19 December 2025

K200826-6a

Goodland Group Limited
PO Box 302247
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Auckland

GEOTECHNICAL RFI LETTER
PLAN CHANGE 120 - 2127 KAIPARA COAST HIGHWAY, MAKARAU

1. INTRODUCTION

At the request of Airey Consultants Limited (ACL), KGA Geotechnical Group Limited (KGA) has provided a response to the Planning Plus Limited on behalf of Auckland Council Request for Further Information (RFI) contained in their email to The Urbanist, dated 2 December 2025, under Resource Consent Number BUN60406128. Specifically, this response addresses the following query:

"You may be aware that Council has notified a proposed Plan Change 120 and the natural hazard aspects of this affect the site. The provisions have immediate legal effect, and as such additional assessments will be required."

KGA have carried out the assessment as requested, specifically to provide the following:

Item 1)

a. *A landslide hazard risk assessment report as per Standard E36.6.A1(1)(b).*
b. *A hazard risk assessment in accordance with E36.9(1) and (2). Note this should be proportionate the level of risk (and so would be informed by the results of the landslide hazard risk assessment).*
c. *If necessary, based on the results of the landslide hazard risk assessment, an update to the geotechnical report.*

Item 2)

On completion of the landslide hazard risk assessment, please confirm the activity status of the proposal and provide an assessment against the relevant assessment criteria and objectives and policies under PC120.

2. BACKGROUND

This letter should be read in conjunction with the following Geotechnical Reports, previously provided as part of the Subdivision consent process:

Table 1: Relevant Geotechnical Information

Document Type	Reference Number	Date Issued
Geotechnical Investigation Report (GIR)	K200826-1C	28 August 2024
Geotechnical RFI Letter AC (RFI Letter)	K200826-2	9 August 2024
Geotechnical RFI Letter AC (RFI Letter)	K200826-3	1 March 2024
Geotechnical RFI Letter to AC (RFI Letter)	K200826-4	28 August 2025
Geotechncial RFI Letter to NZTA (RFI Letter)	K200826-5	17 October 2025

We recommend that the reader be familiar with the contents of the aforementioned documents, as the information contained therein is pertinent to the assumption presented in this letter. In particular, quantitative analysis carried out in accordance with Auckland Council Code of Practice (AC COP) confirmed that FoS against instability can be achieved provided recommendations within the relevant reports are adopted.

3. RISK ASSESSMENT

The risk assessment for this site has been carried out in general accordance with Appendix 24 of the Plan Change 120 documentation, “Landslide Hazard Risk Assessment Methodology”, dated 3 November 2025. This process includes a four-stage approach to quantify the risk and to determine Activity Status in accordance with Table E36.4.1B of the Auckland Unitary Plan (AUP); PC120 modifications. The four-stage approach includes the following:

- Stage 1: Desktop study including a review of landslide susceptibility maps and mapped landslides.
- Stage 2: Determination of risk assessment methodology and development of Engineering Geological Models.
- Stage 3: Determination of risk class for selected landslides.
- Stage 4: Use of the risk assessment to determine activity status.

The quantitative assessment addresses the potential risk to life. Its basis is to determine an annual risk of loss of life.

4. STAGE 1 – DESKTOP STUDY; LANDSLIDE SUSCEPTIBILITY MAPS

The Auckland Council GeoMaps (AC GeoMaps) database includes landslide susceptibility maps for both “small-scale shallow landslides” and “large scale landslides”. This mapping is based on Technical Report TR202577 titled, “Auckland Region Landslide Susceptibility Assessment”, dated May 2025. The basis of this document is a regional study carried out by WSP, titled “Auckland Landslide Susceptibility Study Technical Report 2025”, dated February 2025.

The technical document states the following regarding the susceptibility and the use for detailed analysis:

- *“This is a susceptibility dataset and does not describe hazard or risk”.*
- *“This is a regional-level assessment and is not intended for site-specific use without further, more detailed assessment”.*

The subject site comprises 2127 Kaipara Coast Highway, Kakanui 0984, and is legally described as Pt Sec 50 Blk II Kaipara Survey District SO 51097, Sec 1 SO 328127, Pt Makarau Blk 4A SO 28095, Pt Makaray Blk 4B SO 28095. The site has an approximate plan area of 133.9Ha. We have assessed the AC GeoMaps portal to check for mapped susceptibility for both the shallow and deep-seated landslides. For the benefit of this assessment, we have chosen the highest susceptibility risk mapped feature within the four properties for our assessment of shallow instability. For large scale landslides, we are required to assess the highest risk mapped susceptibility at the site and within a 150m runout zone.

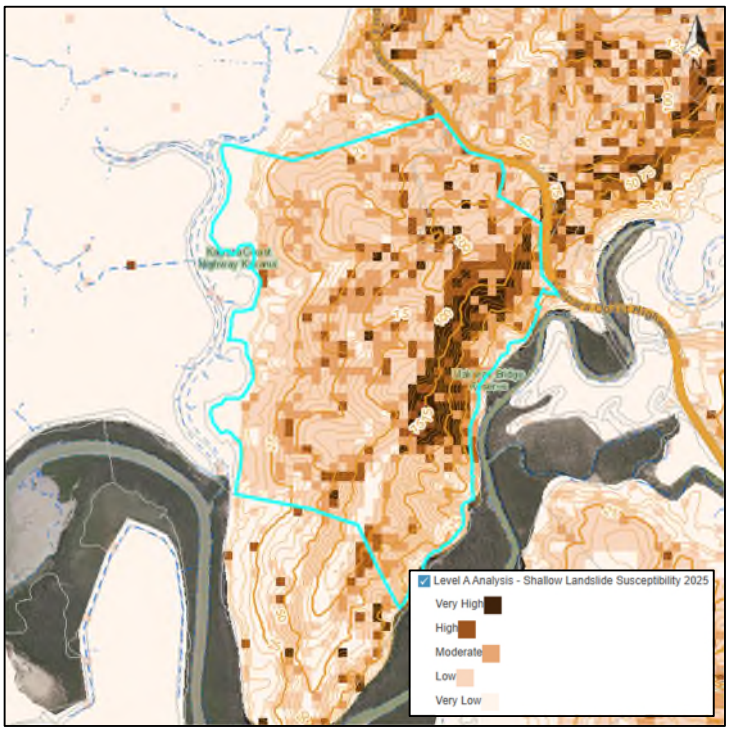

Figure 1: Shallow Landslide Susceptibility Map (North Up Page)

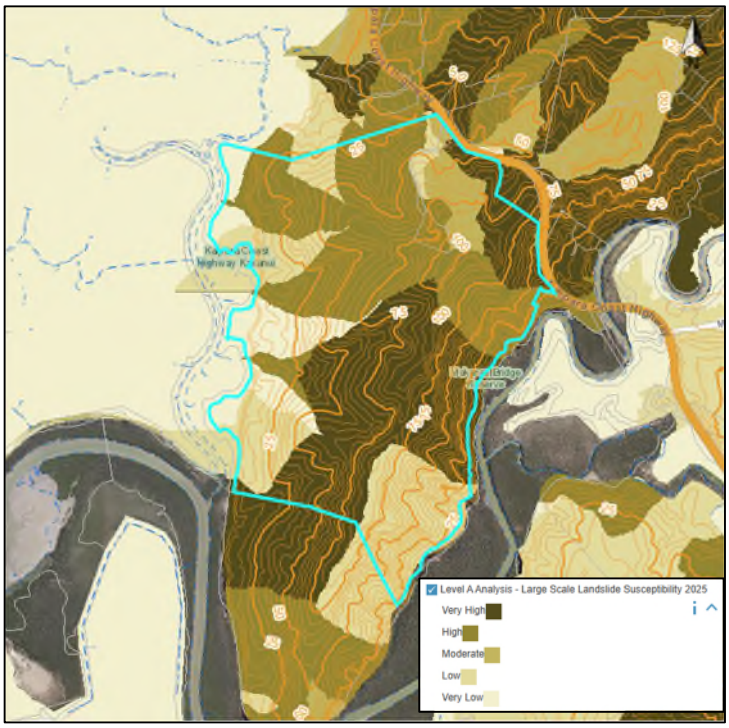

Figure 2: Large Scale Landslide Susceptibility Map (North Up Page)

These maps indicate that the land within these properties is classified as medium to very high susceptibility for both shallow and large-scale landslides.

5. STAGE 2 – GROUND MODEL AND LANDSLIDE TYPE

5.1 Ground Model

KGA previously provided 17 representative geological ground models at critical sections across the proposed development; Cross-Sections A-A' to N-N presented in our 2024 GIR, and Cross-Section O-O' presented in our 2025 RFI letter, reference No. K200826-5. We also prepared a representative, worst case slope stability scenario to assess potential stability of the proposed wastewater fields, presented in our 2024 RFI Letter, reference No. K200826-4.

These representative ground models are based on interpretation of:

- 39 x Hand Auger Boreholes (AH1 to AH38, and AH2501)
- 18 x Wastewater Boreholes (WWAH1 to WWAH18)
- 7 x Machine Boreholes (From previous Geotechnical Investigation Report, prepared by KR Miller & Associates, dated November 2004)

5.2 Site Geomorphology and Observed Failures

In regional terms, the proposed development site is topographically variable but can be broadly described by a local high point located within the northeast portion of the site. This high point forms part of a ridgeline that trends generally northsouth. The eastern flanks of the ridge are steeply sloping towards the Makarau River, whereas the western slopes, where the proposed development is concentrated are gently to moderately sloping westward. Several gully features are incised into the west-facing slopes, draining in an east-to-west direction.

Towards the western boundary of the site, the slopes steepen abruptly to form a coastal cliff-like feature above the near-level floodplain. The pronounced contrast in topography between the eastern and western sides of the site is considered to reflect underlying geological controls.

As part of our 2024 GIR, we undertook a geomorphological assessment and mapped several relic shallow translational landslides within the gully slopes, along with a larger scarp feature in several locations. No evidence of ongoing movement of these larger features was observed during any of our site walkovers.

Following the Auckland Anniversary Floods and Cyclone Gabrielle (January–February 2023), KGA revisited the site to undertake a detailed walkover assessment. One additional shallow soil slip was observed on the eastern slope (on the far side of the ridgeline and away from the proposed development). No slope instability was observed on the western slopes during this inspection.

5.3 Assessed Landslide Types

PC120 requires the risk assessment to be carried out for three landslide types. We have considered the following landslides for our risk-based assessment based on the regional setting, location of a ridgeline and geology. Our assessment of landslides generally follows guidance contained in Cruden & Varnes (1996). Appendix 24 requires landslide types representing 'high likelihood', 'median likelihood' and 'maximum credible' events.

1) High likelihood - Shallow Translational Land Movement on the steeper eastern side of the main ridge and on the cliff-like feature below the western slopes (rapid, wet, earth slide)
2) Median likelihood – Clay/silt rotational slides with the gully heads (slow to rapid, moist, soil slide/slump).
3) Maximum credible - Deep-Seated Movement (slow, moist, earth slide).

6. STAGE 3 – PC120 Risk Assessment Methodology

6.1 General

To determine the required method for the quantitative assessment, we have made reference to Table 1 of PC120 Appendix 24. This table specifies the land use activity and the susceptibility class to determine the methodology.

For the Land Use Type: “Subdivision”. The required assessment is “Method 2”, due to the Very High Susceptibility of large and shallow landslides.

The Method 2 assessment must include the following, as defined by PC120 Appendix 24:

1. *A semi-quantitative risk assessment which covers a wide range of potential impacts. The approach is identical to Method 1. If Method 1 has already been undertaken, the results from this earlier assessment can be used without revision.*
2. *A quantitative risk assessment which covers individual risk to life.*

We provide in this response the semi-quantitative risk assessment (Method 1) covering a range of potential impacts (human safety, societal, building damage) and a quantitative assessment (Method 2) to determine the Annual Individual Fatality Risk (AIFR).

6.2 Clay/silt rotational slides – High Likelihood

Geomorphological mapping identified several shallow slips within the gully features, typically located near the gully heads where long-term, incremental regression has progressively modified the slope formation. These comprise shallow rotational failures within the residual soils, consistent with the slow retreat processes characteristic of Waitemata Group gully evolution. While generally small in scale, such features can produce relatively rapid debris runout when occurring on steeper slopes, and collectively they represent the gradual, shallow retreat of the gully heads over thousands of years rather than any deep-seated mass movement.

These rotational slides could result in underslips below localised sections of the accessways (including areas along the main ridgeline) and may also affect the proposed building platform within Lot 24. There is also the potential for debris runout to become channelised within incised gullies, posing a risk to downslope areas. To minimise these risks, the alignment of accessways and the locations of building platforms have been set back from gully heads and established flow paths.

6.3 Shallow Translational Movement – Medium Likelihood

The site walkover undertaken following the 2023 extreme rainfall events confirmed the presence of shallow translational movement on the steeper eastern slopes of the main ridgeline. A similar mechanism is also considered plausible along the cliff-like feature forming the western boundary of the site.

As part of the 2024 GIR, slope stability modelling was carried out for the proposed Lots and associated building platforms. The analyses included cross-sections J–J' through L–L' along the western boundary, incorporating the cliff-like feature. All sections achieved factors of safety (FoS) well above Auckland Council minimum requirements, under static, raised groundwater, and seismic loading scenarios.

The only exception was Cross-Section N–N', representing a portion of the accessway located near the crest of the steeper eastern slopes. This analysis returned FoS values below Auckland Council criteria (though all FoS > 1.0), consistent with the shallow movement observed during the 2023 walkover. In response, the proposed accessway alignment was shifted further west, set back from the slope crest. Updated analyses demonstrate compliant FoS along the revised alignment.

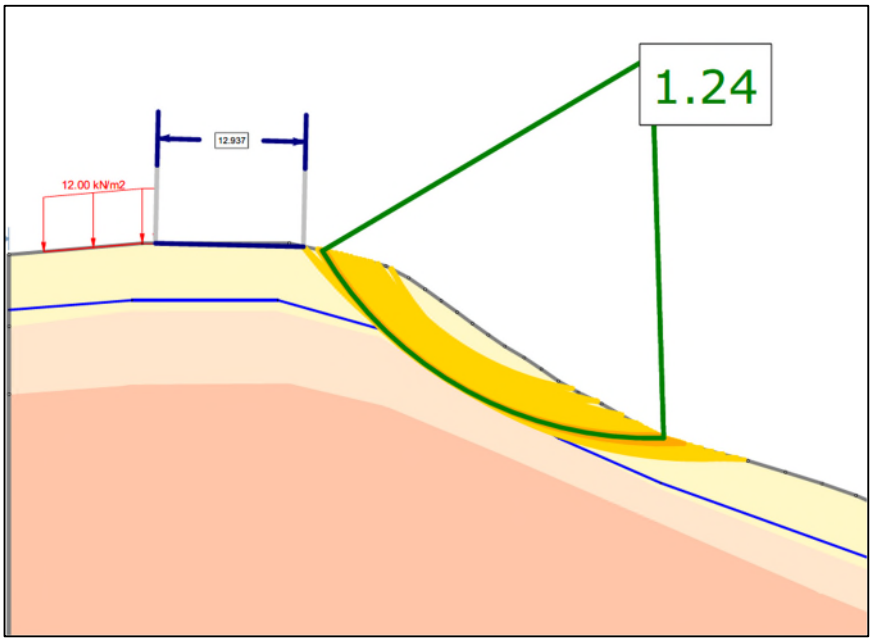

Figure 3: Example of Cross-Section N–N' showing offset from raised-groundwater failure surfaces (FoS < 1.3).

6.4 Deep Seated Landslide – Maximum Credible

A larger-scale relic landslide feature was mapped on the northwest-facing slope above Lot 8. This feature is considered ancient and did not show evidence of reactivation during the 2023 extreme rainfall events.

Previous deep investigations across the site encountered competent transitional materials and/or rock at shallow depths (approximately 3m to 10 m). To assess the potential for deep-seated reactivation, slope stability modelling was completed along Cross-Section D–D'. For conservatism, the model assumed no rock at depth, relying solely on soil strength parameters. The results indicated no reactivation of the mapped relic feature, and no deep-seated failure surfaces were identified.

6.5 Semi-Quantitative Risk Assessment (Method 1)

The semi-quantitative risk assessment has been carried out in accordance with PC120 Appendix 24, Tables 3 to 6, to evaluate the likelihood and consequences of the three relevant landslide mechanisms identified for the site:

- Shallow translational movement
- Shallow soil creep
- Deep-seated instability

The Method 1 assessment is intended to provide an initial classification of risk before proceeding to the quantitative (Method 2) evaluation required under the PC120 framework.

6.5.1. Likelihood Assessment

The likelihood ratings have been derived from the results of the detailed stability analyses (17 cross-sections), geomorphological mapping, and subsurface investigation, consistent with the likelihood definitions in Table 3 of Appendix 24. Based on site-specific evidence:

- **Shallow translational movement - Likely:**
  Shallow translational movement is assessed as *Likely* (1 in 100 years). This mechanism is most credible on the steep eastern slopes and along the steeper cliff-like slope at the western boundary, where the near-surface residual soils are susceptible to shallow shear displacement under elevated groundwater or intense rainfall. The risk to the proposed development is mitigated through the use of development setbacks, which locate building platforms and accessways outside the potential influence zones. Stability modelling shows factors of safety well above Auckland Council requirements, with the exception of Cross-Section N-N', assessing the eastern slopes, where a distinct setback has been applied.
- **Clay/Silt Rotational Slips – Likely:**
  Shallow rotational slips within clay- and silt-dominant residual soils are also assessed as *Likely* (1 in 100 years). These slips occur within localised gully-head features and reflect long-term geomorphic processes typical of Waitemata Group terrain. Potential movement is mitigated by development setbacks, which locate building platforms outside the influence zones.
- **Deep-seated instability – Unlikely:**
  Deep movement likelihood is identified as Unlikely (1 in 10,000 years). No deep failure mechanisms were identified in any cross-section. Investigations show competent transitional materials and/or rock at 3 to 10 m depth.

6.5.2. Consequence Assessment

Consequences have been assessed in accordance with Table 4 of Appendix 24, considering both Human Safety and Buildings Accommodating Sensitive Activities. For conservatism, the higher of the two consequence categories has been adopted for each landslide mechanism.

- **Shallow translational movement — Minor:**
  Any potential shallow translational movement is expected to be small-scale, limited to slope margins along the steep eastern slopes and cliff-like western slope break. Building platforms are set back from these areas, and any movement is unlikely to directly affect the development. Damage, if it occurs, would be limited and readily reinstated.

- **Clay/Silt Rotational Slips —Minor:**
  Shallow rotational slips may result in minor under slips and/or localised debris runout within the incised gully features. The accessways and lots are appropriately set back from gully flow paths, limiting the potential for ongoing regression of the gully head to reach the structures over the design life of the development. Debris volumes are expected to be minimal and confined to the gullies, making it highly unlikely that future building platforms would be affected.
- **Deep-seated instability — Major (structural), Minor to Medium (human safety):**
  Although deep-seated instability is assessed as "Unlikely," the worst-case structural consequence is conservatively assigned as "Major" due to the hypothetical extent of deformation if such an event were to occur. Human safety consequences remain lower, reflecting the unlikely nature of rapid or catastrophic failure in this geological setting.

6.5.3. Risk Classification

Based on the above assessed likelihood and consequence, we have utilised Table 6 from PC120, to assess the risk. Translational movement is circled red, rotational slips circled blue and deep-seated movement circled purple for visual purposes.

Risk classification table:

Likelihood category	Consequence category: Insignificant	Minor	Medium	Major	Catastrophic
Almost certain	Medium (tolerable)	High (significant)	High (significant)	High (significant)	High (significant)
Likely	Low (acceptable)	Medium (tolerable)	High (significant)	High (significant)	High (significant)
Possible	Low (acceptable)	Low (acceptable)	Medium (tolerable)	High (significant)	High (significant)
Unlikely	Low (acceptable)	Low (acceptable)	Low (acceptable)	Medium (tolerable)	High (significant)
Rare	Low (acceptable)	Low (acceptable)	Low (acceptable)	Low (acceptable)	Medium (tolerable)
Barely credible	Low (acceptable)	Low (acceptable)	Low (acceptable)	Low (acceptable)	Low (acceptable)

Figure 3: Annotated Risk Classification Table taken from PC120; Appendix 24

Based on Figure 5, the development site should be considered "tolerable", with respect to building. We point out that if the consequence for the "deep-seated" landslide assumes "Human Safety" (Minor to Medium) instead of "Building", the risk becomes acceptable.

6.6 Quantitative Risk Assessment (Method 2)

6.6.1. General

Method 2 requires calculation of the Annual Individual Fatality Risk (AIFR) for each relevant landslide mechanism. The assessment follows the PC120 Appendix 24 risk equation and uses probability components informed by site-specific modelling, investigation data, and representative values from AGS (2007c) for vulnerability and occupancy. The Method 2 analysis focuses on actual risk to future dwellings, incorporating:

- The proposed earthworks
- Engineered retaining structures
- Development setback zones
- Location of lots on ridge crest or level engineered fill

Accordingly, the probabilities used in Method 2 reflect the likelihood of a landslide hazard resulting in death, not the natural slope below.

The AIFR is calculated using:

$$R_{LoL} = P(H) \times P(S{:}H) \times P(T{:}S) \times V(D{:}T)$$

Where:

- P(H) = annual probability of the landslide occurring
- P(S:H) = conditional probability of the slide impacting the dwelling
- P(T:S) = probability of a person being present (Consistent with residential use, **0.7** has been adopted (AGS 2007 typical value).
- V(D:T) = vulnerability of an exposed person given the impact.

6.6.2. AIFR Calculations

Table 2: Shallow Translational Movement AIFR Calculations

Parameter	Value	Justification
P(H)	0.01	Shallow slips may occur on steep natural slopes during adverse conditions (consistent with "Likely").
P(S:H)	0.02	Geometry and setbacks mean only ~2% chance of affecting a building platform or accessway. Although "Likely" in natural unmitigated slopes, such failures are not expected to reach building platforms, which are positioned on stable ground as indicated in slope stability assessment.
P(T:S)	0.1 to 0.7	Minimal chance persons will be occupying potion of Accessway when slip occurs. 70% with Residential occupancy.
V(D:T)	0.01	Slip expected to cause local ground deformation, not structural collapse.
Total		$\boldsymbol{R_{LoL} = 0.01 \times 0.02 \times 0.7 \times 0.01 = 1.4 \times 10^{-6}}$

Table 3: Shallow Soil Creep AIFR Calculations

Parameter	Value	Justification
P(H)	0.01	Clay/silt rotational slips within the gully features may occur on steep natural slopes during adverse conditions (consistent with "Likely").
P(S:H)	0.02	Set-back from the gullies and flow paths are unlikely to affect future dwellings, debris runout
P(T:S)	0.1 to 0.7	Minimal chance persons will be occupying potion of Accessway when slip occurs. 70% with Residential occupancy.
V(D:T)	0.01	Slip expected to cause local ground deformation, not structural collapse.
Total		$\boldsymbol{R_{LoL} = 0.01 \times 0.02 \times 0.7 \times 0.01 = 1.4 \times 10^{-6}}$

Table 4: Deep-Seated Land AIFR Calculations

Parameter	Value	Justification
P(H)	0.0001	"Deep-seated failure is assessed as Unlikely, supported by rock/transitional soils at 3m to10 m, 17 cross-sections showing FoS > AC requirements and geomorphology inconsistent with deep rotational mechanisms
P(S:H)	0.1	Deep movement, if it occurred, would be broad and slow, with very low likelihood of impacting ridge-crest lots, given proposed setbacks and retaining structures.
P(T:S)	0.1 to 0.7	Minimal chance persons will be occupying potion of Accessway when slip occurs. 70% with Residential occupancy.
V(D:T)	0.05	If a deep failure occurred, structural damage possible, but rapid catastrophic collapse unlikely in this geology.
Total		$\boldsymbol{R_{LoL} = 0.0001 \times 0.1 \times 0.7 \times 0.05 = 3.5 \times 10^{-7}}$

6.6.3. Total Annual Individual Fatality Risk (AIFR)

$$R_{Total} = 1.4 \times 10^{-6} + 1.4 \times 10^{-6} + 3.5 \times 10^{-7}$$
$$\boldsymbol{R_{Total} \approx 3.15 \times 10^{-6}}$$

Using Figure 5, contained in PC120; Appendix 24, this results in an overall "Medium" risk and a resultant "Tolerable" classification.

7. ACTIVITY STATUS

We consider that the quantitative (Method 2) analysis is the most appropriate for use in determining the activity status for the development. This is compliant with PC120; Appendix 24 "Stage 4", which states, *"Where multiple risk assessment methods are applied, results from Method 2 shall take precedence over those from Method 1".*

We have made reference to relevant activity type in Table E36.4.1B of Unitary Plan E36 as detailed below.

The assessment carried out within this letter complies with E36.6.A1 Standard (risk assessment carried out by a geotechnical professional and geotechnical report, Reference K250235-1, prepared in accordance with Auckland Council Code of Practice for Land Development and Subdivision).

Table 5: Relevant Activities from Table E36.4.1B of Unitary Plan E36

E36.4.1B Activity Table		Assessment	Activity Status
A112	On-site septic tanks, wastewater treatment and disposal systems, effluent disposal fields, underground storage tanks, water tanks (including rainwater tanks) or stormwater pipes or soakage fields, accessways private roads and roads intended to be vested in landslide hazard risk areas that comply with Standard E36.6.A1	The landslide risk assessment in respect to AFIR is considered to be 'Tolerable'	Permitted
A124	New structures and buildings and external additions and alterations to existing structures and buildings (as existing at 03/11/25) with a gross floor area more than 20m2 associated with activities sensitive to natural hazards in landslide hazard risk areas that comply with Standard E36.6.A1		Restricted Discretionary
A128	All other buildings and structures, including retaining walls, in landslide hazard risk areas the comply with Standard E36.6.A1		Permitted

8. LIMITATIONS

This letter was prepared in the context defined in Section 1 must not be relied upon by any other party other than that for whom it was prepared and the relevant Territorial Authority. It has been compiled with respect to the brief given to us and must not be relied upon in any other context or recreated for any other purpose.

Conclusions and risk assessments contained in this letter report are based on our knowledge of the local geology, subsurface data carried out within the subject site and our experience in landslide failure types and should not be construed as a guarantee.

The result of this assessment is for use in planning only.

Yours faithfully,
p.p. KGA Geotechnical Group Limited

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