



### Landslide Hazard Series

**Background, Aim and Purpose**

This map is one of a set of thematic maps addressing regional landslide susceptibility and hazard for urban areas and surrounds in Tasmania. The project is undertaken by Mineral Resources Tasmania, in partnership with Local Government and sponsored by the Natural Disaster Mitigation Programme (Involving Federal and State contributions).

Large tracts of land throughout Tasmania are subject to slope instability and over 75 houses have been destroyed by landslides since the 1950s with many more significantly damaged. The only natural form of life has occurred in highly dramatic, and often deadly events and the impact on individuals, organisations and the State runs into many millions of dollars. Record disasters such as the Theobald Landslide in New South Wales, came to a similar scale of the potential for loss of life over relatively small landslides. Fortunately, landslide damage can be avoided when ground conditions are properly understood before construction proceeds and in already developed areas, this understanding can be used to mitigate the hazard through various measures.

**Method**

A methodology has been specially developed for this map series and is used for other areas of Tasmania. Refer to the document "Tasmanian Landslide Map Series: User Guide and Technical Methodology" for further information. The methodology has evolved since the earlier maps were published, in part due to the Australian Geomechanical Society publishing guidelines for landslide zoning (AGS 2007a,b) - changes have been made to conform to these as much as possible.

**Methodology used is based on:**

- Recording observations of land instability in- and surrounding- the study area (the landslide inventory).
- Analysis of the processes that control each landslide type.
- Computer assisted modelling that simulates each of the landslide processes to predict areas that could be affected by future landslides.

**Caveats for Use**

The information provided in the public domain and anyone is free to use it provided they read and understand the purpose and limitations.

The following caveats shall apply to the maps:

- The hazards identified are based on imperfect knowledge of ground conditions and models to represent our current understanding of the landslide process. As this knowledge improves our perception of the hazard and the depiction on the map may 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 maps.
- The local intensity of the data should be considered as all areas exceeding this limit could lead to inaccurate decisions about the hazard.
- Site specific assessment of the data 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.
- Atmospheric 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 of all potential hazards has 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.

### Rockfall Hazards

The rockfall susceptibility zones shown on this map apply to two types of landslide process, rockfall (overhanging cliffs) and toppling. A rockfall is defined as the independent movement of rock or soil fragments through freefall, bouncing, rolling and sliding. They are usually sourced from cliffs on steep slopes and are a fast moving type of landslide. As toppling is the same process involves a forward rotation of material, usually on an escarpment, that may develop into a rockfall if the landslide and properties of the displaced mass allow. For the purposes of the map they are modelled together and for convenience generally referred to as rockfall. It is possible that a third process may be involved in some cases - rock falls involving that describe the movement of a large number of boulders in a single event but this has not been witnessed in the region and is difficult to prove from available geological evidence.

The process of rockfall modelling consists of predicting source areas and runout paths. The methodology is explained more fully in Macgregor (2006) and Macgregor and Stevenson (2010, 2011) but it has been necessary to modify some aspects to suit local conditions and to satisfy the AGS (2007a) guidelines for "Landslide Risk Management". Source areas were determined by selecting slopes greater than or equal to 42 degrees. The choice of angle is based on the angle of repose for debris piles defined in published literature (e.g. Carey, 1983) and from unpublished field observations in Tasmania. It is recognised that isolated rockfalls can occur on slopes lower than this value, but this is considered to be generally of lower probability. A 10m pixel digital elevation model (DEM) was constructed from which the source areas were derived. It is important to realise that the reliability of the source prediction is variable because the digital elevation model from which the source is derived is based on a combination of disparate data sources and the resolution of the source prediction is limited by the resolution of the DEM. Areas were extracted from the 10m DEM which were subsequently reclassified to 10m pixels. In the reclassification process the 10m DEM was used which experience shows, tends to underpredict rock fall source areas.

Runout paths were modelled from each source cell, travelling in the direction of maximum downhill slope as defined by an aspect digital terrain model derived from the 10m DEM. This is a simplistic technique that represents the most likely path of boulder(s) travelling downhill. In reality the actual path of material may deviate from this to some degree. The model does not take into account obstacles and small scale topography that are beyond the resolution of the input layers, such as trees, structures and protection fences. The extent of each runout path is defined using the travel angle method with two values, 34 and 30 degrees, representing decreasing probability respectively. Low, moderate and high risk areas are based on field studies of debris talus fan slope angles in Tasmania. For rockfalls occurring in weaker rock units, the travel angle values chosen may, in many instances, be too low and thus overestimate the runout distance.

Relative or quantitative susceptibility descriptors of Very Low, Low, Moderate and High as defined in the AGS (2007a) guidelines were not adopted because of insufficient field evidence in the study areas. Instead the guidelines allow an alternative approach, although not entirely satisfactory, of rockfall in the landslide database, which is partly a reflection of the limited areas in which the process can be considered as susceptible to rockfall. Areas outside these zones are considered not susceptible with the proviso that because the modelling is not perfect there may be special cases where rockfall could occur.

This map identifies a number of locations (less than 0.05% of the study area) that could be affected by rockfall events. The main areas are associated with steep and isolated escarpments and cliffs along coastal and estuarine cliffs, basal escarpments such as Brandy Lockett and rocky valley walls in discrete such as Sully Creek. Rockfalls will also occur on artificial slopes such as quarry and mine faces and road cuttings that are spread throughout the study area. There are few records of rockfall in the landslide database, which is partly a reflection of the limited areas in which the process can be considered as susceptible to rockfall. The main areas on the map (shown in red) are generally visible on aerial photographs and other not reported.

The velocity and size of boulders involved in rockfall is expected to vary from place to place and should be considered in site specific investigations. The potential loss from rockfall are highly variable ranging from minor to serious injury or death to unreported persons. Structures could also receive significant damage from typical sized boulders of local or distant.

The frequency of rockfall events in the study area is difficult to quantify and needs further work for site specific instances.

Rainstorms, ocean waves, frost heaving, colluvial wedging, road jacking and human activities are all potential triggers for rockfall events. Seismic shaking (earthquake) is specifically excluded from the map. The intensity of the study area is such that the probability of strong ground shaking is considered to be minimal (Burbridge 2012).

### Conclusions

The rockfall susceptibility map identifies small areas of land within the modelled boundaries that may experience this potentially dangerous process. Most of these areas are in remote and sparsely populated regions where exposure of structures and persons is minimal. While a low record (European rockfall records are known, there is insufficient information to calculate likelihood).

Despite the low spatial incidence of the rockfall hazard, caution is required in the susceptible zones identified. We recommend that new developments within these areas should require geotechnical investigation - the methodology outlined in the Practice Note Guidelines for Landslide Risk Management (AGS 2007c). The risks should also be assessed in established developments and on steep slopes such as walking tracks and roads. The cost of destruction of property, injury or loss of life should be considered in site specific. Rockfall may also occur in areas modelled as not susceptible given the limitation of the methodology used and consideration should be given to the hazard for developments on or adjacent to steep slopes.

**References**

AGS 2007a: Guideline for Landslide Susceptibility, Hazard and Risk Zoning for Land Use Planning, Australian Geomechanics, 42(1), 13-36.

AGS 2007b: Commentary on Guideline for Landslide Susceptibility, Hazard and Risk Zoning for Land Use Planning, Australian Geomechanics, 42(1), 37-58.

AGS 2007c: Practice note guidelines for landslide risk management, Australian Geomechanics, 42(1), 63-114.

AGS 2007d: Commentary on practice note guidelines for landslide risk management, Australian Geomechanics, 42(1), 115-158.

Burbridge, D.R. (ed.), 2012. The 2012 Australian Earthquake Hazard Map, Record 2012/71, Geoscience Australia, Canberra.

Caine, N., 1963. The mountains of northern Tasmania. A.A. Balkema, Rotterdam, 200pp.

Macgregor, C., 2006. The Tasmanian landslide hazard map series. Methodology, Tasmanian Geological Survey Record 2006/04, Mineral Resources Tasmania, Hobart, 43pp.

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Macgregor, C., Stevenson, M.D. 2011. Evaluation of the Tasmanian North-west Coast landslide map series against the AGS 2007 landslide zoning guidelines. Australian Geomechanics 46(2): 219-233.

**Further Information**

**IMPORTANT: This map should be used in conjunction with an understanding of the information contained within the document "Tasmanian Landslide Map Series: User Guide and Technical Methodology" (Macgregor, C and Stevenson, M.D. 2010), Tasmanian Geological Survey Record 2010/01.**

This document, and other information on the map series or Tasmanian landslides in general can be obtained from the MRT web site at [www.mrt.tas.gov.au](http://www.mrt.tas.gov.au) or by contacting the agency directly. Copies of the map images (PDF format) are freely available from the MRT website. GIS layers developed by MRT and shown on the map are applied to each Council in the area and are available for purchase at a minimal cost of supply.

Summary information from the MRT landslide database and map images from the Tasmanian Landslide Map Series can be viewed with the MRT online web map viewer (choose Map, Landslides).

