DATUM:	NZVD2016	DIMENSIONS:	4m by 1.2m	CHECKED BY:	MJL

EXCAVATION TESTS | ENGINEERING DESCRIPTION | GEOLOGICAL

PENETRATION	SUPPORT	WATER	SAMPLES, TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	SOIL NAME, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, SECONDARY AND MINOR COMPONENTS	MOISTURE CONDITION / WEATHERING	STRENGTH/DENSITY CLASSIFICATION	ESTIMATED SHEAR STRENGTH (kPa)	DEFECTS, STRUCTURE, COMMENTS	UNIT
1 2 3	Minor collapse	06/11/2019 Seepage			41	1		SILT; dark brown. Firm, dry, low plasticity, contains organics.	D	F	10 25 50 100 200		Top
					40	2		Clayey silty GRAVEL with some cobbles and boulders; light brown. Moderately tightly packed, moist to wet. Gravel sub-rounded to rounded, clasts are tuff and breccia.	M	MD			
					39	3							
					38	4			W				
					37								Alluvial Deposits
						5		4.9m: Machine limit					
					36	6							
					35	7							
					34								

SKETCH / PHOTO:



COMMENTS:

Hole Depth 4.9m

Scale 1:67

Rev.: B

EXCAVATION LOG

Tonkin+Taylor

Excavation Id.: **TP16**

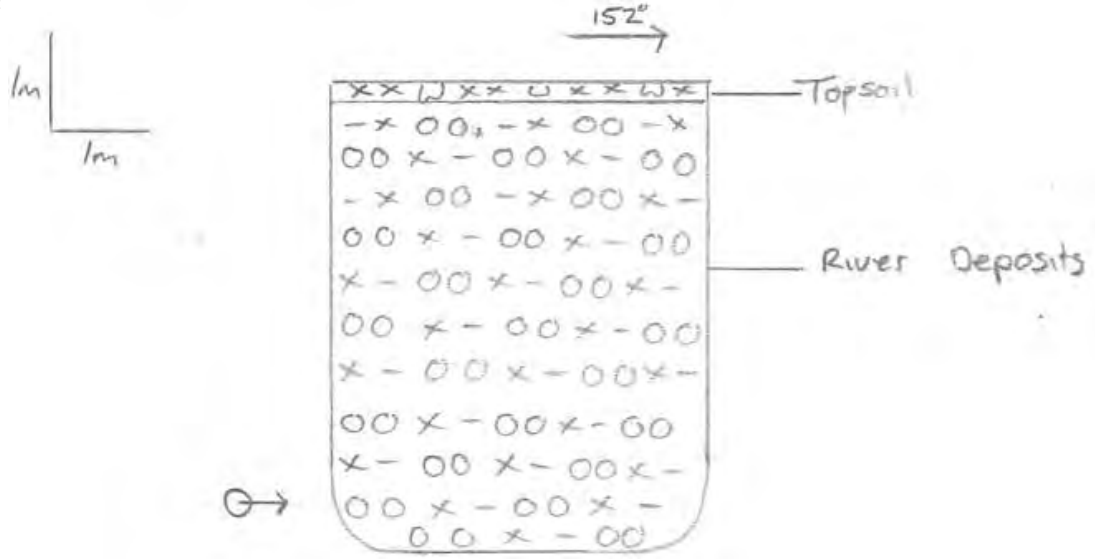
SHEET: 1 OF 1

PROJECT: Kaka Hill Subdivision		LOCATION: Kaka Hill Subdivision		JOB No.: 1012397.0000	
CO-ORDINATES: (NZTM2000)	5431675.70 mN 1626057.69 mE	EXPOSURE METHOD:	TP	EXCAV. STARTED:	06/11/2019
		EQUIPMENT:	20 T Excavator	EXCAV. FINISHED:	06/11/2019
R.L.:	40.20m	OPERATOR:	Tony	LOGGED BY:	SAPR
DATUM:	NZVD2016	DIMENSIONS:	4m by 1.2m	CHECKED BY:	MJL

EXCAVATION TESTS | ENGINEERING DESCRIPTION | GEOLOGICAL

PENETRATION	SUPPORT	WATER	SAMPLES, TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	SOIL NAME, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, SECONDARY AND MINOR COMPONENTS	MOISTURE / WEATHERING CONDITION	STRENGTH/DENSITY CLASSIFICATION	ESTIMATED SHEAR STRENGTH (kPa)	DEFECTS, STRUCTURE, COMMENTS	UNIT
1 2 3	None-Stable	06/11/2019 Seepage			40	0		SILT; dark brown. Firm, dry, low plasticity. Contains organics.	D	F	10 25 50 100 200		Top
					39	1		Clayey silty GRAVEL with some cobbles and boulders; light brown. Moderately tightly packed, moist to wet, well graded. Gravel sub-rounded to rounded.	M	MD			
					38	2		1.2m: Gravel content increases					
					37	3							Alluvial Deposits
					36	4			W				
						5		5m: Machine limit					
					35	6							
					34	7							
					33								

SKETCH / PHOTO:



COMMENTS:

Hole Depth 5m

Scale 1:67

Rev.: B

Tonkin+Taylor

EXCAVATION LOG

Excavation Id.: **TP17**

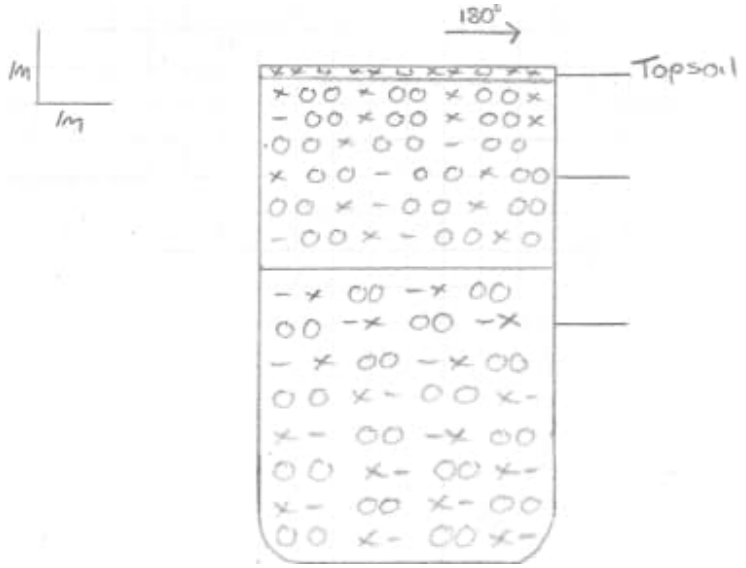
SHEET: 1 OF 1

PROJECT: Kaka Hill Subdivision	LOCATION: Kaka Hill Subdivision		JOB No.: 1012397.0000
CO-ORDINATES: (NZTM2000) 5431768.64 mN 1625907.34 mE	EXPOSURE METHOD: TP	EXCAV. STARTED: 07/11/2019	
	EQUIPMENT: 20 T Excavator	EXCAV. FINISHED: 07/11/2019	
R.L.: 92.20m	OPERATOR: Tony	LOGGED BY: SAPR	
DATUM: NZVD2016	DIMENSIONS: 4m by 1.2m	CHECKED BY: MJL	

EXCAVATION TESTS | ENGINEERING DESCRIPTION | GEOLOGICAL

PENETRATION	SUPPORT	WATER	SAMPLES, TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	SOIL NAME, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, SECONDARY AND MINOR COMPONENTS	MOISTURE CONDITION / WEATHERING	STRENGTH/DENSITY CLASSIFICATION	ESTIMATED SHEAR STRENGTH (kPa)	DEFECTS, STRUCTURE, COMMENTS	UNIT
1 2 3	None-Stable	DRY 07/11/2019			92	0		SILT; dark brown. Soft, dry, low plasticity. Contains organics.	D	MD	10 25 50 100 200		Top
					91	1		Silty GRAVEL with some clay; light orangy brown. Moderately tightly packed, dry. Gravel is angular moderately strong tuff. (RESIDUAL SOIL)					
					90	2							
					89	3		Clayey silty GRAVEL; light greyish brown. Moderately tightly packed, moderately weatehred, dry, well graded. (Clasts break down to clayey silt under hand pressure). (RESIDUAL SOIL)					Whakapuaka Phyollonite
					88	4							
					87	5							
					86	6							
					85	7		6.7m: Machine limit					

SKETCH / PHOTO:



COMMENTS:

Hole Depth 6.7m

Scale 1:67

Rev.: B

EXCAVATION LOG

Excavation Id.: **TP18**

SHEET: 1 OF 1

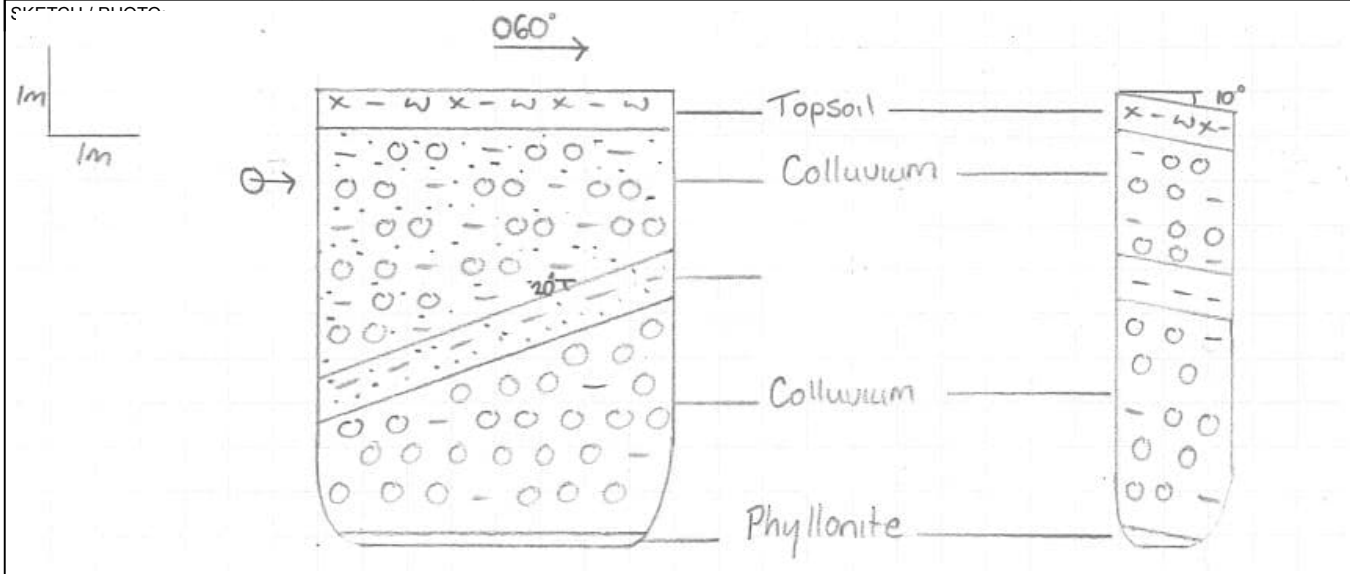
PROJECT: Kaka Hill Subdivision	LOCATION: Kaka Hill Subdivision	JOB No.: 1012397.0000

CO-ORDINATES: (NZTM2000)	5431868.83 mN 1626024.95 mE	EXPOSURE METHOD:	TP	EXCAV. STARTED:	06/11/2019
		EQUIPMENT:	20 T Excavator	EXCAV. FINISHED:	06/11/2019
R.L.:	51.20m	OPERATOR:	Tony	LOGGED BY:	SAPR
DATUM:	NZVD2016	DIMENSIONS:	4m by 1.2m	CHECKED BY:	MJL

EXCAVATION TESTS | ENGINEERING DESCRIPTION | GEOLOGICAL

PENETRATION	SUPPORT	WATER	SAMPLES, TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	SOIL NAME, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, SECONDARY AND MINOR COMPONENTS	MOISTURE / WEATHERING CONDITION	STRENGTH/DENSITY CLASSIFICATION	ESTIMATED SHEAR STRENGTH (kPa)	DEFECTS, STRUCTURE, COMMENTS	UNIT
	Collapsing	06/11/2019 Seepage			51	0	TS	Clayey SILT; dark brown. Soft, wet, low plasticity. Contains organics.	W	S			Top
					50	1		Clayey sandy GRAVEL; light bluish grey with orange mottle. Loosely packed, moist, well graded.		MD			
					49	2		Clayey SAND with minor gravel; dark bluish grey. Loosely packed, wet, well graded.		L			Colluvium Deposits
					48	3		Sandy GRAVEL with some clay; light orangish brown. Moderately tightly packed, wet, well graded.		MD			
					47	4							
						5		Slightly weathered Phyllonite; dark grey, Very weak, Crushed quartz. Recovered as silty clay with some gravel, moderate plasticity.	M /				Wp
					46	6		5.1m: Collapse					
					45								
					44	7							

SKETCH / PHOTO



COMMENTS: Water ponded at surface.

Hole Depth 5.1m

Scale 1:67

Rev.: B

EXCAVATION LOG

Tonkin+Taylor

Excavation Id.: **TP19**

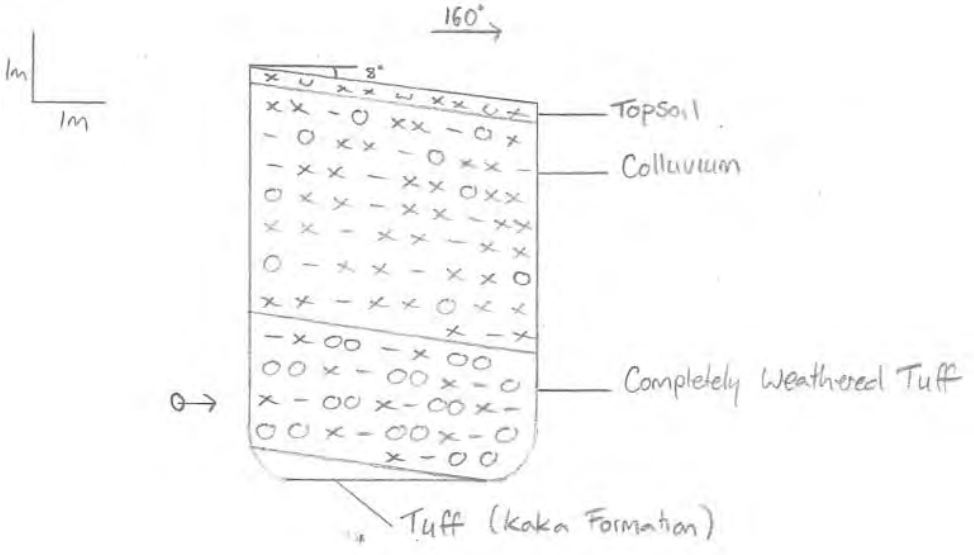
SHEET: 1 OF 1

PROJECT: Kaka Hill Subdivision	LOCATION: Kaka Hill Subdivision		JOB No.: 1012397.0000
CO-ORDINATES: (NZTM2000) 5431643.54 mN 1625870.87 mE	EXPOSURE METHOD: TP	EXCAV. STARTED: 07/11/2019	
	EQUIPMENT: 20 T Excavator	EXCAV. FINISHED: 07/11/2019	
R.L.: 51.10m	OPERATOR: Tony	LOGGED BY: SAPR	
DATUM: NZVD2016	DIMENSIONS: 4m by 1.2m	CHECKED BY: MJL	

EXCAVATION TESTS | ENGINEERING DESCRIPTION | GEOLOGICAL

PENETRATION	SUPPORT	WATER	SAMPLES, TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	SOIL NAME, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, SECONDARY AND MINOR COMPONENTS	MOISTURE / WEATHERING CONDITION	STRENGTH/DENSITY CLASSIFICATION	ESTIMATED SHEAR STRENGTH (kPa)	DEFECTS, STRUCTURE, COMMENTS	UNIT
1 2 3					51	0		SILT; dark brown. Soft, dry, low plasticity. Contains organics.	D	S	10 25 50 100 200		Top
	None-Stable							Clayey SILT with some gravel; light orangy brown. Stiff to very stiff, moist, low plasticity. Gravel sub-angular tuff.	M	St-VSt			Fan Deposits
					50	1							
					49	2							
					48	3							
		07/11/2019			47	4		Clayey silty GRAVEL; medium orangy brown. Tightly packed, moist, well graded. Gravel subangular to angular. (RESIDUAL SOIL)		D			Botanical Hill Formation
					46	5		Moderately weathered; light greeny grey TUFF, Moderately strong. Excavates as 60-200 mm angular blocks. 5.7m: Machine limit	W / MW				
					45	6							
					44	7							

SKETCH / PHOTO:



COMMENTS:

Hole Depth 5.7m

Scale 1:67

Rev.: B

Tonkin+Taylor

EXCAVATION LOG

Excavation Id.: **TP20**

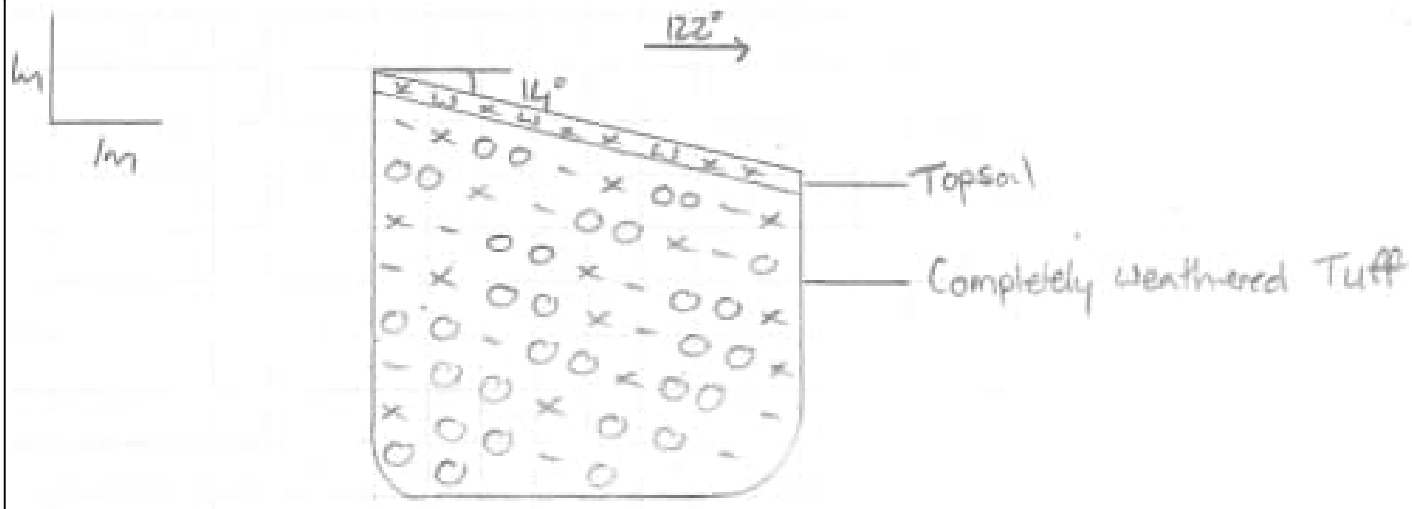
SHEET: 1 OF 1

PROJECT: Kaka Hill Subdivision	LOCATION: Kaka Hill Subdivision		JOB No.: 1012397.0000
CO-ORDINATES: (NZTM2000) 5431623.19 mN 1625722.43 mE	EXPOSURE METHOD: TP	EXCAV. STARTED: 06/11/2019	
	EQUIPMENT: 20 T Excavator	EXCAV. FINISHED: 06/11/2019	
R.L.: 72.20m	OPERATOR: Tony	LOGGED BY: SAPR	
DATUM: NZVD2016	DIMENSIONS: 4m by 1.2m	CHECKED BY: MJL	

EXCAVATION TESTS | ENGINEERING DESCRIPTION | GEOLOGICAL

PENETRATION	SUPPORT	WATER	SAMPLES, TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	SOIL NAME, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, SECONDARY AND MINOR COMPONENTS	MOISTURE / WEATHERING CONDITION	STRENGTH/DENSITY CLASSIFICATION	ESTIMATED SHEAR STRENGTH (kPa)	DEFECTS, STRUCTURE, COMMENTS	UNIT
1 2 3	None-Stable	DRY 06/11/2019			72	0		SILT; dark brown. Firm, dry, low plasticity. Contains organics.	D	F	10 25 50 100 200		Top
						0.5		Clayey silty GRAVEL with some cobbles; light orangy brown. Moderately tightly packed, dry, well graded. Gravel sub-rounded to sub-angular clasts of moderately weathered greeny grey tuff. (RESIDUAL SOIL)		MD			
					71	1.0							
						1.5							
					70	2.0							
						2.5		2.5 - 4.0m: Gravel content increases and grades to tightly packed		D			
					69	3.0							
						3.5							Botanical Hill Formation
						4.0		4m: Machine limit					
					68	4.5							

SKETCH / PHOTO:



COMMENTS:

Hole Depth 4m

Scale 1:42

Rev.: B

Tonkin+Taylor

EXCAVATION LOG

Excavation Id.: **TP21**

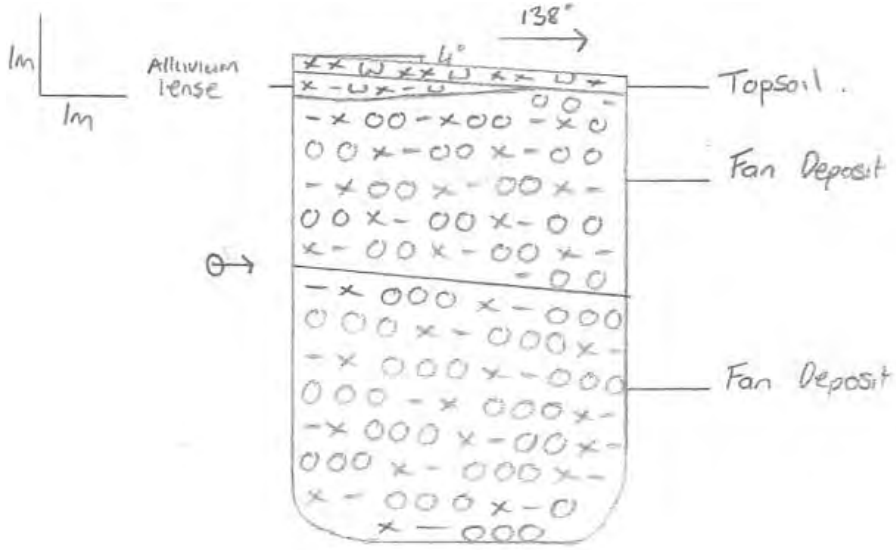
SHEET: 1 OF 1

PROJECT: Kaka Hill Subdivision		LOCATION: Kaka Hill Subdivision		JOB No.: 1012397.0000	
CO-ORDINATES: (NZTM2000)	5431565.51 mN 1625896.89 mE	EXPOSURE METHOD:	TP	EXCAV. STARTED:	07/11/2019
		EQUIPMENT:	20 T Excavator	EXCAV. FINISHED:	07/11/2019
R.L.:	39.80m	OPERATOR:	Tony	LOGGED BY:	SAPR
DATUM:	NZVD2016	DIMENSIONS:	4m by 1.2m	CHECKED BY:	MJL

EXCAVATION TESTS | ENGINEERING DESCRIPTION | GEOLOGICAL

PENETRATION	SUPPORT	WATER	SAMPLES, TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	SOIL NAME, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, SECONDARY AND MINOR COMPONENTS	MOISTURE / WEATHERING CONDITION	STRENGTH/DENSITY CLASSIFICATION	ESTIMATED SHEAR STRENGTH (kPa)	DEFECTS, STRUCTURE, COMMENTS	UNIT
1 2 3					39	1		SILT; dark brown. Soft, moist, low plasticity. Contains organics.	M	S	10 25 50 100 200		Top
								Clayey silty GRAVEL; dark reddish brown. Moderately tightly packed, moist, well graded. Gravel moderately weatehred, sub-rounded.		MD			Fan Deposits
	None- Stable	07/11/2019 Seepage			38	2							
					37	3		Clayey silty GRAVEL; light brown, Moderately tightly packed to tightly packed, wet, well graded. Gravel moderately weathered sub angular tuff and phyllonite. (RESIDUAL SOIL)	W	MD-D			Whakapuaka Phyollonite
					36	4							
					35	5							
					34	6		5.8m: Collapse					
					33	7							
					32								

SKETCH / PHOTO:



COMMENTS:

Hole Depth 5.8m

Scale 1:67

Rev.: B

EXCAVATION LOG

Excavation Id.: **TP22**

SHEET: 1 OF 1

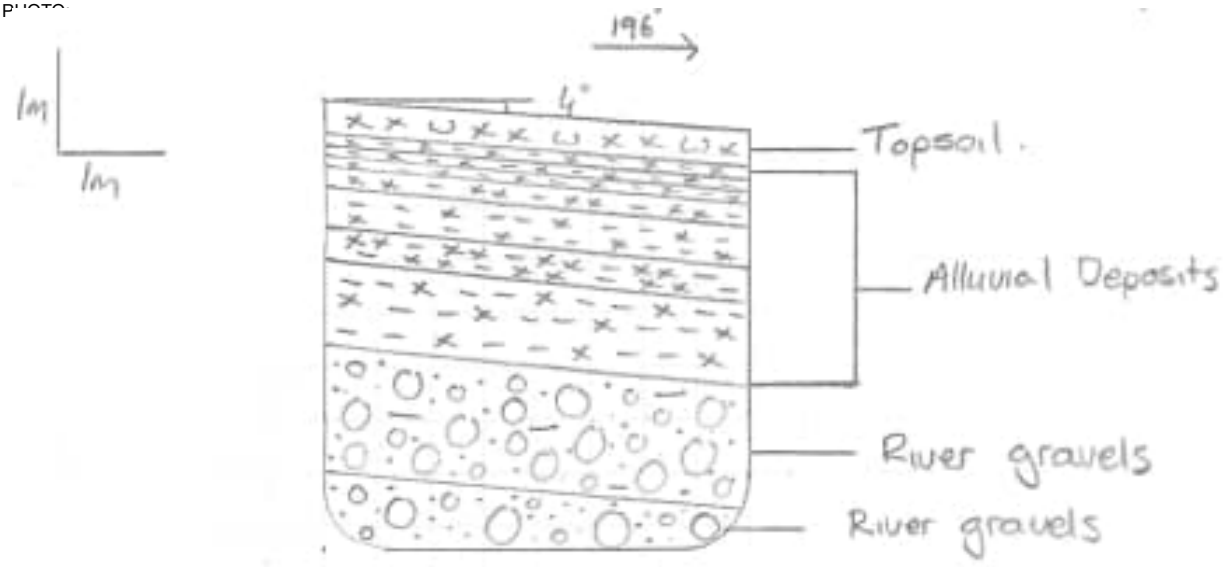
PROJECT: Kaka Hill Subdivision	LOCATION: Kaka Hill Subdivision	JOB No.: 1012397.0000

CO-ORDINATES: (NZTM2000)	5431486.40 mN 1625987.71 mE	EXPOSURE METHOD:	TP	EXCAV. STARTED:	07/11/2019
		EQUIPMENT:	20 T Excavator	EXCAV. FINISHED:	07/11/2019
R.L.:	24.80m	OPERATOR:	Tony	LOGGED BY:	SAPR
DATUM:	NZVD2016	DIMENSIONS:	4m by 1.2m	CHECKED BY:	MJL

EXCAVATION TESTS | ENGINEERING DESCRIPTION | GEOLOGICAL

PENETRATION	SUPPORT	WATER	SAMPLES, TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	SOIL NAME, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, SECONDARY AND MINOR COMPONENTS	MOISTURE / WEATHERING CONDITION	STRENGTH/DENSITY CLASSIFICATION	ESTIMATED SHEAR STRENGTH (kPa)	DEFECTS, STRUCTURE, COMMENTS	UNIT
1 2 3											10 25 50 100 200		
	Collapsing	07/11/2019 Seepage ▼			24	0.5	TS	SILT; dark brown, Soft, moist, low plasticity. Contains organics.	M	S			TSoil
								Silty CLAY; light orangy brown. Firm, moist, high plasticity. Contains rootlets.		F			
						1.0		Clayey SILT; Dark brown. Firm, moist, moderate plasticity. Contains organics.					
								Silty CLAY; light orangy brown. Firm, moist, high plasticity. Contains rootlets.					
						1.5		Clayey SILT; Dark brown. Firm, moist, moderate plasticity. Contains organics.					
					23			Silty CLAY with some gravel; light orangy brown. Firm, moist, moderate plasticity. Contains rootlets.					
						2.0		Clayey SILT; Dark brown. Firm, moist, moderate plasticity. Contains organics.					
						2.5		Silty CLAY with some gravel; light orangy brown. Firm, moist, moderate plasticity. Contains rootlets.	W	L			Alluvial Deposits
					22			Sandy gravelly COBBLE with minor clay and local boulder; light bluish grey. Loose, wet, well graded. Gravel rounded.					
						3.0							
						3.5		Sandy gravelly COBBLE with local boulders; light brown. Loose, wet, well graded. Gravel rounded.					
					21								
						4.0							
								4.2m: Collapse					
					20	4.5							

SKETCH / PHOTO



COMMENTS:

Hole Depth 4.2m

Scale 1:42

Rev.: B

Tonkin+Taylor

EXCAVATION LOG

Excavation Id.: **TP23**

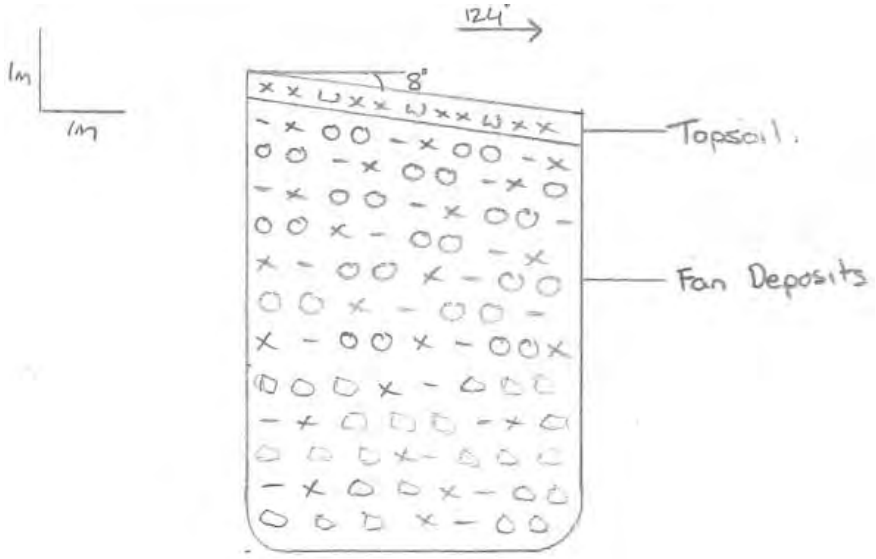
SHEET: 1 OF 1

PROJECT: Kaka Hill Subdivision	LOCATION: Kaka Hill Subdivision		JOB No.: 1012397.0000
CO-ORDINATES: (NZTM2000) 5431528.00 mN 1625778.51 mE	EXPOSURE METHOD: TP	EXCAV. STARTED: 07/11/2019	
	EQUIPMENT: 20 T Excavator	EXCAV. FINISHED: 07/11/2019	
R.L.: 52.60m	OPERATOR: Tony	LOGGED BY: SAPR	
DATUM: NZVD2016	DIMENSIONS: 4m by 1.2m	CHECKED BY: MJL	

EXCAVATION TESTS | ENGINEERING DESCRIPTION | GEOLOGICAL

PENETRATION	SUPPORT	WATER	SAMPLES, TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	SOIL NAME, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, SECONDARY AND MINOR COMPONENTS	MOISTURE / WEATHERING CONDITION	STRENGTH/DENSITY CLASSIFICATION	ESTIMATED SHEAR STRENGTH (kPa)	DEFECTS, STRUCTURE, COMMENTS	UNIT
1 2 3	None-Stable	DRY 07/11/2019			52 51 50 49 48 47 46 45	1 2 3 4 5 6 7		SILT; dark brown. Firm, dry, low plasticity. Contains organics.	D	F	10 25 50 100 200		Top
								Silty clayey GRAVEL with local cobble; orangy brown. Moderately tightly packed to tightly packed, dry, well graded. Gravel moderately weathered, sub-rounded to sub-angular tuff. (RESIDUAL SOIL)		MD			
								3.5m: Angularity and density increases with depth		D			Botanical Hill Formation
								5.7m: Machine limit					

SKETCH / PHOTO:



COMMENTS:

Hole Depth 5.7m

Scale 1:67

Rev.: B

EXCAVATION LOG

Excavation Id.: **TP24**

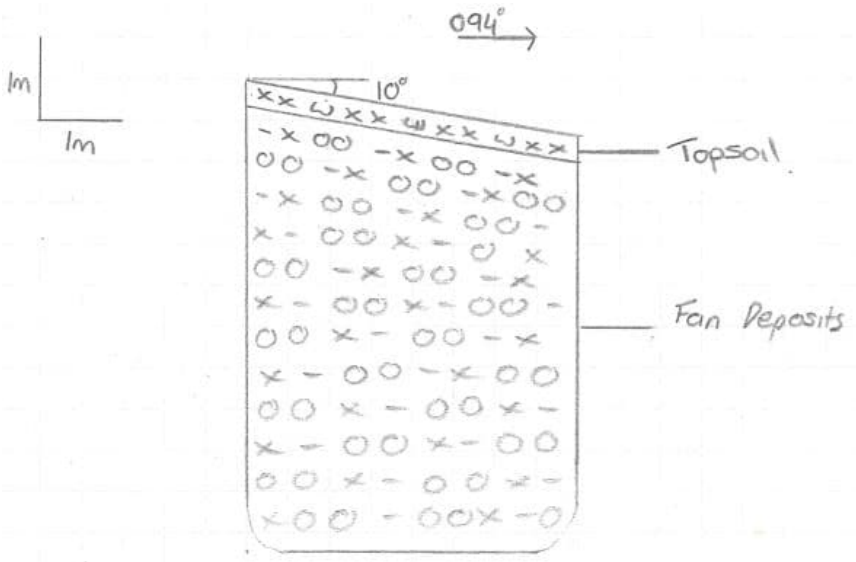
SHEET: 1 OF 1

PROJECT: Kaka Hill Subdivision	LOCATION: Kaka Hill Subdivision		JOB No.: 1012397.0000
CO-ORDINATES: (NZTM2000) 5431465.30 mN 1625871.28 mE	EXPOSURE METHOD: TP	EXCAV. STARTED: 07/11/2019	
	EQUIPMENT: 20 T Excavator	EXCAV. FINISHED: 07/11/2019	
R.L.: 34.40m	OPERATOR: Tony	LOGGED BY: SAPR	
DATUM: NZVD2016	DIMENSIONS: 4m by 1.2m	CHECKED BY: MJL	

EXCAVATION TESTS | ENGINEERING DESCRIPTION | GEOLOGICAL

PENETRATION	SUPPORT	WATER	SAMPLES, TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	SOIL NAME, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, SECONDARY AND MINOR COMPONENTS	MOISTURE / WEATHERING CONDITION	STRENGTH/DENSITY CLASSIFICATION	ESTIMATED SHEAR STRENGTH (kPa)	DEFECTS, STRUCTURE, COMMENTS	UNIT
1 2 3	None-Stable	DRY 07/11/2019			34 33 32 31 30 29 27	0 1 2 3 4 5 6 7		SILT; dark brown. Firm, dry, low plasticity. Contains organics.	D	F	10 25 50 100 200		Top
								Clayey silty GRAVEL; light orangy brown. Moderately tightly packed to tightly packed, moist, well graded. Gravel moderately weathered, sub-angular to sub-rounded tuff.	M	MD-D			Alluvial Deposits
								5.7m: Machine limit					

SKETCH / PHOTO:



COMMENTS:

Hole Depth 5.7m

Scale 1:67

Rev.: B

EXCAVATION LOG

Tonkin+Taylor

Excavation Id.: **TP25**

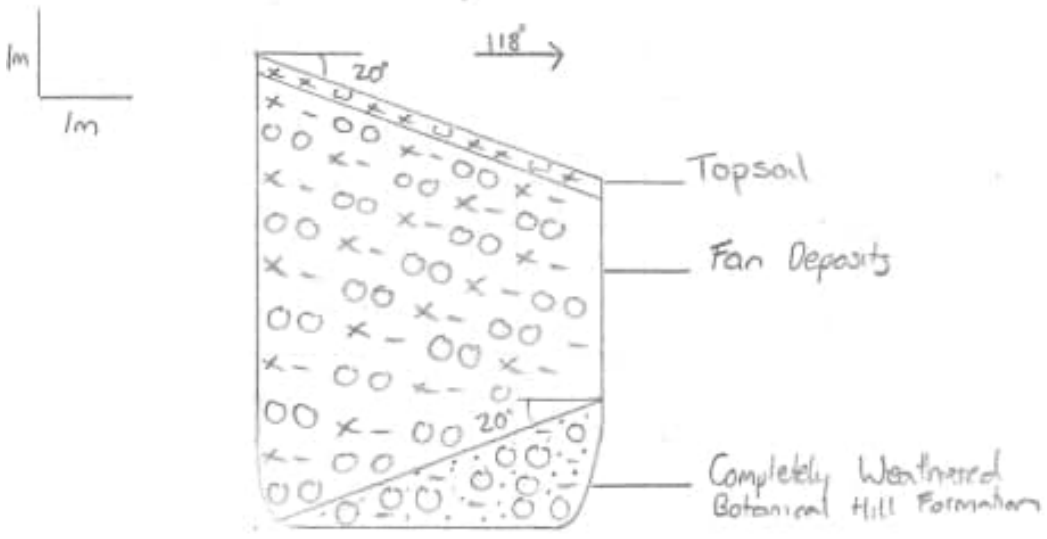
SHEET: 1 OF 1

PROJECT: Kaka Hill Subdivision		LOCATION: Kaka Hill Subdivision		JOB No.: 1012397.0000	
CO-ORDINATES: (NZTM2000)	5431468.49 mN 1625668.21 mE	EXPOSURE METHOD:	TP	EXCAV. STARTED:	06/11/2019
		EQUIPMENT:	20 T Excavator	EXCAV. FINISHED:	06/11/2019
R.L.:	77.50m	OPERATOR:	Tony	LOGGED BY:	SAPR
DATUM:	NZVD2016	DIMENSIONS:	4m by 1.2m	CHECKED BY:	MJL

EXCAVATION TESTS | ENGINEERING DESCRIPTION | GEOLOGICAL

PENETRATION	SUPPORT	WATER	SAMPLES, TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	SOIL NAME, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, SECONDARY AND MINOR COMPONENTS	MOISTURE CONDITION / WEATHERING	STRENGTH/DENSITY CLASSIFICATION	ESTIMATED SHEAR STRENGTH (kPa)	DEFECTS, STRUCTURE, COMMENTS	UNIT
1 2 3	None-Stable	DRY 06/11/2019			77	0		SILT; dark brown. Firm, dry, low plasticity. Contains organics	D	F	10 25 50 100 200		Top
					76	1		Silty clayey GRAVEL; light brown; moderately tightly packed, dry, well gravel. Moderately weathered, gravel sub-angular to angular clasts of tuff.		MD			Fan Deposits
					75	2							
					74	3							
					73	4		Completely weathered Breccia. Recovered as sandy clayey GRAVEL; light greyish brown. Tightly packed, dry, well graded. Gravel moderately weathered subangular to angular clasts of breccia. Breccia crumbles to moderate plasticity sandy clay under hand pressure.		D			Whakapuaka
					72	5		5.5m: Machine limit					
					71	6							
					70	7							

SKETCH / PHOTO:



COMMENTS:

Hole Depth 5.5m

Scale 1:67

Rev.: B

EXCAVATION LOG

Excavation Id.: **TP26**

SHEET: 1 OF 1

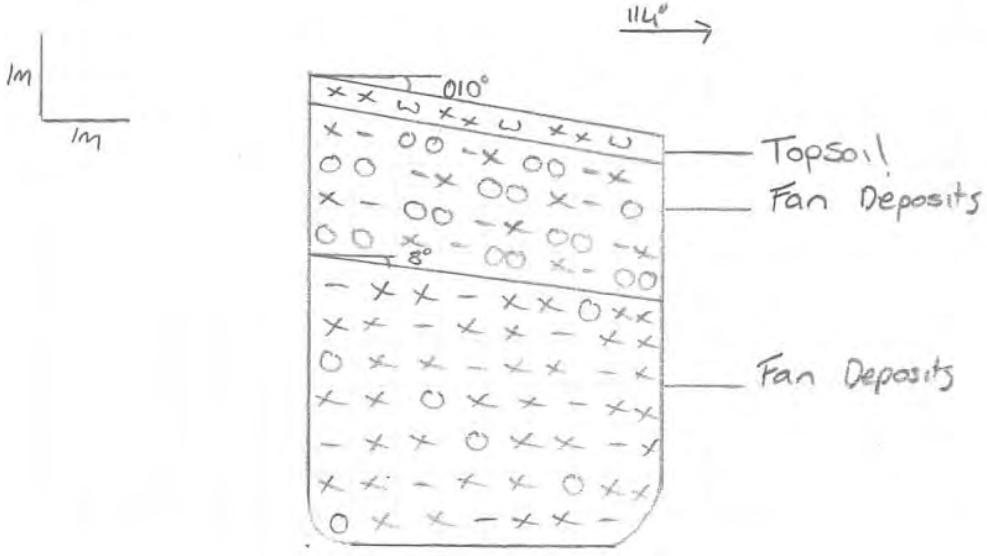
PROJECT: Kaka Hill Subdivision	LOCATION: Kaka Hill Subdivision	JOB No.: 1012397.0000

CO-ORDINATES: (NZTM2000)	5431390.74 mN 1625753.27 mE	EXPOSURE METHOD:	TP	EXCAV. STARTED:	07/11/2019
		EQUIPMENT:	20 T Excavator	EXCAV. FINISHED:	07/11/2019
R.L.:	33.70m	OPERATOR:	Tony	LOGGED BY:	SAPR
DATUM:	NZVD2016	DIMENSIONS:	4m by 1.2m	CHECKED BY:	MJL

EXCAVATION TESTS | ENGINEERING DESCRIPTION | GEOLOGICAL

PENETRATION	SUPPORT	WATER	SAMPLES, TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	SOIL NAME, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, SECONDARY AND MINOR COMPONENTS	MOISTURE / WEATHERING CONDITION	STRENGTH/DENSITY CLASSIFICATION	ESTIMATED SHEAR STRENGTH (kPa)	DEFECTS, STRUCTURE, COMMENTS	UNIT
1 2 3	None-Stable	DRY 07/11/2019			33 32 31 30 29 28 27 26	0 1 2 3 4 5 6 7		SILT; dark brown. Soft, dry, low plasticity. Contains organics.	D	S	10 25 50 100 200		Top
								Silty clayey GRAVEL; orangy brown. Moderately tightly packed. moist, well graded. Gravel moderately weathered sub-rounded to sub-angular tuff and micaceous siltstone.	M	MD			
								Clayey SILT with some gravel; light brown. Stiff to very stiff, moist, moderate plasticity. Gravel moderately weathered subangular to sub rounded tuff and siltstone		St-VSt			Fan Deposits
								5.3m: Machine limit					

SKETCH / PHOTO:



COMMENTS:

Hole Depth 5.3m

Scale 1:67

Rev.: B

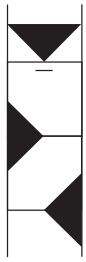
Tonkin+Taylor

Engineering log terminology

General

Soil and rock descriptions follow the "Guidelines for the field classification and description of soil and rock for engineering purposes" by the New Zealand Geotechnical Society (2005). Refer to this document for methods of field determination.

Water



Core recovery

Expressed as percentage of the length of the core run recovered.

Drilling method/casing

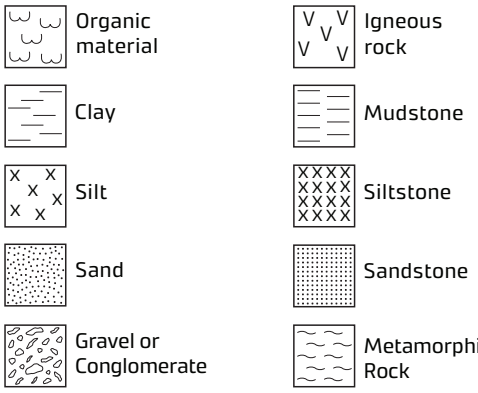
Common types:

OB	Open barrel
W	Wash
HQ3	HQ triple tube
PQ3	PQ triple tube
HSA	Hollow Stem Auger
WS	Window Sampler
HA	Hand Auger
HFS	High Frequency Sonic Drilling
LFS	Low Frequency Sonic Drilling

Graphic logs

The graphic log shows soil and rock types. The defect log indicates the location, orientation and abundance of defects of all types.

Typical material symbols:



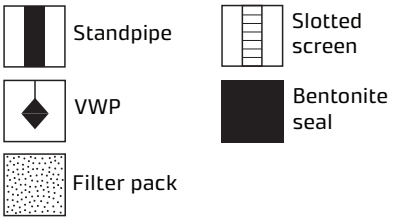
Tests

- **N=22:**SPT uncorrected blow count for 300 mm
- **75/12:**Undrained shear strength (peak /residual as measured by field vane.

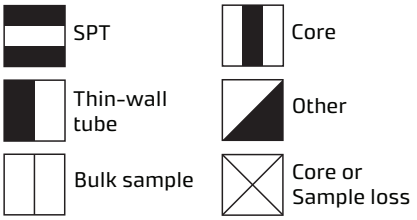
Laboratory test(s) carried out:

PMT	Pressuremeter test
LT	Lugeon test
LV	Laboratory vane
AL	Atterburg limits
UU	Undrained triaxial
PSD	Particle size distribution
c' Ø'	Effective stress
CONS	Consolidation
DS	Direct shear
COMP	Compaction
UCS	Unconfined compression
IS_{50}	Point load

Installation type



Sample type



Soil description

Moisture content

D	Dry, looks and feels dry
M	Moist, no free water on hand when remoulding
W	Wet, free water on hand when remoulding
S	Saturated, free water present on sample

Consistency/undrained shear strength

		S_u(kPa)
VS	Very soft	< 12
S	Soft	12 to 25
F	Firm	25 to 50
St	Stiff	50 to 100
VSt	Very stiff	100 to 200
H	Hard	> 200

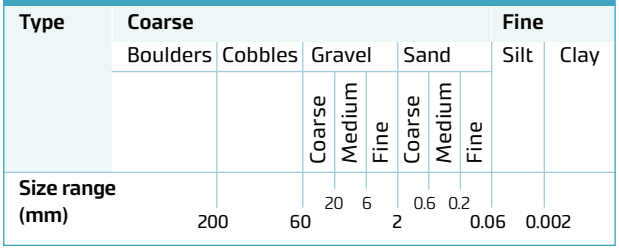
Density index

		SPT(N) - uncorrected
VL	Very loose	0 to 4
L	Loose	4 to 10
MD	Medium dense	10 to 30
D	Dense	30 to 50
VD	Very dense	> 50

Proportional terms definition (Coarse soils)

Fraction	Term	% of soil mass	Example
Major	(UPPER CASE)	Major constituent	GRAVEL
Subordinate	(lower case)	> 20	Sandy
Minor	with some...	12 - 20	with some sand
	with minor...	5 - 12	with minor sand
	with trace of... (or slightly)...	< 5	with trace of sand (slightly sandy)

Grain size criteria



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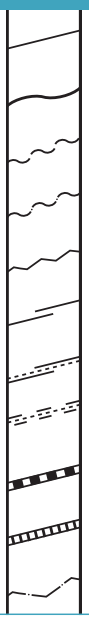
Engineering log terminology

Rock description

Signifcant defects

B	Bedding
J	Joint
Sc	Schistosity
Cl	Cleavage
BZ	Broken zone/crushed zone
F	Fault
Fg	Fault with gouge
SZ	Shear zone
Iz	Infilled seam
XD	Extremely weathered seam
DD	Drilling - induced defect



Weathering

UW	Unweathered
SW	Slightly weathered
MW	Moderately weathered
HW	Highly weathered
CW	Completely weathered
RS	Residual soil

Defect shape

ST	Stepped
UN	Undulating
PL	Planar

Roughness of defect surface

R	Rough
SM	Smooth
SL	Slickensided

Field strength

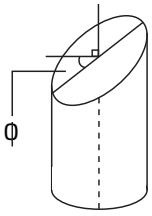
		UCS (MPa)	$I_{S(50)}$ (MPa)
EW	Extremely weak	< 1	N/A
VW	Very weak	1 - 5	N/A
W	Weak	5 - 20	N/A
MS	Moderately strong	20 - 50	1 - 2
S	Strong	50 - 100	2 - 5
VS	Very strong	100 - 250	5 - 10
ES	Extremely strong	> 250	> 10

Defect coding

Type
Angle (perpendicular to core axis)
Infilling description (as per soil description)

J 60˚, PL, SL, T, CV, STIFF GREEN CLAY

- Infilling/coating type
- Aperture
- Roughness
- Shape



Defect Orientation: for vertical unoriented boreholes defect orientation is measured normal to core axis e.g horizontal = 0˚(see diagram). For angled boreholes defect orientation is measured relative to core axis e.g parallel to core axis = 0˚.

Aperture

		Aperture (mm)
T	Tight	nil
VN	Very narrow	0 - 2
N	Narrow	2 - 6
MN	Moderately narrow	6 - 20
MW	Moderately wide	20 - 60
W	Wide	60 - 200
VW	Very wide	> 200

Infillings and coatings

CG	Clay gouge	Joints have openings between opposing faces of intact rock substance in excess of 1 mm filled with clay gouge. Clay is generally described in terms of soil properties.
CV	Clay veneers	Joints contain clay coating whose maximum thickness does not exceed 1 mm. Note: Describe clay in terms of soil properties.
PL	Penetrative limonite	Joint traces are marked in terms of well defined zones of slightly to moderately weathered ferruginised rock-substance within the adjacent rock.
FeSt	Limonite stained	Joint surfaces are stained or coated with limonite, although the rock substance immediately adjacent to the joints is fresh.
CT, SC	Coated	Joints exhibit coatings other than clay or limonite, e.g. Carbonate (CT) or Silica (SC).
CL, CS, CC	Cemented	Joints are cemented with limonite (CL), Silica (CS), or Carbonates (CC).
CN	Clean	Joint surface show no trace of clay, limonite, or other coatings.

Spacing

Term	Spacing
Very wide	> 2 m
Wide	0.6 - 2 m
Moderately wide	200 - 600 mm
Close	60 - 200 mm
Very close	20 - 60 mm
Extremely close	> 20 mm

Excavator penetration

Easy	1
Moderate	2
Difficult	3

RQD: Rock Quality Designation - percentage of core run consisting of sound rock longer than 10 cm.

Appendix D Liquefaction assessment

DESIGN CALCULATIONS

16 August 2023

Job Name:	Kaka subdivision	Revision No:	1
Job Location:	Nelson	Job No:	1012397.1000
Design Case:	Liquefaction assessment	Designer:	DJA

Revision History

Ref	Scope	Reviewed by	Date checked	PD Review	Comments
1	Liquefaction susceptibility and triggering assessment	HJB	27/11/23		These calculations are to support Resource Consent. All calculations to be reviewed and updated as part of detailed design

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1 Summary

1.1 Key design conclusions

Item	Description	Comments from Reviewer
1		
2		

2 Design purpose

Carry out a liquefaction assessment for the subsurface soils in the vicinity of the lower flood plain within the Kaka subdivision area.

3 Design objective

- Assess liquefaction susceptibility of soils underlying the site
- Assess what level of EQ is likely to trigger liquefaction at the site
- Assess the liquefaction risk at the site for appropriate design events

4 Design method

- Assess design earthquake Magnitude and Peak Ground Acceleration (PGA) as per MBIE/NZGS Earthquake geotechnical engineering practise Module 1. Overview of the guidelines[1]
    - Compare these loads to those described in in the 2022 GNS release of the National Seismic Hazard Model (NSHM)[2]
- Assess the soil conditions at the site
- Assess liquefaction susceptibility as described in MBIE/NZGS Earthquake geotechnical engineering practise Module 3[3]
- Liquefaction triggering calculations carried out following the method of Idriss and Boulanger (2014)
- Liquefaction risk assessment at the site as per MBIE Planning and Guidance for potentially liquefaction prone land[4]
- Based on the expected performance of the land, assess what the equivalent Technical Category (TC1, TC2 or TC3) would be based on Build it Right Canterbury Guidelines[5]

5 Input parameters and assumptions

5.1 Site Investigation plan

Below shows relevant site investigations. 6 CPT's were attempted at the site but were not able to penetrate the gravely near surface soils.

[1] Module 1: Overview of the geotechnical guidelines | Building Performance
[2] NZ NSHM (gns.cri.nz)
[3] MODULE 3: Identification, assessment and mitigation of liquefaction hazards - Earthquake geotechnical engineering practice (building.govt.nz)
[4] Planning and engineering guidance for potentially liquefaction-prone land (building.govt.nz)
[5] Canterbury residential technical guidance - Part a: technical guidance (building.govt.nz)

Figure 1, site investigation plan

Borehole logs are attached.

5.2 Design earthquake Magnitude and Peak Ground Acceleration (PGA) parameters

Table 1, design earthquake parameters

Earthquake return period	Comments	MBIE/NZGS Module 1 values for design		2022 GNS NSHM values	
		M	PGA (g)	M	PGA (g)
1 in 25 year	Typical Serviceability Limit State (SLS) EQ event	6.1	0.10	7.5	0.08-0.10
1 in 100 year		6.1	0.20	7.5	0.20-0.23

1 in 500 year	Typical Ultimate Limit State (ULS) EQ event for IL2 structures (i.e. residential houses)	6.1	0.41	7.5	0.46-0.49
1 in 1000 year	Typical Ultimate Limit State (ULS) EQ event for IL3 structures	6.1	0.53	7.5	0.63-0.65

5.3 Soil conditions

A number of subsurface investigations have been carried out the site. Useful and relevant investigations for this assessment include:

- T+T boreholes BH001-BHB009, drilled in 2022
- T+T Cone Penetration Tests (CPT's) and Dynamic Probe Super Heavy (DPSH) 1-4, carried out in February 2022
- Logs from piezometer installations, PZ01-09, installed in 2022
- Numerous Test Pit (TP) logs

Based on the above data, our interpretative geotechnical engineering ground model is described in Table 1 below. Note that the floodplain is in a valley bounded by moderately to steeply inclined hill slopes to the east, north and west. Depths to bedrock are shallow around the edges of the floodplain, near the base of the slopes, and deepen toward the center of the floodplain.

Table 2, soil types present in the interpretative geotechnical engineering ground model

Unit	Name (refer to interpretative geotechnical engineering ground model above)	Depth to top of layer (m)	Description	Testing results
1a	Recent Alluvium	0	Interbedded layers typically ≤1m thick, but occasionally thicker, comprising gravel, gravelly silt, silty gravel, clayey silt and sand	SPT N = 4-50+ CPT typically UTP due to gravels
1b	Alluvium	1.4 to 5.0	Interbedded layers typically >1m thick, but occasionally thinner, typically comprising gravel, silty/sandy gravel, and sand. Occasional layers of clayey silt.	SPT N = 15-50+ CPT typically UPT due to gravels
1c	Alluvium	4.5 to 9.7+	Cobbles and boulders	
2	Weathered Grampian Formation sandstone/siltstone	5.2 to 10.5+	Mudstone and sandstone layers	

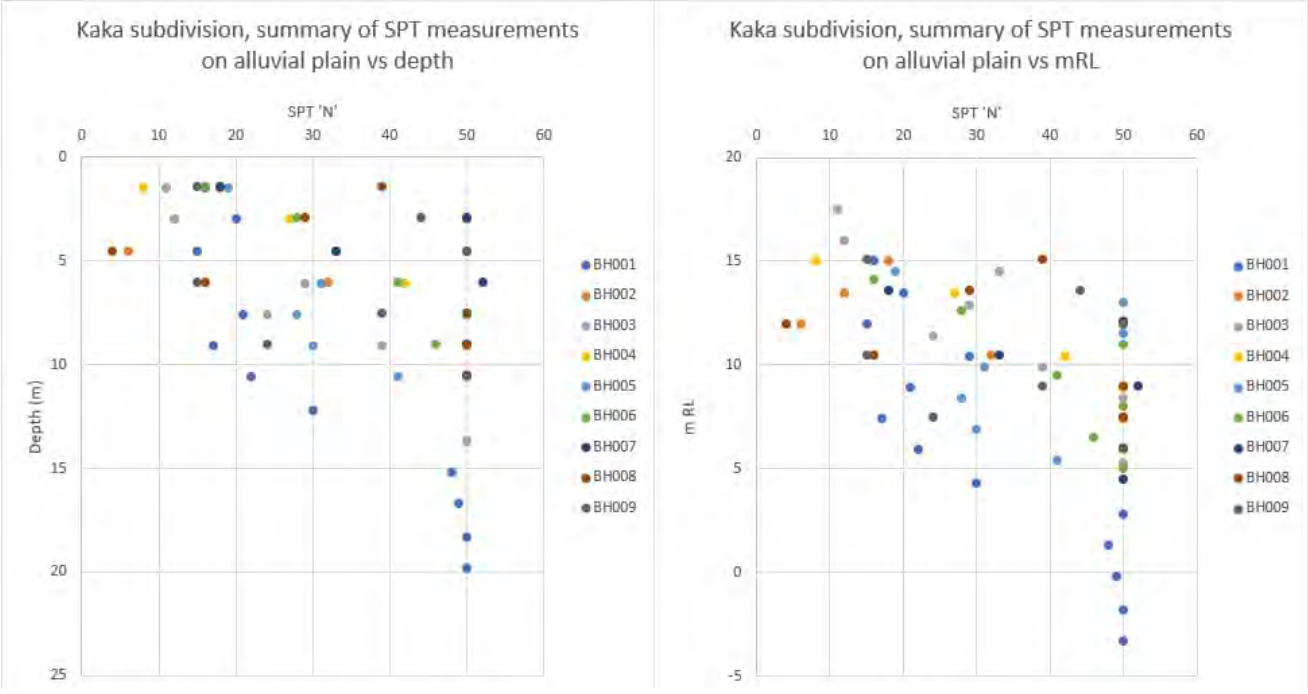

Figure 2, plot showing measured SPT 'N' values measured in the alluvial soils across the lower flood plain in terms of depth from ground level (left plot) and mRL (right plot)

5.4 Groundwater levels

- T+T has been monitoring 12 standpipe piezometers across the flood plain since April 2023.
- In general, the normal groundwater level across the majority of the site varies from 0 m to 2 m bgl (approx.). Groundwater is 3-4m deep near the head of the floodplain, as the ground surface is elevated there
- Groundwater depths recorded in selected subsurface investigations are shown on the attached figure.

6 Results

6.1 Liquefaction susceptibility assessment

Our liquefaction susceptibility assessment is summarised in Table 3 below.

Table 3, liquefaction susceptibility assessment

Unit	Name (refer to interpretative geotechnical engineering ground model above)	Depth to top of layer (m)	Description	Testing results	Susceptible to liquefaction?
1a	Recent Alluvium	0	Interbedded layers typically ≤1m thick, but occasionally thicker, comprising gravel, gravelly silt, silty gravel, clayey silt and sand	SPT N = 4-50+ CPT typically UTP due to gravels	Some thin and discontinuous (horizontal and vertical) layers of non/low plasticity silts and sands may be susceptible.

					Gravels are typically too dense to be susceptible
1b	Alluvium	1.4 to 5.0	Interbedded layers typically >1m thick, but occasionally thinner, typically comprising gravel, silty/sandy gravel, and sand. Occasional layers of clayey silt.	SPT N = 15-50+ CPT typically UPT due to gravels	Very few thin and discontinuous (horizontal and vertical) layers of non/low plasticity silts and sands may be susceptible. Gravels are typically too dense to be susceptible
1c	Alluvium	4.5 to 9.7+	Cobbles and boulders		No
2	Weathered Grampian Formation sandstone/siltstone	5.2 to 10.5+	Mudstone and sandstone layers		No

6.2 Liquefaction triggering assessment

As CPT's attempted at the site were not able to penetrate the alluvial gravels, we have carried out a liquefaction triggering assessment based on the measured SPT 'N' values from the boreholes and the method of Idriss and Boulanger 2008 & 2014.

Table 4, liquefaction triggering calculation results

Borehole	Groundwater depth used in analysis (m)	Liquefaction predicted in			
		1 in 25 yr EQ (SLS)	1 in 100 yr EQ	1 in 500 yr EQ (ULS for IL2 developments)	1 in 1000 yr EQ (ULS for IL3 developments)
BH_TT229889	1	No	No	No	No
BH_TT229890	1	No	No	No	No
BH3	1	No	No	No	No
BH_TT229892	1	No	No	Yes @ 1-2.4 m bgl*. No liq above or below this	Yes @ 1-2.4 m bgl*. No liq above or below this
BH_TT229893	1	No	No	No	No
BH_TT229894	1	No	No	No	No
BH_TT229895	1	No	No	No	No
BH_TT229896	0	No	Yes @ 3.8-5.1 m bgl**. No liq above or below this	Yes @ 3.8-5.1 m bgl**. No liq above or below this	Yes @ 3.8-5.1 m bgl**. No liq above or below this
BH_TT229897	1	No	No	No	No

*This layer is logged as 'Gravelly fine to coarse sand, some silt, grey. Gravel fine to coarse, rounded to subrounded'. This layer is circled in red in Figure 3 below. Based on this, the vast majority of this layer appears susceptible to liquefaction and is likely to liquefy under the levels of ground shaking described in Table 4.

Figure 3, potentially liquefiable materials in BH_TT229892

**This layer is logged as 'Silt, light bluish grey. Very soft to soft, medium to high plasticity'. Upon inspection of the core photos, the majority of this layer appears to be too plastic to liquefy, however some portion in the order of 40-60% by thickness (see red circled zones in Figure 4 below), appears to be less plastic and may liquefy under the levels of ground shaking described in Table 4.

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Figure 4, silty materials in BH_TT229896 that appear to have lower plasticity and are likely to be susceptible to liquefaction

This assessment shows:

- No liquefaction is expected in an SLS level earthquake
- Liquefaction is expected to be triggered at around a 1 in 100 yr level earthquake
- Liquefaction is predicted in 2 of the 9 boreholes.
  - At one of these locations it is expected between 1 and 2.4 m bgl
  - At one of these locations it is expected between 3.8 and 5.1 m bgl
- No liquefaction is predicted in 7 of the 9 boreholes
- Investigations are typically 40-100m apart, and adjacent investigations no not show that liquefaction is expected at consistent levels. Therefore, liquefaction is likely to occur in discontinuous, spatially isolated layers or pockets.

7 Liquefied residual strength

We have assessed the potential residual strength for the upper liquefied layer and the lower one using the methods of Idriss and Boulanger 2014 with and without fines redistribution.

7.1 Upper liquefiable layer residual strength

The assessment results for the upper liquefiable layer are shown in Figure 5 below.

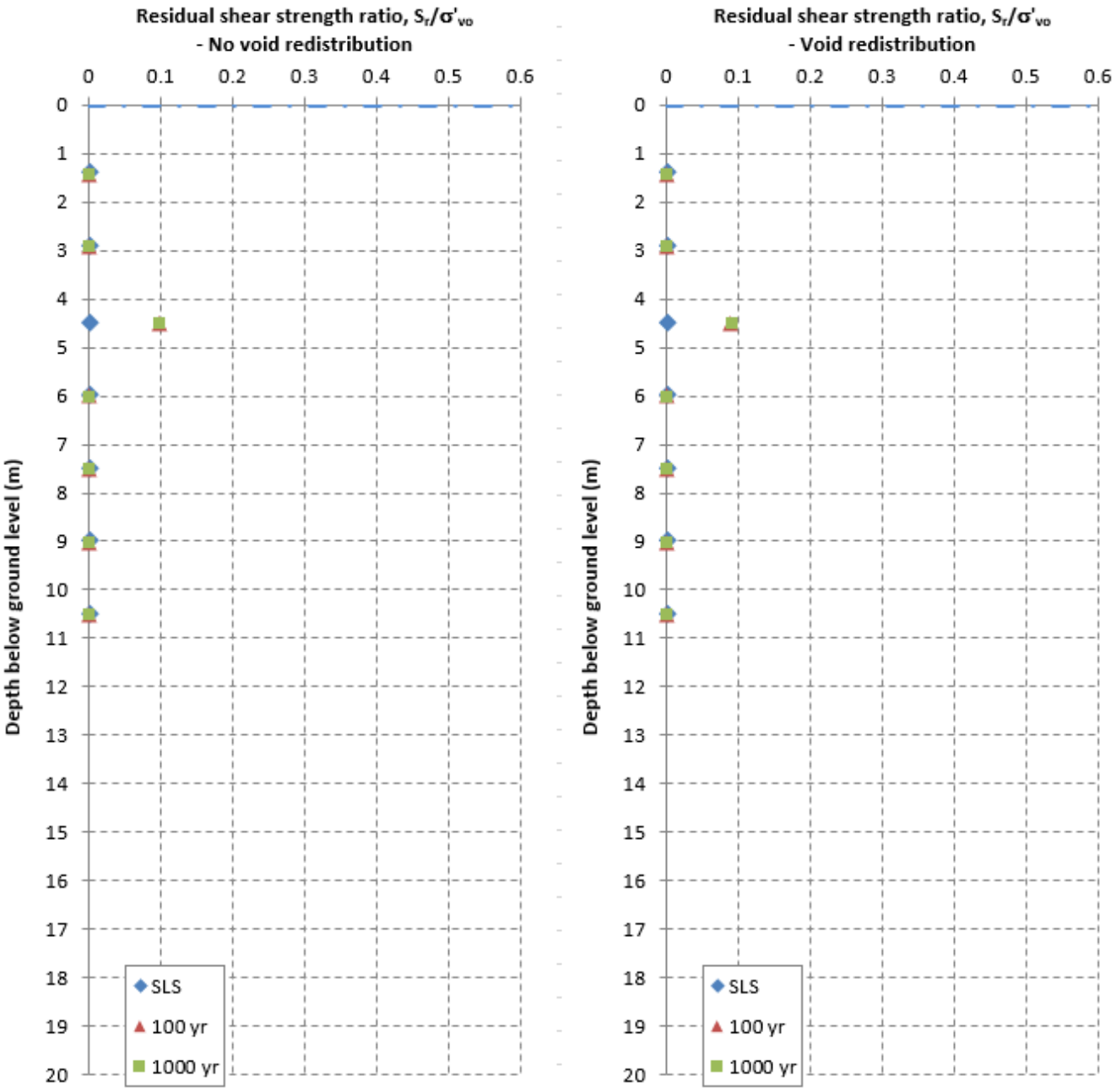


Figure 5, residual strength assessment for the upper layer of liquefiable material

Based on this assessment, a residual strength ratio of $\tau/\sigma'_{vo} = 0.1$, or an equivalent effective friction angle of $\phi' = 6^\circ$ is reasonable for further assessment and remedial works design.

7.2 Lower liquefiable layer residual strength

The assessment results for the lower liquefiable layer are shown in Figure 5 below.

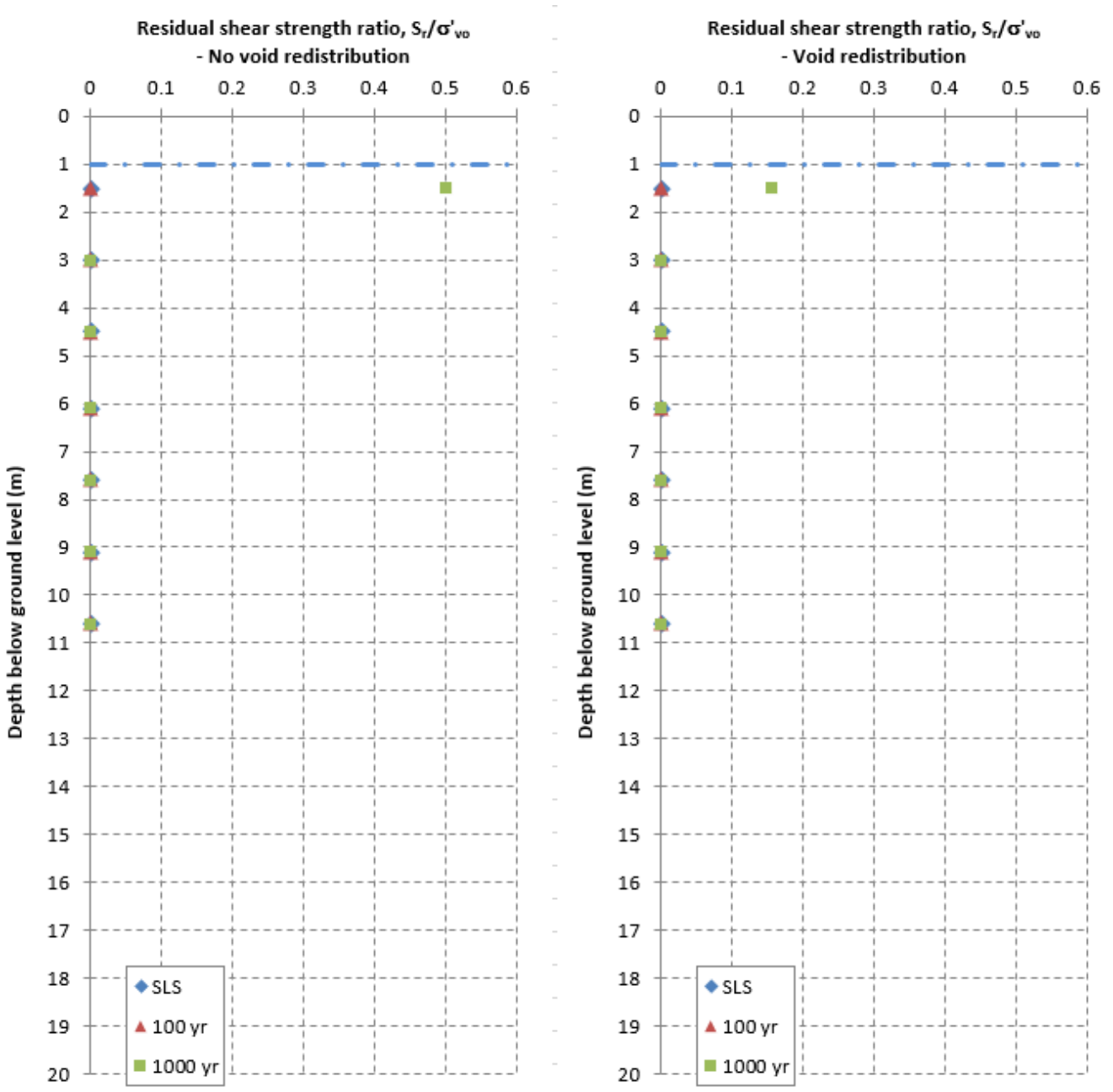


Figure 6, residual strength assessment for the lower layer of liquefiable material

Based on this assessment, a residual strength ratio of τ/σ'_{vo} = 0.15 to 0.16, or an equivalent effective friction angle of ϕ' = 9˚ is reasonable for further assessment and remedial works design.

8 Liquefaction induced ground damage assessment

Typical liquefaction induced ground damage mechanisms include:

- Ground surface settlement attributed to volumetric strain/void redistribution within liquefied layers
- Ground surface settlement due to loss of volume from ejecta
- Shear strain/deformation of sites where there is sloping ground or out of balance loading conditions, due to the softening of liquefied layers
- Landslide displacements due to co-seismic inertia loads acting on ground that sits on the liquefied layers

- Lateral spreading or flow-failure where ground sitting on liquefied layers is unstable under gravity loading

8.1 Ground surface settlement from volumetric strain/void redistribution

We have estimated the potential ground surface settlement at the site attributed to volumetric strain/void redistribution using the method of Zhang, Robertson and Brahcman (2004). The results are presented in Table 5 below.

Table 5, ground surface settlement from volumetric strain/void redistribution assessment results

BH / liquefiable layer	Potential ground surface settlement (mm) at the site attributed to volumetric strain/void redistribution in:			
	1 in 25 yr EQ	1 in 100 yr EQ	1 in 500 yr EQ	1 in 1000 yr EQ
BH_TT229892 (upper liquefiable layer)	0	0-10	50	50
BH_TT229896 (lower liquefiable layer)*	5-10	20-30	20-30	20-30

- 50% of calculated value taken as approx. 40-60% of this layer is expected to be susceptible to liquefaction

8.2 Ground surface settlement due to loss of volume from ejecta

We have assessed the potential for ejecta induced ground surface settlement considering the paper "Stability of natural deposits during earthquakes" by Ishihara (1985), and our experience in the Canterbury Earthquake Sequence.

Based on our assessment, some for ejecta induced ground surface settlement may occur in areas where the upper liquefiable layer is not capped with fill. Approx. 50mm of settlement may occur in a ULS level earthquake. This is not expected to affect buildings that will be built on the fill platform.

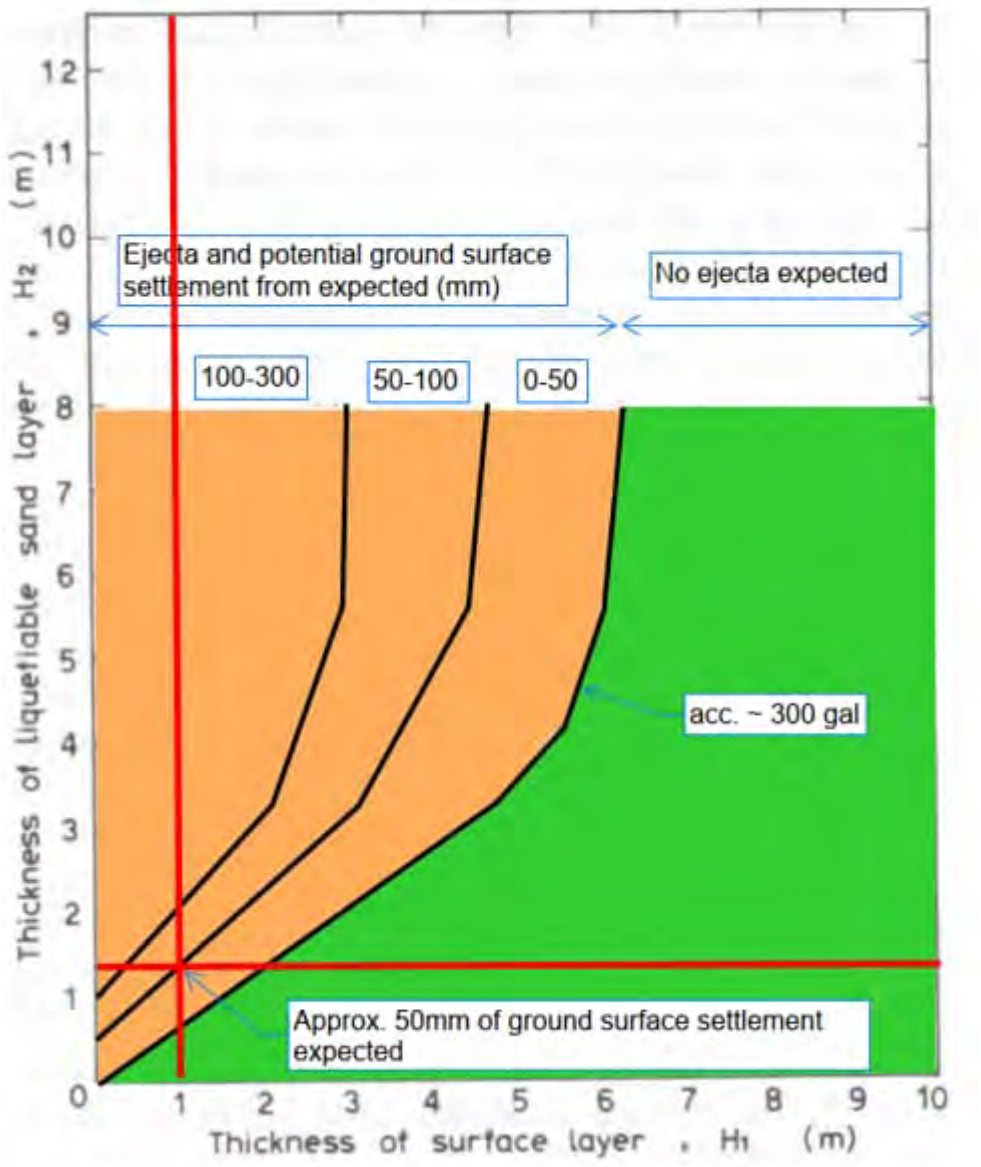


Figure 7, assessment of ejecta induced ground surface settlement for the upper liquefiable layer in a 1 in 500 year EQ

8.3 Shear deformation

The proposed subdivision development includes altering the landform in the flood plain by building up a fill platform by 2.5 to 5m above the current ground level. The front face of this fill will slope down to the flood plain. This will introduce a liquefaction iduced shear strain deformation risk around the edge of the fill.

We have assessed this risk using a Plaxis 2D model. Liquefaction soil strengths were assigned as described in Section 7. The stiffness of the liquefied layers was reduced by 90%.

Table 6, liquefaction induced shear deformation assessment results

BH / liquefiable layer	No remediation		With conceptual remedial/stabilising works*	
	Horizontal deformation (ux, mm)	Vertical deformation (uy, mm)	Horizontal deformation (ux, mm)	Vertical deformation (uy, mm)
BH_TT229892 (upper liquefiable layer)	NA - lateral spreading/flow failure expected	NA - lateral spreading/flow failure expected	0-10	0-10
BH_TT229896 (lower liquefiable layer)*	0-10	10-20	0-10	10-20

* Conceptual remedial/stabilising works are described further in Section 9

8.4 Co-seismic landslide deformation

The proposed subdivision development includes altering the land form in the flood plain by building up a fill platform by 2.5 to 5m above the current ground level. The front face of this fill will slope down to the flood plain. This will introduce a slope instability/co-seismic displacement risk around the edge of the fill.

We have calculated the yield acceleration of failures that are likely to affect the front face of the fill slope and extend back into building areas using Slope/W and the liquefied soil strengths described in Section 7. Expected co-seismic landslide displacements were then assessed using the method of Bray & Macedo 2019. The 2022 NSHM was used to generate spectra for this assessment.

As an approximation, vertical settlement has been taken as 50% of the horizontal co-seismic landslide deformation.

Table 7, liquefaction induced co-seismic landslide displacement of fill face during a 1 in 500 yr EQ

BH / liquefiable layer	No remediation			With conceptual remedial/stabilising works*		
	Yield acc. (g)	Horizontal deformation (ux, mm)	Vertical deformation (uy, mm)	Yield acc. (g)	Horizontal deformation (ux, mm)	Vertical deformation (uy, mm)
1 in 100 yr EQ						
BH_TT229892 (upper liquefiable layer)	No liquefaction at this level of shaking					
BH_TT229896 (lower liquefiable layer)*	0.08	$D_{16\%}$ = 170 mm $D_{50\%}$ = 80 mm $D_{84\%}$ = 40 mm	$D_{16\%}$ = 90 mm $D_{50\%}$ = 40 mm $D_{84\%}$ = 20 mm	0.20	$D_{16\%}$ = 10 mm $D_{50\%}$ = 20 mm $D_{84\%}$ = 40 mm	$D_{16\%}$ = 10 mm $D_{50\%}$ = 10 mm $D_{84\%}$ = 20 mm
1 in 500 yr EQ						
BH_TT229892 (upper liquefiable layer)	0.04	$D_{16\%}$ = 1600 mm $D_{50\%}$ = 800 mm $D_{84\%}$ = 400 mm	$D_{16\%}$ = 800 mm $D_{50\%}$ = 400 mm $D_{84\%}$ = 200 mm	0.20	$D_{16\%}$ = 200 mm $D_{50\%}$ = 100 mm $D_{84\%}$ = 50 mm	$D_{16\%}$ = 100 mm $D_{50\%}$ = 50 mm $D_{84\%}$ = 25 mm
BH_TT229896 (lower liquefiable layer)*	0.08	$D_{16\%}$ = 900 mm $D_{50\%}$ = 430 mm $D_{84\%}$ = 210 mm	$D_{16\%}$ = 450 mm $D_{50\%}$ = 220 mm $D_{84\%}$ = 110 mm	0.20	$D_{16\%}$ = 200 mm $D_{50\%}$ = 100 mm $D_{84\%}$ = 50 mm	$D_{16\%}$ = 100 mm $D_{50\%}$ = 50 mm $D_{84\%}$ = 25 mm
1 in 1000 yr EQ						
BH_TT229892 (upper liquefiable layer)	0.04	$D_{16\%}$ = 2800 mm $D_{50\%}$ = 1400 mm $D_{84\%}$ = 650 mm	$D_{16\%}$ = 1400 mm $D_{50\%}$ = 700 mm $D_{84\%}$ = 330 mm	0.20	$D_{16\%}$ = 410 mm $D_{50\%}$ = 200 mm $D_{84\%}$ = 100 mm	$D_{16\%}$ = 260 mm $D_{50\%}$ = 100 mm $D_{84\%}$ = 50 mm
BH_TT229896 (lower liquefiable layer)*	0.08	$D_{16\%}$ = 2500 mm $D_{50\%}$ = 1220 mm $D_{84\%}$ = 600 mm	$D_{16\%}$ = 1250 mm $D_{50\%}$ = 610 mm $D_{84\%}$ = 300 mm	0.20	$D_{16\%}$ = 90 mm $D_{50\%}$ = 180 mm $D_{84\%}$ = 370 mm	$D_{16\%}$ = 50 mm $D_{50\%}$ = 90 mm $D_{84\%}$ = 190 mm

* Conceptual remedial/stabilising works are described further in Section 9

8.5 Post shaking stability and lateral spreading/flow failure

We have assessed the FoS against instability with liquefied soil layers after the earthquake shaking has stopped.

Table 8, post shaking stability

BH / liquefiable layer	No remediation FoS	With conceptual remedial/stabilising works FoS*
BH_TT229892 (upper liquefiable layer)	1.00	>2.0
BH_TT229896 (lower liquefiable layer)*	1.58	>2.0

* Conceptual remedial/stabilising works are described further in Section 9

Based on these results, there is a risk of uncontrolled failure (flow failure/lateral spreading) is areas where liquefiable layers are close to the surface, if no remedial works are carried out.

8.6 Total liquefaction induced ground damage

Tables 9 & 10 below present the total calculated earthquake induced liquefaction ground deformation at the site with no remedial measures.

Table 9, summary of liquefaction induced ground deformation expected at the site, back from the fill face, with no remedial/strengthening works

No remedial/strengthening works, ground within the vicinity of the fill face									
Location	Ground damage mechanism	Potential ground surface settlement (mm) at the site in:				Potential lateral ground displacement (mm) at the site in:			
		1 in 25 yr EQ	1 in 100 yr EQ	1 in 500 yr EQ	1 in 1000 yr EQ	1 in 25 yr EQ	1 in 100 yr EQ	1 in 500 yr EQ	1 in 1000 yr EQ
BH_TT229892 (upper liquefiable layer)	Volumetric strain/ void redistribution	0	0-10	50	50	0	0	0	0
	Volume loss due to ejecta	0	0	0	0	0	0	0	0
	Shear deformation	0	0	0-10	0-10	0	0	0-10	0-10
	Co-seismic landslide displacement ($D_{50\%}$ taken)	0	0	0	0	0	0	0	0
	Total	0	0-10	50-60	50-60	0	0	0-10	0-10
BH_TT229896 (lower liquefiable layer)	Volumetric strain/ void redistribution	5-10	20-30	20-30	20-30	0	0	0	0
	Volume loss due to ejecta	0	0	0	0	0	0	0	0
	Shear deformation	0	0-10	0-10	0-10	0	0	0-10	0-10
	Co-seismic landslide displacement ($D_{50\%}$ taken)	0	0	0	0	0	0	0	0
	Total	5-10	20-40	20-40	20-40	0	0	0-10	0-10

Table 10, summary of liquefaction induced ground deformation expected at the site, within the vicinity of the fill face, with no remedial/strengthening works

No remedial/strengthening works, ground within the vicinity of the fill face									
Location	Ground damage mechanism	Potential ground surface settlement (mm) at the site in:				Potential lateral ground displacement (mm) at the site in:			
		1 in 25 yr EQ	1 in 100 yr EQ	1 in 500 yr EQ	1 in 1000 yr EQ	1 in 25 yr EQ	1 in 100 yr EQ	1 in 500 yr EQ	1 in 1000 yr EQ
BH_TT229892 (upper liquefiable layer)	Volumetric strain/ void redistribution	0	0-10	50	50	0	0	0	0
	Volume loss due to ejecta	0	0	0	0	0	0	0	0
	Shear deformation	0	0	NA - lateral spreading/flow failure expected		0	0	NA - lateral spreading/flow failure expected	
	Co-seismic landslide displacement ($D_{50\%}$ taken)	0	0	400	700	0	0	800	1400
	Total	0	0-10	Lateral spreading/flow failure expected		0	0	Lateral spreading/flow failure expected	
BH_TT229896 (lower liquefiable layer)	Volumetric strain/ void redistribution	5-10	20-30	20-30	20-30	0	0	0	0
	Volume loss due to ejecta	0	0	0	0	0	0	0	0
	Shear deformation	0	10-20	10-20	10-20	0	0-10	0-10	0-10
	Co-seismic landslide displacement ($D_{50\%}$ taken)	0	40	220	610	0	80	430	1220
	Total	0	50-60	250-270	640-660	0	80-90	430-440	1220-1230

As the remedial measures are at the concept design stage, Table 11 below indicates the approximate performance level that could be achieved with the use of simple remedial/strengthening works, which are described in Section 9.

Table 11, summary of liquefaction induced ground deformation expected at the site, within the vicinity of the fill face, with remedial/strengthening works

With remedial/strengthening works									
		Potential ground surface settlement (mm) at the site in:				Potential lateral ground displacement (mm) at the site in:			
	Mechanism	1 in 25 yr EQ	1 in 100 yr EQ	1 in 500 yr EQ	1 in 1000 yr EQ	1 in 25 yr EQ	1 in 100 yr EQ	1 in 500 yr EQ	1 in 1000 yr EQ
BH_TT229892 (upper liquefiable layer)	Volumetric strain/ void redistribution	0	0-10	50	50	0	0	0	0
	Volume loss due to ejecta	0	0	0	0	0	0	0	0
	Shear deformation	0	0	0-10	0-10	0	0	0-10	0-10
	Co-seismic landslide displacement ($D_{50\%}$ taken)	0	0	50	100	0	0	100	200
	Total	0	0-10	180	230	0	0	120	220
BH_TT229896 (lower liquefiable layer)	Volumetric strain/ void redistribution	5-10	20-30	20-30	20-30	0	0	0	0
	Volume loss due to ejecta	0	0	0	0	0	0	0	0
	Shear deformation	0	10-20	10-20	10-20	0	0-10	0-10	0-10
	Co-seismic landslide displacement ($D_{50\%}$ taken)	0	10	50	90	0	20	100	180
	Total	0	40-60	80-100	120-140	0	20-30	100-110	0-190

9 Remedial works concepts

We recommend the following liquefaction risk remedial works:

1. Around the toe of the fill, excavate a 15m wide strip approx. 15m wide as deep as site conditions allow (likely 1-2m deep)
2. Carry out CPT testing with an appropriately heavy rig to identify and refine where liquefiable materials are located and where treatment is required. This testing will also be required beneath the center of the fill platform where internal batters transition fgl elevations
3. In areas where liquefiable soils are located, install 1-3 layers of geogrid at the base of the fill to resist co-seismic landslide displacements, and improve the post shaking stability to acceptable levels.

A concept cross section sketch of these remedial works is shown below.

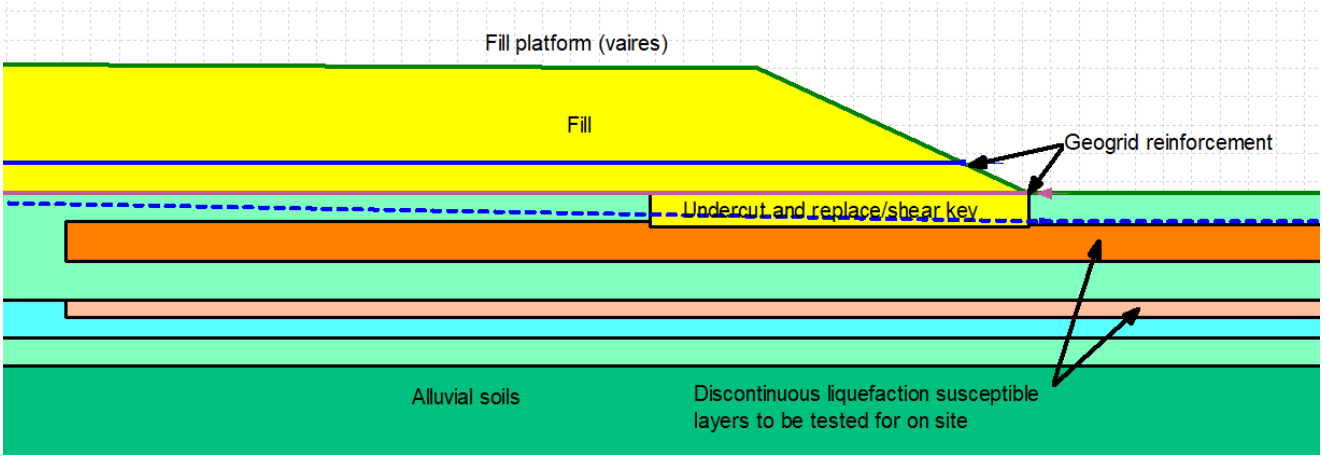


Figure 8, potential strengthening works to reduce liquefaction induced ground damage near the fill face

10 Equivalent Technical Category (TC)

In areas where liquefaction is not expected to occur, which is generally over the majority of the site, no liquefaction damage is expected and the land would be similar to TC1 land.

In areas where liquefaction may occur and the ground subsequently damaged as described in Section 8:

- With no remedial measures, the land near the fill face would be equivalent to TC3 land
  - With simple remedial measures (as described in Section 9), the land could achieve TC2 levels of performance
- Back from the fill face, with no remedial measures, the land near the fill face would be equivalent to TC2 land

Testing could be carried out during construction to further refine where liquefaction may occur, and refine the remedial works areas.

11 Liquefaction risk as per MBIE/MfE guidelines

As per the MfE/MBIE document 'Planning and Engineer Guidance for Liquefaction Prone Land'[6], in areas where liquefaction is expected to occur:

- With no remedial measures, liquefaction induced land damage near the fill face is likely to be 'Moderate to Severe'[7]
  - With remedial measures, liquefaction induced land damage is likely to be 'Minor to Moderate'[8]
- Back from the fill face, with no remedial measures, liquefaction induced land damage is likely to be 'Minor to Moderate'

With remedial measures in place, as per the guidance, where liquefaction is expected to occur, there would be a 'Medium' liquefaction vulnerability.

[6] Planning and engineering guidance for potentially liquefaction-prone land (building.govt.nz)
[7] Planning and engineering guidance for potentially liquefaction-prone land (building.govt.nz), Table A1
[8] Planning and engineering guidance for potentially liquefaction-prone land (building.govt.nz), Table A1

Figure 4.2: Flow chart for determining the liquefaction vulnerability category

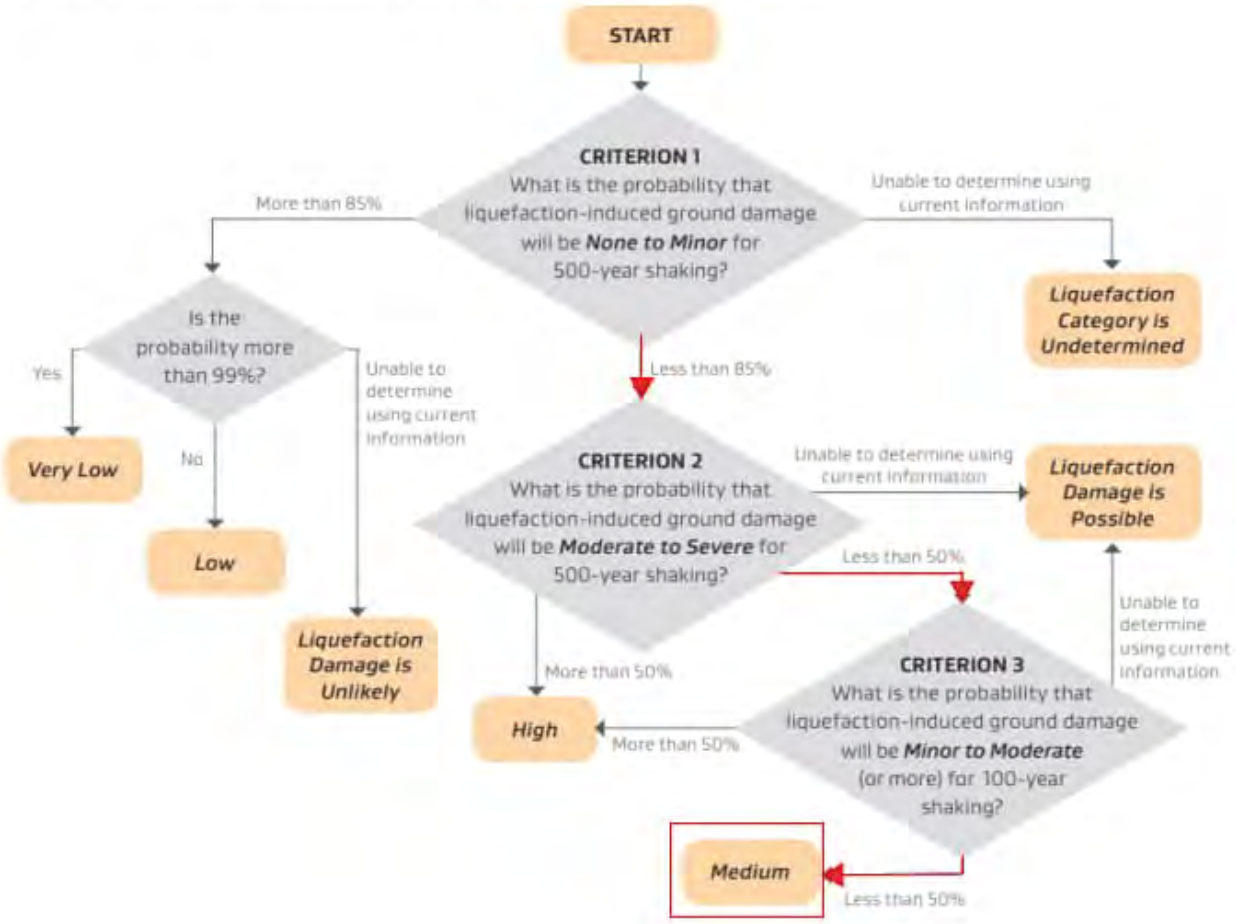


Figure 9

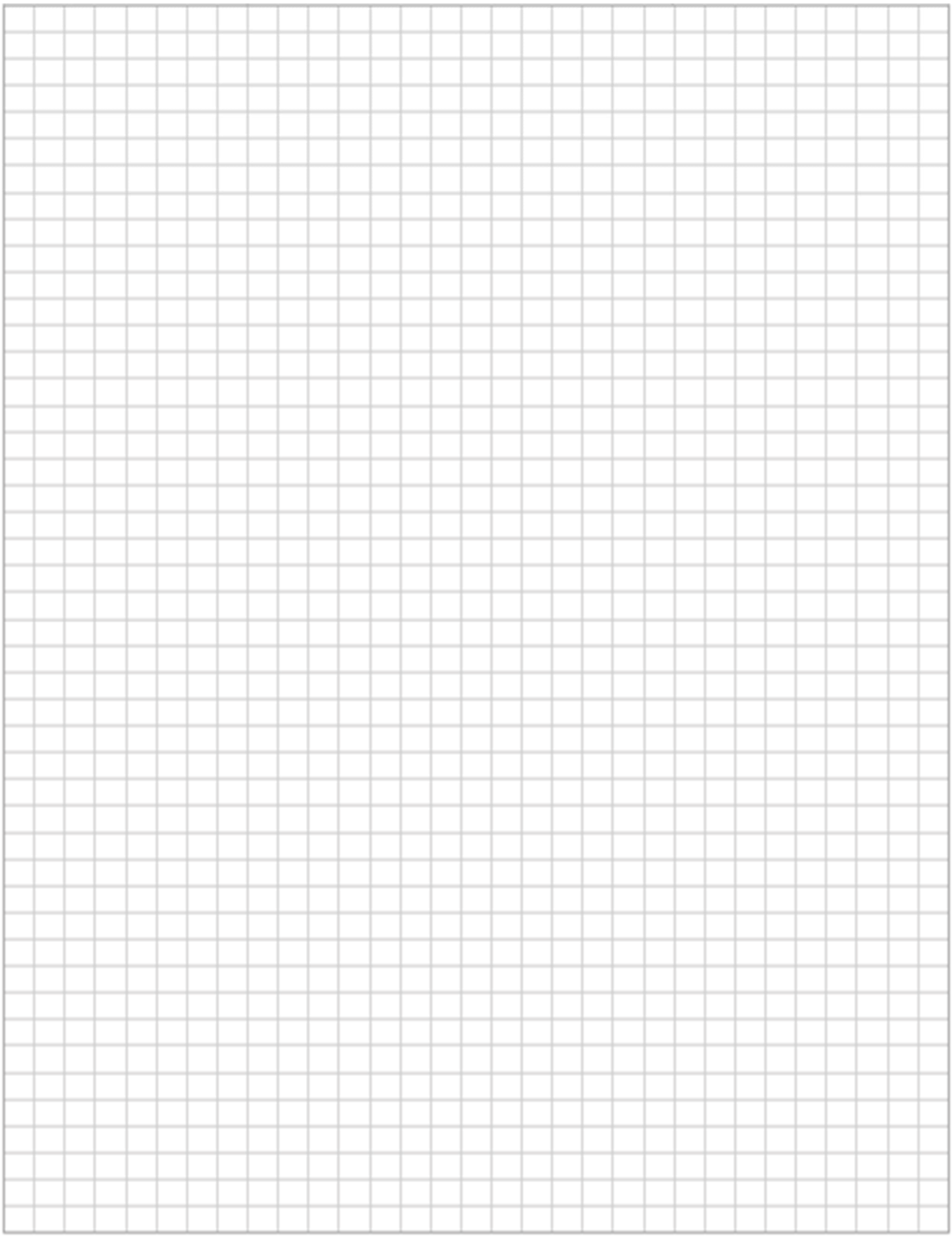
12 Risks / uncertainties

- The SPT is not a continuous test with depth. There is a risk that some layers of soils that are susceptible to liquefaction were note tested.

13 Reference documents

Ref	Title	Link / Ref
	Liquefaction triggering calcs	See attached
	Ground investigation data	Selection of most important logs attached

1 March 2024
p:\1012397\workingmaterial\geotech\liquefaction\liquefaction assessment dja 16.08.23.docx



Appendix E Kākā Lower Reach groundwater assessment and Kākā Stream realignment

DESIGN CALCULATIONS

31 January 2025

Job Name:	Maitahi/Kaka subdivision	Revision No:	1
Job Location:	Nelson	Job No:	1012397.1000
Design Case:	Groundwater assessment for Kaka Stream realignment	Designer:	DJA

Revision History

Ref	Scope	Reviewed by	Date checked	PD Review	Comments
1	Flood plain groundwater assessmet	HJB	1/12/23		These calculations are to support Resource Consent. All calculations to be reviewed and updated as part of detailed design
2	Minor figure updates				These calculations are to support Resource Consent. All calculations to be reviewed and updated as part of detailed design

Table of contents

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1 Summary

1.1 Key design conclusions

Item	Description	Comments from Reviewer
1	Proposed channel alignment shown on figures 1012397.1000-GW-110-112	
2	Proposed channel generally cut down to intercept groundwater to supplement existing flows and reduce the risk of the stream drying up	

1.2 Key design verification requirements / further Work

Item	Description	Comments from Reviewer
3	Continue piezo monitoring over the summer months	
4	Check team happy with proposed horizontal and vertical alignment	
5	Planner to check RC requirements	

2 Design purpose

Kaka stream is an ephemeral watercourse fed by a series of gullies. As it approaches the Maitai river, which it discharges into, it crosses an alluvial flood plain. During summer months, it has been known to dry up partway across this floodplain. The location of Kaka stream is shown on the attached figure 1012397.1000-GW-103.

The stream is to be realigned around the toe of a proposed fill platform that will raise new development above flood level on the alluvial flood plain. The client, in conjunction with his ecologist, desires that the stream realignment incorporates works to reduce the likelihood of the stream drying up and keep water flowing more often.

3 Design objective

- Define a realignment in plan and also in the vertical direction
- Define if lining any portion of the stream would be beneficial

4 Design method

1 Install groundwater monitoring piezometers and collect monitoring data in order to understand the groundwater regime in the floodplain

2 Identify the upstream and downstream ends of the realignment

3 Identify constraints on the realignment corridor from the toe of the proposed fill and the steep bush covered slope to the west

4 Draw up steam realignment

5 Carry out groundwater modelling to check that the stream invert will remain saturated. At this time, only normal groundwater conditions can be modelled, as we do not have summer monitoring data

6 Discuss if lining any portion of the proposed stream may be beneficial/decrease the risk of the stream drying up

The Stormwater Engineers have provided us with a channel cross section profile for flood conveyance.

5 Results

5.1 Groundwater monitoring

We have installed 12 piezometers across the flood plain and monitored these periodically between April 2023 and January 2024. Figure 1012397-GW-103 attached summarise the measured groundwater levels.

Of particular interest is that groundwater has been noted at surface near the base of the bush covered hill to the west of the flood plain.

5.2 Upstream and downstream ends of realignment

The upstream end of the realignment is governed by the proposed earthworks filling surface. This location is shown below.

The downstream end of the realignment where the stream discharges to the Maitai River has been located to get the RL as low as possible so that the vertical alignment of the stream can be made as low as possible to intercept groundwater. This location is shown below.

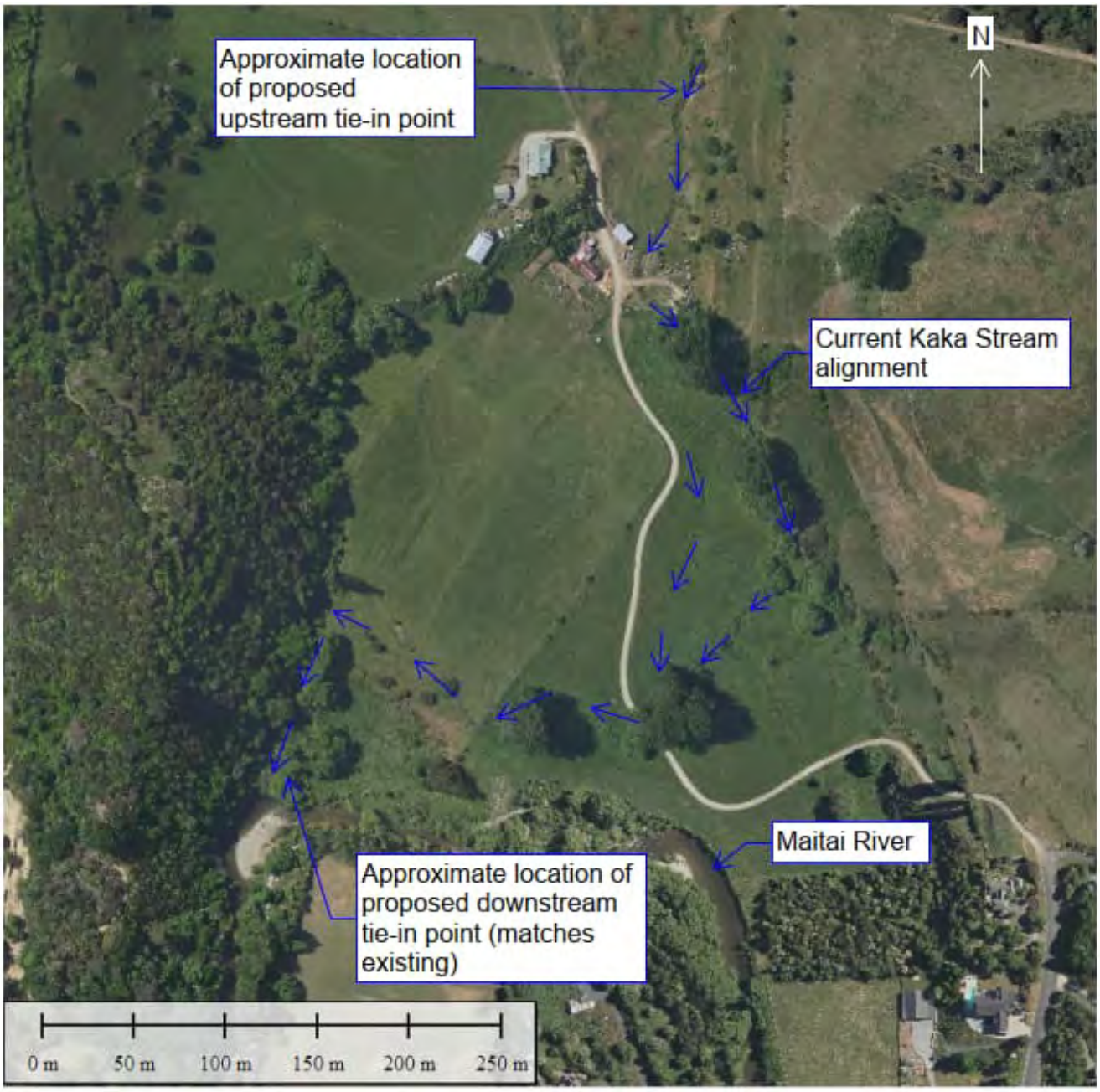

Figure 1, proposed upstream and downstream stream realignment tie-in locations

5.3 Toe of fill constraints

The earthworks design which shows the proposed fill platform location has been provided by Davis Ogilvie Ltd and is shown below.

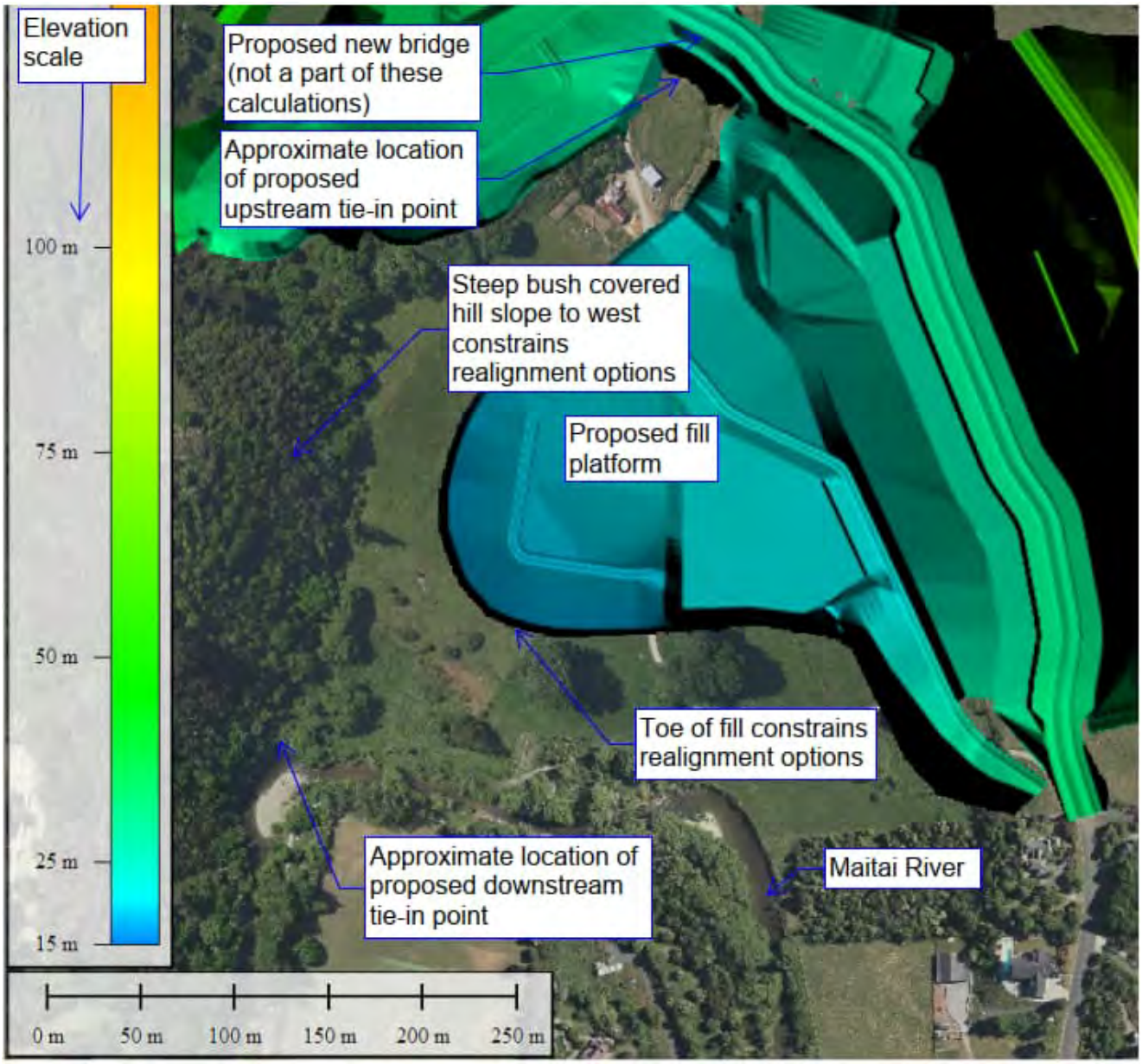

Figure 2, constraints on stream realignment corridor due to fill platform and hill slopes

5.4 Stream realignment

The proposed stream realignment is shown on figure 1012397.1000-SW-103 attached, with typical cross sections shown on figures 1012397.1000-SW-111 & 112. Key considerations include:

- Groundwater has been consistently observed at the ground surface near the base of the steep bush covered hill to the west of the flood plain. Cutting the new channel to the maximum feasible depth in this area, while still maintaining the minimum fall to the outlet into the Maitai River, gives the highest likelihood of supplementing the stream flows from the gullies upstream with groundwater
- Pushing the channel away from the toe of the proposed fill reduces potential negative effects on the fill slope stability

5.5 Groundwater modelling

We have carried out groundwater modelling of the pre and post development alluvial flood plain using Geostudio Seep/W3D. The model is shown in Figure 3 below.

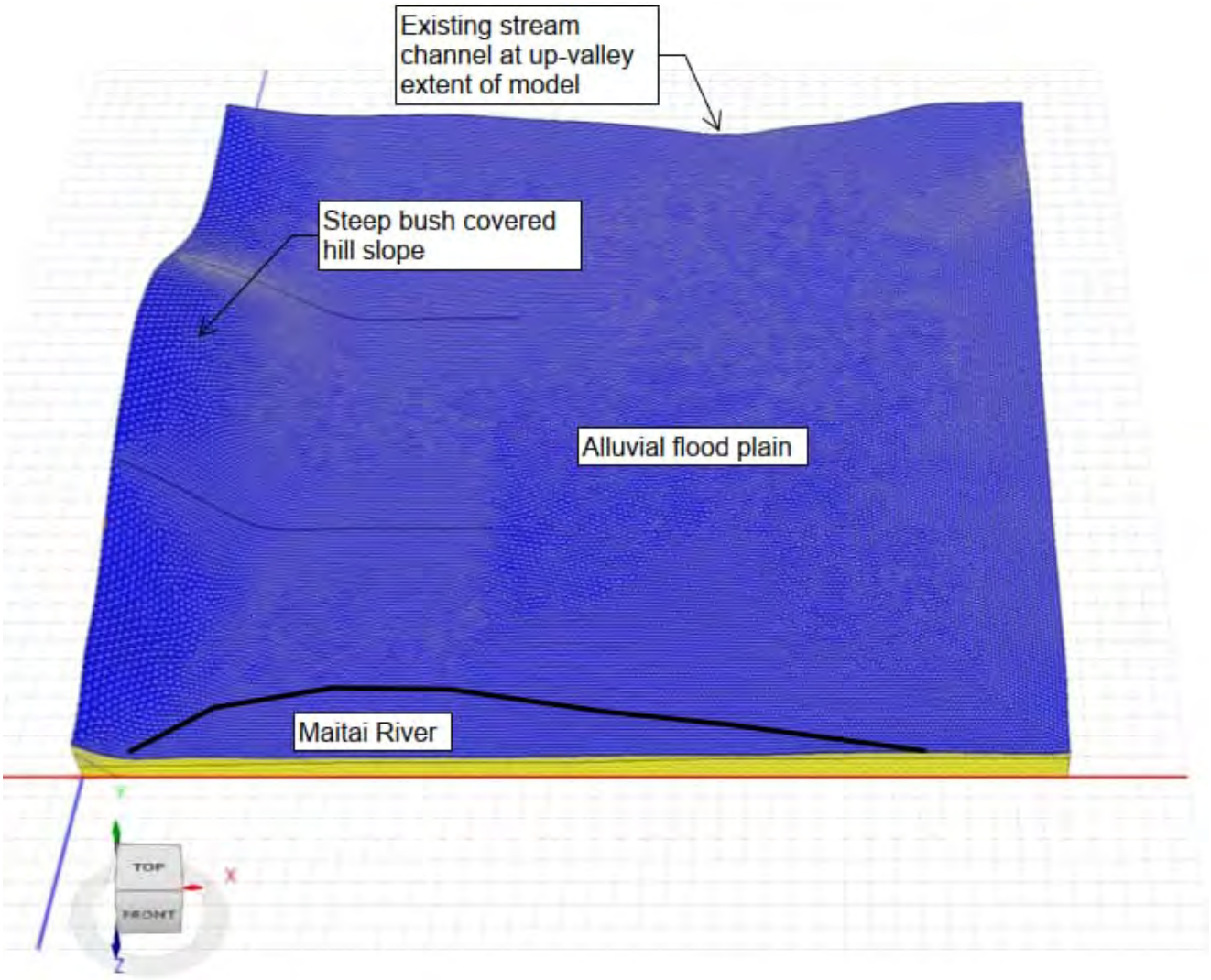

Figure 3, Seep/W3D model

The model uses simplified topography and subsurface strata, shown in Figure 4 below.

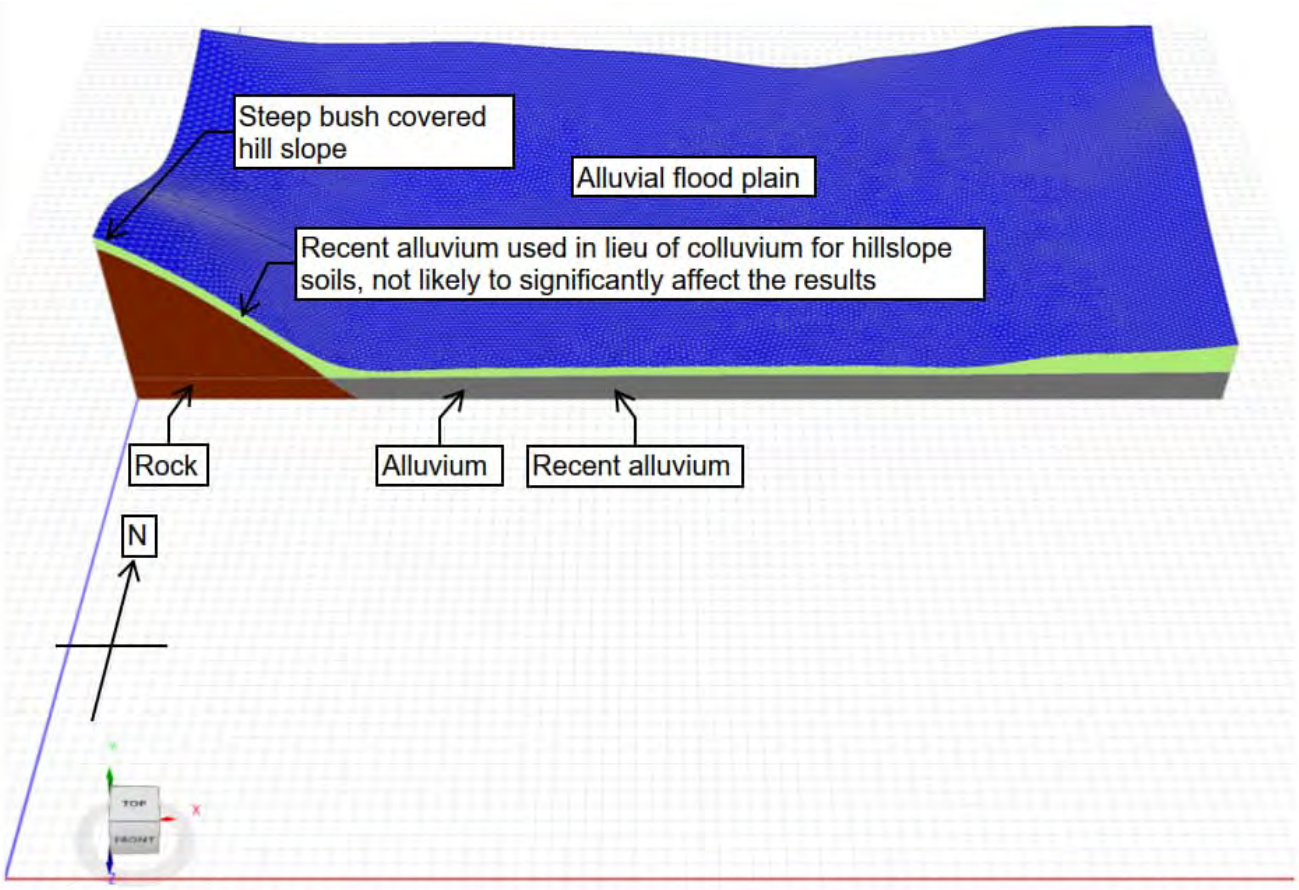

Figure 4, Seep/W 3D model strata

Key material parameters are described below. Some iteration was carried out for the existing ground profile case to check what values of Ky/Kx produced results closest to our observations to date.

Table 1, Seep/W 3D material parameters

Material	Hydaulic conductivity, Kx, m/s	Ky/Kx
Recent alluvium	1e-5	1
Alluvium	9e-5	0.1
Rock	9e-7	1

The model was run as follows:

1. With the existing ground surface topography to confirm the results provide a reasonable approximation of what we have measured/observed at the site to date
2. With the proposed topography, including the proposed cut for the new stream channel, and the new fill platform, to check if the new stream channel will be saturated.

Results are shown below. Note that the model results for the existing topography show that groundwater is predicted at the ground surface. This has been observed on site, as shown on figure 1012397.1000-GW-103.

5.5.1 Existing ground surface topography model run

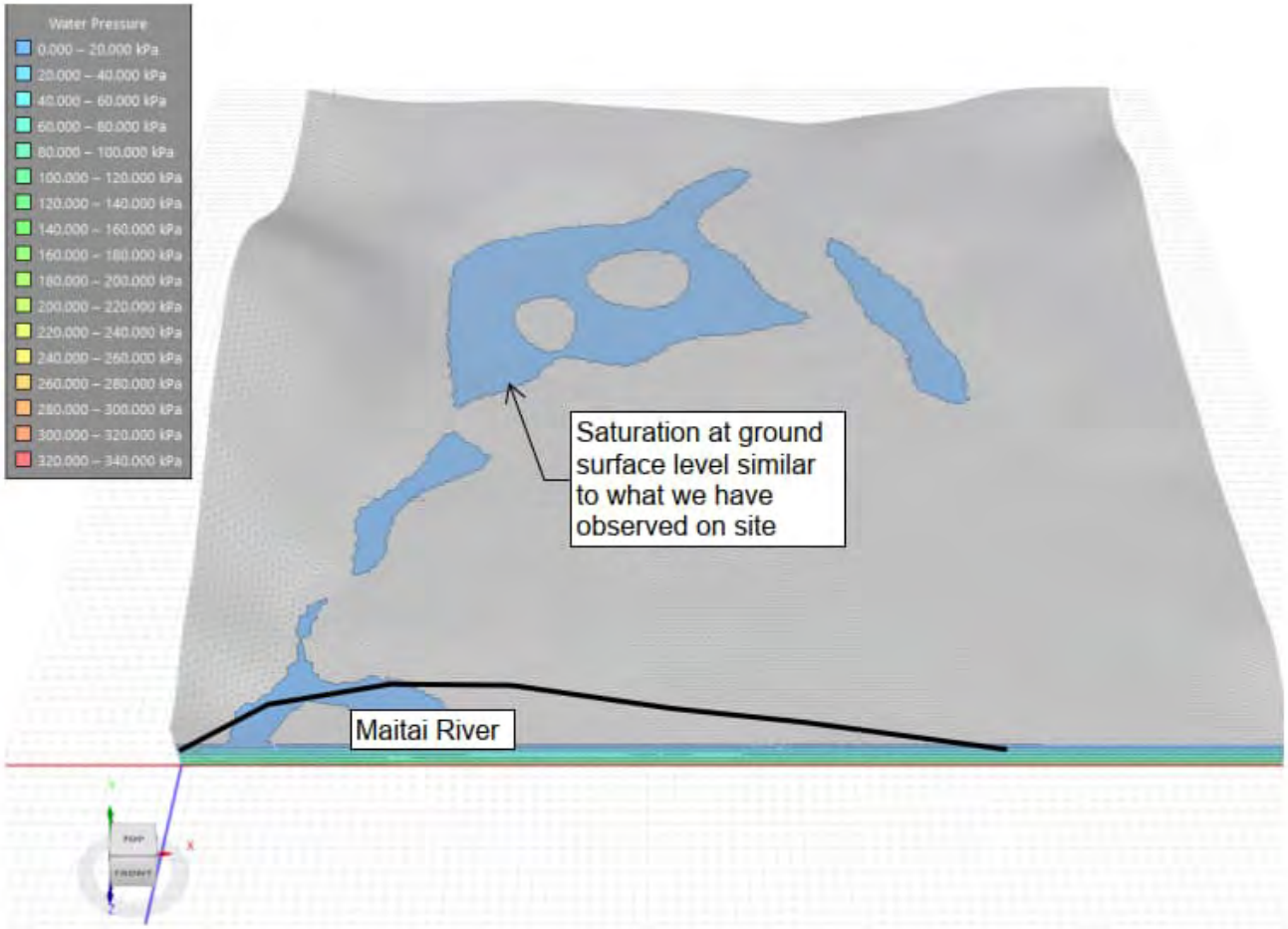

Figure 5, Seep/W3D model results for the existing ground surface topography, showing predicted saturation at surface

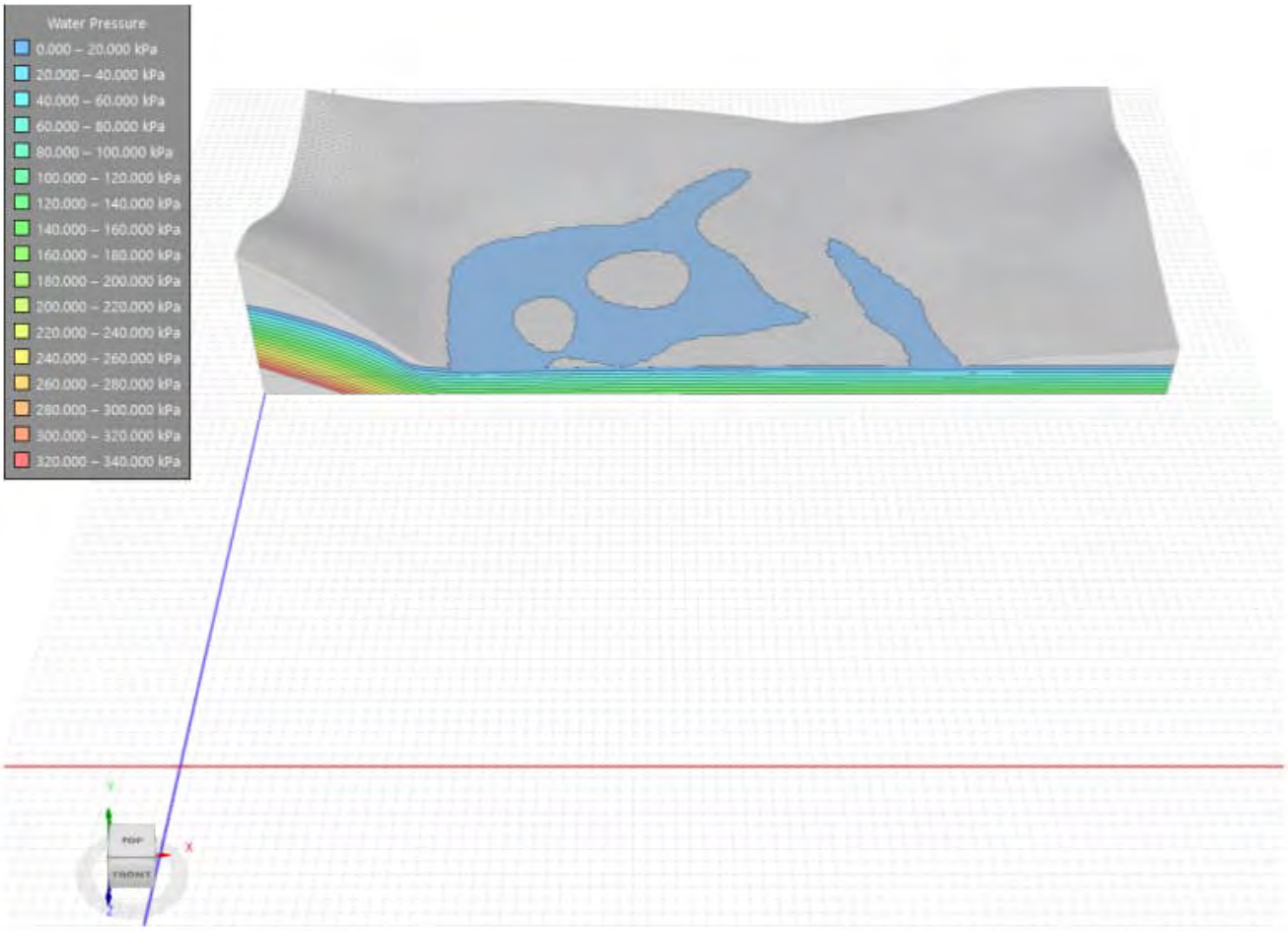

Figure 6, Seep/W3D model results for the existing ground surface topography, showing pore water pressure on a cross section

5.5.2 Proposed ground surface topography model

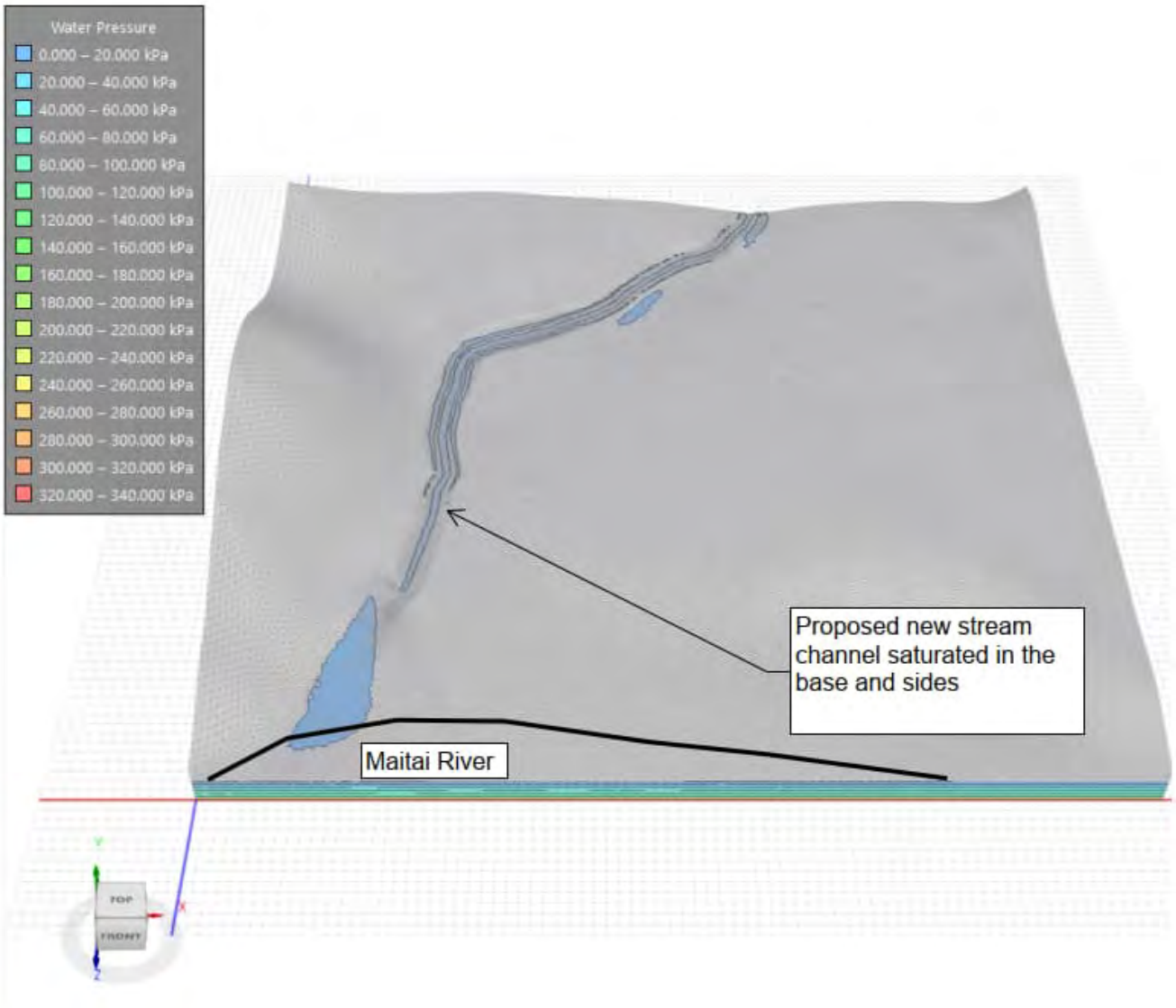

Figure 7, Seep/W3D model results for the proposed ground surface topography, showing predicted saturation of the new stream channel

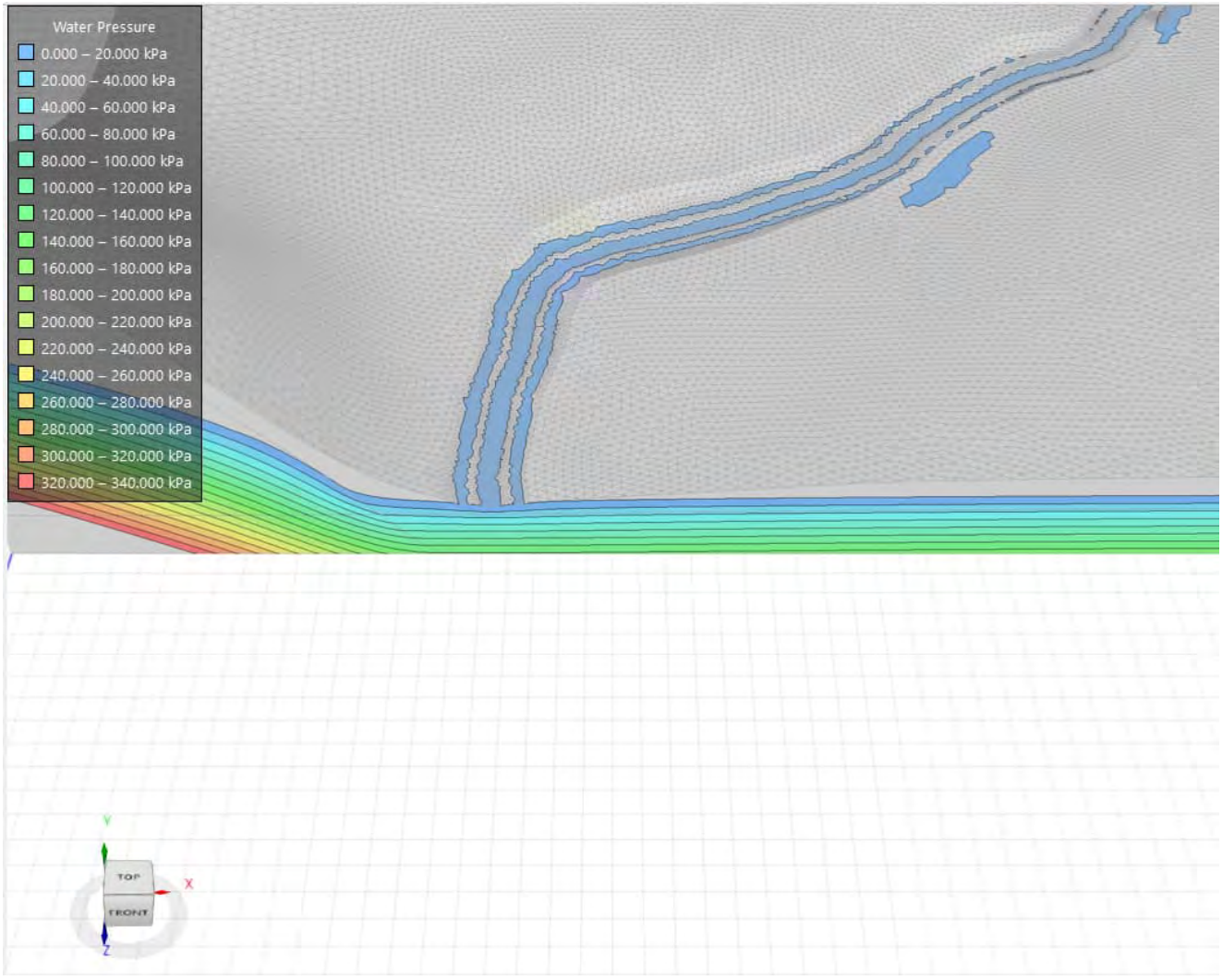

Figure 8, Seep/W3D model results for the proposed ground surface topography, showing pore water pressure on a cross section. Drawdown of groundwater is isolated to withing approx. 15m of the new stream channel.

5.6 Channel lining

During the peak months of summer, the client has informed us that the existing stream dries up approximately half way across the flood plain, even though it does flow at the head of the alluvial plain year-round. It is likely that the existing stream loses water in the vertical direction through the permeable alluvial deposits.

As the majority of the proposed channel intercepts the groundwater level, we do not anticipate that a lined invert will be required. Some localised lining near the top of the channel may be required if permeable soils are encountered before the new invert drops down to the groundwater level.

If, for any reason, the invert of the proposed channel is raised higher than that described here, lining may be required.

6 Risks / uncertainties

- We have not measured water levels through a drought. There is a risk that the regional groundwater table lowers during drought conditions, which could reduce water in the realigned stream

7 Key design verification requirements / further work

Measure groundwater levels over the summer months and update this assessment.

8 Attachments

Figures:

- 1012397.1000-GW-103, Groundwater and stream realignment, summary of water levels and stream realignment
- 1012397.1000-GW-111, Typical sections sheet 1/2
- 1012397.1000-GW-112, Typical sections sheet 2/2

9 Reference documents

Ref	Title	Link / Ref
	Piezo monitoring spreadsheet	\\ttgroup.local\corporate\Nelson\Projects\1012397\1012397.1000\WorkingMaterial\Geotechnical\Groundwater\Piezometers\Leveloggers and WL monitoring\Piezo water level monitoring.xlsx
	Seep.W 3D model	P:\1012397\1012397.1000\WorkingMaterial\Geotechnical\Groundwater\Modelling

30 January 2025
document2

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ORIGINAL IN COLOUR

A3 SCALE 1:1500
0 20 40 60 80 100 (m)

PZ1

PZ2

PZ3 @ EGL (19.8 mRL)
GWL @ 19.8 mRL, 11/05/23
GWL @ 18.2 mRL, 15/02/24

PZ4 @ EGL (19.4 mRL)
GWL @ 19.5 mRL, 11/05/23
GWL @ 18.1 mRL, 15/02/24

PZ4A @ EGL (19.4 mRL)
GWL @ 19.4 mRL, 11/05/23
GWL @ 18.0 mRL, 15/02/24

EXISTING STREAM DRY FROM APPROXIMATELY THIS POINT

PZ5 @ EGL (18.1 mRL)
GWL @ 17.9 mRL, 11/05/2023
DRY, 15/02/2024

PZ6a & 6b @ EGL (16.8 mRL)
GWL @ 16.8 mRL, 19/09/2023
GWL @ 16.3 mRL, 15/02/2024

SURFACE WATER AS OF JUNE 2023

SURFACE WATER AS OF FEBRUARY 2024

PZ8 @ EGL (16.7 mRL)
GWL @ 15.1 mRL, 11/05/2023
GWL @ 13.5 mRL, 15/02/2024

PZ7a & 7b @ EGL (15.0 mRL)
GWL @ 14.3 mRL, 11/05/2023
GWL @ 12.9 mRL, 15/02/2024

PZ9 @ EGL (16.6 mRL)
GWL @ 16 mRL, 11/05/23
GWL @ 14.7 mRL, 15/02/2024

PROPOSED STREAM REALIGNMENT

MAITAI RIVER

LEGEND

- EXISTING GROUND CONTOURS
- EDGE OF PROPOSED FILL PLATFORM
- PIEZOMETER LOCATION AND REPRESENTATIVE MEASURED MIN. AND MAX. GWL RANGE
- EXISTING STREAM ALIGNMENT
- PROPOSED STREAM REALIGNMENT
- OBSERVED WATER AT GROUND SURFACE, FEB 24
- OBSERVED WATER AT GROUND SURFACE, JUNE 23
- PROPOSED GROUND CONTOURS PROVIDED BY DAVIS OGILVIE LTD, JAN 2025

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DRAWN	FEOH	Feb.24	
DESIGN CHECKED			
DRAWING CHECKED			

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TITLE GROUNDWATER AND STREAM REALIGNMENT SUMMARY OF WATER LEVEL RANGES

SCALE (A3) 1:1500 DWG No. 1012397.1000-GW-103 REV 1

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ORIGINAL IN COLOUR

Datum RL(m) 10

Design Ground RL (m)	29.08	28.81	26.57	23.18	20.96	18.69	19.08	19.12	19.79	19.86	19.8	19.99	19.99	19.91	19.58	19.6	19.43	19.21	19.18	19.03	19.03	18.93	18.78	18.63	18.52	18.48	18.42	18.52	18.47	18.43	18.39
2021 LiDAR	29.08	28.81	26.57	23.18	20.96	19.93	20.11	19.87	19.79	19.86	19.80	19.99	19.99	19.91	19.58	19.60	19.43	19.21	19.18	19.03	19.03	18.93	18.78	18.63	18.52	18.48	18.42	18.52	18.47	18.43	18.39
CHAINAGE (m)	5.00	10.00	15.00	20.00	25.00	30.00	35.00	40.00	45.00	50.00	55.00	60.00	65.00	70.00	75.00	80.00	85.00	90.00	95.00	100.00	105.00	110.00	115.00	120.00	125.00	130.00	135.00	140.00	145.00	150.00	155.00

CROSS SECTION 1

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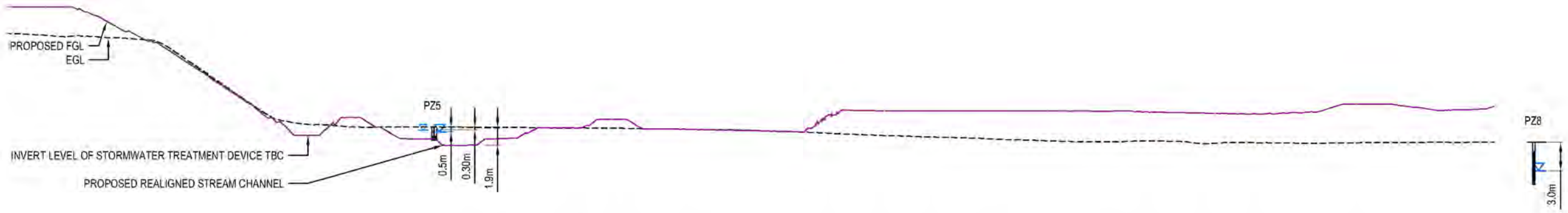
Vertical Scale 1:500



Datum RL(m) 5

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2021 LiDAR	27.58	27.40	26.64	23.23	19.82	18.32	17.93	17.94	17.94	17.93	17.89	17.88	17.77	17.69	17.65	17.51	17.34	17.12	16.92	16.76	16.55	16.41	16.35	16.42	16.16	16.25	16.19	16.22	16.27	16.29	16.28
CHAINAGE (m)	5.00	10.00	15.00	20.00	25.00	30.00	35.00	40.00	45.00	50.00	55.00	60.00	65.00	70.00	75.00	80.00	85.00	90.00	95.00	100.00	105.00	110.00	115.00	120.00	125.00	130.00	135.00	140.00	145.00	150.00	155.00

CROSS SECTION 2

Horizontal Scale 1:500

Vertical Scale 1:500

A3 SCALE 1:500

0 5 10 15 20 25 (m)

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REV	DESCRIPTION	CAD	CHK	DATE	APPROVED	DATE
1	CLIENT INFORMATION	FEOH				

DESIGNED			DRAWING STATUS
DRAWN	FEOH	Feb.24	
DESIGN CHECKED			
DRAWING CHECKED			

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PROJECT **MAITAHI SUBDIVISION, MAITAI VALLEY, NELSON**

TITLE GROUNDWATER AND STREAM REALIGNMENT TYPICAL SECTIONS SHEET 1/2

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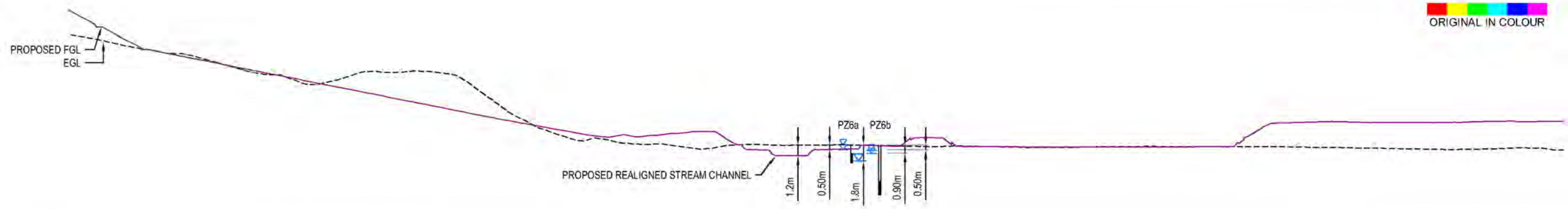
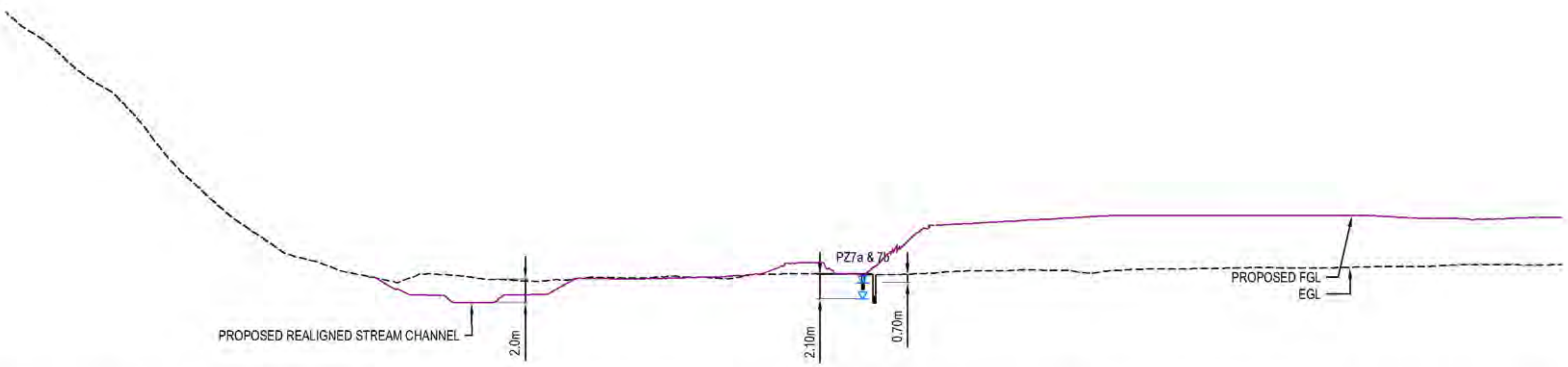


Datum RL(m) 5

CHAINAGE (m)	2021 LiDAR	Design Ground RL (m)
5.00	28.14	28.14
10.00	27.22	27.22
15.00	26.38	26.38
20.00	25.00	25
25.00	24.08	24.08
30.00	24.05	24.05
35.00	24.90	24.9
40.00	25.00	25
45.00	23.50	23.5
50.00	19.98	19.98
55.00	17.83	17.83
60.00	17.37	17.37
65.00	16.79	16.79
70.00	16.36	16.07
75.00	16.74	15.20
80.00	16.69	15.02
85.00	16.72	15.89
90.00	16.69	16.69
95.00	16.56	16.56
100.00	16.62	16.62
105.00	16.52	16.52
110.00	16.47	16.47
115.00	16.52	16.52
120.00	16.56	16.56
125.00	16.53	16.53
130.00	16.54	16.54
135.00	16.54	16.54
140.00	16.47	16.47
145.00	16.37	16.37
150.00	16.30	16.3
155.00	16.22	16.22
160.00	16.28	16.28
165.00	16.38	16.38

CROSS SECTION 3
Horizontal Scale 1:500
Vertical Scale 1:500



Datum RL(m) 5

CHAINAGE (m)	2021 LiDAR	Design Ground RL (m)
5.00	51.83	51.83
10.00	47.63	47.63
15.00	43.06	43.06
20.00	38.18	38.18
25.00	34.27	34.27
30.00	30.50	30.5
35.00	24.61	24.61
40.00	20.09	20.09
45.00	16.85	16.85
50.00	15.33	15.33
55.00	14.64	14.03
60.00	15.02	13.13
65.00	14.62	13.26
70.00	14.76	14.15
75.00	14.83	14.83
80.00	14.92	14.92
85.00	15.01	15.01
90.00	15.21	15.21
95.00	15.17	15.17
100.00	15.19	15.19
105.00	15.46	15.46
110.00	15.55	15.55
115.00	15.27	15.27
120.00	15.61	15.61
125.00	15.67	15.67
130.00	15.75	15.75
135.00	15.72	15.72
140.00	15.82	15.82
145.00	15.86	15.86
150.00	16.03	16.03
155.00	15.99	15.99

CROSS SECTION 4
Horizontal Scale 1:500
Vertical Scale 1:500

A3 SCALE 1:500
0 5 10 15 20 25 (m)

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REV	DESCRIPTION	CAD	CHK	DATE	APPROVED	DATE
1	CLIENT INFORMATION	FEOH				

DESIGNED		
DRAWN	FEOH	Feb.24
DESIGN CHECKED		
DRAWING CHECKED		

DRAWING STATUS

NOT FOR CONSTRUCTION

THIS DRAWING IS NOT TO BE USED FOR CONSTRUCTION PURPOSES UNLESS SIGNED AS APPROVED

CLIENT CCKV MAITAI DEV CO LP AND BAYVIEW NELSON LTD
PROJECT MAITAHI SUBDIVISION, MAITAI VALLEY, NELSON
TITLE GROUNDWATER AND STREAM REALIGNMENT TYPICAL SECTIONS SHEET 2/2

SCALE (A3) 1:500   DWG No. 1012397.1000-GW-113   REV 1

Appendix F Slug Test and infiltration assessment results

- **Slug test results Memo (31 January 2024)**

Tonkin+Taylor

Memo

To:	Neil Donaldson, Jacob Anderson	**Job No:**	1012397.1000
From:	Amelia Horne	**Date:**	31 January 2024
cc:	Tim Dodd, Mark Lile		
Subject:	Kaka Slug testing		

1 In-situ hydraulic conductivity testing

This memo provides details of in-situ slug testing and analysis undertaken in September 2023 to estimate hydraulic conductivity for the screened sections of boreholes BH01-0723, BH02-0723, BH06-0723, BH06 Deep, and BH06 Shallow in the Kaka Valley.

1.1 Piezometers

Groundwater piezometers were installed in each borehole following completion of machine drilling. Piezometer details are shown in Table 1.1 (below). Installation records for the piezometers are presented on the bore logs (attached).

Table 1.1: Piezometer details

Piezometer	Screen section (m bgl)	Screen length (m)	Diameter (mm)	Top of casing (m agl)	Static water level (m bgl)	Date static water level measured
BH01-0723	18.5 – 21.5	3.0	38	0.46	8.76	20/09/2023
BH02-0723	13.3 – 15.53	2.23	38	0.27	8.86	20/09/2023
BH06-0723	2.5 – 3.5	1.0	38	0.31	0.88	19/09/2023
BH06 Deep	4.0 – 5.5	1.5	38	0.425	0.88	19/09/2023
BH06 Shallow	1.0 – 2.0	1.0	38	0.405	0.39	20/09/2023

Notes: m bgl denotes metres below ground level and m agl denotes meters above ground level

1.2 Field method

Slug tests, comprising both falling and rising head tests, were carried out at BH06-0723 and BH06 Deep on 19 September 2023 and BH01-0723, BH02-0723, and BH06 Shallow on 20 September 2023. One falling and rising head test was carried out in each piezometer.

To initiate the falling head test, a slug with a volume of 0.39 L (1.03 m length and 22 mm diameter), was lowered into the piezometer to displace the water. The falling head test was followed by a rising head test, which was initiated by removing the slug from the piezometer.

Water levels were recorded every one second by Solinst brand level loggers (unvented pressure transducers) and were also manually recorded intermittently (approximately one minute intervals) using a handheld dip-meter.

1.3 Field results

The groundwater level data recorded during the falling and rising head tests for BH101, BH102, BH103, BH104 and BH105 are shown in Figure 1.1 to Figure 1.5. The manual and logger records are consistent i.e. both show similar groundwater levels as each test progressed. At BH06 groundwater levels were observed to recover quickly to the initial static water level(deep) during both the falling and rising head tests(within approximately 30 seconds). BH01-0723 did not recover to initial static water levels in 60 minutes for both the rising and falling head tests. For the other piezometers (NH02-0723, BH06-0723 and BH06 Shallow) the groundwater levels recovered to the initial static water levels within 30 minutes of the rising and falling head tests.

Test lengths were variable, typically until the water level had returned to the initial static wate level (e.g. at BH06 deep and shallow, BH02-0723, BH06-0723) or until approximately one hour had elapsed (e.g. at BH01-0723).

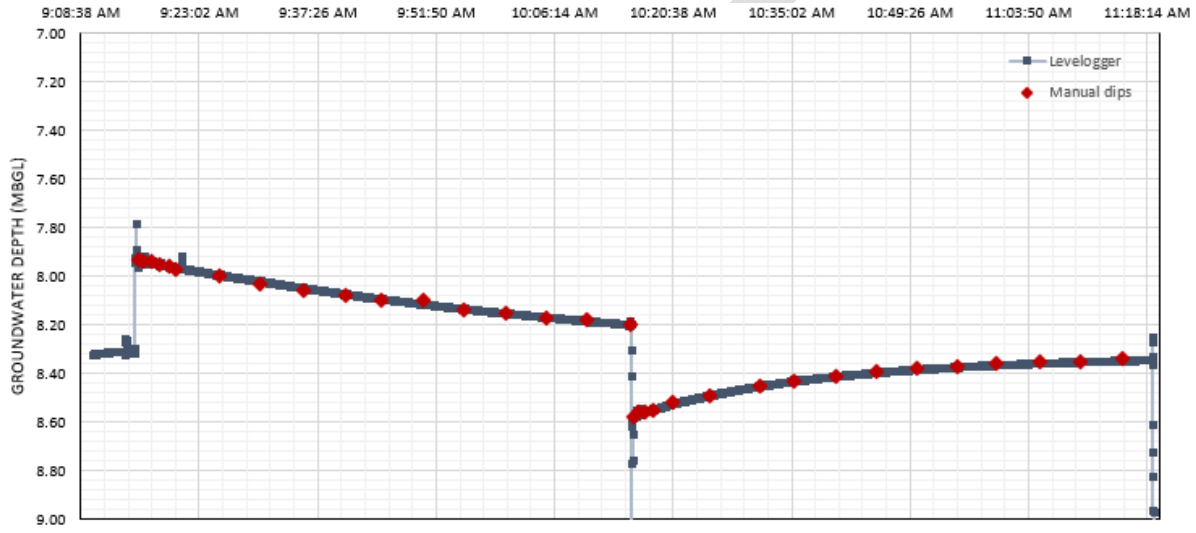


Figure 1.1: BH01-0723 groundwater levels recorded during the falling and rising head tests.

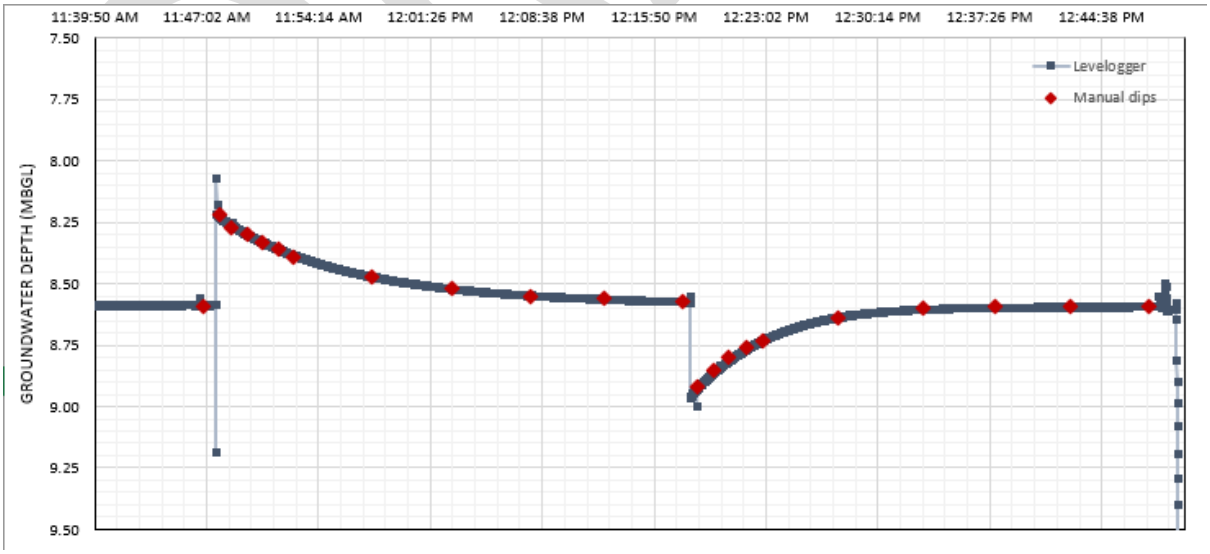


Figure 1.2: BH02-0723 groundwater levels recorded during the falling and rising head tests.

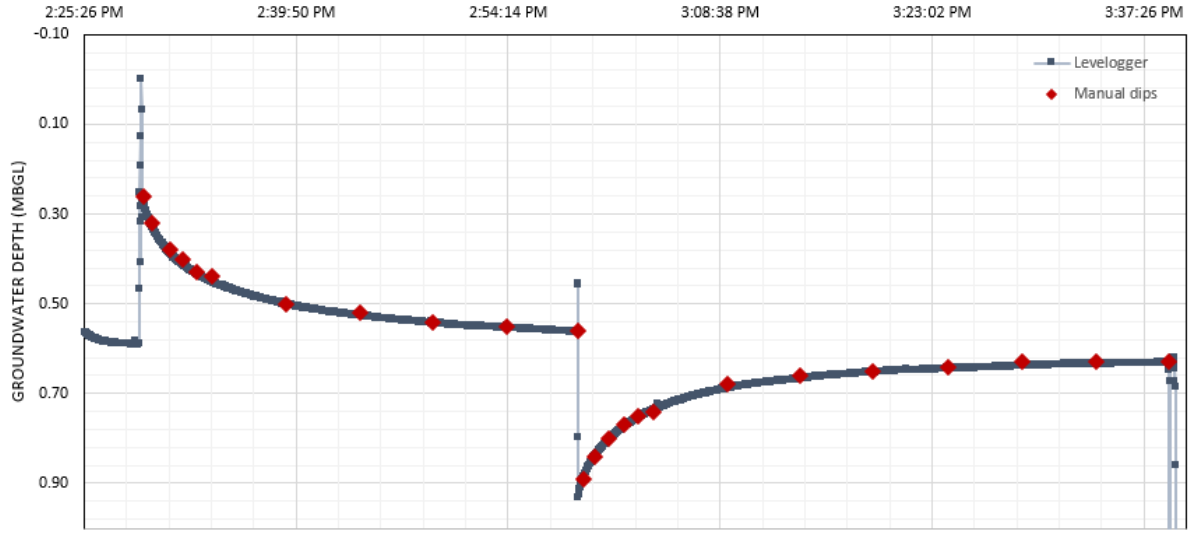


Figure 1.3: BH06-0723 groundwater levels recorded during the falling and rising head tests.

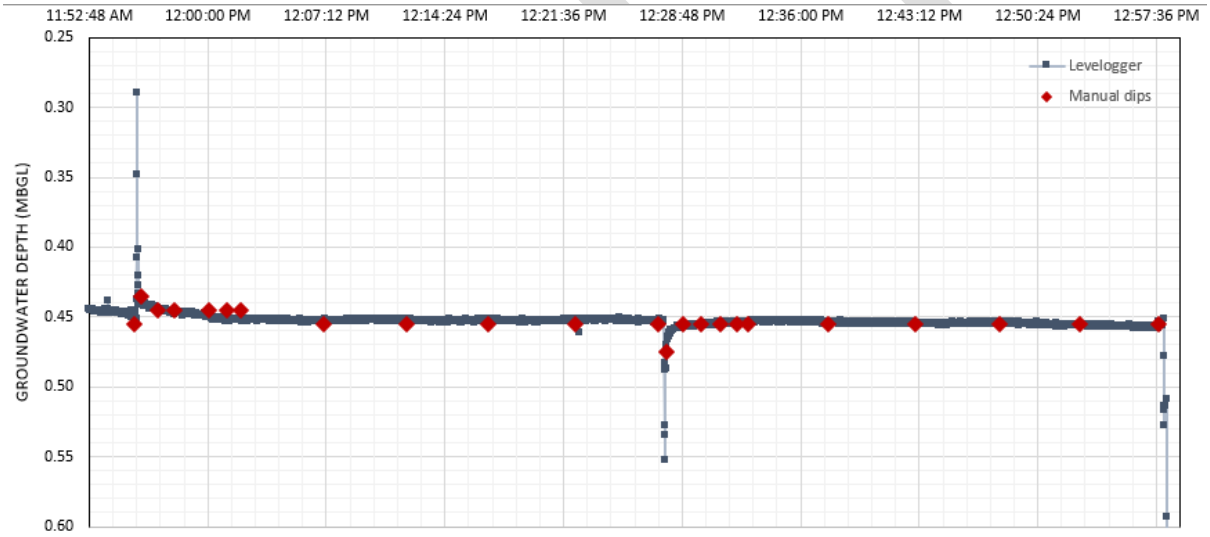


Figure 1.4: BH06 Deep groundwater levels recorded during the falling and rising head tests.

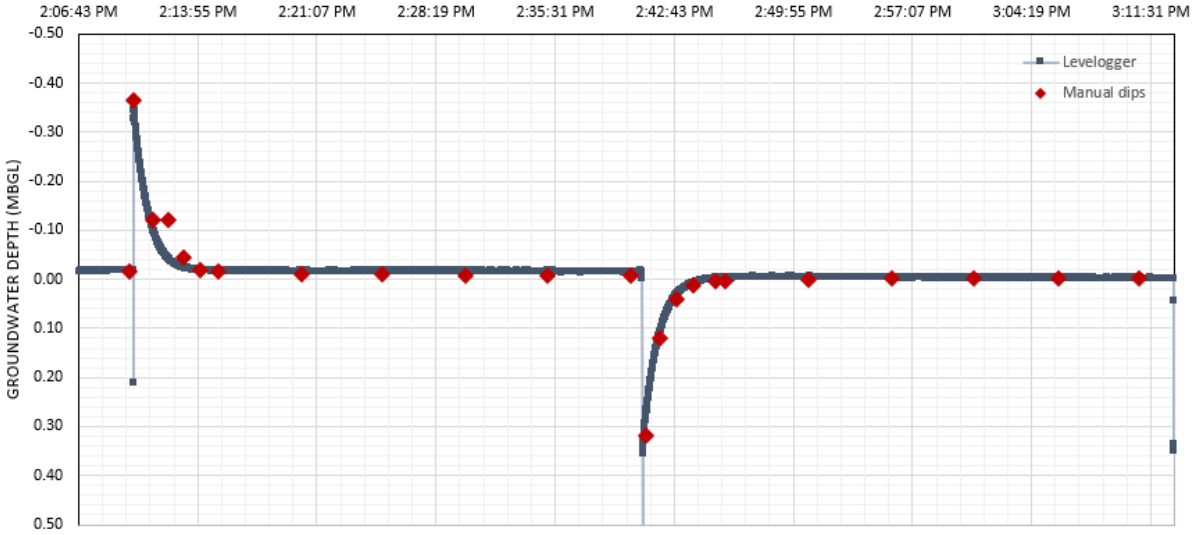


Figure 1.5: BH06 Shallow groundwater levels recorded during the falling and rising head tests.

1.4 Analysis method

The falling and rising head field results were analysed using the Hvorslev[1], and Bouwer & Rice[2] methods available in AquiferTest Pro[3] to estimate the hydraulic conductivity for the geological material at the screened section of the boreholes.

For a concave up appearance, Butler[4] recommends matching the straight-line slug test solutions to the data within recommended normalised head ranges to provide a reliable data analysis. For the Hvorslev method this range is recommended to be from 0.15 to 0.25, and 0.20 to 0.30 for the Bouwer & Rice method.

1.4.1 Assumptions

The Hvorslev solution[1] assumes the following:

- Unconfined or non-leaky confined aquifer of “apparently” infinite extent
- Homogeneous, isotropic aquifer of uniform thickness
- Water table is horizontal prior to the test
- Instantaneous injection/withdrawal of a volume of water results in an instantaneous change in water level
- Inertia of water column and non-linear well losses are negligible
- Fully penetrating well
- The well is considered to be of an infinitesimal width
- Flow is horizontal toward or away from the well

And the Bouwer & Rice method[2] assumes:

[1] Hvorslev, M.J., 1951. Time Lag and Soil Permeability in Ground-Water Observations, Bull. No. 36, Waterways Exper. Sta. Corps of Engrs, U.S. Army, Vicksburg, Mississippi, pp. 1-50.
[2] Bouwer, H. and R.C. Rice, 1976. A slug test method for determining hydraulic conductivity of unconfined aquifers with completely or partially penetrating wells, Water Resources Research, vol. 12, no. 3, pp. 423-428.
[3] AquiferTest Pro: Version 10.0, Waterloo Hydrogeologic, Ontario, Canada
[4] Butler, J.J., Jr., 1998. The Design, Performance, and Analysis of Slug Tests, Lewis Publishers, New York, 252p

- Unconfined or leaky-confined aquifer (with vertical drainage from above) of “apparently” infinite extent
- Homogeneous, isotropic aquifer of uniform thickness
- Water table is horizontal prior to the test
- Instantaneous change in head at start of test
- Inertia of water column and non-linear well losses are negligible
- Fully or partially penetrating well
- The well storage is not negligible
- The flow to the well is in a steady state
- There is no flow above the water table

1.5 Analysis results

The hydraulic conductivity results of individual field tests and analysis methods are shown in Table 1.2. The Aquifer Test Pro outputs are provided in Appendix B.

The geometric mean for hydraulic conductivity values was calculated. Results for each field test and analysis method are presented in Table 1.3. The overall geometric mean hydraulic conductivity value for the sandy aquifer (also referred to as alluvials in Table 1.2[5]) is calculated as 2.72 m/day.

The calculated hydraulic conductivities for the sandy aquifer are within the expected range of hydraulic conductivity described by Bouwer 1978[6], which report hydraulic conductivity for fine to coarse sand in order of 1 to 100 m/day respectively.

We note that the slug test method is used to estimate hydraulic conductivity values for the geologic medium immediately outside the screened section of the piezometers and the results are typically valid within one order of magnitude.

Table 1.2: Hydraulic conductivity analysis results

Borehole	Geologic Formation	Screened lithology (m bgl)	Hydraulic conductivity (m/day)		
			Test	Hvorslev method	Bouwer & Rice method
BH01-0723	Grampian Formation		Falling head test	0.009	0.007
			Rising head test	0.004	0.003
BH02-0723	Grampian Formation	Sandstone	Falling head test	0.061	0.048
			Rising head test	0.110	0.083
BH06-0723	Not logged	Clayey Silt	Falling head test	0.077	0.070
			Rising head test	0.017	0.024
BH06 Deep	Alluvials	Gravels	Falling head test	10.800	8.415
			Rising head test	6.394	5.236
BH06 Shallow	Alluvials	Not logged (Assumed sand and gravels)	Falling head test	1.356	1.045
			Rising head test	0.942	0.740

[5] Note that hydraulic conductivity values in Table 1.2 have been rounded from m/s and reported in units of m/day.
[6] Bouwer, H. 1978. Groundwater hydrology. McGraw-Hill Book, New York, 480 pp.

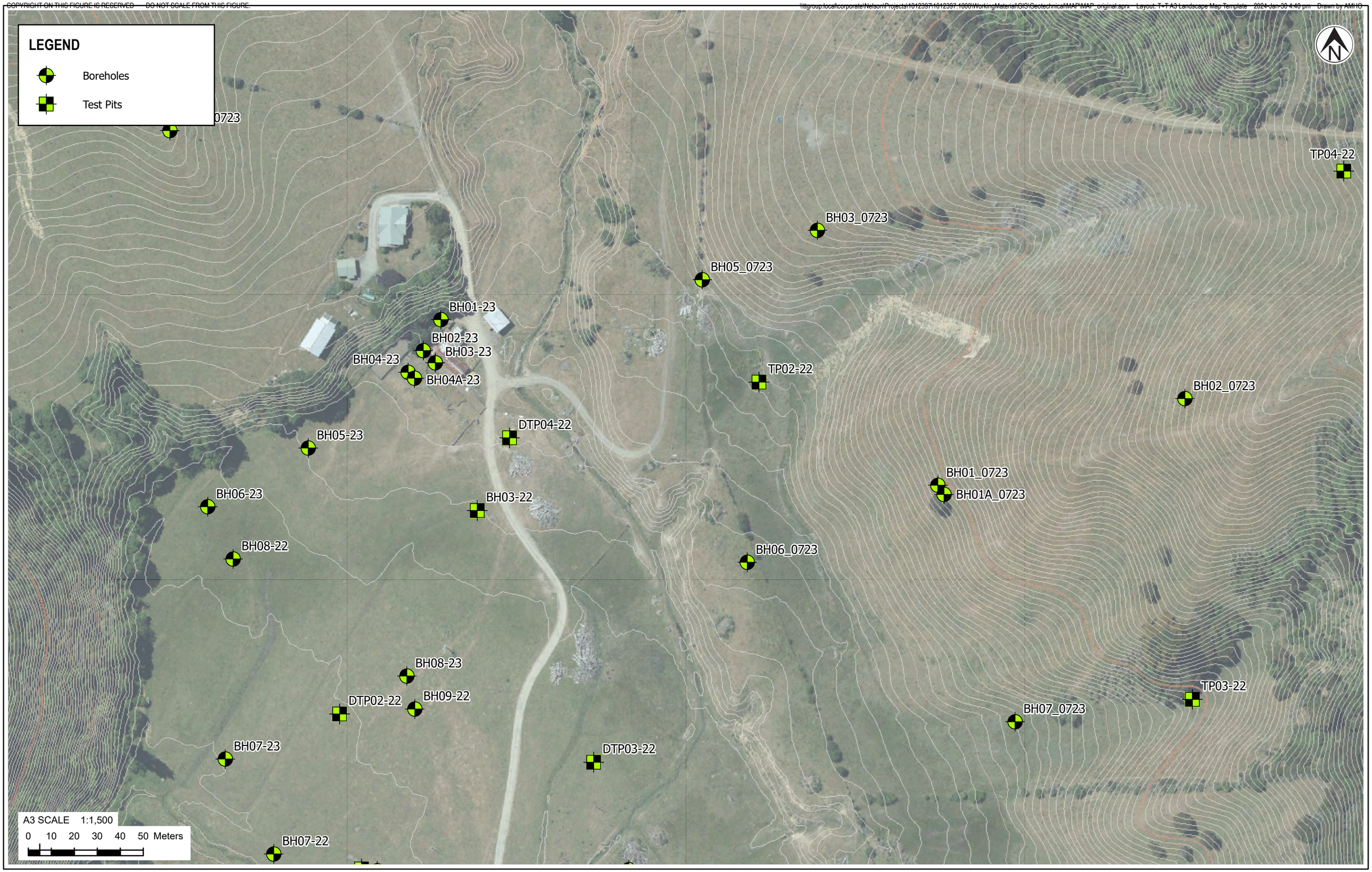
Table 1.3: Mean hydraulic conductivity results.

Borehole	Hydraulic conductivity geometric mean (m/s)	Hydraulic conductivity geometric mean (m/day)
BH01-0723	6.38×10^{-8}	5.53×10^{-3}
BH02-0723	8.32×10^{-7}	7.19×10^{-2}
BH06-0723	4.46×10^{-7}	3.85×10^{-2}
BH06 Deep	8.60×10^{-5}	7.43×10^{0}
BH06 Shallow	1.15×10^{-5}	9.97×10^{-1}

Appendix A Site Investigation Data

- **Figure 1 – Site Plan Investigations**
- **Borehole Logs – BH01-BH06**

\\ttgroup.local\corporate\Nelson\Projects\1012937\1012937.1000\WorkingMaterial\GIS\Geotechnical\MAP\MAP_original.aprx Layout: T+T A3 Landscape Map Template 2024-Jan-30 4:40 pm Drawn by AMHO



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NOTES:
Basemap NZ Navigation Map: Eagle Technology, LINZ, StatsNZ, NIWA, Natural Earth, © OpenStreetMap contributors.. NZ Imagery: Eagle Technology, Land Information New Zealand, GEBCO, Community maps contributors. CacheContour:

REV	DESCRIPTION	GIS	CHK	DATE
0	First version	AMHO		01/24

LOCATION PLAN

PROJECT No.	1012937.1000	
DESIGNED	AMHO	JAN.24
DRAWN	AMHO	JAN.24
CHECKED		
APPROVED		DATE

CLIENT **CCKV MAITAI DEV CO LP**
PROJECT **KAKA SUBDIVISION, MAITAI VALLEY, NELSON**
TITLE SITE PLAN - SITE INVESTIGATIONS
SCALE (A3) 1:1,500 FIG No. FIGURE 1. REV 0

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DRAFT
This data has not been fully reviewed.
It may be subject to change.

BOREHOLE LOG

BOREHOLE No.: BH01_0723

SHEET: 1 OF 5

PROJECT: Maitahi	CO-ORDINATES: (NZTM2000) 5431321 mN 1626162 mE	R.L. GROUND: 48m
JOB No.: 1012397.1000.1000		R.L. COLLAR:
LOCATION: Kaka Valley	DIRECTION: 0°	DATUM: NZVD2016
	ANGLE FROM HORIZ.: -90°	SURVEY: Map or aerial photograph

DRILLED BY: Dylan
LOGGED BY: ANCO
CHECKED: JXWW
START DATE: 03/07/2023
FINISH DATE: 07/07/2023
CONTRACTOR: CW Drilling

GEOLOGICAL UNIT	MATERIAL DESCRIPTION (SOIL: Classification, colour, consistency / density, moisture, plasticity; ROCK: Weathering, colour, fabric, name, strength, cementation)	Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK MASS DISCONTINUITIES: Defect Log	Fracture Spacing (mm)	RQD (%)	Description & Additional Observations	Water Level / Fluid Loss (%)	Casing	Installation	Core Box No
Colluvium Deposits	*0. 00m:* Clayey SILT, some gravel; Orange -brown and grey, massive. Very soft to soft, moist, non-plastic to low plasticity. Gravel, sub-angular, highly weathered, sandstone, Tuffaceous. (TUFF).			HQ3	93		47	0.5									
Grampian Formation	*1. 50m:* Moderately weathered, Brownish -green grey, TUFF. Moderately strong to strong, medium grained, porphyritic, limonite staining. Minor lithics. Numerous fractures.. (UNDIFFERENTIATED VOLCANICS).			HQ3	96		46	1.0 1.5				33	*1.60m:* J, ST, R, *1.70m:* J, ST, SM		HQ		
	1.87m: Clay seam *1.95 - 1. 98m:* Quartz? vein							2.0					*1.87m:* J, ST, SM, Clay veneer *1.87m:* Clay seam *1.95m:* Quartz vein				
	2.10 - 3. 59m: Fault zone? *2.15 - 3. 27m:* Minor lithics possibly increasing with depth. "Apple - green" coloured mineral locally present. Some silica / quartz. Occasional quartz veinlet *2.20 - 3. 55m:* Clay on some joint surfaces			HQ3	90		45	2.5				33	*2.10m:* J, ST, SM, Some clay; orange- brown *2.00m:* Rod spin *2.20m:* J, ST, R, Minor clay *2.35m:* J, ST, R *2.36m:* J, ST, SM *2.40m:* J, ST, SM *2.50m:* J, ST, SM *2.51m:* J, ST, SM *2.55m:* J, ST, SM *2.56m:* J, ST, SM *2.57m:* J, ST, SM *2.80m:* J, ST, SM *2.81m:* J, ST, SM, Some clay; orange- brown *2.85m:* J, ST, SM *2.86m:* J, ST, SM				Box 0.00-2.70m
	3.27 - 3. 59m: PARTIAL CORE LOSS - Suspect fines washed out Moderately weathered. Weak to moderately strong. Broken ground. Fault Zone?.			HQ3	92		44	3.0 3.5				49	*3.27m:* Fg, ST, SM, Clay gouge with fine rock fragments	06/07/2023			
	3.59 - 4. 20m: PARTIAL CORE LOSS - Suspect fines washed out Moderately weathered, Orange - brown. Weak to moderately strong. Broken ground / brecciated. Fault Zone?.			HQ3	73							0	*3.53m:* J, UN, SM, Some clay *3.59m:* Fg, ST, R, Clay gouge and rock fragments				
	4. 20m: Slightly weathered, Brownish grey, SANDSTONE. Strong, fine to medium grained. Interbedded with fine siltstone and mudstone beds and re-healed fracture zones.			HQ3	100			4.0				93	*4.16m:* Fg, ST, R, Clay gouge and rock fragments				
	4. 55m: Slightly to moderately weathered, Dark -grey, broken, clayey MUDSTONE. Weak to moderately strong, fine grained. Broken ground (crushed), fractured, brecciated. Localised zones of clay gouge with rock fragments (Faulted?).			HQ3	87		43	4.5				0	*4.40m:* J, ST, SM *4.47m:* J, ST, SM *4.55 - 6. 00m:* Fault Zone?				
				HQ3	90							0	*4.67m:* Fg, ST, SM, Clay gouge with rock fragments *4.75m:* J, ST, SM *4.76m:* J, PL, SM *4.77m:* Fg, ST, SM, Clay gouge and rock				

COMMENTS: Weather fine / overcast/ windy

Hole Depth 22m

Scale 1:25

Rev: A

BOREHOLE LOG

BOREHOLE No.: BH01_0723

SHEET: 2 OF 5

PROJECT: Maitahi	CO-ORDINATES: (NZTM2000) 5431321 mN 1626162 mE	R.L. GROUND: 48m
JOB No.: 1012397.1000.1000		R.L. COLLAR:
LOCATION: Kaka Valley	DIRECTION: 0°	DATUM: NZVD2016
	ANGLE FROM HORIZ.: -90°	SURVEY: Map or aerial photograph

DRILLED BY: Dylan
LOGGED BY: ANCO
CHECKED: JXWW
START DATE: 03/07/2023
FINISH DATE: 07/07/2023
CONTRACTOR: CW Drilling

GEOLOGICAL UNIT	MATERIAL DESCRIPTION (SOIL: Classification, colour, consistency / density, moisture, plasticity; ROCK: Weathering, colour, fabric, name, strength, cementation)	Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK MASS DISCONTINUITIES: Defect Log	Fracture Spacing (mm)	RQD (%)	Description & Additional Observations	Water Level / Fluid Loss (%)	Casing	Installation	Core Box No
Grampian Formation	[CONT] *4.55m:* Slightly to moderately weathered, Dark -grey, broken, clayey MUDSTONE. Weak to moderately strong, fine grained. Broken ground (crushed), fractured, brecciated. Localised zones of clay gouge with rock fragments (Faulted?).												fragments *5.00m:* Fg, ST, SM, Clay gouge *5.10m:* J, ST, R *5.11m:* J, ST, SM				
	5.10 - 5. 80m: Strongly crushed, highly fractured and brecciated.			HQ3	100							0	*5.30m:* Loss of return. Water pressure increasing				Box 2 5.0-5.20m
	5.45 - 6. 00m: PARTIAL CORE LOSS - Suspect fines washed out.				80		42	5.5									
	5.80 - 6. 00m: Highly fractured, crushed with some clay. Loss of return and increased water pressure through this zone. Fault Zone? .			HQ3	64							0	*5.80m:* J, ST, SM *5.81m:* Fg, ST, R, Clay gouge with rock fragments				
	6. 00m: Slightly weathered, Light brown-grey, bedded, SILTSTONE. Strong, fine grained. Some fine mudstone beds. Highly fractured with possible fault zones locally, and some healed fractures throughout. Bedding.							6.0					*6.17m:* J, UN, SM				
	6.65 - 7. 10m: PARTIAL CORE LOSS - Suspect soft material washed out Slightly weathered. Weak to moderately strong. Broken ground. Highly crushed. Fault Zone?.			HQ3	95		41	6.5				15	*6.42m:* J, ST, SM *6.50m:* J, ST, SM *6.51m:* J, ST, SM *6.60m:* J, ST, SM				
	7.10 - 7. 50m: PARTIAL CORE LOSS - Suspect fines washed out Slightly weathered, Light brown grey. Broken ground.			HQ3	67			7.0				0					
	7. 50m: Moderately weathered, Dark -orange brown, broken, MUDSTONE. Weak, fine grained. Highly fractured (crushed?).			HQ3	94		40	7.5				0	*7.40m:* J, PL, SM		HQ		Box 5.20-7.70m
	8. 35m: Slightly weathered, Greyish -brown, SANDSTONE. Strong.			HQ3	43			8.0				0					
	8.40 - 8. 70m: Clayey SILT; Orange brown. Soft to firm, moist, non-plastic. Suspect some re-drill. Fault zone?.						39	8.5				28	*8.35m:* Bit becoming blocked, pulled rods to clean bt				
	8.70 - 9. 00m: PARTIAL CORE LOSS - Suspect fines washed out.			HQ3	17							0	*8.70m:* J, ST, SM *8.70m:* "Finger catcher" added to bit to help recovery				
	9.00 - 9. 65m: PARTIAL CORE LOSS - Suspect fines washed out Slightly weathered, Orange -brown. Strong, fine grained. Broken ground.			HQ3	80			9.0				0	*9.00 - 9. 25m:* High water pressure				
	9.25 - 9. 65m: Broken ground.												*9.25m:* J, ST, SM				
	9.60 - 10.10m: Clay on some joint surfaces			HQ3	73		38	9.5				18	*9.60m:* J, ST, SM, Minor clay; white *9.70m:* J, ST, SM, Trace clay; white				
	9. 65m: Slightly weathered, Bluish -grey, MUDSTONE. Strong, fine grained. Numerous healed fractures.			HQ3	94							43					

COMMENTS: Weather fine / overcast/ windy

Hole Depth 22m

Scale 1:25

Rev: A

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DRAFT
This data has not been fully reviewed.
It may be subject to change.

BOREHOLE LOG

BOREHOLE No.: BH01_0723

SHEET: 3 OF 5

PROJECT: Maitahi
JOB No.: 1012397.1000.1000
LOCATION: Kaka Valley

CO-ORDINATES: 5431321 mN, 1626162 mE (NZTM2000)
DIRECTION: 0°
ANGLE FROM HORIZ.: -90°

R.L. GROUND: 48m
R.L. COLLAR:
DATUM: NZVD2016
SURVEY: Map or aerial photograph

DRILLED BY: Dylan
LOGGED BY: ANCO
CHECKED: JXWW
START DATE: 03/07/2023
FINISH DATE: 07/07/2023
CONTRACTOR: CW Drilling

GEOLOGICAL UNIT	MATERIAL DESCRIPTION (SOIL: Classification, colour, consistency / density, moisture, plasticity; ROCK: Weathering, colour, fabric, name, strength, cementation)	Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK MASS DISCONTINUITIES: Defect Log	Fracture Spacing (mm)	RQD (%)	Description & Additional Observations	Water Level / Fluid Loss (%)	Casing	Installation	Core Box No
Grampian Formation	[CONT] *9.65m:* Slightly weathered, Bluish -grey, MUDSTONE. Strong, fine grained. Numerous healed fractures.												*10.00m:* J, ST, SM *10.01m:* J, ST, SM, Some clay; orange-brown *10.02m:* J, ST, SM, Some clay; orange-brown				
	10.25m: J, ST, R, Minor clay; white																
	10.40m: J, ST, R, Some clay; orange-brown																
	10.50m: J, PL, SM, Some clay						37	10.5									
	10.60 - 11.35m: PARTIAL CORE LOSS - Suspect fines washed out.			HQ3	47							0	*10.60m:* J, ST, R, Some clay *10.65 - 10.30m:* Mixed muds used. Ground becoming softer				Box 7.70-10.60m
	11.20 - 11.35m: Clayey gravelly SILT; Grey - brown. Soft to firm. At 70 degrees to core axis. Fault zone? .							11.0									
	11.35 - 11.90m: Local quartz? vein.			HQ3	91		36	11.5				27	*11.20m:* Fg, Highly crushed				
	11.90 - 12.10m: CORE LOSS.			HQ3	75			12.0				0					
	12.10 - 12.95m: PARTIAL CORE LOSS - Suspect fines washed out.			HQ3	82		35	12.5				35			HQ		
	12.95m: CORE LOSS.			HQ3	0			13.0				0	*12.95 - 13.30m:* Core Loss				
Grampian Formation	*13.30m:* Unweathered to slightly weathered, Light grey, bedded, SANDSTONE. Strong, fine grained. Interbedded dark grey mudstone. Breccia locally present - cemented. Occasional quartz veins. Bedding.			HQ3	33		34	13.5				0	*13.60 - 13.75m:* Decreasing rotation				
	13.75 - 13.85m: PARTIAL CORE LOSS - Suspect fines washed out.			HQ3	50							0	*13.75 - 13.85m:* Water pressure increased *13.85m:* B, Mudstone beds				Box 10.60-14.00m
	14.00 - 16.05m: Slightly weathered, White - grey. Moderately strong, fine grained. With fine inter- beds of siltstone and discontinuous lenses of mudstone. Occasional quartz veins.			HQ3	102		33	14.0 14.5				56	*14.10m:* J, ST, SM *14.25m:* J, ST, R, Minor FeSt *14.60m:* J, ST, R, Minor FeSt *14.70m:* J, ST, R, Srong FeSt *14.80m:* J, ST, R, FeSt *14.90m:* J, ST, SM, FeSt				

COMMENTS: Weather fine / overcast/ windy

Hole Depth 22m

Scale 1:25

Rev: A

BOREHOLE LOG

Tonkin+Taylor

BOREHOLE No.: BH01_0723

SHEET: 4 OF 5

PROJECT: Maitahi
JOB No.: 1012397.1000.1000
LOCATION: Kaka Valley

CO-ORDINATES: 5431321 mN
(NZTM2000) 1626162 mE
DIRECTION: 0°
ANGLE FROM HORIZ.: -90°

R.L. GROUND: 48m
R.L. COLLAR:
DATUM: NZVD2016
SURVEY: Map or aerial photograph

DRILLED BY: Dylan
LOGGED BY: ANCO
CHECKED: JXWW
START DATE: 03/07/2023
FINISH DATE: 07/07/2023
CONTRACTOR: CW Drilling

GEOLOGICAL UNIT	MATERIAL DESCRIPTION (SOIL: Classification, colour, consistency / density, moisture, plasticity; ROCK: Weathering, colour, fabric, name, strength, cementation)	Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK MASS DISCONTINUITIES: Defect Log	Fracture Spacing (mm)	RQD (%)	Description & Additional Observations	Water Level / Fluid Loss (%)	Casing	Installation	Core Box No
Grampian Formation	[CONT] *13.30m:* Unweathered to slightly weathered, Light grey, bedded, SANDSTONE. Strong, fine grained. Interbedded dark grey mudstone. Breccia locally present - cemented. Occasional quartz veins. Bedding. *15.25 - 15.55m:* Clay on some joint surfaces			HQ3	94		32	15.5				26	*15.15m:* J, ST, R, Minor FeSt *15.25m:* J, ST, R, Clay; orange-brown. FeSt *15.50m:* J, ST, SM, Minor clay; FeSt *15.65m:* J, ST, R, Broken ground *15.80m:* J, ST, R, Broken ground				Box 14.00-16.30m
	16.05 - 16.60m: Slightly weathered, Greenish -grey. Moderately strong. With some finer beds of siltstone and mudstone. Highly fractured in places.			HQ3	95		31	16.0 16.5				43	*16.00 - 16.60m:* Slowed rotation *16.08m:* J, ST, SM, FeSt. Minor quartz. *16.35m:* Fg, ST, SM, Clay gouge with rock fragments				
	16.60m: Slightly weathered, Dark grey black, MUDSTONE. Strong, fine grained. Very fine quartz? veins throughout. *16.75 - 16.90m:* Clayey SILT; Greenish - grey. Very soft. Clay gouge - Fault Zone?. *16.90 - 17.10m:* Unweathered, Greenish -grey and light grey. Weak to moderately strong, choritized. Fractured. Re- cemented / re-healed fault zone? .			HQ3	100		30	17.0 17.5 18.0				8	*16.64m:* J, ST, SM *16.70m:* J, ST, SM *16.77m:* Fg, ST, SM, Clay gouge *16.82m:* Fg, ST, SM, Clay gouge		HQ		
				HQ3	97		29	18.5				56	*18.37m:* J, ST, SM				Box 16.30-18.65m
								19.0					*18.97m:* J, ST, SM				
				HQ3	97		28	19.5				54	*19.37m:* J, ST, SM, Broken ground *19.66m:* J, ST, SM *19.72m:* Fg, ST, SM, Clay gouge *19.75m:* Fg, ST, SM, Clay and rock fragments *19.80m:* J, ST, SM *19.85m:* J, ST, SM				

COMMENTS: Weather fine / overcast/ windy

Hole Depth 22m

Scale 1:25

Rev: A

Tonkin+Taylor

DRAFT
This data has not been fully reviewed.
It may be subject to change.

BOREHOLE LOG

BOREHOLE No.: BH01_0723

SHEET: 5 OF 5

PROJECT: Maitahi
JOB No.: 1012397.1000.1000
LOCATION: Kaka Valley

CO-ORDINATES: 5431321 mN
(NZTM2000) 1626162 mE
DIRECTION: 0°
ANGLE FROM HORIZ.: -90°

R.L. GROUND: 48m
R.L. COLLAR:
DATUM: NZVD2016
SURVEY: Map or aerial photograph

DRILLED BY: Dylan
LOGGED BY: ANCO
CHECKED: JXWW
START DATE: 03/07/2023
FINISH DATE: 07/07/2023
CONTRACTOR: CW Drilling

GEOLOGICAL UNIT	MATERIAL DESCRIPTION SOIL: Classification, colour, consistency / density, moisture, plasticity ROCK: Weathering, colour, fabric, name, strength, cementation	Rock Weathering (UW SW MW HW DW RS)	Rock Strength (VS+ S MS W VW EW)	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK MASS DISCONTINUITIES: Defect Log	Fracture Spacing (mm) (2000 600 200 60 20)	RQD (%)	Description & Additional Observations	Water Level / Fluid Loss (%) (25 50 75)	Casing	Installation	Core Box No
Grampian Formation	[CONT] *16.60m:* Slightly weathered, Dark grey black, MUDSTONE. Strong, fine grained. Very fine quartz? veins throughout.			HQ3	100		27	20.5				48	*20.17m:* J, ST, SM *20.27m:* J, ST, SM *20.35m:* J, ST, SM *20.50m:* J, ST, SM		HQ		Box 18.65-21.10m
							26	21.0 21.5					*21.20m:* J, ST, SM *21.43m:* J, ST, SM *21.56m:* J, ST, SM *21.66m:* J, ST, SM				Box 21.10-22.00m
	22m: END OF BOREHOLE. Target depth.						25 24 23	22.0 22.5 23.0 23.5 24.0 24.5					*21.90m:* J, ST, SM				

COMMENTS: Weather fine / overcast/ windy

Hole Depth 22m

Scale 1:25

Rev A

DRAFT
This data has not been fully reviewed.
It may be subject to change.

Tonkin+Taylor

DRAFT
This data has not been fully reviewed. It may be subject to change.

CORE PHOTOS

BOREHOLE No.: **BH01_0723**

PROJECT: Maitahi	LOCATION: Kaka Valley	JOB No.: 1012397.1000.1000
CO-ORDINATES: 5431321 mN (NZTM2000) 1626162 mE R.L.: 48m DATUM: NZVD2016	DRILL TYPE: Hanjin D8 METHOD: Rotary cored	HOLE STARTED: 03/07/2023 HOLE FINISHED: 07/07/2023 DRILLED BY: CW Drilling LOGGED BY: ANCO CHECKED: JXWW

0.00-2.70m

2.70-5.20m

Tonkin+Taylor

DRAFT
This data has not been fully reviewed. It may be subject to change.

CORE PHOTOS

BOREHOLE No.: **BH01_0723**

PROJECT: Maitahi	LOCATION: Kaka Valley	JOB No.: 1012397.1000.1000
CO-ORDINATES: 5431321 mN (NZTM2000) 1626162 mE R.L.: 48m DATUM: NZVD2016	DRILL TYPE: Hanjin D8 METHOD: Rotary cored	HOLE STARTED: 03/07/2023 HOLE FINISHED: 07/07/2023 DRILLED BY: CW Drilling LOGGED BY: ANCO CHECKED: JXWW

5.20-7.70m

7.70-10.60m

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DRAFT
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CORE PHOTOS

BOREHOLE No.: **BH01_0723**

PROJECT: Maitahi	LOCATION: Kaka Valley	JOB No.: 1012397.1000.1000
CO-ORDINATES: 5431321 mN (NZTM2000) 1626162 mE R.L.: 48m DATUM: NZVD2016	DRILL TYPE: Hanjin D8 METHOD: Rotary cored	HOLE STARTED: 03/07/2023 HOLE FINISHED: 07/07/2023 DRILLED BY: CW Drilling LOGGED BY: ANCO CHECKED: JXWW

10.60-14.00m

14.00-16.30m

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CORE PHOTOS

BOREHOLE No.: **BH01_0723**

PROJECT: Maitahi	LOCATION: Kaka Valley	JOB No.: 1012397.1000.1000
CO-ORDINATES: 5431321 mN (NZTM2000) 1626162 mE R.L.: 48m DATUM: NZVD2016	DRILL TYPE: Hanjin D8 METHOD: Rotary cored	HOLE STARTED: 03/07/2023 HOLE FINISHED: 07/07/2023 DRILLED BY: CW Drilling LOGGED BY: ANCO CHECKED: JXWW

16.30-18.65m

18.65-21.10m

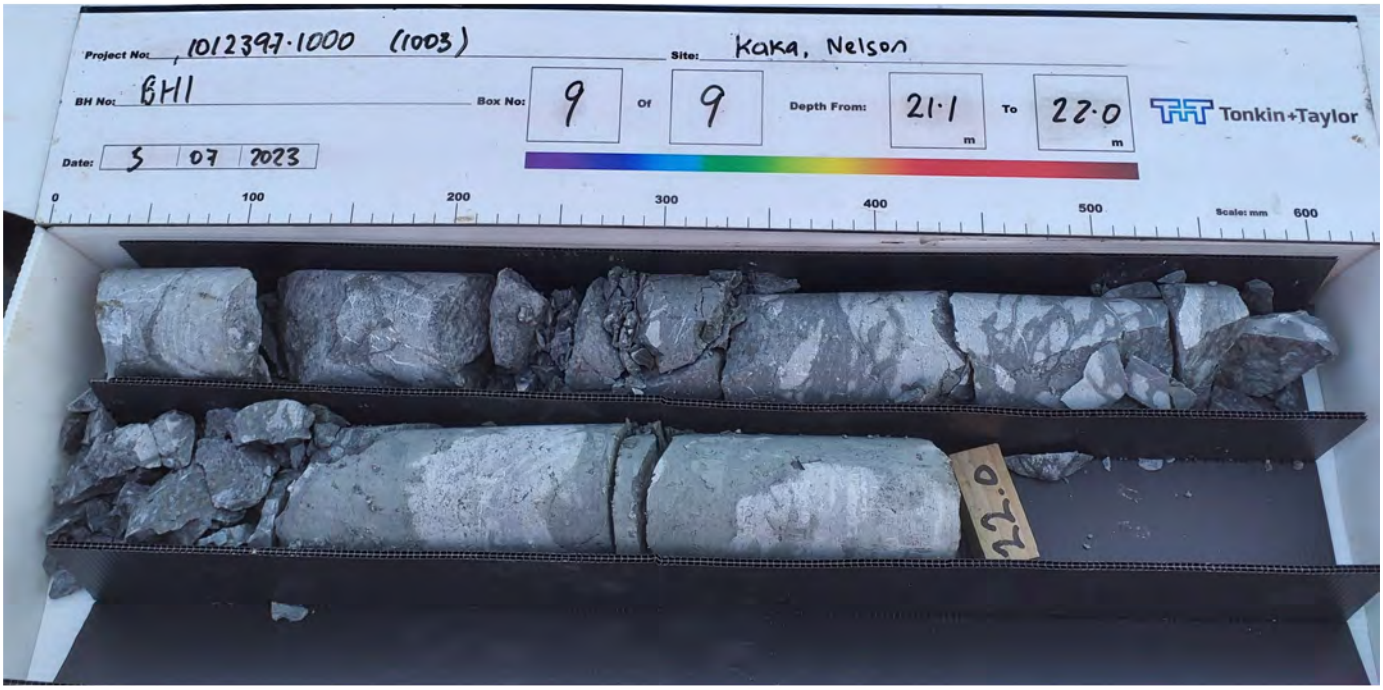
Tonkin+Taylor

DRAFT
This data has not been fully reviewed. It may be subject to change.

CORE PHOTOS

BOREHOLE No.: **BH01_0723**

PROJECT: Maitahi	LOCATION: Kaka Valley	JOB No.: 1012397.1000.1000
CO-ORDINATES: 5431321 mN (NZTM2000) 1626162 mE R.L.: 48m DATUM: NZVD2016	DRILL TYPE: Hanjin D8 METHOD: Rotary cored	HOLE STARTED: 03/07/2023 HOLE FINISHED: 07/07/2023 DRILLED BY: CW Drilling LOGGED BY: ANCO CHECKED: JXWW



21.10-22.00m

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DRAFT
This data has not been fully reviewed.
It may be subject to change.

BOREHOLE LOG

BOREHOLE No.: BH02_0723

SHEET: 1 OF 4

PROJECT: Maitahi
JOB No.: 1012397.1000.1000
LOCATION: Kaka Valley

CO-ORDINATES: 5431359 mN, 1626270 mE (NZTM2000)
DIRECTION: 0°
ANGLE FROM HORIZ.: -90°

R.L. GROUND: 85m
R.L. COLLAR:
DATUM: NZVD2016
SURVEY: Map or aerial photograph

DRILLED BY: Dylan
LOGGED BY: ANCO
CHECKED: JXWW
START DATE: 10/07/2023
FINISH DATE: 13/07/2023
CONTRACTOR: CW Drilling

GEOLOGICAL UNIT	MATERIAL DESCRIPTION (SOIL: Classification, colour, consistency / density, moisture, plasticity; ROCK: Weathering, colour, fabric, name, strength, cementation)	Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK MASS DISCONTINUITIES: Defect Log	Fracture Spacing (mm)	RQD (%)	Description & Additional Observations	Water Level / Fluid Loss (%)	Casing	Installation	Core Box No
Colluvium Deposits	*0.00m:* Clayey SILT, minor organics; Orange -brown. Soft, moist, low plasticity. *1.25 - 1.30m:* Firm. Rootlets.			HQ3	100		84	0.5 1.0									
Grampian Formation	*1.30m:* Highly to completely weathered, Orange -brown greyish white, SANDSTONE. Very weak to weak. *1.50 - 1.80m:* PARTIAL CORE LOSS - Suspect fines washed out.			HQ3	88			1.5				75			HQ		
	1.80m: Highly weathered, Orange - brown bluish grey, indistinctly bedded, SANDSTONE. Weak, fine grained. Inter-bedded with mudstone / siltstone.			HQ3	100		83	2.0									
	2.30m: Moderately weathered, Orange -brown, SANDSTONE. Moderately strong, medium to coarse grained.							2.5				75	*2.25m:* J, 30-70°, ST, R *2.27m:* J, PL, SM *2.50m:* J, ST, SM				Box 0.00-2.80m
	3.25m: Moderately weathered, Orange -brown greyish brown, bedded, SANDSTONE. Moderately strong. Inter-bedded with siltstone and finer mudstone. Bedding.			HQ3	100		82	3.0				42	*3.00m:* Water pressure 100 -125 Psi *3.07m:* J, ST, R *3.14m:* J, ST, SM *3.25m:* J, ST, SM				
	3.50m: Moderately weathered, Dark grey mixed with minor orange-brown, MUDSTONE. Moderately strong, fine grained. *3.50m:* Clay on bedding surface *3.80 - 4.00m:* PARTIAL CORE LOSS - Suspect fines washed out, Brownish - grey. Broken ground.			HQ3	100			3.5				90	*3.40m:* BF, ST, SM *3.50m:* B, ST, R, minor clay *3.50m:* Water pressure dropping; talk increasing				
				HQ3	75							0					
	4.00m: Moderately weathered, Brownish - grey, SANDSTONE. Moderately strong, medium grained. *4.20 - 4.60m:* PARTIAL CORE LOSS - Suspect fines washed out Moderately weathered, Brownish - grey. Moderately strong, fine grained. With closely spaced recemented fractures - healed fracture? / fault zone? Locally brecciated.			HQ3	95		81	4.0				23					
	4.60m: CORE LOSS Moderately weathered, Brownish -grey, broken, SANDSTONE. Moderately strong, fine grained. Interbedded sandstone - siltstone and mudstone.			HQ3	50			4.5				0					

COMMENTS: Weather fine / windy. Wet overnight

Hole Depth 16.5m

Scale 1:25

Rev: A

BOREHOLE LOG

Tonkin+Taylor

BOREHOLE No.: BH02_0723

SHEET: 2 OF 4

PROJECT: Maitahi
JOB No.: 1012397.1000.1000
LOCATION: Kaka Valley

CO-ORDINATES: 5431359 mN, 1626270 mE (NZTM2000)
DIRECTION: 0°
ANGLE FROM HORIZ.: -90°

R.L. GROUND: 85m
R.L. COLLAR:
DATUM: NZVD2016
SURVEY: Map or aerial photograph

DRILLED BY: Dylan
LOGGED BY: ANCO
CHECKED: JXWW
START DATE: 10/07/2023
FINISH DATE: 13/07/2023
CONTRACTOR: CW Drilling

GEOLOGICAL UNIT	MATERIAL DESCRIPTION	Depth (m)	RL (m)	Description & Additional Observations
Grampian Formation	[CONT] *4.60m:* CORE LOSS Moderately weathered, Brownish -grey, broken, SANDSTONE. Moderately strong, fine grained. Interbedded sandstone - siltstone and mudstone.			
	5.30m: Moderately weathered, Brownish-yellow -grey, broken, SANDSTONE. Moderately strong, fine to coarse grained.	5.5	79	
	5.40 - 5.55m: PARTIAL CORE LOSS - Suspect fines washed out. Broken ground.			*5.60m:* J, ST, R
	5.90 - 5.97m: Clayey gravelly SILT; orange brown. Wet. Gravel, sandstone. Rock fragments. Fault zone?.	6.0		*5.90m:* J, PL, R *5.95m:* Fg, ST, R
	6.00 - 6.70m: CORE LOSS - Suspect washed out.	6.5		
	7.20 - 7.85m: CORE LOSS - Suspect washed out.	7.0	78	*6.90m:* J, PL, R
	8.05 - 8.10m: Clayey gravelly SILT; orange brown. Soft to firm. Gravel, moderately to highly weathered, mudstone. Fault zone?.	7.5		
	8.10m: Slightly weathered, Dark -grey orange-brown, MUDSTONE. Strong.	8.0	77	*7.90m:* J, ST, R *8.00m:* J, ST, R *8.10m:* Fg, ST, R,
	9.00 - 9.20m: PARTIAL CORE LOSS - Suspect fines washed out.	8.5		
	9.40m: Clay on joint surface	9.0	76	*9.20m:* F, UN *9.30m:* J, ST, R *9.38m:* J, ST, R, some clay; light green
	9.67 - 10.90m: Orange - brown. Limonite staining.	9.5		*9.60m:* J, PL, R *9.67 - 10.90m:* Colour change *9.70m:* J, ST, R *9.85m:* J, ST, R

Sampling Method	Core Recovery (%)	RQD (%)
HQ3	100	50
HQ3	90	80
HQ3	36	0
HQ3	100	28
HQ3	50	0
HQ3	71	0
HQ3	100	69
HQ3	75	0
HQ3	100	53

Casing: HQ

Installation: Box 2.80-5.30m; Box 5.30-8.45m

Core Box No

COMMENTS: Weather fine / windy. Wet overnight

Hole Depth 16.5m

Scale 1:25

Rev: A

Tonkin+Taylor

DRAFT
This data has not been fully reviewed.
It may be subject to change.

BOREHOLE LOG

BOREHOLE No.: BH02_0723

SHEET: 3 OF 4

PROJECT: Maitahi
JOB No.: 1012397.1000.1000
LOCATION: Kaka Valley

CO-ORDINATES: 5431359 mN, 1626270 mE (NZTM2000)
DIRECTION: 0°
ANGLE FROM HORIZ.: -90°

R.L. GROUND: 85m
R.L. COLLAR:
DATUM: NZVD2016
SURVEY: Map or aerial photograph

DRILLED BY: Dylan
LOGGED BY: ANCO
CHECKED: JXWW
START DATE: 10/07/2023
FINISH DATE: 13/07/2023
CONTRACTOR: CW Drilling

GEOLOGICAL UNIT	MATERIAL DESCRIPTION (SOIL: Classification, colour, consistency / density, moisture, plasticity; ROCK: Weathering, colour, fabric, name, strength, cementation)	Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK MASS DISCONTINUITIES: Defect Log	Fracture Spacing (mm)	RQD (%)	Description & Additional Observations	Water Level / Fluid Loss (%)	Casing	Installation	Core Box No
Grampian Formation	[CONT] *8.10m:* Slightly weathered, Dark -grey orange-brown, MUDSTONE. Strong.			HQ3	100							0	*9.95m:* B, PL				Box 8.45-10.80m
	10.90m: Slightly weathered, Greenish-grey, SANDSTONE. Strong, fine to medium grained. Interbedded with dark- grey, very fine mudstone. Bedding is fine 3mm-			HQ3	100		74	11.0				53	*11.00m:* J, ST, SM *11.45m:* J, ST, SM *11.60m:* J, PL, SM *11.75m:* J, ST, SM		HQ		
	13.30 - 13.35m: Limonite staining. - strong. Broken ground.			HQ3	100		73	12.0				60	*12.20m:* B, PL *12.40m:* J, ST, R, *12.60m:* J, PL, SM				
	14.15 - 14.45m: PARTIAL CORE LOSS - Suspect fines washed out.			HQ3	100		72	13.0				100	*13.30m:* J, ST, R *13.45m:* J, ST, R *13.60m:* B, PL, SM				Box 10.80-13.60m
	14.45 - 15.10m: Some fine (2mm) quartz? veins. Re- cemented fracture / fault zone?			HQ3	100		71	14.0				0 66	*14.05m:* J, ST, SM *14.47m:* may have lost core here *14.35m:* J, ST, R				
				HQ3	100			14.5				52	*14.45m:* J, ST, SM *14.46m:* B *14.50m:* J, ST, SM *14.60m:* J, ST, SM *14.61m:* B, UN, SM *14.67m:* J, ST, SM *14.68m:* J, UN, SM				

COMMENTS: Weather fine / windy. Wet overnight

Hole Depth 16.5m

Scale 1:25

Rev: A

Tonkin+Taylor

DRAFT
This data has not been fully reviewed.
It may be subject to change.

BOREHOLE LOG

BOREHOLE No.: BH02_0723

SHEET: 4 OF 4

PROJECT: Maitahi
JOB No.: 1012397.1000.1000
LOCATION: Kaka Valley

CO-ORDINATES: 5431359 mN
(NZTM2000) 1626270 mE
DIRECTION: 0°
ANGLE FROM HORIZ.: -90°

R.L. GROUND: 85m
R.L. COLLAR:
DATUM: NZVD2016
SURVEY: Map or aerial photograph

DRILLED BY: Dylan
LOGGED BY: ANCO
CHECKED: JXWW
START DATE: 10/07/2023
FINISH DATE: 13/07/2023
CONTRACTOR: CW Drilling

GEOLOGICAL UNIT	MATERIAL DESCRIPTION (SOIL: Classification, colour, consistency / density, moisture, plasticity; ROCK: Weathering, colour, fabric, name, strength, cementation)	Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK MASS DISCONTINUITIES: Defect Log	Fracture Spacing (mm)	RQD (%)	Description & Additional Observations	Water Level / Fluid Loss (%)	Casing	Installation	Core Box No
Grampian Formation	[CONT] *10.90m:* Slightly weathered, Greenish-grey, SANDSTONE. Strong, fine to medium grained. Interbedded with dark- grey, very fine mudstone. Bedding is fine 3mm-			HQ3	93			15.5				42			HQ		
	15.70 - 15.90m: Disseminated fine pyrite																
	15.90m: Unweathered to slightly weathered, Greenishgrey, SANDSTONE. Strong, fine to medium grained, pyritized. Rare dark red mineral.						69	16.0									Box 13.60-16.30m
	16.5m: END OF BOREHOLE. Target depth.							16.5									
							68	17.0									
								17.5									
							67	18.0									
								18.5									
							66	19.0									
								19.5									

COMMENTS: Weather fine / windy. Wet overnight

Hole Depth
16.5m

Scale 1:25

Rev: A

DRAFT
This data has not been fully reviewed.
It may be subject to change.

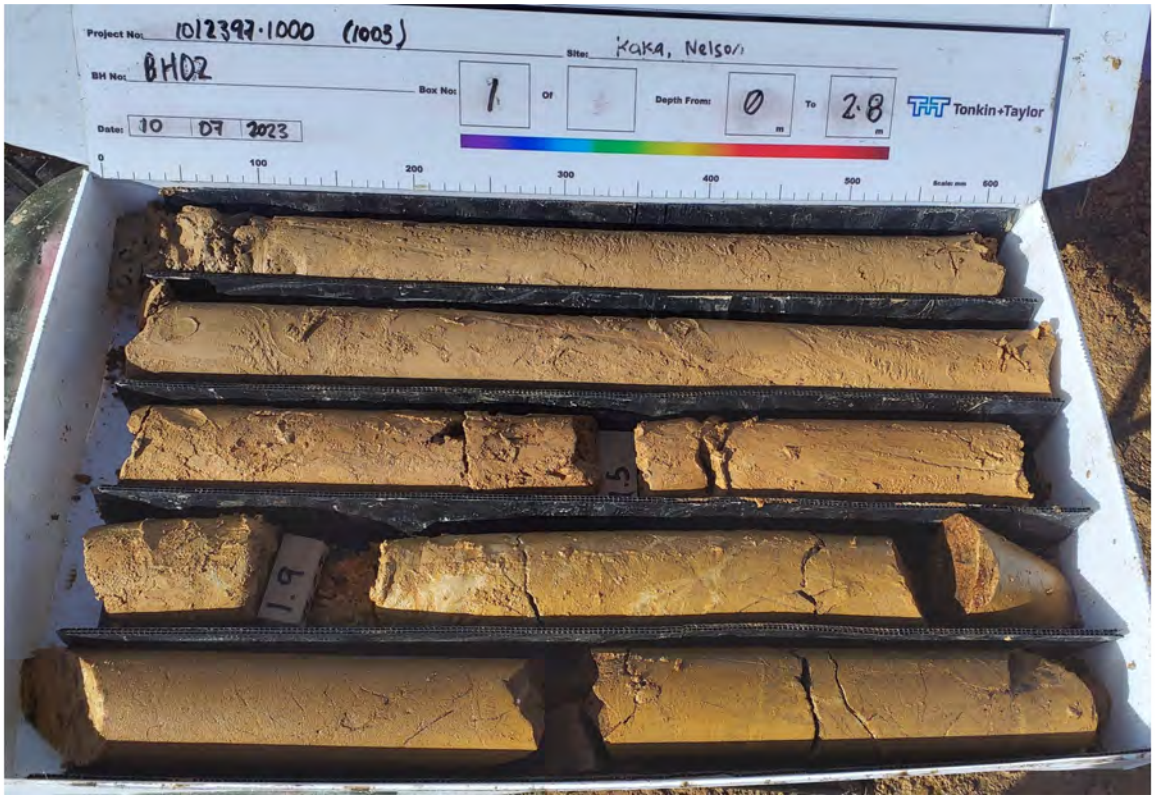
Tonkin+Taylor

DRAFT
This data has not been fully reviewed. It may be subject to change.

CORE PHOTOS

BOREHOLE No.: **BH02_0723**

PROJECT: Maitahi	LOCATION: Kaka Valley	JOB No.: 1012397.1000.1000
CO-ORDINATES: 5431359 mN (NZTM2000) 1626270 mE R.L.: 85m DATUM: NZVD2016	DRILL TYPE: Hanjin D8 METHOD: Rotary cored	HOLE STARTED: 10/07/2023 HOLE FINISHED: 13/07/2023 DRILLED BY: CW Drilling LOGGED BY: ANCO CHECKED: JXWW



0.00-2.80m

2.80-5.30m

Tonkin+Taylor

DRAFT
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CORE PHOTOS

BOREHOLE No.: **BH02_0723**

PROJECT: Maitahi	LOCATION: Kaka Valley	JOB No.: 1012397.1000.1000
CO-ORDINATES: 5431359 mN (NZTM2000) 1626270 mE R.L.: 85m DATUM: NZVD2016	DRILL TYPE: Hanjin D8 METHOD: Rotary cored	HOLE STARTED: 10/07/2023 HOLE FINISHED: 13/07/2023 DRILLED BY: CW Drilling LOGGED BY: ANCO CHECKED: JXWW

5.30-8.45m

8.45-10.80m

Tonkin+Taylor

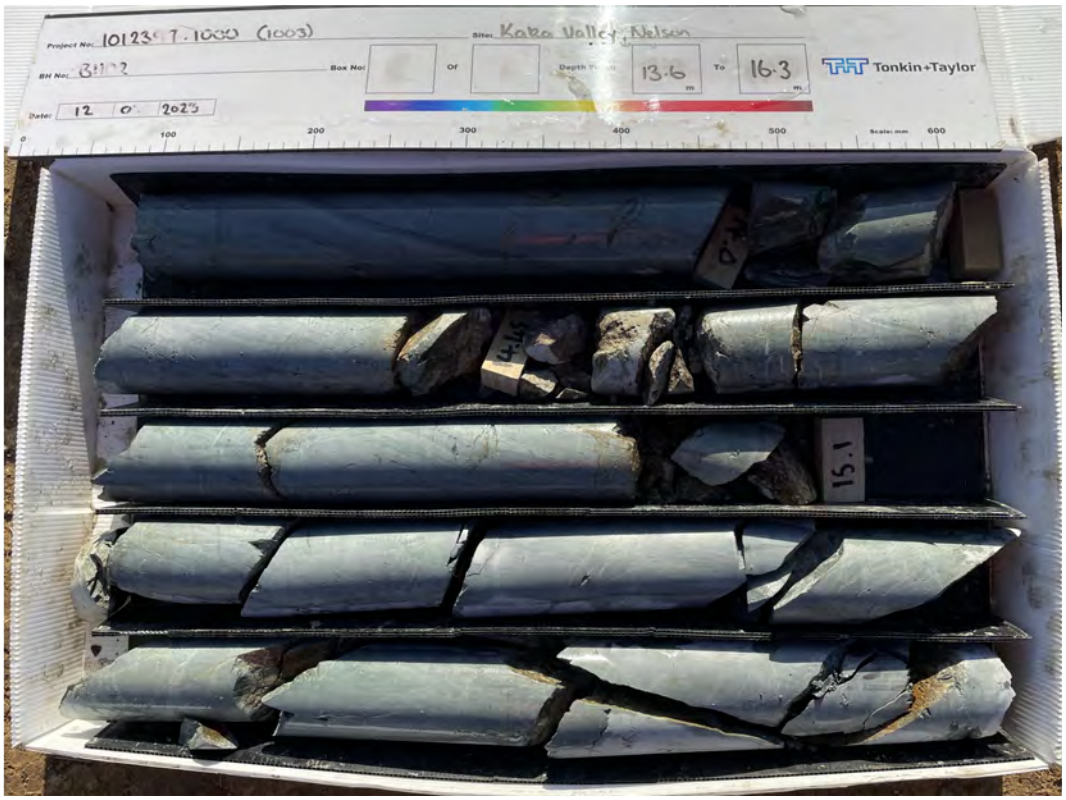
DRAFT
This data has not been fully reviewed. It may be subject to change.

CORE PHOTOS

BOREHOLE No.: **BH02_0723**

PROJECT: Maitahi	LOCATION: Kaka Valley	JOB No.: 1012397.1000.1000
CO-ORDINATES: 5431359 mN (NZTM2000) 1626270 mE R.L.: 85m DATUM: NZVD2016	DRILL TYPE: Hanjin D8 METHOD: Rotary cored	HOLE STARTED: 10/07/2023 HOLE FINISHED: 13/07/2023 DRILLED BY: CW Drilling LOGGED BY: ANCO CHECKED: JXWW

10.80-13.60m



13.60-16.30m

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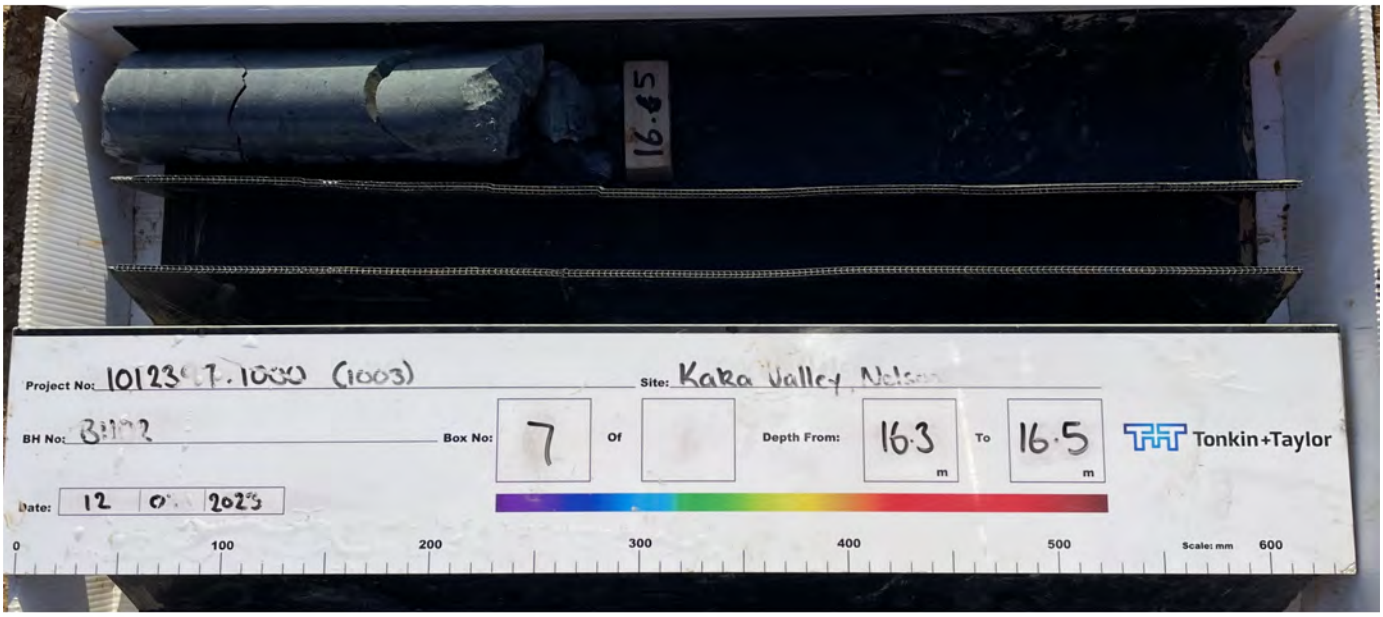
CORE PHOTOS

BOREHOLE No.: **BH02_0723**

PROJECT: Maitahi	LOCATION: Kaka Valley	JOB No.: 1012397.1000.1000
CO-ORDINATES: 5431359 mN (NZTM2000) 1626270 mE R.L.: 85m DATUM: NZVD2016	DRILL TYPE: Hanjin D8 METHOD: Rotary cored	HOLE STARTED: 10/07/2023 HOLE FINISHED: 13/07/2023 DRILLED BY: CW Drilling LOGGED BY: ANCO CHECKED: JXWW



16.30-16.50m

Tonkin+Taylor

DRAFT
This data has not been fully reviewed.
It may be subject to change.

BOREHOLE LOG

BOREHOLE No.: BH06_0723

SHEET: 1 OF 1

PROJECT: Maitahi
JOB No.: 1012397.1000.1000
LOCATION: Kaka Valley

CO-ORDINATES: 5431287 mN
(NZTM2000) 1626079 mE
DIRECTION: 0°
ANGLE FROM HORIZ.: -90°

R.L. GROUND: 25m
R.L. COLLAR:
DATUM: NZVD2016
SURVEY: Map or aerial photograph

DRILLED BY: Dylan
LOGGED BY: ANCO
CHECKED: JXWW
START DATE: 14/09/2023
FINISH DATE: 14/09/2023
CONTRACTOR: CW Drilling

GEOLOGICAL UNIT	MATERIAL DESCRIPTION SOIL: Classification, colour, consistency / density, moisture, plasticity ROCK: Weathering, colour, fabric, name, strength, cementation	Rock Weathering (UW SW MW HW VW RS)	Rock Strength (VS+ S MS W VW EW)	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK MASS DISCONTINUITIES: Defect Log	Fracture Spacing (mm) (2000 600 200 60 20)	RQD (%)	Description & Additional Observations	Water Level / Fluid Loss (%) (25 50 75)	Casing	Installation	Core Box No
TSoil	*0.00m:* Brown. Top soil.												*0.00 - 0.50m:* Drillers Log				
Alluvial Deposits	*0.50m:* Clayey SILT; Yellowish brown.												*0.50 - 0.70m:* Drillers Log				
	0.70m: GRAVEL; Yellowish -brown.												*0.70 - 2.00m:* Drillers Log				
	2.00m: Silty GRAVEL; Orange - brown. Soft to firm, moist, low plasticity.			RO	0									DRY 14/09/23	HQ		
	2.80m: Clayey gravelly SILT; Orange - brown grey. Moist, low plasticity.																
	4m: END OF BOREHOLE. Target depth.																

COMMENTS: Weather fine.

Hole Depth 4m

Scale 1:30

Rev: A

DRAFT
This data has not been fully reviewed.
It may be subject to change.

BOREHOLE LOG

Tonkin+Taylor

BOREHOLE No.: BH06-23

SHEET: 1 OF 1

PROJECT: Maitahi

JOB No.: 1012397.1000.1000

LOCATION: Kaka Valley

CO-ORDINATES: 5431311.46 mN, 1625844.56 mE (NZTM2000)

DIRECTION:

ANGLE FROM HORIZ.: -90°

R.L. GROUND: 16.82m

R.L. COLLAR:

DATUM: NZVD2016

SURVEY: Handheld GPS

DRILLED BY: Dylan

LOGGED BY: FEOH

CHECKED: SCON

START DATE: 18/04/2023

FINISH DATE: 18/04/2023

CONTRACTOR: CW Drilling

GEOLOGICAL UNIT	DESCRIPTION OF CORE SOIL: Classification, colour, consistency / density, moisture, plasticity ROCK: Weathering, colour, fabric, name, strength, cementation	Depth (m)
Alluvial Deposits	*0.00m:* Gravelly SILT, some organics; greyish brown. Moist, low plasticity. Gravel, fine, sub-rounded to sub-angular.	0
	1.00m: Silty fine to coarse GRAVEL; grey. Moist. Gravel, sub-rounded to sub-angular; silt, light brown.	1
	1.50m: Gravelly SILT; light brown. Moist, low plasticity. Gravel, fine, sub-rounded to sub-angular. *1.80 - 1.90m:* Grey.	
	1.90m: Fine to coarse GRAVEL, some silt; light brownish grey. Moist. Gravel, sub-rounded to sub-angular. *2.20 - 2.60m:* Dry.	2
	2.60m: Drilling continued in search for rock but was not logged.	3
	4.50 - 4.65m: Sandy layer. *4.65 - 5.50m:* Alluvial gravels becoming coarse.	4
	5.5m: END OF BOREHOLE	5

Rock Weathering: UW, SW, MW, HW, EW

Rock Strength: ES, VS, S, MS, W, VW, EW

Sampling Method

Core Recovery (%)

Testing

RL (m): 16, 15, 14, 13, 12, 11

Graphic Log

ROCK DEFECTS

Defect Log

Fracture Spacing (mm): >2000, 600, 200, 60, 20

RQD (%)

Description & Additional Observations

Fluid Loss (%): 25, 50, 75

Water Level: 18/04/2023

Casing

Installation

Core Box No

COMMENTS:

Hole Depth 5.5m

Scale 1:30

Rev.: A

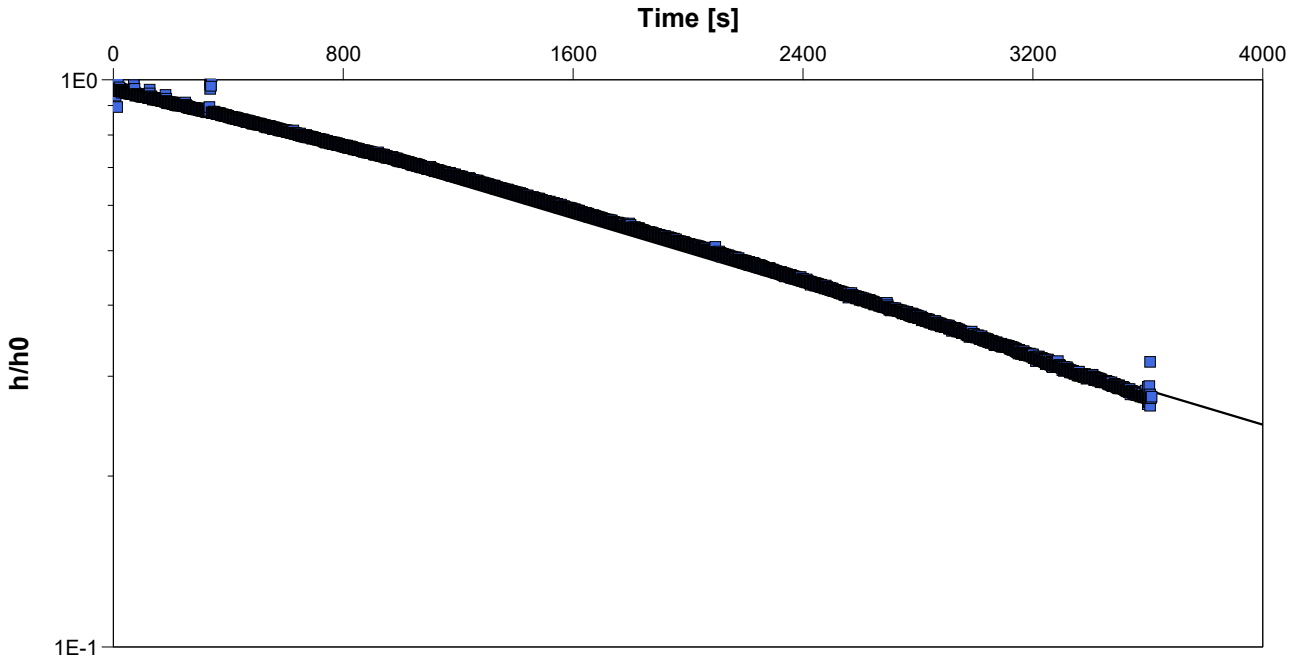
General Log _ - 30/01/2024 4:17:07 pm - Produced with Core-GS by GeRoc v4.0.01

Appendix B Slug Test Analysis Report

- **Boreholes BH01-BH06**

Tonkin & Taylor Ltd PO Box 1009 Nelson7040 Lucas House 51 Halifax Street Nelson 7010	**Slug Test Analysis Report** Project: Kaka Subdivision Number: 1012397.1000 Client: CCKV Maitai Dev Co Lp

Location: Maitai Valley Road	Slug Test: Falling Head Test	Test Well: BH01-0723
Test Conducted by: AMHO		Test Date: 20/09/2023
Analysis Performed by: AMHO	Hvorslev	Analysis Date: 28/09/2023
Aquifer Thickness: 13.20 m		

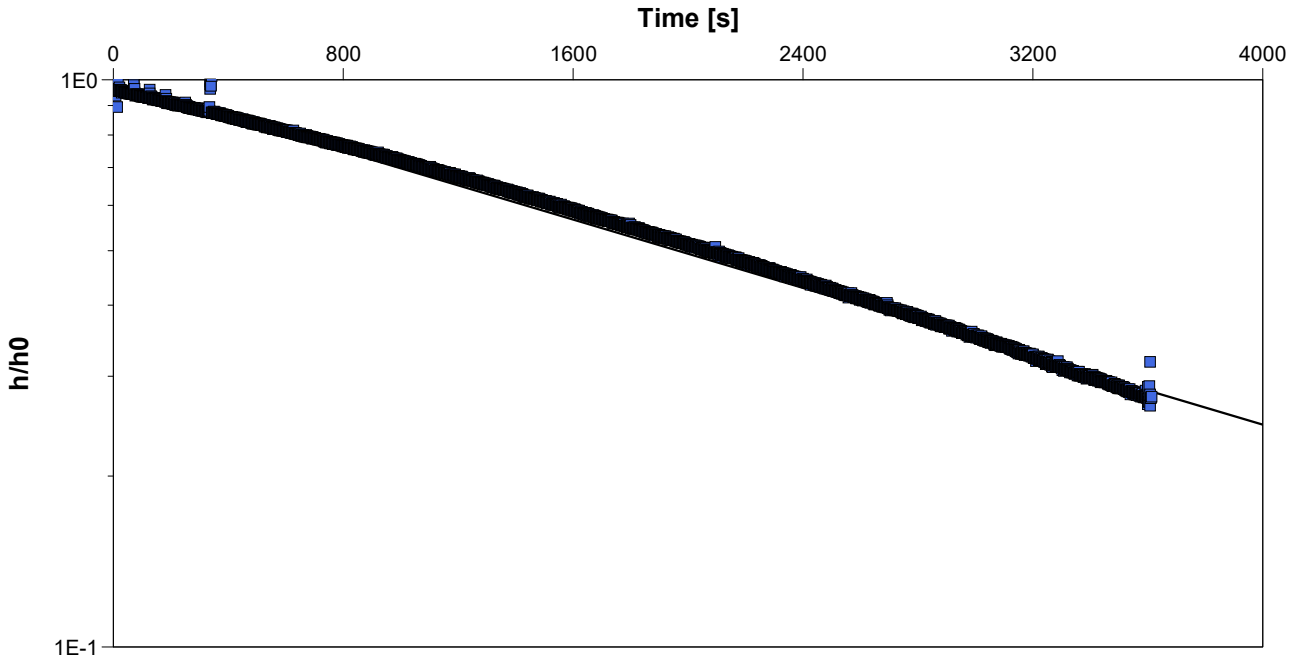


Calculation using Hvorslev

Observation Well	Hydraulic Conductivity [m/s]	
BH01-0723	1.07×10^{-7}	

Tonkin & Taylor Ltd PO Box 1009 Nelson7040 Lucas House 51 Halifax Street Nelson 7010	**Slug Test Analysis Report** Project: Kaka Subdivision Number: 1012397.1000 Client: CCKV Maitai Dev Co Lp

Location: Maitai Valley Road	Slug Test: Falling Head Test	Test Well: BH01-0723
Test Conducted by: AMHO		Test Date: 20/09/2023
Analysis Performed by: AMHO	Bouwer & Rice	Analysis Date: 2/10/2023
Aquifer Thickness: 13.20 m		

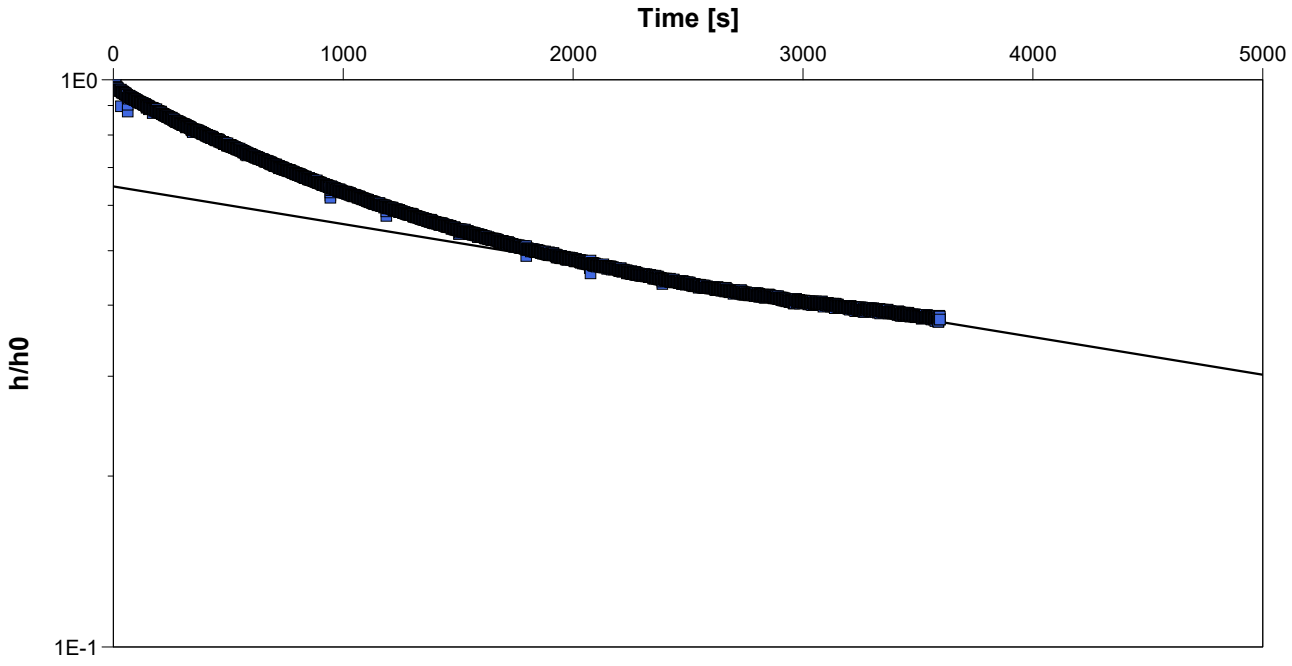


Calculation using Bouwer & Rice

Observation Well	Hydraulic Conductivity [m/s]	
BH01-0723	8.25×10^{-8}	

Tonkin & Taylor Ltd PO Box 1009 Nelson7040 Lucas House 51 Halifax Street Nelson 7010	**Slug Test Analysis Report** Project: Kaka Subdivision Number: 1012397.1000 Client: CCKV Maitai Dev Co Lp

Location: Maitai Valley Road	Slug Test: Rising Head Test	Test Well: BH01-0723
Test Conducted by: AMHO		Test Date: 20/09/2023
Analysis Performed by: AMHO	Hvorslev	Analysis Date: 28/09/2023
Aquifer Thickness: 13.20 m		

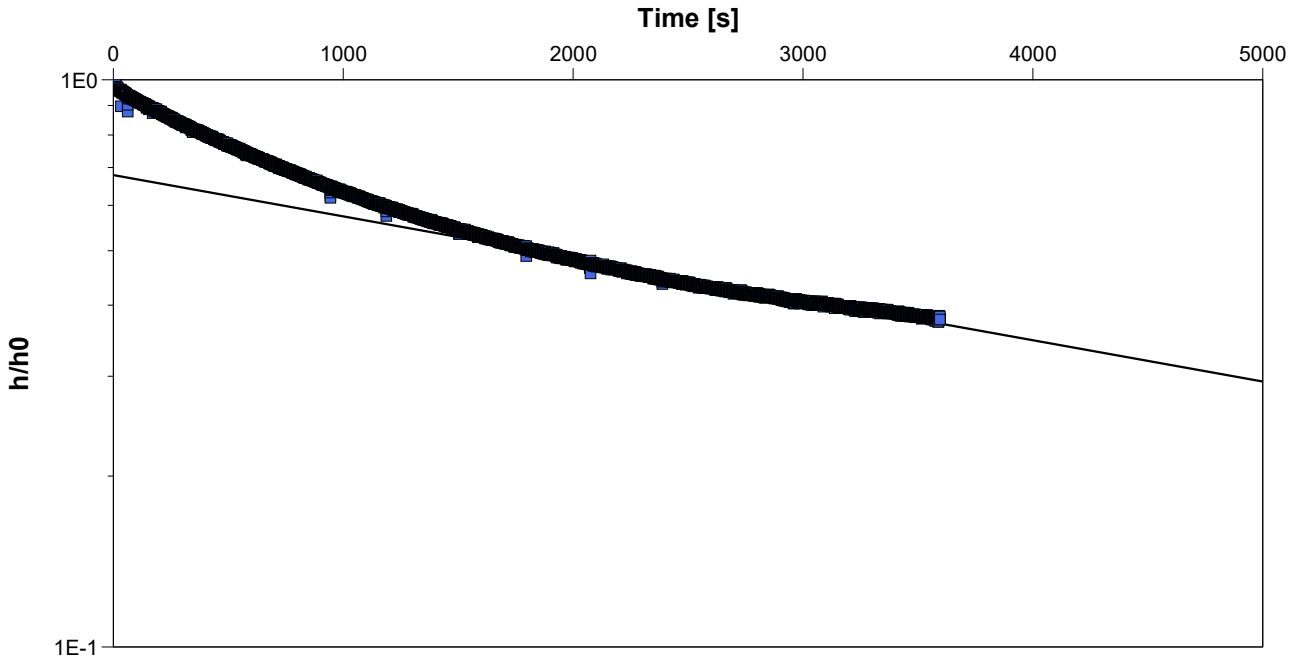


Calculation using Hvorslev

Observation Well	Hydraulic Conductivity [m/s]	
BH01-0723	4.69×10^{-8}	

Tonkin & Taylor Ltd PO Box 1009 Nelson7040 Lucas House 51 Halifax Street Nelson 7010	**Slug Test Analysis Report** Project: Kaka Subdivision Number: 1012397.1000 Client: CCKV Maitai Dev Co Lp

Location: Maitai Valley Road	Slug Test: Rising Head Test	Test Well: BH01-0723
Test Conducted by: AMHO		Test Date: 20/09/2023
Analysis Performed by: AMHO	Bouwer & Rice	Analysis Date: 2/10/2023
Aquifer Thickness: 13.20 m		

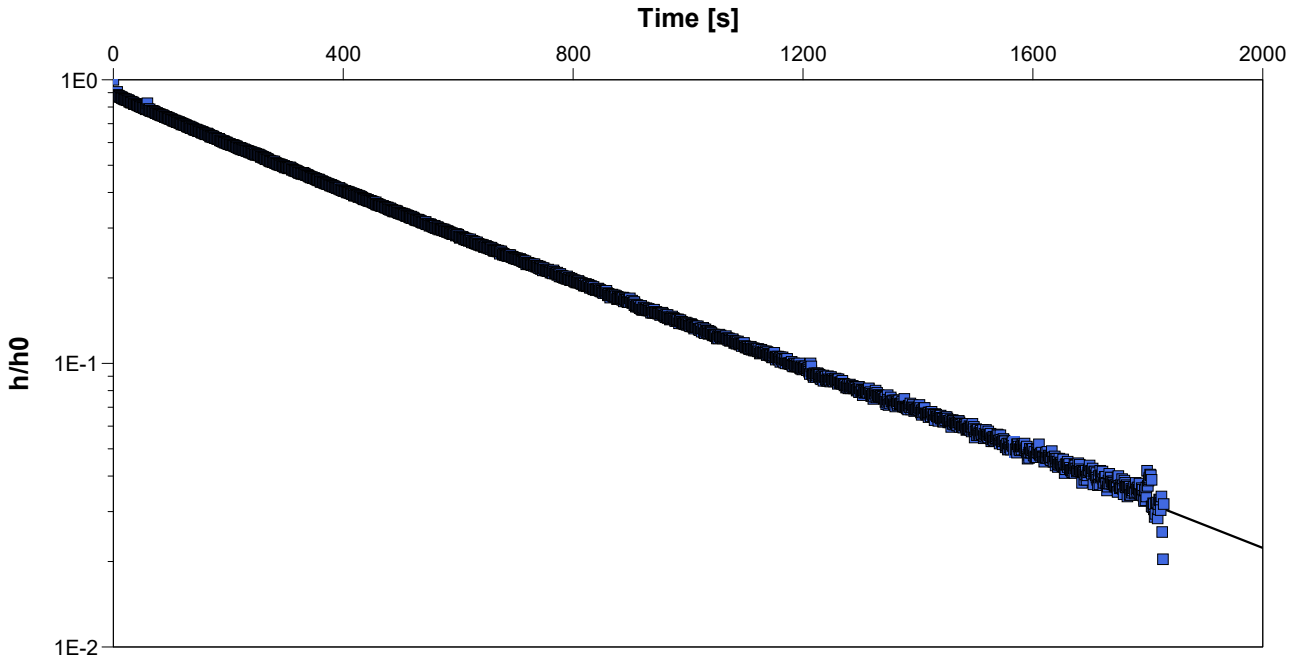


Calculation using Bouwer & Rice

Observation Well	Hydraulic Conductivity [m/s]	
BH01-0723	3.99×10^{-8}	

Tonkin & Taylor Ltd PO Box 1009 Nelson7040 Lucas House 51 Halifax Street Nelson 7010	**Slug Test Analysis Report** Project: Kaka Valley Subdivision Number: 1012397.1000 Client: CCKV Maitai Dev Co Lp

Location: Maitai Valley	Slug Test: Falling Head	Test Well: BH02-0723
Test Conducted by: AMHO		Test Date: 20/09/2023
Analysis Performed by: AMHO	Hvorslev	Analysis Date: 29/09/2023
Aquifer Thickness: 7.21 m		

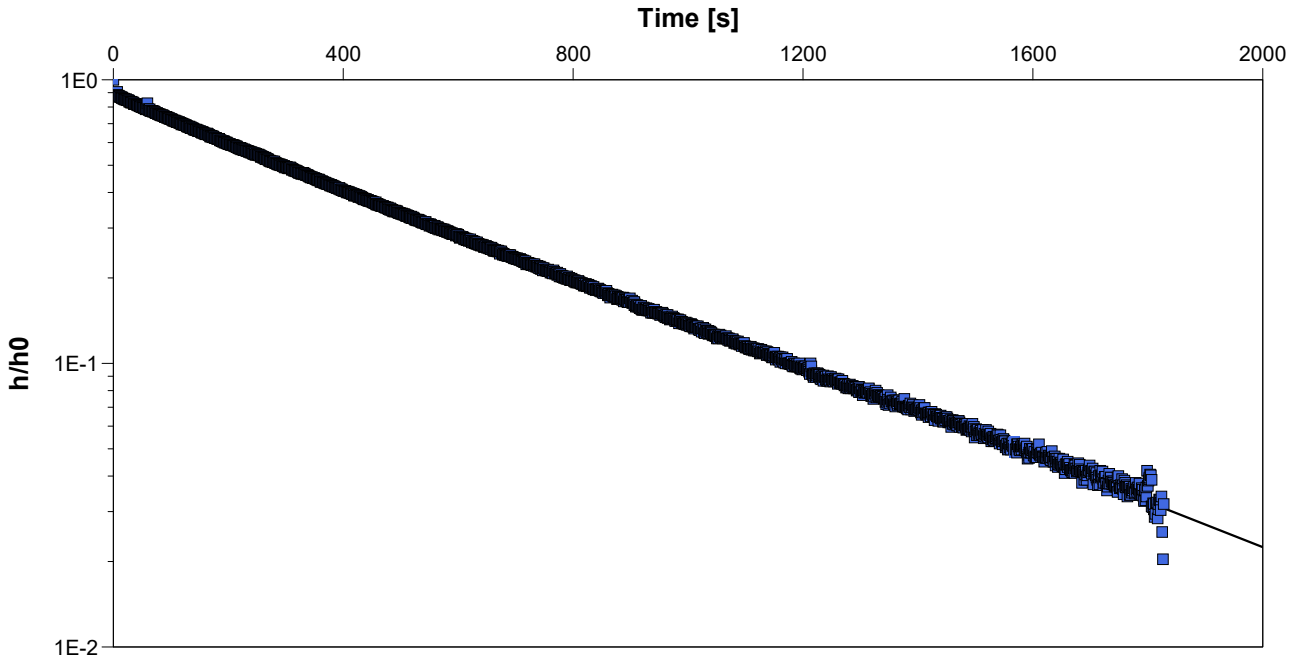


Calculation using Hvorslev

Observation Well	Hydraulic Conductivity [m/s]	
BH02-0723	7.10×10^{-7}	

Tonkin & Taylor Ltd PO Box 1009 Nelson7040 Lucas House 51 Halifax Street Nelson 7010	**Slug Test Analysis Report** Project: Kaka Valley Subdivision Number: 1012397.1000 Client: CCKV Maitai Dev Co Lp

Location: Maitai Valley	Slug Test: Falling Head	Test Well: BH02-0723
Test Conducted by: AMHO		Test Date: 20/09/2023
Analysis Performed by: AMHO	Bouwaer & Rice	Analysis Date: 4/10/2023
Aquifer Thickness: 7.21 m		

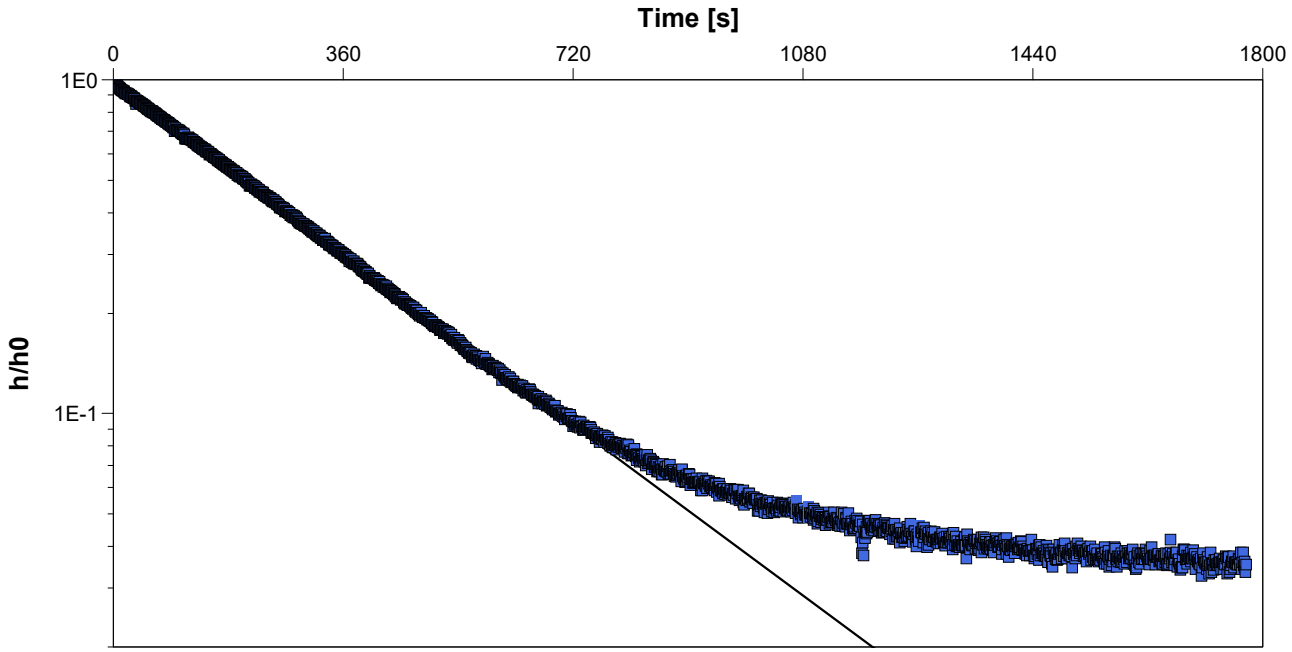


Calculation using Bouwer & Rice

Observation Well	Hydraulic Conductivity [m/s]	
BH02-0723	5.50×10^{-7}	

Tonkin & Taylor Ltd PO Box 1009 Nelson7040 Lucas House 51 Halifax Street Nelson 7010	**Slug Test Analysis Report** Project: Kaka Valley Subdivision Number: 1012397.1000 Client: CCKV Maitai Dev Co Lp

Location: Maitai Valley	Slug Test: Rising Head	Test Well: BH02-0723
Test Conducted by: AMHO		Test Date: 20/09/2023
Analysis Performed by: AMHO	Hvorslev	Analysis Date: 29/09/2023
Aquifer Thickness: 7.21 m		

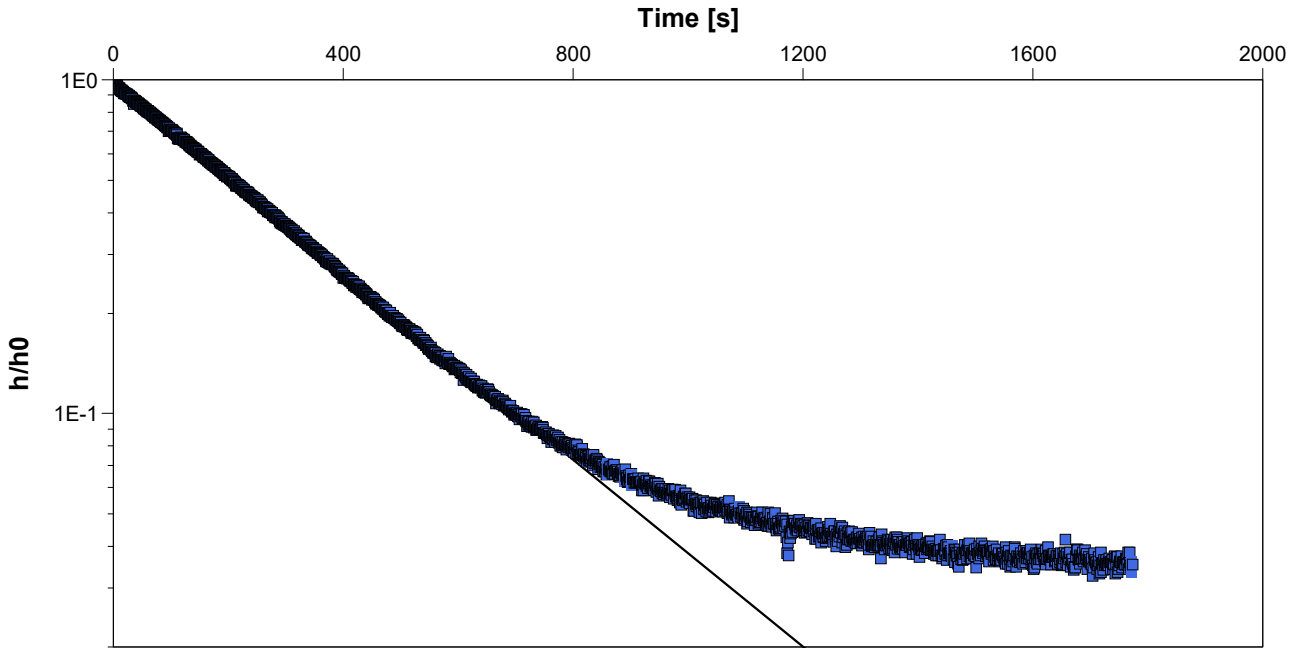


Calculation using Hvorslev

Observation Well	Hydraulic Conductivity [m/s]	
BH02-0723	1.27×10^{-6}	

Tonkin & Taylor Ltd PO Box 1009 Nelson7040 Lucas House 51 Halifax Street Nelson 7010	**Slug Test Analysis Report** Project: Kaka Valley Subdivision Number: 1012397.1000 Client: CCKV Maitai Dev Co Lp

Location: Maitai Valley	Slug Test: Rising Head	Test Well: BH02-0723
Test Conducted by: AMHO		Test Date: 20/09/2023
Analysis Performed by: AMHO	Bouwer & Rice	Analysis Date: 4/10/2023
Aquifer Thickness: 7.21 m		

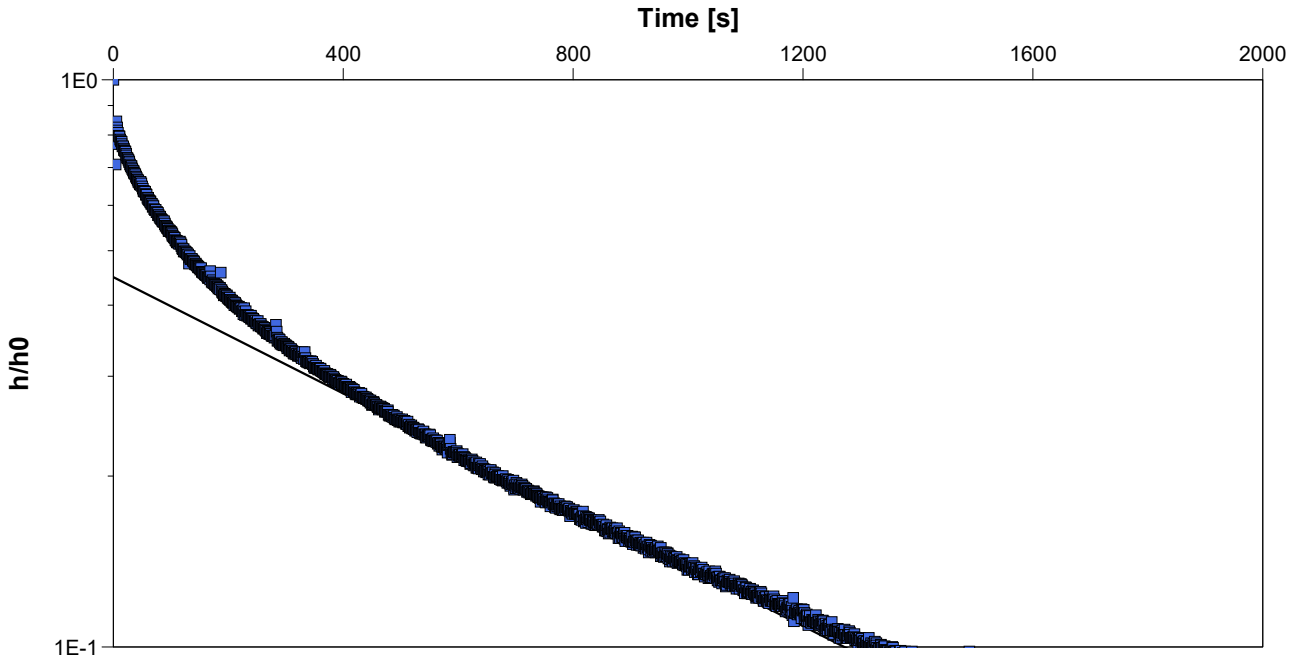


Calculation using Bouwer & Rice

Observation Well	Hydraulic Conductivity [m/s]	
BH02-0723	9.66×10^{-7}	

Tonkin & Taylor Ltd PO Box 1009 Nelson7040 Lucas House 51 Halifax Street Nelson 7010	**Slug Test Analysis Report** Project: Kaka Valley Subdivision Number: 1012397.1000 Client: CCKV Maitai Dev Co Lp

Location: Maitai Valley Road	Slug Test: Falling head test	Test Well: Bh06-0723
Test Conducted by: AMHO		Test Date: 29/09/2023
Analysis Performed by: AMHO	Hvorslev	Analysis Date: 29/09/2023
Aquifer Thickness: 2.93 m		



Calculation using Hvorslev

Observation Well	Hydraulic Conductivity [m/s]	
Bh06-0723	8.89×10^{-7}	

Tonkin & Taylor Ltd
PO Box 1009
Nelson7040

Lucas House
51 Halifax Street
Nelson 7010

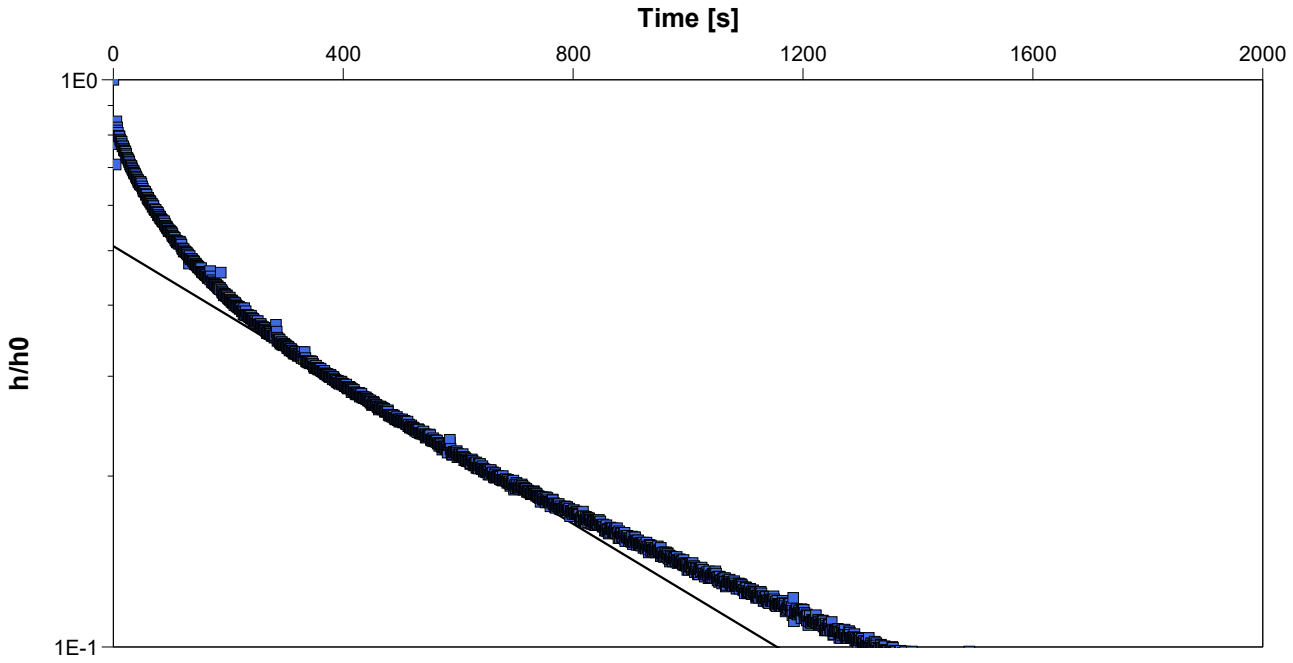
Slug Test Analysis Report

Project: Kaka Valley Subdivision

Number: 1012397.1000

Client: CCKV Maitai Dev Co Lp

Location: Maitai Valley Road	Slug Test: Falling head test	Test Well: Bh06-0723
Test Conducted by: AMHO		Test Date: 29/09/2023
Analysis Performed by: AMHO	Bouwer & Rice	Analysis Date: 4/10/2023
Aquifer Thickness: 2.93 m		

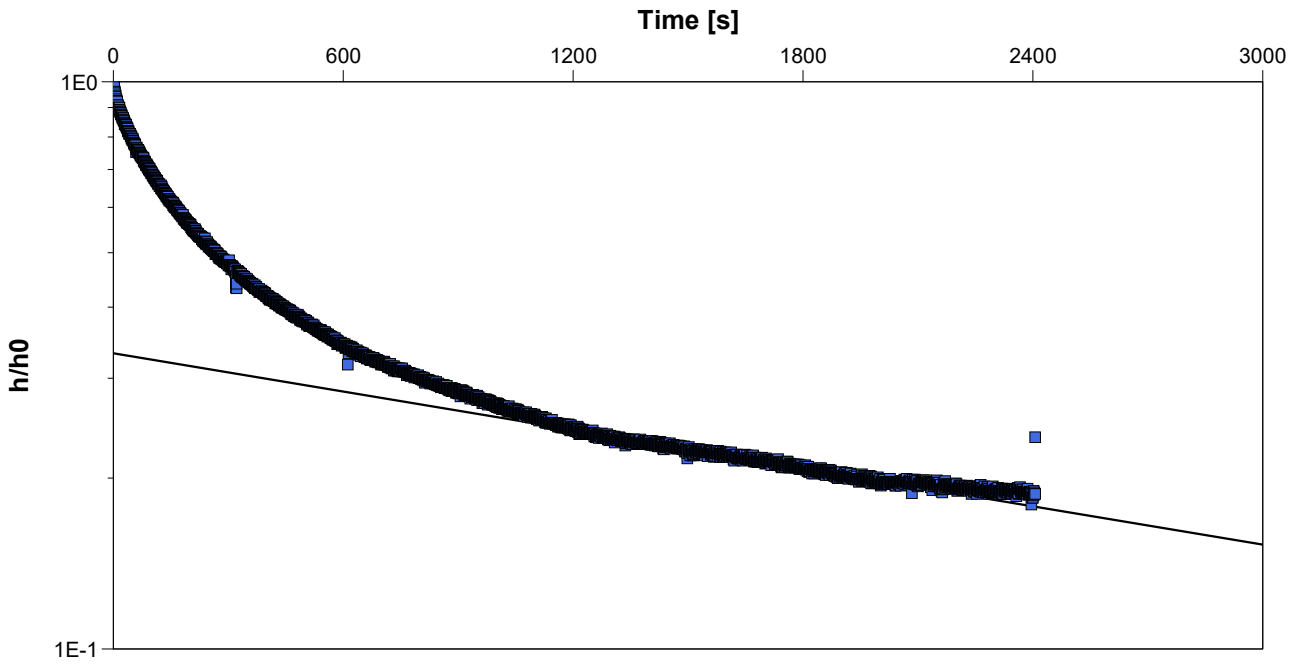


Calculation using Bouwer & Rice

Observation Well	Hydraulic Conductivity [m/s]	
Bh06-0723	8.12×10^{-7}	

Tonkin & Taylor Ltd PO Box 1009 Nelson7040 Lucas House 51 Halifax Street Nelson 7010	**Slug Test Analysis Report** Project: Kaka Valley Subdivision Number: 1012397.1000 Client: CCKV Maitai Dev Co Lp

Location: Maitai Valley Road	Slug Test: Rising head test	Test Well: Bh06-0723
Test Conducted by: AMHO		Test Date: 29/09/2023
Analysis Performed by: AMHO	Hvorslev	Analysis Date: 29/09/2023
Aquifer Thickness: 2.93 m		

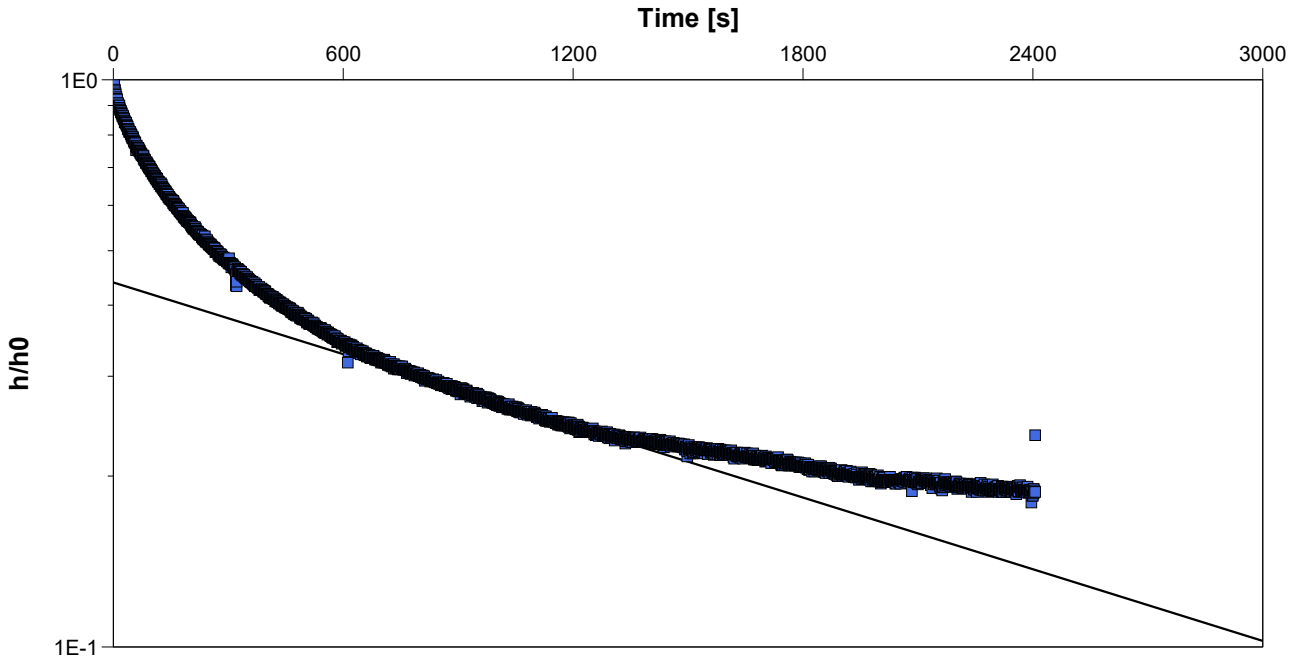


Calculation using Hvorslev

Observation Well	Hydraulic Conductivity [m/s]	
Bh06-0723	1.95×10^{-7}	

Tonkin & Taylor Ltd PO Box 1009 Nelson7040 Lucas House 51 Halifax Street Nelson 7010	**Slug Test Analysis Report** Project: Kaka Valley Subdivision Number: 1012397.1000 Client: CCKV Maitai Dev Co Lp

Location: Maitai Valley Road	Slug Test: Rising head test	Test Well: Bh06-0723
Test Conducted by: AMHO		Test Date: 29/09/2023
Analysis Performed by: AMHO	Bouwer & Rice	Analysis Date: 4/10/2023
Aquifer Thickness: 2.93 m		



Calculation using Bouwer & Rice

Observation Well	Hydraulic Conductivity [m/s]	
Bh06-0723	2.80×10^{-7}	

Tonkin & Taylor Ltd
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Nelson7040

Lucas House
51 Halifax Street
Nelson 7010

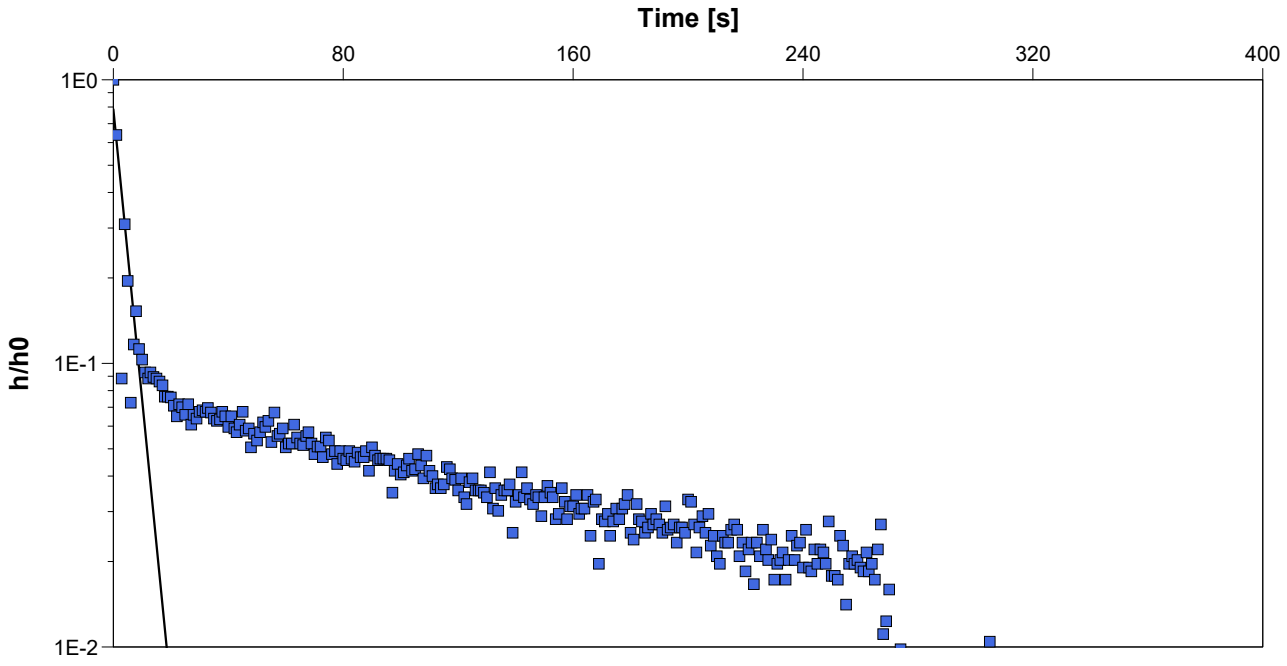
Slug Test Analysis Report

Project: Kaka Valley Subdivision

Number: 10122397.1000

Client: CCKV Maitai Dev Co Lp

Location: Maitai Valley	Slug Test: Falling Head	Test Well: BH06 deep
Test Conducted by: AMHO		Test Date: 19/09/2023
Analysis Performed by: AMHO	Hvorslev	Analysis Date: 29/09/2023
Aquifer Thickness: 5.05 m		



Calculation using Hvorslev

Observation Well	Hydraulic Conductivity [m/s]	
BH06 deep	1.25×10^{-4}	

Tonkin & Taylor Ltd
PO Box 1009
Nelson7040

Lucas House
51 Halifax Street
Nelson 7010

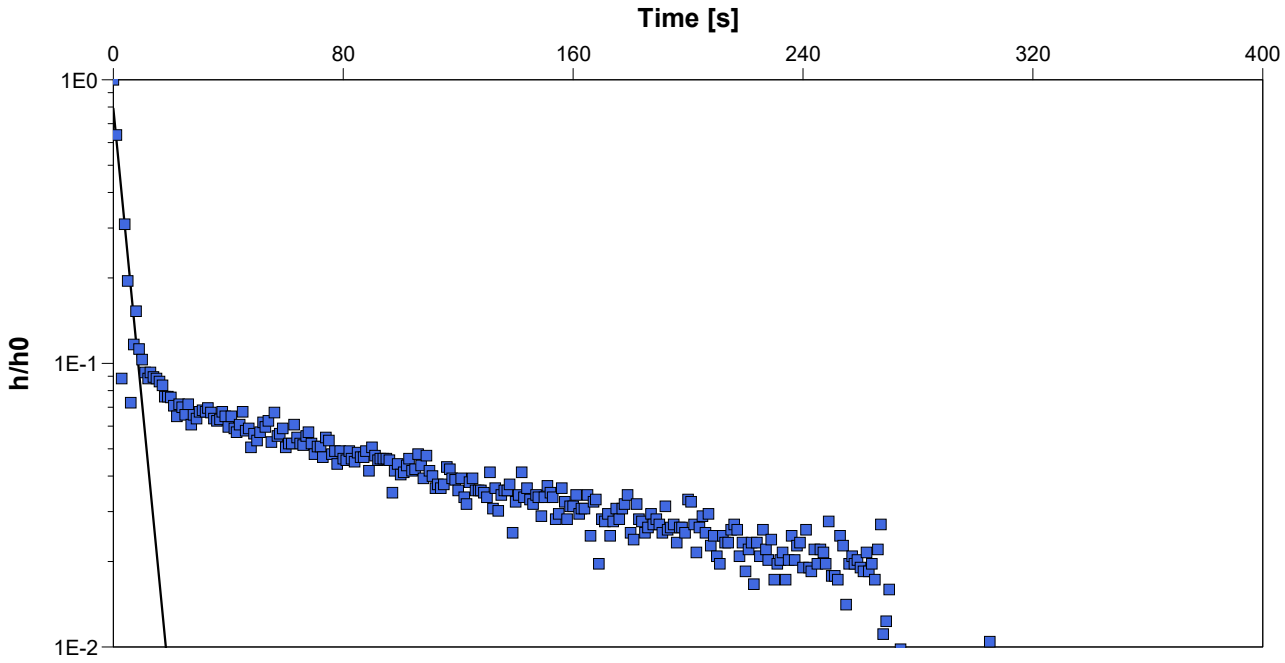
Slug Test Analysis Report

Project: Kaka Valley Subdivision

Number: 10122397.1000

Client: CCKV Maitai Dev Co Lp

Location: Maitai Valley	Slug Test: Falling Head	Test Well: BH06 deep
Test Conducted by: AMHO		Test Date: 19/09/2023
Analysis Performed by: AMHO	Bouwer & Rice	Analysis Date: 4/10/2023
Aquifer Thickness: 5.05 m		

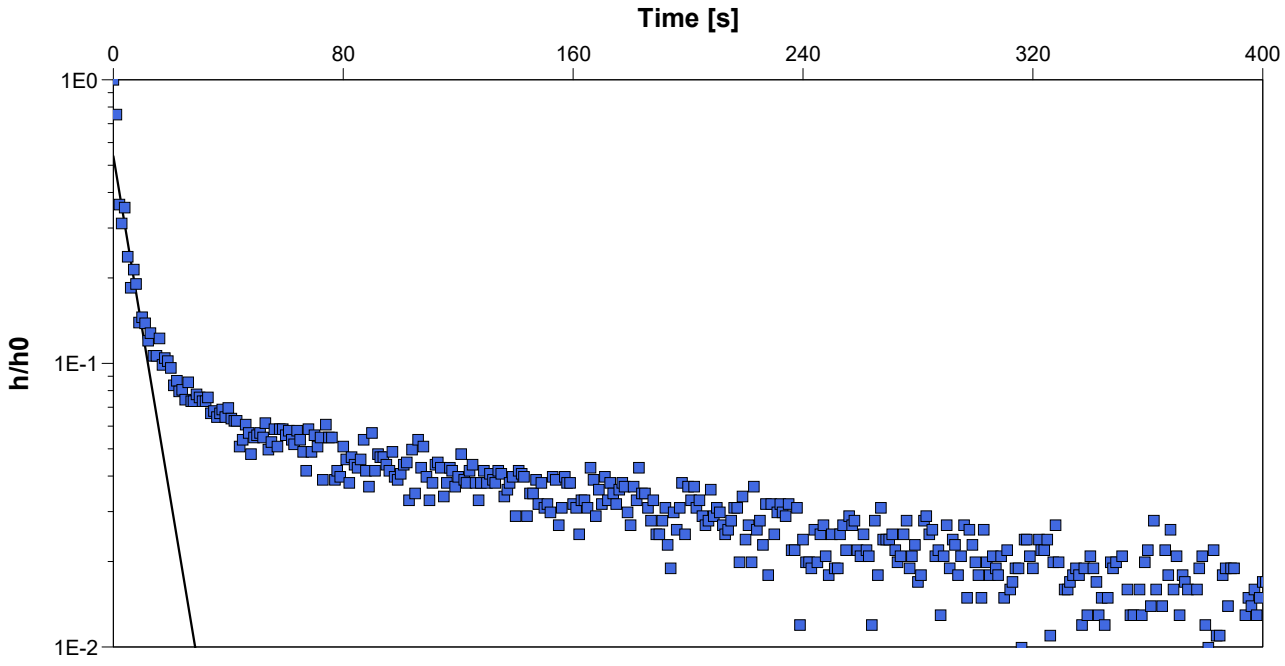


Calculation using Bouwer & Rice

Observation Well	Hydraulic Conductivity [m/s]	
BH06 deep	9.74×10^{-5}	

Tonkin & Taylor Ltd PO Box 1009 Nelson7040 Lucas House 51 Halifax Street Nelson 7010	**Slug Test Analysis Report** Project: Kaka Valley Subdivision Number: 10122397.1000 Client: CCKV Maitai Dev Co Lp

Location: Maitai Valley	Slug Test: Rising Head	Test Well: BH06 deep
Test Conducted by: AMHO		Test Date: 19/09/2023
Analysis Performed by: AMHO	Hvorslev	Analysis Date: 29/09/2023
Aquifer Thickness: 5.05 m		

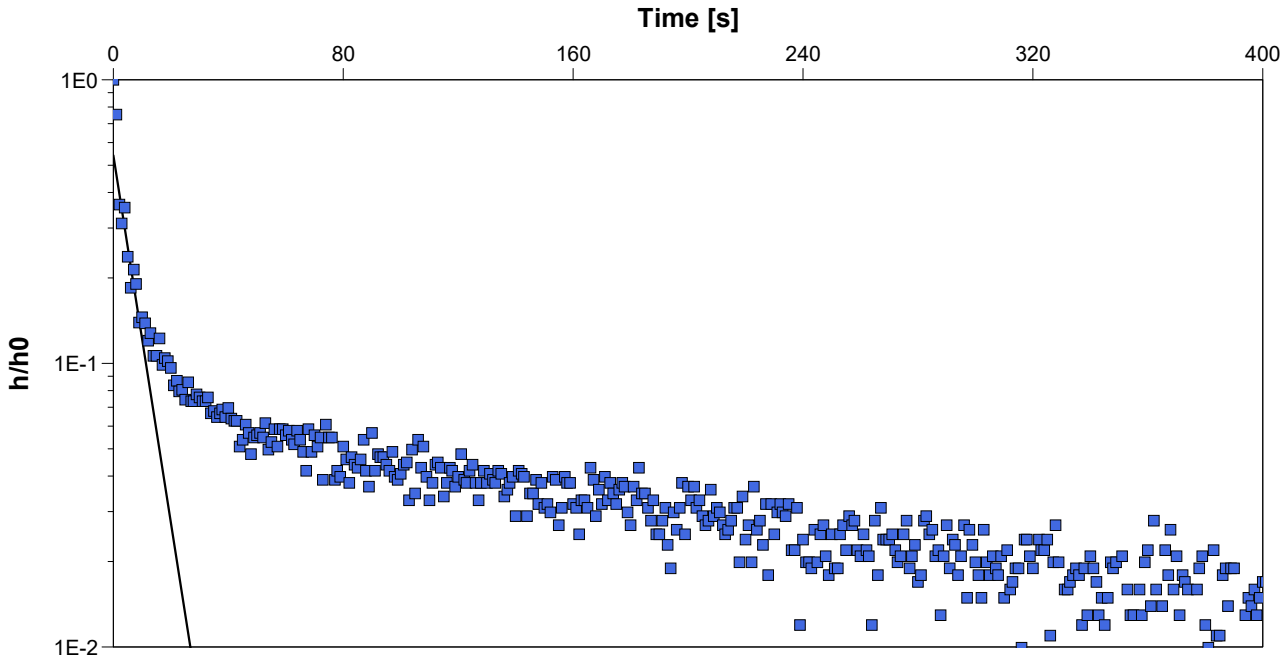


Calculation using Hvorslev

Observation Well	Hydraulic Conductivity [m/s]	
BH06 deep	7.40×10^{-5}	

Tonkin & Taylor Ltd PO Box 1009 Nelson7040 Lucas House 51 Halifax Street Nelson 7010	**Slug Test Analysis Report** Project: Kaka Valley Subdivision Number: 10122397.1000 Client: CCKV Maitai Dev Co Lp

Location: Maitai Valley	Slug Test: Rising Head	Test Well: BH06 deep
Test Conducted by: AMHO		Test Date: 19/09/2023
Analysis Performed by: AMHO	Bouwer & Rice	Analysis Date: 4/10/2023
Aquifer Thickness: 5.05 m		



Calculation using Bouwer & Rice

Observation Well	Hydraulic Conductivity [m/s]	
BH06 deep	6.06×10^{-5}	

Tonkin & Taylor Ltd
PO Box 1009
Nelson7040

Lucas House
51 Halifax Street
Nelson 7010

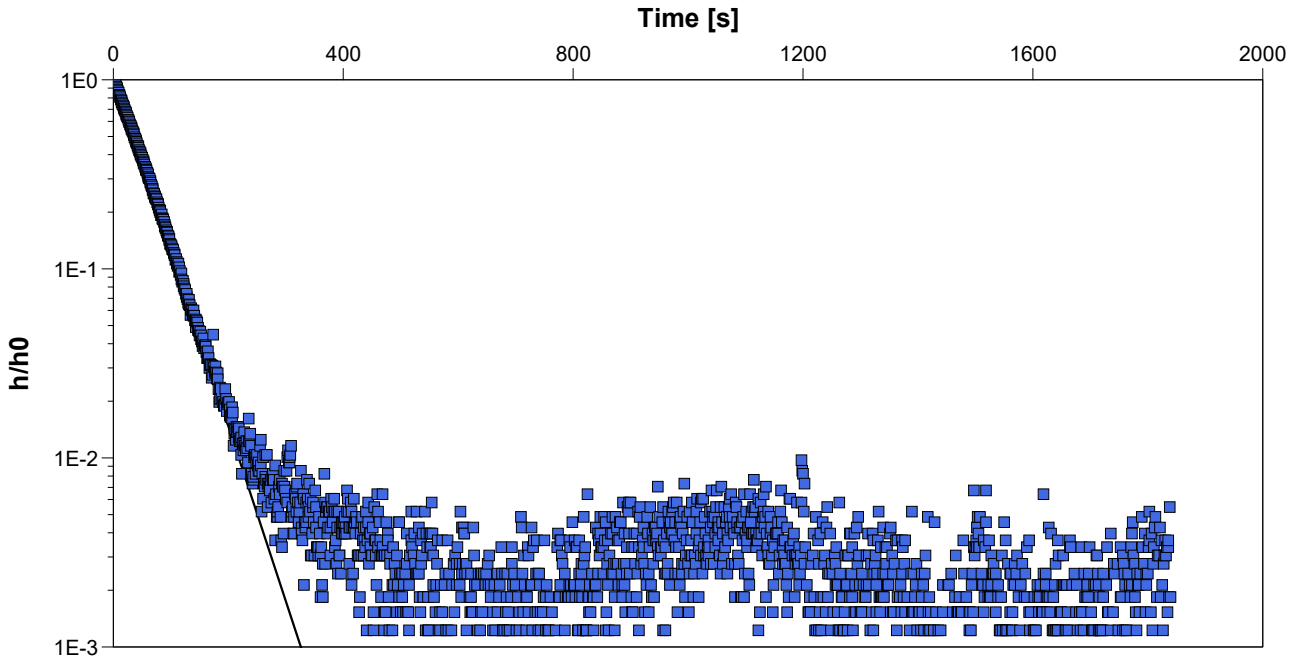
Slug Test Analysis Report

Project: Kaka Valley Subdivision

Number: 1012397.1000

Client: CCKV Maitai Dev Co Lp

Location: Maitai Valley Road	Slug Test: Falling Head Test	Test Well: BH06 Shallow
Test Conducted by: AMHO		Test Date: 20/09/2023
Analysis Performed by:	Hvoerslev	Analysis Date: 29/09/2023
Aquifer Thickness: 2.02 m		

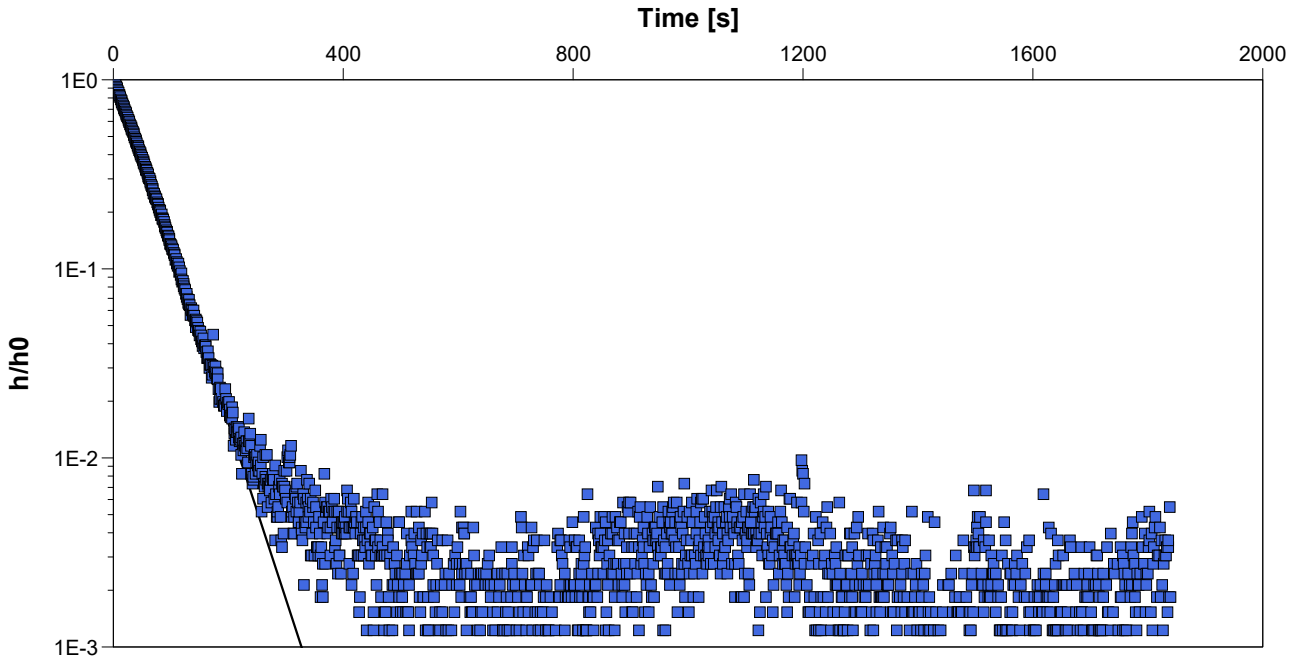


Calculation using Hvorslev

Observation Well	Hydraulic Conductivity [m/s]	
BH06 Shallow	1.57×10^{-5}	

Tonkin & Taylor Ltd PO Box 1009 Nelson7040 Lucas House 51 Halifax Street Nelson 7010	**Slug Test Analysis Report** Project: Kaka Valley Subdivision Number: 1012397.1000 Client: CCKV Maitai Dev Co Lp

Location: Maitai Valley Road	Slug Test: Falling Head Test	Test Well: BH06 Shallow
Test Conducted by: AMHO		Test Date: 20/09/2023
Analysis Performed by: AMHO	Bouwer & Rice	Analysis Date: 4/10/2023
Aquifer Thickness: 2.02 m		

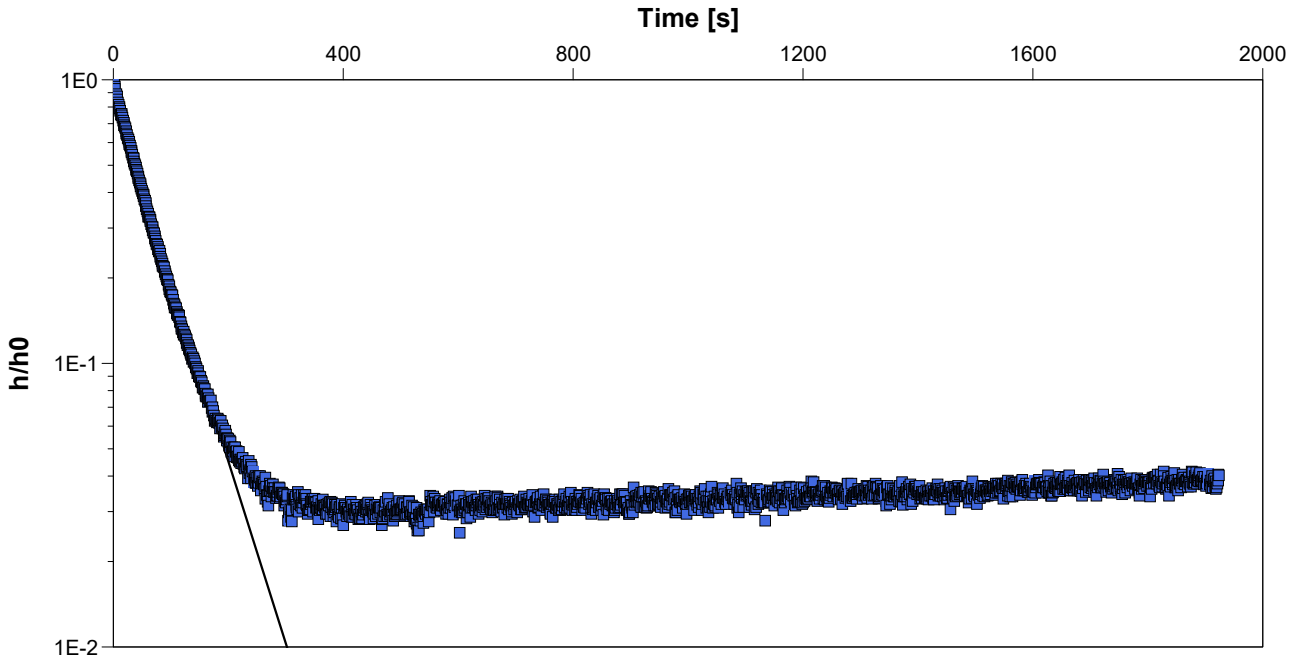


Calculation using Bouwer & Rice

Observation Well	Hydraulic Conductivity [m/s]	
BH06 Shallow	1.21×10^{-5}	

Tonkin & Taylor Ltd PO Box 1009 Nelson7040 Lucas House 51 Halifax Street Nelson 7010	**Slug Test Analysis Report** Project: Kaka Valley Subdivision Number: 1012397.1000 Client: CCKV Maitai Dev Co Lp

Location: Maitai Valley Road	Slug Test: Rising Head Test	Test Well: BH06 Shallow
Test Conducted by: AMHO		Test Date: 20/09/2023
Analysis Performed by: AMHO	Hvorslev	Analysis Date: 29/09/2023
Aquifer Thickness: 2.02 m		



Calculation using Hvorslev

Observation Well	Hydraulic Conductivity [m/s]	
BH06 Shallow	1.09×10^{-5}	

Tonkin & Taylor Ltd
PO Box 1009
Nelson7040

Lucas House
51 Halifax Street
Nelson 7010

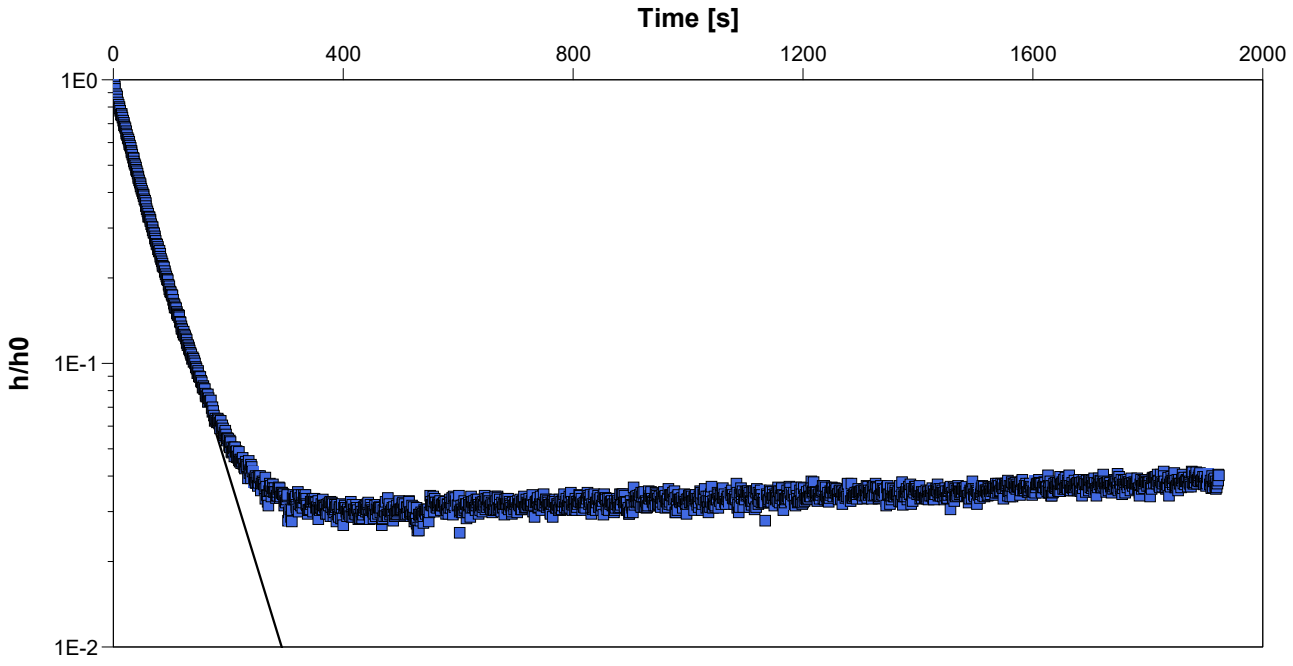
Slug Test Analysis Report

Project: Kaka Valley Subdivision

Number: 1012397.1000

Client: CCKV Maitai Dev Co Lp

Location: Maitai Valley Road	Slug Test: Rising Head Test	Test Well: BH06 Shallow
Test Conducted by: AMHO		Test Date: 20/09/2023
Analysis Performed by: AMHO	Bouwer & Rice	Analysis Date: 4/10/2023
Aquifer Thickness: 2.02 m		



Calculation using Bouwer & Rice

Observation Well	Hydraulic Conductivity [m/s]	
BH06 Shallow	8.56×10^{-6}	

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