bnhcrc.com.au

DEMOGRAPHIC PROFILING: QUEENSLAND FLOODS 2010-11 CASE STUDY BRISBANE RIVER CATCHMENT AREA

Optimising post disaster recovery interventions in Australia

Farah Beaini, Mehmet Ulubasoglu
Deakin University & Bushfire and Natural Hazards CRC

Version	Release history	Date
1.0	Initial release of document	18/12/2019

Publisher:
Bushfire and Natural Hazards CRC

December 2019

Citation: Beaini, F, Ulubasoglu, M 2019, *Demographic profiling: Queensland floods 2010-11 case study Brisbane river catchment area*, Optimising post disaster interventions in Australia, Bushfire and Natural Hazards CRC

Cover: A flooded 'water over road' sign in Rockhampton, Queensland. Credit: Flickr Rex Boggs CC BY NC-ND

TABLE OF CONTENTS

ACKNOWLEDGEMENTS

Deakin University warmly thanks our Queensland Floods 2010-11 case study end-user Queensland Reconstruction Authority for their cooperation, ongoing support and guidance.

INTRODUCTION

ABOUT THE PROJECT

The "Optimising post-disaster recovery interventions in Australia" project explores the impact of a number of Australian natural disasters on the disaster-hit individuals' economic resilience. By analysing Australian 2006 (baseline year), 2011 and 2016 Census data, the project determines whether their income levels were able to recover post disaster in the short and medium term, considering demographic factors and employment sectors.

The project's natural disaster case studies are:

- The Victorian Black Saturday Bushfires 2009
- The Western Australian Toodyay Bushfires 2009
- The Queensland Floods 2010-11
- Cyclone Oswald 2013

ABOUT THIS REPORT

In this report, we provide some high-level demographic profiling and descriptive analysis of the Queensland Flood 2010-11 flood-affected Brisbane River catchment local government areas (LGAs):

- Brisbane City Council (Brisbane)
- Ipswich City Council (Ipswich)
- Lockyer Valley Regional Council (an amalgamation of the Shire of Gatton and Shire of Laidley since 2008)
- Somerset Regional Council (an amalgamation of the Shire of Esk and the Shire of Kilcoy since 2008).

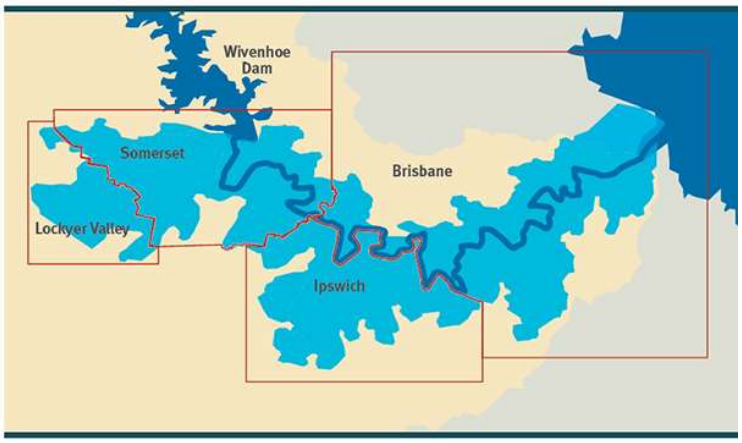

FIGURE 1 BRISBANE RIVER CATCHMENT AREA

SOURCE 1 Queensland Reconstruction Authority, 2017

The profiling utilises the ABS Census as the primary data source (in line with project methodology) as well as official government reports for flood-related statistics.

In presenting this information, we note that our demographic profiling captures the overall population-level trends for these areas, which are affected by factors including migration and population growth. This enables us to present a baseline of the overall socioeconomic characteristics and conditions of these areas both prior to (2006) and post the floods (2011, 2016).

This report is part of a series of demographic profiling reports which will be released for each of the project case studies.

DEMOGRAPHIC PROFILE

LITERATURE REVIEW

Natural disaster economic and emergency management literature suggest that certain underlying socioeconomic characteristics can affect a community's vulnerability to natural hazards, and thus its ability to prepare, respond and ultimately recover from disasters (Finch et al., 2010).

Regions with a larger portion of children, elderly, the poor and less educated populations are considered more vulnerable to natural disasters (DELWP, 2016; Cutter et al, 2008; Frankenberg et al. 2013). These characteristics affect the physical, mental and financial capacity of individuals to respond to natural disasters when they occur.

Many of these characteristics are highly correlated or interdependent, particularly with income, affirming our project's income focus. For example, the affordability of accommodation type and car ownership is often dependent on income, while educational level and income are also interdependent.

Income itself has been shown to be an important socio-economic indicator of vulnerability to natural hazards. Low-income earners tend to be more vulnerable as their limited economic resources mean they're more likely to be under-insured or uninsured (DELWP, 2016) and live in hazard-prone areas, thus are more limited in their ability to recover from losses once disasters strike. In the case of bushfires, the longevity of disruptions to income post-disaster has been shown to materially affect the mental health of those affected by bushfires (Gibbs et al., 2016).

Understanding these underlying socioeconomic vulnerabilities can help assist policymakers identify more vulnerable areas and cohorts as part of risk-mitigation and in post-disaster recovery interventions.

The ABS SEIFA Indexes (Socio Economic Indexes for Areas) are derived from the ABS Censuses. These indices assign weights to these and other relevant indicators to rank LGAs according to their relative advantage and disadvantage compared to other LGAs within their state and Australia as a whole. The lower the decile ranking, the higher the relative level of disadvantage.

Only broad comparisons can be made with over the Census periods as the SEIFA indices are point-in-time estimates, with some changes to underlying index construction. Nevertheless, they provide useful snapshots of socioeconomic conditions of the Shire of Toodyay as they capture many of the population vulnerabilities discussed in natural hazard risk analysis research (see Appendices).

In the next section, we report on the decile rankings of each LGA within the Brisbane river catchment area in relation to other LGAs within Queensland, and supplement this with relevant demographic information.

BRISBANE RIVER CATCHMENT AREA

Based on the SEIFA Indexes, the Brisbane River catchment area is heterogenous, capturing LGAs across the economic development spectrum with marked variation in the underlying social characteristics of their populations.

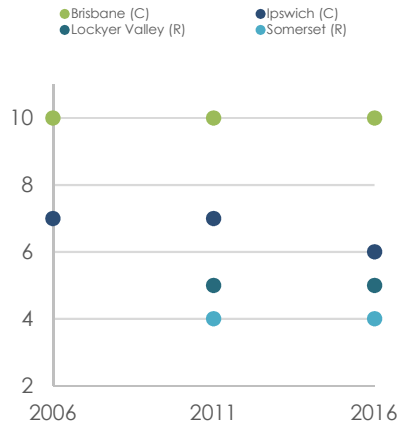

FIGURE 2 ABS INDEX OF RELATIVE SOCIOECONOMIC DISADVANTAGE DECILE RANKINGS (QUEENSLAND)

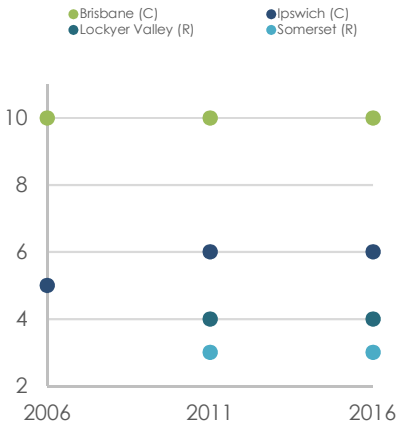

FIGURE 3 ABS INDEX OF EDUCATION AND OCCUPATION DECILE RANKINGS (QUEENSLAND)

SOURCE 2 ABS, CAT 2033.0.55.001, Census of Population and Housing: Socio-Economic Indexes for Areas (SEIFA), Australia

Unsurprisingly, as the state capital, Brisbane ranks within the highest deciles across SEIFA indexes in all Census years. Its population is relatively young (median age of around 34.6 across the decade) and highly skilled, with over 40% of its population holding a bachelor's degree or higher. The area's economic significance (around 27% of Queensland's businesses are in Brisbane) and service-oriented economy underscore its relatively low unemployment rate and comparably higher median personal and household income. Its population grew from 987,831 in 2006 to 1,184,752 in 2016.

In contrast, the historical provincial city of Ipswich presents a mixed profile. The region is one of the ten fastest growing LGAs in Queensland, growing from 141,986 in 2006 to 200,103 in 2016. Its median age dropped slightly from 33.2 to 32.5 years over the decade. The region is characterised by relatively lower educational attainment levels and high rates of income support (Department of Employment, 2014). The unemployment rate has consistently exceeded the state average, rising from 5.1% in 2006 to 9% in 2016. While median income was generally in line with the state average, the region is economically dependent on Brisbane, with almost half (49%) of Ipswich residents travelling outside the region for work, with the Brisbane LGA being the main destination (Department of Employment, 2014).

The regional councils of Lockyer Valley and Somerset are relatively more socioeconomically disadvantaged. Their populations are smaller (31,305 and 19,608 respectively in 2006), remaining below 40,000 throughout the period. They are also relatively older, with median age rising to 39 years in Lockyer Valley and 43 years Somerset by 2016. Educational attainment levels are also low, placing these councils within the lowest 5 deciles within the state. Median personal income over the period was below the state average, equivalent to ~65-68% of what a typical neighbouring Brisbane resident would earn in a given year. Unemployment rates were persistently above the state average.

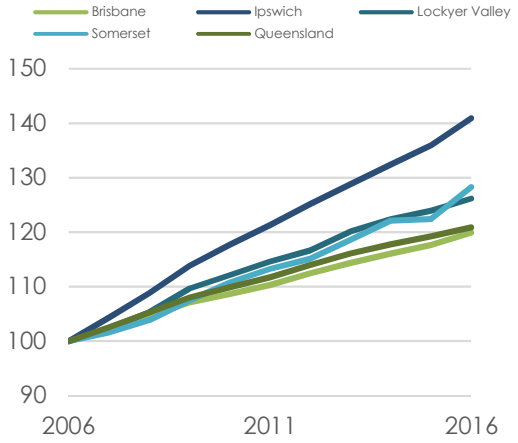

FIGURE 4 POPULATION GROWTH (2006=100)

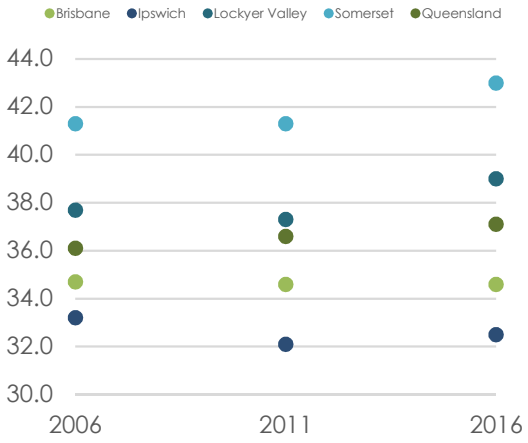

FIGURE 5 MEDIAN AGE

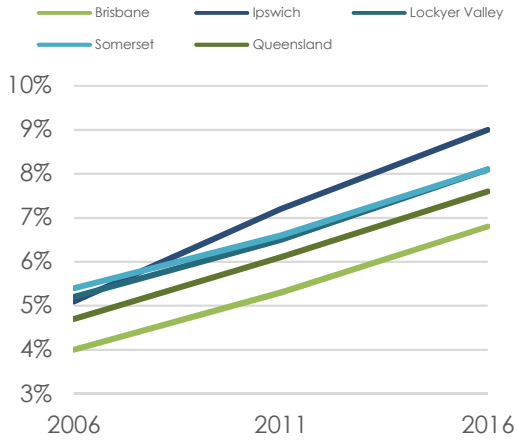

FIGURE 6 UNEMPLOYMENT RATE (%)

FIGURE 7 EDUCATIONAL ATTAINMENT - BACHELOR'S DEGREE OR HIGHER (% OF POPULATION)

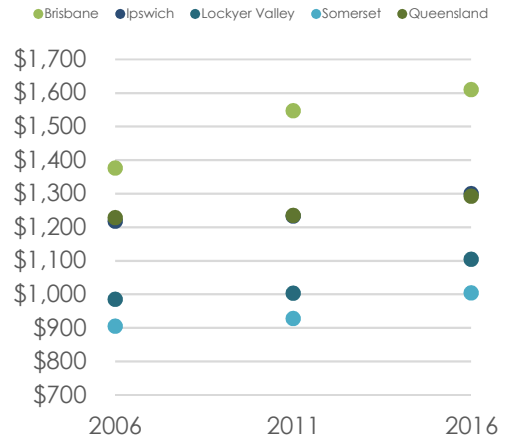

FIGURE 8 REAL HOUSEHOLD INCOME (2011-12 = BASE)

FIGURE 9 REAL PERSONAL INCOME (2011-12 = BASE)

SOURCE 3 ABS, Census of Population and Housing: Quickstats (2006, 2011, 2016); ABS, CAT 3218.0 Regional Population Growth; ABS, CAT 6401.0 Consumer Price Index, Australia.
Note: Income figures are in 2011-12 dollars (based on ABS Brisbane All Groups CPI figures)

ECONOMIC PROFILE

LITERATURE REVIEW

Estimating the total economic costs of natural disasters can be difficult, owing to the lack of complete and systematic data, conceptual difficulties (Kousky, 2014), and divergent predictions from growth theory about the effects of natural disasters on economic growth (Loayza et al., 2012).

It is unsurprising, therefore, that the literature on overall economic effects is inconclusive, with some studies reporting negative effects, while others finding positive or insignificant effects (Loayza et al., 2012).

This isn't to say there are no areas of agreement. For example, a meta-analysis of natural disaster economic literature conducted by Lazzaroni and van Bergeijk (2014) finds that natural disasters have a negative impact in terms of direct costs. Multiple studies show that economic and human losses are more pronounced in poorer countries (Schumacher and Strobl, 2011), with institutional factors and educational attainment levels important determinants that influence resilience and recovery (Kousky, 2014; Felbermayra and Gröschl, 2014).

Broadly, there is also support for differentiated impacts based on the disaster severity and frequency. For example, more severe disasters, particularly those with higher fatalities and/or ones with multiple events, cause the highest damage, and are more likely to lead to long-term and/or negative consequences (Boustan et al., 2017; Kousky, 2014).

There is also evidence of distributional effects, with some industry sectors being harder hit, while others benefiting from transfers natural disasters generate, at least in the short-term. Due to its land-intensive nature, the agricultural sector is often the most adversely affected sector by natural disasters. In developing countries, it has been estimated that the agriculture sector absorbs approximately 22 percent of the economic impact caused by medium and largescale natural hazards (FAO, 2015). Locally, a study of major Victorian bushfires found that industries most susceptible to direct or indirect impacts are the Agriculture, forestry and fishing sector and retail trade (Stephenson, 2010). Conversely, the construction sector may experience a boom in the immediate aftermath of the disaster as households redirect expenditure towards rebuilding that they otherwise would've deferred, only to experience a lull in the next few years once that expenditure subsides (Kousky, 2014).

Relying on a single economic sector for income has also been shown to make communities more vulnerable and slower to recover from a disaster compared to diversified economies (Cutter et al., 2008). Even with a diversified economy structure, the interdependence of sectors can have knock-on effects despite a sector's own ability to withstand the immediate effects of the disaster (Yu et al., 2014). Thus, industries more heavily reliant on inputs from the agricultural sector are likely to experience adverse effects to their production.

In the next section, we complement our demographic profiling with an overview of the economic composition of the Brisbane River Catchment area, noting to the dominant industries of employment over a fifteen-year period.

BRISBANE RIVER CATCHMENT AREA

The Brisbane River catchment area is economically significant.

On average, 31% of Queensland's employed workforce and 30% of its businesses are located in the area. This figure is largely driven by Brisbane. In 2006-07[1], it had 103 businesses per 1000 residents, with a significant share of these businesses (~39%) employing staff.

In contrast, Ipswich has the lowest business per capita count among LGAs in the Brisbane River catchment area, with population growth (3.4% annualized growth between 2006-07 and 2015-16) far exceeding growth in net business entries (0.9%) over the same time period.

The regional council areas are characterised by a much larger share of non-employing businesses[2] (particularly Somerset), with a high concentration of these businesses in the disaster-sensitive agricultural industry.

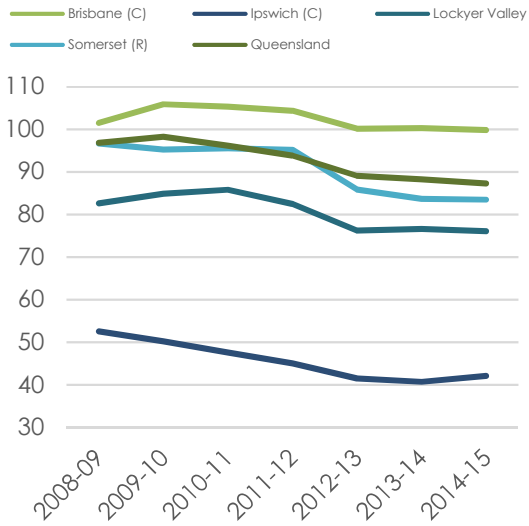

FIGURE 10 TOTAL BUSINESSES PER CAPITA ('000 PERSONS)

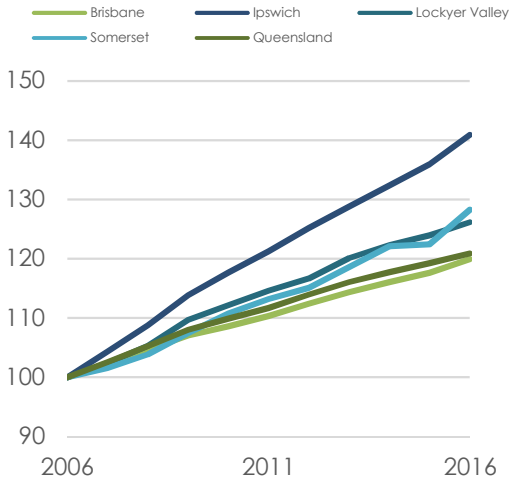

FIGURE 11 POPULATION GROWTH (2006=100)

[1] Due to changes in ABS industry classifications post 2006-07 and unavailability of 2007-08 data, 2006-07 and 2007-08 data are not included in these charts.
[2] The ABS defines non-employing businesses as businesses that are sole proprietorships or partnerships without employees.

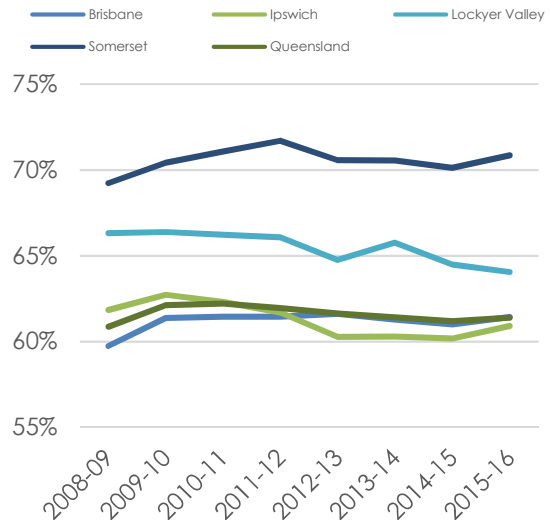

FIGURE 12 NON-EMPLOYING BUSINESSES (% TOTAL BUSINESSES)

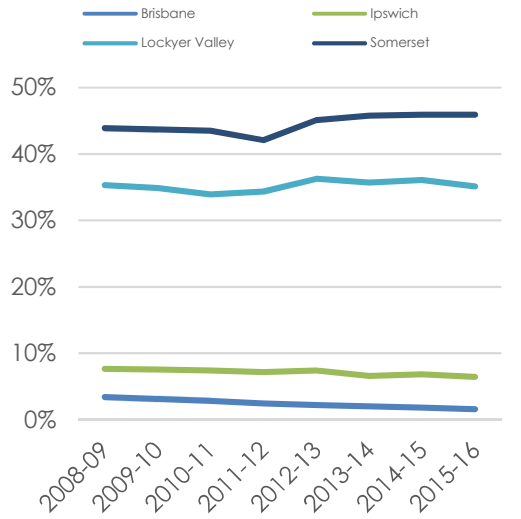

FIGURE 13 NON-EMPLOYING AGRICULTURAL BUSINESSES (% TOTAL NON-EMPLOYING BUSINESSES)

SOURCE 4 ABS, CAT 8165.0 Counts of Australian Businesses, including Entries and Exits; ABS, CAT 3218.0 Regional Population Growth

Across the Brisbane River catchment area, the top 5 industries account for on average approximately 50% of employment. While the overall rankings are different, the common top industries of employment across LGAs between 2001 and 2016 were Health care and social assistance; Professional, scientific and technical services; Retail trade; Education and training; and Manufacturing.

Since 2001, these areas have had marked changes to their economic composition. Their workforce has seen a shift away from historically significant industry sectors including agriculture and manufacturing, though these industries remain important in the regional councils and Ipswich. The Lockyer Valley represents approximately 12-14 per cent of the Queensland agricultural economy (Lockyer Valley, 2011), while Ipswich holds approximately 40% of south east Queensland's available industrial land (Ipswich City Council, 2014).

Notably, the strongest negative annualised change in employment share of manufacturing has been in Brisbane (-4.28%) and Ipswich (-3.79%), with the disaster-sensitive agricultural sector also ranking lowest in share of employment in these LGAs across the 2006-2016 period.

TABLE 1 BRISBANE RIVER CATCHMENT AREA TOP INDUSTRIES OF EMPLOYMENT (% OF TOTAL, BY LGA)

Top 5 industries of employment, by LGA	2001	2006	2011	2016	Trendline	2001-2016 Annualised Δ
Brisbane						
Health care and social assistance	11.0%	11.7%	13.2%	14.2%		***1.73%***
Retail trade	10.6%	10.6%	9.2%	8.9%		***-1.12%***
Manufacturing	9.9%	9.0%	7.3%	5.2%		***-4.28%***
Education and training	9.7%	9.2%	9.3%	10.6%		***0.65%***
Professional, scientific and technical services	9.3%	9.7%	11.3%	10.9%		***1.07%***
Public administration and safety	7.0%	7.9%	8.1%	7.7%		***0.68%***
Ipswich						
Manufacturing	18.7%	18.2%	14.7%	10.5%		***-3.79%***
Retail trade	11.2%	11.5%	11.1%	11.0%		***-0.10%***
Health care and social assistance	11.1%	11.6%	12.5%	13.8%		***1.46%***
Public administration and safety	9.0%	8.6%	9.9%	9.5%		***0.36%***
Education and training	7.0%	6.9%	7.1%	8.5%		***1.30%***
Construction	6.1%	7.5%	7.8%	8.8%		***2.45%***
Lockyer Valley						
Agriculture, forestry and fishing	17.9%	15.1%	12.6%	14.5%		***-1.39%***
Manufacturing	13.0%	11.5%	9.9%	7.4%		***-3.67%***
Retail trade	10.1%	11.6%	11.2%	9.5%		***-0.39%***
Education and training	9.0%	8.4%	8.5%	9.6%		***0.41%***
Health care and social assistance	7.7%	8.9%	9.8%	10.2%		***1.91%***
Construction	5.7%	7.4%	7.8%	8.7%		***2.83%***
Somerset						
Agriculture, forestry and fishing	17.1%	12.2%	9.9%	9.6%		***-3.76%***
Manufacturing	15.1%	14.9%	13.9%	12.9%		***-1.01%***
Retail trade	9.0%	10.0%	10.3%	9.5%		***0.34%***
Health care and social assistance	8.2%	9.2%	10.3%	10.7%		***1.76%***
Education and training	7.9%	7.8%	7.6%	8.3%		***0.35%***
Construction	5.5%	7.8%	8.6%	9.7%		***3.79%***

SOURCE 5 ABS Census of Population and Housing, Industry of Employment by Occupation (LGA) (2001, 2006, 2011, 2016). Excludes "not stated" and "not applicable" categories

FLOOD PROFILE

QUEENSLAND FLOODS

The 2010-2011 Queensland floods is one of the most devastating floods in Australian history. Almost the entire state of Queensland was declared a natural disaster zone, with the floods causing an estimated $6.7 billion in damage, with an overall cost of $14.1 billion (Deloitte Access Economics, 2016). According to Beecroft et al (2017), approximately 20% (6,709 km) of the state-controlled network required full or partial reconstruction.

Coupled with Cyclone Yasi and wetter than usual weather conditions, the floods were estimated by Queensland Treasury (2012) to have detracted 2¼ percentage points from Queensland's Gross State Product in 2010-11, with losses in sectors that form key drivers of Queensland's economic growth:

- $1.4 billion losses in the agricultural sector
- $5.7 billion losses in the mining sector.

The impact on the population was also substantial, with some 29,000 homes and businesses suffering inundation and 33 lives lost (Queensland Floods Commission of Inquiry, 2012). A total 56,200 flood-related insurance claims were made at a total reserved insured value of $2.55 billion, with $1.23 billion paid to insured Queenslanders as at July 2011(Queensland Government, 2011).

The widescale devastation of the floods and subsequent Cyclone Yasi led to a national flood levy in 2011-12 income year (the Temporary Flood and Cyclone Reconstruction Levy) to help fund the rebuilding of essential infrastructure, including roads, bridges and schools damaged by natural disasters.

BRISBANE RIVER CATCHMENT AREA

The Brisbane River catchment area was severely affected by the floods. According to 2009-10 ABS estimates, 29.4% of Queenslanders and Queensland's businesses would have been residing/located within the Brisbane catchment area at the time of the floods.

TABLE 2 BRISBANE RIVER CATCHMENT FATALITIES AND EXPOSED RESIDENTIAL AND BUSINESS POPULATION

	2009-10 demographics		
	Resident Population (a)	Businesses (b)	Fatalities (c)
Case study LGAs	**1,297,105**	**127,133**	**21**
Brisbane	1,073,144	113,688	1
Ipswich	167,134	8,395	1
Lockyer Valley	35,110	2,981	17
Somerset	21,717	2,069	1
Queensland	**4,404,744**	**433,029.0**	**35**

SOURCE 6 (a) ABS, CAT 3218.0 Regional Population Growth; (b) ABS, CAT 8165.0 Counts of Australian Businesses, including Entries and Exits; (c) Queensland Floods Commission of Inquiry (2012), Queensland Office of the State Coroner (2012)

The region accounted for 60% of total flood fatalities, most heavily felt in the Lockyer Valley. Over 30,000 residential and business properties in the region were partially or fully inundated. 33% of Ipswich City Council's properties were inundated, with approximately 1200 homes being significantly affected and 188 businesses directly impacted (Ipswich City Council, 2011).

TABLE 3 BRISBANE RIVER CATCHMENT AREA, SUMMARY OF INUNDATED RESIDENTIAL AND BUSINESS

	Inundated properties (a)			Insurance claims (b)	
	Total	Residential	Business	No.	Value ($m)
Case study LGAs	**33,847**	**25,706**	**7,859**	**31,698**	**$1,053**
Brisbane	29,768	22,097	7,671	19,779	$892
Ipswich	8,600	na	na	na	na
Lockyer Valley	2,409	2,409	na	11,919	$161
Somerset	282	na	na	na	na
Queensland	**136,000**	**na**	**na**	**56,200 (c)**	**$2, 550 (c)**

SOURCE 7 (a) Brisbane: Flood Response Review Board (2011) Ipswich (2011), Lockyer Valley (2012), Somerset City Regional Council (2012) (b) Queensland Government (2011), (c) NDIR (2011)

The councils were among only 37% of Queensland LGAs to activate the NDRRA Category D assistance, reserved for the most severe impact disasters (Queensland Reconstruction Authority, 2011).

The per-capita council flood costs for Lockyer Valley and Somerset councils were among the 20 highest recorded in the state, with 77% of Lockyer Valley's local road infrastructure destroyed. Brisbane City Council took two years to restore the city (Sultana et al, 2016), with an estimated recovery cost of $440 million (Brisbane City Council, 2011).

TABLE 4 ESTIMATES OF COST OF NATURAL DISASTER EVENTS FOR QUEENSLAND COUNCIL ASSETS (2010-11)

	Population density (a)	Total council asset costs (2010-11) (b)	
		($m)	per capita ($) (a)
Case study LGAs	**127**	**$ 479.60**	**$ 376.23**
Brisbane	799.2	$ 129.90	$ 121.05
Ipswich	154.0	$ 99.70	$ 596.53
Lockyer Valley	15.5	$ 154.70	$ 4,406.15
Somerset	4.0	$ 95.30	$ 4,388.27
Queensland	**2.6**	**$ 2,175.90**	**$ 542.89**

SOURCE 8 (a) ABS, CAT 3218.0 Regional Population Growth (2009-10), (b) LGAQ (2014). Note: 2010-11 council figures include Cyclone Yasi costs.

REFERENCES

1 Australian Bureau of Statistics (2001, 2006, 2011, 2016), Census of Population and Housing

2 Australian Bureau of Statistics (2006, 2011, 2016), 2033.0.55.001 - Census of Population and Housing: Socio-Economic Indexes for Areas (SEIFA), Australia

3 Australian Bureau of Statistics (2018), 6401.0 - Consumer Price Index, Australia

4 Australian Bureau of Statistics (2017), 8165.0 - Counts of Australian Businesses, including Entries and Exits

5 Australian Bureau of Statistics (2006), 2039.0.55.001- Socio-Economic Indexes for Areas (SEIFA) - Technical Paper

6 Australian Bureau of Statistics (2016), 4130.0 - Housing Occupancy and Costs

7 Australian Bureau of Statistics (2017), 3218.0 Regional Population Growth, Australia

8 Beecroft A, Peters E, Toole T (2017), Life-cycle costing of rain and flood events in Queensland - case studies and network-wide implications, Road & Transport Research: A Journal of Australian and New Zealand Research and Practice, vol 26(3), Sep 2017: pp 22-35

9 Boustan L, Kahn M.K, Rhode P.W, Yanguas, M.L (2017), The effect of Natural Disasters on Economic Activity in US Counties: A Century of Data, NBER Working Paper No. 23410, May 2017, JEL No. N42,Q5,R23

10 Brisbane City Council (2011), Submission to Queensland Flood Commission Inquiry, Initial Submission 11 March 2011 http://www.floodcommission.qld.gov.au/__data/assets/file/0015/10950/Brisbane_City_Council_4.pdf , accessed 1 July 2018

11 Commonwealth of Australia (2011), National Disasters Insurance Review: Inquiry into flood insurance and related matters, June 2011 http://www.ndir.gov.au/content/issuespapers/NDIRIssuesPaper.pdf, accessed 1 July 2018

12 Cutter S, Barnes L, Berry M, Burton C, Evans E, Tate E, Webb J (2008), Community and regional resilience: perspectives from hazards, disasters, and emergency management, CARRI Research Report 1, University of South Carolina

13 Deloitte Access Economics 2016, The economic cost of the social impact of natural disasters. March 2016,http://australianbusinessroundtable.com.au/assets/documents/Report%20%20Social%20costs/Report%20-%20The%20economic%20cost%20of%20the%20social%20impact%20of%20natural%20disasters.pdf , accessed 1 July 2018

14 Department of Employment (2014), Labour market conditions in the Ipswich-Logan region, https://docs.jobs.gov.au/system/files/doc/other/survey_of_employers_recruitment_experiences_in_ipswich-logan_report.pdf, accessed 1 July 2018

15 Department of Environment, Land, Water and Planning (2016), Demographics for Fire Risk Analysis Regional Victoria and per-urban Melbourne, Forward policy & Research Branch, June 2016, ISBN 978-1-76047-152-1

16 Felbermayr G, Gröschl, J (2014), Naturally negative: the growth effects of natural disasters, Journal of Development Economics, vol 111, pp. 92–106

17 Finch C, Emrich C, Cutter S (2010), Disaster disparities and differential recovery in New Orleans, Population and Environment, vol 31(4): pp.179-202

18 Flood Response Review Board (2011), Independent Review of Brisbane City Council's Response to the January 2011 Flood, https://www.brisbane.qld.gov.au/sites/default/files/emergency_management_Independent_Review_of_BCCs_Response_Final_Report_v4.pdf accessed 1 July 2018

19 Food and Agriculture Organisation of the United Nations (2015), The Impact of Natural Hazards and Disasters on Agriculture and Food Security and Nutrition: A call for action to build resilient livelihoods, http://www.fao.org/3/a-i4434e.pdf, accessed 1 July 2018

20 Frankenberg E, Sikoki B, Sumantri C, Suriastini W, Thomas D (2013), Education, vulnerability, and resilience after a natural disaster, Ecology and Society vol 18(2), p.16

21 Gibbs L, Bryant R, Harms L, Forbes D, Block K, Gallagher HC, Ireton G, Richardson J, Pattison P, MacDougall C, Lusher D, Baker E, Kellett C, Pirrone A, Molyneaux R, Kosta L, Brady K, Lok M, Van Kessell G, Waters E, (2016), Beyond Bushfires: Community Resilience and Recovery Final Report, November 2016, University of Melbourne, Victoria, Australia

22 Ipswich City Council (2011), First Submission to the Queensland Flood Commission Inquiry: Submission on Flood Preparedness by the Ipswich City Council, http://www.floodcommission.qld.gov.au/__data/assets/file/0006/10878/Ipswich_City_Council_first_submission.pdf accessed 1 July 2018

23 Kousky C (2014), Informing climate adaptation: A review of the economic costs of natural disasters, Energy Economics, vol 46, pp.576–592

24 Lazzaroni S, van Bergeijk P (2014), Natural disasters' impact, factors of resilience and development: A meta-analysis of the macroeconomic literature, Ecological Economics, vol 107, pp. 333–346

25 Loayza N, Olaberria E, Rigolini J, Christiaensen L (2012), Natural Disasters and Growth: Going Beyond the Averages, World Development, vol 40(7), pp. 1317–1336

26 Local Government Association of Queensland (2014), Submission into the Inquiry into Natural Disaster Funding, Productivity Commission Issues Paper: Appendix A: Estimates of cost of natural disaster events for Queensland council assets, 9 May 2014, https://www.pc.gov.au/inquiries/completed/disaster-

funding/submissions/submissions-test/submission-counter/sub034-disaster-funding-attachment.pdf , accessed 1 July 2018

27 Lockyer Valley Regional Council (2014), Submission to the Australian Government Productivity Commission Response to Natural Disaster Funding Arrangements Draft Report September 2014, https://www.pc.gov.au/inquiries/completed/disaster-funding/submissions/submissions-test2/submission-counter/subdr125-disaster-funding.pdf , accessed 1 July 2018

28 Queensland Floods Commission of Inquiry (2012), Final Report, March 2012, http://www.floodcommission.qld.gov.au/publications/final-report, accessed 1 July 2018

29 Queensland Government (2012), Submission to The Natural Disaster Insurance Review; and Commonwealth House of Representatives Standing Committee on Social Policy and Legal Affairs inquiry into the operation of the insurance industry during disaster events, July 2011, http://www.ndir.gov.au/content/submissions/issues_paper_submissions/Queensland_Government.pdf

30 Queensland Office of the State Coroner (2012), Inquest into the deaths caused by the south-east Queensland floods of January 2011, 5 June 2012, https://www.courts.qld.gov.au/__data/assets/pdf_file/0019/152362/cif-seq-floods-20120605.pdf, accessed 1 October 2018

31 Queensland Reconstruction Authority (2011), Disaster Event – Queensland flooding and Tropical Cyclones Tasha and Anthony, November 2010 – February 2011, supplied.

32 Queensland Reconstruction Authority, (2017), Brisbane River Strategic Floodplain Management Program, https://www.qra.qld.gov.au/sites/default/files/2018-11/strategic_floodplain_management_program.pdf, accessed 10 October 2018

33 Queensland Treasury (2011a), Executive Minute: Impact of the Queensland Floods on House Prices and Rents - 20 January 2011 , http://archive.treasury.gov.au/documents/2049/PDF/26_TEM_Impact_of_the_Queensland_Floods_on_House_Prices_and_Rents_110120.pdf, accessed 1 July 2018

34 Queensland Treasury (2011b), Queensland Economic Review March 2011, http://www.qgso.qld.gov.au/products/reports/qld-econ-review/qld-econ-review-201103.pdf

35 Queensland Treasury (2011c), June 2011 http://www.qgso.qld.gov.au/products/reports/qld-econ-review/qld-econ-review-201106.pdf , accessed 1 July 2018

36 Queensland Treasury (2012), Budget Paper 2: Budget Strategy and Outlook, Queensland Budget 2011-12, https://s3.treasury.qld.gov.au/files/bp2-2011-12.pdf, accessed 1 July 2018

37 Rose A, (2007), Economic resilience to natural and man-made disasters: Multidisciplinary origins and contextual dimensions, Environmental Hazards, vol 7(4), pp. 383–398

38 Schumacher I, Strobl E (2011), Economic development and losses due to natural disasters: The role of hazard exposure, Ecological Economics, vol 72, pp. 97–105

39 Somerset Regional City Council (2012), Annual Report 2011-12, http://www.somerset.qld.gov.au/annual-reports, accessed 1 July 2018

40 Stephenson C (2010), The impacts, losses and benefits sustained from five severe bushfires in south-eastern Australia, Department of Sustainability and Environment: Fire and adaptive management report no. 88, Bushfire and Natural Hazards CRC

41 Winsemius H, Jongman B, Veldkamp T, Hallegatte S, Bangalore M, & Ward P (2018), Disaster risk, climate change, and poverty: Assessing the global exposure of poor people to floods and droughts. Environment and Development Economics, vol 23(3), pp. 328-348

42 Yu, K.D, Tan R.R, Aviso K.B, Promentilla M.A.B, Santos J.R (2014), A Vulnerability Index for post-disaster key sector prioritization, Economic Systems Research, vol 26(1), pp. 81–97

APPENDICES

APPENDIX 1

TABLE 5 Population Vulnerability Indicators and corresponding ABS SEIFA Indexes Indicators

Indicator	Index of Relative Social Disadvantage	Index of Economic Resources	Index of Education and Occupation	Indicator description
Single parents	**ONEPARENT**	**ONEPARENT**	—	Face demands of dependent children but with no additional support
Volunteering	—	—	—	More likely to have social networks which can be of assistance in times of emergency by providing information, support and resources
Income	**INC_LOW**	INC_HIGH **INC_LOW**	—	Low income households may face more difficulty in recovering materially from a disaster. They may also be underinsured or uninsured
Employment and Occupation	**UNEMPLOYED** **OCC_LABOUR** **OCC_DRIVERS** **OCC_SERVICE_L** **CHILDJOBLESS**	**UNEMP_RATIO** **UNEMPLOYED1 (2016 only)**	**UNEMPLOYED** OCC_SKILL1 OCC_SKILL2 **OCC_SKILL4** **OCC_SKILL5**	
New to region	—	—	—	If a person has moved to an area in recent years, they may be unfamiliar with local environmental hazards and may be unaware of procedures for preparing for, or responding to, an emergency
Housing	**LOWRENT** **OVERCROWD** **RENT_SOCIAL (2006 only)**	**LOWRENT** **HIGHRENT (2006 only)** **RENT_SOCIAL (2006 only)** **OVERCROWD** **OWNING** **MORTGAGE** **HIGHBED** **HIGHMORTGAGE** **LONE** **GROUP (2011 and 2016)**	—	Socio-economic disadvantage is a requirement for receiving public housing and those who are disadvantaged are likely to have a variety of social and economic problems that may require additional support in an emergency situation Absentee owners may not have high levels of engagement with the local community nor may they have the time to attend meetings or undertake full fire preparations on their property
Education level	NOSCHOOL (2006 only) NOQUAL (2006 only) NOYR12ORHIGHER NOEDU	—	NOYR12ORHIGHER CERTIFICATE **ATUNI** DIPLOMA NOEDU (2016 only) NOYEAR12 (2006 only) NOQUAL (2006 only)	People with high levels of education are more likely to understand a range of information related to risks and preparation as well as warnings information

Need assistance	**DISABILITYU70**	—	—	People who identify that they have a need for assistance with self-care are likely to need help in an emergency, for instance with evacuation. **Youth at risk:** Dependent on others for care **Elderly:** Tend to be frailer, have more health issues, and may be dependent on others for care. While individual older people may be fit and active, aggregate data show that the number of people needing assistance increases with age
Car ownership	**NOCAR**	**NOCAR**	—	People with no car access will be unable to evacuate themselves in an emergency
Language Proficiency	**ENGLISHPOOR**	—	—	People with limited English may find it more difficult to access or understand various emergency messages and information
Indigenous	**INDIGENOUS (2006 only)**	—	—	Indigenous Australians are more likely to have socio-economic disadvantage in relation to health status, education and employment outcomes, and life expectancy compared to non-Indigenous
Other	NONET DIVORCED (2006 only)	—	—	—

SOURCE 9 DELWP, 2012 (Vulnerability Indicators); ABS, CAT 2039.0.55.001, 2006 (SEIFA Indicators)