

# Flood Risk Categorisation, Ex-Tropical Cyclone Gabrielle Impacted Areas: Addendum (Category 3 areas other than Pakowhai)

• Prepared for

Hawkes Bay Regional Council

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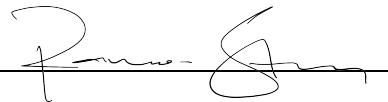
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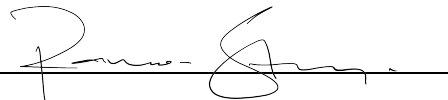
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## Executive Summary

Over the course of 13 and 14 February 2023 parts of the Hawkes Bay Region were, along with the other parts of Te Ika-a-Māui/ the North Island (including neighbouring Tairāwhiti), impacted by ex-Tropical Cyclone Gabrielle (ETC Gabrielle).

In some places ETC Gabrielle caused catastrophic damage and resulted (in the Hawkes Bay region) in the loss of 8 lives; the economic impact has yet to be fully determined but will be substantial and will be felt well beyond 2023. Following the event central Government, through the office of the Cyclone Recovery Minister, asked councils in those impacted areas to “build a picture of high-risk areas following Cyclone Gabrielle”<sup>1</sup>, including categorisation in accordance with specified criteria. The primary consideration with this task is the location of the residential properties that were most impacted – where risk to life is intolerably high and where the ability to mitigate practically/ cost-effectively appears to be limited.

Risk to life with future events on a scale comparable to ETC Gabrielle can be articulated in general terms but is difficult to codify with little national guidance. Factors such as flood depth and velocity are common risk assessment considerations but the picture for Hawkes Bay is much more complex than that – other factors such as the rate of rise of the floodwaters, and entrained silt and debris loads are also important.

Catchment locations and characteristics are also important hazard considerations, as is topography. An example of the latter is the Dartmoor Road Category 3 area – the ridge on the south side of the river that directs/ concentrates flood flows in such a way that the likelihood of very similar catastrophic impacts with future extreme weather events is high.

Category 3 areas identified for Hawkes Bay broadly fit two contexts – valley floors and floodplain bounded by major lowland rivers where stopbanking contains/ impounds breach discharges (ie the Pakowhai area between the lower reaches of the Tutaekuri and Ngaruroro Rivers). Narrow, incised valley floors are a particular risk where the valley sides concentrate floodwater, compounded by high debris loads - debris dams progressively forming and releasing, stripping away riverbank vegetation as the flood peak proceeds downstream.

The focus of the revised mapping has been on confirming the Category 3 boundaries - the lower sections of the Aropaoanui and Te Ngarue (Tangoio) valleys, the lower Esk, Mangaone at Rissington, Tutaekuri true left berm west of Puketapu and opposite Waiohiki, and Ohiwi Stream immediately upstream of

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<sup>1</sup> 1 May 2023 Beehive press release.

Taihape Road. Note that the Pakowhai Category 3 area is covered in a separate report.

Feedback from those impacted has been a key component associated with the modifications to the Category 3 boundaries from the preliminary mapping released in June – in general those in Category 3 who would prefer not to be and those not in Category 3 who want to be. The changes to the Category 3 boundaries are, for the most part, relatively minor and generally related to the margins. In some cases (particularly the Esk) the amendments largely reflect a better match to the extents of the valley floor - with others the changes reflect the inherent challenges of defining the core risk area where the hazard decreases gradually and is not clearly defined by topographical features.

In any other context determining such hazard areas would take a number of years - the development of comprehensive numerical hydraulic models and a detailed, granular assessment of the event impacts. Those timelines are not compatible with the understandable need those impacted have for certainty and to meet that need the mapping is an amalgam of applied value judgements based on contextual factors and some of the broad considerations outlined in the report, informed by a range of different datasets.

Category 3 signifies not only the scale of the hazard/ risk to life but also the limited ability to mitigate that hazard. In many ways that is self-evident – the sheer scale of the destruction evident particularly for the likes of the Esk and Rissington – but valley confinement combined with high sediment and debris loads (the short shelf life stopbanking would have as berms rapidly build with deposited silt) is an inescapable constraint. The exception is the Tutaekuri berm off Dartmoor Road where stopbanking is already present (and was so comprehensively overwhelmed with ETC Gabrielle). The particular characteristics of this area suggest possible mitigations are unlikely to adequately/ robustly address the hazard in extreme events.

## Table of Contents

SECTION	PAGE
<b>Executive Summary</b>	<b>i</b>
<b>1.0 Introduction</b>	<b>1</b>
<b>2.0 Flood Impact Summary</b>	<b>2</b>
<b>3.0 Defining Unsafe in a Flood Hazard Context</b>	<b>3</b>
<b>4.0 Categorisation Framework</b>	<b>5</b>
<b>5.0 Revised Category 3 Boundaries</b>	<b>5</b>
<b>6.0 Mitigation Approaches</b>	<b>6</b>

## Appendices

Appendix A: HBRC Land Categorisation Methodology

Appendix B: Feedback from Pakowhai Residents

## 1.0 Introduction

PDP have been engaged by Hawkes Bay Regional Council (HBRC) to review, collate and summarise flood hazard categorisation/ mapping undertaken following the Ex-Tropical Cyclone Gabrielle weather event (ETC Gabrielle) that occurred in February 2023. ETC Gabrielle impacted Hawkes Bay to varying degrees, with rainfall largely concentrated in the northern and central parts of the Region, resulting in catastrophic impacts to a number of communities.

Those impacts have been categorised in accordance with the definitions contained in Appendix A - this report focusses on those Category 3 areas excluding Pakowhai (the subject of a separate report). That separation is based on compatible hazard types – difference between the broad flood plain between the lower reaches of the Tutaekuri and Ngaruroro Rivers that is Pakowhai and the other largely valley floor contexts.

Those areas typically have a documented history of flooding. A commonly cited reference publication in regard to historic recorded floods is Flood in New Zealand 1920 – 1953 (With notes on some earlier floods) published in 1957 by The Soil Conservation and Rivers Control Council, a now defunct central Government entity. It covers the country by region from north to south, noting in the Hawkes Bay chapter numerous large historic floods dating back to 1867 including the 1938 floods, the most significant recorded event behind ETC Gabrielle.

Flow patterns/ mechanisms associated with ETC Gabrielle are recognisable with the with past events that are described in that report eg “the Tutaekuri also broke it's south bank at Puketapu and flowed over the Moteo area towards Omahu”. With that same event (March 1924) it describes how “the Esk River rose quickly to levels 4 to 5 ft. higher than previous records, and in one place soared 6 ft. in fifteen minutes”. It also notes that “two houses were washed away at Tangoio”. The July 1927 event notes the “destruction of the Rissington Bridge”.

In some areas flood impacts have been compounded by the 1931 earthquake effects – the coastal uplift that occurred particularly around Whirinaki – and accordingly those impacts are mainly centred on the lower reaches of both the Esk and Te Ngarue valleys.

8 people lost their lives in the Hawkes Bay region as a result of the ETC Gabrielle weather event. The technical work summarised in this report does not presuppose or speculate on the circumstances of those deaths which will presumably be the subject of a future formal coronial enquiry. Such a formal enquiry would be beneficial to informing this technical work but such enquiries may be years away; like many other aspects circumstance and the need for certainty has dictated the order and speed of events.

## 2.0 Flood Impact Summary

Note that this summary is not a complete summary of the impacts to Hawkes Bay with ETC Gabrielle – it focusses solely on the impacts to the Category 3 areas addressed in this report.

A number of catchments associated with the catastrophic damage that occurred on 14 February have their headwaters in the Maungaharuru, Te Waka and Maniaroa Ranges, a distinct topographical feature that forms a gradual arc in northern Hawkes Bay. The resulting orographic effects (particularly the position and orientation of the ranges) appear to have amplified the effects of ETC Gabrielle, consistent with the rivers that have their headwaters in those ranges (the Esk and the Mangaone).

Those orographic effects diminish somewhat further south, although flows from Ohiwa/ Ohiwi Stream (a tributary of the Ngaruroro that joins at Fernhill) appear to have been a significant factor with the multiple overtopping initiated stopbank breaches of the Ngaruroro true left stopbank around and east of Omahu.

Impacts to the lower reach of Te Ngarue Stream (Tangoio) vary, suggesting unlike many other areas ETC Gabrielle may not have been the largest event since records began in the mid to late 1800's, consistent with the smaller size and more coastal nature of the catchment. Storm surge/ sea conditions were a particular factor, exacerbating flood impacts closer to the coast. Like most other areas silt and debris deposition during the event was significant.

Impacts to the lower Esk valley during ETC Gabrielle were arguable the most visible and extreme of the event, with a number of houses moved off their foundations by the force of the floodwater. Analysis by the University of Canterbury concluded that the ETC Gabrielle event resulted in the deposition of 2.7M tonnes of sediment over the lower 5km of the valley floor alone. Not unexpectedly the impacts of the event generally lessened toward the valley margins.

The direct impacts of the flood in the Mangaone River were concentrated on Rissington, literally burying a number of houses in silt. Residents have provided extraordinary descriptions of the flood, noting the stepped escalation of the flood attributable to multiple debris dams forming and breaking as the flood wave propagated downstream.

Flows from the Mangaone catchment were a major component of the inundation that occurred to properties along Dartmoor Road west of Puketapu. The worst of those impacts were centred approximately 3km west of Puketapu, where a ridge on the south side projects north toward the Tutaekuri River. With ETC Gabrielle that ridge directed flood flows travelling along the right berm of the river across the main channel, overwhelming the stopbanks on both sides of the river and severely impacting a number of properties located on the left berm between Dartmoor Road and the river.

Significant/ notable flood flows occurred in the Ohiwi Stream (labelled as Ohiwa Stream on topographic maps but referred to by local residents as Ohiwi Stream) on 14 February, likely a particular function of the catchment size and the particular characteristics (spatial and temporal distribution of the rainfall) of ETC Gabrielle. A new subdivision off Ohiti Road (not currently identified as Category 3) and a new home located off Taihape Road (identified as Category 3) were flooded; the stopbank located between the house and the stream was overwhelmed with ETC Gabrielle. Note that in this instance the stopbank was part of a drainage scheme and accordingly the level of protection was less than the typical 1% Annual Exceedance Probability (AEP) protection standard for HBRC flood protection schemes.

### 3.0 Defining Unsafe in a Flood Hazard Context

Risk to life is clearly the primary consideration in categorising hazard type based on ETC Gabrielle impact and that approach is adopted for this assessment. That's defined as a function of:

- ∴ The maximum depth and rate of rise of floodwater;
- ∴ How swift or otherwise the floodwater was;
- ∴ How quickly a river rises and overtops its banks (how much warning those living close to a river might have that a flood is imminent) and how accessible safe egress is for those potentially impacted;
- ∴ The volume of silt and debris entrained in the floodwater;
- ∴ Particular geographic features that exacerbate the hazard e.g. valley confinement;
- ∴ How apparent the hazard is to those potentially impacted. That encompasses understanding/ awareness of the hazard (which will inevitably decline with time following ETC Gabrielle) but also whether the connect between the flood source and where people live is clear (whether their level of exposure is obvious or not);
- ∴ The complexity of the flood hazard.

Some of the ETC Gabrielle impacts will be unique/ specific to that event. Others follow a pattern from past events and accordingly have a high likelihood of being repeated (in the absence of any interventions) with future extreme events, an important consideration with any risk assessment.

Stopbank breach pattern (plan view) is an example – the breach pattern in a future extreme flood event is, in general, likely to look different from that experienced with ETC Gabrielle, for a range of reasons. In some instances (notable the Dartmoor Road area west of Puketapu) a similar event is likely to lead to a similar outcome due to particular topographical features.



Equally areas close to the coast (Esk, Tangoio) are influenced to some degree by river mouth conditions and those conditions are likely to differ from event to event (a lower level of confidence as to the repeatability of the characteristics associated with the ETC Gabrielle event).

Other factors that influence and that are potentially subject to change over time but not able to be predicted with any certainty at the current point in time include the future configuration/ standard of flood defences and bridge crossings (the exacerbating effect that many bridges had on flooding with the ETC Gabrielle event). Clearly it would be desirable for any new bridges to be built to a standard sufficient to allow unimpeded passage of a ETC Gabrielle type event and for that to be done in a manner that complements the Region's flood defences.

The areas identified solely relate to flood hazard and do not include other forms of natural hazard such as land instability, seismic-related hazards (liquefaction/lateral spread) or coastal hazards (inundation and/ or erosion). The mapping does not account for climate change effects – sea level rise and the change in flood frequency relationship for the region's rivers over time – nor future earthquake-related impacts.

A range of data sources have been used to define the Category 3 areas identified in this report, a key one being the rapid assessment categorisation of impacted properties (dwellings that were either red or yellow stickered - prohibited and restricted access respectively reflecting the levels of impact). The mapping is also informed by:

- ∴ Contour information derived from LiDAR data collected in November 2020;
- ∴ Aerial photography taken following the event;
- ∴ Information received from the public and various meetings with flood-affected homeowners.

The assessments are not informed by any specific flood modelling and are based solely on ETC Gabrielle observed/ recorded impacts. While there are some limitations with that approach (impacts specific to that event – the particular temporal and spatial characteristics of ETC Gabrielle) those limitations are substantially outweighed by the advantages of basing the assessment on an actual extreme event (the inherent limitations associated with theoretical/ model-based assessments).

The ETC Gabrielle event will almost certainly lead to a comprehensive review of approaches to flood protection and protection standards for impacted communities, work that will inevitably be involved, complex and time-consuming. The demand for certainty in a timely fashion from those impacted is understandably high, posing a very difficult challenge in determining whether the

issues so graphically highlighted with Gabrielle are resolvable or not well in advance of that more detailed technical work, requiring further value judgement in that regard.

#### **4.0 Categorisation Framework**

Categorisation follows the criteria outlined in Appendix A.

What constitutes an acceptable level of residual risk in a flood context is inherently very complex and subjective, a function of those risk to life factors identified earlier and the nature of any flood defences. With the latter specifically the reliability/ robustness of any flood defences, their gross protection standard and their ability to cater for events that exceed that design standard.

Value judgements are inevitably applied based on generally accepted 'norms' that relate to both flood protection standards and residual risk in a national context – what constitutes an acceptable level of flood risk in a broad sense. That's generally accepted as a 100 year Return Period/ 1% Annual Exceedance Probability protection standard but that's equally a far from complete definition of what's acceptable/ tolerable in regard to residual risk.

There are, for a multitude of reasons (affordability being one – Wairoa being a prime example in northern Hawkes Bay where the town has a high level of exposure to flooding and no flood defences), many exceptions to that and a wide spectrum of protection standards exist around the country, one of many reasons why flood protection resists 'codification' at a national level.

Judgements around what constitutes an acceptable level of risk/ residual risk (where flood defences exist) in a flood hazard context is further complicated by the fact that what constitutes a 1% AEP event is constantly evolving as river flow records continue to lengthen with time, without accounting for either climate change effects or natural processes that cause protection standards to vary over time. Protection standards for Hawkes Bay's major river systems will alter with ETC Gabrielle added to the flow record – by how much is the subject of a separate piece of technical work currently underway.

#### **5.0 Revised Category 3 Boundaries**

The effects to those lower Esk valley and Rissington properties are catastrophic by any measure and represent the upper end of the Category 3 spectrum. Considerations for these areas have largely been the properties at the margins – the extent of the impacts and availability/ accessibility of safe egress. Timelines with the original June reporting did not permit refinement of the maps to better match topography – this confirmed version has more precision in regard to valley floor extents and has provided the time for a number of individual conversations with impacted property owners.

For Rissington the Category 3 area has been revised to cover just the left berm, capturing all of the residential houses on that side of the river. The lodge was considered less impacted with ETC Gabrielle (protected to some degree from the full impacts due to its location and elevation) and has safe egress.

Dartmoor Road follows in regard to that spectrum of impact – discussion has centred on whether properties on the margins (the 2C\* area on the north side of Dartmoor Road and the 2A areas east and west of the original Category 3 area) should be included. The revised mapping extends the Category 3 boundary both east and west but retains Dartmoor Road (more or less) as the northern boundary.

Ohiwi at Taihape Road is an additional Category 3 area reflecting the very exposed nature of this house and the absence of safe egress (the Ohiwi Stream lies between the house and the hill to the north-east. A property located along Springfield Road adjacent to Waiohiki has also been added.

The Category 3 area for Aropaoanui remains unchanged from the June report. Te Ngarue/ Tangoio remains largely unchanged, with the notable edit being the removal of the Pakuratahi arm as a result of submissions and discussions around the scale of the hazard. The basis for that amendment included the nature of the flooding (relatively low velocities – backwater from the Te Ngarue) and the correspondingly low debris/ entrained silt volumes with the floodwater.

## 6.0 Mitigation Approaches

Mitigation options for these Category 3 areas are, by implication, limited. Relatively narrow valley floors concentrate flooding, increasing the depth and speed of the floodwaters, factors that directly impact risk to life. The particular characteristics of the Esk and Mangaone catchments identified earlier further amplify that risk. ETC Gabrielle has demonstrated that when those concentrating effects are combined with high sediment and debris loads communities in the path are essentially unprotectable.

Significant stopbanking would be required to protect relatively narrow corridors of land with very high residual risks. Stopbanks would also confine/ concentrate sediment deposition to the stopbanked river corridor – protection standards would diminish relatively rapidly with that deposition.

Detention as a mitigation approach (flood storage dams in the upper catchment) for the likes of the Esk and Mangaone is fraught with difficulty. The nature of the catchment requires many small dams and while there are precedents for that in New Zealand (eg the detention dams located around Hunterville) the challenging geology, high seismic environment and very high sediment loads (the dams would rapidly fill with sediment) give detention as a mitigation option a very poor cost/ benefit ratio.

Dartmoor was slightly different to both the lower Esk and Rissington, having existing stopbanked protection. As noted earlier however the particular topographical characteristics of the Tutaekuri valley saw flood flows concentrated/ directed at houses with ETC Gabrielle. The ability to engineer a protection scheme to such a standard to adequately address that risk with future extreme flood events is not seen as realistic.

Mitigation in the form of warning systems has been the subject of a number of discussions with affected residents - in many cases the hazard is just too high for warning systems to be a reliable means of safeguarding against loss of life. That's a function of the stress that such events inevitably exert on communication systems, the wide range of age/ awareness/ mobility in the population and the significant difference between an event occurring during the day (largely the case with ETC Gabrielle) and at night.

Perhaps most significantly 85 years elapsed between the 1938 event and the 2023 ETC Gabrielle event. Even comprehensive systems will become problematic and prone to malfunction with such infrequent operation. Ex-tropical cyclone impacts to the eastern parts of Te Ika-a-Māui are amongst the most difficult weather to forecast for the country (pers. comm with MetService staff) - slight changes in speed/ track have a significant bearing on what part of the region is impacted the most, often at very short notice. With the level of exposure that Hawkes Bay has many false alarms can be expected before something akin to a 'direct hit' (ETC Gabrielle) occurs, with all of the challenges that will entail.

# Appendix A: HBRC Land Categorisation Methodology

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# Hawke's Bay Regional Council



## Hawke's Bay Regional Council's Land Categorisation Process and Framework following Cyclone Gabrielle






*September 2023*

<b>Prepared by:</b>	Hawkes Bay Regional Council
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The purpose of this report is to outline how the Hawke’s Bay Regional Council (HBRC) applied the Government’s Future of Severely Affected Land Risk Categorisation Framework.

## BACKGROUND OF LAND CATEGORISATION

1. On 1 May 2023, the Government released its initial risk categories and associated definitions to guide local authorities’ decision making in respect of the risk categorisation of affected properties. These categories and definitions do not have a specific statutory basis.
2. The Government’s three risk categories were to be applied to flood and landslide affected properties in areas impacted by Cyclone Gabrielle and January floods across the North Island. The Government’s three categories were:
  - a. Low Risk – Repair to previous state is all that is required to manage future severe weather event risk. This means that once any flood protection near the property is repaired, the home can be rebuilt at the same site.
  - b. Managed Risk – Community or property-level interventions will manage future severe weather event risk. This could include the raising of nearby stop banks, improving drainage or raising the property.
  - c. High Risk – Areas in the high risk category are not safe to live in because of the unacceptable risk of future flooding and loss of life. Homes in these areas should not be rebuilt on their current sites.
3. The descriptions of the categories are as follows:

Category	1 	2P 	2C 	2A 	3 
Description	Repair to previous state is all that is required to manage future severe weather risk event.	Property level interventions are needed to manage future severe weather event risk, possibly in tandem with community level interventions	Community level interventions are needed for managing future severe weather risk events.	Significant further assessment is required to assess a property, as well as engagement with property owner.	Future severe weather event risk cannot be sufficiently mitigated. Some land uses may remain acceptable, while intolerable risk of inquiry or death for residential land use.
Actions	Flood damage to repair, but no need for community interventions.	Property specific measures are necessary, for example improved drainage, raising houses. Benefits accrue to property owners.	Local government could repair and enhance flood protection schemes to adequately manage the risk of future flooding events. Cost is shared by the community.	Interventions may be required or possible, but insufficient information to answer all questions. These may subsequently move between “2” categories or to categories 1 or 3.	In the face of enhanced climate risk to the property there is unacceptable risk of future flooding. This will involve combined local and central government assistance.

4. The Government has been clear that categorisation of properties (and the articulation of the technical metrics that are used to determine whether risk is “intolerable”) is the responsibility of local government.
5. Staff have developed a process and technical framework to assess risk to affected residential properties in the Hawke’s Bay region, which were primarily impacted by flooding during the Cyclone Gabrielle event. This is generally limited to impacts at a community scale rather than impacts to discrete / individual residential properties. Where the future risk to residential properties from flooding is intolerably high and where that risk cannot be sufficiently mitigated, those properties will be identified as “Category 3”.
6. Individual vulnerability to flood hazard is highly variable and context dependent, being a function of factors that reflect the specific characteristics of the areas, properties, and people exposed to flood hazard. The outcome of a risk assessment considers risks that are tolerable or acceptable, and takes into account the community’s social, cultural, environmental and economic situation. This makes the quantitative estimation of risk to life from flooding at a property level complex. Whether risks can be mitigated through viable and cost-effective property or community level interventions is a further complex consideration.
7. It is important to note that in the Hawke’s Bay region the affected areas for the purpose of categorisation relate solely to flood hazards arising from Cyclone Gabrielle, and do not include other forms of natural hazard

such as land instability, seismic related hazards (liquefaction/lateral spread) or coastal hazards (inundation and/or erosion). This is because flooding was the only known cause of community scale impacts in the Hawke’s Bay region, following Cyclone Gabrielle.

8. Additionally, the process and technical framework does not account for climate change effects such as sea level rise and the change in flood frequency relationship for the region’s rivers over time, nor future earthquake-related impacts.

## NEGOTIATED FUNDING OUTCOMES

9. An integrated package of funding has been negotiated by Hawke’s Bay Councils and the Government to support recovery from Cyclone Gabrielle. HBRC sought Government funding specifically for contributions to repair, restore and construct flood protection measures.
10. On 2 August 2023, HBRC accepted the Government’s offer of \$203.5 million towards flood mitigation and approved an additional \$44.15 million of debt to fund its cost-share portion. The combined funding is based on community interventions to move properties out of Category 2 to Category 1, thus limiting the number of properties that might otherwise become Category 3. The funding package also includes other region-wide projects such as repairs and upgrades to telemetry.
11. The proposed distribution of funding for impacted communities is as follows:

Funding for flood mitigation measures*		
Wairoa (100% Crown Funded)	Potential flood mitigation measures for areas in the vicinity of Wairoa and Frasertown (2A).	\$ 70,000,000
Hastings and Central Hawkes Bay (Costs shared between Crown and HBRC)	Potential flood mitigation measures for areas in the vicinity of: <ul style="list-style-type: none"> <li>○ Havelock North (2C)</li> <li>○ Omahu (2A)</li> <li>○ Pakowhai (2C)</li> <li>○ Porangahau (2A)</li> <li>○ Tongoio (2A)</li> <li>○ Waiohiki (2C)</li> <li>○ Whirinaki (2A)</li> </ul>	\$109,650,000
General Works		
	Provision for additional work to rapid repair sites following technical review	\$30,000,000
	Telemetry network repairs and upgrade	\$5,000,000
	Drainage pump station repairs/upgrades required	\$30,000,000
	Scheme reviews - to reconfigure & build resilience	\$3,000,000
	<b>Total</b>	<b>\$247,650,000</b>

\*These figures represent the best estimate of potential protection works required for areas in Category 2 to move to Category 1. It is noted that, following full technical assessment (particularly in relation to Category 2A), flood mitigation may not be feasible in all Category 2 areas. In such cases, affected properties will be recategorised to Category 3.

12. The availability of funding for flood mitigation works has informed the land categorisation process, in particular the application of Category 2. However, should initial investigation and design work highlight that specific proposed flood mitigations cannot be delivered, these properties will likely be recategorised to Category 3. It is envisaged that should this occur, HBRC will enter into negotiations with the Crown with a view that unused funding from the Crown for flood mitigation measures will be reallocated to the relevant territorial authority for the purpose of Category 3 buy-outs.
13. At the time of negotiations with the Government, the costings for flood mitigation measures were based on high level estimates of possible solutions to mitigate flood risk in identified areas.



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## DEVELOPMENT OF TECHNICAL RISK ASSESSMENT

14. Following the direction from Government, HBRC commenced work to develop a categorisation approach that satisfied the principles the Government had articulated. This approach was required for the Hawke's Bay Region to be eligible for the Government's funding contribution. HBRC's land categorisation methodology is detailed in the next section below.
15. Developing the methodology in a principled and equitable manner, whilst limiting Council's financial and legal exposure has been complex. This was compounded by the need to move at pace to meet the timeframes set by Government, including those relating to negotiations for funding contributions, and to limit as much as possible the negative social impacts on communities brought on by flood damage and the uncertainty of the land categorisation framework.
16. The over-arching consideration when determining categorisation has been whether there is an intolerable risk to life from flooding. This is a technical question that has been considered by technical experts alone. While the categorisation process is underway, work will continue to ensure the methodology and technical frameworks are appropriate and that the categorisation process is evidence-based and robust.
17. From the outset, HBRC amended the Government's risk categories and definitions to make them applicable to the Hawke's Bay context following Cyclone Gabrielle. The assessment of "managing future severe weather risks" was refined to "mitigating future flood risk from design events".
18. An additional Category 2C\* was defined which enabled HBRC to move a number of communities to Category 1 at pace to avoid the prolonged uncertainty of sitting in Category 2. For Category 2C\*, future flood risk is capable of being sufficiently mitigated because of existing flood infrastructure in the area that could be repaired and restored by "HBRC Rapid Repair" teams.
19. It is critical to note that being in Category 1 does not mean there is no risk to life, or that there was no impact from Cyclone Gabrielle. For the purpose of this process, Category 1 has been applied to properties where there is no intolerable risk to life.

### Technical assessment

20. The considerations required for a risk to life assessment were detailed by Pattle Delamore Partners in their report from June 2023. Pattle Delamore Partners stated that risk to life for future events on the scale of Cyclone Gabrielle can be articulated in general terms but was difficult to codify. There is little national guidance in this space with the NZS9401 Managing Flood Risk – A Process Standard being the primary guiding document.
21. Assessments will involve consideration of:
  1. Damage assessment: an assessment of flood levels and damage sustained during the Cyclone Gabrielle event.
  2. Assessment of Flood Danger and Flood Damage Risk as a combination of:
    - a. Event likelihood (in terms of the probability of an event of a given magnitude being equalled or exceeded within a year – the Annual Exceedance Probability, or AEP);
    - b. Hazard (the level of risk to life by flooding);
    - c. Exposure (what is exposed to flood hazard in a given place); and
    - d. Vulnerability (propensity to suffer adverse effects of flooding, based on individual characteristics and external factors).
  3. These factors are complex, interrelated and are taken into account to inform categorisations.
22. All decision making throughout the land categorisation process has been informed by the available expert advice and applied standard industry concepts and processes as detailed in the Pattle Delamore reports. In all of the above we considered evidence from the event and from site visits in addition to other information

submitted by affected residents. The risk to life assessment used in Hawke’s Bay is detailed further in the methodology below.

## Quality assurance

23. HBRC commissioned Pattle Delamore Partners to independently review and assure its provisional mapping. Site visits to all Category 3 locations were completed in order to validate the provisional mapping.
24. The Cyclone Gabrielle Recovery Taskforce Secretariat engaged Tonkin & Taylor Ltd to provide a high-level assurance review of the process followed by HBRC and Pattle Delamore Partners. Tonkin & Taylor considered that the preliminary risk categorisation process used was technically valid and appropriate given the constraints of the available information and the need for timely decision making and community engagement.
25. Tonkin & Taylor specifically noted that the process used to identify Category 2 and 3 areas relied heavily on expert judgement applied by HBRC and Pattle Delamore Partners. The process was informed by observations of the flood damage that occurred during the event with some input from territorial authorities. They considered this was a suitable approach for the initial assessment, and for very high-risk situations where Category 3 is clearly appropriate. It was acknowledged that more detailed technical assessment would be required to confirm the feasibility and levels of service for community and property-level interventions and to resolve cases on the borders between Category 2 and 3.
26. While the categorisation process is underway, the detailed technical assessment will continue to be worked through for each categorised area by teams of technical experts. Areas are recategorised as soon as possible following completion of technical assessments.
27. Pattle Delamore Partners will provide a final peer review of decision making and a quality assurance report with recommendations to the HBRC Chief Executive to inform completion of the technical risk assessment.

## LAND CATEGORISATION METHODOLOGY

### 1. Identification of Impacted Areas

METHODOLOGY	PATHWAY
In determining areas that will be subject to the land categorisation process, a technical expert will consider the following question:	No – Area not included in provisional categorisation process.
1. Is the area impacted by flooding caused by Cyclone Gabrielle at a community scale?	Yes – Area included in provisional categorisation process.

### 2. Provisional Categorisation

METHODOLOGY	PATHWAY
In determining provisional categorisation, a technical expert will consider the following questions:	Category 1 - Repair to previous state is all that is required to mitigate risk to life from flooding.
1. Is there an intolerable risk to life from flooding?	Note: Category 1 does not mean there is no risk, or that there was no impact from Cyclone Gabrielle, but that there is no intolerable risk to life.
The risk to life assessment, as detailed by Pattle Delamore Partners, considers the following factors: <ul style="list-style-type: none"> <li>- The maximum depth and rate of rise of floodwater;</li> <li>- How swift or otherwise the flood water was;</li> <li>- How quickly a river rises and overtops its banks and/or flood management system (how much warning those living close to a river might have that a flood is imminent)</li> </ul>	Category 2C* - Repairs to existing flood scheme assets are effective in

<ul style="list-style-type: none"> <li>- How accessible safe egress is for residents of affected areas;</li> <li>- The volume of silt and debris entrained in the floodwater;</li> <li>- Particular geographic features that exacerbate the hazard eg valley confinement;</li> <li>- How apparent the hazard is to those potentially impacted. That encompasses understanding / awareness of the hazard (which will inevitably decline with time following Cyclone Gabrielle) but also whether the connect between the flood source and where people live is clear (whether their level of exposure is obvious or not);</li> <li>- The complexity of the flood hazard.</li> </ul> <p>2. Are mitigations available to sufficiently reduce the risk to life from flooding so the area or property can be reinhabited. This includes through:</p> <ol style="list-style-type: none"> <li>a) Repairs to flood scheme assets?</li> <li>b) Community level interventions?</li> <li>c) Property level interventions?</li> </ol> <p>3. Is significant further assessment required to determine the risk to life?</p>	<p>mitigating future flood risk from design events.</p> <hr/> <p>Category 2C – Additional community level interventions are effective in mitigating future flood risk from design events.</p> <hr/> <p>Category 2P - Property level interventions are needed to mitigate future flood risk, including in tandem with community level interventions.</p> <hr/> <p>Category 2A - Significant further assessment required before category determined.</p> <hr/> <p>Category 3 - Future flood risk cannot be sufficiently mitigated.</p>
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### 3. Refinement of Categorisation Mapping

METHODOLOGY	PATHWAY
<p>Provisional mapping will be refined to address alignment of the provisional mapping boundaries for properties around the border of categorised areas.</p> <p>The further detailed assessment will take into consideration the following factors:</p> <ul style="list-style-type: none"> <li>- Topographical features;</li> <li>- Known level of damage;</li> <li>- Property boundaries; and</li> <li>- How accessible safe egress is for potentially impacted residents.</li> </ul> <p>Refinement to the boundary of categorised areas will occur where the further detailed assessment reveals issues with the alignment of the provisional mapping boundaries.</p>	<p>Refinement of categorised boundaries.</p>

### 4. Recategorisation of Category 2s

METHODOLOGY	PATHWAY
<p><b>Category 2C*</b></p> <p>Future flood risk can be mitigated by reinstating existing flood infrastructure to pre-Cyclone Gabrielle standards and levels of service utilising similar construction techniques and design to the original. The reinstatement of flood infrastructure must reduce risk to life to a tolerable level.</p> <p>Category 2C* areas will be recategorised to Category 1 following these steps:</p> <ol style="list-style-type: none"> <li>1. Asset has been reinstated to the original standard prior to Cyclone Gabrielle of 1% AEP.</li> <li>2. Materials selection has been overseen by dedicated geotechnical engineers.</li> <li>3. Compaction testing has been undertaken by nuclear densometer given real time results with compaction results required to be met prior to proceeding with the next layer of construction.</li> <li>4. Quality assurance commenced by independent experts.</li> </ol> <p>Note: An AEP (annual exceedance probability) of 1% for a given flood level means there is a 1% chance of having a flood exceed that level in any one year.</p>	<p>Release to Category 1.</p>

<p><b>Category 2C</b></p> <p>Additional community level interventions will be implemented to mitigate future flood risk from design events. These will be considered where there are no adequate existing flood protections.</p> <p>The intervention must contribute to reducing risk to life to a tolerable level for a community and will take into consideration the following factors:</p> <ul style="list-style-type: none"> <li>- Land use;</li> <li>- Practicality and feasibility;</li> <li>- Favourable cost / benefit analysis;</li> <li>- Overall cost;</li> <li>- Funding availability; and</li> <li>- Consenting risks.</li> </ul> <p>Subject to confirmation of this pathway, Category 2C's will be released to Category 1 when the following conditions are met:</p> <ul style="list-style-type: none"> <li>- A sound concept that has a consenting pathway; and</li> <li>- A legal interest in favour of HBRC in the relevant land; and</li> <li>- Available funding.</li> </ul>	<p>Intention is to release to Category 1 but if viable solution is not found then area may be moved to Category 3.</p>
<p><b>Category 2P</b></p> <p>Additional property level interventions will be implemented in order to mitigate future flood risk.</p> <p>The intervention must contribute to reducing risk to life to a tolerable level for a residential property owner and will take into consideration the following factors:</p> <ul style="list-style-type: none"> <li>- Practicality and feasibility;</li> <li>- Safe egress;</li> <li>- Favourable cost / benefit analysis;</li> <li>- Overall cost;</li> <li>- Funding availability; and</li> <li>- Consenting issues.</li> </ul> <p>Subject to confirmation of this pathway, Category 2P's will be reclassified to Category 1 when appropriate property level interventions have been completed to the satisfaction of the building consent authority or other relevant authority.</p>	<p>Intention is to release to Category 1 but if viable solution is not found then area may be moved to Category 3.</p>
<p><b>Category 2A</b></p> <p>Significant further assessment is required before categorisation can be determined.</p> <p>The process for further assessment will involve:</p> <ol style="list-style-type: none"> <li>1. The appointment of independent experts to conduct a review of potential community and/or property level interventions that can mitigate risk;</li> <li>2. Engagement with the community, facilitated by HBRC and the relevant territorial authority, on potential solutions; and</li> <li>3. Consideration of community feedback by technical experts; and</li> <li>4. Experts will then make recommendations to HBRC on future mitigation works, and final categorisation of properties.</li> </ol> <p>Based on the outcome of the further assessments, HBRC will determine whether reclassification to Category 2C or 2P, with a view to moving to Category 1 is appropriate. If not, then Category 3 will be applied as an intolerable risk to life cannot be mitigated.</p>	<p>Significant further assessment required before category determined.</p>

## 5. Reassessment Process

METHODOLOGY	PATHWAY
<p>All requests for reassessment from landowners and territorial authorities will be considered while the categorisation is provisional, and where relevant new information is provided.</p> <p>Any reassessment will be undertaken by a technical expert, and may involve the following steps and considerations:</p> <ol style="list-style-type: none"> <li>1. Review the desktop assessment to determine if there are any errors, or other justification for reconsidering the categorisation.</li> <li>2. Decide whether further information is required for an additional technical review.</li> <li>3. Consult with additional experts where further detailed assessment is required.</li> <li>4. Arrange a site visit where required.</li> <li>5. Factors that may be considered at the point of reassessment are:               <ol style="list-style-type: none"> <li>a. Topographical features;</li> <li>b. Observed level of damage;</li> <li>c. Property boundaries; and</li> <li>d. How accessible safe egress is for potentially impacted residents.</li> </ol> </li> <li>6. Reassessment recommendation internally peer viewed by HBRC, with a recommendation provided to HBRC Chief Executive for decision.</li> <li>7. The HBRC Chief Executive may seek further technical advice or information as required before making a final decision.</li> </ol>	<p>Re-categorisation where appropriate.</p>

## 6. Completion of Risk Assessment

METHODOLOGY	PATHWAY
<p>The land categorisation process will be completed following:</p> <ol style="list-style-type: none"> <li>1. Notification to affected landowners of the intent to close the land categorisation process;</li> <li>2. A public meeting will occur for each Category 3 community;</li> <li>3. A period of two weeks will be provided for final feedback;</li> <li>4. Feedback will be considered and assessed by technical experts, including any requests for reassessment;</li> <li>5. Pattle Delmore Partners will provide a final peer review and quality assurance report with recommendations to the HBRC Chief Executive.</li> </ol>	<p>HBRC will release completed land categorisation maps to the Government and territorial authorities to inform future processes.</p>
<p>HBRC Chief Executive will direct the release of the land categorisations to the Government and territorial authorities. HBRC will only consider further changes to land categorisations after this point in the event that new compelling information is presented that was not previously available to the technical experts.</p>	
<p>HBRC will publicly release:</p> <ul style="list-style-type: none"> <li>- Pattle Delmore Partners provisional categorisation report;</li> <li>- Pattle Delmore Partners supplementary land categorisation report;</li> <li>- Tonkin + Taylor land categorisation process assurance report;</li> <li>- Land categorisation methodology; and</li> <li>- Land categorisation process mapping.</li> </ul>	



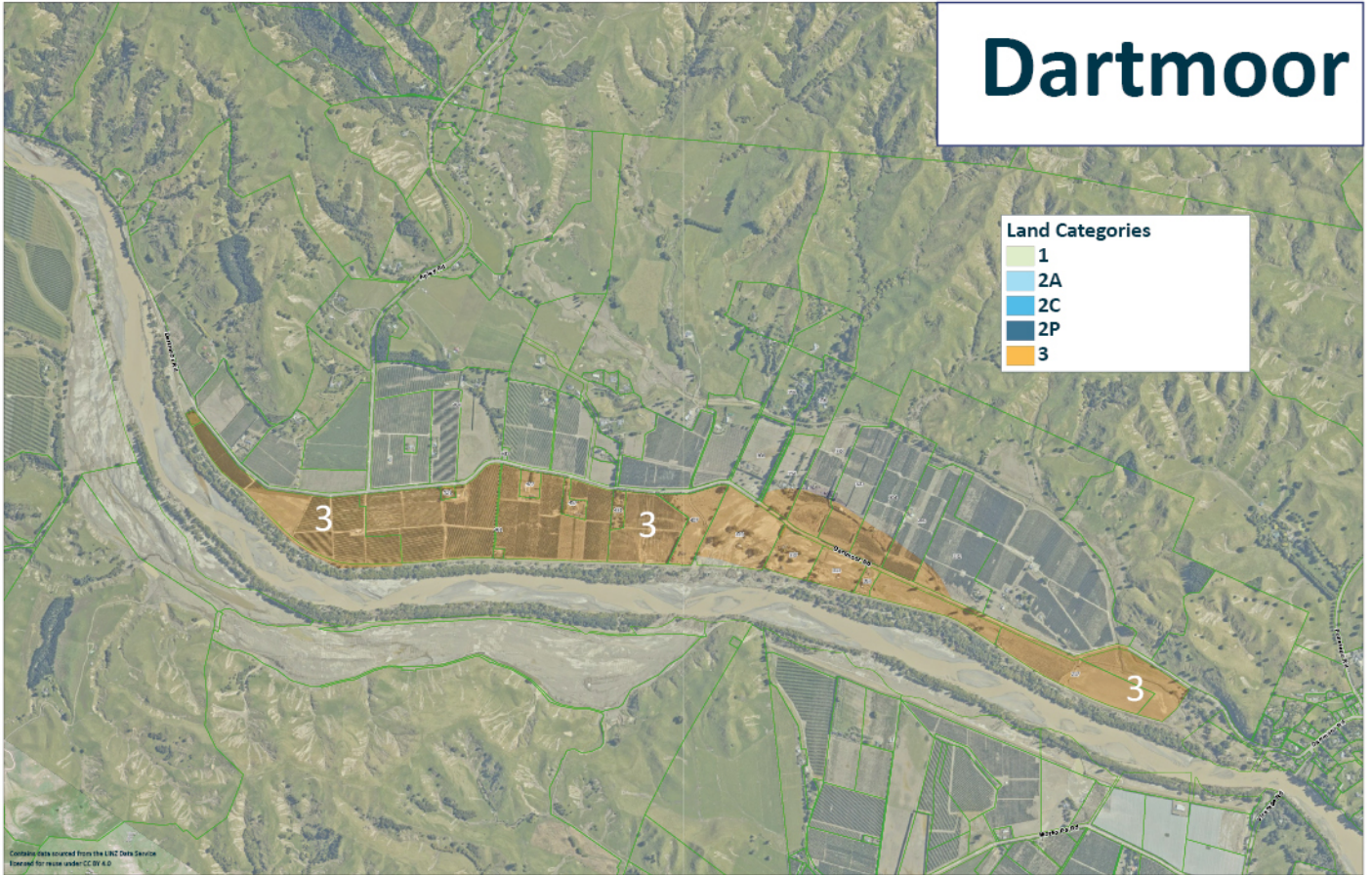
# Arapaoanui/Arapawanui



# Dartmoor

## Land Categories

- 1
- 2A
- 2C
- 2P
- 3

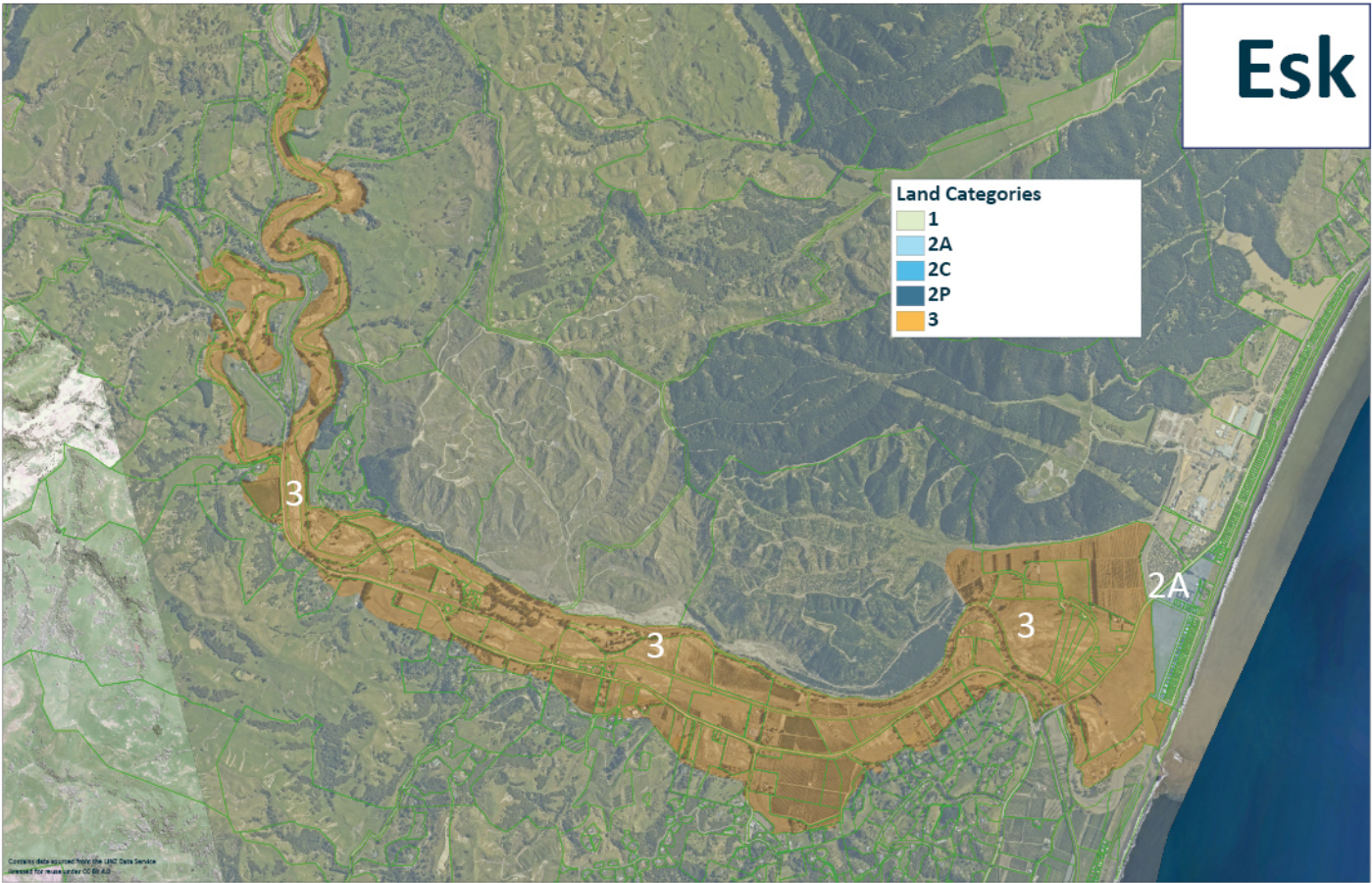




# Esk

## Land Categories

- 1
- 2A
- 2C
- 2P
- 3



## Land Categories

-  1
-  2A
-  2C
-  2P
-  3

# Mangaone Rissington

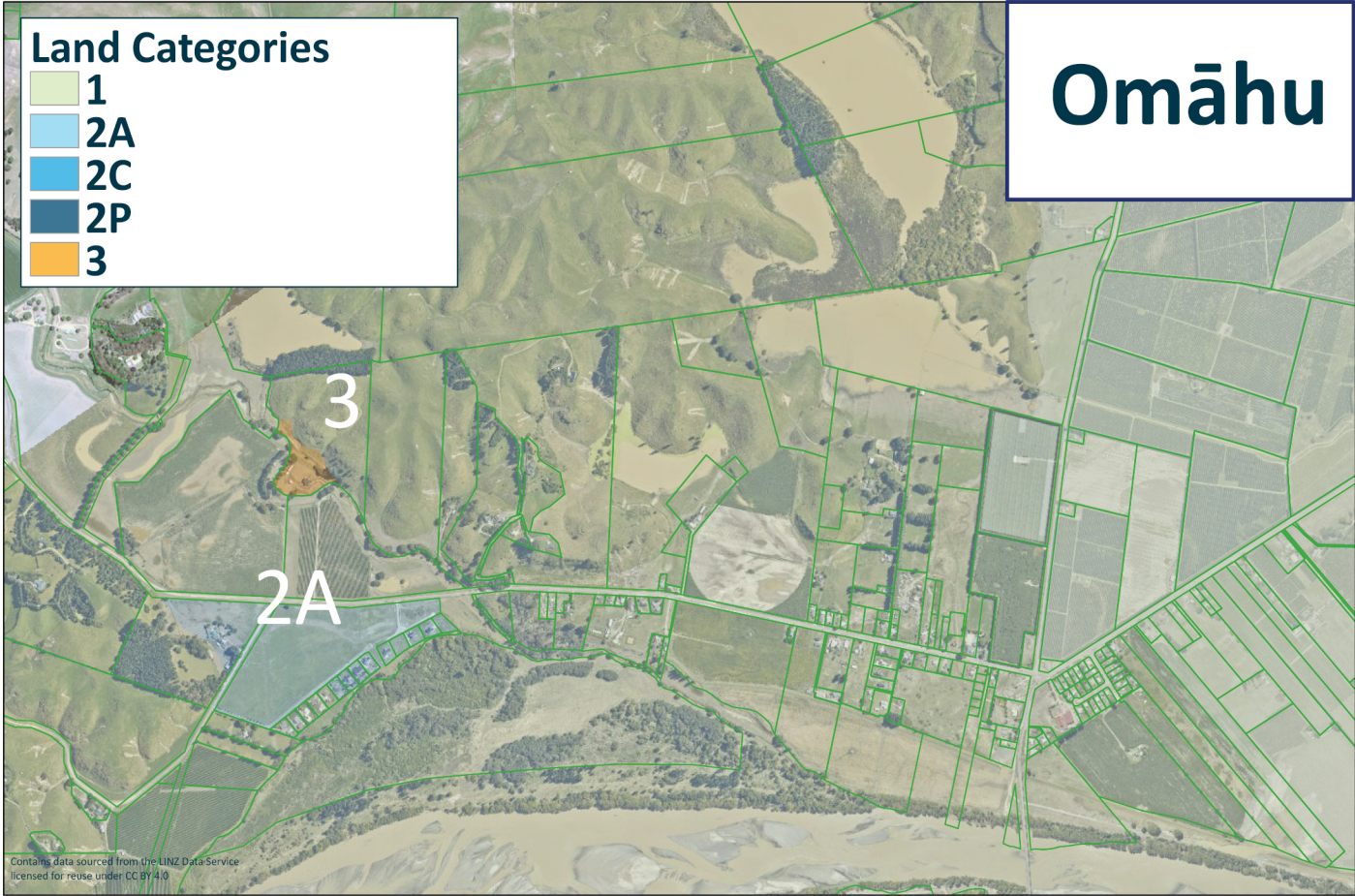
2P

3

# Omāhu

## Land Categories

- 1
- 2A
- 2C
- 2P
- 3

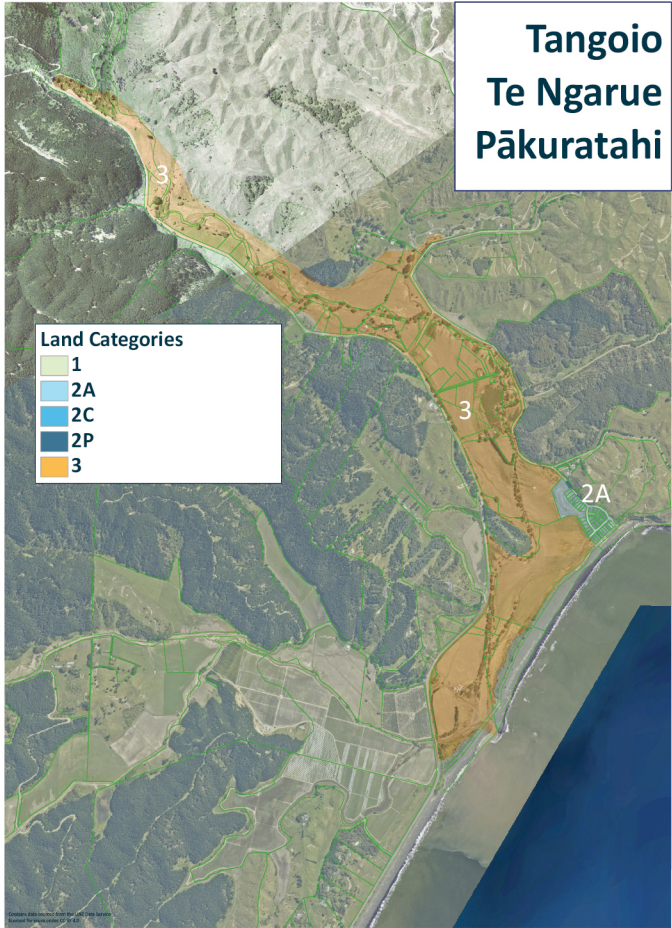


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# Tangoio Te Ngarue Pākuratahi

## Land Categories

- 1
- 2A
- 2C
- 2P
- 3



# Waiohiki - Springfield Rd

