CMW Geosciences
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30 June 2025

Arataki Residential Project

Arataki and Brookvale Roads, Havelock North

# GEOTECHNICAL INVESTIGATION REPORT

CDL Land New Zealand Ltd

Job No. NAP2024-0007AC | Version 0

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## Version Control

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## Review and Update History

| Revision | Date | Comments |
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| A | 08 April 2025 | Initial draft for internal review |
| B | 11 April 2025 | Draft for client review |
| C | 05 May 2025 | Draft issue of external review |
| 0 | 30 June 2025 | Final issue to client |

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## Appendices

# 1.0 INTRODUCTION

CMW Geosciences (CMW) was engaged by CDL Land New Zealand Ltd (CDL) to carry out a geotechnical investigation of a site located at 86, 108 & 122 Arataki Road, Havelock North, which is being considered for a residential development .

The scope of work and associated terms and conditions of our engagement were detailed in our services proposal letter referenced NAP2024-0007AB, Rev 0 dated 11 February 2025.

The purpose of this report is to describe the geotechnical investigations carried out, and the ground conditions encountered and to provide recommendations with respect to geotechnical aspects of the proposed development, including site preparation, foundation considerations, and stormwater disposal recommendations.

This report has been prepared to support CDL's Substantive Application to the Environmental Protection Authority (EPA) under the Fast Track Approvals Act (FTAA). The report is also suitable as one of the documents to support a resource consent application to the Hastings District Council (HDC) and provides the basis for the Statement of Professional Opinion (SOPO) provided in ***Appendix B.***

A statement of experience for the CMW staff involved in the preparation of this report is provided in ***Appendix B.***

# 2.0 SITE DESCRIPTION

## 2.1 General

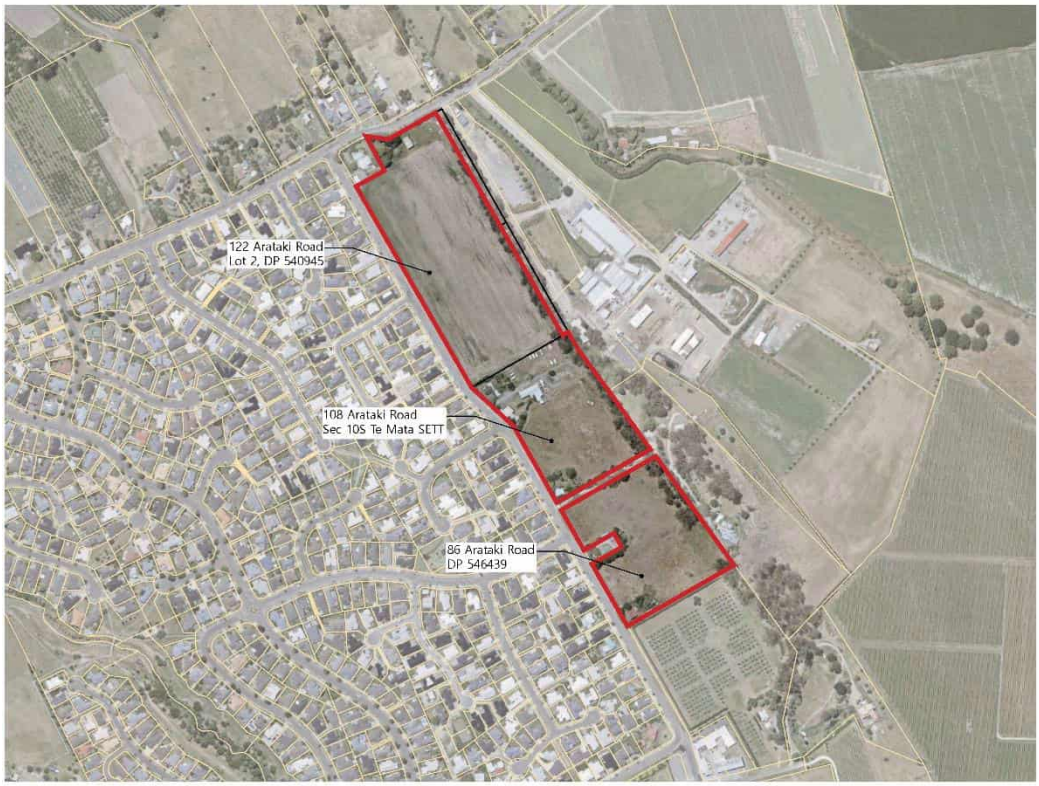
The site subject to this substantive application is located at 86, 108, 122 Arataki Road, Havelock North, Hawkes Bay (referred to as "the Site"), as depicted in Figure 1 below. Comprising a total area of approximately 11ha, the site is held in three separate titles, all owned by CDL. This site is located at the eastern edge of the existing urban area of Havelock North, approximately 2.5 kilometres from the Havelock North Village Centre.

The site has a gentle crossfall from south to north and is currently used for grazing purposes. A scattering of buildings is present within the site. Vegetation (predominantly exotic species) is largely limited to garden areas around these buildings and a shelter below alongside the eastern boundary. The site sits upon a natural terrace and the landform is elevated above the rural property to the east approximately 6m.

The site is generally bounded by Brookvale Road to the north and Arataki Road to the west. The land to the south is used as an olive orchard, and the land to the east is used for rural and light industrial purposes. Access to the site is provided via five existing crossings along Arataki Road.

The planning report prepared to support the substantive application under the FTAA provides a full site description. With respect to matters relating to the geotechnical aspects of the project, comments are made in the subsequent sections.

Figure 1: Site Location Plan (Image supplied by Woods)




## 2.2 Landform

The current general landform, together with associated features located within and adjacent to the site is presented on the attached Geotechnical Investigation Plan as shown in ***Drawing 01.***

The site is situated on an elevated terrace feature which grades gently from approximately RL31.5m (NZVD2016) along the southeastern boundary to approximately RL13.5m along the northwestern boundary. Immediately beyond the northeastern boundary, the landform grades moderately to steeply down to a board valley at approximately RL12m to RL10m. The escarpment is typically 7m to 10m high with slope gradient of between 20 and 45 degrees. The steeper slope gradients appear to the attributed to historic earthworks associated with the formation of accessways and platforms in the property downslope of the proposed development.

The landform to the west is generally near level to gently sloping with similar elevations to the proposed development area.

The nearest body of water is the Karamu Stream, located approximately 1.3km to the west of the site, which is situated at approximately RL3.0m. The Tukituki River is a large river and is located approximately 1.5km to the east of the site and is situated at approximately RL10.0m.

A series of ephemeral watercourses were observed on the board valley at the toe of the eastern escarpment. During our site walkover these were either dry or had localised areas of ponding water, indicating these are likely to be controlled by surface water flows.

## 2.3 Site History

Based on our review of the historic aerial imagery[1], the landform appears to have undergone modifications, with the following land changes noted:

- 1949 (earliest available image): the majority of the site and area to the east is in orchard with the southern portion of the site in pasture. The eastern escarpment is vegetated in large trees, with some earthworks evident along the slope. The board valley to the east in is pasture and the ephemeral watercourses observed during our site walkover are present.
- 1964: the majority of the site is in pasture expect for the northern portion which remains in orchard. Further earthworks along the eastern escarpment is evident.
- Building development at the toe escarpment appears to have occurred progressively from the mid-1970's to approximately the early 2000s, with evidence to suggest earthworks occur on or near the toe of the slope during this time.
- From the early 2000s through to approximately 2015, intensive residential development occurred to the east of the site.
- The site itself has remained relatively unchanged since the 1970's. Some earthworks is evident in 2021 near the south eastern boundary to 108 Arataki Road, which appears to have resulted in steep cut batters at this location.

# 3.0 PROPOSED DEVELOPMENT

This report is submitted in support of CDL's Substantive Application to the EPA to authorise the subdivision and development of the Arataki Extension land, located at 86, 108, 122 Arataki Road, Havelock North, Hawkes Bay (Site).

The proposal, which is also referred to as the "Arataki Project", will provide for the residential subdivision of the site to enable the development of 171 detached dwellings to contribute additional housing capacity to Havelock North and the Hawkes Bay region. The development will be supported by a local road network, pedestrian accessways, and required infrastructure. A planning design framework is proposed to facilitate residential built form development on the future lots.

The Arataki Project will comprise two phases of development. The first phase will realise the residential subdivision of the land and will be delivered by CDL. The residential subdivision and bulk earthworks phase will create 171 residential lots (average lot sizes 450m$^2$), a drainage reserve to vest, 4 roads to vest and a series of JOALs, bulk earthworks landform modification, infrastructure provision, buffer planting and external boundary fencing.

The second phase of development will deliver the residential built form in accordance with the planning design framework established for the site. This phase of development will be delivered by CDL's build partners and will involve house construction on individual lots and include vehicle access, parking, landscaping and fencing.

The planning report prepared to support the substantive application under the FTAA provides a full description of the proposal. With respect to matters relating to geotechnical aspects of the development the following is proposed:

- The current landform will be modified to form level, terraced lots by cuts and fills in the order of 1.5m, typically 0.5m.

[1] https://retrolens.co.nz/ & Google Earth Pro

- Cut batters and fill embankments are typically in the order of 1.0m high with gradients less than approximately 1(V):2.5(H). Retaining walls up to approximately 1.0m are also proposed to form level platforms.
- A stormwater dry basin is proposed within the northern portion of the site, where concentrated stormwater flows from roads and future lots will be attenuated before being discharged to the existing watercourse to the north via a 600mm diameter culvert with scruffy dome bubble up discharge point. The dry basin will be predominately formed in cut, with proposed cuts and fills in the order of 2.5m and 0.5m respectively. Batter gradients into the dry basin will be between approximately 1(V):3(H) and 1(V):5(H).
- Wastewater will be connected to the existing reticulated council system.

The proposed scheme plan[2] provided by Woods is presented in ***Appendix C*** and duplicated on ***Drawing 01***.

# 4.0 FIELD INVESTIGATIONS

## 4.1 Previous Investigations

WSP Opus and Initia Ltd previously completed geotechnical investigations for the site with the results presented in the following reports:

- WSP Opus, 108, 122 & 160 Arataki Road, Havelock North, Preliminary Geotechnical Assessment (ref. 2-S5376.00|18|01 Issue 1, dated 2 October 2018)
- WSP Opus, 86-96 Arataki Road, Havelock North, Preliminary Geotechnical Assessment (ref. 2-S5376.01 Issue 1, dated 26 March 2019)
- Initia Ltd, Arataki Residential Subdivision, Geotechnical Report – For Resource Consent (ref. 1190 Rev A, dated February 2022)

The geotechnical investigations comprised the following:

- 14 Test Pits to depths of between 2.2m and 3.5m.
- 4 Machine Boreholes to depths of between 7.65m and 7.95m.

The approximate locations of the relevant investigations referred to above are shown on ***Drawing 01,*** and a copy of the investigation logs are presented in ***Appendix C*** and referenced throughout this report.

## 4.2 CMW Investigations

Following a dial before you dig search and onsite service location, the field investigations for the proposed site were carried out on the 4 October 2024 and between 19 and 20 February 2025. All fieldwork was carried out under the direction of CMW Geosciences in general accordance with the NZGS specifications[3] and logged in accordance with NZGS guidance[4]. The scope of fieldwork completed was as follows:

- A site walkover by a CMW Engineering Geologist to assess the general landform and site conditions.
- 5 Test Pits, denoted as TP01-25 to TP05-25, were excavated using a 26-tonne hydraulic excavator fitted with a 2m wide bucket to a target depth of 4.0m below existing ground levels. Engineering logs of the test pit, together with peak and remoulded vane shear strengths, are presented in ***Appendix D.***

[2] Woods, Arataki Development – Havelock North, DWG No. P24-244-00-0100-GE Rev 2, DWG No. P24-244-00-1000-EW Rev 2, DWG No. P24-244-00-1100-EW Rev 2, dated June 2025
[3] NZ Geotechnical Society (2017) NZ Ground Investigation Specification, Volume 1 – Master Specification
[4] NZ Geotechnical Society (2005), Field Description of Soil and Rock, Guideline for the classification and description of soil and rock for engineering purposes.

- 10 hand auger boreholes, denoted HA01-25 to HA10-25, were drilled using a 50mm diameter auger to depths of between 0.4 and 1.1m below existing ground levels to visually observe the near-surface soil profile and to facilitate in-situ vane shear strength testing. Hand auger boreholes refused at shallow depths due to the gravelly nature of the material encountered. Engineering logs of the hand auger boreholes, together with peak and remoulded vane shear strengths, are presented in ***Appendix D.***
- Dynamic cone penetrometer (DCP) tests were carried out adjacent to each of the test pits and hand auger boreholes to provide soil density profiles. DCP tests were also carried out along the proposed road alignments to provide preliminary subgrade CBR values. Graphical results of the DCP testing are presented on the engineering logs in ***Appendix D.***

The approximate locations of the respective investigation locations referred to above are shown in ***Drawing 01***. Test locations were measured using handheld GPS. Elevations were inferred from the Hastings District Council GIS lidar contour data.

# 5.0 GROUND MODEL

## 5.1 Published Geology

The published geological map[5] of the area, as shown in Figure 2 below, depicts the regional geology for the area as comprising:

- Middle to late Pleistocene aged River deposits, described as "*moderately weathered undifferentiated poorly sorted loess-covered alluvial gravel deposits*"; and
- Holocene aged River deposits, described as "*poorly consolidated alluvial gravel, sand and mud*".

Some superficial depths of fill may be present as a result of previous and existing land use activities.

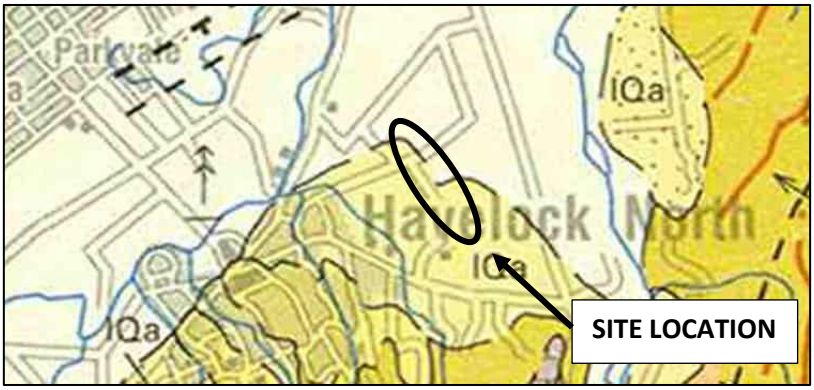



Figure 2: Regional Geology (sourced from GNS, Geological Map 8)

## 5.2 Stratigraphic Units

The ground conditions encountered and inferred from the investigations were generally consistent with the published geological information for the area and can be generalised according to the following subsurface sequences, as presented on Table 1 and presented on the appended Cross Section A as ***Drawing 02***.

[5] Geological and Nuclear Sciences, 1:250 000 Geological Map 8, Geology of the Hawke's Bay Area

Table 1: Summary of Strata Encountered

| Geological Unit | Depth to base (m) | | Thickness (m)* | | Strength Testing Results | |
|---|---|---|---|---|---|---|
| | Min | Max | Min | Max | SPT | DCP |
| Existing Fill (dense sandy Gravel with some silt/ dense sandy silt) ** | 0.4 | 0.5 | 0.4 | 0.5 | - | - |
| Topsoil | 0.1 | 0.8 | 0.1 | 0.8 | - | 2-9 |
| Pleistocene River Deposits (dense to very dense fine silty sand/fine sand some silt lenses) | 0.0.3 | 2.3 | 0.1 | 2.1 | - | 6-20+ |
| Pleistocene River Deposits (dense to very dense sandy gravel/gravel with occasional silt/clay lenses) | 0.65 | >4.0 | 0.2 | >3.6 | 33 | 6-20+ |
| Silt ("Hard Pan") *** | 0.7 | 1.8 | 0.2 | 0.8 | - | - |
| Pleistocene River Deposits (stiff sandy/gravelly silt with gravel beds) | >4 | >9 | * | * | 11-50+ | 20+ |
| Dense silty sand with gravel beds**** | 6.9 | 6.9 | 4.6 | 4.6 | 40-50+ | - |
| Pleistocene River Deposits (very dense silty sandy gravel trace cobble with interbedded silts) | >2.5 | >8.0 | * | * | 50+ | - |

Notes:

* Base not encountered

** Only encountered in TP04 (2019) and TP07 (2019)

*** Only encountered in TP01 (2018), TP07 (2018) and TP02 (2025)

**** Only encountered in BH03 (2021)

## 5.3 Groundwater

Groundwater was not encountered within any of the investigations completed to date across the site and is expected to be at depths greater than 8m below the site, based on Initia's BH01, which was drilled at the lowest elevation (RL 14m) to a depth of approximately 8m (RL 6.0m).

A site walkover of the surrounding area, in particular the open swale drains to the northeast of the site along Brookvale Road was undertaken to assess the general landform. During our site walkover these were either dry or had localised areas of ponding water, indicating these are likely controlled by surface water flows. These swales are situated at approximately RL 8.0m.

Based on the above observations, a conservative groundwater level at RL 6.0m has been adopted for the site.

# 6.0 GEOHAZARD ASSESSMENT

## 6.1 Context

Section 106 of the Resource Management Act[6] (RMA) requires an assessment of the risk from natural hazards to be carried out when considering the granting of subdivision consent. S106 RMA specifically states that the assessment must consider the combined effect of the natural hazard likelihood and material damage to land or structures (consequences).

The following sections of this report provide an assessment of the geohazards relevant to this site and prove the basis for the Natural Hazards Risk Assessment presented in ***Appendix E.***

## 6.2 Seismicity

### 6.2.1 Seismic Site Subsoil Category

The geological units encountered beneath the site comprise of soils strength materials, which with respect to the seismic site subsoil category defined in Section 3.1.3 of NZS1170.5, is defined as having a UCS < 1MPa. However, the depth to bedrock at this location has not been confirmed.

Based on the site location, understanding the surrounding geology in the area and in the absence of proof drilling to confirm the depth of competent rock the seismic site subsoil category is assessed as 'Class D' (deep soils) in general accordance with NZS1170.5:2004.

### 6.2.2 Earthquake Loading

A seismic assessment has been carried out in general accordance with NZGD guidance[7]. The serviceability limit state (SLS) and ultimate limit state (ULS) peak ground accelerations (PGAs) were assessed based on a 50-year design life and an importance level (IL) 2 structure with the New Zealand Building Code[8].

The recommended PGAs and earthquake magnitudes for geotechnical assessment at this site are presented in Table 2.

Table 2: Design Peak Ground Acceleration (PGA) for Various Limit States

| Limit State | AEP | PGA (g) | $Magnitude_{eff}$ |
|---|---|---|---|
| SLS | 1/25 | 0.12 | 6.4 |
| ULS | 1/500 | 0.58 | 7.1 |
| Note: AEP = annual exceedance probability | | | |

## 6.3 Fault Rupture

The Institute of Geological and Nuclear Sciences (GNS) Active Faults Database[9] shows the nearest active fault is the Waiana Fault Zone and Parkhill Fault Zone located approximately 3.0km east of the site. As such the risk of fault rupture to the proposed development is low.

[6] Resource Management Act (1991), as of 29 October 2019
[7] NZ Geotechnical Society publication "Earthquake geotechnical engineering practice, Module 1: Overview of the standards', (November 2021)
[8] Ministry of Business, Innovation and Employment (1992) NZ Building Code Handbook, Third Edition, Amendment 13 (effective from 14 February 2014).
[9] https://data.gns.cri.nz/af/

## 6.4 Liquefaction and Lateral Spread

Liquefaction occurs in loose saturated cohesionless soils that are subject to cyclic shear loading during an earthquake. This process leads to pore pressure build-ups, soil grains moving into suspension and temporary loss of strength causing vertical ground deformation.

Following the onset of liquefaction, the liquefied soils behave as a very weak undrained material, which at shallow depths can give rise to lateral spreading where a free face is present within the vicinity of the site or across the sloping ground. For lateral spread to occur, liquefaction must develop within shallow continuous soil layers that extend a sufficient length and width towards a free face or across sloping ground.

Review of the Hawkes Bay Hazard Portal indicates the site is located within a zone denoted as “Liquefaction damage is possible – medium liquefaction vulnerability”.

The liquefaction susceptibility of the soils at this site have been assessed in accordance with the MBIE/NZGS guidance[10]. The groundwater table is expected to be at depths greater than 8m below the site (RL 6m), generally at depths greater than 10m below the proposed lot levels. Given the relatively deep groundwater table and the generally dense nature of the soils encountered beneath the site, the risk of both liquefaction and lateral spread is considered low.

## 6.5 Slope Stability

### 6.5.1 Overview

A review of the Hawkes Bay Hazard Portal indicates that the site is located outside any mapped landslide risk areas.

The natural escarpment to the east of the site is considered relatively stable in its current conditions but does not provide the adequate slope stability factors of safety with respect to building construction.

Slope stability analyses were carried out on a representative section (Cross Section A), through a steep section of the escarpment, which did not appear to have been significantly modified by historic earthworks, to provide building setbacks for future development across the wider site.

### 6.5.2 Design Criteria

The stability of the natural escarpment under a range of design conditions is expressed in terms of a factor of safety (FoS), which is defined as the ratio of forces resisting failure to the forces causing failure. The following performance standards are recommended for slope stability assessment.

Table 3: Slope Stability Factor of Safety Criteria

| Case | Target Factor of Safety (FoS) |
|---|---|
| Static long-term conditions (Drained soil conditions, normal groundwater) | 1.5 |
| Transient short-term conditions (Elevated groundwater, Ru=0.15 to 0.3) | 1.2 |
| Ultimate Limit State (ULS) seismic conditions | 1.0* |
| Notes: *Factor of safety <1.0 is acceptable where a displacement-based approach is adopted. | |

Transient short-term analyses were based on elevated pore water pressures ($R_u$ = 0.15 to 0.3) in the soils above the groundwater level to simulate wetting fronts moving through the profile during and following intense rainfall events.

[10] Earthquake Geotechnical Engineering Practice, Module 3: Identification, assessment and mitigation of liquefication hazards (November 2021)

### 6.5.3 Geotechnical Parameters

Representative effective stress parameters were developed for each of the identified geological units based on the results of the geotechnical investigations, experience in modelling these materials and calibration of the units using back analysis techniques.

Back analysis of the steepest natural slopes was carried out to assess the effective stress shear strength parameters of the units that control the stability of these slopes. Analyses were based on elevated pore water pressures (Ru = 0.1 to 0.3), targeting a FoS of 1.

The strength parameters adopted for the site are summarised in Table 4 below.

Table 4: Effective Stress Shear Strength Parameters

| Geological Unit | Unit Weight (kN/m$^3$) | c' (kPa) | Ø' (deg) |
|---|---|---|---|
| Pleistocene River Deposits (dense to very dense fine silty sand/fine sand some silt lenses) | 18 | 2 | 36 |
| Pleistocene River Deposits (dense to very dense sandy gravel/gravel with occasional silt/clay lenses) | 20 | 0 | 38 |
| Pleistocene River Deposits (stiff sandy silt/silty sand with gravel beds) | 18 | 3 | 35 |
| Pleistocene River Deposits (very dense silty sandy gravel trace cobble with interbedded silts) | 20 | 0 | 37 |
| Note: Where c' = effective cohesion, Ø' = effective friction angle | | | |

### 6.5.4 Slope Stability Analysis

Slope stability analyses were undertaken using the Morgenstern-Price method of slices under both circular and translational failure mechanisms using the proprietary software Rocscience Slide.

Seismic displacements were estimated based on a Newmark Sliding Block approach using 50$^{th}$ percentile correlations published in Jibson (2007) and Ambraseys (1995) with the worst case displacements presented.

Selected stability outputs are presented in ***Appendix F*** and summarised in Table 5 below.

Table 5: Slope Stability Analysis Results

| Slope Stability Factor of Safety | | | | Seismic Yield Ac | ULS Displacement (mm) |
|---|---|---|---|---|---|
| Scenario | Prevailing | Transient Groundwater | ULS Seismic | | |
| Cross Section A – Worst Case | 1.22 | 0.98 | 0.44 | 0.10 | 195 |
| Cross Section A – 1(V):2(H) Crest Setback | 1.5 | 1.2 | 0.44 | 0.20 | 50 |
| Cross Section A – 1(V):2.2(H) Crest Setback | >1.5 | >1.2 | 0.44 | 0.26 | 25 |

Results show the requisite FoS under prevailing long term and transient elevated groundwater conditions are achieved at a setback equivalent to a 1(V):2(H) projection line from the toe of the slopes. Requisite FoS were not achieved on the downslope side of this projection line.

Under ULS seismic loading, based on the yield accelerations presented in Table 5 above, seismic displacements are predicted to be less than 50mm upslope of the 1(V):2(H) setback, with this decreasing to 25mm upslope of the 1(V):2.2(H) setback. Displacements in the order of 50mm are likely to require specific foundations design, with displacements less than 25mm considered minor and need not be considered in future foundation design.

Based on the results of our stability assessment detailed above, building restriction lines (BRLs) have been nominated for the site, as described in Section 7.1 below.

## 6.6 Load-Induced Settlement

Load induced settlement occurs in soils that are subject to static loading (e.g., by fill and/or building loads) where the magnitude of settlement is governed by the soil stiffness and the load applied.

The soils encountered beneath the site generally comprise dense to very dense silty sand/sand underlain by dense to very dense gravels, which are not considered to be prone to significant or excessive static settlements under typical residential development loads.

Provided the recommendations outlined in Section 6.4 below are followed, the risk of excessive static settlements across the proposed development is considered to be low and should comply with the maximum differential settlement criteria of 25mm over 6m under the serviceability limit state scenario as recommended in Appendix B of Section B1VM4 of the NZ Building Code.

# 7.0 GEOTECHNICAL RECOMMENDATIONS

## 7.1 Slope Stability Management

The natural escarpments that will remain to the east of the proposed development provide inadequate slope stability factors of safety and therefore, an appropriate setback from the crest of those escarpments to any future building will be required.

Slope stability analyses results show that the distance from the crest of the slope to where the requisite factors of safety are achieved equates to a projection line gradient of 1 (V):2.2(H) from the toe of the steep escarpment section.

Building Restriction Lines (BRLs) have been identified on ***Drawing 01*** based on the 1 (V):2.2(H) projection line (with setback distances varying depending on the height of slopes). If cuts/fills of >1.0m are proposed in proximity to a BRL, then the 1(V):2.2(H) projection line may need to be reassessed and BRL shifted to tie in with design levels. The location of the BRLs will be confirmed in a Geotechnical Completion Report (GCR) at the completion of earthworks.

All structures requiring building consent must be located entirely upslope of the BRL (unless supported by further geotechnical investigation and/or assessment by a Chartered Professional Geotechnical Engineer). This may include:

- Piling that part of the structure beyond the BRL.
- Lowering ground existing ground profile, which in turn would move the BRL close to the crest of the slope.
- Providing physical land protection works, such as a barrier pile wall.

Following development earthworks (ie. those works certified within the GCR), any filling downslope of the BRL is not recommended on account of land stability considerations.

## 7.2 Earthworks

### 7.2.1 Overview

All earthworks and building platform preparation activity must be carried out in general accordance with the requirements of NZS 4431[11] and the requirements of the District and Regional Council's and any other relevant documentation under the guidance of a Chartered Geoprofessional.

### 7.2.2 Site Won Fills

Generally, the proposed minor cuts across the site are likely to encounter the sand and sandy gravel units.

We expect that the excavation of this material will generally be achieved with normal earthworks plant, such as excavators. Due to the dense nature of the gravels, consideration should be given to using larger plant to reduce construction risks and programme delays. During the recent CMW investigations, it was noted that the 26-tonne hydraulic excavator fitted with a 2m wide, smooth edge bucket struggled at times excavated through gravelly material at depth within the test pits.

The sandy gravels are generally considered to be suitable for reuse as engineered fill, provided it is free from any organic material and has no particles greater than 100mm in diameter.

Individual particles of greater than 100mm in diameter shall be removed or broken down.

Soil textures and moisture contents may vary and careful management, conditioning and compaction control will be required.

### 7.2.3 Subgrade Preparation

Subgrade preparation should comprise the removal of all vegetation, topsoil, and any soft material / existing fill.

Following this the exposed subgrade should then be proof rolled using a large vibrating drum roller to densify and provide a more uniform subgrade. The proof roll should be completed under the guidance of the Chartered Professional Geotechnical Engineer. Where any loose materials are encountered during the proof rolling process, these should be undercut and replaced with engineered fill.

In addition to a proof roll, a series of shallow (i.e 1m deep or less) hand augers and/or DCP tests should be undertaken across the exposed subgrade surface. Where adverse ground conditions are encountered (i.e unsuitable/organic soils), these should be undercut, removed and backfilled with engineered fill.

The target subgrade specification is as follows:

- Shear vane values equal to or greater than 60kPa, or
- Dynamic Cone Penetrometer (DCP) blows per 100mm of equal to or greater than 4 blows/100mm.

### 7.2.4 Cut and Fill Batter Gradients

To reduce the effects of possible minor slumping or scour, self-supporting long term cut and fill batters on this site should be formed to no steeper than 1(V):2.5(H) where dense/stiff and dry subsoils are exposed.

[11] NZS 4431:2022 Engineered fill construction for lightweight structures, New Zealand Standard.

All formed batters should be covered by topsoil and then grassed as soon as practicable following construction to reduce the effects of surficial scour/rilling or alternatively supported to full height by specifically designed retaining walls.

Temporary construction cut and fill batters (ie. Less than 2 to 3 months duration) may be formed up to 1(V):1(H) to a maximum height of 2m where no groundwater seepage is evident (not expected based on deep groundwater) and not having any surcharge loading within 3 metres of the batter crest.

### 7.2.5 Earthfill Quality Control

Earthfill must be placed, spread and compacted in controlled lifts under the direction of a Chartered Geoprofessional. The fill may comprise either granular or cohesive material subject to being free of any organic material and having no particles greater than 100mm in diameter.

All earthfill must be placed to ensure adequate knitting of successive fill lifts by ripping any natural subgrade or fill surfaces that have become dry prior to placing the following fill lift.

The source of any imported fill will need to be discussed and approved by the project geoprofessional, and appropriate testing or material certificates will need to be provided to verify the fill suitability prior to importing any material.

The source and/or type of material used for engineered fill will dictate the type of quality control testing undertaken. The recommended specification for the proposed development is presented in Table 6 below.

Table 6: Earthfill Compaction Requirements

| Fill Class | Fill Type | Test Method | Compaction Requirements | Minimum Testing Frequency |
|---|---|---|---|---|
| Engineered Fill | Silt / Sandy Silt (Cohesive) | Vane Shear Strength | Minimum average over 10 consecutive tests – 150kPa<br>Minimum single value – 120kPa | 1 set / 500m$^3$ with at least 1 set per 0.5m fill lift (1 set to include 4 x shear vanes and 1 x air voids within a 3m radius) |
| | | Air Voids | Maximum average over 10 consecutive tests – 10%<br>Maximum single value –12% | |
| | | Compaction Curve | Min. 3 compaction and solid density tests per material fill type prior to construction | |
| | Sand / Silty sand (Granular) | Dynamic Cone Penetrometer (DCP)* | 5 blows per 100mm (subject to NDM calibration) | 1 set / 500m$^3$ (1 set to include 1 x 0.9m deep DCP and 1 x NDM within a 3m radius) |
| | | Maximum Dry Density | 95% of Maximum Dry Density (MDD) | |
| | | Compaction Curve | Min. 3 compaction and solid density tests per material fill type prior to construction | |
| Notes:<br>Testing frequency may vary at the discretion of the project geoprofessional, which may include small and / or deep isolated fill areas.<br>Laboratory moisture content must be carried out in conjunction with all NDM's.<br>* where DCP not considered suitable due to the more gravelly nature of the material used, this may be substituted for Clegg/Impact Hammer testing with the target CIV subject to calibration with the NDM | | | | |

## 7.3 Foundations

Based on the investigation data and subject to the development earthworks being undertaken in accordance with recommendations in Section 7.2 above, a geotechnical ultimate bearing capacity of 300kPa should be available for the construction of shallow strip and pad foundations such as those designed in accordance with NZS3604:2011.

There may be areas where localised variations in shear strength / density within the natural cut ground may occur. Further confirmation of available bearing pressures will be addressed at the time of post earthworks soil testing. At the completion of development earthworks, a GCR will be prepared, which will advise on anticipated foundation design parameters based on the results of post earthworks soil testing.

As required by section B1/VM4[11] of the New Zealand Building Code Handbook, the following strength reduction factors must be applied to all recommended geotechnical ultimate soil capacities in conjunction with their use in factored design load cases:

- 0.8 for load combinations involving earthquake overstrength;
- 0.5 for all other load combinations.

## 7.4 Civil Works

### 7.4.1 Retaining Walls

Specific engineer design retaining walls may be required to support cuts and/or fills and terraced lots as part of the proposed residential development. It is anticipated that these will be completed in conjunction with the development earthworks to provide near level building platforms for future lot owners.

Retaining walls, aside from those considered 'landscape walls', should be designed by a suitably qualified and experienced Chartered Professional Engineer familiar with the contents of this report, taking into consideration undrained (short term) and drained (long term) ground conditions, seismic loads, groundwater conditions, surcharges above and toe slopes.

Recommended design parameters for permanent retaining walls are provided in Table 7 below. These design parameters assume a horizontal ground surface above and below the retaining structure.

It is noted that some ground movement may occur behind temporary or permanent retaining walls. By definition movements of the walls must occur to fully mobilise the active and passive earth pressure coefficient provided in the above. The extent of this movement is dependent on the height of retaining, the type of wall selected methodology. This must be considered during the design and construction of the retaining wall to ensure that adjacent structures are not adversely affected.

At the completion of the development, Specific Design Zones are expected to be applied to protect retaining walls from future overloading at the crest or undermining at the toe that could lead to instability. These zones typically extend the same distance as the wall height, and where they are present above a wall require deepening of foundations unless the wall has been designed for future foundation loads. Where they are present below a wall, careful consideration needs to be given to the location, depth and timing of any future excavations. Specific Design Zones will be identified within the GCR once development earthworks and retaining wall construction is complete.

As discussed in Section 5.2 above, dense to very dense gravels were encountered at various depths across the site. These gravel layers could pose construction risks for the retaining walls especially if cantilever retaining walls are proposed and should be considered in the selection and design of any retaining walls across the site.

Table 7: Retaining Wall Design Parameters

| Soil Unit | γ (kN/m³) | c' (kPa) | Ø' (deg)p | $K_o$ | $K_a$ | $K_p$ |
|---|---|---|---|---|---|---|
| Engineered Fill (granular) | 18 | 0 | 38 | 0.50 | 0.22 | 8.17 |
| Pleistocene River Deposits (Dense to Very Dense fine silty sand/Fine sand some silt) | 18 | 2 | 36 | 0.50 | 0.24 | 7.02 |
| Pleistocene River Deposits (Dense to Very Dense Sandy Gravel/Gravel) | 20 | 0 | 38 | 0.50 | 0.22 | 8.17 |
| Pleistocene River Deposits (Stiff sandy silt/silty sand with gravel beds) | 18 | 3 | 35 | 0.50 | 0.24 | 6.52 |
| Pleistocene River Deposits (Very dense silty sandy Gravel trace cobble with interbedded silts) | 20 | 0 | 37 | 0.50 | 0.21 | 7.56 |
| Notes: γ - Soil unit weight; Ø' – effective angle of internal friction; c' – effective cohesion, $K_0$ – coefficient of earth pressure at rest, $K_a$ – coefficient of lateral active earth pressure, $K_p$ – coefficient of lateral passive earth pressure.<br>The retaining wall designer must adopt the above set of $K_a$ and $K_p$ parameters relevant to the actual construction method adopted.<br>The above parameters are based on horizontal ground above and below the retaining structure. Applicable surcharge loads behind the wall must be considered in the design. | | | | | | |

### 7.4.2 Subgrade CBR

The internal roads and pavements are likely to be formed in a combination of cut and fill. Following earthworks and subgrade trimming, a CBR of between 12% and 20% is anticipated for the natural soils and engineered fills.

It is recommended a program of penetration resistance testing is carried out at routine intervals when the road and pavement areas are being formed to their final design levels to confirm actual CBR values.

### 7.4.3 Service Trenches

Most of the materials expected to be exposed during the excavation of service trenches should be able to be removed using an excavator, with the possibility of some more dense gravel areas taking a bit more effort.

Trench collapse is not seen as a concern due to the deep groundwater table and the densely packed sands that stood vertically during test pit investigations, however this may be a risk where excavations/trenches are left exposed for longer durations due to the drying of exposed surfaces.

At the completion of the development, Specific Design Zones for services will be applied to protect future foundations from settlement from poorly compacted trench backfill and to prevent new loads crushing service pipes. This is a restriction on building foundations within the 45 degree zone of influence from pipe inverts.

## 7.5 Stormwater

### 7.5.1 General

The management of stormwater flows is important to help promote site stability.

It is important that all concentrated flows of stormwater generated from roof, driveway and other impervious surfaces are collected and diverted away from the steeper parts of the site to where the risk of erosion is low

Under no circumstances should concentrated stormwater be discharged into the ground or over the steep escarpment on account of slope stability considerations.

Based on the Hawke's Bay Regional Council Open Data Portal, the site is located above the mapped Heretaunga Plains Aquifer which is a significant water resource for the Hawke's Bay region.

### 7.5.2 Stormwater Dry Basin

It is understood that a stormwater dry basin and associated discharge infrastructure is being considered in the northern portion of the site that will collect stormwater generated from the development before being discharged to the existing watercourse to the north via a 600mm diameter culvert with scruffy dome bubble up discharge point.

We understand that the design of the dry basin is still being undertaken, but it is likely to involve excavation of the internal area. Based on the results of the field investigation, the cut batters and base of the dry basin are likely to comprise sands and gravels with groundwater at least 5m below the invert of the dry basin.

Due to the granular nature of the underlying material and proximity to slopes, it is recommended that the base and walls of the dry basin are lined an engineer-approved synthetic liner (HDPE or Geosynthetic liner (GSL)) to prevent seepage and adverse slope instability. A capping layer of low-permeability cohesive engineered fill may be considered as an alternative to the synthetic liner, with the thickness of the capping layer subject to specific geotechnical assessment and design.

Based on the results of the slope stability analyses, the proposed dry basin is situated a sufficient distance from the crest of the escarpment to the north and east such that the risk of global slope stability effecting the dry basin is considered low.

The design of the dry basin and associated discharge infrastructure must be subject to specific geotechnical assessment and design by a Chartered Professional Geotechnical Engineer to consider the range of operating conditions and design criteria.

# 8.0 SUMMARY OF RECOMMENDATIONS

A summary of the geotechnical recommendations outlined in Section 7.0 above is provided as follows:

- The escarpments that will remain to the east of the proposed development provide inadequate slope stability factors of safety and therefore building restriction lines have been identified based on a 1(V):2.2(H) projection line from the toe of the slope.
- All earthworks and building platform preparation activities should be carried out under the guidance and direction of a Chartered Geoprofessional, including subgrade preparation works and placement and compaction of earthfill.
- Self-supporting long term cut and fill batters should be formed no steeper than 1(V):2.5(H) unless supported by specifically designed retaining walls.
- A preliminary Geotechnical Ultimate Bearing Capacity of 300kPa should be available for standard shallow NZS3604:2011 foundations. At the completion of the earthworks, a Geotechnical Completion Report will be prepared which will advise on anticipated foundation design parameters based on the results of post earthworks soil testing.
- Retaining walls (aside from those considered 'landscape walls') should be by a suitably qualified and experienced Chartered Professional Engineer giving consideration to geotechnical parameters outlined in Section 7.4.1 above. At the completion of the development, Specific Design Zones are expected to be applied to protect retaining walls from future overloading at the crest or undermining at the toe that could lead to instability.

- For internal roads and pavements, CBR values of between 12% and 20% are anticipated for the natural soils and engineered fills across the site.
- Specific Design Zone for services will be applied at the completion of the development, restricting building foundations within 45 degree zones of influences from pipe inverts.
- It is recommended that the base and walls of the proposed stormwater dry basin are lined with an engineer approved synthetic liner or low permeability cohesive fill capping layer to prevent seepage and adverse instability. The design of the dry basin and associated discharge infrastructure must be subject to specific geotechnical assessment and design by a Chartered Professional Geotechnical Engineer to consider the range of operating conditions and design criteria.

# 9.0 FURTHER WORK

Additional geotechnical inputs are anticipated to be required during the detailed design and construction phases of the project, including:

- Geotechnical plan review of the final earthworks and landform design plans prior to earthworks commencement.
- Detailed design of retaining walls (if required).
- Geotechnical investigation, analyses and specific design of stormwater dry basin and associated discharge infrastructure (refer to ***Appendix G*** for suggested report outline).
- Laboratory testing for earthworks, including standard compaction testing, solid densities and moisture contents in proposed fill materials.
- Construction monitoring, including earthfill compaction control testing.
- Post construction verification testing across building platforms prior to building consent applications.
- Preparation of geotechnical completion reports intended to be used for geotechnical certification for the future residential allotments following completion of bulk earthworks, providing the results of geotechnical observations and relevant quality control data as well as recommendations/requirements specific to each of the lots. It is anticipated that the GCR would be suitable as one of the documents to support a building consent application for the future lot owners.

# 10.0 CLOSURE

This report has been prepared for use by CDL Land New Zealand Ltd in relation to the proposed residential subdivision located at Arataki and Brookvale Roads, Havelock North in accordance with the scope, proposed uses and limitations described in the report. Should you have further questions relating to the use of your report please do not hesitate to contact us.

Where a party other than CDL Land New Zealand Ltd seeks to rely upon or otherwise use this report, the consent of CMW should be sought prior to any such use. CMW can then advise whether the report and its contents are suitable for the intended use by the other party.

## USING YOUR CMW GEOTECHNICAL REPORT

Geotechnical reporting relies on interpretation of facts and collected information using experience, professional judgement, and opinion. As such it generally has a level of uncertainty attached to it, which is often far less exact than other engineering design disciplines. The notes below provide general advice on what can be reasonably expected from your report and the inherent limitations of a geotechnical report.

**Preparation of your report**

Your geotechnical report has been written for your use on your project. The contents of your report may not meet the needs of others who may have different objectives or requirements. The report has been prepared using generally accepted Geotechnical Engineering and Engineering Geology practices and procedures. The opinions and conclusions reached in your report are made in accordance with these accepted principles. Specific items of geotechnical or geological importance are highlighted in the report.

In producing your report, we have relied on the information which is referenced or summarised in the report. If further information becomes available or the nature of your project changes, then the findings in this report may no longer be appropriate. In such cases the report must be reviewed, and any necessary changes must be made by us.

**Your geotechnical report is based on your project's requirements**

Your geotechnical report has been developed based on your specific project requirements and only applies to the site in this report. Project requirements could include the type of works being undertaken; project locality, size and configuration; the location of any structures on or around the site; the presence of underground utilities; proposed design methodology; the duration or design life of the works; and construction method and/or sequencing.

The information or advice in your geotechnical report should not be applied to any other project given the intrinsic differences between different projects and site locations. Similarly geotechnical information, data and conclusions from other sites and projects may not be relevant or appropriate for your project.

**Interpretation of geotechnical data**

Site investigations identify subsurface conditions at discrete locations. Additional geotechnical information (e.g. literature and external data source review, laboratory testing etc) are interpreted by Geologists or Engineers to provide an opinion about a site specific ground models, their likely impact on the proposed development and recommended actions. Actual conditions may differ from those inferred to exist due to the variability of geological environments. The actual interface between materials may be far more gradual or abrupt than assumed based on the facts obtained. Nothing can be done to change the actual site conditions which exist, but steps can be taken to reduce the impact of unexpected conditions. Interpretation of factual data can be influenced by design and/or construction methods. Where these methods change review of the interpretation in the report may be required.

**Subsurface conditions can change**

Subsurface conditions are created by natural processes and then can be altered anthropically or over time. For example, groundwater levels can vary with time or activities adjacent to your site, fill may be placed on a site, or the consistency of near surface conditions might be susceptible to seasonal changes. The report is based on conditions which existed at the time of investigation. It is important to confirm whether conditions may have changed, particularly when large periods of time have elapsed since the investigations were performed.

**Interpretation and use by other design professionals**

Costly problems can occur when other design professionals develop their plans based on misinterpretations of a geotechnical report. To help avoid misinterpretations, it is important to retain the assistance of CMW to work with other project design professionals who are affected by the contents of your report. CMW staff can explain the report implications to design professionals and then review design plans and specifications to see that they have correctly incorporated the findings of this report.

**Your report's recommendations require confirmation during construction**

Your report is based on site conditions as revealed through selective point sampling. Engineering judgement is then applied to assess how indicative of actual conditions throughout an area the point sampling might be. Any assumptions made cannot be substantiated until construction is complete. For this reason, you should retain geotechnical services throughout the construction stage, to identify variances from previous assumption, conduct additional tests if required and recommend solutions to problems encountered on site.

A Geotechnical Engineer, who is fully familiar with the site and the background information, can assess whether the report's recommendations remain valid and whether changes should be considered as the project develops. An unfamiliar party using this report increases the risk that the report will be misinterpreted.

**Environmental matters are not covered**

Unless specifically discussed in your report environmental matters are not covered by a CMW Geotechnical Report. Environmental matters might include the level of contaminants present of the site covered by this report, potential uses or treatment of contaminated materials or the disposal of contaminated materials. These matters can be complex and are often governed by specific legislation.

The personnel, equipment, and techniques used to perform an environmental study can differ significantly from those used in this report. For that reason, our report does not provide environmental recommendations. Unanticipated subsurface environmental problems can have large consequences for your site. If you have not obtained your own environmental information about the project site, ask your CMW contact about how to find environmental risk-management guidance.

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# APPENDIX A
## Drawings


LEGEND:

- SITE BOUNDARY
- PROPOSED LOT BOUNDARY
- EXISTING GROUND CONTOUR (MAJOR)
- EXISTING GROUND CONTOUR (MINOR)
- TP1 — TEST PIT (TP) LOCATION - WSP 2018
- TP1 — TEST PIT (TP) LOCATION - WSP 2019
- BH01 — MACHINE BOREHOLE (BH) LOCATION - INITIA 2021
- HA01 — HAND AUGER (HA) LOCATION - CMW 2025
- TP01 — TEST PIT (TP) LOCATION - CMW 2025
- BRL — PROPOSED BUILDING RESTRICTION LINE (BRL)

NOTES:

1. AERIAL IMAGE COURTESY OF BING MAPS.
2. SCHEME PLAN BASED ON PROVIDED DRAWING P24-244-00-0100-GE
3. EXISTING GROUND CONTOURS CREATED FROM LINZ - HAWKE'S BAY LiDAR 1m DEM (2023-2024), CONTOURS SHOWN IN 0.5m INTERVALS.
4. CRS: NZGD2000 HAWKES BAY. VERTICAL DATUM IN TERMS OF NZVD2016.
5. TEST LOCATIONS ARE INDICATIVE ONLY.

0 25 50 75 100 125 m

1:2500

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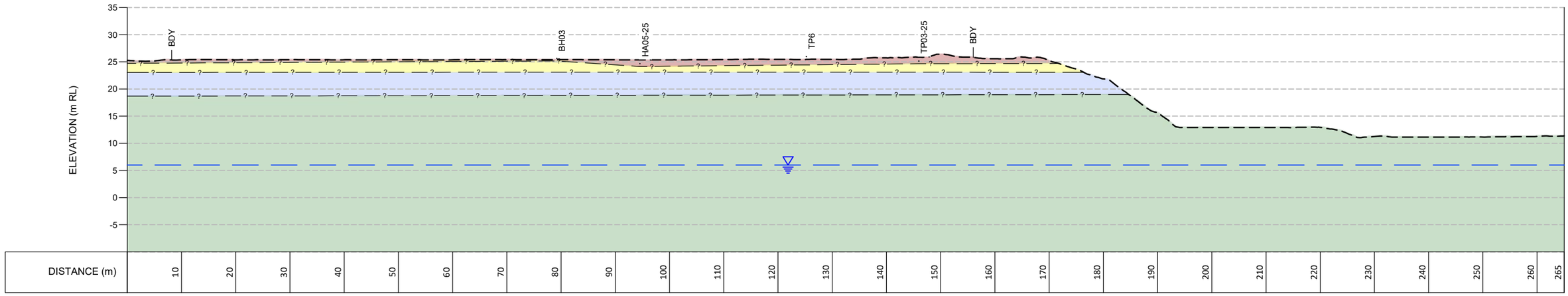
| | | | |
|---|---|---|---|
| CLIENT: CDL LAND NEW ZEALAND LTD | | DRAWN: IW | PROJECT: NAP2024-0007 |
| PROJECT: ARATAKI RESIDENTIAL SUBDIVISION, CNR ARATAKI AND BROOKVALE ROADS, HAVELOCK NORTH | | CHECKED: IA | DRAWING: 01 |
| | | REVISION: 01 | SCALE: 1:2500 |
| TITLE: GEOTECHNICAL INVESTIGATION PLAN | | DATE: 30/06/2025 | SHEET: A3 P |




CROSS SECTION A

LEGEND:

- EXISTING GROUND PROFILE
- INFERRED GEOLOGY BOUNDARY
- GROUND WATER LEVEL
- PLEISTOCENE RIVER DEPOSITS (DENSE TO VERY DENSE FINE SILTY SAND/FINE SAND SOME SILT LENSES)
- PLEISTOCENE RIVER DEPOSITS (DENSE TO VERY DENSE SANDY GRAVEL/GRAVEL WITH OCCASIONAL SILT/CLAY LENSES)
- PLEISTOCENE RIVER DEPOSITS (STIFF SANDY SILT/SILTY SAND WITH GRAVEL BEDS)
- PLEISTOCENE ROVER DEPOSITS (VERY DENSE SILTY SANDY GRAVEL TRACE COBBLE WITH INTERBEDDED SILTS)

NOTES:

1. EXISTING GROUND PROFILE CREATED FROM LINZ - HAWKE'S BAY LIDAR 1m DEM (2023-2024).
2. VERTICAL DATUM IN TERMS OF NZVD2016.
3. TEST LOCATIONS ARE INDICATIVE ONLY.

1:750 0 7.5 15 22.5 30 37.5 m

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PRINT IN COLOUR

| | | | |
|---|---|---|---|
| CLIENT: CDL LAND NEW ZEALAND LTD | DRAWN: IW | PROJECT: NAP2024-0007 |
| PROJECT: ARATAKI RESIDENTIAL SUBDIVISION, CNR ARATAKI AND BROOKVALE ROADS, HAVELOCK NORTH | CHECKED: IA | DRAWING: 02 |
| | REVISION: 0 | SCALE: 1:750 |
| TITLE: CROSS SECTION A | DATE: 09/04/2025 | SHEET: A3 L |

W:\2024\NAP2024-0007 Arataki Residential Subdivision\Drawings\NAP2024-0007 GI PLANS_09.04.25.dwg

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# APPENDIX B

## Statement of Professional Opinion & Statement of Experience

**APPENDIX 62**
**FORM 2**

To: Hastings District Council
Private Bag 9002
HASTINGS 4156

**STATEMENT OF PROFESSIONAL OPINION AS TO SUITABILITY OF LAND FOR SUBDIVISION PRELIMINARY GEOTECHNICAL REPORT (Submit with Subdivision Consent Application)**

Subdivision Arataki & Brookvale Roads, Havelock North

Owner/Developer: CDL Land New Zealand Ltd

Location: 86, 108 & 122 Arataki Road, Havelock North, Hawkes Bay

I Robert Taylor of CMW Geosciences (CMW Geotechnical NZ Ltd)
(Name and address)

hereby confirm that:

1. I am a suitably qualified and registered professional experienced in the field of Geotechnical Engineering and was retained by the owner/developer in this regard on the above subdivision. My qualifications are: BEng, BSc, MEngSC, CMEngNZ, CPEng

2. Site investigations have been carried out under my direction and are described in my report dated 30 June 2025, ref NAP2024-0007AC

3. I am aware of the details of the proposed scheme of subdivision and of the general nature of the proposed engineering works as shown on the following drawings
CMW Drawing 01, dated 30 June 2025, ref NAP2024-0007AC
WOODS, Arataki Development - Havelock North, Design Contour Plan DWG No. P24-24-00-1100-EW & Cut Fill Plan DWG No. P24-24-00-1200-EW dated June 2025

4. In my professional opinion, I consider that the proposed works give due regard to land slope and foundation stability considerations that the land is suitable for the proposed subdivision, providing that:

   a The recommendations in my report dated 30 June 2025, ref NAP2024-0007AC are followed.

   b .....

   c .....

This professional opinion is furnished to the Council and the owner/developer for their purposes alone, on the express conditions that it will not be relied upon by any other person and does not remove the necessity for further inspection during the course of the works.

Signed: . ..... Date 30 June 2025

# STATEMENT OF QUALIFICATION & EXPERIENCE

## Izzy Atchley (Project Manager)

I am a Senior Engineering Geologist at CMW Geosciences (CMW). CMW is a specialist geotechnical consultancy delivering first-class geotechnical engineering, engineering geology, hydrogeology and geophysics throughout Australia and New Zealand. I have been employed at CMW since February 2022.

I hold the qualifications of a Bachelor of Science majoring in Geology with an Endorsement in Environmental Science, a Postgraduate Diploma in Engineering Geology and a Master of Engineering Management; all from the University of Canterbury, which I completed in 2016. I am a member of the New Zealand Geotechnical Society and Engineering New Zealand.

I have over 8 years of professional experience in geotechnical consulting, including working on a range of development projects. My experience includes planning, scoping, managing and undertaking a variety of ground investigations for medium to large scale developments, construction monitoring and quality assurance, geotechnical analysis and design.

I confirm that, in my capacity as project manager of this report, I have read and abide by the Environment Court of New Zealand's Code of Conduct for Expert Witness Practice Note 2023.

## Mitchell Keyte (Author)

I am a Project Geotechnical Engineer at CMW Geosciences (CMW). CMW is a specialist geotechnical consultancy delivering first-class geotechnical engineering, engineering geology, hydrogeology and geophysics throughout Australia and New Zealand. I have been employed at CMW since October 2024.

I hold the qualification of Bachelor of Civil Engineering with honours (first class) from the University of Waikato, which I completed in 2020. I am an Emerging Professional Member of Engineering New Zealand.

I have 4 years of professional experience in geotechnical consulting, including roles such as Engineers Reps Assistant and project geotechnical Engineer. My experience includes undertaking and managing ground investigation, construction monitoring, geotechnical analysis and design.

I confirm that, in my capacity as author of this report, I have read and abide by the Environment Court of New Zealand's Code of Conduct for Expert Witness Practice Note 2023.

## Kirstin Brown (Project Principal)

I am an Associate Geotechnical Engineer at CMW Geosciences (CMW). CMW is a specialist geotechnical consultancy delivering first-class geotechnical engineering, engineering geology, hydrogeology and geophysics throughout Australia and New Zealand. I have been employed at CMW since May 2015.

I hold the qualification of Bachelor of Science in Geology with honours, a Master of Engineering Science (Geotechnical) with excellence at the University of Otago (2011) and New South Wales (2022) respectively. I am a Chartered Professional Engineer (CPEng) in the field of Geotechnical Engineering, Chartered Member of the Engineering New Zealand (CMEng), a member of New Zealand Geotechnical Society (NZGS) and a member of the International Society for Soil Mechanics and Geotechnical Engineering (ISSMGE).

I have over 12 years of professional experience in geotechnical consulting, including working on a range of land development projects of a similar type and scale to that of the Arataki Development. I have extensive experience in planning, scoping, and supervising geotechnical site investigations and construction supervision on medium to large scale land development projects including developing project specific earthworks specification and quality assurance programme. My key skills include foundation and ground improvement design, geological modelling, slope stability, soft soil engineering.

I confirm that, in my capacity as project principal of this report, I have read and abide by the Environment Court of New Zealand's Code of Conduct for Expert Witness Practice Note 2023.

## Robert Taylor (Independent Reviewer)

I am a Principal Geotechnical Engineer at CMW Geosciences (CMW). CMW is a specialist geotechnical consultancy delivering first-class geotechnical engineering, engineering geology, hydrogeology and geophysics throughout Australia and New Zealand. I have been employed at CMW since February 2016.

I hold the qualification of a Bachelor of Earth Science, a Bachelor of Civil Engineering with honours and a Master of Engineering Science (Geotechnical) from the University of Waikato (2005), the University of Southern Queensland (2014) and the University of New South Wales (2019) respectively. I am a Chartered Professional Engineer (CPEng) in the field of Geotechnical Engineering, Chartered Member of the Engineering New Zealand (CMEng), a member of New Zealand Geotechnical Society (NZGS), a member of the International Society for Soil Mechanics and Geotechnical Engineering (ISSMGE) and a member of New Zealand Society on Large Dams (NZSOLD).

I have 20 years of professional experience investigating ground conditions across Australia and New Zealand and implementing practical design solutions for a multitude of projects. I have considerable experience in soft soil engineering and liquefiable soils.

I confirm that, in my capacity as an independent reviewer of this report, I have read and abide by the Environment Court of New Zealand's Code of Conduct for Expert Witness Practice Note 2023.

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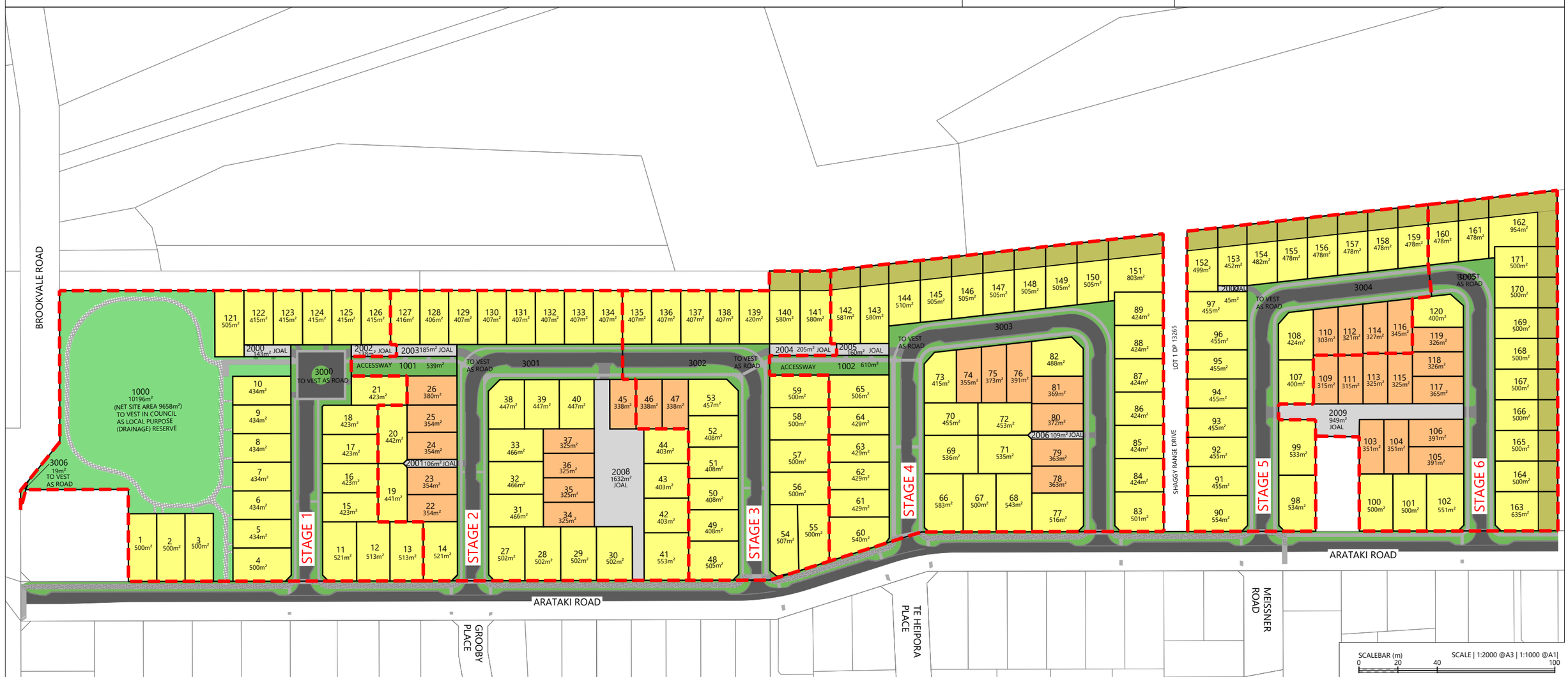
# APPENDIX C
## Development Plans

| ARATAKI DEVELOPMENT | STAGE 1 | STAGE 2 | STAGE 3 | STAGE 4 | STAGE 5 | STAGE 6 | TOTAL |
|---|---|---|---|---|---|---|---|
| STANDALONE LOTS | 24 | 35 | 21 | 40 | 24 | 27 | **171** |

LEGEND

- STAGE BOUNDARIES
- BOUNDARIES
- ROAD CARRIAGEWAY
- PEDESTRIAN PATHS
- INFORMAL PEDESTRIAN PATHS
- SHARED PATHS
- JOINT OWNED ACCESS LOTS (JOAL)
- LOT TYPE 1
- LOT TYPE 2
- PROPOSED DRAINAGE RESERVE
- COVENANT AREA OVER LOT TYPE 1




SCALEBAR (m) 0 20 40 100

SCALE | 1:2000 @A3 | 1:1000 @A1|

| REVISION DETAILS | | INT | DATE | SURVEYED | WOODS |
|---|---|---|---|---|---|
| 1 | ISSUED FOR DISCUSSION | BM | APR 2025 | DESIGNED | AB |
| 2 | ISSUED FOR CONSENT | TB | JUNE 2025 | DRAWN | BM |
| | | | | CHECKED | BLO |
| | | | | APPROVED | BF |


BUILDING B, LEVEL 1
8 NUGENT ST, GRAFTON,
AUCKLAND 1023
+64 9 308 9229

WOODS.CO.NZ


CDL LAND NEW ZEALAND LIMITED

# ARATAKI DEVELOPMENT - HAVELOCK NORTH

## DEVELOPMENT CONTROL PLAN

| STATUS | ISSUED FOR CONSENT | REV |
|---|---|---|
| SCALE | 1:2000 @ A3 | 2 |
| COUNCIL | HASTINGS DISTRICT COUNCIL | |
| DWG NO | P24-244-00-0100-GE | |

Plot Date: 2:01:43 pm,17 June 2025, TIMOTHYB

File: C:\12DSYNERGY\DATA\WP-PEN-APP-01\P24-244 - ARATAKI - HAVELOCK NORTH_21690\02 DRAWINGS\01 ENG\P24-244-00-0100-GE_DEVELOPMENT CONTROL PLAN.DWG

LEGEND

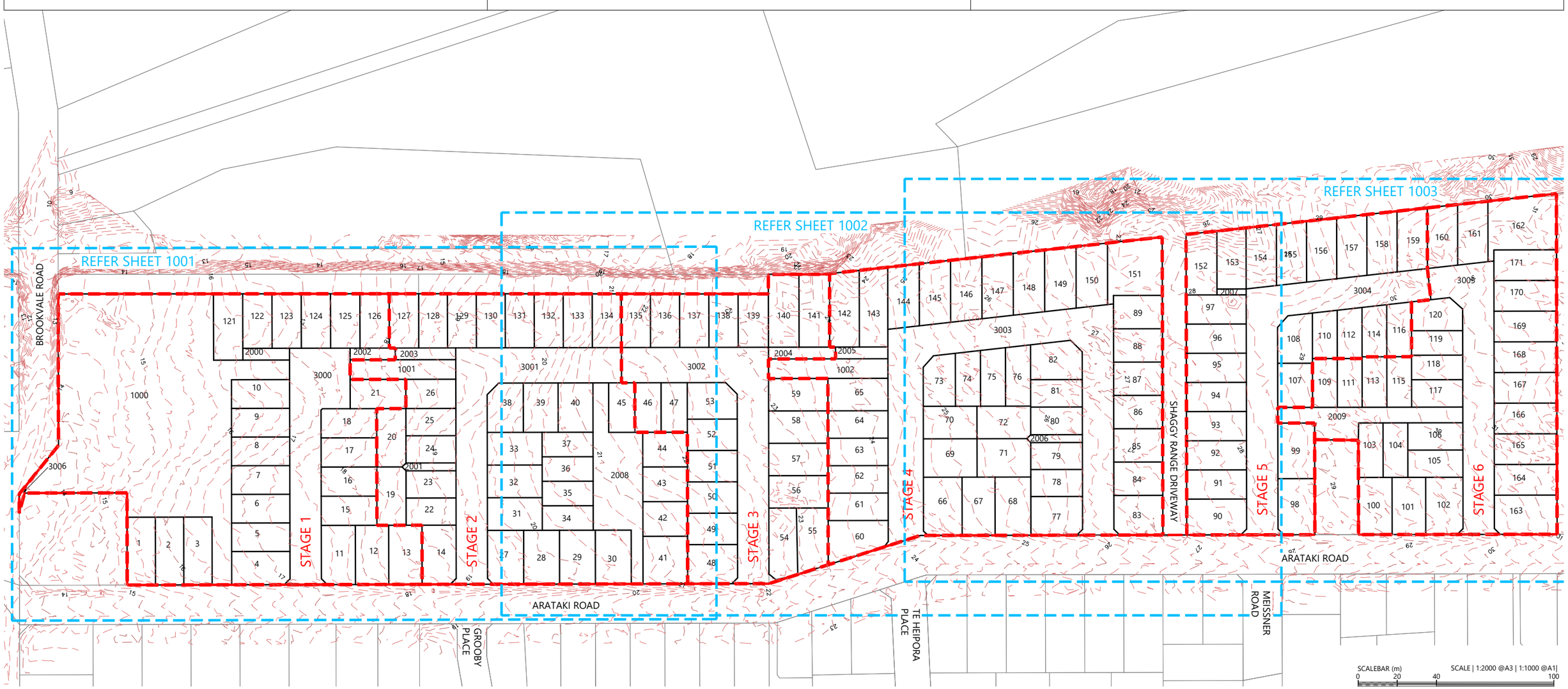
STAGE BOUNDARIES

PROPOSED BOUNDARIES

EXISTING CONTOURS (0.5m) — — — 23 — — —

NOTES

1. UNDERFILL DRAINAGE IS TO BE INSTALLED AT THE DIRECTION OF THE ENGINEER. IF THE CONTRACTOR ENCOUNTERS SPRINGS OR OTHER SOURCES OF WATER HE IS TO NOTIFY THE ENGINEER.
2. ALL UNSUITABLE MATERIAL AS DEFINED IN THE SPECIFICATION IS TO BE REMOVED AND THE STRIPPED AREAS INSPECTED BY THE ENGINEER BEFORE COMMENCES.
3. EARTHWORKS ARE NOT TO BE EXTENDED INTO ADJOINING SITES UNLESS THE ENGINEER HAS ISSUED SPECIFIC INSTRUCTIONS.
4. THE CONTRACTOR IS RESPONSIBLE FOR IDENTIFYING AND PROTECTING EXISTING SERVICES AND DRAINAGE ON SITE.
5. THE CONTRACTOR SHALL CLARIFY THE AREAS AND EXTENT OF CLEARING WITH THE ENGINEER BEFORE COMMENCEMENT AND CONFIRM THAT ALL NECESSARY CONSENTS ARE IN PLACE.




| REVISION DETAILS | | INT | DATE | SURVEYED | WOODS |
|---|---|---|---|---|---|
| 1 | ISSUED FOR DISCUSSION | TB | APR 2025 | DESIGNED | AB |
| 2 | ISSUED FOR CONSTRUCTION | TB | JUNE 2025 | DRAWN | TB |
| | | | | CHECKED | BLO |
| | | | | APPROVED | BF |


BUILDING B, LEVEL 1
8 NUGENT ST, GRAFTON,
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WOODS.CO.NZ


CDL LAND NEW ZEALAND LIMITED

# ARATAKI DEVELOPMENT - HAVELOCK NORTH

## EXISTING CONTOUR PLAN

| | |
|---|---|
| STATUS | ISSUED FOR CONSENT |
| SCALE | 1:2000 @ A3 |
| COUNCIL | HASTINGS DISTRICT COUNCIL |
| DWG NO | P24-244-00-1000-EW |
| REV | 2 |

Plot Date: 9:13:25 am,26 June 2025, TIMOTHYB

File: C:\12DSYNERGY\DATA\WP-PEN-APP-01\P24-244 - ARATAKI - HAVELOCK NORTH_21690\00 DRAWINGS\01 ENG\P24-244-00-1000-EW_EXISTING CONTOUR PLAN.DWG

LEGEND

STAGE BOUNDARIES

PROPOSED BOUNDARIES

EXISTING CONTOURS (0.5m) — 23 —

NOTES

1. UNDERFILL DRAINAGE IS TO BE INSTALLED AT THE DIRECTION OF THE ENGINEER. IF THE CONTRACTOR ENCOUNTERS SPRINGS OR OTHER SOURCES OF WATER HE IS TO NOTIFY THE ENGINEER.
2. ALL UNSUITABLE MATERIAL AS DEFINED IN THE SPECIFICATION IS TO BE REMOVED AND THE STRIPPED AREAS INSPECTED BY THE ENGINEER BEFORE COMMENCES.
3. EARTHWORKS ARE NOT TO BE EXTENDED INTO ADJOINING SITES UNLESS THE ENGINEER HAS ISSUED SPECIFIC INSTRUCTIONS.
4. THE CONTRACTOR IS RESPONSIBLE FOR IDENTIFYING AND PROTECTING EXISTING SERVICES AND DRAINAGE ON SITE.
5. THE CONTRACTOR SHALL CLARIFY THE AREAS AND EXTENT OF CLEARING WITH THE ENGINEER BEFORE COMMENCEMENT AND CONFIRM THAT ALL NECESSARY CONSENTS ARE IN PLACE.

BROOKVALE ROAD

STAGE 1

STAGE 2

ARATAKI ROAD

ARATAKI ROAD

SCALEBAR (m) 0 10 20 50

SCALE | 1:1000 @A3 | 1:500 @A1|

Plot Date: 9:13:25 am,26 June 2025, TIMOTHYB

File: C:\12DSYNERGY\DATA\WP-PEN-APP-01\P24-244 - ARATAKI - HAVELOCK NORTH_21690\02 DRAWINGS\01 ENG\P24-244-00-1000-EW_EXISTING CONTOUR PLAN.DWG

| REVISION DETAILS | | INT | DATE |
|---|---|---|---|
| 2 | ISSUED FOR CONSENT | TB | JUNE 2025 |

| | |
|---|---|
| SURVEYED | WOODS |
| DESIGNED | AB |
| DRAWN | TB |
| CHECKED | BLO |
| APPROVED | BF |

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# ARATAKI DEVELOPMENT - HAVELOCK NORTH

## EXISTING CONTOUR PLAN - SHEET 1

| | |
|---|---|
| STATUS | ISSUED FOR CONSENT |
| SCALE | 1:1000 @ A3 |
| COUNCIL | HASTINGS DISTRICT COUNCIL |
| DWG NO | P24-244-00-1001-EW |
| REV | 2 |

LEGEND

STAGE BOUNDARIES

PROPOSED BOUNDARIES

EXISTING CONTOURS (0.5m) — — — 23 — — —

NOTES

1. UNDERFILL DRAINAGE IS TO BE INSTALLED AT THE DIRECTION OF THE ENGINEER. IF THE CONTRACTOR ENCOUNTERS SPRINGS OR OTHER SOURCES OF WATER HE IS TO NOTIFY THE ENGINEER.
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5. THE CONTRACTOR SHALL CLARIFY THE AREAS AND EXTENT OF CLEARING WITH THE ENGINEER BEFORE COMMENCEMENT AND CONFIRM THAT ALL NECESSARY CONSENTS ARE IN PLACE.

STAGE 3

STAGE 4

STAGE 5

SHAGGY RANGE DRIVEWAY

ARATAKI ROAD

ARATAKI ROAD

SCALEBAR (m) 0 10 20 50

SCALE | 1:1000 @A3 | 1:500 @A1|

| REVISION DETAILS | | INT | DATE | SURVEYED | WOODS |
|---|---|---|---|---|---|
| 2 | ISSUED FOR CONSENT | TB | JUNE 2025 | DESIGNED | AB |
| | | | | DRAWN | TB |
| | | | | CHECKED | BLO |
| | | | | APPROVED | BF |

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# ARATAKI DEVELOPMENT - HAVELOCK NORTH

EXISTING CONTOUR PLAN - SHEET 2

| | |
|---|---|
| STATUS | ISSUED FOR CONSENT |
| SCALE | 1:1000 @ A3 |
| COUNCIL | HASTINGS DISTRICT COUNCIL |
| DWG NO | P24-244-00-1002-EW |
| REV | 2 |

Plot Date: 9:13:26 am,26 June 2025, TIMOTHYB

File: C:\12DSYNERGY\DATA\WP-PEN-APP-01\P24-244 - ARATAKI - HAVELOCK NORTH_21690\02 DRAWINGS\01 ENG\P24-244-00-1000-EW_EXISTING CONTOUR PLAN.DWG

LEGEND

STAGE BOUNDARIES

PROPOSED BOUNDARIES

EXISTING CONTOURS (0.5m) — 23 —

NOTES

1. UNDERFILL DRAINAGE IS TO BE INSTALLED AT THE DIRECTION OF THE ENGINEER. IF THE CONTRACTOR ENCOUNTERS SPRINGS OR OTHER SOURCES OF WATER HE IS TO NOTIFY THE ENGINEER.
2. ALL UNSUITABLE MATERIAL AS DEFINED IN THE SPECIFICATION IS TO BE REMOVED AND THE STRIPPED AREAS INSPECTED BY THE ENGINEER BEFORE COMMENCES.
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5. THE CONTRACTOR SHALL CLARIFY THE AREAS AND EXTENT OF CLEARING WITH THE ENGINEER BEFORE COMMENCEMENT AND CONFIRM THAT ALL NECESSARY CONSENTS ARE IN PLACE.

WOODS Est.1970

STAGE 4

STAGE 5

STAGE 6

SHAGGY RANGE DRIVEWAY

ARATAKI ROAD

ARATAKI ROAD

SCALEBAR (m) 0 10 20 50

SCALE | 1:1000 @A3 | 1:500 @A1|

Plot Date: 9:13:26 am,26 June 2025, TIMOTHYB

File: C:\12DSYNERGY\DATA\WP-PEN-APP-01\P24-244 - ARATAKI - HAVELOCK NORTH_21690\02 DRAWINGS\01 ENG\P24-244-00-1000-EW_EXISTING CONTOUR PLAN.DWG

| REVISION DETAILS | | INT | DATE | SURVEYED | WOODS |
|---|---|---|---|---|---|
| 2 | ISSUED FOR CONSENT | TB | JUNE 2025 | DESIGNED | AB |
| | | | | DRAWN | TB |
| | | | | CHECKED | BLO |
| | | | | APPROVED | BF |

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# ARATAKI DEVELOPMENT - HAVELOCK NORTH

## EXISTING CONTOUR PLAN - SHEET 3

| | |
|---|---|
| STATUS | ISSUED FOR CONSENT |
| SCALE | 1:1000 @ A3 |
| COUNCIL | HASTINGS DISTRICT COUNCIL |
| DWG NO | P24-244-00-1003-EW |

REV 2

## NOTES

1. UNDERFILL DRAINAGE IS TO BE INSTALLED AT THE DIRECTION OF THE ENGINEER. IF THE CONTRACTOR ENCOUNTERS SPRINGS OR OTHER SOURCES OF WATER HE IS TO NOTIFY THE ENGINEER.
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5. THE CONTRACTOR SHALL CLARIFY THE AREAS AND EXTENT OF CLEARING WITH THE ENGINEER BEFORE COMMENCEMENT AND CONFIRM THAT ALL NECESSARY CONSENTS ARE IN PLACE.

## LEGEND

STAGE BOUNDARIES

PROPOSED MAJOR CONTOURS (1m) — 23 —

PROPOSED MINOR CONTOURS (0.25m)

EXTENTS OF WORKS

REFER SHEET 1101

REFER SHEET 1102

REFER SHEET 1103

BROOKVALE ROAD

STAGE 1

STAGE 2

STAGE 3

STAGE 4

STAGE 5

STAGE 6

SHAGGY RANGE DRIVEWAY

ARATAKI ROAD

GROOBY PL

TE HEIPORA PL

MEISSNER RD

WW CONNECTION FOR #160 ARATAKI ROAD, PRIOR TO REMOVAL OF SEPTIC TANK

WW CONNECTION FOR #96 ARATAKI ROAD, PRIOR TO REMOVAL OF SEPTIC FIELD

SCALEBAR (m) 0 20 40 100

SCALE | 1:2000 @A3 | 1:1000 @A1|

| REVISION DETAILS | | INT | DATE | SURVEYED | WOODS |
|---|---|---|---|---|---|
| 1 | ISSUED FOR DISCUSSION | TB | APR 2025 | DESIGNED | AB |
| 2 | ISSUED FOR CONSENT | TB | JUNE 2025 | DRAWN | TB |
| | | | | CHECKED | BLO |
| | | | | APPROVED | BF |

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# ARATAKI DEVELOPMENT - HAVELOCK NORTH

## DESIGN CONTOUR PLAN

| | |
|---|---|
| STATUS | ISSUED FOR CONSENT |
| SCALE | 1:2000 @ A3 |
| COUNCIL | HASTINGS DISTRICT COUNCIL |
| DWG NO | P24-244-00-1100-EW |
| REV | 2 |

Plot Date: 9:18:47 am,26 June 2025, TIMOTHYB
File: C:\12DSYNERGY\DATA\WP-PEN-APP-01\P24-244 - ARATAKI - HAVELOCK NORTH_21690\02 DRAWINGS\01 ENG\P24-244-00-1100-EW_DESIGN CONTOUR PLAN.DWG

## LEGEND

- STAGE BOUNDARIES
- PROPOSED MAJOR CONTOURS (1m) — 23
- PROPOSED MINOR CONTOURS (0.25m)
- EXTENTS OF WORKS

## NOTES

1. UNDERFILL DRAINAGE IS TO BE INSTALLED AT THE DIRECTION OF THE ENGINEER. IF THE CONTRACTOR ENCOUNTERS SPRINGS OR OTHER SOURCES OF WATER HE IS TO NOTIFY THE ENGINEER.
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BROOKVALE ROAD

STAGE 1

STAGE 2

WW CONNECTION FOR #160 ARATAKI ROAD, PRIOR TO REMOVAL OF SEPTIC FIELD

ARATAKI ROAD

ARATAKI ROAD

SCALEBAR (m) 0 10 20 50

SCALE | 1:1000 @A3 | 1:500 @A1|

| REVISION DETAILS | | INT | DATE | SURVEYED | WOODS |
|---|---|---|---|---|---|
| 2 | ISSUED FOR CONSENT | TB | JUNE 2025 | DESIGNED | AB |
| | | | | DRAWN | TB |
| | | | | CHECKED | BLO |
| | | | | APPROVED | BF |

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# ARATAKI DEVELOPMENT - HAVELOCK NORTH

DESIGN CONTOUR PLAN - SHEET 1

| | |
|---|---|
| STATUS | ISSUED FOR CONSENT |
| SCALE | 1:1000 @ A3 |
| COUNCIL | HASTINGS DISTRICT COUNCIL |
| DWG NO | P24-244-00-1101-EW |
| REV | 2 |

Plot Date: 9:21:47 am,26 June 2025, TIMOTHYB

File: C:\12DSYNERGY\DATA\WP-PEN-APP-01\P24-244 - ARATAKI - HAVELOCK NORTH_21690\02 DRAWINGS\01 ENG\P24-244-00-1100-EW_DESIGN CONTOUR PLAN.DWG

## LEGEND

- STAGE BOUNDARIES
- PROPOSED MAJOR CONTOURS (1m) — 23
- PROPOSED MINOR CONTOURS (0.25m)
- EXTENTS OF WORKS

## NOTES

1. UNDERFILL DRAINAGE IS TO BE INSTALLED AT THE DIRECTION OF THE ENGINEER. IF THE CONTRACTOR ENCOUNTERS SPRINGS OR OTHER SOURCES OF WATER HE IS TO NOTIFY THE ENGINEER.
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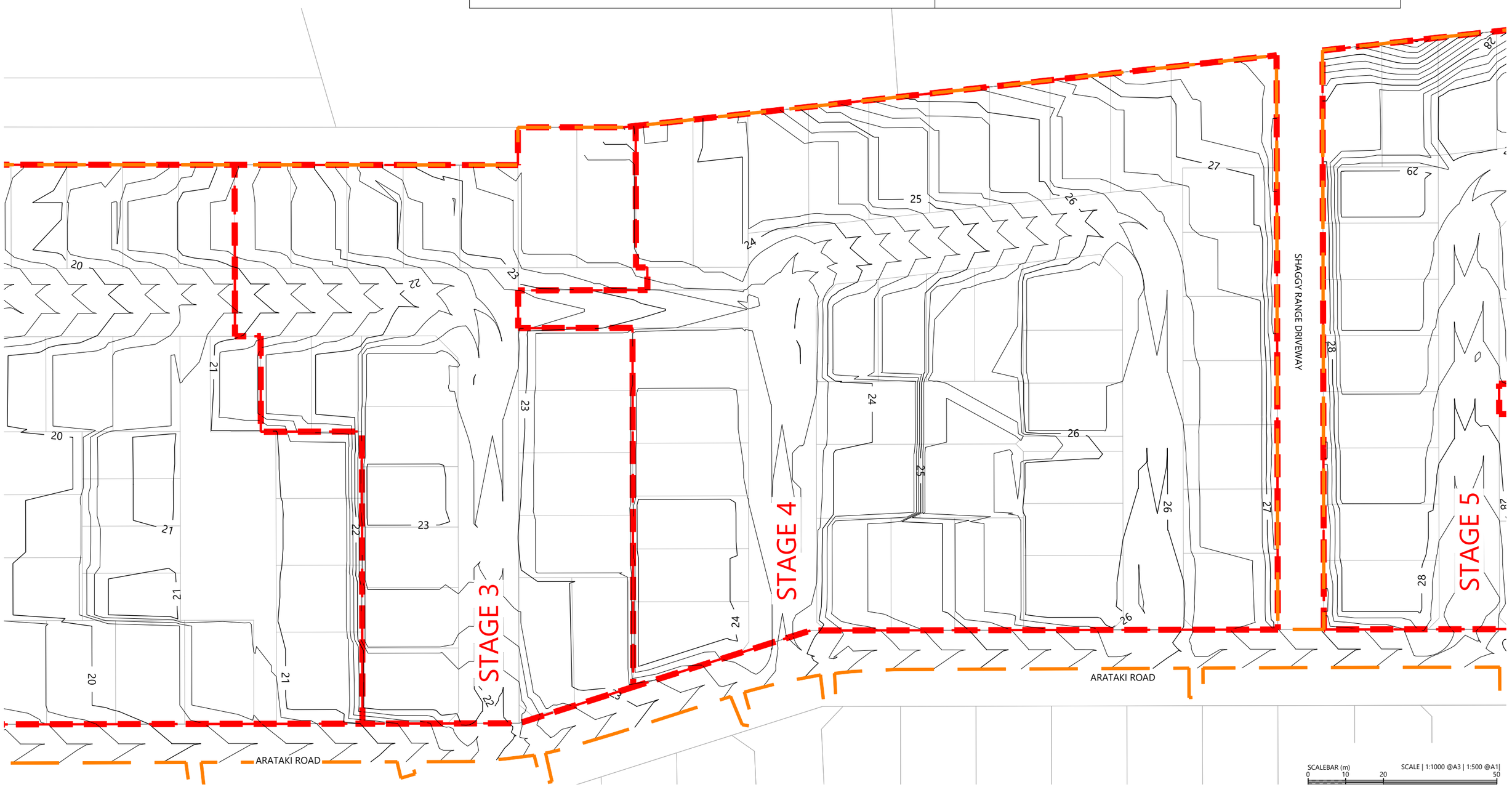
5. THE CONTRACTOR SHALL CLARIFY THE AREAS AND EXTENT OF CLEARING WITH THE ENGINEER BEFORE COMMENCEMENT AND CONFIRM THAT ALL NECESSARY CONSENTS ARE IN PLACE.




| REVISION DETAILS | | INT | DATE | SURVEYED | WOODS |
|---|---|---|---|---|---|
| 2 | ISSUED FOR CONSENT | TB | JUNE 2025 | DESIGNED | AB |
| | | | | DRAWN | TB |
| | | | | CHECKED | BLO |
| | | | | APPROVED | BF |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# ARATAKI DEVELOPMENT - HAVELOCK NORTH

## DESIGN CONTOUR PLAN - SHEET 2

| | |
|---|---|
| STATUS | ISSUED FOR CONSENT |
| SCALE | 1:1000 @ A3 |
| COUNCIL | HASTINGS DISTRICT COUNCIL |
| DWG NO | P24-244-00-1102-EW |
| REV | 2 |

Plot Date: 9:21:47 am,26 June 2025, TIMOTHYB

File: C:\12DSYNERGY\DATA\WP-PEN-APP-01\P24-244 - ARATAKI - HAVELOCK NORTH_21690\02 DRAWINGS\01 ENG\P24-244-00-1100-EW_DESIGN CONTOUR PLAN.DWG

## LEGEND

- STAGE BOUNDARIES
- PROPOSED MAJOR CONTOURS (1m) — 23
- PROPOSED MINOR CONTOURS (0.25m)
- EXTENTS OF WORKS

## NOTES

1. UNDERFILL DRAINAGE IS TO BE INSTALLED AT THE DIRECTION OF THE ENGINEER. IF THE CONTRACTOR ENCOUNTERS SPRINGS OR OTHER SOURCES OF WATER HE IS TO NOTIFY THE ENGINEER.
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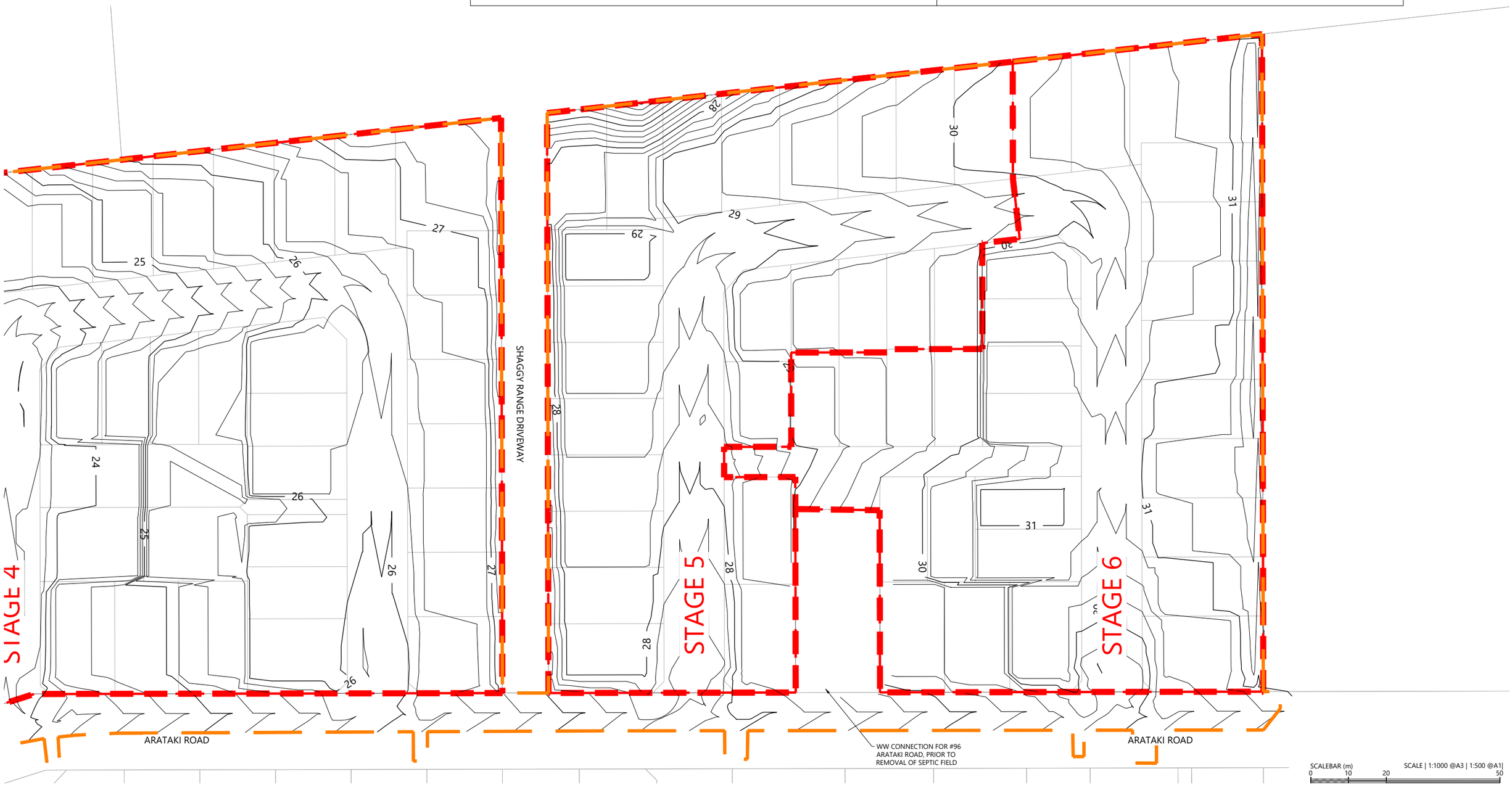


| REVISION DETAILS | | INT | DATE |
|---|---|---|---|
| 2 | ISSUED FOR CONSENT | TB | JUNE 2025 |

| | |
|---|---|
| SURVEYED | WOODS |
| DESIGNED | AB |
| DRAWN | TB |
| CHECKED | BLO |
| APPROVED | BF |


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# ARATAKI DEVELOPMENT - HAVELOCK NORTH

## DESIGN CONTOUR PLAN - SHEET 3

| | |
|---|---|
| STATUS | ISSUED FOR CONSENT |
| SCALE | 1:1000 @ A3 |
| COUNCIL | HASTINGS DISTRICT COUNCIL |
| DWG NO | P24-244-00-1103-EW |
| REV | 2 |

Plot Date: 9:21:47 am,26 June 2025, TIMOTHYB

File: C:\12DSYNERGY\DATA\WP-PEN-APP-01\P24-244 - ARATAKI - HAVELOCK NORTH_21690\02 DRAWINGS\01 ENG\P24-244-00-1100-EW_DESIGN CONTOUR PLAN.DWG

## NOTES

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5. THE CONTRACTOR SHALL CLARIFY THE AREAS AND EXTENT OF CLEARING WITH THE ENGINEER BEFORE COMMENCEMENT AND CONFIRM THAT ALL NECESSARY CONSENTS ARE IN PLACE.

## LEGEND

STAGE BOUNDARIES

EXTENTS OF WORKS

AREA OF FILL

AREA OF CUT

CUT/FILL CONTOUR (0.5m) — 1.5

CUT/FILL ZERO LINE — 0.0

## VOLUMES

CUT / FILL VOLUMES

CUT: 35,400 m³,

FILL: 16,400 m³,

BALANCE: 19,000 m³, EXCESS CUT TO BE REMOVED FROM SITE

NOTE:
CUT / FILL VOLUMES EXCLUDE TOPSOIL.
EXCLUDES BULKING / COMPACTION FACTORS.

TOPSOIL VOLUMES

TOPSOIL STRIP: 24,500 m³, ASSUMED 200mm DEPTH

TOPSOIL PLACE: 12,500 m³,

NOTE:
TOPSOIL STRIP IS ASSUMED AS 200mm DEPTH OVER THE SITE.
TOPSOIL PLACE IS ASSUMED AS 100mm DEPTH OVER LOTS, 300mm DEPTH OVER GARDEN AREAS, AND 150mm DEPTH OVER BERMS.

WOODS Est.1970

Plot Date: 9:25:39 am,26 June 2025, TIMOTHYB

BROOKVALE ROAD

REFER TO SHEET 1210-EW FOR STORMWATER OUTLET EARTHWORKS

EXTENT OF WORK ASSOCIATED WITH DRAINAGE WORKS

REFER SHEET 1201

REFER SHEET 1202

REFER SHEET 1203

STAGE 1

STAGE 2

STAGE 3

STAGE 4

STAGE 5

STAGE 6

SHAGGY RANGE DRIVEWAY

ARATAKI ROAD

GROOBY PLACE

TE HEIPORA PLACE

MEISSNER ROAD

EXTENT OF WORK ASSOCIATED WITH DRAINAGE WORKS

SCALEBAR (m) 0 20 40 100

SCALE | 1:2000 @A3 | 1:1000 @A1|

| REVISION DETAILS | | INT | DATE | SURVEYED | WOODS |
|---|---|---|---|---|---|
| 1 | ISSUED FOR DISCUSSION | TB | APR 2025 | DESIGNED | AB |
| 2 | ISSUED FOR CONSENT | TB | JUNE 2025 | DRAWN | TB |
| | | | | CHECKED | BLO |
| | | | | APPROVED | BF |

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# ARATAKI DEVELOPMENT - HAVELOCK NORTH

## CUT FILL PLAN

| | | |
|---|---|---|
| STATUS | ISSUED FOR CONSENT | REV |
| SCALE | 1:2000 @ A3 | 2 |
| COUNCIL | HASTINGS DISTRICT COUNCIL | |
| DWG NO | P24-244-00-1200-EW | |

File: C:\12DSYNERGY\DATA\WP-PEN-APP-01\P24-244 - ARATAKI - HAVELOCK NORTH_21690\02 DRAWINGS\01 ENG\P24-244-00-1200-EW_CUT FILL PLAN.DWG

## LEGEND

- STAGE BOUNDARIES
- EXTENTS OF WORKS
- AREA OF FILL
- AREA OF CUT
- CUT/FILL CONTOUR (0.5m) — 1.5
- CUT/FILL ZERO LINE — 0.0

## NOTES

1. UNDERFILL DRAINAGE IS TO BE INSTALLED AT THE DIRECTION OF THE ENGINEER. IF THE CONTRACTOR ENCOUNTERS SPRINGS OR OTHER SOURCES OF WATER HE IS TO NOTIFY THE ENGINEER.
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5. THE CONTRACTOR SHALL CLARIFY THE AREAS AND EXTENT OF CLEARING WITH THE ENGINEER BEFORE COMMENCEMENT AND CONFIRM THAT ALL NECESSARY CONSENTS ARE IN PLACE.

## VOLUMES

CUT / FILL VOLUMES

CUT: 35,400 m³,

FILL: 16,400 m³,

BALANCE: 19,000 m³, EXCESS CUT TO BE REMOVED FROM SITE

NOTE:
CUT / FILL VOLUMES EXCLUDE TOPSOIL.
EXCLUDES BULKING / COMPACTION FACTORS.

TOPSOIL VOLUMES

TOPSOIL STRIP: 24,500 m³, ASSUMED 200mm DEPTH

TOPSOIL PLACE: 12,500 m³,

NOTE:
TOPSOIL STRIP IS ASSUMED AS 200mm DEPTH OVER THE SITE.
TOPSOIL PLACE IS ASSUMED AS 100mm DEPTH OVER LOTS, 300mm DEPTH OVER GARDEN AREAS, AND 150mm DEPTH OVER BERMS.

BROOKVALE ROAD

EXTENT OF WORK ASSOCIATED WITH DRAINAGE WORKS

EXTENT OF WORK ASSOCIATED WITH DRAINAGE WORKS

STAGE 1

STAGE 2

ARATAKI ROAD

ARATAKI ROAD

SCALEBAR (m) 0 10 20 50

SCALE | 1:1000 @A3 | 1:500 @A1|

| REVISION DETAILS | | INT | DATE | SURVEYED | WOODS |
|---|---|---|---|---|---|
| 2 | ISSUED FOR CONSENT | TB | JUNE 2025 | DESIGNED | AB |
| | | | | DRAWN | TB |
| | | | | CHECKED | BLO |
| | | | | APPROVED | BF |

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# ARATAKI DEVELOPMENT - HAVELOCK NORTH

CUT FILL PLAN - SHEET 1

| | |
|---|---|
| STATUS | ISSUED FOR CONSENT |
| SCALE | 1:1000 @ A3 |
| COUNCIL | HASTINGS DISTRICT COUNCIL |
| DWG NO | P24-244-00-1201-EW |
| REV | 2 |

Plot Date: 9:25:40 am,26 June 2025, TIMOTHYB

File: C:\12DSYNERGY\DATA\WP-PEN-A\PP-01\P24-244 - ARATAKI - HAVELOCK NORTH_21690\02 DRAWINGS\01 ENG\P24-244-00-1200-EW_CUT FILL PLAN.DWG

## LEGEND

- STAGE BOUNDARIES
- EXTENTS OF WORKS
- AREA OF FILL
- AREA OF CUT
- CUT/FILL CONTOUR (0.5m) — 1.5
- CUT/FILL ZERO LINE — 0.0

## NOTES

1. UNDERFILL DRAINAGE IS TO BE INSTALLED AT THE DIRECTION OF THE ENGINEER. IF THE CONTRACTOR ENCOUNTERS SPRINGS OR OTHER SOURCES OF WATER HE IS TO NOTIFY THE ENGINEER.
2. ALL UNSUITABLE MATERIAL AS DEFINED IN THE SPECIFICATION IS TO BE REMOVED AND THE STRIPPED AREAS INSPECTED BY THE ENGINEER BEFORE COMMENCES.
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5. THE CONTRACTOR SHALL CLARIFY THE AREAS AND EXTENT OF CLEARING WITH THE ENGINEER BEFORE COMMENCEMENT AND CONFIRM THAT ALL NECESSARY CONSENTS ARE IN PLACE.

## VOLUMES

CUT / FILL VOLUMES

CUT: 35,400 m³,

FILL: 16,400 m³,

BALANCE: 19,000 m³, EXCESS CUT TO BE REMOVED FROM SITE

NOTE:
CUT / FILL VOLUMES EXCLUDE TOPSOIL.
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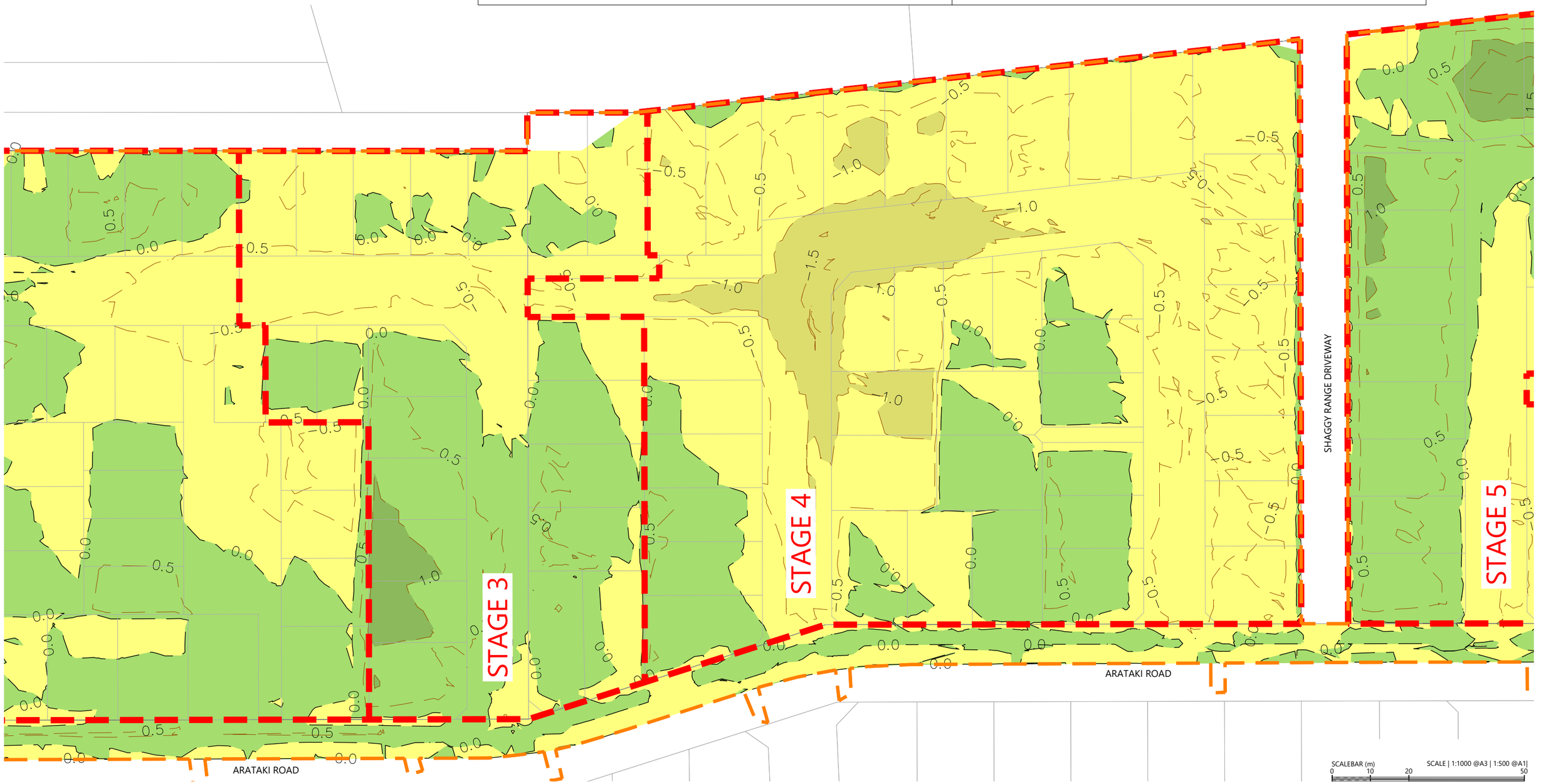
TOPSOIL VOLUMES

TOPSOIL STRIP: 24,500 m³, ASSUMED 200mm DEPTH

TOPSOIL PLACE: 12,500 m³,

NOTE:
TOPSOIL STRIP IS ASSUMED AS 200mm DEPTH OVER THE SITE.
TOPSOIL PLACE IS ASSUMED AS 100mm DEPTH OVER LOTS, 300mm DEPTH OVER GARDEN AREAS, AND 150mm DEPTH OVER BERMS.




| REVISION DETAILS | | INT | DATE | SURVEYED | WOODS |
|---|---|---|---|---|---|
| 2 | ISSUED FOR CONSENT | TB | JUNE 2025 | DESIGNED | AB |
| | | | | DRAWN | TB |
| | | | | CHECKED | BLO |
| | | | | APPROVED | BF |


BUILDING B, LEVEL 1
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CDL LAND NEW ZEALAND LIMITED

# ARATAKI DEVELOPMENT - HAVELOCK NORTH

CUT FILL PLAN - SHEET 2

| | |
|---|---|
| STATUS | ISSUED FOR CONSENT |
| SCALE | 1:1000 @ A3 |
| COUNCIL | HASTINGS DISTRICT COUNCIL |
| DWG NO | P24-244-00-1202-EW |

REV 2

Plot Date: 9:25:40 am,26 June 2025, TIMOTHYB

File: C:\12DSYNERGY\DATA\WP-PEN-APP-01\P24-244 - ARATAKI - HAVELOCK NORTH_21690\02 DRAWINGS\01 ENG\P24-244-00-1200-EW_CUT FILL PLAN.DWG

## LEGEND

- STAGE BOUNDARIES
- EXTENTS OF WORKS
- AREA OF FILL
- AREA OF CUT
- CUT/FILL CONTOUR (0.5m) — 1.5
- CUT/FILL ZERO LINE — 0.0

## NOTES

1. UNDERFILL DRAINAGE IS TO BE INSTALLED AT THE DIRECTION OF THE ENGINEER. IF THE CONTRACTOR ENCOUNTERS SPRINGS OR OTHER SOURCES OF WATER HE IS TO NOTIFY THE ENGINEER.
2. ALL UNSUITABLE MATERIAL AS DEFINED IN THE SPECIFICATION IS TO BE REMOVED AND THE STRIPPED AREAS INSPECTED BY THE ENGINEER BEFORE COMMENCES.
3. EARTHWORKS ARE NOT TO BE EXTENDED INTO ADJOINING SITES UNLESS THE ENGINEER HAS ISSUED SPECIFIC INSTRUCTIONS.
4. THE CONTRACTOR IS RESPONSIBLE FOR IDENTIFYING AND PROTECTING EXISTING SERVICES AND DRAINAGE ON SITE.
5. THE CONTRACTOR SHALL CLARIFY THE AREAS AND EXTENT OF CLEARING WITH THE ENGINEER BEFORE COMMENCEMENT AND CONFIRM THAT ALL NECESSARY CONSENTS ARE IN PLACE.

## VOLUMES

CUT / FILL VOLUMES

CUT: 35,400 m³,

FILL: 16,400 m³,

BALANCE: 19,000 m³, EXCESS CUT TO BE REMOVED FROM SITE

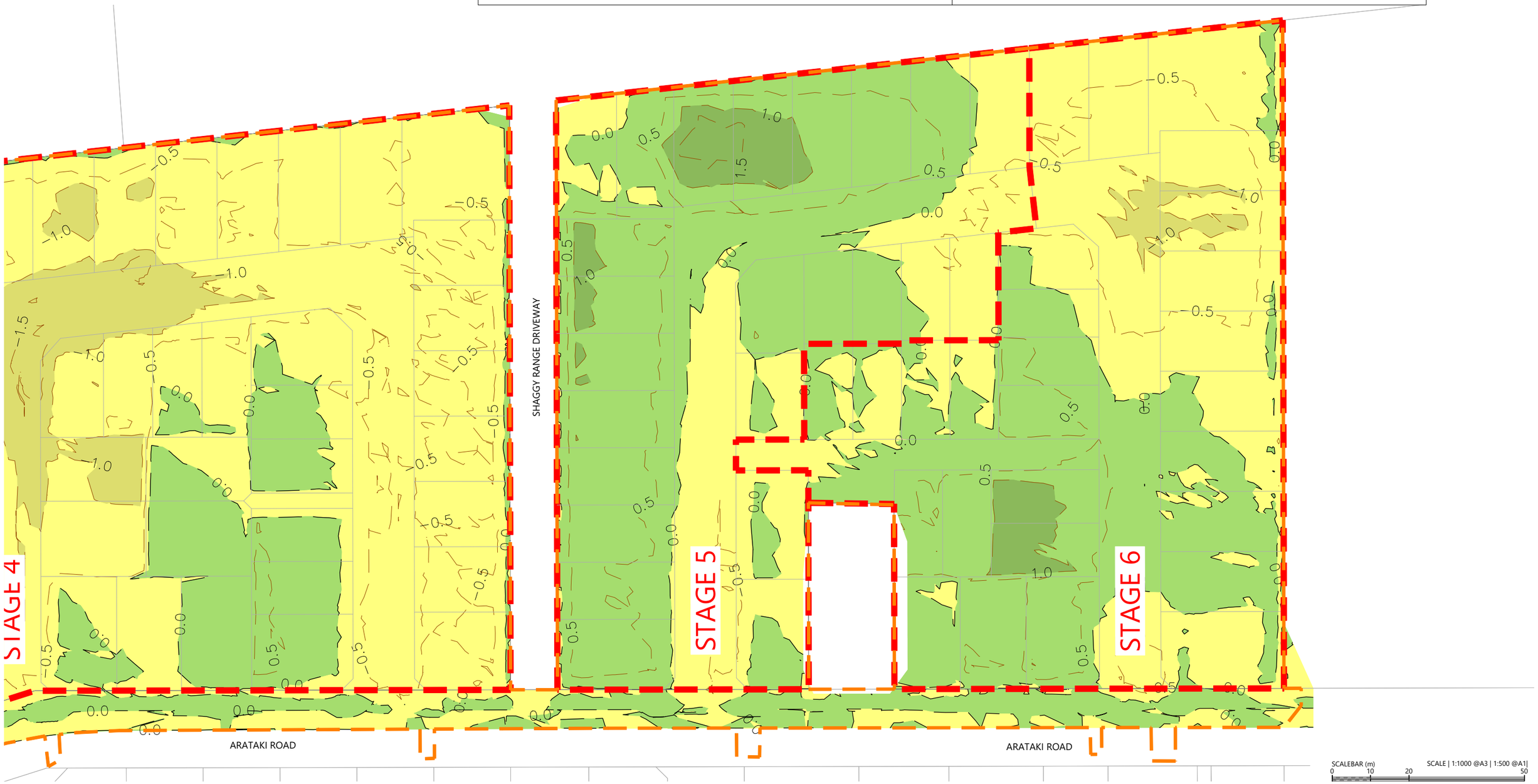
NOTE:
CUT / FILL VOLUMES EXCLUDE TOPSOIL.
EXCLUDES BULKING / COMPACTION FACTORS.

TOPSOIL VOLUMES

TOPSOIL STRIP: 24,500 m³, ASSUMED 200mm DEPTH

TOPSOIL PLACE: 12,500 m³,

NOTE:
TOPSOIL STRIP IS ASSUMED AS 200mm DEPTH OVER THE SITE.
TOPSOIL PLACE IS ASSUMED AS 100mm DEPTH OVER LOTS, 300mm DEPTH OVER GARDEN AREAS, AND 150mm DEPTH OVER BERMS.




SCALEBAR (m) 0 10 20 50

SCALE | 1:1000 @A3 | 1:500 @A1|

| REVISION DETAILS | | INT | DATE | SURVEYED | WOODS |
|---|---|---|---|---|---|
| 2 | ISSUED FOR CONSENT | TB | JUNE 2025 | DESIGNED | AB |
| | | | | DRAWN | TB |
| | | | | CHECKED | BLO |
| | | | | APPROVED | BF |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CDL LAND NEW ZEALAND LIMITED

# ARATAKI DEVELOPMENT - HAVELOCK NORTH

CUT FILL PLAN - SHEET 3

| | | |
|---|---|---|
| STATUS | ISSUED FOR CONSENT | REV |
| SCALE | 1:1000 @ A3 | 2 |
| COUNCIL | HASTINGS DISTRICT COUNCIL | |
| DWG NO | P24-244-00-1203-EW | |

Plot Date: 9:25:41 am,26 June 2025, TIMOTHYB

File: C:\12DSYNERGY\DATA\WP-PEN-APP-01\P24-244 - ARATAKI - HAVELOCK NORTH_21690\02 DRAWINGS\01 ENG\P24-244-00-1200-EW_CUT FILL PLAN.DWG

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# APPENDIX D
## Site Investigation Data

# DRILLHOLE LOG

INITIA
GEOTECHNICAL SPECIALISTS

**HOLE NO.:** BH01

**CLIENT:** Development Nous
**PROJECT:** Arataki Extension Residential Subdivision
**SITE LOCATION:** Arataki Road and Brookvale Rd, Havelock North
**Project Ref.:** P-001190

**CO-ORDINATES:** 1934742mE, 5602994mN
**Co-ordinate system:** NZTM
**Location method:** GPSH
**ORIENTATION (°):** Vertical
**ELEVATION:** 14m
**Datum:** NZVD 2016
**Level method:** CONTOUR
**INCLINATION (°):** 90
**CONTRACTOR:** Geotech Driiling
**RIG:** CRS-T (Sonic)
**DRILLER:** Drew
**START DATE:** 21/09/2021
**END DATE:** 21/09/2021
**LOGGED BY:** MDH
**CHECKED BY:** APK

| UNIT | MATERIAL DESCRIPTION (See Classification & Symbology sheet for details) | DEPTH | RL |
|---|---|---|---|
| Topsoil | SILT, with some sand. Low plasticity. | | |
| Pleistocene River Deposits | Sandy GRAVEL, with minor silt; brown. Dense; low plasticity; gravel, fine to coarse, subangular to subround. | | |
| | 0.90m - 1.05m: GRAVEL. Gravel, fine to medium, subround. | 1 | 13.0 |
| | Sandy SILT; brown. Very stiff; low plasticity; moist; sand, fine. | 2 | 12.0 |
| | Clayey SILT, with trace gravel; light brown. Very stiff; low plasticity; moist. | 3 | 11.0 |
| | 4.00m: grades to absent of gravel. | 4 | 10.0 |
| | 4.50m: COBBLE. | | |
| | Sandy SILT; brown mottled grey. Stiff; low plasticity; wet; sand, fine. | 5 | 9.0 |
| | Gravelly SILT, with minor sand. Hard; gravel, fine to medium, subangular to subround; sand, fine to coarse. | 6 | 8.0 |
| | Sandy SILT; brown. Very stiff; low plasticity; moist; sand, fine. | 7 | 7.0 |
| | EOH: 7.95m | | 6.0 |
| | | | 5.0 |

| SAMPLES | METHOD | TCR (%) | RQD (%) | INSITU TESTING (SPT 'N' Vane shear strength) |
|---|---|---|---|---|
| | SNC | 93 | | |
| | SPT | 44 | | 4, 5 / 5, 8, 9, 11 N=33 |
| | SNC | 100 | | |
| | SPT | 66 | | 5, 9 / 9, 11, 10, 6 N=36 |
| | SNC | 85 | | |
| | SPT | 100 | | 2, 2 / 3, 3, 2, 3 N=11 |
| | SNC | 95 | | |
| | SPT | 100 | | 0, 0 / 0, 9, 26, 15 for 45mm N=50+ for 270mm |
| | SNC | 97 | | |
| | SPT | 100 | | 0, 3 / 4, 7, 7, 6 N=24 |

DISCONTINUITIES — DESCRIPTION

WATER

INSTALLATION: Bentonite to 7.95m

CORE BOXES: Box 1, 0.0-2.6m; Box 2, 2.6-5.6m; Box 3, 5.6-8.0m

**REMARKS:**
GWL was not encountered

# CORE PHOTOS

**HOLE NO.:** BH01
**JOB NO.:** P-001190

Box 1, 0.0-2.6m


Box 2, 2.6-5.6m


Box 3, 5.6-8.0m

# DRILLHOLE LOG

INITIA
GEOTECHNICAL SPECIALISTS

**HOLE NO.:** BH02

**CLIENT:** Development Nous
**SITE LOCATION:** Arataki Road and Brookvale Rd, Havelock North
**PROJECT:** Arataki Extension Residential Subdivision
**Project Ref.:** P-001190

**CO-ORDINATES:** 1934895mE, 5602668mN
**ELEVATION:** 22.9m
**CONTRACTOR:** Geotech Driiling
**START DATE:** 22/09/2021

**Co-ordinate system:** NZTM
**Datum:** NZVD 2016
**RIG:** CRS-T (Sonic)
**END DATE:** 22/09/2021

**Location method:** GPSH
**Level method:** CONTOUR
**DRILLER:** Drew
**LOGGED BY:** MDH

**ORIENTATION (°):** Vertical
**INCLINATION (°):** 90
**CHECKED BY:** APK

| UNIT | MATERIAL DESCRIPTION (See Classification & Symbology sheet for details) | GRAPHIC | WEATHERING (UW SW MW HW CW) | STRENGTH (EW VW W MS S VS ES) | DEPTH | RL | SAMPLES | METHOD | TCR (%) (25 50 75) | RQD (%) (25 50 75) | INSITU TESTING (SPT 'N' Vane shear strength) | DISCONTINUITIES DESCRIPTION | WATER | INSTALLATION | CORE BOXES |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Topsoil | SILT, with some rootlets, with trace sand; dark brown.<br>Low plasticity; sand, fine.<br>0.30m: grades to brown | TS | | | 0 | 22.9 | | SNC | 100 | | | | | | |
| Pleistocene River Deposits | Sandy GRAVEL, with minor silt.<br>Low plasticity; gravel, subround; sand, fine to medium. | | | | 1 | 22.0 | | | | | | | | | |
| | Gravelly SILT, with minor sand; brown.<br>Hard; low plasticity; gravel, fine to medium, subround. | | | | 2 | 21.0 | | SPT | 100 | | 6, 6 / 9, 8, 6, 9<br>N=32 | | | | |
| | | | | | | | | SNC | 88 | | | | | | Box 1, 0.0-2.4m |
| | 3.90m: Grades to dry | | | | 3 | 20.0 | | SPT | 100 | | 6, 11 / 17, 13, 14, 6 for 30mm<br>N=50+ for 255mm | | | | |
| | | | | | 4 | 19.0 | | SNC | 90 | | | | | Bentonite | |
| | Sandy gravelly SILT; brown.<br>Hard; high plasticity; moist. | | | | | 18.0 | | SPT | 100 | | 8, 9 / 7, 7, 5, 13<br>N=32 | | | | Box 2, 2.4-5.4m |
| | SILT, with some sand; brown.<br>Hard; low plasticity; sand, fine. | | | | 5 | | | SNC | 100 | | | | | | |
| | Gravelly SILT, with some sand; brown.<br>Hard; low plasticity; gravel, fine to coarse, subround, moderately weathered; sand, fine. | | | | 6 | 17.0 | | SPT | 100 | | 2, 3 / 1, 2, 2, 2<br>N=7 | | | | |
| | SILT, with trace sand; brown.<br>Very stiff; low plasticity; sand, fine. | | | | | 16.0 | | SNC | 100 | | | | | | |
| | EOH: 7.95m | | | | 7 | 15.0 | | SPT | 100 | | 4, 5 / 6, 5, 6, 6<br>N=23 | | | 7.95m | Box 3, 5.4-8.0m |
| | | | | | | 14.0 | | | | | | | | | |
| | | | | | | 13.0 | | | | | | | | | |

**REMARKS:**
GWL was not encountered

# CORE PHOTOS

**HOLE NO.:** **BH02**
**JOB NO.:** P-001190

Box 1, 0.0-2.4m

Box 2, 2.4-5.4m

Box 3, 5.4-8.0m

# DRILLHOLE LOG

INITIA
GEOTECHNICAL SPECIALISTS

**HOLE NO.:** BH03

**CLIENT:** Development Nous
**SITE LOCATION:** Arataki Road and Brookvale Rd, Havelock North
**PROJECT:** Arataki Extension Residential Subdivision
**Project Ref.:** P-001190

**CO-ORDINATES:** 1934968mE, 5602576mN
**ELEVATION:** 25.7m
**CONTRACTOR:** Geotech Driiling
**START DATE:** 21/09/2021

**Co-ordinate system:** NZTM
**Datum:** NZVD 2016
**RIG:** CRS-T (Sonic)
**END DATE:** 22/09/2021

**Location method:** GPSH
**Level method:** CONTOUR
**DRILLER:** Drew
**LOGGED BY:** MDH

**ORIENTATION (°):** Vertical
**INCLINATION (°):** 90
**CHECKED BY:** APK

| UNIT | MATERIAL DESCRIPTION (See Classification & Symbology sheet for details) | GRAPHIC | WEATHERING (UW SW MW HW CW EW) | STRENGTH (VW W MS S VS ES) | DEPTH | RL | SAMPLES | METHOD | TCR (%) (25 50 75) | RQD (%) (25 50 75) | INSITU TESTING (SPT 'N' Vane shear strength) | DISCONTINUITIES DESCRIPTION | WATER | INSTALLATION | CORE BOXES |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Top soil | SILT (TOPSOIL), with minor rootlets, with trace sand; dark brown. Sand, fine to coarse. | TS | | | | | | | | | | | | | |
| Pleistocene River Deposits | Silty sandy GRAVEL. Non-plastic; gravel, fine to coarse, subround. | | | | | 25.0 | | SNC | 100 | | | | | | |
| | Clayey SILT; grey. Very stiff; high plasticity. | | | | 1 | | | | | | | | | | |
| | Sandy SILT, with minor gravel; brown. Low plasticity; sand, fine to coarse; gravel, fine to medium, subround. | | | | | 24.0 | | SPT | 100 | | 4, 7 / 7, 7, 9, 10 N=33 | | | | |
| | Silty sandy GRAVEL; brownish grey. Dense; gravel, fine to medium, subround. | | | | 2 | | | SNC | 90 | | | | | | Box 1, 0.0-2.5m |
| | Silty SAND, with minor gravel, with trace cobbles. Dense; low plasticity; sand, fine to coarse; gravel, fine. | | | | | 23.0 | | SPT | 44 | | 4, 6 / 7, 9, 12, 12 N=40 | | | | |
| | | | | | 3 | | | SNC | 100 | | | | | | |
| | 4.50m: Grades to very dense | | | | | 22.0 | | SPT | 57 | | 7, 10 / 24, 20, 6 for 40mm N=50+ for 190mm | | | | |
| | | | | | 4 | | | SNC | 91 | | | | | | Box 2, 2.5-5.5m |
| | | | | | | 21.0 | | SPT | 100 | | 5, 12 / 15, 14, 12, 9 for 35mm N=50+ for 260mm | | | | |
| | | | | | 5 | | | SNC | 91 | | | | | | |
| | Silty sandy GRAVEL, with trace cobbles. Very dense; gravel, fine to coarse, subangular to subround. | | | | | 20.0 | | SPT | 100 | | 20, 24 N=50+ | | | | |
| | | | | | 6 | | | | | | | | | Bentonite | |
| | | | | | | 19.0 | | | | | | | | | Box 3, 5.5-7.7m |
| | | | | | 7 | | | | | | | | | 7.65m | |
| | EOH: 7.65m | | | | | 18.0 | | | | | | | | | |
| | | | | | | 17.0 | | | | | | | | | |
| | | | | | | 16.0 | | | | | | | | | |

**REMARKS:**
GWL was not encountered

Checked By: APK

# CORE PHOTOS

**HOLE NO.:** BH03
**JOB NO.:** P-001190

Box 1, 0.0-2.5m


Box 2, 2.5-5.5m


Box 3, 5.5-7.7m

# DRILLHOLE LOG

INITIA
GEOTECHNICAL SPECIALISTS

**HOLE NO.:** BH04

**CLIENT:** Development Nous
**SITE LOCATION:** Arataki Road and Brookvale Rd, Havelock North
**PROJECT:** Arataki Extension Residential Subdivision
**Project Ref.:** P-001190

**CO-ORDINATES:** 1935108mE, 5602400mN
**ELEVATION:** 30.7m
**CONTRACTOR:** Geotech Driiling
**START DATE:** 22/09/2021

**Co-ordinate system:** NZTM
**Datum:** NZVD 2016
**RIG:** CRS-T (Sonic)
**END DATE:** 22/09/2021

**Location method:** GPSH
**Level method:** CONTOUR
**DRILLER:** Drew
**LOGGED BY:** MDH

**ORIENTATION (°):** Vertical
**INCLINATION (°):** 90
**CHECKED BY:** APK

| UNIT | MATERIAL DESCRIPTION (See Classification & Symbology sheet for details) |
|---|---|
| Topsoil | SILT (TOPSOIL), with some rootlets, with trace sand; dark brown. Sand, fine to coarse. |
| | 0.20m: grades to light brown |
| | 0.40m: cobbles |
| Pleistocene River Deposits | Silty gravelly SAND; brown. Sand, fine; gravel, fine to medium, subround. |
| | Clayey SILT; orange brown/grey. Very stiff to hard; high plasticity. |
| | Gravelly SILT, with minor sand; brown. Low plasticity; gravel, fine to medium; sand, fine to coarse. |
| | 4.6 m - 4.8 m: Core loss |
| | EOH: 7.95m |

GRAPHIC | WEATHERING (UW SW MW HW CW EW) | STRENGTH (VW W MS S VS ES)

| DEPTH | RL | SAMPLES | METHOD | TCR (%) | RQD (%) | INSITU TESTING (SPT 'N' Vane shear strength) |
|---|---|---|---|---|---|---|
| 0 | 30.0 | | SNC | 93 | | |
| 1 | 29.0 | | SPT | 100 | | 4, 7 / 11, 12, 13, 14 N=50+ |
| | | | SNC | 97 | | |
| 2 | 28.0 | | SPT | 100 | | 8, 11 / 18, 28, 4 for 20mm N=50+ for 170mm |
| 3 | 27.0 | | SNC | 84 | | |
| 4 | 26.0 | | | | | 12, 38 for 5mm N=50+ |
| 5 | 25.0 | | SNC | 73 | | |
| 6 | 24.0 | | SPT | 100 | | 9, 16 / 26, 18 for 55mm N=50+ for 130mm |
| 7 | 23.0 | | SNC | 90 | | |
| | | | SPT | 100 | | 8, 9 / 4, 7, 21, 18 for 50mm N=50+ for 275mm |
| | 22.0 | | | | | |
| | 21.0 | | | | | |

DISCONTINUITIES — DESCRIPTION

WATER

INSTALLATION: Bentonite (7.95m)

CORE BOXES: Box 1, 0.0-2.7m; Box 2, 2.7-5.6m; Box 3, 5.6-7.9m

**REMARKS:**
GWL was not encountered

# CORE PHOTOS

**HOLE NO.:** **BH04**

**JOB NO.:** P-001190

Box 1, 0.0-2.7m


Box 2, 2.7-5.6m


Box 3, 5.6-7.9m

# TEST PIT INVESTIGATION
# TEST REPORT

Project : Proposed Subdivison Consent
Location : Arataki Road, Havelock North
Client : Surveying The Bay
Contractor : WSP-Opus

Water level (m) : Not Encounted
Reduced level (m) : Existing Ground Level

TP 7 - E1935011 N5602513

| | |
|---|---|
| **Project No :** | **2-S5376.00** |
| **Lab Ref No :** | **NA2061 / 7** |
| **Client Ref No :** | **'00001** |

**Test Results**

| Depth (m) | Shear Strength (kPa) | Sample Details | Material Description |
|---|---|---|---|
| 0.20 | | | SILT, Black, Soft, Moist, Non Plastic, TOPSOIL |
| 0.35 | | | Sandy SILT, Brown, Soft, Moist |
| 0.70 | | | GRAVEL, Some Silt, Red Brown, Tight, Moist, Well Graded |
| 0.90 | | | SILT, Reddish Brown, Weakly cemented (Hard Pan) |
| 2.50 | | | GRAVEL, Red/ Brown, Moist, Minor Sand & Traces of Silt, Well Graded 200mm, Sub Angular/ Sub Rounded |
| | | | Test Pit END at 2.5mbgl, Target Depth Reached |

| Test Methods | Notes |
|---|---|
| Field Description of Soils and Rocks in Engineering Use, NZ Geomechanics Society | |

Date tested : 14/09/18
Date reported : 02/10/18



**Approved**

Designation : ***Laboratory Manager***
Date : 02/10/18



WSP Opus
Napier Laboratory
Quality Management Systems Certified to ISO 9001

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Private Bag 6019, Hawkes Bay Mail Centre, Napier 4142, New Zealand

Telephone +64 6 833 5590
Website www.wsp-opus.co.nz

# TEST PIT INVESTIGATION
# TEST REPORT

Project : Proposed Subdivison Consent
Location : Arataki Road, Havelock North
Client : Surveying The Bay
Contractor : WSP-Opus

Water level (m) : Not Encounted
Reduced level (m) : Existing Ground Level

TP 1 - E1934790 N5602991

| | |
|---|---|
| **Project No :** | **2-S5376.00** |
| **Lab Ref No :** | **NA2061 / 1** |
| **Client Ref No :** | **'00001** |

**Test Results**

| Depth (m) | Shear Strength (kPa) | Sample Details | Material Description |
|---|---|---|---|
| 0.20 | | | SILT, Black, Soft, Moist, Non Plastic, Topsoil |
| 0.50 | | | Silty Fine SAND, Reddish Brown, Stiff, Moist, Minor Gravel |
| 0.65 | | | GRAVEL, Reddish Brown, Tight Packed, Moist, Traces of Sand & Silt, Well Graded 60mm Sub Rounded |
| 1.10 | | | SILT, Reddish Brown, Weakly Cemented, (Hard Pan) |
| 2.50 | | | GRAVEL, Reddish Brown, Tight Packed, Moist, Well Graded 200mm, Sub Rounded & Sub Angular, Minor Sand & Traces of Silt |
| | | | Test Pit END at 2.5mbgl, Target Depth Reached |

| Test Methods | Notes |
|---|---|
| Field Description of Soils and Rocks in Engineering Use, NZ Geomechanics Society | |

Date tested : 14/09/18
Date reported : 02/10/18



**Approved**

Designation : ***Laboratory Manager***
Date : 02/10/18



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# TEST PIT INVESTIGATION
# TEST REPORT

Project : Proposed Subdivison Consent
Location : Arataki Road, Havelock North
Client : Surveying The Bay
Contractor : WSP-Opus

Water level (m) : Not Encounted
Reduced level (m) : Existing Ground Level

TP 2 - E1934224 N56022924

| | |
|---|---|
| **Project No :** | **2-S5376.00** |
| **Lab Ref No :** | **NA2061 / 2** |
| **Client Ref No :** | **'00001** |

**Test Results**

| Depth (m) | Shear Strength (kPa) | Sample Details | Material Description |
|---|---|---|---|
| 0.20 | | | SILT, Black, Soft, Moist, Non Plastic |
| 0.50 | | | Silty Fine SAND, Reddish Brown, Soft, Moist |
| 0.70 | | | SILT, Light Brown, Soft, Moist, Low Plasticity, Traces of Gravel |
| 0.90 | | | Gravely SAND, Reddish Brown, Tight, Moist, 20mm |
| 2.50 | | | GRAVEL, Reddish Brown, Tight, Moist, Minor Sand & Traces of Silt, 200mm, |
| | | | Test Pit END at 2.5mbgl, Target Depth Reached |

| Test Methods | Notes |
|---|---|
| Field Description of Soils and Rocks in Engineering Use, NZ Geomechanics Society | |

Date tested : 14/09/18
Date reported : 02/10/18

**This report may only be reproduced in full**

**Approved**

Designation : ***Laboratory Manager***
Date : 02/10/18



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Website www.wsp-opus.co.nz

# TEST PIT INVESTIGATION
# TEST REPORT

Project : Proposed Subdivison Consent
Location : Arataki Road, Havelock North
Client : Surveying The Bay
Contractor : WSP-Opus

Water level (m) : Not Encounted
Reduced level (m) : Existing Ground Level

TP 3 - E1934796 N5602822

| | |
|---|---|
| **Project No :** | **2-S5376.00** |
| **Lab Ref No :** | **NA2061 / 3** |
| **Client Ref No :** | **'00001** |

**Test Results**

| Depth (m) | Shear Strength (kPa) | Sample Details | Material Description |
|---|---|---|---|
| 0.20 | | | SILT, Black, Soft, Moist, Non Plastic, TOPSOIL |
| 2.50 | | | GRAVEL, Reddish Brown, Tight Packed,Moist, Well Graded 90mm |
| | | | Test Pit END at 2.5mbgl, Target Depth Reached |

| Test Methods | Notes |
|---|---|
| Field Description of Soils and Rocks in Engineering Use, NZ Geomechanics Society | |

Date tested : 14/09/18
Date reported : 02/10/18



**Approved**

Designation : ***Laboratory Manager***
Date : 02/10/18



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# TEST PIT INVESTIGATION
# TEST REPORT

Project : Proposed Subdivison Consent
Location : Arataki Road, Havelock North
Client : Surveying The Bay
Contractor : WSP-Opus

Water level (m) : Not Encounted
Reduced level (m) : Existing Ground Level

TP 4 - E1934910 N5602761

| | |
|---|---|
| **Project No :** | **2-S5376.00** |
| **Lab Ref No :** | **NA2061 / 4** |
| **Client Ref No :** | **'00001** |

**Test Results**

| Depth (m) | Shear Strength (kPa) | Sample Details | Material Description |
|---|---|---|---|
| 0.20 | | | SILT, Black, Soft, Moist, Non Plastic, TOPSOIL |
| 1.10 | | | GRAVEL, reddish Brown, Tight Moist, Well Graded 60mm, Minor Sand & Silt<br>Pockets of Clayey SILT at 0.80 & 0.85 |
| 2.50 | | | GRAVEL, Reddish Brown, Some Sand, Tight,Moist, Well Graded, Sub rounded |
| | | | Test Pit END at 2.5mbgl, Target Depth Reached |

| Test Methods | Notes |
|---|---|
| Field Description of Soils and Rocks in Engineering Use, NZ Geomechanics Society | |

Date tested : 14/09/18
Date reported : 02/10/18

**This report may only be reproduced in full**

**Approved**

Designation : ***Laboratory Manager***
Date : 02/10/18



WSP Opus
Napier Laboratory
Quality Management Systems Certified to ISO 9001

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Telephone +64 6 833 5590
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# TEST PIT INVESTIGATION
# TEST REPORT

Project : Proposed Subdivison Consent
Location : Arataki Road, Havelock North
Client : Surveying The Bay
Contractor : WSP-Opus

Water level (m) : Not Encounted
Reduced level (m) : Existing Ground Level

TP 5 - E1934887 N5602668

| | |
|---|---|
| **Project No :** | **2-S5376.00** |
| **Lab Ref No :** | **NA2016 / 5** |
| **Client Ref No :** | **'00001** |

**Test Results**

| Depth (m) | Shear Strength (kPa) | Sample Details | Material Description |
|---|---|---|---|
| 0.30 | | | Black, SILT, Soft, Non Plastic |
| 0.60 | | | GRAVEL & SILT Mix, Red Brown, Traces of Sand, Tight, Moist, Sub rounded Gravel |
| 2.50 | | | GRAVEL, Some Sand, Traces of Silt, Red Brown, Tight,Moist, Well Graded, 150mm Sub Rounded/ Sub Angular |
| | | | Test Pit END at 2.5mbgl, Target Depth Reached |

| Test Methods | Notes |
|---|---|
| Field Description of Soils and Rocks in Engineering Use, NZ Geomechanics Society | |

Date tested : 14/09/18
Date reported : 02/10/18

**Approved**

Designation : ***Laboratory Manager***
Date : 02/10/18





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# TEST PIT INVESTIGATION
# TEST REPORT

Project : Proposed Subdivison Consent
Location : Arataki Road, Havelock North
Client : Surveying The Bay
Contractor : WSP-Opus

Water level (m) : Not Encounted
Reduced level (m) : Existing Ground Level

TP 6 - E1935012 N5602610

| | |
|---|---|
| **Project No :** | **2-S5376.00** |
| **Lab Ref No :** | **NA2061 / 6** |
| **Client Ref No :** | **'00001** |

**Test Results**

| Depth (m) | Shear Strength (kPa) | Sample Details | Material Description |
|---|---|---|---|
| 0.30 | | | SILT, Black, TOPSOIL, Soft, Moist, Non Plastic |
| 2.50 | | | GRAVEL, Reddish Brown, Tight, Moist, Well Graded, Minor Sand & Traces of Silt, 200mm, Sub Angular/ Sub Rounded |
| | | | Test Pit END at 2.5mbgl, Target Depth Reached |

| Test Methods | Notes |
|---|---|
| Field Description of Soils and Rocks in Engineering Use, NZ Geomechanics Society | |

Date tested : 14/09/18
Date reported : 02/10/18



**Approved**

Designation : ***Laboratory Manager***
Date : 02/10/18



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# TEST PIT INVESTIGATION
# TEST REPORT

WSP | OPUS

Project : Proposed Subdivison Consent
Location : Arataki Road, Havelock North
Client : Surveying The Bay
Contractor : WSP-Opus
Shear vane number :
Shear vane correction :
Water level (m) : Not Encounted
Reduced level (m) : Existing Ground Level

TP 1 - E1934965.868 N5602454.988

| | |
|---|---|
| **Project No :** | **2-S5376.01** |
| **Lab Ref No :** | |
| **Client Ref No :** | **'00001** |

**Test Results**

| Depth (m) | Shear Strength (kPa) | Sample Details | Material Description |
|---|---|---|---|
| 0.20 | | | Silty fine-medium SAND with some rootlets, dark brown, medium dense, dry, non-plastic (TOPSOIL) |
| 0.35 | | | Fine-medium SAND with some Silt, brown, firm, dry, non-plastic |
| 1.0 | | | Sandy fine-course GRAVEL with trace cobbles, Redish Brown, sub-angular-sub-rounded, slightly-moderatly weathered, greywacke, moist, well graded, 200mm, sand is fine-medium<br>Becoming wet |
| 1.5 | | | Interbedded with two layers of SILT, grey, 50mm thick |
| 3.5 | | | |
| | | | Test Pit END at 3.5mbgl, Target Depth Reached |

| Test Methods | Notes |
|---|---|
| Shear Strength using a Hand Held Shear Vane: NZ Geotechnical Soc Inc 8/2001<br>Field Description of Soils and Rocks in Engineering Use, NZ Geomechanics Society | IANZ accreditation does not apply to material descriptions |

Date tested : 20/03/19
Date reported : 21/03/19

# TEST PIT INVESTIGATION
# TEST REPORT

WSP | OPUS

Project : Proposed Subdivison Consent
Location : Arataki Road, Havelock North
Client : Surveying The Bay
Contractor : WSP-Opus
Shear vane number :
Shear vane correction :
Water level (m) : Not Encounted
Reduced level (m) : Existing Ground Level

TP 2 - E1935067.050 N5602518.871

| | |
|---|---|
| **Project No :** | **2-S5376.01** |
| **Lab Ref No :** | |
| **Client Ref No :** | **'00001** |

**Test Results**

| Depth (m) | Shear Strength (kPa) | Sample Details | Material Description |
|---|---|---|---|
| 0.20 | | | Silty fine-medium SAND with some rootlets, dark brown, medium dense, dry, non-plastic , (TOPSOIL) |
| 0.30 | | | Fine-medium SAND with some Silt and some rootlets, light brown, medium dense, dry, non-plastic |
| | | | Sandy fine-course GRAVEL with trace cobbles, Redish Brown, sub-angular-sub-rounded, slightly-moderatly weathered, greywacke, moist, well graded, 200mm, sand is fine-medium |
| 1.3 | | | Interbedded with layer of silty fine-medium SAND, light brown, dense, dry, 150mm thick |
| 1.45 | | | Becoming moist |
| 2.6 | | | |
| | | | Test Pit END at 2.6mbgl, Target Depth Reached |

| Test Methods | Notes |
|---|---|
| Shear Strength using a Hand Held Shear Vane: NZ Geotechnical Soc Inc 8/2001 | IANZ accreditation does not |
| Field Description of Soils and Rocks in Engineering Use, NZ Geomechanics Society | apply to material descriptions |

Date tested : 20/03/19
Date reported : 21/03/19

# TEST PIT INVESTIGATION
# TEST REPORT

WSP | OPUS

Project : Proposed Subdivison Consent
Location : Arataki Road, Havelock North
Client : Surveying The Bay
Contractor : WSP-Opus
Shear vane number :
Shear vane correction :
Water level (m) : Not Encounted
Reduced level (m) : Existing Ground Level

TP 3 - E1935071.254 N5602423.513

| | |
|---|---|
| **Project No :** | **2-S5376.01** |
| **Lab Ref No :** | |
| **Client Ref No :** | **'00001** |

**Test Results**

| Depth (m) | Shear Strength (kPa) | Sample Details | Material Description |
|---|---|---|---|
| 0.20 | | | Silty fine-medium SAND with some rootlets, dark brown, medium dense, dry, non-plastic (TOPSOIL) |
| 0.35 | | | Fine-medium SAND with some Silt and some rootlets, light brown, medium dense, dry, non-plastic |
| | | | Sandy fine-course GRAVEL with trace cobbles, Redish Brown, sub-angular-sub-rounded, slightly-moderatly weathered, greywacke, dry, well graded, 200mm, sand is fine-medium |
| 0.80 | | | Interbedded with layer of silty fine-medium SAND, light brown, dense, dry, 150mm thick |
| 0.95 | | | Becoming moist |
| 1.5 | | | Lense of silty CLAY, grey, orange mottle, 100mm, soft, wet, medium plasticity |
| 2.0 | | | Lense of silty CLAY, grey, orange mottle, 50mm, soft, wet, medium plasticity |
| 2.6 | | | |
| | | | Test Pit END at 2.6mbgl, Target Depth Reached |

| Test Methods | Notes |
|---|---|
| Shear Strength using a Hand Held Shear Vane: NZ Geotechnical Soc Inc 8/2001 | IANZ accreditation does not |
| Field Description of Soils and Rocks in Engineering Use, NZ Geomechanics Society | apply to material descriptions |

Date tested : 20/03/19
Date reported : 21/03/19

# TEST PIT INVESTIGATION
# TEST REPORT

WSP | OPUS

Project : Proposed Subdivison Consent
Location : Arataki Road, Havelock North
Client : Surveying The Bay
Contractor : WSP-Opus
Shear vane number :
Shear vane correction :
Water level (m) : Not Encounted
Reduced level (m) : Existing Ground Level

TP 4 - E1935143.587 N5602439.211

| | |
|---|---|
| **Project No :** | **2-S5376.01** |
| **Lab Ref No :** | |
| **Client Ref No :** | **'00001** |

**Test Results**

| Depth (m) | Shear Strength (kPa) | Sample Details | Material Description |
|---|---|---|---|
| 0.50 | | | Sandy GRAVEL with some Silt and trace cobbles, dense, dry, non plastic, well-graded, pieces of brick and cinder blocks up to 150mm, (FILL) |
| 0.80 | | | Silty fine-medium SAND with some rootlets, dark brown, medium dense, dry, non-plastic (TOPSOIL) |
| 1.0 | | | Fine-medium SAND with some Silt and some rootlets, light brown, medium dense, dry, non-plastic |
| 2.6 | | | Sandy fine-course GRAVEL with trace cobbles, Redish Brown, sub-angular-sub-rounded, slightly-moderatly weathered, greywacke, dry, well graded, 200mm, sand is fine-medium |
| | | | Test Pit END at 2.6mbgl, Target Depth Reached |

| Test Methods | Notes |
|---|---|
| Shear Strength using a Hand Held Shear Vane: NZ Geotechnical Soc Inc 8/2001 | IANZ accreditation does not |
| Field Description of Soils and Rocks in Engineering Use, NZ Geomechanics Society | apply to material descriptions |

Date tested : 20/03/19
Date reported : 21/03/19

# TEST PIT INVESTIGATION
# TEST REPORT

WSP | OPUS

Project : Proposed Subdivison Consent
Location : Arataki Road, Havelock North
Client : Surveying The Bay
Contractor : WSP-Opus
Shear vane number :
Shear vane correction :
Water level (m) : Not Encounted
Reduced level (m) : Existing Ground Level

TP 5 - E1935015.616 N5602357.956

| | |
|---|---|
| **Project No :** | **2-S5376.01** |
| **Lab Ref No :** | |
| **Client Ref No :** | **'00001** |

**Test Results**

| Depth (m) | Shear Strength (kPa) | Sample Details | Material Description |
|---|---|---|---|
| 0.20 | | | Silty fine-medium SAND with some rootlets, dark brown, medium dense, dry, non-plastic (TOPSOIL) |
| 0.40 | | | Fine-medium SAND with some Silt, brown, firm, dry, non-plastic |
| 0.50 | | | Sandy fine-course GRAVEL with trace cobbles, Redish Brown, sub-angular-sub-rounded, slightly-moderatly weathered, greywacke, dry, well graded, 200mm, sand is fine-medium<br>Becoming moist |
| 1.0 | | | Becoming wet |
| 1.5 | | | Interbedded with layer of silty fine-medium SAND, grey-brown, soft, 100mm thick |
| 2.5 | | | |
| | | | Test Pit END at 2.5mbgl, Target Depth Reached |

| Test Methods | Notes |
|---|---|
| Shear Strength using a Hand Held Shear Vane: NZ Geotechnical Soc Inc 8/2001<br>Field Description of Soils and Rocks in Engineering Use, NZ Geomechanics Society | IANZ accreditation does not apply to material descriptions |

Date tested : 20/03/19
Date reported : 21/03/19

# TEST PIT INVESTIGATION
# TEST REPORT

WSP | OPUS

Project : Proposed Subdivison Consent
Location : Arataki Road, Havelock North
Client : Surveying The Bay
Contractor : WSP-Opus
Shear vane number :
Shear vane correction :
Water level (m) : Not Encounted
Reduced level (m) : Existing Ground Level

TP 6 - E1935136.503 N5602358.868

| | |
|---|---|
| **Project No :** | **2-S5376.01** |
| **Lab Ref No :** | |
| **Client Ref No :** | **'00001** |

**Test Results**

| Depth (m) | Shear Strength (kPa) | Sample Details | Material Description |
|---|---|---|---|
| 0.20 | | | Silty fine-medium SAND with some rootlets, dark brown, medium dense, dry, non-plastic (TOPSOIL) |
| 0.35 | | | Fine-medium SAND with some Silt and some rootlets, light brown, medium dense, dry, non-plastic |
| 0.50 | | | Sandy fine-medium GRAVEL, light brown, subangular-subrounded, slightly weathered, greywacke, dry, sand is fine-course |
| 0.65 | | | Fine-medium SAND with some Silt, light brown, medium dense, dry, non-plastic |
| 1.0 | | | Sandy fine-course GRAVEL with trace cobbles, Redish Brown, sub-angular-sub-rounded, slightly-moderatly weathered, greywacke, dry, well graded, 200mm, sand is fine-medium<br>Becoming moist |
| 1.5 | | | Becoming wet |
| 2.2 | | | |
| | | | Test Pit END at 2.2mbgl, Target Depth Reached |

| Test Methods | Notes |
|---|---|
| Shear Strength using a Hand Held Shear Vane: NZ Geotechnical Soc Inc 8/2001<br>Field Description of Soils and Rocks in Engineering Use, NZ Geomechanics Society | IANZ accreditation does not apply to material descriptions |

Date tested : 20/03/19
Date reported : 21/03/19



**Approved**

Designation : *Laboratory Manager*
Date : 02/10/18

# TEST PIT INVESTIGATION
# TEST REPORT

Project : Proposed Subdivison Consent
Location : Arataki Road, Havelock North
Client : Surveying The Bay
Contractor : WSP-Opus
Shear vane number :
Shear vane correction :
Water level (m) : Not Encounted
Reduced level (m) : Existing Ground Level

TP 7 - E 1935169.806 N5602394.189

| | |
|---|---|
| **Project No :** | **2-S5376.01** |
| **Lab Ref No :** | |
| **Client Ref No :** | **'00001** |

**Test Results**

| Depth (m) | Shear Strength (kPa) | Sample Details | Material Description |
|---|---|---|---|
| 0.10 | | | Silty fine-medium SAND with some rootlets, dark brown, medium dense, dry, non-plastic (TOPSOIL) |
| 0.40 | | | Sandy SILT with trace Gravel and trace rootlets, firm, dry, non plastic (FILL) |
| 0.60 | | | Silty fine-medium SAND with some rootlets, dark brown, medium dense, dry, non-plastic (Buried TOPSOIL) |
| 1.0 | | | Fine-medium SAND with some Silt and some rootlets, light brown, medium dense, dry, non-plastic |
| 1.2 | | | Sandy fine-course GRAVEL with trace cobbles, Redish Brown, sub-angular-sub-rounded, slightly-moderatly weathered, greywacke, dry, well graded, 200mm, sand is fine-medium<br>Becoming Moist |
| 2.6 | | | Becoming Wet |
| | | | Test Pit END at 2.6mbgl, Target Depth Reached |

| Test Methods | Notes |
|---|---|
| Shear Strength using a Hand Held Shear Vane: NZ Geotechnical Soc Inc 8/2001 | IANZ accreditation does not |
| Field Description of Soils and Rocks in Engineering Use, NZ Geomechanics Society | apply to material descriptions |

Date tested : 20/03/19
Date reported : 21/03/19

# HAND AUGER BOREHOLE LOG - HA01-25

Client: CDL Land NZ Ltd
Project: Arataki Residential Subdivision
Site Location: Havelock North
Project No.: NAP2024-0007
Date: 19/02/2025
Borehole Location: Refer to Site Plan  Logged by: KvR  Checked by: IA  Scale: 1:25  Sheet 1 of 1

CMW Geosciences
Great People | Practical Solutions

Position: 1935069.2mE; 5602353.7mN Projection: NZGD2000
Elevation: 30.50m  Datum: NZVD2016  Survey Source: HDC GIS

| Groundwater | Samples & Insitu Tests: Depth | Samples & Insitu Tests: Type & Results | RL (m) | Depth (m) | Graphic Log | Material Description<br>Soil: Soil symbol; soil type; colour; structure; bedding; plasticity; sensitivity; additional comments. (origin/geological unit)<br>Rock: Colour; fabric; rock name; additional comments. (origin/geological unit) | Moisture Condition | Consistency/ Relative Density | Dynamic Cone Penetrometer (Blows/100mm) |
|---|---|---|---|---|---|---|---|---|---|
| | | | 30.5 | | | OL: Fine sandy SILT: Light brown. Low plasticity. Sensitive. Trace rootlets. (Topsoil) | | VL | 2 |
| | | | 30.3 | | | ML: Fine SAND with trace silt: Light orange brown. Uniformly graded. Rounded. (Pleistocene River Deposits) | D | MD | 6 |
| | | | | | | | | D | 8 |
| | | | | | | | | | 9 |
| | | | | | | | | VD | 26 |
| | | | | | | | | | 30 |
| | | | | | | Borehole terminated at 0.6 m | | | |

Termination Reason: Refusal on hard ground.
Shear Vane No:  DCP No: 35
Remarks: Groundwater not encountered. DCP conducted 0.0 - 0.5mbgl, material augered out, auger refused at 0.5mbgl, DCP conducted 0.5 - 0.6mbgl refusing.

This report is based on the attached field description for soil and rock, CMW Geosciences - Field Logging Guide, Revision 5 - August 2024.

# HAND AUGER BOREHOLE LOG - HA02-25

Client: CDL Land NZ Ltd
Project: Arataki Residential Subdivision
Site Location: Havelock North
Project No.: NAP2024-0007
Date: 19/02/2025
Borehole Location: Refer to Site Plan  Logged by: KvR  Checked by: IA  Scale: 1:25  Sheet 1 of 1

CMW Geosciences
Great People | Practical Solutions

Position: 1935117.5mE; 5602450.7mN Projection: NZGD2000
Elevation: 29.00m  Datum: NZVD2016  Survey Source: HDC GIS

| Groundwater | Samples & Insitu Tests: Depth | Samples & Insitu Tests: Type & Results | RL (m) | Depth (m) | Graphic Log | Material Description<br>Soil: Soil symbol; soil type; colour; structure; bedding; plasticity; sensitivity; additional comments. (origin/geological unit)<br>Rock: Colour; fabric; rock name; additional comments. (origin/geological unit) | Moisture Condition | Consistency/ Relative Density | Dynamic Cone Penetrometer (Blows/100mm) |
|---|---|---|---|---|---|---|---|---|---|
| | | | 29.0 | | | OL: Fine sandy SILT: Light brown. Low plasticity. Sensitive. Trace rootlets.<br>(Topsoil) | | MD | 6<br>7 |
| | | | 28.8 | | | ML: Fine SAND with trace silt: Light brown. Uniformly graded. Rounded.<br>(Pleistocene River Deposits) | D | D | 8<br>8<br>9 |
| | | | | | | *... at 0.50m, becoming light orange brown mottled trace white. Auger refusing.* | | VD | 17<br>30 |
| | | | | | | Borehole terminated at 0.7 m | | | |

Termination Reason: Refusal on hard ground.
Shear Vane No: DCP No: 35
Remarks: Groundwater not encountered. DCP conducted 0.0 - 0.6mbgl, material augered out, auger refused at 0.6mbgl, DCP conducted 0.6 - 0.8mbgl refusing.

This report is based on the attached field description for soil and rock, CMW Geosciences - Field Logging Guide, Revision 5 - August 2024.

# HAND AUGER BOREHOLE LOG - HA03-25

Client: CDL Land NZ Ltd
Project: Arataki Residential Subdivision
Site Location: Havelock North
Project No.: NAP2024-0007
Date: 19/02/2025
Borehole Location: Refer to Site Plan  Logged by: KvR  Checked by: IA  Scale: 1:25  Sheet 1 of 1

CMW Geosciences
Great People | Practical Solutions

Position: 1935001.1mE; 5602434.7mN Projection: NZGD2000
Elevation: 28.50m  Datum: NZVD2016  Survey Source: HDC GIS

| Groundwater | Samples & Insitu Tests: Depth | Samples & Insitu Tests: Type & Results | RL (m) | Depth (m) | Graphic Log | Material Description<br>Soil: Soil symbol; soil type; colour; structure; bedding; plasticity; sensitivity; additional comments. (origin/geological unit)<br>Rock: Colour; fabric; rock name; additional comments. (origin/geological unit) | Moisture Condition | Consistency/ Relative Density | Dynamic Cone Penetrometer (Blows/100mm) |
|---|---|---|---|---|---|---|---|---|---|
| | | | 28.5 | 0 | | OL: Fine sandy SILT: Light brown. Low plasticity. Sensitive. Trace rootlets. (Topsoil) | M | VL | 2 |
| | | | 28.3 | | | ML: Fine SAND with trace silt: Light orange brown. Uniformly graded. Rounded. (Pleistocene River Deposits) | | MD | 4 |
| | | | | | | | | | 7 |
| | | | | | | ... at 0.40m, Auger grinding and refusing. Inferred gravels. | | D | 9 |
| | | | | | | | | | 5, 10 |
| | | | | | | | | | 19 |
| | | | | | | | | | 20 |
| | | | | | | | | | 10, 16 |
| | | | | | | | | | 17 |
| | | | | | | | | VD | 20 |
| | | | | 1 | | | | | 20 |
| | | | | | | Borehole terminated at 1.1 m | | | |
| | | | | 2 | | | | | |
| | | | | 3 | | | | | |
| | | | | 4 | | | | | |
| | | | | 5 | | | | | |

Termination Reason: Refusal on hard ground.
Shear Vane No:  DCP No: 35
Remarks: Groundwater not encountered. DCP conducted 0.0 - 1.0mbgl, material augered out, auger refused at 0.4mbgl, DCP conducted 0.4 - 1.1mbgl refusing.

This report is based on the attached field description for soil and rock, CMW Geosciences - Field Logging Guide, Revision 5 - August 2024.

# HAND AUGER BOREHOLE LOG - HA04-25

Client: CDL Land NZ Ltd
Project: Arataki Residential Subdivision
Site Location: Havelock North
Project No.: NAP2024-0007
Date: 19/02/2025
Borehole Location: Refer to Site Plan  Logged by: KvR  Checked by: IA  Scale: 1:25  Sheet 1 of 1

CMW Geosciences
Great People | Practical Solutions

Position: 1934991.0mE; 5602535.3mN Projection: NZGD2000
Elevation: 26.50m  Datum: NZVD2016  Survey Source: HDC GIS

| Groundwater | Samples & Insitu Tests: Depth | Samples & Insitu Tests: Type & Results | RL (m) | Depth (m) | Graphic Log | Material Description (Soil: Soil symbol; soil type; colour; structure; bedding; plasticity; sensitivity; additional comments. (origin/geological unit) Rock: Colour; fabric; rock name; additional comments. (origin/geological unit)) | Moisture Condition | Consistency/ Relative Density | Dynamic Cone Penetrometer (Blows/100mm) |
|---|---|---|---|---|---|---|---|---|---|
| | | | 26.5 | 0 | | OL: Fine sandy SILT: Light brown. Low plasticity. Trace rootlets. (Topsoil) | D | L | 2 |
| | | | | | | | | MD | 6 |
| | | | 26.2 | | | ML: SAND with trace silt: Light orange brown. Uniformly graded. Rounded. (Pleistocene River Deposits) | | D | 9, 13 |
| | | | | | | | | VD | 20, 20 |
| | | | | | | Borehole terminated at 0.6 m | | | |
| | | | | 1 | | | | | |
| | | | | 2 | | | | | |
| | | | | 3 | | | | | |
| | | | | 4 | | | | | |
| | | | | 5 | | | | | |

Termination Reason: Refusal on hard ground.
Shear Vane No: DCP No: 35
Remarks: Groundwater not encountered. DCP conducted 0.0 - 0.5mbgl, material augered out, auger refused at 0.5mbgl, DCP conducted 0.5 - 0.6mbgl refusing.

This report is based on the attached field description for soil and rock, CMW Geosciences - Field Logging Guide, Revision 5 - August 2024.

# HAND AUGER BOREHOLE LOG - HA05-25

Client: CDL Land NZ Ltd
Project: Arataki Residential Subdivision
Site Location: Havelock North
Project No.: NAP2024-0007
Date: 19/02/2025
Borehole Location: Refer to Site Plan  Logged by: KvR  Checked by: IA  Scale: 1:25  Sheet 1 of 1

CMW Geosciences
Great People | Practical Solutions

Position: 1934943.8mE; 5602614.5mN Projection: NZGD2000
Elevation: 24.50m  Datum: NZVD2016  Survey Source: HDC GIS

| Groundwater | Samples & Insitu Tests: Depth | Samples & Insitu Tests: Type & Results | RL (m) | Depth (m) | Graphic Log | Material Description<br>Soil: Soil symbol; soil type; colour; structure; bedding; plasticity; sensitivity; additional comments. (origin/geological unit)<br>Rock: Colour; fabric; rock name; additional comments. (origin/geological unit) | Moisture Condition | Consistency/ Relative Density | Dynamic Cone Penetrometer (Blows/100mm) |
|---|---|---|---|---|---|---|---|---|---|
| | | | 24.5 | | | OL: Fine sandy SILT: Light brown. Low plasticity. Sensitive.<br>(Topsoil) | | L | 3 |
| | | | 24.3 | | | ML: Fine SAND with trace silt: Light orange brown. Uniformly graded. Rounded.<br>(Pleistocene River Deposits) | D | MD<br>D | 5<br>9 |
| | | | | | | *... at 0.40m, Auger grinding and refusing. Inferred gravels.* | | VD | 19<br>20 |
| | | | | | | Borehole terminated at 0.5 m | | | |

Termination Reason: Refusal on hard ground.
Shear Vane No:  DCP No: 35
Remarks: Groundwater not encountered. DCP conducted 0.0 - 0.5mbgl, material augered out, auger refused at 0.4mbgl, DCP conducted 0.4 - 0.5mbgl refusing.

This report is based on the attached field description for soil and rock, CMW Geosciences - Field Logging Guide, Revision 5 - August 2024.

# HAND AUGER BOREHOLE LOG - HA06-25

Client: CDL Land NZ Ltd
Project: Arataki Residential Subdivision
Site Location: Havelock North
Project No.: NAP2024-0007
Date: 19/02/2025
Borehole Location: Refer to Site Plan  Logged by: KvR  Checked by: IA  Scale: 1:25  Sheet 1 of 1

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Position: 1934911.3mE; 5602708.9mN Projection: NZGD2000
Elevation: 22.70m  Datum: NZVD2016  Survey Source: HDC GIS

| Groundwater | Samples & Insitu Tests: Depth | Samples & Insitu Tests: Type & Results | RL (m) | Depth (m) | Graphic Log | Material Description<br>Soil: Soil symbol; soil type; colour; structure; bedding; plasticity; sensitivity; additional comments. (origin/geological unit)<br>Rock: Colour; fabric; rock name; additional comments. (origin/geological unit) | Moisture Condition | Consistency/ Relative Density | Dynamic Cone Penetrometer (Blows/100mm) |
|---|---|---|---|---|---|---|---|---|---|
| | | | 22.7 | | | OL: Fine sandy SILT: Light brown. Low plasticity. Sensitive. Trace rootlets. (Topsoil) | | | 9 |
| | | | 22.6 | | | ML: Fine SAND with trace silt: Light orange brown. Uniformly graded. Rounded. (Pleistocene River Deposits) | D | D | 11 |
| | | | | | | | | | 16 |
| | | | | | | | | VD | 20 |
| | | | | | | Borehole terminated at 0.4 m | | | |

Termination Reason: Refusal on hard ground.
Shear Vane No: DCP No: 35
Remarks: Groundwater not encountered. DCP conducted 0.0 - 0.4mbgl, material augered out, auger refused at 0.3mbgl, DCP conducted 0.3 - 0.4mbgl refusing.

This report is based on the attached field description for soil and rock, CMW Geosciences - Field Logging Guide, Revision 5 - August 2024.

# HAND AUGER BOREHOLE LOG - HA07-25

Client: CDL Land NZ Ltd
Project: Arataki Residential Subdivision
Site Location: Havelock North
Project No.: NAP2024-0007
Date: 19/02/2025
Borehole Location: Refer to Site Plan  Logged by: KvR  Checked by: IA  Scale: 1:25  Sheet 1 of 1

Position: 1934806.7mE; 5602715.9mN Projection: NZGD2000
Elevation: 20.50m  Datum: NZVD2016  Survey Source: HDC GIS

| Groundwater | Samples & Insitu Tests: Depth | Samples & Insitu Tests: Type & Results | RL (m) | Depth (m) | Graphic Log | Material Description<br>Soil: Soil symbol; soil type; colour; structure; bedding; plasticity; sensitivity; additional comments. (origin/geological unit)<br>Rock: Colour; fabric; rock name; additional comments. (origin/geological unit) | Moisture Condition | Consistency/ Relative Density | Dynamic Cone Penetrometer (Blows/100mm) |
|---|---|---|---|---|---|---|---|---|---|
| | | | 20.5 | | | OL: Fine sandy SILT: Light brown. Low plasticity. Sensitive. Trace rootlets. (Topsoil) | | MD | 6 |
| | | | 20.4 | | | ML: Fine SAND with trace silt: Light orange brown. Uniformly graded. Rounded. (Pleistocene River Deposits) | D | D | 9 |
| | | | | | | | | | 15 |
| | | | | | | | | VD | 30 |
| | | | | | | Borehole terminated at 0.4 m | | | |

Termination Reason: Refusal on hard ground.
Shear Vane No:  DCP No: 35
Remarks: Groundwater not encountered. DCP conducted 0.0 - 0.3mbgl, material augered out, auger refused at 0.3mbgl, DCP conducted 0.3 - 0.4mbgl refusing.

This report is based on the attached field description for soil and rock, CMW Geosciences - Field Logging Guide, Revision 5 - August 2024.

# HAND AUGER BOREHOLE LOG - HA08-25

Client: CDL Land NZ Ltd
Project: Arataki Residential Subdivision
Site Location: Havelock North
Project No.: NAP2024-0007
Date: 19/02/2025
Borehole Location: Refer to Site Plan  Logged by: KvR  Checked by: IA  Scale: 1:25  Sheet 1 of 1

CMW Geosciences
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Position: 1934817.8mE; 5602799.9mN Projection: NZGD2000
Elevation: 19.50m  Datum: NZVD2016  Survey Source: HDC GIS

| Groundwater | Samples & Insitu Tests: Depth | Samples & Insitu Tests: Type & Results | RL (m) | Depth (m) | Graphic Log | Material Description<br>Soil: Soil symbol; soil type; colour; structure; bedding; plasticity; sensitivity; additional comments. (origin/geological unit)<br>Rock: Colour; fabric; rock name; additional comments. (origin/geological unit) | Moisture Condition | Consistency/ Relative Density | Dynamic Cone Penetrometer (Blows/100mm) |
|---|---|---|---|---|---|---|---|---|---|
| | | | 19.5 | | | OL: Fine sandy SILT: Light brown. Low plasticity. Sensitive. Trace rootlets. (Topsoil) | | | 10 |
| | | | 19.4 | | | ML: Fine SAND with trace silt: Light orange brown. Uniformly graded. Rounded. (Pleistocene River Deposits) | D | D | 15 |
| | | | | | | | | | 12 |
| | | | | | | | | VD | 20 |
| | | | | | | | | | 20 |
| | | | | | | Borehole terminated at 0.5 m | | | |
| | | | | 1 | | | | | |
| | | | | 2 | | | | | |
| | | | | 3 | | | | | |
| | | | | 4 | | | | | |
| | | | | 5 | | | | | |

Termination Reason: Refusal on hard ground.
Shear Vane No:  DCP No: 35
Remarks: Groundwater not encountered. DCP conducted 0.0 - 0.3mbgl, material augered out, auger refused at 0.3mbgl, DCP conducted 0.3 - 0.4mbgl refusing.

This report is based on the attached field description for soil and rock, CMW Geosciences - Field Logging Guide, Revision 5 - August 2024.

# HAND AUGER BOREHOLE LOG - HA09-25

Client: CDL Land NZ Ltd
Project: Arataki Residential Subdivision
Site Location: Havelock North
Project No.: NAP2024-0007
Date: 19/02/2025
Borehole Location: Refer to Site Plan  Logged by: KvR  Checked by: IA  Scale: 1:25  Sheet 1 of 1

CMW Geosciences
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Position: 1934741.7mE; 5602847.6mN Projection: NZGD2000
Elevation: 17.50m  Datum: NZVD2016  Survey Source: HDC GIS

| Groundwater | Samples & Insitu Tests: Depth | Samples & Insitu Tests: Type & Results | RL (m) | Depth (m) | Graphic Log | Material Description<br>Soil: Soil symbol; soil type; colour; structure; bedding; plasticity; sensitivity; additional comments. (origin/geological unit)<br>Rock: Colour; fabric; rock name; additional comments. (origin/geological unit) | Moisture Condition | Consistency/ Relative Density | Dynamic Cone Penetrometer (Blows/100mm) |
|---|---|---|---|---|---|---|---|---|---|
| | | | 17.5 | | | OL: Fine sandy SILT: Light brown. Low plasticity. Sensitive. Trace rootlets. (Topsoil) | | VL | 1 |
| | | | 17.4 | | | ML: Fine SAND with trace silt: Light orange brown. Uniformly graded. Rounded. (Pleistocene River Deposits) | D | VD | 20 |
| | | | | | | *... at 0.30m, Auger grinding and refusing. Inferred gravels.* | | | 20 |
| | | | | | | Borehole terminated at 0.4 m | | | |

Dynamic Cone Penetrometer (Blows/100mm): 5, 10, 15

Termination Reason: Refusal on hard ground.
Shear Vane No:  DCP No: 35
Remarks: Groundwater not encountered. DCP conducted 0.0 - 0.3mbgl, material augered out, auger refused at 0.3mbgl, DCP conducted 0.3 - 0.4mbgl refusing.

This report is based on the attached field description for soil and rock, CMW Geosciences - Field Logging Guide, Revision 5 - August 2024.

# HAND AUGER BOREHOLE LOG - HA10-25

Client: CDL Land NZ Ltd
Project: Arataki Residential Subdivision
Site Location: Havelock North
Project No.: NAP2024-0007
Date: 19/02/2025
Borehole Location: Refer to Site Plan  Logged by: KvR  Checked by: IA  Scale: 1:25  Sheet 1 of 1

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Position: 1934800.6mE; 5602909.2mN Projection: NZGD2000
Elevation: 16.80m  Datum: NZVD2016  Survey Source: HDC GIS

| Groundwater | Samples & Insitu Tests: Depth | Samples & Insitu Tests: Type & Results | RL (m) | Depth (m) | Graphic Log | Material Description<br>Soil: Soil symbol; soil type; colour; structure; bedding; plasticity; sensitivity; additional comments. (origin/geological unit)<br>Rock: Colour; fabric; rock name; additional comments. (origin/geological unit) | Moisture Condition | Consistency/ Relative Density | Dynamic Cone Penetrometer (Blows/100mm) |
|---|---|---|---|---|---|---|---|---|---|
| | | | 16.8 | | | OL: Fine sandy SILT: Light brown. Low plasticity. Sensitive. Trace rootlets. (Topsoil) | | MD | 6 |
| | | | 16.7 | | | ML: Fine SAND with minor fine to coarse gravel and trace silt: Light orange brown. Uniformly graded. Rounded. Gravel is angular. (Pleistocene River Deposits) | D | D | 11 |
| | | | | | | | | | 11 |
| | | | | | | | | | 12 |
| | | | | | | Borehole terminated at 0.4 m | | | 8 |
| | | | | | | | | | 7 |
| | | | | | | | | | 6 |
| | | | | 1 | | | | | 10 |
| | | | | | | | | | 12 |
| | | | | | | | | | 10 |
| | | | | | | | | | 11 |
| | | | | | | | | | 10 |
| | | | | | | | | | 18 |
| | | | | | | | | | 14 |
| | | | | | | | | | 15 |
| | | | | | | | | | 9 |
| | | | | | | | | | 9 |
| | | | | | | | | | 20 |
| | | | | 2 | | | | | |
| | | | | 3 | | | | | |
| | | | | 4 | | | | | |
| | | | | 5 | | | | | |

Termination Reason: Refusal on hard ground.
Shear Vane No: DCP No: 35
Remarks: Groundwater not encountered. DCP conducted 0.0 - 1.1mbgl, material augered out, auger refused at 0.4mbgl, DCP conducted 1.1 - 1.8mbgl refusing.

This report is based on the attached field description for soil and rock, CMW Geosciences - Field Logging Guide, Revision 5 - August 2024.

# TEST PIT LOG - TP01-25

Client: CDL Land NZ Ltd
Project: Arataki Residential Subdivision
Site Location: Havelock North
Project No.: NAP2024-0007
Date: 20/02/2025
Test Pit Location: Refer to Site Plan  Logged by: KvR  Checked by: MK  Scale: 1:25  Sheet 1 of 1
Position: 1935021.0mE; 5602516.5mN  Projection: NZGD2000  Pit Dimensions: 2.0m by 1.0m
Elevation: 27.50m  Datum: NZVD2016  Survey Source: HDC GIS

| Groundwater | Samples & Insitu Tests: Depth | Samples & Insitu Tests: Type & Results | RL (m) | Depth (m) | Graphic Log | Material Description (Soil: Soil symbol; soil type; colour; structure; bedding; plasticity; sensitivity; additional comments. (origin/geological unit) Rock: Colour; fabric; rock name; additional comments. (origin/geological unit)) | Moisture Condition | Consistency/ Relative Density | Dynamic Cone Penetrometer (Blows/100mm) | Structure & Other Observations (Discontinuities: Depth; Defect Number; Defect Type; Dip; Defect Shape; Roughness; Aperture; Infill; Seepage; Spacing; Block Size; Block Shape; Remarks) |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | 27.5 | 0 | | OL: Fine sandy SILT: Brown. Low plasticity. Sensitive. Trace rootlets. (Topsoil) | D | MD | 6 | |
| | | | 27.4 | | | ML: Silty fine SAND: Light brownish grey. Uniformly graded. Rounded. (Pleistocene River Deposits) | | D | 9 | |
| | | | | | | | | | 16 | |
| | | | | | | | | VD | 2 | |
| | | | 27.1 | | | GW: Fine to coarse GRAVEL with some fine to coarse sand, some cobbles and trace silt: Light brownish white. Well graded. Subangular to subrounded. (Pleistocene River Deposits) | | | 1 | |
| | | | | | | | | TP | | |
| | | | | 1 | | | | | | |
| | | | | | | | | D | 12 | |
| | | | | | | | | | 15 | |
| | | | | | | | | | 16 | |
| | | | | | | | | VD | 2 | |
| | | | | 2 | | ... at 2.00m, Excavator visibly lifting off ground. | | | 3 | |
| | | | | | | | M | TP | | |
| | | | 24.5 | 3 | | GM: Fine to coarse GRAVEL with some fine to coarse sand, some silt, minor cobbles: Dark orange brown. Well graded. Subrounded to subgular. Red metal (Pleistocene River Deposits) | W | | | |
| | | | | 4 | | Test pit terminated at 4.00 m | | | | |
| | | | | 5 | | | | | | |

Termination Reason: Target depth reached.
Shear Vane No:  DCP No: 35

Remarks: Groundwater not encountered. DCP cconducted next to pit. DCP conducted at 1.0mbgl in pit. 26tn Excavator.

This report is based on the attached field description for soil and rock, CMW Geosciences - Field Logging Guide, Revision 5 - August 2024.

# TEST PIT LOG - TP02-25

Client: CDL Land NZ Ltd
Project: Arataki Residential Subdivision
Site Location: Havelock North
Project No.: NAP2024-0007
Date: 20/02/2025
Test Pit Location: Refer to Site Plan  Logged by: KvR  Checked by: MK  Scale: 1:25  Sheet 1 of 1

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Position: 1934924.0mE; 5602656.7mN Projection: NZGD2000
Elevation: 24.00m  Datum: NZVD2016
Pit Dimensions: 2.0m by 1.0m
Survey Source: HDC GIS

| Groundwater | Samples & Insitu Tests: Depth | Samples & Insitu Tests: Type & Results | RL (m) | Depth (m) | Graphic Log | Material Description | Moisture Condition | Consistency/ Relative Density | Dynamic Cone Penetrometer (Blows/100mm) | Structure & Other Observations |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | 24.0 | | | OL: Fine sandy SILT: Light brown. Low plasticity. Trace rootlets. (Topsoil) | D | D | 7 | Discontinuities: Depth; Defect Number; Defect Type; Dip; Defect Shape; Roughness; Aperture; Infill; Seepage; Spacing; Block Size; Block Shape; Remarks |
| | | | 23.9 | | | ML: Fine to medium SAND with some silt: Light grey brown. Gap graded. Subangular. (Pleistocene River Deposits) | | | 15 | |
| | | | 23.7 | | | GM: Fine to coarse sandy fine to coarse GRAVEL with trace silt: Light brownish white. Well graded. Subangular. (Pleistocene River Deposits) | | | 11 | |
| | | | | | | | | | 13 | |
| | | | | | | | | VD | 2 | |
| | | | | | | | | | 3 | |
| | | | | | | | | TP | | |
| | | | 23.0 | 1 | | ML: Silty fine to medium SAND with minor cobbles: Light orange brown mottled light grey and streaked orange. Blocky. Well graded. Subrounded to subangular. Limonite staining. Hardpan (Pleistocene River Deposits) | M | MD | 5 | |
| | | | | | | | | D | 12 | |
| | | | | | | | | VD | 2 | |
| | | | | | | | | | 0 | |
| | | | 22.1 | 2 | | GM: Fine to coarse GRAVEL with some fine to coarse sand, some silt, minor cobbles: Dark brownish red. Well graded. Subangular to subrounded, Red metal. (Pleistocene River Deposits) | M to W | TP | | |
| | | | | 3 | | | W | | | |
| | | | | | | | W to S | | | |
| | | | | 4 | | Test pit terminated at 4.00 m | | | | |
| | | | | 5 | | | | | | |

Termination Reason: Target depth reached.
Shear Vane No:  DCP No: 35

Remarks: Groundwater not encountered. DCP cconducted next to pit. DCP conducted at 1.0mbgl in pit. 26tn Excavator.

This report is based on the attached field description for soil and rock, CMW Geosciences - Field Logging Guide, Revision 5 - August 2024.

# TEST PIT LOG - TP03-25

Client: CDL Land NZ Ltd
Project: Arataki Residential Subdivision
Site Location: Havelock North
Project No.: NAP2024-0007
Date: 20/02/2025
Test Pit Location: Refer to Site Plan  Logged by: KvR  Checked by: MK  Scale: 1:25  Sheet 1 of 1

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Position: 1934987.7mE; 5602654.2mN Projection: NZGD2000
Elevation: 25.00m  Datum: NZVD2016
Pit Dimensions: 2.0m by 1.0m
Survey Source: HDC GIS

| Groundwater | Samples & Insitu Tests: Depth | Samples & Insitu Tests: Type & Results | RL (m) | Depth (m) | Graphic Log | Material Description | Moisture Condition | Consistency/ Relative Density | Dynamic Cone Penetrometer (Blows/100mm) | Structure & Other Observations |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | 25.0 | | | OL: Fine sandy SILT: Brown. Low plasticity. Sensitive. Trace rootlets. (Topsoil) | | VD | 2 | |
| | | | 24.9 | | | ML: Fine sandy SILT: Light brownish grey. Low plasticity. Moderately sensitive. (Pleistocene River Deposits) | | | 2 | |
| | | | 24.6 | | | GM: Fine to coarse sandy fine to coarse GRAVEL with trace cobbles: Light brownish white. Well graded. Subangular to subrounded. (Pleistocene River Deposits) | D | VD | | |
| | | | | 1 | | | | MD | 6 | |
| | | | | | | | | | 10 | |
| | | | | | | | | | 10 | |
| | | | | | | | | D | 9 | |
| | | | | | | | | | 7 | |
| | | | | | | | | | 14 | |
| | | | | | | | M | VD | 2 | |
| | | | 23.0 | 2 | | GM: Fine to coarse GRAVEL with some fine to coarse sand, some silt, minor cobbles: Dark orange brown. Well graded. Subrounded to subgular. Red metal (Pleistocene River Deposits) | | | 1 | |
| | | | | | | | M to W | TP | | |
| | | | | 3 | | | W | | | |
| | | | | 4 | | Test pit terminated at 4.00 m | | | | |
| | | | | 5 | | | | | | |

Termination Reason: Target depth reached.
Shear Vane No:  DCP No: 35

Remarks: Groundwater not encountered. DCP cconducted next to pit. DCP conducted at 1.0mbgl in pit. 26tn Excavator.

This report is based on the attached field description for soil and rock, CMW Geosciences - Field Logging Guide, Revision 5 - August 2024.

# TEST PIT LOG - TP04-25

Client: CDL Land NZ Ltd
Project: Arataki Residential Subdivision
Site Location: Havelock North
Project No.: NAP2024-0007
Date: 20/02/2025
Test Pit Location: Refer to Site Plan

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Checked by: MK Scale: 1:25 Sheet 1 of 1

Position: 1934725.9mE; 5603006.8mN Projection: NZGD2000
Elevation: 14.00m Datum: NZVD2016

Pit Dimensions: m by m
Survey Source: HDC GIS

| Groundwater | Samples & Insitu Tests: Depth | Samples & Insitu Tests: Type & Results | RL (m) | Depth (m) | Graphic Log | Material Description | Moisture Condition | Consistency/ Relative Density | Dynamic Cone Penetrometer (Blows/100mm) | Structure & Other Observations |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | 14.0 | | | OL: Fine sandy SILT: Light brown. Low plasticity. Sensitive. Trace rootlets. (Topsoil) | | MD | 6 | |
| | | | 13.9 | | | ML: Fine SAND with some silt: Light orange brown. Uniformly graded. Rounded. (Pleistocene River Deposits) | D | D | 12, 15 | |
| | | | 13.6 | | | GM: Fine to coarse gravelly fine to coarse SAND with some cobbles.: Light orange brown. Uniformly graded. Rounded. Gravel is angular. Cobbles are subangular. (Pleistocene River Deposits) | | | 13, 12 | |
| | | | 13.5 | | | GM: Fine to coarse sandy fine to coarse GRAVEL with trace cobbles: Light brownish white. Well graded. Subangular to subrounded. (Pleistocene River Deposits) | | VD | 2, 1 | |
| | | | | 1 | | | M | D | | |
| | | | | | | | | VD | | |
| | | | 12.0 | 2 | | GM: Fine to coarse GRAVEL with some fine to coarse sand, some cobbles and trace silt: Dark orange brown. Well graded. Subrounded. Gravel is Subangular. Red metal. (Pleistocene River Deposits) *... at 2.00m, becoming finer graded* | W | TP | | |
| | | | | 3 | | | W to S | | | |
| | | | | 4 | | Test pit terminated at 4.00 m | | | | |
| | | | | 5 | | | | | | |

Termination Reason: Target depth reached.

Shear Vane No: DCP No: 35

Remarks: Groundwater not encountered. DCP conducted next to pit. 26tn Excavator.

This report is based on the attached field description for soil and rock, CMW Geosciences - Field Logging Guide, Revision 5 - August 2024.

# TEST PIT LOG - TP05-25

Client: CDL Land NZ Ltd
Project: Arataki Residential Subdivision
Site Location: Havelock North
Project No.: NAP2024-0007
Date: 20/02/2025
Test Pit Location: Refer to Site Plan  Logged by: KvR  Checked by: MK  Scale: 1:25  Sheet 1 of 1

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Position: 1934755.1mE; 5602995.6mN Projection: NZGD2000
Elevation: 14.50m  Datum: NZVD2016
Pit Dimensions: 2.0m by 1.0m
Survey Source: HDC GIS

| Groundwater | Samples & Insitu Tests: Depth | Samples & Insitu Tests: Type & Results | RL (m) | Depth (m) | Graphic Log | Material Description | Moisture Condition | Consistency/ Relative Density | Dynamic Cone Penetrometer (Blows/100mm) | Structure & Other Observations |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | 14.5 | | | OL: Fine sandy SILT: Light brown. Low plasticity. Sensitive. Trace rootlets. (Topsoil) | | MD | 6 | |
| | | | 14.3 | | | ML: Fine SAND with trace silt: Light orange brown. Uniformly graded. Rounded. (Pleistocene River Deposits) | | D | 9 | |
| | | | 14.1 | | | GM: Fine to coarse gravelly fine to coarse SAND with some cobbles: Light orange brown minor white. Uniformly graded. Subrounded. Gravel is Subangular. Cobbles are subangular. (Pleistocene River Deposits) | D | D | 10 | |
| | | | | | | ... at 0.80m, Excavator lifting when scraping with effort. | | VD | 10 | |
| | | | 13.5 | 1 | | GM: Fine to coarse gravelly fine to coarse SAND with some cobbles and trace silt: Dark orange brown. Gap graded. Subrounded. Gravel is Subangular. Red metal. (Pleistocene River Deposits) | | | 11 | |
| | | | | | | | | | 13 | |
| | | | | | | | | | 30 | |
| | | | | 2 | | | M | D | | |
| | | | | | | | | VD | | |
| | | | | 3 | | | W | TP | | |
| | | | 10.9 | | | MH: SILT with some clay: Light grey brown with some light to dark orange streaks. High plasticity. Moderately sensitive. Limonite staining. (Pleistocene River Deposits) | M to W | St | | |
| | 4.0 | Peak = 98kPa Residual = 33kPa | | 4 | | Test pit terminated at 4.00 m | | | | |
| | | | | 5 | | | | | | |

Termination Reason: Target depth reached.
Shear Vane No: 3965  DCP No: 35

Remarks: Groundwater not encountered. DCP conducted next to pit. In-situ handheld shear vane test undertaken at base of pit. 26tn Excavator.

This report is based on the attached field description for soil and rock, CMW Geosciences - Field Logging Guide, Revision 5 - August 2024.

# PHOTOGRAPH SHEET - TP01-25

Client: CDL Land NZ Ltd
Project: Arataki Residential Subdivision
Location: Havelock North
Project ID: NAP2024-0007
Date: 20/02/2025

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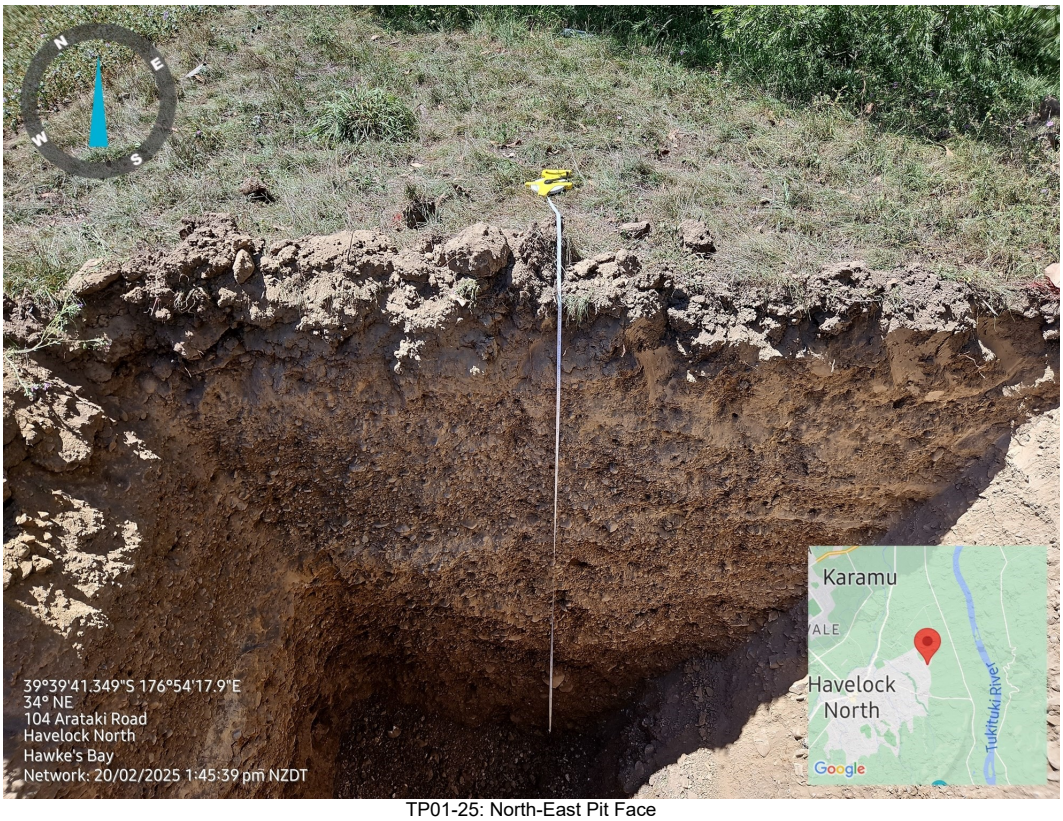
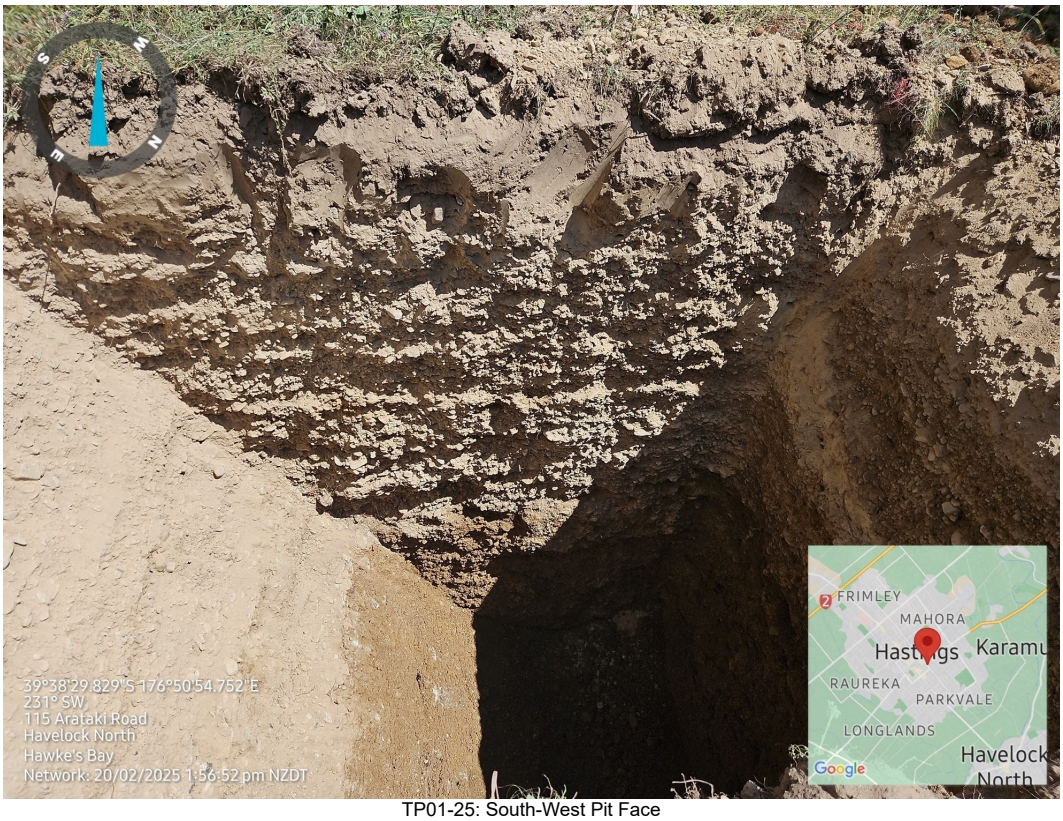



TP01-25: North-East Pit Face




TP01-25: South-West Pit Face

# PHOTOGRAPH SHEET - TP02-25

Client: CDL Land NZ Ltd
Project: Arataki Residential Subdivision
Location: Havelock North
Project ID: NAP2024-0007
Date: 20/02/2025

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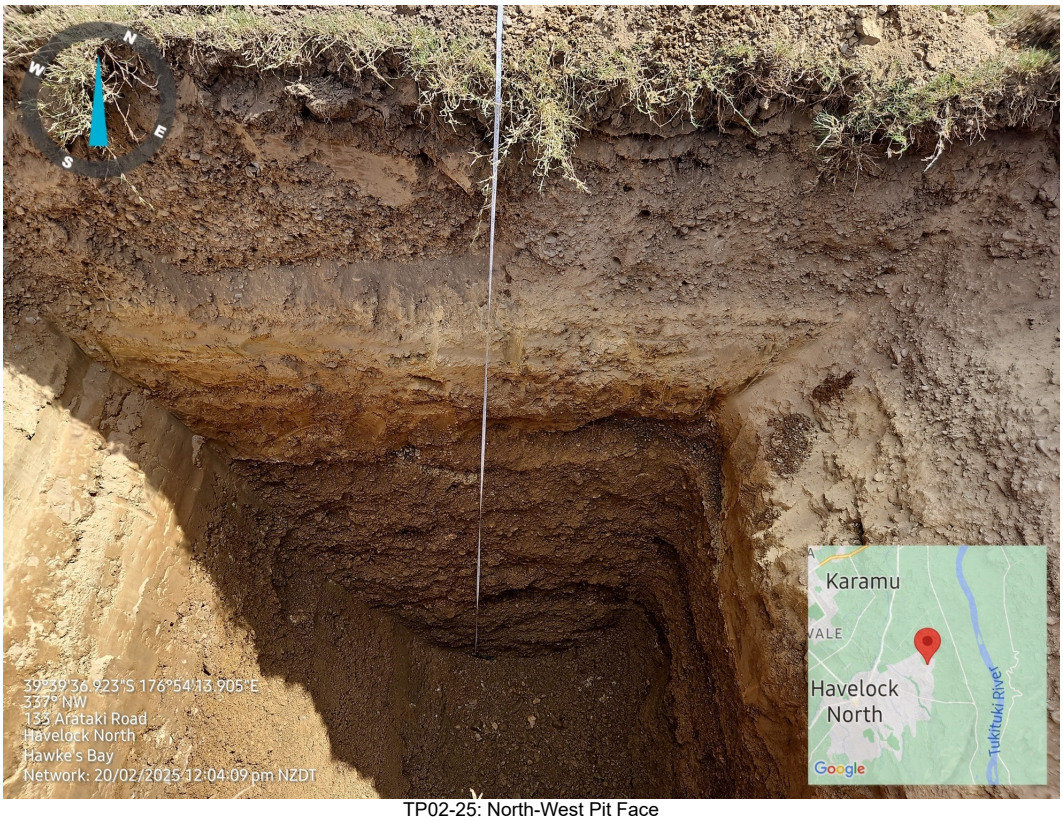
TP02-25: East Pit Face




TP02-25: North-West Pit Face

# PHOTOGRAPH SHEET - TP03-25

Client: CDL Land NZ Ltd
Project: Arataki Residential Subdivision
Location: Havelock North
Project ID: NAP2024-0007
Date: 20/02/2025

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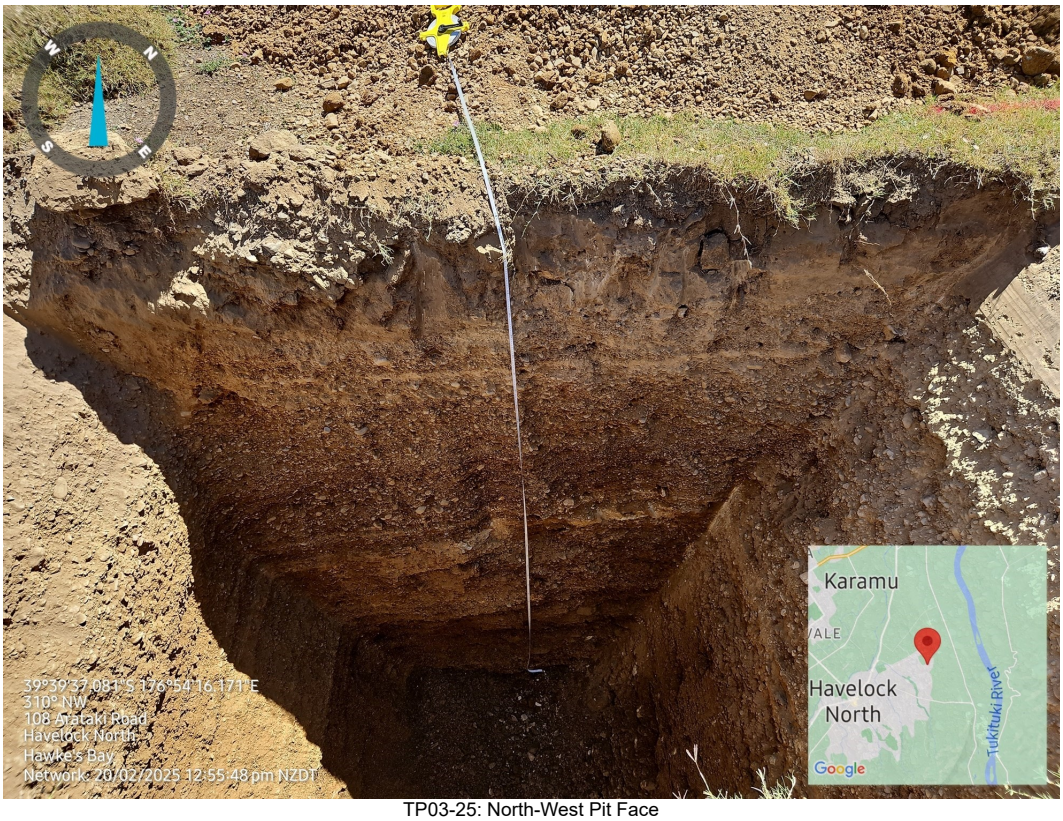
TP03-25: North-East Pit Face




TP03-25: North-West Pit Face

# PHOTOGRAPH SHEET - TP04-25

Client: CDL Land NZ Ltd
Project: Arataki Residential Subdivision
Location: Havelock North
Project ID: NAP2024-0007
Date: 20/02/2025

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TP04-25: East Pit Face


TP04-25: North Pit Face

This borehole report must be read in conjunction with accompanying notes and abbreviations. It has been prepared for geotechnical purposes only, without attempt to assess possible contamination.

# PHOTOGRAPH SHEET - TP05-25

Client: CDL Land NZ Ltd
Project: Arataki Residential Subdivision
Location: Havelock North
Project ID: NAP2024-0007
Date: 20/02/2025

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TP05-25: North-East Pit Face


TP05-25: South-East Pit Face

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# APPENDIX E
## Natural Hazard Risk Assessment

# NATURAL HAZARDS RISK ASSESSMENT FOR LAND SUBDIVISION

Proposed Rural Residential Subdivision, Arataki and Brookvale Roads, Havelock North

# 1 CONTEXT

Section 106 of the Resource Management Act (RMA) requires an assessment of the risk from natural hazards to be carried out when considering the granting of a subdivision consent. S106 RMA specifically states that the assessment must consider the combined effect of the natural hazard likelihood and material damage to land, other land, or structures (consequence).

Section 2 of the RMA defines natural hazards as any atmospheric or earth or water related occurrence (including earthquake, tsunami, erosion, volcanic and geothermal activity, landslip, subsidence, sedimentation, wind, drought, fire, or flooding) the action of which adversely affects or may adversely affect human life, property, or other aspects of the environment.

This appendix to CMW report reference NAP2024-0007 Rev 0 sets out the criteria for and presents the results of an assessment of the geotechnical-related natural hazards associated with this proposed subdivision development. The remaining hazards, i.e. tsunami, wind, drought, fire, and flooding hazards are not covered by this assessment.

# 2 BASIS OF ASSESSMENT

## 2.1 Risk Classification

The occurrence of natural hazards and their potential impacts on the proposed subdivision development is assessed in terms of risk significance, which is based on likelihood and consequence factors. A risk table is used to help assess the likelihood and consequence factors, the form of which used by CMW for this project is presented in Table B1.

**Table B1: Natural Hazard Risk Classification**

| Risk Matrix | | Consequence | | | | |
|---|---|---|---|---|---|---|
| | | Insignificant 1 | Minor 2 | Moderate 3 | Major 4 | Catastrophic 5 |
| Likelihood | Almost Certain 5 | Medium 5 | High 10 | Very high 15 | Extreme 20 | Extreme 25 |
| | Likely 4 | Low 4 | Medium 8 | High 12 | Very high 16 | Extreme 20 |
| | Moderate 3 | Low 3 | Medium 6 | Medium 9 | High 12 | Very high 15 |
| | Unlikely 2 | Very low 2 | Low 4 | Medium 6 | Medium 8 | High 10 |
| | Rare 1 | Very low 1 | Very low 2 | Low 3 | Low 4 | Medium 5 |

## 2.2 Likelihood

With respect to assessing the likelihood or chance of the risk occurring, the qualitative definitions used by CMW for this project are provided in Table B2 for each likelihood classification.

| Table B2: Qualitative Natural Hazard Likelihood Definitions | | |
|---|---|---|
| 1 | Rare | The natural hazard is not expected to occur during the design life of the project |
| 2 | Unlikely | The natural hazard is unlikely, but may occur during the design life |
| 3 | Moderate | The natural hazard will probably occur at some time during the life of the project |
| 4 | Likely | The natural hazard is expected to occur during the design life of the project |
| 5 | Almost Certain | The natural hazard will almost definitely occur during the design life of the project |

## 2.3 Consequence

In terms of determining the consequence or severity of the natural hazard occurring, the qualitative definitions used by CMW for this project are provided in Table B3 for each consequence classification.

| Table B3: Qualitative Natural Hazard Consequence Definitions | | |
|---|---|---|
| 1 | Insignificant | Very minor to no damage, not requiring any repair, no people at risk, no economic effect to landowners. |
| 2 | Minor | Minor damage to land only, any repairs can be considered normal property maintenance no people at risk, very minor economic effect. |
| 3 | Moderate | Some damage to land requiring repair to reinstate within few months, minor cosmetic damage to buildings being within relevant code tolerances, does not require immediate repair, no people at risk, minor economic effect. |
| 4 | Major | Significant damage to land requiring immediate repair, damage to buildings beyond serviceable limits requiring repair, no collapse of structures, perceptible effect to people, no risk to life, considerable economic effect. |
| 5 | Catastrophic | Major damage to land and buildings, possible structure collapse requiring replacement, risk to life, major economic effect, or possible site abandonment. |

## 2.4 Risk Acceptance

It is recognised that the natural hazard risk assessment provided herein is qualitative and, due to the wide range of possible geohazards that could occur, is somewhat subjective. Other methods are available to quantitatively assess an acceptable level of geotechnical related natural hazard risk, such as defining an acceptable factor of safety with respect to slope stability or acceptable differential ground settlements with respect to recommended building code limits.

Therefore, to give this qualitative natural hazard risk assessment some relevance to more commonly adopted numerical or quantitative geotechnical assessment techniques, a residual risk rating of very low to medium (risk value = 1 to 9 inclusive) is considered an acceptable result for the proposed subdivision development.

A risk rating of high to extreme (risk value ≥ 10) is considered an unacceptable result for the proposed subdivision development.

# 3 RISK ASSESSMENT

The natural hazards relevant to this proposed subdivision development and adjacent, potentially affected land have been assessed with respect to the criteria outlined above.

Assessment is based on proposed post development ground conditions with and without any geotechnical controls. The latent risk was first assessed with the site in its proposed developed state to consider the risks to the development and surrounding land, including assessment of land modifications from the pre-existing natural state, without any implemented geotechnical controls. The specific geotechnical mitigation measures and engineering design solutions outlined in the table below and CMW report, where relevant, were then considered to determine the natural hazard residual risk remaining after the proposed controls have been implemented.

Results of this assessment are presented in Table C1 below.

| Table C1: Natural Hazard Risk Assessment Results | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| RMA S2 Hazard | Description | Proposed Site Latent Risk of Damage to Land / Structures | | | Comments and Geotechnical Control | Proposed Site Residual Risk of Damage to Land / Structures OR Acceleration / Worsening of Hazard with Geotechnical Controls Implemented | | | |
| | | Likelihood | Consequence | Risk Rating | | Likelihood | Consequence | Risk Rating | |
| Earthquake | Fault Rupture | 1 | 3 | Low 3 | The closest known active fault is approximately 3.0km to the east of the site. Site is located outside of fault avoidance zone. | 1 | 3 | Low 3 | |
| | Liquefaction Induced Flooding and/ or Subsidence | 1 | 3 | Low 3 | risk of liquefaction considered low due to the deep groundwater level and composition/density of subsoils | 1 | 3 | Low 3 | |
| | Lateral Spread | 1 | 3 | Low 3 | Low risk due to low liquefaction susceptibility. | 1 | 3 | Low 3 | |
| Volcanic Activity | Ash & Pyroclastic Falls | 1 | 2 | Very Low 2 | Low risk due to distance from closest active volcano | 1 | 2 | Very Low 2 | |
| | Lava flows & Lahars | 1 | 2 | Very Low 2 | Low risk due to distance from closest active volcano | 1 | 2 | Very Low 2 | |
| Geothermal Activity | Formation of geysers, hot springs, fumaroles, mud pools | 1 | 2 | Very Low 2 | Low risk due to distance from closest known geothermal area | 1 | 2 | Very Low 2 | |
| Erosion | Cut & Fill Batters | 2 | 3 | Medium 6 | Cut or fill batters to be retained or formed at batter angles no steeper than 1(V):2.5(H). | 1 | 3 | Low 3 | |
| Landslip | Global Slope Instability | 3 | 4 | Very high 12 | A building restriction line has been implemented to mitigate risk of instability affecting future building development. | 1 | 4 | Low 4 | |
| | Cut & Fill Batter Instability | 2 | 3 | Medium 6 | Cut or fill batters to be retained or formed at batter angles no steeper than 1(V):2.5(H). | 1 | 3 | Low 3 | |

| Table C1: Natural Hazard Risk Assessment Results | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| RMA S2 Hazard | Description | Proposed Site Latent Risk of Damage to Land / Structures | | | Comments and Geotechnical Control | Proposed Site Residual Risk of Damage to Land / Structures OR Acceleration / Worsening of Hazard with Geotechnical Controls Implemented | | | |
| | | Likelihood | Consequence | Risk Rating | | Likelihood | Consequence | Risk Rating | |
| Subsidence | Soft Soils | 2 | 3 | Medium 6 | Undercut and remove any surficial soft soils and replace with engineered fill. Geotechnical engineer to observe building platform preparation | 1 | 3 | Low 3 | |
| Sedimentation | Rockfall, Debris Inundation | 1 | 2 | Very Low 2 | Development is situated away from the toe of any steep escarpments. | 1 | 2 | Very Low 2 | |

Notes:

- Assessments include the impact of the proposed subdivision works on adjacent properties.
- The following reference(s) contain information on the hazards contained in this assessment and the non-geotechnical hazards that have not been included:
    - **Hawke's Bay Hazard Portal**
      https://gis.hbrc.govt.nz/hazards/

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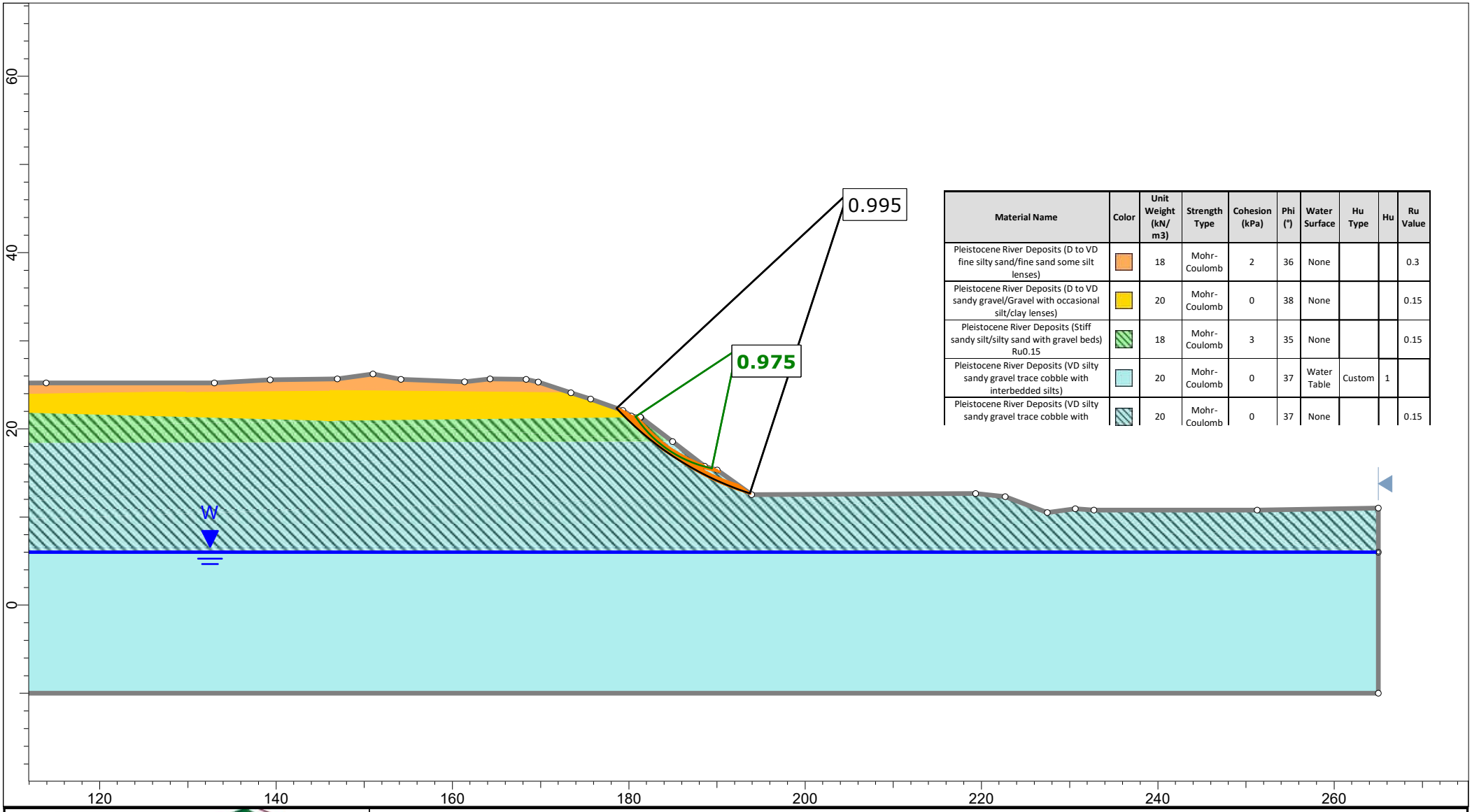
# APPENDIX F
## Slope Stability Analysis




| Material Name | Color | Unit Weight (kN/m3) | Strength Type | Cohesion (kPa) | Phi (°) | Water Surface | Hu Type | Hu | Ru Value |
|---|---|---|---|---|---|---|---|---|---|
| Pleistocene River Deposits (D to VD fine silty sand/fine sand some silt lenses) | | 18 | Mohr-Coulomb | 2 | 36 | None | | | 0.3 |
| Pleistocene River Deposits (D to VD sandy gravel/Gravel with occasional silt/clay lenses) | | 20 | Mohr-Coulomb | 0 | 38 | None | | | 0.15 |
| Pleistocene River Deposits (Stiff sandy silt/silty sand with gravel beds) Ru0.15 | | 18 | Mohr-Coulomb | 3 | 35 | None | | | 0.15 |
| Pleistocene River Deposits (VD silty sandy gravel trace cobble with interbedded silts) | | 20 | Mohr-Coulomb | 0 | 37 | Water Table | Custom | 1 | |
| Pleistocene River Deposits (VD silty sandy gravel trace cobble with | | 20 | Mohr-Coulomb | 0 | 37 | None | | | 0.15 |

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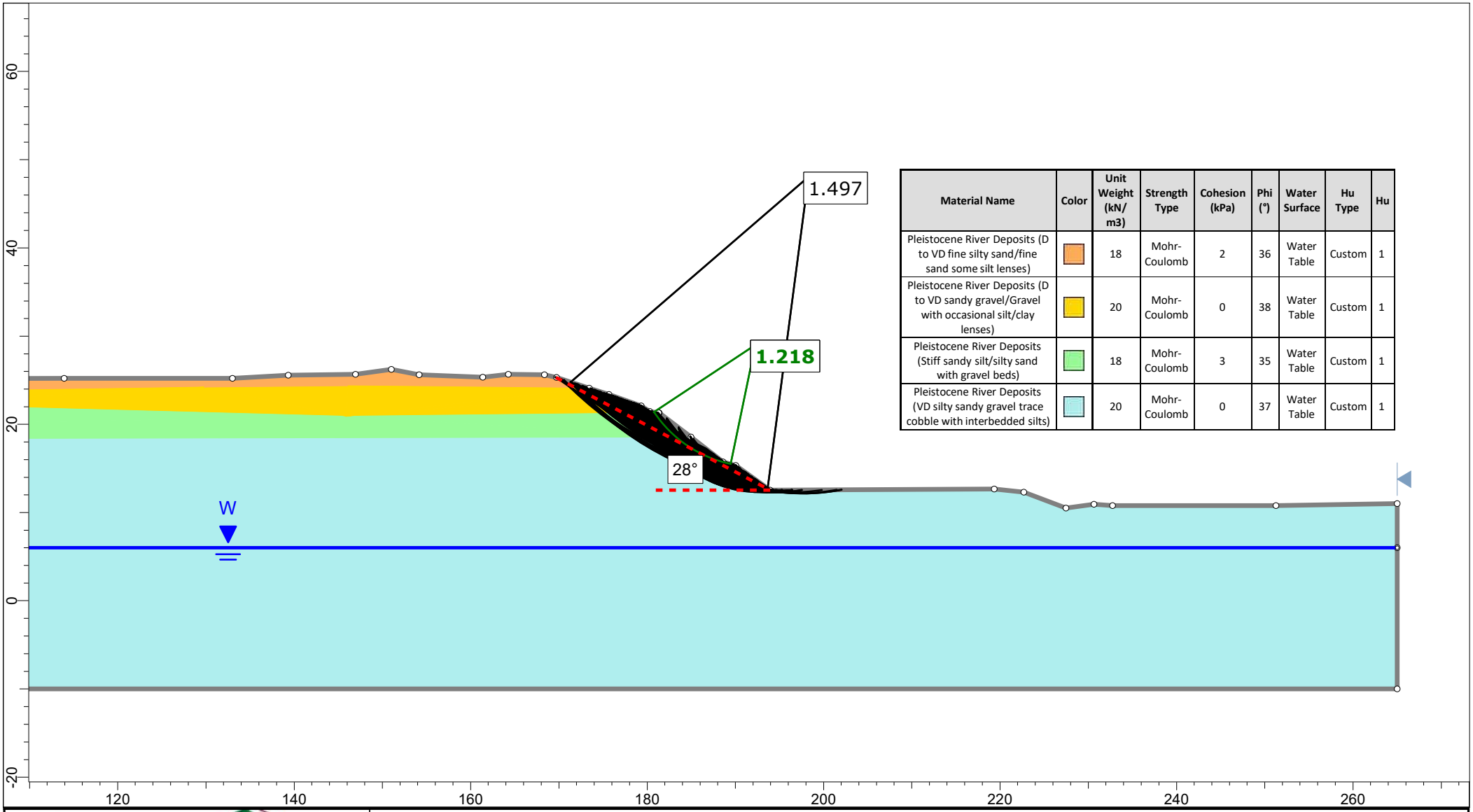
| | | | |
|---|---|---|---|
| *Project* | Arataki and Brookvale Roads, Havelock North | | |
| *Group* | Cross Section A | *Scenario* | Back Analysis |
| Client | CDL Land New Zealand Ltd | *Company* | CMW Geosciences |
| *Date* | 10/04/2025 | *File Name* | Slope Stability - KB.slmd |

SLIDEINTERPRET 9.034




| Material Name | Color | Unit Weight (kN/m3) | Strength Type | Cohesion (kPa) | Phi (°) | Water Surface | Hu Type | Hu |
|---|---|---|---|---|---|---|---|---|
| Pleistocene River Deposits (D to VD fine silty sand/fine sand some silt lenses) | | 18 | Mohr-Coulomb | 2 | 36 | Water Table | Custom | 1 |
| Pleistocene River Deposits (D to VD sandy gravel/Gravel with occasional silt/clay lenses) | | 20 | Mohr-Coulomb | 0 | 38 | Water Table | Custom | 1 |
| Pleistocene River Deposits (Stiff sandy silt/silty sand with gravel beds) | | 18 | Mohr-Coulomb | 3 | 35 | Water Table | Custom | 1 |
| Pleistocene River Deposits (VD silty sandy gravel trace cobble with interbedded silts) | | 20 | Mohr-Coulomb | 0 | 37 | Water Table | Custom | 1 |

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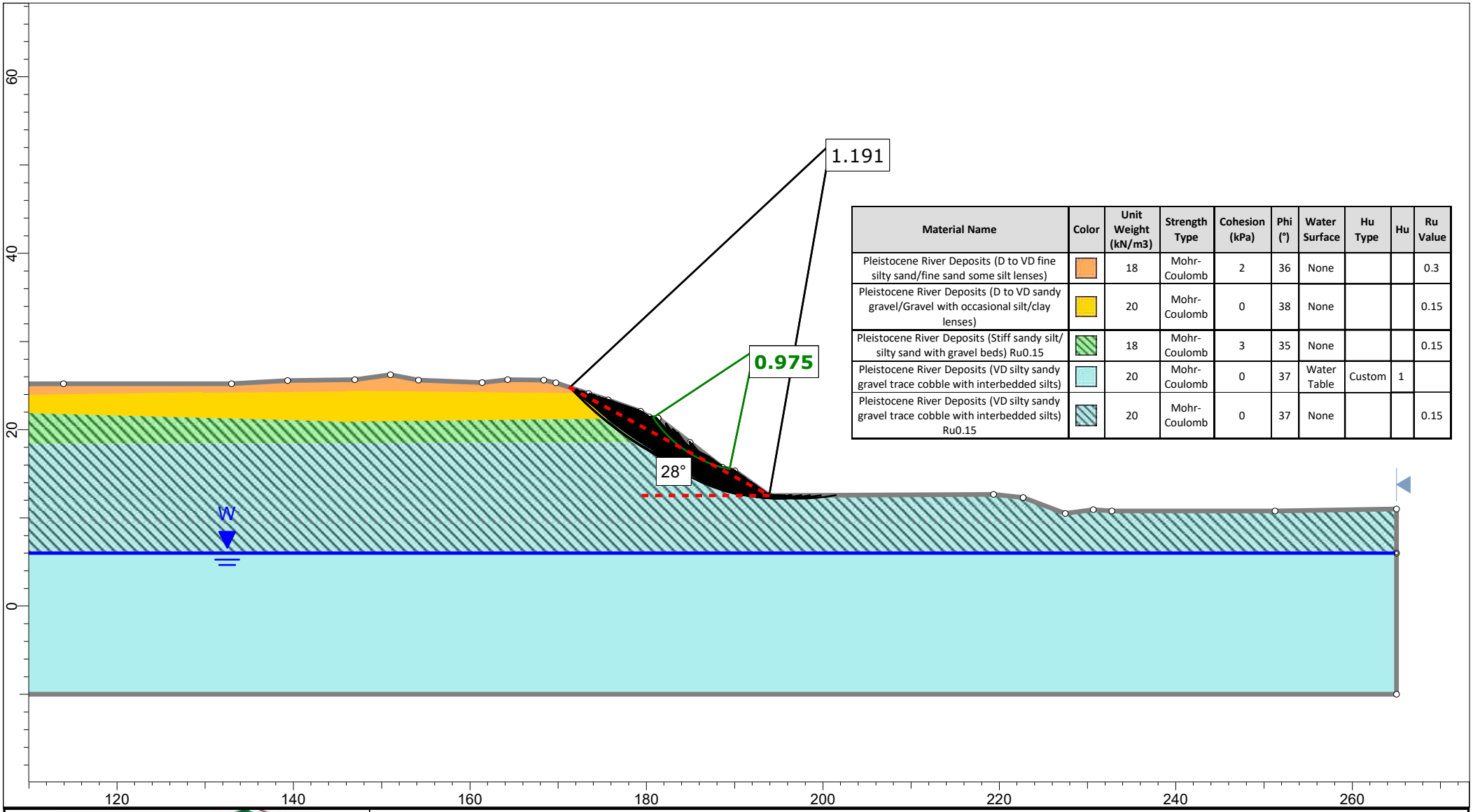
| | | | |
|---|---|---|---|
| *Project* | Arataki and Brookvale Roads, Havelock North | | |
| *Group* | Cross Section A | *Scenario* | Prevailing |
| Client | CDL Land New Zealand Ltd | *Company* | CMW Geosciences |
| *Date* | 10/04/2025 | *File Name* | Slope Stability - KB.slmd |




| Material Name | Color | Unit Weight (kN/m3) | Strength Type | Cohesion (kPa) | Phi (°) | Water Surface | Hu Type | Hu | Ru Value |
|---|---|---|---|---|---|---|---|---|---|
| Pleistocene River Deposits (D to VD fine silty sand/fine sand some silt lenses) | | 18 | Mohr-Coulomb | 2 | 36 | None | | | 0.3 |
| Pleistocene River Deposits (D to VD sandy gravel/Gravel with occasional silt/clay lenses) | | 20 | Mohr-Coulomb | 0 | 38 | None | | | 0.15 |
| Pleistocene River Deposits (Stiff sandy silt/ silty sand with gravel beds) Ru0.15 | | 18 | Mohr-Coulomb | 3 | 35 | None | | | 0.15 |
| Pleistocene River Deposits (VD silty sandy gravel trace cobble with interbedded silts) | | 20 | Mohr-Coulomb | 0 | 37 | Water Table | Custom | 1 | |
| Pleistocene River Deposits (VD silty sandy gravel trace cobble with interbedded silts) Ru0.15 | | 20 | Mohr-Coulomb | 0 | 37 | None | | | 0.15 |

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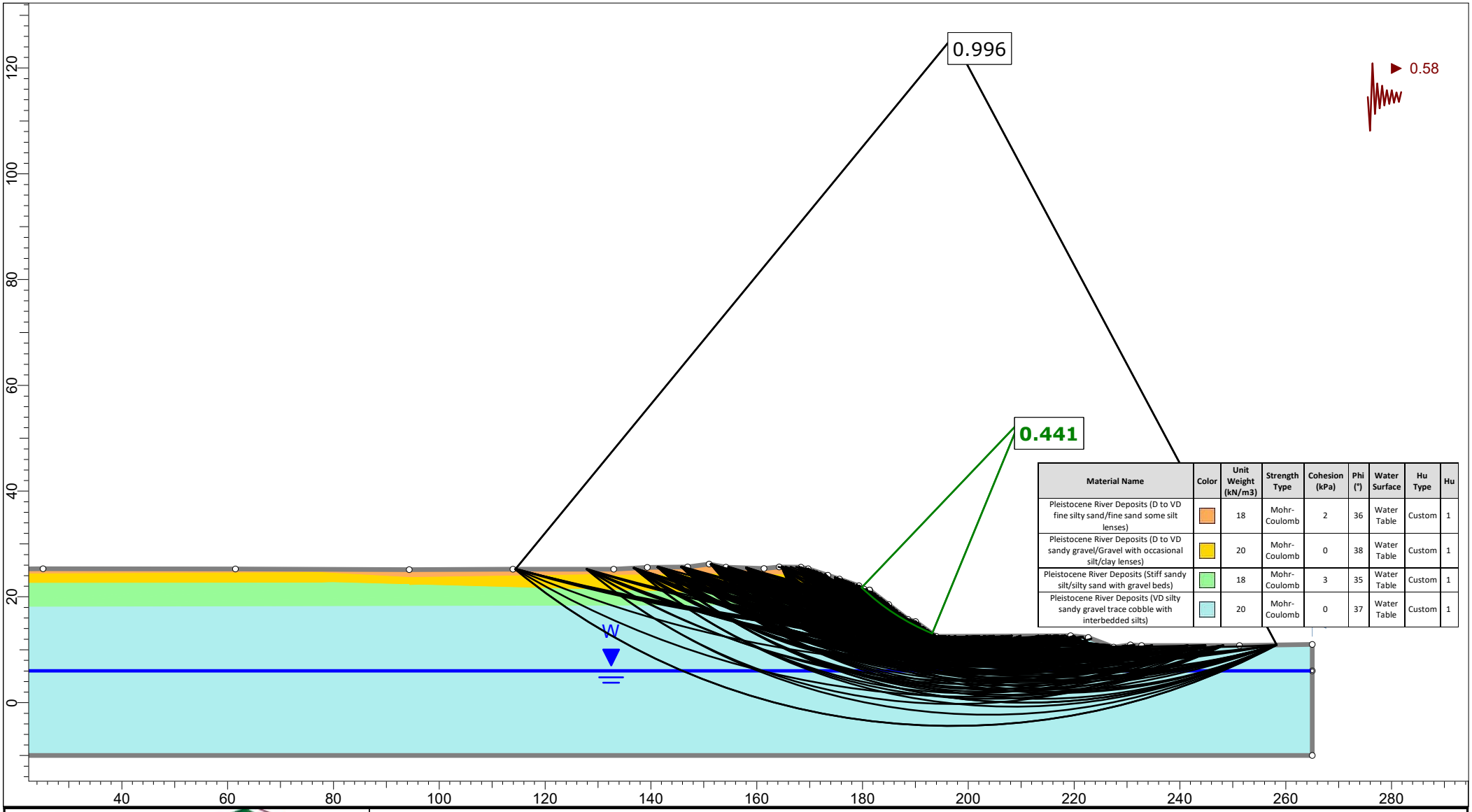
| | | | |
|---|---|---|---|
| *Project* | Arataki and Brookvale Roads, Havelock North | | |
| *Group* | Cross Section A | *Scenario* | Transient |
| Client | CDL Land New Zealand Ltd | *Company* | CMW Geosciences |
| *Date* | 10/04/2025 | *File Name* | Slope Stability - KB.slmd |

SLIDEINTERPRET 9.034




| Material Name | Color | Unit Weight (kN/m3) | Strength Type | Cohesion (kPa) | Phi (°) | Water Surface | Hu Type | Hu |
|---|---|---|---|---|---|---|---|---|
| Pleistocene River Deposits (D to VD fine silty sand/fine sand some silt lenses) | | 18 | Mohr-Coulomb | 2 | 36 | Water Table | Custom | 1 |
| Pleistocene River Deposits (D to VD sandy gravel/Gravel with occasional silt/clay lenses) | | 20 | Mohr-Coulomb | 0 | 38 | Water Table | Custom | 1 |
| Pleistocene River Deposits (Stiff sandy silt/silty sand with gravel beds) | | 18 | Mohr-Coulomb | 3 | 35 | Water Table | Custom | 1 |
| Pleistocene River Deposits (VD silty sandy gravel trace cobble with interbedded silts) | | 20 | Mohr-Coulomb | 0 | 37 | Water Table | Custom | 1 |

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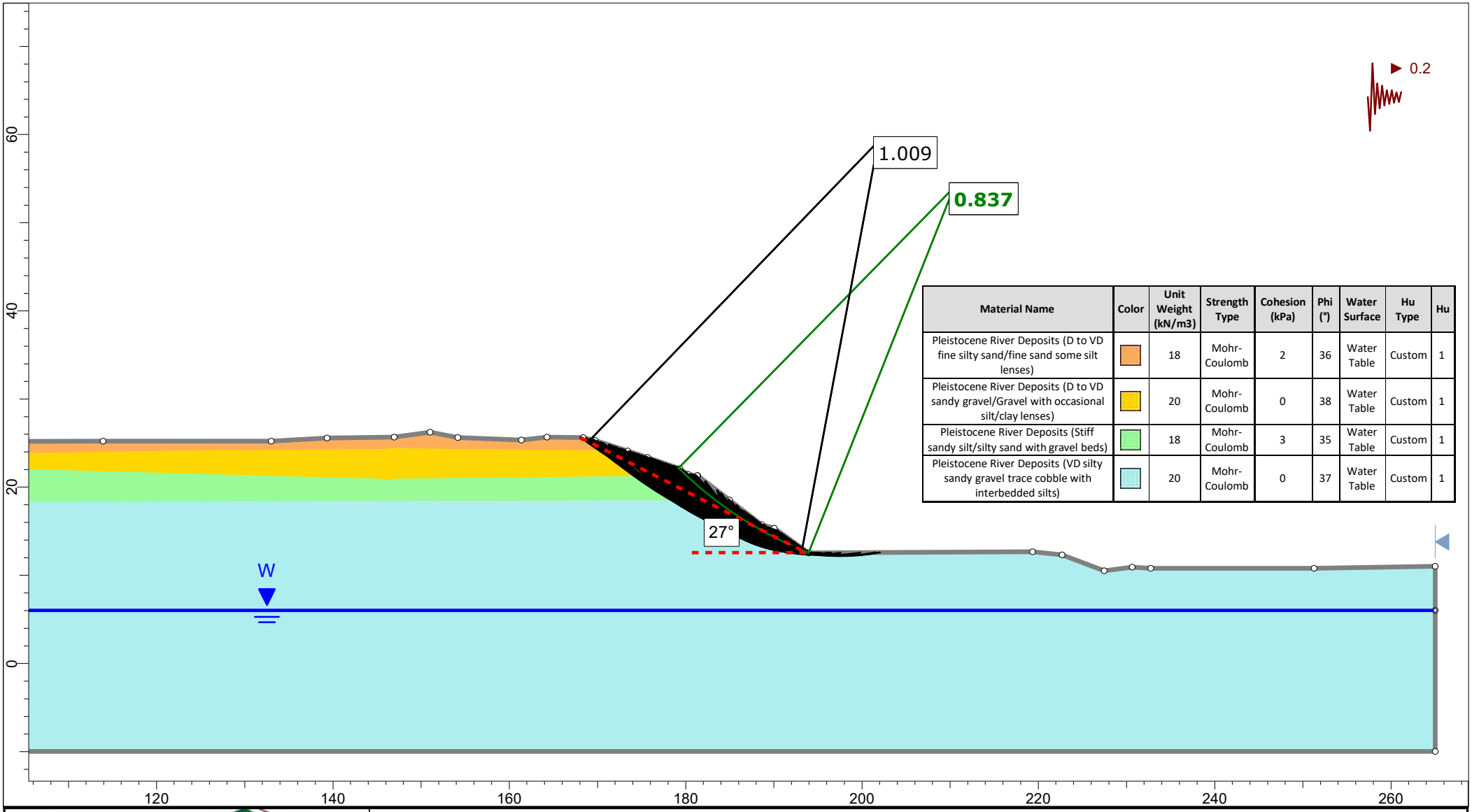
| | | | |
|---|---|---|---|
| *Project* | Arataki and Brookvale Roads, Havelock North | | |
| *Group* | Cross Section A | *Scenario* | Seismic |
| Client | CDL Land New Zealand Ltd | *Company* | CMW Geosciences |
| *Date* | 10/04/2025 | *File Name* | Slope Stability - KB.slmd |

SLIDEINTERPRET 9.034




| Material Name | Color | Unit Weight (kN/m3) | Strength Type | Cohesion (kPa) | Phi (°) | Water Surface | Hu Type | Hu |
|---|---|---|---|---|---|---|---|---|
| Pleistocene River Deposits (D to VD fine silty sand/fine sand some silt lenses) | | 18 | Mohr-Coulomb | 2 | 36 | Water Table | Custom | 1 |
| Pleistocene River Deposits (D to VD sandy gravel/Gravel with occasional silt/clay lenses) | | 20 | Mohr-Coulomb | 0 | 38 | Water Table | Custom | 1 |
| Pleistocene River Deposits (Stiff sandy silt/silty sand with gravel beds) | | 18 | Mohr-Coulomb | 3 | 35 | Water Table | Custom | 1 |
| Pleistocene River Deposits (VD silty sandy gravel trace cobble with interbedded silts) | | 20 | Mohr-Coulomb | 0 | 37 | Water Table | Custom | 1 |

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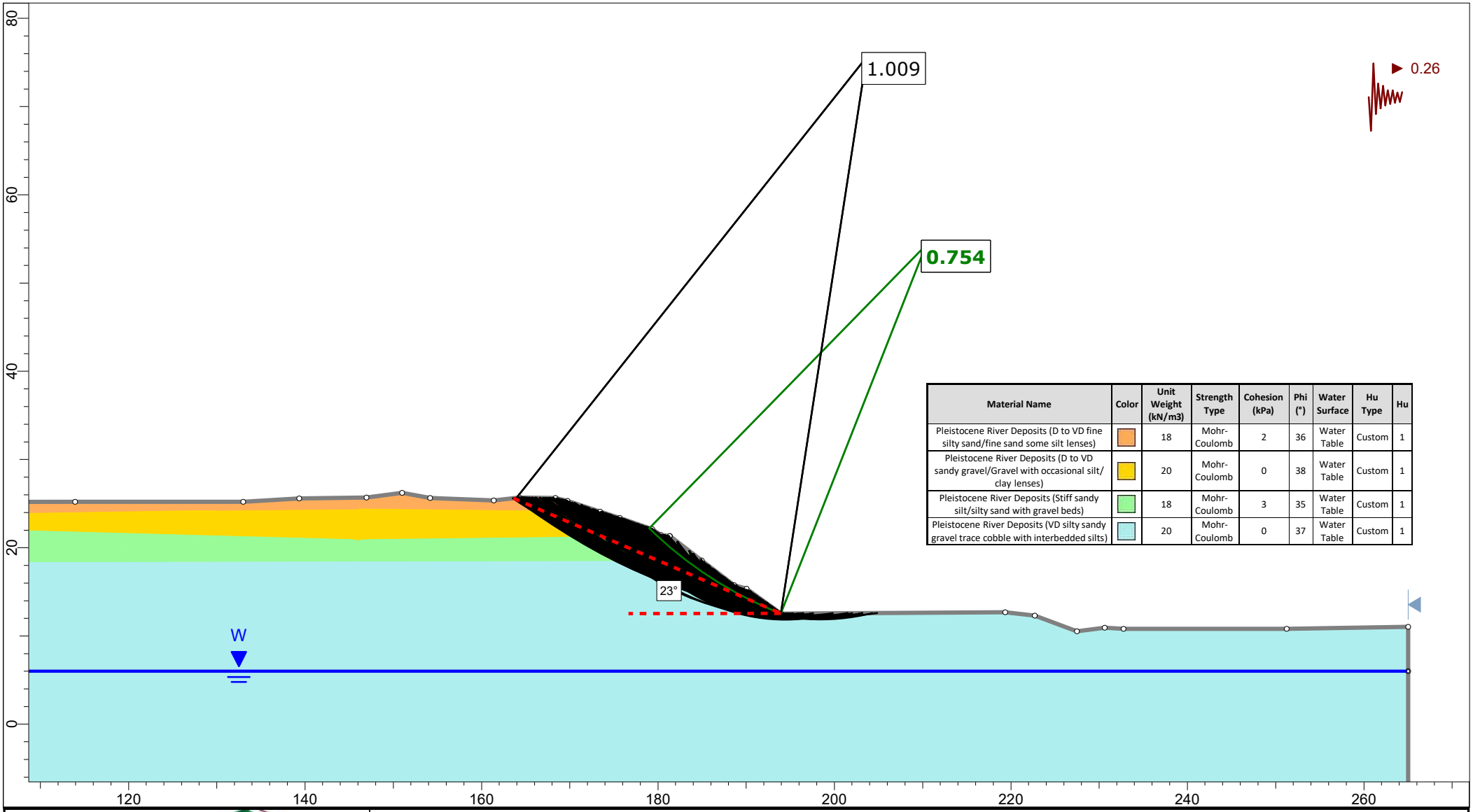
| | | | |
|---|---|---|---|
| *Project* | Arataki and Brookvale Roads, Havelock North | | |
| *Group* | Cross Section A | *Scenario* | Seismic Yield 1:2 |
| Client | CDL Land New Zealand Ltd | *Company* | CMW Geosciences |
| *Date* | 10/04/2025 | *File Name* | Slope Stability - KB.slmd |




| Material Name | Color | Unit Weight (kN/m3) | Strength Type | Cohesion (kPa) | Phi (°) | Water Surface | Hu Type | Hu |
|---|---|---|---|---|---|---|---|---|
| Pleistocene River Deposits (D to VD fine silty sand/fine sand some silt lenses) | | 18 | Mohr-Coulomb | 2 | 36 | Water Table | Custom | 1 |
| Pleistocene River Deposits (D to VD sandy gravel/Gravel with occasional silt/clay lenses) | | 20 | Mohr-Coulomb | 0 | 38 | Water Table | Custom | 1 |
| Pleistocene River Deposits (Stiff sandy silt/silty sand with gravel beds) | | 18 | Mohr-Coulomb | 3 | 35 | Water Table | Custom | 1 |
| Pleistocene River Deposits (VD silty sandy gravel trace cobble with interbedded silts) | | 20 | Mohr-Coulomb | 0 | 37 | Water Table | Custom | 1 |

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| | | | |
|---|---|---|---|
| *Project* | Arataki and Brookvale Roads, Havelock North | | |
| *Group* | Cross Section A | *Scenario* | Seismic Yield 1:2.2 |
| Client | CDL Land New Zealand Ltd | *Company* | CMW Geosciences |
| *Date* | 10/04/2025 | *File Name* | Slope Stability - KB.slmd |

SLIDEINTERPRET 9.034

| | | | |
|---|---|---|---|
| CMW Geosciences<br>Great People \| Practical Solutions | CLIENT: **CDL Land New Zealand Ltd** | DESIGNER: | MK |
| | PROJECT: **Arataki and Brookvale Roads, Havelock North** | CHECKED: | KB |
| | | REVISION: | 7 |
| | TITLE: **COSEISMIC DISPLACEMENTS (1V:2.2H)** | DATE: | 10/04/2025 |
| | | PROJECT: | NAP2024-0007 |

**WHEN TO USE THIS SHEET:**
Use this sheet when calculating the coseismic displacements of a slip using peak strength parameters.

**1. INPUT PARAMETERS**

| | | | |
|---|---|---|---|
| $a_c$ | 0.26 | g | *Yeild Acceleration (Factor of Safety = 1 with non-liquefied soil strengths)* |
| PGA | 0.58 | g | *Design Peak Ground Acceleration* |
| M | 7.1 | | *Earthquake Magnitude* |
| h | 20 | km | *Focal Depth* |
| d | 3 | km | *Source Distance* |

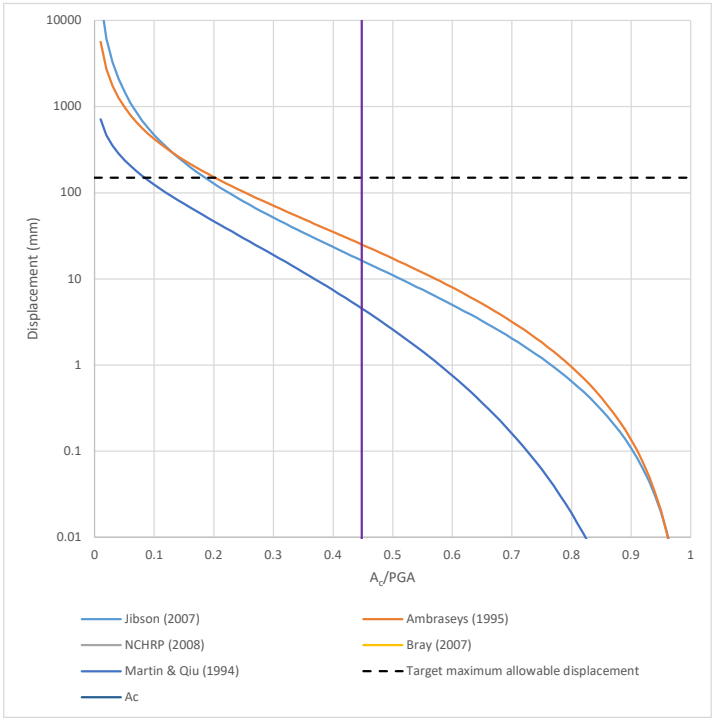
| | |
|---|---|
| ac/PGA | 0.44828 |
| r | 20.2237 |
| PGV/PGA Factor | 60 |

**2. RESULTS**

| | Peak Strengths | | |
|---|---|---|---|
| **Probability of Exceedence:** | **Jibson (2007)** | **Ambraseys (1995)** | **Martin & Qiu (1994)** |
| 50% | 16 mm | 25 mm | 5 mm |
| 16% | 46 mm | 95 mm | |
| 5% | 91 mm | 225 mm | |
| 2.5% | 127 mm | 343 mm | |
| 0.5% | 241 mm | 781 mm | |

**3. CHART OPTIONS**

Displacements Limit 150 mm



| | | | |
|---|---|---|---|
| CMW Geosciences<br>Great People \| Practical Solutions | CLIENT: **CDL Land New Zealand Ltd** | DESIGNER: | MK |
| | PROJECT: **Arataki and Brookvale Roads, Havelock North** | CHECKED: | KB |
| | | REVISION: | 7 |
| | TITLE: **COSEISMIC DISPLACEMENTS (1V:2H)** | DATE: | 10/04/2025 |
| | | PROJECT: | NAP2024-0007 |

**WHEN TO USE THIS SHEET:**
Use this sheet when calculating the coseismic displacements of a slip using peak strength parameters.

**1. INPUT PARAMETERS**

| | | | |
|---|---|---|---|
| $a_c$ | 0.2 | g | *Yeild Acceleration (Factor of Safety = 1 with non-liquefied soil strengths)* |
| PGA | 0.58 | g | *Design Peak Ground Acceleration* |
| M | 7.1 | | *Earthquake Magnitude* |
| h | 20 | km | *Focal Depth* |
| d | 3 | km | *Source Distance* |

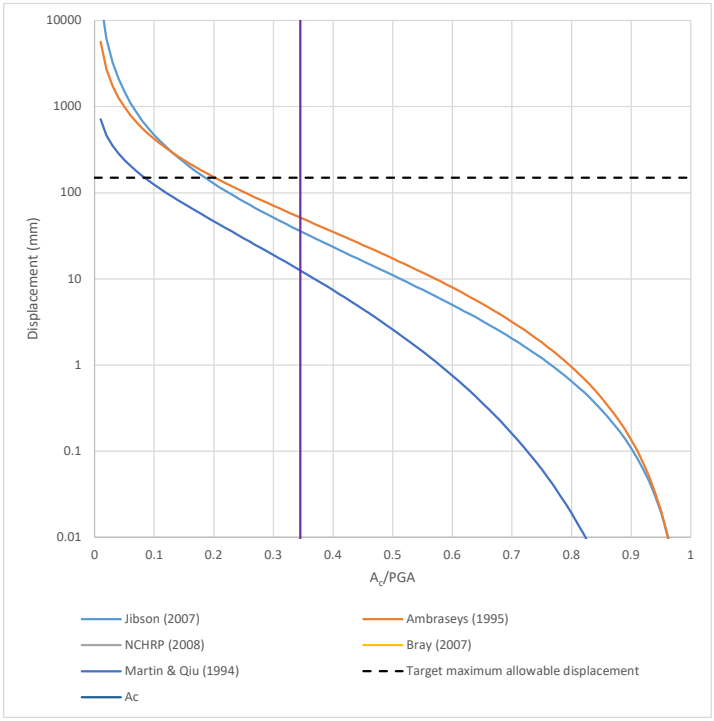
| | |
|---|---|
| ac/PGA | 0.34483 |
| r | 20.2237 |
| PGV/PGA Factor | 60 |

**2. RESULTS**

| | Peak Strengths | | |
|---|---|---|---|
| **Probability of Exceedence:** | **Jibson (2007)** | **Ambraseys (1995)** | **Martin & Qiu (1994)** |
| 50% | 36 mm | 51 mm | 13 mm |
| 16% | 102 mm | 196 mm | |
| 5% | 200 mm | 463 mm | |
| 2.5% | 279 mm | 705 mm | |
| 0.5% | 530 mm | 1606 mm | |

**3. CHART OPTIONS**

Displacements Limit 150 mm



| | | | |
|---|---|---|---|
| CMW Geosciences<br>Great People \| Practical Solutions | CLIENT: **CDL Land New Zealand Ltd** | DESIGNER: | MK |
| | PROJECT: **Arataki and Brookvale Roads, Havelock North** | CHECKED: | KB |
| | | REVISION: | 7 |
| | TITLE: **COSEISMIC DISPLACEMENTS (Worst Case)** | DATE: | 10/04/2025 |
| | | PROJECT: | NAP2024-0007 |

**WHEN TO USE THIS SHEET:**
Use this sheet when calculating the coseismic displacements of a slip using peak strength parameters.

**1. INPUT PARAMETERS**

| | | | |
|---|---|---|---|
| $a_c$ | 0.1 | g | *Yeild Acceleration (Factor of Safety = 1 with non-liquefied soil strengths)* |
| PGA | 0.58 | g | *Design Peak Ground Acceleration* |
| M | 7.1 | | *Earthquake Magnitude* |
| h | 20 | km | *Focal Depth* |
| d | 3 | km | *Source Distance* |

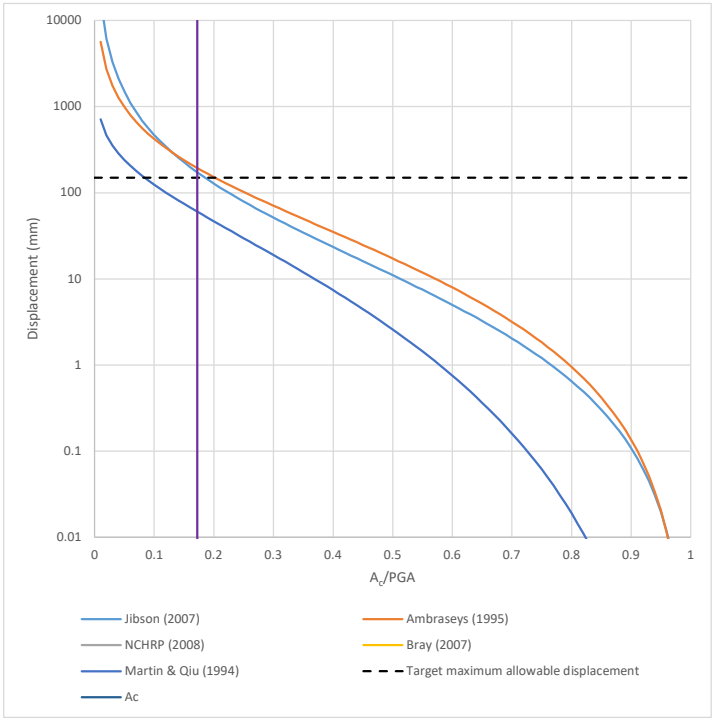
| | |
|---|---|
| ac/PGA | 0.17241 |
| r | 20.2237 |
| PGV/PGA Factor | 60 |

**2. RESULTS**

| | Peak Strengths | | |
|---|---|---|---|
| **Probability of Exceedence:** | **Jibson (2007)** | **Ambraseys (1995)** | **Martin & Qiu (1994)** |
| 50% | 173 mm | 193 mm | 60 mm |
| 16% | 491 mm | 735 mm | |
| 5% | 963 mm | 1740 mm | |
| 2.5% | 1339 mm | 2650 mm | |
| 0.5% | 2549 mm | 6033 mm | |

**3. CHART OPTIONS**

Displacements Limit 150 mm



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# APPENDIX G

## Stormwater Dry Basin Design Report Contents Page

# GEOTECHNICAL DESIGN OF STORMWATER DRY BASIN


**Napier**

6 Ossian Street
Ahuriri
Napier 4110
New Zealand

www.cmwgeosciences.com