Re-Imagining Coastal Architecture

Chase Gause
Tutor: Elin Daun
Examiner: David Andreen

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This project focuses on nature as an actor and activator in the design process. Specifically focusing on the sites provocative onto the needs of the built, time frame of whats possible along with needs of the city. Possibilities of how the nature inhibits these changes within the built architecture and utilizing these site specific moments within the process. The site chosen for this project is Copenhagen and creating an alternative proposal for a proposed city extension. Tackling the old ways of creating large masses and re-imagining coastal construction.

City of Copenhagen and Site Context

Personal HIstory

I was born in Florida from a family that was apart of the founding people of the small city of Tarpon Springs. Raised in a family that commercially fished, chartering captains along with being boat and dock builders. Utilizing my knowledge of the seas and coastal construction I pursued a project that delves into the value of coastal construction and changing the typology of how we can build our cities along and outward into the ocean.

Site Exploration

With my history of living and experiencing coast lines throughout the world. I wanted to focus on local coastal architecture of each region and how the cities deal with cities expansion into the water along with coastal constructions longevity.

I've been able to explore the coastlines of Florida through my life. The coastal construction around USA during road trips and site exploration of my bachelors degree. My later part of education I explored Italy, Switzerland, Netherlands and now currently living in Sweden along with working in Denmark.

The coastal architecture changes and adapts throughout the world. Dealing with city expansion, erosions, rising sea levels and weather.

Narrowing down to Copenhagen where I currently work and experience their expansion into the sea. Focusing in on a massive proposal of Lynettenholm and an alternative proposal.

Npr Florida

Charelston

Torre Di Fossa Italy

Lomma

Malmo

Copenhagen

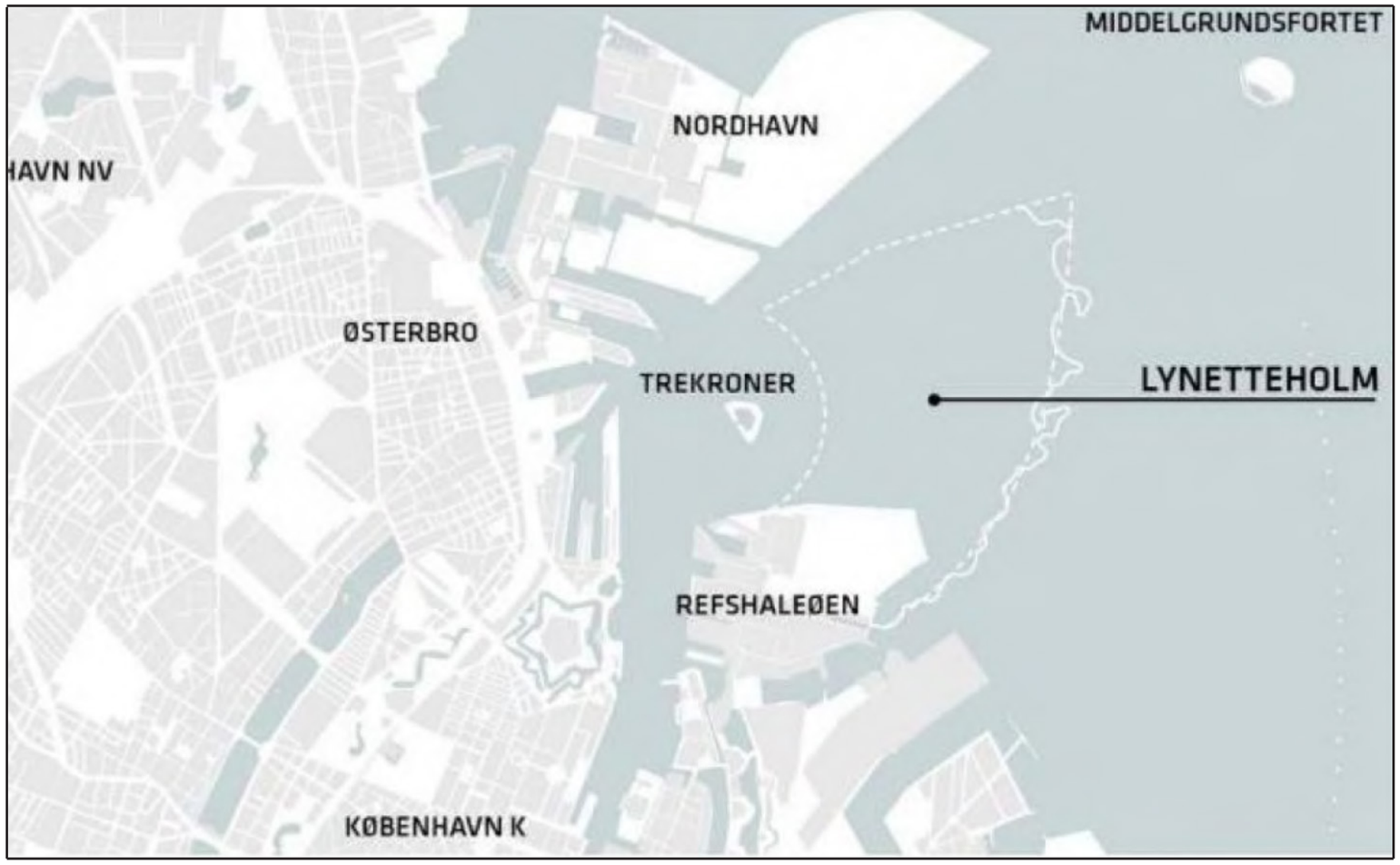
Site Research and Alternative Proposal

Lynetteholm doubles as a residential and business district housing 35,000 people. It will be Copenhagen's largest construction projects ever pursued.

However the potential ecological harm caused by this project through movement of sediments and its impact on water quality have pushed environmental groups to question this project.

With 350 daily lorry trips needed to move soil and other raw materials from Danish construction sites to the barrier island. Concerns over daily life and its effect on the matter for the next several decades.

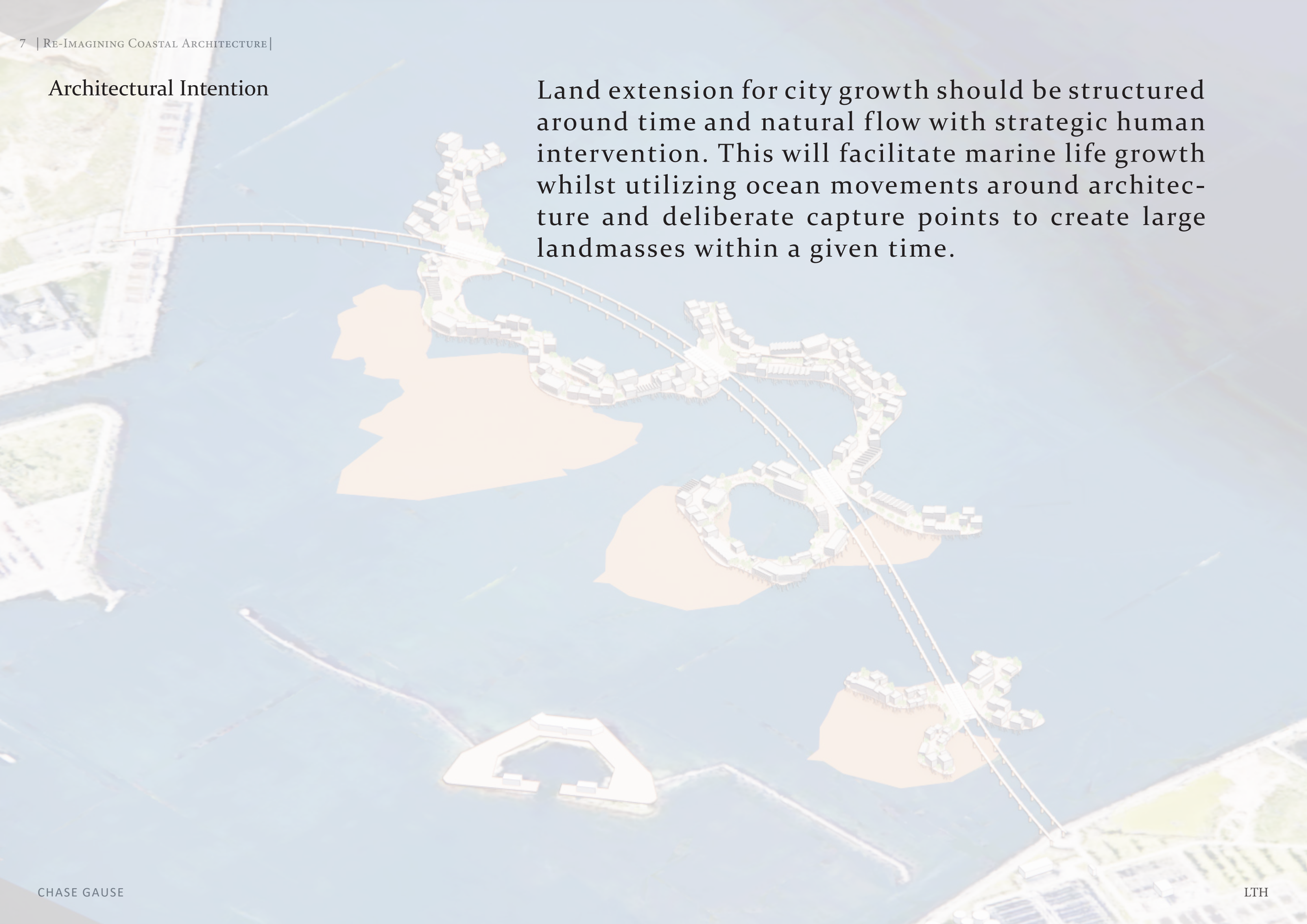
The scale of this project is massive as the foundations will be scheduled to be set in the year 2035 and full completion by 2070.



Lynetteholm Site

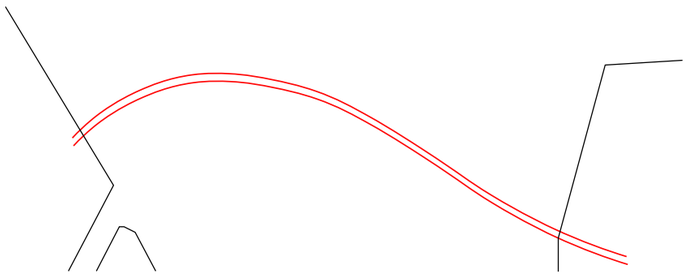
Architectural Intention

Land extension for city growth should be structured around time and natural flow with strategic human intervention. This will facilitate marine life growth whilst utilizing ocean movements around architecture and deliberate capture points to create large landmasses within a given time.

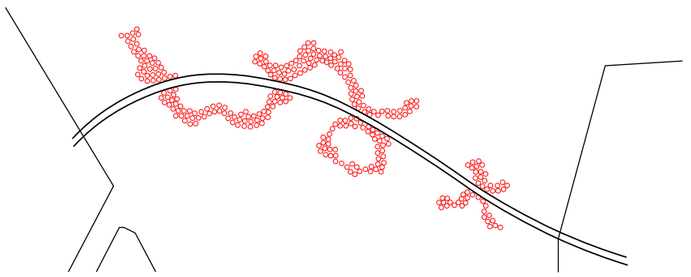


Stages of Project

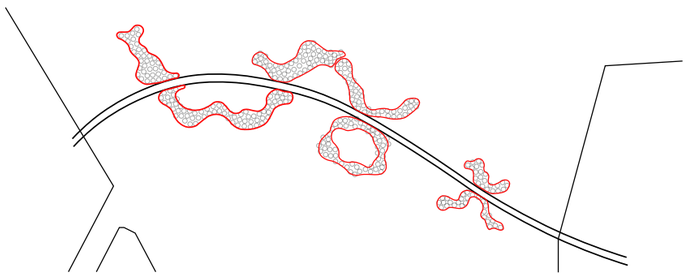
1-Site Connection



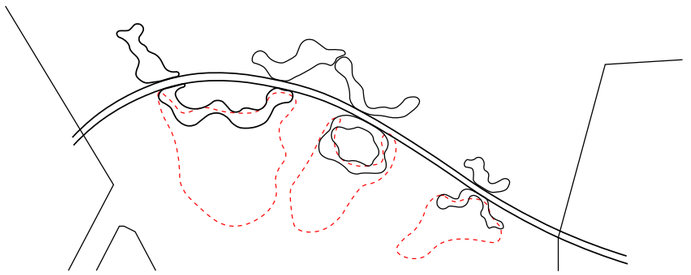
2-Built Environment



3- Intentional Land Growth

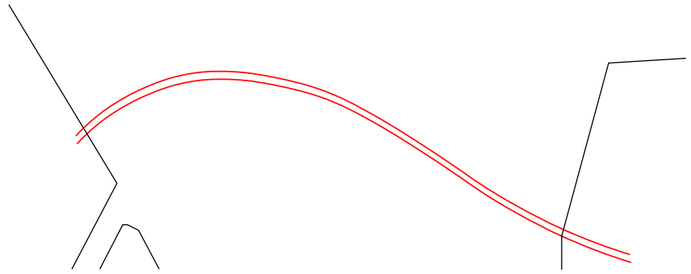


4- Development

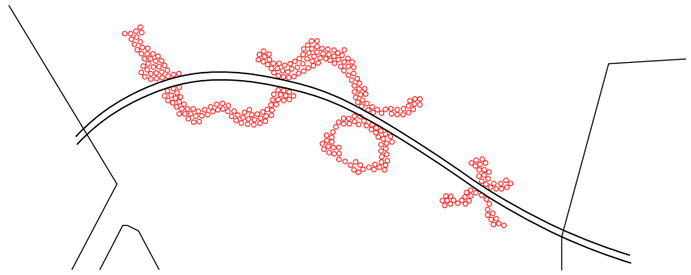


5- Architectural Response

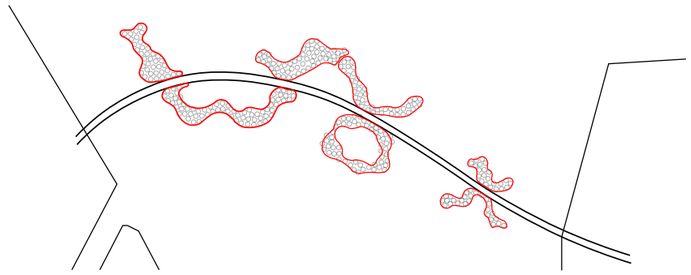
Stage 1: Represents site research and transportation ideas through the site. Connecting to the city and utilizing the language of the location to bring uniformity from the new to the old.



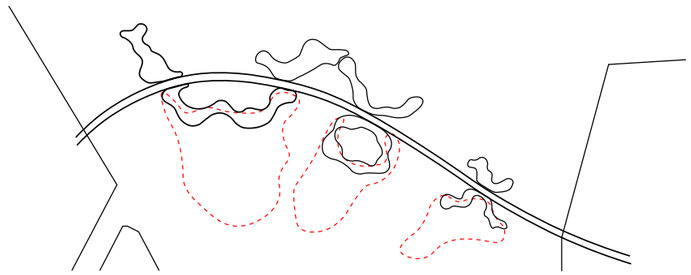
Stage 2: Represents the structures built typology and what this built structure is entailed to do with sedimentation.



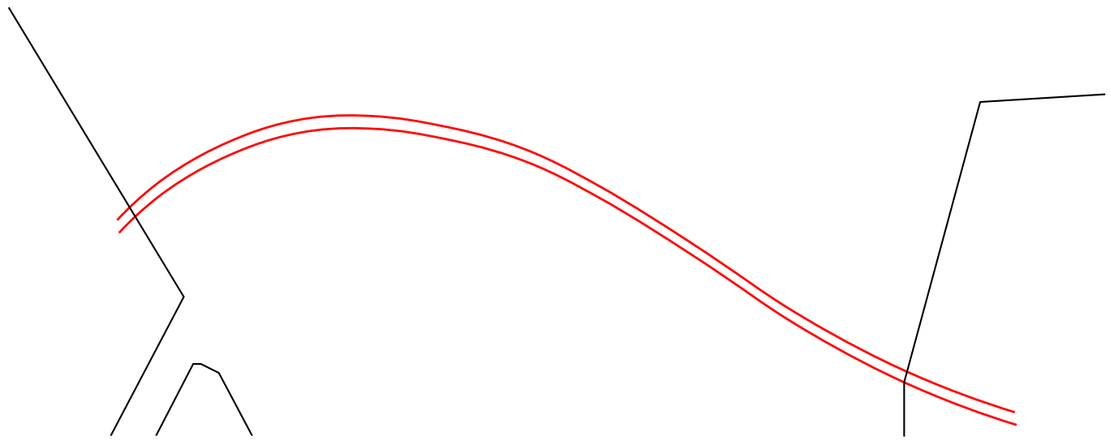
Stage 3: Represents my design choice in the form of the built structure and what these forms will accomplish throughout the timeframe of the project.



Stage 4: Represents the built spaces and what these look like during the build up of sediments. Looking into section, plan and renders of the project.



Stage 5: Represents the projected final stage of the project. 50+ years of sediment build up and the typology of the built environment on said land. Brining in architectural language of the city into the layout of extension of the city and the duality of built structured spaces to the built on the natural built landscape.



1-Site Connection

Copenhagen

The Site connection begins with looking into the surrounding city. History of Copenhagen and its' connection with the sea, continually expanding outwards to accommodate population growth. I'll be tackling this old methodology that is a proven tactic to build outward into the sea. This consist of blockading the ocean with metal plating, siphon out the water and filling the void with landfill. This alters the land below, sediments, currents and marine life. I'll be providing a counter proposal on land growth throughout this project.

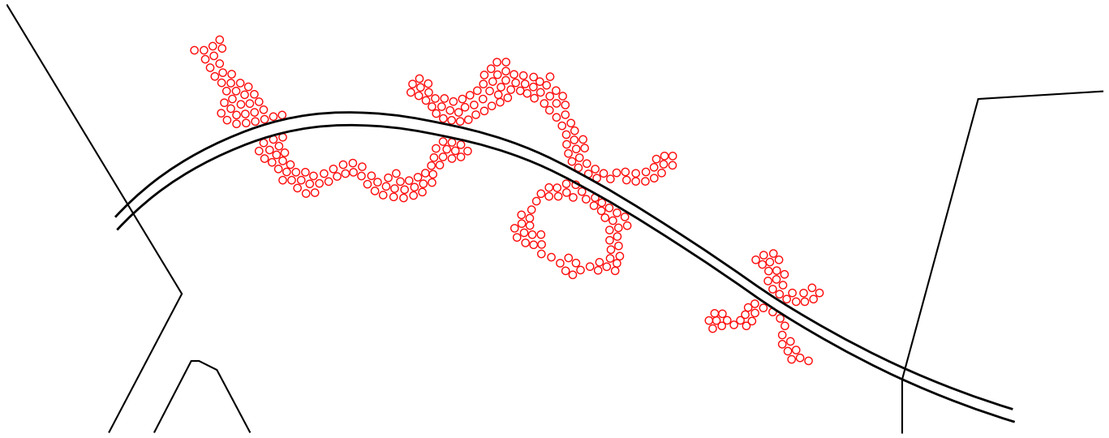
The next step is the movement throughout the city and into my specific site. Main transportation varies throughout Copenhagen, with metro lines, roads that accommodate both car, bus routes and bike path along with scenic walkways interwoven into the city grid.

Types of Transportation and City Movement

Transportation Circle

Connecting the Transportation Loop

When looking into city context I wanted to present a solution of connectivity between both sides of my site. Utilizing a common transportation throughout Copenhagen that can be lifted above the water and can run at set intervals for ease of access. Using a metro line that can start at stage one connecting the two sides of the city, whilst maintaining passageways for boats underneath. This closes the transportation loop and provides quicker transportation for locals and easing existing bus and bike paths that have to be taken at the moment. The metro line will have four stops along the route that will signify the center points of city extension. Each stop will connect the extensions of the built architecture and create reprieve between programmed structures.



2-Built Environment

Built Intention: Sediment Tranport and Deposition

Moving to the built environment I talked about nature as an activator in the design process, in turn I will look into a method of land growth for this site. Starting with research with sediment and the act of building it up. How these sediments can be directed towards a specific zone, what type of built structure can inhibit this action whilst utilizing forms of nature into this design.

What is sediment?

Sediment refers to a collection of organic and inorganic materials, that can be carried away mainly by water and wind. While the term is often used to indicate soil-based, mineral matter (e.g. clay, silt and sand), decomposing organic substances and inorganic biogenic material are also considered sediment.[1] The material I'll be focusing on the most is mineral sediment that comes from erosion and weathering.

In an aquatic environment, sediment can either be suspended (floating in the water column) or bedded (settled on the bottom of a body of water). When both floating and settled particles are monitored, they are referred to as SABS: Suspended And Bedded Sediments.[1]

Bed load refers to the portion of sediment that rolls, slides or bounces along the bottom of a waterway. When the force of the water flow is strong enough to overcome the weight and cohesion of the sediment this forces sediments to roll and to be known as bed load. Bed load transport can occur during low flows (smaller particles) or at high flows (for larger particles). Approximately 5-20% of total sediment transport is bed load.[1]

While there is often overlap, the suspended load and suspended sediment are not the same thing. Suspended sediment are any particles found in the water column, whether the water is flowing or not. The suspended load, on the other hand, is the amount of sediment carried downstream within the water column by the water flow. Suspended loads require moving water, as the water flow creates small upward currents (turbulence) that keep the particles above the bed. The size of the particles that can be carried as suspended load is dependent on the flow rate. Larger particles are more likely to fall through the upward currents to the bottom, unless the flow rate increases, increasing the turbulence at the streambed. In addition, suspended sediment will not necessarily remain suspended if the flow rate slows.)[1]

The wash load is comprised of the finest suspended sediment. The wash load is differentiated from the suspended load because it will not settle to the bottom of a waterway, as such these aren't accounted for when building up landmass.

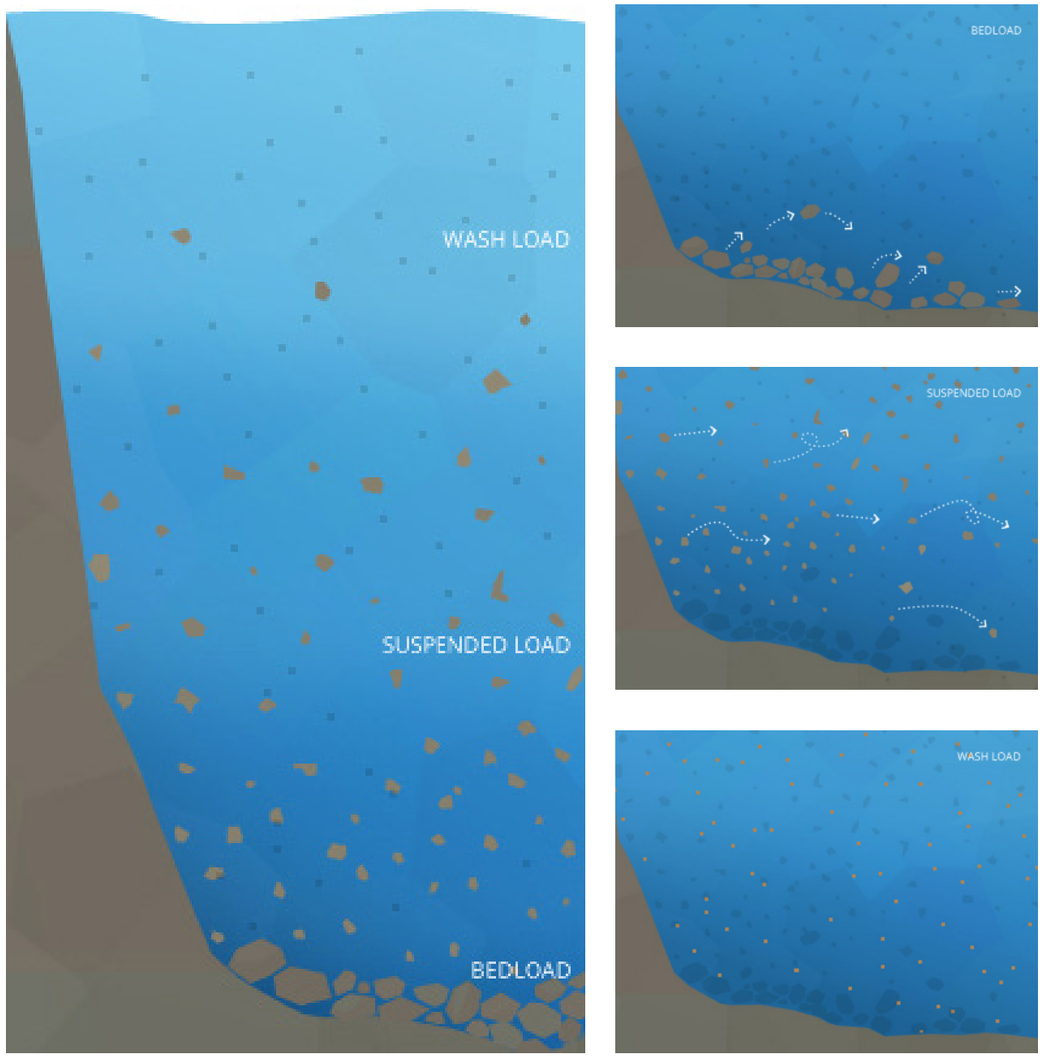


Figure (D)

Sedimentary Distribution

These graphs represents water movement within a target area. These movements are universal throughout the world and can be seen at the building site. Wave, tidal and distributed movements along the coast line. These movements can be used to determine sedimentary build up zones.

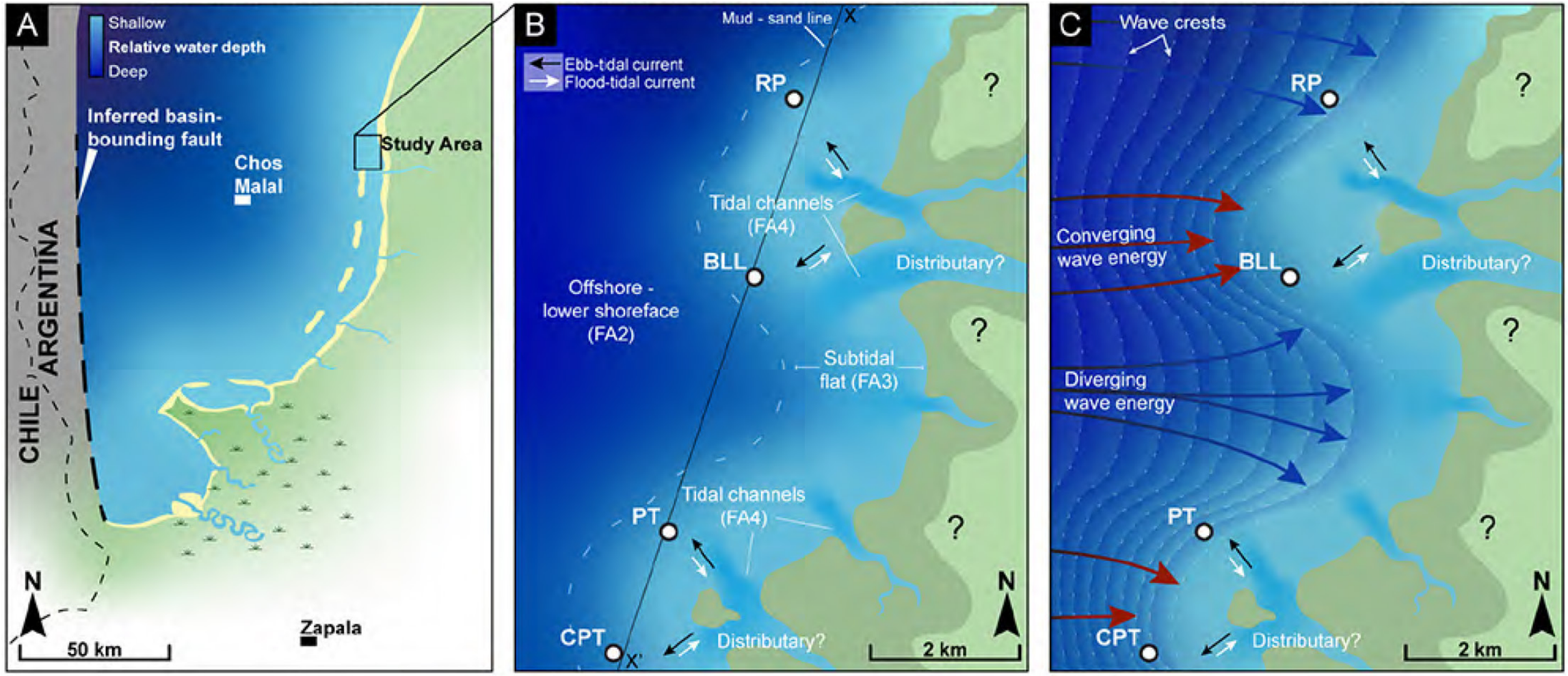


Figure (A)

Types of Sedimentation build up and Supporting Nature

These graphs represents deposit build up and the nature of which it is influenced by. These deposits can be captured and built up utilizing human intervention such as clay deposits.

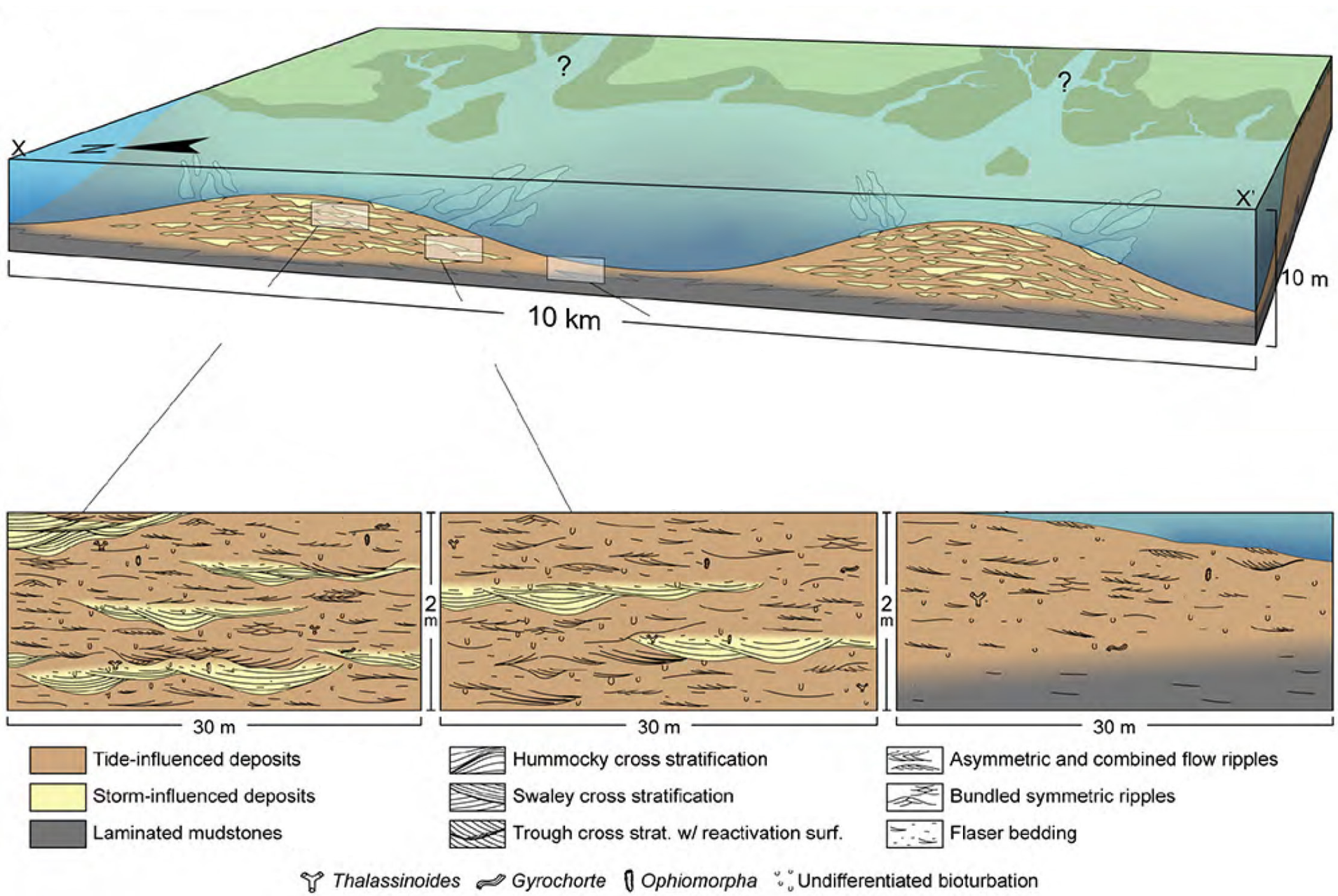


Figure (B)

Sections of Types of Sediments

These sections represents the typology and differences of structure between different types of deposits that lay on the ocean floor.

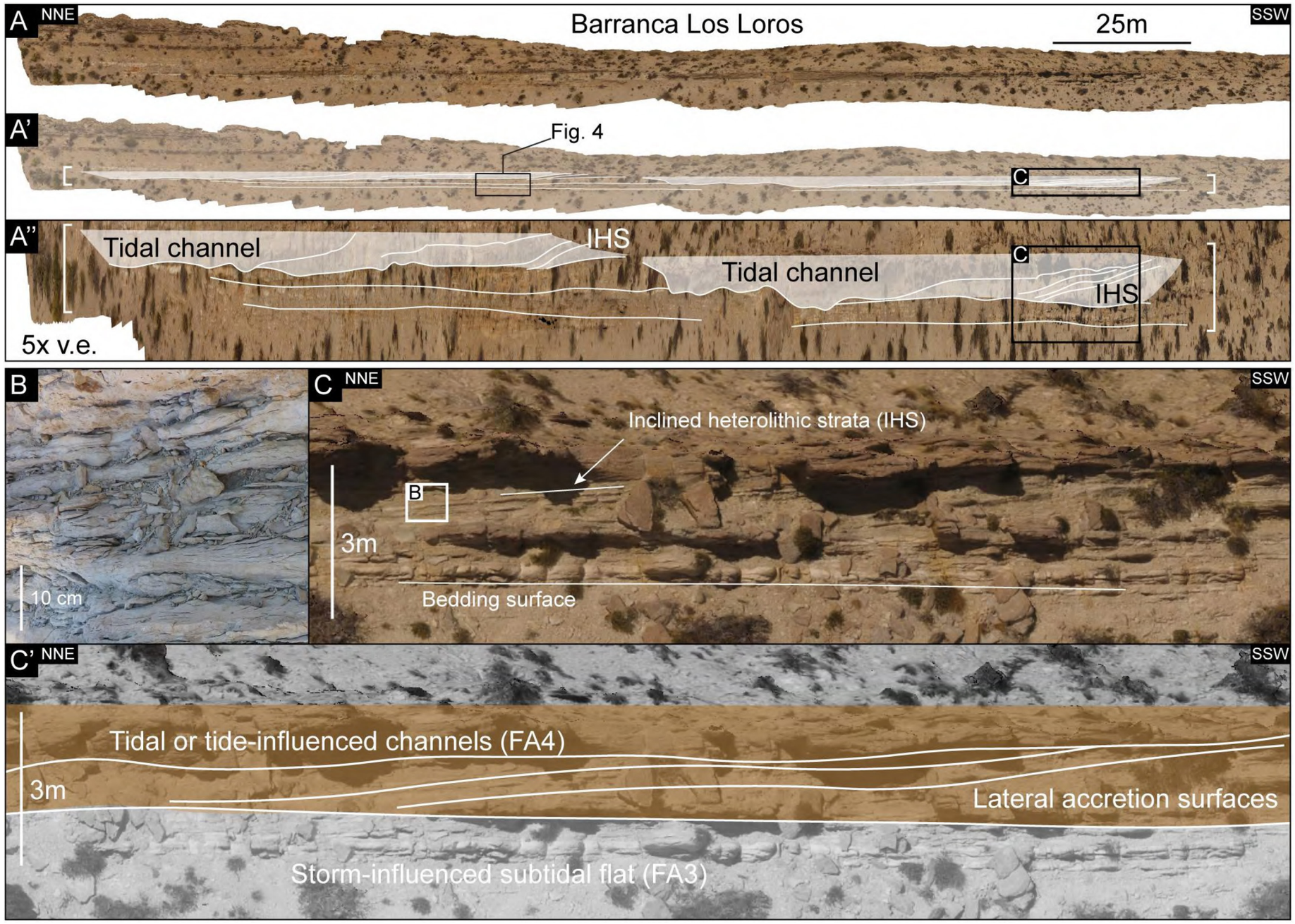
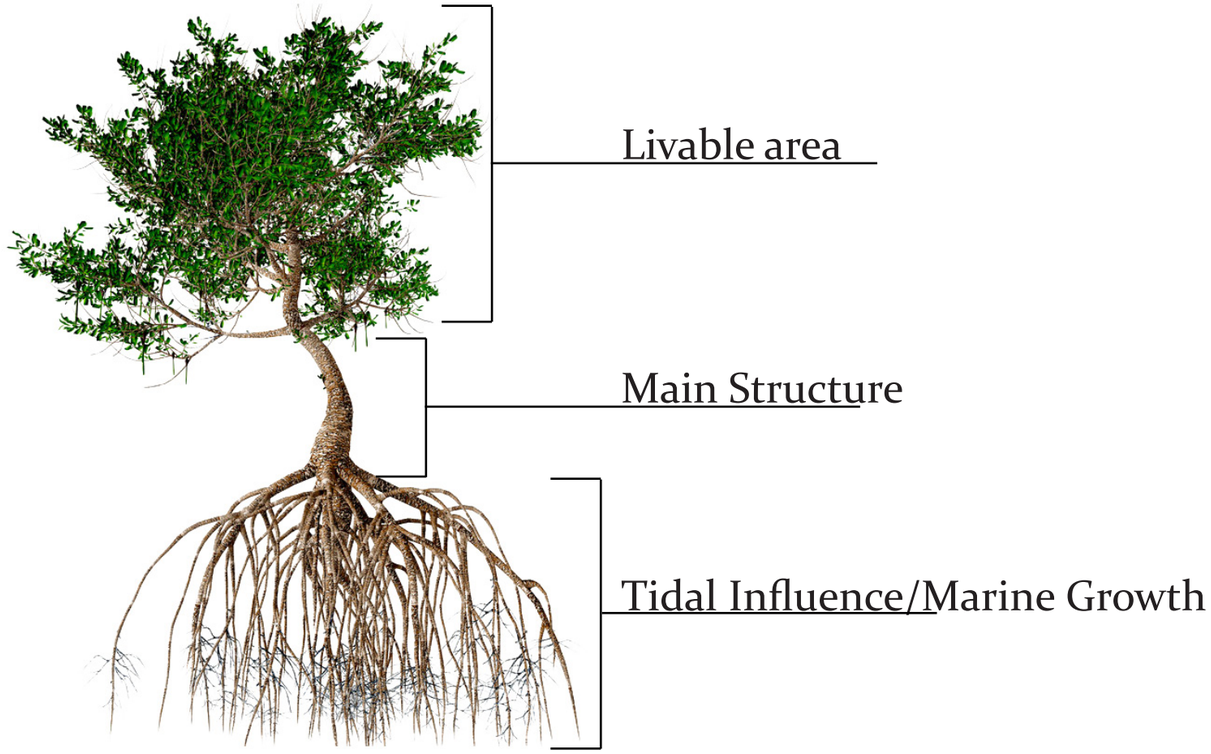


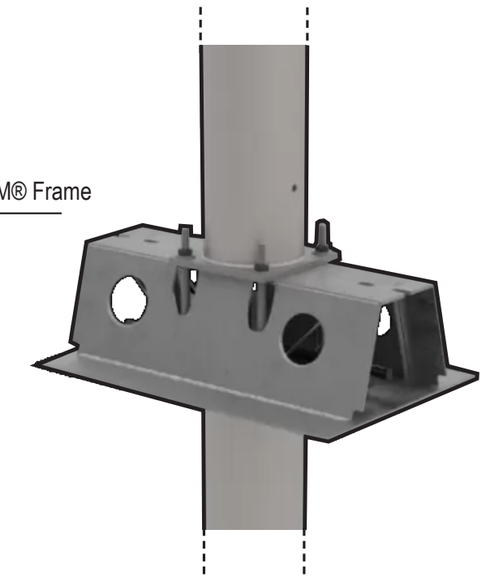
Figure (C)

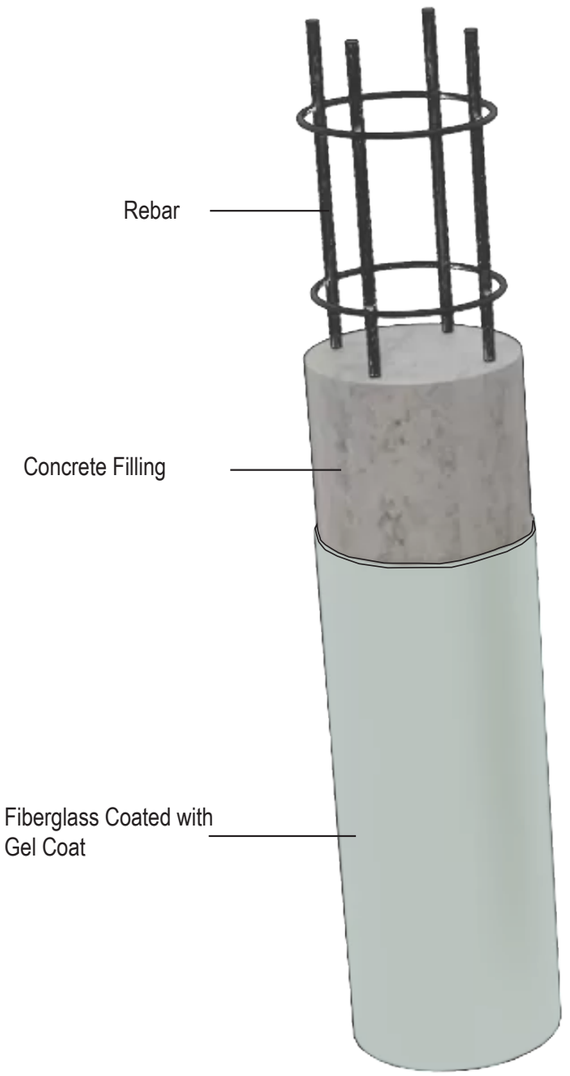
Structure Ideology

With the movement of sedimentations and the ocean life to be accounted for I wanted a system that could be suited for each whilst providing a structure that can be built upon. I looked into the mangrove, which is sprawled all over the coast of Florida. What peaked my interest the most was their root system and how dense they are that it slows the current, breaks ocean waves, and felicitates ocean life. An organic system that is multifaceted which could translate well into an architectural system that'll utilize intentional intervention.

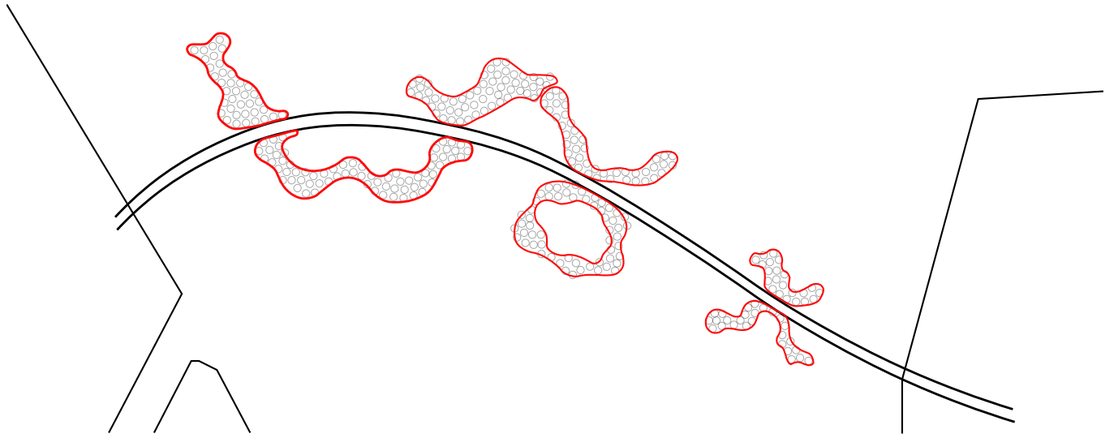


Utilizing columns that interweave with one another to represent mangroves along with structural stability. These columns can be rebuilt and extended to further platforms above to account for rising sea levels and possible erosion throughout the years. Utilizing DELTABEAMS to be placed along the columns to connect together forming a stable platform that can be built upon. The density of these columns are for the sediments within the tide to be slowed down whilst providing an environment for marine life.



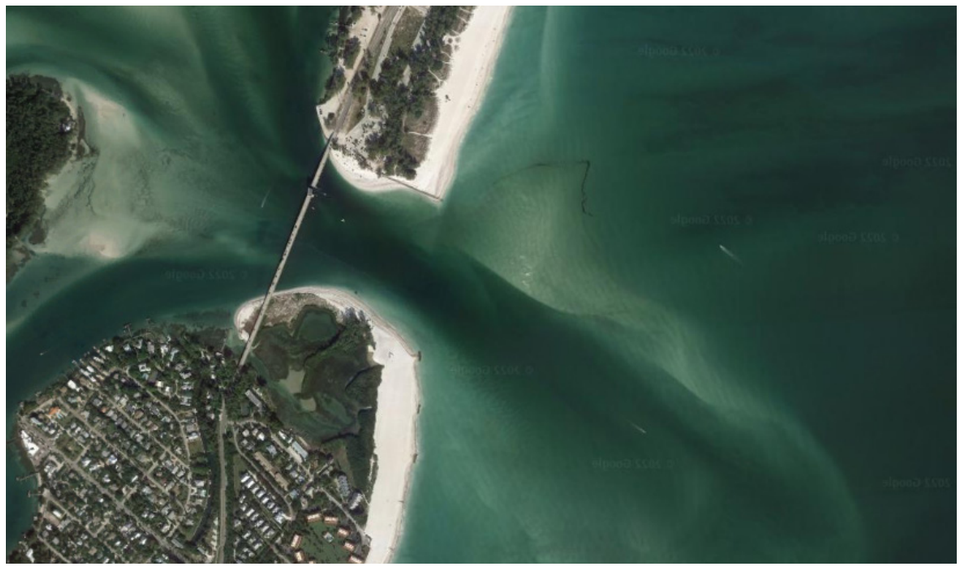


Piller Diameter Sizes	300mm	240mm	170mm	100mm
Material	Reinforced Concrete Filled	Reinforced Concrete Filled	Reinforced Concrete Filled	Fiber Glass Rod

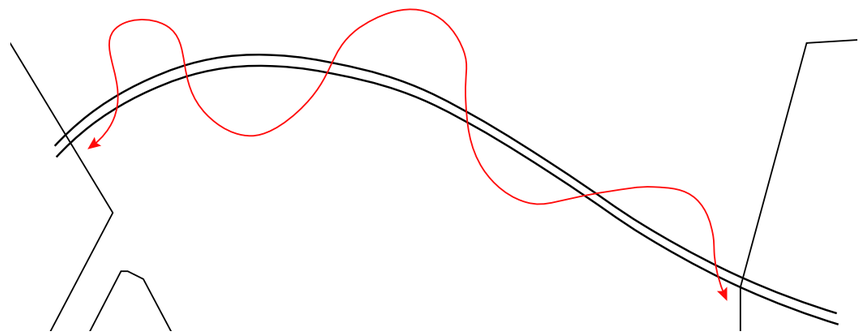


3- Intentional Land Growth

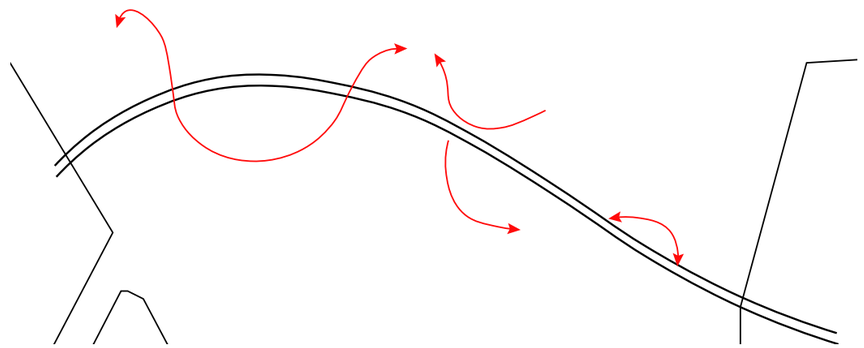
Architectural Language



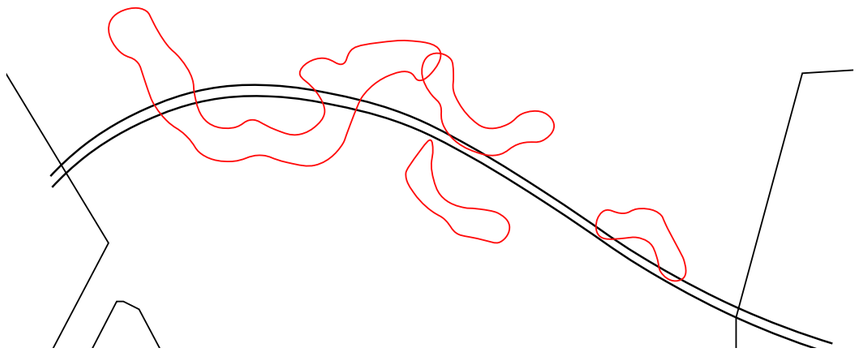
Step 1 - Natural Flowing Edges



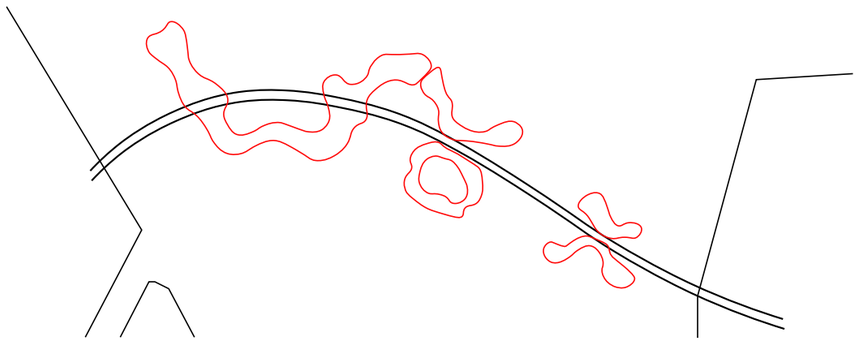
Step 2 - Pass ways for Water Flow

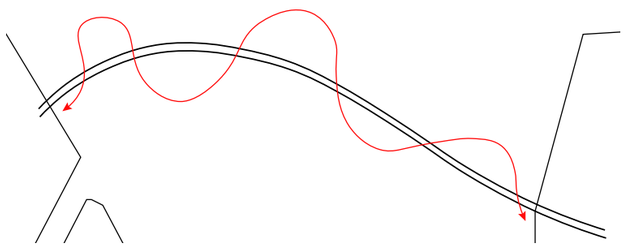


Step 3 - Formation of Shape



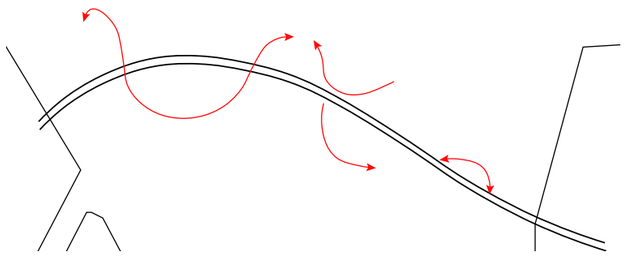
Step 4 - Refining Typology for Sediment Capture Points





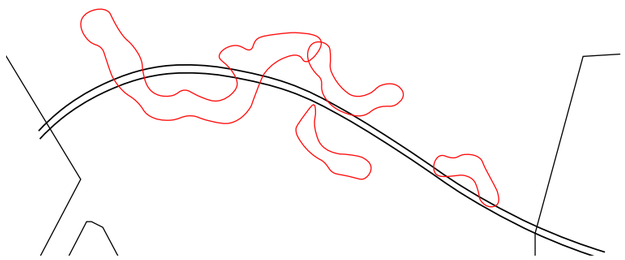
Step 1 - Natural Flowing Edges

I used the transportation route to begin my design process for the structures movement through the site. Looking into natural shapes that move sediments and created from said sediment as well. This formed a flowing line through the transportation line.



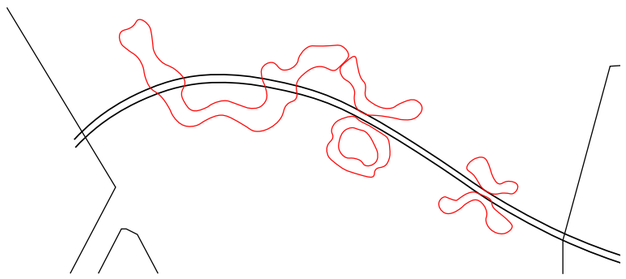
Step 2 - Pass ways for Water Flow

Next step required me to break these flowing edges to create openings between zones to allow greater water flow. This will then in turn start to create channels in between and carry the sediments from the bottom of the channels up and around the structure.



Step 3 - Formation of Shape

Now that i have the flow pattern of the structure, the next step is to create the initial spaces that follow these typologies. I began the formation of these shapes from islands and typologies of land masses that move sediments.



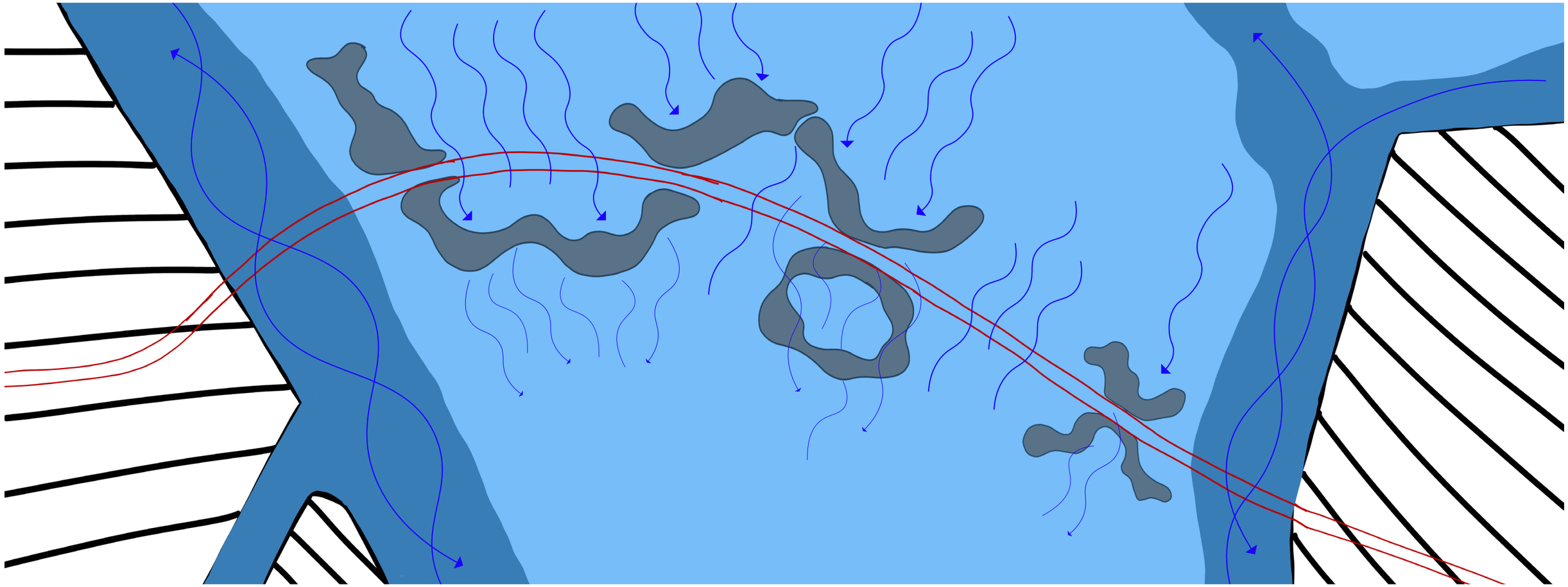
Step 4 - Refining Typology for Sediment Capture Points

When refining the shapes the idea behind these decisions came with sediment capture points behind along with how each space reflects on the other. Creating multiple different zones that support the others all within one site. The massing also allow more structure underneath to help move and slow down sedimentation.

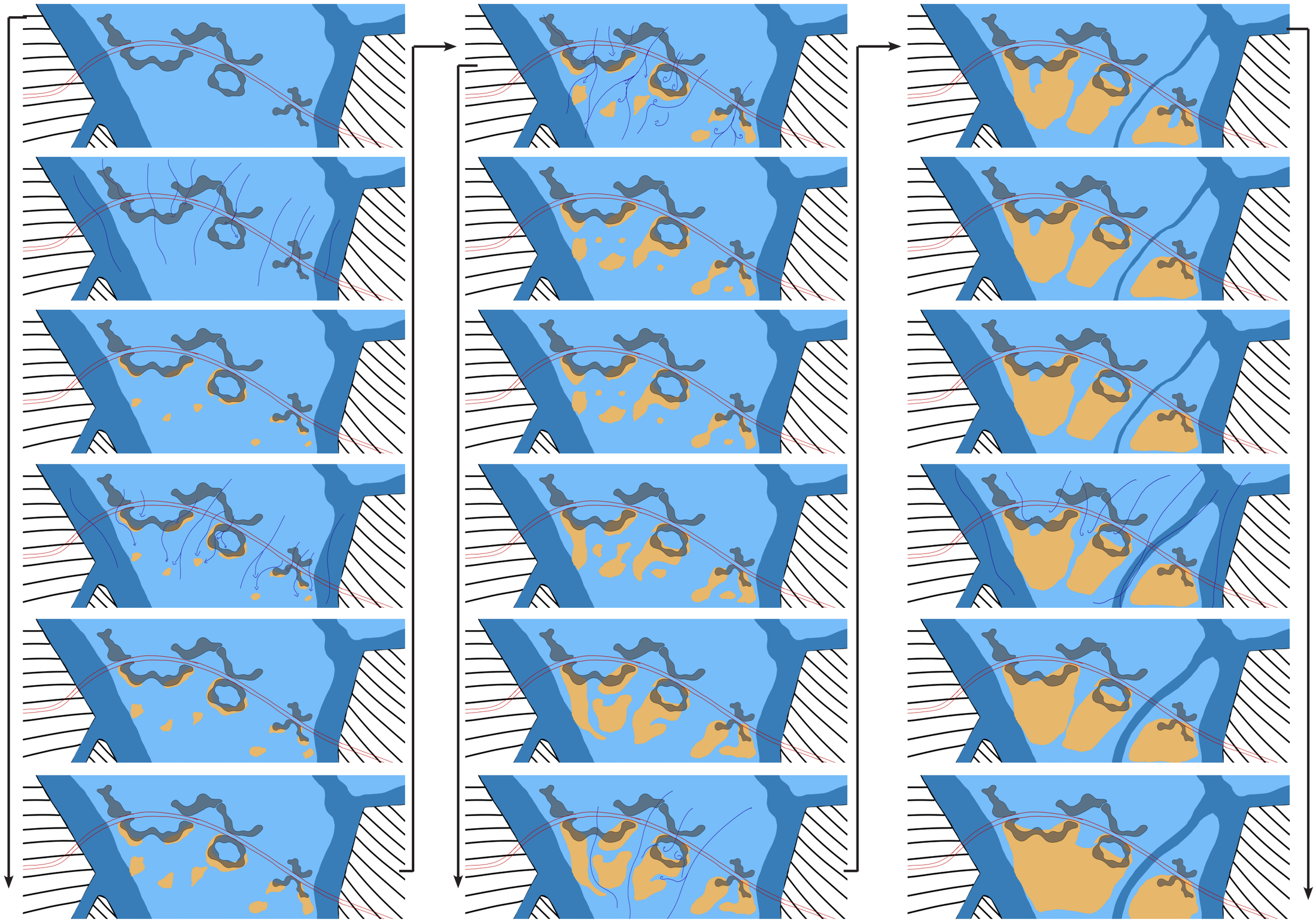
Sediment Movement

The next diagram showcases the tidal and current movements through the site and how the main structure will utilize these pathways. Utilizing these pathways to dictate where the land mass will grow and subsequent landfill can be utilize to help the sediments build up within a given time frame to keep the project on the time frame needed for the city.

Current and Tidal Path



Sediment Build Up

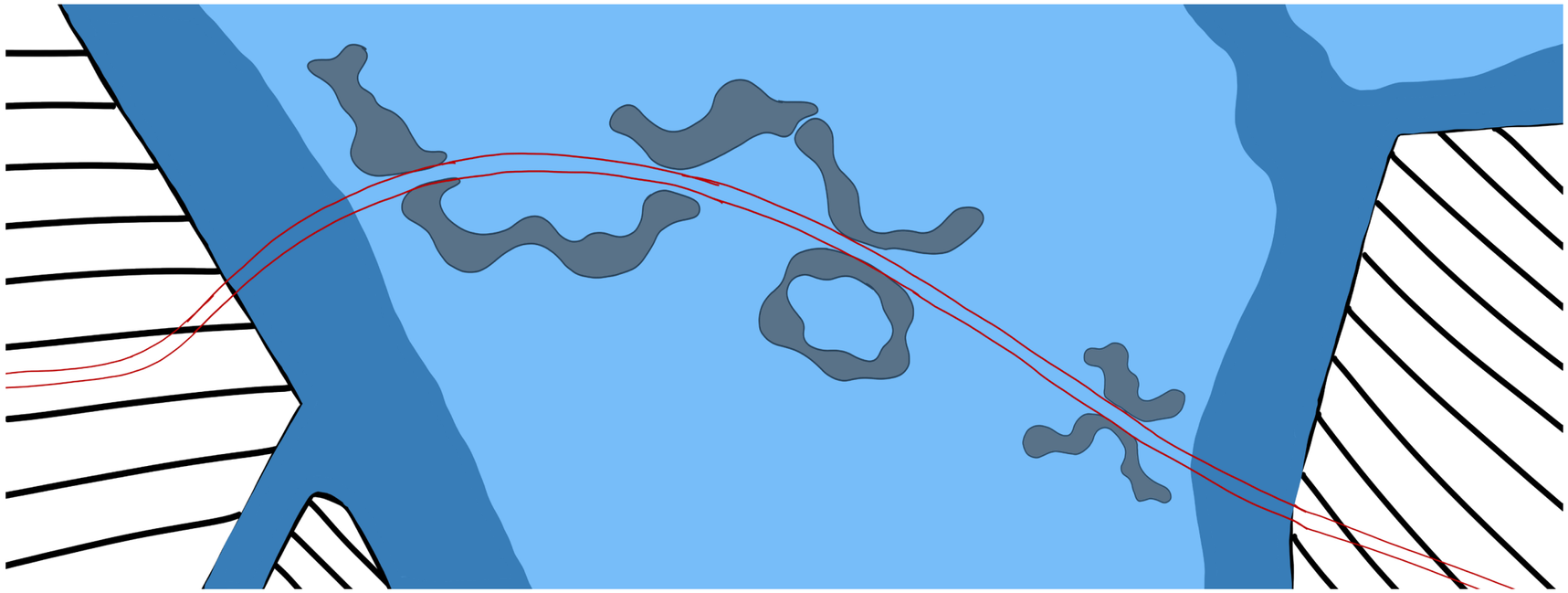


The diagrams here showcase a time line of buildup of sediments gathered behind the structure. During the first couple years studies will show where land is forming, from there landfill can be placed to help facilitate this land growth at a quicker rate.

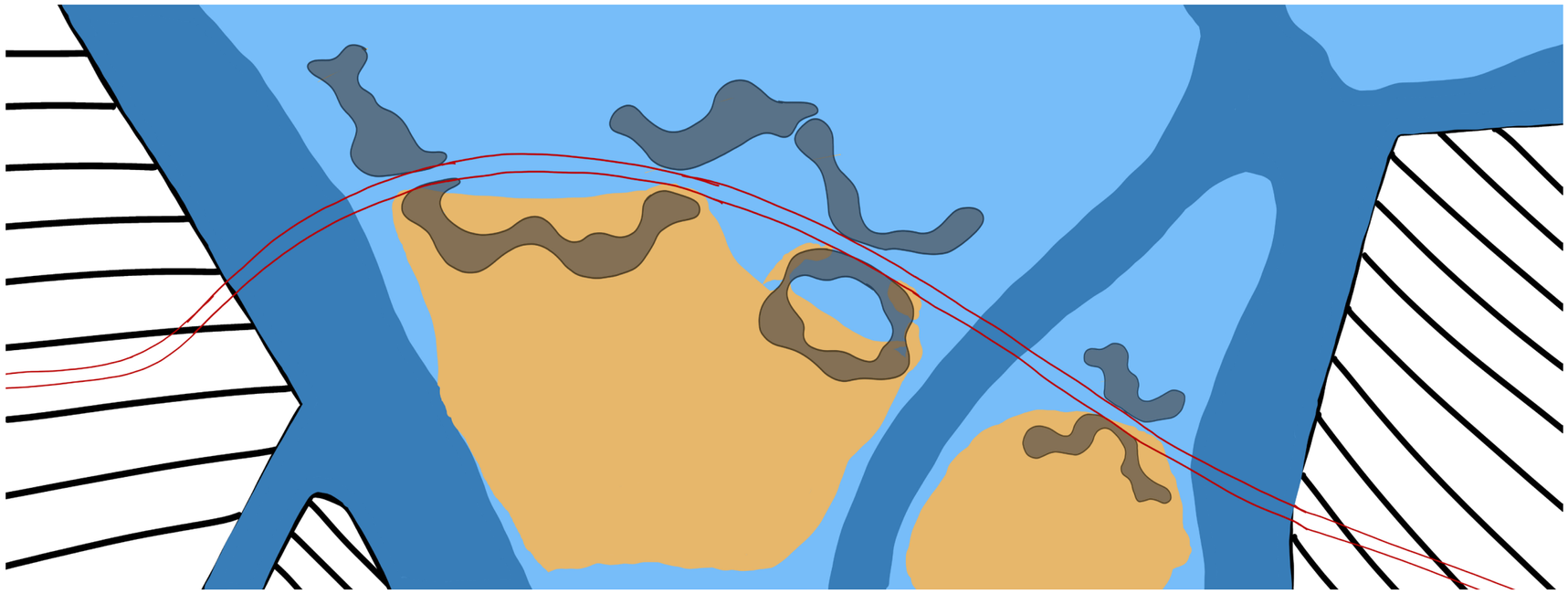
The spacing between structures will form channels in between forcing the sediments from this channel path up and around each structure at intentional capture points.

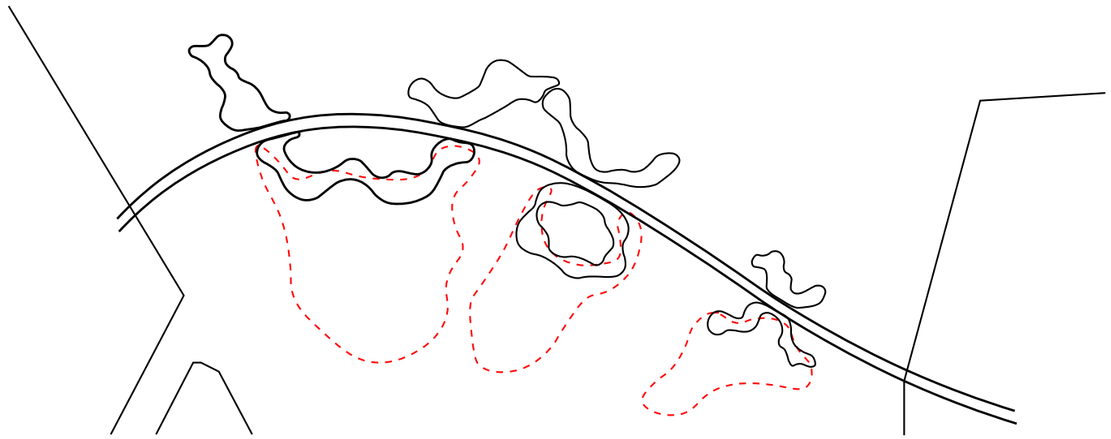
This time frame is set for 50-70 years from after the initial construction is completed. The dark blue lines show how the tidal paths will change with time and this dictates the sediment growth.

Stage 1 Year 0 103.000 M^2



Stage 3 Year 50-70 245.000 expansion M^2





4- Development

Site Plan

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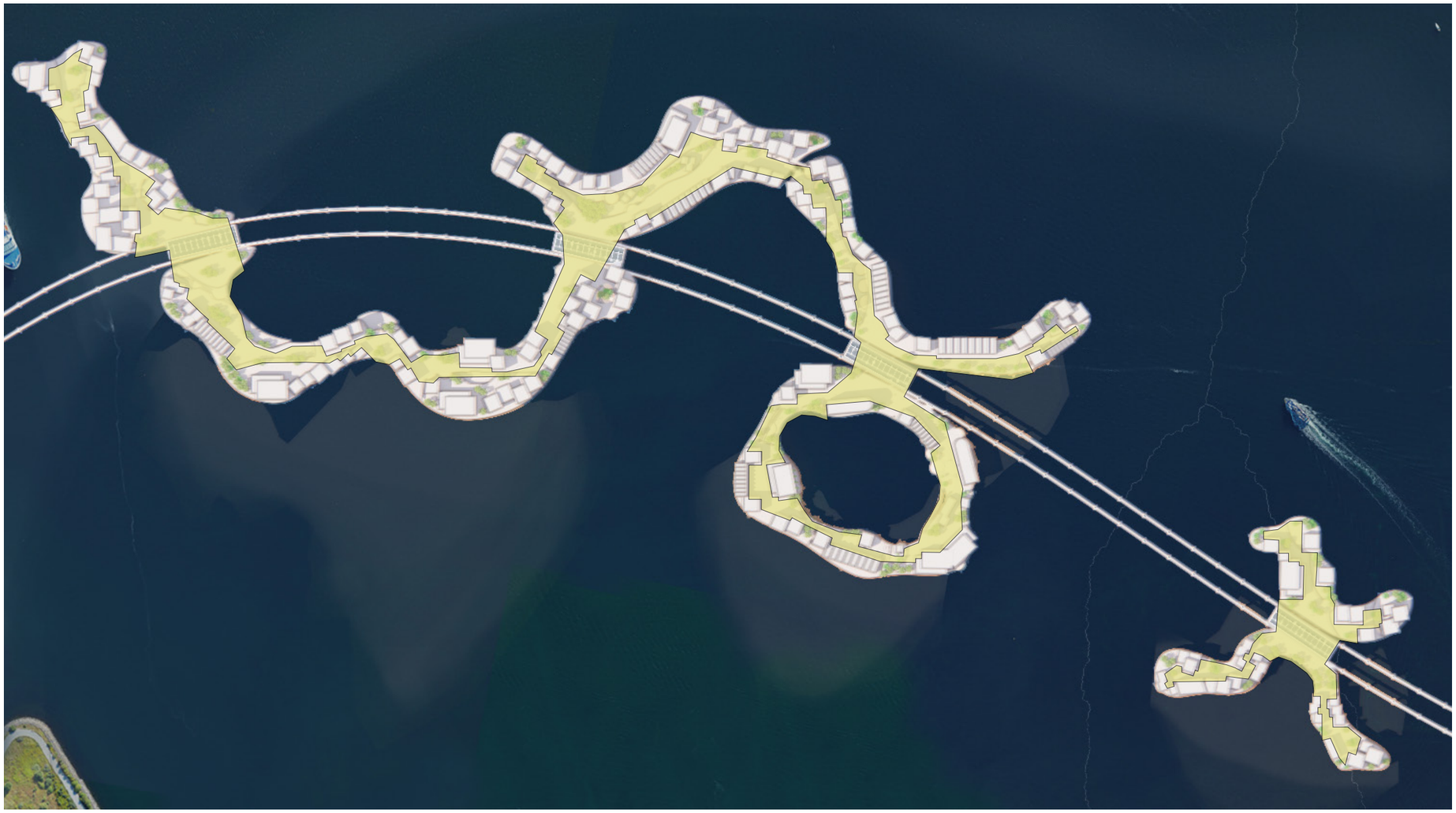
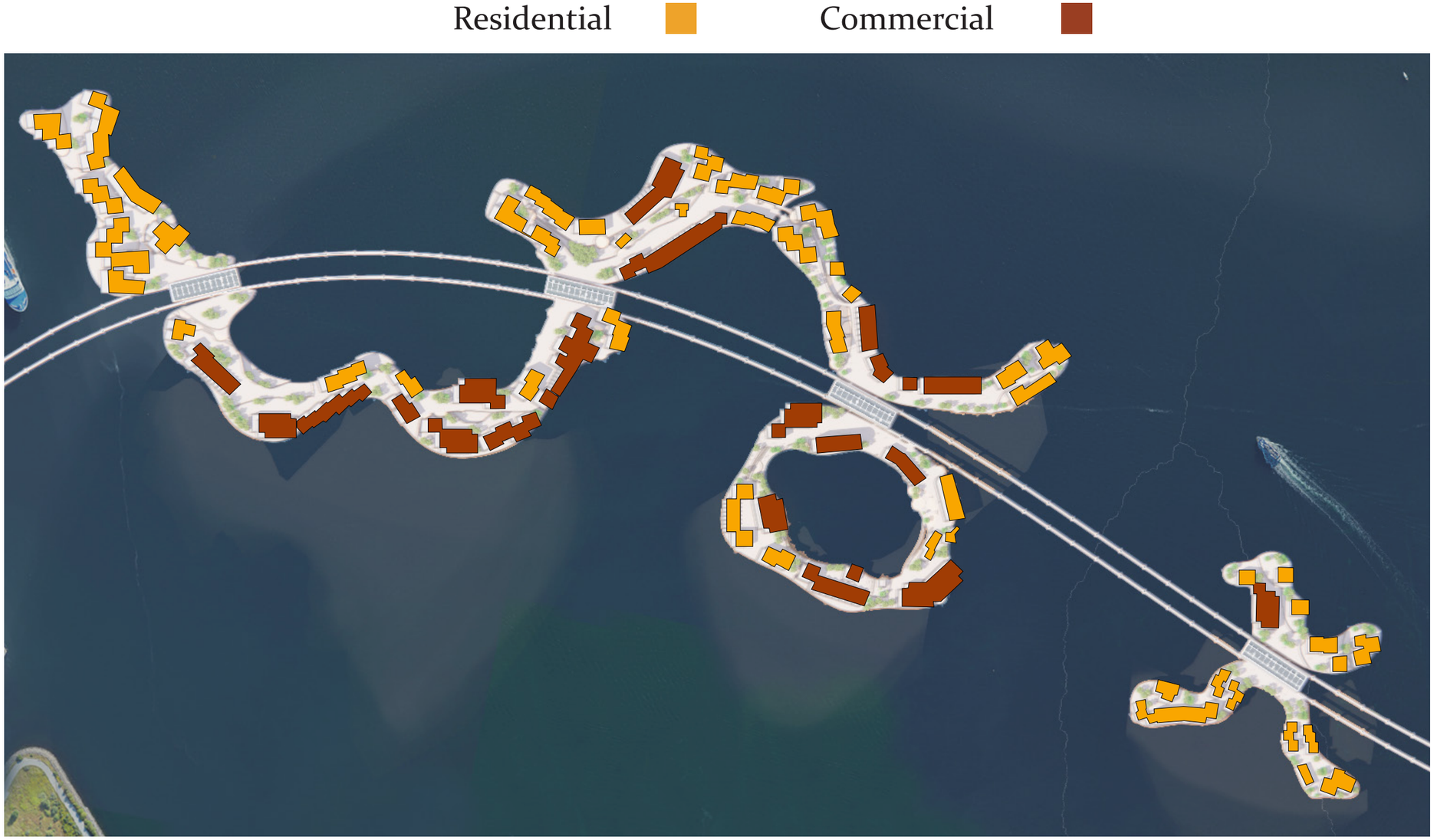
Path Connection

The pathways are created by the space in between buildings that along the edges of the platforms. This creates protect spaces from the wind and ocean spray that can arise. The pathways lead to personal spaces, behind buildings, down near the water, and into large gathering areas.



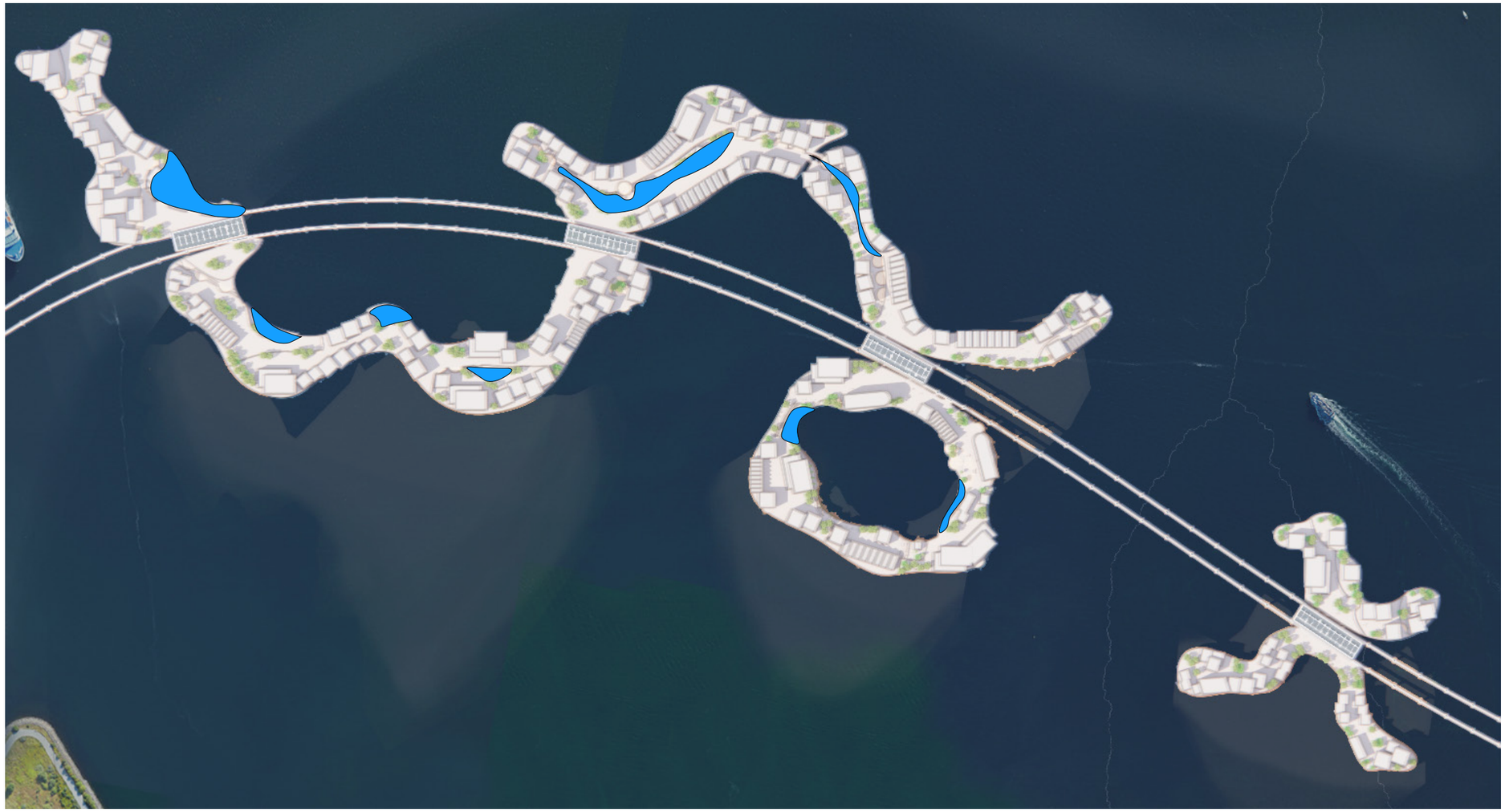
Functions

The structure will be able to facilitate both residential and commercial buildings. The layout allows for residential to be out towards the sea for a better sight line whilst the commercial will be set back towards the city, placed around larger communal areas.



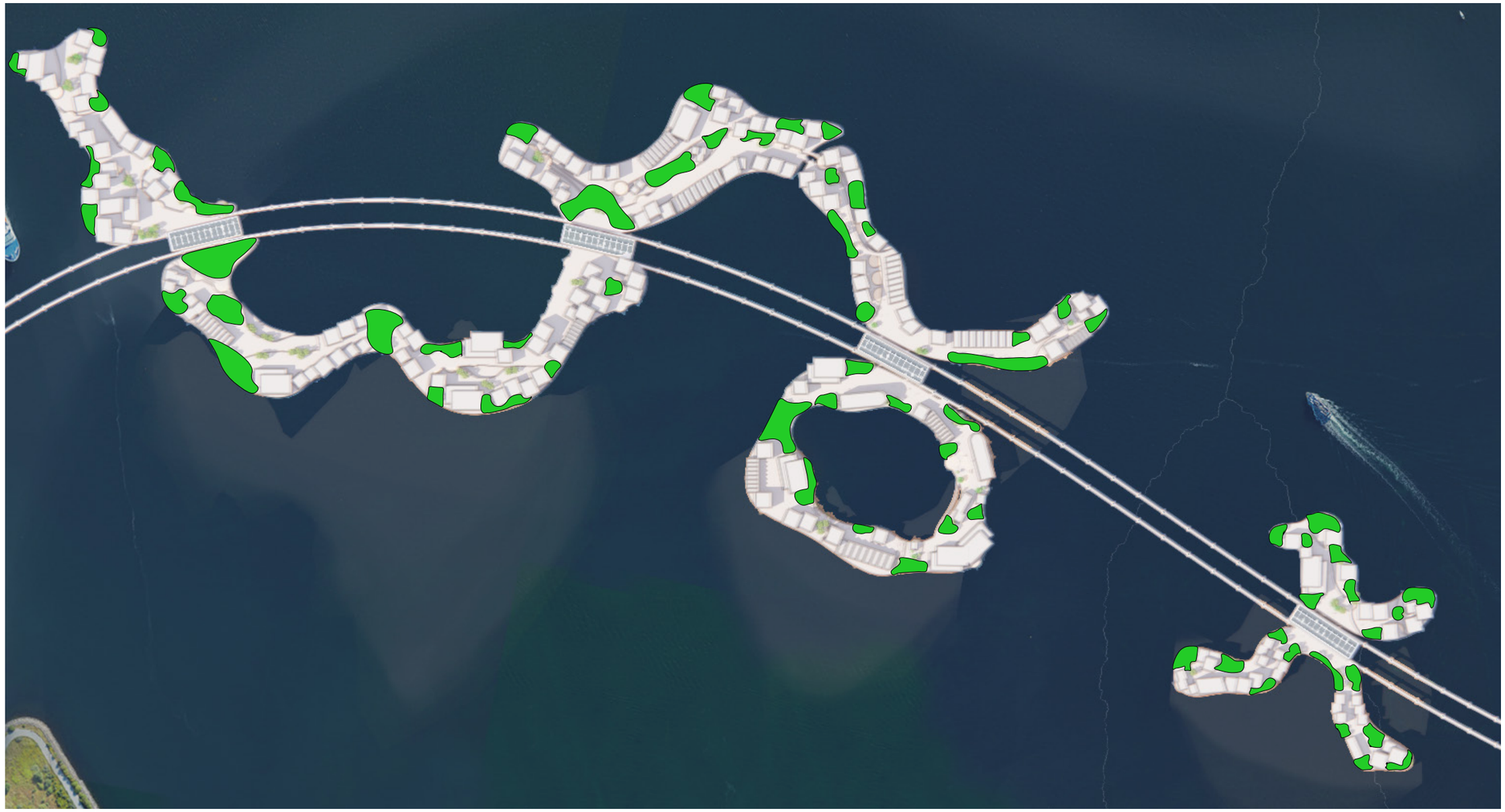
Diving Platforms

These spaces are down touching the water and can be flooded at certain high tides. Allowing access to and from the water by kayaks, boats and swimmers.



Public Spaces

The public spaces are green zones that will be accompanied with trees that can be planted on the platform with a shallow soil bed. These spaces will also be utilized for local performances, food vendors and communal gatherings.



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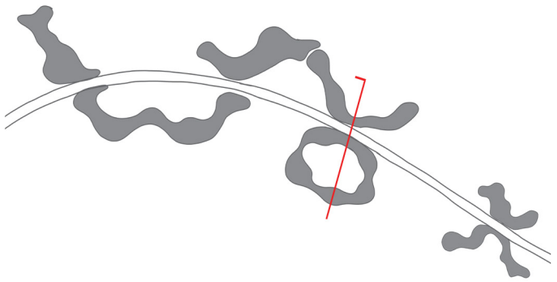
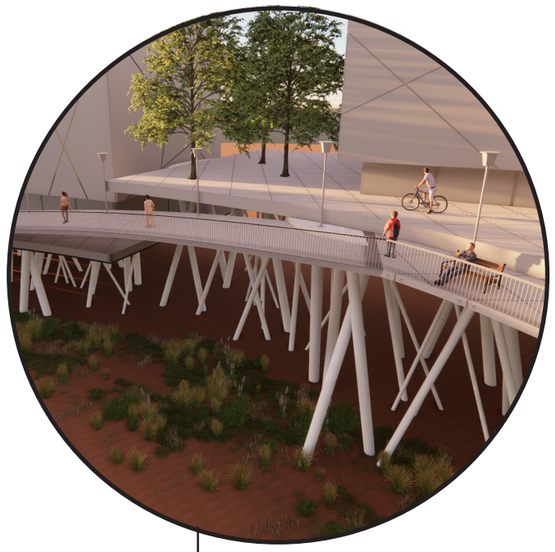
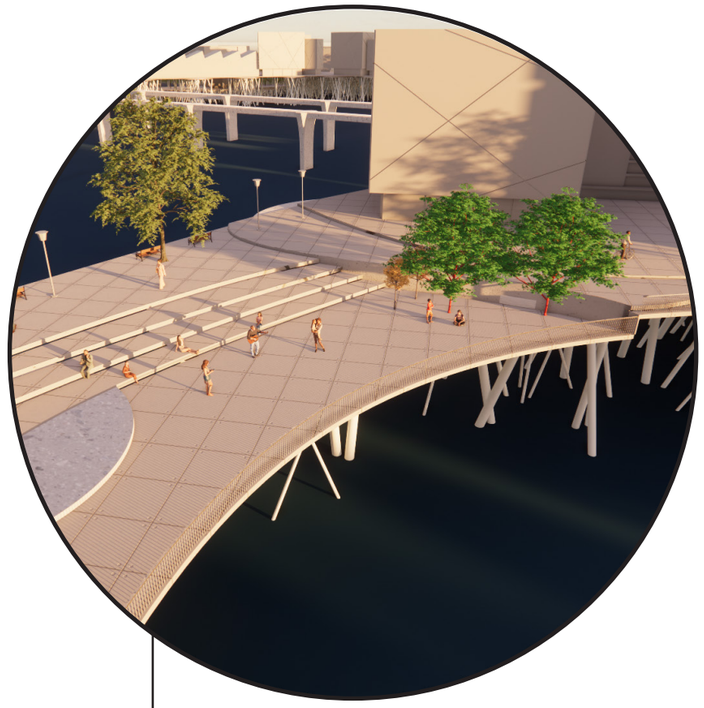
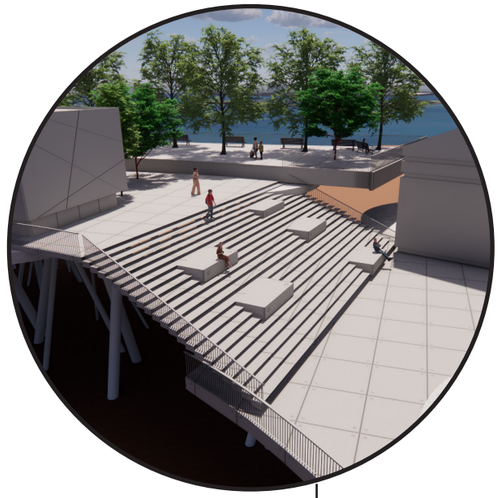
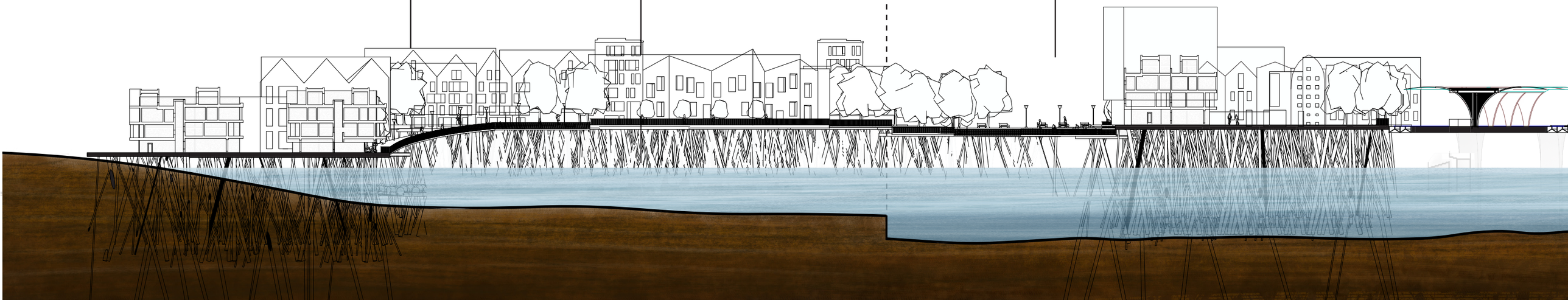


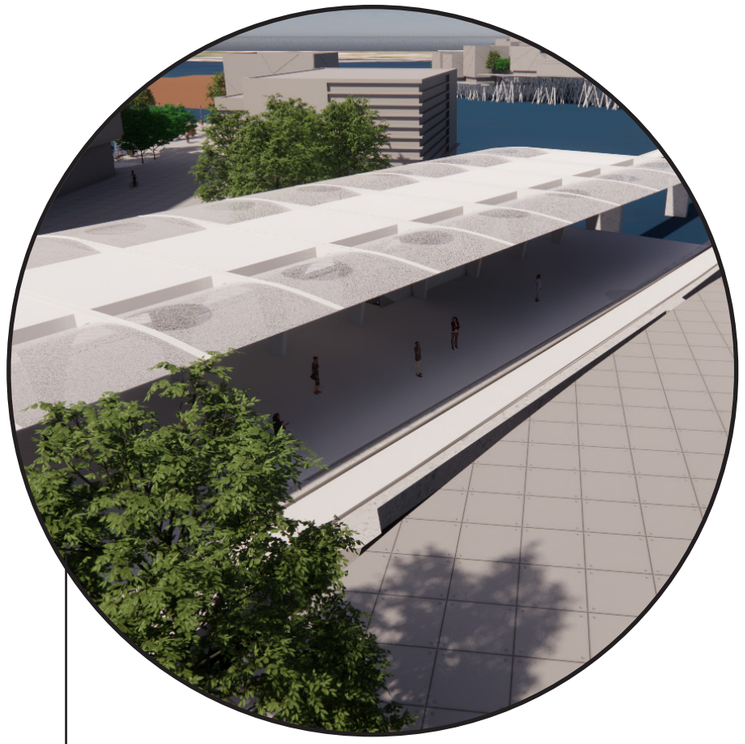


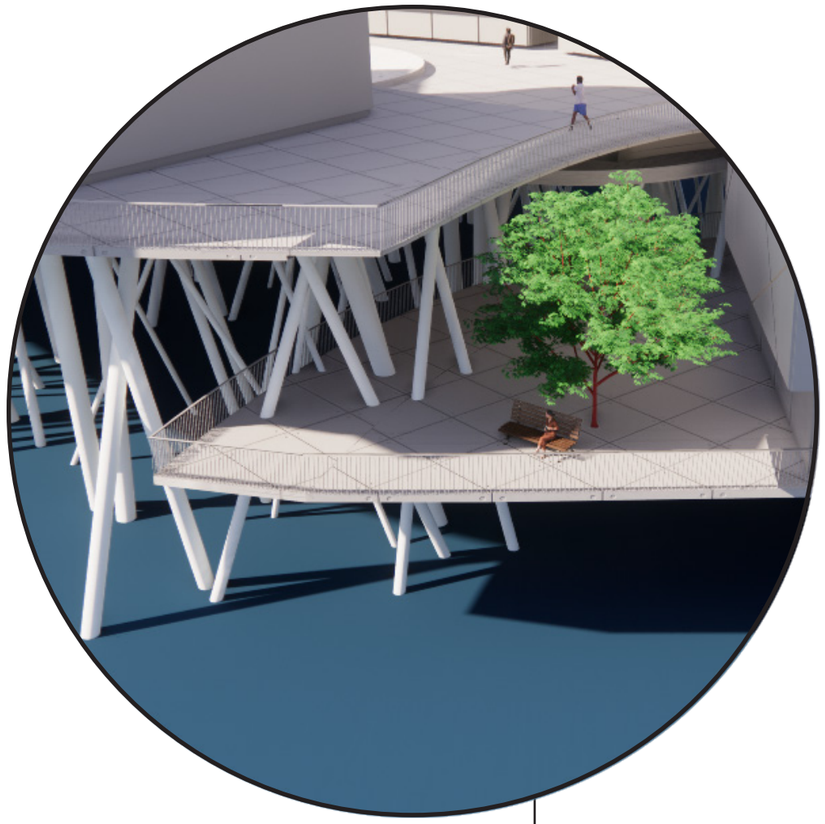




Y.50+

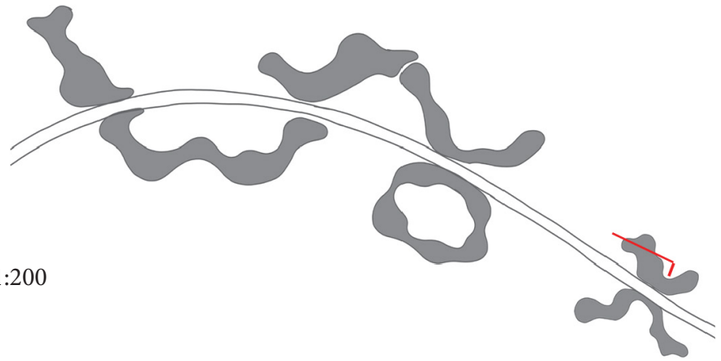






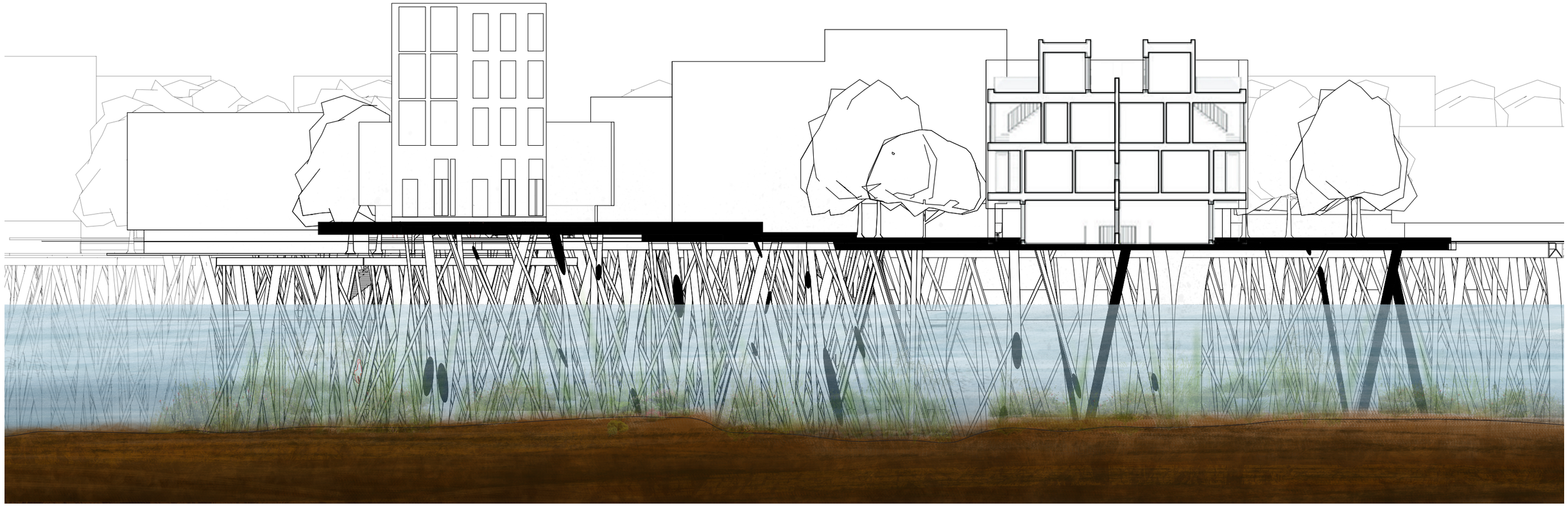
Y. 20

Y.10

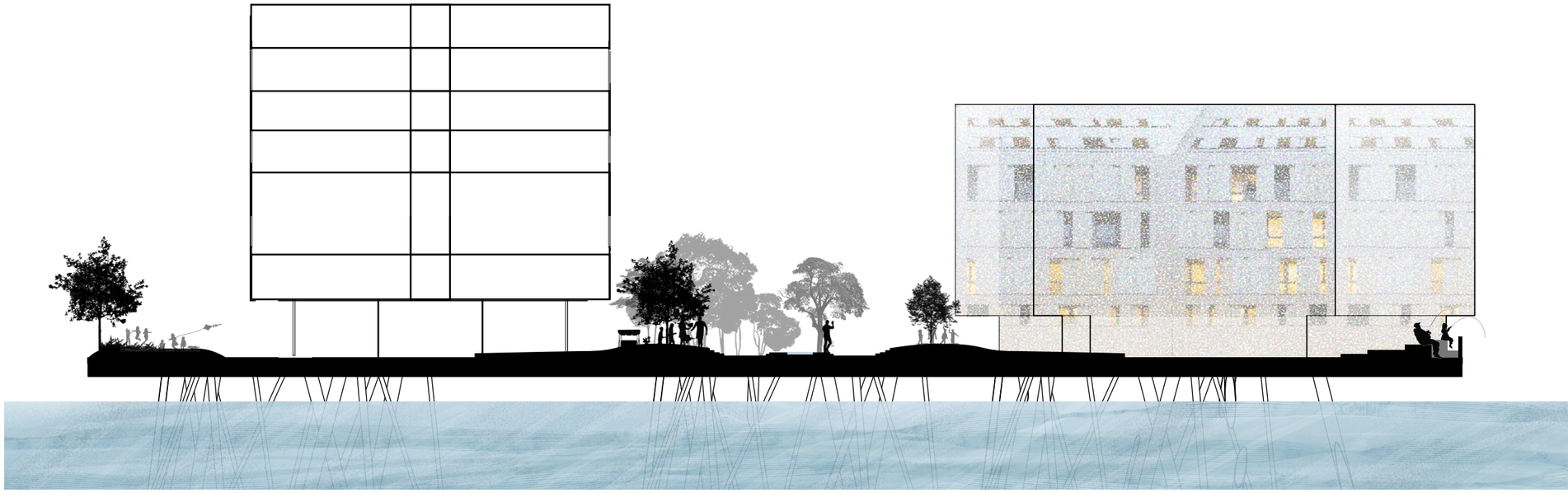


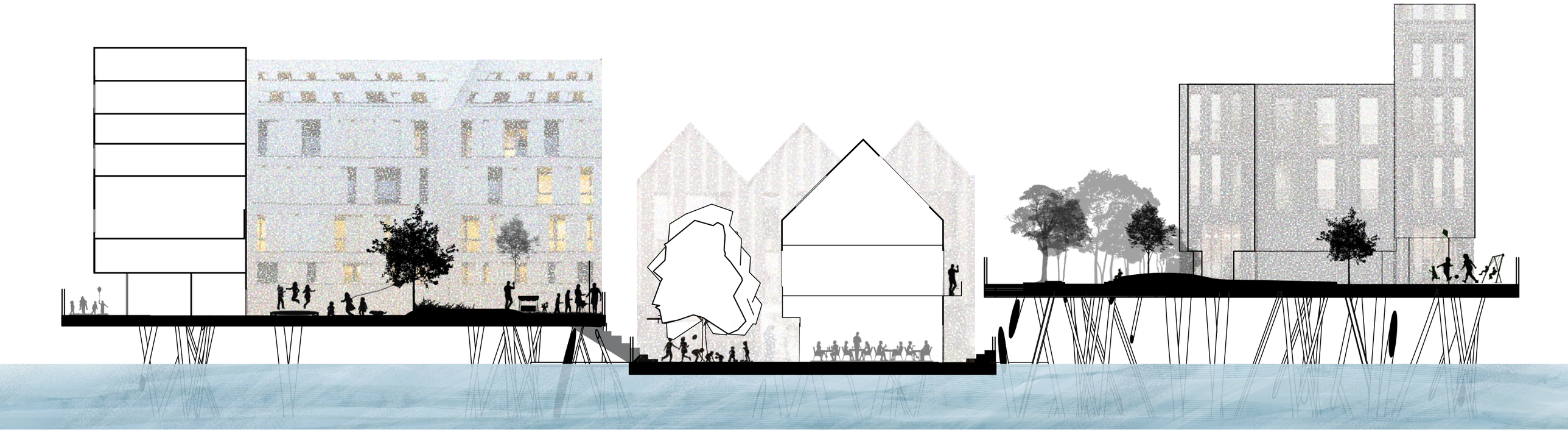
1:200

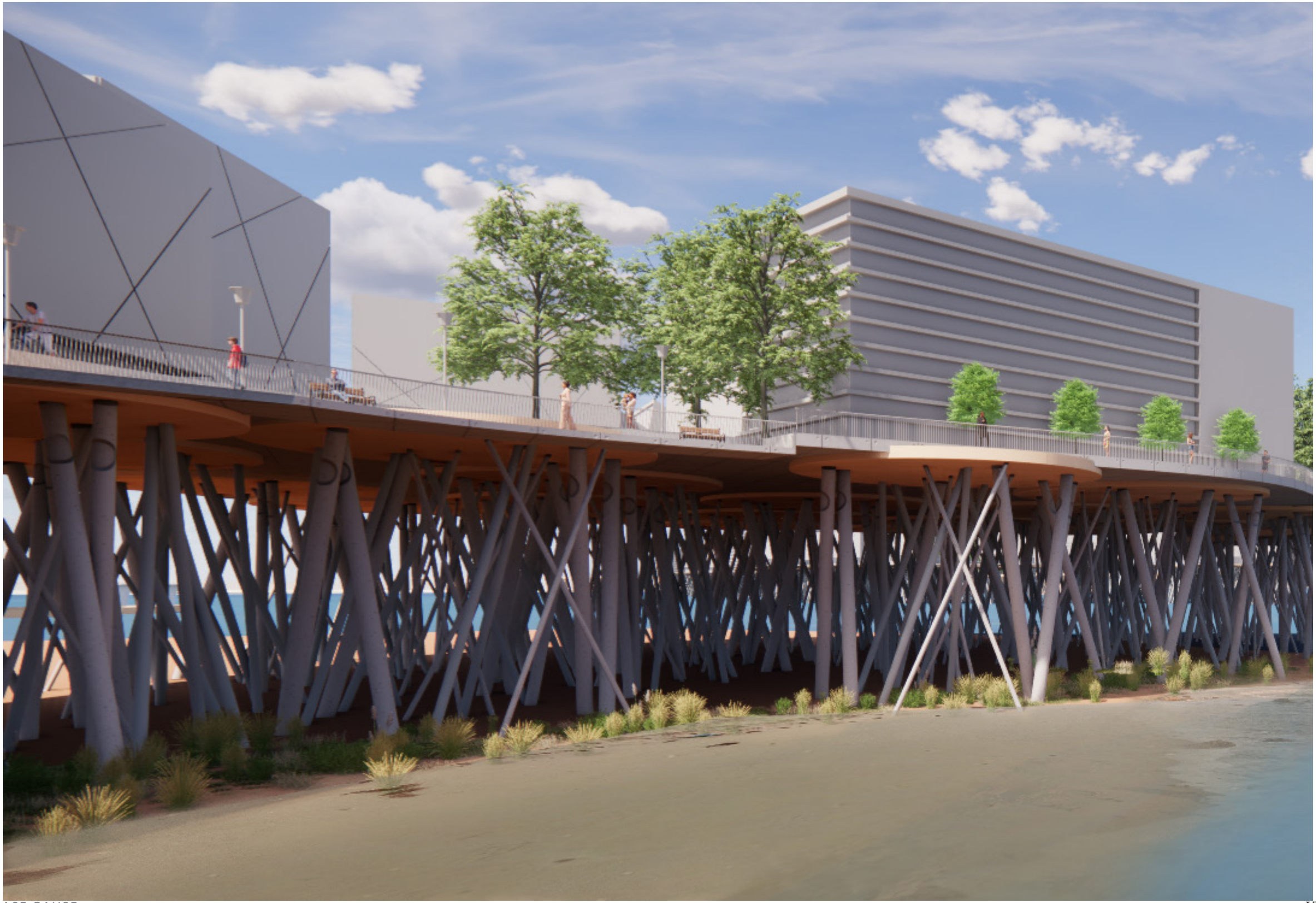
This section showcases the marine life growing below the platforms in between and along the pilings. Algea growing along the columns facilitates other marine life to flourish. The section also shows the space between the programmed buildings and the connection to the water.



These two section showcase the space between buildings that can be built up with land, or pulled downwards engaging with the ocean. The edge creates opportunities for raised ground or sitting steps to further engage with the oceans edge.







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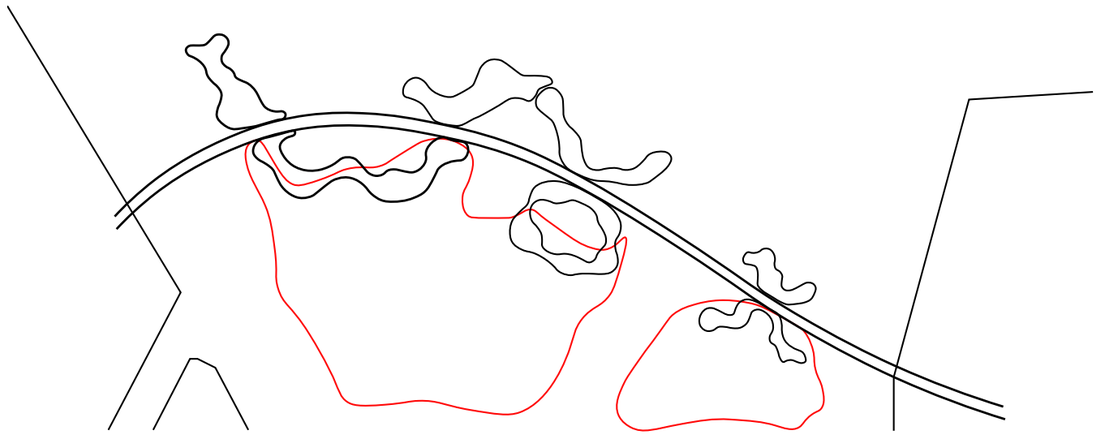
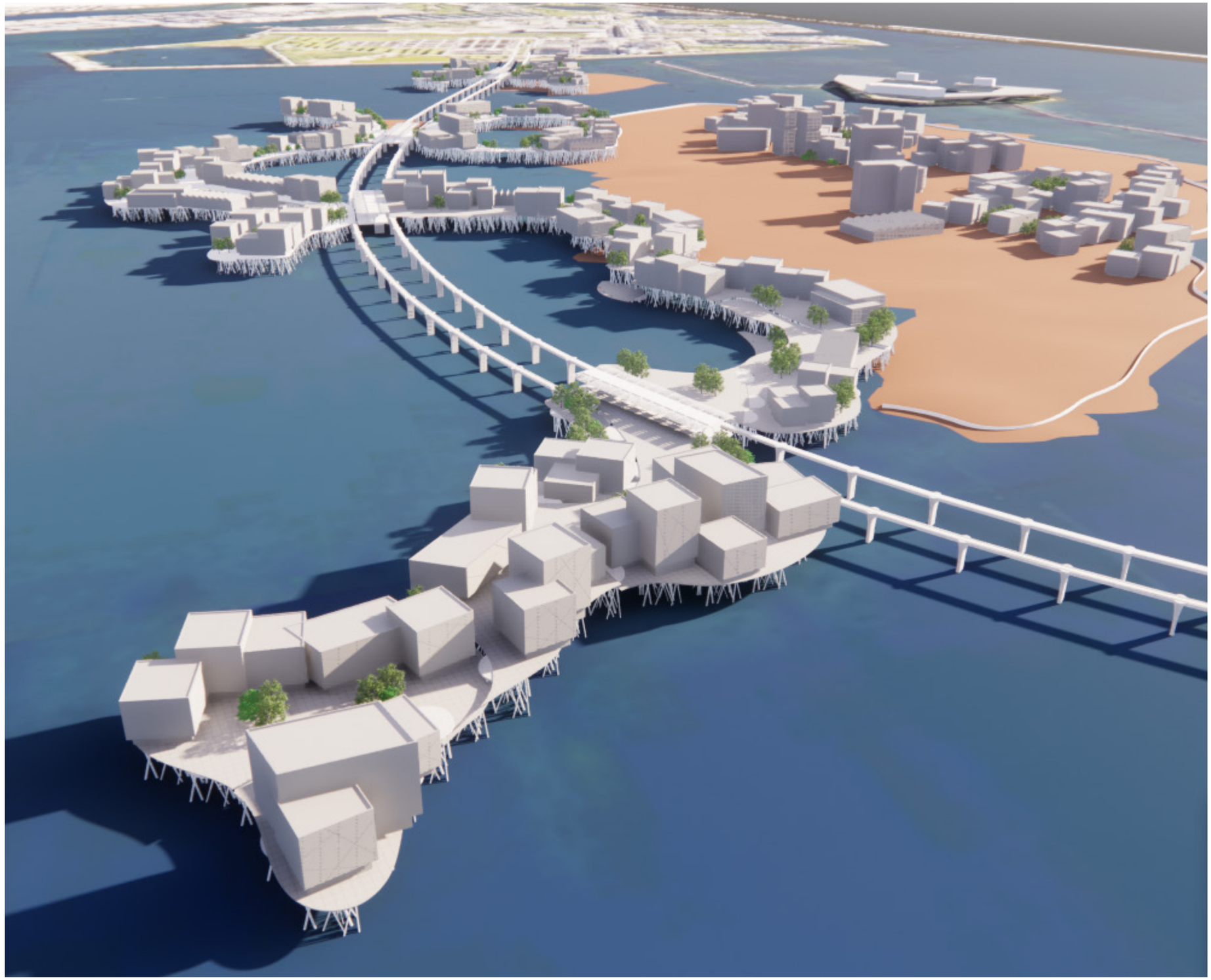
Diving Platform



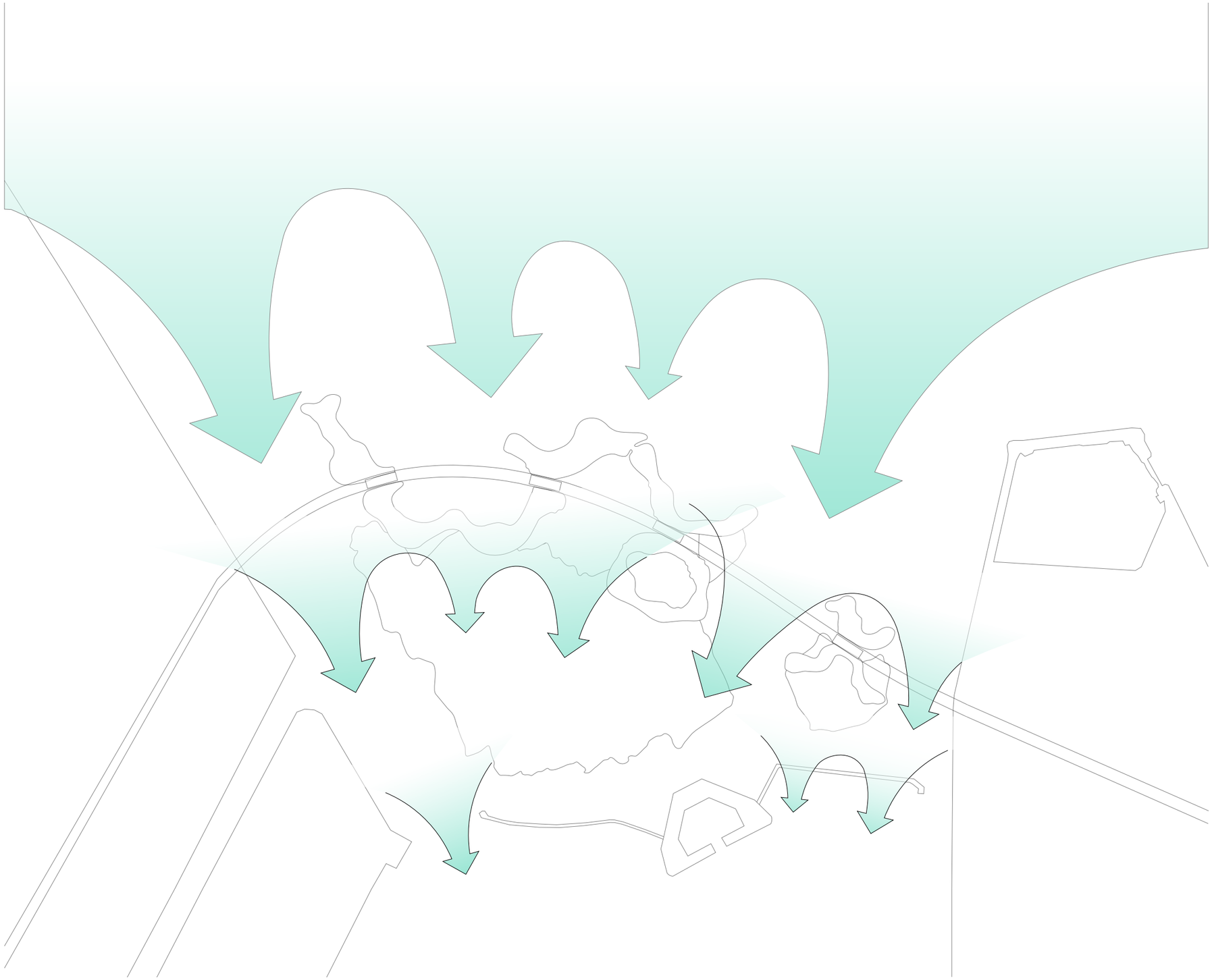
5- Architectural Response

Start of Stage 3, 50Years



Wind/Storm tide Movement

This diagram showcases a few different goals of the built structure. Protecting the naturally built land from the wind utizling the higher built structure. The columns underneath will break oncoming storm and wind waves to lessen the impact on the coast line and subsequent sea walls. The land and built environment will also protect against rising sea levels.



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Reflections

Key Takeaways - Nature as an actor in the design process, Connectivity of old and new, Natural Expansion and Longevity

This project brought reflection onto city expansion and how time, sustainable methods and how nature as an activator can be brought into this process. Starting at my initial thought process on developing a new methodology of expansion through natural means along with time. I am satisfied with my final structure that provides a new solution to land mass growth, however that doesn't mean that it is perfect. This process revolved around being a counter proposal to this specific site gave me restrictions and bottlenecked my imagination. As in I wanted to provide housing to the city right away with the substructure that provided a slow and methodical expansion of land that would provide enough land to counter propose Lynnetholm.

First though I'll talk about my initial research and realization for this project. Growing up along the water and witnessing land masses shifting and disappearing, with the sandbars that I used to park my boat on and relax dissipating within a couple years. This sand didn't vanish, it was carried and deposited on the other side of a large island building up a new sandbar that is larger and always above hightide. This all happened within 20 years and with traveling coastlines I pondered why these sediment movements weren't incorporated into marine architecture. Most of my initial research was firsthand experience, however I found myself towards the latter half of my project missing experiments or utilizing more mathematics found in sedimentation movement studies. My core design has enough understanding to hypothetically do what is proposed, however it is missing a technical approach.

The research proposed in pages 17-19 aren't located in Denmark, as stated in the diagrams as technical movements of sediment and tidal studies haven't been made in the area. I utilized the time feature in google earth to see sediment build up around the area over the years and used that as a bases of possibility. Further technical approach would be placing small interventions within the site, measuring around the objects and zones of intention of sediment build up. Coming back to the location that could be marked with buoys and remeasuring after 3-6-12 months to see the effect. The span of the project wouldn't provide much feedback however, as the size of the object I could create and get approval to place along the oceans bed within the site which is currently under construction. By the time I could place the structure and measure any sediment movements wouldn't provide enough evidence, so speculation based around Denmark had to be utilized at the given site. Pages (26-27)

Needing to find a form that could move or gather sediments I began utilizing the piling form. Due to my experience around piling structures of docks and piling houses along Florida. I could see the practicality behind it along with the ease of understanding the project from an outsider view. In turn when I initially created my first design it included large pilings resembling oil rig construction that had wings to capture sedimentation and build up land underneath the platforms that connected on top of each pillar. This idea was spurred from my firsthand experiences around structures that tend to build up sediment's underneath. However, the space provided wasn't engaging and the typology of the construction and feasibility was lacking. This idea changed to a more practical construction that mimicked the mangrove (Pg 18). The thought occurred that I could have designed built structures to sustain my architectural intention and expansion of land that didn't have to be built upon or integrated into the city fabric. The design would still be multi-dimensional by being a sedimentation activator whilst acting as a marine growth center point, as seen in artificial reefs.

In key with artificial reefs, the material chosen in my project as referenced to pg.21 could be taken a step further, by researching materials that could provide a growth bed for algae, having capabilities of longevity within the scope of the timeframe and sustainable. I created this project to combat the old methodology of land expansion outwards into the ocean, however, to combat this with structural ideology used today with concrete pilings. Utilizing this typology because of its tangibility compared to the dystopian scope of the design. Critically thinking this inhibited me from exploring different ideas of construction and material uses that could have expanded my project further. Such as utilizing 3-D printed substructures, bio-organic material or the use of parametric design.

The project mainly tackled the architecture proposal by formatting around an alternative proposal to lynnetholm. This helped formulate my methodology for livable spaces on top of the sedimentation activators, the site connections, and the barrier to the created land and subsequently the city beyond (Pg5). This forced my hand to try and solve everything Lynnetholm is proposed to, along with creating a new form of architecture. I would say this helped me organize my ideas and narrow down on what needs resolution and how to provide counter proposals. The sole creation of the livable platforms above the pillars came directly from counter proposing this project, in doing so, some methodology of how this space could be created and utilized was unsolved. As I was just findings myself creating lifeless platforms that can be considered spaces to be built upon.

Not until late into the project was the space created from the pillars finally took initiative and was a glaring issue even now. I started to utilize the form of my pillars and the possibility of shifting platforms, connecting walkways, pockets spaces, and water engagement that can be expressed through this interesting construction. Exploring these ideas in section mainly on page 37, I began to use language throughout

Copenhagen, which utilizes its coastline and riverways to its fullest potential. I believe there is still more possibilities that are to be realized the deeper I explore into the substructure and the subsequent spaces built upon and in-between the pillars. The spaces I did create did take influence from the surrounding city and take its own language of an island of sorts (pg. 31-35).

The rendered spaces begin to speak of this nature but are inhibited due to the construction and changes needed to the heights of the platforms. The dive platform begins to describe this coastal island way of life (pg40). After reengaging around Copenhagen and seeing construction that is adapted to higher tides and can sustain itself submerged for a time being. I believe adding that language would benefit, if the structure itself is adaptable proving for the future and the nature itself. The platform and programmed spaces above should do the same. Co-existence with the ocean and spaces that change with the tides, forming further engagement of architecture and nature.

Now referencing the substructure and it's built environment I begin to look back into the main material used to build this infrastructure, as it is practical in the sense of language and probability. This is a crutch I've said before, that does help some understand the project and could be seen as practical. However, I could have formulated around 3-d printing along the transport line or utilizing more natural shapes to create the substructure to the platforms. Further exploration of large subterranean rocks and forms could be further utilized in nature as an actor in the design process. These ideas are only made possible after pursuing multiple other typologies such as my single mass pillars and multicolumn. After deliberating with critiques and colleagues, as well as self-reflecting on my choices. This shows the importance of communication and collaboration between architects and other fields of experience. The utilization of expertise revolving around nature is essential for sustainable architecture when revolving around time and resources.

The core of the project remains from site to site; Nature as the actor is the design process. This is my initial architectural approach to this typology, extension of the city utilizing a new method of expansion. These types of projects are essential for architects and society to look beyond the common method approach and create for the future. As society as a whole is becoming more environmentally conscious and so should our architecture. We aren't designing for today anymore, with the use of sustainable construction materials and net zero consumption; our architecture should facilitate this thought through its existence as well, providing for its inhabitants and environment around it.

References

Figure:

(A) Paleogeographic reconstruction of the upper Mulichinco Fm. basin development, modified from Schwarz and Howell (2005; Figure 12f); study area, cities, and national border are indicated. https://www.frontiersin.org/articles/10.3389/feart.2020.00219/full

(B) Interpretation of sedimentary environment of the upper Mulichinco Fm. regressive development in the study area, based on the succession between FS5.2 and FS6 (Figure 10), scale and localities indicated; absolute distance to shoreline not intended, and landward extent of depositional setting remains unknown. CPT, Cerro Pampa Tril; PT, Pampa Tril; BLL, Barranca Los Loros; RP, Río Pequenco. https://www.frontiersin.org/articles/10.3389/feart.2020.00219/full

(C) Storm wave refraction as explanation for the concentration of storm deposits at BLL and CPT localities, while limited or absent at PT and RP localities. (D) Block diagram showing distribution of storm- versus tide-influenced deposits of FA3, based on succession between FS5.2 and FS5.3 (Figure 10); ternary diagram plots included for the portrayed FA3 succession (diagrams modified from Dashtgard et al., 2012), close-up views of representative sedimentary facies and observed architecture are from annotated figures, vertical scale is exaggerated, and absolute water depth and proximity to shoreline is not intended. See legend for facies and trace fossils; letters refer to Table 1, BI, bioturbation intensity. https://www.frontiersin.org/articles/10.3389/feart.2020.00219/full

(d) Sediment Tyoes Diagreams representing Bedload, Suspended Load and Wash Load : Fondriest Environmental, Inc. “Sediment Transport and Deposition.” Fundamentals of Environmental Measurements. 5 Dec. 2014. Web. < https://www.fondriest.com/environmental-measurements/parameters/hydrology/sediment-transport-deposition/ >.

Photos:

All untitled photos came from Google Earth/Maps

Cited Text:

(1) Fondriest Environmental, Inc. “Sediment Transport and Deposition.” Fundamentals of Environmental Measurements. 5 Dec. 2014. Web. < https://www.fondriest.com/environmental-measurements/parameters/hydrology/sediment-transport-deposition/ >.