

Instrat[®] Briefing

26 April 2006

Tropical Cyclone Larry

The following Guy Carpenter Instrat Briefing on Tropical Cyclone Larry is preliminary and provides information on the cyclone and the economic and insured losses that were sustained in Queensland. This briefing also precedes a more comprehensive report that will be released in May. In addition to the information published in Guy Carpenter's CAT-i reports at the time of the event, this report uses statistics taken from the national meteorological and disaster management organisations. The report will also contain details of ground and air surveys carried out jointly by Peter Cheesman of Guy Carpenter and Ryan Crompton of RiskFrontiers. A summary of the survey's observations, including some comparisons to past events, will also be included in the report.

Overview

On 20 March 2006, Cyclone Larry made landfall south of Innisfail, a coastal town of 8,500 people in Queensland, bringing destructive winds to the region. The cyclone's intensity at landfall remains unclear, however it seems Larry's landfall wind speeds were lower than those of a category 5 cyclone. Although not confirmed by the Australian Bureau of Meteorology (BoM), it is estimated that Larry was a category 4 storm on the Australian Tropical Cyclone Intensity Scale (see Table 1) as it came ashore between 06:20 and 07:20 AEST (20:20 and 21:20 UTC 19 March). As shown in Table 2, a category 4 cyclone on the Australian scale can equate to a category 3 hurricane on the Saffir-Simpson Scale.

Table 1: Australian Tropical Cyclone Intensity Scale (Source: BoM)

Category	Strongest Gust (km/h)	Average Maximum Wind (km/h)	Approximate Central Pressure (hPa)	Typical Effects
1	< 125	63 - 88	> 985	Negligible house damage. Damage to some crops, trees and caravans. Craft may drag moorings.
2	125 - 169	89 - 117	985 - 970	Minor house damage. Significant damage to signs, trees and caravans. Heavy damage to some crops. Risk of power failure. Small craft may break moorings.
3	170 - 224	118 - 159	970 - 955	Some roof and structural damage. Some caravans destroyed. Power failures likely. (e.g. <i>Winifred</i>)
4	225 - 279	160 - 199	955 - 930	Significant roofing loss and structural damage. Many caravans destroyed and blown away. Dangerous airborne debris. Widespread power failures. (e.g. <i>Tracy</i>)
5	> 279	> 200	< 930	Extremely dangerous with widespread destruction.

Larry packed sustained winds of around 190 kmph (120 mph) as it made landfall and major damage was reported along the Queensland coast. By global standards Larry was a relatively small storm with destructive winds (+170 kmph) extending up to 50km (31 miles) from the centre. In contrast, Hurricane Katrina in 2005 had winds extending greater than 160km (100

miles) at its peak. The cyclone crossed on a neap tide, so the effects of the 1.8m (6 feet) storm surge were minimised. However, some low lying areas did receive some salt water inundation due to the storm surge.

Table 2: Comparison between the Saffir-Simpson Scale and Australia's Tropical Cyclone Intensity Scale (Source: BoM)

10-min av. wind speed (knots)	1-min av. wind speed (knots)	Saffir Simpson	Australian Scale	Wind gusts (km/h)	Wind gusts (knots)
57	65	Category 1	Category 2	148	80
61	70			157	85
65	75			169	91
70	80	Category 2	Category 3	181	98
74	85			193	104
78	90			202	109
83	95	Category 3	Category 4	215	116
87	100			226	122
91	105			235	127
96	110	Category 4	Category 5	248	134
100	115			259	140
105	120			272	147
109	125	Category 5	Category 5	283	153
113	130			293	158
118	135			306	165
122	140	Category 5	Category 5	317	171
126	145			326	176
131	150			339	183

The Queensland Government stated around 12,500 sq km of land was affected by Larry, from Mareeba in the north to Tully in the south and west to beyond Mount Garnet. About 250,000 people live in the area hit by Larry and officials said the cyclone was unusual in the extent of destruction it left up to 200km (125 miles) inland.

Larry caused significant damage to houses, businesses, infrastructure, crops and state forests, incurring a total economic damage bill of at least A\$1.5bn (US\$1.1bn) and an insured loss estimated to exceed A\$350m (US\$255m).

Meteorological Summary

Larry developed on 17 March from a low pressure system located in the Coral Sea, 1,200km (745 miles) off the Queensland coast. The system became a tropical cyclone the following day whilst tracking west towards the Queensland coastline. Larry reached category 5 status on 19 March before weakening slightly prior to landfall. Larry continued to weaken after coming ashore but

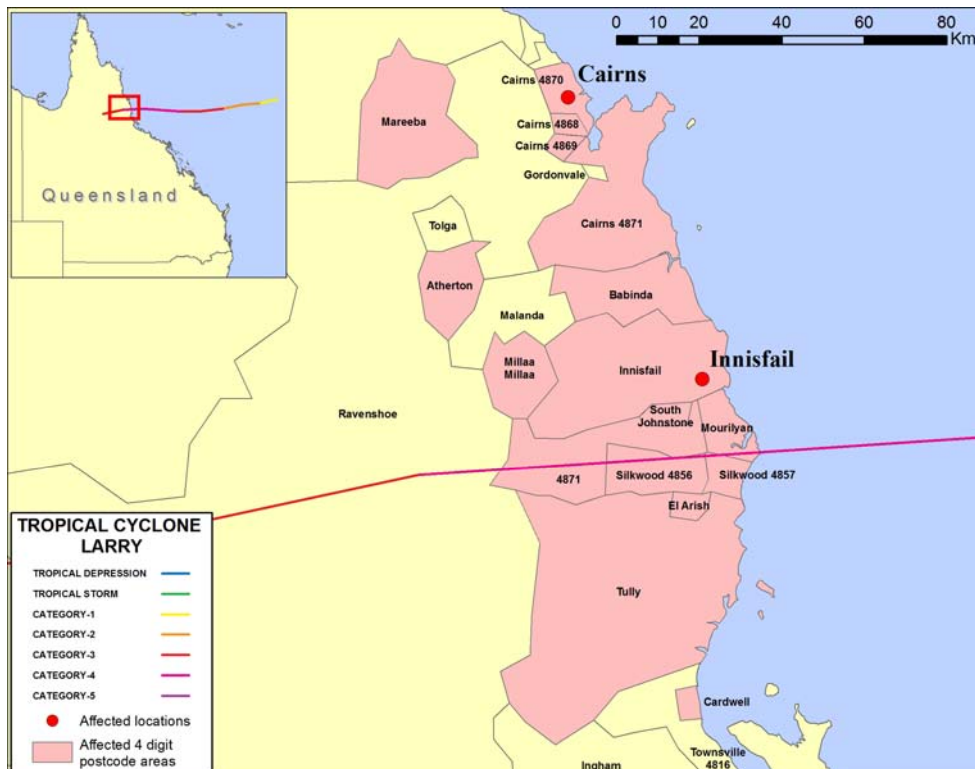
sustained its inland track into western Queensland to the north of Mount Isa, approximately 200km (125 miles) inland. A detailed description of Larry’s progress across Queensland will be provided in the report.

Event Summary

Wind gusts of around 280 kmph (175 mph) and sustained winds of 190 kmph (120 mph) were recorded as Larry hit land (Figure 1), causing extensive damage and prompting Queensland State Premier Peter Beattie to declare a state of emergency. Mr Beattie said property damage in the area was “immense”. Roofs were torn off houses and power lines and trees were downed as the cyclone ripped through the coast. Reports said thousands of buildings were damaged and the region’s banana and sugarcane crops were devastated. The storm cut power to around 120,000 homes and injured 30 people. No-one was killed. The swath of destructive winds stretched from Cardwell in the south to Cairns in the north, the BoM said.

The towns of Innisfail, Silkwood and Babinda were hardest hit by the storm with extensive roof and structural damage, according to reports. In Innisfail, the Counter Disaster and Rescue Service (CDRS) said up to 10,000 buildings were damaged, leaving thousands of people homeless. Assessments carried out by Queensland’s Disaster Management Services (QDMS) showed 50% of homes in Innisfail were damaged while 35% of private industry structures needed repairs. Around 25% of Innisfail’s government buildings were also severely damaged, including the hospital, while the town’s roads and bridges were impassable.

Figure 1: Locations in Queensland damaged by Cyclone Larry



Smaller communities in the region also took the brunt of the cyclone. The most severe damage to buildings occurred in the town of Silkwood (population 384). QDMS said 99% of Silkwood homes lost roofs or suffered structural damage. Homes south of Silkwood sustained severe damage also. Around half the commercial properties in El Arish (population 774) incurred

damage. Several homes in the immediate coastal communities of Kurrimine Beach (population 850) and Mission Beach (population 1,000) were also severely damaged.

Property damage was also reported further afield in Atherton, Eacham, Mareeba, Cardwell and Tully. Furthermore, in Babinda (population 1,200), 80% of buildings sustained major damage and virtually all crops were destroyed, according to CDRS. The city of Cairns also suffered disruption and damage as a result of Larry. Schools and businesses were forced to shut before the storm hit land. The cyclone also caused some property and infrastructure damage in the city.

In addition to property damage, Larry devastated Queensland's banana and sugar industries. The banana industry reported losses of up to A\$350m (US\$255m), with around 80% of crops destroyed. The Australian Banana Growers Council (ABGC) said the bulk of the industry's production would be affected for about a year and the bill for infrastructure damage would also be high. However, the ABGC added that banana growers in Queensland did not have crop insurance after insurers withdrew from the market after a series of storms in the 1990s. The sugar industry, meanwhile, estimated its losses at A\$200m (US\$145m), with 10% of Australia's sugar production lost in the cyclone. Larry also affected avocado production. Furthermore, building industry sources estimated the cost of repairing government-owned infrastructure such as roads, bridges, railways and power facilities at between A\$400m (US\$285m) and A\$600m (US\$430m).

Insured Losses

According to the Insurance Disaster Response Organisation (IDRO), insured losses from Cyclone Larry will reach at least A\$350m (US\$255m)¹. Insurers reported about 18,000 claims for home, contents, motor vehicles, commercial property, boats and light aircraft. Insured losses were expected to rise, IDRO said. Standard & Poor's Rating Services, meanwhile, estimated insured losses of between A\$300m (US\$220m) and A\$400m (US\$293m) and said the cost will be split between insurers and reinsurers as catastrophe reinsurance contracts will be activated for insurers with significant exposure in the region. Business interruption claims are also expected in Innisfail and the surrounding area.

However, Larry's impact on the insurance industry was limited by the number of uninsured and underinsured homes in the region and the fact it did not hit a major metropolitan centre (e.g. Cairns). Moreover, as indicated above, although crop damage was considerable it was not covered by insurance.

¹ Figure released on 5 April

Table 3: Australia's ten most expensive natural disasters (Source: RiskFrontiers²)

Date	Event	Location	Original Insured loss (A\$m)	Insured Loss as at 2004 (A\$m)
28/12/1989	Earthquake	Newcastle	862	3,567
24/12/1974	TC Tracy	Darwin	200	3,277
14/04/1999	Hailstorm	Sydney	1,700	2,735
16/02/1983	Bushfires	Victoria	176	1,335
18/03/1990	Hailstorm	Sydney	319	1,221
18/01/1985	Hailstorms	Brisbane	180	1,185
25/01/1974	TC Wanda	Brisbane	68	740
10/11/1976	Hailstorm	Sydney	40	612
03/10/1986	Hailstorm	W Sydney	104	588
05/11/1984	Flood	Sydney	80	551

Currently, Larry's insured loss of A\$350m (US\$255m) ranks outside Australia's ten most costly natural disasters, according to recent figures published by RiskFrontiers (see Table 3). However, as indicated below in Table 5, Larry is one of the most expensive tropical cyclones to hit the Queensland coast.

Historical Comparisons

Apart from Tropical Cyclone Ingrid (March 2005), Larry was the first severe tropical cyclone to make landfall at a populated location on Queensland's east coast since Rona crossed near the Daintree River in February 1999. The most devastating cyclones to hit Queensland's east coast prior to Larry are listed in Table 4:

Table 4: Significant cyclones to hit east Queensland prior to 2006 (Source: BoM)

Cyclone Name	Location	Category on impact	Year
Rona	Cow Bay near the Daintree River	3	1999
Aivu	Ayr (south of Townsville)	3	1989
Winifred	Near Innisfail	3	1986
Althea	North of Townsville	4	1971
Ada	Whitsunday Islands	4	1970
Not named	Innisfail	5	1918
Not named	Mackay	5	1918
Mahina	Bathurst Bay	5	1899

² All indexed tropical cyclone losses have been reduced by 50% to adjust for critical building code changes in exposed locations despite the true reduction factor being unique to each tropical cyclone. Using Tropical Cyclone Tracy as an example, research by RiskFrontiers suggests that the current loss for the event would reduce by approximately 65% if Tracy were to recur today and all buildings affected were constructed as per the new building code (i.e. post-1980 construction).

To convert historical losses to current losses, adjustments need be made to account for changes in population, inflation and wealth. RiskFrontiers has developed an indexation methodology incorporating two surrogate factors to account for these factors - changes in both the number and value of dwellings. The approach adjusts only for changes in building value, and thus is independent of land value. Since damage to dwellings often makes up a major component of most catastrophe losses, this approach assures close alignment to insured losses.

Two of the most notable tropical cyclones to impact the Innisfail area prior to Larry include an unnamed event during 1918 and Tropical Cyclone Winifred in 1986. *These cyclones will be explored in detail in the report. Winifred caused widespread damage after coming ashore and incurred an inflation-adjusted insured loss of A\$131m (US\$96m), making it the sixth most expensive cyclone to make landfall in Queensland (see Table 5).*

Table 5: Ten most costly cyclones to make landfall in Queensland (IDRO and RiskFrontiers)

Date	Event	Location	Original Insured loss (A\$m)	Insured Loss as at 2004 (A\$m)
25/01/1974	TC Wanda	Brisbane	68	740
04/03/1973	TC Madge	Queensland	30	478
24/12/1971	TC Althea	Townsville	25	398
20/03/2006	TC Larry	N Queensland	350 est.	350 est.
18/01/1970	TC Ada	Queensland	12	237
02/01/1986	TC Winifred	Innisfail	40	131
03/02/1990	TC Nancy	Brisbane	33	74
19/12/1976	TC Ted	Queensland	15	67
04/04/1989	TC Aivu	Townsville	26	57
02/12/1980	Not named	Brisbane	7.5	42

Exposure and Residential Building Damage in Queensland

Exposure and building standards along the Queensland coast have changed significantly over the last 20 years. In 2001, the total number of houses and flats in the region extending from Babinda down to South Mission Beach and roughly 20km (12 miles) inland was approximately 8,000. This represents around a 100% increase compared to 1981. Furthermore, based on the 1981 and 2001 Australian Census data, there is roughly a 50:50 split between the number of pre-1980 and post-1980 houses and flats in the region. The importance of this split is reflected in the marked improvement in the quality of construction that occurred in tropical cyclone-prone areas during the 1980s.

The property damage left in the wake of Cyclone Larry has generated much attention as it is the first comprehensive test of the newer building standards that were introduced. As expected, newer houses (post-1980 construction) generally performed better than older houses (pre-1980 construction). This result is testament to the change in design of construction. Where buildings were structurally damaged, a common form of failure was the attachment of the battens to the rafters (see Figures 2 and 3 overleaf).

Figure 2: Roof damage in Hudson



Figure 3: The different building standards were very evident in Innisfail



The evolving exposure in Queensland and the damage surveys carried out by Guy Carpenter and RiskFrontiers will be covered in greater detail in the report.

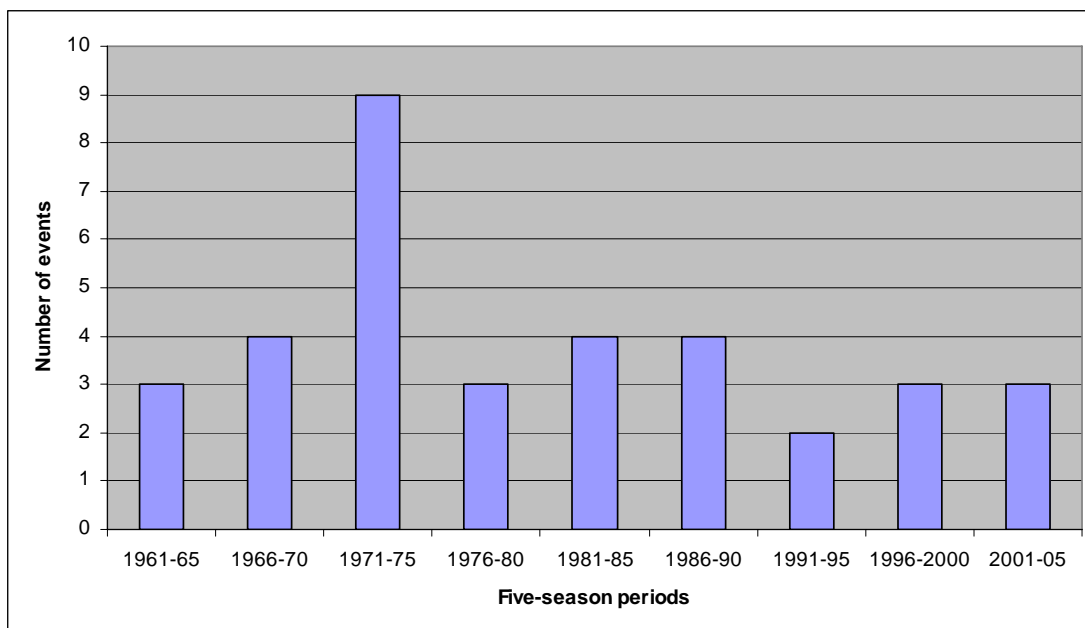
Frequency of Landfalling Tropical Cyclones on the Australian East Coast

Having explored the damage caused by Cyclone Larry and briefly examined the changing exposure and building standards along the Queensland coast, the following analysis focuses on the tropical cyclones that have crossed the east coast of Australia over the last 45 years. *The report will provide a more thorough analysis of this section and consider the potential implications had Larry made landfall in Cairns.*

Cyclone activity in the South West Pacific region is strongly related to the El Niño - Southern Oscillation (ENSO), which is the name given to the large-scale spatial anomalies in sea surface temperature in the Pacific. Its extreme phases characterise the well known El Niño and La Niña episodes. Cooler ocean temperatures exist in the western Pacific and Coral Sea during El Niño and ocean temperatures near the Queensland coast are typically above average during the La Niña phase. Consequently, cyclone activity tends to shift further away from the east coast of Queensland and further north during El Niño, resulting in fewer than normal landfalling cyclones.

Figure 4 shows successive five-season period frequencies of cyclones that have crossed the east coast. Within each of the five-season periods, there are different numbers of El Niño, La Niña and neutral events. There has been between two and four cyclones for each of the five-season periods with only one exception, that being 1971-1975. It comes as no surprise that the La Niña phase of the ENSO cycle dominated this five-season period.

Figure 4: Number of tropical cyclones to cross the east coast during five-year periods (Source: RiskFrontiers)



However, the results shown in Figure 4 only partially explain the damage potential of cyclones over the last 45 years. Another decisive factor is the intensity of each cyclone. Hurricane destruction or loss potential goes up by a factor average of four for each unit of increased Saffir-Simpson intensity category. Moreover, the extent of damage from individual tropical cyclones varies widely as a result of differences in coastal shape, terrain, population, wealth per capita, the direction and speed of the landfalling cyclone, storm surge and rainfall amounts.

Conclusion

The analysis carried out in this report shows that Tropical Cyclone Larry was not unusual in terms of severity or frequency. Wind speeds and storm size were comparable to Tropical Cyclone Tracy in 1974, yet the losses and damage statistics were very different to those in Darwin. This is testament to the improved quality of building design that was implemented to withstand cyclonic events.

Population density has increased rapidly in these coastal regions, meaning the actual physical exposure has also risen, yet the actual risk has not necessarily increased because of the advanced building code standards.

These factors also demonstrate the importance of providing detailed exposure data for the various catastrophe models to ensure more accurate results that reflect the building type and age within a portfolio.

The overall final loss figure is very much determined by the impact of post loss inflation and it will be several months before these aspects are finalised.

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