CHAS Phases 1, 3, 4, 5 and 7

QCoast2100
COUNCILS LEADING COASTAL ADAPTATION

Minimum Standards and Guidelines:
Preparation of a Coastal Hazard Adaptation Strategy (CHAS) for Queensland Coastal Local Government

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$QCoast_{2100}$ - Inaugural Knowledge & Information Sharing Forum
Brisbane 30 | September 2016

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PLANNING + DEVELOPMENT

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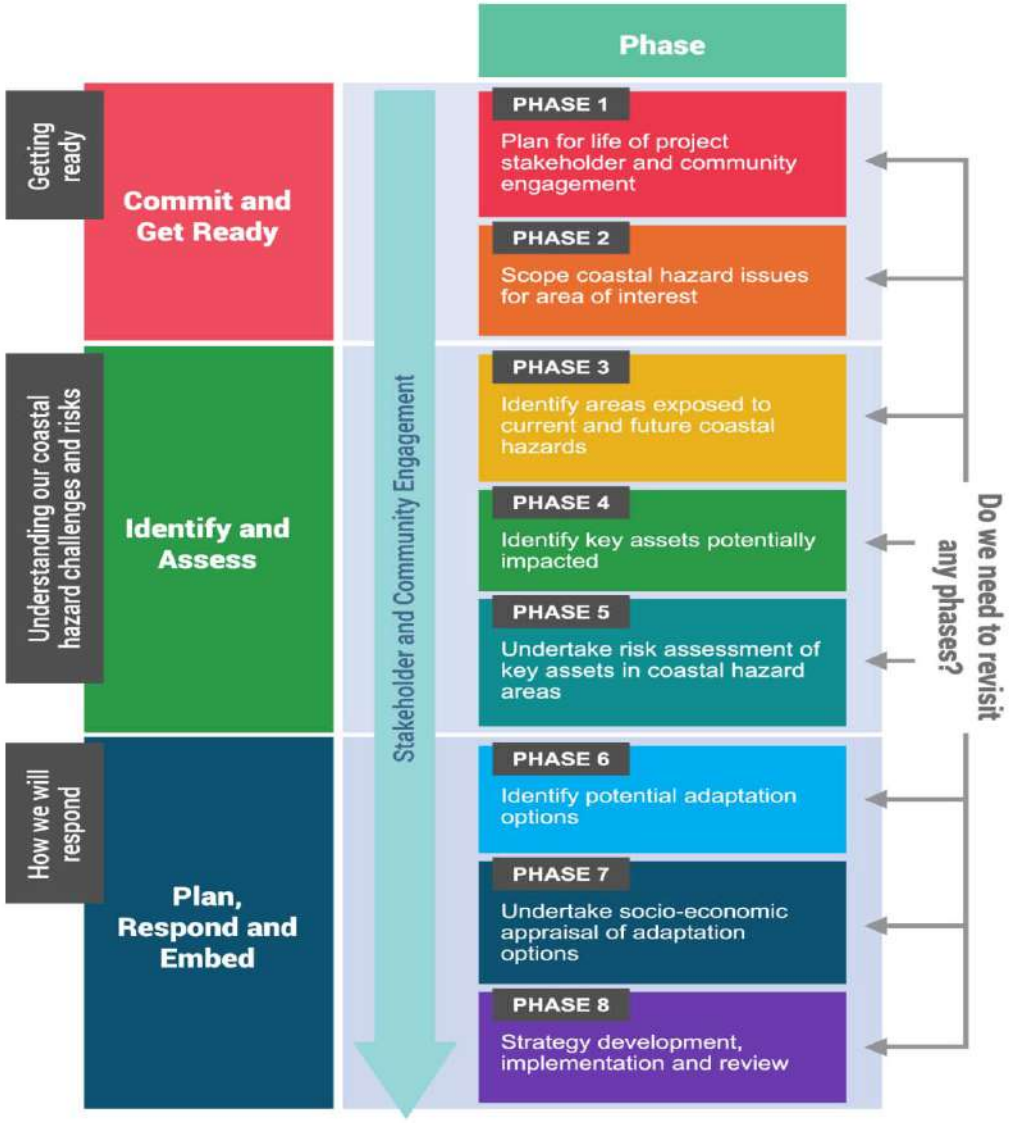
Source: QCoast$_{2100}$ Minimum Standards & Guidelines

Outline

- Importance of ‘life of project’ engagement across all 8 Phases of the CHAS
- Internal and external engagement
- What does the QCoast Guideline say?
- Some best practice examples
- Lessons learned

Engagement underpins all 8 Phases of the CHAS



Source: QCoast$_{2100}$ Minimum Standards & Guidelines

PHASE 1. Plan for life-of-project stakeholder communication and engagement

Internal stakeholder engagement

Image courtesy of Dr Philip Haines

- Effective action requires a strategic "whole of organisation" response
- Not just an engineering or planning response
- Actions need to be implemented using a range of tools:
  - risk management framework
  - long term financial planning & annual budgets
  - asset management
  - disaster management
  - corporate and operational planning
  - land use and infrastructure planning
  - organisational development and workforce planning
  - community & stakeholder engagement policy and plans

External engagement to build community resilience to coastal hazards

Image courtesy of Dr Philip Haines

Needs an understanding of:

1. Risk and consequence

2. Community tolerance for risk
   - **Avoid or protect**
   - **Accommodate**
   - **Accept or retreat**

3. Community capacity to respond to an emergency

4. Governance capacity to implement actions

Phase 1 – Stakeholder communication and engagement:

- a “central plank” to CHAS
- a framework for how communication and engagement will be undertaken
- states the relationship Council seeks to have with stakeholders and community
- identifies ‘who’ - internal and external stakeholders and community
- maps out “touchpoints” to guide ‘how’ and ‘when’ conversations will be had (methods & timing)
- “de-risks” consultation process across the CHAS
- “living” document – needs to be flexible
- provides direction for other plans, strategies and projects that sit outside of CHAS

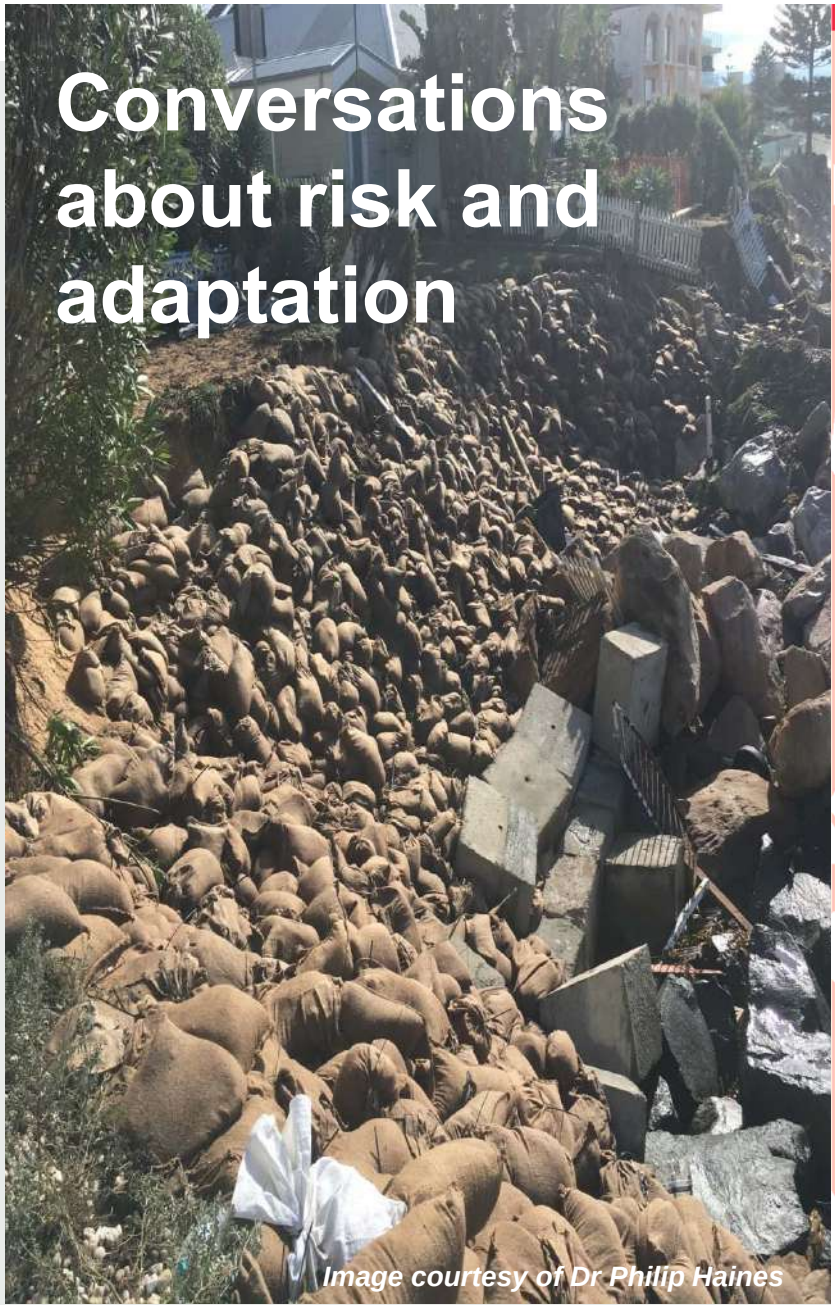


Image courtesy of Dr Philip Haines

QCoast Minimum Standards and Guidelines

Phase 1 Objectives

- Identify all key internal and external stakeholders
- Determine depth of consultation with each stakeholder group
- Identify optimal timing and delivery methods
- Agree council's role and responsibilities
- Document agreed activities

Minimum requirements

The stakeholder engagement plan must document at least:

- Preferred approach to identifying, communicating and engaging
- Identification of all relevant internal and external stakeholders
- Process for undertaking consultation in each phase of CHAS:
  - objectives and messages for each phase
  - timing
  - relevant stakeholders
  - engagement methods
  - risks and mitigation strategies
  - available resources and responsibilities

Awkward conversations or opportunity for connection?

Some key challenges:

- Very emotive and can be politicised
- Highly technical and complex concepts (for internal and external stakeholders and community)
- How do we deal with existing coastal hazard risks expected to increase or worsen due to future sea level rise and other climate change impacts?
- How do we get people interested when they are not directly affected now, but may be at risk in the future?

Image courtesy of Courier Mail

A good starting point…

- Focus on the things that are most important to people
- Values and priorities are a very effective connection point for starting a conversation
- Understand what's important to stakeholders and community as early as possible in CHAS process

Image courtesy of Bruce Harris

Best Practice Examples

- Best Practice Case Study 1: Marks Point and Belmont South Local Adaptation Plan, Lake Macquarie City Council, NSW
- Best Practice Case Study 2: Choiseul Bay Township Climate Change Adaptation Plan, Solomon Islands

Source: Google Maps, 2016

Image courtesy of The Age (Vanishing Island Interactive web-arti

Marks Point and Belmont South Local Adaptation Plan, Lake Macquarie City, NSW

Source: Lake Macquarie City Council, 2015 (Marks Point and Belmont South Local Adaptation Plan)

Figure 1: Lake Macquarie

PHASE 1. Plan for life-of-project stakeholder communication and engagement

Lake Macquarie

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Marks Point and Belmont South Local Adaptation Plan, Lake Macquarie City, NSW

Snapshot:

- LGA wide flood study and risk management plan (2012)
  - up to 10,500 lakeside properties at risk of severe flooding by 2100
  - flood study recommended local area adaptation plans for foreshore management areas

- Marks Point and Belmont South area
  - 1,300 households in study area
  - 939 homes impacted by 0.9m SLR and 1% AEP flood event
  - 4kms of road and 1.8km of stormwater infrastructure permanently under water

Source: *Google Maps, 2016*

Source: Lake Macquarie City Council, 2015 (Marks Point and Belmont South Local Adaptation Plan)

Source: Google Maps, 2016

Who collaborated?

1300 households and property owners in Marks Point and Belmont South received 4 project newsletters during the consultation period from 2013-2015

A call for nominations saw **31** residents join a Community Working Group

11 members of the Community Working Group formed a sub-committee to assess management options

How did we collaborate?

37 residents took part in two community workshops in November 2013

31 residents volunteered to participate in a community working group

3 community workshops held

4 Working Group meetings held

15 sub-committee meetings

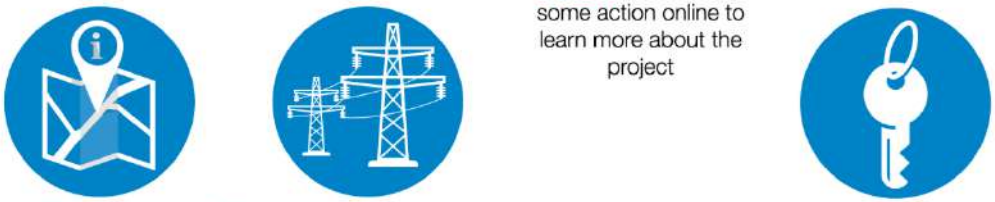
6 drop-in sessions and information stalls

3 postal surveys

23,115 project web visits

6827 people took some action online to learn more about the project

136 people took part in the online surveys and forums



3 site tours

1 insurance information night

20 agencies and service providers invited to public workshops and informed of progress

1 real estate agents' workshop

1 valuers' workshop

Source: Lake Macquarie City Council, 2015 (Marks Point and Belmont South Local Adaptation Plan)

Key outcomes

Effectiveness of Community Working Group to evaluate adaptation options:

- Broader community engagement identified 39 adaptation options to reduce or manage risks
- Community working group evaluated the acceptability of options, using four 'show-stopper' criteria:
  - Will it maintain community lifestyle?
  - Will it reduce the risk of flooding and inundation?
  - Are the environmental effects manageable?
  - Do the benefits outweigh costs?
- 16 of the 39 actions were ruled out using 'show stopper' criteria and remaining 23 options were evaluated
- 6 key adaptation actions formed basis of adaptation strategy

Key outcomes

Community engagement found that:

- Locals wanted to be involved in designing the process and the adaptation planning
- People wanted to share their significant local knowledge
- Property values and insurance a big concern
- Access to water and lifestyle of those who live around the lake was important
- Successful use of community working group/sub-committee to act as bridge between technical experts and community

Consultation in 2013

- Community consultation to determine best approach to developing a Local Adaptation Plan for Marks Point and Belmont South
- Information sessions on insurance, property prices, planning controls
- Issues raised by community in workshops and surveys informed development of draft objectives and criteria to guide the Marks Point Belmont South Local Adaptation Planning project.

Community Consultation - March 2014
Community feedback on the draft objectives and criteria of the Marks Point Belmont South Local Adaptation Plan

Memo to Councillors – project update

Councillors Briefing
Progress to date and plan to complete

Marks Point – Belmont South
Local Adaptation Planning Project
Community Working Group (CWG)

Workshop 1 – Introduction

- Agree on CWG program and meetings
- Review objectives and criteria
- Consider adaptation options

Workshop 2

- Recap activities of the last workshop
- Walk through process for reviewing management options using objectives and criteria

Field Trip
Field tour to discuss issues and proposed management options on site

Workshop 3 – Update from Sub-committee
Report back to Community Working Group

Workshop 4 – Draft Plan

- Sub-committee reports back response to community working group feedback
- Finalise list of management options
- Agree on format and content of draft plan

Broader Community Consultation – Outputs of CWG process

Decision made to form a sub-committee to report back to the Community Working Group

Sub-committee of the Community Working Group

- Conduct a first-pass assessment of the management options: feasible; not feasible; more information required
- Assess the feasible options in more detail, and 'bundle' options
- Link options to specific risks, assets, and locations
- Identify the hazard thresholds to trigger management options
- Incorporate bundled management options, triggers and threshold etc. into a draft Local Adaptation Plan

Source: Lake Macquarie City Council, 2016 (Marks Point and Belmont South Local Adaptation Plan – Engagement Website) http://haveyoursaylakemac.com.au/future-flood-planning

Council reviews Plan and endorses for public exhibition

Broader Community Consultation – Exhibition of Draft Plan

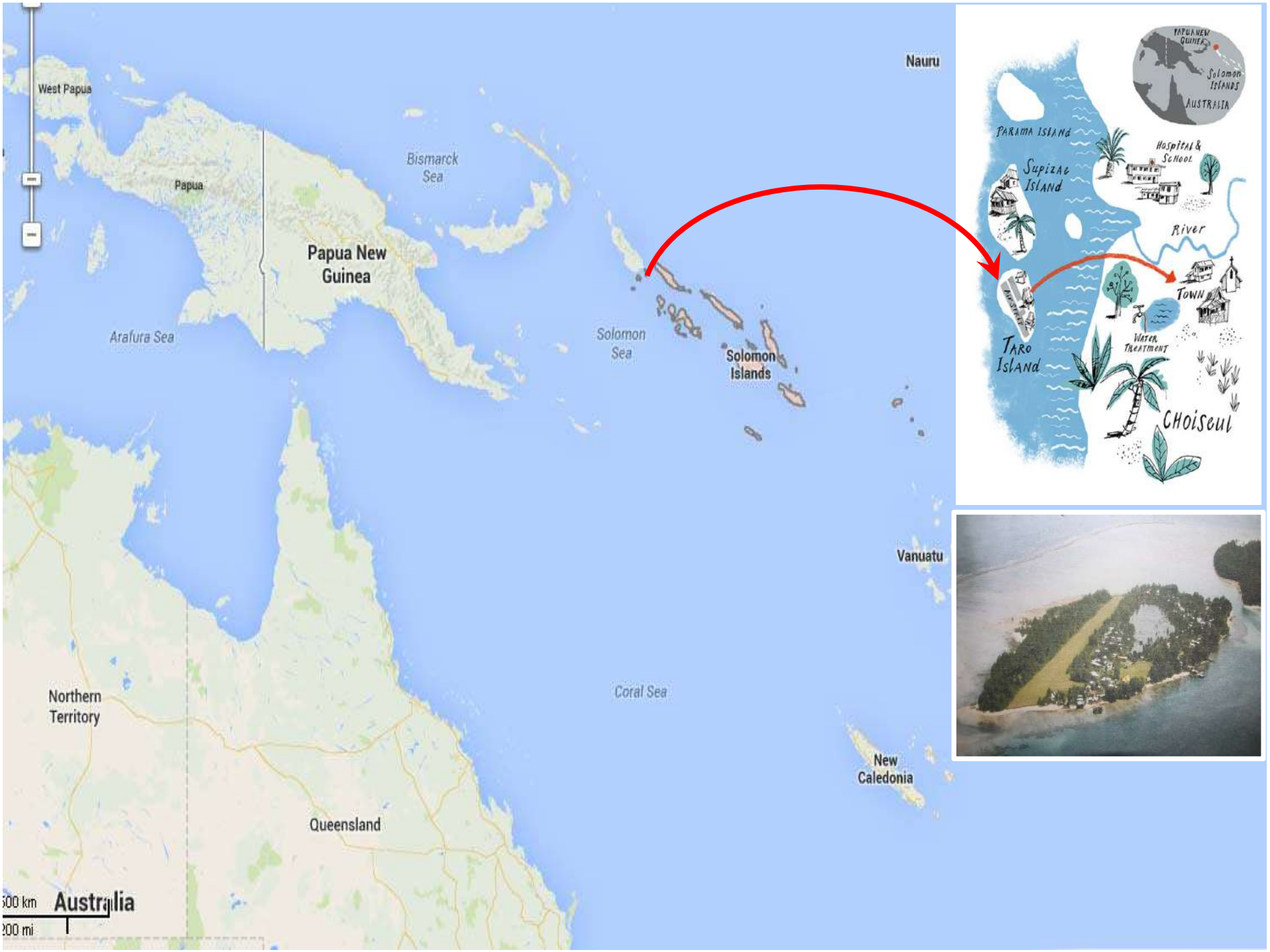
Draft Plan to Council
Final Plan

Lessons Learned

- Adaptation plan undertaken at the local scale after region wide technical study
- Council asked the community how they would like to be engaged and involved in the project
- Community working group established to evaluate adaptation options
- Community working group/sub-committee worked closely with Council officers and technical experts
- ‘Bridged the gap’ between technical experts and broader community.
- Understanding and ownership of risk and adaptation options maximises successful implementation

Image courtesy of The Age (Vanishing Island Interactive web-article).

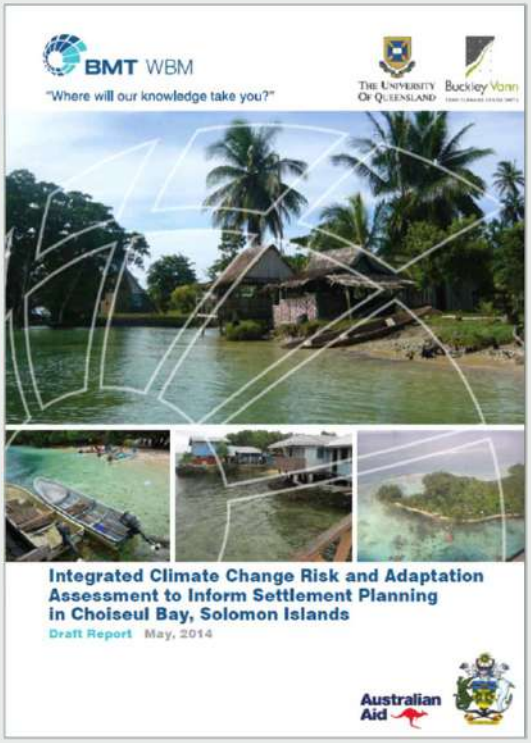
Choiseul Bay Climate Change Adaptation Plan Solomon Islands

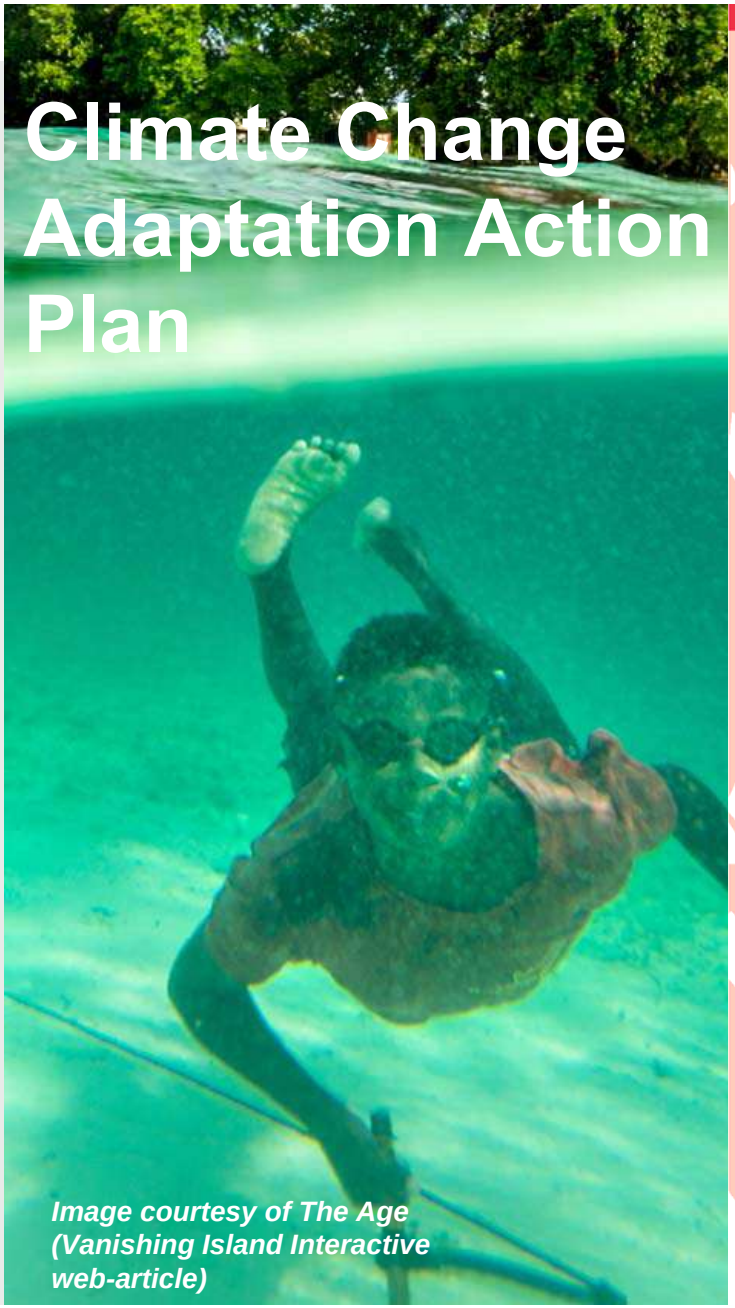

West Papua
Papua
Papua New Guinea
Bismarck Sea
Arafura Sea
Solomon Sea
Solomon Islands
Nauru
Vanuatu
New Caledonia
Coral Sea
Northern Territory
Queensland
Australia
500 km
200 mi
Papua New Guinea
Solomon Islands
Australia
Parama Island
Hospital & School
Supizae Island
River
Town
Water Treatment
Taro Island
Choiseul

- People fearful of tsunami
- Evacuation response risking lives
- People seeing changes in ocean and loss of land
- Vulnerability increasing as development continues
- Community vision for a safe town
- Relocation only viable option as future risks worsen

Image courtesy of The Age (Vanishing Island Interactive web-article)

- Emergency Response Plan
- Asset and infrastructure management
- Shoreline revegetation
- Monitoring
- Vision and Planning Scheme





PHASE 1. Plan for life-of-project stakeholder communication and engagement

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Conversations about risk and adaptation

- Fundamental to <u>all stages</u>
- Lead the community on a '*technical journey*'
- Make complex things simple
- Highly graphical engagement materials
- Show how feedback was reflected in:
  - refinement of risk assessment outcomes
  - adaptation options
  - planning for new town

"The project followed the ways of our traditions – talking with people, listening to people and reflecting the desires of the people."

Jackson Kiloe, Premier Choiseul Province

Community engagement

- Community ownership important because:
  - risk assessment relies on judgement decisions to assign likelihood and consequence levels
  - community engagement used to validate and refine risk assessment outcomes

- Community engagement also ensures:
  - local knowledge is reflected in adaptation options
  - options are practical, realistic and within means and financial constraints of community
  - options fit for purpose and acceptable to community

- Engagement strategy for 'whole of community'
- Engagement values
- Community & political ownership **essential** for successful implementation
- "Top down" and "bottom up" approach

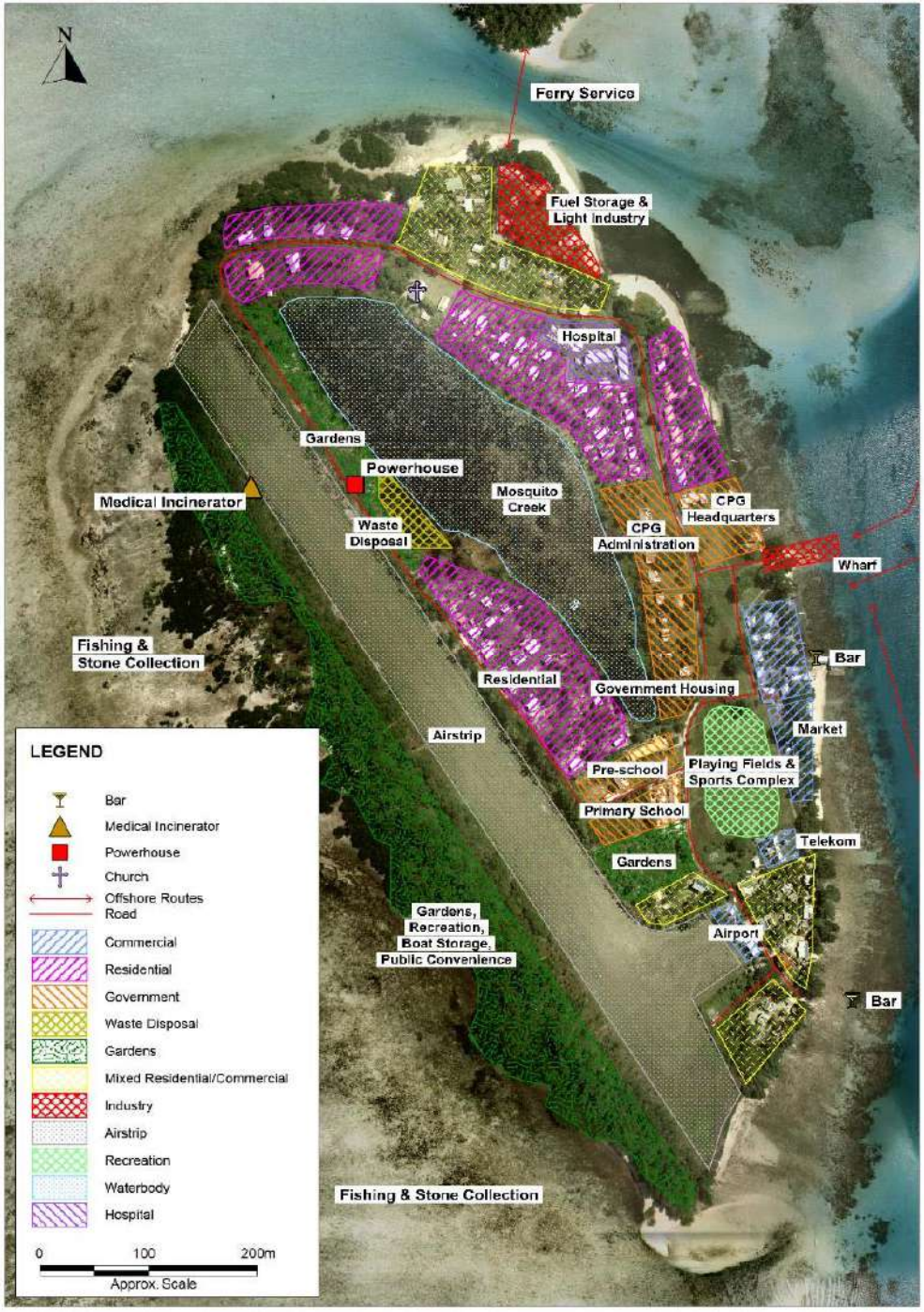
Community engagement

What did we do?

- 7 in-country visits over 8 months
- Creative, inclusive, culturally responsive & to build trust
- Whole of community activities
- Draw out and validate community aspirations

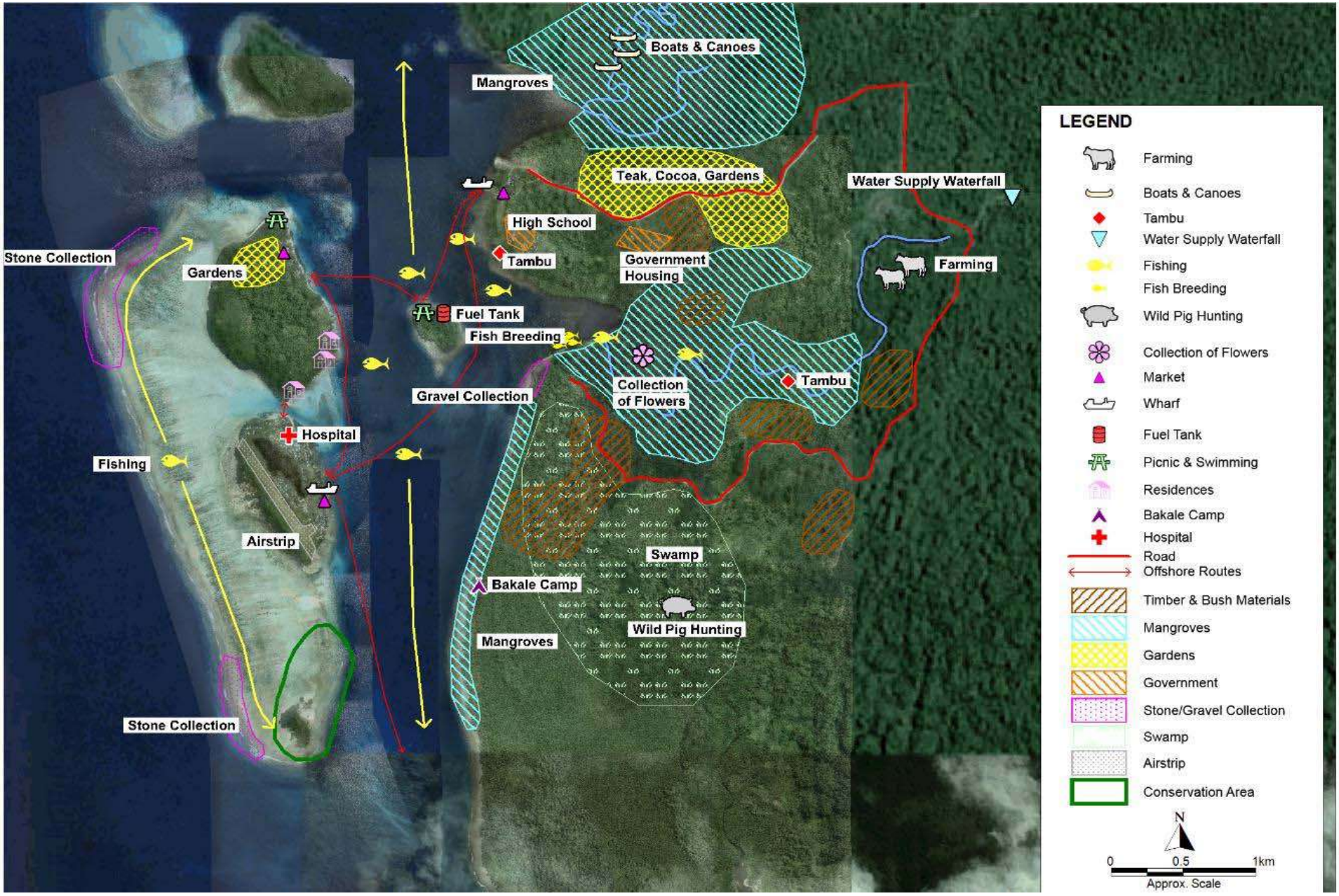
Participatory stakeholder workshops very effective to:

- prioritise assets, values and adaptation options
- understand co-dependency between coastal hazards, assets and adaptation responses



Valued Land, Assets and Infrastructure

In total, the project team spoke to over 300 community members!


Boats & Canoes
Mangroves
Teak, Cocoa, Gardens
Water Supply Waterfall
High School
Tambu
Government Housing
Farming
Stone Collection
Gardens
Fuel Tank
Fish Breeding
Gravel Collection
Collection of Flowers
Tambu
Hospital
Fishing
Airstrip
Swamp
Bakale Camp
Wild Pig Hunting
Mangroves
Stone Collection
LEGEND
Farming
Boats & Canoes
Tambu
Water Supply Waterfall
Fishing
Fish Breeding
Wild Pig Hunting
Collection of Flowers
Market
Wharf
Fuel Tank
Picnic & Swimming
Residences
Bakale Camp
Hospital
Road
Offshore Routes
Timber & Bush Materials
Mangroves
Gardens
Government
Stone/Gravel Collection
Swamp
Airstrip
Conservation Area
N
0
0.5
1km
Approx. Scale

Lessons Learned

- Community engagement strategy – key tool
- Local knowledge and community values essential to inform options
- Communicate science & risk simply
- Highly graphical materials
- Focusing on values puts emphasis on the things that matter most to people
- Engaging the ‘hard to reach’ – geographically, socially, etc

Image courtesy of The Age (Vanishing Island Interactive web-article)

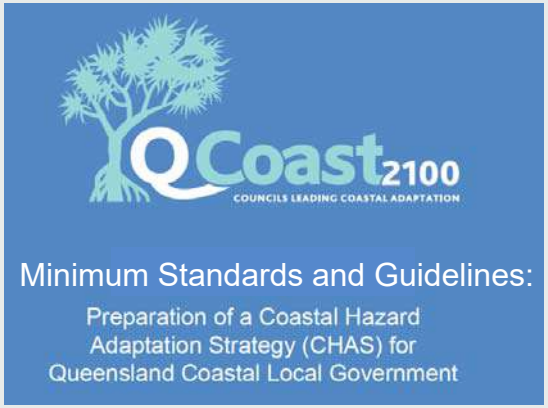
Key Messages

- Coastal hazard adaptation is about people. Invest in internal and external engagement
- Integrate science, engineering, planning, economics + local knowledge and community feedback
- Trust the community to make good decisions if provided with good information and time
- Many methods for stakeholder and community engagement – tailor to project and community circumstances
- Engagement strategy a 'central plank' to CHAS. Needs to be flexible
- Sequence engagement activities to ensure community/stakeholders are "ready"
- Values and priorities are an effective connection point for starting a conversation
- Integrate with other Council forward planning consultation activities – corporate plan, visioning, planning scheme etc
- Consider engagement beyond just plan preparation and into implementation

Phases 3, 4, 5 of CHAS: Identification of hazards, assets and risk assessment

Overview

1. Coastal hazards and how they are defined, modelled and mapped (Phase 3)
2. Identification of assets that may be affected by coastal hazards (Phase 4)
3. Using risk assessment to 'set up' adaptation responses and pathways (Phase 5)

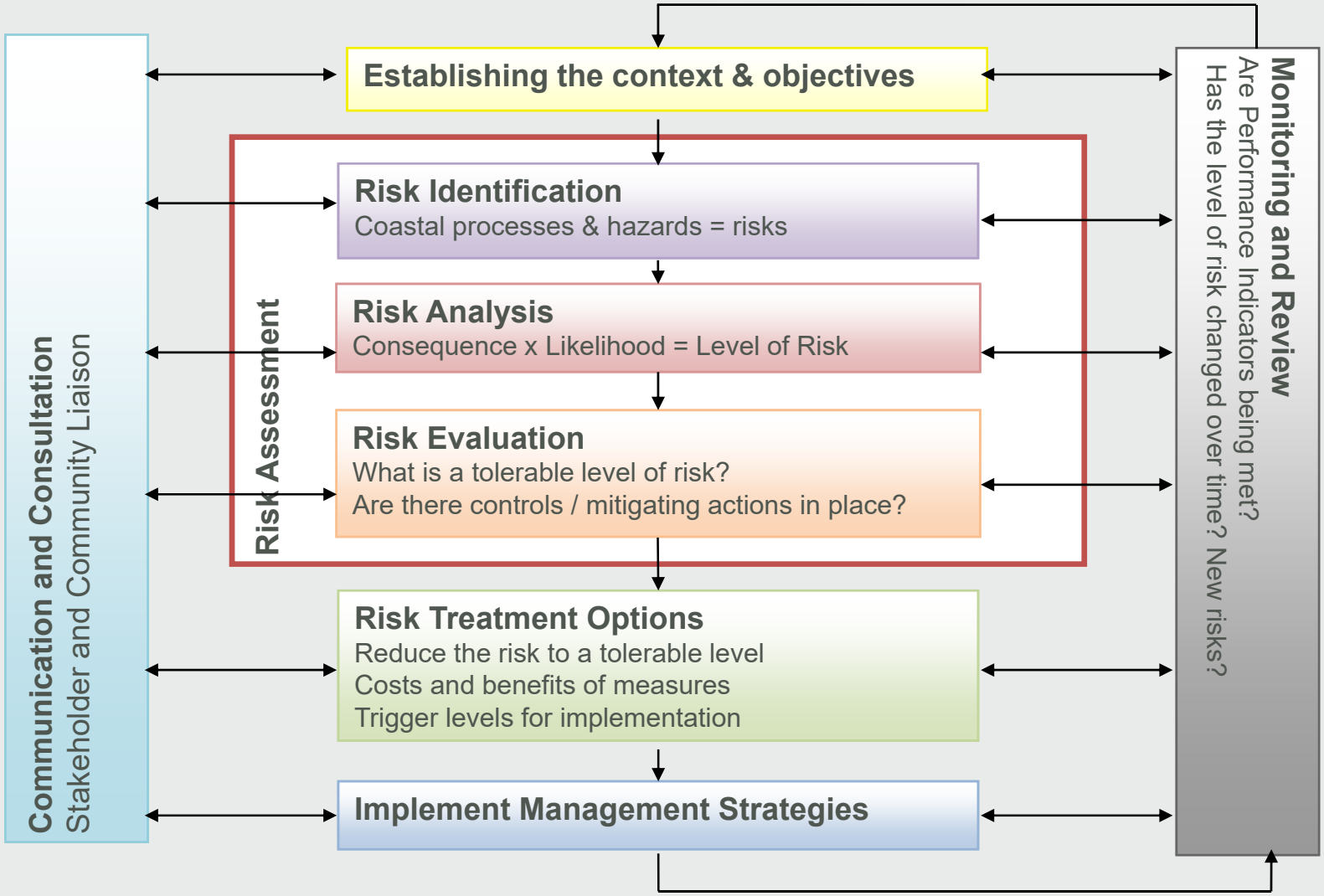


PHASE 3. Identify areas exposed to current and future coastal hazards

Why Risk-Based Approaches?

- Accommodates uncertainty – sea level rise, coastal processes, local geomorphology and expected beach response
- Framework for developing actions even when little data / high uncertainty
- Based on accepted standard - ISO 31000:2009 Risk Management Principles and Guidelines
- Can focus finite resources towards those aspects / areas at greatest risk (prioritisation process)
- Process for incorporating improved data over time
- Monitor low risks, change in risk level over time

Application of the ISO 31000 Risk Process to Coastal Management (Rollason, Fisk and Haines 2010)



PHASE 3. Identify areas exposed to current and future coastal hazards

Phase 3: Coastal Hazards

Terms and Terminology

Opportunity to introduce science to the risk assessment

Coastal hazards can take many forms – both natural and man-made:

- Coastal Erosion and Recession (storm induced, exacerbated by structures)
- Storm Tide Inundation (barometric, wind, wave)
- Catchment flooding (especially coincident with storm tide inundation)
- Tsunami

Areas potentially affected by hazards can be identified by maps, lines and spatial polygons.

Coastal Inundation (storm tide, flooding, tsunami)

TEMPORARY IMPACTS



Coastal Erosion and Shoreline Recession (sediment supply)

PERMANENT IMPACTS



Implications of Climate Change

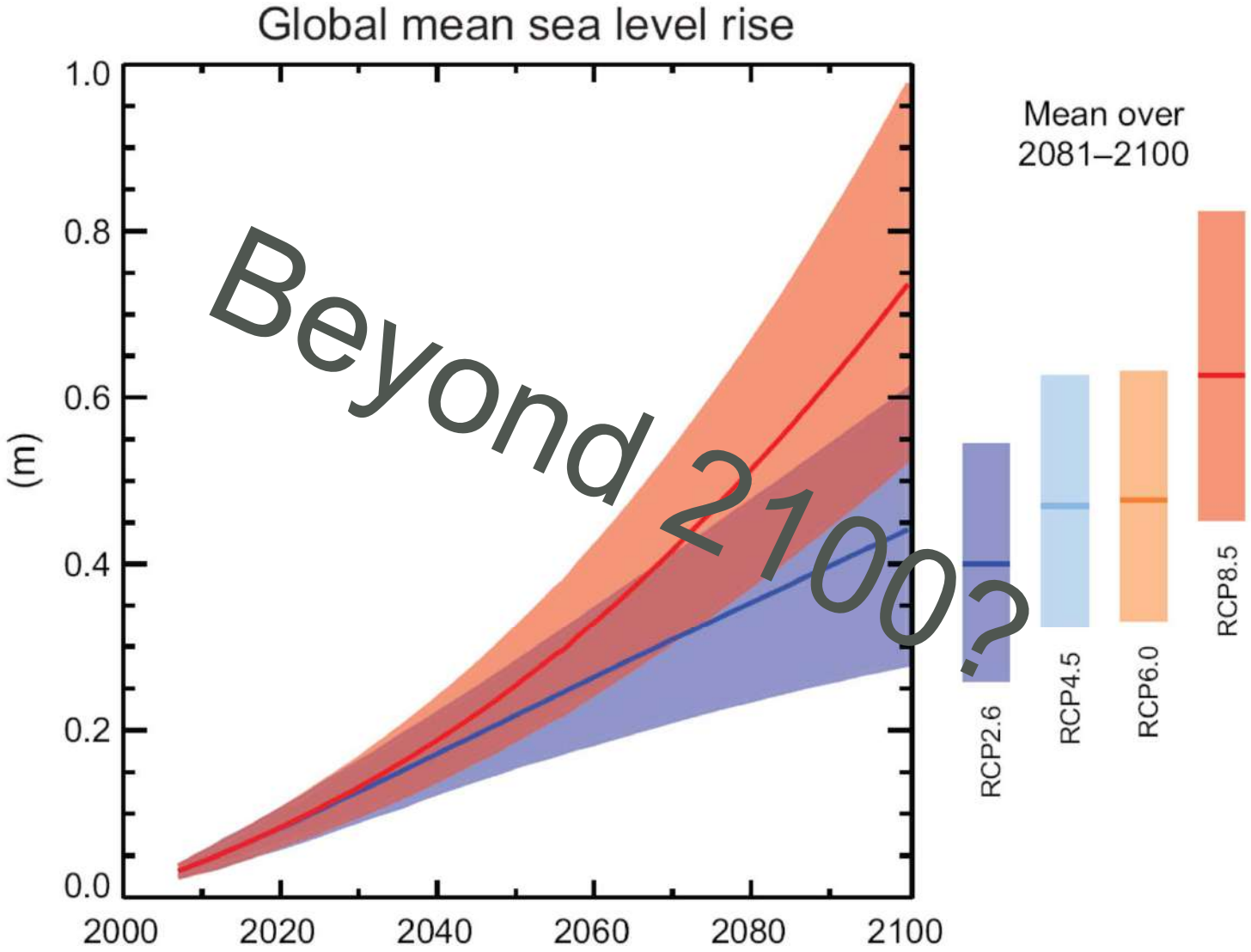
Coastal Erosion and Shoreline Change

- Sea level rise will reduce the buffer between coastal development and coastal processes
- Sediment transport patterns may be altered
- The loss of existing and the immergence of new shoreline controls (eg. a headland becoming permanently inundated)
- Changes to climatology and increased severity of storms

Coastal Inundation

- Low-lying land may be permanently inundated due to sea level rise
- An increase in the frequency and severity of coastal defence overtopping and inundation events

So what SLR projections should we adopt?



PHASE 3. Identify areas exposed to current and future coastal hazards

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Defining the Line = Likelihood

Probability			
Almost Certain		2060	Immediate Hazard Line
Likely	Immediate	Immediate Hazard Line	2060 Hazard Line
Unlikely	Immediate Hazard Line	2060 Hazard Line	2100 Hazard Line
Rare	2060 Hazard Line	2100 Hazard Line	
	2100 Hazard Line		

PHASE 3. Identify areas exposed to current and future coastal hazards

Coastal Hazard Areas Map
Erosion Prone Area

8259-423 KULBURN

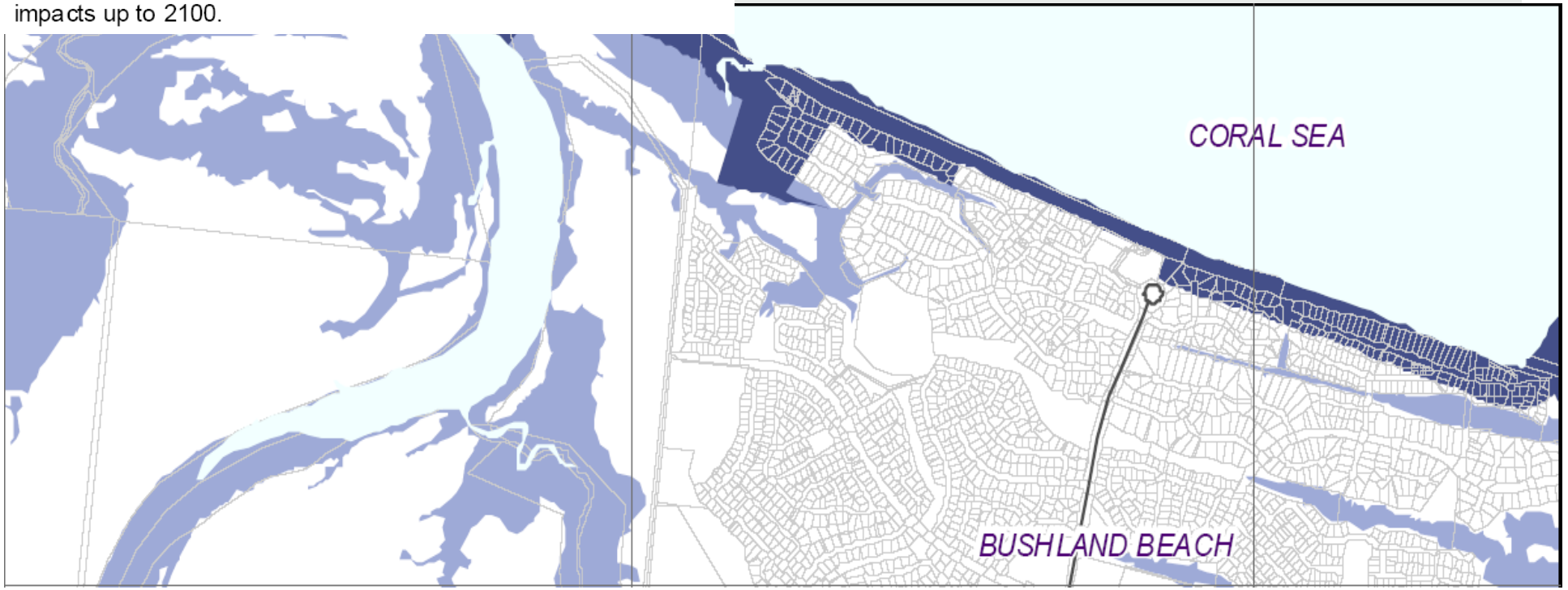
Indicative Erosion Prone Area (including projected climate change impacts to 2100) *

- Erosion due to storm impact and long term trends of sediment loss and channel migration
- Erosion and permanent tidal inundation due to sea level rise

* The erosion prone areas shown on this map are indicative of the erosion and inundation extent that may occur with climate change impacts up to 2100.

Simple assessments by adding a SLR factor eg. hazard areas with 'static' coastal zone

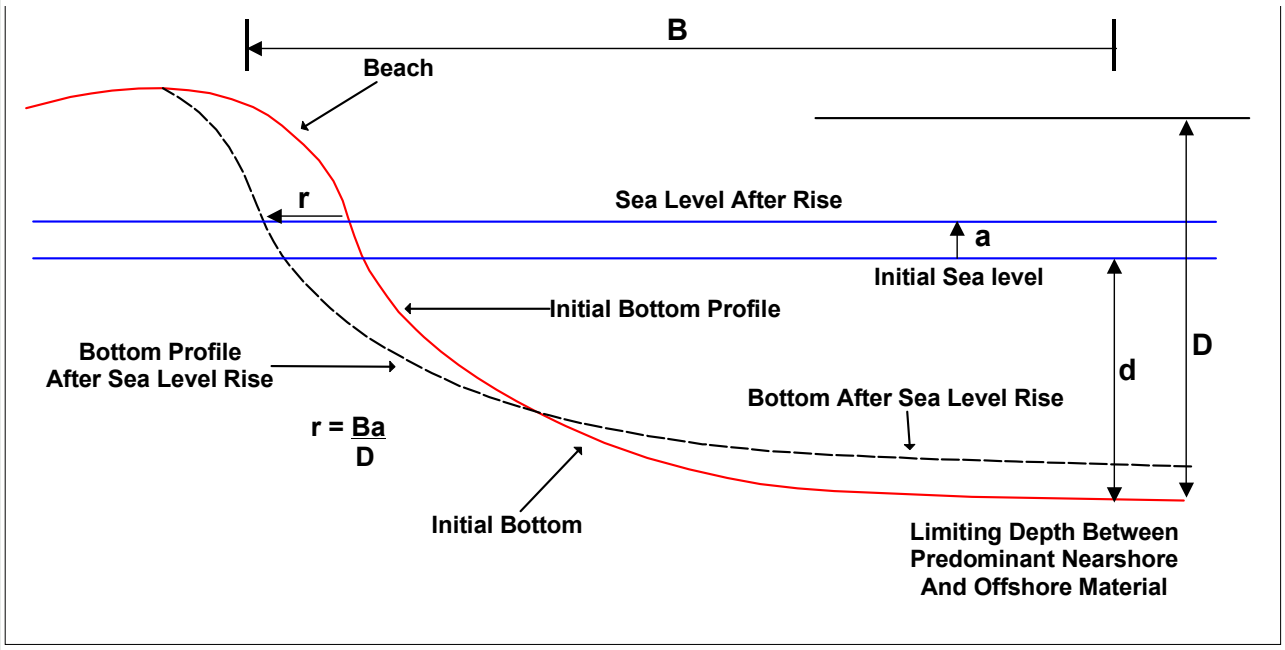
- No recognition shoreline evolution during the planning period



Mapping Future SLR Impacts

Simple assessments by adding a SLR factor eg. Brunn Rule

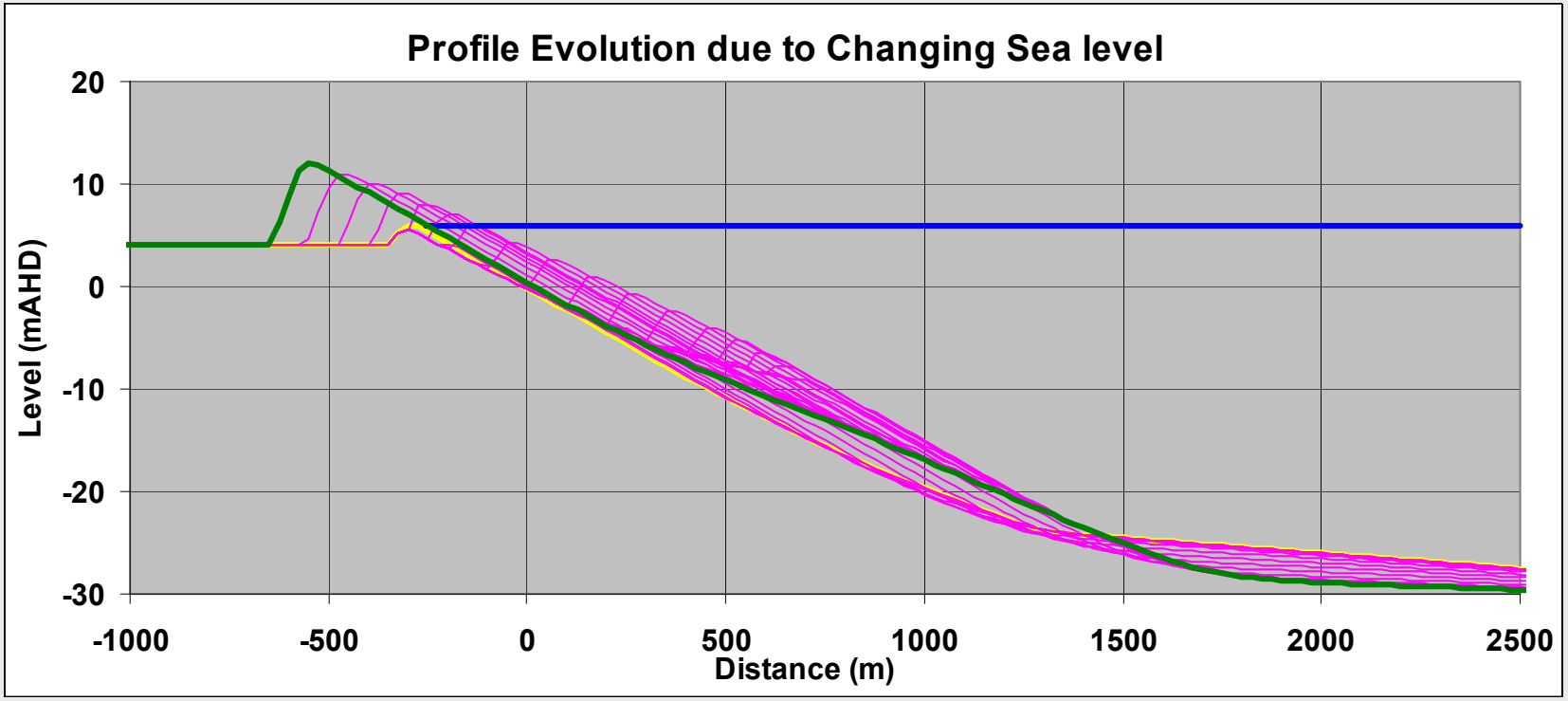
- 1D cross-shore profile evolution
- No representation of longshore shoreline change, coastal headlands or other controls



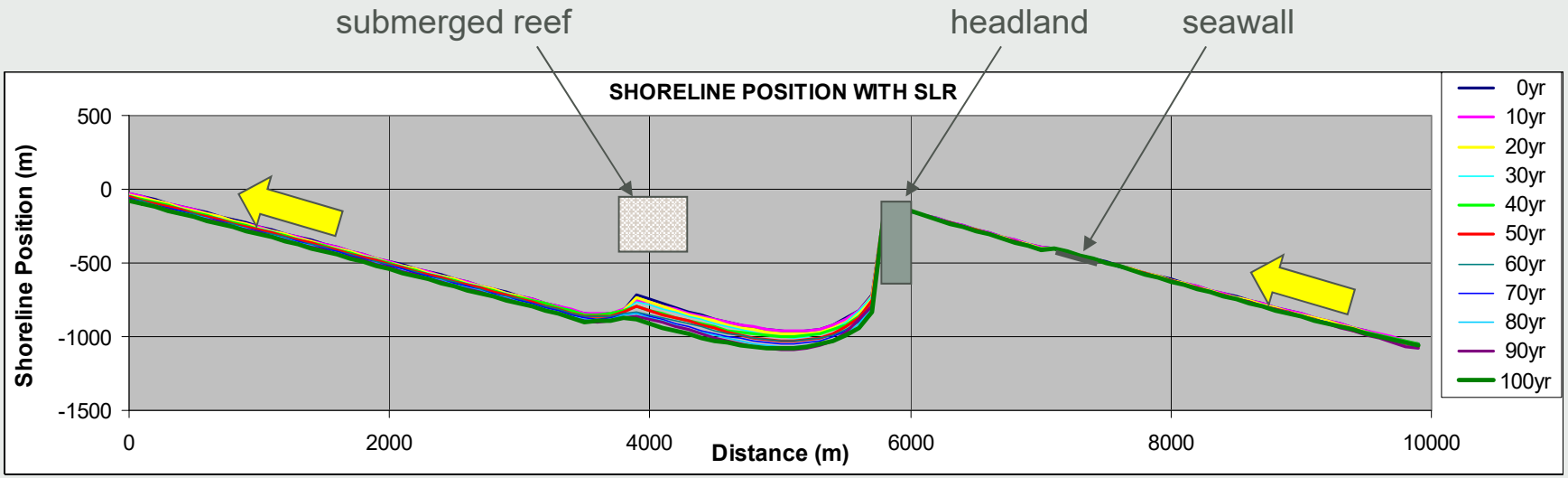
Incorporating Climate Change

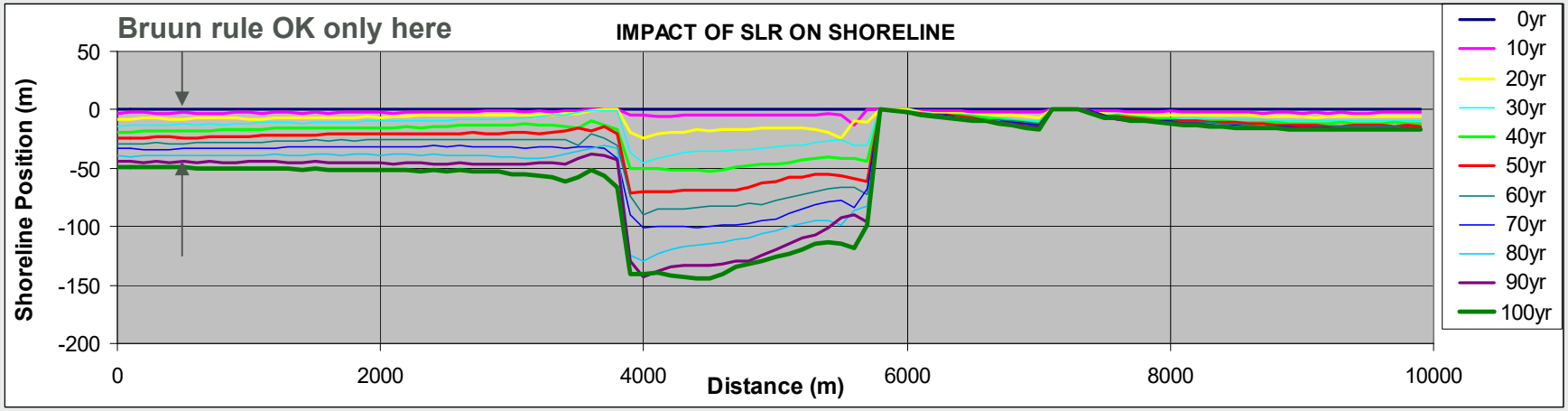
Detailed assessments that consider the physical changes throughout the planning period

- Profile response to changing sea levels



Incorporating Climate Change – Quasi 2D Modelling





PHASE 3. Identify areas exposed to current and future coastal hazards

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Coastal Hazard Areas Map
Storm Tide Inundation Area

8259-423 KULBURN

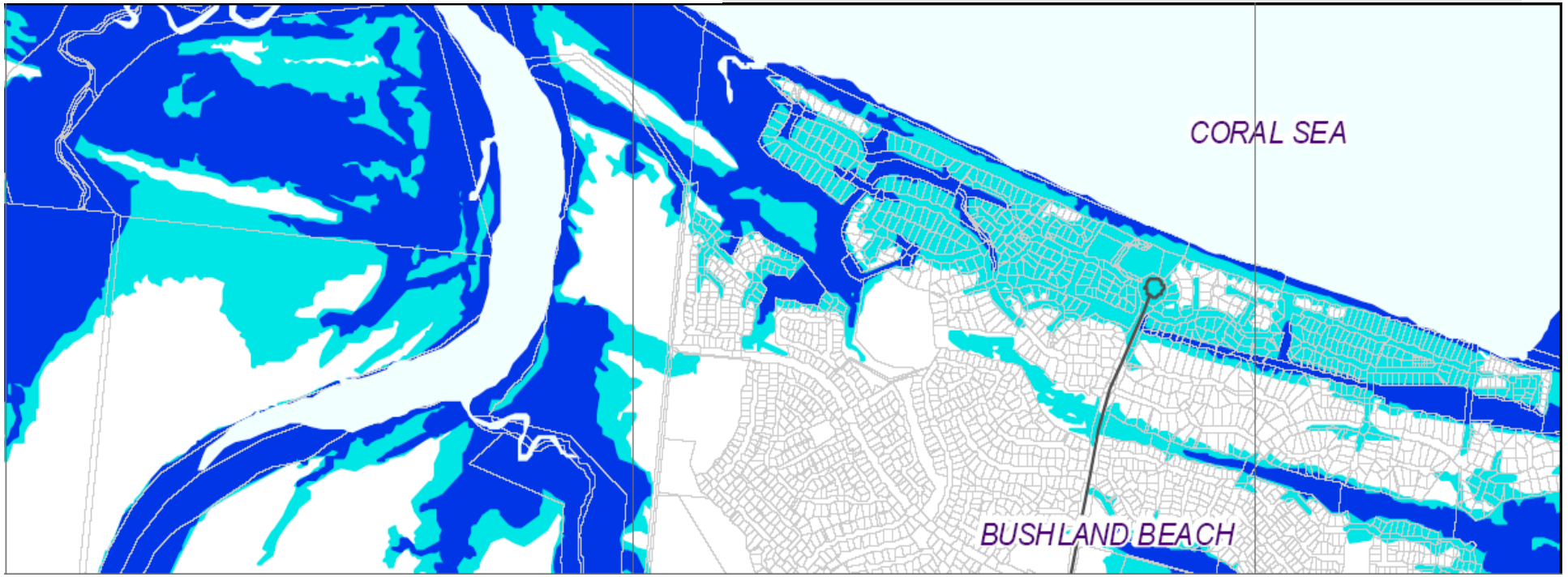
Storm Tide Inundation Area (including projected climate change impacts to 2100)

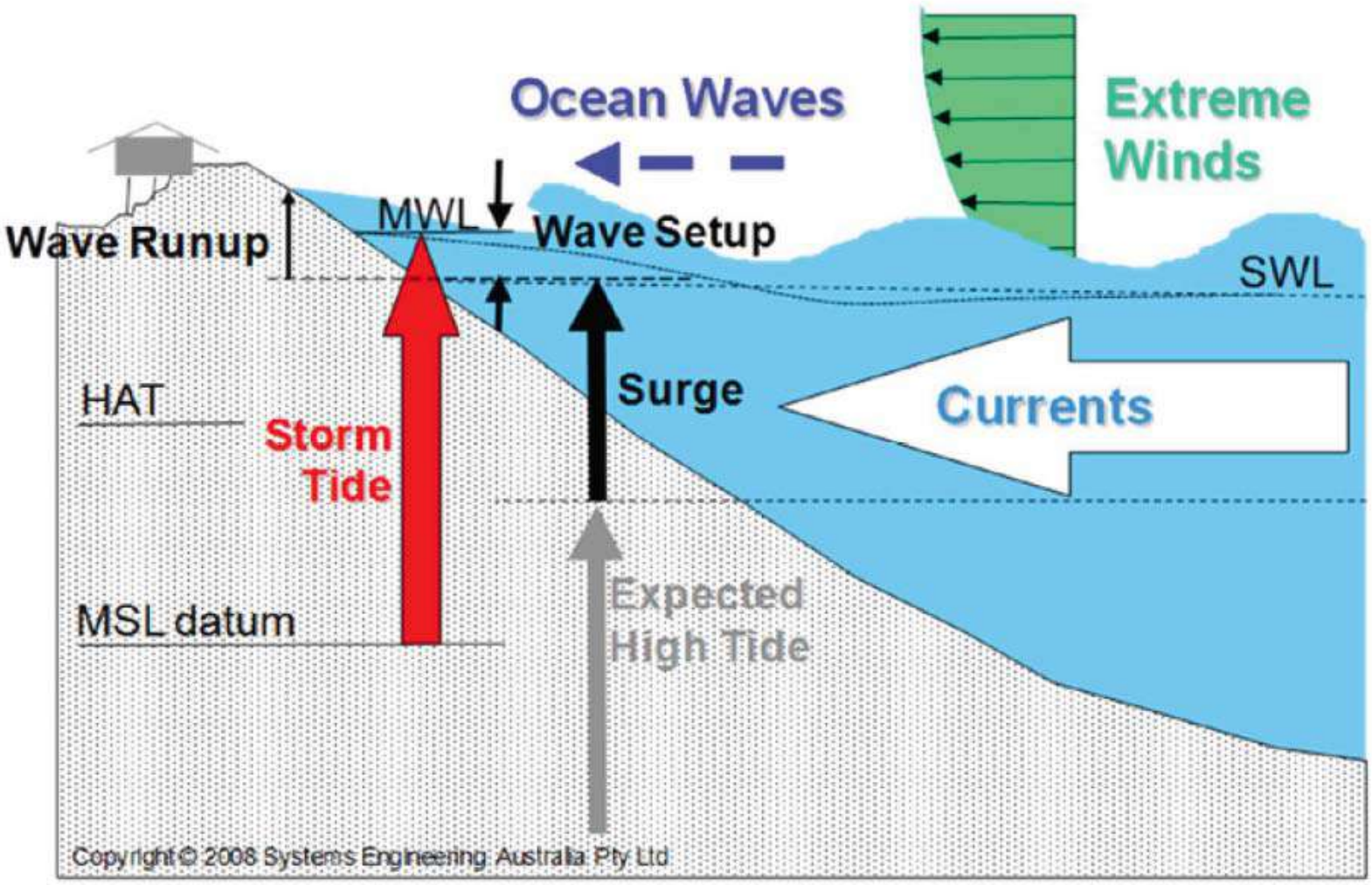
High hazard area
(greater than 1.0 m water depth)

Medium hazard area
(less than 1.0 m water depth)

Simple 'bathtub' assessment

- No recognition shoreline evolution during the planning period
- No recognition of inundation patterns or volumes

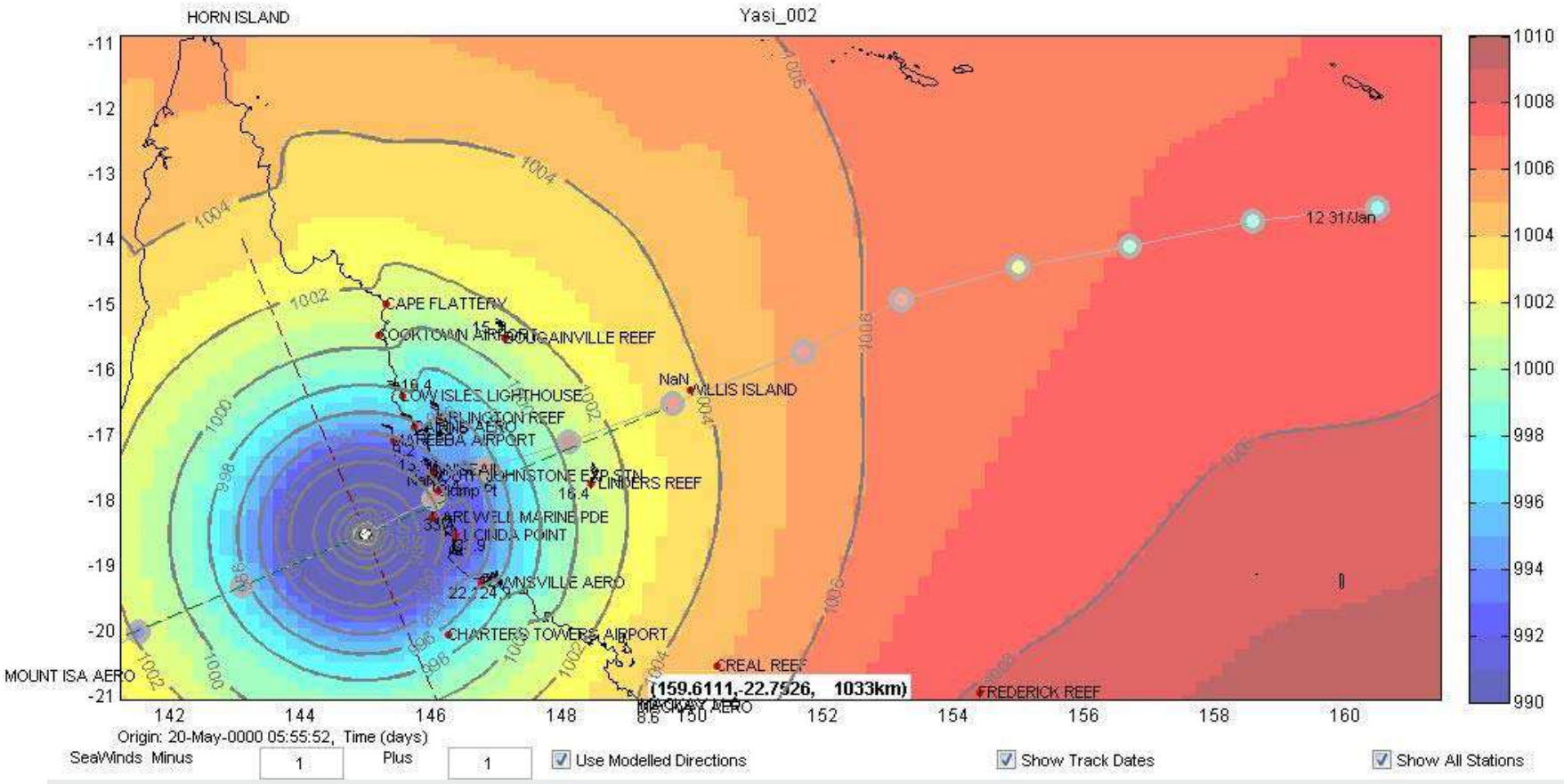




Source: NDRP Storm Tide Hazard Interpolation Study, 2014.

Wind and Atmospheric Pressure Modelling

Tropical Cyclone Yasi Reconstruction (CyCal, *J. McConochie*)

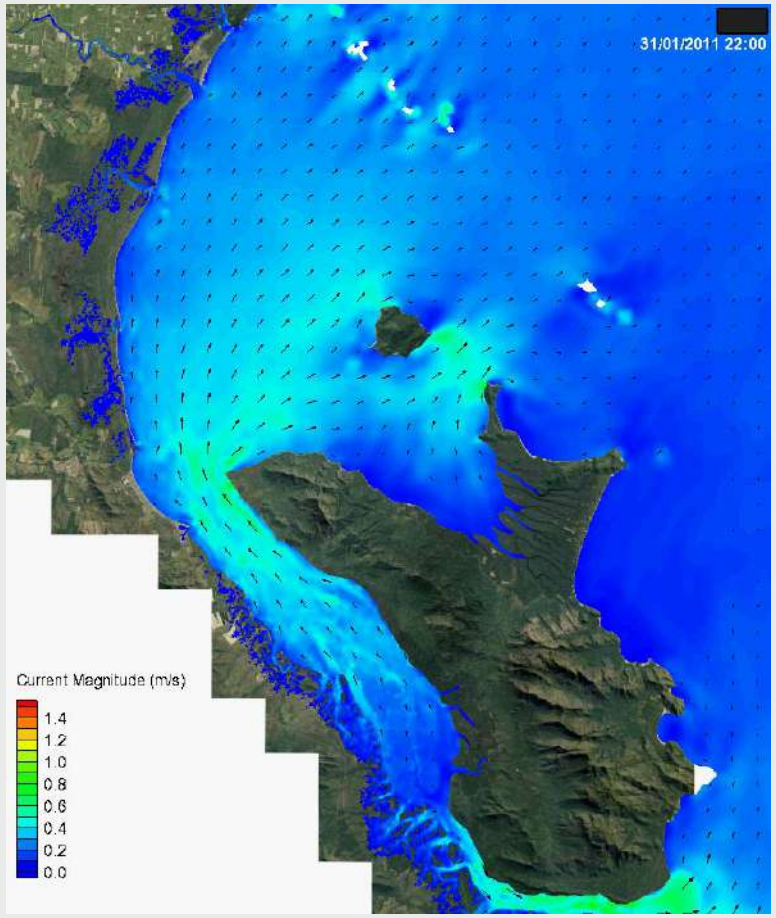


PHASE 3. Identify areas exposed to current and future coastal hazards

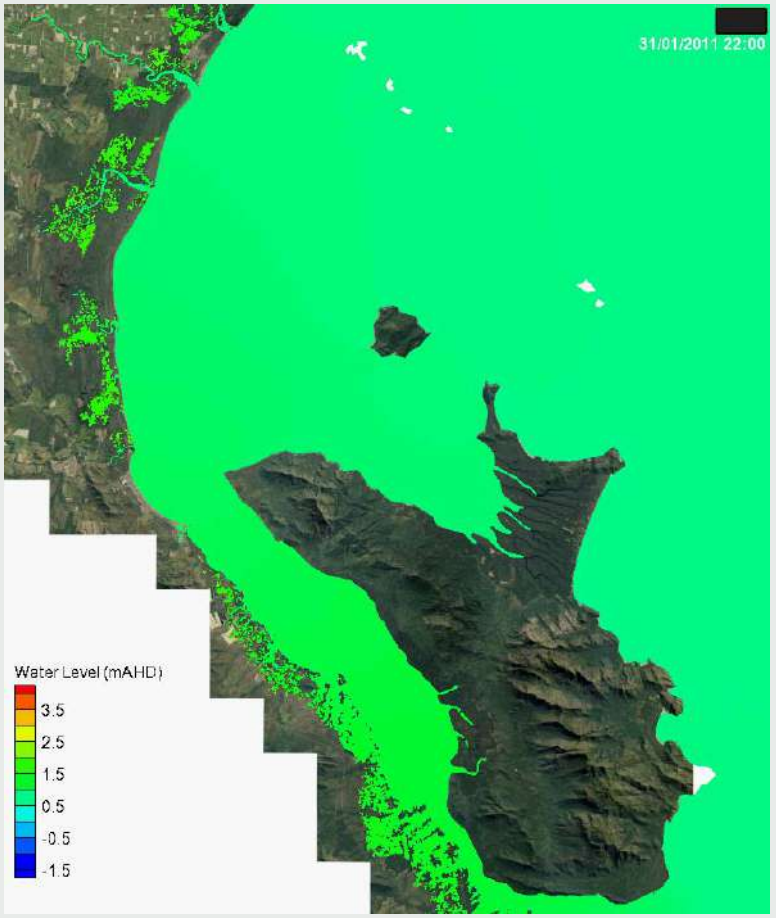
Storm Tide Inundation Modelling

TC Yasi Storm Tide hindcast simulation

Currents



Water Level



PHASE 3. Identify areas exposed to current and future coastal hazards

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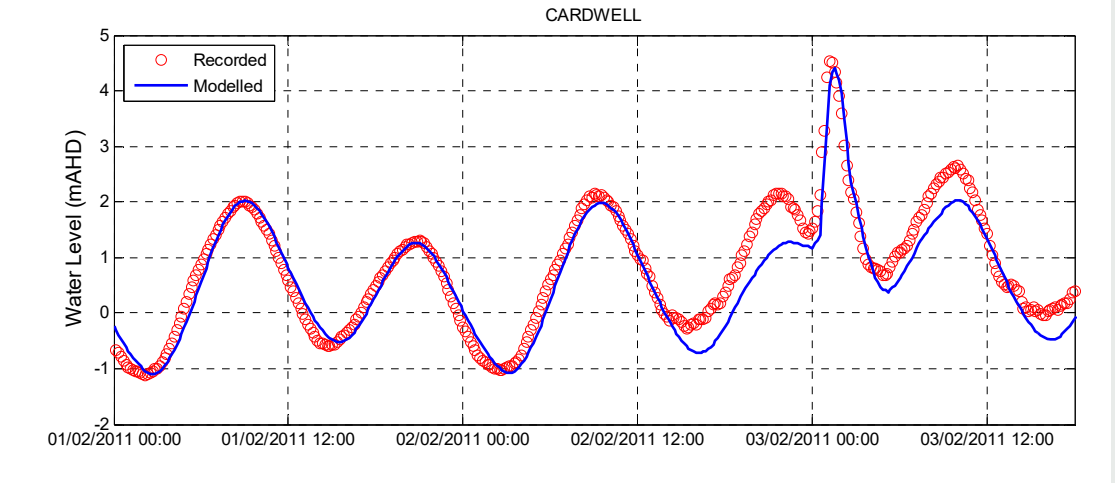
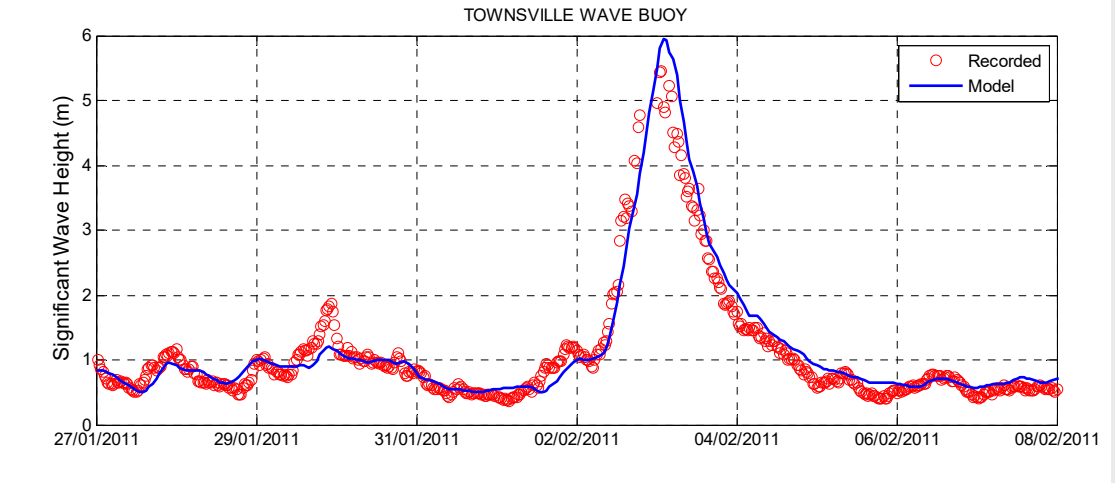
Model Validation



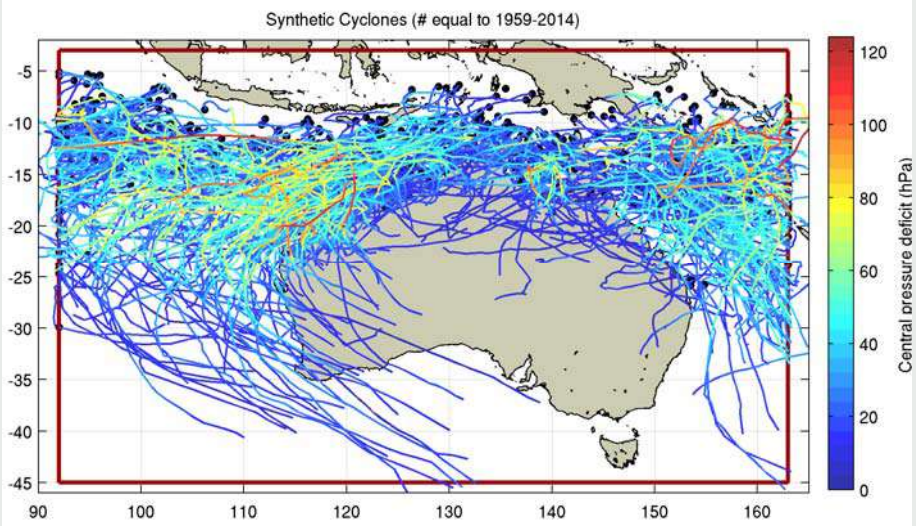


PHASE 3. Identify areas exposed to current and future coastal hazards

Queensland Storm Tide Hazard Studies

Typically include…

- Climatology analysis and wind field modelling (TC and non-TC events)
- Development of a synthetic storm population to model
- Tide, surge and wave modelling
- Likelihood of co-incident fluvial flooding
- Coastal barrier overtopping consideration
- Simulation of +50,000 years to generate long-term statistics



Source: Synthetic TC Storm Database (Harper and Mason, 2016)

Lots of human and computation effort!

PHASE 3. Identify areas exposed to current and future coastal hazards

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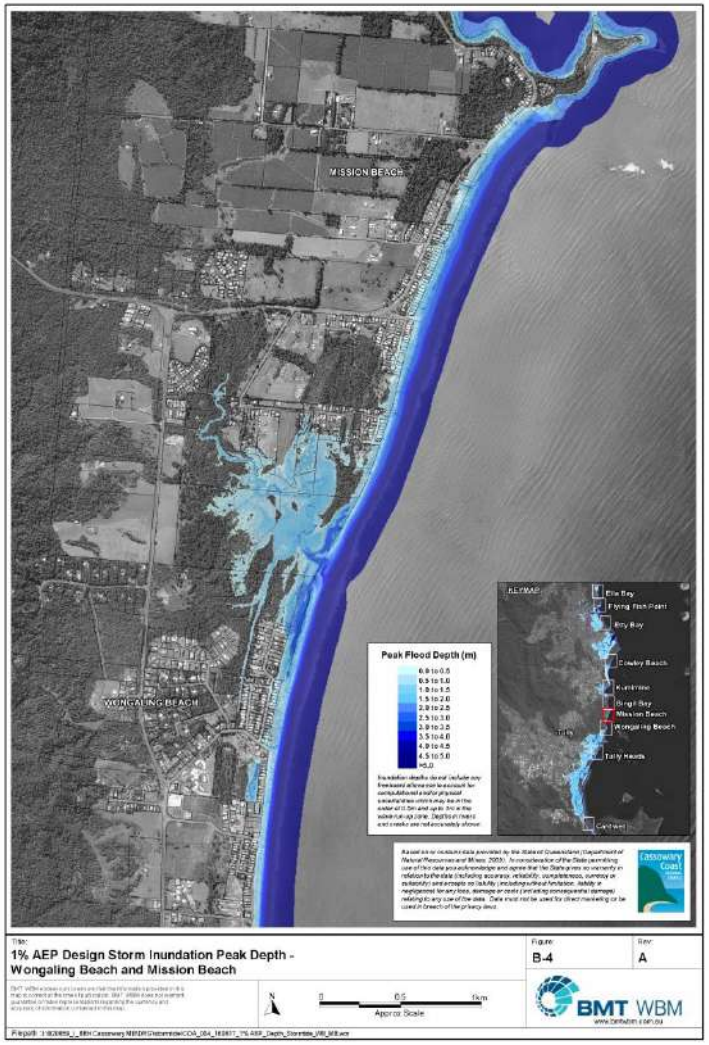
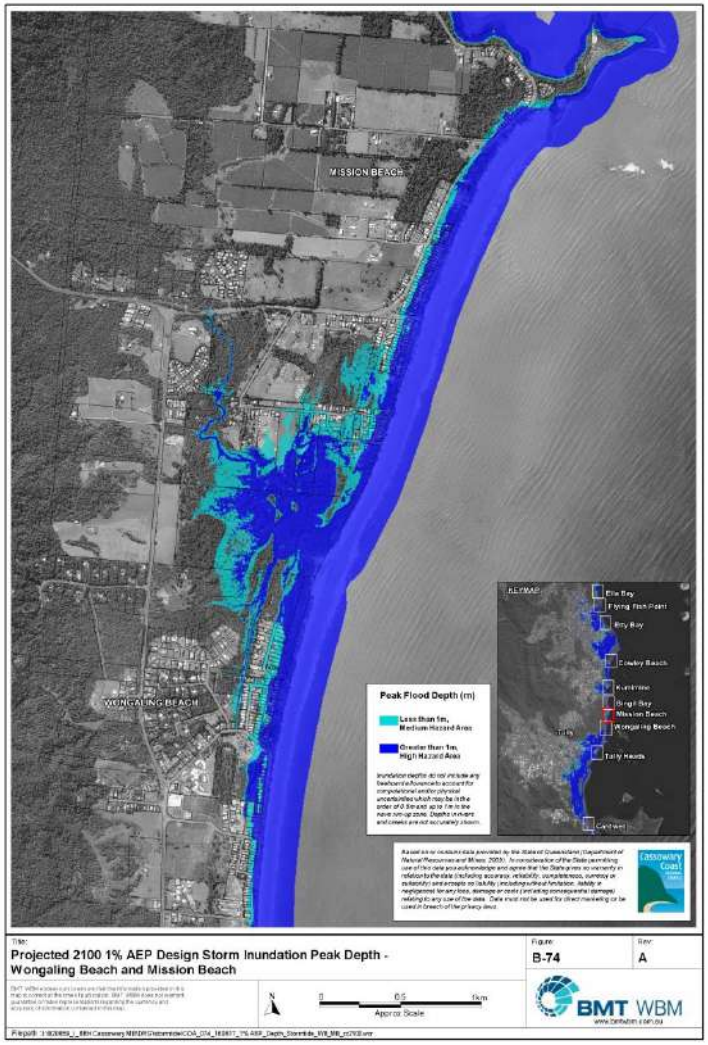
Storm Tide Hazard Mapping





PHASE 3. Identify areas exposed to current and future coastal hazards

Phase 4 – So I have some hazard lines – what next?

PHASE 4. Identify key assets potentially impacted

What are the assets on the coast we are concerned about?

Built/Economic

Society/Community

Environmental

Likelihood

- **Likelihood** is the frequency that a coastal hazard event will occur
- It is:
  - the part of the risk equation you can see
  - depicted as a hazard line or a spatial polygon
  - indicates a reasonable probability that an event will occur within a timeframe
  - but does not necessarily mean there will be impacts to the assets within the lines!

Erosion Hazard Lines Overlaying Various Assets on the Coast

Groyne/
Headland

Popular
Beach and
Surf Break

Dune and
Vegetation

Foreshore
Park Reserve
and Toilets

Residential
Houses and
Small
Businesses

Undeveloped
Esplanade

Local Road
(water and sewerage
infrastructure)

Asset Register with Likelihood

Asset Name	Asset Type	Risk Likelihood at 2100	Consequence (Erosion Risk)				Overall Risk Level Likelihood x Consequence
			Social	Environmental	Economic	Combined	
Transport Infrastructure							
Minor Roads (multiple)	Minor Road	Likely					
Eversons Road	Access Lane	Unlikely					
Other Infrastructure							
Stormwater Lines	Stormwater Infrastructure	Unlikely					
Water Supply Lines	Water (Potable) Supply Line	Rare					
Sewer Lines	Sewerage Infrastructure	Rare					
Community Infrastructure							
Hat Head Holiday Park	Community Facilities	Almost Certain					
Hat Head Surf Club	Community Facilities	Almost Certain					
Amenities / Block / Shed - Blueys Beach (south)	Community Facilities	Almost Certain					
Boat Ramp	Community Facilities	Likely					
Beach Access Paths	Community Facilities	Unlikely					
Urban & Rural Development							
Residential Property (multiple)	Residential Development	Unlikely					
Rural Landscape	Rural Land	Unlikely					
Natural Assets							
Hat Head Beach	Beach	Almost Certain					
Coastal Vegetation (Foredune)	Terrestrial Habitat	Almost Certain					
National Park	Parks and Reserves	Unlikely					
Environmental Conservation Land	Environmental Land	Unlikely					
Environmental Management Land	Environmental Land	Likely					

Consequence

Consequence is the relative impact to an asset in response to the event:

- the ‘so what’ factor
- need to unpack the ‘magnitude’ of impact – what is it’s severity, intensity, and duration
- nature of the impact on the asset – major/minor damage, loss of use (for a time), cost of repair versus replace, more frequent maintenance
- can be considered both in terms of existing or proposed assets
- different consequence scales can be developed depending on if it is a built, societal or natural asset

Consequence Scale (….permanent or temporary impacts)

Consequence	Society / Community	Environment	Economy
Catastrophic	Widespread permanent impact to community's services, wellbeing, or culture (eg, > 50 % of community affected), or national loss, or no suitable alternative sites exist	Widespread, devastating / permanent impact (e.g. entire habitat destruction), or loss of all local representation of nationally important species (e.g. endangered species). Recovery unlikely.	Damage to property, infrastructure, or local economy > $20 million*
Major	Major permanent or widespread medium term (somewhat reversible) disruption to community's services, wellbeing, or culture (eg up to 50 % of community affected), or regional loss, or Only a few suitable alternative sites exist	Widespread semi-permanent impact, or widespread pest / weed species proliferation, or semi-permanent loss of entire regionally important habitat. Recovery may take many years.	Damage to property, infrastructure, or local economy >$5 million - $20 million
Moderate	Minor long term or major short term (mostly reversible) disruption to services, wellbeing, or culture of the community (eg, up to 25 % of community affected), or sub-regional loss, or Some suitable alternative sites exist	Significant environmental changes isolated to a localised area, or loss of regionally important habitat in one localised area. Recovery may take several years.	Damage to property, infrastructure, or local economy >$500,000** - $5 million
Minor	Small to medium short term (reversible) disruption to services, wellbeing, finances, or culture of the community (eg, up to 10 % of community affected), or local loss, or many alternative sites exist	Environmental damage of a magnitude consistent with seasonal variability. Recovery may take one year.	Damage to property, infrastructure, or local economy >$50,000 -$500,000
Insignificant	Very small short term disruption to services, wellbeing, finances, or culture of the community (eg, up to 5 % of community affected), or neighbourhood loss, or numerous alternative sites exist	Minimal short term impact, recovery may take less than 6 months, or habitat affected with many alternative sites available.	Damage to property, infrastructure, or local economy >$50,000

Determine Consequence to Asset if Hazard Occurs

Asset Name	Asset Type	Risk Likelihood at 2100	Consequence (Erosion Risk)				Overall Risk Level Likelihood x Consequence
			Society and Community	Environmental	Economic	Combined	
Transport Infrastructure							
Minor Roads (multiple)	Minor Road	Likely	*Insignificant*	*Insignificant*	*Major*	*Major*	
Eversons Road	Access Lane	Unlikely	*Insignificant*	*Insignificant*	*Major*	*Major*	
Other Infrastructure							
Stormwater Lines	Stormwater Infrastructure	Unlikely	*Minor*	*Minor*	*Moderate*	*Moderate*	
Water Supply Lines	Water (Potable) Supply Line	Rare	*Minor*	*Minor*	*Moderate*	*Moderate*	
Sewer Lines	Sewerage Infrastructure	Rare	*Moderate*	*Minor*	*Moderate*	*Moderate*	
Community Infrastructure							
Hat Head Holiday Park	Community Facilities	Almost Certain	*Minor*	*Insignificant*	*Moderate*	*Moderate*	
Hat Head Surf Club	Community Facilities	Almost Certain	*Minor*	*Insignificant*	*Moderate*	*Moderate*	
Amenities / Block / Shed - Blueys Beach (south)	Community Facilities	Almost Certain	*Major*	*Insignificant*	*Moderate*	*Major*	
Boat Ramp	Community Facilities	Likely	*Minor*	*Insignificant*	*Moderate*	*Moderate*	
Beach Access Paths	Community Facilities	Unlikely	*Minor*	*Insignificant*	*Moderate*	*Moderate*	
Urban & Rural Development							
Residential Property (multiple)	Residential Development	Unlikely	*Minor*	*Insignificant*	*Major*	*Major*	
Rural Landscape	Rural Land	Unlikely	*Minor*	*Insignificant*	*Major*	*Major*	
Natural Assets							
Hat Head Beach	Beach	Almost Certain	*Major*	*Minor*	*Major*	*Major*	
Coastal Vegetation (Foredune)	Terrestrial Habitat	Almost Certain	*Minor*	*Major*	*Minor*	*Major*	
National Park	Parks and Reserves	Unlikely	*Major*	*Major*	*Minor*	*Major*	
Environmental Conservation Land	Environmental Land	Unlikely	*Minor*	*Major*	*Insignificant*	*Major*	
Environmental Management Land	Environmental Land	Likely	*Minor*	*Major*	*Insignificant*	*Major*	

Phase 5 – Bringing it together

Risk = Likelihood x Consequence

		CONSEQUENCE				
		Insignificant	Minor	Moderate	Major	Catastrophic
LIKELIHOOD	Almost Certain	Low	Medium	High	Extreme	Extreme
	Likely	Low	Medium	High	High	Extreme
	Possible	Low	Medium	Medium	High	Extreme
	Unlikely	Low	Low	Medium	High	Extreme
	Rare	Low	Low	Low	Medium	High

Assigning Risk and Developing a Risk Register

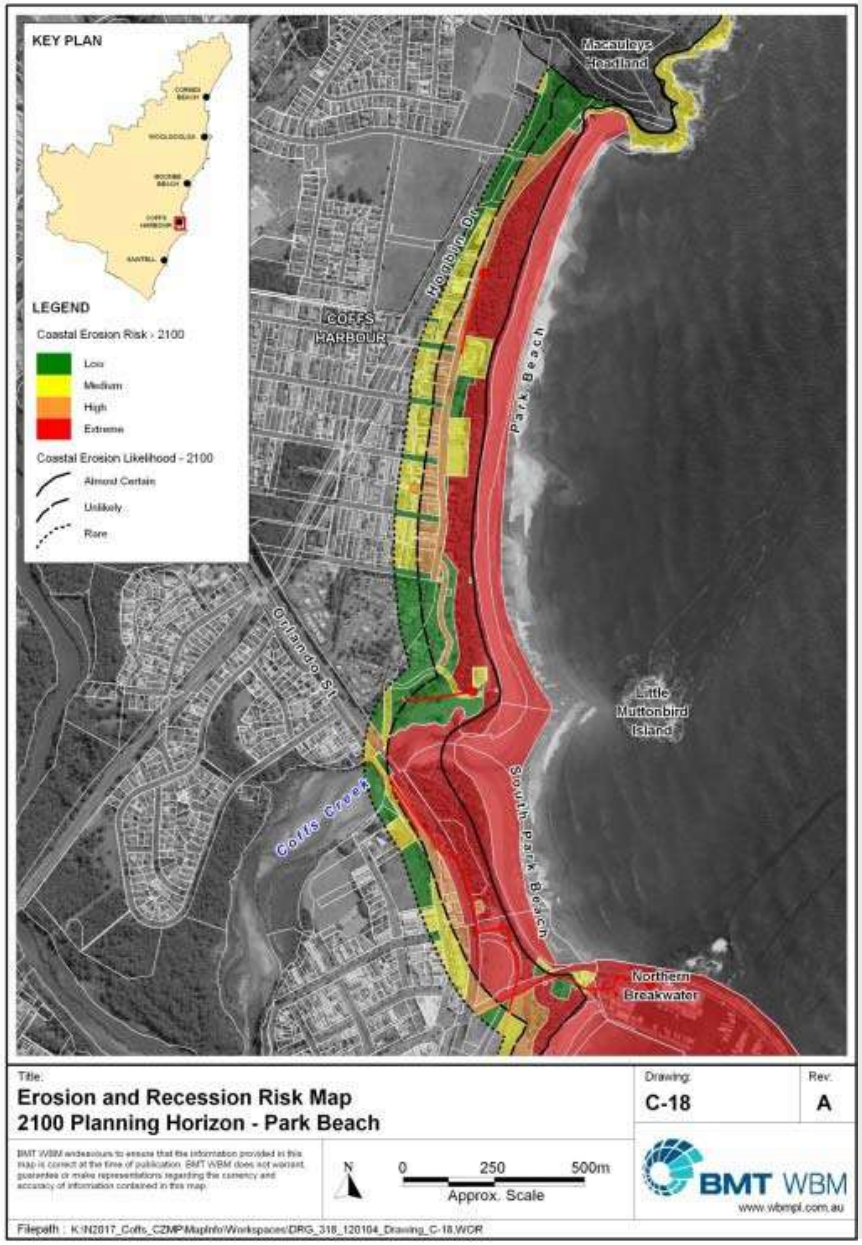
Asset Name	*Asset Type*	*Risk Likelihood at 2100*	*Consequence (Erosion Risk)*				*Overall Risk Level Likelihood x Consequence*
			Society and Community	*Environmental*	*Economic*	*Combined*	
Transport Infrastructure							
Minor Roads (multiple)	Minor Road	Likely	*Insignificant*	*Insignificant*	*Major*	*Major*	*High*
Eversons Road	Access Lane	Unlikely	*Insignificant*	*Insignificant*	*Major*	*Major*	*High*
Other Infrastructure							
Stormwater Lines	Stormwater Infrastructure	Unlikely	*Minor*	*Minor*	*Moderate*	*Moderate*	*Medium*
Water Supply Lines	Water (Potable) Supply Line	Rare	*Minor*	*Minor*	*Moderate*	*Moderate*	*Low*
Sewer Lines	Sewerage Infrastructure	Rare	*Moderate*	*Minor*	*Moderate*	*Moderate*	*Low*
Community Infrastructure							
Hat Head Holiday Park	Community Facilities	Almost Certain	*Minor*	*Insignificant*	*Moderate*	*Moderate*	*High*
Hat Head Surf Club	Community Facilities	Almost Certain	*Minor*	*Insignificant*	*Moderate*	*Moderate*	*High*
Amenities / Block / Shed - Blueys Beach (south)	Community Facilities	Almost Certain	*Major*	*Insignificant*	*Moderate*	*Major*	*Extreme*
Boat Ramp	Community Facilities	Likely	*Minor*	*Insignificant*	*Moderate*	*Moderate*	*High*
Beach Access Paths	Community Facilities	Unlikely	*Minor*	*Insignificant*	*Moderate*	*Moderate*	*Medium*
Urban & Rural Development							
Residential Property (multiple)	Residential Development	Unlikely	*Minor*	*Insignificant*	*Moderate*	*Moderate*	*Medium*
Rural Landscape	Rural Land	Unlikely	*Minor*	*Insignificant*	*Moderate*	*Moderate*	*Medium*
Natural Assets							
Hat Head Beach	Beach	Almost Certain	*Major*	*Minor*	*Major*	*Major*	*Extreme*
Coastal Vegetation (Foredune)	Terrestrial Habitat	Almost Certain	*Minor*	*Major*	*Minor*	*Major*	*Extreme*
National Park	Parks and Reserves	Unlikely	*Major*	*Major*	*Minor*	*Major*	*High*
Environmental Conservation Land	Environmental Land	Unlikely	*Minor*	*Moderate*	*Insignificant*	*Moderate*	*Medium*
Environmental Management Land	Environmental Land	Likely	*Minor*	*Minor*	*Insignificant*	*Minor*	*Medium*

Risk Mapping

Combines likelihood (hazard areas) with consequence (so what?)

Provides information at an asset or lot level

Spatial representation through GIS



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Risk Evaluation: Are Existing Controls Effective?

- **Critical Step !!!!!!**
- **What existing controls are in place?**
- **Do the controls reduce the likelihood or consequence of the hazard?**

Examples:

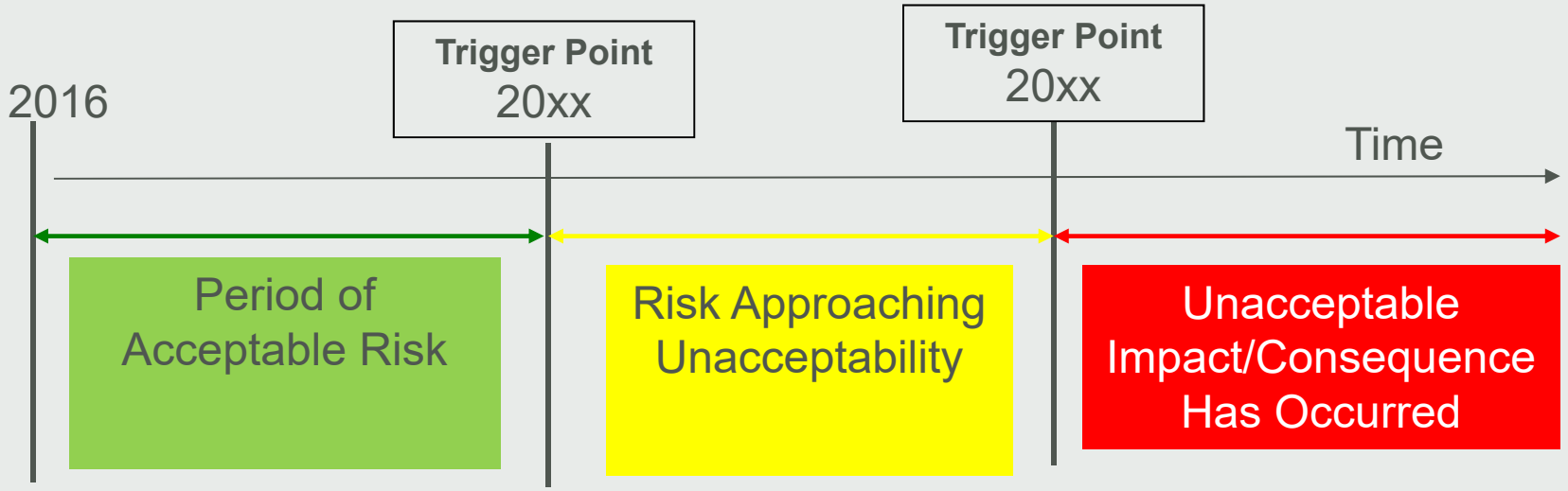
- *Does our flood code effectively cover areas prone to inundation from the sea?*
- *If not, can the code be extended and used in a similar manner?*
- *Are our setbacks for development on the open coast suitable or can they be modified to address larger risk areas?*
- *Have we built the risk information into our asset maintenance register?*
- *Have we considered this in the context of capital works and/or design of council facilities and buildings?*

Risk Evaluation: What is the tolerance to the risk?

Risk Levels	Description	Likely Management Action
Low	Risk currently acceptable but trend in the risk to be tracked over time.	Existing control measures (if any) are suitable. Monitoring of risk likelihood and consequence over time to identify if risk is increasing, decreasing or staying the same.
Medium	Risk likely to be acceptable but trend in the risk to be tracked over time.	Existing control measures (if any) are suitable. Monitoring of risk likelihood and consequence over time to identify if risk is increasing, decreasing or staying the same.
High	Risk may be acceptable with suitable risk control measures in place.	Review of existing management controls or activities for the risk. Increased or different management controls or activities may be needed.
Extreme	Risk less likely to be acceptable; additional risk control measures may need to be considered.	Review of existing management controls or activities for the risk. Increased or different management controls or activities are likely to be needed.

Tolerability and Timescales

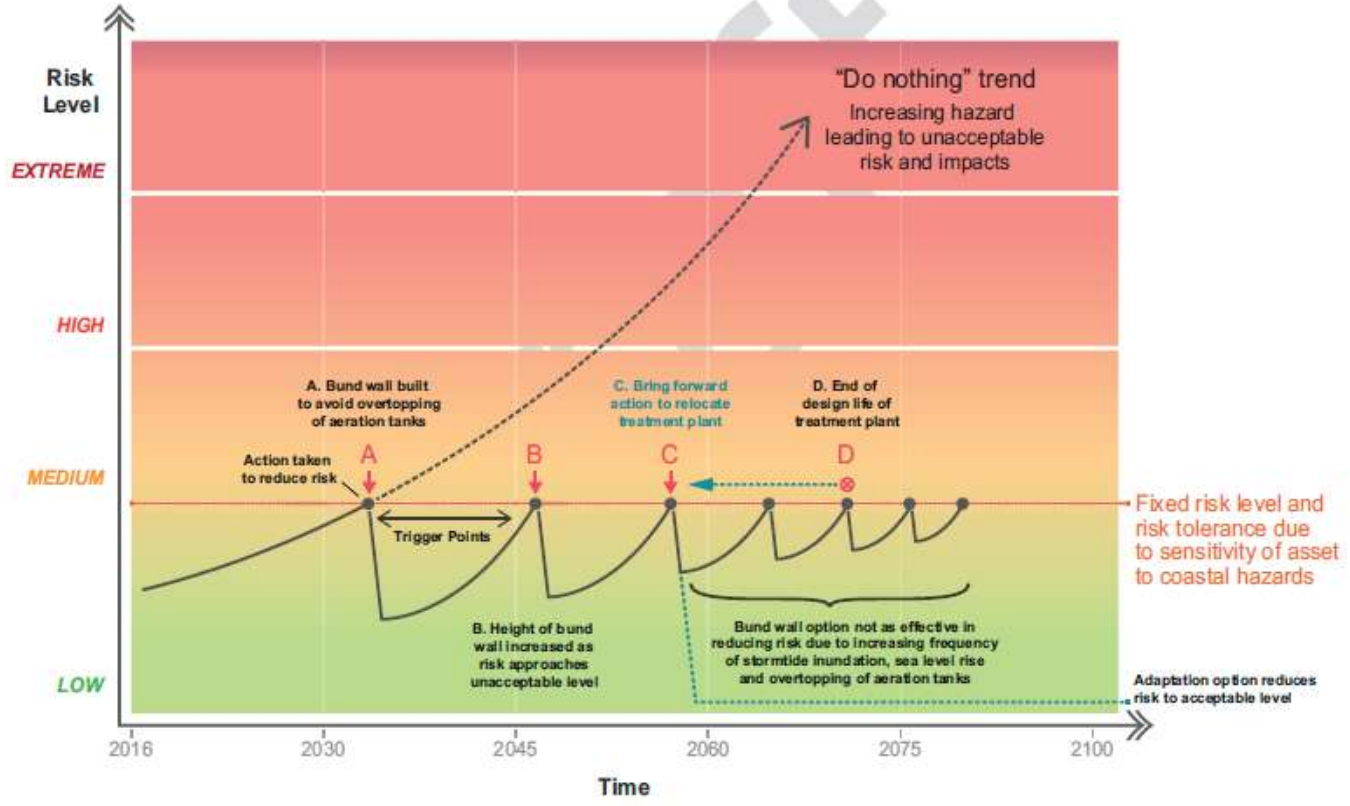
Risk Level	Action required	Tolerance
Extreme / High	**Eliminate or Reduce** the risk	**Intolerable**
Medium	**Reduce** the risk or **accept** the risk (provided residual risk level is understood)	**Tolerable**
Low	**Accept** the risk	**Acceptable**



Changing risk profile and tolerance over time

Hypothetical Example - Sewerage Treatment Plant - Fixed Risk Level

- 'Fixed' risk tolerance and low acceptability of impacts due to sensitivity of asset.
- Reducing effectiveness of risk reduction actions.
- Increasing frequency of risk reduction actions.



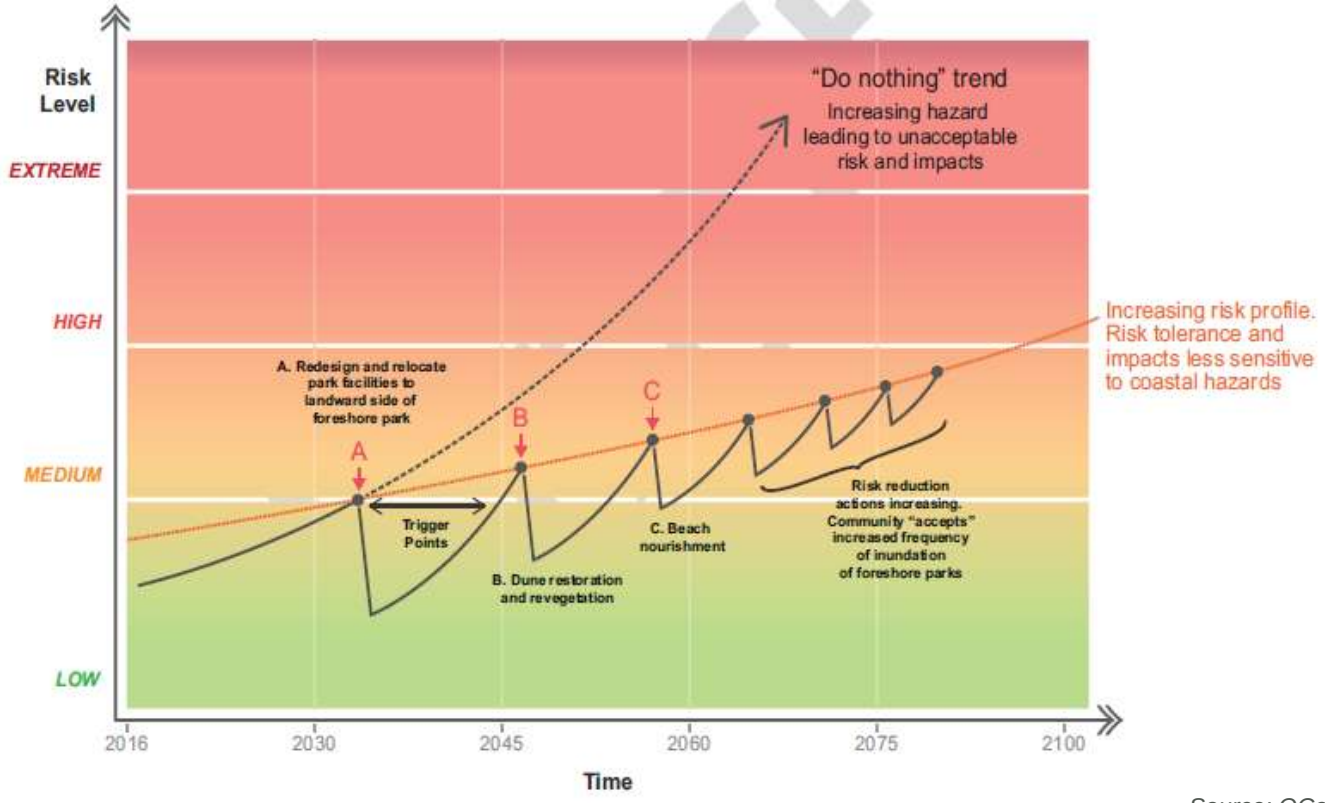
Source: QCoast$_{2100}$ Minimum Standards & Guidelines

PHASE 5. Risk assessment of key assets in coastal hazard areas

Changing risk profile and tolerance over time

Hypothetical Example - Inundation of Foreshore Parks - Changing Risk Tolerance and Risk Profile Over Time

- Risk profile increasing over time.
- Increasing frequency of coastal hazard events.
- Increasing frequency of action to reduce risk
- Reduction in effectiveness of risk reduction measures
- Increasing acceptability of impacts and risk tolerance as asset not as sensitive to coastal hazard impacts.



Source: QCoast$_{2100}$ Minimum Standards & Guidelines

Some Take Home Messages – Phases 3, 4, 5

- Simplicity in defining hazards (as a single line or polygon) is attractive, but misleading and can lead to sub-optimal outcomes
- Likewise too many lines is counterproductive – are we managing for the almost certain, the rare or somewhere in between?
- Consequence is critical to the risk equation
- Consequence needs to be considered on an asset by asset scale
- Risk can be mapped to assist spatial understanding and priorities
- Risk evaluation – need to think about tolerance of the risk and timeframes to avoid mal-adaption

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Phase 7 - Socio-economic appraisal of adaptation options

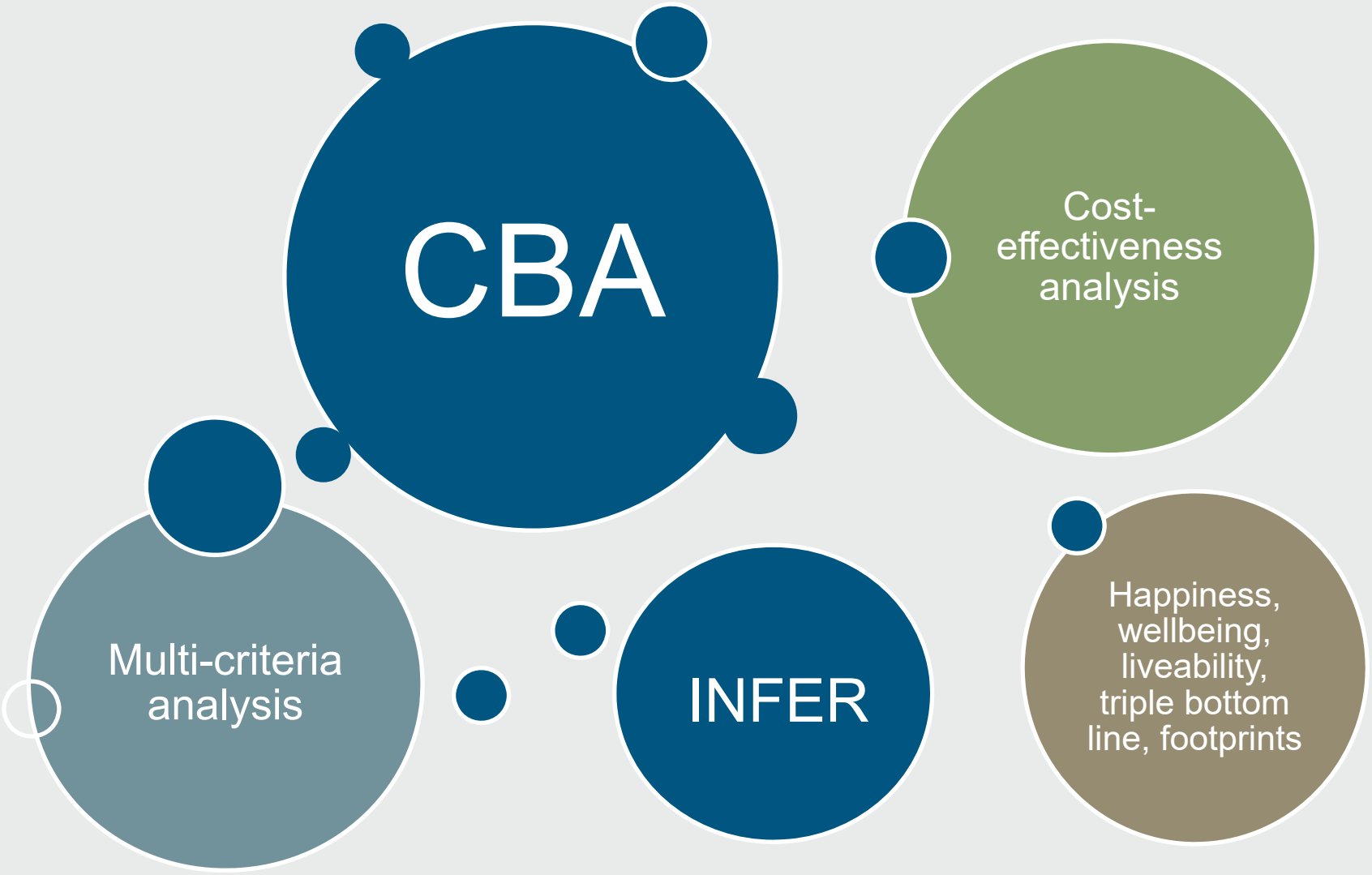
Overview

- The importance of socio-economic appraisal of adaptation options
- The methods available
- MCA and CBA basics
- Benefits of a good CBA
- A coastal example

The importance of socio-economic appraisal of adaptation options

- Revealing all costs, values and benefits of options
- Building a business case
  - competing priorities
  - investor confidence
- Decision making tool
- Communication tool

The methods available



Phase 7 – CHAS requirements

- Multi-criteria analysis
- Cost-benefit analysis
- Leading practice

Multi-criteria analysis

- Qualitative framework
- Involves defining policy objectives, determining a set of criteria to measure performance against each objective and assigning weights to criteria
- Each option is given a score for each criterion and these are weighted and added up to give an overall score
- Often used where non-market outcomes are important

Cost-benefit analysis

- A conceptual framework for the evaluation of option which tries to consider all gains and losses from the project – environmental, social and financial
- Takes a long and wide view:
  - now and into the future
  - include effects on all relevant parties
- Expresses costs and benefits in the common metric of today's money

Benefits and limitations

MCA benefits

- Avoids need to capture benefits in dollar terms
- Useful engagement and prioritisation tool

MCA limitations

- It usually does implicitly assign dollar values but in a subjective way
- Prone to inconsistency
- Highly influenced by the stakeholders in the room at the time

Benefits and limitations

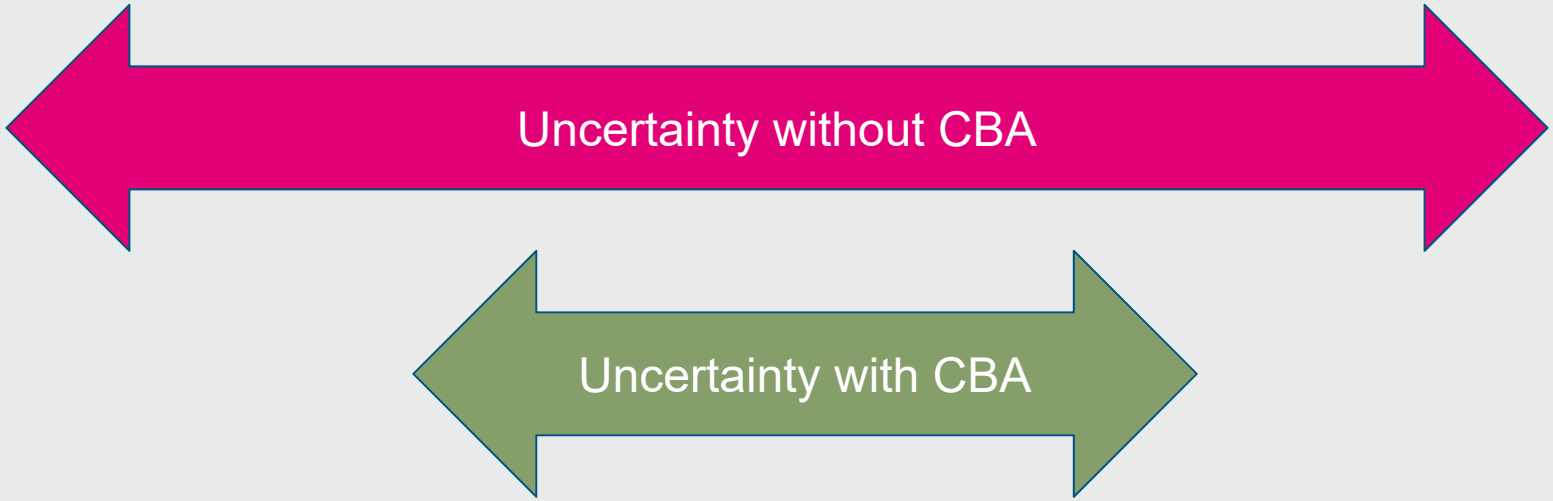
CBA benefits

- Makes assumptions explicit
- Like for like comparison
- The language of investors

CBA limitations

- Usually requires expert input
- Can be more costly than a MCA
- Value judgements are still required
- Perceived limitations

Case for CBA



- Will still make ‘wrong’ decisions with a robust CBA
- But will tend to be closer than without one
- Improving decision making can result in substantial benefits

Flood warning systems

- Provide advice on impending flooding so people can take action to minimise its negative impacts

- Helps facilitate:
  - temporarily removing people and property out of the flood zone
  - temporarily flood-proofing with sandbags and other measures
  - early alerting of emergency services
  - orderly disruption of utility network systems and
  - suspension of sensitive works

- Likely to be one of the coastal adaptation options available and can be evaluated through CBA

Key assumptions

Cost assumptions

- Cost of system ($5m)

Benefit assumptions

- Probability of flood (10 per cent)
- Risk preferences of people exposed to flood damages (risk neutral)
- Flood damages without system ($500m)
- Extent to which flood damages are reduced with system (20 per cent)

Extent to which flood damages are reduced with flood warning system (%)

Depth of flooding (m)	Warning			
	<2 hours	2-4 hours	4-6 hours	6-8 hours
1.2	25.3	35.7	38.7	40.7
0.9	26.4	37.6	40.6	42.6
0.6	25.5	37.2	40.2	42.2
0.3	30	42.1	45.1	47.1

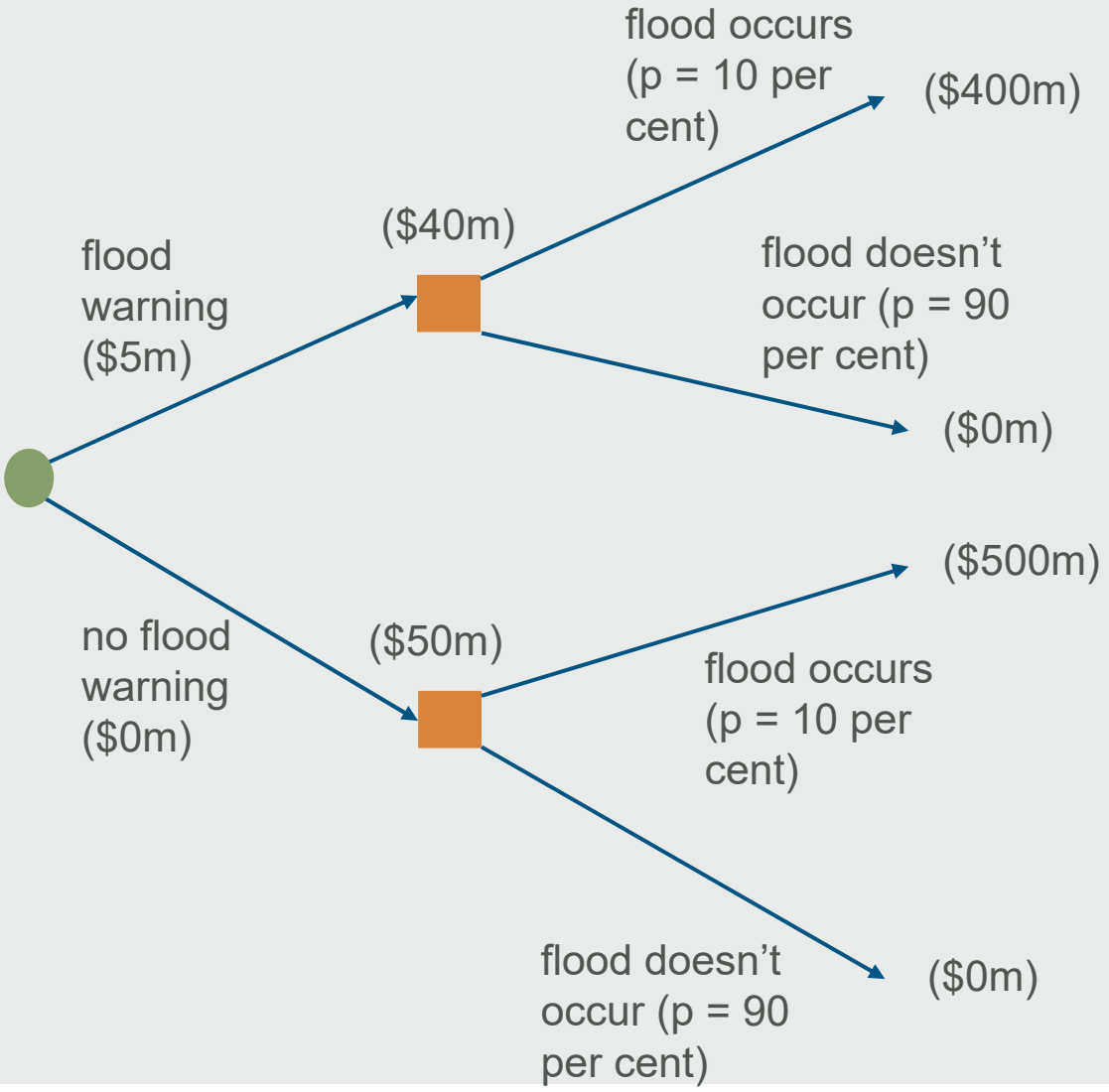
Can also make adjustments for:

- Some residents not receiving warning
- Some residents not being willing or able to respond to warning
- Experience in responding to floods

Accounting for uncertainty

- Quantifying costs relatively straightforward
- Quantifying benefits more difficult as future is unknown
- What not to do:
  - wait until the risk or uncertainty is resolved, and calculate the benefits based on the outcome that eventuated
  - calculate the benefits in advance based on the most likely outcome (or the best/worst possible outcome)
- Ideally, want to calculate the benefits in advance based on many potential outcomes

Simple decision tree



Costs and benefits

- Cost of system = $5m
- Benefits of system (reduction in flood damages) = $10m
- Net benefits = $5m
- Net benefits would be higher if people exposed to flood damages were risk averse
  - system would have an insurance value

Timing under uncertainty

- Model above is very simple – real world models are more complicated
- An important additional complexity is the timing of investment in the flood warning system under uncertainty
  - relevant where the costs of the investment cannot be fully recovered and the uncertainty is partly resolved over time
- Numerous modelling approaches to working when to make the investment, accounting for the option value in deferring investment

Some take home messages – Phase 7

- Benefits of socio-economic appraisal of adaptation options are broader than just choosing between options
- MCA and CBA both have strengths and limitations
- Consider MCA and CBA as tools in a broader toolbox
- CBA can help deal with timing and uncertainty issues
- There is a lot of value in undertaking a good CBA


Thank you
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