Hawthorn Geddes
engineers & architects ltd

In reply please quote: 13124 Revision 1

9th April 2024

Resource Consents Manager
Kaipara District Council
Private Bag 1001
Dargaville
0340

Attention: Paul Waanders
Email: pwaanders@kaipara.govt.nz

MANGAWHAI HILL LIMITED PROPOSED PLAN CHANGE PPC84
GEOTECHNICAL ASSESSMENT REGULATORY REVIEW

Purpose

The purpose of this letter is to summarise the results of the geotechnical suitability review of the information contained within the private plan change (PPC) application package lodged by Barker & Associates Ltd, on behalf of Mangawhai Hills Limited.

The advice contained herein is suitable to inform the PPC decision by KDC or instigate further discussion between relevant experts to address matters of concern.

The subject PPC application area encompasses 218.3 hectares of principally pastoral/rural land between Tara Road, cove Road, Moir Road, and Old Waipu Road, and is Kaipara District Council (KDC) reference PPC84.

Documents referenced and reviewed as part of the assessment contained herein include (information as it relates to geotechnical hazards only):

Appendix 3 Proposed Mangawhai Hills Development Structure Plan
- 5.1 Structure Plan, page 34

Appendix 9 Stormwater Management Plan, PPC Package:
- Chester report titled "*Stormwater Management Plan (DRAFT)*" Dated 23 February 2023, reference 15209.

Appendix 10 Geotechnical Statement, PPC Package:
- Tetra Tech Coffey (TTC) report titled "*Geotechnical Desktop Study for Plan Change for Proposed Frecklington Farm Subdivision, Mangawhai*" dated 16 December 2022, reference 773-AKLGE305593,

- Wiley Geotechnical Limited (WGL) report titled "Preliminary Geotechnical Investigation for Proposed Subdivision of Lot 2 DP 172698 at Tara Road Subdivision, Mangawhai," dated 21 August 2021.

Appendix 13a/13b APEX EOI Wastewater Management, PPC Package:

- Apex Water Limited (Apex), report titled "*EOI for Mangawhai Hills Development – Wastewater Management*," dated January 2023.

I have also undertaken an independent preliminary site walkover assessment, and desktop review to better inform the advice and commentary contained herein. This letter has been revised to include a summary of my assessment.

The term '*property'* herein refers to the land encompassed within the PPC84 area.

Introduction, Qualifications & Experience

My name is Callum Bernard Sands, I am a Chartered Geotechnical Engineer, the lead geotechnical engineer, and one of four company Directors with Hawthorn Geddes Engineers & Architects Limited ("HGEA").

I graduated from The University of Auckland with a Bachelor of Engineering (Honours) in Civil Engineering, in 2019. I completed my bachelor's degree from 2015 to 2018. I am a Chartered Professional Engineer (CPEng), and a Chartered Member of Engineering New Zealand (CMEngNZ) in the field of geotechnical engineering; Engineering New Zealand registration number 1161318.

I have over 5 years of experience working as a geotechnical engineer in Northland, New Zealand. During this time, I have undertaken and/or supervised numerous geotechnical suitability assessments for residential development over a wide range of Northland terrain and geology.

PPC84 Geotechnical Consideration

A preliminary assessment of the adequacy of the geotechnical assessments provided in PPC84 Appendix 10 is presented below. The intent of the application assessment is to determine the suitability of the land encompassed within the PPC84 area to accommodate potential development density to provide for 400 to 600 residential lots. This evaluation examines the technical content's appropriateness in informing suitability for this level of development intensity.

<u>WGL Subsoil Investigation</u>

The proposed PPC84 spans 218.3 hectares of land, with WGL physical investigation covering all land west of, and including Allotment 245 PSH of Mangawhai. Consequently, approximately a 60-hectare portion (approaching 30%) of the land within PPC84 has not been subject to any subsoil

investigation. This includes a lower-lying area identified by GNS Science as being underlain by the geological unit OIS5 (Late Pleistocene) river deposits, a unit that was neither identified nor investigated as part of the WGL assessment. The Mangawhai Hills Structure Plan indicates the majority of this non-investigated area is *Proposed Residential Area,* and *Native Regeneration*.

A total of twenty hand-augured boreholes (HA) and six cone penetrometer tests (CPTs) were conducted across 160 hectares within the PPC84 area. However, in accordance with the latest guidelines outlined in the Ministry of Business Innovation and Employment's (MBIE) Modules for Geotechnical Engineering, released in November 2021, specifically MBIE Module 2 Geotechnical Investigations, the extent and depth of the subsoil investigation carried out by WGL are deemed insufficient.

Section 2.4.3 of MBIE Module 2, addresses the Spacing of Investigation Points, and Table 2.1 and Table 2.2, set out recommendations for minimum deep investigations required to support plan changes. Referencing these guidelines, and considering the PPC84 area of 218 hectares, and likely small-scale urban infill of lot less than 1 hectare, MBIE recommends a minimum of 63 deep investigations, be undertaken over all land for which the plan change is proposed to adequately inform the plan change process. Deep investigations, as defined in Module 2, are defined as CPT or machine-drilled boreholes.

The locality of the WGL subsoil investigation has been focused on the crest (top) of ridges and within a low-lying area northeast of Tara Road, informed by prior subdivision intent. There is a notable absence of subsoil investigation over the steeper slopes beneath the ridges, where the Mangawhai Hills Structure Plan indicates the *Proposed Residential Area*. Additionally, no subsoil investigation has been carried out in areas highlighted within the WGL report as prone to slope instability i.e. over flanks of the ridges and steeper slopes. Moreover, deeper investigation through CPTs has not been carried out in any of the lower-lying ground, where geotechnical hazards settlement and liquefaction are more likely prevalent and CPT more informative/appropriate.

<u>WGL/TTC Geotechnical Assessment & Reporting</u>

The geotechnical stability assessment provided in both the WGL and TTC geotechnical reports appears to be primarily based on visual observations and is not supported by any visual representation such as site photos, aerial photos, or topographical/geographic information system (GIS) modelling. Their assessments also lack any numerical stability analysis or consideration of post-development effects (i.e. earthworks or stormwater management).

The WGL report stated the identification of areas of historical large-scale slope instability, as well as small-scale slope instability such as soil creep and hummocky ground, however, does not specify, nor present on plan the locations of these slope movements. Moreover, there are no recommendations regarding setbacks from unstable areas or restrictions on slope angles over which residential development is suitable. Additionally, there is no discussion on the potential impacts of future large-scale residential development on overall

global stability, including concerns such as benching and filling over steep slopes towards the incised gulley.

Wastewater Disposal/Stormwater Management

It is noted that there were no comments in relation to onsite wastewater disposal in the TTC report. The WGL report provides an assessment of the onsite soils in terms of AS/NZS: 1574-2000, however, does not provide advice as to what application method and rates are suitable for the property, and restrictions on such in relation to slope instability or potential maximum acceptance rates.

The portion of land proposed by Apex for onsite wastewater disposal was subject to subsoil investigation by Wiley Geotechnical, as mentioned above. Apex proposes to dispose of high-quality treated effluent via subsurface at a daily irrigation rate (DIR) of 10mm per day. It is likely this will exceed the acceptance rate for the soils on the site.

The Apex preliminary wastewater disposal design approach, presented within their EOI utilises a design loading rate (DLR) of 540 litres per household per day, based on an assumed design occupancy of three persons, which is typical for a two-bedroom dwelling only. It is noted that mid to high-end residential developments in the surrounding Mangawhai area typically consist of three to four-bedroom dwellings with higher water usage. Furthermore, based on the proposed 400 to 600 new residential sites and the area denoted in the PPC84 for residential development, the likely lot size will be greater than 1800 square meters, and suited to a three to four-bedroom lifestyle type dwelling. Consequently, the proposed DLR is deemed inappropriate and, in conjunction with a suitable DIR, likely significantly underestimates the required land for onsite wastewater disposal.

The WGL report offers recommendations for onsite stormwater management, suggesting the utilisation of existing surface features and subsoil infiltration, which were largely adopted and carried forward in the Chester Consultants stormwater report. However, the WGL report fails to provide any clear indication regarding limitations on discharge rates or permissible discharge locations. Given the site's characteristics, including incised overland flow paths, gullies, historical and active slope movement, and evidence of soil erosion, there is a notable absence of advice on how appropriate stormwater management will mitigate the exacerbation of these features and/or maintain stability in the post-development regime.

Independent Preliminary Geotechnical Assessment

I have undertaken a preliminary, visual-only, geotechnical assessment of the subject property. This has comprised a detailed site walkover, a review of historical aerial photographs using Google Earth and Retrolens, and a geomorphological assessment using the GIS computer software QGIS, adopted from Northland LiDAR data. The results of this assessment are summarised below.

The subject property comprises 158 hectares of mostly moderate to very steep slopes on either side of two dominant ridgelines. These ridgelines are separated by a dominant south-east trending gully. The crests of the ridgelines are typically shallow sloping and narrow, with soft-margin, locally defined gullies formed by erosion and overland flow prevalent throughout the landscape. Very steep slopes and hard-margin gullies are more concentrated and frequent in the northeastern and central portions of the subject property.

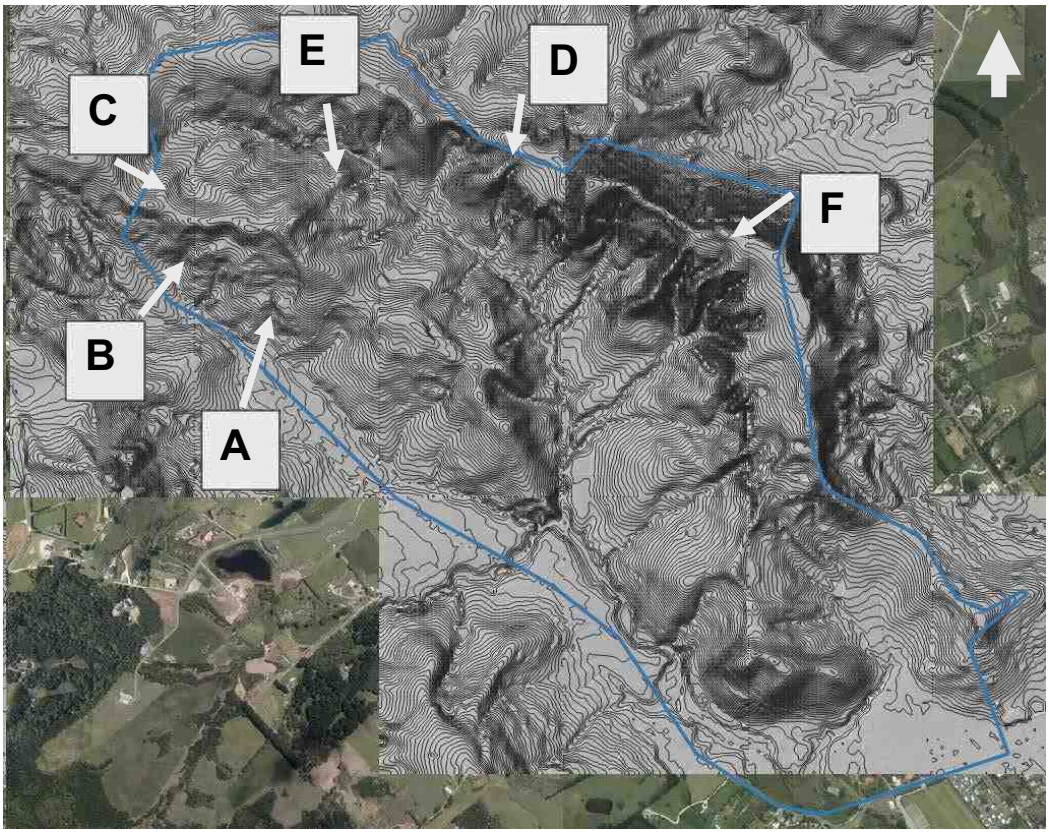


Figure A – GIS model of the subject site with 1.0m contours and hill-shade modelling. (Source: QGIS and Northland LiDAR data). The blue line indicates the extent of the PPC84 boundary.

There is evidence of historic/ancient, recent, and active slope movement widespread over the property. This comprises both deep-seated and shallow slope movement, evident by visibly hummocky/undulating ground, well defined head scarps, and terracettes over the landscape. Examples of these features

are illustrated by the attached photos labelled A through F. The approximate locality of these photos and the features observed within them is indicated in Figure A above.

Figure A above presents the QGIS hill-shade model used to visually assess the subject property. Steeper slopes are observed by dark shadowing and tightly spaced contour lines. Shading in the model also aids in highlighting the property topography i.e. gives shape to historic slope movement, hummocky/undulating ground, and locates gullies. The locality of the slope instability features observed in this model and during my site walkover are highlighted in Figure B below. It is noted that slope instability features are generally concentrated to steeper slopes over the head of gullies, and towards the toe of the slopes. These feature vary from active to historic movements.

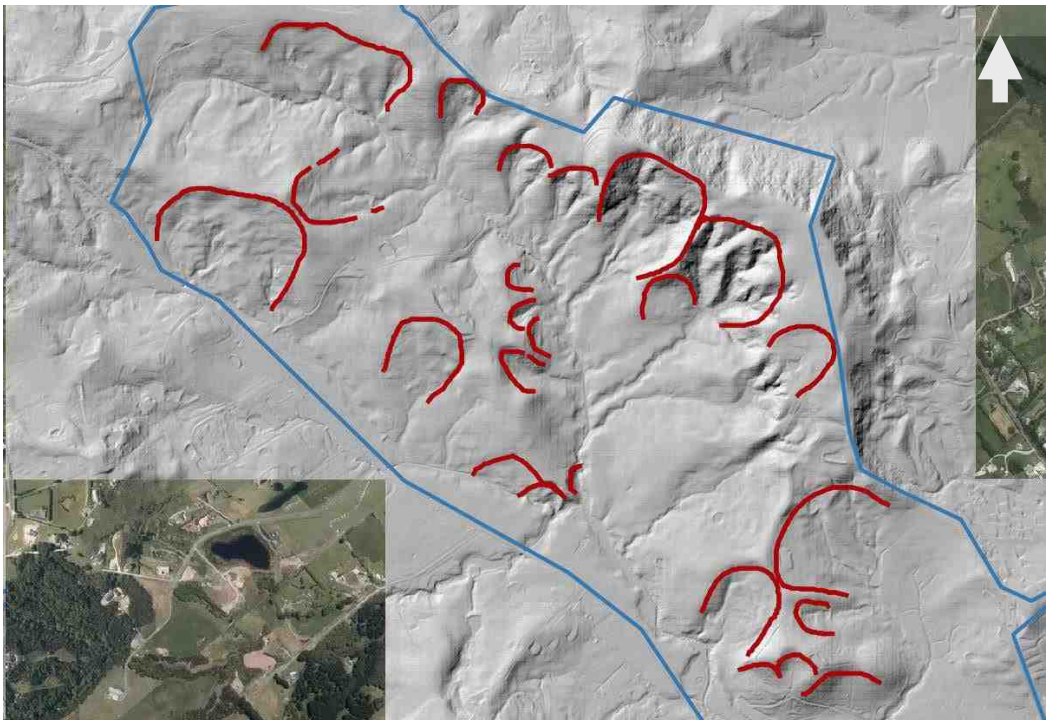


Figure B – GIS model of the subject site, hill-shade modelling. (Source: QGIS and Northland LiDAR data). The blue line indicates the extent of the PPC84 boundary. Identifiable slope instability features are outlined in red.

Figure C below indicates areas of the site that are within the *Proposed Residential Area* on the Mangawhai Hills Structure Plan that are considered to be prone to moderate to high slope instability and should be subject to further geotechnical assessment. Also indicated are areas of low-lying land that may be subject to settlement, and/or liquefaction. These areas are assessed based on site observations and the QGIS model.

Figure C – GIS model of the subject site with 1.0m contours. (Source: QGIS and Northland LiDAR data). Red hatching indicates areas potentially prone to high slope instability hazard, and orange low-lying land susceptible to moderate settlement/liquefaction (subsidence) hazards.

A large format copy of Figures A, B and C are attached to this letter.

Recommendations for Further Information

Based on the results of my independent, preliminary site review and the information presented in the aforementioned documents, it is considered likely that a portion of the land designated as *Proposed Residential Area* on the Mangawhai Hills Structure Plan may not be suitable for large-scale, high-density residential development. This is due to the presence of multiple geotechnical hazards, predominately slope stability hazards. It is my recommendation that if the application is to be progressed, further geotechnical investigation and assessment should be undertaken to verify the suitability of the land to support the proposed density or the structure plan revised to include areas better suited to lifestyle type development.

Based on the results of my independent, preliminary assessment it is considered likely that portions of the land designated as *Proposed Residential*

Area on the Mangawhai Hills Structure Plan are not suitable for high-density development, and better align with lifestyle bocks sized lots at 1 to 2 hectares.

Further investigation, associated assessment, and reporting are recommended to be undertaken in the areas denoted as *high and moderate geotechnical hazard risks*, on the attached Figure C. It is recommended that KDC request the applicant undertake further engineering assessment, to better support the PPC84 application and address the following points:

- What geohazards are present at the property, and how do these limit development in the *Proposed Residential Areas,*
- Identify on plan the locality of any active and historic, large-scale and small-scale slope instability,
- Address global stability, and the effects of future, high-density large-scale residential development,
- Are there areas over the property that are not suitable for significant modification due to stability risk, and are better suited to a larger lot size,
- What, if any setbacks are likely to be put in place from active slope movement and steeper slopes, and what restrictions does this apply to the net developable area,
- What slopes (angles) are suitable for residential development,
- What restrictions are appropriate on earthworks,
- What restrictions are appropriate on on-site wastewater disposal, and how does this relate to slope instability, is the proposed 10mm per day from Apex compatible with the site soil conditions,
- What restrictions are there on stormwater management, and how does this relate to slope instability,
- What areas, if any are underlain by soft soils and prone to consolidation settlement, and how does this potentially limit residential development in the *Proposed Residential Areas,*
- What areas, if any are prone to liquefaction and lateral spreading, and how do these hazards potentially limit future residential development in the *Proposed Residential Areas.*

Further subsoil investigation is deemed necessary to support the PPC84 engineering assessment in satisfying the above points. Note, that it is not considered necessary to undertake a deep subsoil investigation programme commensurate with the minimum requirements set out in MBIE Module 2 (63 total investigation points). The extent of the subsoil investigations shall be appropriately determined by the applicant's consulting engineers, WGL/TCL, or others. At the very least, it is anticipated that this will include the following:

- Additional shallow and deep subsoil investigation over the 60 hectares not yet investigated,
- Subsoil testing over the steeper slopes below the ridge crests to inform slope stability and development density,
- Deep subsoil investigation within areas of low-lying, potential soft ground to inform settlement and liquefaction analysis.

It may also be beneficial, in the areas denoted as *high geotechnical hazard risk*, on the attached Figure C, to undertake deep subsoil testing to define the nature and continuity of the strata over areas deemed prone to slope movement, with the investigation terminating at a depth below which slipping is most likely. This may be undertaken by means of test pits and/or continuous recovery core drilling to inform appropriate residential development density.

It is recommended that the preliminary wastewater assessment by Apex be reconsidered following comments from the geotechnical engineer. This revised assessment shall consider an increased design occupancy commensurate with the expected standard of residential development anticipated for the PPC and reflective of development scale in the wider Mangawhai area.

Limitation

This letter has been prepared solely for the benefit of my client the Kaipara District Council in relation to the purpose for which this letter was prepared.

The comments in it are limited to the purpose stated in this report. No liability is accepted by Hawthorn Geddes engineers & architects ltd in respect of its use by any other person, and any other person who relies upon any matter contained in this report does so entirely at their own risk.

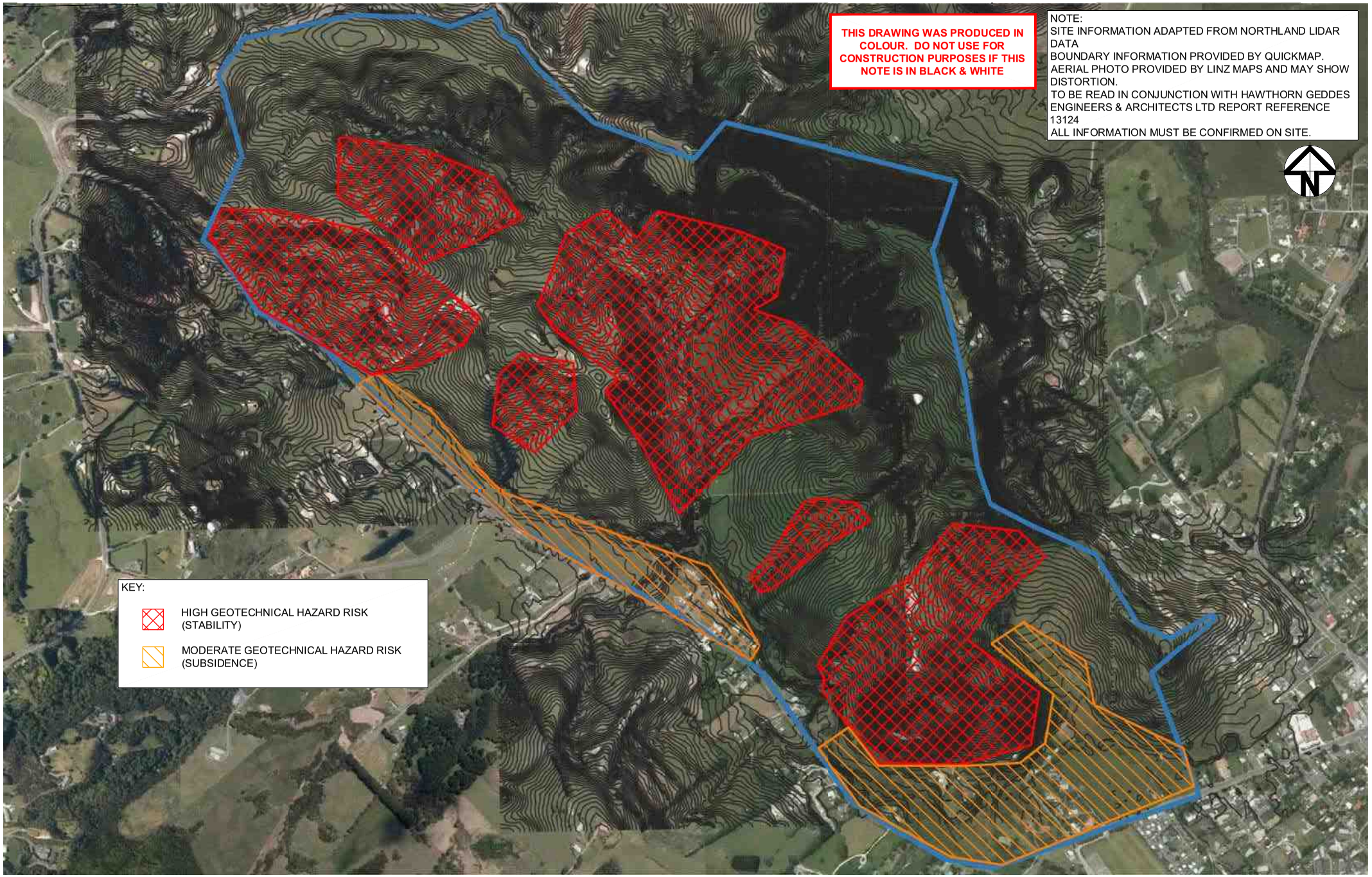
Yours faithfully,

Callum Sands
Director
Geotechnical Engineer
BE (Hons) CMEngNZ CPEng

Hawthorn Geddes
engineers & architects ltd

incl :

- Figures 01 to 04 (4 x A3 pages)
- Annotated photos (6 x A4 pages)



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Hawthorn Geddes
engineers & architects ltd
7 Selwyn Avenue
Whangarei 0110
Phone: 09 438 7139
hg@hgcs.co.nz
Unit 21a, The Grange
Warkworth 0910
Phone: 09 283 3428
www.hawthorngeddes.co.nz

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PROJECT No. **13124**

FIGURE No. **01**

REV. **~**

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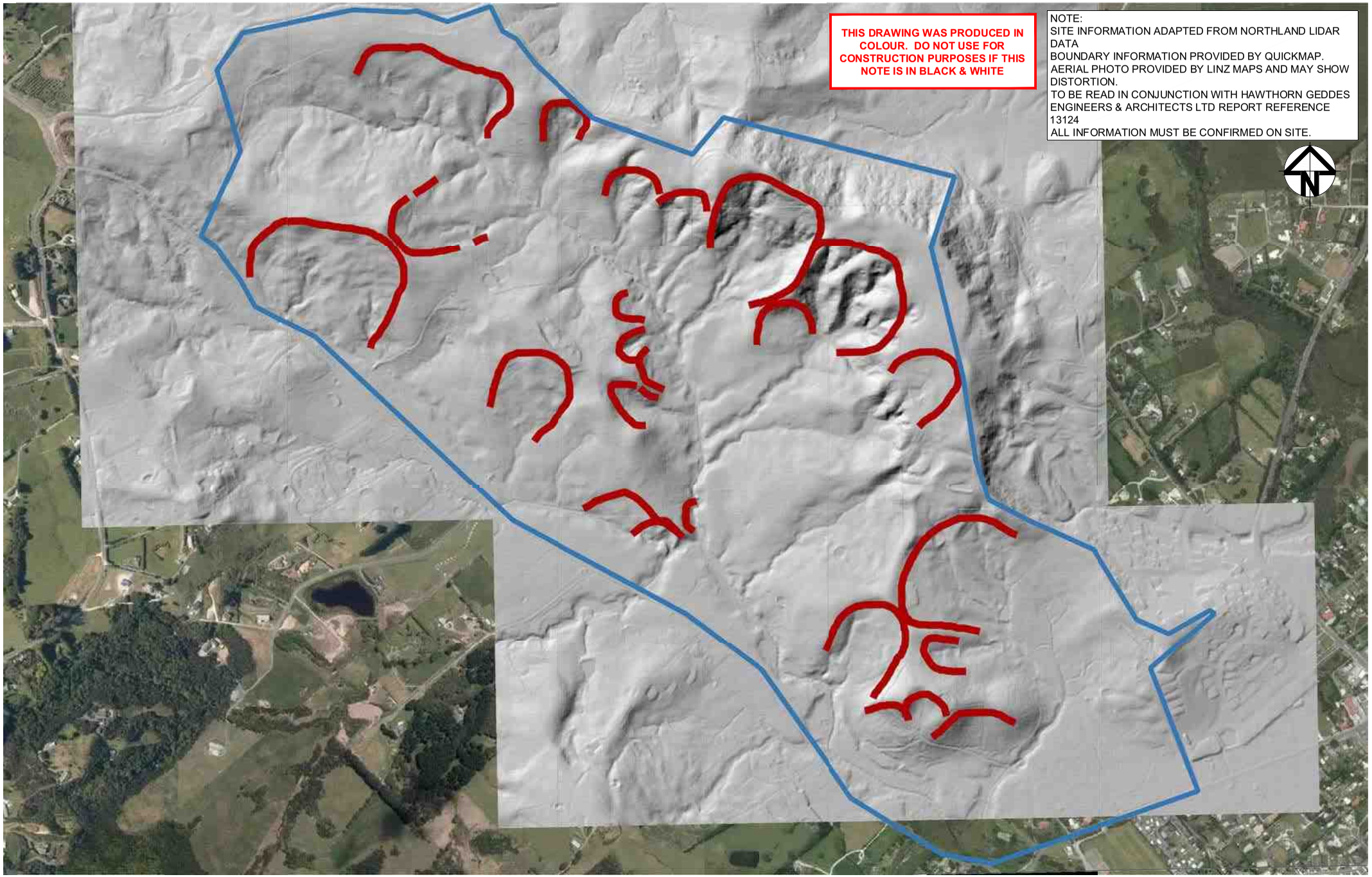

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Hawthorn Geddes
engineers & architects ltd
7 Selwyn Avenue
Whangarei 0110
Phone: 09 438 7139
hg@hgcs.co.nz
Unit 21a, The Grange
Warkworth 0910
Phone: 09 283 3428
www.hawthorngeddes.co.nz

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PROJECT No. 13124

FIGURE No. 02

REV. ~

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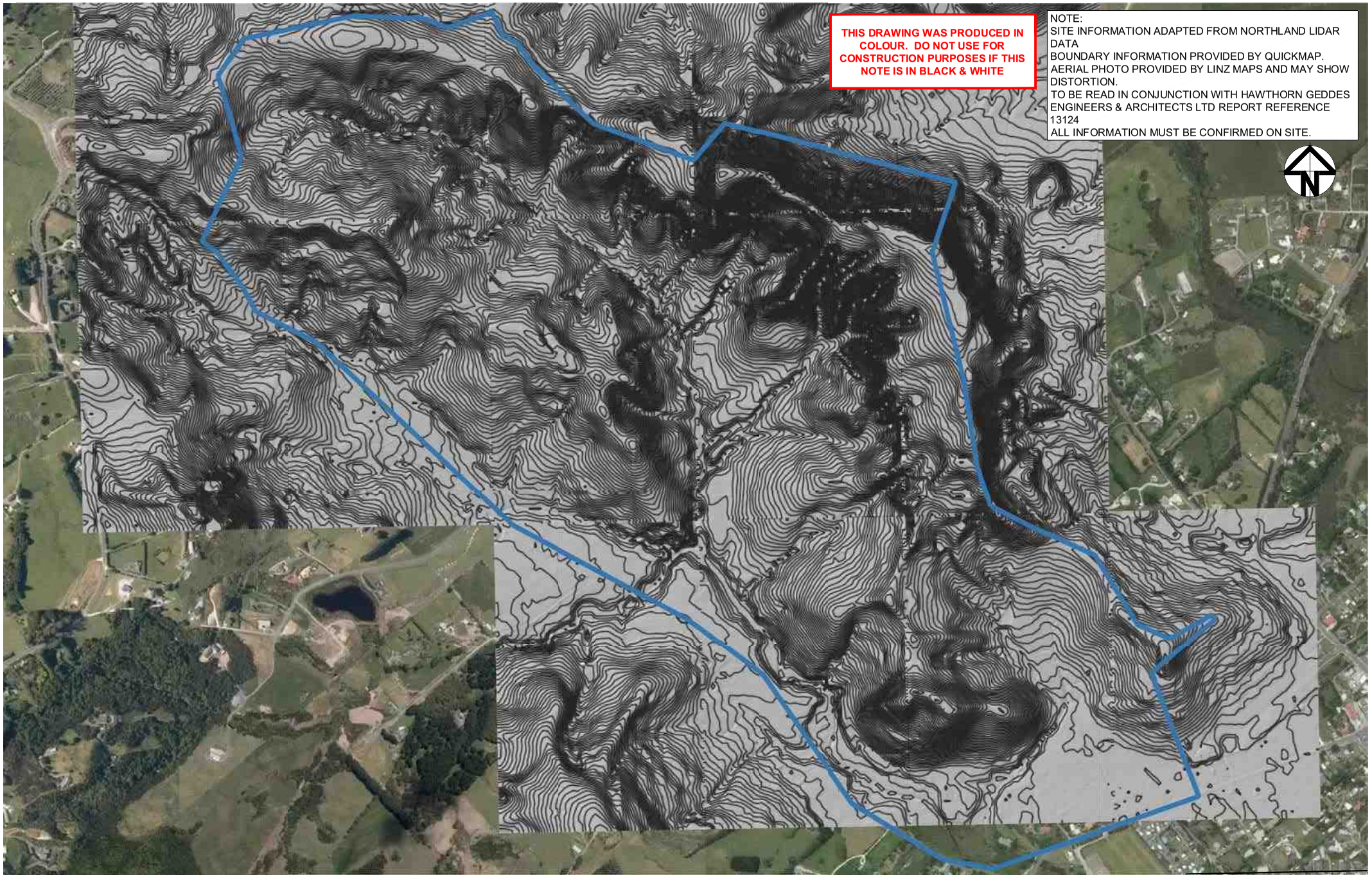

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Whangarei 0110
Phone: 09 438 7139
hg@hgcs.co.nz
Unit 21a, The Grange
Warkworth 0910
Phone: 09 283 3428
www.hawthorngeddes.co.nz

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PROJECT No. **13124**
FIGURE No. **03**
REV. **~**

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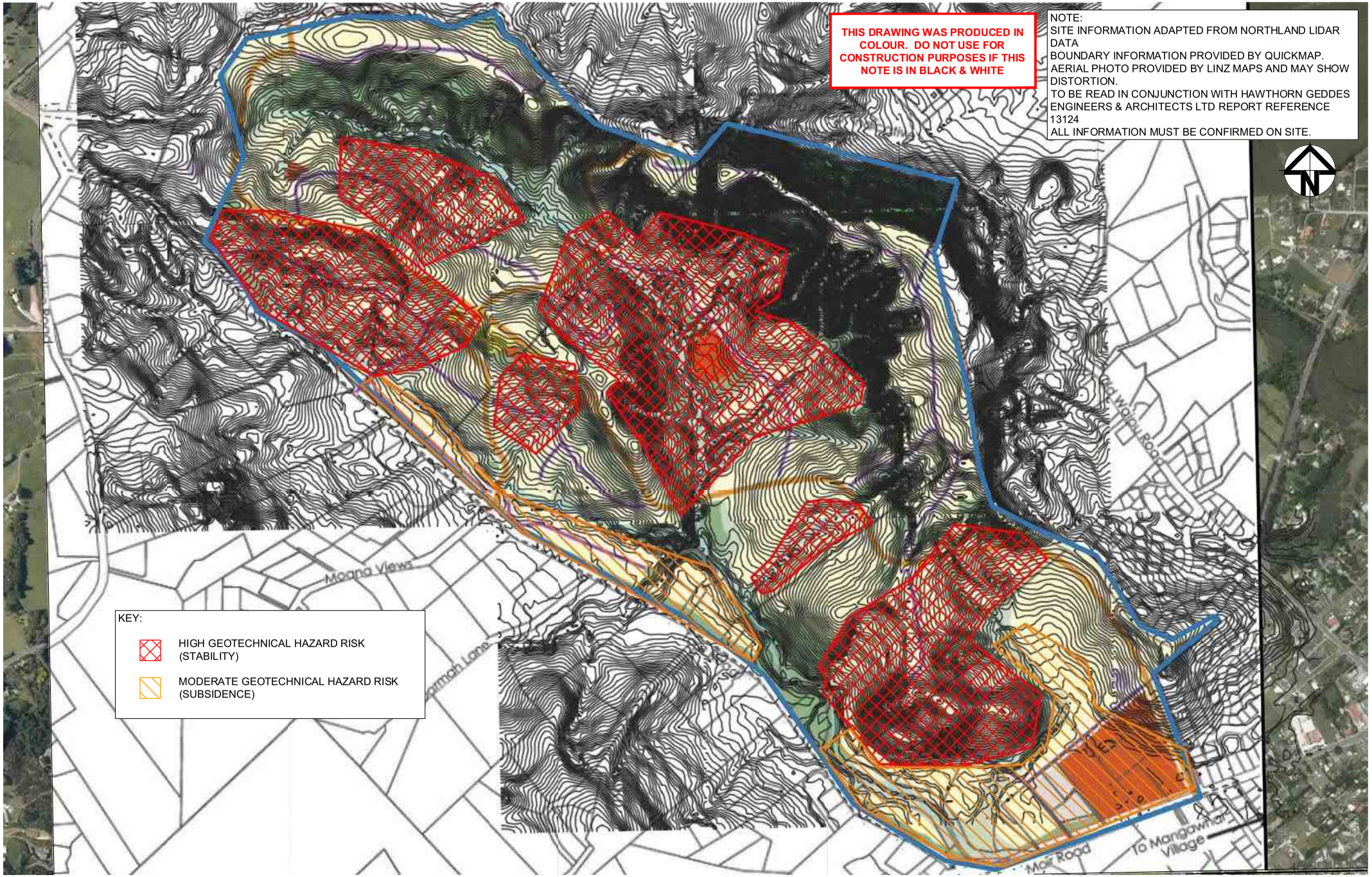

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Whangarei 0110
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hg@hgcs.co.nz
Unit 21a, The Grange
Warkworth 0910
Phone: 09 283 3428
www.hawthorngeddes.co.nz

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PROJECT No. **13124**

FIGURE No. **04**

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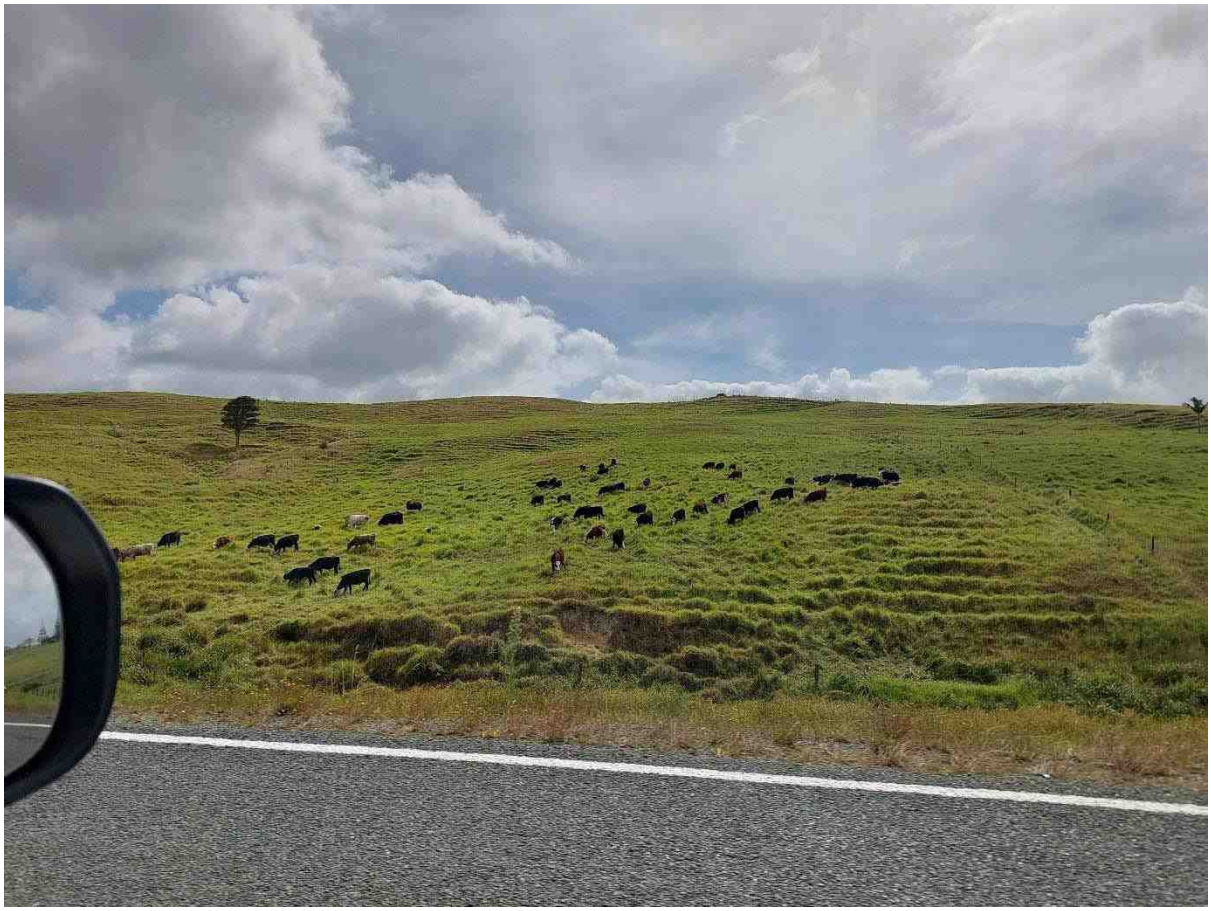
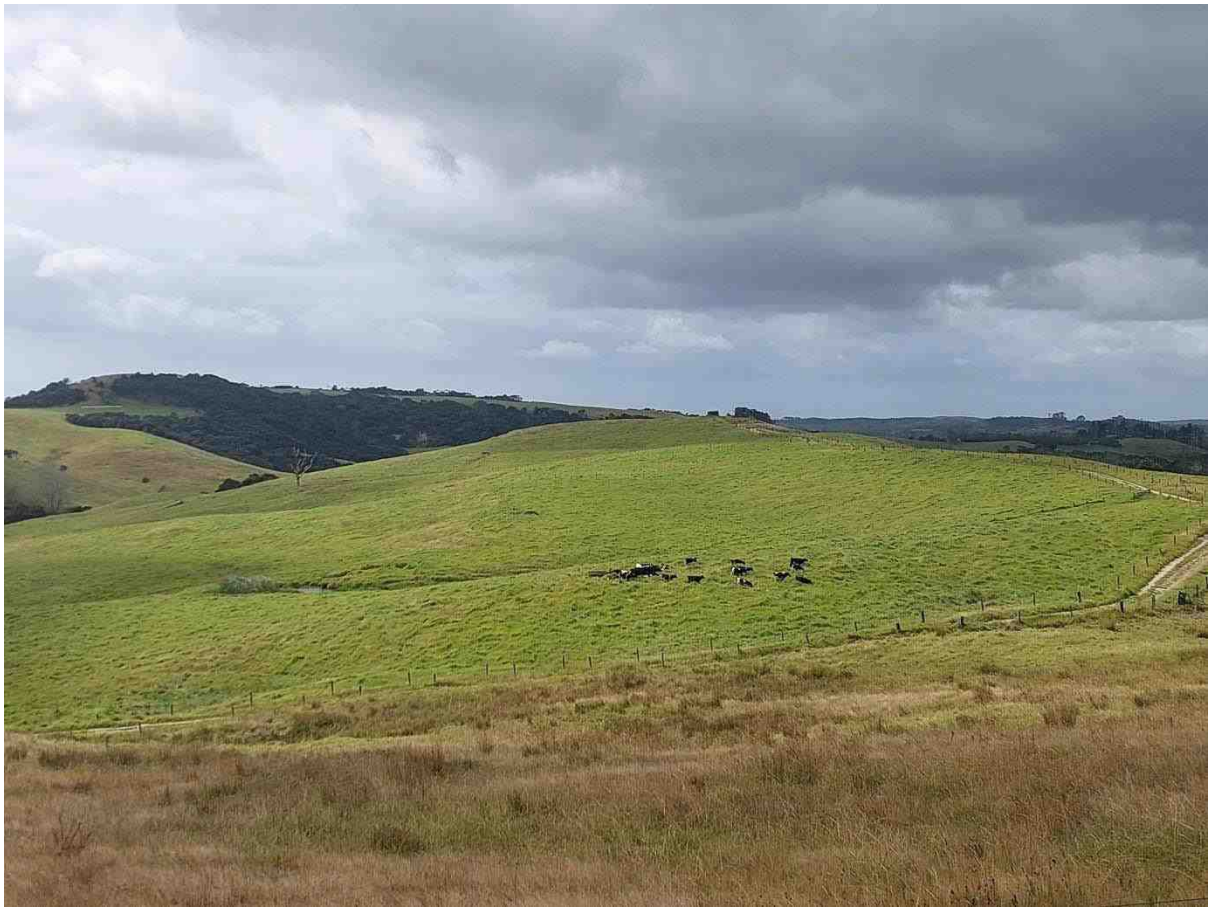
Photograph A – Hummocky ground and incised overland flow paths.



Photograph B – Hummocky/undulating ground, as well as soil creep.



Photograph C – Planar slopes over the crest of the ridge and shallower sloping ground

Photograph D – Steep slopes subject to soil creep, evident by terraces. Locality over the head of a gully.

Photograph E – Generally Planar slopes over the crest of ridgelines, becoming hummocky towards the centre of the Gulley.

Photograph F – Well-defined head of steep-sided and sloping gulley just below the crest of the ridgeline. Terraces are evidence of shallow surface movement/soil creep.