

## **Appendix C**

### **Management options toolbox**



Protect (existing development in a hazard area)

Option	Detail	Solution Timing	Costs	Benefit	Applicable Pathway
Seawall	A rock (or sandbag) wall along the dunes of the beach	Medium Term (see costs)	<p>Loss of sandy beach in front of the wall – there is no beach – loss of amenity</p> <p>Expensive capital outlay (\$ millions) plus needs ongoing maintenance and re-designed due to sea level rise</p> <p>In cases where private property is protected, some may consider it unfair to spend public money to protect private property</p> <p>Cannot be built in sections (individual properties) because beach erodes next to seawall. Wall must be built along lengths/major segments of beach</p>	Hold shoreline in current position (i.e. the land behind the beach is protected at the sacrifice of the beach)	2 & 3
Beach nourishment	Putting sand on the beach from land-based or marine sources (estuary or offshore)	Short Term – Medium Term depending on rates of erosion and sea level rise and availability of sand	<p>Very expensive option (e.g. \$1- 2 million for first episode, \$1 million for ongoing episodes)</p> <p>Needs to be continually repeated (ie every 5-10 yrs now, may be once a year by 2110)</p>	Retains a sandy beach in current position Largely retains beach amenity	2 & 3
Dune re-vegetation / stabilisation	Planting / ensuring vegetation on dunes to capture sediment	Short term option only – will not stop shoreline	May be cost effective in short term, but dunes don't provide an engineering solution to a receding coastline over the long term (dunes will erode).	In short term, provides a store of sand to buffer from storms	1 & 2

Protect (existing development in a hazard area)					
Option	Detail	Solution Timing	Costs	Benefit	Applicable Pathway
		receding	Can form part of other long term solutions (e.g. stabilising nourished sands).		
Artificial Reef/Offshore breakwater	Building a reef just offshore to dampen waves attacking the shoreline	Medium Term	Very expensive to build and maintain (\$ millions...) Multi-function (e.g. surfing reefs) have not been successful in other locations because the design for surfing is different to the design needed to protect the shore during storms Will not stop impacts of sea level rise unless the reef is continually raised (ongoing expense – more \$\$)	Suitable to protect short sections of shoreline only (salient only forms behind reef).	3
Groynes	Rock revetments built perpendicular to shore to capture sand	Long Term	Very expensive to build (\$ millions...), as groynes are built into the surfzone The interruption of longshore transport may cause erosion to downdrift beaches Loss of beach amenity from natural conditions - a number of groynes are required along beach to be effective and reduce erosion effects at end of groyne field Unlikely to be effective for long term sea level rise (groynes don't increase sediment budget for beach)	Retains a sandy beach in current position In some scenarios, can provide recreational amenity (fishing, surfing)	3
Levee Banks	Embankment to	Medium Term	Similar to seawall – capital costs and	Prevent flooding	3

Protect (existing development in a hazard area)					
Option	Detail	Solution Timing	Costs	Benefit	Applicable Pathway
	prevent intrusion of saltwater/storm tide (e.g. coastal inundation)		then maintenance and re-design costs to accommodate rising seas. Once a levee is overtopped, the water is trapped behind levee (cannot drain back into the sea / lake).	into developed areas	

Accommodate (existing development in a hazard area)					
Option	Detail	Solution Timing	Costs	Benefit	Applicable pathway
Redesign/retrofit building or structure	Make modifications to a building/infrastructure to withstand shoreline recession or coastal inundation	On-going strategy as buildings or structures need to be maintained, repaired or replaced Could be part of a proactive strategy of upgrades for areas of high/extreme risk as a schedule of upgrades	Over long term, modifications may not be able to stop recession impacts Design modification may not be able fully reduce risk and may be very expensive (retreat or accept damage a better/cheaper option)	Allows extended life for existing asset	1 & 2
Emergency management	Monitoring and warning systems including evacuation strategies	Short to medium term until hazards become more extreme and regular	Initial capital outlay for new systems and processes Requires continuing investment in coordination and education that must be trialled and updated. Will still need to be done in	If effective, can reduce or eliminate risk of loss of life. Pre-warning and education can help to	1 & 2

Accommodate (existing development in a hazard area)

Option	Detail	Solution Timing	Costs	Benefit	Applicable pathway
			conjunction with other strategies	minimise loss of property.	
Insurance	<p>Taking out coverage of buildings and structures in current and future hazard areas</p> <p>Note that insurance is not currently available for coastal inundation but does cover 'storm' damage</p>	Short term or as long as insurance companies are willing to insure	<p>Premiums will increase over time with increasing numbers of claims</p> <p>No currently available insurance covers "actions of the sea".</p> <p>Risk that insurance does not cover event that causes damage (what is a 'storm' compared with a 'flood'?). Will still need to be done in conjunction with other strategies</p>	<p>If able to be insured, assets can be re-built as a result of claims or insurance moneys can pay for the relocation landward or redesign</p>	1, 2 & 3

Planned Retreat (existing development in a hazard area)					
Option	Detail	Solution Timing	Costs	Benefit	Applicable pathway
Relocate item of infrastructure or development	Relocating roads, buildings etc landward beyond the hazard zone	Can be progressive over time (if the building or structure is easily relocatable) Otherwise best long term option	A suitable alternative location must exist Private landholders must pay for the relocation of private buildings, which may not yet need replacement due to wear and tear	The sandy beach is retained because it can recede naturally. The relocation can mean a brand new building / road / facility in replacement of an old one	1
Abandon (sacrifice) item of infrastructure or development	Allow the land or building to be lost to the sea	Long term strategy	Private landholders are not compensated for the loss of land or property. The community may lose public facilities or land	The sandy beach is retained because it can recede naturally. Particularly suitable for park land and low cost facilities (e.g. access ways, walkways)	1
Buy back – lease back	Buy high risk properties then rent out at market rates, until the property becomes impacted	Medium term solution at least until hazard become immediate and the building/structure is either relocated or sacrificed	Many freehold coastal land owners will never accept the arrangement voluntarily – preference to protect freehold land Council / State government must commit to mortgage arrangements Erosion may occur earlier than planned, reducing the return from rent.	Private property owners are adequately compensated. The public retains a sandy beach and gains public land. Leasing at market rates can reduce the mortgage costs to Council. Current rental return of ~ 4% pa compared with interest rates ~ 7% pa. Mortgage means gov't does not have to fund the whole	1

Planned Retreat (existing development in a hazard area)					
Option	Detail	Solution Timing	Costs	Benefit	Applicable pathway
				purchase at once.	
Compulsory /voluntary acquisition	Properties at highest risk are bought at market rates then demolished	Long term strategy	The public (Council/State Govt) must fund full purchase price up-front. Coastal property can be very expensive, particularly where they have ocean views, are large blocks/houses, apartment blocks etc. Some may consider it unfair to spend public funds on private property. Many freehold coastal land owners will never accept the arrangement voluntarily – preference to protect freehold land	Private property owners are adequately compensated The public retains a sandy beach and gains public land	1
Rolling easement	Property boundary is based on a distance to the shoreline, and therefore will move landward as the shoreline does	Medium term strategy until hazard become immediate and frequent	There may not be a legal mechanism to introduce this style of land title (for existing land parcels or new subdivisions) Private property owners bear the cost of lost land / assets	The sandy beach is retained because it can recede naturally. Property owners are aware of lifespan of development – no need for compensation = low cost to public.	1



Planned Retreat (existing development in a hazard area)					
Option	Detail	Solution Timing	Costs	Benefit	Applicable pathway
Development approval based on distance to shoreline	New developments/redevelopments are legal until the eroding shoreline comes within a distance to the property	Medium term strategy until hazard become immediate and frequent	May be difficult to implement for redevelopments where owners have an expectation to have the same rights for a new building as they had with the old building	The sandy beach is retained because it can recede naturally. Property owners are aware of lifespan of development – no need for compensation = low cost to public.	1

Avoid (future development in a hazard area)					
Option	Detail	Solution Timing	Costs	Benefit	Applicable pathway
Retaining existing zoning or rezoning of land from urban to more appropriate zone	Retain and/or change land use through amendment of the planning instrument to either: <ul style="list-style-type: none"> <li>• Not allow future development in hazard areas (greenfield); or</li> <li>• Not allow intensification of development in hazard areas (infill)</li> </ul>	Long term solution	Potential impediment to economic growth and to accommodating population growth Existing land values may reduce Existing owners would have an investment-backed expectation to be able to develop land Potential for compensation due to loss of development rights	Maintains current risk profile (by not allowing development in current or future hazard areas) The sandy beach is retained because it can recede	1
Setbacks/building lines	Buildings are built a required distance back from the relevant hazard line or erosion scarp Only temporary or re-locatable structures are permitted to be located in hazard areas seaward of a setback or building line	Long term solution	Reduced area within property boundary for development potential	The sandy beach is retained because it can recede into setback Minimal cost to public Prolonged life of development	1
Protecting/Filling the land	Associated with new development, establishing protection structures (seawalls, levees) or	Long term solution	Large costs on the developer/owner to import fill Potential drainage, erosion and landscape issues with	Works can avoid the risk of current and future hazard	3

	otherwise filling the land to elevations that prevent inundation		neighbouring lands – eg. seawall on open coast causing erosion to adjacent beach & land Protection measures can fail and require maintenance over time		
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Accommodate (future development in a hazard area)					
Option	Detail	Solution Timing	Costs	Benefit	Applicable pathway
Consider life span (design life) of development in setting location in the hazard zone	The effective lifespan of the proposed building or structure (e.g. 30 years, 50 years, 70 years) is considered in siting in the hazard area, with a view to abandonment or dismantling	Medium term strategy unless in immediate hazard zone	Reduced area within property boundary for development potential Shorter lifespan of the building or structure – owners/community may not be willing to part with it once hazards become immediate	Cost of building/structure may be reduced if shorter design life elements are incorporated If effective, this strategy can help avoid the risk during the functional life of the building The sandy beach is retained because it can recede No cost to broader public. Cost is borne by the landowner.	1
Require development to be located as far landward in hazard zone as practicable	Ensure new development is situated as far landward as practicable in the hazard zone on the subject land (applies where no setback or building line alignment has been declared)	Short term for immediate; Medium term for other timeframes	Reduced area within property boundary for development potential May have visual impacts if not common alignment with other buildings in the erosion prone area	Life of development may be extended. The sandy beach is retained because it can recede No cost to broader public. Cost is borne by the landowner.	1
Design with appropriate floor level height	Design of floor heights consider future flood levels and allows for current and future hazard from inundation to be minimised	Medium term strategy until hazard becomes immediate and frequent	Increases cost of building Higher building may interrupt coastal views and landscapes not in character with other buildings	No cost to broader public. Cost is borne by the landowner. Life of development is extended.	2

Accommodate (future development in a hazard area)					
Option	Detail	Solution Timing	Costs	Benefit	Applicable pathway
Design with adequate foundations	Foundations piles down to bedrock to increase ability of the structure to withstand coastal processes (not slab on ground).	Medium term strategy until hazard becomes immediate and frequent	Increases cost of building Higher building may interrupt coastal views and landscapes not in character with other buildings	No cost to broader public. Cost is borne by the landowner. Life of development is extended.	1 & 2
Structural Design	Construction of a relocatable, temporary or sacrificial structure. Structures are built to be easily decommissioned, de-assembled or re-locatable	Medium term strategy until hazard becomes immediate and frequent	Over long term, structure will have to be moved or abandoned. This must be clearly understood by owners.	Property owners are aware of lifespan of development – no need for compensation. The sandy beach is retained because it can recede No cost to broader public as cost is borne by the landowner. Cost of structures may be cheaper than typical house costs	1
Emergency management	Require preparation of monitoring and warning systems including provision for safe evacuation from the land	Short to medium term until hazards become more extreme and regular	Initial capital outlay for new systems and processes Requires continuing investment in coordination and education Will still need to be done in conjunction with	If effective, can reduce risk of loss of life – but does not avoid risk. Pre-warning and education can help to minimise loss of property (securing loose items, boarding windows, etc).	1 & 2

Accommodate (future development in a hazard area)					
Option	Detail	Solution Timing	Costs	Benefit	Applicable pathway
			other strategies		
Set aside land for future protection works	As part of site planning access and a buffer are provided in the design to facilitate protection of the land from coastal processes in the future. This could be sufficient area for a seawall, levee bank or similar hard protection work The area set aside for protection works should be wholly situated on freehold land – not on State land.	Medium to long term	Reduced area within property boundary for development potential No financial or legal assurance that protection will be built in the future (e.g. disputes if owner(s) change) Protection structures may impact on beach amenity (as per seawall option) and neighbouring blocks	Allows for future protection Allows for development to proceed cognisant of erosion risk. No cost to broader public. Private owners fund future cost of seawall and manage offsite impacts.	2 & 3

Accept (future development in a hazard area)					
Option	Detail	Solution Timing	Costs	Benefit	Applicable pathway
Do nothing – no controls on new development in immediate hazard area	No attempt to avoid or accommodate coastal hazards for new development	Short term	Possible liability for Council as increased exposure to risk of loss of life and property (short term) in spite of hazard information Decisions could be overturned as a result of Council not properly considering hazard in decision making Future generations bear cost of impacts on more intensely developed land (fall back to protect, accommodate, retreat).	No imposition on new development	n/a under SPP 2.6
Do nothing – no controls on new development in 2070 hazard area	No attempt to avoid or accommodate coastal hazards for new development	Medium Term	Possible liability for Council as increased exposure to risk of loss of life and property (medium term) Decisions could be overturned as a result of Council not properly considering hazard in decision making Future generations bear cost of impacts on more intensely developed land (fall back to protect, accommodate, retreat).	No imposition on new development	n/a under SPP 2.6
Do nothing – no controls on new development in 2110 hazard area	No attempt to avoid or accommodate coastal hazards for new development	Long Term	Possible liability for Council as increased exposure to risk of loss of life and property (long term) Decisions could be overturned as a result of Council not properly considering hazard in decision making Future generations bear cost of impacts on more intensely developed land (fall back to protect,	No imposition on new development	n/a under SPP 2.6

			accommodate, retreat).		
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