

## Research - Physical Environments for Healthcare Delivery (presentation)

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Centre for Health Assets Australasia

## RACMA NSW STATE COMMITTEE – 21 April 2010

### Research – physical environments for healthcare delivery

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Faculty of the Built Environment, University of New South Wales, Sydney, Australia





## CHAA and its research

- Introduction to CHAA
- AusHFG – funding, development, current program, the future; example of development process
- ARC Linkage project – Climate Change and Health Facilities
- Other research projects:
  - Health Infrastructure NSW – flexible and adaptable hospitals
  - Single rooms vs multi-bed rooms – Qld Health
  - ICT and technology developments – impact on design – NZ MOH
- Other Activities:
  - ACHSM / CHAA joint national conference 2010
  - Student projects
- Questions and Discussion

## Introduction to CHAA

- Based within the Faculty of the Built Environment at UNSW
- Result of Australia / NZ wide tender by Australasian Health Infrastructure Alliance (AHIA) representing State / Territory health depts of Australia and NZ
- 2 x 3 year research agreements – largely focused on development of Australasian Health Facility Guidelines (AusHFG); plus some additional competitive and other grants
- 2<sup>nd</sup> contract period ends at 31 Dec 2010 – the future?
- Expected to develop a broader research agenda and to seek ARC and other competitive funding – some success
- Only research program of its kind in Australia and NZ – new area of research in this country / region

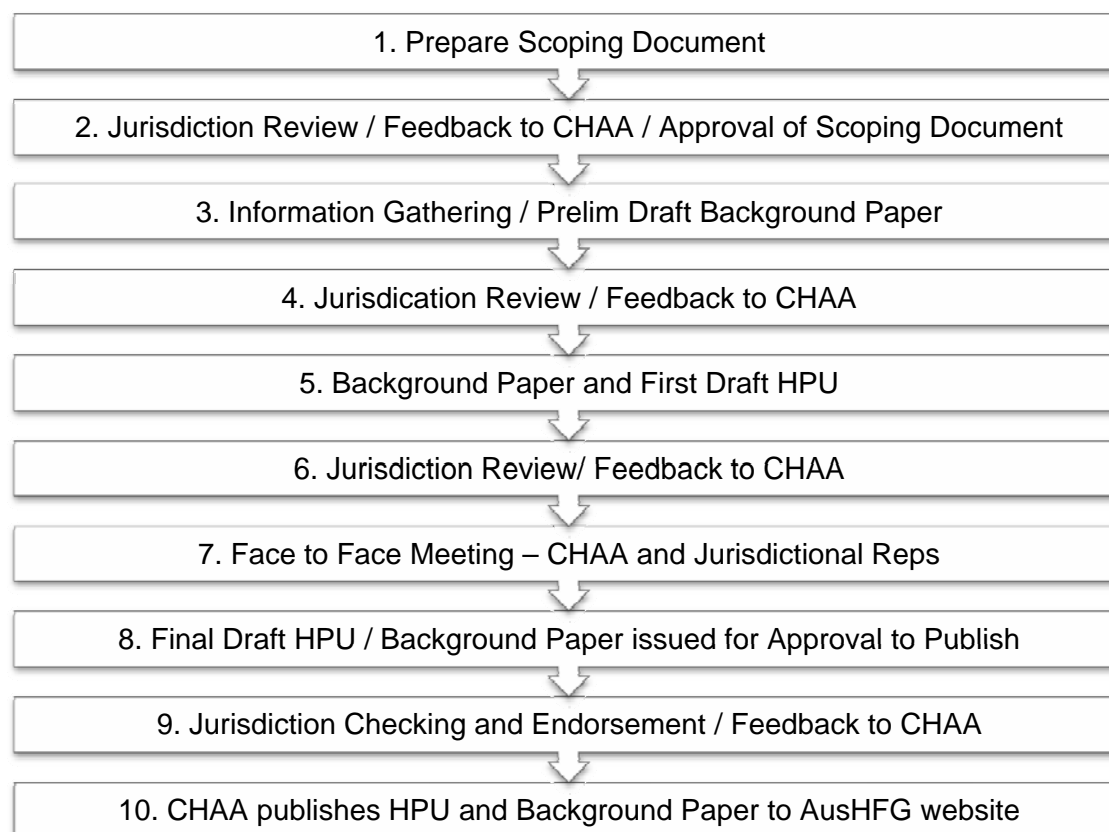
## **AusHFG Project – Rationale for their development**

- Australian health expenditure in 2005 – 06 was \$86.9billion or 9% of GDP, (AIHW 2008)
- Capital expenditure was 6% of this (\$5.2 billion)
- Design standards for health buildings are used to maximise returns on this investment
- Equity through providing a consistently high standard of facilities in all locations – urban, rural and remote
- Health facilities must suit their clientele (patients), their staff – clinicians and other workers, their communities and the purposes of those who pay for their development (State governments for public Australian health facilities)
- Therefore must be considered and their involvement in guideline many stakeholders development encouraged, yet managed, in a suitable manner in a politically sensitive environment.

## AusHFG - Introduction

- AusHFG are a web-based information tool free to download and use for the briefing and design of health projects
- Departure from long tradition of paper-based guidelines
- Used extensively on public health projects in Australia and New Zealand.
- Major project of Centre for Health Assets Australasia (CHAA) based at the University of NSW.
- Funded on a population % basis by all the State / Territory Health Depts in Australia and the NZ MOH.

# Review and Development of the Australasian Health Facility Guidelines



Development Process for AusHFG

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Part A – Introduction & Instructions for Use

Centre for Health Assets Australia



Part B – Briefing & Planning

80 General Requirements

90 Standard Components

Room Data Sheets (RDS)

Room Layout Sheets (RLS)

120 – 700 Health Planning Units (HPU)

Part C – Access, Mobility, OHS & Security

Part D – Infection Prevention & Control

Part E – Engineering Services

Part F – Project Implementation – NSW only

680 Furniture, Fittings & Equipment

950 Operational Commissioning

How to Use

Performance Recommendations & Advisory

Reference Only

**AusHFG -  
Structure**



## Review of the Operating Unit Guideline – HPU520

- **Evidence considered - Types of evidence**

- **Personal experience, opinions or perspectives** offered by clinicians, managers, health planners, architects, other designers and other experts resulting from their experience with current projects, clinical practice, or knowledge of forthcoming technologies, sometimes drawn from literature of various kinds, study tours, information from overseas colleagues, conferences, seminars, etc.
  - requires analysis and consideration of how to generalise these findings for use on all Australian/NZ projects.
  - strong feelings and forceful personalities may overly influence the conclusions drawn from these sources.
- **Examples drawn from current practice on projects** being briefed, designed, constructed or recently completed in Australia, New Zealand and more remotely.
  - whole project briefs including recurrent and capital cost estimates, outline of models of care, projected service demand, planning principles and schedules of accommodation to enable assessment of the context surrounding the evidence provided.
  - guards against special circumstances for one project becoming the role model for all future projects without an appropriately rigorous assessment of the approach adopted.

## Review of the Operating Unit Guideline – HPU520

- Evidence considered - Types of evidence (continued)
- **Literature offering opinions, examples of practice and the reasons for these** – within the Australian, New Zealand and other health systems.
  - range of literature available - newspaper articles, trade journals, technical reports, conference proceedings/presentations through to academic journal articles, etc. The research that this literature is drawn from thus varies in rigour, quality and applicability to the question being considered.
  - Rarely rigorous, peer-reviewed;
  - SG2 and Advisory Board reports – US-focussed, needs to be considered for Australian project context
- **Research evidence drawn from evaluation of existing projects** preferably analysing a ‘before and after’ scenario resulting from the proposed revision scenarios. e.g. testing whether increasing the size of operating theatres really does improves workflow, theatre utilisation, throughput and enhanced patient outcomes.
  - Extremely rare but would be more rigorous
  - Not possible to test everything or forecast all trends
  - Few examples of really useful post occupancy evaluations undertaken in Aust or NZ.

## Review of the Operating Unit Guideline – HPU520

- Evidence considered - Extent of evidence

*Evidence-based design is still in its infancy, and few elements promoted by the evidence-based design movement are supported by real evidence; for now, most facility investments are informed by preference and precedent, not compelling proof.*

*Innovations Center, 'Hospital of the Future, Lessons for Inpatient Facility Planning and Strategy', The Advisory Board Company, 2007*

### – Literature reviewed

- ANZCA,
- NHS Trust
- Academic papers - health journals
- Trade journals
- Qld Health papers
- SA Health papers
- Health Care Advisory Board
- Various workshop presentations made at SA Health workshop

## **Review of the Operating Unit Guideline – HPU520**

- Evidence considered - Using evidence to determine action and make decisions re guideline content and individual projects
  - SA Health workshop – presentations, brainstorming, feedback sessions
  - Review of information from current projects where available – SA, WA, Qld, NSW, Tas
  - Review of guidelines – AusHFG and Victorian

## Review of the Operating Unit Guideline – HPU520

- Issues raised
  - **Operating Room size** – need for more space, more complex procedures, advances in technology, flexibility/adaptability, increasing amount of equipment, specialist theatres, differing requirements for day, general/laparoscopy, major procedures, trauma, interventional imaging, etc
  - **Operating Room layout** including impact of workflow issues – standardising design, pods, dedicated specialties, workforce pressures, anaesthetic bays, hazards from cabling, hoses & carts, eqt booms, storage, eqt outside room, ergonomics, post anaesthesia care, etc
  - **Interventional Imaging** – incorporate imaging technologies – convergence, different planning models, ‘integrated interventional platforms’
  - **Operating room integration and IT infrastructure** – bandwidth, real-time, displays, lighting, digital technologies
  - **Other issues** – engineering, infection control

## **Review of the Operating Unit Guideline – HPU520**

- Context for making decisions re guideline content
  - Conservative stance adopted – a guideline can neither be ‘cutting edge’ nor totally out of date
  - Guidelines should not tell you more than you need to know and do not replace the need for project-specific research and decision-making
  - Guidelines prescribe a ‘minimum’ not a ‘maximum’ standard to be met
  - Can always be varied for individual projects based on service need, budget, other local requirements
  - Should not conflict with other parts of the AusHFG – due to sequential nature of review, this is not always possible but deviations are attended to as soon as they are recognised.

## **Review of the Operating Unit Guideline – HPU520**

- Decisions that need to be made in reviewing the guideline:
  - What to include in the revised guideline and what to leave out or for project teams or clients to determine.
  - Operating suite layout – pods of theatres, ‘clean’ and ‘dirty’ corridors, technology rooms, etc, etc
  - Size of rooms – operating rooms (especially), storage rooms and spaces, how big, how assembled in pods or units
  - How to determine the costs and benefits associated with changes to the current guideline esp in regard to future staffing levels, future technology, etc.
  - Is a consensus approach possible across Australia and NZ; what happens if this is not possible?

## Review of the Operating Unit Guideline – HPU520

- Outcome of review (preliminary)
  - Operating Room Size
    - Increase size of operating rooms – for Levels 4 – 6 range to 55 sqm
    - Specialty or trauma theatres may be larger (60sqm) in accordance with specific project requirements
    - Smaller theatres not recommended but possible (42sqm) to suit local req'ts
  - Operating Suite Layout
    - Consider vertical relationships between key elements to augment horizontal relationships
    - Control rooms/viewing rooms – more investigation needed
    - Increase storage – but by how much?
    - Induction rooms?
    - Planning models – 'barn theatres'?
    - HVAC – laminar flow, etc?



## **Review of the Operating Unit Guideline – HPU520**

- Outcome of review (preliminary)
  - Interventional Imaging
    - Need for a sterile operating environment for all interventions?
    - Access to PACS essential
    - Failsafe backup of critical infrastructure required
    - High quality networking and bandwidth requirements
  - Operating room integration and IT infrastructure
    - Bandwidth needs
    - Future integration of wireless and non-wireless environments
    - Electronic medical records
    - Flexible design required – view to future expansion of technologies
  - General Issues
    - Infection control issues require further investigation
    - Engineering covered under other topics

## **Review of the Operating Unit Guideline – HPU520**

The Way Forward – in final publication stages - 2010

- Major issues considered in the revised draft HPU include:
  - operating room size – everyone has an opinion!
  - allowance for technology provision – ‘crystal ball’??
  - planning for flexibility of use and future upgrades – some strategies proposed
  - new planning models for operating suites including pods, barn theatres, etc – need more information
  - spaces for different types, levels and sizes of facilities,
  - staffing and workforce issues – few real experts
  - storage needs – everyone says ‘more needed’ – how much?
  - capital and recurrent cost implications – first is relatively easy, but the second is difficult

## **ARC Linkage Project LP0884116**

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

**Research Question:** what are the risks posed by hospital facilities to effective healthcare delivery during extreme weather events?

**Partners:** NSW Health, SA Health, Qld Health and NZ MOH

**Budget:** Total = \$~900k

Stage 1: 2009 – vulnerability assessment – 4 case studies

Stage 2: 2010 – assess adaptive capacity / develop adaptation strategies

Stage 3: 2011 – Action Plan + evidence base for design and adaptation strategies → AusHFG

# **ARC Linkage Project LP0884116**

## **Case Studies – extreme weather events:**

NSW – Coffs Harbour Hospital – flooding (flash – creek)

Qld – Cairns Base Hospital - cyclone

SA – Ceduna MPS - heatwave

NZ – Whangerei Hospital – Northland (flooding from river /extreme rain)

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# ARC Linkage Project LP0884116

## Case Studies – extreme weather event:

NSW – Coffs Harbour Hospital – flooding (flash – creek)





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Nov 2009

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31 Mar 2009

# ARC Linkage Project LP0884116

## Case Studies – extreme weather event:

NSW – Coffs Harbour Hospital – flooding (flash – creek)



31 Mar 2009



# ARC Linkage Project LP0884116

## Case Studies – extreme weather event:

NSW – Coffs Harbour Hospital – flooding (flash – creek)



31 Mar 2009

# **ARC Linkage Project LP0884116**

## **NSW Case Study – extreme weather event:**

### **Coffs Harbour Hospital – flooding (flash – creek)**

Selected due to:

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

# **ARC Linkage Project LP0884116**

## **NSW Case Study – extreme weather event: Coffs Harbour**

### **Stage #1: Vulnerability Analysis**

Risk Management Workshop conducted using ROMS  
([www.risk-opportunity.com](http://www.risk-opportunity.com)).

“Risk and Opportunity Management Software”

- Structured approach / international stds of risk management
- Identify and prioritise stakeholder objectives
- Identify risks and opportunities
- Assess and prioritise
- Develop Action Plan to address (next stages of project)

# ARC Linkage Project LP0884116

## NSW Case Study – extreme weather event: Coffs Harbour

### Focus group of key stakeholders: Analysis

Ability to implement project objectives

		Low	High
Objectives affected by project outcomes	Low	<b>Minor Stakeholders</b> All Support Services (e.g. Cleaners, Kitchen, etc) Trade Services Other Government Department Laboratories / pathology	<b>Important Stakeholders</b> 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	<b>Major Stakeholders</b> Local Government Designers Union	<b>Key Stakeholders</b> 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

# ARC Linkage Project LP0884116

## NSW Case Study – extreme weather event: Coffs Harbour

### Stage #1: Vulnerability Analysis

### ROMS Output Step One

Step 1:

#### Project Information



	Project Information
Project Name	Coffs Harbour
Project Stage*	1
Workshop/Interview Number*	1
Workshop Faciliator*	Martin Loosemore
Workshop Participants	Physical resources representative
	Disaster management representative
	General Manager
	Director of nursing
	Director of medical services
	Health Department representative
Decision, Task or Problem	How do ensure that our facilities do not respresent a risk to our response to climate change related extreme weather events



# **ARC Linkage Project LP0884116**

## **NSW Case Study – extreme weather event: Coffs Harbour**

### **Stage #1: Vulnerability Analysis**

ROMS Output Step Two – choose level of complexity for analysis – chosen as level 3  
(scale 1 – 4 from simple – very complex / probabilistic analysis)

Step Three – Stakeholder consultation – to identify, rank, weight and agree on 5 objectives to be assessed.

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# ARC Linkage Project LP0884116

## NSW Case Study – extreme weather event: Coffs Harbour ROMS Step 3 Output – Stakeholder consultation

Step 3:

### Stakeholder Consultation



Key Stakeholders	Key Stakeholder Objectives
Physical resources representative	Maintain essential services (water, electricity, gas, communications (IT) communications, sewerage) Keep water out To respond to demands of service providers on site To Monitor the ongoing situation
Disaster management representative	To receive timely and accurate information to and from the wider emergency management sector (SES, police, ambulance, Coffs Harbour health campus) To ensure staff and patient safety To maintain service delivery to community
General Manager	To ensure continuity of service delivery To ensure access in and out of facility for staff, patients and emergency vehicles (to ensure resources available to cope, patients can get treatment etc) To maintain integrity of the facility (no flooding etc) Effective inter agency communication (vertical and horizontal) Accurate ongoing information to manage the risk (effective communications)
Director of nursing	No Objectives Entered
Director of medical services	Assurance of service provision for acute patients Assurance that we have key staff/resources available to provide core health services (access etc) That we have the key people to respond to the event itself
Health Department representative	To understand wider state implications from the event - communications (before, during, after)

Common Objectives	Key Performance Indicators (KPIs)
To ensure staff and patient safety (including vulnerable patients within the community ) Weighting: 40%	
Maintain essential services and physical fabric (water, electricity, gas, communications (IT) communications, sewerage and sufficient supplies) Weighting: 20%	
To ensure continuity of service delivery (core clinical services - theatre, emergency, maternity, ICU and ensuring adequate staff resources to deliver health services - senior management and health staff) Weighting: 20%	
To ensure timely access in and out of facilities for staff, patients and emergency vehicles (to ensure we maintain adequate resources and staff available to cope, patients can get treatment etc) - including wider access in catchment area Weighting: 10%	
Effective internal and external communications (EXTERNAL horizontal - SES, police, council, community services, power/energy - all LEMC members; Vertical - dept of health, HSFAC) INTERNAL - on-site services, staff etc Weighting: 10%	

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# ARC Linkage Project

LP0884116

## NSW Case Study – extreme weather event: Coffs Harbour ROMS Step 4 Output – Identify Risks and Opportunities

Step 4:

### Identify Risks & Opportunities



5 Common Objectives (Ranked)	Risks and Opportunities	Ways Risks and Opportunities Arise*
<p>To ensure staff and patient safety (including vulnerable patients within the community )</p> <p>Weighting: 40%</p>	<p>Flooding into clinical areas</p> <p>Roads being cut</p> <p>Inability to respond to speed of event</p> <p>Lack of disaster procedures for vulnerable patients</p> <p>Lack of ability to cope with surge of demand</p> <p>Unpredictability of pattern of event (intensity, nature/pattern/location of impact etc)</p> <p>Not having leadership available ON SITE causing poor coordination during event</p> <p>Adequacy of community age care facilities BCM plans and capacity to implement those plans</p> <p>Develop and implement flood mitigation strategy for the site (eg. Coffs Harbour bypass may present opportunity, engage with urban planning controls)</p> <p>Build a multistorey car park</p>	
<p>Maintain essential services and physical fabric (water, electricity, gas, communications (IT) communications, sewerage and sufficient supplies)</p> <p>Weighting: 20%</p>	<p>Flooding into essential services (usually in the basement)</p> <p>Inability of key maintenance staff to get to work</p> <p>Inadequate building design (eg. low pitch roof design, drains, essential services located in flood-prone areas - at low levels etc)</p> <p>No back-up essential services (due to cost savings etc)</p> <p>Just-in-time models for logistics resulting in reduced on-site stock levels</p> <p>External service providers - cessation of services such as food, linen, waste etc</p> <p>Not having an adequate minimum level of supplies maintained (fuel, food, etc)</p> <p>Capacity of emergency services to get necessary resources to site</p> <p>Increase self-sufficiency (utilise roof space for water collection, solar, use of new technologies etc)</p> <p>Revise HPG and other regulations and guidelines re: design and planning of critical infrastructure</p>	
<p>To ensure continuity of service delivery (core clinical services - theatres, emergency, maternity, ICU and ensuring adequate staff resources to deliver health services - senior management and health staff)</p> <p>Weighting: 20%</p>	<p>Specialist staff themselves being affected by the flood (cant get to work - their priority will be their family and property)</p> <p>Lack of new growing population's knowledge of flood events</p> <p>Being regional we have a limited pool of casual staff and specialised staff to draw on and no back-up supply of staff (eg. intensive care nurses)</p> <p>Timing of the event - if occurs after hours increased risk</p> <p>Lack of availability of staff over an extended period - replacement of fatigued staff</p> <p>Adapting other facilities to accommodate staff during an emergency</p>	
<p>To ensure timely access in and out of facilities for staff, patients and emergency vehicles (to ensure we maintain adequate resources and staff available to cope, patients can get treatment etc) - including wider access in catchment area</p> <p>Weighting: 10%</p>	<p>Hub and spoke model of service delivery can be compromised by loss of access in wider catchment area</p> <p>Singular access to the site and potential secondary access is also flood-prone</p> <p>Availability of appropriate vehicles to cross flooded areas (eg. water police, boats, large 4WD etc)</p> <p>Co-location of ambulance means cant get out during a flood</p>	

# ARC Linkage Project LP0884116

## NSW Case Study – extreme weather event: Coffs Harbour

### ROMS Step 5 Output – Assess and Prioritise

#### Step 5:

#### Assess and Prioritise

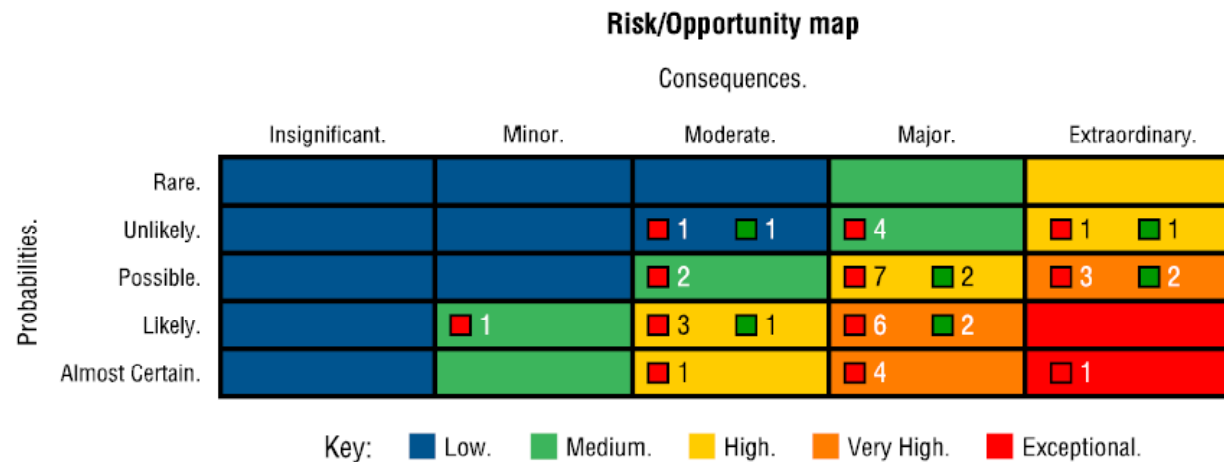


Risks and Opportunities	Existing Controls	Probability	Consequence	Level	Urgency*	Controllability*	Rank
To ensure continuity of service delivery (core clinical services - theatres, emergency, maternity, ICU and ensuring adequate staff resources to deliver health services - senior management and health staff)	Excellent (E) Good (G) Adequate (A) Inadequate (I)	Rare (R) Unlikely (U) Possible (P) Likely (L) Almost Certain (A)	Insignificant (I) Minor (Mi) Moderate (Mo) Major (Ma) Extraordinary (E)	Low (L) Medium (M) High (H) Very High (V) Exceptional (E)	Low (L) Medium (M) High (H)	Low (L) Medium (M) High (H)	1-45
Weighting: 20%							
Specialist staff themselves being affected by the flood (cant get to work - their priority will be their family and property)	Adequate	Almost Certain	Major	Very High	Low	Low	18
Being regional we have a limited pool of casual staff and specialised staff to draw on and no back-up supply of staff (eg. intensive care nurses)	Adequate	Almost Certain	Major	Very High	Low	Low	18
Lack of availability of staff over an extended period - replacement of fatigued staff	Good	Likely	Moderate	High	Low	Medium	28
Lack of new growing population's knowledge of flood events	Inadequate	Likely	Moderate	High	Low	Low	31
Timing of the event - if occurs after hours increased risk	Good	Possible	Moderate	Medium	Low	Low	40
Adapting other facilities to accommodate staff during an emergency	Good	Likely	Moderate	High	Low	Medium	28

# ARC Linkage Project LP0884116

## NSW Case Study – extreme weather event: Coffs Harbour

### ROMS Step 5 Output – Assess and Prioritise

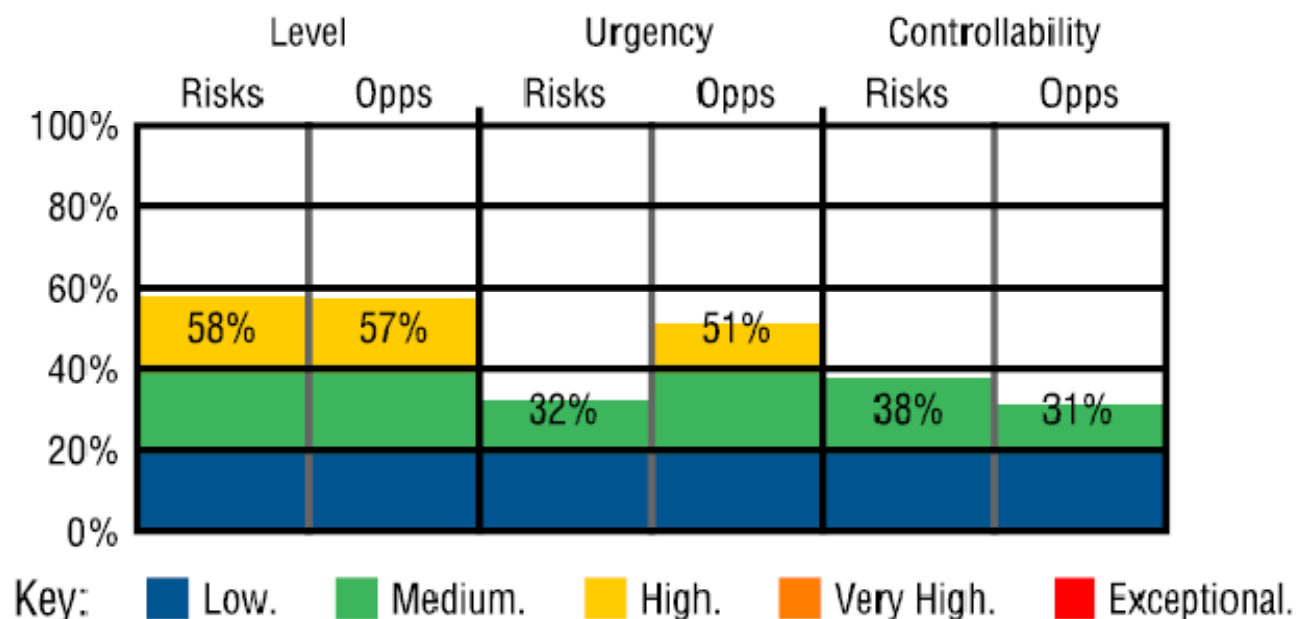


# ARC Linkage Project LP0884116

## NSW Case Study – extreme weather event: Coffs Harbour

### ROMS Step 5 Output – Assess and Prioritise

#### Risk/Opportunity calculator

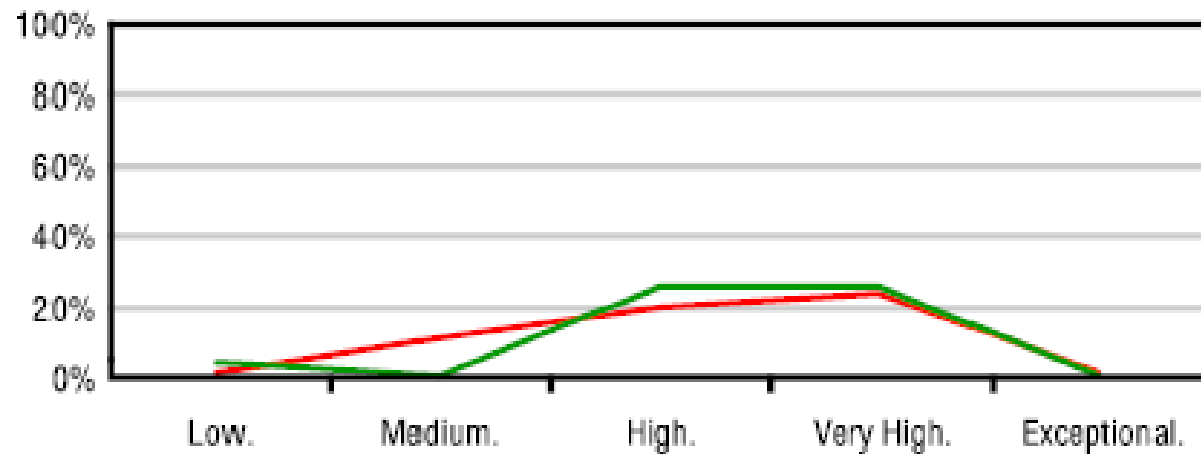


# ARC Linkage Project LP0884116

## NSW Case Study – extreme weather event: Coffs Harbour

### ROMS Step 5 Output – Assess and Prioritise

Risk/Opportunity profile





# **ARC Linkage Project LP0884116**

## **NSW Case Study – extreme weather event: Coffs Harbour**

### **Conclusions**

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

4 key areas associated with vulnerability:

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 the hospital for staff and patients

# **ARC Linkage Project LP0884116**

## **NSW Case Study – extreme weather event: Coffs Harbour**

### **Next Steps:**

Explore areas of vulnerability further and adaptive capacity in another workshop in August 2010

Develop an action plan to address issues identified

Develop an evidence base regarding design and facilities management adaptation strategies for hospitals faced with increasing exposure to floods and other extreme weather events.

## **Other research projects (examples)**

- Health Infrastructure NSW – flexible and adaptable hospitals:
  - stage 1: international case studies - 2009
  - stage 2: Australian focus - 2010
- Single rooms vs multi-bed rooms – Qld Health
- ICT and technology developments – impact on design – NZ MOH

# **Health Infrastructure NSW – Flexible and Adaptable Hospitals:**

1. Future Directions Project
2. Flexibility: Beyond the buzzword
3. Some considerations when designing new hospitals
4. Lessons from case studies
  - a. Martini Teaching Hospital, Groningen, Netherlands
  - b. Insel Hospital, Bern, Switzerland
  - c. St Olavs Hospital, Trondheim, Norway
  - d. Clarian Health, Indianapolis, Indiana USA
5. Future Research
6. Q & A

# 1. Future Directions Project

Purpose: Guide the planning and delivery of health infrastructure for the next 20-30 years

Problem: Lack of flexibility lead to early obsolescence & expensive replacements/upgrades

Method: International systematic literature review (49 publications, 11 nationalities)

Result: Studied 19 case studies

Outcome: Cost-effective ways to future-proof health assets

## 2. Flexibility: Beyond the Buzzword

- What does flexibility mean?
- “Flexibility is often described as an option – the right but not obligation to a specific future action” *(Neufville, et al., 2008)*
- Actions might involve:
  - Different modes of treatment for patients;
  - Adapting to technological advances;
  - Layout of rooms to accommodate fluctuations in patient demand;
  - Future expansions on site..... etc



## 2. Flexibility: Beyond The Buzzword

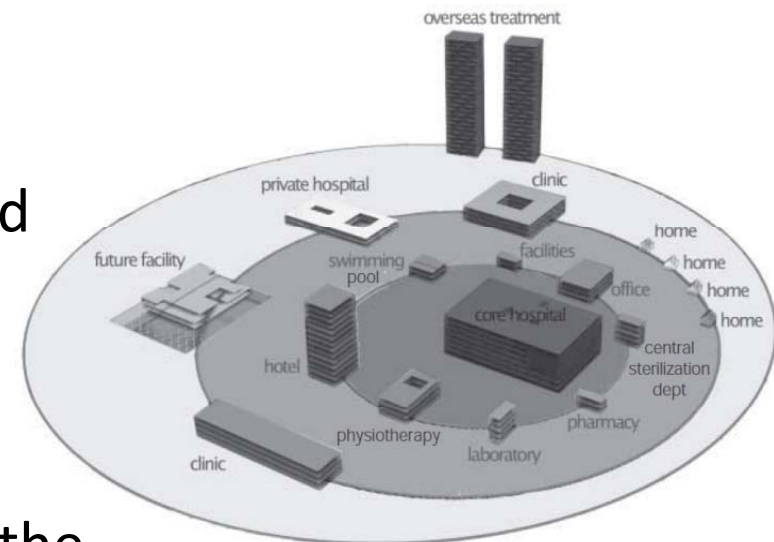
Focus	Managerial considerations	Functional requirement	Building system
Micro ↓ Macro	<b>Operational</b>	<b>Adaptability</b>	<b>Tertiary</b>
	<b>Tactical</b>	<b>Convertibility</b>	<b>Secondary</b>
	<b>Strategic</b>	<b>Expandability</b>	<b>Primary</b>
<i>Source</i>	<i>(Neufville, et al., 2008)</i>	<i>(Pati, et al., 2008)</i>	<i>(Kendall, 2005b)</i>

### 3. Funding / tendering

- Life-cycle approach - total construction costs = 2-3 years operational cost *(Valen & Larssen, 2006)*
- Beware of over-specifying contracts *(Building Design Partnership, 2004)*
- Engage with hospital staff and committee members *(Bush, et al., 2005) & (Rechel, et al., 2009)*
- Past PFI in UK “stifles innovation” - should consider design stage separate to tendering process *(Barlow & Koberle-Gaiser, 2009)*
- Quantifiable measures for flexibility written as conditions to PFI agreement *(Neufville, et al., 2008)*

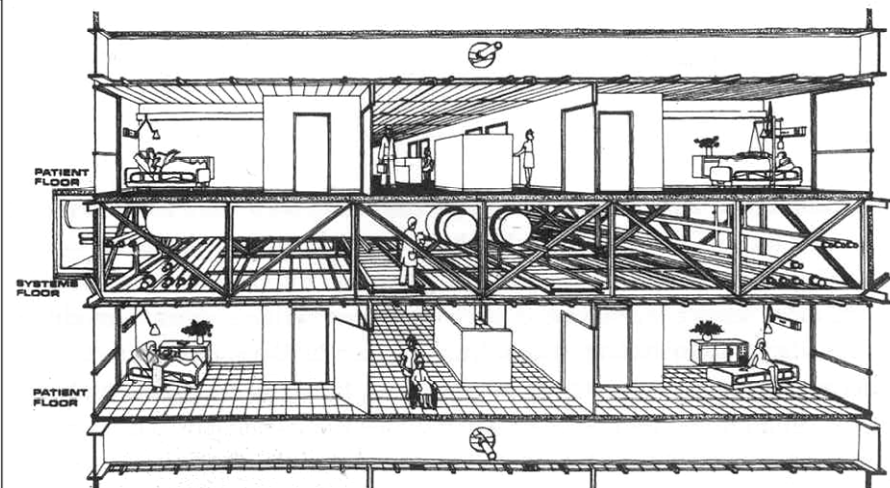
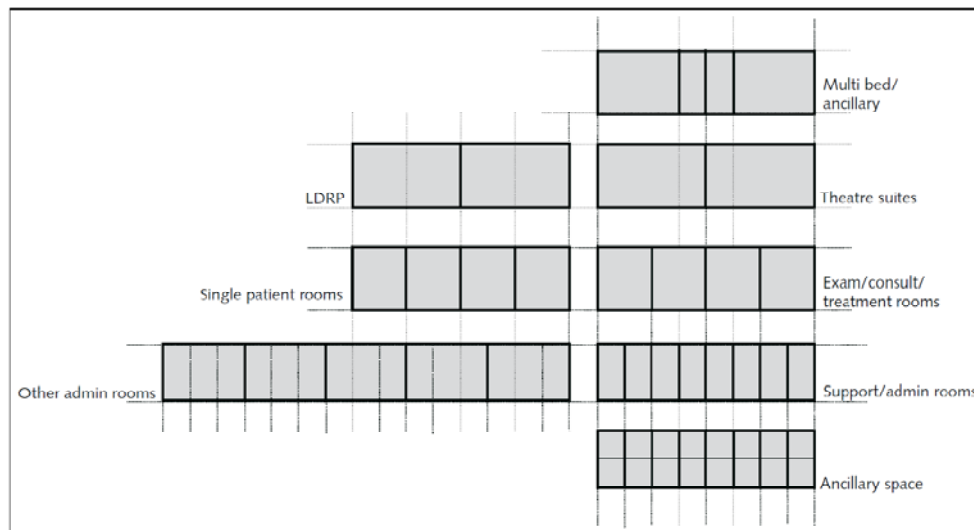
### 3. Masterplanning

- The “Core hospital”: up to 50% of hospital functions as ancillary buildings (*Bjørberg & Verweij, 2009*)
- The “hospital-on-demand”: 30% permanent / “fixed” space, 40% short lease, 30% hired on demand (*Neufville, et al., 2008*)
- Incorporated in contract using option fees (*Lee, 2007*)
- “Empty chair” strategy based on the “four quadrants” principle (*Thiadens, et al., 2004*)



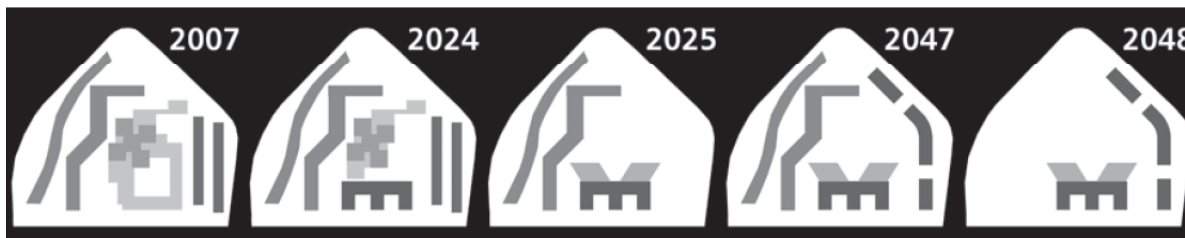
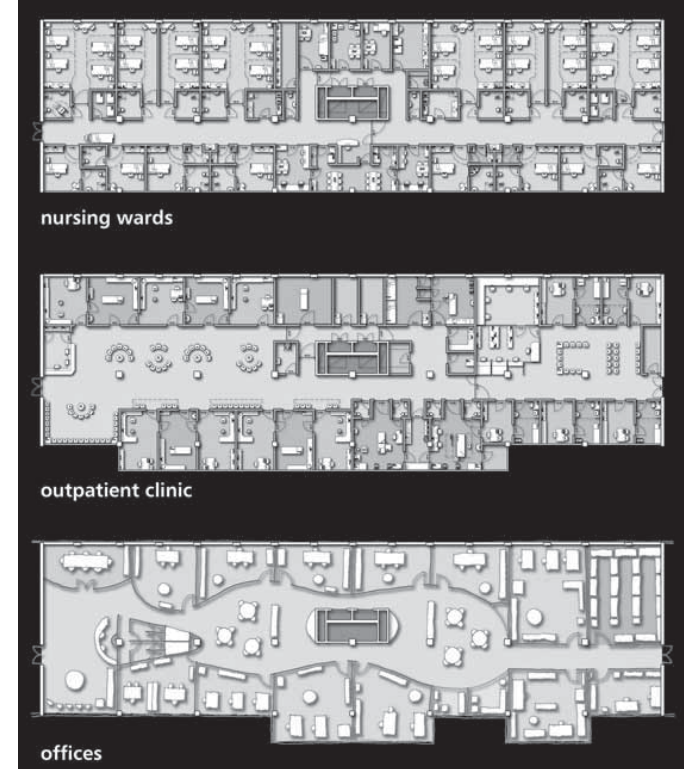
### 3. Building Design

- Modular Architecture: Based on uniform grid that is then subdivided to suit a range of functions (*Diamond, 2006*)
- Interstitial Floors: full height (> 1.8m) servicing floors between “patient floors”, to allow for universal wall-less cabling and servicing (*Verderber & Fine, 2000*)



## 4. Martini Teaching Hospital, Groningen, Netherlands

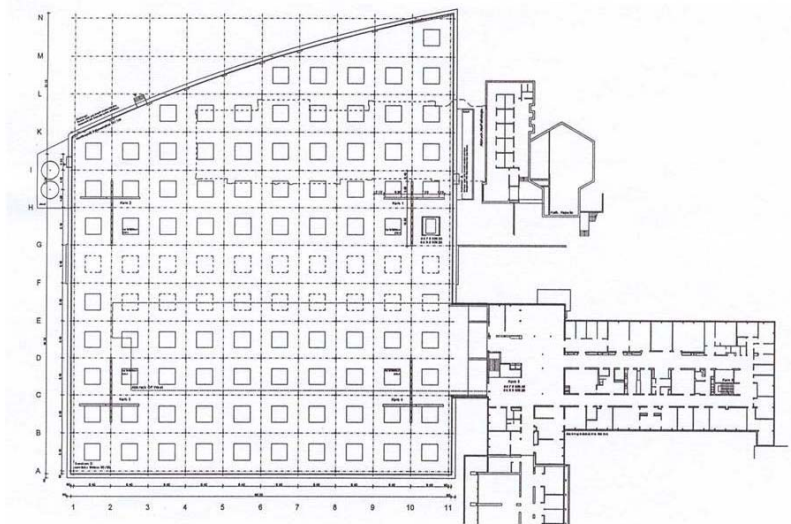
- “Empty chair” strategy
- 16m x 60m floor plan





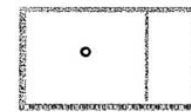
## 4. Insel Hospital, Bern Switzerland

- Primary, secondary, tertiary systems
- Floor structure grid of 8.4m x 8.4m<sup>2</sup>, with openings of 3.6m x 3.6m<sup>2</sup>, which can be opened later for vertical access, cables, pipes, lift shafts or light shafts (*Geiser, 2004*)



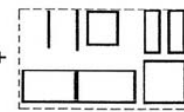
### SPATIAL ORGANIZATION

#### System Level 1



Primary system, fixed:  
Site logistics  
Building envelope  
Structure system  
Interior logistics

#### System Level 2

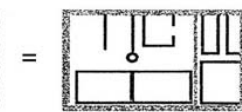


Secondary system, adjustable:  
Interior walls  
Floor covering  
Ceilings

#### System Level 3



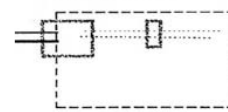
Tertiary system, flexible:  
Furniture  
Mechanical equip  
Hospital supplies



Composite system

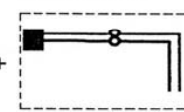
### TECHNICAL SYSTEM ORGANIZATION

#### System Level 1



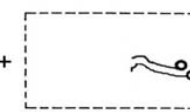
Primary system, fixed:  
Electronics  
Location of head offices  
Installation structure

#### System Level 2

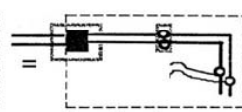


Secondary system, adjustable:  
Equipment for head offices  
Installations  
Illumination

#### System Level 3



Tertiary system, flexible:  
Ports for apparatus  
Room specific installations

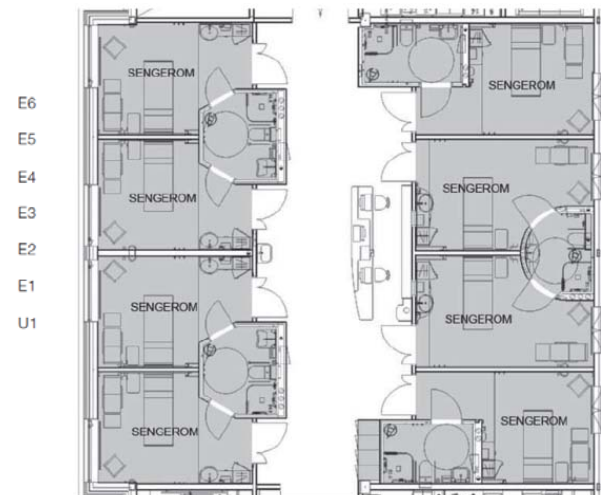
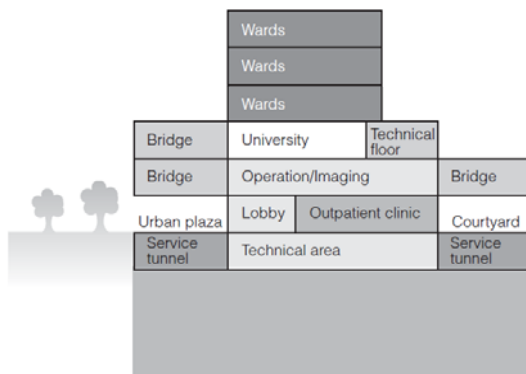


Composite system



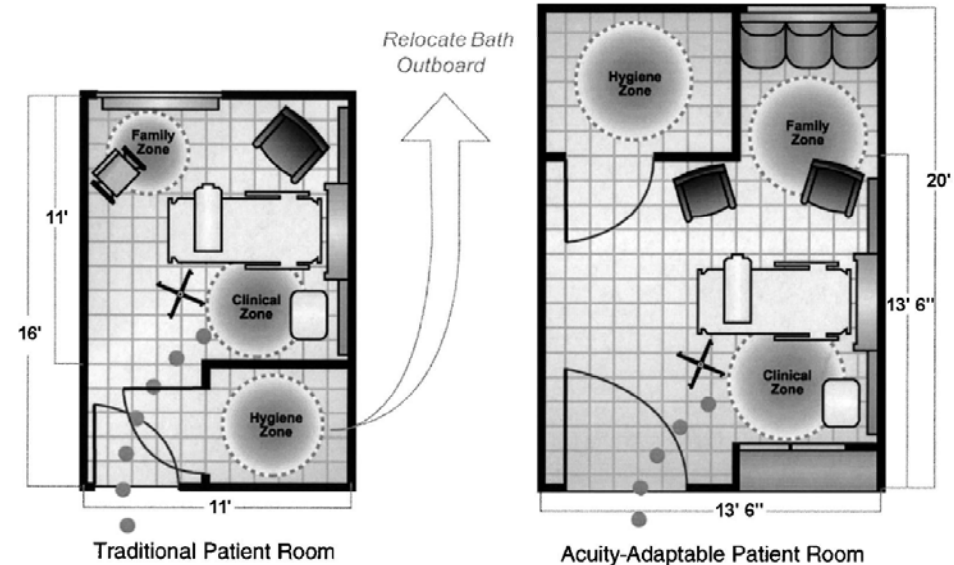
## 4. St Olav's Hospital, Trondheim, Norway

- “Generic Clinic”: identical locations of functions on each floor (*Jensø & Haugen, 2005*)
- User participation: engagement with hospital staff (*Rechel et al, 2009*)
- Surplus HVAC capacity of 20-30% (*Valen & Larssen, 2006*)



## 4. Clarian Health Partners, Indianapolis, Indiana USA

- Patient-focussed care: acuity-adaptable rooms
- Transports of patients decreased by 90% and medication errors decreased by 70% (Hendrich, et al., 2004)
- Decentralised nursing stations



## 5. Future Research

- Need to widen search frame to include older facilities
- Focus on Australian hospitals
- Review existing facilities

### EXAMPLE AUSTRALIAN CASE STUDIES

- |  |   |
|--|---|
| • Westmead Hospital, NSW (1978)        | • Toowoomba Base Hospital, QLD (1997)     |
| • Mount Druitt Hospital, NSW (1980)    | • Princess Alexandra Hospital, QLD (2002) |
| • Prince of Wales Hospital, NSW (1995) | • Townsville Hospital, QLD (2002)         |
| • St Vincent's Hospital, NSW (2002)    | • Royal Melbourne Hospital, VIC (1942-95) |
| • Blacktown Hospital, NSW (2002)       | • The Alfred Hospital, VIC (1990)         |
| • Coffs Harbour Hospital, NSW (2002)   | • Sunshine Hospital, VIC (2002)           |



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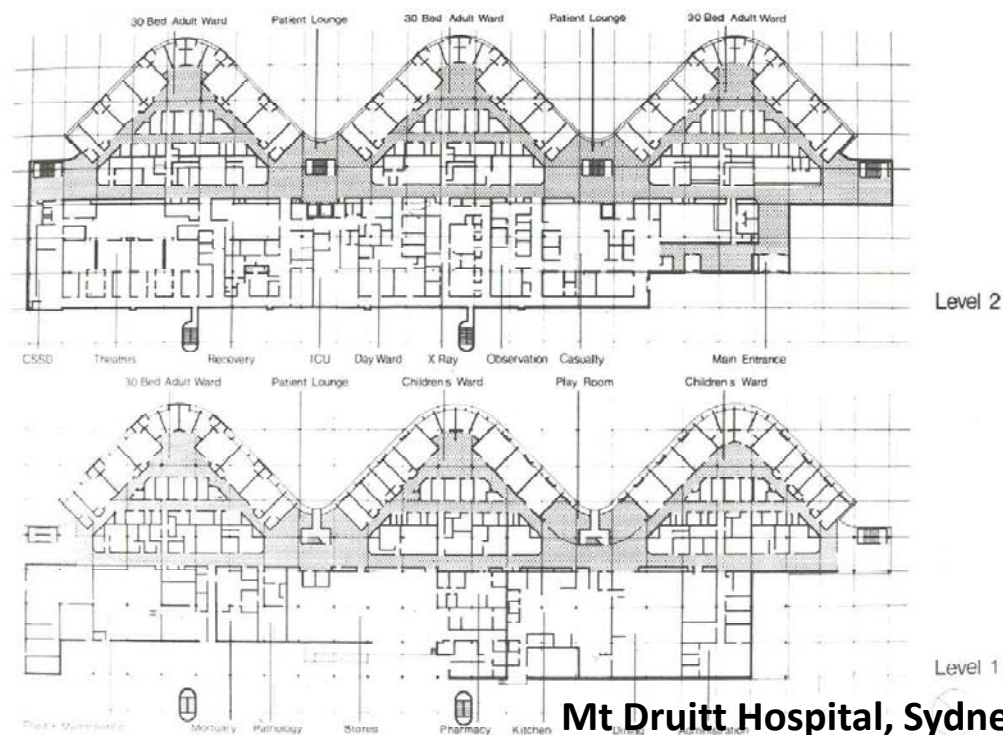
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## 5. Future Research



**Princess Alexandra Hospital, Brisbane**



**Mt Druitt Hospital, Sydney**

## Other Activities

**ACHSM / CHAA joint national conference 2010 – 14-16 July,  
Fremantle WA**

“Sailing the Tides of Turbulence”

14 - 16 July 2010 - Esplanade Hotel, Fremantle, Western Australia

[www.achse.org.au](http://www.achse.org.au)

**Various student projects** e.g. vulnerability/resilience index for hospitals; disaster management & planning approvals; patient experience in single bed rooms; landscaped courtyards for spinal injury patients.

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