

CHAPTER 2: THE CAIRNS SETTING

Introduction

Cairns is the most northerly of Queensland's cities and one of the fastest growing communities in Australia. It is also an isolated community, located some 1 400 km in a direct line, or 1 706 km by road, from Brisbane. Melbourne is marginally closer to Brisbane than is Cairns. An aerial image of Cairns city and inner suburbs viewed from the east is shown in [Figure 2.1](#) (reproduced by permission of Brian Cassey Photography).

The 160 square kilometre area administered by Cairns City Council has a resident population of approximately 120 000. This total can exceed 150 000 at the height of the tourist season in July-August. This combination of size, rapid growth and isolation, together with its significant history of natural hazard events (most notably cyclones and floods) makes Cairns an ideal community on which to base a case study of urban vulnerability to a range of geohazards.

Community risk research on Cairns commenced under the TCCIP in 1995 with a particular focus on the risks associated with storm tide inundation. That effort provided an ideal base on which to develop the wider community risk research described in this report.

The Physical Setting

Topography: The major structural features of the Cairns area are shown in [Figure 2.2](#). The dominant feature is the very steep coastal scarp that forms the eastern edge of the Atherton Tableland. That scarp is marked by (from south to north) the Isley Hills, the Lamb Range and the McAlister Range. The Whitfield Range is an offshoot from the Lamb Range and separated from it by the valley of Freshwater Creek. To the east of, and running parallel to, the main range system lies the Thompson Range. Elevations within the study area range from sea level to approximately 800 metres (m).

The main drainage features are:

- the Barron River, which rises on the Atherton Tableland and enters the coastal plain through the spectacular Barron Gorge;
- Freshwater Creek, which joins the Barron River below the Gorge and drains the Lamb and Whitfield Ranges. The Freshwater is dammed at Copperload Falls to create Lake Morris - the main storage for the Cairns water supply; and,
- the network of small creeks that flow into Trinity Inlet. This system represents the original delta of the Mulgrave River.

The Mulgrave River itself, which flows onto the coastal plain to the south of Gordonvale, is not significant within the study area, although the alluvial sediments deposited in the Mulgrave River corridor certainly are significant to this study. The course of the Mulgrave probably alternated north and south after flowing eastward from the mountains onto the broad, relatively high alluvial plain near Gordonvale. During a sea level fall in the Pleistocene, it incised a channel into the sediments southward and has flowed south to Mutchero Inlet since then (Willmott and others, 1988). The basalt flows at Green Hill volcano, north-east of Gordonvale, have been dated at 986 000 years (Muller and Henry,

1982) and doming associated with this volcanic episode does not seem to be responsible for damming the Mulgrave river course north to Trinity Inlet (Willmott and others, 1988).

Geology: Bedrock in the Cairns region consists of more than 200 million year old sequences of folded and cleaved metamorphosed sediments and granite bodies. The prominent escarpments were probably formed from a modified land surface more than 65 million years old, which was formerly a continental highland. The granite bodies probably formed the highest points of this land surface because of their resistance to erosion.

Around 60 million years ago the eastern part of the continental highland was rifted, leaving a steep eastern slope. This slope has been retreating since, and reached close to its present position about 1 million years ago. Erosion has occurred most rapidly in the metamorphosed sediments leaving the granite as isolated hills and ranges (Willmott and others, 1988). Whether or not there has been further uplift or faulting since the rifting of around 60 million years ago is not known. There is little direct evidence that the Mulgrave River corridor is a former rift valley, however, this seems possible given its flat, sediment-floored valley, steep bedrock sides and the presence of the Green Hill volcano.

Climate: Cairns lies on the coast of Queensland at approximately 17° south latitude and consequently has a moist tropical climate. Rainfall is seasonal, with the heaviest rain occurring during the summer months. Extreme rainfall events are associated with tropical cyclones. Cairns comes under the influence of tropical cyclones on average at least once every two years, though ‘direct hits’ by severe tropical cyclones are not common.

Temperatures rarely exceed 35.0°C or go below 10.0°C for extended periods.

The main climatic statistics are summarised in [Table 2.1](#).

Table 2.1: Selected climatic statistics for Cairns (BoM, 1998)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Mean max temp (°C)	31.4	31.1	30.5	29.2	27.5	25.9	25.6	26.5	27.9	29.4	30.6	31.4	28.9
Mean min temp (°C)	23.6	23.7	23.0	21.5	19.9	17.7	17.1	17.5	18.6	20.5	22.2	23.3	20.7
Highest daily temp (°C)	40.4	38.9	37.7	36.8	31.3	30.1	30.1	31.0	33.9	35.4	37.2	40.5	
Lowest daily temp (°C)	18.2	17.9	18.6	13.0	10.1	6.2	7.3	7.8	11.1	12.4	14.6	17.1	
Av. rainfall (mm)	405	432	417	195	98	49	30	28	36	41	92	179	2001
Highest daily rain (mm)	368	286	403	186	90	70	31	63	80	87	185	230	
Av. daily sunshine (hrs)	6.8	6.1	6.4	6.8	6.4	7.5	7.3	7.8	8.5	8.8	8.6	7.7	7.4

Vegetation: The natural vegetation of the area is a species-rich tropical rainforest. Extensive areas of this type still exist along the ranges and are now incorporated, under World Heritage listing, into the Wet Tropics Management Area. Rainforest grades to various forms of eucalypt-dominated forest or woodland and grassland in areas exposed to frequent burning, especially on the hill slopes. Most of the valley and coastal plain areas not occupied by urban development are under sugar cane cultivation or are covered by mangrove communities.

Settlement

The present-day boundaries of Cairns City were established in 1995 following the amalgamation of the former local governments of Mulgrave Shire and Cairns City. The area covered by this study includes all of the significant urban areas extending from the suburb of Palm Cove in the north to the settlement of Gordonvale in the south. It also includes the Yarrabah Aboriginal Community to the east of Cairns. This area is shown in [Figure 2.3](#).

European settlement of Cairns was established in 1876 to provide a port and supply base for the Hodgkinson River goldfields (to the north-west of present-day Mareeba) and named for the then Governor of Queensland, Sir William Wellington Cairns. Over the ensuing 123 years the city has continued to play a major role as the transport, logistic and administrative centre for an increasingly large hinterland. Today, that hinterland includes Cape York Peninsula, Torres Strait, the savanna country facing the Gulf of Carpentaria and extends as far as the mineral-rich areas of the Mount Isa district. It also reaches beyond Australia to cover significant mining operations in Papua New Guinea and the Indonesian Province of Irian Jaya.

Cairns is a major tourist destination with about one million international and one million domestic passengers passing through the Cairns International Airport annually. It is also the centre for a significant proportion of Australia's sugar industry, based on the Mulgrave Mill at Gordonvale, and fishing operations in the northern Great Barrier Reef.

The original settlement was established along the low-lying swamp and dune country that formed the shores of Trinity Bay and Trinity Inlet. The area occupied by settlement has been progressively filled (by between two and four metres) to bring it above tide and flood level, initially using material dredged from the inlet and material excavated during the building of the Cairns to Kuranda railway.

This low-lying area is still the focus for commercial, transport, logistic and tourist activities. Residential development first grew around the port and subsequently spread across the coastal plain to the north and west. In more recent times, development has spread north across the Barron River to the northern beaches, west onto the low hills and foot slopes of the Whitfield Range, and south into the Mulgrave River valley towards Gordonvale.

Population

According to the National Census taken in September 1996, the population of the Cairns Statistical Local Area (SLA - a combination of the total Cairns City local government and Yarrabah Aboriginal Community Council areas) was 128 026 (64 330 males and 63 696 females). Of these, 15 131 were recorded as 'visitors' of whom 9 269 (or about 60%) were from overseas. The study area contained 123 826 people (62 149 male and 61 677 female).

The age/sex makeup of the resident Cairns population is shown in [Figure 2.4](#) compared to the makeup of the Queensland population as a whole. Of particular note in Cairns is the significant bulge in the working age cohorts from 20 to 50 for both sexes (50.4% of the total population compared with 46.4% in the Queensland population) and the relatively small proportion of people over 65 (9.1% of the total compared with 12.5% in the whole of Queensland). The very young (under 5 years) make up 7.5% (Queensland total is 7.4%). Gender balance is 0.99 females to every male as opposed to 0.92 females to every male in the total Queensland population.

Growth of the Cairns population is shown in [Figure 2.5](#). Until around 1970, growth was reasonably steady and was based to a large degree on a rural economy. It took off rapidly after 1970 as the tourist industry became significant. It took almost 100 years for Cairns to reach a population of 50 000; it only took another 20 years for it to add the next 50 000!

It is interesting to note that overseas arrivals numbers are at their greatest during the Cairns summer (i.e. the northern winter) whilst domestic arrivals are at their greatest during the winter. Average length of stay in Cairns by tourists ranges from 5 days during the March quarter (January-March); to 4.6 days in the June quarter; to 5.2 days in the September quarter; and 4.7 days in the December quarter. Given

these figures, we estimate that the total population of the city on any given day will range from around 122 000 to 125 000 in May to between 130 000 and 150 000 in August.

The tourist population in Cairns adds significantly to the total and fluctuates seasonally as shown in [Figure 2.6](#).

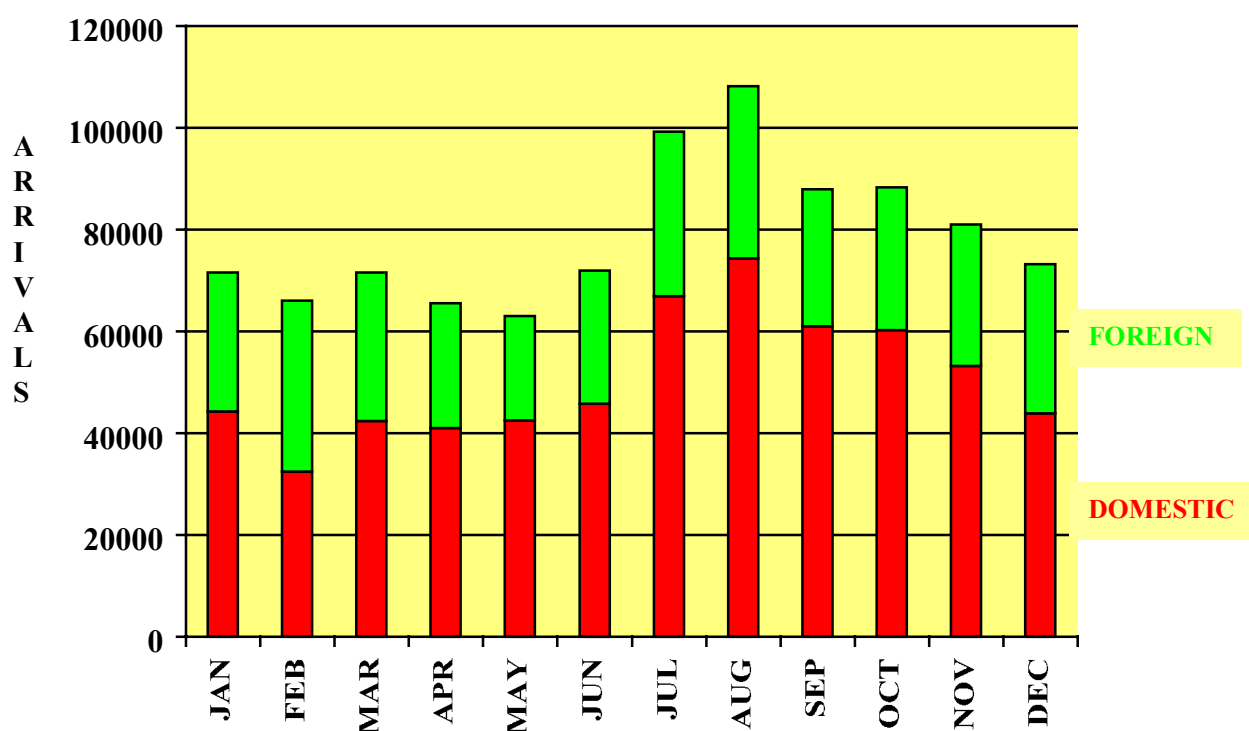


Figure 2.6: Cairns monthly tourist arrivals during 1997 (Source: various ABS bulletins)

External Links

Cairns is not a self sufficient community. It depends very heavily on outside sources of supply for its food, energy and material requirements as well as its principal sources of income. Such dependence clearly imposes limits to the community's resilience.

Cairns is heavily reliant on its transportation links to the rest of the world. They are:

- the main road links including: to the south, via the Bruce Highway to Brisbane (1 706 km) and beyond; north to Mossman and Port Douglas via the Captain Cook Highway (75 km); west to Mareeba via the Kennedy Highway (64 km) and beyond to Cooktown or the Cape; or south-west to Atherton via the Gillies Highway (80 km) and beyond to the Gulf;
- the main-line rail link to the south to Brisbane which carries regular passenger and freight services; a low capacity link (mainly freight) also exists to the west via Kuranda and beyond to Chillagoe or south-west to Forsayth;
- the international airport, located at the mouth of the Barron River, has over 300 domestic services per week; nine major international carriers operate 94 services each week to countries including Indonesia, Singapore, Malaysia, Hong Kong, Taiwan, Korea, Japan, PNG, the USA and New Zealand; and,

- the sea port with berths for passenger/cruise ships, general cargo, containers, bulk dry cargo, tankers discharging both oil and LPG and a bulk sugar terminal; a patrol boat base for the RAN (HMAS *Cairns*) and a commercial fishing base is also located within the port; extensive provision of marinas and pile moorings also cater for charter vessels and other small craft.

Power supply for the Cairns area is drawn from the State grid. The closest major power stations are at Stanwell (near Rockhampton) and Gladstone, each more than 1 000 km to the south. Peak loads are supplemented by power from the Barron Gorge and the Kareeya (north-west of Tully) hydro-power stations. The 60 megawatt Barron Gorge station does not have the capacity to supply Cairns on its own without significant load shedding. Stanwell, Barron Gorge and Kareeya power stations are operated by Stanwell Corporation Limited (a state-owned enterprise), whilst Gladstone power station is operated by the private company, NRG.

The major transmission lines of the State grid are operated by Powerlink Queensland, whilst power distribution within the Cairns region is managed by the Far North Queensland Electricity Company (which trades as FNQEB) - both are state-owned enterprises.

Hazard Monitoring

Cairns is an ideal first pilot study location because of its significant history of hazard impacts, as well as its expanding exposure to risk. Historically, Cairns has come under the influence of at least 53 tropical cyclones, seven major river flooding events, major landslides, earthquakes up to Richter magnitude 5.0, bushfires and Australia's first major LPG explosion. Details of the significant hazard impacts will be dealt with more fully in subsequent chapters.

The hazard environment of Cairns is now amongst the best understood and monitored in Australia. Seismic monitoring has been enhanced with the installation of new instruments under the Joint Urban Monitoring Program (JUMP - a joint Commonwealth-State program). These instruments, consisting of a combined seismograph and accelerograph located at Henley Hill and an accelerograph at Tunnel Hill, were installed in February 1997.

Prior to their installation, seismic events in the Cairns region were only recorded on more distant instruments, the closest of which is at Carron Creek (near Koombooloomba Dam) approximately 100 km to the south. The smallest magnitude earthquake at Cairns that could be detected prior to installation of the JUMP instruments was around Richter magnitude 3.5. The JUMP instruments can now detect events as small as Richter magnitude 1.5. A detailed discussion of the seismic monitoring coverage of Cairns is included in [Chapter 4](#) and a list of seismic recording stations within 500 km of Cairns is in [Table 4.1](#).

Cairns is also covered by a sophisticated monitoring and warning systems for tropical cyclones and floods, operated by the Bureau of Meteorology. At the heart of this system are the weather radars at Morningson Island, Cairns (Saddle Mountain), Townsville (Mount Stuart) and on Willis Island. The radar data is complemented by data from a range of imaging satellite systems such as the Japanese Geostationary Meteorology Satellite (GMS) and the Advanced Very High Resolution Radiometer (AVHRR) instrument on polar orbiting satellites operated by the US National Oceanographic and Atmospheric Administration (NOAA). The Bureau also operates an extensive coverage of automatic weather stations as well as having access to data from a network of rainfall and climatic instruments operated by various public agencies and private citizens.

The Bureau and the Queensland Department of Natural Resources also operate networks of stream gauging stations. These range from digital ALERT stations, which are accessed by radio telemetry, to

manual stations. The Queensland Department of Environment's Coastal Management Branch also collects 'real-time' wave and tidal data from remote gauges by telemetry.