Cowes East Foreshore Erosion Protection, Rose Avenue to Coghlan Road – Functional Design Report

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Synopsis: This report documents the functional design for foreshore erosion protection of Cowes East between Rose Av and Coghlan Rd, completed by BMT for Bass Coast Shire Council

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1 Introduction

Cowes East Beach, on the north-eastern side of Phillip Island experiences large fluctuations in beach width and suffers from episodic coastal erosion which can threaten public assets. There is a long history of foreshore protection structures along this coastline, many of the existing structures are well past the end of their design life and have deteriorated to the point where they are no longer effective and even pose safety hazard to the public.

The Victorian Department of Environment Land Water and Planning (DELWP) and Bass Coast Shire Council (Council) are progressively upgrading the foreshore protection along this coastline to improve beach amenity and protect assets. As part of this process Bass Coast Shire Council engaged BMT to undertake a functional design for foreshore erosion protection works at Cowes East foreshore between Rose Ave and Coghlan Rd.

1.1 Project Objectives and Scope

There are many possible foreshore protection options that have been canvassed by Council, DELWP, previous studies by consultants and the community. The objectives of this study are to review the options, recommend a suitable approach and develop concept/functional design plans for works to protect public land and beach amenity from coastal erosion within the study area.

The recommended approach is documented in a concept plan which will allow Council to seek tenders for detailed design services.

As per the brief, options considered include:

- Replacement or removal of existing structures
- Wet sand fencing
- Beach nourishment and scraping
- Timber groynes
- Rock revetment.

1.2 Study Area

The focus of this project is the 450m of coastline from Rose Ave to Coghlan Rd in Cowes East. For the purpose of context and the analysis of coastal processes, the study also considers the broader geomorphologic unit within which the study area sits: this is Cowes East Beach, formed by a sandy spit extending from Erehwon Point in Cowes about 5.5 km eastward to Observation Point, as shown in Figure 1-1.

Figure 1-1 Study Area

1.3 Previous Studies

Five previous studies of coastal processes and erosion on the north coast of Phillip Island have been identified and drawn upon to inform this report, as described below. These studies all recommend or support some combination of beach nourishment, groynes and seawalls for erosion protection at Cowes East Beach.

1.3.1 The Problem of Beach Erosion on the North Coast of Phillip Island, Phillip Island Conservation Society with Eric Bird, 1987 (PICS 1987)

This extensive study covered the entire north coast of Phillip Island and provided information on geomorphology, coastal processes and the history of erosion and erosion management practices and structures along the coast. A number of options for erosion protection at Cowes East were considered, including:

(a) Maintenance and extension of sea walls, bounder ramparts and groynes on eroding sectors of the coastline

(b) Removal of present structures

(c) No further extension to structures until private property or public facilities are directly threatened

(d) Beach renourishment

(e) Construct offshore breakwaters

Option D was recommended, noting that the sand on Cowes Bank is too fine for use in nourishment and sand would need to be sourced from elsewhere. The only suggested sand source was dredging of shipping channels. Options A and C were also considered feasible.

1.3.2 **Western Port Local Coastal Hazzard Assessment: Report 6(R06) – Review of Representative Locations**, Report for Melbourne Water, Water Technology, 2014 (WT 2014)

The Local Coastal Hazard Assessment involved a detailed assessment of coastal processes throughout Westernport. The Cowes East area (Erehwon Pt to Observation Pt) was selected as a representative area for erosion and inundation hazard mapping, considering current conditions and the impacts of climate change. No specific recommendations for managing coastal erosion were provided.

1.3.3 **Cowes Beach Renourishment Coastal Report**, Atkins Maritime Engineering Report for Bass Coast Shire Council, July 2016 (AME 2016)

Detailed study of the feasibility of nourishing Cowes Main Beach (west of Jetty) using sand from Anderson Road boat ramp.

1.3.4 **Coastal Erosion Management Options – Cowes Main Beach Foreshore Reserve**, Water Technology report for Bass Coast Shire Council, April 2018 (WT 2018a)

Recommended sand nourishment for Cowes Main Beach using sand from Andersons Rd boat ramp as per AME 2016 - this has now been successfully implemented.

1.3.5 **Cowes East Foreshore: Erosion Management Options**, Water Technology Report for Bass Coast Shire Council, August 2018 (WT 2018b)

This study considered the area from Erehwon Pt to Observation Point, providing information on coastal processes and the recent history of erosion. Litpak modelling was used to predict the potential along-shore sediment transport rate at 12,000 m^3/yr to the east on the beach and 40,000 m^3/yr to the east on the outer bank. Multiple erosion protection options were reviewed; nourishment, seawalls and groynes were all recommended for further consideration.

2 Site Investigations

2.1 Survey

An unmanned aerial vehicle (UAV or drone) was used to conduct a photogrammetric survey of the beach and foreshore on 30 March 2020. Deliverables from this survey (shown in Figure 2-1) were:

- Digital Elevation Model (DEM) of study area including beach and nearshore area.
- High-resolution orthorectified air photo.

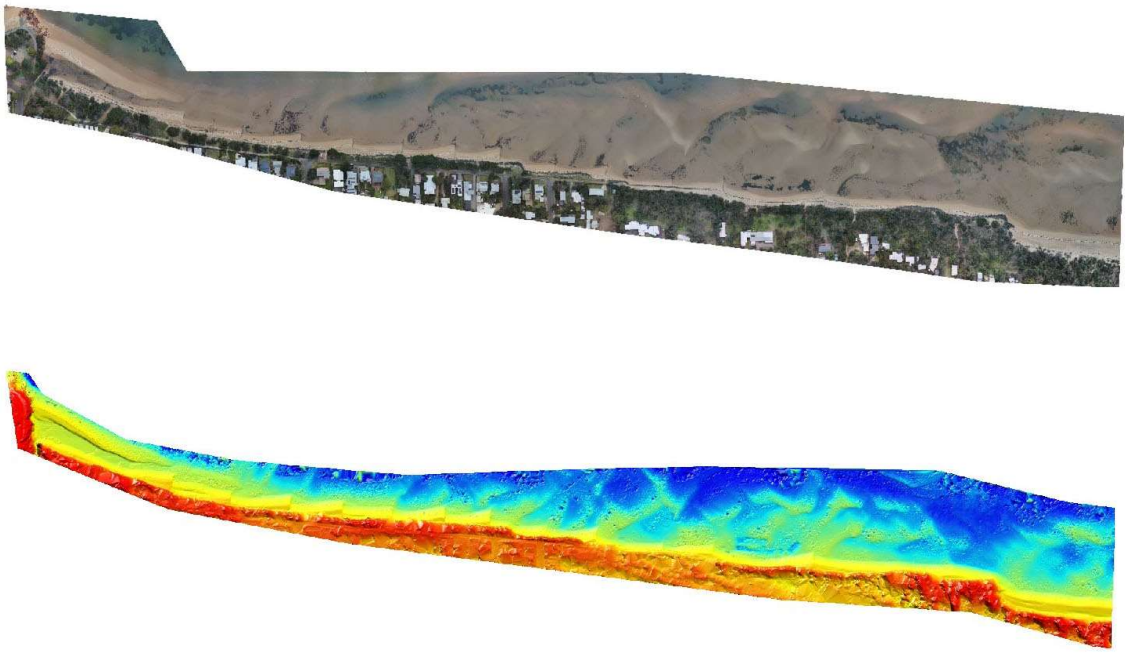


Figure 2-1 Orthophoto and Digital Elevation Model from UAV photogrammetric survey 30/3/2020

2.2 Site Visit and Sand Sampling

A site visit and visual inspection was conducted on 31 March 2020 (refer to section 0 for notes of existing structures). Sand samples collected for particle size distribution (PSD) analysis in order to inform recommendations on beach nourishment. Four samples from Cowes East foreshore were collected as shown on Figure 2-2 below, three of these at the high tide line of the beach and one on the low-tide flats of Cowes Bank. One sample was also collected from a potential sand source for nourishment: the intertidal beach east of Anderson Rd boat ramp (1.8km west of site).

Results of PSD testing are shown in Figure 2-3. On this plot the horizontal axis is particle diameter or sieve size, in mm, on a logarithmic scale. The vertical axis is the % of the sample passing through a seize of a given size. For example the A1 sample had 85% pass through he 0.6mm sieve, meaning

the at 15% is coarser than 0.6mm and 85% is finer. Soil classifications according to the wentworth scale (fine, medium and coarse sand) are also shown along the horizontal axis.

The four samples from Cowes East (beach and bank, C1 to C4) were all medium-fine sand with a D_{50} of approximately 0.3mm. The Sand from Anderson St Boat Ramp (A1) was medium-coarse sand with a D_{50} of 0.45mm, confirming this could be a potential source of sand for nourishment from the grain size perspective.

Figure 2-2 Sand sampling locations from Cowes East Beach

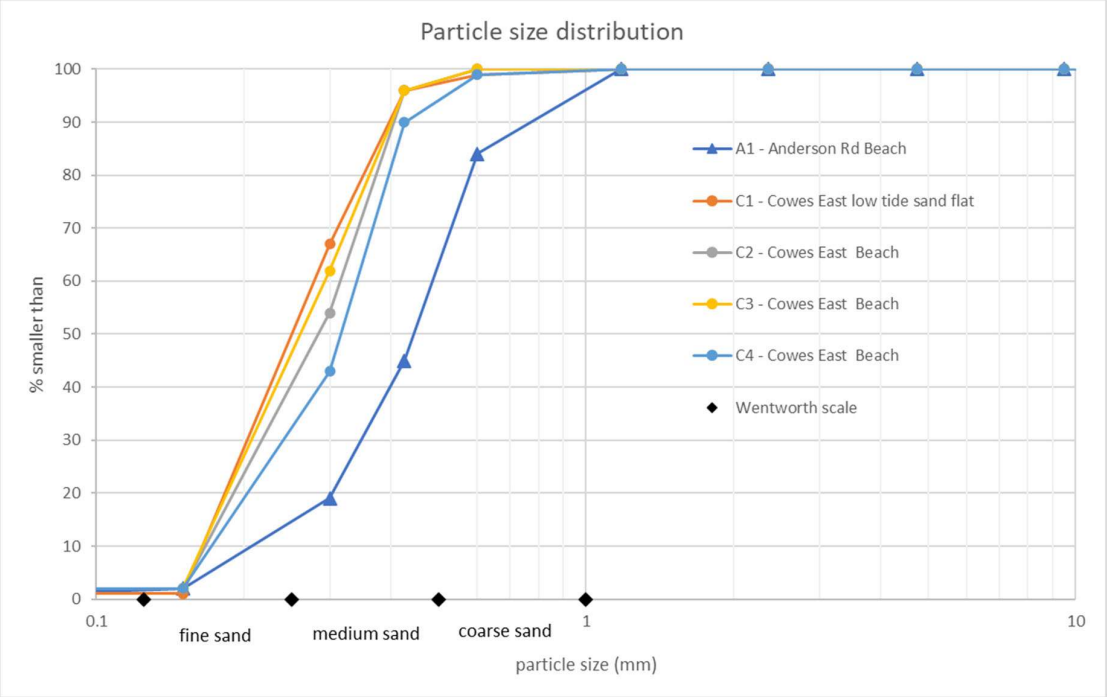


Figure 2-3 Particle size distribution results

3 Coastal Processes

3.1 Site Description

The north coast of Phillip Island from Erehwon Pt to Observation point is a sand spit built up since the Holocene marine transgression (i.e. in the last 6,000 years since sea levels stabilized) by east-moving sand transported in from Bass Strait and along the north coast of the Island by wave and wind action (Bird 1993, WT 2014).

A major feature of this coast is Cowes Bank, a 400m wide and 5km long shallow area, exposed at low tide. The origins and internal structure of the bank are unknown, but the surface consists of a series of undulating bars and troughs made up of medium-fine sand.

The beach in the study area is relatively narrow and steep, as shown in Figure 3-1. The beach face rises from approximately 0m AHD to the dune crest or rock wall crest at 2.5m to 4.0m AHD. There is no high-tide berm (flat area above high tide line) evident at the time the survey was taken.

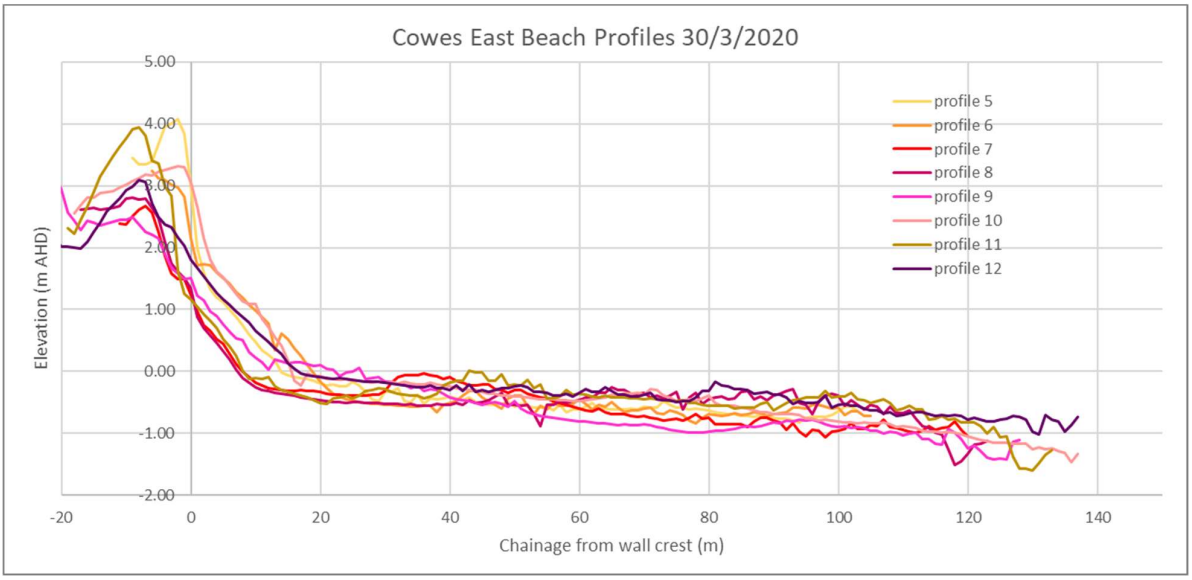


Figure 3-1 Beach Profiles in study area (approx. 50m spacing between Rose Ave and Coghlan Rd)

3.2 Wind, Waves and Water Levels

The wind climate, wave climate and water levels are described in detail in WT (2014) and WT (2018b); a summary is provided here.

- Wind waves are greatest in autumn and winter when strong winds from the north and north-north-west generate wave up to 1m (offshore of Cowes Bank).
- During summer a larger portion of the waves are generated by light north to north-easterly winds.
- Greater than 80% of the time the wave climate is calm due to light winds or offshore winds.

- The more persistent and larger north-north-west waves in winter drive the net along-shore transport to the east.
- The influence of swell wave east of Erehwon Pt is negligible.

Water levels at the site are driven by astronomical tides and storm surge and water level variation in Bass Strait, as summarised in Table 3-1.

Table 3-1 Tidal and storm water levels

Astronomical Tide (Stoney Point)	Level, m AHD
Highest recorded	2.09
HAT	1.62
MHSW	1.15
MHWN	0.70
MSL	0
MLWN	-0.63
MLWS	-1.08
LAT and Chart Datum	-1.69
Storm Tide for Westernport	**Level, m AHD**
1% AEP	2.20
10% AEP	1.62

Data sources: Vic tide tables 2015, Melbourne Water 2017, McInnes 2009.

3.3 Sediment Transport

3.3.1 Longshore Transport

The dominant mode of sediment transport is along-shore in a west to east direction driven by the local wind wave climate. Water Technology estimated the potential net transport rate at 12,000 m^3/yr to the east on the beach and 40,000 m^3/yr to the east on the outer edge of Cowes Bank. The actual rate of along-shore transport varies considerably with the amount of available sediment. A feature of this coast is the passage of sand lobes along the beach. These are large volumes of sand that enter the system around Erehwon Point then move along the beach over several years, or even decades. As the sand lobe moves past a section of coast it experiences a period of accretion followed by a period of erosion (WT 2018b).

The beach in the study area has been in an eroding cycle since about 2017, attributed to a reduction in sand supply around Erehwon Pt from the west. It is likely that construction of new groynes to the west in 2015 and 2018 have captured some of the along-shore transport and further reduced supply to the study area.

3.3.2 Cross-shore Transport

Significant cross-shore sediment transport also occurs, with sand eroded from the beach during periods of high waves and elevated water levels, to be deposited on the inshore surface of Cowes

Bank. When the beach is depleted by this process the backshore is exposed to greater wave attach and erosion.

During periods of smaller waves this sand is reworked and moved back onto the beach. It is a cyclical process and there is no evidence of long term changes to the elevation of Cowes Bank or the loss of sediment offshore.

3.4 Climate Change

The Cowes East area is very low-lying, as such the study area is vulnerable to increasing coastal hazard due to sea level rise. The Local Coastal Hazard Assessment by Water Technology (2014) mapped inundation and erosion hazards for Cowes East and Silverleaves for the current time and sea level rise of 0.2, 0.5 and 0.8m. Figure 3-2 shows predictions of sea level rise for the broader Bass Coast region for different emission scenarios.

the WT 2014 mapping indicates that some low-lying backshore areas within the study area would be at risk of inundation in a 1% AEP event with a sea level rise of 0.5m due to flooding from Rhyll Inlet. This my occur from about 2070 onwards. Rising saline groundwater may also cause impacts around this time.

Climate change may also impact on wind, wave and sediment transport patterns. Water Technology (2014) concluded that the sandy spit forming the study area was highly dynamic and its response to climate change could not be predicted. As such all land within approximately 100m of the beach was mapped as at risk of erosion by 2100.

While this area is vulnerable to sea level rise, major impacts driving changes or land use are not likely to occur until well past 2070, provided appropriate foreshore protection measures are implemented.

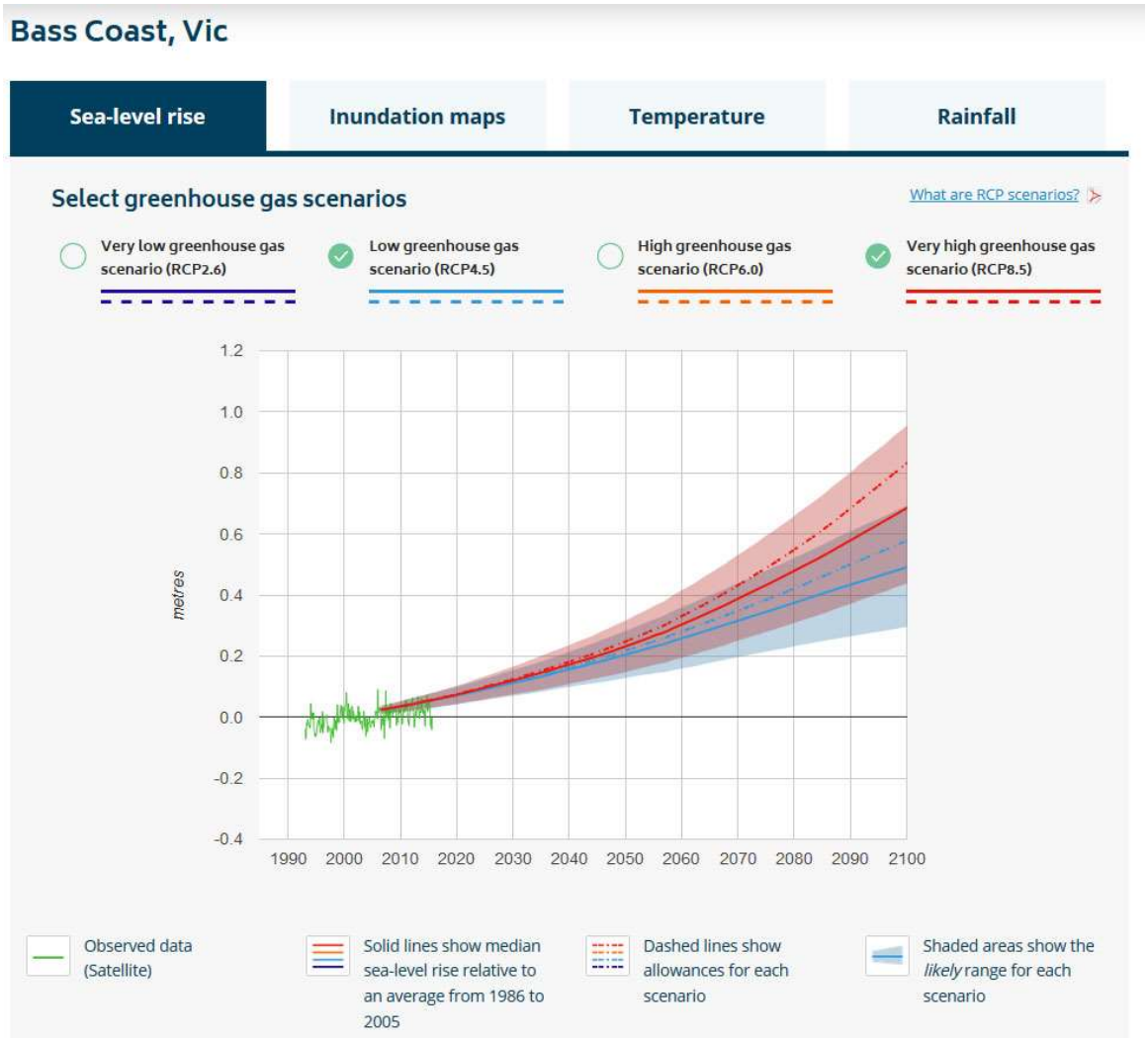


Figure 3-2 Sea Level Rise predictions for Bass Coast, from CoastAdapt

3.5 History of Coastal Protection and Management

The shoreline east of Erehwon Point has a history of cyclical erosion and accretion, with cycles lasting several years or decades. Overall, the trend has been towards erosion (shoreline recession) and coastal protection works have been implemented over the years, starting at the western end of the beach in 1947 and moving westward as far as Sanders Rd. Table 3-2 gives a timeline of erosion and protection works for Cowes East foreshore based on literature review and consultation. Locations of current existing structures are shown on Drawing 001 in Appendix A.

Table 3-2 History of Erosion and Protection Works

Date	Erosion and Protection Works	Source
1947	Commenced construction Groynes and revetment from Erehwon Pt to Dunsmore Rd	PICS 1987
Shortly after 1947	Groynes and revetment extended from Dunsmore to Rose Av	PICS 1987
Unknown	8 Groynes constructed from Rose Ave to Sanders Rd (groynes from Coghlan Rd to Sanders Rd were removed in the 60s or 70s)	WT 2018b
Unknown	Erosion cut into Lovers Walk (beach front road reserve) and private property east of Rose Av	PICS 1987
1969 and 1975	Timber seawall between Rose Ave and Coghlan Rd built in two stages (PICS 1987) (WT 2018b give the date as 1940s)	PICS 1987
Unknown	Erosion behind timber walls	PICS 1987
1976	Beach scraping to form beach in front of timber wall, washed away within 6 months	PICS 1987
1977	Rock revetment from east of Coghlan Rd	PICS 1987
1986	Beach scraping to form beach in front of timber wall	PICS 1987
2015 (between 17/5 and 28/10)	Three new groynes constructed at Dunsmore Rd, cost $150k	WT 2018b Pers. comm. BCSC
10 May 2016	Storm erosion waves washing over wall at Dunsmore Rd	Photo provided by CEFPAG
2018 (between 25/11/17 and 24/8/18)	Four new groynes constructed, 3 between Dunsmore and Rose Ave, 1 west of Dunsmore Ave, cost $187k	WT 2018b Pers. comm. BCSC
15 June 2018	Storms cause significant erosion Rose to Coghlan at timber wall and behind.	WT 2018b
August 2018	Beach scraping to provide sacrificial sand as erosion protection Rose Av to Coghlan Rd commences	Pers. comm. BCSC
	Beach scraping Rose to Coghlan continues throughout 2018, 2019 and 2020 winter seasons. Typically 2 to 3 times per year	Pers. comm. BCSC
27 Feb 2020	Beach scraping underway between Rose and Coghlan to repair erosion behind wall.	Pers. comm. BCSC
10-12 April 2020	Easter storm, erosion all along Cows East Beach	Pers. comm. BCSC/CEFPAG
5 May 2020	Beach scraping between Rose Ave and Coghlan Rd to replace sacrificial sand along and behind wall	Pers. comm. BCSC and
15 May 2020	High tides and onshore winds have eroded most of the sand placed along timber wall last week	Pers. comm. CEFPAG

'BCSC' is Bass Coast Shire Council, 'CEFPAG' is Cowes East Foreshore Protection Action Group

4 Condition of Existing Erosion Protection Structures in Study Area

Detailed condition assessment of the existing structures has not been carried out, but general observations or condition and effectiveness have been made in this report based on literature review and visual inspection during site visits, in Figure 4-1 to Figure 4-7.

The timber seawalls and groynes in the study area (Rose Ave to Coghlan Rd) are thought to date from 1975 or earlier and are in poor to very poor condition, providing limited erosion protection.

The rock seawalls in the study area are considered to be reasonably effective although they do not meet modern design standards. Issues identified on the rock seawalls include dislodged armour rocks on the beach and a variable crest height that in places are impacted by wave overtopping. It is expected that these issues will be exacerbated by sea level rise.

Figure 4-1 Existing structures in study area

Figure 4-2 Groyne No 14 at Rose Ave. Condition is poor but it is still partially effective

Figure 4-3 Rock wall looking east from Rose Ave, condition fair and reasonably effective

Figure 4-4 Groyne No 15 west of Rose Ave and the Scotch College ramp. The Groyne is in poor condition but still partially effective

Figure 4-5 Groyne No 16 and 17, and timber seawall, all in very poor condition and of very limited effectiveness

Figure 4-6 Groyne No 18 and eastern end of timber seawall, both are in very poor condition and providing very little erosion protection

Figure 4-7 Rock wall and pedestrian access path at Coghlan Rd. Condition of this section of rock wall is fair and reasonably effective

5 Review of New Groynes West of Study Area

DELWP has constructed seven new timber groynes at Cowes East Beach since 2015, immediately to the west of the current study area. Conditions are very similar along the beach, therefore, the performance of these new groynes provides an indication of how similar groynes will perform in the study area.

The groynes were built in two tranches:

- Three around Dunsmore Rd in 2015 (numbers 7, 9 and 10; refer to Drawing 001 in Appendix A);
- Four more in 2018 – three between Dunsmore and Broughton Ave (numbers 11, 12, 13) and one to the west of Dunsmore Rd (number 5).

Each of these new timber groynes is built close to the location of a 1947 groyne and the remains of the old groynes were removed. New groynes are approximately 25m long and start just seaward of the rock wall. A typical example is shown in Figure 5-1.

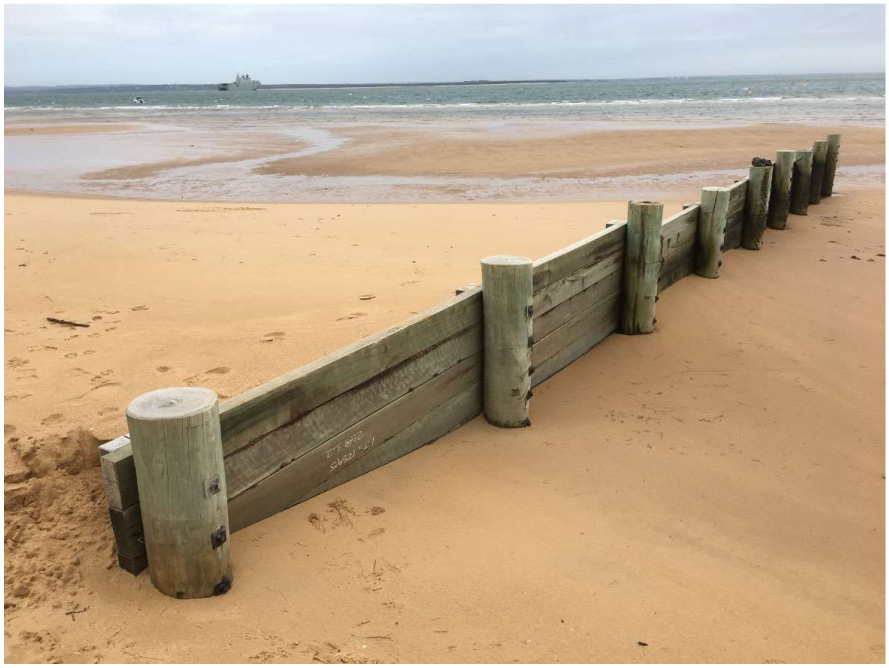


Figure 5-1 Groyne no 13 at Broughton Ave west of Rose Av, built 2018

5.1 Performance

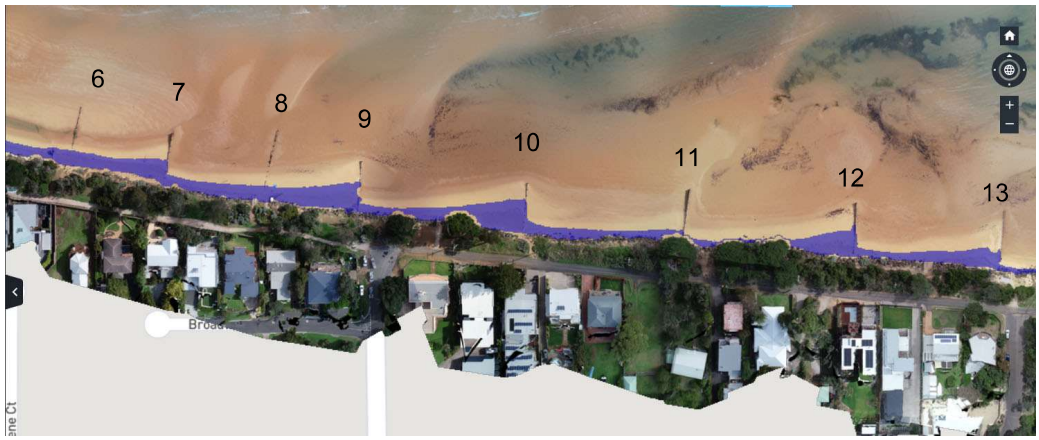
The objectives of installing groynes is to capture longshore drift (sand moving along the coast) and build a higher and wider beach, thus increasing beach amenity. The wider beach in turn can provide a buffer against storm erosion.

5.1.1 Have the new groynes created a wider beach?

Aerial survey data collected as part of the Victorina Coastal Monitoring Program (VCMP 2020) was analysed to understand the impact of the new groynes on beach width. The VCMP has 12 data sets for Cowes East Beach collected between 24/8/2018 and 28/2/2020, which are available through the

propeller website. Note that the VCMP data has not been quality checked and a longer record is required to draw firm conclusions.

Figure 5-2 shows (highlighted in purple) the beach area above 1.2m AHD (high tide) for the new groynes around Dunsmore Rd and for the study area between Rose Ave and Coghlan Rd. Asymmetrical beaches have formed in the compartments between the new groynes (number 7, 9, 10, 11,12, 13), 0 to 5 m wide on the western side of the compartment (eastward of the groynes) and 10 to 15m wide on the eastern side of the compartment (westward of the groynes). In comparison, within the study area (between groynes number 14 to 18) the usable beach above high tide is generally less than 5m wide, noting that much of the purple area shown is actually behind the wooden seawall, which is not ideal for recreation.



Dunsmore Rd to Broughton Av

Rose Ave to Coghlan Rd

Figure 5-2 Beach area above high tide (1.2m AHD) 28/2/2020. Data from VCMP

Figure 5-3 shows how the volume of sand in 3 groyne compartments changes over time (for the period of the VCMP data set, August 2018 to February 2020). Compartments 12-13 and 10-11 are between new groynes. In contrast, Compartment 16-17 is between old and not very effective groynes

in the study area. The volume of sand between the new groynes fluctuates but appears to be steady, i.e. no temporal trends are evident; whereas the volume between the old groynes 16 and 17 appears to be on a downward trend. This indicates that the new groynes are being more effective at maintain sand volume on the beach.

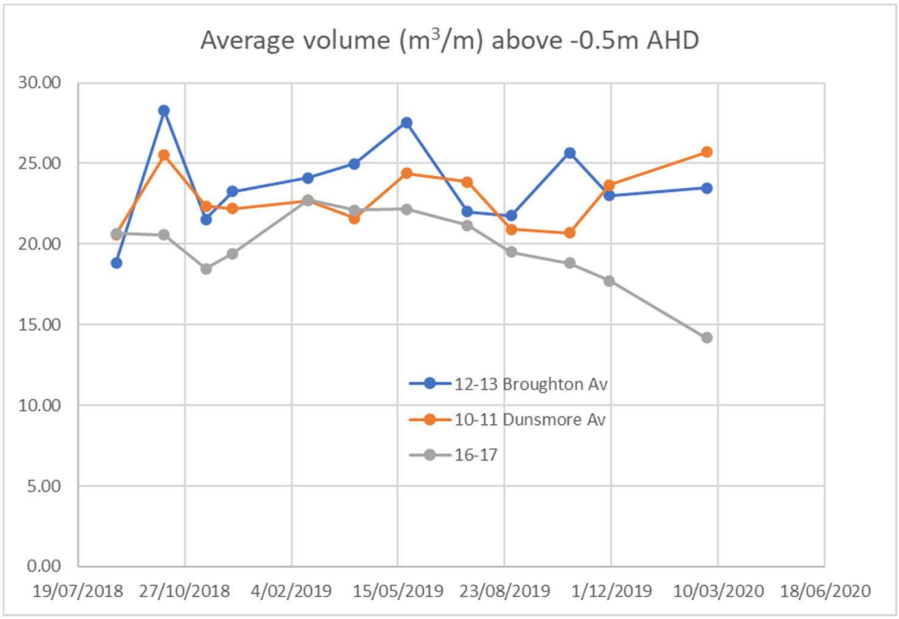


Figure 5-3 Sand volume in groyne compartments over time. Data from VCMP

Examination of more than 20 air photos since 2015 shows that large fluctuation in beach width occur all the way along Cowes East Beach. The area with new groynes however does seem to maintain more sand during episodes of erosion, which is preserved in small fillet beaches on west sides of the groynes.

Conclusion: Yes, the groynes create wider beaches, however they are not continuous along the shore and are still subject to large fluctuations.

5.1.2 Does the wider beach provide protection from storm erosion?

During a moderate erosion event, as has occurred several times already this year, the wave run-up level is estimated as high spring tide (1.1m) plus moderate wave run-up (0.5m) to give a level of 1.6m AHD. Figure 5-4 shows the area of beach above this level (highlighted in pink, in the area of new groynes from Dunsmore Rd to Broughton Ave. The protection offered by the beach is very patchy, in some compartments there is no beach above wave run-up level at all (i.e. the purple area on the map is on top of the rock wall).

During storm events the beach can be rapidly lowered as sand is eroded and moved offshore, thereby reducing the protection afforded by the beach. Figure 5-5 shows waves directly impacting the rock seawall at Dunsmore Rd during a storm in June 2018. The top of the new groynes are just visible, indicating the water level is approximately 1.6m AHD, and no beach is visible. There are anecdotal reports of this occurring several times since 2018.

Conclusion: The beach formed by the new groynes provides only limited protection to the foreshore during minor erosion events. During major erosion events (occurring once or twice per year) the beach is eroded and no protection is provided.

Figure 5-4 Beach area above typical wave runup level (1.6m AHD) 28/2/2020. Data from VCMP

Figure 5-5 Waves impacting rock wall at high tide15/6/2018. Looking west from Dunsmore Rd over new groynes numbers 9, 7 and 5 (Photo from CEFPAG)

5.2 Other Issues

5.2.1 Groyne Length and Spacing

The beach within the groyne compartments has a typical 'full' profile and plan-form that is repeated along the beach, as shown in Figure 5-6 and Figure 5-7. The toe of the beach face is at a level of -0.5 to 0m AHD and the top of the beach face 15-20m further landward is at a level of approximately 1.6m AHD.

The beach plan-form remains more or less the same (except after erosion events) but the position of the beach face is controlled by the outer end of the groyne on the down-drift (east) side of the compartment (when there is sufficient sediment available to fill the compartment). Hence, the width of the beach can be increased by moving this control point, i.e. either by lengthening the groynes, or decreasing the groyne spacing. To create a 5 to 10m wide beach for the full length of the groyne compartments at Cowes East Beach (noting groynes are 70 to 90m apart) it is estimated that the groynes would need to be extended from 25 to 40m long.

- The gap analysis has found no 'show stoppers' for the project

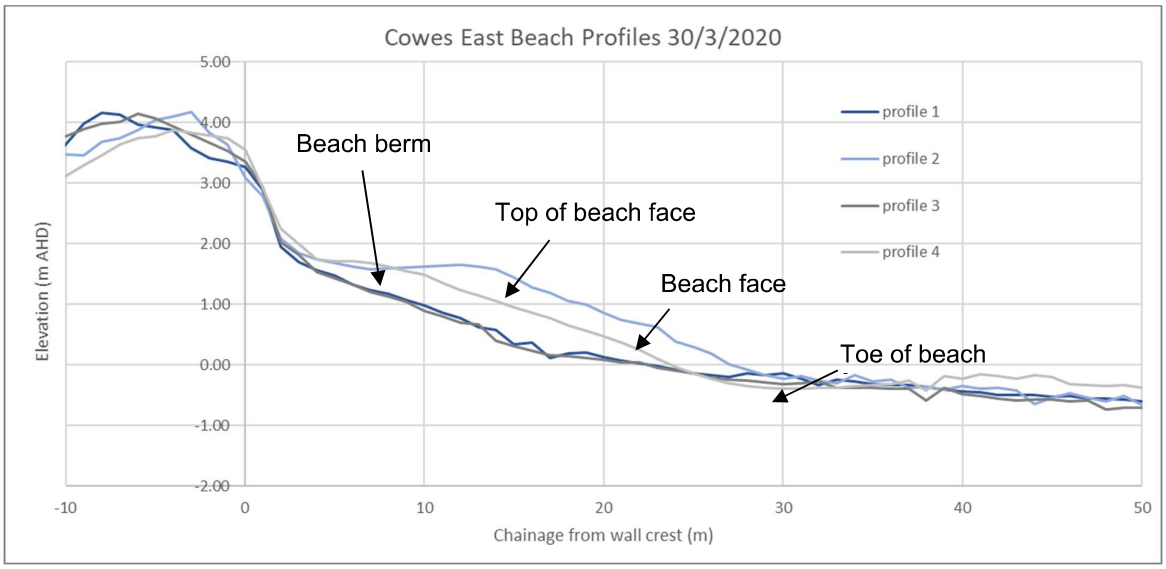


Figure 5-6 Beach profiles in new groyne field

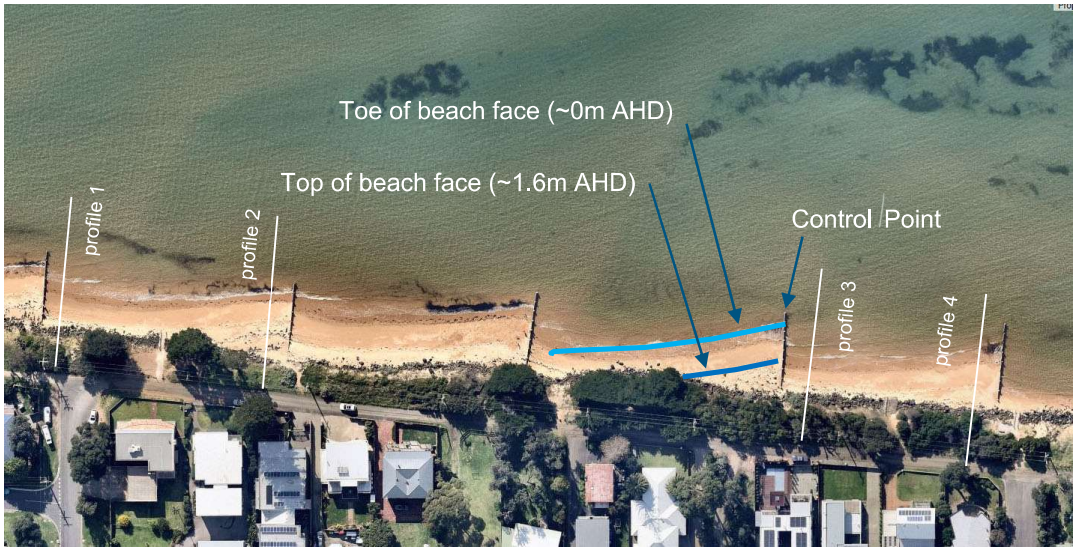


Figure 5-7 Typical beach shape between groynes, Dunsmore Rd to Broughton Ave 31/3/2020

5.2.2 Crest and Toe Levels

The crest and toe levels of the new groynes are not known precisely. Design drawings by AW Maritime (AWM 2018) give indicative levels 'to be confirmed on site', that do not seem to match what was constructed. Based on surrounding beach levels the existing crest level at the landward end is estimated at approximately 1.6 m AHD, and toes levels are the Seward end are estimated at approximately -0.5 to 0.5 AHD respectively.

The crest levels as built seem appropriate, generally matching the typical level of beach berms on natural profiles at other locations along the beach.

The toe levels however may be too high. The toe of the beach face can be as low as -0.5m AHD where it intersects a trough on the surface of Cowes Bank. If gaps exist or form in segments underneath the toe of the groyne (for example as shown in Figure 5-8) then the groyne is not as effective at trapping sand.

To maintain the effectiveness of the groynes it is necessary to replace any panels that are dislodged. A gap underneath will hamper sand capture and a gap on top will reduce the height of the formed beach.

Figure 5-8 Gaps under new groyne no. 13 (photo from CEFPAG, precise date not known)

6 Review of Beach Scraping

Erosion behind the timber seawall is currently managed via a program of ‘beach scraping’.

Beach scraping is the practice of taking sand from the lower part of the profile and moving it to the upper part of the profile to repair storm damage or provide a buffer against erosion. Not to be confused with ‘beach nourishment’, which is bringing in sand from another location to build up the profile (Carley and Cox 2017).

After an erosion event, Council uses a bulldozer and/or excavator to replace sand eroded behind the wall and place a sand buffer in front of the wall, using sand taken from the low tide sand flat of Cowes Bank nearby (Figure 6-1). The sand placed by beach scraping is considered by Council as "sacrificial sand" that provides short-term protection, and there is a requirement for further scraping when the sand is lost to erosion.

Figure 6-1 Beach Scraping underway after erosion events in 2018 (photos courtesy of BCSC)

The first recoded use of beach scaping at this site was in 1976 when it was used to form a beach in front of the timber seawall. PICS (1987) reported that the beach washed away within 6 months. The exercise was repeated in 1986 but the results are not known.

PICS (1987) suggested that beach scraping was ineffective because the sand on the surface of Cowes Bank had a smaller grain size (medium-fine) than the sand on the beach (medium-coarse). Sand of a smaller grain size is less stable and will typically erode quickly if used in beach nourishment.

Beach scraping was used again in 2018 to repair erosion behind the wall and it has been used two to three times per year since then, typically in winter. In 2020, scraping was required three times in the period February to May, but has not been required since.

Sediment sampling for this project (refer section 2.2) in March 2020 found a good match in grain size between the beach and the near-shore surface of the bank, both were medium-fine sand. This may be because most of the sand currently on the beach has actually been derived from Cowes Bank via recent beach scraping (yet, regular monitoring would be required to ascertain this).

Overall, the beach scraping program has been successful at limiting erosion to a zone of approximately 5m width behind the timber seawall. Without this intervention the erosion could have progressed much further.

Beach scraping is a practical short-term management measure for coastal erosion in the study area. However the foreshore is still vulnerable to further erosion from extreme events. It is also high-maintenance and it is concerning that the frequency of scraping seems to be increasing. This is likely to continue at least until the current erosion cycle reverses (may be years or decades).

7 Consultation

Targeted consultation was carried out with key community groups/stakeholders identified by Council to seek background information on the use and values of the area, the history of erosion and their views on the proposed foreshore protection works. Summary notes from the consultation conversations are provided in Appendix B.

Cowes East Foreshore Preventative Action Group (CEFPAG)

CEFPAG is a residents group formed in 2014 in response to concern about beach erosion from Erehwon Point to end of the Silverleaves estate. They expressed the view that upgraded coastal protection is needed to prevent further erosion of the dune area on public and private property. Initially they preferred groynes, wet sand fencing and dune revegetation for erosion control rather than a rock wall, but in later conversations in May, after more erosion recently observed, their view had changed and they thought a rock wall would be required, in combination with groynes.

Scotch College

Scotch College have a school camp fronting the foreshore to the east of Rose Ave. They have a small wooden ramp over the rock wall to provide access to the beach and to facilitate the launching of small boats. This ramp is also used as a pedestrian access point for the broader community, and a light vehicle access point by the Council. Scotch College would like the ramp to remain in place or be upgraded in the foreshore works.

Local Resident

A discussion was held with one local resident of Cowes East who uses an ‘all terrain’ wheelchair to access the beach via the Scotch College ramp (although the ramp does not meet all-abilities access standards). The resident expressed the view that the ramp to remain in place or be upgraded (extended) as part of the foreshore protection works.

8 Erosion Protection Options Assessment

8.1 Objectives and Assumptions

The primary objective of the erosion protection works, as defined in the brief, is to protect the public assets from coastal erosion. The assets to be protected include the beach, the coastal reserve and dune habitat, and public access to the foreshore and along the foreshore.

A secondary objective of the works is to improve beach amenity. After consultation with community groups and Council, the key objectives in relation to amenity are understood to be:

- Increase width of beach at high tide (currently no beach at high tide in much of the study area)
- Maintain or improve access to the beach for pedestrians at all current access points and for boat trailers at Scotch College ramp
- Consider allowance for a future along-shore walkway behind structures (design of this walkway is not within the scope of this project)
- Removal of old structures when no longer required once new measures are in place.

The design life for or assessment period for protection options is nominally 50 years.

8.2 Options

8.2.1 Do nothing – maintain current practice

With no intervention at all the full width of the public coastal reserve would be at significant risk from erosion at least until the current erosion cycle reverses, which may be several years or decades. Over time sea level rise will increase the risk. This outcome is considered unacceptable as erosion of the narrow strip of public reserve remaining above high tide level could cut public access to and along the foreshore.

With continued beach scraping as required, the erosion risk would be reduced but still present for severe storms. This would be a poor outcome for the coastal reserve, dune habitat and beach amenity.

8.2.2 Removal of existing structures

Removal of the existing structures (timber seawalls and groynes) without replacement would greatly increase the risk of erosion to public and private land and as such it is not considered an acceptable option.

8.2.3 Replacement of existing structures

Replacement of the existing dilapidated timber groynes and seawall with like-for-like would be an effective means of protecting the foreshore from further erosion. It would however be a poor outcome for amenity because the groynes are too short and too widely spaced to generate a large increase in beach area and the vertical timber wall would tend to lower the beach profile due to wave reflection.

8.2.4 Wet sand fencing

West Sand fencing is an experimental erosion control measure consisting of low, slatted, shore-parallel fences installed in the surf zone, as shown in Figure 8-1. The idea is that the fence is positioned at the top of the beach face where it slows the velocity of wave runup and thereby encourages deposition of sand and wrack.

This approach is unlikely to be effective at Cowes East. In any position seaward of the existing timber wall it would be submerged at high tide and have minimal impact on wave energy reaching the dunes.

The existing timber sea wall, which is slatted and deteriorating, is in many ways similar to a wet sand fence in that it is a permeable shore-parallel wall. It is positioned high on the beach face close to the eroding dune, yet it has not been effective in preventing erosion, although it may have mitigated the severity of erosion.

This option does not provide any amenity benefits and may present a hazard to beach users as it can be partially buried or undermined by fluctuating sand levels.

Figure 8-1 Wet sand fencing at Inverloch (from Bass Coast Shire Council)

8.2.5 Beach nourishment

Beach nourishment by itself is unlikely to be effective because in a longshore transport dominated environment, such as Cowes East Beach, the nourishment sand will be rapidly transported away to the east. If used in combination with groynes however it may be an effective approach.

In order to provide effective protection from storm erosion a wide and stable beach and dune are required, which in turn require large groynes and a high quantity of nourishment sand. Further analysis and/or modelling would be required to define the size of beach required to provide a specific level of protection, but based on the review of the new groyne performance to the west, it is estimated that nourishment of 35 m^3/m might be required. Protection of 300m of coast would require 4 groynes 40m long and approximately 10,000 m^3 of nourishment sand.

Nourishment is not a permanent solution and it may need to be repeated every 2 to 20 years, depending on the fluctuations in natural supply of sand to the beach.

Beach nourishment is more effective when the grain size of the nourishment material is equal or greater than the grain size of the native material on the beach. If the source sand is finer the nourishment material is lost very quickly. Sand removed from Anderson Road boat ramp has been tested for particle size and is significantly coarser than the sand at the site, making it an appropriate source for nourishment material.

Beach nourishment in combination with groynes should provide significant increase in beach amenity through a larger and wider beach and easier access (no wall to cross).

However, construction would have a negative social impact due to about 1,000 truck movements through Cowes required to cart the sand from Anderson Road boat ramp to the site.

8.2.6 Timber groynes

Timber groynes of the type, length and spacing of those built recently to the west, used in isolation, should increase beach width, at least close to the groynes, but provide only limited erosion protection (refer to section 5).

Groynes used with a rock revetment would be effective and would mitigate the negative amenity impacts of the revetment, as described below.

Much larger groynes in combination with the beach nourishment could be effective as described in the section above.

8.2.7 Rock revetment

Rock revetments are a proven, robust and long-lasting coastal protection solution and should be effective in this location.

A rock revetment by itself would however have a negative impact on beach amenity by reducing beach level in front of the revetment as reflected waves initiate scour. It is likely that there would be no high tide beach in front of the revetment much of the time, at least while the current erosion cycle continues. Revetments also present a barrier to beach access and dedicated access structures may need to be included. Truck movements for delivery of armour rock would also have temporary negative impact on the community.

Negative impacts of the revetment can be mitigated by installation of groynes and/or beach nourishment. Groynes would trap sediment and raise the beach profile, increasing high tide beach area and making access easier (smaller difference in level across the revetment). Note the length of groynes and quantity of nourishment required is less than for the groynes and nourishment options described above.

8.3 Assessment of Options

A qualitative, multi-criteria assessment of the options has been performed by BMT based on our knowledge of the site and experience with these options at many other locations, as shown in Table 8-1. The criteria used in the assessment are:

- Erosion Protection – effectiveness of the option for erosion protection
- Amenity – impact on beach amenity and amenity of surrounding residents
- Cost – relative cost to implement and maintain.

No environmental criteria are included because (without further assessment) there is no clear difference in environmental impacts of the options. The only major identified social impact are the truck movements associated with transport of sand for beach nourishment or rocks for revetment

construction, and this has been factored into the amenity score. Criteria are scored on a 5 point, qualitative scale as follows:

Strongly positive	✓✓
Positive	✓
Neutral	-
Negative	x
Strongly negative	xx

Table 8-1 Erosion Protection Options Assessment

Option	Erosion Protection	Amenity	Cost
1. Do nothing - with continued beach scraping as required	x	-	✓✓
2. Replace existing - timber groynes and timber seawall, like for like	✓	xx	-
3. Beach nourishment - and large groynes 40m long and 80m spacing	-	✓	x
4. New timber groynes - as per recently built groynes to the west, 25m long at 80m spacing	x	✓	-
5. Rock revetment – 330m long to replace timber seawall	✓✓	x	xx
6. Rock revetment, nourishment and timber groynes - 30m long at 64m spacing	✓✓	✓✓	xx

8.4 Erosion Protection Recommendations

8.4.1 Recommended Option

The recommended option is number 6 – rock revetment, nourishment and new timber groynes. This is the most expensive option to construct, but it also has the longest life.

Of the other options with neutral to positive scores for erosion protection, each has a serious flaw.

Rebuilding the vertical timber seawall would have the most negative impact on amenity as vertical structures are particularly prone to wave reflection and beach scour. It is also noted that timber structures have a much shorter design life than rock; around 30yrs, as opposed to 50 or 100yrs.

Beach nourishment and large groynes could work, but there is a higher degree of uncertainty about their effectiveness, in particular how often re-nourishment would be required. This would depend primarily on variations in the larger scale sediment transport processes which cannot be predicted

8.4.2 Revetment

Revetments are usually constructed of interlocking rock armour over smaller underlayer and geotextile on a design slope of 1V:1.5H. Alternatively an ‘rock armour’ approach can be used where a larger volume of rock is placed in a more random fashion (i.e. with less emphasis on placement of interlocking) over the existing profile.

The 'revetment' approach is recommended over the 'rock armour' approach for Cowes East because it offers improved stability (for a given rock size) and greater public amenity (a smoother surface), but the preferred approach can be resolved during detailed design.

8.4.3 Groynes and Nourishment

The groynes and nourishment are not necessary for erosion protection but would improve the amenity and can be easily justified as the additional cost is small in comparison to the revetment.

Groynes recommended for the study area are slightly longer (30 vs. 25m) and at a closer spacing (64 vs. 68 to 78) than the groyne field to the west. These adjustments are made in order to achieve a more continuous beach, while still maintaining a level of consistency with the beach to the west in terms of visual amenity and access.

Construction of the groynes may be staged, and as each groyne is constructed it is best practice to place sand on the updrift (western side) to 'fill' the groyne compartment in order to minimise impact on down-drift coastline. The sand may be sourced via beach scaping from Cowes Bank rather than imported from Anderson Rd to reduce costs and construction impacts. Using local sand via beach scaping will result in a less stable beach than using imported sand, but this is acceptable because further erosion is prevented by the revetment. A somewhat transient beach with seasonal variations should be acceptable from an amenity point of view as this occurs all the way along the Cowes East foreshore. Typically, amenity is lowest is during the colder months when storm surge and strong northerlies occur. During summer the beach width and amenity is predicted to higher, corresponding to the period of higher beach use.

Beach nourishment or scaping is only required once when the groynes are constructed. After initial construction the beach can be allowed to fluctuate with natural cycles of longshore and cross shore sediment transport without risking further foreshore erosion.

8.4.4 Impact on Coastal Processes

Revetments, groynes and beach nourishment can all have impacts on the coastal processes in the immediate and surrounding areas. The area which is a greatest risk of impact from the construction of the foreshore protection works is the down-drift coastline to the east, which could be impacted by a reduction in longshore transport. In this case the effects on surrounding areas are expected to be negligible because:

- potential impacts have been mitigated in the design;
- the total amount of sand that could be trapped by the new groynes (6,000m^3) is an order of magnitude smaller than the estimated average annual longshore transport (40,000m^3); and
- the down-drift coastline is resilient to the natural occurring large fluctuations in longshore transport.

The revetment will transition into existing rock walls at either end so the issue of end-scour is avoided. The revetment may also lower the beach profile on the seaward side, but this will be mitigated by the groynes and nourishment which raise the beach profile.

Filling the groyne compartments at the time of construction means they do not become an immediate sink for longshore transport, and the existing longshore transport regime is maintained. This should minimise any impacts down-drift.

The volume of sand required to fill the groyne compartments is approximately 1000m^3 per compartment. This could be taken from a 50m x 60m area 0.3m deep. Groyne construction and beach scraping from Cowes Bank to fill the compartments should be staged so that surface of Cowes Bank has time to readjust between scaping episodes.

The 200m of coastline immediately to the east of the site is protected by a substantial rock wall. Further east the Silverleaves coastline already experiences cyclic erosion and accretion with the natural fluctuations in longshore transport and there is a wide coastal reserve providing a buffer between the beach and public or private assets.

9 Concept/Functional Design

9.1 Recommended Works

The following works are recommended for erosion protection at Cowes East Beach between Rose Ave and Coghlan Rd. The layout of the works is shown on Drawing 002 in Appendix A

(1) **Remove existing timber groynes** – numbers 16, 17 and 18. These groynes are ineffective and deteriorating to the point where they could present a hazard to beach users.

(2) **Remove existing timber seawall** – wall is ineffective and deteriorating to the point where it could present a hazard to beach users. Rock rubble behind the wall may be suitable for reuse in the revetment.

(3) **Construct new rock revetment** – to replace timber seawall, approximately 330m, tied into existing rock walls at either end. Provide pedestrian access over revetment to align with existing beach access points.

(4) **Construct six new timber groynes** – length 30m and spacing approximately 64m.

(5) **Fill groyne compartment –** use beach scraping to establish a 'fillet' beach on the western side of each groyne.

(6) **Repair timber groynes** – numbers 14 and 15 at Rose Ave and Scotch College. Replace missing panels to improve the performance of these groynes.

9.1.1 Optional Items

(7) **Upgrade rock revetment** – the 50m stretch of informal rock wall in front of the Scotch College Boat shed has a lower crest level than surrounding structures and this area could be vulnerable to overtopping. Upgraded revetment would need to incorporate a boat and vehicle access ramp.

(8) **Replace timber groynes** – numbers 14 and 15 at Rose Ave and Scotch College. These structures are reaching the end of their serviceable life. If they cannot be repaired, or deteriorate further, then replacement should be considered.

9.2 Sequencing

The major structural items – the rock revetment and new timber groynes – are independent and do not need to be built at the same time.

If the groynes are built first, then the existing timber seawall should be retained, and beach scaping continued to provide erosion protection until the revetment is constructed.

If the revetment is built first, then there is no urgency to construct the groynes, however lowering of the beach and consequent loss of amenity for users is expected until the groynes are in place.

beach nourishment (via beach scraping) should take place when each groyne is constructed.

The existing timber groynes should be removed when the new groynes are constructed.

The optional items are not required at the current time but are likely to be needed in the medium term (5 to 20 years), and it may be advantageous to include them in the current project to provide a consistent level of protection along the foreshore.

9.3 Issued to be Addressed in Detailed Design

The following issues should be considered and addressed in the detailed design of the Erosion Protection Works:

- Design Objectives, in order of priority:
  - Protect public land and dune habitat from further coastal erosion
  - Improve amenity for beach users by:
    - Increasing beach area at high tide
    - Maintain or improve access to the beach for pedestrians at all current access points and for boat trailers and wheelchairs at Scotch College ramp.
    - Consider allowance for a future along-shore walkway on public land on the shoreward side of revetment (design of this walkway in not within the scope of this project).
    - Removal of derelict structures when no longer required.
  - Design Life – recommend 50 yrs for revetment, with the capacity to upgrade and extend design life if required, and 30 yrs for timber groynes.
  - Metocean design conditions to be defined, including waves, currents and water levels.
  - Geotechnical conditions structure foundations, for revetment stability and settlement.
  - Design toe level of structures (revetment and groynes) with regard to the maximum possible scour level.
  - Design crest level of structures (revetment and groynes) with regard to elevated water levels, sea levels rise, wave run-up, beach profile variation and visual impact.
  - Specify materials suitable for the environment and design life
  - Constructability
  - Safety in Design
  - Requirements for future maintenance
  - Construction and maintenance cost

10 References

(PICS 1987) The Problem of Beach Erosion on the North Coast of Phillip Island, Phillip Island Conservation Society with Eric Bird (1987)

(Bird 1993) The Coast of Victoria – The Shaping of Scenery, Eric Bird, 1993

(AME 2016) Cowes Beach Renourishment Coastal Report, Atkins Maritime Engineering report for Bass Coast Shire Council, July 2016

(WT 2014) Western Port Local Coastal Hazzard Assessment: Report 6(R06) – Review of Representative Locations, Water Technology, 2014

(WT 2018a) Coastal Erosion Management Options – Cowes Main Beach Foreshore Reserve, Water Technology report for Bass Coast Shire Council, April 2018

(WT 2018b) Cowes East Foreshore: Erosion Management Options, Water Technology report for Bass Coast Shire Council, August 2018

Vic tide tables 2015, Port of Melbourne Corporation,

(McInnes 2009) McInnes, K. L., Macadam, I., & O'Grady, J., 2009. The Effect of Climate Change on Extreme Sea Levels Along Victoria's Coast, report prepared for Department of Sustainability and Environment, Victoria as part of the 'Future Coasts' Program, CSIRO Marine and Atmospheric Research

Coast Adapt, website https://coastadapt.com.au/sea-level-rise-information-all-australian-coastal-councils#VIC_BASS_COAST, accessed 27/5/2020

(VCMP 2020), website https://www.marineandcoasts.vic.gov.au/coastal-programs/victorian-coastal-monitoring-program, accessed 27/5/2020

(Carley and Cox 2017) Guidelines for Sand Nourishment. NSW Office of Environment and Heritage's Coastal Processes and Responses Node - Technical Report, October 2017

(AWM 2018) CONSTRUCTION OF TIMBER GROYNES COWES EAST BEACH, set of drawings numbered 3112-S000, 3112-S001, 3112-S010, 3112-S011, 3112-S012, rev A Issue for Tender, AW Maritime, 15/3/2018.

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Appendix A Drawings

LEGEND

Existing Structures

- Rock revetment wall
- Timber revetment wall
- Groyne 1947
- Groyne 1960/70
- Groyne 2015
- Groyne 2018

Cadastral boundaries

Data Sources: Cadastral Boundaries, Department of Environment, Land, Water & Planning, VIC

Title:

Cowes East Foreshore Erosion Protection - existing coastal protection structures

DRAFT

N

0 200

metres

Drawing: M21297.BC.001A

Rev: A

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LEGEND

- Structures for removal
- Proposed timber groynes
- Proposed rock revetment wall
- Cadastral boundaries
- Optional rock revetment
- 14 Groyne number

Data Sources: Cadastral Boundaries, Department of Environment, Land, Water & Planning, VIC

Title:
Cowes East Foreshore Erosion Protection Concept Design Layout

DRAFT

Drawing: M21297.BC.002A

Rev: A

N

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metres

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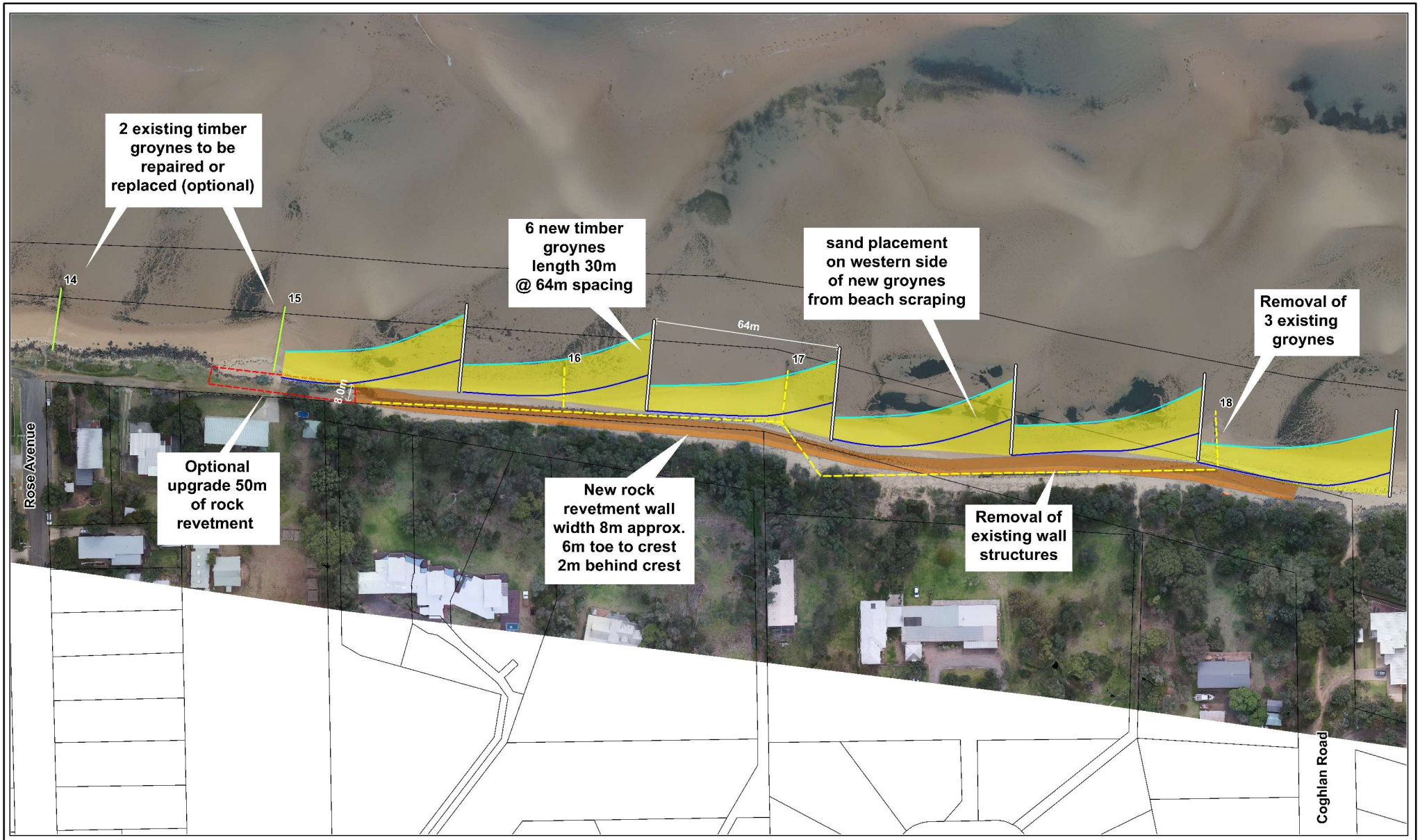

LEGEND

- 14 Groyne number
- Structures for removal
- Proposed timber groynes
- Proposed rock revetment wall
- Beach Contours (mAHD): 0.0 (toe line), 1.6 (top line)
- Sand placement
- Cadastral boundaries
- Optional Works: Rock revetment
- Existing groynes repaired/replaced

Data Sources: Cadastral Boundaries, Department of Environment, Land, Water & Planning, VIC

Title:
Cowes East Foreshore Erosion Protection Concept Design Layout

Drawing: M21297.BC.002B

Rev: B

N

0 48 metres

BMT www.bmt.org

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Appendix B Consultation Records

MEETING MINUTES

By:	Christian Taylor	**To:**	
Meeting Date:	Tuesday 31 March – by phone	**Time:**	
Subject:	Cowes East Foreshore Erosion Protection – Disabled Access		
Attendees	Christian Taylor (BMT) Local Resident (name withheld for privacy)		

Attachments:

Item	Item Description	Responsible
	Welcome and Introductions	
	• Description of Project Scope – Rose Ave to Coghlan Rd • Groynes and/or Sewall are the most likely options	
	Local Resident's Views on Disabled Access and Erosion and Protection Options	
	• Can access beach using Scotch collage ramp and special rough terrain motorized wheelchair. The ramp is the only access point • Drop-off at toe of ramp can be a problem if sand levels are low - would be good to extend ramp. • Beach level varies, but is gradually being worn away • Groynes preferred over rock wall	

MEETING MINUTES

By:	Christian Taylor	**To:**	
Meeting Date:	Friday 3 April – by phone Tuesday 12 May – by phone	**Time:**	10:00am– 11:00am
Subject:	Cowes East Foreshore Erosion Protection – Consultation With Cowes East Foreshore Preventative Action Group (CEFPAG)		
Attendees	Christian Taylor (BMT) Ken Hailey (CEFPAG) Derek Hibbert (BCSC)		
Attachments:			

date	Item Description	Responsible
3/4/2020	**Welcome and Introductions**	**CT, KM, DH**
	• Description of Project Scope – Rose Ave to Coghlan Rd • Groynes and/or Sewall are the most likely options	
	CEFPAG views on Erosion and Protection Options	**KH**
	• CEFPAG formed 2014 in response to concern about erosion from Erehwon Pt to end of houses at Silverleaves. • Doing regular drone surveys of beach as part of Victorina Coastal Management Program. <u>History of erosion and foreshore protection</u> • Rose Ave to Coghlan Rd rock wall built in the 60s or 70s, left a 300m gap. • Sand roadway behind wall has subsequently eroded, lost 20 to 30m in places • Sand has moved from dunes to sand flat, which has become shallower <u>Current Situation</u> • At high tide there is no beach at all in study area – bad for beach amenity and tourism • Old groynes in study area are ineffective and dangerous – want them replaced. • New groynes to west have been effective, good build up of sand. But they 15-20 shorter than old groynes, should be longer to form a wider beach. • With very high tide and northerly storm all sand can be removed from between groynes – can provide photos • Residents don't want alongshore timber wall removed unless it is replaced. <u>Future Foreshore Protection</u> • Protection needed to prevent further erosion of dune area, public and property. • Originally wanted to upgrade rock wall to level of 3m • Now thinking groynes, planting, wet sand fencing • CEFPAG aim to create a foreshore walking track from Cowes to Sliverleaves – currently stops at Rose Ave.	

	Climate Change Ground water level is already very high in residential areas behind beach, you can see the tidal signal. No point building wall for sea level rise, are will flood from groundwater.	**KH / DH**
12/5/2020	**Follow up conversation after Easter erosion event**	**KH**
	• Nourishment completed last week has been washed away with high tides and northerly winds, • Beach in between new groynes to the west has also been impacted, wave reaching rock wall all the way to Dunsmore Rd. • Advocating a rock wall and groynes for the study area • Foreshore bath could be built behind wall • Photos of erosion will be provided	

MEETING MINUTES

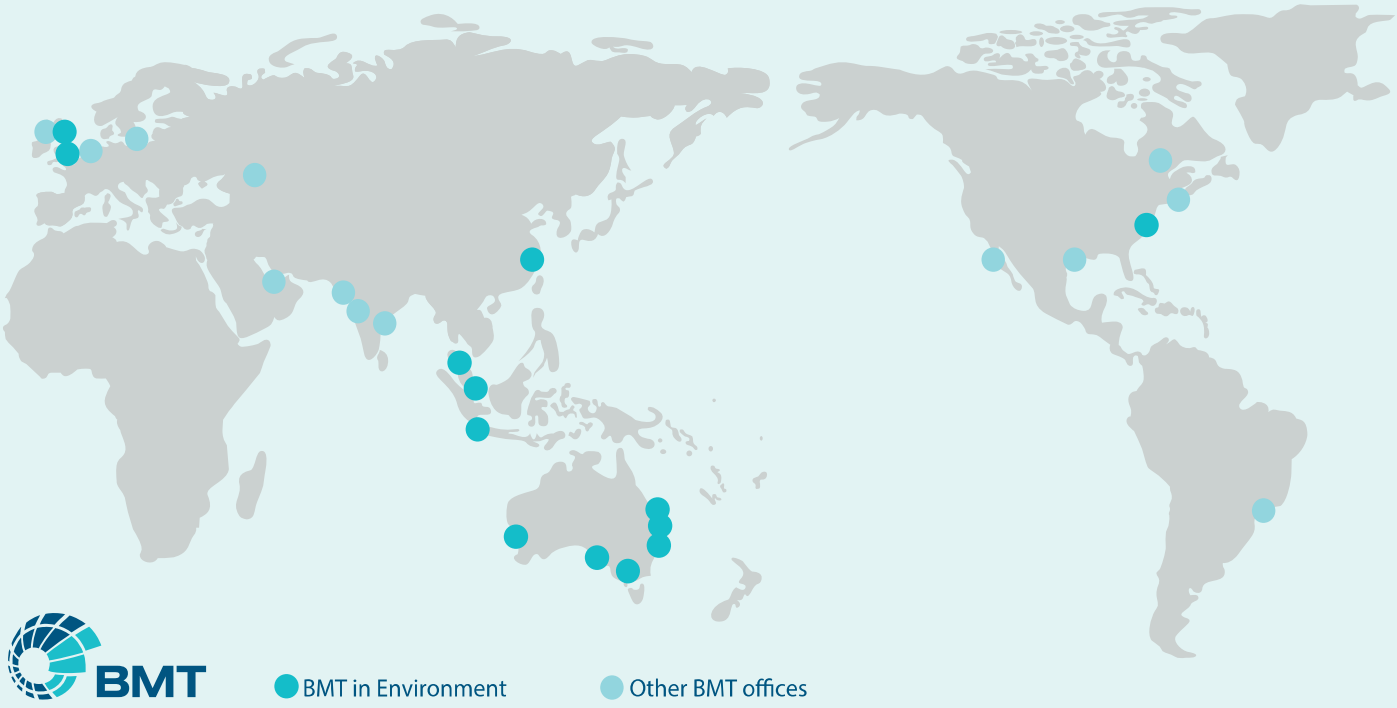
By:	Christian Taylor	**To:**	
Meeting Date:	Tuesday 31 March – on site	**Time:**	
Subject:	Cowes East Foreshore Erosion Protection – Consultation With Scotch Collage		
Attendees	Christian Taylor (BMT) Bill Sciarretta (SC)		
Attachments:			

Item	Item Description	Responsible
	Welcome and Introductions	**CT**
	• Description of Project Scope – Rose Ave to Coghlan Rd • Groynes and/or Sewall are the most likely options	
	Observations of Ramp	
	• Small ramp, timber deck on timber bearers. Concrete piers • Aprox. 2m wide, 1:8 slope	
	Scotch views on Erosion and Protection Options	**BS**

	• Scotch maintain a small ramp over rock wall on east side of existing groynes which they use to access the beach with:
	  ○ Sailing dinghies on beach trollies
	  ○ A RIB on trailer pulled by small tractor
	  ○ Kayaks and paddle boards carried by hand
	  ○ A small swimming pontoon
	• Current ramp is a bit too narrow, sometimes has drop off at the end when sand levels are low.
	• Ramp also used by public, including disabled access, and Council for light vehicle access to beach.
	• No current plans to upgrade, but would like too, with funding contribution from Council
	• New erosion protection works should not interfere with ramp, or incorporate upgraded ramp.
	• Would like to keep the ramp on the east side of groynes where beach is narrower.	

BMT has a proven record in addressing today's engineering and environmental issues.

Our dedication to developing innovative approaches and solutions enhances our ability to meet our client's most challenging needs.



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