Landslide Planning Map Update

Report on mapping changes and consultation

18 December 2025

Department of State Growth

Tasmanian Government

Technical reviewer endorsement statement:

I confirm that the updates align with the 2010 methodology. All comments have been carefully considered, and many improvements have been made throughout the report. The review process has been transparent and open, with nearly all recommendations incorporated. Where my suggestions have not been adopted an explanation for these decisions has been provided.

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Glossary

Term	Definition	Source
AS2870 Site Classification	Means a report prepared for a residential dwelling by Site Classifier after their investigation of a site using the methodology of the Australian Standards AS2870 "*Residential slabs and footings*" as amended from time to time, and may include certification provided under s.266 of the Building Act 2006.	TPS-Landslip Code
Geotechnical Practitioner	Means a person who may prepare a Landslip Hazard Report: 1. an Engineer-Civil accredited under the accreditation scheme; or 2. a Geo-technical Engineer; or 3. an Engineering Geologist, and who have the qualifications and expertise specified by the Director of Building Control	TPS-Landslip Code
Hazard*	Source of potential harm Note 1: Hazard can be a risk source	ISO 31073:2022
	A condition with the potential for causing an undesirable consequence. The description of landslide hazard should include the location, volume (or area), classification and velocity of the potential landslides and any resultant detached material and the probability of their occurrence within a given period of time.	AGS 2007a
Inventory [Landslide]	A record of the location, classification, volume, activity and date of occurrence of individual landslides in an area.	AGS 2007a
Landslide	The movement of a mass of rock, debris, or earth (soil) down a slope.	AGS 2007a
Landslide Hazard Area	The land within a Landslip Planning Map which is classified into one of four landside hazard bands (Low, Medium, Medium-Active, High).	TPS-Landslip Code
Landslide (Landslip) Planning Map - Components	The scientific datasets that underpin the landslide planning map hazard bands. These datasets include landslide inventory mapping, susceptibility modelling and slope angle mapping. See Section 7.1 for a full list of components.	TPS-Landslip Code
Landslide (Landslip) Hazard Bands	Five bands (acceptable, low, medium, medium–active, and high) that guide the management of landslides in Tasmania through the land use planning and building regulatory systems.	TPS-Landslip Code
Landslip	Landslide	TPS-Landslip Code
Landslip Design Guide	Includes the following publications: 1. "Good Hillside Construction Practice", Australian Geoguide LR8 (Construction Practice), published by the Australian Geomechanics Society; or 2. "Landslide Hazards Handbook", published by the Australian Building Codes Board;	TPS-Landslip Code

Landslip Hazard Report (planning and building)	Means a report prepared by a "Geotechical practitioner" in a format specified by the Director for a building application, using the methodology outlined in the *Building for Landslide: Guidance for Geotechnical reporting in Tasmania (MRT 2016).* This applies the AGS 2007 Guidelines (as amended from time to time) published by the Australian Geomechanics Society to the Tasmanian context and may include certification provided under s.266 of the Act. The planning and building regulations ask that the report demonstrates that the use, development, or work: 1) Is not likely to cause or contribute to the occurrence of a Landslip event on the site or on adjacent land; and 2) Can achieve and maintain a tolerable level of risk, while considering: a) the nature, intensity and duration of the use; b) the type, form and duration of any development; c) the likely change in the risk across the intended life of the use or development; d) the ability to adapt to a change in the level of risk; e) the ability to maintain access to utilities and services; f) the need for specific landslip hazard reduction or protection measures on the site; g) the need for landslip hazard reduction or protection measures beyond the boundary of the site; h) any landslip hazard management plan in place for the site and/or adjacent land; and any advice relating to the ongoing management of the use.	TPS-Landslip Code

Risk	Effect of uncertainty on objectives Note 1 to entry: An effect is a deviation from the expected — positive and/or negative. Note 2 to entry: Objectives can have different aspects (such as financial, health and safety, and environmental goals) and can apply at different levels (such as strategic, organization-wide, project, product and process). Note 3 to entry: Risk is often characterised by reference to potential events (3.5.1.3) and consequences (3.6.1.3), or a combination of these. Note 4 to entry: Risk is often expressed in terms of a combination of the consequences of an event (including changes in circumstances) and the associated likelihood (3.6.1.1) of occurrence. Note 5 to entry: Uncertainty is the state, even partial, of deficiency of information related to, understanding or knowledge of, an event, its consequence, or likelihood.	ISO 31073:2022
	A measure of the probability and severity of an adverse effect to health, property or the environment. Risk is often estimated by the product of probability and consequences. However, a more general interpretation of risk involves a comparison of the probability and consequences in a non-product form. For these [*AGS 2007 landslide risk management*] guidelines risk is further defined as: (a) *For life loss,* the annual probability that the person most at risk will lose his or her life taking account of the landslide hazard and the temporal spatial probability and vulnerability of the person. (b) *For property loss*, the annual probability of the consequence or the annualised loss taking account of the elements at risk, their temporal spatial probability and vulnerability.	AGS 2007a
Site Classifier	Means a person who may prepare an AS 2870 Site Classification 1. Soil Scientist; or 2. Engineer – Civil accredited under the accreditation Scheme; or 3. Geo-technical Engineer; or an 4. Engineering Geologist And who have qualifications and expertise specified by the Director of Building Controls;	TPS-Landslip Code

Significant works	means any of the following: a) excavation equal to or greater than 1m on depth, including temporary excavations for the installation or maintenance or services or pipes; b) excavation or depositing of material of greater than 100m3 whether or not material is sourced on the site or imported; c) felling or removal of vegetation over a contiguous area greater than 1,000m2; d) the collection, pooling or storage of water in a dam, pond, tank or swimming pool with a volume of more than 45,000 litres; e) removal, redirection, or introduction of drainage for surface or groundwater; and f) discharge of stormwater, sewage, water storage overflow or other wastewater.	TPS-Landslip Code
Susceptibility [Landslide]	A quantitative or qualitative assessment of the classification, volume (or area) and spatial distribution of landslides which exist or potentially may occur in an area. Susceptibility may also include a description of the velocity and intensity of the existing or potential landsliding.	AGS 2007a

Tolerable Risk	**Tolerable risk** means the lowest level of likely risk from the relevant hazard: (a) to secure the benefits of a use or development in a relevant hazard area; and (b) which can be managed through: (i) routine regulatory measures; or (ii) by specific hazard management measures for the intended life of each use or development. Characteristics - Zone, Use and form of development o New critical use, hazardous use, or vulnerable uses in the landslide planning map is restricted o new use or development in the Medium-Active or High hazard band is restricted o must demonstrate that significant works located in the low, medium, medium - active or high hazard bands will not cause or contribute to a landslide, and o Subdivision in the medium, medium-active, or high hazard bands must be designed to reduce the need for mitigation measures. At the site-specific level the AGS 2007(c) risk assessment process considers the tolerable risk to life, after treatment to be: o Existing slope/ existing development 10-4/ annum (equivalent to a likelihood of death of 1 in 1,000 years) o New constructed slope/ new development/ existing landslide 10-5/ annum (equivalent to a likelihood of death of 1 in 10,000 years) o Characteristics of developments defined in the provision of the code o the land is not destabilised, o the water table is not increased, o engineered works meets the standards set out in Practice Note Guidelines for Landslide	TPS-Landslip Code AGS 2007(c)

Executive Summary

Landslide risk in Tasmania is primarily managed privately, with the issue only becoming a public concern when the landslide poses a risk to life, housing, or infrastructure. Historically, the State and local Governments have become the insurer of last resort to private landowners in these situations. The Landslide Planning Map, along with the land use planning and building control systems, aims to support landowners in understanding their potential exposure and reducing their ongoing vulnerability to new uses and developments.

The current system was developed in 2013, and the mapping that underpins it has recently been updated. The 2025 methodology broadly aligns with the methods outlined in earlier documents, particularly Mazengarb and Stevenson (2010). This report outlines the technical changes made to the Landslide Planning Map during the 2025 update. The statutory tools are being reviewed through the State Planning Provisions Review, with updates to the provisions being progressed separately. The first update to the SPPs provisions relating to landslides was taken forward in 2024. Where possible, consultation has been coordinated.

The Landslide Planning Map is the output of a policy process to translate scientific information into a map and planning controls to reduce the risk of landslide for new use and development. The Landslide Planning Map does this by dividing the landscape into five hazard bands (acceptable, low, medium, medium-active, and high), which describe the minimum level of intervention on private land considered necessary to address a potential landslide hazard to new uses and developments. The hazard bands have been developed based on:

- mapped landslides
- proclaimed Landslip Areas (as defined under the *Mineral Resources Development Act 1995*)
- susceptibility modelling, and
- slope angle calculations.

The 2013 Landslide Planning Map was based on good scientific principles, and no change was made to the overarching mapping approach. Component datasets were updated to use the best available data, including a new LiDAR-based 10 m Digital Elevation Model. A targeted peri-urban mapping programme was undertaken to identify landslide features in previously unmapped areas of the state, and this has significantly improved Mineral Resources Tasmania’s (MRT) landslide inventory database. Landslide susceptibility modelling was refreshed in the Tamar Valley and expanded in key areas (Evandale and Penna), and changes were made to the susceptibility slope angle approach where landslide evidence suggested the old thresholds were inappropriate (primarily along the northwest coast).

The 2025 mapping update has increased the total regulated area statewide by 5.6% compared to 2013. This includes a 4.1% rise in medium and a 1.6% rise in low hazard band coverage, primarily due to a reduction in the slope angle threshold from 11° to 9° in northern local government areas such as Burnie, Central Coast, Kentish, Latrobe, and Waratah-Wynyard. Conversely, Hobart and Glenorchy saw a reduction in total hazard area due to refinements in the rockfall model.

Despite the increase in total coverage of low-high hazard bands, the proportion of residential buildings within regulated areas has remained stable, indicating that much of the expanded hazard areas are located outside of the urban growth boundary. Vacant parcel analysis indicates that most land with likely future development potential lies within the acceptable hazard band (86%), with only a minor increase in the low hazard band. Notably, the percentage of parcels currently available for development within the medium band has decreased by 2%. This decline likely reflects the impact of maturing regulatory controls since 2013, which have successfully directed development away from higher hazard bands.

These changes were made in consultation with local government, state agencies, and private practitioners across the land use and development fields. Stakeholders have broadly agreed with the proposed changes to the mapping and its application into the hazard bands, which will be taken forward into the statutory amendment process.

The authors note that modelling is an iterative process. Future refinements may be possible with additional data and improved methodologies. Notably, MRT has a Disaster Resilience Fund project to improve understanding of active ground movements and produce updated landslide mapping, and the Australian Geomechanics Society is currently reviewing its guidance on landslide mapping and risk analysis. The results of these projects should inform future reviews of the Landslide Planning Map and approaches to landslide management in the planning and development systems.

1 Introduction

In September 2023 the then Minister for Planning approved the review and update to Tasmania's Landslide Planning Map to reflect the latest scientific evidence and mitigate risks to public safety and property. The purpose of the review was to consider:

1. Necessary amendments to the landslide hazard planning map that consider and incorporate improvements in new scientific data and evidence,
2. The ranking, thresholds and controls for the Landslide Planning Map – Hazard Bands – Acceptable, Low, Medium, Medium-active, and High,
3. Mechanisms to more readily incorporate information about newly identified and expanding areas of landslides into Tasmania's planning and building controls.

The review did not consider (or reconsider) the underlying rationale for the declaration of Landslip A or B areas that have been made under the *Mineral Resource and Development Act 1995* or prior legislation.

This report outlines the updates and outcomes of the review as they relate to the Landslide Planning Map, including base data improvements and changes to the ranking and thresholds within the map bands. At the same time, updates to the planning provisions have been progressed separately as part of the State Planning Provision review. A mechanism to incorporate information about newly identified landslides has also been introduced.

This report is intended to inform land use planners and policy makers of changes made to the 2013 landslide planning map (detailed in Department of Premier and Cabinet, 2013). While the document is not written for a general audience, it may also be of interest to landowners, developers, and community members seeking to understand how landslide risk is managed through the planning system, along with the State Planning Office (SPO) fact sheet that describes the integration of landslide into the planning and building system. More detailed technical information on the mapping methodology can be found in Mazengarb and Stevenson (2010), and the regulatory controls for land use planning and building control are outlined in the Tasmanian Planning Provisions Landslip Hazard Code and Director's Determination - Landslip Hazard Areas (Department of Justice, 2018), respectively.

It is important to note that the term 'hazard' is used in the context of ISO 31073:2022, as a 'source of potential harm'. It is recognised that geotechnical practitioners interpret this term differently (AGS 2007a), and users should be aware that the hazard bands do not imply an absolute likelihood, landslide intensity or frequency.

The Landslide Planning Map is the instrument used to translate the science into the landslip overlay that underpins the operation of the Landslip Hazard Code in the Tasmanian Planning Scheme and the associated Building Controls. This map includes two layers: the components and hazard bands. The components are the key inputs based on scientific landslide datasets. The hazard bands are the resulting classification of land based on the available data. The Landslip Hazard Code overlay under the Tasmanian Planning Scheme then guides decision-making for appropriate land use planning and building control regulations.

The planning and building controls recognise that landslides are a natural process, commonly triggered by events such as rainfall or earthquakes. However, the effects of these natural processes can be exacerbated by development and human modification of slopes without appropriate mitigation measures. Consequently, the planning and building system seeks to reduce, as far as is reasonably practical, the exposure of developments to the risk of landslide and contribution of new developments or works to the occurrence of new landslides. To meet this objective, each hazard band has a range of interventions implemented through the planning and building system that seek to:

- move new use and development opportunities away from active landslide areas (medium-active and high hazard bands) by using performance-based solutions, including site-specific risk assessments, and
- require new use and development in the low and medium to demonstrate that site use, design, civil engineering, foundation design, groundwater management and vegetation management will not contribute to an increased risk of landslide occurring.

The updates outlined below have been made possible through significant investment by the State Government in the capture and analysis of high-resolution elevation data for all private land in Tasmania. This initiative also received strong support from Local Government and industry bodies. While consultation between parties has been robust, these discussions have ultimately strengthened the integration of scientific data into the planning and building control systems.

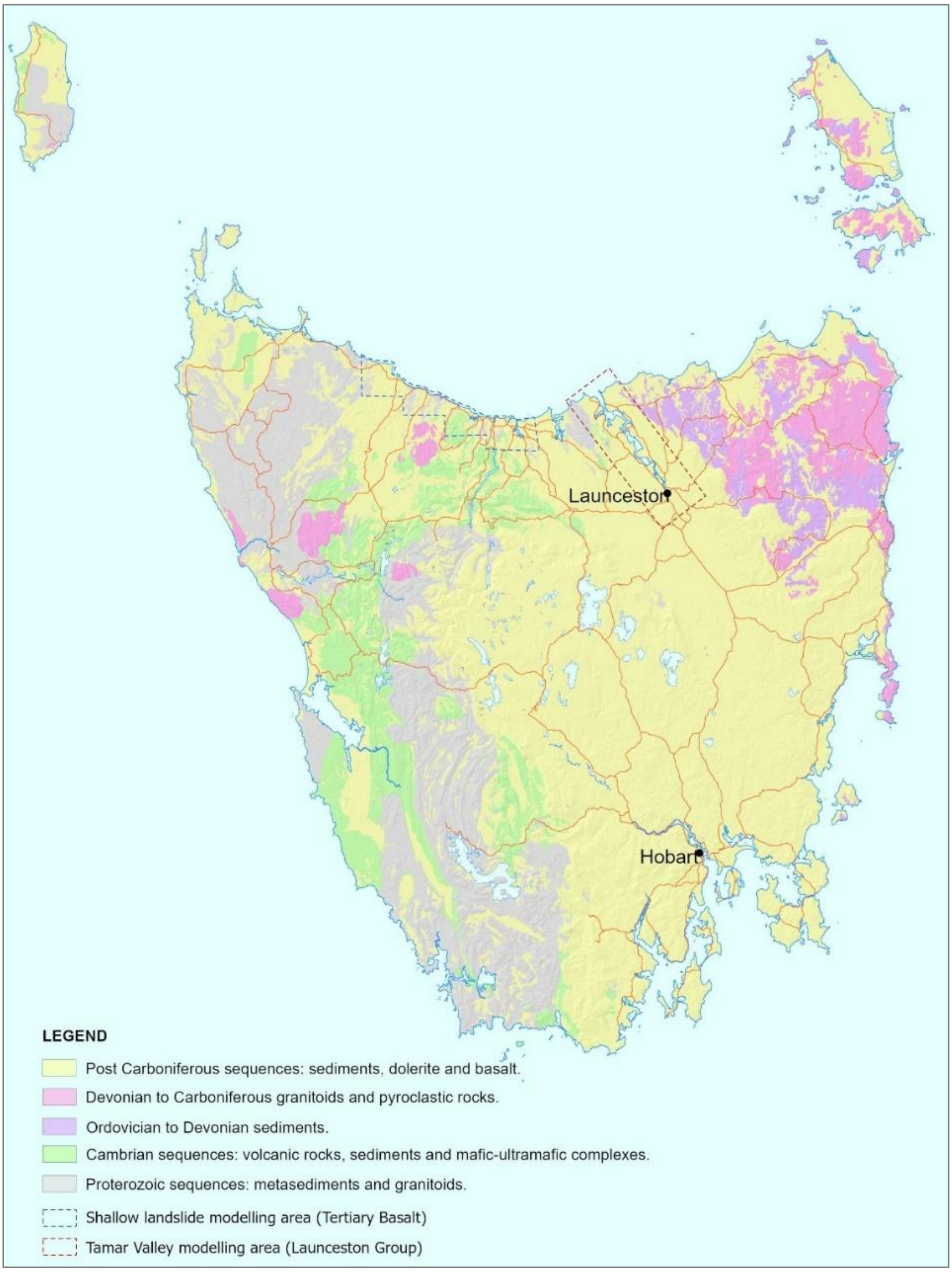


Figure 1. Simplified geological map of Tasmania

2 Landslides in Tasmania

2.1 Definition and driving factors

A landslide is the downslope movement of a mass of rock, earth, or debris and includes falls, topples, slides, flows and spreads (AGS 2007b). Other geotechnical issues relating to soils, ground subsidence and shallow soil creep have been excluded and are addressed through the site classification process in the building system.

Landslides occur due to gravity, but certain combinations of land characteristics can make a slope more prone to failure. These factors may include:

- Slope angle,
- Geology, soil,
- Geomorphology, and
- Vegetation cover.

Factors that trigger landslides in susceptible areas include intense rainfall, changes to groundwater levels, human modification of slopes, erosion along rivers or estuaries, and earthquakes. Landslides have been known to occur all over Tasmania, but two parts of the state are particularly prone to slope failures: the Tamar Valley and the Central-North West Coast. The Tamar Valley is underlain by the weakly lithified Launceston Group sedimentary sequence, and the Central-North West Coast by deeply weathered Tertiary basalt flows (Figure 1).

2.2 History of landslides and mapping in Tasmania

Since the early 1950s, over 170 buildings are known to have been damaged or destroyed by landslides in Tasmania. The most significant events in Northern Tasmania include the Lawrence Vale landslide, which destroyed 43 houses in the 1950s, and the Beauty Point landslide, which destroyed 15 houses and significantly damaged another 13 in the 1970s. All of these occurred in the Launceston-Tamar Valley area.

More recently, landslides in Deviot and Legana (also in the Tamar Valley) led to the removal of or damage to several houses. In Southern Tasmania, the Taroona landslide (Hobart) affected 10 houses and a high school, and the Rosetta landslide (Glenorchy) resulted in damage and/or demolition of 23 houses since 1992. MRT publishes an inventory of landslide locations and damaged housing.

MRT and its predecessor, the Department of Mines, has a long history of landslide mapping around Tasmania. Historically, this work was largely focused on site-specific investigations and mapping of active landslide areas in urban settings. The first zoning and regulatory system for landslide was introduced in the 1960s as Proclaimed (or Declared) Landslip A and B Areas, which involved delineating areas of known or suspected instability (Landslip A area) and an optional setback area (Landslip B) based on site investigations. Between 1970 and 2003 a number of these zones were proclaimed under the Mineral Resources Development Act 1995 and preceding legislation, allowing for restrictions around building and other activities on unstable land. As they are set in place through legislation, these zones have been incorporated into the current mapping system, as outlined in Section 4.1.

In the 1990s and early 2000s MRT developed an expanded mapping programme, which included a new landslide inventory, detailed geomorphic mapping and susceptibility modelling in selected locations. The results were published under the Tasmanian Landslide Map Series, and regional-scale Advisory Landslide Zoning maps were produced at 1:25 000 scale for the Tamar Valley and 1: 12 500 scale for Burnie, Pengiun and Karoola-Lilydale. These advisory maps divided the landscape into five classes (I-V), with Class V reflecting known active landslides, Class IV old landslides, and the remaining three classes reflecting levels of susceptibility approximated from geology (Class III – susceptible geology and slopes > 7°, Class II – 'soft geology' and slopes < 7°, and Class I – generally not susceptible). These zones were used to determine the level of geotechnical investigation and intervention required for development, although regulation was limited to Classes IV and V.

Data availability and the science of landslide zoning evolved considerably in the early 2000s, and in 2001 MRT developed a new methodology for landslide susceptibility mapping; published as the Tasmanian Landslide Map Series. These maps included a landslide inventory, geomorphological and geological mapping, and landslide susceptibility modelling. The first of these maps were published for Hobart and Glenorchy in 2004 at 1:25 000 scale (Mazengarb, 2005). With the introduction of the Australian Geomechanics Society (AGS) Guidelines for Landslide Risk Management in 2007, the methodology was modified to conform as much as possible to the AGS guideline for landslide susceptibility, hazard and risk zoning for land use planning. Map series sets were subsequently published for the Tamar Valley and North West Coast regions. The methodology behind this mapping is further explained in Section 3.

The 2013 mapping built on this scientific data and incorporated the Tasmanian Landslide Map Series and Proclaimed Landslip Areas into the Landslide Planning Map, along with an expanded landslide inventory and generalised susceptibility measures where detailed mapping was unavailable. The publication of the 2013 landslide mapping led to the development of a more informed system for land use planning decision-making and building control regulation. It is hoped that with the continued refinement of the data and models behind these maps and regulations, and greater consistency in decision-making, landslide impacts on communities will be limited to areas developed prior to the adoption of this approach.

2.3 Legislative context for landslide

Land use planning in Tasmania is guided by the Resource Management and Planning System (RMPS), which was established in 1993. The principal objective of the RMPS is to promote sustainable development in Tasmania, and is comprised of three complementary Acts, namely:

- Land Use Planning and Approvals Act 1993 (LUPAA)
- State Policies and Projects Act 1993 (SPP Act)
- Tasmanian Planning Commission Act 1997.

For RMPS, 'sustainable' is defined as:

> *… managing the use, development and protection of natural and physical resources in a way, or at a rate, which enables people and communities to provide for their social, economic and cultural wellbeing, and for their health and safety, while:*
>
> - *sustaining the potential of natural and physical resources to meet the reasonable foreseeable needs of future generations;*
> - *safeguarding the life-supporting capacity of air, water, soil and ecosystems; and*
> - *avoiding, remedying or mitigating any adverse effects of activities on the environment.*

RMPS objectives inform land use planning instruments at the state, regional and local levels through State Polices, Tasmanian Planning Policies, Regional Land Use Strategies and the Tasmanian Planning Scheme.

Concurrently to the RMPS, two other Acts guide the regulation of landslide areas, including:

- Mineral Resource and Development Act 1995
- Building Act 2016

2.4 Planning reform and landslide planning

Land use planning in Tasmania has been a process of gradual change towards a statewide planning system, which has been driven by the introduction of the Resource Management and Planning System (RMPS) in 1993. Prior to 1993, the state had some 60 planning schemes in 48 Local Governments, with some dating back to the 1940s. In this context, landslide controls were typically managed reactively through local knowledge or the declaration of Landslide A and B areas. This changed in the 1970s with MRT undertaking advisory mapping in the Tamar Valley, classifying the landscape into five zones (I-V) with differing levels of intervention and management.

Following the introduction of the RMPS in 1993, the state updated and consolidated the previous schemes into 33 schemes dating between 1979 and 2006. Generally, the schemes applied a variety of slope and geology controls, Landslip A and B, Tamar Valley Zonation (I-V), regional zonation mapping (MRT), and local knowledge. In 2009, development of regional land use strategies began as part of the development of temporary planning controls for 3 model interim planning schemes, designed for use while the statewide scheme was developed. Each of the interim schemes included landslide controls, with the southern region and northwestern region using the 2013 Landslide Planning Map as the regulatory overlay. In contrast, the northern region retained the Tamar Vally Zonation (Class IV and V) and Landslip A and B as the regulatory overlay while including the 2013 Landslide Planning Map as a supplementary advisory layer.

A summary of the landslide planning controls in use within the RMPS is provided in Appendix 1.

In 2014, amendments to the Land Use Planning and Approval Act 1993 were introduced to provide for a streamlined planning system, including a single planning scheme for Tasmania. Legislation for the Tasmanian Planning Scheme, comprising the State Planning Provisions and Local Provision Schedules, was gazetted in December 2015. The amendments also allowed for the creation of Tasmanian Planning Policies (TPPs).

The TPPs are land use planning policies in Tasmania that establish objectives and strategies for development across the state. They inform regional land use strategies, with the overall goal of promoting a consistent and strategic planning system that balances environmental protection, economic development, social needs, and heritage preservation. Policy 3.2 Landslip sets the objective "*to reduce the risk of harm to human life, property and infrastructure from the adverse impacts of landslip hazards*."

The updates to the Landslide Planning Map, as outlined in this report, forwards strategy 1 of the policy which reads "…Identify and map land that is susceptible to landslip hazards…". However, the Landslide Planning Map is a susceptibility-based model and does not have adequate information to associate a likelihood of a rainfall event with a landslide occurring, while coastal processes such as sea level rise are captured through the coastal erosion planning map.

The TPPs will come into effect on 1 July 2026.

Within the context of the Tasmanian Planning Scheme, planning authorities are required to prepare draft Local Provisions Schedules that operationalise the State Planning Provisions and align with the Regional Land Use Strategy. SPP Clause LP1.7.12 Landslip Hazard Code, requires that each LPS use the Landslide Planning Map.

2.5 Development of the 2013 Landslide Planning Map and hazard bands

In 2013, the draft Landslide Planning Map was provided to local government and state agencies to inform the development and coordination of appropriate management, land use planning, and building controls to reduce the risk of landslides to future development within tolerable limits.

The Landslide Planning Map uses the best available evidence to describe areas exposed or susceptible to landslides, employs a qualitative process to assess relative landslide susceptibility, groups areas into hazard bands, and describes controls to manage the potential consequences of a landslide occurring due to the new use or development. Figure 2 below shows the translation of the components into the landslide planning – hazard bands.

Input datasets include peer-reviewed landslide inventory mapping and landslide susceptibility modelling performed by MRT. In areas without detailed landslide mapping or susceptibility modelling, landslide susceptibility is estimated from slope angle, calculated on a 10 m Digital Elevation Model derived from LiDAR. Because susceptibility differs by type of landslide, the zones are derived by combining

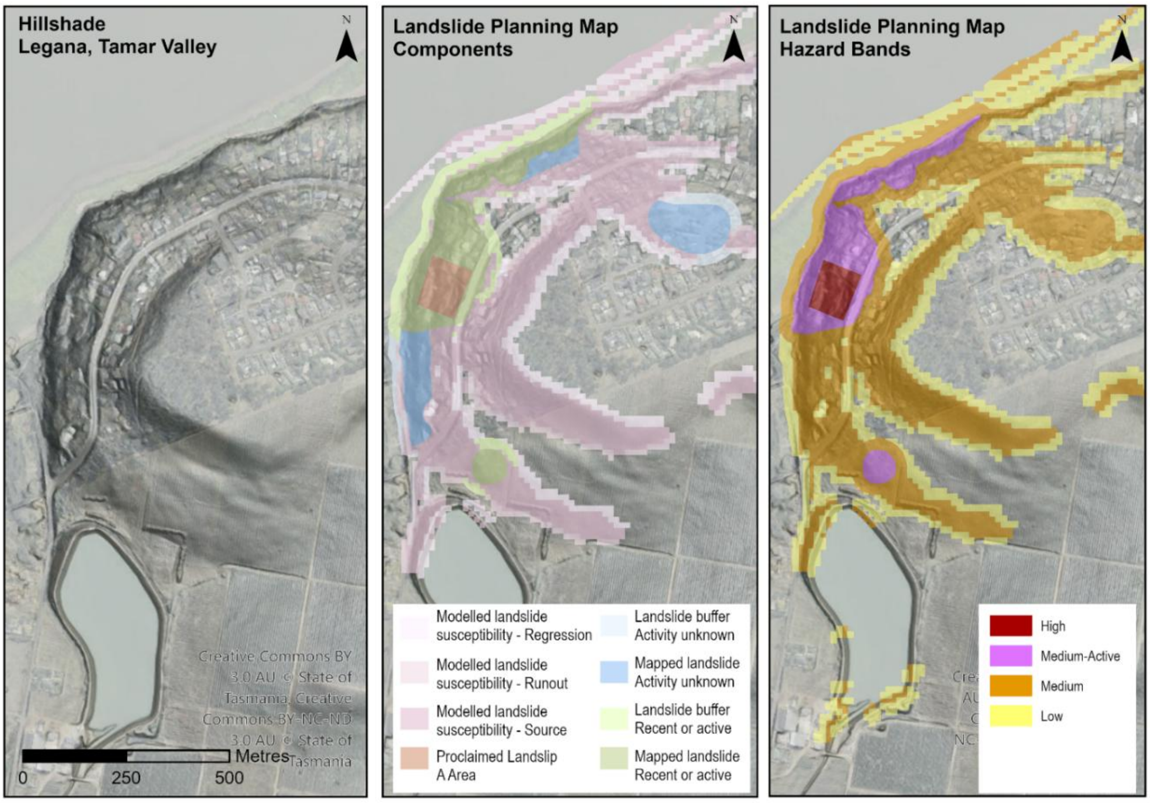


Figure 2 An example of landslide component and hazard band mapping for an area in part of Legana, north of Launceston. Components are derived from MRT mapping and modelling, proclaimed landslip zones, and slope thresholds, as described in Mazengarb and Stevenson (2010).

components (individual map layers) that separately consider shallow landslides and flows, deep-seated landslides, rockfalls/topples, and debris flows.

The methodology (shown in Figure 3) seeks to translate the outputs of the MRT mapping programme, including the landslide inventory mapping and zonation, into planning controls. It was developed jointly by DPAC and MRT. The boundaries between the hazard bands were defined based on a qualitative (pairwise assessment) ranking process and consultation with regulators in local government and industry practitioners. The thresholds between the bands are an expert judgment made in a workshop setting and tested based on known examples, considering that the most severely impacted areas in the Greater Hobart region, Tamar Valley and Tasmania's northwest coast have undergone more detailed mapping. This report documents the process used to update the 2013 Landslide Planning Map. A summary of the planning and building controls is provided in Appendix 2.

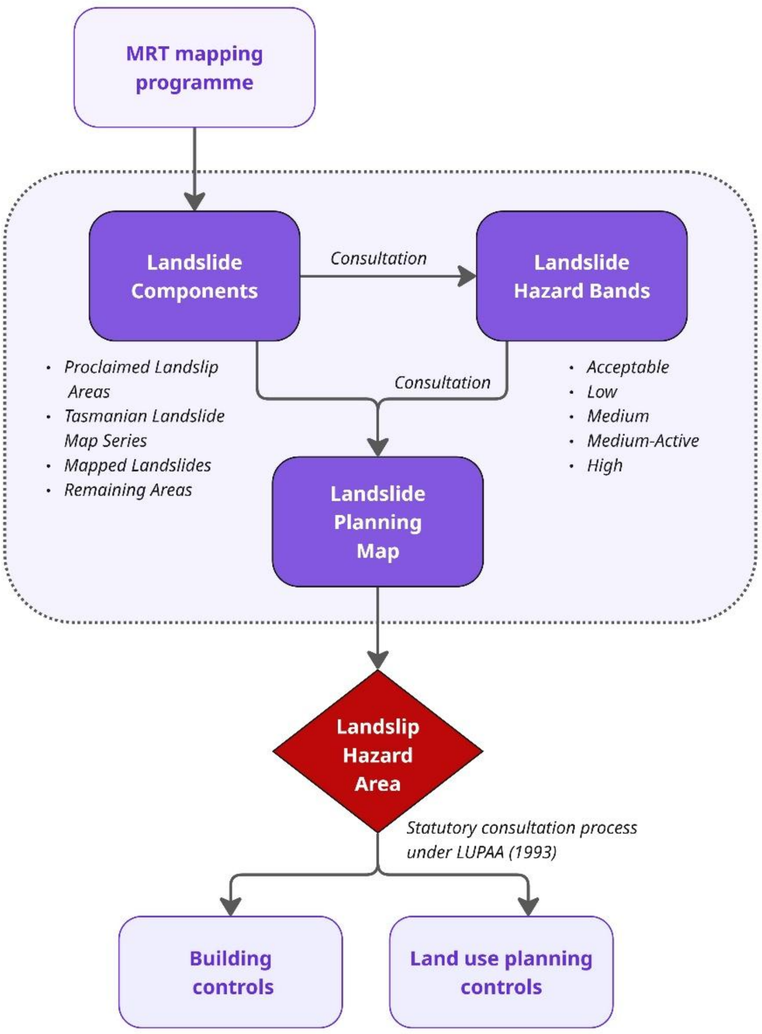


Figure 3. Process to develop the Landslide Planning Map and hazard bands, and their relationship to the regulatory environment.

2.6 Consultation for the review of the State Planning Provisions and Landslide Planning Map

The State Planning Provisions (SPPs) came into effect on 2 March 2017, as the statewide set of consistent planning rules in the Tasmanian Planning Scheme (TPS). These provisions cover 23 zones and 16 codes, and comprise a suite of requirements for the application on zones and codes for local government planning authorities to develop or adopt through the Local Provisions Schedule (LPS) for each municipal area.

The SPPs Landslip Hazard Code includes five natural hazard codes that manage proposals for use and development in areas subject to natural hazards. Clause LP1.7.12 (a) Landslip Hazard Code of the SPP requires that:

> *Each LPS must contain an overlay map produced by the Department of Premier and Cabinet, showing landslip hazard areas for the application of the Landslip Hazard Code, unless modified by the planning authority for part of the municipal area. If modified, the modified map must be shown.*

In May 2022 the then Minister for Planning launched the first 5 yearly reviews of the SPPs required by the *Land Use Planning and Approvals Act 1993* (LUPAA). A consultation process resulted in 163 submissions, which included comments on the hazard codes. The report on the consultation was published in July 2023 and outlined a work program for the SPPs review. This work programme was structured around seven Action Groups and a prioritised list of projects to address the issues.

The more complex issues raised through the SPPs Review regarding these hazard codes are being addressed through Action Group 2 projects, which include the update to the Landslide Planning Map. A more detailed review of the hazard codes will also be undertaken as an Action Group 2 project to deliver any additional improvements to their operation. There are also ongoing Action Group 6 projects for developing improved guidance material to assist with SPPs implementation and interpretation. More information on the SPPs review work program is available on the Planning in Tasmania website.

Concurrent with the SPPs review, the Department of Premier and Cabinet (DPAC) was supporting West Tamar Council and MRT in the management of active landslips at Legana and Brickmakers Point along the Tamar River. While providing this support, it became apparent that the way exemptions to the Landslip Code operate can lead to developments that include significant works not appropriately considering the medium, medium-active or high landslip hazard bands. Lessons learned through this support informed the changes being made to the exemptions, the mapping review, and the development of process to advise local government of active landslide for inclusion in the planning system.

In September 2023 DPAC and MRT commenced a review and update of the 2013 Landslide Planning Map to reflect the latest scientific evidence. Consultation on the mapping update was coordinated with the SPP amendment that responded to issues raised about the interpretation and operation of the exemptions in the Landslip Hazard Code. This amendment was taken forward to the Minister in 2024.

In this consultation process, a number of concerns were raised, including:

- The accuracy of the 2013 mapping,
- The process used to categorise hazard bands,
- The need for a process to update mapping quickly in areas of active landslides,
- The terminology used to describe the hazard bands,
- That the mapping describes areas susceptible to landslide, not just areas of active landslides or with defined active landslide processes assessed in a site-specific risk assessment.

- The need for supporting documents to help with the interpretation of the planning code and building regulations.

This report and the 2025 mapping update address these concerns through improvement to the accuracy of the 2013 mapping, providing an outline of the process to review the hazard band classification, and provides guidance on the mechanisms to recognise active landslide mapping in the planning and building systems ahead of an LPS amendment.

This report also addresses questions relating to the terminology (see Section 5.2). Stakeholders supported the use of a banded approach to describe areas in which landslide hazard is addressed, as outlined in the 2013 Landslide Planning Report (DPAC 2013c) and associated policy guidance on the mitigation of natural hazards in the planning and building systems (DPAC 2013a, DPAC 2013b).

Whilst the Landslip A and B areas, which are administered by MRT and declared under the *Mineral Resources Development Act 1995,* are recognised in the Landslide Planning Map, the rationale for each declaration is not part of the scope of this report or review. During consultation, some questions were raised regarding the rationale and process to define Landslip A and B areas, along with concerns around additional regulation outside of the planning system that falls under the *Building Act 2016.* These concerns were specific to individual areas and best addressed on a case-by-case basis, independently from this review. In these cases, advice was provided to seek further advice from the relevant state and local government agencies.

The State Planning Office with MRT and CBOS are preparing supporting documents for the Landslip Hazard Code, including:

- Website updates to provide further guidance on the planning system
- Questions and Answers document.
- A fact sheet for the landslip hazard code, similar to that currently available for the coastal hazard codes.
- Development and publication of a mapping layer showing newly identified active landslides and guidance materials on how to apply in the planning and building systems.
- Reviewing the “Tasmanian Landslide Map Series technical methodology” (Mazengarb and Stevenson, 2010).

This report describes updates made to the 2025 Landslide Planning Map when compared to the 2013 Landslide Planning Map. It is intended to support the public consultation process required under LUPAA to update or amend the Local Planning Provisions.

3 Updates to the Landslide Planning Map Components

This section describes the changes to the component datasets that underpin the Landslide Planning Map hazard bands. In most cases, changes involve updates to input data or expansion of mapping and modelling. The 2025 methodology broadly aligns with the methods outlined in earlier documents, particularly Mazengarb and Stevenson (2010).

Table 1 summarises the final changes to the components, which are discussed in the remainder of Section 4.

Table 1. Summary of updates to the landslide component datasets that underpin the hazard banding.

Mapping type	2013 Landslide Planning Map Component	Updates	2025 Landslide Planning Map Component
Proclaimed Landslip Areas	Landslip A areas	Minor boundary updates where declared zones intersect the coastline	Landslip A areas
	Landslip B areas	Minor boundary updates where declared zones intersect the coastline	Landslip B areas
Tasmanian Landslide Map Series	Rockfall susceptibility source + runout area 34 degrees	Expanded coverage (statewide)	Rockfall susceptibility source + runout area 34 degrees
	Rockfall susceptibility runout area 30 degrees	Expanded coverage (statewide)	Rockfall susceptibility runout area 30 degrees
	NA	New component (statewide)	Regression areas adjacent to cliffs > 42 degrees
	Shallow slide + flow susceptibility source high	No change (NW Tas)	Shallow slide + flow susceptibility source high
	Shallow slide + flow susceptibility source moderate	No change (NW Tas)	Shallow slide + flow susceptibility source moderate
	Shallow slide + flow susceptibility source low	No change (NW Tas)	Shallow slide + flow susceptibility source low
	NA	New component (NW Tas)	Shallow slide + flow susceptibility runout

	Debris flow susceptibility Mountain source + runout > 30 degrees	No change	Debris flow susceptibility Mountain source + runout > 30 degrees
	Debris flow susceptibility Mountain source + runout 30-26 degrees	No change	Debris flow susceptibility Mountain source + runout 30-26 degrees
	Debris flow susceptibility Mountain source + runout 26-22 degrees	No change	Debris flow susceptibility Mountain source + runout 26-22 degrees
	Debris flow susceptibility Mountain source + runout 22-12 degrees	No change	Debris flow susceptibility Mountain source + runout 22-12 degrees
	Debris flow susceptibility Mountain runout – dam-burst	Removed component	NA
	Launceston Group slide susceptibility (large and small) Undifferentiated slide susceptibility (source/regression/runout)	Expanded coverage – Evandale and Penna Removed Launceston Group specification Standardised as source/regression/ runout	Landslide susceptibility – Source Area Landslide susceptibility – Regression Area Landslide susceptibility – Runout Area
	Hobart-Glenorchy deep-seated slide susceptibility (Rosetta scenario)	No change	Deep-seated landslide susceptibility – Source (Rosetta scenario)
Known landslides - actual	Mapped slides – deep-seated/Launceston Group, recently active	Merged components and expanded to new map areas across the state	Mapped landslides – Recent or active
	Mapped slides – other slides/flows, recently active		
	Mapped slides – deep-seated/Launceston Group, activity unknown	Merged components and expanded to new map areas across the state	Mapped landslides – Activity unknown
	Mapped slides – other slides/flows, activity unknown		
Remaining areas susceptibility	Slope < 11 degrees	Updated DEM and reviewed thresholds	Remaining areas: Slope < 9 degrees (Tertiary sediments) Slope < 11 degrees (elsewhere)
	Slope 11-20 degrees	Updated DEM and reviewed thresholds. Slope threshold for Low was reduced to 9	Remaining areas: Slope 9-20 degrees (Tertiary sediments)

		degrees in some northern areas.	Slope 11-20 degrees (elsewhere)
	Slope > 20 degrees	Updated DEM and reviewed thresholds	Remaining areas: Slope > 20 degrees

3.1 Proclaimed Landslip A and B Areas

Proclaimed (or Declared) Landslip Areas are legally designated zones under the Mineral Resources Development Act 1995. Landslip A covers recent or historically active landslides, and Landslip B applies to adjacent land that is considered to be unstable. This system was developed to restrict or prohibit development on unstable ground, and legislated controls apply to use and development within these areas. There are only 10 proclaimed Landslip Areas around the state:

- Beach Rd, Legana (2001)
- Beauty Point - Beaconsfield (1984, 2002)
- Boat Harbour (1975, amended 2008)
- Casuarina Crescent, Glenorchy (2001)
- Freshwater Point, Legana (1988)
- Hone Rd, Rosetta (1992)
- Lowana Rd, Strahan (2003)
- Panorama Heights, Devonport (1975)
- Parnella, St Helens (1981)
- Windermere (1988)

No new proclaimed Landslip A or B areas have been declared since the 2013 mapping. However, slight boundary shifts have been made in some cases where the existing proclaimed landslip areas are legally tied to cadastral or coastline boundaries. Minor adjustments have been made to the zones at Boat Harbour, St Helens, Beauty Point, and Windermere. These changes ensure that the digital layers match their counterparts (i.e. the planning map and the cadastre or mean high water mark) and do not affect the legal zone boundaries as surveyed on the ground.

Activities in Landslip A areas are controlled by separate legislation and are fundamentally different to other components in the Landslide Planning Map. The option of separating these from the other components was raised but ultimately rejected as infeasible during the consultation process.

Summary: Minor adjustments to boundaries were made where required for some Landslip A and B areas.

3.2 Tasmanian Landslide Map Series – Susceptibility Zones

The Tasmanian Landslide Map Series (Mazengarb and Stevenson, 2010) includes regional-scale susceptibility mapping across parts of the state (Figure 4), derived from GIS-based susceptibility modelling. Modelled processes include rockfall source and runout, debris flow source and runout, and both deep-seated and shallow landslides. The modelled coverage varies for each of these processes

(Table 2). For detailed technical information on the modelling methodology and failure thresholds, see Appendix 5 and Mazengarb and Stevenson (2010).

Table 2. Regions covered by susceptibility modelling.

Process	Coverage
Rockfall	Statewide
Debris flow	Glenorchy, Hobart
Deep-seated landslide	Glenorchy, Hobart, Tamar Valley
Shallow landslide/flow	North west

The Launceston Group susceptibility modelling distinguishes landslide source areas, regression areas, and runout areas. This mapping methodology has been extended to two new areas: Evandale (near Launceston) and Penna (near Hobart) (Figure 4). These regions were prioritised due to observed active landslide processes coinciding with interest in development. The new susceptibility modelling was performed at 10 m resolution and the existing modelling in the Tamar Valley was refreshed for consistency and to take advantage of new LiDAR data collection. The name 'Launceston Group' has been removed from the 2013 component names and replaced with 'Landslide susceptibility – Source/Regression/Runout area'. This change has created a consistent naming convention across the entire state and has allowed corrections to be made for incorrectly categorised areas in the existing datasets. The merging of affected 2013 components does not result in any loss of information, because the underlying geology is considered in the slope thresholds applied in the susceptibility modelling. In addition, the geological information can be queried using MRT's publicly available geology layers. The coverage of MRT's detailed landslide susceptibility mapping programme is shown in Figure 4.

The Evandale mapping is an extension of the Tamar Valley and Launceston mapping available in 2013. A comparative example of the 2013 and 2025 mapping for this area (Figure 5) highlights the limitations of using simple slope thresholding to estimate landslide susceptibility in areas where the geology is complex or has low material strength. The changes here are significant because recent mapping has identified additional landslides from LiDAR mapping, and the modelling has highlighted susceptible areas that were not previously captured by the simple slope categorisation algorithm.

The shallow landslide and flow susceptibility components apply to a limited area in northern Tasmania, and are separated into low, moderate and high susceptibility (Figure 6). This mapping methodology has not been extended to any other areas of the state since 2013. However, the 'Shallow landslide and flow – Runout area' component is now included alongside the 'Shallow landslide low/medium/high – Source' susceptibility areas. This component was excluded from the final published mapping in 2013. Note that shallow landslides do not regress to the same extent as deeper failures and so there is no 'Shallow landslide and flow susceptibility – Regression' component.

Deep-seated landslide susceptibility modelling of a simpler type covers parts of the Greater Hobart region. This modelling also includes source, regression and runout areas, with no new use of this methodology since 2013. The separation between this and the northern modelling in the components has been maintained because they use different methodologies and there are significant differences in the material strength of the geological units involved.

The rockfall susceptibility coverage was limited in 2013 (to the area around kunanyi/Mt Wellington and along the central north coast). Furthermore, it only considered rockfall source and runout areas, with thresholds of 34 degrees and 30 degrees. This modelling has been expanded to a statewide rockfall model and a rockfall regression component has been added, which represents a susceptible set-back area behind steep slopes and cliffs (>42 degrees). The chosen angles are based on the angle of repose for dolerite talus (Caine, 1983) and from unpublished field observations in Tasmania. The modelling has been undertaken on a 10 m statewide DEM, of which approximately 70% is built from LiDAR data. An example of the rockfall source and runout mapping is shown in Figure 7.

No changes have been made to the primary debris flow susceptibility and runout components. These components were modelled on a 10 m LiDAR-based DEM and remain fit for purpose in the current mapping. However, the debris flow – dam burst component has been removed. This component was originally named to represent a scenario-specific model of the 1872 Glenorchy debris flow (with a proposed mechanism that has not been proven) and has now been superseded by more recent data. However, it is important to note that debris flow risk remains an important consideration for Glenorchy, and the other debris flow components are still part of the Landslide Planning Map. Furthermore, low-slope-angle debris flow runout shares many characteristics of flash flooding and may be better captured by flood risk management processes.

Summary: Updates have been made to incorporate new landslide susceptibility mapping and simplify the component names. Rockfall susceptibility has been expanded to a statewide model. The debris flow – dam-burst component has been removed.

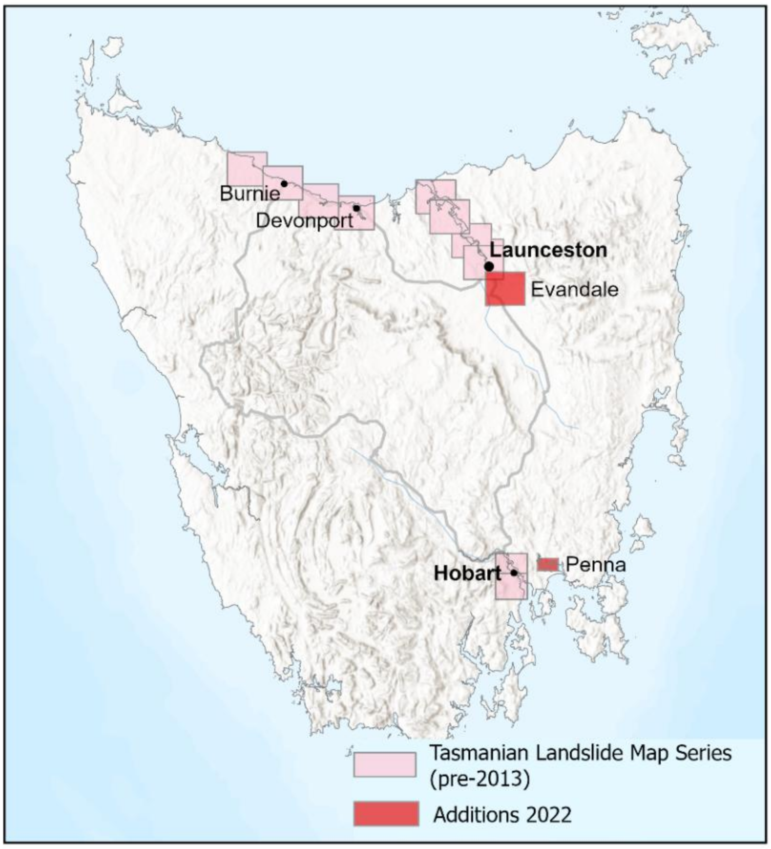


Figure 4. Spatial coverage of the Tasmanian Landslide Map Series. Evandale and Penna have been mapped since the previous version of the Landslide Planning Map was released.

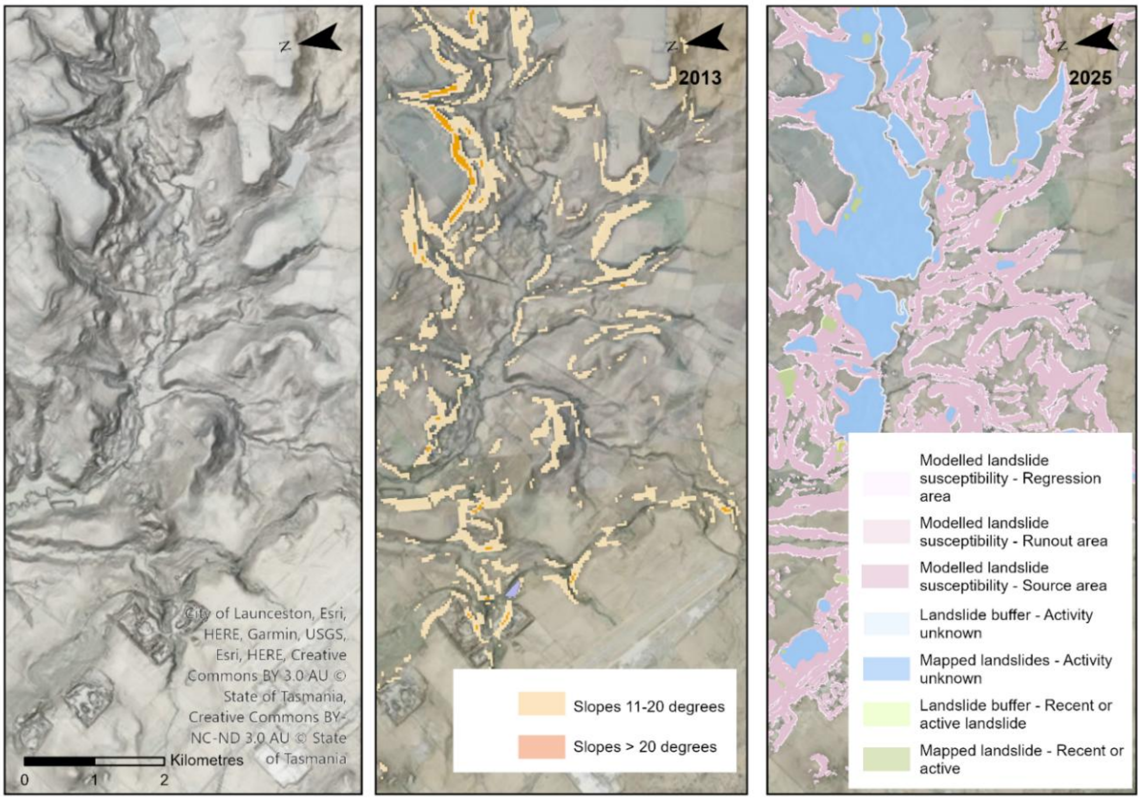


Figure 5. A comparison of the components around Evandale, in 2013 (middle) and 2025 (right).

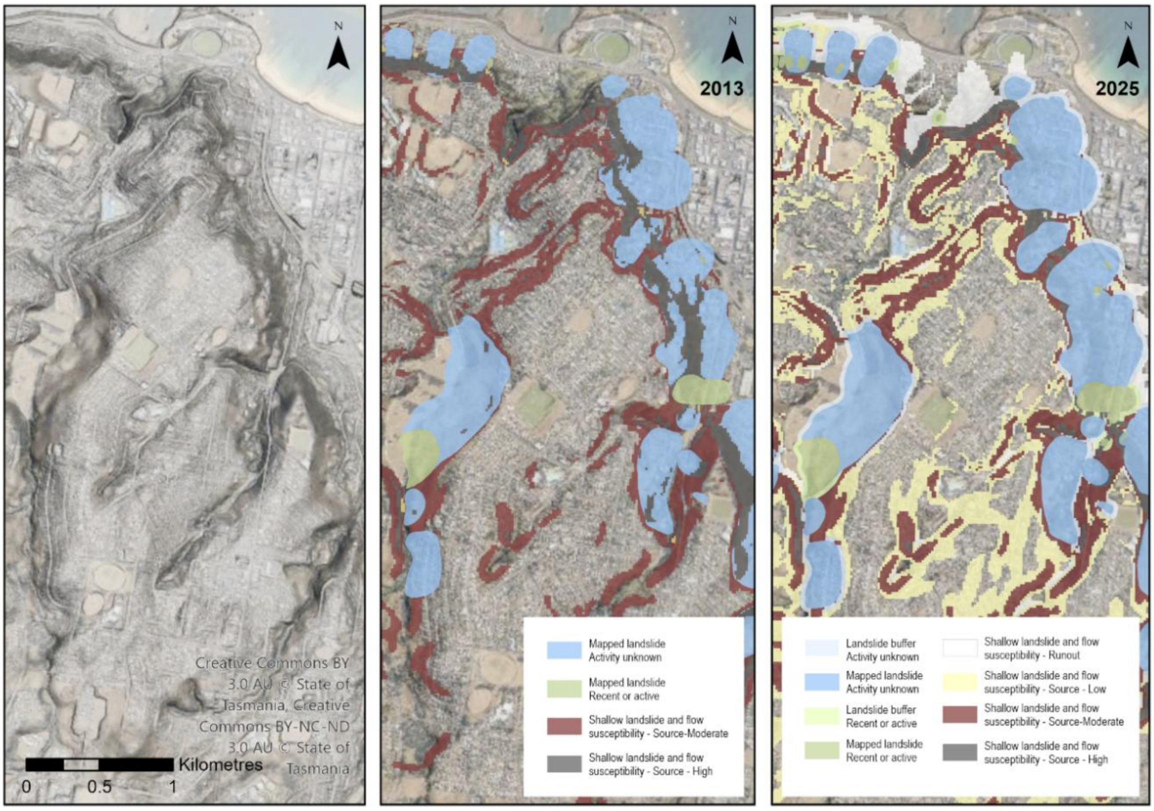


Figure 6. Shallow slide and flow susceptibility mapping around Burnie, showing the addition of runout and source-low components as a result of the 2025 updates. Note that mapped landslides are also shown.

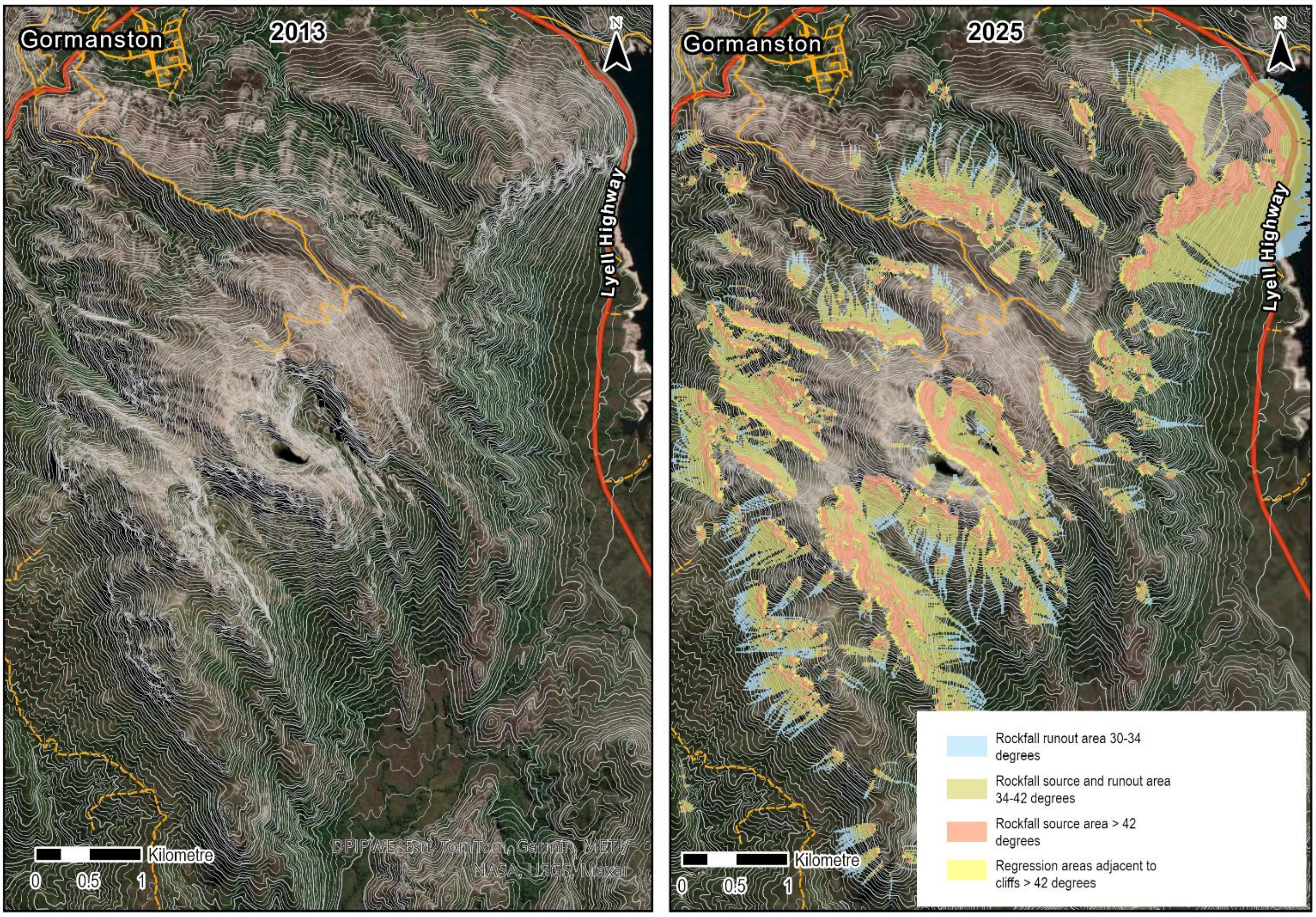


Figure 7. Example of the statewide rockfall source and runout layers.

3.3 Mapped Landslides

Landslides that appear in the Landslide Planning Map are derived from MRT's landslide database, which is a dynamic inventory that is continually updated with newly mapped landslide features. In it, mapped landslides are identified as either 'recent or active' or 'activity unknown'. The 'recent or active' group are landslides that have occurred or reactivated over the last ~200 years. If the timing of a landslide's last movement is not known, it is entered in the database as 'activity unknown'.

To inform the Landslide Planning Map update, MRT recently completed a programme of systematic landslide mapping across priority urban and peri-urban areas using LiDAR data to identify additional landslides in the landscape (Figure 8). These areas include Tasman Peninsula and Greater Hobart, Central Coast, main highways, and parts of the Western Tiers. Since the 2013 Landslide Planning Map was released approximately 6700 landslides have been added to MRT's database, which now totals over 9400 entries. Of this total, 1958 are classed as recent or active, with 507 of these active since 2013. Some of the 'activity unknown' group may still have occurred or reactivated in the last ~200 years, but most probably predate the nineteenth century. However, it is important to note that landslide features that have not been historically active could reactivate in the future. An example of the updated feature mapping in the Huon Valley area is shown in Figure 9.

The 2013 Landslide Planning Map Components further divide mapped landslides into Launceston Group deep-seated slides and other slides/flows, making a total of four components. However, some of those landslides were incorrectly mapped as Launceston Group and are located in areas with different underlying geology. In the 2025 planning map update, these four components have been simplified into two: ‘Mapped landslides – Recent or active’ and ‘Mapped landslides – Activity unknown’. No information is lost in this merging process, as the underlying geology can be queried in MRT’s publicly available geology layers. MRT also maintains a database of point features, which represent landslides that have not been mapped in detail.

The issue of defining a landslide boundary was raised by a geotechnical practitioner during the consultation process. To address this uncertainty and the potential expansion of landslides beyond the mapped boundary (through regression, runout, or lateral expansion), a 20 m external buffer has been added to all mapped features, which translates to the addition of two new Landslide Planning Map Components: ‘Landslide Buffer – Activity unknown’, and ‘Landslide Buffer – Recent or active’.

Summary: Updates take advantage of new mapping and simplify component names. A buffer of 20 m has been generated around each landslide feature.

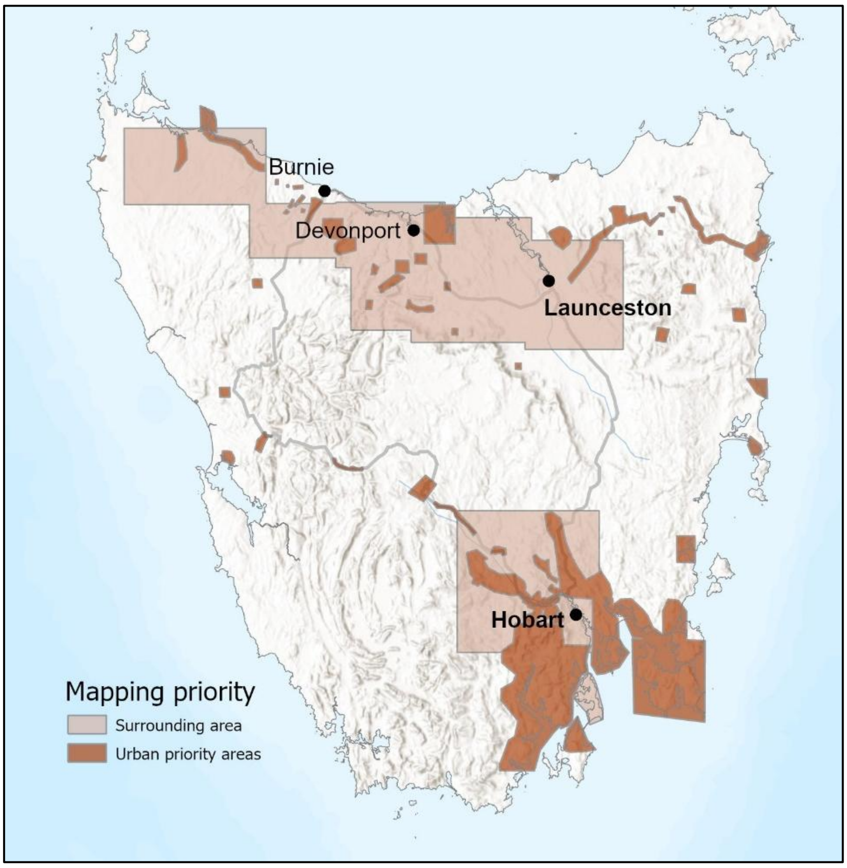


Figure 8. Areas of focus for MRT’s 2022-2023 peri-urban mapping programme

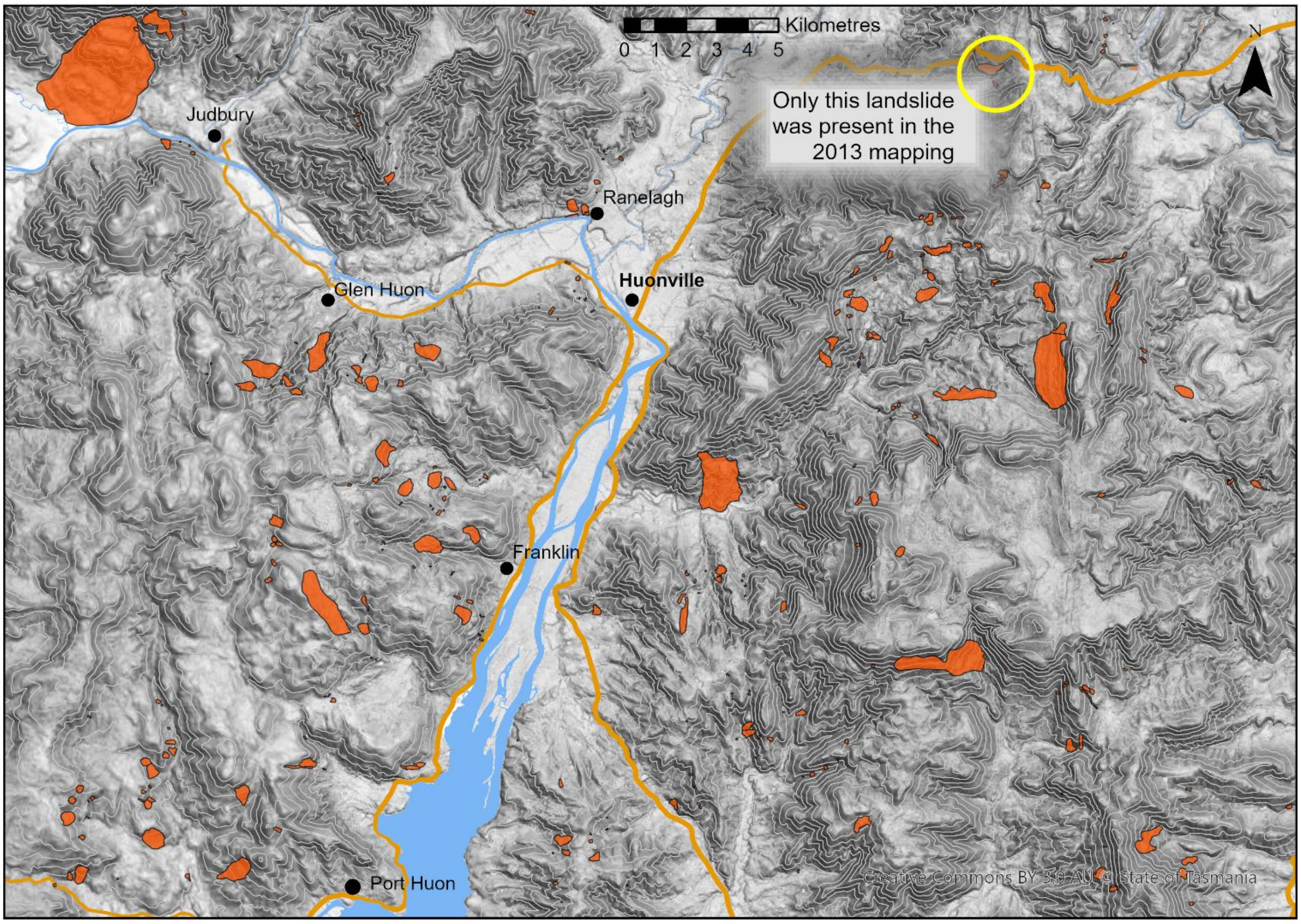


Figure 9. Landslide features mapped around the Huon Valley, showing the improvement in MRT's inventory between 2013 and 2025.

3.4 Remaining Areas – Susceptibility

Slope angle is used as a proxy for landslide susceptibility in areas that are not covered by the feature mapping or source-regression-runout susceptibility modelling. Since 2013, a substantial amount of new LiDAR data has been captured and a new 10 m DEM has been created for the state. The slope angle mapping has been refreshed using the latest DEM, which is a significant improvement from the previous 25 m DEM that underlies the 2013 slope angle calculations. An example of the improvement in resolution is shown in Figure 10Figure 10.

The 2013 approach divided the landscape into three slope categories with thresholds of <11 degrees, 11-20 degrees, and >20 degrees. These parameters were defined in 2013 using the cumulative frequency of mapped landslides against slope angle, separated by geology (DPAC, 2013). The suitability of these values was assessed by revising this analysis using the updated landslide inventory (Figure 11) and performing a geospatial analysis of mean slope angle for mapped landslides. The results found that a significant proportion of landslides in the northern part of the state (i.e. in the areas of Tertiary sedimentary and basaltic units) occurred on slopes < 11 degrees and were not captured by the 2013 hazard bands. The approximate boundary of these more failure-prone geological units was mapped (Figure 12) and the slope thresholds in these areas were adjusted to < 9 degrees, 9-20 degrees, and > 20 degrees. Note that the zone boundaries for Launceston Group and basalt landslides in Figure 11 appear lower than 9 degrees on the frequency curve, which occurs because the mean slope of the landslide considers the total failed mass. Observations of adjacent slopes, combined with values from published literature suggested a threshold of 9 degrees was appropriate. In addition, most of the urban areas situated on these geological units are covered by more detailed susceptibility modelling, which means that this simple slope-based zoning does not apply to these areas.

Summary: The slope angle threshold mapping was updated using the most recent DEM for Tasmania. This change improves the slope mapping resolution from 25 m to 10 m. The acceptable-low threshold value has been decreased from 11 to 9 degrees in northern areas covered by weak sedimentary units like Tertiary sediments and basalts.

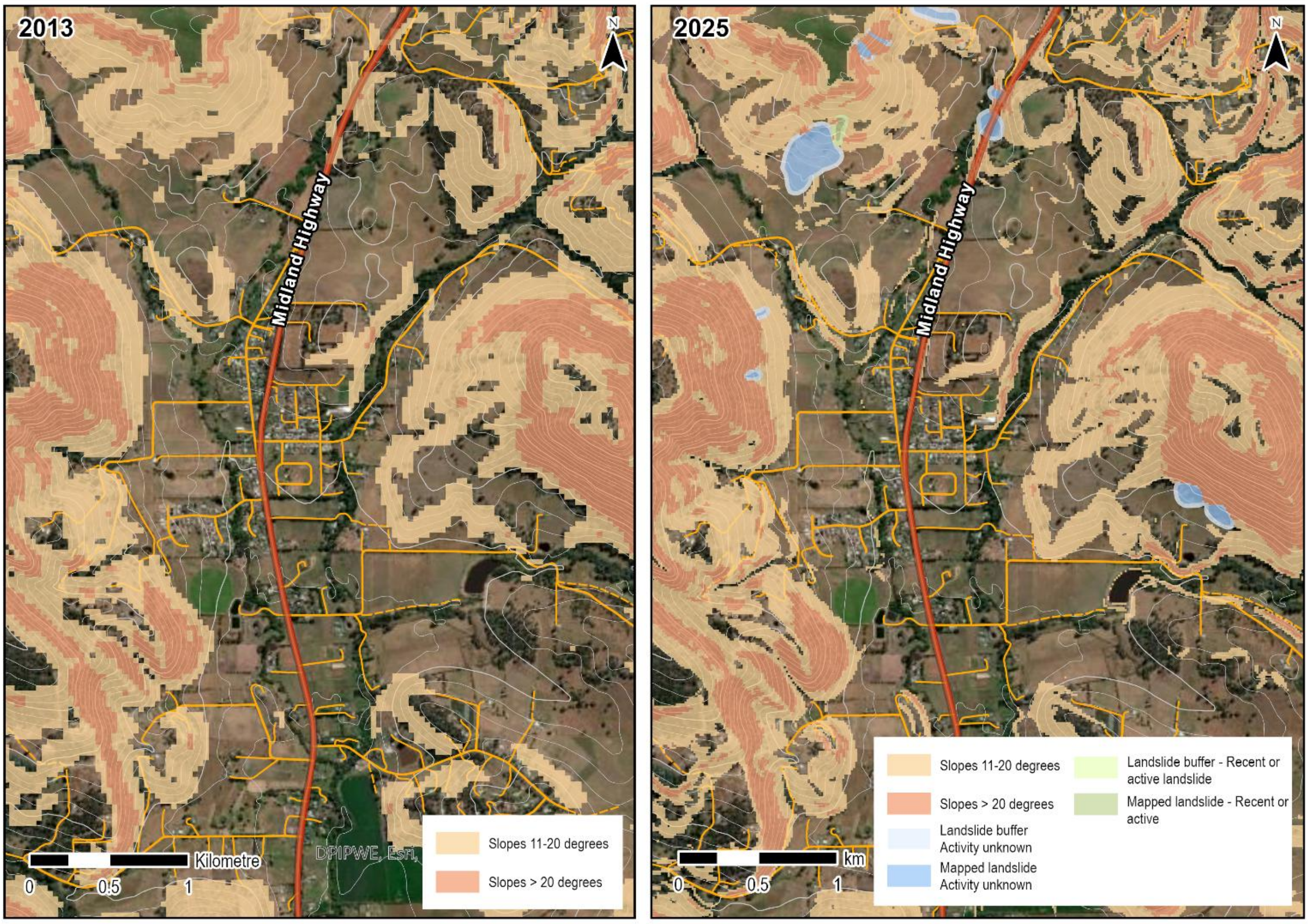
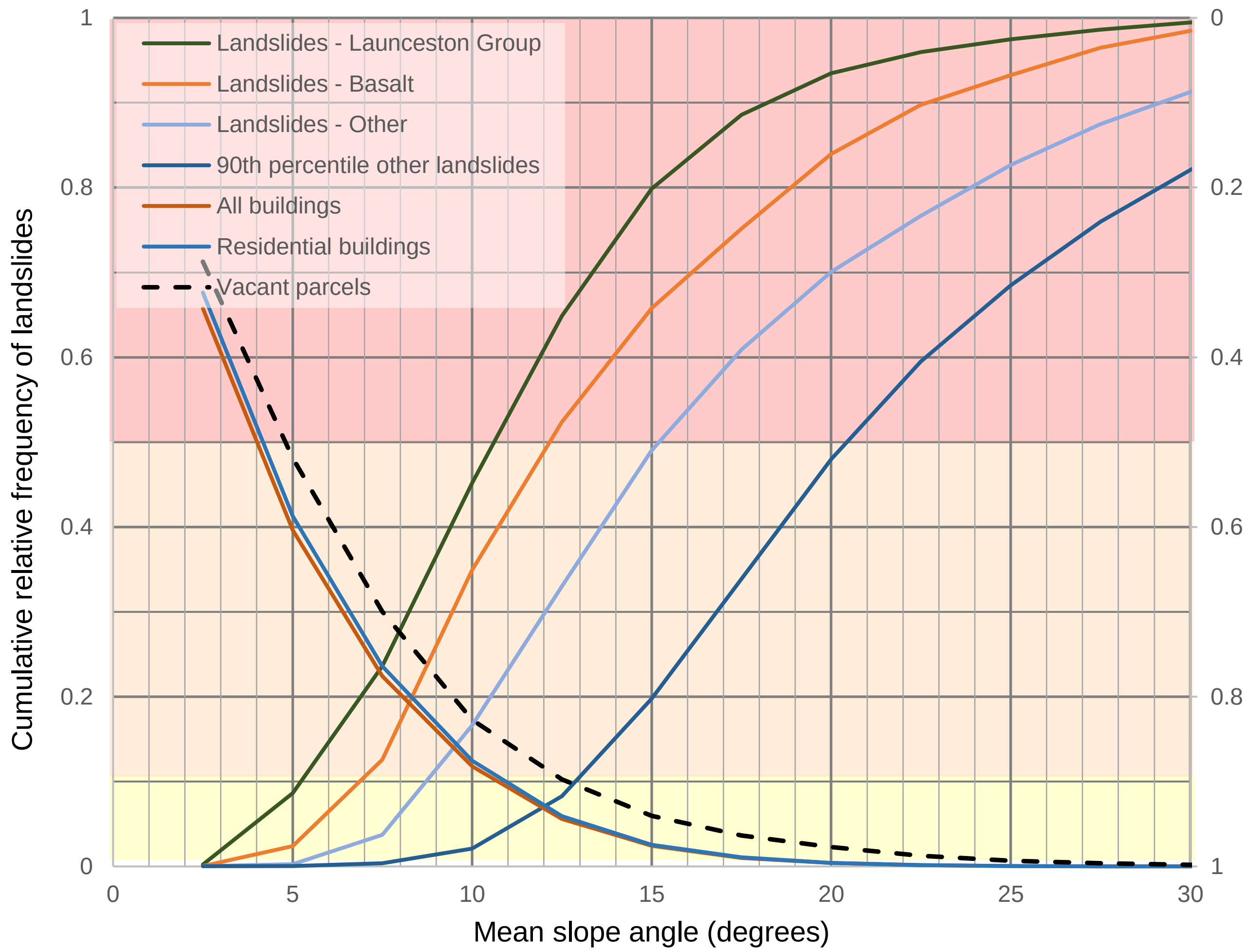


Figure 10. Remaining areas, slope angle components as mapped in 2013 using a 25 m DEM and the updated 2025 outputs using a 10 m DEM.



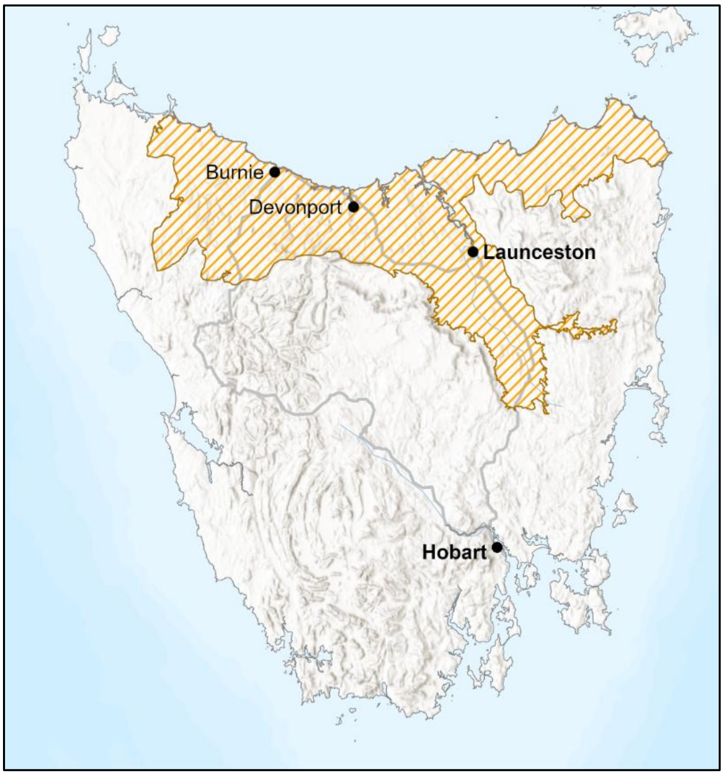


Figure 11(above). The distribution of landslides, buildings and vacant land by slope angle. Note the lower mean slope angles for landslides in basalt or Launceston Group sediments. Alongside the observed spatial distribution of landslides across the state, this graph further justifies the lowering of the acceptable-low threshold in areas underlain by tertiary sediments and weathered basalts.

Figure 12 (left). Map showing the area where the 9 degree acceptable-low threshold applies across northern Tasmania (hatched area). This area encompasses Tertiary basalts and sediments, which are more failure prone, including the Launceston Group. The threshold remains at 11 degrees elsewhere

4 Changes to the Landslide Hazard Bands policy map

Updates to the component mapping are largely limited to improvements in input data. However, these updates have resulted in some changes to the boundaries of the zones in the hazard bands. These changes were explored in the second consultation workshop and were coordinated with the review of the State Planning Provisions (SPPs) to ensure that all changes are complementary.

4.1 Translation of the Components to Hazard Bands

The 2013 Landslide Planning Map used a pairwise assessment to rank the components. A pairwise assessment is a decision-making tool that helps determine the relative importance of a set of categorical variables. This assessment used the *Potentially All Pairwise Rankings of all possible Alternatives* (PAPRiKA) method (Hansen and Ombler, 2009), which gives a qualitative overall rank to each component by independently comparing its relative importance to every other component and summing the results. By breaking down the comparison into sets of two variables, it provides a systematic and direct evaluation of each component against each of the others (albeit derived from expert judgement), which reduces bias when compared with ranking components holistically as a list (Hansen and Ombler, 2009). This method was chosen because the data does not contain sufficient information on landslide intensity or frequency to support a quantitative analysis.

Where a component was ranked as more important than the other in a pair, it was scored 0, with the least important component scored 1000. If they were considered of equal importance, each was given a score of 100 for that pairing. The components with the lowest overall score were ranked the highest. Note that there are two types of possible pairs – dominated (that have a natural order of importance, such as slope angle or legislative controls) and un-dominated pairs (relying on expert judgement to decide which is more important). When the pair is not implicitly ranked, the following criteria is used:

- Is one more likely to occur than the other?
- Which has a greater area subject to an event?
- How broad is the category, and does it encompass more than one landslide hazard type?
- Which presents the greater hazard to areas of existing or likely future development?
- Are land use controls required by legislation?

The resultant pairwise ranking table is a decision support tool that gives an indication of the relative importance of each component in terms of intervention requirements. Notably, the ranking gives an order to the components but does not indicate the degree to which each is more or less important than the component directly before or after it. The pairwise comparison was completed by five geohazard scientists or engineers (four of whom specialise in landslide processes). The final ranking of the component was subject to sensitivity testing and expert judgement.

The pairwise comparison process was repeated with the 2025 components, which produced the rankings provided in Table 3 and Figure 13. The raw pairwise comparison table is shown in Appendix 3. The boundaries of the hazard bands were assigned to approximately the same pairwise score levels as 2013, to ensure the mapping fitted appropriately into the existing statutory controls. Expert judgement was applied to the results to avoid unnecessarily increasing the regulatory impost because of the changes, resulting in three manual adjustments being made to the component-hazard band translation.

These included the adjustment of ‘Shallow slide susceptibility-Moderate’, ‘Landslide susceptibility – Regression’ and ‘Landslide susceptibility – Runout’, which moved from the medium to a low hazard band. In the context of Tasmanian landslides, these components represent slow landslides that do not pose a risk to life. Note that debris flow source and runout in moderate to steep slopes has increased from low to medium in the latest ranking process, and this change was retained due to the hazardous and rapid nature of debris flow processes.

It is important to understand and account for the interplay between science, policy and legislation in the ranking process. This translation cannot be viewed simply from a science perspective, nor purely from a regulatory perspective. For example, both Proclaimed Landslip A areas and Mapped Landslides – Recent or active represent historically active landslides and are not scientifically different. However, rigid legislative controls apply to Landslip A areas and so they must be separate, even though they are both ‘high susceptibility’. As previously discussed, terminology changes were considered but not supported by stakeholders. Similarly, the decision to adjust several components was made by asking whether the resulting regulatory level (set by existing legislation) was reasonable for each component.

Table 3. Summary of the pairwise comparison ranking process for the translation of the Landslide Planning Map components to hazard bands.

Component	Pairwise score	2025 Hazard Band	2013 Hazard Band
Mapped landslides – Recent or Active	18	Medium-Active	Medium-Active
Proclaimed Landslip A	1117	High	High
Debris flow susceptibility – Mountain source and runout – steep slopes (30-34 deg)	1710	Medium	Medium
Regression areas adjacent to major cliffs	2106	Medium	Medium
Shallow slide susceptibility – Source - High susceptibility	2106	Medium	Medium
Mapped landslides – Activity Unknown	2808	Medium	Medium
Rockfall susceptibility – Source and runout areas > 34 degrees	2907	Medium	Medium
Debris flow susceptibility – Mountain source and runout – (26-30 degrees)	3205	Medium	Medium
Proclaimed Landslip B	3205	Medium	Medium
Deep-seated slide susceptibility – Source area	4005	Medium	Medium
Statewide - Steep slopes (>20 degrees)	4509	Medium	Medium
Rockfall susceptibility – Source area and runout area >30 degrees	5706	Low	Low
Deep-seated slide susceptibility – Regression area	6804	Low	Low
Deep-seated slide susceptibility – Runout area	6903	Low	Low
Debris flow susceptibility – Mountain source and runout areas (20-26 degrees)	7506	Low	Low
Shallow slide susceptibility – Source area, moderate susceptibility	10503	Low	Low

Statewide – Moderate slopes (9-20 degrees in north, or 11-20 degrees elsewhere)	12501	Low	Low
Debris flow susceptibility – Mountain source and runout (14-20 degrees)	14103	Acceptable	Acceptable
Shallow slide susceptibility – Source, low susceptibility	16101	Acceptable	Acceptable
Statewide – Low slopes (< 9/11 degrees)	17100	Acceptable	Acceptable
Shallow slide susceptibility - Runout	18001	Acceptable	Acceptable

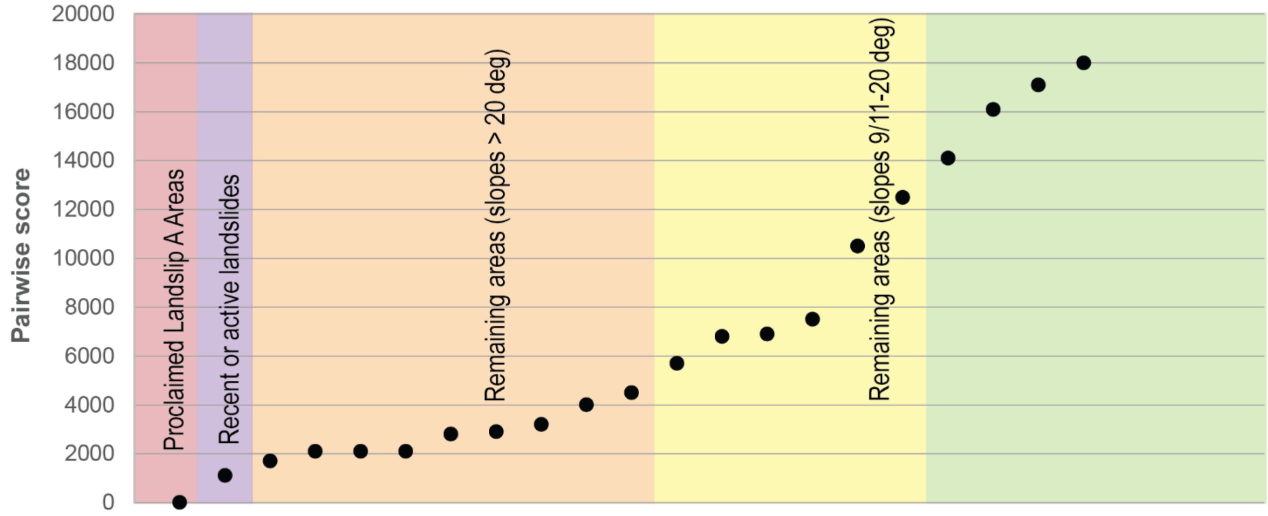


Figure 13. Graph of the Pairwise Comparison ranking scores for the 2025 components. Lower scores represent higher rankings. The breaks depicted correspond approximately to the levels shown in Table 4 below, noting that manual adjustments were made to some components.

4.2 Terminology

As part of the consultation process, the naming convention of the hazard band levels was considered. It is important to note that the term ‘hazard’ is used in the context of ISO 31073:2022, as a ‘source of potential harm’. It is recognised that geotechnical practitioners interpret this term differently (AGS 2007a), and users should be aware that the hazard bands do not imply an absolute likelihood, landslide intensity or frequency.

The 2013 outputs use an ordinal scale from acceptable, through low, medium, medium-active, and high (see Appendix 2 for a description of controls that apply to each band). Feedback from some users suggested that the difference between medium, medium-active, and high can cause confusion for users (including practitioners unfamiliar with the banding methodology).

Other potential options for naming these levels were explored and MRT put forward two possible alternatives: 1) Replace these terms with a numerical naming convention of Landslide Planning Band 1-5 (or similar); 2) Adjust the terms to very low, low, medium, high, and very high (Proclaimed Landslip A

Area). The relationship between the proposed naming conventions and the 2013 system is shown in Table 4.

Most attendees in the consultation workshop favoured retaining the 2013 naming system. Reasons included familiarity with the existing system, the administrative and legislative burden of changing the names of the bands (when changes are not otherwise required), the potential to cause further confusion with the previous systems (option 1 with recently retired Tamar Valley Class I-V mapping), or further conflate the terminology of site specific risk assessments with the banding names, and a broad acceptance of cross-disciplinary differences in language.

Notably, there were some supporters for each of the newly proposed options, and a general agreement that if, in the future, a new approach to landslide hazard management is proposed, the naming of the bands should be considered then.

Table 4. Options for hazard band names presented at the second consultation workshop.

Current Band	Option 1	Option 2
Acceptable	Band 1	Very Low
Low	Band 2	Low
Medium	Band 3	Medium
Medium-Active	Band 4	High
High	Band 5	Very High (Proclaimed Landslip A Area)

5 Implications of the mapping changes

The mapped areas were compared to the 2013 coverage and the results were presented for consultation. When considering the changes at a statewide level (visually summarised in Figure 14), the new mapping represents a total increase in regulated area of 5.6% (3908 km^2). This includes a 4.1% increase in coverage of the medium hazard band (2822 km^2) and a 1.6% increase (1077 km^2) in coverage of the low hazard band (Table 5).

These changes are broken down by Local Government Area (LGA) in Table 5, with the magnitude of difference and an explanation of the components driving the change detailed in Appendix 4. The greatest increase in coverage from 2013 to 2025 occurred in northern LGAs that are affected by the reduction in slope angle threshold from 11 to 9 degrees to reflect the updated understanding of the risk in these areas. These include Burnie, Central Coast, Kentish, Latrobe, and Waratah-Wynyard. Note that the coverage of the medium and low hazard bands decreased in Hobart and Glenorchy due to improvements in the rockfall modelling algorithm, which reduced the instances of isolated pixel blocks relating to rockfall hazard on the lower slopes of kunanyi/Mt Wellington.

Analysis of the impacts to residential buildings and vacant parcels (a proxy for future development) showed that the total number of residential buildings sitting within a regulated area has increased, but the percentages in each band have not changed significantly from 2013 to 2025 (Figure 16).

The relative stasis in the percentage of residential buildings within the regulated area (despite a 5.6% increase in hazard band coverage from 2013 to 2025) could be due to two factors. Firstly, much of the increase in regulated area applies to land that is outside of urban or developable areas. For example, many of the newly mapped landslide polygons occur on steep slopes above or away from urban areas. The same is true of the area covered by the new slope threshold categories. Secondly, the hazard band system has gradually come into effect over the last 10 years and so the regulatory system is now acting to restrict development in unsuitable areas across all LGAs through planning and building controls. An analysis of developable land shows that most vacant private cadastral parcels fall within the acceptable hazard band (86%), with 6.5% in low and less than 5% falling within medium, medium-active or high hazard bands. When comparing these numbers with the 2013 banding (Figure 15), there has been a 3% increase in the number of parcels falling within the acceptable hazard band, a 0.5% drop in parcels falling within the medium band and a 1.1% drop in low. These changes are almost certainly reflecting the impacts of regulatory changes resulting from the 2013 banding, whereby subdivision and development have been subject to increased checks and balances in the higher hazard bands.

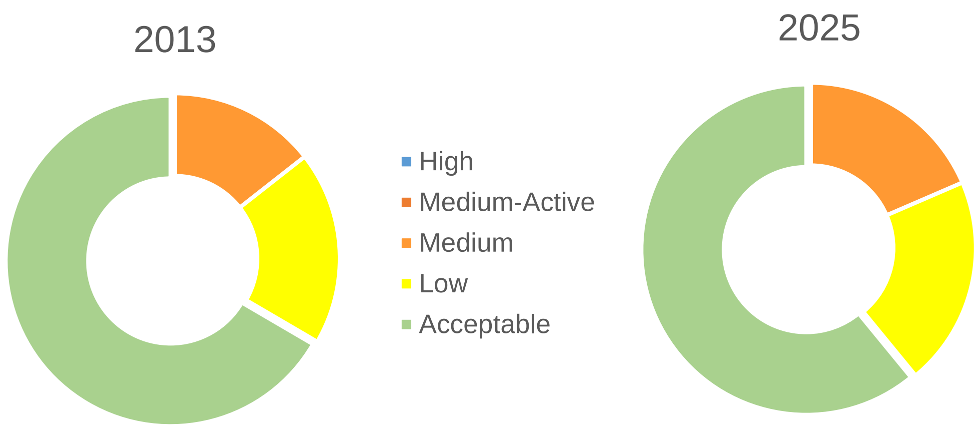
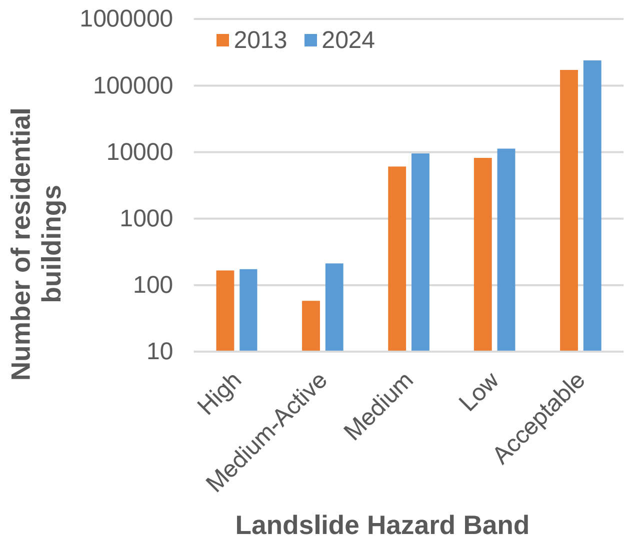


Figure 14. Statewide summary of the hazard band coverage by area, comparing 2025 and 2013.

Table 5. Percentage change to hazard band coverage by LGA.

LGA	High	Medium-Active	Medium	Low	Acceptable
Break Oday	0.0	0.0	4.6	0.4	-5.0
Brighton	0.0	0.0	2.1	1.1	-3.2
Burnie	0.0	0.0	6.4	8.3	-14.8
Central Coast	0.0	0.0	6.1	5.9	-12.1
Central Highlands	0.0	0.0	2.0	0.7	-2.7
Circular Head	0.0	0.0	3.0	4.4	-7.4
Clarence	0.0	0.0	1.4	0.6	-2.0
Derwent Valley	0.0	0.0	5.6	0.1	-5.7
Devonport	0.0	0.0	0.2	0.6	-0.9
Dorset	0.0	0.0	2.4	5.5	-7.9
Flinders	0.0	0.0	1.1	0.9	-2.0
George Town	0.0	0.0	1.4	5.6	-7.1
Glamorgan Spring Bay	0.0	0.0	3.0	0.7	-3.7
Glenorchy	0.0	2.3	3.2	-2.5	-2.9
Hobart	0.0	0.3	-1.3	-3.2	4.2
Huon Valley	0.0	0.0	5.5	-0.5	-5.1
Kentish	0.0	0.0	8.4	5.1	-13.5
King Island	0.0	0.0	0.1	0.8	-0.8
Kingborough	0.0	0.0	5.3	0.3	-5.7
Latrobe	0.0	0.0	3.6	5.5	-9.1
Launceston	0.0	0.0	4.2	0.6	-4.9
Meander Valley	0.0	0.0	6.6	1.6	-8.2
Northern Midlands	0.0	0.0	1.9	1.5	-3.5
Sorell	0.0	0.0	2.1	1.3	-3.5
Southern Midlands	0.0	0.0	2.5	1.1	-3.6
Tasman	0.0	0.0	6.6	1.1	-7.7
Waratah Wynyard	0.0	0.0	7.6	3.4	-11.0
West Coast	0.0	0.0	5.5	0.0	-5.5
West Tamar	0.0	0.0	3.4	4.7	-8.2
Statewide	**0.0**	**0.0**	**4.1**	**1.6**	**-5.6**



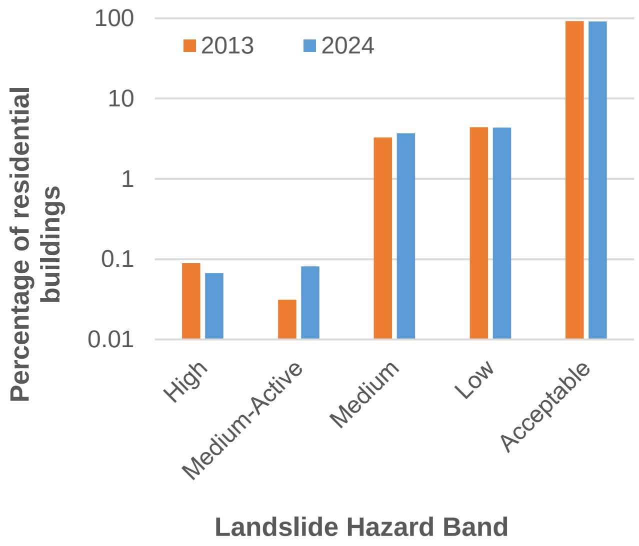


Figure 16. Comparison of the number (left) and percentage (right) of residential buildings in each hazard band in 2013 and 2025.

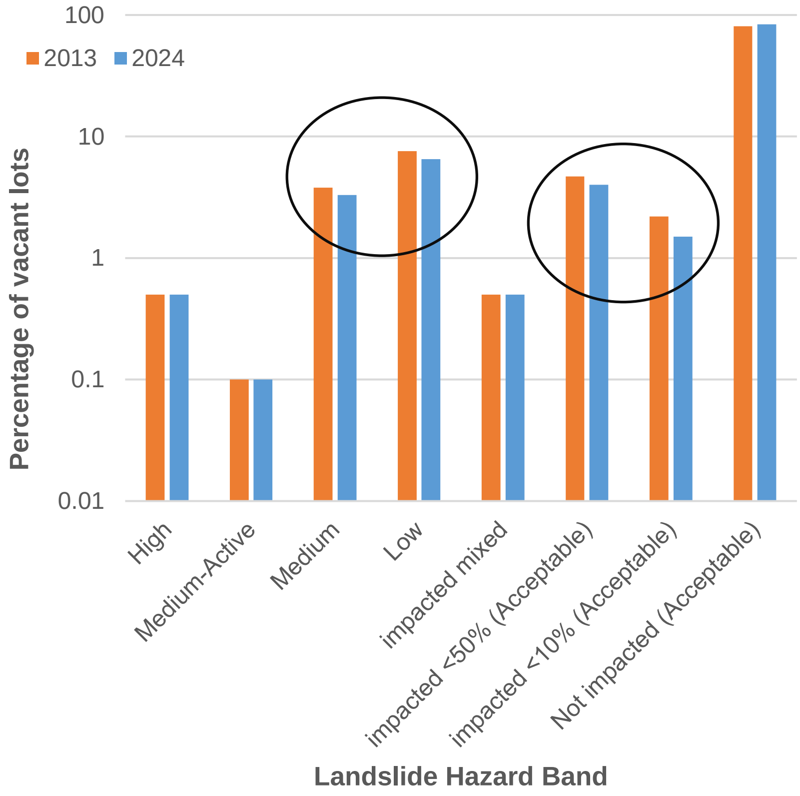


Figure 15. Comparison of the percentage of vacant residential parcels in each hazard band in 2013 and 2025. Note the decrease in vacant lots falling within low, medium, impacted 10-50%, and impacted < 10%.

6 Mechanisms to incorporate new active landslide information between reviews

MRT maintains a live landslide inventory, which is available via public-facing web services. If MRT becomes aware of a new landslide activity, officers will update the inventory, and it will be available immediately. However, this new active landslide information is not incorporated into the statutory mapping as a Medium-Active hazard area until the next update to the Landslide Planning Map.

A new web feature layer has been developed to identify active landslide areas that have been mapped since the last release of the Landslide Planning Map. Guidance has also been developed for planning authorities on the application of Sections C15.2.1(b) and C15.2.2 of the Landslip Hazard Code, where the planning authority "reasonably believes, based on information in its possession, that the use or development of land has the potential to cause or contribute to landslip."

The Landslide Planning Map hazard bands have classified the active landslides as "Medium-Active" based on current knowledge of their locations and the level of intervention required to manage them. The planning authority may consider a mapped feature present in the recent or active landslides layer to be considered equivalent to the medium-active landslide planning hazard band for the purpose of the State Planning Provisions (C15.0 Landslip Hazard Code) and building regulation via the Director's Determination – Landslip Hazard Areas. Figure 17 gives an overview of the proposed process.

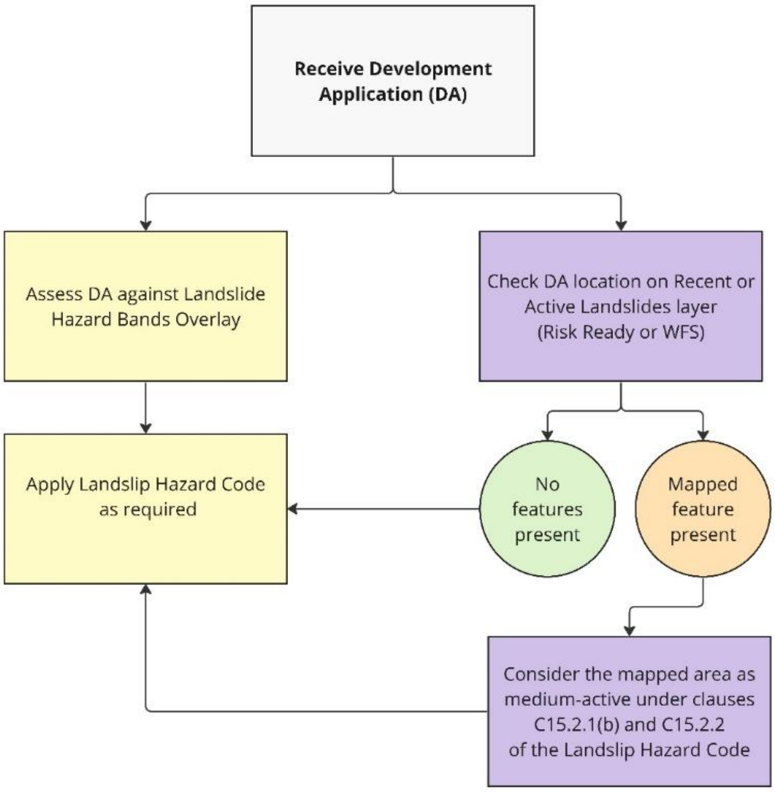


Figure 17 Application of the recent or active landslides layer in the development application assessment process.

6.1 Layer ownership and update process

The layer will be updated as MRT receives information about active or historically-active landslides that have been mapped. This process relies on industry, local government, or public contacts to provide MRT with field observations, maps, aerial photographs or spatial layers of active landslides so that they can be entered into the database. Descriptions alone are not sufficient.

For a full inventory of landslides mapped by MRT, see MRT's Geohazards TIGER database. At times, MRT staff will perform mapping of active landslides as part of daily business. However, MRT does not routinely perform site visits for the purpose of mapping landslides. Most updates will require industry, local government, or public contacts to provide MRT with maps, aerial photographs or spatial layers of active landslides so that they can be considered for entry into the database.

Landslide features can only be entered or edited in TIGER by authorised members of the Geohazards team. This ensures an appropriate level of expertise and quality control on additions.

Maintenance of this layer will be undertaken as part of MRT's broader TIGER database maintenance processes.

While the layer is owned by MRT, it is based on the available knowledge that is provided to MRT by local government, practitioners, or identified through MRTs work program but is not authoritative. As each new feature is added the Director of Mines will:

1. Authorise the feature to be included in the layer,
2. Write to the relevant planning authority to advise them of the change, and
3. Republish the layer with the updated feature.

Features in the layer will be updated at each review point, or if the landslide is considered significant enough to warrant an immediate amendment to the SPP/ LPS.

6.2 Accessing the layer

- Landowners, managers, or regulators can access the layer via a property based search on Risk Ready:
  https://alert.tas.gov.au/get-ready/risk-ready/
- Or connected directly into local GIS software via a REST data service:
  https://data.stategrowth.tas.gov.au/ags/rest/services/MRT/GeohazardsWFS/MapServer
- Or connected directly into local GIS software as a web feature service (e.g. if REST is not supported):
  https://data.stategrowth.tas.gov.au/ags/services/MRT/GeohazardsWFS/MapServer/WFSServer?service=WFS&request=GetCapabilities
- Note that the primary dataset is hosted by MRT's Geohazards TIGER database. This layer is a subset of MRT's landslide polygon layer.

7 Limitations and future work

When developing the 2025 update to the Landslide Planning Map, a re-analysis was performed to compare the mapping against AGS principles (Appendix 6) for the designing of the landslide zonation for planning and building controls (After AGS 2007A1). Key limitations identified from this analysis and stakeholder feedback are:

- **Language:**

  The use of some elements of language in the Tasmanian Landslide Planning Map, Hazard bands, matrix, Planning Code, and Directors Determination does not align with the AGS guidelines, including use of the terms: landslip; hazard; Low, Medium, Medium-Active and High hazard bands; tolerable risk; risk assessment; or zoning.

  The language used is based where possible on the International Standard for Risk Assessment (ISO 31000: 2018). It is also influenced by historical definitions used in Tasmanian landslide planning, the definitions agreed through the development of the products in 2013, and subsequent hearings and assessments processes.

- **Lack of likelihood:**

  The Landslide Planning Map information does not consider the likelihood of failure, as this is not feasible with the available information. It is noted that studies to assess the frequency of landslides with respect to major rainfall events are yet to be completed.

  The Landslide Planning Map and Hazard Bands have been designed to ensure, as far as is reasonably practicable, that new developments consider landslide in the use, site design, construction and site management to reduce the contribution of new developments in causing landslides.

- **Mapping and quantitative susceptibility assessment**

  The mapping used in 2013 and in this update to the 2025 Landslide Planning Map represents the best available information to the state, as developed by MRT. When classified under the AGS Guidelines, they could typically be characterised as Inventory and Susceptibility mapping at Regional Information or Regional Advice standards.

  Quantitative or relative susceptibility descriptors could not be applied in either the 2013 or 2025 version of the mapping, and this is indeed difficult to achieve at a strategic scale. At a statewide level, this is precluded by the availability of necessary geological information, including regolith modelling and landslide dating data. Within MRT's inventory, dating information is largely restricted to two classes: recent or active (some dates known) and activity unknown (likely to be beyond ~200 years old, but not necessarily).

  The inventory and slope angle analysis presented in Figure 11 goes some way to addressing this issue, with the best available data, along with the analysis presented in Figure 1 of Appendix 5. This analysis considers landslide velocity and damage for different landslide types in Tasmania.

  This information has been used to inform expert judgements for qualitative assessments of relative susceptibility, but was not considered adequate to assign either quantitative or relative susceptibility values as outlined in section 7.2 of the AGS Guidelines.

- **Barriers to implementation.**

  Both local government and state agencies indicated that significant barriers existed for them to undertake and require risk assessments that are consistent with the AGS (2007) guidelines. The barriers include:

    - The cost of the risk assessments when considering the value of the potential developments, can be prohibitive.
    - The lack of sufficient practitioners to either undertake work or peer review work to AGS process and standards.
    - The AGS guidelines are not well integrated into the existing footing and foundation classification system as set out in the AS 2870 -2011 Residential Slabs and Footings Design.
    - The lack of a state-level agency to coordinate landslide policy and support regulators in assessing complex landslide risk assessments.

Recommendations for future mapping and analysis are centred around improving understanding of landslide frequency, intensity and likelihood. Although this update included substantial new inventory mapping and some updates to susceptibility modelling, these were done concurrently and so there was no opportunity to use the updated inventory to inform the susceptibility modelling updates. Moreover, much of the susceptibility modelling data has been carried over from the 2013 mapping without update. Prior to future updates, the following set of actions have been recommended by the authors, stakeholders and/or peer reviewers:

- Explore whether susceptibility classes can be quantitatively linked to likelihood estimates
- Targeted landslide dating, necessary to begin considering landslide frequency and temporal probability
- Account for climate change in the hazard mapping
- Establish a consistent susceptibility metric to allow direct comparison of components
- Perform a back-analysis of known landslide events to determine whether these would have been appropriately classified in the susceptibility modelling
- Perform a comparative analysis of statistical versus physically based models to determine the most appropriate methodology for future susceptibility modelling
- Update the older susceptibility modelling, such as Greater Hobart area and the Central-North West Coast
- Perform further work to better link the susceptibility mapping to landslide intensity

MRT is currently undertaking a Disaster Resilience Fund project (funded by the State and Commonwealth Governments) to help identify, understand and address active landslides and other ground movement hazards in Tasmania. The outcomes of this project will enable a review of the current approaches to landslide management in Tasmania and enhance geohazard risk reduction for individuals, communities, utilities, and local and state governments.

The project output will create and improve public-facing maps, overlays, and publications that enable better site management, land-use, infrastructure routing, and governance decisions. The project will achieve this by identifying and communicating the locations, extents, behaviour, likelihood, and drivers of landslides and other ground movements (sinkholes, settlement, uplift) that can threaten lives and infrastructure across Tasmania’s urban and rural landscapes.

The Australian Geomechanics Society is also currently reviewing its Landslide Risk Management Guidelines (AGS, 2007), with the intent to release an updated set of guidelines in 2026 that will cover both Australia and New Zealand. While it was unfortunate that this review was not available in time for the current mapping review or State Planning Provision Review to consider its recommendations, the AGS and geotechnical practitioners did provide comment on MRT's technical mapping approach as part of a separate workshop. The authors of this review note that the Tasmanian system seeks to operationalise much of the AGS 2007 guidelines for methodologies, including the classification of land for landslide risk, the identification of landslide features, and the undertaking of site-specific risk assessments.

8 Conclusion

The Landslide Planning Map was developed in 2013, and is part of a system of scientific maps, statutory overlays, land use planning controls and building controls, which together make up Tasmania's regulatory system for landslide hazard. This report describes the 2025 updates to the Landslide Planning Map, which were undertaken in response to a review of current processes. The outcomes of the review identified three key objectives for consideration:

1. Necessary amendments to the landslide hazard planning map that consider and incorporate improvements in new scientific data and evidence,
2. The ranking, thresholds and controls for the Landslide Planning Map – Hazard Bands – Acceptable, Low, Medium, Medium-active, and High,
3. Mechanisms to more readily incorporate information about newly identified and expanding areas of landslides into Tasmania's planning and building controls.

The 2013 Landslide Planning Map was based on good scientific principles, and no change was made to the overarching approach. Component datasets were updated to use the best available data and a targeted peri-urban mapping programme was undertaken to identify landslide features in previously unmapped areas of the state. Landslide susceptibility modelling was refreshed in the Tamar Valley and expanded in key areas (Evandale and Penna), and changes were made to the susceptibility slope angle approach where landslide evidence suggested the old thresholds were inappropriate (primarily along the northwest coast).

The total regulated area has increased by 5.6 % in the 2025 mapping update, compared to 2013. This increase can be explained by the reduction in slope angle threshold from 11° to 9° in northern local government areas such as Burnie, Central Coast, Kentish, Latrobe, and Waratah-Wynyard. Conversely, Hobart and Glenorchy saw a reduction in total hazard area due to refinements in the rockfall model.

However, despite the increase in total hazard coverage, the proportion of residential buildings within regulated areas has remained stable, indicating that much of the expanded hazard areas are located outside of the urban growth boundary. Vacant parcel analysis indicates that most land with likely future development potential is mapped in the acceptable hazard band (86%), and the number of vacant parcels in both the low and medium hazard bands has reduced since 2013. This decline is a positive outcome that likely reflects the impact of maturing regulatory controls since 2013, which have successfully directed development away from higher hazard bands.

These changes were made in consultation with local government, state agencies, and private practitioners across the land use and development fields.

The authors note that modelling is an iterative process. Future refinements may be possible with additional data and improved methodologies, and future iterations of the Landslide Planning Map should consider the forthcoming revised Landslide Risk Management Guidelines from the AGS. Notably, MRT has a Disaster Resilience Fund project to improve understanding of active ground movements and produce updated landslide mapping, and the Australian Geomechanics Society is currently reviewing its guidance on landslide mapping and risk analysis. The results of these projects should inform future reviews of the Landslide Planning Map and approaches to landslide management in the planning and development systems.

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Land Use Planning and Approvals Act 1993 (LUPAA): https://www.legislation.tas.gov.au/view/html/inforce/current/act-1993-070

Landslip Hazard Code (Section C15.0 of Tasmanian Planning Scheme State Planning Provisions): https://tpso.planning.tas.gov.au/tpso/external/planning-scheme-viewer/30/section/2?effectiveForDate=2025-07-17

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Tasmanian Planning Scheme: https://tpso.planning.tas.gov.au/tpso/external/tasmanian-planning-scheme

Regional Land Use Strategies (in review)

- Cradle Coast Regional Land Use Planning Strategy 2010-2030
- Northern Tasmania Regional Land Use Strategy
- Southern Tasmania Regional Land Use Strategy 2010-2035

Planning Schemes – Interim Planning Scheme :

- Northern Tasmanian model Interim Planning Schemes (2013)
- Cradle Coast model Interim Planning Scheme (2014)
- Southern Tasmania Model Interim Planning Schemes (2015)
    - Kingborough Interim Planning Scheme 2015 (in operation)

Planning Schemes – Pre Interim:

- Huon Valley Planning Scheme 1979.
- Port Cygnet Planning Scheme 1988.
- Esperance Coast Planning Scheme 1989.
- City of Hobart Planning Scheme 1982.
- Battery Point Planning Scheme 1979.
- Sullivan’s Cove Planning Scheme 1997.
- Break O’Day Council Planning Scheme 1996.
- Brighton Council Planning Scheme 2000.
- Burnie City Council Planning Scheme 1989.
- Central Coast Planning Scheme 2005.
- Circular Head Planning Scheme 1995.
- Clarence Planning Scheme 2007.
- New Norfolk Council Planning Scheme 1993.
- Devonport and Environs Planning Scheme 1984.
- Flinders Planning Scheme 1994.
- Dorset Planning Scheme 1996.
- Municipality of George Town Planning Scheme 1991.
- Glenmorgan Spring Bay Planning Scheme 1994. K
- King Island Planning Scheme 1995.
- Kingborough Planning Scheme 2000.
- Latrobe Planning Scheme 1994.
- Launceston Planning Scheme 1994.
- Sorell Planning Scheme 1993.

- Tasman Planning Scheme 1979.
- Waratah Wynyard Planning Scheme 2000.
- West Coast Planning Scheme 2000.
- West Tamar Planning Scheme 2006.

10 Appendix 1: Planning Controls - Landslide

Table 1 : Consideration of landslip/landside in the Pre Interim Planning Schemes (1979 -2006)

Southern region planning schemes (10 LGAs / 14 Planning Schemes)	**Northern Region Planning Schemes (9 LGAs)**	**North Western Planning Schemes**
Brighton (2000) • Development must minimise the need for engineered solutions to protect life and property **Clarence City (2007)** • Identification and mitigation of the risk from landslide **Derwent valley council (1993)** • Consider landslide • Consider if land is subject to landslide • Consider the capability of the land **Hobart city (1982)** • Risk from landslip is to be reduced to an acceptable level. • triggered by a either a rock type and slope, or landslide A and B zones • Consider the capability of the land • Consider land stability as part of a site development plan. • Identify potential impacts **Battery Point (1979)** • Consider the capability of the land **Glenorchy (1992)** • Consider landslide as part of a site development on land with a slope greater than 1 in 4 or know to be potentially unstable. • Council must be satisfied a development will not cause a landslip • The development must not place an undue risk to the occupants, the public, or property. **Sullivans Cove (1997)** • Consider the capability of the land **Esperance planning scheme (1989)** • Risk from landslide is to be acceptable • Consider landslide • Consider the capability of the land • Account if the development contributes to an increase in exposure to landslide • Stormwater will not increase the risk from landslide. • Development will not cause landslide • Development is not affected by landslide **Huon Planning scheme (1979)** • Consider the capability of the land • Council must be satisfied that the risk is acceptable • Avoidance of land instability **Port Cygnet planning scheme (1988)** • Council must be satisfied that the risk is acceptable • Consider if the land is affected by landslip • Consider the capability of the land • Rural B zone is to maintain soil stability on steep slopes. **Kingborough (2000)** • Development can occur on slopes greater than 1 in 5 if development will not be subject to landslip **Sorell Planning scheme (1993)** • Consider landslip as part of a development • Account for landslide as part of a development where it applies • Consider the capability of the land **Southern Midlands (1998)** • Clearance of vegetation will not cause a landslip • Consider if the development is subject to landslide **Tasman Planning scheme (1979)** • In areas of soft rock over a slope of 25% councils should make reference to the MRT mapping • Refer development to MRT if landslide is a potential. **Central Highlands (1998)** • No consideration	**Break O'Day (1996)** - reasonable avoidance in landslip - Demonstrate management in landslip - A and b zones and some areas a 10% slope - no development in high risk coastal areas **Dorset (1996)** - Consider landslip on slopes >20% - Consider capability of land **Flinders island (1994)** - Consider landslip on excessive slope - No development on land with a unacceptable level of risk - Other risk levels responded to through design - Landslide is assessed on a slope of 1 in 4, or is known to be susceptible **George Town (1991)** - In mapped landslip areas refer to MRT for advice. - Building sites must be free of hazard **Launceston (?)** - Class v – prohibit development - May apply discretion for 3 and 4 - for some type of developments, this would include a geotech report - Minimise the risk from hazard - Prevent development in active landslide areas. - Prevent the increase in risk to life and property - Building envelope to be free of landslip - Consider capacity of land **Meander Valley (1995)** - Consider landslip - No increase in risk or landslide potential in areas of known / suspected landslip or on slopes greater than 25%. **Northern Midlands (1995)** - Consider landslip - No increase in risk or landslide potential in areas of known / suspected landslip or on slopes greater than 25%. - Consider land capability **West Tamar (2006)** - Do not cause or contribute to landslip - Consider the risk of landslide in areas identified by MRT - To protect human life and property by avoiding where practicable or lessening the adverse impacts of landslip. - Assess risk in accordance with MRT **Glenmorgan Spring Bay (1994)** - No consideration of landslide	**Burnie (1989)** - Development in landslip areas should cause a landslip on or adjacent to the property. - Requires an engineers certificate state the above. - Consider the capability of the land. - Areas identified as doubtful land stability. **Central Coast (2005)** - Requires a vulnerability report based on the AGS guidelines. - Development does not increase the risk of landslide. - Development must have a acceptable risk to life and property. - Triggered by land considered to of "doubtful land stability" which includes MRT mapping and a steep slope based on the opinion of the planner assessing the application. **Circular Head (1995)** - Consider if the land is subject to landslip or excessive slope - No development in areas of know landslip, unless council is satisfied that the development will not cause or further a land slide. - Regard for the impact of landslip - Triggers – know landslide or a slope 1 in 4 **Devonport (1984)** - Consider the potential for landslip. - Consider the capability of the land. - Perform a geotechnical assessment in areas of doubtful land stability identified in scheme. - Assessment must demonstrate the development is safe. - Areas of doubtful land stability are based on MRT mapping. **Kentish (2005)** - Development should not cause a landslip to present a risk to life or property. - Comply with the proclaimed landslide zones A and B. - Hazard risk assessment that considers landslip in the cradle gateway **King Island (1995)** - Consider the affect of landslip - Have regard to landslip when considering a development - Consider the capability of the land **Latrobe (1994)** - Consider if the site is subject to landslip - Consider the capability of the land **Waratah-Wynyard (2000)** - No increase in landslide potential. - Identifies A and B zones in scheme **West Coast (?)** - Consider the level of risk from natural hazards (inc landslide). - Does not cause or accelerate land instability. - Development should avoid landslip areas. - Developers must assess if the hazard will occur on their land. - Does not provide guidance on how to respond to natural hazards.

Table 2: **Consideration of landslip/landside in the Interim Planning Schemes (2015 - 2026)**		
Southern Councils	**Northern Councils**	**North western Council**
Common landslide code • Consider land slip in the landslide planning map • Development will not result in an unacceptable risk . • Risk to be determined in accordance with: • Australian Geomechanics Society – Practice Note - Guidelines for Landslide Risk Management 2007;	Common landslide code (E3) Development will not cause or have a cumulative effect to increase the risk of landslide (E3.0) Applies to all areas identified in the code overlay, or potentially affected by landslide. (E3.2) Avoid development in areas of landslide risk, A or B Zones, or take suitable measures to protect life and property by demonstrating (in a landslip management report) that the residual risk is low or very low as defined in the scheme (E3.5.1). Risk based approach (E3.5.2). Trigged by the Tamar Valley mapping Class IV and V or state wide landslide planning map.	Common hazard code in the regional planning project as an interim until the state wide code: The Common Natural and Environmental Hazard Management Code (E8) - Minimise unacceptable public an d private risk - Identify a tolerable level of risk - Private risk is to be owned by the individual (not sure how this will be interpreted given the Clarence precedent) Application: - shown on the planning scheme map; or - land identified in any Mineral Resources Tasmania Landslide Planning Map; or - if the characteristics or investigations of the site and surrounding area suggest that there is a potential for landslide movement; and - land within a Landslip A or B area proclaimed under Part 9A of the Mineral Resources Development Act 1995 - The level of likely risk from exposure to a natural or environmental hazard is tolerable for the type, scale, and density of use or development

11 Appendix 2 : Landslide hazard bands matrix

Three tables: Landslip Hazard Code, Building Controls, and Definitions in the code

<table>
<tr><th colspan="4">Landslip Hazard Code</th></tr>
<tr><th>Exempt Use or Development</th><th>Use Standards</th><th>Subdivision</th><th>Development and work standards</th></tr>
<tr>
<td rowspan="4">The following use or development is exempt from the requirements of the landslip hazard code:

The following use or development is exempt from this code:
A change in use of land within a low or medium landslip hazard band, unless for critical use, hazardous use or vulnerable use;
use or development of land for Extractive Industry where a mining lease under the Mineral Resources and Development Act 1995 is in force, unless it includes hazardous use;
A change in use within all hazard bands if for:
(i) Natural and Cultural Values Management;
(ii) Passive Recreation;
(iii) Resource Development; or
(iv) Utilities;
development, including subdivision and work in the low hazard band unless it involves significant works.
Development including work in the medium hazard band unless:
it is a subdivision
it involves significant work
Subdivision for boundary adjustment</td>
<td>Uses in the medium-active and high landslip planning hazard bands
Landslip hazard report required to demonstrate that a tolerable risk can:
be achieved and maintained for the life of the use.
does not require specific hazard reduction activities or protection measures.</td>
<td rowspan="2">Acceptable solution for each lot, or a lot proposed in a plan of subdivision, within a landslip hazard area, must:
be able to contain a building area, vehicle access, and services, that are wholly located outside a landslip hazard area;
be required for public use by the Crown, a council or a State authority; or
(d) be required for the provision of Utilities</td>
<td rowspan="2">Low and Medium landslip hazard bands
Work, as defined in the planning scheme, is exempt in the low and medium hazard bands if it is not significant work.
Landslip hazard report required to demonstrate that a tolerable risk can:
be achieved and maintained for the life of the use.
does not require specific hazard reduction activities or protection measures.</td>
</tr>
<tr>
<td>Critical use in all landslip hazard bands
Landslip hazard report required to demonstrate that a tolerable risk can:
be achieved and maintained for the life of the use.
does not require specific hazard reduction activities or protection measures.
Critical uses demonstrate that they can maintain their service at a design level if a landslip occurs.</td>
</tr>
<tr>
<td>Hazardous use in all landslip hazard bands
Landslip hazard report required to demonstrate that a tolerable risk can:
be achieved and maintained for the life of the use.
does not require specific hazard reduction activities or protection measures.
Hazardous uses demonstrate how the release of hazardous substances will not unreasonably impact on the health and safety of people and the environment.</td>
<td rowspan="2">Performance Solution :

Each lot, or a lot proposed in a plan of subdivision, within a landslip hazard area must not create an opportunity for use or development that cannot achieve a tolerable risk from landslip, having regard to:
(a) any increase in risk from a landslip for adjacent land;
(b) the level of risk to use or development arising from an increased reliance on public infrastructure;
(c) the need to minimise future remediation works;
(d) any loss or substantial compromise, by a landslip, of access to the lot on or off site;
(e) the need to locate building areas outside the landslip hazard area;
(f) any advice from a State authority, regulated entity or a council; and
(g) The advice contained in a landslip hazard report.</td>
<td rowspan="2">Medium -Active and High planning hazard bands

4.
All development is required to complete a Landslip hazard report required to demonstrate that a tolerable risk can:
be achieved and maintained for the life of the use.
does not require specific hazard reduction activities or protection measures.</td>
</tr>
<tr>
<td>Vulnerable use in all landslip hazard bands
Landslip hazard report required to demonstrate that a tolerable risk can:
be achieved and maintained for the life of the use.
does not require specific hazard reduction activities or protection measures.
Vulnerable uses demonstrate how the occupants or emergency service personnel can be protected, evacuated, and be informed of what to do.</td>
</tr>
</table>

Building Act 2016 and Building Regulation 2016				

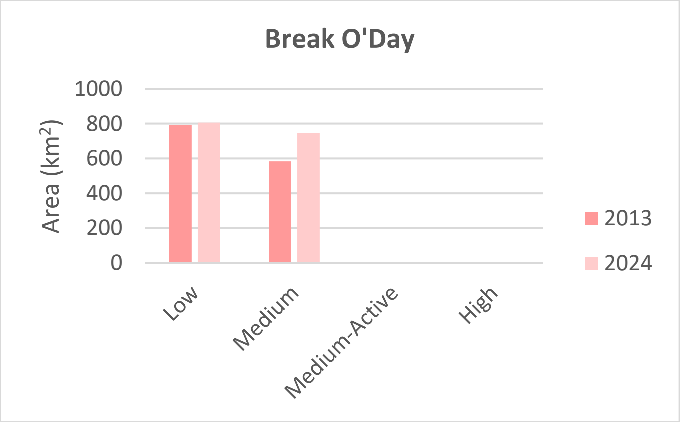
Landslip A and B areas declared under the Mineral Resource Development Act 1995 have specific controls under the Building Act 2016 applies specific controls to Landslip A and B areas. These controls apply in addition to the controls imposed through the land use planning system. There are restrictions about what types of building work or other activities may be carried out in landslip A and B areas:
• In a landslip A (high) and B area, a permit authority or general manager must provide written approval prior to work commencing that takes into account any landslip hazard report and any relevant landslip management plan,
• A person in landslip A or B area must not fell or remove vegetation, or use earthmoving or vibration compaction equipment in either,
• A person in a landslip B area must not store more than 10, 000l of water or a dangerous substance.
• The requirements for the high hazard band apply to work in a landslip A area.
	In a **low hazard band**
	• Specified work and significant work to become notifiable work unless already permit work.
	• A soil scientist can undertake a AS2870 site classification,
	• A landslip hazard report may be required by the site classifier, engineer-civil, building surveyor,
	• Footing system must be designed by an engineer – civil unless AS2870 report considers site to not be a P site for landslip
	• The building design (including footings and significant works) must demonstrate that they have applied the AS2870 report, landslip hazard plan, and landslip design guidelines
	• The building surveyor, prior to issuing the CLC, must be satisfied that the design of the works demonstrates compliance with the recommendations of reports concerning landslip.
	• The permit authority must consider the AS2870 report, geotechnical investigations and relevant management plan when a permit is to be issued.
		In a **medium-hazard band**
		• Specified work and significant work to become notifiable work unless already permit work.
		• AS2870 site classification must be undertaken by geotechnical practitioner,
		• A landslip hazard report may be required by the AS2870 report, engineer-civil, building surveyor,
		• Footing system must be designed by an engineer – civil unless AS2870 report considers site to not be a P site for landslip
		• The building design (including footings and significant works) must demonstrate that they have applied the AS2870 report, landslip hazard plan, and landslip design guidelines
		• The building surveyor, prior to issuing the CLC, must be satisfied that the design of the works demonstrates compliance with the recommendations of reports concerning landslip.
		• The permit authority must consider the AS2870 report, geotechnical investigations and relevant management plan when a permit is to be issued.
			In a **medium-active hazard band**
			• Specified work and significant work to become notifiable work unless already permit work.
			• AS2870 site classification must be undertaken by geotechnical practitioner,
			• A landslip hazard report must be prepared,
			• Footing system must be designed by an engineer – civil
			• The building design (including footings and significant works) must demonstrate that they have applied landslip hazard plan, and landslip design guide
			• The building surveyor, prior to issuing the CLC, must be satisfied that the design of the works demonstrates compliance with the recommendations of reports concerning landslip.
			• The permit authority must consider the AS2870 report, geotechnical investigations and relevant management plan when a permit is to be issued.
				In a **high hazard band (including Landslip A)**
				• See section on landslip A and:
				• Work may not be performed if it involves the erection, re-erection, construction, alternation or addition to premise.
				• The permit authority cannot authorise a person to :
				  ○ Erect an insubstantial building
				  ○ Carry out work other than erections; or
				  ○ Erect a building within the boundaries of a wharf
				• A landslip hazard report must be prepared,
				• Footing system (when permitted) must be designed by an engineer – civil
				• The building design (including footings and significant works) must demonstrate that they have applied landslip hazard plan, and landslip design guide
				• The building surveyor, prior to issuing the CLC, must be satisfied that the design of the works demonstrates compliance with the recommendations of reports concerning landslip.
				• The permit authority must consider the AS2870 report, geotechnical investigations and relevant management plan when a permit is to be issued.

12 Appendix 3: Pairwise comparison table

More important is 1000, Less important 1, Equal importance is 100	atewide slopes 0-11 degrees	atewide slopes 11-20 degrees	tewide slopes > 20 degrees	gression areas adjacent to major cliffs	ckfall susceptibility source + runout area > 34 degrees	ckfall susceptibility source + runout area 30 degrees	bris flow susceptibility Mountain source + runout >30 degrees Q1	bris flow susceptibility Mountain source + runout 30-26 degrees Q2	bris flow susceptibility Mountain source + runout 26-22 degrees Q3	bris flow susceptibility Mountain source + runout 22-12 degrees Q4	allow slide susceptibility - source high	allow slide susceptibility source - moderate	allow slide susceptibility source - low	ep-seated slide susceptibility - source	ep-seated slide susceptibility - regression	ep seated slide susceptibility - runout	apped slides - Recently active	apped slides - Activity unknown	oclaimed Landslip A	oclaimed Landslip B	allow susceptibility runout
Statewide slopes -low slopes		1	1	1	1	1	1	1	1	1	1	1	100	1	1	1	1	1	1	1	1
Statewide slopes -moderate slopes	1000		1	1	1	100	1	1	1	1	1	100	1	100	100	100	1	1	1	1	1000
Statewide slopes - steep slopes	1000	1000		100	100	100	1	1	1000	1000	100	1000	1000	100	1000	1000	1	1	1	1	1000
Regression areas adjacent to major cliffs	1000	1000	100		100	100	100	100	1000	1000	100	1000	1000	100	1000	1000	1	100	1	100	1000
Rockfall susceptibility source + runout area > 34 degrees	1000	1000	100	100		1000	1	100	100	1000	100	1000	1000	100	1000	1000	1	100	1	100	1000
Rockfall susceptibility source + runout area 30 degrees	1000	100	100	100	1		1	1	100	1000	100	1000	1000	100	1	100	1	100	1	100	1000
Debris flow susceptibility Mountain source + runout - steep slopes	1000	1000	1000	100	1000	1000		1000	1000	1000	100	1000	1000	100	100	100	1	100	1	100	1000
Debris flow susceptibility Mountain source + runout moderate to steep	1000	1000	1000	100	100	1000	1		1000	1000	100	100	1000	100	100	100	1	100	1	100	1000
Debris flow susceptibility Mountain source + runout moderate	1000	1000	1	1	100	100	1	1		1000	1	100	1000	1	1000	1000	1	100	1	100	1000
Debris flow susceptibility Mountain source + runout lower moderate slopes	1000	1000	1	1	1	1	1	1	1		1	1	1000	1	1000	1000	1	1	1	100	1000
Shallow slide susceptibility - source high susceptibility	1000	1000	100	100	100	100	100	100	1000	1000		1000	1000	100	100	100	1	100	1	100	1000
Shallow slide susceptibility source - moderate susceptibility	1000	100	1	1	1	1	1	100	100	1000	1		1000	1	100	100	1	1	1	1	1000
Shallow slide susceptibility source - low susceptibility	100	1000	1	1	1	1	1	1	1	1	1	1		1	1	1	1	1	1	1	1000
Deep-seated slide susceptibility - source area	1000	100	100	100	100	1000	100	100	1000	1000	100	1000	1000		1	1	1	100	1	100	1000
Deep-seated slide susceptibility - regression area	1000	100	1	100	1	1	100	100	1	1	100	100	1000	1000		100	1	100	1	100	1000
Deep seated slide susceptibility - runout area	1000	100	1	100	1	1	100	100	1	1	100	100	1000	1000	100		1	100	1	100	1000
Mapped slides - Recently active	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000		1000	100	1000	1000
Mapped slides - Activity unknown	1000	1000	1	100	100	100	100	100	100	1000	100	1000	1000	100	100	100	1		1000	100	1000
Proclaimed Landslip B	1000	1000	1000	100	100	100	100	100	100	100	100	1000	1000	100	100	100	1	100	1	1000	1000
Shallow susceptibility - runout	1000	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1		
																				1	
Column totals	17100	12501	4509	2106	2808	5706	1710	2907	7506	12105	2106	10503	16101	4005	6804	6903	18	2106	1117	3205	18001

13 Appendix 4: Landslide Hazard Bands Update – LGA change report

3 May 2024



Percent change:

High	0.0
Medium-Active	0.0
Medium	4.6
Low	0.4
Acceptable	-5.0
Total (L-H)	5.0

Components driving change:

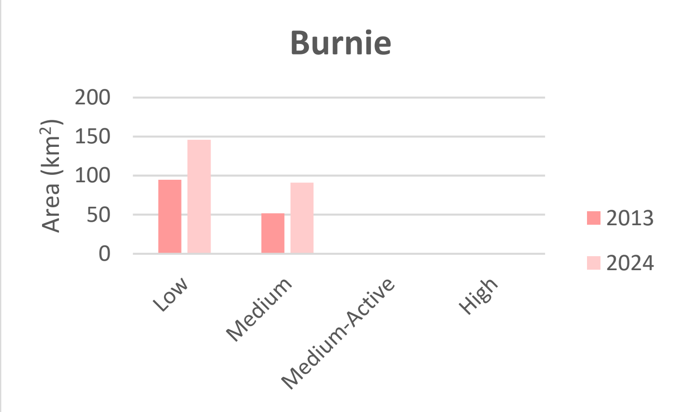
- Remaining areas, slope thresholds. (improved underlying elevation model)
- Rockfall (now statewide)

Percent change:

High	0.0
Medium-Active	0.0
Medium	2.1
Low	1.1
Acceptable	-3.2
Total (L-H)	3.2

Components driving change:

- Remaining areas, slope thresholds. (improved underlying elevation model)

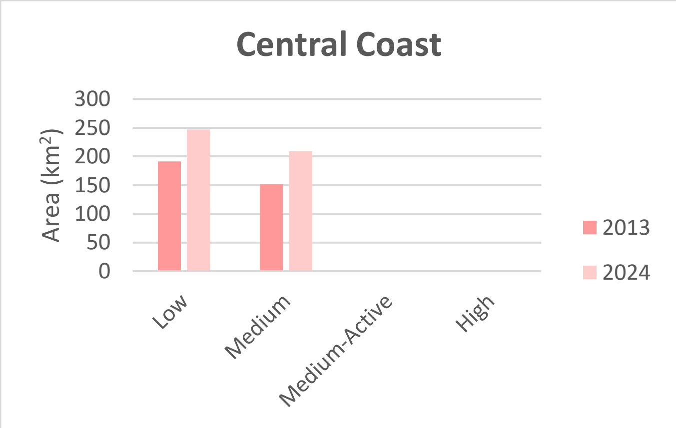


Percent change:

High	0.0
Medium-Active	0.0
Medium	6.4
Low	8.3
Acceptable	-14.8
Total (L-H)	14.8

Components driving change:

- Mapped landslides – Activity unknown (peri-urban mapping programme)
- Remaining areas, slope thresholds (threshold reduction from 11 to 9 degrees for Low)

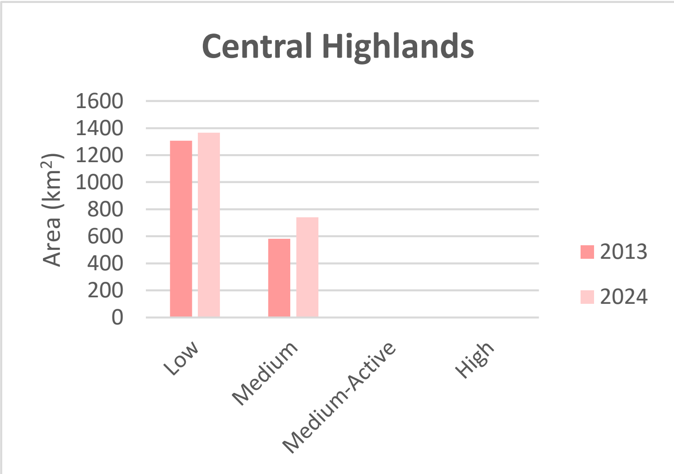


Percent change:

High	0.0
Medium-Active	0.0
Medium	6.1
Low	5.9
Acceptable	-12.1
Total (L-H)	12.1

Components driving change:

- Mapped landslides – Activity unknown (peri-urban mapping programme)
- Remaining areas, slope thresholds (threshold reduction from 11 to 9 degrees for Low)

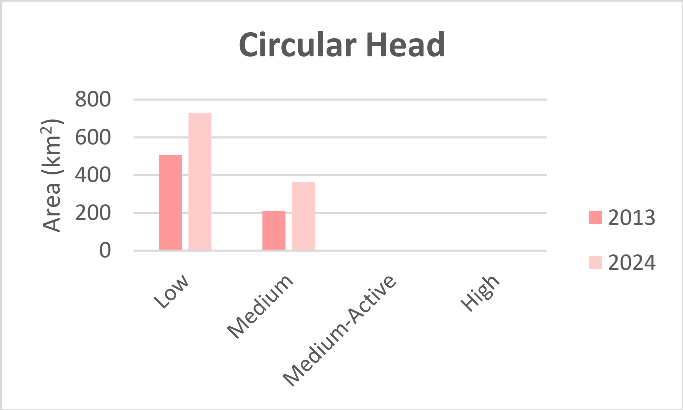


Percent change:

High	0.0
Medium-Active	0.0
Medium	2.0
Low	0.7
Acceptable	-2.7
Total (L-H)	2.7

Components driving change:

- Mapped landslides – Activity unknown (peri-urban mapping programme)
- Remaining areas, slope thresholds. (improved underlying elevation model)
- Rockfall (now statewide)

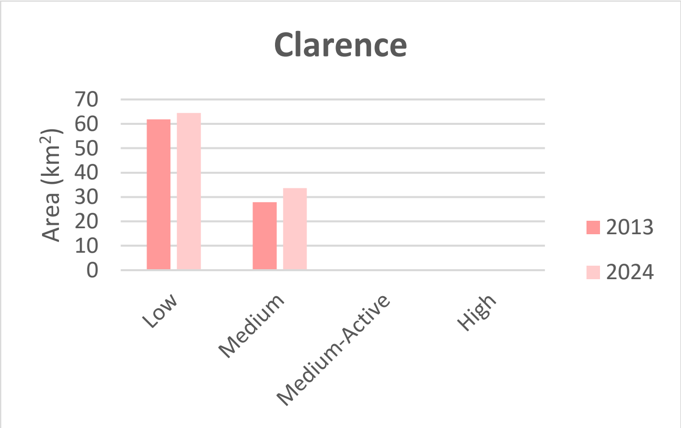


Percent change:

High	0.0
Medium-Active	0.0
Medium	3.0
Low	4.4
Acceptable	-7.4
Total (L-H)	7.4

Components driving change:

- Mapped landslides – Activity unknown (peri-urban mapping programme)
- Remaining areas, slope thresholds (partial threshold reduction from 11 to 9 degrees for Low)

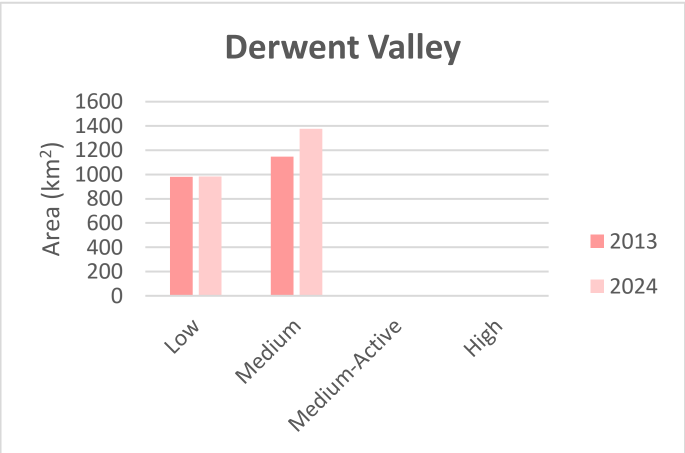


Percent change:

High	0.0
Medium-Active	0.0
Medium	1.4
Low	0.6
Acceptable	-2.0
Total (L-H)	2.0

Components driving change:

- Remaining areas, slope thresholds. (improved underlying elevation model)
- Mapped landslides – Activity unknown (peri-urban mapping programme)

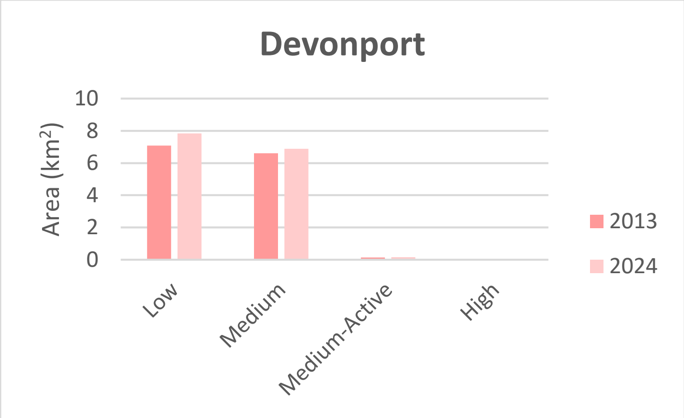


Percent change:

High	0.0
Medium-Active	0.0
Medium	5.6
Low	0.1
Acceptable	-5.7
Total (L-H)	5.7

Components driving change:

- Mapped landslides – Activity unknown (peri-urban mapping programme)
- Remaining areas, slope thresholds. (improved underlying elevation model)

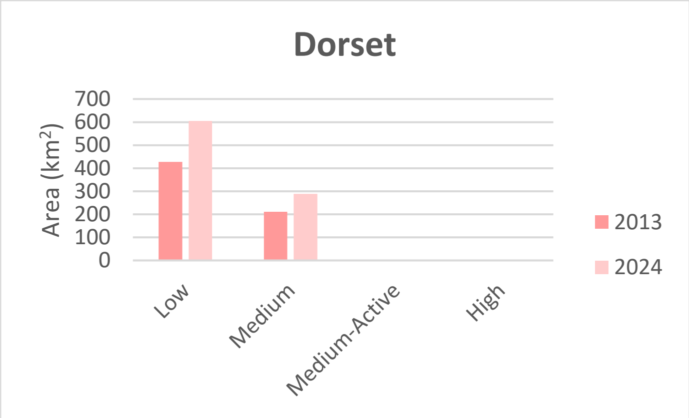


Percent change:

High	0.0
Medium-Active	0.0
Medium	0.2
Low	0.6
Acceptable	-0.9
Total (L-H)	0.9

Components driving change:

- Mapped landslides – Activity unknown (peri-urban mapping programme)
- Remaining areas, slope thresholds (threshold reduction from 11 to 9 degrees for Low)

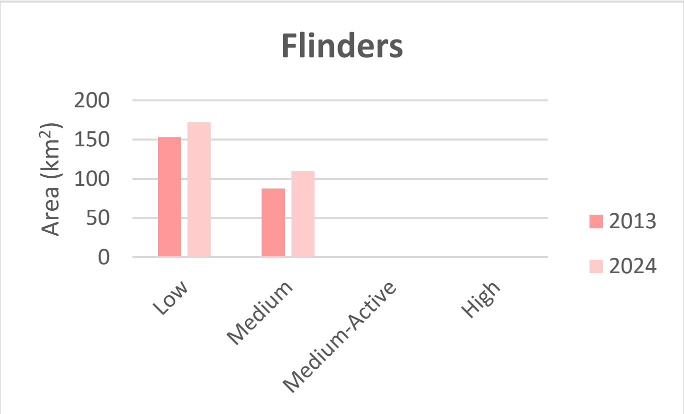


Percent change:

High	0.0
Medium-Active	0.0
Medium	2.4
Low	5.5
Acceptable	-7.9
Total (L-H)	7.9

Components driving change:

- Mapped landslides – Activity unknown (peri-urban mapping programme)
- Remaining areas, slope thresholds (threshold reduction from 11 to 9 degrees for Low)

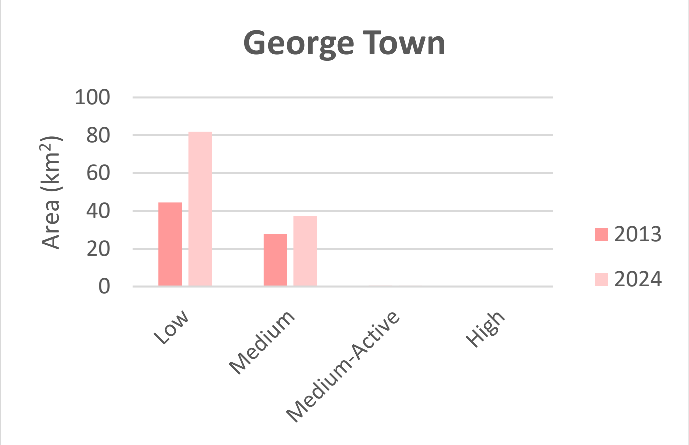


Percent change:

High	0.0
Medium-Active	0.0
Medium	1.1
Low	0.9
Acceptable	-2.0
Total (L-H)	2.0

Components driving change:

- Remaining areas, slope thresholds. (improved underlying elevation model)

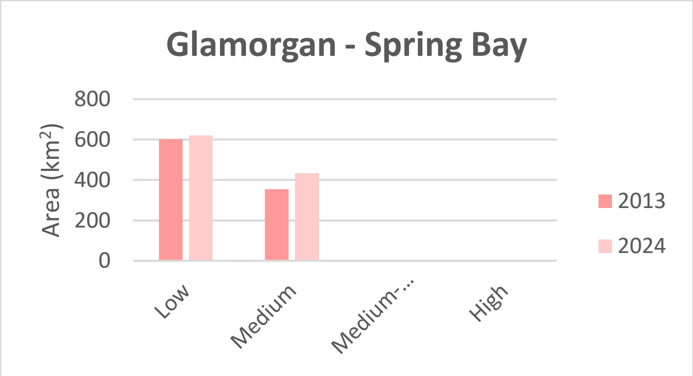


Percent change:

High	0.0
Medium-Active	0.0
Medium	1.4
Low	5.6
Acceptable	-7.1
Total (L-H)	7.1

Components driving change:

- Deep-seated landslide susceptibility (improved model for Tamar Valley)
- Mapped landslides – Activity unknown (peri-urban mapping programme)

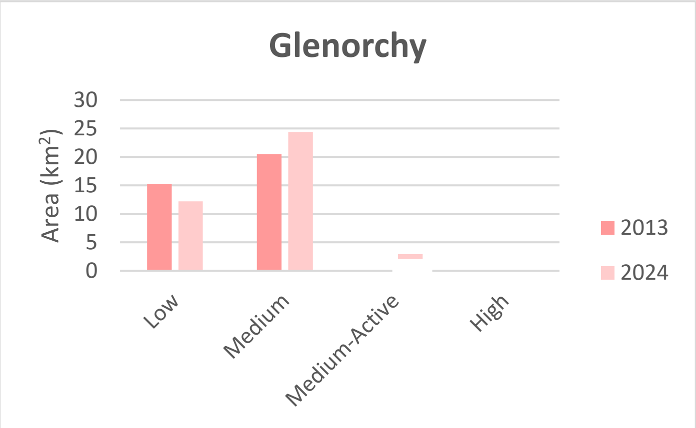


Percent change:

High	0.0
Medium-Active	0.0
Medium	3.0
Low	0.7
Acceptable	-3.7
Total (L-H)	3.7

Components driving change:

- Remaining areas, slope thresholds. (improved underlying elevation model)
- Rockfall (now statewide)

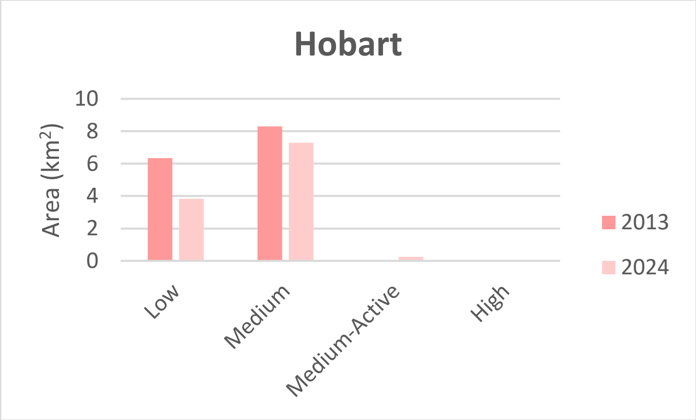


Percent change:

High	0.0
Medium-Active	2.3
Medium	3.2
Low	-2.5
Acceptable	-2.9
Total (L-H)	2.9

Components driving change:

- Mapped landslides – Activity unknown (peri-urban mapping programme)
- Rockfall (decrease in Low due to the new rockfall model)

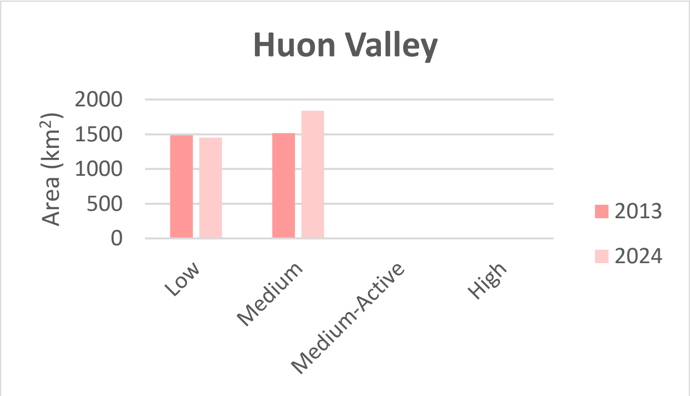


Percent change:

High	0.0
Medium-Active	0.3
Medium	-1.3
Low	-3.2
Acceptable	4.2
Total (L-H)	-4.2

Components driving change:

- Rockfall (decrease due to the new rockfall model)

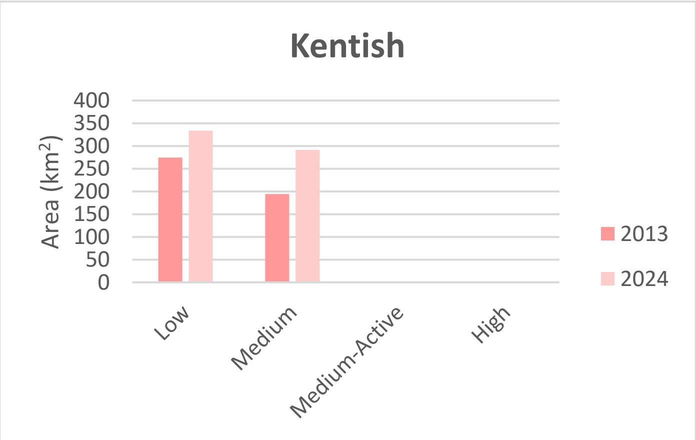


Percent change:

High	0.0
Medium-Active	0.0
Medium	5.5
Low	-0.5
Acceptable	-5.1
Total (L-H)	5.1

Components driving change:

- Mapped landslides – Activity unknown (peri-urban mapping programme)



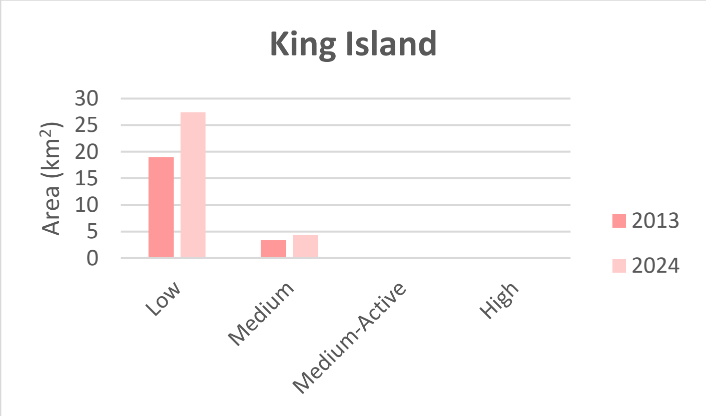
Percent change:

High	0.0
Medium-Active	0.0
Medium	8.4
Low	5.1
Acceptable	-13.5
Total (L-H)	13.5

Components driving change:

- Remaining areas, slope thresholds (partial threshold reduction from 11 to 9 degrees for Low)

- Mapped landslides – Activity unknown (peri-urban mapping programme)

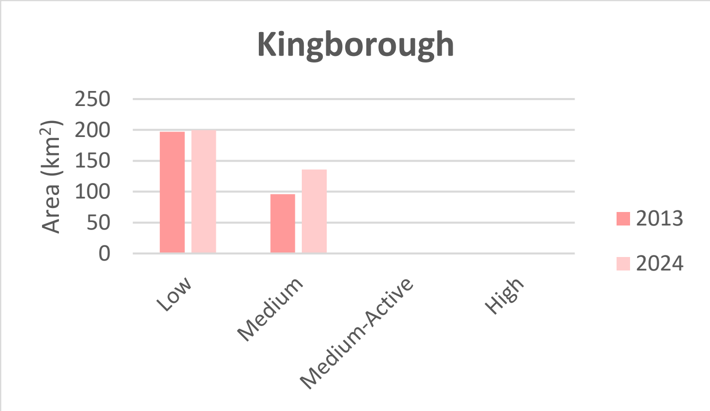


Percent change:

High	0.0
Medium-Active	0.0
Medium	0.1
Low	0.8
Acceptable	-0.8
Total (L-H)	0.8

Components driving change:

- Remaining areas, slope thresholds. (improved underlying elevation model)

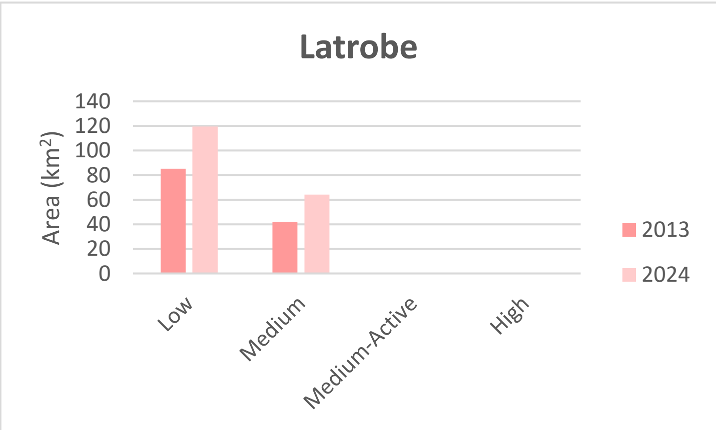


Percent change:

High	0.0
Medium-Active	0.0
Medium	5.3
Low	0.3
Acceptable	-5.7
Total (L-H)	5.7

Components driving change:

- Mapped landslides – Activity unknown (peri-urban mapping programme)
- Remaining areas, slope thresholds. (improved underlying elevation model)

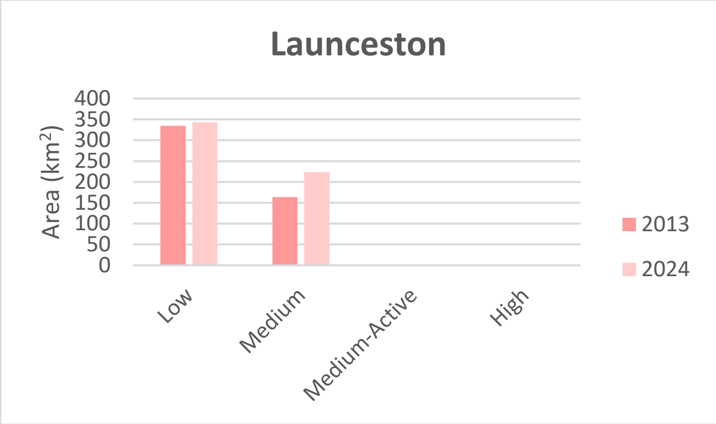


Percent change:

High	0.0
Medium-Active	0.0
Medium	3.6
Low	5.5
Acceptable	-9.1
Total (L-H)	9.1

Components driving change:

- Mapped landslides – Activity unknown (peri-urban mapping programme)
- Remaining areas, slope thresholds (threshold reduction from 11 to 9 degrees for Low)

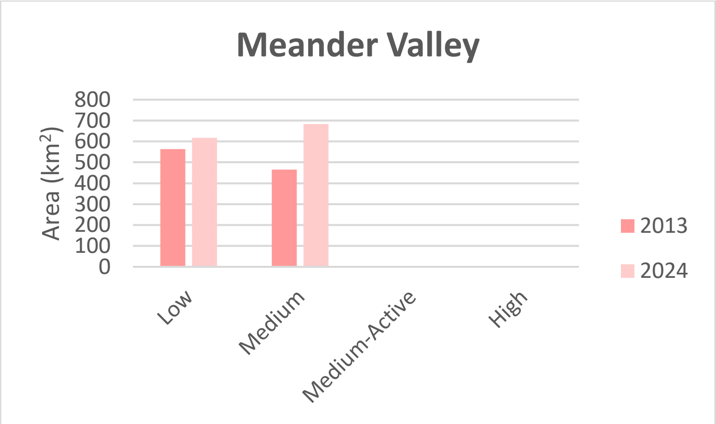


Percent change:

High	0.0
Medium-Active	0.0
Medium	4.2
Low	0.6
Acceptable	-4.9
Total (L-H)	4.9

Components driving change:

- Deep-seated landslide susceptibility (improved model for Tamar Valley)
- Mapped landslides – Activity unknown (peri-urban mapping programme)

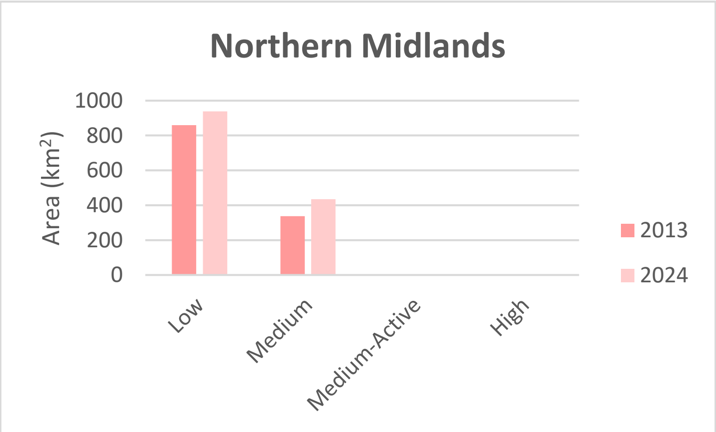


Percent change:

High	0.0
Medium-Active	0.0
Medium	6.6
Low	1.6
Acceptable	-8.2
Total (L-H)	8.2

Components driving change:

- Remaining areas, slope thresholds (partial threshold reduction from 11 to 9 degrees for Low)
- Mapped landslides – Activity unknown (peri-urban mapping programme)

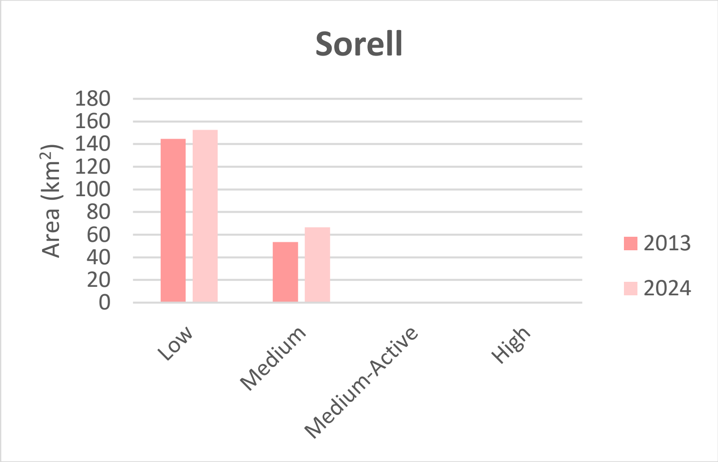


Percent change:

High	0.0
Medium-Active	0.0
Medium	1.9
Low	1.5
Acceptable	-3.5
Total (L-H)	3.5

Components driving change:

- Deep-seated landslide susceptibility (improved model for Tamar Valley)
- Remaining areas, slope thresholds (partial threshold reduction from 11 to 9 degrees for Low)

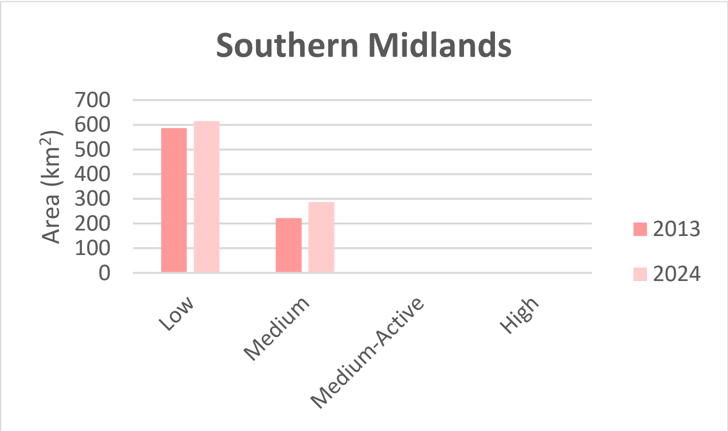


Percent change:

High	0.0
Medium-Active	0.0
Medium	2.1
Low	1.3
Acceptable	-3.5
Total (L-H)	3.5

Components driving change:

- Deep-seated landslide susceptibility (improved model for Tamar Valley)
- Mapped landslides (peri-urban mapping programme)
- Remaining areas, slope thresholds. (improved underlying elevation model)

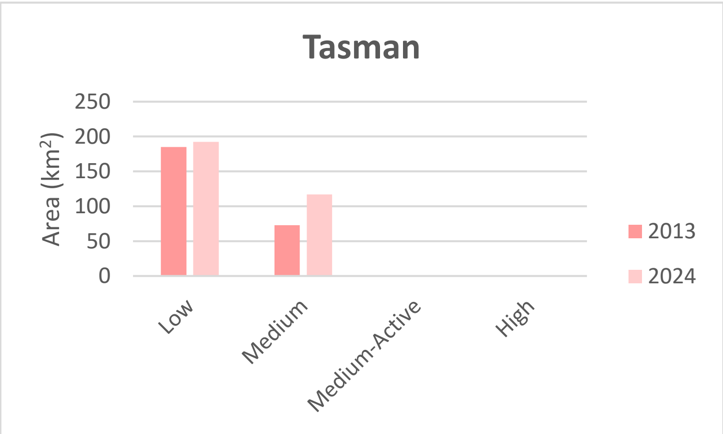


Percent change:

High	0.0
Medium-Active	0.0
Medium	2.5
Low	1.1
Acceptable	-3.6
Total (L-H)	3.6

Components driving change:

- Mapped landslides – Activity unknown (peri-urban mapping programme)
- Remaining areas, slope thresholds. (improved underlying elevation model)
- Rockfall (now statewide)

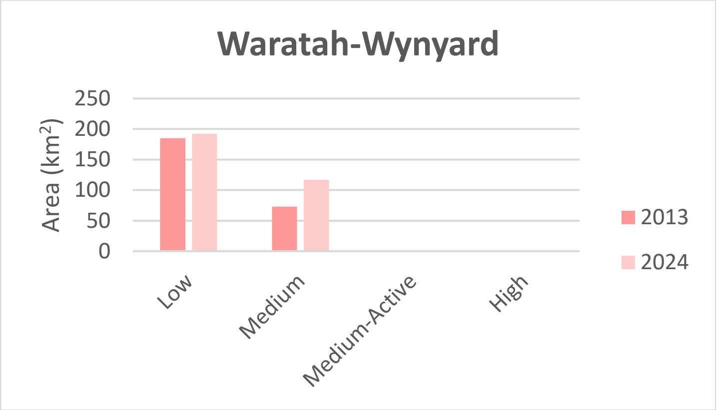


Percent change:

High	0.0
Medium-Active	0.0
Medium	6.6
Low	1.1
Acceptable	-7.7
Total (L-H)	7.7

Components driving change:

- Mapped landslides – Activity unknown (peri-urban mapping programme)
- Remaining areas, slope thresholds. (improved underlying elevation model)
- Rockfall (now statewide)

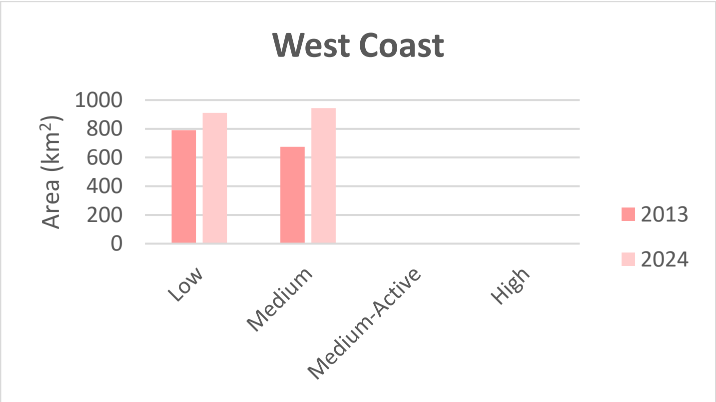


Percent change:

High	0.0
Medium-Active	0.0
Medium	7.6
Low	3.4
Acceptable	-11.0
Total (L-H)	11.0

Components driving change:

- Mapped landslides – Activity unknown (peri-urban mapping programme)
- Remaining areas, slope thresholds (partial threshold reduction from 11 to 9 degrees for Low)
- Rockfall (now statewide)

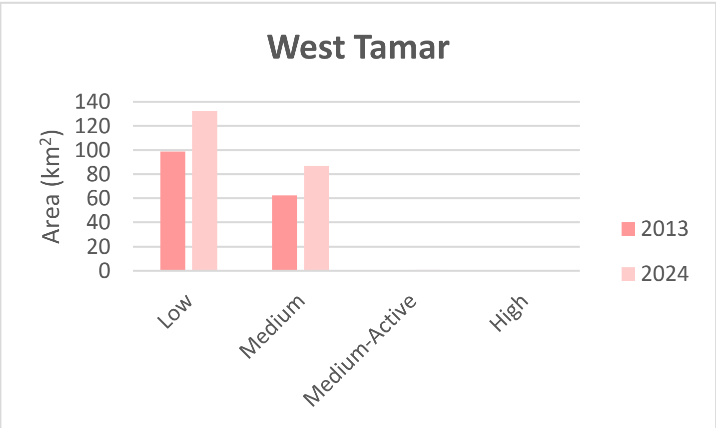


Percent change:

High	0.0
Medium-Active	0.0
Medium	5.5
Low	0.0
Acceptable	-5.5
Total (L-H)	5.5

Components driving change:

- Remaining areas, slope thresholds. (improved underlying elevation model)
- Rockfall (now statewide)



Percent change:

High	0.0
Medium-Active	0.0
Medium	3.4
Low	4.7
Acceptable	-8.2
Total (L-H)	8.2

Components driving change:

- *Error in calculation: the 2024 layers will be clipped to the coast before publication*
- Deep-seated slide susceptibility (improved model for Tamar Valley)

14 Appendix 5 - A Statewide Landslide Susceptibility Zonation in Tasmania

Reproduced from DPAC (2013)

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Contents

1 Purpose

This document provides scientific evidence and analysis of landslide mapping in Tasmania. It is intended to support the development of a statewide policy and its mapped implementation.

1.1 History of landslide zoning in Tasmania

Mineral Resources Tasmania (MRT) has a long history of undertaking landslide site investigations and regional scale landslide zoning in the State. Much of the earlier work, between the 1970s and 1990s, is largely summarised by Peter Stevenson (2011) and includes the drivers for undertaking this work.

In 2001, an independent consultant, Dr Fred Baynes, was contracted by MRT to review the previous zoning methodologies employed thus far (Appendix 1 in Mazengarb 2005). He outlined a number of issues, including inconsistent approaches between the various study areas, and that there were no real concepts of risk to evaluate the potential impact of landslides of differing levels of activity. In order to address these issues, Baynes proposed a new methodology to be used in future mapping by MRT. One of the key components of the new approach was the adoption of GIS software that had recently become available for use on mainstream personal computers.

In 2003, MRT embarked on a new phase of landslide zoning in Tasmania, which is hereafter known as the Tasmanian Landslide Map Series, and which utilises the Baynes methodology. The mapping has targeted the major urban areas of the State and areas of likely future development where it is considered that a significant landslide hazard exists.

It is important to note that the methodology developed by Baynes has been modified progressively by MRT staff for a number of reasons that are discussed in full elsewhere. However, in brief, one of the reasons for change was to adapt to local conditions in each study area. The methodology used by MRT has been published in Mazengarb (2005) and Mazengarb and Stevenson (2010), with additional details provided on the published maps.

A more significant driver for modifying the methodology was the publication of a set of guidelines for landslide zonation by the Australian Geomechanics Society in 2007 (AGS 2007 a, b), which is regarded as best practice in Australia. In 2011, MRT undertook a review and self-assessment of its Tasmanian Landslide Map series in order to compare it against the AGS documents (Mazengarb and Stevenson 2011). The authors concluded that their landslide zoning maps broadly fit into the framework of the AGS guidelines and were fit for purpose.

Outside of the targeted areas for the Tasmanian Landslide Map Series, much of the State has not been assessed for landslide susceptibility or hazard in a systematic way and, therefore, little guiding information exists for land use planning and other purposes.

2 Methodology for the development of a statewide landslide planning map

2.1 Guiding Principles

The following guiding principles are adopted:

- The Australian Geomechanics Society guidelines 2007a,b are accepted as best practice in the absence of a landslide standard. Where these guidelines are not sufficiently specific, the approach adopted will be based on professional judgement subject to independent peer review.
- The statewide planning map will be based on a susceptibility approach to landslide zoning, given that landslide hazard (*sensu strictu*) is currently very poorly constrained.
- The statewide planning map will take advantage of the best available information where it exists.
- Improvements will be made to previous mapping, where time allows to reflect the discovery of obvious errors, improvements in technology and methods, and the subsequent information and advances in our understanding of landslide processes that results from the systematic mapping projects.
- The transformation of the landslide susceptibility mapping into a planning map will be based on expert judgement using a pairwise ranking approach in a matrix.
- The process is sufficiently documented and transparent.

2.2 Data components

The data components forming the Statewide Landslide Planning Map are derived from MRT data. The components are divided into four principal groups:

- Known Landslides.
- Proclaimed Landslip Areas.
- Tasmanian Landslide Map Series – Modelled Susceptibility Zones.
- Remaining Areas Susceptibility – Statewide Slope Categories.

The components within these groups will be described in sufficient detail below. A further technical report in preparation will provide additional information to support the approaches taken.

2.2.1 Known landslides – MRT's landslide database

MRT has compiled and maintained a database of landslides in Tasmania since 2003 – the MRT Geohazards database. This inventory of landslides has been mainly compiled from recent mapping programmes and also research into MRT archives dating back to the 1960s. Known or mapped landslides include several types of features including slides, flows, falls and spreads, as identified in the field or by remote sensing techniques (eg aerial photo interpretation or airborne laser scanning (LiDAR) survey interpretation).

The Geohazards database was designed approximately 10 years ago to conform to international best practice as demonstrated in key references contained in Turner and Schuster (1997). It is consistent with the AGS 2007a guideline in that it refers to a collection of landslide records that capture information on the location, classification, volume, activity and date of occurrence, amongst other attributes. The MRT landslide database represents an intermediate to sophisticated resource as assessed by ourselves (Mazengarb and Stevenson 2011) against the AGS Guidelines 2007. Furthermore, we consider it rates very favourably against other landslide databases in Australia.

About 2 700 landslide records currently exist in the MRT database, but there will be many more in areas that have not yet been mapped. In addition to the mandatory fields described previously, the database stores all reported records of landslide damage to buildings, property and infrastructure since about the 1950s; currently totalling about 260 records. It also records compensation paid to landholders for landslide damage, largely under landslide compensation Acts, with a total of 96 compensation payouts to date.

2.2.1.1 Spatial and Attribute Accuracy and Reliability of Database

The inventory of landslide records in the MRT database is mainly derived from systematic mapping projects that cover only a small percentage of the area of the State. We expect that in the ‘Remaining Areas’ of the State there will be many landslide features in the landscape that have not yet been recognised.

The landslide data is divided into two parts reflecting its heritage; the pre-2003 mapping and the later mapping undertaken as part of the Tasmanian Landslide Map series.

- The earlier, pre-2003 mapping has a number of limitations, such as inconsistent mapping methodology and classification. Many of the landslides have only been recorded as points when, in fact, they may be of a significant size. Some landslides have been included into zones when, in fact, some could have been mapped separately, and some of these have been further amalgamated incorrectly during the conversion of cartographic maps into GIS form.

The data was largely collated on 1:25 000 base maps prior to modern GIS and GPS technology becoming available. The implications of these limitations are that the spatial accuracy of the features is lower than our current mapping practices. Fortunately, much of this mapping, as mentioned below, has been revised in the course of producing the Tasmanian Landslide Map series.

- The methodology for capturing landslide information as part of the post-2003 Tasmanian Landslide Map series is largely reported within Mazengarb & Stevenson (2010) and parts of it are repeated below. Landslide mapping is largely a subset of the geomorphological analysis MRT geologists undertake as part of the Tasmanian Landslide Map series. Within each study area this involves a substantial component of aerial photograph interpretation (API) assisted by field inspections. The geomorphological analysis included re-mapping of all the landslides appearing on earlier maps, and spatially adjusting them to more accurately fit the current map base, while some have been substantially reinterpreted. This component also draws on historical records of recent movement that could not be derived from API alone. The historical research is by no means comprehensive, but has included researching earlier MRT/Department of Mines reports, various other State and local government reports, newspaper reports and some consultants' reports for individuals or organisations. It is recognised that much more information exists in local government records and elsewhere that could not be easily retrieved. All councils in mapping project areas were contacted to obtain any relevant geotechnical information they may have held. However, this proved to be a more difficult task than originally anticipated, as the information is often not stored in a readily accessible manner.

The spatial accuracy of data capture has generally improved in recent years as new mapping technology has become available to us at MRT. This has meant that the accuracy of most of our mapped features is now well below 5 metres in many instances.

Landslides are classified according to a confidence measure into two types, to indicate whether the feature recognised is *certain or probable*, or *possible.* These descriptors reflect whether there is strong evidence for the existence of a landslide or not. An example of the latter is where there are features in the landscape morphology or records of damage whose cause is somewhat uncertain and not necessarily related to a landslide process.

The MRT landslide database contains many fields for capturing information about each landslide and provides a valuable tool to support our analysis and reporting requirements. Most landslides can be confidently classified according to material and movement type (eg earth flow, rock fall, etc). However, it is often not practically possible to reliably determine other important properties specified in the AGS guidelines and professional judgement is often used to determine these parameters:

- The volume of many of our landslides, which is used by AGS (2007) to discriminate between large and small landslides that are either greater or lesser than 1 000 m^3, cannot be easily calculated without knowing the depth of the failure plane, something that would typically require a drilling rig to determine. Given the number of landslides in our database, this is beyond our resources to consider.
- The approximate depth of failure is an alternative method to the volume-based method, above, that has been used by MRT since 2003 to subdivide our landslides into shallow or deep-seated features. It is roughly synonymous with the volume-based method that, for the reasons given above, is often difficult to determine.
- The date of first time failure and the activity state is poorly known across most of the landslide records. Landslide events that have been directly observed and recorded since European settlement are classified as *Recent or Active*. However, for most of the landslides in the landscape their age is uncertain and they have not been directly dated using established geological dating methods, which is beyond our resources. These landslides are classified as *Activity Unknown*. Geomorphic considerations of the landscape can provide some constraints to enable us to attempt a qualitative assessment of likelihood. The determination of these parameters is critical in order to determine likelihood. The lack of reliable likelihood indications has been the principal reason why MRT has not produced true hazard maps to date.
- The velocity of landslide movement is an important parameter as it is used as an indicative proxy for the destructive potential of landslides in the AGS Guidelines (AGS 2007a). Unfortunately, the velocity of movement has only been measured in a few instances in Tasmania, and other recorded velocities are largely an estimate based

on professional judgement.

However, with the limited velocity and frequency data that is available for landslides in Tasmania as points of knowledge, it is possible to make some professional judgements and inferences to assess qualitative likelihood against typical landslide velocities for broad groups of landslide types. The foundations for these judgements and inferences are based on the many years of landslide research conducted by Mineral Resources Tasmania and its predecessor, the Department of Mines. The results of this qualitative assessment are shown on a chart in Figure 1. This chart demonstrates the likelihood vs velocity characteristics for the typical range of landslides in each major landslide group. The points on the chart show landslides that have caused damage and for which the velocities (maximum and/or average) are well established and an estimate of the frequency can be made.

The landslide points with associated damage in Figure 1 also show the number of buildings damaged in each case. It is quite apparent from Figure 1 that the great majority of building damage caused by landslides in Tasmania is related to very slow-moving landslides. It is also apparent that most of these damaging landslides are reactivations of existing deep-seated landslides and/or have occurred within the Launceston Group sediments of the Tamar Valley.

An important consideration in using the Known Landslide data as a component of the Statewide Landslide Planning map is that the MRT landslide database is a live database and subject to change. Landslide records are added as new landslide events occur and are reported, and landslide records are also modified, including changes to the mapped extent, as new information comes to light and new mapping programmes are undertaken. This will, over time, result in differences between the Known Landslides component of the Landslide Planning Map being utilised by the planning community and MRT's live database, which is available for the public to access.

2.2.1.2 Components of the Landslide Database used in the Landslide Planning Map

A series of queries and geoprocessing operations have been performed to extract and categorise the Known Landslide data, from the MRT landslide database, for inclusion in the Statewide Landslide Planning Map. The following pre-conditions have been applied in performing these operations:

- Only the most current mapped extents (polygons) of landslides have been included. All out-dated interpretations that have been 'retired' or 'closed' in the MRT landslide database were excluded.
- Landslide records without polygons have been excluded. Mapping and research is required to define the extent of these landslide features, and defining an arbitrary spatial extent for the point records will not be valid in a large number of cases.
- The polygons of landslide records for debris flow and rock fall events have been excluded. The extents of such polygons often do not reflect very well the areas of likely future failure. The existing susceptibility mapping and statewide slope categories will be better suited to identifying areas of likely future failure. Where debris flow or rock fall polygons are located in association with an underlying 'parent' landslide feature, the polygon has been merged with the 'parent' landslide.

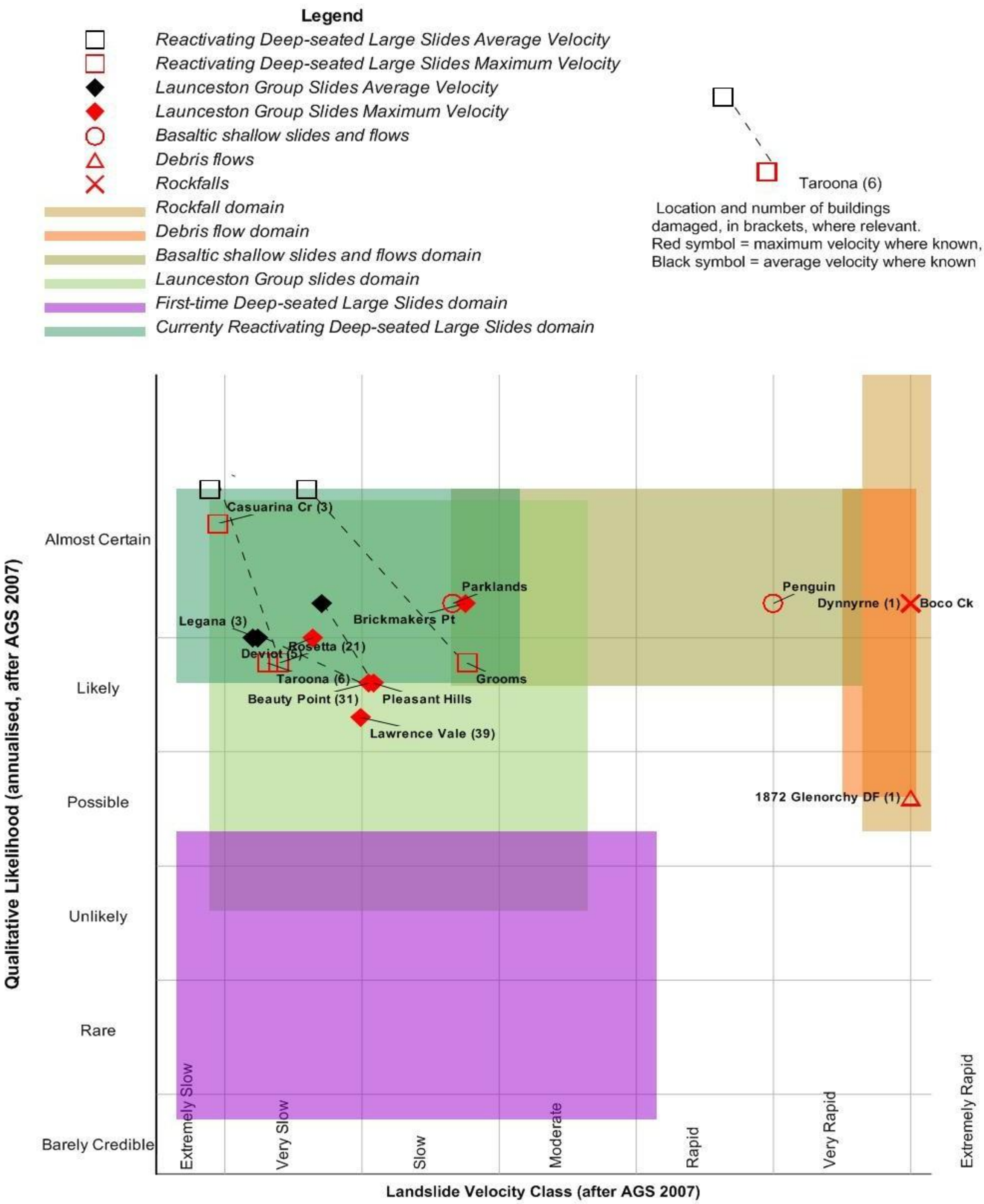

Chart of qualitative likelihood vs velocity for major landslide types in Tasmania, with indication of damage to buildings. The x-axis provides a proxy to the probable destructive significance figure of AGS 2007, but suprisingly most of the damage to buildings in Tasmania are in the second lowest category (Very Slow) contrary to the consequence description. The symbols provide our known control on the expected behaviour of each landslide type. Note that much of the damage recorded in the state is associated with reactivations of existing landslides.

Figure 1. Qualitative likelihood plotted against typical landslide velocities for broad groups of landslide types in Tasmania. This chart demonstrates the likelihood vs velocity characteristics for the typical range of landslides within each major landslide group.

The queries and geoprocessing operations are guided by AGS guidelines and our professional judgement of which mapped landslide features represent a potential hazard to the community. The four principal extracted components to be included are:

1. **Mapped slides – deep-seated/Launc. Gp, activity unknown**. This group contains large, deep-seated landslides, including possible landslides and landslide zones, whose activity is unknown. It also includes most of the slides in the Tertiary sediments of the Launceston Group, which show a range of failure depths from shallow to deep. Experience and analysis has shown that the range of Launceston Group landslides are expected to represent a similar hazard to the community as the mapped large, deep-seated landslides (refer to Figure 1). Some of the landslides in this group could be reactivating periodically, or even seasonally, at very slow rates – but without evidence to the contrary this is difficult to prove. Landslides within the Launceston Group that have specific evidence for being quite shallow have been placed in the 'Other slides/flows' categories.

2. **Mapped slides – deep-seated/Launc. Gp, recently active**. These landslides are similar to the above, but there is evidence or documentation showing that they have either failed for the first time or reactivated since European settlement. Many of the reactivating landslides respond to climatic variables, either short-term (seasonal) or long-term (eg inter-decadal cycles). In several cases, movement may have been initiated by disturbance of the slopes. The majority of the records of landslide damage in Tasmania are related to landslides in this category.

3. **Mapped slides – other slides/flows, activity unknown**. This group contains all of the landslides that have been recorded as shallow in the MRT landslide database, including possible landslides and landslide zones, whose activity is unknown. This includes some slides within the Launceston Group that have specific evidence for being quite shallow. The landslides in this group are generally much smaller than the above groups.

4. **Mapped slides – other slides/flows, recently active**. These landslides are the same as the above, but there is evidence or documentation of recent activity.

2.2.2 Proclaimed Landslip Areas

2.2.2.1 Definition

Proclaimed Landslip Areas constitute legislated areas in Tasmania on which strict controls to development exist. The geographic areas are defined by MRT in accordance with the *Mineral Resources Development Act 1995*, whereas the controls are contained in the *Building Act 2000* and its Regulations, which are administered by Workplace Standards Tasmania. The two pieces of legislation override controls contained in the State's planning scheme legislation – the *Land Use Planning and Approvals Act 1993*.

Landslip Areas comprise two components, A areas and B areas.

- The A area represents places where, essentially, no more building is allowed, recognising that this is the area in which the highest potential/actual risk of landslide is considered to be located.
- Landslip B areas have strict development controls. They serve as buffer zones to Landslip A areas and recognise the importance of activities within the B area with the potential to affect the stability of the adjacent sensitive A areas. Parts of the B area could also be susceptible to landslide movement.

2.2.2.2 Methodology and Spatial Accuracy

The existing Proclaimed Landslip Areas (proclaimed from 1971 to 2003) represent a very small portion of the State and have been defined using a variety of methodologies, some of which are poorly documented. Most of the areas have been created as a reaction to landslide disasters between 1970 and 1990. For instance, a significant zone was created in 1992 at Rosetta (Glenorchy), where a number of houses were damaged, several of which were demolished. This document need not detail how each area was created as they are enshrined in law and not readily open to challenge. Rather, the spatial accuracy of the features, as represented in the GIS landslide planning map, needs to be clarified to provide a level of certainty to the users of the information on the ground.

The location of each Proclaimed Landslip Area is defined on a registered plan that typically includes surveyors' measurements and cadastral boundaries. The plan must be regarded as the ultimate point of truth, although relating the plan to real world coordinates exposes a number of issues. In some cases, the boundaries were created to coincide with cadastral boundaries, whereas in other places they follow geomorphic features with curved (non-linear) form. The translation from plan to GIS format has been with reference to the statewide digital cadastre layer, the accuracy of which has been improved over a series of iterations spanning a number of years. In these cases, as each iteration has occurred, it has meant that the precise landslip area has had to be adjusted once the cadastre shift was discovered. For boundaries coinciding with geomorphic features, an additional challenge is introduced in clearly transposing the boundary to digital form, especially given the potential for inaccuracies in decades old mapping that may have relatively poor spatial control. Furthermore, the curved form has proved challenging for surveyors to accurately identify in the field and for Councils to check to ensure that developments are not encroaching into the Proclaimed Landslip Areas.

Even with these uncertainties, we suggest that the boundary uncertainty of the Proclaimed Landslip Areas will normally be much less than 2 metres horizontal.

2.2.2.3 Components of the Landslip Areas

The two types of Proclaimed Landslip Area, Landslip A and Landslip B, need to be treated as separate components in the Statewide Landslide Planning Map. The two types have significantly different implications for planning due to their legislated controls.

1. **Proclaimed Landslip A areas**. The legislated intent of these proclaimed areas is not to allow any further development, except for some insubstantial buildings or modifications, but only then with Ministerial approval.

2. **Proclaimed Landslip B areas**. The legislated intent of these proclaimed areas is to only allow development that will not compromise the stability of the underlying slopes or the stability of an adjacent Landslip A area.

2.2.3 Tasmanian Landslide Map Series – Modelled Susceptibility Zones

2.2.3.1 Definition

The Tasmanian Landslide Map series provides a collection of input layers that feed directly into the Statewide Landslide Planning Map. These input layers are landslide susceptibility zones presented on maps within the map series.

The susceptibility zones are derived by MRT using sophisticated modelling techniques, and each has been developed to predict areas where particular landslide processes could occur in the landscape. Each major type of landslide process is modelled separately because each has unique characteristics. Each landslide modelling process will identify a source area and, depending on the process, runout and regression areas.

2.2.3.2 Methodology, Spatial Accuracy and Reliability

The mapping and modelling methodology has evolved with each new mapping programme due to the varying landslide processes in different areas, and the differences in available input data. The methodologies are described in detail in Mazengarb (2005) and Mazengarb and Stevenson (2010), with additional details provided on individual map sheets.

In providing quality assurance to stakeholders, periodic independent peer reviews of the maps in the Tasmanian Landslide Map Series, and the associated documents, have been undertaken by respected practitioners, and, as far as possible, the recommendations have been implemented into our mapping programmes.

Like all maps, those of the Tasmanian Landslide Map Series have limitations. Standard caveats are placed on the maps:

- The hazards identified are based on imperfect knowledge of ground conditions and models that represent our current understanding of the landslide process. As this knowledge improves, our perception of the hazard, and the depiction on the map, may also change.

- These maps can be used as a guide (or flag) to the need for specific assessment in potential hazard areas.
- Planning decisions should not be made solely on the basis of the zones delineated on the map.
- The scale limitations of the data should be considered at all times, as exceeding this limit could lead to inaccurate decisions about the hazard.
- Site-specific assessment of landslide hazard and risk should be undertaken by suitably qualified and experienced practitioners in the fields of engineering, geology, and geotechnical engineering.
- Practitioners undertaking site-specific assessments should read the map text and associated documents to obtain a thorough understanding of the methodology and limitations of the maps.
- Areas where no susceptibility or hazard is shown can still have issues with slope instability.
- Anthropogenic influence on slopes cannot be predicted and the occurrence of slope instability resulting from the influence of human actions is specifically excluded from these maps.
- The identification and performance of cut and filled slopes have not been specifically considered in map production and their scale is such that they often cannot be resolved on the maps. The presence of such slopes should always be considered in site-specific assessments.

Note: the use of the word 'hazard' in these standard caveats does not imply any knowledge of the likelihood of any particular type of landslide movement.

2.2.3.3 Components of the Modelled Susceptibility

For the purpose of the Statewide Landslide Planning Map the following components of modelled landslide susceptibility are supplied as inputs layers:

1. **Rockfall susceptibility, source and runout area 34° –** modelled susceptibility for source areas of rockfall and runout to a travel angle of 34° (refer to Figure 2). The travel angle is based on field measurements of existing talus slopes.

2. **Rockfall susceptibility, runout area 30° –** modelled susceptibility for extended rockfall runout to a travel angle of 34° to 30° (refer to Figure 2). This increasing runout will occur with decreasing likelihood.

3. **Debris flow susceptibility (Mountain), source and runout >30° –** modelled susceptibility for source areas of mountain debris flow and runout to a travel angle of 30°. This travel angle represents the first quartile of possible runouts. MRT will be producing an updated set of debris flow susceptibility zones for the Hobart and Glenorchy map-sheet areas as part of an upcoming review of the earlier debris flow modelling of the Mt Wellington slopes, and this update will benefit significantly from the 2011 LiDAR survey now available.

4. **Debris flow susceptibility (Mountain), runout 30-26° –** modelled susceptibility for mountain debris flow runout to a travel angle of 30° to 26°. This travel angle represents the second quartile of possible runouts. MRT will be producing an updated set of debris flow susceptibility zones for the Hobart and Glenorchy map-sheet areas as part of an upcoming review of the earlier debris flow modelling of the Mt Wellington slopes, and this update will

benefit significantly from the 2011 LiDAR survey now available.

5. **Debris flow susceptibility (Mountain), runout 26-22° –** modelled susceptibility for mountain debris flow runout to a travel angle of 26° to 22°. This travel angle represents the third quartile of possible runouts. MRT will be producing an updated set of debris flow susceptibility zones for the Hobart and Glenorchy map-sheet areas as part of an upcoming review of the earlier debris flow modelling of the Mt Wellington slopes, and this update will benefit significantly from the 2011 LiDAR survey now available.
6. **Debris flow susceptibility (Mountain), runout 22-12° –** modelled susceptibility for mountain debris flow runout to a travel angle of 22° to 12°. This travel angle represents the fourth quartile of possible runouts. The susceptibility zones for this component initially provided by MRT for the draft Statewide Landslide Planning Map were produced in 2004, and were originally conceived to model runouts with travel angles of 22° to 5°. This broad range of runouts was designed to include the relatively uncommon dam-burst scenario (see below), and so in its current form this component will be an over-estimation. MRT will be producing an updated set of debris flow susceptibility zones for the Hobart and Glenorchy map-sheet areas as part of an upcoming review of the earlier debris flow modelling of the Mt Wellington slopes, and this update will benefit significantly from the 2011 LiDAR survey now available. The updated susceptibility zones for this component will be restricted to runouts with travel angles of 22° to 12°.

7. **Debris flow susceptibility (Mountain), runout – dam-burst –** modelled susceptibility for mountain debris flow runout in extreme cases of debris dam formation, followed by a catastrophic dam burst (eg the 1872 Glenorchy debris flow). The modelling for this component will be produced by MRT along with an updated set of debris flow susceptibility zones for the Hobart and Glenorchy map-sheet areas, which will be part of a review of earlier debris flow modelling of the Mt Wellington slopes. It is our professional judgement that the frequency of these types of events impacting on developed areas is reasonably low (perhaps 1 in 100 to 500-year event); so at this stage, pending further study, we consider that it is not required as an input to the draft Statewide Landslide Planning Map.

8. **Shallow slide and flow susceptibility, source high –** modelled high level of susceptibility for shallow slides, as well as earth or debris flows in environments other than mountain slopes (eg North-West coastal escarpment).

9. **Shallow slide and flow susceptibility, source moderate –** modelled moderate level of susceptibility for shallow slides, as well as earth or debris flows in environments other than mountain slopes (eg North-West coastal escarpment).

10. **Shallow slide and flow susceptibility, source low and flow runout –** modelled low level of susceptibility for shallow slides, as well as earth or debris flows in environments other than mountain slopes (eg North-West coastal escarpment).

11. **Launceston Group slide susceptibility (large and small) –** modelled susceptibility to slides and flows in the relatively weak Tertiary sediments of the Launceston Group, which shows a range of failure depths from shallow to deep. Many of the records of landslide damage in Tasmania are related to landslides within the Launceston Group, and many of those have occurred on relatively low slopes. Because of the well-documented history of property damage on a wide range of slopes within the Launceston Group, the modelled susceptibility zones (based on two slope thresholds) have been combined for the purposes of the Statewide Landslide

Planning Map. The susceptibility zones for this component initially provided by MRT for the draft Statewide Landslide Planning Map were produced in 2006 and only cover the Launceston map-sheet area. MRT will be producing an updated set of susceptibility zones to cover the Launceston map-sheet and the three new Tamar Valley map-sheets, and this update will benefit significantly from the 2008 LiDAR survey now available.

12. **Hobart-Glenorchy deep-seated slide susceptibility (Rosetta scenario)** – modelled susceptibility to deep-seated slides within the Hobart-Glenorchy region using the published "B model" (2004), which, for the Tertiary sediments of the area, is based on the Rosetta landslide scenario. This component includes both the modelled source and setback areas for deep-seated slides, using the "B model". The modelled susceptible areas could possibly include pre-existing deep-seated landslides that may be prone to reactivation, but due to erosion and/or human modification of the landscape these may not be particularly evident. It is thought that one such disguised landslide existed at Rosetta and was reactivated by the subdivision and development of the area.

13. **Deep-seated slide susceptibility (source-runout-regression)** – the combined modelled source, runout and regression areas for first-time failure of deep-seated landslides, other than those occurring in the Tertiary sediments of the Launceston Group. This does not include the reactivation of pre-existing deep-seated landslides in the landscape, some of which are possibly reactivating periodically. The first-time failure of deep-seated landslides is considered to be a rare event under existing environmental conditions, and the initial formation of the pre-existing deep-seated landslides was probably related to past climatic regimes not operating currently.

14. **Very low to no susceptibility** – those areas covered by the Tasmanian Landslide Map Series that are not included in the various modelled landslide susceptibility zones (eg Figure 2). This does not completely rule out the possibility of any of the landslide types occurring within these areas, but the susceptibility on the natural slopes is considered to be at least very low, as defined by the AGS Guidelines (2007a). However, as stated above in the caveats on map use, the affects of human modifications of the slopes cannot be predicted and the occurrence of slope instability resulting from human actions is specifically excluded from the susceptibility mapping. The presence of such slopes should always be considered in site-specific assessments.

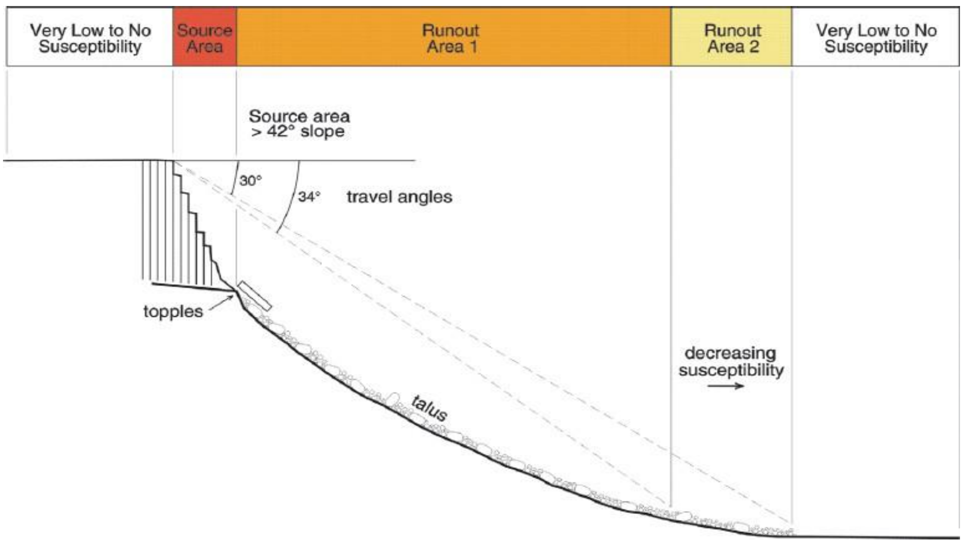

Figure 2. Conceptual diagram of the rockfall modelling process. The setting in this example is based on a dolerite talus slope.

2.2.4 Remaining Areas Susceptibility – Statewide Slope Categories

2.2.4.1 Definition

In the remaining areas of the State that do not have the advantage of detailed mapping or susceptibility modelling, a somewhat simplistic and pragmatic approach is required to define the zones that are potentially susceptible to landslides. The 'Remaining Areas' are defined as those parts of the State where no detailed landslide susceptibility modelling has been carried out by MRT, where there are no proclaimed Landslip Areas, and no landslide features have been mapped – with the exclusion of mapped landslide features that only exist as points in the MRT database, or represent debris flows or rock falls.

In the 'Remaining Areas' of the State, a basic indication of landslide susceptibility could be simply defined by slope alone, or by slope and geology.

Slope

Slope as an indicator of basic susceptibility provides a very simple indicator for assessing the potential for landslide activity.

Slope is commonly used in existing planning schemes throughout Tasmania. However, the parameters used range from 15 per cent slope (9 degrees) to 25 per cent slope (14 degrees). This approach is also used by both Queensland (2003) and Western Australia (2006). Table 1 provides an overview of the current use of slope as an indicator for landslide susceptibility within Tasmania and in other States.

Table 1. Slope-based triggers and Council Planning Schemes

Slope	Council
25 per cent (14 degrees)	Circular Head, Flinders, Meander Valley, Northern Midlands, Glenorchy, Tasman
20 per cent (11 degrees)	Dorset, Kingborough
15 per cent (9 degrees)	Launceston (interim) in areas outside of MRT susceptibility mapping Queensland state planning policy 1/03 Western Australian policy on natural hazards

The strength of using slope as an indicator of landslide susceptibility is that it is easy to measure, to communicate, and relatively easy to map. The most significant weakness, however, is that it is a crude indicator and does not accommodate the significant local conditioning factors that will contribute to landslide susceptibility (eg geology, hydrological influences). The use of slope alone may over-predict areas that are not truly susceptible to landslide, and under-predict areas that are susceptible.

Slope and Geology

Geology is a significant conditioning factor for landslide susceptibility. The underlying geology, or upslope geology, is usually a significant factor in determining what surficial material is present and the degree to which the substrate is prone to movement under certain conditions.

While geology is an essential component of detailed susceptibility mapping, its use as a broad indicator of landslide susceptibility across the Tasmanian landscape is significantly undermined by the scale, accuracy and intent of much of the available geological mapping. Current geology maps in Tasmania have been developed primarily for mineral exploration purposes with a focus on sub-surface geology, and, while informative, are not always suitable for sub-regional modelling of landslide susceptibility. The surface geology and soils are of much greater importance to landslide susceptibility.

There are some examples that use slope-geology indicators for landslide susceptibility in Tasmania but the parameters used differ markedly. Table 2 outlines, for comparative purposes, the MRT deep-seated landslide susceptibility parameters, the landslide slope indicators in the Forest Practices Code (FPB 2000), and the current parameters used in the Interim Planning Scheme for Hobart.

Using slope and geology as indicators of landslide susceptibility in Tasmania would require a review and reconciliation of the indicators outlined in Table 2, between each other and with the 165 types of geology identified in the Statewide 1:250 000 geology maps. Reconciliation and expansion of the indicators would require MRT to develop cumulative frequency analysis for the geology types and make assumptions of what is a reasonable slope threshold in that area. For many of the geology types there are simply not enough landslide records or materials analyses in our databases to be able to make a useful assessment.

Preferred approach to defining landslide susceptibility in the 'Remaining Areas'

The preferred approach to identifying potential landslide susceptibility in the remaining areas of the State is to use the slope only method. This method may be crude, but it provides a simple method given the available data for the remaining areas of the State. With this approach, three broad slope categories have been used to define very basic susceptibility zones across the State.

The slope categories are based on slope alone without any consideration given to the underlying geology, geomorphology or past instability.

Table 2. Geology Slope Indicators

Geological rock type	Draft landslide code/Hobart draft scheme instability indicator	MRT deep-seated failure parameter (Mazengarb, C, and Stevenson, M D, (2010))	Landslide slope indicators (FPB 2000)
Jurassic dolerite	12°	41° (Hobart/Glenorchy) 50 (Launceston) 12-15° (Launceston – weathered)	
Tertiary sediments (Clay, Sandy Clay, Lignite)	5°	10° (Rosetta) 6.5° (Taroona) 7-12° (Launceston)	11°
Tertiary basalt	12°	38° (Hobart/Glenorchy) 50° (Launceston) 14° (North-West for weathered)	19°
Quaternary sediments and talus landforms • Colluvium • Dolerite Slope Deposits (Talus) • Basalt Slope Deposits (Talus) • Landslide Debris • Fluvioglacial Deposits, Till	7°	Not assessed	 15° 19° 15° 11° 15°
Parmeener supergroup: Triassic Sediments • Triassic sandstone • Triassic mudstone (Mudstone, Siltstone, Shale, Coal, Coal Measures, Carbonaceous Mudstone) Permian Sediments • Permian sandstone • Permian mudstone (Mudstone, Siltstone, Micaceous Shale, Carbonaceous Shale and Mudstone, Coal, Coal Measures)	 10° 10°	 41° 41° 32° 32° (Hobart/Glenorchy) 16° (North-West)	 15° 15°
Basaltic colluvium		14° (North-West)	
Triassic Basalt			19°
Cambrian (Volcanics and Greywacke)			19°
Precambrian (Phyllite, Schist)			19°

2.2.4.2 Methodology and Spatial Accuracy

In order to determine appropriate slope thresholds for the 'Remaining Areas' an analysis of three major landslide associations was carried out. These three associations were chosen because they occur on a range of slopes and geomorphic settings and a large amount of data is currently available from Tasmania. The three landslide associations are: the *mountain debris flows*, *basaltic soils*, and *Launceston Group soils*.

- While there is currently little development on the source areas of the mountain debris flows, as will be seen below, this setting provides an upper limit for setting thresholds.
- The Launceston Group soils provide a worst-case example, or lower limit, to the setting of thresholds. This association has seen significant past landslide issues in and around the Tamar Valley. Fortunately, most of the Launceston Group and other equivalent Tertiary sediment units have been included on the modelled Launceston and Tamar Valley landslide susceptibility maps.
- The basaltic soils refer to those areas of the State composed of weathered in situ basalt and associated sediments and its transported equivalents, the colluvial soil deposits. This association occurs widely in the North-West of the State and significant development has occurred in these areas.

The determination of the slope threshold values for these three associations is substantially based on professional judgement in consideration of:

- Determination and analysis of the general natural slope (pre-failure conditions) for each of the recognised landslides occurring in each geological unit and charting their frequency distribution in accordance with AGS 2007a.
- Analyses of the material properties for each geological unit and particularly those from site investigations related to specific landslides.
- Analysis of the landforms that occur in each of the major geological units and with regard to the geomorphic setting.

Comparison of the data for the three landslide associations indicates that each type has unique characteristics, from which distinct slope thresholds can be nominated.

Table 3. Nominated slope thresholds for each of the three Geological Associations.

Geological Association	Landslide Slope Distribution 99 per cent	Landslide Slope Distribution 90 per cent	Analysed Physical Properties
Launceston Group	>5°	>7°	
Basaltic soils	>5°	>10°	>10°
Mountain Debris Flows	>13°	>19°	>12°

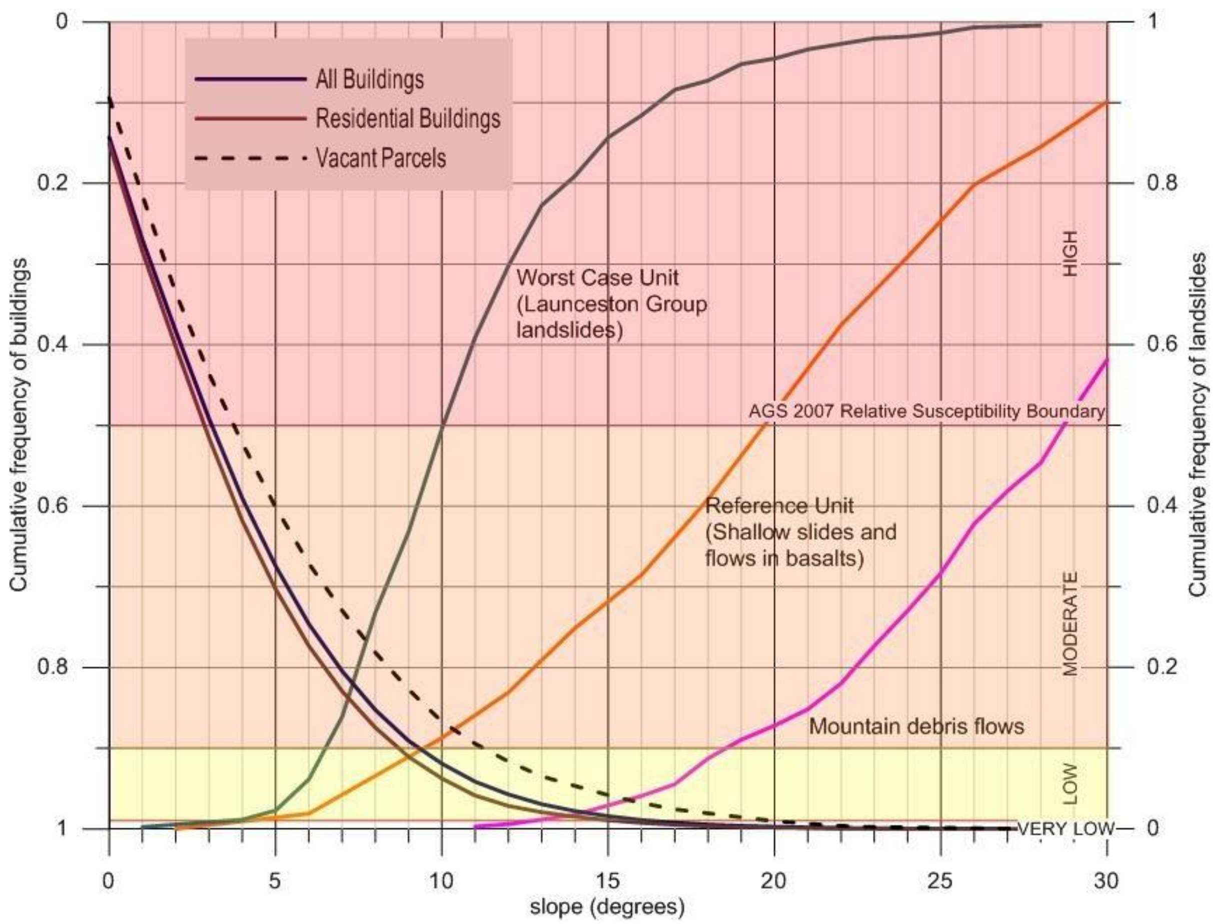

Figure 3. Cumulative frequency distribution of the three landslide associations on the natural general slopes (at right). Also shown is the cumulative frequency distribution of buildings and vacant parcels on the general slopes.

Figure 3 plots the cumulative frequency of landslides from each association in Tasmania against the natural slopes on which they occur – based on the mapped landslides within the MRT landslide database.

It is clear from Figure 3, and Table 3, that landslides generally occur on much lower slopes in association with the Launceston Group. There are some cases of landslides in basaltic soils that can also occur on similarly low slopes, but generally the landslides are expected on the steeper slopes.

As stated above, most of the Launceston Group and other equivalent Tertiary sediment units have been included on the modelled Launceston and Tamar Valley landslide susceptibility maps. This provides some justification for ignoring the slope thresholds derived for the Launceston Group in determining appropriate thresholds for the statewide slope categories. However, it will need to be accepted that there may be some cases of weak Tertiary clays, which can fail at low slope angles, within the State that will not be included in any of the slope categories or existing modelled landslide susceptibility.

Various investigations conducted by MRT and its predecessor, the Department of Mines, as well as other studies for forestry purposes, suggest that landslides associated with most other geological associations in Tasmania occur above slope thresholds that all exceed those for the basaltic soils and Launceston Group. So, on the basis that the slope thresholds for the Launceston Group do not need to be considered, it is reasonable to use the slope threshold for the basaltic soils as a lower threshold for the statewide slope categories.

Using the data summarised in Table 3 and Figure 3, a slope threshold of 11° has been chosen for the lower limit of a slope category that defines where a potential landslide hazard may exist. A second slope threshold of 20° was chosen to define an upper slope category where a greater potential landslide hazard may exist.

The justification for a 20° slope threshold is less well defined. However, for the susceptibility modelling for shallow slides and flows in the North-West of Tasmania, a threshold of 20° was used as the boundary between moderate and high susceptibility. That threshold was chosen on the basis of a statistical analysis of the known shallow landslides in the region. In addition, on slopes above 20° there is a significantly greater risk of debris flows and rock falls. Table 3 shows that 90 per cent of mapped debris flows occur on slopes greater than 19°. Figure 3 shows that about 99 per cent of existing buildings in Tasmania are on slopes less than about 15°, so it is expected that this upper slope category will have relatively little impact on future development in the 'Remaining Areas' of the State.

The slope values for the 'Remaining Areas' will largely be derived from a coarse 25 metre digital elevation model (DEM) supplemented with airborne laser scanning (LiDAR) surveys where available. The slope values derived from the 25 metre DEM, and relevant to this analysis, will tend to be underestimated (by around 2-5°). There will, therefore, be a slight underestimation of the area for each of the slope categories in the 'Remaining Areas'.

Because these slope categories do not consider the underlying geology, geomorphology or past instability, they will result in a large overestimation of the land potentially affected by landslides. Many of the steeper slopes around the State are steeper because they are underlain by more erosion-resistant, harder geology, and so may be quite stable in many cases. However, slopes greater than 42°, while generally not having any significant soil development and so cannot be the source of soil or debris slides, are quite prone to rock failures. Rock falls originating on these steep slopes can then move downslope to affect the lesser slopes at the base of the scarp.

Much of the steeper land included by these statewide slope categories is, in fact, land that is unlikely to ever be developed. That is, land on steep escarpments around dolerite mountains and mountainous land within existing parks and reserves. While about 99 per cent of existing buildings in Tasmania are on slopes less than about 15°, about 90 per cent are on slopes less than about 9° (Figure 3).

2.2.4.3 Components of Remaining Areas Susceptibility

The following slope categories are used for the remaining areas of the State not covered by detailed landslide susceptibility modelled by MRT:

I. **Remaining Areas susceptibility, slopes >20°** – slopes greater than 20°, based on a 25 metre digital elevation model (DEM) supplemented with airborne laser scanning (LiDAR) surveys where available. Excluding areas of detailed landslide susceptibility modelling carried out by MRT, proclaimed Landslip Areas, and mapped slide-type landslides.

2. **Remaining Areas susceptibility, slopes 11-20° –** slopes from 11° to 20°, based on a 25 metre digital elevation model (DEM) supplemented with airborne laser scanning (LiDAR) surveys where available. Excluding areas of detailed landslide susceptibility modelling carried out by MRT, proclaimed Landslip Areas, and mapped slide-type landslides.

3. **Remaining Areas susceptibility, slopes 0-11° –** slopes less than 11°, based on a 25 metre digital elevation model (DEM) supplemented with airborne laser scanning (LiDAR) surveys where available. Excluding areas of detailed landslide susceptibility modelling carried out by MRT, proclaimed Landslip Areas, and mapped slide-type landslides. For the purpose of the Statewide Landslide Planning Map, this category is treated as having very low to no susceptibility to landslides.

3 Appendix 6. Analysis of the Landslide Planning Map against the AGS (2007) principles

Comparison of the AGS principles for the designing of the landslide zonation for planning and building controls with the 2013 and 2025 Landslide Planning Map (After AGS 2007a)

AGS Factors	AGS description	2013 Landslide Planning Map Response	2025 Landslide Planning map response
The stage of development of the land use zoning plan or engineering project	Susceptibility and hazard zoning are more likely to be used in preliminary stages of development with hazard and risk zoning for more detailed stages. However the choice depends mostly on the intended purpose of the zoning in land use management.	The development of the 2013 mapping was driven by the need to move from reactive management of failures to a proactive approach. This process sought to improve the design and construction of new developments to minimise exposure to landslides and avoid contributing to slope failure. The 2013 mapping was built from existing information developed by MRT using their established 2010 methodology. New slope based susceptibility modelling was developed to fill in the gaps where we did not have regional zonation.	No change to the 2013, Note that the slope based susceptibility and inventory were upgraded based on the upgraded LiDAR model. Tasmania's planning and building system has developed and matured since 2013. The regional zoning (Landslide Planning Map) guides decisions and investigations at the planning stage, while detailed site-specific landslide hazard or risk assessments may be required at the subdivision or building stage.
The type of development.	Risk zoning is more likely to be used for existing urban developments, where the elements at risk are defined or for existing and planned road and railway developments where the elements at risk (the road or rail users) are readily predicted. However, the elements at risk often vary with time so risk zoning needs to be updated regularly.	The purpose is to: 1. replace the 30 different versions of landslide regulation in Tasmania to provide consistent controls and standards. 2. The purpose of the landslide planning map is to help inform the development and coordination of appropriate management, land use planning, and building controls to reduce risks the risk from landslide to future development within tolerable limits. Includes ensuring that the regulatory impact on developments and local government is proportional 3. Communicate landslide hazard at the earliest possible stage in the development and building process. **Note** the approach does not indicate the likelihood of failure for existing infrastructure.	The purpose and functional processes of the landslide planning map remain unchanged. The 2013 goal to create a unified statewide approach to landslide regulation has been achieved, with the development of the Tasmanian Planning Scheme and successive adoption of the Landslide Planning Map by all 29 Councils. Since 2013, it has been serving its purpose as a large scale zoning tool to guide planning decisions. It is not intended to be used as a measure of risk to specific elements, but to trigger the requirement for a risk assessment where the level of susceptibility and/or scale of development warrants a higher level of investigation or intervention.
The classification, activity, volume or intensity of landsliding.	Risk zoning is more likely to be required where the landslides are likely to travel rapidly and or have a high intensity as measured by the combination of volume and velocity (e.g. rock fall, debris flows, rock avalanches). For these situations life loss is more likely so it is useful to use risk zoning as this allows land use zoning to be determined using life loss risk criteria.	Since the 1950s over 150 houses have been lost to landslide - typically following rainfall events. Data sets unavailable to undertake risk zoning, and such detailed zoning is not feasible or necessary at strategic (statewide) level. Available data is limited to susceptibility and inventory.	The inventory has been expanded, and the susceptibility modelling has been improved in Evandale and Penna. Further work is required to address questions around frequency and intensity of different landslide types in Tasmania. This would allow risk zoning (or at least quantitative hazard zoning) to be introduced in areas that are

			exposed to high velocity or intensity landslides.
Funds available.	While the purpose should determine the level of zoning and the scale of the maps, the funding available may be a practical constraint. Landslide susceptibility zoning is lower cost than hazard zoning, and hazard zoning is somewhat lower cost than risk zoning, so land use planners may opt for a lesser type and level of mapping at least in a staged introduction of landslide land use planning.	Grant funds were obtained to develop a methodology for landslide hazard mapping to support land use planning. In kind support was provided from DPAC, Local Government, and MRT.	No specific funding was available. Mapping updates to the components (notably the landslide inventory, susceptibility modelling, and slope thresholding) were entered as a project under MRT's geoscience work programme. In kind support was provided from DPAC and Local Government.. **Note** MRT has a current $1.4 million DRF grant program to upgrade the landslide information for the state.
The amount and quality of available information.	Only susceptibility zoning can be performed where data on frequency of landslides either do not exist or are so uncertain as to not be relied on.	Available data is limited to susceptibility and inventory. A hazard band and planning matrix was developed based on expert judgement, strategic planning outcomes, and coordination of controls.	No change Further work is required to address questions around frequency and intensity of different landslide types in Tasmania. This would allow quantitative hazard zoning to be introduced in some areas.
History of land use.	The history of the area being zoned and its evolution in terms of land use must be carefully taken into account as human activities may modify the slope instability environment and modify the susceptibility to and likelihood of landsliding and hence the hazard.	All land outside the TWWHA (49% of the state) has been substantially modified over the last 150-200 years, including urbanisation, broad-scale land clearance, infrastructure development or mining.	No change
Degree of quantification.	Qualitative methods are often used for susceptibility zoning and sometimes for hazard zoning. It is better to use quantitative methods for both susceptibility and hazard zoning. Risk zoning should be quantified. More effort is required to quantify the hazard and risk but there is not necessarily a great increase in cost compared to qualitative zoning.	Available data is limited to susceptibility and inventory. A hazard band and planning matrix was developed based on expert judgement, strategic planning outcomes, and coordination of controls.	No Change Further work is required to address questions around frequency and intensity of different landslide types in Tasmania. This would allow quantitative hazard zoning to be introduced in some areas, and support a quantitative susceptibility ranking for all components.
The required accuracy of the zoning boundaries.	Where statutory land use planning constraints are proposed large scale maps with appropriate levels of inputs should be used. In this regard it should be noted that State and Local governments may have different requirements. The largest scale required will determine the level and scale of landslide zoning.	Available data is limited to susceptibility and inventory. Decision by government to use the best available data to create a planning overlay. Allow proponents / councils to develop their own maps to override strategic-level state maps.	No change Tasmania's planning and building system has developed and matured since 2013. The regional zoning (Landslide Planning Map) guides decisions and investigations at the planning stage, while detailed site-specific landslide hazard or risk assessments may be required at the subdivision or building stage. Councils are able to apply more detailed landslide maps and/or landslide management plans via a Special Area Plan provision.
Linkage to the proposed planning controls.	The use of complementary or linking processes such as planning schedules and development control plans whereby the landslide zoning initiates a more detailed assessment at site scale. In this case, the use of landslide susceptibility mapping which defines a planning control area may be sufficient to identify where	Available data is limited to susceptibility and inventory is integrated in to the landslide planning map and associated, hazard band and matrix based on expert judgement, strategic planning outcomes, coordination of controls. Planning and building controls test different use, developments, works,	No change SPP has been reviewed as being updated. Since 2013, the controls and processes have been successively developed, implemented, and matured.

	a more detailed landslide risk assessment is needed	buildings at different stages. For example low and medium hazard bands a LRM has to be undertaken as part of the planning application, while houses on single blocks are considered in building. Allow proponents / councils to develop there one maps to override sate maps	Despite the expected challenges, language conflicts, and foibles of a complex system, the Landslide Planning Map, land use planning controls, and building control system is working in exactly this way. The statewide zoning (Landslide Planning Map) guides decisions and investigations at the planning stage, while detailed site-specific landslide hazard or risk assessments may be required at the planning, subdivision or building stage depending on the susceptibility and type of development.

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