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# Two Rocks Coastal Erosion Review

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creating better coasts and ports

# Presentation Outline

- Background
- Study Area
- Previous Work
- Summary of Coastal Processes
- Outcomes of Stage 1 Investigations
- Stage 2 Coastal Management Investigations
- Comparison of Stage 2 Options
- Summary & Recommendations

# Background

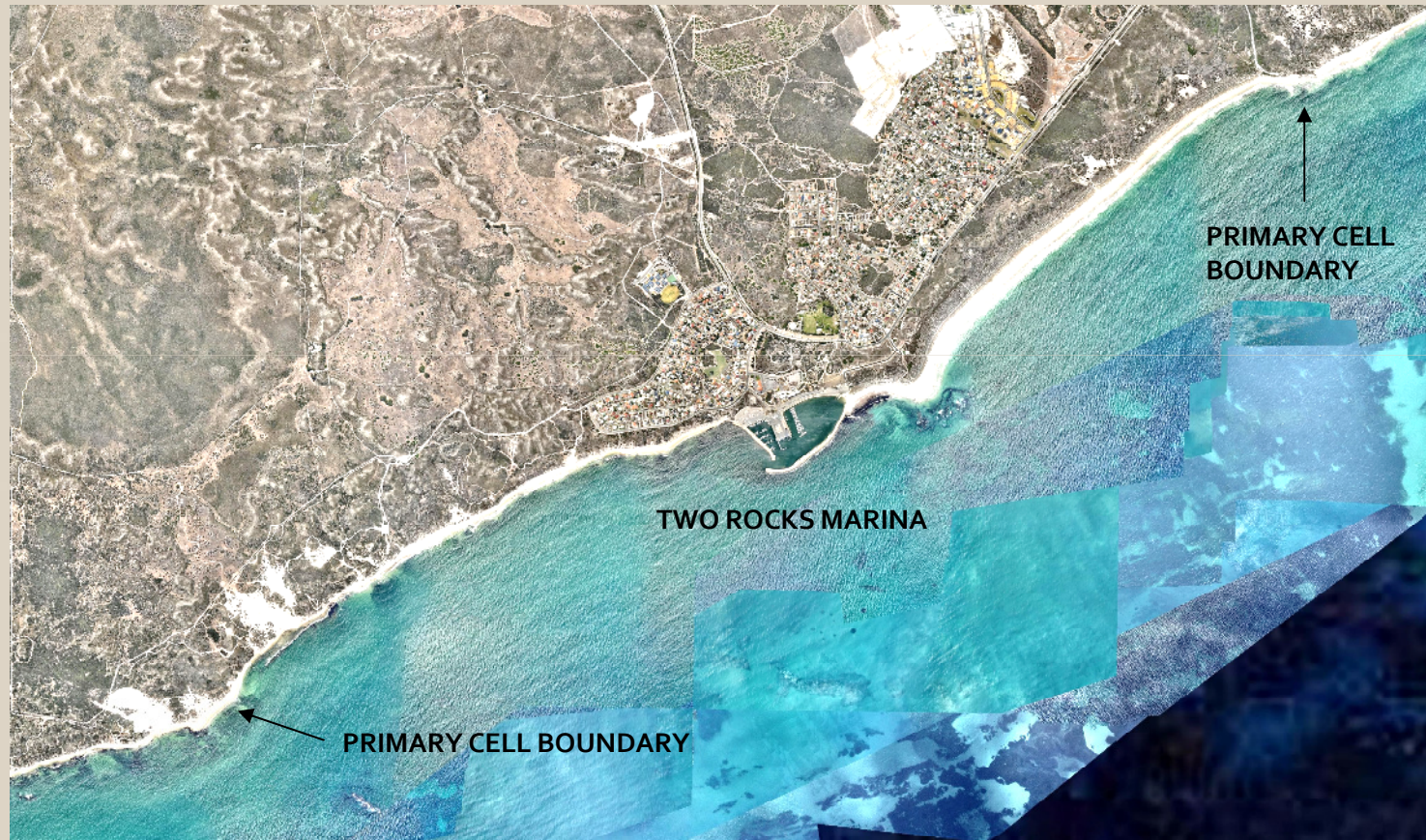
- Two Rocks Marina constructed in 1973
- Following construction of the Marina, shoreline has undergone large changes
- Significant accretion south and erosion north of the Marina
- In 2005 the City of Wanneroo commissioned an investigation into the erosion

# Review of MRA (2005)

- Assessed the required buffers to infrastructure over 30 year timeframe
- Long term erosion north of marina, accretion to south
- Loss of approx 14,000 m<sup>3</sup>/yr of sand to the north
- Coastal management options assessed
- Net Present Value analysis ranked 'Do Nothing' and Staged Groynes options highest
- Analysis extended to 60 year timeframe
- Staged Groyne option ranked highest
- Study recommended review in 5 years time

# Study Area

- ▣ Determined from sediment cell analysis



# Coastal Processes Update

- The existing assessment was updated to 2011
- The appropriate buffer to development was determined from the coastal processes
  - Storm erosion allowance
  - Shoreline movement allowance
  - Sea level rise allowance
- Sediment budget was developed for the full study area

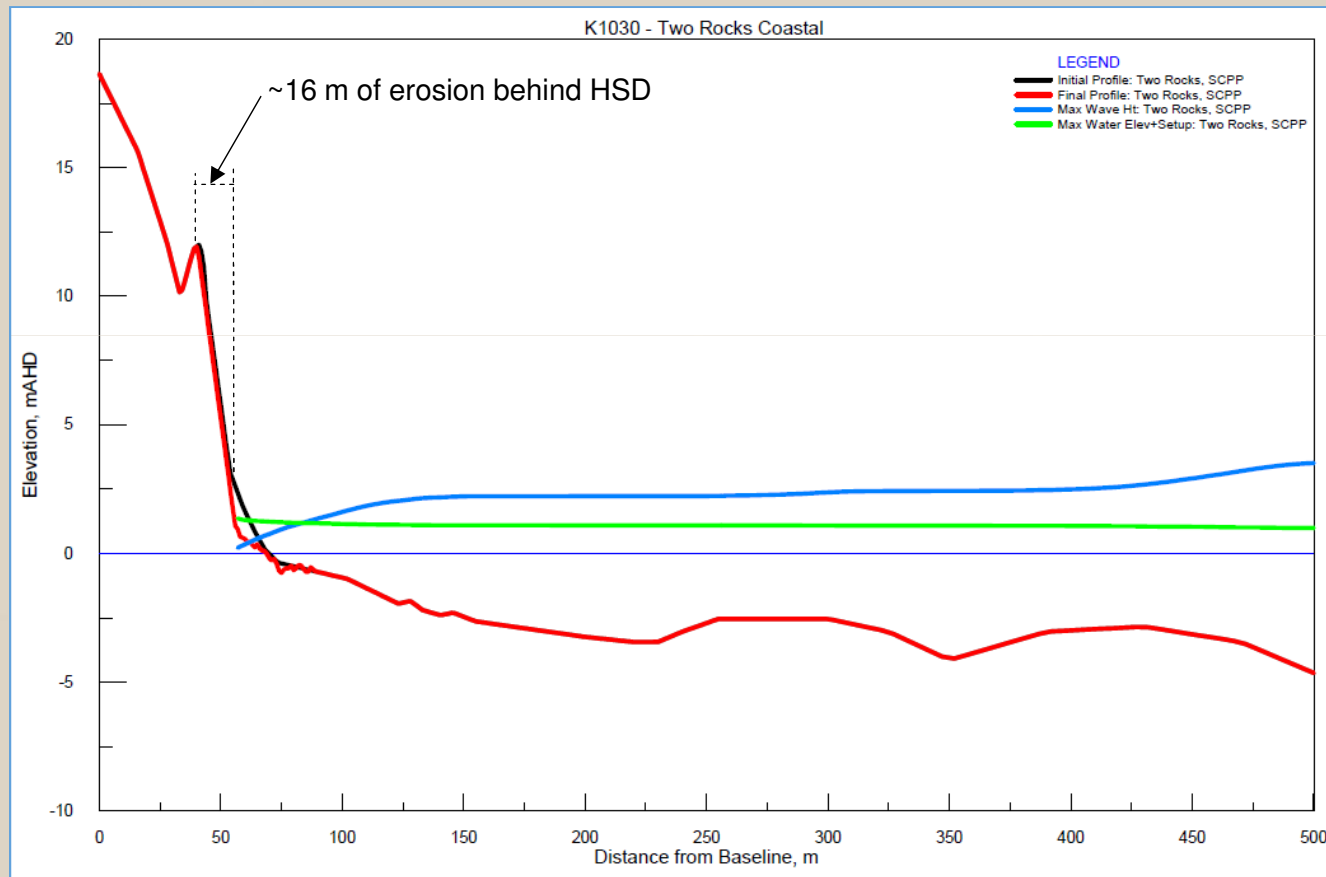
# Summary of Coastal Processes

- Continued accretion south of marina and erosion to north observed since 2005
- Isolated rock outcrops and platforms observed on beach



# Summary of Coastal Processes

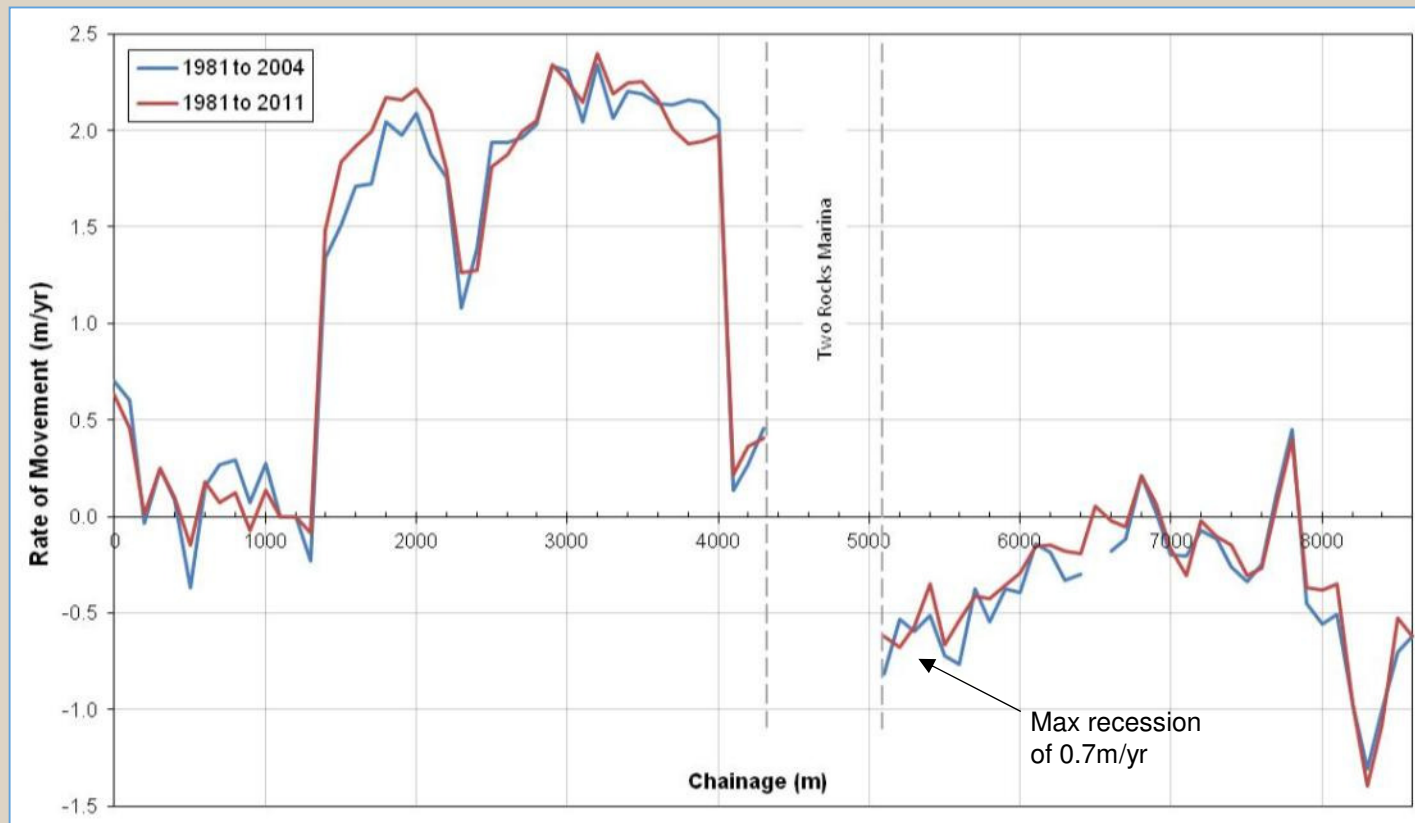
- Storm erosion modelling completed for the site





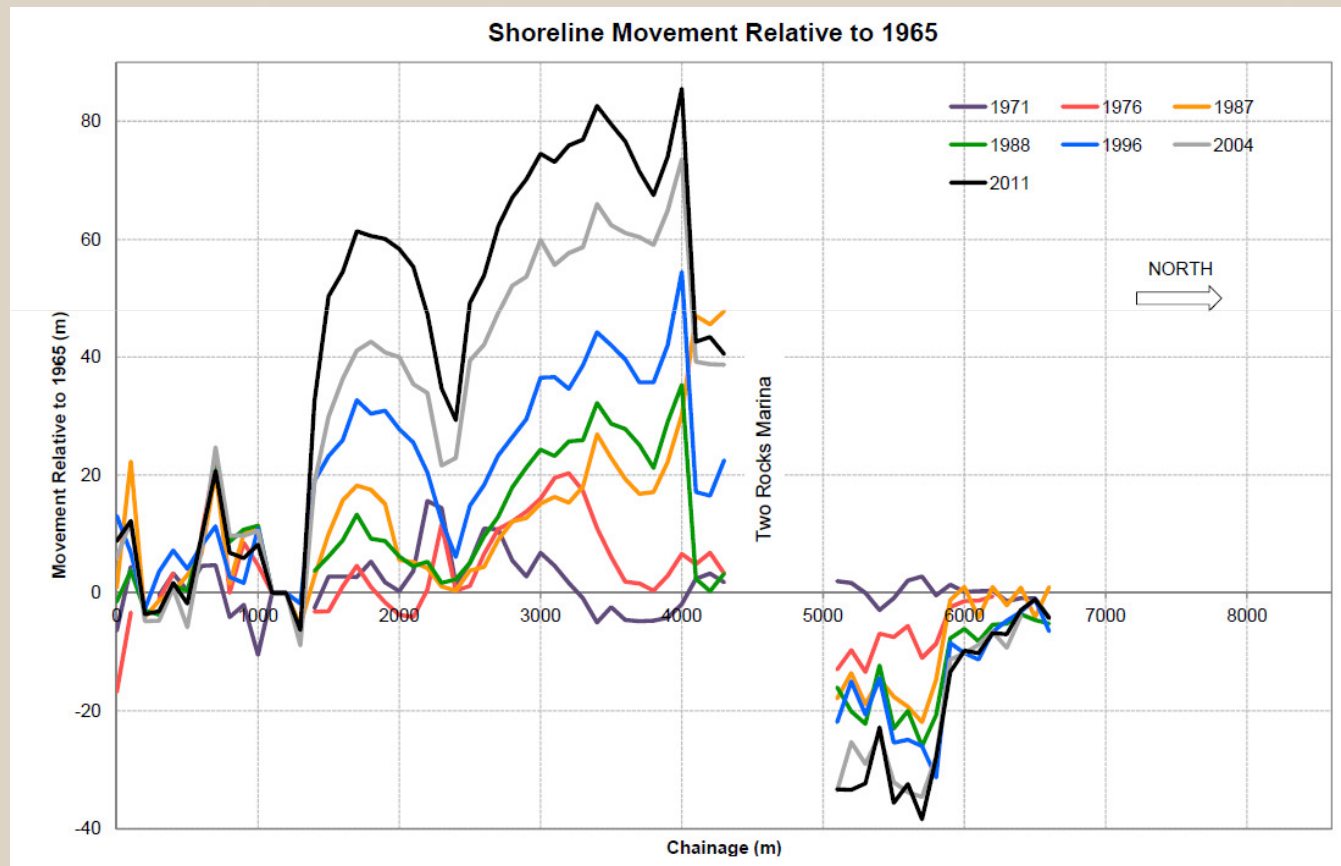
# Summary of Coastal Processes

- Updated analysis using DoT and MRA data
- Similar trends to previous study



# Cause of Erosion

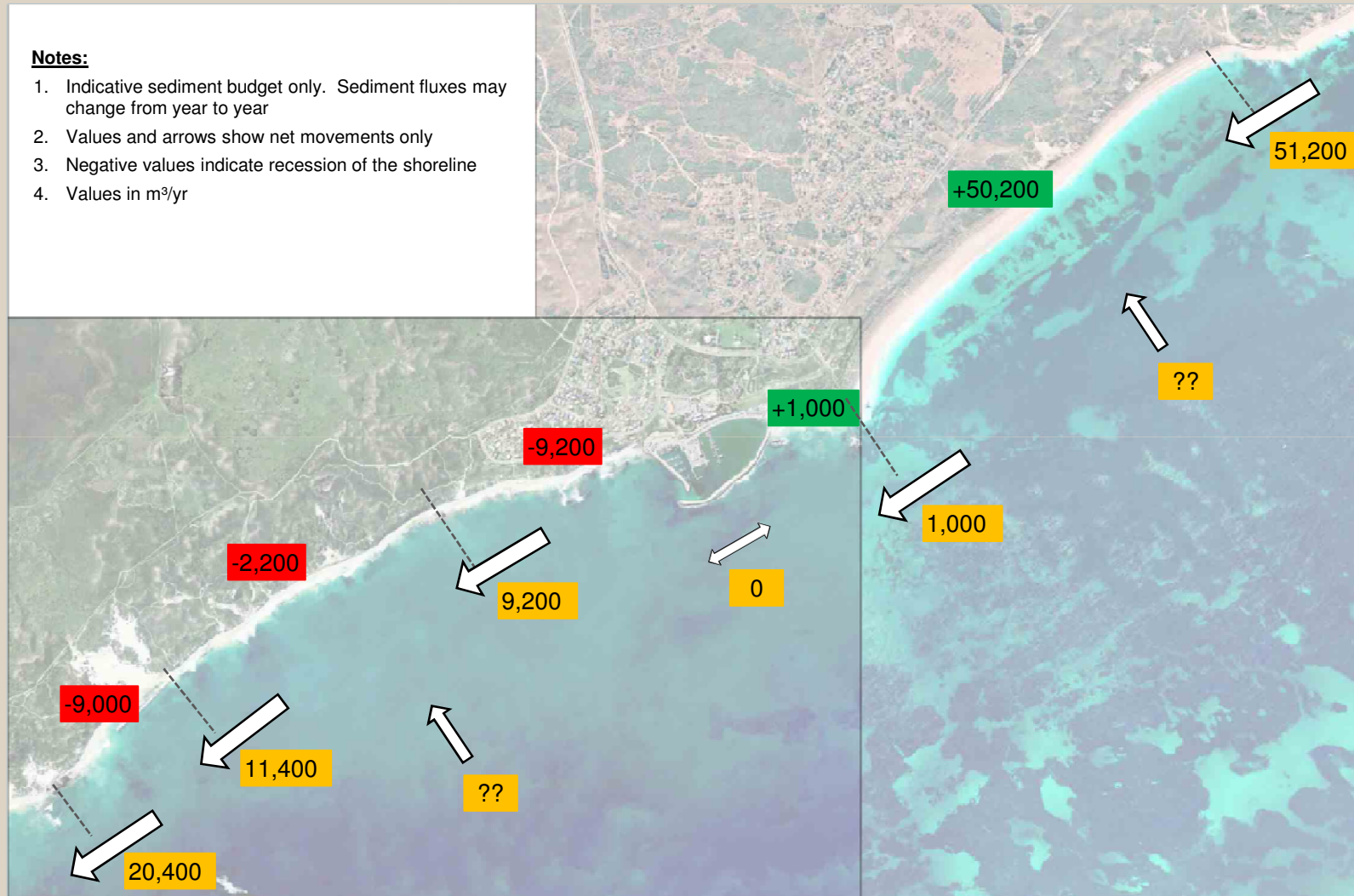
- Construction of Marina interrupted longshore transport
- Consistent with previous data, findings and reports



# Sediment Budget 1981-2011

**Notes:**

1. Indicative sediment budget only. Sediment fluxes may change from year to year
2. Values and arrows show net movements only
3. Negative values indicate recession of the shoreline
4. Values in m<sup>3</sup>/yr



# Summary of Coastal Processes

- Updated coastal processes assessment confirmed similar trends to earlier study
- Approximately 20,000 m<sup>3</sup>/yr of sand eroding from shoreline north of the Marina
- Estimated on current trends there could be 25m of shoreline lost in coming 10 years, and 42.5m in 25 years
- Options for management required

# Stage 1 Coastal Management Options

- Coastal Management Options
  - Managed Retreat
  - Sand Nourishment
  - Sand Bypassing
  - Seawall
  - Groynes
  - Offshore Breakwaters
- Recommended Managed Retreat & Staged Groynes for Stage 2 Investigations

# Managed Retreat



# Sand Nourishment

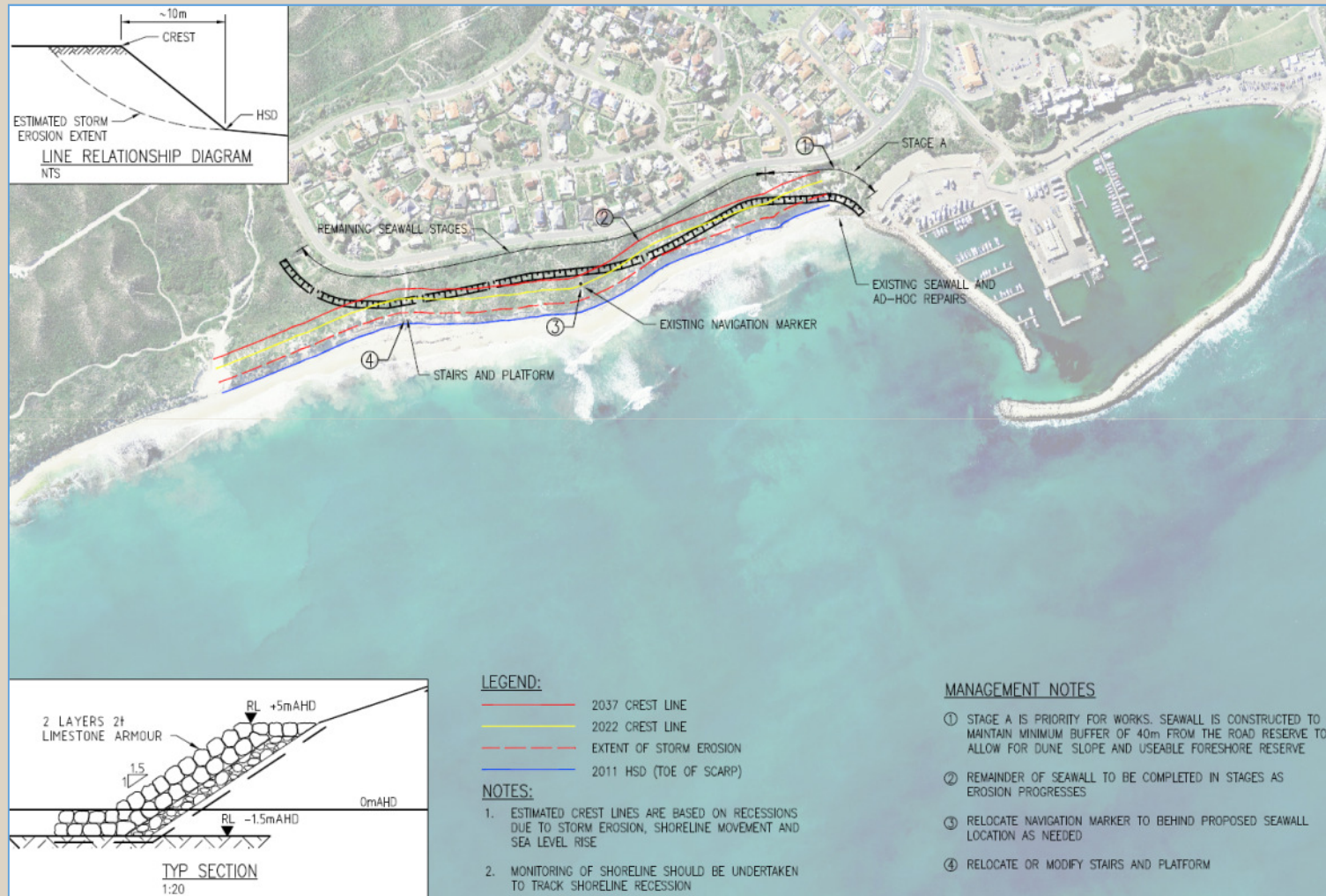


# Sand Bypassing

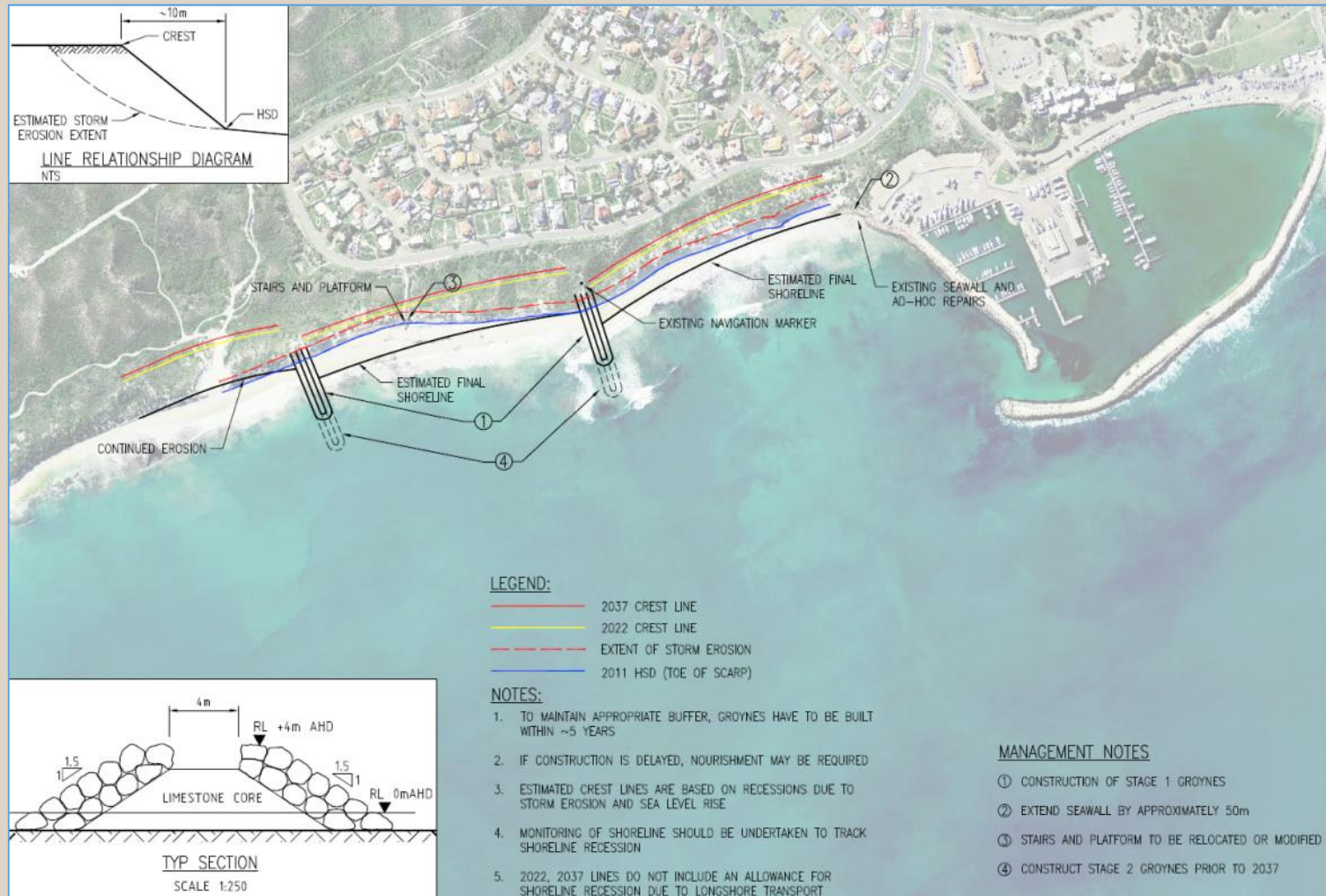




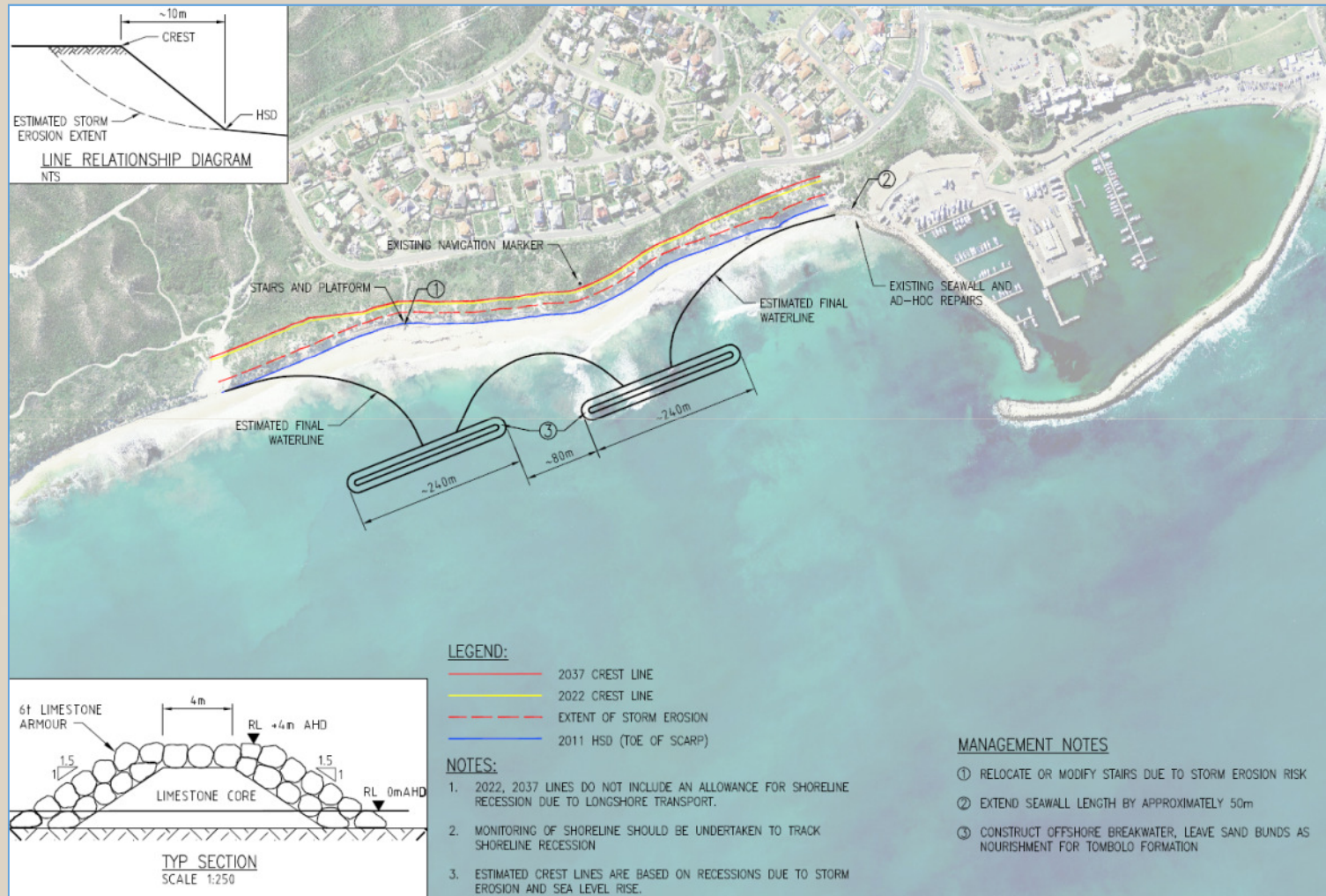
# Seawall



# Groynes



# Offshore Breakwaters



# Coastal Management Options

Management Option	Benefits to 2037	Disadvantages to 2037
<b>Managed Retreat</b>	<ul style="list-style-type: none"> <li>Beach amenity is retained</li> <li>No additional interference with coastal processes.</li> <li>Low cost to 2037.</li> <li>Low social impact over the planning period.</li> </ul>	<ul style="list-style-type: none"> <li>Unlikely to be a viable long term option.</li> <li>Large erosion scarp and reduced public safety and beach access.</li> <li>Would still require management of stairs, platform and navigation aid.</li> </ul>
<b>Sand Nourishment</b>	<ul style="list-style-type: none"> <li>Beach amenity is retained till the end of the planning period.</li> <li>Partial replication of natural processes in the area.</li> <li>Better understanding of local coastal processes through monitoring.</li> </ul>	<ul style="list-style-type: none"> <li>Ongoing annual commitment to undertake sand nourishment.</li> <li>Potential social impacts to local community.</li> <li>Requires management of stairs, platform and seawall extension.</li> </ul>
<b>Sand Bypassing</b>	<ul style="list-style-type: none"> <li>Large sediment source available. Bypassing amount is less than half of the accretion to the south of the marina.</li> <li>Beach amenity is retained</li> <li>Partial replication of natural processes in the area.</li> <li>Allows refinement of scheme through monitoring.</li> </ul>	<ul style="list-style-type: none"> <li>Ongoing annual commitment to undertake sand nourishment.</li> <li>Potential social impacts to local community.</li> <li>Requires management of stairs, platform and seawall extension.</li> </ul>
<b>Seawall</b>	<ul style="list-style-type: none"> <li>Protects infrastructure.</li> <li>Works can be constructed in stages.</li> <li>Maintenance costs are periodic and relatively low.</li> </ul>	<ul style="list-style-type: none"> <li>Large capital cost.</li> <li>Beach amenity could be lost in the long term and visual impact</li> <li>Would still require management of stairs, platform and navigation aid.</li> <li>Erosion likely to continue north of the seawall.</li> </ul>
<b>Groynes</b>	<ul style="list-style-type: none"> <li>Beach access is maintained.</li> <li>Works can be constructed in stages.</li> <li>Maintenance costs are periodic and relatively low.</li> <li>Allows refinement of scheme through monitoring.</li> </ul>	<ul style="list-style-type: none"> <li>Moderate capital cost.</li> <li>Requires management of stairs, platform and seawall extension.</li> <li>Visual impact.</li> <li>Erosion likely to continue north of the groynes.</li> </ul>
<b>Offshore Breakwaters</b>	<ul style="list-style-type: none"> <li>Beach access is maintained/increased.</li> <li>Shoreline recession due to longshore sediment transport is prevented.</li> <li>Construction works include an initial sand nourishment.</li> </ul>	<ul style="list-style-type: none"> <li>Expensive construction and maintenance costs.</li> <li>Requires management of stairs, platform and seawall extension.</li> <li>Changes the coastal processes of the area.</li> <li>Erosion will continue north of the offshore breakwaters.</li> </ul>

# Coastal Management Costs

- Estimated capital costs and maintenance costs
- Appropriate for concept level
- Used in NPV analysis

# Multi Criteria Analysis

- Options assessed for impacts

Management Option	Impacts over 25 years			Long Term Risk to Infrastructure (Over 100 years)	Overall Ranking (Rating Value)
	Environmental	Social	NPV over 25 years		
Managed Retreat	Medium	Low	Low	High	<b>1</b> (9)
Sand Nourishment	Low/Medium	Low/Medium	High	Medium	<b>6</b> (8)
Sand Bypassing	Low/Medium	Low/Medium	Medium/High	Medium	<b>5</b> (8.5)
Seawall	Medium	Medium/High	Medium	Low	<b>3</b> (8.5)
Groynes	Medium	Low/Medium	Medium	Low/Medium	<b>2</b> (9)
Offshore Breakwaters	Medium	Low/Medium	Medium/High	Low/Medium	<b>4</b> (8.5)

# Stage 1 Coastal Management Options

- Recommended Managed Retreat & Staged Groynes for Stage 2 Investigations

# Stage 2 Investigations

- Further investigation of recommended options
  - Managed Retreat
  - Staged Groynes
- Also assessed
  - Impact on coastline
  - Benefits and disadvantages of option
  - Works required to protect coastal infrastructure under proposed management option
- Updated cost estimates and NPV



# Managed Retreat

- Under this Option
  - Coastal processes continue
  - Infrastructure relocated/modified as required
  - Shoreline continues to recede
  - Shoreline monitoring used to track shoreline recession

# Managed Retreat



# Managed Retreat



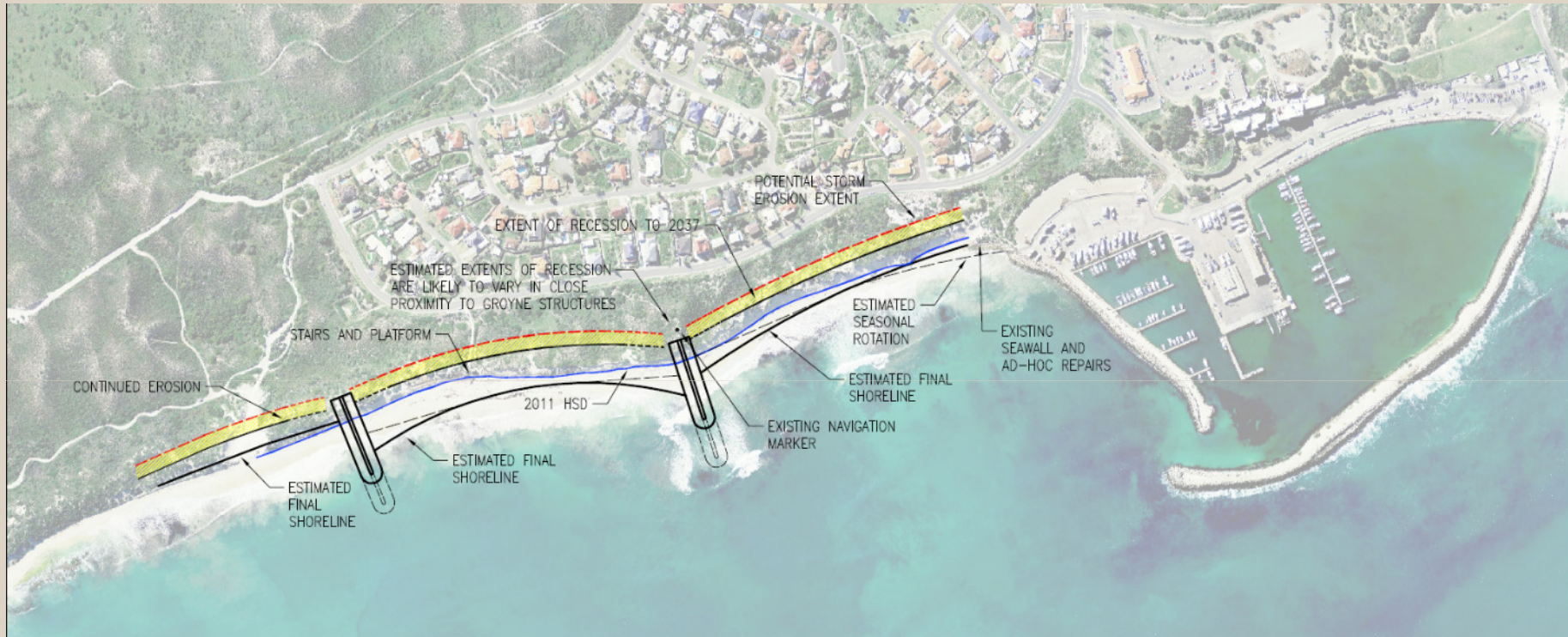
# Managed Retreat

- Timing of mitigation works under Managed Retreat
  - 80 m extension of northern seawall of the Marina as soon as possible
  - Relocation of Sceptre Court stairs and viewing platform as soon as possible
  - Relocation of navigation marker in 10 to 15 years
- Estimated vulnerability of Sovereign Drive road reserve in approximately 45 years (2057)

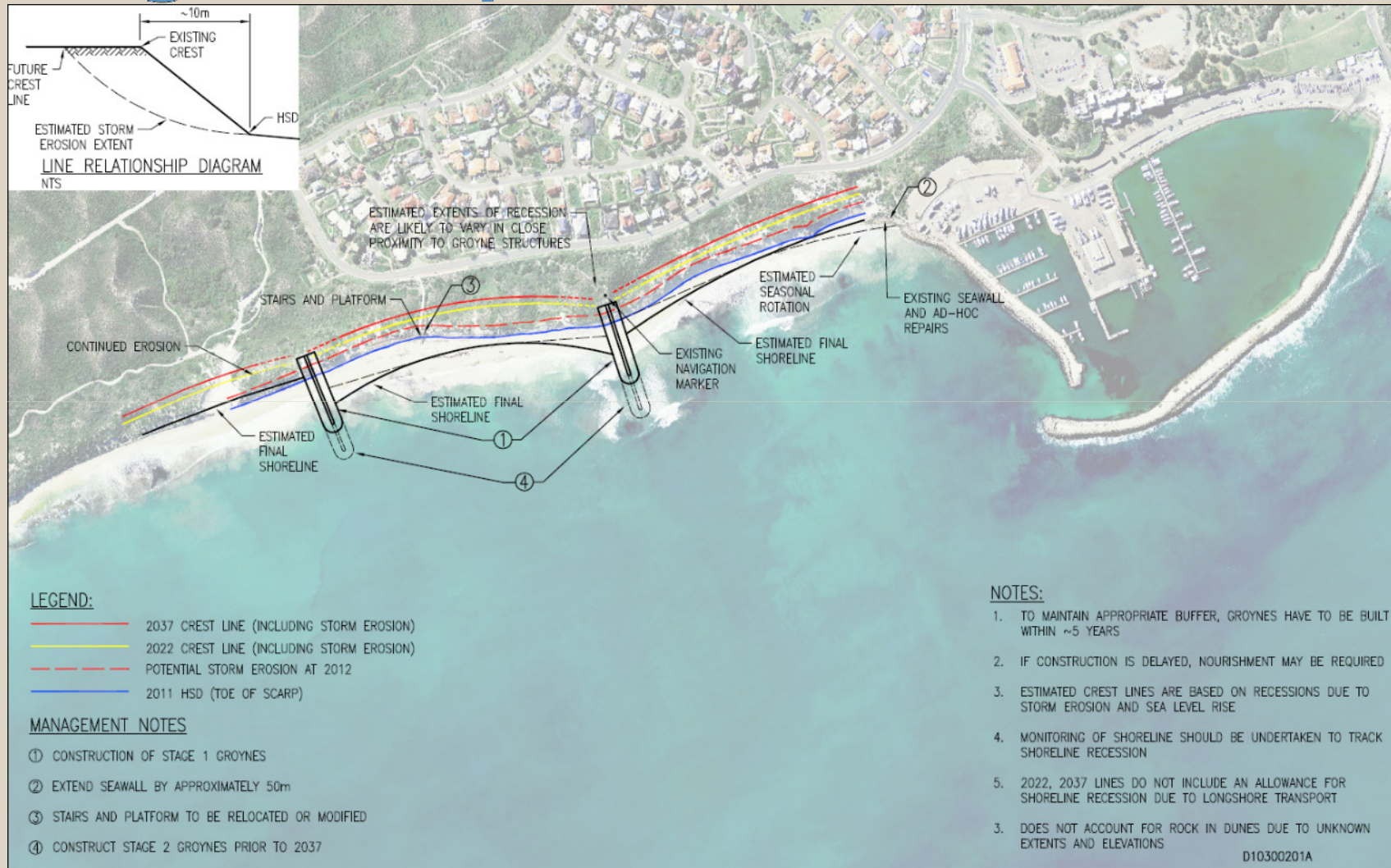
# Staged Groynes

- Under this Option
  - Initial groyne construction within 5 years
  - Extension to groynes in 15 years
  - Shoreline recession is reduced
  - Infrastructure relocated/modified as required
  - Shoreline monitoring used to track shoreline recession

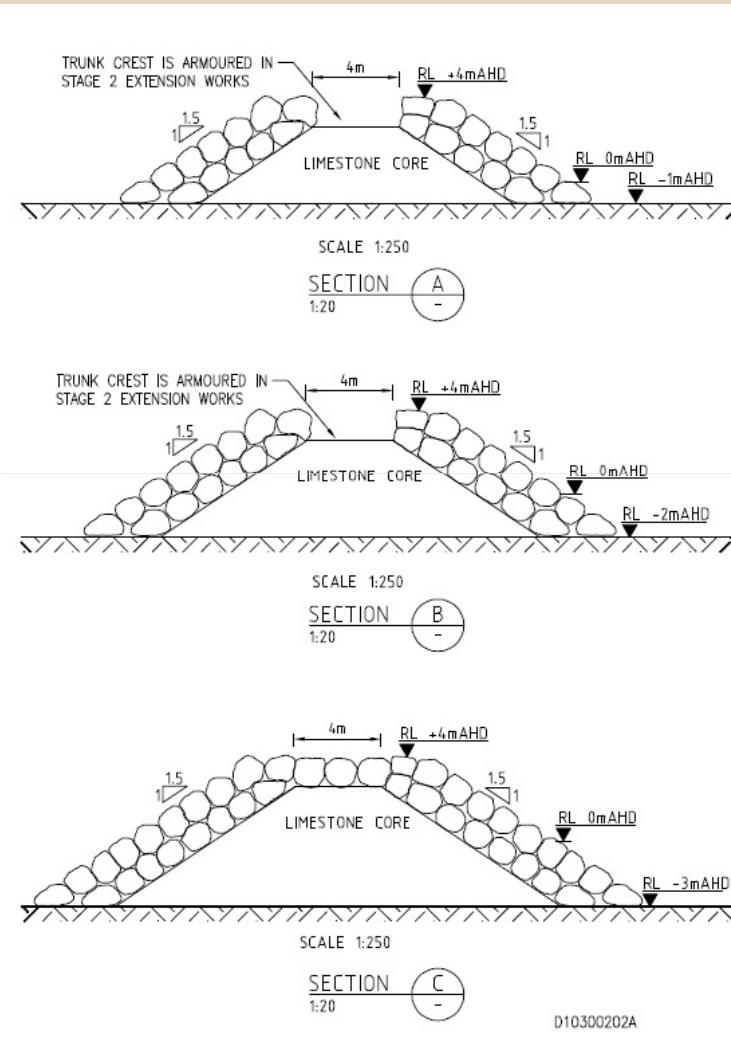
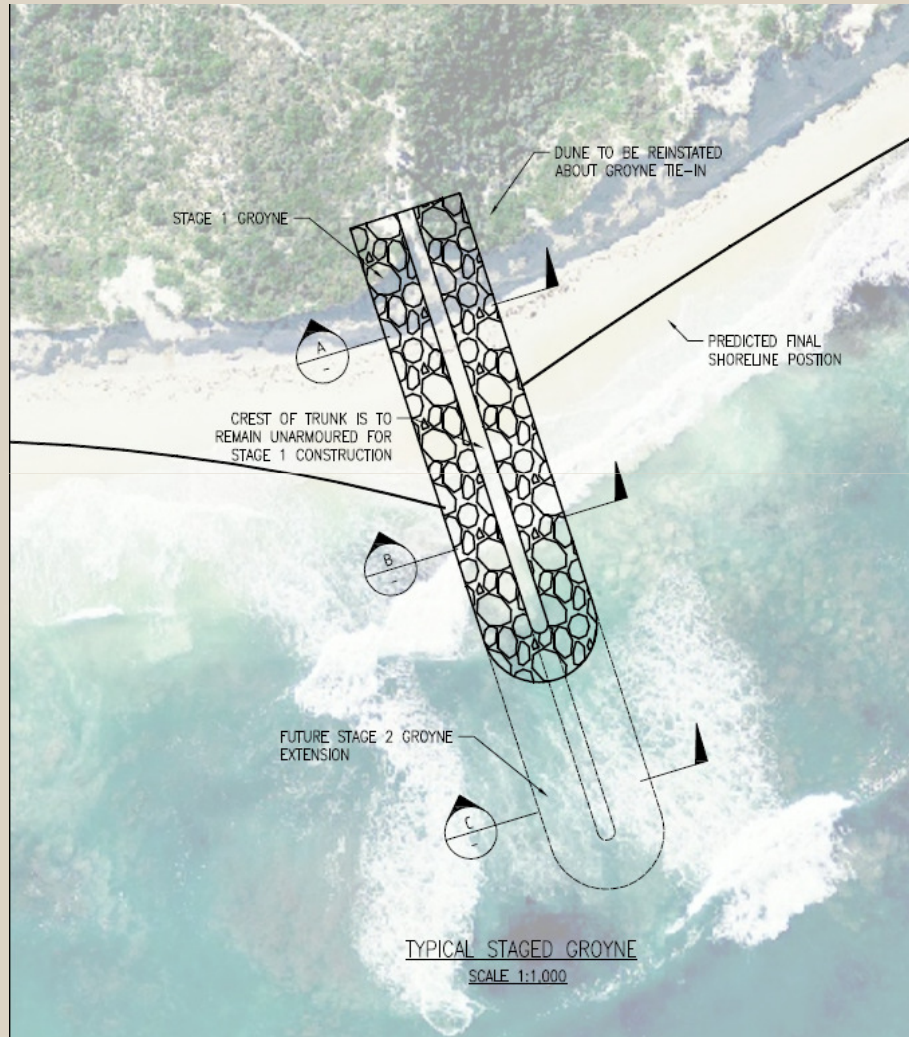
# Staged Groynes



# Staged Groynes



# Staged Groynes

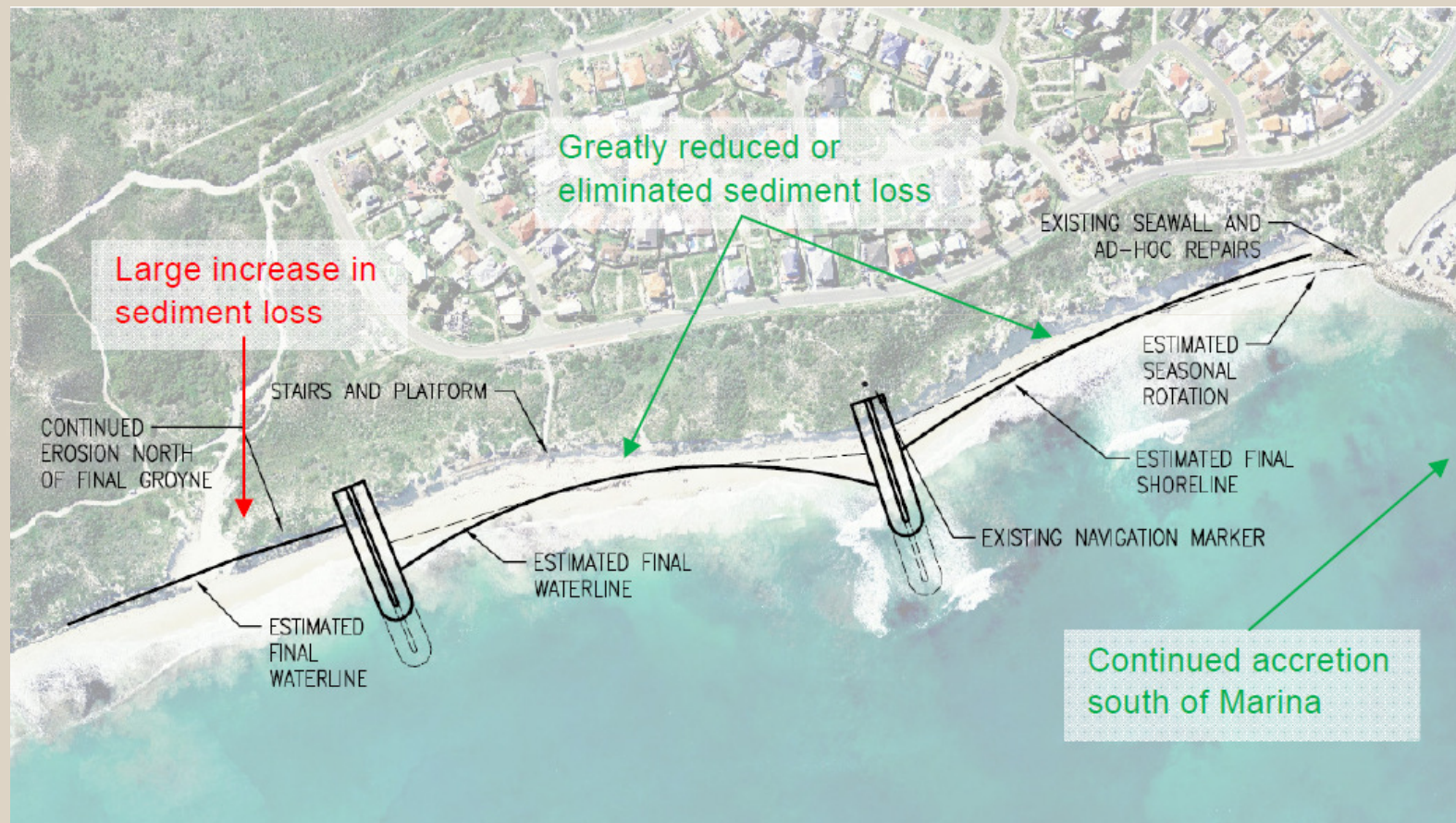


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# Staged Groynes

- Estimated impact of option on coastal processes



# Staged Groynes

- Timing of mitigation works under Staged Groynes
  - 50 m extension of northern seawall of the Marina as soon as possible
  - Relocation of Sceptre Court stairs and viewing platform as soon as possible
- Estimated vulnerability of Sovereign Drive road reserve in approximately 80 years (2092)

# Stage 2 Management Costs

- Revised capital and maintenance costs
- Determined NPV for cost estimates for 25 year timeframe

Item	Management Option	Capital Cost	Undiscounted Net Cost over 25 years	Net Present Value at 6% for 25 years
1	Managed Retreat	\$995,440	\$1,286,440	\$1,045,718
2	Staged Groyne Construction	\$4,652,900	\$5,684,900	\$3,742,668

# Comparison of Stage 2 Options

## ■ Compared Benefits and Disadvantages

Management Option	Benefits to 2037	Disadvantages to 2037
<b>Managed Retreat</b>	<ul style="list-style-type: none"> <li>• Beach amenity is retained</li> <li>• No additional interference with coastal processes</li> <li>• Low cost to 2037</li> <li>• Low social impact over the planning period</li> </ul>	<ul style="list-style-type: none"> <li>• Unlikely to be a viable long term option</li> <li>• Large erosion scarp and reduced public safety and beach access</li> <li>• Loss of foreshore asset</li> <li>• Would still require management of stairs, platform and navigation aid</li> </ul>
<b>Groynes</b>	<ul style="list-style-type: none"> <li>• Beach access is maintained</li> <li>• Works can be constructed in stages</li> <li>• Maintenance costs are periodic and relatively low</li> <li>• Allows refinement of scheme through monitoring</li> </ul>	<ul style="list-style-type: none"> <li>• Moderate capital cost</li> <li>• Requires management of stairs, platform and seawall extension</li> <li>• Environmental impact on nearshore reefs</li> <li>• Visual impact</li> <li>• Erosion likely to continue north of the groynes</li> </ul>

# Comparison of Stage 2 Options

- Assessed for environmental, social impacts, long term risk to infrastructure and NPV
- Managed Retreat ranked highest for 25 year timeframe

Management Option	Impacts over 25 years			Long Term Risk to Infrastructure (Over 100 years)	Overall Ranking (Rating Value)
	Environmental	Social	NPV over 25 years		
Managed Retreat	Medium	Low	Low	High	1 (9)
Groynes	Medium	Low/Medium	Medium	Low/Medium	2 (9)

# Further Considerations

- Final buffer to infrastructure of 31 m is considered a trigger point for coastal management works
- Geotechnical investigations of limestone rock presence (done since study)



# Summary & Recommendations

- Managed Retreat ranked highest for 25 year timeframe, but not viable in the long term
- Recommend that shoreline monitoring program be implemented

# Thank you

- Questions?

