



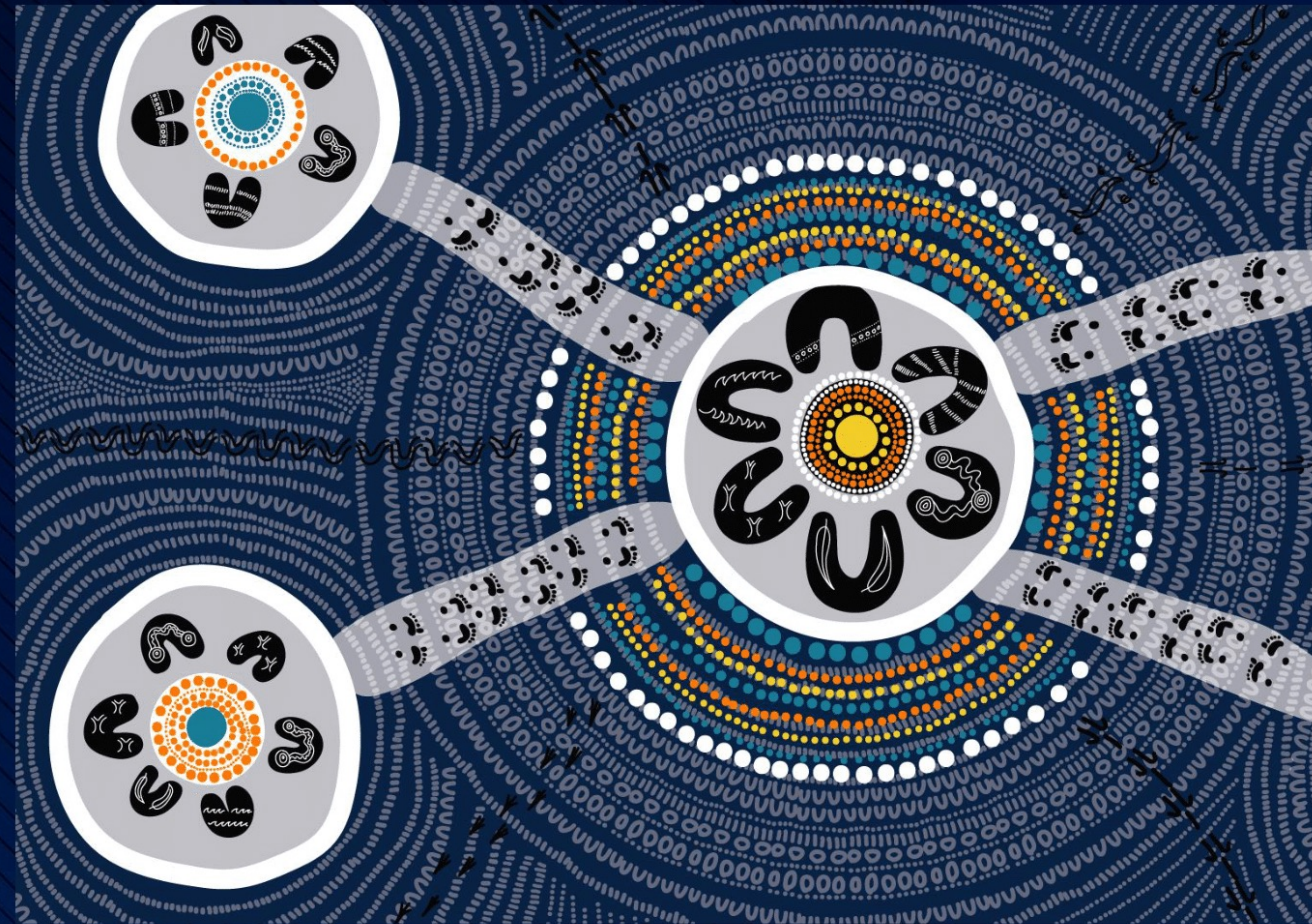
# IS Ratings | Innovations Case Study Webinar

16 May 2024



# Acknowledgment Of Country

The Infrastructure Sustainability Council would like to begin by acknowledging the Traditional Custodians of the land on which we meet today. I acknowledge their deep connection to land, water and culture, and pay my respects to their Elders past and present.





# Agenda



1

**Te Ara Tupua** - Ed Breese, Ali Houppapa, Marcus Cameron and Tom Shand from Te Ara Tupua Alliance

2

**Tonkin Gap Project & Associated Works** - Emilie Stenmark from Tonkin Gap Alliance

3

**Q&A**

Please add any questions to the Q&A button







# Te Ara Tupua

Ed Breese, Ali Houppapa, Marcus Cameron and Tom Shand  
Te Ara Tupua Alliance





# ISC: Innovations Case Study

Thursday 16 May 2024





# Karakia Tīmata (opening Karakia)

ĀIO KI TE RANGI

ĀIO KI TE WHENUA

ĀIO KI TE MOANA

ĀIO KI NGĀ TĀNGATA KATOA

TĪHEI MAURI ORA



## Whakataukī (proverb)

### **WHATUNGARONGARO TE TANGATA, TOITŪ TE WHENUA.**

The importance and permanence of land.

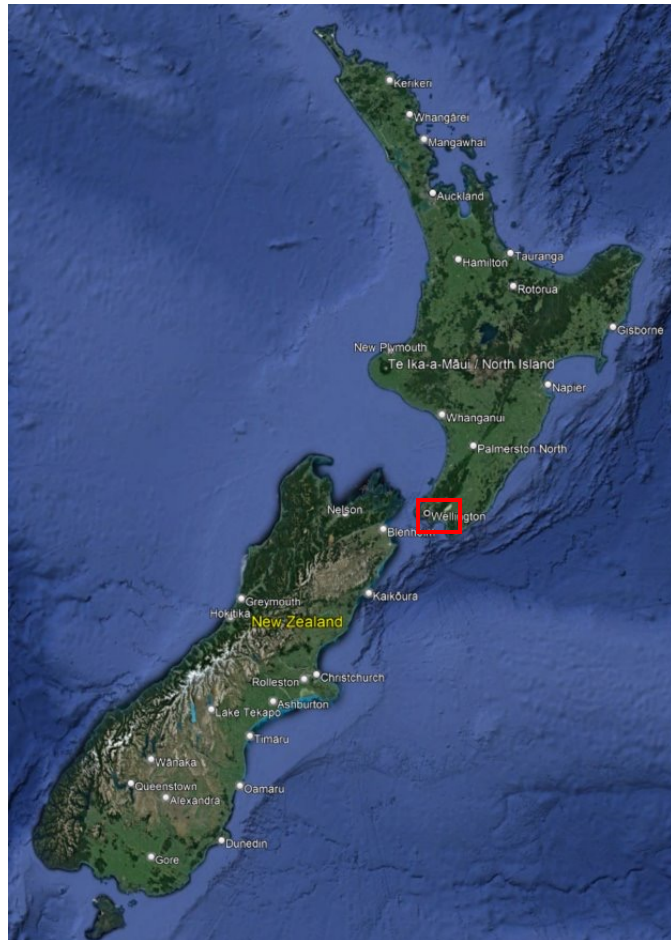
While people will come & go, the land remains.

As humans we rely on the land.

We must think long-term and see the big picture to ensure the sustainability of the land.



# Te Ara Tupua – Ngā Ūranga ki Pito-One







**Te Ara Tupua Alliance**

Shifting gear to connect past, present and future





# Sustainability Innovations

## XBlocPlus armour units

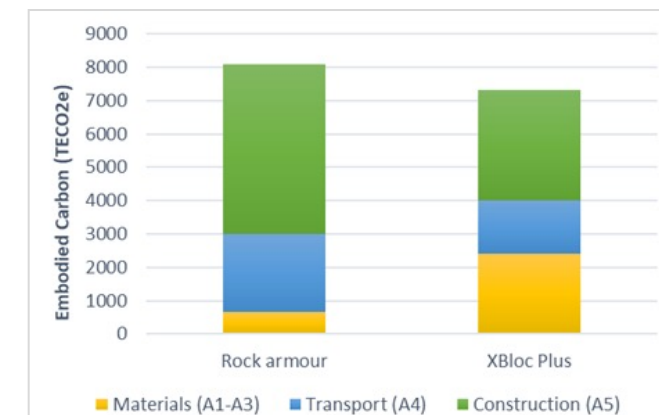
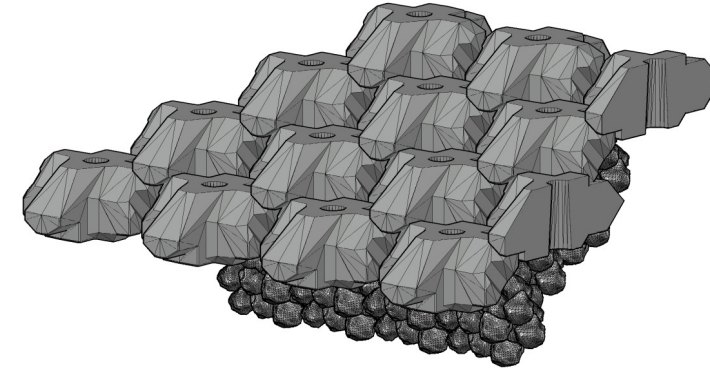
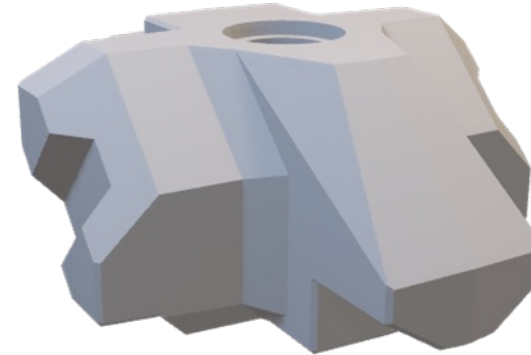
- Single layer, pattern placed concrete units as primary revetment armour – *Australasian 1<sup>st</sup>*
- Ecological and architectural/landscape modifications – *World 1<sup>st</sup>*
- Multi-model testing and design approach to seismic performance – *World 1<sup>st</sup>*

## Reef enhancement

- Artificial reef habitat consisting of purpose-built concrete reef units
- Specifically designed to improve habitat and diversity of marine life
- First subtidal application of the Biodiversity Compensation Model (BCM) to calculate quantum of compensation required
- *New Zealand 1<sup>st</sup> and largest in Australasia*

# XBlocPlus concrete armour units

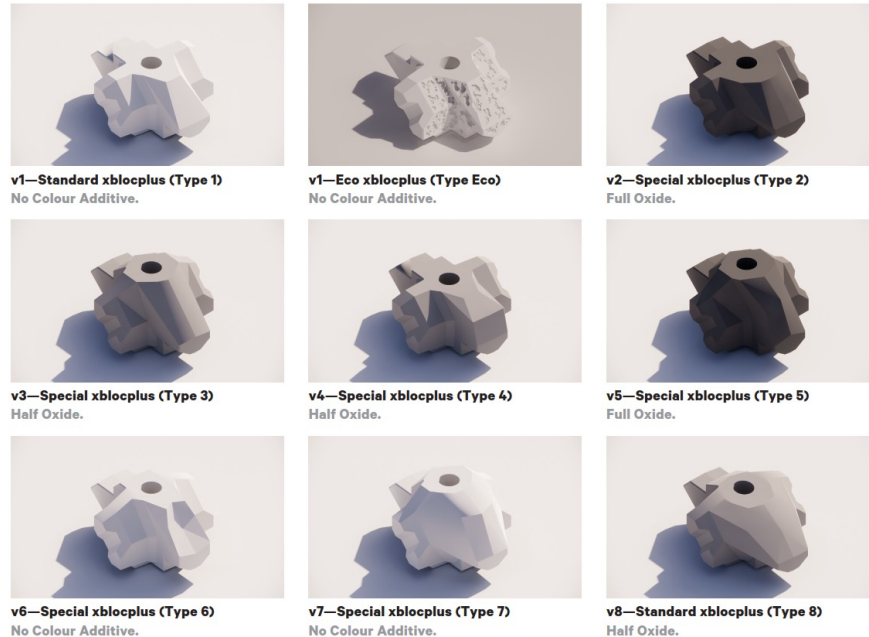
- Started project with a design that was over consented footprint and required very large volume of rock armour
- Large transport distances due to limited local supply
- Single-layer, pattern placed concrete armour unit
- Developed by Delta Marine Consultants (Netherlands)
- Units interlock providing more stability than rock enabling smaller units
- First use XP in Australasia (World 4th)
- Reduced cost, programme and embodied carbon compared to rock only solution





# XBlocPlus – Landscape and Ecological Enhancements

- Started out as very uniform pattern
- Standard units modified to include variable form, size and colour



## Variable Form+Colour xbloplus Revetment Close Coastal View



Macro Value Opportunities—Coastal Revetment.  
Concrete Block Revetment Optioneering.  
Te Ara Tupua Alliance.

# XBlocPlus – Landscape and Ecological Enhancements

- Started out as very uniform pattern
- Standard units modified to include variable form, size and colour
- Surface modifications to encourage growth of aquatic flora – modelled after kelp holdfast
- Ecological enhancement integrated with cultural narrative - designed by Len Hetet
- Modifications iterative with designers, precasters, construction to ensure they could be cast and units retained interlocking character
- World 1st modification of these blocks, first to include cultural narrative





# XBlocPlus - Testing & Design

- Construction over a large, active faultline caused unique issues
- No one has tested behaviour of these type of units during seismic activity - no established methods, models available
- Innovative, multi-model approach developed to test, understand and develop solutions
- First time seismic performance has been considered in the design of these units
- First time this combination of physical and numerical approaches applied



# Reef Enhancement initiative





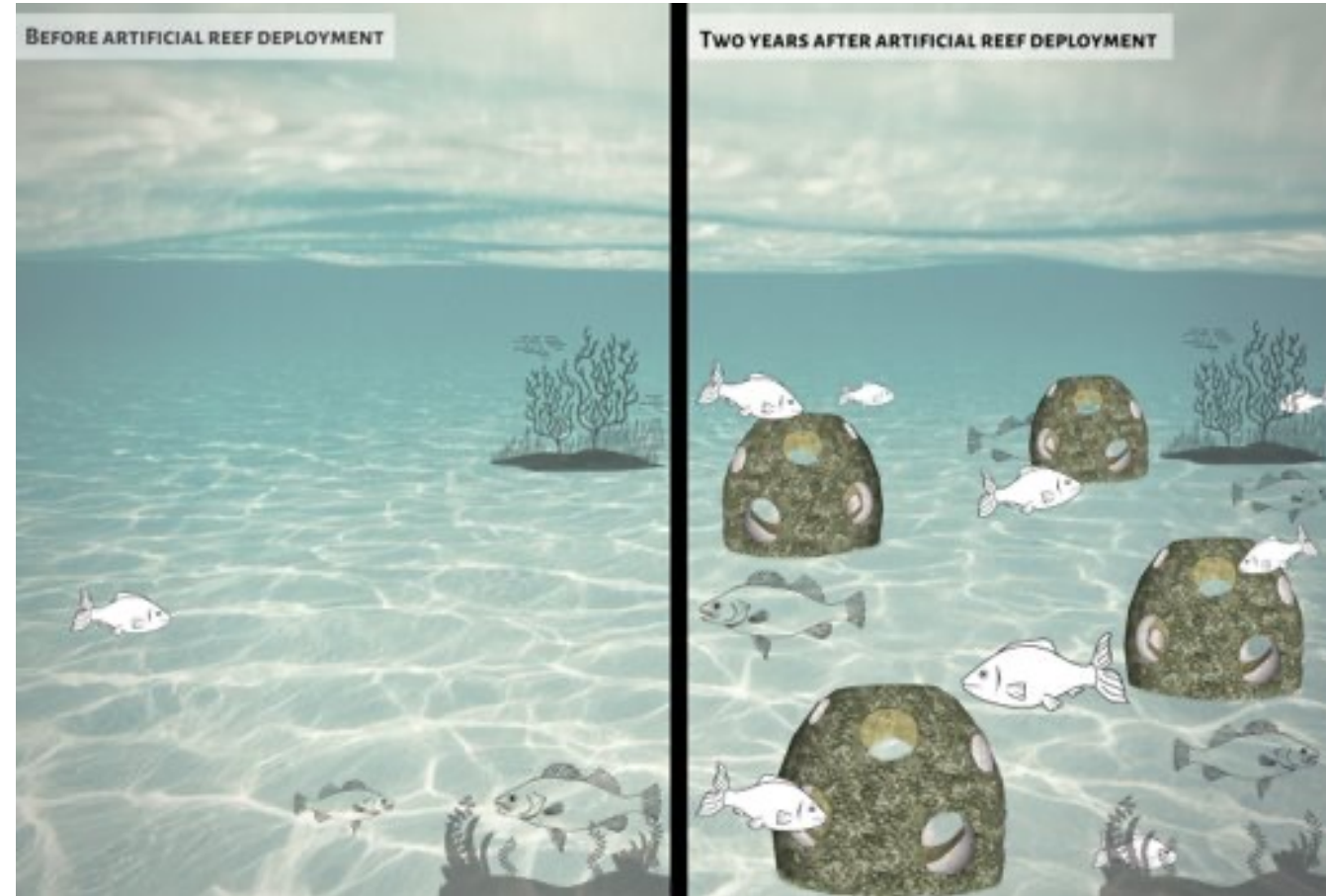
# Why was ecological compensation needed?

- Permanent loss of 5 ha of high value marine habitat due to Ngā Ūranga ki Pito-One build
- Lost habitat - a mosaic of rocky outcrops, boulders and sand
- Replaced with - rock revetment, seawalls, offshore rocky habitats
- So, additional compensation was needed for very high *residual* ecological effects
- Various compensation options considered, reef enhancement considered to be best.



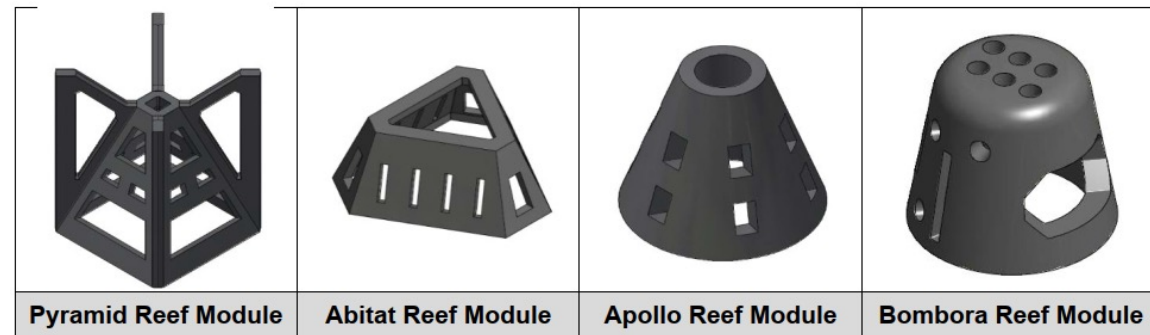
# Why was a reef enhancement considered best?

- Widely used nature-based solution globally (although not in NZ)
- Strong track record of improving marine biodiversity in habitat limited areas
- Similar successional development, food and shelter resources to natural reefs
- Range of ecosystem services provided (water filtration, carbon sequestration etc)
- As similar to what is being lost as possible

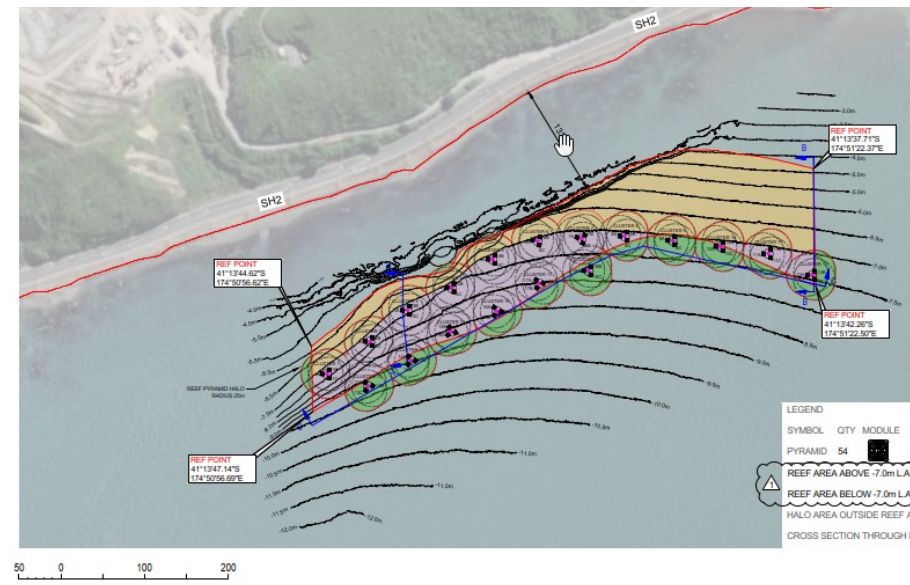
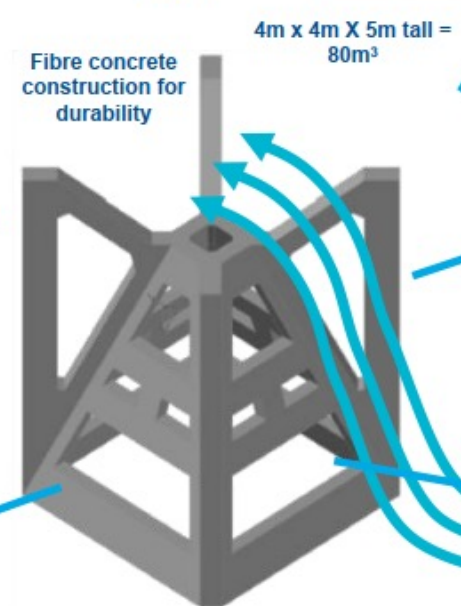




# Reef modules: Options and layout



## TECHNOLOGY



NZ TRANSPORT AGENCY		MMA OFFSHORE	
REV.	DATE	REVISION DESCRIPTION	DRAWN CHECKED ENGINEER APPROVED
1	2003/04	BATHYMETRY UPDATED, WATER DEPTH REVISED	JFR ANJ JFR
0	2004/04	ISSUED FOR CONSTRUCTION	JFR ANJ JFR

54 pyramid units  
5 Ha area  
18 clusters of 3 units



# What we hope to see...



*Parapercis colias*  
New Zealand Blue Cod



*Notalabrus fucicola*  
Purple or Banded Wrasse



*Nemadactylus macropterus*  
Tarakihi



*Odax pullus*  
Butterfish



*Carpophyllum*  
Common Flapjack



*Macrocystis pyrifera*  
Giant Kelp



*Ecklonia radiata*  
Common / Stalked Kelp



*Undaria pinnatifida*  
Wakame



*Notalabrus celidotus*  
Spotty Wrasse



*Fosterygion lapillum*  
Common Triplefin



*Pseudocaranx georgianus*  
Silver Trevally



*Perna canaliculus*  
Green-lipped Mussel



# Part of a wider compensation package

- Seaweed translocation (NIWA)
- Research opportunities with Vic uni and mana whenua (Cultural, biosecurity and adaptive management)
- 5-year monitoring programme:
  - Western science
  - Cultural monitors and indicators
- Revetment including Eco-Enhanced XBlocPlus
- EConcrete tide pools
- Dune restoration



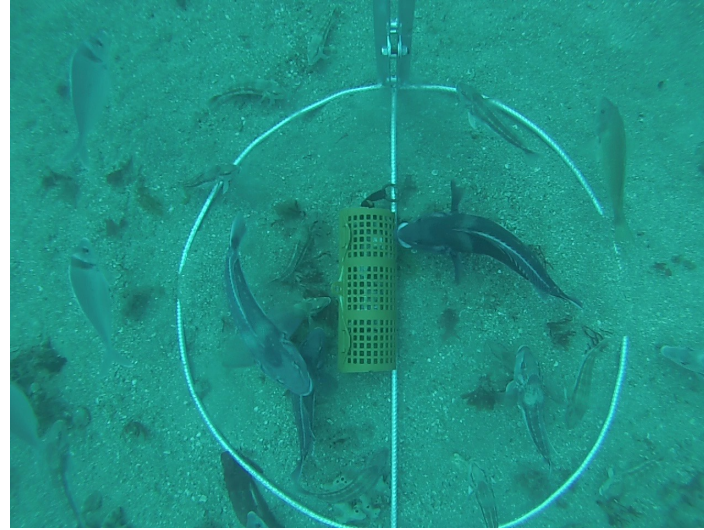
Figure 6: EConcrete® Tide pool (source:EConcrete)





# Where are we now?

- Baseline monitoring just completed
- Pyramid Units currently being fabricated and deployed
- Expect to complete deployment in June
- First monitoring round post deployment in Feb/March 2025





# Sustainability Outcomes

## XblocPlus Units

- Reduced quantity of embodied GHG emissions:
  - Lower volume of armour needed when compared to rock
  - Reduction in heavy transport movements
  - Faster construction programme
- Safer and more efficient placement and post-event repair methodology
- Improved ecological outcomes
- Enabling mana whenua to exercise Kaitiaki over Te Whanganui-a-Tara

## Reef Enhancement

- Increased biodiversity through a high value habitat type that is currently limited
- Minimal seabed impact - reduced footprint when compared to rock piles or a larger number of smaller units
- Multiple ecosystem services - carbon sequestration (e.g. seaweed, shellfish), water filtration, food provisioning
- Enabling mana whenua to exercise Kaitiaki over Te Whanganui-a-Tara

# Karakia Whakamutunga (closing)

ĀIO KI TE RANGI

ĀIO KI TE WHENUA

ĀIO KI TE MOANA

ĀIO KI NGĀ TĀNGATA KATOA

TĪHEI MAURI ORA



# Thank you.







# **Tonkin Gap Project & Associated Works**

Emilie Stenmark  
Tonkin Gap Alliance

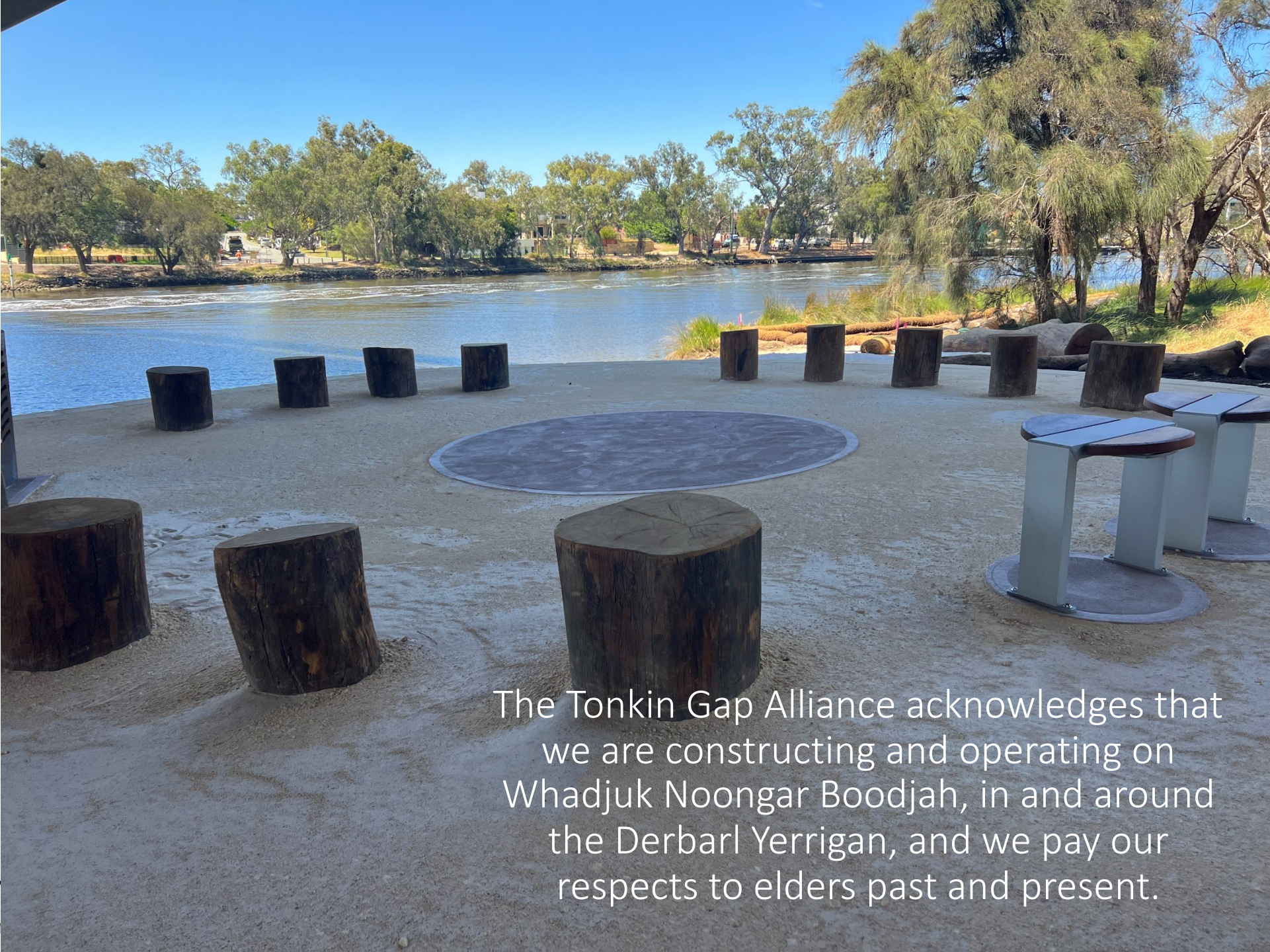


# Tonkin Gap Project & Associated Works

## ISC Innovation Case Study Webinar

Emilie Stenmark - Sustainability Lead





The Tonkin Gap Alliance acknowledges that we are constructing and operating on Whadjuk Noongar Boodjah, in and around the Derbarl Yerrigan, and we pay our respects to elders past and present.



# Project overview



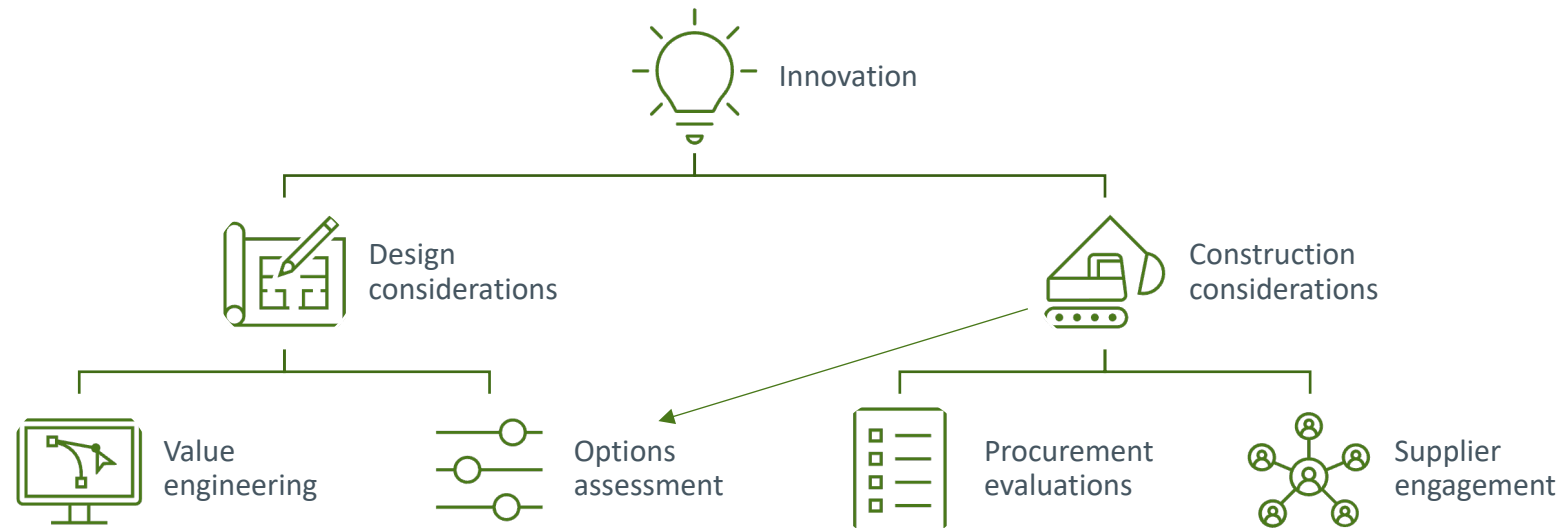
## Tonkin Gap

- Widening of Tonkin Highway between Dunreath Drive to Collier Road
- New bridges over the Swan River and other local roads
- Principle Shared Path

## Associated Works

- Rail-enabling works for the METRONET Morley-Ellenbrook Line
- Includes underpasses and dive structures

# Pathway to innovation



Innovative outcomes are the result of various project processes and multi-disciplinary input coming together to challenge business as usual approaches.





# Outcomes



# Permanent Pre-cast Barrier System

## > Australia First Innovation

↓ Energy 452 tCO<sub>2</sub>e-

↓ Disruption to users

↓ Waste 108 m<sup>3</sup> concrete





# Incinerator Bottom Ash Aggregate (IBAA) Blocks

## > Australia First Innovation

↓ Waste to landfill

↑ Market demand

↓ Virgin materials

↑ Circular economy



# De-lithiated Beta Spodumene (DBS) Blocks

## > Australia First Innovation

↓ Waste to landfill

↓ Virgin materials

↑ Market demand

↑ Circular economy





# Removal of temporary pier

## > Australia First Innovation

↓ Environmental footprint

↓ Disruption to users

↓ Energy 16 tCO<sub>2</sub>e-

↓ Materials 25 t steel





Thank you



# Question & Answer

