



Strategies to Enable Mitigation to Reduce Loss and Quicken Community Recovery for Small Business in the Whitsunday Regional Council area

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Report: TS1240
September, 2021

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ACKNOWLEDGEMENTS

The authors thank the small business owners and employees of Proserpine, Airlie Beach, Cannonvale and Bowen communities who generously assisted with this study by volunteering information in person and online.

FUNDING STATEMENT

This project was contracted by the Whitsunday Climate Change Innovation Hub with funding provided under the Category C Far North Queensland and North Queensland Monsoon Trough Flexible Funding Grant – Round Two: a grant jointly funded under the Commonwealth/State Disaster Recovery Funding to implement projects aimed at driving recovery and building resilience.

Cyclone Debbie and the Whitsunday region.

Severe Tropical Cyclone (STC) Debbie impacted Queensland's Whitsunday coast near the township of Airlie Beach on the 28th of March, 2017. As well as possessing wind ratings of a category 4 system, the associated tropical low drenched the region with rain for several days after the event. The impact of the rain event was felt as far south as Brisbane (BOM, 2021). STC Debbie was also an extremely slow moving system, meaning that communities in the region were exposed to extreme wind levels for many hours. In combination with the subsequent rain event, STC Debbie wreaked destruction on the region.

The current project aims to identify the nature of the preparatory actions, if any, taken by small businesses and Whitsunday Regional Council (Council) in the lead up to STC Debbie. The project will aim to identify the barriers and enablers of the performance of such actions with the view to informing the development of more effective communications and guidance regarding preparation for cyclonic events for these groups.

What do we know about the impact of disaster events on small businesses?

In order to answer the question about the impact of disaster events on small business, it is useful to examine the best documented impacts of extreme events experienced in Queensland. Between December 3rd 2010 and February 3rd 2011 Queensland experienced three cyclones and extensive flooding throughout the State. At that time small businesses represented 96.5% of the private sector in Queensland and contributed 39% of the Queensland economy. (CCQI, 2011)

In August 2011, the Chamber of Commerce and Industry Queensland (CCQI, 2011) reported the results of a survey from 211 businesses impacted by the natural disasters in Queensland over the period in question. It needs to be noted when interpreting the figures below that only businesses directly impacted by flood and cyclones were targeted for the survey so the numbers do not reflect proportions of all small businesses in Queensland. Businesses which were not impacted were not invited to complete the survey.

The CCQI survey reported that 13.7% of respondents were impacted by STC Yasi and approximately 56% reported short term closure of their business. The most frequently reported types of direct impacts experienced are shown in Figure 1.

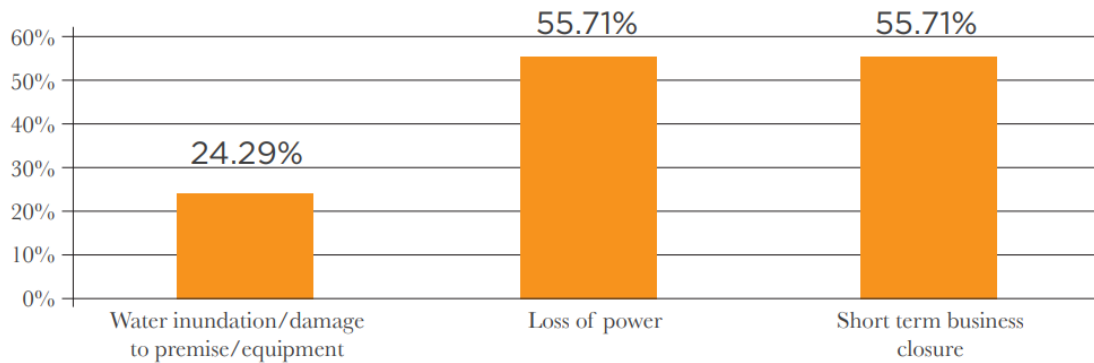
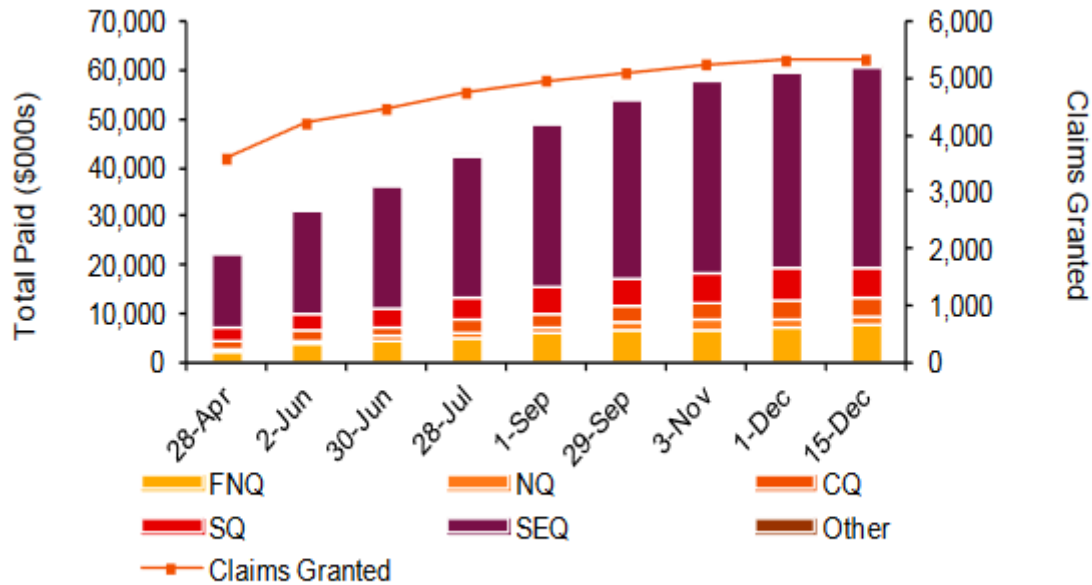


Figure 1: The direct impacts for businesses affected by Cyclone Yasi. Source: CCIQ, 2011.

In terms of accessing government assistance, in March 2011 the newly formed Queensland Reconstruction Authority (QRA) reported that 2,151 small business grants had been paid out with a total value of approximately \$10.8 million. These grants were designed to assist small businesses with the cost of clean-up, restoration and temporary relocation to other premises if needed. By the end of July 2011 4,750 grants had been delivered to small business with a value of \$42.4 million. Figure 2 shows that by December 2011 just over 5,000 grants had been approved with a value of around \$60.7 million.



Source: QRAA as at 15 December 2011

Figure 2: Number and value of small business grants distributed post flood events and TC Yasi to December 2011

Figure 3 below shows the damage cost reports (column 1) for businesses directly impacted by the 2011 floods directly after the event (column 2), by businesses impacted by that same event reported 6 months later (column 3) and by businesses impacted by STC Yasi reported 6 months after that event (column 4). It can be seen that six months on, one in three businesses directly impacted by Cyclone Yasi had a damage bill of between \$100,000 and \$500,000.

COST OF DAMAGE	BUSINESSES DIRECTLY IMPACTED BY THE FLOODS (JANUARY 2011)	BUSINESSES DIRECTLY IMPACTED BY THE FLOODS (AUGUST 2011)	BUSINESSES DIRECTLY IMPACTED BY CYCLONE YASI (AUGUST 2011)
\$1-\$4,999	10.6%	5.6%	5.0%
\$5,000-\$9,999	10.6%	5.6%	20.0%
\$10,000-\$19,999	12.8%	5.6%	5.0%
\$20,000-\$49,999	14.9%	16.7%	15.0%
\$50,000-\$99,999	14.9%	8.4%	20.0%
\$100,000-\$499,999	10.6%	41.7%	35.0%
\$500,000-\$999,999	8.5%	5.6%	-
\$1,000,000+	17.0%	11.1%	-
Average physical damage	\$588,689	\$364,253	\$89,650
Median physical damage	\$40,000	\$110,000	\$50,000

Source: Six Months on Queensland's Natural Disasters Survey – August 2011

Figure 3: Cost of damage for businesses affected by Cyclone Yasi. Source: CCIQ, 2011.

The damage bill is not the only cost businesses incur after an event. Approximately 40% of businesses directly impacted by the events of 2011 reported that the negative effects of abnormal business and economic conditions were felt 6 months and more after the event (CCQI, 2011).

Abnormal business and economic conditions also effect business *indirectly*. For respondents who were affected by STC Yasi, the most commonly reported indirect effect on business was reduced income due to overall depressed economic activity (see Figure 4). This depression was most commonly attributed to the effect of the event on customers: either by direct impacts on customers or negative impacts on consumer confidence and a general low demand for goods and services.

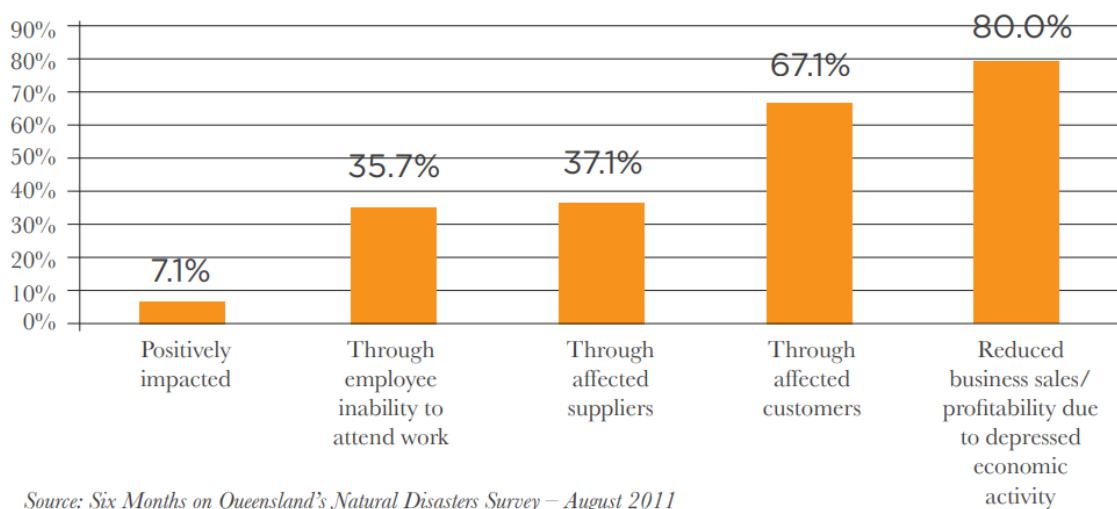


Figure 4: The indirect impacts for businesses affected by Cyclone Yasi. Source: CCIQ, 2011.

The costs of doing business also increase after disaster in the form of increased prices for insurance. The Queensland Business Insurance Report 2014 (CCIQ, 2014) stated that business insurance costs had increased over the period 2011-2013 by a median of 12.1% and an average of 58.2%. This large skew between median and average indicates that there were large increases for a small number of businesses. Inspection of the data indicates that the greatest increases were seen by businesses operating in North and Far North Queensland and South West Queensland – the areas most impacted by the disaster events over the same time period.

There is a ripple effect after a disaster which lasts for some time. The cumulative effect of loss due to disaster, depressed income due to broad economic trends, related and unrelated to events, and the increased costs of doing business all contribute to a precarious environment for small

businesses. As shown in Figure 5, after experiencing a major material loss to property, 43% of businesses never re-open and only 29% survive over 3 years.

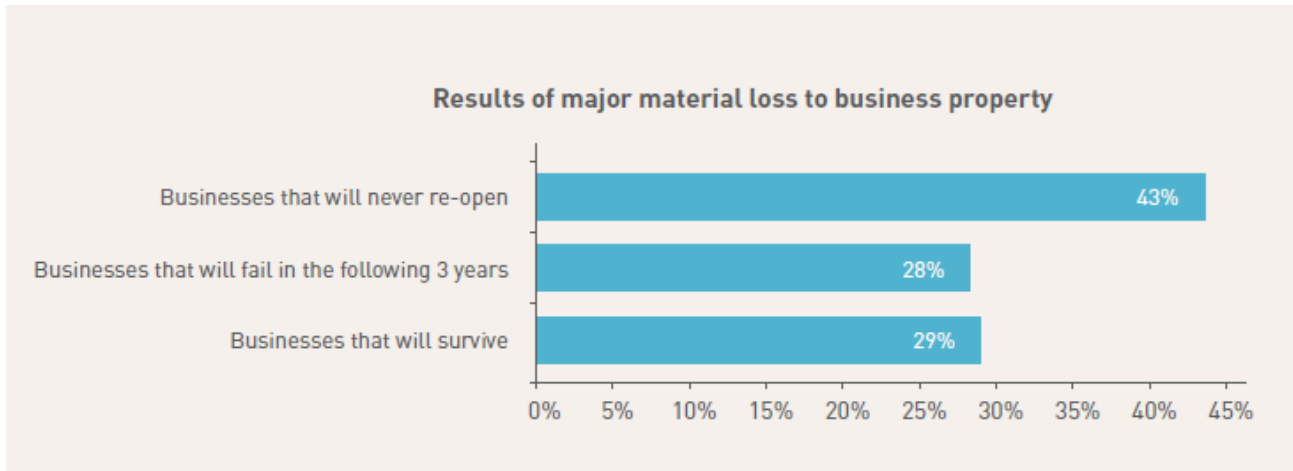


Figure 5: Percentages of businesses surviving major property loss at different post event time points. (CCIQ, 2014)

Similar figures regarding business survival are reported from the United States. A review of post-event recovery in the US also suggests that 40% of businesses do not reopen after a disaster and another 25 percent fail within one year according to the US Federal Emergency Management Agency (FEMA). Statistics from the United States Small Business Administration indicate that over 90 percent of businesses fail within two years after being struck by a disaster. Given the challenges smaller and regional communities face in attracting and retaining businesses, statistics such as these suggest that the impact of disaster on business sustainability may be greater in such communities. Once a business is lost, others may not arise to take its place.

The full CCIQ report can be found at the link below.

http://www.floodcommission.qld.gov.au/data/assets/file/0004/10966/Chamber_of_Commerce_and_Industry_Qld.pdf

The Queensland Business Insurance Report conducted by the CCQI can be found here:

<https://www.cciq.com.au/assets/Documents/Advocacy/submissions/Qld-Business-Insurance-Report-Final-Screen.pdf>

What resources are available to small business to prepare for extreme events?

Publicly available guidelines and documentation are critical to promoting cyclone preparation and informing small businesses of the most effective ways to prepare. Although a number of public resources are available for small businesses regarding planning and preparation (e.g., business continuity, emergency kits, data back-up, etc.) for cyclones, the resources specifically related to cyclone damage mitigation actions are relatively limited. This section provides a brief review of currently available information for small businesses in Australia as well as the United States.

Preparedness and Mitigation Resources available in Queensland

As Queensland is the most populated cyclone-prone state within Australia, it is not surprising that the Queensland Government produces the bulk of available information for small-business owners. One of the most prominent resources is a guide that includes the top 10 tips for small businesses to manage natural hazards summarised as follows:

1. Make a plan
 - Identify risks, response actions (including evacuation plans), staff roles, emergency contacts (identify customer, supplier, insurer), local emergency alert channels. Conduct emergency drills, create an event log and capture 'before and after' damage photos for insurance purposes. Create a recovery plan to document steps after an incident.
2. Review insurances, policies and finances
 - Check insurances, building repair needs, etc. Photograph assets, review approaches to managing orders and cancellations, check financial reserves and emergency cash. Download the Small business disaster hub app to access information when the internet is unavailable, note it can also send alerts to let you know when disaster grants open for applications.
3. Prepare your business

- Clear vegetation, back-up data, prepare emergency kits, secure windows and doors, clear gutters, set sandbags, relocate stock, equipment and vehicles, store hazardous materials. Check coastal hazards in your area and the cyclone resilience of the building (i.e. was it constructed after 1980s? Has it been maintained? Etc.).
4. Plan for alternatives
 - Plan for power outages, loss of deliveries, access and alternate ways to operate
 5. Monitor the incident
 - Listen to emergency alerts, know where to shelter or evacuate and follow advice
 6. Assess impact on your business
 - When safe to return, assess and photograph the damage, and contact your insurer and bank
 7. Connect
 - Connect and communicate with staff, customers, guests and community
 8. Financial recovery
 - Apply for financial assistance and other business support
 9. Communicate and promote
 - Develop marketing strategies to communicate with customers and promote positive news or deals
 10. Recovery planning
 - Consider what you've learned and update policies, plans and staff training

These steps are discussed in more detail (including storm surge considerations) at the following link:

<https://www.business.qld.gov.au/running-business/protecting-business/disaster-resilience/disaster-hub/small-business/natural-disasters/cyclone-storm-surge#prepare>

The Queensland Government has also established a small business disaster hub with sector-specific advice for dealing with a range of disasters. This includes a number of tips to help small businesses across different sectors to prevent, prepare, respond, recover and communicate when disasters strike. A small business disaster hub smartphone app is also available to enable access to information when the internet is unavailable. The app can also send alerts to let businesses know when disaster grants open for applications:

<https://www.business.qld.gov.au/running-business/protecting-business/disaster-resilience/disaster-hub/resources>

In addition to the above resources, the Queensland Government has also developed a coastal hazard mapping tool that allows homeowners to select their address and view Queensland Coastal Hazard Areas maps which show areas vulnerable to coastal erosion or storm tide inundation:

<https://apps.des.qld.gov.au/map-request/coastal-hazards/>

Small Business Resources for Climate Change Adaptation

Climate change and extreme events affect all Australians. Globally much is being done to reduce carbon emissions and limit the extent and impact of climate change, but the need to adapt remains. Increasingly the finance and insurance sectors are taking a greater interest in how businesses may be impacted by a changing climate, and in what they are doing to understand and reduce any associated risks to their operations, supply chains and staff. There is clear recognition that small businesses do not have sufficient staff, resources and time to take a proactive approach in considering climate change, yet many are already exposed to extreme events.

Responding to this, the Chamber of Commerce and Industry Queensland (CCIQ) with the support of the Queensland Government and in consultation with Queensland businesses, developed a Small and Medium Enterprises Sector Adaptation Plan for Queensland. The Plan, developed under the Queensland Climate Adaptation Strategy, recommends a number of steps including the development of resources to support small and medium enterprises (SMEs) start their adaptation journey. In response, the Queensland Government funded development of a Climate Change Risk Management Tool. This tool contains information on climate change (what, where and how much). It is simple and quick to use, and also provides links to other resources that can be accessed and used as required. By taking these first steps in determining risks faced from extreme events and a changing climate, businesses will be better able to address their risks by updating business continuity plans or developing them from scratch. More information about the tool is provided at the link below:

https://www.qld.gov.au/data/assets/pdf_file/0026/132398/ccrmt-businesses-full.pdf

Resources available in the US

The review found a number of resources in the US to help small business owners prepare for hurricanes (i.e. cyclones). Key resources are summarised below. Similar to those available in Queensland, these resources predominantly focus on general preparedness and business continuity as opposed to actions aimed at on-site cyclone damage mitigation for businesses.

Insurance Institute for Business and Home Safety (IBHS)

The IBHS Research Center is US-based state-of-the-art research facility located in South Carolina. This unique facility enables researchers to more fully and accurately evaluate residential and commercial construction materials and systems under realistic re-creations of severe weather hazards. The research conducted here significantly advances building science and influences residential and commercial structural design and construction, helping to create more resilient communities.

Commercial Ready is an IBHS program that features guidance for seasonal preparedness projects and business continuity planning exercises, as well as last-minute steps to take before closing the doors and evacuating when a hurricane is approaching. The guide is designed to help business owners navigate the hurricane planning process and know what to ask a contractor when looking to make improvements to the building. Included in the guide are:

1. Low-cost ways to get a business ready for hurricane season
2. Improvement projects to get businesses ready for hurricane season
3. Last-minute hurricane preparation for the business

The Commercial Ready guide applies the latest research from IBHS engineers to reduce losses caused by wind and wind-driven rain during hurricanes:

<https://disastersafety.org/hurricane/commercial-ready/>

IBHS also has a training program to help prevent business disruption. The Open for Business-EZ (OFB-EZ) toolkit helps small businesses take the steps they need to keep functioning in the event of

a major disaster or even a small disruption. The goal is for SMEs to continue to perform the most critical operations, which will help reduce short- and long-term losses. Business owners can download the free OFB-EZ toolkit and create their own business continuity plan using ten modules. After completing the modules, business owners can make multiple copies of their plan and store them both at their business and in a safe, off-site location. The OFB-EZ toolkit enables small businesses to:

- Identify the business activities that are essential for continued operation during a disruption;
- Deal with risks faced by the organization; and
- Create an easy-to-use recovery plan tailored to the individual business, providing confidence if the worst occurs

More information is available on this program at: <https://disastersafety.org/business-protection/ofb-ez/>

US Small Business Administration (SBA)

The US Small Business Administration offers a guide to help small business owners in the US consider how a hurricane might impact operations and determine how to prepare before they strike. Recommendations include for the beginning of hurricane season include:

- Putting a system in place to back up critical business data. Data should be backed up regularly and should be accessible off-site, making cloud data solutions ideal options.
- Ensuring insurances includes relevant protections for hurricanes. According to the US Federal Emergency Management Agency (FEMA), standard insurance policies in the US do not cover flooding, including storm surge flooding, but flood insurance is available for business owners through a separate National Flood Insurance Program.
- Developing an emergency communications plan for how to communicate with key stakeholders – including employees, customers, and suppliers – during and after a hurricane. As a part of the plan, it is recommended to keep an up-to-date list of these stakeholders' contact information accessible off-site.

- Ensuring the disaster kit is fully stocked. If on-site at your business during a weather disaster, it is important to have a disaster kit with critical supplies such as water, food, masks, a flashlight, a first aid kit, and more.

Once a hurricane watch or warning is issued recommendations include:

- Take precautions to ensure that items outdoors will not blow away or cause damage. Remove all loose debris and anchor or relocate all nonessential equipment to a safe indoor location.
- Install windstorm shutters or plywood over windows and doors. Doing so will help prevent interior damage to your building.
- Disconnect the main electrical feeds to the facility. This will help prevent a potential fire caused by short-circuiting of damaged equipment. Similarly, shut off natural gas supply to minimize fire loss.
- Get ahead of post-storm recovery efforts. Have cash on hand for post-storm needs, such as buying food and supplies. Additionally, fill fuel tanks of generators, fire pumps, and all company-owned vehicles.
- If an official evacuation order is in place during a hurricane, no employees should stay behind. However, if you are on-site at your business during the storm, remain in a place that has been identified as safe from wind and flood.

Recommendation for recovering the business after a storm are as follows:

- Wait until the storm has passed and local officials declare your area safe before entering your business to secure the site and survey damage. Start any needed repairs as soon as possible to prevent further damage.
- If your business is in a federally declared disaster area, you may qualify for SBA disaster assistance. Check here to see if a disaster has been declared in your area and apply for a disaster loan. SBA resource partners are available to help you apply for disaster loans and to walk you through the steps of rebuilding your business. You can get free preparedness advice and guidance on how to recover from a local resource partner here.

What does the academic literature say about small business preparation for disaster?

A review of the academic literature was conducted using appropriate keywords including *small business, cyclone, hurricane, flood, disaster, flood, preparedness, disaster preparation, disaster recovery*. Only articles dealing with businesses operating in a context similar to that of Australian businesses were included. The majority of the articles dealing with the relationship between preparation for and outcomes after an event were retrospective in nature and targeted business which had experienced damage. There were no prospective studies found. In other words, no research looked at the activities of small business prior to an event. Businesses were recruited after an event and asked about their pre-event activities. The main risk here is in bias in memory and reporting of preparation activities. The majority of reviewed articles described the experiences of American businesses pre and post major hurricanes. The Australian literature almost exclusively included small business within a consideration of whole of community experiences of recovery from extreme events or focused specifically upon tourism businesses and their recovery. Other articles found in the Australian context were opinion pieces in professional journals. Again these exclusively focused upon recovery rather than preparation.

In the literature, the issues reported by small business people post-event are very similar to those issues described earlier in this report in Figure 1 and Figure 4. Loss of power, employee shortages, few or no customers among other issues are predictable outcomes of disaster level events. What was striking was the large proportion of businesses reporting that they did minimal preparation for events. Mayer et al (2008) in their study of the experience of 97 small businesses after Hurricane Rita, reported that approximately 60% of businesses interviewed by them stated that they did only a 'few' or 'some' preparatory activities for the event. The majority of these activities took the shape of storing important data off-site and ensuring that the contact details of employees were up to date. Very little performance of structural mitigation prior to the event was reported. This is not an usual statistic. Sage software conducted a study with 504 small businesses across the USA in 2012. Just over 60% of businesses in this study reported that they did not have an emergency response plan in place.

It seems that not a lot has changed over time. Josephson et al (2017) conducted telephone interviews with small business owners in southern Mississippi regarding their preparation activities for Hurricane Katrina and subsequent events. These researchers found the majority of businesses reported minimal levels of preparatory behaviours being performed. However, they also found that factors such as mandated insurance, zoning laws, and strategies mandated by mortgagors had a positive impact on the uptake of structural mitigation activities. The authors however did advise that this is of little assistance to tenant businesses who may be unaware of their premise's structural nature or have little agency to get such mitigation done. The authors conclude that tenants may need information about the relevant issues to consider when leasing to address this knowledge gap.

Depressingly, prior experience of a hurricane does not appear to greatly influence subsequent business behaviour in terms of preparation. Scarinci (2016) reported on business preparatory behaviour before and after Hurricane Sandy in the USA. Of the firms interviewed, all of which had received a government loan for recovery post Sandy, only 42% of businesses with fewer than 10 employees reported that they had developed a plan to deal with subsequent events. But upon further questioning it appeared that only 13% of these businesses had their plan in a format appropriate for distribution to employees or management. The majority of 'plans' were not documented in a physical or electronic form. They were informal, verbal conversations and agreements. Such patterns were replicated across businesses of increasing size. Regardless of business size, plans were unlikely to exist in a formal format.

In the Australian context the story is strikingly similar to that told above. Businesses relied upon insurance to buffer the impacts of extreme events far more than by enacting preparatory responses such as structural mitigation. The only study found which examined crisis planning in Queensland (and indeed in Australia) did not study natural hazards exclusively but included them in the umbrella term of 'low probability, high impact events' (Ritchie et al., 2011). This particular survey of 386 accommodation managers reported that around three quarters of this sample stated that their organization had crisis plans in place. However the presence of a plan and preparedness behaviours was influenced by an organization's size, age and star rating. Those managers working within larger, older and more starred accommodation businesses were significantly more likely to report the presence of a crisis plan and the enacting of crisis preparation in their organization. Smaller,

younger and lower starred businesses were far less likely to report having a crisis plan or engaging in crisis preparation. Given that these latter types of businesses are likely to be more marginal, the lack of a plan does not bode well for recovery from an extreme weather event.

Where to from here?

What is missing from the literature is any attempt to work in a systematic manner with small businesses in order to assist them to engage with and enact preparatory actions. Given that such approaches are used with individuals and other organisations within communities, this is an oversight of a sector which is crucial to Australia's, and especially regional Australia's, economic wellbeing. In the literature cited in the previous section, attempts to relate pre-event preparatory behaviours with outcomes focused on using variables such as the nature, size and age of the business as predictors. A few articles examined the demographics of the business owner – such as age, gender and whether they were owner occupiers – to attempt to use such characteristics to predict engagement in preparatory actions. What is missing is the inclusion of variables known to be related to the performance of protective responses in other contexts. These variables are reflective of motivation to perform behaviours and the manner in which threat is conceptualised by an individual. The balance between these two factors – motivation and threat appraisal- is the basis for a set of theories called Expectancy Value theories. The one of particular interest to the current investigation is the Protection Motivation Theory (PMT) (Rogers, 1975).

As can be seen in Figure 6, the PMT suggests that an action, in this case performing cyclone mitigation behaviours, is predicted by two main factors: Threat Appraisal and Coping Appraisal. Threat Appraisal is argued to be a function of how likely an individual thinks the occurrence of a cyclone to be (perceived probability) and how severe an individual thinks the event will be (perceived severity). Coping Appraisal is suggested to be a function of whether an individual thinks they can perform the required response (Self-efficacy), whether they perceive that the response will result in the desired outcome (Response efficacy), and how much time, effort and money the response will cost to perform (Response Cost). It needs to be noted that such perceptions of threat and coping may not accurately reflect objective measures of the same. As in all human psychology, prior experience, preexisting beliefs and opinions about the future all play a part in turning objective reality into personal perceptions.

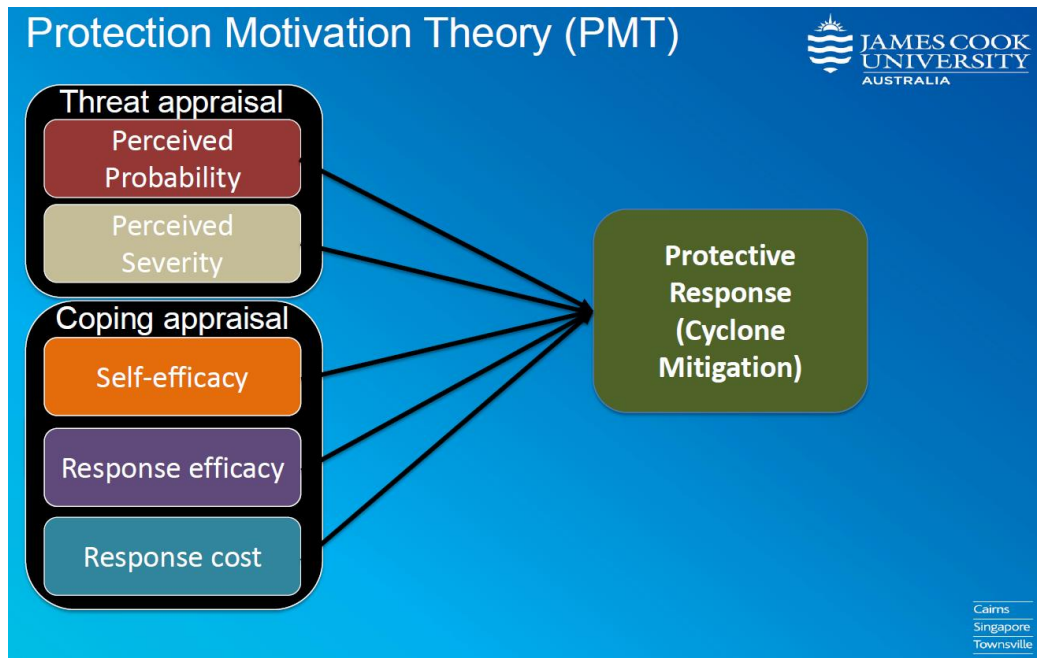


Figure 6: The components of the Protection Motivation Theory and their relationship to behavioural action.

It is the balance between threat and coping which is argued to determine whether or not an individual will perform a desired mitigation behaviour. Obviously some level of threat perception is necessary to spur protective actions, however if that level exceeds an individual's perception of their ability to cope with an event, the theory argues that attempts at protection will not occur - the threat is perceived as being beyond what the individual thinks they can cope with. If a threat is perceived to be within an individual's coping ability, the theory argues that it is more likely that mitigating behaviours will be performed - the behaviours needed to mitigate the threat are perceived as 'do-able' and effective by the person.

Thinking about behaviour in terms of the variables which may facilitate or hinder performance in this fashion also allows the generation of questions to assess the variables in a systematic fashion. This is the approach taken in the current interviews. So as seen in Figure 7, questions pertaining to Threat Appraisal were broken down into questions regarding perceived probability (top right hand side), perceived severity (bottom right hand side) and questions asking about the factors we know feed into the formation of both of these perceptions (middle bubble right hand side).

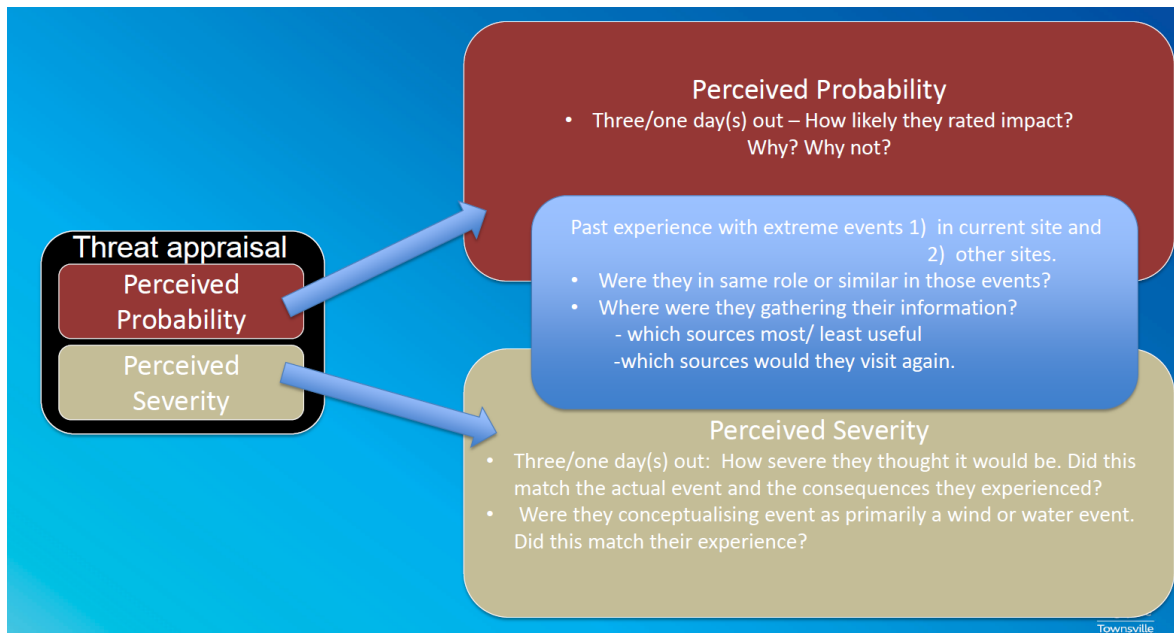


Figure 7: Questions used to assess Threat Appraisal in the current investigation.

Similarly, coping appraisal can be broken down into its constituent parts and questions devised to elicit information on each of these parts.

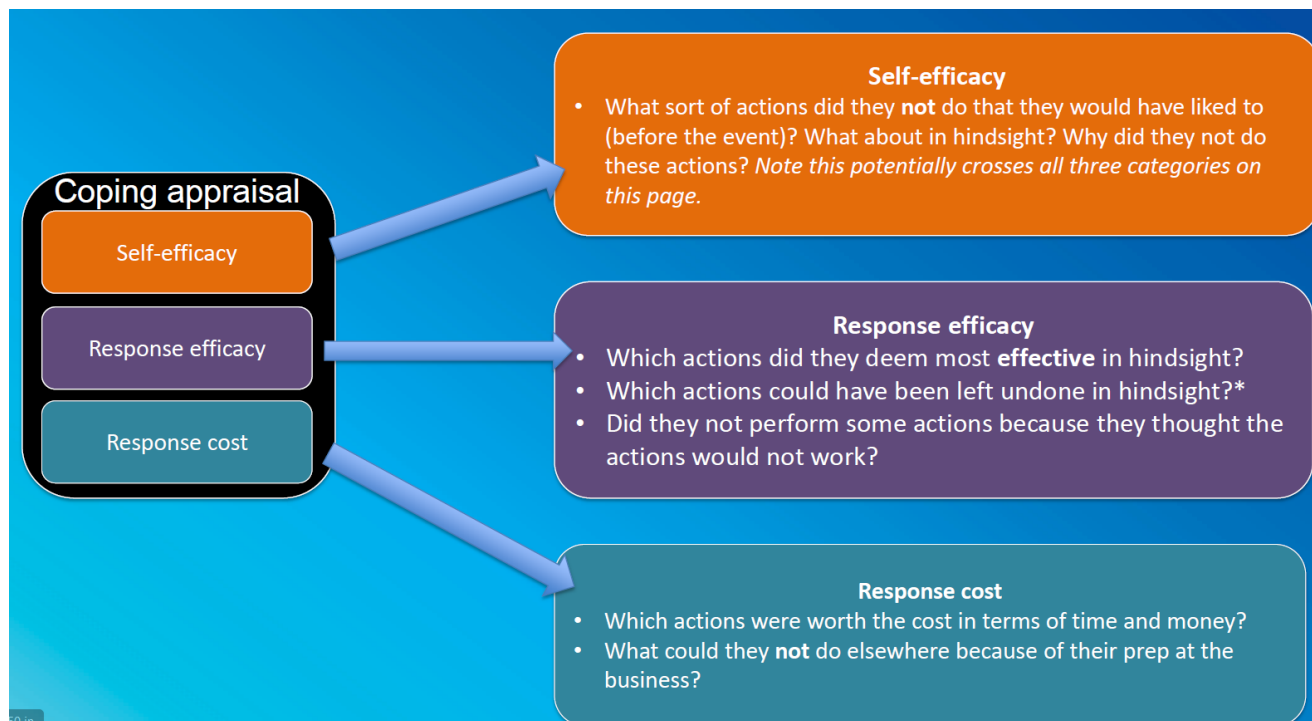


Figure 8: Questions used to assess Coping Appraisal in the current investigation.

To increase the specificity of the questions, coping appraisal was further broken down into Hazard – related and Resource-related attributes. This is in line with another Expectancy Value theory – the

Protective Action Decision Model (PADM) (Lindell & Perry, 2012). The components of each of these Attribute groupings can be seen in Figure 9.

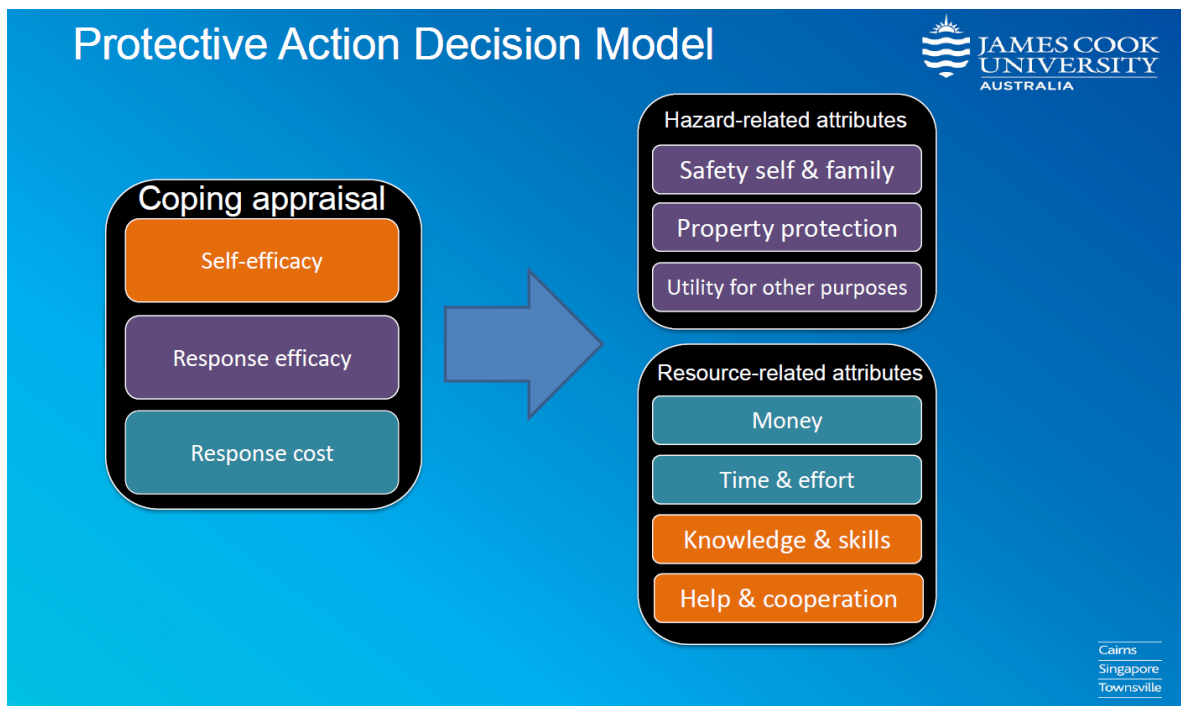


Figure 9: Breakdown of Coping Appraisal into Hazard and Resource related attributes.

Looking at Figure 10, it can be seen that the Hazard-related attribute questions reflect the assessment of the safety and protection of property and family. This is in contrast to the resource-related attribute questions which focused on the material and immaterial resources the individual had available to them at the time of the threat (see Figure 11).

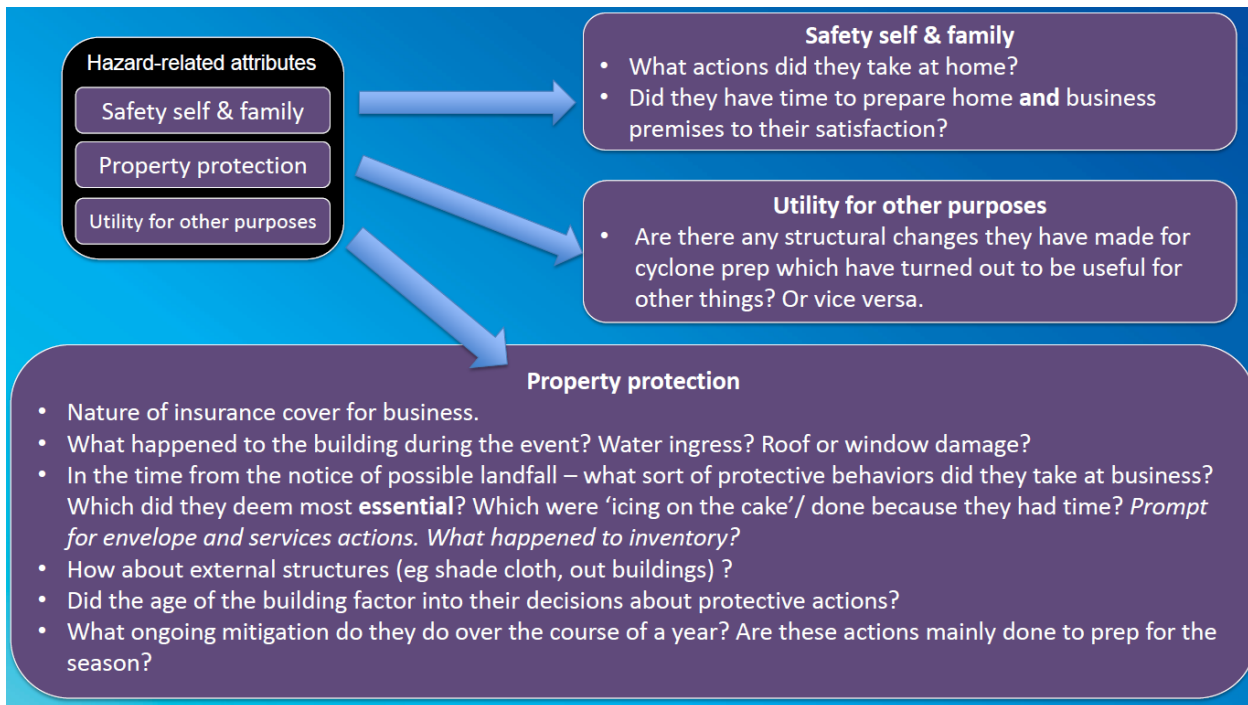


Figure 10: Questions about hazard-related attributes as per the PADM.

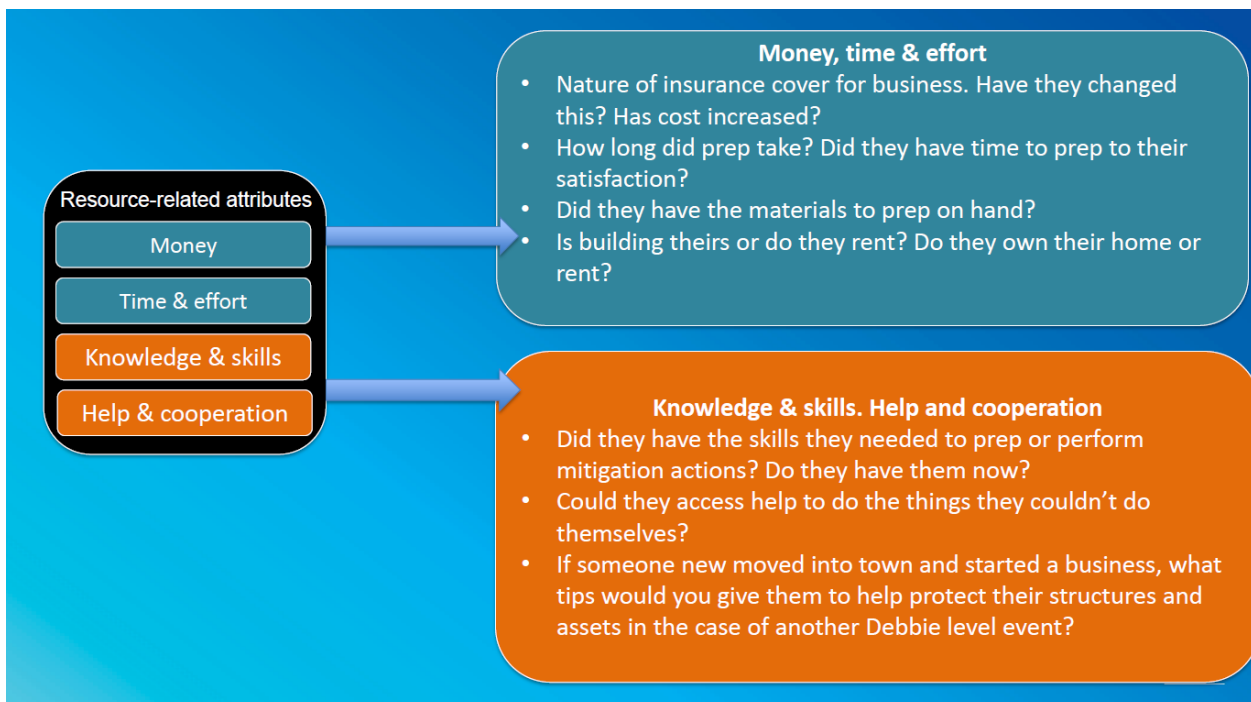


Figure 11: Questions about resource-related attributes as per the PADM.

The questions in the above figures formed the basis of the interviews conducted in the Whitsunday area. Using the Expectancy Value theories to structure interviews and survey questions is a common approach when examining preparatory behaviour of individuals with regards to their residences. There is no reason to think that the basic framework detailed in the figures cannot be translated

into explaining preparatory behaviour of small business owners. What may change is the weighting of different variables within the broader framework in the decision making process.

Brief Method.

The project was approved by James Cook University Human Research Ethics Committee (approval number H8456). Interviews were conducted with small business owners in the Whitsunday Council region between the 1st and 4th of June, 2021. Given the aim of the study was to ascertain what types of mitigation, structural or behavioural, businesses undertook in the lead up to STC Debbie, businesses in large retail complexes were not included in the study. Owners in such complexes have no ability to engage in structural mitigation of their premises and are subject to the decisions made by complex owners in terms of when business will shut and reopen. Thus, the investigation focused upon business owners who may not have owned their premises but had the ability to make decisions about their actions in the lead up to STC Debbie.

The investigators visited premises in Proserpine, Cannonvale, Airlie Beach and Bowen, and introduced the study to the business owner. As an initial screening question, individuals were asked if they 1. owned the business and 2. were the business owner at the time that STC Debbie impacted the region. If the individual was not a business owner then they were thanked and not interviewed further. In two instances, the person who was interviewed was a long standing staff member who was the person who prepared the premises in anticipation of STC Debbie. In both instances this was due to the owner attending another business site. In both instances, the owners of the business had given permission for the staff member to be interviewed about the business.

An information sheet was given to the interviewee to read and questions answered. Interest in discussing the events surrounding STC Debbie was ascertained and informed consent to conduct and record the interview (either electronically or in note-taking form) was obtained. Interviews were also conducted with three key local council staff who were involved in the response to STC Debbie. In all, 28 businesses were approached with 5 owners either actively declining to be involved or not contacting the investigators after taking an information sheet. Table 1 below shows the type, number of each type and locations of businesses whose owners, or long-term staff, were interviewed for this project. Due to the concentration of many small retail businesses in large malls in Cannonvale, businesses in this area tended not to meet the criteria for interview.

Type of business	Location
Local council officer x 3	Proserpine
Fashion outlet x4	Proserpine Airlie Beach
Hardware and building supplies x4	Proserpine Bowen
Financial services x1	Proserpine
Food services x2	Proserpine
Fuel and auto services x2	Proserpine
Early childhood services x1	Cannonvale
Garden, florist and landscaping supplies x3	Cannonvale Proserpine Bowen
Newsagency x1	Bowen
Veterinary services x1	Bowen

Table 1: Type, number and location of businesses interviewed for the project.

In addition to the questions detailed earlier, some basic demographics were collected. Individuals were asked the following:

- Their relationship to the business.
- How long the business had been in the current site/building.
- The age of the current building or structure.
- Whether they owned the structure or building.
- Their residency status in the local area and the nature of that household.

Results

Of the final group of interviewees, 16 owners of businesses were interviewed. Of the remaining 7 individuals, 3 were council staff and 4 were senior staff within a small enterprise. These 4 staff were all long-term staff who had been involved in preparing the premises for the impact of STC Debbie. All respondents lived in an area local to their business or place of work. The majority were long term residents of the north Queensland region who reported past experience with cyclones.

Threat appraisal: Did interviewees perceive a threat?

When asked about their behaviour and thoughts in the lead up to the impact of STC Debbie, all interviewees either stated that they perceived the system as potentially threatening, or their behaviour in preparing their premises indicated that they believed this was the case. All interviewees engaged in at least some preparatory actions to protect their business. Interviewees also appeared to appreciate the likely severity of STC Debbie prior to the system impacting the coast. However what did emerge from the conversations was the perception that STC Debbie was going to be primarily a wind event, which was not how the situation unfolded. The associated slow moving, low pressure system meant that water, rather than wind, was the salient feature of the system. So while the respondents did accurately appraise STC Debbie as threatening, the precise nature of the threat was not accurately perceived by the majority of those interviewed. This could be put down to the nature of STC Debbie being so different to that of past cyclones which passed through faster and were not followed by a significant multi day rain event. As one long term business owner noted:

“Debbie was just unique.....incredible because it just sat there for 30 hours and didn’t move....and more are going to be like that, bigger and wider and slower.”

Coping Appraisal: What did people do to prepare?

Interviewees were very candid in their thoughts about splitting their efforts between their business and their residence: preparing their residence was more important. Those who had people at home to assist in preparing the residence acknowledged that this gave them extra time to prepare their business. Those that did not have people at home to help prepare stated that they did what they could at work and then went home and performed more extensive preparations there.

The most frequently reported types of actions undertaken for the businesses included:

- Sandbagging around doors. This was by far the most frequently reported action taken.
- Taping an X onto large windows, done by the majority of the group. It should be noted that this is an ineffective action.
- Raising electronic goods and equipment off the floor onto shelves or counters and covering with tarp or plastic.
- Moving stock away from windows into back rooms or sheds.
- Taking computers home.
- Placing paper accounts or other records into plastic bags and storing them in filing cabinets or safes. One business reported using silicon to seal around the doors and drawers of cabinets and safes.
- Photographing stock for later insurance claims was reported by a minority of the sample.
- Moving heavy equipment against doors and roller doors to protect the doors and thus the building was undertaken by a few businesses.

It is interesting to note that the cleaning of roof top gutters for business premises was not mentioned by any individual, however when asked about preparing their residences interviewees often reported this action being taken in that context. Given the rainfall associated with the event, blocked gutters appear to have significantly contributed to the damage reported to buildings. Reasons such as time constraints, inability to access guttering and that such an action was the responsibility of the landlord were given for not clearing gutters.

The Queensland Government Small Business Disaster Hub checklist presented earlier in this report has at its first two points 1. Making a plan to guide preparatory actions and; 2. Reviewing insurances, policies and finances. These are actions which need to be done some time prior to the arrival of an event. No business owner reported having an explicit plan for disaster prior to the event which was then activated as STC Debbie approached. Plans for preparation appear to have been made as required as the 24 hours prior to STC Debbie unfolded. These actions focused around performing the preparatory behaviours in the list reported above rather than planning for recovery. No business owner reported any plan for managing orders and cancellations post event. Again these

were dealt with on a day to day basis. Generally, the actions taken appear to have happened immediately prior to the event and then in the response and recovery periods.

Coping Appraisal: Did people think their actions were effective?

It should be noted that the behaviours listed above are relatively low cost and easy to perform. Two factors which put them within the ability of most people to perform. When interviewees were asked about their assessment of the *effectiveness* of their actions however, responses were mixed. In Airlie Beach, businesses reported that the simple measures on the list above appeared to be effective but did credit that outcome to the fact that the area was not 'hammered' by the cyclone. In Cannonvale, business owners reported little to no effectiveness of the actions listed as the wind damage in that area was extreme and most of the actions do not target wind. In Proserpine it was the volume of water experienced that was reported to have caused the most damage. Despite sandbagging on external doors, water entered via lifted roofing, via the overflow from clogged box gutters, via internal floor drains and around windows and doors. In the words of one interviewee:

"You have no idea...there was just SO much water..."

Interviewees reported that water ingress resulted in floor fittings being ruined, walls being damaged – in one case completely collapsed - ceilings caving in and shelving collapsing. Some individuals cleaned their premises directly after the wind event and had to return and repeat the process after the rain event ended. However the majority of respondents did not return to their premises between the cyclone and the storm events and so could not state what damage was due to which event.

Post event, mould was reported to be a major problem for business owners, particularly in Proserpine and Cannonvale. Individuals in Bowen and Airlie Beach did not report the same degree of mould problems. The actions taken in preparation were not perceived to effectively impact on the occurrence of mould. Mould was a particular issue if the business owner had not been able to return to the premises due to safety concerns, inaccessible roads, or had been asked by the building's owner or a loss adjuster not to return until advised. Mould was the greatest cause of stock loss for nonperishable stock. Given that electricity supplies were not reconnected for some time after the event, there was little chance to hasten the drying out of fittings etc. to avoid mould.

The lack of electricity also meant that security systems did not work, and two premises reported break-ins. The opinion of some interviewees is summed up below:

....prepare for the after, the after is worse than the event....

Property protection.

The majority of businesses did not own the buildings in which the business was based. However when asked about structural mitigation for cyclone, there were no distinct differences in responses between those who owned their premises and those who did not. Very few individuals reported performing any structural mitigation regardless of whether or not they owned their building. The one exception to this was the fortifying of roller doors. Two businesses reported having done such work prior to STC Debbie and the doors successfully held during that event. No individual reported recent gutter clearing or cleaning being done by their landlord or themselves.

Not owning the building also meant that some business owners were not in possession of knowledge about the buildings past use. Thus they often do not know about previous structural modifications which may affect them. This had import for one interviewee who reported a sizeable amount of water ingress from the roof into the ceiling of her premises in a storm prior to STC Debbie. Inspection revealed an extractor fan in the roof cavity which remained from the building's previous life as a takeaway store. The fan had been removed below the ceiling but not above. Water was entering via the roof top exit of the fan, which itself was not well connected to the building structure. The business owner was able to have this removed and the roof repaired prior to STC Debbie but, understandably, wondered what would have happened if the repairs had not happened.

All business owners except for one reported that they had appropriate insurances including business interruption insurance. The one exception did not hold disruption insurance due to a complex series of events. Post STC Debbie they now hold the insurance. The majority of interviewees gave having appropriate insurance as the main way a business owner could protect themselves from the negative impact of extreme weather. This did not differ depending upon the experience of the owner with insurance companies when trying to claim. The ability to pay staff while not trading was repeatedly cited as the main benefit to the business owner.

What other actions did business owners perceive would have been effective?

As a group business owners did not perceive that taking any additional actions above the ones they performed would have made a significant positive impact on the outcomes from STC Debbie. For those who experienced significant damage, the consensus was that the nature of the event – the slowness of the cyclone’s passage and the three day rain event – was beyond mitigation. Others who experienced little damage due to their location, expressed the same sentiments:

‘If it had hit Airlie, nothing I did beforehand would have made a difference.

It was too wet.’

When asked what advice they would give another business owner facing a similar event, the acquisition of a generator was the option endorsed by all bar a few business owners. Generators were seen as ways to save stock by providing refrigeration and thus assist with getting back to business. The exceptions to this endorsement were those in the fashion/clothing industry who did not see how a generator would have returned them to trading faster. Once stock was lost they needed to ship in new stock, an event which would not be able to be done for some time due to impaired road access into the region. Business owners in the fashion trade who did not lose stock (two individuals) stated that they could open earlier as they used an iPad for their trading which could be powered off battery packs for a substantial period of time. These in turn could be recharged off generators at their residences. The only other suggestion which was made more than once was the acquisition of a battery operated security system. This was made by two owners who had experienced vandalism in the wake of STC Debbie during the electrical outage.

Business owners who did not own their premises perceived that they had limited ability to either undertake structural mitigation on the building themselves or to get the landlord to undertake such mitigation. This was a source of frustration to business owners particularly when they perceived the actions they were asking to be performed were relatively easy ones. An example was the clearing of gutters on a regular basis. Given the source of much damage was water ingress in part due to gutter overflow, the frustration of many owners is understandable.

Discussion.

The findings of the current investigation mimic findings from the USA and Australia. Preparatory actions were undertaken in the short period before the event and then subsequent efforts were focused towards response and recovery. Generally the nature of preparatory actions undertaken by those interviewed did not address structural issues with buildings and were designed to mitigate amounts of water entry way below that experienced during STC Debbie. So, for example lifting stock up off the floor. In Proserpine, Cannonvale and Bowen, these actions were not enough to deal with the large amount of water which entered buildings, often via the roof not the floor.

Planning for the impact of cyclones outside the period immediately preceding an event was not reported by the interviewees. While all reported having an idea of what needed to be done prior to STC Debbie, no one reported a written plan which covered all the suggested items on the Queensland Government Small Business Disaster Hub checklist. Indeed few owners reported knowing about the Disaster Hub itself. Given that the Hub had released an app in the week prior to the interviews being conducted, this seems to be a failure of dissemination about its existence.

Expectancy value theories such as the PMT argue that individuals weigh up the performance of preparatory actions by assessing the level of threat they perceive on one hand versus how efficacious they perceive the actions to be in mitigating the threat, their own ability to perform these actions and the cost of performing the actions. It's argued that people are most likely to perform preparatory actions when an event is perceived as threatening but the individual perceives that they can cope if they perform the action. All interviewees reported perceiving STC Debbie as a threat to their business in the period prior to landfall. All interviewees perceived that the actions they did so might be useful. But the actions that they did perform were limited. This was largely due to the 'cost' of the actions for many owners. They had residences to prepare as well. Many had family obligations. The perceived 'cost' of damage to the business by not performing all possible preparatory actions appeared to be offset by the perception that addressing that gap was the function of their business insurance.

Expectancy value theories also suggest that past experience feeds in to the perceptions of the efficacy of actions and thus influences the likelihood that these actions will be repeated in the future. If that is the case then it would be unlikely that the interviewees in this study would repeat

any actions they perceived as high cost in the future. None of the actions performed had any great impact on outcomes in STC Debbie. The amount of rainfall and the entry of water via overflowing gutters and internal drainage overwhelmed the extent of the preparatory actions taken. Indeed there was an air of fatalism expressed by many interviewees that nothing they could have done would have changed the outcome for them and their business.

It could be argued that STC Debbie was a taste of what cyclones are predicted to become in the future – bigger, wetter, and slower (IPPC 6th Assessment). Very much water as well as wind events. This shift may require different preparatory behaviours and ways of thinking about cyclone preparation. For example a shift towards structural mitigation rather than actions that do not address the structure of the building and its utilities. If that is the case, then does advice to small business owners need to change? The current group of interviewees in the main, reported performing their preparation activities in the period immediately preceding the arrival of STC Debbie. This is not a time period where significant structural mitigation can occur. Such actions require time and planning outside the imminent arrival of a cyclone. However it is easy to see how at such times structural mitigation drops off the radar of individuals trying to make a living from a business.

Given that the predicted changing nature of cyclones and the decreasing efficacy of basic preparatory actions indicates a shift towards greater structural mitigation may have greater payoffs for a business owner, how can this be encouraged? Outside of cyclone season such actions become less of a priority and few business owners in this investigation actually owned their buildings. This meant that their ability to perform improvements to the structure was limited. Any intervention or program of change will need to engage with landlords. Talking to landlords was outside the scope of the current investigation and so no statement can be made as to the appetite of the group for undertaking structural mitigation of their building stock. However it would not be unreasonable to assume that undertaking expensive upgrades for no sure benefit would not be appealing to a building owner. There may or may not be another event like STC Debbie during the period they own the building.

So what can be offered to building owners to encourage them to undertake upgrades? The obvious incentive is discounting of insurance premiums for both building damage and business interruption

insurance. Drivers of loss (building damage and disruption to income/loss of rent) have been identified through the survey and described in Appendix B. Mitigation actions such as regular maintenance, installing rated cyclone shutters, ensuring roof vents and other attachments to the building envelope are to current building standards, reduce the risk of damage to the building and minimise chances of water ingress into the building. Engagement with the Insurance industry to acknowledge and reward lowering of risk is required. Examples of this are happening with premium discounts from retrofitting of older “pre-code” homes (<https://www.qld.gov.au/housing/buying-owning-home/financial-help-concessions/household-resilience-program#about>) through some insurers, as well as premium reductions of strata properties that have undertaken and actioned resilience ratings and reports from the Strata Title Inspection Program (<https://stp1.hpc.jcu.edu.au/#/>).

While insurance discounts address the bricks and mortar issues of preparation, there are other tasks around building maintenance which need to be done regularly to maintain integrity. For example the clearing of gutters and drains prior to cyclone season. Several other examples are outlined in Appendix C. Local Councils have addressed similar issues by instituting annual events such as Cyclone Ready Streets in Townsville where local residents register their efforts to get their street ready for cyclone season over a three-week period. Residents are encouraged to send in pictures of their cleanup and are rewarded with small gifts from local businesses. The residents’ efforts are supported by Council removal of waste at the end of the period. It may be possible to run a similar program for those who own building stock. However investigation as to what constitutes a ‘reward’ for landlords needs to be done. Social badging is an increasingly popular way to indicate successful completion of a task which has value to the community within which the individual moves. So, a landlord who does complete tasks such as clearing gutters or drains in the lead up to cyclone season may obtain a ‘badge’ which can be displayed in the front window of the premises. Those who do not, do not have a badge to display.

Such a system does need to be administered by some entity and so there are costs to the implementation. While local councils are an obvious place to situate such schemes, the capacity of such organisations needs to be evaluated. While the implementation costs are obvious, the benefits are not. For example, benefits in terms of the economic impact of time to recovery after an event need to be considered and these are not easy to cost. Perhaps the most telling statistic to be taken

into account is that of business failure after the event. As reported in Figure 5, around 70% of businesses who experience major property damage do not survive more than 3 years following an event. This can only be compounded in regional areas, such as the Whitsundays which already face issues attracting and retaining businesses due to the high transiency in the region. So, for such areas, the loss of a business may not mean that it is replaced by another. Thus the protection and retention of small businesses has implications for the income of landlords and for councils. It is suggested that investigating the appetite of each of these groups for schemes encouraging building maintenance is a priority.

Key findings and future directions

- Given the competing time demands prior to the event, business owners prioritised their home preparation over their business preparation. Having business insurance was seen as a mitigating action against loss in a way that insurance on a residential property was not.
- A shift in thinking about preparedness as an activity done outside the immediate lead up to an event, may facilitate the performance of more demanding mitigation activities.
- Business owners, as a group, performed non-structural, rather than structural mitigation actions in their preparation for STC Debbie.
- Most business owners did not own their operating premises. This was the most frequently offered reason for not performing structural mitigation activities.
- Most business owners reported that non-structural activities such as gutter and drain clearing was not performed by their landlords in the lead up to STC Debbie.
- Landlords as a group are not included in investigations of barriers and facilitators of property preparation for extreme events. Investigations of these issues for this group would benefit the design and implementation of future preparedness programs.

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Note that this list does not contain the references for Government hubs and other tools listed in the report. Links to those web pages are given in the relevant sections directly after the descriptions of each item.

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Appendix A: Summary of interviews with council staff.

As stated in the Method section, three council staff were interviewed and asked their impressions of the response immediately prior to and for some time after STC Debbie. Staff were asked for interview based upon their role at the time of Debbie giving them responsibility for organising preparation and response to the event. A summary of these interviews is presented here.

Staff reported that the preparations of council buildings was done as well as it could be given the time available for preparation. Many council buildings already had security fittings (eg mesh and bars) which also functioned to provide extra protection to windows, doors etc. Larger shade sails were taken down due to the risk they posed to other assets. Smaller ones were left up as they posed no threat to other infrastructure and the staff required to take them down were deployed elsewhere. All staff agreed that while there were some actions which prior to the event they wished they had been able to do, the severity of STC Debbie and the associated rain event meant that these actions would not have been effective in mitigating damage.

Prior to the event staff conceded that the plan for operations was not as firm as it could be, however after the event the plan which was put into place was reported as very effective and recovery proceeded quickly. Prior to the event staff ensured depo fuel bowsers were full and had sourced and stocked relevant equipment. Contractors were also alerted to source fuel and check equipment prior to the event and to turn up to the council depo in their town when the weather cleared. This meant that when the weather allowed clean up to begin, contractors were ready, council was ready and no time had to be spent sourcing fuel or equipment. The exception to this preparation appears to be the sourcing of generators. These took around 7 days post event to source. Council has now addressed this issue with the purchase of generators and the allocation of generators to pump and water stations.

Contractors were allocated a geographical area to service. Staff referred to a 'war room' type atmosphere where contractor locations were overlaid onto a map of the region in order to assist with tracking and communication. Briefings were held daily. Contractors who could not get to a depo but were known to council were contacted by phone and assigned tasks. One issue that was not considered in the lead up to the event was the logistics around the provision of food and water

for out-of-town contractors. The lack of generators contributed to this issue as refrigeration was not accessible. This has been taken as a learning from the event.

Communications with residents were noted as critical to clean up due to the importance of keeping hard and green waste separate. Comments on how this went were generally positive. Residents appeared to take the messages on board and comply with the requests. What was initially underestimated was the amount of green waste/mulch storage which was needed as clean up progressed. This surpassed expectations and it appears that planned storage locations needed to be revised in the immediate aftermath and noted for future planning. Currently the areas used post Debbie are now no longer available.

The extent of the water event also surprised council staff. Storm drainage became an issue as the winds associated with STC Debbie stripped tree canopies and loosened debris from vegetation floors. The ensuing deluge then transported this into storm and open drains, clogging the system and contributing to flooding. Given the loss of canopy over the region, this may become even more of an issue in the future. Subsequent growth becomes weaker and thus more likely to be stripped and enter drainage as debris in subsequent events. Canopy loss also encourages weed growth which becomes a management problem, particularly in open drains. The location of the council area adjacent to the Great Barrier Reef Marine Park also means that sediment runoff is an issue to note when planning future land management.

Staff appear to have taken on board the lessons that they learnt from STC Debbie and implemented strategies to address gaps in planning. Discussions with staff noted the development of asset registers, level of service documents for assets, plans for managing open drains and the implementation of betterment projects for infrastructure in the post Debbie period. It was not clear the extent to which these were integrated into a formal plan or were at the level of organised or informal record keeping.

The transient nature of the population of the Whitsunday region was noted by all staff as an issue when trying to communicate and build resilience capacity with residents. One school in the region was reported to have a turnover of one third of its student body annually. This means that council needs to maintain messaging about preparation to residents and new business owners. It also

means that residents who are likely to leave the area are less likely to invest in more expensive preparatory actions such as buying a generator. Another issue which was raised in this context was the increased likelihood of home owners to take cash payments from insurers and then not spend all the cash on repairs or to implement cheaper repairs which may not be optimal. This may be more likely to happen when individuals do not plan to stay in the region for a significant time period and thus see a building/home as temporary for them. What it does mean for council is a decrease in the quality of the building stock in the region. Which, in turn, may mean worse outcomes during the next event.

What was very clear during the interviews was the dedication of the staff to carrying out their roles in the period around STC Debbie. Staff spoke of putting in long days in extreme conditions, of not getting home for several days, of sleeping in makeshift quarters and, in one instance, of continuing to assist in coordinating response efforts while the old Council Chambers slowly came apart around them. In all of this, no response related adverse event for staff or contractors was reported. After the response phase, the loss of the Council Chambers meant that staff based there were scattered between other council locations for the time it took to rebuild the chambers. This was around 4 years. On top of the stress of the event and response phase and the experience of any damage to one's residence, the disruption to work routine is another stressor for staff which needs to be acknowledged. Along with the suggestions outlined above, perhaps a plan for staff return to work after extreme events might be operationalised. This may have positive impacts on morale and also, given the transient nature of the Whitsunday region population, this may assist with staff retention and retention of corporate knowledge.

Appendix B: Building damage from severe weather

Damage investigations carried out by the CTS following severe wind storms provide critical information for understanding building performance. The damage investigations have typically shown that houses and commercial properties built prior to the 1980s do not offer the same level of structural performance during cyclones as buildings constructed to contemporary building standards. The investigations also show that the majority of houses designed and constructed to current building regulations have performed well structurally by resisting wind loads and remaining intact (Boughton *et al.* 2017 and 2011, Henderson *et al.* 2006). However, these reports also detail failures of these contemporary structures resulting from design and construction failings, or degradation of construction elements (i.e. corroded screws, nails and straps, and decayed or insect-attacked timber).

The damage investigations highlighted recurring issues with current construction such as loss of soffits and poor performance of flashings, box gutters and roller doors which led to some damage. These are similar to the issues identified from the interviews with business owners that damaged the buildings and delayed recovery.

From the CTS damage investigations following STC Marcia and STC Debbie, the majority of buildings resisted the severe wind loads and remained substantially intact – as they should have as the wind speeds impacting the buildings were less than the design levels for contemporary construction. However, as detailed in project with Insurers IAG and Suncorp (CTS 2018), approximately 70% of Strata claims reviewed had some form of damage from water ingress. That number rises to almost all properties in exposed locations.

The combined damage survey including wind field assessments with the claims data highlighted several issues such as; wind driven rain water ingress, poor design and/or construction practice of structural elements especially in exposed locations (e.g. hills or waterfront), the need for more robust materials and connection choices for building components in hard to reach (and maintain) areas (e.g. soffits and flashings on multistorey buildings), damage to non-wind load designed elements such as fences, and the need for continued maintenance. The study also showed that these issues are the same across single dwelling homes as well.

During strong winds, differential pressure between the outside and inside of a building can drive rain through any small openings or gaps on the windward side. The report showed that in the cyclone events analysed, wind-driven rain had entered some buildings through weepholes or gaps around seals in windows or doors; under missing or damaged flashings and gutters; or through eaves, gable or roof vents. The rain water ingress caused damage to vulnerable elements such as plasterboard wall linings and ceilings; floor coverings; and personal belongings. In multistorey buildings, the rain percolated down through the building for a number of storeys below the original point of entry. Another one of the issues as a result of wind driven rain ingress is an inspection of electrical circuits is required, adding further costs and delays to recovery.

From damage surveys, the most effective method of reducing wind driven rain via windows and doors is to use wind rated cyclone shutters. This has the added benefit of mitigating wind driven debris entering into the building and providing added security to the property. If shutters are not available, using plastic sheeting has been demonstrated to reduce water ingress via windows and doors as detailed in CTS 2018, by using a strip of plastic sheet taped on the inside of the window sill. This strip of thin plastic increased the height of the window sill, caught the water and allowed it to drain back out of the house via the weep holes. A step by step guide for installation of plastic to reduce wind driven rain ingress through windows and doors is given in:

https://www.jcu.edu.au/data/assets/pdf_file/0004/1175107/Guide-to-protect-window_20181029.pdf

Failures of garage doors have been commonly observed in all damage investigations. Changes to building standards in 2013 introduced new requirements for these large opening doors (e.g. roller doors) to be able to withstand the design cyclone wind load. But this only applies to new doors in buildings since 2013. Some interviewees protected their large roller doors by installing additional wind lock devices or by parking equipment on the inside of the doors to reduce likelihood of doors blowing inwards.

Water entry via roof vents was noted in the interviews for some business operators. Failure of roof attachments (e.g. vents, air conditioner units, flashings etc.) have been documented in all damage surveys. Improvements to design and installation of these elements were greatly updated in 2018 in revisions to building standards. An example of a failed roof mounted vent which led to internal

water damage to the building is shown in Figure B1. The replacement vent with robust connections is shown in Figure B2.



Figure B1: Failed roof vent and damage to interior



Figure B2: Upgraded roof vent supports

Water inundation from under doorways was noted by some of the interviewees. Damage was to flooring, skirting boards etc., and in some cases also required checking of electrical systems. Examples of water ingress came from (a) drains on property (e.g. in front of doors or adjacent to building below downpipes) not having enough capacity to take the water and/or having some blockage, and (b) from inundation from storm water from roadway entering via doorway. As part of the pre-storm season checklist is to check gutters, drains, etc. to be clear of obstructions, however

as noted by some interviewees this was not undertaken by them or the landlords. A useful check for potential rain runoff from road reserve is to observe how far the door sill (floor level) is above the crown of the road. Figure B3 shows the road being of similar elevation to that of the buildings floor. A mitigation measure that can be employed is to use plastic sheet and sandbagging lines across the front of the doors. QFES has details on effective sandbagging methods:

<https://www.disaster.qld.gov.au/dmp/sandbagging/Pages/default.aspx>

<https://www.qfes.qld.gov.au/sites/default/files/2021-05/DIYSandbag.pdf>



Figure B3: Height of road and drains relative to floor level of building

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Appendix C: Preliminary maintenance (service) schedule

Buildings are systems that have many components that need to be in good condition so the building can function and resist severe weather. Not unlike machinery (car, pump, etc.) regular maintenance for buildings is needed.

Inspections (e.g. building envelope, structure and pest inspection) should be undertaken prior to purchase or lease and then at set intervals, as per a vehicle.

A suggested maintenance schedule could contain items such as:

Timing	Task
Yearly (~2 months prior to cyclone season so repairs can be undertaken)	Clean gutters
	Check gutter brackets
	Visual check for any corrosion/damage to roof screws, cladding and flashings (especially around roof penetrations like vents and skylights)
	Visual check for cracks/gaps in roof tile ridge cap pointing etc.
	Check seals on doors, windows and skylights
	Conduct a Termite inspection
	Check for corrosion/rot around footings e.g. veranda posts, gazebos, etc.
	Inspect for rot in fascia and barges, window sills etc
	Check operation of roll down storm shutters
	If have removable shutters – check that all pieces still available so can install
	Check downpipes and drains around the building not blocked
	Test run generators and sump pumps if have them
Every 7 years (every 5 years if within 1km from salt water)	Structural inspection by licensed builder/certifier
	Inspection to include visual of condition of connections within roof space (via access or fibre optic camera)
	Inspection to include structural elements and building envelope elements (tie downs, bracing, posts, flashings, cladding, etc.)

The five or seven year inspection cycle should be conducted following any impact following any severe storm that caused damage to buildings or houses in the area.

The maintenance schedule is a companion to a cyclone preparation plan (clear yard, drop shade cloths, etc.) that the home or business owner enacts when the Bureau of Meteorology declares a cyclone watch. (A Tropical Cyclone Watch is issued for coastal communities when the onset of gales is expected within 48 hours, but not within 24 hours)