27 May 2026

Rangitoopuni Development Limited Partnership (RDLP)
Attn: Mitch Tweedie
Lot 2, 7 Falcon Street
Parnell
Auckland

Dear Mitch,

Rangitoopuni Forest Referral for Fast-Track Submission – Forestry Road, Riverhead, Auckland

(Our Reference: 20190.000.001_34)

1 Introduction

ENGEO Ltd was requested by Rangitoopuni Development Limited Partnership (RDLP) to prepare this geotechnical referral letter for the proposed development at Forestry Road, Riverhead, Auckland. This work has been carried out in accordance with the signed agreement dated 14 May 2026.

The letter serves as notice of the intention of Te Kawerau ā Maki, in partnership with Avant Property Development Limited ('Avant') under RDLP, to lodge an application for referral of the Rangitoopuni Forest project under the Fast Track Approvals Act (FTAA). The discussion of geotechnical constraints in this letter is based on a combination of desktop studies, local geotechnical investigations completed by ENGEO to date and provides commentary on the anticipated geotechnical hazards, considerations and recommendations to enable the proposed development. Further geotechnical investigations and analysis will be required to support design stages across the sites.

Prior to this letter, ENGEO have undertaken geotechnical investigations and analysis for Lots 1 (countryside living) and 2 (retirement village) within the south-eastern portion of the site. This included a suite of machine borehole investigations, groundwater monitoring piezometers, cone penetration testing and hand auger boreholes.

2 Site Layout and Proposed Development

The site comprises Lots 2 through 8, DP 590677, and is located within Riverhead Forest, north of the Auckland townships of Riverhead, Kumeū and Huapai. The site forms part of a wider forestry landscape characterised by a mix of recently harvested plantation areas, regenerating vegetation, and rural–residential land uses.

The landform is defined by undulating to steep terrain, comprising a series of elongated ridgelines separated by incised gullies and drainage channels. Elevations typically range from approximately 30 m RL within gully systems to around 120 to 150 m RL along elevated ridges. Slope gradients are variable, generally gentle across ridge crests (3° to 10°), increasing to moderate (10° to 20°) on mid-slopes, and locally steep (> 35°) adjacent to gullies and slope breaks.

Drainage is controlled by an extensive network of ephemeral and permanent flow paths, which are associated with steeper slopes and more active geomorphic processes. The landform exhibits features of shallow-seated slope instability, including head scarps and colluvial deposits, particularly in association with incised gullies.

Overall, the site comprises a typical Auckland residual soil landscape, where landform is governed by the interaction of topography, drainage, and weathered soils, resulting in variable terrain suitable for development in selected areas subject to geotechnical constraints and appropriate design controls.

We have been provided with the Boffa Miskell Illustrative Masterplan for the development which we have included in Appendix 1.

The plans show that the Rangitoopuni Forest development comprises a large-scale master planned subdivision within Riverhead Forest, Auckland, involving the staged conversion of existing production forestry to predominantly rural-residential and open space land use. The proposal provides for approximately 3,446 to 4,212 residential bush lots across a gross developable area of approximately 2,228 ha , supported by a roading network, localised commercial and community hubs, 573 ha reserve and associated infrastructure. The wider site covers approximately 3,284 ha, with a yield analysis area of approximately 2,978 ha.

3 Existing Information

3.1 Other Consultants

Tonkin and Taylor Ltd prepared a Preliminary Geotechnical Assessment for the wider Rangitoopuni Riverhead Development Project (referenced 1008462.v1 and dated April 2019). The purpose of the assessment was to undertake a desktop study of the general geotechnical site characteristics and provide commentary on potential geotechnical hazards that may affect the proposed development. As part of the assessment a site walkover was completed, however no intrusive investigations were undertaken.

The assessment determined the site to be geotechnically feasible for land development; however variable engineering controls would be required to mitigate the risk of the geohazards on-site. A ‘development premium model’ was presented to address slope instability and of soil compressibility, the findings and recommendations outlined in the report have contributed to our understanding of the site.

3.2 ENGEO Work

ENGEO have previously undertaken geotechnical investigations at Lot 1 and Lot 2 of the Riverhead Forest Development. A summary of the investigation data available for Lot 1 and Lot 2 includes:

- Thirty machine borehole investigations.
- Sixteen standpipe piezometers used for groundwater monitoring.
- Twenty-two Cone Penetration Tests (CPTs).
- Ninety-four hand auger boreholes.

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Following the investigations, ENGEO completed a suite of Geotechnical Interpretative reports to support fast-track application approvals for resource consent. These include the following:

- ENGEO Limited; Geotechnical Investigation Report – Lot 1 Substages 1 to 5, reference 20190.000.001_15, dated 16 April 2025.
- ENGEO Limited; Geotechnical Investigation Report – Lot 1 Substages 6 to 14, reference 20190.000.001_16, dated 16 April 2025.
- ENGEO Limited, Geotechnical Investigation Report – Lot 2 Retirement Village, reference 20190.000.001_19, dated 5 May 2025.

4 Desktop Study

4.1 Mapped Geology

Most of the site has been mapped by Edbrooke (2001) at a scale of 1:250,000 as part of the GNS *Auckland Geological Map 3*. The site is interpreted to be predominantly underlain by East Coast Bays Formation flysch deposits, comprising interbedded sandstone and mudstone, with variable volcanic content and occasional volcaniclastic grit horizons.

Outcrops of Albany Conglomerate are mapped in the northern and eastern parts of the site. This unit is described as well-cemented, comprising predominantly pebble-sized clasts of dolerite and spilitic basalt, with lesser sedimentary clasts within a sandy matrix.

Areas of low-lying topography in the northern, south-western, and central-eastern parts of the site are mapped as being underlain by the Takaanini Formation and Tauranga Group Alluvium. These deposits typically comprise pumiceous sand, silt, clay, and mud, with interbedded gravel and peat layers.

The northern portion of the site is also mapped as being underlain by Hukerenui Mudstone of the Mangakahia Complex within the Northland Allochthon. This unit typically comprises red, brown, green, and grey, non-calcareous mudstone, which is commonly highly sheared.

Figure 1 presents the mapped geology for the site and wider area.

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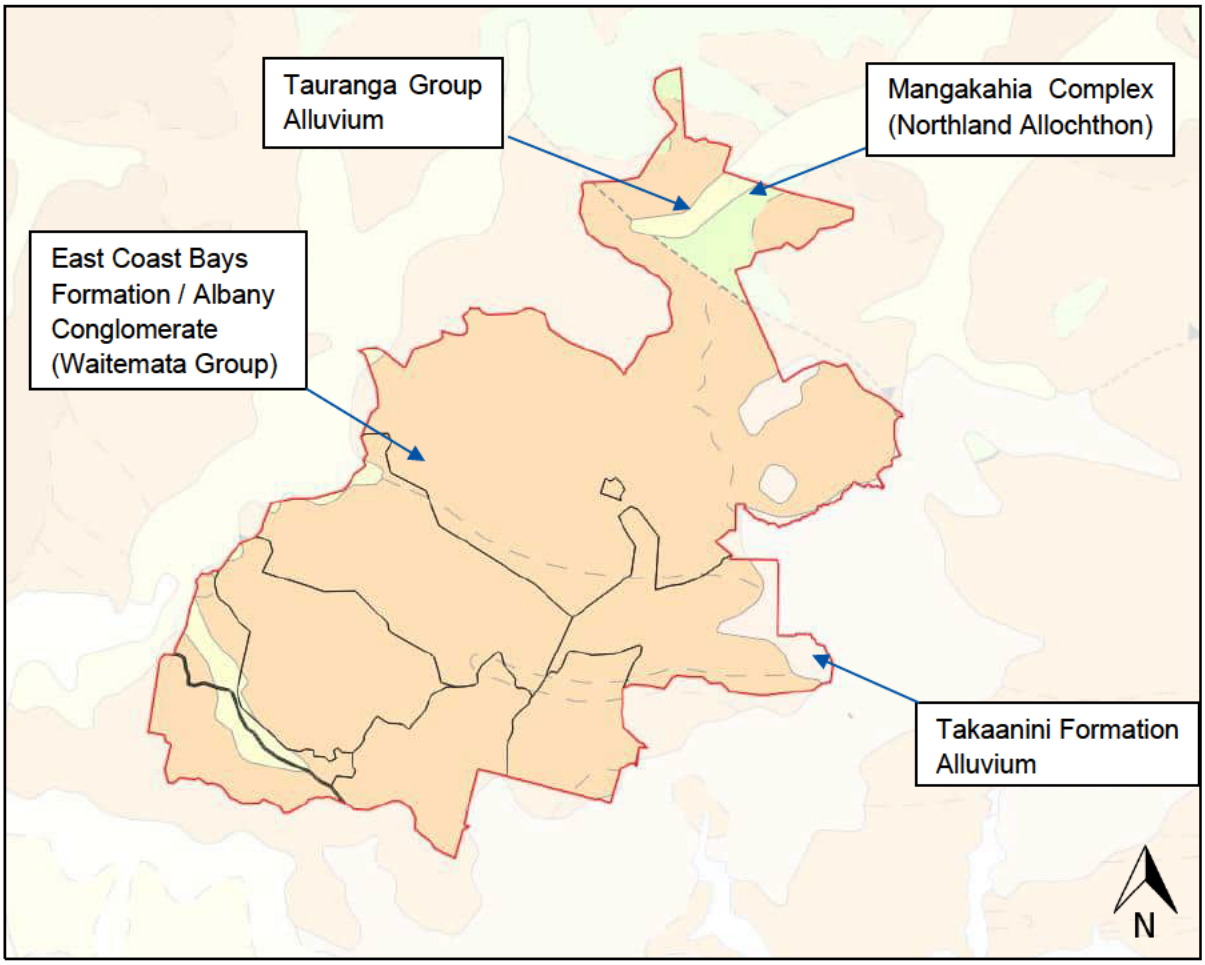


Figure 1: Mapped Geology

4.2 Mapped Geomorphology

The mapped geomorphology indicates the site comprises a typical ridge and gully landscape, with elongated ridgelines separated by incised drainage features and locally steep slopes. This is consistent with what we have observed through site walkovers and investigations completed within Lots 1 and 2 in the south-eastern portion of the site (reports referenced in Section 3.2).

Our work to date shows the ridges are generally underlain by stiff to hard residual ECBF soils, with ground conditions becoming more variable downslope, where colluvium and localised alluvial soils are present within gullies and drainage features. We observed common geomorphic features including head scarps, hummocky ground and debris lobes, which are indicative of past shallow slope instability and gully regression processes associated with concentrated drainage pathways.

Subsurface investigations (including boreholes, CPTs and hand augers) identified variable thicknesses of colluvium overlying stronger residual soils, with weaker alluvial soils present in low-lying areas. The slope instability observed in these areas is generally shallow (typically within the upper 1 to 3 m), and driven by groundwater and surface water effects, rather than deep-seated failure within the underlying rock.

Limited evidence of large-scale or deep-seated instability was identified in the areas investigated to date.

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Overall, the mapped geomorphology aligns well with the conditions we have observed and tested within Lots 1 and 2, and is considered representative of the wider site, although local variation is expected depending on slope gradient, drainage and geology. This provides a basis for interpreting the aerial photographs in Section 4.3, where vegetation and land use influence how clearly these features can be identified.

4.3 Historical Aerial Photographs

We have completed a high-level review of historical aerial photographs for the proposed development area in the context of landform changes.

Historical aerial imagery indicates the site has undergone repeated forestry clearing and regrowth cycles since at least the 1940s to present.

Periods of clearing expose the underlying landform, allowing ridges, gullies, drainage pathways and localised erosion features to be clearly observed. Periods of established or dense vegetation obscure these features, limiting the ability to interpret geomorphology from the aerial imagery.

Where the ground surface is visible due to periodic forestry clearing, we note that the imagery highlights gully erosion and surface drainage patterns consistent with shallow slope instability processes. We did not observe evidence of recent deep large-scale / deep-seated instability as part of our limited review, however there may be relict features that are not clearly visible due to the forest operations.

The 2024 aerial provides a clear image of a recently cleared area within the central-northern portion of the site. The image provides clear visibility of the underlying landform in an area of the site that contains well defined ridges, gullies and drainage pathways. The image highlights surface erosion and many shallow instability features. Forestry tracks and haul roads are visible, often tracking along ridgelines and traversing mid-slope areas. In some locations, it appears that the tracks influence surface water flow and contribute to localised erosion or disturbance. We have used this aerial image to further discuss slope instability mechanisms in Section 4.6.

Overall, the aerial review supports the interpretation that slope instability across the site is dominated by shallow, rainfall-driven processes rather than deep-seated instability.

4.4 Earth Sciences NZ – Active Fault Maps

We have reviewed the Earth Sciences New Zealand (formerly GNS) active fault maps database and note that there are no mapped active faults within the site shown on the publicly available online portal.

4.5 Mapped Landslide Susceptibility

We have reviewed the Auckland Council Geomaps landslide susceptibility maps which present recently published shallow and large scale landslide susceptibility mapping.

Figure 2 presents the ‘Large-Scale Landslide Susceptibility Layer’ for the site.

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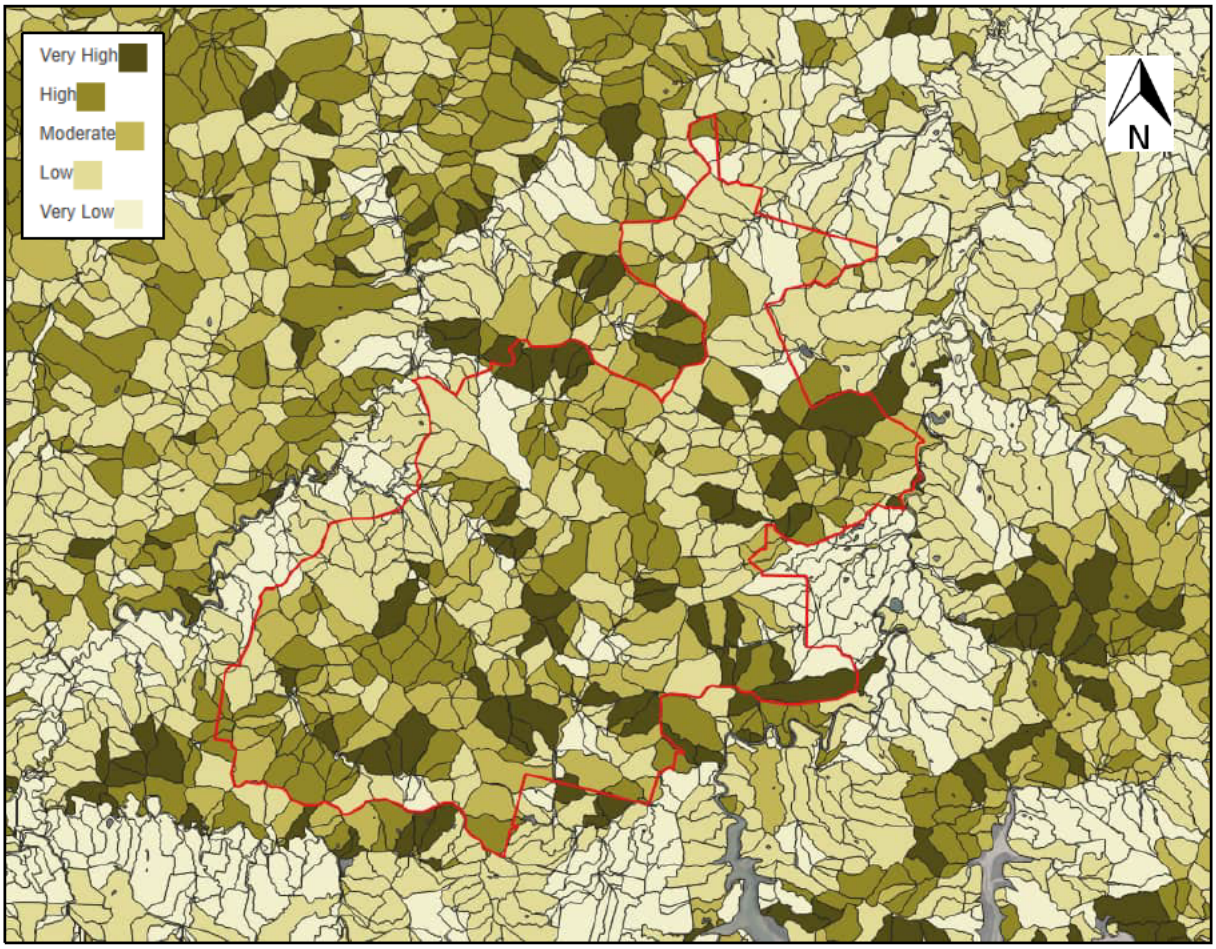


Figure 2: Auckland Council Geomaps – Mapped Large Scale Landslide Susceptibility

The large-scale landslide susceptibility mapping indicates that the Riverhead Forest area is characterised by predominantly moderate to high susceptibility, with locally distributed zones of very high susceptibility. The spatial pattern is heterogeneous, forming a mosaic of susceptibility classes that generally correlate with topographic variability. Areas of higher susceptibility are interpreted to be associated with steeper slopes, incised drainage features, and slope breaks, where soil materials are more prone to instability. Lower susceptibility zones tend to coincide with flatter ridge tops and gently undulating terrain. As a regional-scale (Level A) dataset, the mapping provides a broad indication of relative landslide potential only and does not account for site-specific factors such as local geology, groundwater conditions, or land disturbance.

Figure 3 presents the 'Shallow Landslide Susceptibility' map for the site.

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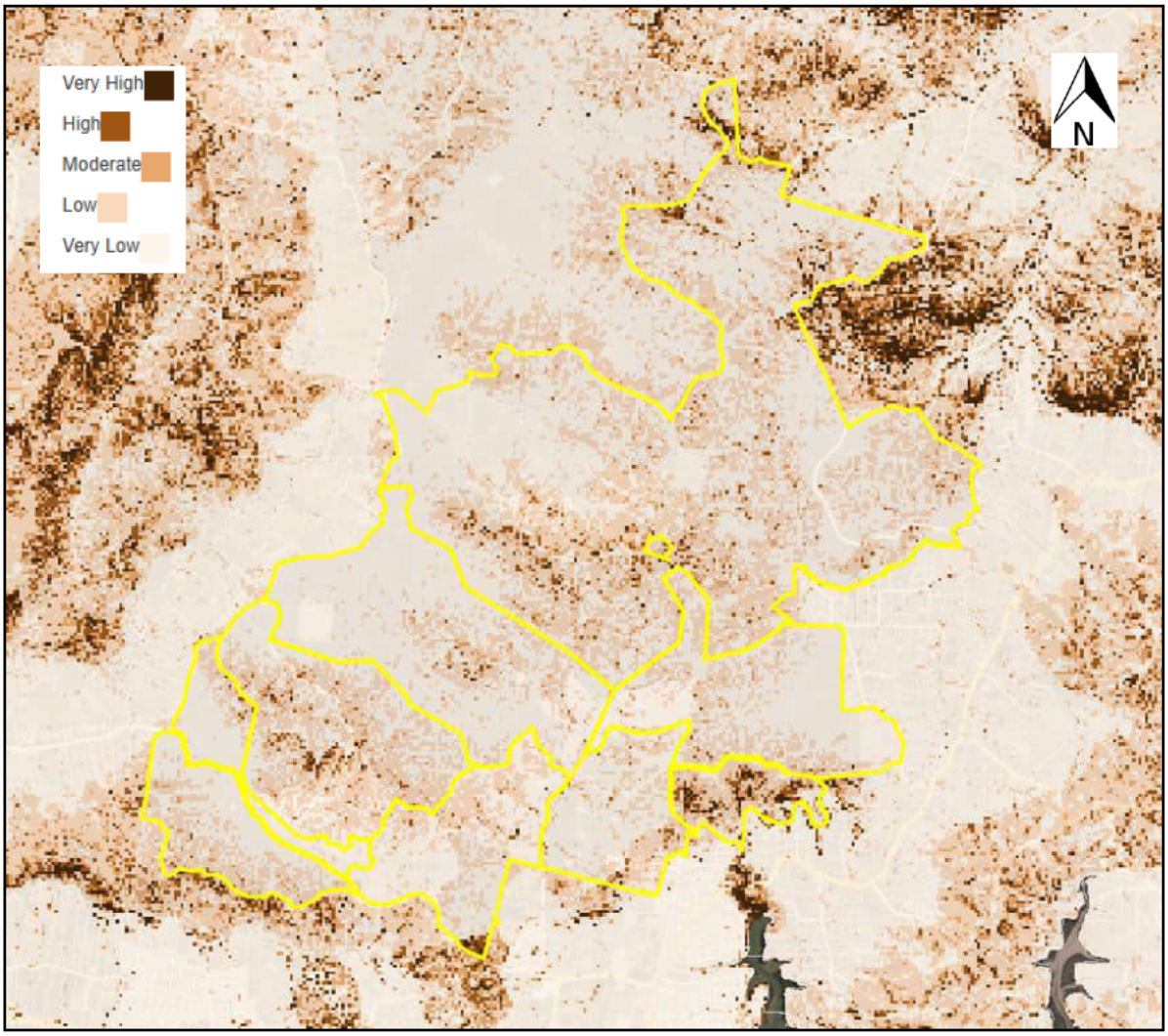


Figure 3: Shallow Landslide Susceptibility

The mapped landform within the site boundary is characterised by gently undulating to locally steeper terrain, with a variable distribution of shallow landslide susceptibility across the slopes. Areas of moderate to high susceptibility are concentrated along steeper valley flanks. The broader lower-gradient areas exhibit low to moderate susceptibility.

4.6 Representative Area of Elevated Slope Stability Hazard and Observed Instability

A representative area within the central-northern portion of the site (grid references 2 and 4 on the overview plan) has been identified where a cluster of recent landslides is mapped within the Auckland Council Geomaps "Landslide Inventory" layer (refer to yellow points shown on Appendix 3, Figure 4 and 2024/2025 Aerial on Figure 5). It covers an area that was cleared through forestry activities prior to the Auckland Anniversary and Cyclone Gabrielle extreme rainfall events in January and February 2023. It demonstrates the susceptibility of the cleared land to shallow instability associated with high intensity rainfall events. The area is mapped as having moderate to high shallow and large-scale landslide susceptibility.

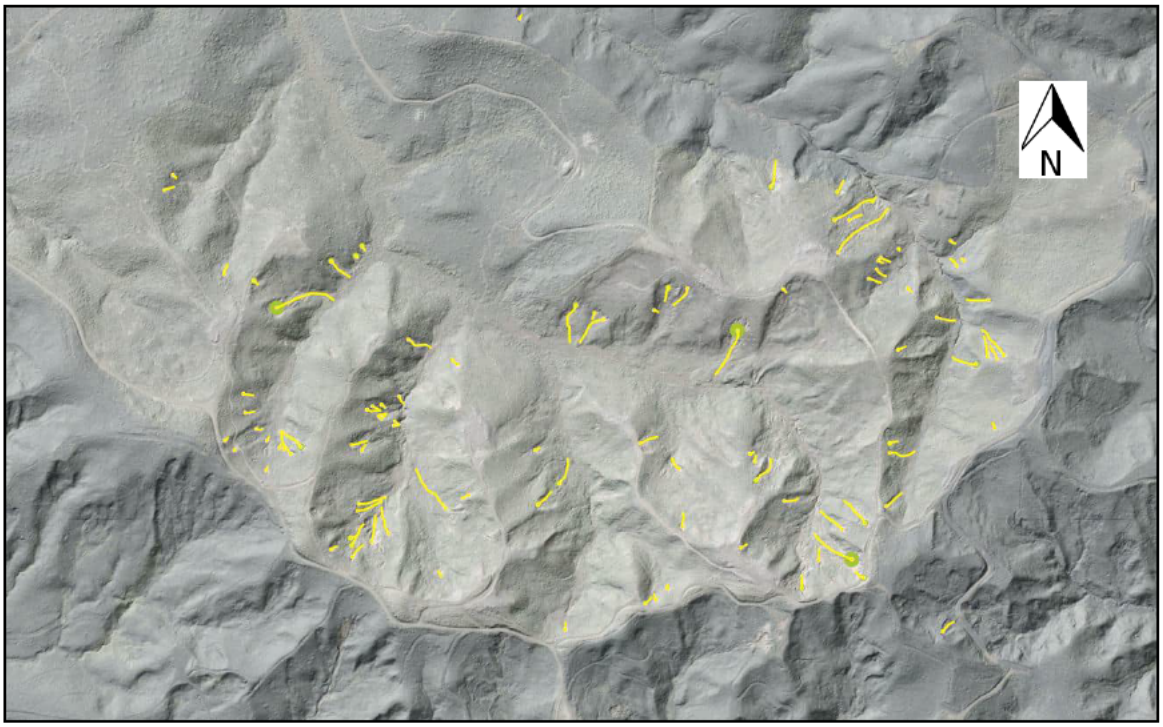


Figure 4: Mapped Landslide with Digital Elevation Model (Grid 2 and 4)

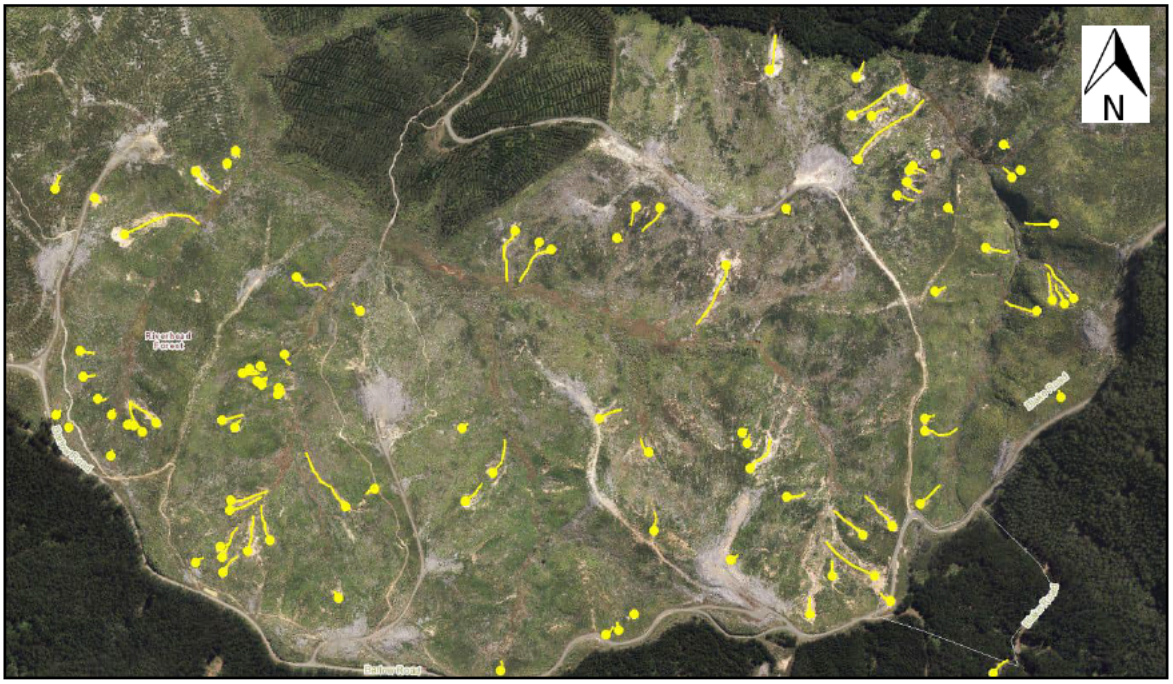


Figure 5: 2024/2025 Aerial of Mapped Landslides

These landslides generally initiate on moderately to steeply sloping ground within the residually weathered soils (silt and clay), often in areas of concentrated drainage or where slopes have been disturbed (e.g., forestry operations or track formation). The landslides commonly exhibit distinct source areas on upper to mid-slopes, with runout extending downslope into gullies, in some cases transitioning into earthflows or debris flows within the lower slope and alluvial channels. The failure mechanism is interpreted to be controlled by elevated pore water pressures within the fine-grained residual soils, resulting in a reduction in shear strength and mobilisation along shallow failure planes, typically near the soil–weathered rock interface or within weaker soil horizons. The thin veneer of alluvium within gully floors likely acts as a runout pathway and depositional environment, rather than a primary initiation zone. Overall, the observed failures are consistent with rainfall-triggered, shallow slope instability typical of highly weathered terrain, and support the mapped moderate to high landslide susceptibility across this part of the site.

4.7 Classifiable Dam

A new attenuation dam with an approximate height of 5.4 m and a storage volume of 57,000 m^3 is proposed to attenuate runoff generated within the proposed development. As the dam storage height exceeds 4 m and the storage volume exceeds 20,000 m^3, it is classifiable in accordance with the New Zealand Building (Dam Safety) Regulations 2022.

A requirement of the Regulations is that a classifiable dam must be assessed for its potential impact classification (PIC); which could be low, medium or high PIC.

The PIC of a dam is a reflection of the hazard it poses and forms the basis upon which criteria for dam design, construction and operational safety constraints are based (NZSOLD, 2024). Three key inputs used to determine a PIC are:

- The assessed damage level.
- The Population at Risk (PAR).
- The Potential loss of life (PLL).

To assess these inputs, hydraulic models are developed to determine likely extent of flood inundation, the impact on the population at risk, and the level of possible damage and disruption (NZSOLD, 2024).

We envision the dam to fall into a low PIC, with no further regulatory requirements other than completing and submitting a PIC certificate to Auckland Council. However, this will be confirmed during the detailed design stage.

5 Key Geotechnical Considerations and Constraints

This section discusses the key geotechnical considerations and constraints to the future development based on our experience and knowledge of the area. Slope instability is considered the most significant risk to future development and is discussed in detail in the following sections, with the remaining geotechnical considerations and constraints presented in Table 1.

5.1 Slope Instability

The Riverhead Forest area is characterised by gently to moderately steep terrain, with a mix of rolling ridges and incised gullies that influence how water moves across and through the ground. The soils in the area are generally highly weathered and clay-rich and can lose strength when they become wet. As a result, parts of the landscape are naturally prone to slope instability, particularly on steeper slopes and near drainage features where water can accumulate. Forestry activities can also affect stability by changing vegetation cover and groundwater conditions. Overall, the combination of terrain, soil conditions, and drainage means there is a moderate to locally high risk of slope instability; however, these risks are characteristic of Auckland soil landscapes and are routinely managed through established planning controls and geotechnical design.

5.1.1 Slope Heat Map

We have prepared a series of slope heat maps for the site which characterise the topography into three categories to provide a visual reference for the site topography:

- Green Zone – slopes that are less than 14 degrees.
- Yellow Zone – Slopes that are 14 to 30 degrees.
- Red Zone – Slopes that are greater than 30 degrees.

These maps are included in Appendix 2. The plan presents a grid reference so that areas of the site can be easily identified. As the development plan progresses, we can overlay proposed building platform and roads to provide geotechnical advice at an initial planning stage to manage risks associated with slope instability.

The slope zoning demonstrates that a substantial proportion of the site falls within the 'Green' and 'Yellow' categories, which are considered feasible for development subject to standard and targeted engineering controls. The land discussed in Section 4.6 reflects areas that are mapped 'Yellow' and 'Red' in this context.

Green Zone

The land zoned green has flatter slope gradients, less than 14°, with minor drainage pathways traversing the area. This zone is considered feasible for residential land development generally in accordance with NZ3604, subject to site-specific investigations and stability assessments. Development is likely to incorporate setbacks from identified instability features or steeply sloping ground.

Yellow Zone

The land zoned yellow covers moderately sloping terrain with gradients ranging from 14° up to 30° and is typically proximal to the fringes of steeply sloping gullies. Engineering measures may include bulk earthworks to mitigate unstable ground (i.e., drainage, shear keys and / or buttress fills), or the construction of retention structures (e.g., palisade walls) to form stable building platforms. Piled foundations for new buildings may be preferred to minimise site contouring, consisting of leading-edge piles and / or palisade walls as necessary on a lot-by-lot basis

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Red Zone

This land comprises steeply sloping terrain (> 30°) typically beyond slope breaks and the deep incised gullies where historical slope instability is indicated. We consider land in this zone will likely be prone to future instability, and as such significant engineering control would be required to mitigate risk of slope instability.

5.1.2 Managing Slope Instability Risk

Based on a review of aerial imagery, contour data, and Auckland Council landslide inventory mapping, slope instability within the site can be typically characterised by small- to medium-scale, shallow planar slides with the immediate head scarp behaving as a rotational landslide. This has also been supported by detailed geomorphological site walkover and mapping completed for Lot 1 and Lot 2 within the south-eastern portion of the site completed to date.

Slope instability can be managed through a combination of planning controls and engineered solutions. Appropriate setbacks from slope crests, head scarps, and gullies should be adopted to reduce exposure to instability. Where development is proposed near steeper terrain, engineered solutions such as in-ground retaining / shear structures, mechanically stabilised earth (MSE) slopes, or buttress fills may be required.

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5.2 Other Geotechnical Constraints

Table 1: Other Geotechnical Considerations and Constraints

Geotechnical Constraint	Commentary	Potential Remedial/Mitigation Solutions
Liquefaction and Lateral Spread	The site is predominantly underlain by cohesive East Coast Bays Formation (ECBF) residual soils, with localised alluvial deposits within gullies. Liquefaction and lateral spread are assessed as low likelihood across most of the site and are not expected to be a controlling constraint on development	Liquefaction hazard can be appropriately managed through the use of standard shallow foundations across most of the site, combined with site-specific foundation solutions in localised areas of elevated risk. Where required, mitigation may include stiffened raft or ribbed slab foundations and targeted ground improvement (such as rammed aggregate piers or stone columns). Additional CPT testing following earthworks is recommended to confirm residual conditions and inform detailed design. Setbacks from incised gullies and stream channels will further reduce the potential for lateral deformation.
Consolidation Settlement	Settlement likelihood is generally low to moderate across the site due to the presence of stiff residual soils. However, localised areas of compressible alluvium, colluvium, or uncontrolled fill within low-lying gullies may result in differential settlement, particularly where engineered fill is placed over variable ground.	Settlement hazard can be mitigated through removal and replacement of compressible or organic soils prior to filling, and the placement of engineered fill in accordance with controlled compaction and moisture conditioning requirements. In areas of significant fill thickness, settlement monitoring during construction is recommended to confirm consolidation behaviour. Building foundation systems should be designed to accommodate potential differential settlement, and staged construction may be adopted where necessary to allow consolidation to occur prior to structural loading.
Earthworks	Earthworks are expected to be minor across the development and limited to access roads and proposed building platforms. However, they may be significant for commercial hubs/higher density development areas. Based on Lot 1 proposed developments, earthworks cut depths are typically between 1 to 2 m. However, for Lot 2 (Retirement Village) bulk earthworks are proposed with significant cut and fills.	Earthworks can be successfully managed through implementation of standard geotechnical construction controls, including geotechnical observation, controlled fill placement, and adherence to engineered compaction specifications. Fill slopes should be benched into natural ground and constructed using appropriate batter angles, with geogrid reinforcement or bridging layers adopted where required. Erosion and sediment control measures should be implemented during construction to protect exposed soils and maintain stability.

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Geotechnical Constraint	Commentary	Potential Remedial/Mitigation Solutions
Groundwater	Groundwater conditions are controlled by topography, with shallow groundwater typically encountered in low-lying gullies and deeper levels beneath ridges. Groundwater may influence slope stability and earthworks, particularly during periods of elevated rainfall or where excavations intercept groundwater.	Groundwater effects can be managed through installation of subsoil drainage systems, including underdrains and bench drains within fill areas and at the base of cut slopes. Surface water should be controlled and directed away from slope faces to limit infiltration. Where deeper excavations are undertaken, localised dewatering may be required, supported by monitoring of groundwater levels to inform design and construction. Integration with site-wide stormwater management is critical to maintaining long-term stability.
Expansive Soils	The site is predominantly underlain by clay-rich ECBF residual soils, which are susceptible to shrink–swell behaviour with seasonal moisture variation.	The effects of expansive soils can be mitigated through appropriate foundation design, including the use of stiffened raft or waffle slab systems capable of accommodating ground movement. Control of surface drainage and moisture conditions around structures is essential to minimise seasonal volume change. Laboratory testing following earthworks is recommended to confirm soil behaviour and refine design parameters, and service installations should be detailed to accommodate potential ground movement.

6 Suitability for Proposed Development

Based on the available geotechnical information, including previous investigations and regional datasets, the site is considered suitable for the proposed development at a strategic level.

The identified geotechnical constraints, including slope instability, variable ground conditions, and groundwater influences, are typical of large-scale developments within Auckland's residual soil landscapes and are well understood within current geotechnical practice.

While localised areas of elevated landslide susceptibility are present, these are generally associated with identifiable landform features (e.g., steep slopes and gullies) and can be appropriately managed through a combination of site planning, setbacks, drainage control, and targeted engineering solutions.

No geotechnical hazards have been identified that would preclude or fundamentally constrain the development of the site, and identified risks are considered capable of being mitigated through established planning, design and construction methodologies.

On this basis, the site is considered appropriate for progression under the Fast Track Approvals pathway, with further investigation and detailed design to be undertaken at subsequent stages.

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7 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, Rangitoopuni Development Limited Partnership (RDLP), 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, site assessments and subsurface investigations described in this report based on accepted normal methods of site investigations. Only a limited amount of information has been collected to meet the specific financial and technical requirements of the Client's brief, and this report does not purport to completely describe all the site characteristics and properties. The nature and continuity of the ground between test locations 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



Rhys Bridges, CMEngNZ (CPEng)
Senior Geotechnical Engineer

Report reviewed by



Heather Lyons, CMEngNZ (PEngGeol)
Principal Engineering Geologist

Attachments:

Appendix 1 – Boffa Miskell Proposed Master Plan Development

Appendix 2 – Overview and Slope Heat Map

Appendix 3 – Mapped Landslide Cluster Plan