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# Preparing for the expected: cyclone threats

Peer reviewed

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## Background

The *State Natural Hazard Risk Assessment 2017* (Queensland Fire and Emergency Services 2017) identified tropical cyclone risk as the highest priority for Queensland alongside riverine flooding. A similar conclusion was reached in the *Queensland 2021/22 State Disaster Risk Report* (Queensland Fire and Emergency Services 2022) that also identified tropical cyclone risk as the second highest priority after riverine flooding. Given this priority, tropical cyclones require an in-depth follow-on analysis.

In 2018, a collaborative project was formed between Queensland Fire and Emergency Service, Geoscience Australia, Department of Environment and Science and James Cook University Cyclone Testing Station to better understand the potential effects of tropical cyclones on population centres and critical infrastructure across Queensland. The intent of the project was to explore and assess a range of scenarios extending beyond historical analyses of prior severe weather events to inform decision-making for rarer but higher-consequence events. As a result of this work, the Severe Wind Hazard Assessment Queensland (SWHA-Q) was completed in 2020 and released in 2022 (Arthur *et al.* 2020).

In January 2020, 6 coastal local governments in South East Queensland and their stakeholders (emergency response agencies, non-profit organisations, industry and academia) worked to develop the *Severe Wind Hazard Assessment for South East Queensland* (SWHA-SEQ). The project's objectives were to improve understanding of the present wind risks in the region and to develop actions that could feed into future planning to reduce this risk. Over the course of the project, the group expanded to 19 stakeholders. The project was jointly funded (25% local councils, 50% state government and 25% insurance industry) and resulted in an aligned view of wind risk in the region through expertise, data and information-sharing.

The project findings were of particular interest to planners in the Gold Coast region, one of the largest concentrations of population in South East Queensland, with business activity, tourism and infrastructure important to the economies of Queensland and Australia. The region is home to over 630,000 people (City of Gold Coast 2023), which makes it Australia's second largest local government area behind

## Abstract

The Gold Coast is a bustling region in South East Queensland with a large concentration of people and has dynamic and growing business and tourism activity. The region is subject to thunderstorms and tropical cyclones that can generate damaging winds. The *Severe Wind Hazard Assessment for South East Queensland* evaluates the risk posed by severe winds and has strategies for managing this risk (Edwards *et al.* 2022). Results from the most recent assessment showed that older residential houses were the most damaged by severe winds and that this contributed disproportionately to community risk. However, lessons from recent wind damage caused by Tropical Cyclone Seroja in Western Australia in 2021 indicated that modern house designs have important vulnerabilities. These findings are a concern for any exposed coastal area and, in particular, for South East Queensland. This paper presents a suite of scenarios developed to address this vulnerability. Specifically, we describe how emergency and disaster managers can conduct capability analyses with the goal to enhance intelligence and planning capabilities. An example of the City of Gold Coast was used to show how it has leveraged these capabilities to improve emergency risk-based planning and begin a community resilience transformation with effective places of refuge and evacuation centres for the community.

Brisbane City Council and Australia's sixth largest and fastest growing city. Projected population for the city is expected to reach 1.1 million by 2050 (Queensland Government population projections 2023). The speed and magnitude of this growth, reflected in continued urban development and a rapid increase in the city's geography and town designs, create vulnerabilities for local communities, especially related to cyclone exposure (Queensland Fire and Emergency Services & Geoscience Australia 2022). The city's river catchments, canals and waterways require deliberate and strategic consideration of the severe wind risk (similarly to those witnessed during a tropical cyclone) and consequent mitigation measures.

To support and explore what the project's findings mean for the Gold Coast region, Queensland Fire and Emergency Service conducted *Exercise Avernuncus* that explored issues around preparation, response and initial recovery for a tropical cyclone making landfall in the area. The focus of the exercise was on interoperability and interdependencies between local and state governments. It identified exposures for the community, residential buildings and critical infrastructure resulting from severe winds, storm surges and riverine flooding. Participant discussions during the exercise focused on infrastructure resilience, the ability to evacuate large numbers of people and the use of public messaging such as emergency alerts, dashboard information, social media and traditional media. The exercise explored residential properties and not the impacts on commercial or strata title properties.

The exercise was based on Tropical Cyclone Seroja that made landfall in the Western Australian town of Kalbarri in 2021. Kalbarri shares a similar longitude to the City of Gold Coast on the east coast. A similar cyclone event to the one experienced in Kalbarri in the built-up areas of South East Queensland would be catastrophic at many levels due to population, manufacturing, business and tourist activities.

## Findings

South East Queensland has experienced tropical cyclones in the past and will remain exposed to storms and cyclones into the future. The area has a significantly increased risk for cyclone and thunderstorm than other parts of the state, predominately due to higher exposure of people (population density) and building vulnerability (design standards).

Findings from the SWHA-SEQ report include a semi-quantitative analysis of climate change effects for severe wind risk indicating that the region is likely to see an increase in the proportion and intensity of very rare severe tropical cyclone events. The realisation of such a risk could cause catastrophic damage for communities, especially given the extent of predicted building damage to the current residential stock. To explore these risks, 5 scenarios were modelled as part of the assessment.

The scenarios followed the Queensland Inspector-General Emergency Management Cyclone Debbie Review, especially recommendation 7.b, that highlighted:

*Significant effort should be invested to provide disaster decision-makers at every level with a shared*

*understanding of risks, the situation and capability, so that they can agree on the best decisions for the communities they serve (Office of the Inspector-General Emergency Management 2017, p.23).*

The City of Gold Coast selected Scenario 1 (see Table 1) to form the base for future planning actions to address severe wind and its risks. Scenario 1 refers to a 10.

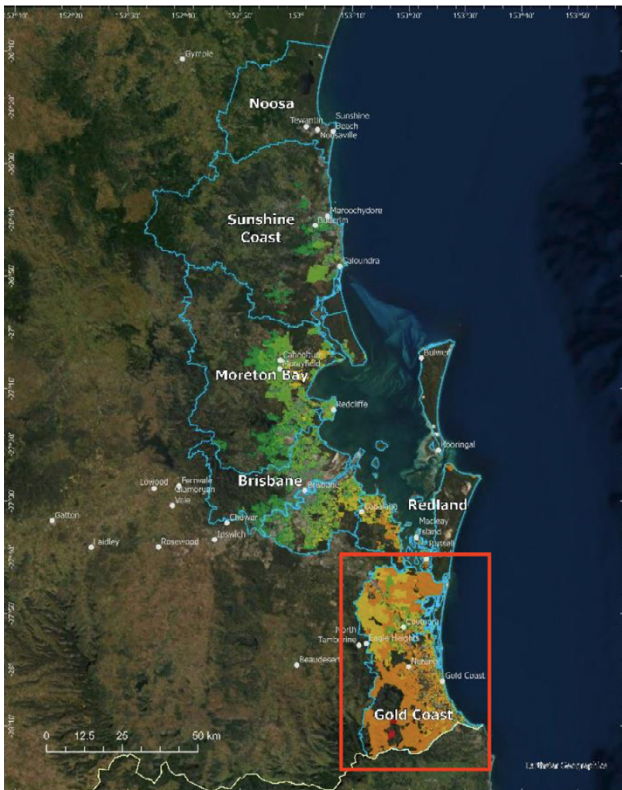
*[The event] forms near the Solomon Islands in late January, initially moving southwards for the first five days. By 4 February, the cyclone intensifies into a severe tropical cyclone and changes direction to a more southwesterly track, but remains slow moving. By 10 February, the cyclone is around 350 km off the coast of Mackay and turns back to a southerly course. The cyclone remains off the coast and moves slowly southwards, maintaining intensity as a category 4 storm. Early on 13 February, the cyclone turns southwest and moves towards the coast, slowly weakening as it approaches. Through the evening 13th, of the cyclone accelerates and enters Moreton Bay, making landfall towards the southern shores near Wellington Point in the early hours of 14 February. Strongest winds are experienced across Mulgumpin (Moreton Island), and through the Gold Coast, including the hinterland regions. Through 14 February, the cyclone dissipates over northern NSW (Edwards et al. 2022, p.74).*

Scenario 1 revealed that 137,115 residential buildings in the Gold Coast would experience moderate to extensive damage from severe winds (see Figure 1).

A further 4 plausible scenarios were analysed and considered to support planning, risk assessments and Gold Coast response plan development. These scenarios were 'selected for the expected swath of maximum winds, consideration of historical events [...], and propensity to impact all local government areas in the study region' (see Edwards et al. 2022, pp.89–96 for a detailed description of each scenario).

The SWHA-SEQ showed locations and types of houses that were exposed disproportionately to the wind risk. Offering incentives to these house owners to retrofit their properties to reduce risk through a cost-sharing scheme would make a meaningful change to the risk profile. However, for most houses, retrofitting may not be cost effective until other implications of societal disruption are factored in. The majority (79%) of residential houses in the study region are in lower-hazard site conditions<sup>1</sup> where retrofit, even with incentives, would not appear cost-effective (Edwards et al. 2022). Residential strata title buildings are also significant contributors to risk and have not been considered in this study. In summary, the findings showed that tropical cyclones and severe winds are posing an increasing risk that would have significant effects on the Gold Coast region and that requires preparation and action plan.

1. A low-hazard site condition refers to a property that, if exposed to severe wind event, the likelihood and potential impact will be relatively low.



**Average damage state**  
 ■ Negligible ■ Slight ■ Moderate ■ Extensive ■ Complete

Figure 1: Areas of potential inundation for the Gold Coast area resulting for Scenario 1 modelling.

## The City of Gold Coast response

To address the findings in this project, the City of Gold Coast council established a project to ‘prepare for the expected’. Project AIR (Advocacy, Information and Resilience) aims to prepare for the effects of severe wind or tropical cyclone and focuses on protecting critical infrastructure and services, increasing community readiness and resilience and safeguarding

the Gold Coast way of life. The Project AIR steering committee is chaired by a Local Disaster Coordinator with 3 supporting subcommittees (each focusing on a specific project stream of advocacy, information and resilience) and representatives from across the City of Gold Coast. The 6-year project will be completed in phases to deliver its outcomes:

- Identification and structure assessment of critical infrastructure for the City of Gold Coast.
- Identification of infrastructure improvements required to elevate the standards.
- Infrastructure hardening of existing infrastructure and influencing design of new projects.
- Development of an Advocacy Strategy Plan.
- Development of an Information and Education Strategy Plan.

The project outcomes are that resilience is achieved across the community for the built environment and that the shared understanding of risk of tropical cyclones and severe winds is improved and sustained. This project involves investigating opportunities to mitigate risk exposure to existing infrastructure, particularly in locations that may be used as places of refuge for people without suitable shelter-in-place arrangements. Places of refuge refer to buildings that have been identified as somewhere to stay during the passage of a cyclone (Inspector-General Emergency Management 2019). Places of refuge are not evacuation centres that are established to cater for long-term accommodation of evacuees for a minimum of 2 weeks (Inspector-General Emergency Management 2019).

A stocktake of the places of refuge and evacuation centres will assess the current level of building suitability to withstand a severe wind event and determine if infrastructure improvement is required to provide people with a safe option for shelter during these events. Project AIR’s phased approach will contribute to future planning and construction projects for the Gold Coast. In addition, it is anticipated that the project will provide detailed information that can be considered in future land-use planning decisions, coastal hazard adaptation actions and emergency and disaster management.

Table 1: Categorical building damage for current residential stock – Scenario 1.

	Negligible	Slight	Moderate	Extensive	Complete
<b>Noosa</b>	5,500	0	0	0	0
<b>Sunshine Coast</b>	57,900	9,800	1,400	1	0
<b>Moreton Bay</b>	83,600	47,300	15,000	1,900	0
<b>Brisbane</b>	188,100	91,000	39,000	4,200	0
<b>Redland</b>	13,400	6,900	13,000	30,300	365
<b>Gold Coast</b>	28,400	21,000	36,900	99,400	815

Source: Arthur *et al.* (2020, p.81)

## Pilot phase (study)

Following the SWHA-SEQ report, the City of Gold Coast engaged the James Cook University Cyclone Testing Station to pilot a critical infrastructure review to understand the suitability of evacuation centres. The pilot also assessed locations identified as a place of refuge and recommended remediation works to protect the community and city operations.

Thirty facilities were identified and a desktop assessment was conducted against the principals of:

- facilities must be accessible in the hours leading up to the extreme winds
- facilities must be safely clear of flood levels under flash flooding, riverine flooding and storm surge as modelled by the City of Gold Coast hazard modelling team and the data provided through SWHA-SEQ
- facilities must have a structure and cladding system that is likely to survive an extreme wind event
- facilities must provide safety against debris impact and injuries sustained because of wind-driven rain.

Nine physical facility inspections were conducted and the Cyclone Testing Station team reported building age, materials used, vulnerabilities, location, design criteria used for construction, potential use as a place of refuge and remediation works required. This concluded the pilot phase of this project.

## Project AIR phase 1 substreams

Building on the pilot study conducted in collaboration with the Cyclone Testing Station, Project AIR initiated its first phase that was split into 3 subcommittees.

### Advocacy

To help mitigate risk from severe winds and tropical cyclones, the Advocacy Subcommittee will create and deliver a plan for relevant building legislation and codes. This aims to influence design criteria and guidelines to improve resilience in increased wind-load conditions during severe wind events. Wind-load design needs to account for increased wind loads from a breach in the building envelope (e.g. failed window or door) and for wind-driven rain. The building needs to remain intact and provide safe shelter for occupants during a cyclone.

The City of Gold Coast will seek cost-sharing opportunities or grant schemes from the Queensland and Australian governments to determine resilience of built infrastructure along with community education activities during the project. This will include working with stakeholders on a collective plan that can deliver change. Stakeholders scoped for inclusion in this work are:

- Insurance Council of Australia
- University of Queensland
- Local Government Association Queensland
- South East Queensland local government areas
- National Emergency Management Agency
- commercial and private infrastructure asset owners.

### Information

Severe wind risk is often underestimated by communities and points to a need to raise community awareness and enhance preparedness. The Information Subcommittee will develop and deliver an information and education campaign about how communities can prepare for increased wind events such as cyclones. The campaign will be integrated into the Queensland 'Get Ready'<sup>2</sup> campaign. A key element of the campaign is to promote stronger personal resilience (self and home) and to provide a variety of tools for people to use to prepare for and respond appropriately during severe wind events.

Through the SWHA-SEQ, Geoscience Australia provided data sets from the 5 modelled tropical cyclone scenarios that identified local wind speed across 20 annual exceedance probabilities. Geoscience Australia also provided risk information that identified areas with greater vulnerability in terms of structural damage to residential housing. The City of Gold Coast will use this data to develop community messaging and identify shelter-in-place and evacuation options.

### Resilience

The Resilience Subcommittee will investigate opportunities to mitigate the exposure risks to existing infrastructure, particularly for locations that may be used as places of refuge. This would be for people without suitable shelter-in-place arrangements. The resilience stream is a phased approach and will expand into future construction as part of a implementation strategy of Project AIR outcomes.

During the pilot phase, critical infrastructure was identified and structural assessments completed. Phase 1 includes the initial remediation works to harden this infrastructure so they meet elevated standards for resilience and suitability for use as places of refuge. Phase 2 is a longer-term plan for moderate-to-major works to occur for identified infrastructure. This work leverages the expertise and materials already developed by the Cyclone Testing Station, Queensland Fire and Emergency Service and the Queensland Reconstruction Authority.

## Conclusion

The population of the Gold Coast is predicted to almost double over the next 30 years and this will require an expansion of secure infrastructure. This growth is considered with regards to the area's exposure to severe winds and tropical cyclones and so requires a deliberate and planned approach to preparing local communities and infrastructure for these events.

Following in-depth analysis of expert findings, and in response to the increasing risk to the city and its residents, the City of Gold Coast is implementing Project AIR in a phased approach over 5 years. The aim is to improve resilience in the community and for the City of Gold Coast critical infrastructure. Project AIR is a collaboration of local government areas across South East Queensland and will be monitored and evaluated to identify lessons for future activities.

2. Queensland Get Ready campaign, at [www.getready.qld.gov.au](http://www.getready.qld.gov.au).

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### About the author

**Heidi Turner** is a disaster and emergency management coordinator. In 2023, she was appointed as coordinator of Project AIR and has been leading the project. Heidi works to improve the City of Gold Coast's preparedness and resilience to disasters.

**Fannie Couture** is an assistant professor of strategy at HEC Montreal. Her research employs practice and process theories to explore strategy in pluralistic contexts to address socio-environmental issues.