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Benefits and costs of provision of post-cyclone emergency services in Cairns

Final Report

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BENEFITS AND COSTS OF PROVISION OF POST-CYCLONE EMERGENCY SERVICES IN CAIRNS

The Australian National University

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TABLE OF CONTENTS

ABSTRACT

The key issue in this report is whether it would be socially desirable to provide enhanced post-cyclone emergency services in towns such as Cairns. One means of addressing the issue is to estimate the net social benefit that would accrue to Cairns residents. Focus groups of residents identified four services as being the most relevant: accommodation of pets in shelters, police patrols for a longer period after a cyclone, faster resupply of fresh food to shops, and faster reconnection of utilities such as electricity and sewerage. A choice experiment indicated that Cairns households were on average prepared to pay about $124 per annum for faster resupply of fresh food, and almost three times more each year for faster reconnection of utilities, but only about $11 per annum for each additional day of police patrols. However, residents expressed an average negative willingness to pay about -$99 per annum per household for accommodation of pets in a shelter after a cyclone. It was not possible to obtain entirely satisfactory corresponding estimates of costs for these services. It was also clear that it might not always be possible to achieve faster provision of emergency services, given the post-cyclone logistical challenges faced by commercial organisations as well as government agencies. Nevertheless, estimated net present values for faster provision of fresh food, faster reconnection of utilities, and longer police patrols are all positive.

EXECUTIVE SUMMARY

Cyclones can damage a wide range of infrastructure, including housing. Residents of cyclone-affected towns rely on government agencies to provide emergency assistance to restore infrastructure services such as mains electricity and sewerage, as well as facilitating the supply of fresh food. Restoration of basic day-to-day functionality after a cyclone can typically take a week, and even longer.

It is possible for government agencies to provide more resources, or to subsidise private enterprise, in order to restore basic services more quickly. However, this would require the use of more public resources, and may mean that offsetting reductions would be required in the provision of other publicly provided goods and services such as health services or education.

If governments are to allocate resources efficiently, in a way that increases overall community well-being, then the social benefits of any policy or program must exceed the corresponding social costs. While cost-benefit analysis is sometimes carried out for major programs, there does not appear to have been any analysis of the social costs and social benefits of post-cyclone emergency services. This study is therefore a first step in providing information that can help guide the allocation of budgets and resources in the area by government agencies.

The social benefit of any change in the provision of emergency services needs to be based on estimates of individual households' willingness to pay for improvements. Because most emergency services are not available in commercial markets, the information needs to be obtained through stated preference surveys. The survey used in this project, a Choice Experiment, allowed interviewees to choose from alternative 'bundles' of emergency services that include a cost component.

Each 'bundle' contained a combination of different quantities of services as well as a cost. Based on the choices made by a random sample of Cairns households, estimates were made of their average willingness to pay for different levels of emergency services. Based on the advice of focus groups of Cairns residents, the services comprising the 'bundles' were: the accommodation in shelters of pets, longer duration of police patrols across the city, faster reconnection of utilities like electricity and sewerage, and faster resupply of fresh food.

Cairns households were on average prepared to pay about $125 per annum for faster resupply of fresh food, and almost three times more each year for faster reconnection of utilities, but only about $11 per annum for each additional day of police patrols. However, households expressed an average negative willingness to pay about -$99 per annum for accommodation of pets in a shelter after a cyclone.

Corresponding social costs of providing improved services were necessarily estimated from a variety of sources. Except in the case of provision of post-cyclone shelter for pets, the net social benefit was positive for each of the services analysed.

If cyclones were to become more frequent or intense due to climate change or some other factor, then the damage caused is likely to increase or become more widespread. And as population grows, more people will be affected. The estimates obtained in this study of willingness to pay for post-cyclone emergency services provides a basis for estimating the net social benefits of improved services, but scientific uncertainty about the effect of climate change on future cyclone patterns precludes incorporation of this factor into the analysis.

1. OBJECTIVES OF THE RESEARCH

1.1 Original proposal

In February 2009, major retail food outlets in central Cairns had empty shelves in the fresh meat and vegetable sections. Local media reports (e.g. *The Cairns Post*, 11 and 12 February 2009) pointed out that major retailers truck fresh produce to Cairns from Brisbane but the flooding of the Bruce Highway had cut supply chains from the south. Although some dry goods were still being shipped in by sea and air, a shortage of refrigerated containers precluded this option in the case of fresh and frozen food.

Direct observation, as well as media reporting, gave rise to the question of whether there might be better alternatives for the resupply of fresh food to north Queensland communities isolated by cyclonic flooding. In particular, it was considered that greater use of established private sector logistics had the potential of improving resupply, possibly with some government subsidy if supported by the results of a cost-benefit analysis. Cairns was used as the case study.

In Cost-Benefit Analysis, social benefits are measured as the willingness to pay for a good or service, and social costs are measured in terms of opportunity cost. Although both benefits and costs are generally expressed in monetary units, use of a monetary numeraire is simply a matter of convenience.

Where emergency services are provided by government, they are not bought and sold in a commercial market like many other goods and services. It is therefore not possible to observe prices of emergency services in the same way that the price of a restaurant meal can be observed. Nor is it therefore possible to estimate individuals' willingness to pay for goods and services by using analogous markets or other techniques that rely on observed (revealed) preferences.

More particularly, where better services are provided, such as reconnection of electricity supplies within 3-4 days rather than 5-8 days, there is no price change, only a change in the quality or quantity of the service. The measurement of change in a community's welfare therefore needs to be determined on the basis of estimates of willingness to pay elicited from stated preference techniques such as the Choice Experiment survey used in this project.

Where research proposals of post-disaster assistance seek to elicit preferences from victims about their needs through surveys, but without facing respondents without the reality of the cost of provision, responses are likely to simply be a wish list based on 'free goods'. To avoid this situation, an important aspect of the proposal was to estimate the willingness to pay of residents for improved services by including a 'payment vehicle', in our case a levy on all households as part of their electricity bill.

The original research proposal therefore had the following objective:

- Based on the expectation of increased frequency and/or intensity of cyclonic events due to climate change, carry out a nationally-applicable scoping study using the Cairns community to:

- Estimate the economic benefits of continuity of supply of water and fresh food to isolated communities.

- Based on the stated alimentary preferences of residents, estimate the additional economic costs of supplying water and food using conventional public sector emergency services; and harnessing potential private sector logistical arrangements as an alternative.
- Compare the relative efficiency of public and private sector arrangements, and estimate any additional government subsidies justified by cost-benefit analysis.

Further research made it clear that the objectives would need to be refined to better take into account initial findings. The objective of the original research proposal of investigating the resupply of fresh food was maintained, but was expanded and to include alternative emergency services.

1.2 Refined research objective

Discussion with emergency services experts and focus groups in Cairns indicated that consideration of the resupply of fresh food alone was not realistic. Because fresh food needs to be cooked, any preferences expressed by local residents would need to take into account factors such as the availability of cooking facilities and the ability to remain in one's residence. Resupply of utilities (electricity, water, sewerage) needed to be considered as a complement to the resupply of fresh food.

It had originally been intended to use the Contingent Valuation Method to estimate Cairns residents' willingness to pay for fresh food alone. The expanded scope of the research necessitated a switch to a Discrete Choice Experiment methodology; requiring a substantial increase in research effort. However, the advantage of the change was that was possible to expand the scope of the research to include other aspects of post-cyclone emergency services such as increased police patrols to identify the relative strength of trade-offs between different services.

Further, it became clear that public sector organisations are not generally involved in the resupply of fresh food after a cyclone, except potentially in facilitating transport where normal commercial arrangements are not possible. Commercial suppliers, on the other hand, appear to be strongly motivated to maintain market share through rapid resupply. Residents of coastal towns are also advised by Emergency Services Queensland to maintain stocks of food, water, fuel and other necessities sufficient for at least three days after a cyclone.

2. RESEARCH ACTIVITIES AND METHODS

Research activities and methods undertaken can be delineated into two broad categories: costs and benefits. A survey based on Discrete Choice Experiment methods was employed to estimate benefits of improved delivery of post-cyclone emergency services, and semi-structured interviews were used to elicit information about the potential economic costs of their provision.

2.1 Background

Cairns is located on the Cape York Peninsula, almost 1,000 kilometres north of the tropic of Capricorn. It has a tropical monsoon climate, and frequently experiences the effect of the cyclones that cross the eastern coast of Queensland. The official cyclone season in Cairns is from the beginning of November to the end of April. Recent cyclones that have affected the Cairns region include Justin (1997), Rona (1999), Steve (2000), Abigail (2001), Larry (2006) and Yasi (2011).

With a population of over 150,000, the greater Cairns settlement stretches about 50 kilometres along a narrow coastal strip between the Great Dividing Range and the Coral Sea, with parts of the city built on flood plains (see Figure 1). It is bounded by the Barron River on its northern edge and the Mulgrave River to the south. Road and rail links into the city are often cut when the Barron and Mulgrave rivers flood. Cairns therefore presents an ideal case study of a community that is periodically isolated and requires emergency services.

Queensland residents are advised by Emergency Management Queensland, which oversights the State Emergency Service (SES), to shelter from cyclones in their own homes, or with relatives or friends. Unlike Darwin in the Northern Territory, cyclone-proof shelters are not provided, except for personnel responsible for post-cyclone provision of emergency services. On the other hand, in what was probably an Australian first, about 2,000 Cairns residents took refuge in the Stocklands shopping centre in the Cairns suburb of Earlville during cyclone Yasi in February 2011. The decision to make the shelter available was a last-minute, ad hoc measure implemented by the centre's manager in response to a request by a local politician because of predictions that Yasi would cross the coast as a category 5 cyclone, the most severe category.

Once a cyclone has passed, local governments such as Cairns Regional Council generally make available designated evacuation centres – usually schools or other public or community buildings – to house those whose residences are rendered uninhabitable by cyclonic winds or inundation. Such accommodation is invariably crowded and uncomfortable due to lack of suitable facilities. The expectation is that it will be used only for a few days by those who have no other alternatives. Evacuation centres can also be made available in Cairns where lives may be at risk due to expected storm tides (but not wind threats), but such centres are not necessarily cyclone-proof.

Apart from damaging residential and commercial buildings and their contents, cyclones tend to disrupt overhead electricity supplies, disable sewerage and water supply pumps through sea level rise and inundation, and inhibit access by strewing debris across roads and private property. Power supplies are usually switched off by suppliers like Ergon immediately before a cyclone to reduce risks to people and property. The threat

of disruption to electricity supplies can encourage shops to discard fresh food before a cyclone, and flooding of roads and railways can prevent early restocking after the cyclone has passed.

2.2 Estimation of benefits of improved post-cyclone emergency assistance to Cairns residents

The benefits of improved post-cyclone emergency services were estimated on the basis of a Discrete Choice Experiment. Data were obtained through a paper-based survey of randomly selected households in Cairns in late 2011.

2.2.1 *Survey administration*

It is increasingly standard practice to undertake surveys using internet-based methods. Commercial firms provide a ready-made sample of respondents in selected locations, obviating the need for sample selection by the analyst. An important advantage of internet-based surveys is ease of data entry, which is generally carried out automatically.

Commercial survey providers were cautious about undertaking an internet-based survey in Cairns because they were not able to guarantee a sample of 400 to 500 respondents from their existing stock of registered users. Nor were they able to provide focus groups to test survey material. It was also not entirely clear whether an internet-based survey of a combination of several north Queensland coastal towns could have provided a sufficiently large sample of respondents with similar characteristics and experiences because of different cyclone-related conditions in each town.

According to 2006 Census data, average access to the internet at home in the Cairns Statistical Subdivision (35005) was 64.1 per cent in 2005, close to the national average. However, there are substantial differences within Cairns, ranging from over 70 per cent in the northern and newer southern suburbs to just over 49 per cent in the more densely populated central suburbs like Manoora, Manunda and Mooroobool. Conduct of an internet-based survey would thus have been subject to potentially significant bias, particularly in areas of lower residential internet penetration.

With the assistance of the national office of the Lions Club of Australia we established contact with the President of the Lions Club of Cairns, Ms Thelma Spelta, who obtained the agreement of her members to carry out a paper-based survey in collaboration with the Australian National University (ANU). Ms Spelta also obtained the support of members of the Neighbourhood Watch Program and the Regional Ratepayers Association of Cairns Inc in distributing and collecting survey forms.

A key feature of the collaboration between the ANU and the Lions Club of Cairns was the fact that those distributing the survey forms were able to point out to householders that payment for distribution of the forms would be channelled back into the local community through the Lions Club (see Appendix 1 for ‘introductory comments’ card). Lions Club members wore uniforms and identity badges during distribution and collection of survey forms to instil confidence in the genuine nature of the exercise.

The Lions Club was further provided with the incentive of additional payment for each fully completed survey form collected, in order to maximise the response rate. But

forms were collected in sealed envelopes (provided with the survey form at the time of distribution) in order to avoid the provision of any well-intentioned 'assistance' in completing forms. A covering letter to the survey form (Appendix 2) informed potential respondents that the Lions Club would receive additional funding in return for fully completed surveys.

Three focus groups of about 20 participants each, and a subsequent pilot survey of 50 households were used to test the content of the questionnaire. Substantial changes were made to the questionnaire on the basis of comments received, particularly in shortening the form by reducing the number of available choices for emergency services. For example, focus group participants felt that the option of inoculation against water-borne diseases could be dispensed with because assistance would be provided free of charge by government agencies, if required.

The UBD (2008) Street Directory of Cairns and District was used to select street names for a sample of 100 streets Appendix 3 and Figure 1). The following UBD (2008) map numbers and suburbs were included: 22 (Holloways Beach, Machans Beach), 25 (Kamerunga, Caravonica), 26-27 (Aeroglen, Barron, Brinsmead, Stratford, Edge Hill, Freshwater, Manoora, Manunda, Redlynch, Whitfield), 36-37 (Brinsmead, Redlynch, Kanimbla, Mooroobool, Earlville, Manoora, Manunda, Woree, Bungalow, Westcourt, Parramatta Park, Portsmith), and 43 (Bayview Heights, Woree, Mount Sheridan, White Rock, Edmonton). The Central Business District was not included because of its relatively low residential component. The area covered was slightly larger than the Cairns 4870 postcode.

The expectation of a strong response rate due to the involvement of a respected community group was justified, with 434 survey forms returned out of the 500 distributed. The map in Figure 1 shows the streets selected randomly from the Cairns Street Directory (UBD, 2008). Taking into account the 33 households that declined to participate when approached, and 14 questionnaires returned blank or incomplete, the overall response rate was 77 per cent. Of the 434 questionnaires returned, 407 provided information on personal particulars.

The survey was administered over about four weeks from mid-October 2011, on the cusp of the regular north Queensland cyclone season. Further, cyclone Yasi had caused significant damage to towns near Cairns some nine months earlier, in February 2011. Although Cairns escaped the full force of cyclone Yasi, most respondents would have been well aware of the likely damage that a severe cyclone could potentially cause in Cairns itself. Yasi was a marginal category 5 cyclone when crossing the coast at Mission Beach, south of Cairns. According to the Bureau of Meteorology (2011), 'Yasi is one of the most powerful cyclones to have affected Queensland since records commenced'.

2.2.2 *Survey design*

The questionnaire used in the main survey was structured as follows. The first part collected information on the characteristics of the respondents and their households including information about experience with and behaviour during and after a cyclone. The second part provided information about the past and future availability of after-cyclone emergency services under the do-nothing (status quo) scenario. The third part provided information of alternative scenarios and stated the choice questions. The fourth part included further questions about the characteristics of the respondents and

their households, their attitudes towards the questionnaire and their behaviour in terms of preparation for cyclones.

The main purpose of the survey was to estimate willingness to pay for post-cyclone emergency services. A list of services that might be provided included items such as early collection of debris by the Council or vaccination of residents against various water-borne diseases, a greater degree of preventative services prior to a cyclone, such as provision of sandbags and the collection of green waste to minimise property damage.

Table 1: Contents and design of choice sets

post-cyclone service	status quo	change options and levels	coding
accommodation of pets	pets stay at home with owner or friend	• pets housed in shelter for up to 5 days after a cyclone	• home or friends: 0 • shelter: 1
security patrols	minimal extra police	• patrols for 3 days after cyclone • patrols for 10 days after a cyclone	• 0 • 3 • 10
fresh food resupply	delivered to shops 5-8 days after cyclone	• delivered to shops 3-4 days after cyclone	• 5-8 days: 0 • 3-4 days : 1 •
reconnection of utilities	water, electricity, sewerage, gas, reconnected in 5-8 days	• reconnection within 3-5 days after a cyclone	• 5-8 days: 0 • 3-5 days: 1
cyclone levy	$0 per year	• $50 a year (about 15 cents a day) • $300 a year (about $1 a day) • $700 a year (about $2 a day) • $1,000 a year (about $3 a day) • $1,500 a year (about $4 a day)	• 50 • 300 • 700 • 1000 • 1500

Reservations by focus groups about the cognitive capacity of potential respondents resulted in the limitation of the choice sets in the survey questionnaire to the five characteristics of post-cyclone emergency services identified by focus groups and the pilot survey as being the most important to Cairns residents. These are set out in Table 1. Potential alternative services that were discarded in the interest of achieving a reasonable balance between coverage and a satisfactory response rate included ‘clean up and rubbish removal’ (focus groups felt that this would happen sooner or later anyway, and did not significantly affect normal activity), as well as inoculation against

mosquito and water-borne diseases (considered marginal because it would be carried out by government, irrespective of consumer preferences).

An experimental design was used to establish the mixture of attribute levels (shown in Table 1) that comprised the 30 choice sets used in the survey. Each choice set had three choice options: one zero cost choice option reflecting the 'do-nothing' option (status quo), and two non-zero cost choice options reflecting change options. The 30 choice sets were divided into 5 blocks and distributed at random to respondents. Each respondent was offered 6 choice sets. The choice set order of each block was randomised.

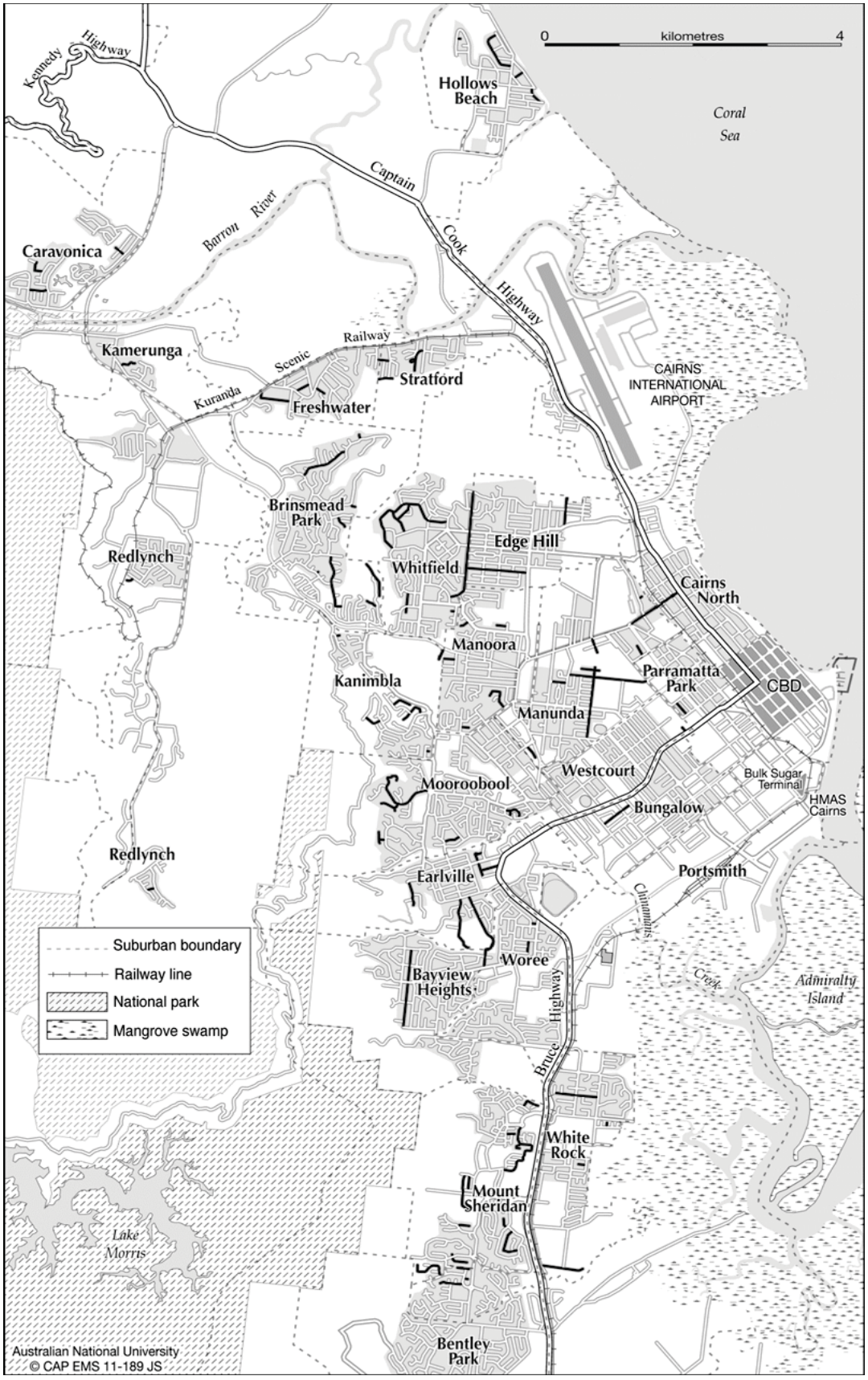
Choices were presented to respondents as three alternative 'bundles': the 'do nothing' option and two change options. The 'do nothing' option involved no new services, and no charge. Each respondent was given six sets of 'bundles' to consider. The attribute levels of the 'do-nothing' option were fixed across choice sets, whereas the attribute levels of the change options varied across choice sets. That is, the 'do-nothing' option was the same in all choice sets.

Selection of a realistic payments vehicle as part of the choice set was initially problematic, with consideration given to increased state government taxes, increased local council rates, a reduction in the then current $1,000 payment to eligible adults under the Australian Government Disaster Recovery Payment (AGDRP) scheme. It was not clear, however, that these possibilities would have strong incentive-compatible properties: local advice was that many Cairns residents had low incomes and some do not pay taxes, and not all residents would be eligible for AGDRP payments after a cyclone.

At the suggestion of a Cairns resident, the payment vehicle selected was an additional charge on all electricity bills, because occupants of dwellings would be charged as a household rather than individually. In addition, the Queensland Government had only recently discontinued its ambulance levy, which had been charged on electricity accounts until July 2011. As well as universality, the advantage of proposing a payment levied in this way was greater realism and incentive-compatibility. The realism of this approach was evident from the fact that several respondents to the survey reacted strongly in written comments; one even pointing out that they had almost left Queensland because of the previous ambulance levy.

The questionnaire also included questions about respondents' personal experience and economic circumstances. For example, ownership of pets was seen as a possible indicator of the strength of preference regarding provision of pet accommodation after a cyclone. Similarly, the presence of a respondent in Cairns during cyclone Yasi might be expected to influence preferences because of the expected potential for significant damage that the cyclone initially posed. Other information sought included items such as insurance held by the respondent household, whether the respondent considered that 'people should be responsible for looking after themselves', and whether the respondent's house or flat had 'ever been flooded, cut off by floodwaters, or lost gas, electricity, water or sewerage'. Variables such as household income were defined consistent with the 2006 Census: the results of the 2011 Census were not scheduled at the time of the survey to become available before mid-2012.

Figure 1: Cairns streets included in Discrete Choice Experiment survey



2.2.3 *Discrete Choice Experiment methodology*

Economists generally prefer to use observed data, so-called Revealed Preferences, when estimating economic benefits. Where there is no market for a good or service, however, Stated Preference methods can be used. For example, the benefits of environmental services, such as swimming in an unpolluted river, can be estimated by asking respondents how much they would be willing to forgo of other goods and services (represented by the numeraire of money) to obtain the benefit of the environmental service. Respondents effectively reveal what they would be willing to pay for the environmental service by making a trade-off in terms of alternative goods and services available to them.

The Stated Preference technique used for this project is a Discrete Choice Experiment (DCE). The DCE methodology is also known as 'Choice Modelling' and a 'Choice Experiment'. The word 'choice' reflects the concept of a person choosing between alternative goods and services.

Underlying the DCE methodology is the concept that a good or service is composed of a set of characteristics, each of which can be valued separately; a concept that also underlies the Revealed Preference technique of hedonic pricing. In the case of post-cyclone emergency services, the key characteristics or attributes (as identified by focus groups of Cairns residents) are those listed in Table 1.

Individual users of emergency services will have different preferences regarding the mix and amount of different attributes. Some may prefer the security of a longer police presence after a cyclone over faster resupply of fresh food, while others may prefer faster reconnection of utilities over both. Because payment of a cost, in the form of a levy on the household's electricity bill, is one of the attributes included, choosing a particular 'bundle' of attributes (see Appendix 4) other than the 'do nothing' bundle, will indicate that respondent's willingness to pay for a specific combination of attributes.

It is assumed that a respondent chooses the combination of attributes that provides the greatest utility to him or her relative to the other options made available. However, the choice may be influenced by subjective but unobservable factors that cannot be perceived by the analyst. The analyst cannot 'look inside the head' of the respondent (Hensher et al., 2005, p. 82). Because of the unobservable influences there is an 'error' component involved in estimation of utility levels so that any prediction of utilities must be carried out using probabilistic methods rather than deterministic calculations.

Following Bateman et al. (2002, pp. 278-281), an individual's preferences can be represented by a utility function U that involves 1 … m observable, marketed goods X as well as 1 … n non-marketed, unobservable goods Z.

$U = U(X_1 .. X_m ; Z_1 \dots Z_n)$

However, observation of marketed goods X will involve measurement and other error, and the elements of Z are unknown. This situation can be represented by a two-part utility function U(·) between the observable (deterministic) part of the utility function V(·) and its 'error' component e(·) . The utility function can thus be rewritten as follows:

$U = U(X_1 \dots X_m ; Z_1 \dots Z_n) = V(X) + \varepsilon(X,Z)$

where V(X) may include socio-demographic variables

Taking a probabilistic approach, the preference of an individual *i* for an option ('bundle') *g* in a choice set over an option *h*, can be represented as

$$\text{Prob}\,[\,(V_{ig} + \varepsilon_{ig}) > (V_{ih} + \varepsilon_{ih})\,] = \text{Prob}\,[\,(V_{ig} - V_{ih}) > (\varepsilon_{ih} - \varepsilon_{ig})\,]$$

Two assumptions can be made to make the solution tractable. The 'error' terms 'ε' are assumed to be independently and identically distributed (IID) in the form of an extreme-value Gumbel distribution. The behavioural outcome of the statistical IID assumption is that the relative probabilities of the two options are not affected by the introduction or removal of other alternatives (Independence of Irrelevant Alternatives, IIA). These assumptions lead to the Conditional Logit (CL) model[1]:

$$P\,(U_{ig} > U_{ih}) = \frac{\exp(\mu V_{ig})}{\sum_{j} \exp(\mu V_{ij})} = P_i(\text{choose g}) = \text{probability that individual i chooses g}$$

over all the other options j, and where μ represents a scaling factor (scale parameter) that is inversely proportional to the standard deviation of the error distribution.

The 'observable' part of utility (V) has been assumed here to be a linear function of the attributes X which can include socio-economic variables such as income, number of pets in the household, previous experience of cyclones, insurance cover, etc. Attributes can take different levels: in Table 1 above, for example, fresh food can be delivered within 5-8 days (the status quo level) or 3-4 days if new arrangements are instituted.

$$V_k = \alpha + \beta_{1k}X_{1k} + \beta_{2k}X_{2k} + \beta_{3k}X_{3k} + \ldots + \beta_{nk}X_{nk}$$

where one of the X_k is the 'cost' attribute with coefficient β_C, the household electricity bill levy in the current case.

The β_k coefficients show the effect on utility of a unit change in an attribute X_k, and their values for the (n+1) attributes were estimated from the CL model with NLOGIT 4.0 software using maximum likelihood procedures. The value of β_C (that is the coefficient of the cost attribute) is the effect of a positive or negative change in the cost of the option on the likelihood of choosing that option, and therefore represents the effect on utility of a change in cost. The constant α (called the Alternative Specific Constant) for each alternative V_k, represents the difference in utility relative to a base, when all attribute levels are equal. The value of α will differ for each V_k and can include status quo bias as well as unobserved effects. Results are presented in Table 2 below.

Implicit prices (willingness to pay) for each attribute (per household per annum) are estimated using the following formula:

[1] The CL model is used for explanatory variables that vary across choice options (for example, attributes), yet invariant variables can be included in this specification by interacting the invariant variables with the constant; in contrast, the multinomial logit (MNL) model is specified for explanatory variables that are invariant across choice options (for example, socio-demographics) (Cameron and Triverdi, 2005).

$$IP_k = -\frac{\beta_k}{\beta_C}$$

If the value of multiple changes in attributes is required, Compensating Surplus (CS) can be estimated as

$$CS = -\frac{1}{\beta_C}(V_1 - V_0)$$

where V_0 is the utility 'before' new arrangements are instituted (i.e. the 'do nothing' option) and V_1 is the utility 'after' the change (with the change being specified by levels of the attributes that are different to the 'do nothing' option levels), and:

$V_0 = \beta_1 X_{01} + \beta_2 X_{02} + \beta_3 X_{03} + \ldots + \beta n X_{0n}$
$V_1 = \alpha + \beta_1 X_{11} + \beta_2 X_{12} + \beta_3 X_{13} + \ldots + \beta n X_1 n$

However, estimates in section 3 below of potential benefits to Cairns residents have been made for changes in the key attributes only, using the implicit prices shown in Table 4.

2.3 *Estimating Costs*

It was not clear at the outset of the project what information might be available regarding the costs of providing emergency services. Further, it was not clear precisely which services were to be costed until focus groups had helped us determine the key services that should be included in the survey questionnaire in order to estimate the benefits that would accrue to Cairns residents.

Because cost information had to be gleaned from a wide range of diverse sources, semi-structured interviews were used to elicit the potential economic costs. As might be expected, those interviewed were invariably unable to give precise figures because commercial enterprises and government agencies would not normally keep data in the form requested.

It was envisaged that semi-structured interviews with commercial companies and government agencies would provide the best sources of information about the costs of alternative methods of supplying a town like Cairns with fresh food after cyclone-induced flooding had disrupted normal logistic chains. Care was taken when approaching potential interlocutors to emphasise that commercial information was not being sought.

Nevertheless, we encountered a most surprising level of difficulty in identifying commercial organisations willing to discuss issues. In some cases, we were helpfully referred on to another company, only to be referred back to the original contact after navigating a circuitous chain of referrals. While all contacts were friendly, a common claim was that their company lacked sufficient expertise to comment on the project. In other cases, we were unable to obtain any response at all to multiple email and telephone calls.

Although the focus in this study was the provision of post-cyclone emergency services, it is clear that there are trade-offs between pre- and post-cyclone activities. One example is the clearance of green waste and other loose items from properties to reduce damage caused by flying objects during the cyclone. This issue was raised

informally with officials in Cairns at an early stage of the study but we were informed that Cairns Regional Council can only claim National Disaster Relief and Recovery Arrangements payments for post-cyclone clean-ups, including rubbish removal. This perverse payment incentive was apparently under review by the Attorney-General's Department in Canberra in 2011. The issue may well be rather more important than localised house damage, because a post-Yasi study in Townsville found that, out of 26 locations of reported power outage, 22 were due to trees coming into contact with power lines (Calvert 2011, p. 61).

2.3.1 *Re-supply of food*

Alternative re-supply options considered as part of the project included the following:

- Supply by sea using chartered Australian coastal vessels or through the issue of Single Voyage Permits to foreign tramp or liner shipping;
- Chartered air transport
- Further increasing the height of the Bruce Highway to make it 'flood-proof'
- Greater use of rail in the event that lines can be operated safely after flooding

The information below was compiled from a number of sources which are not identified here in order to preserve commercial-in-confidence anonymity. Reference to 'ambient' goods is to dry goods that can be stored in ambient temperature conditions in warehouses although they tend to deteriorate faster in the northern Queensland climate. Refrigerated transport is used for fresh food.

Sea transport

Chartering ships to deliver fresh food to Cairns currently appears to represent the least practical option available.

The only regular domestic shipping service from Brisbane goes only as far north as Townsville. On-delivery to Cairns would mean interrupting regular schedules, which might take time to negotiate unless prior arrangements were in place. Ships would also need to be willing to travel inside the reef during rough cyclone or post-cyclone weather conditions. Further, the port of Cairns is likely to silt up during a storm so that prior dredging would be required, or barges would have to be used to offload containers. Equally important, refrigerated containers require three-phase power sources, but most domestic shipping does not possess this facility.

Chartering international shipping is probably even more difficult than acquiring services from domestic companies. Tight schedules, pre-planned container loads and a focus on the export trade is unlikely to entice international shipping to divert to Cairns even if the harbour could accommodate large ships. Even if a Single Voyage Permit were obtained for the journey, any food loaded onto an international ship immediately becomes subject to Customs and Quarantine control, 'and the paperwork is just not worth it' (anonymous personal communication).

The cost of chartering a ship of about 3200 twenty foot equivalent unit (a standard container size) capacity is about $24,000 an hour, but this cost would be dwarfed by stevedoring costs and port charges.

Rail

Rail was considered to be the commercially ideal option for freight transport to Cairns, but current conditions make it highly impractical during a cyclone season. The 1680 km line from Brisbane can be cut in multiple locations during the cyclone season, so it would need to be 'flood-proofed' along its entire length. A further problem is that passenger trains are given priority over freight trains and the line is mainly single track. Population and housing between Brisbane and the Sunshine Coast is a key issue because the track cannot be easily expanded because of housing density, and flooding in the Sunshine Coast area can cut the line.

Road

Major food retailers in Cairns are supplied from warehouses in Brisbane and Townsville. Some fresh food is supplied from Townsville, particularly local fruit and vegetables. Faster, reliable re-supply by road would require 'flood-proofing' the Brisbane to Cairns highway over its whole length. One claim was that this would require raising the road by 3 metres virtually along its whole length; clearly an inordinately expensive proposition that was not pursued further.

Use of alternative routes to the west of the Dividing Range was considered to be impractical. Most are simply 'developmental' roads that become unsafe as soon as they have been churned up by a few trucks. Since inland roads become wet during the cyclone season, they cannot be relied on.

Pre-positioning and storage of fresh food and groceries

One estimate of the quantity of fresh food delivered to Cairns on an industry basis (all three major wholesalers) is about 90 to 100 pallets per day, six days a week (one refrigerated container contains 22 pallets). However, some fresh food is sourced locally: milk, for example, is mainly obtained from the Atherton tablelands.

It would be possible to pre-position ambient goods in distribution centres such as Townsville. Provided that road, sea or rail links were usable, re-supply to Cairns could be effected relatively quickly when required. However, even ambient goods tend to deteriorate faster in the north Queensland climate so that they would need to be stored for short periods and used quickly at end destinations.

The option of developing a dedicated container park for positioning refrigerated containers before or during the cyclone season was not considered to be feasible. Motors required to maintain refrigeration tend to burn out in the north Queensland heat, and even functioning motors are often inadequate to maintain temperatures at requisite low levels. And storage of fresh food in containers would require rapid turnover of the contents to ensure that use-by dates were not passed.

Construction of a dedicated cold storage facility in Cairns for the high risk period of mid-February to mid-March is a possibility. The likely cost would be 'hundreds of millions' because of the need to place it underground with sufficient cyclone-proof generating capability. However, it would need to be operated by government because competing wholesalers would not be willing to collaborate in its management. Further, any wholesaler using the facility would need to be assured of retail offtake on a steady basis to maintain the quality of fresh food.

Air transport

Air transport appears to offer the most practicable, and possibly cost-effective means of faster re-supply in the case of Cairns. Fresh food could be packed into 'cool bags' during the flight, and repacked immediately on arrival into refrigerated containers for local distribution in Cairns. This has been done in the past but experience has shown that using military transport (Hercules C130) can be problematic because of differing operational procedures used by the military. Commercial pallets, for example, can be incompatible with military equipment.

At least two of the major wholesalers have focused on maintaining market share in Cairns by ensuring rapid re-supply. It was claimed that they had gone to considerable expense to hire both ships and aircraft ("even helicopters") to ensure that their retail outlets were supplied as quickly as possible.

Most Australian air freight is transported at night, so it would be relatively easy to hire aircraft during the day. The AERgo company based in Brisbane considers that freight versions of the Boeing 737 and Hercules C130 can be obtained at relatively short notice. Larger planes, such as the Ilyushin 76 can also be obtained from Europe within 2 to 3 days. The payloads of suitable planes are approximately as follows:

- Boeing 737 (freight version): 22 tonnes (10 to 11 pallets)
- Boeing 747 (freight version): 40-50 tonnes
- C130: 20 tonnes and only 5 pallet spaces, but about 120 cubic metres of space (i.e. plenty of room above)
- Ilyushin 76: more than 80 tonnes
- Antonov 124: more than 80 tonnes (can accommodate a semi-trailer)

Cairns airport is usually in good condition after a cyclone. Provided that ground handling support is available, offloading can be carried out quickly. The cost of chartering aircraft for the Brisbane-Cairns return flight is about $50,000 to $60,000 plus GST, with ground handling in Cairns costing about $2,000 more.

2.3.2 *Utilities*

Power

Because electricity is supplied through overhead wires, considerable labour-intensive checking is required of lines and household circuits before re-connection is possible. Increasing the number of trained personnel may not always be effective, because long distance transmission lines may also fail, so that no electricity is delivered to Cairns for local distribution. One problem encountered by repair crews is the abuse from residents for perceived slow connection, underlining the high willingness to pay noted above for faster re-supply of utilities.

In areas where power cannot be restored quickly, large generators can be brought in to supply local areas. After cyclone Yasi, Ergon Energy flew in 200 large generators leased from mining companies. On the other hand, repair crews have been abused in the past for connecting electricity too quickly after an initial delay, thus denying

residents the $1,000 government grant. Police protection for crews is therefore sometimes required.

An increasing number of residents is purchasing small petrol generators to maintain refrigeration of food in their homes, although these can be noisy. Gas generators are also coming into use. This could offer a better solution in terms of self-sufficiency, especially if the $1,000 government grant were used to supply small generators.

One option for faster resupply of electricity would be to maintain a cadre of trained personnel to repair lines. It is estimated by Ergon Energy that it would cost about $100,000 per annum to maintain a trained person, and that 200 people would be required after a severe cyclone to repair lines within about 4 days; an annual cost of $20 million. Electricity restoration after cyclone Yasi cost about $80 million, about 25 per cent of which was for materials. The cost after cyclone Larry was $40 million. Given that cyclone frequency is about 4 or 5 years, maintenance of a trained cadre of repair personnel would not seem to be economic.

Rather than maintaining a cadre of trained personnel in Cairns, an option is to fly in personnel from other locations. This was done after cyclone Yasi when Victorian and New South Wales personnel were flown in. However, there are considerable problems with doing so. Personnel new to the area need to be directed and supervised by local staff, thus using up scarce local resources. Equipment also needs to be brought in by road, rail or barge to equip the personnel who are flown in: a problem that delayed reconnection in Townsville after the March 2012 'tornado' event because the roads were cut. A problem shared with local police forces, and in competition with them, is the difficulty of securing accommodation and meals for 'imported' personnel who are usually not accustomed to post-cyclone conditions. Finally, out-of-state personnel may not have the requisite Queensland electricity certificates: there is a case here for considering harmonisation or at least mutual recognition by the states of certification.

Distribution of gas in Cairns is mainly through refilling of gas bottles. Households that use gas for fuel are generally self-sufficient after a cyclone, provided that they have stored enough. Survey responses indicated that about half the Cairns population had three to seven days of fuel in reserve before a cyclone.

Water and sewerage

Water supply appears to be a relatively minor concern in Cairns. According to Cairns Regional Council personnel, most assets are below ground and the extensive network of reservoirs is structurally sound. The highest risk factor is generally small suburban lift stations which have been built by developers to service small residential pockets on hill slopes above Council design limits. These lift stations generally have a small switchboard which can be damaged by falling trees or debris but this is a rare occurrence.

The Cairns community is supplied with water from Copperlode Falls Dam and Behana Creek. Cairns water storage facilities are sufficient for 3 days of normal supply and 7 days with restrictions. Power loss during cyclone Yasi meant that water could not be pumped to three reservoirs for less than 24 hours. However, if the main water treatment plant were damaged and direct access to the secondary source, river water, were blocked, supply problems could be far more serious. No specific cost estimates are available for reconnection of water supplies because it is not clear whether reservoirs, pipelines or the water treatment plant would or could be affected by a

cyclone. In any case, Cairns Regional Council would be able to arrange emergency supplies using polypipe.

Loss of mains electricity power supply is the primary reason for sewage overflow during a cyclone. Cairns has over 230 pump stations that require mains power for operation. However, major stations or critical stations with low retention times have emergency generators or diesel pump sets as backup. Mobile power equipment is also available for use where required.

However, most of the sewer network relies on gravity flow. Even with power failure, flow continues to pump stations where overflow is diverted to drains. According to Cairns Regional Council personnel, less than 1 per cent of residents would lose sewerage services in a category 4/5 cyclone, with most services at property level continuing to operate.

Cairns Water (which is responsible for waste water services as well as the supply of potable water) has installed 13 standby pumps at critical pump stations at a cost of $65,000 per site. In a scenario of power being unavailable for a period of three days, for example, it is estimated by Cairns Regional Council personnel that 20 employees working for 30 hours would be required at a cost of $26,500 including on-costs. Plant costs would be in the order of $9,500 and diesel fuel for generators $28,125 (based on 25 generators using 250 litres of fuel per day. Diesel fuel for the 13 standby pumps would require approximately 100 litres of fuel each, adding a further $6,000. Operating costs would therefore be just over $70,000 for the three days, an average of about $23,400 per day.

2.3.3 *Security and police patrols*

Media reports of looting in Cairns after a cyclone do not appear to be supported by the evidence. Such reports are apparently partly due to lack of other worthwhile news at the time, and partly due to misunderstandings. Police work after a cyclone is primarily directed to traffic control and assisting electricity restoration crews. Evacuation centres may also require attention because they often attract people who may prey on young children accommodated there.

Information was sought on the number of additional police personnel who would be required to maintain a longer presence in Cairns after a cyclone. Unfortunately, approaches to Cairns Police for information on the number of police brought into Cairns before and after cyclone Yasi were unsuccessful despite an earlier commitment to provide information.

2.3.4 *Accommodation of pets after a cyclone*

According to Cairns Regional Council personnel, there are about 22,000 registered dogs, and it is estimated that there are a further 10,000 unregistered dogs.

The results in Table 2 below indicate that Cairns residents are, on average, willing to pay a negative amount for the care of pets after a cyclone. This finding does not appear to differ between those residents who own pets, and those who do not. Although we were not able to obtain a copy, personnel from Cairns Regional Council informed us that a survey carried out four or five years ago was inconclusive about

post-cyclone demand for pet accommodation. It has been the practice in Cairns to leave animals at home during a cyclone, whether the owner has stayed home or not.

The RSPCA was not able to provide accurate figures, but considered that provision by other organisations of basic needs for a dog would cost on average $20 per day, and $15 for a cat. However, vaccination and worming requirements would add a further cost of $25 and $10 respectively. Construction costs would also be incurred should a facility be built in the region.

3. RESULTS AND OUTPUTS

3.1 *Benefits*

3.1.1 Modelling

The choice experiment was carried out using a conditional logit (CL) model (McFadden, 1974) and a panel Error Component (pECM) model (Hensher et al. 2007) using Nlogit 4.0. The panel specification accounts for the fact that respondents in a choice experiment make repeated choices and that these choices may be correlated. An error component specification introduces, additional to the generic error term, ε, a random error term, η (normally distributed random parameter with a zero mean and estimated variance), which is associated with options. Hence, the pECM relaxes the IID assumption underlying the CL model by decomposing the error term into IID and non-IID error terms.

The utility functions are specified as follows:

CL model: $$U_j = \sum_{k=1}^{K} \beta_k x_k + \varepsilon_j$$

pECM model: $$U_{qj} = \sum_{k=1}^{K} \beta_k x_k + \eta_{qj} + \varepsilon_j .$$

The results of the choice modelling are presented in Table 2. Numerous models were fitted to the data, but those shown produced the best results.

The model statistics (McFadden pseudo ρ^2, log-likelihood ratio test, AIC, BIC, HQIC) suggest that the pECM is superior to the CL model. The error component in this model relaxes the IID assumption underlying the CL model. The respective sigma coefficient is significantly different from zero at the 1 per cent confidence level suggesting that the error variances are not IID across the 'do nothing option' and the two change options as assumed in the CL model.

In both models, the estimated coefficients for the attributes 'pets', 'food', 'utilities', and 'levy' are statistically significantly different from zero at the 5 and 1 per cent confidence levels. With the exception of the 'pet' coefficient, they also have the expected sign. The estimated coefficient for 'security' (lengthier police patrols) was statistically different from zero only at the 10 per cent level (p = 0.06) as highly significant, statistically in the pECM model, but not statistically significantly different from zero in the Conditional Logit model.

The results suggest that respondent households have positive preferences towards the faster restocking of fresh food and the faster reconnection of water, electricity, gas, and sewage utilities. The negative sign of the levy coefficient indicates that respondents, as expected, have negative preferences towards paying an annual levy. The negative sign of the 'pets' coefficient' shows that households have negative preferences towards pets being housed in a shelter for up to 5 days after a cyclone. The positive sign of the 'security' coefficient suggests that they have positive preferences for longer police security patrols.

Table 2: Results of the CL and the pECM models

	CL		*pECM*	
Variable	Coefficient[a]	Standard error	Coefficient[a]	Standard error
Pets	-0.14976** (0.0297)	0.06887	-0.13851** (0.0228)	0.06083
Security	-0.00078 (0.9209)	0.00786	0.01580* (0.0632)	0.00850
Food	0.14729** (0.0365)	0.07043	0.17424** (0.0170)	0.07297
Utilities	0.44010*** (<0.0001)	0.07334	0.49846*** (<0.0001)	0.06293
Levy	-0.00096*** (<0.0001)	0.7634D-04	-0.00140*** (<0.0001)	0.6646D-04
Con[b]	-0.55784*** (<0.0001)	0.11331	-1.00674*** (0.0090)	0.38536
Responsibility	-0.20100*** (<0.0001)	0.04590	-0.59887** (0.0344)	0.28305
Damage	0.38667*** (<0.0001)	0.04574	1.05218*** (0.0002)	0.28497
Insurance	-0.30318*** (<0.0001)	0.05370	-0.87661** (0.0163)	0.36500
Sigma[c]			4.62980*** (<0.0001)	0.43721
Model statistics				
n (observations)	2460		2460	
$LL_{\beta(pECM)}$			-1478.82623	
$LL_{\beta(CL)}$	-2110.39894			
χ^2, 1 compared to $LL\beta(CL)$			p<0.0001	
McFadden pseudo ρ^2adj.	0.22		0.45	
AIC[d]	1.72309		1.21043	
AIC[d] finite sample	1.72312		1.21046	
BIC[d]	1.74434		1.23404	
HQIC[d]	1.73081		1.21901	

***=significant at 1% level, **=significant at 5% level, *=significant at 10% level;
[a] p-values in parentheses
[b] Generic constant term included in utility function of change options
[c] Error component included in utility function of 'do nothing' option
[d] Normalised by sample size

The coefficients of the variables 'responsibility', 'damage', and 'insurance', each interacted with the constant term, are all significantly different from zero at the 5 or 1 per cent confidence levels in both models. The negative 'responsibility' and 'insurance' coefficients suggest that respondents who believe that people should be responsible for looking after themselves, and those with house or content insurance tend to prefer the status quo over any change alternative. In contrast, the positive 'damage' coefficient indicates that people who considered their house or flat would be likely to

sustain damage during a Category 5 cyclone preferred change alternatives such as faster resupply of food and reconnection of utilities.

3.1.2 Estimation of implicit prices for attributes

The results of the pECM model were used to calculate implicit prices (IP):

$$IP_k = -\frac{\beta_k}{\beta_C}$$

The confidence intervals around the implicit price estimates were calculated using the Delta method. The mean values of the implicit prices and their associated 95% confidence intervals are presented in Table 3. The 95 per cent confidence intervals suggest that implicit prices are significantly different from zero for 'pets', 'food', and 'utilities'. It should be noted that the 95 per cent confidence interval for 'security' includes zero.

Table 3: Implicit prices based on the results of the pECM model

Attribute	Implicit price (mean) per household per annum	p-value	Confidence interval (95%)
Pets	-99.29	0.0242	-185.65; -13.01
Security	11.32	0.0723	-1.02; 23.67
Food	124.90	0.0189	20.71; 229.08
Utilities	357.30	<0.0001	260.79; 453.82

The implicit prices can be interpreted as follows:

- The sample of Cairns households was found to be willing to pay an average amount of about $125 per annum for a faster (3-4 days instead of 5-8 days) resupply of fresh food to shops after a cyclone.

- Surveyed Cairns households were willing to pay an average of about $357 per annum to have utilities (water, sewage, electricity, gas) reconnected in 3-4 days rather than the current 5-8 days. This was almost three times more than they were willing to pay for faster food re-supply.

- The sample of Cairns resident households that participated in the survey expressed an aversion to paying for the accommodation of pets in a shelter rather than keeping them at home or with friends after a cyclone, reflected in a negative implicit price of an average of about -$99 per annum. This sentiment was also reflected in occasional written comments in the questionnaires, with respondents stating that humans should have priority over animals in access to emergency services. This is a surprising because anecdotal input from emergency services workers is that disaster victims are generally reluctant to be evacuated without their pets. One explanation may be that about 80 per cent of survey respondents stated that they would normally stay at home during a cyclone: it is possible that there is an expectation of remaining there after the event with pets as well. An element of optimism may also have influenced

responses if Cairns residents believe that their dwelling will not be significantly affected by future cyclones.

- The implicit price for 'security' of about $11 for each additional day of police patrols was only statistically significant at the 10 per cent level. This suggests that the surveyed Cairns households are willing to pay for a longer police presence after a cyclone, but the amount is relatively low compared to other services such as faster resupply of food. Recent disasters in Queensland have seen some media reports about looting, but there has been little evidence of a widespread problem, if any. Since about 80 per cent of those surveyed stated that they would normally stay at home during a cyclone, there may also be an expectation of remaining in the house after the cyclone has passed.

3.1.3 Estimation of benefits for Cairns as a whole

Based on Australian Bureau of Statistics data, the estimated resident population of Cairns on 30 June 2011 was 162,740 (Cairns Regional Council, 2012). The average number of people per household for greater Cairns (Statistical Area Level 4) in 2011 was 2.5 (Australian Bureau of Statistics 2011), giving approximately 65,000 households.

However, the overall response rate to the choice experiment survey was only 77 per cent, taking into account both incomplete and blank forms as well as households that declined to complete the survey or were not available when approached. Because there is no independent information on non-respondents' preferences, they have been treated in this report as preferring the status quo. Adjusting the estimated benefits downwards to take account of non-response results in a more conservative estimate of overall benefits, but produces a more defensible figure. The results are shown in the final column in Table 4.

Table 4 Estimated benefits for Cairns residents based on the pECM model

Service	Annual per household benefit	Number of households in Cairns	Survey response rate	Annual aggregate benefit $
Pets: housed in shelter 5 days after cyclone	- 99.29	65,000	0.77	- 4,969,465
Security: police patrols for three extra days after cyclone	33.96	65,000	0.77	1,699,698
Security: police patrols for ten extra days after cyclone	113.20	65,000	0.77	5,665,660
Food: resupply within 3 to 4 days	124.43	65,000	0.77	6,227,722
Utilities: reconnection within 3 to 5 days	357.30	65,000	0.77	17,882,865

source: Table 3 and text.
note: 'Annual aggregate benefits' are based on implicit prices determined on the basis of the choice experiment survey. They are gross amounts because they do not include the costs of provision of the services. Net benefits are shown in Table 5.

3.2 Costs

Determination of cost for the emergency services analysed in this report proved to be more difficult than expected, partly because of the disparate nature of the services themselves. More important, nominated 'services' such as post-cyclone pet care are currently not provided at all. Potential provision of faster fresh food re-supply involves complex logistical arrangements and commercially sensitive information. The estimates provided here are therefore necessarily approximate.

3.2.1. Pet care and accommodation

The following assumptions have been made:

- No estimate is available of the cost of a suitable pet shelter that could be used to accommodate animals after a cyclone. Construction costs would also need to be attributed to more than one cyclone, preferably in terms of economic depreciation (physical wear and tear on the building). It has been assumed that a suitable, non-luxurious shelter could be constructed for $5m and an admittedly arbitrary assumption is that physical depreciation would be 10 per cent for each cyclone; that is, $0.5m.
- Only 6 requests for pet accommodation were made to the RSPCA after cyclone Yasi. It has been assumed that a 'worst case' scenario would be that 1 per cent of dog-owning households in Cairns seek pet shelter for dogs after a cyclone: that is, 320 dogs. An arbitrary assumption of 1 per cent has been made because only those families with totally uninhabitable houses and no family or friends willing to take a dog would apply. The figure of 320 is based on 22,000 registered, and an estimated 10,000 additional unregistered dogs (section 2.3.4 above).
- It is assumed that cat owners are better able to find temporary shelter, so that shelter for dogs would constitute the major portion of demand for shelter.
- The estimated daily operational cost of looking after a dog is $20 and it has been assumed that vaccination ($25) and worming ($10) would also be required as a precaution.

On this basis, it is estimated that the cost of housing pets for 5 days after a cyclone would be in the order of $43,200, rounded up to $0.5m.

3.2.2 Security arrangements: longer police presence

Despite initial agreement by Cairns Police to provide us with the number of additional police brought into Cairns after cyclone Yasi and some associated indicative costs, we were unable to obtain this data.

It was reported by ABC News (4 February 2011) that an additional 30 police officers from central region and Brisbane had been brought into Townsville to help patrol the city after cyclone Yasi. It has therefore been assumed that a similar number might be brought into Cairns after a strong cyclone.

The following assumptions have been made in deriving estimates of costs:

- Each of the 30 officers has been brought in from Brisbane, at the cost of a scheduled commercial economy return airfare of about $500.
- Commercial accommodation is used, and each officer receives an allowance of $264.80 per day (rounded up to $265) to cover accommodation, meals and incidental expenses (based on Australian Taxation Office 2011-2012 rates for annual salaries of between $100,841-$179,350 (this may be an overestimate of actual salary levels paid, but the difference would not affect allowance rates significantly): viewed 22 September 2012 http://atotaxrates.info/PDFS/td2011-017.pdf) Equipment such as radios, cars, etc. is available from local stocks. Use of petrol has not been included because it is likely that patrols would continue to be made by locally-based police who are familiar with hot spots and 'the usual suspects'. Non-local police are more likely to be used for traffic duty (traffic lights are often out of commission due to disrupted power supplies), coordination, administrative duties, etc.
- Additional officers fly in to Cairns the day before a cyclone. It is unlikely that deployment would occur much beforehand because of the expense, and may even occur after the cyclone.
- No additional salary costs are incurred, because active officers would have been paid had they remained in Brisbane. It is possible that other officers who remain in Brisbane need to be paid overtime to cover any manpower shortfall, but we do not have sufficient information to form an estimate of the cost.

On this basis, the estimated cost of an additional police presence in Cairns after a cyclone would be approximately as follows. It should be noted that an additional day has been added to the costs to allow for time spent in transit to and from Cairns, as well as any time spent 'settling in'.

For three (actually four) days: $46,800
For ten (actually eleven) days: $102,450

3.2.3 Faster provision of fresh food

As discussed in section 2.3.1 above, delivery of fresh food to Cairns by sea appears to represent the least practical option available because of the difficulty of chartering ships, silting up of the harbour after a cyclone and possible residual rough weather inside the reef. Road and rail transport both suffer from the risk of disruption due to flooding anywhere between Brisbane and Cairns, with alternative routes west of the Dividing Range being impractical. Prepositioning and storage of food inside Cairns would require construction of a very expensive facility and its operation might not be practical in the face of competition between rival suppliers.

Air transport appears to offer the most feasible option in terms of reducing the current 5-8 days for re-supply. The following assumptions have been made, based on the discussion and information presented in section 2.3.1:

- Cairns airport can be re-opened for freight operations within 24 hours after a cyclone.
- Re-supply can start within a day or so because freight aircraft can be hired relatively easily, especially for daytime operation within Australia. Disaster situations usually get priority from aircraft owners.
- Resupply would continue for a period of 4 days

- The normal pattern of consumption in Cairns of about 90 to 100 pallets per day would continue. A conservative figure of 100 pallets has been used.
- Aircraft leased are predominantly Boeing 737 that can carry about 10 pallets at a cost of $60,000 per return trip Brisbane-Cairns, including ground handling in Cairns. Ten trips per day would be required.
- No sum has been included for loading in Brisbane because the cost of trucks that would normally have been loaded in Brisbane, as well as the fuel used to transport goods to Cairns, would be saved and would therefore offset the cost of loading in Brisbane and any additional transport in Cairns.
- Cool packs are used to keep food cool on the flight to Cairns, with transhipment to local refrigerated trucks on arrival.

On this basis, it is estimated that re-supply of fresh food to Cairns by air would cost in the order of $2,400,000 for the 4 days of re-supply. This figure has been rounded up to $2.5m in Table 5 below to allow for other likely costs.

3.2.4. Faster reconnection to utilities

Maintaining a trained local cadre of trained personnel to speed up reconnection of mains electricity would cost about $20million per annum, and would therefore be uneconomic for a cyclone return period of 4 to 5 years.

A cheaper alternative would be to use emergency generators powered by petrol or gas for both households and for pumping requirements for water and sewerage.

The following assumptions have been made in estimating the cost of using generator equipment by households:

- Long distance electricity transmission via Townsville is not affected by a cyclone. While eternal disruption has been a problem in the past, the Cyclone Area Reliability Enhancement program has since 2001-02 been strengthening infrastructure assets between Townsville and Cooktown.
- Households in Cairns would be issued with a free LPG generator every 5 years for use during power outages. Ergon Energy estimates that some 10 per cent of Cairns households already own generators capable of running key appliances such as refrigerators: the number of households without generators is therefore estimated to be about 59,000.
- The cost of an LPG generator is assumed to be $1,000, although commercial models are available for about $700 to $800 (http://www.elgas.com.au/appliances/lpg-clothes-dryers-lpg-refrigerators-a-lpg-generators/lpg-generators <viewed 22 September 2012>). The advertised run time for a basic LPG generator is 28 hours on 9 kg of fuel.
- A 20 cu. ft. refrigerator with a frostless freezer typically consumes 800W per hour. Smaller refrigerators or those with non-frostless freezers consume between about 400W and 450W per hour. An 800W generator would therefore be adequate for purpose because refrigerators could be switched off for short periods while other appliances were used.
- Many Cairns households use gas cylinders, both for domestic use and barbecues, so fuel is widely distributed (and typically replenished before imminent cyclones). LPG fuel cost has not been included because it is substituted for the mains electricity that would otherwise have been used.

- Additional equipment would need to be installed to enable switching of mains electricity supply to a generator, including an inverter. It has been assumed that conversion would cost a maximum of $1,000.

It is estimated that a conservative estimate of the cost of supplying generators to 59,000 households in Cairns and installing conversion equipment for emergency use at $2,000 each is $118 million. This is clearly excessive.

Although unable to provide any precise estimates, Ergon Energy, the key mains electricity supplier in Cairns has suggested that its experience with cyclones Larry and Yasi indicates that reconnection of electricity services could be brought forward at a cost of between $2m and $3m per day. However, the estimate appears to be based on average costs. Additional (marginal) costs of faster resupply are likely to be higher, especially if there are limited input factors such as supervisory or equipment resources. Admittedly somewhat arbitrarily, it has been assumed that marginal costs would rise from $3m to $3.5m to $4m for successively faster reconnection from an average of 6.5 (5 to 8) days to 4 (3 to 5) days specified in Table 1 above. Although at clear risk of overestimation, it has been assumed that reconnection at an average of 2.5 days faster than is currently the case would cost an additional $10m. Unfortunately, there appears to be no better means of estimation.

Taking into account the following, it is considered that faster reconnection of water and sewerage would take approximately the same time (3 to 5 days) as accelerated reconnection of mains electricity.

- Faster reconnection of mains electricity is the key factor in ensuring pumping capacity for both continued potable water supply and transmission of sewerage. To the extent that mains electricity is reconnected within about 4 days at a roughly estimated additional cost of $10m, faster reconnection of water and sewerage facilities would be achieved without significant further cost.
- Cairns Regional Council has installed an additional 13 diesel operated stand-by pumps at critical sewerage pump stations since cyclone Yasi. The additional cost of engaging these pumps after a cyclone is estimated by Council as about $93,000 for four days. In a worst case scenario, this cost would be incurred in the period before mains electricity came on stream.
- No specific cost estimates are available for faster reconnection of any potable water infrastructure damaged in a cyclone, but past experience suggests that disruption due to cyclones has been minimal. It has been assumed that no significant additional cost would be incurred for reconnecting water supplies.

With the qualification of considerable uncertainty attached to the estimate, it is estimated that the cost of reconnecting utilities within 3.5 to 4 days, rather than 5 to 8 days, would be in the order of $10.1m.

3.3 Costs and benefits compared

In the absence of better information, it has been assumed that Cairns will experience a serious (category 4 or 5) cyclone once every 5 years. The period of analysis has been arbitrarily taken as 15 years. The investment diagram below therefore shows costs of emergency services being incurred in years 5, 10, 15. No cost is shown for year 0 (2011) because the survey was conducted some nine months after cyclone Yasi, which occurred in January of that year. Implicit prices estimated on the basis of the survey

are therefore considered to be prospective, referring only to future cyclones. To match this approach, costs of providing emergency services have also been considered only for the future years (5, 10, 15).

The representation of costs every 5 years in the investment diagram below implies certainty of occurrence of cyclones precisely every 5 years. Given the assumption that the return period of cyclones is 5 years only an average, it is conceptually preferable to spread the cost of emergency services provision across the 5 years in equal amounts, indicating an equal probability of a cyclone occurring in any one of the 5 years. This can be readily accomplished by using annuities. A discount rate of 4 per cent real over 5 years was used to calculate an annuity factor of 4.452.

A discount rate of 4 per cent per annum was used because post-cyclone services received by Cairns citizens cannot be reinvested, so they can be treated as consumption equivalents. Sensitivity tests at 2 per cent and 6 per cent revealed no surprises.

Survey questions were based on payment of an annual levy by households. Because benefits were estimated on an annual basis they are shown for each year (the arrows above the investment line in the diagram below).

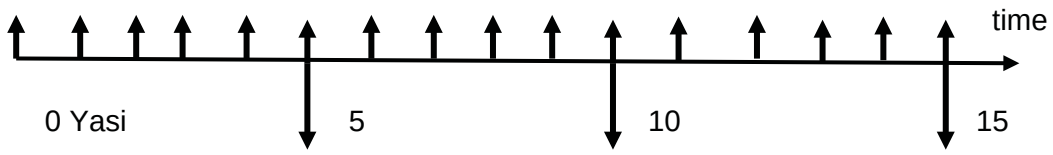


Table 5 Estimated benefits and costs of post-cyclone emergency services in Cairns

Service	Benefit ($m)	Cost ($m)	Net present value ($m 2011)
Pets sheltered 5 days	- 5.0	0.5	-59.6
Police patrols (3 days)	1.7	0.05	19.7
Police patrols (10 days)	5.7	0.1	66.2
Fresh food delivered within 3-4 days	6.2	2.5	65.7
Utilities reconnected within 3-5 days	17.8	10.1	181.0

Notes:

1 Amounts shown are approximate only, and are expressed in $2011.
2 Net Present Value of benefits minus costs over 15 years has been calculated using a discount rate of 4 per cent per annum.

The results in Table 5 confirm that there would be no benefit in providing post-cyclone shelter for pets in Cairns. However, residents are likely to benefit from longer police patrols, faster reprovision of fresh food, and faster reconnection of utilities, especially mains electricity. Each of these estimates is subject to the assumptions made in particular calculations.

It should also be noted that a positive net benefit does not necessarily indicate that the service should be provided or subsidised by government. If alternative projects such as road construction, provision of health or education services, etc., are available, it would be necessary to compare their estimated net present values with the net present value of benefits associated with the provision of higher quality post-cyclone emergency services.

3.4 Net benefits under future climate change

It is noted in section 4 (Discussion) below the most recent IPCC (2012, p. 160) assessment of climate change impacts concludes that:

> ' … it remains uncertain whether past changes in any tropical cyclone activity (frequency, intensity, rainfall) exceed the variability expected through natural causes, after accounting for changes over time in observing capabilities.'

Further, Crompton et al (2010) review cyclone activity and damage from tropical cyclones in the Northwest Pacific, North Atlantic, North Indian, South Pacific, and Southeast Indian basins. They find that damage costs have increased due to socioeconomic factors, including population movement to coasts and increasing values of structures there, but that '… no study has yet been able to detect an anthropogenic climate change influence'.

Because there is little or no solid factual basis on which to project any future increases in cyclone activity due to climate change or any other factor, no modelling of this aspect was undertaken in this study.

More importantly, the estimates of benefits used above have already factored in individuals' perceptions regarding future cyclone activity. The choice experiment survey that was conducted in Cairns was administered to a sample where over 90 per cent of respondents had experienced Cyclone Yasi. About two-thirds did not consider that future cyclones would cause more damage or return more frequently than at present. It would be conceptually erroneous to adjust their stated willingness to pay for emergency services on the basis of a separate estimate of changed cyclone frequency, even if that were feasible. It would be equally conceptually erroneous to increase the willingness to pay estimates for the third of respondents who thought that future cyclone activity would increase, because that would involve double-counting.

However, more frequent cyclones would involve greater cost in terms of the provision of post-cyclone emergency services. Although we do not know the frequency (the reciprocal of the 'return period') of cyclones in Cairns under different conditions of climate change, it is possible to consider the issue from the mirror perspective of net present values as the annual frequency of cyclones increases.

In Table 5, it was assumed that the return period of category 5 cyclones is 5 years. Table 6 shows costs and benefits for a return period of one year and a discount rate of 4 per cent per annum: except for the accommodation of pets, the present value of benefits exceeds costs for each of the emergency services. Net benefits remain

positive for an average return period of four months (a frequency of 1.5 cyclones per year over the six monthly official cyclone period from the beginning of November to the end of April). The net present value of faster reconnection of utilities turns negative once a frequency of two cyclones per year (a long-term average of one every 3 months during the official cyclone season) is experienced, and faster resupply of fresh food becomes more marginal.

Firm conclusions are not possible, because of lack of knowledge about the impacts of climate change in terms of cyclone frequency. But Table 6 indicates that even a fivefold increase in cyclone frequency to one each year would not change the findings of section 3.3 above. Unless there is scientific evidence to suggest that the frequency of severe cyclones in Cairns will exceed one per year, the results in Table 5 can be considered to be relatively robust.

Table 6 Estimated benefits and costs of post-cyclone emergency services in Cairns

Service	**Net present value ($m 2011)**		
Frequency of cyclone (per year)	1	1.5	2
Pets sheltered 5 days	-64.1	-67.0	-69.9
Police patrols (3 days)	19.2	18.9	18.6
Police patrols (10 days)	65.3	64.7	64.1
Fresh food delivered within 3-4 days	43.1	28.5	14.0
Utilities reconnected within 3-5 days	89.7	30.9	-28.0

Notes:

1 Amounts shown are approximate only, and are expressed in $2011.
2 Net Present Value of benefits minus costs over 15 years has been calculated using a discount rate of 4 per cent per annum.
3 Benefits for each cyclone frequency scenario are the same as in Table 5; only costs of emergency services have changed due to increased frequency of their provision.
4 The net present value for reconnection of utilities turns negative at a cyclone frequency of about 1.7 per annum (a long term average of about 3.5 months during the official cyclone season).

4. DISCUSSION

In broad terms, the results of the project suggest that the faster resupply of fresh food and the faster re-connection of utilities are two aspects of post-cyclone emergency services that are particularly valued by the residents of Cairns. Whether government assistance should be provided to facilitate faster provision of these two aspects will depend on a number of factors:

- The balance of benefits and costs over time, taking into account the likelihood of a cyclone striking Cairns on average once every five years (an assumption used in this analysis).

- Alternative budget priorities in terms of benefits and costs. It may be that other, socially more desirable projects (e.g. a life-saving machine for the Cairns hospital or other towns) would have a higher net present value and would therefore be socially more beneficial.

- Given that a large proportion of resident households that completed the questionnaire considered that people should be responsible for their own welfare in a cyclone situation, more detailed research would be required before coming to a firm conclusion.

- The provision of services such as faster re-connection of utilities and faster re-supply of fresh food to shops has some of the characteristics of a collective good because of their 'network' nature. Re-connection of electricity to a particular area means that all local residents will enjoy the benefit. It would be difficult to devise a means of ensuring that only those willing to pay the levy for faster reconnection were able to benefit. Others would inevitably free-ride.

- The resupply of fresh food is currently driven by competition between the three major wholesalers, who seem intent on maintaining market share by ensuring fast re-supply, even at considerable expense in arranging supplementary transport. Unless government assistance could speed up re-supply even more in the face of existing logistical limits, there would be little point in further subsidisation.

No account was taken of potential increases in the frequency or intensity of cyclones that may affect the Cairns area in future due to climate change. The most recent report commissioned by the Intergovernmental Panel on Climate Change (IPCC 2012, p. 160) concluded that:

> 'The AR4 [the Fourth Assessment Report in 2007] Summary for Policymakers concluded that it is *likely* that an increase had occurred in intense tropical cyclone activity since 1970 in some regions … Based on research subsequent to the AR4 … the most recent assessment by the World Meteorological Organization (WMO) Expert Team on Climate Change Impacts on Tropical Cyclones … concluded that it remains uncertain whether past changes in any tropical cyclone activity (frequency, intensity, rainfall) exceed the variability expected through natural causes, after accounting for changes over time in observing capabilities. The present assessment regarding observed trends in

> tropical cyclone activity is essentially identical to the WMO assessment … there is *low confidence* that any observed long-term (i.e., 40 years or more) increases in tropical cyclone activity are robust, after accounting for past changes in observing capabilities.'

On this basis, it would be contrived, if not misleading, to incorporate expansion factors into the benefits or costs for the provision of emergency services.

5. GAPS AND FUTURE RESEARCH DIRECTIONS

Apart from the perennial issue of the availability of more accurate and specific cost data, there are several areas that would warrant further investigation if furhter research were considered to be a priority:

- More comprehensive investigation of costs and benefits over the whole range of emergency services, including, for example, information dissemination and warnings before a cyclone, as well as post-cyclone services. Comparisons between pre and post-cyclone alternatives would assist State Emergency Services in setting priorities and in allocating scarce resources to activities.

- Several Cairns residents pointed out to the project team that there would be considerable merit in a collection of green waste by Cairns City Council before a cyclone because less loose debris and trimmed vegetation would reduce wind-borne missiles and hence property damage. The Council reportedly only collects green waste and debris after a cyclone because NDRC funds are only made available for post-cyclone assistance to prevent local governments from misusing funds for their ordinary activities of waste collection. Further research into a possible solution to this problem and any other regulatory barriers would be useful.

- An influx of specialists and volunteers into towns like Cairns can cause additional problems to those engaged in providing emergency services. For example, the Cairns police were stymied by a lack of suitable accommodation for extra personnel brought in from south-eastern Queensland after cyclone Yasi because it had been booked out by the local electricity supplier who also required accommodation for emergency personnel. In the light of our findings about the relative value that Cairns residents attach to different aspects of emergency services, there may be room for further research into coordinating the influx of outside assistance. In the case of re-connection of electricity, the issue is particularly complex because repair crews have in the past required police protection.

- An area not covered in this project that may warrant further investigation is the potential for negative externalities from the provision of emergency services. The issue of moral hazard is an obvious candidate in terms of possible reduced self-reliance and preparation for cyclones by some residents. However, there may also be less tangible effects such as a reduced communal esprit de corps if outside agencies control the provision of all services. One issue mentioned to the team was the inability of local residents to obtain tarpaulins to effect emergency repairs to roofs because only ‘roof and tarpaulin trained’ State Emergency Services personnel are permitted to make repairs due to legal liability.

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APPENDIX 1

SURVEY INTRODUCTION CARD

1. **Introduce yourself**

- First house or flat: pick one at random
- Normal introduction: hello, name, etc.

2. **Joint project:**

- Lions Club of Cairns and the Australian National University are conducting a survey about emergency services after cyclones in Cairns
- Australian National University is paying Lions to collect information

3. **Helping the community**

- Money received goes back into the Cairns community through Lions activities
- And the information collected will be publicly available to make submissions to governments, so it will help the Cairns community even more

4. **Participation**

- Should take about 20 minutes to fill out the questionnaire
- But the sophisticated statistical approach may make the form look confusing when you are filling it out
- Are you willing to help by filling out the questionnaire???

5. **If person agrees …….**

- Lions (and the community) get extra money for fully completed surveys – ask participant to try to answer every question, even if it looks confusing
- Agree when you will collect questionnaire

6. **If person declines to participate ……**

- Go on to the next house or flat along the street

7. **Collection of questionnaire**

- Ask if all questions have been completed – Lions get extra money for full responses
- Do **not** look inside the questionnaire or help answer questions.
- Place questionnaire in envelope in front of participant, and seal envelope (do **not** write name or address on envelope)
- Return all envelopes to Thelma Spelta.

APPENDIX 2

This survey is part of Australian National University (ANU) research about how the Cairns community values different aspects of emergency assistance before, during and after severe cyclones.

Your household has been selected randomly, and your answers will be absolutely anonymous. The ANU is not able to identify you from the form that you fill out.

The survey is voluntary – you do not have to fill it out.

However, by completing this survey you will be helping the Cairns community because the Lions Club will be paid for its help in distributing and collecting the questionnaires.

The Cairns Lions Club will receive extra money for all fully completed surveys that it collects. Please answer all the questions as best you can. It should only take about 20 minutes.

If you have any queries, please contact Dr Leo Dobes (Leo.Dobes@ANU.edu.au) or on (02) 6125 2557.

Leo Dobes
Adjunct Associate Professor
Crawford School of Economics and Government
Australian National University

Thelma Spelta
President
Lions Club of Cairns

This project operates under the research ethics protocols of the Australian National University, and any questions or complaints can be forwarded to:

Human Research Ethics Committee (Office of Research Integrity)
Innovations Building (124)
Corner Eggleston and Garran Roads
The Australian National University
Canberra ACT 0200

APPENDIX 3

Random selection of street names in Cairns for final survey

Please go down the list from 1 to 100. Choose 5 houses/flats for each street. This gives total of 500 houses/flats. The list contains 110 street names: the 10 extra a spares in case some of those listed in the first 100 are not suitable (dangerous, or non-residential).

1	Mills	cl	Manoora	37	e8
2	De Jarlais	st	Bayview Hts	43	f1
3	Royce	st	Redlynch	36	d18
4	McKinlay	st	Whitfield	37	a2
5	Hillview	cr	Whitfield	27	a17
6	Cottonwood	cl	Mt Sheridan	43	e17
7	Pandanus	st	Holloways Beach	22	g11
8	Suma	c	Mt Sheridan	43	e20
9	Hardwick	st	Stratford	27	b7
10	Torino	st	Woree	37	h20
11	James	st	Manunda	37	p2
12	Lynch	st	Bungalow	37	p13
13	Patula	cl	Manoora	37	e3
14	Adelaide	st	Manunda	37	M4
15	Rockton	pl	Mooroobool	37	a13
16	Wallum	cl	Holloways Beach	22	d9
17	Bassett	st	Kanimbla	37	b8
18	Dollisson	st	Manunda	37	k6
19	Illawarra	st	Caravonica	26	b12
20	Playford	cl	Brinsmead	26	p17
21	Greenock	wy	Brinsmead	36	q2
22	Jensen	st	Edge Hill	27	e17
23	Rambutan	cl	Manoora	37	f6
24	Alderman	st	Mt Sheridan	43	e15
25	Nicholson	cl	White Rock	43	m11
26	Milford	cl	Kanimbla	36	p3
27	Chester	ct	manunda	37	h10
28	Rowe	st	Earlville	37	f17

29	Trumpeter	st	Kanimbla	36	r8
30	Mission	rd	White Rock	43	j19
31	Primrose	st	Mooroobool	37	d15
32	Limewood	st	Mt Sheridan	43	e15
33	Coconut	st	Holloways Beach	22	h12
34	Redwood	st	Whitfield	37	d1
35	Clearwater	st	Freshwater	26	n9
36	Theresa	cl	Woree	43	f6
37	Ponticello	st	Whitfield	37	b1
38	Oriana	st	Brinsmead	26	p17
39	Philp	cl	Kanimbla	37	a10
40	Elkhorn	cl	Redlynch	26	d20
41	De Vecchi	cl	Edmonton	47	b11
42	Gordon	st	Earlville	37	d16
43	Meander	cl	Brinsmead	26	L16
44	Quetta	cl	Manoora	37	e1
45	Mango	dr	Earlville	37	b17
46	Gough	st	Manunda	37	L7
47	Keirle	av	Whitfield	27	d17
48	Barr	st	Earlville	37	f17
49	Fisk	st	Westcourt	37	m10
50	Mangano	cl	Brinsmead	26	L17
51	Boonaree	cl	Mt Sheridan	43	d19
52	Duffy	st	Freshwater	26	k10
53	Keeble	st	Freshwater	26	r7
54	Le Grande	st	Freshwater	26	m9
55	Teatree	cl	Manunda	37	p4
56	Wyuna	dr	Caravonica	25	n3
57	Adam	dr	Brinsmead	26	M14
58	Peace	dr	Kamerunga	26	b8
59	Belleville	st	Stratford	2	r8
60	Upper Perkins	st	Manoora	37	d4
61	Bradford	st	Whitfield	27	a16
62	Hay	st	Mt Sheridan	43	g19

63	Bamboo	st	Holloways Beach	22	f9
64	Cooinda	cl	Woree	43	e3
65	Julian	cl	Mooroobool	36	r15
66	Wilkinson	st	Manunda	37	L5
67	Barellan	cl	Caravonica	25	n2
68	The Peak		Brinsmead	26	q19
69	Fallon	cl	Brinsmead	26	q12
70	Deacon	ct	Mooroobool	37	g13
71	Headrick	st	Manunda	37	L5
72	Hispida	ct	Mt Sheridan	43	h13
73	Jitta	cl	Mt Sheridan	43	d19
74	Yangoora	st	White Rock	43	k10
75	Benjamina	st	Mt Sheridan	43	h12
76	Amazon	cl	Mt Sheridan	43	h10
77	Mayflower	st	Mt Sheridan	43	c20
78	Gregory	st	Westcourt	37	r8
79	McCormack	st	Edge Hill	27	k16
80	Acmena	cl	Redlynch	26	C20
81	Marks	pl	Manoora	37	c4
82	Wilunga	st	Stratford	27	a7
83	Yarrum	st	Earlville	37	e16
84	Venezia	st	Woree	43	h1
85	Cambanora	pl	Mooroobool	37	a13
86	Paradise	cl	White Rock	43	L14
87	Emma	cl	Mt Sheridan	43	e20
88	Mein	cl	Brinsmead	26	n19
89	Bucas	st	Mooroobool	37	g13
90	Richardson	st	Edge Hill	27	e19
91	Fitch	ct	Stratford	27	b7
92	Benn	st	Brinsmead	26	n19
93	Coral	cl	Woree	43	g2
94	Fogarty	st	Whitfield	27	a17
95	Diamond	st	Mt Sheridan	43	d20
96	Harris	st	Parramatta Pk	37	r7
97	Holden	cl	Whitfield	37	d20

98	Hammond	st	Mooroobool	37	g13
99	Messina	cl	Kanimbla	37	a7
100	Summer Hill	dr	Mooroobool	37	a12
101	Maytown	cl	Manoora	37	g3
102	Duane	cl	Brinsmead	26	q16
103	Hollett	cl	Manunda	37	p1
104	Echo	cl	Mt Sheridan	43	g12
105	Clarke	st	Manunda	37	L9
106	Southgate	cl	Woree	37	m20
107	Cliff	cl	Mt Sheridan	43	g17
108	Marti	st	Bayview Hts	43	a5
109	Wooley	cl	Kanimbla	37	c1
110	bauhinia	av	Earlville	37	b18

APPENDIX 4

YOUR HOUSEHOLD'S OPINION ON

EMERGENCY CYCLONE SERVICES IN CAIRNS

About this survey

This survey is about your household's opinions on emergency services that could be provided in the future, after severe cyclones in Cairns:

Part 1: About you and your household. We ask a few questions about you and your household, to make sure our sample is representative of the views of the residents of Cairns.

Part 2: Availability of after-cyclone emergency services. We explain the survey topic.

Part 3: Your household's choices. We ask you to choose between different "bundles" of emergency services after a cyclone, on behalf of your household.

Part 1: ABOUT YOU AND YOUR HOUSEHOLD …….

Approximately how many years have you lived in Cairns? (number) ☐

Were you born in Australia? (Please indicate with cross or tick) YES ☐ NO ☐

How many children (under 15 years of age) live in your household? (number) ☐

How many adults (15 years and over) live in your household? (number) ☐

How many pets do you normally keep in your household?

Please enter number (e.g. 0, 1, 2, 3, …) DOG(S) ☐ CAT(S) ☐ OTHER ☐

Do you think that your house or flat would suffer major damage during a Category 5 cyclone, close to the 'eye'? YES ☐ NO ☐ MAYBE ☐ DON'T KNOW ☐

Have you ever experienced a severe cyclone anywhere? YES ☐ NO ☐

Were you in Cairns during Cyclone Yasi in February 2011? YES ☐ NO ☐

Did you or any of your household members shelter in the Earlville Stocklands shopping centre during Cyclone Yasi? YES ☐ NO ☐

Have you ever lived in a communal evacuation centre after a cyclone? YES ☐ NO ☐

Has your house or flat ever been flooded, cut off by floodwaters, or lost gas, electricity, water or sewerage? YES ☐ NO ☐

Part 2: PROVISION OF EMERGENCY SERVICES AFTER A CYCLONE

In the past

- After a cyclone, Cairns Regional Council has opened 'Evacuation Centres' in public buildings such as schools, for those who have nowhere else to go. It has not been possible to take pets to Evacuation Centres.

- Government, commercial and volunteer organisations have re-connected sewerage, water, electricity and gas, cleaned up and removed rubbish, distributed donations of clothing and furniture, etc.

The future

If nothing is done over the next 10 to 20 years, the emergency services available to people in Cairns, and in other towns, could be reduced because:

- fewer volunteers are available;
-
- the number and severity of cyclones may increase due to changing weather patterns;
-
- the population of Cairns is growing, so available services would have to cover more people.

To avoid this situation

- more equipment could be bought;
- more outside SES volunteers, police and tradespeople could be flown in to help with clean-up, security and reconnection of electricity, etc; and
- evacuation centres could be improved, food storage facilities could be expanded and upgraded, etc.

But this would cost more money. And the budgets of most government agencies are already stretched, so that it may be difficult to maintain or improve levels of service in the future.

Funds could be collected with the electricity bill, just like the old ambulance levy. The money would be deposited into a special Cairns Cyclone Trust Fund, which could only be used only for cyclone relief. A Special Ombudsman would supervise the Fund.

All Cairns households would be required to pay the cyclone levy.

Part 3: YOUR CHOICES

We want to find out what emergency services your household would like to be provided.

In the questions that follow, we ask you to choose between a number of different "bundles" of emergency services that could be provided.

The questions may look the same, but the bundles are slightly different each time.

Now, look at the example on the next page.

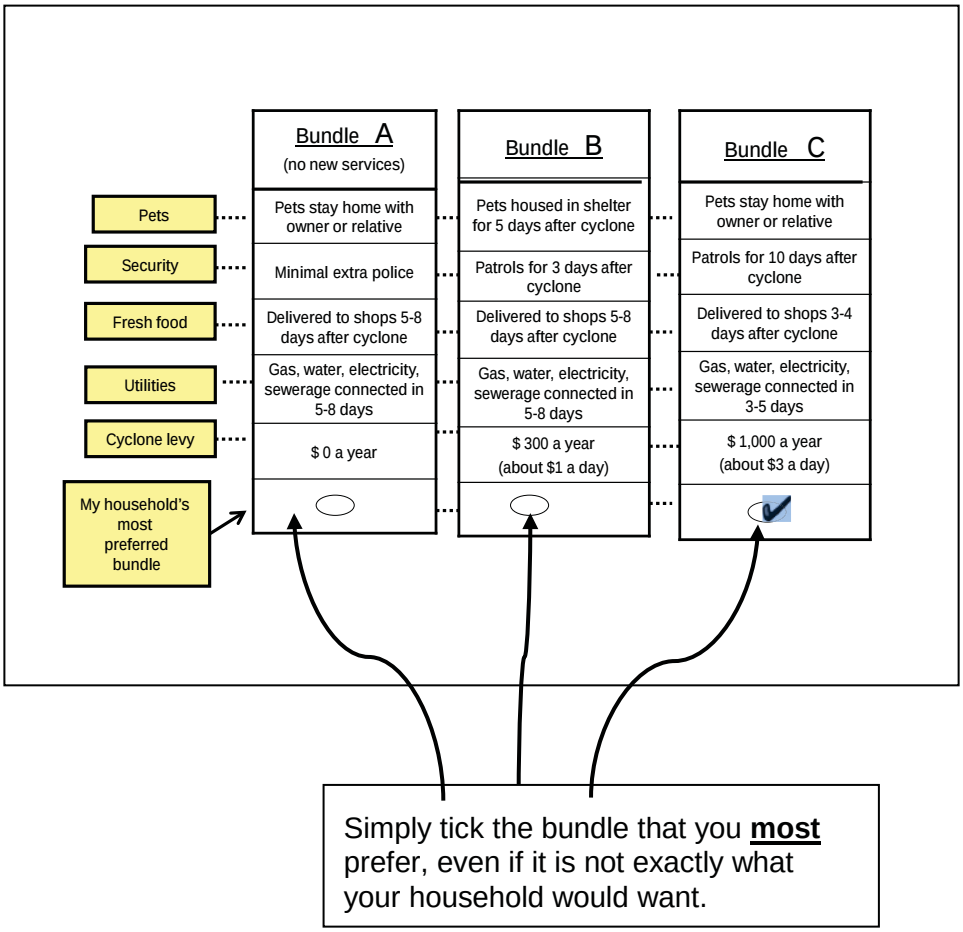
Here is an example of the questions that follow.

You do not need to answer this question.

Bundle A does not involve any new services, and no payment.

Bundles B and C involve changes in emergency services, and some payment.

At the bottom of the table, please tick the bundle that your household would most prefer



Simply tick the bundle that you **most** prefer, even if it is not exactly what your household would want.

SOME THINGS TO KEEP IN MIND WHEN ANSWERING QUESTIONS ON THE FOLLOWING PAGES

The compulsory Cyclone Levy

- would be paid by all Cairns households.
- would be collected with the electricity bill
- money would be put into a Trust Fund, supervised by a special Ombudsman, so that it cannot be used for anything except helping those affected by a cyclone.

Remember that your available income is limited, and you will still need to meet your every day expenses as usual.

Current government assistance would not be affected:

- depending on your circumstances, the Centrelink Disaster Recovery payment is $1,000 per eligible adult and $400 per child. Eligibility includes injury, destruction of residence, isolation of 24 hours from (or in) residence, or loss of utilities for at least 48 hours. Your eligibility for the payment is not affected by your income or assets.
- you may also be eligible for government loans or income support after a cyclone

The "volunteer" approach to helping cyclone victims would continue

- Australians have traditionally helped disaster victims largely on a "volunteer" basis.

  It is not being suggested that this community-based approach should change. Payment would be required in the future to get extra resources if more services are provided.

……. and your opinion definitely counts …….

- For new emergency services to be put in place, the support of a majority of Cairns residents would be necessary. And everyone living in Cairns would have to pay the levy.
- Your answers are important.

This is the <u>first of 6</u> questions: we ask you to choose the "bundle" of emergency services that your <u>household</u> would most prefer.

The questions may look the same, but they are actually different.

<u>Bundle A</u> does not involve any new or additional services, and no payment

<u>Bundles B and C</u> involve changes in emergency services and some payment

Please tick the <u>bundle</u> (A, B or C) that your <u>household</u> would <u>most</u> prefer:

	Bundle A (no new services	**Bundle B**	**Bundle C**
Pets	Pets stay at home with owner or friend	Pets stay at home with owner or friend	Pets housed in shelter for 5 days after cyclone
Security	Minimal extra police	Patrols for 10 days after cyclone	Minimal extra police
Fresh food	Delivered to shops 5-8 days after cyclone	Delivered to shops 5-8 days after cyclone	Delivered to shops 3-4 days after cyclone
Utilities	Gas, water, electricity, sewerage reconnected in 5-8 days	Gas, water, electricity, sewerage reconnected in 5-8 days	Gas, water, electricity, sewerage reconnected in 3-5 days
Cyclone levy	$0 per year	$ 300 a year (about $ 1 a day)	$ 700 a year (about $ 2 a day)
My household's most preferred bundle	◯	◯	◯

Now please go on to the next page. It is really important that you select your household's preferred bundle on each of the following pages as well.

This is the second of 6 questions: we ask you to choose the "bundle" of emergency services that your household would most prefer.

The questions may look the same, but they are actually different.

Bundle A does not involve any new or additional services, and no payment

Bundles B and C involve changes in emergency services and some payment

Please tick the bundle (A, B or C) that your household would most prefer:

	Bundle A (no new services	**Bundle B**	**Bundle C**
Pets	Pets stay at home with owner or friend	Pets housed in shelter for 5 days after cyclone	Pets stay at home with owner or friend
Security	Minimal extra police	Patrols for 10 days after cyclone	Minimal extra police
Fresh food	Delivered to shops 5-8 days after cyclone	Delivered to shops 3-4 days after cyclone	Delivered to shops 5-8 days after cyclone
Utilities	Gas, water, electricity, sewerage reconnected in 5-8 days	Gas, water, electricity, sewerage reconnected in 5-8 days	Gas, water, electricity, sewerage reconnected in 3-5 days
Cyclone levy	$0 per year	$ 1,000 a year (about $ 3 a day)	$ 50 a year (about 15 cents a day)
My household's most preferred bundle	◯	◯	◯

Now please go on to the next page. It is really important that you select your household's preferred bundle on each of the following pages as well.

This is the third of 6 questions: we ask you to choose the "bundle" of emergency services that your household would most prefer.

The questions may look the same, but they are actually different.

Bundle A does not involve any new or additional services, and no payment

Bundles B and C involve changes in emergency services and some payment

Please tick the bundle (A, B or C) that your household would most prefer:

	Bundle A (no new services	**Bundle B**	**Bundle C**
Pets	Pets stay at home with owner or friend	Pets housed in shelter for 5 days after cyclone	Pets stay at home with owner or friend
Security	Minimal extra police	Patrols for 10 days after cyclone	Minimal extra police
Fresh food	Delivered to shops 5-8 days after cyclone	Delivered to shops 5-8 days after cyclone	Delivered to shops 3-4 days after cyclone
Utilities	Gas, water, electricity, sewerage reconnected in 5-8 days	Gas, water, electricity, sewerage reconnected in 3-5 days	Gas, water, electricity, sewerage reconnected in 5-8 days
Cyclone levy	$0 per year	$ 1,000 a year (about $ 3 a day)	$ 50 a year (about 15 cents a day)
My household's most preferred bundle	◯	◯	◯

Now please go on to the next page. It is really important that you select your household's preferred bundle on each of the following pages as well.

This is the fourth of 6 questions: we ask you to choose the "bundle" of emergency services that your household would most prefer.

The questions may look the same, but they are actually different.

Bundle A does not involve any new or additional services, and no payment

Bundles B and C involve changes in emergency services and some payment

Please tick the bundle (A, B or C) that your household would most prefer:

	Bundle A (no new services	**Bundle B**	**Bundle C**
Pets	Pets stay at home with owner or friend	Pets stay at home with owner or friend	Pets housed in shelter for 5 days after cyclone
Security	Minimal extra police	Minimal extra police	Patrols for 10 days after cyclone
Fresh food	Delivered to shops 5-8 days after cyclone	Delivered to shops 3-4 days after cyclone	Delivered to shops 5-8 days after cyclone
Utilities	Gas, water, electricity, sewerage reconnected in 5-8 days	Gas, water, electricity, sewerage reconnected in 5-8 days	Gas, water, electricity, sewerage reconnected in 3-5 days
Cyclone levy	$0 per year	$ 50 a year (about 15 cents a day)	$ 1,000 a year (about $ 3 a day)
My household's most preferred bundle	◯	◯	◯

Now please go on to the next page. It is really important that you select your household's preferred bundle on each of the following pages as well.

This is the fifth of 6 questions: we ask you to choose the "bundle" of emergency services that your household would most prefer.

The questions may look the same, but they are actually different.

Bundle A does not involve any new or additional services, and no payment

Bundles B and C involve changes in emergency services and some payment

Please tick the bundle (A, B or C) that your household would most prefer:

	Bundle A (no new services	**Bundle B**	**Bundle C**
Pets	Pets stay at home with owner or friend	Pets stay at home with owner or friend	Pets housed in shelter for 5 days after cyclone
Security	Minimal extra police	Patrols for 3 days after cyclone	Minimal extra police
Fresh food	Delivered to shops 5-8 days after cyclone	Delivered to shops 5-8 days after cyclone	Delivered to shops 3-4 days after cyclone
Utilities	Gas, water, electricity, sewerage reconnected in 5-8 days	Gas, water, electricity, sewerage reconnected in 5-8 days	Gas, water, electricity, sewerage reconnected in 3-5 days
Cyclone levy	$0 per year	$ 1,500 a year (about $ 4 a day)	$ 50 a year (about 15 cents a day)
My household's most preferred bundle	◯	◯	◯

Now please go on to the next page. It is really important that you select your household's preferred bundle on each of the following pages as well.

This is the last of 6 questions: we ask you to choose the "bundle" of emergency services that your household would most prefer.

The questions may look the same, but they are actually different.

Bundle A does not involve any new or additional services, and no payment

Bundles B and C involve changes in emergency services and some payment

Please tick the bundle (A, B or C) that your household would most prefer:

	Bundle A (no new services	**Bundle B**	**Bundle C**
Pets	Pets stay at home with owner or friend	Pets housed in shelter for 5 days after cyclone	Pets stay at home with owner or friend
Security	Minimal extra police	Patrols for 3 days after cyclone	Patrols for 3 days after cyclone
Fresh food	Delivered to shops 5-8 days after cyclone	Delivered to shops 5-8 days after cyclone	Delivered to shops 3-4 days after cyclone
Utilities	Gas, water, electricity, sewerage reconnected in 5-8 days	Gas, water, electricity, sewerage reconnected in 5-8 days	Gas, water, electricity, sewerage reconnected in 3-5 days
Cyclone levy	$0 per year	$ 1,500 a year (about $ 4 a day)	$ 1,500 a year (about $ 4 a day)
My household's most preferred bundle	◯	◯	◯

Thank you for making your choices.

Part 4: ABOUT YOU AND THE SURVEY

Please tick or cross any or all of the following that applies most to you

- I carefully read all the information and questions ☐
- I read most of the information and questions ☐
- I quickly browsed the information and questions ☐
- I did not really read the information and questions ☐

****

Do you think that Australia's weather patterns are changing?

YES ☐ NO ☐ MAYBE ☐ DON'T KNOW ☐

Do you think that cyclones will become more damaging in Cairns in the future?

YES ☐ NO ☐ MAYBE ☐ DON'T KNOW ☐

-

Do you think that cyclones will happen more often in Cairns in the future?

YES ☐ NO ☐ MAYBE ☐ DON'T KNOW ☐

****

If you agree with any of the following, please tick one or more boxes:

☐ I don't care about emergency services after a cyclone

☐ People should be responsible for looking after themselves

☐ More services should be provided, but I don't have spare money to pay for them

☐ More services should be provided, but I already pay enough in taxes

☐ More services should be provided, but I don't think that I should be the one to pay

☐ More services should be provided, but the "bundles" used above don't make sense

☐ I found making a choice too confusing, so just ticked any box

☐ More services should be provided, but funds collected would not be used correctly

Some other reason (please specify): ……..

We would like now to ask you some background questions.

Your answers are **strictly confidential**. All information provided is **anonymous**.

The reason why we ask this question is to make sure that we have a representative sample of the population of Cairns so that everyone can have a say how the emergency cyclone services in Cairns should be organised in the future.

What is the highest level of **education** that you have completed?

(Please tick or cross one box)

School education	**tick or cross**
Did not go to school	
Year 8 or below	
Year 9	
Year 10	
Year 11	
Year 12	

(Please tick or cross one box)

After leaving school	**tick or cross**
Trade certificate	
Diploma or advanced diploma	
Bachelor degree	
Graduate diploma or certificate	
Postgraduate degree	
None of the above	

****

Do you have any insurance to cover damage to your house or its contents? (tick one box)

YES ☐ NO ☐ DON'T KNOW ☐

Approximately how many days food supply do you store at home before a cyclone ? (enter a number)
days ☐

Approximately how many days fuel do you store at home for cooking before a cyclone ? (enter a number) ☐ days

During a major cyclone, would you normally stay at home, or stay elsewhere (for example, with relatives or friends, leave Cairns, etc) ? (tick one box)

HOME ☐ ELSEWHERE ☐ DON'T KNOW ☐

Household income

As with all your answers, the information provided here is strictly confidential.

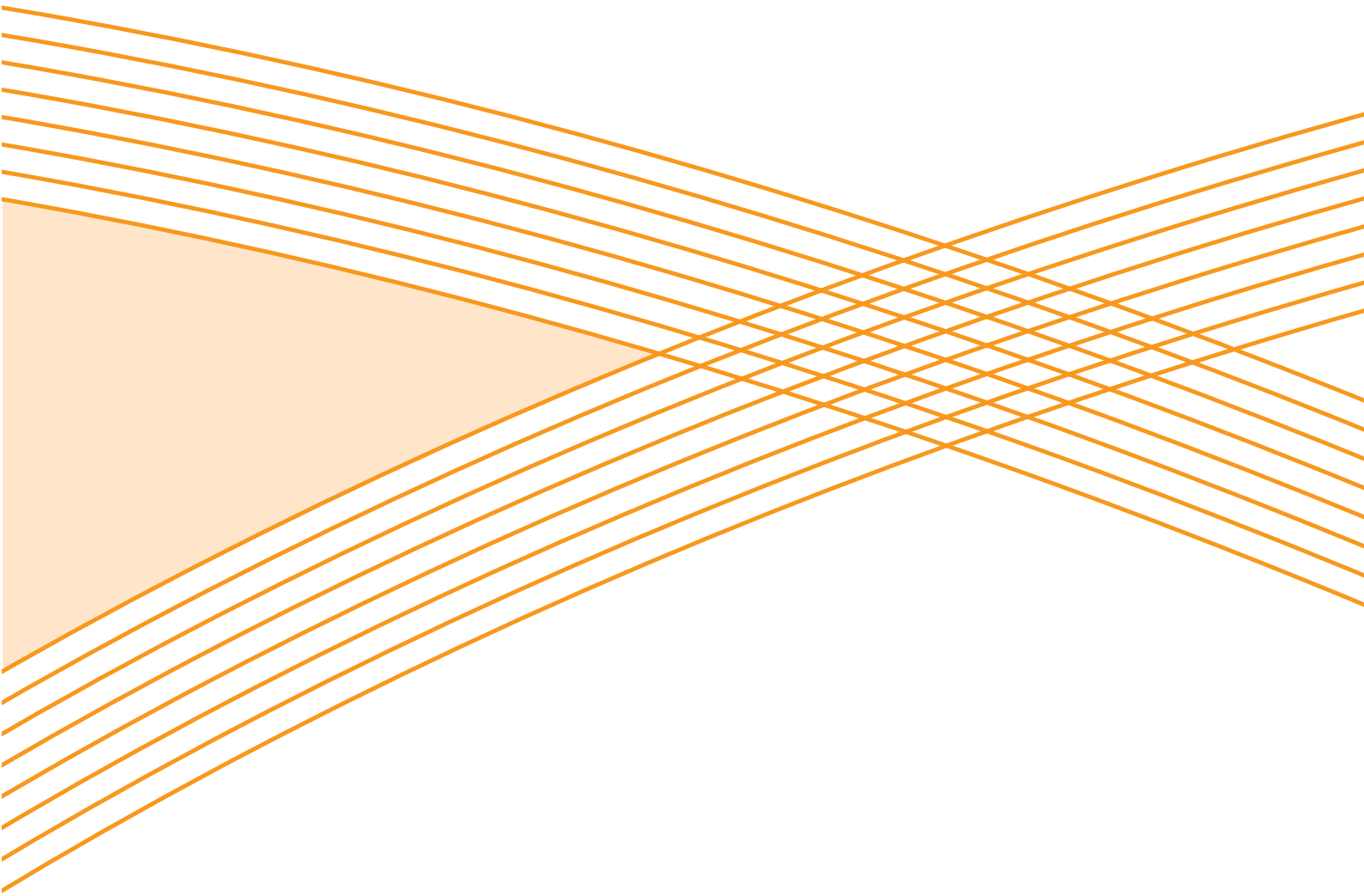
Please indicate in the table the approximate **total income** earned last year by your **household**.

The reason why we ask this question is to make sure that we have a representative sample of the population of Cairns so that everyone can have a say about what emergency services should be available in Cairns in the future.

Income range per year (income range per week)	**Your household's approximate income last year (please tick one box)**
Nil or negative income	
$1 - $7,799 per year ($1 - $149 per week)	
$7,800 - $12,999 ($150 - $249 per week)	
$13,000 - $18,199 per year ($250 - $349 per week)	
$18,200 - $25,999 per year ($350 - $499 per week)	
$26,000 - $33,799 per year ($500 - $649 per week)	
$33,800 - $41,599 per year ($650 - $799 per week)	
$41,600 - $51,999 per year ($800 - $999 per week)	
$52,000 - $62,399 per year ($1,000 - $1,199 per week)	
$62,400 - $72,799 per year ($1,200 - $1,399 per week)	
$72,800 - $88,399 per year ($1,400 - $1,699 per week)	
$88,400 - $103,999 per year ($1,700 - $1,999 per week)	
$104,000 - $129,999 per year ($2,000 - $2,499 per week)	
$130,000 - $155,999 per year ($2,500 - $2,999 per week)	
$156,000 - $181,999 per year ($3,000 - $3,499 per week)	
$182,000 – $207,999 per year ($3,500 - $3,999 per week)	
$208,000 or more ($4,000 per week or more)	
I don't know	

Income includes wages/salaries, government benefits, pensions, allowances and other. Do not deduct tax, superannuation contributions, health insurance, amounts salary sacrificed, or any other automatic deductions.

AND THANK YOU AGAIN FOR COMPLETING THE SURVEY!!!!



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