30 April 2024

Avant Property Development Ltd
Suite 104, 110 Parnell Road
Parnell
Auckland 1052

Attn: Brent Warby

Dear Brent

Geotechnical Summary of Lot 1 and Lot 2 - Rangitopuni Riverhead, Forestry Road, Riverhead, Auckland

(Our Reference: 020190.000.001_08)

1 Introduction and Scope

ENGEO Ltd was requested by Avant Property Development Ltd to prepare a geotechnical summary letter in relation to the proposed future residential development of Lots 1 and 2 at the Rangitopuni Riverhead property at Forestry Road, Riverhead, Auckland. This work has been carried out in accordance with our signed agreement (P2022.000.641_01) dated 21 March 2022.

The proposed development scheme for Lot 1 is to subdivide it into 210 lots. The high-level development scheme for Lot 2 includes development of a 350-unit retirement village. ENGEO has completed a due diligence assessment and intrusive investigations within the Lot 1 area. This information has been included in this letter.

This report is not considered to be suitable to support an application for Resource Consent.

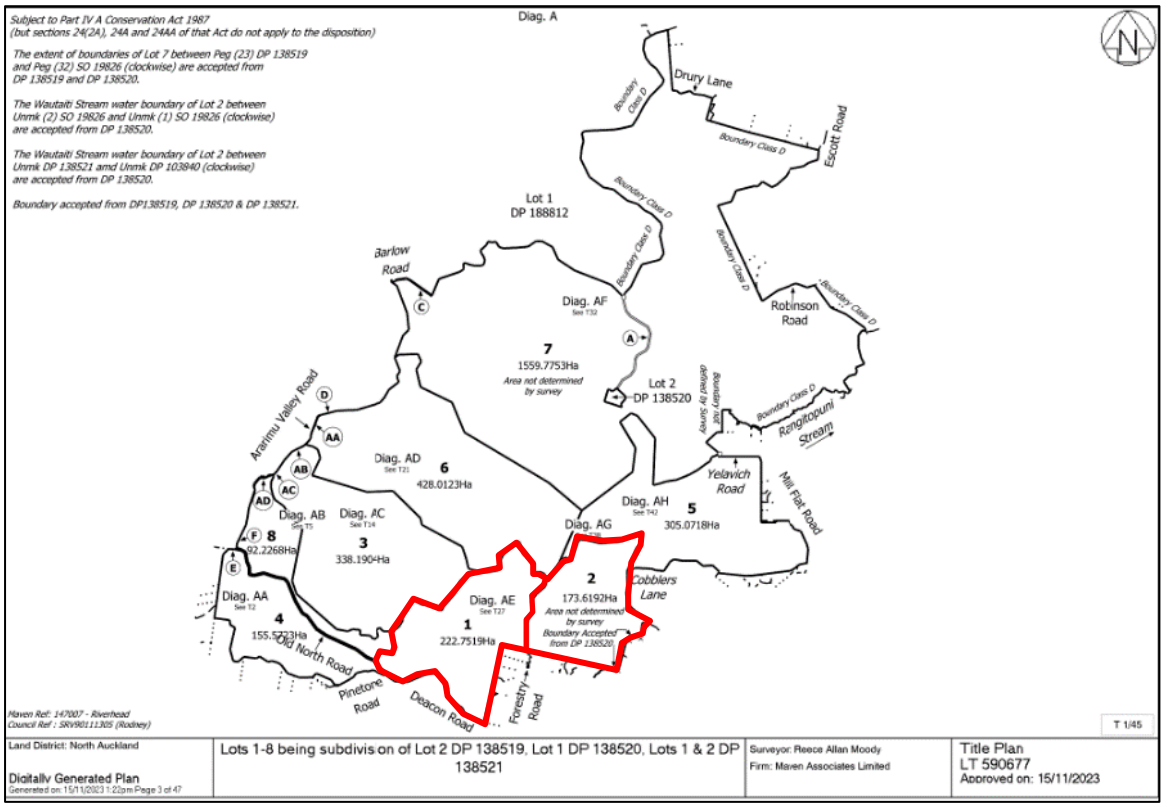
2 Site Description and Proposed Development

The Rangitopuni Riverhead site at Forestry Road is located approximately 1 km northwest of the Riverhead township. The current land use is commercial forestry and a series of gravel roads (constructed to provide access to the forestry blocks) are present within the site.

The Lot 1 development area is located in the southern portion of the overall development area and comprises approximately 222 Hectares (Figure 1). The proposed development for Lot 1 (also referred to as Stage 1), is to subdivide the land into 210 residential lots.

The Lot 2 development area is located in the south-eastern portion of the overall development area and comprises approximately 173 hectares. The high-level concept scheme for Lot 2 is for it to be developed into a 350-unit retirement village.

Figure 1: Title Plan Showing Location of Lots 1 and 2



Plan sourced from Maven dated 15 November 2023.

3 Geotechnical Summary

A geotechnical summary of Lots 1 and 2 is as follows:

- The current land use is commercial forestry. The January 2024 NearMaps aerial image (appended), indicates that densely forested areas are present in the southern and south-eastern areas of Lot 1. Relatively recent vegetation clearance appears to have been undertaken in the northern and western areas of Lot 1. Vegetation in the Lot 2 area appears to have been recently planted and new growth can be observed.
- The landform is characterised by prominent ridges (aligned primarily northeast to southwest) separated by slightly (3° to 15°) to very steeply sloping (35° up to 80°) terrain and incised gullies. Typical land surface elevations range from 50 m RL of the site up to 135 m RL along elevated ridges both east and west of Deacon Road.
- A series of stream catchments intersect the site and permanent watercourses are typically located in lower lying gullies where catchment areas increase.

- Geotechnical investigations were undertaken in the western portion of Lot 1 and comprised hand auger boreholes, machine boreholes and geomorphological mapping. The results indicate that East Coast Bays Formation and Albany Conglomerate deposits are present, broadly consistent with published mapping. We anticipate these ground conditions are likely to be present throughout the Lot 1 and 2 areas.
    - Recent colluvium and alluvium deposits were encountered near the surface in the hand auger boreholes and are likely be encountered in lower lying gullies and depressions across the two lots, typically in the vicinity of streams and watercourses.
    - Residual soils consisting of predominantly stiff to hard silt and clay were encountered in the majority of the hand auger boreholes, underlying any colluvium and alluvium present. These are likely to be present in at least the upper 5 m of the soil profile throughout the two lots.
    - Very weak sandstone was observed in the central area of Lot 1 between 8 m and 14 m depth.
- Based on our investigations, the depth to standing groundwater varies throughout the western portion of the Lot 1 area. In the hand auger boreholes groundwater was measured to be present between 0.2 m and 3.6 m depth, and in some locations was not encountered. Piezometers were installed in some machine borehole locations and standing water levels were recorded to be present between 2.4 m and 4.1 m depth. The depth to groundwater is likely to vary throughout the Lot 1 and 2 areas, near the surface in low-lying areas and deeper along ridgelines.
- Based on the Auckland Council GeoMaps database, the site is assessed as having ‘Very Low Liquefaction Vulnerability’ which is defined as having a probability of more than 99% that liquefaction-induced ground damage will be negligible to minor for a 500-year shaking event. The investigations undertaken in the western portion of the Lot 1 area predominantly consisted of cohesive soils and only minor isolated layers of potentially liquefiable sand layers were encountered.

4 Geotechnical Considerations

Based on our observations, assessment and investigations to date we consider the following to be the key geotechnical considerations for residential development. The primary geotechnical concern at the site is slope instability and this is likely to govern earthworks and engineering designs to create stable building platforms.

Table 1: Geotechnical Considerations

Geotechnical Considerations	Comments
Slope Instability and Erosion	The landform consists of varying topography, although predominantly sloping with slope gradients ranging between 5° and 80°. Vegetation cover is likely to be improving land stability and protecting the landform from erosional processes. Areas where slope gradients are greater than 20° in the western and south-eastern portions of Lot 1 exhibit signs of historic deep-seated slope failures (landslides) as indicated by the presence of circular headscarps and hummocky ground. However, based on aerial imagery captured over the last 50 years, the larger failures predate 1940. Following vegetation clearing works, geomorphological mapping should be undertaken throughout the Lot 1 and 2 areas. Detailed slope stability analyses will be required to assess setback requirements and slope remediation measures.
Liquefaction Hazard	Mapped as having very low liquefaction vulnerability on the Liquefaction Vulnerability Maps by Auckland Council. Predominantly cohesive soils (silt and clay) were encountered in the investigations within the western area of Lot 1. Isolated sand layers were observed within the upper 30 m of the soil profile. Geotechnical investigations should be undertaken throughout the Lot 1 and 2 areas to assess whether potentially liquefiable soils are present, and if so subsequent liquefaction analyses to quantify the hazard.
Groundwater	The depth to groundwater ranged from 0.2 m to 4.1 m within the western portion of the Lot 1 area and is anticipated to vary throughout the site based on the topography. It is likely to be shallow (near-surface) in lower-lying areas and adjacent to watercourses. Groundwater levels are critical for slope stability and earthworks assessments. Additional monitoring of groundwater levels will be essential to inform design.
Expansive Soil Hazard	Mapped geology and the existing investigation data within the western portion of the Lot 1 area indicates high plasticity clay (highly expansive) soils are / likely to be present. Near surface soil samples should be retrieved for laboratory testing to confirm the expansive soil classes.
Weak and Compressible Soils	Weak and compressible soils (colluvium and recent alluvium) were encountered in some investigation locations undertaken within the western portion of the Lot 1 area and are likely to be present in lower-lying areas and near watercourses. Investigations should be undertaken to assess the presence and prevalence of weak and compressible soils, and laboratory testing of soil samples to quantify settlements.

Based on a desktop review, our site observations and investigations within the western portion of the Lot 1 area, Lots 1 and 2 are likely to be geotechnically suitable for future residential and retirement village development provided detailed geotechnical investigations, groundwater monitoring, and analysis are undertaken throughout the Lot 1 and 2 areas that have not previously been investigated.

Broadly, the engineering controls for areas where slope gradients are <15° are likely to include cut / fill earthworks, drainage to control surface runoff, and minor building setbacks. Specific engineering design, significant earth works (i.e. shear keys) and drainage networks, as well as larger building setbacks are likely to be required in areas of historical instability, steeply sloping areas and around incised gullies and permanent watercourses.

Further, where required, adequate slope stabilisation, land drainage and erosion protection measures should be designed and installed, and the recommendations of all subsequent documentation and reports adopted.

5 Limitations

i. We have prepared this report in accordance with the brief as provided. This report has been prepared for the use of our client, Avant Property Development Ltd, their professional advisers and the relevant Territorial Authorities in relation to the specified project brief described in this report. No liability is accepted for the use of any part of the report for any other purpose or by any other person or entity.

ii. The recommendations in this report are based on the ground conditions indicated from published sources and site assessments described in this report based on accepted normal methods of site investigations. This report does not purport to completely describe all the site characteristics and properties. The nature of the ground has been inferred using experience and judgement and it should be appreciated that actual conditions could vary from the assumed model.

iii. Subsurface conditions relevant to construction works should be assessed by contractors who can make their own interpretation of the factual data provided. They should perform any additional tests as necessary for their own purposes.

iv. This Limitation should be read in conjunction with the Engineering NZ / ACENZ Standard Terms of Engagement.

v. This report is not to be reproduced either wholly or in part without our prior written permission.

We trust that this information meets your current requirements. Please do not hesitate to contact the undersigned on (09) 972 2205 if you require any further information.

Report prepared by

Olivia Ellis-Garland

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Report reviewed by

Paul Fletcher, CMEngNZ (CPEng)

Principal Geotechnical Engineer