REVIVING FLOODPLAIN IN MIAMI

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By
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Contents

Overview

This is a thesis carried out in three phases. Phase 1 and Phase 2 are research-based, and Phase 3 is exploring the future design schemes under the principles and criteria that have been set up in Phase 1 and 2.

Phase 1 is focused on understanding the water dynamics and major issues in Miami, questions like why Miami is so vulnerable to flooding, and where the water comes from are answered. The conclusions of this phase are scientific principles of how water behaves and how water is managed in the South Florida region. Moreover, critical issues caused by flooding and sea level rise are identified.

Phase 2 is more specific research and analysis of the conditions along the canals in Miami area. Sea level rise will cause flooding not just coastal but also inland along the canals. Inspired by the historical conditions of the Everglades, the author defines the concept of this thesis to revive floodplain in Miami, to bring back floodplain structures in urban area and let flooding express its dynamic, thus to make the city more resilient. This phase includes research and information that would help the author narrow down time scope and site to design with.

Phase 3 is systematic analysis and schematic design showing how the thesis concept is realized in space. Case studies are carried out to examine what has been done in precedent projects. Detailed landscape design is the focus to express how the author's intentions are displayed in the physical landscape.

Site

The focus site of this thesis is along the canals in Miami, Florida; Including Miami Canal, C4, C5 Canal, Seybold Canal and tertiary canal within the metropolis area. Urban construction has invaded closely to these canals, featuring channelized hard edges and buildings sited just by the river.

The rising sea level will have a great impact on these areas. The canals play a important part in terms of flood control for the whole city, but because the tension of sea level and land is getting worse, the canals will face flooding that goes beyond their capacity, therefore fail to serve the city in future.

The major issue is to examine how the site would make space for water and let flooding express its dynamic without causing risks on urban living. The goal is to ease the impact of future flooding, protect important urban constructions and create safe environment for people and wildlife in Miami.

Phase 1 Understanding

Reasons for Miami's Flooding

Abstract

The goal for this phase is to have a thorough understanding of the flooding issue Miami is facing today. Why is Miami so vulnerable to flooding? Where does the water come from? Through a series of GIS data analysis and literature review, it becomes clear that the geological history of the South Florida Region makes Miami vulnerable to flooding, the canals constructed to drain the former wetland and make way for agriculture and urban development make it even more so.

Apart from the natural and human engineering history of water, Miami is facing climate changes like sea level rising, frequent hurricanes that cause storm surge and excessive rainfalls; they all contribute to the increasing risk with water.

The major consequence of Miami's flooding is saltwater intrusion. It endangers the conditions of freshwater wetland, drinking water system as well as the population in low lying areas.

Miami Before Hurricane Irma (2017)
Photo Credit: https://www.cnbc.com/2017/09/09/florida-braces-for-impact-.html
September 9, 2017. REUTERS/Carlos Barria

Introduction

The first step the author took of understanding Miami's flooding condition is to identify where does the flood water come from and what area does the flooding impact? Projected flooding caused by sea level rise is mapped out based on the NOAA Inter-high sea level projection scenario. The flooding that is happening today includes tidal flooding caused by king tide, storm surge caused by hurricanes and storm events with excessive precipitation.

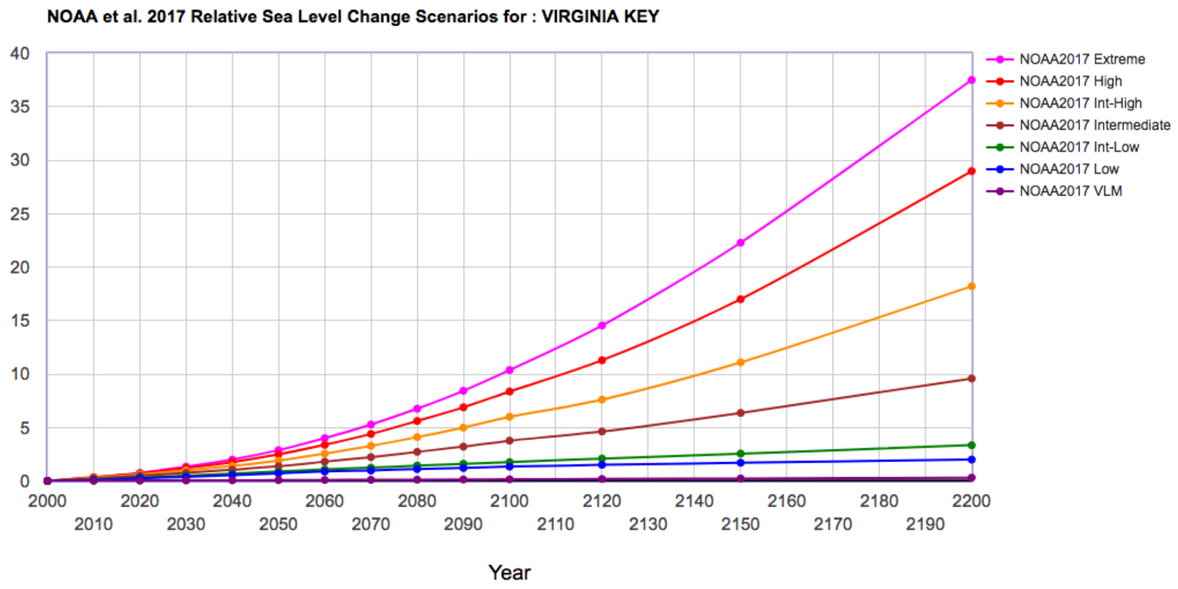
Then the nature and human cultivation history in South Florida Region is researched to explain how the geological condition and overall water management have influenced the way water behaves. South Florida was one continuous wetland formed by the high ground water level and sheet flow from Lake Okeechobee, but after canals were dug in 1910s, water flow was diverted and half of the wetland is drained. Canals are now open gate to tidal flooding and storm surges, salt water starts to press in because there's less fresh water pressing out.

The South Florida Water Management District, a regional governmental agency ,manages and controls the water resources from Orlando to Florida Keys. Water treatment areas and buffer zones are reserved to have better control over flooding and to conserve the Everglades National Park. However, flooding issue remains as a complex situation that has to be dealt with in Miami's future adaptive design.

Methods

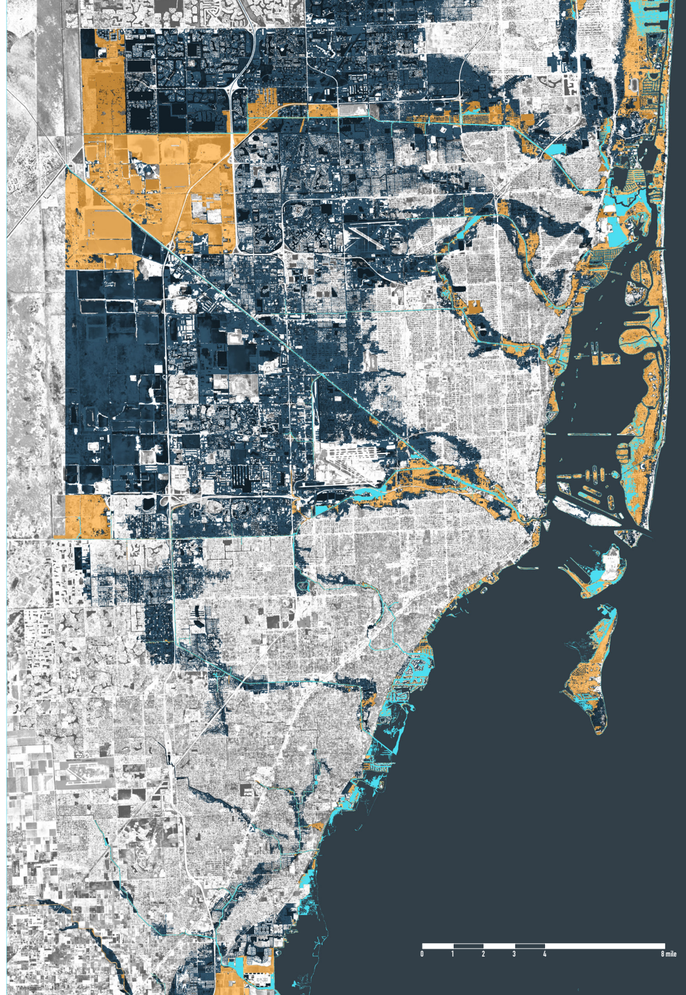
1. GIS data analysis is used to understand the topographic and land cover information in South Florida.
2. Literature review of water management in South Florida, to research the history of canals and the water management methods that are being used today.
3. Visualization of geographic history of limestone and Miami's climate pattern is carried out by charts, diagrams.

Dynamic of Flooding - Sea Level Projection



NOAA's Intermediate-High projection suggest that in 2050, sea level will rise up to 2', in 2080, about 4' rise, and in 2100, the sea level would rise up to 6'.

Data source: https://www.u-surge.net/miami.html



Sea Level Footprint of Miami

2 FEET
2050 SEA LEVEL RISE*

4 FEET
2080 SEA LEVEL RISE*
HURRICANE IRMA (2017) STORM SURGE
TIDAL FLOODING 09/10/2017

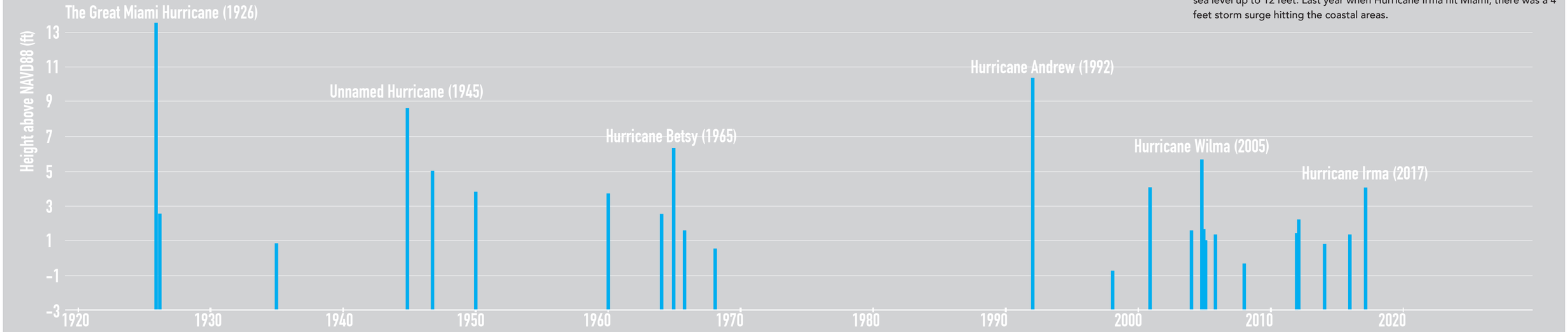
6 FEET
2100 SEA LEVEL RISE*
HURRICANE WILMA (2005) STORM SURGE

*BASED ON NOAA INTER-HIGH PROJECTION VIRGINIA KEY

Most of the coastal ridge area would remains dry, but sea water will go through the canals and rivers and take over the inland area.

Dynamic of Flooding - Severe Storm Surge in History Caused By Hurricane

In the past 100 years, significant number of hurricanes have caused storm surge, and it has become quite frequent these years. Strong wind raises the sea level up to 12 feet. Last year when Hurricane Irma hit Miami, there was a 4 feet storm surge hitting the coastal areas.




The Great Miami Hurricane (1926)


Unnamed Hurricane (1945)


Hurricane Betsy (1965)


Hurricane Andrew (1992)


Hurricane Wilma (2005)


Hurricane Irma (2017)

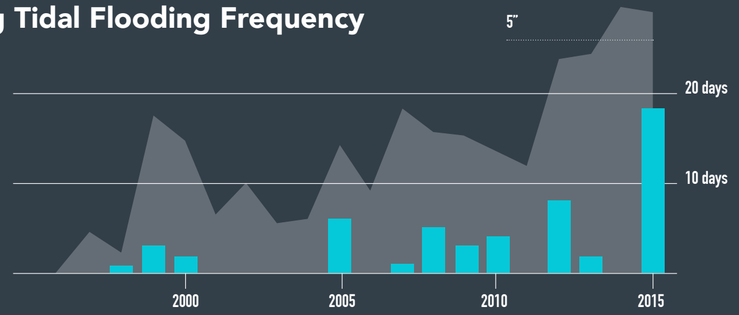
Data source: https://www.u-surge.net/miami.html

Dynamic of Flooding - Increasing Tidal Flooding Frequency

Data in Miami Beach

Days of Tidal Flooding

Mean Sea Level Rise



In the past 10 years, sunny day flooding caused by high tide have increased 4 times in frequency in Miami Beach[1].

Dynamic of Flooding - Climate of Excessive Rainfalls

Heavy Precipitation in Miami

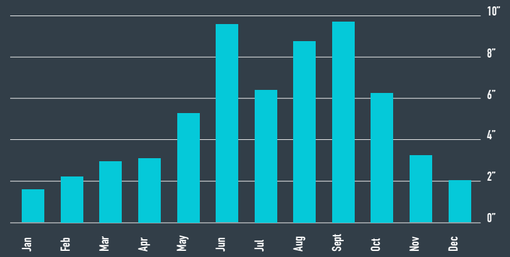
Miami's climate is featured by heavy precipitation, with nearly 62 inches in a year and 128 days of raining, storm events are mostly in summer.

Precipitation Chart

Average annual precipitation – rainfall: **61.93 inch**

Days per year with precipitation – rainfall: **128 days**

Precipitation



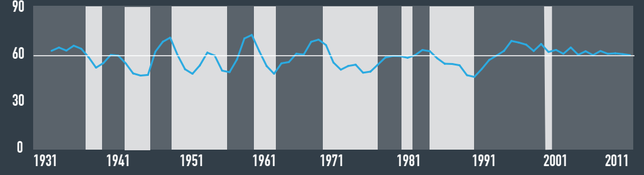
Rainfall Becoming More Extreme in Climate Pattern

Drought and Wet Pattern in the Past 100 Years

Drought Years

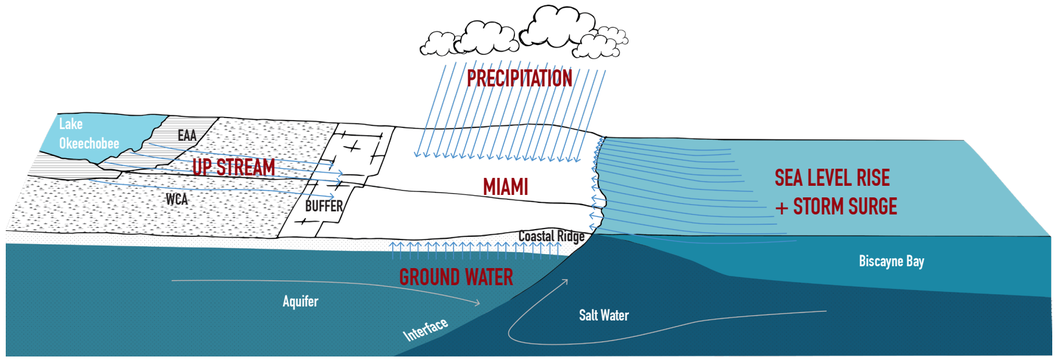
Mean Annual Precipitation (every 3 years)

Mean Annual Precipitation (total)



1. Davies, Richard. "USA – Tidal Flood Events in Miami Beach Increased by 400 Percent in 10 Years." Floodlist. April 6, 2016. Accessed March 12, 2018. http://floodlist.com/america/usa/increased-flooding-sea-level-rise-miami-florida.

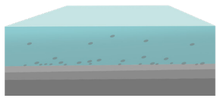
"The Water Comes From Six Sides In Miami"



Porous Base Underground

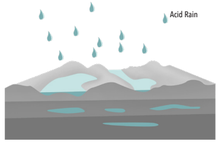
Forming of the Limestone Base

Submerged
Sedimentary Limestone

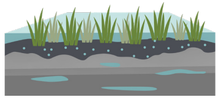


Submerged
Oolitic Deposits

Exposed
Dissolution of Limestone – Porosity
Soil Formation

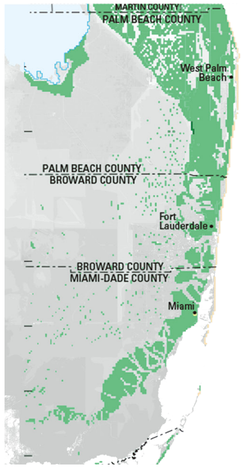


Deposition of Peat
Accumulation of vegetation
Freshwater Storage



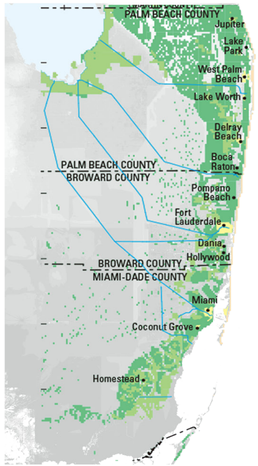
A City Developed on Wet Terrain

1900



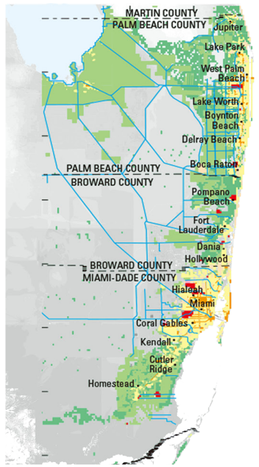
The historic Everglades formed an approximate 3,860 mi² freshwater wetland marsh, extending from Lake Okeechobee to mangrove estuaries that border Florida Bay.

1920



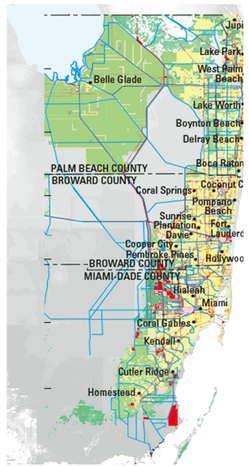
The "land boom" era 1903 to 1926 was signaled by the construction and completion of the primary drainage canals. The conversion of drained wetlands for tropical farm products.

1960



Miami grew quickly into a modern city. During that time, growth was not limited to the larger cities. Outlying municipalities expanded and new municipalities were established.

2000

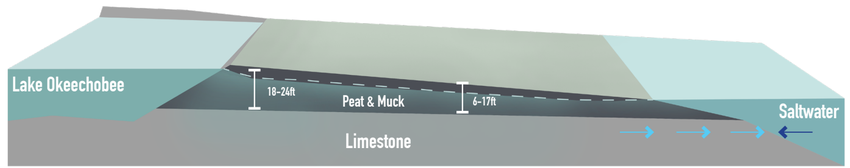


1980s was the beginning of large-scale influx of immigrants from Latin and South America which continued unabated into the 21st century.

Changed Land Surface and Altered Water Flow after Urban Development

Pre-Development Everglades

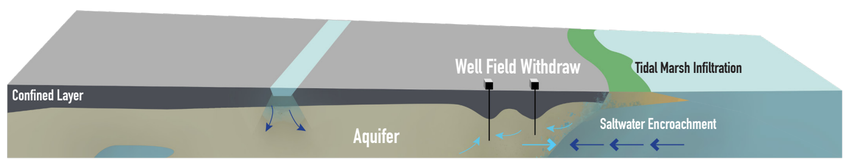
The original landscape of the region is one continuous wetland - the Everglades, often referred as 'the river of grass'.



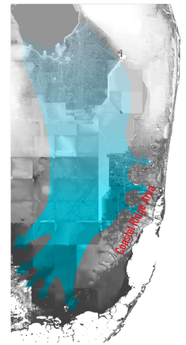
Freshwater Stored in Peat and Limestone

Urban Area in Coastal Ridge

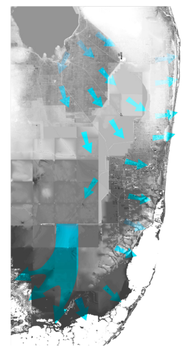
Today's city development took the land in coastal ridge and great amount of ground water is withdrawn for municipal use.

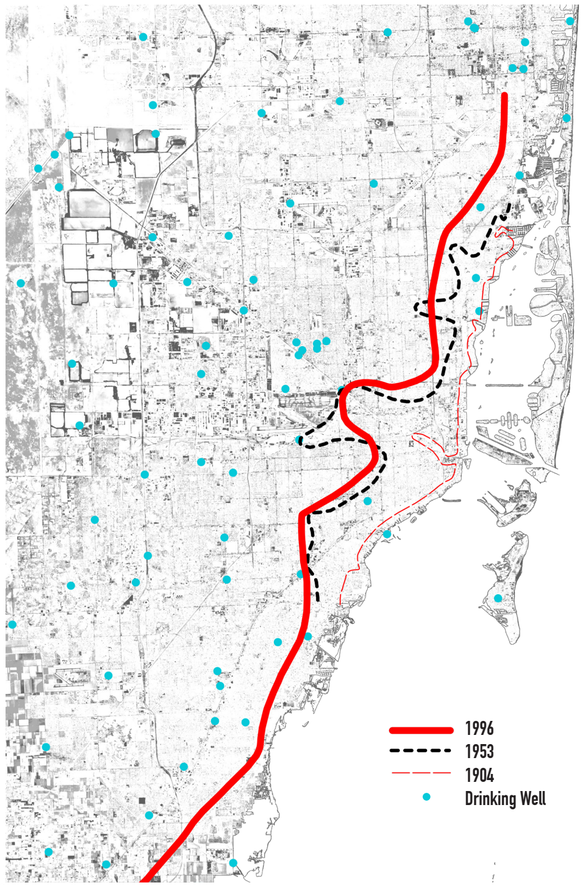


Pre-1900 Water Flow



Diverted Water Flow

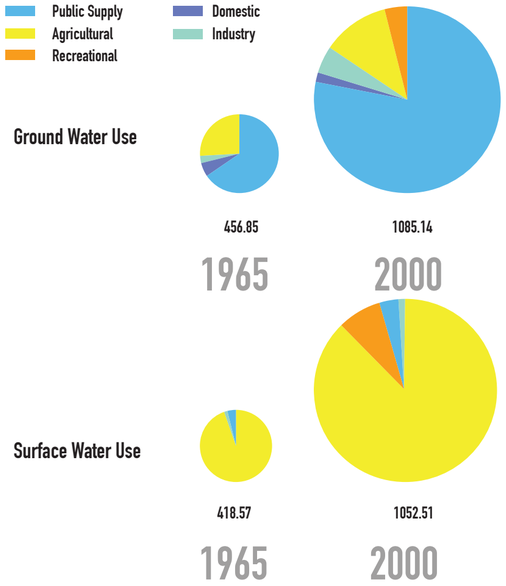




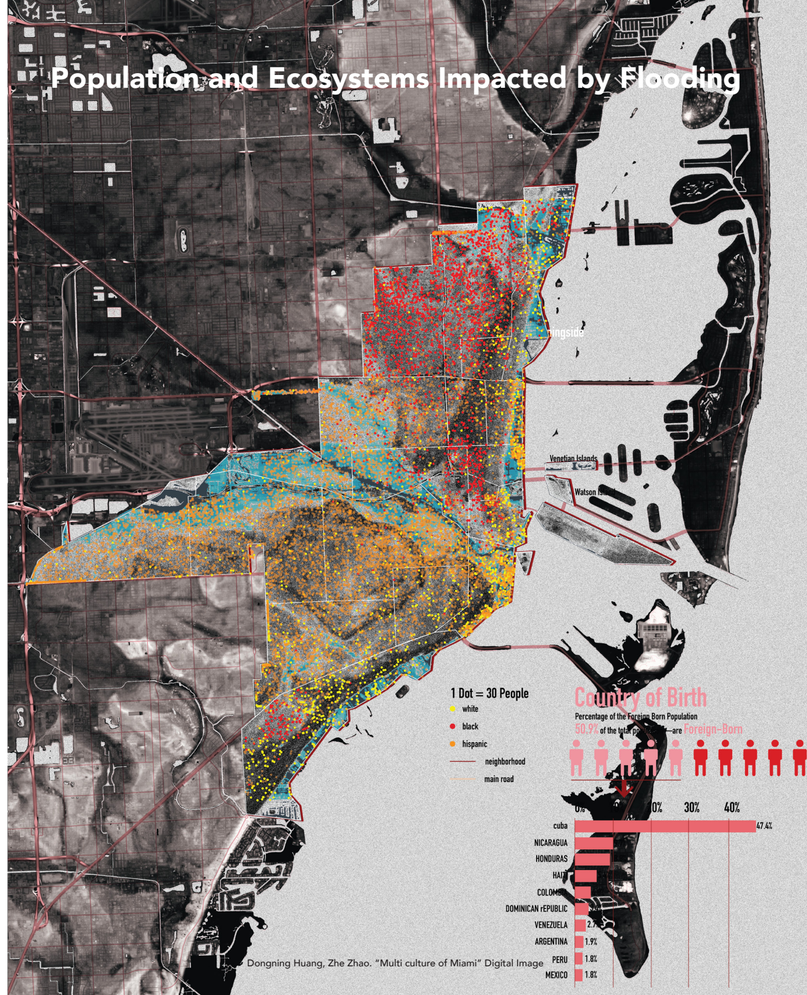
Salt Water Frontier is Encroaching

Saltwater intrusion is a major concern in urban areas, it is mainly because of the large amount of groundwater withdrawn for municipal use. The city Hallandale Beach just north of Miami has already closed most of its drinking wells because the water is contaminated by saltwater intrusion.

Water Usage in Miami-Dade, Broward, Palm Beach Counties

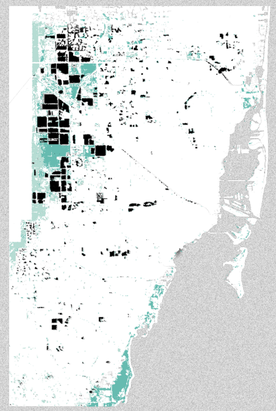


Population and Ecosystems Impacted by Flooding

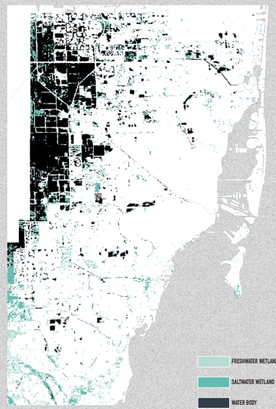


Dongning Huang, Zhe Zhao. "Multi culture of Miami" Digital Image

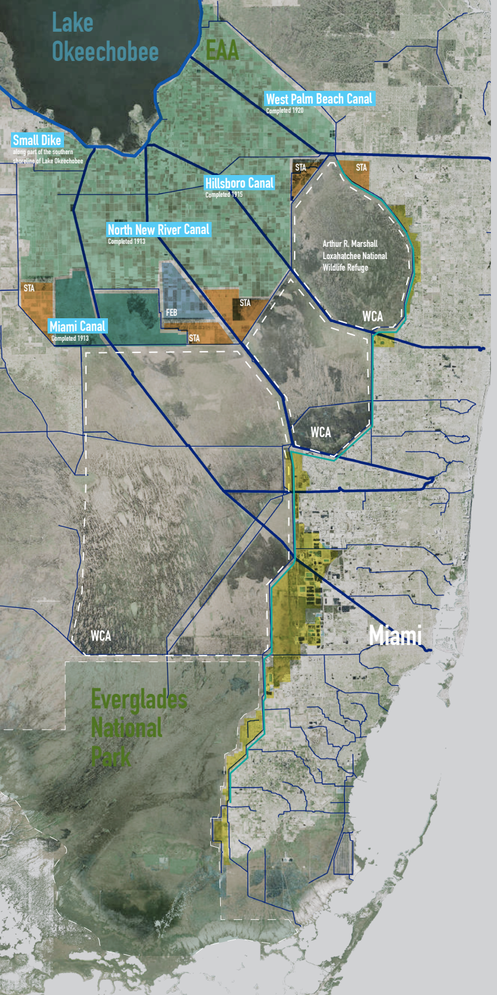
Prediction of Marsh Migration | 2050



Prediction of Marsh Migration | 2100



Chuxiong Feng, Siyu Zheng. "Marsh Migration Projection" Digital Image



Overall Water Management in South Florida

Dredging Miami Canal

Levee Construction

- Water Conservation Area (WCA)
- Everglades Agricultural Area (EAA)
- Storm water Treatment Areas(STA)
- Wildlife Management Area
- Flow Equalization Basin (FEB)
- East Coast Buffer
- East Coast Protective Levee
- Dike
- Canals

Water Management Areas

Comprehensive Everglades Restoration Plan

The Comprehensive Everglades Restoration Plan (CERP) was authorized by Congress in 2000 as a plan to "restore, preserve, and protect the south Florida ecosystem while providing for other water-related needs of the region, including water supply and flood protection."[1]

South Florida Water Management District

The South Florida Water Management District is a regional governmental agency that oversees water resources from Orlando to the Florida Keys.[2]

1. "Comprehensive Everglades Restoration Plan (CERP)." National Parks Service, U.S. Department of the Interior, www.nps.gov/ever/learn/nature/cerp.htm.
2. "South Florida Water Management District." Sfwmd.gov, www.sfwmd.gov/.

Findings + Conclusions

Sea Level Rise is a risk to many coastal cities, but in Miami it is not just a projection, it's already having impacts. From 2011 to 2015, under the influence of climate variation like El Niño, sea level in the Miami area has been racing up at almost one inch per year, that's nearly ten times the rate of average global sea level rise[1], which is 3 mm per year. According to NOAA's Intermediate-High projection, in 2050, sea level will rise up 2'; in 2080, about 4'; and in 2100, 6'. At that time, although most of the coastal ridge area would remain above sea level, salt water is going to come inland through the canals and rivers.

Flooding is not just threatening Miami in future scenarios, it is already happening. Tidal flooding happens 2-3 times every year. In Sept 2017, the king tide was the highest tide ever recorded in Virginia key. Sea level rise up to 4', causing severe flooding in coastal areas. What makes the condition worse is when the hurricanes come, causing storm surges that could raise the sea level up to 12'.

Apart from the threat from sea water, precipitation is another major threat that could cause flooding. With the sea level rising and ground water going up, excessive rainfall has no where to go but the low lying area in urban area, makes inland area vulnerable to flooding.

The region's problem with water starts with its topography. The average elevation of Miami Dade County is only 6' above sea level[2]. Millions of years of changing sea level created sediments that formed today's limestone base in the region. It is porous and has the ability to store water; that's why the ground water is so high.

After 1900s, people dug canals in order to drain the wetland for agriculture; the water flow was diverted to the coastal ridge areas, where the cities were developed. This resulted in soil subsidence in the agriculture area and less water flow into the natural Everglades. Meanwhile, large amount of drinking water was withdrawn from the aquifer; as a result, salt water front is encroaching.

The Comprehensive Everglades Restoration Plan (CERP) together with South Florida Water Management District were the major actions taken to deal with the water issues. Storm water treatment areas and water conservation areas are specifically reversed to treat water, control flood and create buffers between cultivated land and nature areas. However, flooding still remains in Miami, wetland and drinking water are at risk because of salt water intrusion, population in the low lying areas are still suffering from flooding on a frequent basis.

Assessment

In Phase 1 the author is able to explain the reason of Miami's flooding, but the scale of drawings in this step is mainly focused on regional scale and lacks more specific topographic and sub-watershed analysis in Miami city area. Mapping information of specific land use could be more helpful to identify the areas of major concern for creating criteria in Phase 2.

Because the projections of Miami's future sea level and climate is uncertain, in the next step the author should make clear decision of what specific scenario is to be dealt with.

From the conclusions in phase 1, scientific principles of flooding dynamic could be learned. However, the role landscape would play in dealing with water issues is not clear in this phase; it could be better supported by further research in more specific areas in Phase Two.

1. Kolbert, Elizabeth. "Miami Underwater." The New Yorker. July 14, 2017. Accessed March 12, 2018. https://www.newyorker.com/magazine/2015/12/21/the-siege-of-miami.
2. Kolbert, Elizabeth. "Miami Underwater." The New Yorker. July 14, 2017. Accessed March 12, 2018. https://www.newyorker.com/magazine/2015/12/21/the-siege-of-miami.

Phase 2 Investigation

Along the Canals in Miami

Abstract

The goal for this phase is to analyze the flooding levels on future scenarios, clarify the major concept of the thesis, and have further research and analysis on specific areas of concern.

When looking at the future sea level in three steps by the year 2100, the major area of concern in Miami in terms of flooding is along the canals, The author proposes a future vision where city and floodplain would co-exist. The functions of floodplain and the conditions along canals are investigated.

The conclusion in this phase is to evaluate the canals and the areas adjacent to then, whether they are suitable for future design testing; as a result, the area along Seybold Canal is a suitable site in Phase Three.

View over Miami River. Crowded urban development leaving few spaces for the river to express its flooding dynamic.

Introduction

It is explained clearly in Phase One that canals are open gates of flooding in Miami. In this phase more detailed mapping of sea level rise footprint is created and three steps of flooding over time is concluded: In 2050, river edge affected; In 2080, riverside communities inundated; In 2100, wide city areas along canals are under shallow water.

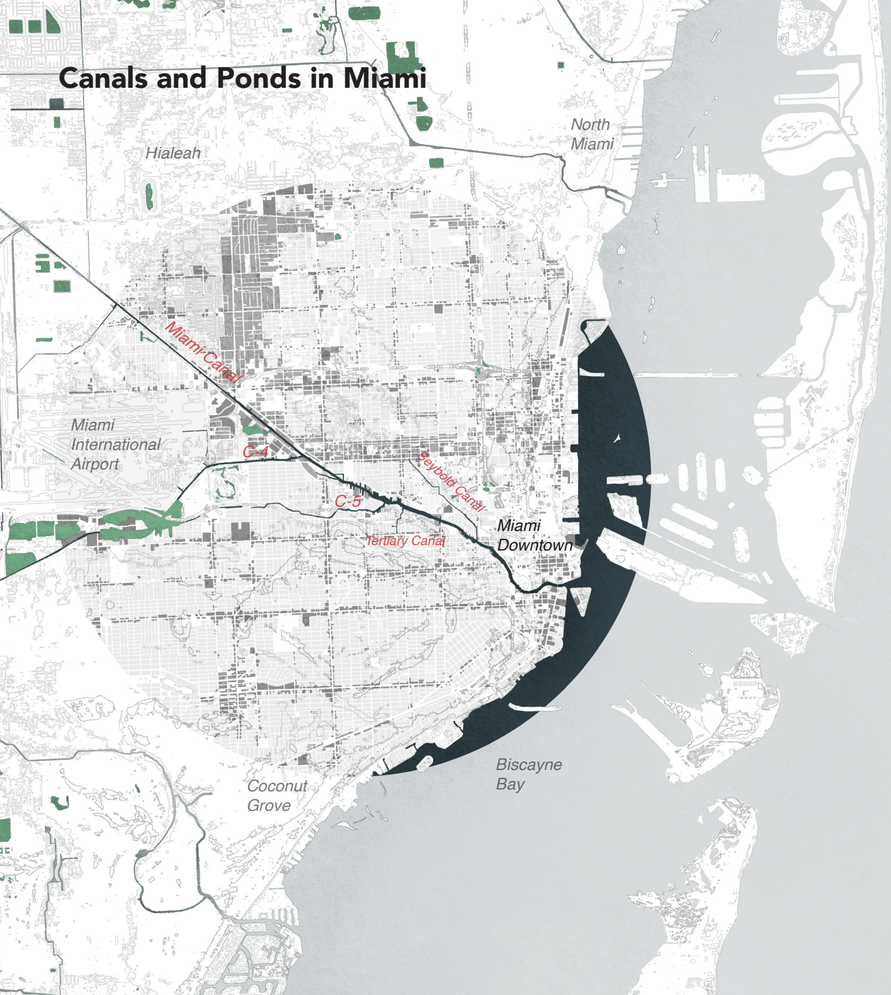
Here the author states the thesis concept: To generate future design that tests out the co-existence of city and the floodplain. The important portions of a floodplain are explained, as well as how different edge conditions and land uses could adapt.

Better understanding of the places along canals is achieved by a series of transactions. By lists of observations, the author could make an evaluation of the canals and focus on one specific site with most intriguing condition for the future design of co-existence of the city and the floodplain.

Methods

1. Literature review of the functions of primary, secondary and tertiary canals in Miami area.
2. Site visit and documenting the places along canals in Miami.
3. Drawing transactions along the canals to represent the sense of dimension in the place.
4. Drawing diagrams to show typologies and their adaptations with flooding.
5. Mapping of flooding and land use in Miami to understand the sea level footprint and impacted areas.

Canals and Ponds in Miami



Primary Canal

Miami Canal (C6 Canal)

C4 Canal

C5 Canal

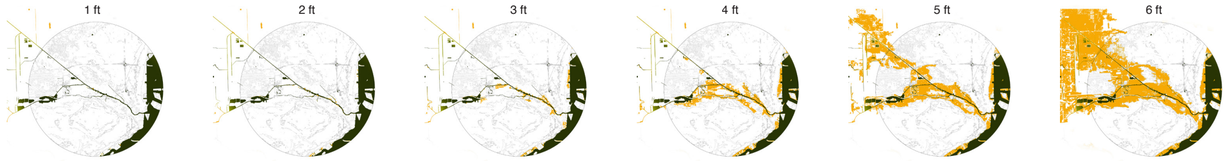
Secondary Canal

Seybold Canal

Tertiary Canal

Creek at Sewell Park

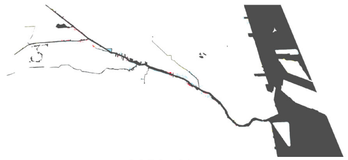
Levels of Flooding along Canals



Areas Impacted by Flooding

Step 1

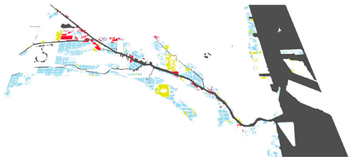
River's edge affected.



2050 2′

Step 2

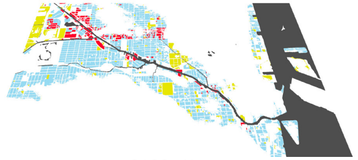
Riverside community inundated.



2080 4′

Step 3

City under shallow water.



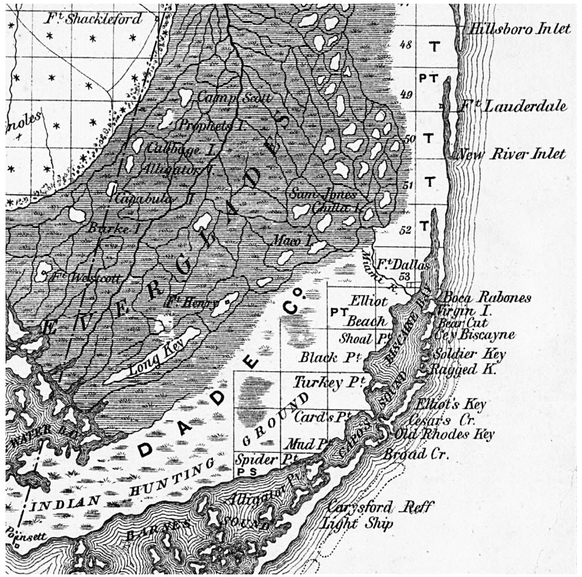
2100 6′

Residential Industrial Institutional

Miami is a city built with many canals and ponds. It is a major reason why it is vulnerable to flooding.
Miami Canal is one of the four major channels built in the 1910s to drain the original Everglades. C-4 and C-5 Canals are primary canals in Miami's water control system. Seybold Canal is secondary canal; there's one tertiary canal connected to Miami Canal. Lakes and lagoons are created adjacent to canals to help collect surface water.

Miami is going to be impacted by flooding in three steps.
First, in 2050, with sea level rise up 2 feet, river's edge is affected. Second, riverside community is inundated in 2080, with 4 feet sea level rise; impacted areas include low-lying residential areas, riverside industries and institutions. Third, in 2100 scenario, areas along Miami Canal are widely flooded, with important institutions suffering from flooding.

How Miami could behave like a floodplain



The 1859 map of Dade County shows its landscape with streams, islands and wetlands. It was more resilient to flooding than the hard surface city today.

Map resource:

Annual Report of the Surveyor General for 1859 (New York, NY: General Land Office, 1859)
Downloaded from *Maps ETC*, on the web at http://etc.usf.edu/maps [map #f3757]

Vision

The inundated future of Miami shows that nature is trying to take back its land and replace the hard surface city back to the original floodplain, which is a healthy state where flooding could fully express its power and dynamic.

This thesis is focused on testing ideas to bring back the functions of a floodplain to the existing hard surface city. Because canals are the deciding factors to let flooding into city, they will be the site to be further researched and designed.

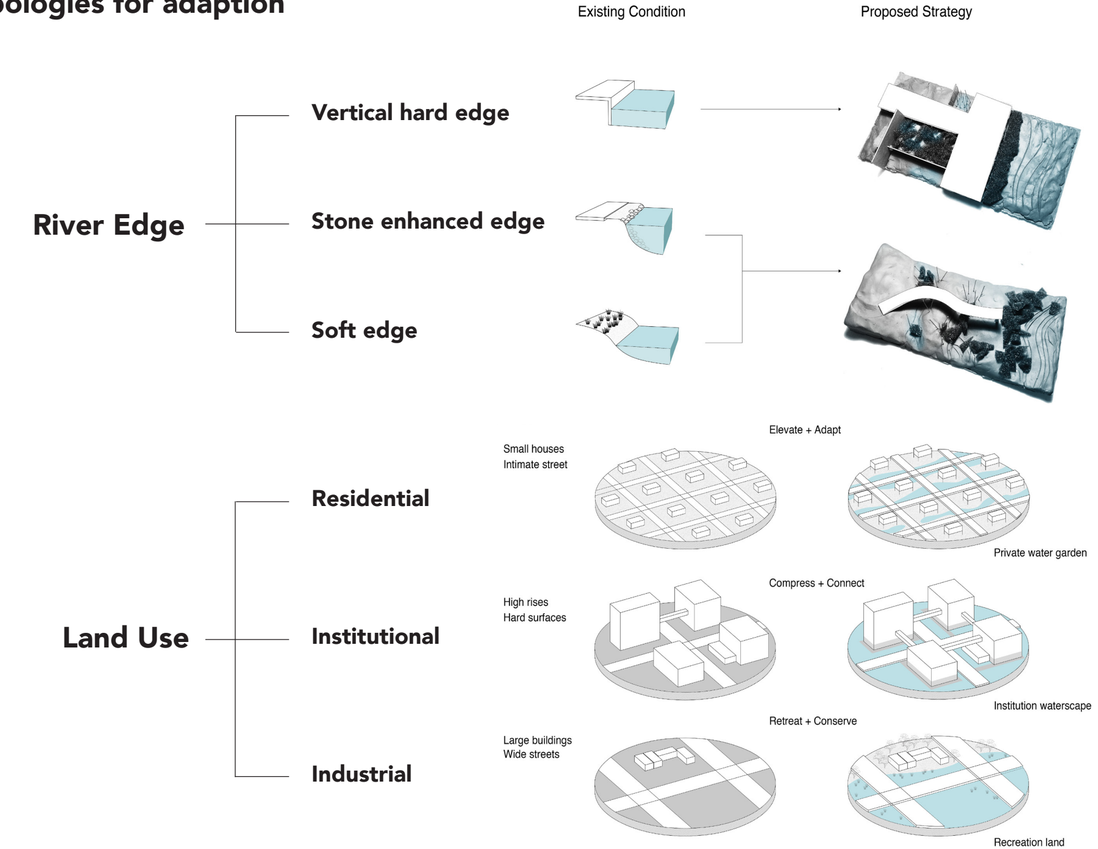
Floodplain

The floodplain during its formation is marked by meandering or anastomotic streams, oxbow lakes and bayous, marshes or stagnant pools, and is occasionally completely covered with water. [1]

The critical portions of a floodplain

- **the stream channel**
- **adjacent areas that are free of encroachment, no blocking of flood flow**
- **space to store flood waters**

Typologies for adaption



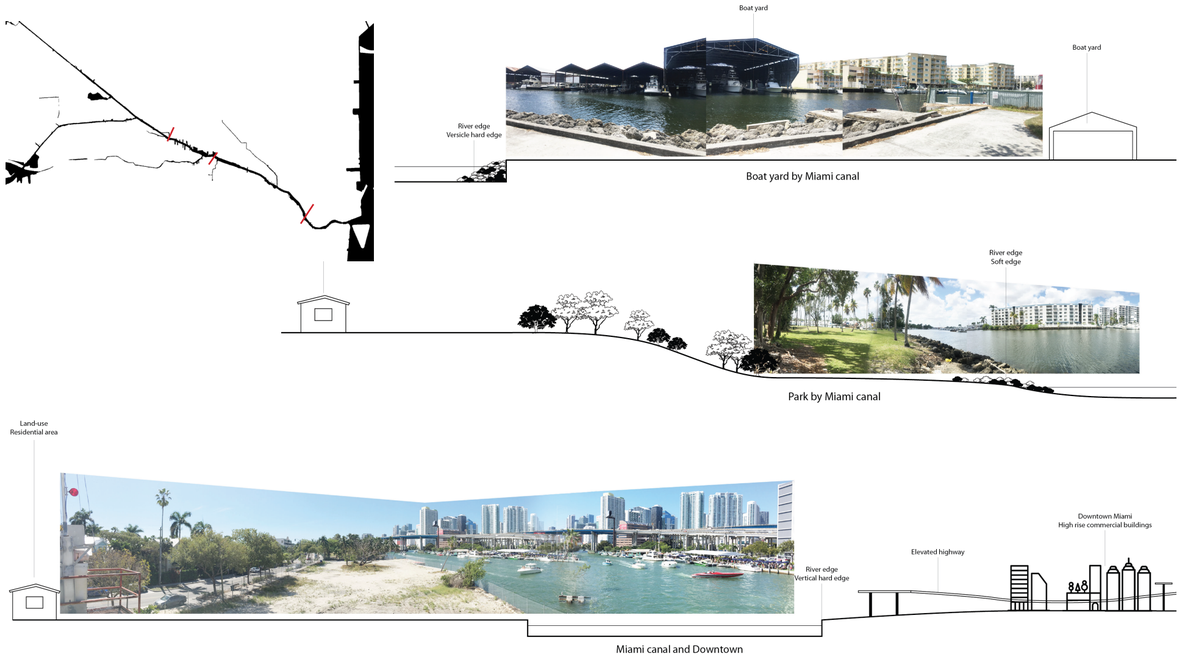
1. "Floodplain." Wikipedia, Wikimedia Foundation, 11 Apr. 2018, en.wikipedia.org/wiki/Floodplain.

Primary Canal - Miami Canal (C6)

Transactions along Miami canal show the existing city development along the river. Including the river edge type, accessibility and surrounding land use type.

River edge type:
- Vertical hard edge
- Stone enhanced edge

Dominating Land Use type:
- Industrial
- Commercial



Observations

Hard edge dominates along river

Miami canal is highly channelized, with vertical hard edge covering most of its riverbank. The use of concrete path is common, and sometimes enhanced with limestones.

Lack of riverside open space

Along the 5 miles of Miami canal in metropolis area, there's only 2 trails along the river which is only in downtown area, 2 under-used public open spaces, and 2 small public accessible parks. Despite of the river's historical importance in being the trigger of Miami's development, it seems that the river is not treated as an important place in citizen's lives.

Busy boatyard and river transportation

Unlike the conditions of pedestrian access, there's a lot of boat yards and boat ramps along the river. Traffic is busy on Miami Canal, with low bridges rising about every 10 minutes to let boats across.

Primary Canal - C4 and C5 Canals

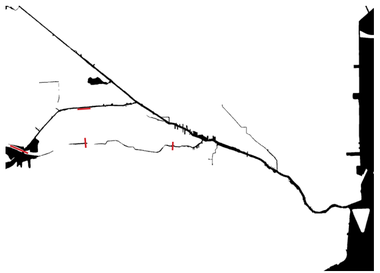
Transactions along C4 and C5 canal show the existing conditions of river edge and adjacent communities.

River edge type:

- Soft edge
- Vertical hard edge

Dominating Land Use type:

- Residential



Lagoon and surrounding community

Community adjacent to C-4 canal

C-5 canal

Open space by C-5 canal

Observations

No access along river

Along the 3 miles of C4 and 3 miles of C5 canal in the research area, there's no public access to the river. The only public space that people could see the water besides over a bridge is at an athletic field on C4, behind fences.

Backyard facing the canal

Single family house is the primary component of riverside communities. They all have their backyard facing the canal so no public access to water. From the sights on bridges and aerial photos, they either have a boat access with a vertical hard edge or a more natural soft edge on the river.

Poorly managed riverside condition

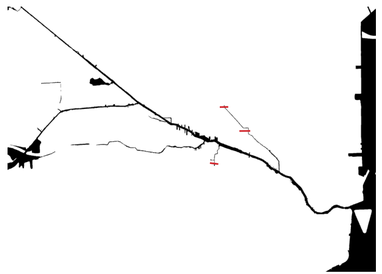
The riverside along city roads shows a poorly managed condition, with plants grow wildly and fallen trees untreated.

Secondary and Tertiary Canals

Transactions along secondary and tertiary canals show the existing river edge conditions and building scales of different land use.

River edge type:
- Soft edge
- Vertical hard edge

Dominating Land Use type:
- Industrial
- Residential
- Institutional



Industrial area by Seybold canal

Institutions by Seybold canal

Communities by tertiary canal

Observations

River landscape not well appreciated

There's sufficient space for people to enjoy the water view along the tertiary canal, but the spatial quality is not satisfying, with typical vertical hard edge and fences to block the river away.

Concerning water quality

In secondary and tertiary canals water is more stagnant. Pollution may come from urban runoff pumped there, untreated garbage and fallen leaves.

Sudden disappearance in urban hard surface

Canals are in a awkward condition that no actions are being made to make their functions more aware of. They only do one thing, to serve urban sewage, and force their way in the crowded and highly constructed urban environment.

Findings + Conclusions

After research about the functions of a floodplain and how river edge and land use typologies could adapt, the author takes further investigation about the conditions along Miami Canal, C4, C5 Canal, secondary and tertiary canal through a series of transactions. The future potentials of these canals could be evaluated, whether they are suitable as a design site as floodplain city in Phase Three.

Miami Canal is connected to larger hydrological systems that could be traced back to Lake Okeechobee. The area of concern is regional, which makes it less viable to be considered as an isolate canal system in Miami area. On the other hand, the existing boatyards and hard edges along it have more straight forward solutions toward future sea level rise: enhance and elevate. In some parts where residential areas are adjacent to the canal, there could be adaptions designed to living with water.

C4 and C5 Canal, although also part of longer canal systems, have a more typical condition within Miami area, with single-family one-story houses adjacent to them. In future scenarios, these houses will suffer from severe flooding. It makes more sense to retreat from those areas rather than adapt the whole urban system to future sea level and only buy them decades of time.

Secondary canal, the Seybold Canal, runs through a mixture of land use condition with different building scales; Those areas will be gradually inundated over time, Which makes it an interesting site to test the co-existing of floodplain and city. The river's existing water quality is concerning and it lacks a sense of identity in the urban setting. It calls for a design solution to solve all these problems.

In conclusion, areas along Seybold Canal are the most ideal site for Phase Three to test out the co-existence of city and floodplain.

Assessment

In Phase Two the author is able to take a stance on the future scenario to be dealt with and make the major issue of future vision clear. The canal conditions in Miami city area are also investigated to specify a design and test site for Phase Three.

The specific site to consider and design needs to be clarified and supported by in-depth analysis around Seybold Canal in Phase Three.

To have a more rational intervention, case studies could help the author in the design process in the next phase.

Phase 3 Testing

Proposals for Reviving Floodplain in Miami

Abstract

According to the findings of previous research, future flooding of Miami will start impacting canal's edge and riverside communities before taking over wide areas along canals. In this phase, the author takes the 2070 scenario of 3 feet sea level rise as the time scope to deal with.

To better understand the structures and functions of a floodplain, the author studies different aquatic conditions in a floodplain through sectional study and modelling. Then through a series of collage the author tests how these floodplain structures could be applied into urban fabric.

After analyzing the flooding impacted areas in 2070 and their potential to adapt to floodplain structures, it turns out that the confluence areas have more potential as design sites, which differs from the conclusion in phase two. In order to have a more diverse outcome, the author takes the confluence areas as final testing sites to explore how the city could change to accommodate more water, and what urban living will be in that proposed future.

Floodplain in South Florida. Structures like channels and backwaters are important components in a floodplain.

Picture source: https://traveldigg.com/everglades-national-park-wildlife-tourism-in-florida/

Introduction

At the begining of this phase, the concept of this thesis is stated: to revive floodplain structures in urban settings. Then it is followed by sectional studies to explain the structures in a floodplain, how people could occupy these spaces and what wild animals could live in these conditions.

The modeling of different aquatic conditions in a floodplain helps us to understand the spatial quality of these structures. Then, by collaging these structures with urban fabrics, we could get a sense of how these structures could meet with urban constructed surface, and what space it could create. Then the author could conclude the strategies of how to bring these structures into urban fabric.

The zoomed-in sites at confluences are chosen because they have the best potential to apply more strategies. Two detailed site designs are carried out to explain the author's approach toward how the city could change to accommodate more water.

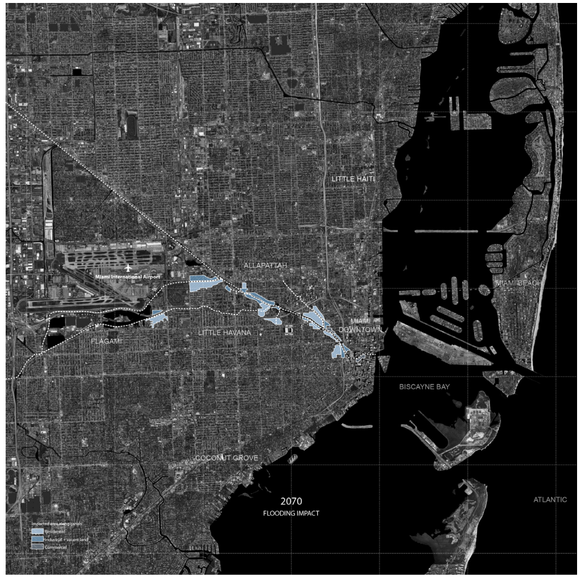
Methods

1. Sectional study of critical structures of a floodplain.
2. Modelling of five types of landforms and aquatic conditions in a floodplain.
3. Collage study of how floodplain structures meet with urban fabrics.
4. Mapping and diagrams of proposed intervention.
5. Sections and perscpective views to represent proposed vision.

2018 Existing Canals

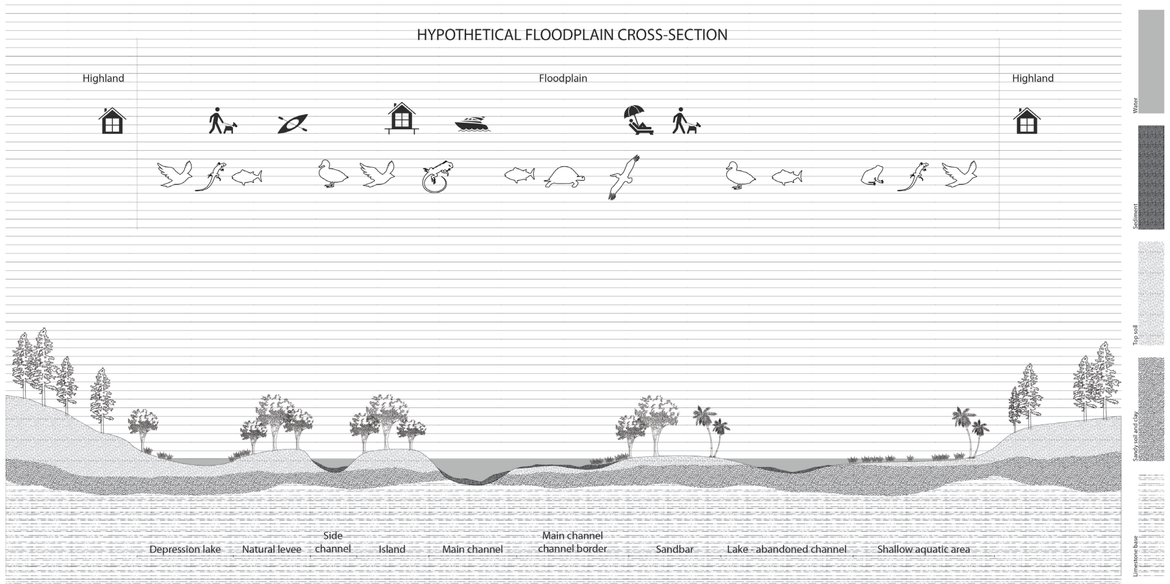
Canals are highly channelized in Miami. There's very little access to the canal, and residential is the dominating landuse along the canals.

2070 Scenario with 3 feet Sea Level Rise



In 2070, sea level rise will have caused flooding in riverside communities. With one more foot of rise, important institutions and main streets will be impacted.

Sectional Studies of Floodplain Structures



Channel

Main channel - navigation channel
Main channel - channel border
Secondary channel
Tributary channel

Backwater

Lake - abandoned channel
Lake - depression lake
Shallow aquatic area

Models of Floodplain Structures

Channel
Enlarge canal border

Channel
Insert River Groyne

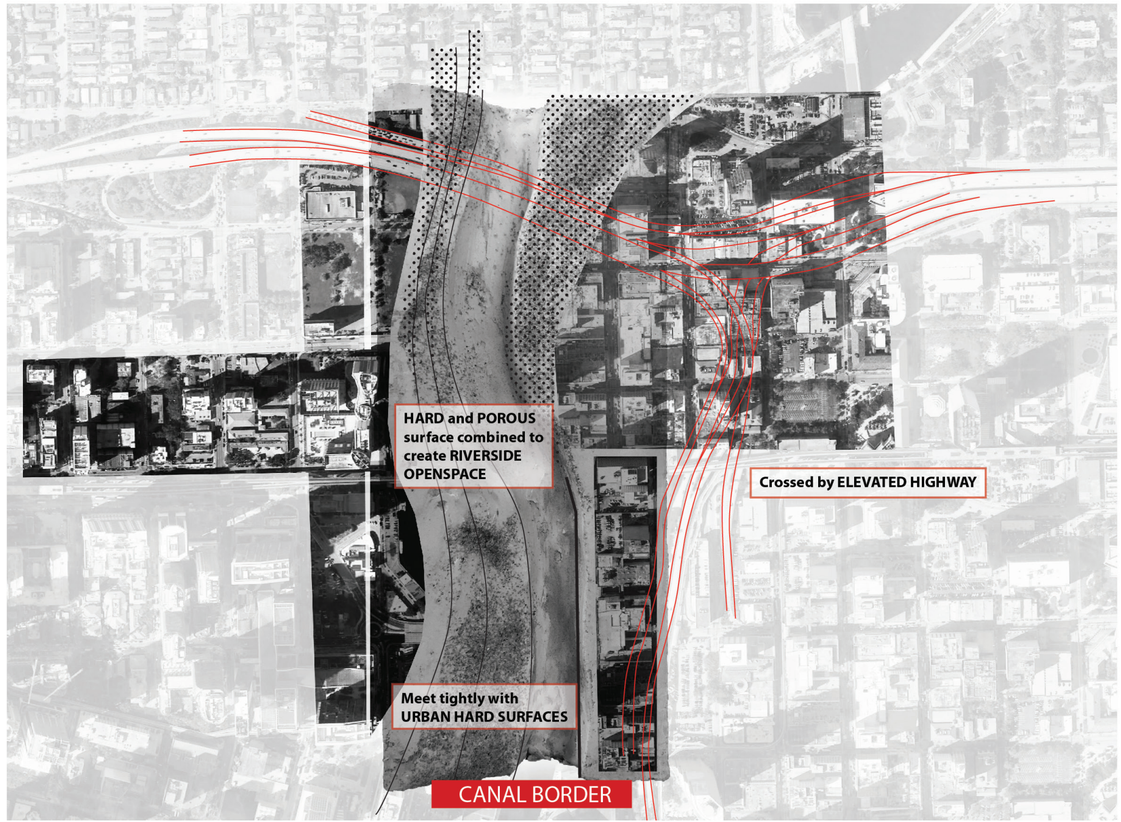
Channel
Braided Secondary Rivers

Backwater
Depression Lakes

Backwater
Shallow Aquatic Area

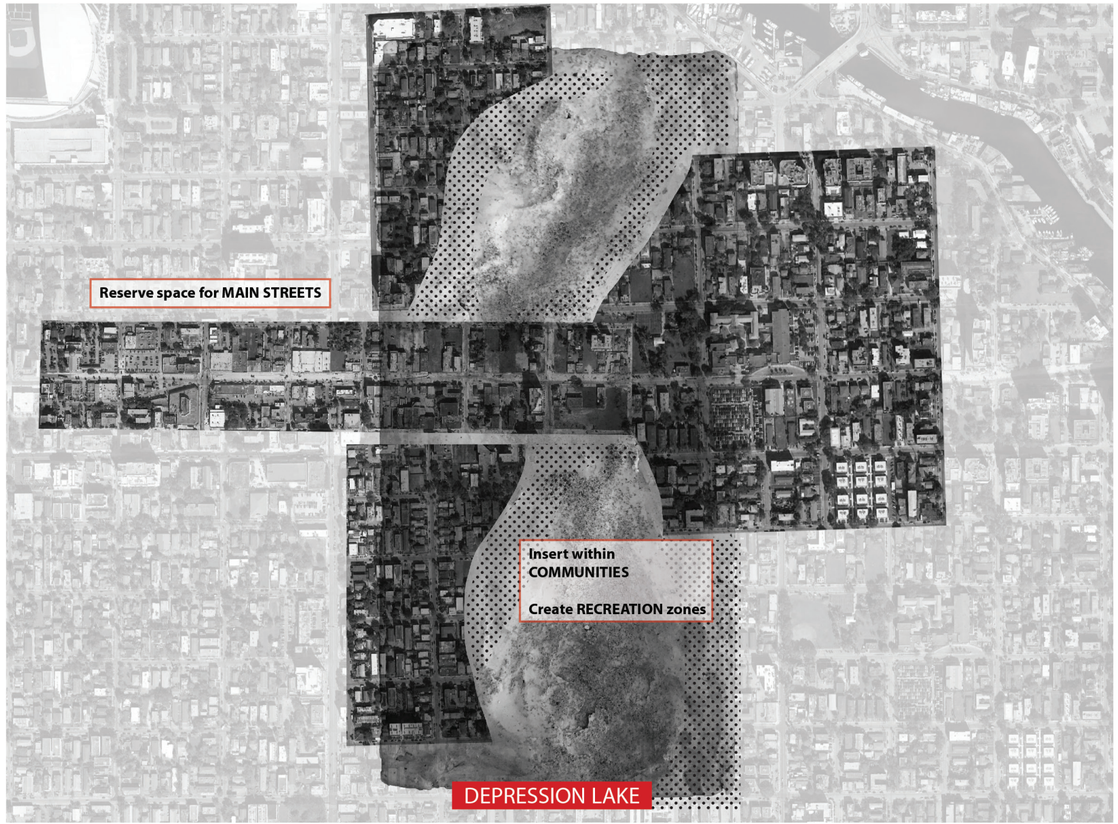
Casted plaster models showing the landforms of different aquatic conditions in a floodplain.

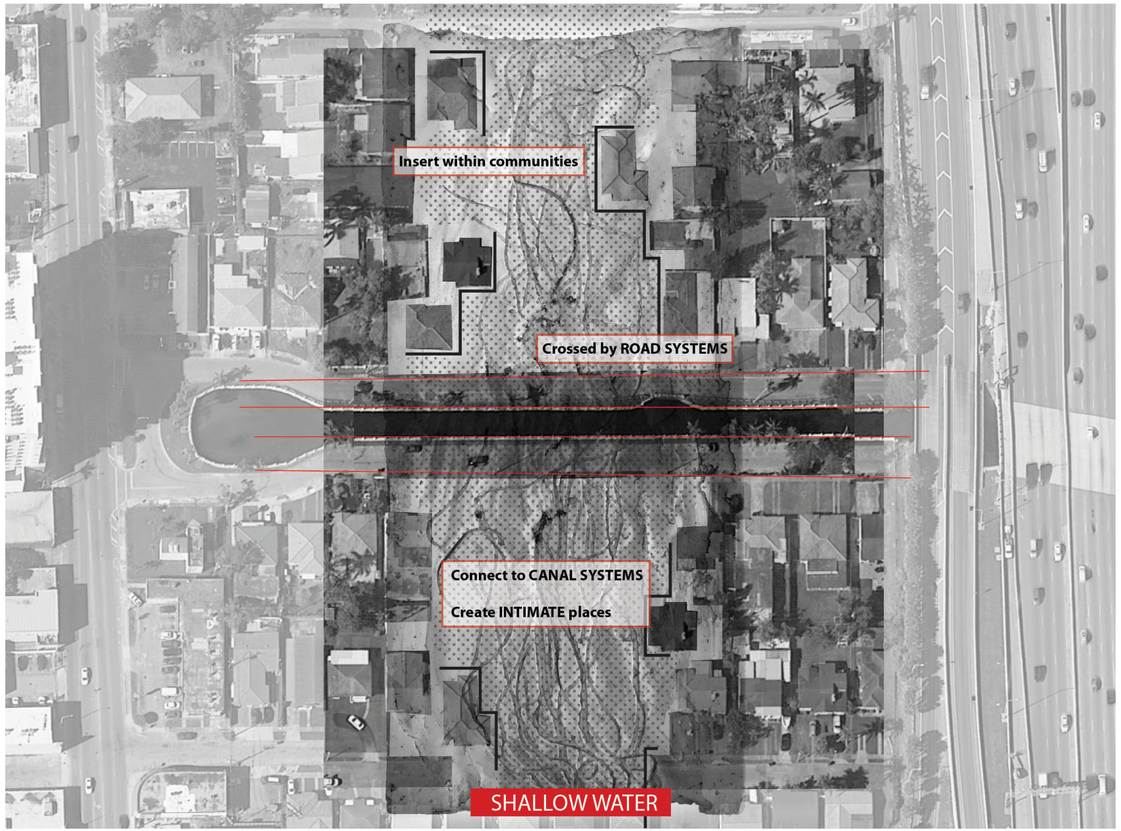
Collage Floodplain Structures with Urban Fabric




Crossed by
ELEVATED MAIN ROAD
Integrate groyne
with ROAD GRID
Use sediment area
as small parks
Combine with
GREEN SPACE
RIVER GROYNE


Reserve green islands for
HABITAT and RECREATION
Crossed by ELEVATED HIGHWAY
Accessed by BOAT/ROAD system
Create a
SMOOTH TRANSFORMATION
from riverside communities
to braided rivers
BRAIDED RIVERS


Reserve space for MAIN STREETS
Insert within
COMMUNITIES
Create RECREATION zones
DEPRESSION LAKE

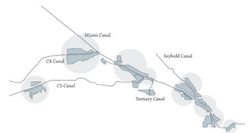

Insert within communities
Crossed by ROAD SYSTEMS
Connect to CANAL SYSTEMS
Create INTIMATE places
SHALLOW WATER

Site Catalog

■ Linear impacted area along canals

Existing land use:
Commercial
Industrial + Vacant land
Residential

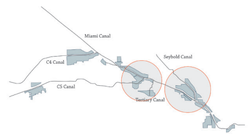
Applicable Strategy:
Enlarge canal border
Create shallow water area
Build river groyne



■ Wide impacted area at confluence

Existing land use:
Residential

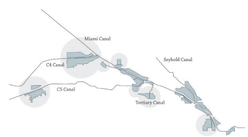
Applicable Strategy:
Enlarge canal border
Build river groyne
Create braided rivers
Create shallow water area
Build depression lakes



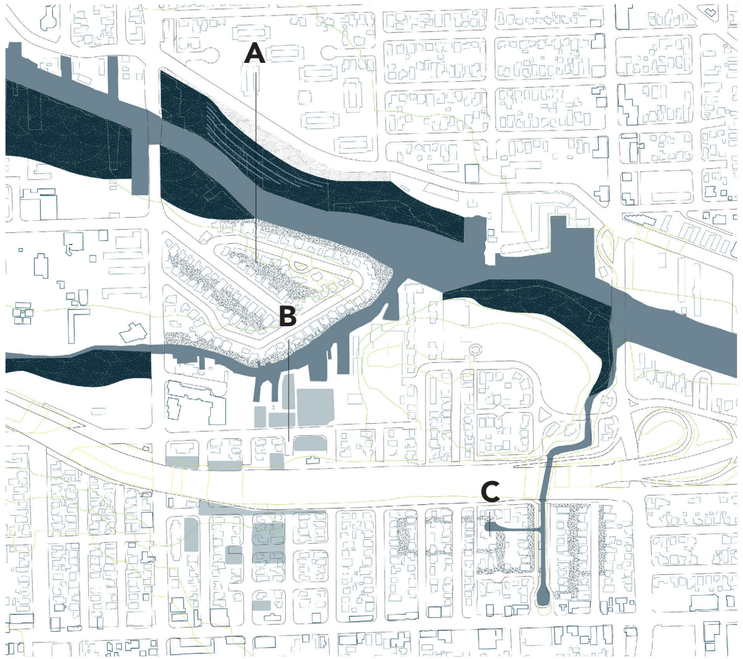
■ Wide impacted area away from canals

Existing land use:
Residential

Applicable Strategy:
Create shallow water area
Build depression lake



Site Design

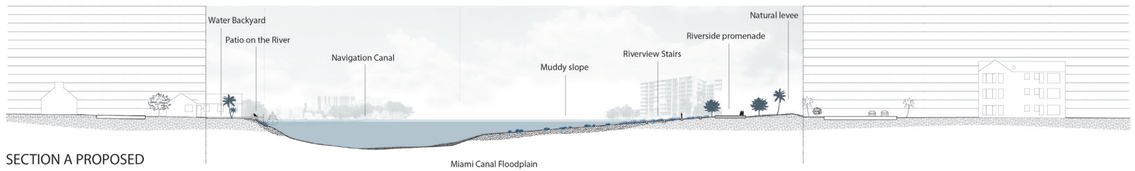


C5 - Miami Canal Confluence

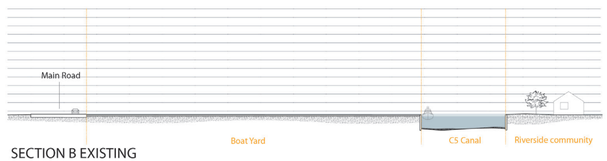
New canal border | Shallow water area | Depression lake | Navigation canal

Sections of C5 - Miami Canal Confluence

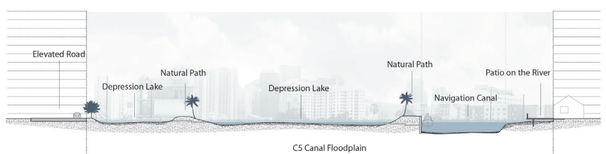
SECTION A EXISTING



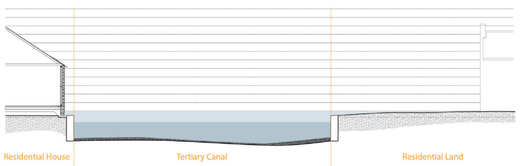
SECTION A PROPOSED



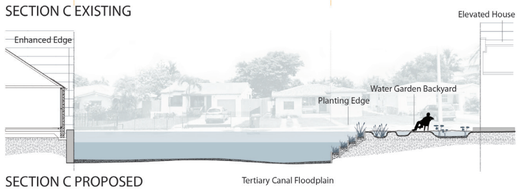
SECTION B EXISTING



SECTION B PROPOSED

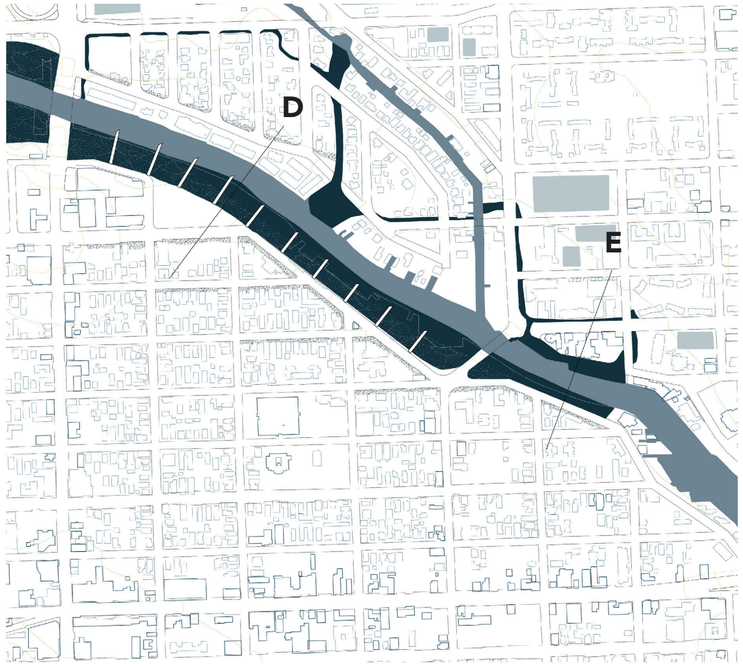


SECTION C EXISTING



SECTION C PROPOSED

Site Design

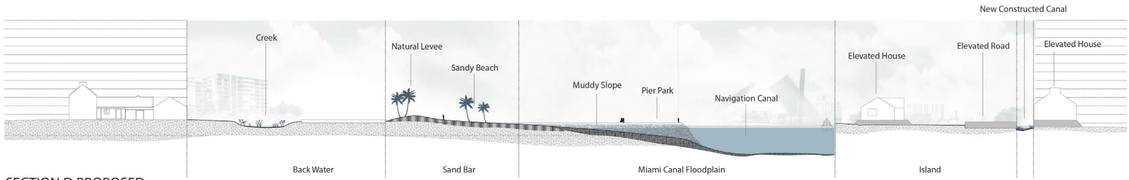


Seybold - Miami Canal Confluence

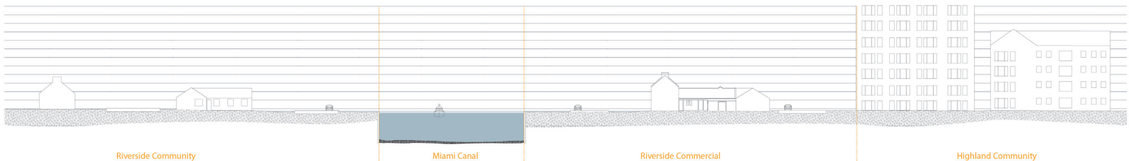
River groyne | New canal border | Shallow water area | Depression lake | New constructed canal

Sections of Seybold - Miami Canal Confluence

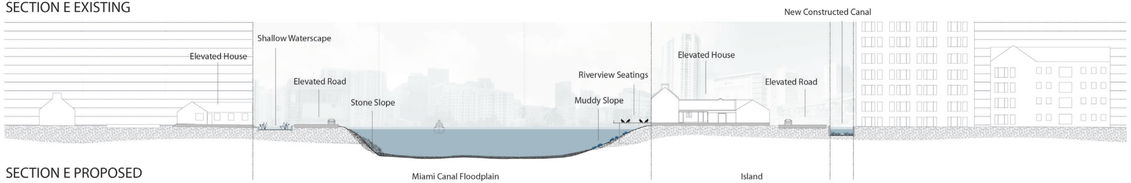
SECTION D EXISTING



SECTION D PROPOSED



SECTION E EXISTING



SECTION E PROPOSED


WELCOME
TO MIAMI 2070

Findings + Conclusions

Although the land of Miami is currently occupied with vast construction, it is not impossible to insert floodplain structures to create space for more water. Strategies like enlarging canal border and inserting river groyne could work by replacing boatyard and vacant land along the canals; new canals could be constructed within communities to create a more diverse waterway; depression lakes could make use of hard surface and low population density land; shallow water area could be applied along roads or residence houses without affecting the existing construction.

Universial principles could be pulled out from the tests in this phase:
1. Replace hard edge and riverside hard surfaces with vegetated edges or permeable public spaces.
2. Adapt riverside housings to open their frontyards or backyards toward canals and develop shallow water areas.
3. Reserve space for depression lakes within the communities by making use of hard surfaces like parking lots.
4. Protect important institutions and main streets form further flooding by elevating and adding natural or constructed levees.

Apart from the increased capacity of water, the proposed scenario also has a great impact on urban living. More spaces along canals are reserved as public open space, and waterscapes will become major components in the environment of riverside communities.

This phase gives suggestions about the first step Miami could take to transform into a more resilient city. These strategies are focused on the areas along the canals, they could deal with flooding problems projected in 2070. With more intense sea level rise projected after 2070, these strategies should be followed by a series of further investigating and testings on broader areas.

Assessment

In Phase Three the author clarifies the concept and the time scope of this thesis. The structures of a floodplain and the types of impacted lands in Miami is researched and explained.

Then the author carries out a series of form studies of different floodplain structures and tests them by collaging them with urban fabric. They are interesting spatial studies and functioning solutions to cope with flooding issues in 2070 scenario.

However, the potential of how this thesis concept could connect tightly with people and communities is overlooked. It could provide a refreshing point of view if the author could give a systematic proposal based on working with proposals rooted in communities rather then working primarily with spatial design.

Overall Assessment

Final Conclusions

Miami is vulnerable to flooding because of the tension of its land and the sea level. The resource of its flooding is tidal flooding, storm surge, precipitation and upstream runoff. All these floodings will become more intense if the sea level rise is as projected in future scenario. It could be concluded that the rising sea is the major threat for the future of Miami.

This thesis identifies a unique condition in Miami: The threatened areas by rising sea level are not just coastal, but also inland areas along the canals. The author analyzes detailed conditions along canals, and finds out that there are great potentials to create more space for water, such as hard edges, hard surfaces along canals, and spaces in residential land use to store water.

After the author studies the critical structures in a floodplain, and tests the combination of these structures and urban fabric, spatial solutions are given to adapt canal's edge and riverside communities to hold more water. This set of solutions is a first step of the whole process of realizing the concept of a floodplain city.

By enabling further water capacity of the canals, the spaces along canals are reserved as public open space, the backwater areas in communities will become community parks that are parts of people's living environment. This provides an amazing scenario where people could live with sea level rising. It is inspiring for further adaption in wider urban area to improve the urban living while adapting to hold more water.

Final Assessment

Questions answered
Through the research in phase one and two, and tests in phase three, this thesis is able to answer the following questions:

Phase one
1. Why is Miami so vulnerable to flooding?
2. Where does the water come from?
3. Where are the areas first impacted by sea level rise?

Phase two
4. How's the condition in these areas?
4. What future scenario is the context of this thesis? Why?

Phase three
5. What are the structures of a floodplain?
6. How could these structures be combined with urban hard surface?
7. How could these spaces intervene with urban life?

Effectiveness of schedule
The schedule in phase one is mostly focused on gathering existing research. It could be better to begin the personal take earlier in this phase, so it would save the effort of defining directions in phase two.

In phase two, a lot of work was done to explain the conditions along canals. If there had been more work to analyze and catalog these conditions, there would be more smooth transitions from the investigation in phase two to the tests in phase three, so the criteria would be more clear to enlighten the decisions in phase three.

In phase three, the logic of applying thesis concept to a specific site is clear, and the schedule works out well.

Major adjustment along process
There is a major adjustment in this thesis, from a conceptual approach in phase two to a more sited design in phase three. This helps the author to develop specific strategies of a certain place rather then stay in theory and concept.

What's the nest step
Next step of this thesis is to further understand what it means to people and community to realize the author's vision, to move beyond spatial interventions and form studies, and propose a comprehensive proposal rooted in the benefits of people's lives and the overall well-being of a community.

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