Anticipatory Archipelagos

Shaunice Ten

To everyone whom I've had the chance to enjoy
architecture with,

LAND ;

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Student: Shaunice Ten
Tutor: Lilian Chee

Source : Author

In the physical systems of territorial expansion in Singapore, land is seen as a geomorphic entity that is endlessly shaped to achieve our nationalistic vision – essentially one that always pursues the bigger, greater and better. In the face of land scarcity, the government's pursuit of more land has become a norm. Land has been reclaimed, commoditised, engineered and manipulated to feed a value system where land is productive for skyscrapers and seas for entrepot trade – a system which results in waste, pollution and a de-valued ecology. As such, Singapore has now become an island that has lost its islandness.

In contrast to this self-centered value of land, this thesis projects Singapore as an altruistic nation which will begin to aid in the restoration of ecology by reducing pollution and re-valuing nature.

The thesis reimagines a restored archipelago where lands and waters are clean and productive in a new value system that shifts away from current systems of cities and trade. It will seek to demonstrate the other valuations of land through an enduring fabrication of new lands which will grow and evolve into a sanctuary for nature and individuals seeking refuge from mainland. The islands will eventually evolve into a marine research and nature park which encapsulates a rich biodiversity, and have interim programmes such as communal farming, aquaculture, and low cost temporary housing for transiting immigrants and marine researchers - a land use which speaks of a different kind of productivity, economy and value – one that is perhaps more rehabilitative and remedial.

This project looks to land as a system that begins to blur the boundaries between architecture and geography. Land sustains the living, it becomes the life.

Anticipatory Archipelagos

Thesis Statement

Source : Author

Land is a geographical entity, a territory demarcated by governmental borders. Beyond its cartographical mapping, it embodies relations and representations of political, economic, cultural and historical systems as well. These intangible extents of land affect the definition of the territory and are often a means through which the desires of a nation are articulated. Hence, land becomes the essential foundation on which conditions can be overlaid. But land is not merely soil. It is a fountain of energy sustaining life. It suspends the tension between architecture and geography. It suggests potentials of occupation and territorialisation of habitable lands and inhabitable waters.

The island of Singapore serves as an example of such significance. In the physical systems of territorial expansion, land is seen as a geomorphic entity that is endlessly shaped to achieve her nationalistic vision – essentially one that always pursues the bigger, greater and better. In the face of land scarcity, the government's pursuit of more land has become a norm. Land has been reclaimed, commoditised, engineered and manipulated to feed a value system where land is productive for skyscrapers and seas for entrepot trade – a system which results in waste, pollution and a de-valued ecology. As such, Singapore has now become an island that has lost its islandness.
In contrast to this self-centered value of land, this thesis projects Sdingapore as an altruistic nation which will begin to aid in the restoration of ecology by reducing pollution and re-valuing nature.

This project looks to land as a system that begins to blur the boundaries between architecture and geography. The thesis reimagines a restored archipelago where lands and waters are clean and productive in a new value system that shifts away from current systems of cities and trade. It will seek to demonstrate the other valuations of land through an enduring fabrication of new lands which will grow and evolve into a sanctuary for

nature and individuals seeking refuge from mainland. The islands will eventually evolve into a marine research and nature park which encapsulates a rich biodiversity, and have interim programmes such as communal farming, aquaculture, waste treatment facilities and low cost temporary housing for transiting immigrants and marine researchers - a land use which speaks of a different kind of productivity, economy and value – one that is perhaps more rehabilitative and remedial.

Yet, land is not simply a static entity. Geographical terrains are constantly and almost instantaneously transformed by reclamation projects. Even in the sea, sailors depend on the global positioning system as their only stable nautical guides. Beyond its allegorical and critical dimensions, the idea that land value be experienced in its verticality rather than its horizontality is strange and powerful. This project proposes lands that grow and evolve both horizontally and vertically; it makes use of bio-rock coral growth, floating platforms and oceanic detritus as its construction materials, coming together to form multiple layers of ground stability and use.

The islands will gradually morph be semi man-made, semi nature – its structural reliance shifts from man-made to organic biorock structures which secure the lands permanence overtime. The growing of land will be informed by a natural and gradual process as opposed to current curated and engineered means which disregard existing ecological systems – This essentially means that ocean currents and sea minerals will dictate the growth of the islands while sea depth and structural density will inform the programmes. Expressing itself as an offshore landscape, the islands become a pioneering adventure in a new system of productivity. In a groundless territory without end, the city attempts to anchor a human presence of livability and self-sustenance with a comprehensible scale. Waste treatment, bio-remediation and closed loop productive systems

on the island become the heart of its sustenance.

Eventually, the archipelagos paint a horizontally vast and intimate landscape as opposed to the towering blocks on the mainland – an image which speaks of an alternate value of land. The islands will serve as an entity of protected islandness, withstanding the test of time.

In this thesis, land sustains the living. It becomes the life.

Anticipatory Archipelagos

Thesis Synopsis

ANTICIPAT

These Statement in the physical systems of terrestrial scarcities in Singapore, now is seen as a geometric entity that is moderately shaped to achieve our naturalistic vision – assimilate into that always pursuits the bigger, greater and better. In the face of land scarcity, the governmental pursuit of more and more reclaimed is born. Land has been reclaimed, commodified, engineered and manipulated to feed a value system where land is prerequisite for shareholders and seen for enhanced trade – a system which results in misery, pollution and a devastated ecology. As such, Singapore has now become an island that has lost its boundaries.

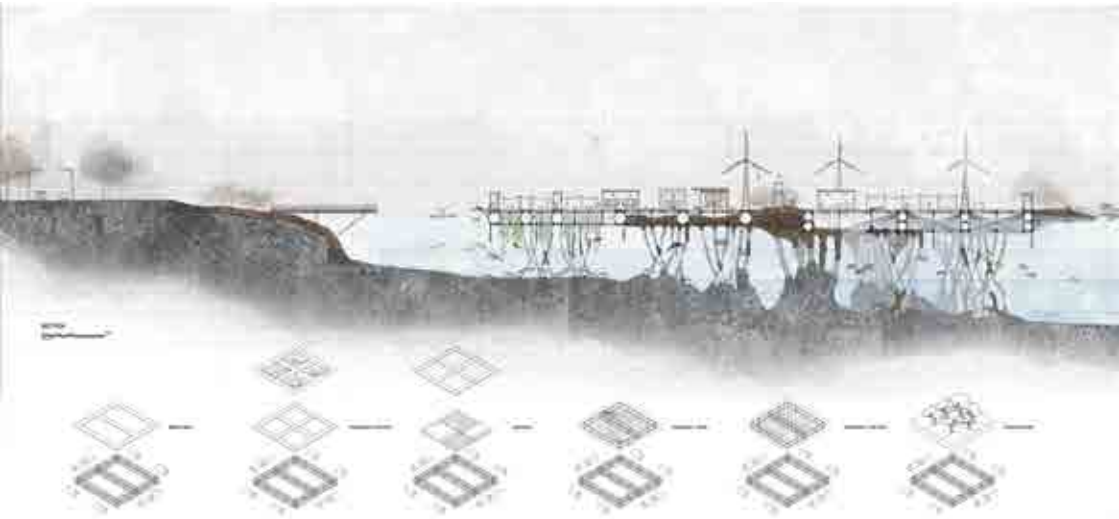
As contrast to this self-confined view of land, this these projects Singapore as an adaptive vision which will begin to aid in the restoration of ecology by reducing pollution and re-valuing nature.

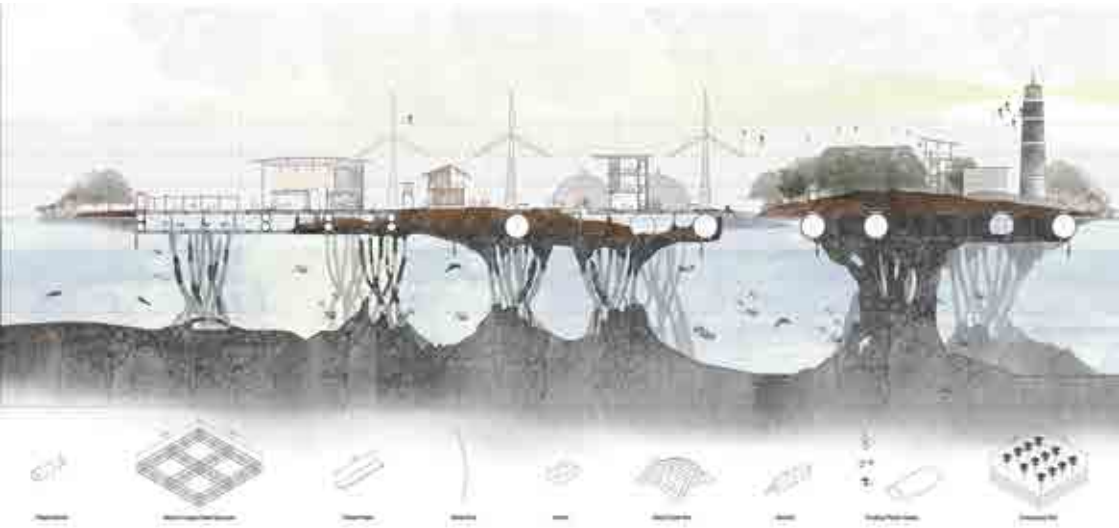
This thesis recognizes a retained archipelago where terrestrial waters are tidely and productive in a new value system that shifts away from current scarcity of cities and habit. It will seek to encompass the other valuations of land through an evolving fabrication of new areas which will grow and evolve into a sanctuary for nature and individuals seeking refuge from mainland. The islands will eventually evolve into a marine research and nature park which encapsulates a rich biodiversity, and have interim programmes such as communal farming, aquaculture, and fish cage incorporate focusing for transfering immigrants and marine researchers – a land use which speaks of a different kind of productivity, economy and value – contrast to perhaps more rehabilitation and remedial.

This project seeks to land as a system that begins to stur the boundaries between commissions and geography. Land sustains the living, it harvests the life.

Anticipatory Archipelagos

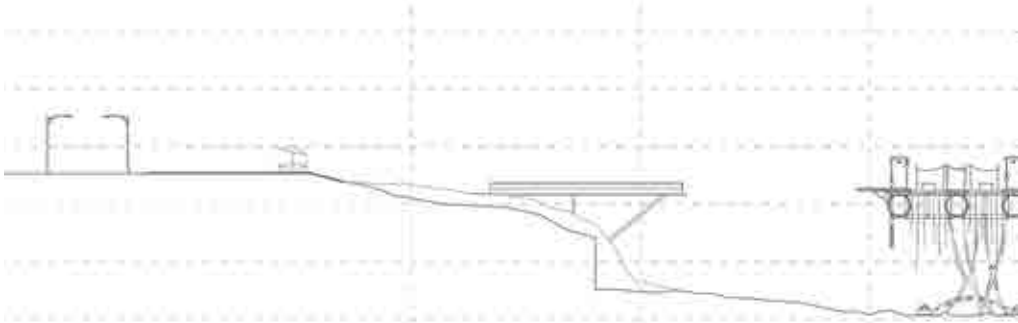
Islandness

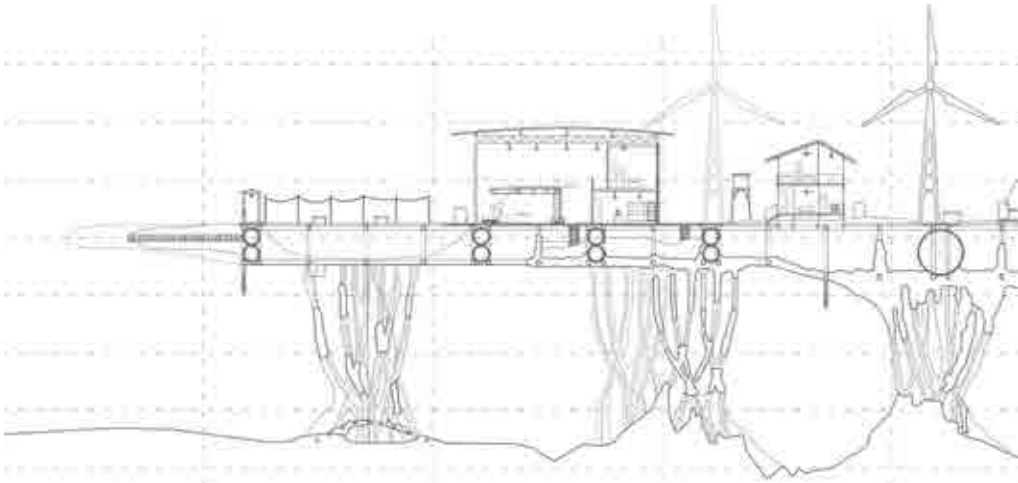


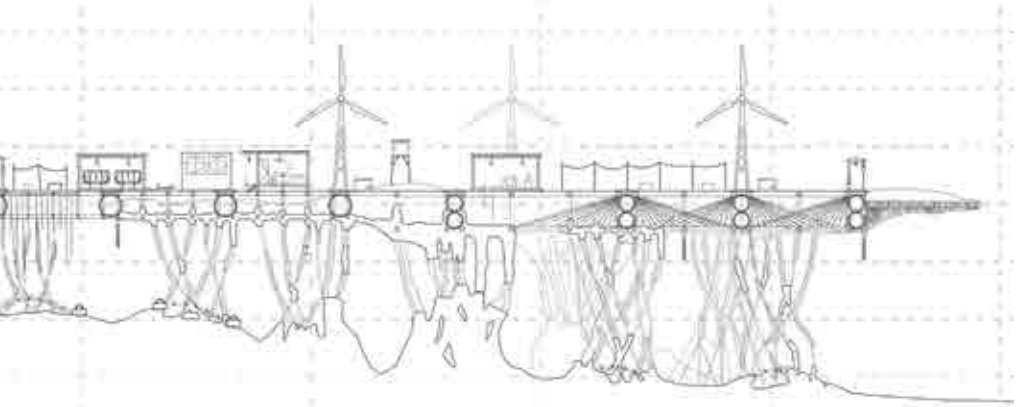


Anticipatory Archipelagos

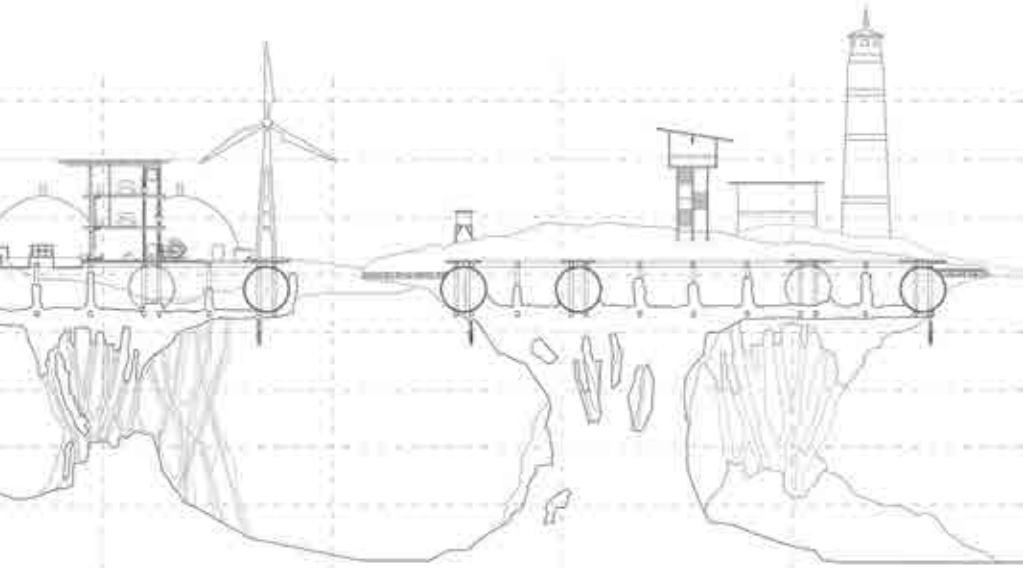
Land blurs Architecture and Geography



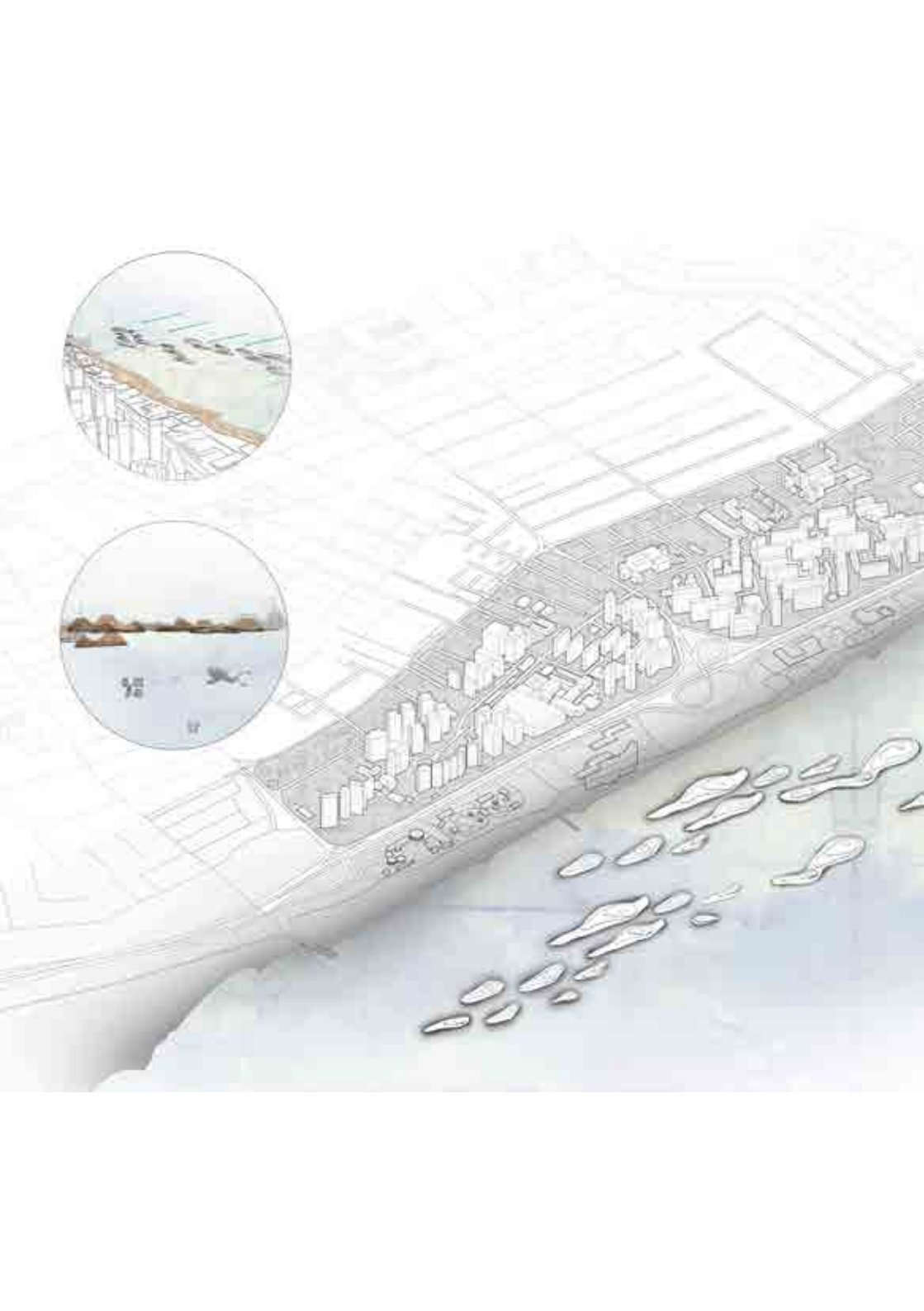


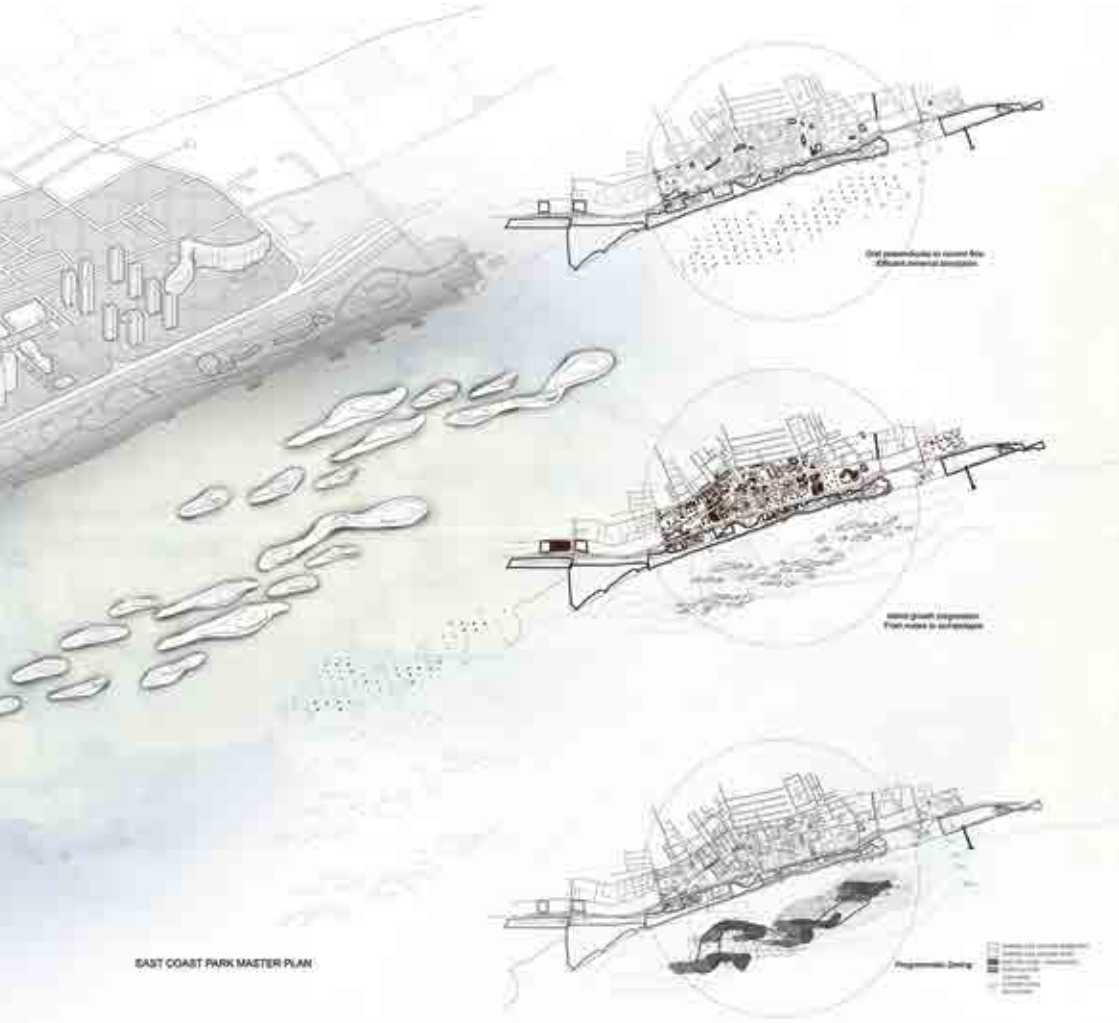


Islands offshore East Coast Park



Development of young to old islands : Multiple layers of stability and overlapping architectural systems.

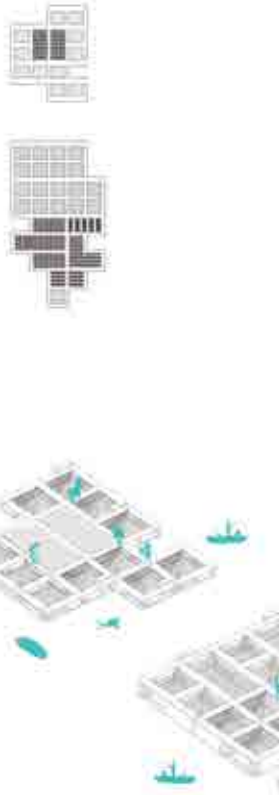




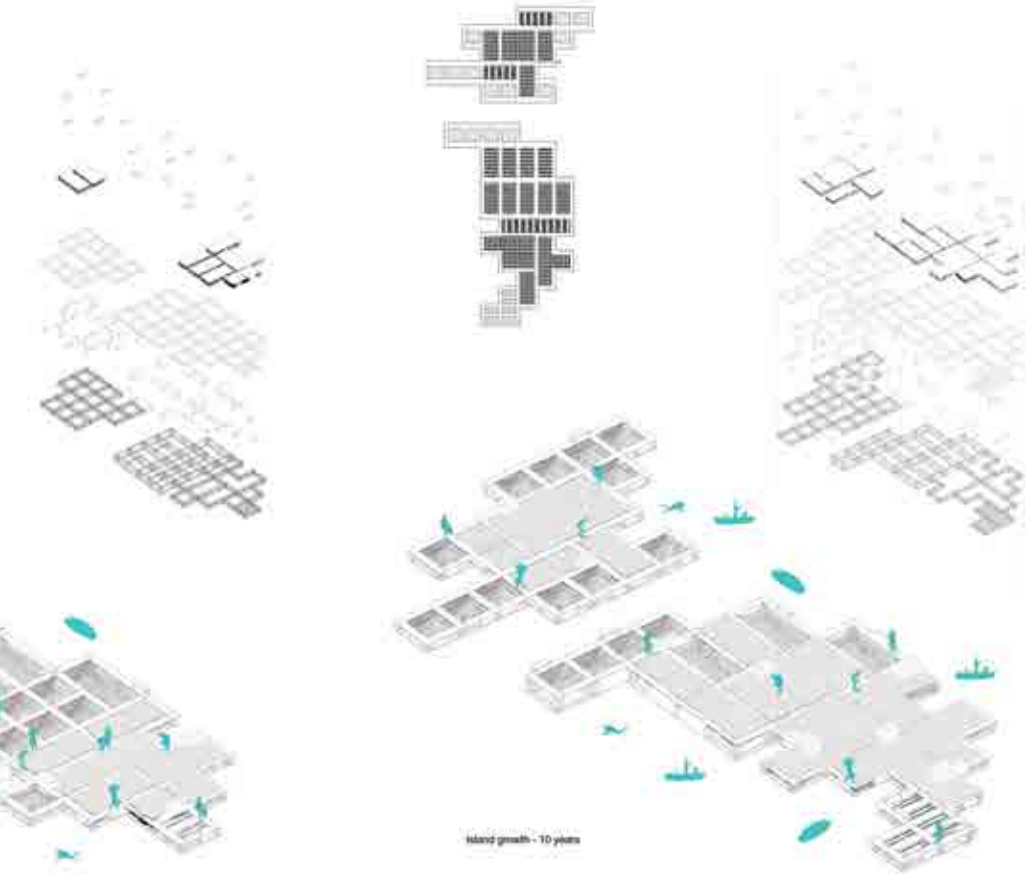
Anticipatory Archipelagos

Masterplan, East Coast Park

Interim programmes: Inland growth - 1 year



Inland growth - 5 years



Anticipatory Archipelagos

Use Values and Programmatic Development

Mariani, Manuela, and Patrick Barron, Eds. *Terrain Vague: Interstices at the Edge of the Pale.* New York: Routledge, 2014.
"Terrain Vague," last accessed February 29, 2016. https://arquitecturayciudades.files.wordpress.com/2014/11/terrainvague2.jpg

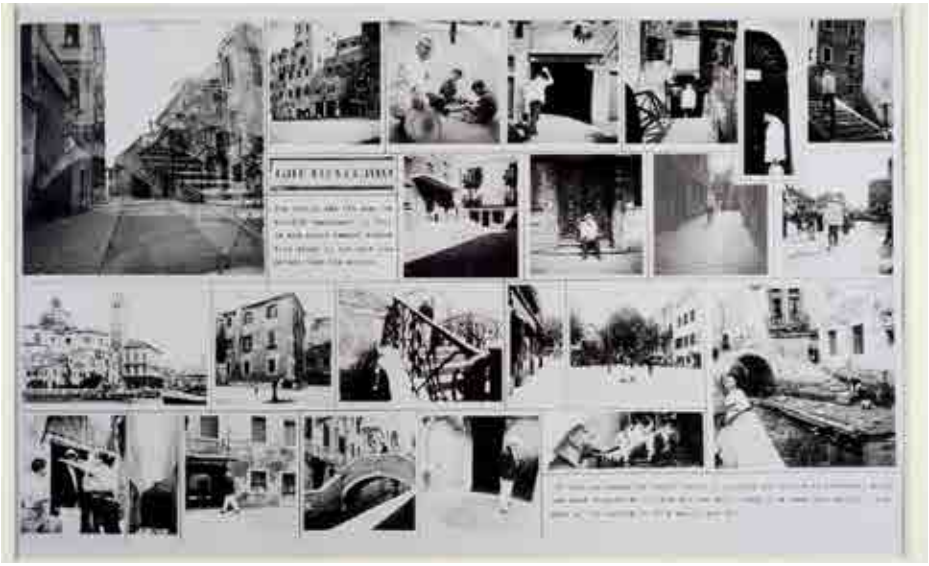
Terrain is the extension of the limited ground, fit for construction, of the city. Larger areas of 'potential' territory while **vague** means movement, oscillation, instability, fluctuation (sea swell), vacant, empty unoccupied – free available and unengaged.

"When architecture and urban design project their desire onto a vacant space, a terrain vague, they seem incapable of doing anything other than introducing violent transformations, changing estrangement into citizenship, and striving at all costs to dissolve the uncontaminated margin of the obsolete into the realism of efficacy."

"the idea of a script of land fit for creation, a dual concept of a plot of land defined by indeterminacy, which has both a spatial as well as a social connection, defined by what it is, but that being specifically defined by how the space is used."

Terrain Vague

Ignasi de sola morales



Psychogeographic map of Venice, 1957

Ralph Rumney

Harald Balder and Salvatore Engel-di Mauro, Eds. *Crtical Geographies: A Collection of Readings*. British Colombia: Praxis(e) Press, 2008.
"Psychogeographic Map of Venice, 1957," last accessed February 29, 2016. http://www.euroinnovators.org/wordpress/wpcontent/uploads/2014/02/PsychogeographicmapofVen. jpg

Psychogeography sets for itself the study of the precise laws and specific effects of the geographical environment, whether consciously organized or not, on the emotions and behavior of individuals. The charmingly vague adjective psychogeographical can be applied to the findings arrived at by this type of investigation, to their influence on human feelings, and more generally to any situation or conduct that seems to reflect the same **spirit of discovery.**

'Introduction to a Critique of Urban Geography'

Guy Debord

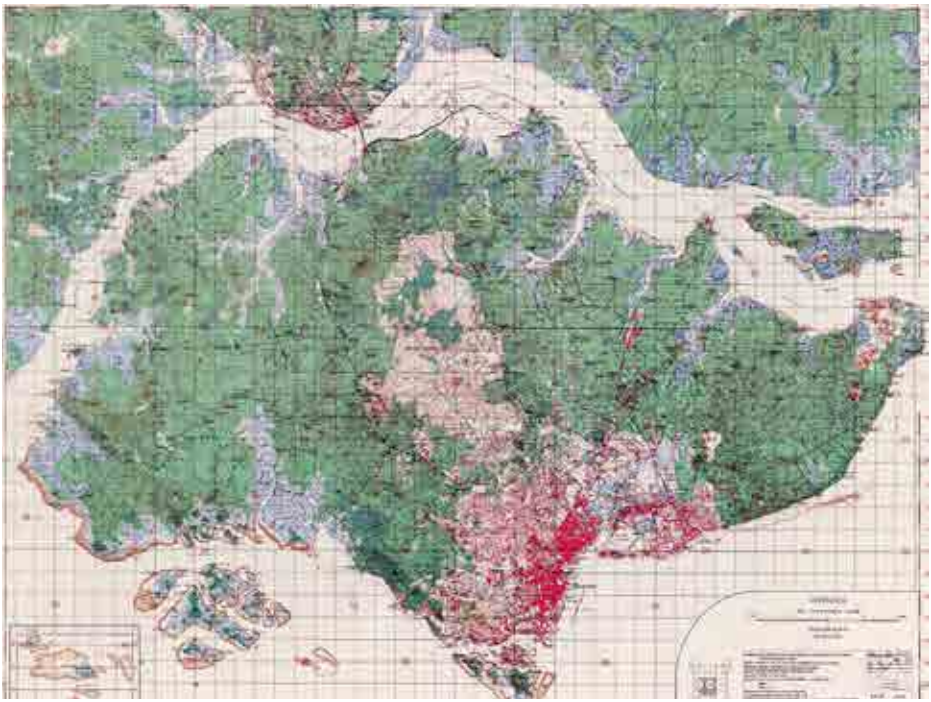
Charles Lim, Ed. *Informatic Naturalism: Notes on SEA State 2*. Singapore: Futureperfect, 2012.

“ In many places, naval PR is about adventure – adventures past and future – tapping the romantic resources of the eternal sea. The Nation, in its projection of a vigilant now, appropriates that forever. **But here in Singapore it is quite the reverse**. The sea is a **horizon of unspecified threats, a domain of unquiet souls.** And the promise of the state is **not its conquest, but its negation**. (You don’t even have to think about the sea. Ever.) The **repressed idea of the sea**, if not its image, belongs to the prophylactic complex that guards a matrix of drip-fed, suburban xenophobia. ”

SEA STATE 2: as evil disappears

Charles Lim

Singapore, 1937



“Singapore Building Plan 1937,” last accessed February, 2016. http://www.nas.gov.sg/archivesonline/maps_building_plans/
“Singapore Building Plan 1971,” last accessed February, 2016. http://www.nas.gov.sg/archivesonline/maps_building_plans/

Singapore, 1971

The topography and extent of vegetation changed significantly from 1937 to 1971 especially during post independence Singapore. Rapid development saw the clearing of forested areas for new towns and the flattening of hills for land reclamation and development purposes.

Topographic Maps

Singapore

1973

2000

2002

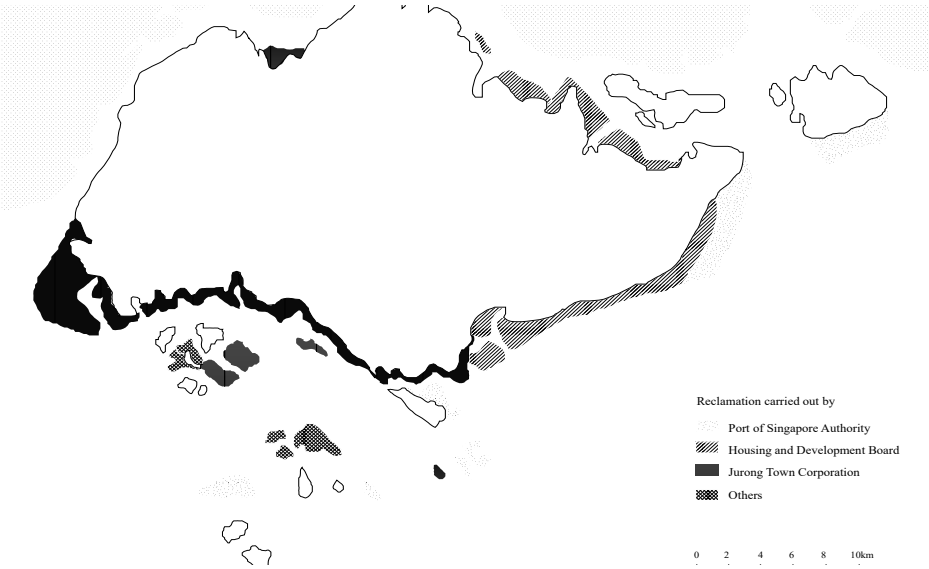
“U.S. Geological Survey, Landsat 7, Singapore ,” last accessed February 29, 2016. http://www.earthshots.usgs.gov/earthshots/Singapore

1989

2009

Shifting coastlines

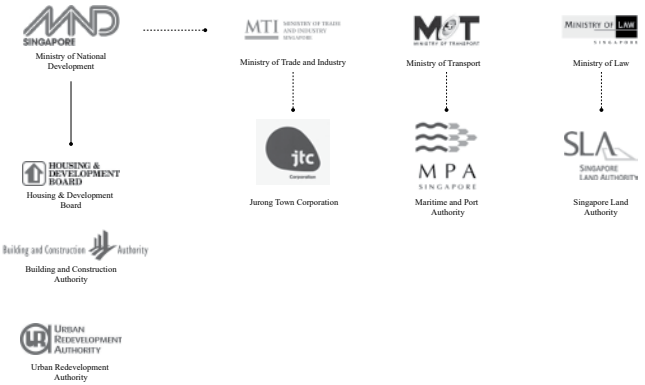
Singapore



Ownership of Reclaimed Land

Singapore

"Types of Soil Used in Land Reclamation," last accessed February 29, 2016. http://www.southchinasea.org
"MND Organisation Structure," last accessed February 29, 2016. http://app.mnd.gov.sg/AboutUs/OrganisationStructure.aspx
Milica Topovic et al. *Architecture of Territory: Hitherland.* Zurich: Architecture of Territory, 2013.



The nation's aspiration to be the regional leader

EDB: Singapore Economic Development Board
1960s: Labour-intensive industrialisation
1970s: Global expansion of EDB
1980s: Capital-intensive, high-technology era
1990s: Manufacturing and investment
2000s: Innovation, knowledge, and R&D

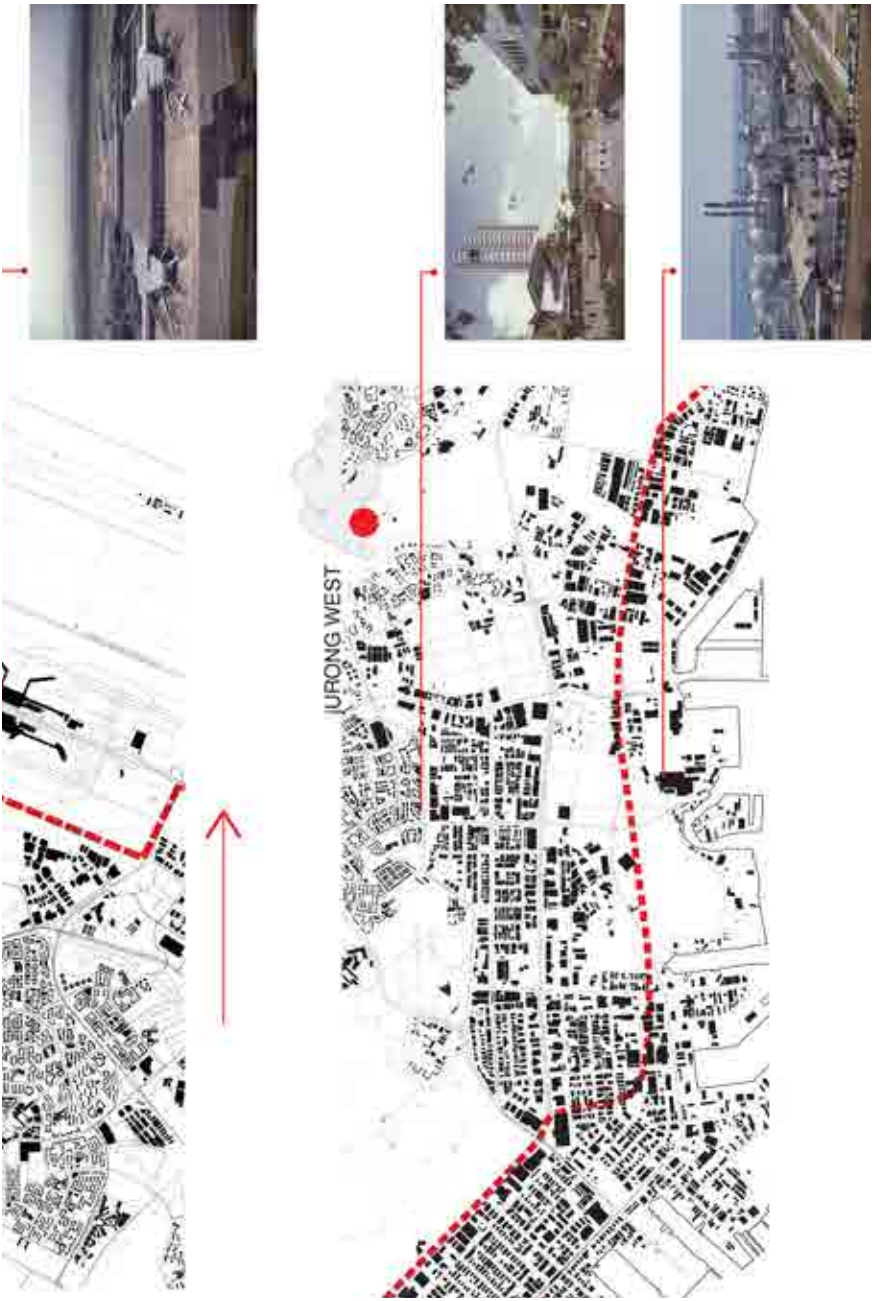
STB: Singapore Tourism Board
Establish Singapore as a regional tourism hub

MTI: Ministry of Trade and Industry
Developing Singapore into a Global Trade Hub

Hierarchy of Government Agencies

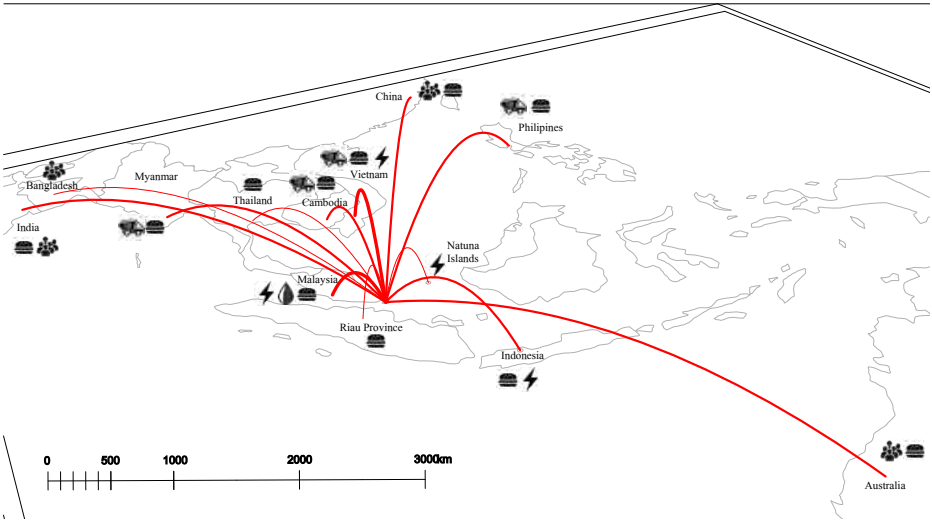
Land Reclamation, Singapore

Milica Topovic et al. *Architecture of Territory: Hitherland.* Zurich: Architecture of Territory, 2013.

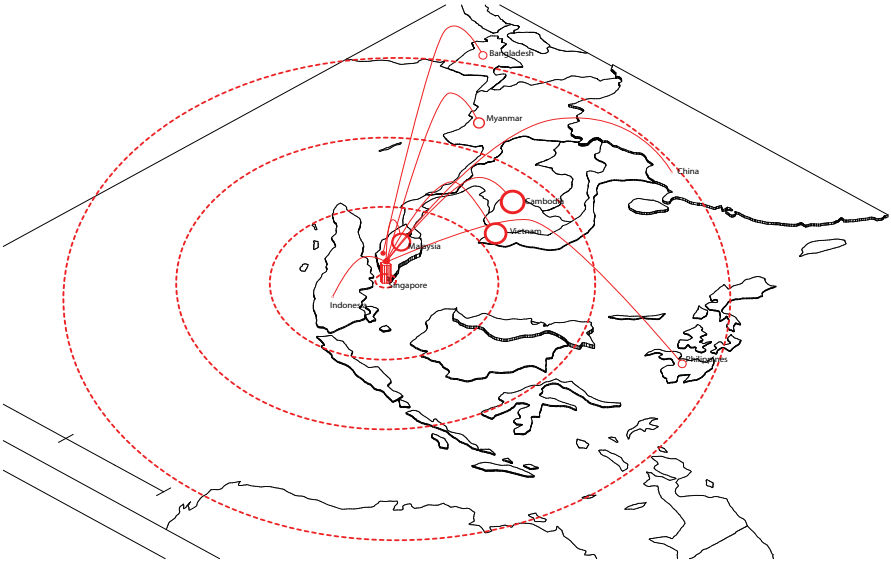


Growing Figure Ground

Developments along the coastline, Singapore



Regional imports of basic resources



Regional sand imports

Tapping on Neighbouring Hinterlands

Regional Imports, Asean Region

Agency : Singapore Government
Agenda : Pollution Control, Ecosystem protection, energy and water efficiency
Funding/ System : Research and Development tax incentive, Land Intensification Allowance incentive, Water Conservation Tax

Agency : NEA
Agenda : Waste minimalisation
Funding/ System : 3R Fund
Co-funding system to encourage organisations to implement waste minimisation and recycling projects.

Agency : NEA
Agenda : Waste management
Funding/ System : Environment Technology Research Programme.
$15 million seed funding programme to build up technological competencies and support compnaies and researchers in waste management.

Agency : MND
Agenda : Pollution Control, Ecosystem protection, energy and water efficiency
Funding/ System : MND Research Fund for the Built Environment
Encourages ‘green’ research and development by covering a 75% of project costs.

Agency : MND
Agenda : Energy efficiency
Funding/ System : Grants for Energy Efficient Technology
Provide funding for up to 20% of qualifying costs, $4 million cap per project.

Funding Schemes

UNEP, ASEAN, SINGAPORE

Agency : UNEP
Agenda : Prevent marine pollution
Funding/ System : Montreal guidelines for the protection of the Marine Environment Against Pollution from Land-based Sources

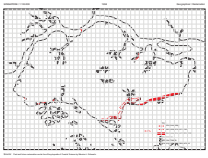
Agency : ASEAN
Agenda : Haze prevention
Funding/ System : Regional Haze Action Plan and ADB Initiative
Prevent land and forest fire through better management policies and enforcement
Regional Technical Assistance project by ADB strengthens capacity of ASEAN to operationalise and monitor RHAP to mitigate transboundary smoke and haze pollution
Funded by ADB, UNEP, Australian and US government, and several other organisations have indicated intrest in providing support for RHAP

Agency : ASEAN
Agenda : Oil spill prevention
Funding/ System : ASEAN - OSRAP
Improving oil spill capability of each ASEAN country by providing mutual assistance in the event an oil spill exceeds the national response capability.

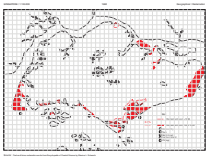
TIMELINE OF LAND RECLAMATION

1821 Sir Stamford Raffles directed the first land fill project

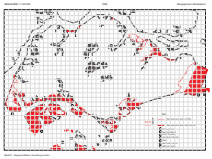
<1958



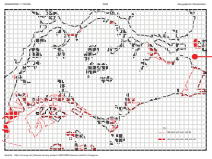
1980



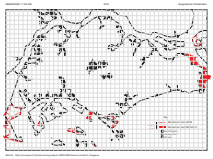
2003



2008



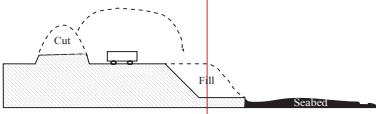
2014



RECLAMATION METHOD: CUT AND FILL

1969, Aida Street Opera Estate

Cut and Fill Diagram



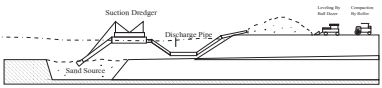
1971, Bedok Hill, Upper East Coast Road

Locally Sourced

RECLAMATION METHOD: DREDGING - SAND IMPORTS

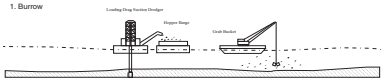
Dredging Techniques

If Fill Source < 2Km Offshore

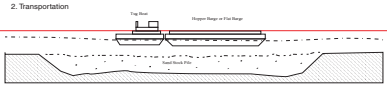


If Fill Source > 2Km Offshore

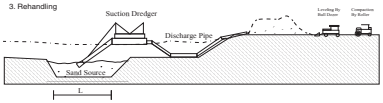
1. Burrow



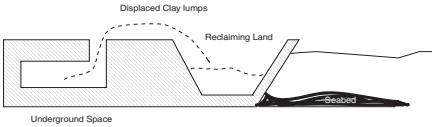
2. Transportation



3. Rehandling



Proposed Alternatives to Land Reclamation



Approved in 2000 for 1500 hectares proposed Pulau Tekong/Ubin reclamation

Maurice L. Schwartz, Ed. *Encyclopedia of Coastal Science.* Netherlands: Springer, 2005.

"U.S. Geological Survey, Landsat 7, Singapore ," last accessed February 29, 2016. http://www.earthshots.usgs.gov/earthshots/Singapore

Marsita Omar. "Pulau Tekong Land Reclamation," *National Library Board: Singapore Infopedia*. Last accessed, February 29, 2016. http://eresources.nlb.gov.sg/infopedia/articles/SIP_1009_2010-05-14.html

Cambodia

Koh Por river, Koh Kong Province

Tatai River
Destruction of vital food sources such as fish, crab and lobsters,eroding river banks

Vietnam

Dong Nai River
Environmental and socio-economic destruction, including deaths of residents due to triggered land-slides.

China

Xiangjiang River

Myanmar

Ngamoeyeik Creek

Malaysia

Tanjung Tokong
Destruction of fishing grounds, environmental effects, landslides

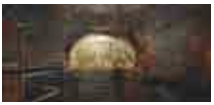
Philippines

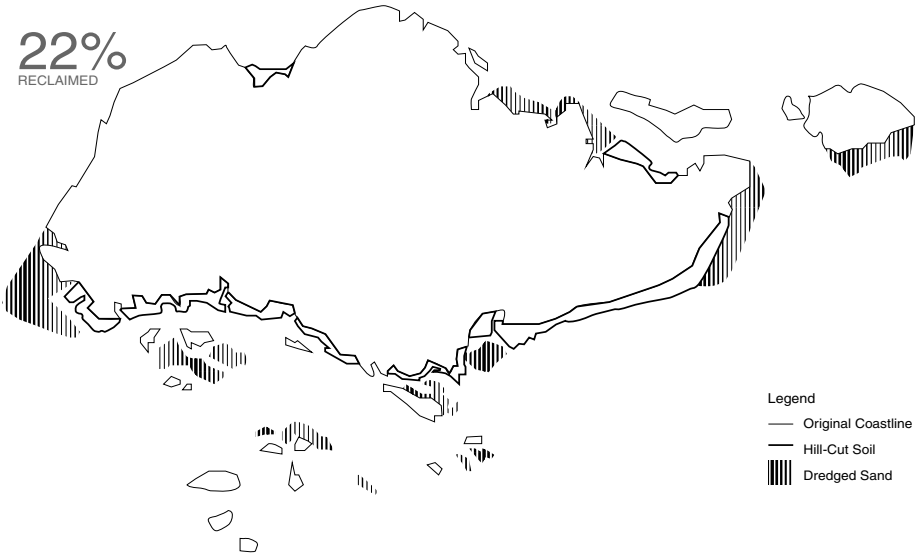
Pinatubo

Locally Sourced

Tatai River

clay lumps, disposal of these unwanted soils, mainly in the form of lumps, fill material for reclamation,



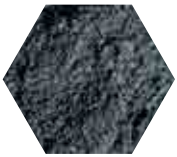


Singapore, 1989

Types of Land Fill materials Used

Singapore

Y. Liang. *Chapter 1: Introduction.* Singapore: National University of Singapore, 2004. Last accessed February 29, 2016. http://www.scholarbank.nus.edu.sg/bitstream/handle/10635/13605/01Chap.pdf?sequence=2



Ash

Rubbish

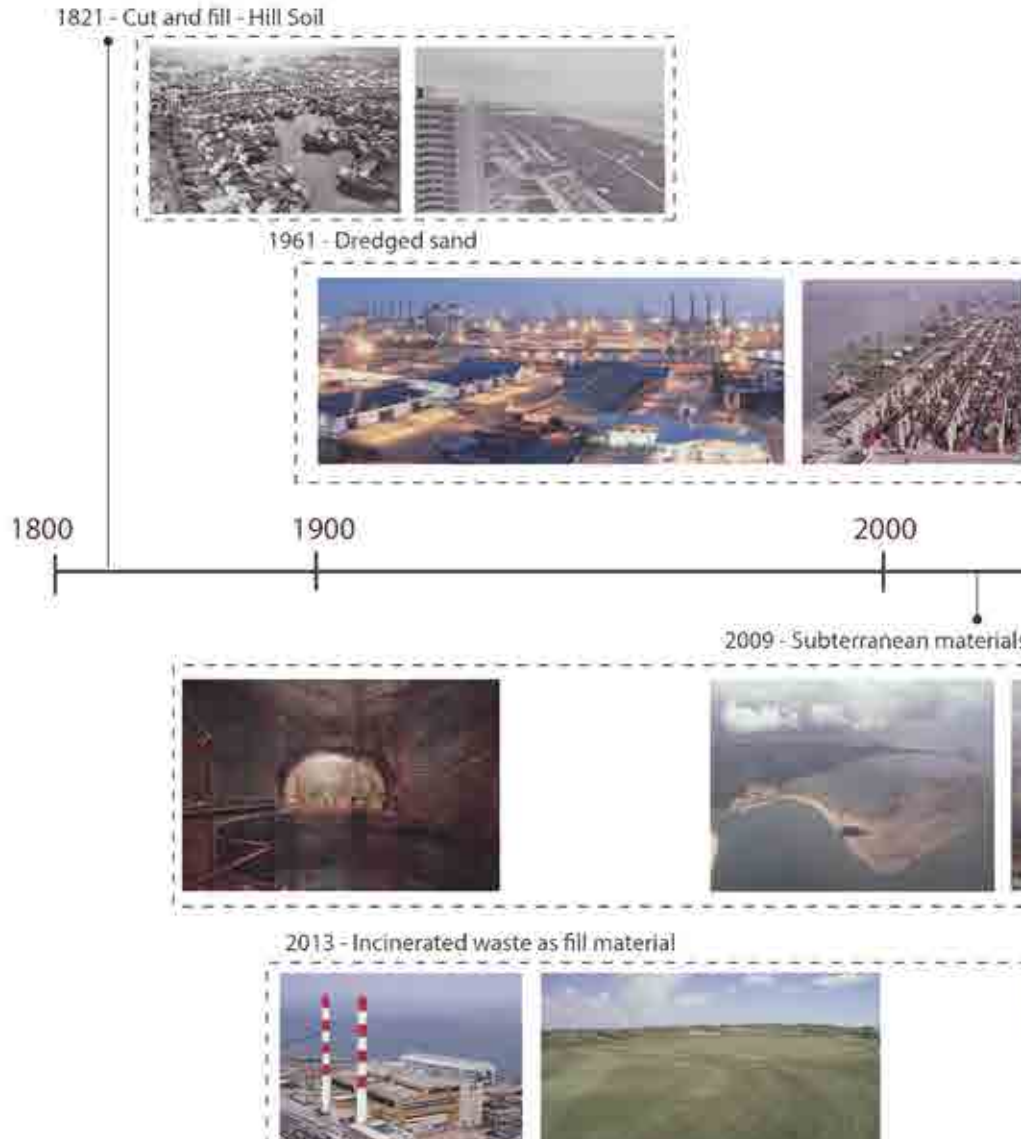
Clay Lumps

Construction Debris

Sand

Soil

Timeline of Singapore's reclamation explorations



Y. Liang. *Chapter 1: Introduction.* Singapore: National University of Singapore, 2004. Last accessed February 29, 2016. http://www.scholarbank.nus.edu.sg/bitstream/handle/10635/13605/01Chap.pdf?sequence=2

Alternatives to Creating Land

Singapore

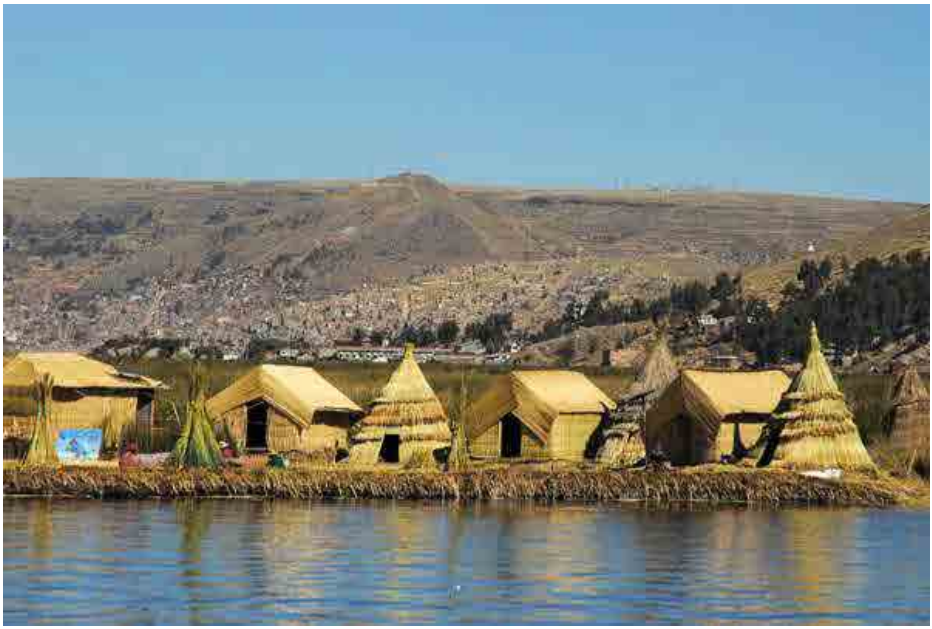
Msir, Timothy. “Singapore Looks Underground for Room to Grow,” *Citiscope*. May 28, 2015
“Jurong Rock Caverns,” last accessed February 29, 2016. http://www.jtc.gov.sg/Style%20Library/jtc/images/banner/dev-jurongrockcaverns1.jpg

“He cited the benefits the caverns bring - they free up 60ha of land, or 70 football fields, above ground - but noted also that they demonstrate how Singapore can "create new space for (itself) both physically and metaphorically."

PM Lee on the Jurong Caverns

Storage and space - Jurong Caverns

Singapore



“Lake Titicaca 5,” last accessed 29 February, 2016. http://www.southamerica.cl
“Floating Islands,” last accessed 29 February, 2016. http://www.discovery-tours.com

These islands are **made with layers of totora reeds** which provide **home, sustenance and transportation** for the indiginous community. The inhabitants believed that they were the owners of the lake and water. The purpose of the island settlements was originally defensive. The floating islands can be moved if the community is threatened.

They are anchored with ropes attached to sticks driven into the bottom of the lake. plants develop and interweave form a natural layer called Khili (about one to two meters thick) that support the islands.

Growing Land - Floating Islands

South America - Lake Titicaca

“Lake Titicaca,” last accessed February 29, 2016. http://www.peruexperience.com/images/slider/3.jpg

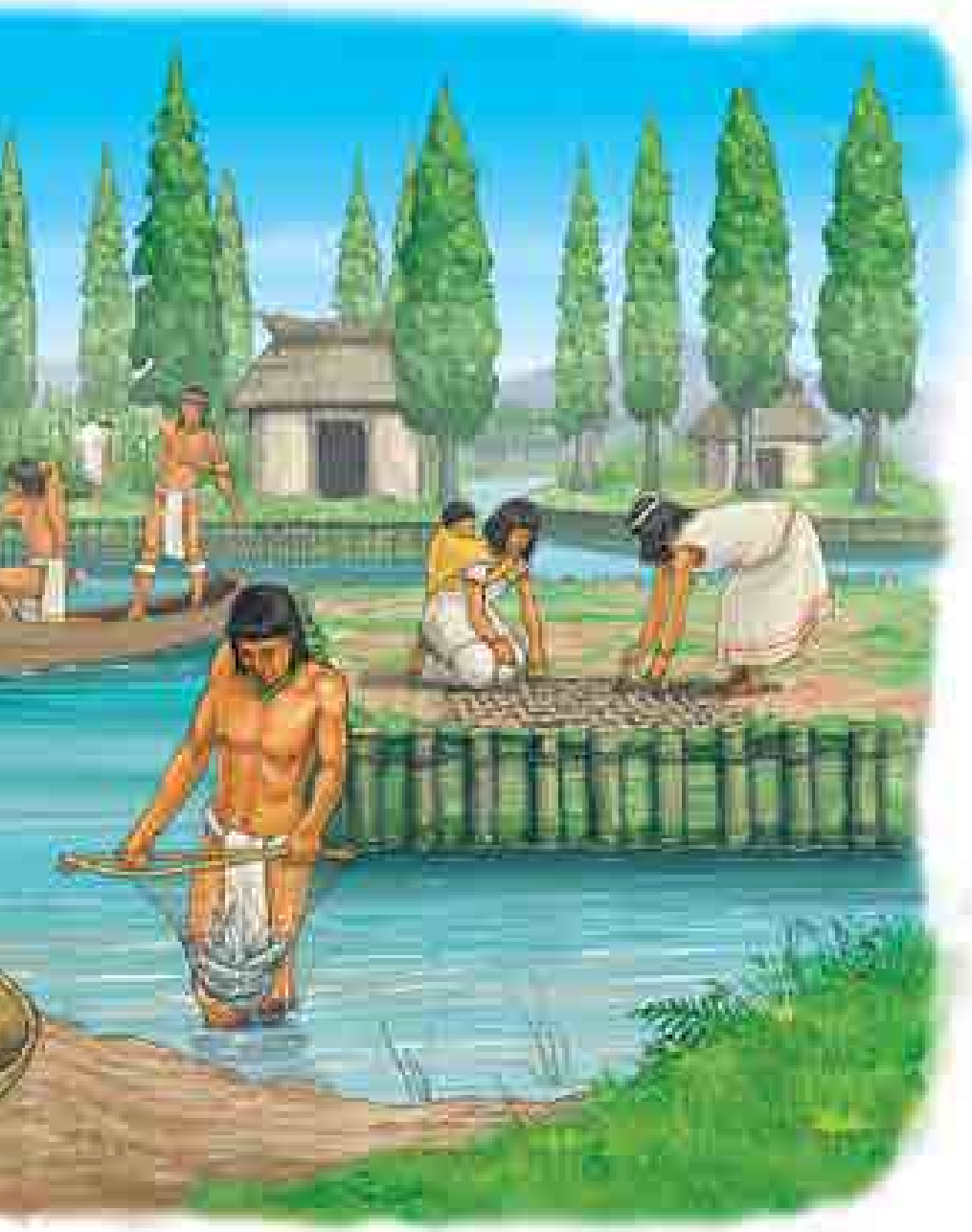
"Farming," last accessed February 29, 2016. http://aztec.com/page.php?page=farming
"ThinkQuest: Aztecs: Farming and Agriculture" last accessed February 29, 2016. http://library.thinkquest.org/16325/y-farm.html
Image, last accessed February 29, 2016. https://smediacacheak0.pinimg.com/originals/c8/f6/c9/c8f6c9e-a394e746815059eb75bad239a.gif

Due to the lack of farmland, the Aztecs created offshore floating farmlands with a new agricultural technique that was called chinampas or floating gardens. These **manmade islands** were from large woven reed mats that were piled with rich earth from the bottom of the lake. The mud was rich in minerals and **ideal for growing crops**. Fast growing willow trees were planted so the **root systems** would grow to the bottom and **anchor the islands**. The islands were planted with crops that produced large amounts of food. They grew tomatoes, avocados, squash, chili peppers, flowers and corn which was their principal crop.The size of the islands was not important, just so two canoes could go between them for navigation.

Growing Land - Chinampas, Floating Gardens

Mexico - Lake Texcoco

"Aztec Chinampas," last accessed February 29, 2016. http://www.curriculumvisions.com/search/C/chinampas/aztecChinampas.jpg



Tokyo Green Space. “Umi-no-Mori - What if a Forest is Created and No One Knows?,” Tokyogreenspace Blog, April 7, 2009, http://tokyogreenspace.com/2009/04/07/umi-no-mori-what-if-a-forest-is-created-and-no-one-knows/

Initiated in 2007, the Sea Forest project aims to **clean the city's air, reduce the heat island effect**, involve elementary school children, and **provide cool breezes** throughout the city in summer. The land is built on top of 12.3 million tons of municipal waste topped with alternating layers of refuse and cover soil, originating at no cost from water purification plants, sewage sludge, city park and street tree compost.

" I perceive this **island as a forest that belongs not just to Tokyo, but to the world**, and through this project, wish to communicate the message of living in harmony with nature."

- Tadao Ando

Umi-no-Mori - The Sea Forest

Japan

Mark, Michelle. “Amid Chinese Territory Disputes, Japan to Grow an Island Out of Coral.” *International Business Times,* December 26, 2015.
“Part VIII - Regime on Islands,” last accessed March 5, 2016. http://www.un.org/depts/los/convention_agreements/texts/unclos/part8.htm

According to the “Regime of Islands” | UNCLOS Part VIII | Article 121

1. An island is a naturally formed area of land, surrounded by water, which is above water at high tide.

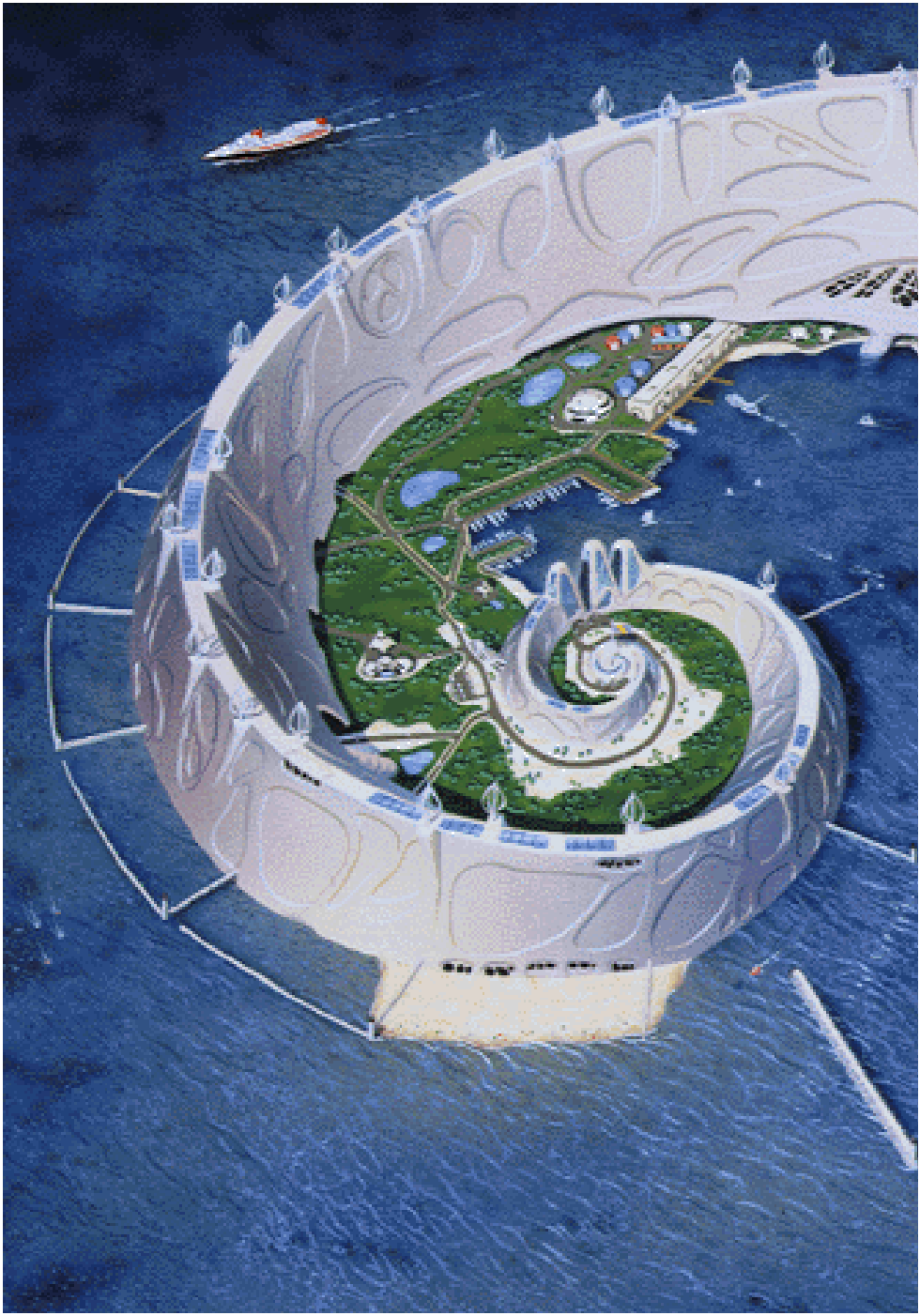
2. Except as provided for in paragraph 3, the territorial sea, the contiguous zone, the exclusive economic zone and the continental shelf of an island are determined in accordance with the provisions of this Convention applicable to other land territory.

3. Rocks which cannot sustain human habitation or economic life of their own shall have no exclusive economic zone or continental shelf.

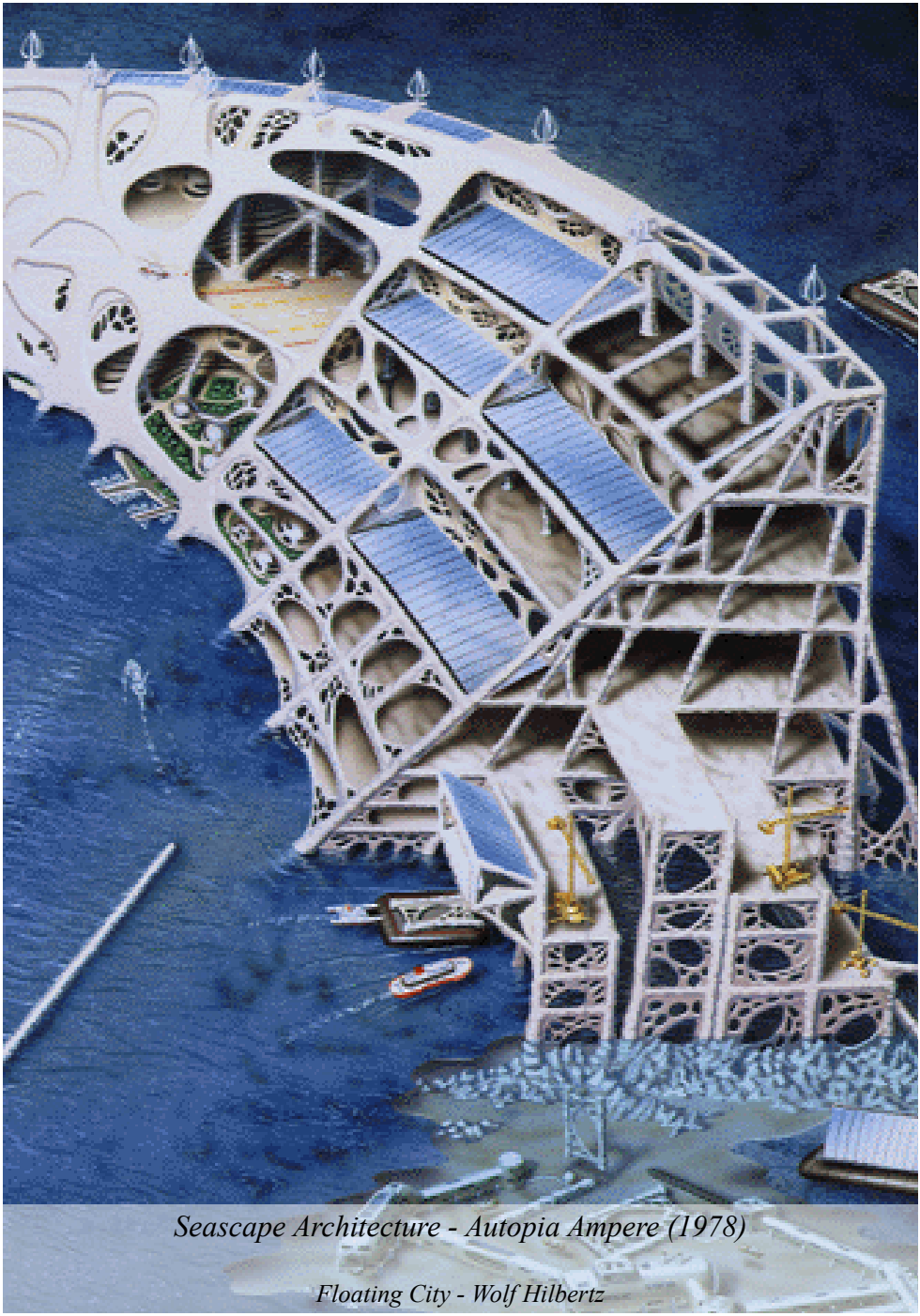
Researchers from Japan brought the coral from Okinotorishima and harvested eggs, and hope to transplant the coral back to the atoll after they grow in a lab for about a year. For Japan, the benefits of **regrowing the island** are twofold: Researchers are keen to find a solution for the world’s rapidly disappearing coral reefs, and the Japanese government seeks to preserve its only landmass in the area, which creates a 200-mile exclusive economic zone and solidifies the country’s **control over the waters**.

Okino-Tori-shima

Disputed geographic feature, South China Sea



"Autopia Ampere," last accessed, March 5, 2016. http://www.climatechange.thinkaboutit.eu/scripts/tinymce/jscripts/tiny_mce/plugins/imagemanager/files/Lucy/AutopiaAmpere.jpg.gif



Seascape Architecture - Autopia Ampere (1978)

Floating City - Wolf Hilbertz

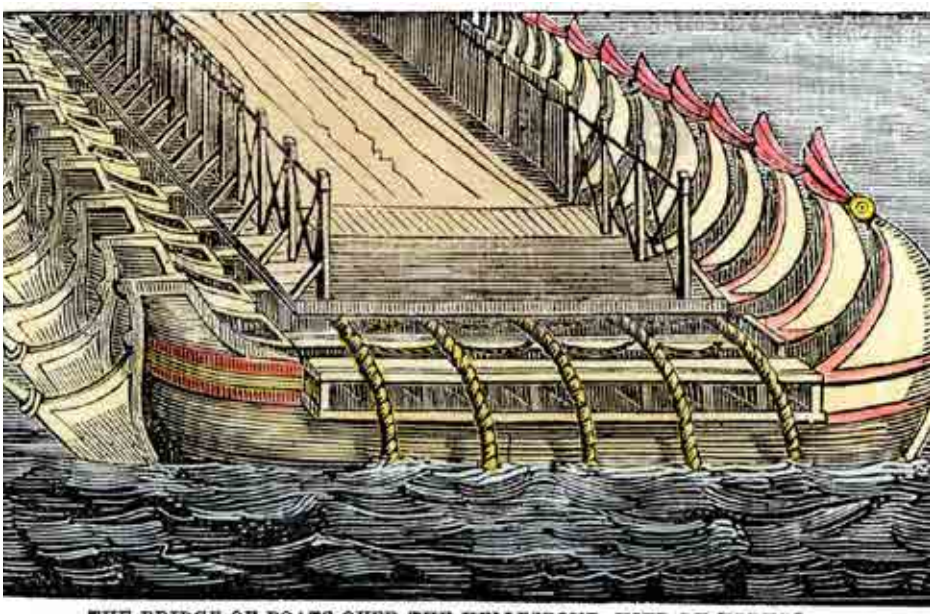
kiwitam. “Marina Bay Floating Music Stage Development,” Skyscrapercity Forum, April 27, 2007. http://www.skyscrapercity.com/showthread.php?t=467845

The floating stage design was conceived as a pontoon-type VLFS, designed to serve as a re-configurable “pier” to cater to various events of different scales.

Modules : 15 pontoons
Size : 40m x 16.6m x 1.2m
Duration : 13 months
Technology : VLFS (Very Large Floating Structures)
Year : 2007
Process : towed to site and fixed
Lifespan : 8 years (exceeded)

Marina Bay Floating Platform - Case study

Marina Bay, Singapore



THE BRIDGE OF BOATS OVER THE HELLESPONT, USED BY XERXES.

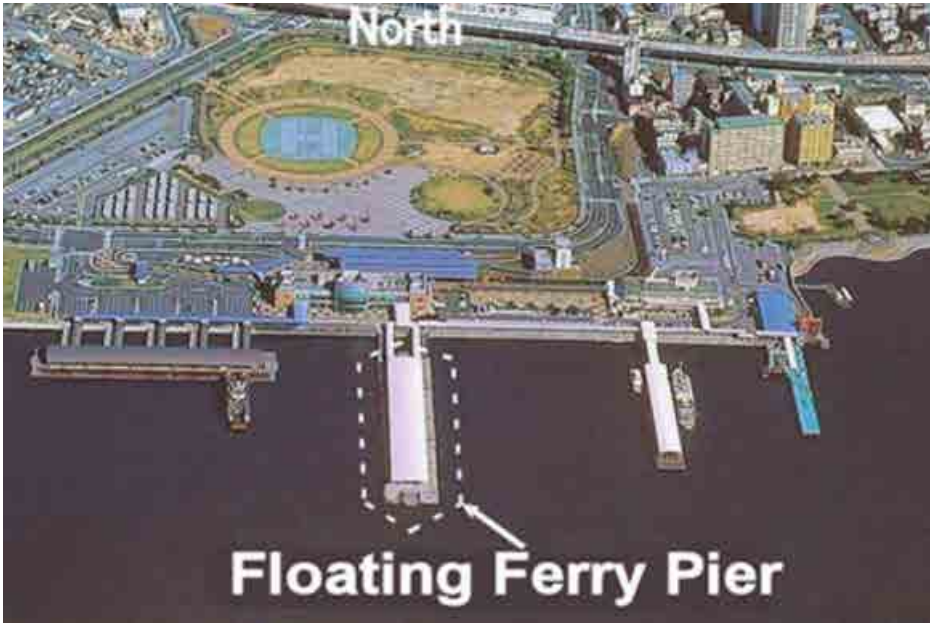
Hammond, Nicholas G. L. "The construction of Xerxes' bridge over the Hellespont", *The Journal of Hellenic Studies* (1996): 88-107.
Stock image, last accessed March 5, 2016. http://alamy.com

Xerxes' Pontoon Bridges were constructed in 480 BC during the second Persian invasion of Greece for the purpose of Xerxes' army to traverse the Hellespont from Asia into Thrace

Materials : 800 solid cubic meters of wood, 314 ships
Size : width of 3.6 m
Duration : unknown
Technology : Manual Labour
Year : 480 BC
Process : anchor ships in place, lay bridge deck
Lifespan : months (destroyed by storm)

Xerxes' Pontoon Bridges - Case study

Hellespont (the present day Dardanelles), Turkey



Kusada, T., and Ueda, S., "Ujina Floating Ferry Pier and Kan-On Floating Breakwater, Japan," *Ocean Engineering and Oceanography* (2014): 107-127.

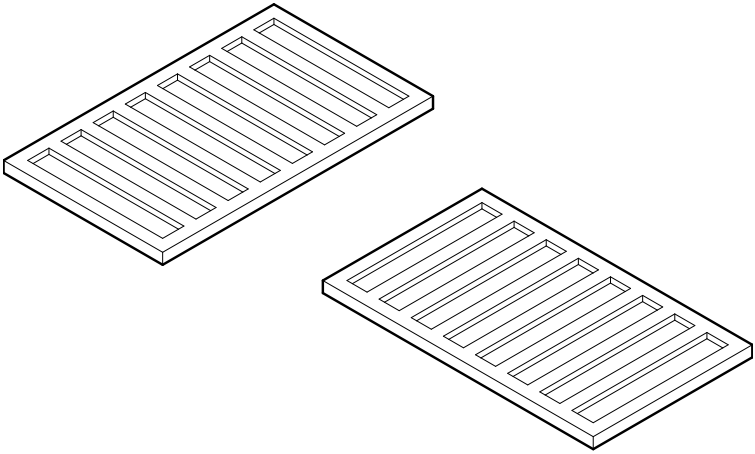
The construction works of the project are in process under the supervision of Hiroshima Prefectural Government and the third sector developer, Hiroshima Wan Kaiyo Kahatsu Company Ltd. undertakes the construction works at the sea area of 20.8 ha off the coast of Kan'on Hiroshima. This project includes mooring facilities for boats, club house and hydrophillic green tract etc. This marina will also be officially used as a yacht racing site in Asian Games to be held in October 1994.

Type: RC hybrid structure
Length: 70.75m
Width: 21.0m
Height: 3.5m
Draft 2.5m

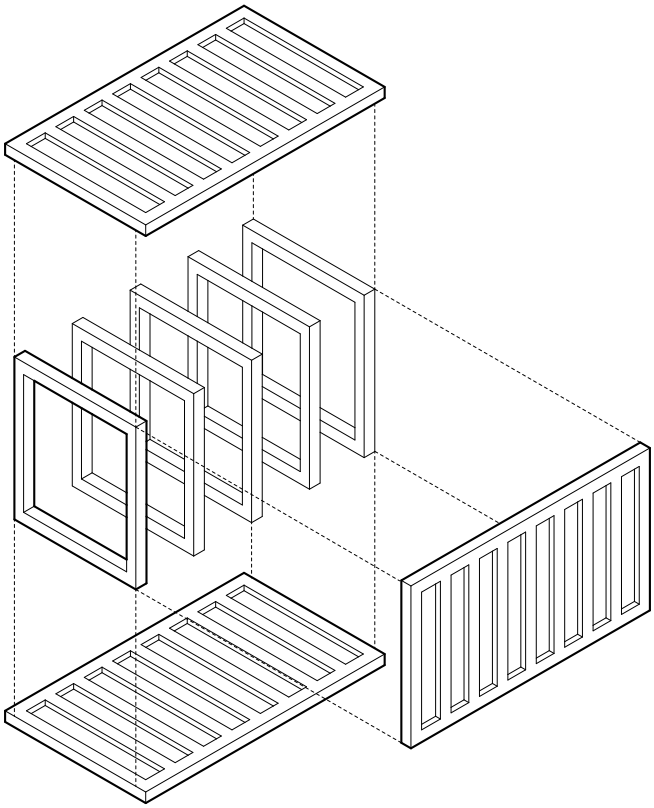
Kan'on Marina Construction Project - Case study

Hiroshima City, Japan

Flow Chart of Pontoon Construction

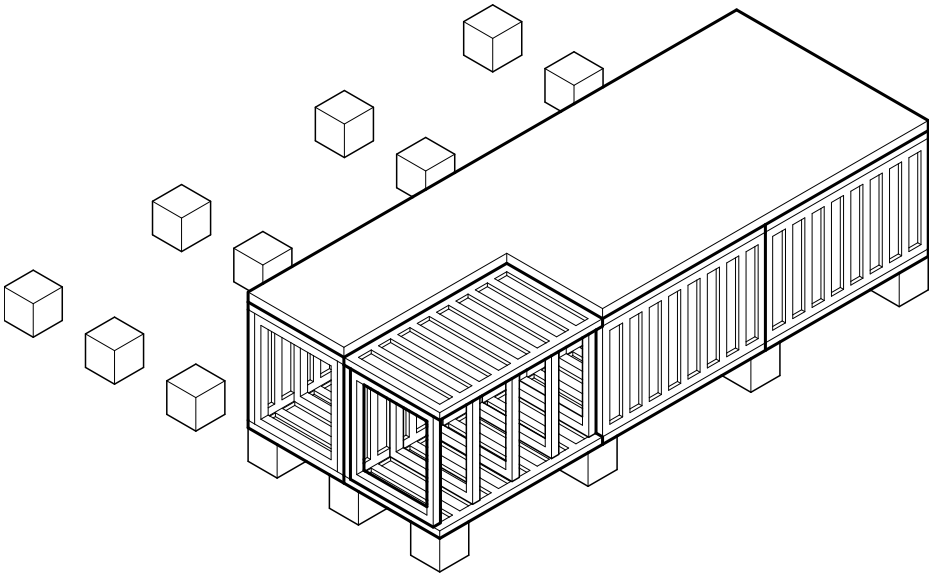


1 Production of Panels

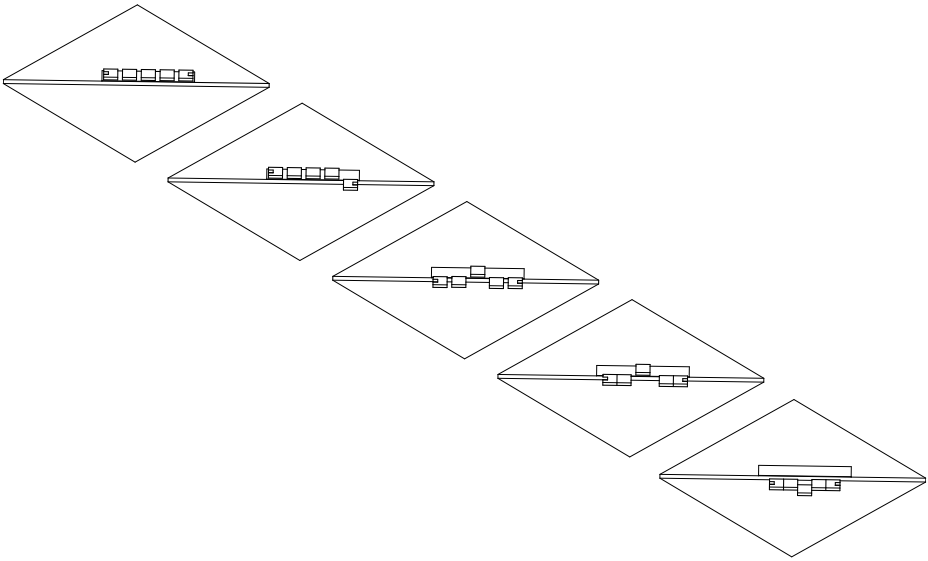


2 Assembling of Blocks

Source : Author



3 Fabrication in Yard



Source : Author

観音浮防波堤の特徴

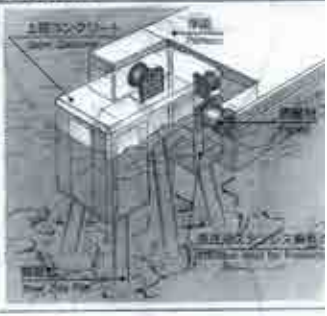
Salient Features of KAN'ON Floating Breakwater

❶ドルフィン係留

Dolphin Mooring System

- チェーン係留方式に比べ波浪エネルギーの吸収性が良好です。
- 係留装置の主要部分が、空中又は海面付近にあるので、メンテナンスが容易です。

- Higher absorption of wave energy than the chain mooring system.
- Easy maintenance of the main parts of the mooring system as they are located above sea level.

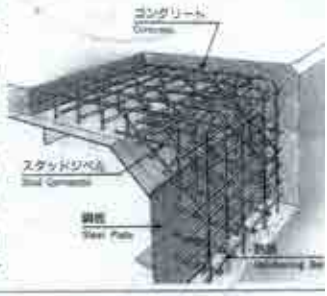


❷鋼板と鉄筋コンクリートの合成構造

RC Hybrid Structure

- 内側に8㎜厚の鋼板を入れていますので、水密性が良好です。
- 内部鋼板と鉄筋コンクリートが一体となって外力に対抗するので、大きな強度が得られます。

- High water-tightness is secured as the steel plates, 8mm thick, are provided on the internal part of the breakwater.
- High strength against external forces as the steel plates and reinforced concrete are composited.

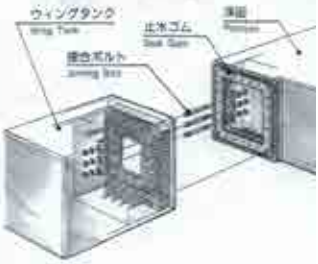


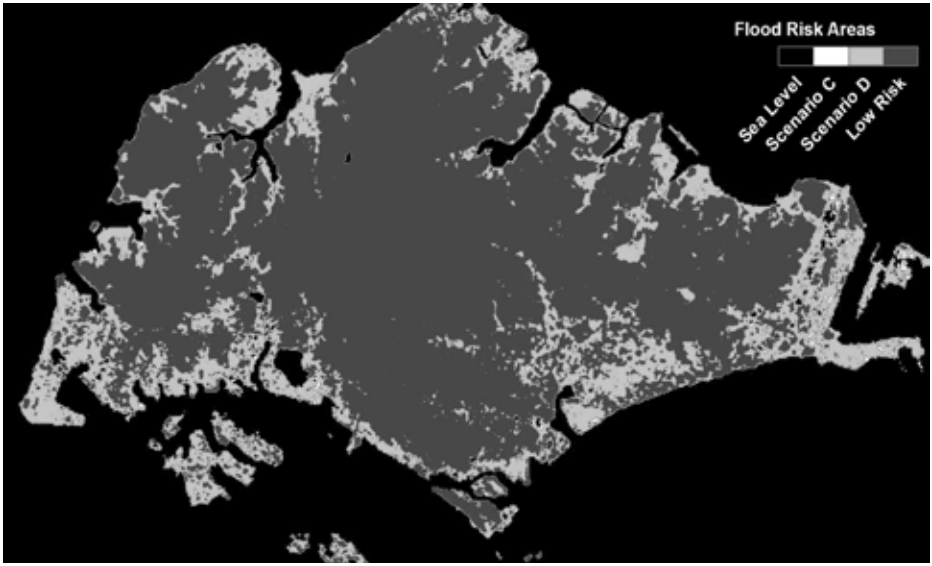
❸ウィングタンクによる着脱可能な構造

Detachable Construction

- 将来の防波堤のレイアウト変更に対応できます。船の衝突による損傷等のとき、ドックに曳航して補修できます。
- 現場での浮函の据付工期が短縮できます。

- Movable construction as the wing tanks are easily detachable.
  Changeable layout of the floating breakwater as required.
- Easy repair as it can be towed easily if the floating breakwater is damaged in a collision with a ship etc.





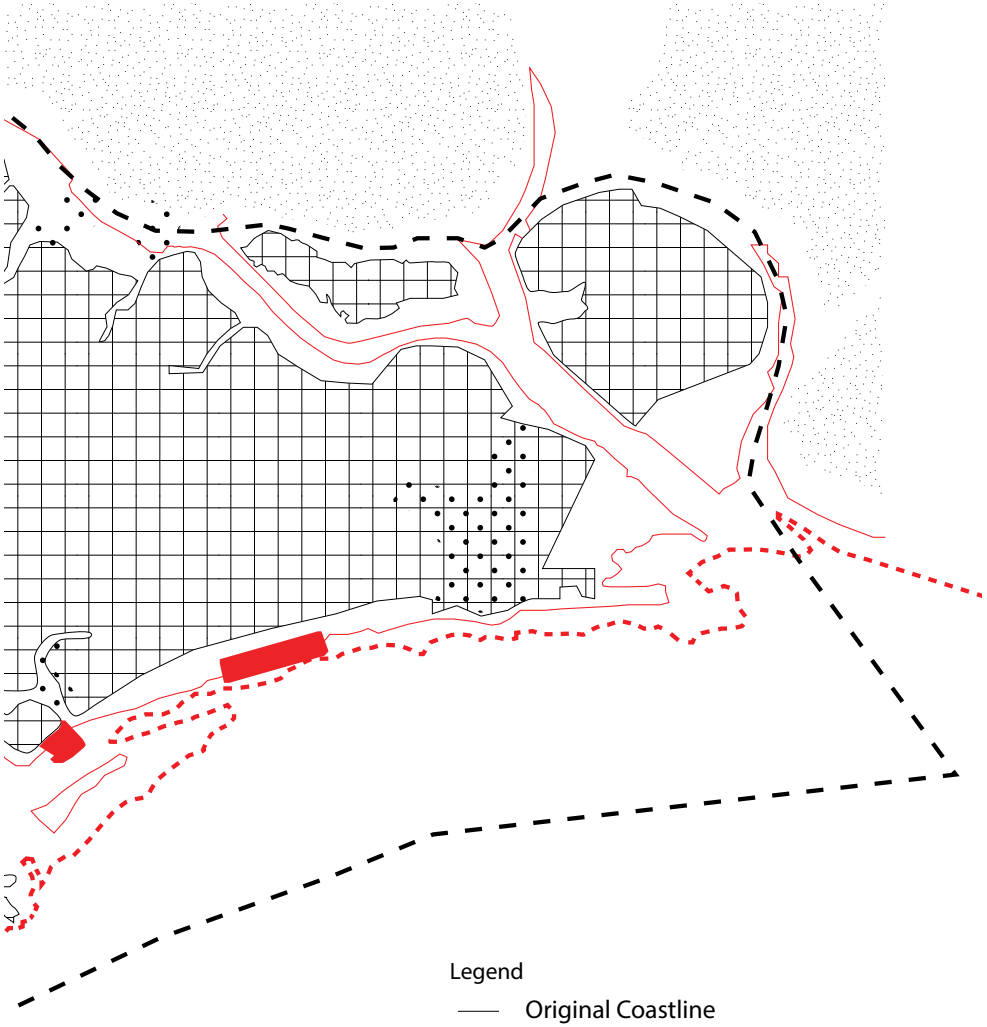
Ding, Debbie. “Bone, Metal, Wood, and Other Artifacts,” Open Urbanism Blog, April 9, 2013. http://openurbanism.blogspot.sg/2013/04/bone-metal-wood-and-other-artefacts.html

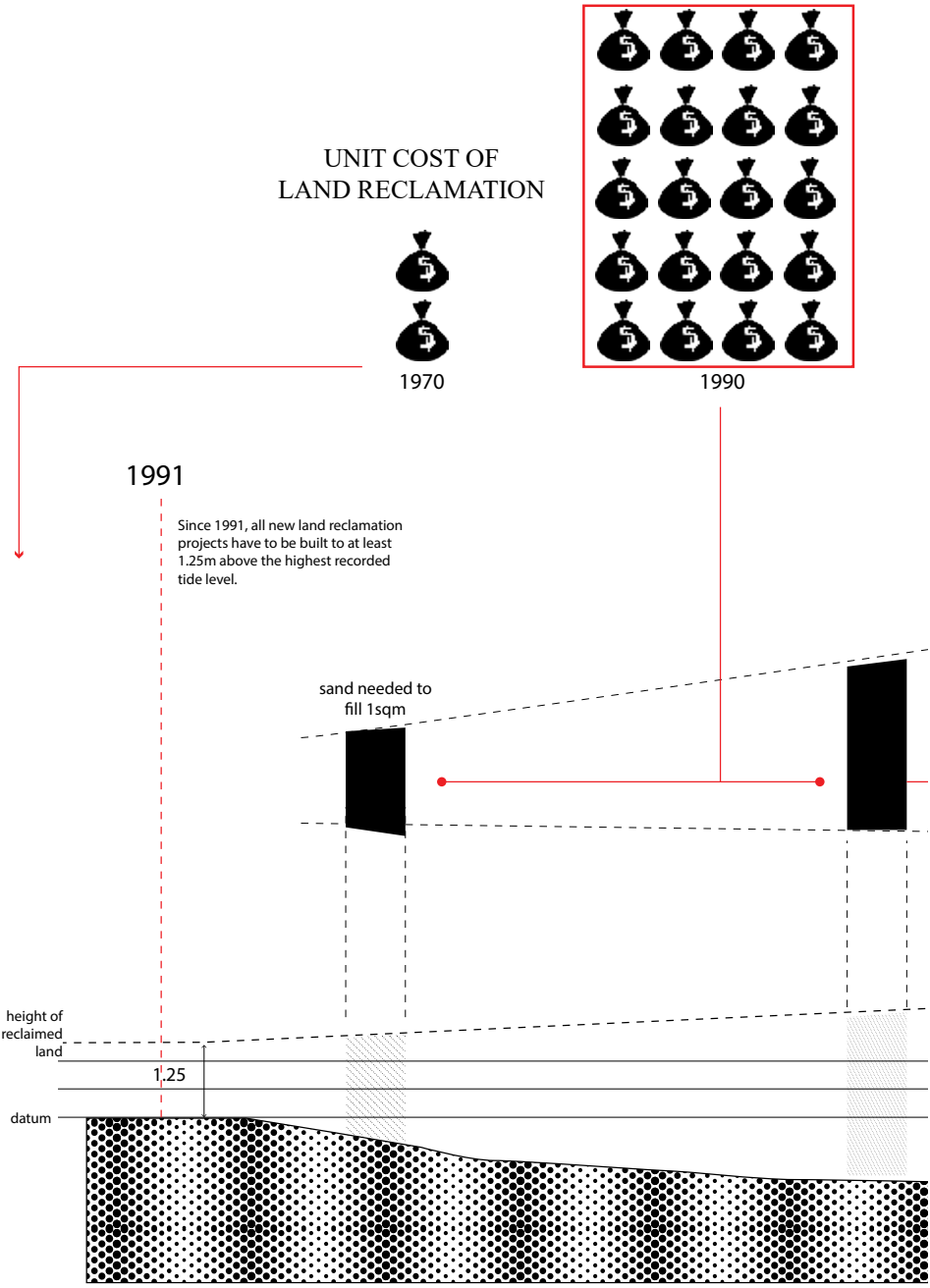
“For Singapore, the map showed that areas around Marina Bay, Changi Airport, Jurong, Tuas, and the Southern Islands are at risk of going underwater if temperatures rise, even by 2C. Map showing which areas in Singapore at at risk from global warming (in light blue) “

Threats to Land - Climatic Factors

Threats to Land - Sea Depth Limit

Urban Redevelopment Authority. *Landuse 6 Publication.*

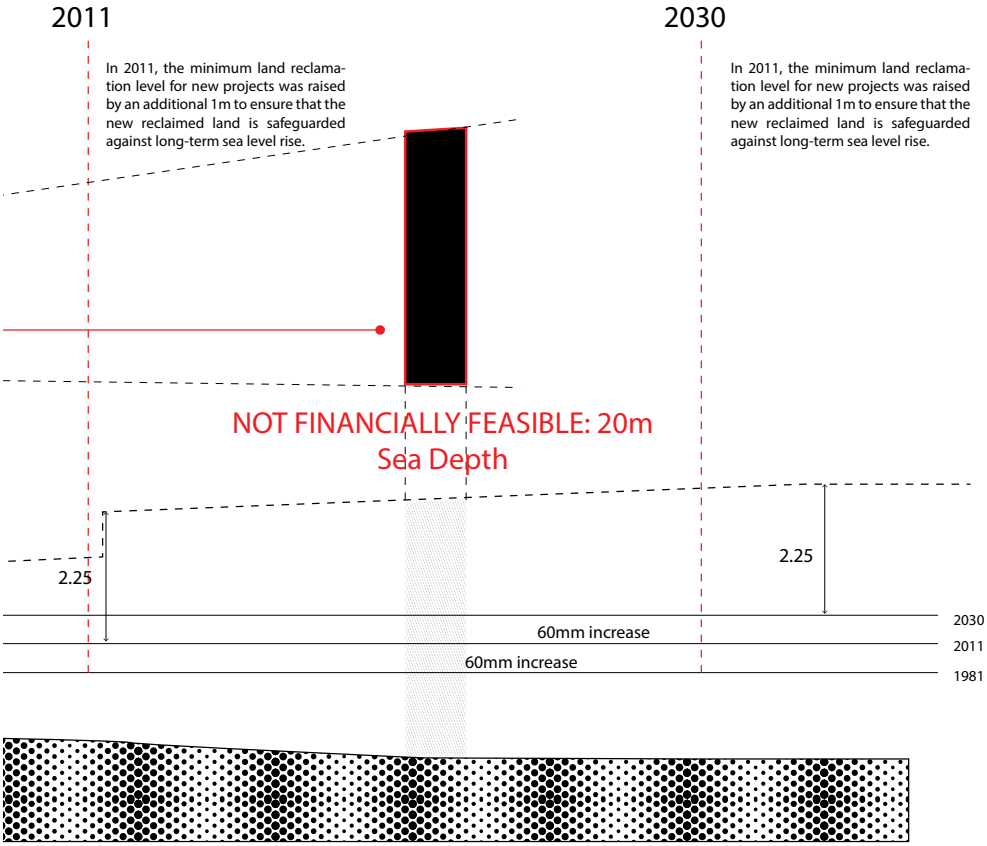

Legend
Original Coastline
Singapore Maritime boundary
20m Sea Depth
Neighbouring Countries
Singapore Land
Submerged land +4 degrees
2030 Projected Reclamation

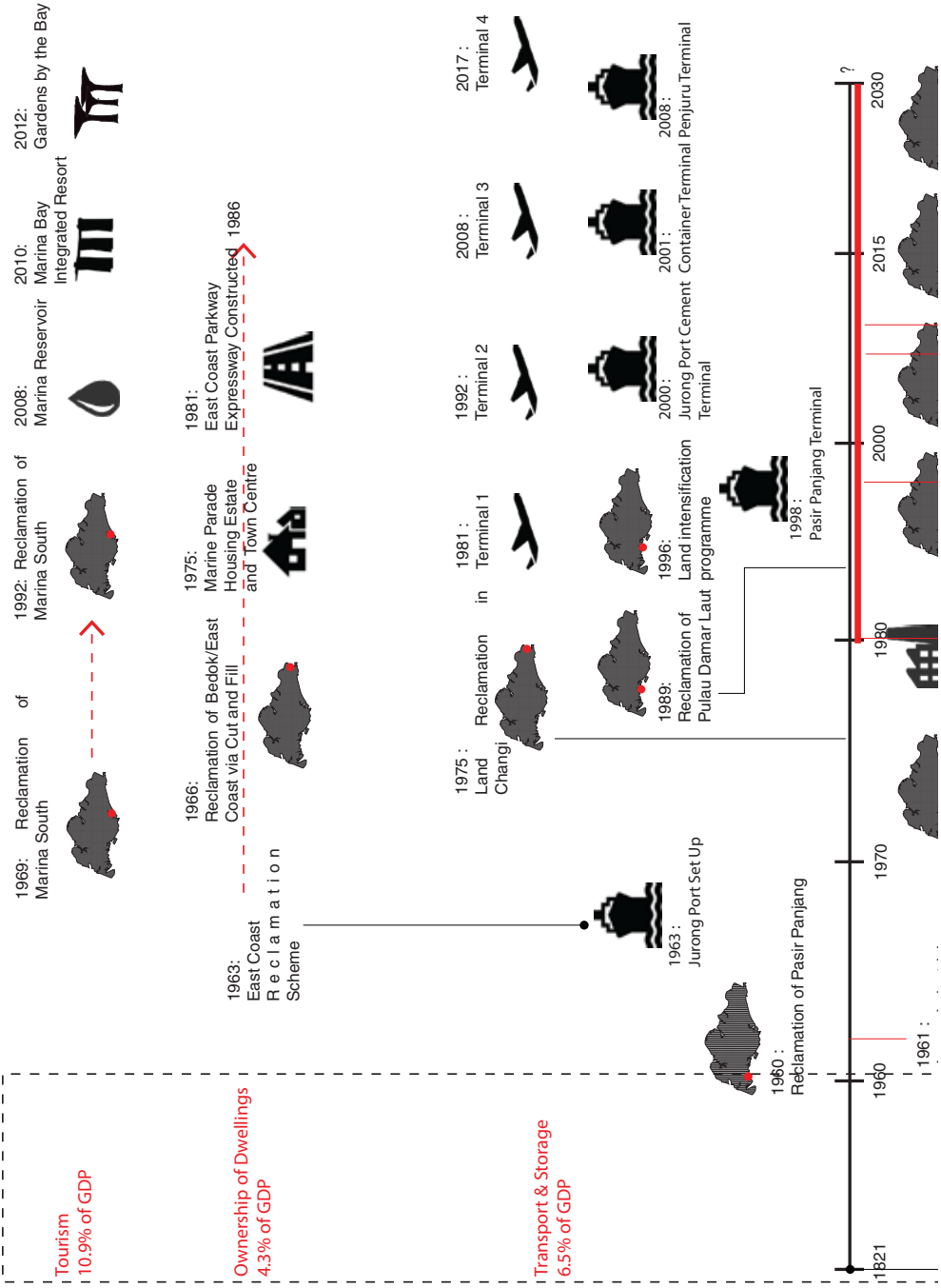


Threats to Land - Technology and Cost

Urban Redevelopment Authority. *Landuse 6 Publication.*
Open Urbanism Blog, last accessed March 5, 2016. http://openurbanism.blogspot.sg

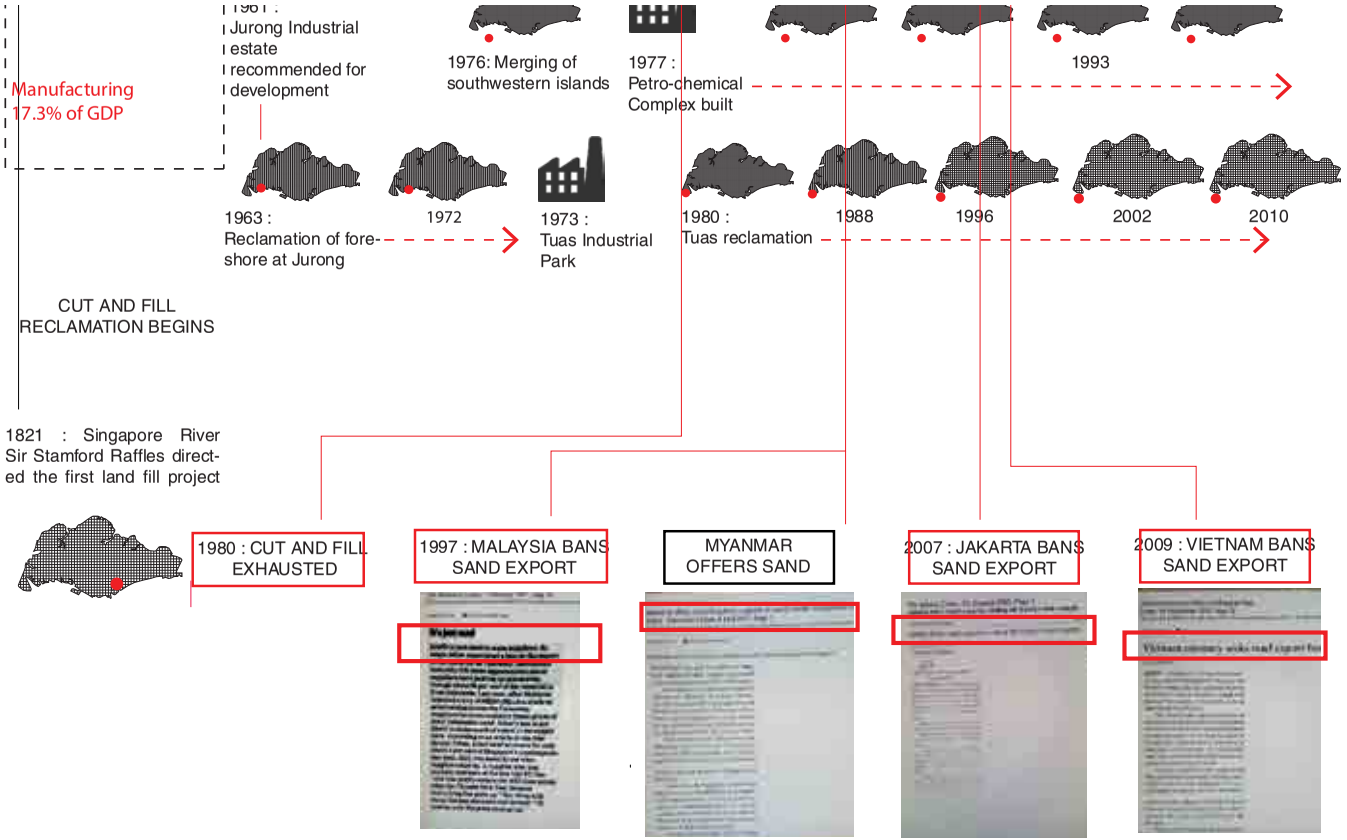
Since 1991, all new land reclamation projects have to be built to at least 1.25m above the highest recorded tide level. In 2011, the minimum land reclamation level for new projects was raised by an additional 1m to ensure that the new reclaimed land is safeguarded against long-term sea level rise.

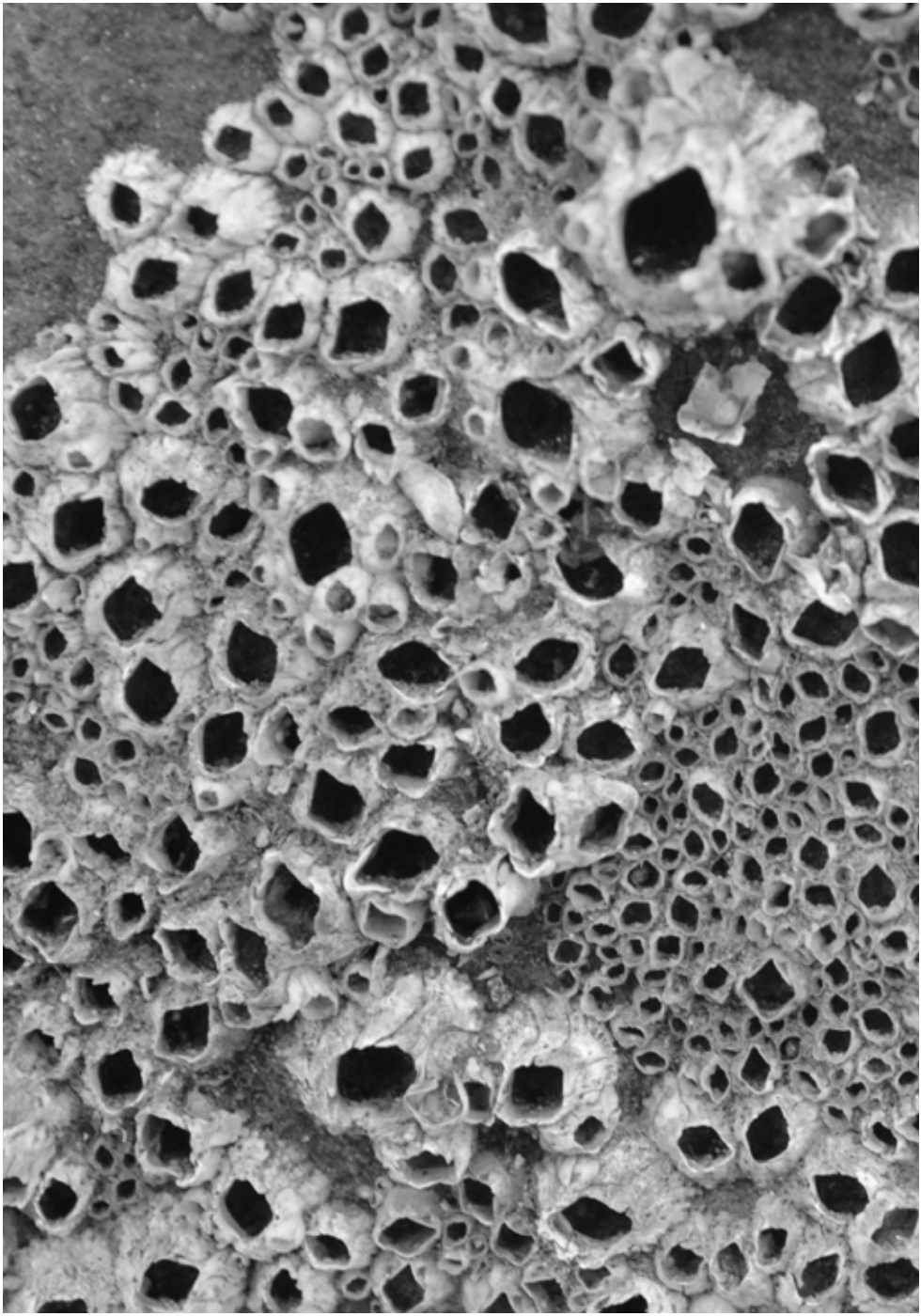


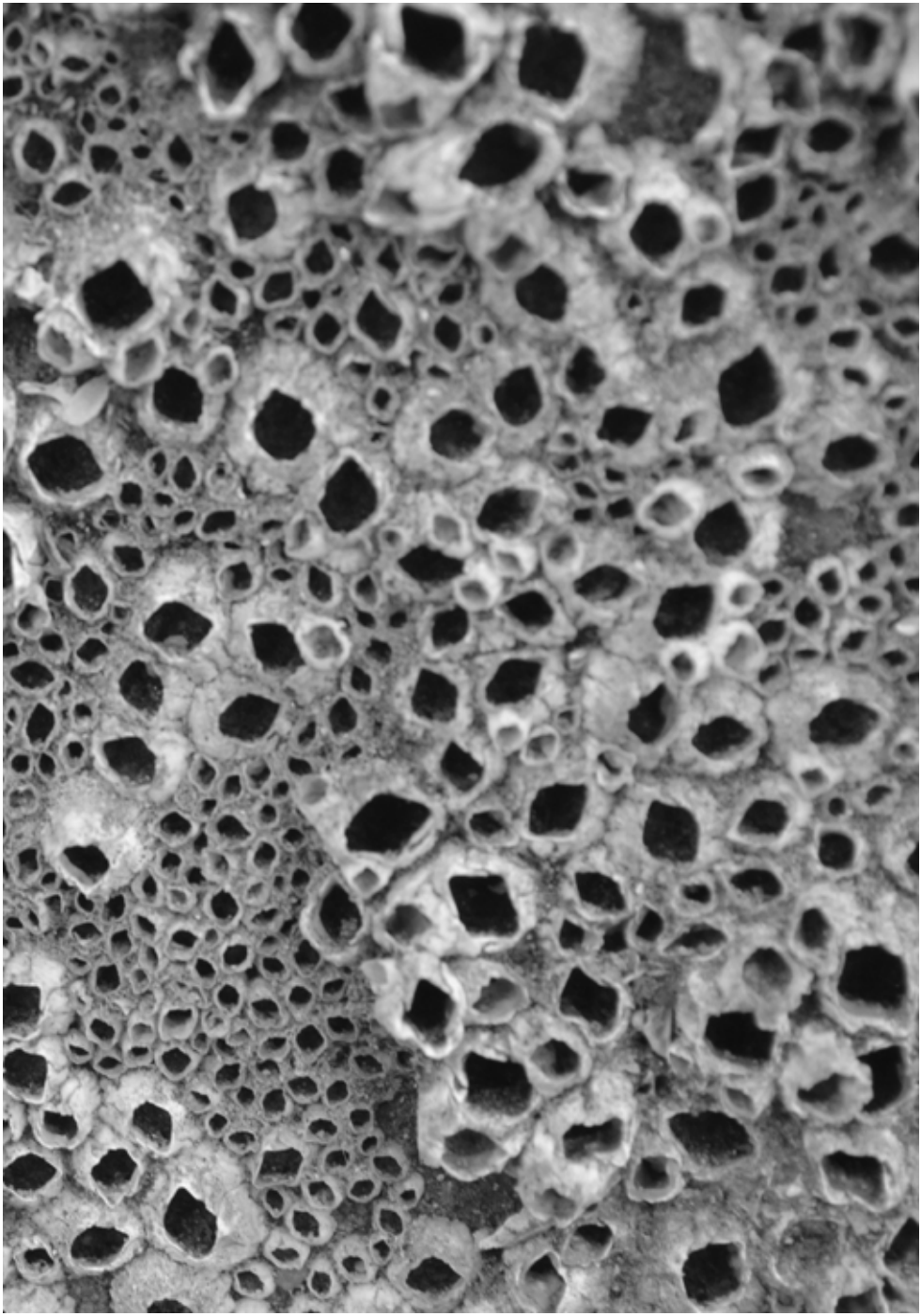


Threats to Land - Sand Bans

Ministry of Trade and Industry. *Economic Survey of Singapore 2013* (2013): i-iv.


Manufacturing
17.3% of GDP
1961 :
Jurong Industrial
estate
recommended for
development
1976: Merging of
southwestern islands
1977 :
Petro-chemical
Complex built
1993
1963 :
Reclamation of fore-
shore at Jurong
1972
1973 :
Tuas Industrial
Park
1980 :
Tuas reclamation
1988
1996
2002
2010
CUT AND FILL
RECLAMATION BEGINS
1821 : Singapore River
Sir Stamford Raffles direct-
ed the first land fill project
1980 : CUT AND FILL
EXHAUSTED
1997 : MALAYSIA BANS
SAND EXPORT
MYANMAR
OFFERS SAND
2007 : JAKARTA BANS
SAND EXPORT
2009 : VIETNAM BANS
SAND EXPORT





Charles Lim. *Buoy in progress* (2015). Courtesy of the artist & Future Perfect, Singapore.

Changes in the sea, indicators of neglect?

Lim explains he only had to sink the buoy for four weeks to achieve this level of barnacle encrustation. It looks like it has been left beneath the waves for decades if not centuries. ‘Another result of the ecological effect of land reclamation,’ he says. ‘Singapore is now the world centre for barnacle studies.’

Pollution - Barnacle Encrusted Buoy

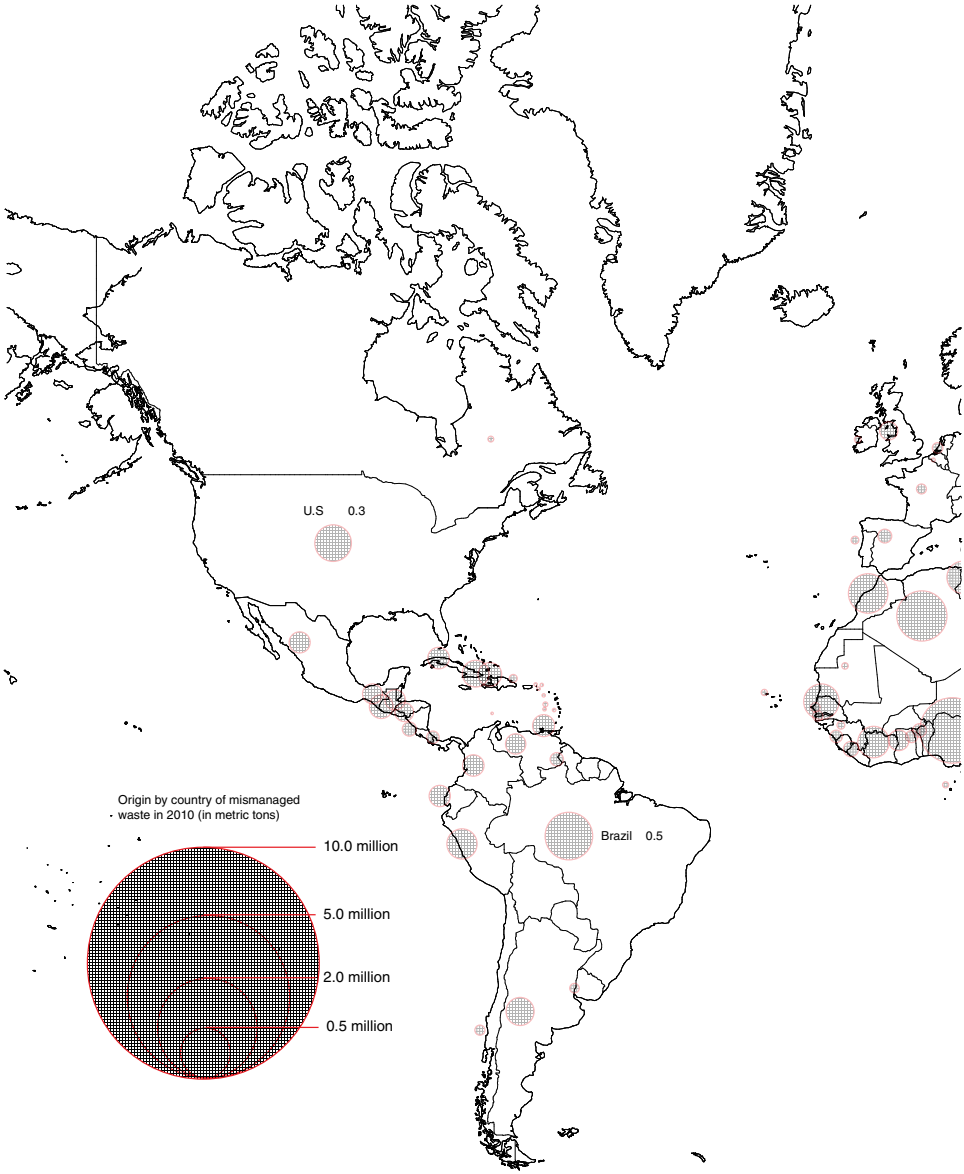
Southern Anchorage Zones, Singapore

Gladys. ‘Clean and Green Singapore, really?’ Underthatsea Blog, March 3, 2015. http://blog.nus.edu.sg/underthatsea/2015/03/03/clean-and-green-singapore-really/
Charles Lim, Ed. *Informatic Naturalism: Notes on SEA State 2*. Singapore: Futureperfect, 2012.

Mutual impact : Value of land, De-valuation of waterspace

“ For water is more dynamic than land, more entropic than even the jungle. Never neutral or passive, it frustrates reification and concretization. The water in these straits lubricates trade, but the same medium – warm, brimming with nutrients – nourishes the fastest growing barnacles in the world, that slow it down… As any sailor can tell you, the seas are never ‘safe’.”

OCEANIC DETRITUS | GLOBAL WASTE FOULING WATERS



Ocean Detritus

SITE

Source : Author

Eastern Anchorages

Singapore Territorial Waters

Source : Author

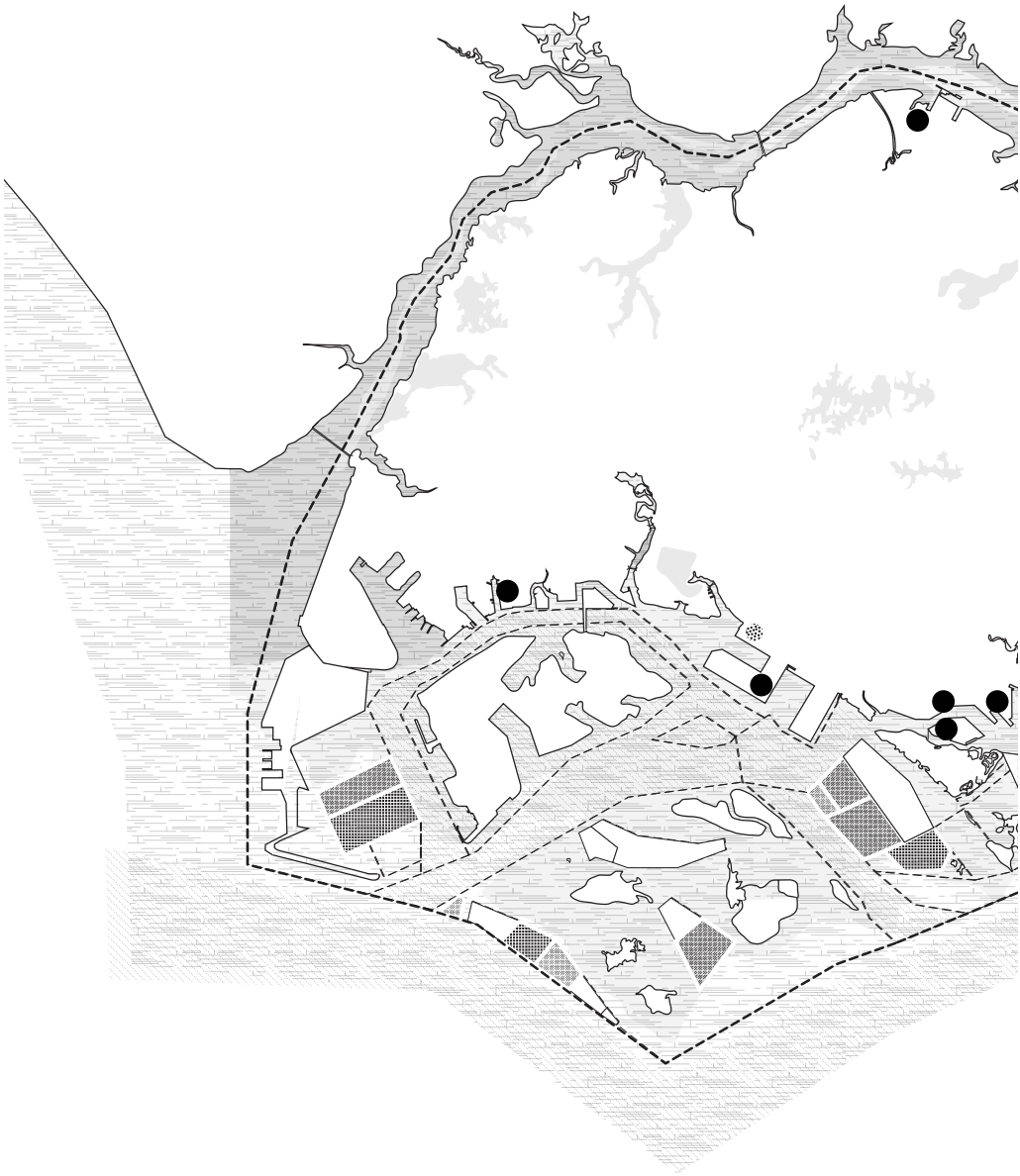
Sinking Trees

East Coast Park, Singapore

Source : Author

Southern Sea Zone

Singapore Territorial Waters



Anchorage Ports

Southern Anchorage Zones, Singapore

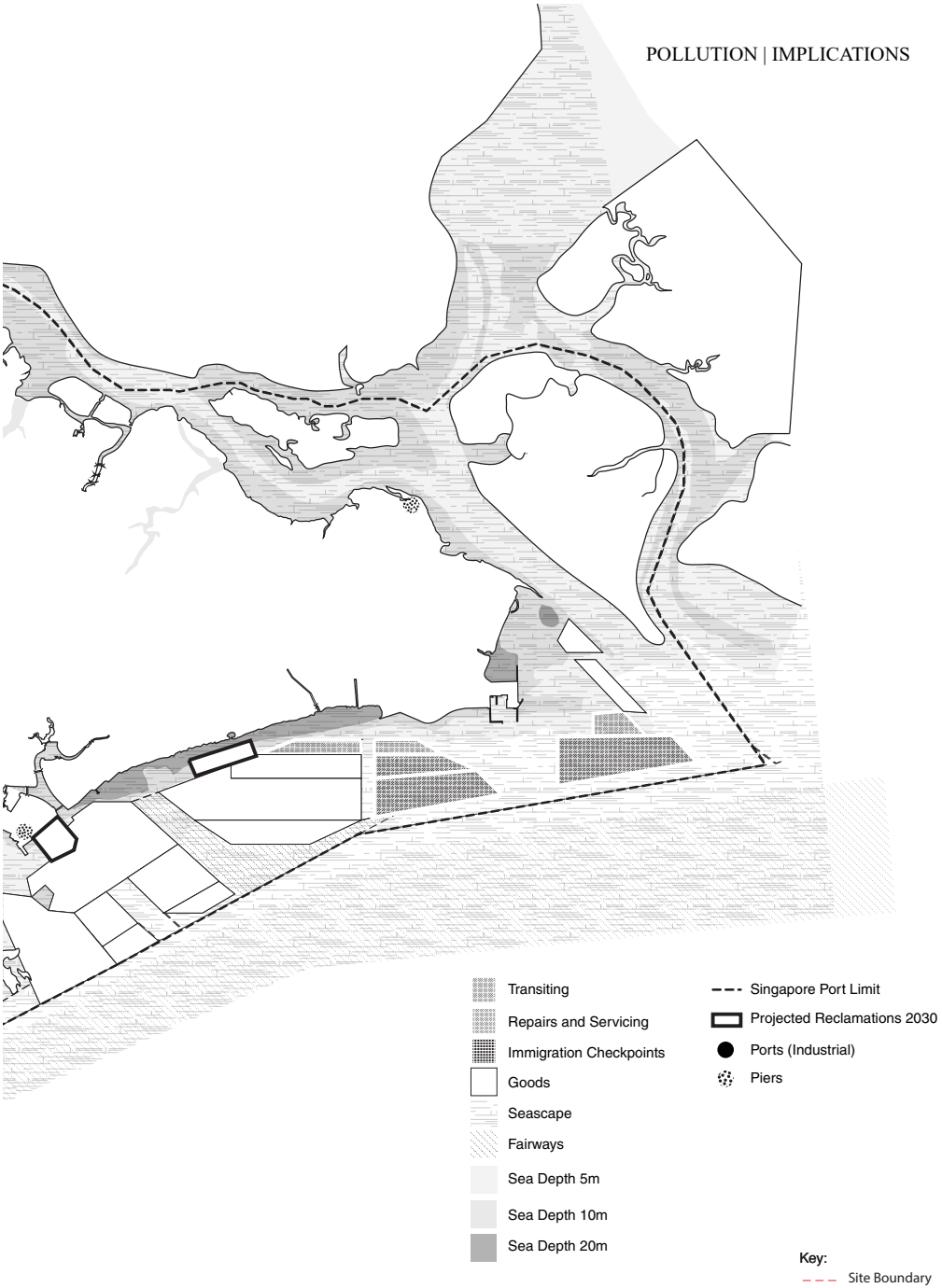
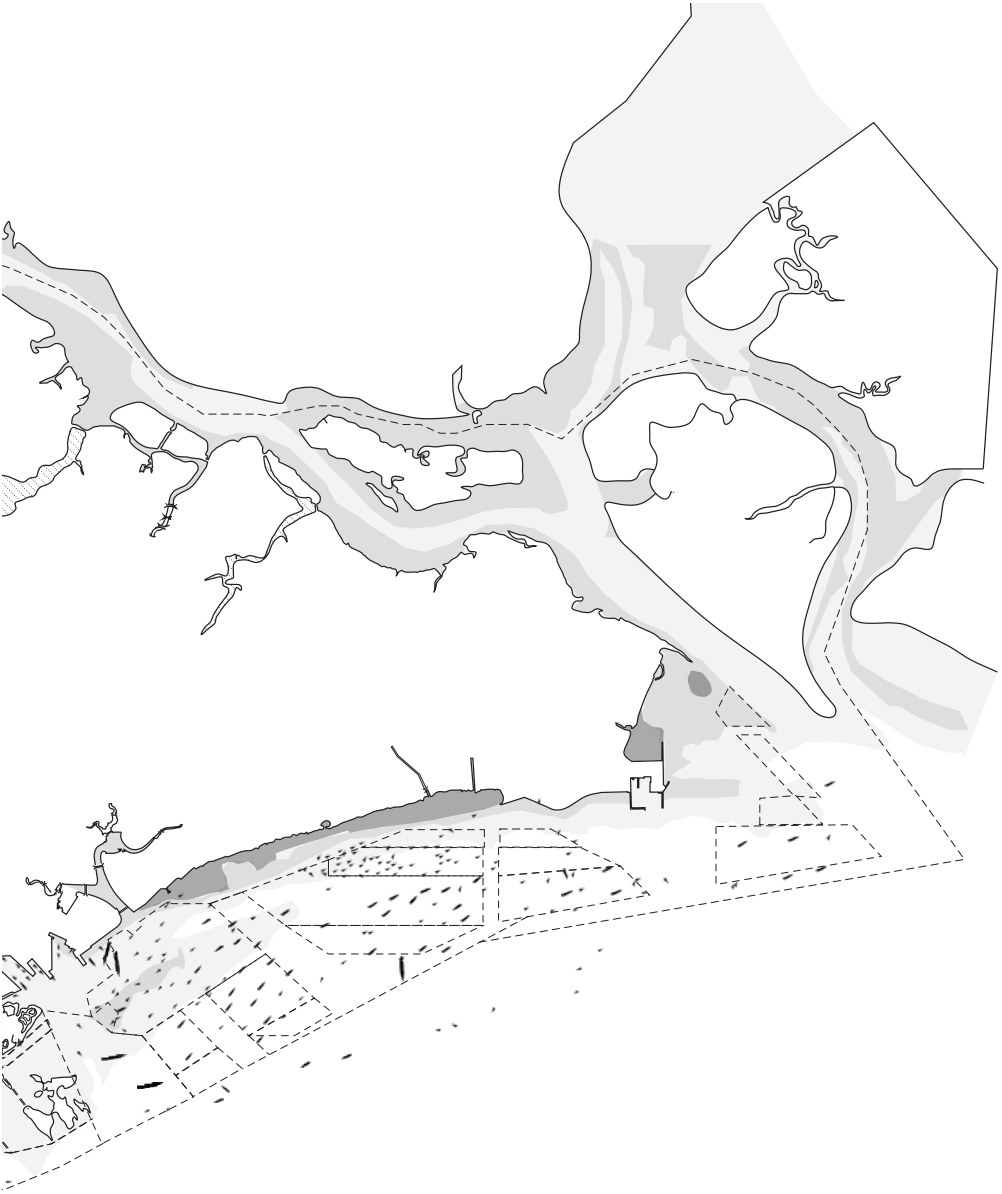
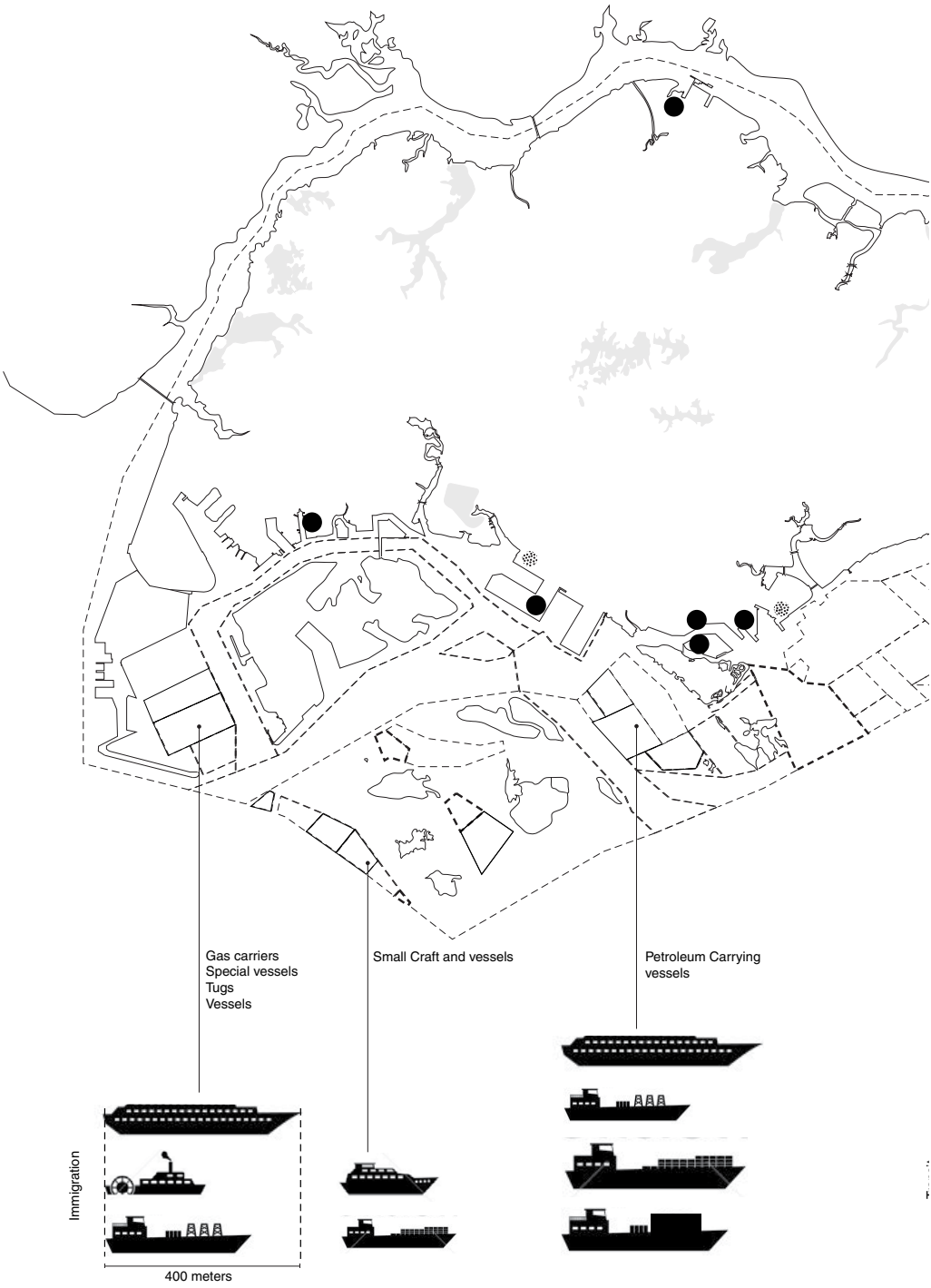
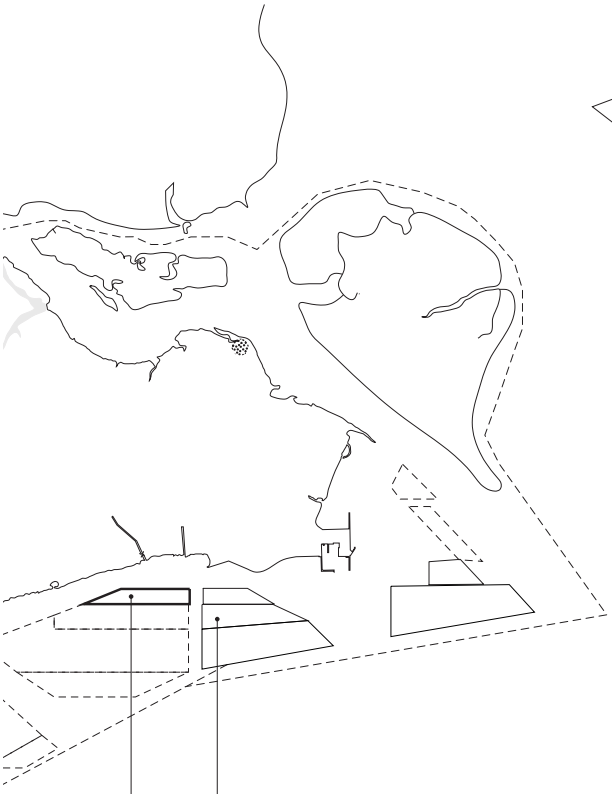

Transiting
Repairs and Servicing
Immigration Checkpoints
Goods
Seascape
Fairways
Sea Depth 5m
Sea Depth 10m
Sea Depth 20m
Singapore Port Limit
Projected Reclamations 2030
Ports (Industrial)
Piers
Key:
Site Boundary

Figure Ground of ships

Southern Anchorage Zones, Singapore




Gas carriers
Special vessels
Tugs
Vessels
Small Craft and vessels
Petroleum Carrying
vessels
Immigration
400 meters



Harbor tugs
Barges
Pontoons
Fishing vessels

Vessels awaiting transit

Transit

Changi Barge Temporary Holding Anchorage (ACBTH)

Changi General Purposes Anchorage (ACGP)

Man-of-War Anchorage (AMOW)

Eastern Bunkering A Anchorage (AEBA)

Eastern Bunkering B Anchorage (AEBb)

Eastern Bunkering c Anchorage (AEPBC)

Small Craft B Anchorage (ASCB)

Small Craft A Anchorage (ASCA)

Eastern Petroleum B Anchorage (AEPBB)

Eastern Special Purposes A Anchorage (AESPA)

Eastern Bunkering C Anchorage (AEBC)

Eastern Holding A Anchorage (AEHA)

Eastern Petroleum A Anchorage (AEPA)

Eastern Anchorages (AEW)

Eastern Holding B Anchorage (AEHB)

Eastern Holding C Anchorage (AEHC)

Western Quarantine and immigration Anchorage (AWQ)

Western Anchorage (AWW)

Western Petroleum A Anchorage (AWPA)

Western Holding Anchorage (AWH)

Western Petroleum B Anchorage (AWPB)

Raffles Reserved Anchorage (ARAFR)

Raffles Petroleum Anchorage (ARP)

Selat Pauh Anchorage (ASPLU)

Selat Pauh Petroleum Anchorage (ASPP)

Sudong Petroleum Holding Anchorage (ASPH)

Sudong Bunkering Anchorage B (ASUBB)

Sudong Explosive Anchorage (ASUEX)

Sudong Special Purpose Anchorage (ASSPU)

Sudong Bunkering Anchorage A (ASUBA)

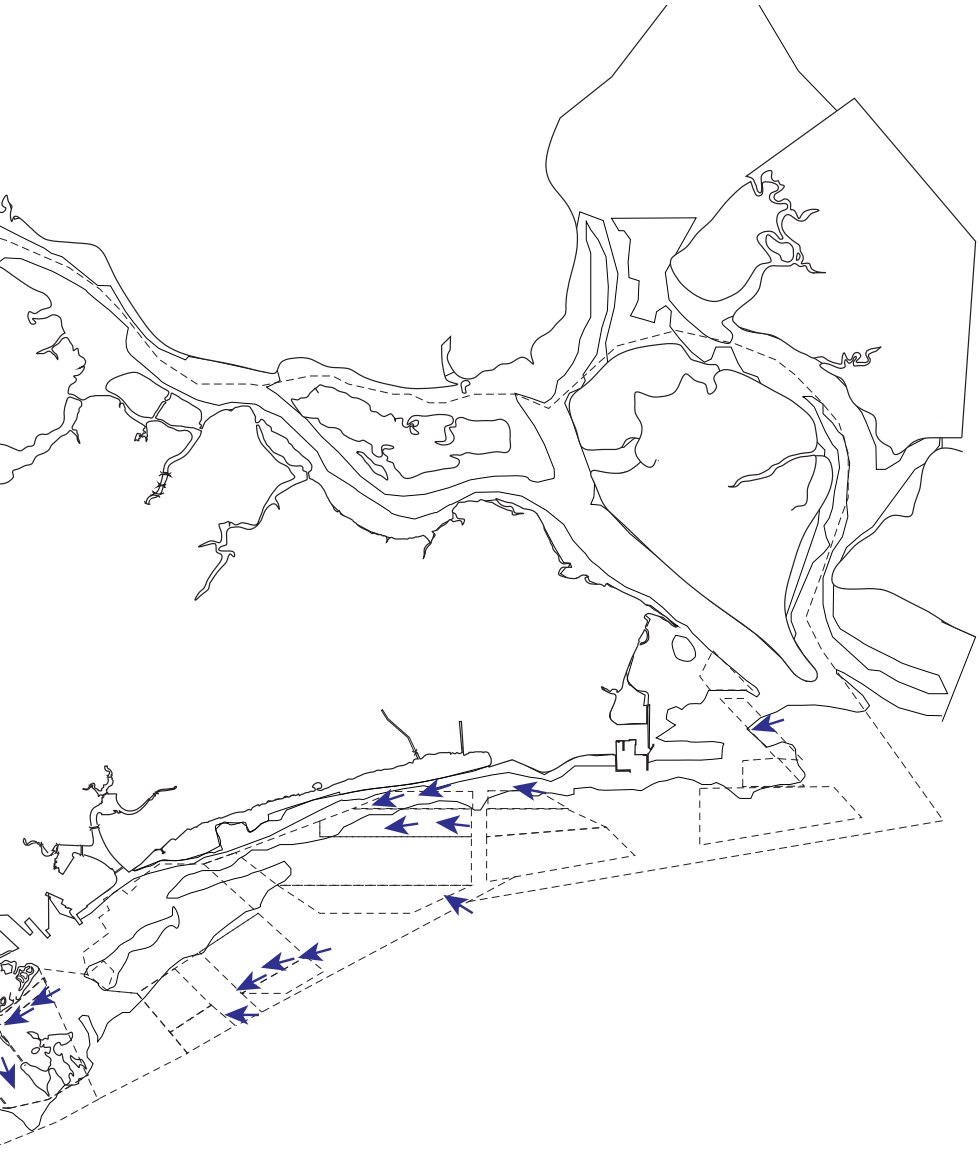
Sudong Holding Anchorage (ASH)

Very Large Crude Carrier Anchorage (AVLCC)

LNG/LPG/Chemical Gas Carrier Anchorage (ALGAS)

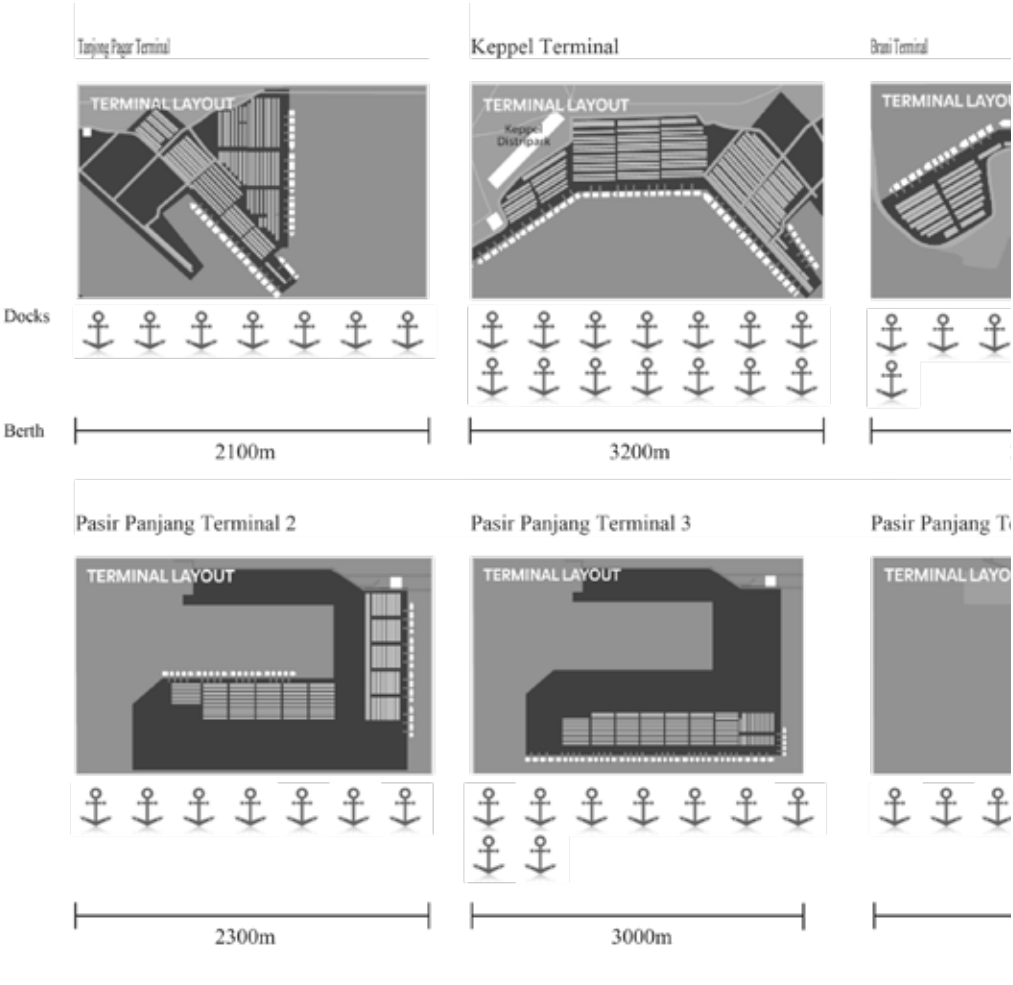
West Jurong Anchorage (AWJ)

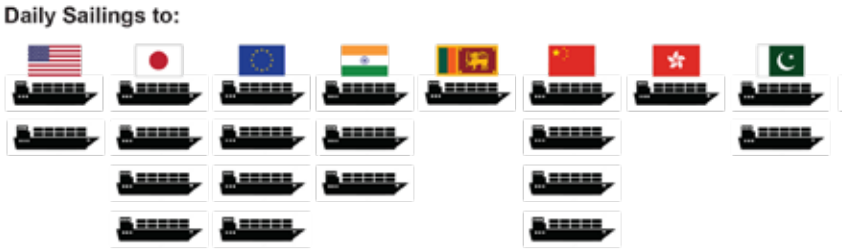
Milica Topovic et al. *Architecture of Territory: Hitherland.* Zurich: Architecture of Territory, 2013.



Ocean Currents

Southern Anchorage Zones, Singapore

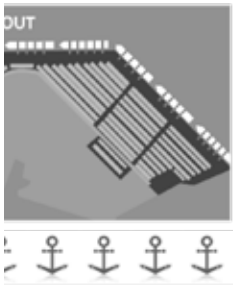




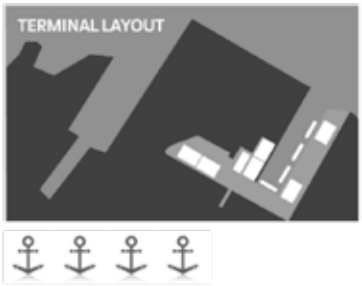
Port Configurations

Singapore

Sembawang Wharves

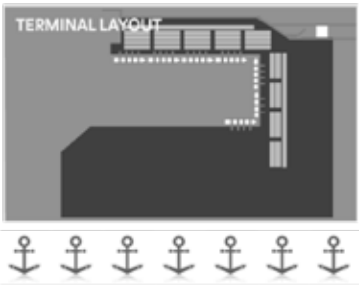


2400m



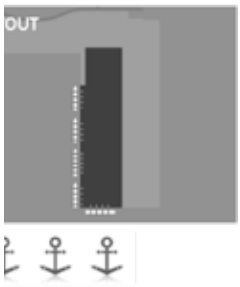
660m

Pasir Panjang Terminal 1



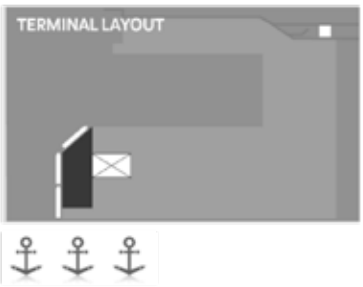
2500m

Terminal 5



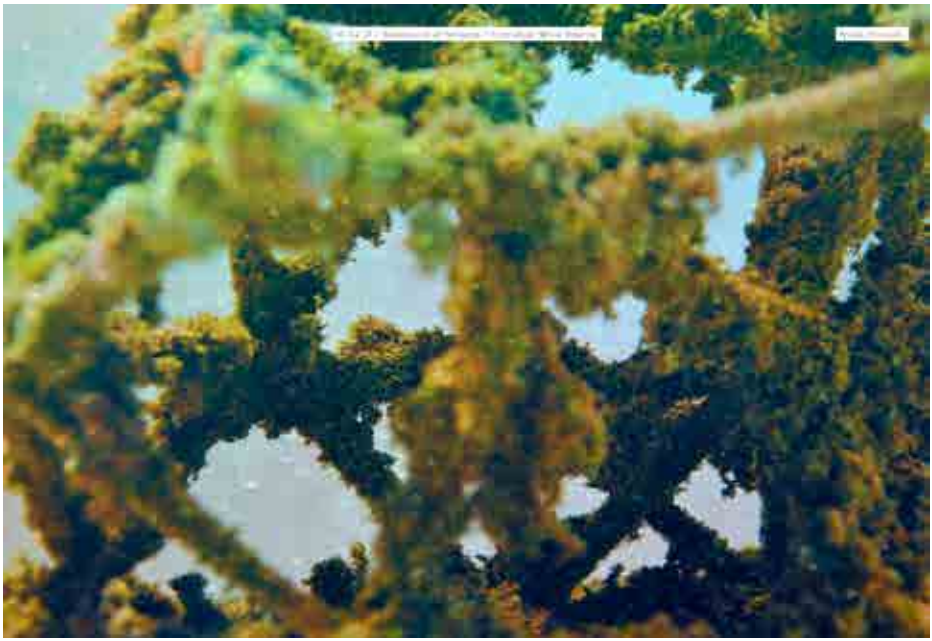
1850m

Pasir Panjang Automobile Terminal



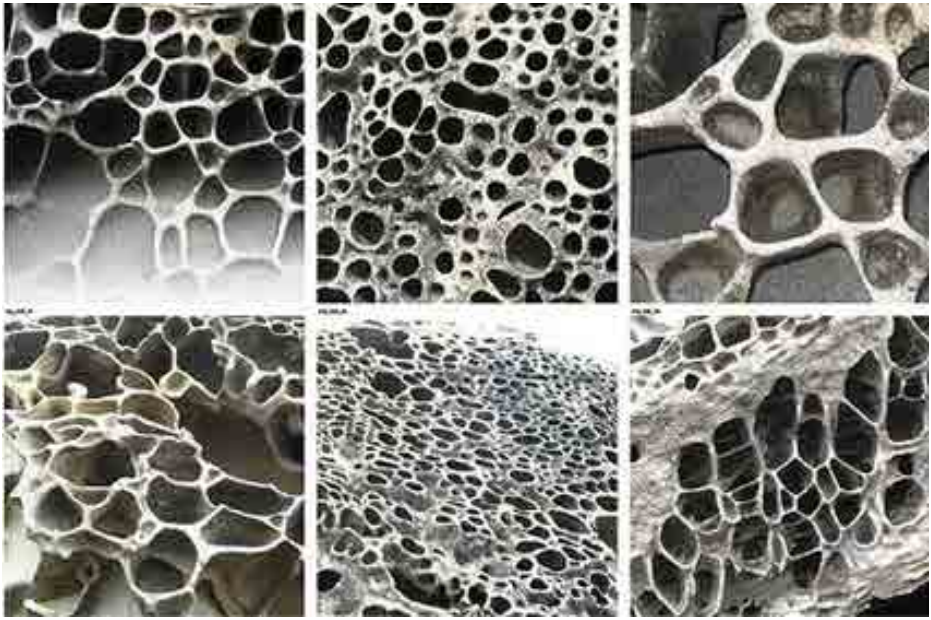
1010m

Source : http://www.biorock.org/



Biorock refers to the an artificial product of electro-accumulation of minerals. The process of biorock formation involves the electrolysis of seawater with the aim of creating a corrosion resistant mineral layer atop a conductive material. The resulting layers of minerals such as calcium carbonate (limestone), confer strength to the Biorock structure. Biorock and its associated process is used in creating artificial reefs, providing corrosion protection for marine structures, and architecture. Architectural applications for Biorock as a structural element stem from its high compressive strength.

Biorock



Magnus Larsson. *Dune: Arenaceous Anti-Desertification Architecture*. 2008.

Several projects have explored the possibility of growing a building through electro-deposition of minerals in seawater. Biorock which grows at a rate of 10cm a year has been scientifically proven to be sufficiently structural for architectural support.

Biorock Structure

DOCUMENTS

Sand export ban will not adversely affect Singapore
Today, 15 May 2009, Page 10
Article also available on microfilm reel NL 30022 [Lee Kong Chian Reference Library - On shelf, arranged by date]

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Sand export ban will not adversely affect Singapore

SINGAPORE does not expect Cambodia's fresh ban on the export of sand to have a major impact on existing projects in the Republic.

The Ministry of National Development said: "Singapore imports both concreting sand for construction and sand for reclamation purposes. Our construction industry does not import concreting sand from Cambodia. As for reclamation sand, we import it through private contractors, who source for supplies from various countries, not just Cambodia."

Cambodian Prime Minister Hun Sen had announced a total ban on sand exports on May 8, over concerns about the environmental impact on the coastline and fish populations.

Cambodian Prime Minister Hun Sen had announced a total ban on sand exports on May 8, over concerns about the environmental impact on the coastline and fish populations.

According to a *Xinhua* report, Cambodia used to export 40,000 to 50,000 tonnes of sand per month from its coastal province of Koh Kong, and the annual value of this business stood at US$35 million ($51 million). Vietnam and Singapore were the major destination countries.

Indonesia was Singapore's main supplier of sand until January 2007, when the Jakarta government banned exports. It significantly impacted projects here and led the Republic to diversify its sources of sand.

Title: Sand export ban will not adversely affect Singapore

"Sand export ban will not adversely affect Singapore," *TODAY*, May 15, 2009.

The Business Times, 1 February 1997, Page 16
Article also available on microfilm reel NL20867 [Lee Kong Chian Reference Libra
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It's just sand

SAND is just sand to some suppliers. So when Johor announced a ban on the export of the material on Thursday, contractors naturally felt some apprehension about suppliers here jacking up prices even though about 95 per cent of the material is from Indonesia. Last year, after Malaysia imposed a levy of M$200 (S$113) a truck on sand coming across the Causeway, suppliers here conveniently hiked prices of their Indonesian sand. Johor's ban is not likely to make much of a dent in the supply here. According to an article in the *New Straits Times*, Johor sand accounts for only about 4 per cent of Singapore's consumption last year. Still, you never know what suppliers may do. A supplier who was initially unaware of the ban told BT that "she was pretty certain she will raise prices after the Chinese New Year because everything has gone up." But when told about the ban she corrected herself: "Of course, now the price must go up."

SAND INDUSTRY HIT:

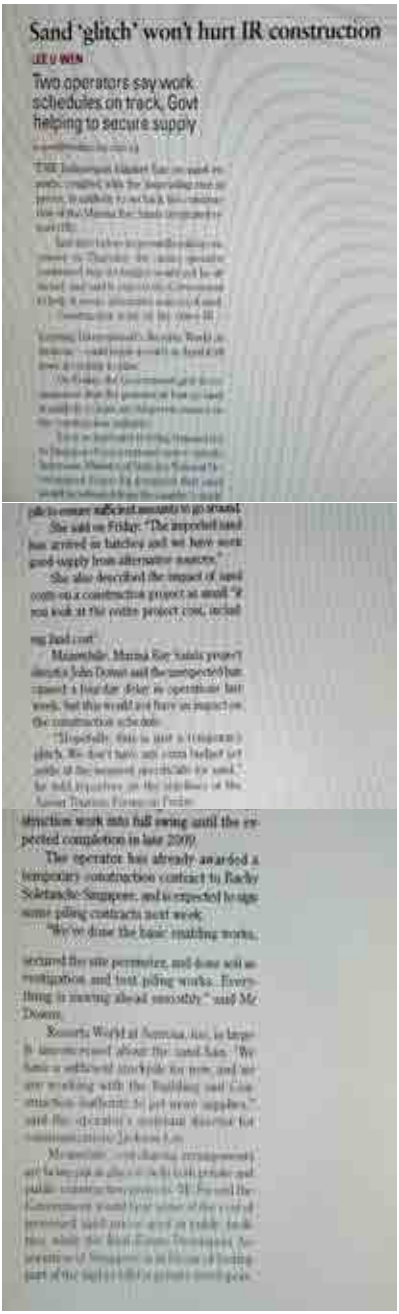
SAND INDUSTRY HIT: Malaysia's sand industry is being affected adversely by the federal government ban on sand exports, according to the Perak Chinese Mining Association.

A spokesman said in Ipoh the government was losing some M$10 million (S$5.7 million) yearly in excise duty from the export of sand to Singapore. — NST.

NST.

Title: It's just sand | Sand Industry Hit

"It's just sand," *The Straits Times,* February 1, 1997.
"Sand industry hit," *The Straits Times,* February 1, 1997.



Sand 'glitch' won't hurt IR construction

LEE U-WEN

Two operators say work schedules on track, Govt helping to secure supply

pile to ensure sufficient amounts to go around.

She said on Friday: "The imported sand has arrived in batches and we have seen good supply from alternative sources."

She also described the impact of sand costs on a construction project as small "if you look at the entire project cost, including land cost".

Meanwhile, Marina Bay Sands project director John Downs said the unexpected has caused a four-day delay in operations last week, but this would not have an impact on the construction schedule.

"Hopefully, this is just a temporary glitch. We don't have any cross-bedded set [illegible]," he told [illegible] of the Asian Tourism Forum on Friday.

struction work into full swing until the expected completion in late 2009.

The operator has already awarded a temporary construction contract to Rachy Soletanche Singapore, and is expected to sign some piling contracts next week.

"We've done the basic enabling works, secured the site perimeter, and done soil investigation and test piling works. Everything is moving ahead smoothly," said Mr Downs.

Resorts World at Sentosa, Inc, is largely unconcerned about the sand ban. "We have a sufficient stockpile for now, and we are working with the Building and Construction Authority to get more supplies," said the operator's assistant director for [illegible] Jackson Lee.

[illegible]

Title: Sand 'glitch' won't hurt IR construction

Lee U-Wen. "Sand 'glitch' won't hurt IR construction," *TODAY*, February 3, 2007.

The Straits Times, 25 January 2007, Page 1
Jakarta bans sand exports, cutting off S'pore's main supply

Jakarta bans sand exports, cutting off S'pore's main supply

Azhar Ghani

Title: Jakarta bans sand exports, cutting off Singapore's main supply

Azhar Ghani. "Jakarta bans sand exports, cutting off Singapore's main supply," *The Straits Times*, January 25, 2007.

Sand ban 'linked to bilateral issues with S'pore'

AZHAR GHANI

▸INDONESIAN EXPORT BAN

Maritime security chief cites border and extradition treaties as reason for measure

By

eral issues with Singapore.

Vice-Admiral Djoko Sumaryono, the head of the maritime security coordinating board, was quoted by the Jakarta Post on Saturday as saying the move was in response to Singapore's foot-dragging over two pacts with Indonesia - a border agreement and a bilateral extradition treaty.

Vice-Admiral Djoko was in Batam, to the Riau islands province, with senior officials from Indonesia's Trade Ministry last week to brief local leaders and sand exporters on the ban.

He is in charge of stepped-up efforts to police the ban, for which Navy, Customs and police officers are being deployed.

given for Jakarta's 2003 ban on the export of marine sand, which is used in reclamation works.

Like the 2003 ban, the latest ban is not indefinite: the ministerial directive said it would be lifted once the two concerns have been fully addressed.

The Trade Ministry's director-general for international trade, Djoh Mansjoer, has already said that the ban would be reviewed within six months or a year.

To date, the ban on marine sand exports is still in place.

But unlike the 2003 ban which specifically linked Singapore to the border issue, the latest ban did not explicitly mention the Republic, said Vice-Admiral Djoko's spokesperson.

The chairman of the Riau Sand Exporters Business Association, Mr Darby Zulfikar Zahidi, who was in

Ongoing talks between Singapore and Indonesia on the border issue began in February 2005, after it was raised at a Jakarta meeting in 2004 between then-deputy prime minister Lee Hsien Loong and former president Megawati Sukarnoputri.

Back then, Singapore said it felt there were only two areas where its boundary with Indonesia was not clearly marked - one to the east, and the other to the west of Singapore.

The Republic has always maintained that its reclamation works are carried out within its territorial waters and will not alter its maritime boundaries with Indonesia.

But Indonesian ministers have often expressed concerns over the possibility that the country's neighbours might try to annex their territory. So, for example, if Singapore's reclamation project were to happen on any uninhabited sand or rock.

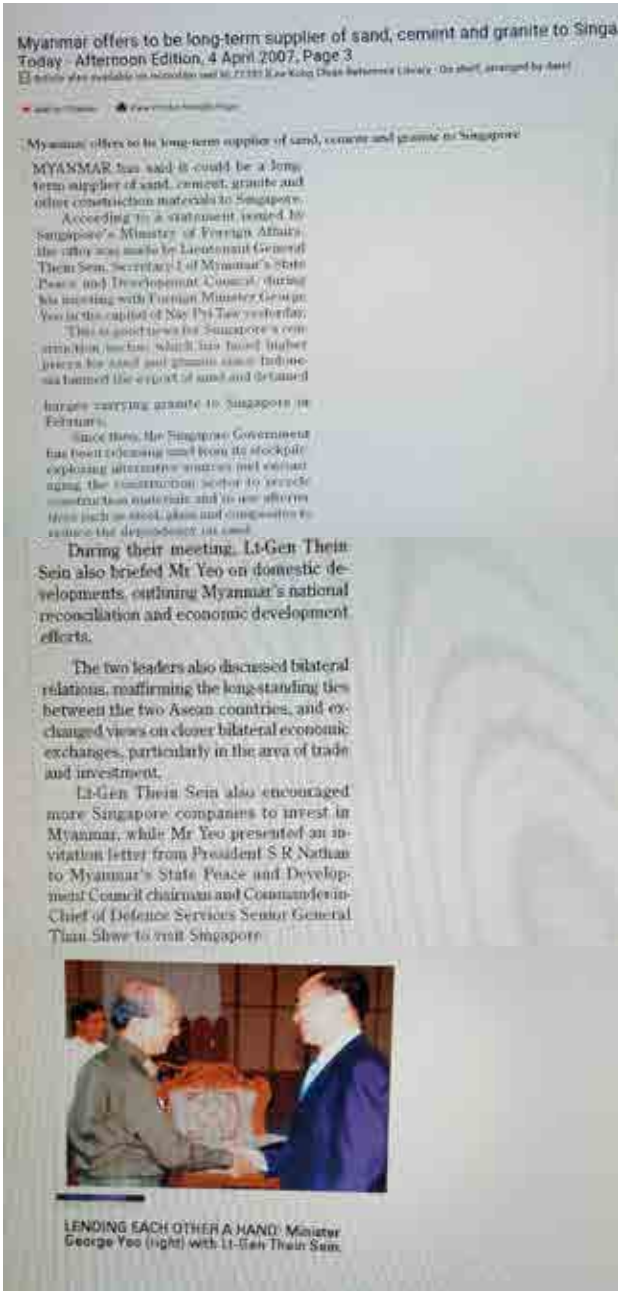
As for the extradition treaty, it is those that are dragged on for nearly a decade.

The two sides have yet to agree on the precise boundaries and definition both - and part from Pedra Branca - in Singapore.

The new sand export ban comes at a time when Singapore's construction sector is seeing [illegible]

Title: Sand ban 'linked to bilateral issues with S'pore'

Azhar Ghani. "Sand ban 'linked to bilateral issues with S'pore'," *The Straits Times*, February 5, 2007.



Myanmar offers to be long-term supplier of sand, cement and granite to Singa
Today - Afternoon Edition, 4 April 2007, Page 3

Myanmar offers to be long-term supplier of sand, concrete and granite to Singapore

MYANMAR has said it could be a long-term supplier of sand, cement, granite and other construction materials to Singapore.

According to a statement issued by Singapore's Ministry of Foreign Affairs, the offer was made by Lieutenant General Thein Sein, Secretary-1 of Myanmar's State Peace and Development Council, during his meeting with Foreign Minister George Yeo in the capital of Nay Pyi Taw yesterday.

This is good news for Singapore's construction sector, which has faced higher prices for sand and granite since Indonesia banned the export of sand and detained barges carrying granite to Singapore in February.

Since then, the Singapore Government has been releasing sand from its stockpile, exploring alternative sources and encouraging the construction sector to recycle construction materials, and to use alternatives such as steel, glass and composites to reduce the dependence on sand.

During their meeting, Lt-Gen Thein Sein also briefed Mr Yeo on domestic developments, outlining Myanmar's national reconciliation and economic development efforts.

The two leaders also discussed bilateral relations, reaffirming the long-standing ties between the two Asean countries, and exchanged views on closer bilateral economic exchanges, particularly in the area of trade and investment.

Lt-Gen Thein Sein also encouraged more Singapore companies to invest in Myanmar, while Mr Yeo presented an invitation letter from President S R Nathan to Myanmar's State Peace and Development Council chairman and Commander-in-Chief of Defence Services Senior General Than Shwe to visit Singapore.

LENDING EACH OTHER A HAND: Minister George Yeo (right) with Lt-Gen Thein Sein.

Title: Myanmar offers to be long-term supplier

"Myanmar offers to be long-term supplier of sand, cement and granite to Singapore," *TODAY: Afternoon Edition*, April 4, 2007.

Vietnam ministry seeks sand export ban
Today, 18 September 2009, Page 20

Vietnam ministry seeks sand export ban

HANOI — Vietnam's construction ministry has asked Prime Minister Nguyen Tan Dung to temporarily ban sand exports from November to ensure domestic supply and protect the country's environment from unsustained production.

"We should halt sand exports until all provinces can provide specific information on reserves, exploitation capacity and plans to meet demand," Mr Le Van Tos, head of the ministry's Department for Construction Materials, said yesterday. He estimated it may take several months for local governments to submit these reports.

Vietnam's sand exports surged from May as demand increased following Cambodia's ban on sand shipments, he said. Unplanned dredging can cause landslides and riverbank collapses along the Mekong River in Vietnam's southern region, which provides the bulk of sand for export, Mr Tos said.

The ministry expects demand from local construction projects will rise in the coming years and domestic sand supplies may run out if exports continue at the current pace.

Vietnam shipped nearly 9 million cubic metres of sand in the first eight months this year, compared with a total 8.3 million cubic metres last year, Mr Tos said, citing figures from the Can Tho Customs Department, which handles most of Vietnam's sand exports.

Singapore was the biggest buyer so far this year, customs data show.

Title: Vietnam ministry seeks sand export ban

Bloomberg. "Vietnam ministry seeks sand export ban," *TODAY*, September 18, 2009.

Title: How things work - Land Reclamation

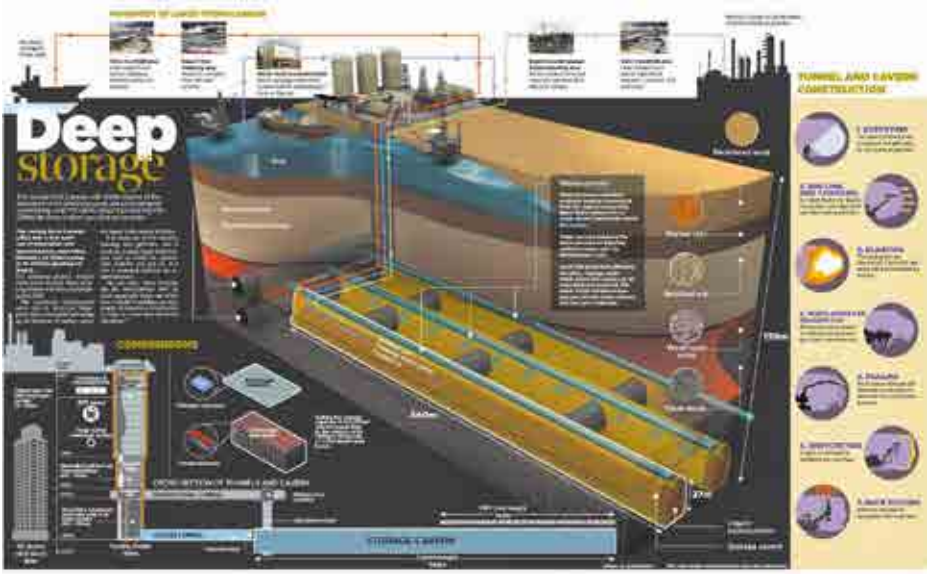
Source : The Straits Times

A6 | TOP OF THE NEWS FRIDAY, FEBRUARY 1, 2013 THE STRAITS TIMES

LAND USE PLAN

Title: 2030 - More Land, more homes, more greenery

"2030: More land, more homes, more greenery," *The Straits Times*, February 1, 2013.



"Deep storage," *The New Paper*, September 15, 2014.

Global sea levels rising at an historic rate

WASHINGTON – Sea levels are rising faster than ever before, and this is accelerating because of man-made global warming, according to new scientific studies.

An international team of scientists dug into two dozen locations across the globe to chart rising and falling seas over the past 2,800 years.

Until the 1880s and the age of industrialisation, the highest sea level rise was about 1 to 1.5 inches (3cm to 4cm) per century. During that time, global sea levels really did not get much higher or lower than 3 inches (7.5cm) above or below the 2,000-year average.

But in the 20th century the world's seas rose 5.5 inches (14cm). Since 1993, the rate has soared to a foot per century (30cm).

And two different studies published on Monday in the journal Proceedings of the National Academy of Sciences, said by 2100 that the world's oceans will rise between 11 to 52 inches (28cm to 131cm), depending on how much heat-trapping gas the Earth's industries and vehicles expel.

"There's no question that the 20th century is the fastest (in terms of sea level rise)," said Rutgers University earth and planetary sciences professor Bob Kopp, lead author of the study that looked back at sea levels over the past three millennia.

"It is because of the temperature increase in the 20th century which has been driven by fossil fuel use."

To figure out past sea levels and rates of rise and fall, scientists engaged in a "geological detective story", said study co-author Ben Horton, a Rutgers marine scientist.

CONTINUED ON PAGE 4

Global sea levels rising at a historic rate

CONTINUED FROM PAGE 1

They went around the world looking at salt marshes and other coastal locations and used different clues to figure out what the sea level was at different times. They used single-cell organisms that are sensitive to salinity, mangroves, coral, sediments and other clues in cores, said Prof Horton.

When Prof Kopp and colleagues charted the sea level rise over the centuries — they went back 3,000 years, but are not confident in the most distant 200 years — they saw the earth's sea level was on a downward trend until the industrial age. Sea level rise in the 20th century is mostly man-made, said the authors.

A separate, not-yet-published study by Prof Kopp and others found that since 1950, about two-thirds of the United States' nuisance coastal floods in 27 locales have the fingerprints of man-made warming.

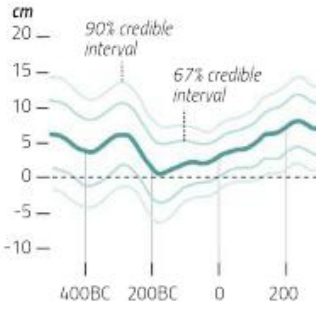
"There is such a tight relationship between sea level and temperature," said Prof Horton. "I wish there wasn't, then we wouldn't be as worried."

The link to temperature is basic science, said the study's authors. Warm water expands. Cold water contracts.

If greenhouse gas pollution continues at the current pace, both studies

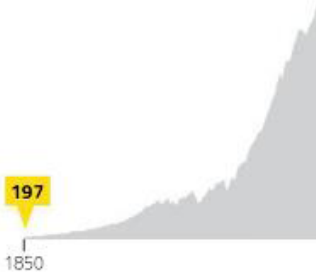
Sharp rise in se

● Global sea level average



● CO_2 emissions since 1850

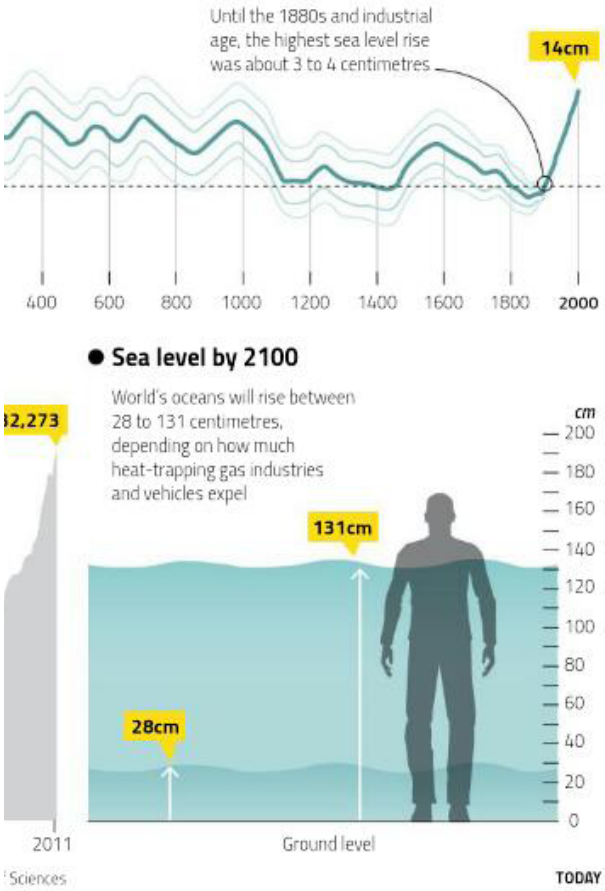
Greenhouse gas emissions measured in million metric tons of CO_2 equivalent



Source: Proceedings of the National Academy of

"Global Sea Levels rising at a historic rate," *Today* February 24, 2016

a levels in last two centuries



> There is such a tight relationship between sea level and temperature. I wish there wasn't, then we wouldn't be as worried.
>
> **Professor Ben Horton**
> RUTGERS MARINE SCIENTIST

project increases of about 22 to 52 inches (57cm to 131cm). If countries fulfil the treaty agreed upon last year in Paris and keep the rise of global temperatures "well below 2°C" above pre-industrial levels, sea level rise would be in the 11 to 22 inch range (28cm to 56cm).

In line with the Paris agreement, Singapore has pledged to reduce Emissions Intensity by 36 per cent from 2005 levels by 2030, and stabilise greenhouse gas emissions with the aim of peaking around 2030.

To meet the pledge, the National Climate Change Secretariat (NCCS) had said that it will require concerted effort by all stakeholders. Enhanced energy efficiency, both within households and businesses, will play a key role to manage emissions. Singapore will also continue to invest in research and technology to develop innovative solutions to address the Republic's needs in the areas of energy, emissions reduction, water and land use, said NCCS.

To address sea level rise, PUB, the national water agency, has called for a tender for an engineering study to identify possible measures to protect Singapore's coastal reservoir structures such as dams, tidal gates, dykes and spillways at 11 reservoirs against future sea level rise. **AGENCIES**

Beneath the Waves, Old Oil Rigs Are Rich With Sea Life

EUREKA OIL PLATFORM OFF CALIFORNIA COAST — Twelve kilometers off the coast of Long Beach, California, the oil rig Eureka, which has stood here for 30 years, is a study in contrasts. From a distance, it looks like just another offshore platform, an artifact of the modern industrial landscape.

But beneath the waves, the Eureka and other rigs like it in the area are home to a vast and thriving community of sea life that some scientists say is one of the richest marine ecosystems on the planet.

"They are more productive than coral reefs, more productive than seamounts," said Milton Love, a professor of marine biology at the University of California, Santa Barbara. "It just turns out by chance that platforms have a lot of animals that are growing really quickly."

Dr. Love, who has published research on marine life at offshore drilling sites, said the location of these rigs — in marine protected areas in a cold current that sweeps down from British Columbia — have made them perfect habitats for fish and other sea life.

Scientists and divers have been aware of the abundant life here for years, but a 2014 paper that Dr. Love co-wrote confirmed what many experts had suspected: that most of the life was concentrated at the rig rather than having come from other parts of the ocean and settled around the concrete pylons.

"The mass of these many ecosystems like the rockfishes. There's no question that there are more of them out on Southern California waters because the platforms are there," Dr. Love said.

Title: Beneath the Waves, Oil Rigs Are Rich With Sea Life

Erik Olsen. "Beneath the Waves, Oil Rigs Are Rich With Sea Life," *The New York Times International Weekly*, March 19, 2016.

This insight is adding momentum to efforts to convert these rigs into artificial reefs once they are no longer operational.

Blue Latitudes, an organization founded in 2014 by two young scientists, is trying to increase awareness of the value of rigs as permanent homes for sea life. "I think it's time for us to step outside the box and think creatively about the resources we have," said Amber Jackson, an oceanographer who co-founded Blue Latitudes with Emily Callahan, a marine scientist. "To lose these ecosystems just because they are on an oil platform structure, I feel, is short-sighted."

While so- called rig-to-reef programs in the Gulf of Mexico have existed for decades — more than 400 rigs have been approved for conversion since 1985 — the idea is controversial in California. So far, none off the coast of California have been converted into artificial reefs.

"It's seen as something which benefits the oil industry, and opposing the oil industry is the role taken by many environmental groups," said George Steinbach, the executive director of the California Artificial Reef Enhancement program, a nonprofit advocacy organization funded by the oil industry.

The Eureka is one of 27 oil rigs off the California coast. Several major oil

Emily Callahan and Amber Jackson have advocated the conversion of decommissioned oil rigs into artificial reefs.

spills have occurred since they were built half a century ago, giving rise to a persistent environmental movement that has long advocated complete removal of the rigs.

"People have been hoping for these oil platforms to go away," said Linda Krop, an environmental lawyer with a California advocacy group based in Santa Barbara, where several offshore rigs can be easily seen from shore.

But just beneath the surface of the Eureka rig, one from proof in the crystal clear waters, rockfish and bright orange Garibaldi swim in the swift currents, and fluid impacts of invertebrates and seaborne sitting in the rig's pylons.

"It's like an oasis. The structure itself is really impressive. It gives you a sense of total weightlessness," said Ashleigh Pritchett, a San Diego-based conservation biologist.

In 2014, Ms. Jackson and Ms. Callahan started advocating to allow oil companies to keep large sections of the rigs in place after they are no longer functioning.

The process of removing a rig and cleaning the site, known as decommissioning, is complicated and expensive. A total decommissioning means the removal of the entire structure. In a typical rig-to-reefs effort, only the top portion of the rig is removed, usually to a depth of about 25 meters. The rest remains in place as a haven for sea life.

The savings to the oil industry from converting all of the rigs off California to reefs, rather than removing them, could be more than $1 billion. But under the law, oil companies would be required to give at least half of the money they save to the state to fund conservation programs. That has some groups speaking out in favor of the rigs-to-reefs program.

"Nobody wants to see more oil spills," said Mary Gleason, the lead oil-script for the Nature Conservancy in California. "But in some cases it may make more sense and have more environmental benefits if we could do a partial decommissioning and see any rest savings to fund more ocean conservation and management."

Floating a novel idea for the future East Coast Park

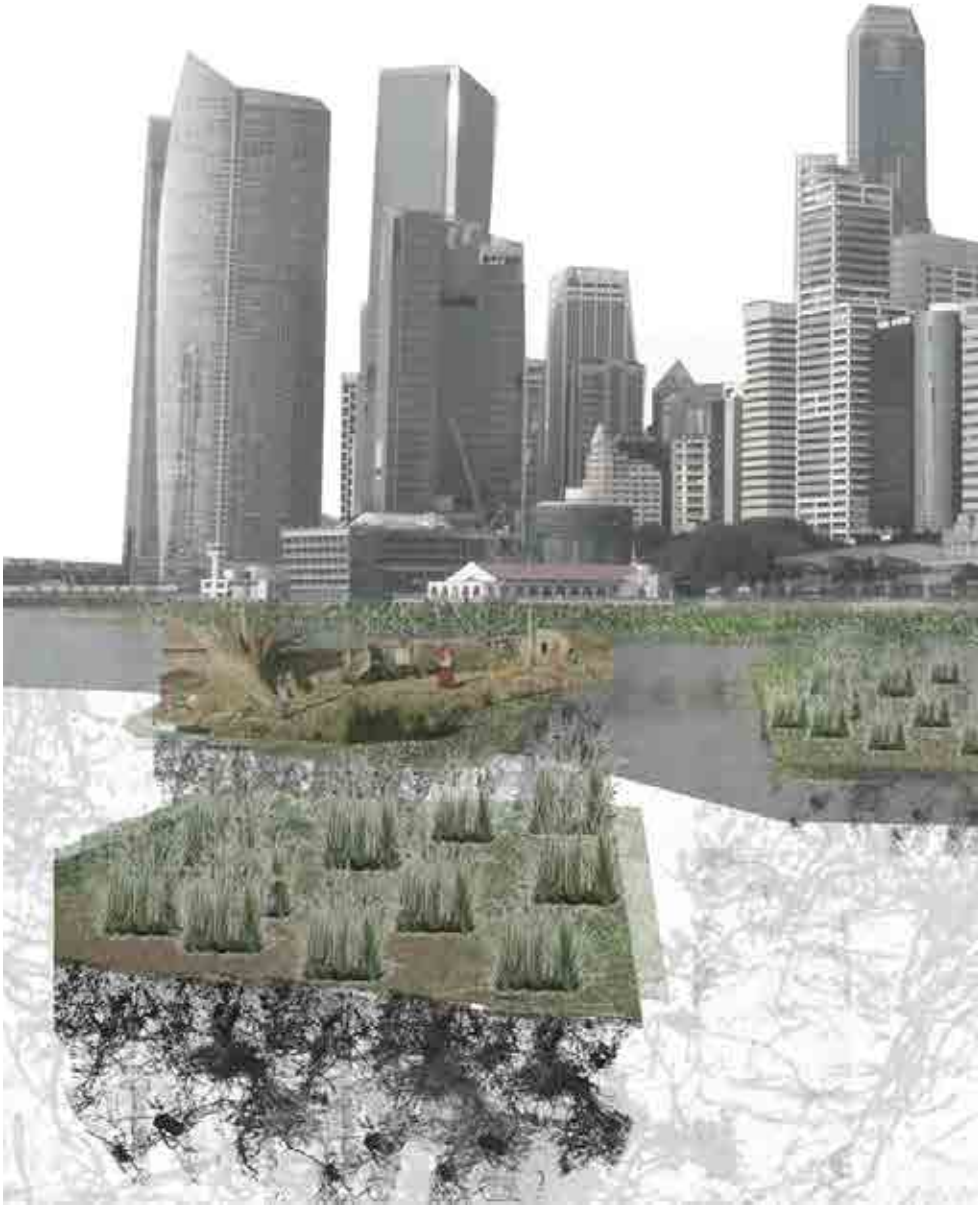
Lim Soon Heng

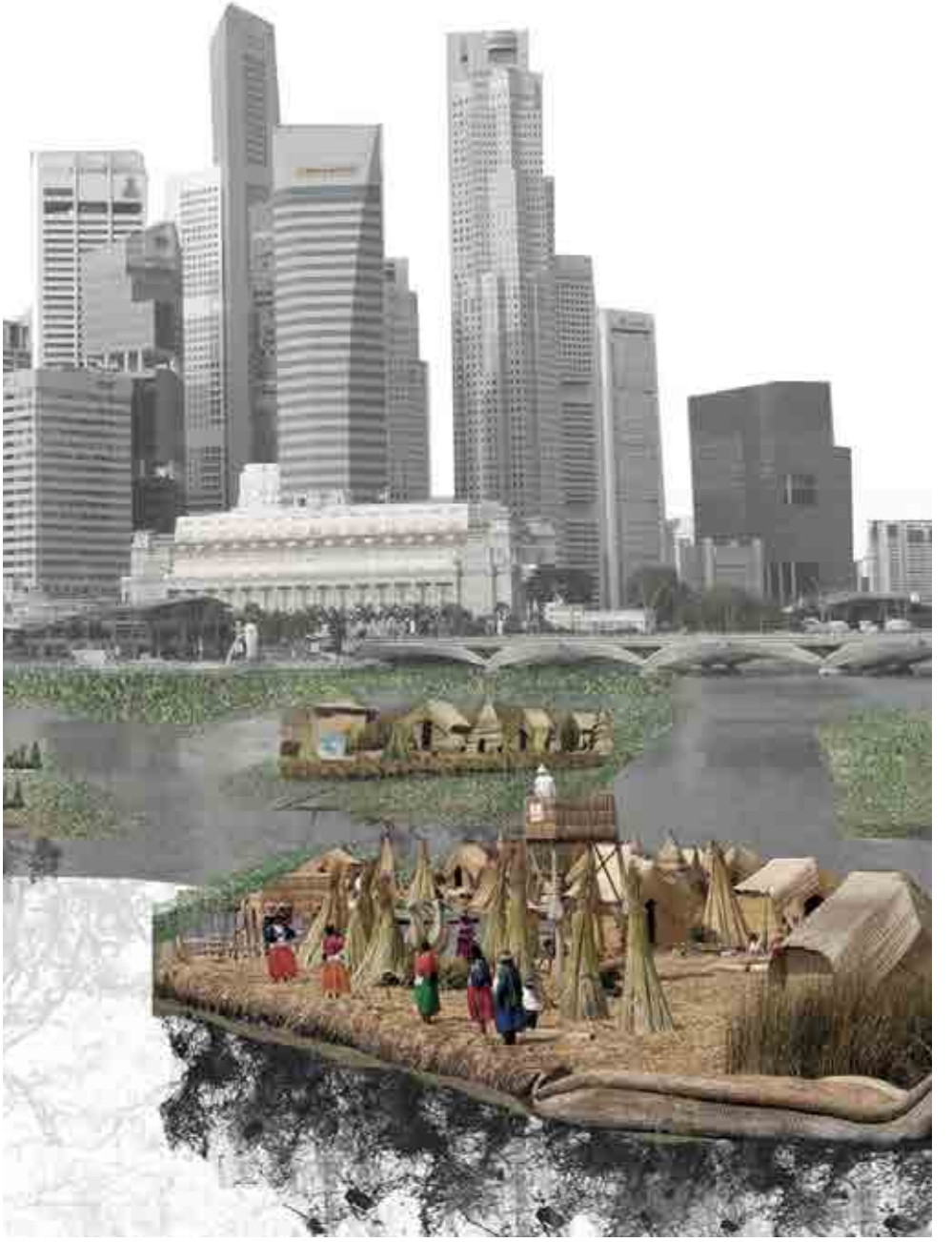
For The Straits Times

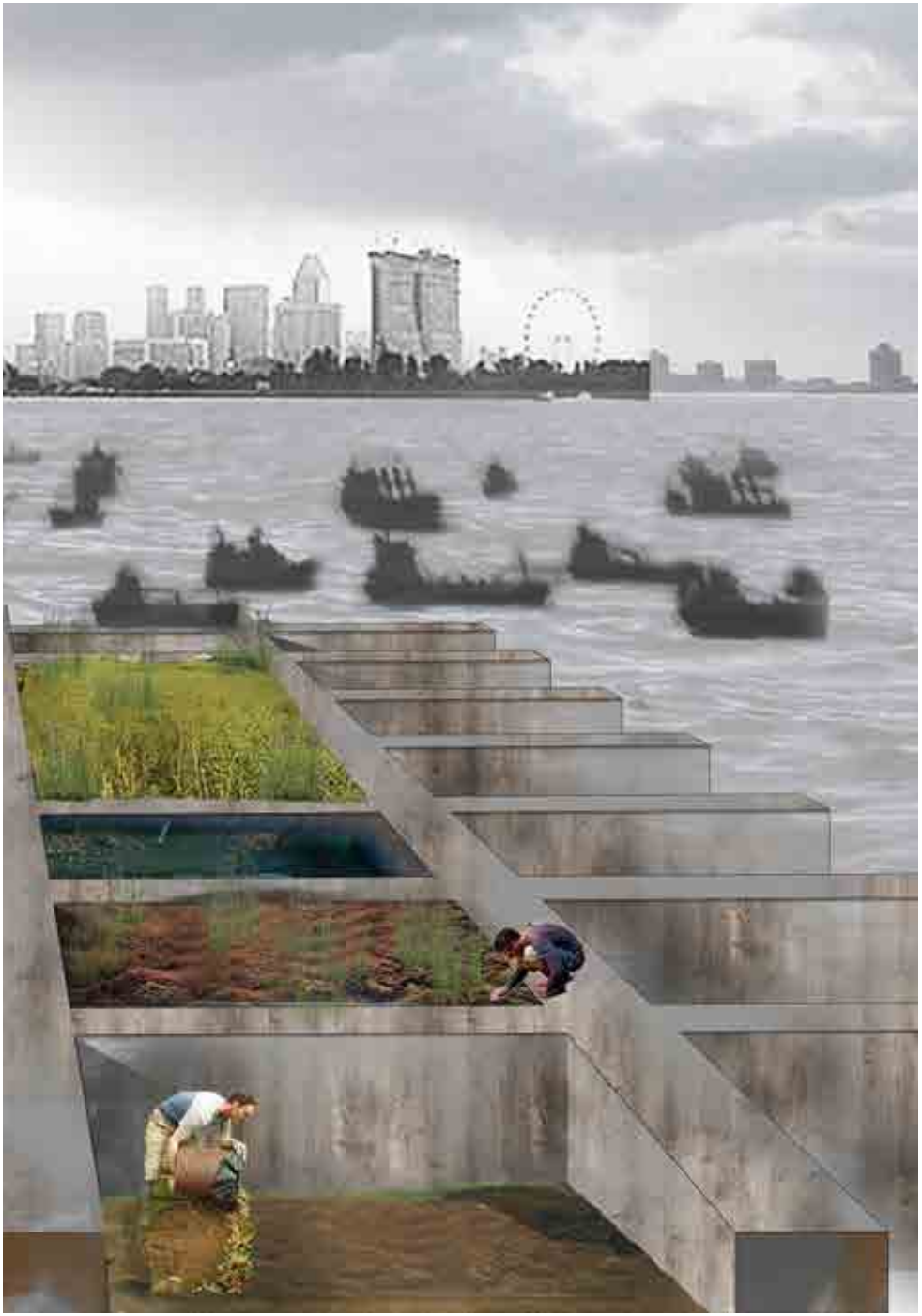
Lim Soon Heng. "Floating a novel idea for the future East Coast Park," *The Straits Times*, March 15, 2016.

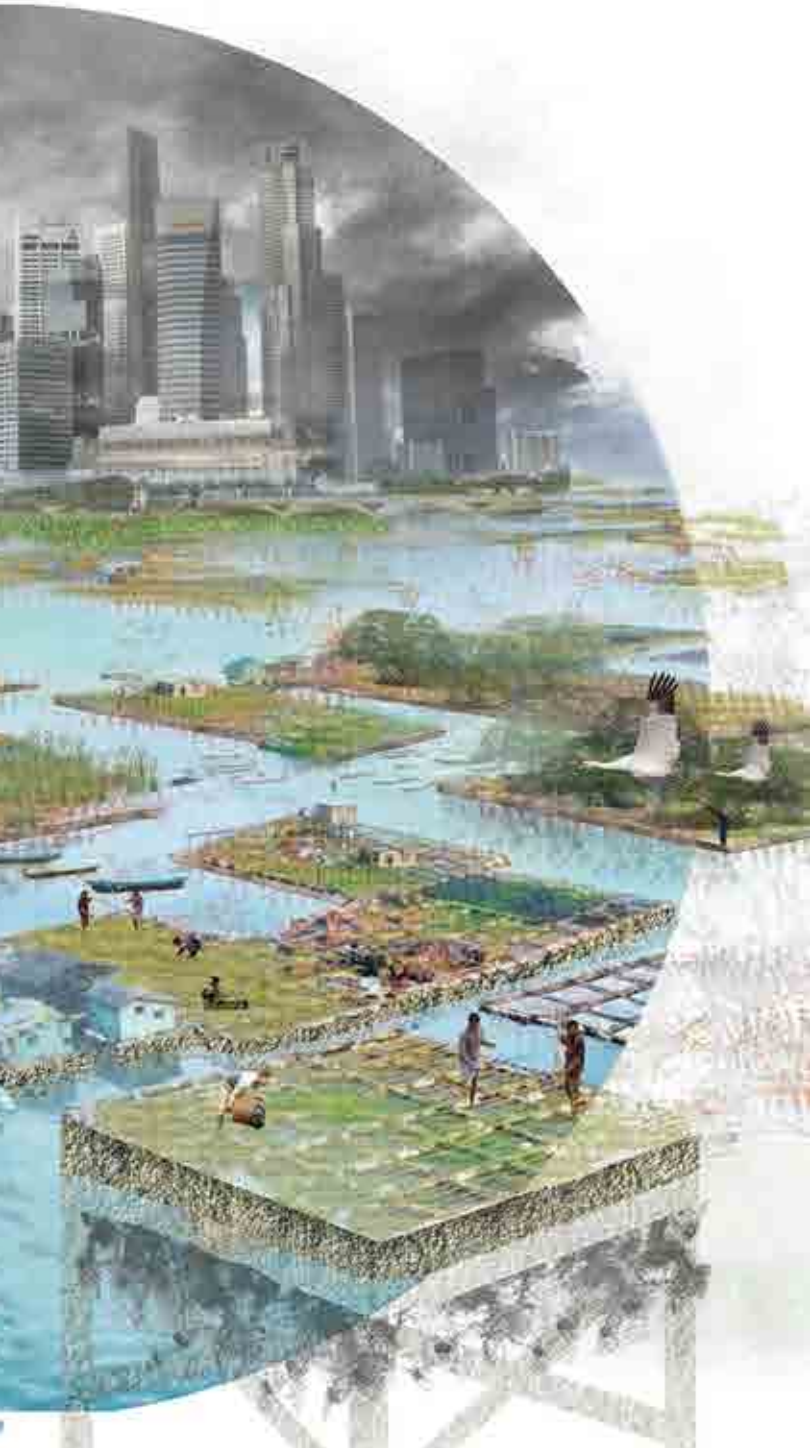
PROCESS

Growing Domestic Land





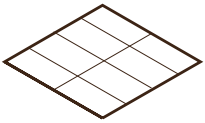


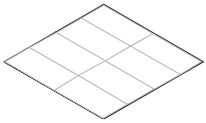


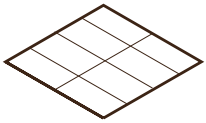
F MAXIMUM DIMENSION FOR FLOATING
ODULE IS 20M X 20M = 400SQM

PHASE I

PHASE II







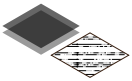
Food Waste (Tonnes)

100 - 15% = 85 %
85% - 500 Tonnes
15% =90 Tonnes = 54 M3
1 Year = 648 M3
After Composting = 130 M3

130 M3

260 M3

IF RATIO OF SOIL : COMPOST = 2:1



260 M3

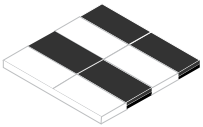
520 M3

DEPTH OF COMPACTED SOIL

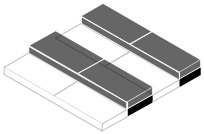
0.65 M

1.3 M

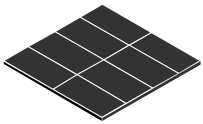
FILLING THE CELLS



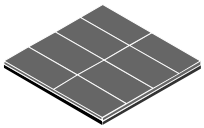
1.3 M



2.6 M



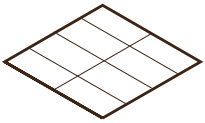
0.65 M



1.3 M

PHASE III

PHASE IV

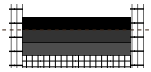


390 M3

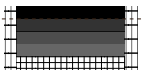
420 M3

780 M3

840 M3

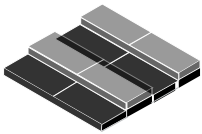


1.95 M

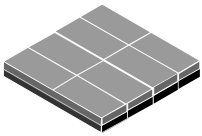


2.6 M

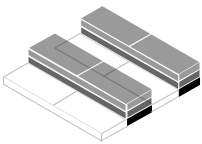
WATERLINE



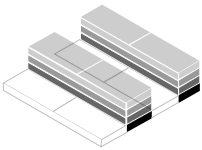
2.6 M



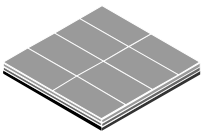
2.6 M



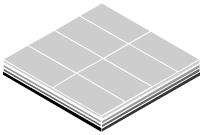
5.2 M



5.2 M



1.3 M



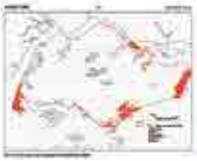
1.3 M

TIMELINE OF LAND RECLAMATION

1821 Sir Stamford Raffles directed the first land fill project

<1955

1990



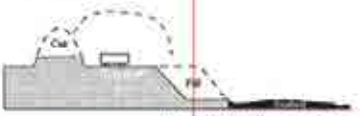
2000

2008

2014

RECLAMATION METHOD: CUT AND FILL

Cut and Fill Diagram



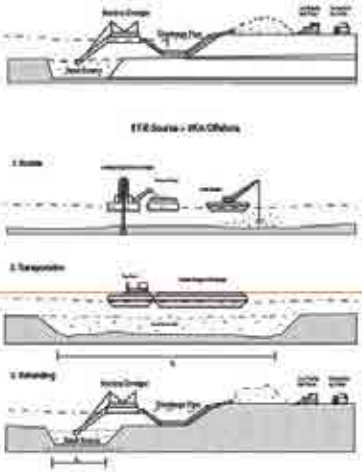
1960, Alda Street Opera Estate

1971, Bedok Hill, Upper East Coast Road

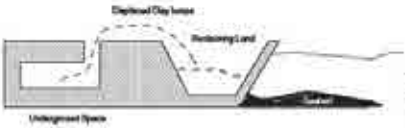
Locally Sourced

RECLAMATION METHOD: DREDGING - SAND IMPORTS

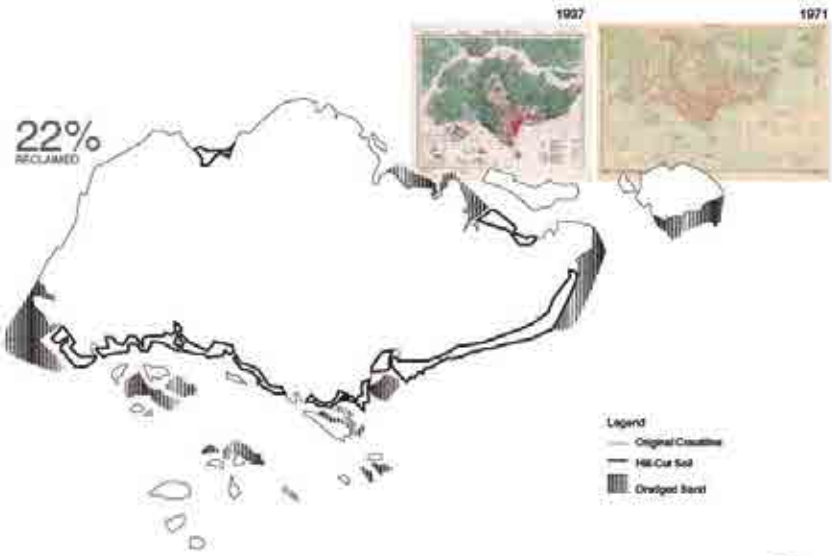
Dredging Techniques



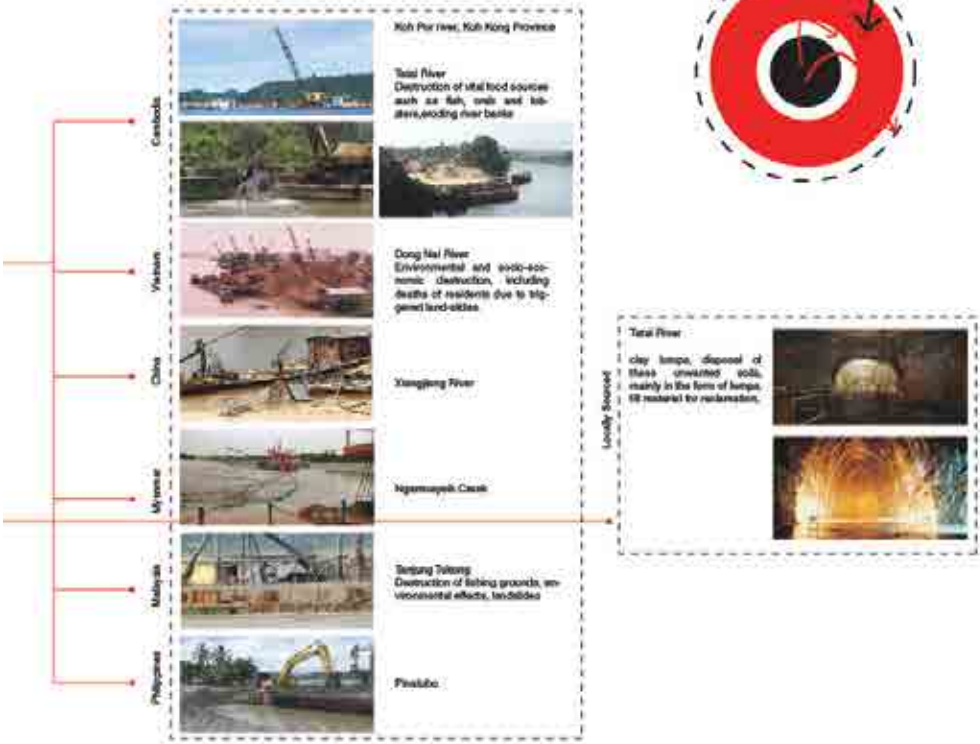
Proposed Alternatives to Land Reclamation



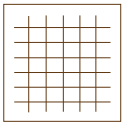
Approved in 2000 for 1500 hectares proposed Pulau Tekong/Ubin reclamation



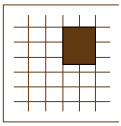
Singapore 1969, Reclaimed land and fill materials used in Singapore



Land sea ratio



Land: 20 %
Water: 80 %



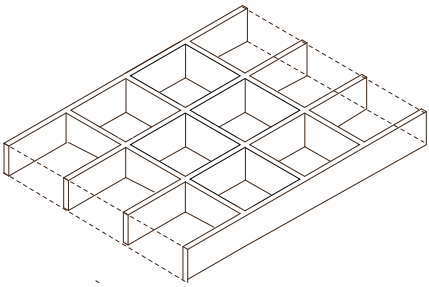
Land: 25 %
Water: 75 %

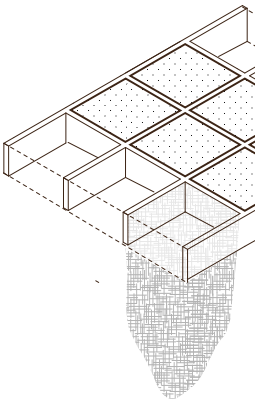
Phase I: Casting concrete

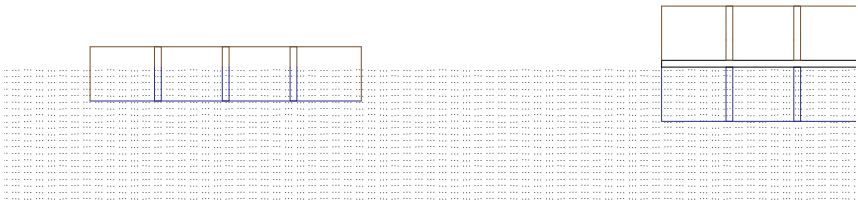
Phase II: Growing Land

Phase Iil: Growing Land

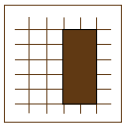
Pha



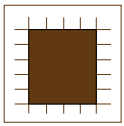




% 5 %

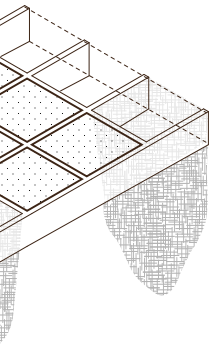


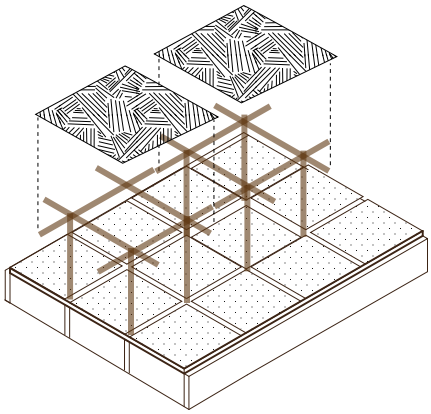
Land: 50 %
Water: 50 %

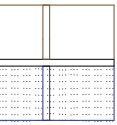


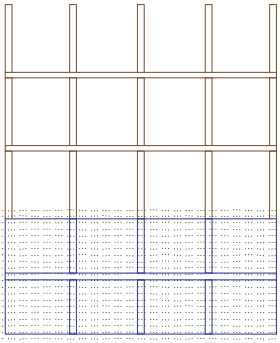
Land: 90 %
Water: 10 %

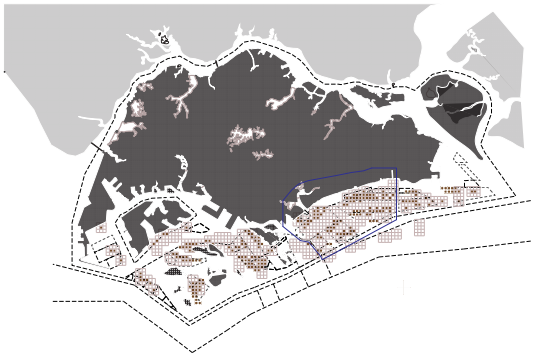
Phase IV: Mature Land

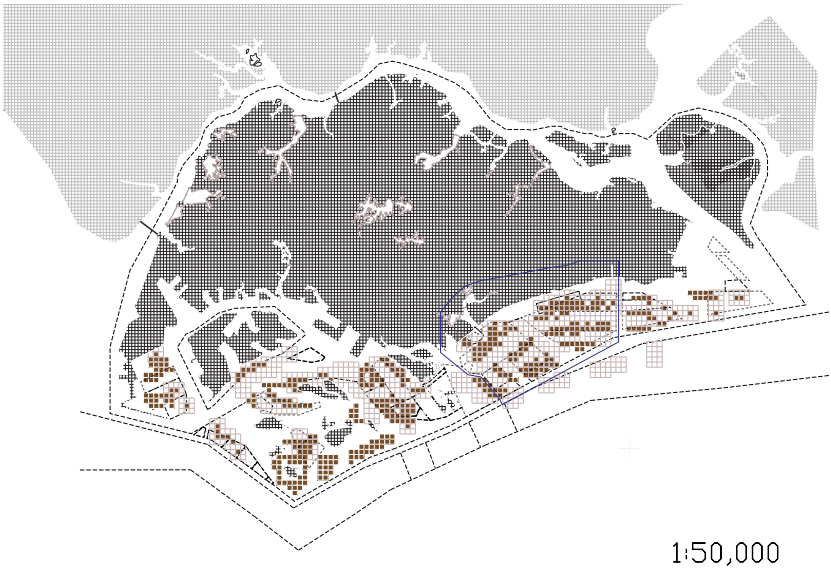










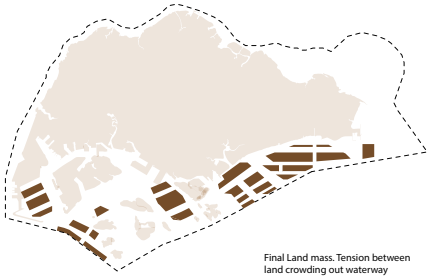


1:50,000

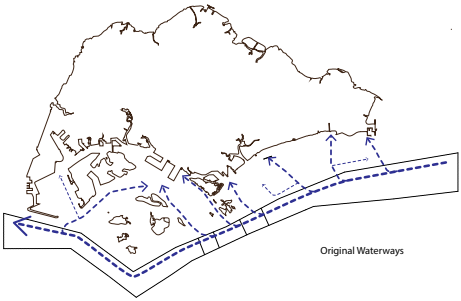
Original ecology

New Ecology

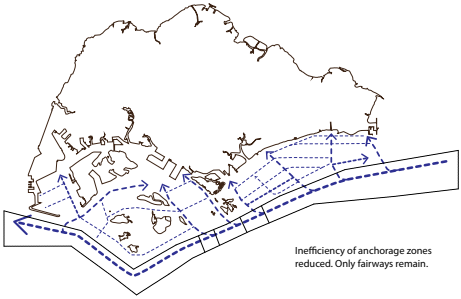
Original Land mass



Final Land mass. Tension between land crowding out waterway

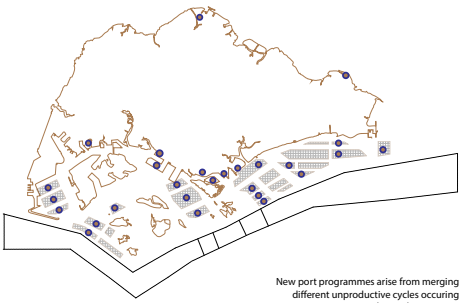


Original Waterways



Inefficiency of anchorage zones reduced. Only fairways remain.

Original Port Distribution



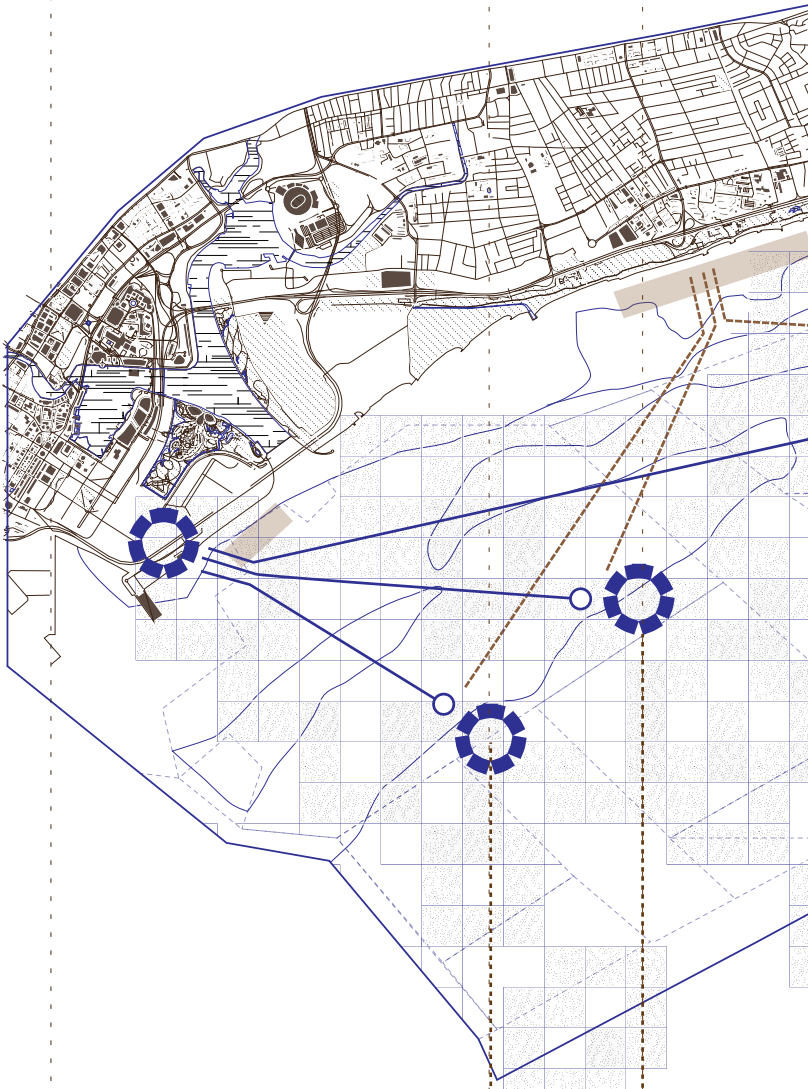
New port programmes arise from merging different unproductive cycles occuring within in the seascape

PHASE I

00:00:02:00:00

YEARS MTHS WEEKS DAYS HOURS

INDUSTRIAL WASTE



FOOD COMPOST

PHASE II

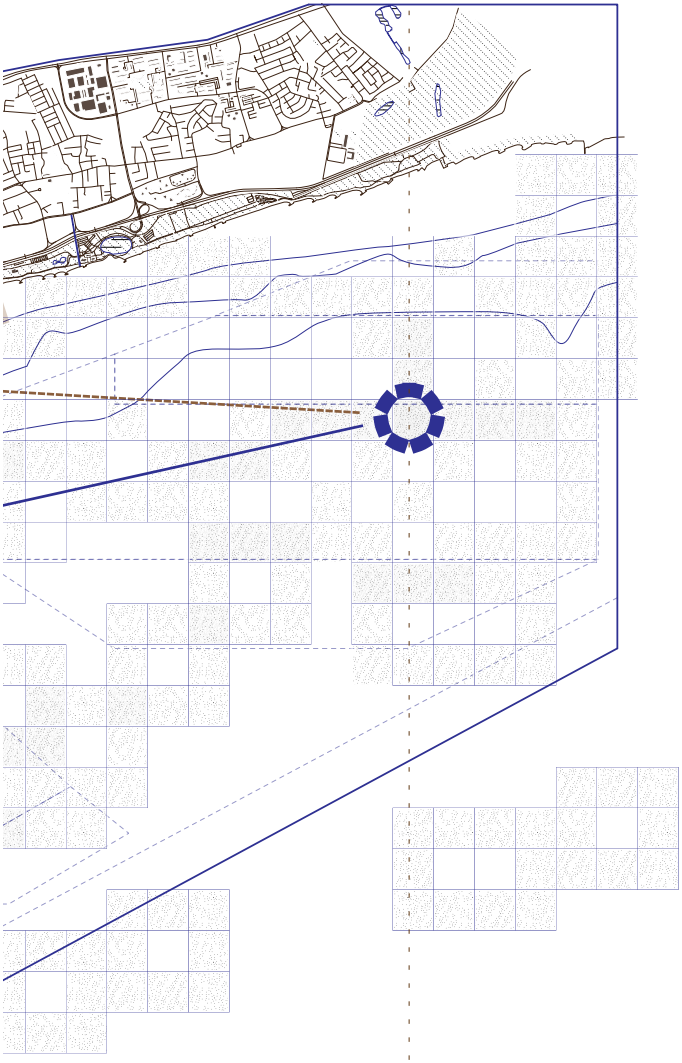
00:01:01:00:00

YEARS MTHS WEEKS DAYS HOURS

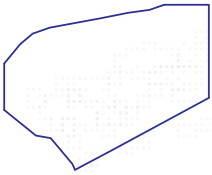
PHASE III

00:05:01:00:0

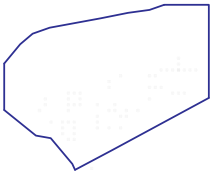
YEARS MTHS WEEKS DAYS HO



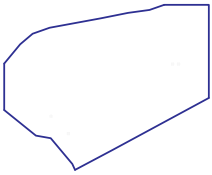
POTENTIAL ZONES FOR
PRE-CURSOR LANDS



Periphery of heavily used anchorage zones



Primary overlapping of potential zones



Secondary overlapping of potential zones

PHASE IV

99:99:99:99:99

YEARS MTHS WEEKS DAYS HOURS

0

URS

METALS

SITE PLAN
1: 25,000

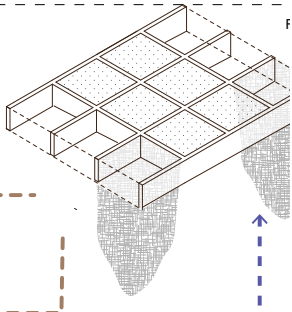
PHASE I

Concrete mixture

Transfer ind

Cast into concrete

Tugged to Site



SHIPS IN WAIT

Cargo Ships

Servicing

Barges

Fresh Food Resources

Warships

AQUACULTURE

Fish

EXCESS

Cruise

FARMING

Vegetable

Compost Layer

PHASE III

Small craft

SECONDARY ACTIVITIES

Sowing in exchange for fresh food supplies

USER GROUPS

Researchers

Quarantined Immigrants
Transiting Individuals

Aquaculture

Poultry farmers

ustrial waste

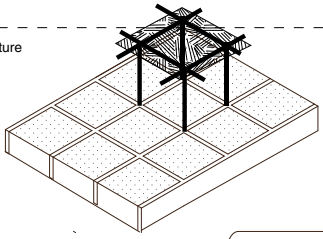
Chemical Industries

Materials from Mainland

By Barge

Soil

Floating Structure



By Ship

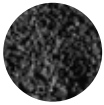
Water

By Ship

Gas

By Ship

Farm produce



Charcoal

PHASE II

Coffee Grounds

Rosemary

Farming

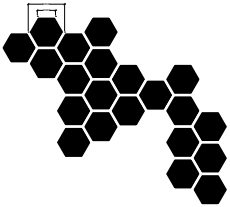
Chicken Farm

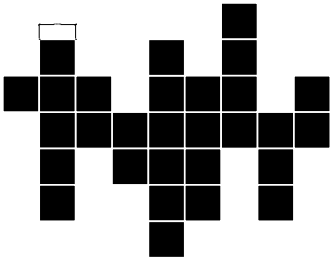
Pig Farm

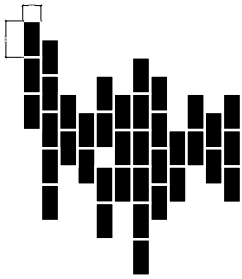
Construction

Temporary Accomodation

SYSTEM OF GRIDS/ TESSALATION - 20 X 20M





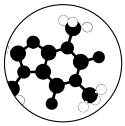


Algae Farms

Saltwater Marshlands

Mangroves

5m



Nitrogen and Phospherous

< 80cm

< 20 cm

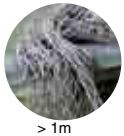
10m

Human and Marine Bacteria

< 60cm

< 15 cm

20m



> 1m

< 40cm

< 10 cm

30m

> 2m

< 20cm

< 8 cm

Remediation & Rehabilitation
Alternate Uses

Structure and growth of land filters and cleans the seascape - returning value to waterspace

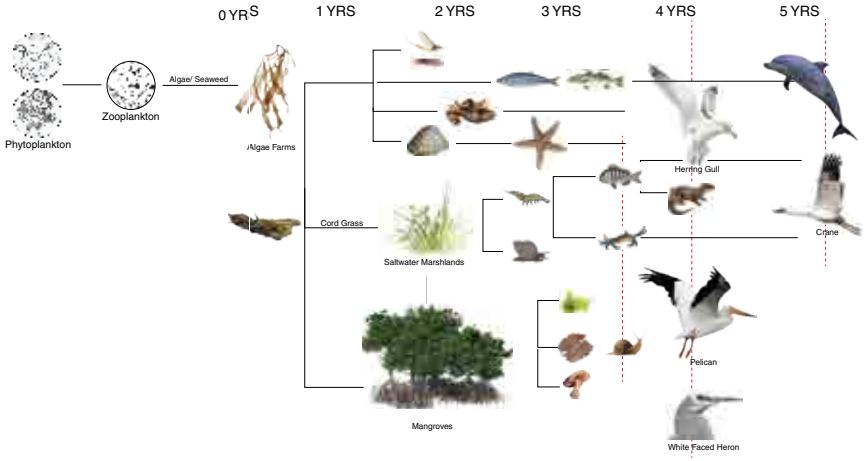
Algae Farms
Saltwater Marshlands
Mangroves
Ocean bound communities

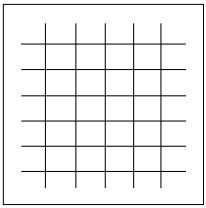
Growing Algae Farms - builds primary layer for land, uses contextual elements to grow, questions current value of land as commodity (primary intent to earn high profits from as little land as possible) - benefits: biofuel, feed, remediates pollutive waters

Saltwater Marshlands - builds upon algae as secondary layer for land, uses contextual elements to grow, questions current value of land as commodity (???) -benefits: restores biodiversity, acts as filters for water

Mangroves - builds upon nutrient rich and partially stable land, uses contextual elements to grow, questions the devaluation of the environment in the process of attaining land

Ocean Bound Communities - builds upon nutrient rich and partially stable land, uses contextual elements to grow, questions the devaluation of the environment in the process of attaining land





Land: 20 %
Water: 80 %

Sea Depth

5m

Depth of Base Structure - free-board : draft

3m - 1m : 2m

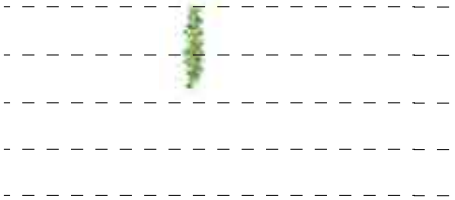
4m

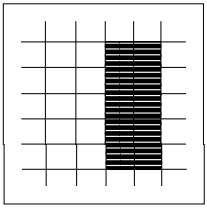
If growth rate is 10cm/day

3m - 30 days?

8

Algae farms and root lengths + time needed





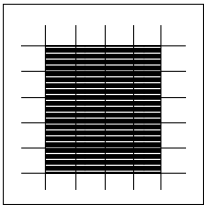
Land: 50 %
Water: 50 %

Salt Marsh Lands

0.5m

Soil Layer

200 m3



Land: 90 %
Water: 10 %

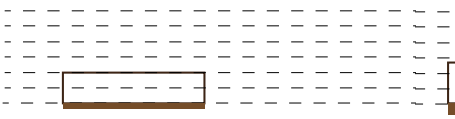
Mangrove Forest

Density (40%)

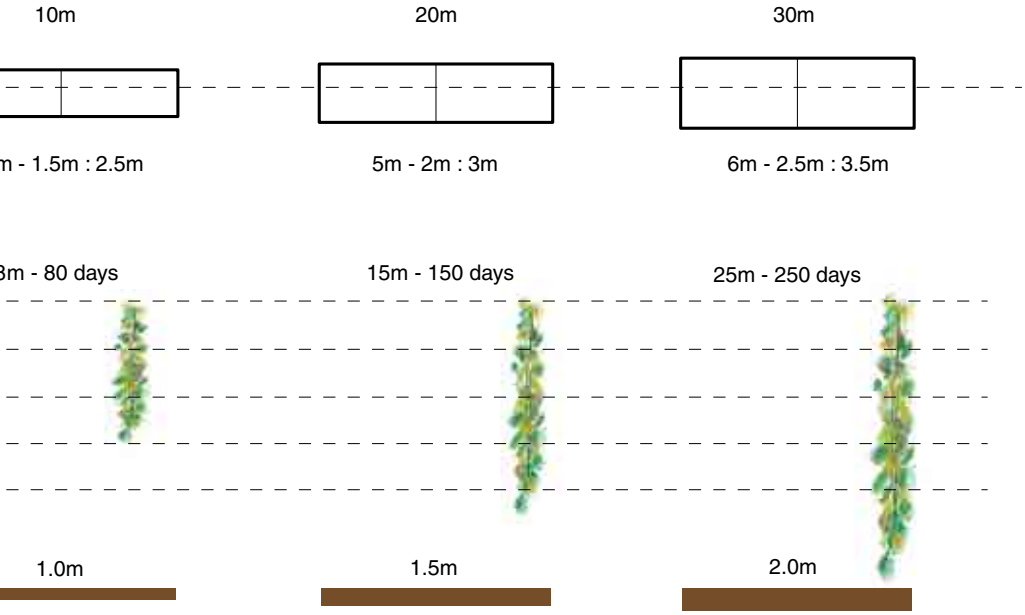
Density (60%)

Habitation for ocean bound communities
- vessels with refugees
- plagued ships

5m + 0.5m

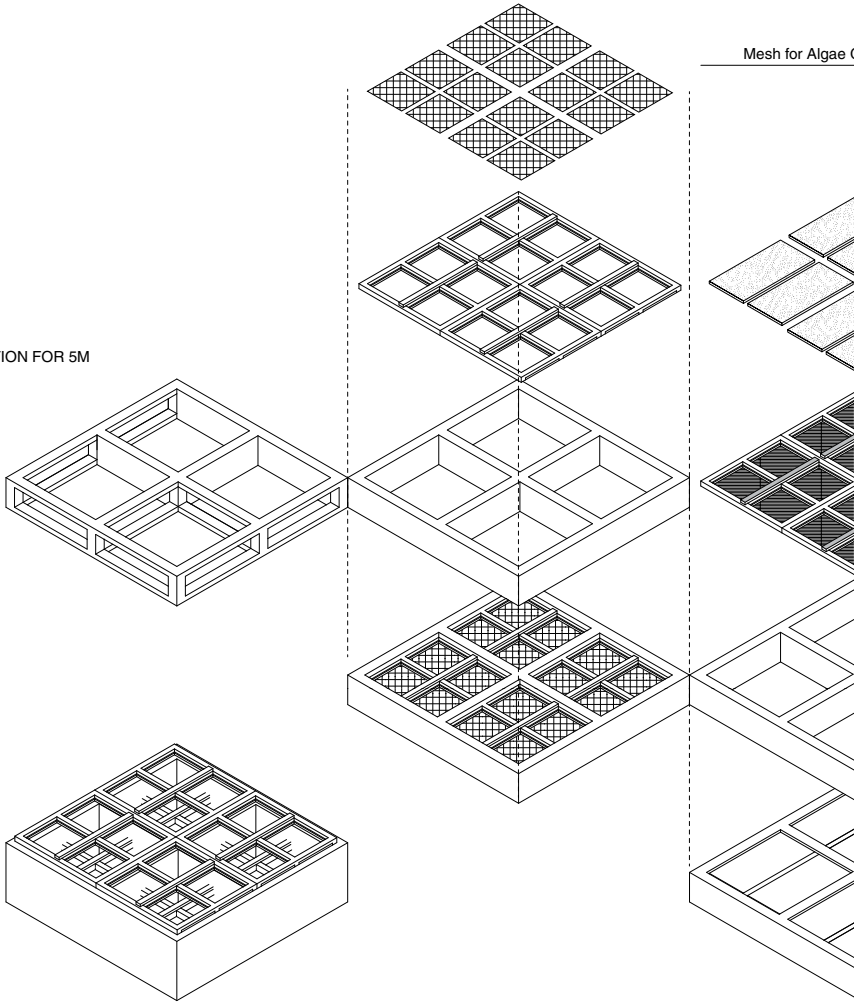


structure and growth of land filters and cleans the seascape - returning value to water-space

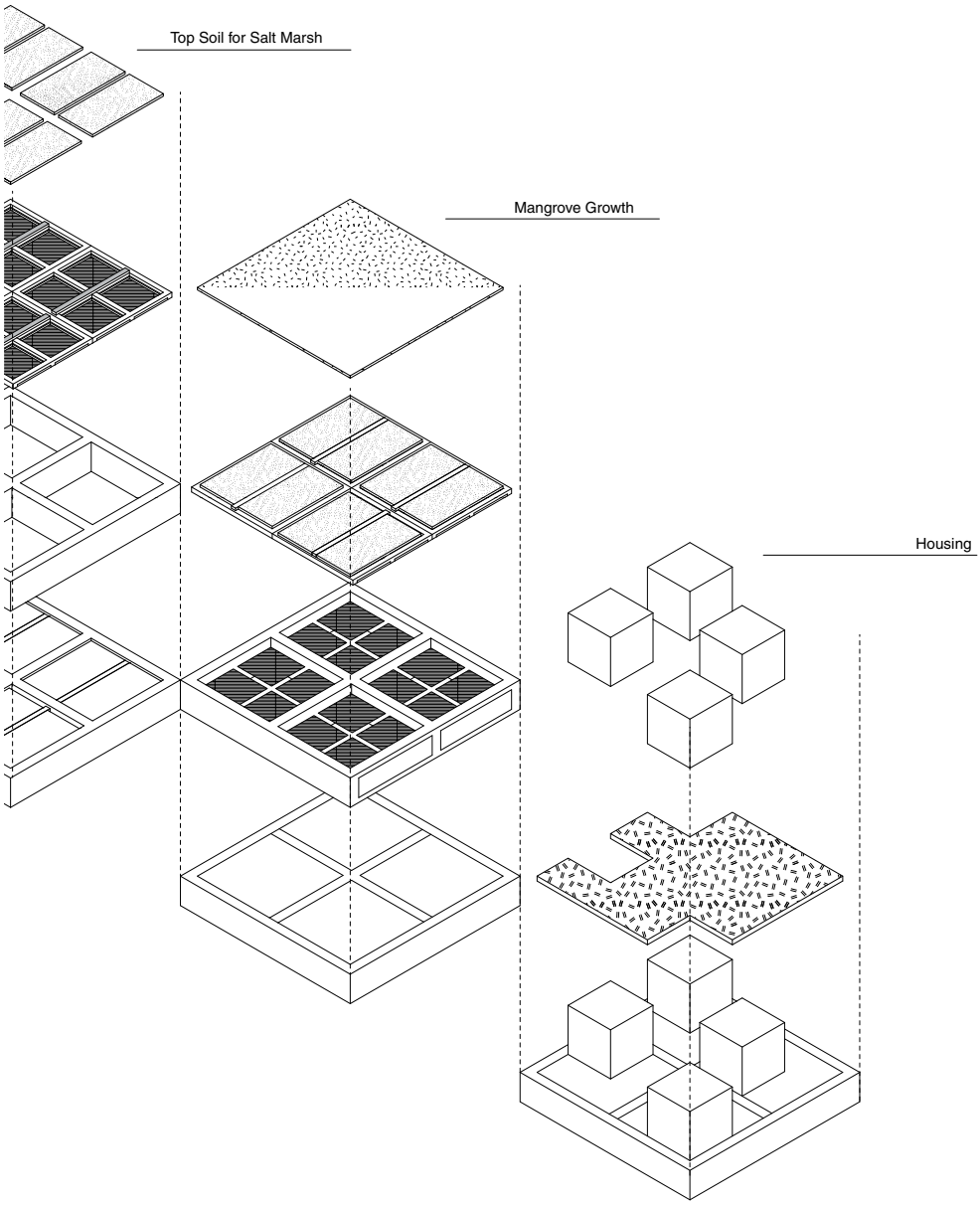

10m
20m
30m
m - 1.5m : 2.5m
5m - 2m : 3m
6m - 2.5m : 3.5m
3m - 80 days
15m - 150 days
25m - 250 days
1.0m
1.5m
2.0m
400 m3
600 m3
800 m3
Density
(80%)
Density
(100%)
8m + 1.0m
10m + 1.5m
15m + 2.0m

Mesh for Algae C

CONFIGURATION FOR 5M



Growth



LAND BOUND COMMUNITIES

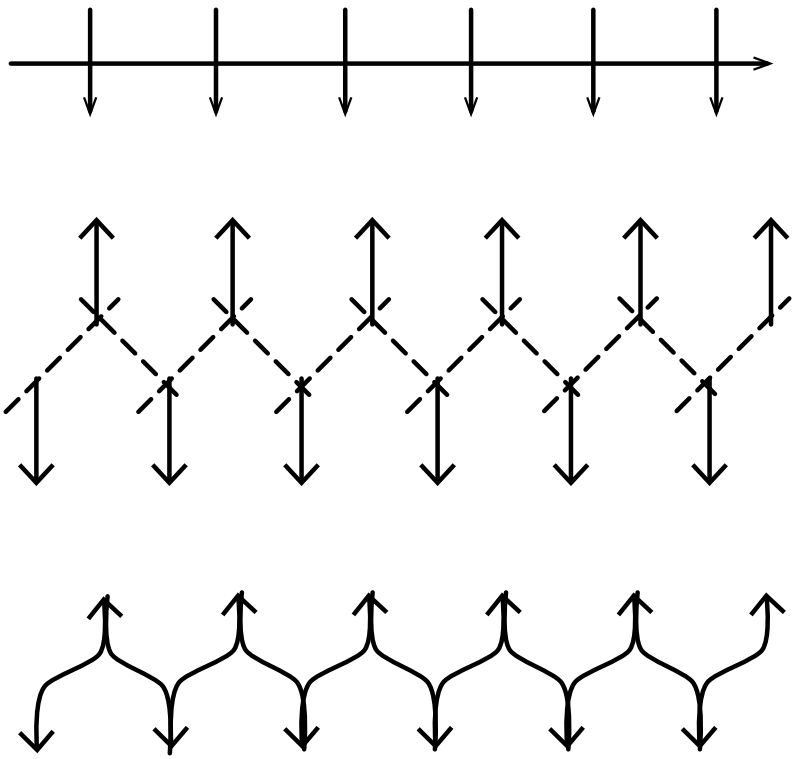
OCEAN BOUND COMMUNITIES

User Groups:

Transiting Migrants

Quarantined Immigrants

Circulation



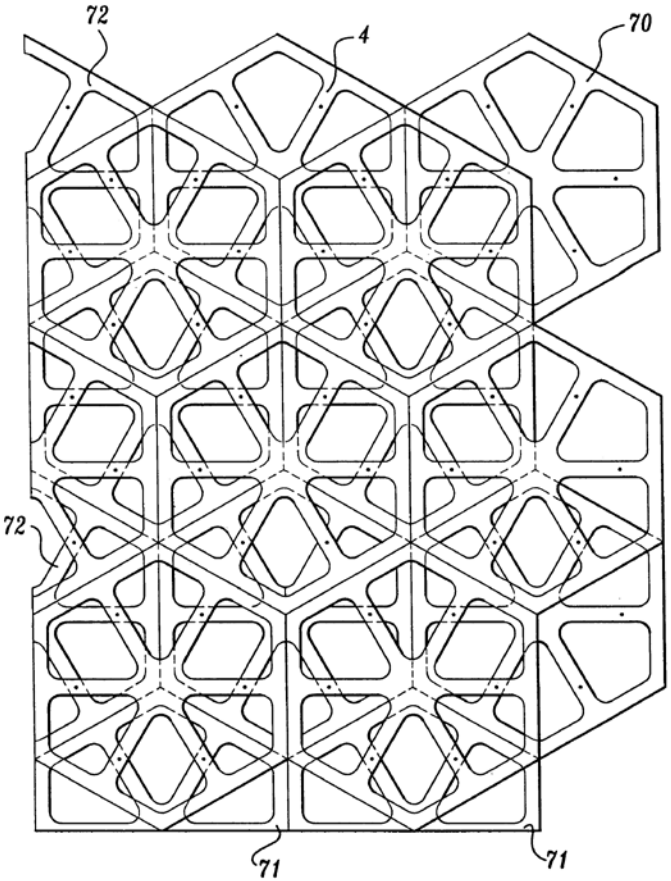
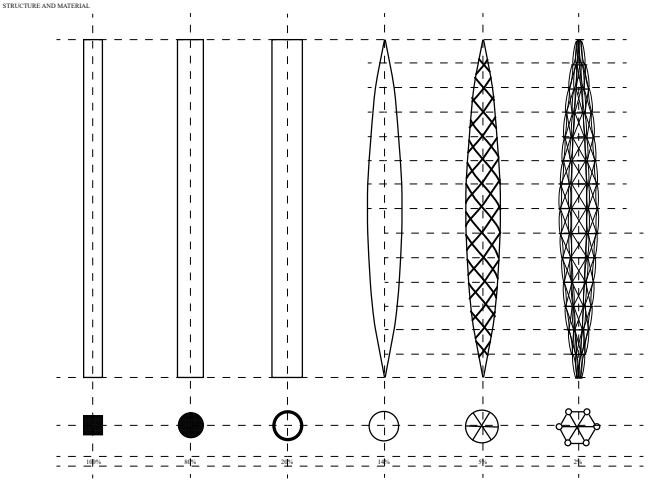
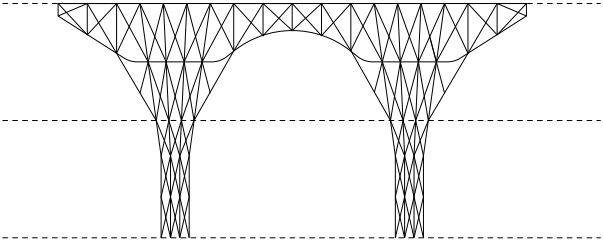


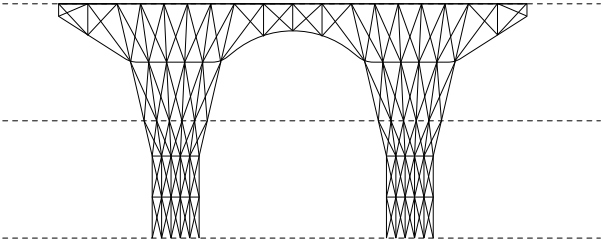
Fig. 42.

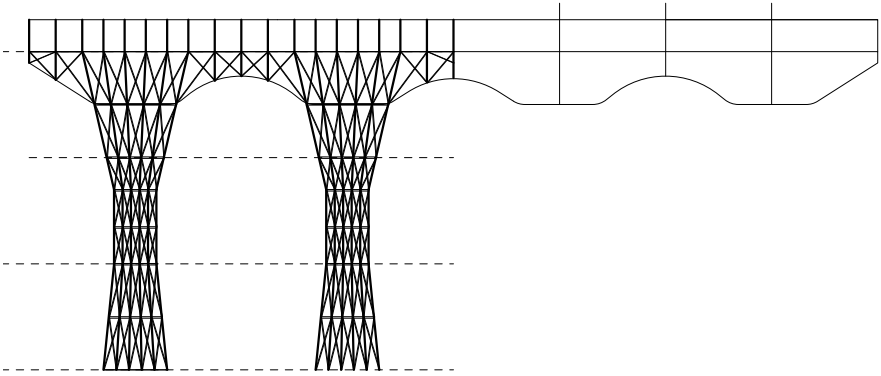
Fig. 43.

KELP FARM
AGRICULTURE
WILDLIFE NATURE PARK
BIOREMEDIATION
MARINE AND NATURE RESEARCH
OYSTER FARM
FISH FARM
KELP FARM
1:15,000


STRUCTURE AND MATERIAL

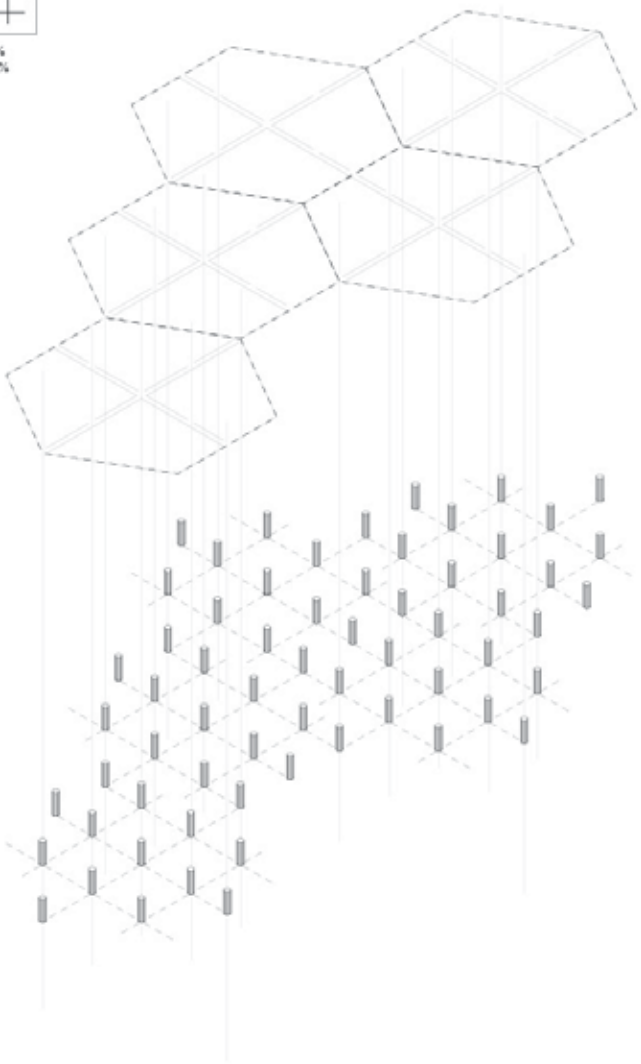




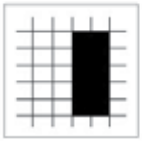


MARINE NATURE

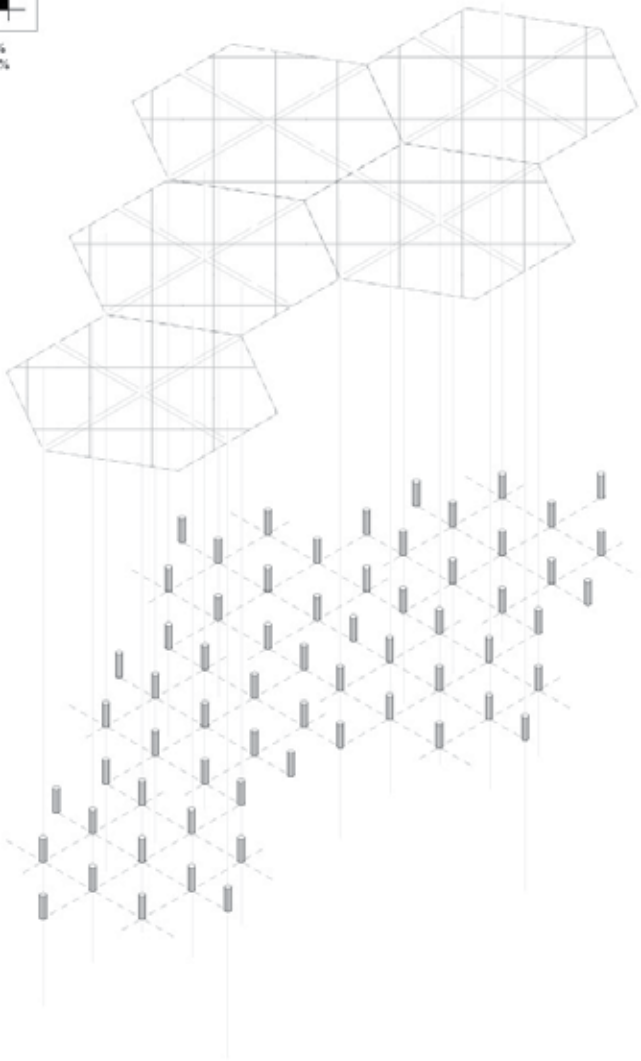
Land: 20 %
Water: 80 %



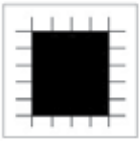
MARINE NATURE



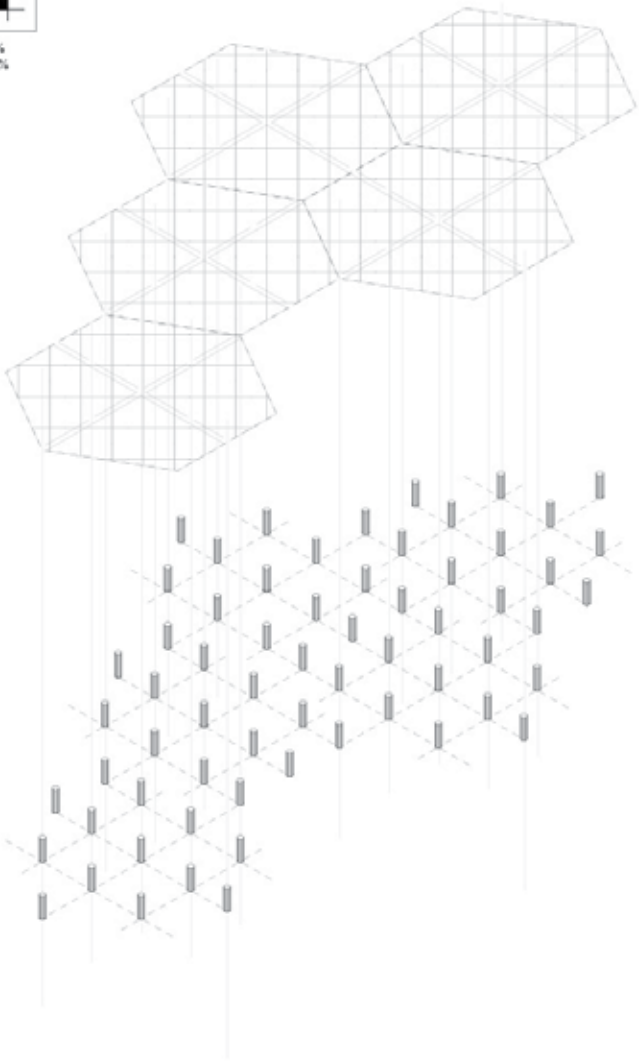
Land: 50 %
Water: 50 %



MARINE NATURE



Land: 80 %
Water: 20 %



Seakura Seaweed

Seaweed algae farming

Mangrove forest

Seaweed Farms

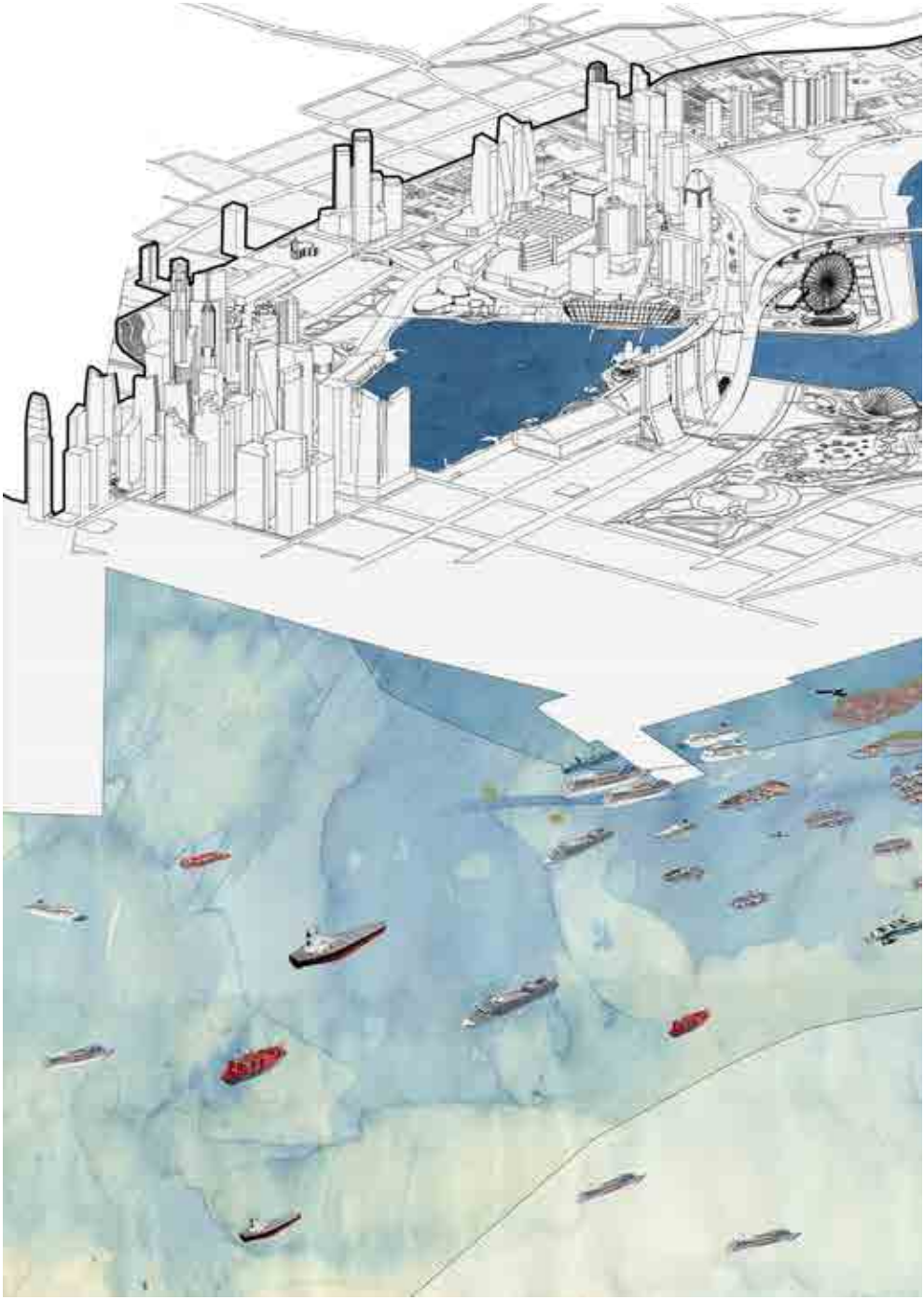
Fish farm

Kelp farm

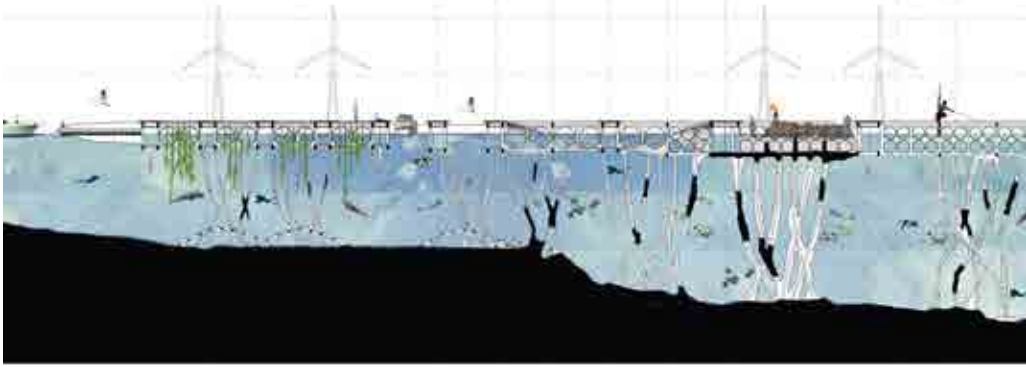
Saltwater marsh

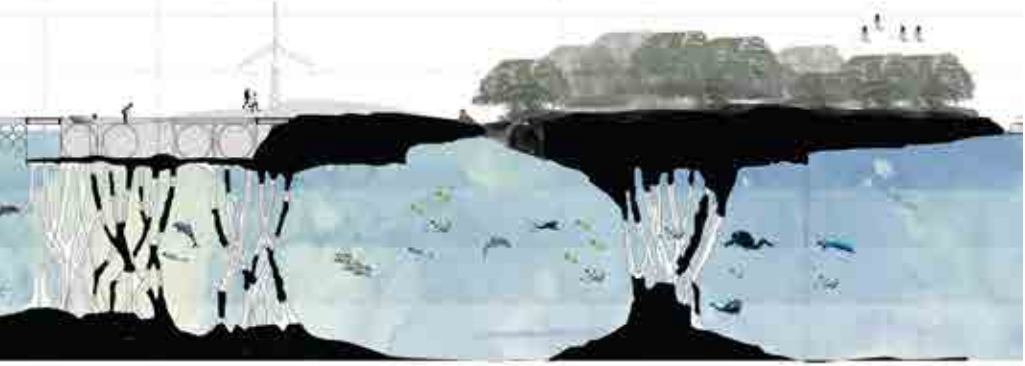
Saltwater marsh

Site Plan 1:7500



Growing Domestic Land





Section 1:100