

**Sea-level Rise and Flood Risk Perceptions
of Residents and Businesses
in Port Adelaide, South Australia**

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DEDICATION

I dedicate this work to

Professor Graeme John Hugo AO

(5 December 1946 – 20 January 2015),

who had offered extraordinary supervision

with immense knowledge, enthusiasm and vision

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ABSTRACT

The human-environment nexus has yet to be fully understood in the context of natural hazards and climate change. This thesis provides a case study of the issues relating to flood risk perception and response to present and future sea level rise scenarios in Port Adelaide. The study employed a mixed-method approach, using quantitative and qualitative analyses, to include a survey of households in the area to gauge their perceptions of risk and the ways they have experienced, and adapted to, floods that occur frequently. In-depth interviews were also undertaken with local businesses to establish the context for understanding the problems and the ways in which they have adapted to flood situations and the likelihood of future changes.

The resident survey indicated that the risk from storm tides was largely overlooked and the main concern related to local flooding. The property owners mainly wanted to improve drainage capacity to cope with storm water, rather than consider the long-term effects of sea-level rise. The majority of residents did not consider sea-level rise seriously. In general, flood impact was not high on their environmental concerns, as most residents tended to perceive the risks (such as those from king tides) as acceptable. Although storm tides had caused some inconvenience and minor flooding, complaints were mainly about inundation induced by extreme rainfall events. To overcome the impact of floods, government planning was seen to be inadequate to protect properties.

The survey of businesses suggested that overall flood risk was not a major concern. The participants tended to describe their on-site water problems as “unusual weather conditions”, including wave damage to port facilities and tidal inundation to the shipyards and workshops. As a consequence, business activities were temporarily disrupted with concerns about the extra costs of cleaning and repair. Raising the ground level of their site was regarded as too costly by small and medium-scale business owners, as was constructing a breakwater extension. To some large businesses, a potential

hazardous inundation of fuel terminals raised concerns about fire, pollution and the likely impacts on the State's public fuel supply.

Insights into business responses and the risk perceptions of residents for the study area indicate that the stakeholders were more likely to respond when they perceived higher risks from floods. Specifically, businesses with larger adaptive capacity demonstrated proactive adaptation to flood impacts. The statistical modelling results also emphasised a number of influences on risk perception and response related to socio-demographic, spatial and psychological factors. The significant impact on business capital value suggests it is a credible indicator for predicting adaptive response under sea-level rise scenarios.

The study recommends that the State government consider optimising the Sea-level Rise Planning Benchmarks in line with up-to-date predictions. The findings from this research can be used to inform decision-making processes (in particular those relating to land-use planning, coastal infrastructure developments and insurance policies), by providing a means to better determine such things as risk assessment, risk perceptions and the causal factors behind consequential risk adaptation.

DECLARATION

I certify that this work contains no material which has been accepted for the award of any other degree or diploma in my name, in any university or other tertiary institution and, to the best of my knowledge and belief, contains no material previously published or written by another person, except where due reference has been made in the text. In addition, I certify that no part of this work will, in the future, be used in a submission in my name, for any other degree or diploma in any university or other tertiary institution without the prior approval of the University of Adelaide and where applicable, any partner institution responsible for the joint-award of this degree.

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Dandong Zheng

May 24th 2017

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ABBREVIATIONS AND ACRONYMS

ABS	Australian Bureau of Statistics
AHD	Australian Height Datum
ARI	Average recurrence intervals (in years)
AR4 (IPCC)	IPCC Fourth Assessment Report (2007)
AR5 (IPCC)	IPCC Fifth Assessment Report (2014)
ASGS	Australian Statistical Geography Standard (2011)
BOM	Bureau of Meteorology, Australian Government
DTM	Digital Terrain Model
IPCC	Intergovernmental Panel on Climate Change
ISO	International Organization for Standardization
LGA	Local Government Areas, a Non – ABS Structure (structure not defined by the ABS in ASGS, but is approximated using region from the ABS Main Structure)
NCCARF	National Climate Change Adaptation Research Facility (Australia)
PAE(C)	City of Port Adelaide Enfield or the Port Adelaide Enfield City Council
SA2	Statistical Area Level 2 (ASGS)
SLR	Sea-level rise
SRES	IPCC Special Report on Emissions Scenarios (2000)
SREX (IPCC)	IPCC Special Report “Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation” (2012)
TAR (IPCC)	IPCC Third Assessment Report (2001)
WGII AR5	IPCC Fifth Assessment Report: “Climate Change 2014: Impacts, Adaptation and Vulnerability, Working Group II

GLOSSARY OF TERMS

Acceptable risk

‘A concept describing that level of risk that is sufficiently low that society is comfortable with it. Society does not generally consider expenditure in further reducing such risks justifiable’ (Koob 1998, p. 1).

Adaptation

In human systems, the process of adjustment to actual or expected climate and its effects, in order to moderate harm or exploit beneficial opportunities. In natural systems, the process of adjustment to actual climate and its effects; human intervention may facilitate adjustment to expected climate.

Adaptive capacity

The combination of the strengths, attributes, and resources available to an individual, community, society, or organisation that can be used to prepare for and undertake actions to reduce adverse impacts, moderate harm, or exploit beneficial opportunities.

Climate extremes (extreme weather/climate events)

The term generally refers to the occurrence of a value of a weather or climate variable above (or below) a threshold value near the upper (or lower) ends of the range of observed values of the variable. For simplicity, both extreme weather events and extreme climate events are referred to collectively as ‘climate extremes’ (IPCC 2012, p. 557).

Exposure

‘The presence (location) of people, livelihoods, environmental services and resources; infrastructure, or economic, social, or cultural assets in places that could be adversely affected’ (IPCC 2012, p. 559).

Mean sea level

Sea level is measured by a tide gauge with respect to the land upon which it is situated. Mean sea level is normally defined as the average relative sea levels over a period, such as a month or a year, long enough to average out transients such as waves and tides (IPCC 2012, p. 561).

Mental model

‘Mental models are personal, internal representations of external reality that people use to interact with the world around them’ (Jones et al. 2011, p. 2).

Port Adelaide 2005 Flooding Study

‘Port Adelaide Seawater Storm water Flooding Study’, a flood risk assessment commissioned by Tonkin Consulting and WBM Oceanics Australia in 2005, in conjunction with funding from the Federal and State government agencies.

Storm surge

The temporary increase, at a particular locality, in the height of the sea due to extreme meteorological conditions (low atmospheric pressure and/or strong winds); defined as being the excess above the level expected from the tidal variation alone at that time and place (IPCC 2012, p. 563).

Subjective norm

In the theory of planned behaviour (TPB), subjective norm means perceived social pressure arising from one’s perception to engage or not to engage in a behaviour (Ajzen and Fishbein 1980, p. 6).