Connecting Coastal Champions Forum 23rd November 2017

Presentation by Ralph Roob
City of Greater Geelong – Senior Environmental Engineer & University of Melbourne – PhD Candidate

Living Shoreline Response to Building Coastal Resilience

The concept of building coastal resilience through implementing ecological engineering principles to establish a living shoreline is not new, human kind has been working with nature throughout the ages to address impacts of severe weather and changing environmental conditions.

Figure 1 Examples of Living Shorelines

Over the last two centuries the construction of hard engineering structures such as rock seawalls and groynes have been common place. In recent years there has been a change in community attitude towards these structures, some believe them to be unsightly, obstruct access and alter ecological and physical processes.

Figure 2 Examples of seawalls in Port Phillip Bay

The move back to softer engineering responses that work with natural processes is increasing and new innovative techniques are being explored. This project aims to implement a design that has minimal impact on the coast, delivering its primary objective in stabilising the foreshore and realising co-benefits in terms of habitat creation and restoration.

Location of subject site

Our subject site is Ramblers Road foreshore which is near Portarlington on the Bellarine Peninsula approximately 43km south west of Melbourne.

Figure 3 Portarlington in relation to Port Phillip Bay

Dynamic nature of the Ramblers Road Foreshore

The Ramblers Road foreshore is dynamic in nature, particularly in relation to sediment transport and coastal alignment. In recent years we have witnessed both coastal recession and accretion, some areas have receded up to 30 metres while in others it has accreted.

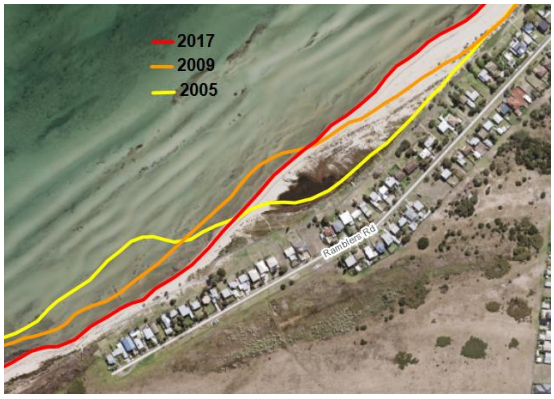

Figure 4 Change in coastal alignment since 2005

There has also been considerable seagrass loss since 2005.

Figure 5 Seagrass loss since 2005

Vulnerability of the Ramblers Road Foreshore

The foreshore is extremely vulnerable to inundation and in recent years severe storms have lashed and inundated the foreshore as well as adjacent private properties. This begs the question as to what we are adapting to? In the case of this site I believe it to be longer duration of storms and wind events as well as more frequent or multiple consecutive events. I will also be investigating if there has been any change to the predominant wind direction over the past 10-15 years.

There has been increasing pressure on the City of Greater Geelong Council by residents to implement hard engineering solutions to address the issue, their preference was to construct a seawall, however this was considered to be cost prohibitive and may not have delivered a desirable outcome.

Figure 6 Storm tide event and resulting inundation

Initial soft engineering approaches

Initially Council opted for softer engineering approaches and to date we have used a number of techniques aimed at stabilising the foreshore, these include sand renourishment incorporated with straw bales / coir logs as well as sand fencing all having various measures of success.

Figure 7 Beach renourishment and coir log installation

Trial of an integrated living shoreline response to building coastal resilience

In consultation with the residents The City of Greater Geelong instead has opted to trial a integrated living shoreline response to build coastal resilience along the western end of the Ramblers Road foreshore. The primary objective being to reduce inundation, stabilise the foreshore, dampen wave energy and accrete sand thereby broadening the beach.

When developing an integrated living shoreline response, the foreshore terrain and vegetation, in particular the wetlands and marshes, need to be considered so as the design minimalises disturbance to existing and in part replicates what was along the foreshore in the past. Information relating to dune and beach morphodynamics, coastal processes as well as the marine environment are all essential inputs into the design and modelling.

Onshore works

The foreshore works involves raising the low lying land between the residential properties and the beach. Swales have been introduced into the landscape to replicate former marsh areas and contain water overtopping during severe storm tide events. The swales will be planted out with coastal native ground covers and rushes. The shared path along the foreshore was also raised providing and additional barrier.

Figure 8 Onshore works - raising the level of the foreshore

Offshore works

The offshore works involve the construction of a semi submersible breakwater or artificial reef with a modular design that is constructed on land, quickly installed and modified if required is scheduled for installation later this Summer.

Figure 9 Pre-fabricated reef modules

The reef will be established 100m from the land and parallel with the shore, it will be 130m long and 4m wide.

Figure 10 Location and orientation of the reef

Reef design

Various configurations of the reef in terms of shape and size, with or without spacings were also considered and the one that was chosen aimed at accumulating sand and maintaining an element of cross shore drift. This was based on various studies and examples of how similar structures have performed.

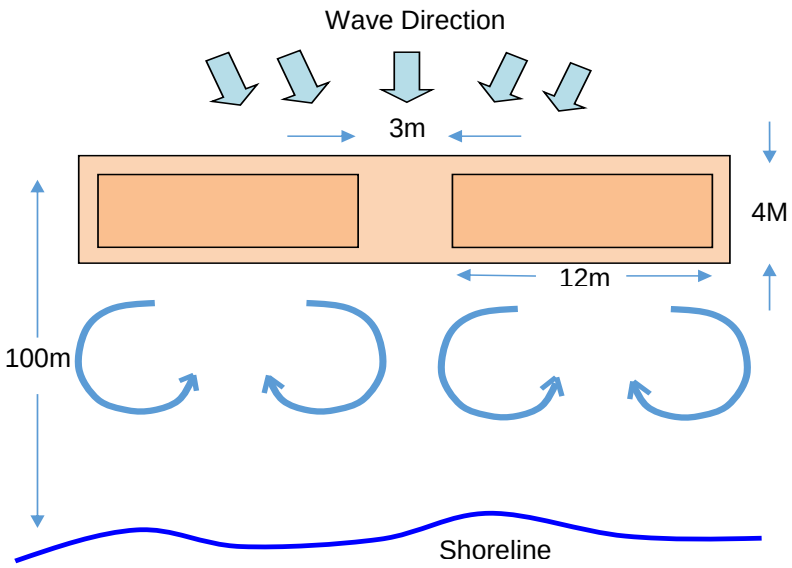

Figure 11 Reef configuration based on a design that accumulates sand and maintains littoral drift (Yoshioka et al 1993)

Wave attenuation modelling

Modelling of the wave attenuation properties of different reef configurations was undertaken by Cardno to better understand the effectiveness the structure in protecting the shore during moderate to severe weather events.

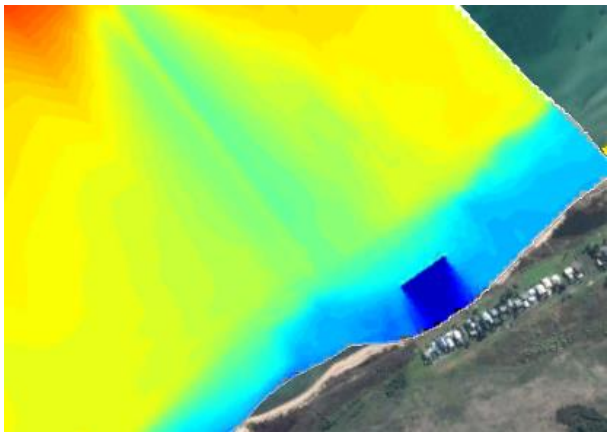

Figure 12 Wave attenuation modelling - dark blue representing the "wave shadow"

Construction materials

A number of construction materials were considered, including sand filled geotextile tubes, pre cast concrete structures and gabion baskets filled with rock and shell material. Some of these techniques are prone to failure, others detract from the amenity of the beach or they are simply just not fit for purpose.

Figure 13 Alternate reef construction materials

The preferred technique is to use steel cages filled with rock and shell where it is anticipated that the cages will take in the order of 15 years to corrode leaving a primarily natural reef. An investigation into how effective marine reef communities are in “cementing” the structure together will be undertaken, it is anticipated that tube dwelling polychaete worms, will colonise gaps between the rock and shell.

Monitoring and evaluation

The City of Greater Geelong has partnered with the University of Melbourne to develop and implement an elaborate and detailed monitoring and evaluation program that aims to deliver learnings that can be applied to other sections of the coast.

The monitoring program will employ a variety of techniques to inform us on the impact that the reef will have on sediments, seagrass restoration, colonisation of shallow and intertidal marine communities as well as sediment transport and accretion. Part of the reef will also be “greened” by using shell as well as rock to fill the cages and then seeding these with mussel spat.

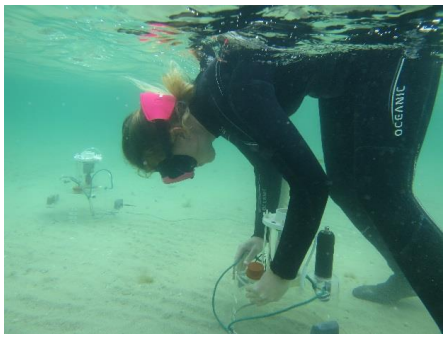

Figure 14 Environmental monitoring - benthic chambers and photo quadrats

This is a relatively small structure, however if it can be proven that it is successful in protecting the coast from storms and at the same time provide significant co-benefits in terms of increases in biodiversity of shallow water and intertidal reef communities, including the recolonisation of seagrass, it may encourage other coastal managers to implement this technique.

Summary

Lessons leaned from the trial seeding of native Blue Mussels may also assist with the future re-greening of existing structures around Port Phillip Bay. There are potentially multiple benefits of promoting colonisation by mussels on existing structures such as improving water quality through their filter feeding capacity and providing fewer opportunities for invasive species to establish.

The broader integrated living shorelines approach may also be the way forward instead, of addressing issues in isolation. Due to its application being across a number of jurisdictions, it may encourage strategic collaboration between the coastal management sector including state and local government, catchment management authorities, waterway managers and foreshore committees of management.

It may also be considered when developing coastal management plans, which in my view need to extend across all coastal land, not just crown land and into the nearshore marine environment and be developed and resourced in collaboration by multiple agencies.

Project partners

Finally I would like to thank the State Government, City of Greater Geelong, the University of Melbourne and the National Centre for Coasts and Climate, for not only providing funding and resources but having the willingness to take the risk to trial new and innovative techniques to address coastal erosion and a changing climate.

Thank you