Tasmania
Explore the possibilities

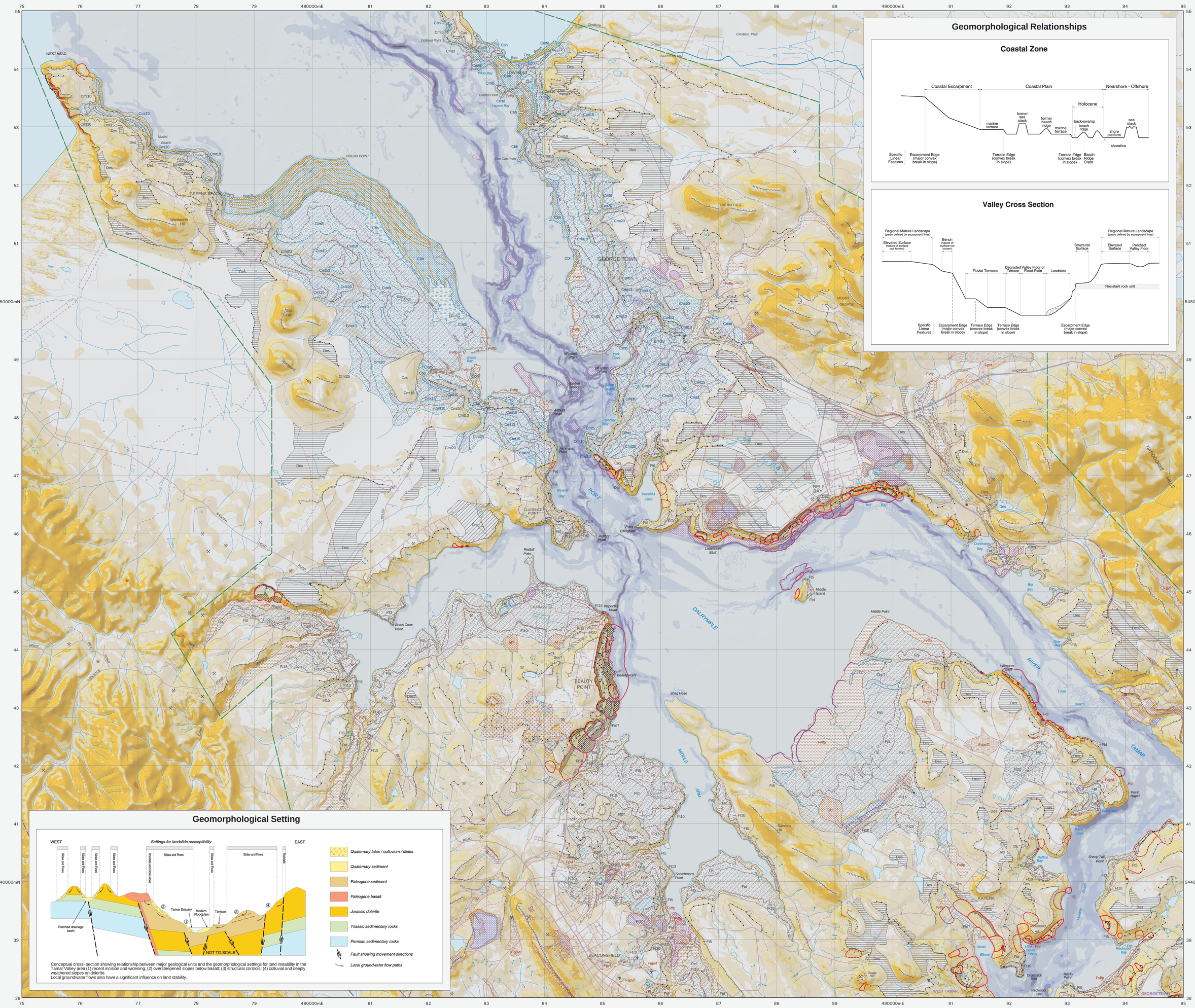
Department of Infrastructure Energy and Resources
MINERAL RESOURCES TASMANIA

TASMANIAN LANDSLIDE MAP SERIES

BELL BAY - GEOMORPHOLOGY

MAP 2

West Tamar COUNCIL



Geomorphological Relationships

Coastal Zone

Valley Cross Section

Geomorphological Setting

Conceptual cross- section showing relationship between major geological units and the geomorphological settings for land instability in the Tamar Valley area (1) recent incision and widening; (2) oversteepened slopes below basalt; (3) structural controls; (4) colluvial and deeply weathered slopes on dolerite.
Local groundwater flows also have a significant influence on land stability.

Landslide Map 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. While only minimal loss of life has occurred such events are highly traumatic to those directly affected and the financial cost to individuals, organisations and the State runs into many millions of dollars. Recent disasters such as the Thredbo Landslide in New South Wales, serve to remind society of the potential for loss of life even from 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" (see Further Information). The methodology has evolved since the earlier maps were published, in part due to the Australian Geomechanics Society publishing guidelines for landslide zoning (AGS 2007a,b) - changes have been made to conform to these as much as possible.

The 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 is 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 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.

Geomorphology

This map shows the regional geomorphic features mapped in and around the Tamar Valley. These features represent both individual geomorphic units and structural aspects of the landscape that assist in understanding its evolution and in particular land instability.

The base layer of the map is a hillshade digital terrain model that emphasises landscape relief. Draped on top of this is a slope classification based on Demek (1972) and stability thresholds determined by reference to the local underlying geology.

Manually mapped units are depicted as lines, polygons and points to represent a range of natural and artificial features whose relationships are included in the associated diagrams. The process of mapping made substantial use of detailed aerial photography, viewed in stereo pairs, and an airborne laser scanning (LiDAR) survey. The photos and their interpretations were orthorectified to a real- world precision better than 5m in most cases. Older aerial photos (e.g. 1946, 1952 and 1975) were also used in the mapping. Older photos have the advantage of allowing the identification of features subsequently obscured by urban development, roads or land degradation in intensively farmed areas. Limited field checking accompanied the mapping and the accuracy of the units recognised is reflected in the classification contained in the legend.

Natural features mapped include landslides and their internal features where discernable, as a special category of importance, in addition to fluvial and coastal landforms. Emphasis has been placed on mapping various surfaces such as fluvial and marine terraces that have age significance. This information is used to constrain the age of the landscape and in particular the landslides. Such information in turn can allow for an estimation of likelihood of recurrence.

Artificial features mapped include quarries, major road cuts - notably along the East Tamar and West Tamar Highways, and areas of landfill and reclamation. It should be noted that equivalent units in the accompanying geology map may not always align and be generally less accurate due to different mapping approaches and emphases.

A fuller explanation of the mapped features is contained with the digital dataset associated with these maps.

Geomorphological Setting

The Tamar Valley is the largest of a series of NNW- SSE trending parallel valleys. It contains the modern River Tamar estuary, North Esk and Rose Rivulet fluvial systems, and is joined from the southwest by the modern South Esk fluvial system through the Cataract Gorge. The River Tamar and its tributaries have a catchment that covers over 20% of Tasmania's land mass. The River Tamar estuary was formed as a drowned river valley (a 'ria') as a result of rising sea levels following the last glacial period - the estuary is about 70km long and flanked on the east and west by ranges of Jurassic dolerite hills. In the lower reaches of the River Tamar, north of Beauty Point, the rocky floor of the estuary has been cut by a deeply incised channel, which can be traced about 4km offshore.

There are a range of geomorphological features expressed in the broader area, many of which reflect the underlying geological structure. The Tamar Valley is situated within the central valley of an asymmetric graben system resulting from a series of NNW- SSE trending faults. Gently SW- tilted fault blocks, with some western blocks tilted to NE, have given rise to a sub- parallel system of ridges and valleys formed in Jurassic dolerite with Paleogene and Quaternary sediment infills. Paleogene fluvial and lacustrine sediments are now primarily found in the central Tamar Valley, with some deposits preserved in smaller parallel valleys. An extensive peneplain, the Woodstock Surface (Nicolls 1960), is found south and southwest of the Tamar Valley with its northern margins now at 140- 220m ASL. There is some evidence for highly eroded remnants of a high- level surface, at about this level, poorly preserved on the Jurassic dolerite along the eastern and western flanks of the Tamar Valley.

Basalt flows occurred at intervals within the Paleogene sequence - some of which were quite extensive. These basalts overlie the much softer Paleogene sediments with the bases of several at an elevation similar to the peneplain. Due to differential erosion the remaining Paleogene basalt now forms prominent plateaus and ridge tops within the Tamar Valley (Grindelwald, Gaunts Hill, Murphys Hill area, Rowella, along the Batman Highway, behind Beauty Point and behind Bell Bay).

Uplift of the landmass since the Paleogene is believed to have triggered significant rejuvenation of the landscape to leave it substantially dissected. The uplift, probably in several phases, caused streams to lower their base levels, with incision occurring progressively in a headward fashion. The junction between the mature landscape and the more youthful incised valleys and streams is typically expressed as knickpoints. Other, more direct evidence for uplift is expressed in the form of marine and fluvial terraces whose elevation cannot be explained solely by natural sea- level fluctuations in the Pleistocene. In addition to the terraces there are remnants of higher elevated semiplanar surfaces (at approx. 35, 45, 75 and 100m ASL) that are highly eroded and often have associated ferruginous duricrusts or ferricretes. These surfaces become increasingly degraded with elevation and are probably related to much earlier phases in the valley evolution.

Quaternary alluvial sediments, including the modern floodplain and elevated fluvial terraces, have been deposited in the Tamar valley in association with long- term downcutting and episodic aggradational phases. Between the Jurassic dolerite ranges, outside of the central valley, Quaternary valley fills have formed in perched drainage basins. In places there are also remnants of older perched valley floors that are now abandoned by their original watercourses. Along the modern coast Holocene deposits are generally found as either a narrow beach or a series of beach ridges and dunes with a backswamp behind.

Incised valley slopes in soft Paleogene sediments, steepened through downcutting and valley widening, are particularly prone to slope failure. In addition, differential erosion between the Paleogene sediments and much harder basalts has led to over- steepened slopes on the sediments, and the accumulation of extensive basalt talus deposits on these slopes. In places within the Tamar Valley the river is more directly causing instability by actively undercutting the slopes on the outsides of bends.

In general, the Jurassic dolerite and older rock sequences are harder and more erosion resistant than the younger Paleogene units, and derived slope deposits. However, there are a number of places where the dolerite can be shown to be very deeply weathered, although it is difficult to map the extent with any certainty. These deeply weathered Jurassic dolerites, as well as some members of the Permian- Triassic Parmeener Supergroup sediments, can also be prone to landslides.

In many instances springs are associated with instability, highlighting the importance of groundwater in lowering material strength. The fractured basalt rock that caps the Paleogene sediments acts as a reservoir of water. The groundwater moves down into the underlying clay- dominated Paleogene sediments and is usually conducted along the base of sandier/siltier horizons. These horizons probably have a significant influence on landslide susceptibility. However, delineating these in the landscape is made difficult by the widespread slope deposits and the likely high lateral variability within the Paleogene stratigraphy. There is some evidence (Sutherland et al. 2006) in the Tamar Valley for at least one phase of downcutting and infilling of the sediments within the Paleogene.

Four distinct terrace levels (approx. 5, 10, 15 & 20m ASL) have been observed along the north coast of Tasmania. Within the estuarine environment of the Tamar Valley three further terrace levels, though not well preserved, have been recognised (approx. 8, 13 & 25m ASL). These are both aggradation terraces and erosional terraces cut into the soft sediments. Many of the lower slopes in the Tamar Valley steepen below a level of about 25- 30m ASL, and for many landslide zones, with degraded landslide morphology evident above this level, the morphology is often completely absent below - but benches may be present at elevations matching the various terraces. This suggests that the lower slopes of the Tamar Valley have been modified by a significant (and the latest) degradational cycle of the river system, and that all of the observed terraces (5m to 25m) are related to that cycle. These lower slopes are therefore relatively young and many of the documented recent landslides and other landslides with a relatively young morphology are found on these steeper, younger slopes.

References

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

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

Demek, J. 1972. Manual of Detailed Geomorphological Mapping. International Geographical Union Commission on Geomorphological Survey and Mapping.

Nicolls, K.D. 1960. Erosion Surfaces, River Terraces, and River Capture in the Launceston Tertiary Basin. Papers and Proceedings of the Royal Society of Tasmania, 94:1- 12.

Sutherland, F.L., Graham, I.T., Forsyth, S.M., Zwingmann, H. and Everard, J.L. 2006. The Tamar Trough Revisited: Correlations between Sedimentary Beds, Basalts, their Ages and Valley Evolution, North Tasmania. Papers and Proceedings of the Royal Society of Tasmania, 140:49- 72

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" (Mazengarb, C. and Stevenson, M.D. 2010. Tasmanian Geological Survey Record 2010/01).

This document, and other information on this map series or Tasmanian landslides in general can be obtained from the MRT web site at 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 supplied to each Council in the area and are available for purchase at a minimal cost of supply.

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

Hill Country Units

- Fl25 — Fluvial terrace 25m
- Fl20 — Fluvial terrace 20m
- Fl15 — Fluvial terrace 15m
- Fl13 — Fluvial terrace 13m
- Fl10 — Fluvial terrace 10m
- Fl8 — Fluvial terrace 8m
- Fl5 — Fluvial terrace 5m

Approximate terrace height

- Fld — Degraded fluvial terrace remnant

Note: Mapped terraces will include both fluvial and estuarine terraces.

- Hcl — Colluvial footslope
- Al — Alluvial fan
- Fvftp — Valley floor and floodplain
- Fpvf — Perched valley floor upstream of significant knickpoint
- Fapvf — Abandoned perched valley floor
- Db — Bench on midslope (origin uncertain)
- Des — Elevated semiplanar landscape surface of uncertain origin
- Dss — Horizontal or dipping surface of structural origin

Coastal Units

- Cbh — Holocene beach ridge and dune (sand and gravel)
- Cas — Abandoned sea stack or island
- Cbp — Pleistocene beach ridge (sand and gravel)
- Cbs — Backswamp

- Cmt25 — Marine terrace 25m
- Cmt20 — Marine terrace 20m
- Cmt15 — Marine terrace 15m
- Cmt13 — Marine terrace 13m
- Cmt10 — Marine terrace 10m
- Cmt8 — Marine terrace 8m
- Cmt5 — Marine terrace 5m

Approximate terrace height

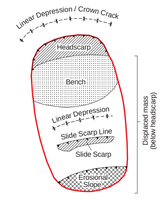
- Cmtd — Degraded marine terrace remnant

Note:
- Mapped marine and fluvial terrace units may include both aggradational and erosional surfaces.
- Units labelled with a question mark (?) indicate uncertainty.

Artificial Units

- Cut (including rock removal in navigation channel)
- Fill
- Cut and fill (undifferentiated)
- Quarry
- Quarry (derived from MRT DEPOSITS database) - Includes both active and historic features

Landslide Components



- Affected area of Landslide
- Affected area of Possible Landslide
- Landslide shown as a point where too small for map's scale
- Uncertain / inferred boundary

Slope Categories

On Land	Below Water
0 - 2 degrees	
2 - 7 degrees	
7 - 13 degrees	
13 - 35 degrees	
35 - 42 degrees	
> 42 degrees	

Note: The techniques used to create the slope layer tend to underestimate values along cliffs.

Linear Geomorphic Features

- Beach ridge
- Major convex break in slope
- Minor or rounded convex break in slope
- Terrace edge
- Terrace edge - poorly defined
- Sharp ridge
- Landscape lineation of uncertain origin
- Cut
- Artificial levee

Point Geomorphic Features

- Significant knickpoint
- Spring or seep oriented downslope (may be concealed under dam or fill)
- Dip direction and dip of structural surface

Miscellaneous

- Municipality boundary
- Limit of detailed geomorphological mapping

Scale: 1:25 000

0 500 1000 1500 2000 2500m

GDA94 - MGA Zone 55. Contour Interval 20 metres.

GDA

Citation:

Stevenson, M.D. and Mazengarb, C. 2013. Bell Bay, map 2 - Geomorphology. Tasmanian Landslide Map Series. Mineral Resources Tasmania, Department of Infrastructure Energy and Resources, Hobart.

Acknowledgements:

Contributions to the map from C. Calver, D. Shearer, R. Blake, J. Bowerman and A. Mayne.

Base data from the Land Information System of Tasmania (LIST), Copyright State of Tasmania.

Sources for digital terrain model: airborne laser data derived from Climate Futures for Tasmania LiDAR dataset (2008), available from the LIST. Bathymetry derived from data supplied by SeaMap Tasmania (Institute of Marine and Antarctic Studies, 2009), and TasPorts Corporation, including the Tamar River Hydrographic Survey (2009).

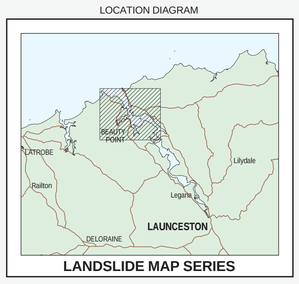
Map produced by the Geoscience Information Branch of Mineral Resources Tasmania using GIS software.

Disclaimer:

While every care has been taken in the preparation of this data, no warranty is given as to the correctness of the information and no liability is accepted for any statement or opinion or for any error or omission. No reader should act or fail to act on the basis of any material contained herein. Readers should consult professional advisers. As a result the Crown in Right of the State of Tasmania and its employees, contractors and agents expressly disclaim all and any liability (including all liability from or attributable to any negligent or wrongful act or omission) to any persons whatsoever in respect of anything done or omitted to be done by any such person in reliance whether in whole or in part upon any of the material in this data.

Crown copyright reserved.

LOCATION DIAGRAM



LANDSLIDE MAP SERIES

Data correct & plotfile generated: 13-MAR-2014

WARNING:INKS ARE LIGHT SENSITIVE