26 July 2024

RURAL SUBDIVISION

PALLISER DOWNS STAGE 1B

GEOTECHNICAL COMPLETION REPORT

Cabra Rural Developments Limited / Rahopara Farms Limited

AKL2019-0017AI Rev 1

AKL2019-0017AI		
Date	**Revision**	**Comments**
29 April 2024	A	Initial draft for internal review
25 June 2024	0	Initial issue to client
23 July 2024	B	Internal revision with additional lot 44 information
26 July 2024	1	Re-issue to client

	Name	Signature	Position
Prepared by	Navneel Karan		Engineering Geologist
Reviewed by	Richard Knowles		Principal Geotechnical Engineer CMEngNZ, CPEng
Authorised by	Chris Ritchie		Principal Engineering Geologist CMEngNZ, PEngGeol

For and on behalf of CMW Geotechnical NZ Limited

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NO TABLE OF FIGURES ENTRIES FOUND.

1 INTRODUCTION

In accordance with our instructions, this Geotechnical Completion Report has been prepared for Cabra Rural Developments Limited / Rahopara Farms Limited as part of the documentation to be submitted to Auckland Council following earthworks to form Stage 1B of the Palliser Downs development.

This report covers the construction period March 2022 to April 2024 and is intended to be used for certification purposes for new lots (listed below) created from existing lots 1 and 2 DP 55674 as follows:

- 3 new rural residential lots numbered lots 41, 44 and 55;
- An extension to an existing cul-de-sac named Ata Rangi Close;

This stage of the Palliser Downs Development is located west of Palliser Downs Drive, Wainui. As can be seen from the as-built plans, building platforms have been formed as follows:

- On lot 41 by cuts and fills each up to 4m deep;
- on lot 44 by cuts up to 6m deep;
- on lot 55 by fills up to 4m deep.

The road alignment has also been filled.

Construction of this subdivision has been undertaken in general accordance with;

- Auckland Council's Resource Consent number SUB60069585-B and Engineering Approval ENG60397250
- NZS4431:1989
- Auckland Council's Code of Practice for Land Development and Subdivision, Chapter 2 - Earthworks and Geotechnical, Version 1.6 dated September 2013.

This development was granted Resource Consent without existing geotechnical investigations. Accordingly, analyses completed to support the recommendations of the report are presented in Appendix F. In granting the Resource Consent, conservatively large on-site wastewater disposal areas were assigned. To date no additional soakage categorisation reporting has been completed.

For the construction of this stage of the development, the following roles were fulfilled as defined in NZS 4431:2022 and the Ministry for the Environment Contaminated Land Management Guidelines:

- Geotechnical Designer: CMW Geotechnical NZ Limited
- Certifier: CMW Geotechnical NZ Limited
- Recognised Laboratory: CMW Geotechnical NZ Limited
- Contractor: Opie Contractors Limited
- Sub-contractor (earthworks): Bob Hick Earthmoving

As CMW has fulfilled the roles of both earth fills Certifier and Geotechnical Designer, this report has been prepared as a combined report covering both of these aspects of the project work.

2 DESCRIPTION OF WORKS

The main earthworks contractor, Bob Hick Earthmoving Limited (BHE), working under Opie Contractors, commenced work on Road 2 through previous stage 1A on 29 March 2022 and worked progressively towards the west along the alignment, reaching the start of the Stage 1B portion of the alignment on 18 May 2022 when the gully muck out for a culvert began. This was backfilled with engineered fill.

There was a break in works at the site between August 2022 and October 2022, due to winter conditions being unsuitable for earthworks, but as work then concentrated in other stage areas, Stage 1B works did not re-commence until the end of 2022. At that time Road 2 was extended to the cul-de-sac and filling was placed to form a building platform on Lot 41 (also numbered as Lot 101 in some documents). In March a shear key was excavated on Lot 55, drained and filled to support proposed further filling on this lot.

Road 2 was stabilised and tested in March 2023 and metal was placed on the road on 18 to 19 April 2023.

Again work concentrated on other portions of the site for a while and the contractors did not return to complete the filling on Lot 55 until December 2023.

The main items of plant used by the earthworks sub-contractors included:

- 1 x CAT 320C Excavator
- 1 x 20T Excavator
- 1 x Cat 815 Padfoot Compactor
- 1 x Moxy Dump Truck
- 1 x Bulldozer

3 GEOTECHNICAL QUALITY CONTROL

3.1 Site Observations

During the works site visits were typically undertaken several times each week to assess compliance with NZS 4431 and project specific design recommendations and specifications.

Site visits were carried out to observe and confirm compliance relating to:

- Adequate topsoil stripping;
- Adequate undercutting in the formation of the lot 55 shear key to
- Fill areas prior to the placement of fill materials to ascertain that all topsoil, existing uncertified fills and soft inorganic subsoils had been removed;
- Installation of subsoil drains, excluding road under-channel drains;
- Backfilling of subsoil drains;
- Placement and compaction of engineered fills.

3.2 Compaction Control

Compaction of engineered earth fills was controlled by undrained shear strength measured by handheld shear vane calibrated using the NZGS 2001 method and by air voids as defined by NZS4402.

The criteria for undrained shear strength were a minimum single value of 100 kPa and minimum average of any 10 consecutive tests of 140 kPa.

The criteria for air voids were a maximum single value of 12% and maximum average of any 10 consecutive tests of 10%.

Vane shear strength, water content and in situ density tests were carried out on all areas of the engineered filling to at least the frequency required by the project specification (1 per 500m^3).

While these tests showed on a few occasions that the contractor was struggling to achieve the required compaction standards with the prevailing site and soil conditions, to the best of our knowledge, all areas of fill were re-worked as necessary. Subsequent testing confirmed compliance with the specification.

4 EVALUATION OF COMPLETED EARTHWORKS

4.1 Natural Hazards

Natural hazards have been assessed for the completed landform across the lots and on each lot a **Stable Building Area** considered suitable for NZS 3604 type building development has been defined as depicted on the appended as-built plans. These areas are considered to be free of the natural hazards described in Section 71(3) of the Building Act, i.e. erosion, falling debris, subsidence, slippage, and inundation.

Consideration of the inundation hazard was outside the scope of CMW's brief and has been assessed by others.

4.1.1 Land Stability

Design of the works to provide appropriate stability conditions that meet regulatory requirements for the land, including grassed, planted and rock-faced batters, has led to earthworks undercuts being completed in some areas to replace low strength soils with engineered fills, and to the installation of subsoil drainage.

Stability conditions for finished ground profiles have been assessed under a range of groundwater conditions which satisfy ultimate limit state design criteria. The soil parameters for the analyses were selected from investigations undertaken at the site and from experience in this terrain. Details of our investigations and analyses are provided in ***Appendix F***.

Stability conditions outside the **Stable Building Areas** may not achieve the same stability conditions as the **Stable Building Areas** and in most cases contain sloping land or are adjacent to sloping land. Accordingly, the following zones of restricted activity have been applied outside the **Stable Building Areas**:

- **Specific Design Zones** – All areas that are not either **Stable Building Areas** or **Bush Covenant Zones**. Development is not prohibited in these areas but it will be subject to specific investigation and design intended to protect any building development from natural hazards, including long term creep effects on or adjacent to steep slopes, and to protect the slopes from inappropriate loading or undermining. These zones include batter areas recently mulched planted as part of the development of the subdivision and areas of historic instability that have not needed to be remediated to create roads, building platforms and accessways.
- **Bush Covenant Zones** – intended to protect areas of established vegetation and to ensure that stability conditions are not able to be compromised.

  Plantings within some areas of the lots is protected by Resource Consent conditions and accordingly vegetation removal, earthworks and building development are prohibited in these areas. These areas are present on all the lots on this stage of the development but are outside the **Stable Building Areas**. Their extents are depicted on the appended C&R Surveyors Limited as-built plans.

  The **Bush Covenant Zones** contain land that has not been evaluated or engineered to improve the natural stability conditions. Land in these areas may be subject to natural hazards as described in section 71(3) of the Building Act however the presence of the existing vegetation in these areas will provide a degree of enhancement to stability conditions as described in Section 4.1.2 below.

Full descriptions of the restrictions associated with these zones are presented in our Opinion on Suitability in ***Appendix A***. Additional information is also provided in some of the following sections.

4.1.2 Erosion

On all sloping land in this geological setting, including on engineered batter slopes, localised surface stability can be compromised, and erosion can be instigated by indiscriminate disposal of concentrated stormwater onto the ground surface and/ or by removal of vegetation. Further comments on stormwater disposal are provided in Section 4.7 below.

On batters, depths of mulch and topsoil should be limited to less than 150mm to minimise the risks of saturation leading to localised slumping on batter face, which is typified by the mulch layer sliding off the clay subgrade beneath. Wherever practical on such land, and particularly on steep batters, any plantings and grass cover should be well maintained as the roots of an established vegetation cover can serve to bind the surface soils, while the foliage can reduce rain infiltration and soil saturation, resulting in better resistance to erosion and shallow slumping.

4.1.3 Liquefaction

The liquefaction risk for the lots on this development has been assessed by review of Auckland Council GIS maps that confirm the damage category to be: Very Low Vulnerability.

4.1.4 Fill Induced Settlement

On the basis of the relatively minor magnitude of fill depths beneath **Stable Building Areas**, together with the elapsed time since it was placed, we consider that remaining post-construction settlements will be within code limits.

4.2 Subsoil Drains and Groundwater

The as-built plans show the positions of subsoil drains and their outlets that were installed during the earthworks as described in the following sub-sections.

Descriptions of restrictions associated with these drains and outlets are contained in our appended Opinion on Suitability in ***Appendix A***.

These drains were installed at the bases of fills, cut benches and shear keys to assist with the earthworks operations by capturing seepages at the cleared ground level. While they require no specific maintenance, they provide ongoing control of groundwater levels and pore water pressure relief to assist with long term stability conditions so their ongoing function should not be compromised by future works.

Typically these drains comprise punched draincoils surrounded by drainage gravel. Specific design details are provided in the project reports and specifications. If drain depths are unclear at specific locations, they can be estimated from the depths of fills depicted on the as-built plans.

4.2.1 Subsoil Drain Outlets

On lots where subsoil drainage discharges to bush it is important that the function of these outlets is maintained. Details of the locations are shown on the as built plans.

4.2.2 Groundwater

Groundwater levels beneath the engineered fills can be expected to be controlled by the underfill drains and should therefore typically be deeper than 2m, subject to seasonal variations.

Based on our work to date we anticipate groundwater levels remaining well below the depth of influence of anticipated earthworks and foundation works for NZS 3604 type dwellings.

4.3 Road Subgrades

Penetration resistance testing was carried out on the road subgrades during construction and the results of this testing were forwarded to Hutchinson Consulting Engineers Limited for pavement remedial design. Where soft

ground with low equivalent CBR values was identified it was generally undercut and hardfill was placed. All road subgrade areas were subsequently lime stabilised to achieve appropriate CBR values.

Benkelman Beam testing of the base course was carried out by Road Test Limited on each road and those results were also forwarded to Hutchinson Consulting Engineers.

4.4 Design of Shallow Foundations in Stable Building Areas

The as-built plans depict the extents of areas described as **Stable Building Areas**. Details for development within these areas are as follows:

4.4.1 Bearing Capacity

Once bulk earthworks and top-soiling of the building platforms had been completed, our staff drilled hand auger boreholes on platforms in natural ground to determine representative finished ground conditions and hence evaluate likely foundation options for future building development. Our assessments of bearing capacity for the design of shallow foundations on each building platform are contained in our Opinion on Suitability in ***Appendix A.***

If higher geotechnical ultimate bearing capacities are required than have been specified, further specific site investigation and design of foundations should be carried out prior to Building Consent application.

4.4.2 Foundation Settlements

At the bearing pressures specified in ***Appendix A*** and subject to the design requirements for soil expansiveness provided below, differential settlement of shallow foundations for buildings designed in accordance with NZS 3604 (including the 600mm subfloor fill depth limit) should be within code limits.

4.4.3 Soil Expansiveness Classification

Seasonal soil moisture variations within most clay-rich soils typically result in the soil swelling during winter months and then shrinking during summer months. These seasonal movements can cause issues such as cracking of concrete floors, brittle cladding and masonry walls or distortion of building frames causing doors and windows to jam from differential settlement. The effects are further compounded by local influences that worsen differential movements. These may include growth of high demand trees and shrubs that cause localised soil drying or either leaking pipes or tree root removal, leading to localised wetting.

The potential effects need to be managed in a combination of appropriate:

- classification of the level of risk
- design of foundations
- management of soil moisture conditions by contractors during construction
- management of landscaping and plantings by homeowners throughout a building's lifetime

Testing on two samples, one on a cut building platform and one in fill within this stage of the development, was completed in accordance with the requirements of NZS 3604. All testing was completed by RoadTest Limited, a testing laboratory accredited by IANZ for the tests undertaken. Results are provided in ***Appendix D*** together with important additional information for landowners.

Results of our assessment for each lot are contained in our Statement of Opinion on Suitability of Land in ***Appendix A.***

4.4.4 Site (Seismic) Class

Our assessments of NZS 1170.5 site Class(es) is provided in our Opinion of Suitability and the Summary Table, both in ***Appendix A***.

4.5 Construction of Foundations in Stable Building Areas

4.5.1 Topsoil Depths on Stable Building Areas

Topsoil depths on Stable Building Areas have been checked by the drilling of a borehole in the approximate centre of the building platform on each lot. The results are considered indicative for each lot, but may be subject to variations. Topsoil depths are between 50 and 300mm on this stage of the development.

Site specific findings are contained in our Opinion on Suitability Summary in ***Appendix A***. However, it is possible that further levelling works have been undertaken since our investigations and accordingly, we strongly recommend that lot purchasers complete their own checks of topsoil depths at proposed building locations.

4.5.2 Brown Inorganic Soils

Beneath the clay soil mantle across the site, naturally occurring dark greyish brown deposits of inorganic Hukerenui soils from the Northland Allochthon Group are present. These deposits may be exposed beneath topsoil in areas that have been cut during the bulk earthworks, or may be included in engineered fills that have been placed. These are NOT topsoil and are suitable for foundations but may be difficult to distinguish from topsoil other than from their high clay content and absence of organic odour. If uncertainty exists, professional advice should be sought from an experienced geo-professional familiar with the contents of this report to avoid unnecessary construction delay and expense.

4.5.3 Soil Expansivity

Appendix D contains important additional recommendations for contractors for the appropriate preparation of subgrade areas prior to floor construction to minimise risks of shrinkage and swelling due to high soil expansivity.

4.6 Design of Foundations in Specific Design Zones

On all lots, Specific Design Zone (SDZ) areas are present adjacent to nominated Stable Building Areas. The SDZ areas have either not been specifically stabilised to achieve the same stability conditions as the Stable Building Areas or are adjacent to areas of less stable land. Building development is not prohibited in the SDZs but will require engineering input as described in Clause 4(b) of the Statement of Opinion on the Suitability of Land for Building Construction in Appendix A. It is expected that designs in these areas may require works such as foundation piling, subsoil drainage, retaining walls or in-ground walls, depending on the proximity of proposed building works to less stable ground and the nature of the development proposals.

4.7 On Site Effluent Disposal

The appended CMW Drawing 01 shows areas outside **Stable Building Areas** that have been nominated as Effluent Disposal Areas and have been assessed by CMW Geosciences as being geotechnically suitable (stable) for surface mounted dripper lines for effluent disposal fields.

The total size of disposal area assigned on each lot complies with the requirements of the Resource Consent and was conservatively sized for low permeability soils. Site specific testing may provide beneficial results.

Our investigations confirmed no groundwater within 0.9m of the ground surface and on the basis of our investigations, we consider the soils to be GD06 Category 5.

4.8 Stormwater Disposal

As mentioned in Section 4.1.2 above, surface stability can be severely compromised by indiscriminate disposal of concentrated stormwater onto the ground surface and/ or by removal of vegetation.

Building and landscape designers must ensure that all runoff from solid surfaces is directed into appropriately designed and located outlets to minimise these risks. It is also important that care is paid to the disposal of

stormwater during construction so that concentrated discharges (e.g. from unconnected spouting) are not directed towards steep ground.

Appropriate locations for stormwater outlets are typically either:

- formed outlet structures with scour control located in gully inverts (the geotechnically preferred option), or
- engineered spreader bars located on low-gradient land, with appropriate downslope scour control.

On this stage of the development, all of the lots contain gullies within **Bush Covenant Areas** that are suitable for private discharge of stormwater using the first option above. Stormwater disposal into the roadside swales is not permitted.

Each lot is located adjacent to bush/ stream area suitable for discharge of stormwater via a spreader bar if desired. The design should be undertaken by an experienced civil engineer at the time of Building Consent, taking into account the anticipated disposal volumes from all solid surfaces, including water tank overflows and any overflows anticipated from swimming pools.

Nevertheless we recommend as part of the architectural and landscape design on these lots, that designers and owners consider methods to limit the extents of solid surface areas that lead to the need to collect and concentrate stormwater to an outfall, but rather consider use of permeable surfaces and surface water infiltration across broad areas as would occur in natural, undeveloped landforms.

5 CLOSURE

Additional important information regarding the use of your CMW report is provided in the '*Using your CMW Report*' document attached to this report.

This report has been prepared for use by Cabra Rural Developments Limited / Rahopara Farms Limited in relation to the Rural subdivision Palliser downs Stage 1B project 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.

Although regular site visits have been undertaken for observation, for providing guidance and instruction and for testing purposes, the geotechnical services scope did not include full time site presence. To this end, our Opinion on Suitability in ***Appendix A*** and our Suitability Statement in ***Appendix B*** also rely on the Contractors' work practices and assumes that when we have not been present to observe the work, it has been completed to high standards and in accordance with the drawings, instructions and consent conditions provided to them.

Similarly, they assume that all as-built information and other details provided to the Client and/ or CMW by other members of the project team are accurate and correct in all respects.

Where a party other than Cabra Rural Developments Limited / Rahopara Farms Limited 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.

APPENDIX A: STATEMENT OF PROFESSIONAL OPINION ON SUITABILITY OF LAND FOR BUILDING CONSTRUCTION

STATEMENT OF PROFESSIONAL OPINION ON SUITABILITY OF LAND FOR BUILDING CONSTRUCTION

Development: Stage 1B of the Palliser Downs Development
Developer: Cabra Rural Developments Limited / Rahopara Farms Limited
Location: Palliser Downs Drive, Wainui

I, Richard Knowles, of CMW Geotechnical NZ Limited, Auckland, hereby confirm that:

1. As a Chartered Professional Engineer experienced in the field of geotechnical engineering, I am a Geo-professional as defined in clause 1.2.2 of NZS 4404:2010 and was retained by the Developer as the geo-professional on the above development.
2. The extent of analyses carried out to date are presented in ***Appendix F***. The extent of my inspections during construction, and the results of all tests and/ or evaluations carried out are as described in my Geotechnical Completion Report dated 25 June 2024.
3. My certification of the earth fills placed on this site is contained in ***Appendix B***.
4. In my professional opinion, not to be construed as a guarantee, I consider that:
    a. The completed earthworks take into account land slope and foundation stability considerations on the Stable Building Areas. Outside the Stable Building Areas the land contains **No Build Bush Covenant Zones** as depicted on the as-built plans**.** All other areas are **Specific Design Zones** and contain areas specified as suitable for effluent disposal fields. A stable accessway has been provided to each **Stable Building Area**.
    b. No building construction and no earthworks (i.e. cut or fills of any depth) should take place within the designated **Specific Design Zone** areas unless endorsed by a Chartered Professional Engineer experienced in geomechanics and familiar with the contents of this report. The endorsement will need to consider the implications of the proposals on both global stability conditions and soil creep on the buildings, control of surface water and temporary support requirements construction of all earthworks, foundations and retaining walls and if necessary, comment on what aspects require engineering inspections and certification.

       This limitation also applies to long term landscaping works, including any proposed minor cuts either on or near batter toes to be retained by new landscaping walls that might not normally require engineering, and to landscaping fills on or immediately above the batter slopes.
    c. **No Build Bush Covenant Zone** areas defined on Lots 41, 44 and 55 on the as-built plans are designated no-build zones on the basis of potential for instability and/ or because of the presence of protected bush.

       No building construction and no earthworks may take place in these areas other than as required for construction of stormwater outlets.
    d. The function of the subsoil drains shown on the as-built plans must not be impaired by any building development or landscaping works. Any bored or driven piles must be positioned to avoid damaging the draincoils. Where any subsoil drain is intercepted by building works, it must be reinstated under the direction of a Chartered Professional Engineer to ensure the integrity of the subsoil drainage system.
    e. On all Stable Building Platforms (i.e. lots 41, 44 and 55 inclusive) a geotechnical ultimate bearing capacity of 300 kPa may be assumed for shallow foundation design on the **Stable Building Areas**.

f. The site (seismic) subsoil class has been assessed in accordance with NZS1170.5:2004 Clause 3.1.3 from borelogs that included measurements of geotechnical properties. Our assessment is that the Stable Building Areas on lots 41, 44 and 55 are all Class C- shallow soil.

g.

Assessment of Characteristic Surface Movements and Design Classes for NZS 3604 Compliant Buildings on Stable Building Platforms		
Lots	**Assessed AS2870 Site Class / 300 Year Design Characteristic Surface Movement (Ys)**	**Anticipated Equivalent NZBC B1/AS1 Expansivity Class for Design / 500 Year Design Characteristic Surface Movement(Ys)**
Lots 41 and 55 (fill)	M (moderately reactive) / 35mm	M / 44mm
Lot 44 (cut)	H1 (highly reactive) / 45mm	H / 78mm

B1/AS1 provides an Acceptable Solution through NZS 3604 for foundation design applying to a limited range of compliant building sizes, shapes and materials and only for concrete floor design with strip footings. In all other cases, NZS 3604 directs the use of AS2870 or a specific design.

If AS2870 is used for the design solution, it must be noted that the characteristic surface movements in that code apply to a (less conservative) 300 year return period drought while B1/AS1 provides for a 500 year return period drought.

Prior to the introduction of the B1/AS1 design information in November 2019, minimum foundation depths recommended as appropriate by geotechnical consultants in Auckland for shallow footing design under AS2870 were typically of the order of 600mm for Class M and 750mm for Class H1.

h. On the basis of the earth fill certification and subject to the geotechnical limitations, restrictions and recommendations contained in clauses 4(a), 4(b), 4(c), 4(d), 4(e), 4(f), 4(g) and 4(h) above, the filled and natural ground is generally suitable for buildings constructed in accordance with NZS 3604 and the requirements of AS2870 for the appropriate expansive soil class associated and characteristic surface movement. Alternatively, a specific foundation and structural design may be undertaken by a Chartered Professional Engineer, or for buildings falling within the prescribed geometry and materials limits, the Acceptable Solution described in NZBC Clause B1/AS1 can be used with the appropriate expansive soil class.

i. As described in Section 4.7 of the Geotechnical Completion Report, stormwater disposal should be to formed outlets in gully areas that are typically located in the **Bush Covenant Areas**, or to engineer designed spreader bars in suitable locations. The design must consider anticipated future flows and appropriate scour/ erosion controls.

5. Road subgrades have been formed with appropriate regard for slope stability and settlement risks.

6. Nominated Effluent Disposal Areas are considered to have appropriate stability conditions for their intended use and have been assessed to contain GD06 Category 5 soils. Groundwater was not present within 0.9m of the ground surface.

The following table summarises the conditions on each of the **Stable Building Areas**.

For and on behalf of CMW Geosciences

Richard Knowles

Principal Geotechnical Engineer CMEngNZ, CPEng

SOPO Summary Table							
Condition	Specific Design Zone (slope)	Bush Covenant / No Build Zone	Subsoil Drains Present	Geotechnical Ultimate Bearing Capacity (kPa)	NZS 1170.5 Site (seismic) Class	AS2870 Expansive Class	Indicative Topsoil Depth (mm)
Lot Number (Stable Building Area)	GCR SOPO Clause						
	4(b)	4(c)	4(d)	4(e)	4(f)	4(g)	
41	✓	✓	✓	300	C	M	200
44	✓	✓		300	C	H1	300
55	✓	✓	✓	300	C	M	200

APPENDIX B: STATEMENT OF SUITABILITY OF ENGINEERED FILL FOR LIGHTWEIGHT STRUCTURES

STATEMENT OF SUITABILITY OF ENGINEERED FILLS FOR LIGHTWEIGHT STRUCTURES

To:	Auckland Council
Development:	Stage 1B of the Palliser Downs Development
Land Title(s):	Lot 1 DP 556774, Lot 2 DP 556774
Location:	Palliser Downs Drive, Wainui
Resource Consent Nos:	SUB60069585-B
Developer:	Cabra Rural Developments Limited / Rahopara Farms Limited
Geotechnical Designer:	Richard Knowles of CMW Geotechnical NZ Limited
Certifier:	Richard Knowles of CMW Geotechnical NZ Limited

This Statement of Suitability is provided as an appendix to the CMW Geosciences Geotechnical Completion Report referenced in the page footer below, that also contains all as-built plans, test results and test inspection records relevant to the work completed.

1. I, Richard Knowles, confirm that I am qualified as a certifier as defined in NZS4431:2022.
2. During this work, I was retained as certifier and I or my certifier's representative undertook inspections and testing as documented in the Geotechnical Completion Report.
3. I am satisfied that the engineered fill shown in the attached as-built survey was placed, compacted and tested in accordance with the attached specification and that all variations and non-compliances have been documented in the Geotechnical Completion report.
4. Based on the information available, I certify that, to the best of my knowledge, the intent of the geotechnical designer has been achieved.
5. This certification does not remove the necessity for normal inspection and design of foundations as would be made in natural ground.

For and on behalf of CMW Geosciences

Richard Knowles

Principal Geotechnical Engineer CMEngNZ, CPEng

APPENDIX C: AS-BUILT DRAWINGS

I certify that these Asbuilt Plans are an accurate record of the works undertaken and that:
-The coordinates (x, y) are in terms of NZTM on NZGD2000 and are within ±50mm
-The levels (z) are in terms of Auckland Vertical Datum 1946 and are within the following tolerances:

- for all pipe inverts & roadside channels to be within ±10mm (local circuit ie. internal / relative consistency required only)
- for all other assets ±20mm (eg. manhole covers, earthworks)

Name: Rick Bull

Signed: _____
Registered Professional Surveyor

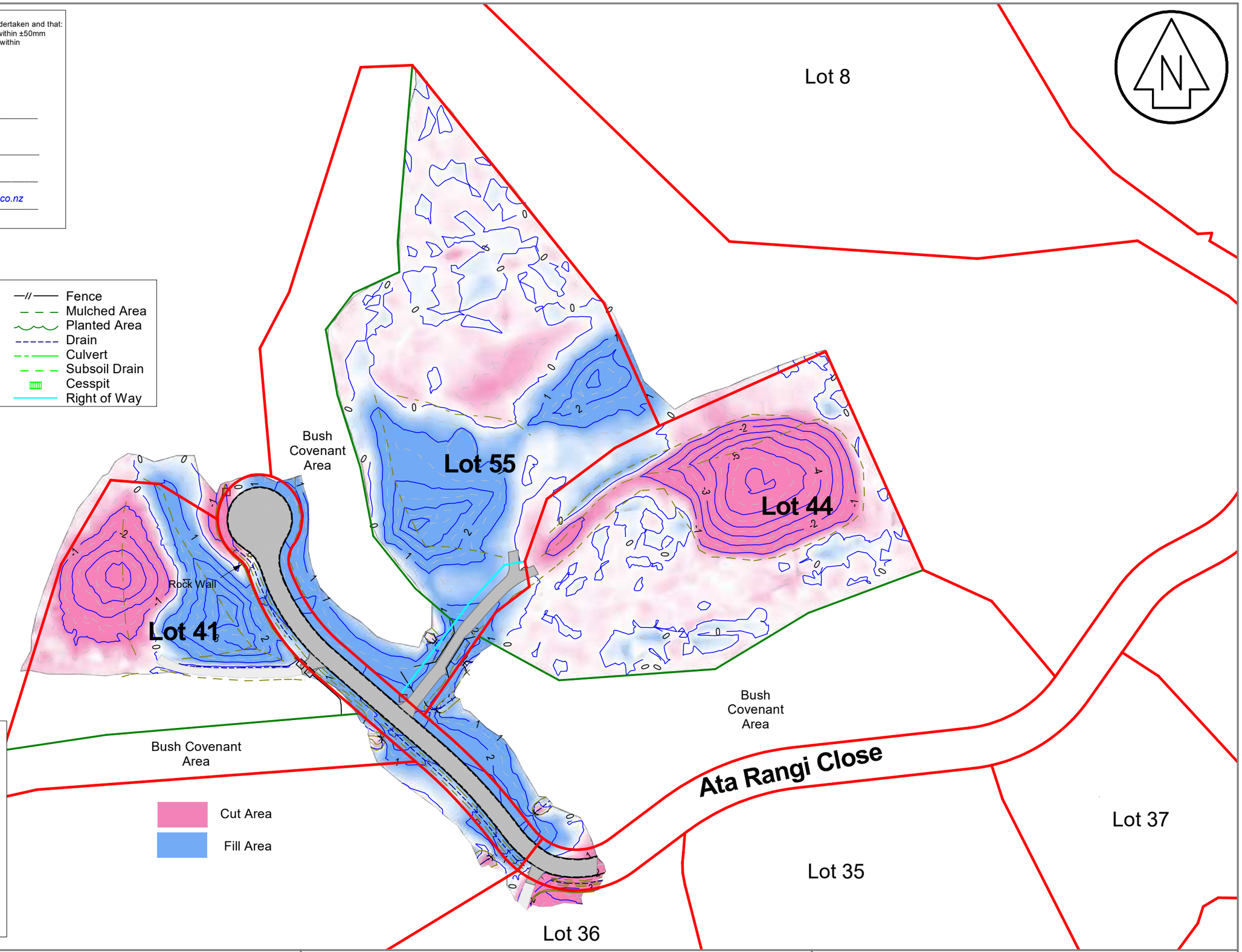
Registration Number: 341 Date: 07/05/2024

Contact Phone: 0274 902 879 Email: rick@crsurveyors.co.nz

ENG60397250

Legend

- Boundary
- Covenant
- Road
- Major Contour (1m Interval)
- Minor Contour (0.5m Interval)
- Top of Bank
- Bottom of Bank
- Fence
- Mulched Area
- Planted Area
- Drain
- Culvert
- Subsoil Drain
- Cesspit
- Right of Way



Earthworks Notes

Area of Earthworks:
Total Area: 44452m²
Cut Area: 22923m²
Fill Area: 21529m²

Volume of Earthworks:
Cut: 19824m³
Fill: 23251m³

Cut and fill volumes and levels are based from existing surface (after earthworks) to original surface

Registered Professional Land Surveyors
PO Box 564
Orewa 0946
Phone (09) 426 4051
www.crsurveyors.co.nz

Client: Cabra Rural Developments & Rahopara Farms Ltd

Ata Rangi Close - Wainui

Drawing Title: **Cut to Fill Contour Plan**

Original Size:	Original Scale:	Date:	Job Number:
A3	1:1500	07/05/2024	7723

JH

SURFACES:
=========
Design:□□ 3526 - Asbuilt - Stage 1B (07-05-2024) - STAGE 1B - 07-05-2024
Natural:□□ 3526_Topo_Merged_26Nov2021 - DTM-02

REGION:
======
Boundary: DTM Boundary

SURFACE AREAS:
============
Design: 48659.7 (square meters)
Natural: 45390.1 (square meters)

PLAN AREAS:
============
Boundary: 47559.8 (square meters) within the boundary
Design: 47559.8 (square meters) within the boundary and within design surface
Natural: 44451.7 (square meters)

Factor:
======================
Swell: 1.000
Shrink: 1.000

CUT/FILL/MATCHING AREAS:
======================
Cut: 22922.6 (square meters)
Fill: 21529.1 (square meters)
Matching: 0.0 (square meters)
Total Area: 44451.7 (square meters)
Cut 3D: 23489.1 (square meters)
Fill 3D: 21901.1 (square meters)
Matching 3D: 0.0 (square meters)
Total Area 3D: 45390.1 (square meters)

VOLUMES:
=========
Cut to Fill Ratio: 0.853
Cut: 19823.783 (cubic meters)
Fill: 23250.704 (cubic meters)
Net: 3426.921 (cubic meters) [fill]

Cut: 0.865 (cubic meters) / (square meters)
Fill: 1.080 (cubic meters) / (square meters)

Average Cut Depth: 0.865 (m)
Maximum Cut Depth: 6.127 (m)
Average Fill Depth: 1.080 (m)
Maximum Fill Depth: 5.336 (m)

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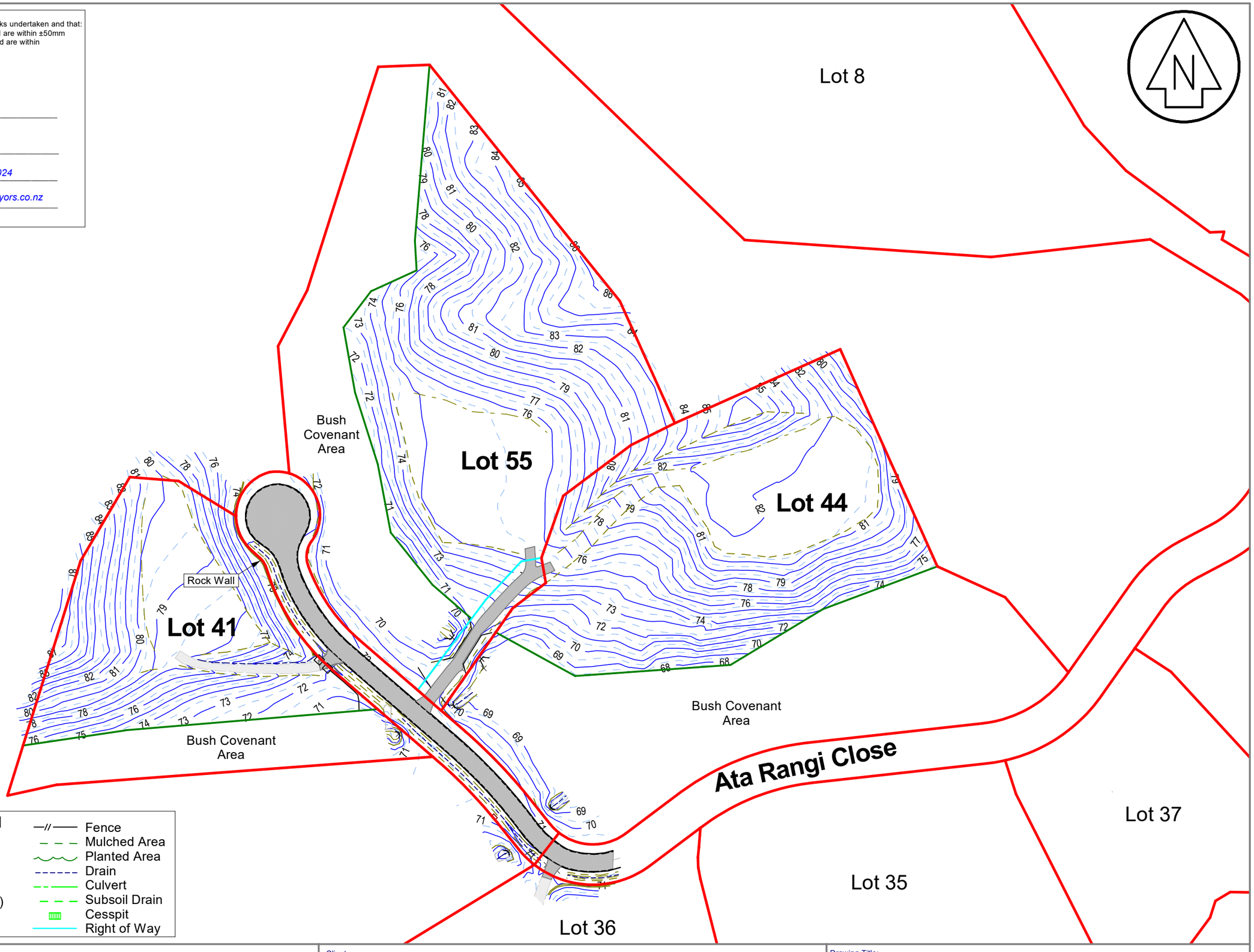

Legend

- Boundary
- Covenant
- Road
- Major Contour (1m Interval)
- Minor Contour (0.5m Interval)
- Top of Bank
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Client:
Cabra Rural Developments &
Rahopara Farms Ltd
Ata Rangi Close - Wainui

Drawing Title:
Asbuilt - Contour Plan

Original Size:	Original Scale:	Date:	Job Number:
A3	1:1500	07/05/2024	7723

JH

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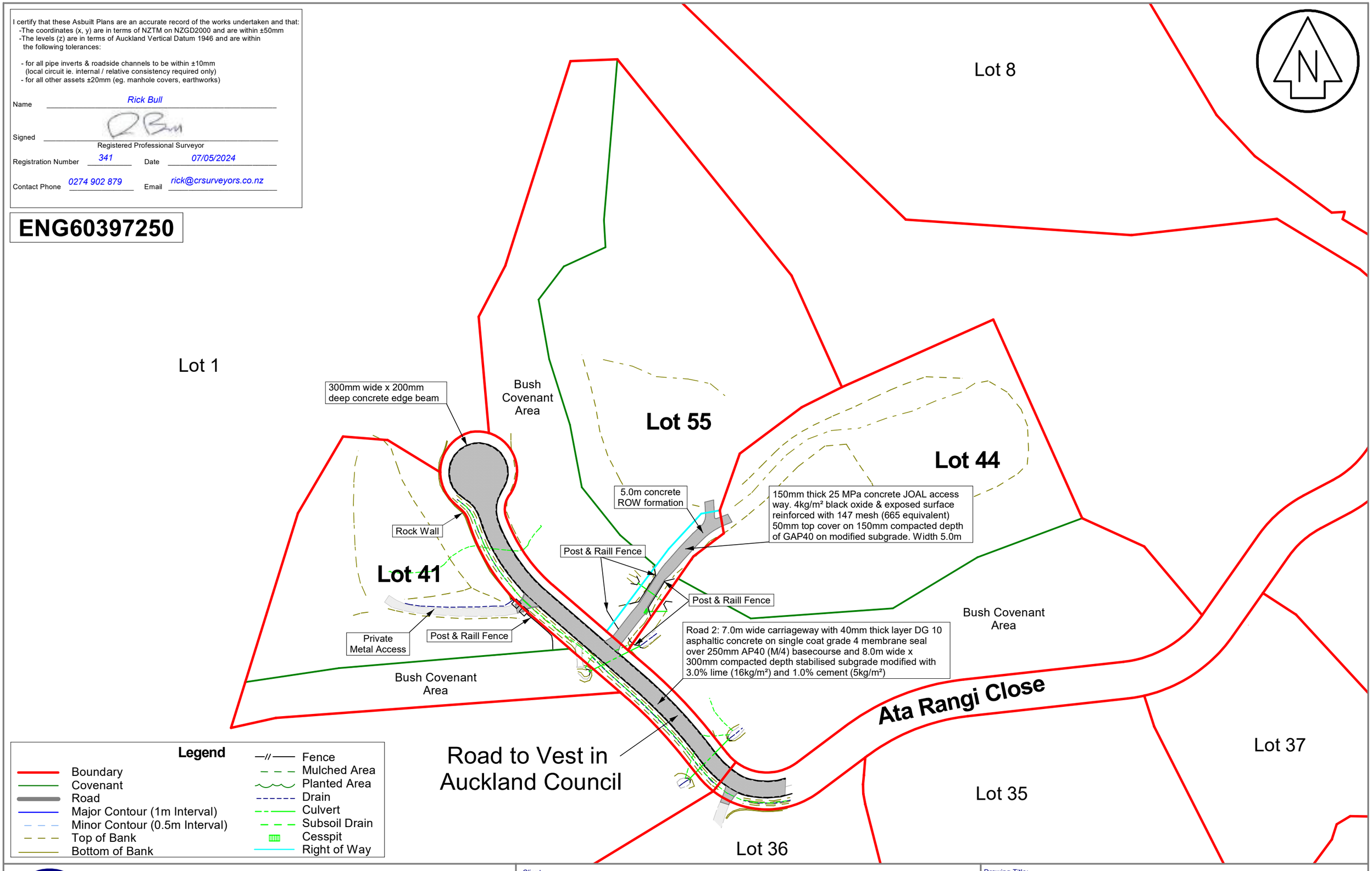

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www.crsurveyors.co.nz

Client:

Cabra Rural Developments & Rahopara Farms Ltd
Ata Rangi Close - Wainui

Drawing Title:

Asbuilt - Roading Plan

Original Size:	Original Scale:	Date:	Job Number:
A3	1:1500	07/05/2024	7723

JH

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-The levels (z) are in terms of Auckland Vertical Datum 1946 and are within the following tolerances:

- for all pipe inverts & roadside channels to be within ±10mm (local circuit ie. internal / relative consistency required only)
- for all other assets ±20mm (eg. manhole covers, earthworks)

Name: Rick Bull

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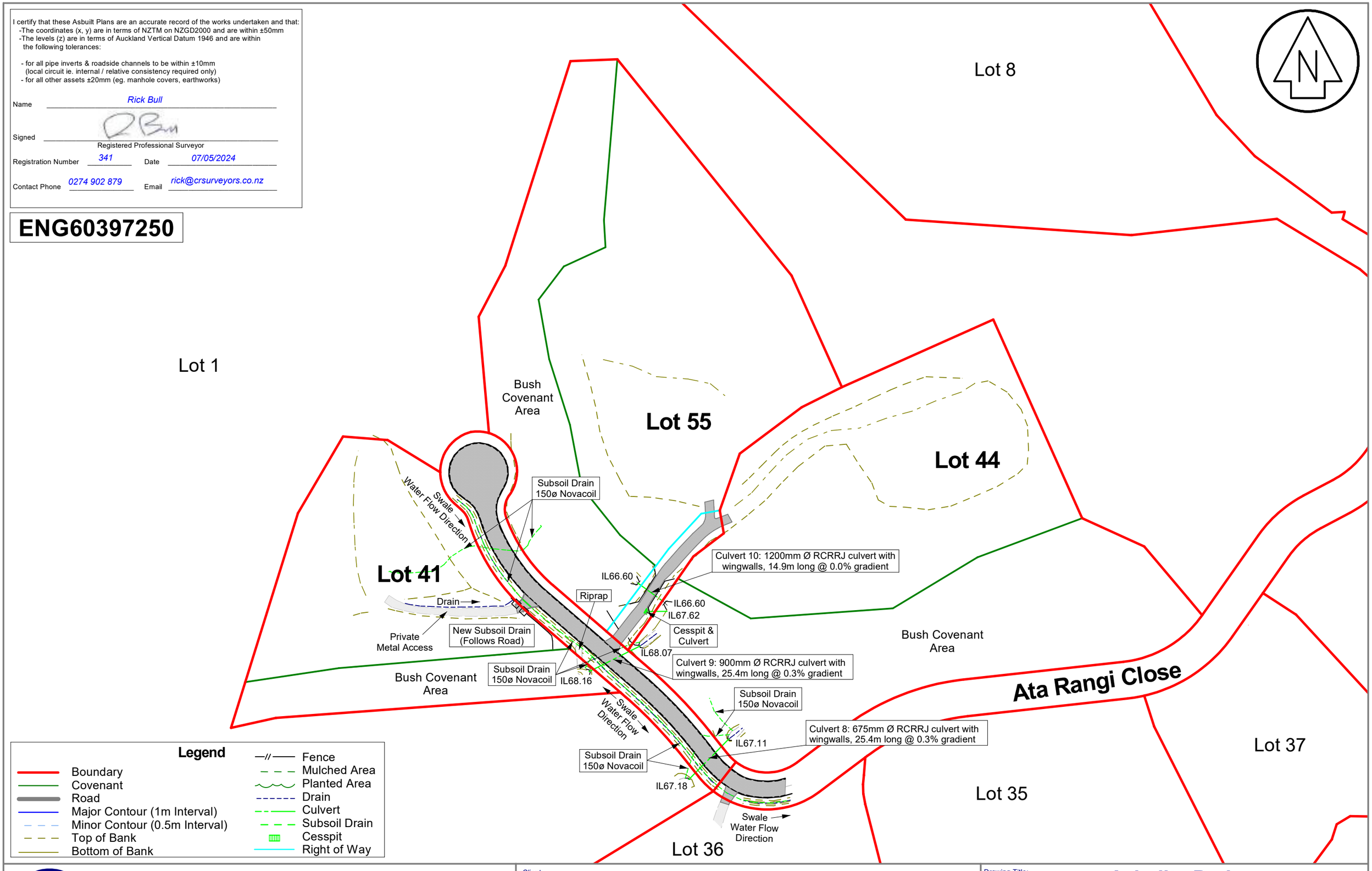
Registered Professional Surveyor

Registration Number: 341 Date: 07/05/2024

Contact Phone: 0274 902 879 Email: rick@crsurveyors.co.nz

ENG60397250



Registered Professional Land Surveyors

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Client:

Cabra Rural Developments & Rahopara Farms Ltd
Ata Rangi Close - Wainui

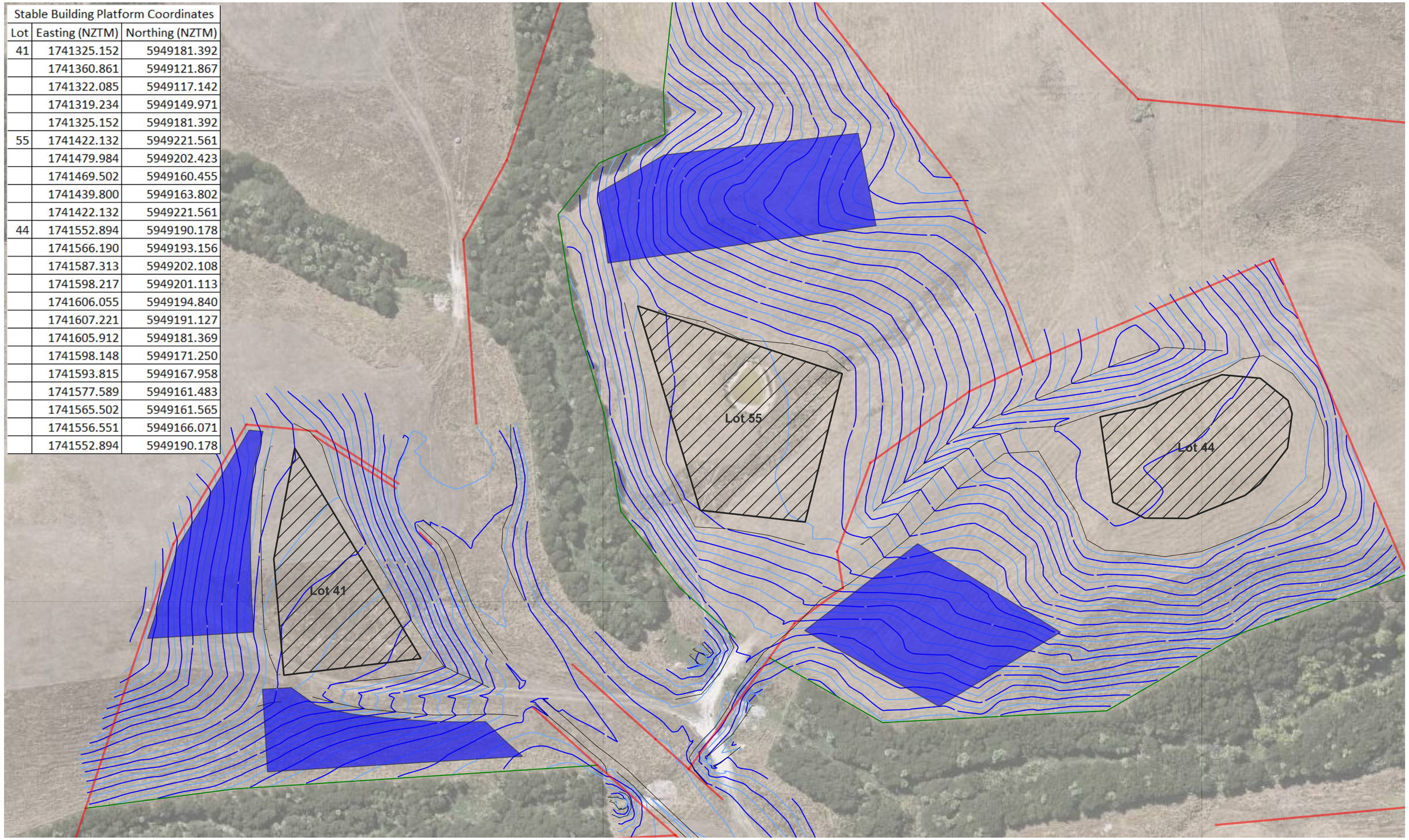
Drawing Title:

Asbuilt - Drainage Stormwater Plan

Original Size:	Original Scale:	Date:	Job Number:
A3	1:1500	07/05/2024	7723

JH

Stable Building Platform Coordinates		
Lot	Easting (NZTM)	Northing (NZTM)
41	1741325.152	5949181.392
	1741360.861	5949121.867
	1741322.085	5949117.142
	1741319.234	5949149.971
	1741325.152	5949181.392
55	1741422.132	5949221.561
	1741479.984	5949202.423
	1741469.502	5949160.455
	1741439.800	5949163.802
	1741422.132	5949221.561
44	1741552.894	5949190.178
	1741566.190	5949193.156
	1741587.313	5949202.108
	1741598.217	5949201.113
	1741606.055	5949194.840
	1741607.221	5949191.127
	1741605.912	5949181.369
	1741598.148	5949171.250
	1741593.815	5949167.958
	1741577.589	5949161.483
	1741565.502	5949161.565
	1741556.551	5949166.071
	1741552.894	5949190.178



LEGEND:

Effluent Disposal Areas

Stable Building Areas

NOTES: 1
2.

0 25 50 75 100 125 m

CMW Geosciences
Great People | Practical Solutions

CLIENT: **CABRA RURAL DEVELOPMENTS LTD / RAHOPARA FARMS LTD**	DRAWN: MJC	PROJECT: AKL2019-0017
PROJECT: **PALLISER DOWNS**	CHECKED: RK	DRAWING: 01
	REVISION: 1	SCALE: 1:1000
TITLE: **STAGE 1B STABLE BUILDING & EFFLUENT DISPOSAL AREAS**	DATE: 25/07/2024	SHEET: A3 L

APPENDIX D: SOIL EXPANSIVITY

SOIL EXPANSIVITY			
Project:	Palliser Downs Stage 1B Rural Subdivision	**Job Number:**	AKL2019-0017AI Appendix D
Site Address:	Palliser Downs Drive, Wainui	**Client:**	Cabra Rural Developments Ltd & Rahopara Farms Limited
Prepared by:	Richard Knowles	**Reviewed by:**	Chris Ritchie

1 INTRODUCTION

Seasonal soil moisture variations within most clay-rich soils typically result in the soil swelling during winter months and then shrinking during summer months. These seasonal movements can cause issues such as cracking of concrete floors, brittle cladding and masonry walls or distortion of building frames causing doors and windows to jam from differential settlement. The effects are further compounded by local influences that worsen differential movements. These may include growth of high demand trees and shrubs that cause localised soil drying or either leaking pipes or tree root removal, leading to localised wetting.

The potential effects need to be managed in a combination of appropriate:

- classification of the level of risk (refer to Sections 2 to 4)
- design of foundations (refer to Section 4)
- management of soil moisture conditions by contractors during construction (refer to Section 5)
- management of landscaping and plantings by homeowners throughout a building's lifetime (refer to Section 6)

2 FRAMEWORK OF CLASSIFICATION METHODS

References		
Reference	**Identification Method(s)**	**Potential Assessment Outcomes**
NZS3604-2011 *Timber Framed Buildings*	*(Refer to "Definitions – Good Ground")* Liquid Limit (LL) and Linear Shrinkage (LS) (NZS4402-1986 Test 2.2 and 2.6)	"Good Ground" OR Not "Good Ground" = LL>50 and LS>15
AS2870-2011 *Residential Slabs and Footings*	*(Refer to Clause2.3.2)* Shrink-Swell Indices (AS1289 Tests 7.1.1 to 7.1.3), OR Correlation with other clay index tests, OR Visual-tactile ID by a qualified person	*(Refer to Table 2.3 and Section 3)* Classes S, M, H1, H2, E with associated characteristic ground movements and design solutions for 300 year return period drought.
BRANZ Report SR120A (2008) *Soil Expansivity in the Auckland Region*	Shrink-Swell Indices (AS1289 Tests 7.1.1 to 7.1.3) Recommended soil suction profile given	Use of AS2870 Classes
NZBC Acceptable Solution B1/AS1 (from Nov 2019) **Applied amendments to the wording of NZS3604** to cover a method for a simple building form.	*(Clause7.5.13)* Specific requirements for the Acceptable Solution for Simple Buildings: Enquiry at local TA, and/ or a Cert. of Suitability per NZS4431, and/ or Soil tests by a qualified Engineer *(Clause7.5.13.1.2)* Soil tests are: Shrink-Swell Indices (AS1289 Tests 7.1.1 to 7.1.3)	Provides an Acceptable Solution for only a limited range of NZS3604 building sizes, shapes and materials on expansive soils. The provided acceptable design solution is only for a concrete slab with perimeter foundation. Classes S, M, H and E. and Characteristic ground movement limits based on a 500 year return period

Auckland Council Code of Practice for Land development and Subdivision (Chapter 2, version 2, May 2023) (ACCoPs)	*(Clause2.5.2)* Moisture Content (MC), Liquid Limit (LL), Plastic Limit (PL) (NZS4402-1986 Tests 2.1 to 2.4) plotted on plasticity chart (Plasticity Index, PI=LL-PL vs LL)	Use of NZBC B1/AS1 for foundation design. Any other specific design method to require Auckland Council or external review
Notes: Liquid Limit test can be replicated by Cone Penetration Limit (CPL) Test, NZS4402-1986 Test 2.5. Assessments using shrink-swell indices have been found to be unreliable in the Auckland context and are therefore not favoured in ACCoPs B1/AS1 converted characteristic surface movements from 300 years in AS2870 to 500 years by multiplying values by 1.11. B1/AS1 did not alter the NSZ 3604 “Good Ground” definition and did not repeal NZS3604 Informative Section 17 on expansive soils.		

3 TESTING REGIME

Testing on 2 samples was completed in accordance with the requirements of NZS 3604 and ACCoPs. All testing was completed by RoadTest Limited, a testing laboratory accredited by IANZ for the tests undertaken. Results are as shown.

ROADTEST LTD

Revision: 1

DETERMINATION OF THE
WATER CONTENT, CONE PENETRATION LIMIT, PLASTIC LIMIT, PLASTICITY INDEX & LINEAR SHRINKAGE
TEST METHOD NZS 4402 : 1986 TEST 2.1, 2.3, 2.4, 2.5 & 2.6

Project Name :	**Palliser Downs**		
Client :	CMW Geosciences Ltd	Project No :	24 0001 38
Address :	PO Box 300206 Albany, Auckland	Date of Order :	03.05.24
		Sample Method :	Hand Auger
Attention :	Melissa Campbell	Sample Date :	03.05.24
		Sampled By :	CMW Geosciences Ltd

Test Details :	Test performed on :	Whole Sample			
	History :	Natural			
Tested By:	KC	Date :	15 to 17.05.24		
Calculated By :	KC	Date :	20.05.24		
Checked By :	ZH	Date :	21.05.24		

Sample No.	Location	Depth (m)	Cone Penetration (CPL)	Plastic Limit (PL)	Plasticity Index (PI)	Linear Shrinkage (LS)	Natural Water Content (%)
849T	Lot 41	0.4 to 0.8	59	21	38	17	32.1
850T	Lot 44	0.5 to 0.9	89	36	53	18	48.3

1 of 1

Figure 1: Laboratory Test Results.

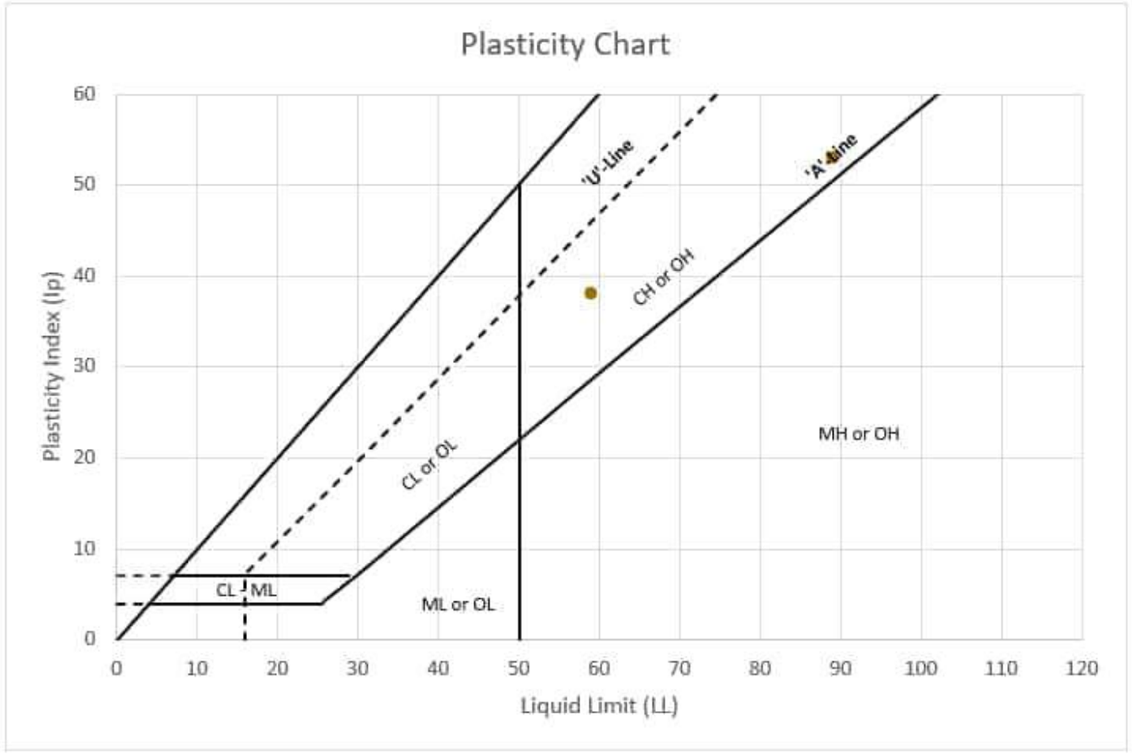


Figure 2: Plasticity Chart with Test Results

ASSESSMENT OF TEST RESULTS

The testing confirms that both of the soils tested were expansive in terms of the NZS 3604 definition and were therefore outside the definition of "good ground".

Assessment of Characteristic Surface Movements and Design Classes for NZS 3604 Compliant Buildings on Stable Building Platforms		
Platform	**Assessed AS2870 Site Class / 300 Year Design Characteristic Surface Movement (Ys)**	**Anticipated Equivalent NZBC B1/AS1 Expansivity Class for Design / 500 Year Design Characteristic Surface Movement(Ys)**
Lots 41 fill areas and Lot 55 (all fill)	M (moderately reactive) / 35mm	M / 44mm
Lot 41 cut areas and Lot 44 (all cut)	H1 (highly reactive) / 45mm	H / 78mm

B1/AS1 provides an Acceptable Solution through NZS 3604 for foundation design applying to a limited range of compliant building sizes, shapes and materials and only for concrete floor design with strip footings. In all other cases, NZS 3604 directs the use of AS2870 or a specific design.

If AS2870 is used for the design solution, it must be noted that the characteristic surface movements in that code apply to a (less conservative) 300 year return period drought while B1/AS1 provides for a 500 year return period drought.

Prior to the introduction of the B1/AS1 design information in November 2019, minimum foundation depths recommended as appropriate by geotechnical consultants in Auckland for shallow footing design underAS2870 were typically of the order of 600mm for Class M and 750mm for Class H1.

For building types where neither B1/AS1 nor AS2870 design solutions are required to be applied, such as for IL1 buildings or commercial / industrial buildings, the structural designer should still consider the implications of the potential characteristic surface movement.

5 SITE PREPARATION DURING CONSTRUCTION

Foundation contractors need to be aware of the extreme damage potentially caused by expansive soils and the imperativeness of maintaining optimum moisture contents in all footing excavations and across building platform subgrades between the time of excavation and the pouring of concrete. Pouring foundations on dry, desiccated ground in summer months can lead to heaving and cracking, requiring extensive repairs or even complete house re-builds. Similarly, where perimeter foundations have been treated but floor slabs have been poured on dry ground, infiltration of moisture via pipe bedding can lead to localised heave, uplift and significant slab damage.

Remedial actions that may be appropriate include combinations of platform protection with a hard fill layer, pouring of a blinding layer of concrete in footing bases and soaking of the building platform with sprinklers for an extended period.

6 SITE MAINTENANCE AND LANDSCAPING

Landowners must be mindful of the potential impacts of planting or removal of high water demand plants. Where their roots may extend close to footings (i.e. within a lateral distance of 1.5 times the mature tree height), these actions can lead to significant settlement or heave damage.

For a comprehensive understanding of the potential effects of expansive soils, maintenance recommendations and vegetation management information, we strongly recommend that land owners obtain a copy of CSIRO publication BTF 18 (Foundation Maintenance and Footing Performance – A Homeowners Guide) that is available online.

APPENDIX E: FIELD TEST DATA

LF11 Rev.15 Soil Field Density NDM Direct Transmission with VSS Report (Cohesive Soils)

Auckland Laboratory
CMW Geosciences (NZ) Ltd Partnership
11/63, Arrenway Drive, Rosedale, NZ 0632
PO Box 300206, Albany, Auckland, NZ 0752
Phone: +64 (09) 4144 632

Project:	Palliser Downs
Project No:	AKL2019-0017
Location:	Wainui
Report No:	AKL2019-0017LAA Rev.1
Report Date:	6/03/2024
Client:	Cabra Rural Developments Limited
Client Address:	3 Alice Ave, Orewa 0931

Test Methods:
NZS 4407 2015 Test 3.1 ◊
NZS 4407 2015 Test 4.2
NZGS:August 2001

Notes:
Solid Density: Assumed
Solid Density Data Source: N/A
Testing Locations Selected By: CMW Field Staff
◊ Only samples <2.0mm will be considered for endorsed testing
① Blade size of 19mm used.

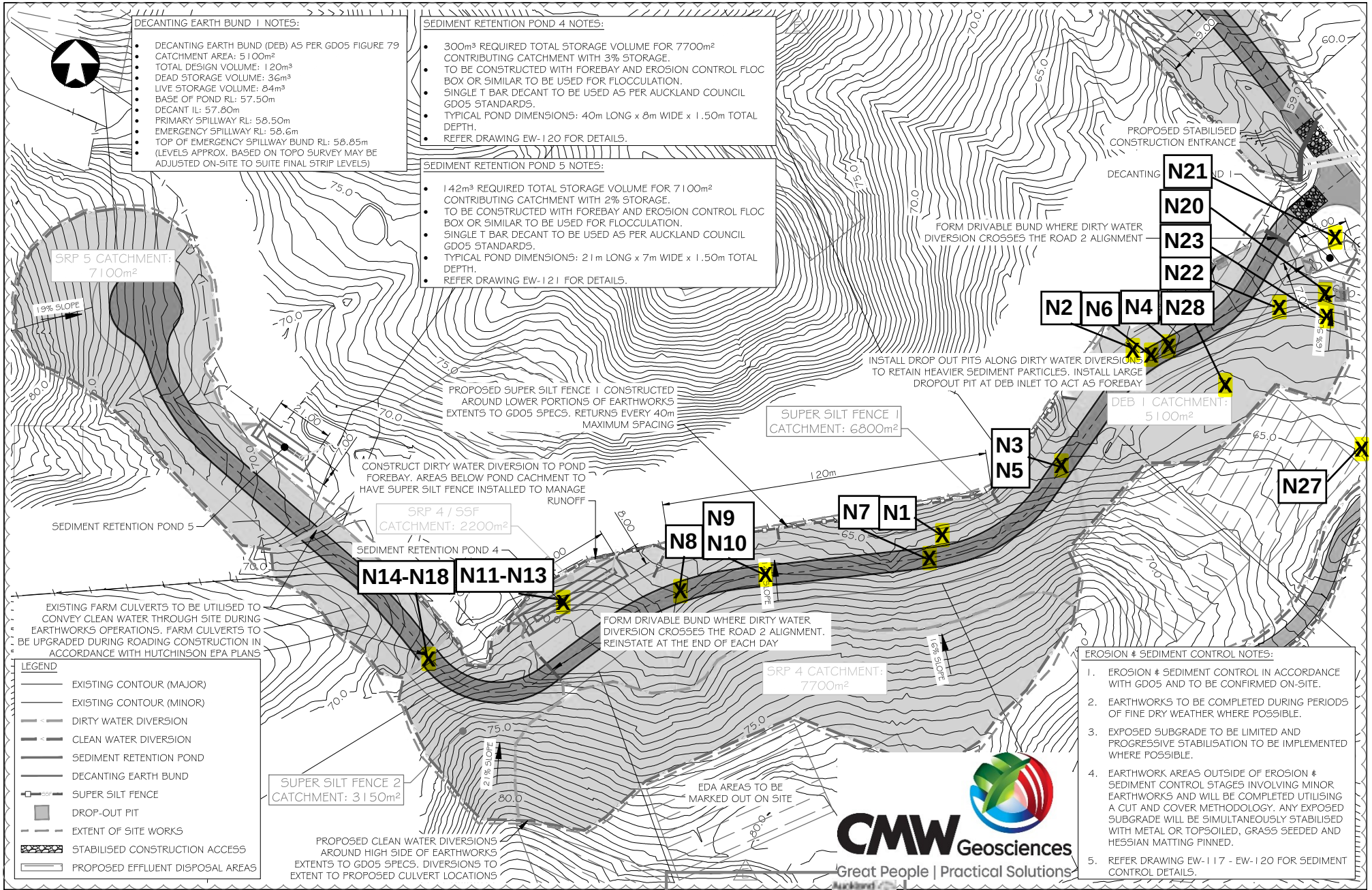
Measurements marked * are not accredited and are outside the scope of the laboratories accreditation

Date Sampled	Sample No.	Test Location*		Soil Description*	Solid Density (t/m³) *	Vane ID		In-situ Vane Shear Strengths					Field and Laboratory Testing Data								Comments
		Test Site	RL/Details			Head #	Blade # ①	Test 1 (kPa)	Test 2 (kPa)	Test 3 (kPa)	Test 4 (kPa)	Ave.	Gauge Wet Density (t/m³) **	Gauge Dry Density (t/m³)	Gauge Water Content (%)	Gauge Air Voids (%)	Gauge Probe Depth (mm)	Oven Water Content (%)	Oven Dry Density (t/m³)	Oven Calculated Air Voids (%) *	
4/04/2022	N1	Undercut filling	-	CLAY	2.70	1824	1824	84	135	113	138	118	1.72	1.19	44.5	3	300				
	N2	Undercut filling	-	CLAY	2.70	1824	1824	154	206	235	154	187	1.84	1.38	33.7	2	300	27.7	1.44	7	
8/04/2022	N3	Road 2	-	CLAY	2.70	1824	1824	151	145	154	171	155	1.75	1.22	43.9	2	300	40.1	1.25	4	
	N4	Road 2	-	CLAY	2.70	1824	1824	154	148	138	196	159	1.86	1.40	33.4	2	300	30.9	1.42	3	
11/04/2022	N5	Road 2	-	CLAY	2.70	1824	1824	235	235	235	235	235	1.75	1.26	39.0	5	300	40.8	1.24	4	
29/04/2022	N6	Road 2	-	CLAY	2.70	1824	1824	235	132	193	203	191	1.78	1.20	47.7	-2	300	45.4	1.22	-1	
	N7	Road 2	-	CLAY	2.70	1824	1824	209	235	193	203	210	1.76	1.25	41.5	2	300	40.5	1.26	3	
3/05/2022	N8	Road 2	-	CLAY	2.70	1824	1824	235	235	219	203	223	1.77	1.27	39.5	3	300	37.0	1.29	4	
2/05/2022	N9	Road 2	-	CLAY	2.70	1824	1824	158	171	171	200	175	1.87	1.39	34.2	1	300	34.1	1.39	1	
4/05/2022	N10	Road 2	-	CLAY	2.70	1824	1824	235	235	235	219	231	1.82	1.35	34.5	3	300	31.7	1.38	5	
12/05/2022	N11	Pond	-200mm	CLAY	2.70	1824	1824	106	122	100	100	107	1.79	1.31	36.9	3	300	37.2	1.31	3	
	N12	Pond	-1000mm	CLAY	2.70	1824	1824	126	161	154	138	145	1.82	1.34	35.8	3	300	43.7	1.26	-2	
	N13	Pond	-1000mm	CLAY	2.70	1824	1824	135	138	235	235	186	1.83	1.41	29.3	6	300	-	-	-	No sample taken
25/05/2022	N14	Culvert fill	-	CLAY	2.70	1824	1824	106	109	97	100	103	-	-	-	-	-	-	-	-	No sample taken
	N15	Culvert fill	-	CLAY	2.70	1824	1824	122	132	138	154	137	1.75	1.26	39.4	4	300	40.2	1.25	4	
	N16	Culvert fill	-	CLAY	2.70	1824	1824	203	206	154	206	192	1.75	1.19	46.8	0	300	39.7	1.25	4	
26/05/2022	N17	Culvert 1	-	CLAY	2.70	1824	1824	206	119	64	119	127	1.77	1.24	42.9	1	300				No sample taken
	N18	Culvert 1	-	CLAY	2.70	1824	1824	138	206	235	235	204	1.80	1.38	29.8	7	300	28.9	1.39	8	
27/10/2022	N20	Lot 34 Undercut 1st half	+1000mm	CLAY	2.70	2080	2080	140	142	145	151	145	1.84	1.40	31.7	4	300	28.5	1.43	6	
29/10/2022	N21	Lot 34 Batter edge/HP edge	+500mm	CLAY	2.70	2080	2080	140	155	145	140	145	1.86	1.38	35.1	1	300	30.0	1.43	4	
7/11/2022	N22	Lot 34 Undercut area 2	+800mm	CLAY	2.70	2992	2992	155	155	141	124	144	1.82	1.38	31.4	5	300	30.4	1.39	6	
16/11/2022	N23	Lot 34	-	CLAY	2.70	1824	1824	123	112	95	137	117	1.90	1.44	31.5	1	300	-	-	-	No sample taken
29/11/2022	N27	Lot 34	-	CLAY Fill	2.70	1195	1195	160	156	139	189	161	1.79	1.36	30.9	7	300	30.1	1.37	8	
	N28	Lot 34	-	CLAY Fill	2.70	1195	1195	160	174	186	203	181	1.83	1.36	34.3	3	300	32.9	1.38	4	
23/02/2023	N48	Lot 33	-700mm	CLAY Fill	2.70	2992	2992	197	183	141	155	169	1.88	1.38	36.2	-1	300	27.8	1.47	5	
5/03/2023	N53	Road 2	+600mm	ENG CLAY Fill	2.70	2080	2080	151	161	158	165	159	1.77	1.25	41.1	2	300	40.1	1.26	3	
13/03/2023	N54	Lot 33 BP edge	+1000mm	ENG CLAY Fill	2.70	2080	2080	140	140	140	140	140	1.80	1.31	36.8	3	300	35.2	1.33	4	

** Gauge Wet Densities outside of the calibrated range of 1.754 to 2.611 t/m³ are not accredited and are outside the laboratories scope of accreditation.

This report should only be reproduced in full.
This report replaces reports numbered AKL2019-0017LAA Rev.0 - **Master Site Plan updated, no change to point locations.**

Created By: JLM Date: 11/04/2022
Checked By: JP Date: 6/03/2024
Authorised Signatory (KTP): JLM Date: 6/03/2024



No.	Revision	Drawn	Chk.	Appd.	Date
E	EDA AREAS ADDED	MS	PF	IH	MAR 2022
D	SRP 4 & SILT FENCE CATCHMENTS CLOSED UP	MS	PF	IH	MAR 2022
C	DEB 1 DROP OUT PIT & DRIVEABLE BUNDS ADDED. EXISTING CULVERTS TO BE UTILISED FOR CLEAN WATER	MS	PF	IH	MAR 2022
B	DEB 4 UPDATED TO SEDIMENT POND 5	MS	PF	IH	MAR 2022
A	SEDIMENT CONTROL DETAILS REVISED	MS	PF	IH	FEB 2022

Hutchinson
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Design	M. SYMONS	FEB 2022
Drawn	M. SYMONS	FEB 2022
Checked	P. FARLEY	FEB 2022
Approved	I. HUTCHINSON	FEB 2022
Scale	1:1250 @ A3	
Scale vert. exag.		

ENG60397250 / VIJAY.K
Approved Engineering Plan
09/09/2022

Project: CABRA RURAL DEVELOPMENTS & RAHOPARA FARMS LTD
PALLISER DOWNS STAGE 2 (2021)
PALLISER DOWNS DRIVE
WAINUI
ENGINEERING PLAN APPROVAL

Title: ROAD 2 EROSION & SEDIMENT CONTROL PLAN

Sheet No.: EW-115

Job No.: A3-24066 EPA

Rev.: E

LF11 Rev.17 Soil Field Density NDM Direct Transmission with VSS Report (Cohesive Soils)

Auckland Laboratory
CMW Geotechnical NZ Limited
11/63, Arrenway Drive, Rosedale, NZ 0632
PO Box 300206, Albany, Auckland, NZ 0752
Phone: +64 (09) 4144 632

Project:	Palliser Downs
Project No:	AKL2019-0017
Location:	Wainui
Report No:	AKL2019-0017LAD Rev.1
Report Date:	6/03/2024
Client:	Cabra Rural Developments Limited
Client Address:	3 Alice Ave, Orewa 0931

Test Methods:
NZS 4407 2015 Test 3.1 ◊
NZS 4407 2015 Test 4.2
NZGS:August 2001

Notes:
Solid Density: Assumed
Solid Density Data Source: N/A
Testing Locations Selected By: CMW Field Staff
◊ Only samples <2.0mm will be considered for endorsed testing
① Blade size of 19mm used.

Measurements marked * are not accredited and are outside the scope of the laboratories accreditation

Date Sampled	Sample No.	Test Location*		Soil Description*	Solid Density (t/m³) *	Vane ID		In-situ Vane Shear Strengths					Field and Laboratory Testing Data								Comments
		Test Site	RL/Details			Head #	Blade # ①	Test 1 (kPa)	Test 2 (kPa)	Test 3 (kPa)	Test 4 (kPa)	Ave.	Gauge Wet Density (t/m³) **	Gauge Dry Density (t/m³)	Gauge Water Content (%)	Gauge Air Voids (%)	Gauge Probe Depth (mm)	Oven Water Content (%)	Oven Dry Density (t/m³)	Oven Calculated Air Voids (%) *	
16/01/2023	N44	Lot 101	-	CLAY Fill	2.70	1702	1702	162	182	169	169	171	1.93	1.49	29.5	1	300	34.5	1.43	-3	
	N45	Lot 101	-	CLAY Fill	2.70	1702	1702	UTP	UTP	UTP	UTP	UTP	1.94	1.51	28.6	1	300	25.9	1.54	3	
23/02/2023	N46	Lot 101	-	CLAY Fill	2.70	2992	2992	169	155	155	141	155	1.79	1.36	31.5	7	300	30.4	1.38	7	
	N47	Lot 101	-	CLAY Fill	2.70	2992	2992	197	197	141	191	182	1.81	1.36	33.3	5	300	32.5	1.36	5	
2/03/2023	N49	Lot 101 Rock undercut	+1000mm	CLAY Fill	2.70	1702	1702	UTP	UTP	UTP	UTP	UTP	2.01	1.71	18.1	6	300	-	-	-	No sample taken
	N50	Lot 101 Rock undercut	+500mm	CLAY Fill	2.70	1702	1702	UTP	UTP	UTP	UTP	UTP	1.96	1.64	19.6	7	300	20.9	1.62	6	
6/03/2023	N51	Lot 55	+1500mm	CLAY Fill	2.70	1702	1702	UTP	UTP	141	177	159+	1.79	1.34	33.7	5	300	35.5	1.32	4	
	N52	Lot 55	+1000mm	CLAY Fill	2.70	1702	1702	UTP	UTP	UTP	UTP	UTP	1.84	1.39	32.3	4	300	31.9	1.39	4	
15/03/2023	N55	Lot 55 shear key 1st lift	-	CLAY Fill	2.70	1702	1702	182	145	139	142	152	1.74	1.27	37.1	6	300	43.1	1.22	2	
29/03/2023	N56	Lot 55 shear key	-	CLAY Fill	2.70	1702	1702	142	139	142	149	143	1.77	1.26	40.9	2	300	39.4	1.27	3	
5/04/2023	N57	Road 1	-	CLAY Fill	2.70	1702	1702	UTP	UTP	UTP	UTP	UTP	1.77	1.37	29.4	9	300	26.9	1.40	11	
	N58	Road 1	-	CLAY Fill	2.70	1702	1702	UTP	UTP	UTP	UTP	UTP	1.71	1.22	39.9	6	300	46.0	1.17	3	
20/04/2023	N59	Lot 55 Shear key	Final lift	CLAY Fill	2.70	1702	1702	UTP	UTP	UTP	UTP	UTP	1.76	1.33	32.4	7	300	-	-	-	No sample taken

** Gauge Wet Densities outside of the calibrated range of 1.754 to 2.611 t/m³ are not accredited and are outside the laboratories scope of accreditation.

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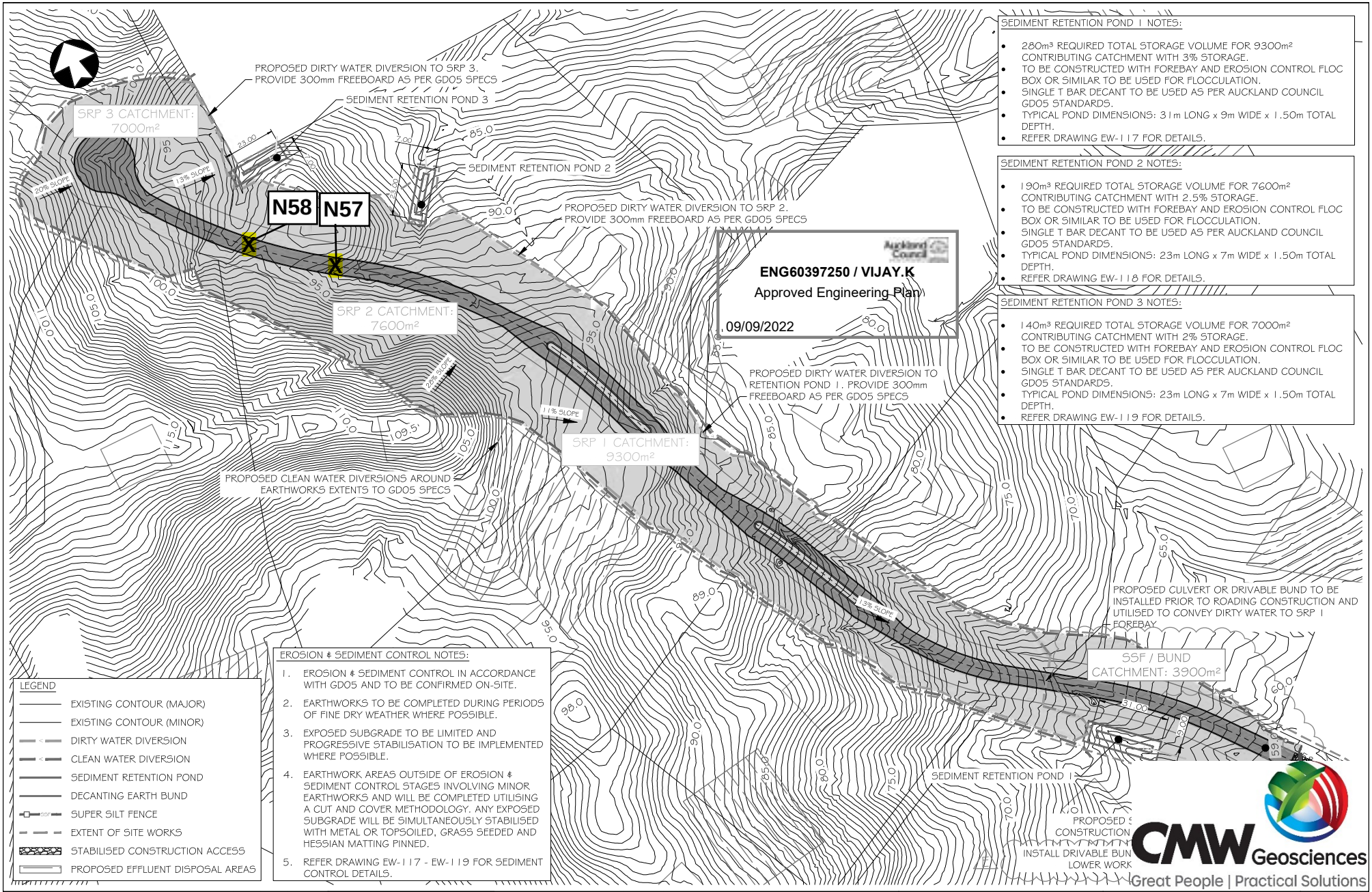
This report replaces reports numbered AKL2019-0017LAD Rev.0 - **Master Site Plan updated, no change to point locations**

Created By: RS Date: 28/02/2023
Checked By: JP Date: 6/03/2024
Authorised Signatory (KTP): JLM Date: 6/03/2024



SEDIMENT RETENTION POND 1 NOTES:

- 280m³ REQUIRED TOTAL STORAGE VOLUME FOR 9300m² CONTRIBUTING CATCHMENT WITH 3% STORAGE.
- TO BE CONSTRUCTED WITH FOREBAY AND EROSION CONTROL FLOC BOX OR SIMILAR TO BE USED FOR FLOCCULATION.
- SINGLE T BAR DECANT TO BE USED AS PER AUCKLAND COUNCIL GD05 STANDARDS.
- TYPICAL POND DIMENSIONS: 31m LONG x 9m WIDE x 1.50m TOTAL DEPTH.
- REFER DRAWING EW-117 FOR DETAILS.

SEDIMENT RETENTION POND 2 NOTES:

- 190m³ REQUIRED TOTAL STORAGE VOLUME FOR 7600m² CONTRIBUTING CATCHMENT WITH 2.5% STORAGE.
- TO BE CONSTRUCTED WITH FOREBAY AND EROSION CONTROL FLOC BOX OR SIMILAR TO BE USED FOR FLOCCULATION.
- SINGLE T BAR DECANT TO BE USED AS PER AUCKLAND COUNCIL GD05 STANDARDS.
- TYPICAL POND DIMENSIONS: 23m LONG x 7m WIDE x 1.50m TOTAL DEPTH.
- REFER DRAWING EW-118 FOR DETAILS.

SEDIMENT RETENTION POND 3 NOTES:

- 140m³ REQUIRED TOTAL STORAGE VOLUME FOR 7000m² CONTRIBUTING CATCHMENT WITH 2% STORAGE.
- TO BE CONSTRUCTED WITH FOREBAY AND EROSION CONTROL FLOC BOX OR SIMILAR TO BE USED FOR FLOCCULATION.
- SINGLE T BAR DECANT TO BE USED AS PER AUCKLAND COUNCIL GD05 STANDARDS.
- TYPICAL POND DIMENSIONS: 23m LONG x 7m WIDE x 1.50m TOTAL DEPTH.
- REFER DRAWING EW-119 FOR DETAILS.

LEGEND

- EXISTING CONTOUR (MAJOR)
- EXISTING CONTOUR (MINOR)
- DIRTY WATER DIVERSION
- CLEAN WATER DIVERSION
- SEDIMENT RETENTION POND
- DECANTING EARTH BUND
- SUPER SILT FENCE
- EXTENT OF SITE WORKS
- STABILISED CONSTRUCTION ACCESS
- PROPOSED EFFLUENT DISPOSAL AREAS

EROSION & SEDIMENT CONTROL NOTES:

1. EROSION & SEDIMENT CONTROL IN ACCORDANCE WITH GD05 AND TO BE CONFIRMED ON-SITE.
2. EARTHWORKS TO BE COMPLETED DURING PERIODS OF FINE DRY WEATHER WHERE POSSIBLE.
3. EXPOSED SUBGRADE TO BE LIMITED AND PROGRESSIVE STABILISATION TO BE IMPLEMENTED WHERE POSSIBLE.
4. EARTHWORK AREAS OUTSIDE OF EROSION & SEDIMENT CONTROL STAGES INVOLVING MINOR EARTHWORKS AND WILL BE COMPLETED UTILISING A CUT AND COVER METHODOLOGY. ANY EXPOSED SUBGRADE WILL BE SIMULTANEOUSLY STABILISED WITH METAL OR TOPSOILED, GRASS SEEDED AND HESSIAN MATTING PINNED.
5. REFER DRAWING EW-117 - EW-119 FOR SEDIMENT CONTROL DETAILS.

No.	Revision	Drawn	Chk.	Appd.	Date
E	CATCHMENT AREA & BUND NOTE ADDED	MS	PF	IH	MAR 2022
D	EDA AREAS ADDED	MS	PF	IH	MAR 2022
C	SRP 1 & 3 REVISED DIMENSIONS	MS	PF	IH	MAR 2022
B	DEB'S CHANGED TO SEDIMENT PONDS	MS	PF	IH	MAR 2022
A	SEDIMENT CONTROL DETAILS REVISED	MS	PF	IH	FEB 2022

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Design	M. SYMONS	FEB 2022
Drawn	M. SYMONS	FEB 2022
Checked	P. FARLEY	FEB 2022
Approved	L HUTCHINSON	FEB 2022
Scale	1:1,500 @ A3	
Scale vert. exag.		

Project: CABRA RURAL DEVELOPMENTS & RAHOPARA FARMS LTD
PALLISER DOWNS STAGE 2 (2021)
PALLISER DOWNS DRIVE
WAINUI
ENGINEERING PLAN APPROVAL

Title: ROAD 1 EROSION & SEDIMENT CONTROL PLAN

Sheet No.: EW-114

Job No.: A3-24066 EPA

Rev.: E

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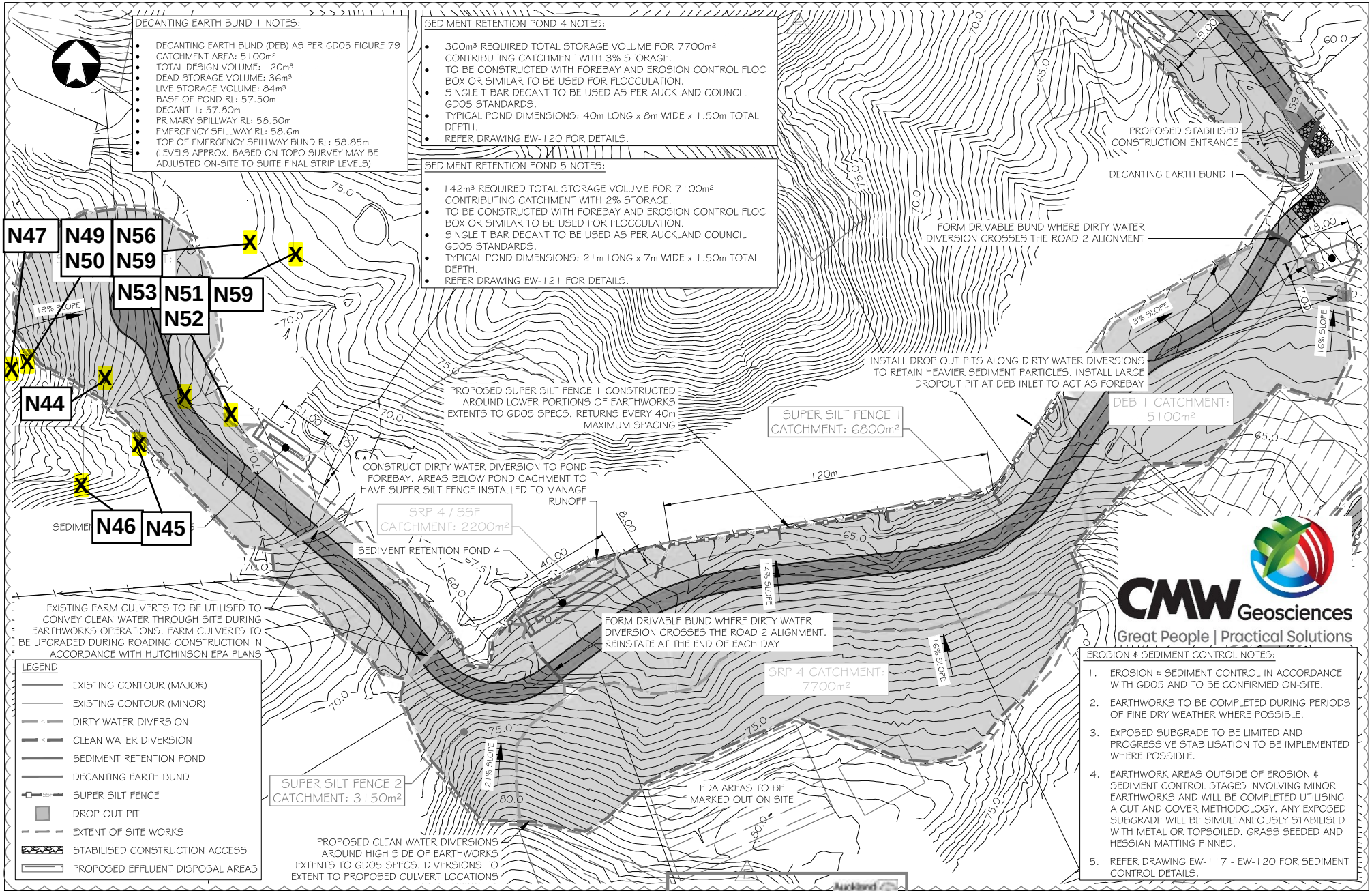

No.	Revision	Drawn	Chk.	Appd.	Date
E	EDA AREAS ADDED	MS	PF	IH	MAR 2022
D	SRP 4 & SILT FENCE CATCHMENTS CLOSED UP	MS	PF	IH	MAR 2022
C	DEB 1 DROP OUT PIT & DRIVEABLE BUNDS ADDED. EXISTING CULVERTS TO BE UTILISED FOR CLEAN WATER	MS	PF	IH	MAR 2022
B	DEB 4 UPDATED TO SEDIMENT POND 5	MS	PF	IH	MAR 2022
A	SEDIMENT CONTROL DETAILS REVISED	MS	PF	IH	FEB 2022

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Drawn	M. SYMONS	FEB 2022
Checked	P. FARLEY	FEB 2022
Approved	I. HUTCHINSON	FEB 2022
Scale	1:1250 @ A3	
Scale vert. exag.		

Auckland Council
ENG60397250 / VIJAY.K
Approved Engineering Plan
09/09/2022

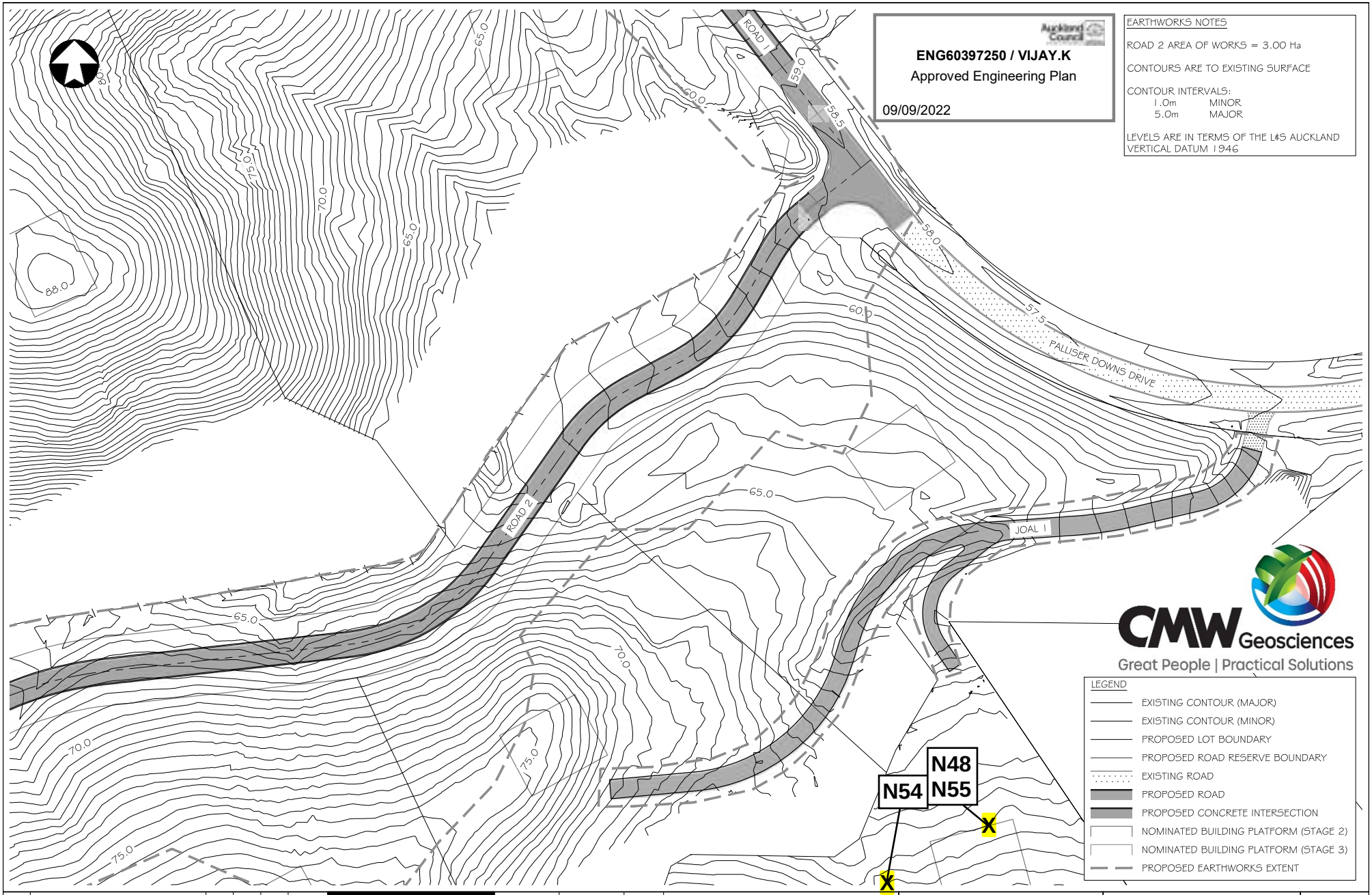
Project: CABRA RURAL DEVELOPMENTS & RAHOPARA FARMS LTD
PALLISER DOWNS STAGE 2 (2021)
PALLISER DOWNS DRIVE
WAINUI
ENGINEERING PLAN APPROVAL

Title: ROAD 2 EROSION & SEDIMENT CONTROL PLAN

Sheet No.: EW-115

Job No.: A3-24066 EPA

Rev.: E



No.	Revision	Drawn	Chk.	Appd.	Date
-	ISSUE FOR EPA APPROVAL	-	-	-	FEB 2022

Hutchinson
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Design	M. SYMONS	FEB 2022
Drawn	M. SYMONS	FEB 2022
Checked	P. FARLEY	FEB 2022
Approved	L HUTCHINSON	FEB 2022
Scale	1:1000 @ A3	
Scale vert. exag.		

Project
CABRA RURAL DEVELOPMENTS & RAHOPARA FARMS LTD
PALLISER DOWNS STAGE 2 (2021)
PALLISER DOWNS DRIVE
WAINUI
ENGINEERING PLAN APPROVAL

Title
ROAD 2 EXISTING CONTOUR PLAN - SHEET 1 OF 2

Sheet No.
EW-103

Job No.
A3-24066 EPA

Rev.
-

LF14 Dynamic Cone Penetration (DCP) Test Report (Rev 16)

NZS 4402: 1988 Test 6.5.2

Project:	Palliser Downs
Project No:	AKL2019-0017
Location:	Wainui
Report No:	AKL2019-0017LAE Rev.1
Test Date:	16/03/2023
Tested By:	PH/DW
Client:	Cabra Rural Developments Limited
Client Address:	3 Alice Ave, Orewa 0931
CBR Test Calculation:	Austroads (2010) (fine grained cohesive)

Auckland Laboratory
CMW Geotechnical NZ Limited
11/63, Arrenway Drive, Rosedale, NZ 0632
PO Box 300206, Albany, Auckland, NZ 0752
Phone: +64 (09) 4144 632

Testing Locations Selected By: CMW Field Staff

Test results indicated as not accredited are outside the scope of the laboratory's accreditation

*** Equivalent CBR Values are not accredited and are outside the scope of the laboratory's accreditation**

Test No	11		12							
Test Location	Road 2		Road 2							
Chainage & Offset	CH580 +5m KL R		CH600 +1.5m KL C							
Material & Layer	Post Stabilised		Post Stabilised							
Depth (mm)	Blow Count	Equiv CBR*	Blow Count	Equiv CBR*	Blow Count	Equiv CBR*	Blow Count	Equiv CBR*	Blow Count	Equiv CBR*
0 - 100	7	15	8	18						
100 - 200	4	8	6	13						
200 - 300	4	8	4	8						
300 - 400	3	6	3	6						
400 - 500	2	4	2	4						
500 - 600	2	4	2	4						
600 - 700	2	4	2	4						
700 - 800	2	4	2	4						
800 - 900	2	4	2	4						
900 - 1000										

Test No										
Test Location										
Chainage & Offset										
Material & Layer										
Depth	Blow Count	Equiv CBR*	Blow Count	Equiv CBR*	Blow Count	Equiv CBR*	Blow Count	Equiv CBR*	Blow Count	Equiv CBR*
0 - 100										
100 - 200										
200 - 300										
300 - 400										
400 - 500										
500 - 600										
600 - 700										
700 - 800										
800 - 900										
900 - 1000										

This report replaces reports numbered AKL2019-0017LAD Rev.0 - **Master Site Plan updated, no change to point location**

Created by: RS Date: 20/03/2023

Checked by: JP Date: 6/03/2024

Authorised Signatory (KTP): JLM Date: 6/03/2024

* Equivalent CBR values are taken from Fig 5.3, Austroads Guide to Pavement Technology, Part 2: Pavement Structural Design, Austroads 2010. Values are relevant to fine grained soils only.

LF14 Dynamic Cone Penetration (DCP) Test Report (Rev 16)

NZS 4402: 1988 Test 6.5.2

Project:	Palliser Downs
Project No:	AKL2019-0017
Location:	Wainui
Report No:	AKL2019-0017LAE Rev.1
Test Date:	16/03/2023
Tested By:	PH/DW
Client:	Cabra Rural Developments Limited
Client Address:	3 Alice Ave, Orewa 0931
CBR Test Calculation:	Austroads (2010) (fine grained cohesive)

Auckland Laboratory
CMW Geotechnical NZ Limited
11/63, Arrenway Drive, Rosedale, NZ 0632
PO Box 300206, Albany, Auckland, NZ 0752
Phone: +64 (09) 4144 632

Testing Locations Selected By: CMW Field Staff

Test results indicated as not accredited are outside the scope of the laboratory's accreditation

*** Equivalent CBR Values are not accredited and are outside the scope of the laboratory's accreditation**

Test No	1		2		3		4		5	
Test Location	Road 2		Road 2		Road 2		Road 2		Road 2	
Chainage & Offset	CH400 R		CH420 +1.5m L		CH440 +1.5m R		CH460 +1.5m L		CH480 +1.5m R	
Material & Layer	Post Stabilised		Post Stabilised		Post Stabilised		Post Stabilised		Post Stabilised	
Depth (mm)	Blow Count	Equiv CBR*	Blow Count	Equiv CBR*	Blow Count	Equiv CBR*	Blow Count	Equiv CBR*	Blow Count	Equiv CBR*
0 - 100	8	18	12	20+	9	20	7	15	10	20+
100 - 200	5	10	6	13	5	10	5	10	5	10
200 - 300	5	10	4	8	3	6	4	8	5	10
300 - 400	4	8	3	6	3	6	4	8	3	6
400 - 500	3	6	2	4	2	4	3	6	2	4
500 - 600	2	4	2	4	1	2	2	4	2	4
600 - 700	3	6	2	4	1	2	2	4	2	4
700 - 800	2	4	2	4	1	2	1	2	2	4
800 - 900	2	4	2	4	1	2	1	2	2	4
900 - 1000	2	4	2	4	1	2				

Test No	6		7		8		9		10	
Test Location	Road 2		Road 2		Road 2		Road 2		Road 2	
Chainage & Offset	CH500 +1.5m L		CH520 +1.5m L		CH450 +1.5m R		CH560 C		CH580 +5m KL L	
Material & Layer	Post Stabilised		Post Stabilised		Post Stabilised		Post Stabilised		Post Stabilised	
Depth	Blow Count	Equiv CBR*	Blow Count	Equiv CBR*	Blow Count	Equiv CBR*	Blow Count	Equiv CBR*	Blow Count	Equiv CBR*
0 - 100	8	18	8	18	11	20+	6	13	8	18
100 - 200	5	10	4	8	6	13	4	8	4	8
200 - 300	4	8	3	6	4	8	3	6	3	6
300 - 400	3	6	3	6	4	8	3	6	3	6
400 - 500	2	4	2	4	4	8	2	4	2	4
500 - 600	2	4	2	4	3	6	2	4	2	4
600 - 700	2	4	2	4	2	4	2	4	2	4
700 - 800	2	4	2	4	2	4	2	4	2	4
800 - 900	2	4	2	4	2	4	2	4	2	4
900 - 1000			2	4	2	4	2	4		

This report replaces reports numbered AKL2019-0017LAD Rev.0 - **Master Site Plan updated, no change to point location**

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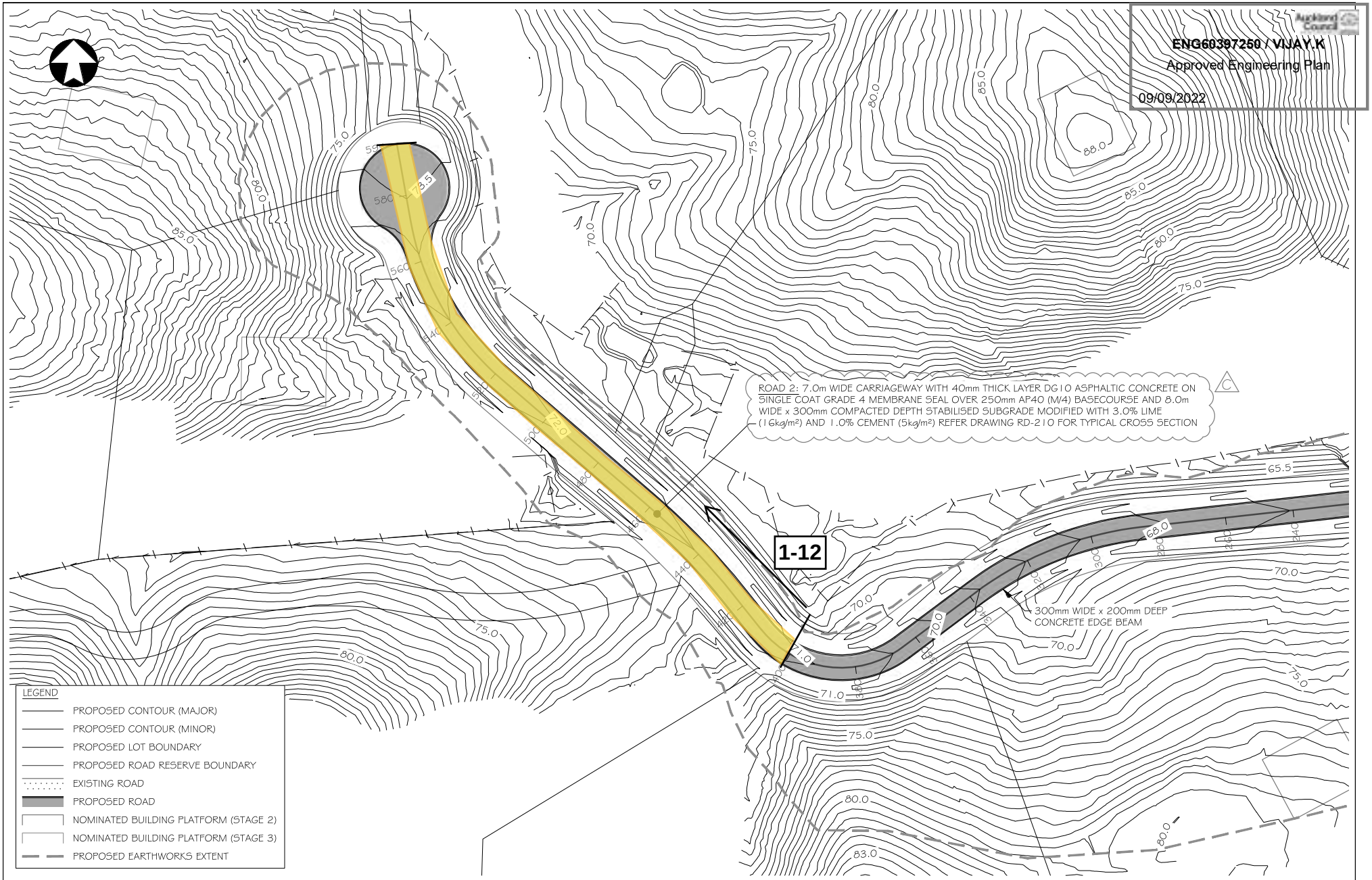
Created by:	RS	Date:	20/03/2023
Checked by:	JP	Date:	6/03/2024
Authorised Signatory (KTP):	JLM	Date:	6/03/2024

* Equivalent CBR values are taken from Fig 5.3, Austroads Guide to Pavement Technology, Part 2: Pavement Structural Design, Austroads 2010. Values are relevant to fine grained soils only.



No.	Revision	Drawn	Chk.	Appd.	Date
C	BASECOURSE DEPTH INCREASED TO 250mm	MS	PF	IH	AUG 2022
B	AC MIX CHANGED FROM DG10 TO DG10	MS	PF	IH	MAY 2022
A	ROAD 2 REVISED LEVELS	MS	PF	IH	APR 2022
-	ISSUE FOR EPA APPROVAL	-	-	-	FEB 2022

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Design	M. SYMONS	FEB 2022
Drawn	M. SYMONS	FEB 2022
Checked	P. FARLEY	FEB 2022
Approved	L HUTCHINSON	FEB 2022
Scale	1:1000 @ A3	
Scale vert. exag.		

Project
CABRA RURAL DEVELOPMENTS & RAHOPARA FARMS LTD
PALLISER DOWNS STAGE 2 (2021)
PALLISER DOWNS DRIVE
WAINUI
ENGINEERING PLAN APPROVAL

Title
PROPOSED ROAD 2 LAYOUT PLAN - SHEET 2 OF 2

Sheet No.
RD-204

Job No.
A3-24066 EPA

Rev.
C

LF11 Soil Field Density NDM Direct Transmission with VSS Report (Cohesive Soils) (Rev 18)

Auckland Laboratory
CMW Geotechnical NZ Limited
11/63, Arrenway Drive, Rosedale, NZ 0632
PO Box 300206, Albany, Auckland, NZ 0752
Phone: +64 (09) 4144 632

Project:	Palliser Downs
Project No:	AKL2019-0017
Location:	Wainui
Report No:	AKL2019-0017LAF Rev.0
Report Date:	27/03/2024
Client:	Cabra Rural Developments Limited
Client Address:	3 Alice Ave, Orewa 0931

Test Methods:
NZS 4407 2015 Test 3.1 ◊
NZS 4407 2015 Test 4.2
NZGS:August 2001

Notes:
Solid Density: Assumed
Solid Density Data Source: N/A
Testing Locations Selected By: CMW Field Staff
◊ Only samples <2.0mm will be considered for endorsed testing
① Blade size of 19mm used.

Test results indicated as not accredited are outside the scope of the laboratory's accreditation

Measurements marked * are not accredited and are outside the scope of the laboratories accreditation

Date Sampled	Sample No.	Test Location*	Soil Description*	Solid Density (t/m³) *	Vane ID		In-situ Vane Shear Strengths					Field and Laboratory Testing Data								Comments
					Head #	Blade # ①	Test 1 (kPa)	Test 2 (kPa)	Test 3 (kPa)	Test 4 (kPa)	Ave.	Gauge Wet Density (t/m³) **	Gauge Dry Density (t/m³)	Gauge Water Content (%)	Gauge Air Voids (%)	Gauge Probe Depth (mm)	Oven Water Content (%)	Oven Dry Density (t/m³)	Oven Calculated Air Voids (%) *	
11/12/2023	N60	Refer to site plan	CLAY Fill	2.70	1824	1824	200+	143	172	200+	179+	1.83	1.38	32.4	4	300	34.9	1.36	2	
	N61	Refer to site plan	CLAY Fill	2.70	1824	1824	200+	160	200+	200+	190+	1.84	1.39	32.3	3	300	35.2	1.36	2	
	N62	Refer to site plan	CLAY Fill	2.70	1824	1824	160	200+	186	200+	187+	1.76	1.22	44.1	1	300	43.7	1.23	1	
14/12/2023	N63	Refer to site plan	CLAY Fill	2.70	3661	3661	220	UTP	UTP	136	178+	1.79	1.30	37.6	3	300	37.4	1.30	3	
	N64	Refer to site plan	CLAY Fill	2.70	3661	3661	159	UTP	UTP	UTP	159+	1.65	1.17	40.7	9	300	39.4	1.18	10	
	N65	Refer to site plan	CLAY Fill	2.70	3661	3661	170	176	237+	193	194+	1.68	1.15	46.1	4	300	49.0	1.13	3	
22/01/2024	N66	Refer to site plan	CLAY Fill with Rock	2.70	1824	1824	200+	157	200+	186	186+	1.69	1.28	32.2	11	300	-	-	-	No Sample Taken
	N67	Refer to site plan	CLAY Fill with Rock	2.70	1824	1824	200+	172	200+	200+	193+	1.51	1.01	49.3	13	300	-	-	-	No Sample Taken
	N68	Refer to site plan	CLAY Fill with Rock	2.70	1824	1824	157	200+	183	157	174+	1.68	1.22	38.0	9	300	10.4	1.52	28	
23/01/2024	N69	Refer to site plan	CLAY Fill with Rock	2.70	1824	1824	200+	200+	UTP	UTP	200+	1.76	1.30	35.2	6	300	34.4	1.31	6	Retest of N68
	N70	Refer to site plan	CLAY Fill with Rock	2.70	1824	1824	200+	100	97	143	135+	-	-	-	-	-	-	-	-	No Sample Taken
1/02/2024	N71	Refer to site plan	CLAY Fill	2.70	1824	1824	117	143	157	126	136	1.59	1.12	42.1	11	300	-	-	-	No Sample taken
	N72	Refer to site plan	CLAY Fill	2.70	1824	1824	143	123	172	157	149	1.63	1.11	47.5	6	300	56.0	1.05	3	
	N73	Refer to site plan	CLAY Fill	2.70	1824	1824	74	114	103	100	98	-	-	-	-	-	-	-	-	No Sample Taken
	N74	Refer to site plan	CLAY Fill	2.70	1824	1824	114	112	143	172	135	1.56	1.12	39.2	14	300	-	-	-	No Sample Taken
30/01/2023	N75	Refer to site plan	CLAY Fill	2.70	1824	1824	200+	UTP	100	143	148+	1.55	1.05	48.0	11	300	52.4	1.02	9	
	N76	Refer to site plan	CLAY Fill	2.70	1824	1824	200+	UTP	157	117	158+	1.61	1.13	42.5	10	300	54.2	1.04	5	
31/01/2024	N77	Refer to site plan	CLAY Fill	2.70	1824	1824	200+	112	143	172	157+	1.59	1.10	44.5	10	300	51.6	1.05	7	
	N78	Refer to site plan	CLAY Fill	2.70	1824	1824	200+	200+	86	114	150+	1.65	1.15	43.9	7	300	49.3	1.11	4	
2/02/2024	N79	Refer to site plan	CLAY Fill	2.70	1824	1824	172	157	152	200+	170+	1.70	1.21	40.6	6	300	47.1	1.16	3	
	N80	Refer to site plan	CLAY Fill	2.70	1824	1824	157	132	143	143	144	1.62	1.13	43.6	9	300	46.1	1.11	8	
	N81	Refer to site plan	CLAY Fill	2.70	1824	1824	124	200+	157	132	153+	1.62	1.11	46.4	8	300	52.8	1.06	5	
7/02/2024	N82	Refer to site plan	CLAY Fill	2.70	1824	1824	UTP	UTP	UTP	UTP	UTP	1.56	1.16	35.0	17	300	-	-	-	No Sample Taken
	N83	Refer to site plan	CLAY Fill	2.70	1824	1824	UTP	200+	UTP	UTP	200+	1.54	1.11	39.3	15	300	-	-	-	No Sample Taken
	N84	Refer to site plan	CLAY Fill	2.70	1824	1824	UTP	UTP	UTP	UTP	UTP	1.55	1.17	32.5	19	300	-	-	-	No Sample Taken
	N85	Refer to site plan	CLAY Fill	2.70	1824	1824	200+	172	UTP	157	176+	1.53	1.09	41.0	15	300	-	-	-	No Sample Taken

** Gauge Wet Densities outside of the calibrated range of 1.754 to 2.611 t/m³ are not accredited and are outside the laboratories scope of accreditation.

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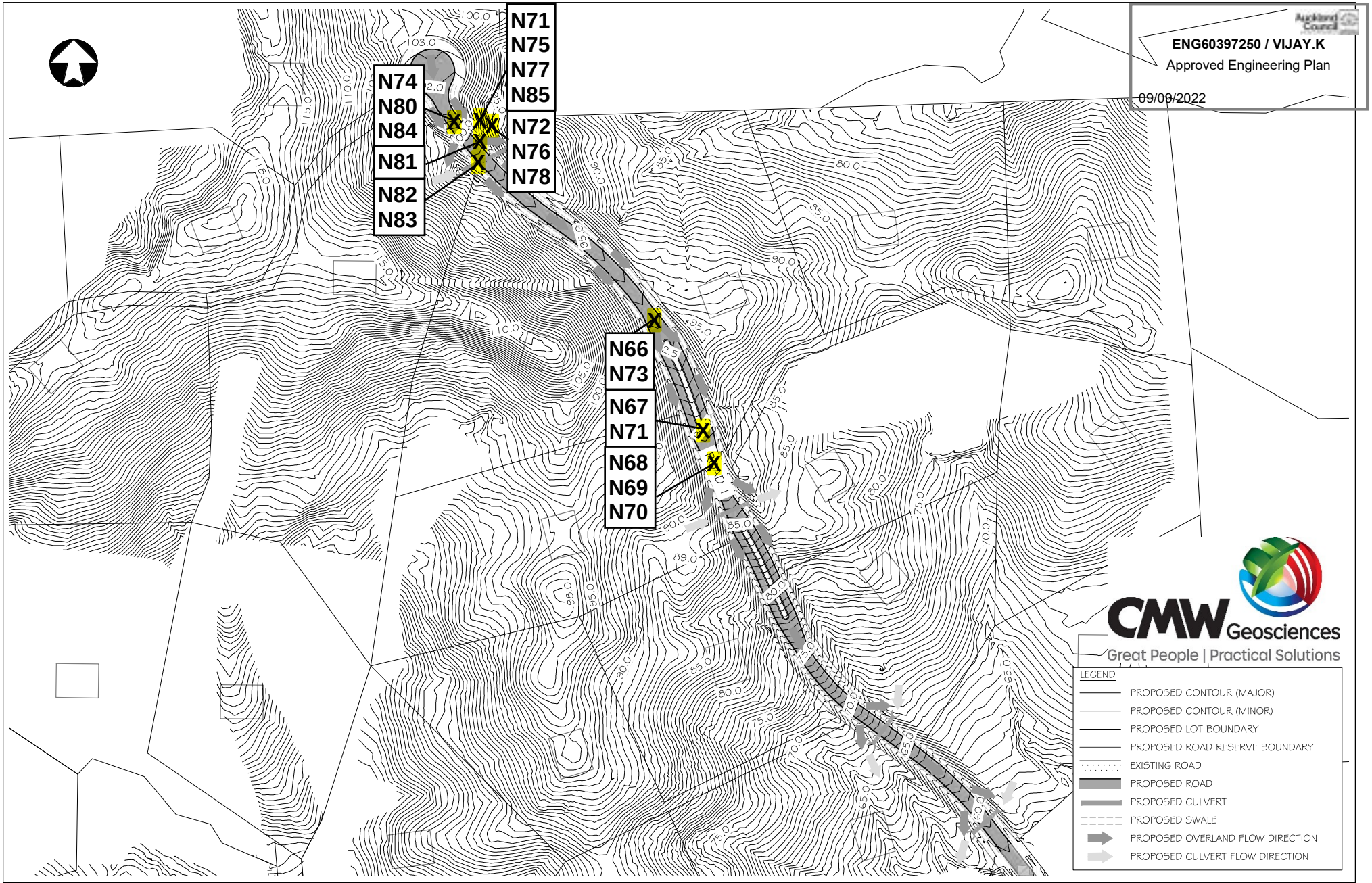
Checked By:	JP	Date:	27/03/2024
Authorised Signatory (KTP):	JLM	Date:	12/04/2024



No.	Revision	Drawn	Chk.	Appd.	Date
-	ISSUE FOR RFI	-	-	-	AUG 2022

Hutchinson
PO Box 150, Orewa 0946
154 Centreway Road, Orewa 0931
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Design	M. SYMONS	JUN 2022
Drawn	M. SYMONS	JUN 2022
Checked	P. FARLEY	JUN 2022
Approved	L HUTCHINSON	JUN 2022
Scale	1:2000 @ A3	
Scale vert. exag.		

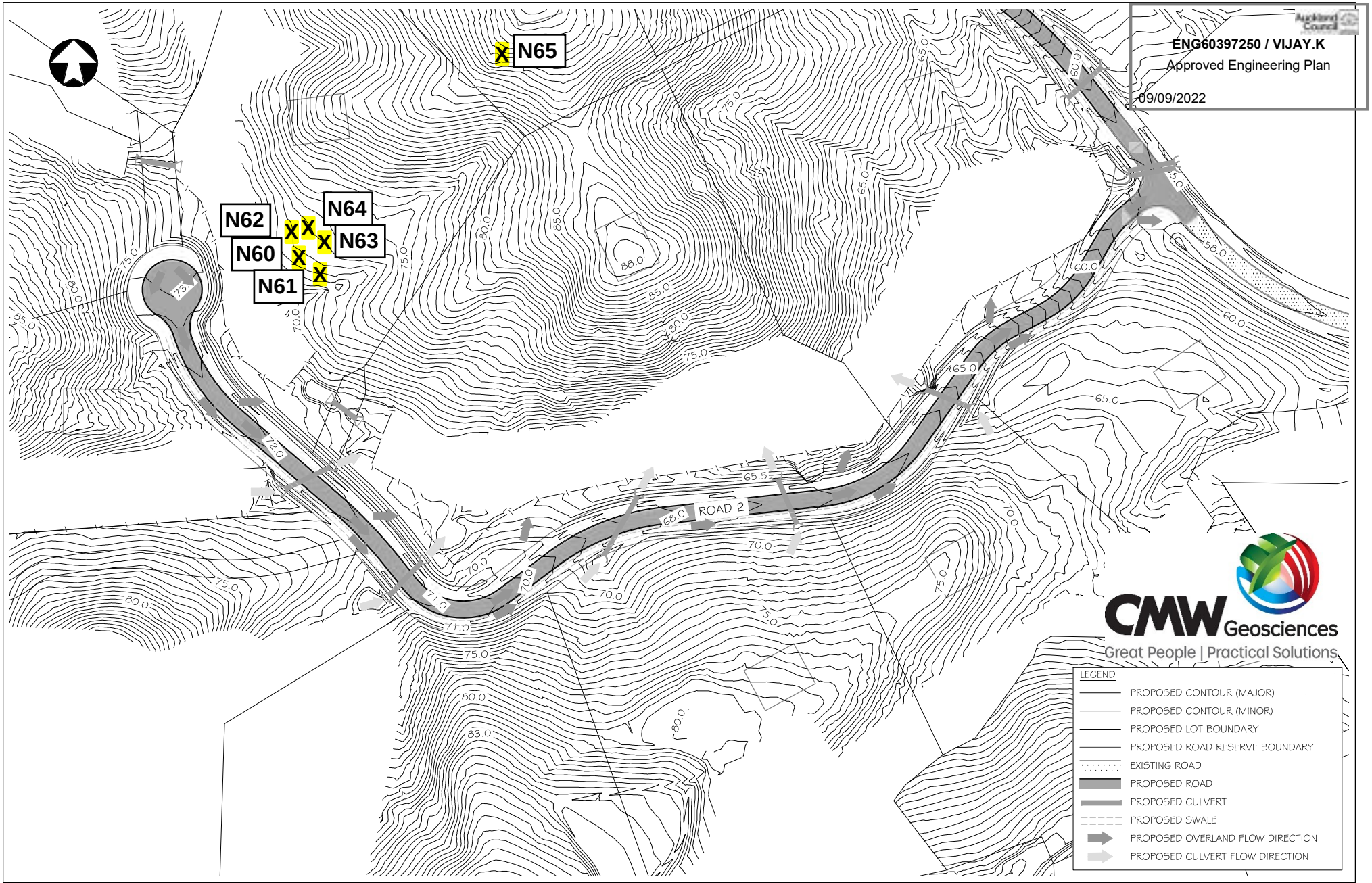
Project
CABRA RURAL DEVELOPMENTS & RAHOPARA FARMS LTD
PALLISER DOWNS STAGE 2 (2021)
PALLISER DOWNS DRIVE
WAINUI
ENGINEERING PLAN APPROVAL

Title
PROPOSED ROAD 1 SWALE & OVERLAND FLOW LAYOUT PLAN

Sheet No.
RD-236

Job No.
A3-24066 EPA

Rev.
-



No.	Revision	Drawn	Chk.	Appd.	Date
-	ISSUE FOR EPA APPROVAL	-	-	-	JUN 2022

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Scale	1:1500_XREF @ A3	
Scale vert. exag.		

Project
CABRA RURAL DEVELOPMENTS & RAHOPARA FARMS LTD
PALLISER DOWNS STAGE 2 (2021)
PALLISER DOWNS DRIVE
WAINUI
ENGINEERING PLAN APPROVAL

Title
PROPOSED ROAD 2 SWALE & OVERLAND FLOW LAYOUT PLAN

Sheet No.
RD-237

Job No.
A3-24066 EPA

Rev.
-

APPENDIX F: STABILITY SUPPLEMENT

SLOPE STABILITY			
Project:	Palliser Downs Stage 1B	**Job Number:**	AKL2019-0017
Site Address:	Palliser Downs Drive, Wainui	**Client:**	Cabra Rural Developments Limited/Rahopara Farms Limited
Prepared by:	Navneel Karan	**Reviewed by:**	Richard Knowles

1 INTRODUCTION

CMW Geosciences (CMW) was engaged by Cabra Rural Developments Limited/Rahopara Farms Limited to carry geotechnical investigations of a site located at Palliser Downs, which is being considered for a rural subdivision, in particular Lots 41, 44 and 55 comprising Stage 1B, to verify earthworks meet geotechnical requirements.

The scope of work and associated terms and conditions of our engagement were detailed in our service proposal letter referenced AKL2019-0017AB, Rev. 0 dated 31 May 2021.

This report is to support a resource consent application to Auckland Council and provides the basis for elements of the Statement of Professional Opinion provided in Geotechnical Completion Report AKL2019-0017AI.

2 SITE DETAILS

The Palliser Downs development comprises an area of approximately 111,1260 m^2 and is located Palliser Downs Drive, Weranui as shown in ***Figure 1.***

Details of the site are as follows:

- Legal description is Lot 1 DP 556774, Lot 2 DP 556774.
- Lots 41, 44, and 55 at the southern end of the development comprise Stage 1B.
- The site is bound by Palliser Downs Drive and residential dwellings east, rural land to the north, west and south.
- Historical aerial photographs[1] show the site remained rural and farmland up until the current development.

Figure 1: Site Location Plan (Auckland Council GIS Geomaps)

[1] Retrolens website, Sourced from http://retrolens.nz and licensed by LINZ CC-BY 3.0

3 INVESTIGATION

The field investigation was carried out in November 2021, June 2023 and July 2024 during winter and summer weather conditions. The scope of the fieldwork completed is shown below:

Investigation Summary			
Test ID	**Test Type**	**Depth (m)**	**Samples[1]**
HA05-22 to HA10-22, HA15-22 to HA18-22	Hand Auger Boreholes	2.2-3.9	-
GCR11-23 to GCR14-23	Geotechnical Completion Report (GCR) Hand Auger Borehole	2.0	4 x disturbed samples
HA01-24 to HA08-24	Hand Auger Boreholes	1.5-5.0	-
Notes: [1]Refer Section 6.3 for details			

The approximate locations of the respective investigation sites referred to above are shown In Figure 2.

Figure 2: Investigation Locations

4 GEOLOGY

Published geological maps[2] for the area depict the regional geology for the area as comprising Hukerenui Mudstone (Mangakahia Complex) of the Northland Allochthon Group. More recent alluvium (stream deposits) and colluvium (landslide deposits) are also known to be present the gullies and on ridge flank areas.

The main geohazards associated with these geological units are presented below:

Published Geology Summary			
Geological Unit	**Location**	**Behaviour**	**Principal Potential Geohazards**
Tauranga Group Alluvium/ Colluvium	Mapped in low-lying areas around adjacent streams	Unconsolidated organic deposits and clays will usually subside if unsupported or overloaded. Susceptible to soil creep and shallow flows on gentle slopes, particularly when saturated.	Load-induced settlement
Hukerenui Mudstone **(part of the Mangakahia Complex of the Northland Allochthon)**	Predominant geology as per published maps.	High plasticity clays prone to debris sliding and deep-seated creep, even on gentle slopes.	Landslips Shrink-swell

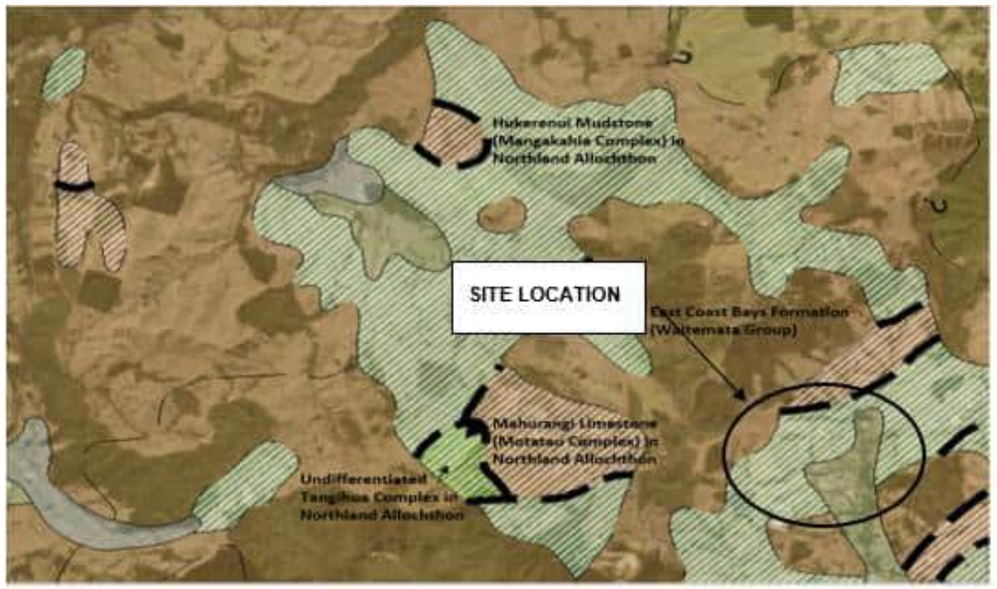


Figure 2: Regional Geological Webmaps (GNS Geology)

[2] Edbrooke, S. W. (compiler) 2001: Geology of the Auckland area. Institute of Geological & Nuclear Sciences 1:250 000 geological map 3. 1 sheet +74 p. Lower Hutt, New Zealand. Institute of Geological & Nuclear Sciences.

5 DESIGN CRITERIA

The stability of cut batters and fill embankments under a range of design conditions is expressed in terms of a factor of safety, 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:

Slope Stability Minimum Factor of Safety Criteria		
Condition	**Building Platforms**	**Amenity or Low Risk Areas**
Normal Groundwater Condition	1.5	1.2
Extreme (worst credible) groundwater condition	1.3	1.1
Seismic condition for ULS PGA (calculated as 0.19g)	1.0	N/A or 1.0

6 DESIGN PARAMETERS

Geotechnical Design Parameters					
Unit Description	**Strength Range**	**γ (kN/m³)**	**c´ (kPa)**	**ϕ´ (deg)**	**S_u (kPa)**
Engineered Fill	100-200kPa	18	8	28	100
Colluvium	45-84kPa	17	5	24	50
Hukerenui Residual Soils (Northland Allochthon)	77 – 200 kPa	17	5	26	60
Hukerenui Transition Zone (Northland Allochthon)	>200kPa/15-20 blows/ 100mm	18	10	12	125
***Hukerenui Parent Rock (Northland Allochthon)**	N = 50+ and >20 blows per 100mm	20.5	20	28	

Notes: γ = soil unit weight (conservative value determined from typical published values for similar soil types)
c´ = effective cohesion (conservative industry accepted values, CMW laboratory testing records and back analysis)
ϕ´ = effective friction angle (conservative industry accepted values, CMW laboratory testing records and back analysis)
*shear normal function used for Hukerenui Mudstone Parent Rock

7 METHODOLOGY

- Slope stability analyses were undertaken using the Morgenstern-Price method of slices under complex failure mechanisms using the proprietary software SLIDE Version 6.
- Based on a body of laboratory shear box tests from this site and others nearby, a shear/normal function was used to model the Hukerenui Mudstone Rock mass
- The method of non-circular and circular surface options and search methods were used to compute slope stability analyses.
- Ru values were used to model groundwater pressures. Hukerenui Mudstone has very low permeability and the rock mass is typically dry. From previous experience, perched groundwater is not characteristic of this geology. An Ru of 0.5 represents fully saturated conditions, whereas Ru of 0 represents dry conditions. As depicted on the stability printouts, Ru values between 0 and 0.45 have been used to model groundwater conditions for various scenarios on the cross sections for this site.

8 INITIAL RESULTS

Slope stability analyses were undertaken on Sections G, H, I, K and Z (see ***Figure 2)***

Results are appended to this memo and are summarised below for the proposed landform.

Slope Stability Analysis Results						
Section	**Stable Building Platforms**			**Amenity Areas**		
	Prevailing	**Transient**	**Seismic**	**Prevailing**	**Transient**	**Seismic**
G (Lot 41)	1.9	1.6	2.5	-	-	-
H (Lot 41)	1.5	1.3	1.9	-	-	-
I (Lot 44)	1.5	1.3	1.5	1.1	1.0	-
K (Lot 55)	1.9	1.5	1.8	-	-	-
Z (Lot 44)	1.5	1.3	1.3			

Based on the slope stability analysis, required factors of safety were met for all five sections for all cases. Section I and Z require 10m and 6m offsets respectively from the crests of the slopes below the stable building area platform on Lot 44. No remediation is required.

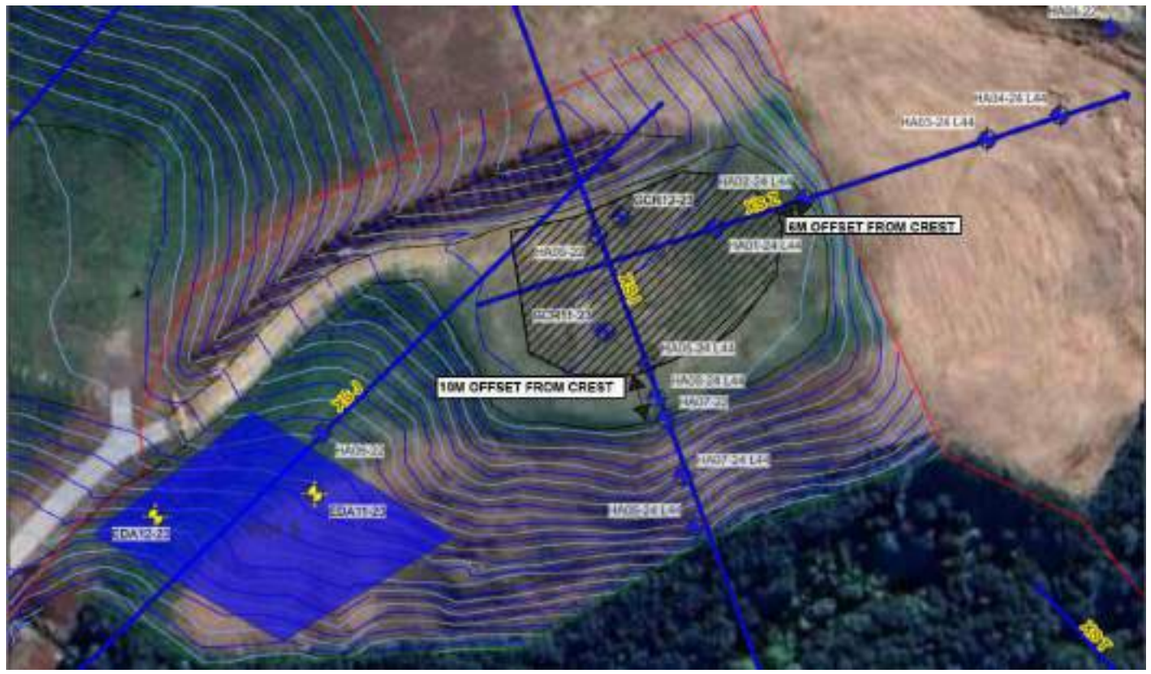
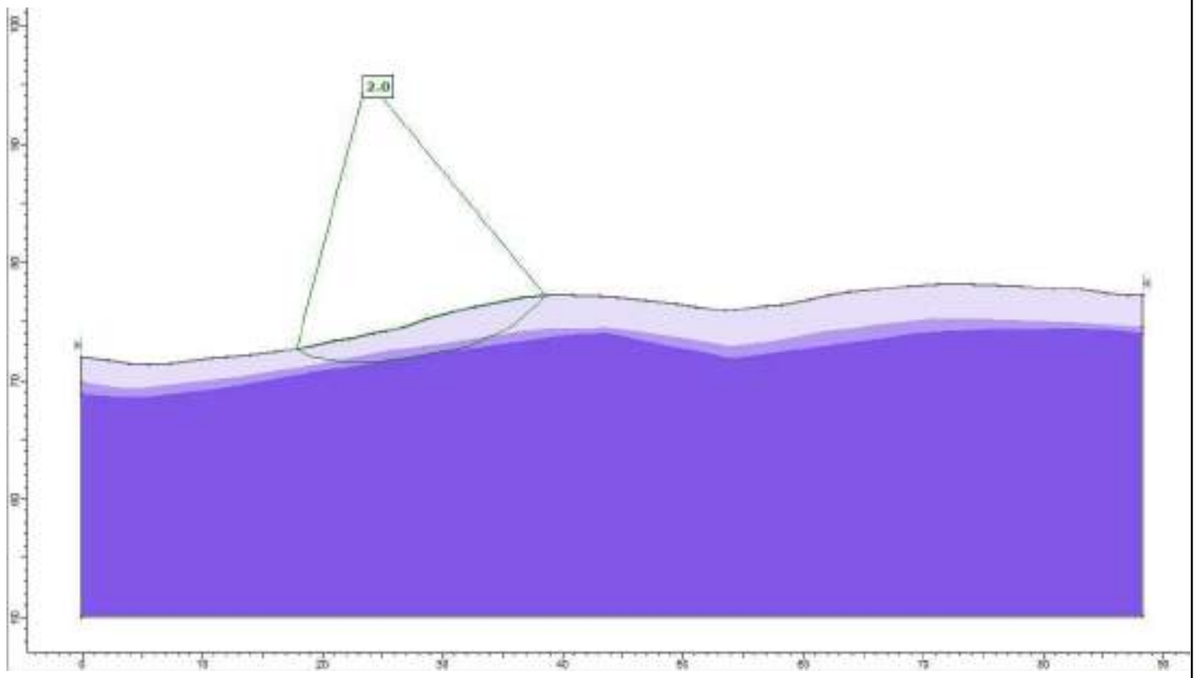


Figure 3: Updated Building Platform Footprint With A 10m Offset From The Southern Crest And 6m Offset From The Eastern Crest.

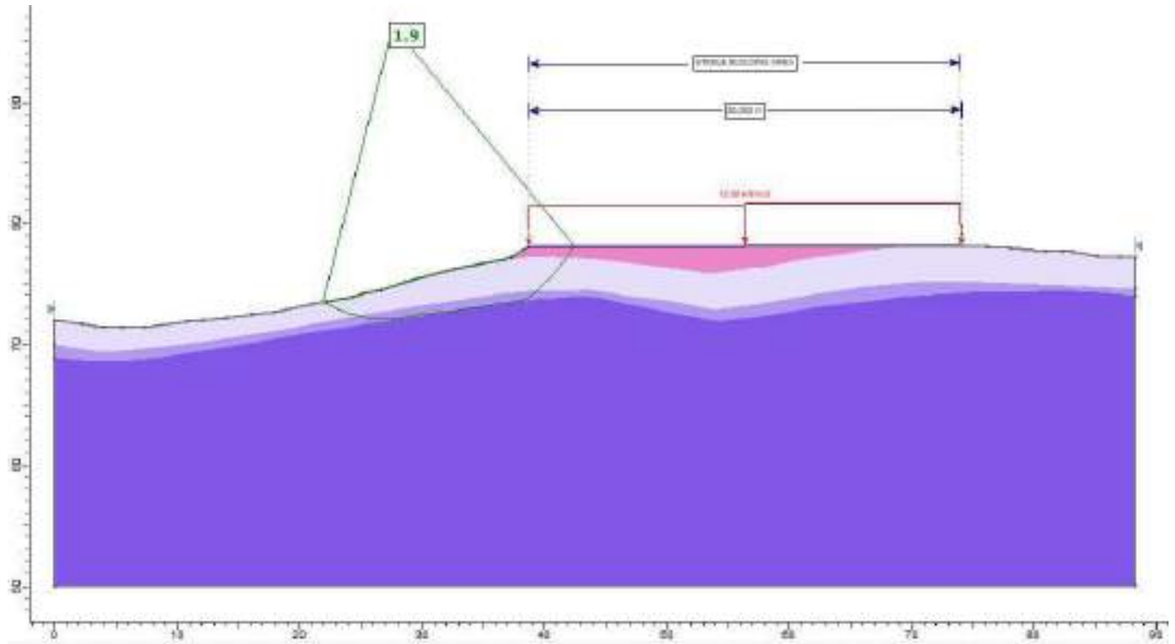
Stability Analysis Summary Table

Client:	Cabra Rural Developments Limited/Rahopara Farms Limited
Project:	Palliser Downs
Project Number	AKL2019-0017
Date:	18/07/2024
Notes:	NGW = Normal Groundwater — Target minimum FoS = 1.5
	HGW = High Groundwater (worst credible) — Target minimum FoS = 1.3
	SEIS = Seismic — Target minimum FoS = 1.0

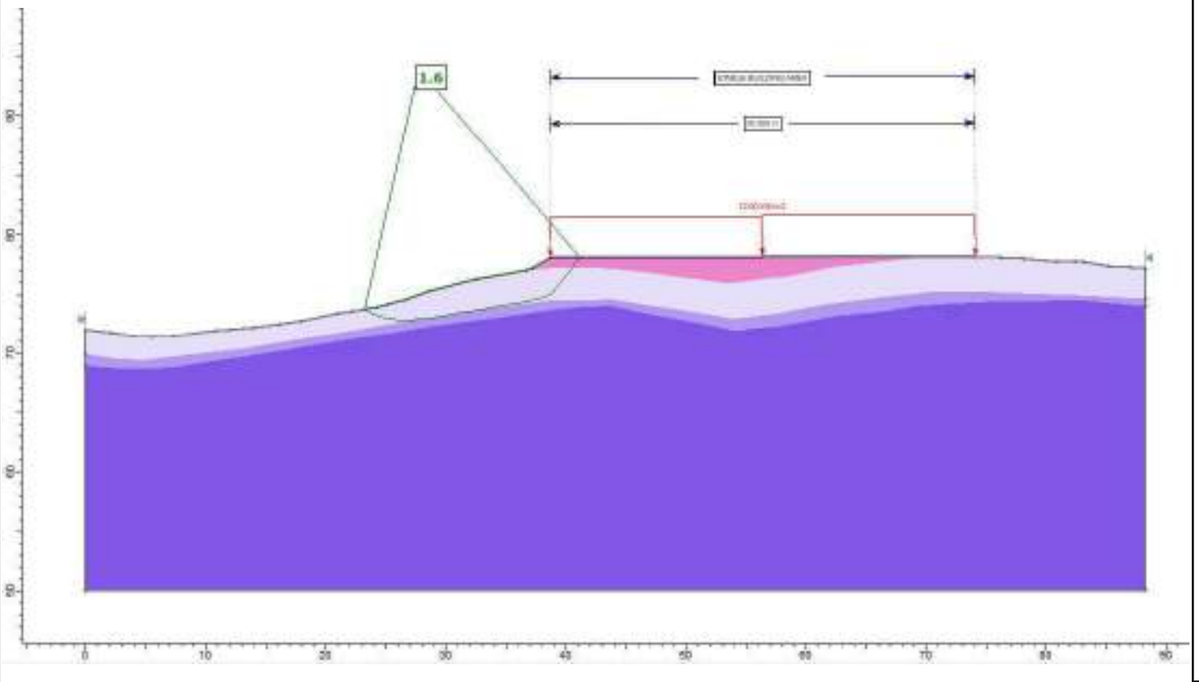
Cross Section	Profile	Design Case	Analysis Type	Factor of Safety	Printout Included	Additional Comments
Section G	Back Analysis	HGW	Non-Circular (Cuckoo)	2.0	✓	
(Lot 41)	Proposed	NGW	Non-Circular (Cuckoo)	1.9	✓	
		HGW	Non-Circular (Cuckoo)	1.6	✓	
		SEIS	Non-Circular (Cuckoo)	2.5	✓	
Section H	Back Analysis	HGW	Non-Circular (Cuckoo)	1.9	✓	
(Lot 41)	Proposed	NGW	Non-Circular (Cuckoo)	1.5	✓	
		HGW	Non-Circular (Cuckoo)	1.3	✓	
		SEIS	Non-Circular (Cuckoo)	1.9	✓	
Section I	Back Analysis	HGW	Non-Circular (Cuckoo)	1.0	✓	
(Lot 44)	Proposed	NGW	Non-Circular (Cuckoo)	1.1	✓	A Factor of Safety of 1.5 is attained in the proposed building platform 10m offset from the batter crest
		HGW	Non-Circular (Cuckoo)	1.0	✓	A Factor of Safety of 1.3 is attained within proposed building platform
		SEIS	Non-Circular (Cuckoo)	1.5	✓	
Section K	Back Analysis	HGW	Non-Circular (Cuckoo)	1.6	✓	
(Lot 55)	Proposed	NGW	Non-Circular (Cuckoo)	1.9	✓	
		HGW	Non-Circular (Cuckoo)	1.5	✓	
		SEIS	Non-Circular (Cuckoo)	1.8	✓	
Section Z	Back Analysis	HGW	Non-Circular (Cuckoo)	1.6	✓	
(Lot 44)	Proposed	NGW	Non-Circular (Cuckoo)	1.5	✓	Factors of Safety requirements met with building platform 6m offset from the cut batter crest
		HGW	Non-Circular (Cuckoo)	1.3	✓	
		SEIS	Non-Circular (Cuckoo)	1.3	✓	



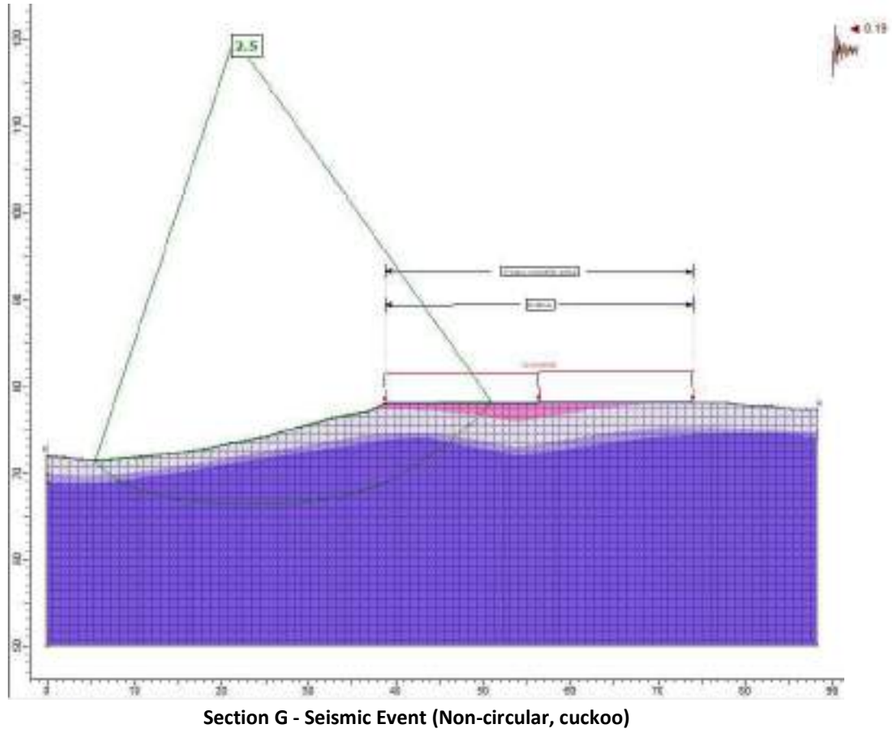
Section G - Back Analysis (Worst Case Scenario) (Non-circular, cuckoo)



Section G - Normal Groundwater Conditions (Non-circular, cuckoo)

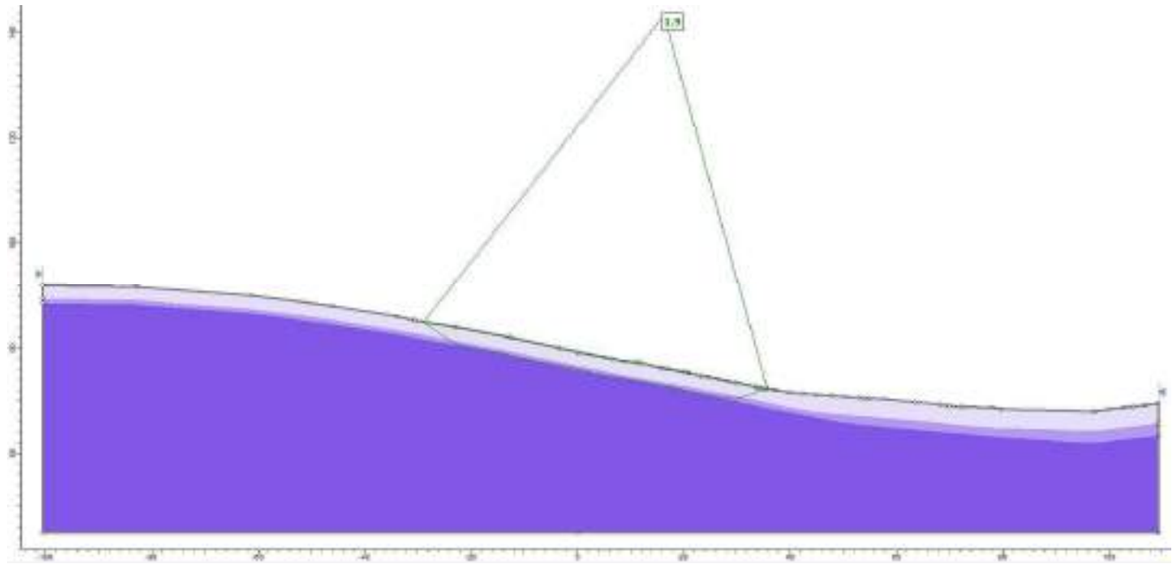


Section G - High Groundwater Conditions (Non-circular, cuckoo)

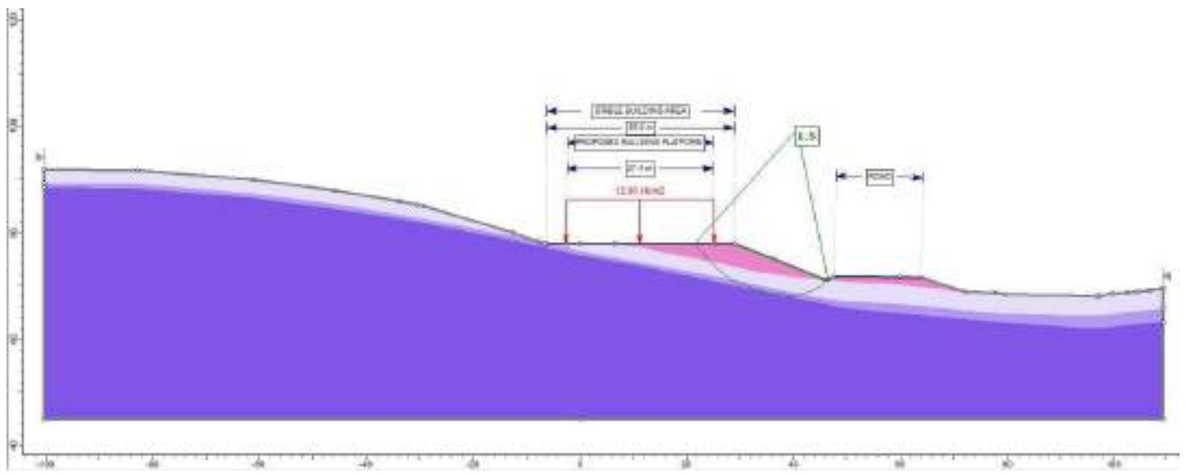


Section G - Seismic Event (Non-circular, cuckoo)

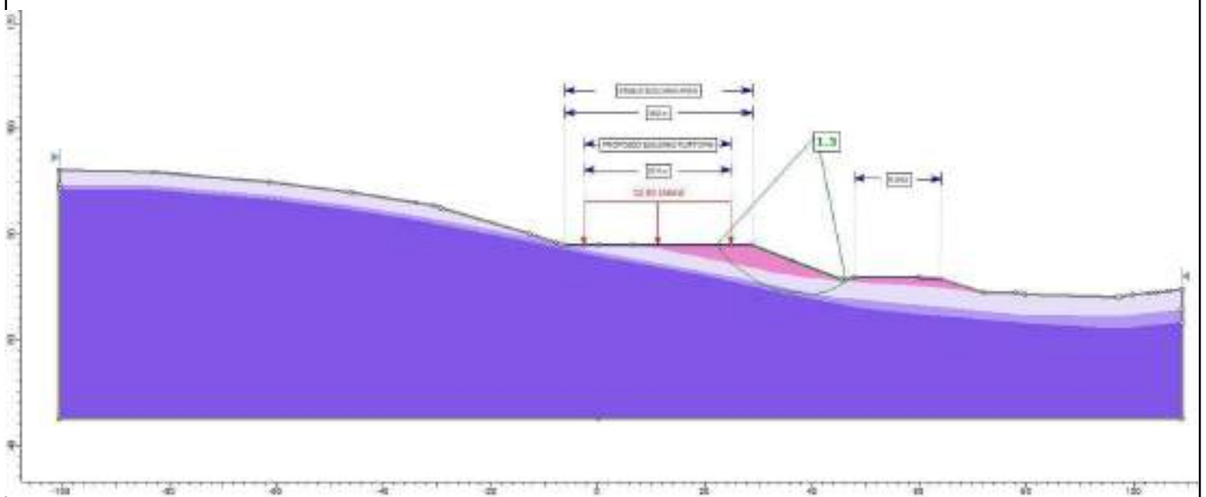
CMW Geosciences Great People | Practical Solutions	*Project* Palliser Downs	*Analysis* Non-circular, cuckoo	*Project No.* AKL2019-0017
	Title Section G	*Date* 20/06/2024	*Drawing* STAB 01



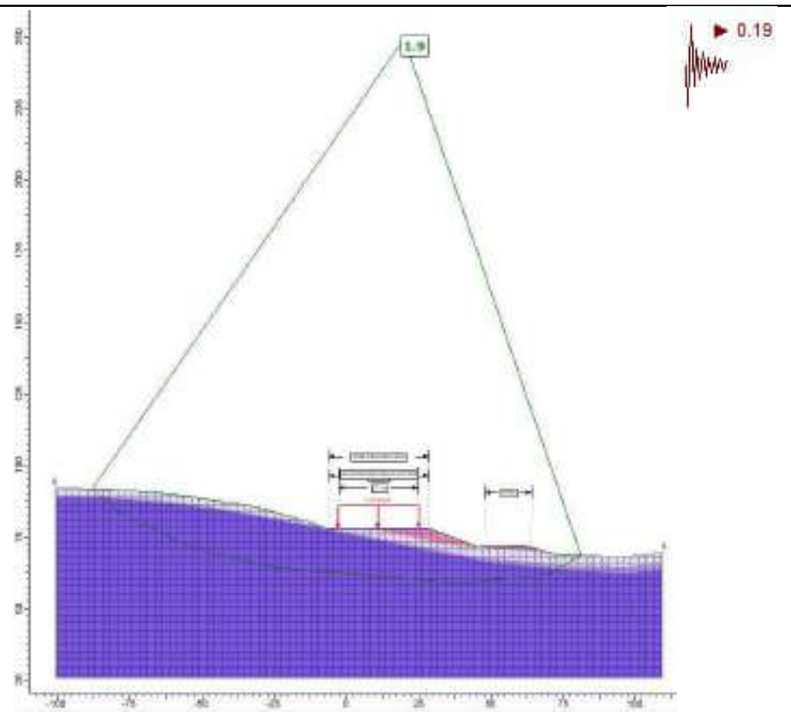
Section H - Back Analysis (Worst Case Scenario) (Non-circular, cuckoo)



Section H - Normal Groundwater Conditions (Non-circular, cuckoo)



Section H - High Groundwater Conditions (Non-circular, cuckoo)



Section H - Seismic Event (Non-circular, cuckoo)

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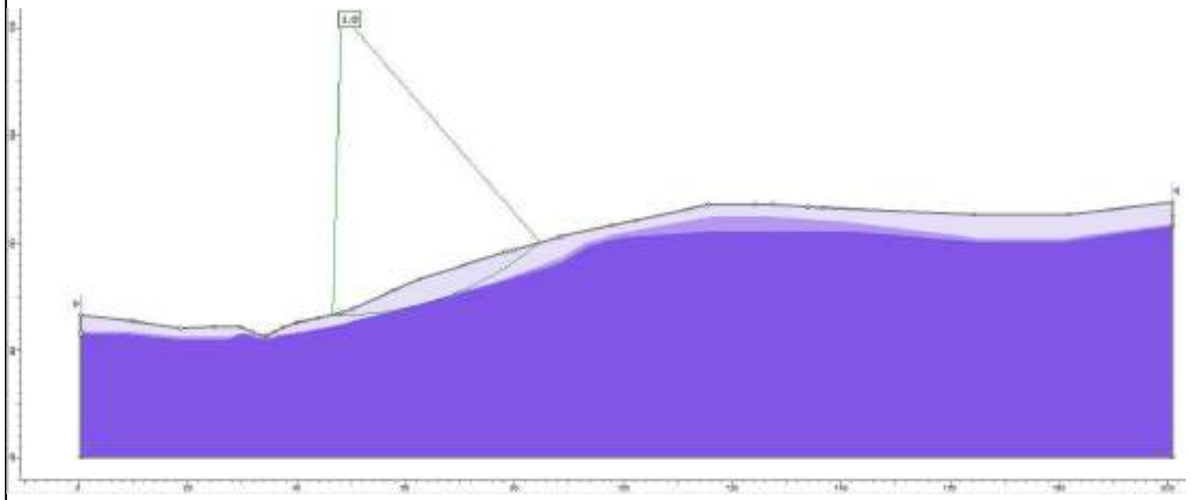
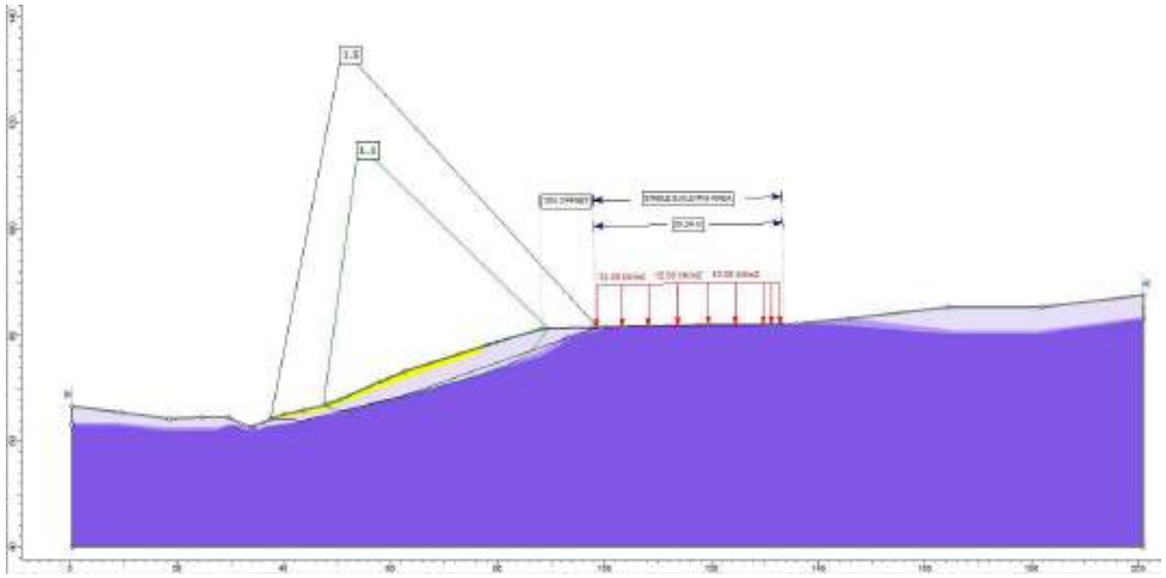
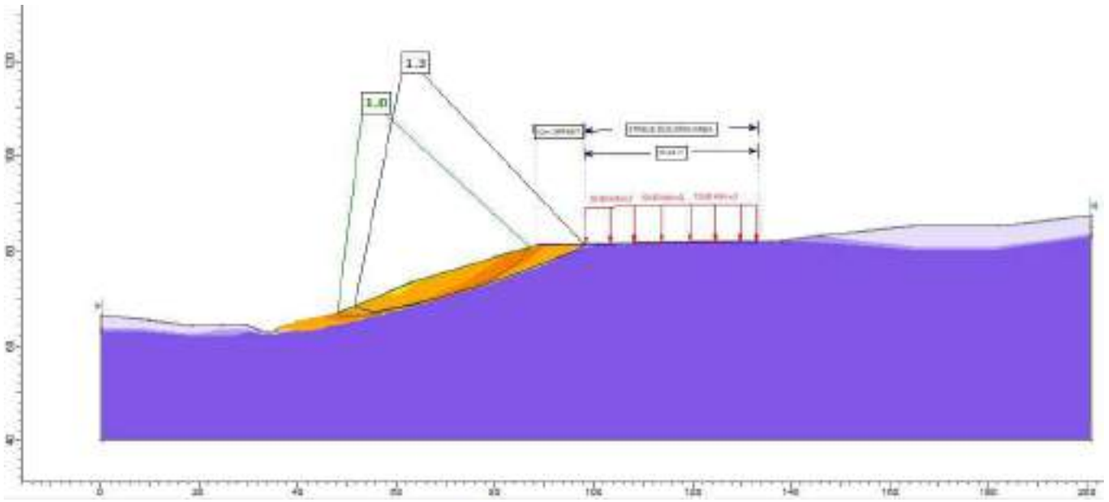
Project Palliser Downs	*Analysis* Non-circular, cuckoo	*Project No.* AKL2019-0017
Title Section H	*Date* 18/07/2024	*Drawing* STAB 02



Section I - Back Analysis (Worst Case Scenario) (Non-circular, cuckoo)



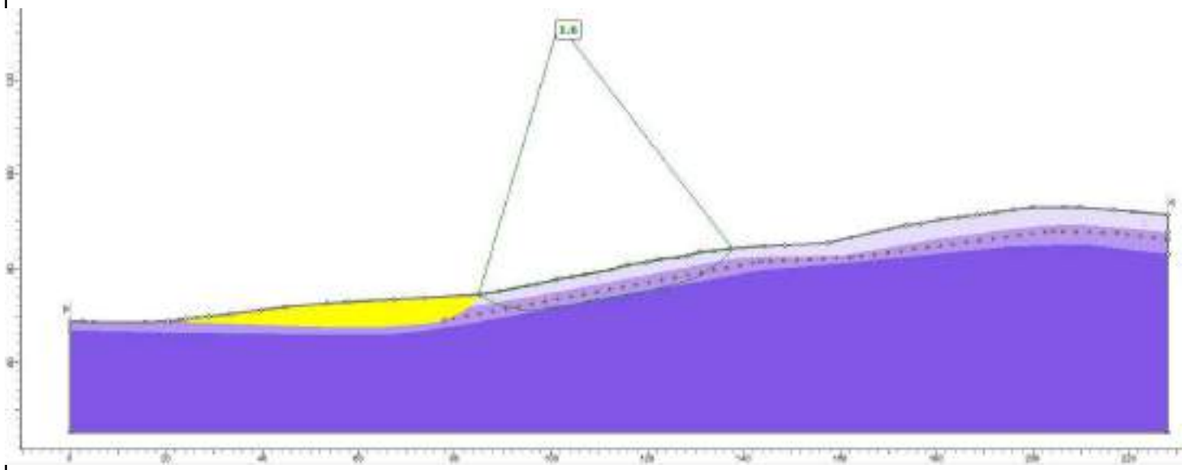
Section I - Normal Groundwater Conditions (Non circular, cuckoo)



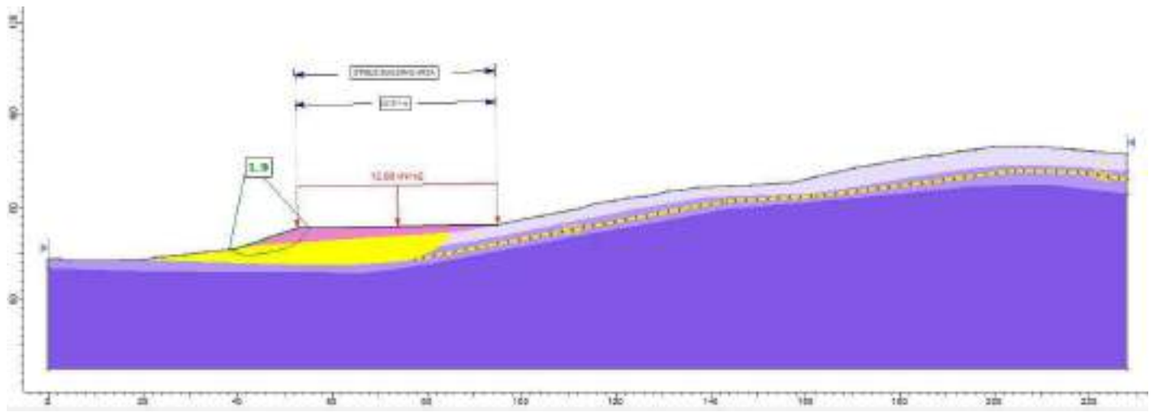
Section I - High Groundwater Conditions (Non-circular, cuckoo)

Section I - Seismic Event (Non-circular, cuckoo)

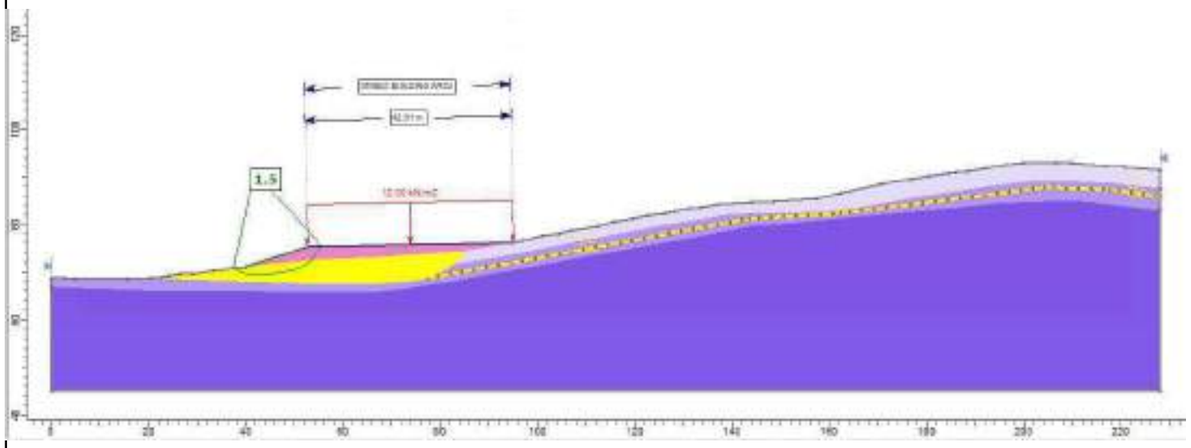
CMW Geosciences Great People | Practical Solutions	*Project* Palliser Downs	*Analysis* Non-circular, cuckoo	*Project No.* AKL2019-0017
	Title Section I	*Date* 18/07/2024	*Drawing* STAB 03



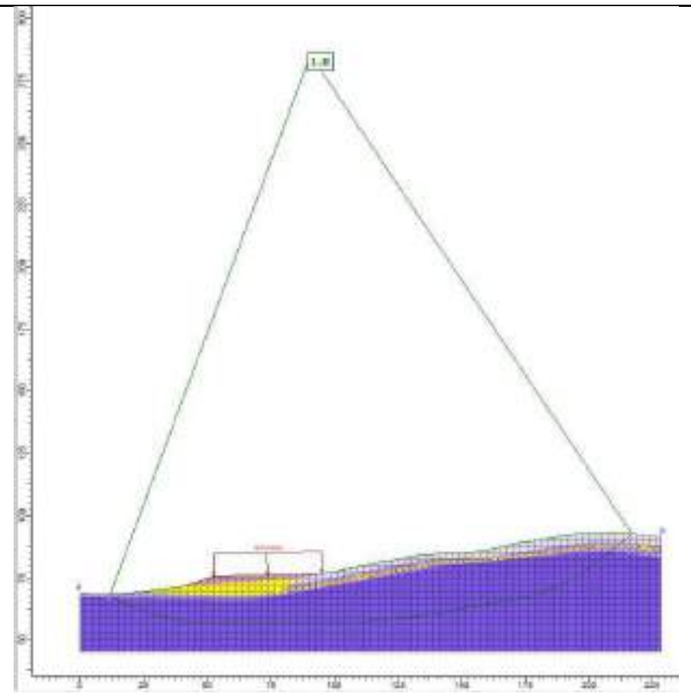
Section K - Back Analysis (Worst Case Scenario) (Non-circular, cuckoo)



Section K - Normal Groundwater Conditions (Non-circular, cuckoo)

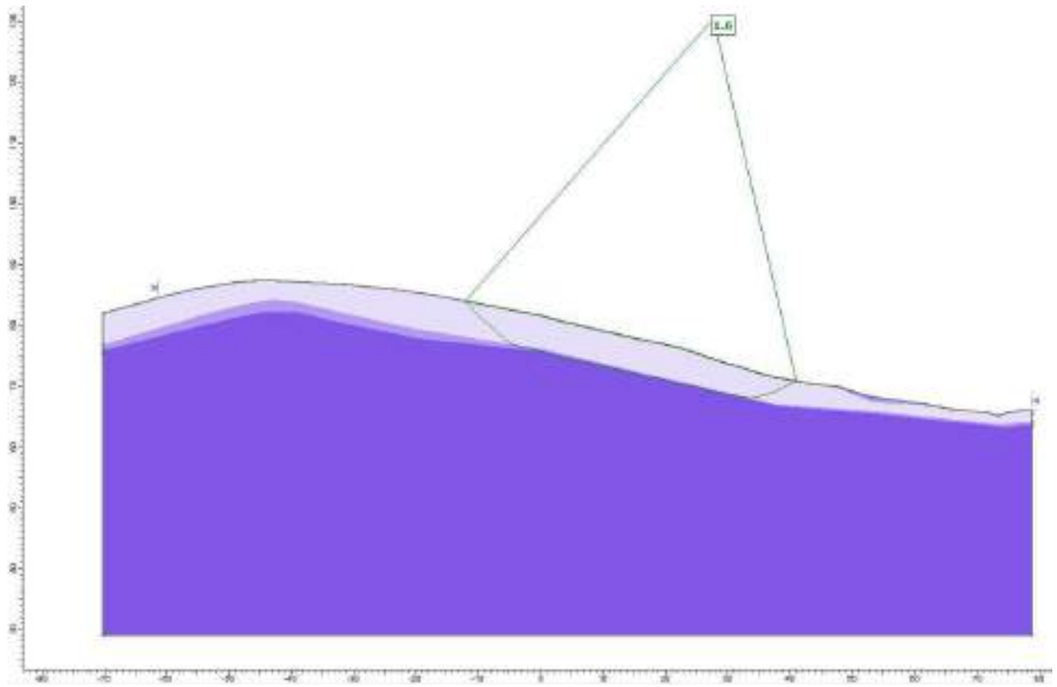


Section K - High Groundwater Conditions (Non-circular, cuckoo)

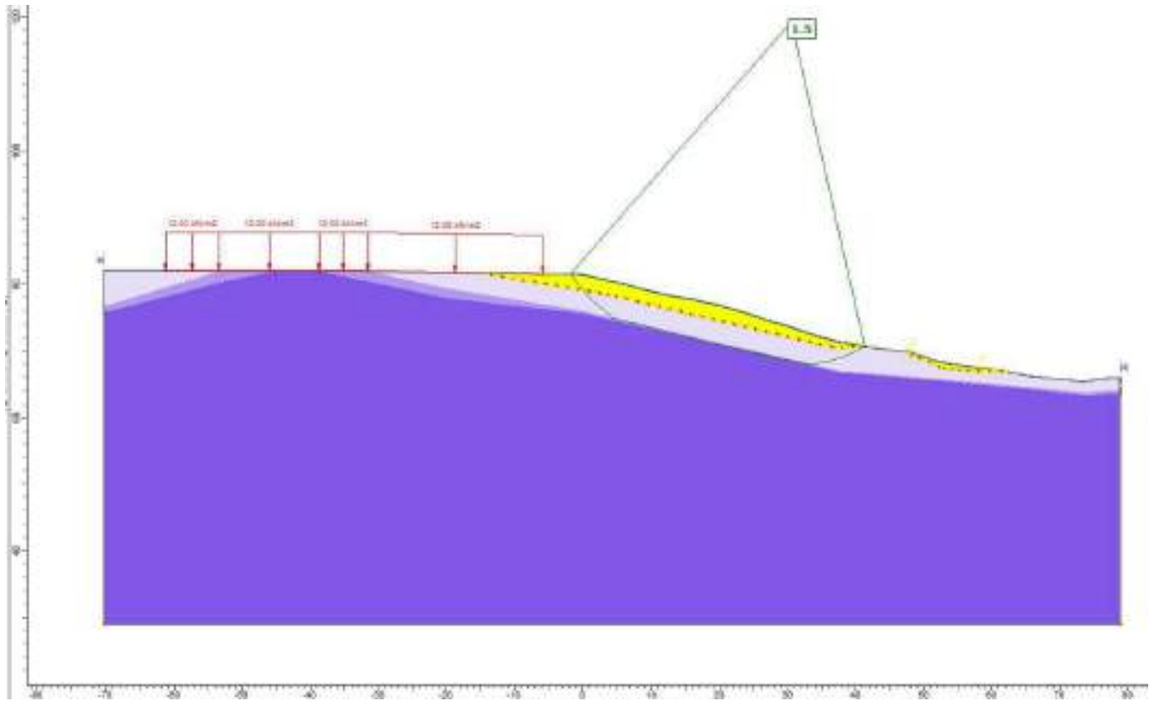


Section K - Seismic Event (Non-circular, cuckoo)

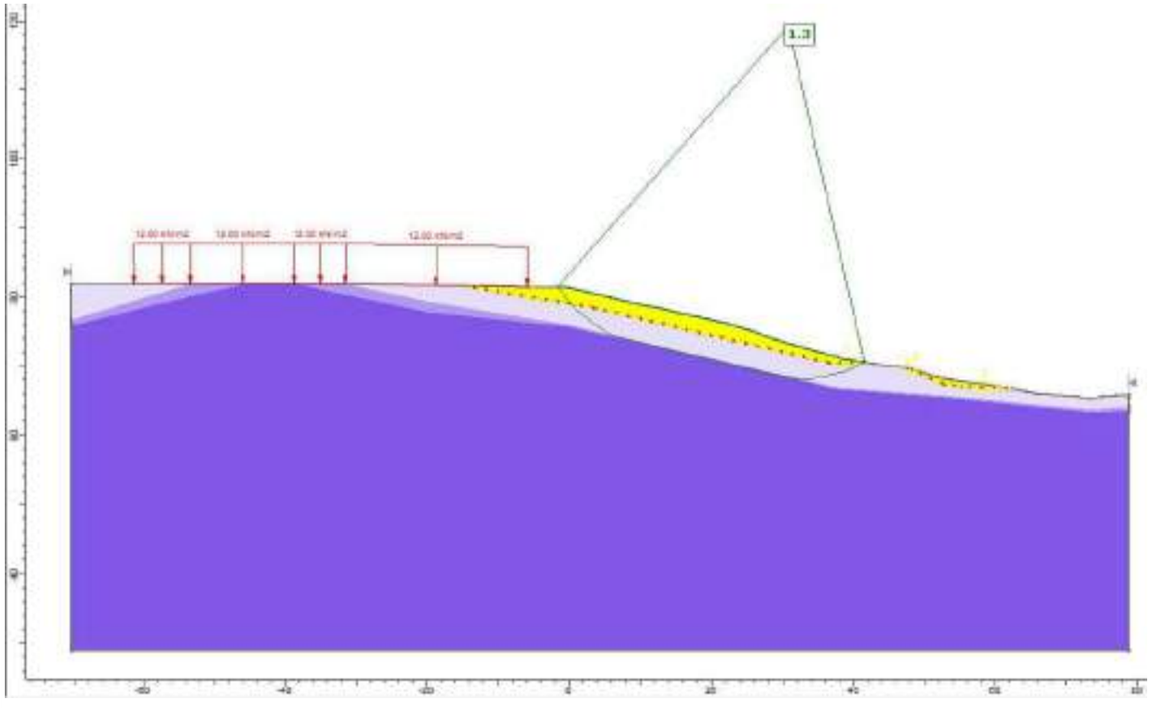
CMW Geosciences Great People | Practical Solutions	*Project* Palliser Downs	*Analysis* Non-circular, cuckoo	*Project No.* AKL2019-0017
	Title Section K	*Date* 20/06/2024	*Drawing* STAB 04



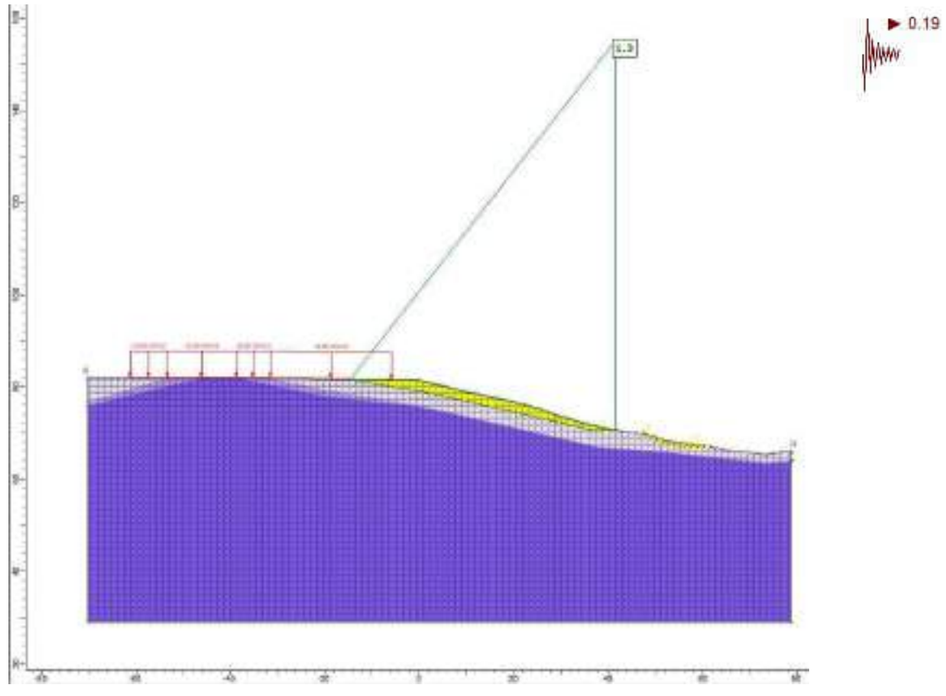
Section Z - Back Analysis (Worst Case Scenario) (Non-circular, cuckoo)



Section Z - Normal Groundwater Conditions (Non-circular, cuckoo)



Section Z - High Groundwater Conditions (Non-circular, cuckoo)



Section Z - Seismic Event (Non-circular, cuckoo)

CMW Geosciences Great People | Practical Solutions	*Project* Palliser Downs	*Analysis* Non-circular, cuckoo	*Project No.* AKL2019-0017
	Title Section Z	*Date* 18/07/2024	*Drawing* STAB 05

Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (°)	Ru Value
Engineered Fill		18	Mohr-Coulomb	8	28	0.05

Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (°)	Ru Value
Colluvium		17	Mohr-Coulomb	5	24	0.2
Hukerenui Mudstone (NA) Residual Soils		17	Mohr-Coulomb	5	26	0.2
Hukerenui Mudstone (NA) Transitional Zone		18	Mohr-Coulomb	10	12	0.05
Hukerenui Mudstone (NA) Parent Rock		20.5	Mohr-Coulomb	20	28	0

Normal Ground Water Conditons Parameters

Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (°)	Ru Value
Engineered Fill		18	Mohr-Coulomb	8	28	0.2

Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (°)	Ru Value
Colluvium		17	Mohr-Coulomb	5	24	0.45
Hukerenui Mudstone (NA) Residual Soils		17	Mohr-Coulomb	5	26	0.45
Hukerenui Mudstone (NA) Transitional Zone		18	Mohr-Coulomb	10	12	0.2
Hukerenui Mudstone (NA) Parent Rock		20.5	Mohr-Coulomb	20	28	0

High Ground Water Conditons Parameters

Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Cohesion Type	Shear/ Normal Function	Ru Value
Engineered Fill (Undrained)		18	Undrained	100	Constant		0.05

Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (°)	Cohesion Type	Shear/ Normal Function	Ru Value
Colluvium (Undrained)		17	Undrained	60		Constant		0.2
Hukerenui Mudstone (NA) Residual Soils (UD)		17	Undrained	60		Constant		0.2
Hukerenui Mudstone (NA) Transition Zone (UD)		18	Undrained	125		Constant		0.05
Hukerenui Mudstone (UD)		20.5	Shear/ Normal Function				Hukerenui Mudstone	0

Seismic Event Parameters

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Project Palliser Downs	*Analysis* Parameters	*Project No.* AKL2019-0017	
Title Parameters	*Date* 18/07/2024	*Drawing* STAB 06	