Key findings:

Cyclone Tracy

The event

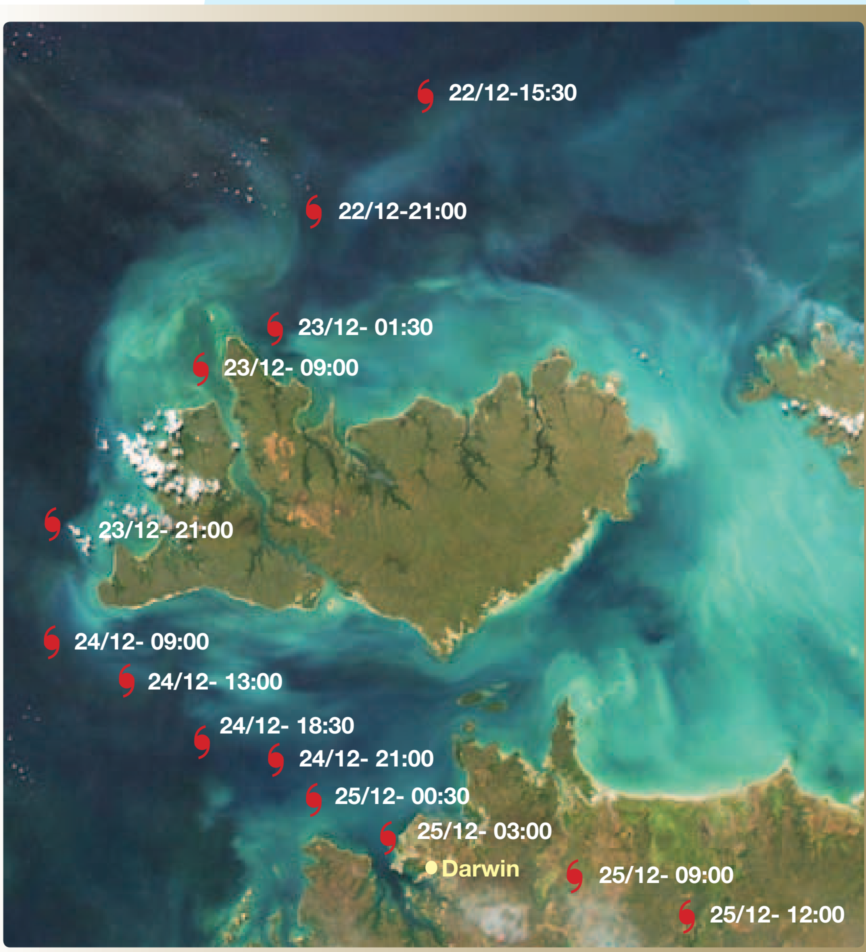
Cyclone Tracy was a Category 4 cyclone that laid waste to the city of Darwin in the Northern Territory early on Christmas morning 1974.

Cyclone Tracy showed the nation just how devastating the impact of a cyclone could be, and awoke the engineering community, local and international, to the true risk of cyclonic wind storms.

Tracy's small size minimised the spatial extent of damage, but her slow forward speed meant the areas beneath her storm track were completely devastated.

Cyclone Tracy resulted in 71 deaths and 650 injuries. Fortunately for Darwin, flooding and storm surge were not major issues or these numbers could have been far higher.

In almost all cases wind was the dominant factor in the ensuing structural damage, which left 94% of housing uninhabitable, approximately 40,000 people homeless and necessitated the evacuation of 80% of the city's residents.



Path of Cyclone Tracy. Image: Matthew Mason

Scale of the disaster

Cyclone Tracy is one of the most prominent and costly natural disasters in Australia's history. Very rarely does a disaster impact an entire major city, as occurred during Tracy.

Tracy was a small but intense cyclone with observed wind gusts up to 217 km/h (60 m/s) prior to instrument failure, and estimated storm maximum wind gusts up to 20% greater. At the time, the gust of 217 km/h was the highest gust speed recorded on mainland Australia and remains, to this day, the highest recorded in the Darwin area.

After the cyclone passed, approximately 60% of Darwin's houses were destroyed beyond repair with only 6% considered immediately habitable. The estimated cost of the event is in the order of about $400-500 million (in 1974 dollars), which equates to between $2 billion and $4 billion in today's money.

Characteristics that resulted in the damaging impacts of the event

The intensity of Tracy was not unprecedented in Darwin's history, with a number of comparable events affecting the region since European settlement. The damaging impacts of Cyclone Tracy were the result of a 'direct hit' on Darwin. Damage to buildings was worsened because Tracy was a slow moving storm resulting in extended periods of exposure to high winds.

Prior to Tracy, cyclone resistant housing construction practices were largely left to individual builders, resulting in unregulated standards of construction, and a level of design that was inadequate for cyclone–prone regions. This situation was coupled with a general lack of understanding and appreciation of the impact of cyclone-force winds on housing.

The community, government and emergency management team did very little to prepare for Cyclone Tracy. A number of false alarms prior to Tracy had left the community complacent. A highly transient population also meant any learnings from the last landfall 35 years previously had largely been lost. Therefore, household preparations and timely evacuations were not undertaken.

Adaptation: during and after the event

The event impacted the way engineers and builders design and construct buildings; particularly housing. Tracy also influenced how emergency services prepare for and have subsequently responded to disasters.

The devastation caused by Tracy meant that even historically reluctant industries, such as the Australian building industry, could not avoid change and they rapidly adapted to their new understanding of cyclonic wind risk. Change to a large entrenched system is often only possible after a disaster when quick action is required. Adaptive processes made in the light of Cyclone Tracy have led to the development of world leading wind-resistant design practice in this country.

In terms of disaster management processes Tracy resulted in the implementation of the Disaster Victims Database and Inquiry System and was influential in structuring the National Disasters Organisation (NDO).

Vulnerability: pre and post event

It is clear that existing housing in Darwin prior to Tracy was not adequately built to withstand an event.

Research has shown that, due to the adaptation measures and changes to design standards that have been put in place post Tracy, in the event of recurrence, the average per structure damage would be reduced by up to 85%. This, importantly, represents a reduction in damage to a level that would no longer necessitate an evacuation.

Cyclone Tracy highlighted the need for improved disaster management processes. Post Tracy there has been a noticeable increase in public awareness and preparedness measures. In fact, long-term residents' knowledge of cyclone impacts is now comparable to that of experts in the field.

It is now understood that assistance should be provided locally in order to keep families and communities together. This will be enabled by the fact that local and Territory-based government and emergency management agencies are now likely to assume control of response and recovery efforts.

Lessons learnt

One of the clearest lessons learned from the damage caused by Cyclone Tracy was that buildings with engineering input into their design and construction performed considerably better than those without. It was clear that the housing design and construction process had to be changed to incorporate engineering principles in order to enhance their resilience. The introduction of engineering-based standards for the design of housing was the outcome, and the significantly improved resilience of housing, not just in cyclone regions, is a continuing legacy of Cyclone Tracy.

Tracy also highlighted the problems with using a design approach based on the everyday performance of a structure (i.e. permissible stress design), and showed how accounting for extreme events, such as the limit state design approach, was essential. Despite the positive changes made, there are still issues with building methods that may unnecessarily increase the risk of failure under extreme wind conditions.

Regular reanalysis of design wind speeds in cyclone prone regions using the most up-to date information and techniques is required, along with improved understanding and design for durability of structural elements. A systematic analysis and upgrade of existing housing stock, not influenced by changes to design standards, would also substantially improve resilience.

Tracy highlighted the need for improved emergency management, including the dissemination of warnings, preparedness and response. It showed clearly that longer-term resilience does not lie simply in improved engineering standards, but also in the psychological welfare of individuals in the impacted community.

Managing the event: successes and failures

Successes:

- The Tropical Cyclone Warning Centre had been monitoring the storm for several days and correctly issued a top priority warning at 12.30pm on the 24th December, although this was not heeded by most of the community.
- The emergency medical team sent to Darwin commended the swift evacuation of the injured which greatly reduced their patient load.

Failures:

- An Emergency Plan existed but was not followed – e.g., the emergency committee did not meet, schools designated as shelters were locked, police did not take radios home.
- The newly formed federal National Disasters Organisation (NDO) was largely untested. It was faced with a major disaster at a point when full procedures were not yet in place. It responded in a military-style command-and-control mode.
- The NDO inhibited the psychological recovery process by not recognising achievements made by Darwin locals immediately after the cyclone. It has since been shown that evacuation and separation from family and community members potentially delays the physical and mental recovery processes of those affected by such events.

About this study

This study is one of a suite of Historical Case Studies of Extreme Events conducted under Phase I of the NCCARF Synthesis and Integrative Research Program. The authors of this study are: Matthew Mason and Katharine Haynes, Risk Frontiers, Natural Hazards Research Centre, Macquarie University.

The study will be available online at www.nccarf.edu.au

National Climate Change Adaptation Research Facility
Griffith University
Gold Coast Qld 4222
07 5552 9333
075552 7333
www.nccarf.edu.au

NCCARF
National
Climate Change Adaptation
Research Facility

This work was supported financially by the Australian Government and the partners in the NCCARF consortium. The views expressed are not necessarily those of the Commonwealth and the Commonwealth does not accept responsibility for information or advice contained within.