The Evolution of the Artificial Wildbird Tidal Mudflat in Fukuoka, Japan

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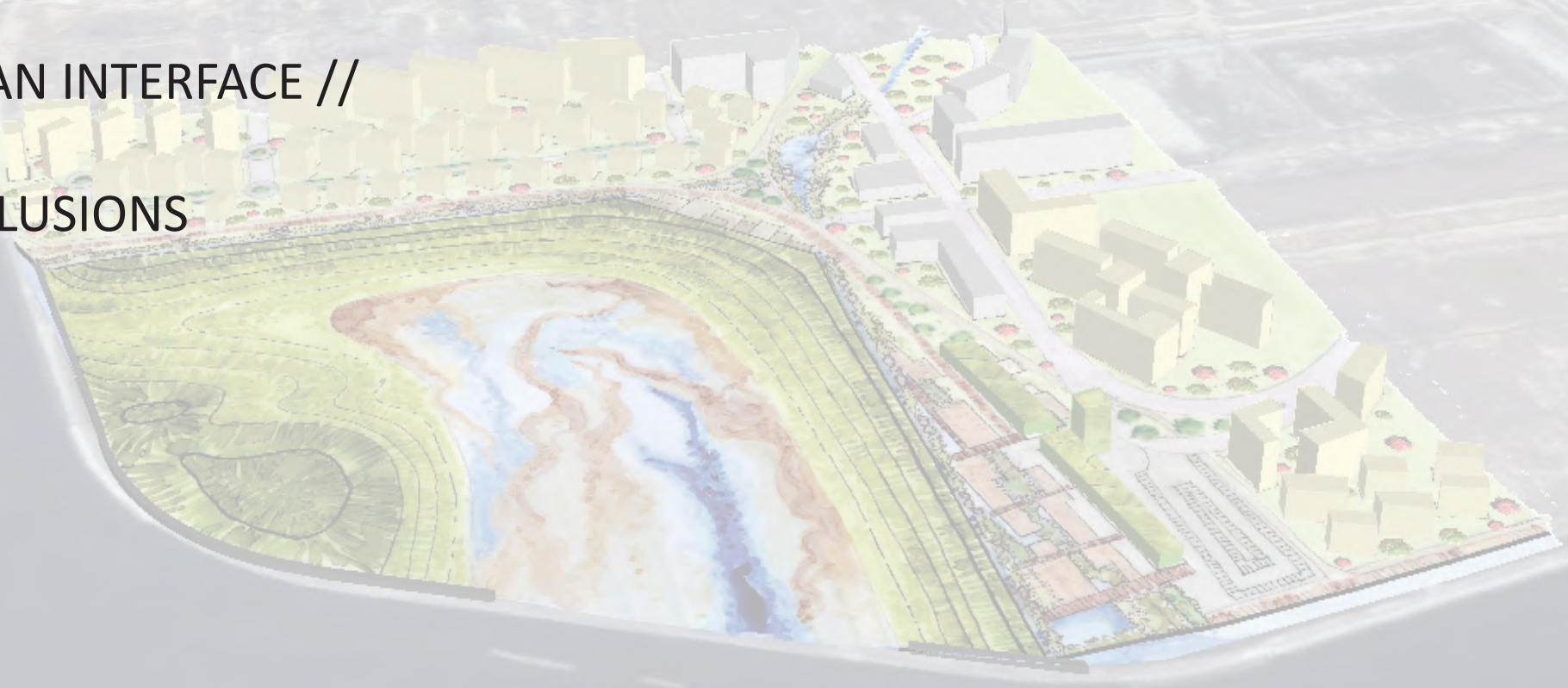
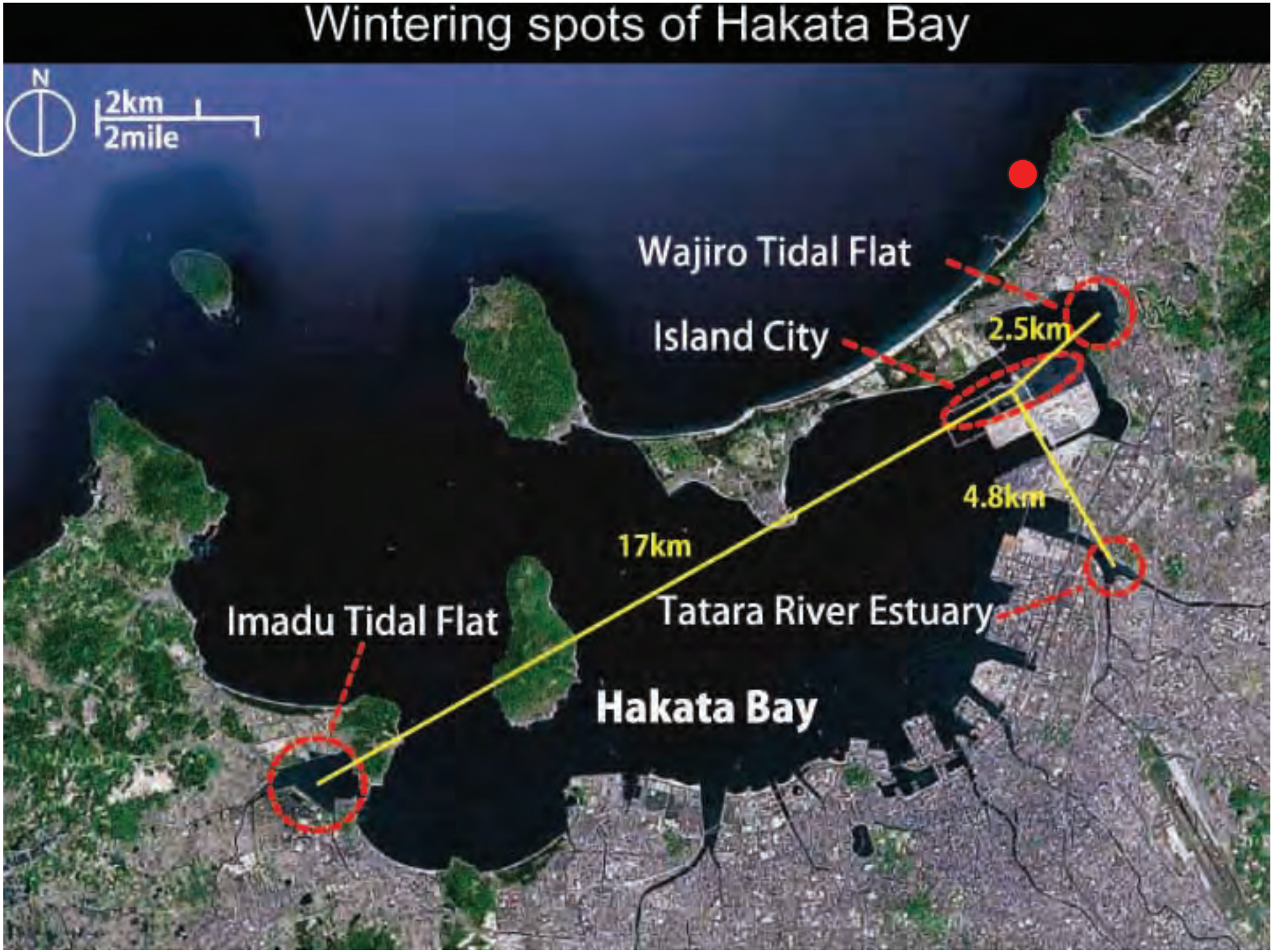
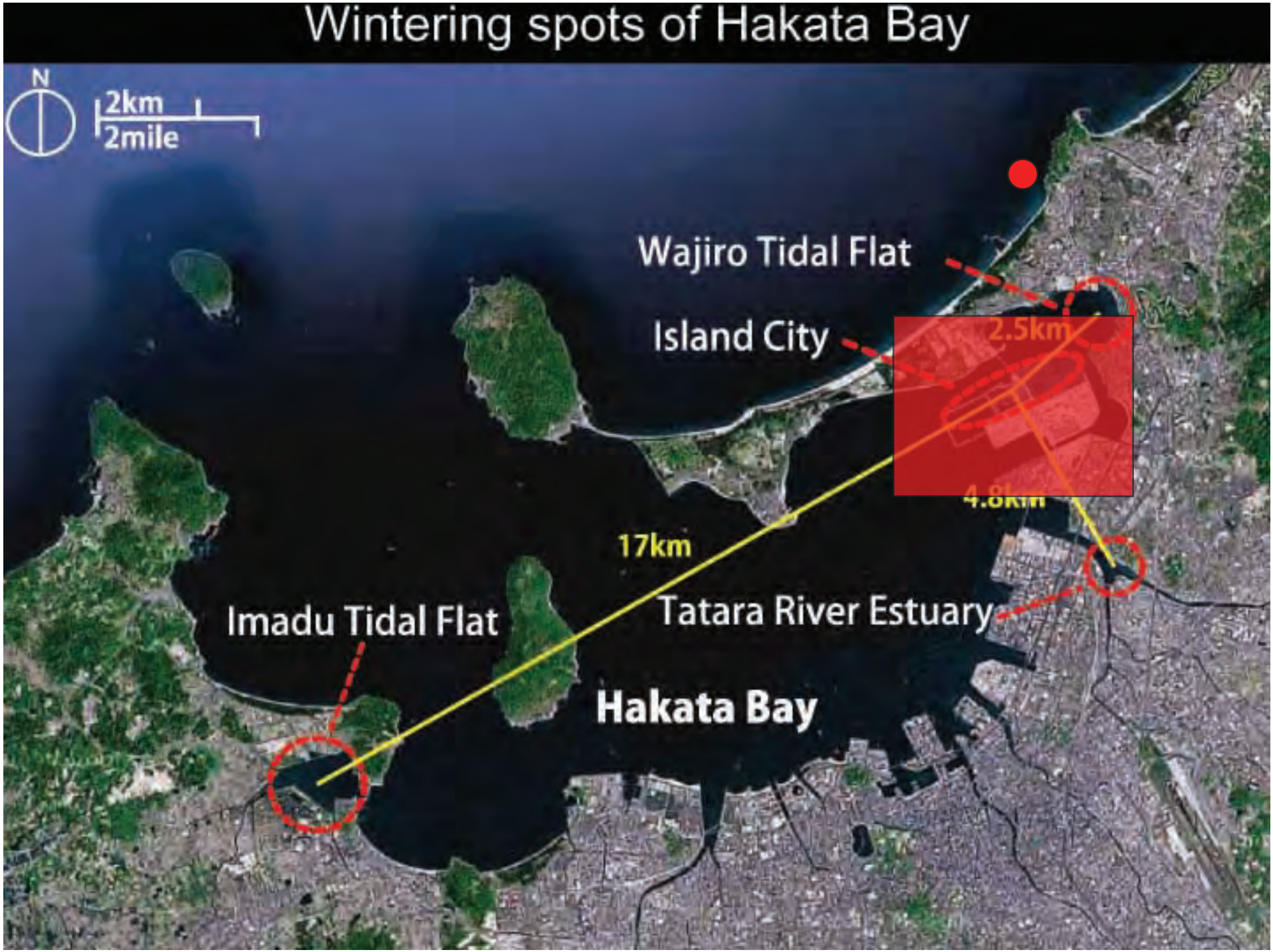


CONTEXT


Russia
China
North Korea
South Korea
Japan
Hakata Bay
Hong Kong
Macao
Taiwan
Philippines
Vietnam
Tsuyazaki
Wajiro
Tidal-flat
Island-city
Fukuoka Bay
Hakata Bay
Tatara River
Estuary
Imazu
Tidal-flat
Kafuri Bay


Wintering spots of Hakata Bay
N
2km
2mile
Wajiro Tidal Flat
Island City
2.5km
4.8km
17km
Imadu Tidal Flat
Tatara River Estuary
Hakata Bay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2km
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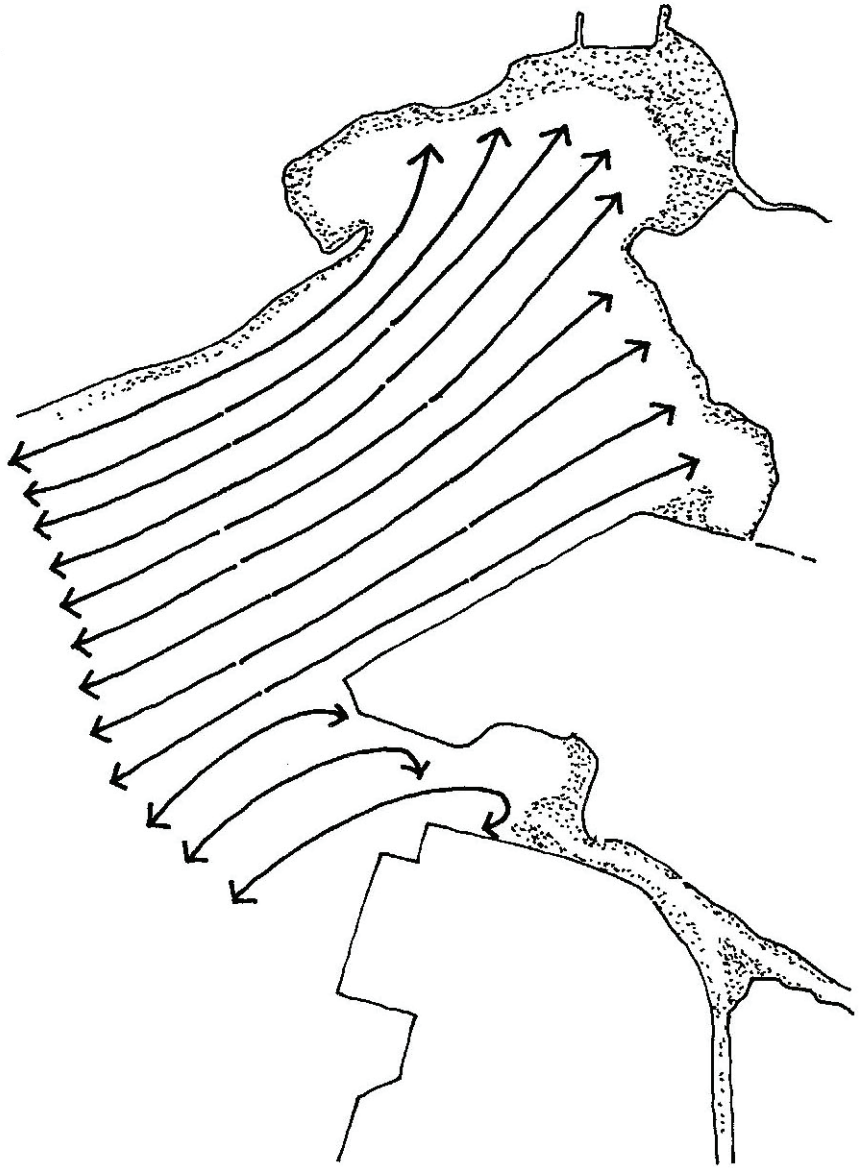
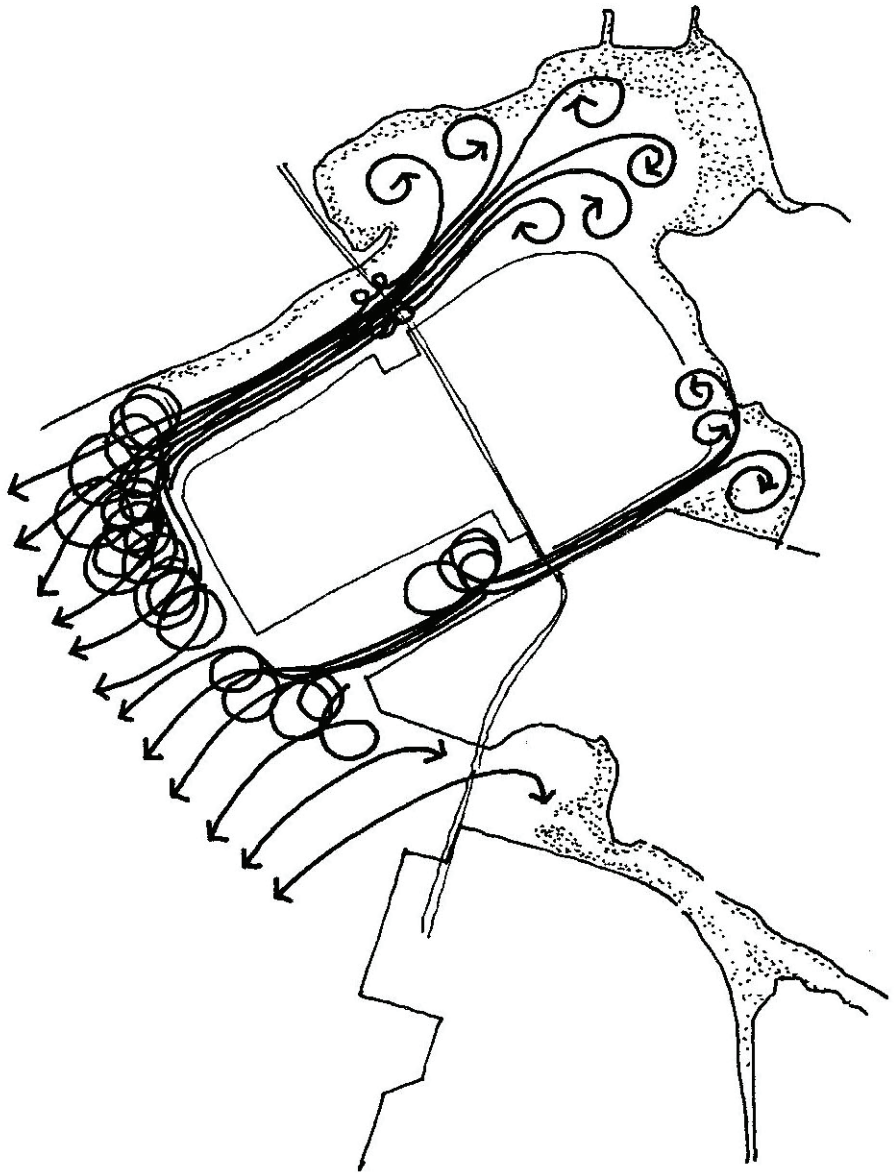
Imadu Tidal Flat
Hakata Bay

CONTEXT

BEFORE

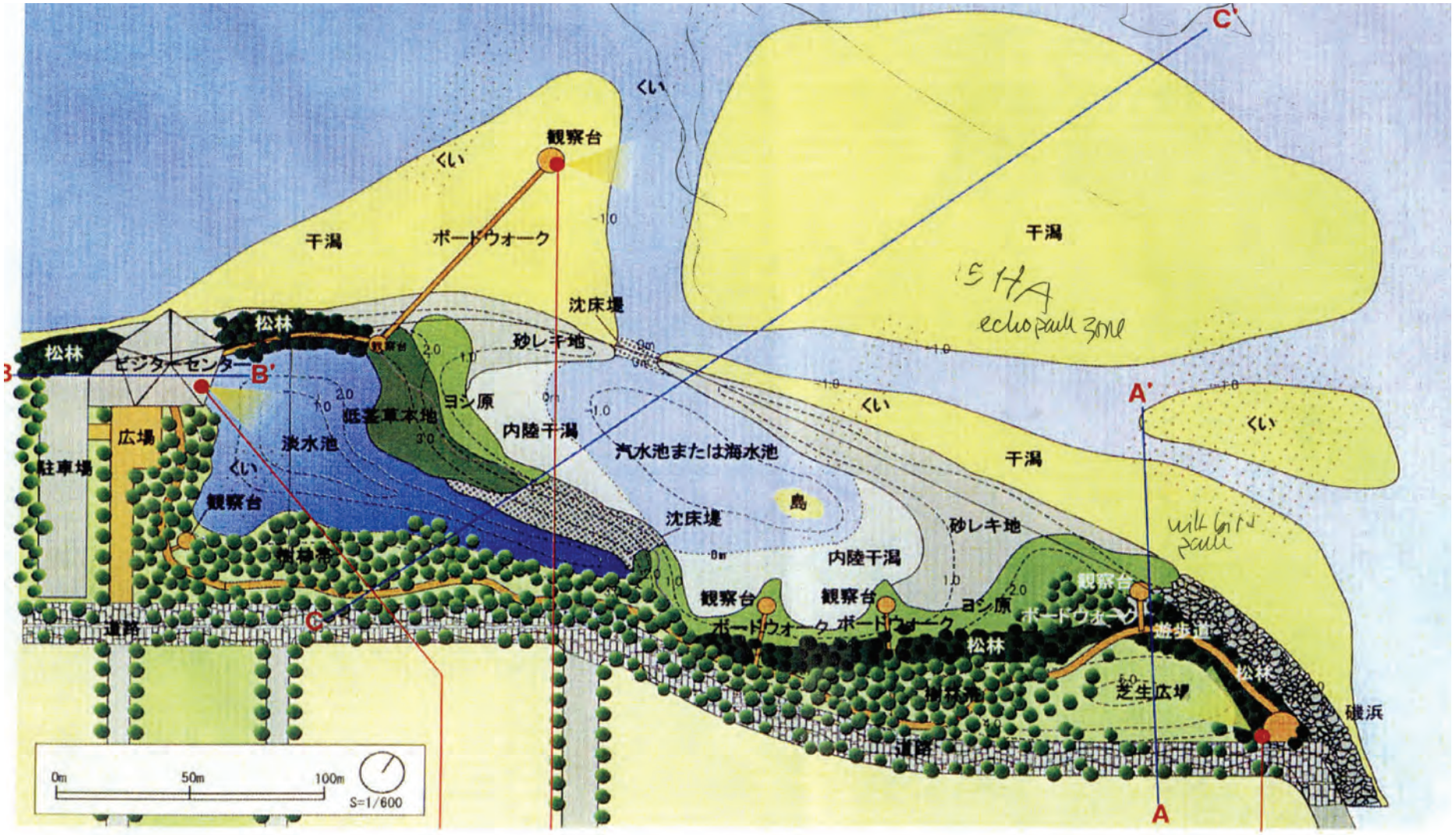


PRESENT




ISLAND CITY

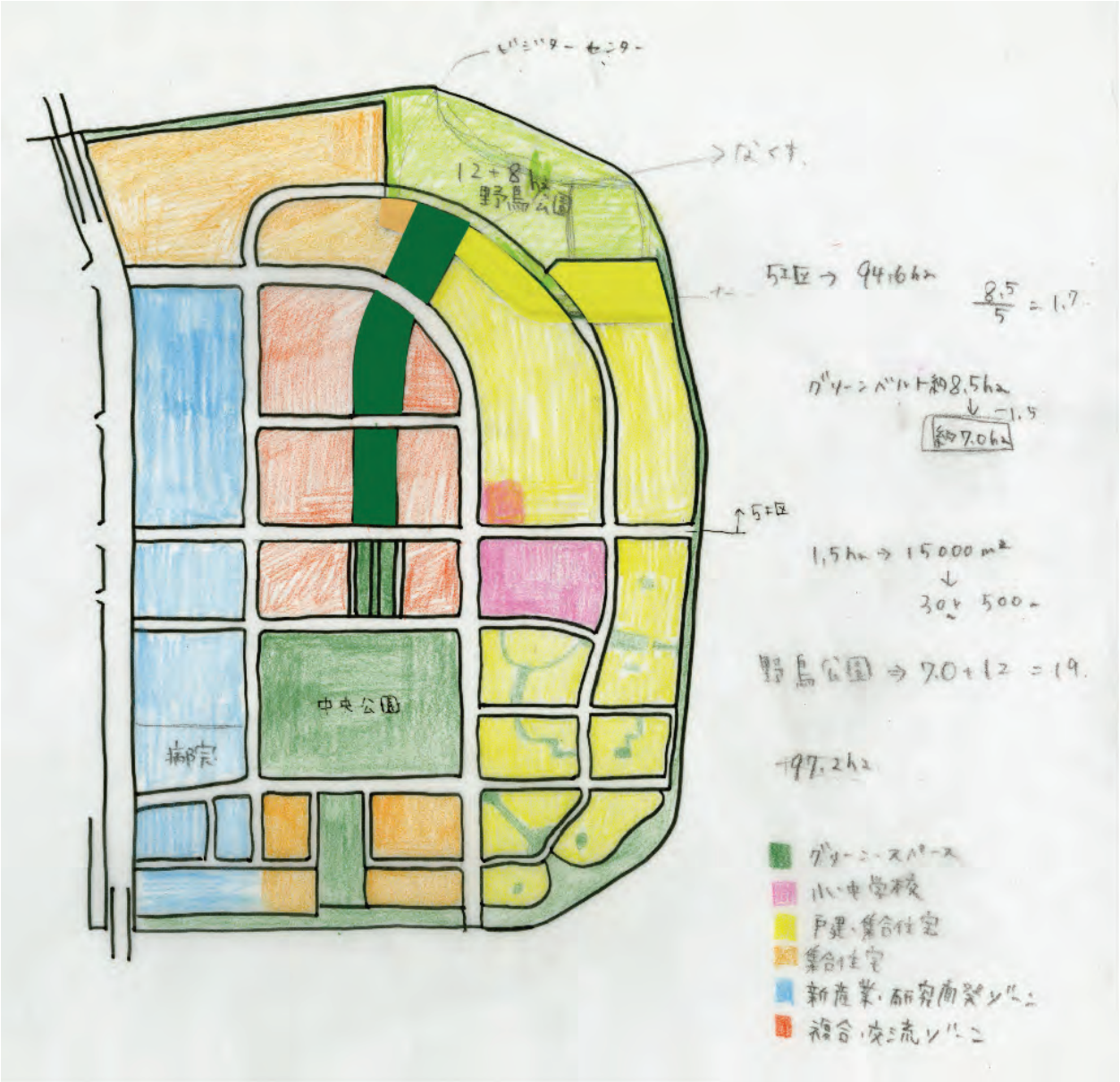
ITERATIONS



Wild Bird Park Plan / Fukuoka City 2006 <8.3ha>

ORIGINAL WETLAND PLAN

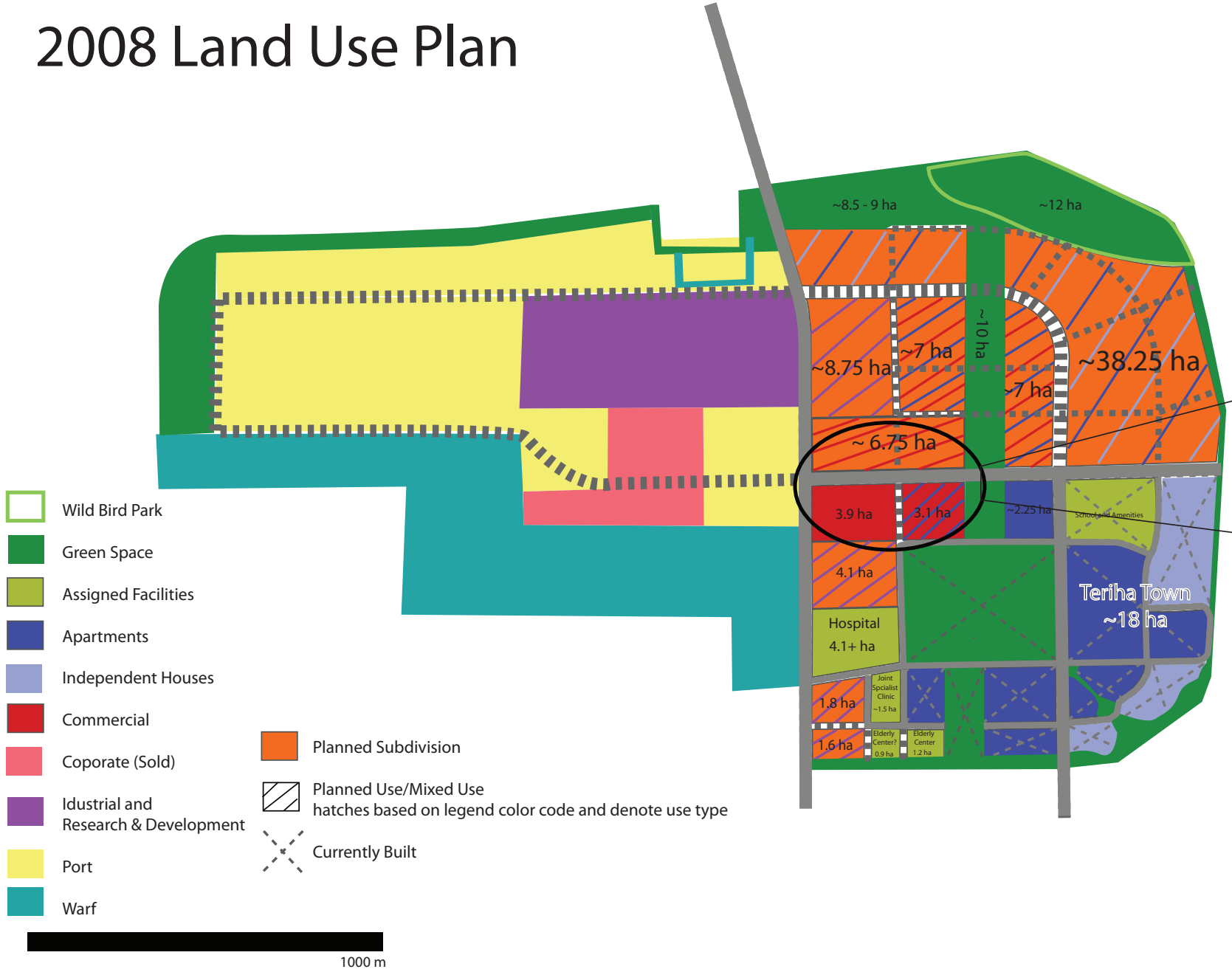
ITERATIONS



JAPAN STUDENT WORKSHOP

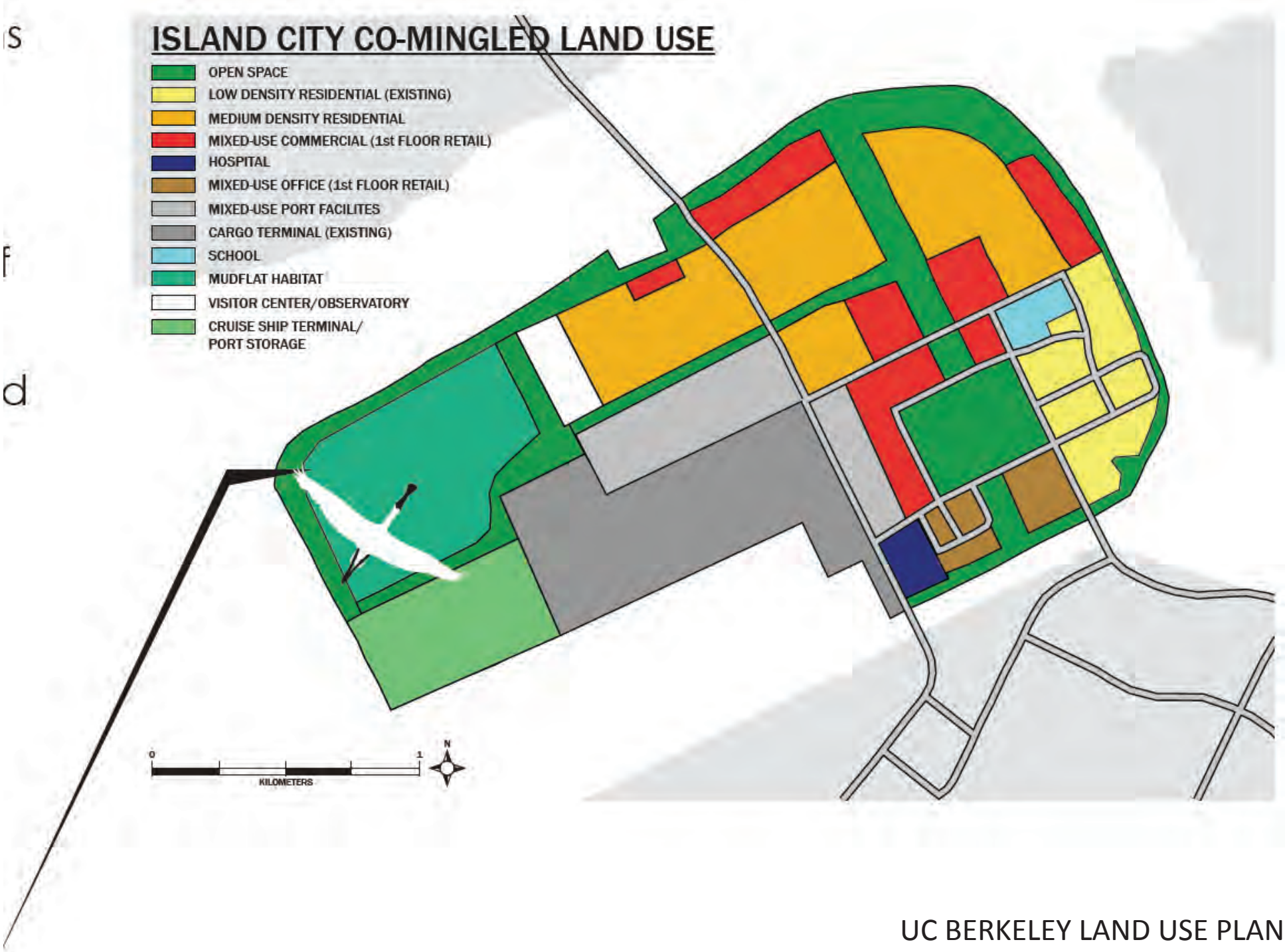
ITERATIONS

2008 Land Use Plan



Setup of the central area
We will establish a lively interactive space by inviting urban functions such as commercial and corporate functions, and dissemination of information on education, culture, and art. Further, public transportation facilities and facilities for convenience are invited to improve the business environment in the area.

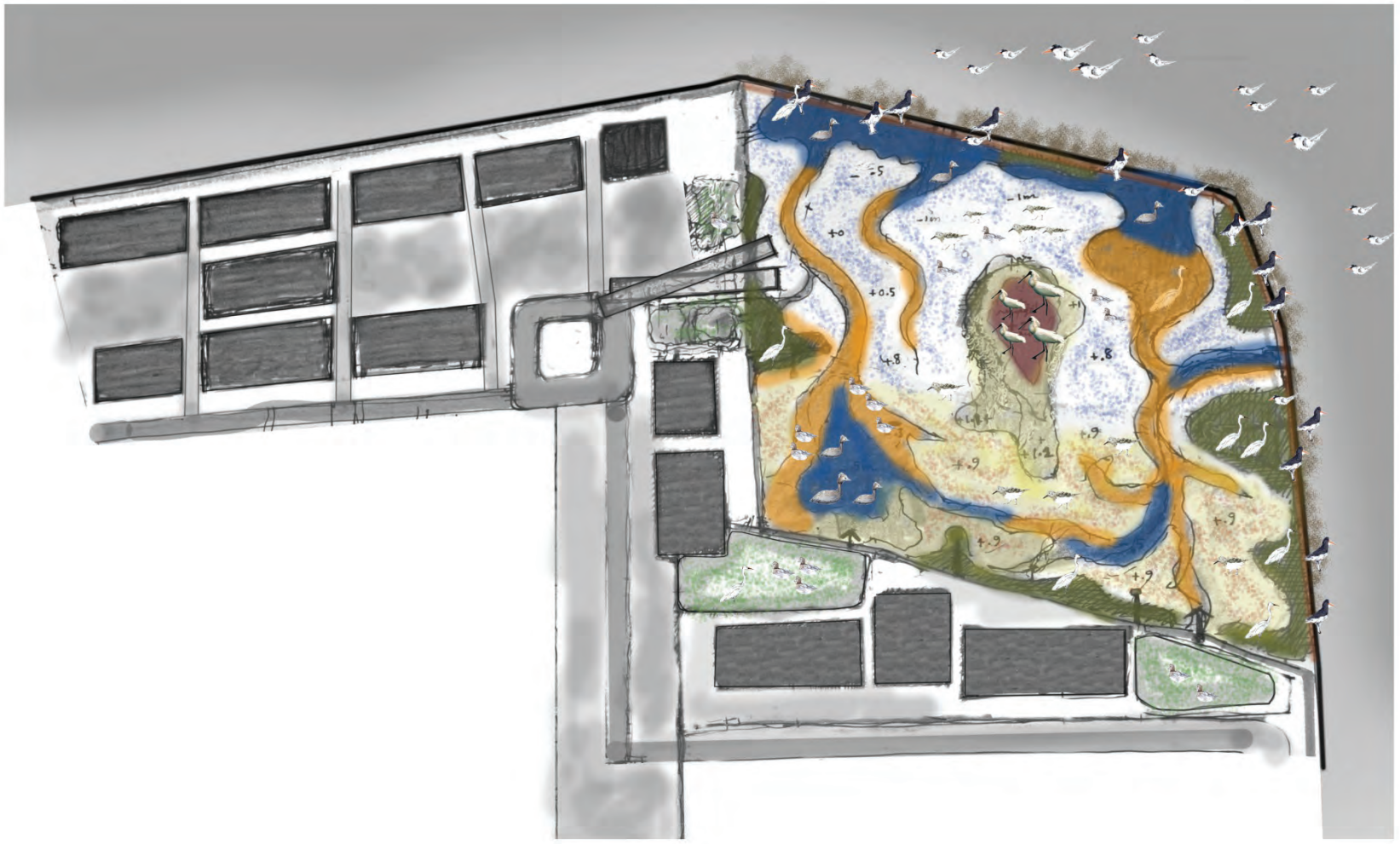
ITERATIONS



UC BERKELEY LAND USE PLAN

ITERATIONS

16 Hectare Wild Bird Park



DESIGN GOALS

Provide natural habitat for migrating bird species with minimal maintenance required

Create vibrant center for environmental education, outdoor recreation and commercial activity

Turn Island City into an international birdwatching destination

Establish Island City as beacon of ecological innovation

GUIDING PRINCIPLES

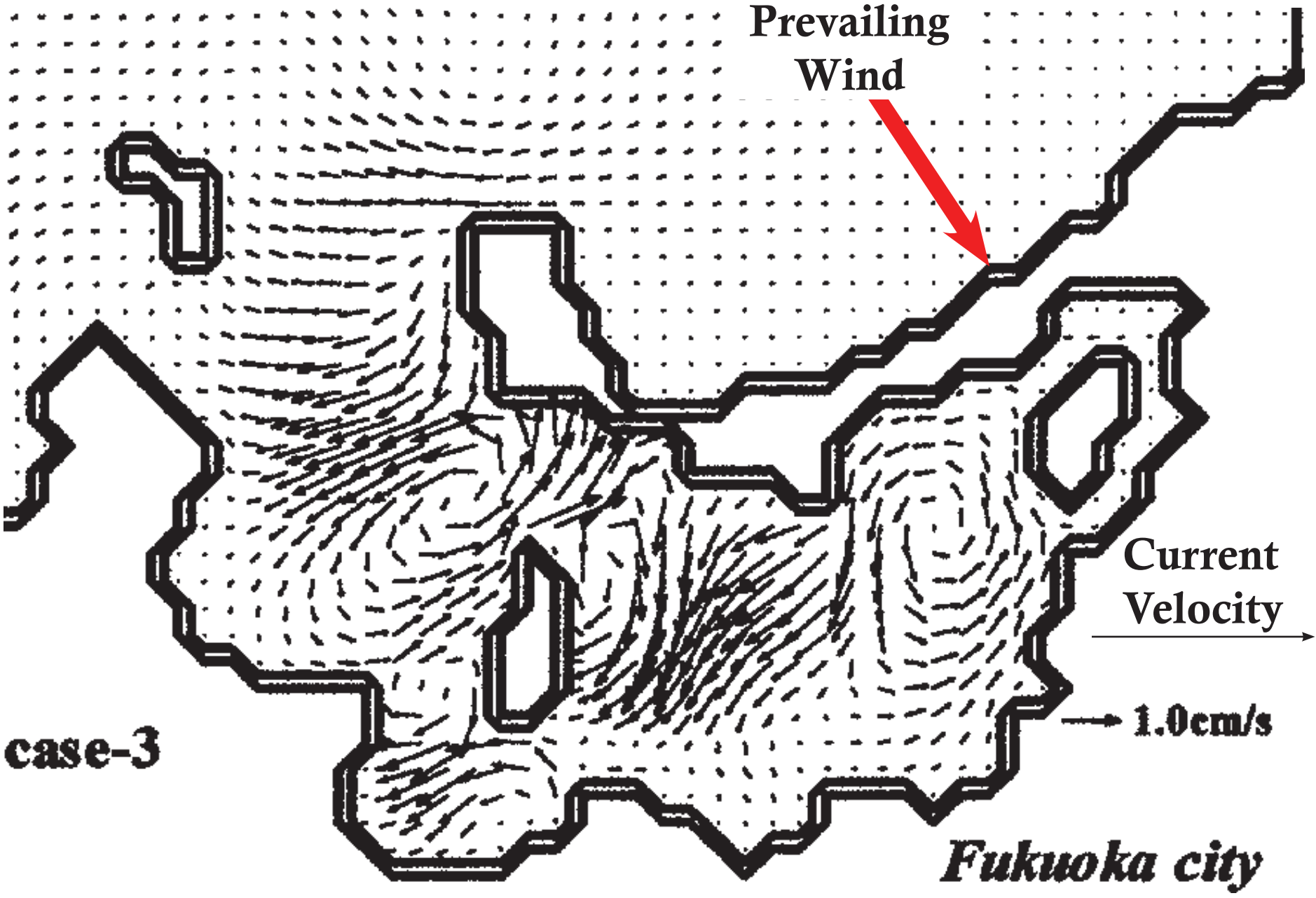
Tidal Marsh Dynamics

Human Engagement

WILD BIRD PARK

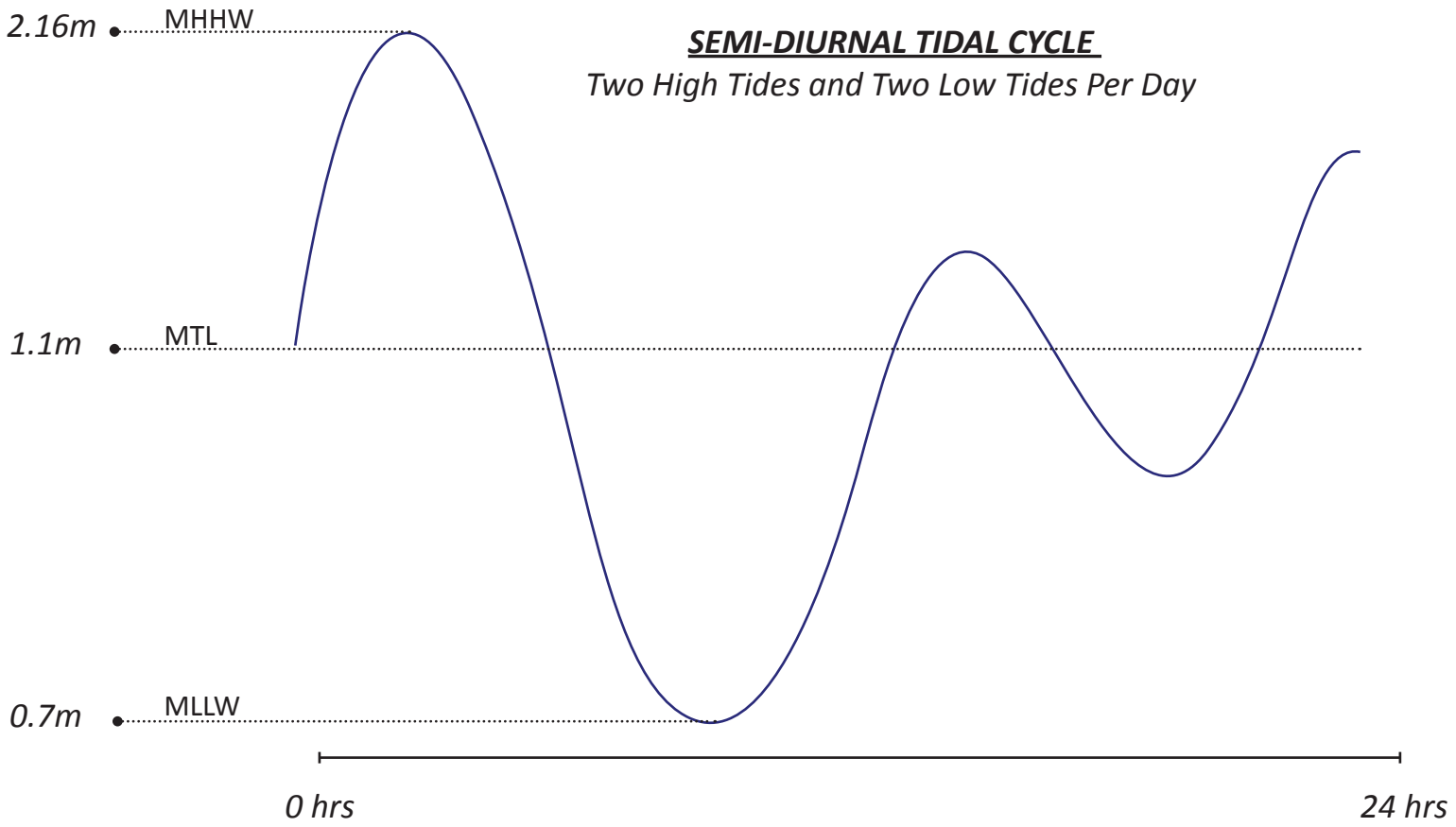
Habitat

PREVAILING WINDS & TIDAL CURRENTS



(Furusho, 2001)

TIDES IN HAKATA BAY



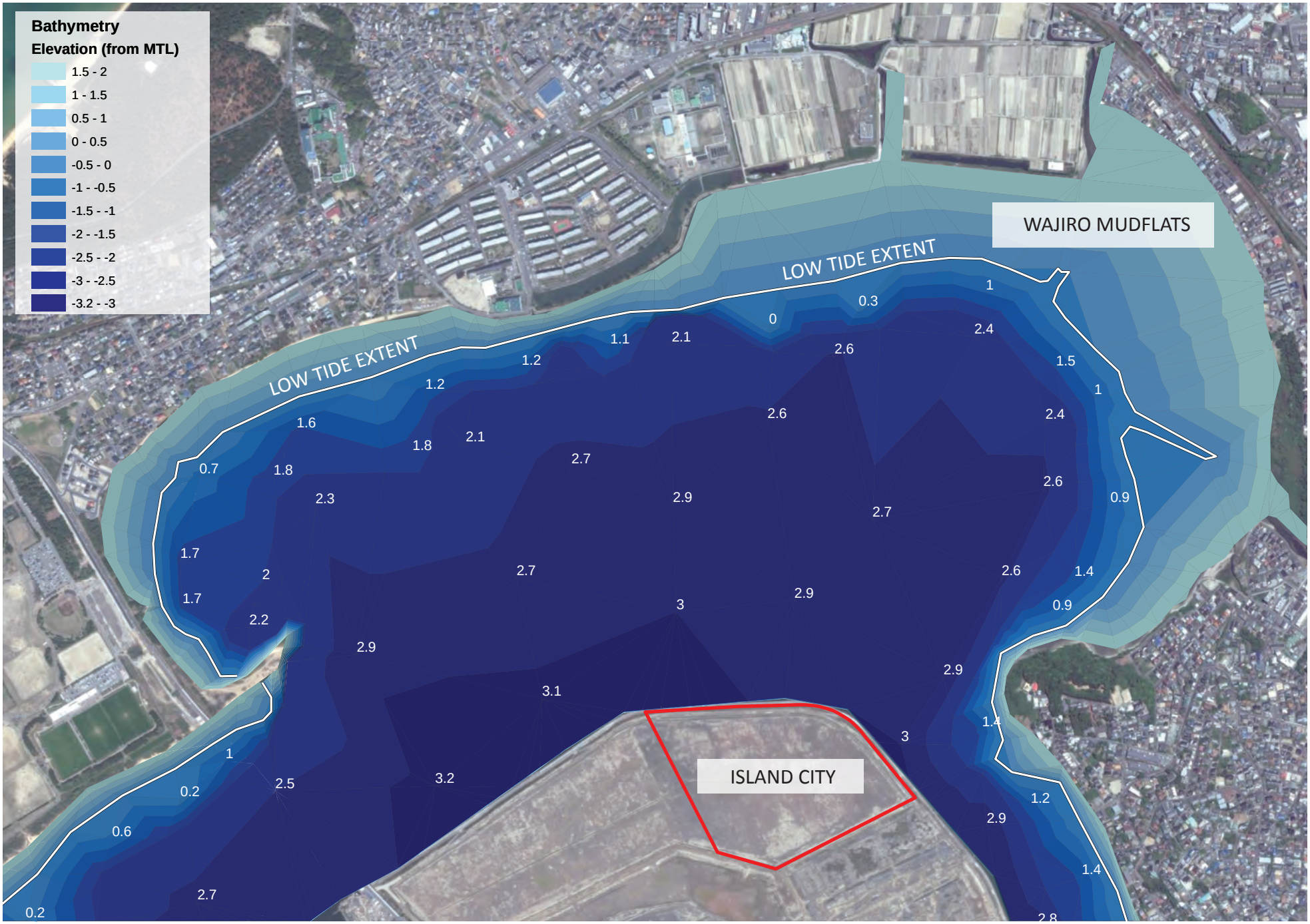
MHHW = Mean Higher High Water, or Average Highest Tide Elevation

MTL = Mean Tide Level

MLLW = Mean Lower Low Water, or Average Lowest Tide Elevation

Source: Port of Hakata, 2012

BATHYMETRY

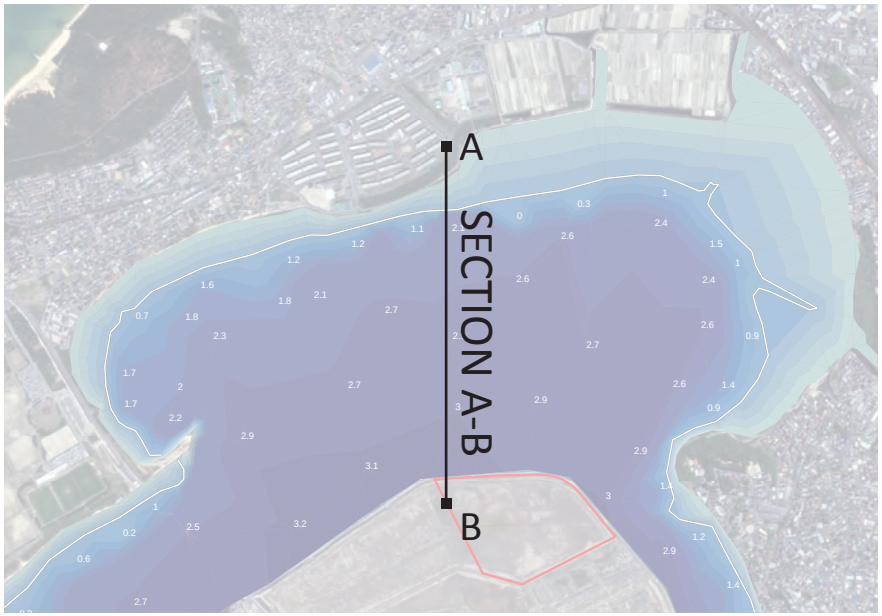


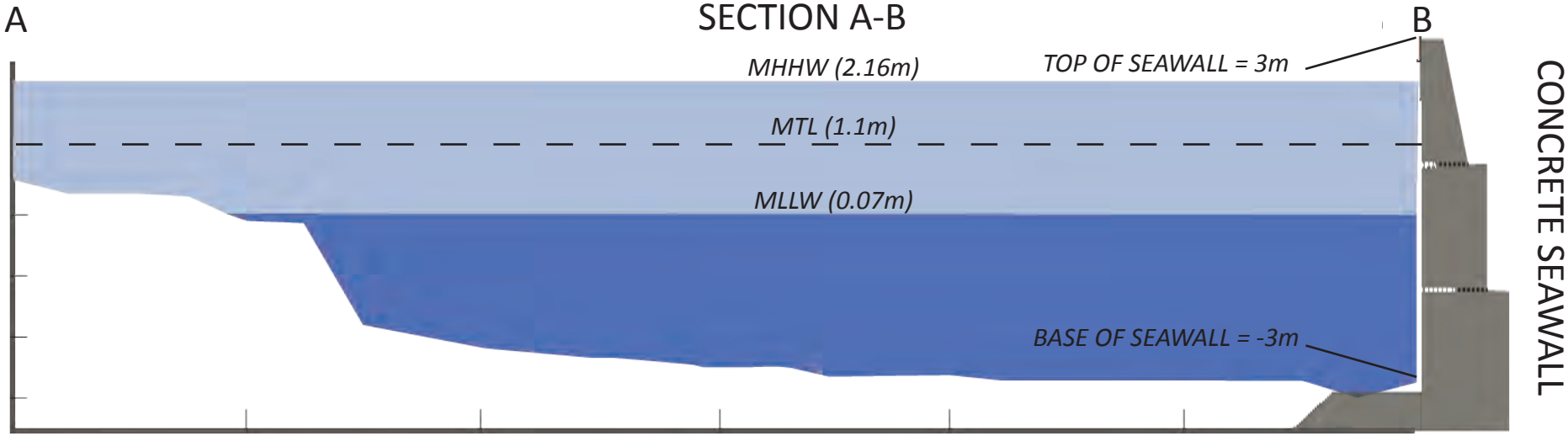
DEPTH SOUNDINGS = METERS BELOW LOW TIDE

SOURCE: BATHYMETRY ADOPTED FROM NGA Chart 97421, Fukuoka Wan, 1996

0 0.25 0.5 1 Kilometers

BATHYMETRY



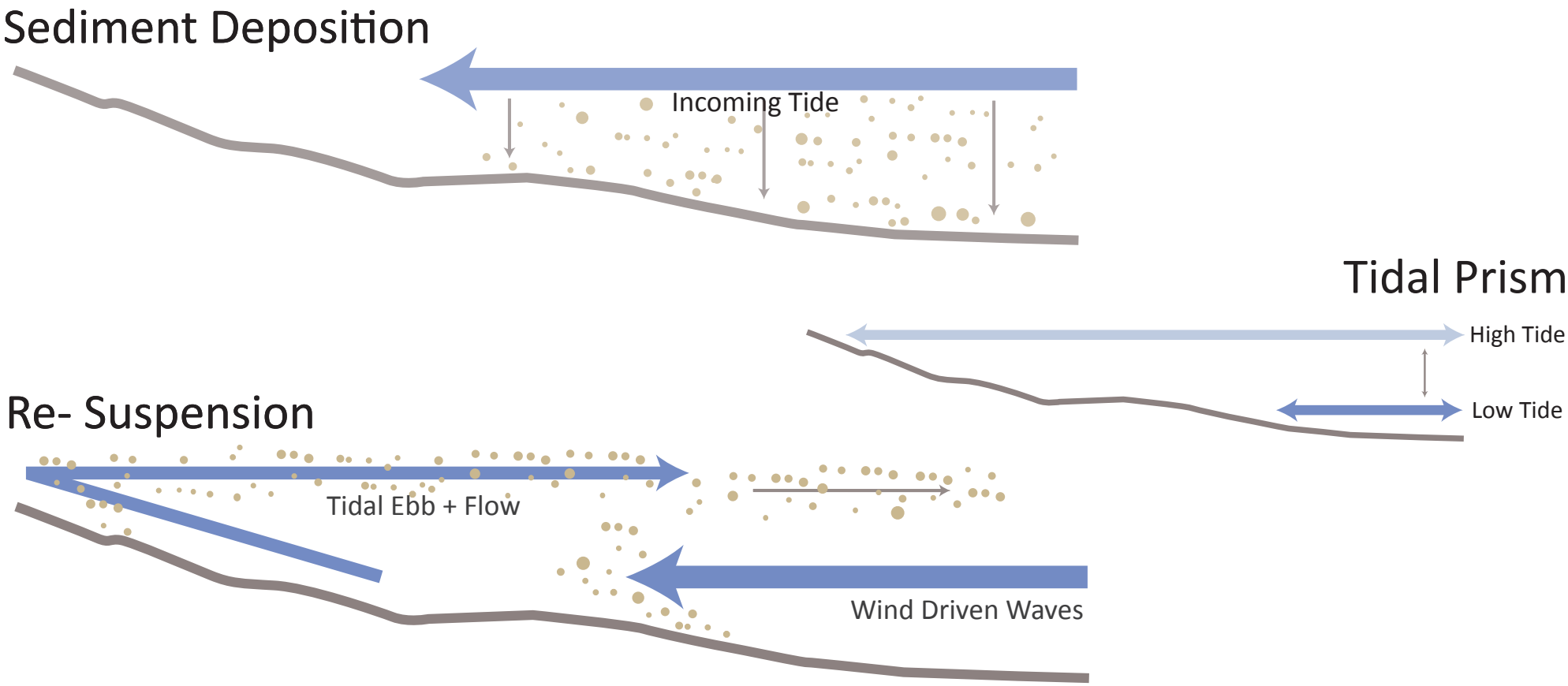


DEPTH SOUNDINGS = METERS BELOW LOW TIDE

SOURCE: BATHYMETRY ADOPTED FROM NGA Chart 97421, Fukuoka Wan, 1996, Port of Fukuoka

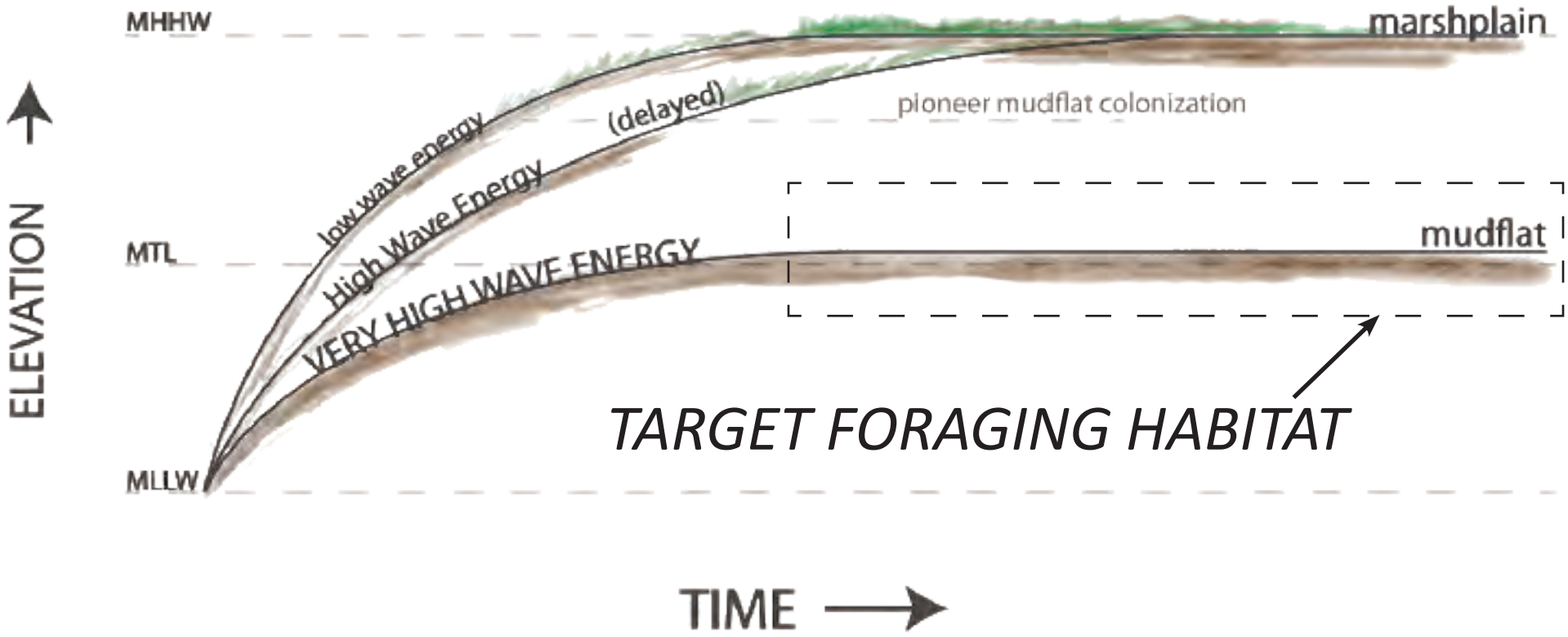
0 0.25 0.5 1 Kilometers

GEOMORPHIC PROCESSES RESPONSIBLE FOR SEDIMENTATION RATES



Take Home **: Increasing tidal prism increases sediment deposition, naturally preventing wetland erosion. Tidal prism can be increased by widening/ enlarging a single opening.**

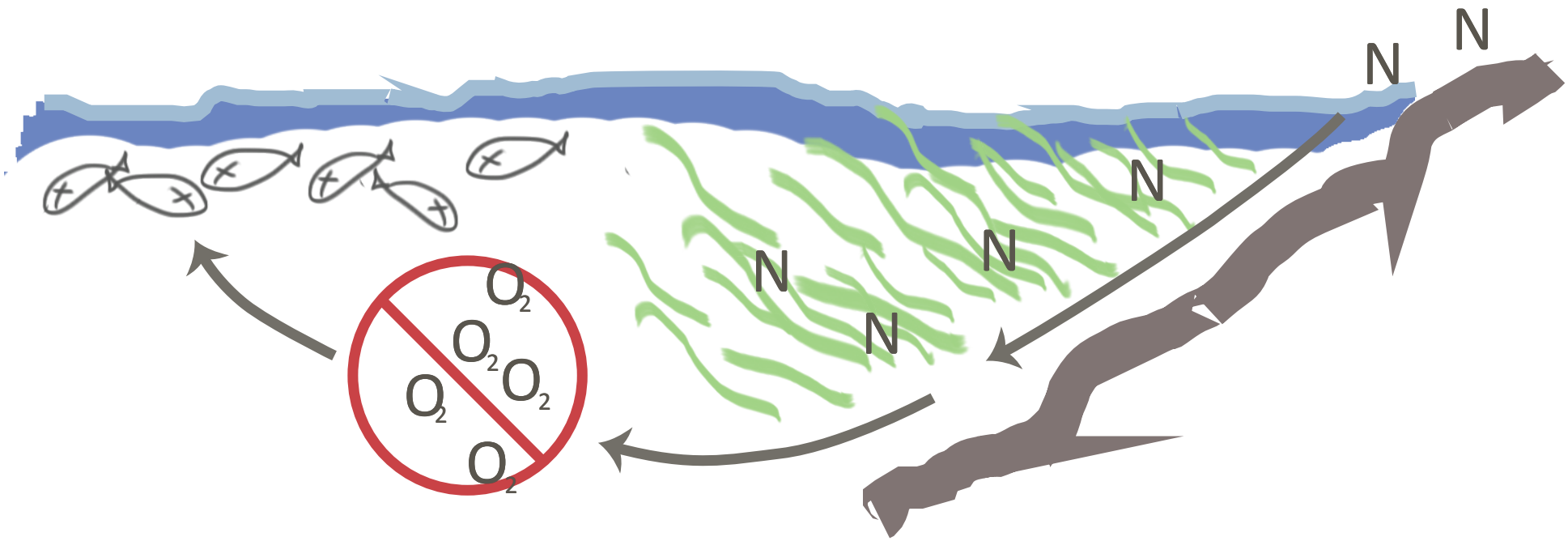
TIDAL MARSH EVOLUTION MODEL



Take Home: The more wave energy a tidal wetland is exposed to, the more tidal mudflat will be sustained.

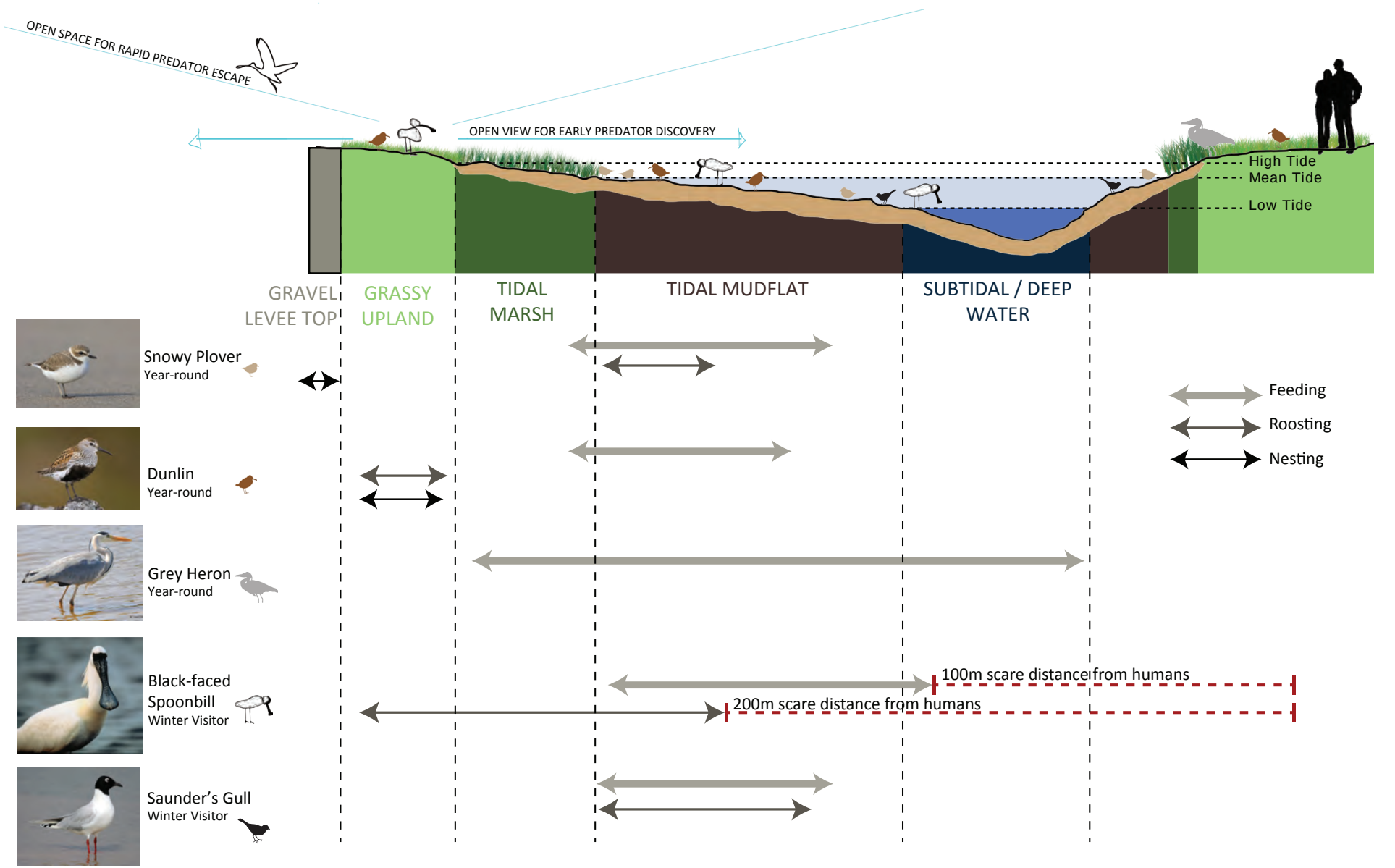
(Williams, 2001)

RED TIDE



Take Home **: Design for Wild Bird Park attempts to minimize Red Tide by maximizing tidal exchange.**

BIRD GEOMETRIES



Mudflats in Hakata Bay also provide habitat for the **Common Shelduck**, **Eurasian Curlew**, **Great Knot**, **Common Greenshank**, **Red-necked Stint**, **Common Ringed Plover**, **Little Stint** and may others. The Wild Bird Park will also attract these species and birdwatching tourists who come to see them.

DESIGN PROCESS

Choose Design Options → Evaluate Physical Structure Stability → Evaluate Available Habitat

Our design suitability process.....

DESIGN PROCESS

TIDE GATE?

OPEN SYSTEM

DESIGN PROCESS

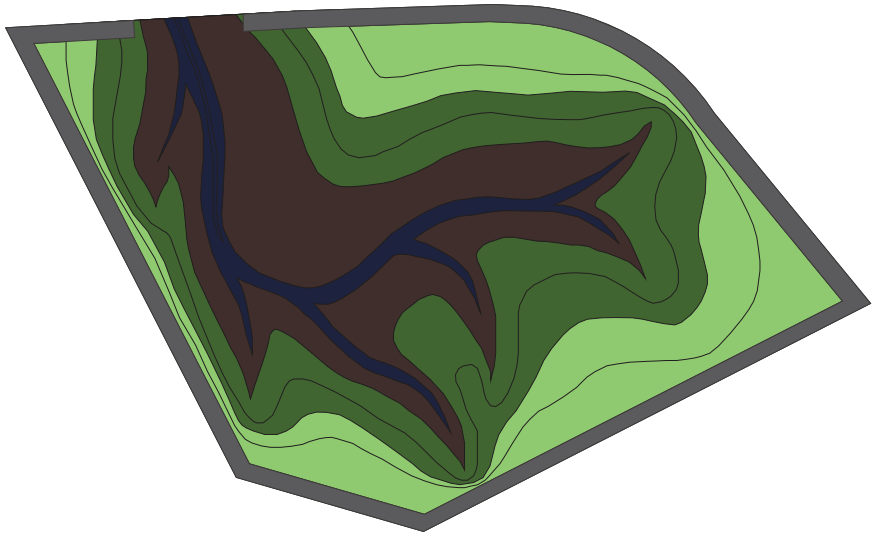
TIDE GATE?

OPEN SYSTEM

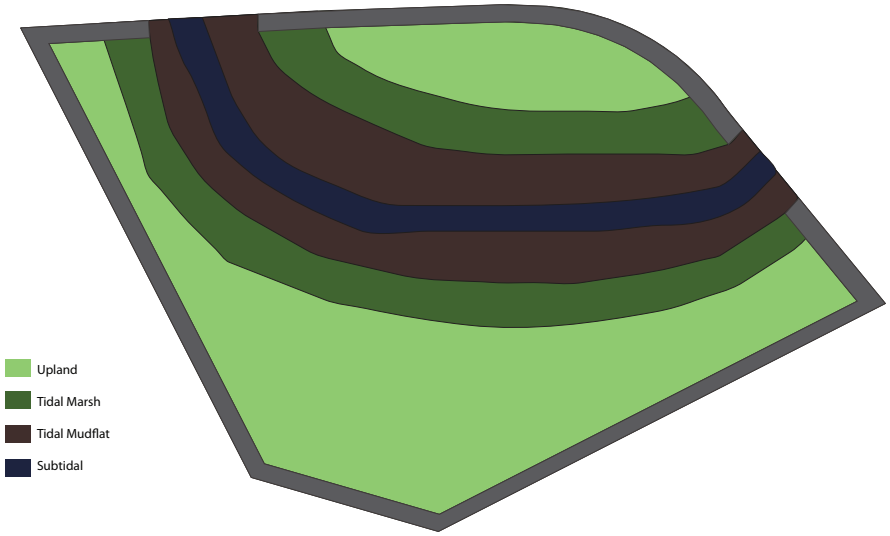
TO ALLOW NATURAL PROCESSES TO FORM HABITAT AND
MINIMIZE MAINTENANCE NEEDS

DESIGN PROCESS

1 OPENING?

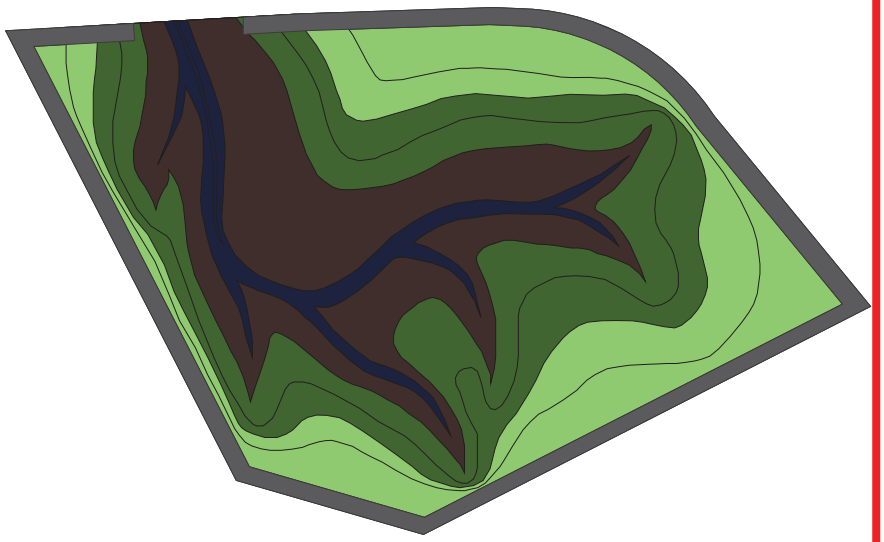


OR 2?

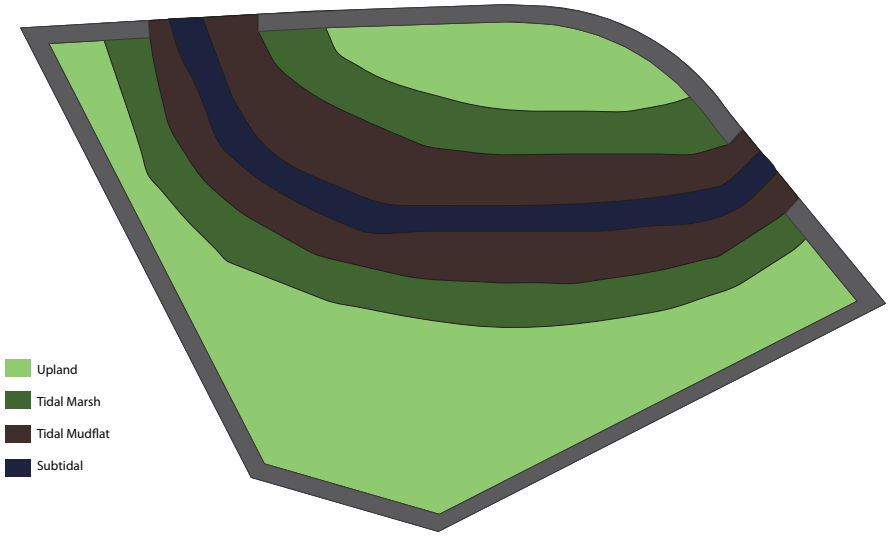


DESIGN PROCESS

1 OPENING?

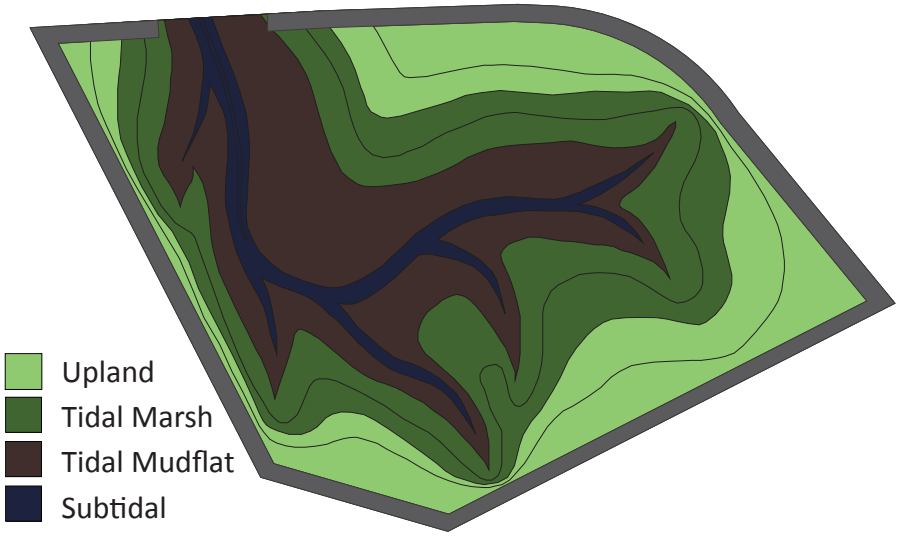


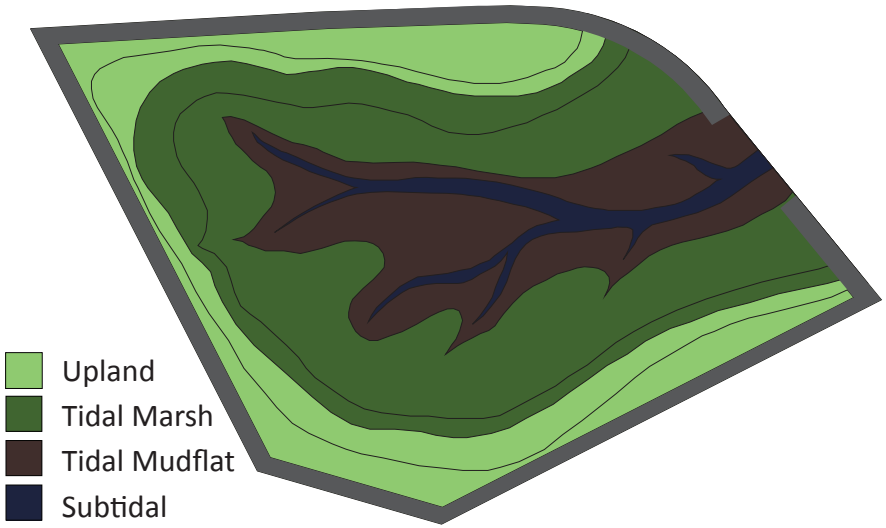
OR 2?



1 OPENING TO MAXIMIZE TIDAL PRISM AND NATURAL PROCESSES

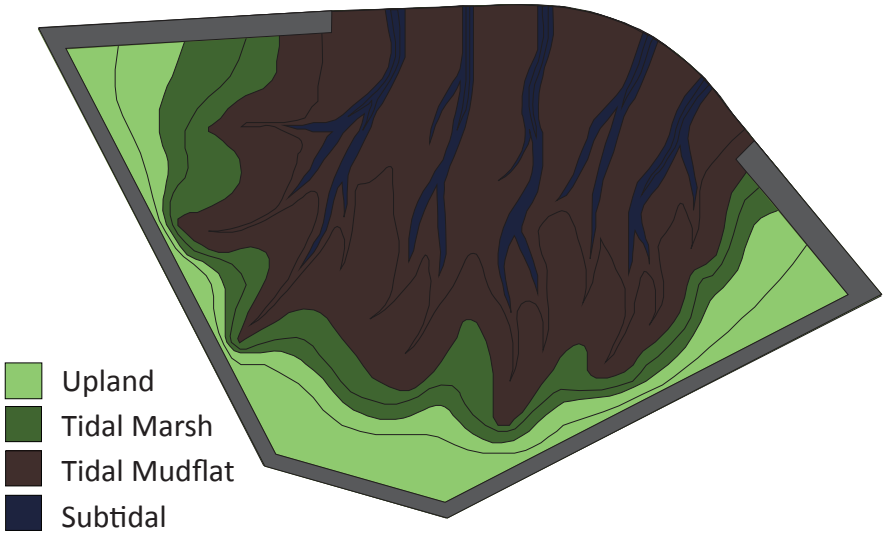
WETLAND DESIGN: Initial Alternatives

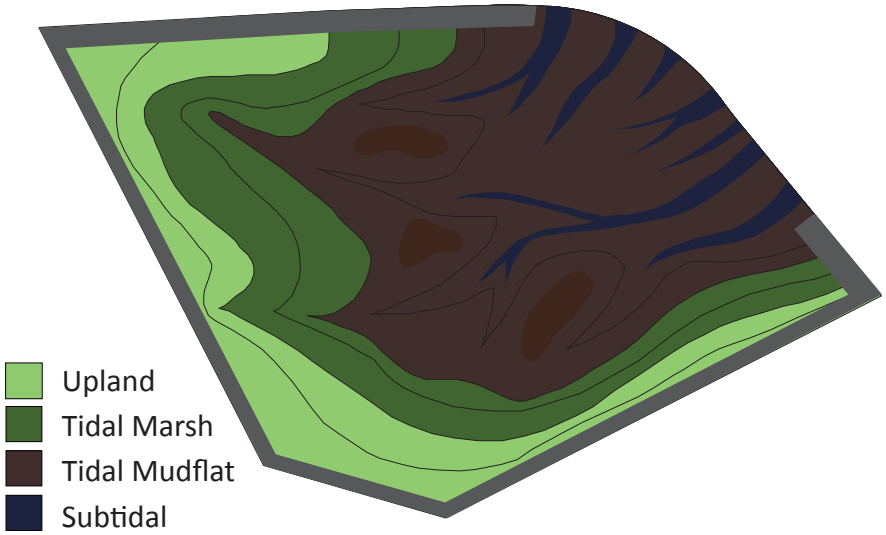




Closed Alternatives

Ecological Zones



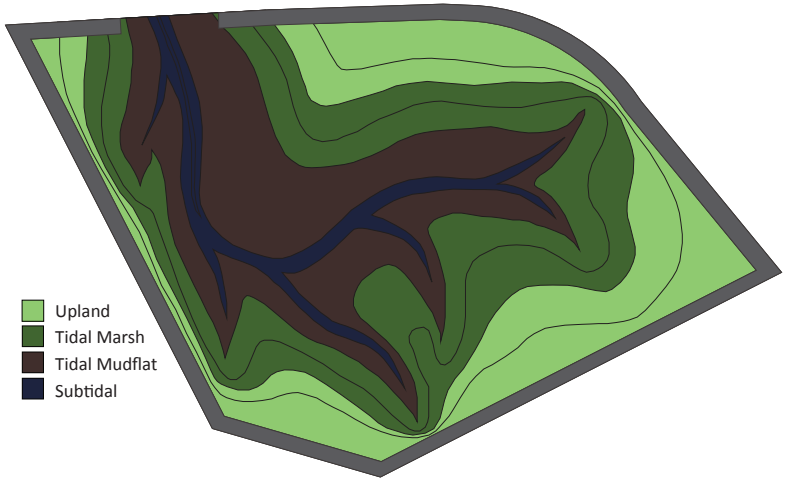


Open Alternatives

Ecological Zones

Closed Alternatives

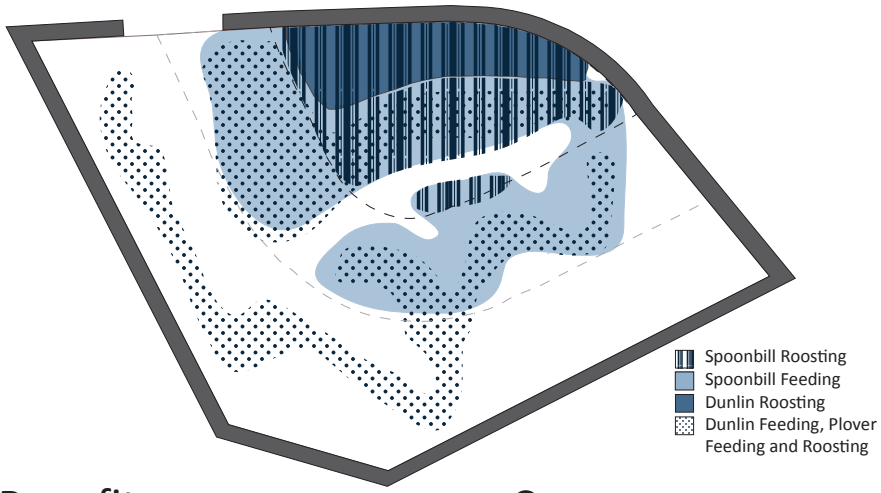
Ecological Zones



Benefits
Better sediment retention

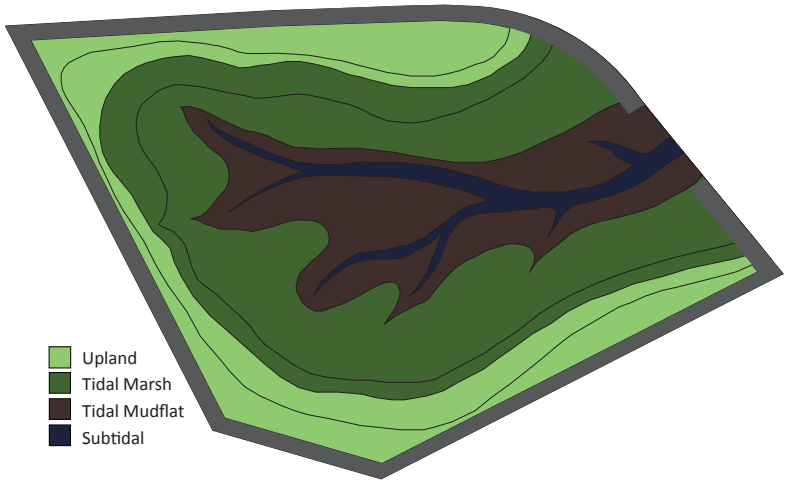
Concerns
Smaller mudflat area
Reduced tidal mixing

Habitat spaces



Benefits
Large spoonbill roosting

Concerns
Limited feeding



Benefits
Better sediment retention

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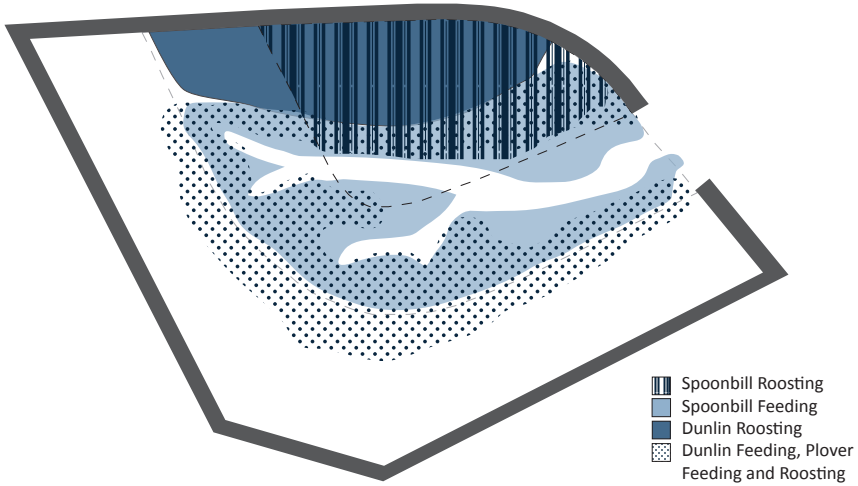
Smaller mudflat area
Reduced tidal mixing

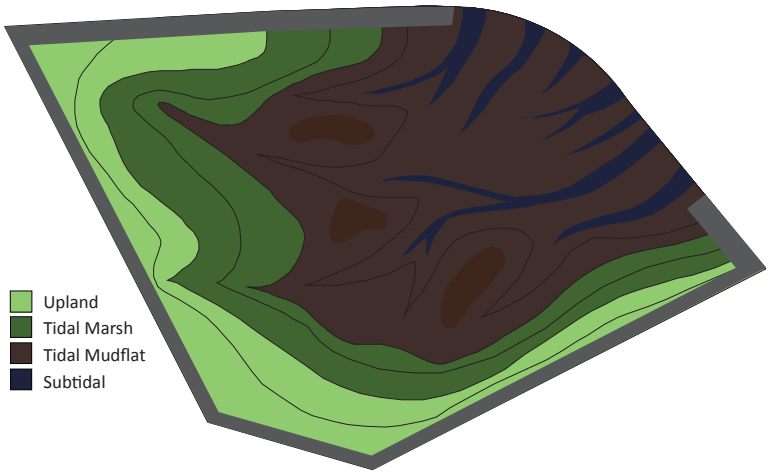


Benefits
Variety of bird habitats

Concerns
Limited feeding

Open Alternatives

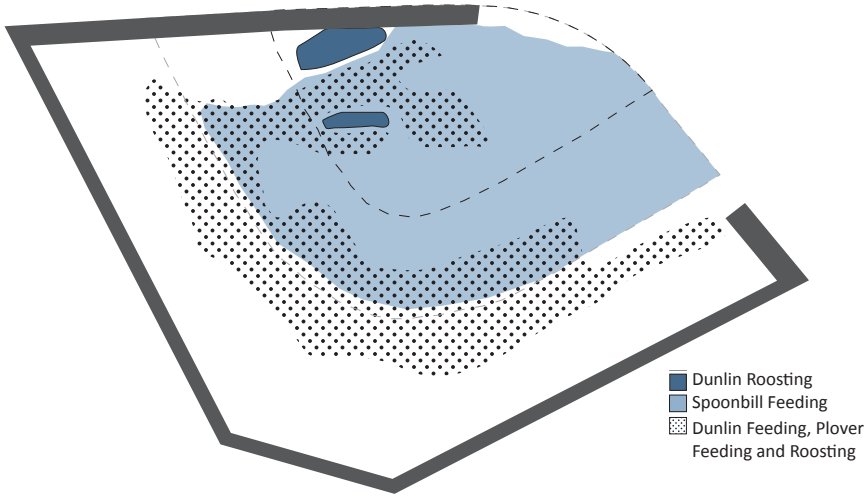
Ecological Zones



Benefits
Large mudflat area
Tidal Mixing

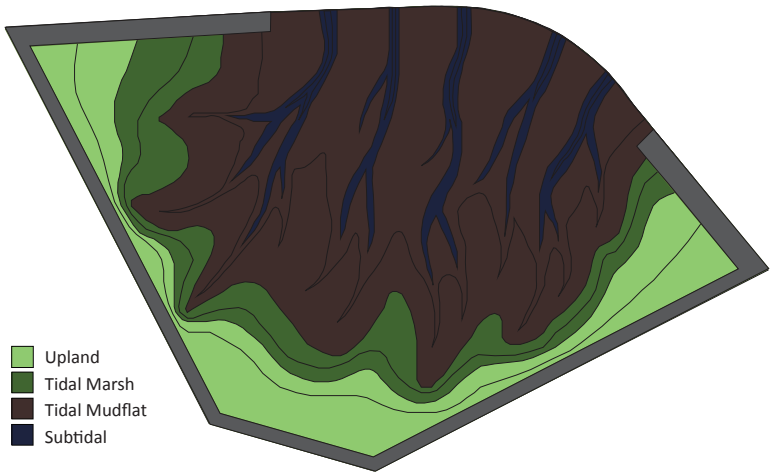
Concerns
Potential sediment loss

Habitat spaces



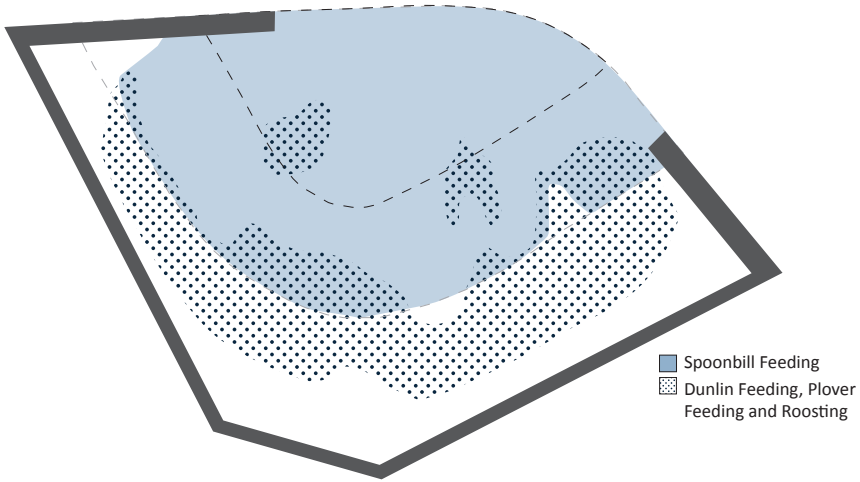
Benefits
Large spoonbill feeding

Concerns
Limited roosting



Benefits
Large mudflat area
Tidal Mixing

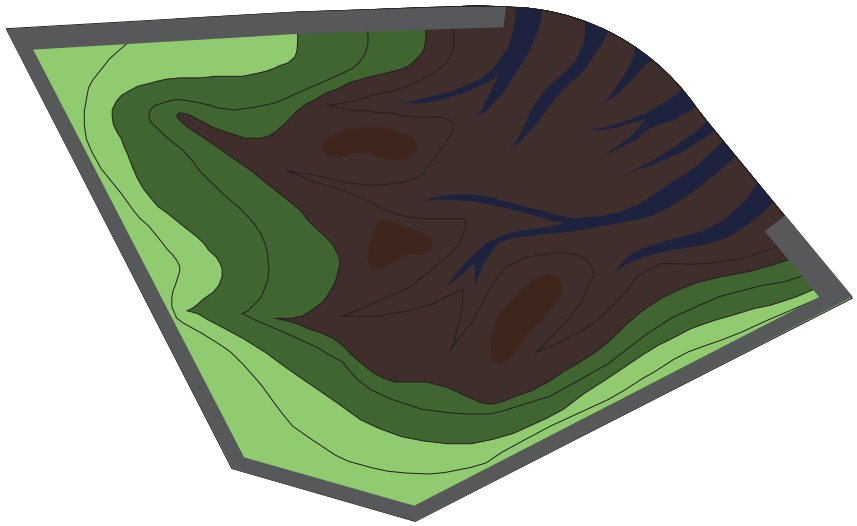
Concerns
Potential sediment loss



Benefits
Large spoonbill feeding

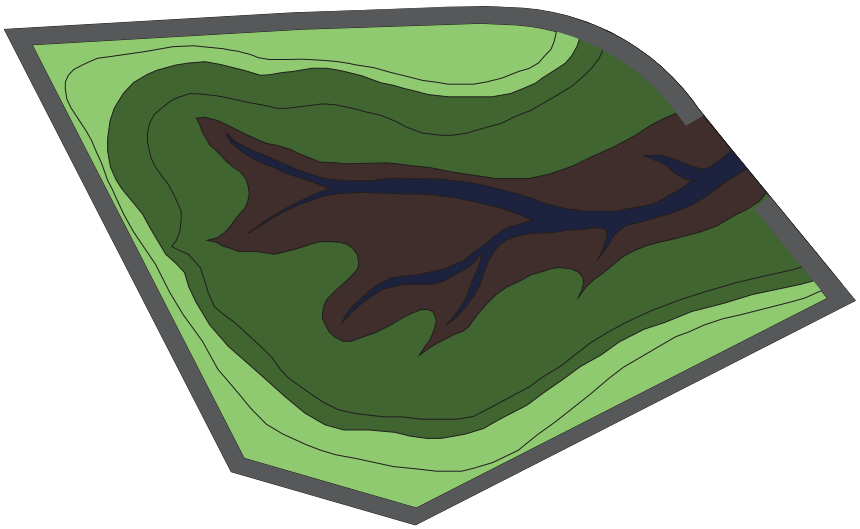
Concerns
No roosting

Initial Alternatives Key Points



Open Conditions

Larger mudflat area
More tidal water mixing
Upland area near people
Larger potential sediment loss



Closed Conditions

Smaller mudflat area
Less tidal water mixing
Upland area away from people
Smaller potential sediment loss

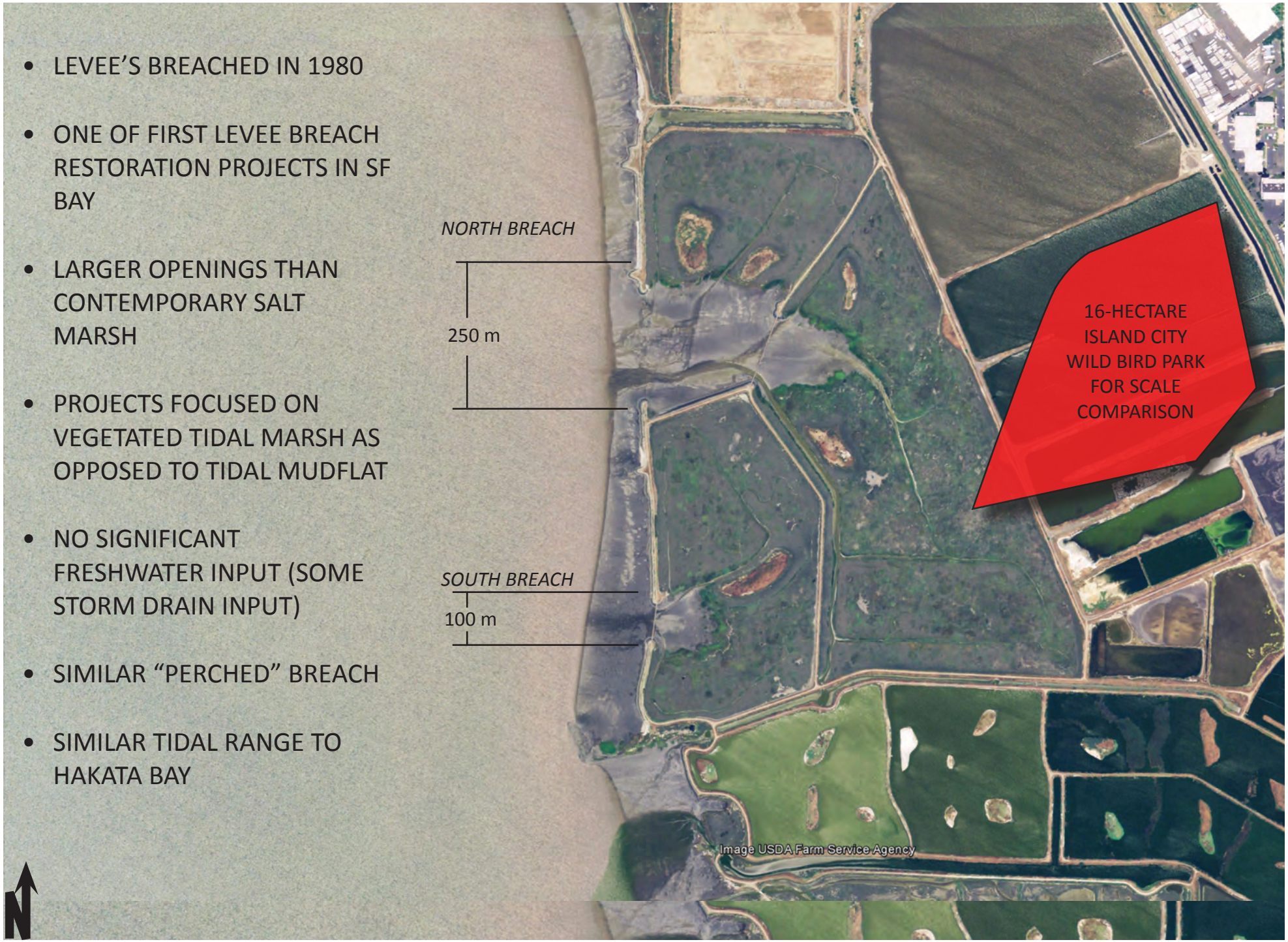
Optimal Conditions

Large mudflat area
Small potential sediment loss
Lots of tidal water mixing
Upland area away from people

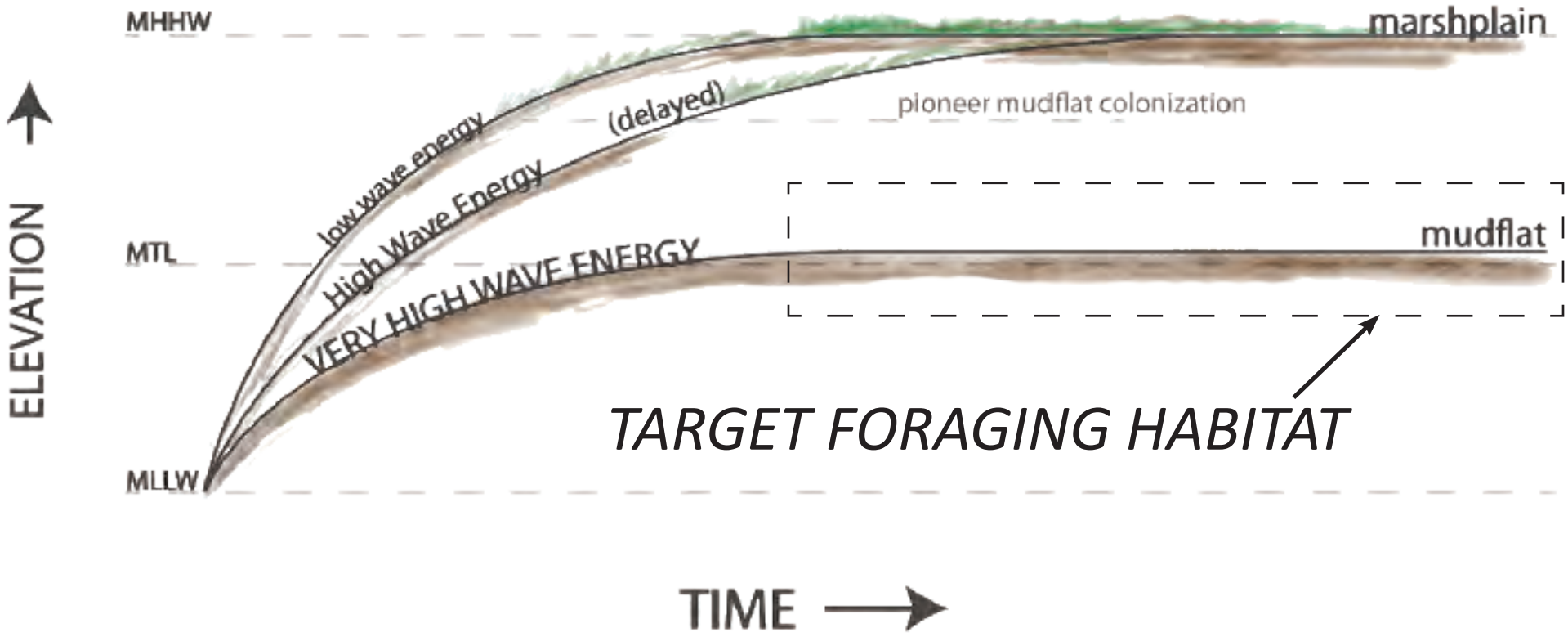
ANALOG PROJECT: Johnson's Landing - Hayward, CA

ANALOG PROJECT: Johnson's Landing - Hayward, CA

- LEVEE'S BREACHED IN 1980
- ONE OF FIRST LEVEE BREACH RESTORATION PROJECTS IN SF BAY
- LARGER OPENINGS THAN CONTEMPORARY SALT MARSH
- PROJECTS FOCUSED ON VEGETATED TIDAL MARSH AS OPPOSED TO TIDAL MUDFLAT
- NO SIGNIFICANT FRESHWATER INPUT (SOME STORM DRAIN INPUT)
- SIMILAR "PERCHED" BREACH
- SIMILAR TIDAL RANGE TO HAKATA BAY



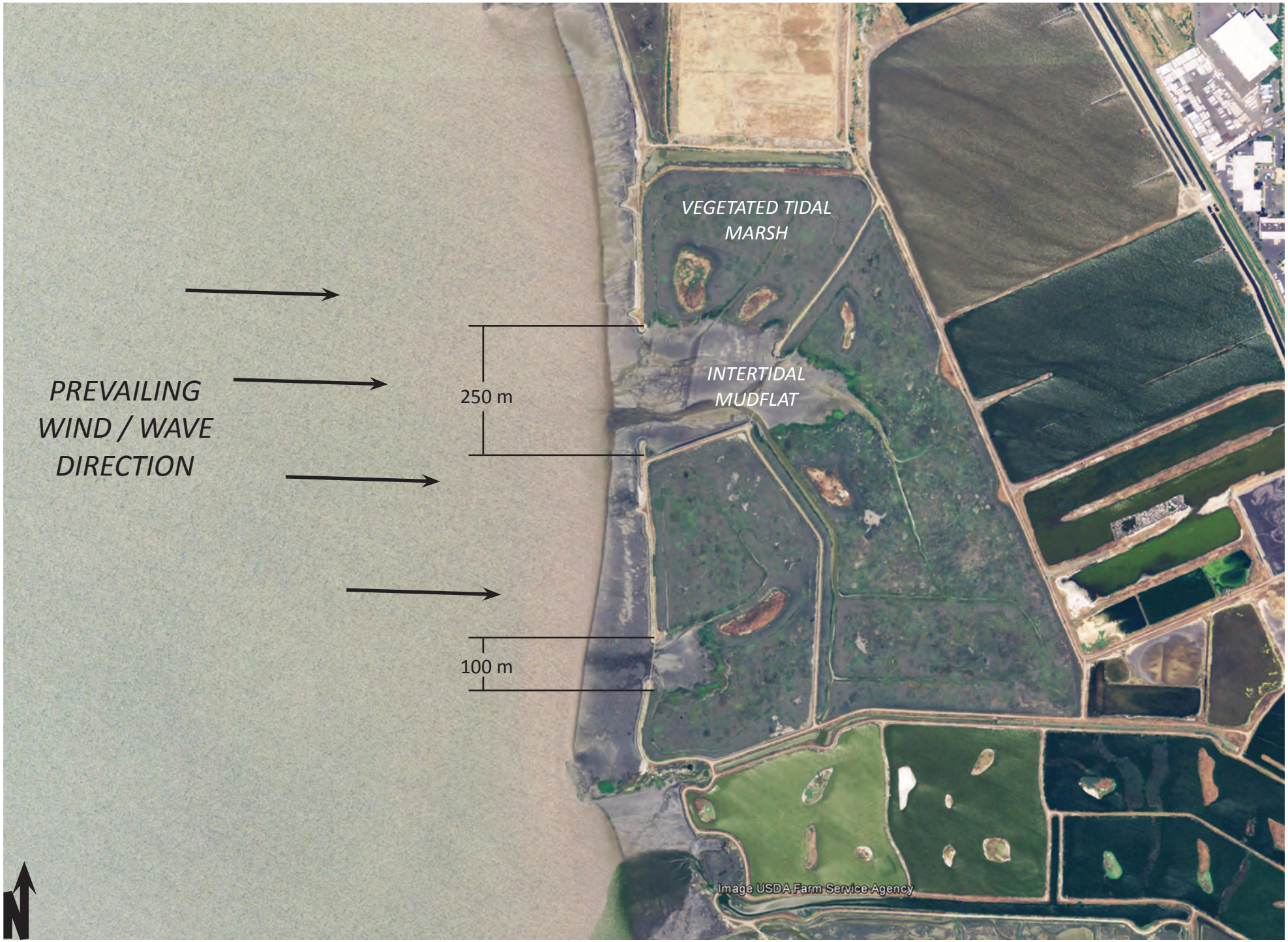
TIDAL MARSH EVOLUTION MODEL



Take Home: The more wave energy a tidal wetland is exposed to, the more tidal mudflat will be sustained.

(Williams, 2001)

ANALOG PROJECT: Johnson's Landing - Hayward, CA



ANALOG PROJECT: Johnson's Landing - Hayward, CA

ORO LOMA MARSH

SMALL BREACH EXAMPLE
(JUST NORTH OF JOHNSON'S LANDING)

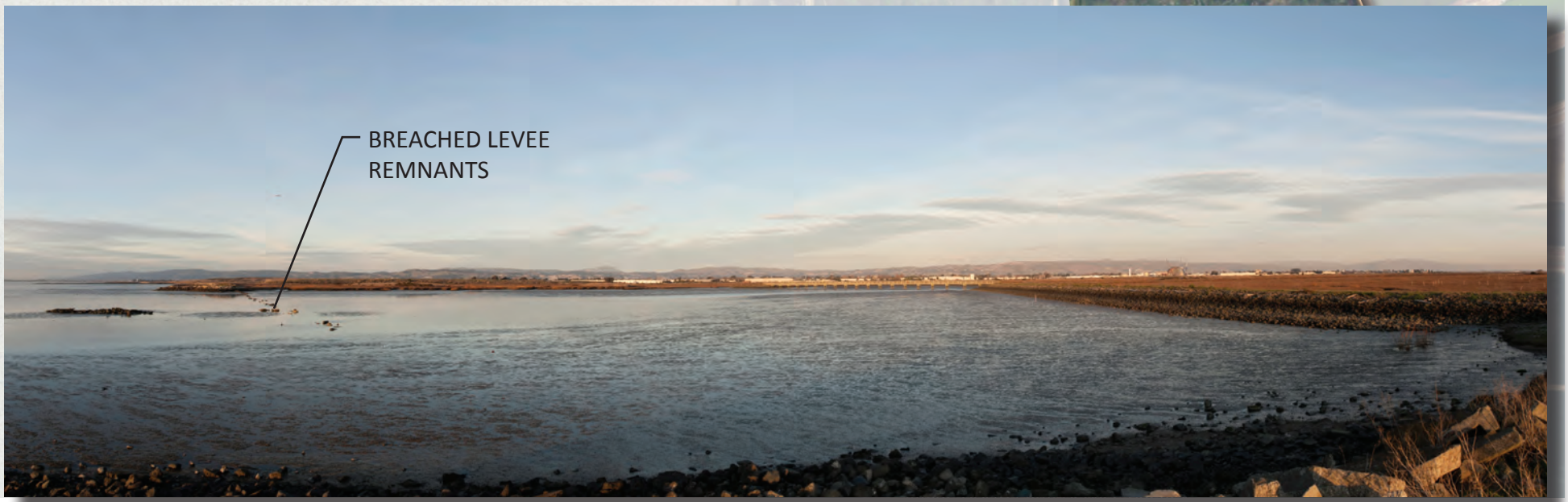
PREVAILING WIND / WAVE DIRECTION

SMALL BREACH MINIMIZES WAVE ENERGY, LIMITS MUDFLAT HABITAT

N

ANALOG PROJECT: Johnson's Landing - Hayward, CA

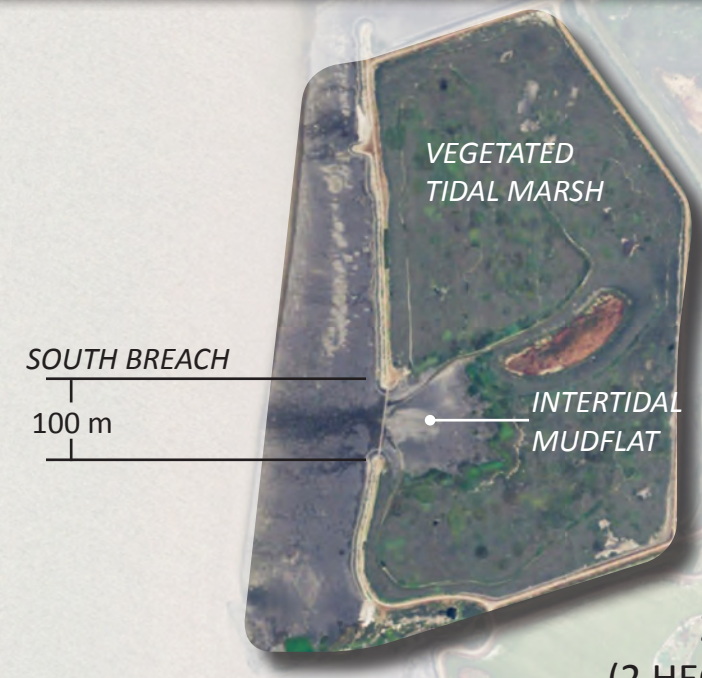
10 HECTARES
OF MUDFLAT ARE
SUSTAINED AT THE NORTH
BREACH SITE



ANALOG PROJECT: Johnson's Landing - Hayward, CA

2 HECTARES
OF MUDFLAT ARE SUSTAINED AT THE SOUTH BREACH.

THE SMALLER BREACH RESULTED IN FAR LESS SUSTAINED MUDFLAT



23 HECTARES
(2 HECTARES MUDFLAT)

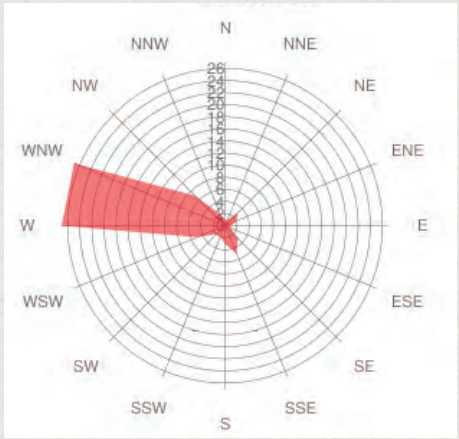
Image USDA Farm Service Agency

WIND FETCH COMPARISON

JOHNSON'S LANDING

ISLAND CITY

WIND DIRECTION



7 knots AVG. WIND SPEED 8 knots

Wind Fetch = Distance of water over which wind travels

LARGER FETCH = LARGE WAVES

TAKE HOME: There will be less wave energy at Island City than Johnson's Landing. A large breach will be required to maintain significant mudflat.

WIND DIRECTION

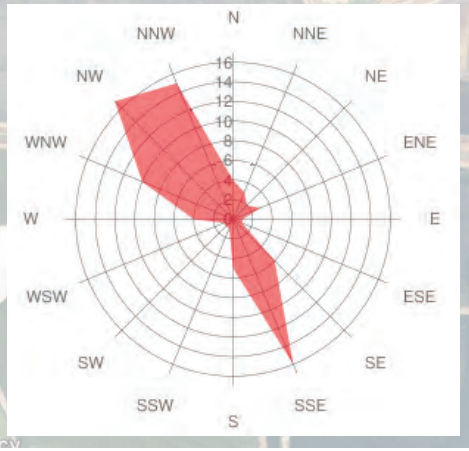


Image USDA Farm Service Agency

DESIGN CONCLUSIONS

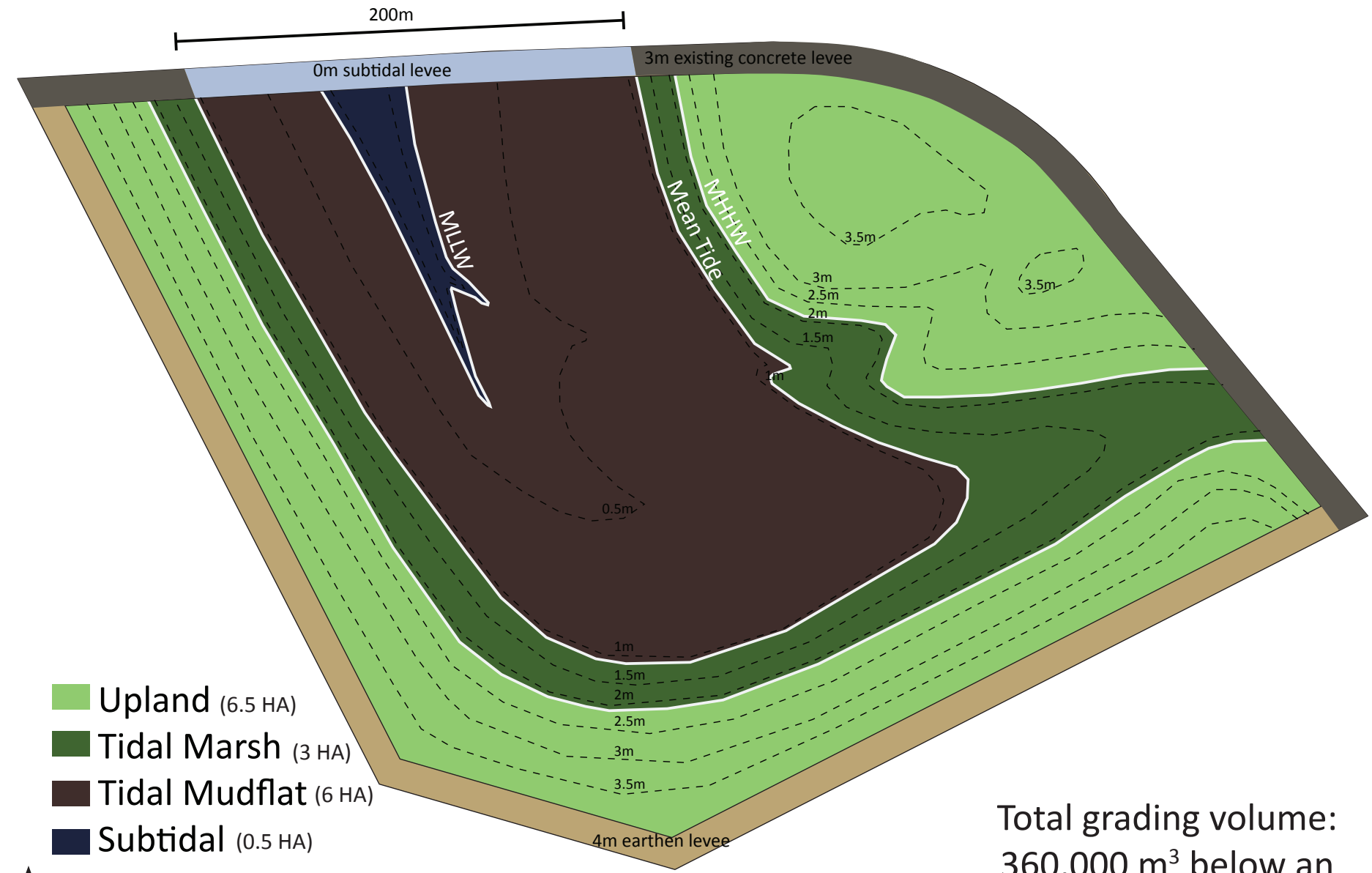
Through analysis of data, site conditions, expert opinion, and comparison with Johnnson's landing, we concluded that a single breach of 200 meters oriented towards prevailing wind and wave direction would be the best design approach.

Doing so maximizes tidal prism and ensures sufficient exposure to wave energy to provide target foraging habitat while protecting against tidal scour.

DESIGN CONCLUSIONS

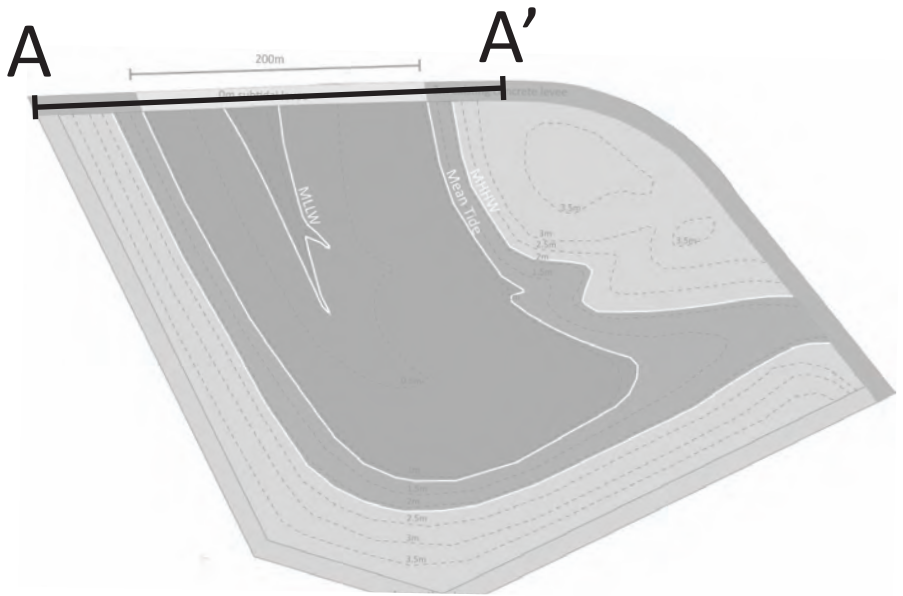
DESIGN CONCLUSIONS

WETLAND GRADING PLAN



Total grading volume:
360,000 m^3 below an
assumed elevation of 4m.

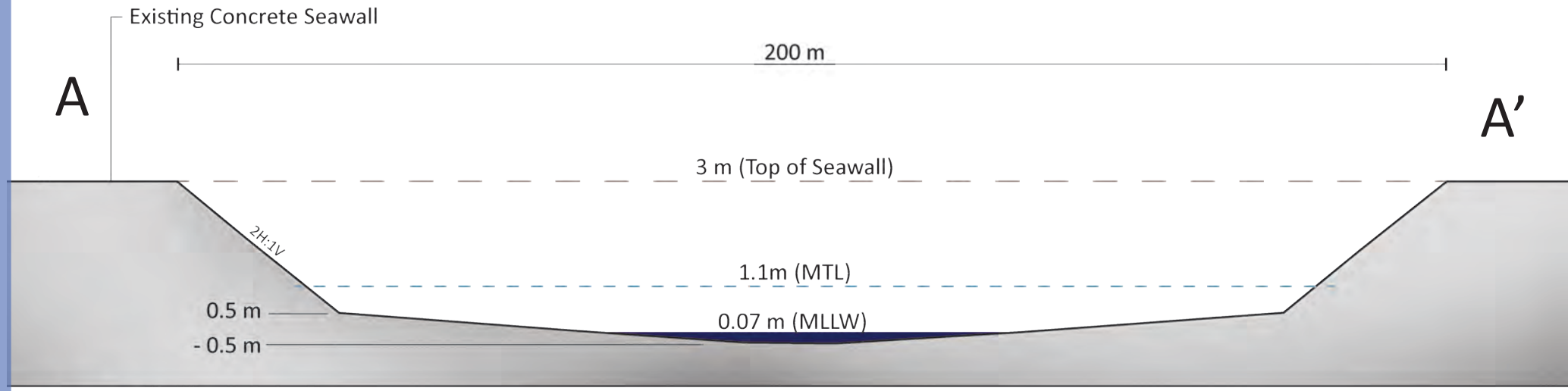
LEVEE BREACH DETAILS



200M BREACH ORIENTED TOWARDS PREVAILING WINDS

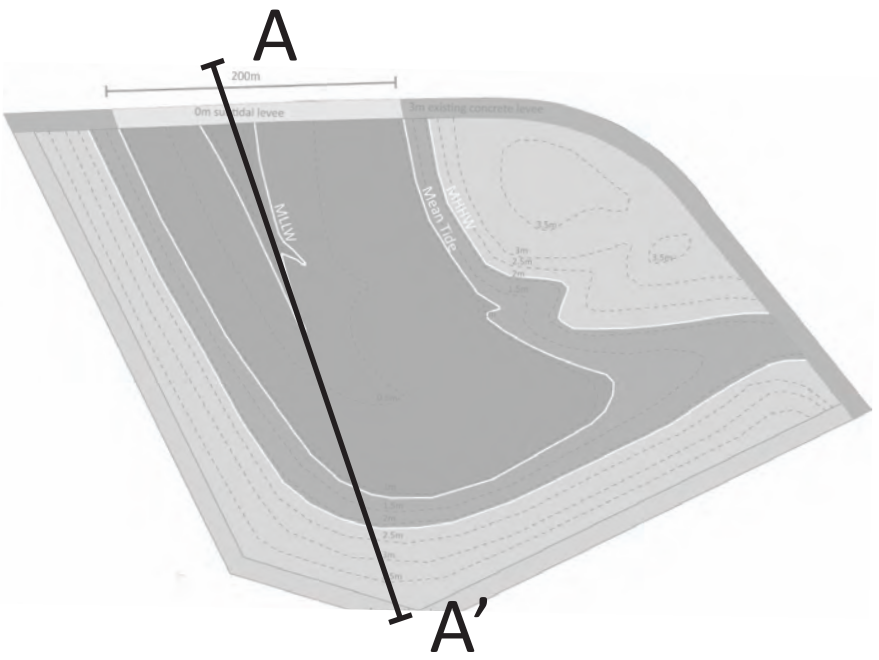
LARGE OPENING TO ALLOW WAVE ENERGY TO SUSTAIN MUDFLAT FORAGING HABITAT

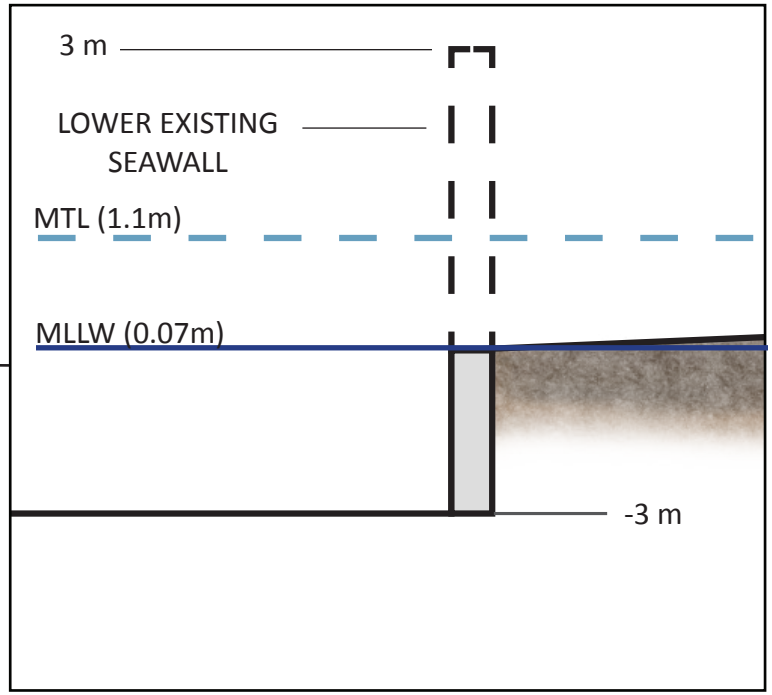
SINGLE BREACH MAXIMIZES TIDAL PRISM



NOT TO SCALE

LEVEE BREACH DETAILS





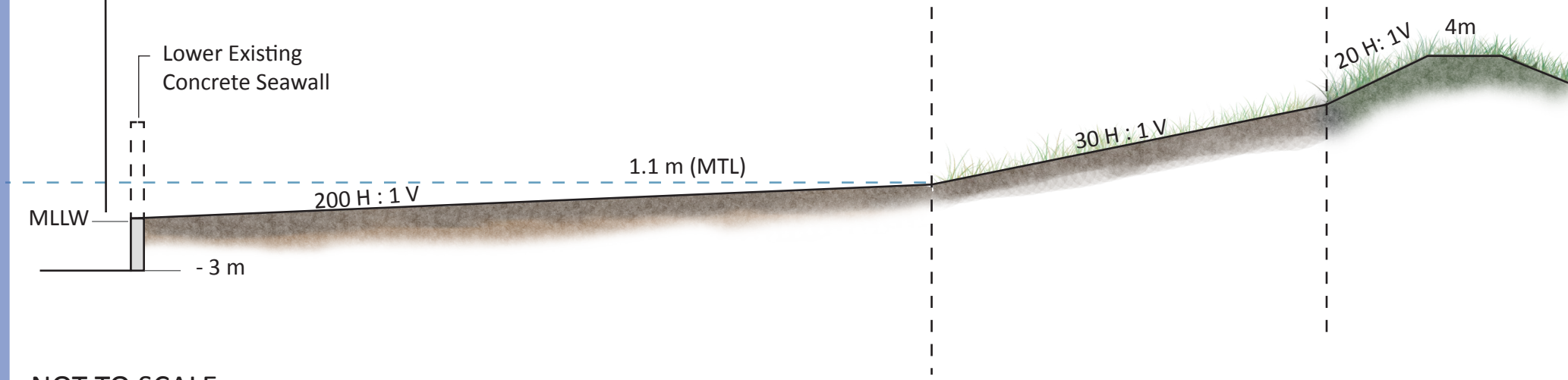
A

A'

INTERTIDAL MUDFLAT

VEGETATED MARSH

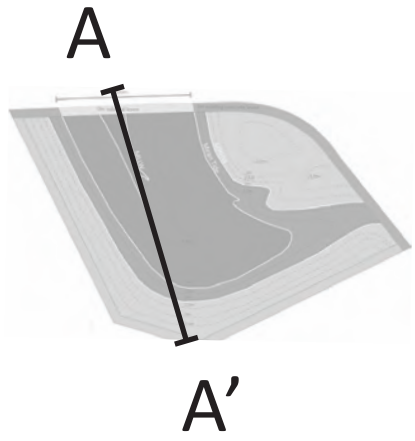
UPLAND

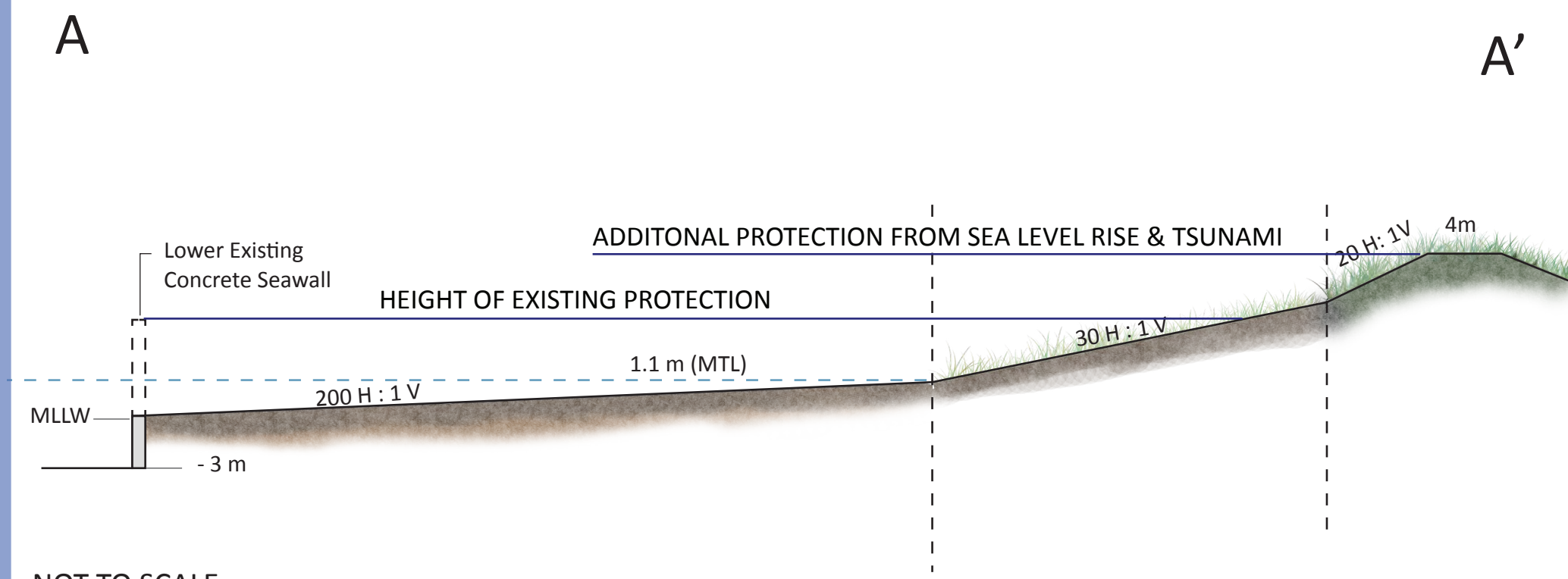


NOT TO SCALE

LEVEE BREACH DETAILS

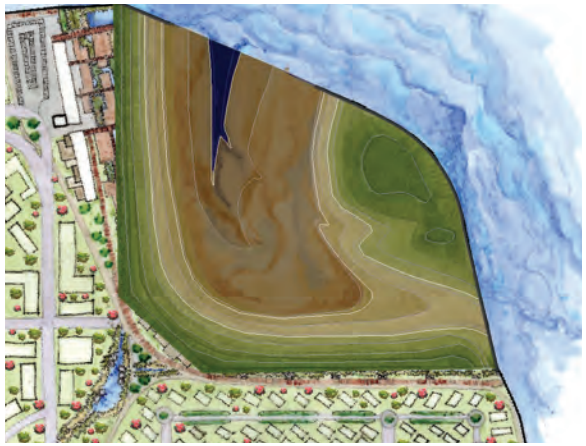
WETLAND HABITAT PROVIDE INCREASED PROTECTION FROM WAVE ENERGY AND TSUNAMI, AND PLANS FOR SEA LEVEL RISE



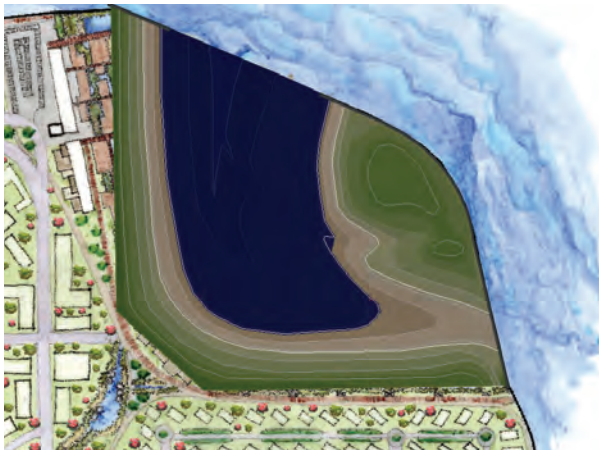


NOT TO SCALE

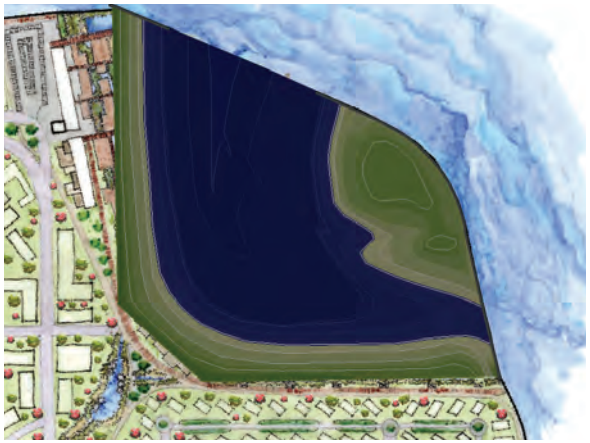
WETLAND PLAN: Tide Levels and Bird Use



Mean Lower Low Water

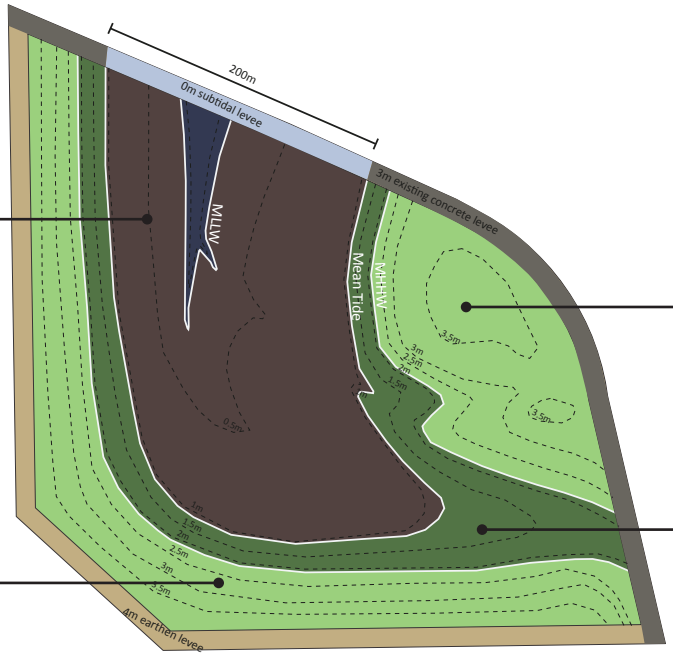


Mean Tide Level



Mean Higher High Water

Mudflat provides **6 hectares** feeding habitat. Dunlins, Plovers, and Gulls feed above tide line. Spoonbills and Herons feed in shallow water.

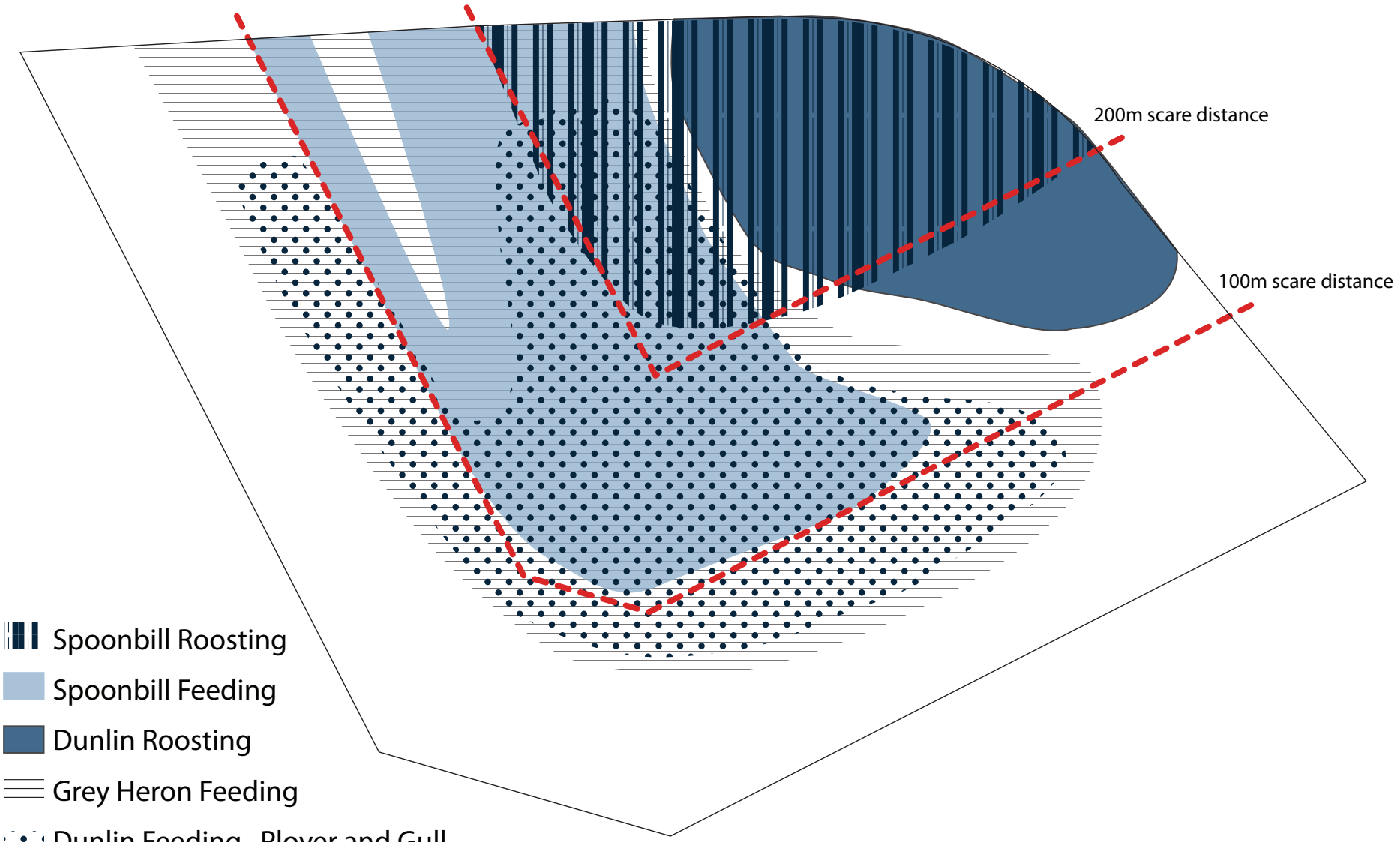


Grassy high ground provides refuge for birds during high tides. Dunlins will nest in this area. Plovers will nest on gravel maintenance road on top of levee.

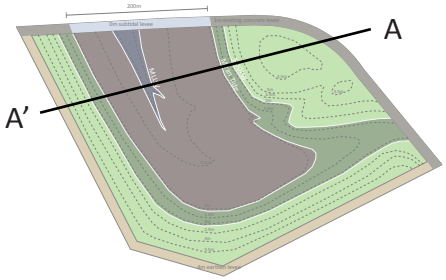
Tidal marsh extending to levee wall helps deter human access onto bird refuge area.

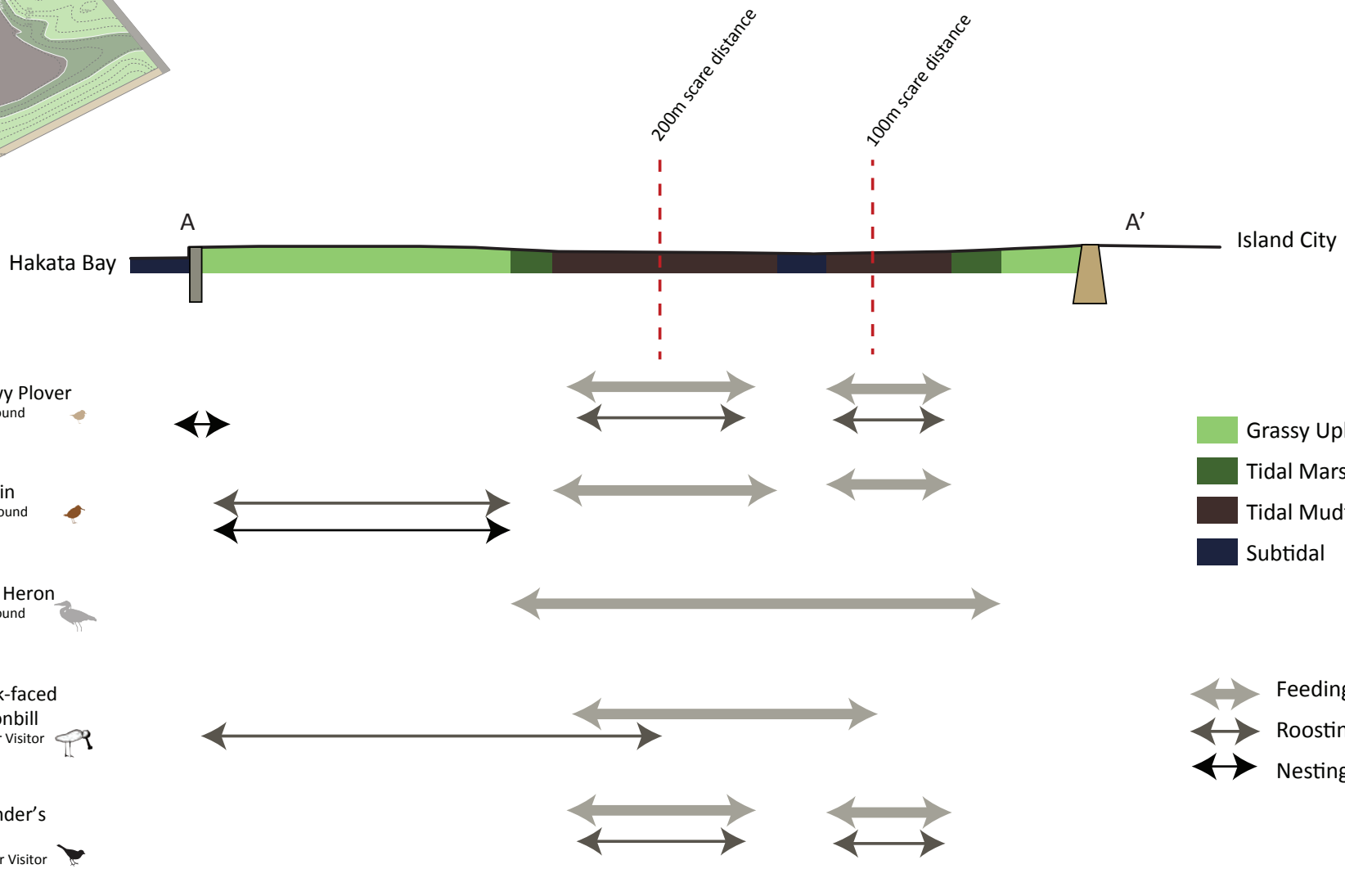
Gradual slope up to human areas creates a natural tidal flat edge, allows for mudflat to climb with sea level rise.

WETLAND PLAN - Bird Geometries

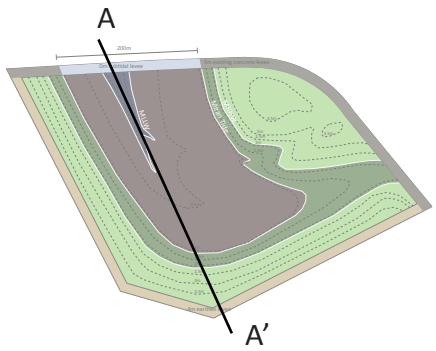


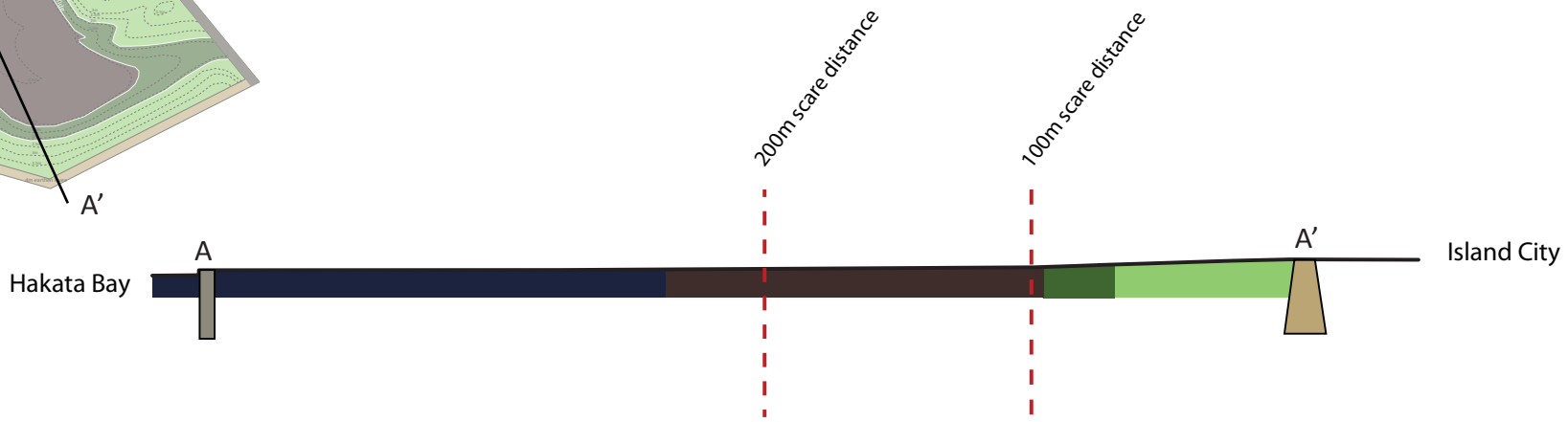
EAST-WEST SECTION - Habitats and Bird Geometries





NORTH-SOUTH SECTION - Habitats and Bird Geometries





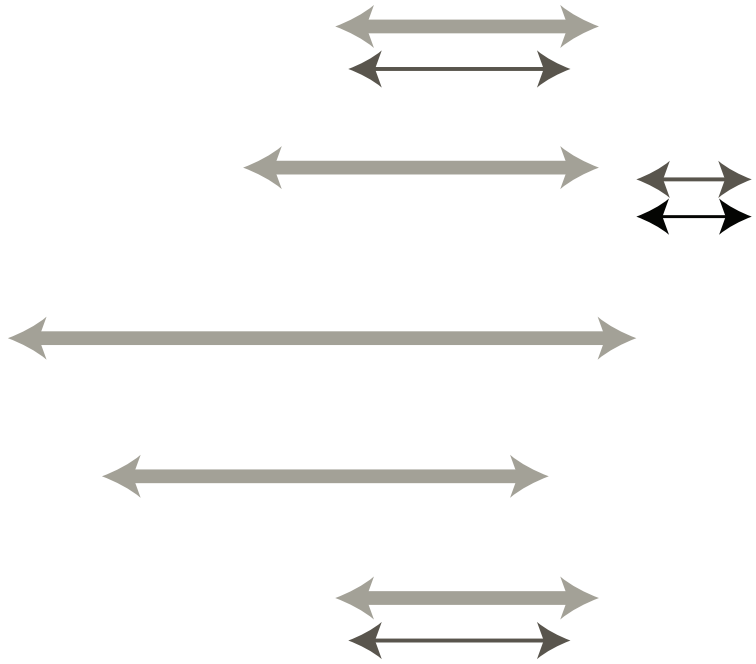
Snowy Plover
Year-round

Dunlin
Year-round

Grey Heron
Year-round

Black-faced
Spoonbill
Winter Visitor

Saunder's
Gull
Winter Visitor



Grassy Upland
Tidal Marsh
Tidal Mudflat
Subtidal

Feeding
Roosting
Nesting

100m

DESIGN CAVEATS

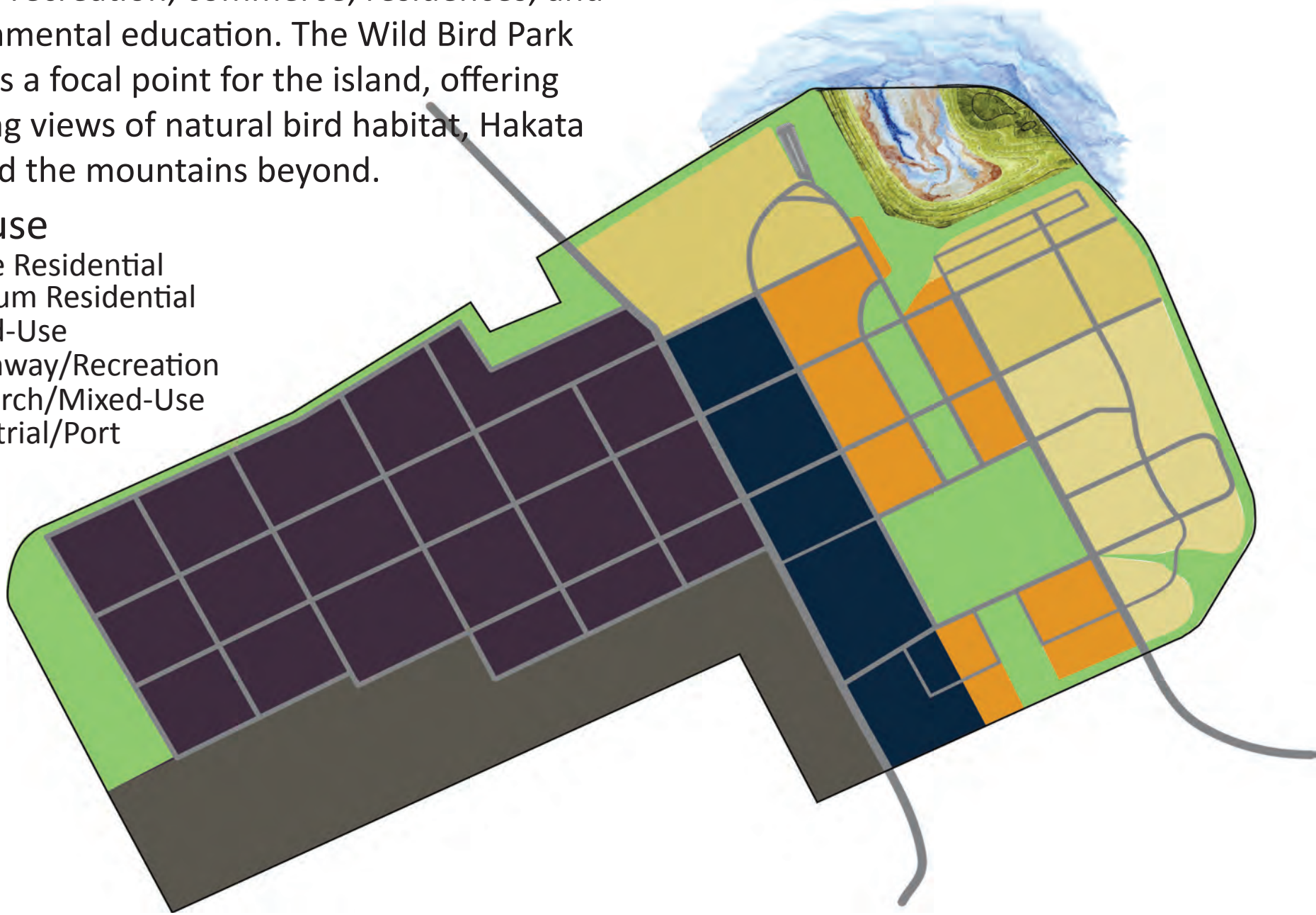
- Primary objectives of design are to incorporate natural processes in an artificial location
- Design is intended to be self-sustaining, but additional maintainance due to the new nature of this type of wetland design.
- Vegetation maintenance may be required if unwanted vegetation types or species (e.g. trees, invasives) establish in the high tide retreat area.

HUMAN INTERFACE DESIGN

Island City's Wild Bird Park anchors a vibrant zone of recreation, commerce, residences, and environmental education. The Wild Bird Park Tower is a focal point for the island, offering stunning views of natural bird habitat, Hakata Bay, and the mountains beyond.

Land use

- Dense Residential
- Medium Residential
- Mixed-Use
- Greenway/Recreation
- Research/Mixed-Use
- Industrial/Port
- Port



MASTER PLAN

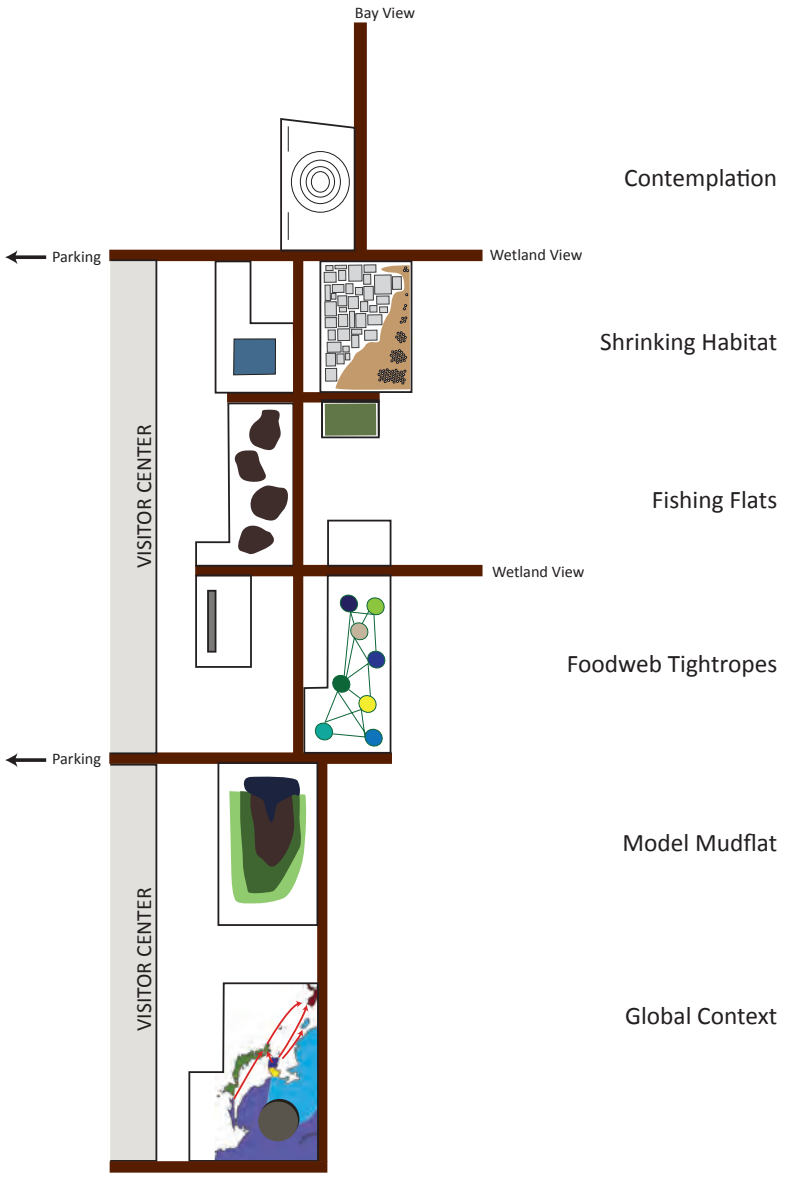

Biotopes
Hike/Bike Trail
Educational center
Bird Park Parking
View Tower
Bird Park pick-up/drop-off
Community Center
Wetland habitat (16 ha)
Linear Rain Garden
Mixed use
Duck Pond
Wetland protection fence
Picnic viewpoints
Hike/Bike
Residential
100m
Greenbelt to Central Park
Hike/Bike Trail

Biotopes

Plan

Traffic

Pick-up/Drop-off



Section

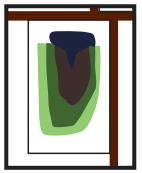
Biotopes

Interactive, entertaining educational experience.

Designed to complement more formal exhibits in the visitor center.

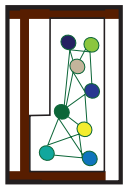
Biotope 1: **HAKATA BAY IN A GLOBAL CONTEXT**

- Map on ground shows migratory bird routes.



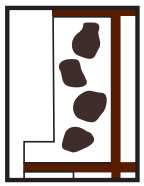
Biotope 2: **MODEL TIDAL MUDFLAT AND WETLAND**

- Scale model of a tidal mudflat and wetland, artificial tide action demonstrates high tides every 10 minutes.



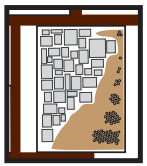
Biotope 3: **HAKATA BAY FOOD WEB TIGHTROPES**

- Walk the tightropes and understand how every species in the bay is interconnected



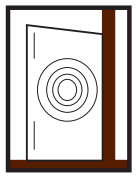
Biotope 4: **EAT LIKE A SPOONBILL**

- Visitors provided with Spoonbill “beaks” that fit over hands, fish for fake shrimp in a series of mudflats.



Biotope 5: **SHRINKING MUDFLATS**

- As visitors walk through, a city will gradually encroach on mudflat walking area until there is nothing left.
- Light-up map shows current and historic mudflats.

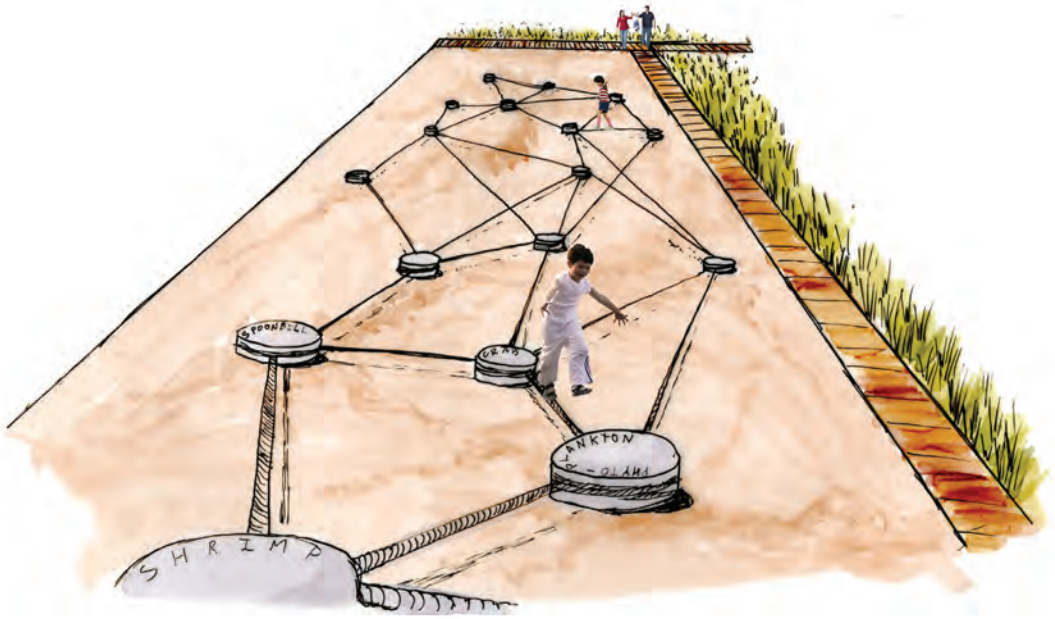


Biotope 6: **WHAT YOU CAN DO**

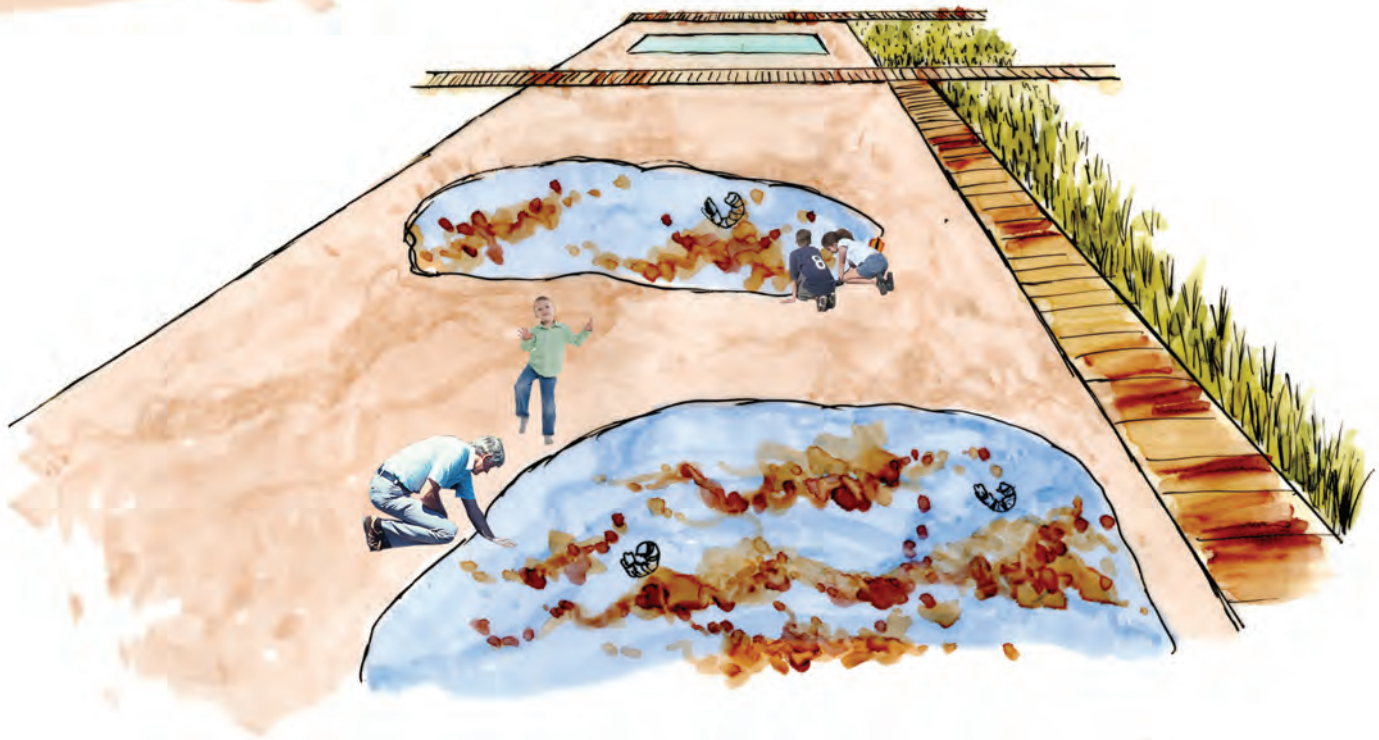
- Contemplative area with signage suggesting what citizens can do to help wild birds.

Biotopes

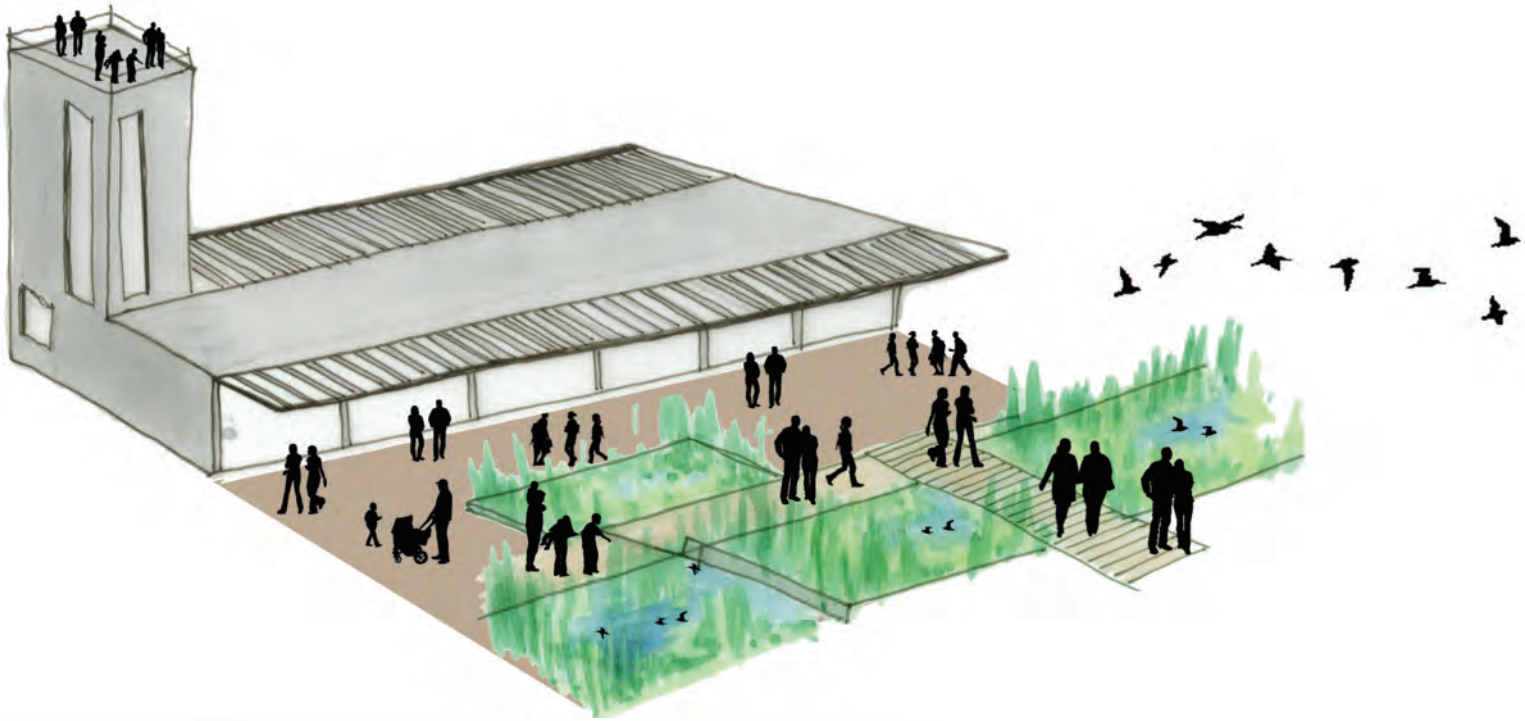
Foodweb Tightropes

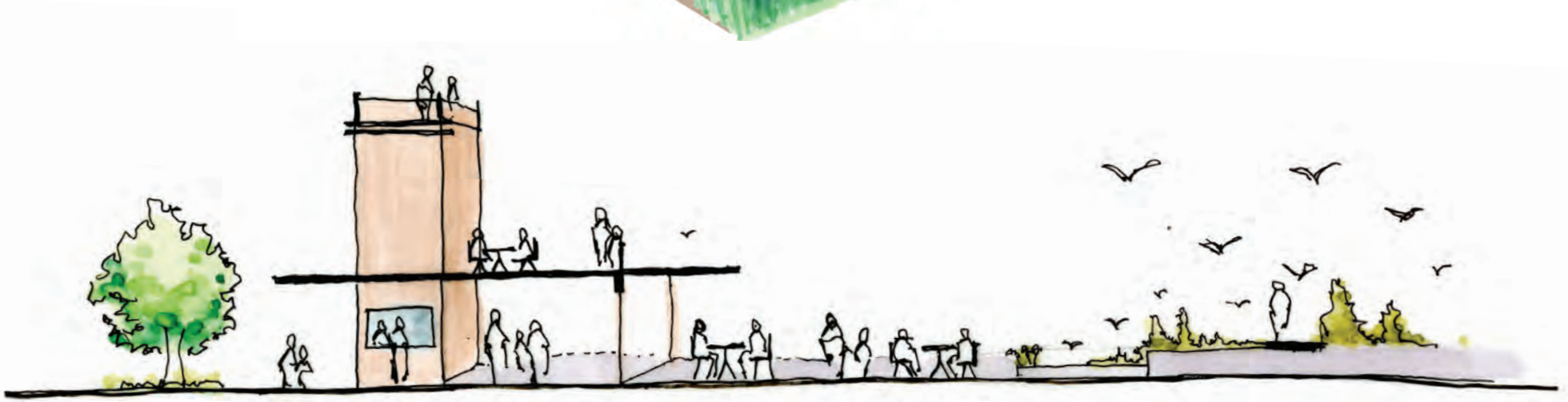


Feeding Flats



Educational Center and Biotopes





View Tower Cafe Seating Biotope Area

CONCLUSIONS

Tidal Marsh Dynamics

Wetland designed to maximize natural processes for minimal human intervention.

Habitat

A range of tidal mudflat, tidal marsh, and upland areas provide habitat for a variety of wild bird species.

Human Engagement

Human interface elements are designed to maximize environmental education opportunities, as well as passive and active recreation activies.

Thank You!

Special acknowledgements to:

NSA, NTU, Randy Hester, Marcia McNally, Phil Williams, Derek Schubert, Fiona Cundy, Yoonju Chang, SAVE International, Matt Kondolf, Kelly Janes, Kenjiro Kito, Port of Fukuoka, Darryl Jones, Hisashi Shibata, Matsumoto

ISLAND CITY
WILD BIRD PARK


謝謝