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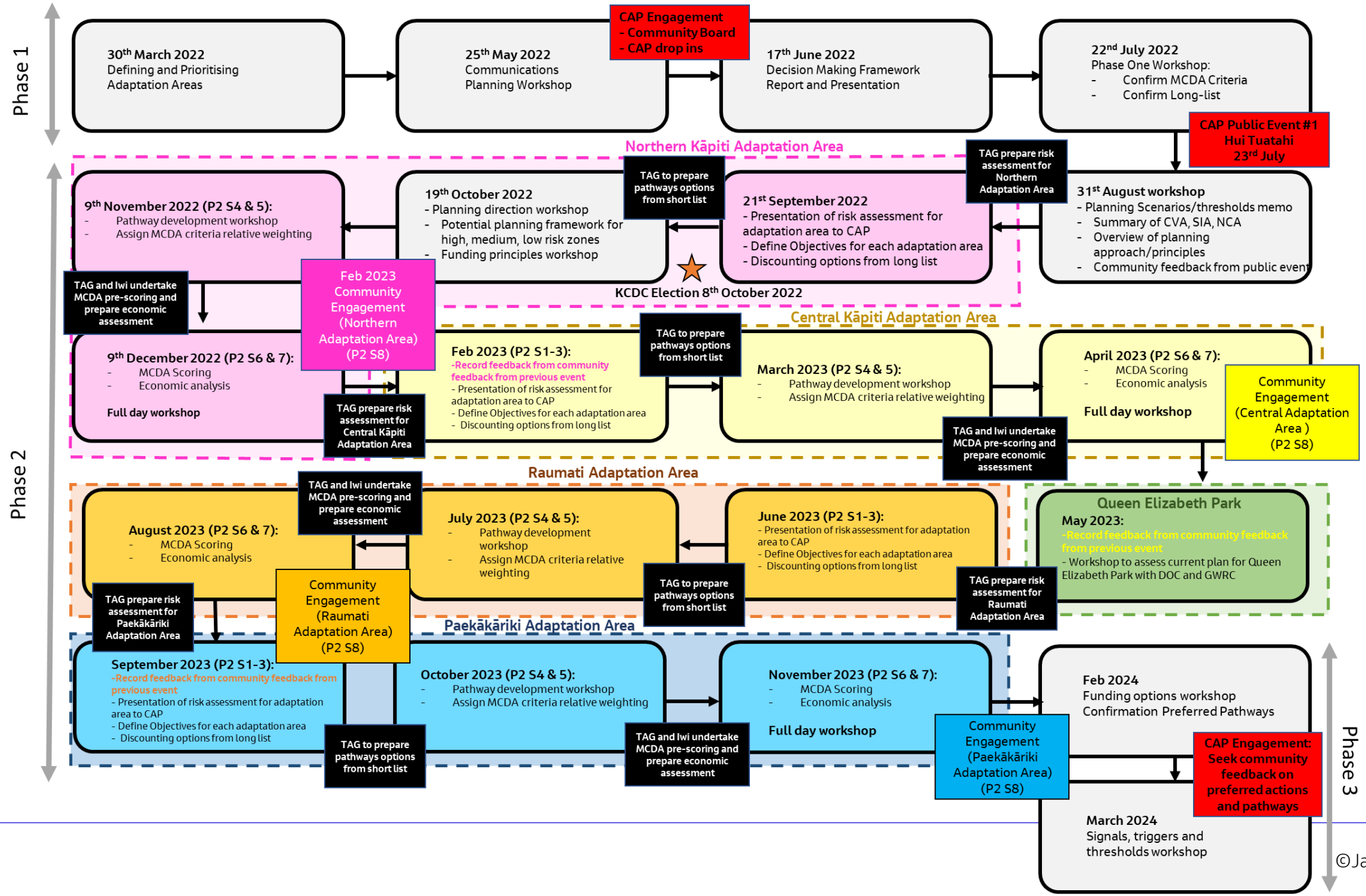
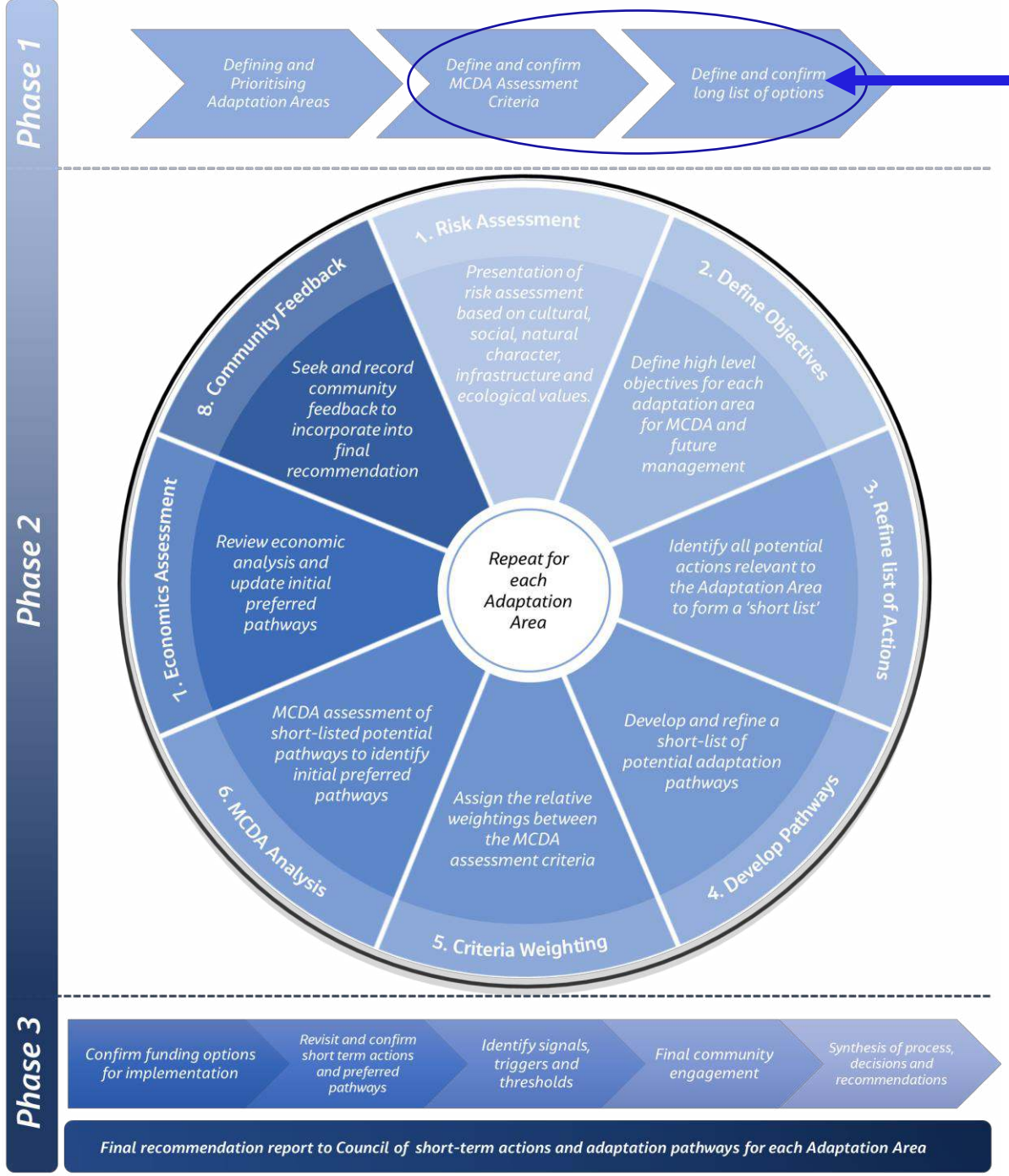
CAP Meeting 22nd July 2022

Phase One Workshop: Confirming MCDA Criteria and Longlist

Session Structure

Item	Time allocated
Workshop updates	5 min
Presentation on MCDA	15 min
Breakout Groups – MCDA Criteria and Descriptions	20 min
Group Discussion and Feedback	15 min
Breakout Groups – MCDA Scoring	15 min
Group Discussion and Feedback	10 min
Tea Break	10 min
Discussion on long list of options	45 min


Phase 1
30th March 2022
Defining and Prioritising Adaptation Areas
25th May 2022
Communications Planning Workshop
CAP Engagement
- Community Board
- CAP drop ins
17th June 2022
Decision Making Framework Report and Presentation
22nd July 2022
Phase One Workshop:
- Confirm MCDA Criteria
- Confirm Long-list
CAP Public Event #1
Hui Tuatahi
23rd July
Northern Kāpiti Adaptation Area
TAG prepare risk assessment for Northern Adaptation Area
TAG to prepare pathways options from short list
31st August workshop
- Planning Scenarios/thresholds memo
- Summary of CVA, SIA, NCA
- Overview of planning approach/principles
- Community feedback from public event
21st September 2022
- Presentation of risk assessment for adaptation area to CAP
- Define Objectives for each adaptation area
- Discounting options from long list
19th October 2022
- Planning direction workshop
- Potential planning framework for high, medium, low risk zones
- Funding principles workshop
KCDC Election 8th October 2022
9th November 2022 (P2 S4 & 5):
- Pathway development workshop
- Assign MCDA criteria relative weighting
TAG and Iwi undertake MCDA pre-scoring and prepare economic assessment
Feb 2023 Community Engagement (Northern Adaptation Area) (P2 S8)
Central Kāpiti Adaptation Area
TAG to prepare pathways options from short list
9th December 2022 (P2 S6 & 7):
- MCDA Scoring
- Economic analysis
Full day workshop
TAG prepare risk assessment for Central Kāpiti Adaptation Area
Feb 2023 (P2 S1-3):
-Record feedback from community feedback from previous event
- Presentation of risk assessment for adaptation area to CAP
- Define Objectives for each adaptation area
- Discounting options from long list
March 2023 (P2 S4 & 5):
- Pathway development workshop
- Assign MCDA criteria relative weighting
TAG and Iwi undertake MCDA pre-scoring and prepare economic assessment
April 2023 (P2 S6 & 7):
- MCDA Scoring
- Economic analysis
Full day workshop
Community Engagement (Central Adaptation Area) (P2 S8)
Raumati Adaptation Area
TAG and Iwi undertake MCDA pre-scoring and prepare economic assessment
August 2023 (P2 S6 & 7):
- MCDA Scoring
- Economic analysis
July 2023 (P2 S4 & 5):
- Pathway development workshop
- Assign MCDA criteria relative weighting
June 2023 (P2 S1-3):
- Presentation of risk assessment for adaptation area to CAP
- Define Objectives for each adaptation area
- Discounting options from long list
Queen Elizabeth Park
May 2023:
-Record feedback from community feedback from previous event
- Workshop to assess current plan for Queen Elizabeth Park with DOC and GWRC
TAG prepare risk assessment for Paekākāriki Adaptation Area
Community Engagement (Raumati Adaptation Area) (P2 S8)
TAG to prepare pathways options from short list
TAG prepare risk assessment for Raumati Adaptation Area
Paekākāriki Adaptation Area
September 2023 (P2 S1-3):
-Record feedback from community feedback from previous event
- Presentation of risk assessment for adaptation area to CAP
- Define Objectives for each adaptation area
- Discounting options from long list
October 2023 (P2 S4 & 5):
- Pathway development workshop
- Assign MCDA criteria relative weighting
November 2023 (P2 S6 & 7):
- MCDA Scoring
- Economic analysis
Full day workshop
TAG to prepare pathways options from short list
TAG and Iwi undertake MCDA pre-scoring and prepare economic assessment
Community Engagement (Paekākāriki Adaptation Area) (P2 S8)
Feb 2024
Funding options workshop
Confirmation Preferred Pathways
CAP Engagement: Seek community feedback on preferred actions and pathways
March 2024
Signals, triggers and thresholds workshop
Phase 2
Phase 3


Phase 1
Defining and Prioritising Adaptation Areas
Define and confirm MCDA Assessment Criteria
Define and confirm long list of options
Todays Session
Phase 2
1. Risk Assessment
Presentation of risk assessment based on cultural, social, natural character, infrastructure and ecological values.
2. Define Objectives
Define high level objectives for each adaptation area for MCDA and future management
3. Refine list of Actions
Identify all potential actions relevant to the Adaptation Area to form a 'short list'
4. Develop Pathways
Develop and refine a short-list of potential adaptation pathways
5. Criteria Weighting
Assign the relative weightings between the MCDA assessment criteria
6. MCDA Analysis
MCDA assessment of short-listed potential pathways to identify initial preferred pathways
1. Economics Assessment
Review economic analysis and update initial preferred pathways
8. Community Feedback
Seek and record community feedback to incorporate into final recommendation
Repeat for each Adaptation Area
Phase 3
Confirm funding options for implementation
Revisit and confirm short term actions and preferred pathways
Identify signals, triggers and thresholds
Final community engagement
Synthesis of process, decisions and recommendations
Final recommendation report to Council of short-term actions and adaptation pathways for each Adaptation Area

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MCDA Criteria Session

Purpose of this session

- Discuss the proposed MCDA criteria and scoring guide
  - Is there anything missing?
  - Does the criteria guide you to consider the total range of key values?
  - Is there any changes that need to be made?

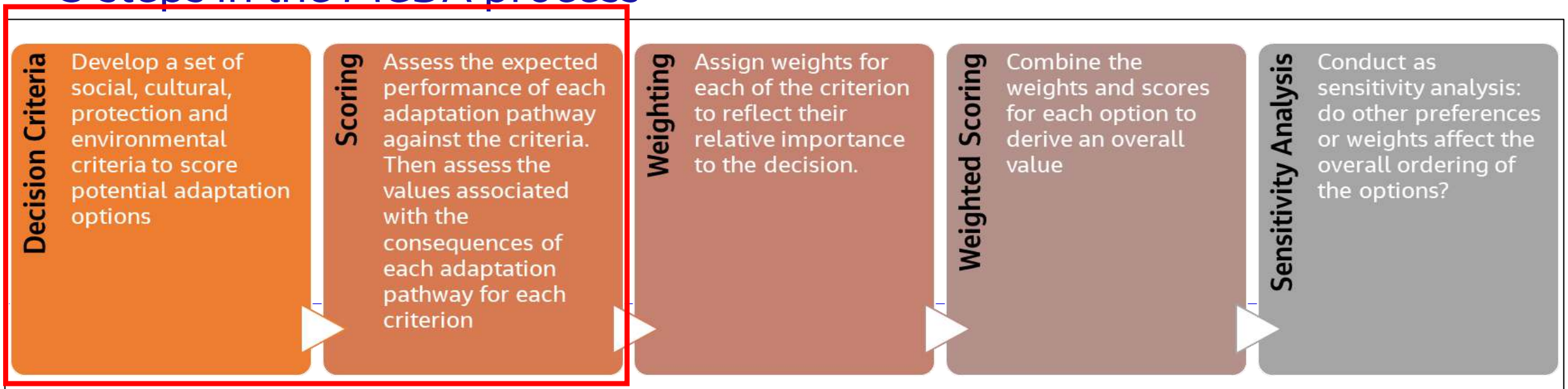
- Get confirmation as a group of the district wide MCDA criteria to move forward into phase 2.

Multi-Criteria Decision Analysis (MCDA)

- Is a tool to assist decision-making where need to consider a number of different criteria, including both qualitative and quantitative.
- Is used in a number of contexts to help provide analysis of different options and outcomes, and how they compare to one another.
- The objective is to provide an overall ordering of options from the most preferred to the least preferred option.

Unit L: Clifton						
Pathway	Short term	→	Medium term	→	MCDA Score	MCDA ranking
PW 1	Renourishment	→	Managed Retreat	→ Managed Retreat	67	2
PW 2	Renourishment + Control Structures	→	Renourishment + Control Structures	→ Managed Retreat	59	3
PW 3	Renourishment + Control Structures	→	Renourishment + Control Structures	→ Renourishment + Control Structures	52	4
PW 4	Renourishment + Control Structures	→	Renourishment + Control Structures	→ Sea wall	43	6
PW 5	Sea wall	→	Sea wall	→ Managed Retreat	70	1
PW 6	Sea wall	→	Sea wall	→ Sea wall	49	5

5 steps in the MCDA process



Confirm MCDA Assessment Criteria and Scoring Guide

- Develop a set of district wide standard criteria against which to score the different adaptation pathways in the MCDA assessment.
- Criteria cover the ability of the pathway to meet a number of principles across the four domains of:
  - Ability to manage the risks of coastal hazards to infrastructure, assets,& services, in a way that does not transfer hazards to other areas and can adapt to increasing risks through time
  - Impacts of the pathway on cultural values
  - Impacts of the pathway on community social values
  - Impacts of the pathway natural environments and ecological habitats.
- Note does no include any cost-based criteria as want the initial assessment to focus on the best outcomes from a core values perspective without getting bias by cost considerations.

MCDA example criteria from Hawkes Bay Strategy

Criteria		Description	Scoring Guide
Technical Assessment Criteria	Manages the risks of storm surge inundation	> Reduced exposure to risks from storm surge inundation > Meets objectives over long timeframes > Proportionate to the scale and nature of risk	5 – High / Good 4 – 3 – Mid 2 – 1 – Low / Bad
	Manages the risks of coastal erosion	> Reduced exposure to risks from coastal erosion > Meets objectives over long timeframes > Proportionate to the scale and nature of risk	5 – High / Good 4 – 3 – Mid 2 – 1 – Low / Bad
	Ability to adapt to increasing risks	> Readily responds to uncertain climate outcomes > Includes measures to support future adjustments	5 – High / Good 4 – 3 – Mid 2 – 1 – Low / Bad
	Risk transfer	> Exacerbation of hazard risk in other areas > The transfer of risk to others, including future generations	5 – Low / Good 4 – 3 – Mid 2 – 1 – High / Bad
Impact Assessment Criteria	Socio-economic Impacts	> Social effects e.g. > Effects on community safety > Loss of amenity value > Decline in recreational values, community facilities > Indirect economic / industry impacts (e.g. tourism, fishing)	5 – Low / Good 4 – 3 – Mid 2 – 1 – High / Bad
	Relationship of Maori and their culture and traditions with their ancestral lands, water, sites, waahi tapu, and other taonga	> Impacts on any cultural sites of significance > Maintains access to, and enables the carrying out of, customary activities	5 – Low / Good 4 – 3 – Mid 2 – 1 – High / Bad
	Natural Environments Impacts	> Impacts on natural coastal ecosystems > Impacts on the natural character of the coastal environment	5 – Low / Good 4 – 3 – Mid 2 – 1 – High / Bad

‘Bananas’ MCDA Video

- https://www.youtube.com/watch?v=7OoKJHvsUbo

Takutai Kapiti Draft MCDA for Discussion Today

#	Criteria	Description	Scoring Guide				
			5. Highly Desirable	4. Desirable	3. Neutral	2. Undesirable	1. Highly Undesirable
1.	**Ecology**	▪ Impact or enhancement on indigenous biodiversity values and habitat; and ecosystem functioning within the coastal environment and surroundings.	Highly likely to provide for enhancement and increase of ecological habitats and values	Likely to provide for some enhancement and increase of ecological habitats and values	Little change likely to ecological habitats and values present	Some reduction in ecological habitats or values. Likely to be limited to the footprint of the options or short term.	Highly likely there will be a reduction in ecological habitat and values, which could be for larger footprint than existing protection and long-lasting
2.	**Landscape**	▪ Impact on the natural character of coastal environment and surroundings ▪ Aesthetic outcomes of implementing the option and the meaning of this to the community.	Positive impact or enhancement of the natural character of the coast, and aesthetic outcomes which align with community expectations.	Likely to provide some increase to the natural character of the coastal environment and aesthetic outcomes mostly align with the community expectations.	Little change likely to the present-day natural character and aesthetics of the coastal environment.	Slight negative impact on natural character and aesthetic outcomes. Aesthetic outcomes do not align with some of the community.	Highly likely to have a negative impact on the natural character of the coastal environment. Aesthetic outcomes do not align with community expectations.
3.	**Te ao Māori values**	▪ Impacts or enhancement of the relationship of Māori and their culture and traditions with their ancestral lands, water, sites, waahi tapu and other taonga. ▪ Maintains access to, and enables the carrying out of customary activities.	Highly likely to have a positive impact or enhancement on the identified Māori cultural values in the area	Likely to have some positive impact to identified Māori cultural values identified in the area	Little change likely to Māori cultural values identified in the area.	Likely small negative impact to identified Māori cultural values in the area	Likely large negative impact to identified Māori cultural values in the area
4.	**Community Social and Economic Wellbeing**	▪ Health and safety of the community ▪ Certainty around future of community ▪ Social cohesion within the community ▪ Protection and insurability of personal assets.	Highly likely to provide for all factors which contribute to community social and economic wellbeing.	Likely to provide for most factors which contribute to community social and economic wellbeing.	Little change from the present-day community social and economic wellbeing.	Only likely to provide for some factors which contribute to community social and economic wellbeing.	Unlikely to provide for any factors which contribute to community social and economic wellbeing.
5.	**Public Access and Recreation**	▪ Wider community/district use of the coastal environment ▪ Opportunities for recreation ▪ Public access to the coastal environment	Highly likely to increase and enhance recreational opportunities and public access to the coastal environment.	Likely to have an increase in recreational opportunities and public access to the coastal environment.	Little change to recreational opportunities and public access from the present day.	Likely to restrict some recreational opportunities and public access to the coastal environment.	Highly likely there will be large restrictions or total loss of public access and recreational opportunities in the coastal environment.
6.	**Consenting and Policy Risk**	▪ Consenting and policy risks of implementing an option including: • Consenting requirements, • District plan changes, or • Deviation from statutory framework.	Low to no risk - Consents are not required or can be easily obtained. No plan change required. Not contrary to statutory framework.	Low risk - Consent or plan change is required but unlikely to be challenged. Not contrary to statutory framework.	Some risk – Requires resource consenting or plan change which could be challenged but is aligned with the current statutory framework.	High risk - Consenting or plan change required which is likely to be challenged. Some elements which are contrary to current statutory framework.	Very high risk - Requires resource consenting or plan change which is highly likely to be challenged by multiple parties, and is contrary to current statutory framework
7.	**Effectively manages the risks of coastal erosion**	▪ Effectively manages the risks of Coastal Erosion ▪ Proportionate to the nature and scale of the risk over time. ▪ Avoids the exacerbation of risk in other areas. ▪ Approaches are supported by best practice and a robust consideration of the science/Mātauranga	Highly likely to provide for all the factors listed which manage the risk of coastal erosion.	Likely to provide for most of the factors listed which manage the risk of coastal erosion.	Likely to provide for some of the factors listed to manage the risks of coastal erosion.	Only likely to provide for one of the factors listed which manage the risk of coastal erosion.	Unlikely to provide for any of the listed factors which manage the risk of coastal erosion.
8.	**Effectively manages the risks of coastal inundation**	▪ Effectively Manages the risks of Coastal Flooding ▪ Proportionate to the nature and scale of the risk over time. ▪ Avoids the exacerbation of risk in other areas. ▪ Approaches are supported by best practice and a robust consideration of the science/Mātauranga	Highly likely to provide for all the factors listed which manage the risk of coastal flooding.	Likely to provide for most of the factors listed which manage the risk of coastal flooding.	Likely to provide for some of the factors listed to manage the risks of coastal flooding.	Only likely to provide for one of the factors listed which manage the risk of coastal flooding.	Unlikely to provide for any of the listed factors which manage the risk of coastal flooding.

Guideline notes:

a. Scoring is relative between the shortlisted pathways
b. Do not necessarily have to have a full range of scores between the pathways – e.g. all pathways could score the same for a criteria. The scoring does not need to be sequential, and does not need to be ranked.
c. All pathways that reach the short list for assessment will need to:
   i. have the ability to adapt and deal with an increase in the hazard and risk; and
   ii. not restrict future implementation of other options (and pathways)

Takutai Kapiti Draft MCDA for Discussion Today

#	Criteria	Description	Scoring Guide				
			5. Highly Desirable	4. Desirable	3. Neutral	2. Undesirable	1. Highly Undesirable
1.	Ecology	Impact or enhancement on indigenous biodiversity values and habitat; and ecosystem functioning within the coastal environment and surroundings.	Highly likely to provide for enhancement and increase of ecological habitats and values	Likely to provide for some enhancement and increase of ecological habitats and values	Little change likely to ecological habitats and values present	Some reduction in ecological habitats or values. Likely to be limited to the footprint of the options or short term.	Highly likely there will be a reduction in ecological habitat and values, which could be for larger footprint than existing protection and long-lasting
2.	Landscape	Impact on the natural character of coastal environment and surroundings Aesthetic outcomes of implementing the option and the meaning of this to the community.	Positive impact or enhancement of the natural character of the coast, and aesthetic outcomes which align with community expectations.	Likely to provide some increase to the natural character of the coastal environment and aesthetic outcomes mostly align with the community expectations.	Little change likely to the present-day natural character and aesthetics of the coastal environment.	Slight negative impact on natural character and aesthetic outcomes. Aesthetic outcomes do not align with some of the community.	Highly likely to have a negative impact on the natural character of the coastal environment. Aesthetic outcomes do not align with community expectations.
3.	Te ao Māori values	Impacts or enhancement of the rel… of Māori and their culture and t… with their ancestral lands, wat… tapu and other taonga. Maintains access to, and… carrying out of custo…	Highly likely to have a positive impact or enhancement on the identified Māori cultural values in the area	Likely to have some positive impact to identified Māori cultural values identified in the area	Little change likely to Māori cultural values identified in the area.	Likely small negative impact to identified Māori cultural values in the area	Likely large negative impact to identified Māori cultural values in the area
4.	Community Social and Economic Wellbeing	Health and safety Certainty arou… Social coh… Protecti… asset…				…ikely to provide for some …s which contribute to …unity social and economic …eing.	Unlikely to provide for any factors which contribute to community social and economic wellbeing.
5.	Public Access and Recreation	Wi… enviro… Opportun… Public acces…				…to restrict some recreational …rtunities and public access to …oastal environment.	Highly likely there will be large restrictions or total loss of public access and recreational opportunities in the coastal environment.
6.	Consenting and Policy Risk	Consenting and po… implementing an opti… • Consenting requirement… • District plan changes, or • Deviation from statutory fram…		No plan change required. Not contrary to statutory framework.	challenged. Not contrary to statutory framework.	could be challenged but is aligned with the current statutory framework.	…risk - Consenting or plan …e required which is likely to be challenged. Some elements which are contrary to current statutory framework.	Very high risk - Requires resource consenting or plan change which is highly likely to be challenged by multiple parties, and is contrary to current statutory framework
7.	Effectively manages the risks of coastal erosion	Effectively manages the risks of Co… Erosion Proportionate to the nature and scale of … risk over time. Avoids the exacerbation of risk in other areas. Approaches are supported by best practice and a robust consideration of the science/Mātauranga	Highly likely to provide for all the factors listed which manage the risk of coastal erosion.	Likely to provide for most of the factors listed which manage the risk of coastal erosion.	Likely to provide for some of the factors listed to manage the risks of coastal erosion.	Only likely to provide for one of the factors listed which manage the risk of coastal erosion.	Unlikely to provide for any of the listed factors which manage the risk of coastal erosion.
8.	Effectively manages the risks of coastal inundation	Effectively Manages the risks of Coastal Flooding Proportionate to the nature and scale of the risk over time. Avoids the exacerbation of risk in other areas. Approaches are supported by best practice and a robust consideration of the science/Mātauranga	Highly likely to provide for all the factors listed which manage the risk of coastal flooding.	Likely to provide for most of the factors listed which manage the risk of coastal flooding.	Likely to provide for some of the factors listed to manage the risks of coastal flooding.	Only likely to provide for one of the factors listed which manage the risk of coastal flooding.	Unlikely to provide for any of the listed factors which manage the risk of coastal flooding.

Guideline notes:

…tive between the shortlisted pathways

b. Do not necessarily have to have a full range of scores between the pathways – e.g. all pathways could score the same for a criteria. The scoring does not need to be sequential, and does not need to be ranked.

c. All pathways that reach the short list for assessment will need to:
   i. have the ability to adapt and deal with an increase in the hazard and risk; and
   ii. not restrict future implementation of other options (and pathways)

Information for each criteria to help CAP inform their scoring will be provided through technical reports, area specific risk assessment, and technical/expert advice.

Breakout Session 1 (20 minutes)

- Split into 2 groups to discuss the MCDA criteria
- Feedback to the group on:
  - Is there anything missing from the criteria?
  - Does the criteria guide you to consider the total range of key values?
  - Is there any wording that might be more appropriate?

Breakout Session 2 (15 minutes)

- Split into 2 groups to discuss the MCDA scoring guide
- Feedback to the group on:
  - Is there anything missing?
  - Is there enough guidance to allow you to score pathways?
  - Is there any changes to the wording needed?

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Tea Break

(10 mins)

Jacobs Challenging today. Reinventing tomorrow.

Confirmation of long list of Options and Actions

(45 min)

Purpose of this session:

- To answer any questions about option and actions on the draft long list (Appendix D & E of the Decision Making Framework Report).
- Add to the long list any actions that are not currently on there.
- Remove any options from the long list that CAP do not think will be considered in Kapiti.

OPTIONS

ENHANCE	ACCOMODATE	PROTECT	RETREAT	AVOID
We maintain and improve what we are already doing	**We live with the hazard**	**We keep the hazard away**	**We move away from the hazard**	**We don't move into the way of the hazard in the first place**
				
ACTIONS				
Dune reconstruction and regeneration Wind trap fencing Coastal wetlands and riparian management and creation Manage access (walkways and ramps) Maintain and strengthen existing structures Increase community education and risk awareness Emergency management Environmental monitoring	Flood-proofing buildings and infrastructure Adaptable and relocatable buildings Elevate floor levels of buildings	Soft engineering: • Renourishment • Beach scraping • Beach drainage Hard engineering: • Vertical sea walls • Rock revetments • Groynes • Stopbanks • Storm surge barriers • Culverts • Breakwaters • Flood gates • Gabion Baskets • Buried terminal walls	Land Acquisitions Buy outs Land swaps Leasebacks Future Interest Conservation easements Transferable development rights	Zoning Trigger-based or time limited land use consents Setback controls Building design – Adaptable, Relocatable, minimum floor levels Reducing intensification or development

From Appendix D: Decision Making Framework Report

Option	Action	Description	Hazard
Accommodate	Adaptable and relocatable buildings	Adaptable buildings are designed to respond to an environmental change while avoiding structural damage. Buildings can also be relocatable to move away from the hazard.	Erosion/Inundation
Accommodate	Building Design – Raising minimum floor levels of existing buildings	Raising the floor levels of existing properties which are at risk from inundation.	Inundation
Accommodate	Flood proofing buildings	Flood proofing measures are best applicable to coastal areas with a small inter-tidal range and where flood depths are low. This involves wet-proofing or dry proofing a building: **Wet proofing** – allowing water to enter the structure but minimizing the structural damage through using flood resistant materials or elevating structures. **Dry proofing** – making buildings water-tight so that water cannot enter,	Inundation
Accommodate	Flood proofing infrastructure	Flood proofing infrastructure such as wastewater, stormwater and drinking water infrastructure, telecommunication infrastructure, and roads may involve modifying existing infrastructure or designing new or replacement infrastructure to withstand coastal hazards.	Inundation
Avoid	Building design – Raising minimum floor levels of new builds	Planning provisions in place for potentially affected areas to ensure floor levels area above design flood levels for new builds.	Inundation
Avoid	Reducing further intensification or development	Planning restrictions to reduce further development or intensification within settlements that are likely to be affected by hazards in the future.	Erosion/Inundation
Avoid	Setback controls	Restricting new development and land use in high-risk areas through the imposition of building setback controls. Setbacks are building restrictions that establish a distance from a predetermined point that factors in future erosion rates where landowners are prohibited from building structures, or they establish a minimum elevation for development that factors in sea level rise and coastal inundation	Erosion/Inundation
Avoid	Trigger-based or time limited land use consents	Trigger based or time limited land use consents include conditions linked to hazards such as sea level rise or erosion rates that create a finite term for a particular land use. The land use consents allow development or redevelopment with the expectation that such uses can only continue until specified trigger points are reached or for a specified time period.	Erosion/Inundation

Option	Action	Description	Hazard
Avoid	Zoning	▪ Allowing increased development density in lower risk areas ▪ Creating areas where new development is not permitted ▪ Changing future land uses in at-risk areas from low resilience to high resilience (e.g., from residential to public space) ▪ Using planning policy and rules (Regional and District) to prohibiting hard shoreline protection structures and promoting natural shoreline protection measures that support inland ecosystem migration.	Erosion/Inundation
Enhance	'Top up' existing structures	Add material to existing structures to increase the level of protection (from both inundation and erosion).	Erosion/Inundation
Enhance	Access steps and ramps	Structures that provide pedestrian and/or small boat access to the coast.	Erosion/Inundation
Enhance	Coastal wetlands, riparian management and living shorelines	Enhance coastal wetlands and riparian corridors are vegetated areas that act as a buffer to inundation and erosion, while also providing new habitats and environmental benefits. Installing or enhancing coastal marshes and wetland areas to dissipate wave energy and reduce inundation risk.	Erosion/Inundation
Enhance	Continue emergency management	Emergency management, including the creation of hazard maps, evacuation plans, civil defence emergency management, and temporary accommodation and protection measures continues.	Erosion/Inundation
Enhance	Continue environmental monitoring	Environmental monitoring may include topographic and bathymetric surveys, shoreline mapping, storm events, ecological surveys, structural assessments, and morphological change assessments	Erosion/Inundation
Enhance	Continue to increase community education and risk awareness	Education is an essential element of the global response to climate change. As people build an understanding of the impacts of climate change it is seen to encourage changes in their attitude and behavior, and helps them adapt to climate change. Education and awareness also allow people to make informed decisions and play a role in both climate change mitigation and adaptation. This can be done through organized events, engagement with schools, updating and sharing online resources.	Erosion/Inundation
Enhance	Dune reconstruction and regeneration	Building wind trap fences on the seaward side of an existing dune to trap sand and promote dune growth, and vegetation planting to stabilise dunes. Make artificial dunes.	Erosion/Inundation
Enhance	Enhance existing inundation protection	Increase existing/install new stop banks to provide greater protection from storm surge inundation. Incorporate SLR and higher intensity events into the design of stormwater management when it is being upgraded.	Inundation

Option	Action	Description	Hazard
Enhance	Maintain current infrastructure systems	Current infrastructure systems such as wastewater, stormwater and drinking water infrastructure, telecommunication infrastructure, and roads will be maintained to restore the present-day level of service	Erosion/Inundation
Enhance	Private owners' responsibility	Through planning tools (district and regional), Council allows for owners of private structures to own and maintain their own structures.	Erosion/Inundation
Enhance	Strengthen existing structures (i.e., concrete walls)	Strengthen and patch existing vertical walls. Could involve removal of top unstable wall sections and retention of lower more stable sections.	Erosion/Inundation
Protect	Beach drainage	Mild upper beach and dune erosion can be controlled by beach drains. Beach drainage (also referred to as coastal drainage or beach dewatering) involves the placement of drains parallel to the shoreline, under the exposed beach face, which are connected to a well so that water which enters the system can be pumped out. Beach drainage lowers the water table and therefore increases the depth of the unsaturated zone under the ground. This lowering of the ground water table also encourages sediments to be deposited on the beach and reduces the sea-ward transport of sediment and therefore accretes sediment at the shore	Erosion
Protect	Beach scraping	Redistribution of sediment across a beach profile to increase the dune/crest elevation on the beach.	Erosion/Inundation
Protect	Buried Terminal wall	A buried wall (concrete, rock, gabion baskets, timber) at the landward limit of where it is acceptable for the beach to retreat to at some time in the future. Normal beach processes would continue in the intervening years, with the wall slowly becoming exposed until it was acting as a fully functional protection structure holding the shoreline in place.	Erosion
Protect	Concrete Mattress system (revetment)	Concrete mattress or interlinked concrete blocks placed on design slope on estuary edge to provide required crest height to prevent overtopping and prevent erosion.	Erosion
Protect	Control weirs on culverts at lagoon/ small river mouth openings	Adjustable gates on culverts which control the elevation at which water can flow in or out of a waterway opening. Generally, at the settlement's inundation can occur from both fluvial and coastal sources, with a weir being used to prevent high seas entering a coastal lagoon/waterway, but being opened to allow high fluvial flows to discharge.	Inundation
Protect	Controlled/ planned mouth openings of lagoons and rivers	Controlled openings of lagoons and stream mouths which naturally close with beach sediment building up across the mouth. Planned opening of the mouths will allow water to flow out to the sea/ lagoon in large fluvial events and reduce water backing up in tributaries further upstream.	Inundation
Protect	Culvert outfalls and flap gate valves at smaller inlet	Construction of culvert outfalls with flap gate valve at the entrance of a small inlet which would allow water to flow out of the inlet, but not in from the sea.	Inundation

2

Option	Action	Description	Hazard
Protect	Detached breakwaters and artificial reefs	The purpose of detached breakwaters are to reduce the wave energy that is reaching the shore through the dissipation, reflection and diffraction of oncoming waves. This creates a low-energy environment close to the shore that encourages the deposition of sediment and therefore the build-up of a wider beach.	Erosion
Protect	Flood gates	Adjustable gates used to prevent storm surges from entering existing waterways, in turn preventing up-stream overtopping and flooding.	Inundation
Protect	Geotextile Sand Containers	Stepped solid barrier along shoreline which prevents the passing of water and sediment between the hinterland and the estuary	Erosion
Protect	Groynes	A groyne (or artificial headland) is a structure built perpendicular to the shoreline out into the sea to catch sediments that are transported along the coast by longshore drift, to reduce coastal erosion. Can be built out of rock, timber, concrete.	Erosion
Protect	Interlocking pre-caste concrete block seawall	Solid vertical barrier constructed by interlocking concrete shapes normally constructed within the beach footprint to 'hold' the shoreline in a fixed location and prevent further shoreline retreat for a considerable timeframe depending on design and cross shore location. Depending on height, it could also reduce/eliminate wave overtopping in storm events, hence also provide protection from coastal inundation. The differences of the interlocking shapes from the vertical seawalls is the ability for variation in the front face and to have a tiered structure.	Erosion/Inundation
Protect	Reno Mattress	Sloping wire basket filled with cobble sized boulders. Placed at steeper slopes to protect the edge and at lower slopes below the edge to prevent lowering of the beach/upper intertidal nearshore.	Erosion
Protect	Retreat the line	Primary defence line retreated inland providing a high standard of inundation protection to properties behind the new defence. (Situation unchanged for those in front)	Erosion/Inundation
Protect	Rock Revetment	Large sized rock placed on design slope on estuary edge to provide required crest height and mass to prevent overtopping or movement of individual rock units that would expose edge to erosion.	Erosion
Protect	Shoreline Renourishment (sand, gravel, cobbles)	Adding sediment to the beach system, either onshore or in the nearshore. Build up natural beach with placement of introduced sand to a design slope.	Erosion
Protect	Stopbanks along settlement boundaries	Engineered stopbanks (most likely earth bunds), along the settlement boundaries to allow surface flooding to occur on the low-lying land around the settlement, but not allowing it to enter into the settlement. Crest height of the stopbanks would be informed through a design level for a specified flood frequency from both coastal and fluvial sources.	Inundation

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Option	Action	Description	Hazard
Protect	Stopbanks and bunds	Continuous elongated structure designed to protect low-lying areas from inundation. Bunds are similar physical structures when compared to stopbanks and serve a similar purpose to reduce flood risk, they can be quickly built and generally use local materials, and only involve minor foundation preparations.	Inundation
Protect	Storm surge Barriers	Storm surge barriers are hard engineered structures that are primarily designed to prevent inundation due to storm surges in tidal inlets, rivers and estuaries, while also decreasing reliance on other flood defences inland of the barrier	Inundation
Protect	Vertical Gabion wall	Porous structure (wire basket filled with cobble sized boulders), which allows water to pass into and potentially through the structure with sediment movement being restricted by the use of geotextile fabric behind the gabion basket.	Erosion
Protect	Vertical permeable sill	A structure within the gravel beach that dissipates wave energy, reducing erosion losses through backwash and longshore drift and promotes the retention of gravel behind the structure.	Erosion
Protect	Vertical sea walls (concrete, timber, sheet piles)	Solid vertical barrier along shoreline which prevents the passing of water and sediment between the hinterland and the sea.	Erosion/Inundation
Retreat	Buyouts	Land buyout programs involve the government acquiring land in at-risk areas by agreement, to reduce vulnerability to hazards. Buyouts involve the transfer of title to land and are typically only used in very high risk areas due to the cost associated with them	Erosion/Inundation
Retreat	Conservation easements	A conservation easement (also referred to as conservation agreements or conservation restrictions) is a legal agreement under which permanent limitations are placed on land use in order to sustain an area's natural function. These agreements can manage hazards such as sea level rise and erosion by prohibiting further development in some areas. Conservation easements can be used to proactively plan for sea level rise by tailoring agreements to the areas current and future risk, suitability for industry, and values.	Erosion/Inundation
Retreat	Future Interests	The acquisition of a future interest involves the purchase of a right to acquire land in specified circumstances in return for an agreed upfront fee. For example, it may be agreed upon that once a certain height of sea level rise has been reached, the holder of the future interest (usually a government agency) has the right to acquire the land.	Erosion/Inundation
Retreat	Land Acquisition	Land acquisition can occur through the purchase of land in fee simple or involve the purchase of development rights to an entire land parcel or part of it.	Erosion/Inundation

Option	Action	Description	Hazard
Retreat	Land Swaps	During a land swap, landowners in a hazard zone are given the opportunity to swap their title to land for a comparable sized parcel in a lower risk area. The land that has been swapped then acts as a buffer against coastal hazards	Erosion/Inundation
Retreat	Leasebacks	Leasebacks involve the acquisition of at-risk land with provision for it to be leased back to the former owner or a third party with terms and conditions that facilitate the management of hazards. The former owners or third party, now the lessee, pays rent and uses the land in accordance to the terms of the lease, but no longer owns the land	Erosion/Inundation
Retreat	Transferable development rights	Transferable development rights (TDR's) are a market-based mechanism that can be used to increase development potential in areas where development is desired, and decrease or eliminate the potential in areas that should be preserved, without requiring public investment. Areas that have been identified for preservation are called 'sending areas'. Development rights are separated from the land and are transferred from the sending parcel to land in an area where development is considered appropriate or is even desired, which are called 'receiving areas'. TDR's from the sending area can either be sold to a landowner or developer in the receiving area, or they can be transferred directly if both parcels of land are under common ownership.	Erosion/Inundation

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