

NETHERLANDS MARITIME UNIVERSITY ROTTERDAM
MASTER SHIPPING AND TRANSPORT

Dr. R.E. Waterman MSc

October 2018
Rotterdam



STC-GROUP



Full speed aheadwith your career

SUSTAINABLE COASTAL ZONE DEVELOPMENT

Integrated Coastal & Deltaic Policy via Building with Nature[®]



$(\alpha+\beta+\gamma)$ knowledge
+ action \rightarrow Δ sustainable

Netherlands Maritime University Rotterdam

October 2018

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SUSTAINABLE COASTAL ZONE DEVELOPMENT

Civilisations were often developed in the border zone land-water, in coastal and deltaic regions. These border-zones are very attractive for living, working, tourism & recreation, transport, water resources, food supply. They are also important for nature values, because of the presence of gradients from wet to dry, from high to low salt & chalk content, differences in height & micro-climate. Gradients are often guarantees for a large variety of species.

Therefore it is not a surprise that in the 21st century, ~ 80% of the largest population centres are found in coastal areas.

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SUSTAINABLE COASTAL ZONE DEVELOPMENT

As an answer to this scarcity of space:

Reclaiming Land in Sea
and
Water in the new Land !

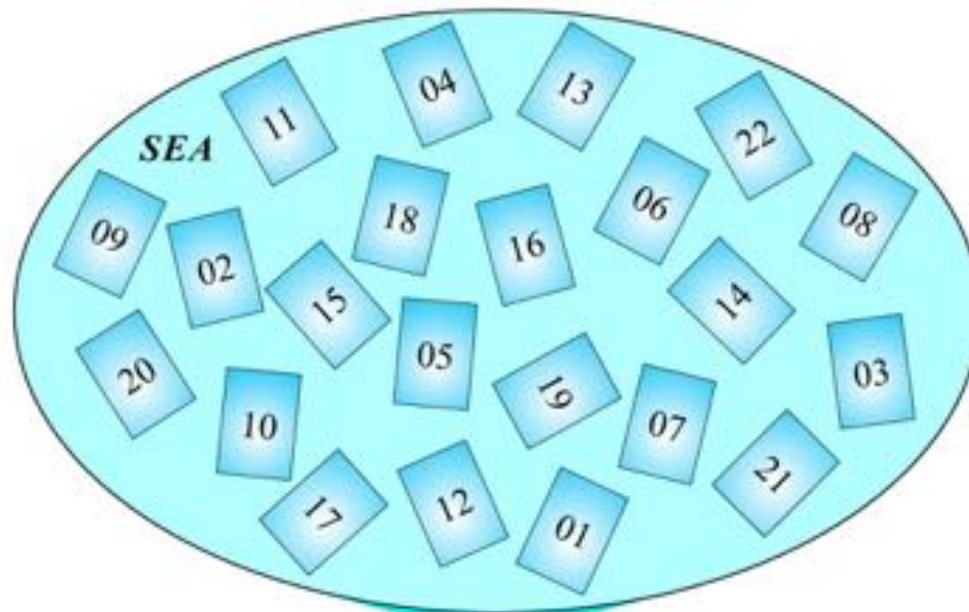
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BUILDING WITH NATURE

Integrated Approach to the coastal zone, including new and old land & sea.

Many functions have to be considered, while using many different disciplines.

Integrating land in sea and water in new and old land, thereby solving many existing and future problems in relation to the hinterland and the bordering sea, while creating added value.



INTEGRATED MULTI-FUNCTIONAL
SUSTAINABLE
COASTAL ZONE DEVELOPMENT



FUNCTIONS



- SAFETY** with regard to:
- flooding (including effects: sea level & river level rise)
 - drought
 - coastal erosion
 - land subsidence
 - salt water intrusion
 - natural disasters
 - human activities



01



ENVIRONMENT (IN GENERAL)

environmental compartments:

- air
- water
- land



02

NATURE

- micro-organisms, flora, fauna (incl. people)
- eco-systems
- nature conservation
- nature development
- bio-diversity
- bio-diversification



LANDSCAPE

- landscape conservation
- landscape development





SEASCAPE



03

04

FUNCTIONS

	<p>WATER RESOURCES MANAGEMENT</p> <ul style="list-style-type: none"> - water quantity - water quality - groundwater - surface water - dune infiltrated water - (desalinated) sea-water - sewer systems - waste water purification 		<p>ENERGY</p> <ul style="list-style-type: none"> - natural gas, oil, coal, etc. - biomass (wood, etc.); organic wastes - nuclear energy - solar-, wind-, water-, geo-energy - combined cycle, isolation, etc. 
05		06	

<p>AGRICULTURE horticulture, forestry, cattle & poultry breeding</p> <p>FISHERY</p> <p>AQUACULTURE</p> 		<p>MINING / EXTRACTION & STORAGE</p> <p>in / on</p> <p>Land / Sea-bed / Sea / Air</p> 	
07		08	

FUNCTIONS



BUILDING SITES FOR LIVING & WORKING

- houses & apartments
+ facilities
- industries & offices
+ facilities
- urban development



09



RECREATION & TOURISM



10

TRANSFER / DISTRIBUTION CENTRES & RELATED ACTIVITIES

- seaport
- riverport,
- lake port
- airport,
- landport



INFRASTRUCTURE

- roads
- railroads
- waterways
- underground systems
- airplanes
- electronic highway



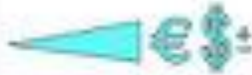
11

12



TRANSPORT MODULES

- bicycle, motor-car, bus, tram, train, maglev (magnetic levitation train),
- metro
- ship,
- container
- airplane, rocket, satellite



13



INFORMATION COMMUNICATION TECHNOLOGY

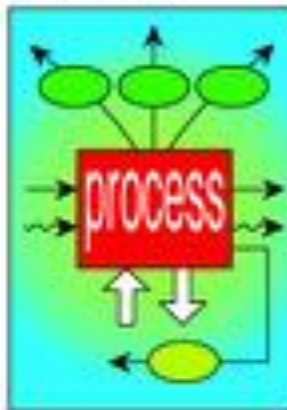
- DATA ACQUISITION
- DATA STORAGE
- DATA TRANSMISSION
- DATA PROCESSING



14

ENVIRONMENT (IN PARTICULAR)

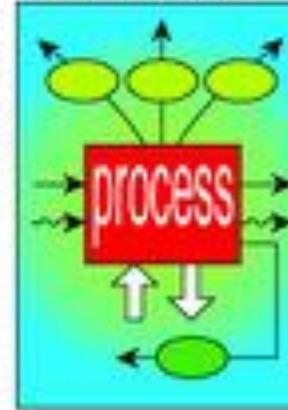
Air- / Water- / Soil-quality
by improvement of
conversion processes
and by end of pipe
purification



15

ENVIRONMENT (IN PARTICULAR)

solid waste reduction
by improvement of
conversion processes and
by environmental friendly
collection - transport -
storage - processing -
recycling - usage



16

FUNCTIONS



GOVERNMENTAL
INSTITUTIONS
NON-GOVERNMENTAL
INSTITUTIONS
CITIZEN GROUPS
INDIVIDUAL CITIZENS
PEOPLE'S
PARTICIPATION
LAW - JUSTICE - ORDER



17



HEALTH & WELFARE
SPORT / PLAYGROUND
HISTORY & CULTURE
RELIGION
PHILOSOPHY OF LIFE
VALUES / STANDARDS
SOCIOSPHERE



18

EDUCATION
&
RESEARCH



DEFENCE
&
RISK MANAGEMENT
SAFETY & SECURITY



19



20

FUNCTIONS



-
-
-

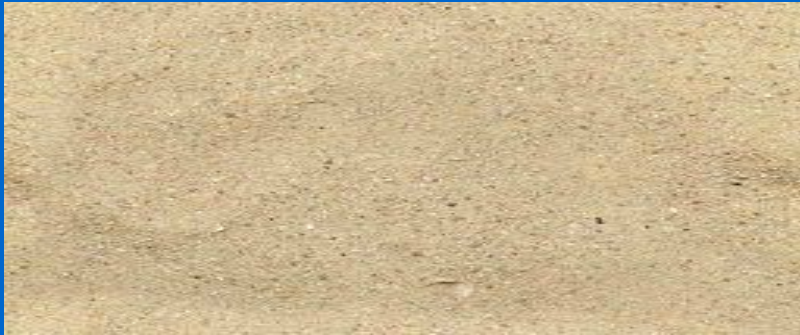
BUILDING WITH NATURE

Realisation of new land, where nature allows us to do so, using the principle of *Building with Nature*.

The essence of this principle is:

Flexible integration of land in sea and of water in the new land, making use of materials and forces/interactions, present in nature, taking into account existing and potential nature values, and the biogeomorphology & geohydrology of coast and seabed.

BUILDING WITH NATURE



Loose mobile material sand & silt from coarse to fine and the forces & interactions to which they are exposed

INORGANIC MATERIALS

gravel/sand
silt/clay

ORGANIC MATERIALS



-
- **FORCES & INTERACTIONS:**
-

01. Tidal action (ebb & flood)

02. Wave action (specifically in the breaking zone) and swell action

03. Sea currents other than tidal currents

04. River outflow (as force and as supplier of freshwater and sediment)

05. Gravity

06. Wind

07. Rain

08. Solar radiation

09. Interaction dunes - vegetation (root system vegetation keeps together sand/silt)

10. Complex interaction marine organisms - sand/silt.

BIOGEOMORPHOLOGY & GEOHYDROLOGY OF

COAST AND SEABED

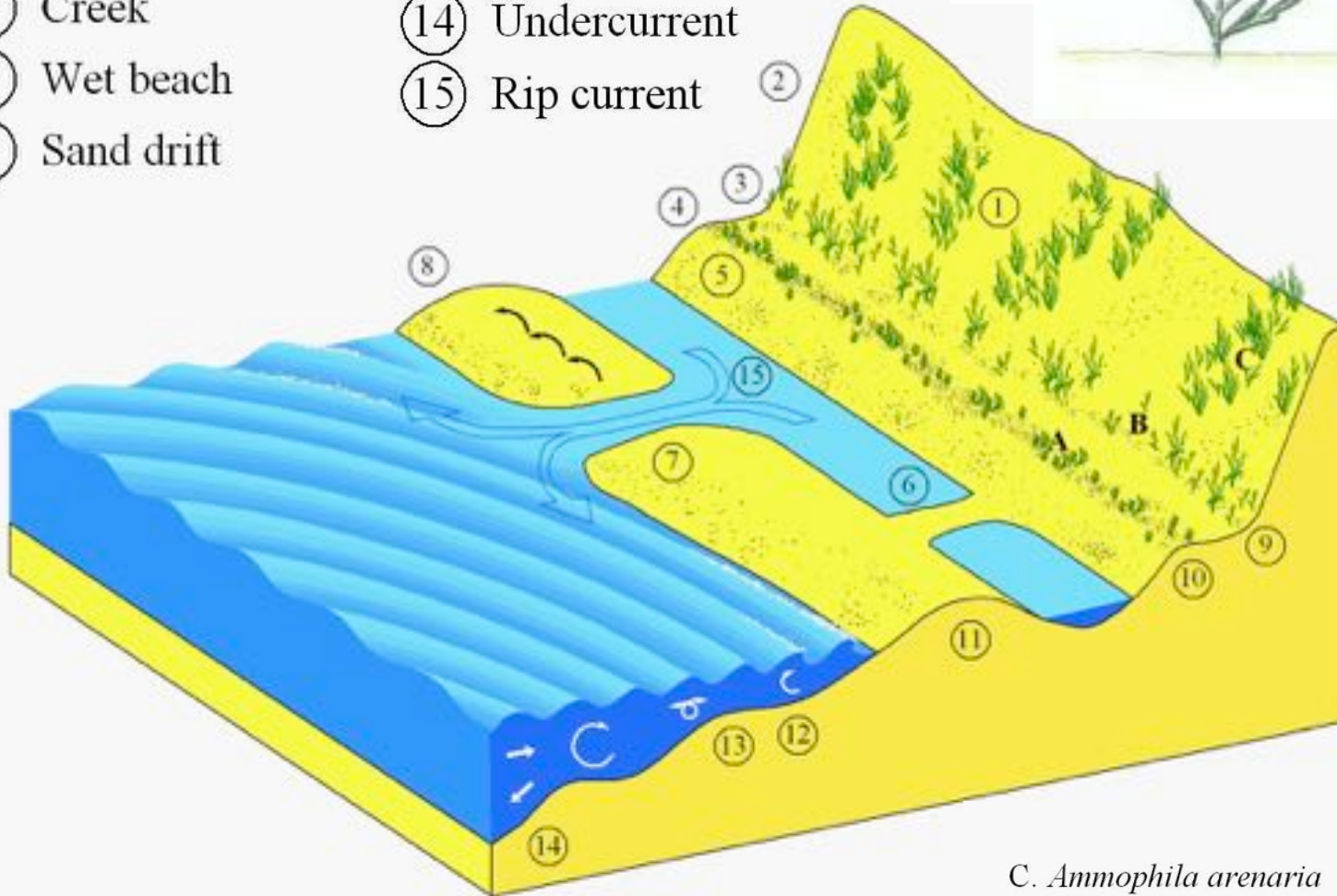
- ① Dune
- ② Coastal strip
- ③ Dune toe
- ④ Flood mark
- ⑤ Dry beach
- ⑥ Creek
- ⑦ Wet beach
- ⑧ Sand drift

- ⑨ High water during storm surge
- ⑩ High water
- ⑪ Low water
- ⑫ Geo valley in surf zone
- ⑬ Geo ridge in surf zone
- ⑭ Undercurrent
- ⑮ Rip current

A. Cakile maritima



B. Elytrigia juncea



C. Ammophila arenaria

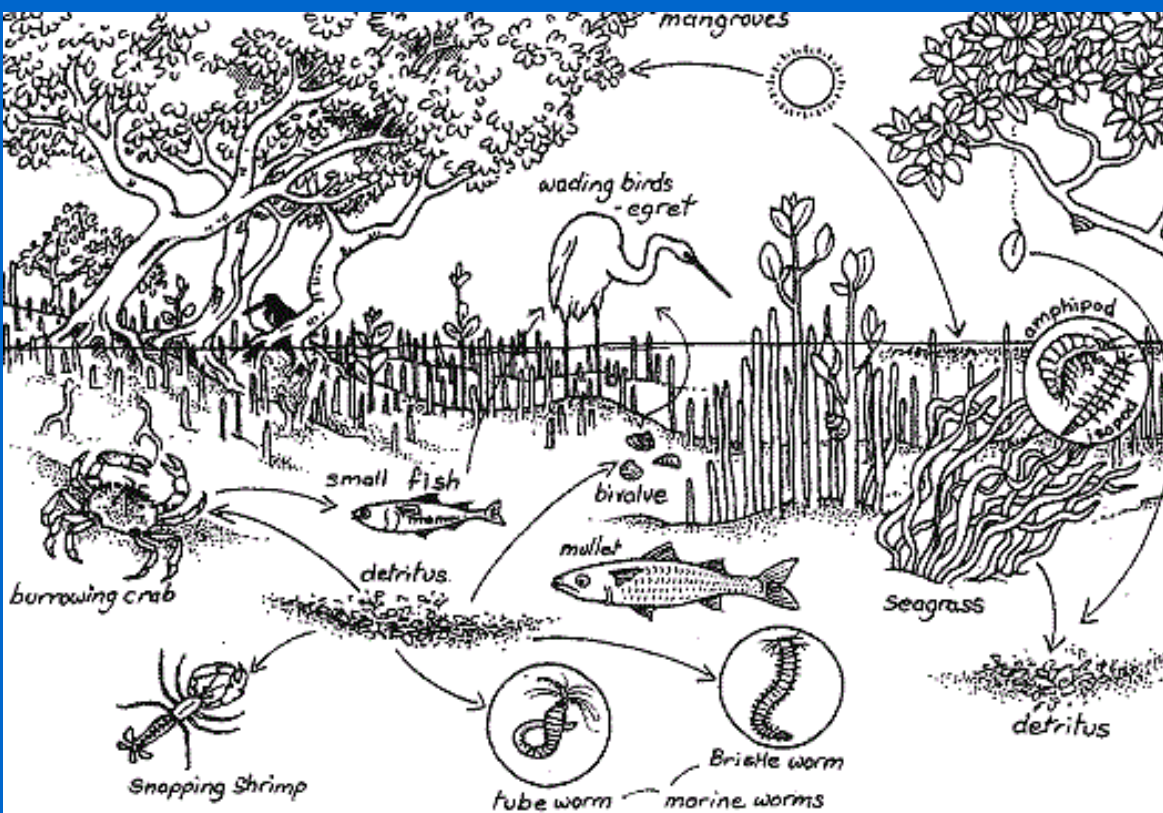


**Application of mangroves in silty coastal zones
for coastal protection & nature development
especially in tropical & subtropical areas**



Mangroves

- Shoreline protection from erosion
- Basis for the complex marine food chain
- Creation of breeding habitats
- Protection for maturing offspring
- Filtering and assimilation of pollutants from upland runoffs
- Stabilisation of bottom sediment
- Improvement of water quality





Peg roots of *Avicennia*



Knee Roots of *Bruguiera*



Peg roots of *Sonneratia*



Prop roots of *Rhizophora*



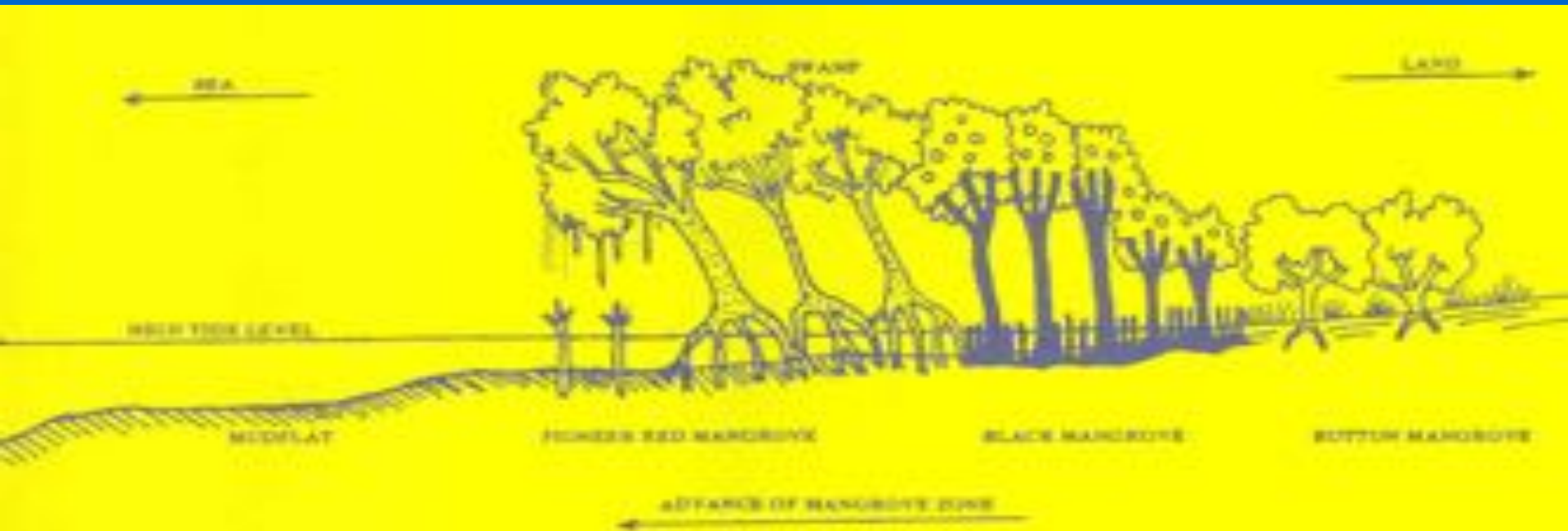
MANGROVES

Dr. Bob Ursem TU Delft

Mangroves characteristics & types

Mangroves for coastal protection

Mangroves as a basis for a rich eco-system





Category 1

First boundary layer of coastal defense, rough salt rich turbulent environment is an excellent growth area for mangroves with stilt pneumatophore root systems: tall trees, robust root systems, well anchored in mud, no settling of silt. Especially good for blocking storms and strong wave impact.

Category 2 and 3

A more inland, relative dynamic up to non turbulent, low saline level environment is an excellent growth area for mangroves with erect pneumatophore root systems: middle to tall tree sizes, sometimes shrubs, root system just reaching the high tide level, relative open to dense root cover, only anchored in mud at the base, creating a perfect alluvial environment.

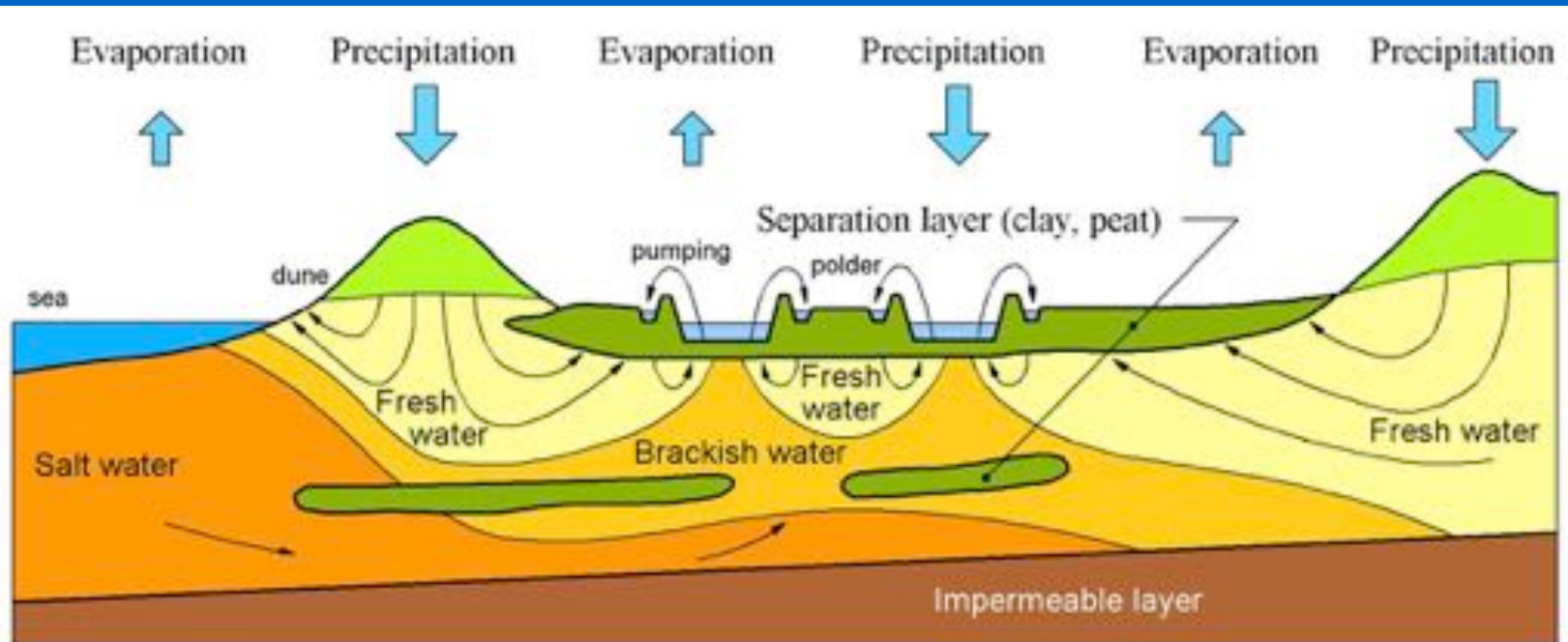


Semi Permeable Dam

To initiate intertidal silt sedimentation
for natural mangrove formation



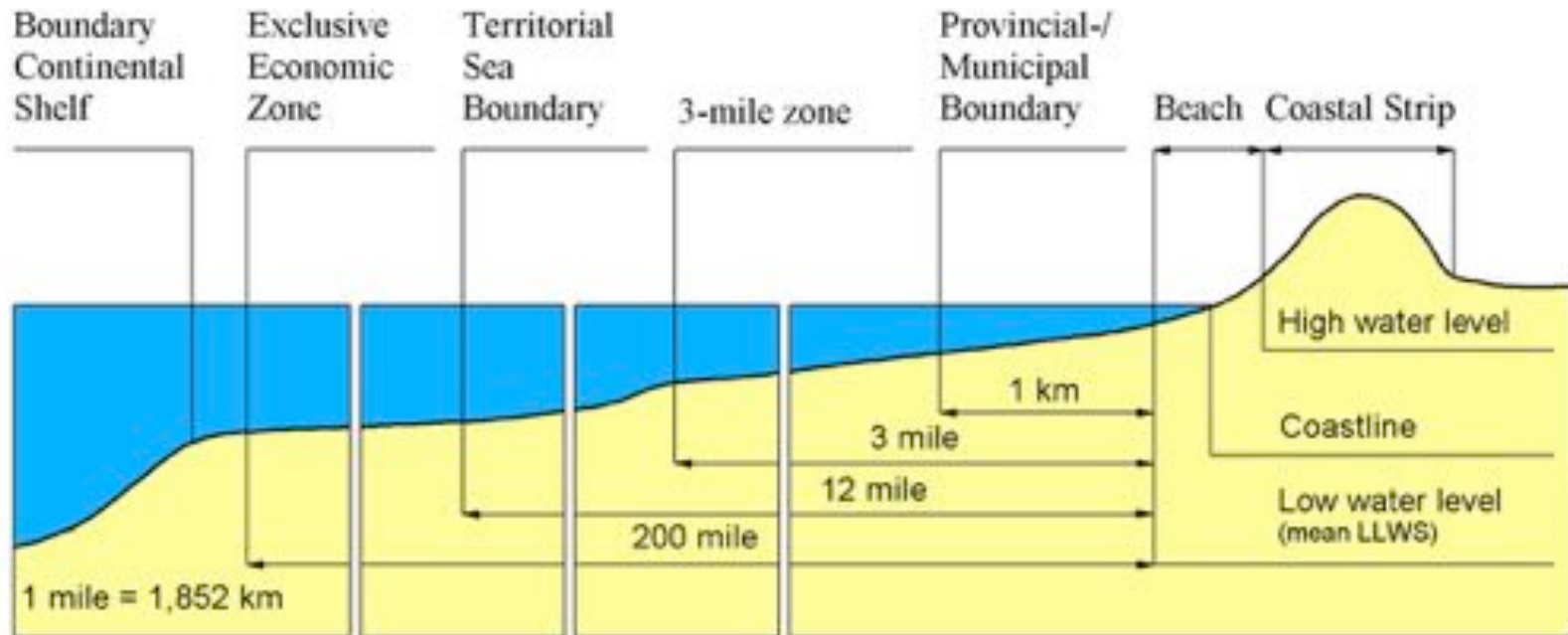
BUILDING WITH NATURE



CROSS SECTION SUBSOIL OF WEST-HOLLAND

Data: Rijks Geologische Dienst - S. Jelgersma

BUILDING WITH NATURE

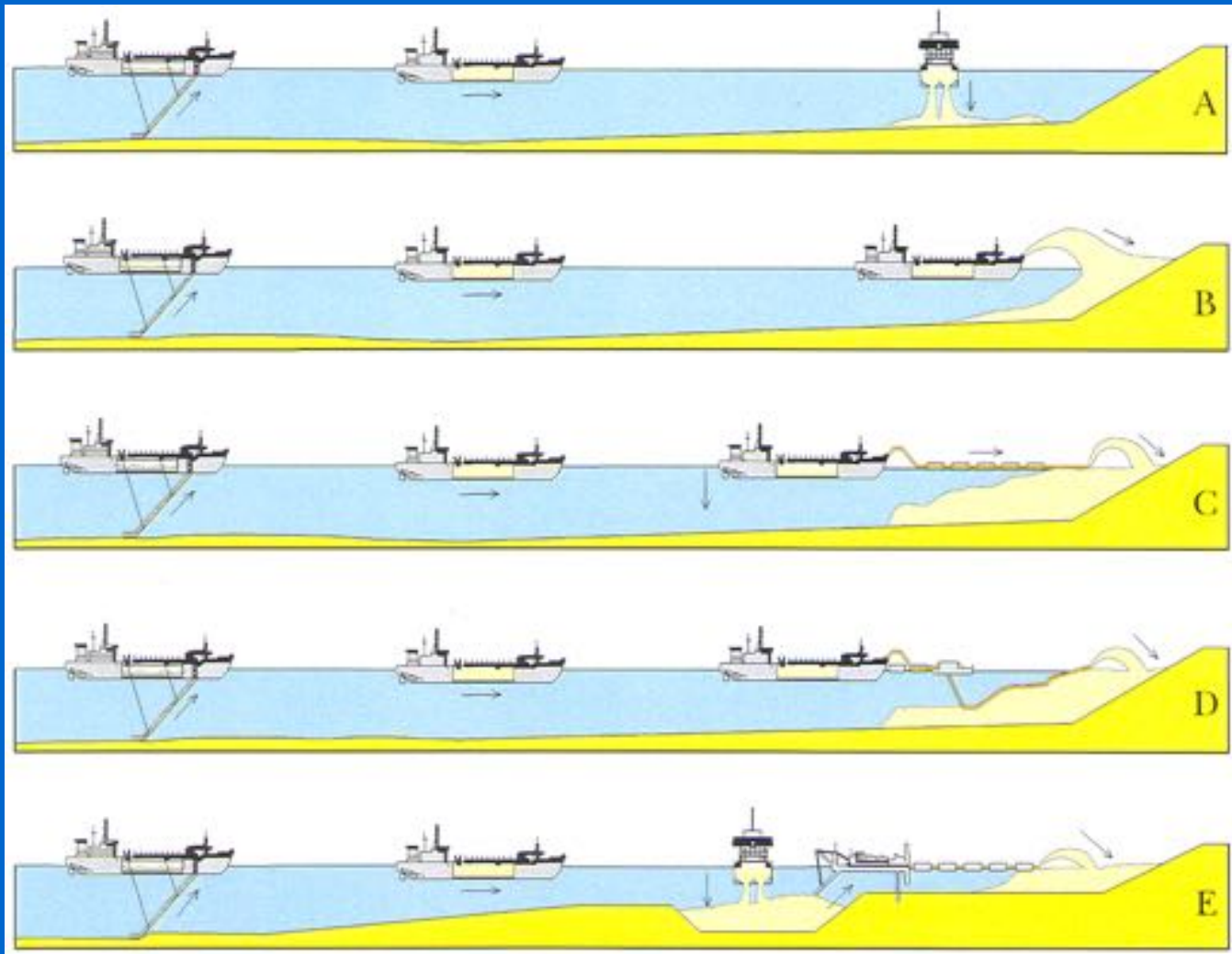


CROSS SECTION COASTAL ZONE
with national & international boundaries

Data: Chef der Hydrografie W.A. van Gein

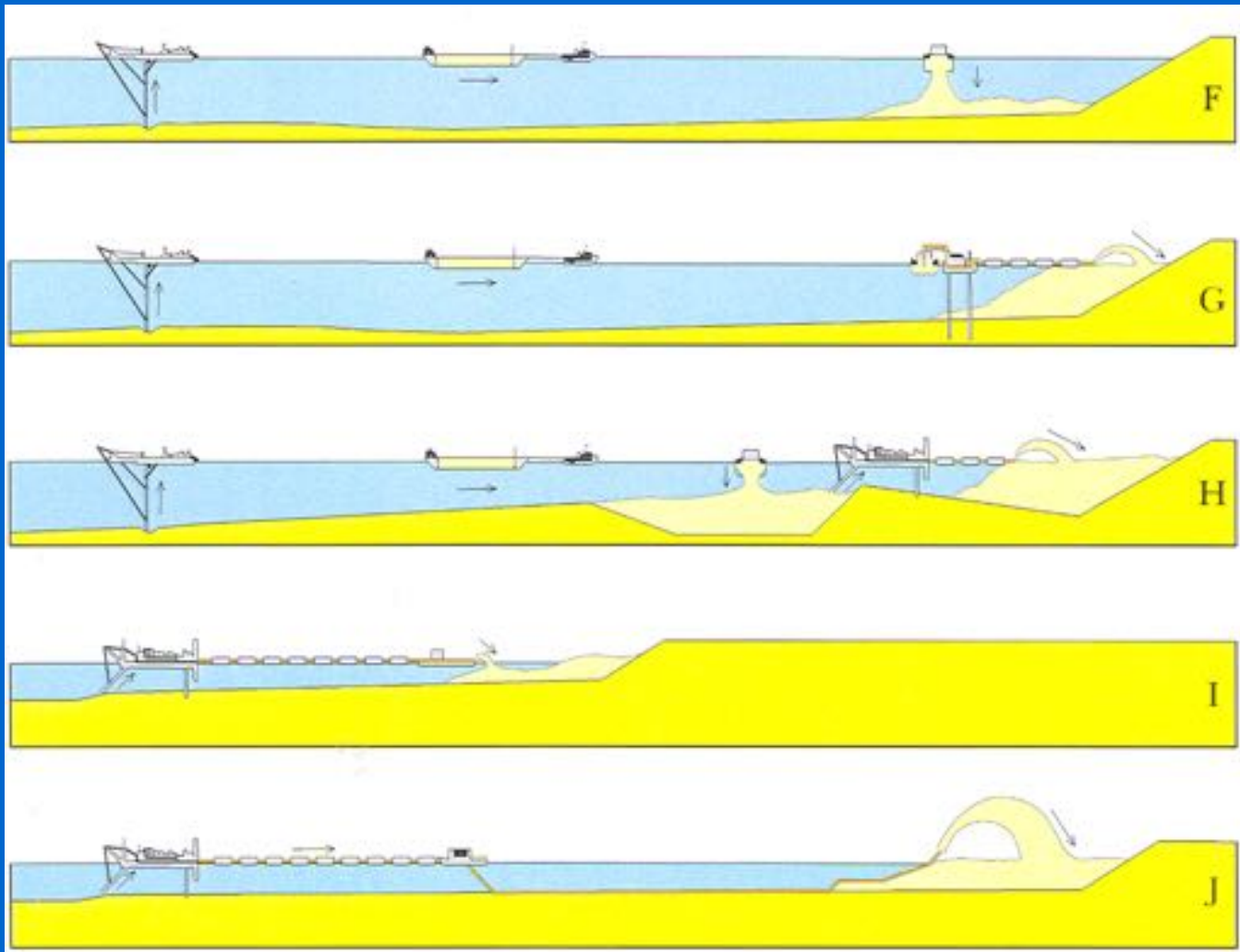
Dredging for Land Reclamation & Beach Nourishment

BUILDING WITH NATURE



Dredging for Land Reclamation & Beach Nourishment

BUILDING WITH NATURE



SOLUTIONS IN FULL HARMONY WITH NATURE: NATURAL BEACHES AND DUNES

1.A.1
Existing Coastline
with Beach and Dunes



1.A.2
Dune and Beach
Nourishment



1.A.3
Foreshore Nourishment



SOLUTIONS USING ARTIFICIAL STRUCTURES IN HARMONY WITH NATURE

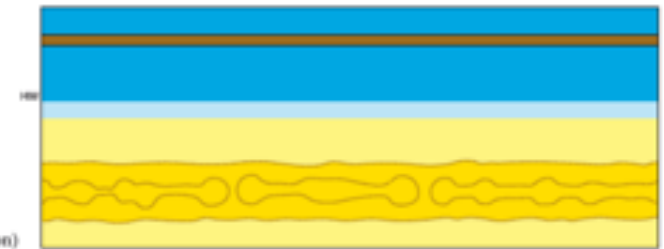
1.B.1
Submerged
Parallel Berm /
Perched Beach
(Sand Retaining Dam)



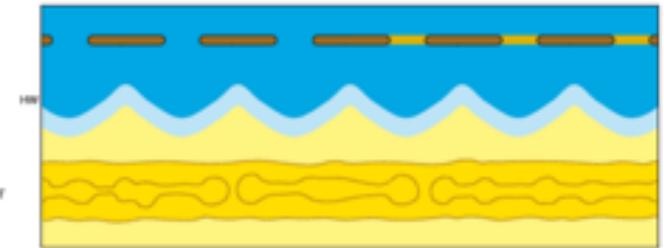
1.B.2
Submerged Offshore
Breakwater - Reef Type
(Sand Retaining Dam,
Wave Energy Reduction)



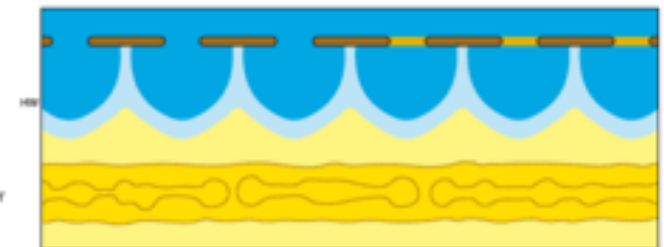
1.B.3
Offshore Breakwater
(Sand Retaining Dam,
Wave Energy Reduction)



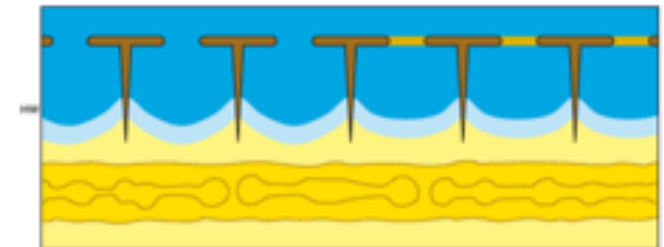
1.B.4
Multiple Offshore
Breakwaters without or
with sills
(Salient Beaches)



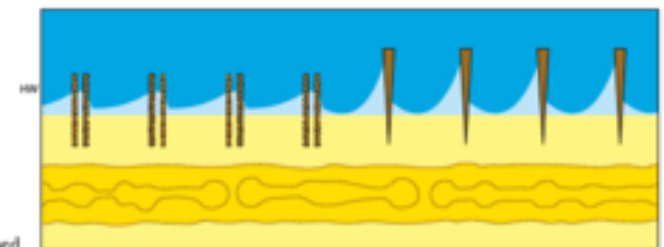
1.B.5
Multiple Offshore
Breakwaters without or
with sills
(Tombolo Beaches)



1.B.6
T-shaped Breakwaters
without or with sills
(Pocket Beaches)

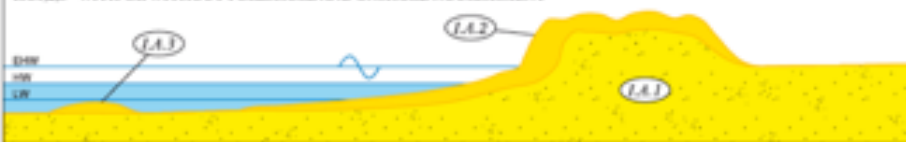


1.B.7
Groynes, Open or Closed



NATURAL BEACHES AND DUNES

1.A.1,2,3 WITH OR WITHOUT FORRESHORE AND ONSHORE NOURISHMENT



SEMI-NATURAL BEACHES AND DUNES

1.B.1 SUBMERGED PARALLEL BERM / PERCHED BEACH



1.B.2 SUBMERGED OFFSHORE BREAKWATER



1.B.4,5,6 (MULTIPLE) OFFSHORE BREAKWATER



SEAWALLS WITH SMOOTH SLOPES

1.C.1 BERM TYPE

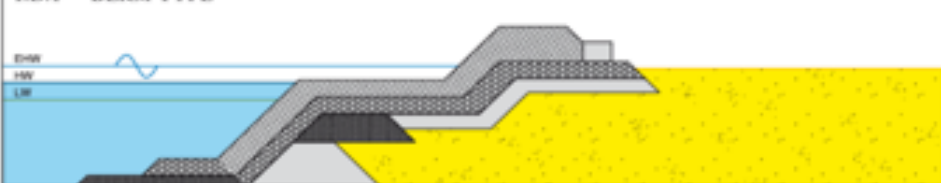


1.C.2 CONTINUOUS SLOPE TYPE

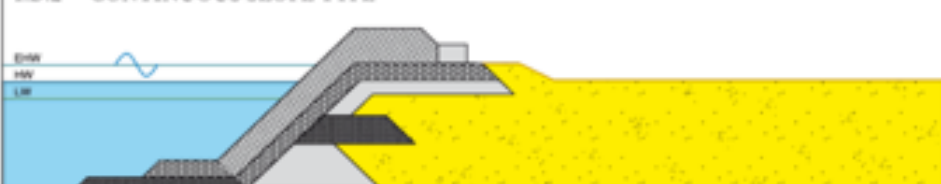


SEAWALLS WITH STEEP SLOPES

1.D.1 BERM TYPE

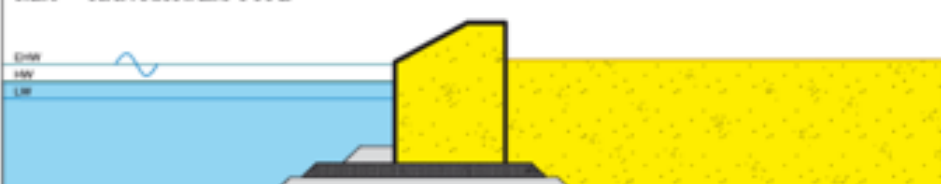


1.D.2 CONTINUOUS SLOPE TYPE

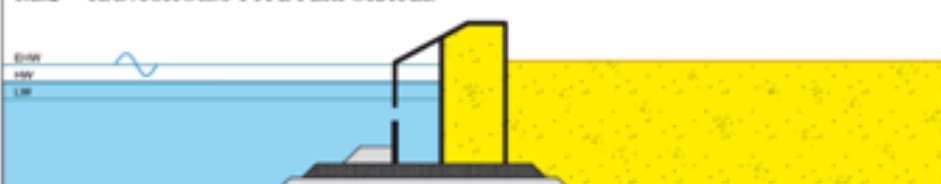


SEAWALLS WITH CAISSONS

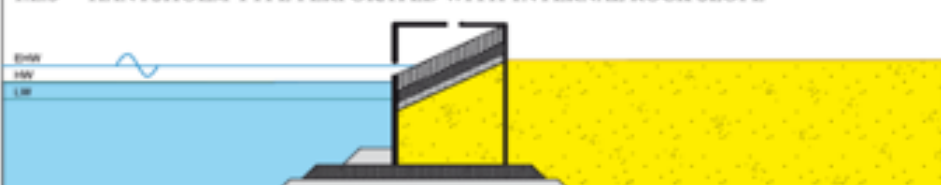
1.E.1 HANTSHOLM TYPE



1.E.2 HANTSHOLM TYPE PERFORATED

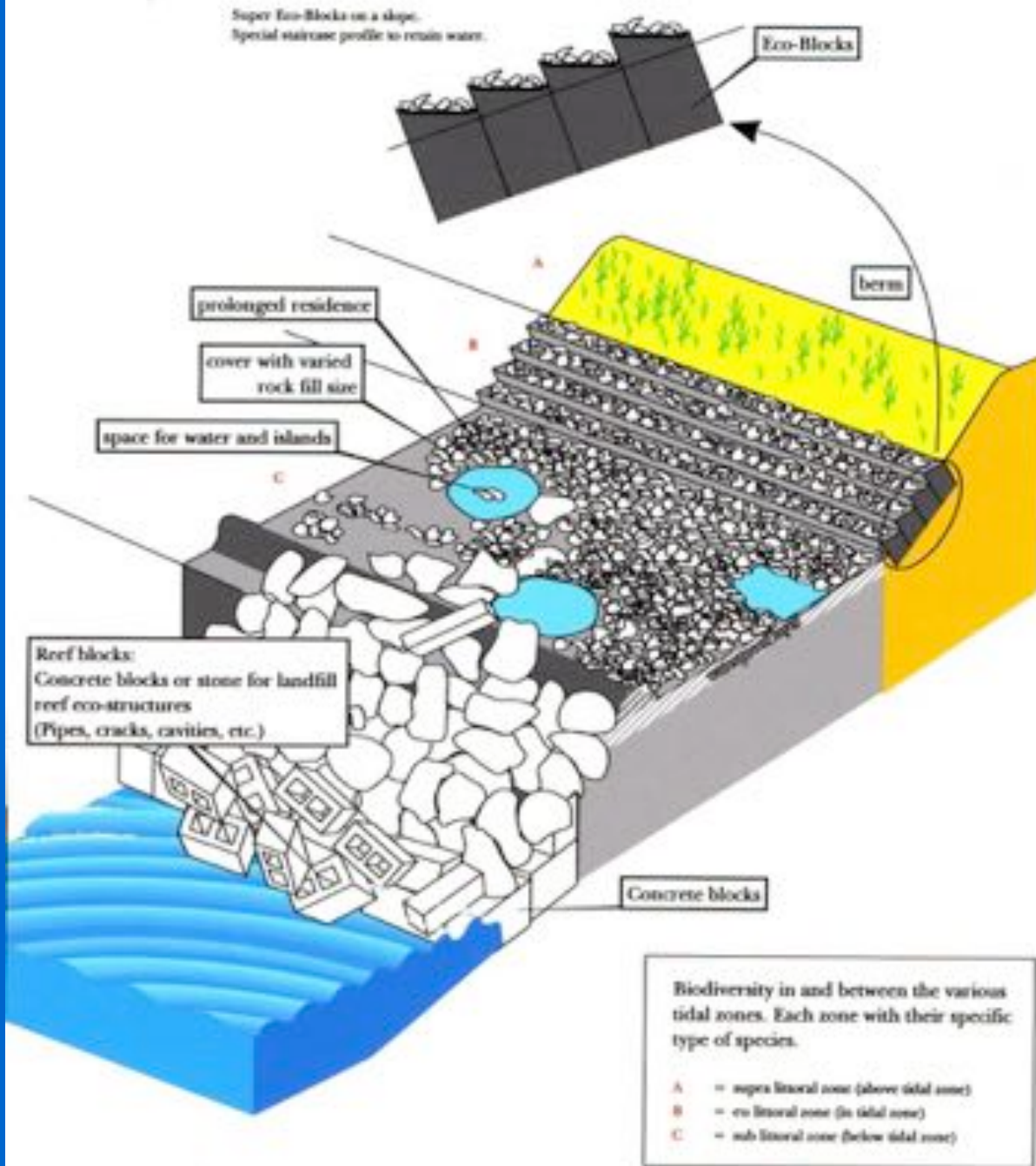


1.E.3 HANTSHOLM TYPE PERFORATED WITH INTERNAL ROCK SLOPE



ECO DAM / ECO DIKE

Eco X-block

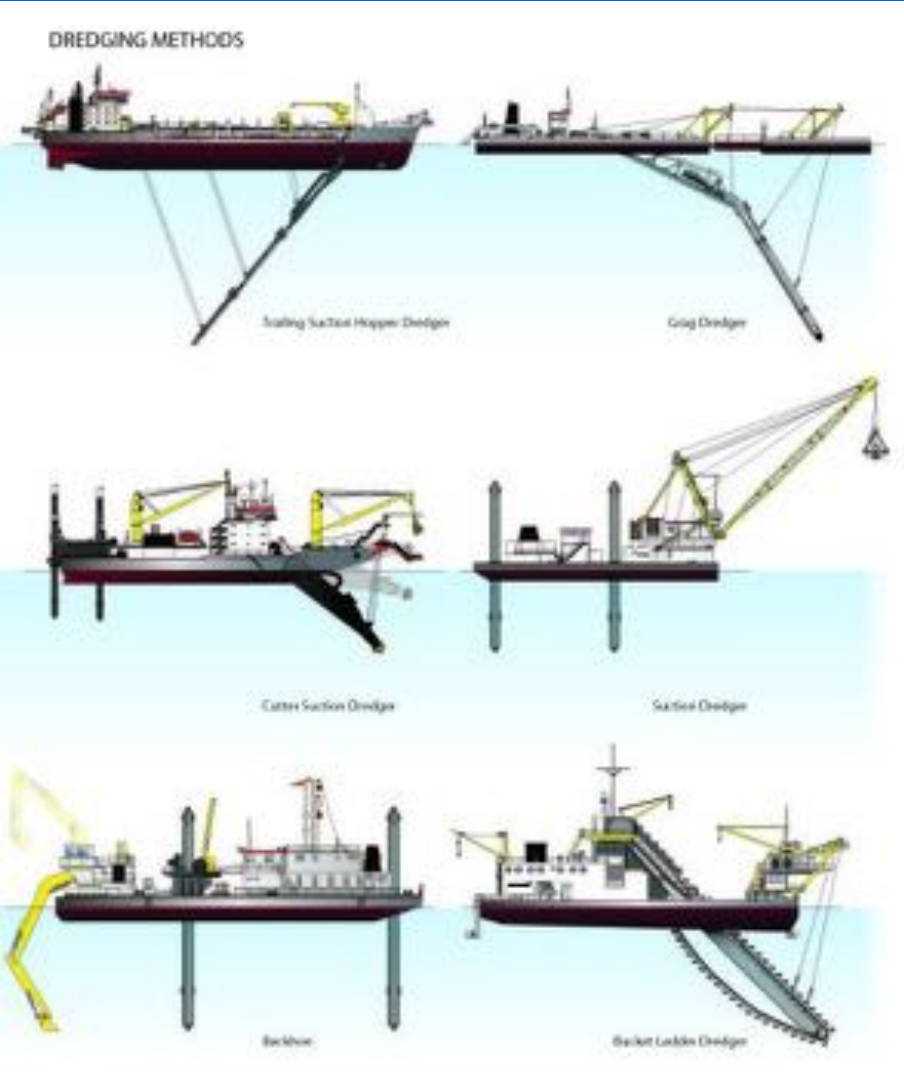


Concrete eco elements



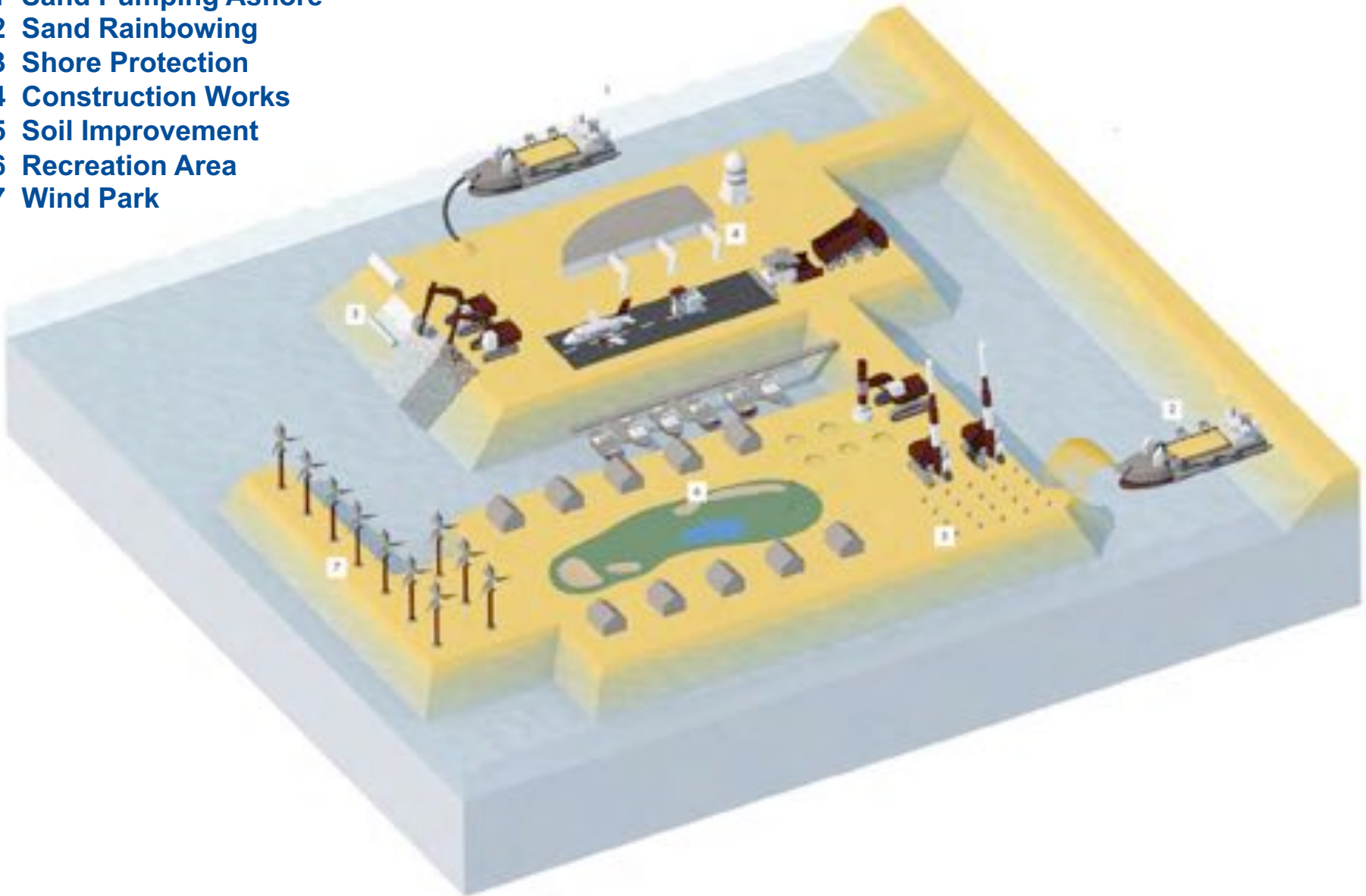
after 6 months

Dredging Methods



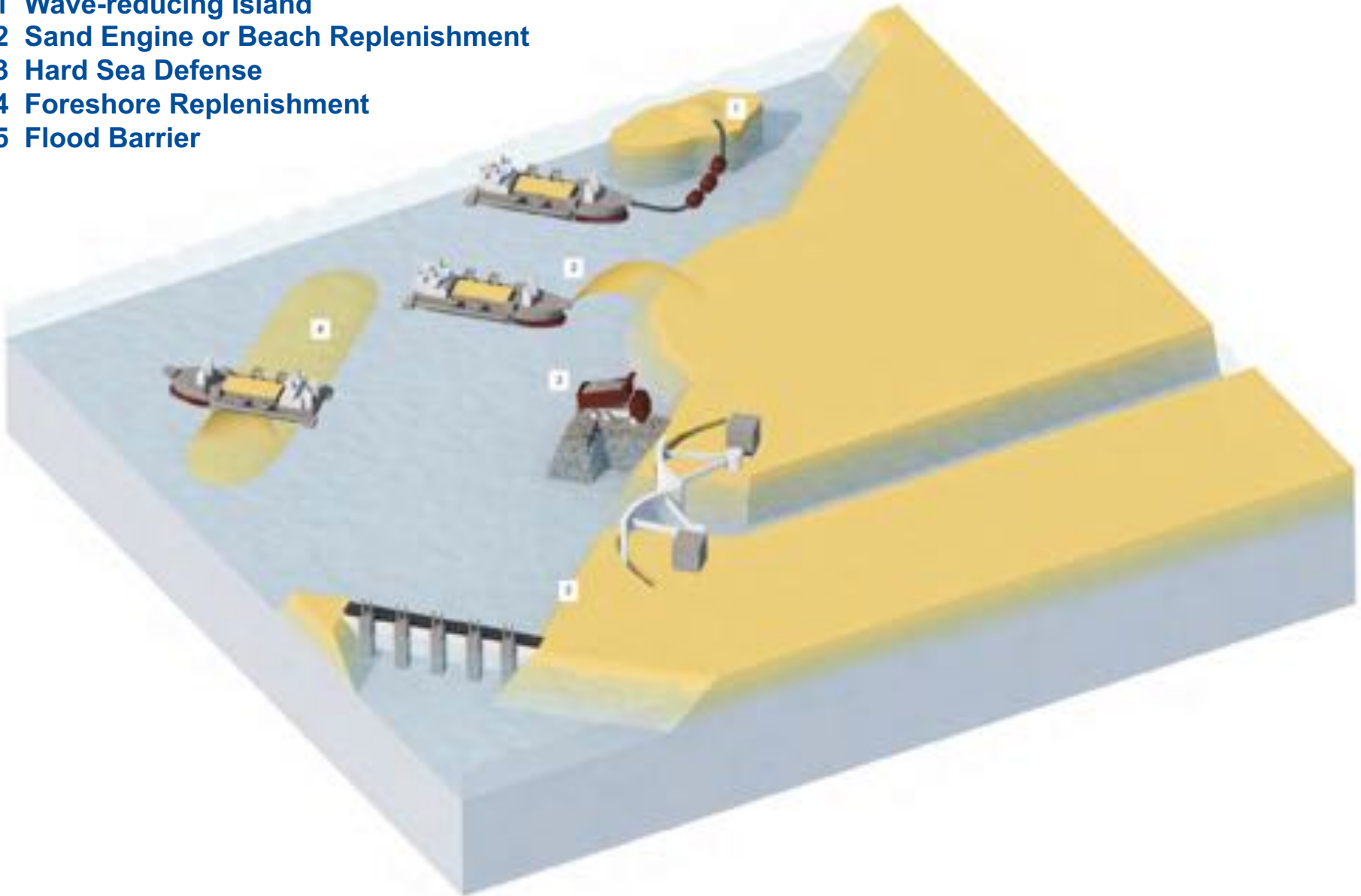
Land Reclamation

- 1 Sand Pumping Ashore
- 2 Sand Rainbowing
- 3 Shore Protection
- 4 Construction Works
- 5 Soil Improvement
- 6 Recreation Area
- 7 Wind Park



Coastal Protection

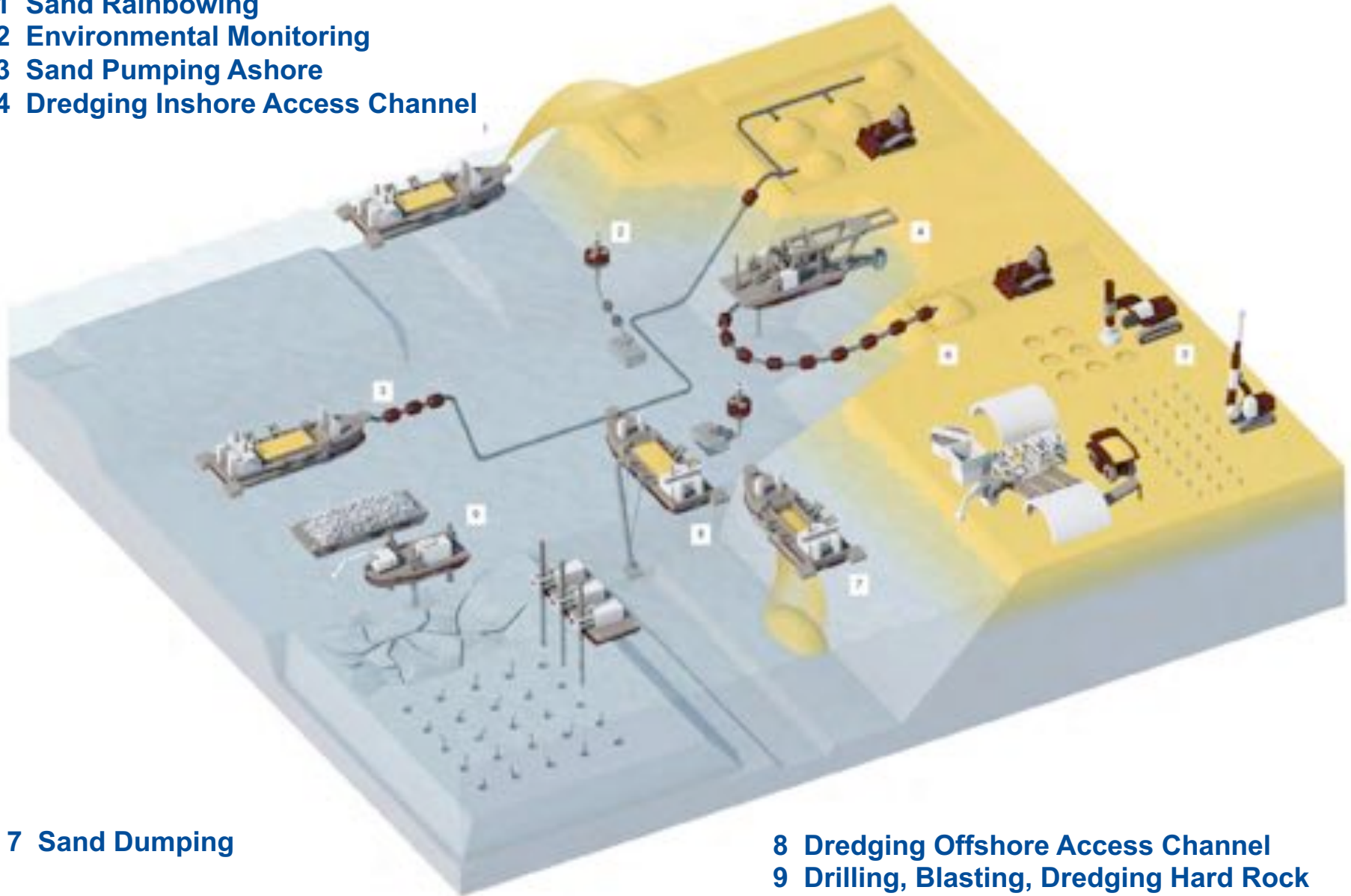
- 1 Wave-reducing Island
- 2 Sand Engine or Beach Replenishment
- 3 Hard Sea Defense
- 4 Foreshore Replenishment
- 5 Flood Barrier



Port Development

- 1 Sand Rainbowing
- 2 Environmental Monitoring
- 3 Sand Pumping Ashore
- 4 Dredging Inshore Access Channel

- 5 Soil Improvement Techniques
- 6 Soil Remediation

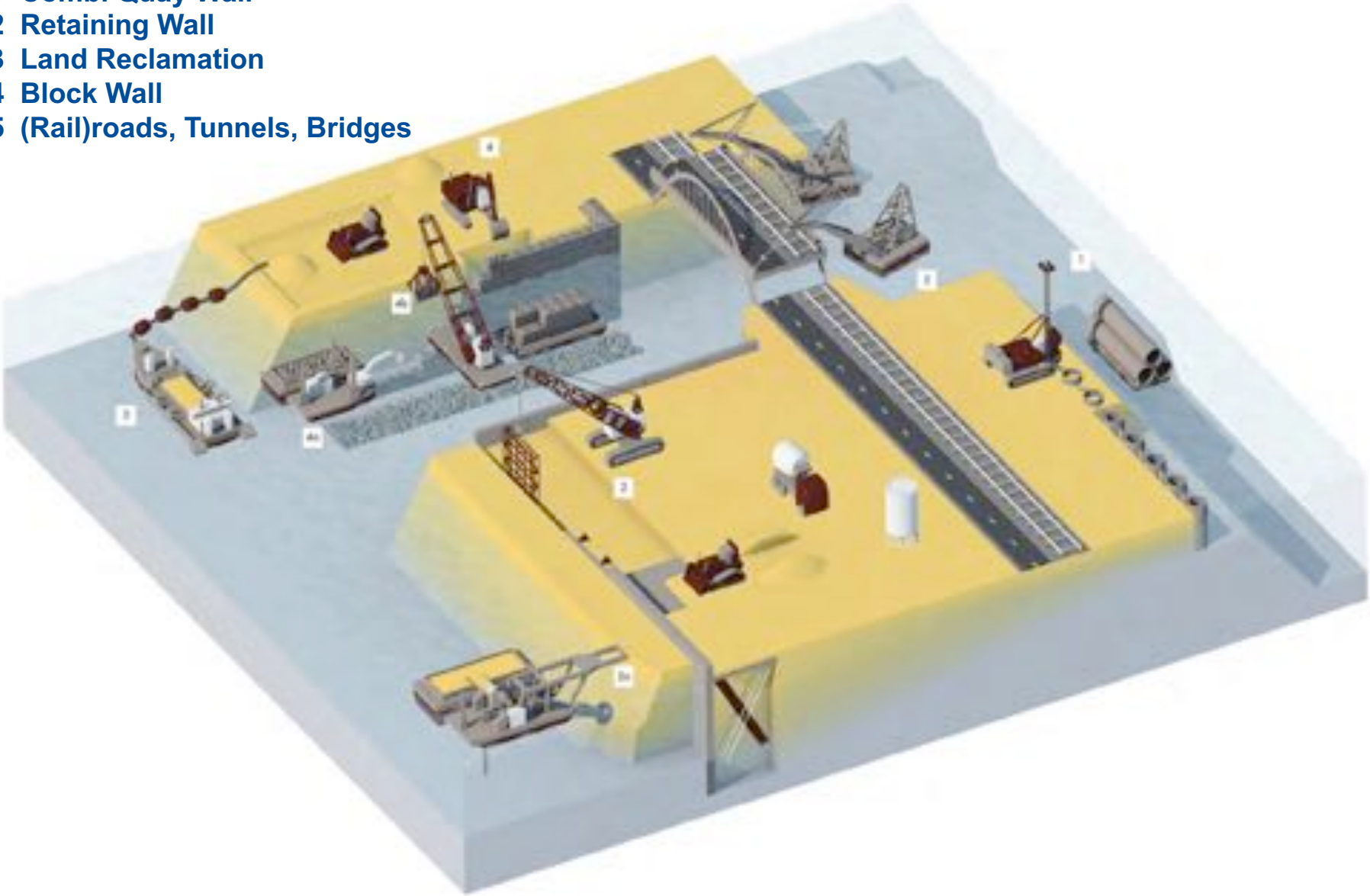


- 7 Sand Dumping

- 8 Dredging Offshore Access Channel
- 9 Drilling, Blasting, Dredging Hard Rock

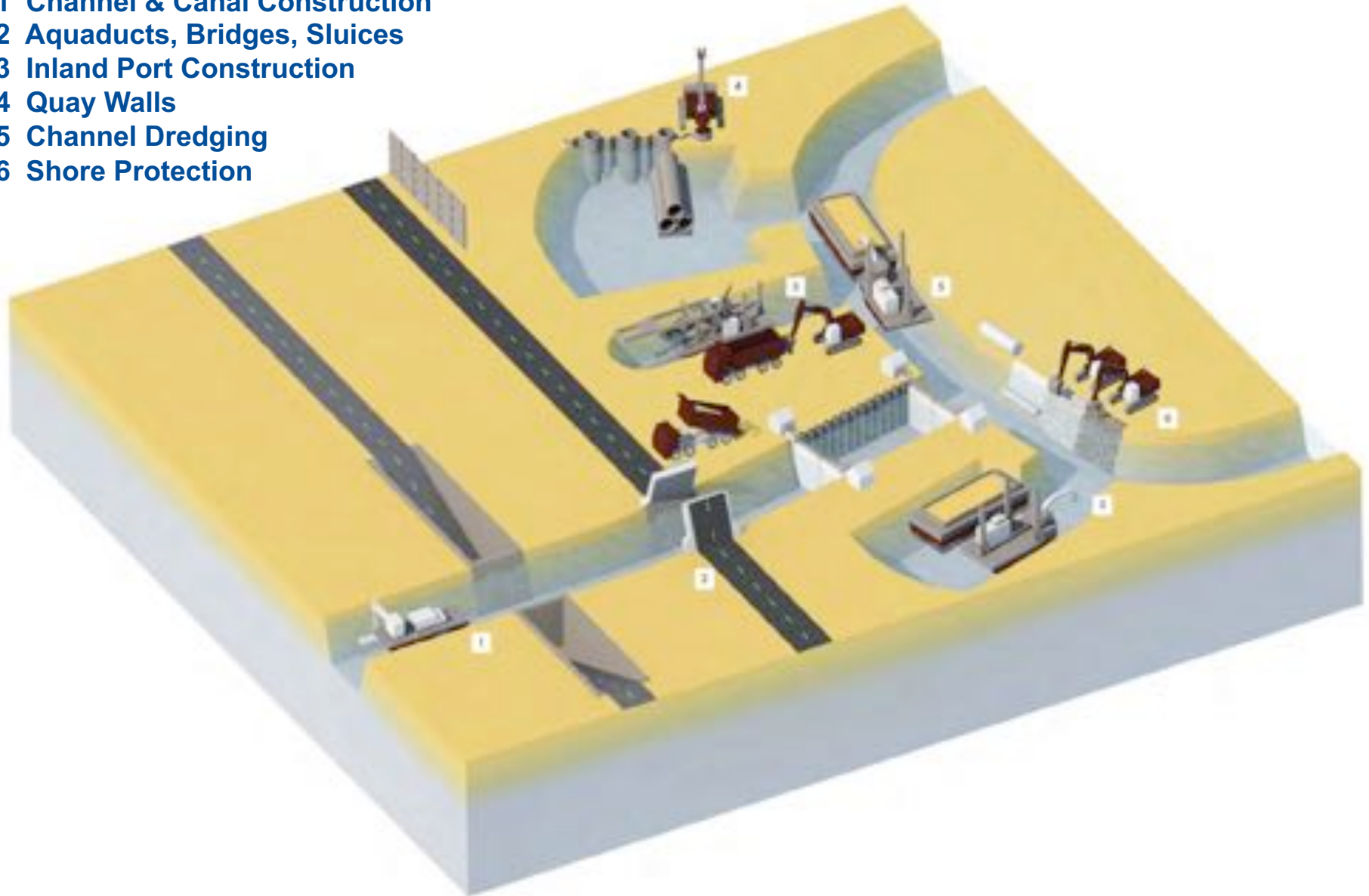
Port Infrastructure

- 1 Combi Quay Wall
- 2 Retaining Wall
- 3 Land Reclamation
- 4 Block Wall
- 5 (Rail)roads, Tunnels, Bridges



Inland Ports & Waterways

- 1 Channel & Canal Construction
- 2 Aquaducts, Bridges, Sluices
- 3 Inland Port Construction
- 4 Quay Walls
- 5 Channel Dredging
- 6 Shore Protection



ENVIRONMENT-FRIENDLY DREDGING METHODS

- 1 Dredging in alternate zones
- 2 Sub-surface dredging
- 3 Application of silt screens
- 4 Specially designed suction heads & pumping systems
- 5 Eco-efficient dredging: instead of shallow dredging over large areas, deep dredging over small areas, combined with seabed landscaping



EUROPE



Plan A

Land reclamation via
Building with Nature®
along North Sea Coast

Plan 4

Plan 3

Plan 6

Plan 2

Plan 1

The Netherlands

Integrated
Coastal
Policy via
**Building
with Nature®**



TOWARDS AN INTEGRATED COASTAL POLICY FOR ZUID-HOLLAND

TOPOGRAPHIC MAP JULY 2005

LEGENDE

- | | | | | | |
|--|-----------------------|--|--|--|---|
| | RAILWAY WITH NUMBER | | COAST WITH ISLAND SEGREGATION FUNCTION | | RESERVATION AREA |
| | RAILWAY WITH NUMBER | | SOIL DEPRIVATION | | RESERVATION AREA PUBLIC GREEN |
| | SECONDARY ROAD | | MUNICIPAL BOUNDARY | | URBAN |
| | LOCAL ROAD | | ADMINISTRATIVE BOUNDARY | | TOWN PLAN |
| | RAILROAD | | BUILDING AREA | | LAKE |
| | FUTURE RAILWAY | | INDUSTRIAL AREA | | WATERBODY |
| | RAILROAD WITH STATION | | POTENTIAL INDUSTRIAL AREA | | BOUNDARY CONTOUR |
| | RAILROAD WITH STATION | | SOIL QUALITY | | INDUSTRIAL ZONE IN THE COASTAL DEVELOPMENT AREA |
| | RAILROAD WITH STATION | | AGRICULTURAL & FORESTED AREA | | LIGHTHOUSE |
| | RAILROAD WITH STATION | | | | |



TOWARDS AN INTEGRATED COASTAL POLICY FOR ZUID-HOLLAND

2015 current situation

0 R.E. WATERWAY

- PRIMARY ROAD WITH NUMBER
- BRIDGE HIGHWAY WITH NUMBER
- SECONDARY ROAD
- LOCAL ROAD
- RHD ROAD
- FUTURE MAJOR HIGHWAY
- FUTURE SECONDARY ROAD
- RAILROAD WITH STATION
- TRAINING & QUALIFICATION DEVELOPMENT AREA
- INDUSTRIAL AREA
- CANAL (0-10)

LEGEND

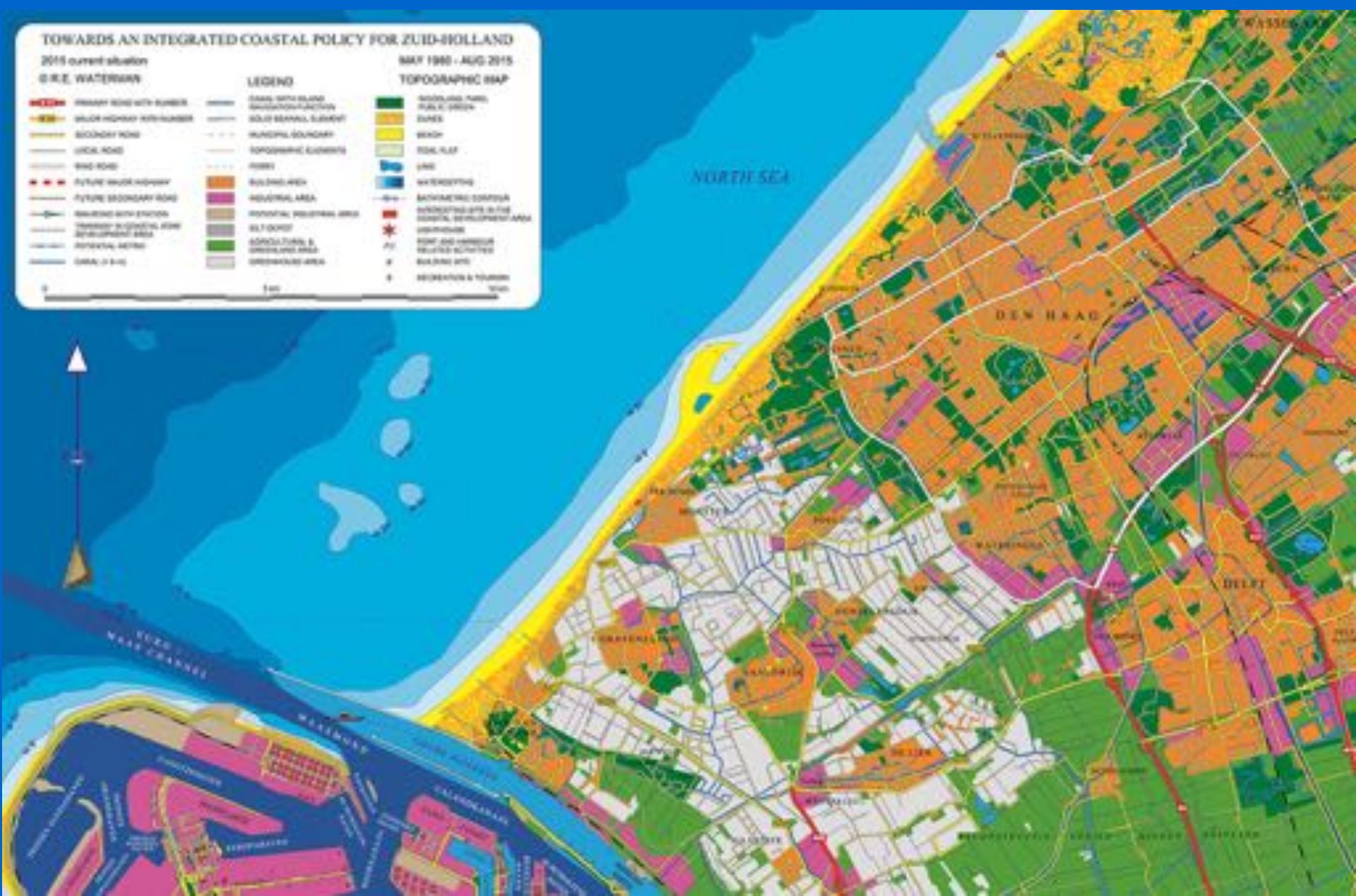
- CANAL WITH SLUICE
- SOLID BRANCH SUBWAY
- MUNICIPAL BOUNDARY
- TOPOGRAPHIC ELEMENTS
- FERRY
- BUILDING AREA
- INDUSTRIAL AREA
- POTENTIAL INDUSTRIAL AREA
- RFL QUART
- AGRICULTURAL & OPENLAND AREA
- OPENLAND AREA

MAP 1990 - AUG 2015

TOPOGRAPHIC MAP

- AGRICULTURAL PARK, PUBLIC GREEN
- DUNE
- WOOD
- TIDAL FLAT
- SAND
- WATERWAY
- BATHYMETRIC CONTOUR
- INTERESTING SITE IN THE COASTAL DEVELOPMENT AREA
- UPPERMOUND
- POINT AND HARBOR RELATED ACTIVITIES
- BUILDING SITE
- RECREATION & TOURISM

0 100 200 300 400 500 600 700 800 900 1000



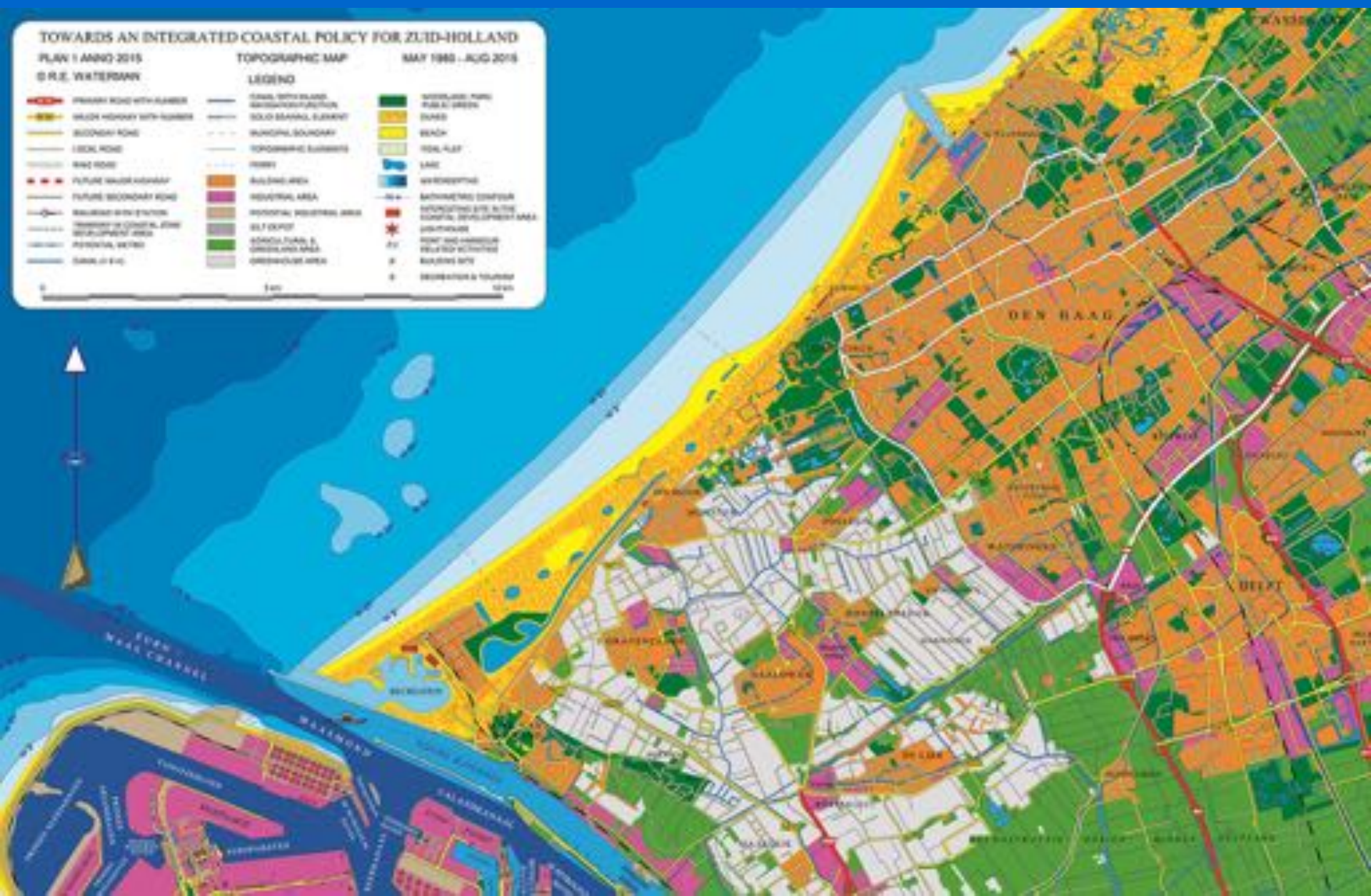
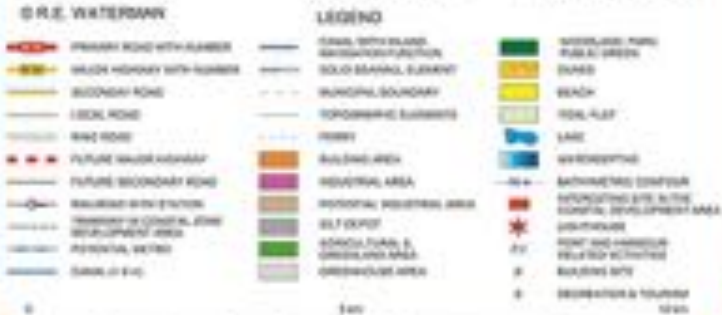
TOWARDS AN INTEGRATED COASTAL POLICY FOR ZUID-HOLLAND

PLAN 1 ANNO 2015

O.R.E. WATERBANK

TOPOGRAPHIC MAP

MAY 1980 - AUG 2015



TOWARDS AN INTEGRATED COASTAL POLICY FOR ZUID-HOLLAND

PLAN 1 G.R.E. WATERMAN

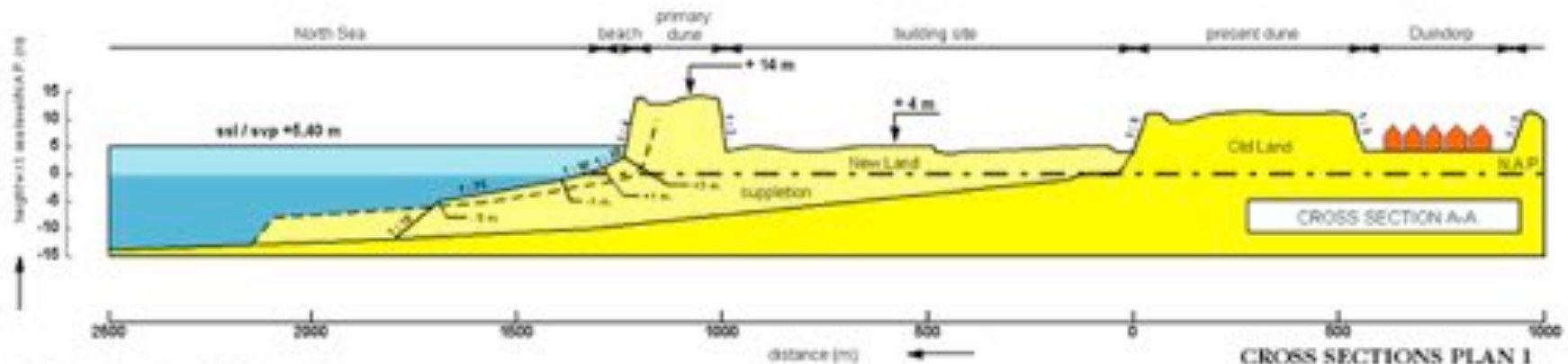
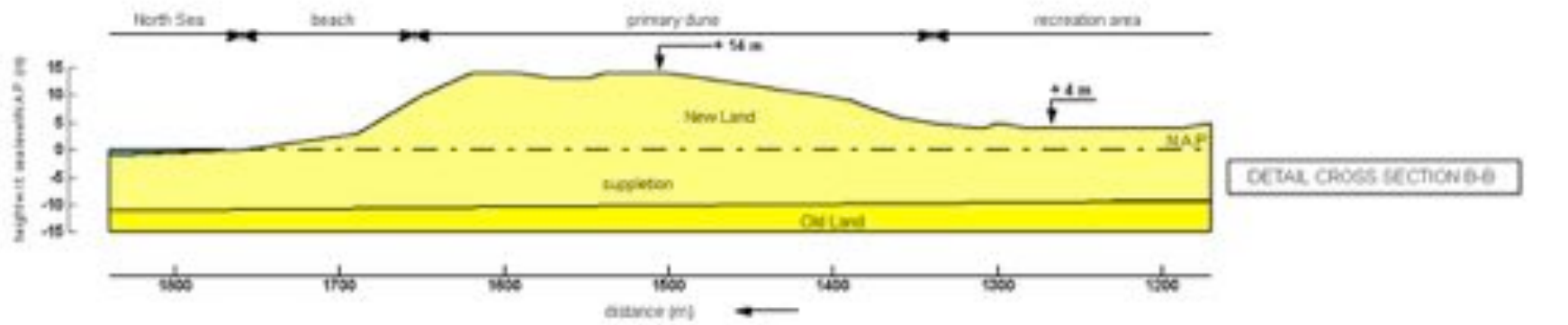
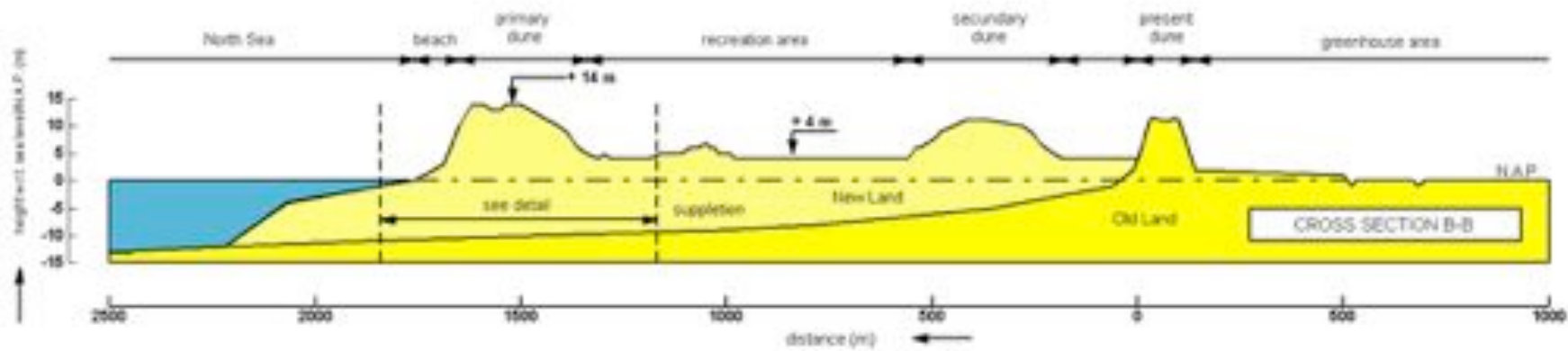
TOPOGRAPHIC MAP

MAY 1980 - AUG 2015

LEGEND

	PRIMARY ROAD WITH NUMBER		CANAL WITH ISLAND		WOODLAND PARK
	MAJOR HIGHWAY WITH NUMBER		SOLID GENERAL STREAM		DUNE
	SECONDARY ROAD		MUNICIPAL BOUNDARY		BEACH
	LOCAL ROAD		TOPOGRAPHIC CONTOUR		TIDE FLAT
	RAIL ROAD		RIVER		LAND
	FUTURE WATER HIGHWAY		BUILDING AREA		WATERCOURSE
	FUTURE SECONDARY ZONE		INDUSTRIAL AREA		ARCHITECTURAL CONTOUR
	RAILROAD WITH STATION		POTENTIAL INDUSTRIAL AREA		INTERVENING SITE IN THE SPATIAL DEVELOPMENT AREA
	TEMPORARY TO CANAL ZONE		ALL F ZONE		LIGHTHOUSE
	DEVELOPMENT AREA		SMALL FARM & WOODLAND AREA		DIKE AND HARBOUR
	POTENTIAL AIRPORT		ORCHARD AREA		BUILDING SITE
	CANAL D & E				RECREATION & TOURISM





N.A.P. = New Amsterdam Zero-Reference Level

Geological Young Dune Wedges



Historic Coastlines Holland

Via the principle *"Building with Nature"* (dunes + beaches with a minimum of solid seawall elements) 1150 ha have already been realised

- I** van Dishoorn-Triangle - Hoek van Holland / Rotterdam
150 ha with Nature Reserve Area (Kapitelduinen-Zuidhollands Landschap); Extension railroad Rotterdam - Hoek van Holland; Waterway centre with 1100 houses + facilities and tidal lagoon
- II** Slufterdam + Predecessor Slufterdam - Rotterdam
800 ha with Nature Reserve Area (ZBL); environmental friendly storage & processing of wastes, incl. contaminated dredged sediments; port- & port related activities; infrastructure; tourism & recreation
- III** Seaport Marina IJmuiden / Kennemer beach - Velsen
Nature Reserve Area (Natuurmonumenten) in relation with Kennemer dunes; lake; yachting harbour (625 berths); 84 apartments; restaurants & shops; Admiralty Club; hotel; infrastructure; ship elevator & ship trailer slope (200 ha total)



BUILDING WITH NATURE

PLAN 1



Rip currents
alongside
groynes
causing
sand transport
towards the
North Sea

1985

COAST OF DELFLAND WITH 69 GROYNES

BUILDING WITH NATURE

PLAN 1



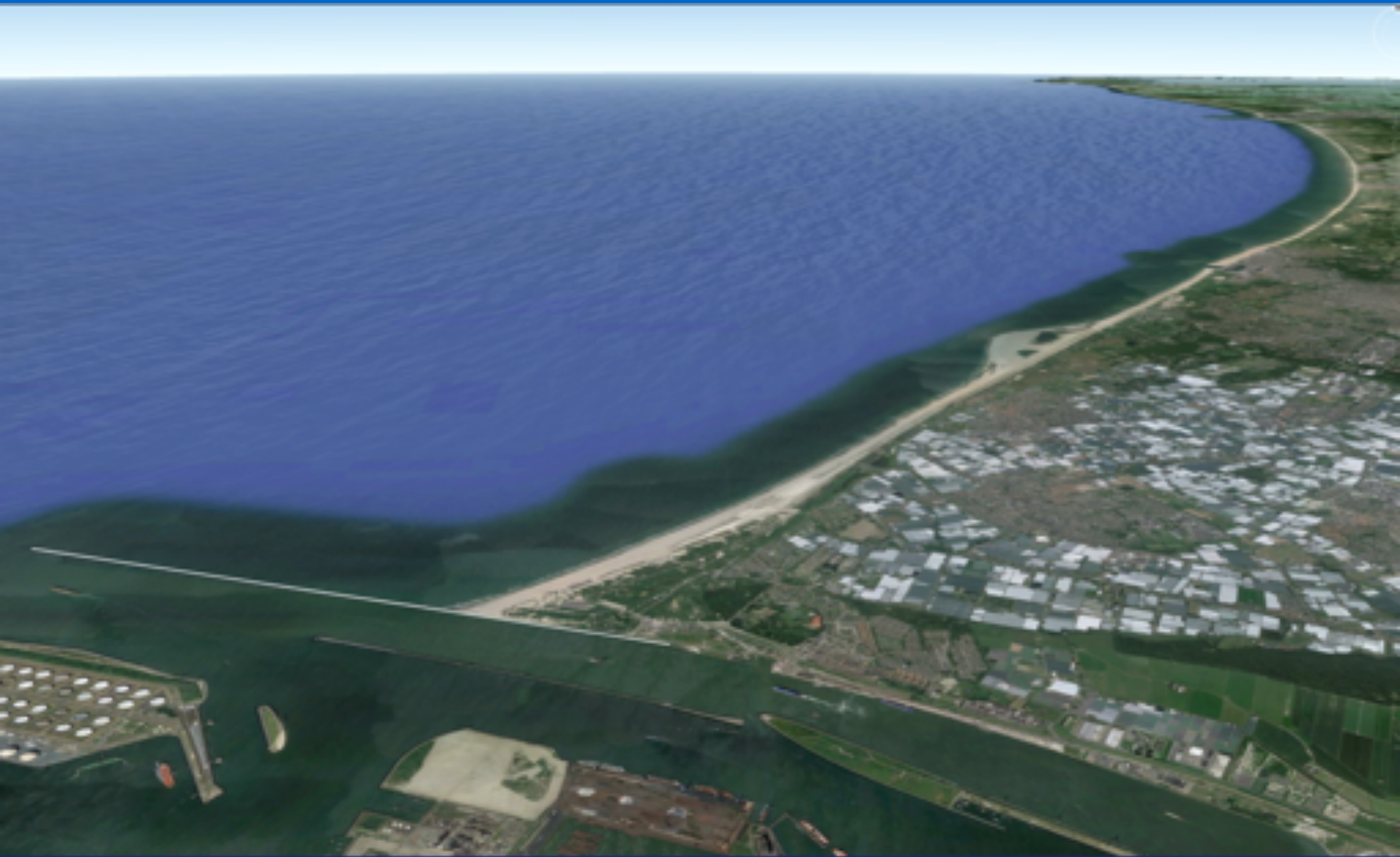
March 16 - 1981

FIRST REALISED SEGMENT OF PLAN 1, NEAR HOEK VAN HOLLAND



Narrow endangered coast of South-Holland near Ter Heijde

16-3-1981



Delfland coast nature reserve



Tidal lagoon Hoek van Holland

Plan A

Land reclamation via
Building with Nature®
along North Sea Coast

Plan 4

Plan 3

Plan 6

Plan 2

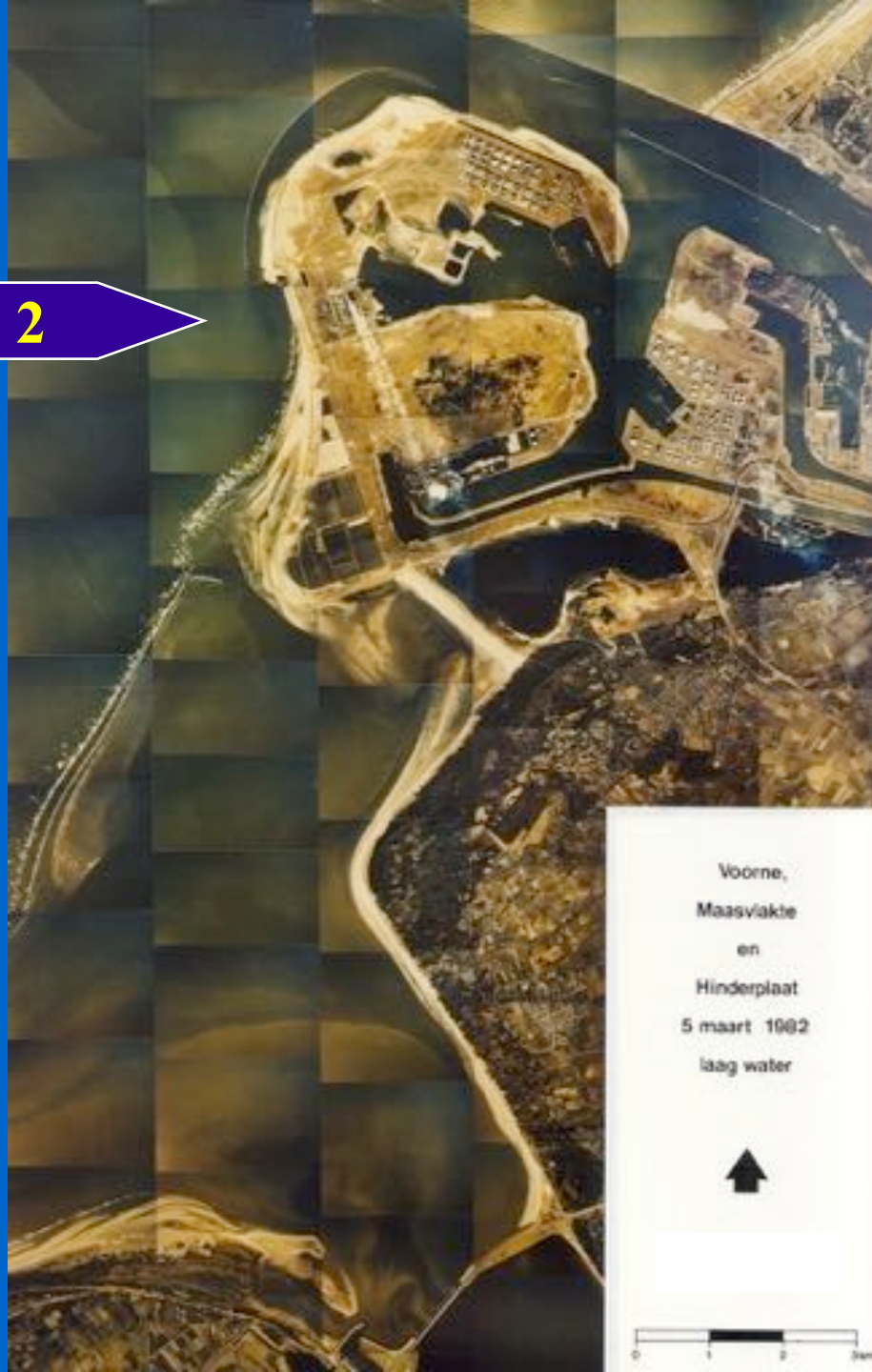
Plan 1

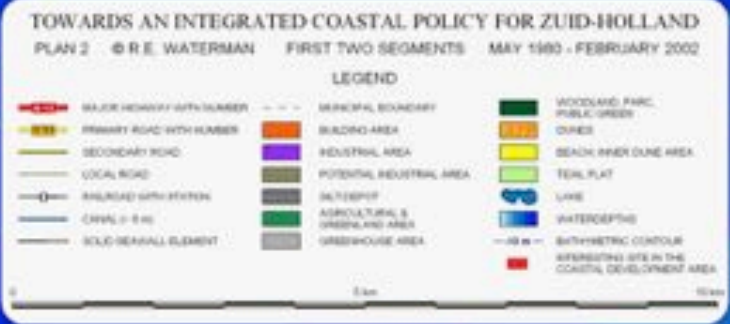
The Netherlands

Integrated
Coastal
Policy via
**Building
with Nature®**



Plan 2





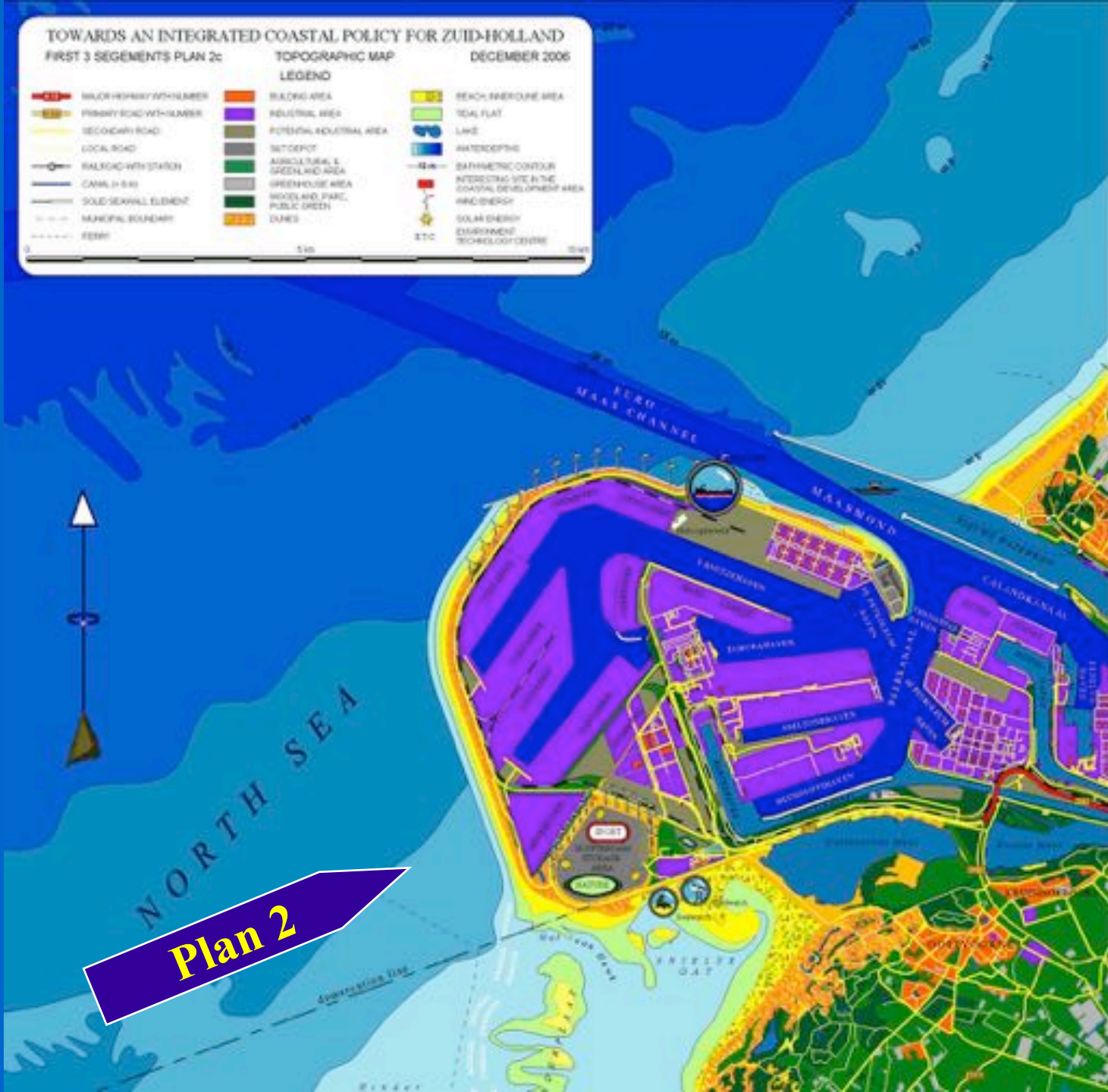
First realised segments of plan 2,
 created by *Building with Nature*



Plan 2

TOWARDS AN INTEGRATED COASTAL POLICY FOR ZUID-HOLLAND
 FIRST 3 SEGMENTS PLAN 2c TOPOGRAPHIC MAP DECEMBER 2006

LEGEND					
	MAJOR HIGHWAY WITH LANE		BUILDING AREA		BEACH RECREATION AREA
	PRIMARY ROAD WITH LANE		INDUSTRIAL AREA		TIDAL FLAT
	SECONDARY ROAD		POTENTIAL INDUSTRIAL AREA		LAKE
	LOCAL ROAD		SOIL DEPOSIT		WATERDEPOT
	RAILROAD WITH STATION		AGRICULTURAL & SPECIALIZED AREA		BATHYMETRIC CONTOUR
	CANAL (1-5 M)		GREENHOUSE AREA		INTERESTING SITE IN THE COASTAL DEVELOPMENT AREA
	SOLID SEAWALL ELEMENT		WOODLAND, PARK, PUBLIC GREEN		WIND ENERGY
	MUNICIPAL BOUNDARY		DUNES		SOLAR ENERGY EQUIPMENT TECHNOLOGY CENTRE
	FEEDIN				ETC



Plan 2

TOWARDS AN INTEGRATED COASTAL POLICY FOR ZUID-HOLLAND

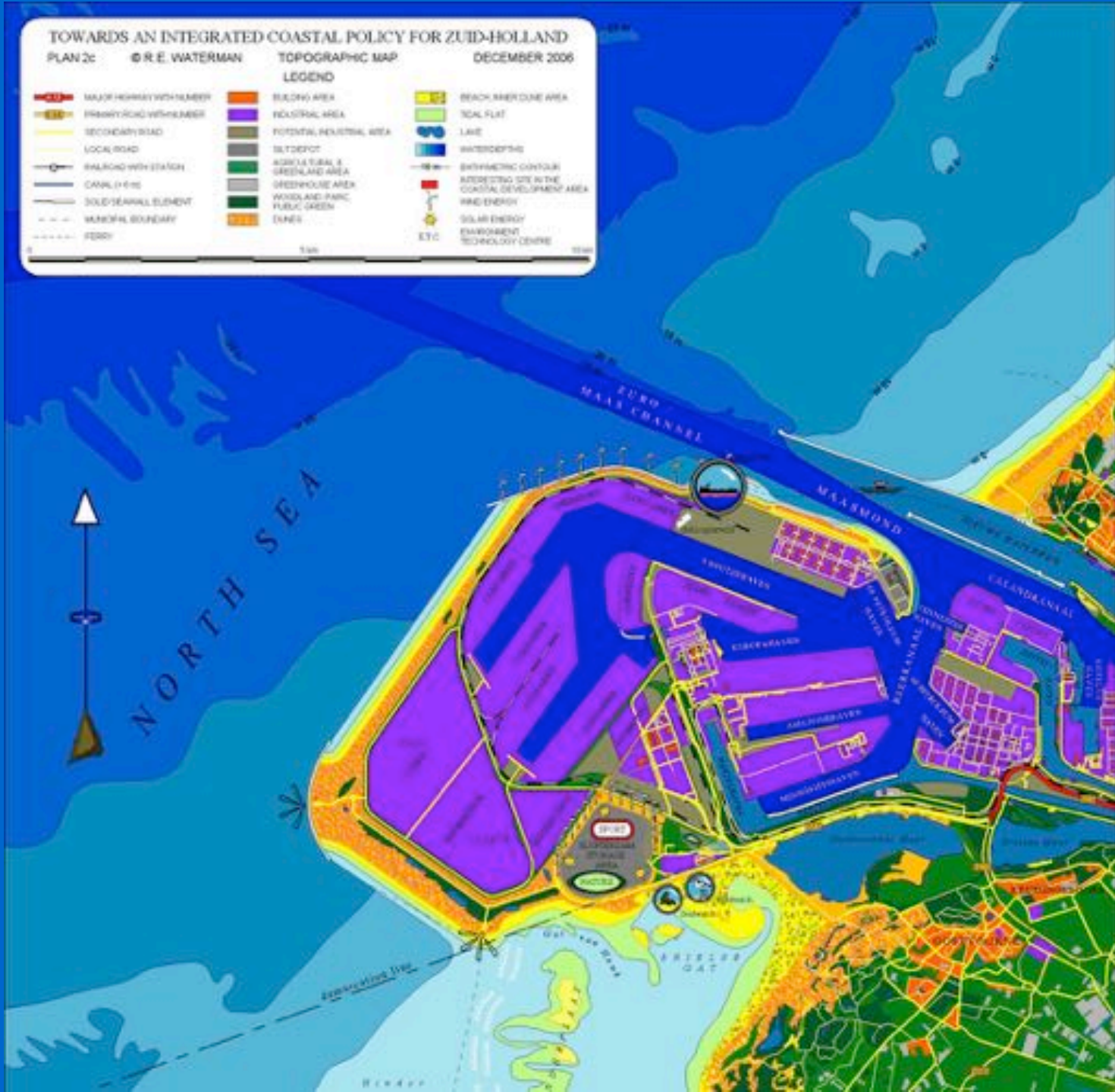
PLAN 2c

© R.E. WATERMAN

TOPOGRAPHIC MAP

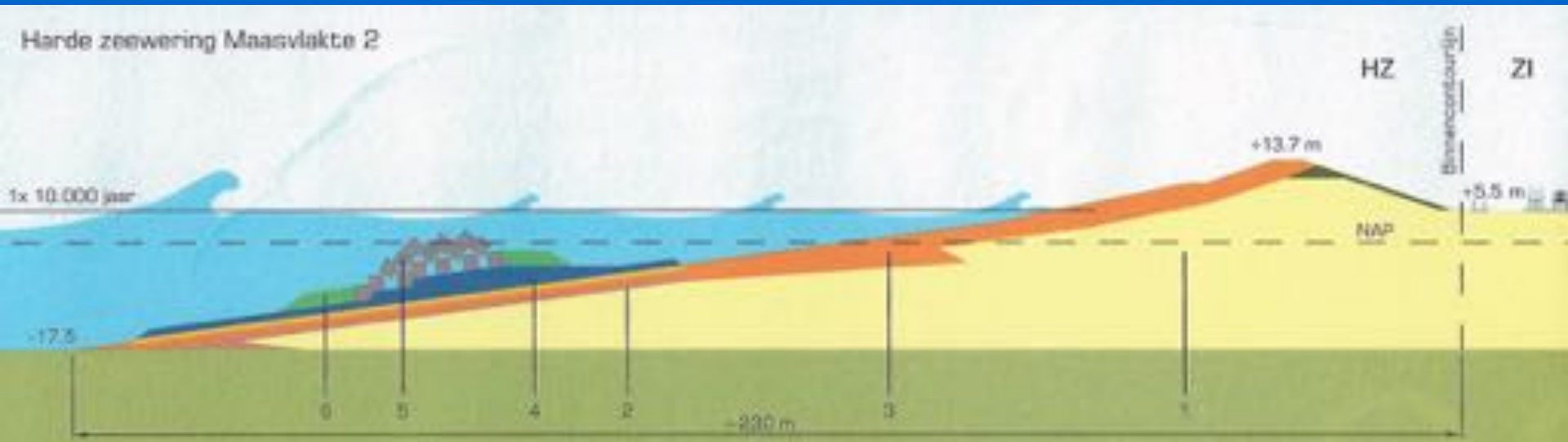
DECEMBER 2006

LEGEND

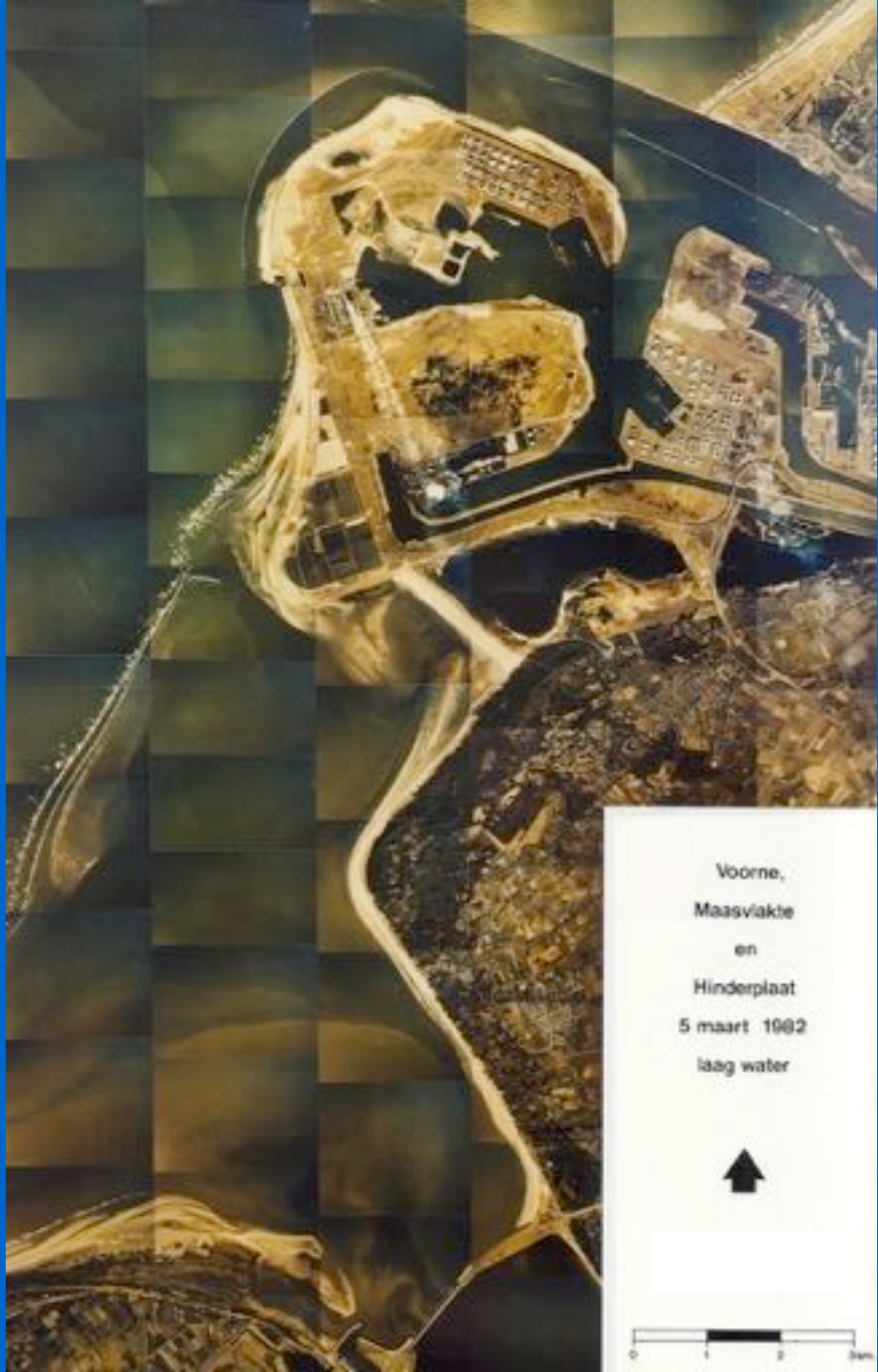


COASTAL DEFENSE MAASPLAIN 2 (RHINEPLAIN)

3,5 km hard construction; 7,5 km soft dune-beach construction



- 1 Sand base layer approx. 150 μm ; top layer min. 370 μm
- 2 Filter layer gravel under concrete block dam 0,3 - 35 mm
- 3 Cobble layer 1 m thickness under concrete block dam up to 4 m thickness on top of gravel dune, diameter cobbles 20 – 135 mm
- 4 Quarry stones 150 – 800 kg on top of quarry stones 5 – 70 kg
- 5 Concrete blocks (17.000 blocks - 2,5 x 2,5 x 2,5 m - 40 à 43 ton) across 3,5 km coastal length
- 6 Toe construction with stones from 1 – 10 ton to prevent sliding of concrete blocks



Voorne,
Maasvlakte
en
Hinderplaat
5 maart 1902
laag water



BUILDING WITH NATURE

PLAN 2



August 17 - 2000

FIRST REALISED SEGMENTS OF PLAN 2

July 2013





Eurokley-bakstenen uit havenslib



Vliegashuis van kolengestookte elektriciteitscentrale



Vliegashuis van kolengestookte elektriciteitscentrale



Aardelite®, kunstgrind



Eco-grind®, kunstgrind



Aardelite®, kunstgrind in betonprodukten

-
-
-

BUILDING WITH NATURE

Plan 2



Parnassia



**Euphorbia
Maritima**



**Sand Engine
August 2011**

**Cakile
Maritima**

-
-
-

BUILDING WITH NATURE

Plan 2



Lacerta Agilis



Plan A

Land reclamation via
Building with Nature®
along North Sea Coast

Plan 4

Plan 3

Plan 6

Plan 2

Plan 1

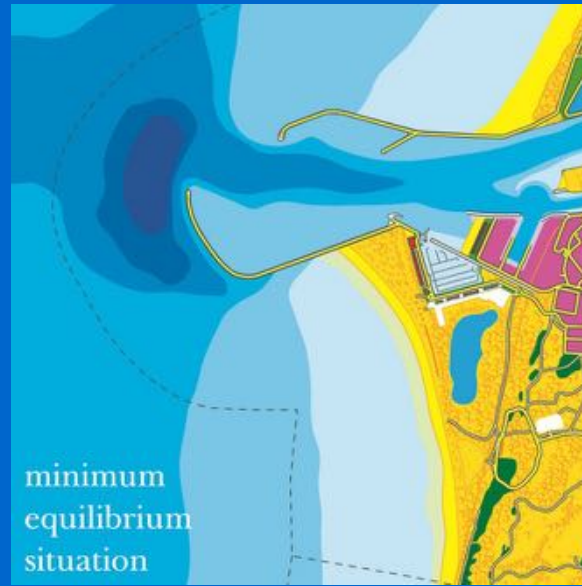
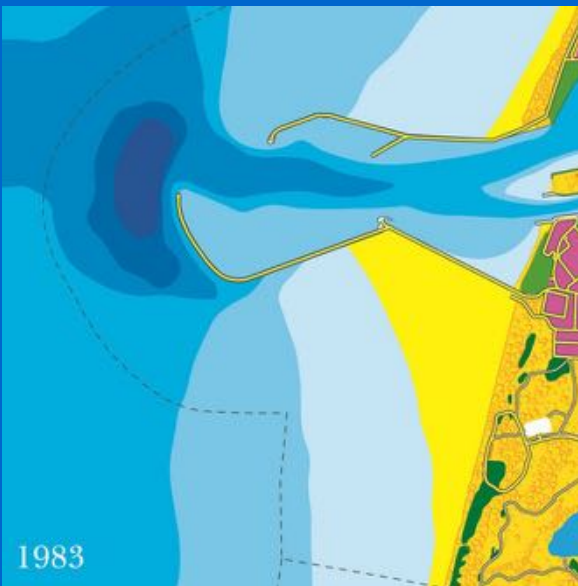
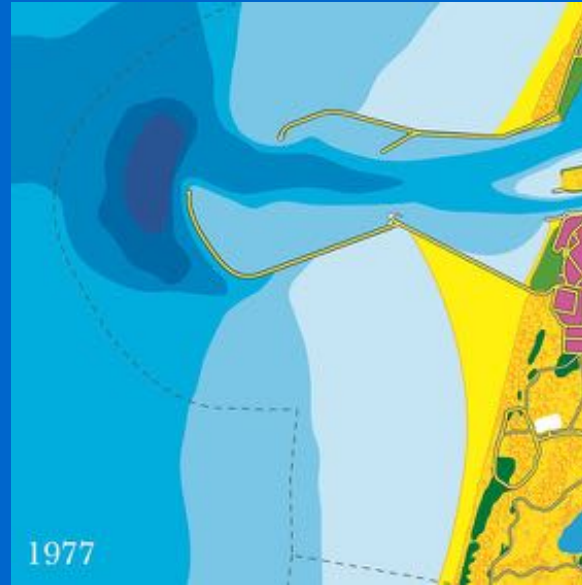
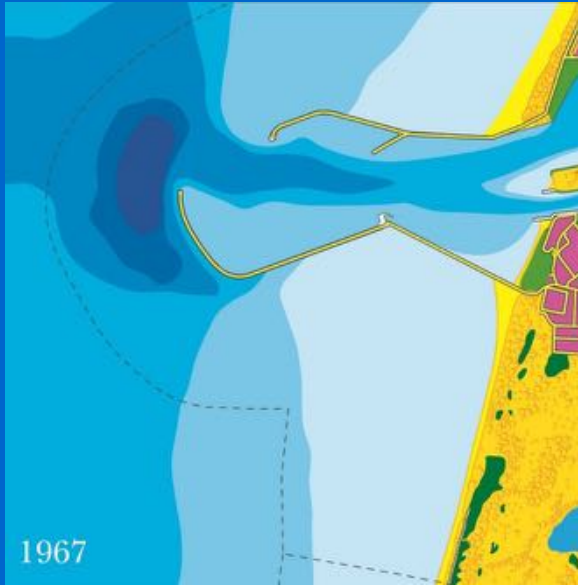
The Netherlands

Integrated
Coastal
Policy via
**Building
with Nature®**



SEAPORT MARINA IJMUIDEN

KENNEMER BEACH



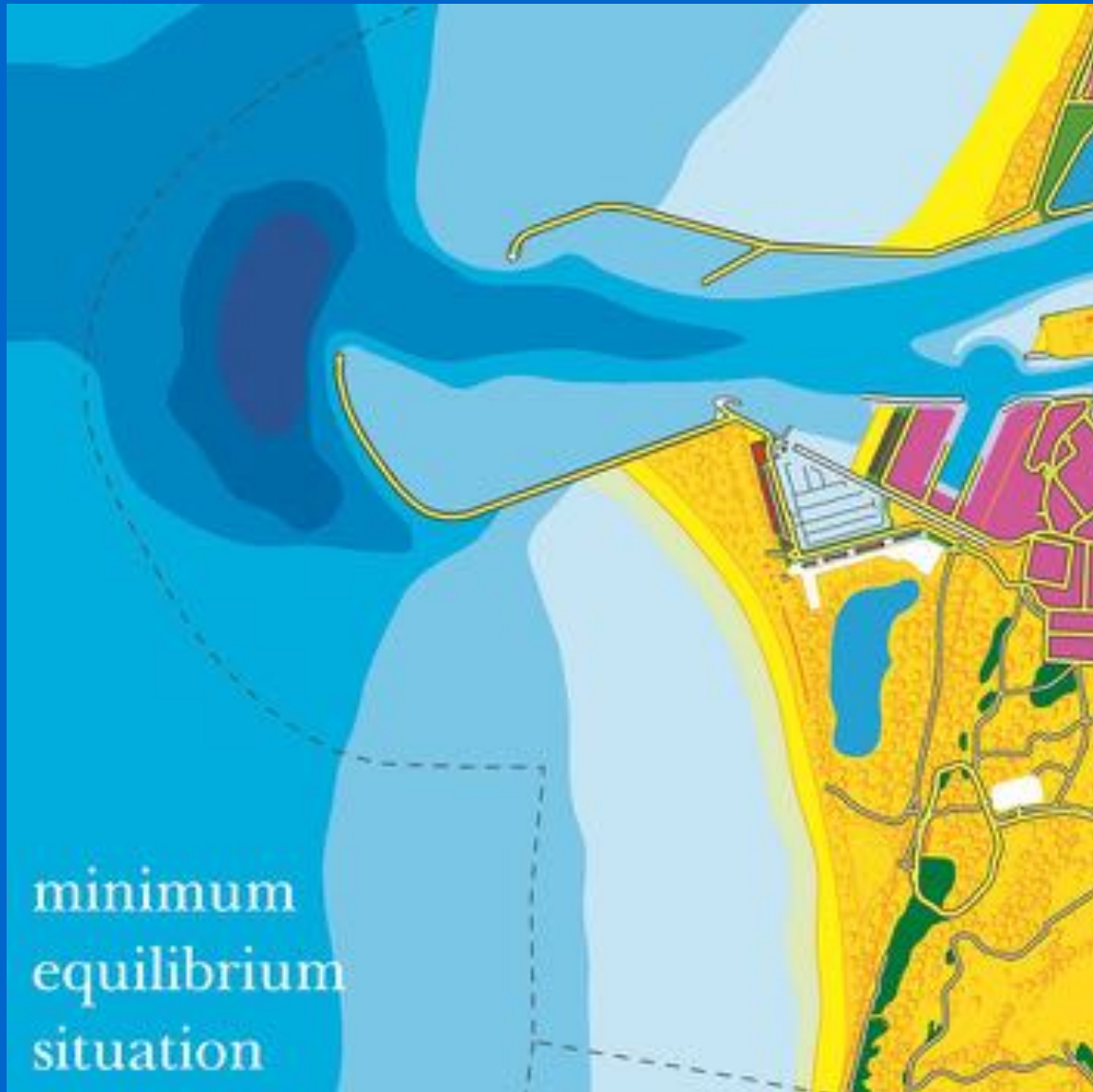
Nature is already developing the new area south of the existing Southern Harbour Mole IJmuiden, owing to littoral sand transport from Province South-Holland to Province North-Holland.

This process is quickened by external and internal dredging operations.



SEAPORT MARINA IJMUIDEN

KENNEMER BEACH



Plan 3a is triangle-shaped and consists of a primary range of dunes with a marina, double boulevard, apartments, restaurants & shops, hotel, infrastructure, recreation & tourism; transition zone with lake; nature reserve area linked to an existing nature reserve area (Kennemer Dunes).

BUILDING WITH NATURE

PLAN 3a



July 10 - 1997

PLAN 3a. Complete with primary range of dunes, beaches, marina, boulevard, apartments, restaurants & shops, hotel, infrastructure, lake & nature reserve area.

BUILDING WITH NATURE

PLAN 3a



June 2000

PLAN 3a. Complete with primary range of dunes, beaches, marina, boulevard, apartments, restaurants & shops, hotel, infrastructure, lake & nature reserve area.

TOWARDS AN INTEGRATED COASTAL POLICY FOR NOORD-HOLLAND

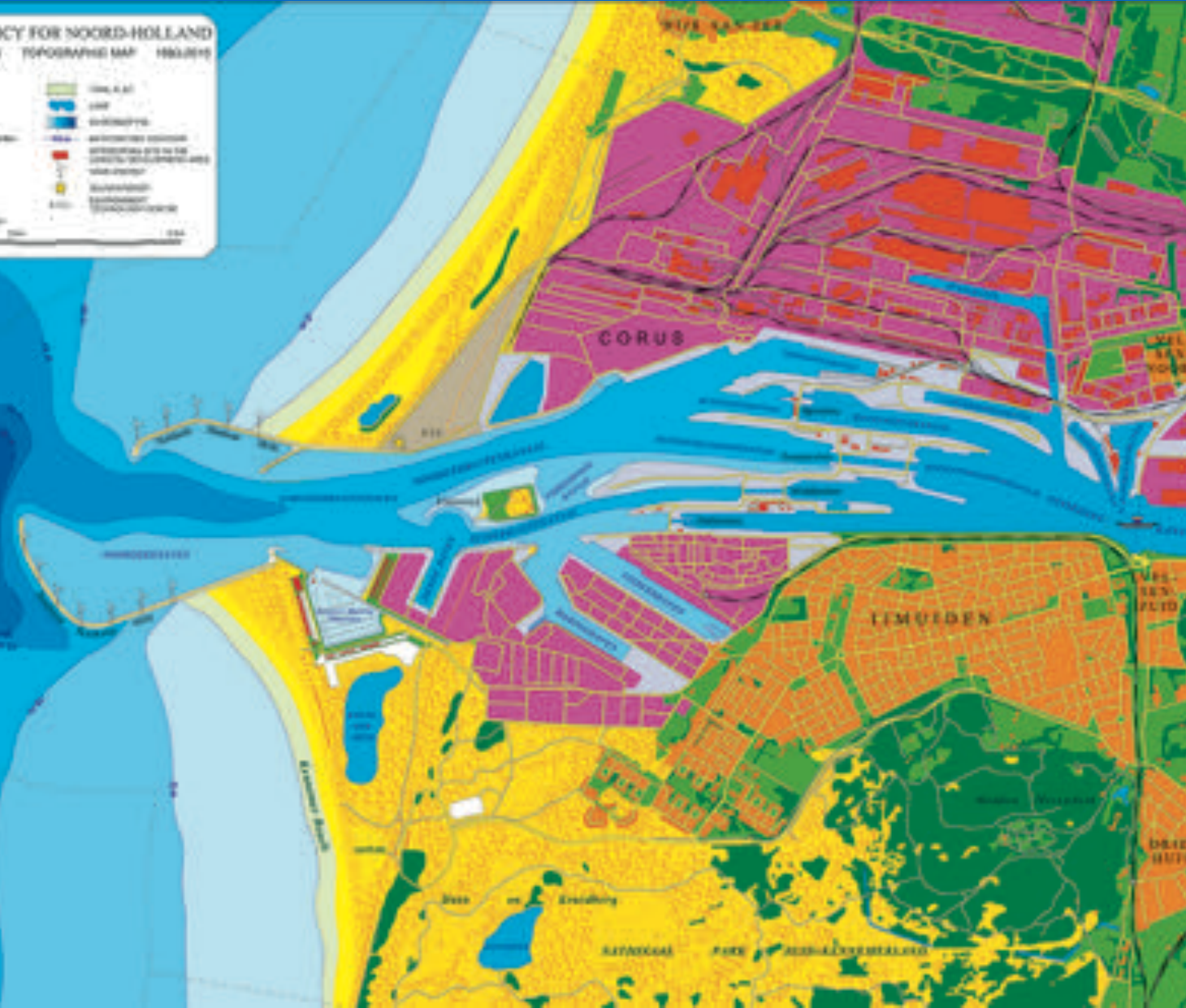
PLAN VAN DE PORT MARHALLANDER - 8 P.E. WATERWIJ - TOPOGRAFISCHE MAP 1992/2015

LEGEND

- | | | |
|------------------------------|------------------------------|------------------------------|
| Water-omgeving met bebouwing | Recreatiegebied | Groen, b.o.c. |
| Water-omgeving met bebouwing | Recreatiegebied | Water |
| Water-omgeving met bebouwing | Water-omgeving met bebouwing | Water |
| Water-omgeving met bebouwing | Water-omgeving met bebouwing | Water |
| Water-omgeving met bebouwing | Water-omgeving met bebouwing | Water-omgeving met bebouwing |
| Water-omgeving met bebouwing | Water-omgeving met bebouwing | Water-omgeving met bebouwing |
| Water-omgeving met bebouwing | Water-omgeving met bebouwing | Water-omgeving met bebouwing |
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| Water-omgeving met bebouwing | Water-omgeving met bebouwing | Water-omgeving met bebouwing |
| Water-omgeving met bebouwing | Water-omgeving met bebouwing | Water-omgeving met bebouwing |



NORTH SEA





North Sea

Plan A

Land reclamation via
Building with Nature®
along North Sea Coast

Plan 4

Plan 3

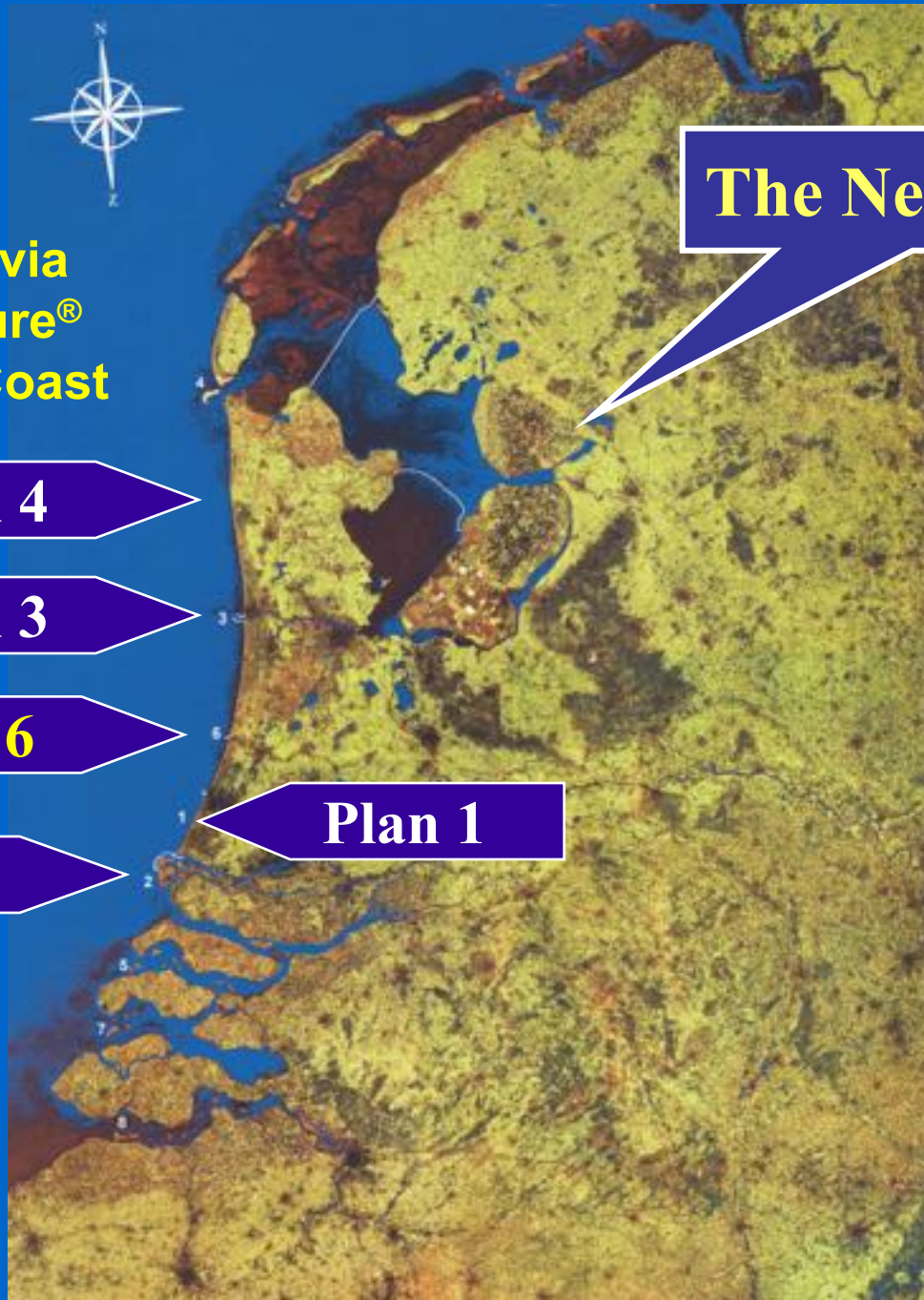
Plan 6

Plan 2

Plan 1

The Netherlands

Integrated
Coastal
Policy via
**Building
with Nature®**



Plan 6. Katwijk aan Zee



Seaport Marina with dune widening on each side for Katwijk & Noordwijk

Future connection with Old Rhine River with sluice or boat conveyor



Plan 6



Plan 6





Plan 6. Katwijk aan Zee 2008



Plan 6. Katwijk aan Zee 2015

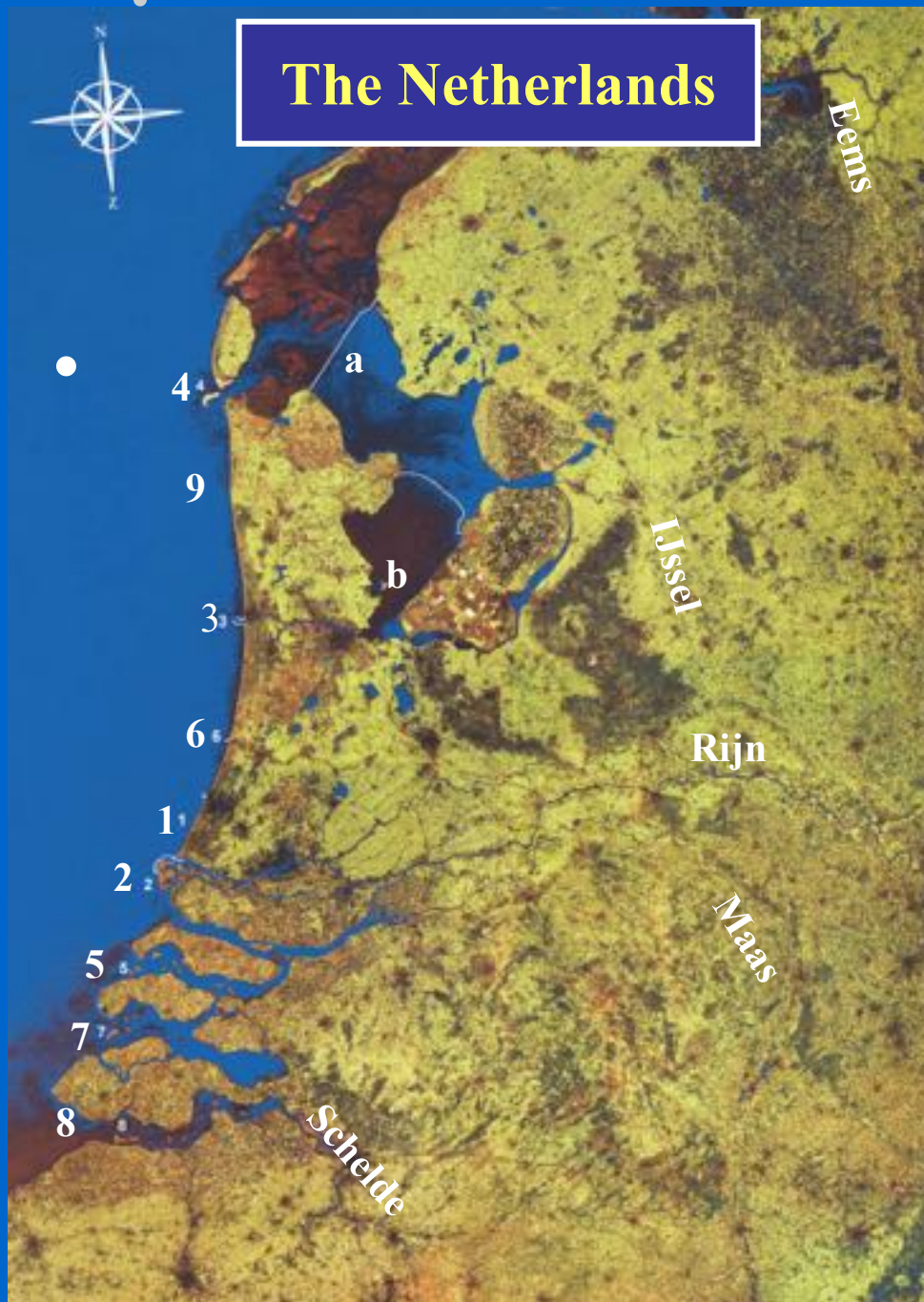


Dune with
underground parking
incorporated

Plan 6.
Katwijk aan Zee



The Netherlands



Space for the Coast Living Coasts

Space for the River Living Rivers

Space in & around the Lakes Living Lakes

Space in & around the Estuaries Living Estuaries

Space for the Delta's Living Delta's



I. Op grote schaal terugtrekken van de dijken, vergroting uiterwaarden.



II. Rivier by-pass constructie ten behoeve van periodiek optredend hoogwatersniveau.



III. Verlagen van krebben



IV. Verlagen van de rivierbedding



V. Verwijdering van hydraulische obstakels uit de rivierbedding en de uiterwaarden.

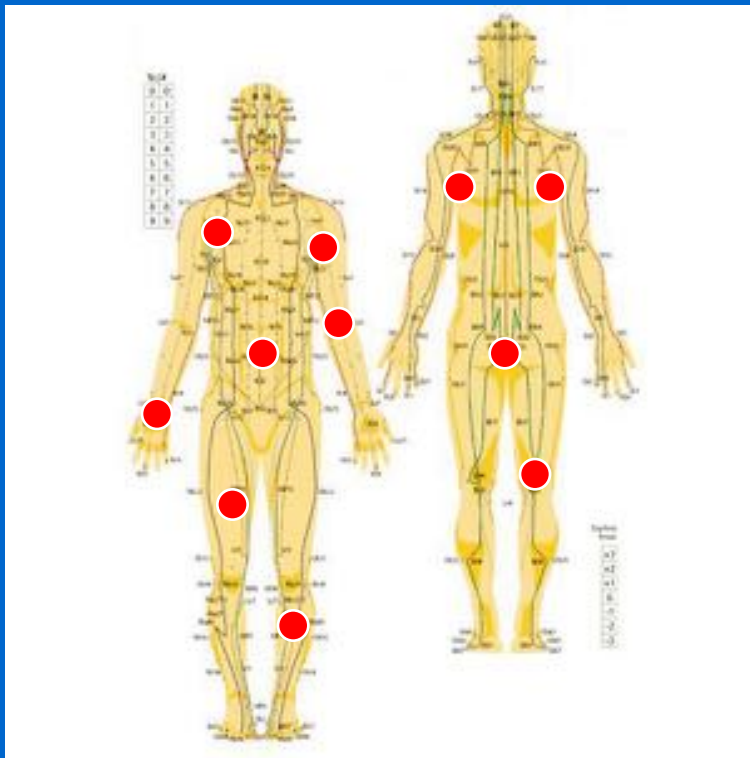


VI. Verlagen van de uiterwaarden, door onder andere het gras van gruien.

Space for the River / Living Rivers

ACUPUNCTURE

to revitalize
the Nervous System
& Human Organs



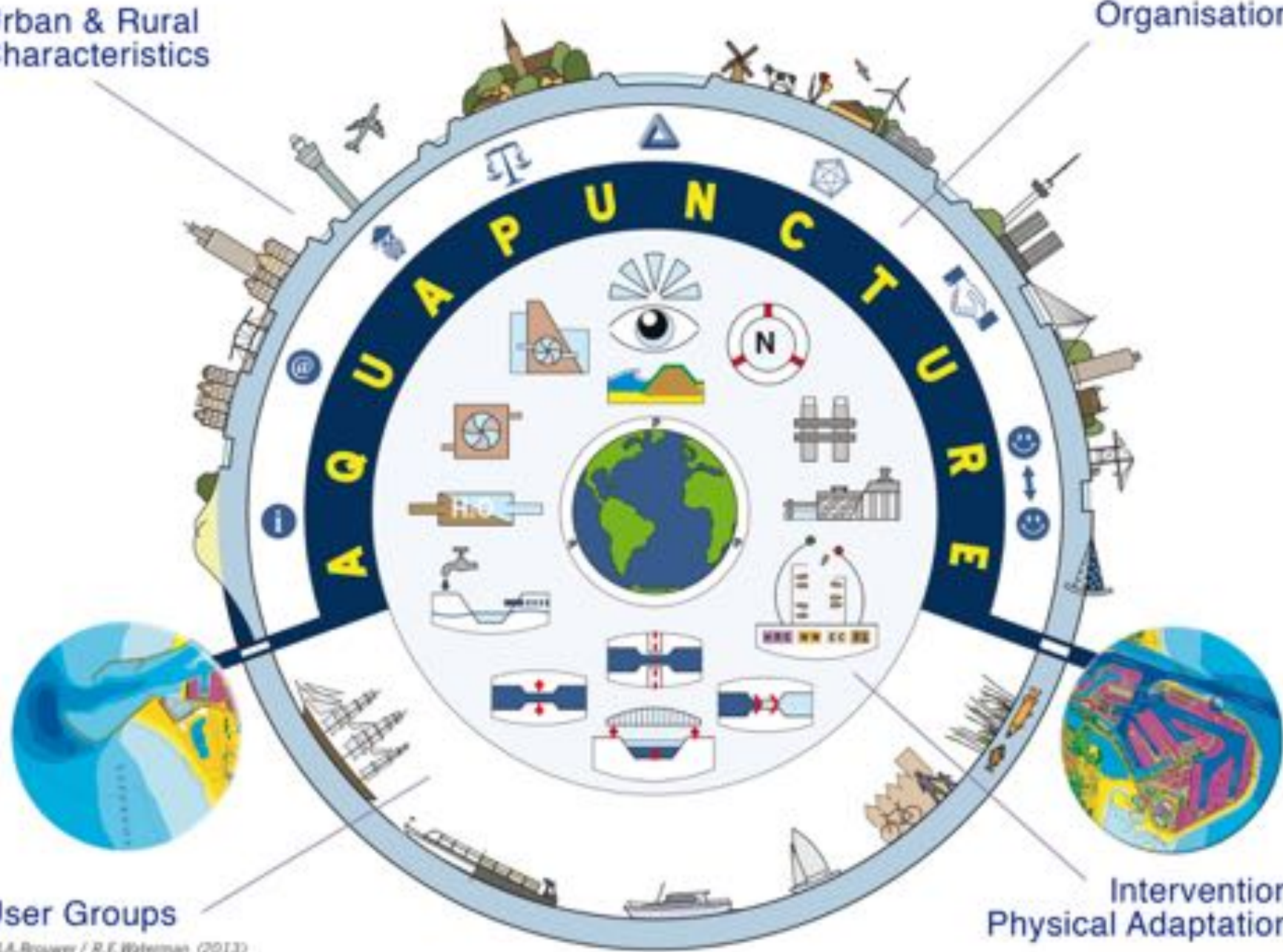
AQUAPUNCTURE

to revitalize
the Waterways & their
Water Fronts



Urban & Rural Characteristics

Organisation

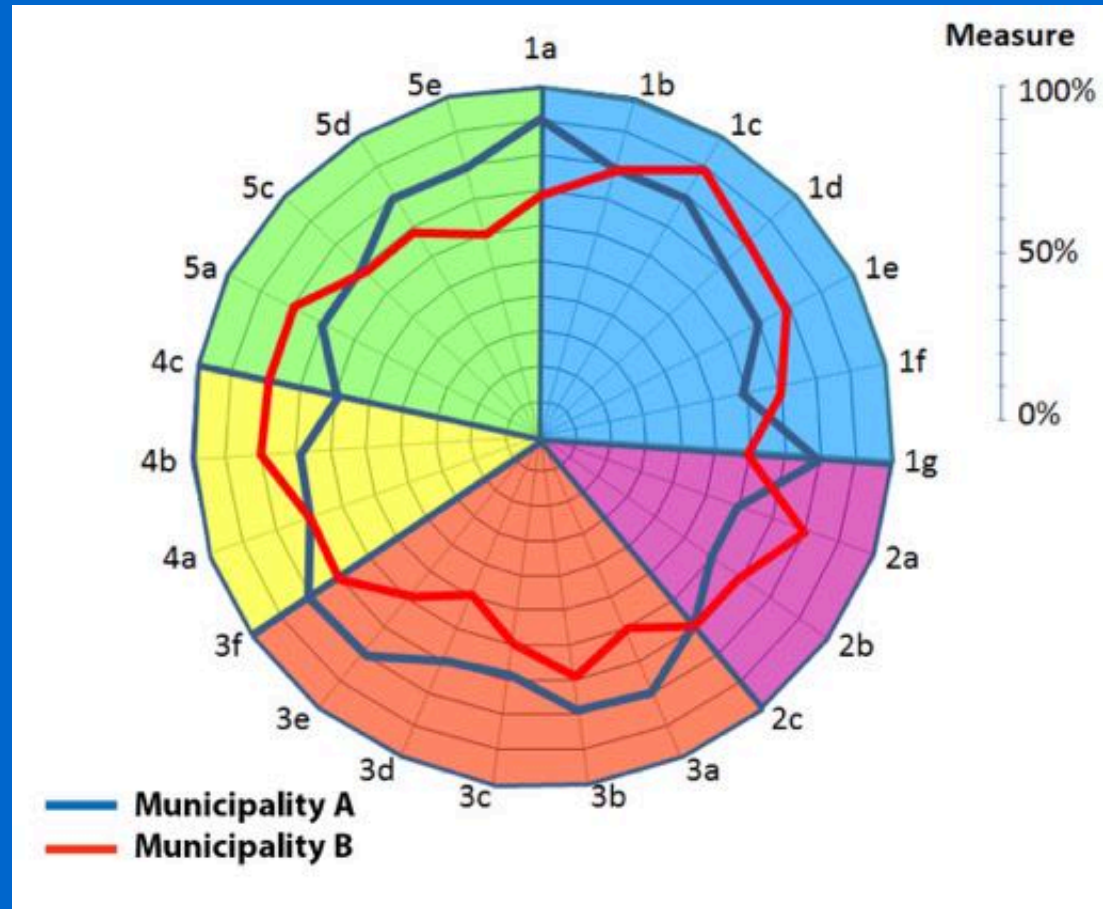


User Groups

Interventions
Physical Adaptations

Values	Objectives
1. Water quantity	<ul style="list-style-type: none"> a) Ensure flood protection b) Surface water & ground water regulation c) Drainage, irrigation for agriculture & aquaculture d) Drinking water supply e) Cooling water f) Process water g) Water flow, thermal, osmotic energy
2. Water quality	<ul style="list-style-type: none"> a) Improvement of water quality for environment b) Improvement of water quality for nature c) Improvement of water quality for health
3. Navigability	<ul style="list-style-type: none"> a) Commercial transport of persons b) Commercial transport of goods c) Tourism and recreation d) Special events on/at water e) Water related sports f) Waterway classification & connectivity
4. Water front revenues	<ul style="list-style-type: none"> a) Increased liveability b) Economic activities c) Increased value of property
5. Spatial quality revenues	<ul style="list-style-type: none"> a) Improved urban & rural environment b) Preservation & restoration of cultural heritage c) Attractive residential & business areas d) Leisure parks, sustainable industrial parks e) Overall sustainability, also with regard to climate & climate change

Aquapuncture - Shared Value: Societal Costs & Benefits Measurement Model



Large scale land reclamation, fresh water lakes & sea defence



Plan B

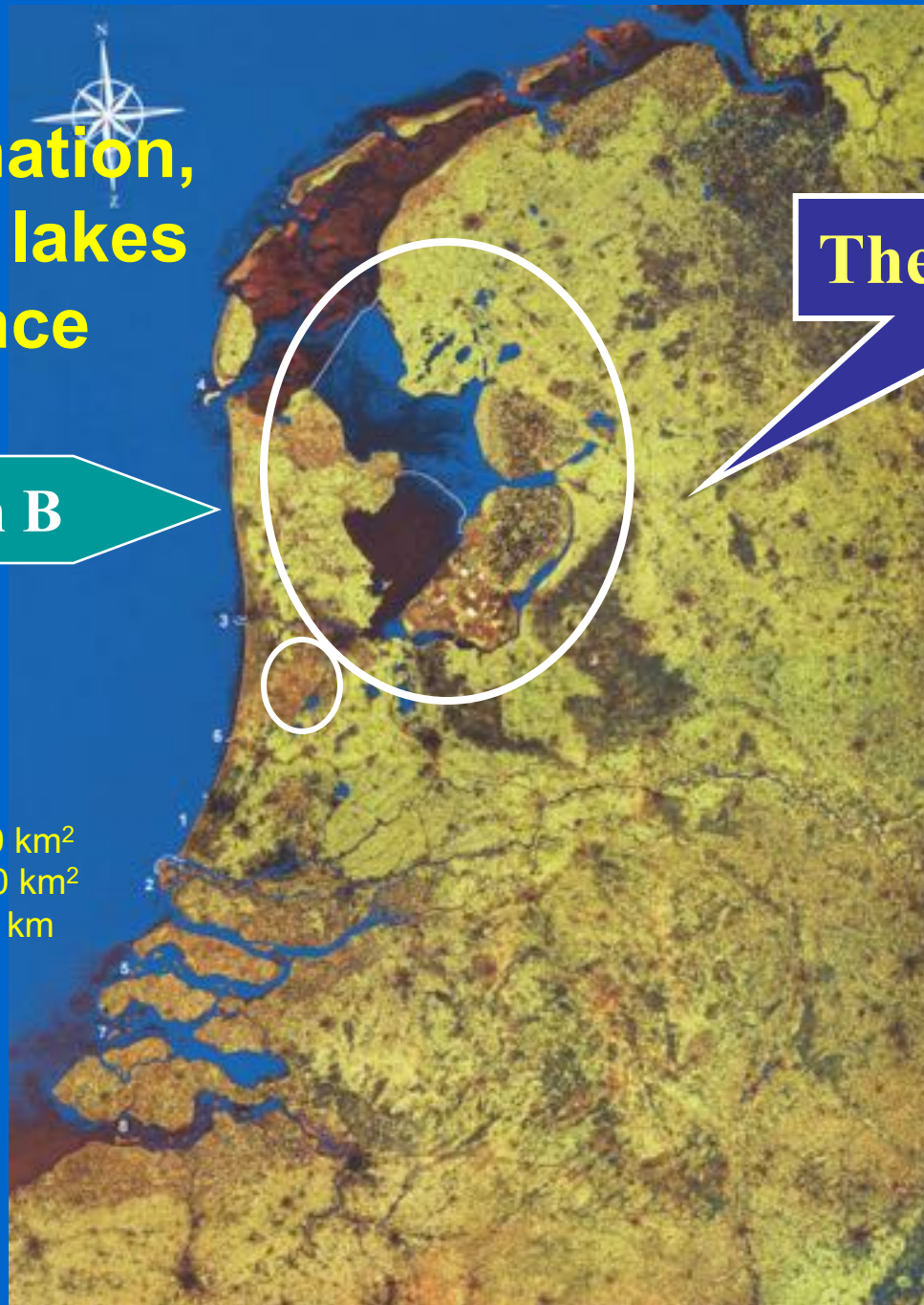
ZUIDERZEE PROJECT

Land Reclamation	1,660 km ²
Fresh Water Lake	1,900 km ²
Enclosure Dike	32.5 km

4 Polders

The Netherlands

Transformation of original South Sea into fresh water IJssel Lake by creating Enclosure Dike with discharge sluices and ship locks and by creating a sequence of 4 large polders with drainage canals and pumping stations

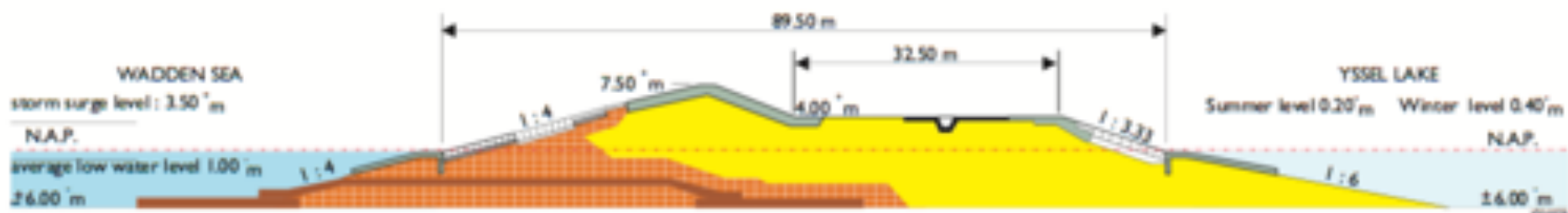




**A Living Nation
is
Building it's Future**



CROSS SECTION : ENCLOSURE DIKE / BARRIER DAM



boulder clay



sand



clay

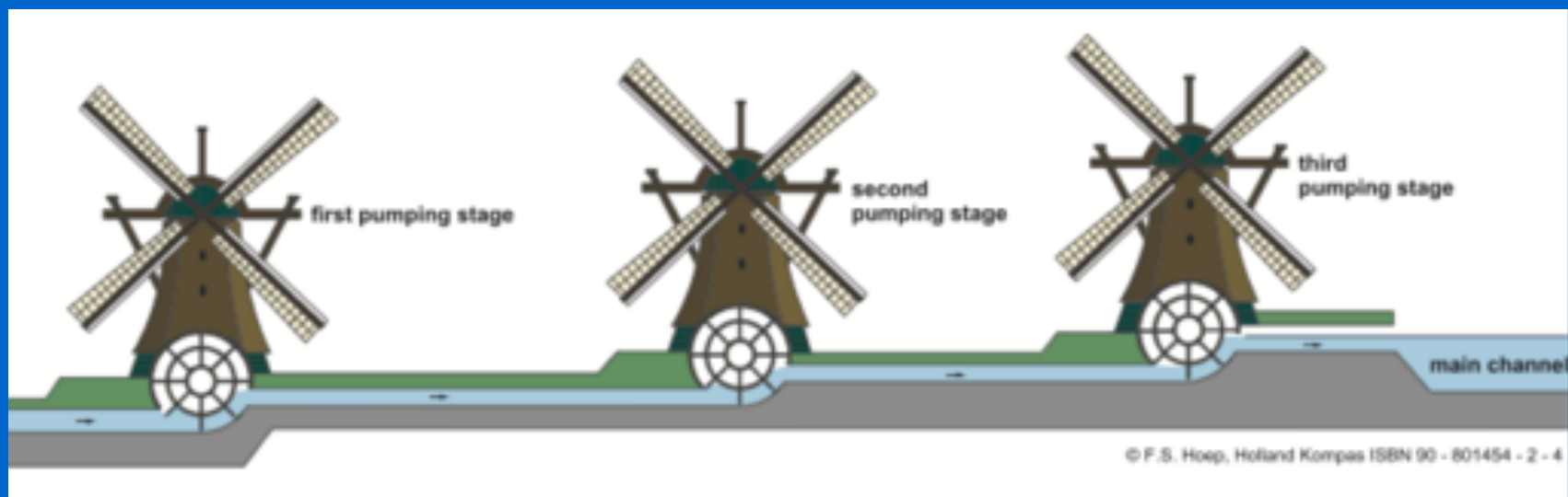


bedding mattress



revetment:
cover layer + filter layer



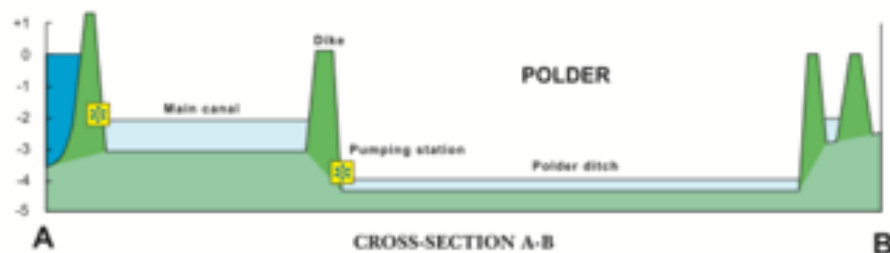


Period of creation	Name of Polder	Area hectares	Pumping Stations		Initially pumped out 10^6 m^3	Maintenance pumping $10^6 \text{ m}^3/\text{yr}$
			number x	power MW		
1927-1932	Wieringermeer Polder	20,000	2	3.28	700	160
1937-1942	North East Polder	48,000	3	6.10	1500	400
1950-1957	East Flevoland	54,000	3	5.94	1600	800
1959-1968	South Flevoland	43,000	1	3.53	1400	

Land-Use in %	Wieringermeer Polder	North East Polder	East Flevoland	South Flevoland
Agriculture	87	87	75	50
Nature (incl. woodland & marshland)	3	5	11	18
Cities	1	1	8	25
Dikes, roads, water	9	7	6	7



GENERAL PRINCIPLE OF POLDER SYSTEMS



OPTIONS FOR ISLAND CONSTRUCTION 1: DIKED AREAS

IL.C.1 POLDER 1: WATER MANAGEMENT BY PUMPING



IL.C.2 POLDER 2: WATER MANAGEMENT BY PUMPING IN COMBINATION WITH LANDFILL



IL.C.3 LANDFILL 1: WATER MANAGEMENT BY GRAVITY DRAINAGE & PUMPING (AT EHW)



IL.C.4 LANDFILL 2: WATER MANAGEMENT BY GRAVITY DRAINAGE



Europe

Netherlands
United Kingdom
Denmark
Belgium

Africa

South Africa
Tunisia
Egypt

Middle East

Israel
Jordan
UAE
Qatar

Asia

India
Bangladesh
Singapore
Indonesia
Brunei
Philippines
Vietnam
China
Korea
Japan

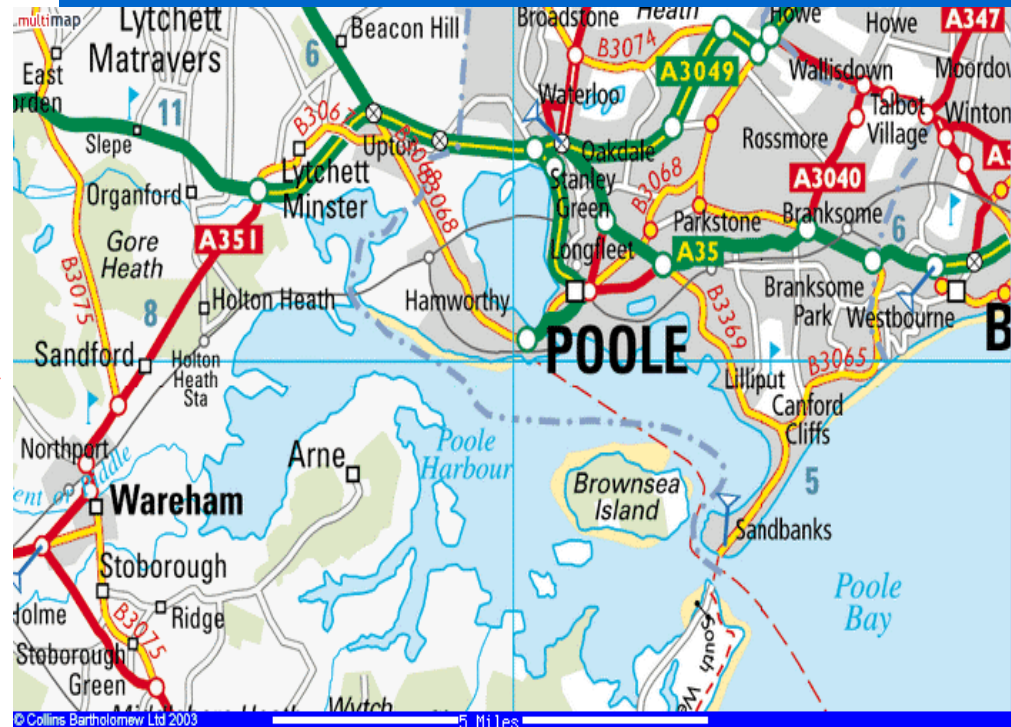
Americas

USA
Mexico
Curacao
Colombia
Argentine
Chile

Australia



BUILDING WITH NATURE



UK, Poole



UK, Poole

Before the land reclamation



UK, Poole

During the land reclamation



UK, Poole

After the land reclamation



Amager Beach Park - Copenhagen - Denmark

**3 - COASTLINE PROJECT WITH ISLAND & LAGOON
WATERFRONT DEVELOPMENTS IN HARMONY WITH NATURE**

BOUWEN MET DE NATUUR



Vlaamse Baaien

Veilig, natuurlijk, aantrekkelijk, duurzaam, ontwikkelend

Van een smalle, harde naar een brede, zachte kust

VLAAMSE KUST 67 km

10 Gemeenten :

- Knokke-Heist



Brugge / Zeebrugge



Blankenberge

- De Haan

- Bredene



Oostende

- Middelkerke



Nieuwpoort - IJzermonding

- Koksijde

- De Panne





Blankenberge - Zeebrugge

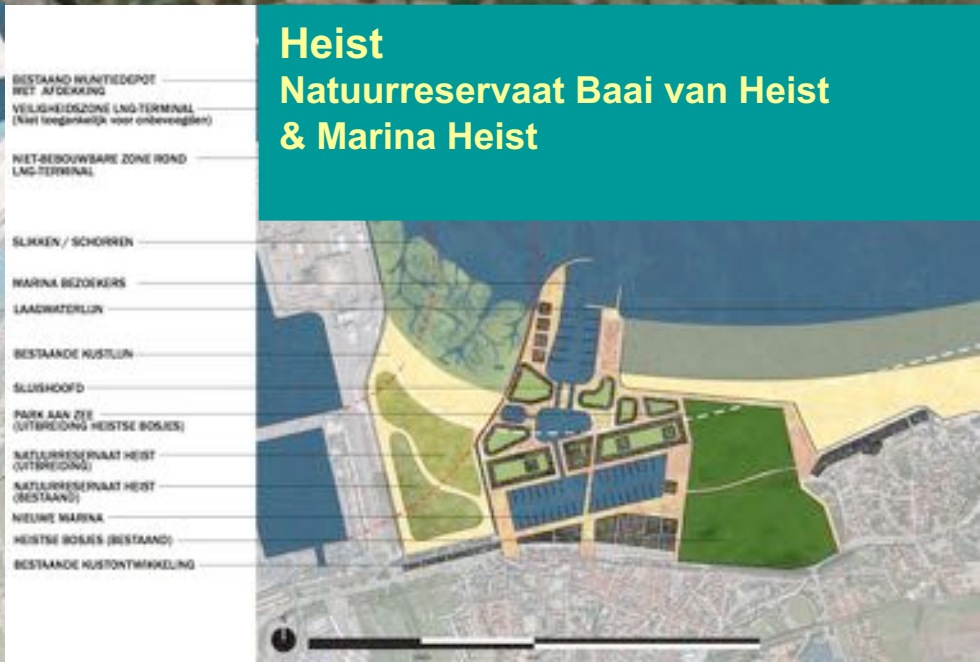
Heist / Knokke - 't Zwin



Blankenberge – Zeebrugge Aanleg havendammen Marina & strandverbreding



Heist Natuurreservaat Baai van Heist & Marina Heist



Blankenberge - Zeebrugge

Heist / Knokke - 't Zwin



Blankenberge – Zeebrugge Aanleg Blankenberge havendammen Marina & strandverbreding



Blankenberge – Zeebrugge Marina Residentie & Lagune met stranden in aansluiting op Zeebrugge II





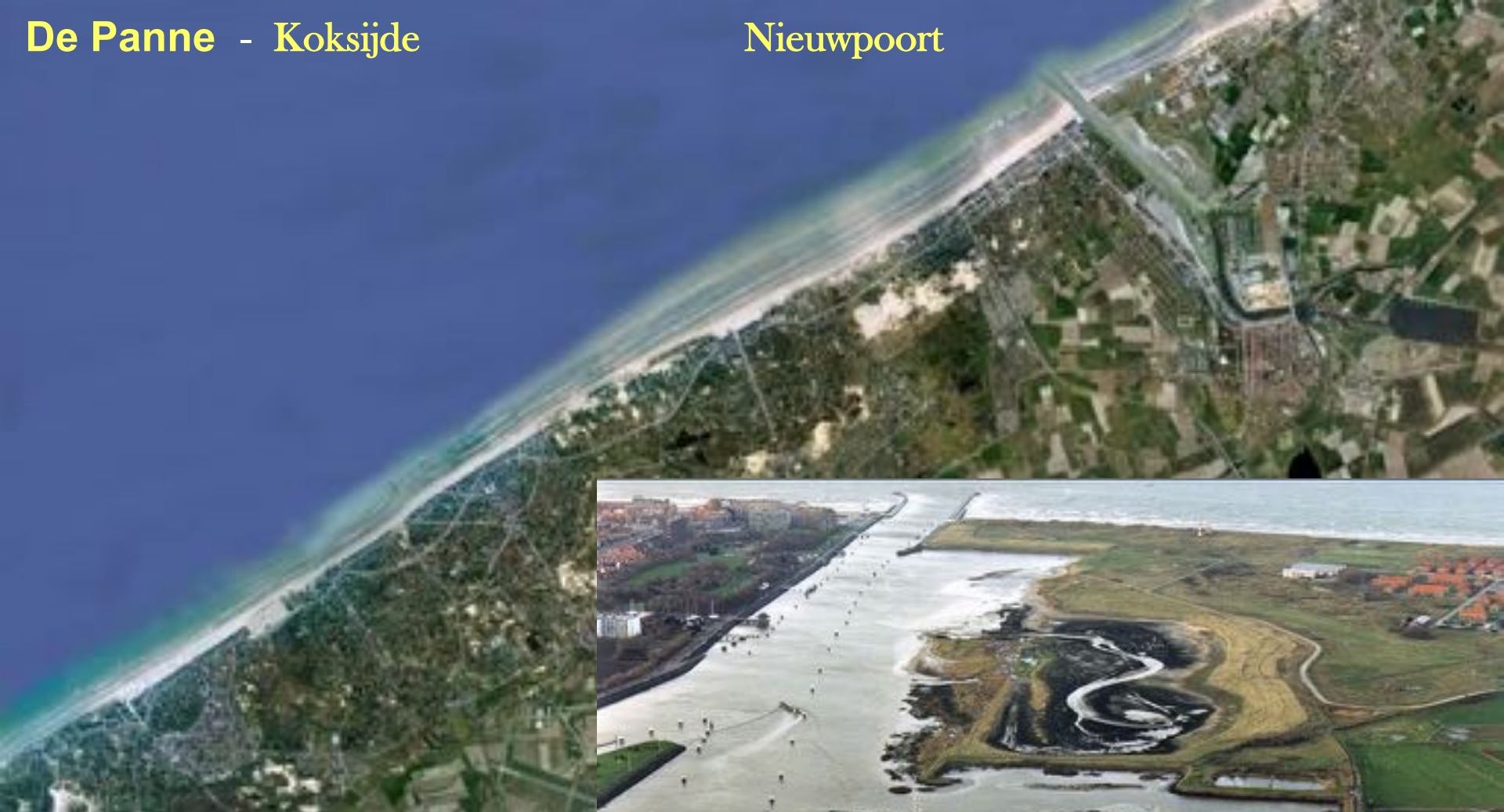
- STRAND
- DUINENTOPPEN / KAMMEN
- BESTAANDE KUSTLUUN
- BRUGGENHOOFD CAMPUS
- HERNIEUWBARE ENERGIE
- NIEUWE STREKDAM
(2x maat van oeverdammen in constructie)
- DUINEN
- HAVEN (voor hernieuwbare energie
campus of voor ro-ro)
- NIEUWE MARINA
- STREKDDAMMEN (in constructie)
- SIGNAALGEBOUW AAN EIND
NIEUWE STREKDDAM
- ONTSLUITING RESORTS
- NIEUWE PIER VOOR CASINO
- SIGNAALGEBOUW
- FORT NAPOLEON
- RESORTS IN DUINEN EN BIJ STRAND
- NATUURLIJKE STRANDAANGROEI
- MILITAIR HOSPITAAL



Oostende
Verlenging havenhoofden
Buitenhaven met Marina
Duin-strand verbreding met
Resorts & voorzieningen
Nieuwe Pier met Casino

De Panne - Koksijde

Nieuwpoort



Nieuwpoort
Bestaande Jachthaven met
1800 ligplaatsen

BUILDING WITH NATURE



SOUTH AFRICA

BUILDING WITH NATURE



CAPE TOWN

-
-
-

BUILDING WITH NATURE

-



CAPE TOWN



BUILDING WITH NATURE



TOGO Coastal protection through Permaculture

Application of vegetable & fruit production and planting of shrubs and trees (banana, coconut) near the beach combined with soil improvement by dung & compost. Thereby strengthening the root system of the vegetation, improving beach protection as well as the local economy

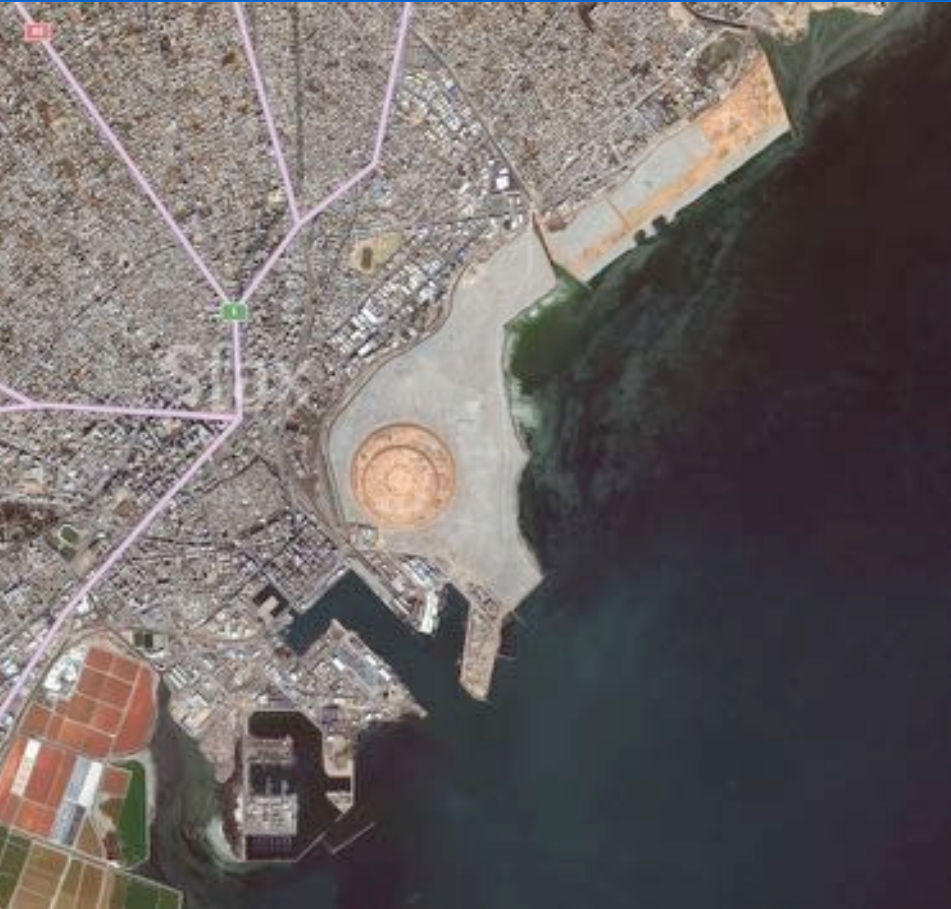








TUNESIA - SFAX



LAND RECLAMATION DESIGN

-
-
-

SUSTAINABLE COASTAL ZONE DEVELOPMENT

Integrated Coastal Policy via Building with Nature



Dr. R. E. Waterman MSc



ALEXANDRIA - EGYPT

CoRI March 2010

THE HAGUE - THE NETHERLANDS

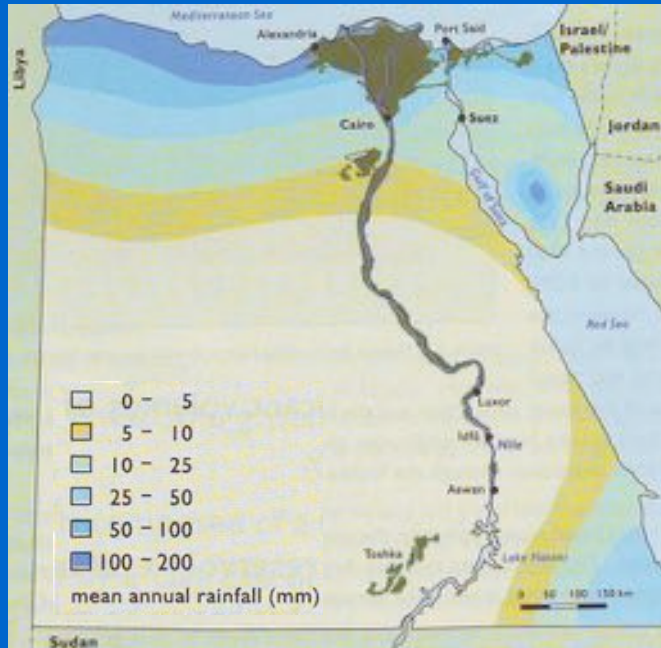
June 2012





ARAB REPUBLIC OF EGYPT

جمهورية مصر العربية



1. <u>Cairo</u>	8,5 million
1. Cairo m.a.	20 million
2. Alexandria	4,5 million
6. Port Said	0,6 million
7. Suez	0,5 million

SURFACE AREA

1,010,000 km² 41,500 km²

INHABITANTS

82 million 16.7 million

COASTAL LENGTH

1,200 km M. Coast 353 km
2,300 km R.S. Coast

MAIN RIVER

Nile	Rhine
6,650 km	1,320 km
5,100 m ³ /s	2,330 m ³ /s

LARGEST CITIES

THE NETHERLANDS



1. <u>Amsterdam</u>	0,8 million
2. Rotterdam	0,6 million
3. The Hague	0,5 million
4. Utrecht	0,3 million
5. Rim City Holland	8,0 million



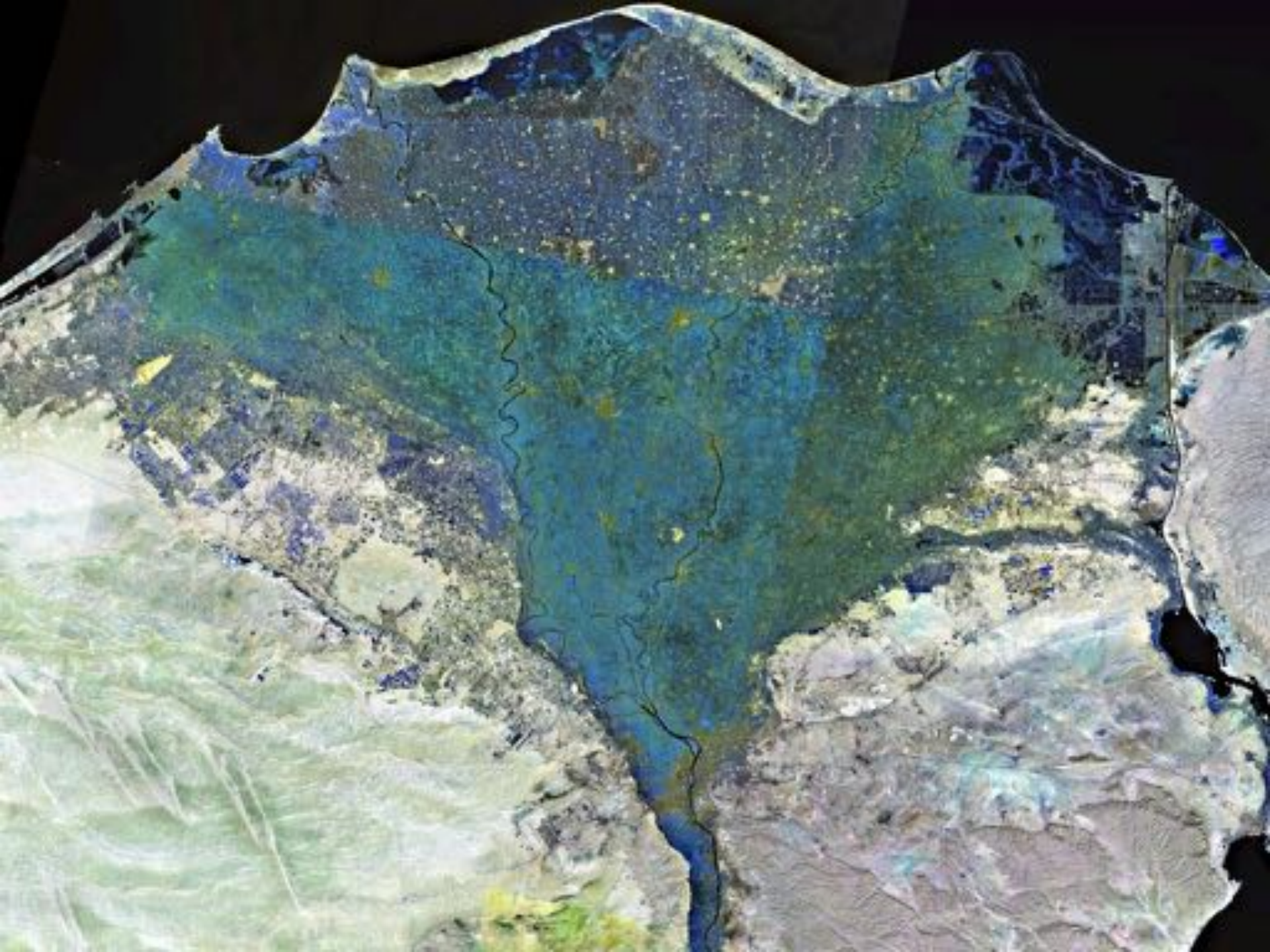
NILE DELTA:

Width 250 km

Length 150 km

Area +/- 35,000 km²

- 1. Lake Maryot
- 2. Lake Edku
- 3. Burullus Lagoon
- 4. Manzalah Lagoon
- 5. Bardawil Lagoon





Alexandria



Tabia



El Gouna





El Gouna



-
-
-

SUSTAINABLE COASTAL ZONE DEVELOPMENT

Integrated Coastal Policy via Building with Nature®

Prof. Dr. R.E. Waterman MSc



ISRAEL - Tel Aviv



Coastal Extensions & Airport



ISRAEL



SURFACE AREA

22,145 km² 33,883 km²

INHABITANTS

7.7 million 16.7 million

COASTAL LENGTH

188 + 10 km 353 km



THE NETHERLANDS



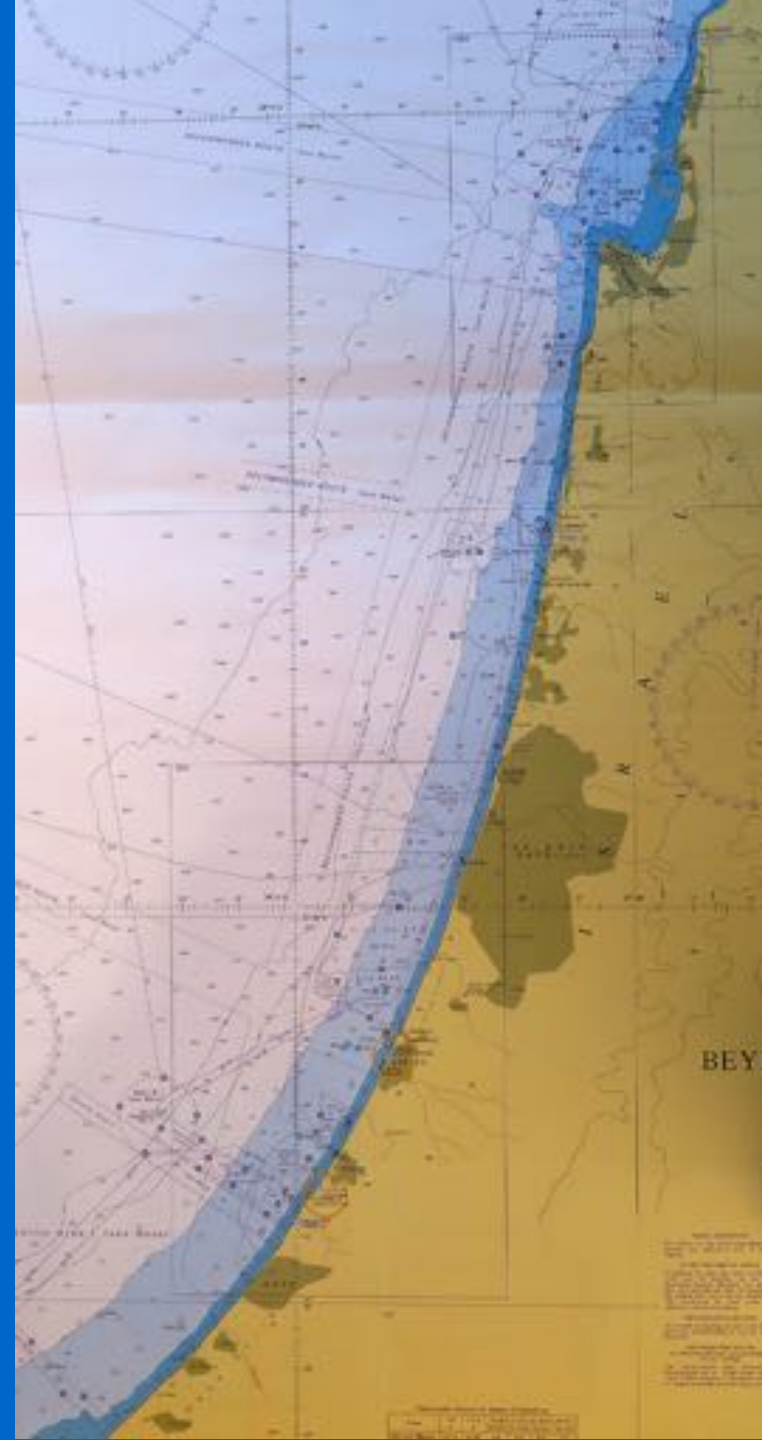
ISRAEL



COASTAL LENGTH

188 km

Rosh Hanikra
Nahariya
Ako
Haifa
Atlit
Caesarea
Hadera
Netanya
Herzliyah
Tel Aviv
Jaffa
Bat Yam
Rishon Letsion
Palmachim
Ashdod
Ashkelon
Zikim



ISRAEL

COASTAL LENGTH ISRAEL ALONG RED SEA 10 KM

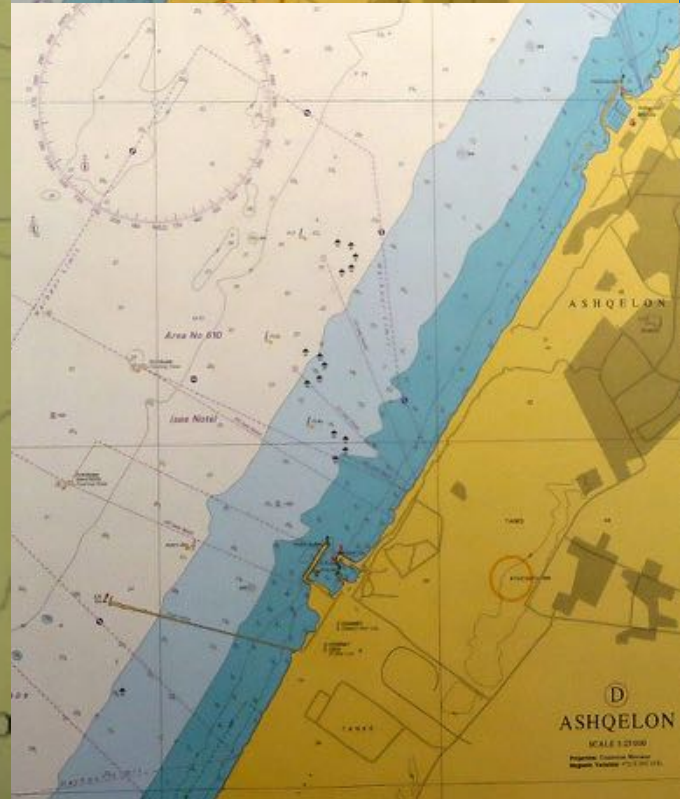
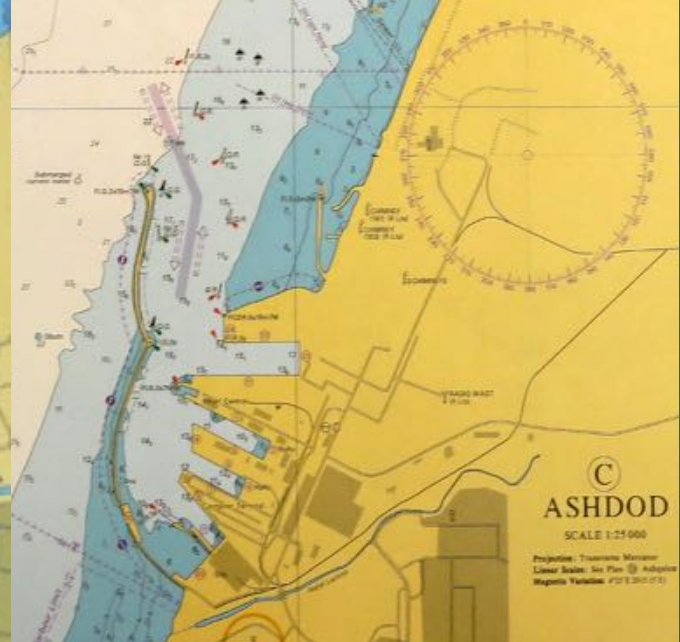
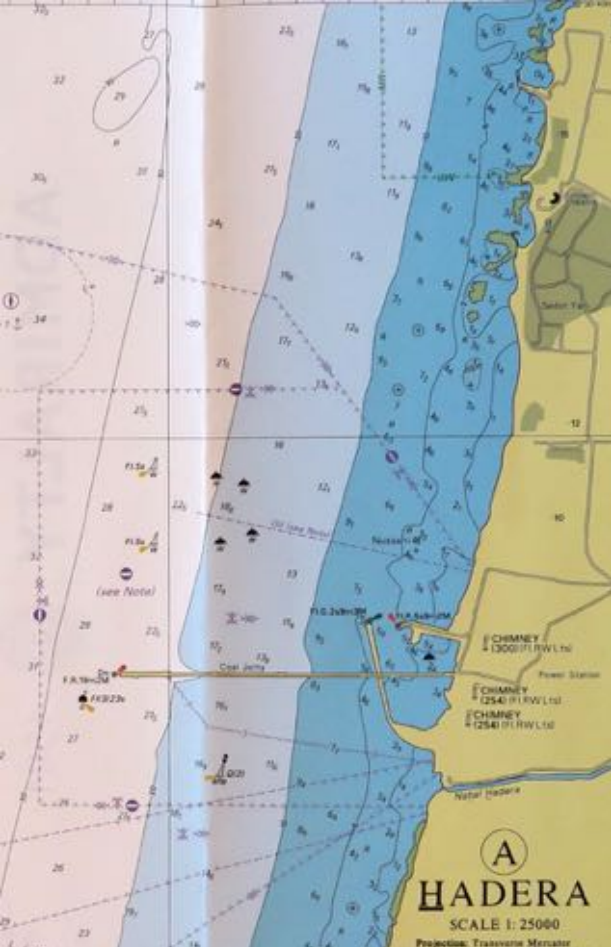
EILATH - AKABA



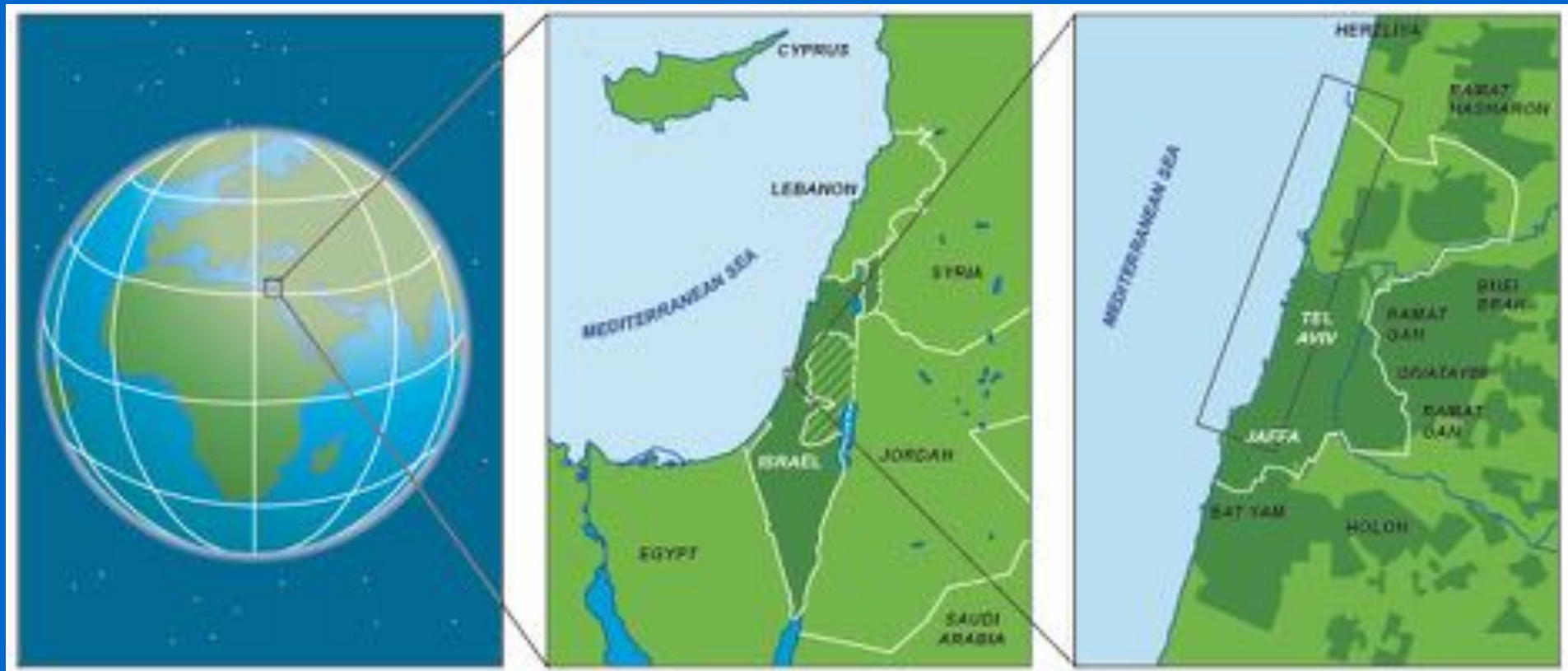
COASTAL LENGTH ISRAEL ALONG RED SEA 10 KM

EILATH - AKABA





Tel Aviv - Jaffa



Jaffa



OLD JAFFA, VIEW TO TEL-AVIV

OLD JAFFA



Mediterranean Sea

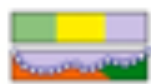


© Chaim Shapiro - 2002
Dov Rosen



JAFFA

Marina / Ferry Port & Seashore development



Promenade / boulevard

Original Coastline

- ① terminal
- ② large yachts & tour boats & ferry
- ③ club / restaurant
- ④ bathing beach
- ⑤ yacht anchorage

- ⊕ residential area
- ⑦ residential & hotel area
- ⊕ fishermen's store house
- ⊕ Jaffa shore park
- Ⓜ marina services
- Ⓜ marina dock yard
- Ⓜ club house

- park, bathing beach & promenade (1500 ha)
- berthing capacity for 400-500 yachts
- ferry harbour & promenade
- residential area (450 units)
- hotel & residential area (350 units or hotels)
- existing Jaffa port area
- underground parking for 2300 cars

0 50 100 150 200 250 m

Tel Aviv Jaffa



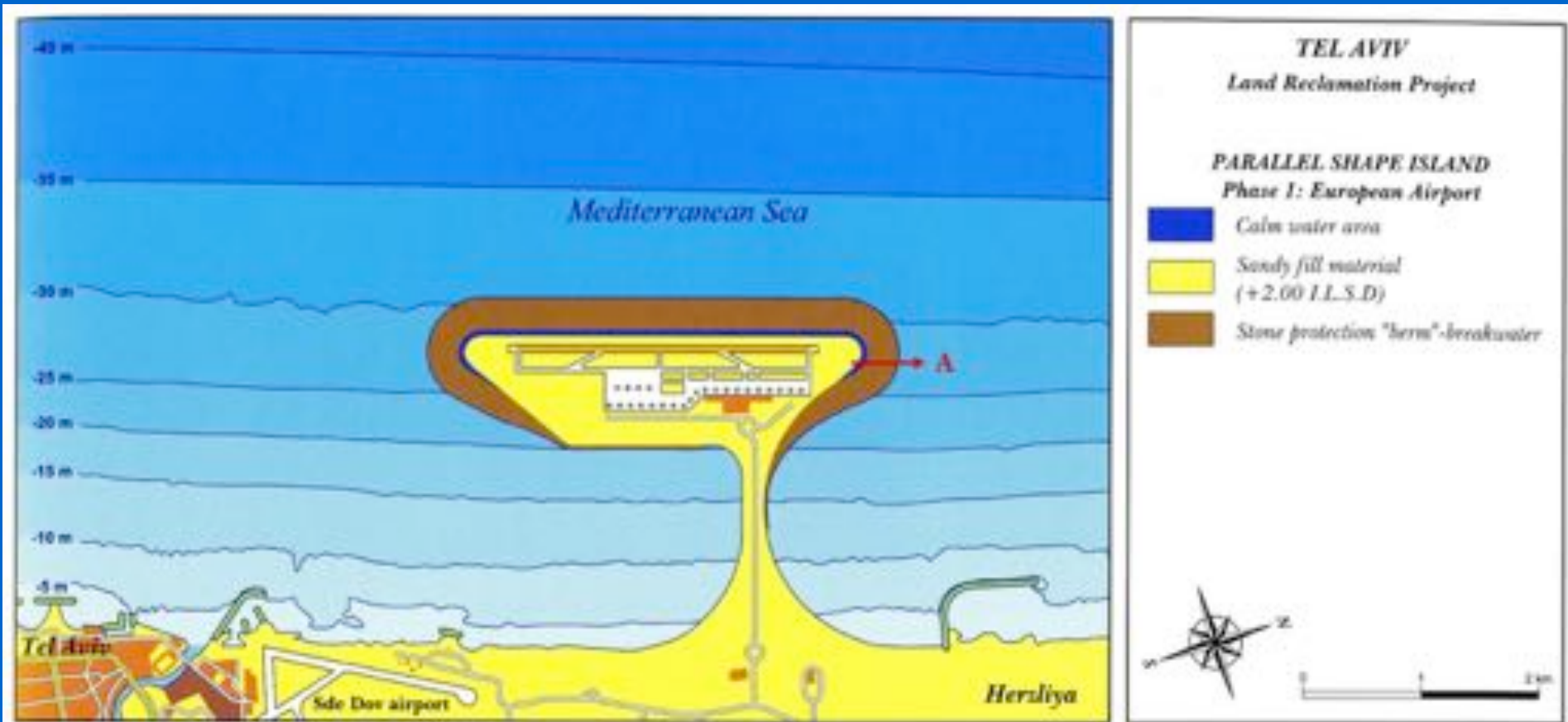
Tel Aviv
Jaffa



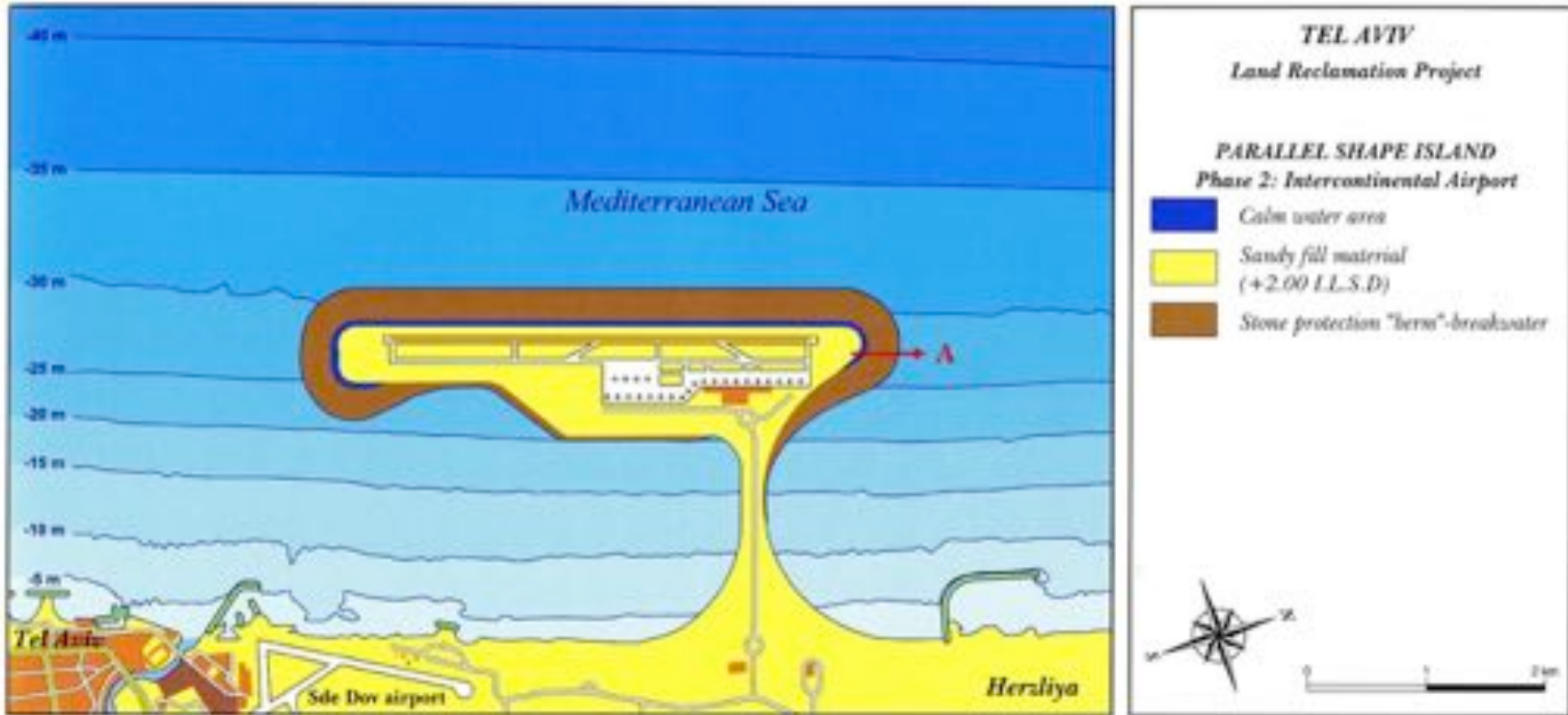
Sde Dov
Herzlia



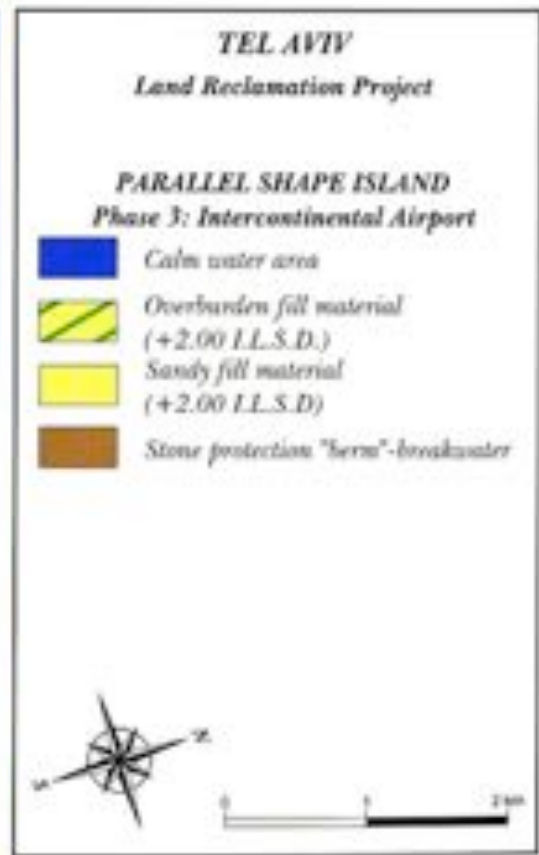
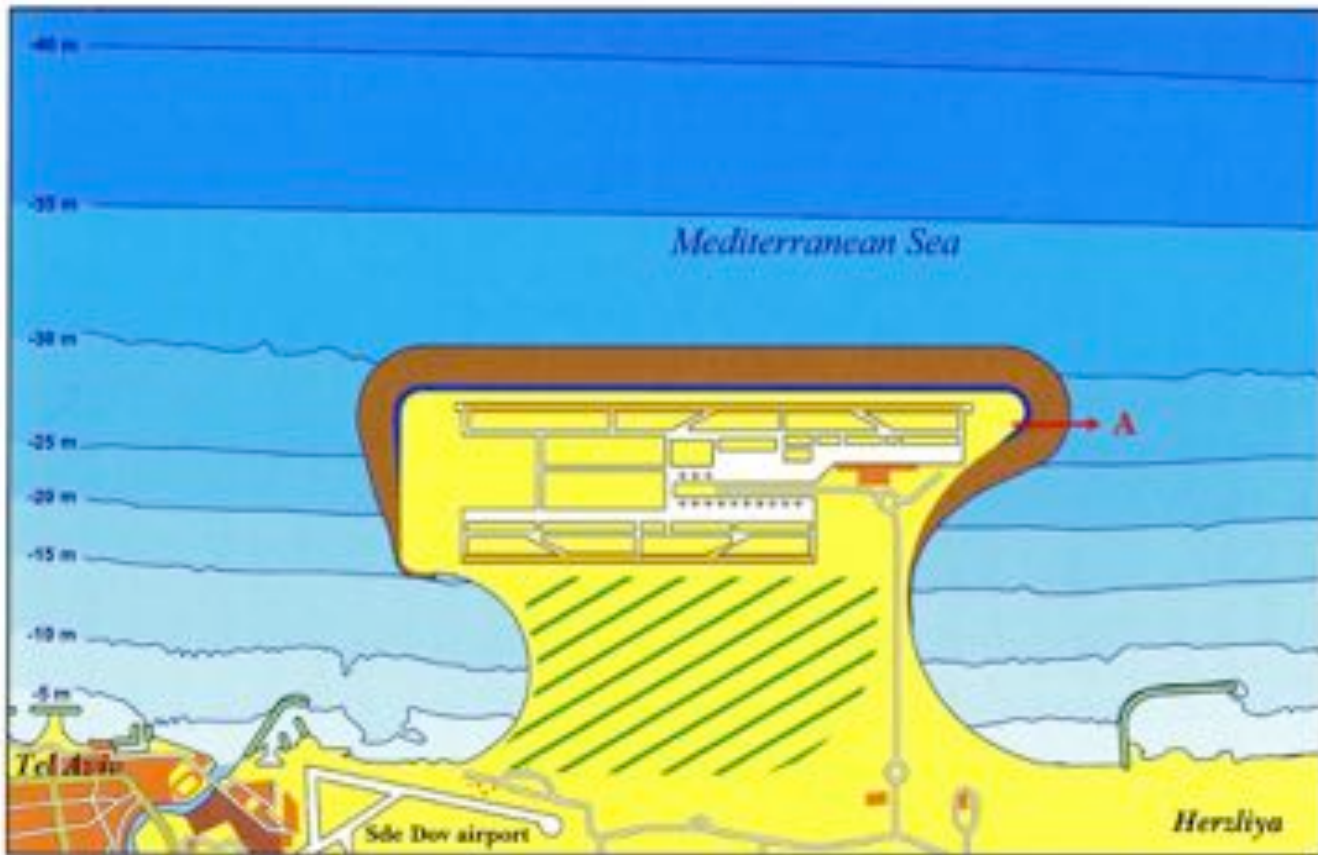
Tel Aviv



Tel Aviv

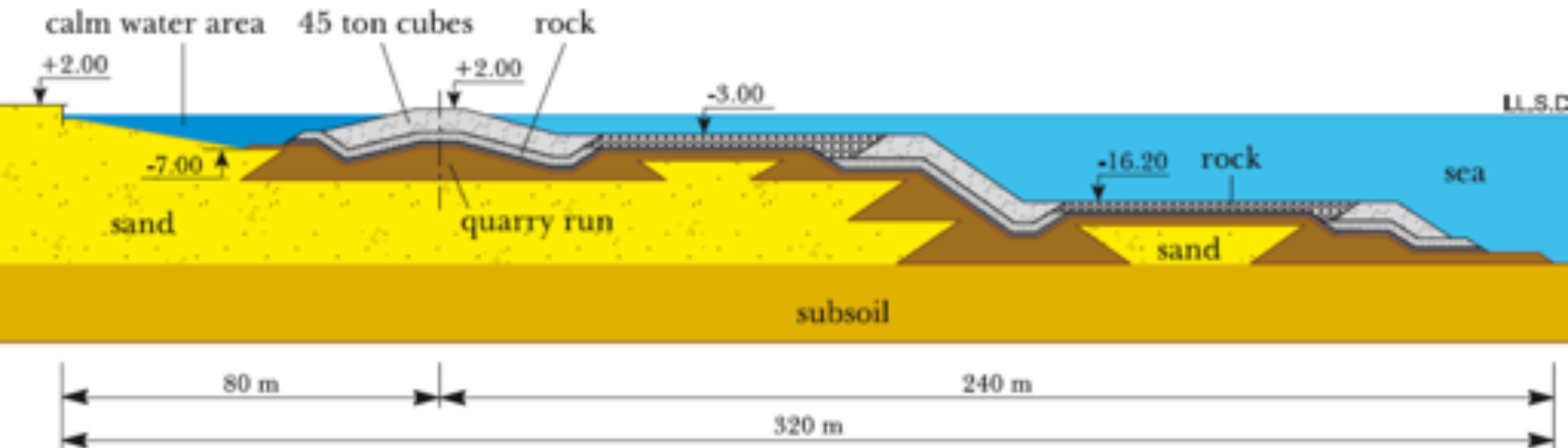


Tel Aviv

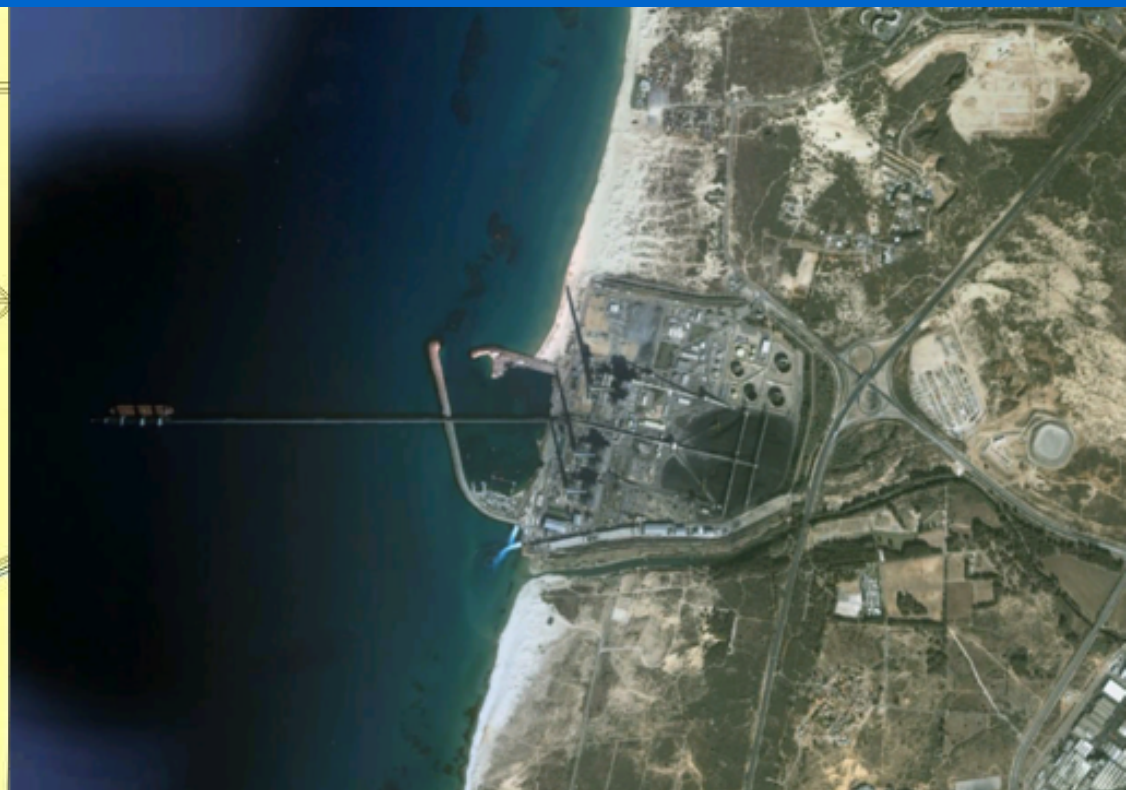
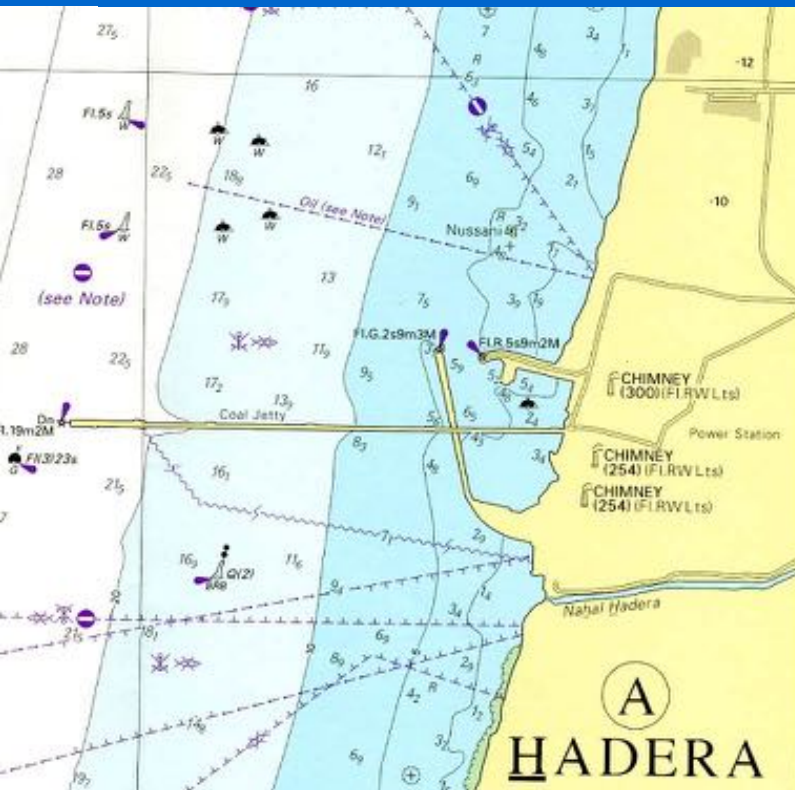


Tel Aviv

TEL AVIV LAND RECLAMATION PROJECT BERM BREAKWATER
CROSS SECTION PROFILE A



Hadera



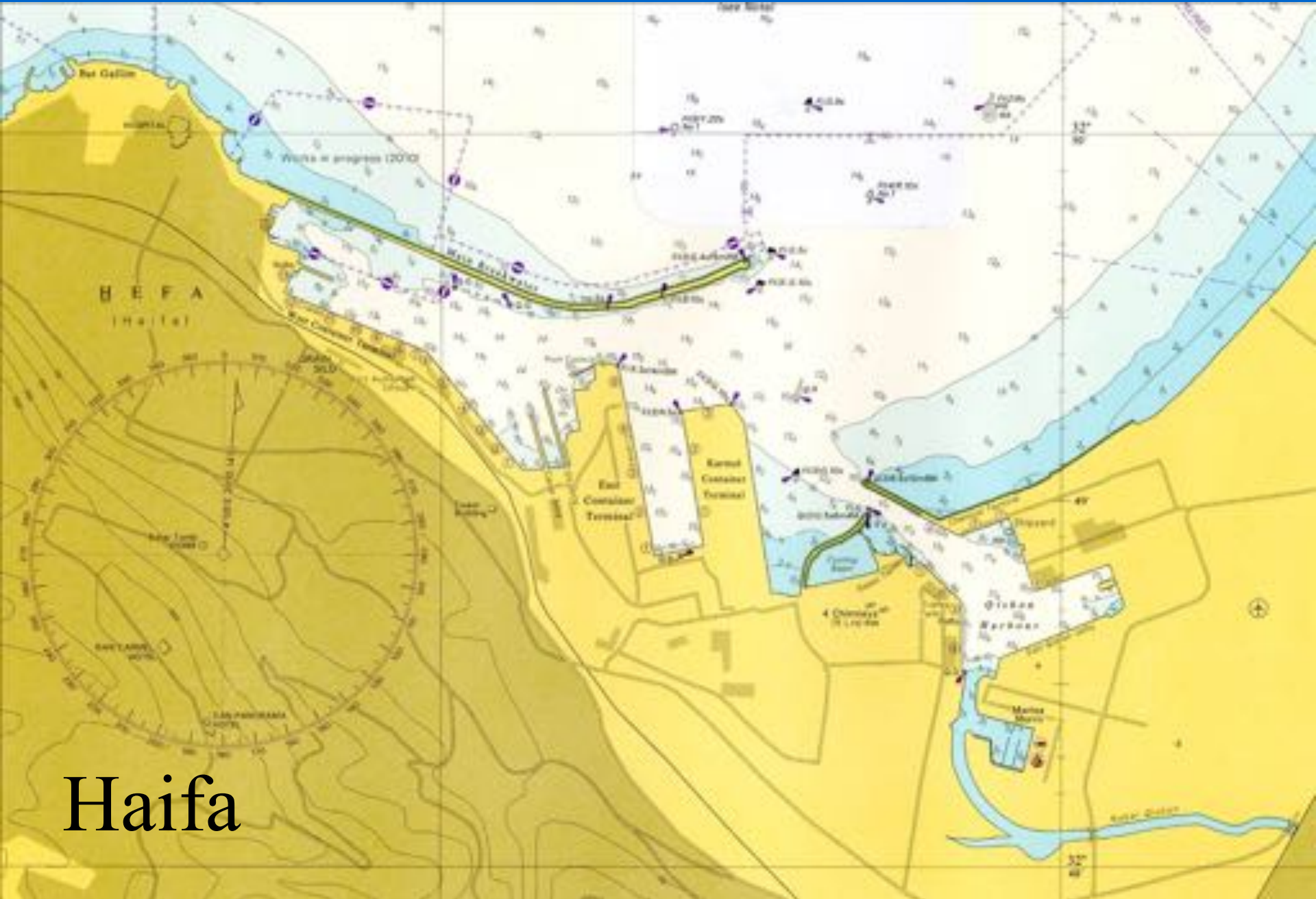


Haifa



Haifa





Haifa

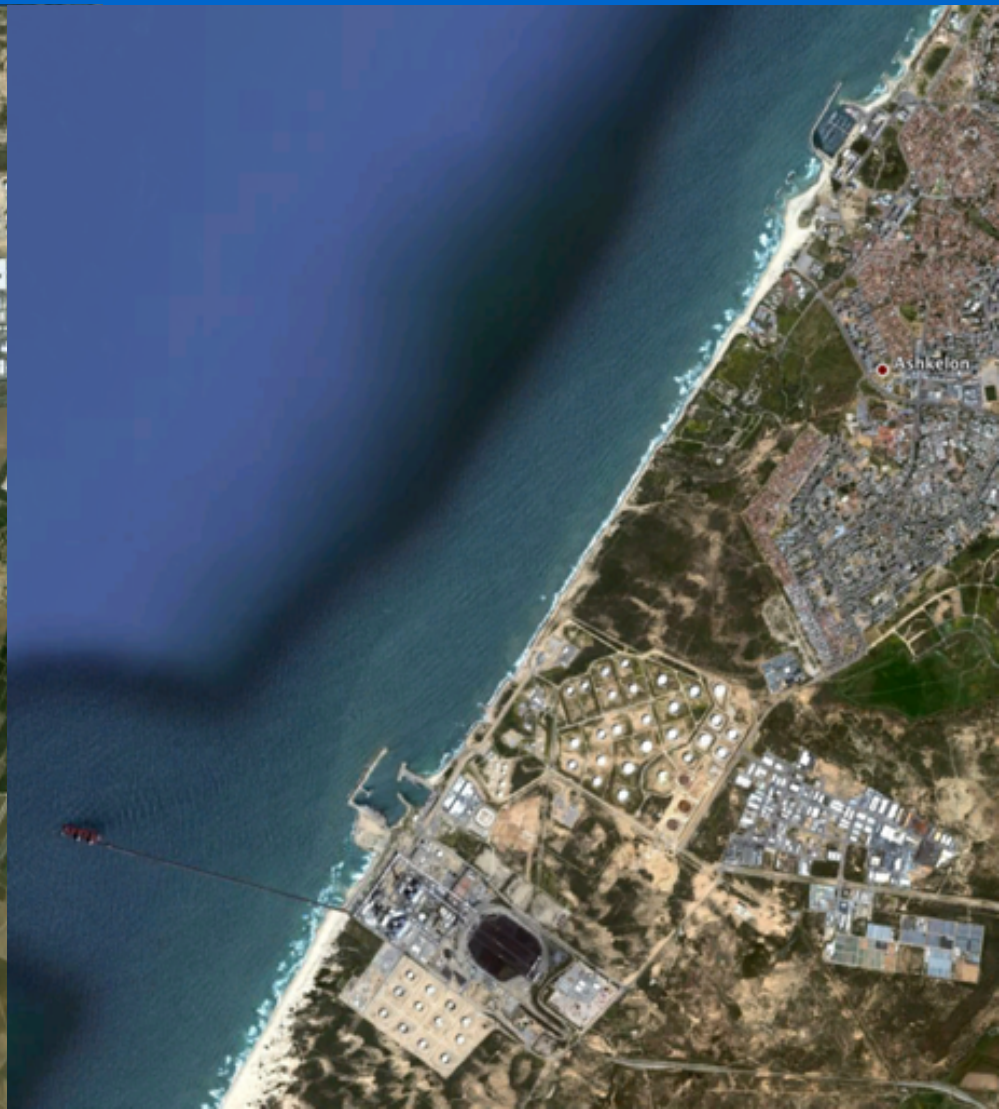


HAIFA
*Development of Haifa Bay Harbor
 Land Reclamations in Phases*

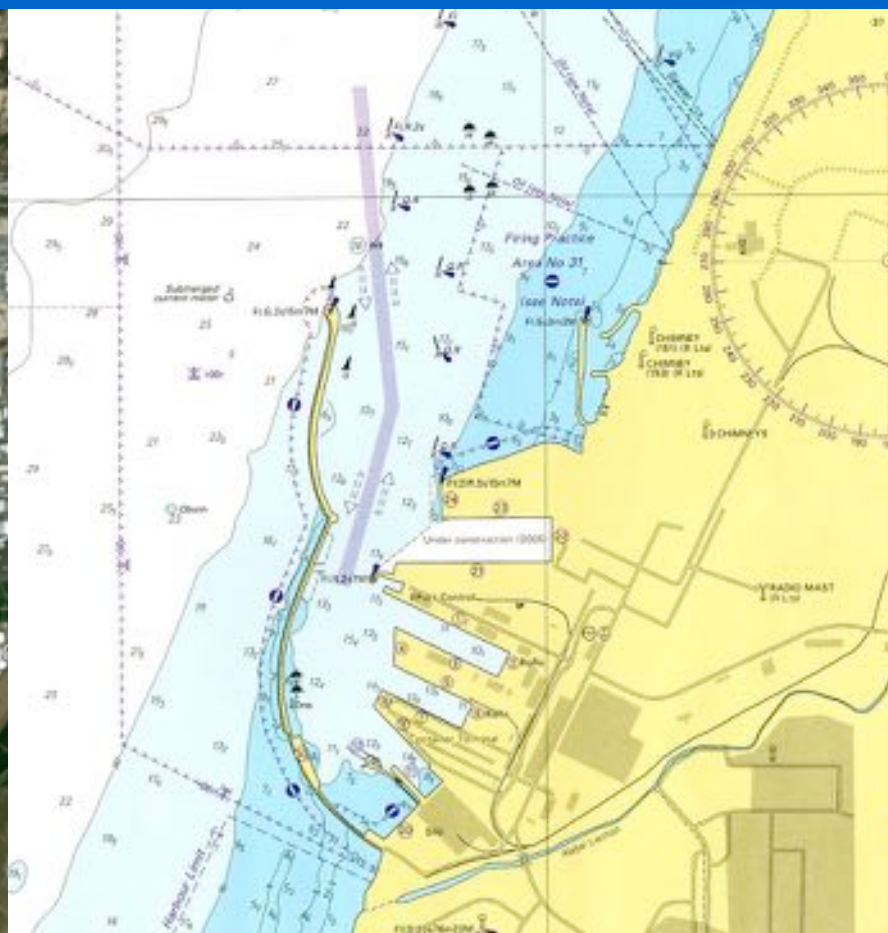
	projected
	1968-2004
	1933-1968
	1900-1933
	Original Coastline

0 200 400 600 800 1000 m

Ashdod - Ashkelon



Ashdod - Ashkelon



Mediterranean Sea

- Longshore transport
- Beach deposit
- Seaward loss
- Cliff abrasion
- Eolean transport

waves

waves



600 - 800,000 m³/year



500 - 800,000 m³/year



215,000 m³/year

Lebanon

Haifa

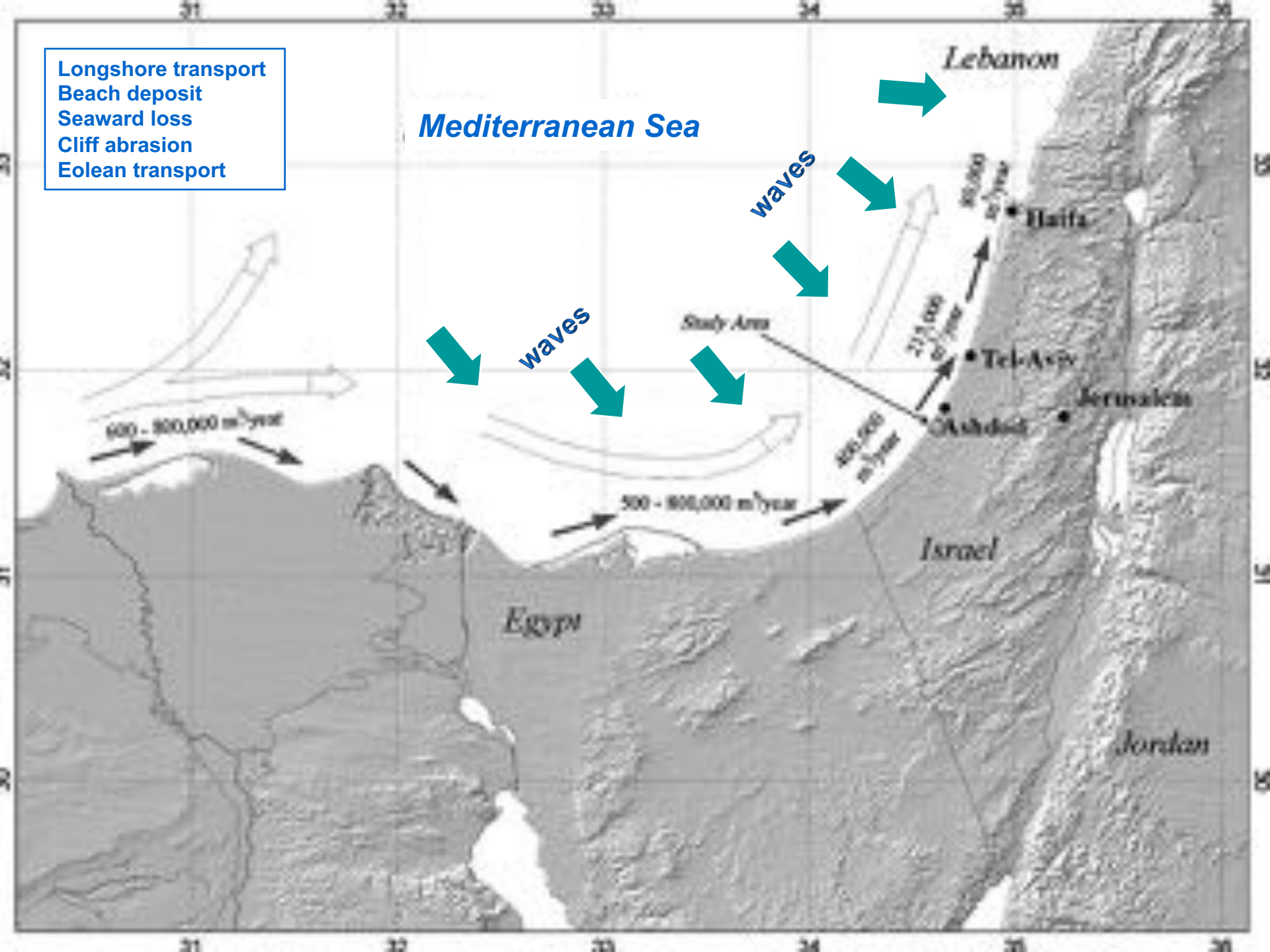
Tel-Aviv

Jerusalem

Israel

Jordan

Egypt





ENVIRONMENTAL RISK ALONG THE SHARON ESCARPMENT

G. Almagor - D. Gill - I. Perath

D. Rosen





Fig. 5-3a: Hermit crab, *Diogenes pugilator*



Fig. 5-3b: Snail Changeable nassa, *Sphaerionassa mutabilis*



Fig. 5-3g: Pink Shrimp (Gamba), *Parapenaeus longirostris*



Fig. 5-3h: Crab, *Galathea intermedia*

Importance of E.I.A.



Fig. 5-3c: White shrimp, *Trachypenaeus curvirostris*



Fig. 5-3d: Pebble crab, *Myra fugax*



Fig. 5-3i: Peacock worm, *Sabella pavonina*



Fig. 5-3j: Snail, *Turritella communis*



Fig. 5-3e: Heart urchin, *Brissopsis lyrifera*

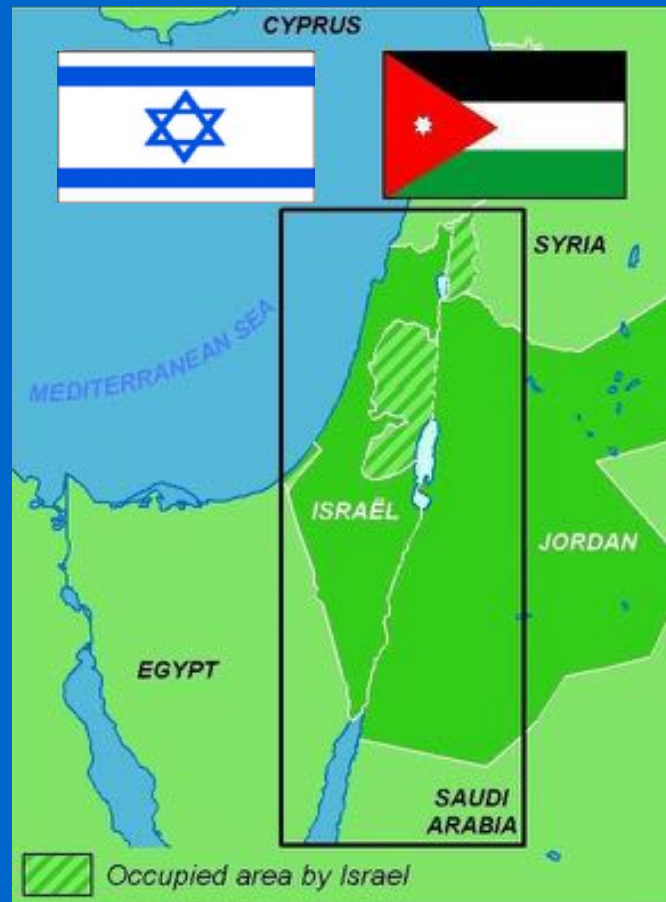


Fig. 5-3f: Mediterranean feather star, *Antedon mediterranea*

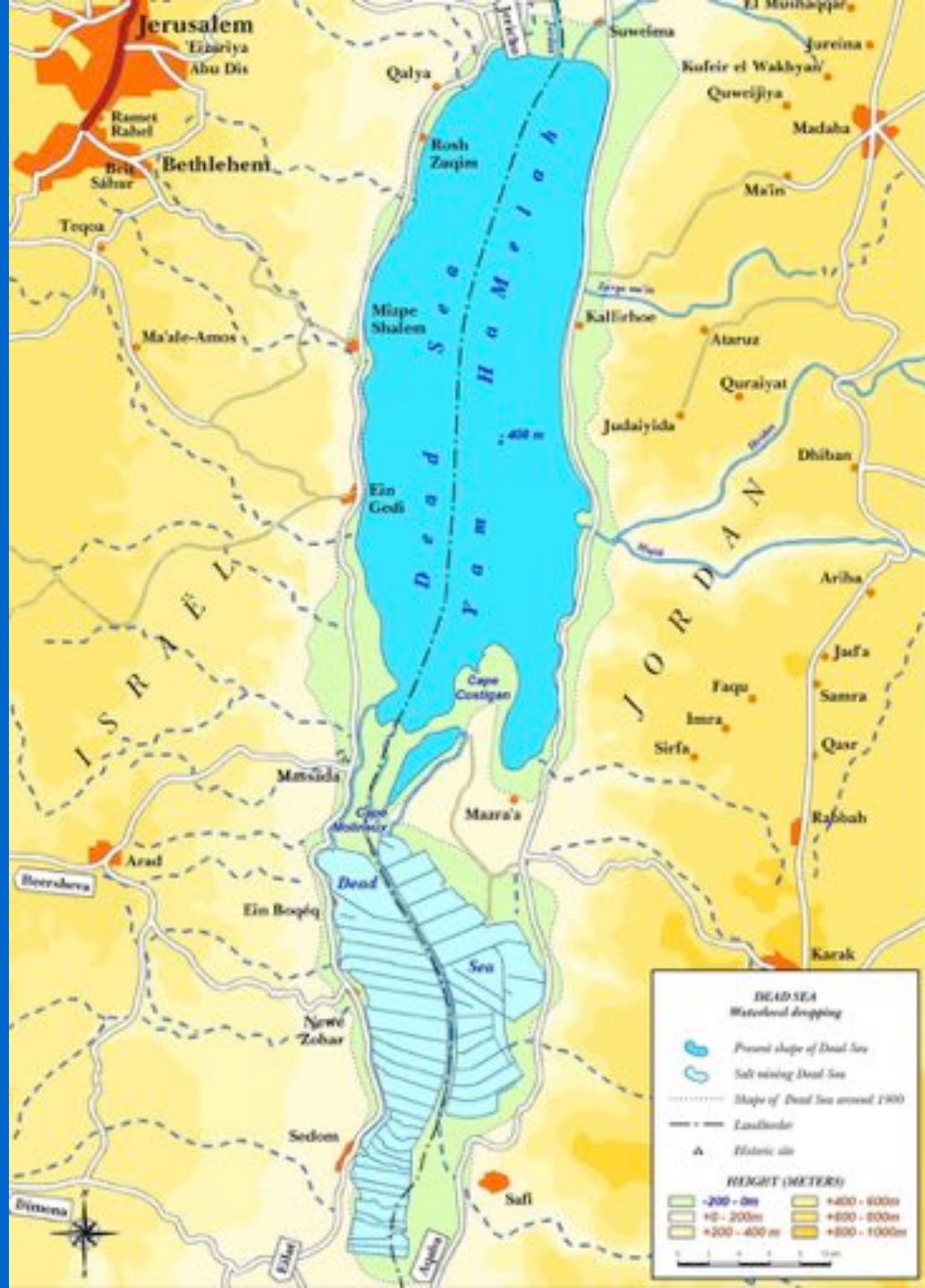


Fig. 5-3k: Soft coral, *Alcyonium palmatum*

BUILDING WITH NATURE

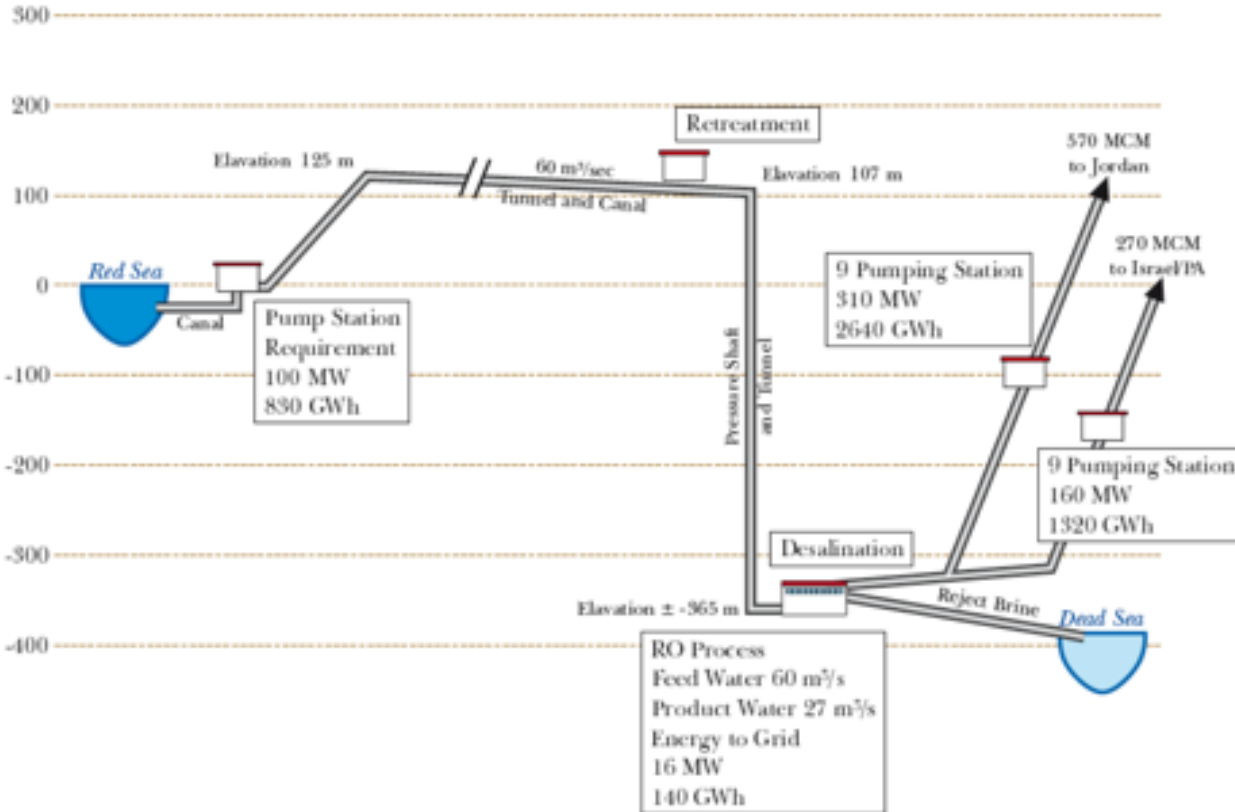


Israël, Jordan



SIMPLIFIED CROSS SECTION RED SEA - DEAD SEA CONNECTION

Sea Level (m)



Pipeline approx. 180 km length

Volume 200 million m³ / year from Red Sea

of which:

approx. 100 million m³ / year desalinated water

approx. 100 million m³ / year residual water into Dead Sea

Environmental concerns

Eilat - Aqaba



BUILDING WITH NATURE



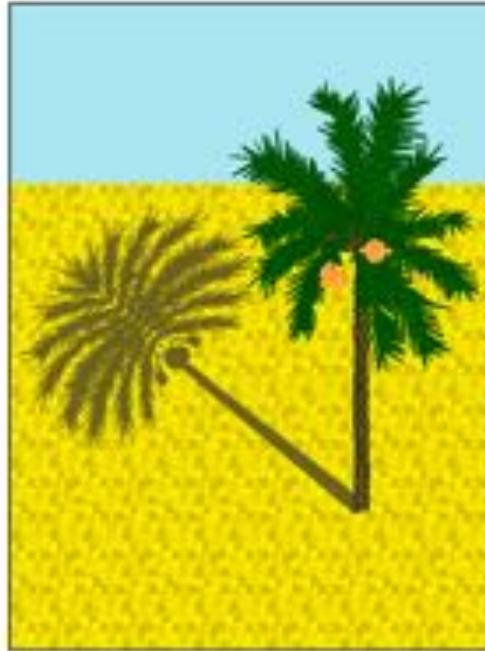
Middle East U.A.E.

BUILDING WITH NATURE



U.A.E.
Dubai

BUILDING WITH NATURE



U.A.E.
Dubai

PALM ISLAND
Land reclamation project

-  *Housing purposes*
-  *Recreational purposes
(shops, clubs, amusements parks)*
-  *Parks and woods*
-  *Beach*
-  *Desert*

0 200 400 600 800 1000 m



-
-
-

Palm Island Jumeirah - Dubai



april 2002



september 2002

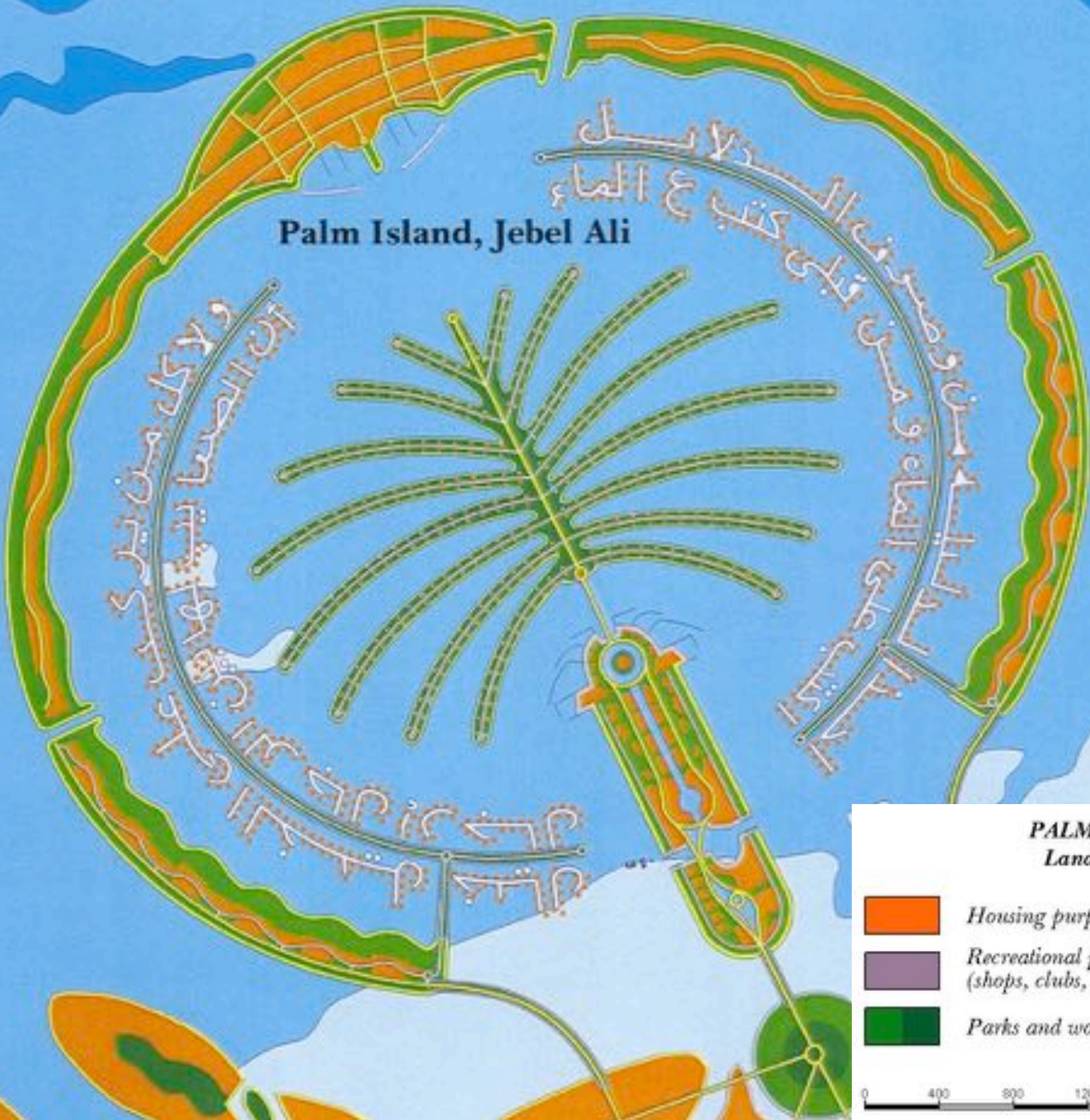


mei 2003









2012

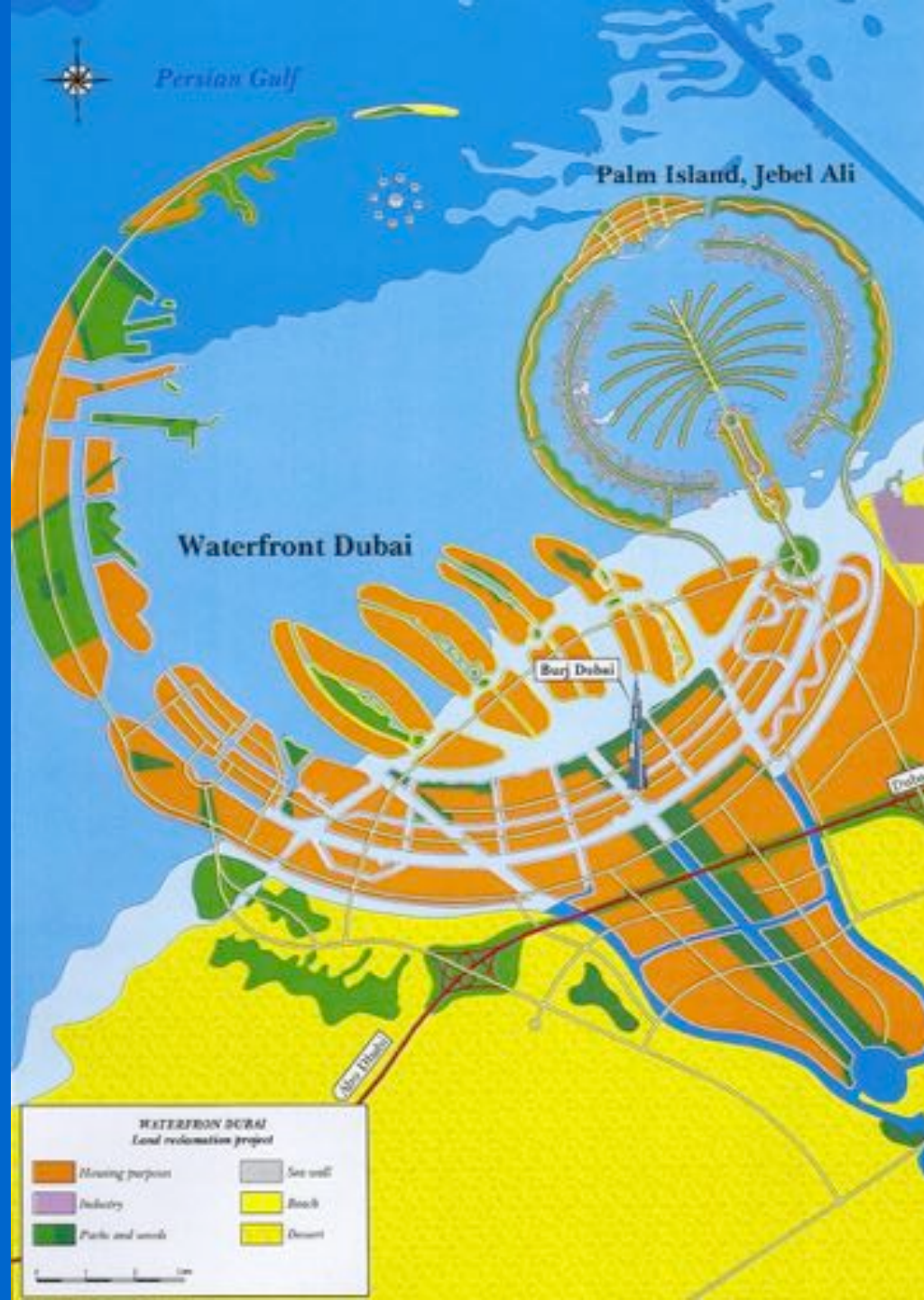
Palm Island, Jebel Ali



PALM ISLAND, JEBEL ALI Land reclamation project

- | | | | |
|---|---|---|-----------------|
|  | <i>Housing purposes</i> |  | <i>Sea wall</i> |
|  | <i>Recreational purposes
(shops, clubs, amusements parks)</i> |  | <i>Beach</i> |
|  | <i>Parks and woods</i> |  | <i>Desert</i> |





The World

approx. 9 km x 6 km
5 km off the coast
of Dubai

ca. 300 Islands

325 million m³ sand

32 million ton stones



The Palm, Deira

approx. 14.3 km x 8.5 km

surface area 80 km²

41 palm leaves

1.3 billion m³ sand

length of outer rim
berm break water
ca. 21 km



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SUSTAINABLE COASTAL ZONE DEVELOPMENT

Integrated Coastal & Deltaic Policy via Building with Nature®



Dr. R.E. Waterman MSc

April 2014



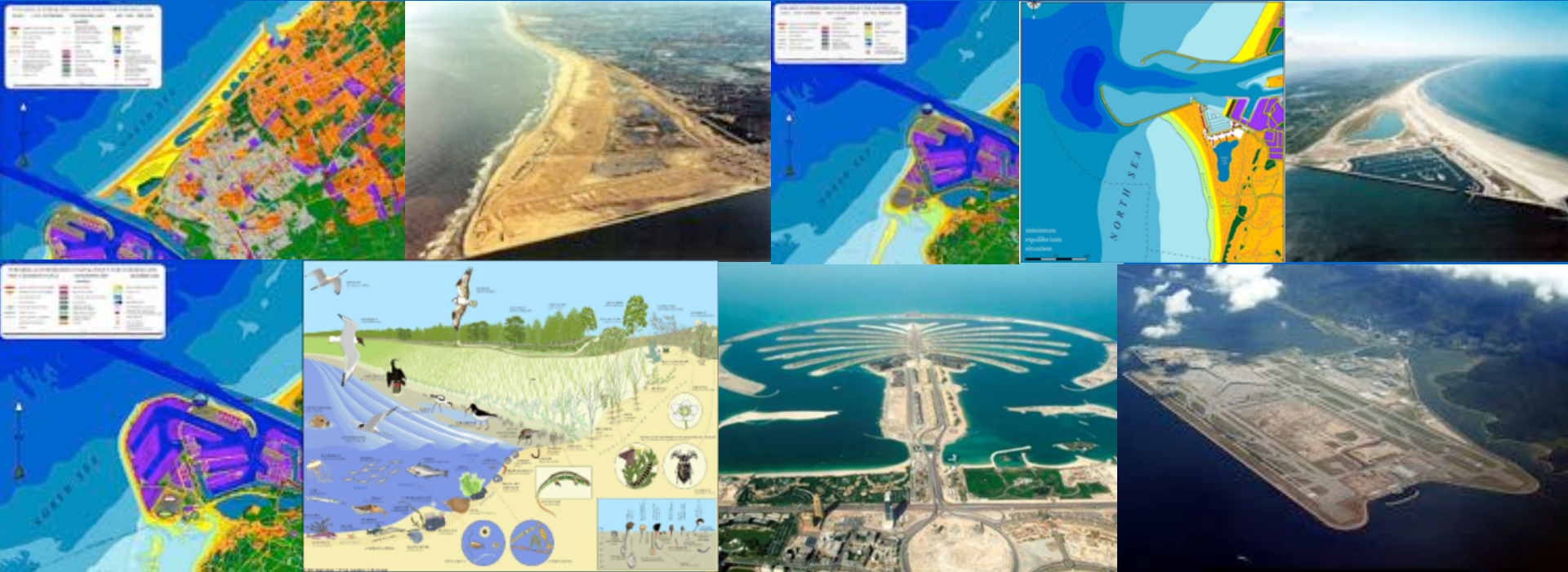
India
The Netherlands





DUTCH EXPERTISE

Building with Nature, Land Reclamation, Transportation & Infrastructure

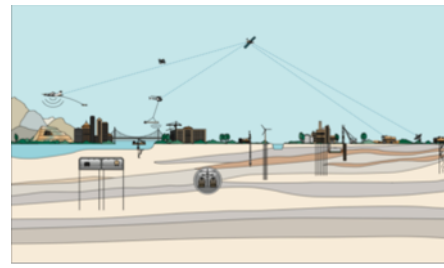
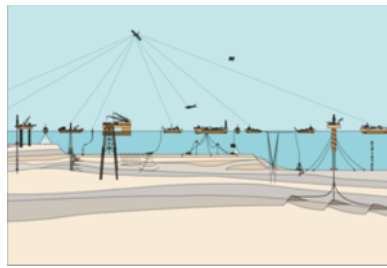


DUTCH PLATFORM OF COMPANIES

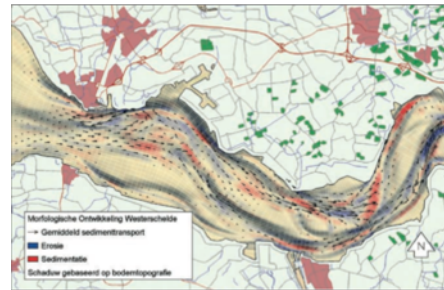
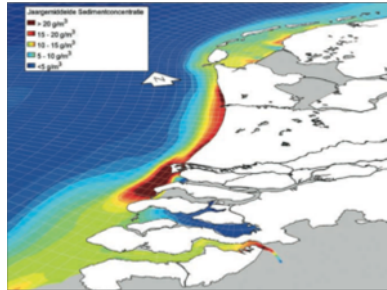


RECLAMATION USING 'BUILDING WITH NATURE'

Land / Seabed Survey



Impact Assessment Modelling



Concept Planning Engineering



Dredging Marine Experts



Dredging Marine Experts

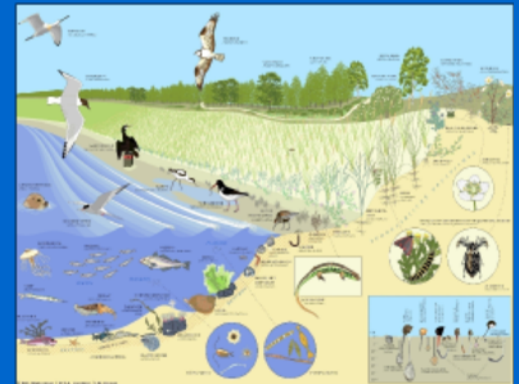


BUILDING WITH NATURE[®]

- Natural system dynamics basis for design & realisation of maritime infrastructure
- Proactive approach for optimizing full economic & environmental potential
- Integration of disciplines: Engineering, Ecology & Governance



*Eco-dynamic
Development &
Design*



INTRODUCTION

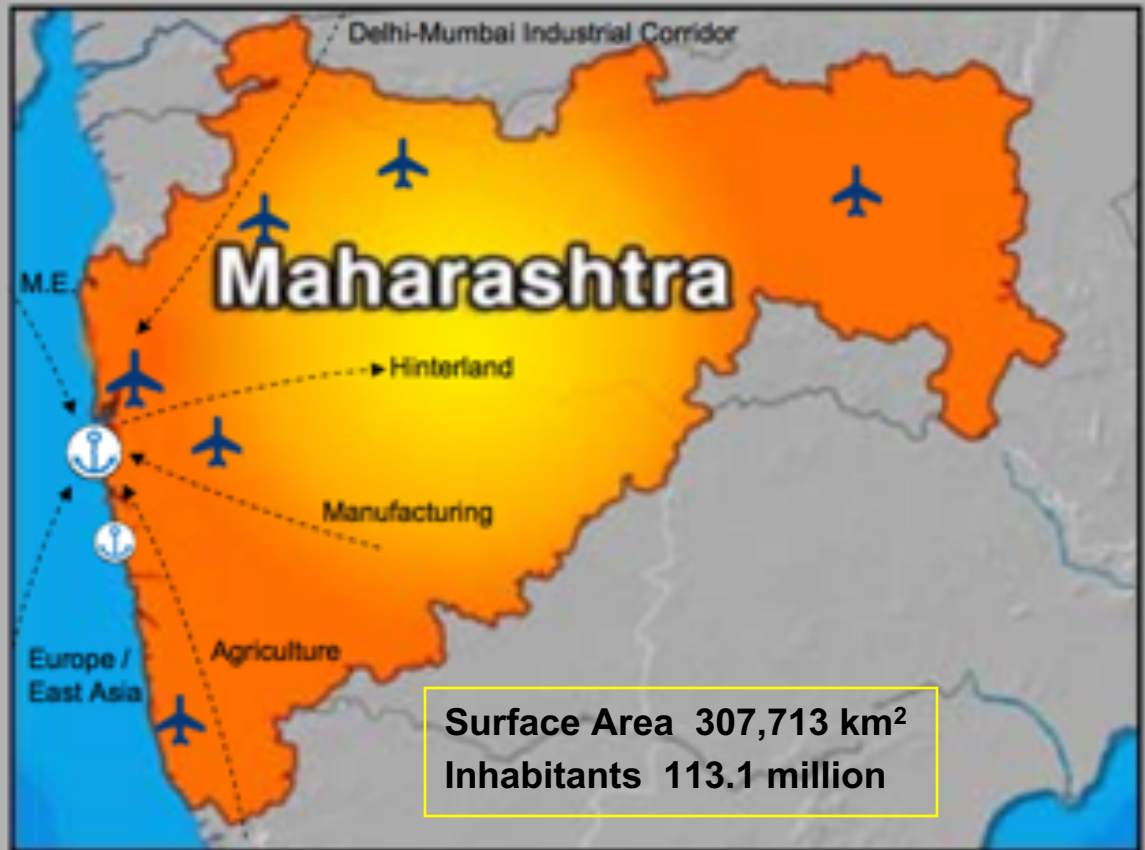
Netherlands Distribution hub, due to efficient use of land and water resources (Coast & Rivers) & continuous Infrastructure improvements



Surface Area, 41,526 km²
Inhabitants 16.7 million

Maharashtra, most Industrialised State of India

Integrated Coastal development & Multi Modal Connectivity will spur further growth



Surface Area 307,713 km²
Inhabitants 113.1 million

MUMBAI – MAHARASHTRA



Surface Area

603 km²

Inhabitants

**Mumbai
14 million**

**Mumbai
Metropolitan
Region
21.5 million**

MUMBAI'S HISTORY

The Metamorphosis of an 'Island City'

When Portugese sailors first sailed east to a number of islands off the Indian mainland, seeking respite from the treacherous Arabian Sea, little did they know that these 7 islands and the 'Bom Baya' (or 'good bay') would some day give rise to the great city of Mumbai.

This is why they did not hesitate to part with their claim on these islands as part of a wedding gift to the king of England.

The Koli fishermen inhabiting these islands knew the value of a well-sheltered bay in these turbulent waters...



17th Century

60km of coastline

(publicly accessible)



In Holland at around the same time, the city of Amsterdam, located on a similarly sheltered bay called the 'Southern Sea', grew to prominence.

And so did the English:

By the 19th century the city they had founded on the biggest of the seven islands had grown so fast due to its sheltered harbour. The requirement for more land had compelled the Royal Engineers to embark on a furious reclamation program that turned the original seven islands into one continuous landmass.

The Koli fishermen communities thus lost large tracts of their precious shoreline, previously used for mooring their vessels and drying their fish.

Another disadvantage was that the Royal Engineers applied a method of merely blocking the inlets in between the islands. This way indeed the inner area stopped getting flooded at high tide, but during monsoon, it was heavily prone to flooding



19th Century

40km of coastline

(publicly accessible)



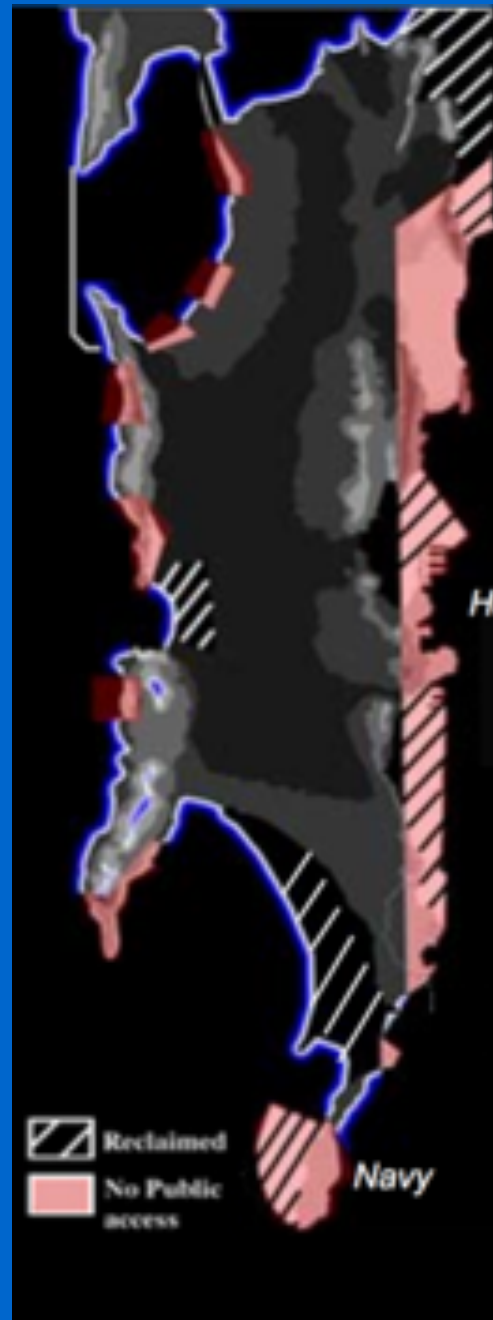
In Holland at around the same time, different water bodies were reclaimed by pumping water out with permanent wind-powered pumping-stations which maintained the low water level for the long term, up till the present-day.

In the 20th century the problem of flooding was understood and the Brimstowad study recommended to apply the Dutch method:

a series of strategic pumping stations to control the water-level and pump out stormwater even during high tide.

Unfortunately this study was commissioned after the 1950's and 1970's which both saw yet more reclamation with the same faults at respectively Marine Drive and Cuff Parade.

Worse still; the study's recommendations were not implemented till 20 years after the study was completed and in 2005 the city had experienced its worst flood ever, leading to massive economic damage and loss of lives.



20th Century

15km of coastline

(publicly accessible)



In Holland the greatest reclamations yet happened after construction of a barrier-cum-road which effectively made the 'Southern Sea' into a fresh water reservoir with a series of new islands for food-production & new cities.

Coastal Road
& existing
Bandra-Worli Sea Link

Haji Ali tomb
not disturbed



In the 21st century people have also started asking whether the method of rampant reclamation used for Nariman Point and Cuff Parade has not affected coastal habitats downstream, leading to for instance erosion at Versova and perhaps affecting mud-flats at Sewri.

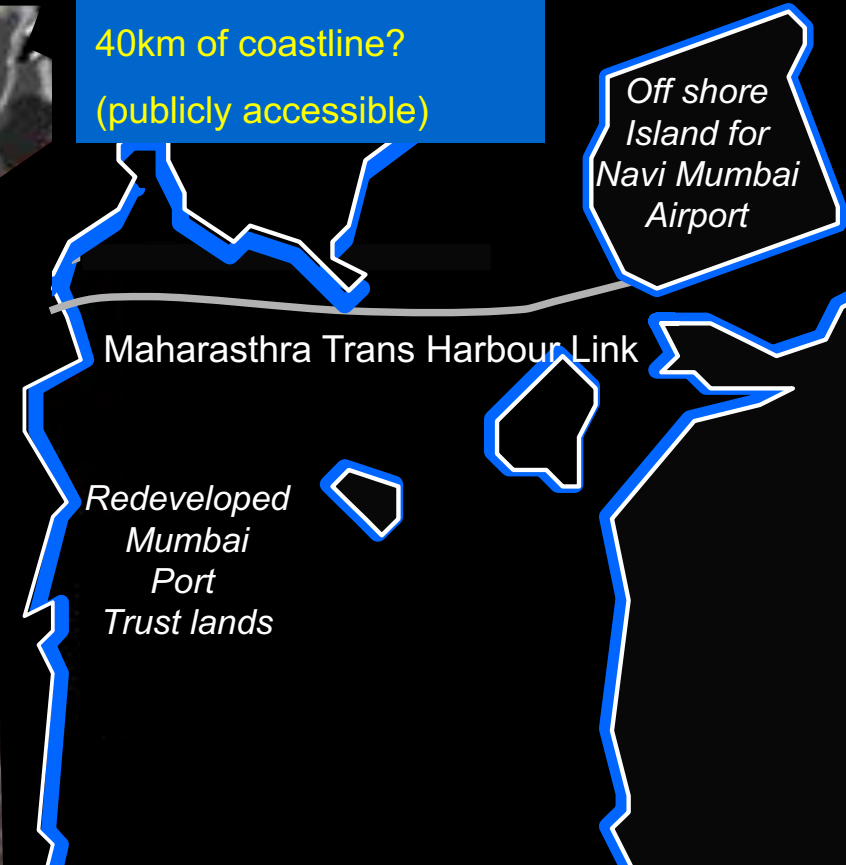
Unfortunately the ocean hydrology and coastal morphology before reclamation was never properly studied, nor was a study done on the possible effects of the reclamation on these systems.

If the Dutch 'Building with Nature' method is applied, projects such as the Coastal Road can be implemented in such a way that existing fragile environments are enhanced and new environments are created. An offshore island for the Navi Mumbai Airport is thus also a feasible proposition, given the environmental & land constraints of the onshore site.



21th Century

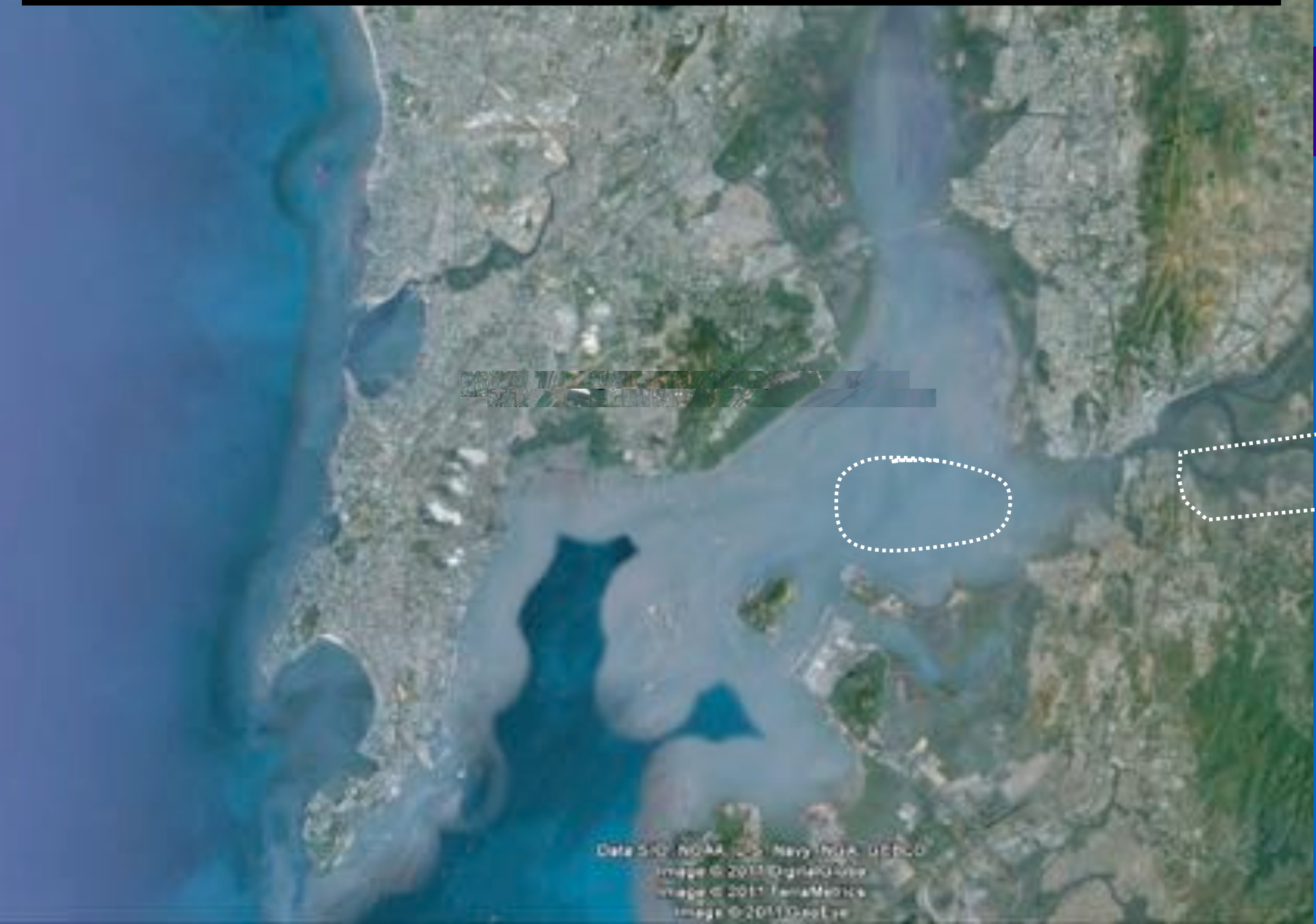
40km of coastline?
(publicly accessible)



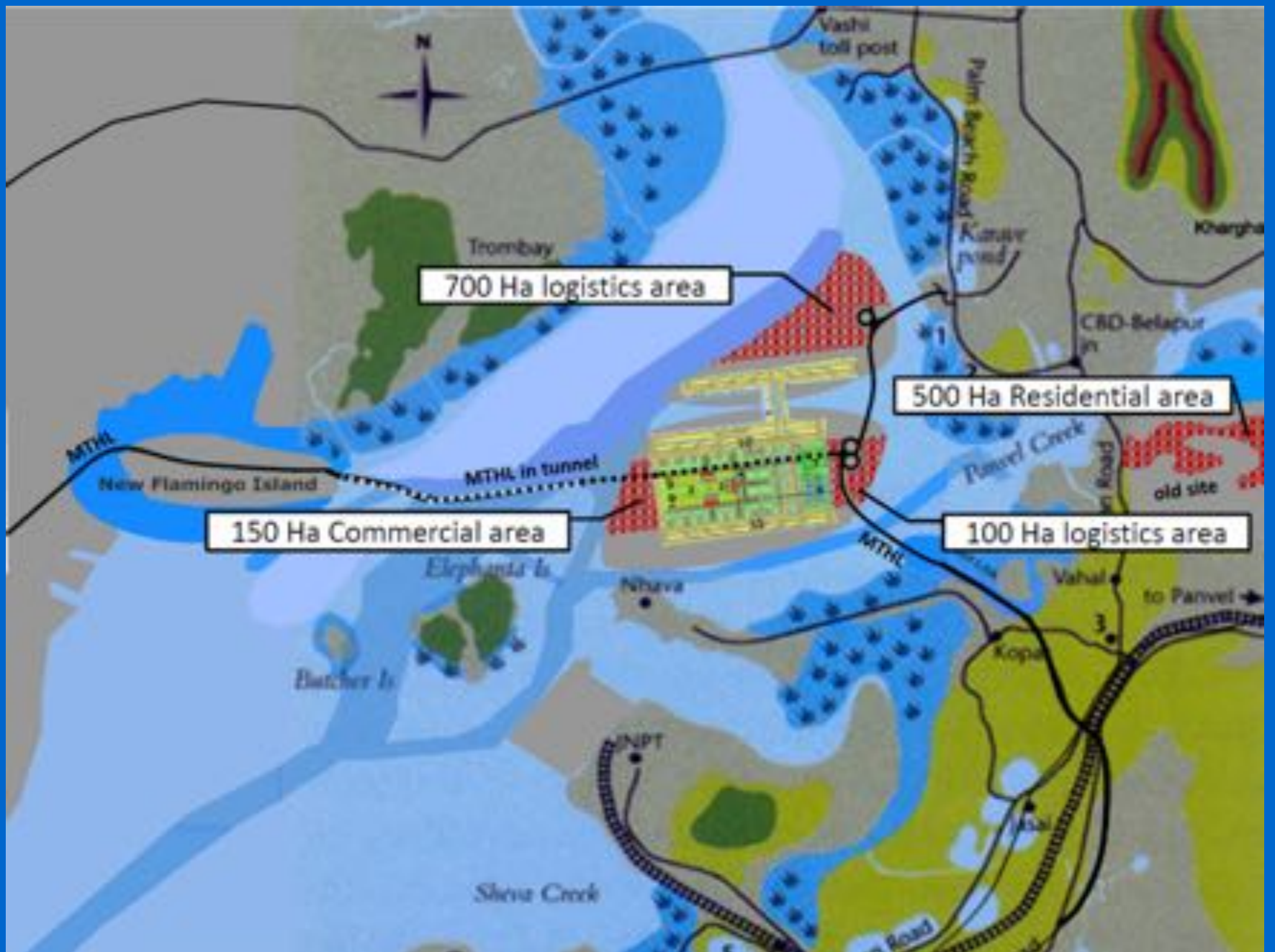
Alternative airport sites

1. Existing Panvel site
2. Rewas site in combination with new port
3. Off-shore Alibag site

TWO SITES FOR NEW AIRPORT



Data SIO, NOAA, US Navy, NGA, GEBCO
Image © 2011 DigitalGlobe
Image © 2011 TerraMetrics
Image © 2011 GeoEye



PROPOSED SITE FOR THE NAVI MUMBAI INTERNATIONAL AIRPORT

400
hectares

Mangrove park

1,200
hectares

Proposed main airport area, which will have two parallel runways.

DIVERSION QADHI RIVER

The river, which flows into the proposed airport site, will be diverted and taken to the Talaje Creek directly. Environmentalists fear this may cause floods in Panvel since the water holding area will get reclaimed.

DIVERSION ULVE RIVER

The Ulve River, which flows from the south of the proposed site into the main site, is proposed to be tilted at a right angle and diverted to the Panvel creek.

SEZ LAND

262 hectares

These areas, 100 and 162 hectares, have been notified as SEZ land and given to private companies.

HILLOCK

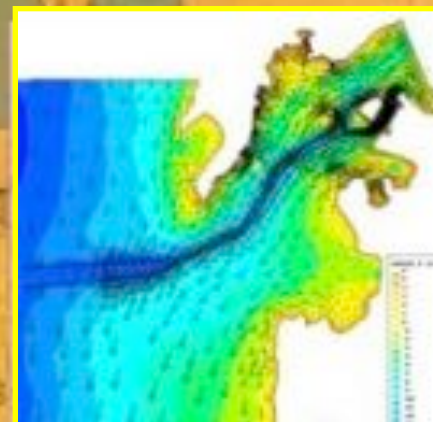
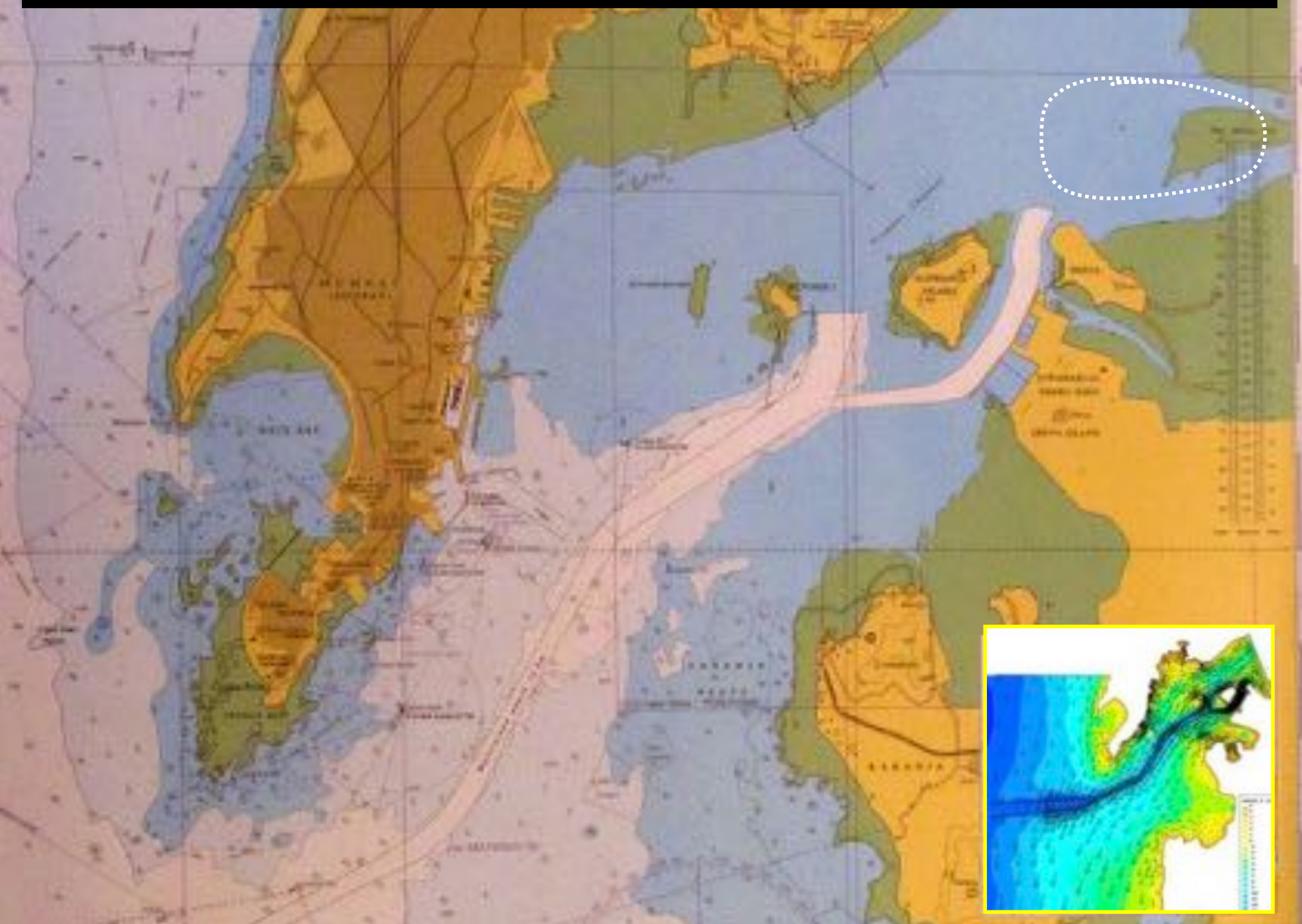
This 62-metre hillock, already being subjected to heavy quarrying, will be flattened to make it useful as an airport site.

300

hectares (approx)
Land held by Cidco has been proposed for an Airport Special Economic Zone. The demand is that this land should be used for commercial purposes.



PROPOSED ALTERNATIVE SITE ON MAN MADE ISLAND



New coastal developments, using 'Building with Nature', coupled with important transportation-linkages will thus help Mumbai achieve its ambition of becoming a truly world-class city ... for its People, its Commerce and for Environmental values.

CASE STUDIES

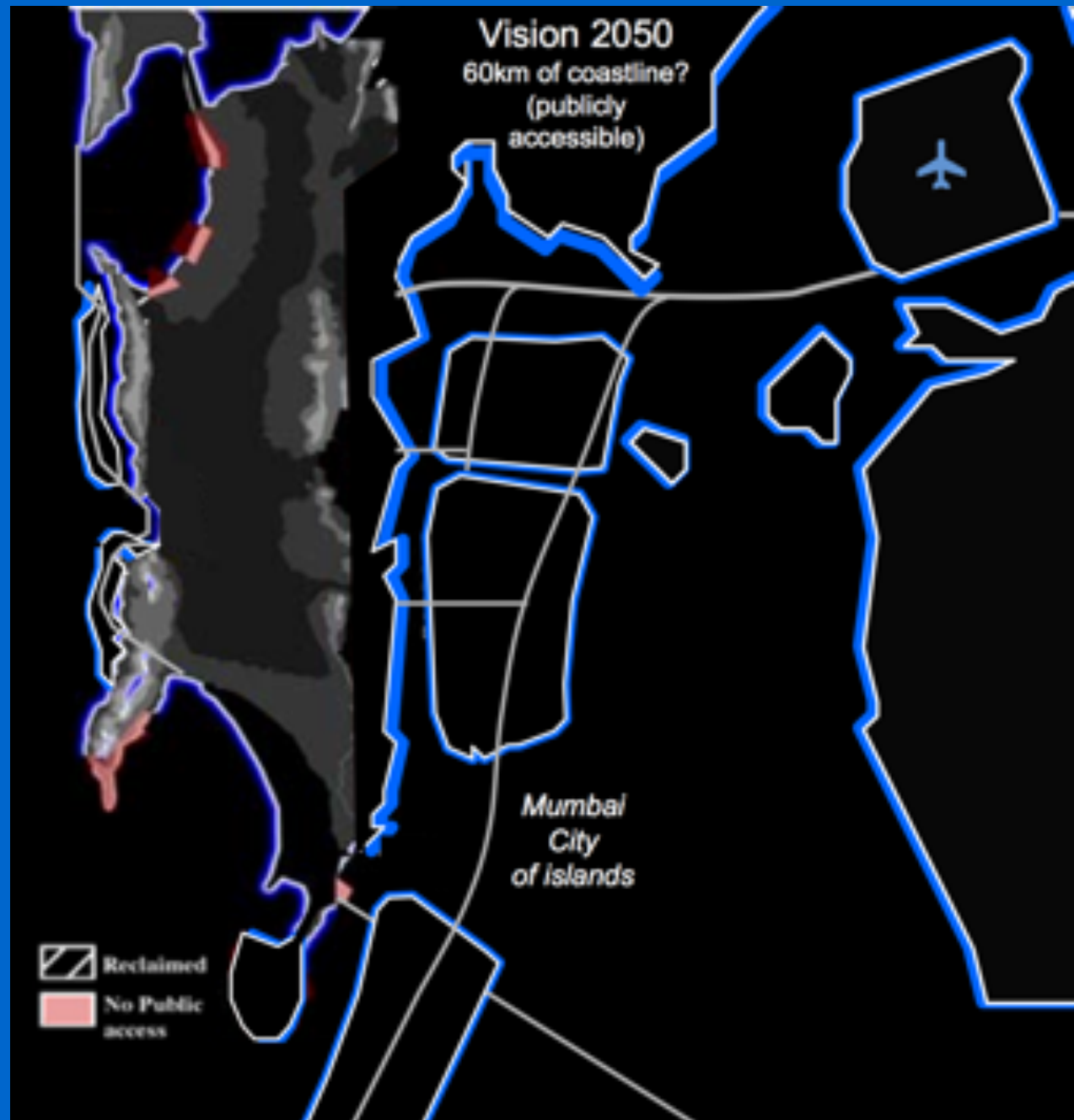
1. Coastal Road vs Sea Link

Opportunity for more linkages to existing city road networks;
Value of reclaimed land makes for a viable PPP case.

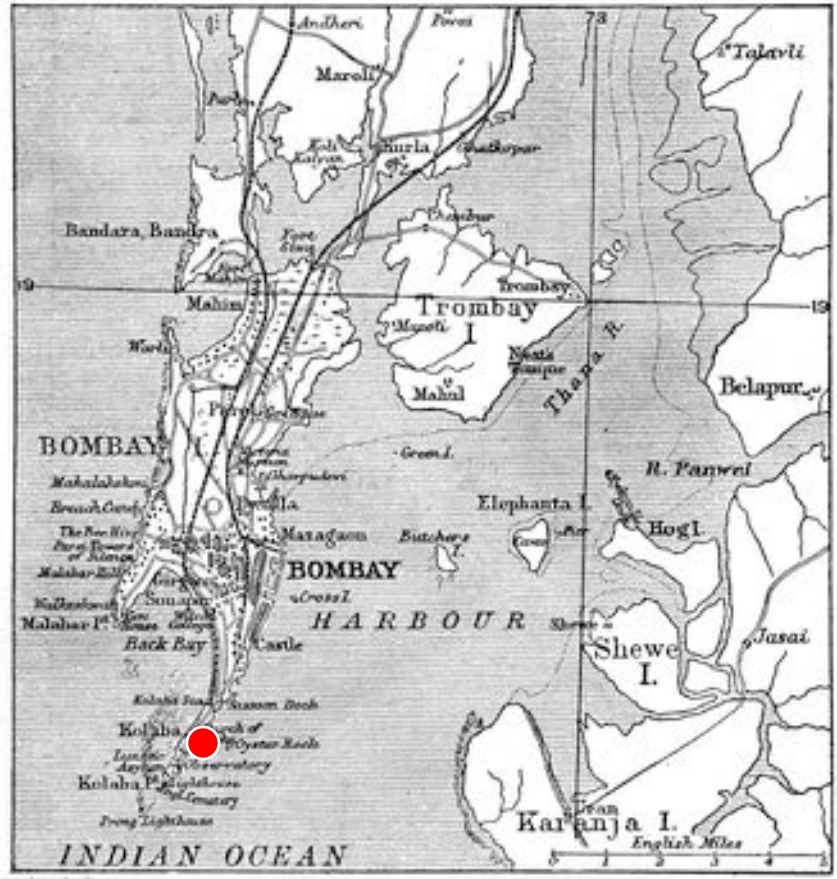
2. Island Airport vs Navi Mumbai site

Island Airport can have unconstrained capacity as opposed to proposed site;

Cost of creek-diversion, hill-demolition and remaining land acquisition for Navi Mumbai site are similar to reclamation!



From Past to Future




Mumbai District

Navi Mumbai Airport

ARABIAN SEA

Rewas New Port



A satellite-style map of Mumbai, India, showing the city's coastline and surrounding areas. A red location pin is placed on the western coast, with the text "Gateway of India" written in white next to it. The map shows the city's layout, including roads, buildings, and green spaces, as well as the surrounding water bodies and hills.

Gateway of India





MISSION FINDINGS

In September 2011, a platform of Dutch Companies presented best practices in Planning, Design and Construction of Coastal Developments and Land Reclamation applying the 'Building with Nature' method.

Based on the response to the conference in Mumbai, the platform came to the following conclusions:

1. Need for a flexible Masterplan that allows for stepwise, phased development

2. Key Priority Projects

- The Coastal Road
- Navi Mumbai Airport
- MTHL Bay-crossing
- Port Expansion
- Integration of sea defences & recreation
- Fresh water reservoirs
- Islands in the bay

3. Priority Studies

For a safe and sustainable approach and full utilization of the 'Building with Nature' concept

- Integrated modeling framework on hydrology, hydrodynamics, waves, sediment transport, morphodynamics, emissions, water quality and ecology
- Design conditions for infrastructural and land reclamation works (currents, waves, etc.)

Identification & analysis of mitigation & compensation measures

Forecast impact of future scenarios such as climate change, economic sector development, population increase on the system

Environmental Impact Assessment

Study of stakeholder concerns / Social Impact Assessment (Koli fishermen communities)

Feedback monitor system



Findings High Level Round Table Conference

1. Flexible masterplan that allows for a stepwise approach (phase after phase, segment after segment) for economic, environmental and financial reasons
2. Improvement of Jawarhal Nehru Port and New Deep Sea Port in Rewas district
3. Site for new Mumbai International Airport with adequate environmental compensation measures
4. Widening / heighthening / extending Beach along Marine Drive (between Malabar Hill and Nariman Point)
5. Land reclamations through the execution of a series of islands parallel to and east of Indira Dock, Victoria Dock and Prince's Dock in the Bay
6. Safeguarding the interests of the local Koli fishermen
7. Infrastructure connections between islands and mainland Mumbai
8. Overall improvement of infrastructure in and around Mumbai Metropolitan area, including the possibility of a coastal road along the west coast
9. Freshwater reservoir through barrage in Mahim Bay. This is only possible if an adequate sewer system and waste water treatment in upstream catchment area are provided for.

Requirements

- **Integrated Study**, taking into account a whole series of functions, covering the entire wider Mumbai area, including:
 - Set-up of an integrated modelling framework addressing the hydrodynamics, waves, morphodynamics / sediment transport, water quality and ecology
 - Design conditions for infrastructural and land reclamation works (currents, waves, siltation, etc.)
 - Effects on ecosystem (terrestrial and aquatic flora and fauna with special emphasis on the mangroves)
 - Identification and analysis of mitigating and compensating measures
 - Taking into account future scenarios such as climate change, sector development, population increase, etc.
 - Environmental impact assessment
 - Respecting the cultural heritage values (Mumbai can become an island city again:
“Good plans have their roots in the past and are pointing to the future”
- **Development of a (feedback) monitoring program**
 - Including a description of the reference situation
- **Application of best practices** in a local context
- **Introducing Building with Nature[®] concepts**

-
-
-

SUSTAINABLE COASTAL ZONE DEVELOPMENT

Integrated Coastal Policy via Building with Nature

BANGLADESH



-

THE NETHERLANDS



March, 2009



Bangladesh



147,570 km²

155,000,000
Inhabitants

6 Divisions

- Dhaka
- Chittagong
- Rajshahi
- Khulna
- Barisal
- Sylhet

64 Districts



Tropical Monsoon Climate
 10 – 35 ° C
 Rainfall
 Cyclones

Padma Meghna Delta:

Water discharge
 6,000-80,000
 m³/sec

sediment discharge
 1,500,000,000
 ton/year

Deltaic Coastline
 710 km
 protected by

Dykes
Mangroves
Beaches
Mud Flats

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SUSTAINABLE COASTAL ZONE DEVELOPMENT

Integrated Coastal Policy via Building with Nature



SINGAPORE

-

THE NETHERLANDS



2015

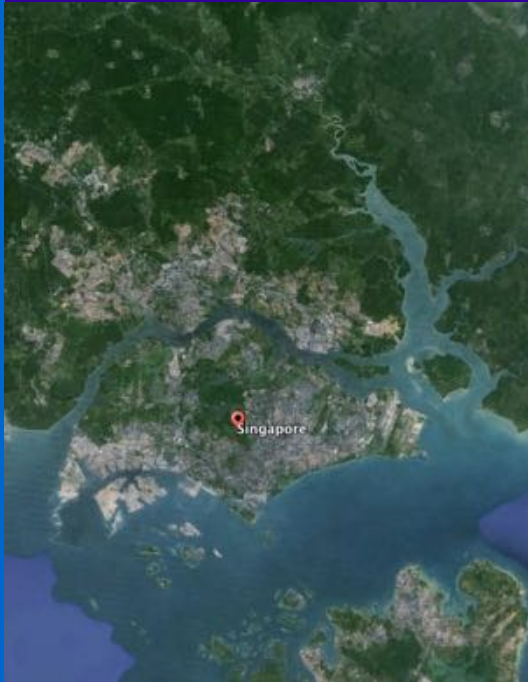


Singapore



ASIA

SINGAPORE



AV. ANNUAL RAINFALL

2,400 mm

IRREGULAR RAINFALL

LAND AREA

716 km² 33,883 km²

EXCL. ECONOMIC ZONE

823 km² 63,912 km²

MARITIME SPATIAL PLAN Functional E.E.Z. Atlas

INHABITANTS

5.6 million 16.9 million

COASTAL LENGTH

193 km 353 km

MAIN PORT

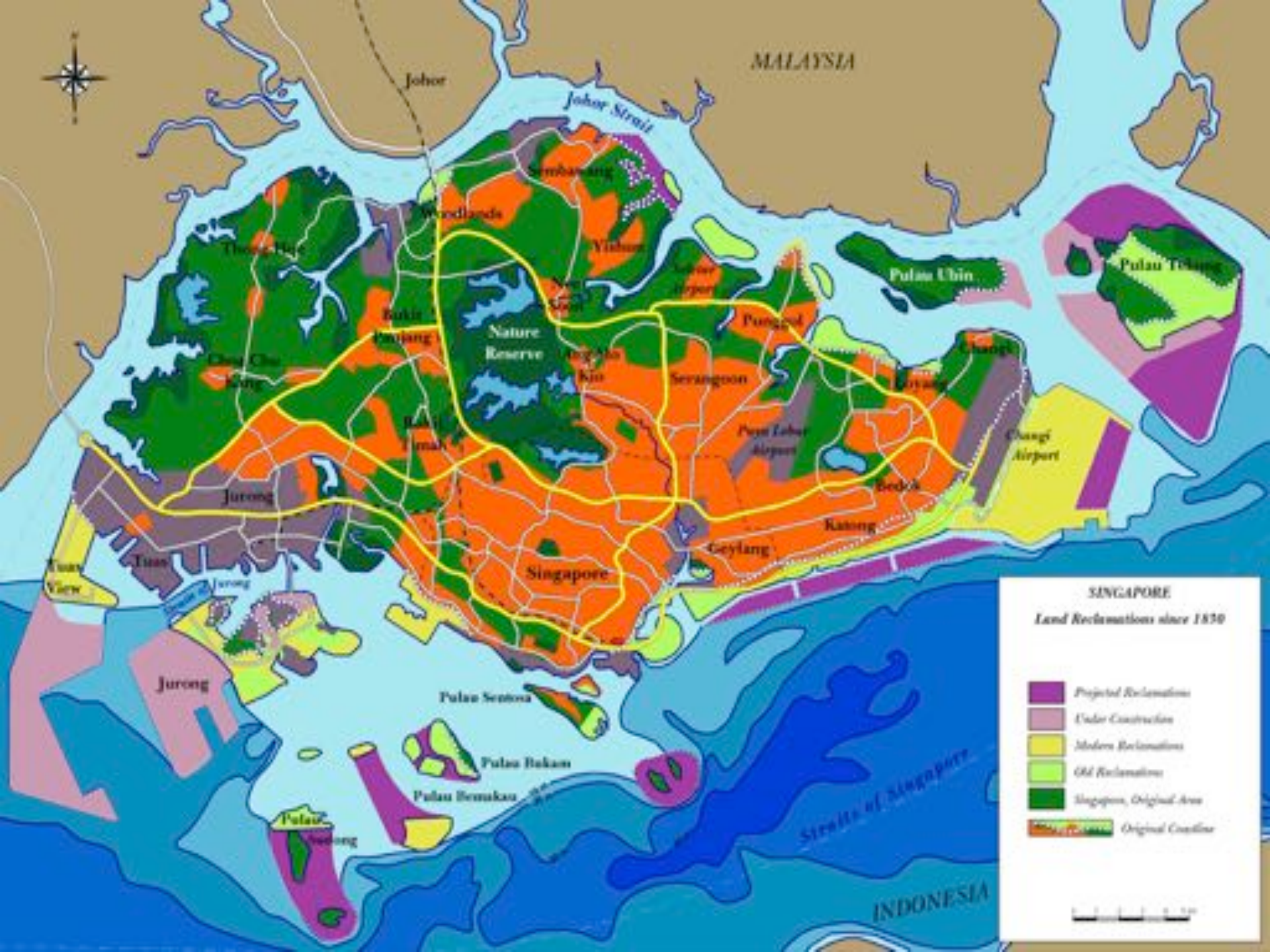
Singapore	Rotterdam
558 mln ton	450
32 mln TEU	12 mln
134,868 vessels	30,000
inland vessels	80,000

THE NETHERLANDS



AV. ANNUAL RAINFALL

850 mm



SINGAPORE

Land Reclamations since 1850

- Projected Reclamations
- Under Construction
- Modern Reclamations
- Old Reclamations
- Singapore, Original Area
- Original Coastline





**Land Reclamation
Around
Singapore River
&
Marina Reservoir**



**Land Reclamation
around
Singapore River**

**Marina Reservoir
Singapore Port
Sentosa**



**Land Reclamation
Pulau Tekong**

**Land Reclamation
Changi Airport**



Northern Singapore & Bridge Connection Johor Bahru



Land Reclamation Tuas & Jurong Island



Land Reclamation Tuas & Jurong Island

Land reclamations & creation of water reservoirs



Upper & Lower
Peirce Reservoir

MacRitchie Reservoir

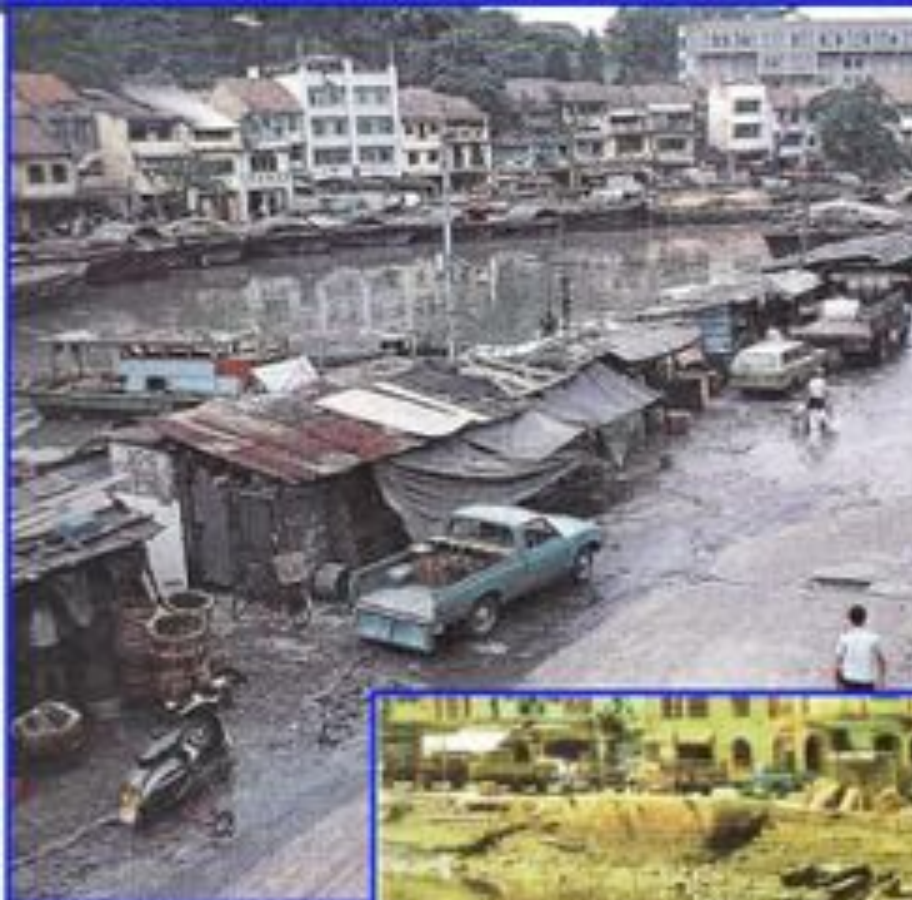
Marina Bay
Reservoir

LEE KUAN YEW WATER PRIZE

Platform for solving global water problems by outstanding technologies & implementing innovative policies and programmes which benefit humanity

Importance
Water Quantity & Quality





Singapore history – 50 years ago



Floods were common occurrences...



Singapore history – 50 years ago



1970s

1990s

Singapore history – solutions found

Catchment Area & Marina Reservoir with Barrage



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SUSTAINABLE FUTURE OF INLAND WATERWAYS

**Stimulating the Blue Green Economy
for
Regional, Socio-Economic &
Spatial Development,
while safeguarding
Environmental Values & Nature,
Navigability as well as Safety**

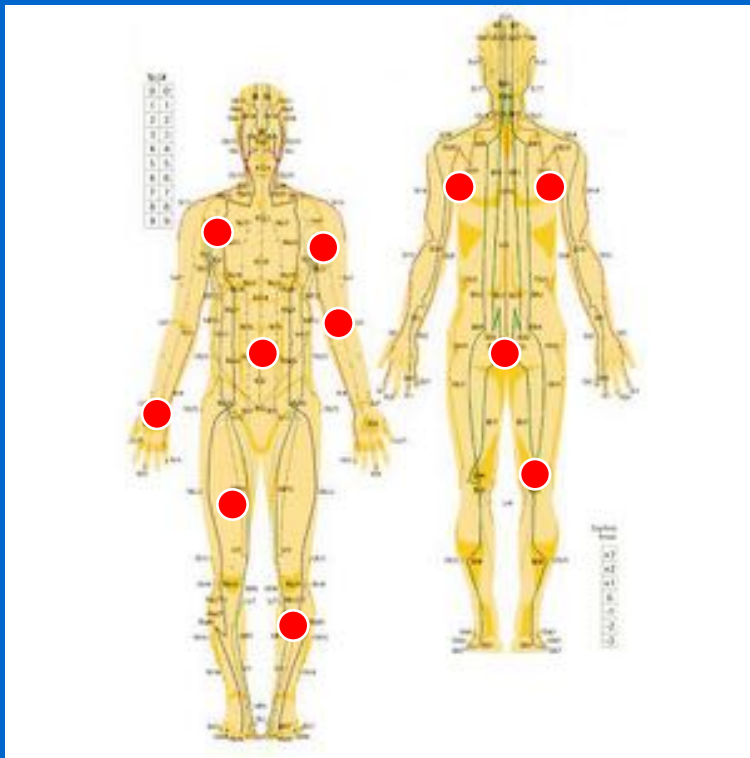
AQUAPUNCTURE[©]

**Introduction of AQUAPUNCTURE[©]
for the optimal use, adaptation, experience &
management of inland waterways and their
waterfronts**

**For economy, employment, spatial quality,
navigability, safety & environmental values**

ACUPUNCTURE

to revitalize
the Nervous System
& Human Organs



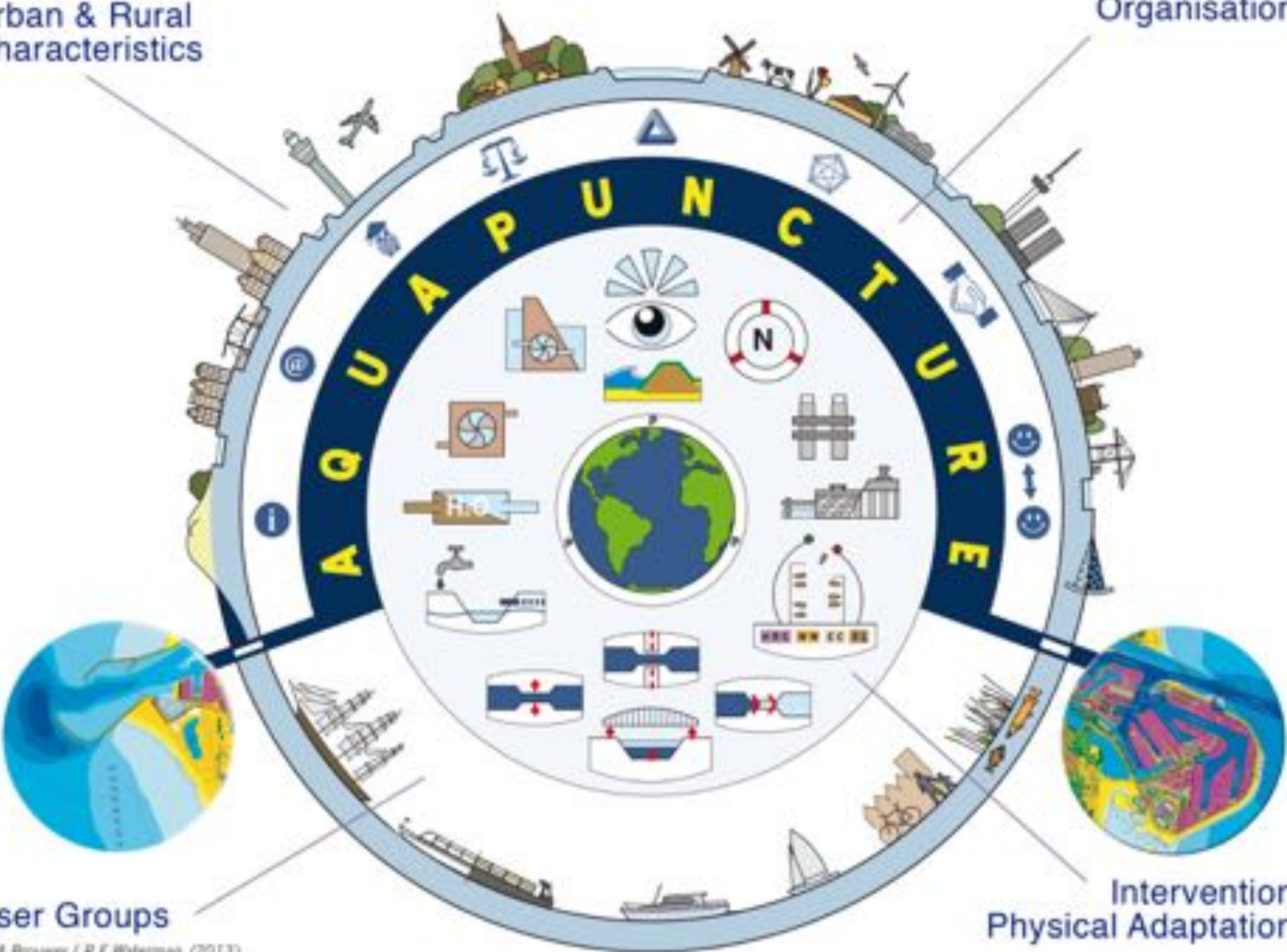
AQUAPUNCTURE

to revitalize
the Waterways & their
Water Fronts



Urban & Rural Characteristics

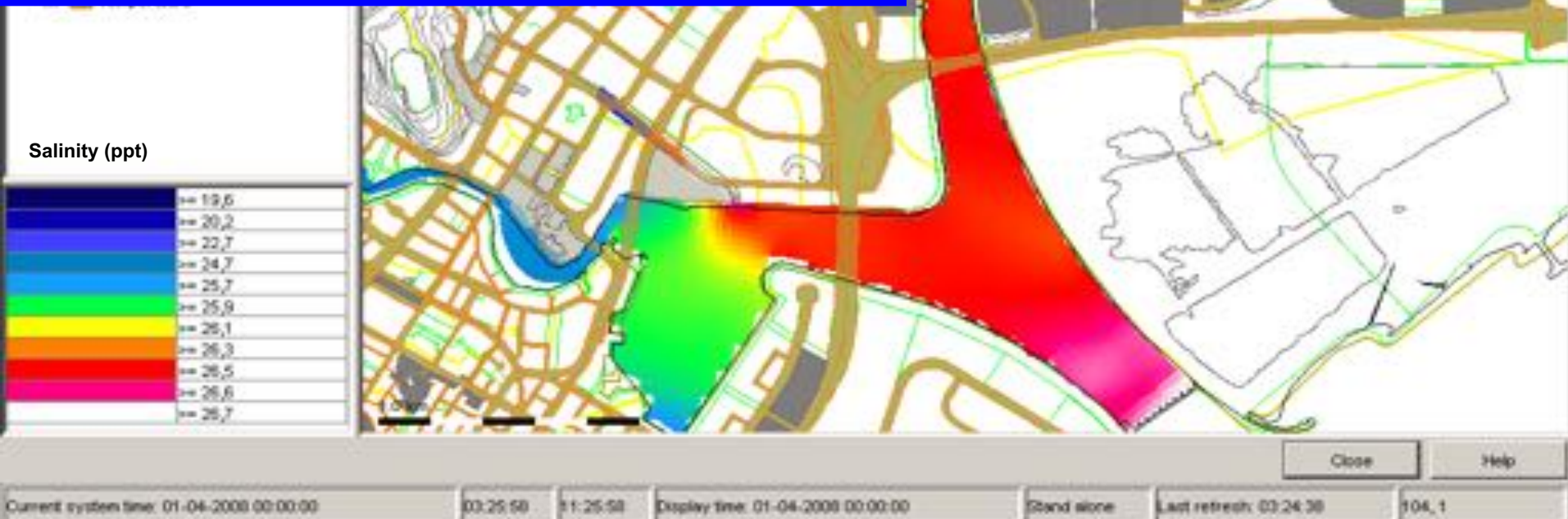
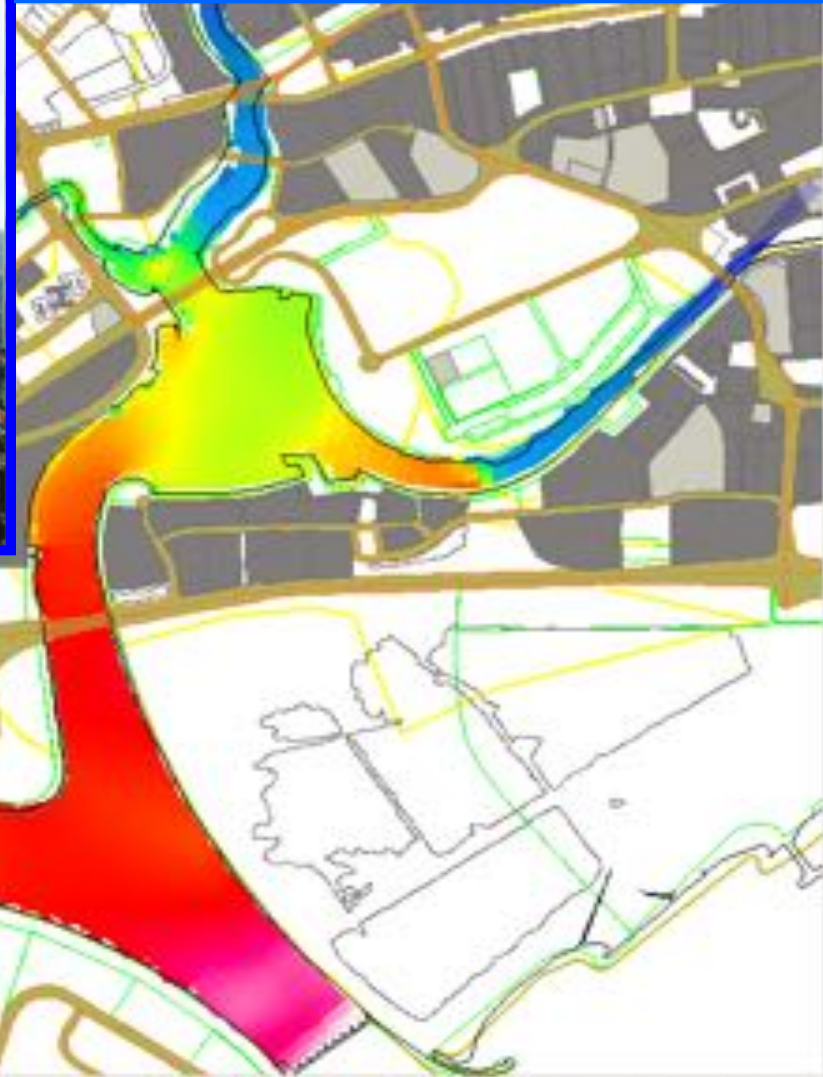
Organisation



User Groups

Interventions
Physical Adaptations

Integrated modelling for Marina Reservoir



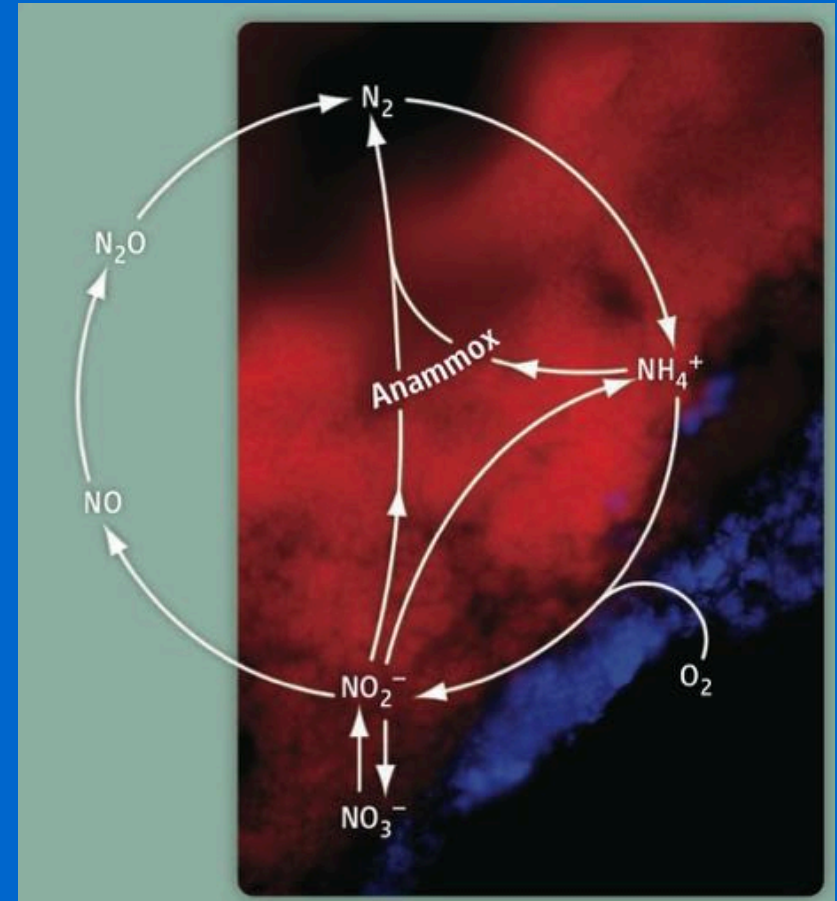
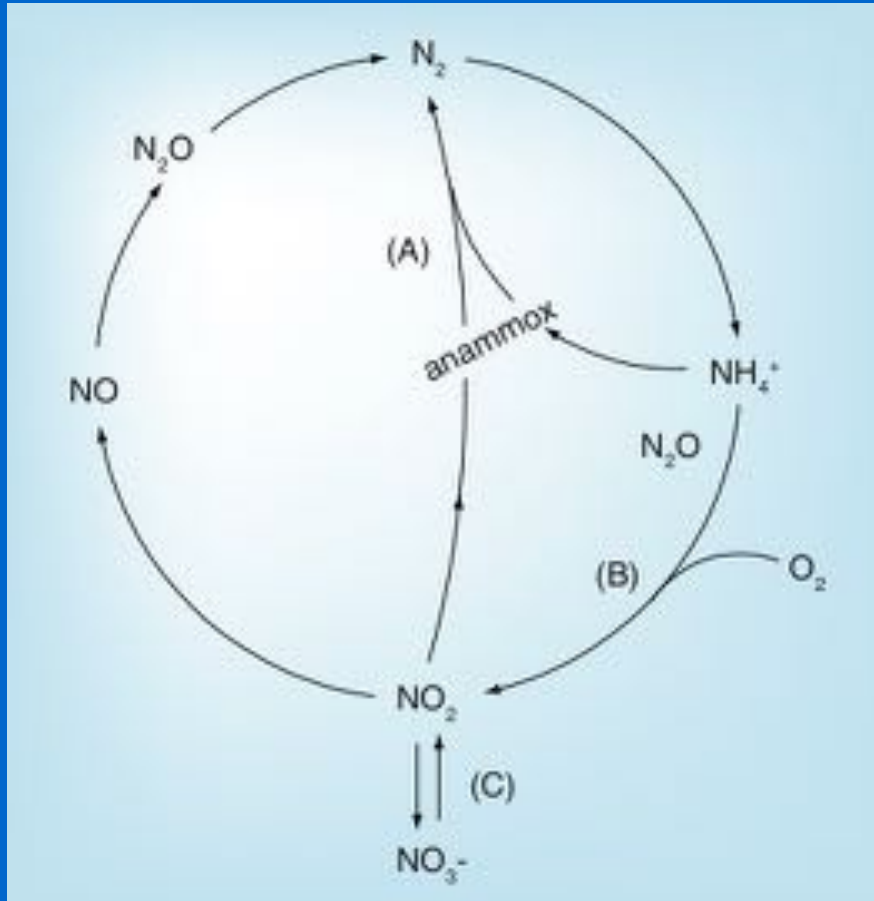
WATER QUANTITY	PARAMETER
Supply	Watervolume
Level	Water level
WATER QUALITY	
Physical-chemical	Salinity
	DO Surface
	DO Bottom
	Turbidity
	TOC
Nutrients	TN
	NH ₄ -NO _x
	TP
	PO ₄ -P
Algae	Micro algae Cyanobacteria
Bacteria	Enterococcus Faecal coliforms Escherichia coli
Ecosystem Health	NH ₃ -N
	pH
	Temperature

**Catchment Area
& Marina
Reservoir with
Barrage**

**Improving
Water Quantity
&
Water Quality**

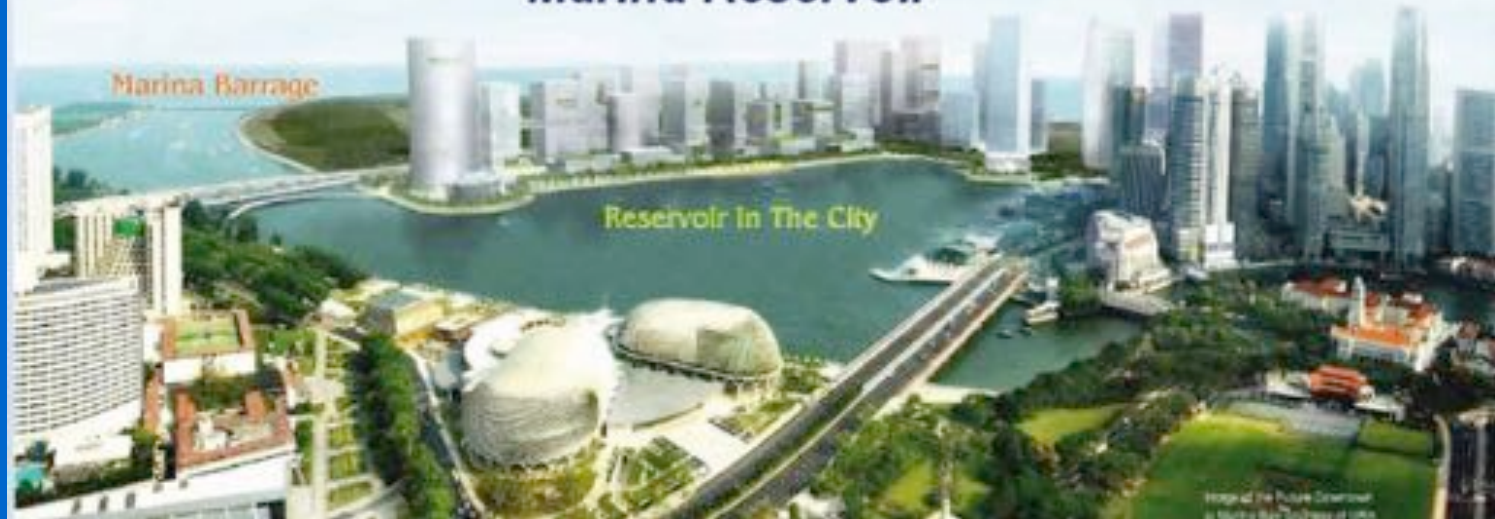
Introducing new Waste Water Purification Method

ANAMMOX – NEREDA Project



Granulated anammox bacteria covered with a skin of nitrite producing bacteria are able to produce nitrogen

Creating a Reservoir in the City – Marina Reservoir



Singapore Catchment Area & Marina Reservoir with Barrage





Aquapuncture[©]



Kallang River at Ang Mo Kio-Bishan Park



Section of the Kallang River at Ang Mo Kio-Bishan Park [Image from Singapore's national water agency, by Atelier Dreiseitl]



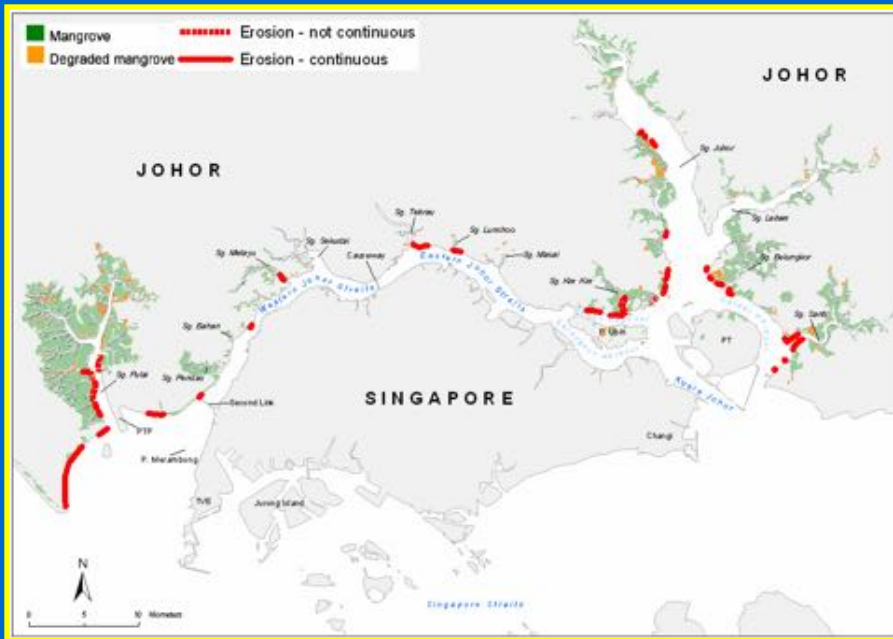
Aquapuncture[©]



Aquapuncture[©]



External impacts on mangroves



Erosion of mangroves observed during boat survey along the coastline



Rhizophora type mangrove tree

-
-
-

SUSTAINABLE COASTAL ZONE DEVELOPMENT

Integrated Coastal & Delta Policy via Building with Nature®

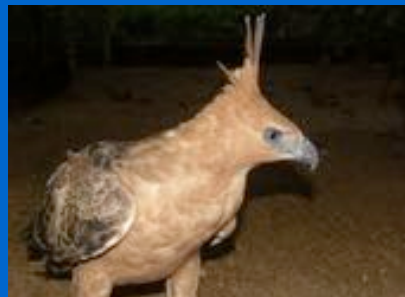
Prof. Dr. R.E. Waterman MSc



INDONESIA – THE NETHERLANDS



2015





PANCASILA



-  KETUHANAN YANG MAHA ESA
-  KEMANUSIAAN YANG ADIL DAN BERADAB
-  PERSATUAN INDONESIA
-  KERAKYATAN YANG DIPIMPIN OLEH HIKMAT KEBIJAKSANAAN DALAM PERMUSYAWARATAN / PERWAKILAN
-  KEADILAN SOSIAL BAGI SELURUH RAKYAT INDONESIA

PEKAT JABAR



Indonesia Jakarta



Indonesia 17,500 islands - 81,000 km coast lines



Jakarta



740.28 km²

10,200,000
Inhabitants

Jabotabek

30,200,000
Inhabitants

30 km
Coastline







Rapid Urbanisation

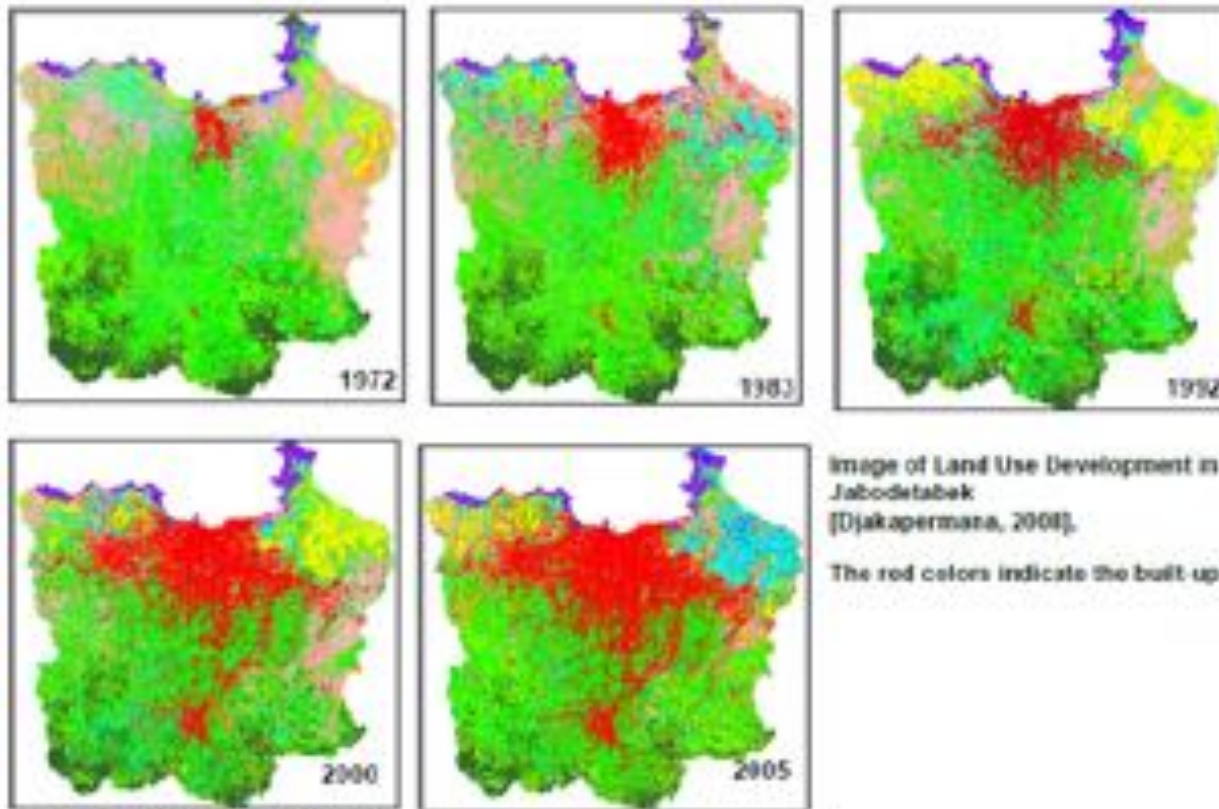


Image of Land Use Development in
Jabodetabek
[Djakapermana, 2001].
The red colors indicate the built-up areas.

Source : Working Group LIACC P&M (P)

INHABITANTS

2000: 20 million

2010: 30 million





COASTAL ZONE DEVELOPMENT & MAIN INFRASTRUCTURE OF JAKARTA UTARA



- KETERANGAN :**
- EKSTISTING PELABUHAN TANJUNG PRIOK
 - AREAL REKLAMASI UNTUK INDUSTRI
 - KAWASAN BERKAWAN NUSANTARA SELUMAS + 300 Ha
 - SISTEM JALAN TOL
 - SISTEM JALAN ARTERI
 - BOTTLE NECK (menuju pelabuhan Tanjung Priok)

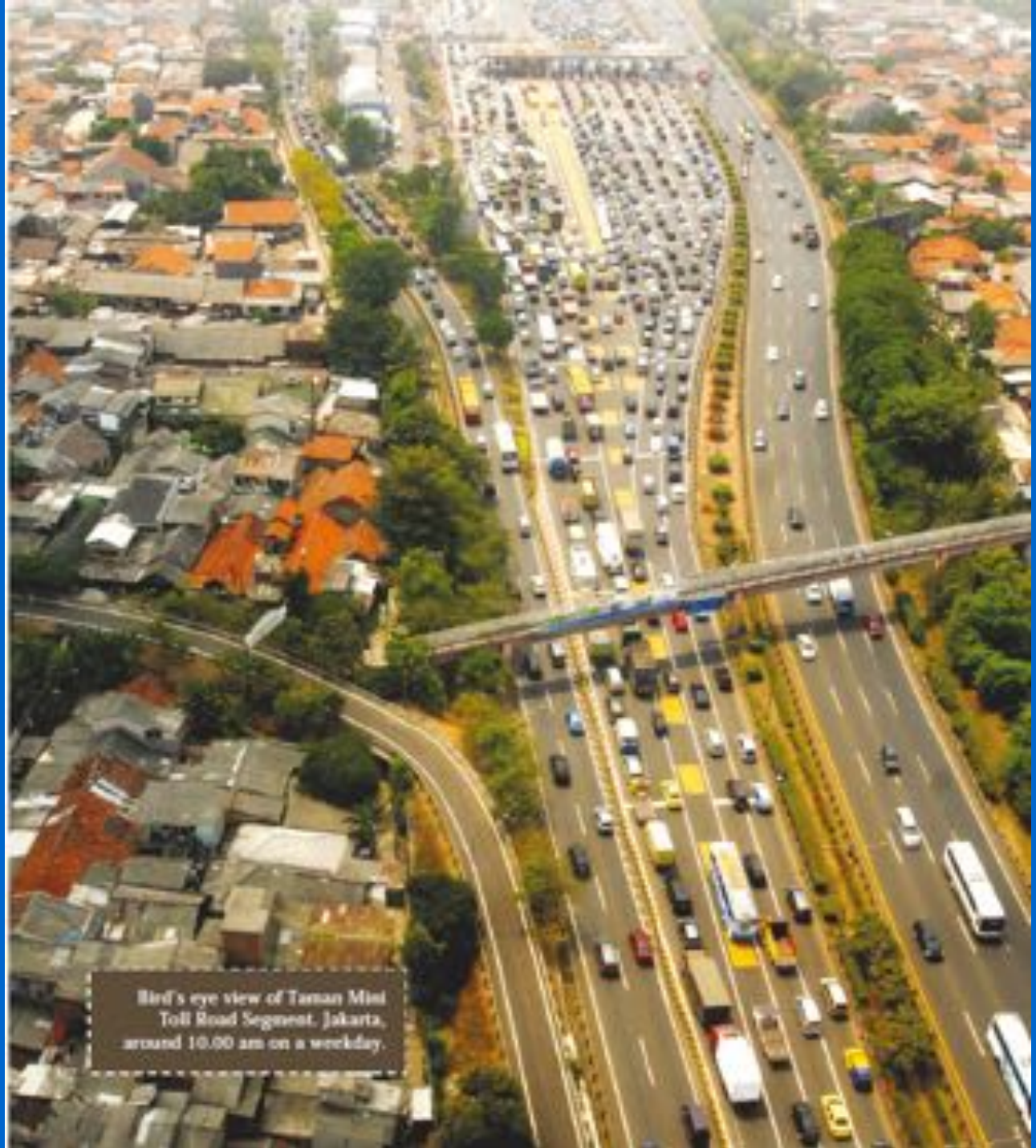


BADAN PELAKSANA REGIONAL
Pemerintahan Jakarta Utara



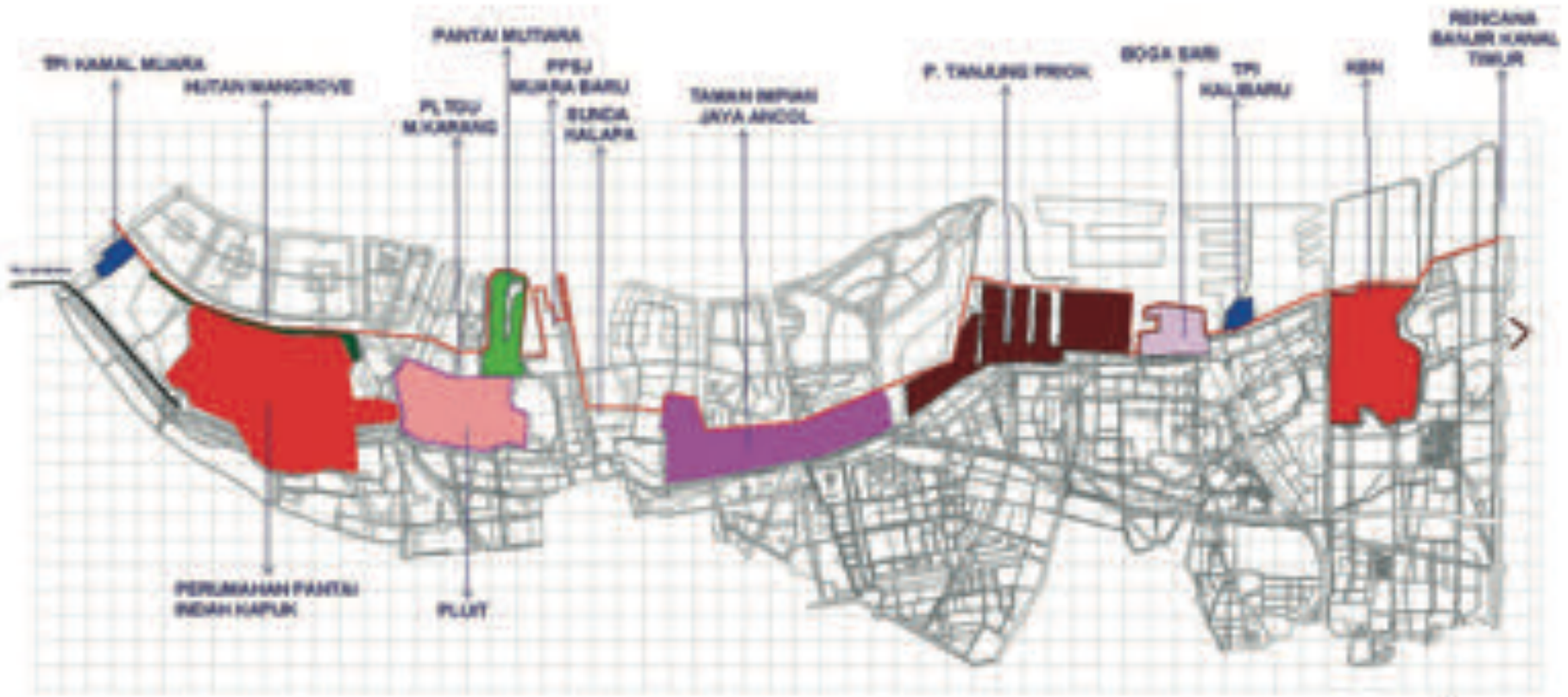
LEGEND COASTAL ZONE JAKARTA 1. EXISTING HARBOUR AREA TANJUNG PRIOK, 2. LAND RECLAMATION FOR INDUSTRI, 3. RECONSTRUCTION OF EXISTING ADJACENT AREA, 4. TOLL ROAD SYSTEM, 5. MAIN ROAD SYSTEM, 6. SEVERIN BOTTLE NECKS IN TRAFFIC SYSTEM THAT NEED TO BE SOLVED

Taman Mini Toll Road Jakarta



Bird's eye view of Taman Mini
Toll Road Segment, Jakarta,
around 10.00 am on a weekday.

LOCATIONS ADJACENT TO THE PROJECTED LAND RECLAMATIONS



KETERANGAN

- BAWA BANGUNAN BERTAMA
- BAWA BANGUNAN BERTAMA



PHYSICAL PLAN COASTAL ZONE JAKARTA UTARA

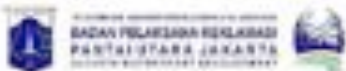
01 Housing + facilities
 02 Housing & public offices + facilities
 03 Garden houses + facilities
 04 Government services + facilities

05 Additional facilities
 06 Public gardens + facilities
 07 Industry & warehouses + facilities
 08 Public buildings

09 Improvement green areas + facilities
 10 Improvement protected green areas
 11 Drains, Rivers, Lakes, Reservoirs, Sea
 12 Roads, Streets



RENCANA TATA RUANG
 KAWASAN PANTAI UTARA JAKARTA



LEGEND :

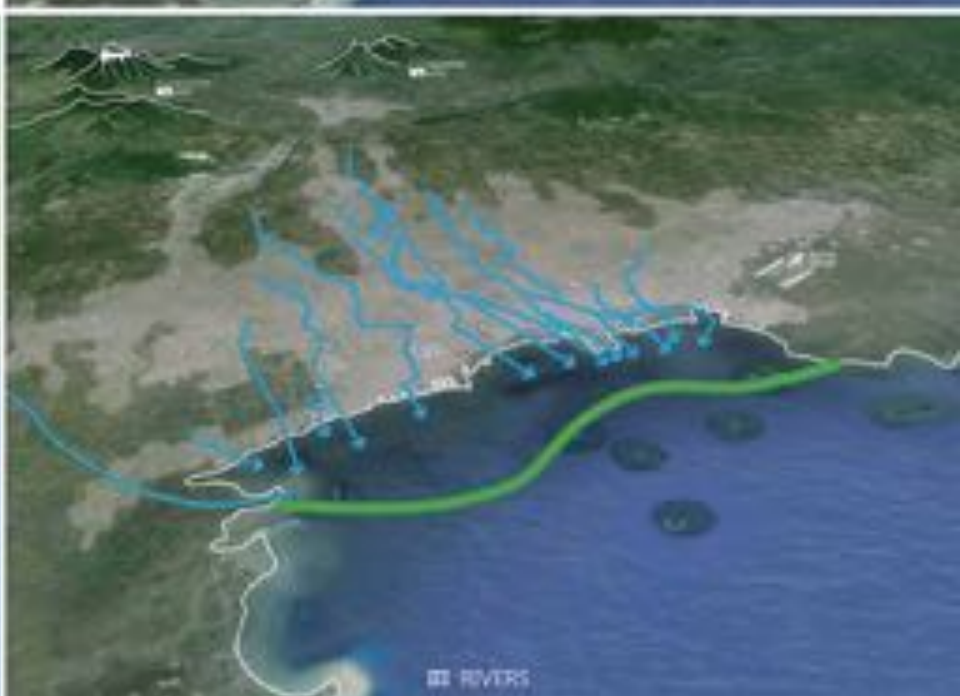
- | | | | |
|---|---|---|--|
|  | WILAYAH DENGAN FASILITASNYA |  | KAWAHLA INDUSTRI PERENCANAAN DENGAN FASILITASNYA |
|  | WILAYAH DAN BANGUNAN UMUM DENGAN FASILITASNYA |  | KAWAHLA BANGUNAN UMUM DENGAN FASILITASNYA |
|  | WILAYAH TAMBAH DENGAN FASILITASNYA |  | PERKEMBANGAN WILAYAH TAMBAH DENGAN FASILITASNYA |
|  | KAWAHLA PEMERINTAH DENGAN FASILITASNYA |  | PERKEMBANGAN WILAYAH UMUM DENGAN FASILITASNYA |
|  | WILAYAH FASILITAS UMUM DENGAN FASILITASNYA |  | SALURAN AIR LUTAS, BENDUNG DAN LAUT |
|  | KAWAHLA TAMBAH DENGAN FASILITASNYA |  | WILAYAH LAUT |

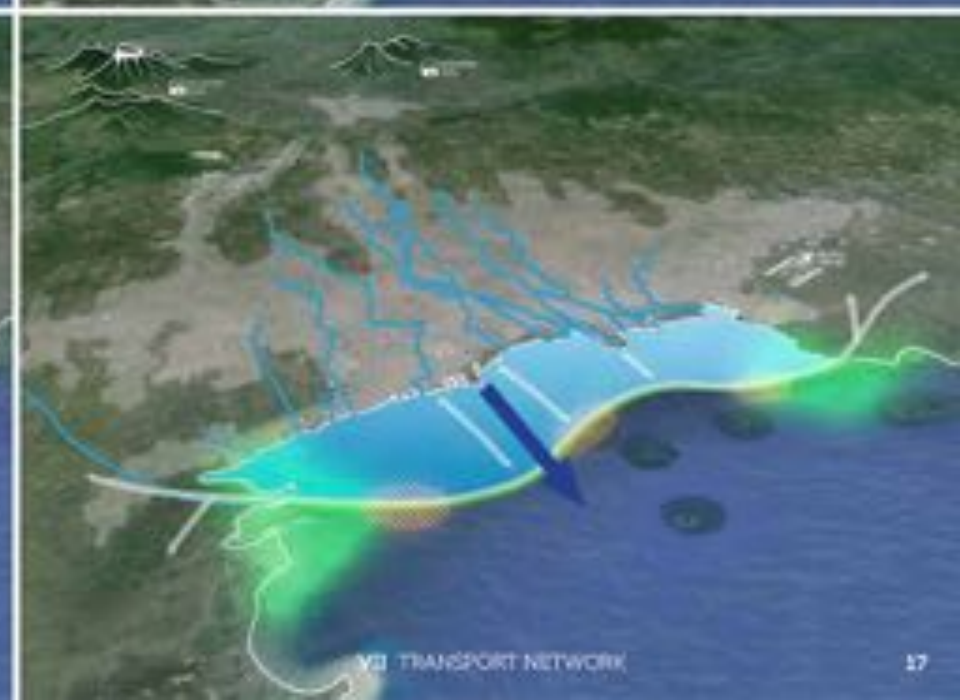


HAL. 1 - 2010



The NCICD aims to stop land subsidence, strengthen Jakarta's existing sea wall and build an offshore Outer Sea Wall for long-term protection.







Other objectives for the NCICD are to secure the future of Jakarta's fishing communities and continue the Mangrove Regeneration Program.







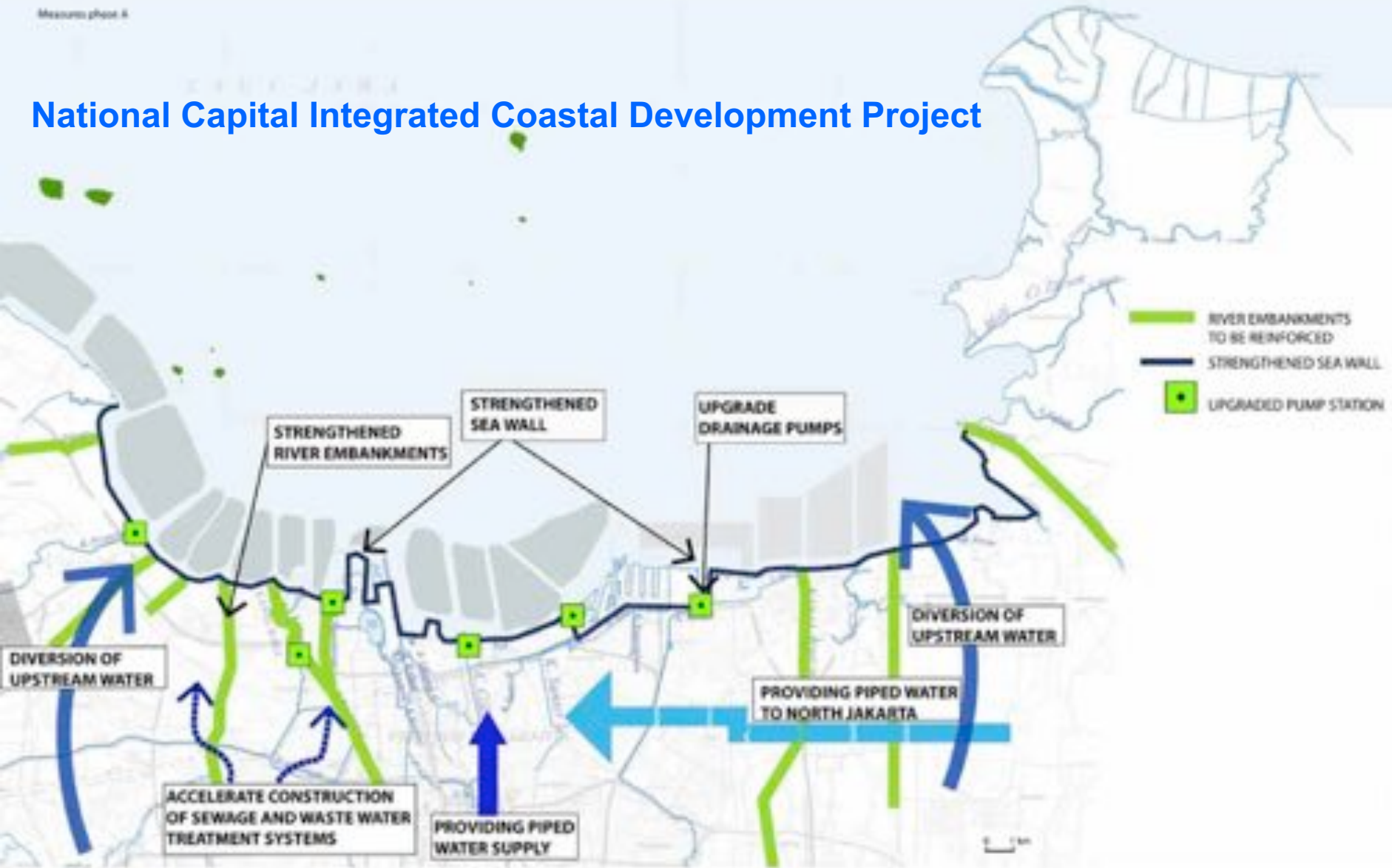
Study on Environmental Impact of Jakarta Giant Sea Wall A Hundred Year Past and Future of Jakarta Environment

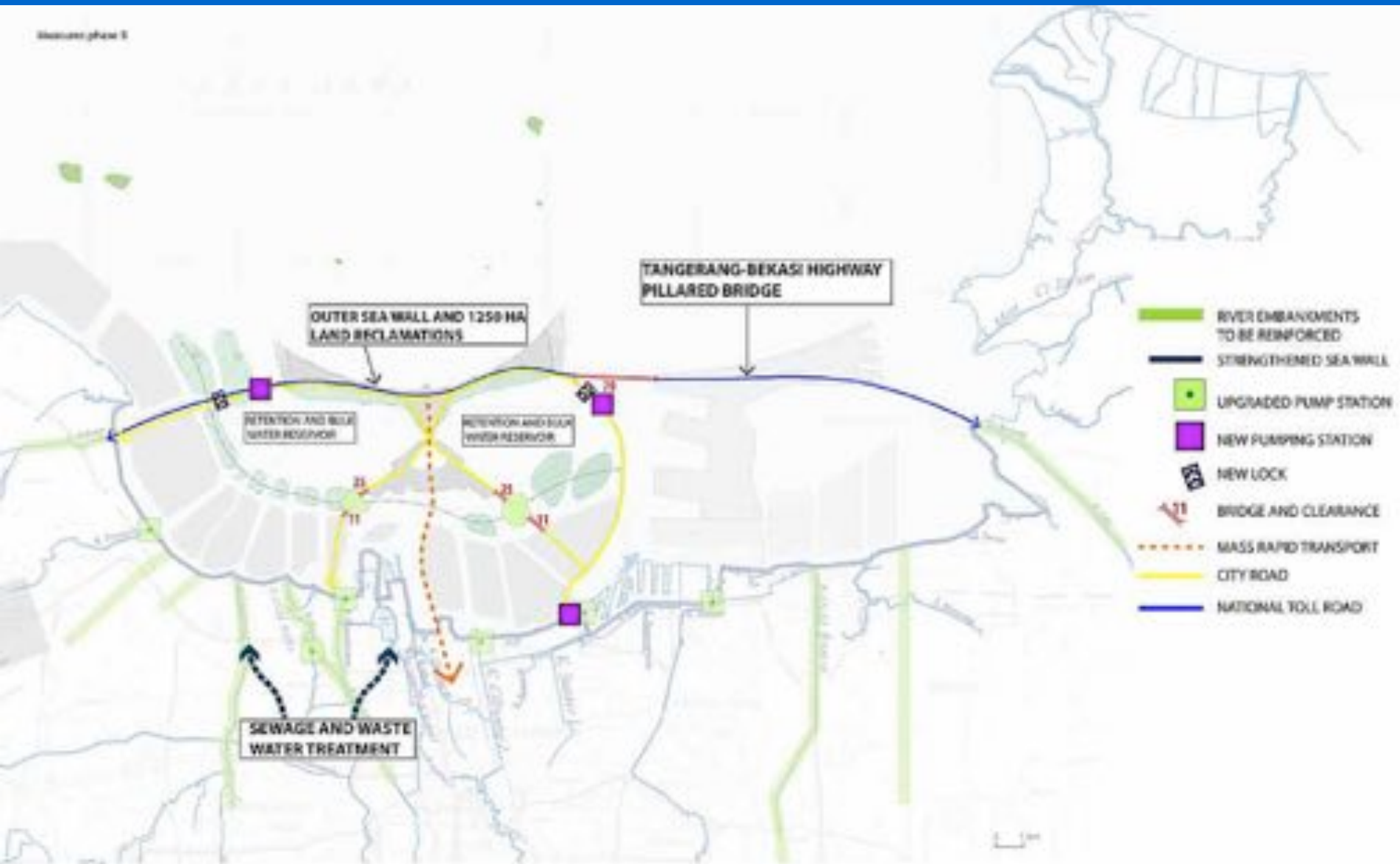
Josaphat Laboratory - CEReS - Chiba University



POISED IN THE MIDDLE OF THE GREAT WING-SHAPED SEA WALL WILL BE A NEW CENTRAL CITY AREA, POSITIONED AS A NATURAL EXTENSION OF THE CENTRAL SPINE AREA OF JAKARTA, IT WILL PROVIDE A SPECTACULAR AND WARM WELCOME TO ALL WHO COME TO THE NATION'S CAPITAL.

National Capital Integrated Coastal Development Project





OUTER SEA WALL AND 1250 HA LAND RECLAMATIONS

TANGERANG-BEKASI HIGHWAY PILLARED BRIDGE

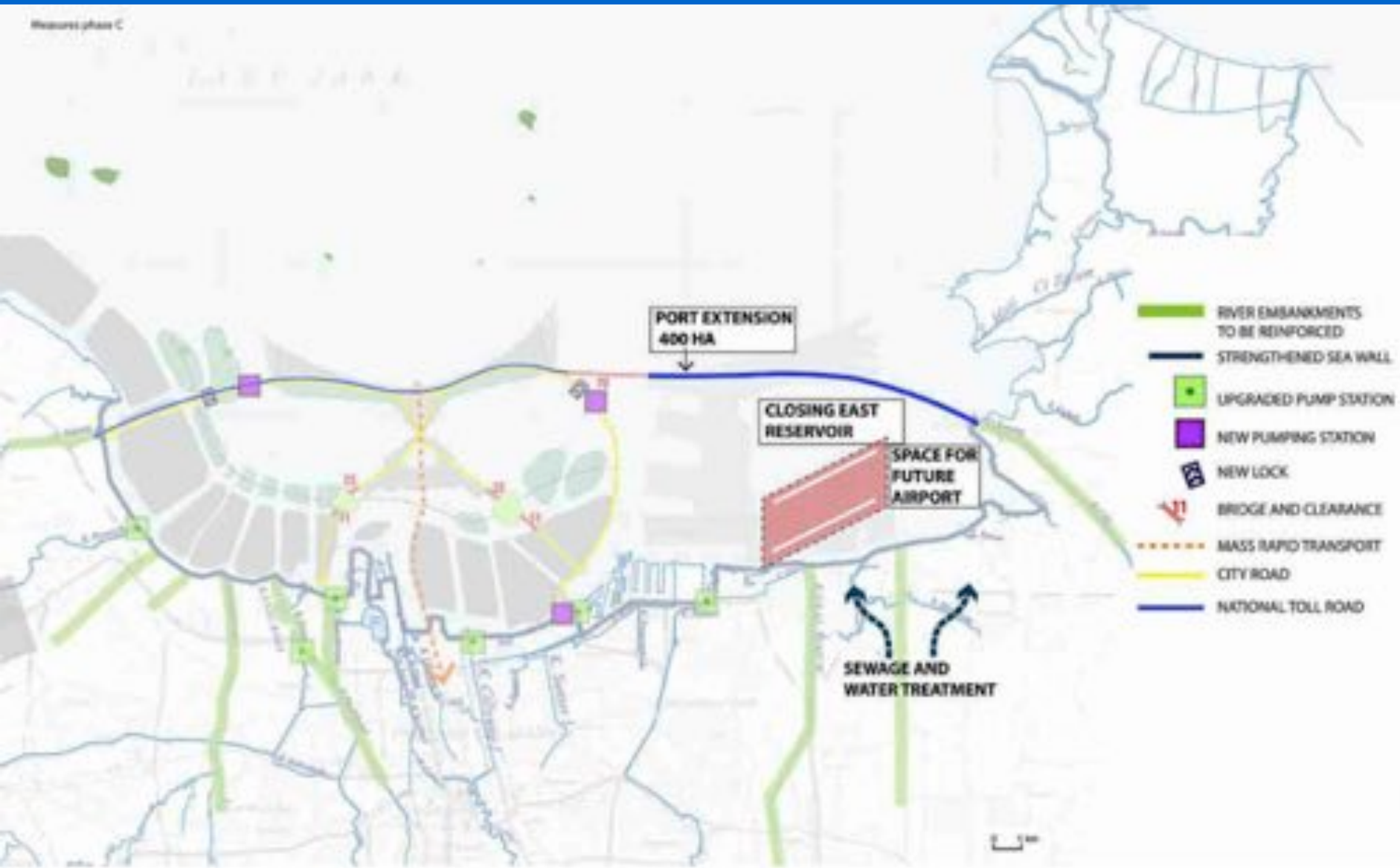
RETENTION AND BULK WATER RESERVOIR

RETENTION AND BULK WATER RESERVOIR

SEWAGE AND WASTE WATER TREATMENT

- RIVER EMBANKMENTS TO BE REINFORCED
- STRENGTHENED SEA WALL
- UPGRADED PUMP STATION
- NEW PUMPING STATION
- 🔒 NEW LOCK
- 🌉 BRIDGE AND CLEARANCE
- - - MASS RAPID TRANSPORT
- CITY ROAD
- NATIONAL TOLL ROAD

1st SEP 2014



PORT EXTENSION
400 HA

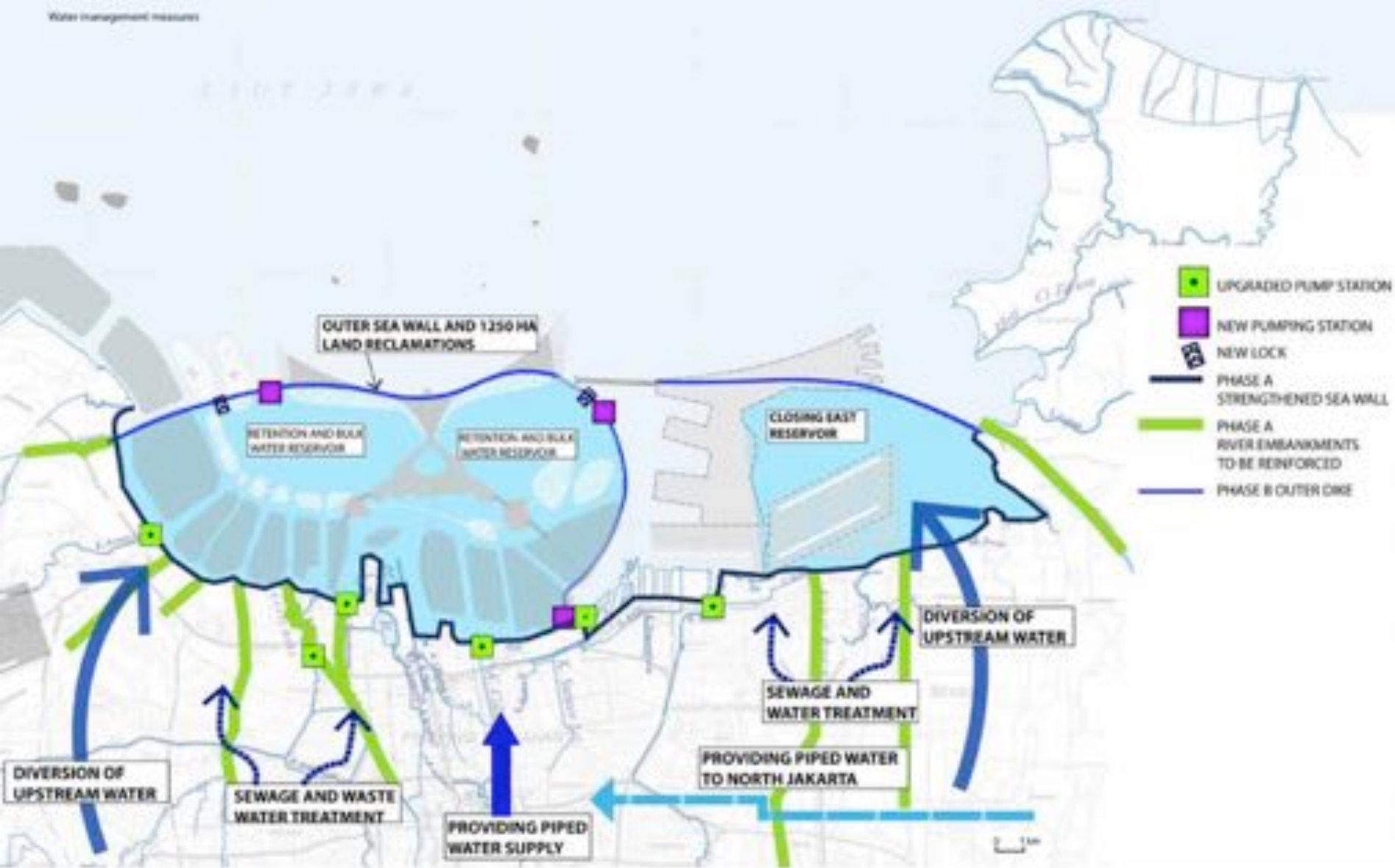
CLOSING EAST
RESERVOIR

SPACE FOR
FUTURE
AIRPORT

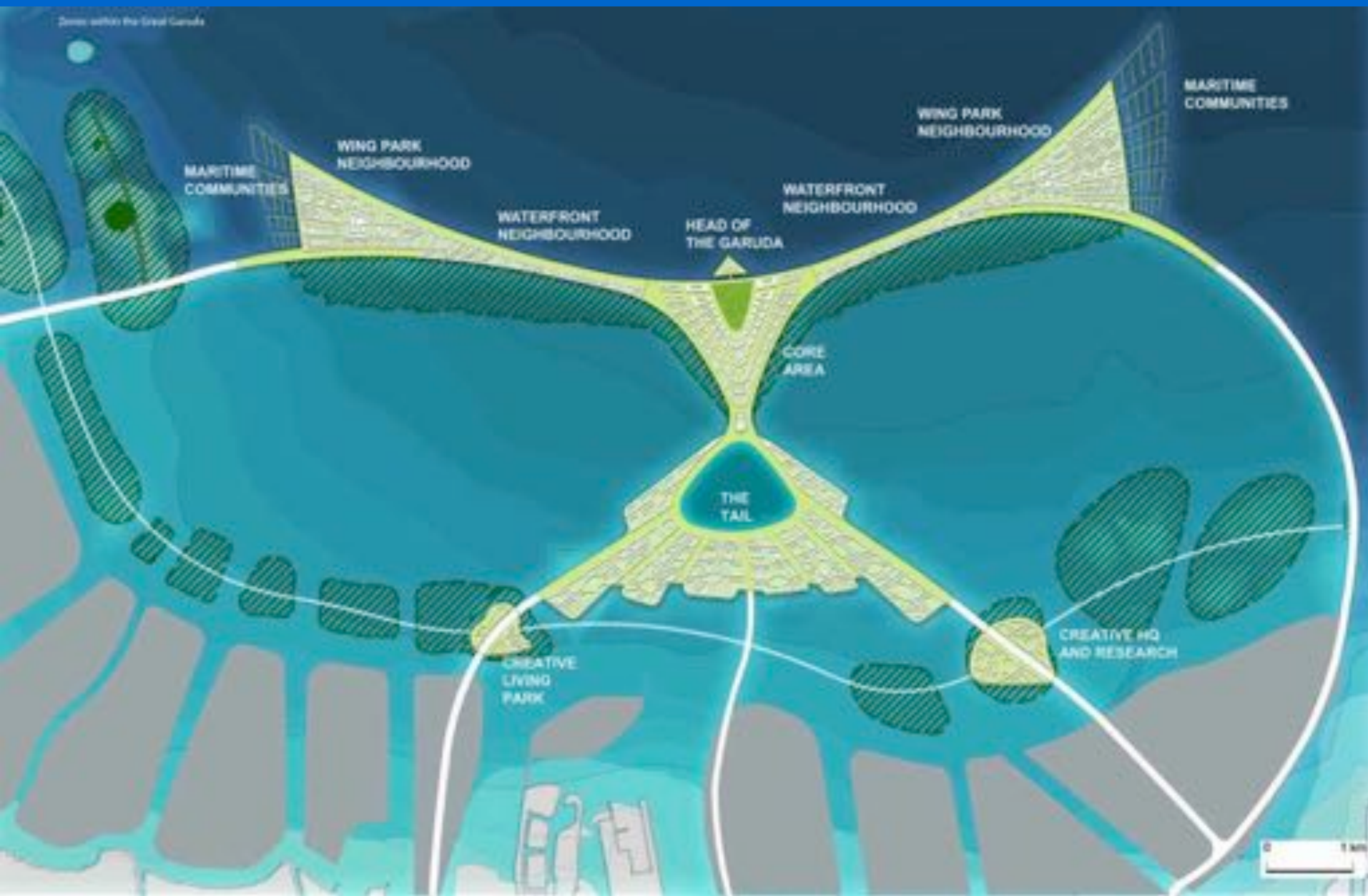
SEWAGE AND
WATER TREATMENT

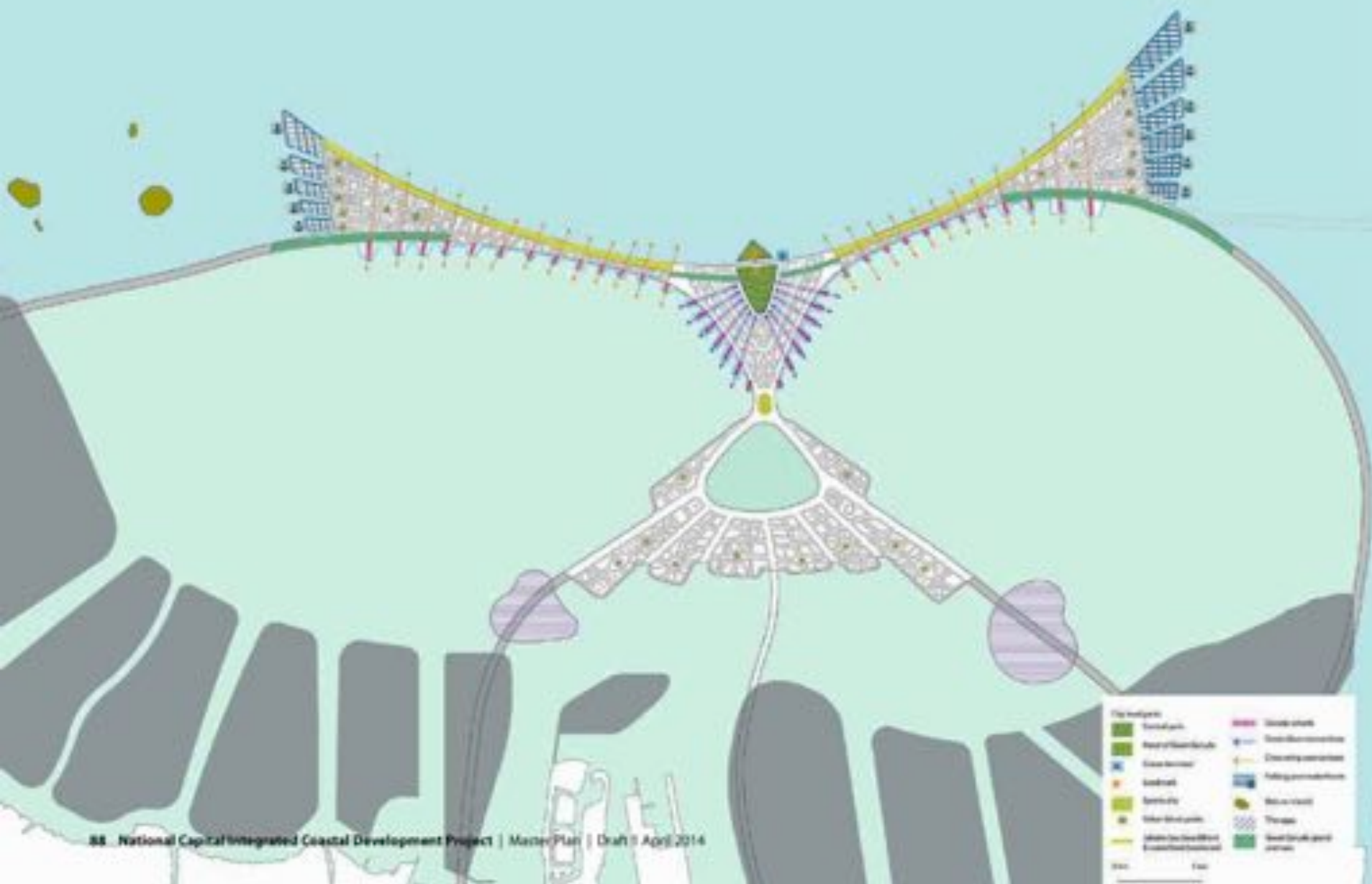
- RIVER EMBANKMENTS TO BE REINFORCED
- STRENGTHENED SEA WALL
- UPGRADED PUMP STATION
- NEW PUMPING STATION
- NEW LOCK
- BRIDGE AND CLEARANCE
- MASS RAPID TRANSPORT
- CITY ROAD
- NATIONAL TOLL ROAD

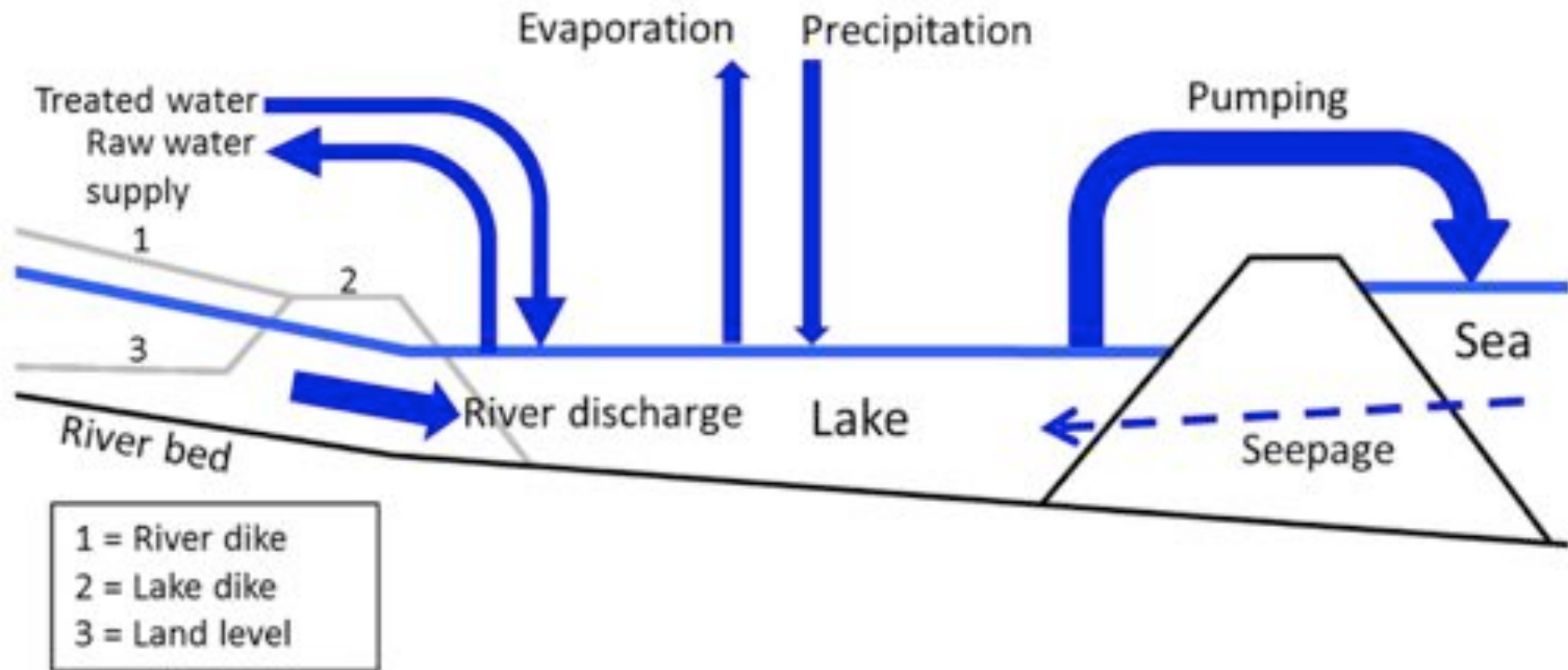
0 5 km



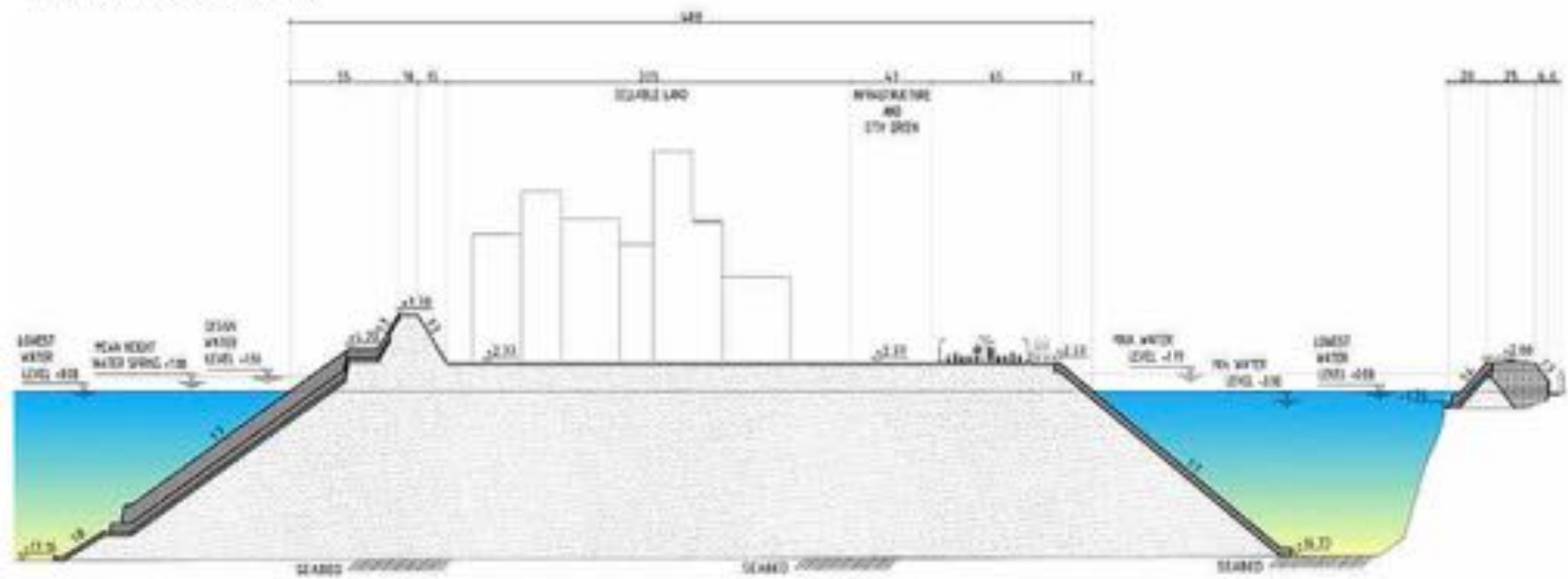
Zones within the Great Garuda

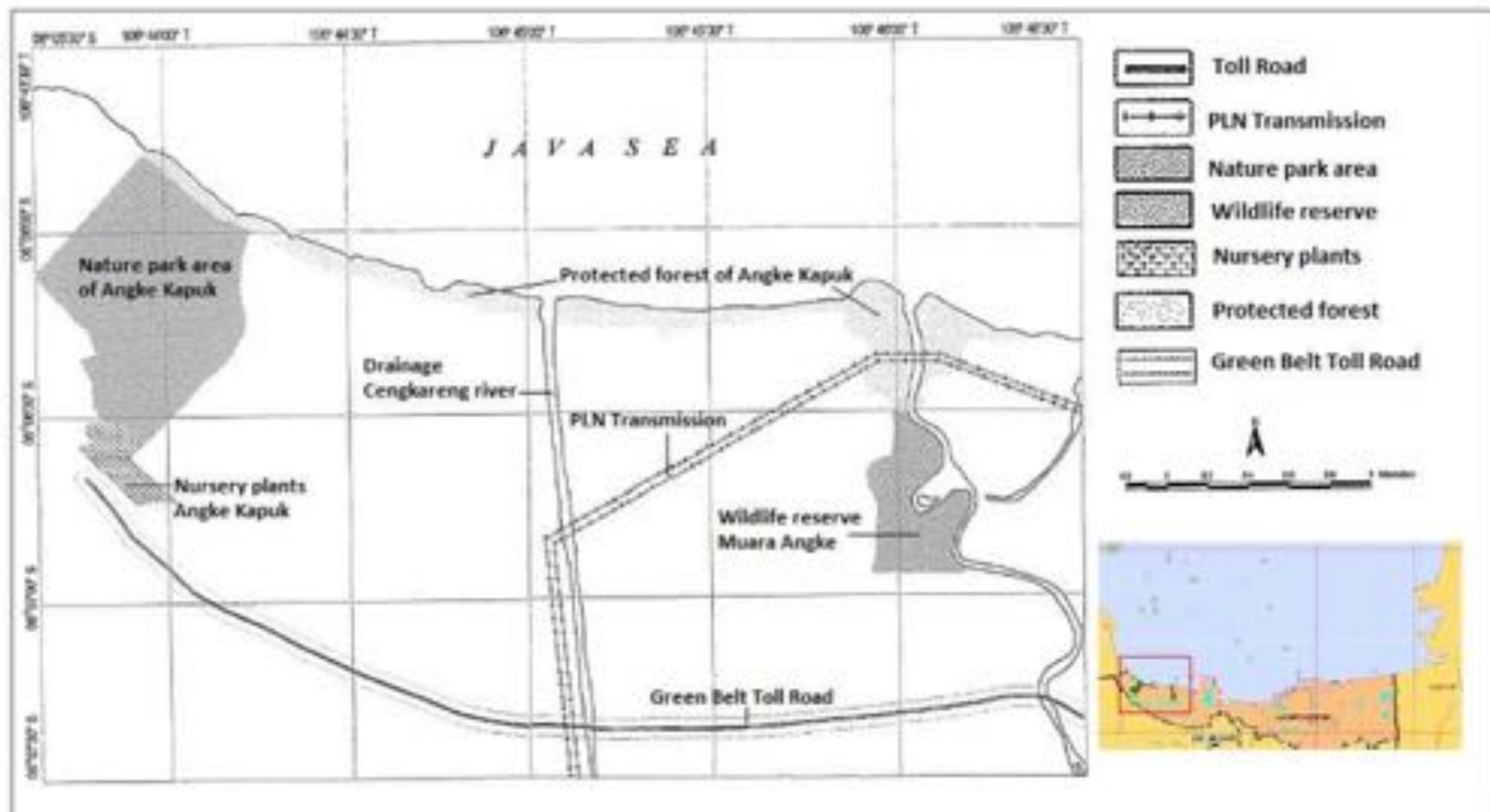






The cross section through the land reclamation





GEODESY

In planning & design Geodesy plays an essential role.

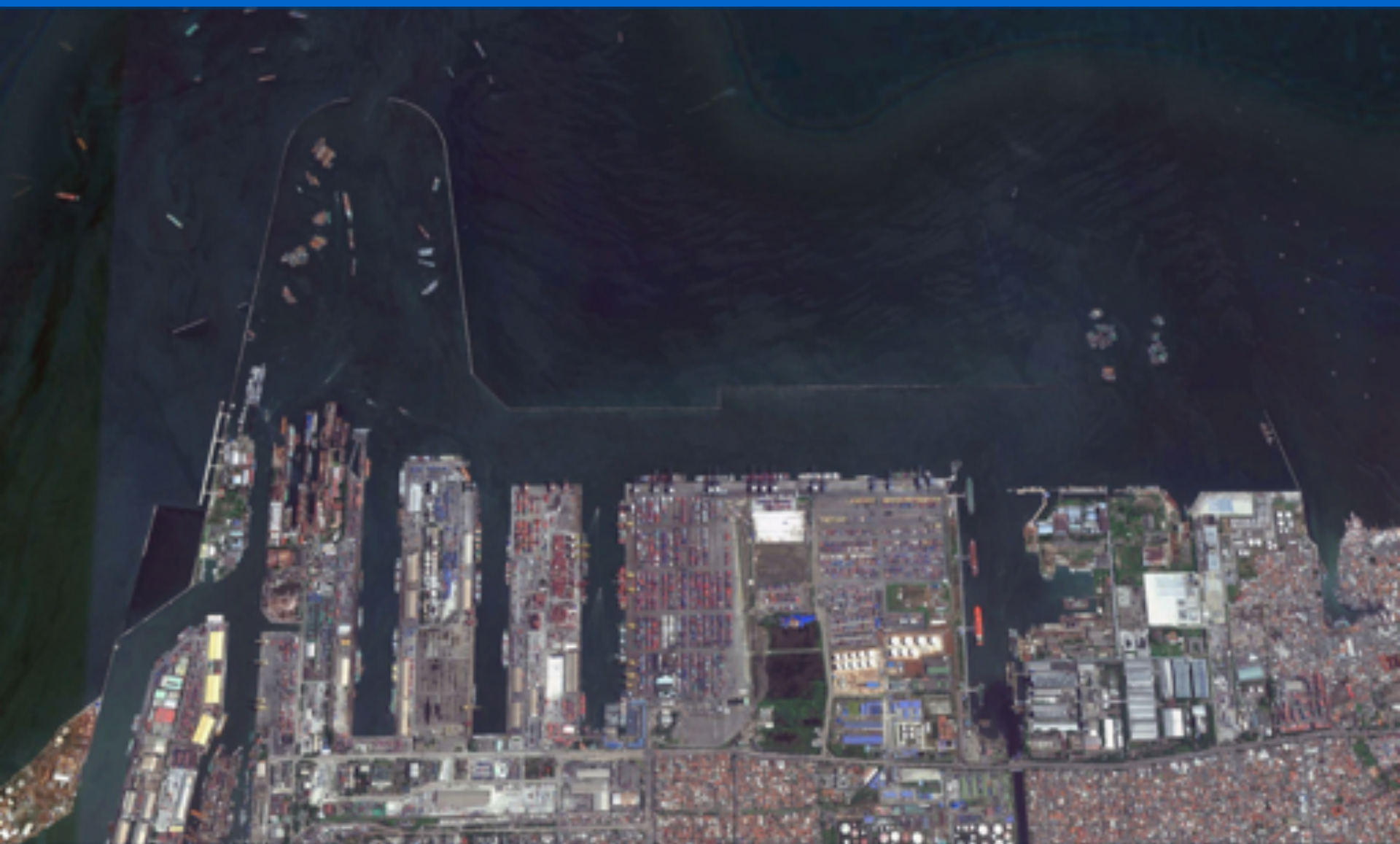
Historical and actual data with regard to land & sea surfaces and sub surfaces are needed for planning & map making.

Measurements are required through land- and sea survey, including Remote Sensing.





A
PELABUHAN
TANJUNGPRIOK
SCALE 1:1000





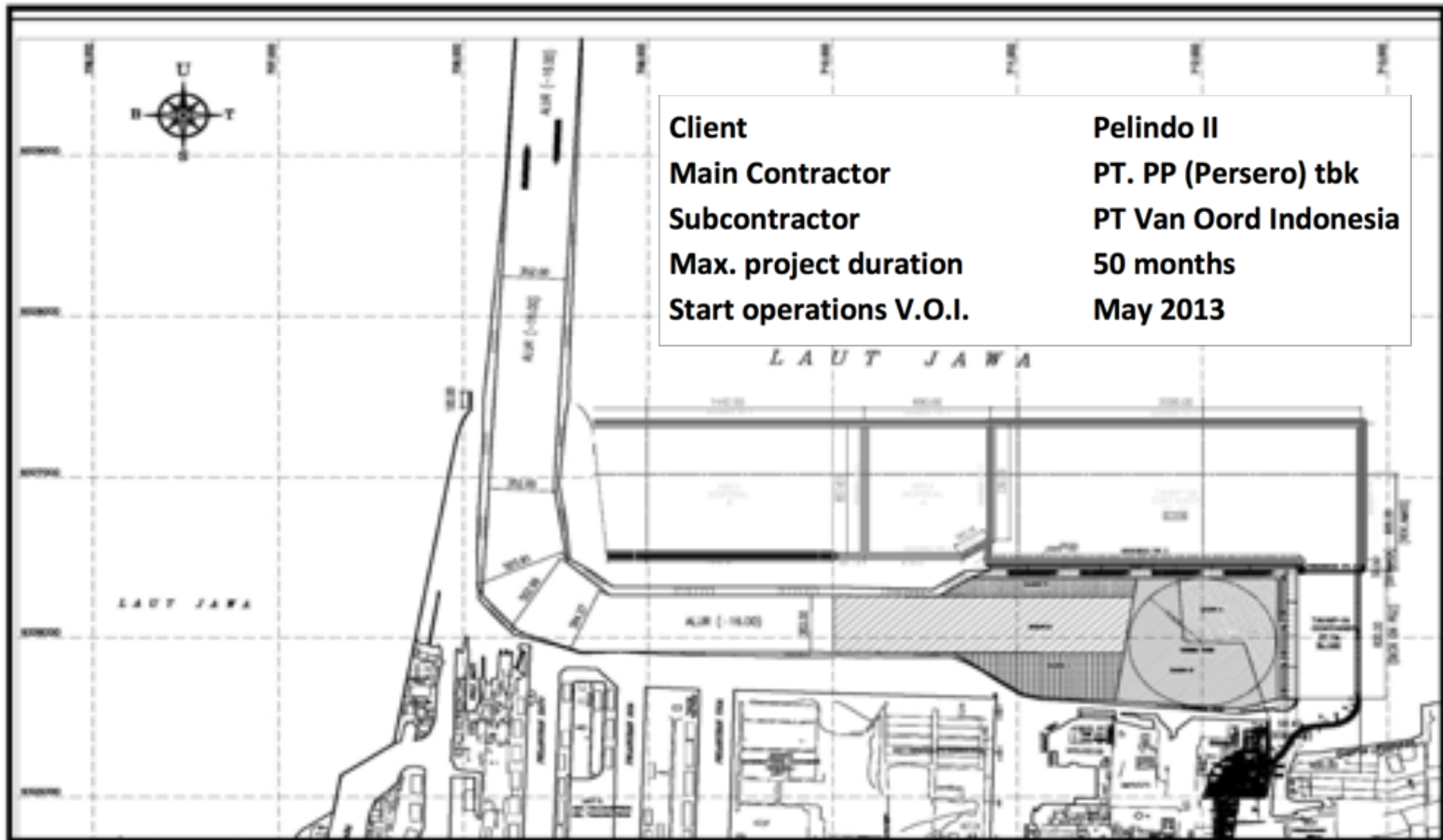


Figure 1: plan lay-out Port Extension









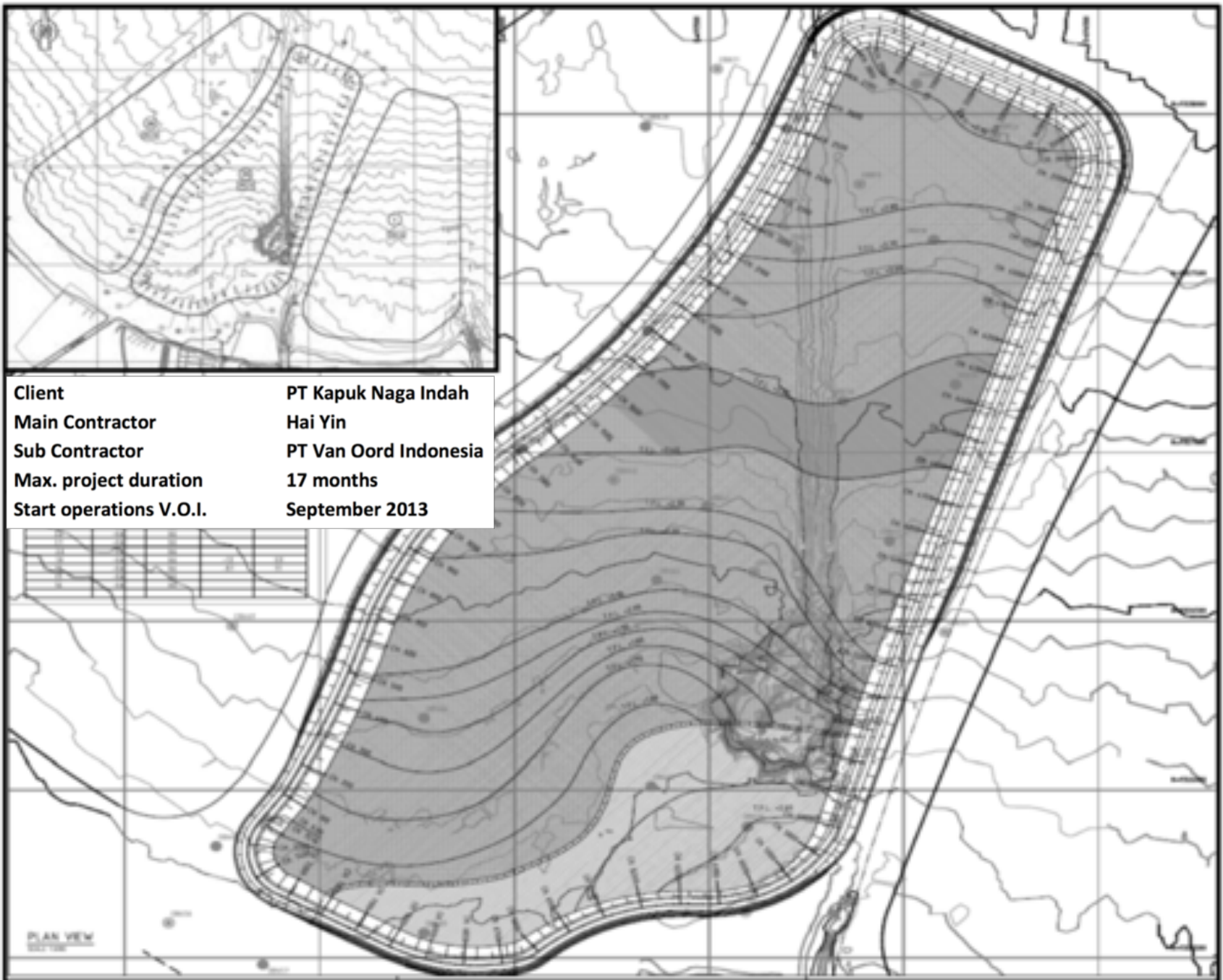


Figure 1: KNI Island 2 A drawing and bathymetry





Weak Local Coastal Defense to be improved



Sea level rise, higher frequency & intensity of stormsurges & rainfall

Land Subsidence up to 10-20 cm / year

Necessity of adequate sewer & drainage systems

Insufficient pumping capacity

Too much drinking water extraction from groundwater

Contaminated surface water

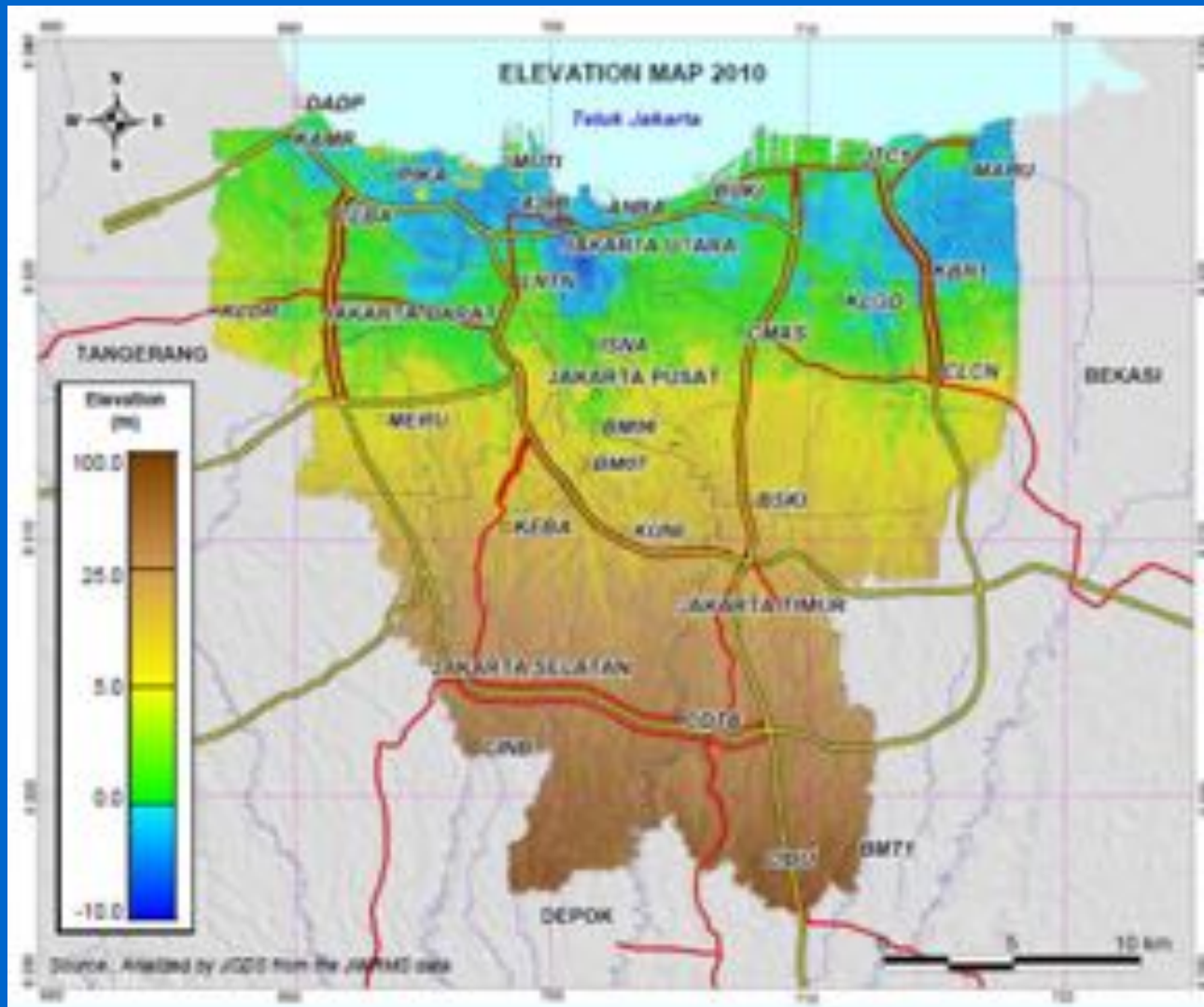
Illegal encroachment into rivers & drains

Necessity collection & treatment of wastes

Outdated infrastructures along rivers & canals (pipelines, cables, bridges, roads)

Flood retaining walls, ring dykes, shore protection

Siltation of rivers & canals











- | | | | |
|--------------------|-------------------|------------------|--------------|
| 1. Klot | 11. Cipang | 21. Mangrove | 31. Serub |
| 2. Angke | 12. Cendek | 22. Marunda | 32. Sunter |
| 3. Benua | 13. Gajah Mada | 23. Mali | 33. Ujung |
| 4. Buaran | 14. Gunung Sahari | 24. Huruja | 34. Western |
| 5. Cakung | 15. Grogol | 25. Mookerwart | Banjir Canal |
| 6. Cempinang | 16. Iram | 26. Padamangan | |
| 7. Cempinang Drain | 17. Jati Kramat | 27. Pertukangan | |
| 8. Odeng | 18. Kallibata | 28. Pesanggrahan | |
| 9. Cjemung | 19. Krukul | 29. Sekretaris | |
| 10. Cikarang | 20. Legas | 30. Seniling | |

RIVERS AND MAJOR DRAINS IN DKI JAKARTA



SCALE 1 : 1,250

- Provincial Boundaries
- Rivers or Major Drains
- Minor Drains
- Contour 1.5 m
- Contour 0.5 m

- | | | | |
|------------------|------------------|------------------|------------------|
| 1. Cakung River | 11. Cakung Drain | 21. Cakung Drain | 31. Cakung Drain |
| 2. Cakung River | 12. Cakung Drain | 22. Cakung Drain | 32. Cakung Drain |
| 3. Cakung River | 13. Cakung Drain | 23. Cakung Drain | 33. Cakung Drain |
| 4. Cakung River | 14. Cakung Drain | 24. Cakung Drain | 34. Cakung Drain |
| 5. Cakung River | 15. Cakung Drain | 25. Cakung Drain | 35. Cakung Drain |
| 6. Cakung River | 16. Cakung Drain | 26. Cakung Drain | 36. Cakung Drain |
| 7. Cakung River | 17. Cakung Drain | 27. Cakung Drain | 37. Cakung Drain |
| 8. Cakung River | 18. Cakung Drain | 28. Cakung Drain | 38. Cakung Drain |
| 9. Cakung River | 19. Cakung Drain | 29. Cakung Drain | 39. Cakung Drain |
| 10. Cakung River | 20. Cakung Drain | 30. Cakung Drain | 40. Cakung Drain |

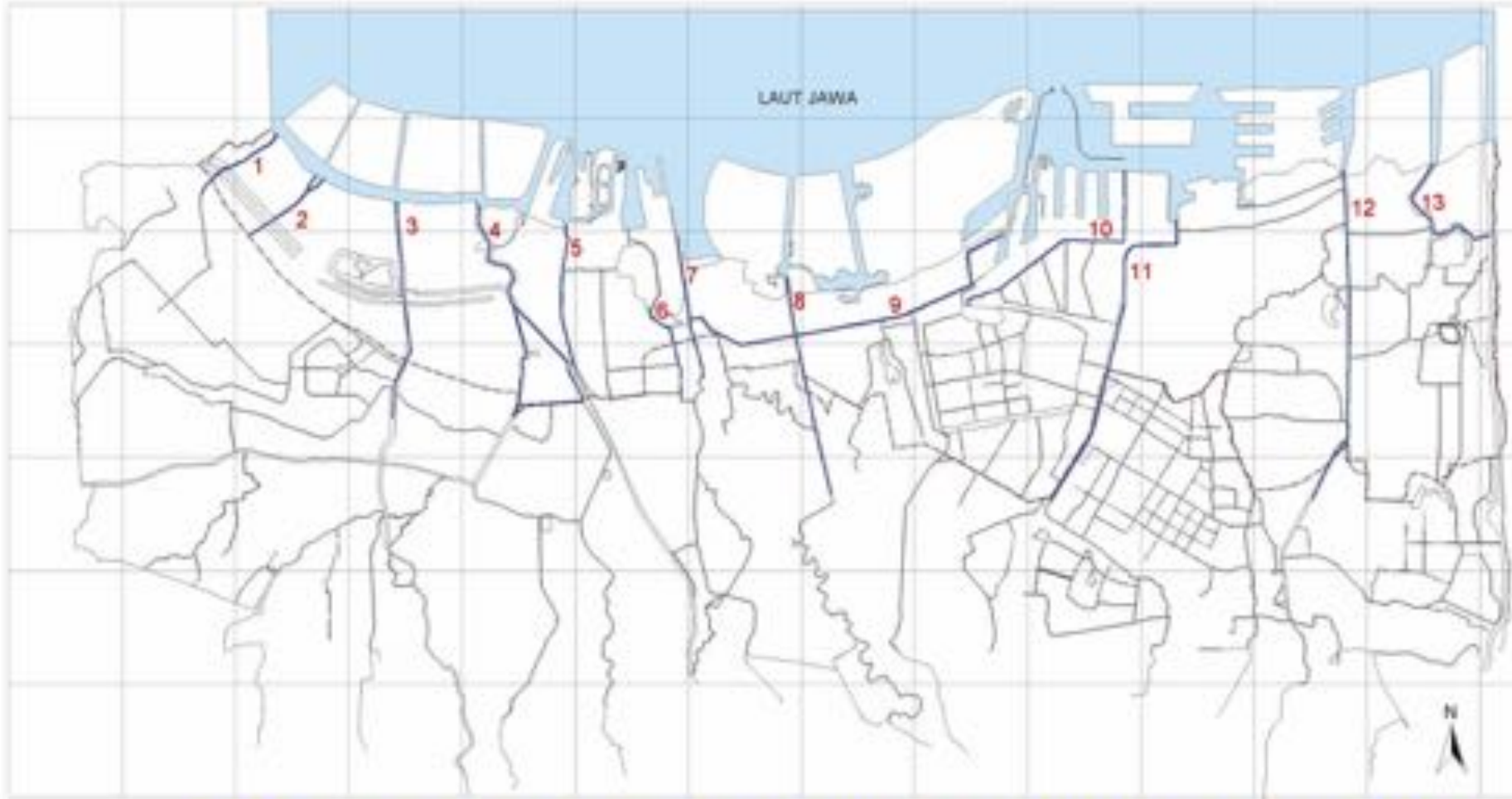
78 OF FLOOD PRONE AREAS IN DKI JAKARTA



SCALE 1 : 1,250

- Provincial Boundaries
- Rivers or Major Drains
- Flood Prone Areas

LOCATION OF 11 RIVERS & 2 DRAINAGE CANALS IN PANTURA ZONE OF JAKARTA



PETA LOKASI 13 SUNGAI DI KAWASAN PANTURA JAKARTA

KETERANGAN :

- | | | | |
|---------------------|-------------------------|------------------|-------------------|
| 1. KALI KAMAL | 5. KALI DURI LEDENG | 9. KALI ANCOL | 13. KALI BLENCONG |
| 2. KALI TUNJUNGAN | 6. KALI OPAK | 10. KALI LAGOA | |
| 3. CENKARENG DRAIN | 7. KALI ANAK CILIWUNG I | 11. KALI SUNTER | |
| 4. KALI MUARA ANGKE | 8. KALI CILIWUNG/MARINA | 12. CAKUNG DRAIN | |

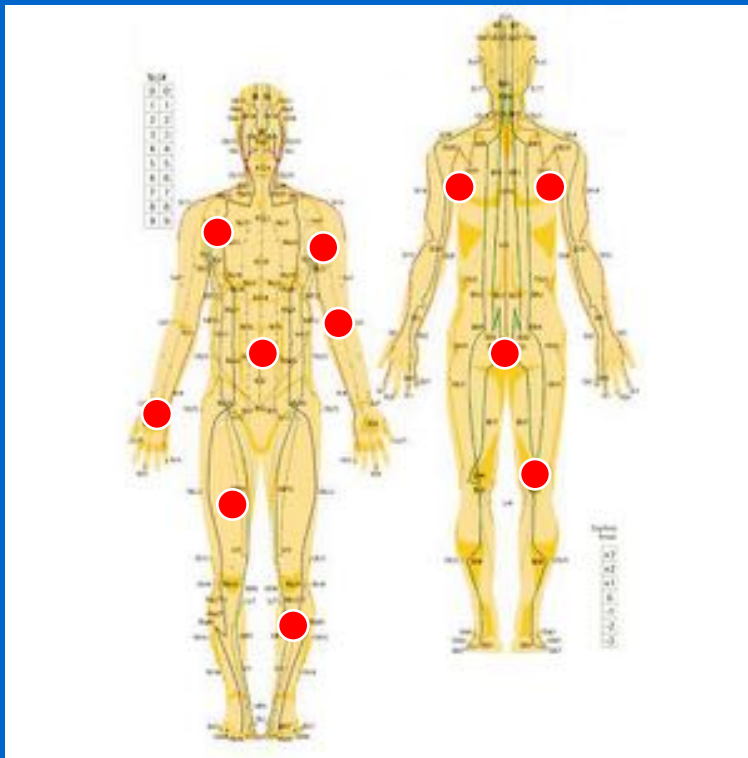


BADAN PELAKSANA REKLAMASI
PANTAU UTARA JAKARTA
JAWA BARU



ACUPUNCTURE

to revitalize
the Nervous System
& Human Organs



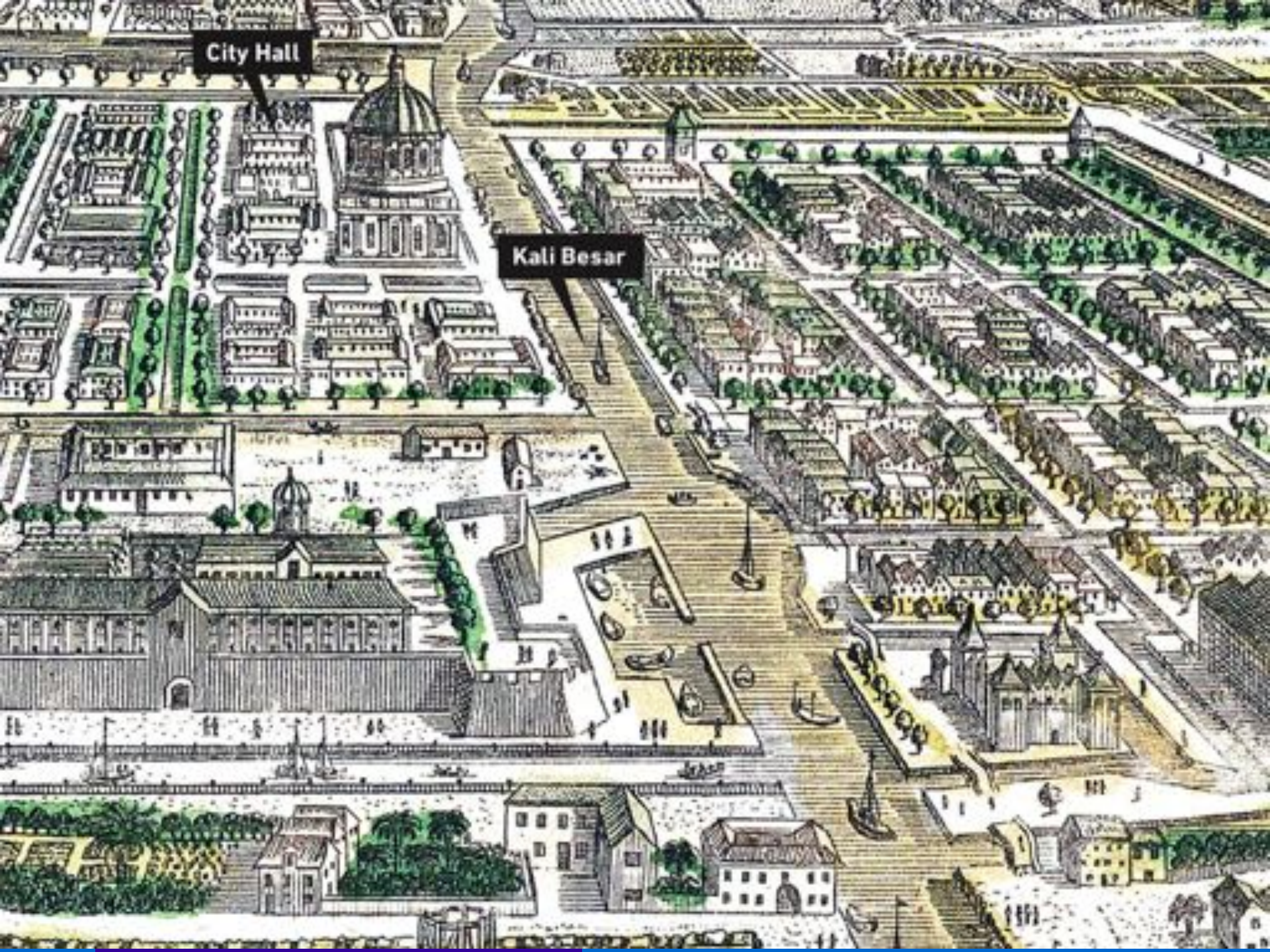
AQUAPUNCTURE

to revitalize
the Waterways & their
Water Fronts



1780





City Hall

Kali Besar

HERITAGE TRAIL



a. Pelabuhan Sunda Kelapa




b. Kampung Luar Batang



g. Taman Fatahillah area



 3 km



d. Galangan VOC



h. Stasiun Kota



i. Klenteng Jin-de Yuan



Museum Bank Indonesia

Toko Merah

Museum Bank Mandiri

Museum Sejarah

Museum Wayang

Stasiun Kota

Museum Keramik

Kantor Pos Indonesia

-
-
-

SUSTAINABLE COASTAL ZONE DEVELOPMENT

Integrated Coastal & Deltaic Policy via Building with Nature®

Prof. Dr. R.E. Waterman MSc



Negara Brunei Darussalam



Bandar Seri Begawan
2013



BRUNEI

SURFACE AREA

5,765 km² 33,883 km²

INHABITANTS

0.422 million 16.7 million

COASTAL LENGTH

161 km 353 km

MAIN RIVERS

Sungai Belait
Sungai Brunei
Sungai Liang
Sungai Tutong
Sungai Temburong

Rhine
Maas
Scheldt
Eems

THE NETHERLANDS



BRUNEI DARUSSALAM





Bandar Seri Begawan



Muara Port



Kuala Belait

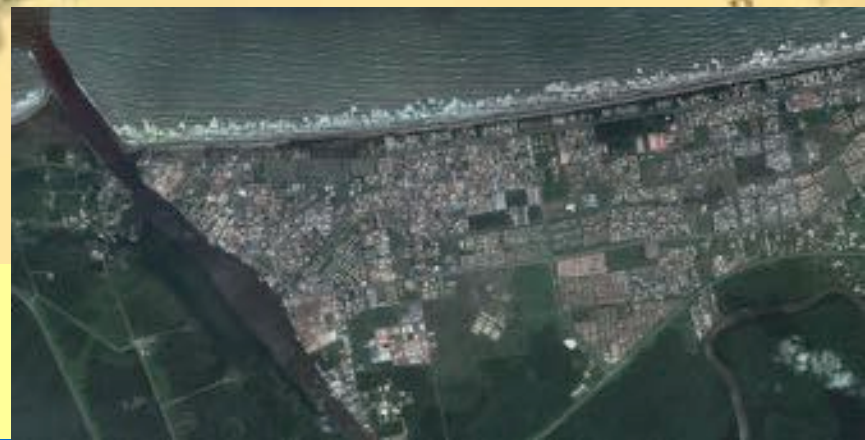
Seria



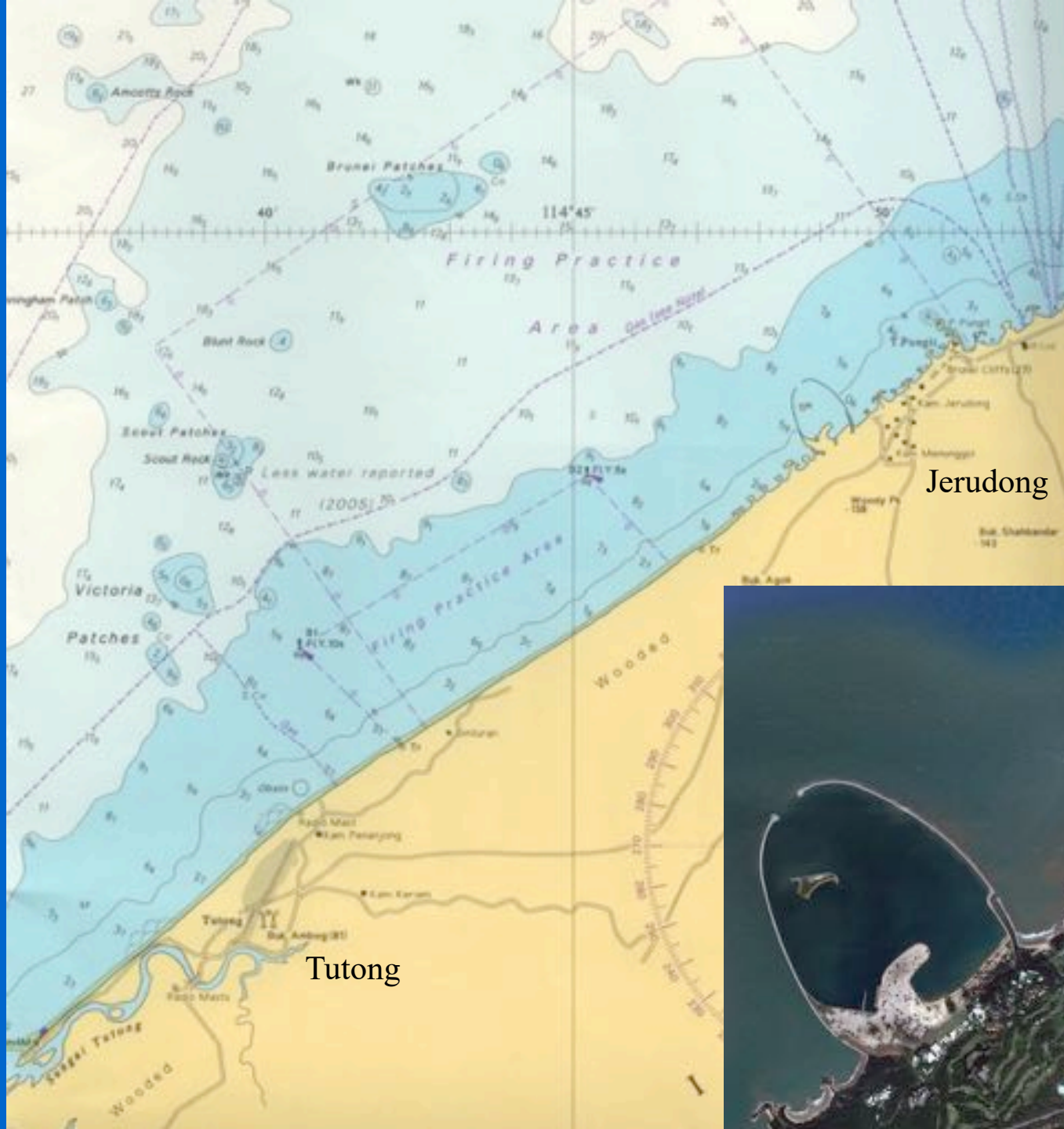
Kuala Belait

Seria

Lumut LNG Terminal



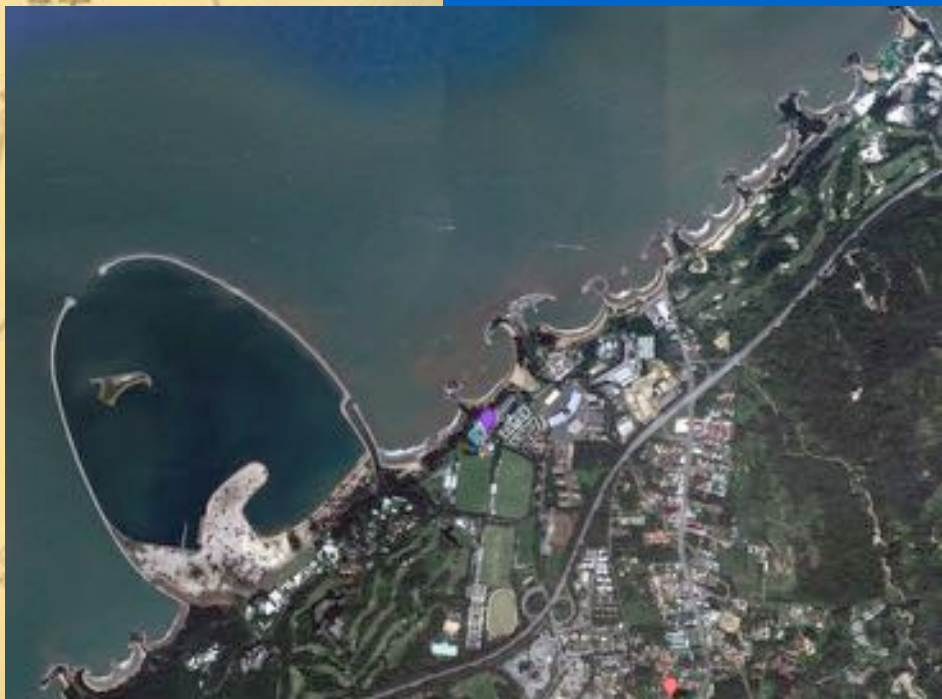
Kuala Belait



Jerudong

Jerudong

Tutong





Muara

Pulau
Muara Besar



Pulau
Pelumpong

Muara

Pulau
Muara Besar

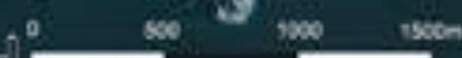
Pulau Muara Besar

Western Channel

-13 m

Eastern Channel

- 260 ha
- Refinery & Aromatics Complex
- Gas-based power plant
- Desalination plant
- Marine supply base
- Logistics



SUSTAINABLE COASTAL ZONE DEVELOPMENT

In all cases of coastal zone & port development it is profitable to make use of the principle of *Building with Nature*[®] taking into account existing and new nature reserve areas.

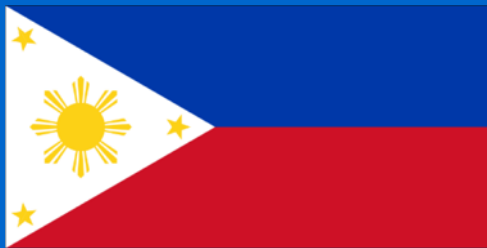
Special attention thereby for the introduction of :

- Renewable Energy
- Production of Aquatic & Terrestrial (halal) Food
 - Pharmaceuticals
 - Necessary Logistics

SUSTAINABLE COASTAL ZONE DEVELOPMENT

Integrated Coastal & Deltaic Policy via Building with Nature®

Prof. Dr. R.E. Waterman MSc



Philippines

2017



PHILIPPINES



SURFACE AREA

300,000 km² 33,883 km²

INHABITANTS

100 million 17.1 million

COASTAL LENGTH

36,289 km 353 km

MAIN RIVERS

Cagayan River	Rhine
	Maas
	Scheldt
	Eems

ISLANDS

7,107 islands 10 small islands

THE NETHERLANDS



PHILIPPINES

- International Treaty Limits
- Kalayaan Claim (Spratlys)
- Archipelagic Waters
- Territorial Sea
- Exclusive Economic Zone (EEZ)



Philippines Manila *Laguna de Bay*

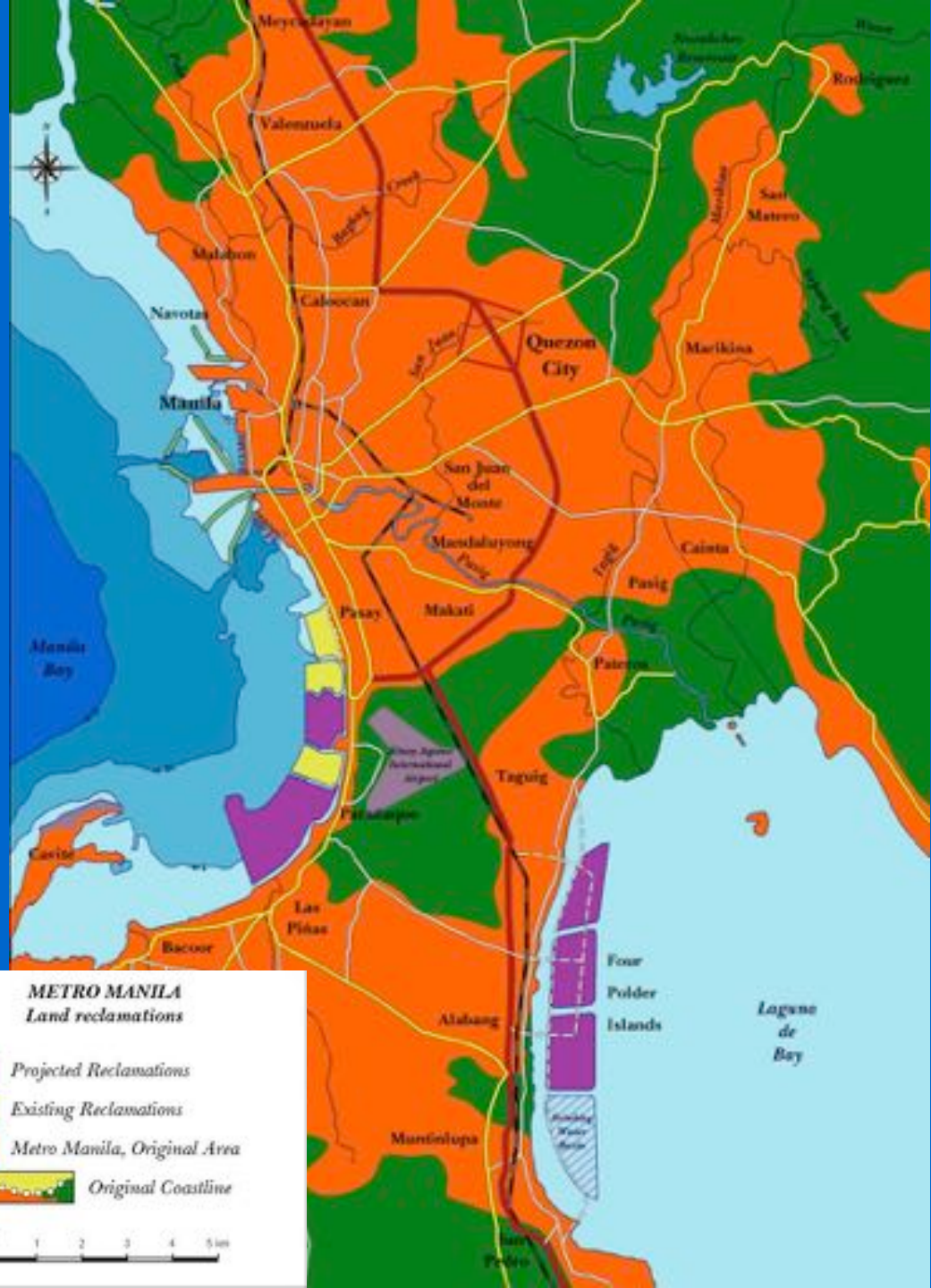


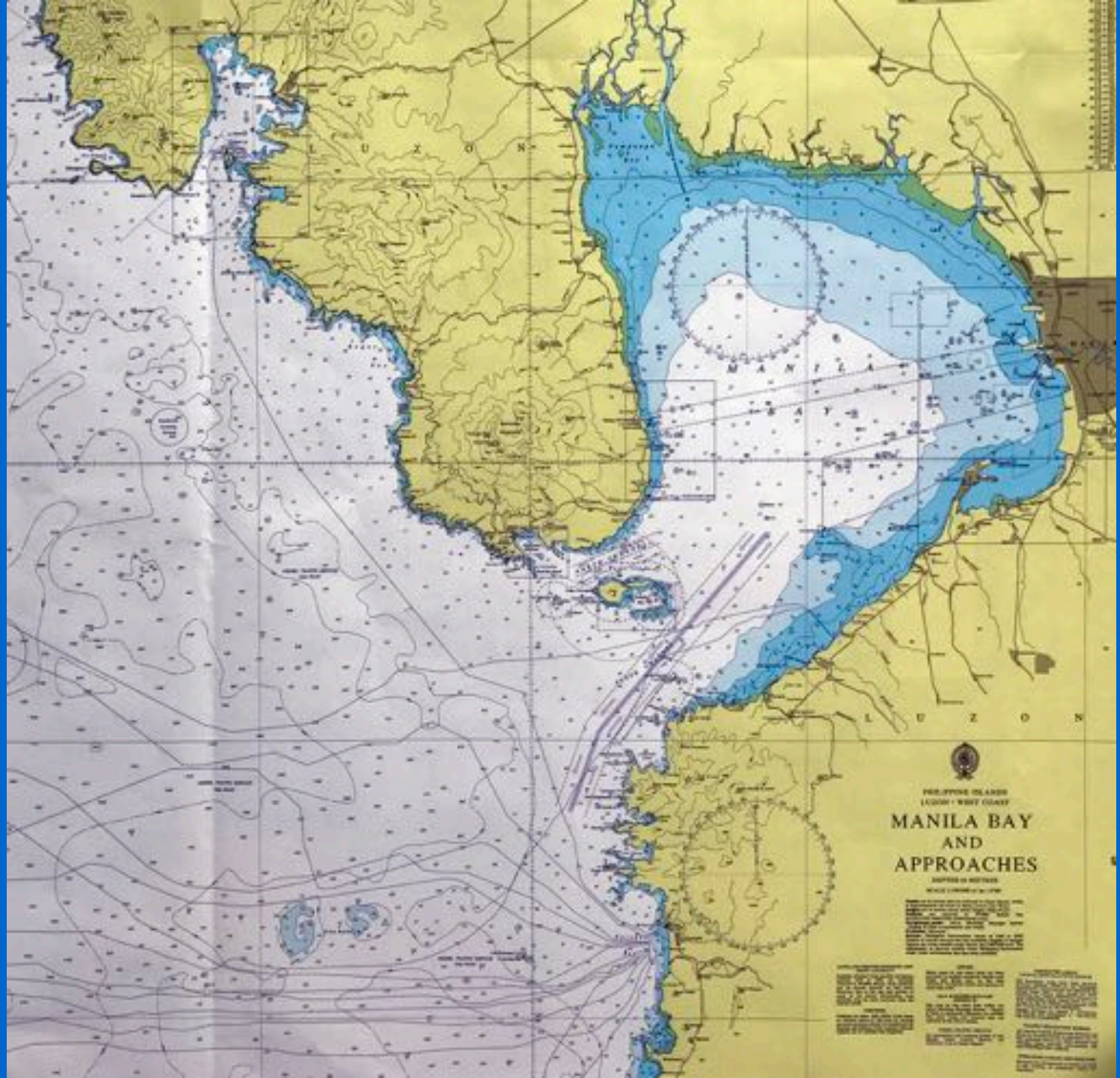
Metro Manila

Inhabitants: 13 million
Total region: 25 million

Land reclamations along
Manila Bay
& Laguna de Bay

Pasig River
between Manila Bay &
Laguna de Bay





PHILIPPINE ISLANDS
 LUCENA - WEST COAST
**MANILA BAY
 AND
 APPROACHES**

DEPTH IN METERS
 SCALE 1:50,000
 SOUNDINGS IN FATHOMS
 SCALE 1:50,000

<p>SYMBOLS AND ABBREVIATIONS</p> <p>Lighted Buoy, Daymark, etc.</p>	<p>ABBREVIATIONS</p> <p>Light, Buoy, etc.</p>	<p>EXPLANATION</p> <p>Light, Buoy, etc.</p>
--	--	--

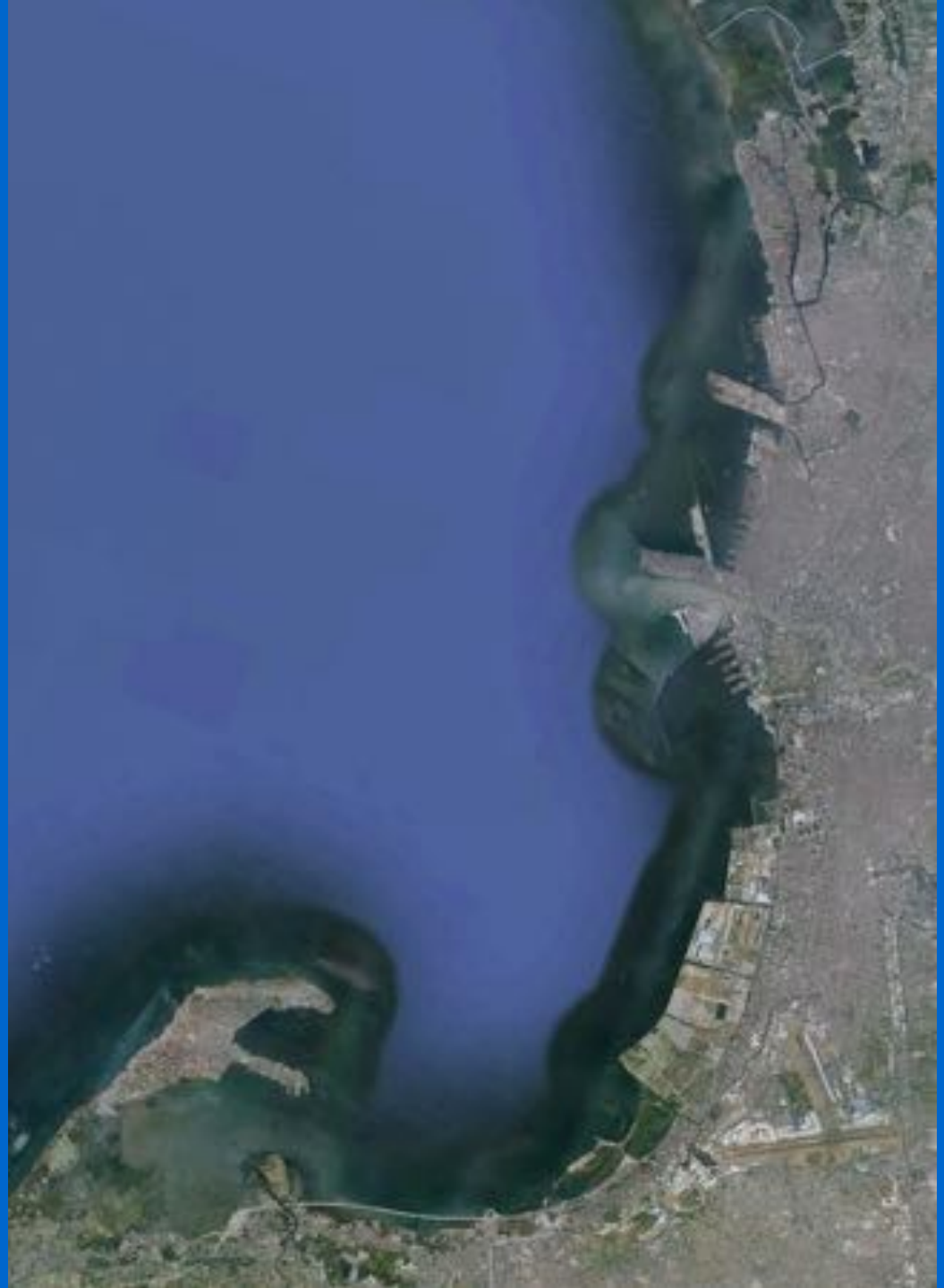




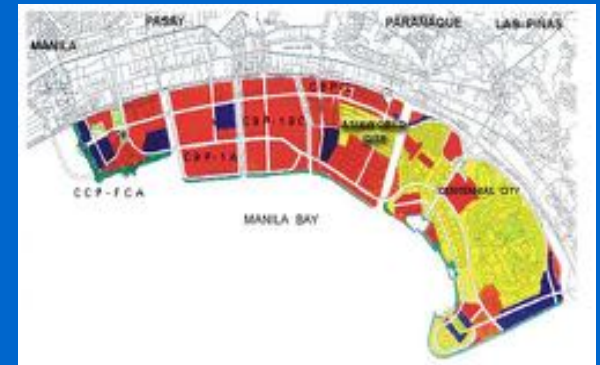


Metro Manila

Land reclamations
along Manila Bay
& Manila Port



Unsolicited development projects along Manila Bay





Metro Manila



Laguna de Bay

-
-
-

SUSTAINABLE COASTAL ZONE DEVELOPMENT

Integrated Coastal & Delta Policy via Building with Nature®

Prof. Dr. R.E. Waterman MSc



Vietnam - Ho Chi Minh City



Mekong Delta & Ho Chi Minh City



VIETNAM



THE NETHERLANDS



SURFACE AREA

330,957 km² 33,883 km²

INHABITANTS

90.6 million 17 million

COASTAL LENGTH

3444 km 353 km

MAIN DELTAS

Mekong Delta 40,000 km²
Red River Delta 14,700 km²

Rhine - Maas - Scheldt Delta
33,000 km²

MEKONG DELTA



SURFACE AREA

40,000 km² 33,883 km²

INHABITANTS

18 million 16.7 million



INHABITANTS HO CHI MINH CITY

8 million

THE NETHERLANDS

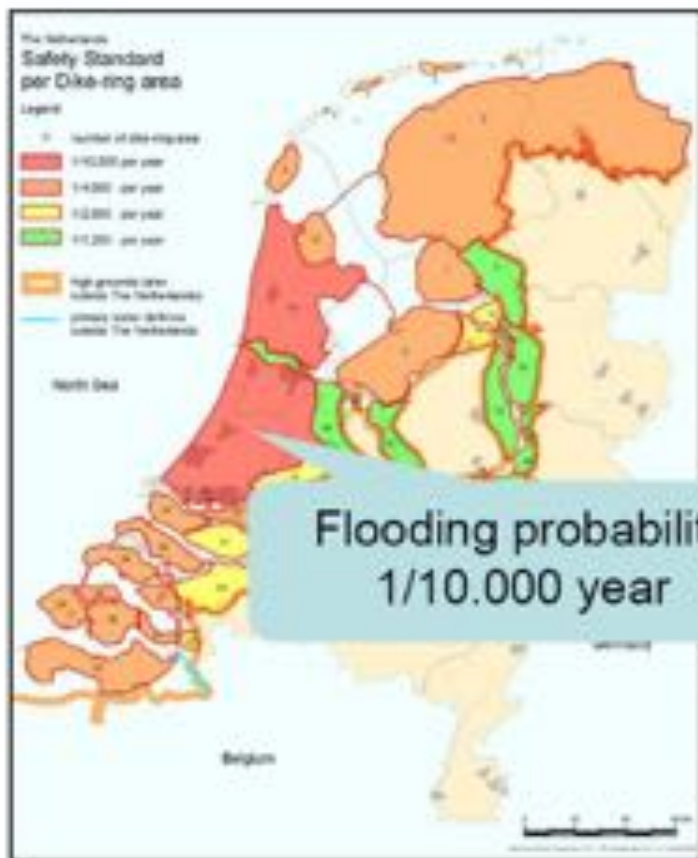


The Dutch Delta in NW Europe and the Mekong Delta in Vietnam



The Netherlands is shaped by the alluvial deposits of Rhine, Meuse, Scheldt and Eems rivers. Approximately the size of the Mekong Delta, which is shaped by the alluvial deposits of the Mekong (and Sai Gon and Dong Nai) river(s). Similar population size ~17 million.

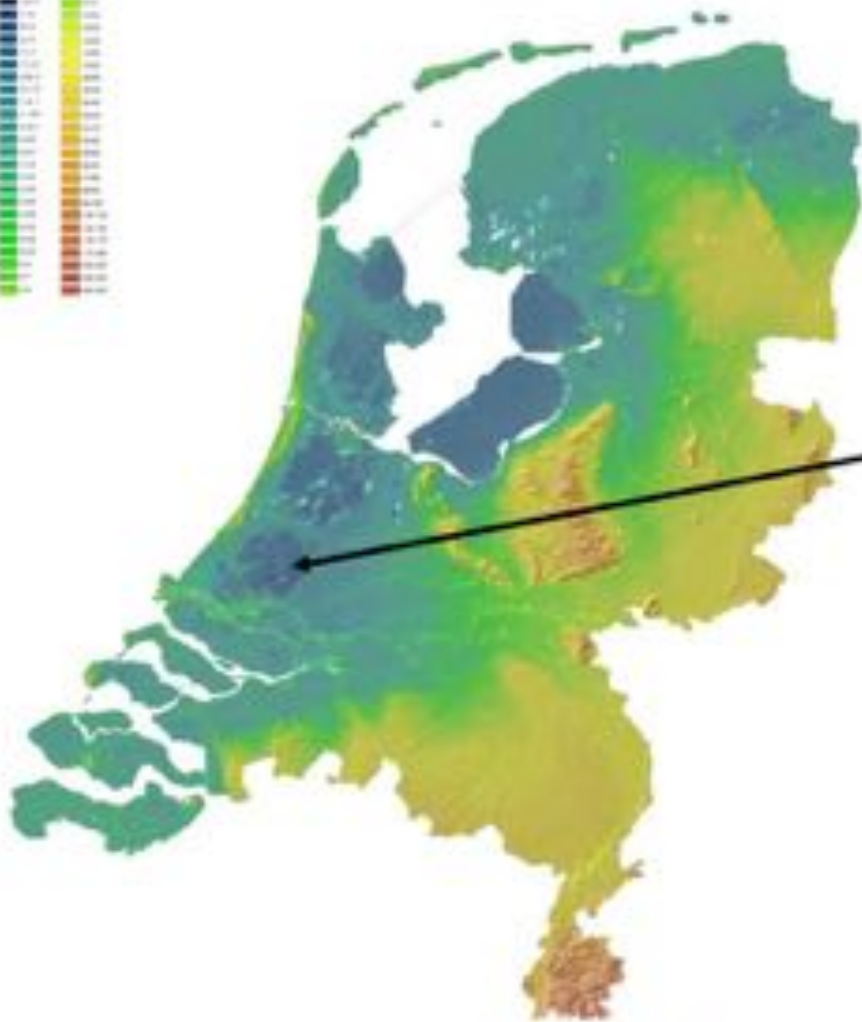
Comparable geography, demography and vulnerability issues, but also marked differences



Flooding probability
1/1 year



Kultureel Hooggebied Nederland (A-01)
met 1000 m/afvalverhoging



- 10 million people in floodprone areas
- Deepest location Zuidplaspolder around Nieuwerkerk aan den IJssel: MSL – 6,76 m.

Safety standard for 53 dike-ring areas



De facto a varying safety:

- NH and ZH 1/10.000 per year
- North and South 1/4.000 per year
- Yellow 1/2.000 per year
- Green: 1/1.250 per year

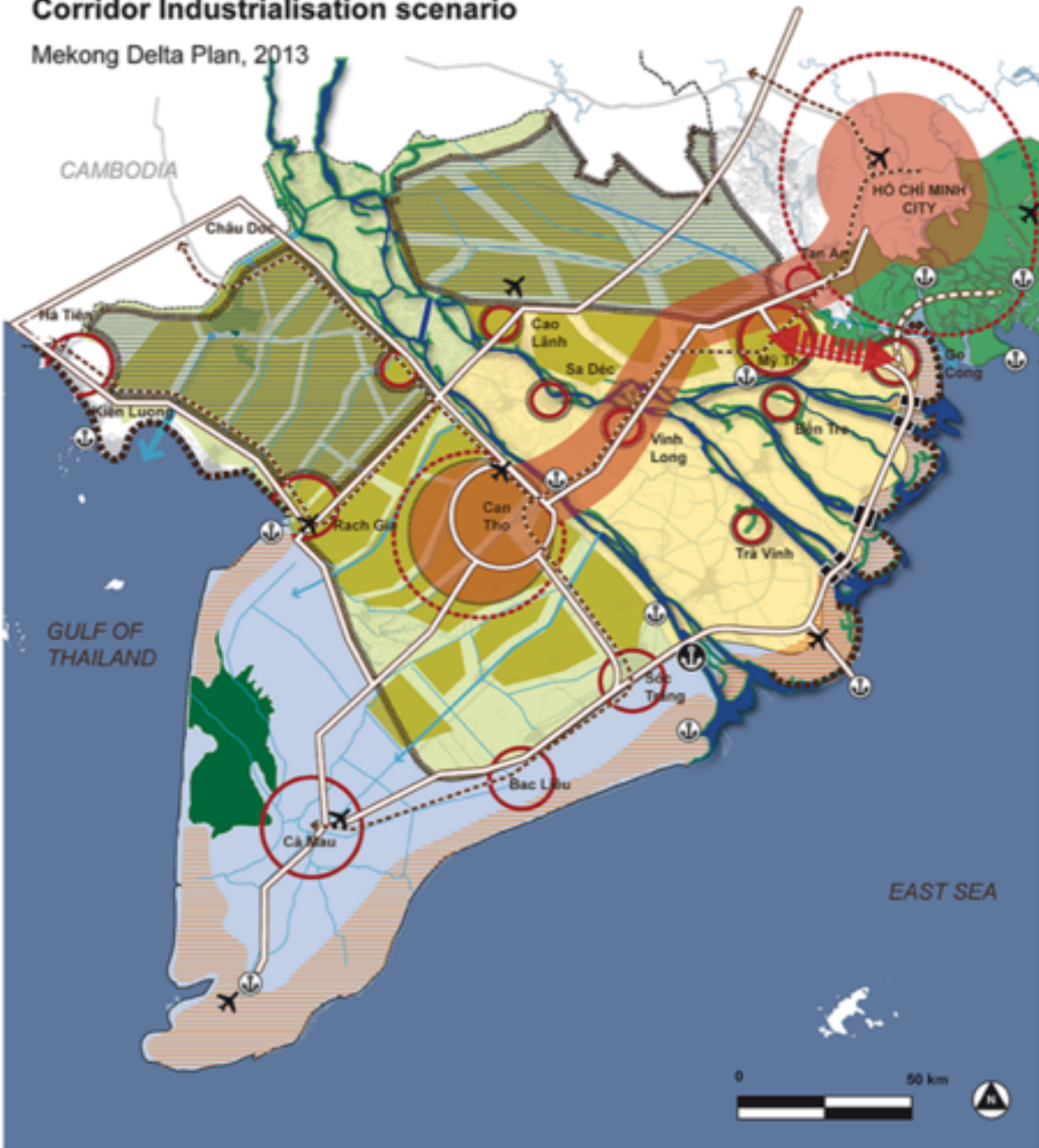
NB:

- Probability individual loss of life in a flooding is 1%, so that the probability due to flooding in the green areas is 1 in 125.000 per year!



Corridor Industrialisation scenario

Mekong Delta Plan, 2013



Water management

- Controlled flooding area
- Water control line
- Coastal defence
- Urban flood protection
- Tidal barriers
- Major diversion channel
- Fresh water supply brackish zone
- Drainage channel
- Securing the Bassac

Land use

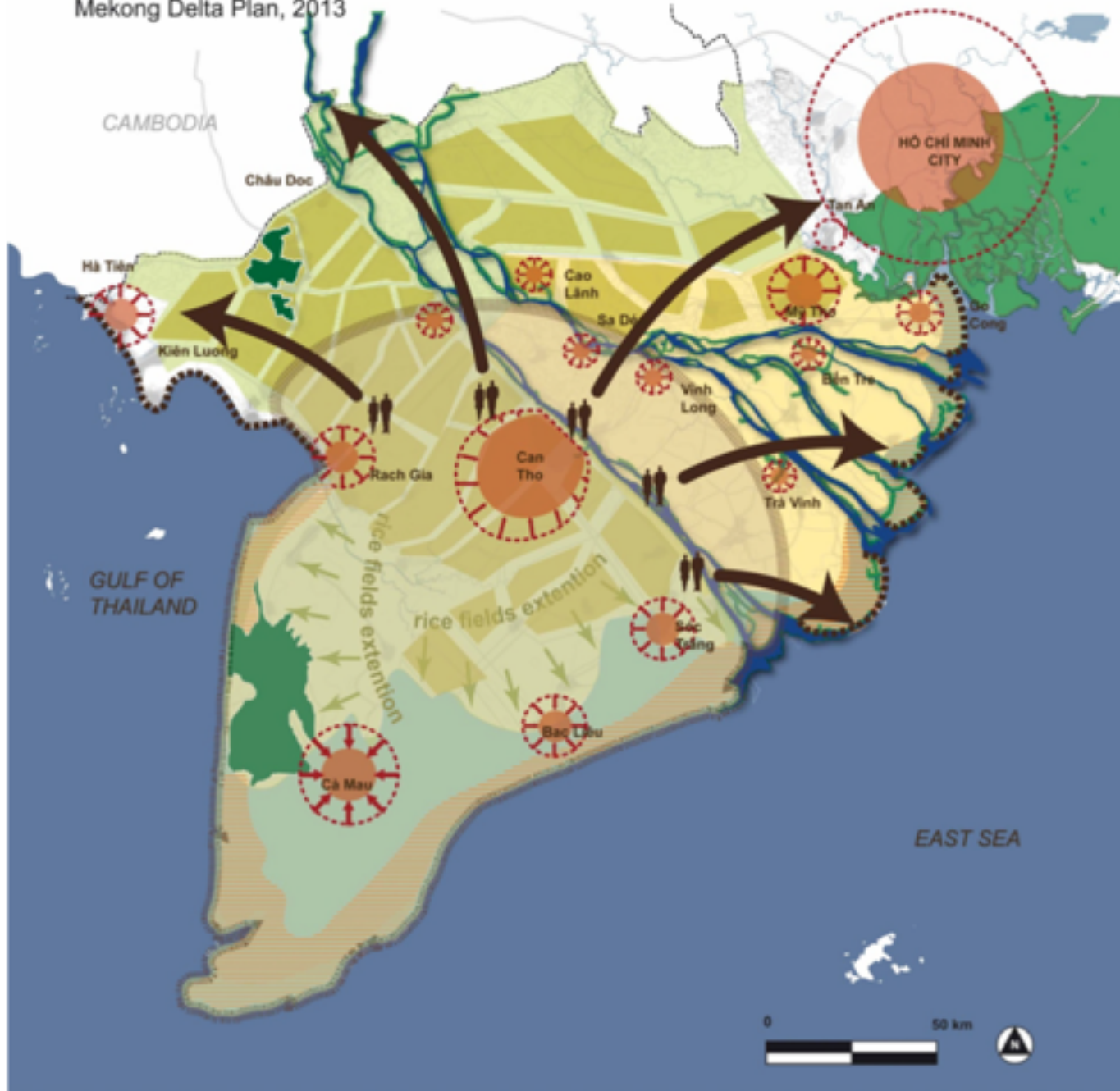
- Trend to triple-crop
- Rice production
- Fruit production
- Brackish water culture
- Shrimp farm
- Protected forest
- Coastal mangrove

Urban & infrastructure

- Urban area
- Urban-commercial zone
- Main highway
- Railway
- Port
- Main port
- Airport

Food Production scenario

Mekong Delta Plan, 2013



Water management

- Poverty agricultural area
- People migrating out of area
- Coastal defence

Land use

- Trend to triple-crop
- Rice production
- Fruit production
- Brackish water culture
- Shrimp farm
- Protected forest
- Coastal mangrove

Urban & infrastructure

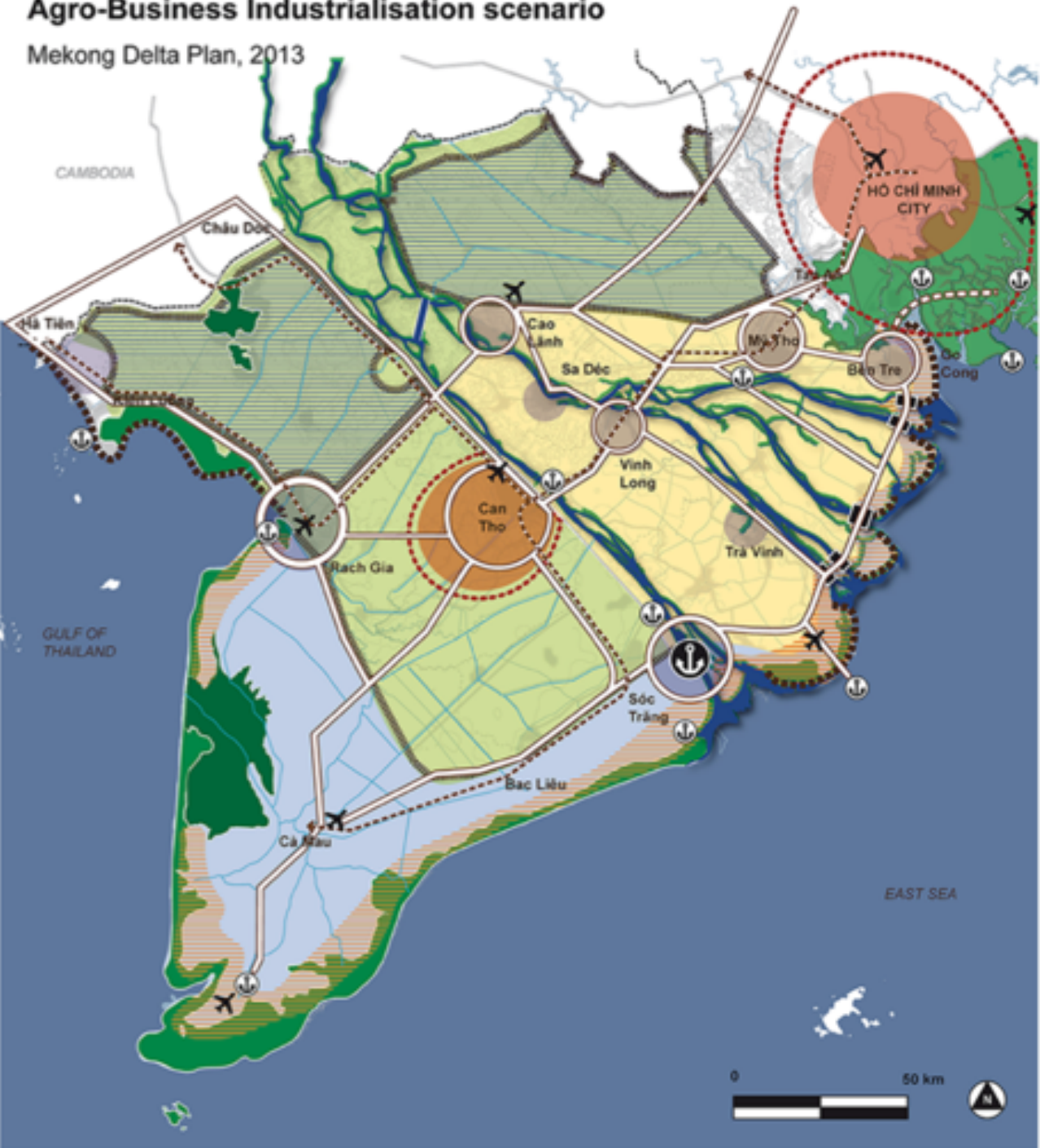
- Urban area
- Population decrease

0 50 km



Agro-Business Industrialisation scenario

Mekong Delta Plan, 2013



Water management

- Controlled flooding area
- Water control line
- Coastal defence
- Urban flood protection
- Tidal barriers
- Major diversion channel
- Fresh water supply brackish zone
- Drainage channel
- Securing the Bassac

Land use

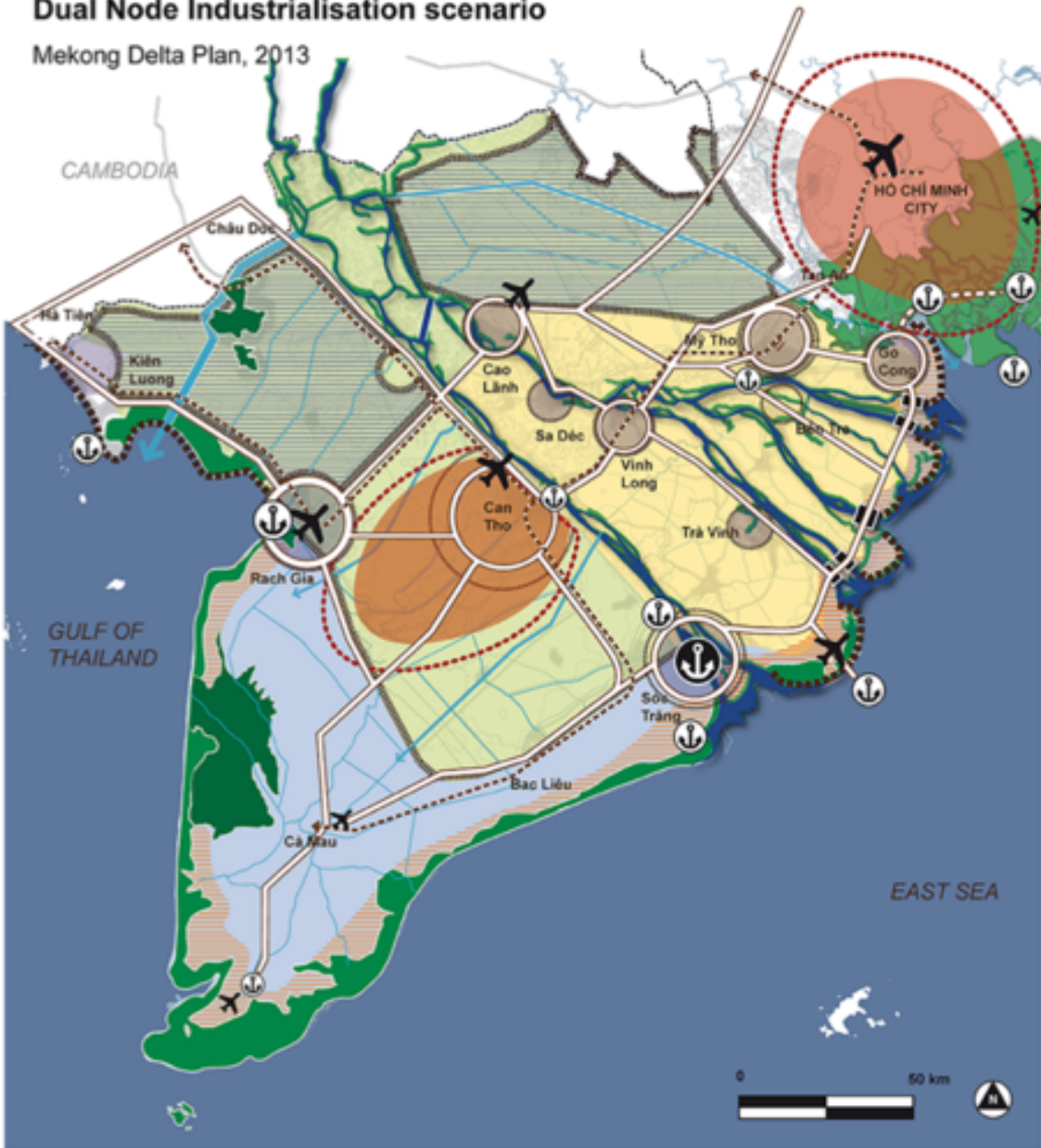
- Intensive agriculture (fruit / rice)
- Aquaculture & High value production
- Sustainable brackish water culture
- Shrimp farm
- Protected forest
- Coastal mangrove

Urban & infrastructure

- Urban area
- Dual Node
- Industrial hubs
- Main highway
- Railway
- Port
- Main port
- Airport

Dual Node Industrialisation scenario

Mekong Delta Plan, 2013



Water management

- Controlled flooding area
- Water control line
- Coastal defence
- Urban flood protection
- Tidal barriers
- Major diversion channel
- Fresh water supply brackish zone
- Drainage channel
- Securing the Bassac

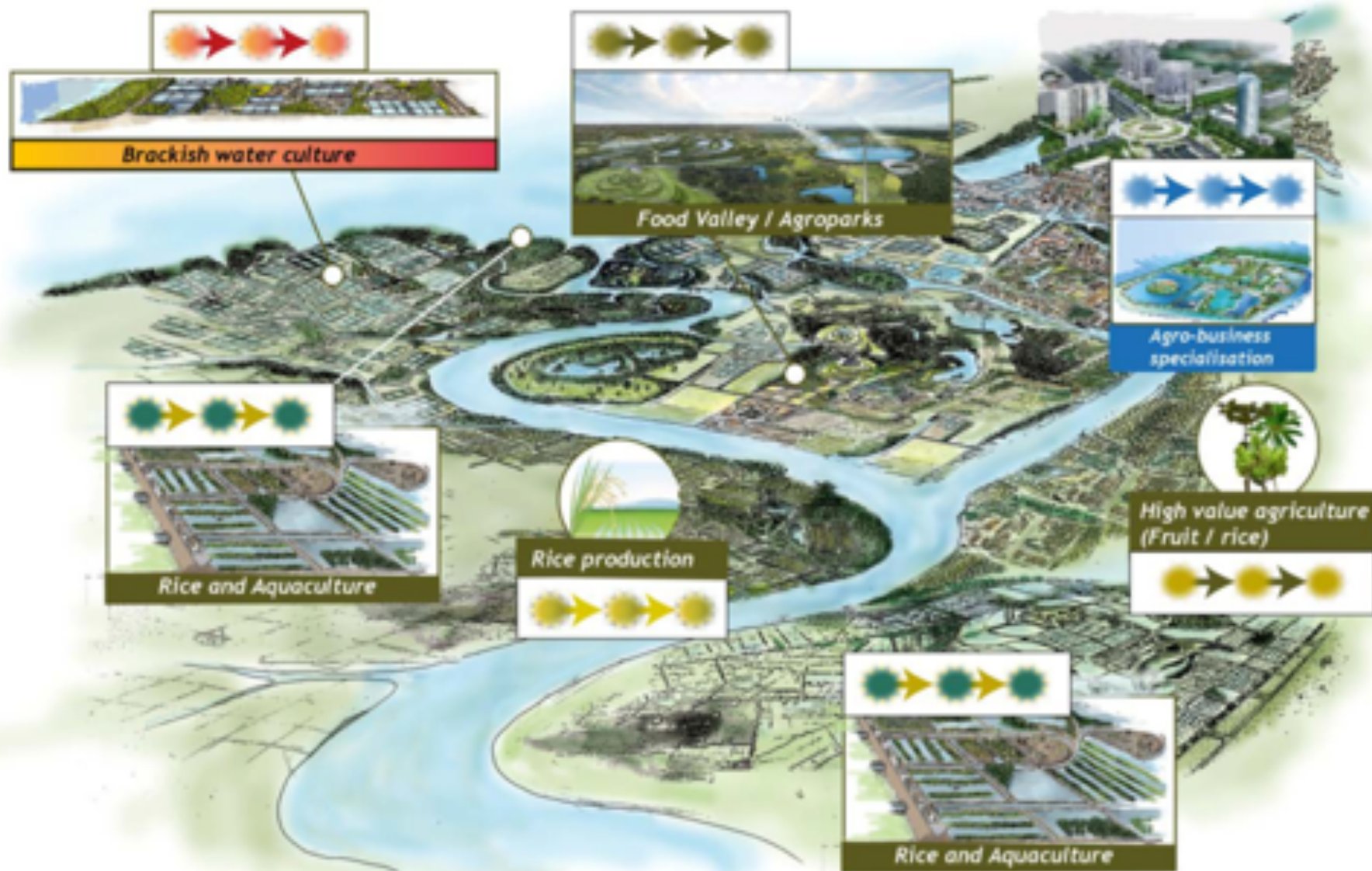
Land use

- Intensive agriculture (fruit / rice)
- Aquaculture & High value production
- Sustainable brackish water culture
- Shrimp farm
- Protected forest
- Coastal mangrove

Urban & infrastructure

- Urban area
- Dual node
- Industrial hubs
- Main highway
- Railway
- Port
- Main port
- Airport

Value Chains

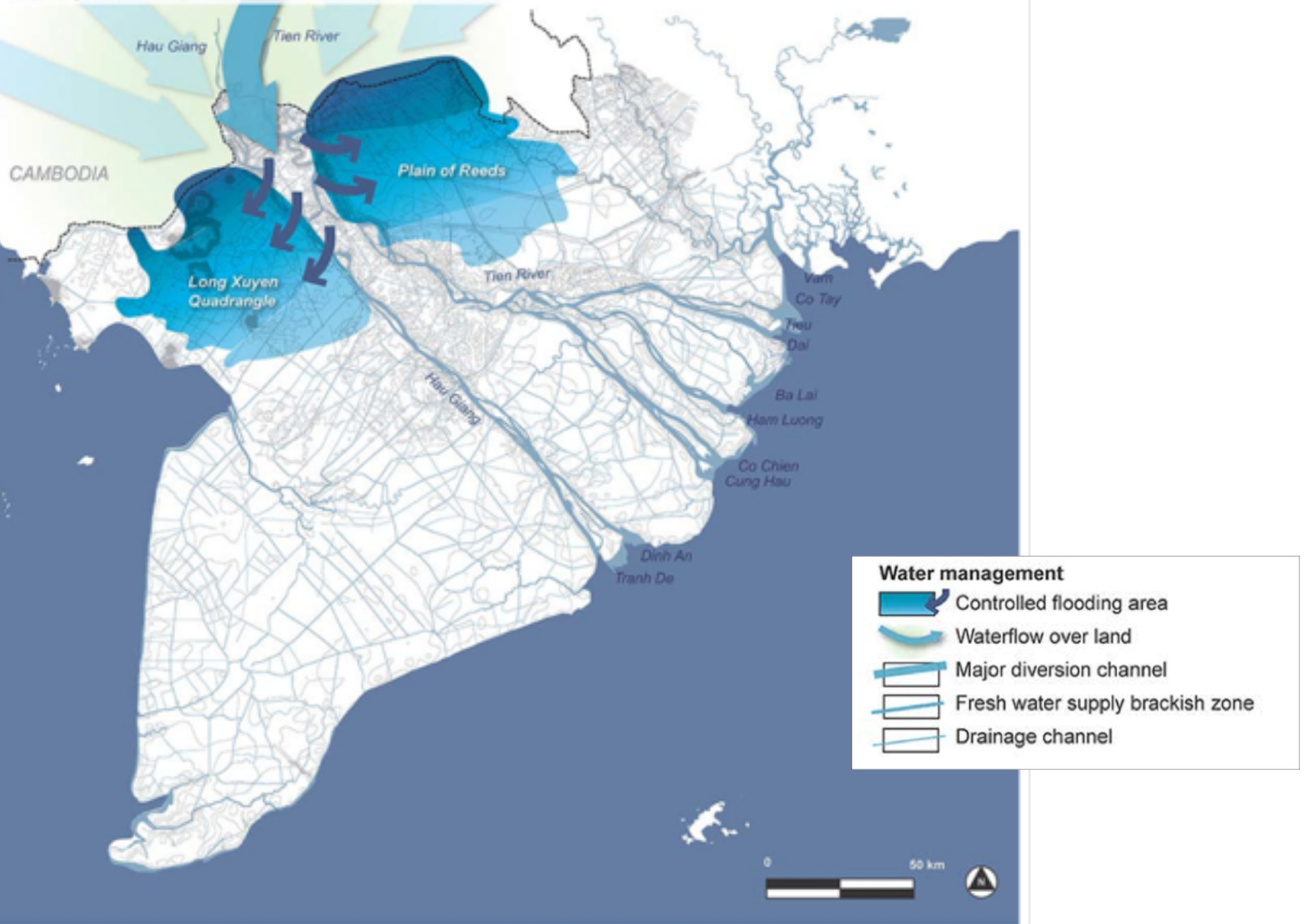






Vision 2100 | Controlled Flooding

Mekong Delta Plan, 2013



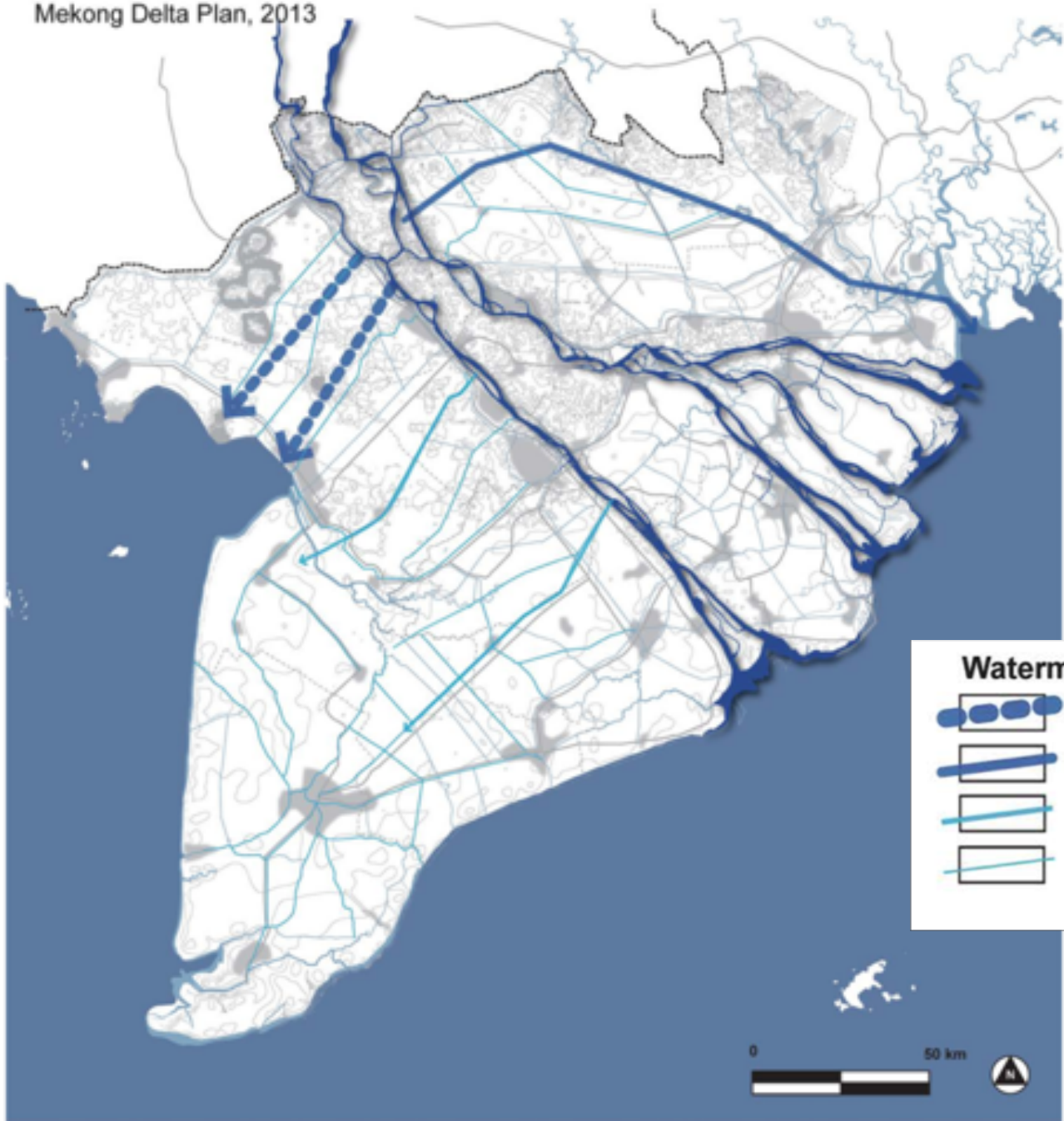
Inundated rice paddies in the wet season (Upper Delta) offer controlled retention of river floods after two crops







Controlled flooding in the Upper Delta, using the inundated paddies for fish farming in the wet season or 'floating vegetables', offering an attractive economic proposition

Vision 2100 | Major Flood Diversion

Mekong Delta Plan, 2013



Watermanagement

-  Major diversion
-  Major diversion
-  Fresh water supply brackish zone
-  Drainage channel

Vision 2100 | Ensuring flow and sediment partition between Hau and Tien river

Mekong Delta Plan, 2013





Hau Giang Tien River

Linking canal

Tien River

Hau Giang

Water management

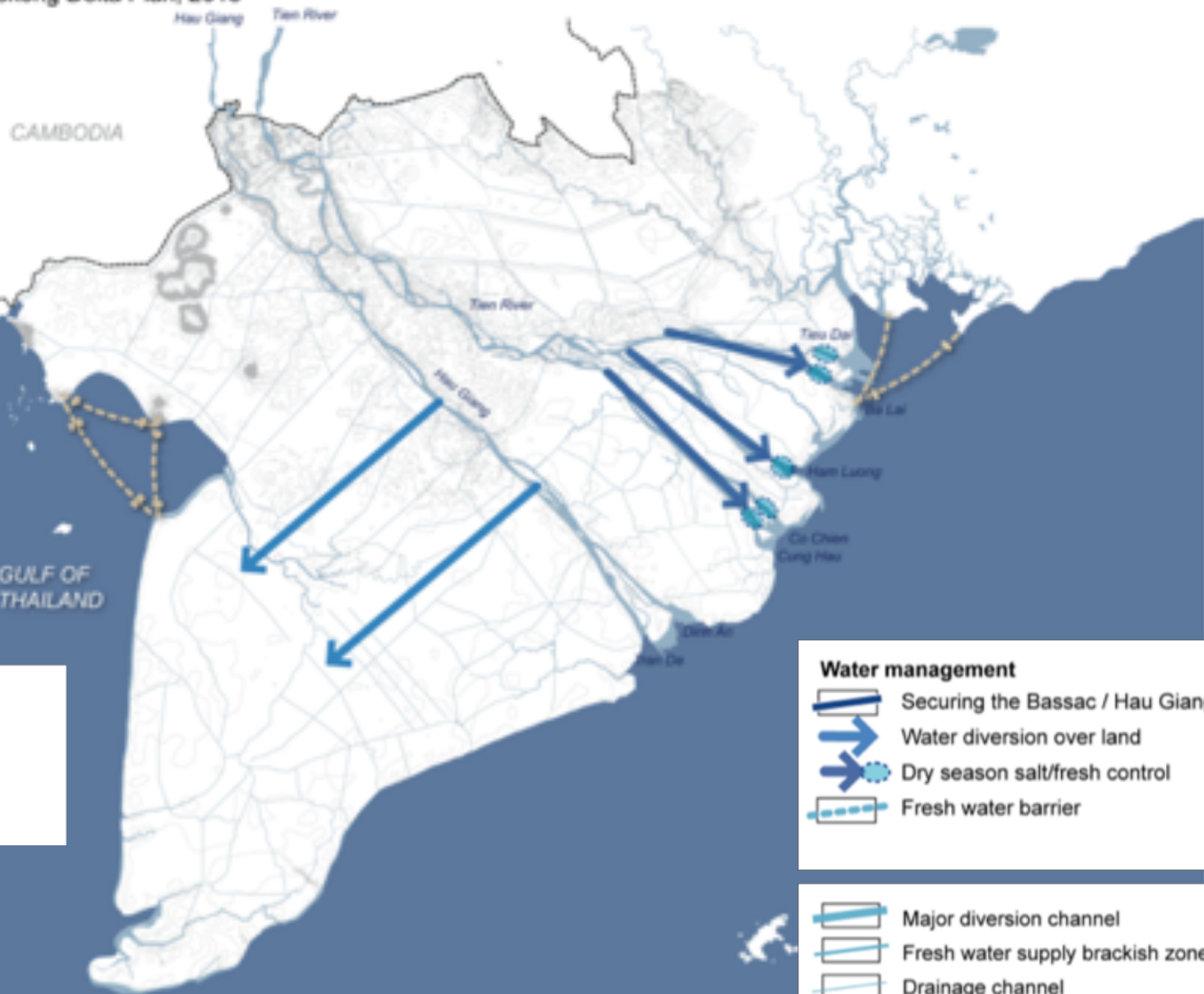
-  Securing the Bassac / Hau Giang
-  Major diversion channel
-  Fresh water supply brackish zone
-  Drainage channel

0 50 km



Vision 2100 | Fresh water supply possibilities

Mekong Delta Plan, 2013



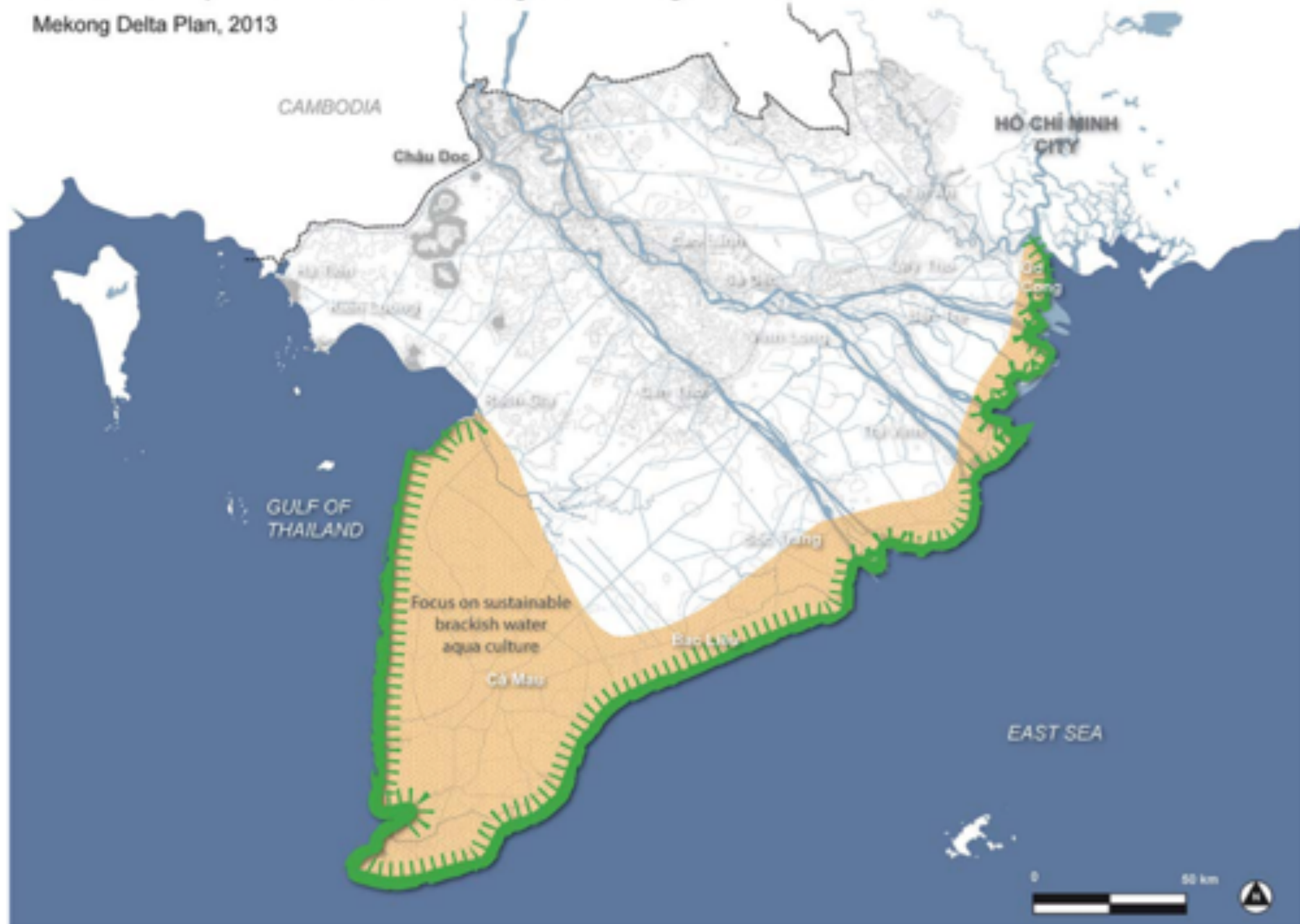
Water management

- Securing the Bassac / Hau Giang
- Water diversion over land
- Dry season salt/fresh control
- Fresh water barrier

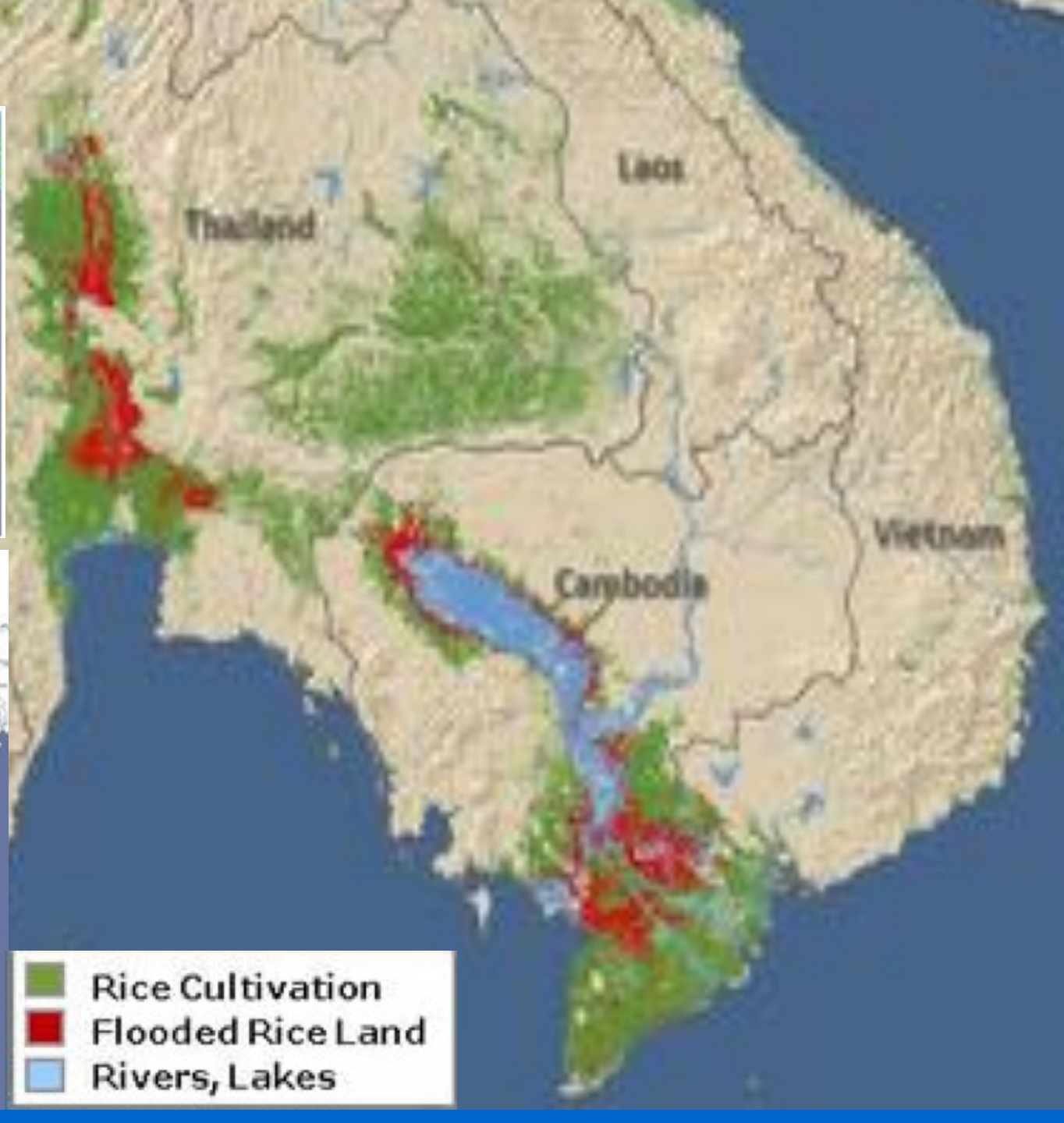
- Major diversion channel
- Fresh water supply brackish zone
- Drainage channel

Coastal Zone | Dual Zone Coastal Management - living with saline water

Mekong Delta Plan, 2013

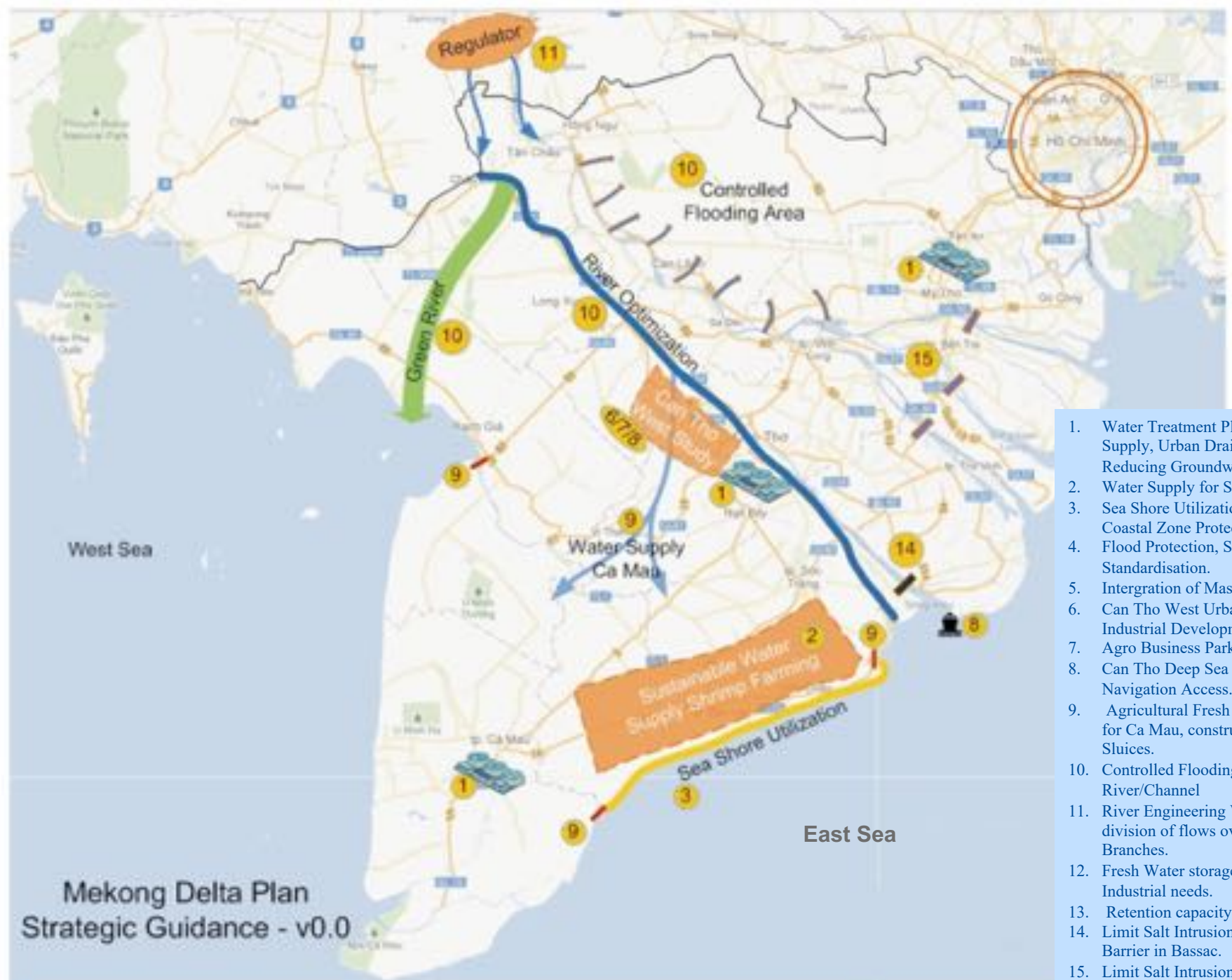


MEKONG DELTA



Regional divisions
Mekong Delta Plan, 2012





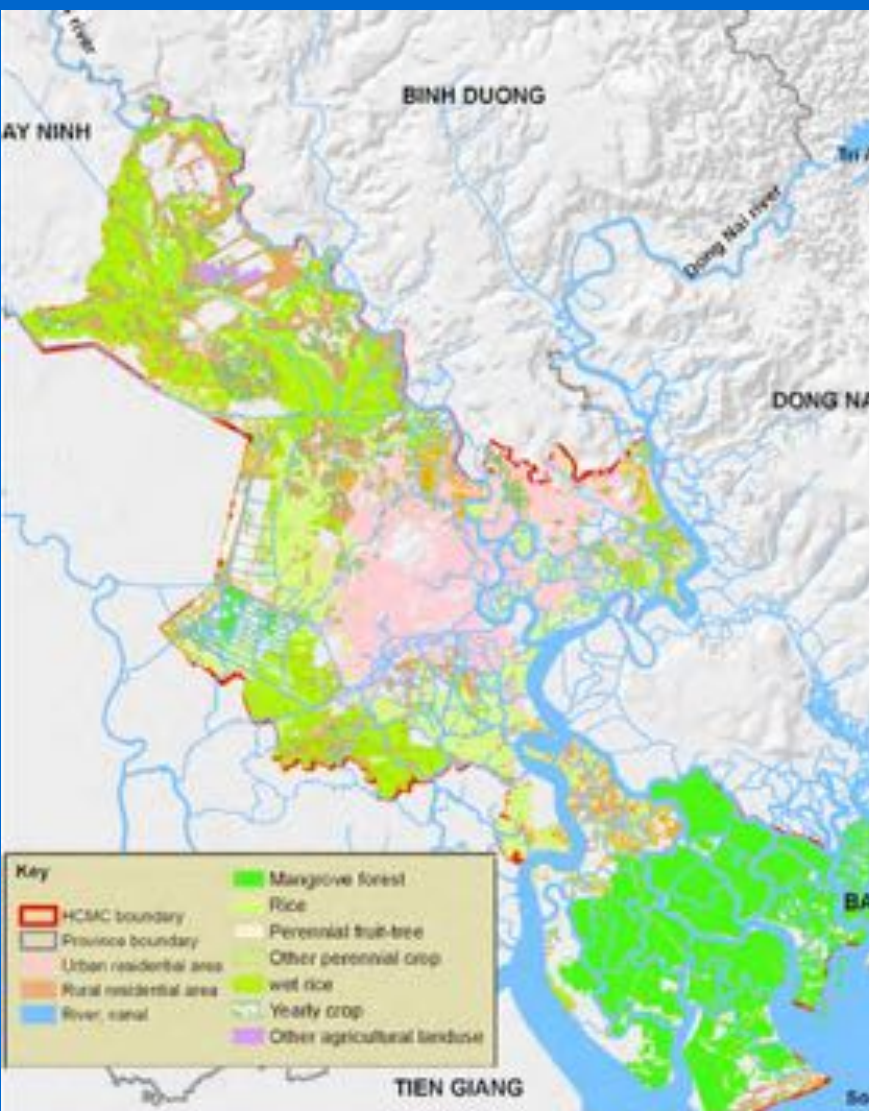
1. Water Treatment Plants, Water Supply, Urban Drainage, Reducing Groundwater Use.
2. Water Supply for Shrimp Farming.
3. Sea Shore Utilization Plan, Coastal Zone Protection.
4. Flood Protection, Safety Level Standardisation.
5. Intergration of Master Plans.
6. Can Tho West Urban & Industrial Development.
7. Agro Business Park.
8. Can Tho Deep Sea Port with Navigation Access.
9. Agricultural Fresh Water Supply for Ca Mau, construction of 3 Sluices.
10. Controlled Flooding, Green River/Channel
11. River Engineering Works for division of flows over the River Branches.
12. Fresh Water storage for Urban & Industrial needs.
13. Retention capacity Urban Areas.
14. Limit Salt Intrusion, Storm Surge Barrier in Bassac.
15. Limit Salt Intrusion, Storm Surge Barrier in River Branches.

Mekong Delta Plan
Strategic Guidance - v0.0

Climate Adaptation Strategy **Ho Chi Minh City**

moving towards the sea with climate change adaptation





Land use map of Ho Chi Minh City in 2005. Source: HCMC Adaptation in Climate Change Study Report



- | | | | |
|--------------------------------|--|------------------------------|------------------------|
| 1. New City Center | 8. Museum | 16. Riverfront Crossway Park | 24. Marina |
| 2. Residential District | 9. Sports Center | 17. City Park | 25. Preserved Island |
| 3. Public Institution District | 10. Research Institution | 18. Aquatic Park | 26. Traditional Town |
| 4. Urban Village | 11. Cultural Center-Information Center | 19. Entertainment | 27. Amphitheater |
| 5. Commercial Center | 12. Neighborhood Center | 20. Business Hotel | 28. Historic Structure |
| 6. Convention Center | 13. Central Plaza | 21. Botanical Gardens | 29. Subway Station |
| 7. Arena | 14. Riverfront Promenade | 22. Delta Research Institute | |

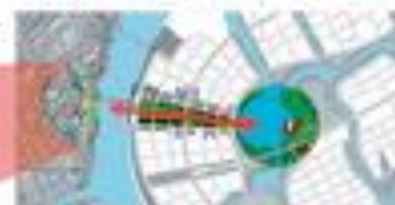


Planning for low-lying areas

Ho Chi Minh City



Low-lying areas in urban area



Low-lying areas in urban area with low-lying part

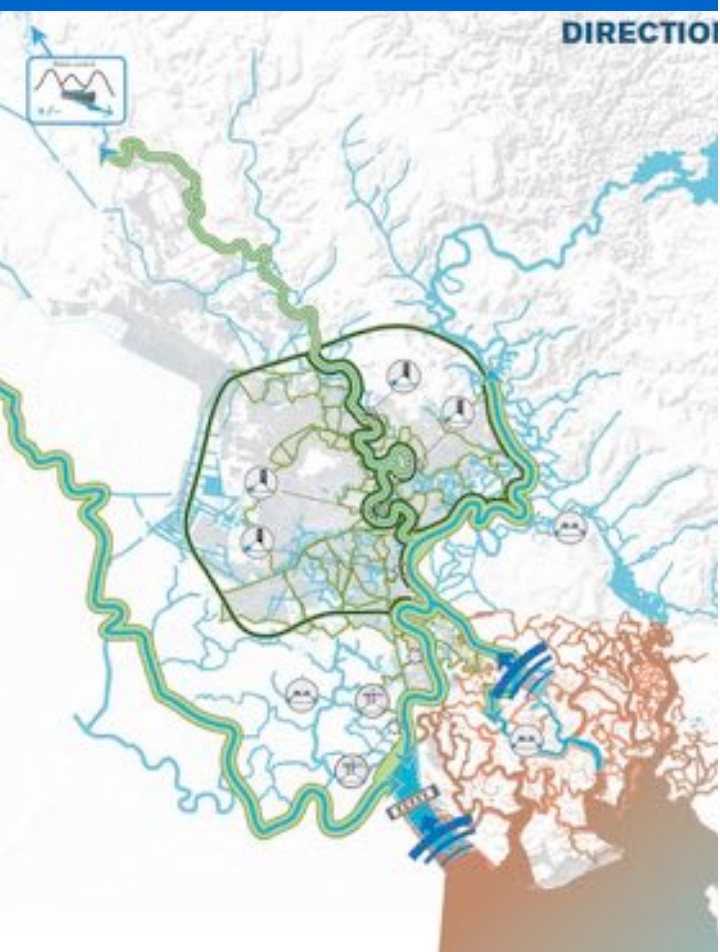
Climate change impact Ho Chi Minh City

increased precipitation peaks





	Strategic Intervention	Term	Type	
1A	Develop new residential areas towards the northwest and east	Short term	No-regret	In all scenarios space is needed for urban expansion. From a climate adaptation point of view the northwest and east are the best locations. Developing towards the south will require large investments in water safety in the future.
1B	Develop harbours towards the south using adaptive measures	Short term, outplacement has already started.	Safety margin, include flexibility	Develop capital intensive harbour areas with a surplus height anticipating future sea level rise. Where possible, leave room for future adjustment. In case of lower economic growth, not all of the proposed locations may be necessary so don't develop too much land at once.
1C	Redevelop old harbours, combining flood protection with attractive water fronts	Short term, outplacement has already started.	Win-win	Developing a delta-dike in some inner-city locations a win-win situation as more space for development becomes available.
1D	Increase urban density in the inner-city	Short term	No-regret	In all scenarios the population of the city grows at least until 2035. Increasing density as a solution means that less new ground will be urbanized, a process that normally is irreversible.
1E	Develop north-south infrastructure	Short term	Robust	Build infrastructure robust, taking into account sea level rise. Measures are necessary for the success of the harbour and industrial areas in the south. The connections are clearly more profitable in high growth scenarios.
1F	Avoid encroachment on waterways	Short term	No-regret	In all scenarios there will be a need to avoid encroachment.



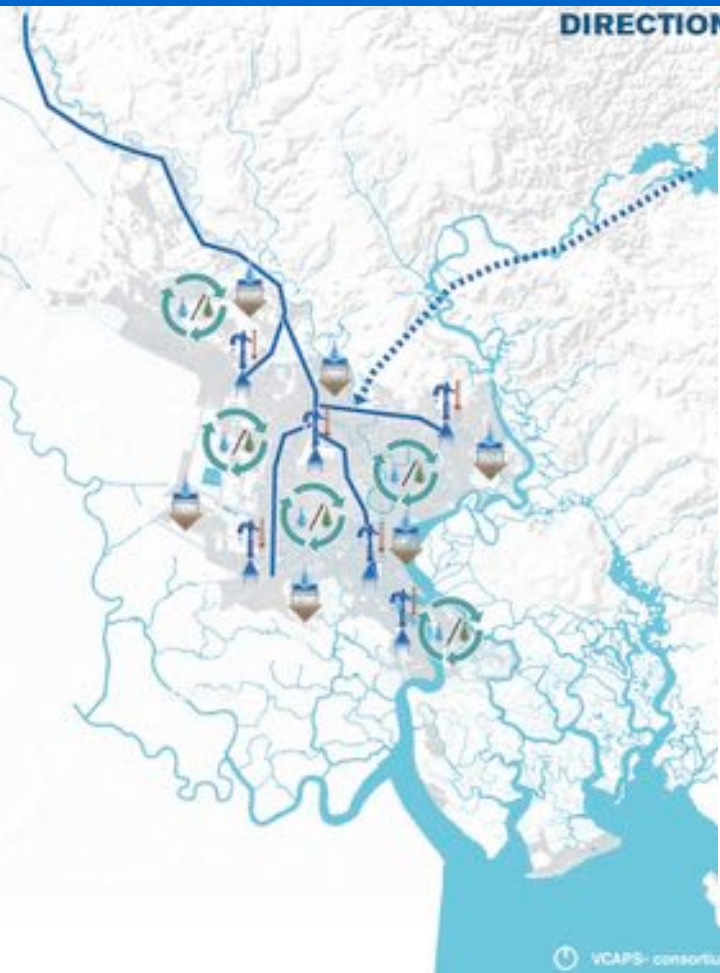
DIRECTION

	Strategic Intervention	Term	Type	
	2A Develop flood risk maps and flood risk standards	Short term		Flood risk maps form the basis for standards
	2B Protect the inner city with ring dikes	Short term	Win-win	Combination with the development of ring road 3 saves costs.
	2C Optimize reservoir management for flood protection	Short term	No regret	Optimizing reservoir operation from a floods perspective will reduce the risks of inundation north of HCMC.
	2D Tidal barrier	Long term		Measure only necessary in case of extreme sea level rise.
	2E Develop district adaptation pathways	Short term	No regret	A bottom-up approach is expected to contribute to resilience at the district level.
	2F Adaptive building towards the south	Short term	Flexible	Building in smaller quantities and on mounds leaving space for future adaptation makes it possible to grow with sea level rise.
	2G Identify and protect the vital and the vulnerable areas in HCMC	Short term	No regret, robust	Create extra robust solutions for vital and vulnerable functions.
	2H Protect the riparian zones along the rivers	Short term	No regret	In all scenarios, safeguarding riparian zones leads to the reduction of flood risks.
	2I Strengthen emergency management	Short term	No regret	Helps to reduce victims and economic damage also in the existing situation.



	Strategic Intervention	Term	Type	
4A	Large scale measures against flooding reduce salt intrusion	Mid-term	Win-win	A ring dike with tidal gates will also reduce the amount of brackish water entering the city's water system. If these measures are taken this will be justified from a foods perspective. Their effect on salt intrusion is a positive side-effect.
4B	Smart dredging to reduce impact	Short term	Delaying action	Coupled to development of harbours. Smart dredging reduces the impact of dredging on salt intrusion compared to normal dredging.
4C	Flush the city's water system	Short term		Measure to reduce impacts.
4D	Evaluate relocation of drinking water intakes and wells	Mid term	No-regret	Locations for water supply station should be reserved on the short term to relocate intakes on the mid-term.
4E	Decrease groundwater extraction to a sustainable level	Short term	No-regret	If groundwater extraction is not reduced to a sustainable level, groundwater resources will be depleted in all scenarios.
4F	Use salt resistant vegetation in flood prone areas	Short term	No-regret	Take midterm changes in salt levels into account when designing public space.

DIRECTION 5



	Strategic Intervention	Term	Type	
5A	Reducing demand and regulating use	Short term	No-regret	Measures are necessary in the current situation and in all scenarios.
5B	Stimulation groundwater recharge	Short term	No-regret	Measures are necessary in the current situation and in all scenarios.
5C	Upgrade water supply from Dau Tieng reservoir	Short term	No-regret	Measure is necessary to replace current groundwater use
5D	Install and execute programme for sanitation and water quality improvement	Short term	No-regret, win-win	The current poor water quality has a high impact on ecological and living conditions in and around the city. In all scenarios investing in water quality will make using river water more economically attractive.
5E	Mitigate effects of subsidence on drainage system	Mid term		The possibility to invest in expensive mitigation measures will depend on the economic scenario. In LP3 and 4 such areas may be abandoned rather than upgraded.



Possible alternatives

Aims:

- Lowering level HCMC
- Lowering salinity Dong Thap Muoi
- Maintaining tide and salt Can Gio
- Maintaining shipping route Cai Mep

May 3, 2013

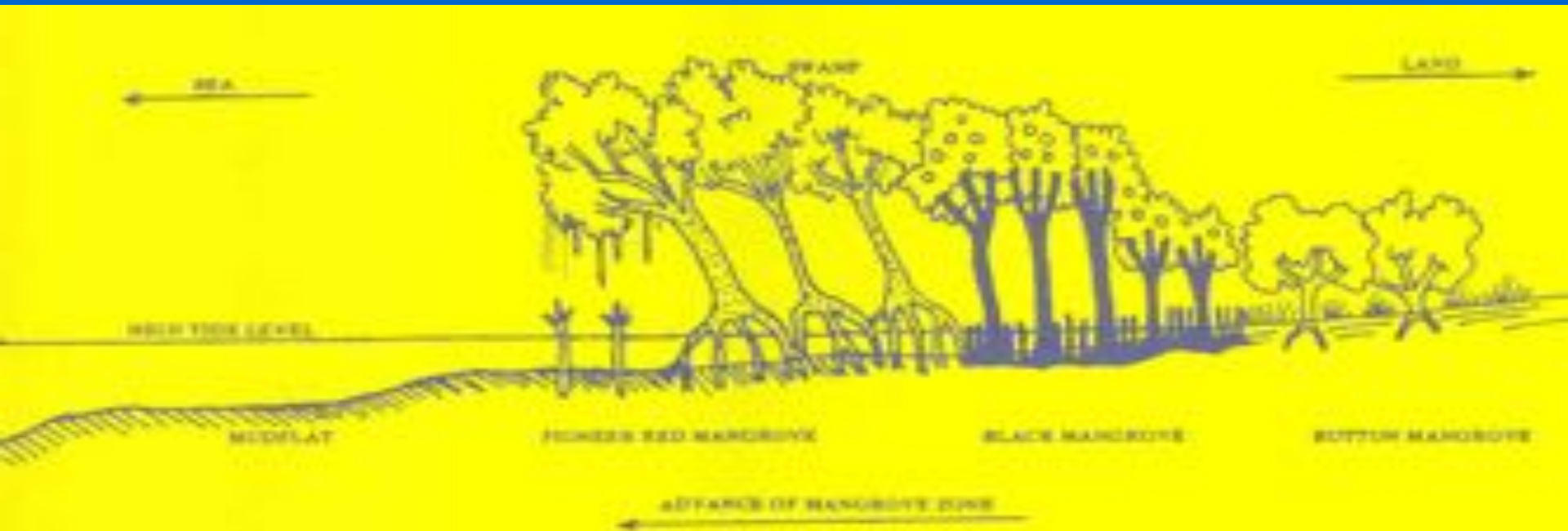
MANGROVES

Dr. Bob Ursem TU Delft

Mangroves characteristics & types

Mangroves for coastal protection

Mangroves as a basis for a rich eco-system





Category 1

First boundary layer of coastal defense, rough salt rich turbulent environment is an excellent growth area for mangroves with stilt pneumatophore root systems: tall trees, robust root systems, well anchored in mud, no settling of silt. Especially good for blocking storms and strong wave impact.

Category 2 and 3

A more inland, relative dynamic up to non turbulent, low saline level environment is an excellent growth area for mangroves with erect pneumatophore root systems: middle to tall tree sizes, sometimes shrubs, root system just reaching the high tide level, relative open to dense root cover, only anchored in mud at the base, creating a perfect alluvial environment.

**Mangroves suitable for coastal defense in Vietnam
(from open sea to the ecological succession of mangrove forests)**



Category 1 *Rhizophora apiculata*

Rhizophora apiculata can handle rough turbulent, high saline conditions and soils of sand flats with slimy mud up to heavy clay/mud conditions. Needs high saline water all year around!

Sonneratia caseolaris



Sonneratia caseolaris prefer sand and mud conditions, most common in estuaries, having high saline up to brackish water (5 up to 10‰).

Red mangroves exclude salt by having significantly impermeable roots which are highly buttressed, acting as an ultra-filtration mechanism to exclude sodium salts from the rest of the plant.

Analysis of water inside mangroves has shown that 90% to 97% of salt has been excluded at the roots. Salt which does accumulate in the shoot concentrates in old leaves which the plant then sheds.

Red mangroves can also store salt in cell vacuoles.

White (or grey) mangroves can secrete salts directly; they have two salt glands at each leaf base (hence their name white mangrove - they are covered in white salt crystals as shown below).



Avicennia marina var. intermedia
(grey mangrove, guava mangrove)



Natural conditions. The islands form a barrier to create sheltered conditions with alluvial accumulation of soil settling and to prevent large wave impacts.



What do mangroves need?

- Preferable a muddy (clay or silt rich/rich silt-sandy soil) with a low gradient.
- An suitable tide range, not extreme, as bottom line a near lacking tide.
- A dynamic environment where soil increase can occur due to alluvial accumulation by mangroves.
- A low water current.
- The saline conditions may be variable, high to low content and never totally fresh water.
- Support in the pioneer growth phase to prevent large impact of waves.



Placing bamboo sticks

- in rows parallel to the coast
- at certain distances from each other
- at a considerable distance from the coast (at least 500 m or more).

Siltation occurs. When the silt layer has a certain thickness planting of mangroves can start in a certain sequence.



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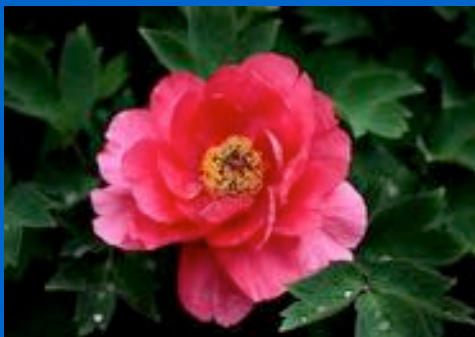
SUSTAINABLE COASTAL ZONE DEVELOPMENT

Integrated Coastal & Deltaic Policy
via Building with Nature[®]



Dr. R.E. Waterman MSc

January 2013



Peoples Republic of China
The Netherlands



BUILDING WITH NATURE



China, Hong Kong



Hong Kong



HONG KONG
Land Reclamations since 1887

- 1977-1996
- 1968-1976
- 1946-1967
- 1925 - 1945
- 1888 - 1924
- Before 1887
- Hong Kong, Original Area
- Original Coastline

0 2 4 6 8 km





Hong Kong International Airport





Hong Kong



SUSTAINABLE COASTAL ZONE DEVELOPMENT

Integrated Coastal & Deltaic Policy via Building with Nature®



Dr. R.E. Waterman MSc

FUJIAN

March 2012



Peoples Republic of China
The Netherlands





THE NETHERLANDS

Surface Area 41,526 km²

Inhabitants 17 million

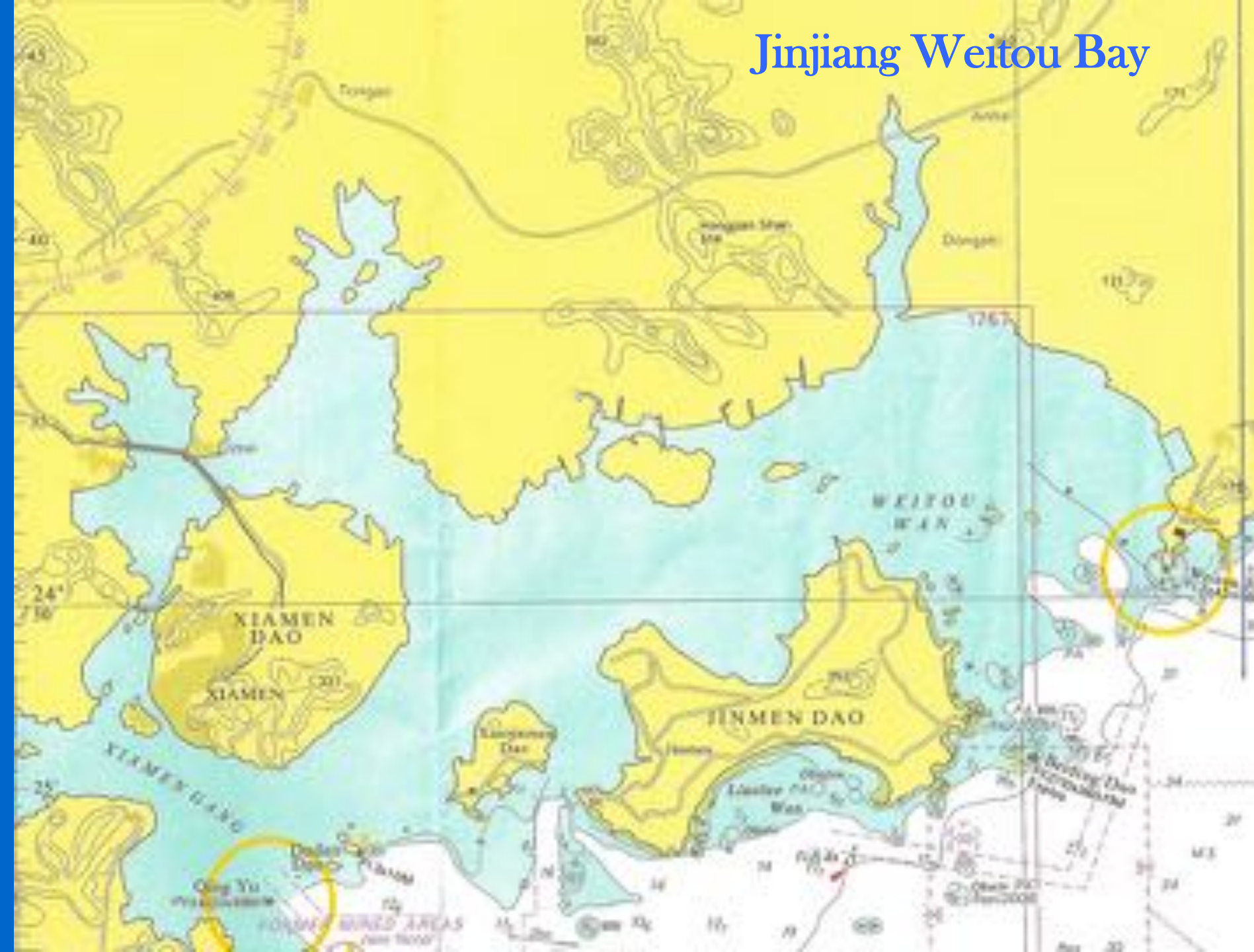


FUJIAN

Surface Area 121,400 km²

Inhabitants 36.9 million

Jinjiang Weitou Bay





Jinjiang Weitou Bay Reclamation

ca. 15 x 3 km : land 34 km² water 10.7 km²



Xiamen

3.5 million inhabitants

Jinjiang

1 million inhabitants

13 neighbourhoods

- a. Residential Area
- b. Ocean park
- c. Business & sports

YUNXIAO

Development Zone
LED Technology Centre
& Fishing Harbour
with Residential Area

YUNXIAO



GULEI PENINSULA
Harbour Development
Zone



DONGSHAN

High Tech Industry
Industry & Logistics
Green Axis
Ecological Farmland
Residential Area
Marine Industry Area
Tourism Area

DONGSHAN DAO & DONGSHAN WAN



BUILDING WITH NATURE



China, Shanghai



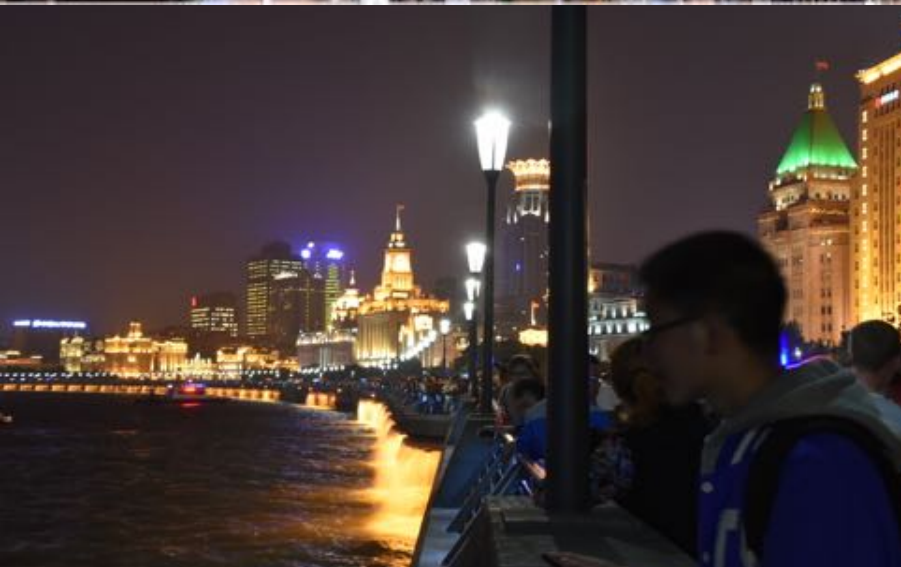
Shanghai



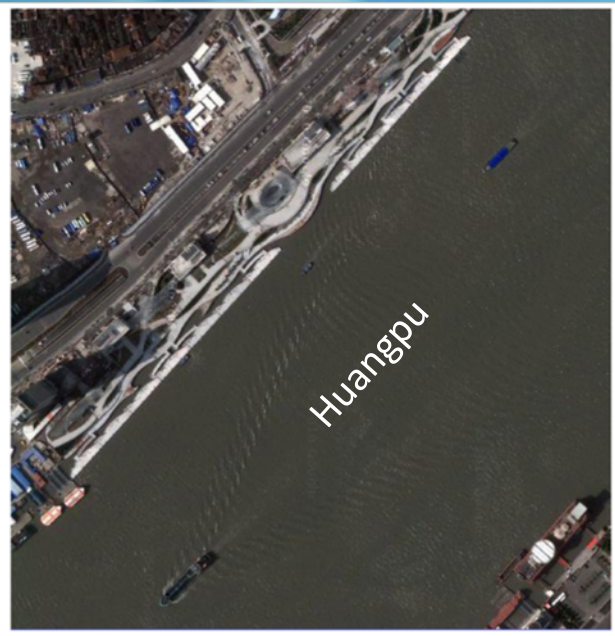
Shanghai



Shanghai



Shanghai - Bund New Horizon Marina River Zone Development





Shanghai - New Horizon Marina

River Zone Development



PRC - HAINAN



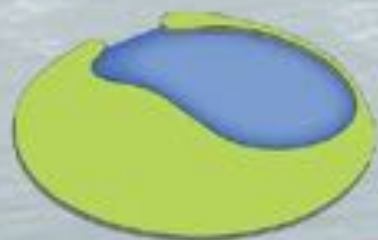


阴阳

是对平衡的追寻

Yin-Yang

Yin Yang is about balance.



启发

岛屿形状为中国传统文化中阴阳的形象。

强调对平衡的坚持。

Inspired by Yin-Yang

The shape of the island is in line with the ancient Chinese symbol of yin-yang. It is emphasizing the strive for balance.



明珠

岛屿的心脏，是明珠所在的地方，也是陆海相接处。

船只停靠在这里，守护着明珠岛的秘密。

The Pearl

In its midst lies the Pearl, pivotal center of Pearl Island. The Pearl, in which sea and land come together and are connected. It holds the secret of Pearl Island.



起伏的边缘

起伏的岛屿边缘是建设区的边界，由流线型的酒店环绕，

形状如同绵延的山脉。

Undulating edge circle

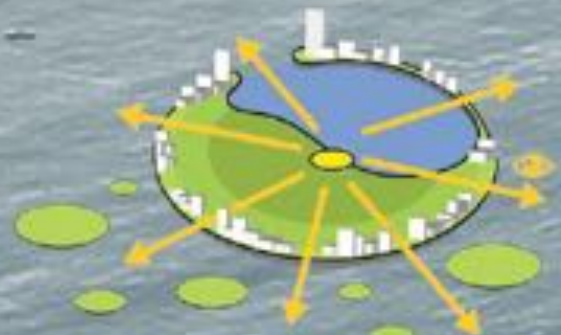
This embracing gesture of welcome, formed by the defined, undulating edge of the city.

变幻的视野

当游轮从海上驶向这片宁静的港湾，郁郁葱葱的绿谷和海洋也随之映入眼帘。这是一座充满花园与绿地、新鲜与奇妙体验的城市。

View open to the sea

As ships arrive from the sea entering a calm bay, their passenger's view opens to a lush, jungle valley, and sea.

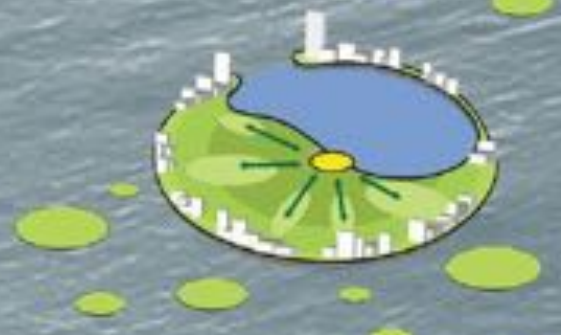


绿蓝交错的室外桃源

置身于明珠岛，恍如进入蓝绿交错的世外桃源。

Paradise of green and blue

Hidden inside the island is a paradise of green, blue for all to discover, savor and experience.



龙凤呈祥

龙凤之城遥相呼应。环绕明珠起舞，展示了律动与宁静的变幻。

Dragon and Phoenix

Phoenix joined with the Dragon in a whirling dance around the Pearl, she embodies lightness and calmness.



明珠岛迎接世界

明珠岛迎接世界，引领世界。城市生态化为城市发展带来全新理念，也为人们带来更舒适的体验。

Pearl Island welcomes the world

It will be a place that leads the world and guiding principles in natural urbanism.







-
-
-

SUSTAINABLE COASTAL ZONE DEVELOPMENT



Dr. R. E. Waterman MSc



**KOREA
THE NETHERLANDS**

JUNE 2012



SOUTH KOREA



SURFACE AREA

100,210 km² 33,883 km²

INHABITANTS

50.8 million 17 million

COASTAL LENGTH

14,800 km 353 km

MAIN RIVERS

Han Gang	Rhine
Nak Dong Gang	Maas
Geum Gang	Scheldt
Yeong San Gang	Eems

4 RIVERS RENAISSANCE

Han Gang, Nak Dong Gang,
Geum Gang, Yeong San Gang

THE NETHERLANDS



Background

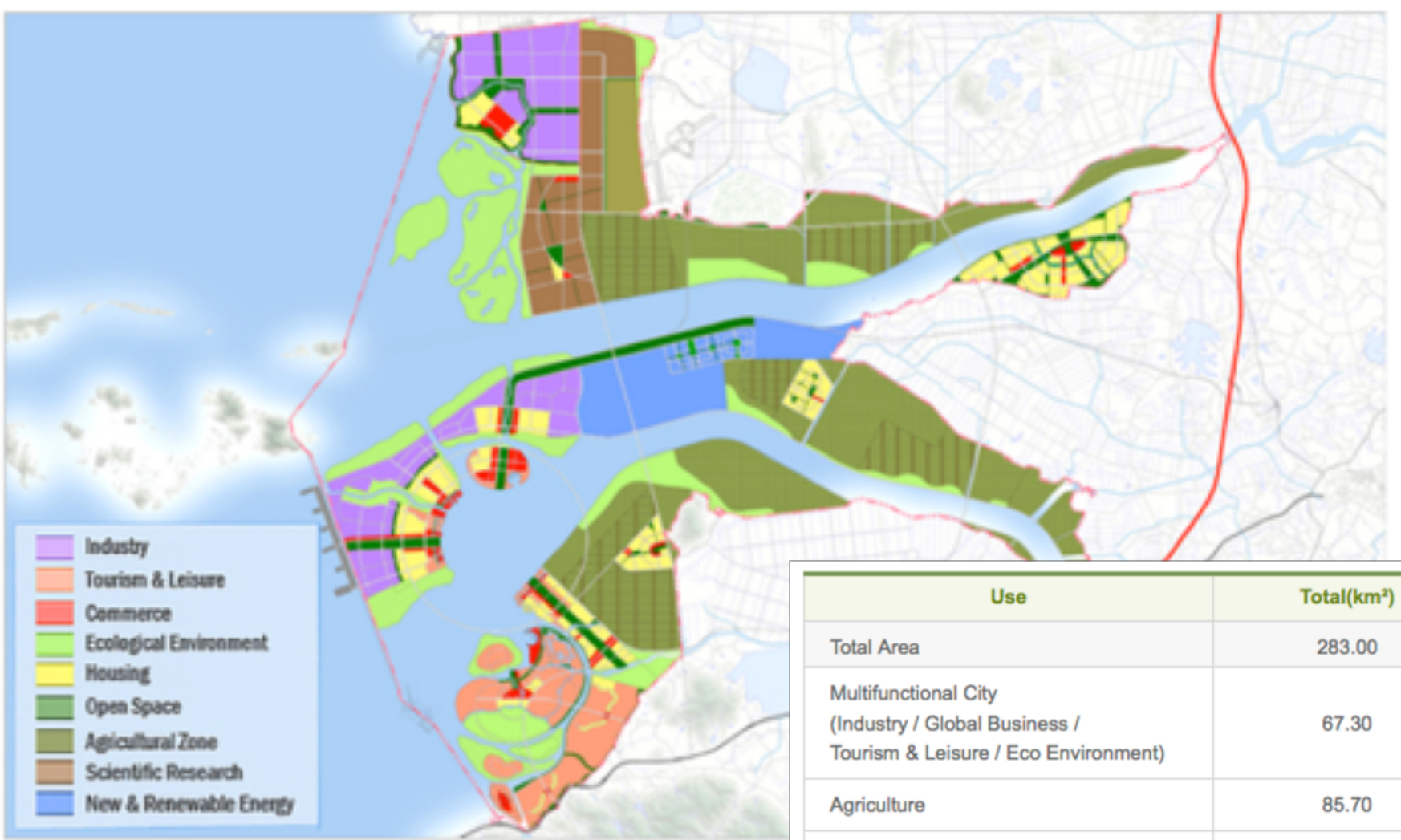
As part of the Four Major Rivers Restoration Project:

- 16 weirs
- 4 river basins



Five core challenges of the Four Major Rivers Restoration Project

- Securing abundant water resources to mitigate water scarcity.



Seamangeum Tideland Reclamation

Total Land Development 283 km²

Large Fresh Water Lake

Sea Dike Length 33.9 km









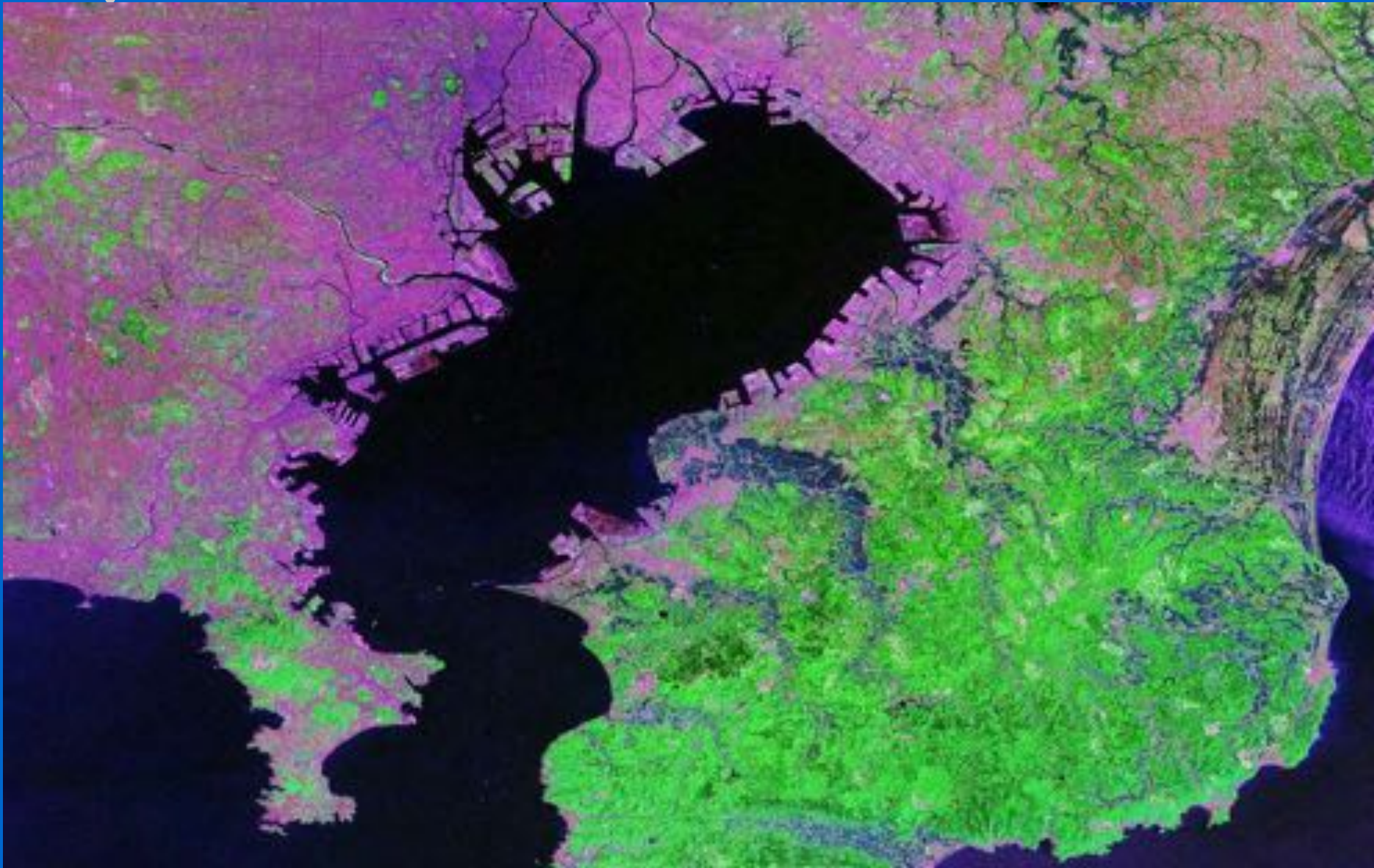
BUILDING WITH NATURE



Japan, Tokyo

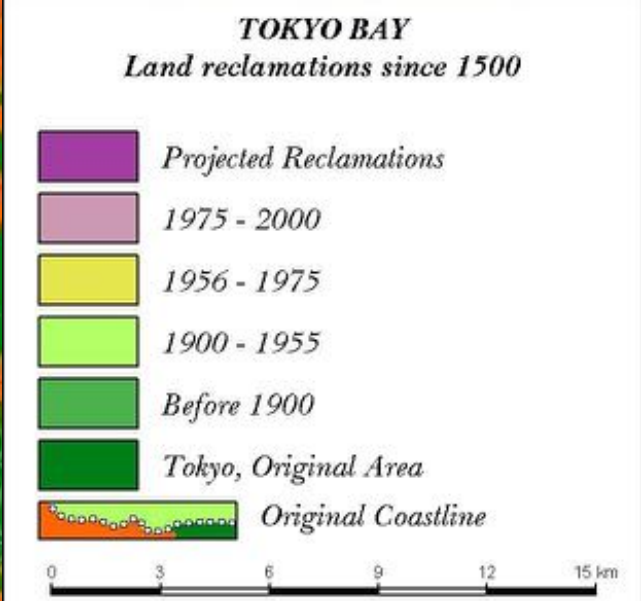


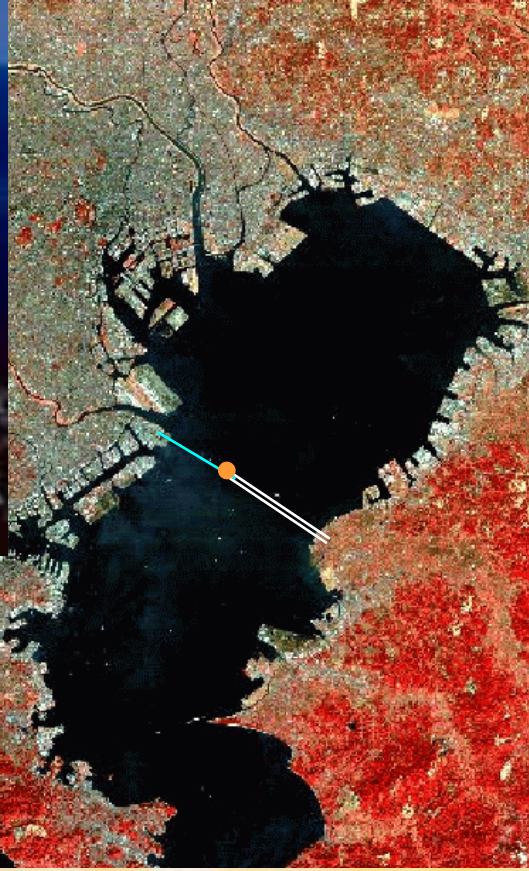
Tokyo



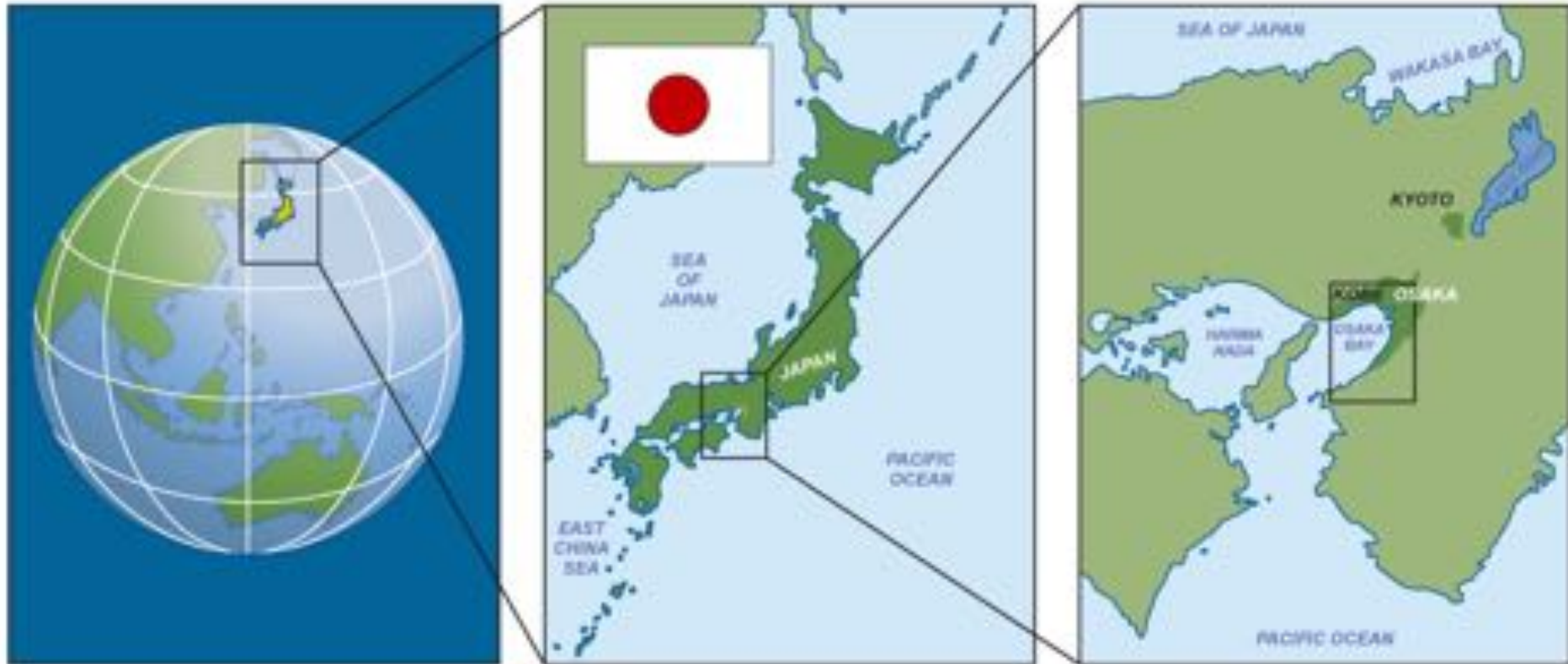
Tokyo

Tokyo



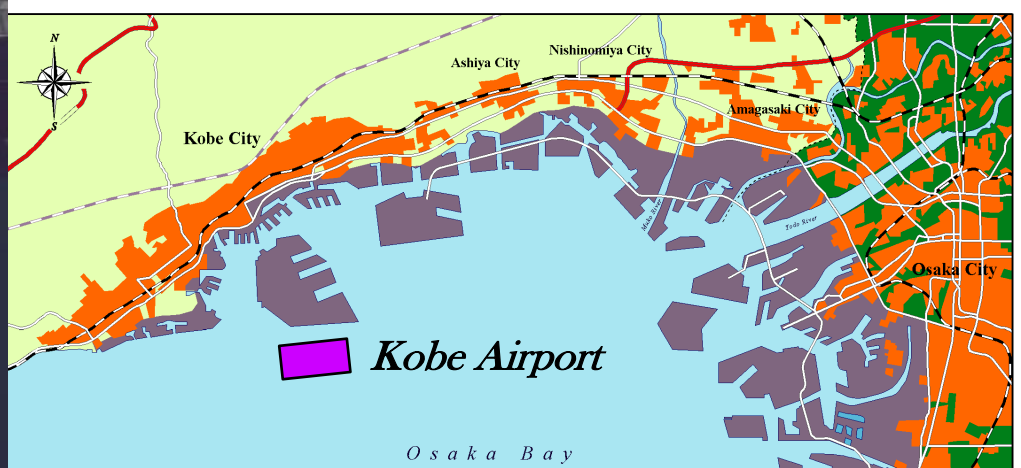


Osaka - Kobe



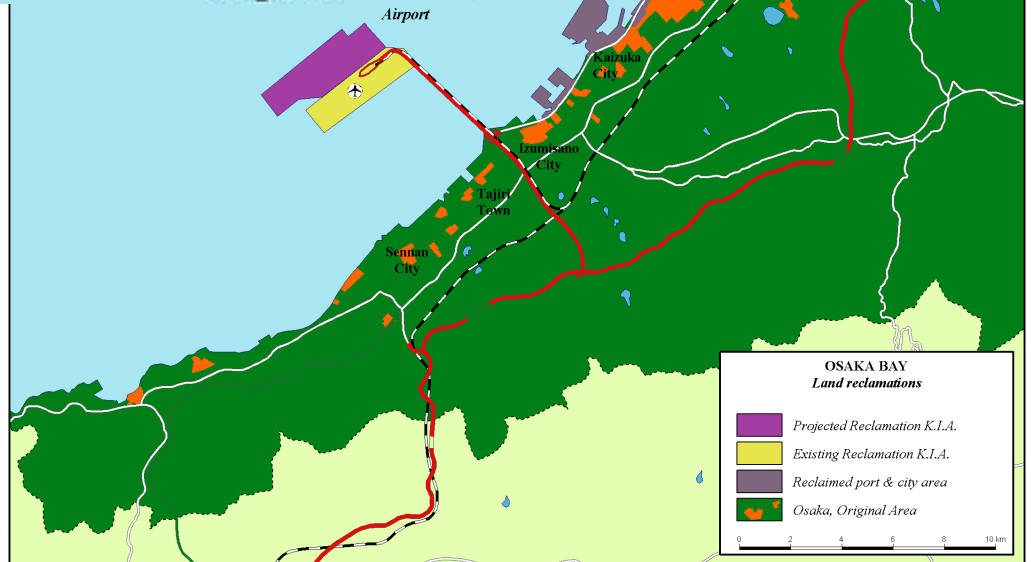


Kobe Airport







	Scale			Natural conditions	
	Landfill dimension	Seawall extension	Amount of landfill soil	Average water depth	Average settlement
Phase I of Island	510 ha	11.2 km	1.8 million m ³	18 m	11.5 m
Phase II of Island	545 ha	13 km	2.5 million m ³	20 m	18 m





Kansai International Airport



OSAKA BAY
Land reclamations

-  *Projected Reclamation K.I.A.*
-  *Existing Reclamation K.I.A.*
-  *Reclaimed port & city area*
-  *Osaka, Original Area*



-  *Projected Reclamation K.I.A.*
-  *Existing Reclamation K.I.A.*
-  *Reclaimed port & city area*
-  *Osaka, Original Area*

Osaka – Kobe *Kansai Int. Airport 1*



Osaka – Kobe *Kansai Int. Airport 2*



Australia - Sydney





SYDNEY
Land reclamations



Harbor area



Original Coastline

Railway Station



-
-
-

Sydney Opera House





***Airport Kingsford Smith
Land reclamations***

-  *Airport Kingsford Smith*
-  *Reclamation*
-  *Original Coastline*

Botany Bay

Sydney Kingsford Smith Airport





Sydney

-
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SUSTAINABLE COASTAL ZONE DEVELOPMENT

Integrated Coastal & Delta Policy via Building with Nature®

Prof. Dr. R.E. Waterman MSc

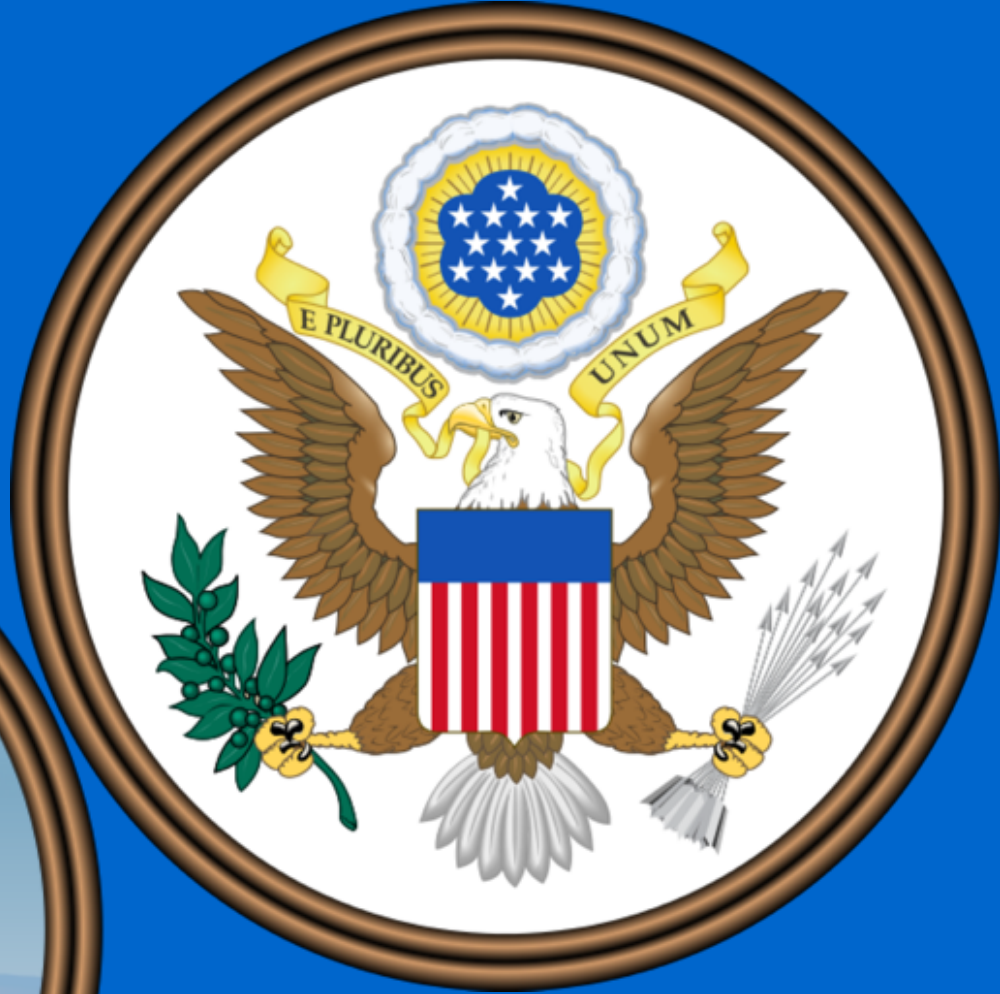


USA – THE NETHERLANDS



2013





HURRICANE SANDY



HURRICANE SANDY impact on New Jersey shore



Remedy:

**Dune - Beach
Widening &
Heightening**

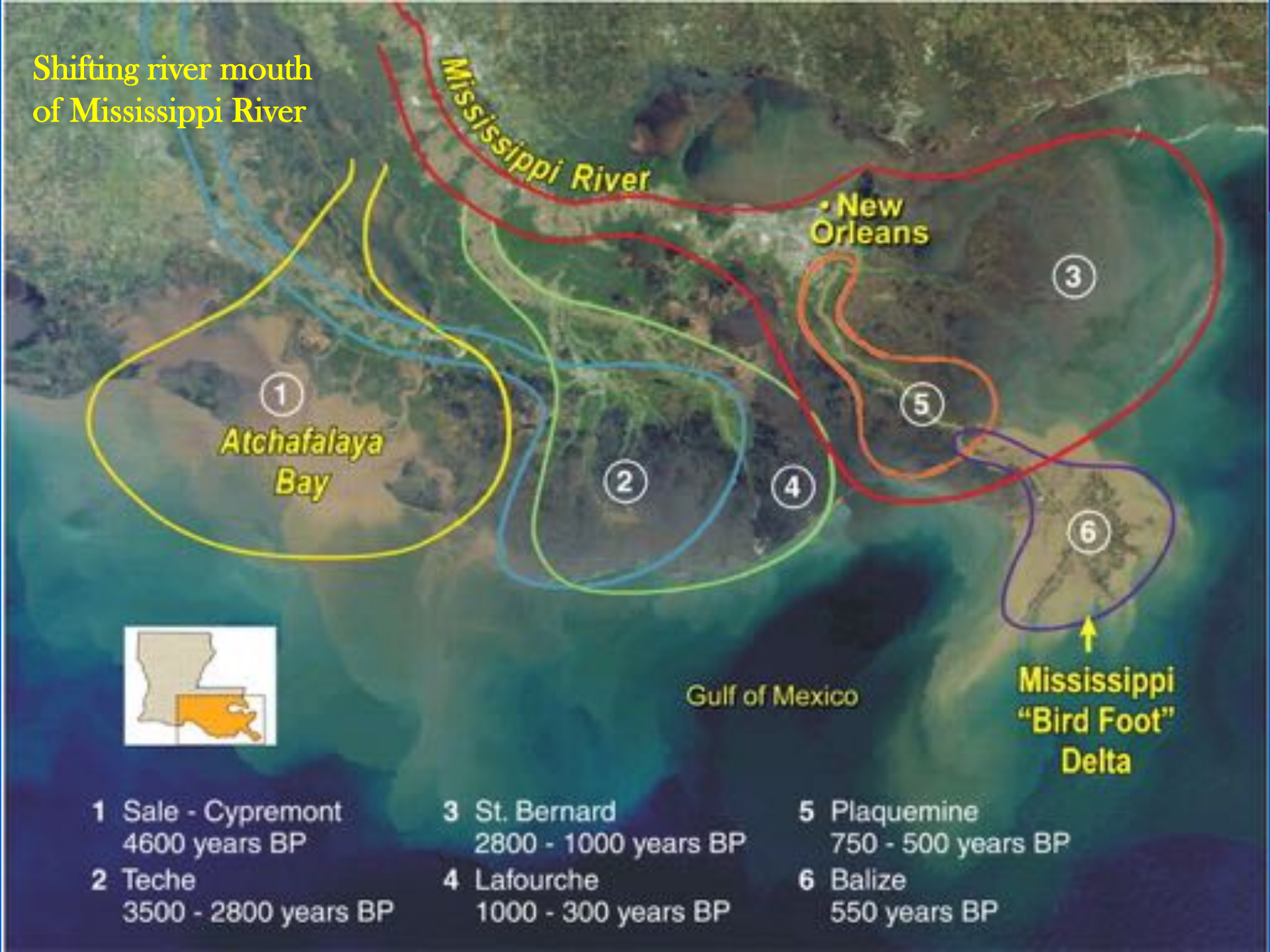
**No constructions
on the 1st range
of protecting
dunes**

New Orleans in Mississippi Delta



- Improving levees
- Improving drainage & pumping systems
- Introducing storm surge barriers
- Wetlands extension for safety & nature development

Shifting river mouth of Mississippi River



①
Atchafalaya Bay

New Orleans

Gulf of Mexico

**Mississippi
"Bird Foot"
Delta**

1 Sale - Cypremont
4600 years BP

2 Teche
3500 - 2800 years BP





3 St. Bernard
2800 - 1000 years BP

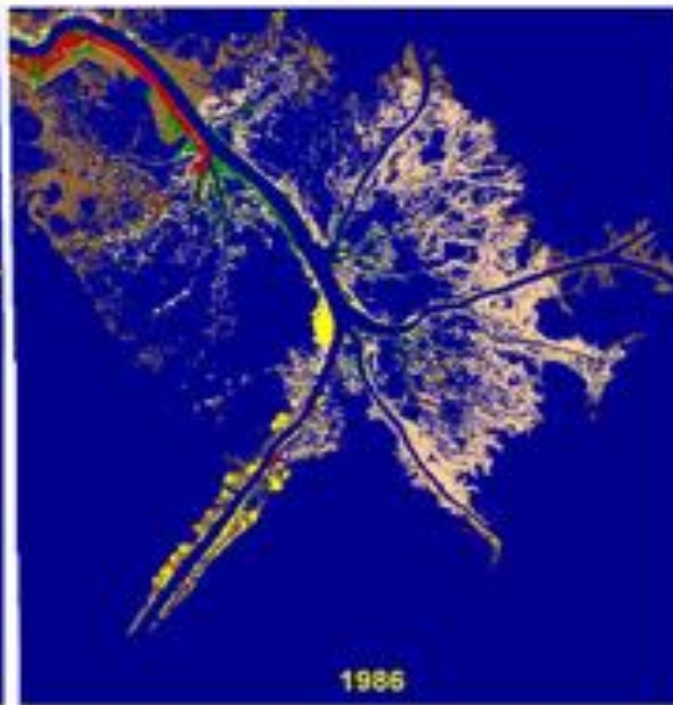
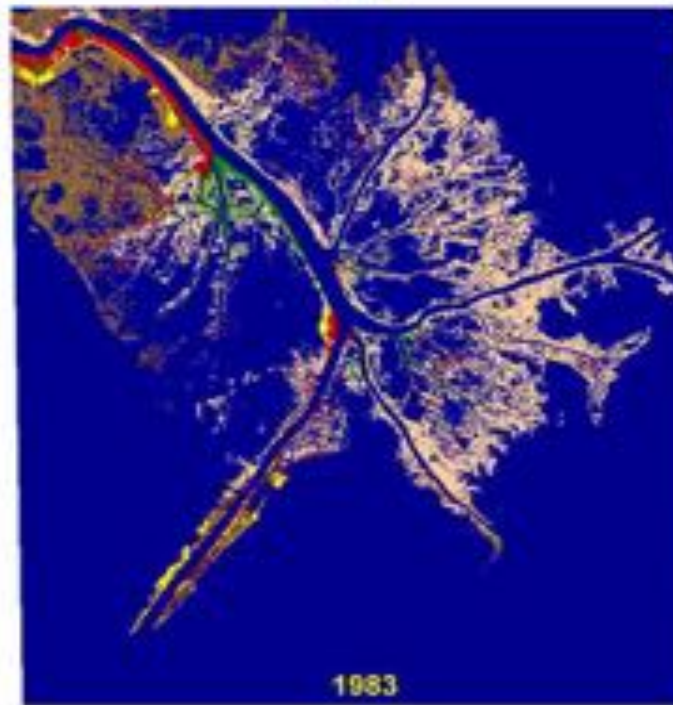
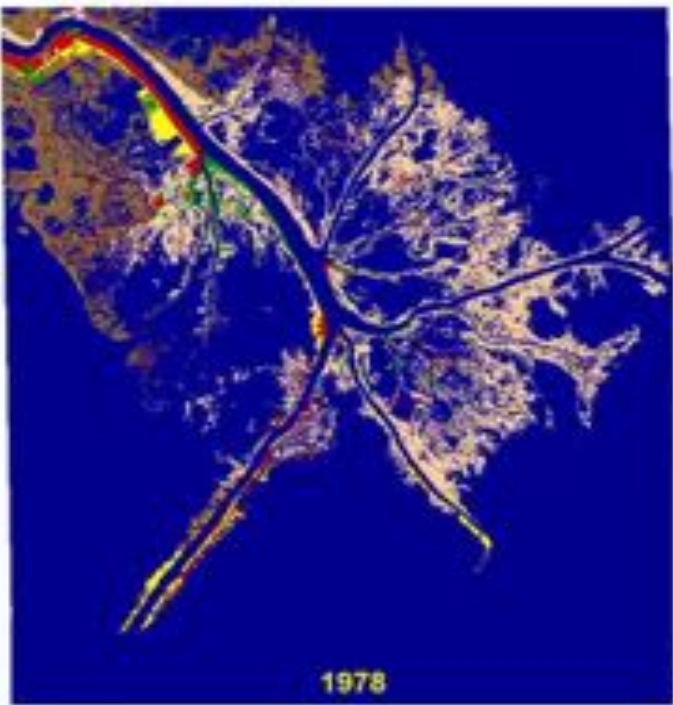
4 Lafourche
1000 - 300 years BP

5 Plaquemine
750 - 500 years BP

6 Balize
550 years BP

Lower Mississippi River Delta Habitat Change

Wetland and Upland Habitats	
	Developed
	Forested / Scrub Shrub
	Fresh Marsh
	Salt Marsh
	Water
	Barren Spoil



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SUSTAINABLE COASTAL ZONE DEVELOPMENT

Integrated Coastal Policy via Building with Nature



Dr. R. E. Waterman MSc



MEXICO
2015







Xochimilco – Chinampas – World Heritage





MEXICO

THE NETHERLANDS



SURFACE AREA
 1,964,375 km² 33,883 km²

INHABITANTS
 116.2 million 16.7 million

COASTAL LENGTH
 2,805 km Gulf of Mexico
 7,338 km Océano Pacifico
 353 km North Sea

SEA PORTS

- Veracruz
- Altamira
- Tampico
- Dos Bocas
- Acapulco



Sea ports of Mexico



Acapulco	Altamira	Alvarado	Cabo San Lucas	Campeche
Cayo Arcas	Ciudad del Carmen	Coatzacoalcos	Cozumel	Dos Bocas
Ensenada	Frontera	Guaymas	La Paz	Lazaro Cardenas
Manzanillo	Marafian	Minatitlan	Moro Redondo	Nanchital
Pichilingue	Progreso	Puerto Escondido	Puerto Madero	Puerto Progreso
Puerto Vallarta	Rosarito Terminal	Salina Cruz	San Carlos	San Juan de la Costa
San Marcos	Santa Maria	Santa Rosalia	Tampico	Topolobampo
Tuxpan	Veracruz	Yukaipeten		

VERA CRUZ



Veracruz, Veracruz



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DOS BOCAS TABASCO



Estado: TABASCO

Municipio: PARAISO

Altitud: 1msnm

Puerto de DOS BOCAS:

Depths 7-10 meter

Turning bassin 300 m diameter

Multipurpose & Specialised Terminals

Petroleum, fruit, meat, machinery, cruise passengers



DOS BOCAS
TABASCO

TERMINAL MARITIMA
PEMEX



Espigones que se han construido frente TMPDB
Breakwaters (groynes) in front of TMPDB





-
-
-



**TUBERIAS DE
SALIDA**

**TUBERIAS DE
LLEGADA**

DOS BOCAS, TABASCO

TERMINAL MARITIMA PEMEX







25 DE NOVIEMBRE DEL 2013



AREA DE QUEMADORES, ESTRUCTURA DE PROTECCIÓN



AREA DE QUEMADORES, ESTRUCTURA DE PROTECCION



AREA DE QUEMADORES, LADO OESTE



ALMACEN, CUBOS DE 3.7, 5.6 TON. Y BASE DEL MASTIL



CUBOS DE 3.7 TON.



CUBOS DE 3.7 TON Y PIEDRA EN GREÑA

25 DE NOVIEMBRE DEL 2013



BASE DEL MASTIL, CUBOS DE 5.6 Y 3.7 TON



CAMINO AL MORRO



CAMINO AL MORRO



CENTRO DE ESTRUCTURA DE PROTECCION



ESTRUCTURA DE PROTECCION, LADO OESTE



ESTRUCTURA DE PROTECCION, LADO ESTE

25 DE NOVIEMBRE DEL 2013



ESTRUCTURA DE PROTECCION, LADO ESTE



ESTRUCTURA DE PROTECCION, LADO



CENRO DE LA ESTRUCTURA DE



ESTRUCTURA DE PROTECCION LADO ESTE



CENTRO DE LA ESTRUCTURA DE PROTECCION



ESTRUCTURA DE PROTECCION, LADO OESTE

25 DE NOVIEMBRE DEL 2013



ALMACEN DE MATERIALES EN AREA DE QUEMADORES



BARDA PERIMETRAL TDN.



BARDA PERIMETRAL TDN.



BARDA PERIMETRAL, TDN.



BARDA PERIMETRAL, TDN.



BARDA PERIMETRAL TDN, 1er, TRAMO

25 DE NOVIEMBRE DEL 2013



BARDA PERIMETRAL, TDN.



BARDA PERIMETRAL, TDN.



BARDA PERIMETRAL, TDN.



TERRAPLEN, TRAMO 7



TERRAPLEN, TRAMO 6



TERRAPLEN, TRAMO 7

25 DE NOVIEMBRE DEL 2013



TERRAPLEN, TRAMO 5



TERRAPLEN, TRAMO 4



TERRAPLEN, TRAMO 4



TERRAPLEN, TRAMO 3



TERRAPLEN, TRAMO 3



TERRAPLEN, TRAMO 2

25 DE NOVIEMBRE DEL 2013



TERRAPLEN, TRAMO 1



Recuperacion y proteccion de la
linea de costa de las instalaciones
PEMEX

Dos Bocas, Tabasco, Mexico

Dr. Ronald Waterman

Equipo

- Ronald Waterman
- Paul Geerders
- David Ortega Grillasca
- Alejandro Gomez Ponce

Antecedentes

- Historia de la problemática
 - Protección tubería marina
 - Protección y reducción de la vulnerabilidad de las instalaciones (incl. quemadores, batería de separación y conversión)
 - Recuperación zona de playa
- Salida de campo
- Sobrevuelo helicóptero

Conclusiones, observaciones

- Hasta ahora: acciones puntuales
- Acciones no han tenido efecto deseado
- Acciones han tenido efectos adversos (ej. eliminacion de las dunas)
- Oportunidad para PEMEX promover su conciencia ambiental
- Potencial de beneficios sociales, economicos para la region

Objetivos

- Plan Maestro: solución holística, integral, multifuncional, sostenible
- Recuperación dunas (incl. vegetación) y playas
- Implementación en fases y segmentos

Concepto: Construir con la Naturaleza

- Usar mas que antes los materiales, las fuerzas e interacciones de la Naturaleza
- Creacion de una nueva linea de costa dinamica y flexible, consistiendo de dunas (con vegetacion) y playas
- Equilibrio entre erosion y acrecion
- Minimo de elementos duros
- Arena requerida a traves de dragado amigable al ambiente y en profundidad mas de 20 m
- Minimo de mantenimiento (alimentacion)
- Monitoreo: antes (linea de base), durante y despues (seguimiento)

Prioridad

- Base de datos e informacion: actualizados, completos, confiables
- Todos aspectos relevantes

Actividades

- Establecimiento de una base de datos e informacion:
 - Evaluacion de datos e informacion historicos
 - Identificacion de posibles vacios en el conjunto de datos e informacion
 - Llenar vacios a traves de mediciones en campo
- Confirmar la factibilidad del Construir con la Naturaleza
- Identificacion de obras prioritarias
- Desarrollo del proyecto definitivo apuntando a una solucion holistica, integral, multifuncional y sostenible

Cronograma

- Hasta finales del 2015
 - Propuesta proyecto datos e informacion
 - Establecimiento base de datos e informacion
 - Desarrollo e implementacion en fases
 - Propuesta proyecto Plan Maestro definitivo (Octubre 2015)
- 2016 -
 - Implementacion proyecto definitivo en fases y segmentos

Planificacion

MesX	1	2	3	4	5	6
Evaluacion datos e informacion historicos	Yellow	Light Blue	Light Blue	Light Blue	Light Blue	Light Blue
Identificacion vacios en el conjunto de datos e informacion	Yellow	Yellow	Light Blue	Light Blue	Light Blue	Light Blue
Llenar vacios a traves de estudios y trabajo de campo	Light Blue	Yellow	Yellow	Light Blue	Light Blue	Light Blue
Confirmar factibilidad Construir con la Naturaleza	Light Blue	Light Blue	Light Blue	Yellow	Light Blue	Light Blue
Identificacion obras prioritarias	Light Blue	Light Blue	Light Blue	Yellow	Light Blue	Light Blue
Desarrollo proyecto definitivo	Light Blue	Light Blue	Light Blue	Yellow	Yellow	Yellow

INTERACTIVE PLAN DEVELOPMENT

DECISION MAKING PROCESS

GOVERNMENTS & PUBLIC

PUBLIC & PRIVATE ACCEPTANCE

CHOICE OF ALTERNATIVES

PUBLIC & PRIVATE COMMITMENT

LEGAL PROCEDURES

LEGAL PROCEDURES

LEGAL PROCEDURES

STARTING POSITION
EXISTING SITUATION

Why?

What? Where?

How?

When? Who?

COMMUNICATION

COMMUNICATION

COMMUNICATION

VISION TERMS OF REFERENCE

ALTERNATIVES (PDS / GIS)

EXECUTION

PLAN DEVELOPMENT PROCESS

STEERING COMMITTEES
WORKING COMMITTEES
RESEARCH INSTITUTES
CONSULTANTS
CONTRACTORS

OPERATION & MAINTENANCE
RESULTING POSITION
NEW SITUATION

$$P_R = F(Q \times A)$$

Probability of Realisation =
Function of Quality & Acceptance

- The interactive plan development must be:
- in accordance with legal procedures & standards;
 - fully equipped for vice-versa communication;
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 - striving for sustainability.

SUSTAINABLE COASTAL ZONE DEVELOPMENT VIA BUILDING WITH NATURE

Atasta, Campeche



-
-
-

SUSTAINABLE FUTURE OF INLAND WATERWAYS

**Stimulating the Blue Green Economy
for
Regional, Socio-Economic &
Spatial Development,
while safeguarding
Environmental Values & Nature
as well as Safety**

MEXICO



THE NETHERLANDS



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1,964,375 km² 33,883 km²

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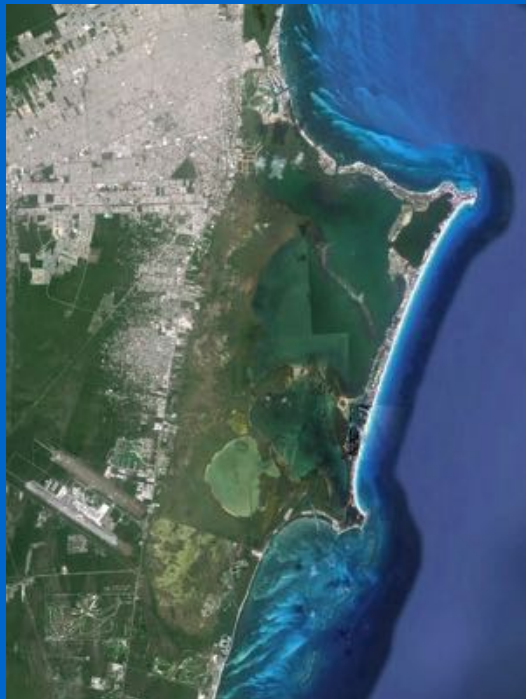
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CANCUN



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Cancun



Puerto Cancun



Cancun



Cancun



Cancun



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- Paul Geerders
- David Ortega Grillasca

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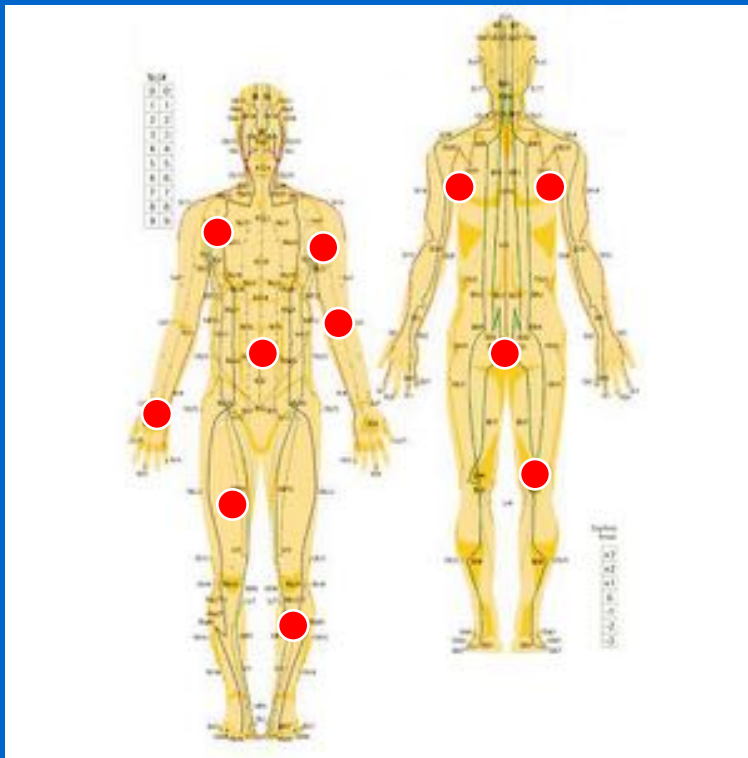
AQUAPUNCTURE[©]

**Introduction of AQUAPUNCTURE[©]
for the optimal use, adaptation, experience &
management of inland waterways and their
waterfronts**

**For economy, employment, spatial quality,
safety & environmental values**

ACUPUNCTURE

to revitalize
the Nervous System
& Human Organs



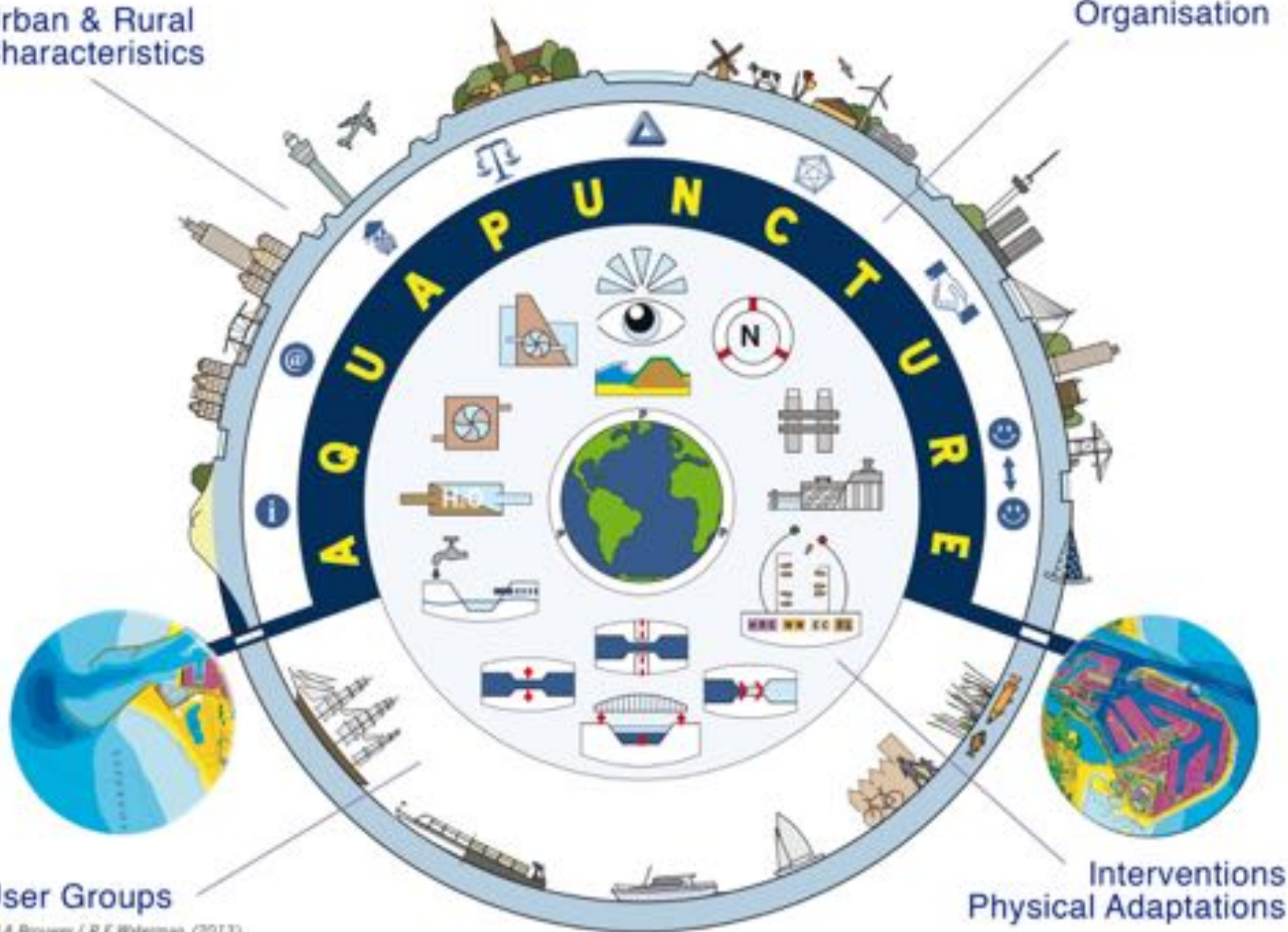
AQUAPUNCTURE

to revitalize
the Waterways & their
Water Fronts



Urban & Rural Characteristics

Organisation



User Groups

Interventions
Physical Adaptations

The GROASIS® TREE TECHNOLOGY is an integrated solution to solve food, soil erosion and climate problems by introducing the WATERBOXX



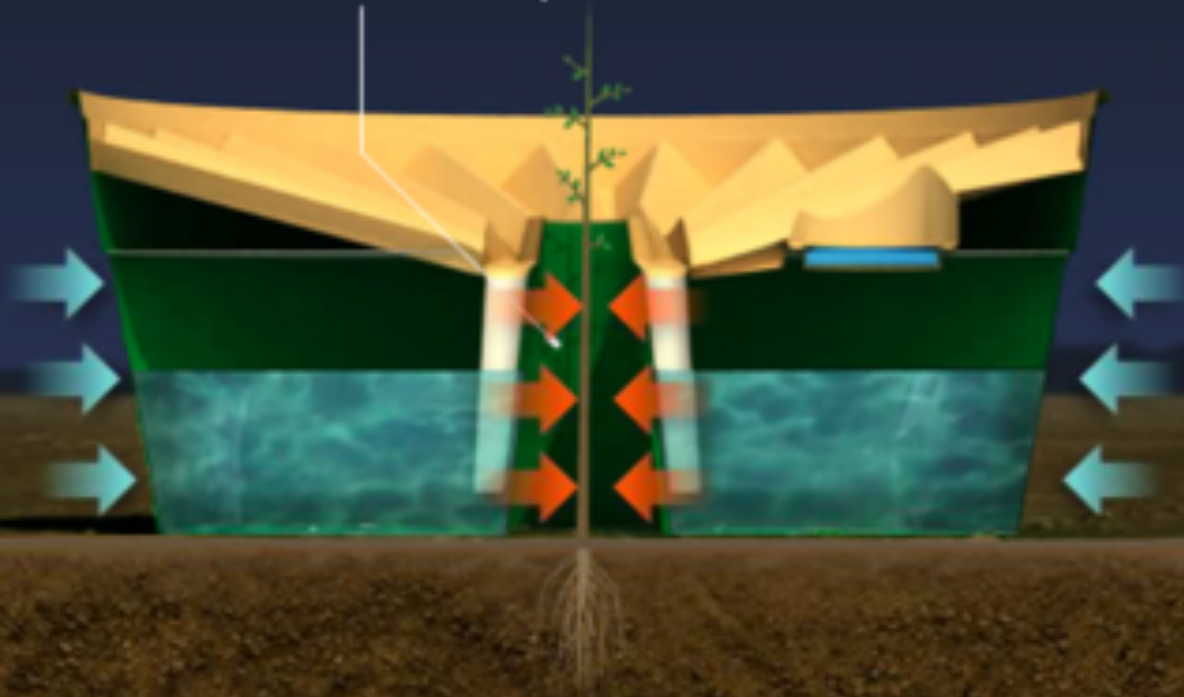
Groasis Greenboxx



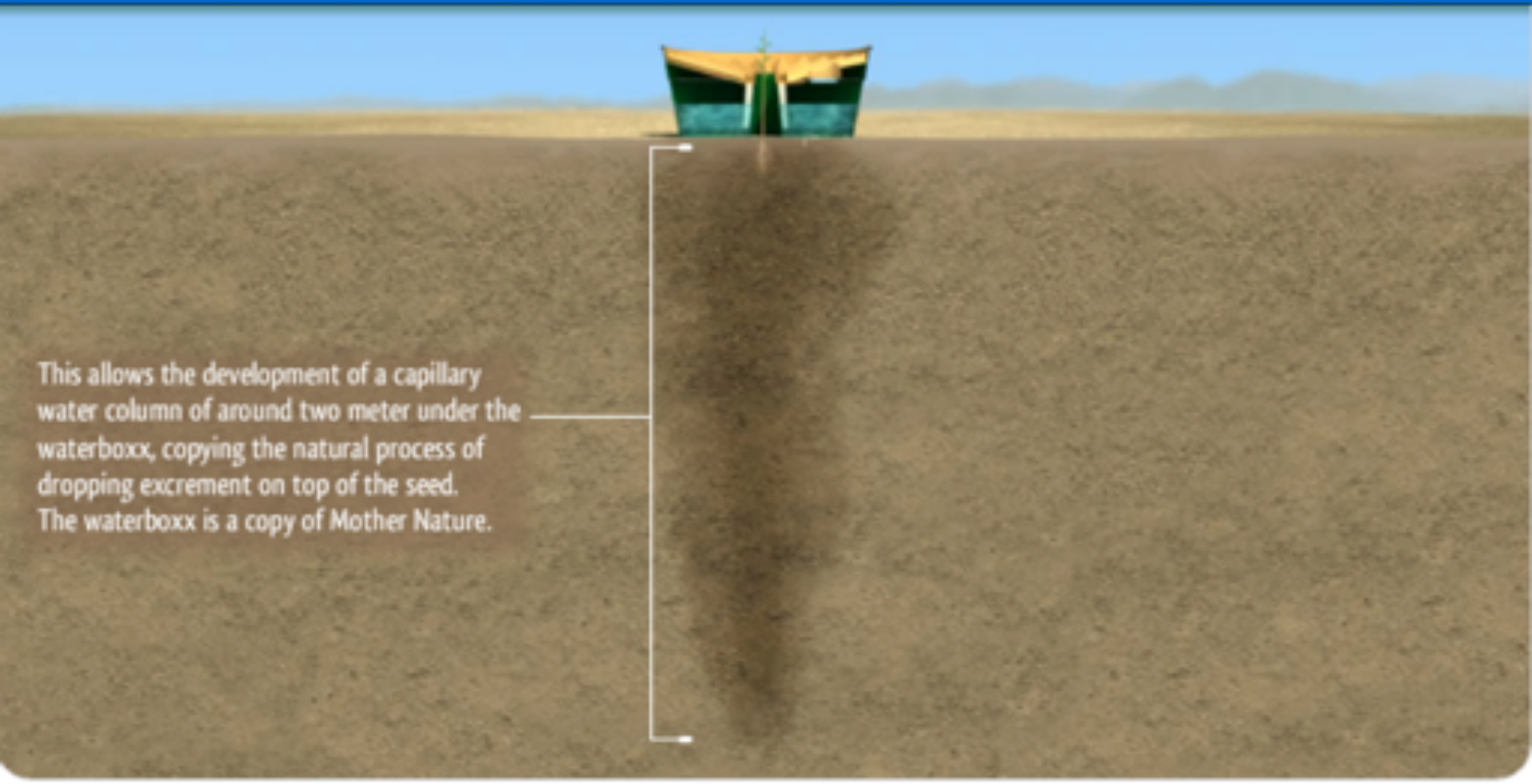
Successful planting in Los Monegros Desert – Zaragoza – Spain

The GROASIS® TREE TECHNOLOGY is an integrated solution to solve food, soil erosion and climate problems by introducing the WATERBOXX

During the night, the (relatively warm) water reservoir ensures a warmer temperature in the tube than the outside temperature.



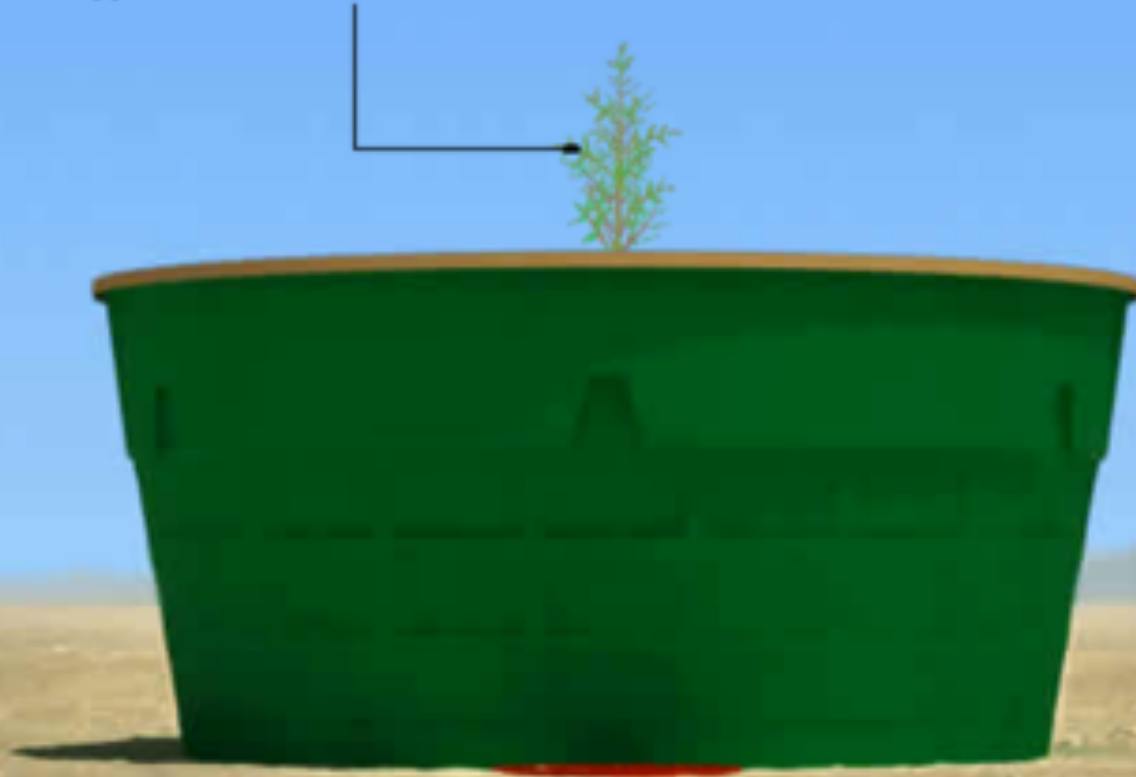
The **GROASIS® TREE TECHNOLOGY** is an integrated solution to solve food, soil erosion and climate problems by introducing the **WATERBOXX**



This allows the development of a capillary water column of around two meter under the waterboxx, copying the natural process of dropping excrement on top of the seed. The waterboxx is a copy of Mother Nature.

The **GROASIS® TREE TECHNOLOGY** is an integrated solution to solve food, soil erosion and climate problems by introducing the **WATERBOXX**

When the roots find enough water, a period of strong growth starts. This is the sign that the plant is able to grow without the support of the waterboxx.



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SUSTAINABLE COASTAL ZONE DEVELOPMENT

Integrated Coastal Policy via Building with Nature



Dr. R. E. Waterman MSc



CURAÇAO
2013



Curaçao



Curaçao



Inhabitants
150,000

Surface Area
444 km²

Length
61 km

Width
5 - 14 km

Coastal Length
364 km

Highest Point
Christoffel Berg
375 m



parking for 1200 cars

Site for future hotels and apartments approximately 300 units

MAMBO BEACH

parking

parking

Shower services

Lagoon

Therapy dolphin lagoons

Animal Encounter Day show

Animal encounter lagoons

Dolphin "swim" lagoons

Aquariums and educational area

Racial assets



CARIBBEAN DEVELOPMENT AUTHORITY
Land Reclamation Project since 1990

- Trees zone
- Asphalt - new and former
- Road building - asphalt
- Drive ways - asphalt/gravel (in some vegetation areas)
- Full cover roadways
- Building area
- Original coastline
- Shoreline
- Shoreline



















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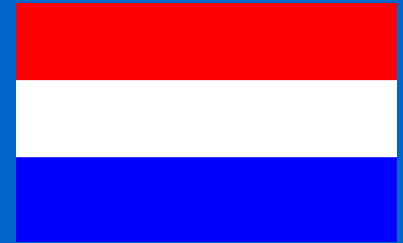
SUSTAINABLE COASTAL ZONE DEVELOPMENT

Integrated Coastal & Delta Policy via Building with Nature®

Prof. Dr. R.E. Waterman MSc



COLOMBIA – THE NETHERLANDS



2015





COLOMBIA



THE NETHERLANDS



SURFACE AREA

1,141,748 km² 33,883 km²

INHABITANTS

48.8 million 17 million

COASTAL LENGTH

1760 km Mar Caribe
1448 km Océano Pacífico
353 km North Sea

MAIN RIVER BASINS

Magdalena-Cauca
Orinoquia
Amazonia
Caribe
Pacífico
Rhine - Maas - Scheldt

SEA PORTS

Cartagena de Indias
Barranquilla
Santa Marta
Buenaventura
Tumaco
Rotterdam - Amsterdam

PACIFIC COAST

Mostly rocky with steep rocky slope

Tidal difference up to 7 m

Currents more random and coastline is prone to tsunamis

Bogotá 7,9 million

Medellín 2,4 million

Cali 2,4 million

Barranquilla 1,2 mill.

Cartagena 0,9 million



ATLANTIC COAST

Includes sandy beaches and a more gradual sandy slope

Tidal magnitude around 40 cm

Along Caribbean coast almost continuous current flows from NE to SW

Large reserves of fresh water

11% national parks

High biodiversity

4 Climatic Zones

- Tierra Caliente
- Tierra Templada
- Tierra Fria
- Tierra Heleda

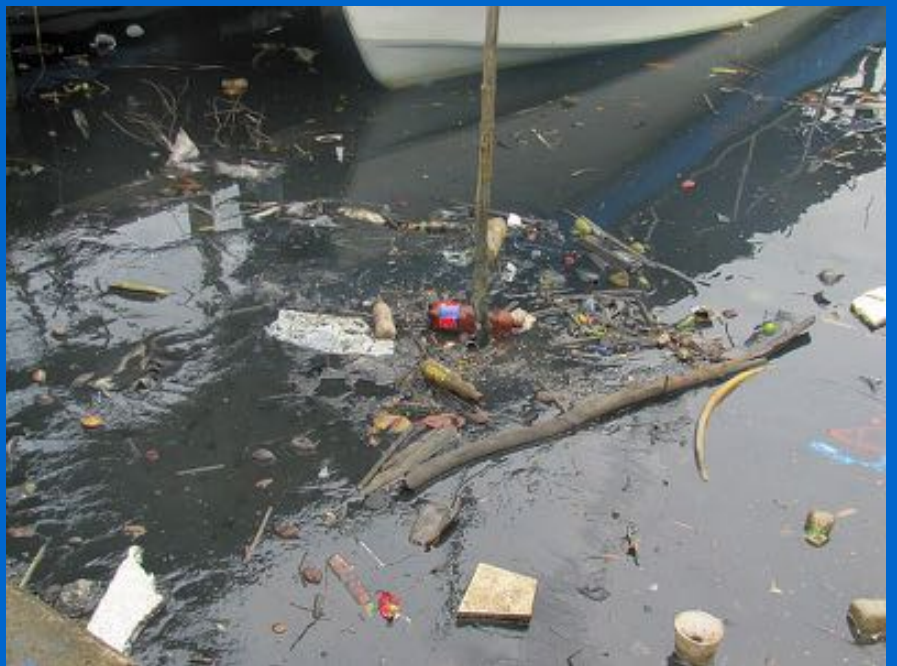
Turbo



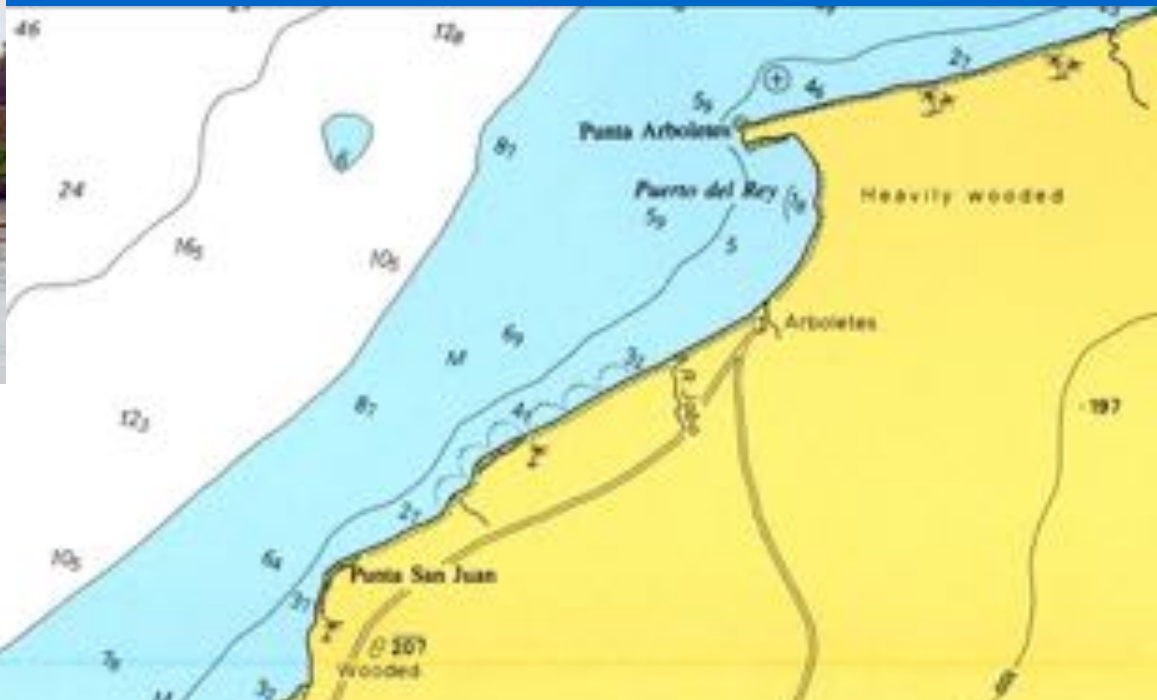
Golfo de Urabá & Turbo



Golfo de Urabá & Turbo



Punta Arboletes



Cartagena de Indias



Cartagena de Indias





Cartagena
de Indias



Cartagena de Indias

Barranquilla & Rio Magdalena



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GEODESY

In planning & design Geodesy plays an essential role.

Historical and actual data with regard to land & sea surfaces and sub surfaces are needed for planning & map making.

Measurements are required through land- and sea survey, including Remote Sensing.

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SUSTAINABLE MULTI-FUNCTIONAL COASTAL ZONE DEVELOPMENT

General approach

A. *Integrated Coastal Policy* to give an answer to the question: How can we solve many existing and future problems in relation to each other, in relation to the existing hinterland on the one hand and in relation to the bordering sea on the other, while creating added value

B. Application of the method ***Building with Nature***[®] using more than before the materials and forces/interactions present in nature, creating a new flexible dynamic equilibrium coast in which accretion and erosion are more or less balancing each other with a minimum of solid seawall elements. Taking into account the bio-geomorphology & geohydrology of coast & seabed.

SUSTAINABLE MULTI-FUNCTIONAL COASTAL ZONE DEVELOPMENT

Local Measures

1. Dune & Beach & Foreshore nourishment
2. Restoration of natural sediment transport
3. Sand Engine for long term maintenance
4. Making work with work: reuse of dredged material
5. Mangrove rehabilitation
6. Application of sand packed geotextiles, poles & sticks
7. Reshaping cliffs with adequate slope combined with vegetation
8. Preservation & restoration of Coral Reefs; artificial reefs
9. Use of existing Barrier Islands
10. Introduction of a minimum of Coast Parallel Breakwaters
11. Spatial Planning

PRINCIPALES MEDIDAS PARA MITIGAR LA EROSION

- 1. La restauración del transporte natural de sedimentos**
- 2. La reutilización de material dragado**
- 3. La regeneración de arena**
- 4. La rehabilitación de manglares**
- 5. La remodelación de acantilados**
- 6. El desarrollo de arrecifes de coral**
- 7. El uso inteligente de estructuras duras**
- 8. Medidas de protección a pequeña escala**
- 9. La planificación espacial**

SOLUTIONS IN FULL HARMONY WITH NATURE: NATURAL BEACHES AND DUNES

I.A.1
Existing Coastline
with Beach and Dunes



I.A.2
Dune and Beach
Nourishment



I.A.3
Foreshore Nourishment



SOLUTIONS USING ARTIFICIAL STRUCTURES IN HARMONY WITH NATURE

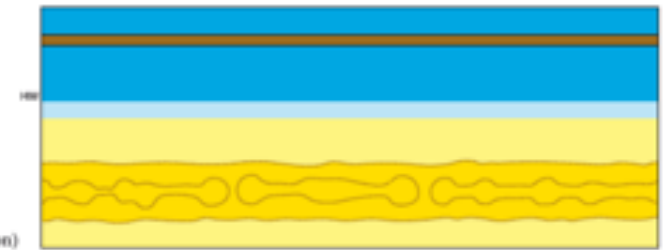
I.B.1
Submerged
Parallel Berm /
Perched Beach
(Sand Retaining Dam)



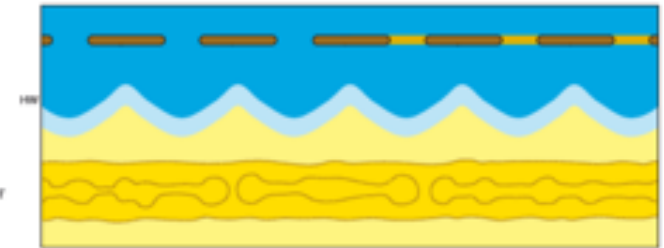
I.B.2
Submerged Offshore
Breakwater - Reef Type
(Sand Retaining Dam,
Wave Energy Reduction)



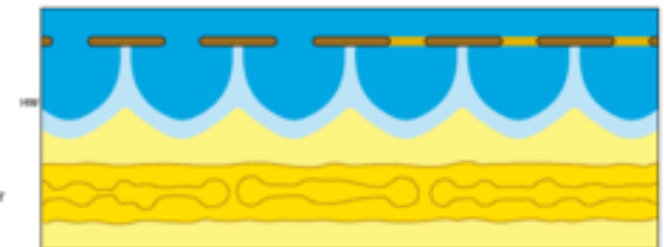
I.B.3
Offshore Breakwater
(Sand Retaining Dam,
Wave Energy Reduction)



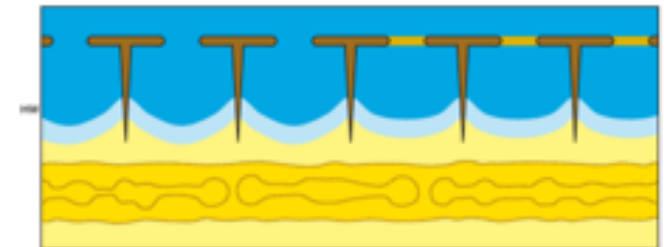
I.B.4
Multiple Offshore
Breakwaters without or
with sills
(Salient Beaches)



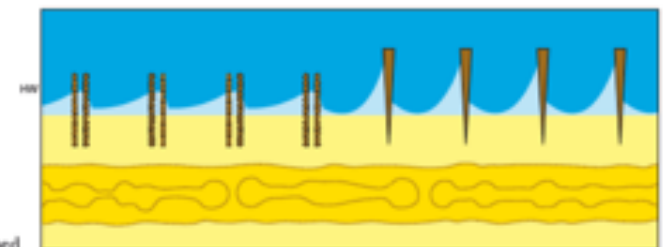
I.B.5
Multiple Offshore
Breakwaters without or
with sills
(Tombolo Beaches)



I.B.6
T-shaped Breakwaters
without or with sills
(Pocket Beaches)

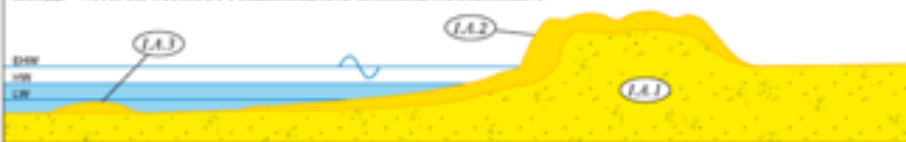


I.B.7
Groynes, Open or Closed



NATURAL BEACHES AND DUNES

1.A.1,2,3 WITH OR WITHOUT FORRESHORE AND ONSHORE NOURISHMENT



SEMI-NATURAL BEACHES AND DUNES

1.B.1 SUBMERGED PARALLEL BERM / PERCHED BEACH



1.B.2 SUBMERGED OFFSHORE BREAKWATER



1.B.4,5,6 (MULTIPLE) OFFSHORE BREAKWATER



SEAWALLS WITH SMOOTH SLOPES

1.C.1 BERM TYPE

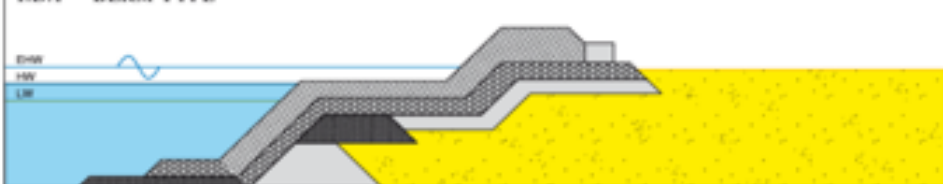


1.C.2 CONTINUOUS SLOPE TYPE

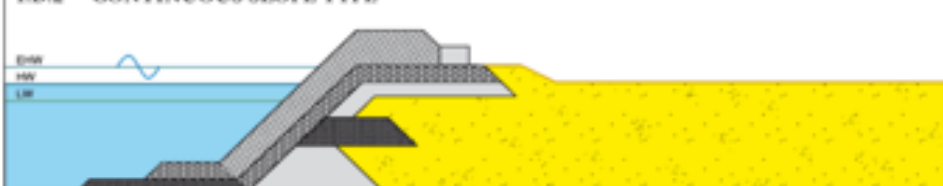


SEAWALLS WITH STEEP SLOPES

1.D.1 BERM TYPE



1.D.2 CONTINUOUS SLOPE TYPE



SEAWALLS WITH CAISSONS

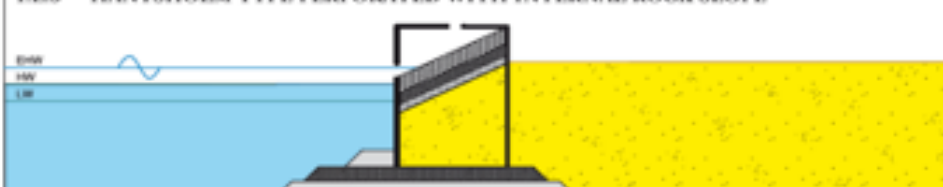
1.E.1 HANTSHOLM TYPE



1.E.2 HANTSHOLM TYPE PERFORATED



1.E.3 HANTSHOLM TYPE PERFORATED WITH INTERNAL ROCK SLOPE



PACIFIC COAST

Mostly rocky with steep rocky slope

Tidal difference up to 7 m

Currents more random and coastline is prone to tsunamis

Bogotá 7,9 million

Medellín 2,4 million

Cali 2,4 million

Barranquilla 1,2 mill.

Cartagena 0,9 million



ATLANTIC COAST

Includes sandy beaches and a more gradual sandy slope

Tidal magnitude around 40 cm

Along Caribbean coast almost continuous current flows from NE to SW

MAIN RIVER BASINS

Magdalena-Cauca

Orinoquia

Amazonia

Caribe

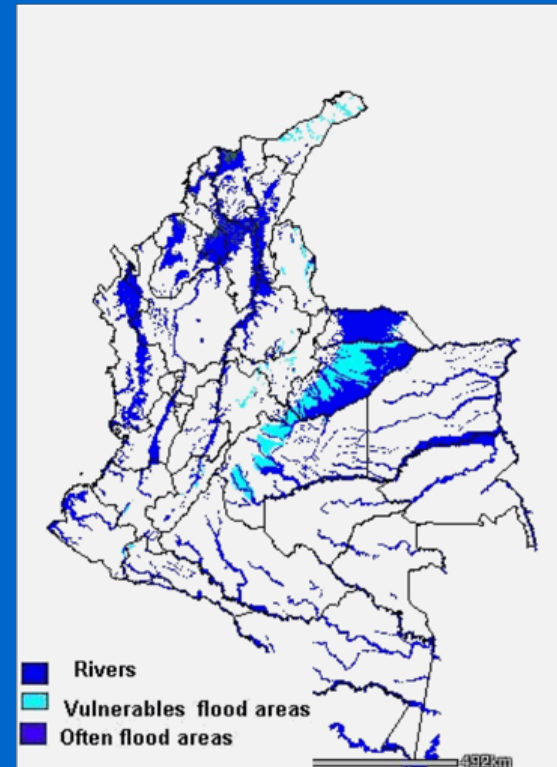
Pacifico



MAIN RIVER BASINS

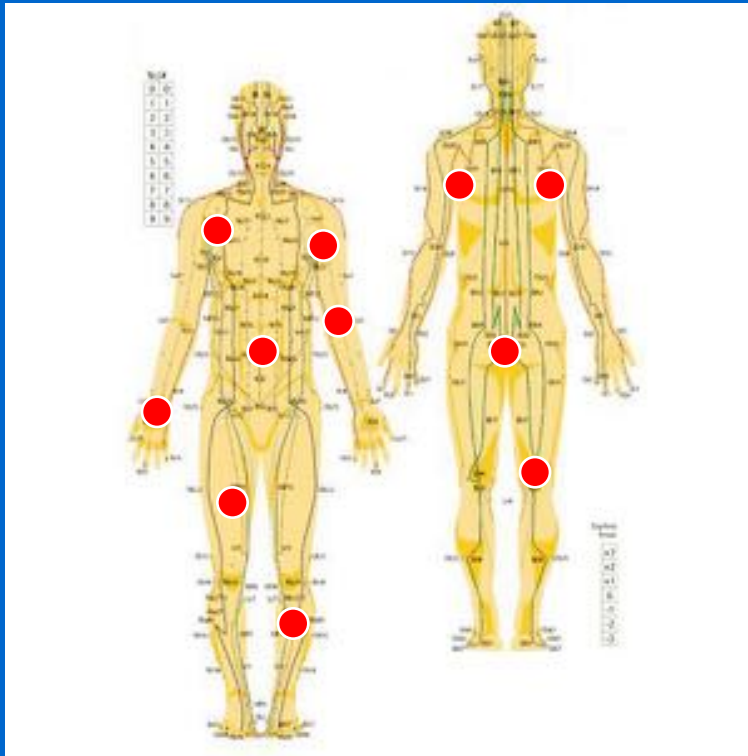
- Magdalena-Cauca
- Orinoquia
- Amazonia
- Caribe
- Pacifico

Flood Areas



ACUPUNCTURE

to revitalize
the Nervous System
& Human Organs



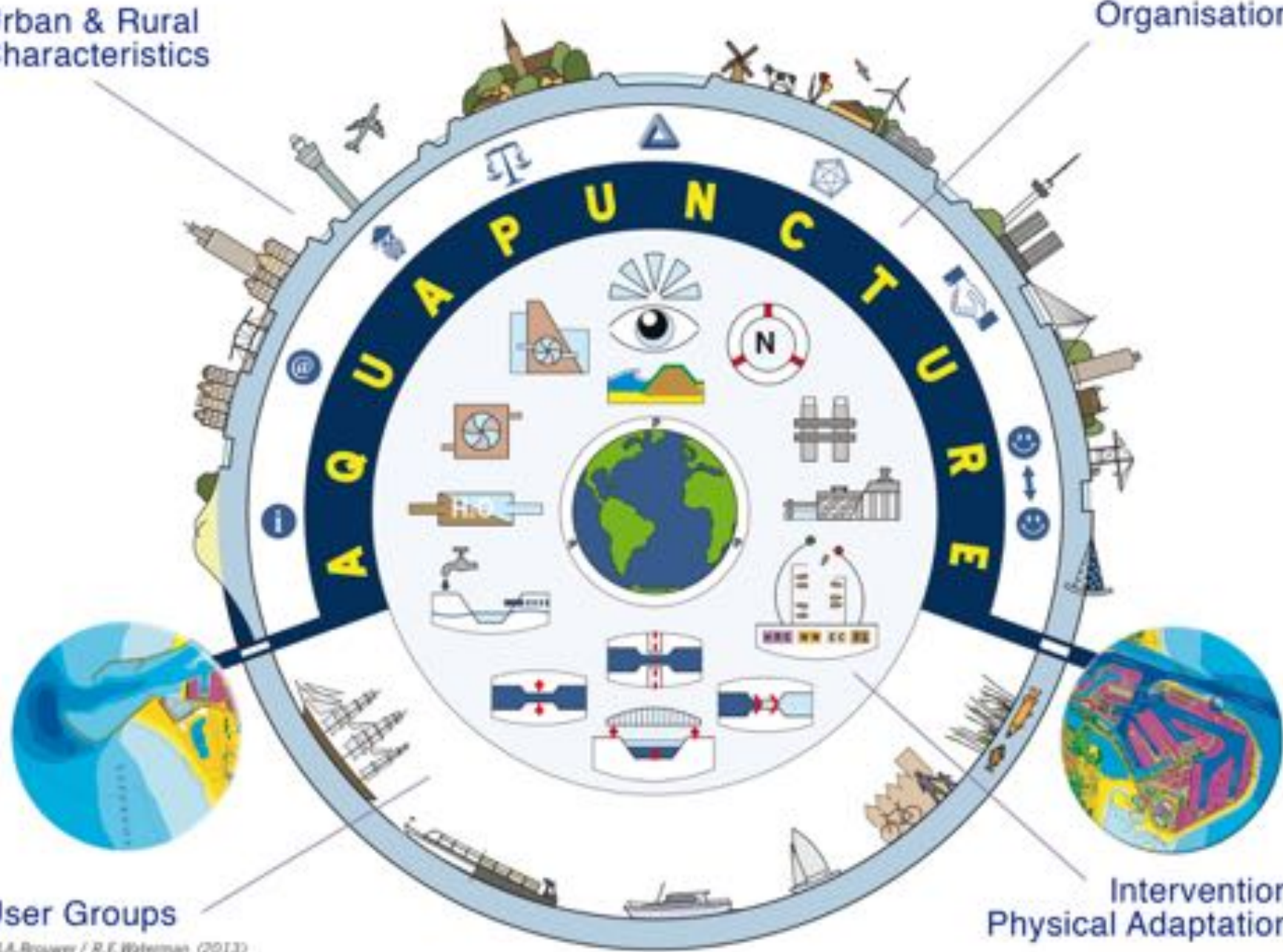
AQUAPUNCTURE

to revitalize
the Waterways & their
Water Fronts



Urban & Rural Characteristics

Organisation



User Groups

Interventions
Physical Adaptations

Recuperación del Canal del Dique



Length 120 km, from Cartagena to Río Magdalena & Calamar

Recuperation complete with dikes, new locks & marsh improvements

AGUAPUNTURA[®]
for the optimal use & adaptation of the waterway
and the waterfronts for economy, employment, environment, nature & landscape



Rio Magdalena



Rio Magdalena -
Length 1540 km



AGUAPUNTURA®
for the optimal use & adaptation
of the waterway and the
waterfronts for economy,
employment, environment,
nature & landscape

Rio Bogotá



The relation between Bogotá and the Rio Bogotá should be improved through AGUAPUNTURA®

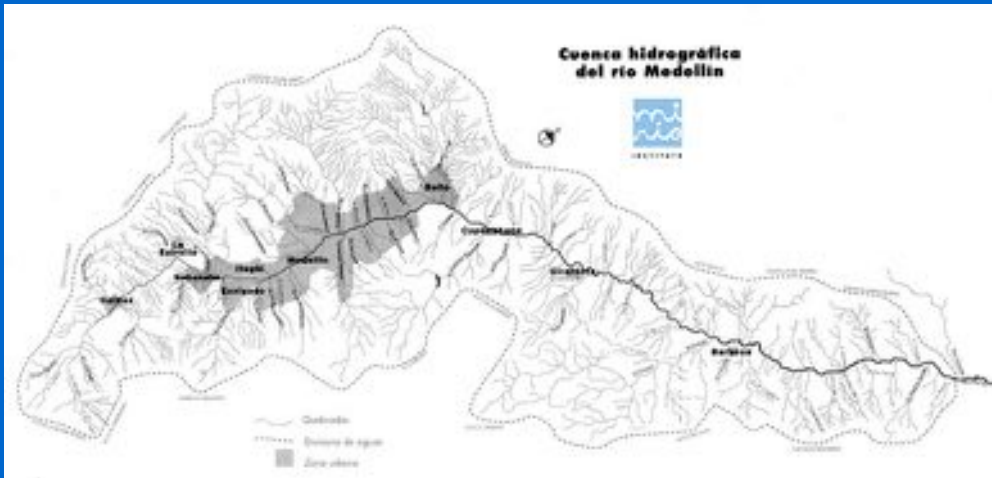
AGUAPUNTURA® for the optimal use & adaptation of the waterway and the waterfronts for economy, employment, environment, nature & landscape

Bogotá

7.9 million inhabitants



Rio Medellin



Medellin - 2.4 million inhabitants

Rio Medellin - Length 100 km
(60 km Medellin & 40 km Porce)

AGUAPUNTURA®
for the optimal use & adaptation of the
waterway and the waterfronts for
economy, employment, environment,
nature & landscape



Rio Cauca



Rio Cauca –
Length 965 km

AGUAPUNTURA®
for the optimal use &
adaptation of the
waterway
and the waterfronts for
economy, employment,
environment, nature &
landscape



Rio Cali



Santiago de Cali -
2.4 million inhabitants

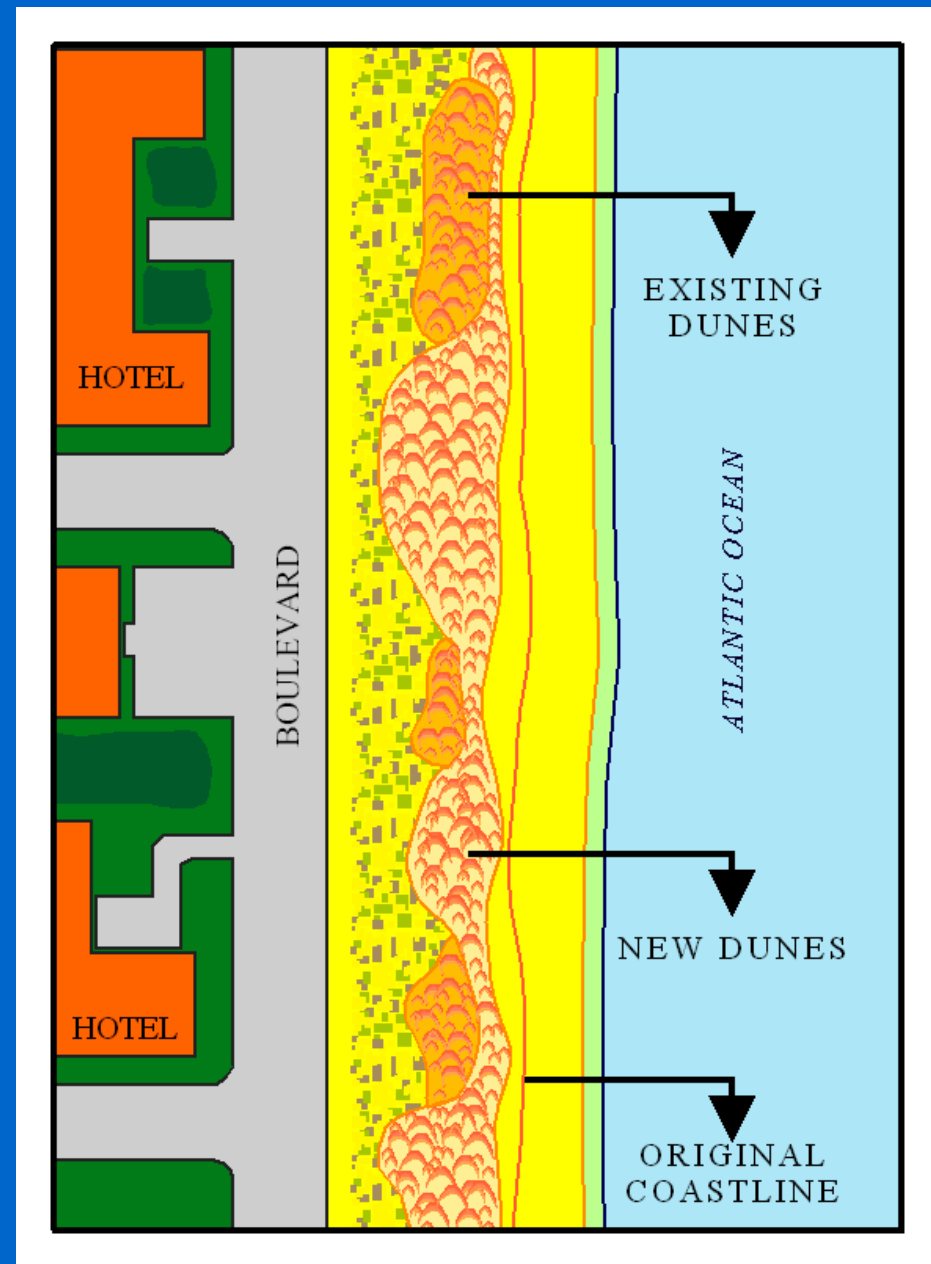
Rio Cali

AGUAPUNTURA®
for the optimal use & adaptation of the
waterway and their waterfronts for
economy, employment, environment,
nature & landscape

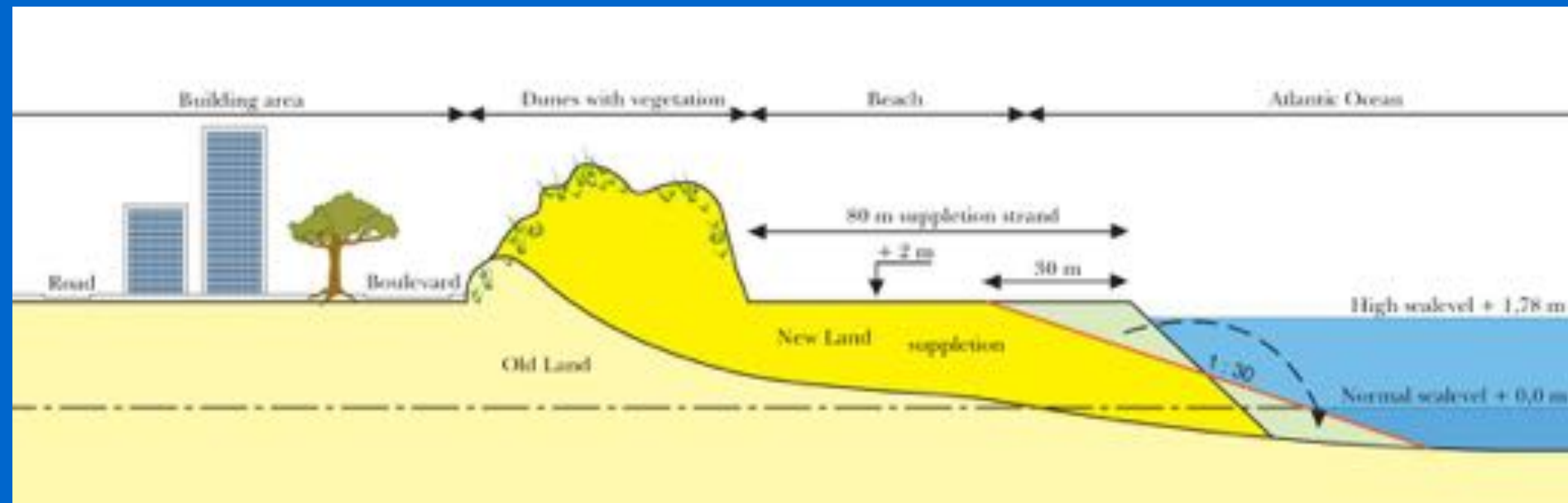


Argentina – *Municipalidad de la Costa*





Argentina – *Municipalidad de la Costa*





Argentina



Mar del Tuyu

**San Clemente
del Tuyu**

Chile

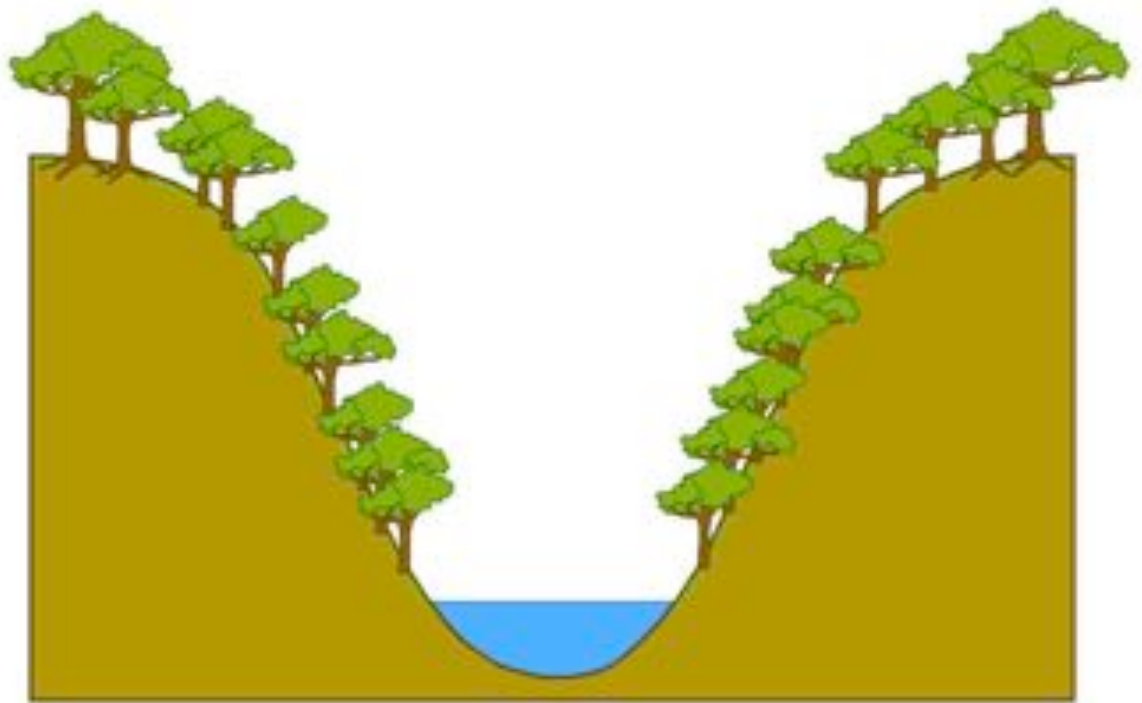


Chile

Rio Bio Bio

RIO BIO BIO IN CHILE

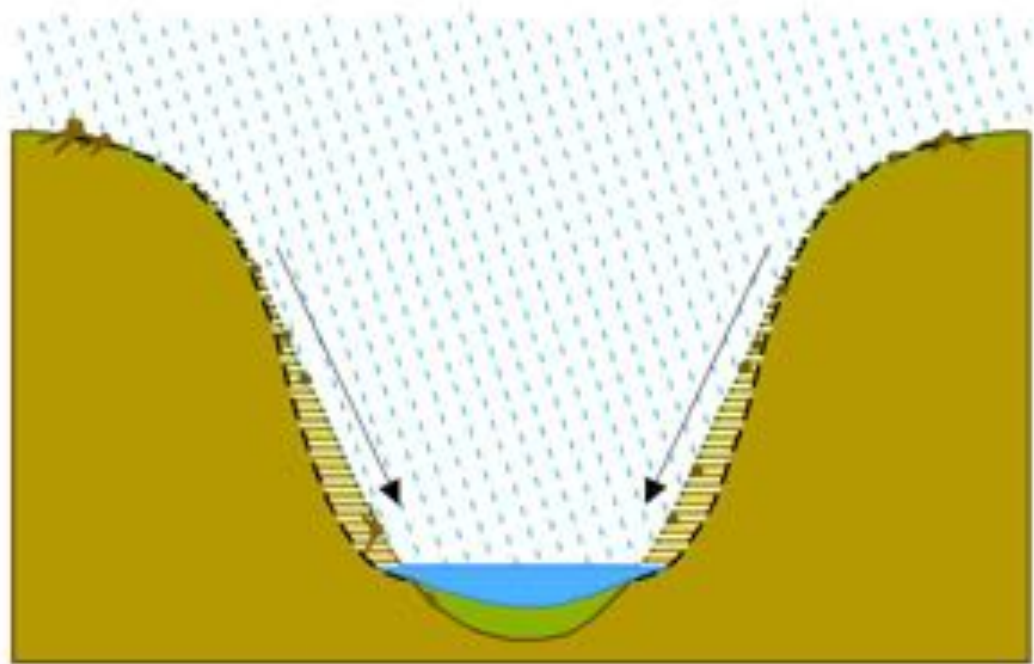
Cross section in original situation of riverbanks with trees, shrubs and a navigable river.



Chile

Rio Bio Bio

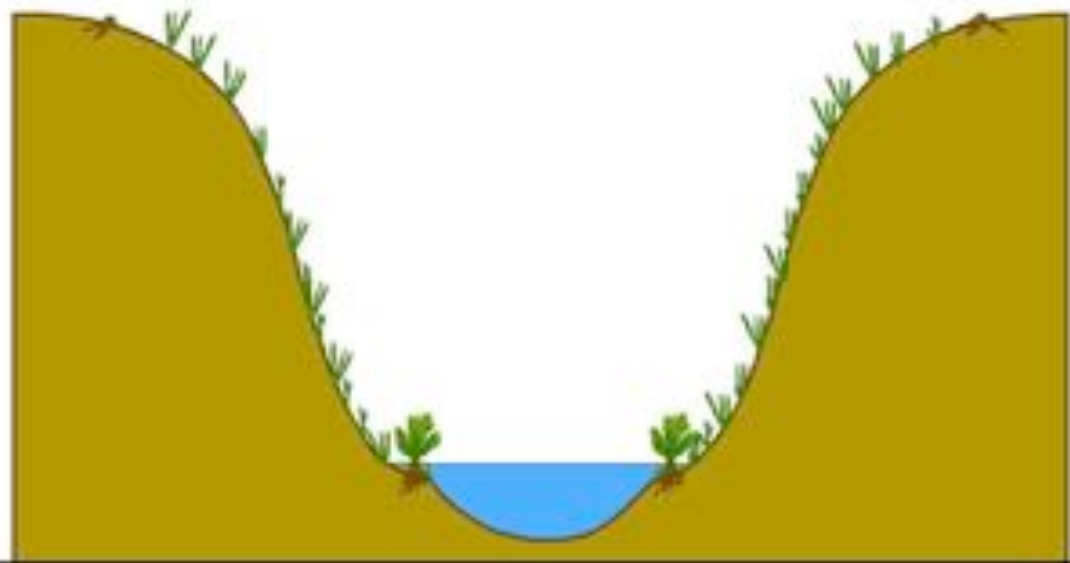
Cross section with man-induced erosion by tree logging leading to a wider but less deep riverbed which in turn causes reduced navigability and reduction of fertile land.



Chile

Rio Bio Bio

Cross section with river bank restoration by tree planting and planting of tree saplings in the river causing local sedimentation and land reclamation, which in turn forces the river in a narrower and deeper riverbed, thereby restoring the original river depth.





Chile *Rio Bio Bio*



BUILDING WITH NATURE



$(\alpha + \beta + \gamma)$ knowledge + action $\rightarrow \Delta_{\text{sustainable}}$

Question Time



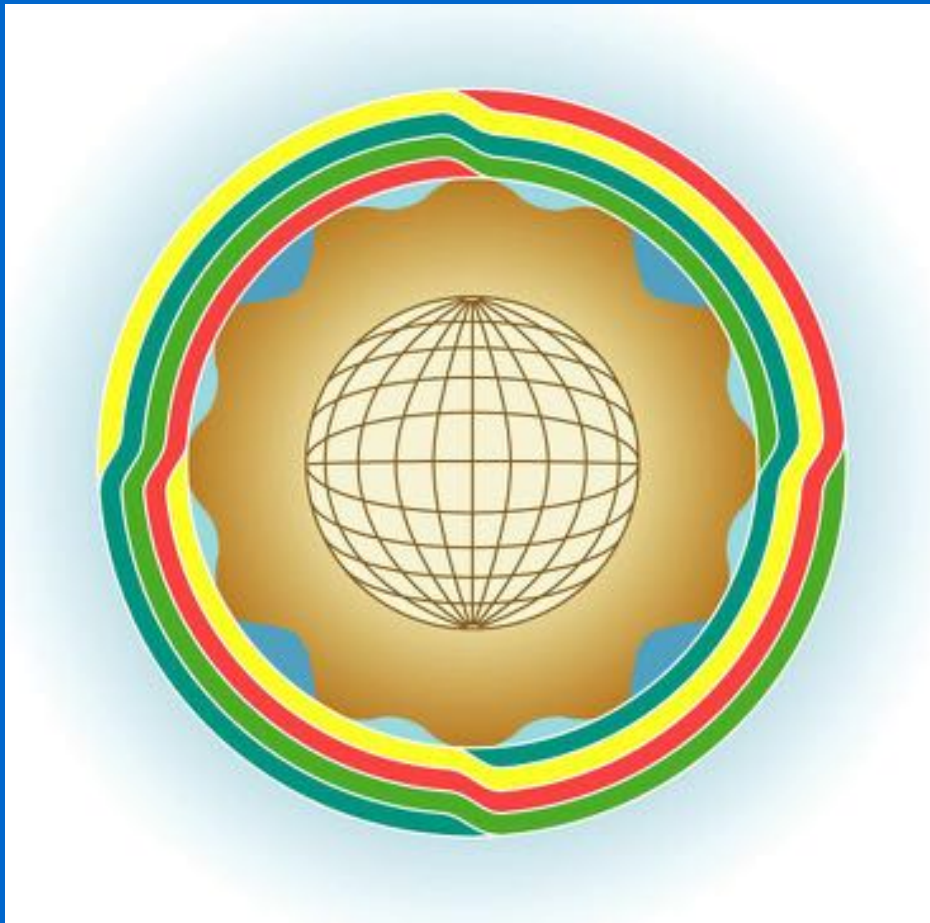
GEODESY

In planning & design Geodesy plays an essential role.

Historical and actual data with regard to land & sea surfaces and sub surfaces are needed for planning & map making.

Measurements are required through land- and sea survey, including Remote Sensing.

Spatial plan based on a six layer system



- Atmosphere Layer
- Occupation Layer
- Infrastructure Layer
- Agriculture & Aquaculture Layer
- Terrestrial & Aquatic Nature Layer
- Soil / Subsoil / Hydrosphere Layer

SUSTAINABLE COASTAL & DELTAIC ZONE DEVELOPMENT VIA BUILDING WITH NATURE

1. Underground Layer (Soil / Hydrosphere)

The underground layer with its composition and structure and all its natural resources serves a whole series of natural functions. In addition to these natural functions, it fulfils and can fulfil a series of human-initiated and humanmade functions in and on the underground layer, which are and have to be based on its soil, sub-soil and hydrosphere characteristics.

This underground layer serves as a basis for:

- *landscape & seascape*
- *agriculture, fishery, aquaculture*
- *exploitation of composite minerals, ores*
- *foundation for building sites and infrastructure*
- *storage for waste products, energy, water and CO₂*
- *terrestrial & aquatic nature values*
- *extraction groundwater & surface water*
- *geothermal energy, water energy, fossil energy*
- *tunnels, cables, pipelines, geodetic domes*
- *preservation historic and archaeological sites.*

The composition and structure of the underground layer are of vital importance for the following layers.

-
-
-

SUSTAINABLE COASTAL & DELTAIC ZONE DEVELOPMENT VIA BUILDING WITH NATURE

Relation

Environment – Economy – Space

SIGNIFICANCE OF THE ANTHROPOCENE



Dr. R.E. Waterman Msc

Estimated age of the universe: approx. 13.5 billion / year

Estimated age of the earth: approx. 4.5 billion / year

Geological periods:

Precambrium

Cambrium

Ordovicium

Silurian

Devonian

Carboniferous

Perm

Triassic

Jurassic

Cretaceous

Tertiary

Quaternary: Pleistocene – Holocene – Anthropocene

ANTHROPOCENE

**For the first time in the geological history
MANKIND has become a geological
factor by numbers and lifestyle**

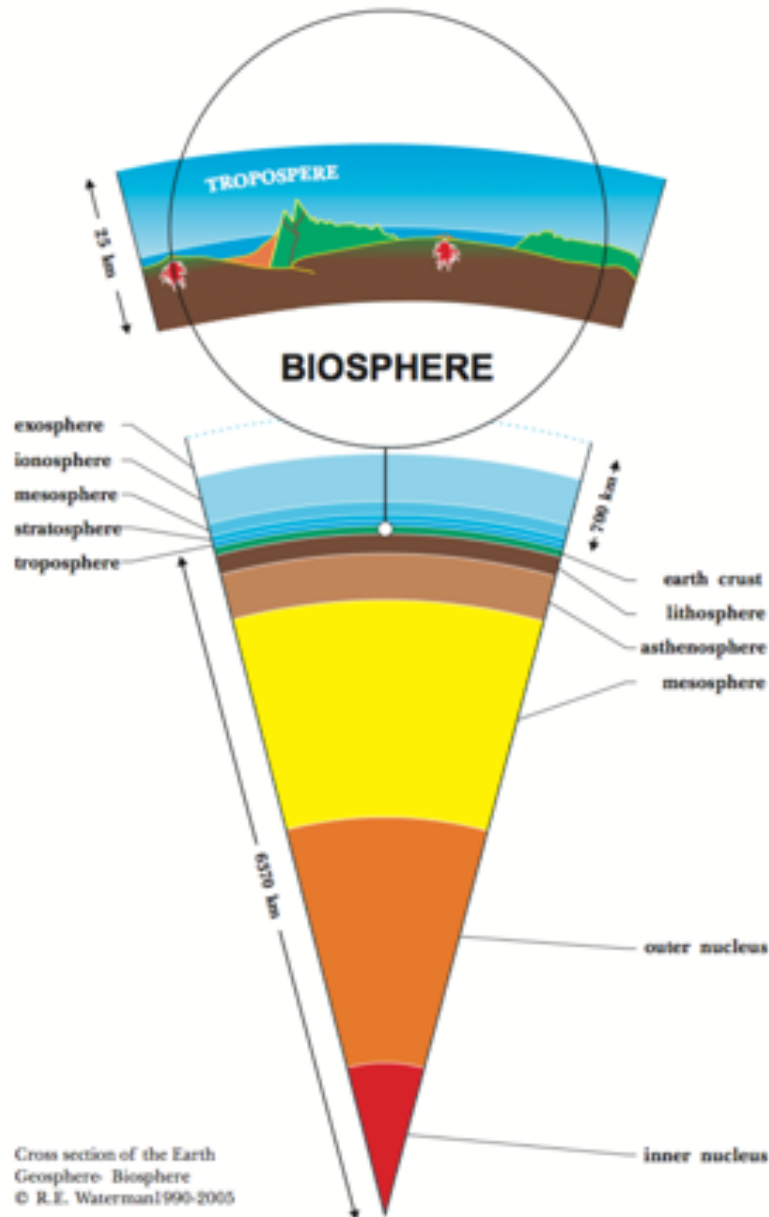


Global footprint =

F (size of population, lifestyle, technology)

**Necessity: stabilizing world population,
lifestyle modification and introduction of
technologies focused on sustainability**

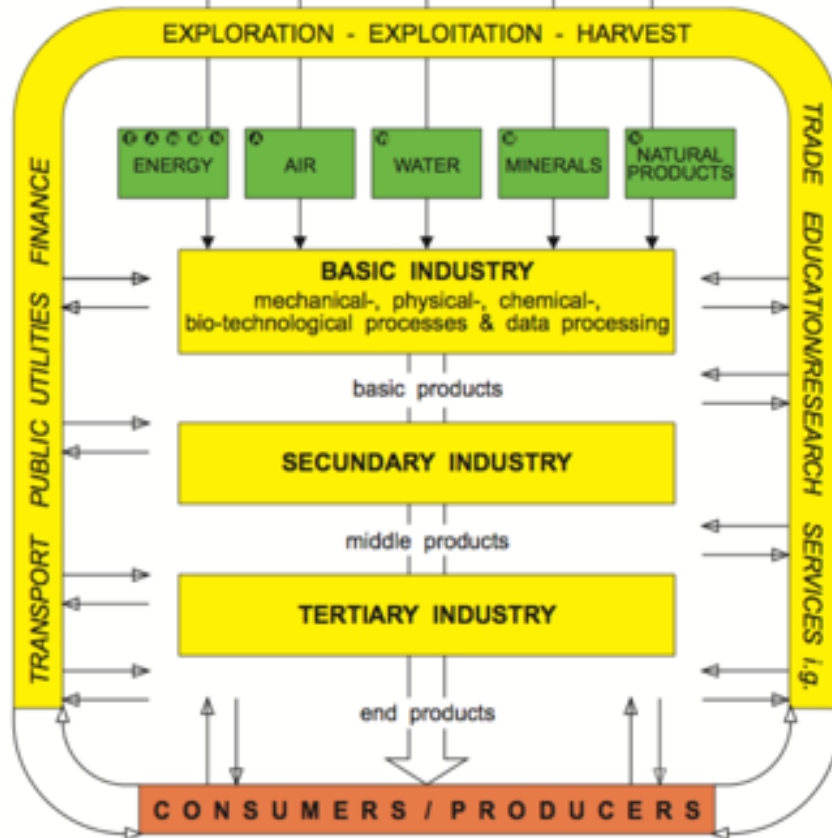
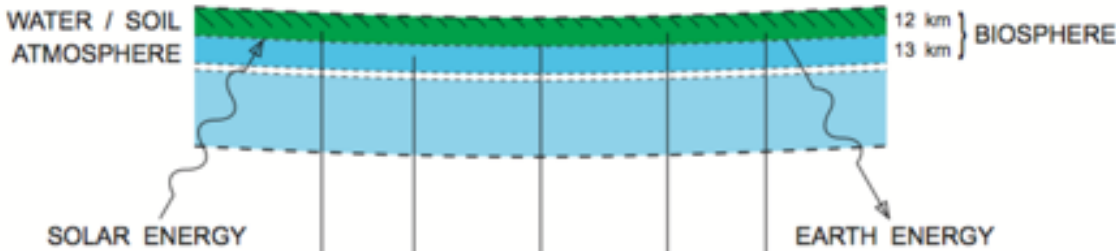
Apart from space travel
all human activities take
place in a thin shell
around the earth: the
geosphere - biosphere –
sociosphere system



There we find the
environmental
compartments
Air – Water – Soil,
flora, fauna, micro-
organisms and people
and all the material
expressions of
human activities

EARTH

Earth radius: circa 6370 km
Total surface area / land + water: $510 \cdot 10^6 \text{ km}^2$
Environmental compartments: AIR/WATER/SOIL
Micro-organisms - Flora - Fauna incl. people



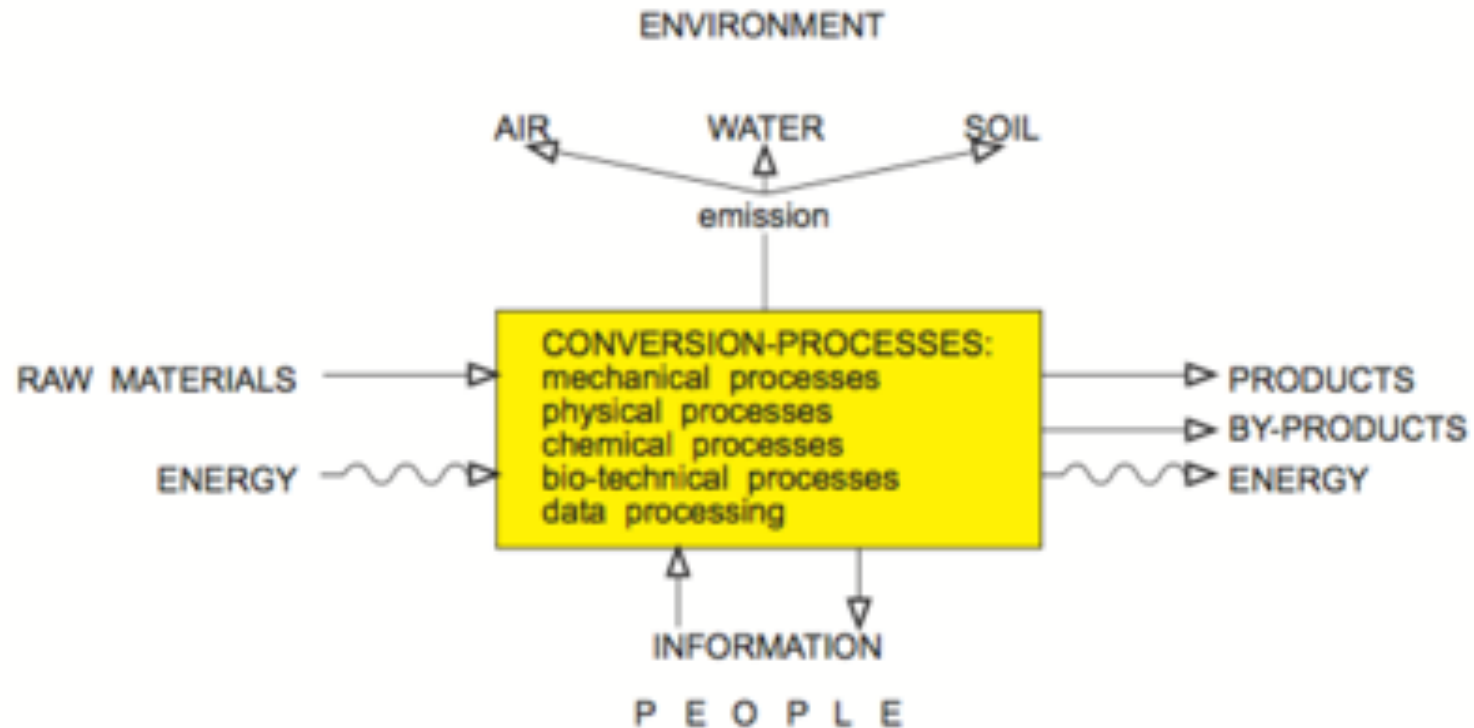
MANKIND extracts
from / in the
geosphere
raw materials
and energy

Every human being
is at the same time

**PRODUCER &
CONSUMER**

1804: 1 billion people
1927: 2 billion people
2000: 6 billion people
2012: 7 billion people
2040: 9 billion people
2090: 11 billion people

Process innovations take place in the environment and are initiated, developed and managed by people



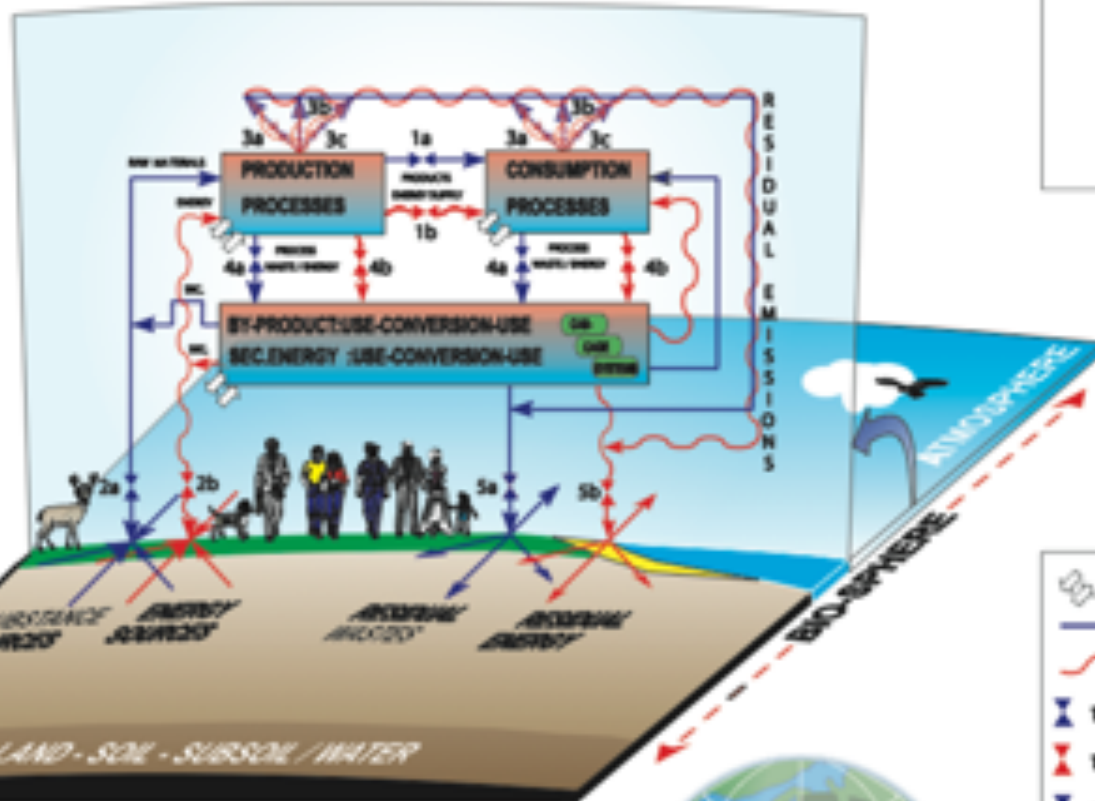
The great challenge of the 21st century is to develop and implement conversion processes in such a way that at the same time the economy is strengthened and the environment improved

Environmental Technology



Triple - C approach

TOWARDS A (CLOSED) MASS / ENERGY - CYCLE IN A SUSTAINABLE SOCIETY (in which up- and downgrading occurs)



- The conversion processes take place in the environment. They are often initiated, developed and managed by people.
- Those processes should be developed whereby with less raw materials and less energy, valuable products can be produced at a higher yield, with less hazardous emissions to air/water/soil.
- In so far by-products are produced, these should be transformed into environmentally friendly products. If this is not feasible these by-products should be safely stored in order to protect the environment.
- Space- and time-factors should also be taken into account.

BIO-SPHERE :

- ENVIRONMENTAL COMMITMENTS, AIR - WATER - SOIL
- MICRO-ORGANISMS, FLORA, FAUNA (CIVIL, PEOPLE)
- ECO - SYSTEMS
- ALL MATERIAL, DEPENDENCIES OF HUMAN ACTIVITIES
- MAIN SOURCES } VIA EXPLORATIONS, EXPLOITATION, MINING, CULTIVATION, HARVEST, ETC.
- ENERGY SOURCES }
- RESIDUAL WASTE } DISPOSAL / RECYCLING / REUSE
- RESIDUAL ENERGY }

ENVIRONMENTAL FOOT IMPRINT (IN HA)

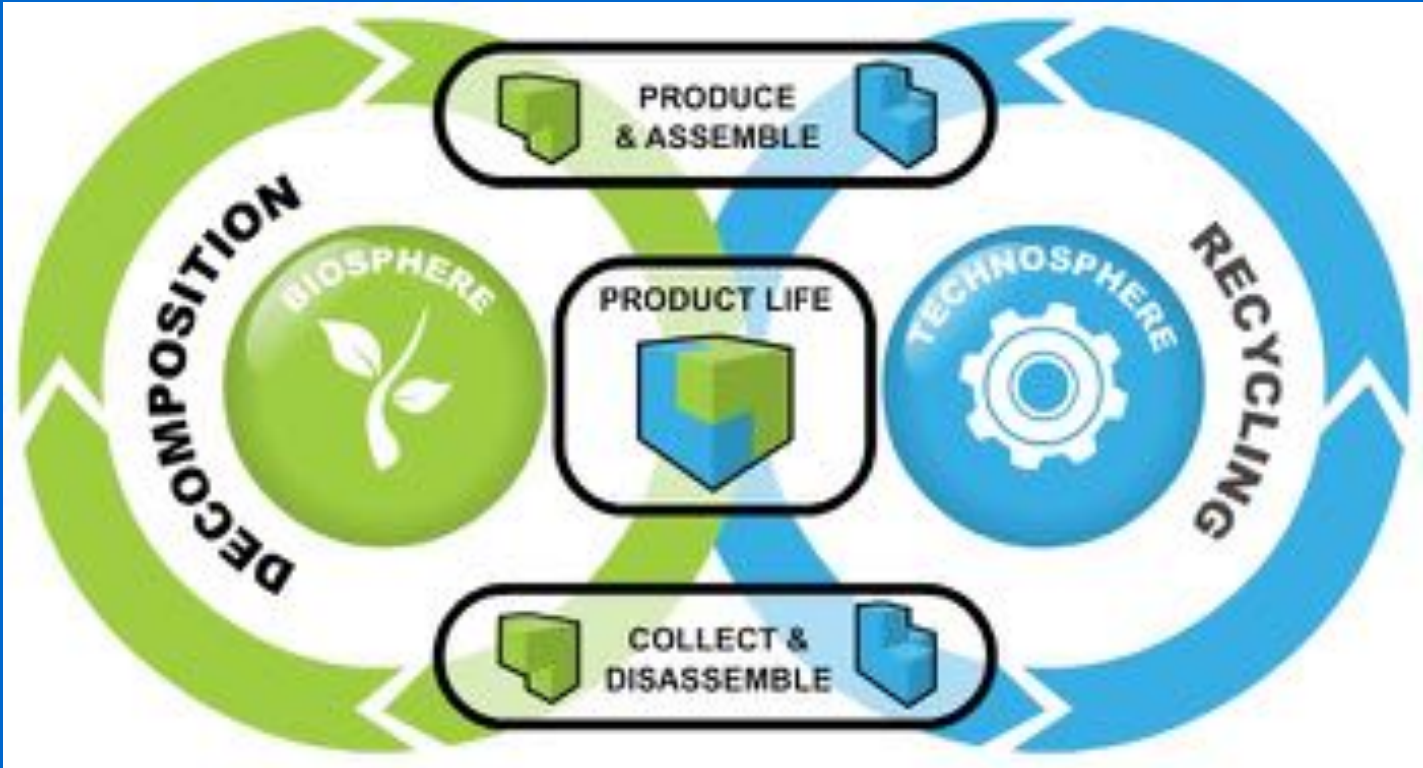
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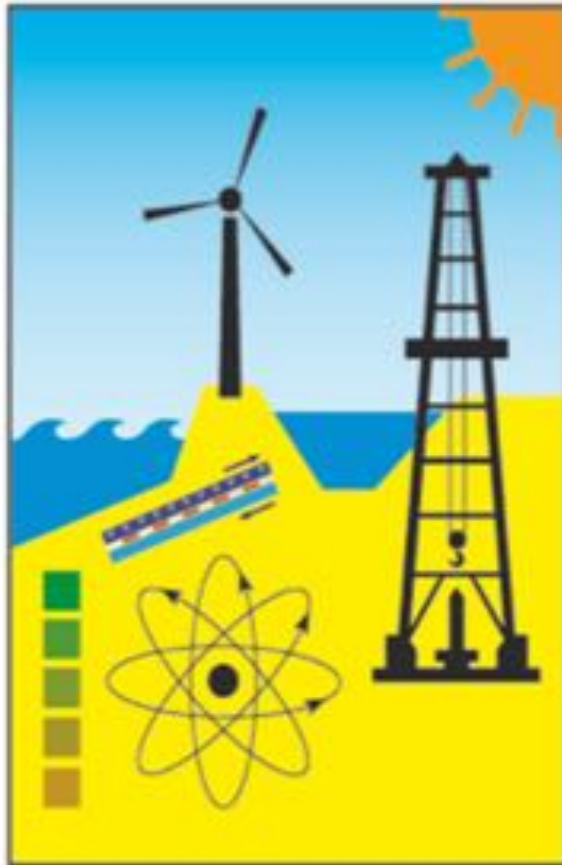
FUNCTION (POPULATION, LIFESTYLE, TECHNOLOGY)



CIRCULAR ECONOMY

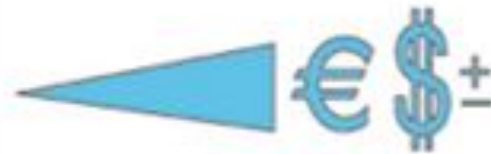
C2C





ENERGY

- natural gas, oil, coal, etc.
- biomass (wood, etc.);
organic wastes
- nuclear energy
- solar-, wind-,
water-, geo-energy
- combined cycle,
isolation, etc.



**Special attention for the Energy Conversion – Storage – Transport
and for the application of Photovoltaic Cells,
Concentrated Solar Power & Biomass**

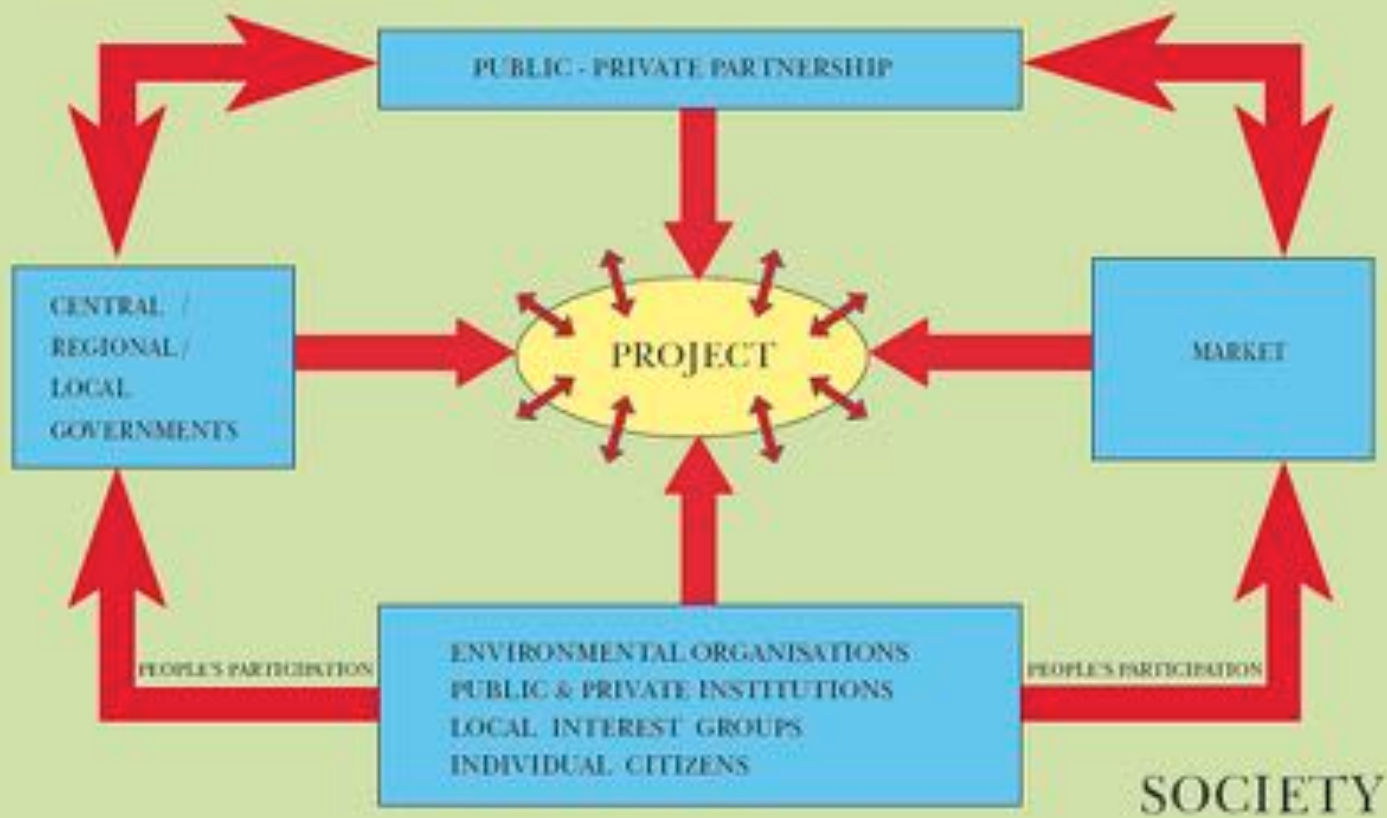
**SUSTAINABLE COASTAL & DELTAIC ZONE
DEVELOPMENT VIA BUILDING WITH NATURE**

Interactive Plan Development

SUSTAINABLE COASTAL & DELTAIC ZONE DEVELOPMENT VIA BUILDING WITH NATURE



ENVIRONMENT



A project - including its plan development - is situated and takes place in the environment and is initiated, propagated, criticised and executed by people. The project influences the environment and is influenced by the environment.

INTERACTIVE PLAN DEVELOPMENT

DECISION MAKING PROCESS

GOVERNMENTS & PUBLIC



LEGAL PROCEDURES



COMMUNICATION



PLAN DEVELOPMENT PROCESS

STEERING COMMITTEES
WORKING COMMITTEES
RESEARCH INSTITUTES
CONSULTANTS
CONTRACTORS



$$P_R = F(Q \times A)$$

Probability of Realisation =
Function of Quality & Acceptance

- The interactive plan development must be:
- in accordance with legal procedures & standards;
 - fully equipped for vice-versa communication;
 - feasible from a financial - economical - social - cultural - environmental point of view;
 - striving for sustainability.

SUSTAINABLE COASTAL & DELTAIC ZONE DEVELOPMENT VIA BUILDING WITH NATURE

Vision

Vision plays a crucial and essential role from start to finish in any interactive plan development process. Without vision neither an excellent plan design, nor its development can be achieved.

Every plan development is or should be based on a well-founded vision.

Ideally, this vision, placed in time and space, should be based on knowledge, insight, sensory perception, analytical skill, sound rational reasoning and intuition, inspiration and creativity.

1.1 *"Creative Thinking – Thoughtful Acting."*
Motto Royal Dutch Institute of Engineers

1.2 *"A Living Nation is Building its Future."*
Dr. Ir. C. Lely (1854 – 1929), the Netherlands

1.3 *"Luctor et Emergo."* ("I struggle and emerge")
Motto Province of Zeeland, the Netherlands

SUSTAINABLE COASTAL & DELTAIC ZONE DEVELOPMENT VIA BUILDING WITH NATURE

Vision

2.1 *"Nature is a brilliant source of inspiration and an excellent teacher for the development of well-designed plans."*

R.E. Waterman

2.2 *"Well-designed plans have their roots in the past and are pointing to the future."*

R.E. Waterman

2.3 *"The great challenge in this era is to develop methods that simultaneously improve the environment and strengthen the economy"*

R.E. Waterman

2.4 *"The most valuable resource available to us is our brain. Therefore let us together use these brains for the benefit of the environment, the economy and our fellow human beings."*

R.E. Waterman

2.5 *"Sharing knowledge is multiplying knowledge."*

Anonymous

2.6 *"Think Long-Term – Act Short-Term."*

P.J.A. van Hessen

3.1 *"If you will, it is no fairy-tale."*

Th. Herzl (1860-1904),
"Altneuland" (1899-1902)

3.2 *"Who doesn't believe in dreams, is not a realist."*

D. Ben Goerion (1886-1973)

3.3 *"Dream great dreams and take practical steps to turn them into reality."*

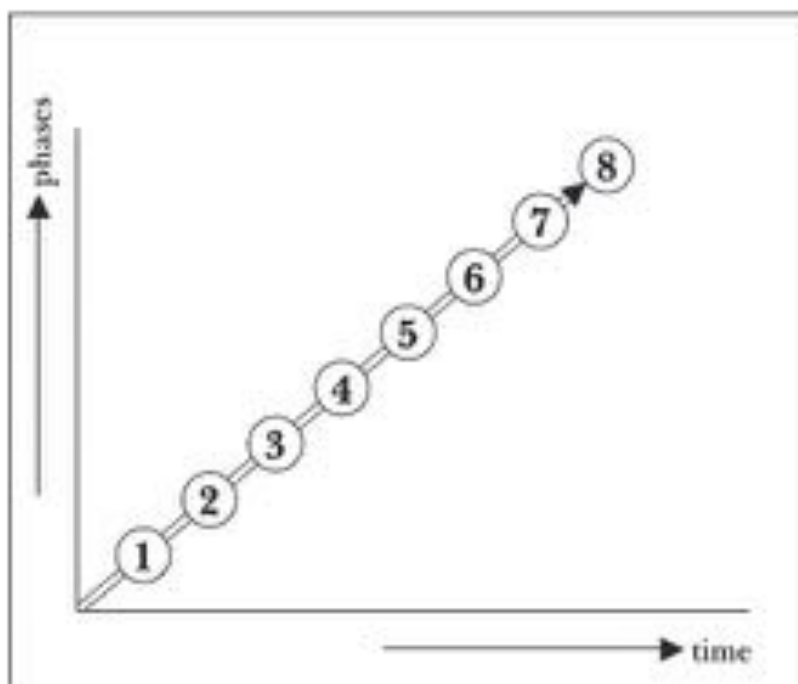
Henrietta Szold (1860-1945)

3.4 *"Dreams are not to soothe us asleep, but to shake us awake."*

R. Magritte (1898-1967), 1929

SUSTAINABLE COASTAL & DELTAIC ZONE DEVELOPMENT VIA BUILDING WITH NATURE

1. PLAN DEVELOPMENT & EXECUTION



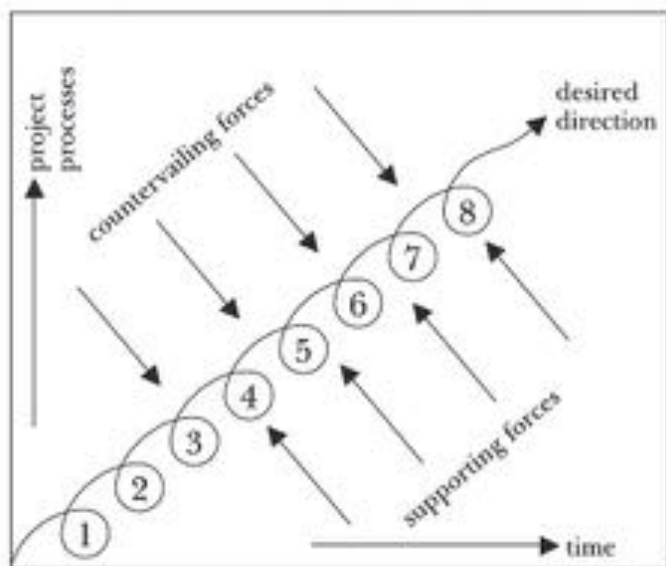
In the development and execution of a plan many phases can be distinguished. All other interacting processes, although of extreme importance, have been left out.

1. Existing situation.
2. Vision for a future situation.
3. Conceptual plan based on acquired data, trends, careful analysis and additional research.
4. From conceptual plan towards a number of concrete plans.
5. Fine tuning and final choice of selected plan.
6. Execution of chosen plan.
7. Wished for resulting situation.
8. Operation and maintenance of executed plan.

Additional Instruments

SUSTAINABLE COASTAL & DELTAIC ZONE DEVELOPMENT VIA BUILDING WITH NATURE

2. SERIES OF CYCLIC PROCESSES IN "FORCES FIELD"



- Mapping of Field Forces
- Field Force Analysis
- Weighing forces for and against a project

Weighing factor = f (availability & power to influence change)

3. SWOT ANALYSIS



4. MULTI-CRITERIA ANALYSIS

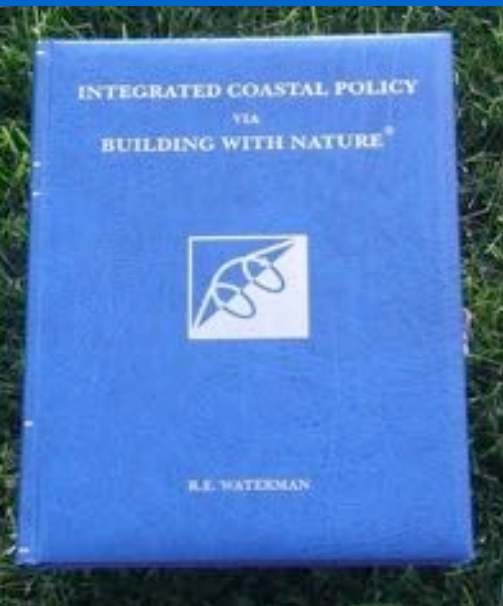
Multi-criteria Analysis which weighs factors for comparative model research, whereby each relevant function from a to z is weighed qualitatively and quantitatively. This is an additional instrument to compare and evaluate a series of plans.

Additional Instruments

•
•
•

Thank you for your attention

Integrated Coastal Policy via Building with Nature[®]



Ronald E. Waterman

Paul T.A. Liesting
Cartography

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