



Living Seawalls: Using biology and design to improve the ecological function of artificial structures

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# The Team



Image: Leah Wood, SIMS



**MACQUARIE**  
University  
SYDNEY · AUSTRALIA

REEF DESIGN LAB

# Populations are growing, especially on the coast

Coastal population and shoreline degradation

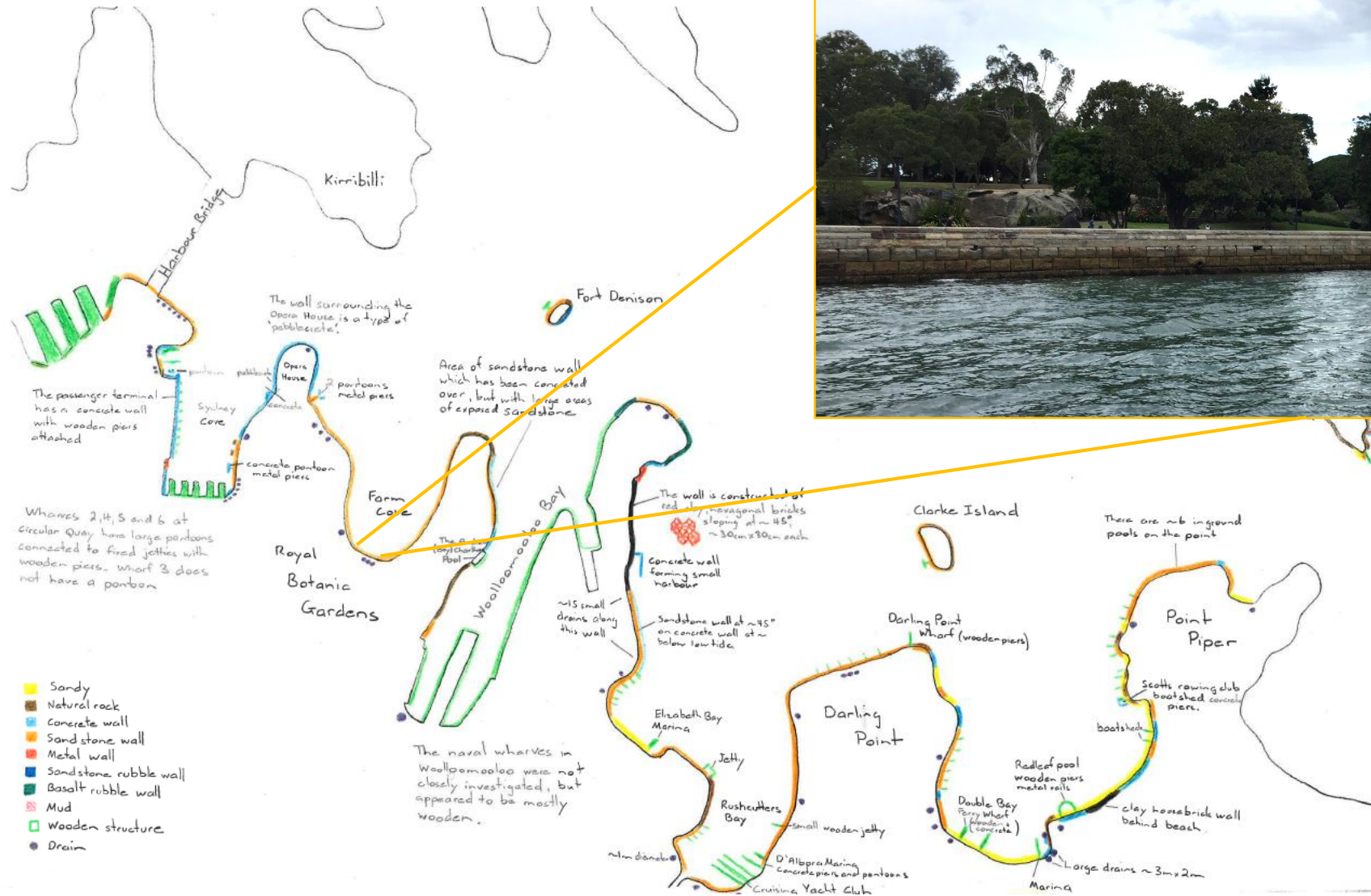
Population living within 100 km of the coast



**OCEAN** Sprawl

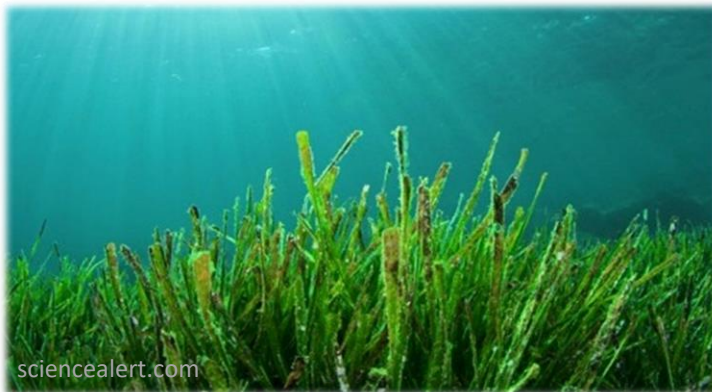
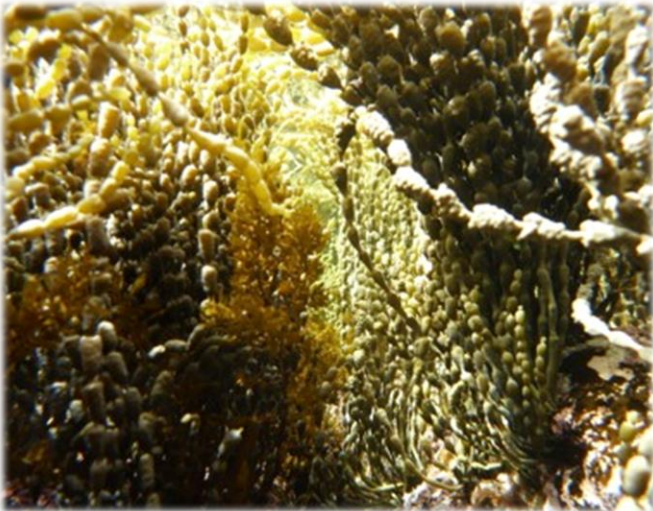
# Urbanisation

- >50% of the Sydney shoreline is armoured



# Diverse marine habitats

- Increased population growth and development
- Modification or loss of natural habitat



# Habitat loss

## Rocky Shores



Gradual, sloping intertidal area  
Contains microhabitats (i.e. rock pools)

## Seawalls



Compressed intertidal area  
Relatively flat and featureless  
**= poor habitat surrogate**

### Artificial Structures:

- Lower biodiversity
- Greater proportion of non-native species
- Variable functional responses

# Interventions

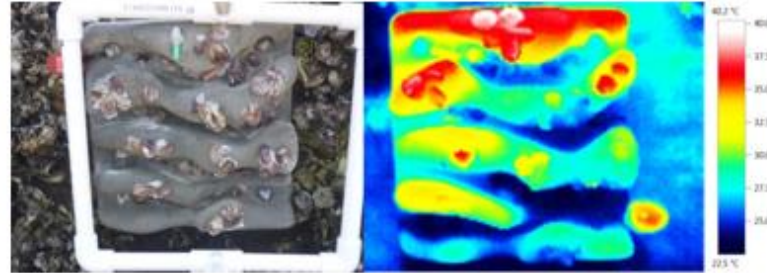
- Increased awareness of the problem has led to innovative interventions



Skylights for seaweed:  
fish: Seattle water front  
project



Flowerpots as  
rockpools: Browne,  
Morris, Coleman from  
the Retrofitting  
Biodiversity project,  
EICC



Crevices and ridges for oysters, snails:  
Strain, Bishop, Steinberg & Reef Design Lab



Oyster castle



Saltmarsh: Kogarah  
Council



Eco-friendly material:  
ECOconcrete



Holes for fish: Reef ball

Image credit: B. Strain



# WG2 - GREEN ENGINEERING

## Global Bivalve Experiment



### 15 Harbours across the world:

#### Australasia

Sydney  
Auckland  
Hobart

#### Middle East

Hafia

#### North America

Chesapeake Bay San  
Francisco

#### Asia

Penang  
Hong Kong  
Keelung

#### South America

Arraial do Cabo  
Coquimbo

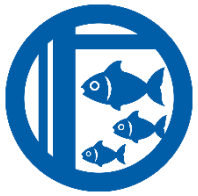
#### Africa

Port Elizabeth

#### Europe

Dublin  
Plymouth  
Ravenna





# WG2 - GREEN ENGINEERING

## Global Bivalve Experiment

Does the addition of microhabitats to seawalls influence:

- Bivalve survivorship?
- Native and non-native biodiversity?

Flat



2.5cm ridges



5cm ridges



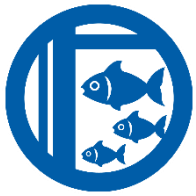
Top row: unseeded



Bottom row: seeded



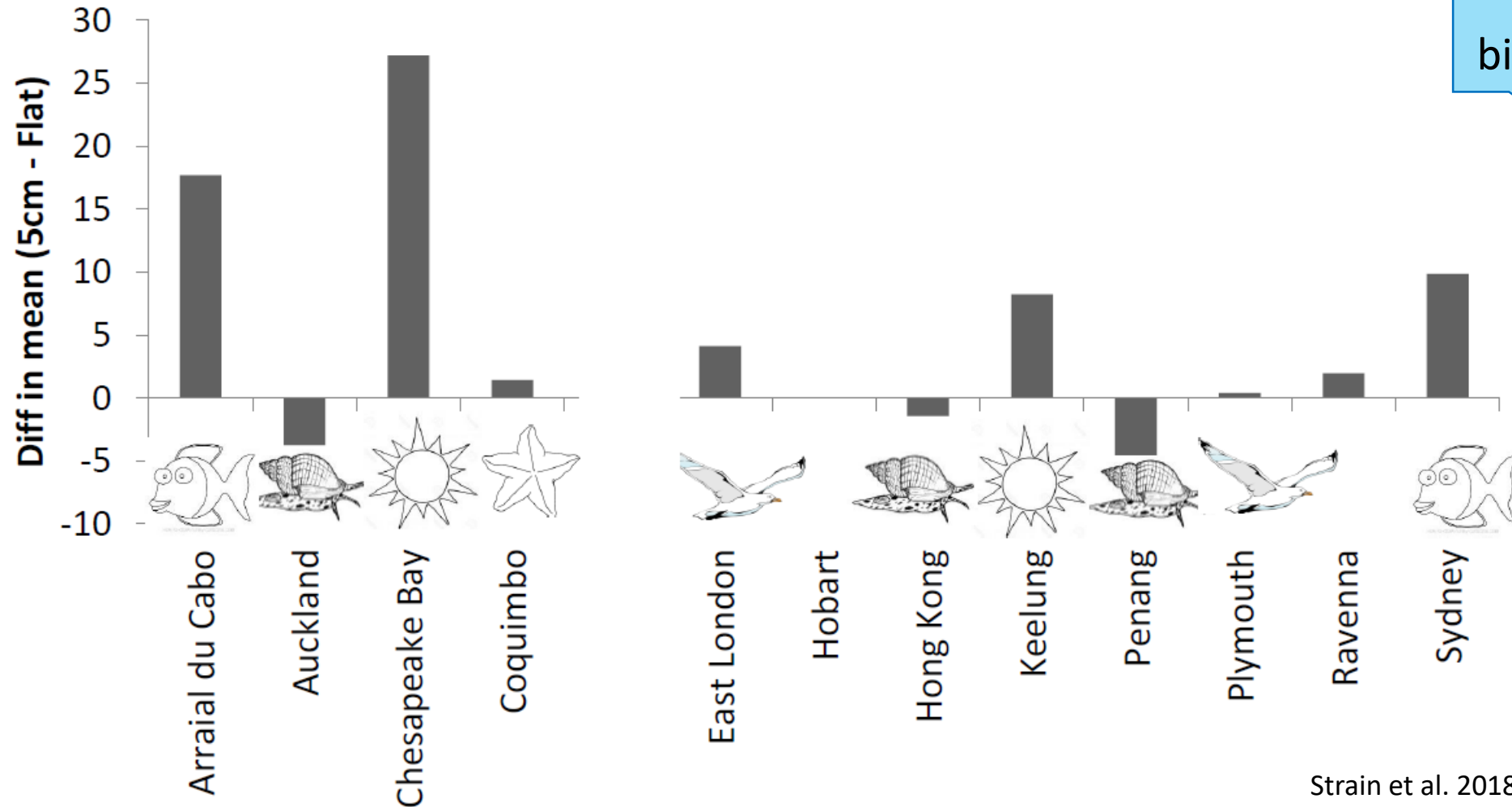
Design by Reefdesign Lab



# WG2 - GREEN ENGINEERING

## Global Bivalve Experiment

Effect of complexity on % live seeded bivalves

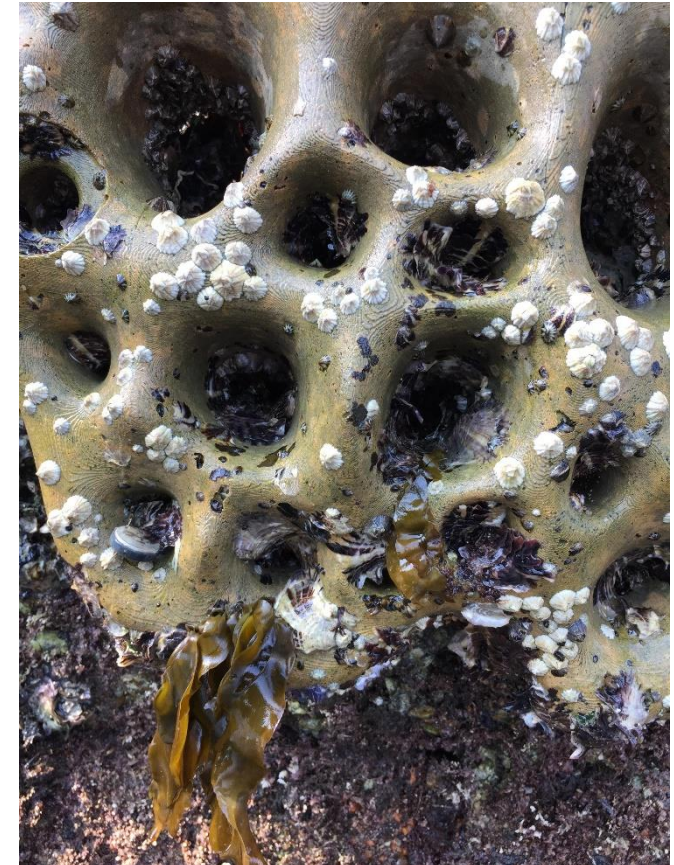


Need to consider local abiotic and biotic stressors

Figure credit: Rebecca Morris

# Living SEAWALLS

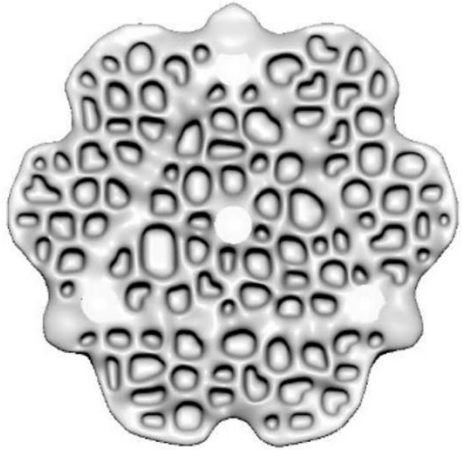
- Scale-up seawall greening research



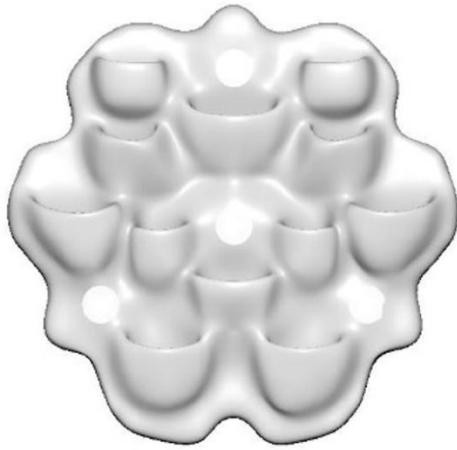
- Objectives:
  - Evaluate whether entire seawalls can be transformed into eco-friendly structures
  - Determine the scale at which greening seawalls alters community structure

How much green engineering is needed to see real ecological effects?

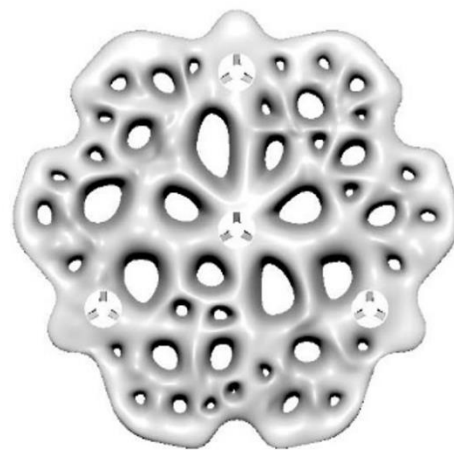
Ecologically informed designs



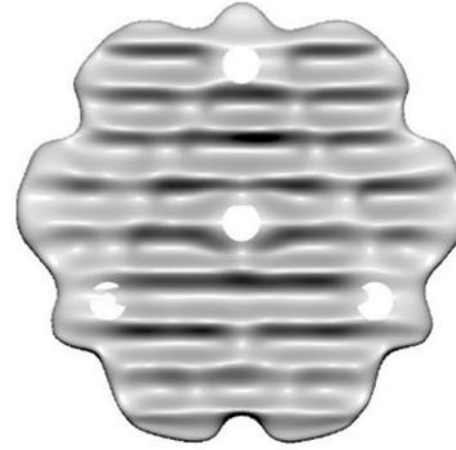
Honeycomb



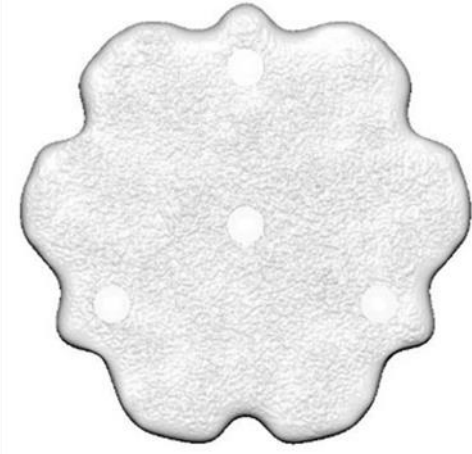
Rockpool



Swimthrough



Crevices



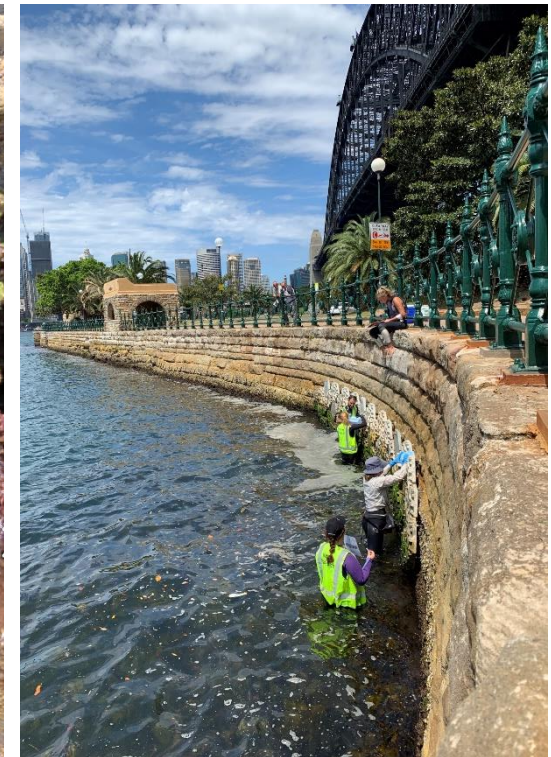
Texture



Designed using  
3D printing  
technology

## Monitoring:

- Before and after (Living Seawalls, control seawalls and reference rocky shores)
- Community composition from microbes to fish
  - Biofilms, PAM
- 3D habitat mapping
- Performance of tile designs and tile configurations:
  - Ecosystem functioning (water filtration)
  - Amelioration of stressors (temperature)
  - Invasion by non-native species





Full & Partial  
Living Seawalls installation  
Sawmillers Reserve  
Oct-Nov 2018



Living Seawalls collaboration  
with Volvo Cars Australia  
Bradfield Park  
Oct 2018



# Building Collaborations



Stakeholder engagement



Councils (North Sydney Council)



# Current Status & Future Directions



Monitoring

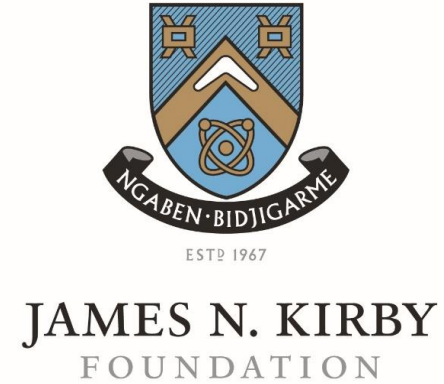


... and more monitoring!

Recruiting Hons,  
MRes and PhD  
students

# Acknowledgements

## Funding



## Collaborators & Field Assistance





# Thank you!

Follow the project:



@LivingSeawalls



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@marialvozzo