Tasmania
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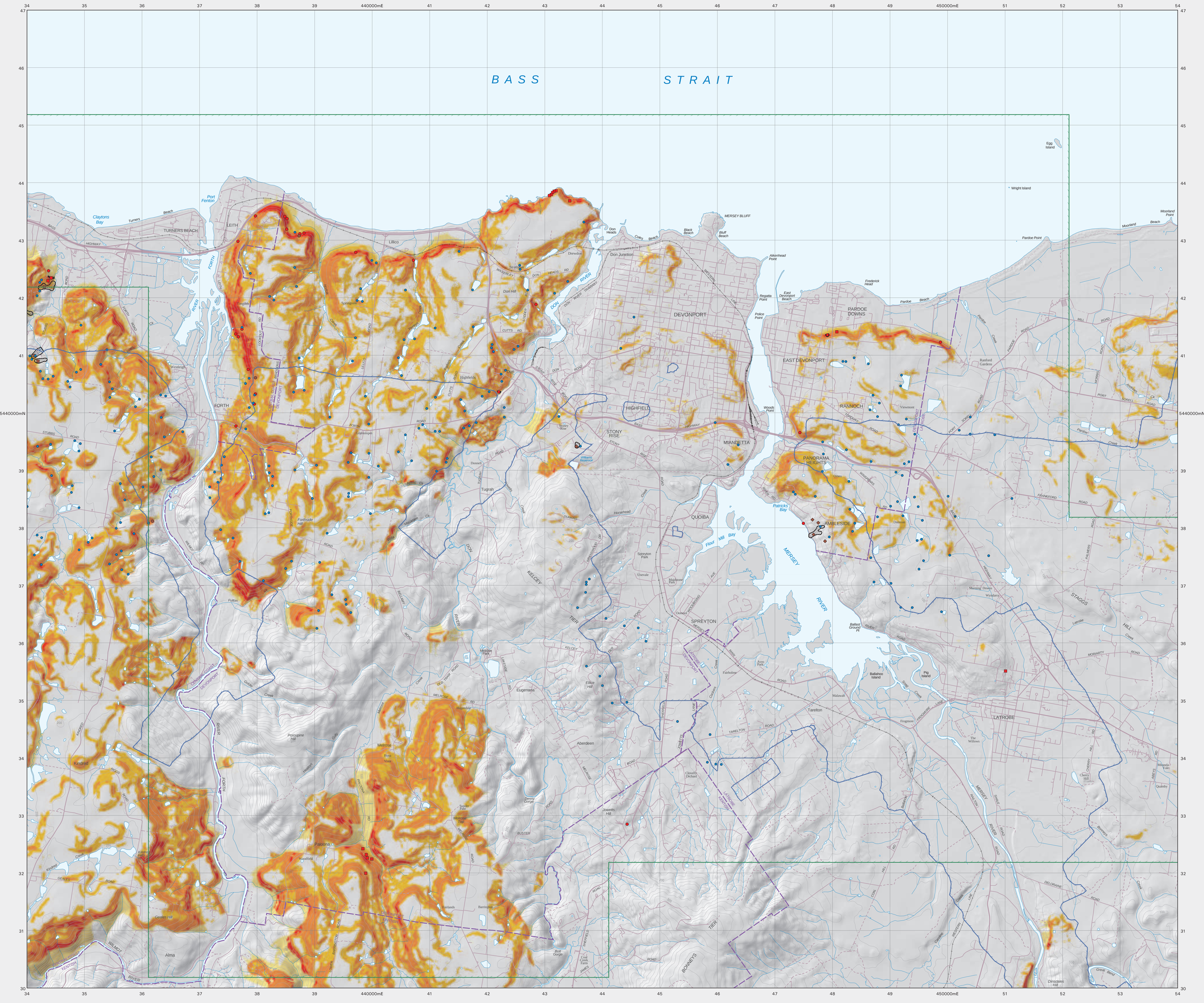
Department of Infrastructure Energy and Resources
MINERAL RESOURCES TASMANIA

TASMANIAN LANDSLIDE MAP SERIES

DEVONPORT – SHALLOW SLIDE AND FLOW SUSCEPTIBILITY

MAP 5



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 60 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. It can be downloaded from the MRT website although minor changes in approach have been made since the first maps were completed. Furthermore, the Australian Geomechanics Society have published guidelines for landslide zoning (AGS 2007a,b) and 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.

Shallow Slide and Flow Susceptibility

The landslide susceptibility zones shown on this map apply to two types of landslides – Shallow Slides and Earth or Debris Flows. Shallow slides are typically small, i.e. <1000m³ in volume – as defined by the Australian Geomechanics Society (AGS) Landslide Risk Management Guidelines (AGS 2007a). These shallow slides are usually less than 5m in depth and are generally smaller than the deep–seated, large landslides that are considered as a separate map theme. Earth and debris flows, collectively referred to here as flows, are a type of landslide often triggered by the action of torrential rain – either directly on a slope or indirectly by the build up of groundwater pressure. Flows often occur as a consequence of an initial slide failure which, if ground conditions are wet enough, then develops into a rapidly moving flow.

Debris flows occur when coarse material, including rocks and vegetation (debris), and finer soil material (earth) mix with water and become saturated – they may lose their strength and flow down slope, eventually coming to rest on the slope when/as if the flow is impeded. In cases where the material involved is devoid of coarse material the flow is termed an earth flow. From a morphological perspective alone, without the benefit of sub–surface information, the deposits from these two types of flow may be difficult to distinguish and for this reason are grouped together in this discussion.

Landslides that initiate as slides and then transform into flows during movement are classified by the dominant movement style involved. If slides or flows enter stream channels they may become diluted enough to form hyper–concentrated flows or debris floods. Alternatively, slides or flows may form temporary dams that in turn fail catastrophically to become flash floods. Upon reaching lowland areas, where the stream channels are unconfined, flows may depart from the channel and deposit lobes of material onto the surrounding landscape.

A number of flows and shallow slides were identified in the course of mapping and added to the landslide database, but many of those shown on the map have occurred since European settlement of the area and the information has been extracted from various records and past maps. Due to the difficulty in recognising past shallow landslides and flows in the landscape, and poor records of landslides since European settlement, there have probably been many more such landslides in the area than is shown on the map. Most of the features identified originate on the coastal escarpment, or steeply incised valley walls, underlain by Tertiary basalt and are often closely associated with springs.

The process of modelling shallow slides and flows involved identifying source areas, for both the shallow slides and flows, and identifying runout paths for the flows. The SHALSTAB technique (described in Mazengarb 2005) and employed in the Hobart debris flow map (Mazengarb 2004) has proved unsuitable for identifying source areas in the northwest coast study area. The reason for this is that groundwater flow appears to be more strongly controlled by geology than by topography within the basalt terrain. As an alternative approach, a combination of slope and geology has been used to identify potential source areas. The analysis has used a digital elevation model (10m cell size) and a simplified geological map in which a variety of basaltic units are treated as one. It is important to realise that the reliability of the source prediction is variable because the digital elevation model is based on a combination of disparate datasets, of varying resolution and quality, and the geological mapping is not always a reliable proxy to materials found on the ground. It must also be understood that the geology map used is not designed to accurately portray surficial materials (regolith), and it would be an extremely challenging task to reliably map the regolith at this regional scale.

It is clear that the limited observations of regolith (including drill–hole records) indicate that the basaltic units are typically deeply weathered. Given the limitations above the modelling has taken a precautionary approach and assumed worst case conditions for slope stability. In a few instances, where fresh basaltic rock has been mapped, these areas have been excluded from the susceptible areas.

Runout paths for flows were modelled from each source cell travelling in the direction of maximum downhill slope (defined by an aspect grid). A travel angle method, using a single value of 12 degrees, provides a limit to runout (see figure). The travel angle value chosen should be regarded as a worst credible case as many flows mapped do not run out this far. A final processing step involved an expand–and–shrink routine (one cell dimension) that filled in minor holes and smoothed ragged edges. This has further ensured that an acceptable cartographic output has been produced for the output scale of the maps.

Relative susceptibility descriptors of Low, Moderate and High susceptibility as defined in the AGS (2007a) guidelines have been applied to the identified source areas on this map on a population–based approach (see table). The susceptibility zones on the map identified as source areas can be considered as susceptible to both shallow slides and flows. In contrast the runout areas can be considered as susceptible to the down slope travel of earth or debris flows, as a result of their wet condition.

While these landslide processes are natural phenomena, the susceptibility of a given slope may be increased by human activities such as land clearance, excavations and inappropriate drainage. Bush fires are another process that may increase susceptibility to shallow slides and flows for some time after the fire, depending on the severity of the fire and vegetation types.

The susceptibility map has a number of inherent limitations and must be regarded purely as an indication of stability from a regional perspective. The parameters chosen represent a worst case scenario that may, with further site investigations, be found to be better than indicated in some instances. The modelling does not take into account obstacles that are beyond the resolution of the map such as trees and debris dams where they exist. Runout paths follow the course of stream channels in the lowland, whereas in reality flows are expected to some extent to breach stream banks and affect a larger area than that shown on the map.

Conclusions

The shallow slide and flow susceptibility map identifies a number of typically small past shallow slides and flows; most of which have been recorded since European settlement. The areas identified as potentially susceptible to these types of landslides, as well as those that have already occurred, are concentrated along the coastal escarpment, or steeply incised valley walls, underlain by Tertiary basalt.

The identified landslides and susceptible areas are not necessarily unstable in their present condition. However, it cannot be assumed that they are suitable for development without first undertaking a geotechnical investigation – as outlined in the Practice Note Guidelines for Landslide Risk Management (AGS 2007c,d). The risk of destruction of property, injury or loss of life should be estimated on a site by site basis within the identified landslides and susceptible areas.

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.

Mazengarb, C. 2004: Map3, Hobart – Potential Debris Flow Hazard, Tasmanian Landslide Hazard Series. Mineral Resources Tasmania, Hobart.

Mazengarb, C. 2005: The Tasmanian landslide hazard map series: Methodology. Tasmanian Geological Survey Record 2005/04, Mineral Resources Tasmania, Hobart. 43p.

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".

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.

Modelling Parameters Employed in Study

Simplified Geology	Source Area	Slope Angle	Percentage of Known Landslide Population
Tertiary basalt and sediments, Cambrian basalts, basaltic colluviums, basaltic landslides[1]	High	> 20 & < 42[2]	50%
	Moderate	10 - 20	40%
	Low	6 - 10	9%
	Very Low	< 6	1%
	Runout Area	12 degree travel angle	

[1] No other geological units were modelled.
[2] Areas steeper than 42 degrees are not included in source zones because they are unlikely to contain sufficient soil material that could fail in this manner.

Susceptibility Zones

- High susceptibility source area.
- Moderate susceptibility source area.
- Low susceptibility source area.
- Flow runout area.

Source area: An area of hillside with the potential to form a slope failure, identified largely on the basis of slope angle and geology.

Runout area: An area down–slope of a source area where the moving earth, debris or rock can potentially travel.

Miscellaneous

- Municipality boundary.
- Spring or seep – which have a known association with landslides in many cases.

Shallow Slide or Flow Features

- Shallow slide or flow affected area.
- Shallow slide, recent or active.
- Shallow slide, activity unknown.
- Earth or debris flow, recent or active.
- Earth or debris flow, activity unknown.
- Unclassified shallow slides or flows.

Data Sources

The sources for the digital elevation model (DEM) used in the susceptibility modelling are:

1 – Airborne Laser Scanning
- Airborne Laser Scanning data boundary.

2 – 1:5 000 topographic contours
- 1:5 000 topographic contour boundary.

3 – 1:25 000 topographic contours

Remainder of mapsheet area

Scale: 1:25 000

0 500 1000 1500 2000 2500m

GDA94 – MGA Zone 55. Contour Interval 20 metres.

GDA

Citation:

Mazengarb, C. 2010: Map 5, Devonport – Shallow Slide and Flow Susceptibility. Tasmanian Landslide Map Series. Mineral Resources Tasmania, Department of Infrastructure Energy and Resources, Hobart.

Acknowledgements:

Contributions to the map from M. Stevenson and J. Bowerman.

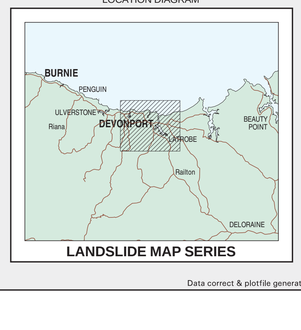
Base data from the Land Information System of Tasmania (LIST), Copyright State of Tasmania.

Airborne Laser Data derived from Climate Futures for Tasmania LIDAR dataset, available from the LIST.

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

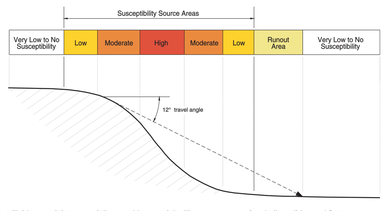
Disclaimer:

LOCATION DIAGRAM



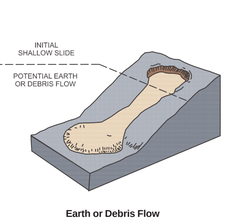
LANDSLIDE MAP SERIES

Conceptual Diagram Illustrating Shallow Slide and Flow Susceptibility Modelling



Hillside containing potentially unstable materials. The source areas for shallow slides and flows are defined on the basis of slope categories whereas the runout area for flows (only) is determined by the travel angle method (see arrow).

Example of Landslides Depicted on the Map



Earth or Debris Flow

(Source: United States Geological Survey fact sheet 2004–3072)

Data correct & plotfile generated: 11-APR-2012

WARNING:INKS ARE LIGHT SENSITIVE