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Tauranga City Council

Tauranga Landslide Slope Hazard (IDC Zones) Study

Addendum Report: Mount Maunganui / Pāpāmoa Update

22 July 2025

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Addendum Report: Mount Maunganui / Pāpāmoa Update

Tauranga City Council

Report No: TG 2025/5

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EXECUTIVE SUMMARY

This addendum report provides an updated assessment of slope instability in the Mount Maunganui and Pāpāmoa areas, building on previous studies to enhance natural hazard mapping and strengthen risk management strategies for Tauranga City Council (TCC).

This updated assessment incorporates a reassessment of geomorphological features and geotechnical parameters to refine mapping to reflects current terrain conditions and slope behaviours.

The key updates include adjustments to the IDC slope zones for the following areas:

- Mount Maunganui and Pāpāmoa
  - Failure zone: **1.75H:1V** (reduced from 2H:1V)
  - Regression zone: **2H:1V** (reduced from 3H:1V)
  - Runout zone: **2H:1V** (reduced from 4H:1V)
- Hopukiore Mount Drury
  - Regression zone: **2.5H:1V** (reduced from 3H:1V)
  - Runout zone: **2.5H:1V** (reduced from 4H:1V)

These refinements recognise the significantly different geology and ground – groundwater conditions in the Mount (rock) and Papamoa (dune sands), compared to other areas of Tauranga District.

The slope hazard IDC zones support TCC's risk management strategies by improving public safety, fostering sustainable urban development, and strengthening Tauranga's long-term resilience to geotechnical risks. They also provide critical insights for key planning and policy initiatives, including:

- Land-use planning – Ensuring development is guided by updated hazard assessments to minimise exposure to slope instability.
- Resource and building consent evaluations – Supplying data for evaluating development proposals within identified hazard zones.
- Infrastructure resilience – Informing the design and maintenance of roads, utilities, and public spaces in areas susceptible to slope movement.

1 INTRODUCTION

Tauranga is a rapidly expanding regional centre with a growing urban area and planned investment in new growth areas, and a need to construct new infrastructure or upgrade existing infrastructure for improved resilience. The city has a unique geographical and geological setting that makes it prone to landsliding, particularly in response to rainfall and earthquake events.

Tauranga City Council (TCC) is aiming to improve the understanding and mapping of landslide hazards across the district, as part of a wider initiative to research, quantify and map a variety of major natural hazards affecting Tauranga to support initiatives to enhance the resilience of infrastructure and the built environment.

TCC has previously invested in landslide hazard mapping, supported by academic research and professional studies. Following significant storm events in the early 2000s, landslide hazard maps — commonly referred to as slope hazard maps or IDC zones — were developed. These maps are widely used by the council, accessible via MAPI, referenced in the Infrastructure Development Code (IDC), and included in Land Information Memorandum (LIM) reports.

Over the past two decades, advances in landslide science, updated datasets, and improved digital terrain models have emerged. To ensure the accuracy and relevance of the existing slope maps, TCC commissioned WSP New Zealand Ltd (WSP) to conduct a city-wide landslide study. The findings were published in two technical reports:1) Tauranga Landslide Slope Hazard (IDC Zones) Study - Technical Report (WSP, 2023a) and 2) Tauranga Landslide Susceptibility Study - Technical Report (WSP, 2023b), and provided an updated understanding of landslide hazards across the region. The WSP (2023a) report showed IDC zones used for the management of slope risk to land and property development, and the accompanying IDC maps used the same zone definitions as was developed in the early 2000s.

Since then, WSP was commissioned to carry out a review of the Mount Maunganui and Pāpāmoa suburbs, to supplement the WSP (2023) report. WSP has updated the IDC zone mapping methodology for these particular areas, through the consideration of additional geomorphological data, limited slope stability modelling, and reassessment of published ground investigations. The impetus for this work was the different geology in these areas compared to much of the rest of Tauranga. This addendum report supplements the WSP (2023) technical report, with a focus on the Mount Maunganui and Pāpāmoa suburbs.

1.1 SCOPE

The scope for this study includes the following item:

a) Review the slope hazard zones for the Mount Maunganui and Pāpāmoa suburbs, and reassess/revise if required.

b) Prepare an addendum report to supplement the WSP (2023a) technical report with associated maps for these areas.

c) Provide digital geospatial data for use of the Council’s geospatial database.

1.2 STUDY AREA

The study area for re-assessment for this amendment report is shown in Figure 1 and includes the Mount Maunganui and Pāpāmoa suburbs of Tauranga. We refer the reader to the WSP (2023a) report for the remainder of Tauranga City.

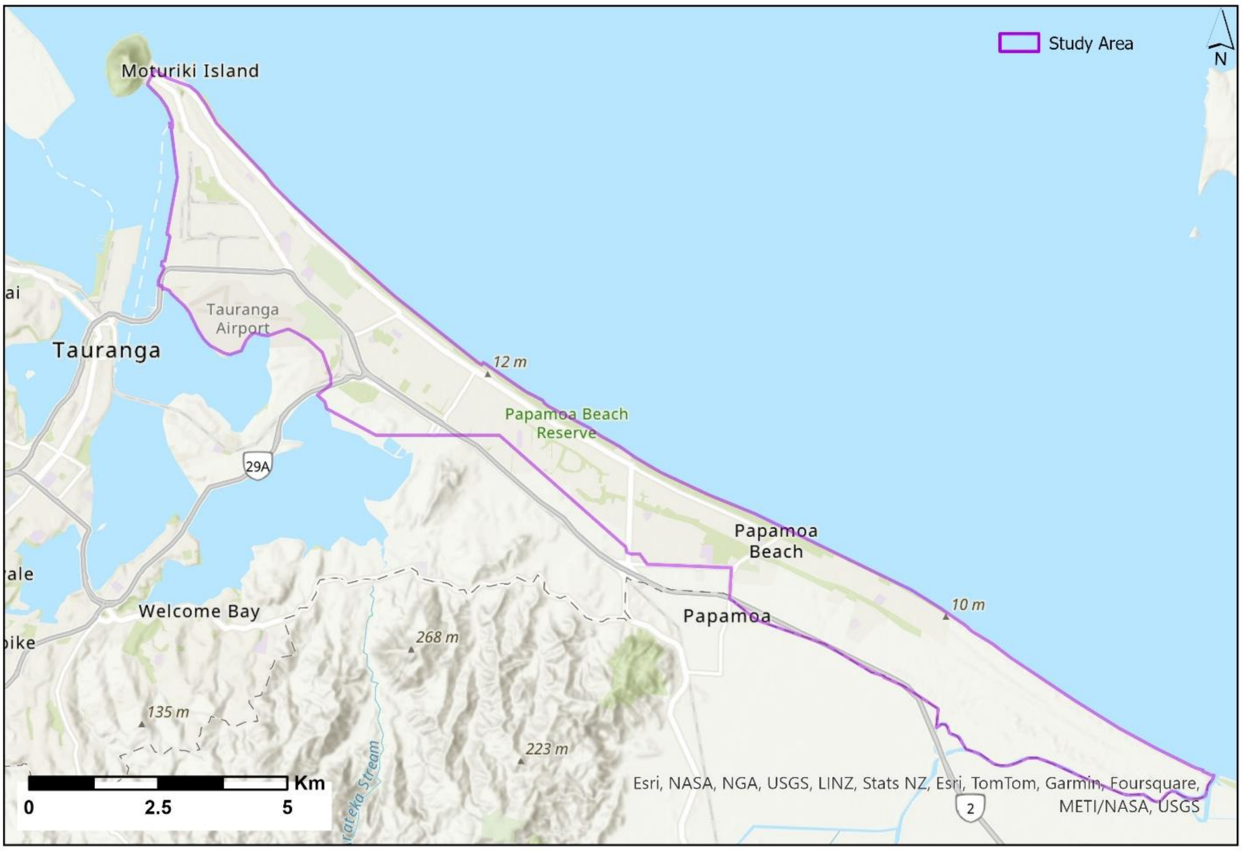

Figure 1: Study Area

1.3 REPORT PURPOSE

This is an addendum report providing an updated assessment of the slope hazard IDC zones and the updated maps.

This report should be read in conjunction with the Tauranga Landslide Slope Hazard (IDC Zones) Study Technical Report, dated September 2023 (WSP, 2023a).

2 STUDY METHODOLOGY

2.1 OUTLINE

The TCC IDC sets out requirements for managing slope hazards, including the accreditation standards that a ‘Geo-Professional’ must meet to carry out specific landslide risk assessments and mitigation.

Slope hazard zones (IDC Zones) were developed based on the relationship between slope height, angle, and landslide occurrence, calibrated for Tauranga using findings from Bell et al. (2001). The IDC zones (2H:1V, 3H:1V, 4H:1V) were generated by Explorer Graphics Ltd in 2002 through an automated process applied to a topographic model. The mapping was updated by WSP in 2023.

The three IDC Zones are described as below (refer to Figure 2):

1. 2H:1V / Failure Zone: this is the area where landslides typically begin, generally on moderately steep to steep slopes.
2. 3H:1V / Regression zone: this is the area typically upslope of a failure zone where if landslides are not identified and/or remediated, land in this zone may become more vulnerable to landslides over time.
3. 4H:1V / Runout zone: this is the land downslope of the failure zone which can be inundated with debris when a landslide occurs.

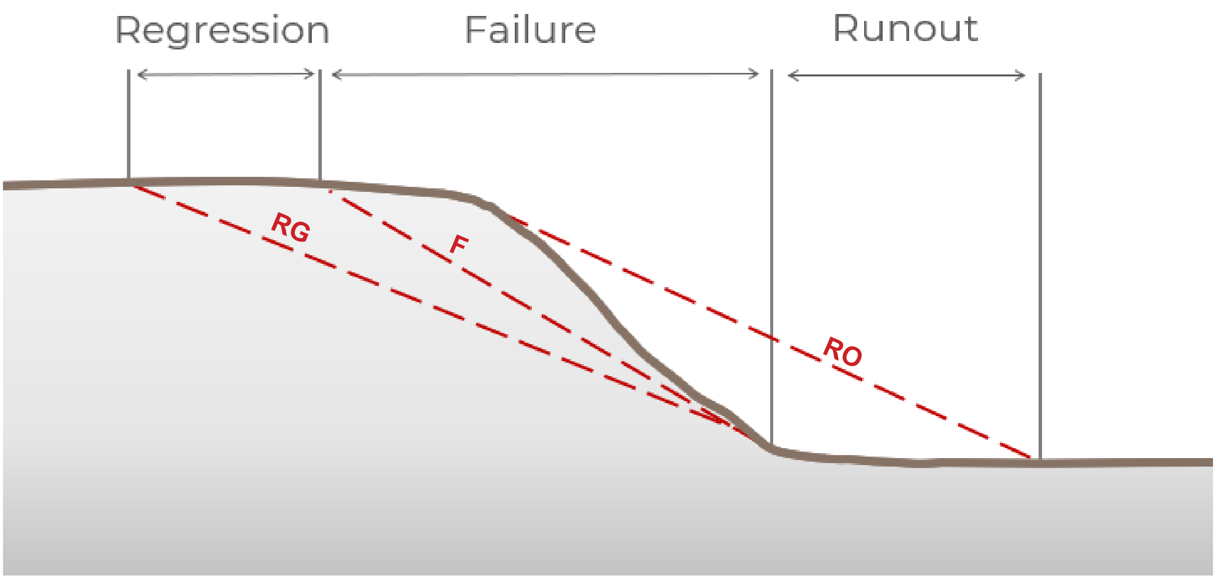

Figure 2: Schematic showing failure, regression and runout zones. Lines RG, F and RO, show the regression, failure and runout lines, respectively, on the slope.

Properties located within these zones also have a notice added to their LIM reports, to inform landowners of the potential landslide hazards affecting their property.

The primary objective of this study is to review and update the current slope instability maps within Mount Maunganui and Pāpāmoa areas that are used by TCC. The slope hazard zones used by TCC for development control were updated in this study.

2.2 DESKTOP REVIEW

An additional desktop review of available data, reports and research papers was undertaken for this re-assessment in order to understand the:

- Geological and geomorphic characteristics of the study area.
- Ground conditions of the study area.
- Typical slope features, including:
  - A review of the landform and geomorphology of Hopukiore Mount Drury, identifying possible debris / colluvium around the base and previous slope failure features (i.e. head scarps).
  - A review of the geomorphology at Te Tumu, identifying typical landform and dune morphology and possible slope failure features. Te Tumu was chosen as a study area as the typical sand landforms are largely unmodified.

The Tauranga City Landslide Study has been conducted at a city-wide scale (refer to WSP, 2023a), and therefore, the level of detail for this assessment has been adjusted accordingly.

2.3 GEOSPATIAL ANALYSIS AND SLOPE MODELLING

The approach used for updating the slope instability zones is described below:

- Generate slope angle and shaded relief (hillshade) maps in GIS, from a 0.25 m resolution digital elevation model (DEM) derived from LiDAR data captured in 2019-2022.
- Review of prevailing slope angles across the study area against the available landslide inventory collated for the previous stage of the study (WSP, 2023a; 2023b), to calibrate the geomorphic assessment of long-term stable slope angles in the local materials.
- Use of the visibility tool in ArcGIS Pro to model various length runout zones in the Hopukiore Mount Drury, Mount Maunganui and Pāpāmoa areas. These were calibrated against runout zones were identified from geomorphological analysis, where possible.
- Limited slope stability analysis was undertaken in Slope/W using ground parameters from nearby ground investigations to model assumed failure mechanisms and determine likely dimensions for slope failure and regression to underpin the slope zone review. Two cases were considered:
  - Case 1: Normal conditions. Static. Target Factor of Safety (FoS) 1.5.
  - Case 2: Storm event. Elevated groundwater. Target FoS 1.2.

2.4 SLOPE MAP ASSESSMENT

Using the desktop assessment, geospatial analysis and slope modelling, the slope failure, runout and regression zones for Mount Maunganui and Pāpāmoa areas were revised and the maps updated. The approach used for updating the slope instability zones is described below:

a) Review characteristics of slope failure, runout and regression in Mount Maunganui and Pāpāmoa areas.

b) Characterise the geomorphology of the study area and map points along the crests and toes of the slopes throughout Mount Maunganui and Pāpāmoa using the slope angle and hillshade maps and cross sections through the elevation dataset. The cross sections were drawn to ensure that variability in slope shape was captured accurately, typically at spacings of 50 m to 100 m depending on the complexity of the terrain.

c) Project failure (F) and regression (RG) lines upslope from the toe, and runout (RO) lines downslope from the crest, see Figure 2, by interrogation of the elevation dataset.

d) Draw polygons representing the slope failure, runout and regression zones by interpolating between the characteristic cross-sections using the hillshade maps and slope angle datasets to trace the boundaries of the zones.

2.5 MAPS

The key deliverable from this study is a GIS spatial overlay that delineate potential slope failure, runout and regression zones. Maps of the updated failure, regression and runout zones are provided Appendix A.

2.6 REPORTING

This addendum report was prepared to present the methodology, results and limitations of the slope IDC mapping.

3 UPDATED SLOPE ZONES

3.1 GEOLOGY AND GEOMORPHOLOGY

According to the 1:250,000 scale geological map of the Rotorua region (Leonard et al., 2010), the Mount Maunganui and Pāpāmoa areas are predominantly underlain by Holocene-aged (<11,700 years) ocean beach deposits. These deposits consist of marine-derived gravel, sand, and mud, typically associated with modern beach environments. The 1:50,000 scale geological map of Tauranga (Briggs et al., 1996) identifies the area as being largely underlain by Holocene fixed foredunes.

In the northwestern part of the study area, the hills of Mauao (Mount Maunganui) and Hopukiore (Mount Drury)are underlain by Minden Rhyolite.

The Mount Maunganui and Pāpāmoa areas reflect the dynamic coastal geomorphology of the Bay of Plenty, shaped by a combination of marine, fluvial, and volcanic processes. This region is characterised by a diverse landscape that includes coastal dunes, lagoons, swamps, estuaries, and alluvial plains. The geological evolution of the area has been significantly influenced by fluctuations in sea level and episodic volcanic activity during the Pleistocene and Holocene epochs (Leonard et al., 2010). These processes have resulted in the accumulation of a thick sequence of both loose and dense sediments, often accompanied by shallow groundwater conditions across much of the coastal zone.

Near-surface soils in these areas are typically composed of wind-blown dune sand. In between sand dunes are dune troughs that often contain interbedded layers of peat and organic-rich silts, reflecting periods of wetland development (Briggs et al., 1996). In some locations, thin layers of volcanic ash, originating from regional eruptions, are interspersed within the sand and organic deposits (Leonard et al., 2010). Anthropogenic influences, including urban development, agriculture, and land modification, have further altered the near-surface stratigraphy through processes such as excavation, filling, regrading and modification of surface water drainage.

3.1.1 HOPUKIORE MOUNT DRURY

Hopukiore Mount Drury represents an erosional remnant of biotite-rich rhyolite lava, geologically linked to the volcanic processes that formed Mauao (Briggs et al., 1996). The dome is predominantly composed of Minden Rhyolite, a fine-grained volcanic rock (Leonard et al., 2010).

Rhyolite outcrops are particularly prominent along the southeastern and eastern flanks, where the rock is exposed at the surface (Figure 3). Near the summit of Hopukiore Mount Drury, boulders are embedded within a matrix of soil. In other areas around the summit, as well as on the northern and western slopes, the terrain is covered by a variable layer of ash, rock, soil, and sand, the thickness of which is not clearly determined

At the base of Hopukiore Mount Drury, especially on the western side, colluvial deposits have accumulated. These deposits, comprising weathered rock fragments and volcanic material, reflect long-term geomorphic processes that have shaped the landform (Figure 4). The northeastern slope has been modified by anthropogenic activity, including terracing of the northeast slope, altering the natural slope profile.

Figure 3: Rhyolite rock outcrops on the southern side of Hopukiore (Mount Drury) (Source: Google)

Figure 4: Colluvial deposits accumulated at the base of the dome Hopukiore (Mount Drury) (Source: https://exploretauranga.co.nz/mount-drury-reserve/)

3.1.2 MOUNT MAUNGANUI AND PĀPĀMOA

The Mount Maunganui–Pāpāmoa coastal corridor is predominantly underlain by Holocene-aged dune deposits, characteristic of the Bay of Plenty's dynamic coastal environment. These dunes, formed by post-glacial aeolian processes, consist mainly of fine to medium sands with minor silt and shell fragments (Briggs et al., 1996; Leonard et al., 2010). Subsurface investigations (NZGD, 2025) indicate a typical stratigraphy of loose to medium dense sands near the surface, transitioning to dense sands or sandy gravels at depth, underlain by estuarine silts and sands.

Coastal processes such as longshore drift and progradation have shaped the foredune and backdune systems (Jenks & Brake, 2001; Dahm et al., 2005). The dunes typically form at or near the angle of repose (approximately 32° for uniformly-graded sand), with gentler slopes varying between the windward and leeward sides. The Te Tumu area includes vegetated dune faces exceeding 4 m in height, particularly near the Kaituna River (Figure 5). While vegetation enhances slope stability, these features remain sensitive to disturbance from human activity or increased water infiltration, which can trigger erosion or slumping.

Inland and southern areas of Pāpāmoa, particularly near the Kaituna River, exhibit more complex geomorphology. The landscape transitions from coastal dunes to fluvial and estuarine environments, with Holocene alluvial deposits including silts, sands, organic-rich layers, and interbedded peat; evidence of historical wetland and lagoon systems.

In urbanised areas like central Mount Maunganui and developed parts of Pāpāmoa, the natural dune morphology has been significantly modified through cut-and-fill operations, retaining structures, and engineered fill placement.

Figure 5: Sand dunes and the Kaituna River looking northwards from the Kaituna Cut to Te Tumu, Pāpāmoa (Source: Tauranga City Council)

3.2 TRIGGER AND FAILURE MECHANISMS

3.2.1 HOPUKIORE MOUNT DRURY

In areas such as Hopukiore Mount Drury, rhyolite slopes may be prone to localised failures, especially where weathered rhyolite interfaces with overlying volcanic ash or colluvial deposits. These zones are vulnerable to rockfalls and shallow landslides, particularly during periods of intense rainfall or seismic activity. During an intense rainfall event in January 2011 associated with Cyclone Wilma, Mauao experienced multiple slope failures (Martin & Brideau, 2014; NIWA, 2018). At least eight large landslides occurred on Mauao comprising of rhyolitic material and colluvium (Martin & Brideau, 2014). These failures were triggered by elevated pore water pressures resulting from the heavy rainfall.

Few earthquake-induced landslides have been recorded in volcanic materials in New Zealand in recent times. However, events such as the 1987 Edgecumbe and 2003 Rotoehu earthquakes demonstrate that moderate to strong shaking (MM VII–X) can trigger failures in similar settings (Hancox et al. 2004). Hopukiore Mount Drury's steep, rhyolitic slopes and colluvial cover suggest it could be susceptible under comparable conditions. International case studies (e.g., Kumamoto 2016 and Hokkaido 2018 earthquakes in Japan) show that landsliding in volcanic materials can have long runout distances and consequently large impacts (Chiaro et al, 2016).

Seismic shaking may also weaken slopes without causing immediate failure, increasing the risk of delayed landslides during subsequent earthquakes or heavy rainfall. This mechanism was observed following the 2016 Kaikōura earthquake (Mason & Brabhaharan, 2021).

3.2.2 MOUNT MAUNGANUI AND PĀPĀMOA

In coastal dune settings such as Mount Maunganui and Pāpāmoa, natural slopes typically form at or near the angle of repose, resulting in steep but generally stable profiles under undisturbed conditions. These dunes are composed of Holocene-aged fine to medium sands, with loose to medium dense sands near the surface overlying denser sands or sandy gravels at depth (Leonard et al., 2010; NZGD, 2025). The loose materials in the near-surface are most susceptible to disturbance and slope instability.

Slope failure in sandy soils occurs when driving forces exceed resisting forces, which are governed by the soil's friction angle, slope geometry, moisture content, and external loading (Das & Sobhan, 2017). Loose sands typically exhibit friction angles around 28°, while dense sands may reach up to 38°. When slope angles exceed these thresholds, the risk of failure increases.

Water plays a critical role in slope stability. While limited moisture can enhance apparent cohesion through capillary tension, excessive saturation (such as during storm events or elevated groundwater conditions) reduces effective stress and shear strength and increases the likelihood of failure. This was evident during the intense rainfall of January 2011, which triggered multiple slope failures, including some on saturated sandy soils and disturbed dune faces (Martin & Brideau, 2014; NIWA, 2018).

Urban development such as construction loading, retaining structures, and cut-and-fill earthworks can increase stress on slopes, particularly near dune crests. Without proper engineering, these modifications may lead to localised failures. This is further compounded by changes to drainage patterns caused by impervious surfaces, stormwater discharge, and landscaping practices, which may lead to instability.

3.3 TERRAIN AND SLOPE ANALYSIS

Based on desktop information additional high-level slope analysis was undertaken of the Mount Maunganui and Pāpāmoa area and is as described below.

3.3.1 DIGITAL ELEVATION MODEL (DEM)

A high-resolution Digital Elevation Model (DEM) was developed using LiDAR datasets acquired between 2019 and 2022, sourced from the Bay of Plenty Regional Council (BoPRC). The combined LiDAR DEM was sampled at a spatial resolution of 0.25 m, and provides detailed terrain information across the study area.

3.3.2 TERRAIN ANALYSIS

LiDAR data was utilised to define slope geometries across the study area. This dataset allowed the detection of topographic variations critical to understanding slope stability. Around Hopukiore Mount Drury, the LiDAR imagery revealed a distinct colluvial apron, especially prominent on the western flank. This can also be seen in historic aerial photographs. This accumulation of debris and weathered material suggests historical mass movement activity.

The DEM is used to delineate coastal dune systems in Mount Maunganui and Pāpāmoa, including areas where dune modification has occurred. Dune crests, slope angles, and relative dune heights are all identified from the DEM. Areas with steep and elevated dune faces are clearly distinguishable, providing insight into zones where slope failure or regression is more likely under saturated or disturbed conditions. Comparison between the slope angles and landslide susceptibility zones identified in the WSP (2023) landslide study show areas of moderate to high slope failure susceptibility correspond to slope angles between 28° and 40°.

3.3.3 SLOPE MODELLING

To assess slope stability under varying environmental conditions, numerical modelling was conducted using Slope/W, a limit equilibrium slope stability software. The Mohr-Coulomb failure criterion was applied for the evaluation of both static and transient (dynamic) conditions.

The primary objectives of the slope modelling were to:

- Undertake generic parametric analyses to characterise slope failures.
- Use the models to calibrate the assessment of where the failure and regression zones extend beyond the slope crest.

Both static and a storm event with elevated groundwater were modelled.

Characteristic cross-sections for Hopukiore Mount Drury and Te Tumu, Pāpāmoa, were developed using desktop assessments of ground conditions. Soil parameters were inferred from nearby ground investigation data available in the NZGD, or, where data was limited, from typical material properties associated with those soils and/or locations.

3.3.4 GIS

Using a combination of desktop data analysis, slope stability modelling results, and LiDAR, slope, and hillshade datasets, the Visibility Tool in ArcGIS Pro was applied to refine slope failure runout zones. Slope projections were adjusted where terrain features warranted modification,. Multiple runout lengths were simulated and calibrated against geomorphologically identified zones, informed by detailed slope morphology and terrain analysis.

Crest and toe points along slopes were mapped in GIS using slope angle maps, hillshade imagery, and elevation cross-sections. Cross-sections were generated at 50–100 m intervals, depending on terrain complexity, to accurately capture slope variability. Using elevation data, failure lines were projected upslope from the toe and regression lines downslope from the crest. Polygons representing slope failure, runout, and regression zones were then delineated by interpolating between cross-sections, guided by hillshade and slope angle datasets.

3.4 FINDINGS

Based on the modelling and terrain analysis, the following IDC zones are adopted:

- **Hopukiore (Mount Drury):**
  - Regression zone: **2.5H:1V** (reduced from 3H:1V)
  - Runout zone: **2.5H:1V** (reduced from 4H:1V)
- **Mount Maunganui and Pāpāmoa:**

- Failure zone: **1.75H:1V** (reduced from 2H:1V)
- Regression zone: **2H:1V** (reduced from 3H:1V)
- Runout zone: **2H:1V** (reduced from 4H:1V)

These adjustments reflect the slope behaviour in the different geology in these areas, based upon a desktop assessment for the purposes of a city-wide landslide study.

The updated runout zone for Hopukiore Mount Drury was reduced from 4H:1V to 2.5H:1V. The terrain is characterised by steep rhyolitic slopes overlain by a mantle of colluvium and volcanic ash, and the analysis indicated that slope instability in this area is primarily driven by shallow sliding of surficial materials, particularly under saturated conditions. While rock mass defects such as jointing and weathering are known to influence slope behaviour, they were not explicitly modelled. However, their presence likely contributes to localised rockfall hazards along exposed outcrops. The 2.5H:1V runout zone captures both landslide and isolated rockfall events, aligning with the geomorphological evidence of historical mass movement.

In the Mount Maunganui and Pāpāmoa areas, a revised failure zone of 1.75H:1V is adopted, to reflect the reduced failure extent appropriate for dune sands compared to the 2H:1V failure zone that was developed for failure in volcanic ash soils elsewhere in Tauranga. Similarly, a revised runout zone of 2H:1V has been adopted based on geomorphological assessment, slope modelling and failure angles in loose to medium-dense sands. Sand dunes exhibit steep, convex profiles and are sensitive to saturation and under storm conditions, shallow translational slides can evolve into fluidised flows, particularly where vegetation is sparse or where anthropogenic modifications have altered natural drainage. The regression zone was also updated from 3H:1V to 2H:1V, reflecting the progressive upslope failure behaviour in these systems where initial failures often trigger a chain reaction of slip events, especially during prolonged rainfall.

Maps of the updated failure, regression and runout zones are provided in Appendix A.

3.5 APPLICATIONS

The Tauranga Landslide Study report WSP (2023a; 2023b) provides applications of the landslide susceptibility and slope IDC maps in the context of Tauranga.

The Slope IDC maps developed for the Mount Maunganui and Papamoa are particularly applicable for management of risk associated with slope failures for property and land development.

3.6 LIMITATIONS

The updated failure, regression and runout zones have been produced at a city-wide scale using a desk-based approach with terrain data in a GIS platform. Limitations associated with this mapping are discussed below.

3.6.1 SCALE OF MAPPING

No site-specific data or analysis has been incorporated into the mapping of the failure, regression and runout zones. The mapping has been completed as part of a city-wide study, and the updated zone maps should not be used at scales greater than 1:5,000, or for site-specific assessments.

Mapping of the failure, regression and runout zones across the hillslopes required interpolation of the extent of the zones between the cross-section locations. This was carried out by engineering geologists, as GIS-based automated processing was unable to determine the zones adequately in areas of undulating terrain. The cross-section spacing was varied, with wider spacing for less complex slopes and a reduced spacing in areas of complex slopes.

Assessment and mapping of the zones will have inherent uncertainties, but these were limited by the use of high-resolution LiDAR terrain data, and sensitivity checking of the mapping at larger scales (approximately 1:1,000 to 1:2,000) on undulating or rounded slopes.

3.6.2 LOW HEIGHT SLOPES

Low height slopes (up to ~4 m) have not been captured in the updated failure, regression and runout zones as it was not practical within the scope of the study to capture all of the individual, small scale slope features.

3.6.3 ENGINEERED OR MODIFIED SLOPES

There are many engineered and treated slopes in Tauranga City, including cuttings, fills, and retaining structures built during residential development and as part of road and rail networks. The available terrain and property information used for mapping of the failure, regression and runout zones does not differentiate engineered slopes from unsupported natural slopes, and the city-wide nature of the study makes it impractical to assess whether each individual slope has been engineered and the standards to which the slope has been designed. Consequently, the mapping will have included engineered slopes in the updated zones.

3.6.4 RECENT GROUND LEVEL CHANGES

The elevation data used to map the updated failure, regression and runout zones was created from LiDAR data captured in 2019-2022. Given that earthworks associated with subdivision and land development are taking place across Tauranga City, changes in ground level that have occurred after the capture of the 2019-2022 elevation data will not be reflected in the updated zones. We recommend that the landslide zones are reviewed periodically as new elevation data is collected, and the zones updated in areas where earthworks have resulted in slope and ground level changes.

3.6.5 LANDSLIDE VOLUME

The volume of potential failures has not been considered as part of this study. The factors that determine the volume and runout characteristics of the landslide, and the consequent impacts on infrastructure in proximity to the slope, could be considered when looking at specific slopes as part of site-specific studies. This should be carried out as part of considering the risk posed to infrastructure or property at particular sites.

4 CONCLUSIONS AND RECOMMENDATIONS

4.1 CONCLUSIONS

TCC's IDC slope zones for the Mount Maunganui and Pāpāmoa areas were updated as part of this study. Updated failure, regression and runout slope zones have been mapped at a scale of 1:5,000. The key updates include:

- Mount Maunganui and Pāpāmoa
    - Failure zone: **1.75H:1V** (reduced from 2H:1V)
    - Regression zone: **2H:1V** (reduced from 3H:1V)
    - Runout zone: **2H:1V** (reduced from 4H:1V)
- Hopukiore Mount Drury
    - Regression zone: **2.5H:1V** (reduced from 3H:1V)
    - Runout zone: **2.5H:1V** (reduced from 4H:1V)

Maps of these zones are provided in Appendix A. It is anticipated that the updated zones will be added by TCC to LIM reports for properties in the Mount Maunganui and Pāpāmoa areas, superseding the existing ones.

4.2 RECOMMENDATIONS

Based on the results of the study, we make the following recommendations for consideration:

Application of the outputs of the study

- The updated IDC slope zones are used by TCC for resource and building consenting processes.
- The updated failure, regression and runout zones prepared as part of this study are added to the TCC GIS, superseding the previous zones.
- The IDC slope zone maps are used at a scale no greater than 1:5,000. A disclaimer should be included that the maps should not be displayed or considered at a larger scale, potentially as overlay text on the map.
- The IDC slope zones are reviewed periodically as new elevation and geotechnical data for the city is collected and updated in areas where there is new information.
- The IDC slope maps in conjunction with the landslide susceptibility maps (WSP, 2023a; 2023b) are used for emergency response planning by lifeline utility owners and TCC's civil defence and emergency management groups to plan their response.

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WSP, 2023a. Tauranga Landslide Slope Hazard (IDC Zones) Study - Technical Report. September 2023, ref: 2-9B441.00 / GER 2023/93

WSP, 2023b. Tauranga Landslide Susceptibility Study - Technical Report. September 2023, ref: 2-9B441.00 / GER 2023/92

LIMITATIONS

This report ('Report') has been prepared by WSP exclusively for Tauranga City Council ('Client') in relation to reviewing the slope mapping for Mount Maunganui and Papamoa ('Purpose') and in accordance with the WSP Offer of Service dated 12 April 2024. The findings in this Report are based on and are subject to the assumptions specified in the report and our Offer of Services dated 12 April 2024 ('Agreement').

Permitted Purpose

This Report has been prepared expressly for the purpose of reviewing the regional-scale assessment of the potential for landslide hazards to occur in for Mount Maunganui and Papamoa for Tauranga City Council ('Permitted Purpose'). WSP accepts no liability whatsoever for the use of the Report, in whole or in part, for any purpose other than the Permitted Purpose. Unless expressly stated otherwise, this Report has been prepared without regard to any special interest of any party other than the Client.

WSP accepts no liability whatsoever for any use of this Report, in whole or in part, by any party other than the Client. Unless WSP agrees otherwise in writing, any use or any reliance on this Report by a third party is at its sole risk without recourse to WSP. Third parties must make their own enquiries and obtain independent advice in relation to any matter dealt with or any conclusion expressed in this Report.

Qualifications and Assumptions

The services undertaken by WSP in preparing this Report were limited to those specifically detailed in the Agreement and the Report and are subject to the scope, qualifications, assumptions and limitations set out in the Report and/or otherwise communicated to the Client. Except as otherwise stated in the Report and to the extent that statements, opinions, facts, conclusion and/or recommendations in the Report ('Conclusions') are based in whole or in part on information provided by the Client and other parties ('Information'). The Information has not been and have not been verified by WSP and WSP accepts no liability for the reliability, adequacy, accuracy and completeness of the Information.

The data reported and Conclusions drawn by WSP in this Report are based solely on information made available to WSP at the time of preparing the Report. The passage of time; unexpected variations in ground conditions; manifestations of latent conditions; or the impact of future events (including (without limitation) changes in policy, legislation, guidelines, scientific knowledge; and changes in interpretation of policy by statutory authorities); may require further investigation or subsequent re-evaluation of the Conclusions.

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This study represents a regional-scale assessment of the potential for landslide hazards to occur across the Tauranga City area. This assessment has been completed through a review of desktop information, mapping and photography. It is not intended to precisely describe landslide risk on an individual property level. Actual risk for an individual property should be determined through appropriate investigations, analyses and reporting completed by a Tauranga City Council (TCC) Geo-Professional.

Disclaimer

No warranty, undertaking or guarantee whether expressed or implied, is made with respect to the data reported or the Conclusions drawn. To the fullest extent permitted at law, WSP, its related bodies corporate and its officers, employees and agents assumes no liability and will not be liable to any third party for, or in relation to any losses, damages or expenses (including any indirect, consequential or punitive losses or damages or any amounts for loss of profit, loss of revenue, loss of opportunity to earn profit, loss of production, loss of contract, increased operational costs, loss of business opportunity, site depredation costs, business interruption or economic loss) of any kind whatsoever, suffered or incurred by a third party.

APPENDIX A

UPDATED IDC SLOPE MAPS FOR MOUNT MAUNGANUI AND PĀPĀMOA AREAS

Figure:

IDC Landslide Management Zones

Prepared For: Tauranga City

Project:
Tauranga Landslide Study
2-9B441.01

Prepared By: wsp

Date:
July 2025

Sheet:
Page 2 of 15

Legend:

IDC Slope Zones
- Failure Zone
- Regression Zone
- Runout Zone
- Study Area - 2025 Update
- Refer to 2023 Report

0 0.23 0.45 0.9 1.35 1.8 Km

Scale: 1:20,000 at A3

Notes:

This map is intended to be viewed in association with the Tauranga Landslide Study Technical Report. This study is a district-wide assessment and does not account for property-specific ground conditions. The recommended scale of usage for this map is between 1:5,000 and 1:25,000.

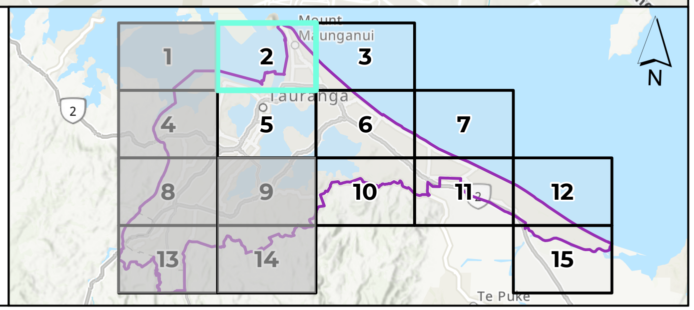

Figure:

IDC Landslide Management Zones

Legend:

IDC Slope Zones

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- Regression Zone
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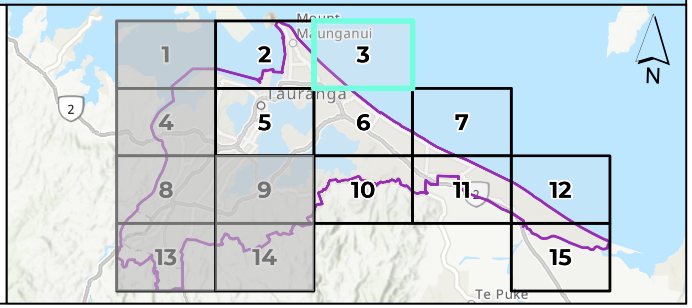

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wsp

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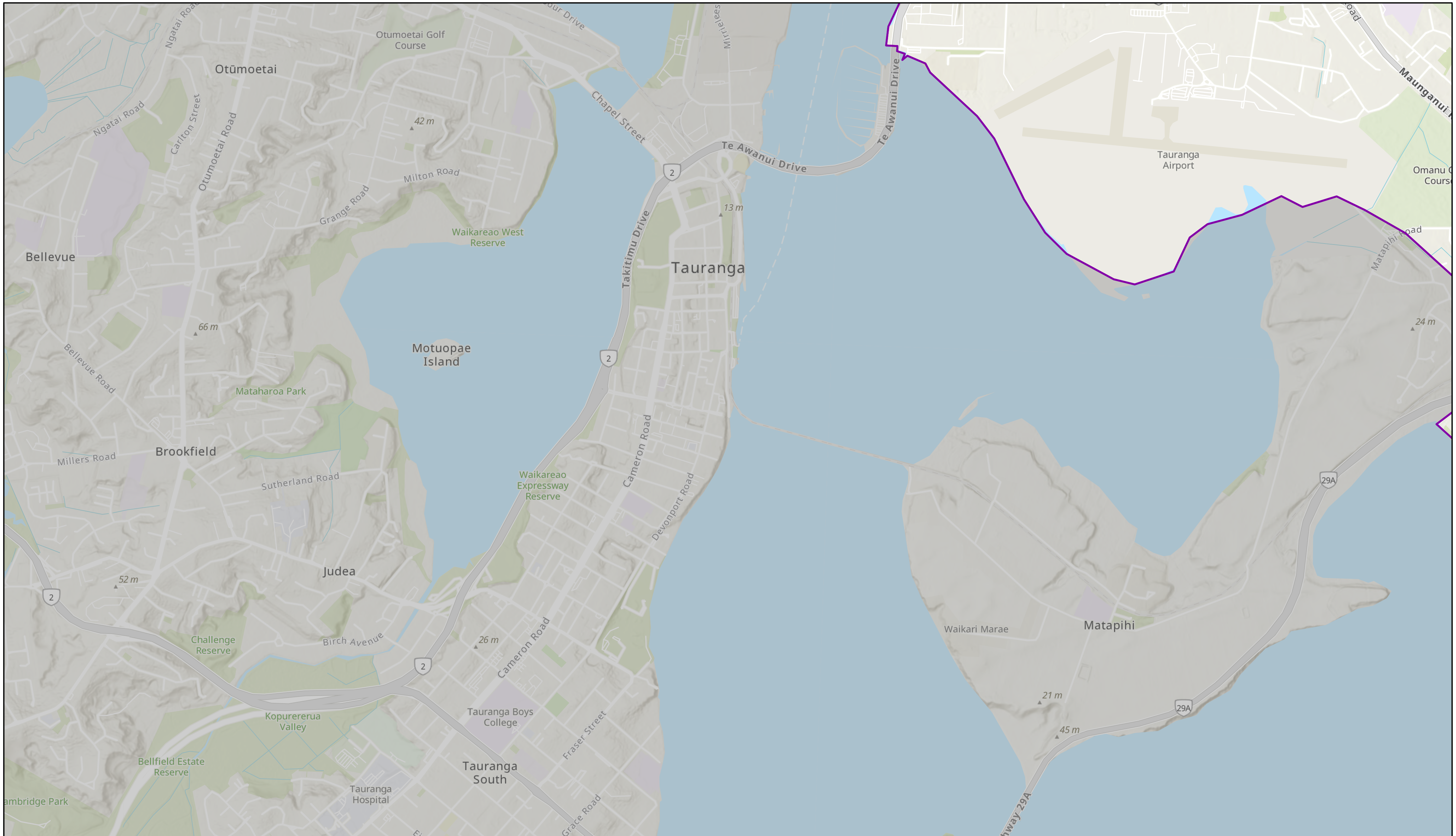

Figure:

IDC Landslide Management Zones

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Project:
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2-9B441.01

Prepared By: WSP

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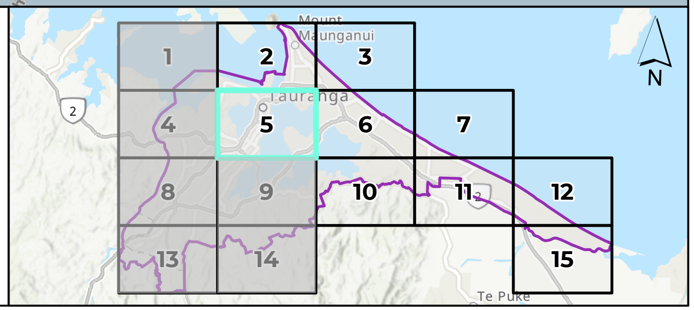

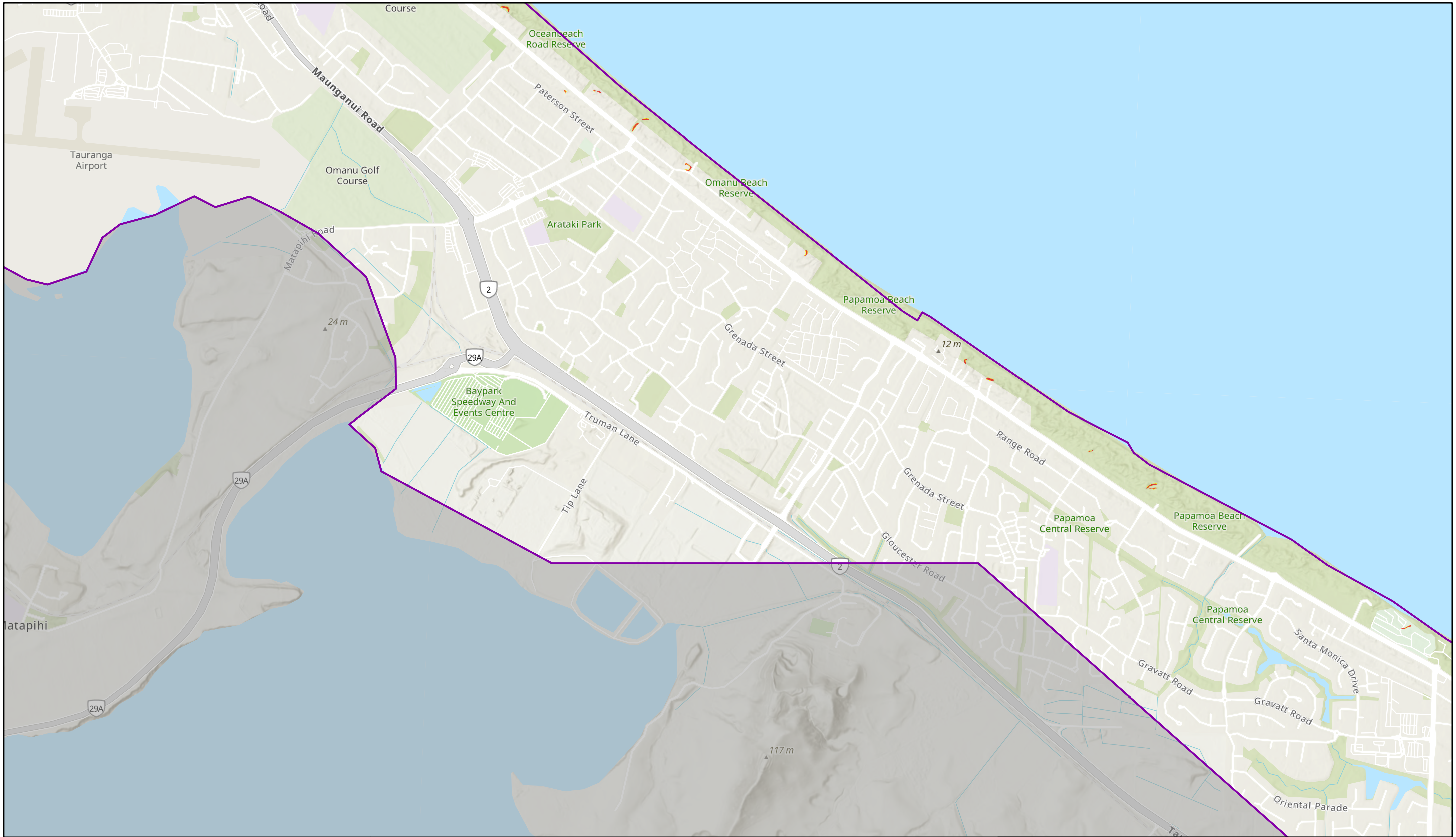

Figure:

IDC Landslide Management Zones

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Prepared By:

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Project:

Tauranga Landslide Study
2-9B441.01

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July 2025

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Legend:

IDC Slope Zones

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- Regression Zone
- Runout Zone
- Study Area - 2025 Update
- Refer to 2023 Report

0 | 0.23 | 0.45 | 0.9 | 1.35 | 1.8 Km

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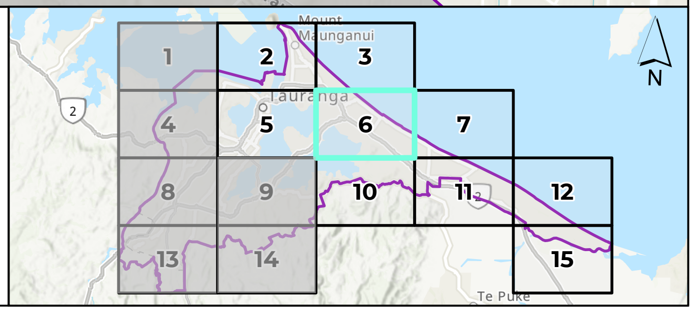

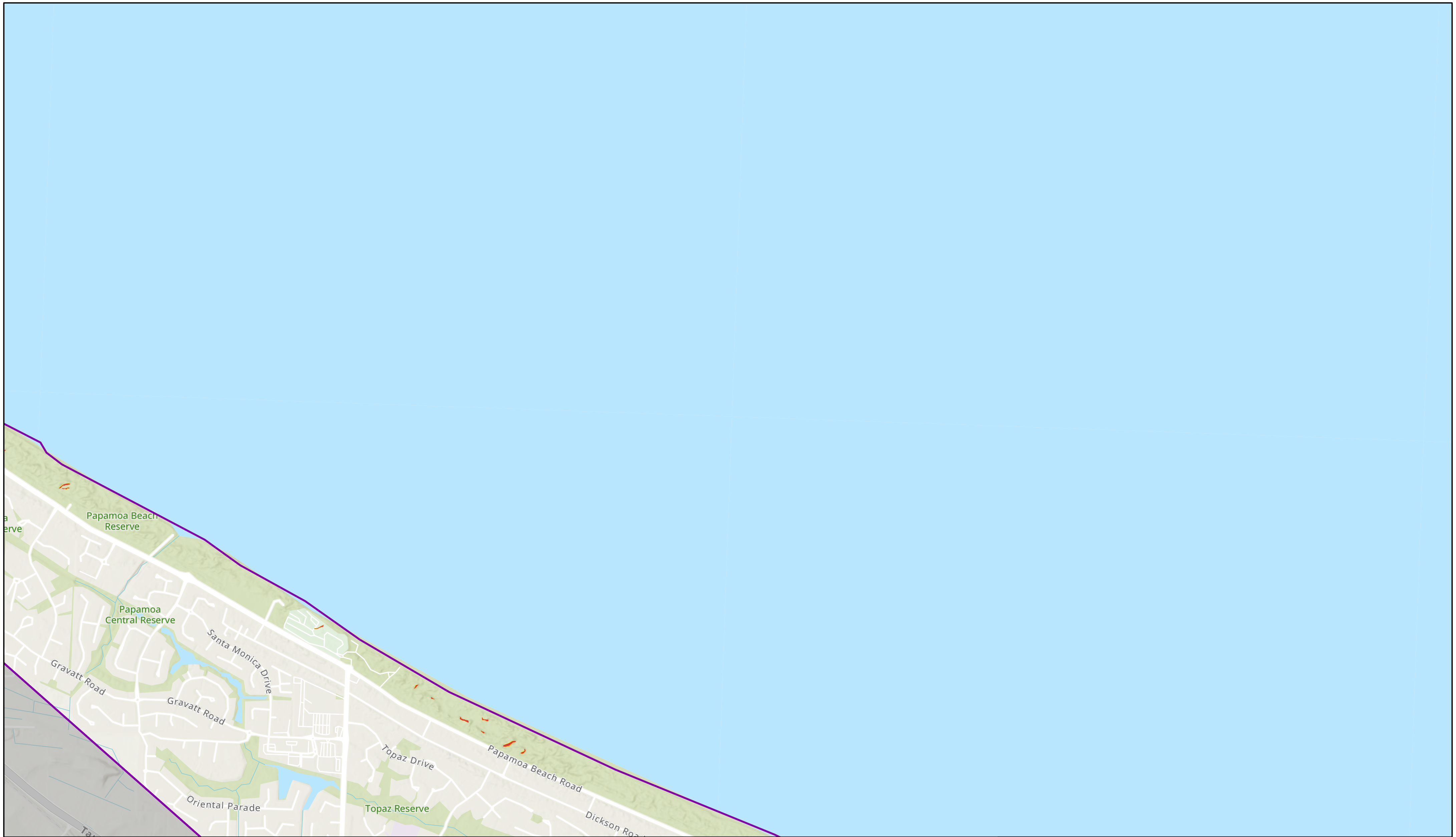

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IDC Landslide Management Zones

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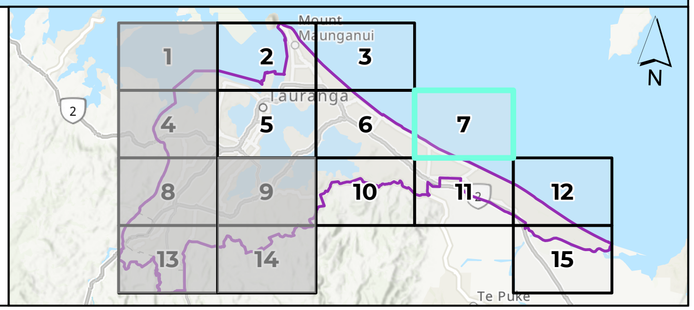

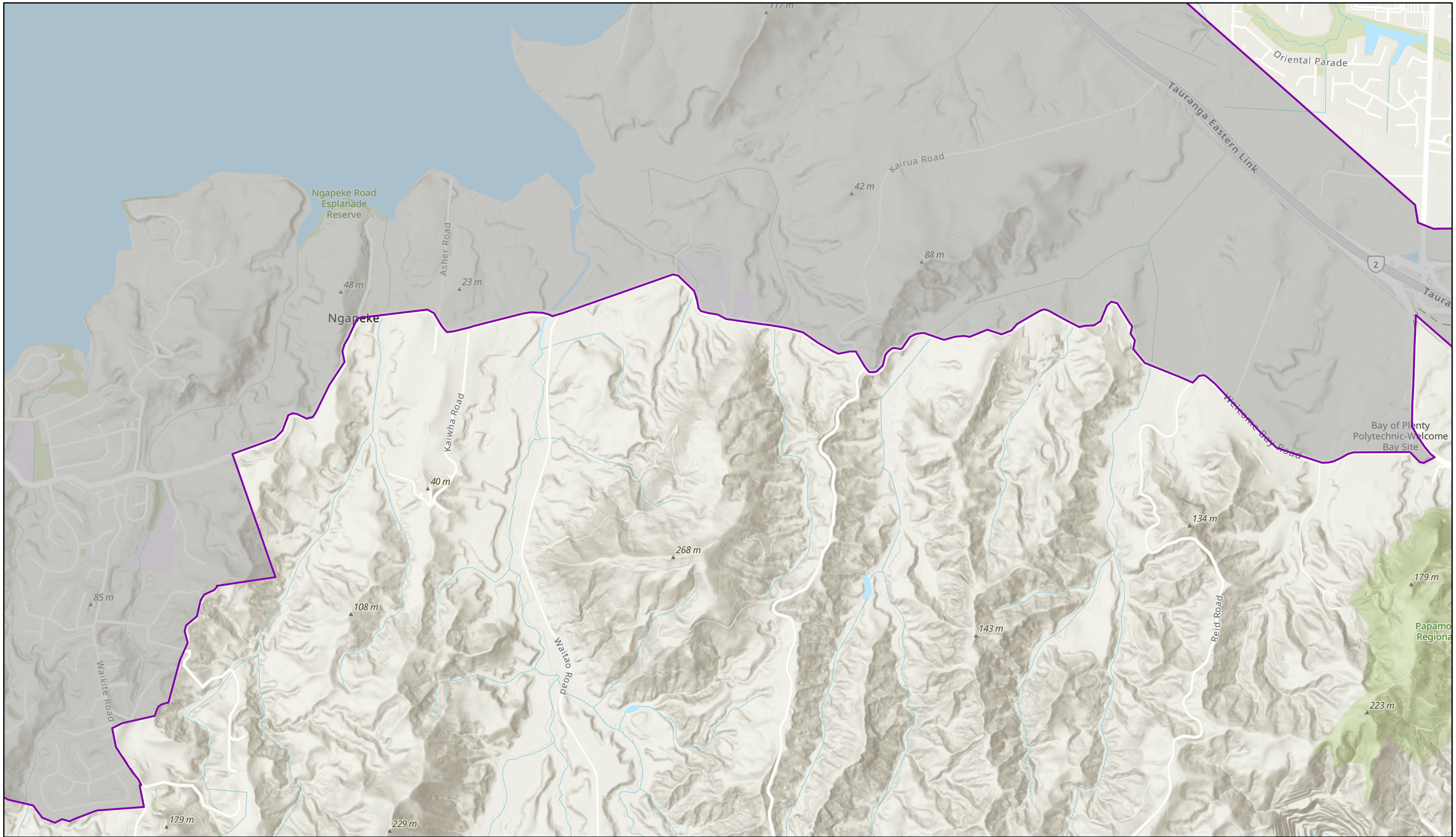

Figure:

IDC Landslide Management Zones

Prepared For: Tauranga City

Project:
Tauranga Landslide Study
2-9B441.01

Prepared By: wsp

Date: July 2025

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Legend:

IDC Slope Zones
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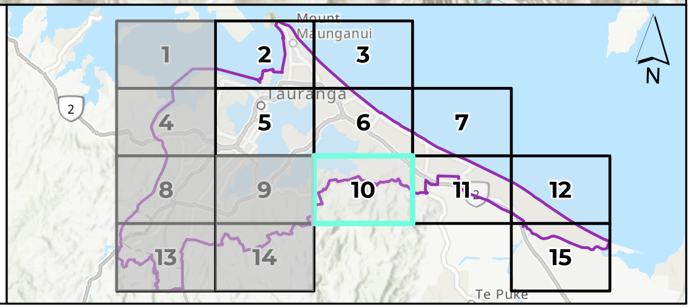

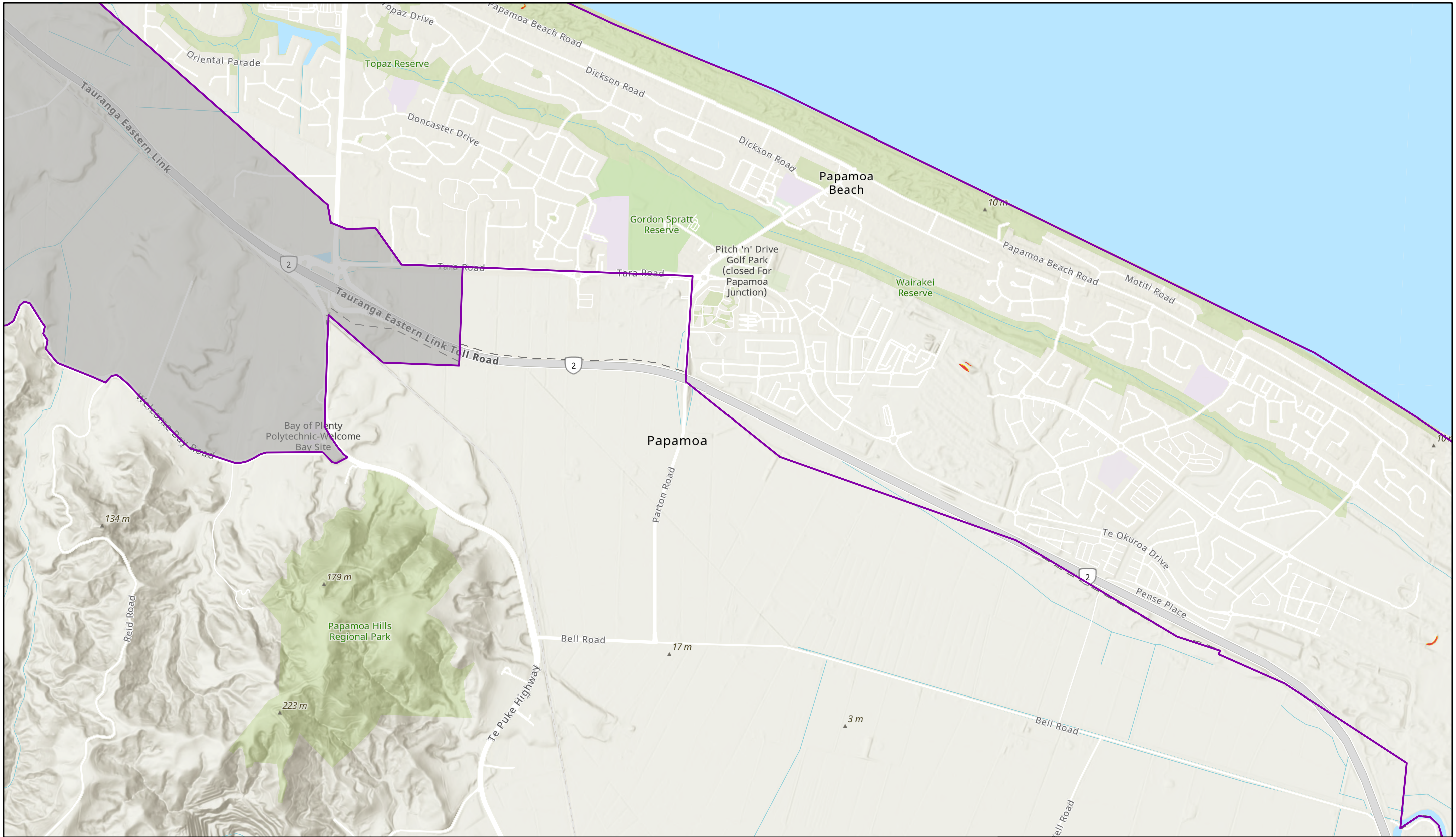

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Tauranga Landslide Study
2-9B441.01

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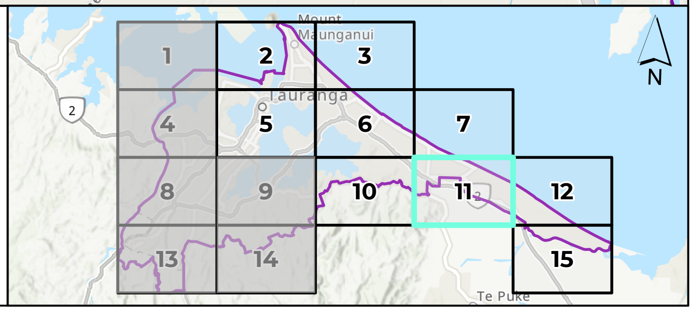

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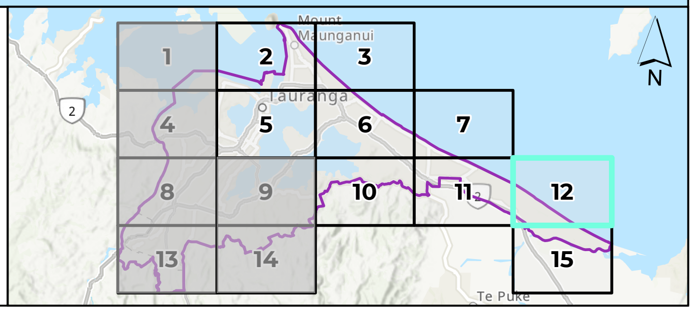

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