



# Landscape propositions

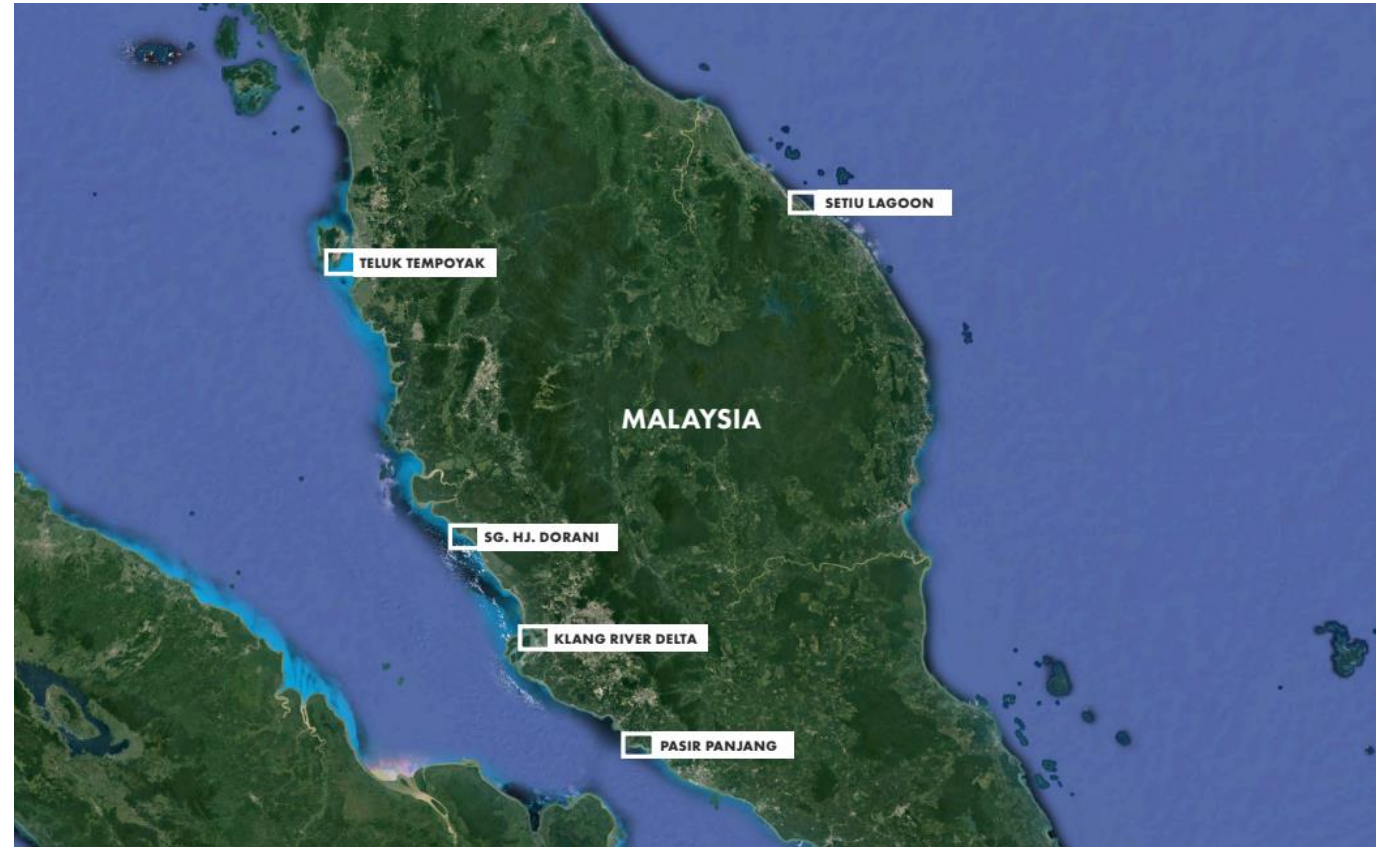
By Yong Huai Mei @ Technical Officer, Wetlands International, Malaysia

20th January 2022

# Five landscape propositions

- Landscape proposition – sites suggested

- ✓ Setiu Lagoon, Terengganu
- ✓ Teluk Tempoyak, Penang
- ✓ Sungai Hj Dorani, Selangor
- ✓ Klang River Delta
- ✓ Pasir Panjang, Negeri Sembilan





An aerial photograph of a coastal lagoon system. The lagoon is a large, irregularly shaped body of water with a complex network of smaller channels and islands. The surrounding land is dark and appears to be forested or densely vegetated. A legend box in the upper right corner contains a small square icon and the text "SETIU LAGOON".

SETIU LAGOON

# SETIU LAGOON

Potential BwN Projects

# SETIU LAGOON, TERENGGANU

## Geographical features:

- Setiu lagoon is to the west of Kuala Terengganu, which is the administrative capital, royal capital and the main economic center of Terengganu, Malaysia.
- The largest natural wetlands in the East Coast region of Peninsular Malaysia
- There is a mixture of riverbank riparian forest, peat swamp, mangroves, brackish lagoons with vegetation and sand islands, seagrass beds and sandy beaches
- There is a diverse array of interconnected ecosystems, namely the sea, beach, mudflat, lagoon, estuary, river, islands, coastal forest and mangrove forest
- Setiu lagoon is now composed of sandy bottom rather than of silt or clay that usually brought by the active riverine system/discharge.





# STRESSES SETIU LAGOON



In-coming high tides

New inlet

Removal of sand via dredging will disturb the benthos

○ Salinization

Extensive sand accumulation caused by the imbalance between inadequate freshwater discharge and in-coming high tides

mangrove

○ Nutrient loading due to high densities of palm oil plantations and shrimp farms and floating cages

Old inlet



Inadequate freshwater discharge

due to  
1. land-use conversions (oil palm plantations, aquaculture ponds, etc.)  
2. the changes in hydrodynamics due to river mouth shift (8km apart)

Sand accumulation has proved detrimental to mangroves

- Sand accumulation in mangroves covering mangrove root systems
- Widespread lobster mounts to alter the inundation frequencies
- Elevated grounds gradually conquered by the terrestrial vegetation

Palm oil plantation

kampung saujana

wetland/ponds





# BWN OPPORTUNITIES SETIU LAGOON

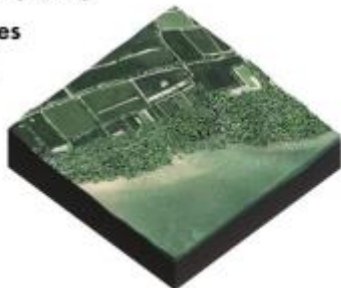


## Coastal strategies:

- To recover the mangrove system impacted by the sand accumulation by increasing upstream freshwater discharge to balance with in-coming high tides, which bring in the marine sand. The recovered mangroves will provide more opportunities for local fisheries and more resources for local people.
- To include hydrodynamics studies before the project construction in laws or regulations
- Sustainable aquaculture can achieve by lowering the nutrient loading from aquaculture by IMTA, which uses waste from one aquatic species as inputs for another. Thereby, local aquaculture can go hand in hand with environmental conservation.
- To involve BwN projects in the Coastal Zone Management plans

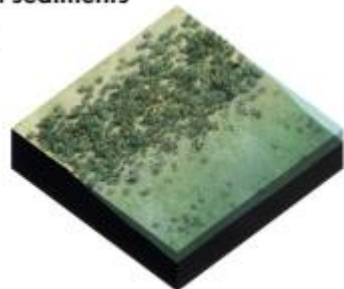
## Rehabilitating mangrove areas

- **restore mangroves**
- contain the proper bacteria to degrade **pollutants**
- **attenuate waves**
- **create habitat**



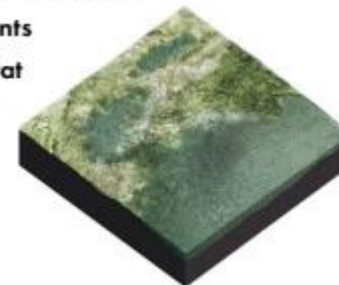
## Growing salt marshes

- **maintain and filter water from aquaculture farms**
- **trap pollutants in sediments**
- **attenuate waves**
- **create habitat**



## Restoring wetland areas

- **maintain fresh water**
- **filter polluted water from aquaculture farms**
- **trap sediments**
- **create habitat**





# LANDSCAPE PROPOSITIONS SETIU LAGOON



CONSTRUCTING BIOSWALES

existing ditches

WIDENING DITCHES

existing ditches

PLANTING WETLAND SPECIES

RESTORING WETLAND AREAS

CONSTRUCTING BIOSWALES

INTEGRATED MULTI-TROPIC AQUACULTURE

WATERWAY CREATING

BRACKISH MARSH PLANTING

1e

1c

1d

1b

1a

4

2

3



# STAKEHOLDERS AND CO-BENEFITS SETIU LAGOON





A grayscale satellite map of a coastal region. The land is dark and textured, showing topography and vegetation. The water is a lighter gray. A white rectangular box with a small square icon to its left is positioned on the left side of the landmass. The text 'TELUK TEMPOYAK' is written in white, uppercase letters inside the box. In the center of the landmass, the text 'TELUK TEMPOYAK' is written in a larger, bold, white, uppercase font, with 'Potential BwN Projects' written below it in a smaller, white, uppercase font. The overall image has a dark, monochromatic aesthetic.

TELUK TEMPOYAK

# TELUK TEMPOYAK

Potential BwN Projects



## TELUK TEMPOYAK, BAYAN LEPAS, PULAU PINANG

### Geographical and economic features:

- Teluk Tempoyak is a fishing village
- Bayan Baru is a city built in 1972 along with industrial zone development
- Penang Island is with a hilly and mostly forested interior and its coastal plains are narrow.
- Due to land scarcity, land reclamation projects have been undertaken in high-demand areas.



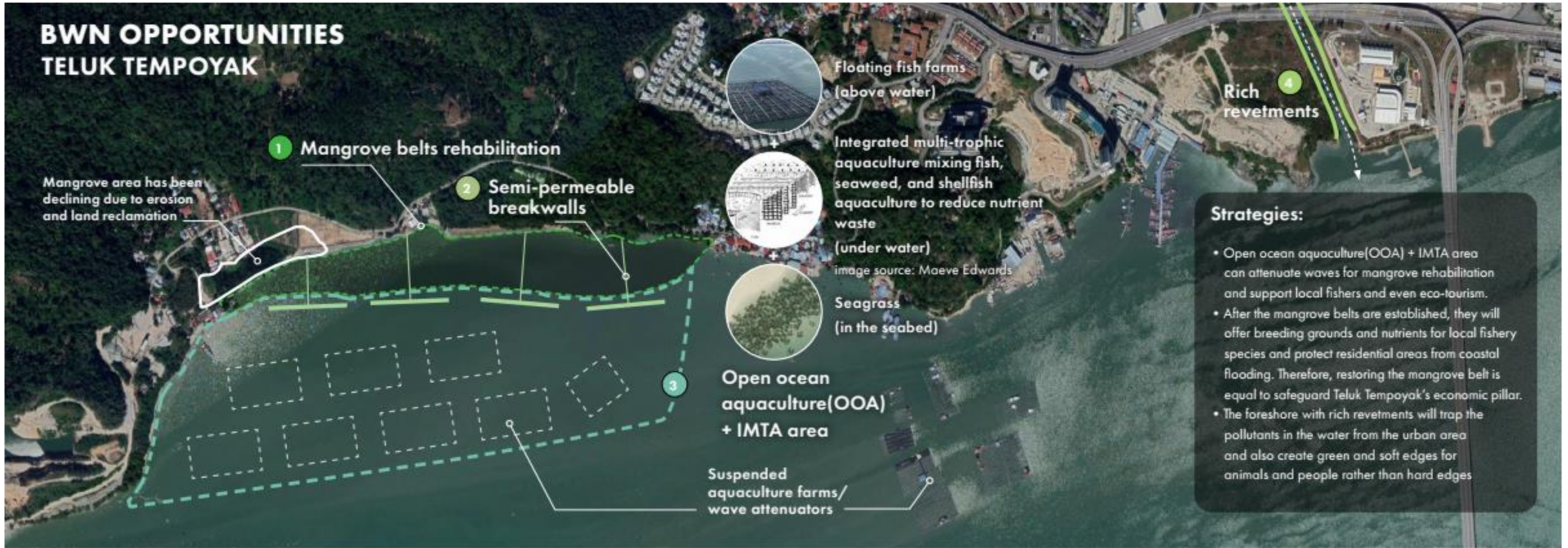


# STRESSES TELUK TEMPOYAK





# BWN OPPORTUNITIES TELUK TEMPOYAK



Mangrove area has been declining due to erosion and land reclamation

1 Mangrove belts rehabilitation

2 Semi-permeable breakwalls



Floating fish farms (above water)



Integrated multi-trophic aquaculture mixing fish, seaweed, and shellfish aquaculture to reduce nutrient waste (under water)

image source: Maeve Edwards



Seagrass (in the seabed)

3 Open ocean aquaculture (OOA) + IMTA area

Suspended aquaculture farms/wave attenuators

4 Rich revetments

**Strategies:**

- Open ocean aquaculture (OOA) + IMTA area can attenuate waves for mangrove rehabilitation and support local fishers and even eco-tourism.
- After the mangrove belts are established, they will offer breeding grounds and nutrients for local fishery species and protect residential areas from coastal flooding. Therefore, restoring the mangrove belt is equal to safeguard Teluk Tempoyak's economic pillar.
- The foreshore with rich revetments will trap the pollutants in the water from the urban area and also create green and soft edges for animals and people rather than hard edges

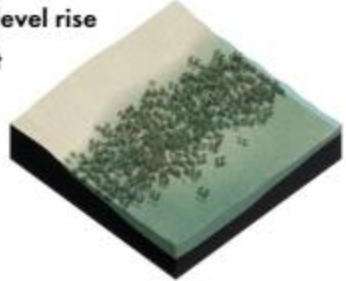
## Creating hanging and floating structures

- in shape of OOA + IMTA on site
- reduce erosion by absorbing wave energy
- withstand storm winds and waves
- filter water by filter-feeders
- produce economic fishery species
- create habitats



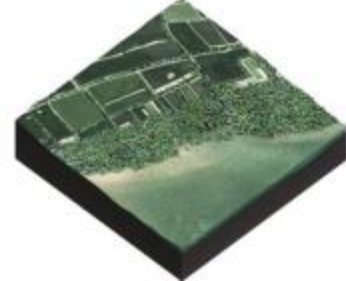
## Establishing seagrass meadows

- trap sediments (thus limiting erosion)
- attenuate waves
- adapt to sea level rise
- create habitat



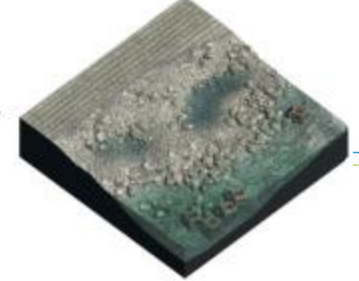
## Rehabilitating mangrove areas

- facilitate soil formation and raise and stabilize the land to adapt to sea level rise
- attenuate waves
- create habitat
- support fisheries



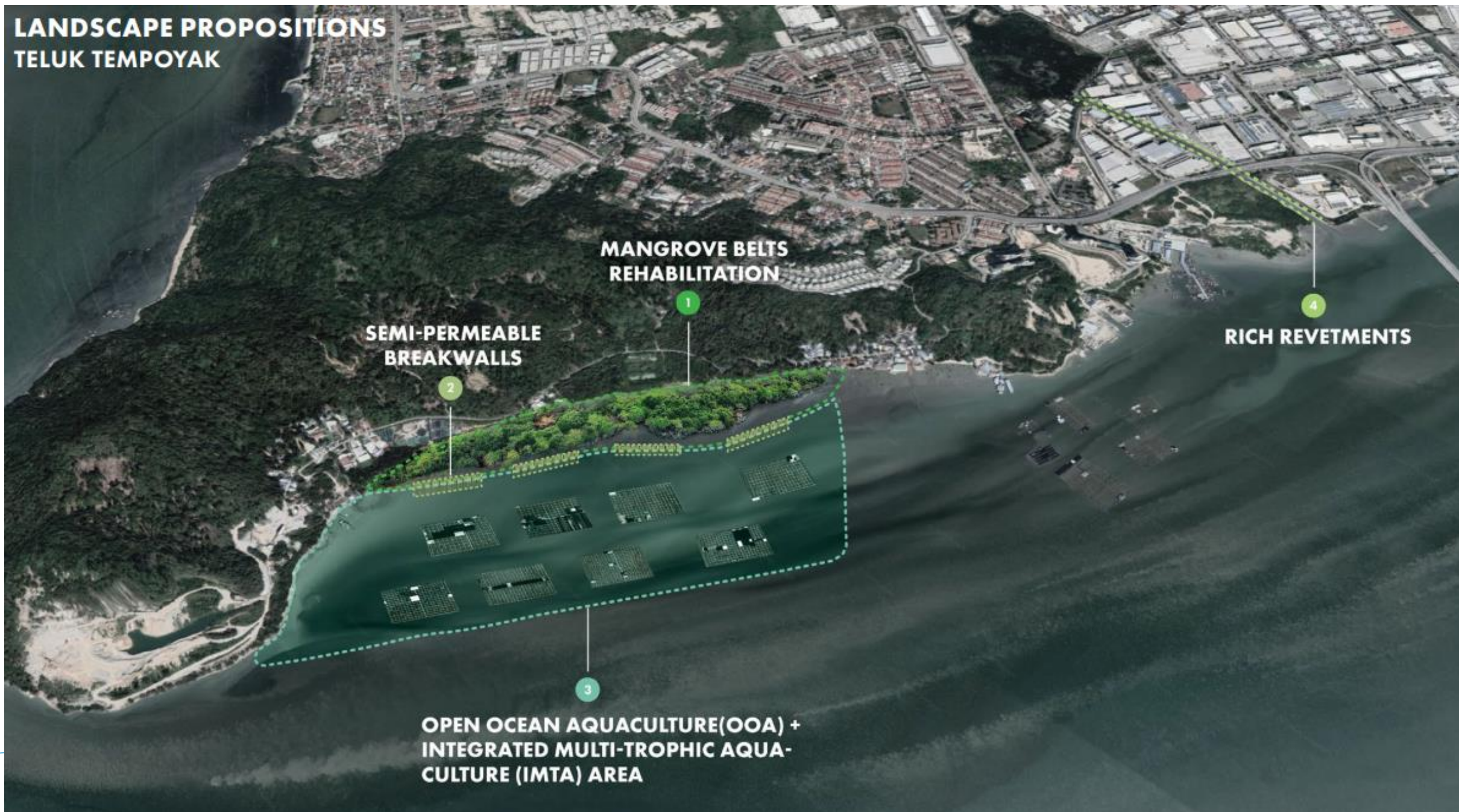
## Creating rich revetments

- varied and textured surface can create habitats for species that can improve water quality
- attenuate waves
- reduce erosion for the river banks





# LANDSCAPE PROPOSITIONS TELUK TEMPOYAK



**MANGROVE BELTS  
REHABILITATION**

1

**SEMI-PERMEABLE  
BREAKWALLS**

2

**RICH REVETMENTS**

4

**OPEN OCEAN AQUACULTURE(OOA) +  
INTEGRATED MULTI-TROPHIC AQUA-  
CULTURE (IMTA) AREA**

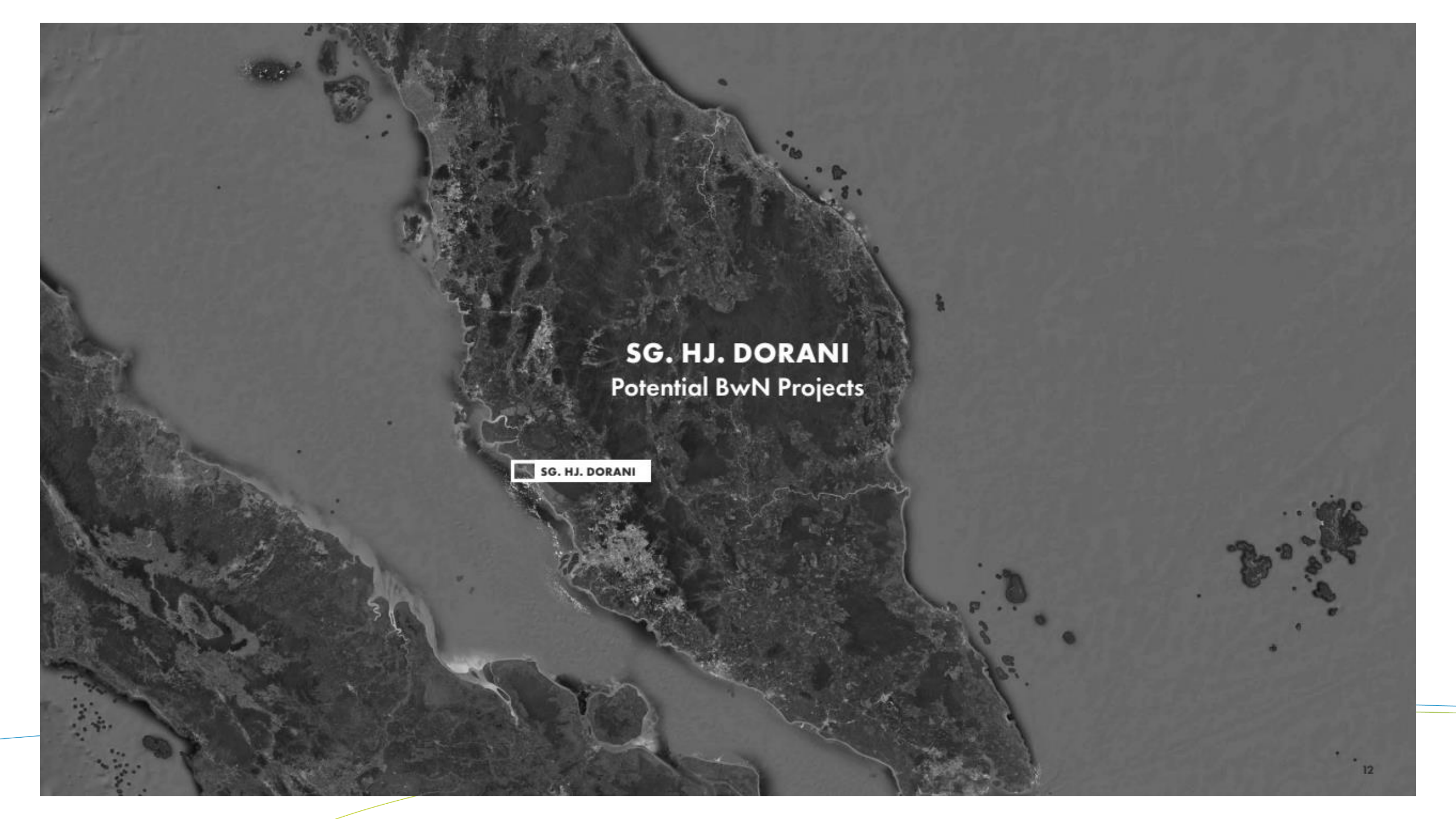
3



# STAKEHOLDERS AND CO-BENEFITS TELUK TEMPOYAK






A grayscale satellite map of a coastal region. The land is dark and textured, showing various terrain features and some structures. The water is a lighter, uniform gray. A white text box is centered on the land, and a smaller white box with a small square icon is located below it. The overall image has a high-contrast, grainy appearance typical of satellite imagery.

## **SG. HJ. DORANI**

Potential BwN Projects

 **SG. HJ. DORANI**



## SG. HJ. DORANI, SABAK BERNAM, SELANGOR

### Geographical and economic features:

- Sg. Hj. Dorani is situated in Sungai Besar, a coastal town in the district of Sabak Bernam in Selangor
- Sg. Hj. Dorani has a flat coastal area
- Coastal bunds were built during the years 1932-42 for land reclamation and agriculture extension
- Agriculture and fisheries are Sabak Bernam's main economic activities
- Mangrove areas

In 2005 the site was chosen as a pilot site to test on different mangrove replanting technique post tsunami. Success has been seen when FRIM managed to replant the mangrove since 2007 with the aid of geotube installed by DID.

About 800m away, another breakwater was (L-Block) installed by researcher from UM.

The purpose for geotube and L-Block was to slow down the impact of waves and provide a calmer area for the replanted mangrove to survive.





# STRESSES

## SG. HJ. DORANI

### Existing erosion-mitigation techniques:

- Primary breakwater: geotube and concrete L-block
- Secondary breakwater: geo-materials (coir log, brush fascines, and geo-piles)

### Geotubes:

#### Advantages:

- fast execution, lightweight, simple equipment requirement, and effectiveness in coastal protection

#### Disadvantages:

- the lower resistance of geotextile to damage, since the geotube were filled with sand slurry, once the filling materials spill out, the height of the tube decreased and so did their performance in wave dissipation and sediment accumulation.

(Siew Cheng Lee, et al., 2014)

Sea level rise

Proposed Wetland International mangrove rehabilitation site

SAUH Revetment, DID-1991

Geotubes

Mangrove degradation due to severe erosion

New mangrove forest was successfully rehabilitated. However, erosion in this area is becoming more severe and plenty of original mangrove trees have collapsed and uprooted.

Limited knowledge transfer between government agencies, NGOs, and researchers/institution on the status and trend of BwN





# BWN OPPORTUNITIES SG. HJ. DORANI



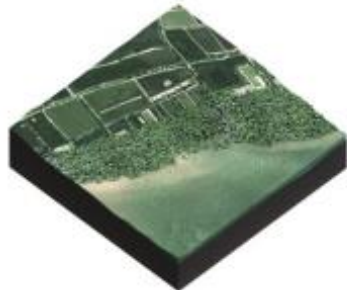
**Strategies:**

Instead of placing geotube and other hard structures which are costly, we proposed grey-grey infrastructures to stabilize the coastline.

- Shellfish reefs as primary breakwaters and salt marshes and semi-permeable breakwall as secondary wave attenuators can reduce erosion for mangrove rehabilitation. Shellfish reefs can also offer local fishers aquaculture areas and provide food and habitat for local fishery species.
- After the mangrove belts are established, they will offer breeding grounds and nutrients for local fishery species and protect farmlands from coastal flooding. Therefore, restoring the mangrove belt is equal to safeguard Dorani's economic pillar.

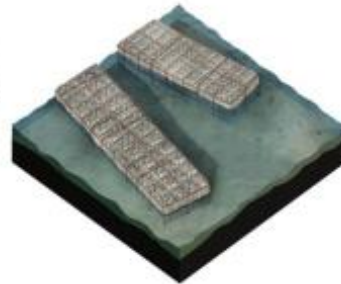
## Rehabilitating mangrove areas

- facilitate soil formation and raise and stabilize the land to adapt to sea level rise
- attenuate waves
- create habitat
- support fisheries



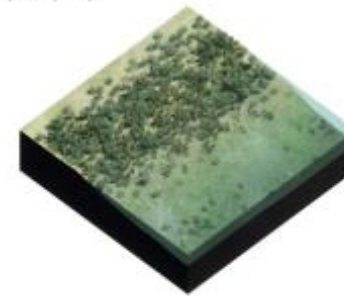
## Building shellfish reefs

- reduce erosion by trapping sediment
- withstand storm winds and waves
- filter water by filter-feeders
- produce oysters and mussels
- support habitats for numerous other fishery species



## Enhancing salt marsh development

- maintain and filter water from aquaculture farms
- trap pollutants in sediments
- reduce erosion





**LANDSCAPE PROPOSITIONS**  
**SG. HJ. DORANI**

**1**  
**MANGROVE BELTS REHABILITATION**

**2**  
**SEMI-PERMEABLE  
BREAKWALLS**

**3**  
**BUILDING SHELLFISH REEFS**

**4**  
**SALT MARSH  
BELT**

Rehabilitated mangrove forest





# STAKEHOLDERS AND CO-BENEFITS

## SG. HJ. DORANI





A grayscale satellite map of the Klang River Delta region. The map shows a complex network of waterways and landmasses. A white text box is overlaid on the central part of the map, containing the title and subtitle. Another white text box with a small square icon is located below the main title.

# KLANG RIVER DELTA

Potential BwN Projects

 KLANG RIVER DELTA



# KLANG RIVER DELTA

## Geographical and economic features:

- Klang river flows through Kuala Lumpur and Selangor and eventually flows into the Straits of Malacca
- It flows through Klang Valley, which is a heavily populated area of more than four million people
- It has 11 major tributaries
- Two major dams in upstream of the river: Batu Dam and Klang Gates Dam, which provide water supply to the people of Klang Valley and mitigate floods

## Existing flood mitigation projects:

- Kuala Lumpur Flood Mitigation
  - mitigate flash floods from Gombak River into a few stormwater ponds
- SMART Tunnel
  - carry storm runoff and function as gigantic storm drain, drainage infrastructure is overwhelmed
- Clean Up Efforts
  - river cleaning, new source of drinking water, environmental protection, flood mitigation, commercial, tourism and land development activities





## STRESSES KLANG RIVER DELTA



**North Port:**  
a terminal of container to transship the coal, oil, and other chemical products

Sea level rise

**South Port:**  
a terminal jetty for fishing boats, ferries, and yachts

**West Port:**  
a main container terminal + industrial complex

Microplastic pollution and Heavy metal water pollution (contamination of Cd, As, Pb, and Hg were between moderate and high contamination in sediments)

Deep siltation

Fluvial flood/Flash flood  
an inability of rivers and drainage systems to handle the flow of water



# BWN OPPORTUNITIES KLANG RIVER DELTA

## Coastal strategies:

- Retention zones and overflow parks to detain and infiltrate stormwater, thus mitigate the flash flood. They also offer recreational destinations and will regulate urban micro-climate.
- Hanging and floating structures, green quay walls, and mangrove conservation to mitigate water pollution
  - filter-feeders can remove heavy metals (especially for Cd) by bioaccumulation
  - mangroves can trap pollutants and sediment.
- Regulations, land, and tax-based instruments to incentivize circular economy, biodegradable material, and reducing and recovery of plastic waste to reduce microplastic pollution and greenhouse gas emissions.

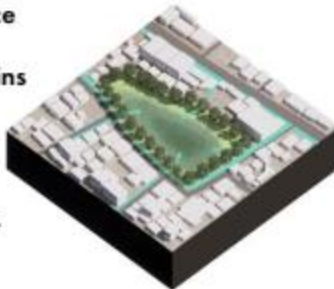


• I want to figure out the land ownership of project 2, public or private?

• If they are private, is it possible to apply BwN projects on it?

### Creating retention parks

- change the existing topo of vacant land or green space in the city as retention basins
- detain stormwater
- regulate microclimates



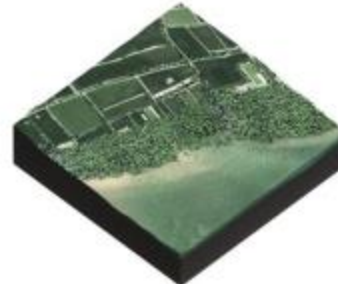
### Creating hanging and floating structures

- filter polluted water by filter-feeders growing on the structures
- create habitats



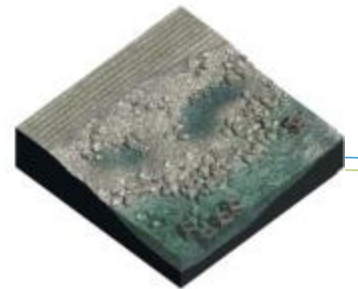
### Conserving mangrove areas

- facilitate soil formation and raise and stabilize the land to adapt to sea level rise
- attenuate waves
- create habitat
- support fisheries



### Green quay walls

- varied and textured surface can create habitats for species that can improve water quality
- attenuate waves
- reduce erosion





# LANDSCAPE PROPOSITIONS KLANG RIVER DELTA





# STAKEHOLDERS AND CO-BENEFITS


## KLANG RIVER DELTA





A grayscale satellite map of a coastal region, likely Pasir Panjang in Singapore. The map shows a large landmass on the left and center, with a coastline that is irregular and includes several small islands and peninsulas. The surrounding water is a uniform light gray. The text 'PASIR PANJANG' and 'Potential BwN Projects' is overlaid on the central part of the landmass.

**PASIR PANJANG**  
Potential BwN Projects

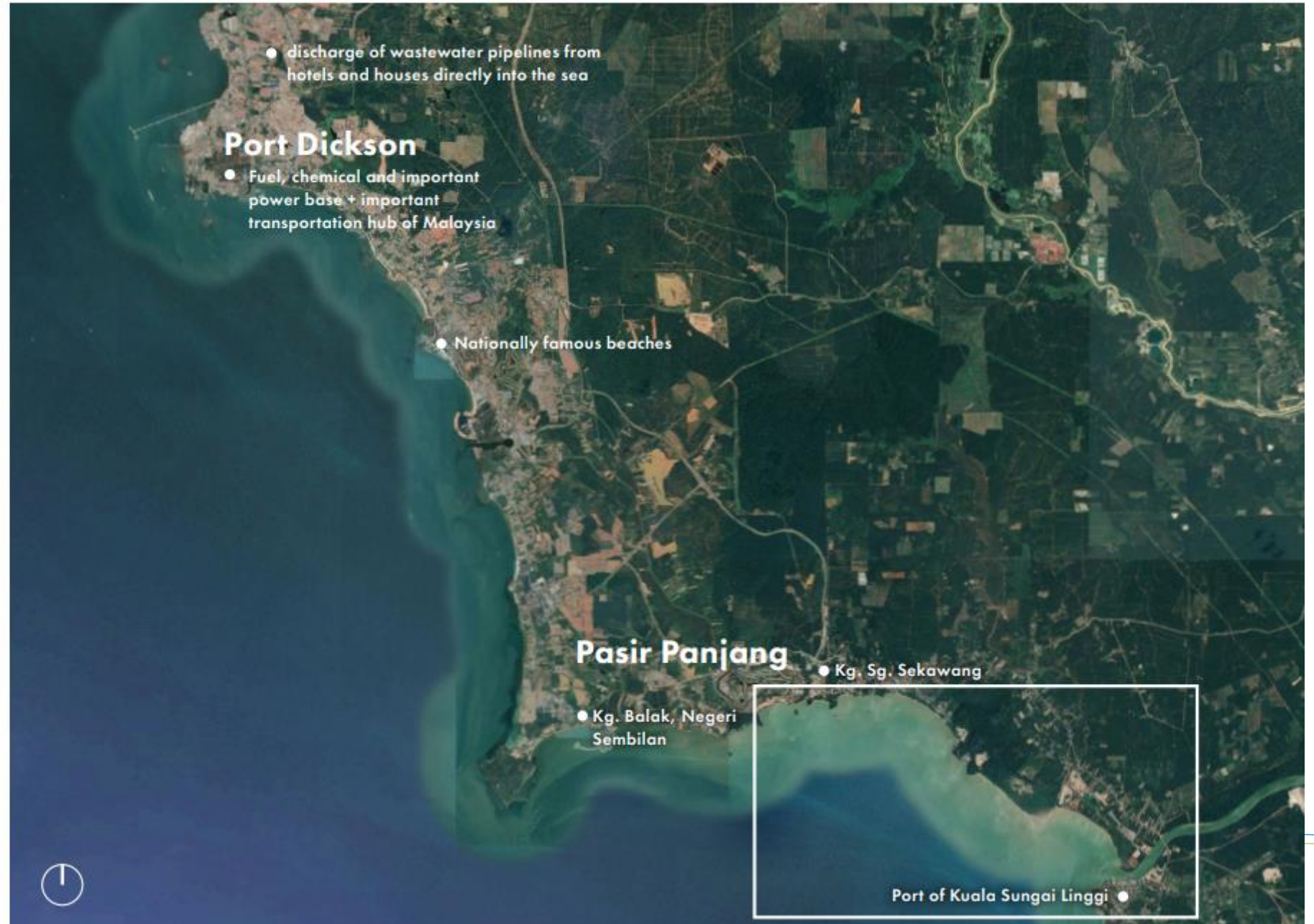
 PASIR PANJANG



# PASIR PANJANG, PORT DICKSON, NEGERI SEMBILAN

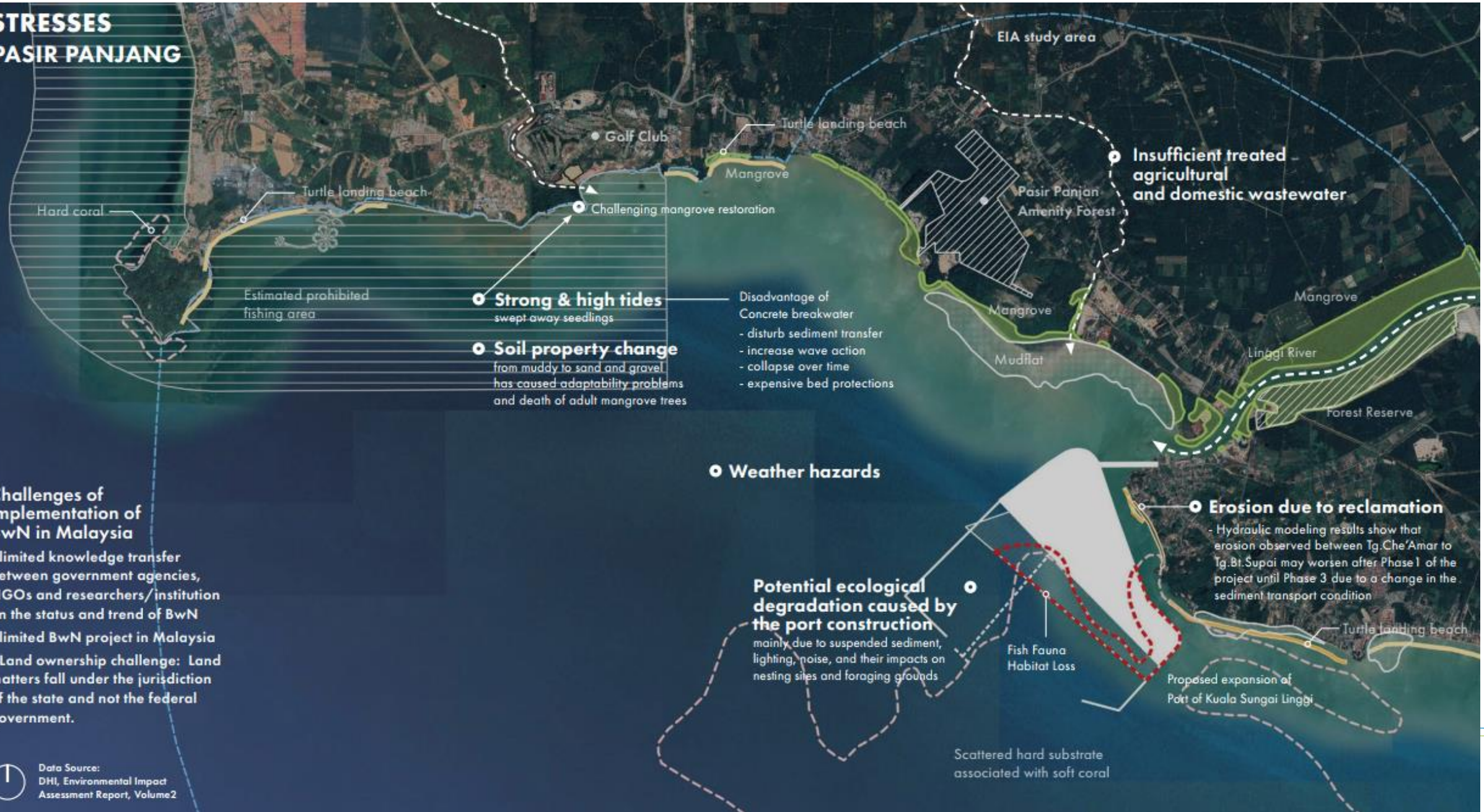
## Geographical and economic features:

- Pasir Panjang is located on the coast of two villages: Kg. Sg. Sekawang and Kg. Balak
- It is a tourist attraction
- There are nationally famous beaches on the 15 km long west coast
- There are a large number of cockles and oysters on the seabed rocks
- Port Dickson is the fuel, chemical and important power base + important transportation hub of Malaysia





# STRESSES PASIR PANJANG



- **Strong & high tides**  
swept away seedlings
- **Soil property change**  
from muddy to sand and gravel  
has caused adaptability problems  
and death of adult mangrove trees

- Disadvantage of  
Concrete breakwater
- disturb sediment transfer
  - increase wave action
  - collapse over time
  - expensive bed protections

## ● Weather hazards

- ## ● Erosion due to reclamation
- Hydraulic modeling results show that erosion observed between Tg.Che'Amar to Tg.Bt.Supai may worsen after Phase 1 of the project until Phase 3 due to a change in the sediment transport condition

- ## Potential ecological degradation caused by the port construction
- mainly due to suspended sediment, lighting, noise, and their impacts on nesting sites and foraging grounds

Fish Fauna  
Habitat Loss

Scattered hard substrate  
associated with soft coral

## Challenges of implementation of BwN in Malaysia

- limited knowledge transfer between government agencies, NGOs and researchers/institution on the status and trend of BwN
- limited BwN project in Malaysia
- Land ownership challenge: Land matters fall under the jurisdiction of the state and not the federal government.



# BWN LANDSCAPE PROPOSITION PASIR PANJANG

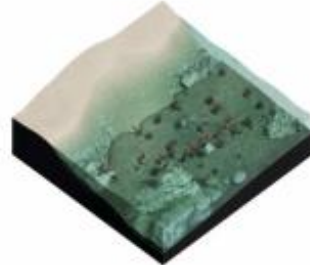
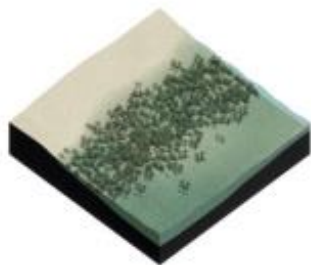
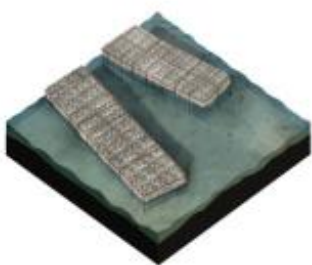
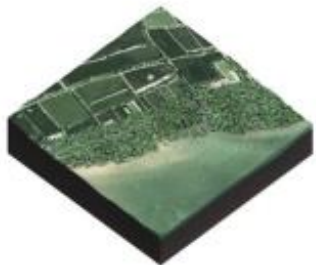


Rehabilitating mangrove belts

Building shellfish reefs

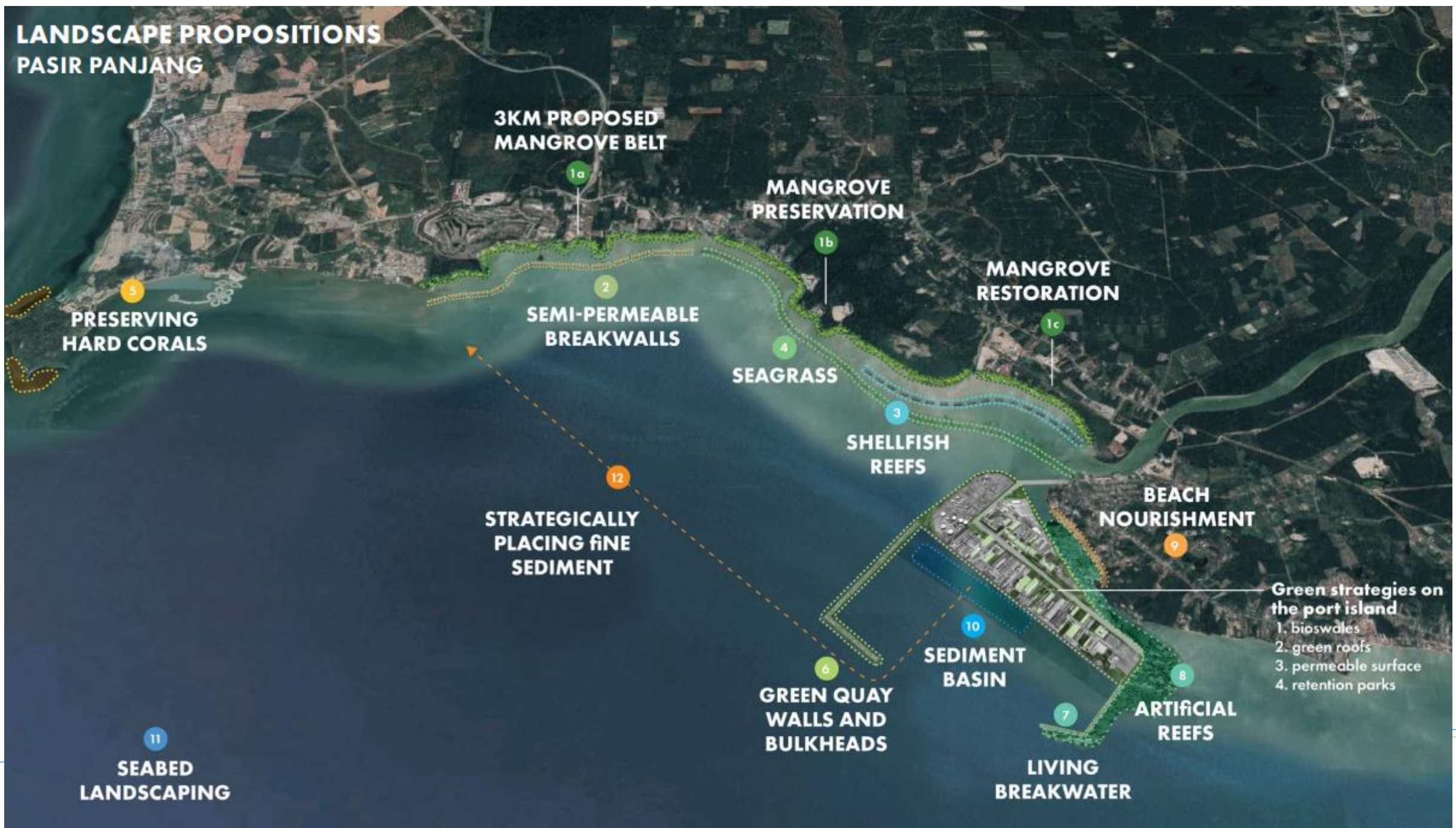
Restoring seagrass meadows

Facilitating coral development





# LANDSCAPE PROPOSITIONS PASIR PANJANG



3KM PROPOSED  
MANGROVE BELT

MANGROVE  
PRESERVATION

MANGROVE  
RESTORATION

PRESERVING  
HARD CORALS

SEMI-PERMEABLE  
BREAKWALLS

SEAGRASS

SHELLFISH  
REEFS

BEACH  
NOURISHMENT

STRATEGICALLY  
PLACING FINE  
SEDIMENT

GREEN QUAY  
WALLS AND  
BULKHEADS

SEDIMENT  
BASIN

ARTIFICIAL  
REEFS

LIVING  
BREAKWATER

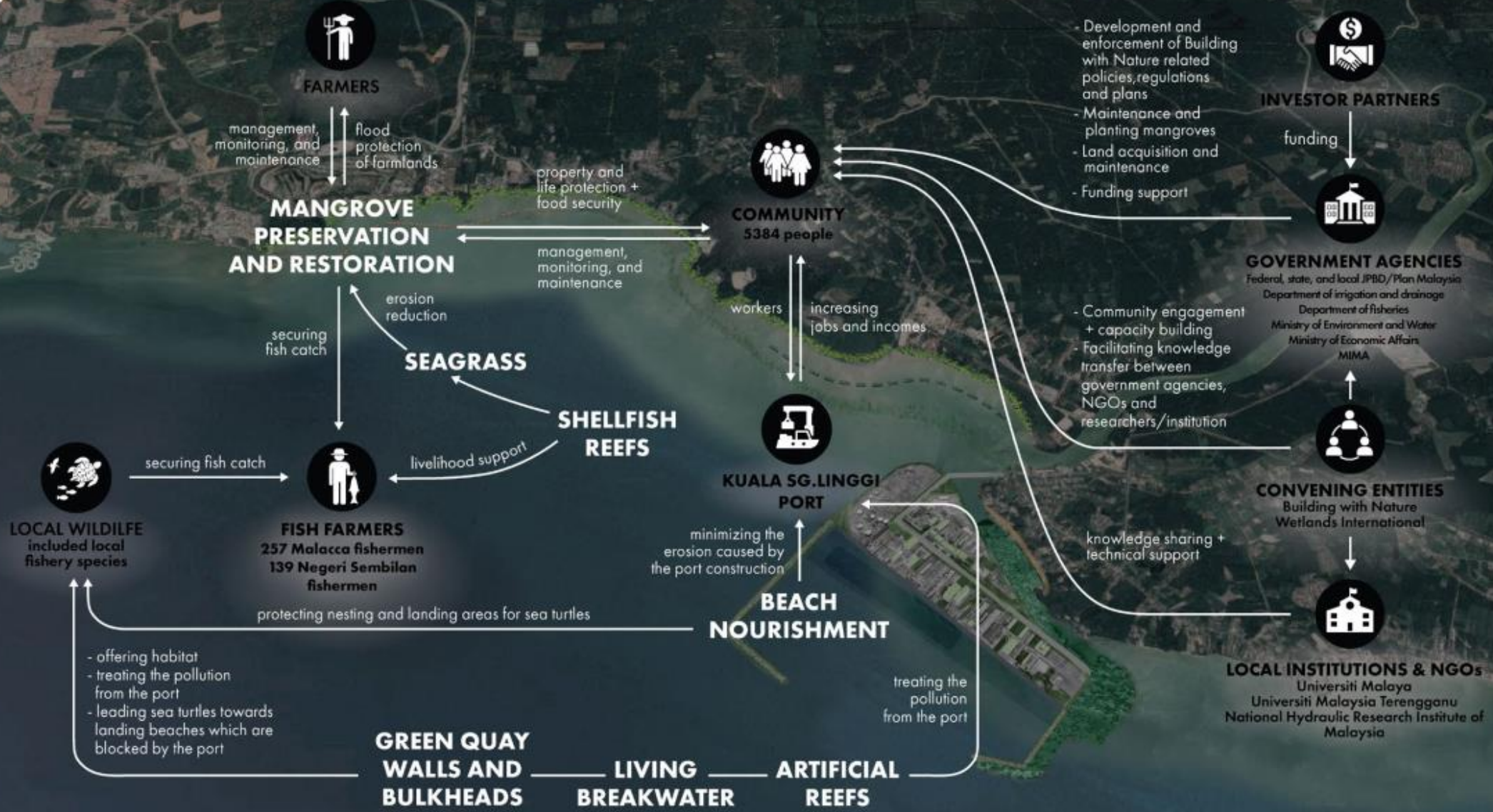
SEABED  
LANDSCAPING

Green strategies on  
the port island

- 1. bioswales
- 2. green roofs
- 3. permeable surface
- 4. retention parks



# STAKEHOLDERS AND CO-BENEFITS PASIR PANJANG





# Discussion point

- Any new site suggestion?
- Suitability of site?
  - ✓ Fits into priorities (sub)national development plan?
  - ✓ Fits into (sub)national priorities on NBS?
- Hazard/ risk to be addressed – adequately?
- Building with Nature opportunities – feasible?
- Stakeholder engagement & local community involvement
  - ✓ Existing groundwork/ network
  - ✓ Stakeholder buy in
  - ✓ Socio-economic impact
  - ✓ Investment case/ business case
  - ✓ Alignment potential



Share your story  
#PowerofWetlands

