

## SOUTHERN CELL SHORTLIST RECOMMENDATIONS

### Coastal Unit L: Clifton

Options recommended for MCDA scoring	Options recommended to be discarded + rationale
1. Status quo	2. Planting
3. Renourishment (gravel)	<i>Not suitable as a standalone option in this location.</i>
11. Inundation accommodation	4. Inter-tidal renourishment (sand)
13. Groynes + nourishment	<i>High wave energy environment; sand will be rapidly lost. Insufficient reduction in wave energy to protect coastal assets</i>
14. Breakwater	5. Beach face de-watering
16. Sea wall	<i>Has not been proven to be reliably successful, and success has only been realised on sandy beaches. Not suitable for this coastline.</i>
18. Managed Retreat	6. Beach-scraping
	<i>No functional beach crest in this location</i>
	7. Enhance shingle crest
	<i>No functional beach crest in this location</i>
	8. Wetland or lagoon creation
	<i>Insufficient space to create additional wetland areas big enough to offer any coastal hazard mitigation benefit</i>
	9. Flood gate
	<i>No waterways in this location suitable for this option</i>
	10. Install / enhance inundation protection (stop banks)
	<i>Limited space to install</i>
	12. Vertical permeable sill
	<i>High wave energy environment. Limited benefit. Benefits to sediment retention are not enough to substantially reduce risk</i>
	15. Offshore Reef
	<i>Predicted reduction in wave energy not sufficient to reduce risk, requires larger breakwater structure</i>
	17. Retreat the line
	<i>No practical location to move the line of defence to</i>

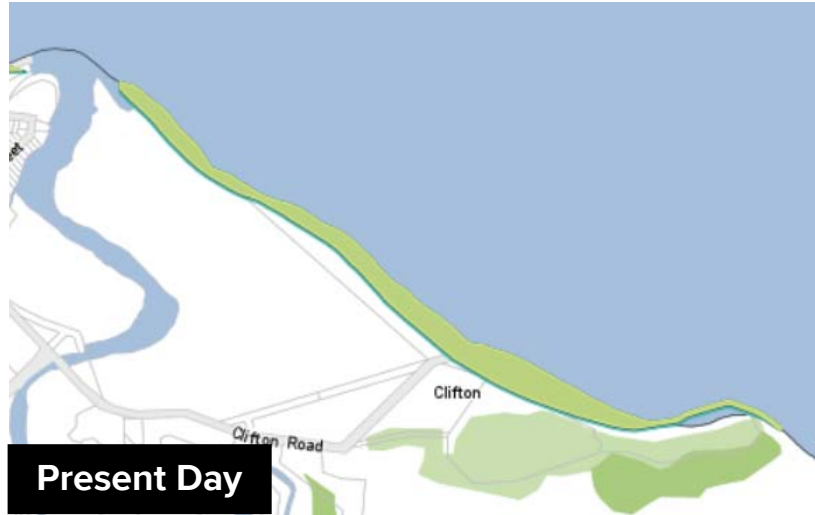
# SOUTHERN CELL

## Coastal Unit L: Clifton

## Option: 1 – Status Quo

**Technical Description:** Maintain current coastal management approaches – i.e. do nothing new.

### Coastal Erosion Risk



### Inundation Risk



Options Guide	Major Benefit	Minor Benefit	Null/Neutral	Negative /Adverse	Key Issues / Considerations <sup>1 2</sup>
Erosion Mitigation					<p><b>Neutral / Factual</b></p> <ul style="list-style-type: none"> <li>➤ Ad hoc approach conducted and funded by a number of entities, often reactive with limited consideration to wider coastal cell</li> </ul> <p><b>Positive</b></p> <ul style="list-style-type: none"> <li>➤ Approaches have reduced impacts of erosion and inundation under past and current climate</li> </ul> <p><b>Negative</b></p> <ul style="list-style-type: none"> <li>➤ Very little in the way of long term planning and adaptive management for climate change and sea level rise</li> <li>➤ Some strategies not viable in the medium to long term, as such require new approach</li> </ul>
Inundation Mitigation					
Adjacent Impacts					
Overall Cell Impacts					
<b>Implementation Commentary</b>					
N/A - no implementation issues					

### Indication of Longevity

Short term

<sup>1</sup> Capital and operational cost considerations excluded at this time

<sup>2</sup> Pending availability of Social and Cultural Impact assessment work

# SOUTHERN CELL

## Coastal Unit L: Clifton

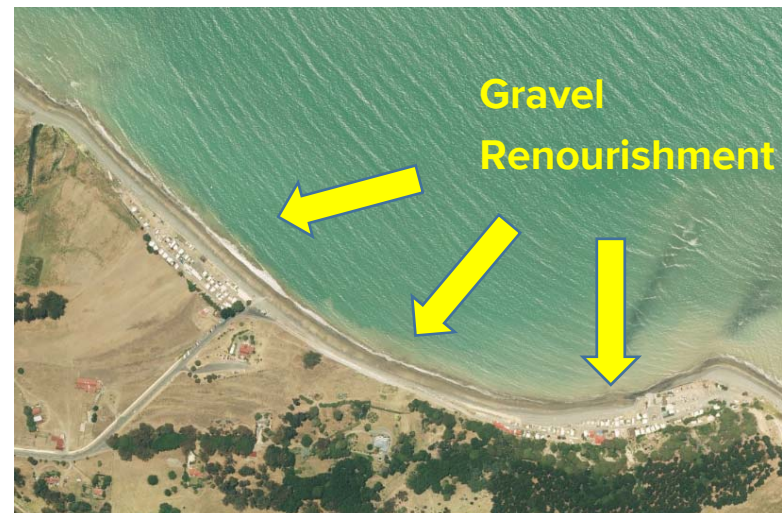
## Option: 3 – Renourishment – Gravel

**Technical Description:** Renourishment of gravel on foreshore area to offset erosion losses, increase beach size and potentially crest height. Larger beach can dissipate more wave energy and reduce/prevent wave overtopping.

### Representative Image



### Concept Plan



- Renourishment volumes, location and frequency to be established during detailed design
- Effectiveness largely dependent on the design beach profile and sediment transport rates

Options Guide	Major Benefit	Minor Benefit	Null/Neutral	Negative /Adverse	Key Issues / Considerations <sup>1 2</sup>
Erosion Mitigation					<p><b>Neutral / Factual</b></p> <ul style="list-style-type: none"> <li>➤ Sediment deficit will change over time as sediment losses increase with climate change</li> </ul> <p><b>Positive</b></p> <ul style="list-style-type: none"> <li>➤ Good understanding of how it works - history</li> <li>➤ Easier consenting pathway than physical structures</li> <li>➤ Performance could be improved with different placement locations</li> </ul> <p><b>Negative</b></p> <ul style="list-style-type: none"> <li>➤ May not benefit areas further south depending on area of placement</li> <li>➤ Sustainability and suitability of supply an issue</li> <li>➤ Regular renourishment works required to maintain beach volumes</li> </ul>
Inundation Mitigation					
Adjacent Impacts					
Overall Cell Impacts					

### Implementation Commentary

Generally straight forward to implement, subject to sourcing a suitable, long term supply of material. Westshore renourishment has been a long term programme, good understanding / history using this option.

### Indication of Longevity

Benefits and longevity can be increased by using in conjunction with other options.

Short to medium term

<sup>1</sup> Capital and operational cost considerations excluded at this time

<sup>2</sup> Pending availability of Social and Cultural Impact assessment work

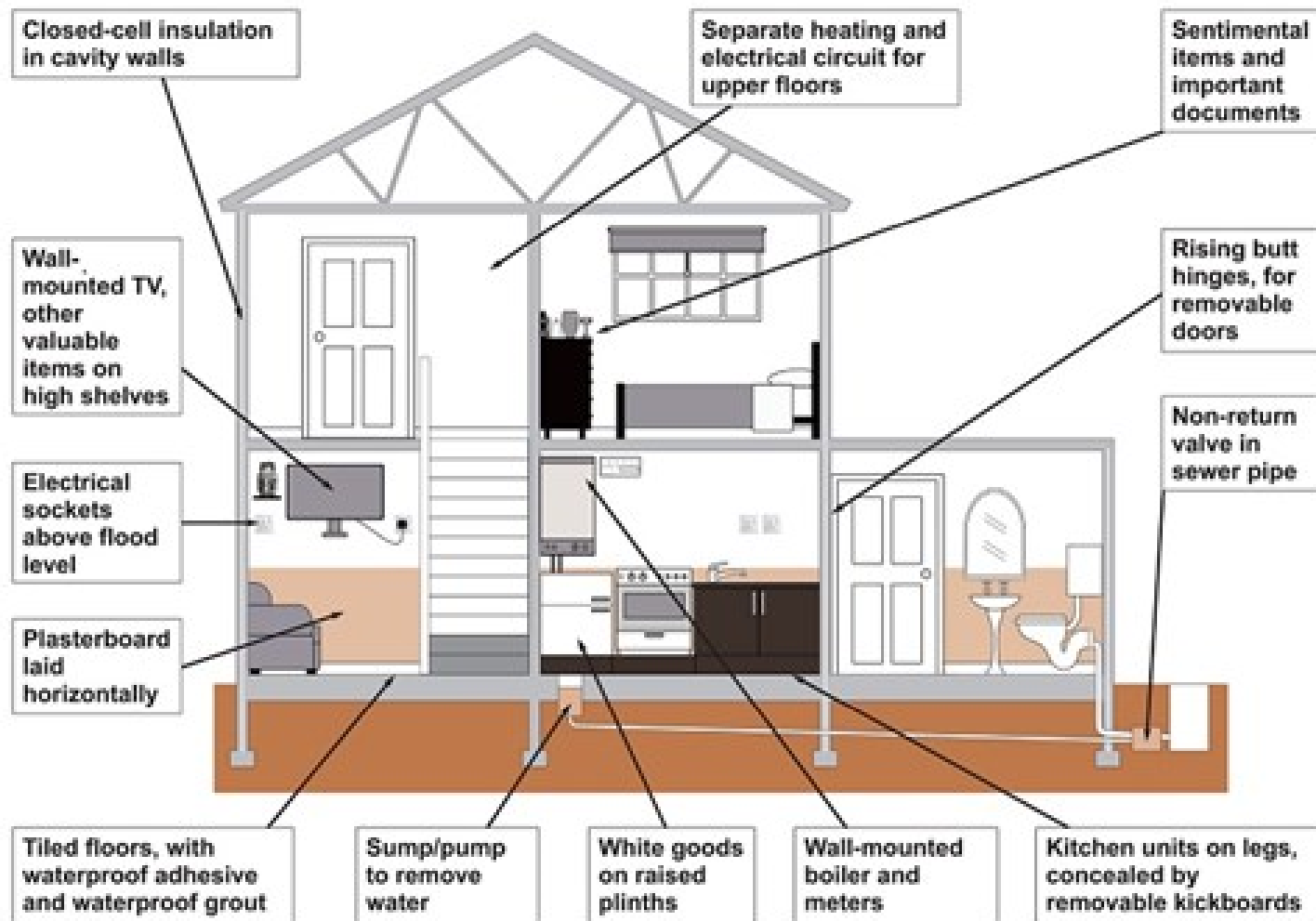
## SOUTHERN CELL

Coastal Unit L: Clifton

Option: 11 – Inundation accommodation

**Technical Description:** Implementation of policy to improve flood resilience of current and future properties

**Representative Image**



Options Guide	Major Benefit	Minor Benefit	Null/Neutral	Negative /Adverse	Key Issues / Considerations <sup>1 2</sup>
<b>Erosion Mitigation</b>					<b>Positive</b> <ul style="list-style-type: none"> <li>➤ Reduces risk of internal flooding</li> <li>➤ Reduces damage/loss in the event of flooding</li> <li>➤ If flooded properties can be refurbished more quickly and at a lower cost</li> </ul> <b>Negative</b> <ul style="list-style-type: none"> <li>➤ Does not reduce the erosion risk</li> <li>➤ Reduces effects of inundation, does not prevent them</li> <li>➤ Only practical if flooding events are fairly infrequent</li> <li>➤ Problem of funding for current properties and unlikely to be a mandatory requirement</li> </ul>
<b>Inundation Mitigation</b>					
<b>Adjacent Impacts</b>					
<b>Overall Cell Impacts</b>					

### Implementation Commentary

In addition to the above concepts external modifications such as removable flood barriers for doorways, shutters for windows and covers for external vents can help reduce the risk.

Complex to implement for existing houses, easier for new builds.

### Indication of Longevity

Short to medium term

<sup>1</sup> Capital and operational cost considerations excluded at this time

<sup>2</sup> Pending availability of Social and Cultural Impact assessment work

# SOUTHERN CELL

## Coastal Unit L: Clifton

## Option: 13 – Groynes + Nourishment

**Technical Description:** Limits the movement of sediment (gravels and sand) along the coast through longshore drift, thereby reducing localised losses to erosion. Nourishment is used to supply sand / gravel to the area protected by the groynes

### Representative Image



Rock Groyne



Concrete Units – Xbloc

### Concept Plan



- Location, size and spacing to be reviewed at detailed design stage
- Construction material used dependant on local availability of rock and a cost estimates of alternatives
- Maintenance of structures should be fairly limited, however additional beach nourishment may be required during the scheme life

Options Guide	Major Benefit	Minor Benefit	Null/Neutral	Negative /Adverse	Key Issues / Considerations <sup>1 2</sup>
Erosion Mitigation					<p><b>Neutral / Factual</b></p> <ul style="list-style-type: none"> <li>➤ Nourishment required in addition to groyne construction</li> <li>➤ Can be constructed from rock, concrete or armour units</li> </ul> <p><b>Positive</b></p> <ul style="list-style-type: none"> <li>➤ Lower ongoing maintenance costs than nourishment on its own (but higher capital/upfront costs)</li> <li>➤ Structures provide greater certainty in terms of standard of protection</li> <li>➤ Maintains beach for amenity use</li> </ul> <p><b>Negative</b></p> <ul style="list-style-type: none"> <li>➤ Reduces supply of sediment northwards</li> <li>➤ Access along the beach may be affected</li> <li>➤ Ongoing beach maintenance</li> </ul>
Inundation Mitigation					
Adjacent Impacts					
Overall Cell Impacts					

### Implementation Commentary

Can be complex to consent and may create amenity issues, however is a tried and tested method of addressing erosion losses, including local examples

Multiple groynes required to be effective – number TBC with detailed design

### Indication of Longevity

Consideration may be given to groyne length and crest elevation in order to be able to create a larger beach (crest height and width) in future years, to combat sea level rise and increasing risk, extending scheme life.

Short to medium term

<sup>1</sup> Capital and operational cost considerations excluded at this time

<sup>2</sup> Pending availability of Social and Cultural Impact assessment work



# SOUTHERN CELL

## Coastal Unit L: Clifton

## Option: 14 – Breakwater

**Technical Description:** Shore parallel offshore breakwater (crest above MHWS). Structures break waves, promote the build up of sediment in the lee of the structure and reduce longshore drift.

### Representative Image



Sea Palling, Norfolk (UK)



Holly Beach, Louisiana (US)

### Concept Plan



- Location, size, spacing and number of structures indicative only
- Parameters to be defined in the detailed design stage
- Material used will depend on the availability of locally sourced rock and the relative cost of alternatives (e.g. concrete units)

Options Guide	Major Benefit	Minor Benefit	Null/Neutral	Negative /Adverse	Key Issues / Considerations <sup>1 2</sup>
Erosion Mitigation					<b>Neutral/Factual</b> <ul style="list-style-type: none"> <li>➤ Offshore bathymetry and wave climate dictates feasibility of option both in terms of size of structures and potential formation/evolution of beach</li> <li>➤ Option would also require beach nourishment</li> </ul> <b>Positive</b> <ul style="list-style-type: none"> <li>➤ Ecologically beneficial (fish habitat)</li> <li>➤ Reduces longshore drift and erosion losses</li> <li>➤ Increased width of beach and amenity area</li> </ul> <b>Negative</b> <ul style="list-style-type: none"> <li>➤ Can cause increased erosion to adjacent coastline</li> <li>➤ Consenting can be problematic</li> <li>➤ Navigational hazard</li> <li>➤ Large volumes of replenishment may be initially required to form the crenular beaches</li> </ul>
Inundation Mitigation					
Adjacent Impacts					
Overall Cell Impacts					

### Implementation Commentary

Length of structures, spacing and crest height all act to determine the natural shape of beach that will form and whether the beach will eventually join up with the structure (tombolo) or accrete part way towards it (salient).

Can be constructed from rock, geotextile bags filled with sand or concrete armour units.

### Indication of Longevity

Medium to long term

<sup>1</sup> Capital and operational cost considerations excluded at this time

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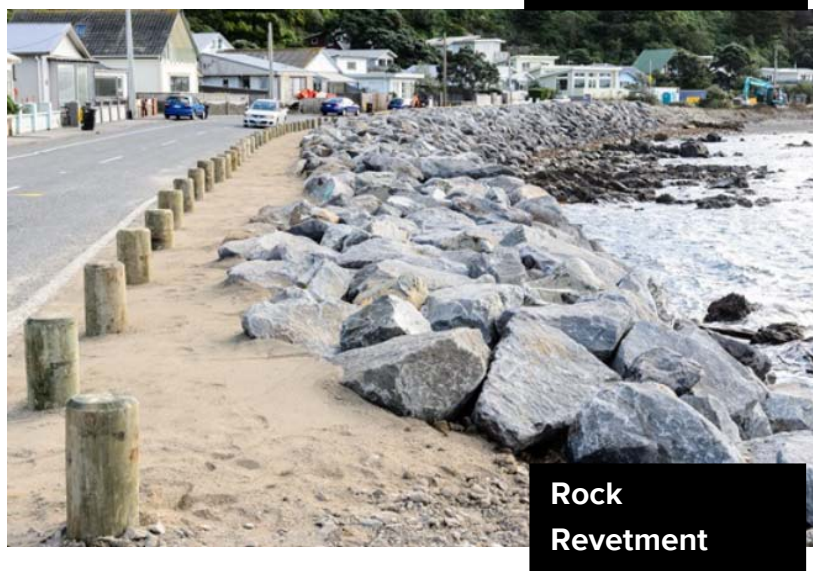
# SOUTHERN CELL

## Coastal Unit L: Clifton

## Option: 16 – Sea Wall

**Technical Description:** A large structure of rocks and/or concrete that absorbs/reflects wave energy and provides a physical barrier to erosion. Crest height of structure designed to limit overtopping and inundation.

### Representative Image



### Concept Plan



- Fixed geometry provides certainty in terms of standard of protection
- If designed well then minimal maintenance required
- Access over the structures is limited and steps would have to be provided at intervals

Options Guide	Major Benefit	Minor Benefit	Null/Neutral	Negative /Adverse	Key Issues / Considerations <sup>1 2</sup>
Erosion Mitigation					<p><b>Neutral / Factual</b></p> <ul style="list-style-type: none"> <li>➤ Vertical seawalls can be used in combination with groynes, renourishment and/or rock revetments.</li> </ul> <p><b>Positive</b></p> <ul style="list-style-type: none"> <li>➤ Effective at reducing erosion risk behind the defence and holding the line</li> <li>➤ Can be designed to prevent inundation and accommodate medium term sea level rise</li> </ul> <p><b>Negative</b></p> <ul style="list-style-type: none"> <li>➤ End effects of structure would need managing</li> <li>➤ Vertical walls can exacerbate beach erosion due to reflected wave energy</li> <li>➤ Height to address overtopping in the mid to long term is significant – impacts on amenity / views</li> <li>➤ Community values – beach and access lost</li> <li>➤ Can build expectations of safety and inadvertently encourage more investment and development within hazard zones</li> </ul>
Inundation Mitigation					
Adjacent Impacts					
Overall Cell Impacts					

### Implementation Commentary

Complex to consent and expensive to construct, however relatively straightforward to design given extensive experience available on similar structures both along this coast and elsewhere.

### Indication of Longevity

Medium to long term

<sup>1</sup> Capital and operational cost considerations excluded at this time

<sup>2</sup> Pending availability of Social and Cultural Impact assessment work



# SOUTHERN CELL

## Coastal Unit L: Clifton

## Option: 18 – Managed Retreat

**Technical Description:** A strategic relocation of assets and people away from areas at risk, enabling restoration of those areas to their natural state

### Representative Image



### Concept Plan



- Property and infrastructure relocated out of the hazard zone
- Equivalent sections made available for construction in order that the size of the community is maintained
- Coastal strip reverted to natural state, with restrictions on building/development, to provide an amenity benefit for public use
- Timing of relocation to be based on current risk and residual life of property

Options Guide	Major Benefit	Minor Benefit	Null/Neutral	Negative /Adverse	Key Issues / Considerations <sup>1 2</sup>
<b>Erosion Mitigation</b>					<b>Neutral / factual</b> <ul style="list-style-type: none"> <li>➤ Early planning</li> <li>➤ Proactive Council policies</li> <li>➤ Issue of fairness – who pays / who benefits</li> </ul> <b>Positive</b> <ul style="list-style-type: none"> <li>➤ Provides complete and long lasting risk reduction</li> </ul> <b>Negative</b> <ul style="list-style-type: none"> <li>➤ Risks influencing the property market / values</li> <li>➤ May be different financial / implementation models that could be more workable</li> <li>➤ Residual infrastructure issues – safety / ecological / amenity issues</li> <li>➤ Social impacts / uncertainty for residents</li> </ul>
<b>Inundation Mitigation</b>					
<b>Adjacent Impacts</b>					
<b>Overall Cell Impacts</b>					
<b>Implementation Commentary</b>					
Implementation can be complex.					
Where risk is considered untenable, consider preventing re-building or significant investment / enhancement in defined areas through plan provisions (District or Regional Plan).					

### Indication of Longevity

Likely the ultimate result at some time in the future as sea levels continue to rise. Key questions to consider are when managed retreat should be implemented, where, how, and how to respond to coastal hazards risks in the interim.

Long term

<sup>1</sup> Capital and operational cost considerations excluded at this time

<sup>2</sup> Pending availability of Social and Cultural Impact assessment work