CITY OF GREATER GEELONG

Intertidal Artificial Reefs
Ramblers & The Dell Reefs

A key element of a hybrid approach to a nature based coastal management solution

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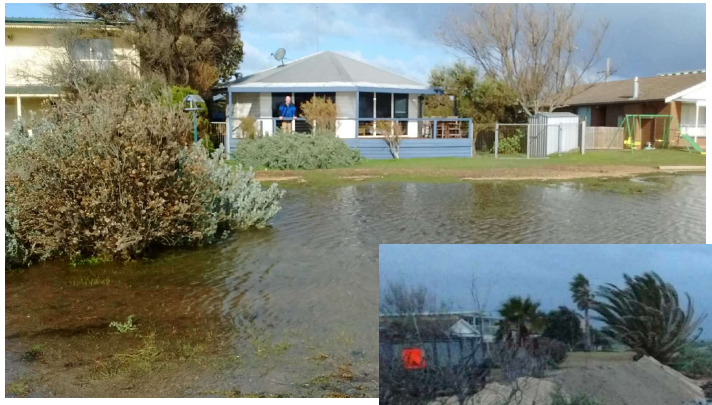
Project locations

Ramblers Foreshore Issues

Inundation and erosion caused by Winter storms



Ramblers Reef Project objectives

Address coastal erosion using eco-engineering principles in a way which meets the following objectives:

- Prevent further coastal recession
- Stabilise the beach
- Attenuate wave energy, run-up and over-topping
- Reduce inundation during peak water events
- Accrete sand
- Cost effective
- Minimal impact on natural coastal processes
- Deliver co-benefits in terms of habitat creation and restoration

Identify where nature based coastal management solutions are an option

Response Options

- Do nothing
- Retreat
- Adapt
- Protect

Protection options

- Seawalls
- Revetments
- Groins
- Sub tidal reef
- Beach renourishment
- Sand fencing
- Primary berm reinforcement
- Dune planting
- Raising low lying section of foreshore land
- Raising & reinforcing shared path
- Semi submersible breakwater / intertidal artificial reef

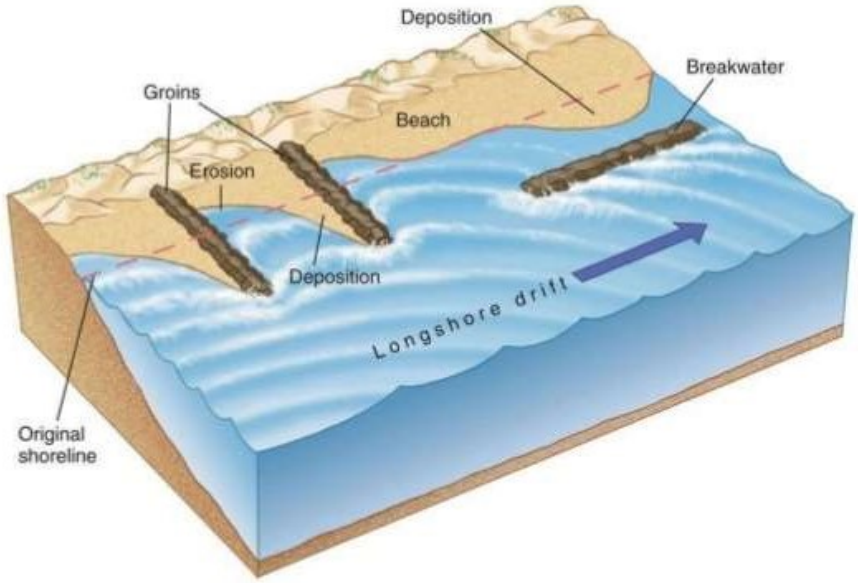






Hybrid approach to nature based coastal management solutions

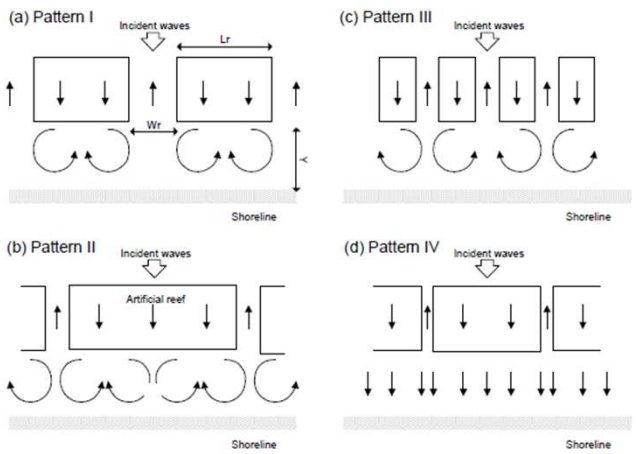
Breakwater and Groin effects



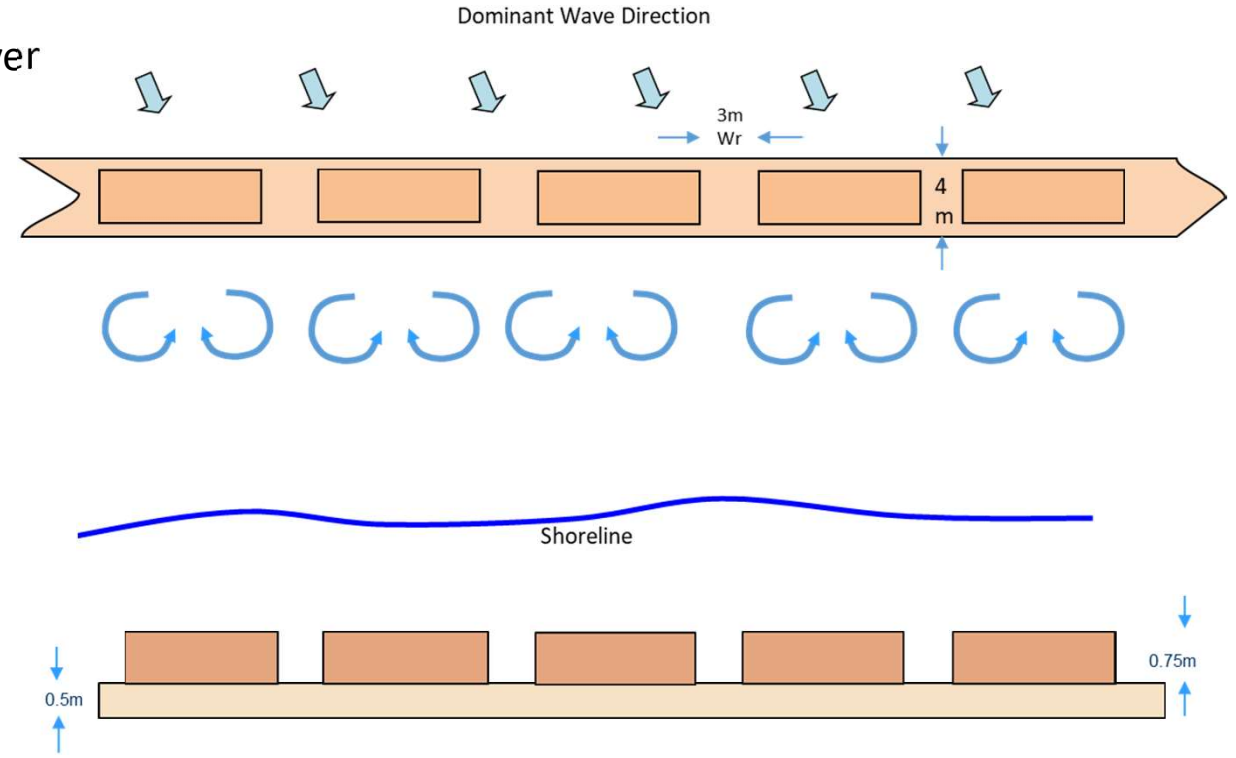
11.7-Jones and Jones, 2003

Reef design - geometry

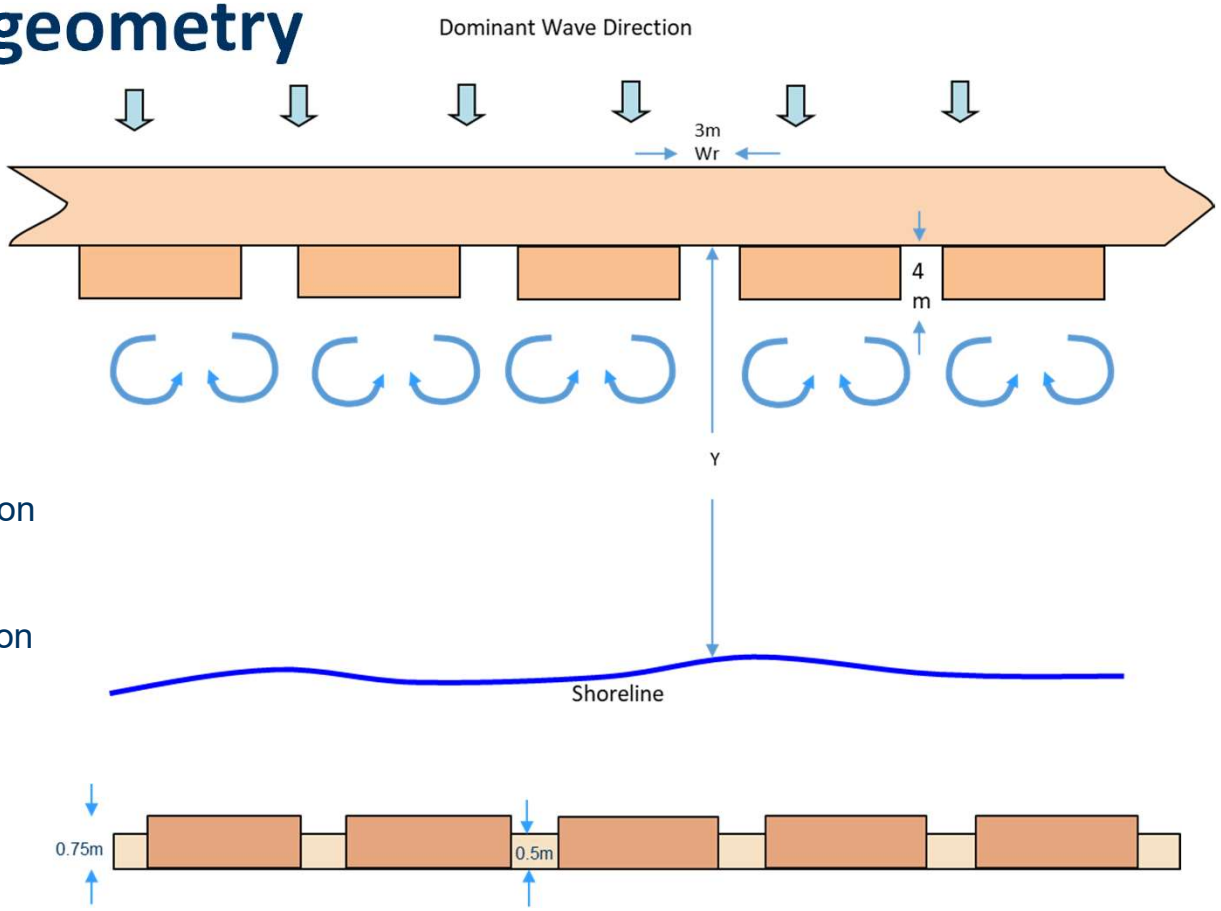
Investigate a design that would deliver on the primary objectives



The design controls sand accumulation and littoral drift
Configuration is based: Wr > 0.25 and Lr < 4
(Yoshioka et al 1993)



Reef design – revised geometry

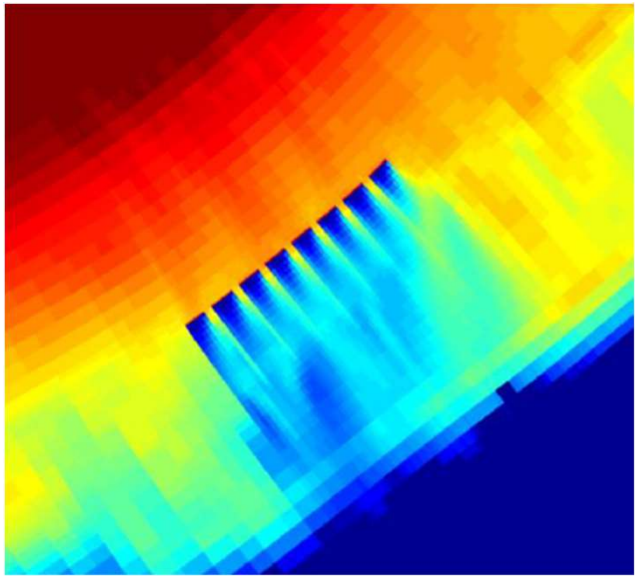


Pros:
- Less visual impact
- Low exposure to upper vertical face
- Cages less prone to severe damage
- Improved habitat opportunities
- Greater crest width – improving wave attenuation

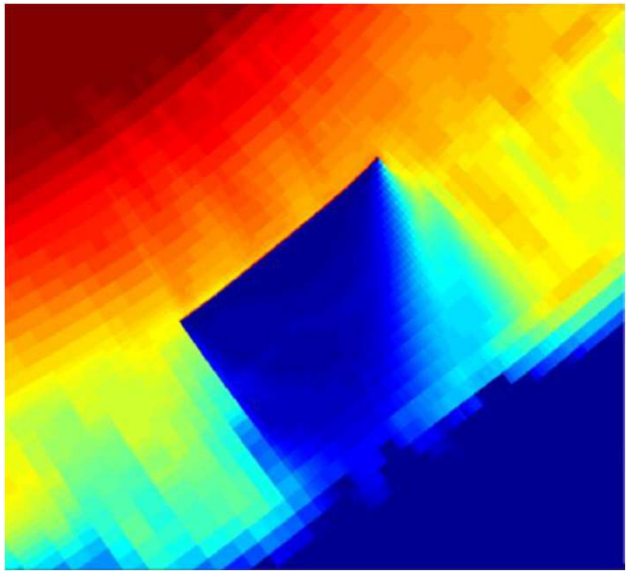
Cons:
- Lower profile – moderately less wave attenuation

Model the design for its effectiveness in attenuating wave energy

Scenarios and design configurations



Reef consisting of 8 modules with spaces



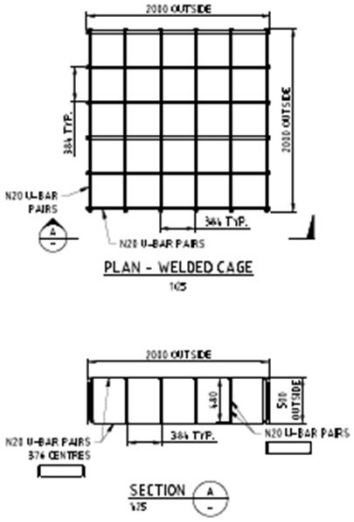
Continuous reef with no spaces

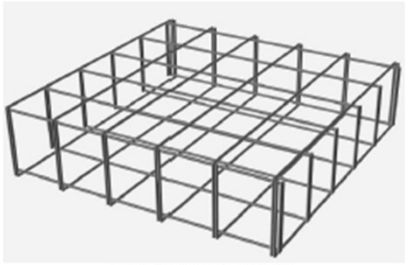
Reef construction materials

Reef module cages constructed using steel rod and weld mesh

Half filled with rock and shell, half filled with rock only

Rock sourced locally from drainage excavation works, shell a bi-product of the Bass Strait scallop fishery





Monitoring and Evaluation

The University of Melbourne has partnered with the City of Greater Geelong and the Port Phillip Eco Centre to establish a monitoring program

Direct benefits

- Changed hydrodynamic conditions
- Physical (geomorphic) response to the beach and marine environment
- Techniques of intertidal mussel seeding

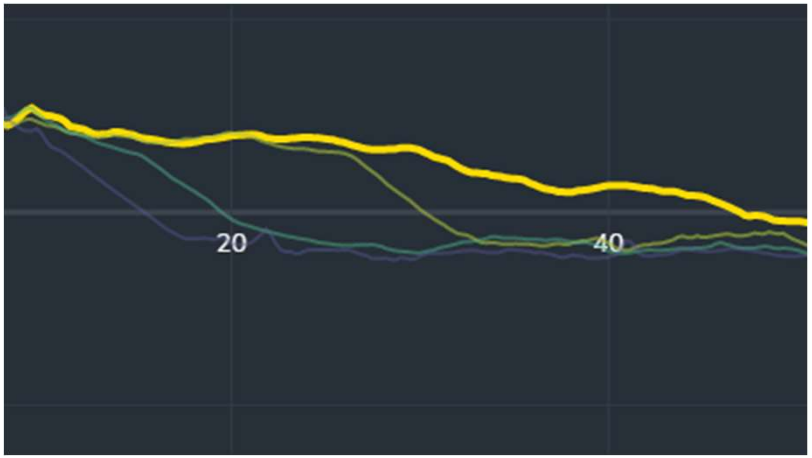
Co-benefits

- Restoring seagrass and stabilising the extent of meadows
- Improved viability of primary berm (“dune”) planting
- Colonisation of intertidal marine reef communities

Physical (geomorphic) response

The artificial reef has performed well in terms meeting all the objectives, in particular its ability to accrete sand on the beach

Changes in beach profile



Ramblers beach sediment volume gain

Mussel seeding

Monitoring and evaluation

Mussel seeding with juvenile mussels from nearby aquaculture operations

Monitoring of survival and growth

Sampling and sorting of invertebrates associated with seeded mussels

Mussel seeding trial results – Year 1

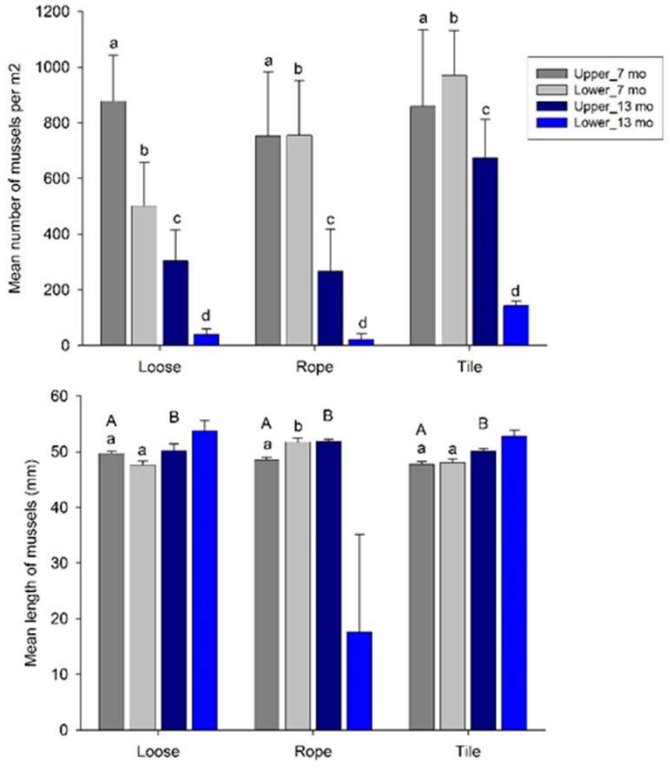
1st mussel seeding trial

Assess seeding methodology
- On growing ropes
- Loose
- On basalt tiles

Most successful seeding technique was on the basalt tiles

Determine optimum / suitable depth – provided by the upper terrace or lower terrace

Greater survival on the upper terrace

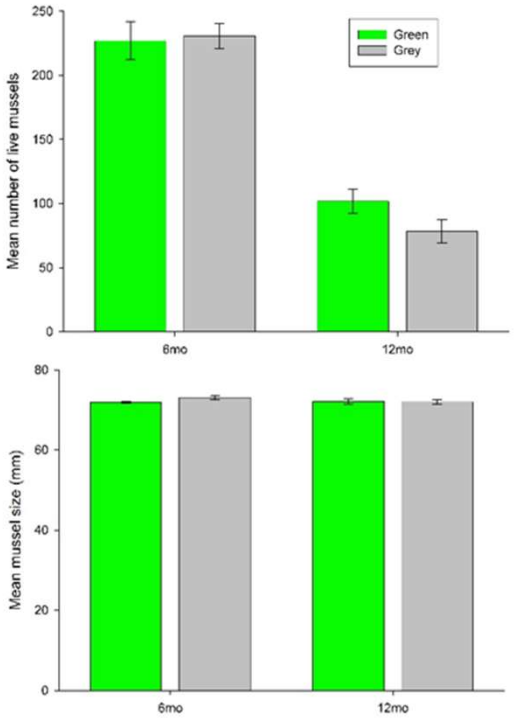


Mussel seeding trial results – Year 2

2nd mussel seeding trial – Green vs Grey

- Green half of the reef basalt rock and scallop shells
- Grey half of the reef, rock only

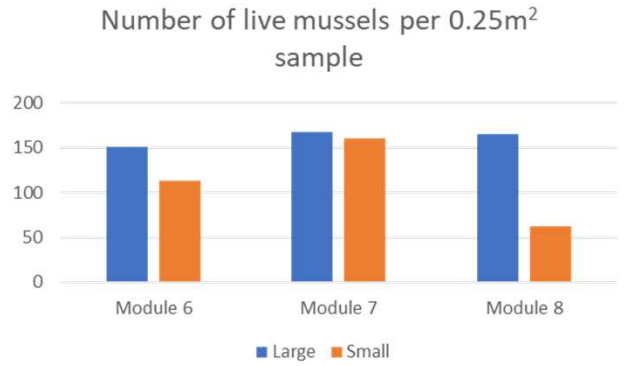
No significant difference

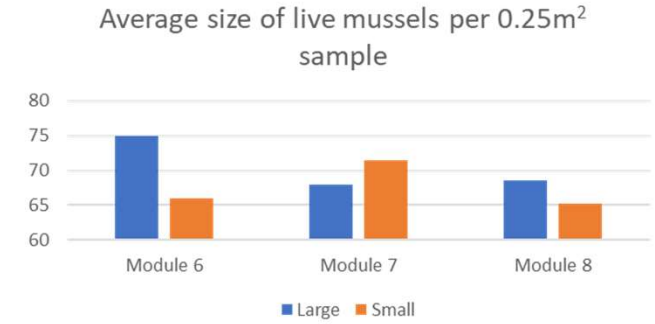


Mussel seeding trial results – Year 3

3rd mussel seeding trial – large plot vs small plots

Large plots of 9m^2 more viable than small plots of 1m^2





Co-benefits

Intertidal reef habitat creation

Seagrass restoration

Primary berm (“dune”) planting

The Dell artificial reef

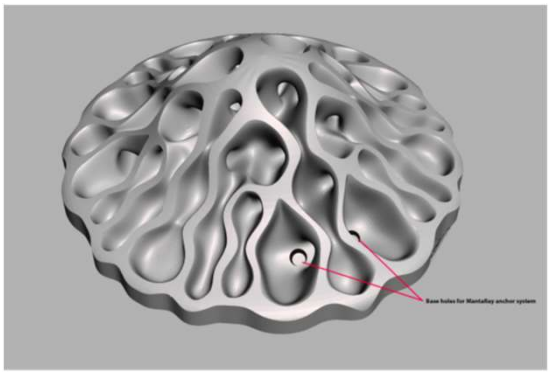
Near Clifton Springs on the Bellarine Peninsula scheduled for installation in October 2022

The Dell Eco Reef

The design we were aiming for needed to be innovative and consist of reef modules that have a sculptural element sympathetic to the marine environment

The shape and format of the array needed to be effective in reducing wave height, thereby preventing further erosion

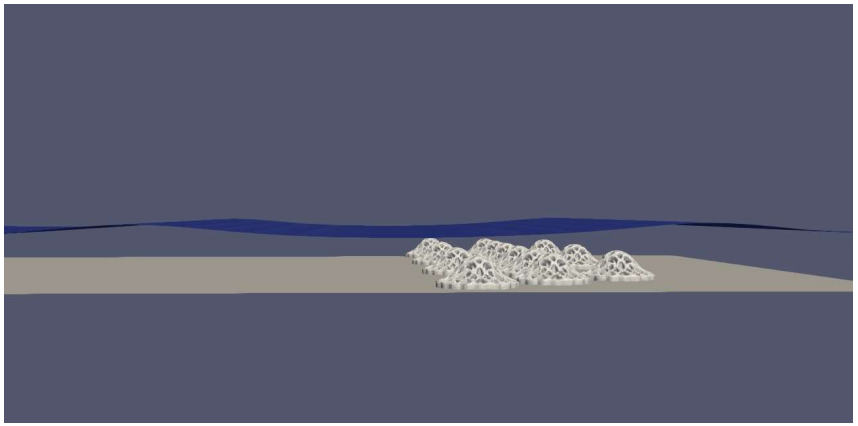
The array will consist of 46 modules that will establish new habitat for reef communities, including refuge for juvenile fish as well as provide safe shallow water snorkelling

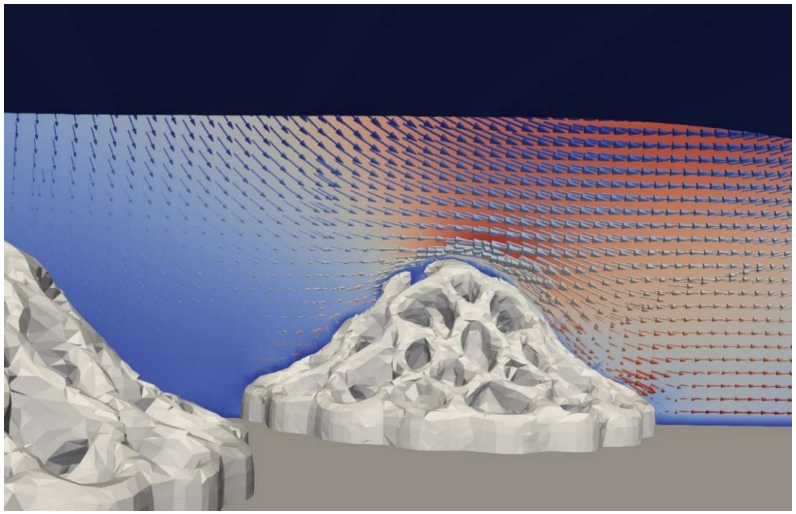


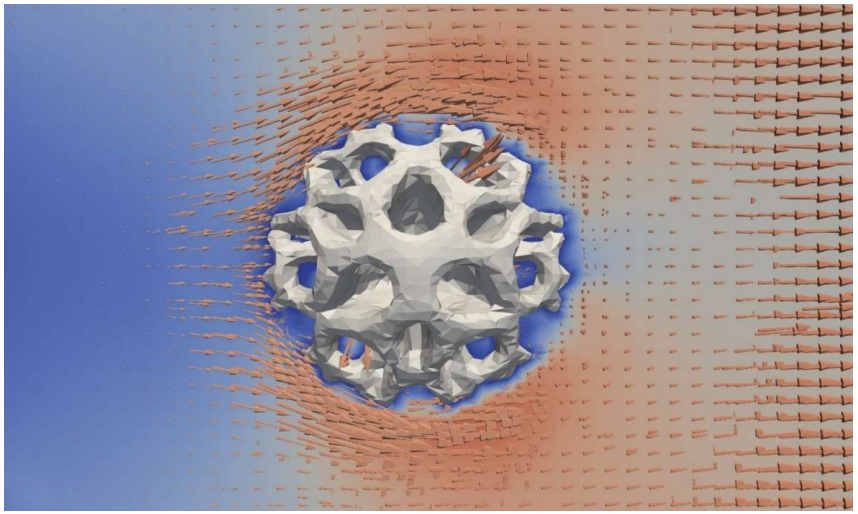
Sculptural modules designed by Alex Goad from The Reef Design Lab

Modelling of waves passing over and through arrays of reef modules

Computational Fluid Dynamics simulations OpenFOAM+ version 1712 and k-ε model was used for turbulence closure





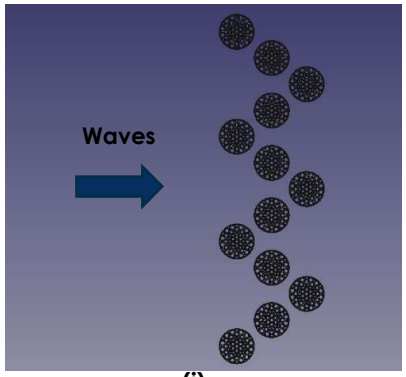


Modelling Results

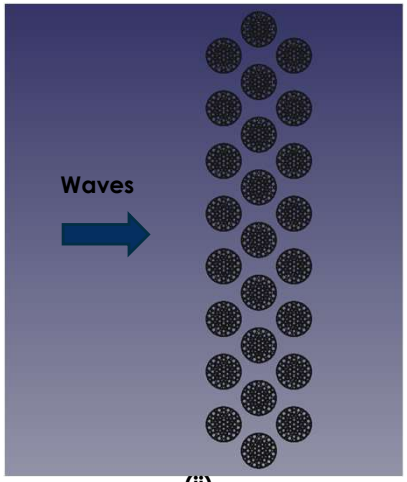
Scenario 2 (mean tide)
- **water depth 0.95 m**
- **wave height 0.35 m**

Reef arrangement ii

Reduction in wave height 0.17 m



(i)



(ii)

	Reefs arrangement	Wave height upstream of the reefs (m)	Wave height downstream of the reefs (m)
Scenario 1	i	0.35 m	0.29 m
Scenario 2	i	0.35 m	0.28 m
Scenario 2	ii	0.35 m	0.18 m
Scenario 3	i	0.35 m	0.20 m

Nature Based Coastal Management Solutions

Working with the University of Melbourne and their development of a National Guideline assisted with the following:

- Establish suitable baseline data and how to collect and compile these
- How to determine morphodynamics and historical change in coastal alignment
- Synthesise what has been effective elsewhere and in what environments
- Understand and promote co-benefits
- Identify risks that could compromise environmental values
- Consider the impacts of altering coastal processes
- Establish a palate of eco-friendly materials
- Understand community perceptions and expectations
- Effective communication and how best to report the findings of the monitoring

Thank you

Questions?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