

Community risk in Cairns: a multi-hazard risk assessment

Community Risk in Cairns is the first of a series of multi-hazard case studies by the AGSO *Cities Project*. It considers earthquake, landslide, flood and cyclone. A report detailing the hazard history of Cairns, the risk assessment methodology and results was released on CD-ROM with a hard copy overview in April 1999.

The AGSO *Cities Project* undertakes research towards the mitigation of the risks posed by a range of geohazards to Australian urban communities. The ultimate objective is to improve the safety of communities, and consequently make them more sustainable and prosperous.

Risk is the outcome of the interaction between a hazard phenomenon and the vulnerable elements at risk (the people, buildings and infrastructure) within the community. We have made extensive use of geographic information system (GIS) to drive our analysis and assessment. *Risk-GIS*, as it has been christened in the *Cities Project*, is a fusion of the decision support capabilities of GIS and the philosophy of risk management.

Community vulnerability

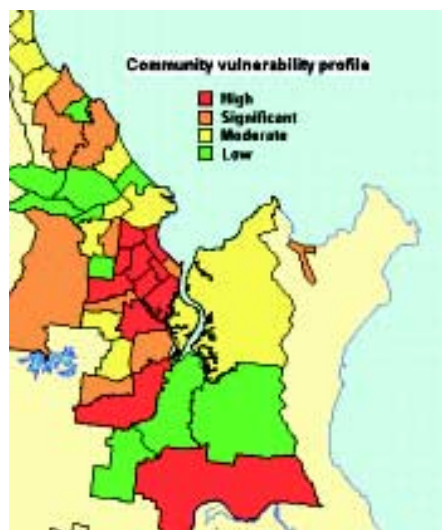


Figure 1: Community vulnerability profile

We have adopted a systematic approach to the description of the elements at risk in the community and their vulnerability, grouping the various elements into the five themes of setting, shelter, sustenance, security and society. We have developed an overall vulnerability profile of Cairns by which to identify those suburbs that provide a disproportionate contribution to community

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risk because of the number and nature of the elements at risk they contain. This is shown in *Figure 1*.

Earthquake risk

Over the past 100 years there have been at least 11 significant earthquakes within 200 km of Cairns. We have constructed earthquake urban hazard zonation maps and, from the building database, produced an inventory of buildings, by construction type and usage, in the zones in these maps.

Whilst all suburbs have some degree of exposure, Risk-GIS analysis of the earthquake hazard reveals that some 86% of Cairns buildings stand on 'soft' sediments of the coastal plains and riverine deltas, or the sands, silts and clays of the lower footslopes. These sediments amplify earthquake shaking. The extensive 'soft' sediments beneath the coastal suburbs, in particular, would aggravate the impact of any significant earthquake. These are also the suburbs that contain many of the critical facilities and have significant concentrations of people, buildings and infrastructure.

In order to produce a suburb-by-suburb ranking of Cairns for earthquake risk from direct damage to buildings, we have introduced a vulnerability ranking of building construction types. The profile of risk exposure by suburb to earthquake is shown in *Figure 2*.

Landslide risk

For Cairns, landslide has been, and remains, a significant risk, as evidenced by events such as the massive debris flows that buried 10 km of the Captain Cook Highway to the north of the city in 1951, and the frequent impact on road and rail links in the district.

As development extends increasingly onto the hill slopes, the risk of landslide impact will increase unless appropriate mitigation strategies are adhered to. Flash flooding in Freshwater Creek, or debris flows, have the potential to disrupt the Cairns water supply by blocking the intake or destroying sections of the pipeline.

The landslide study undertaken here is the first to follow an internationally recognised quantitative landslide risk assessment

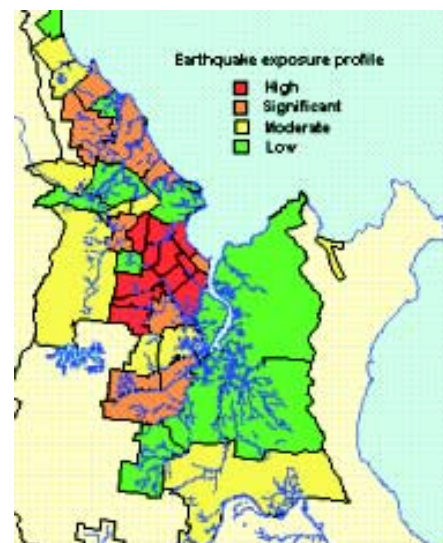


Figure 2: Earthquake exposure profile

methodology at a regional level in Australia, and various maps of specific and total risk of destruction have been produced.

Flood risk

Whilst flooding causes inconvenience and some dislocation in Cairns on average about once every 12 years, it poses a relatively limited threat to people and buildings. This is because urban development has largely been excluded from the most flood-prone areas of the Barron River delta, and the flood warning system for the Barron River operated by the Bureau of Meteorology is very effective.

The most significant inconvenience caused by moderate to major flooding in the Barron River system is the isolation of the northern beachside suburbs from downtown Cairns, with its critical facilities such as hospitals and airport. Cairns can also be isolated by the blocking of road and rail access from the south by flooding in other catchments such as the Mulgrave and Russell Rivers.

Using *Risk-GIS*, we have assessed the number of buildings, length of roads and area of cane land in each of the Barron River delta suburbs that would be affected by Barron River flood scenarios of various annual exceedence probabilities (average recurrence intervals). The impact on these communities, emergency management issues, and key facilities affected have been discussed.

Cyclone risk

Tropical cyclones pose a considerable threat to Cairns. In the 113 years since the settle-

ment was established there have been 53 cyclones that have had some effect on the town—that is, an average of a cyclone every two years. They bring with them the multiple threats of destructive winds, heavy rain and storm tide inundation.

Using *Risk-GIS*, we have assessed the suburbs in terms of wind risk exposure. We have also modelled various annual exceedence probability storm tide scenarios to quantitatively assess their impact on the elements at risk in the Cairns community.

Many people living in areas subject to storm tide inundation would be exposed to a significant risk of drowning, especially if the level of inundation exceeds 1 metre over floor level. For storm tide events with annual exceedence probabilities of 1% or greater (an average recurrence interval of at most 100 years) the numbers of people involved are relatively small and could be easily managed with appropriate warning, planning and community awareness. Beyond that level, however, a considerable effort would be required to undertake and manage the numbers of evacuees involved unless the vast majority were prepared to manage and undertake their own evacuations beginning at least 24 hours before the forecast cyclone impact time.

Whilst a severe cyclone on Cairns will have a major immediate impact with potentially

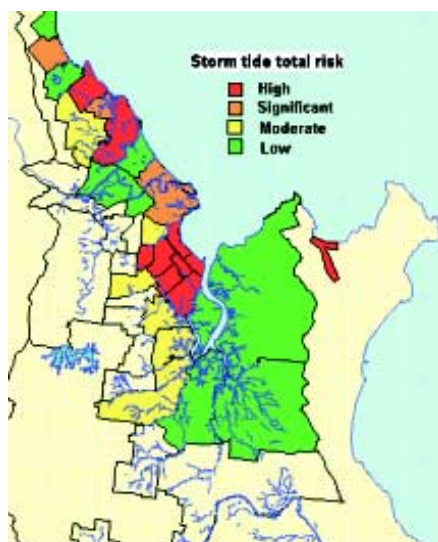


Figure 3: Storm tide total risk, taking community vulnerability into account

significant loss of life and massive damage, the long term effect will also be catastrophic. In an extreme event, most survivors would need to be evacuated to centres as far away as Brisbane and Sydney. The loss of facilities on which the community relies would be such that the city would be virtually uninhabitable for an extended period.

Total risk assessments

For each of the hazards, earthquake, landslide, flood, destructive cyclonic wind, and storm tide, we have constructed total risk

profiles for Cairns, taking into account the vulnerability of the whole community as well as the suburb-by-suburb risk for that hazard. Figure 3 shows the total risk for storm tide.

Is Cairns a risky place?

For an isolated community of more than 120,000 people located in the wet tropics, Cairns has a relatively low level of risk exposure to most hazards within the 1% annual exceedence probability range (i.e. an average recurrence interval of 100 years or less). Whilst events within this range will cause some loss and put lives at risk, the warning systems and other mitigation strategies already in place should keep loss of life to virtually zero and economic loss to the community as a whole to nuisance, or at least tolerable, levels so long as the population is aware and prepared.

The Cairns community does, none the less, have a very high level of residual risk exposure to the less frequent and more severe events, especially strong earthquakes, severe cyclones and major debris flows.

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