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Enhancing Society Together

GOLD COAST WATERWAYS AUTHORITY

Gold Coast Seaway Breakwater Stability Assessment

PIANC APAC Conference – August 2024

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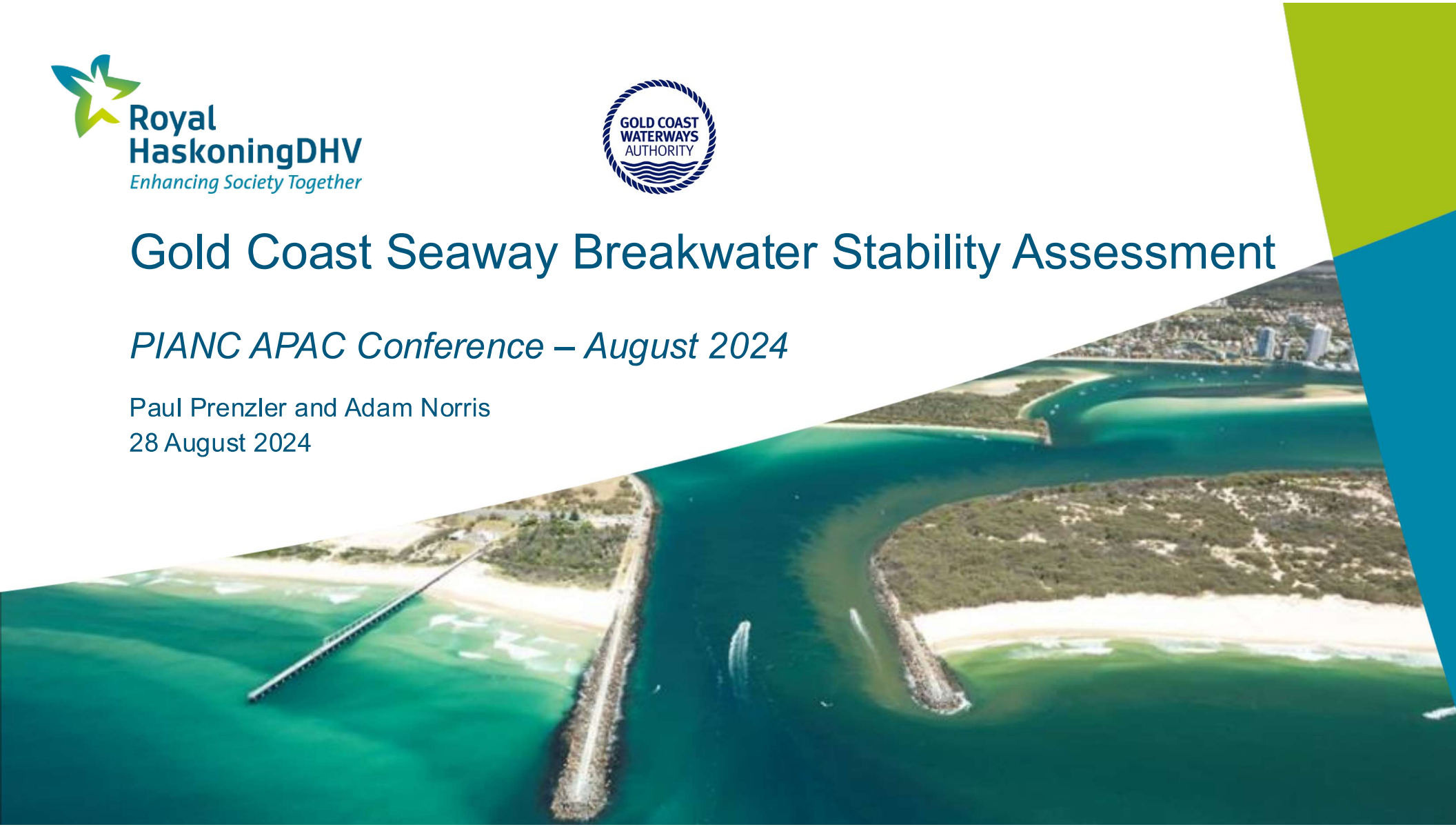
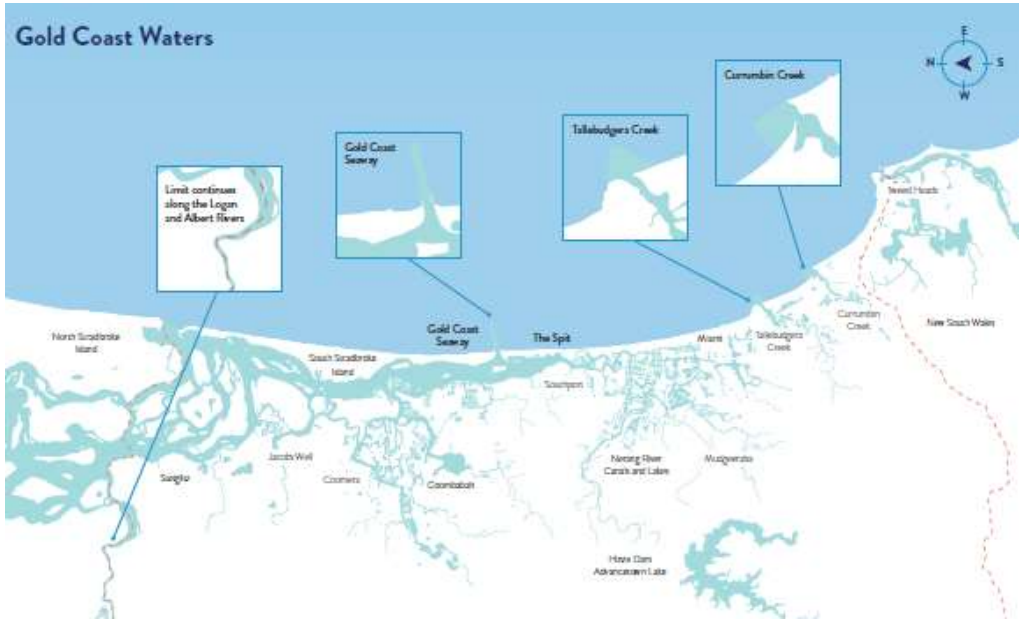
28 August 2024



Background	GCWA roles and responsibilities Gold Coast Seaway purpose
Design Aspects	Gold Coast Seaway infrastructure features Design Aspects of the Seaway Training Walls and Wavebreak Island Breakwaters
Condition Assessment	Application of the Ports Australia WSCAM methodology Condition Results
Survey Analysis	Survey Analysis Issues identified
Summary	Conclusions of stability assessment Recommendations for future actions

Background – Gold Coast Waterways Authority

- Queensland Government established Gold Coast Waterways Authority (GCWA) on 1 December 2012
- Established to deliver the best possible management of Gold Coast waterways



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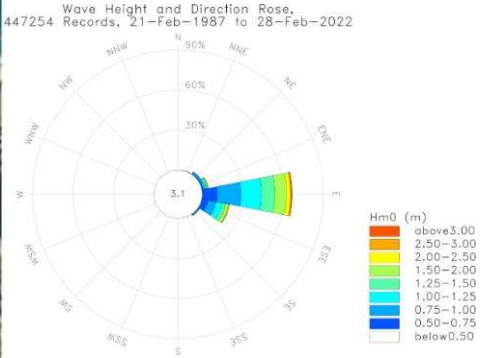
Background – Seaway



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Background – Nerang River Migration

Background

Design Aspects

Condition Assessment

Survey Analysis

Summary

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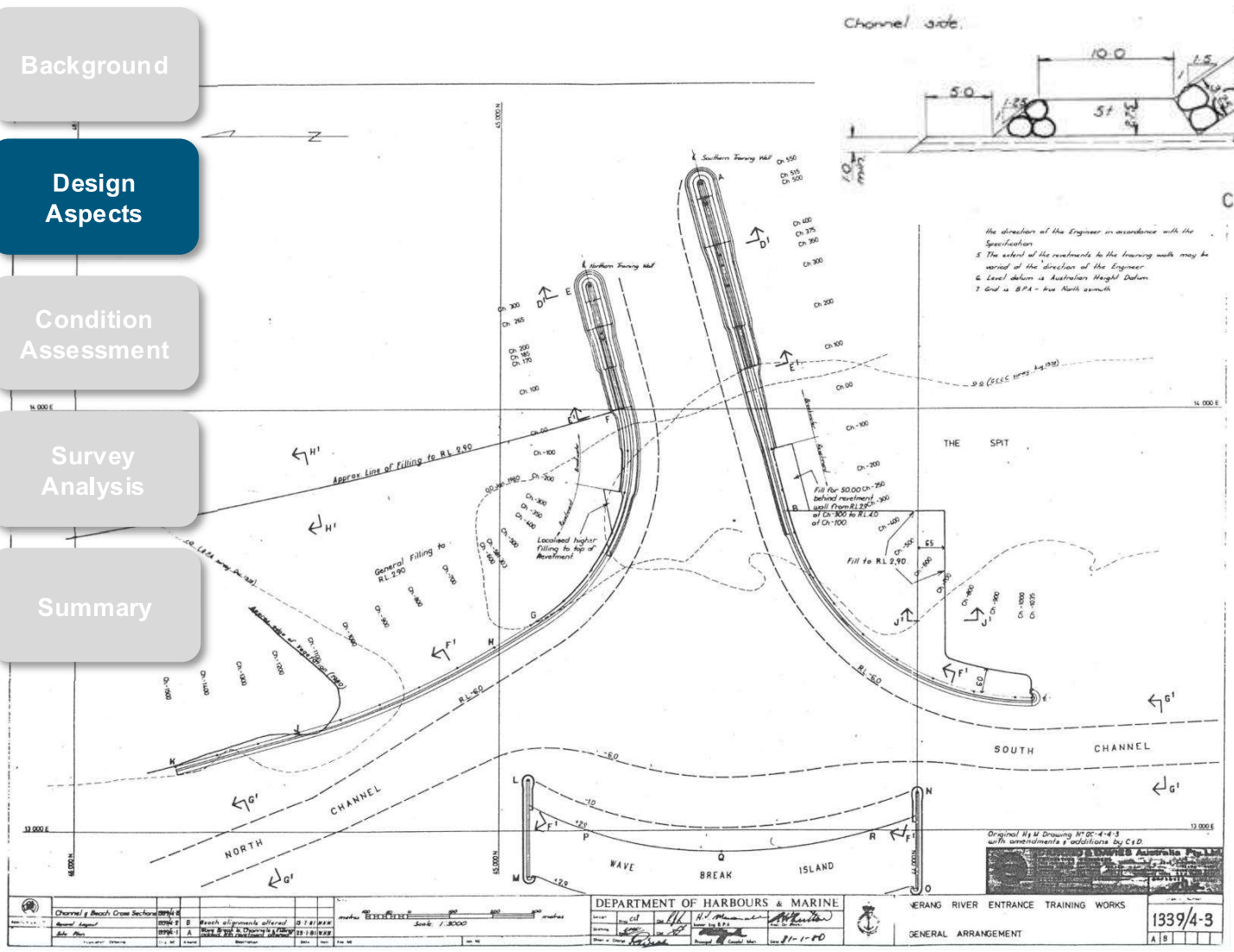

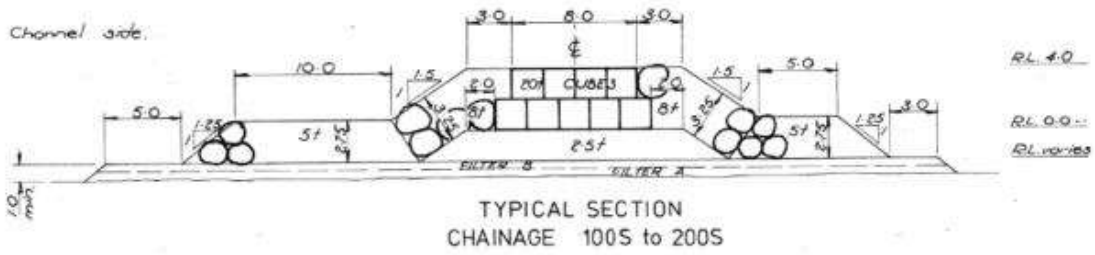

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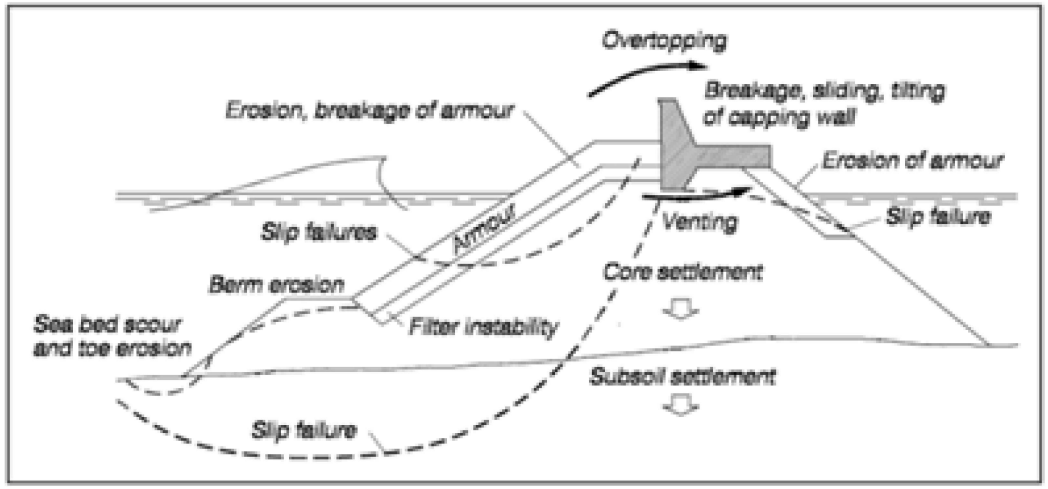
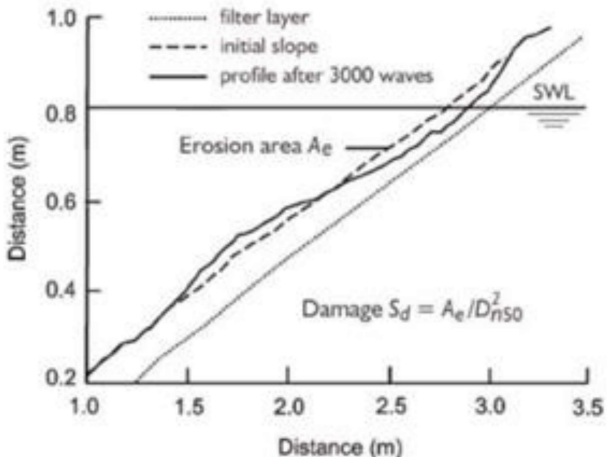
Failure Mechanisms



Failure mode of a rubble mound breakwater (Burcharth et al, 1995).



Damaged profile of a rock armour slope, due to hydraulic instability (S-shape)

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Condition Assessment

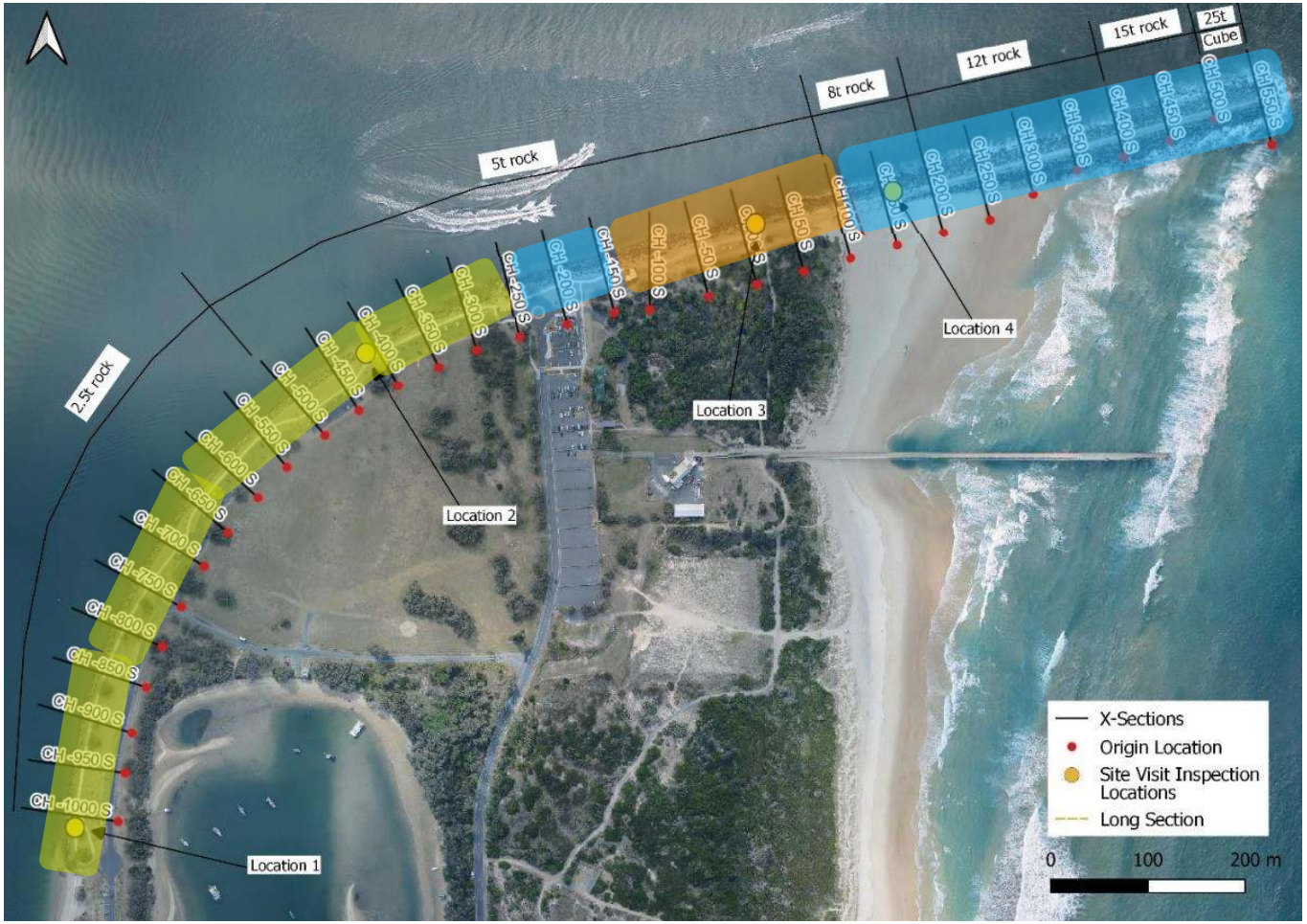
CONDITION RATING	GENERIC DESCRIPTION	EXPECTED REM. LIFE (% of original design life)	RECOMMENDED ACTIONS
1	New. No discernible deterioration	100	None
2	Cosmetic defects that will have no effect on performance. Structure comprises densely packed, well interlocked and stable armour. Alignment retained from shoulder to toe with no settlement of crest behind revetment, no downward sliding, and no bulging or undermining at toe. No loss of backfill.	55–99	None
3	Minor defects that will not reduce the overall performance of the asset. Crest and bank profile intact. Minor settlement of crest but no cracking of retained soil or pavement. Minor bulging, sliding, undermining of toe. Minor loss/movement of armour and no loss of backfill/under layers.	40–54	Continue planned and preventive maintenance
4	Some defects that could reduce performance. Limited weathering or fracture of armour. Some displaced armour with minor deformation or erosion of supporting under layers. Minor settlement and cracking at crest. Minor sliding of revetment and some bulging at toe. Minor washout of fines and damage of filtration layer.	25–39	Reactive maintenance. Consider review of design and minor upgrades to improve durability.
5	Defects that significantly reduce performance. Moderate weathering or fracture of armour. Significant loss of armour and/or loosely packed armour. Significant deformation and erosion of supporting under layers. Moderate settlement of crest with severe cracking. Minor sliding of revetment but severe bulging at toe. Severe washout of fines with filtration missing or severely damaged.	15–24	Plan for significant repairs or upgrade works if protection is still required.
6	Defects that cause almost complete loss of performance. Widespread weathering or fracture of armour. Extensive loss of armour across foreshore. Severe deformation and erosion of supporting under layers. Severe settlement of crest as well as bank/berm with severe cracking. Severe sliding of revetment but severe bulging and undermining at toe. Extensive washout of fines with filtration missing or lost.	1–14	Undertake immediate repairs and/or upgrade works if protection is still required.
7	No significant protection provided by the revetment.	0	Undertake immediate repairs and/or upgrade works if protection is still required.

CONDITION RATING	DESCRIPTION	ROCK ARMOUR
2	Cosmetic defects that will have no effect on performance. Structure comprises densely packed, well interlocked and stable armour. Alignment retained from shoulder to toe with no settlement of crest behind revetment, no downward sliding, and no bulging or undermining at toe. No loss of backfill.	
3	Minor defects that will not reduce the overall performance of the asset. Crest and bank profile intact. Minor settlement of crest but no cracking of retained soil or pavement. Minor bulging, sliding, undermining of toe. Minor loss/movement of armour and no loss of backfill/ under layers.	
4	Some defects that could reduce performance. Limited weathering or fracture of armour. Some displaced armour with minor deformation or erosion of supporting under layers. Minor settlement and cracking at crest. Minor sliding of revetment and some bulging at toe. Minor washout of fines and damage of filtration layer.	
5	Defects that significantly reduce performance. Moderate weathering or fracture of armour. Significant loss of armour and/or loosely packed armour. Significant deformation and erosion of supporting under layers. Moderate settlement of crest with severe cracking. Minor sliding of revetment but severe bulging at toe. Severe washout of fines with filtration missing or severely damaged.	
6	Defects that cause almost complete loss of performance. Widespread weathering or fracture of armour. Extensive loss of armour across foreshore. Severe deformation and erosion of supporting under layers. Severe settlement of crest as well as bank/ berm with severe cracking. Severe sliding of revetment but severe bulging and undermining at toe. Extensive washout of fines with filtration missing or lost.	

Seaway Southern Training Wall:

- 1550m in Length
- Armour varies from 25t to 2.5t

Chainage	Condition Rating	Est. Remaining Life (% of Original Design Life)
-1000 to -250	2	55-99
-250 to -150	3	41-55
-150 to 100	5	15-24
100 to 550	3	41-55



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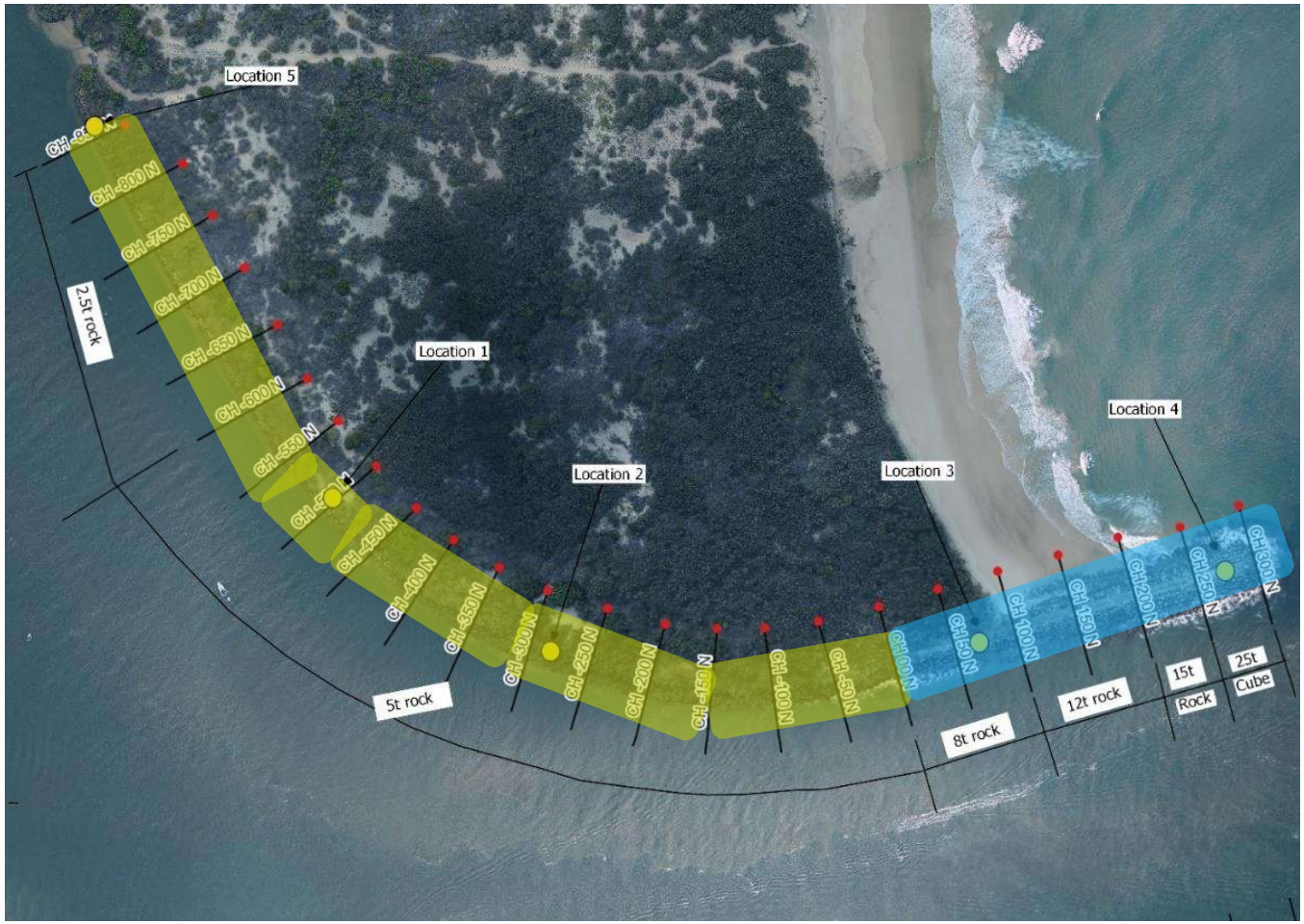
Seaway Northern Training Wall:

- 1150m in Length
- Armour varies from 25t to 2.5t

Chainage	Condition Rating	Est. Remaining Life (% of Original Design Life)
-850 to 0	2	55-99
0 to 300	3	41-55



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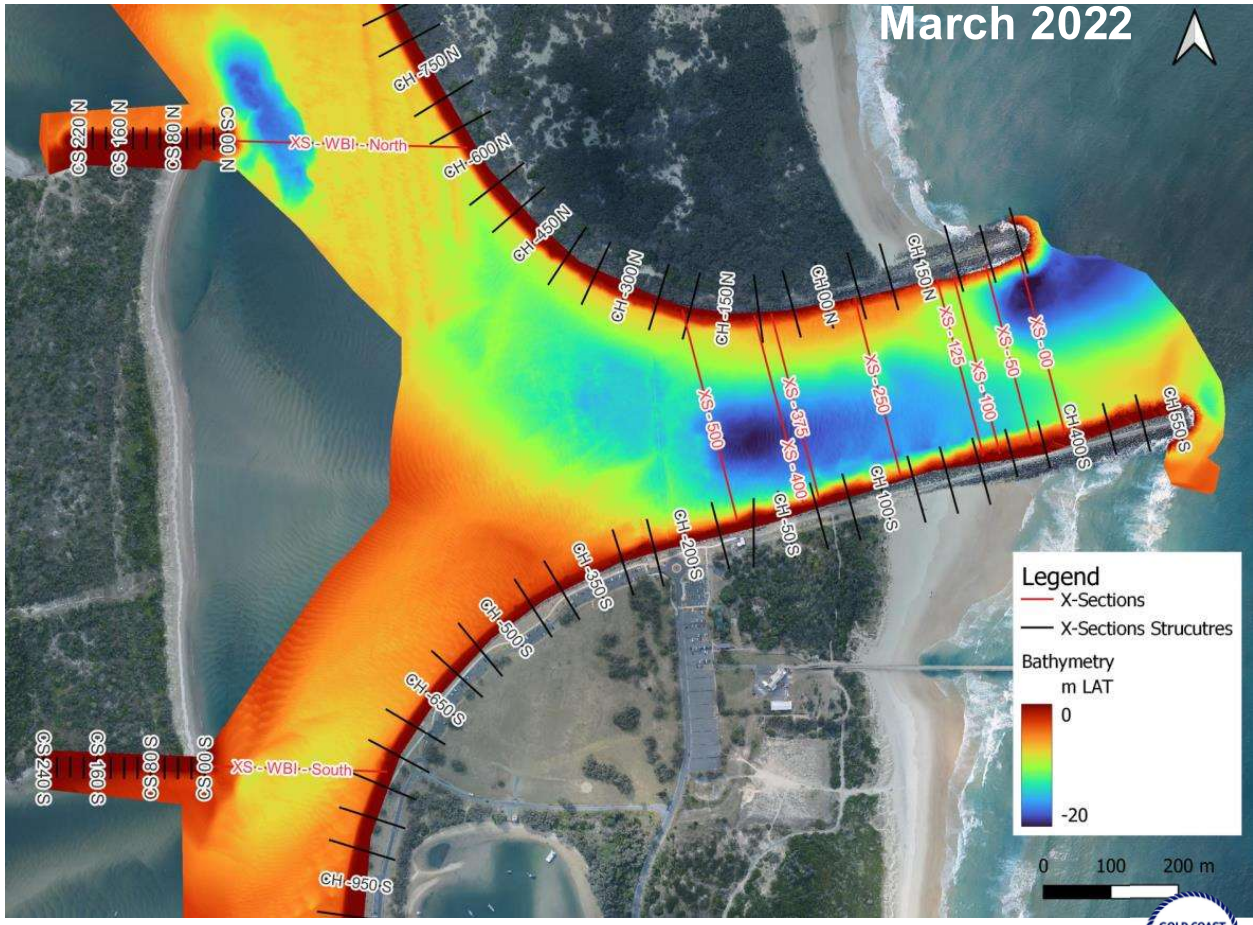
Survey Assessment

- Design channel depth ~ -10m CD
- Seaway has scoured to approx. -6 to -19m CD
- Scour holes located at:
  - Head of northern training wall
  - Middle of southern training wall
  - Head of northern breakwater on Wavebreak Island



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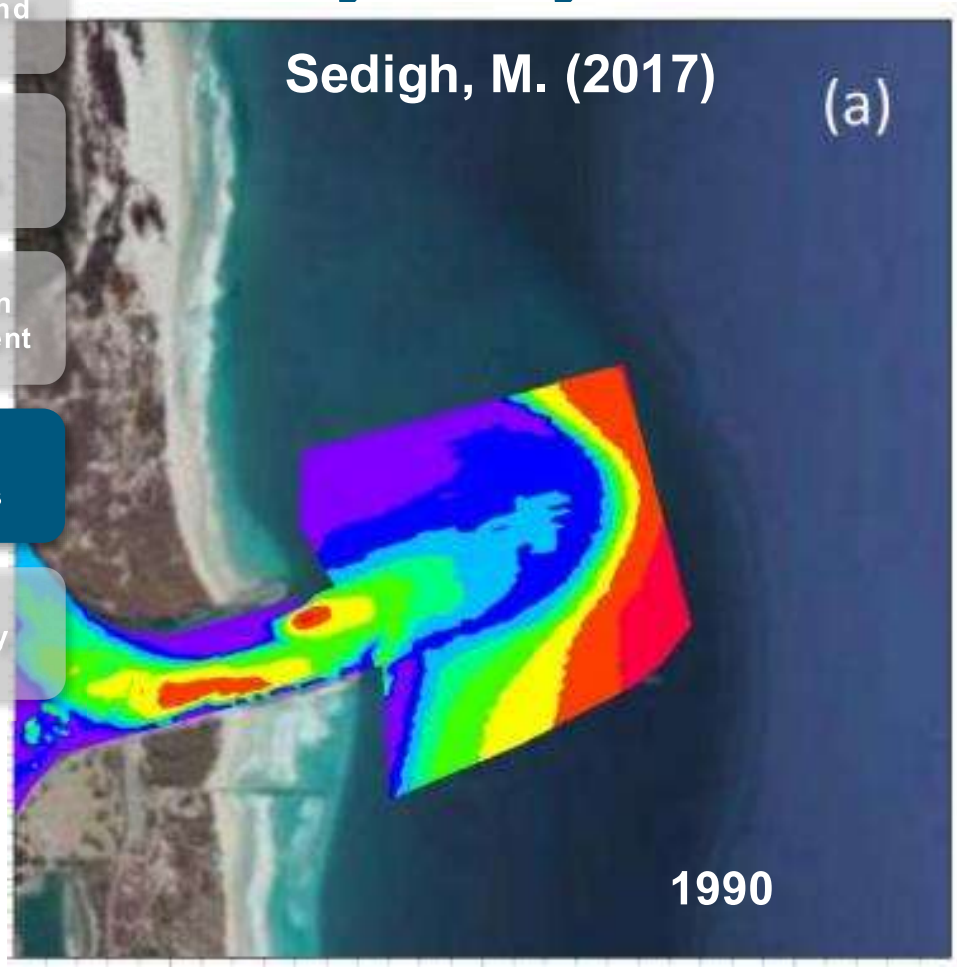
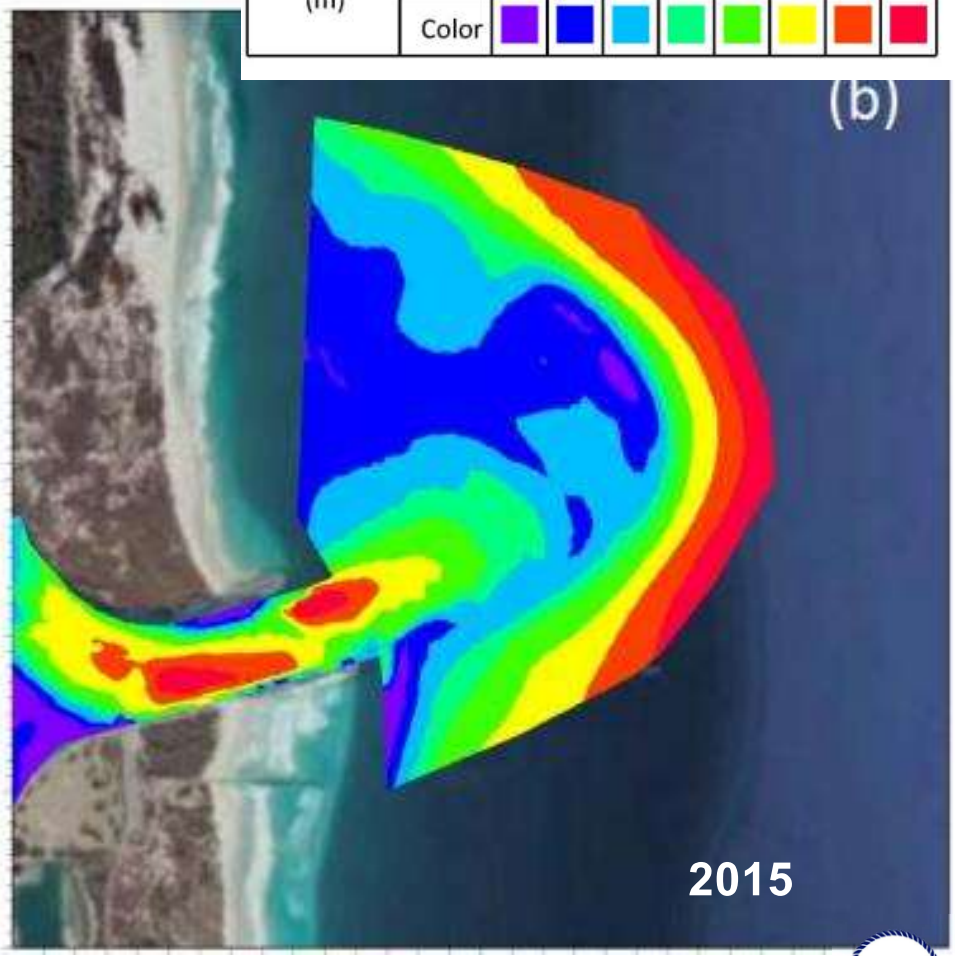
Survey Analysis





Bed level (m)									
	Min	-6	-7	-8	-9	-11	-14	-17	-30
	Max	-1	-6	-7	-8	-9	-11	-14	-17
	Color								

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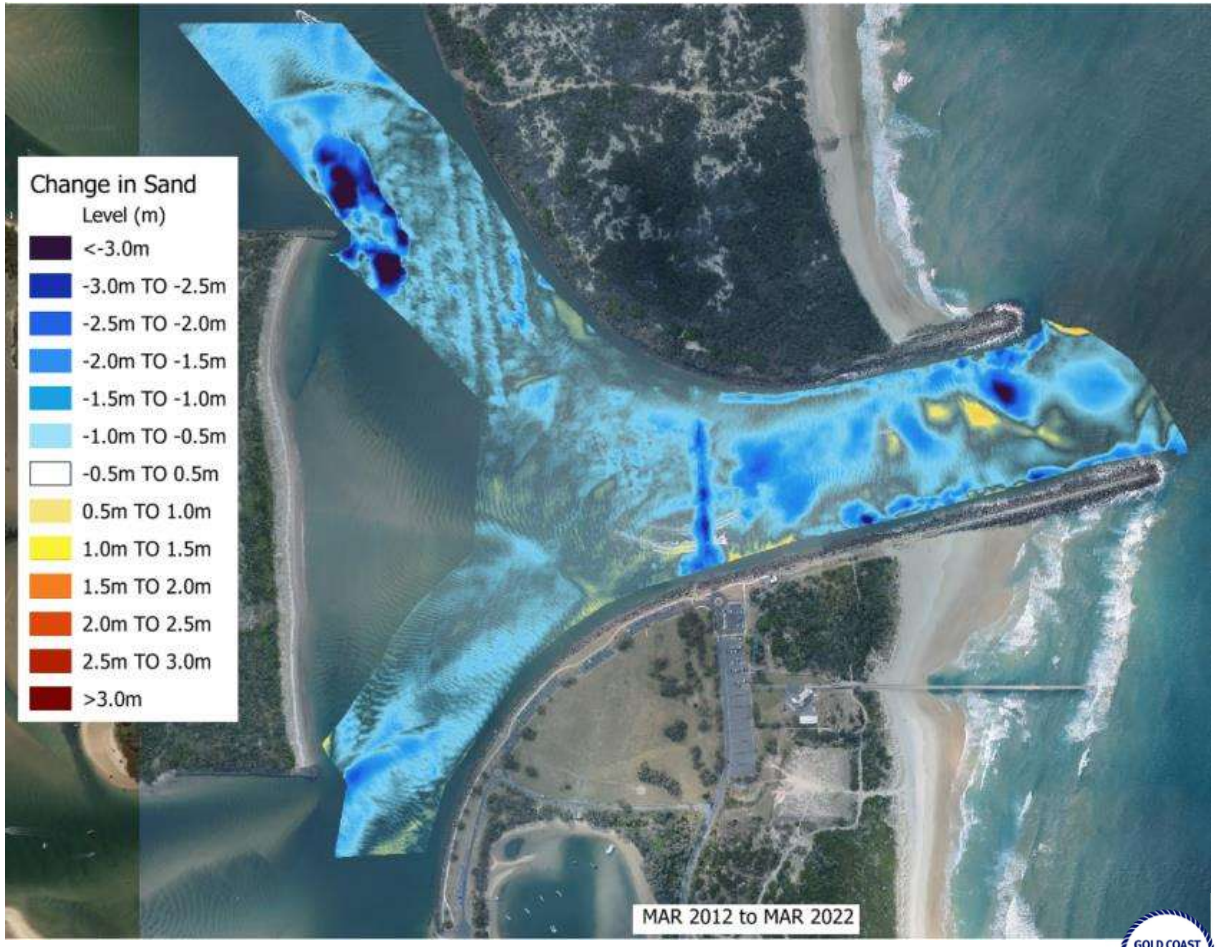
Survey Assessment

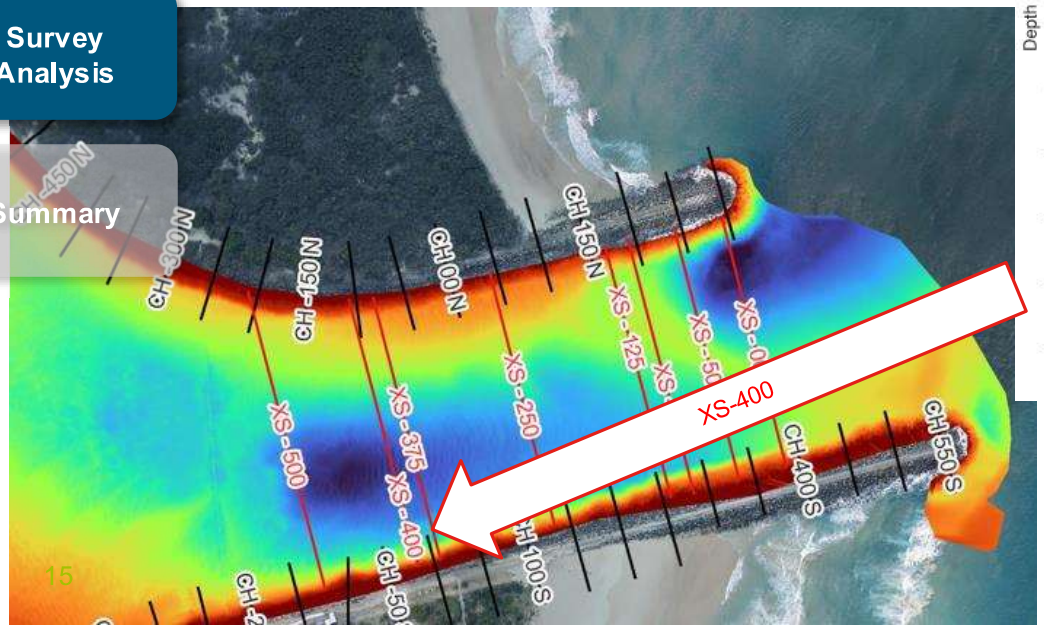
Analysis of survey (2012 – 2022):

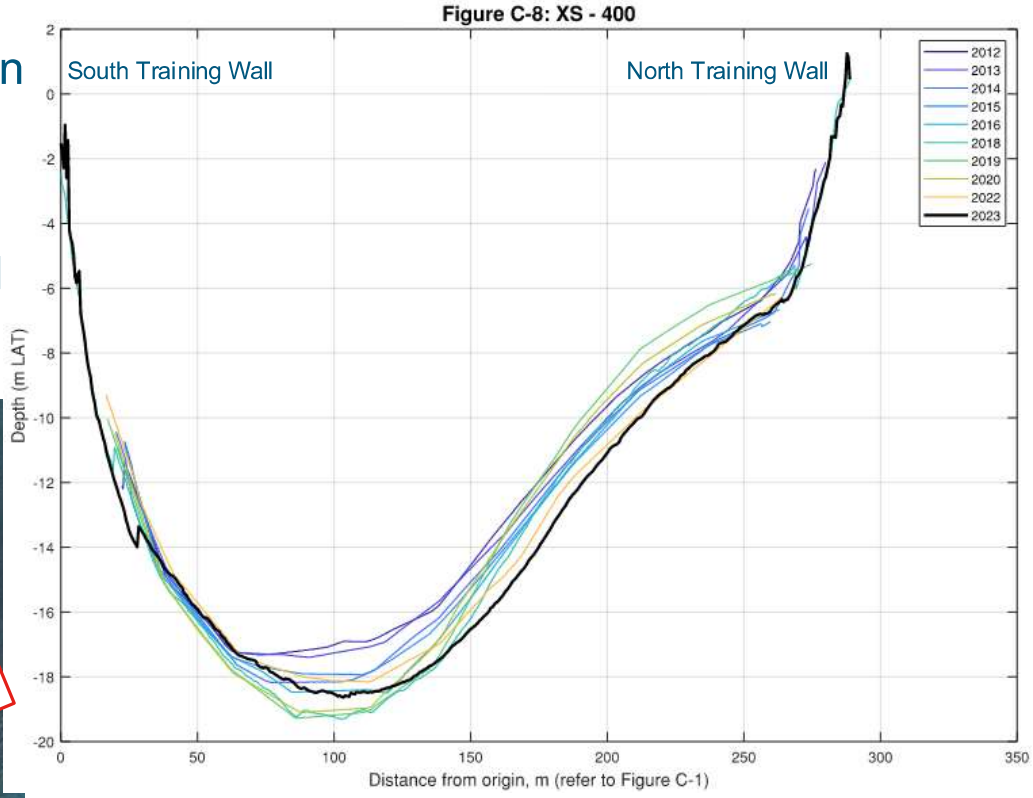
- Scour at head of WBI northern breakwater has deepened and expanded
- Scour within the Seaway been relatively stable
- Slight changes to the scour at the head of the northern training wall



Southern Training Wall

- Scour is continuing to slowly deepen and expand
- Currently -18m CD (1.5m/yr over 11 years)





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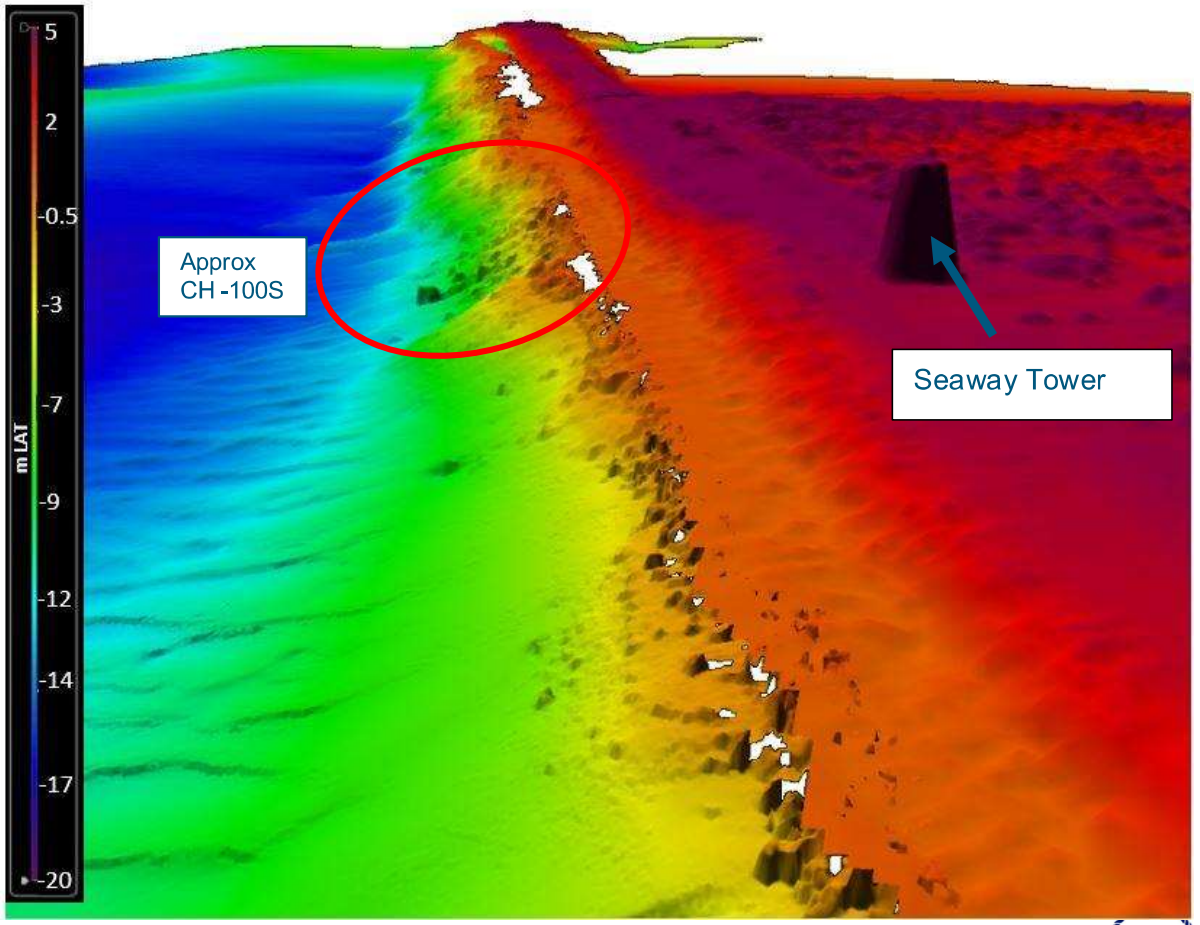
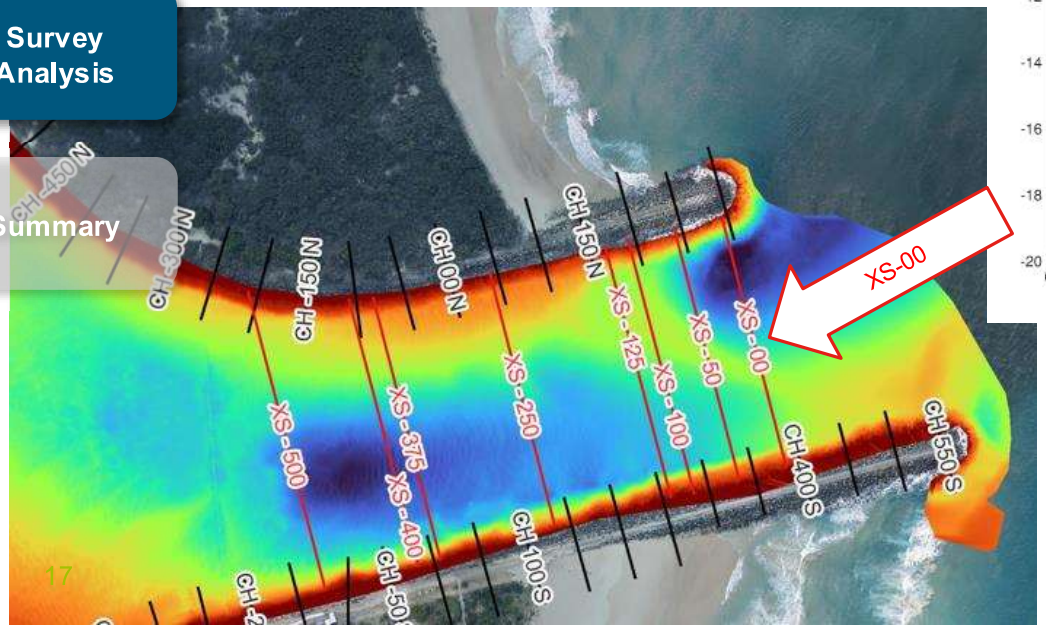
Southern Training Wall

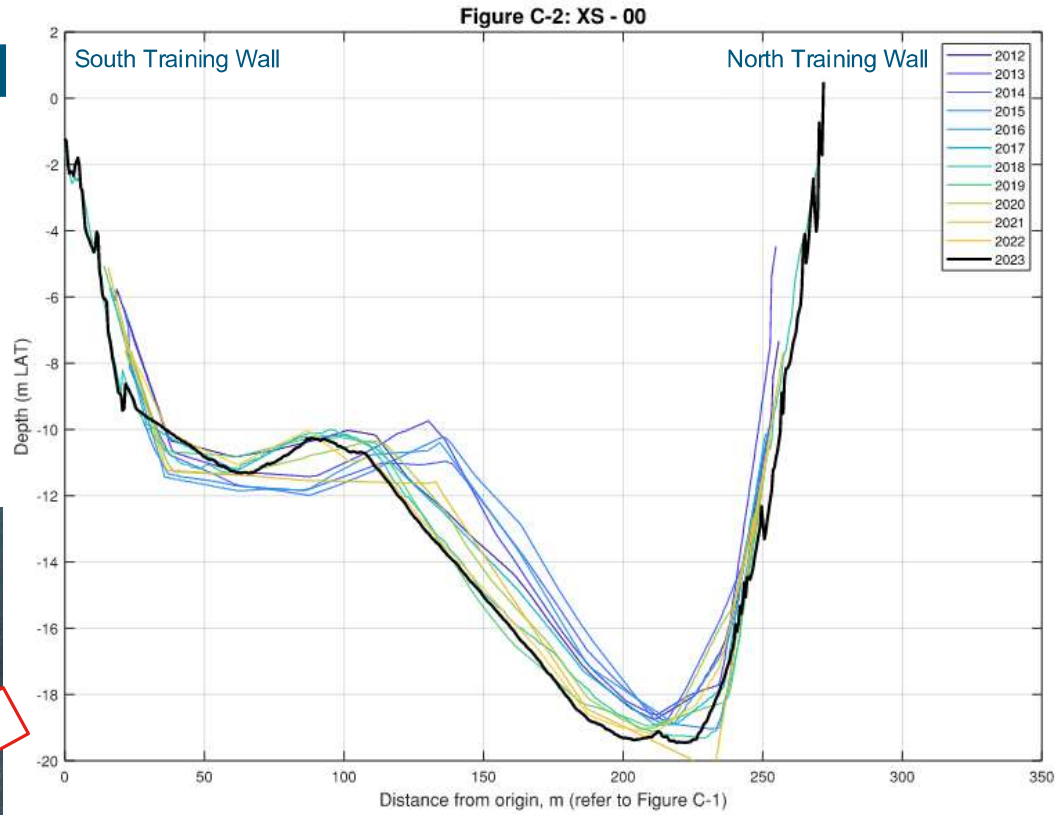
- Deterioration between CH100S and CH-150S coincides with reduction in the design armour mass
- The toe berm is linear and relatively level along the length of the structure
- Scour at the toe of the training wall is expected to lead to reshaping /slumping of the toe berm



Northern Training Wall

- Scour is slowly expanding
- Currently -19m AHD





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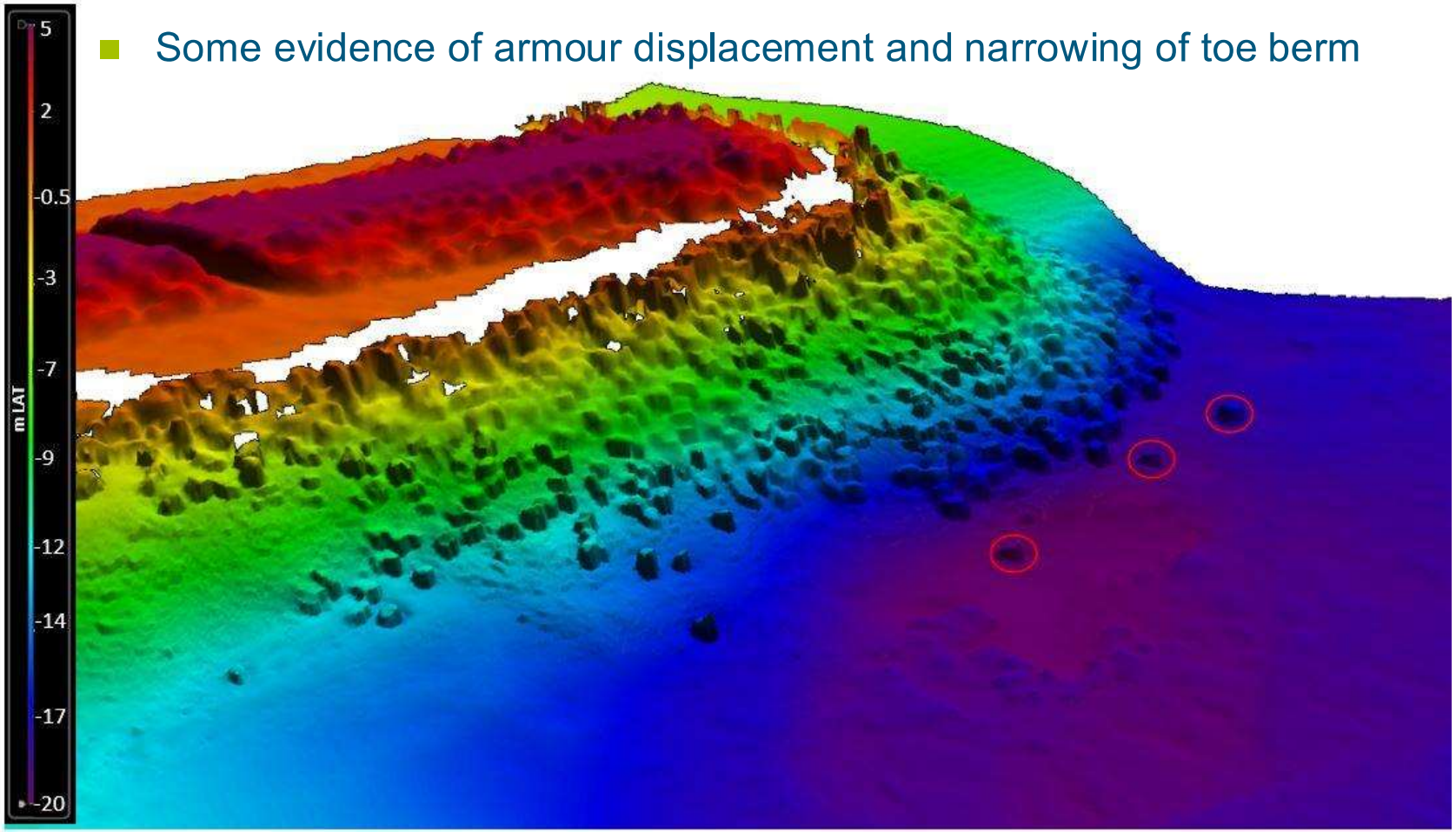
Northern Training Wall

- Some evidence of armour displacement and narrowing of toe berm



Conclusions

- Design drawings indicated that:
  - Seaway channel was dredged to -6m AHD
  - Training Wall appears to be founded at approximately -6m AHD
  - Channel was designed to scour to approximately -10m AHD
- Scour depths within the channel vary from -6m AHD to -19m AHD
- Scour to -19m AHD near the head of the northern Training Wall has occurred:
  - with narrowing of the toe berm and rock armour observed.
- At the southern training wall:
  - the scour hole Coincides with reduction in design armour mass from 8t to 5t
  - The toe berm is linear and level

Recommendations

- Overall, the design of the Seaway Training Walls represents a robust design, and the toe berm (where present) is reshaping in response to scour as expected
- In response to sea level rise, it may be necessary to raise the crest of the training walls (as overtopping and grass burn is currently observed).
- Additional monitoring and investigations are recommended, including slope stability analysis through the Wave Break Island north training wall.
- Biannual monitoring reports to be undertaken with quarterly hydrographic survey.