The implications of extreme weather events for hospital design and facilities management - a case study approach

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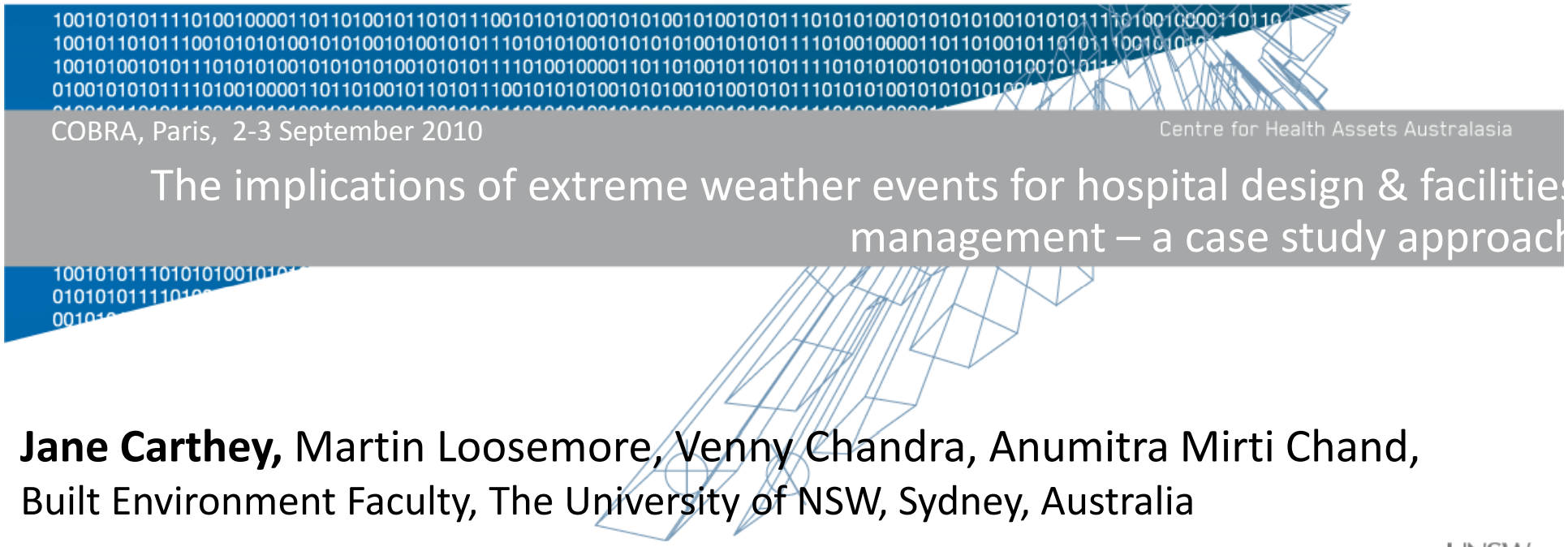

COBRA, Paris, 2-3 September 2010

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The implications of extreme weather events for hospital design & facilities management – a case study approach

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Project Title:

Assessing the adaptive capacity of hospital facilities to cope with climate-related extreme weather events: a risk management approach

Research Question:

How can hospital buildings become more resilient when faced with extreme weather events?

ARC Linkage Project: Australian Research Council (Australian Government)

Academic Partners: A. Pitman (Science, UNSW); A. McMichael, K. Dear (ANU)

Industry Partner: M. Meurisse, Pacific Palisade

Industry Funding Partners: NSW Health, QLD Health, SA Health and NZ MOH

Phase 1: 2009	vulnerability assessment
Phase 2: 2010	assess adaptive capacity / develop adaptation strategies
Phase 3: 2011	action plan + evidence base for design and adaptation strategies

Introduction

Why hospitals? Some thoughts:

More demands being placed on health systems as a result of climate change including increasing incidences of extreme weather.

Creates unique physical and patient demand challenges not envisaged in the original design of health facilities.

During (and immediately following) an extreme weather event, hospitals:

- are the main point of contact for coordination exercises
- have to deal with additional patient loads as a direct result of the event
- have to remain functional in adverse circumstances
- become a place of refuge from other less resilient buildings

Some definitions:

Intergovernmental Panel on Climate Change (McCarthy et al, 2001)

Sensitivity – the degree to which a system is affected either adversely or beneficially by climate change (encompasses all elements, direct and indirect effects)

Vulnerability – the degree to which a system is susceptible to, or unable to cope with, adverse effects of climate change, including climate variability.

Adaptive Capacity – the ability of a system to adjust to climate change, including climate variability and extremes, to moderate potential damages, to take advantages of opportunities, or to cope with the consequences.

Expanded further to:

Vulnerability = the problems that a system will have functioning when exposed to undesirable incidents and the problems it will experience in returning to a normal state of affairs after the event (Lisø, 2006)

Method

- Research Framework
- Case Study Selection
- Data Collection

Method

- **Research Framework**

'Case study methodology' – developing theory inductively by recognising patterns of relationships across cases and the underlying logical arguments.

Rationale:

- Hospitals are complex - many diverse stakeholders
- Responses to extreme weather events are similarly complex and involve an interplay of many economic, social, organisational, political and cultural considerations – can only be explored fully using a case study approach (Yin, 2009)

Method

Case Study Selection - extreme weather events

Jurisdiction	Case study	Study issue
NSW	Coffs Harbour Base Hospital	flash flooding (creek)
QLD	Cairns Base Hospital	cyclones
New Zealand	Whangarei Hospital, Northland	flooding (from river & heavy rain)
SA	Ceduna Health Service	heatwaves

Method

Case Study Selection

- Past records of extreme weather
- Size and age of hospital
- Total population dependencies
- Future climate projections

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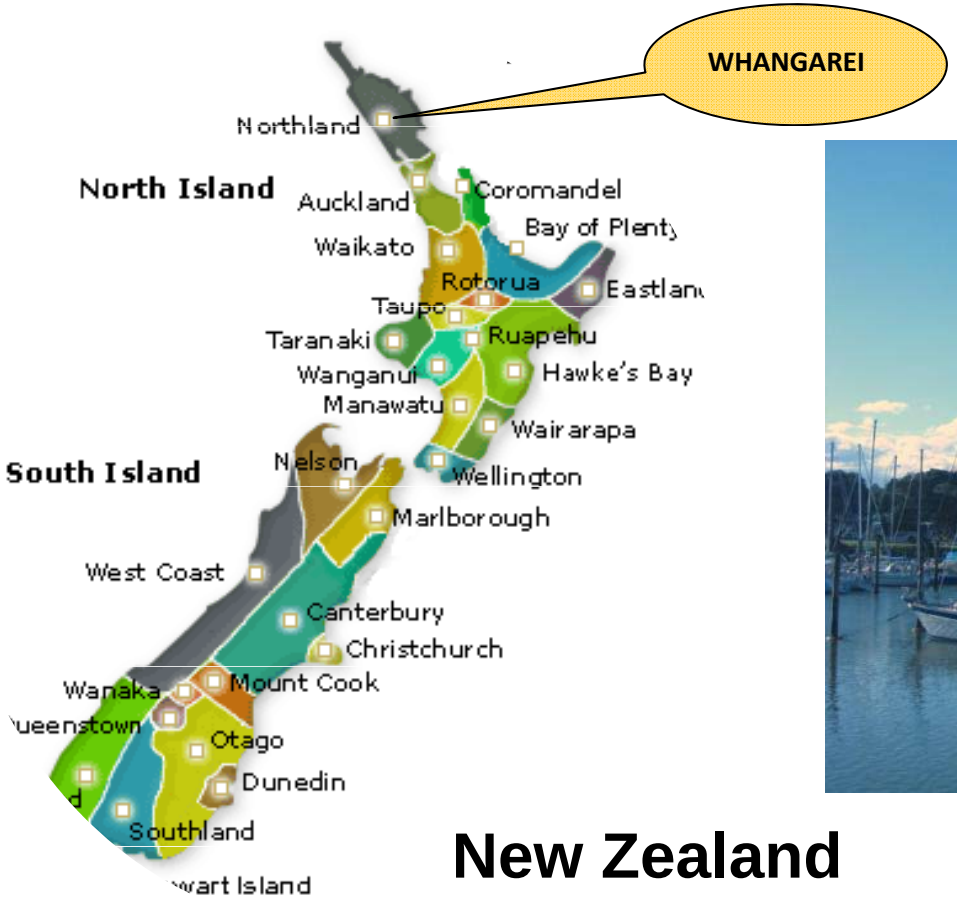
Case Study – extreme weather event:

NZ – Whangarei Hospital – storms/flooding



New Zealand

ARC Linkage Project LP0884116

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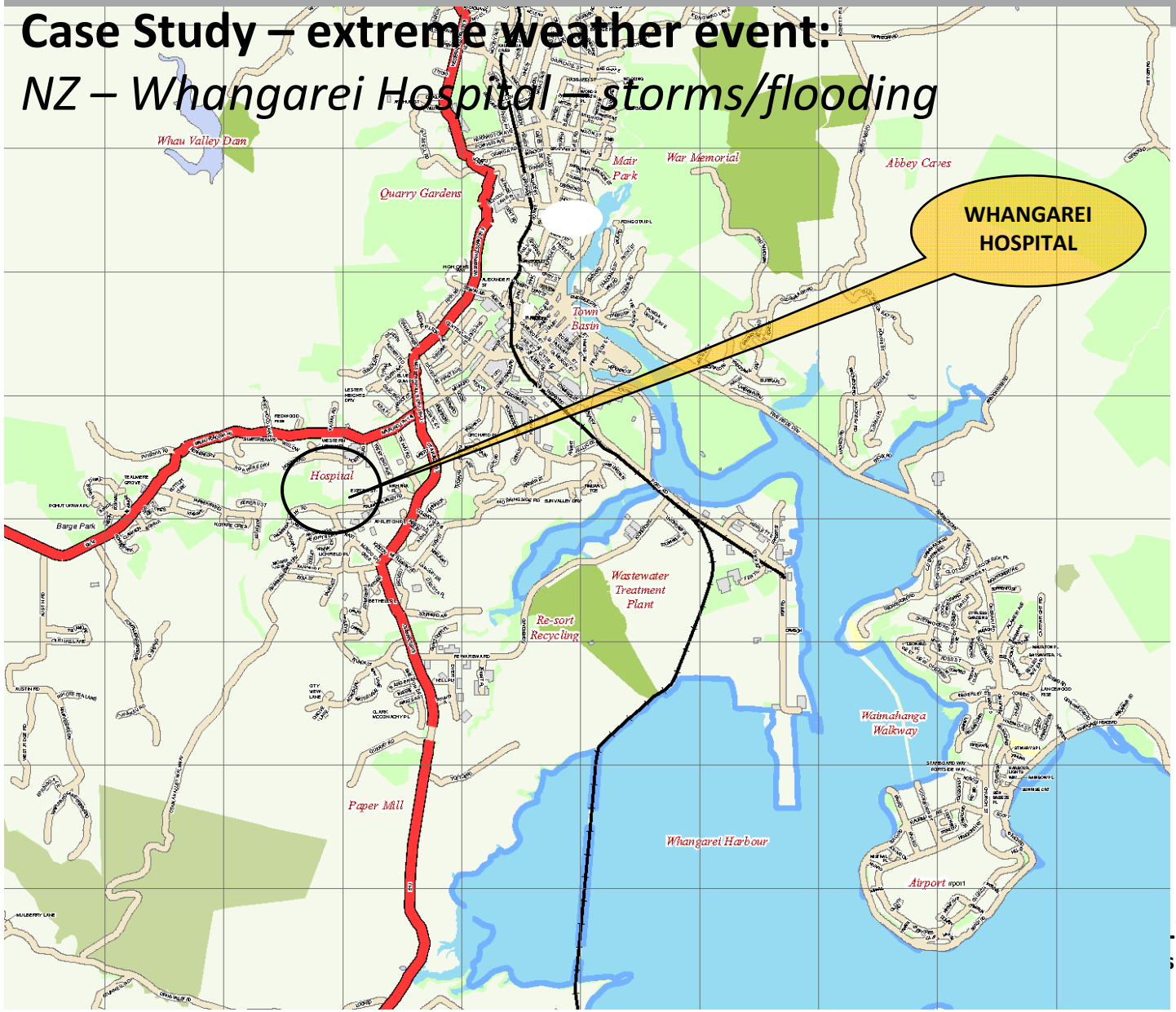
Case Study – extreme weather event:

NZ – Whangarei Hospital – storms/flooding

- Largest hospital in Northland area – New Zealand
- Population of ~ 150,000 – growing at 10% per annum
- Large Maori (indigenous population)
- Major referral hospital in region – secondary level
- 240 inpatient beds
- On present site since 1900; buildings of varying age and condition – most from 1950/60s; major renovation in 2001.
- Earthquakes – NZ issue
- Climate will become warmer, drier + unpredictable weather patterns/more storms & flooding in summer & autumn

Case Study – extreme weather event:

NZ – Whangarei Hospital – storms/flooding



- On a hill with limited access roads – can be cut off due to floods/storm damage
- History of storm-related flooding and road to hospital being blocked; steel framed windows blowing in, etc.

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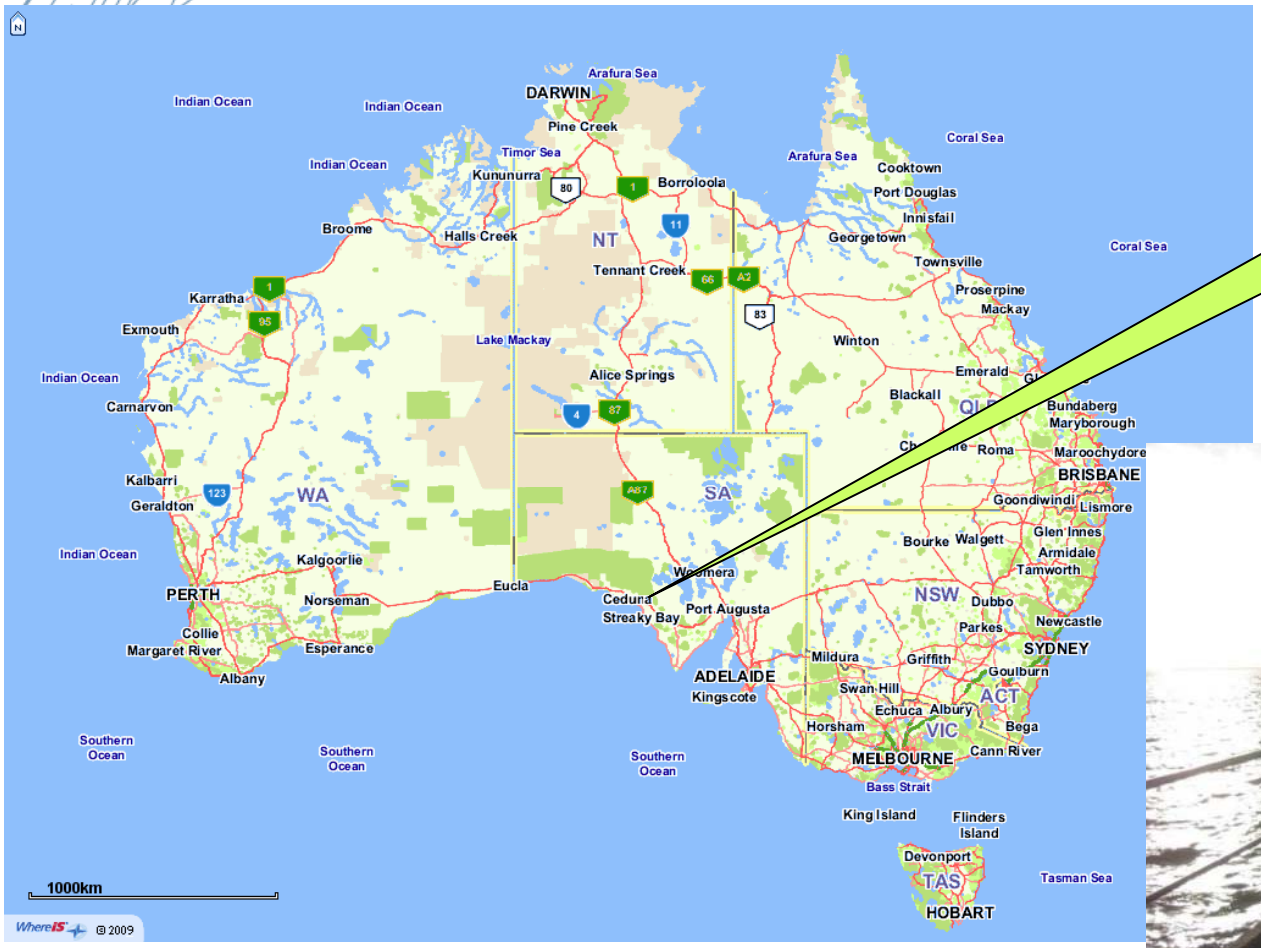
Case Study – extreme weather event:

SA – Ceduna Health Service - heatwaves



Case Study – extreme weather event:

SA – Ceduna Health Service - heatwaves

- Remote – 10 hours from Adelaide
- Some people drive 8 hours to the hospital
- Large indigenous population – poor health status
- ~3700 pop'n total + tourists passing through (up to 20,000 p.a.)
- arid / hot summers / limited rainfall
- 2008: 12 days >35degC; early 2009: 46.2degC
- 25 acute beds + 10 beds High Care aged care + primary health + independent aged care

Case Study – extreme weather event:

SA – Ceduna Health Service

- heatwaves

CEDUNA HEALTH SERVICE

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Case Study – extreme weather event:

SA – Ceduna Health Service - heatwaves

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Case Study – extreme weather event:

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Method

Data Collection:

"Risk and Opportunity Management System" (ROMS)

Workshop conducted using ROMS (www.risk-opportunity.com).

- Structured approach / international standards of risk management
- Identify and prioritise stakeholder objectives
- Identify risks and opportunities
- Assess and prioritise
- Develop Action Plan to address

Focus group of key stakeholders

Ability to implement project objectives

Objectives affected by project outcomes

	Low	High
Low	**Minor Stakeholders** All Support Services (e.g. Cleaners, Kitchen, etc) Trade Services Other Government Department Laboratories / pathology	**Important Stakeholders** Utility (essential) services – power, water, gas Civil Defence and emergency service - (SES) Public Works Dept (State level government dept) Security Patients and community (indigenous, socially disadvantaged, aged, disabled, young, LSE) Staff / Services
High	**Major Stakeholders** Local Government Designers Union	**Key Stakeholders** Director Corporate Services Director of Nursing Facilities Manager including IT Emergency Management Personnel Director of Medical Services Ambulance / emergency services Corporate Asset Manager Quality and Safety Management Public Relations Personnel

Focus group of key stakeholders – objectives

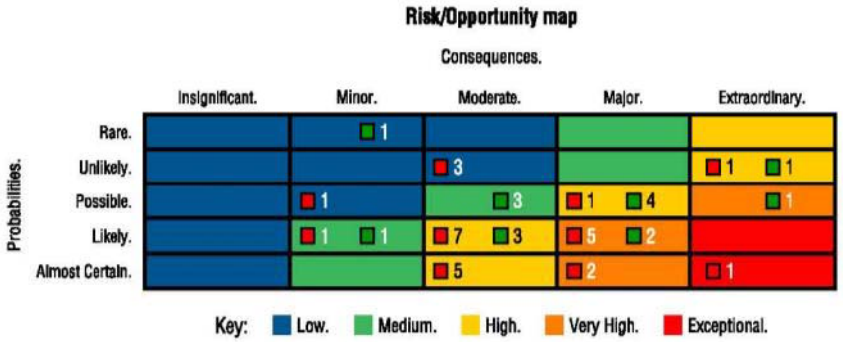
#	Whangarei - Common Objectives	Weighting	Ceduna - Common Objectives	Weighting
1	Maintain physical integrity of the building fabric (leaking roof, windows, flooded basements, etc)	30%	To ensure essential services / utility supplies continue to be delivered during the event (ICT, airconditioning, fridges, water supply, power, etc)	40%
2	Ensure adequate access (staff, patients, emergency services, contractors, suppliers, etc)	20%	To ensure that we have enough staff (nursing, medical, ancillary, etc) available for work even if on leave	30%
3	Ensure appropriate resources to maintain service delivery (staff, food, essential services such as power, IT, water, etc)	20%	To ensure we can manage a large influx of patients (heat stroke, dehydration, etc) – adequate supplies, flexible space, adequate service capacity, pumps, etc.	10%
4	Adequate surge capacity to cope with influx of patients during the event	20%	To coordinate with other health services, emergency services such as SES, fire services, etc to enable coordinated response (to fires, other events when we are already overloaded - -n 200km radius)	10%
5	Maintaining communications with key stakeholders (staff, minister, public, emergency services, etc)	10%	To ensure we can transport supplies/patients etc to and from community (especially Aboriginal communities)	10%

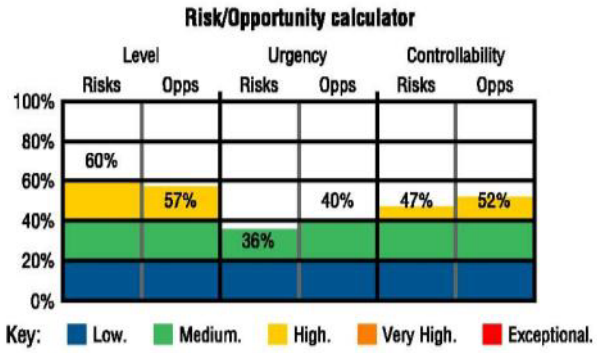
Development of Risk Profile – Whangarei – highest ranked objective

	Risks and Opportunities	Existing controls	Probability	Consequence	Level	Urgency	Controllability	Rank
Objectives	**Maintain physical integrity of the building fabric (leaking roof, windows, flooded basements, etc) (weighting 30%)**	**Excellent Good Adequate Inadequate**	**Rare Unlikely Possible Likely Almost certain**	**Insignificant Minor Moderate Major Extraordinary**	**Low Medium High Very high Exceptional**	**Low Medium High**	**Low Medium High**	**1-45**
Risks	Windows fall out (steel-framed windows in particular) and lack of materials to repair them	Inadequate	Almost certain	Major	Very high	Medium	High	12
	Plant rooms become flooded (most infrastructure is located in basements or in ceiling space which can become flooded)	Adequate	Likely	Major	Very high	Very High	Low	15
	Water ingress through roof (flat roof collects water)	Adequate	Likely	Moderate	High	Medium	Medium	23
	Emergency services not being available to pump out basements	Adequate e	Unlikely	Extraordinary	High	Low	Medium	28
	Waste system can become flooded (because its under the buildings)	Inadequate	Possible	Major	High	Low	Medium	28
	Local authority system floods (if this floods then our system is affected)	Inadequate	Almost Certain	Moderate	High	Low	Low	31
	Getting contractors to site to undertake repairs (after the event due in particular to their capacity constraints)	Good	Unlikely	Moderate	Low	Low	Medium	44
Opportunities	Working with supply chain to develop products that are fit for future purpose (R & D program)	Inadequate	Possible	Major	High	High	High	19
	Increase energy efficiency of the asset without any interventions	Good	Likely	Moderate	High	High	High	19
	Self-sufficiency (rainwater harvesting, solar, change roof structure, etc)	Inadequate	Unlikely	Extraordinary	High	Medium	Medium	23

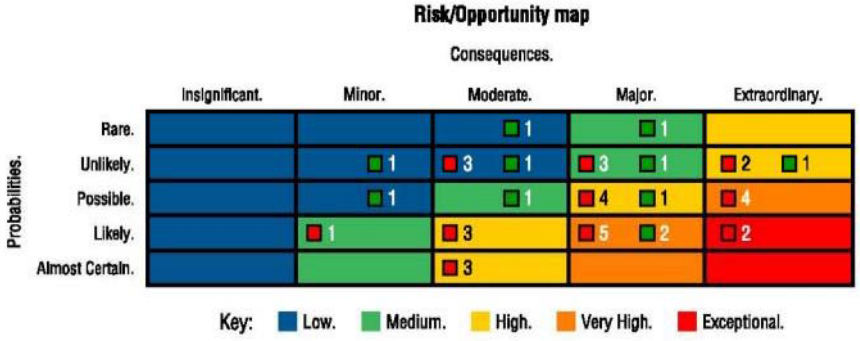
ROMS outputs – from risks identified

Whangarei Hospital



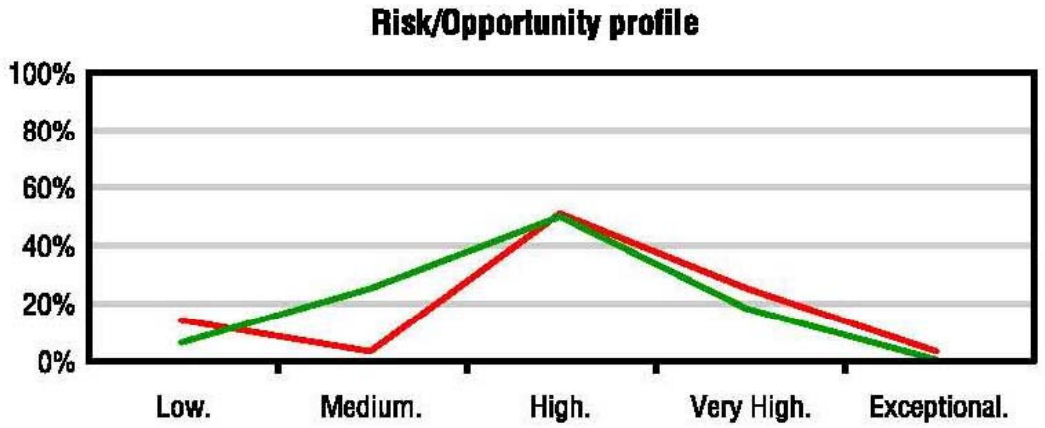


Ceduna Health Service



ROMS Step 5 Output – Risk/Opportunity profile

Whangarei Hospital



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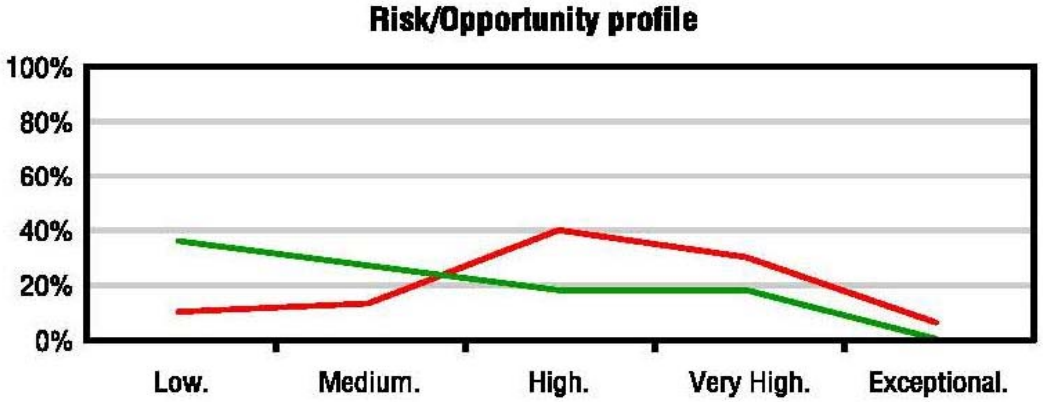

Conclusion

Main objectives identified in ROMS

Overall goal = maintaining continuity of service delivery during an extreme weather event

4 key areas associated with vulnerability resulting from extreme weather:

1. Availability of essential (building) services - supported by
2. Ensuring the physical integrity of the hospital
3. Effective inter-agency communication
4. Maintaining access to and from the hospital for staff and patients

Conclusion

- Risk profiles similar in terms of overall exposure to risk
- Ceduna has fewer opportunities to address the risks than Whangarei
- Remoteness and isolation are the biggest factors in creating risks to health service delivery – require greater levels of self sufficiency
- Next phase of research is further exploration of the risks and possible controls identified – with intention of developing an action plan to address key risks and opportunities.
- Continued development of an evidence base for suitable design and facilities management adaptation strategies for hospitals faced with increasing incidences of extreme weather events.

Next Steps

- Analyse results from follow-up workshop investigating adaptive capacity
- Explore relationship between building and organisational resilience
- Examine the cost of extreme weather events
- Further consider relevant theory/ies that explain(s) the results being discovered
- Develop an action plan to address issues identified (practical outcome for our industry partners)

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For more information about this and other initiatives by CHAA

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Thank you...