# ABSTRACT

Title of Thesis: RETHINKING DEVELOPMENT IN EAST NEW ORLEANS

Austin Van Register, Master of Architecture, 2023

Thesis Directed By: Professor, Ralph Bennett, MAPP

With the present issue of climate change, dangerous flooding events will become an issue that many communities must grapple with. New Orleans is one such city with a long history of inundation. After Katrina, neighborhoods were devastated by a failure of the levee system. This caused many residents to reflect on the viability of a city in constant danger of flooding. Investigating how communities in the past handled flooding events will help inform a path forward. The Louisiana region has a rich history of building vernaculars and settlement patterns. Comparing the strategies used by deltaic communities that share similar issues to New Orleans can inform a settlement pattern that addresses the unique challenges that the city faces. This thesis aims to create a neighborhood plan that addresses the unique climatic factors of East New Orleans, while creating a more cohesive community within the disjointed settlements.

# RETHINKING DEVELOPMENT IN THE NEW ORLEANS DELTA

by

Austin Van Register

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Table of Contents

List of Figures

## Introduction

New Orleans is one of the most unique cities in the United States. A former French colony, the city has been one of the great historic cities of the south. Its future, however, is plagued by environmental concerns. Most of the city is well below sea level due to extensive infrastructure and development as the city grew over the years. Drainage and flood defense projects were proposed and implemented all throughout the city's history, but the success of these projects is constantly called into question.

Hurricane Katrina was one event that caused many to re-evaluate the long term viability of New Orleans. The hurricane caused storm surges that elevated water levels of the Mississippi river by 16 feet. These swells overwhelmed the floodwalls, and caused two massive sections of the industrial canals floodwalls to fail These breaches flooded most of East New Orleans neighborhoods, destroying homes and businesses. In its wake, three quarters of all New Orleans residents were scattered across the country.[1]

The immense damage and loss of life called into the question of the future of the city. Though many of the lower lying neighborhoods were devastated, communities located on higher ground only suffered damages due to wind. An idea began to spread; should New Orleanians relocate to higher ground? This idea of shrinking the cities footprint came into the public eye with the publication of the "green dot map". This map designated areas that needed to prove viability for redevelopment, as well as approximate zones where the city would re-zone as green

[1] Campanella, Richard. *Delta Urbanism - New Orleans*. American Planning Association, 2010.

space.[2] This upset residents living in these areas deemed unfit for rebuilding, particularly compounded by the fact that many of these neighborhoods were minority communities. This caused a large mobilization effort, with residents advocating for their right to return to their homes. The plan was ultimately scrapped, and the cities footprint remained as it was before Katrina.

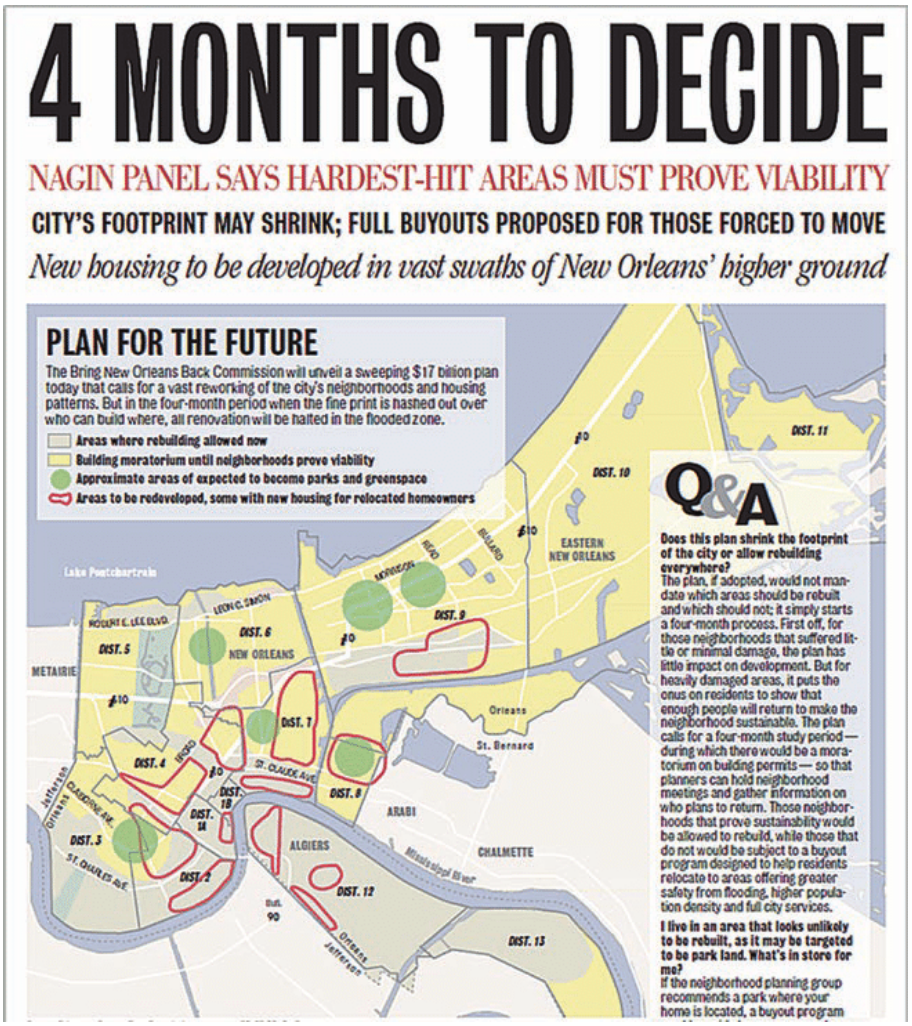


*Figure 1 : Green Dot Map detailing the recovery plan in New Orleans. (Source: ResearchGate)*

[2] Lamb, Zachary. "Connecting the Dots: The Origins, Evolutions, and Implications of the Map That Changed Post-Katrina Recovery Planning in New Orleans." *Louisiana's Response to Extreme Weather* (2020): 65–91.

These events call into question the development patterns of New Orleans. With many of its residents well below the water level, it is not so easy to move everyone to the already scarce higher ground. But rebuilt communities cannot ignore the ever-present question, what if it happens again? To find a new way forward, an effort must be made to understand the environment that caused this catastrophe. The geography and hydrology of the delta, the historic and modern development patterns of New Orleans, and the successes and failures of flood damage prevention should inform the future developments of the city, to avoid making the same fatal mistakes that allowed Katrina to happen.

## Natural History of New Orleans

### The Mississippi River Delta

New Orleans is located within the larger geological structure known as the Mississippi River Delta. A delta is formed when a river empties its accumulated sediment into another body of water. The Mississippi River collects sediment from 31 states, and two Canadian provinces.[3] It then deposits the collected sediment once it reaches the Gulf of Mexico, creating swampy landmasses that spread throughout the coast of Louisiana. These landmasses are where New Orleans, and other coastal towns, are built on. The sediment naturally accumulates along the river bends, creating high points in an otherwise low-lying environment. This creates suitable land that is naturally the highest, safest spots for development.

Within the delta environment, flooding plays an important ecological function. When water levels rise above the natural levee walls along the riverbanks, the landmasses beyond are

[3] "How The Delta Formed." n.d. Restore the Mississippi River Delta. https://mississippiriverdelta.org/our-coastal-crisis/how-the-delta-formed/.

put underwater. Though flooded, the accumulated sediment in the water replenishes the soil with rich nutrients.[4] This process also can happen in gaps in the natural levees, called distributaries. These distributaries not only supply the backswamps with freshwater and sediment, but also create their own natural levees secondary to the main natural levees around the primary river.[5] This, in a nutshell, is how a delta system is formed.

Storm surges, surprisingly, provide a constructive element to the deltas geography. Hurricanes bring storm surges, which overtop the natural levees created by the river. This is destructive to anything manmade, but it also floods the area with new, rich sediment that wouldn't have been able to be deposited otherwise.[6]

The river itself is a dynamic object that changes course over many centuries. A rivers path ebbs and flows with the landscape. Because of this, a delta's geography undergoes rapid change. This is an issue Louisiana is dealing with. The current path of the Mississippi river is not the natural, preferred path. The Mississippi wants to move towards the Atchafalaya River, as it provides a shorter, more direct path into the Gulf of Mexico.[7] Manmade intervention keeps this diversion from happening, as the environment and economy of New Orleans is largely dependent on the Mississippi river maintaining its current course.

This is normal in a delta environment. A natural delta cycle involves three stages: growth, stability, and decay. In the beginning, a new river starts to deposit sediment, creating a new

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[4] Perrin, Grissom. 1957. "The Mississippi Delta Region." *Yearbook of Agriculture*, 524–31.

[5] Campanella, Richard. *Delta Urbanism - New Orleans*. American Planning Association, 2010. 11

[6] Coleman, James M., Harry H. Roberts, and Gregory W. Stone. "Mississippi River Delta: An Overview." *Journal of Coastal Research* 14, no. 3 (1998): 699–716. http://www.jstor.org/stable/4298830.

[7] Ibid.

landmasses in the process.[8] The Atchafalaya River is currently in this stage of the cycle. This landmass creation eventually stabilizes, where the hydrologic efficiency slows down. Eventually, as the river decides on a more favorable course, the delta formation starts to degrade as the river abandons its previous path, starving the area of new sediment. The local hydrology of the delta starts to rework the environment, creating lakes and islands, while submerging the existing land.[9] The Mississippi River, left to its natural devices, would be in the decay state of this cycle, abandoning its existing path with preference to the Atchafalaya River.

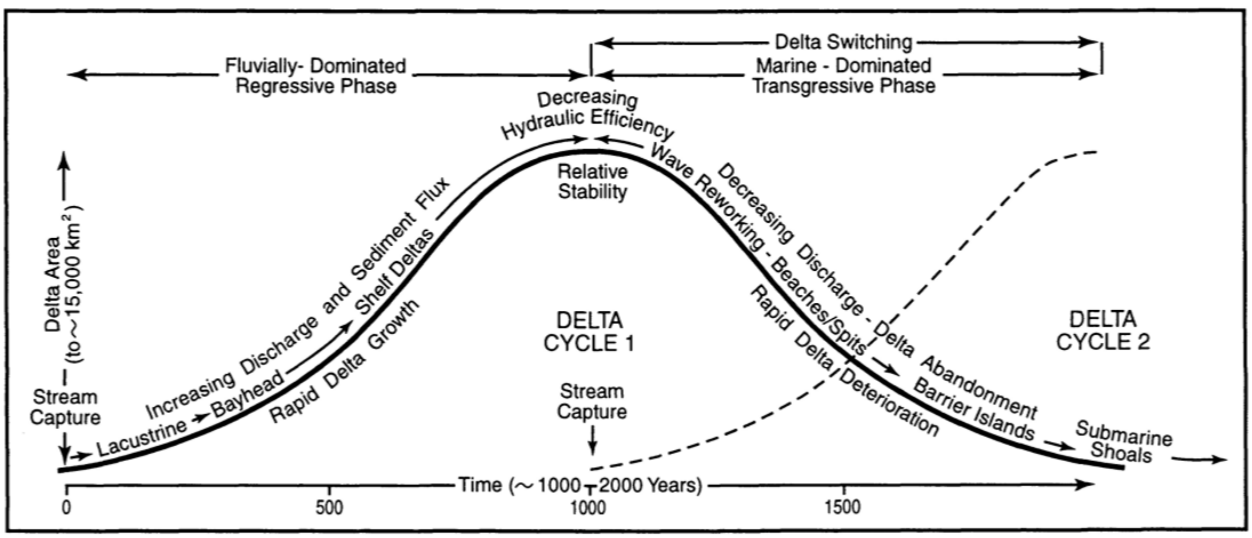


*Figure 2 : Graphic Representation of a Delta Cycle (Source: Journal of Coastal Research)*

## Current Ecological Issues

The current situation of the Mississippi river, and the coastline, is dire. In Louisiana, An estimated 25 to 35 square miles of wetlands are being lost each year.[10] There are a multitude of reasons why Louisiana is rapidly losing land, one being rising sea levels. NOAA released a

[8] Ibid.
[9] Ibid.

[10] Campanella, Richard. *Delta Urbanism - New Orleans*. American Planning Association, 2010. viii

report in 2022 that stated sea levels around the gulf coast could rise around 1.5 to 2 feet by the year 2050.[11] This rapid sea rise submerges islands and landforms, reducing the amount of usable land for both the ecology and the economy of Louisiana.

As previously stated, a natural river delta environment needs a constant supply of sediment brought in through the river. The Mississippi, however, has undergone a massive amount of engineering that interrupts the natural cycle. After a destructive flood in 1927, the Flood control act of 1928 was responsible for the formation of the Mississippi River and Tributaries project.[12] This legislative act financed public works along the river to protect nearby settlements from devastating floods, as well as upkeep for a well-maintained navigation channel. In total, this act created 2,303 miles of levees along the Mississippi River, protecting vast swaths of land previously at risk for flooding.[13] Though it provide local protection, the levees have an adverse effect on the coastal wetlands downstream. Instead of depositing rejuvenating silt onto the delta plains, the engineered levee walls channel all the sediment out into the Gulf of Mexico.[14] This means the already sinking land has no natural way of replenishing itself, causing a loss of landmass that would naturally have enough sediment coming in to stay above water. This, along with the loss of vital nutrients, means that the wetlands surrounding New Orleans are not getting the sediment they need to stay healthy.

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[11] Chavez, Robby. 2022. "How Rising Sea Levels Threaten the Lives of Louisiana's Coastal Residents." PBS. 2022. https://www.pbs.org/newshour/nation/difficult-conversations-how-rising-sea-levels-threaten-the-lives-of-louisianas-coastal-residents.

[12] "History of the Lower Mississippi Levee System." n.d. USACE. https://www.mvd.usace.army.mil/About/Mississippi-River-Commission-MRC/Mississippi-River-Tributaries-Project-MR-T/Levee-Systems/.

[13] Ibid

[14] O'Neill, Karen M. "Broken Levees, Broken Lives, and a Broken Nation after Hurricane Katrina." Southern Cultures 14, no. 2 (2008): 89–108. http://www.jstor.org/stable/26391665.

These Levees also effect lake Pontchartrain, located north of New Orleans. The river not only provides sediment, but also fresh water. Without a constant supply of fresh water, the salinity of lake Pontchartrain increases. This stresses the plants and animals in the swamps, as they did not evolve to deal with seawater. To make things worse, the construction of the Mississippi River Gulf Outlet also allows saltwater to penetrate deeper into the river delta.[15] This creates a feedback loop, where loss of wetland creates more erosion, which allows more salt water to intrude into the environment, which causes a loss of even more wetland.

## Current Solutions

While the rapid loss of wetlands is concerning, the state of Louisiana is working toward solving this crisis. Over the years, local, state, and federal government bodies passed legislation aimed toward solving this issue. One major piece of legislation is the Coastal Wetlands Planning, Protection and Restoration Act (CWPPRA). Established in 1990, the CWPPRA authorized the federal government to fund projects that protect Louisianas rapidly eroding wetland coast.[16] Under this legislation, tasks forces were created to begin work on projects that revitalize at risk wetland areas. Multiple strategies have been implemented, including freshwater reintroduction, sediment diversion, outfall management, marsh creation and management, and hydrologic restoration.

The freshwater reintroduction strategy aims to replicate the natural, delta forming cycle by strategically diverting freshwater from the river into the outlying swamps. At key places,

[15] "The Pontchartrain Basin." n.d. The Louisiana Coastal Wetlands Planning Protection and Restoration Act. https://lacoast.gov/new/About/Basin_data/po/Default.aspx.

[16] United States. Government Accountability Office. 2007. *Coastal Wetlands: Lessons Learned from Past Efforts in Louisiana Could Help Guide Future Restoration and Protection : Report to Congressional Addressees*. Washington, D.C.: U.S. Govt. Accountability Office. https://www.gao.gov/products/gao-08-130

water is funneled through a gate out of the river and into the swamp. The goal is to replenish sediment, introduce nutrients, and prevent excess saltwater intrusion. An example of this is the River Reintroduction into Maurepas Swamp project, which aims to rejuvenate 45,000 acres of swamp, just west of lake Pontchartrain.[17] The US Army Corps of Engineers are surveying the area to investigate possible mitigation measures. Once completed, it will not only improve the health of the wetlands, but it will also strengthen the natural flood protecting elements that the swamp provides.

Another strategy being implemented is sediment diversion. This type of project aims to redirect sediments in an effort to build more landmass within the wetland. This can be done by cutting a gap in the levee wall, allowing large amounts of river water to flow into the swamp. The West Bay diversion project is an example of this strategy. Built in 2003, the diversion was projected to restore over 9,000 acres of marshland.[18] This diversion, however, fell short of its goal. Due to an inadequate amount of sediment, paired with interference with a nearby shipping channel, the project had multiple setbacks. In 2008, the project was shut down because the constant dredging of the nearby channel costed a considerable amount of money.[19] It has since been re-opened, but at a lesser scale than originally proposed.

[17] Henkel, Theryn. 2018. "What Is Needed to Protect and Restore One of the Gulf Coast's Largest Swamps?" Restore the Mississippi River Delta. 2018. https://mississippiriverdelta.org/what-is-needed-to-protect-and-restore-one-of-gulf-coasts-largest-swamps/.

[18] United States Government Accountability Office. 2007. *Coastal Wetlands: Lessons Learned, 16.*

[19] Rodi, Rachel. 2013. "Dredging of Pilottown Anchorage Begins, Benefitting the CWPPRA West Bay Diversion." US Army Corps of Engineers. 2013. https://www.mvn.usace.army.mil/Media/News-Releases/Article/473968/dredging-of-pilottown-anchorage-begins-benefitting-the-cwppra-west-bay-diversion/.


*Figure 3 : Image of the West Bay Sediment Diversion. (Source: USACE)*

Outfall management can be seen as a combination of the two strategies above, but in a more sophisticated manner. This strategy can include gates, locks, cuts, and canal plugs to manage the flow of water and sediment into the wetlands. The Caernarvon Diversion Outfall Management project is an example of this strategy in action. The outfall was built in 2002 to restore 800 acres of wetland.[20] This projects success is debatable, as a study found that there was no statistically significant gain, or loss, of landmass during the period the project was active.[21]

[20] United States Government Accountability Office. 2007. *Coastal Wetlands: Lessons Learned, 17.*
[21] White, John R., Brady Couvillion, and John W. Day. 2023. "Coastal Wetland Area Change for Two Freshwater Diversions in the Mississippi River Delta." *Ecological Engineering* 186. doi:10.1016/j.ecoleng.2022.106819.

Though no land was lost, none was gained either, falling short of its original goal of growing the wetlands.

The environment of New Orleans can be seen as an ever-changing landscape. The delta is undergoing hydrological and geological shifts, both natural and manmade. Current efforts to mitigate the worst of the effects are underway but are not always successful. The delta environment is hard to tame, as even the slightest change in hydrology can result in massive shifts in landmass. Settling in these environments is a massive undertaking, and the city of New Orleans has dealt with the challenges of the delta since the very beginning.

## Urban History of New Orleans

### Colonial Origins

The French explorer Rene-Robert Cavelier, sieur de La Salle laid claim to the territory of Louisiana in 1862. Upon his visit, he envisioned a city "upon the first high ground above the mouth".[22] Even from its early beginnings, elevation was a prime focus in urban development. Its strategic location at the mouth of the Mississippi was of great interest to the French. In 1698, two brothers by the name of Iberville and Bienville were instructed by a French minister, Louis Phélypeaux, comte de Pontchartrain, to set sail for Louisiana to establish a colony along the banks of the Mississippi River.[23] There was much debate as to where this new settlement will be established. Iberville wanted the city to be east near Biloxi Bay, while Bienville advocated for a settlement along the banks of the Mississippi, further west. After much debate, the colony of New Orleans was established in 1718 along the Mississippi river.[24]

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[22] Kendall, John. *History of New Orleans*. Vol. 1. 3 vols. Chicago: The Lewis Publishing Co., 1922. 10
[23] ibid, 12
[24] Ibid.

Its early days, the newly formed colony was met with environmental challenges. A flood in 1719 caused the French to reconsider Bienville's decision to settle so close to the river. A hurricane in 1722 leveled thirty of the meager huts built on the site. Despite these setbacks, the colony continued to develop. A city plan for New Orleans was developed by Pierre Le Blond de la Tour, and Adrien de Pauger.[25] It consisted of a block plan, eleven blocks wide by six squares deep. (Fig. 1) Each of these squares was surrounded by a drainage ditch, which fed into a canal

[25] Maygarden, Benjamin. National Register Evaluation of New Orleans Drainage System, Orleans Parish, Louisiana. EARTH SEARCH INC, 1999

that surrounded the city. This, along with a later levee construction, will be the beginnings of a long tradition of flood prevention infrastructure in New Orleans.

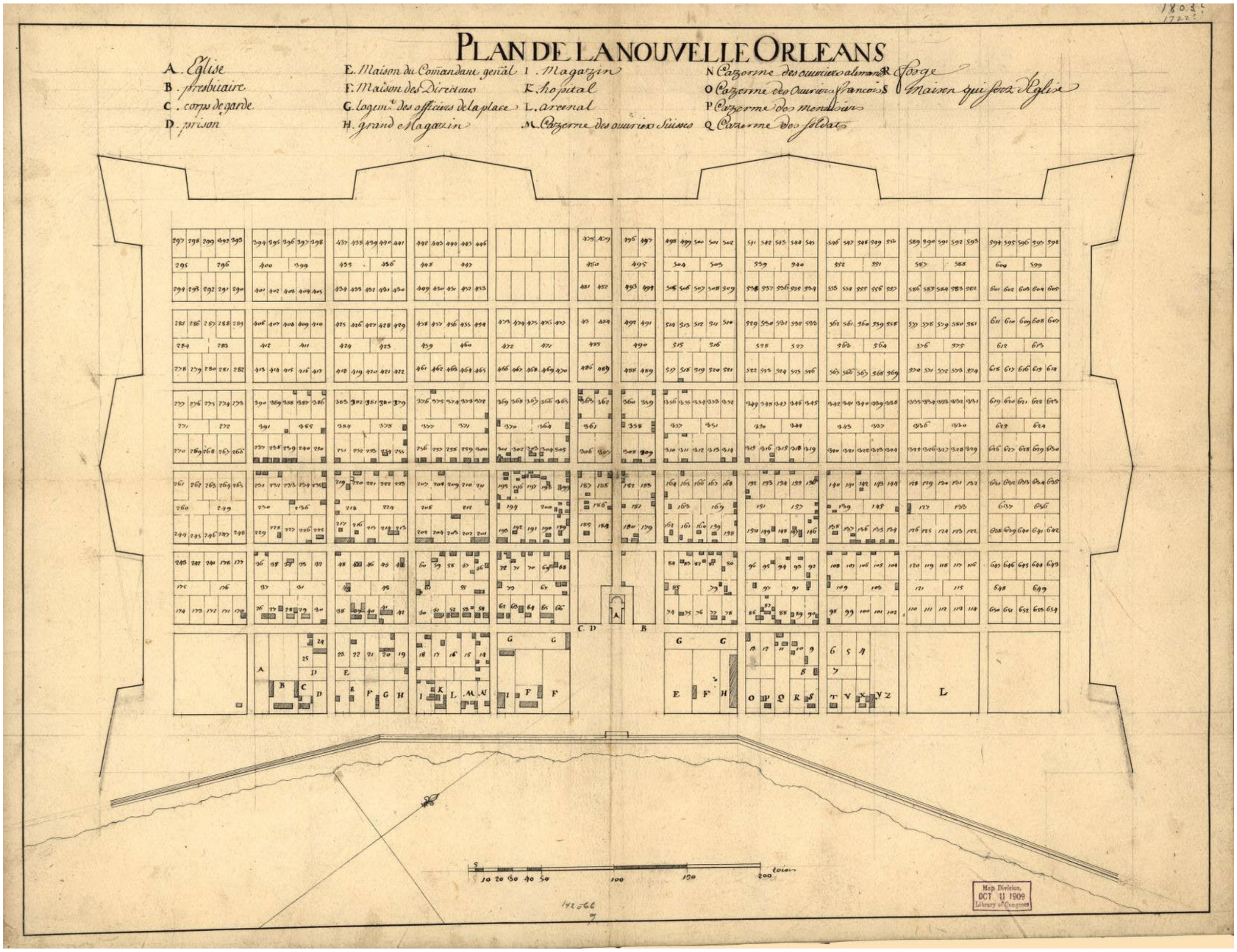


*Figure 4, 1722 Map of New Orleans (Source: The Historic New Orleans Collection)*

Considerable effort was put forth to keep New Orleans where it was, despite the challenges. The site provided many benefits to the French empire. First, it was well positioned to defend access to the rest of the French territory in North America. Second, it served as a major port, with access inland deeper into North America, and outward into the Gulf of Mexico. It was the perfect spot. French observer Francois Marnie Perrin Du Lac stated as such, as he believed "There is not for a great distance a finer, more elevated, or healthier position. If higher, it would be too distant. If lower, subject to inundations."[26]

New Orleans would not remain under the French monarchy. In 1769, Count Alejandro O'Reilly sailed up the Mississippi from Havana, outfitted with twenty-four warships.[27] He was sent because the territory of Louisiana was given to the Spanish in the Treaty of Paris, in 1763. The denizens of New Orleans, however, were not pleased with this decision, and an unruly crowd ejected the Spanish Governor in 1768.[28] When O'Reilly arrived, the rebellion quicky surrendered and pledged loyalty to the Spanish crown. The leaders of the uprising were punished. Six were sent to prison in Havana, the other five executed on what is now known as Frenchman Street.[29] O'Reilly then began to restructure the government in accordance to Spanish ideals. He set up a Cabildo, a common colonial Spanish government organization. It consists of ten city council members, with one governor, O'Reilly.[30] Surprisingly, O'Reilly appointed French citizens to these positions, softening the transition of power.

The now Spanish colony went under expansion under new rule. It served as a major export site, with most of production focused on cash crops such as cotton, tobacco, and indigo.[31] This, however, resulted in a reliance on trade when it comes to staple crops. The city traded their wares with the native tribes further inland, and other colonies using their prime location. The

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[26] Campanella, Richard. *Delta Urbanism - New Orleans*. American Planning Association, 2010. 24
[27] Kendall, *History of New Orleans*. 22
[28] Mizell-Nelson, Catherine. "Alejandro O'Reilly." *64 Parishes*. Last modified 2013.
[29] Ibid.
[30] "LOUISIANA: EUROPEAN EXPLORATIONS AND THE LOUISIANA PURCHASE A SPECIAL PRESENTATION FROM THE GEOGRAPHY AND MAP DIVISION OF THE LIBRARY OF CONGRESS." *Library of Congress*.
[31] Ibid, 42

choice of location of New Orleans provided a rich trade network to offset their overreliance on exports.

The plan of New Orleans began to expand as well. Large plantations began to sprawl out beyond the boundaries of the city, into the surrounding swamps. (Fig. 2) Two fires in the late 18th century prompted rebuilding campaigns as well as a change in building code. The new buildings had material restrictions, limited to adobe or brick walls, and tile roofs.[32] The once French colony now integrated a more Spanish flavor of architecture. By the end of the 18th century, the population of New Orleans reached almost 50,000 people.[33] The city housed a mixture of cultures, as there were French, English, Spanish, Creole and African people living in the city. [34]

[32] Ibid, 44
[33] Ibid, 47


*Figure 5, 1798 Plan of New Orleans (Source: Louisiana Digital Library)*

Relations between the Spanish and the newly founded United States were strained. The westward expansion by the new nation eroded Spanish control of the Mississippi river. The Spanish started to lose the economic benefits of total control of the waterway. A treaty signed in 1795 conceded even more territory to the United States, and allowed both Spanish and United States citizens to navigate the Mississippi freely.[35] This meant that trade in New Orleans would be duty free to the United States, a major victory. For Spain, however, it was an economic defeat.

## American Acquisition

The city would not stay under Spanish rule forever. The Treaty of San Ildefonso was signed in secret on October 1st, 1800.[36] French emperor Napoleon negotiated with Charles IV of Spain to acquire both Louisiana and Florida transferred to France, in exchange for territory in Tuscany. President Thomas Jefferson was not pleased with this change in ownership. Having France as a neighbor would complicate the geo-political relationships in the region, as a conflict with France would ally the United States with Britain, which they had just recently declared independence from.[37] Negotiations with France began, as it was deemed critical that this territory stay under control of the United States. Thomas Jefferson sent James Monroe to Paris to negotiate a deal. Thus, the Louisiana Purchase was made, where the United Sates bought the territory from France for 15 million dollars.[38] The former French, and Spanish, city of New Orleans changes hands once again. The president sent general William C.C. Claiborne to oversee the acquisition of the territory. On December 20th, 1803, the provisional French government received Claiborne, and a ceremony took place to mark the peaceful transfer of power.[39]

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[35] Ibid, 52
[36] Ibid, 39
[37] LOUISIANA, *Library of Congress*, 56
[38] Ibid, 62
[39] Kendall, *History of New Orleans*, 55

President Jefferson began surveying his newly acquired territory, as maps of the area were old, inaccurate, and often incomplete at the time.[40]

New Orleans underwent urban expansion under the United States. Outlying plantations were acquired and then divided up for urban expansion, with plantation owners opting to selling their land for development rather than work the fields. In 1810, for example, the plantation of Claude Tremé was subdivided to expand the fabric of New Orleans north, creating the Tremé neighborhood with its previous owner's surname.[41] Most of the expansion happened up and down the Mississippi river. With this expansion, the city's population doubled every 10 to 20 years.[42] Roads, railroads, and new canals allowed expansion to happen further from the urban core. (Fig 3) Typically, land value followed the rule that the closer to the river, the more valuable the land was, as areas close to the swamp were disease ridden and underdeveloped.

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[40] LOUISIANA, *Library of Congress*, 103
[41] Campanella. *Delta Urbanism,* 35
[42] Ibid, 37

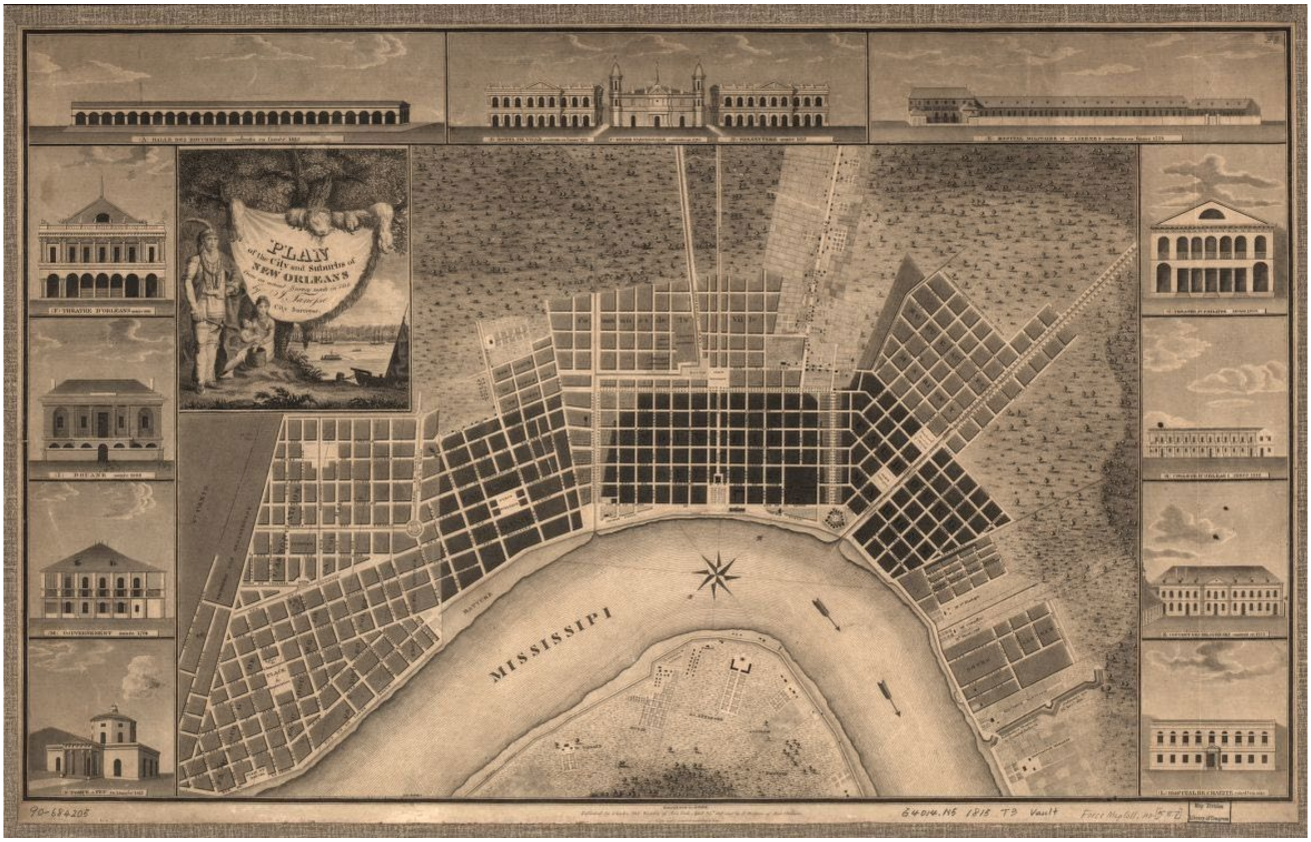


*Figure 6: 1815 plan of New Orleans (Source: Louisiana Digital Library)*

## Antebellum and Postbellum New Orleans

The city boasted a vast, multicultural texture throughout the antebellum era (1812 – 1860). Many visitors would remark on its diversity, some claiming that "no city, perhaps on the globe, presents a greater contrast of national manners, language, and complexion, as New Orleans." [43] One such culture was the Creole population, a mixed race, free persons of color who made up portions of the middle and upper class. New Orleans housed the largest population of free people of color than any other southern city.[44] Immigration was also popular. New Orleans had the second largest immigrant population in the states, second only to New York. These cultures lived in close proximity to each other, though their relations were not always peaceful.

[43] Ibid, 5
[44] Ibid, 58

Seceding from the union was a debated decision among the political party of New Orleans. Opposition leaders Randall Hunt and Christian Roselius were strong opponents to the movement, but ultimately the majority of New Orleans supported leaving the Union.[45] On the night of the Secession, protests broke out as anti-secessionists displayed posters and flags supporting the Union.[46] Surprisingly no property or personal damage was done, and the city held onto a strained, but stable peace. This lasted until the United States blockaded the river in 1862. The city eventually fell, and was placed under the command of General Benjamin F Butler on behalf of the Union.[47] He, along with elected mayors representing the union, held control of the city until the end of the war.

The postbellum period after the civil war saw a shift in demographics. Recently emancipated people of color sought opportunities, and flocked to New Orleans. The black population rose by 110 percent between 1860 and 1870, most of them settling in the swampy areas near the back of town.[48] Post war ideas started to change the social organization in New Orleans as well. The more fluid, gradient caste system became a more exclusive, binary segregation of whites and blacks, creating more segregated communities. The *Plessy vs Ferguson* case of 1896 which upheld segregation was the nail in the coffin for the old way of cultural mixing.

During this time period, technological advances began to facilitate an expansion away from the old urban core. Steam powered streetcar networks allowed for the creation of suburban neighborhoods located further from the urban center of New Orleans. (Fig. 4) By 1878, the

[45] Kendall, *History of New Orleans*, 233
[46] Ibid, 236
[47] Ibid, 274
[48] Campanella. *Delta Urbanism,* 63

population of New Orleans grew to 200,000 people, with people of color representing almost 30% of the population.[49]

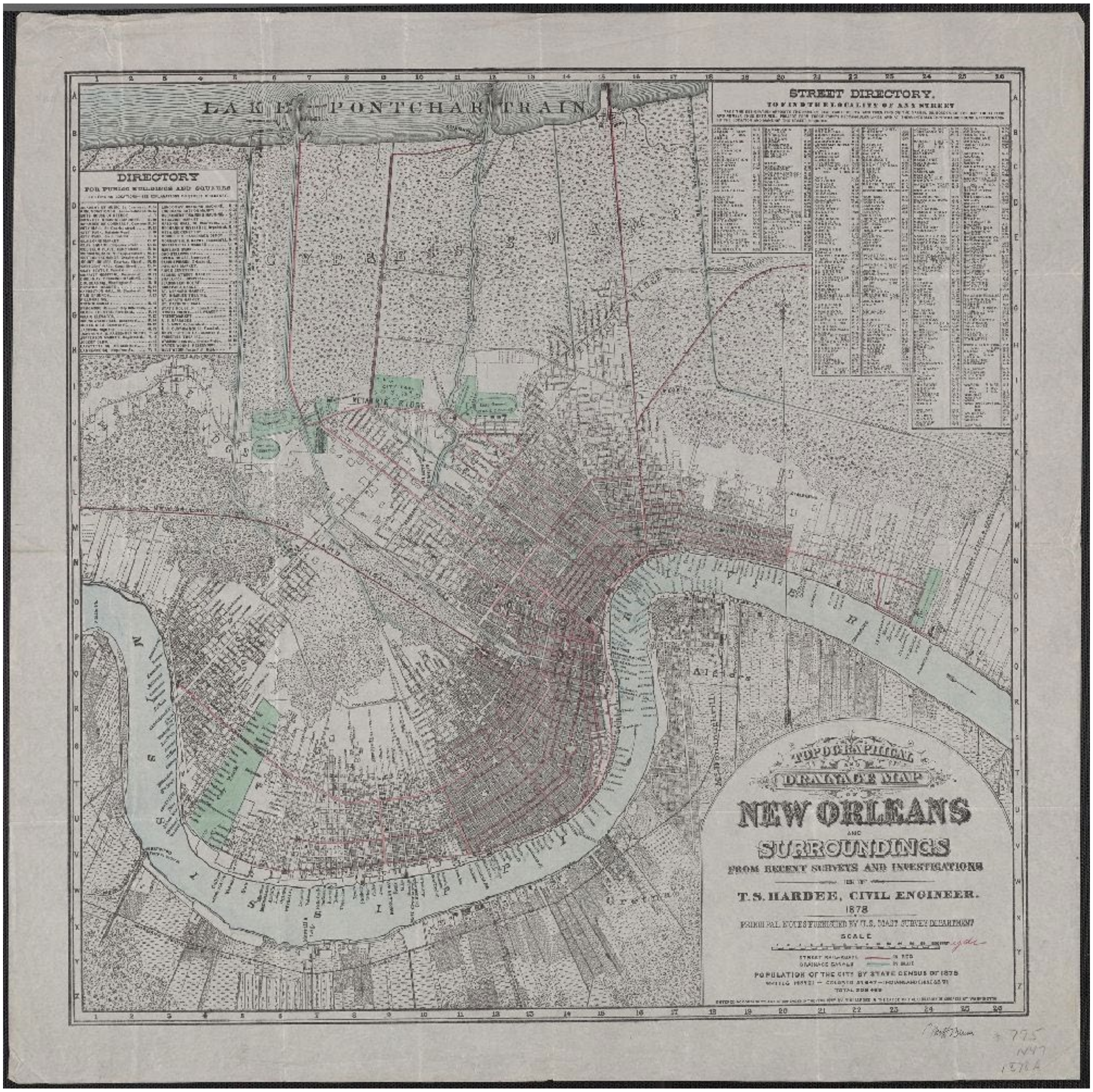


*Figure 4: 1878 plan of New Orleans (Source: Louisiana Digital Library)*

[49] Hardee, T.S. "Topographical and Drainage Map of New Orleans and Surroundings," 1878.

## 20th Century

From 1880 to 1920, New Orleans went under rapid change due to an immense drainage operation. The city government decided that draining the outlying swampland was critical to the development of the city. The New Orleans Drainage Commission was founded in 1896 to develop a water management plan for the city.[50] Their project ultimately improved water quality, decreased disease, and paved the way for more development. These newly drained swamplands became available to build upon, with 22,000 acres of land by 1910.[51] The urban plan of New Orleans became decoupled by topographical restrictions, sprawling away from the river and into the drainage fields. This expansion continued into the 20th century, with the population peaking at 627,000 people in 1960.[52] Without the traditional constraints in place, the city continued to expand without much concern. That all changed after hurricane Katrina.

On August 29, 2005, a category 5 hurricane hit New Orleans. Water levels swelled up and beyond the levee walls and canals, flooding the neighborhoods that lie beyond them. After the storm, three quarters of New Orleanians were displaced from their homes.[53] Hurricane Katrina was a critical moment in the city's history. What was once a rich, historic, multicultural icon of the United States was left in ruin. Previous development strategies were now under scrutiny. How, after centuries of flood prevention, could this disaster be allowed to happen?

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[50] Dunn, Katherine Jollif. "The Pumps That Built (and Sank) the City of New Orleans." *The Historic New Orleans Collection*. Last modified 2020.

[51] Campanella. *Delta Urbanism,* 73
[52] Ibid, 107
[53] Ibid, 153

# Drainage in New Orleans

## Colonial and Early American Attempts

Since the beginning, water management was a critical part of New Orleans infrastructure. Engineers Pierre Le Blond de la Tour and Adrien de Pauger were responsible for laying out the original street grid. The layout was simple; eleven blocks along the river, and six blocks deep. Each block would be surrounded by a ditch, which fed into a canal that surrounded the city. The canal then emptied out into the swamps near the back of the town.[54] This was not the only effort undertaken. Governor Etienne de Perrier oversaw the construction of a levee extending thirty-two miles along the Mississippi river to protect the city from floods.[55] These efforts were meager, and improvements were few and far between during the colonial era.

The Spanish did very little. The one notable project was the Carondelet Canal. Built in 1795, which connected lake Pontchartrain to the city via Bayou St. John. Its intended purpose was both to improve drainage of water and sewage, and to create a better connection to lake Pontchartrain.[56] The effort was unsuccessful, as the canal became impassible because of accumulating weeds and debris. This was typical for most colonial era attempts at draining the swamplands.

The swampy conditions of the site continued to plague residents well into its years as an American state. Disease ran rampant through the city, and mosquitoes were a constant problem. Architect Benjamin Latrobe described the menace as “clouds [that] fill every room in the house,

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[54] Maygarden, Benjamin. *National Register Evaluation of New Orleans Drainage System, Orleans Parish, Louisiana*. EARTH SEARCH INC, 1999.

[55] Kendall, John. *History of New Orleans*. Vol. 1. 3 vols. Chicago: The Lewis Publishing Co., 1922.

[56] Maygarden, *Evaluation of New Orleans Drainage System,* 1999.

as well as the open air. Their noise is so loud as to startle a stranger".[57] These mosquitoes were major carriers of diseases, such as cholera, malaria, and yellow fever which plagued citizens with illness. The city had the highest death rates of any American city with a 7 percent death rate in the late 1700s.[58] If New Orleans were to survive, the issue of drainage would need to be addressed.

Projects to address this were met with failure early on. Latrobe was commissioned to begin a waterworks project in New Orleans at the turn of the 18th century. In 1811, the New Orleans City Council granted Latrobe an ordinance to begin work on his project "to supply the City of New Orleans and its Faubourgs with water by means of one or several steam pumps."[59] Latrobe was chosen because his waterworks project in Philadelphia was completed a decade earlier and was considered successful in reducing the yellow fever outbreaks.

Latrobe's design involved a series of wooden and cast-iron pipes with a steam pump at the edge of the river. This project took a near decade to complete as it faced numerous setbacks. Inadequate funding, paired with a spread-thin Latrobe, caused most of the delays. Latrobe, and his son Henry, would both die of yellow fever during the completion of the project. It was complete in 1821 and was in operation until 1840 when it was replaced.[60]

The city continued on. In 1835, the New Orleans Drainage Company was granted a twenty-year charter to improve and expand drainage efforts. George T. Dunbar, an engineer, was

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[57] Ibid, 10.
[58] Campanella, Richard. *Delta Urbanism - New Orleans*. American Planning Association, 2010.

[59] Donaldson, Gary A. "Bringing Water to the Crescent City: Benjamin Latrobe and the New Orleans Waterworks System." *Louisiana History: The Journal of the Louisiana Historical Association* 28 (1987): 384

[60] Ibid, 395.

called upon to survey the topography of the city, and report back with a proposal. He suggested underground drainage pipes under many major streets, Dunbar stated “No city in the Union needs underground drains more than New Orleans”.[61] His plan was rejected, however, as the cost was too steep for the city at the time. The New Orleans Drainage Company shortly dissolved, their charter never completed.

## Drainage Plan of 1895

Most of the drainage attempts throughout the 19th century would be similar false starts and meager attempts. It wasn’t until the 1890’s where the city began more substantial efforts to drain the city. In 1893, the City Council of New Orleans passed an ordinance, which would create “a complete and comprehensive system of drainage for the City of New Orleans”.[62] A series of topographical and hydrological surveys were conducted to gather a large body of data to support the undertaking.

The city engineer, L.W. Brown, was tasked with this project. He helped the appointed advisory board to research and propose a designed solution. The advisory board submitted a report in 1895, recommending a course of action. One key distinction was the separation of sewage from the drainage system. Previous attempts had a combined the two systems, complicating the efforts. The report states that,

"The recent establishment of a sewerage system, which is to remove from the buildings to a proper outfall, all foul waste matters that can be carried away in suspension by flowing

[61] Maygarden, *Evaluation of New Orleans Drainage System,* 1999.
[62] Ibid, 17.

water, has in some degree affected the drainage question by removing from consideration an element that would have caused a material modification of the problem."[63]

The drainage plan was underway. Construction began in 1896, and by 1905, 40 miles of canals were completed, serving 22,000 acres of land around New Orleans.[64] The city saw immediate benefits, alleviating New Orleans of stagnant gutters, pooling rainwater, and mosquito breeding grounds. The scourge of yellow fever was eradicated, with the last outbreak in 1905. The high death rate decreased from 7 percent to 1.8 percent in the decades following the installation.[65] Lands unavailable for development now were drained enough for construction, feeding the growth of the city. By these metrics, the drainage plan was a major success for New Orleans.

[63] Walmsley, R.M. et. Al. *1895 Advisory Board Report on the Drainage of the City of New Orleans*. New Orleans City Council, 1895.

[64] Maygarden, *Evaluation of New Orleans Drainage System,* 26
[65] Campanella. *Delta Urbanism.* 76.

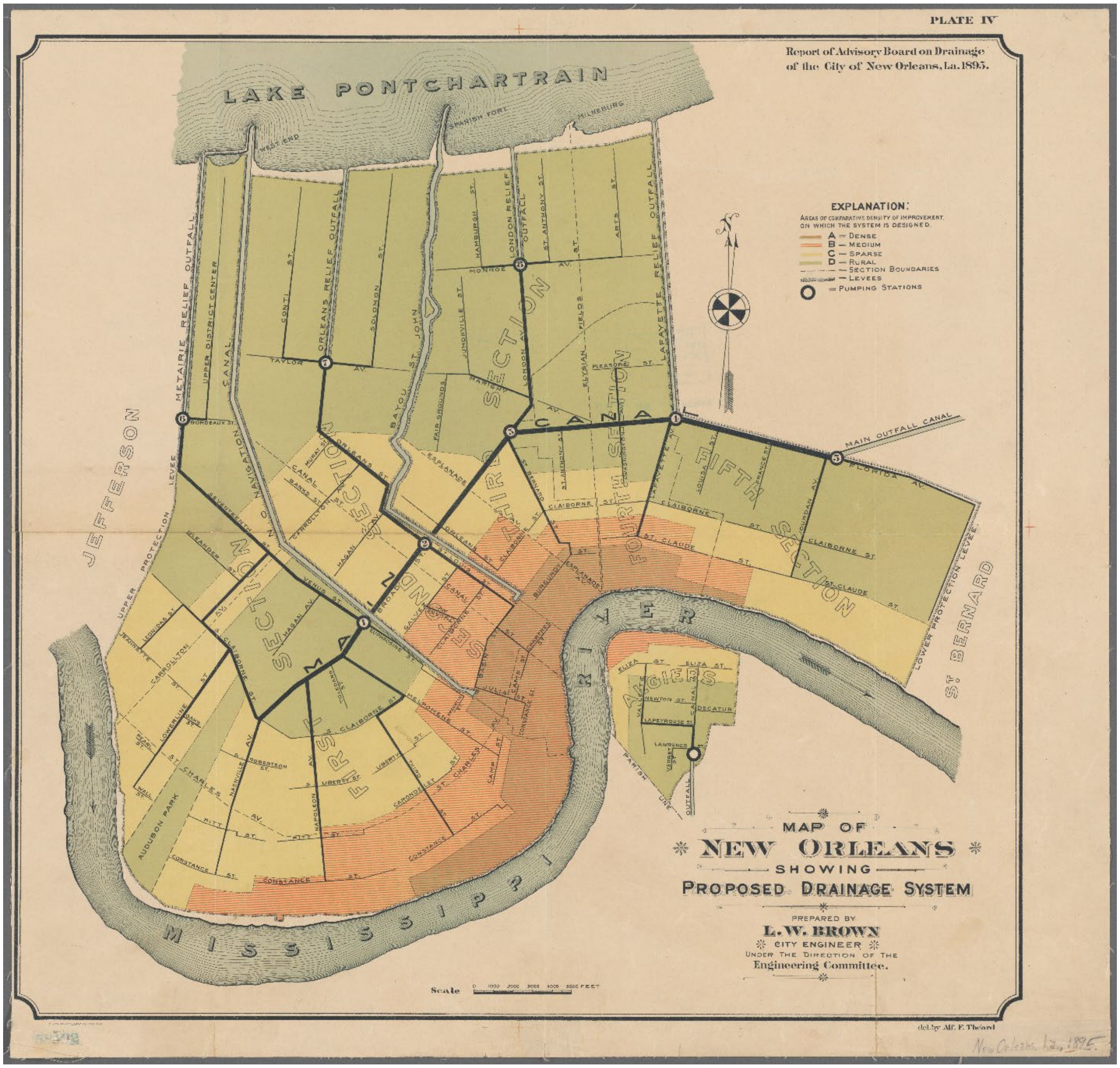


*Figure 5: Proposed drainage plan of 1895 by L.W. Brown*

## 20th century expansion

Throughout the 20th century, this project would be expanded and upgraded to facilitate vast areas of land, and larger quantities of water. Some upgrades came after disaster. The 1927 Good Friday flood highlighted the need to upgrade the pump stations to match the growth of the city. Albert Baldwin Wood, the chief designer of the projects drainage pumps, designed a replacement that doubled the drainage capacity of the system.[66] A hurricane in 1947 spurred the raising of levee walls by one to three meters.[67] These projects continue onward throughout the century, increasing capacity and draining more land for development. The 1893 ordinance passed a century ago set in motion the massive infrastructural drainage system that New Orleans still uses to this day.

## Environmental Concerns

This immense system, however, was shown its faults during the 2005 Katrina disaster. Though designed to withstand such events, the city failed to address all environmental elements. During Katrina, half of the levees built to protect the city failed during Katrina, causing immense damage to the underlying communities.[68] In certain sections, the pilings did not penetrate deep enough to prevent water seeping underneath, causing the levee walls to collapse. The neglect of these flood defense strategies had come to a head when tested against mother nature.

[66] Maygarden, *Evaluation of New Orleans Drainage System,* 29

[67] Rodgers, J.D. "Development of the New Orleans Flood Protection System Prior to Hurricane Katrina." *Journal of Geotechnical and Geoenvironmental Engineering* 134, no. 5 (2008).

[68] van Heerden, Ivor. "The Failure of the New Orleans Levee System Following Hurricane Katrina and the Pathway Forward." *Public Administration Review* 67. Special Issue on Administrative Failure in the Wake of Hurricane Katrina (2007).

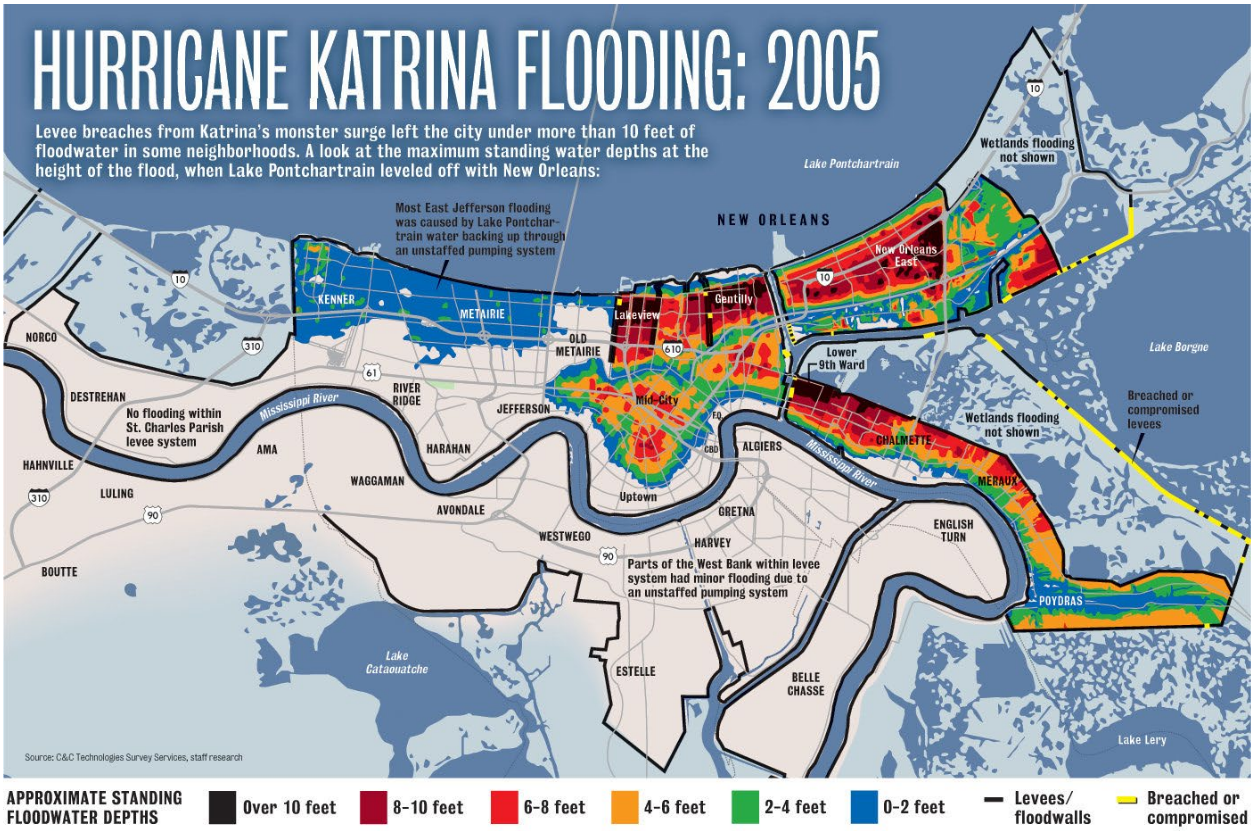


*Figure 7: Standing Floodwater Depths post Katrina (Source: C&C Technology Survey Services)*

Compounding this issue further, the city was gradually sinking as a direct result of drainage and development of the swamplands. Heavy buildings were compressing the soft soils of the delta, resulting in large swaths of urban land sinking below sea level. In 1900, most citizen lived above sea level. In 1960, nearly half of all citizens resided below sea level, some areas sinking two meters below.[69] Previous developments did not consider this elevation change over time.

[69] Campanella. *Delta Urbanism.* 76.

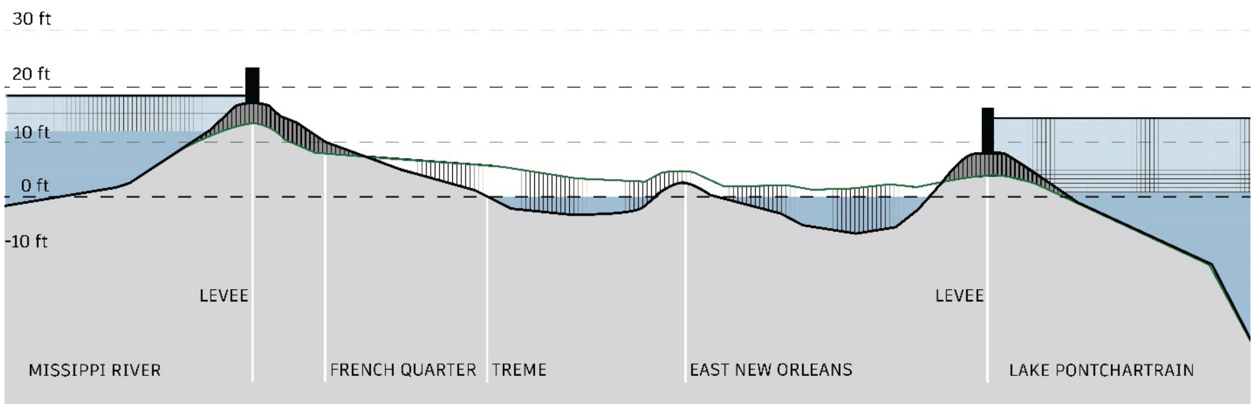


*Figure 8 : Elevation diagram of New Orleans (Source: Author)*

Living below sea level is dangerous. The sinking land causes what is known as the “levee effect”. This is the phenomenon where the levees simultaneously protect properties from potential flood damage, but also increase the potential damages of a flood event should the levees fail.[70] The interlinked, complicated problems of building in a delta start to reveal the immense challenges that lie ahead.

The erosion of outlying wetlands also contributed to the issue. Outlet canals that connected to the gulf allowed for saltwater intrusion on the freshwater marshes, eroding the wetland ecology around New Orleans. Artificial controls of the Mississippi river stopped the delta from receiving replenishing sediments and floodwaters. This results in a rapid erosion of wetland. Since 1930, Louisiana has lost 2,000 square miles of coastal wetlands.[71] These wetlands serve as important buffer zones that reduce storm surges before they reach the city. In a twist of

[70] Ibid. 78
[71] Ibid. 133

irony, manmade efforts to prevent flooding events increased the severity of them. Geographer Gilbert F. White stated as such; “Floods are ‘acts of God,’ but flood losses are largely acts of man”.[72] To reduce the severity of these acts of god, New Orleans must take into account all of these environmental concerns moving forward.

*Figure 9: Map of areas at risk of land loss by 2050 (Source: Author)*

# Flood Prevention Strategies in Other Countries

## Vietnam

The country of Vietnam has shared similar flooding issues. The Mekong Delta shares a similar environment to the Mississippi River Delta. This region is located in south Vietnam, where the Mekong River meets the South China Sea. The Mekong Delta is a major agricultural

[72] Ibid, 78

center for the country. 52% of the nation's food production occurs in this region of Vietnam.[73] Needless to say, it is important for Vietnam to invest resources to protect this productive province.

The communities in the Mekong Delta must deal with flooding events all the same. Annually, the region experiences a 2.7-billion-dollar asset loss due to natural hazards.[74] Flood infrastructure is a major priority in Vietnam, as climate change is only exasperating the already intense inundation events that affect the region. Currently, the major strategy Vietnam utilizes is a system of sea dikes. Along the Mekong Delta coast, there is a system of low and high dikes. Low dikes are used to keep irrigation water inside the rice field, and to protect croplands from the early flooding season.[75] High dikes are geared towards protecting farmlands from larger flood events. There was a disastrous flood in 2000 that compelled the creation of these high dikes.[76] These dikes allow for a longer growing season, as the water levels of the rice patties can be completely controlled.

This system is not perfect. Though high dikes saw yield improvements and safer communities, but there are worries that they are not sustainable. Because floodwaters no longer provide nutrients and sediment to the fields, the soil becomes dry, and strained. This causes an

[73] Nguyen Van Khanh Triet, Nguyen Viet Dung, Hideto Fujii, and Matti Kummu. 2017. "Has Dyke Development in the Vietnamese Mekong Delta Shifted Flood Hazard Downstream?" *Hydrology and Earth System Sciences* 21: 3992.

[74] Rentschler, Jun. 2020. "Resilient Shores : Vietnam's Coastal Development Between Opportunity and Disaster Risk." World Bank.

[75] Nguyen Van Khanh Triet 2017. "Dyke Development in the Vietnamese Mekong Delta" *Hydrology and Earth System Sciences* 21: 3992.

[76] Ibid.

increase in fertilizer use to offset the reduced yield, doubling to 50 kg of fertilizer per 1000m$^2$.[77] This practice, while initially beneficial, is not a sustainable model in the long run.

These high dikes also create a higher flooding hazard in downstream areas. A study revealed that regions that are downstream from high dikes experience higher peak flood conditions. In some regions, there was a maximum water level rise of 9-13 centimeters, and a 15 day duration that was directly related to the high dike effects downstream.[78] This is a common issue in the Mekong Delta, as hydrological interventions effect not just the region, but the entire length of the river as well.

These sea dikes are subject to erosion and disaster damages. Constant maintenance is required to keep the structures intact. The projected cost of sea dike maintenance in the Mekong River Delta from 2005 – 2009 was 100 million US dollars for 1469 km of sea dike.[79] That is around 68,000 US dollars per kilometer of sea dike. If constant repair is necessary because of increased severity of natural disasters, these flood control methods could undergo not only environmental but economical stressors as well.

The provinces of the Mekong River Delta have one, unique solution to preventing excessive damages to the sea dikes. Mangrove in Vietnam were rapidly declining since the

[77] Howie, Charles. 2005. "High Dikes in the Mekong Delta, Vietnam, Bring Social Gains and Environmental Pains." *Aquaculture News* 32. https://www.researchgate.net/publication/280715781_High_Dikes_in_the_Mekong_Delta_Vietnam_bring_social_gains_and_environmental_pains.

[78] Nguyen Van Khanh Triet 2017. "Dyke Development in the Vietnamese Mekong Delta" *Hydrology and Earth System Sciences* 21: 3998.

[79] Danh, Vo Thanh. 2012. "Adaptation to Sea Level Rise in the Vietnamese Mekong River Delta: Should a Sea Dike Be Built?" 2011-RR13. Economy and Environment Program for Southeast Asia. https://idl-bnc-idrc.dspacedirect.org/bitstream/handle/10625/49037/IDL-49037.pdf?sequence=1&isAllowed=y.

1950s, with 80% of mangrove forests being lost.[80] In 2001, however, this trend was reversed, and Vietnam began to reforest the lost mangrove trees. One program, the International Red Cross Disaster Risk Program, had reforested 18,000 ha of mangroves.[81] These mangroves provide critical flood infrastructure that support the existing sea dikes. The shape and structure of the mangroves help reduce wave heights during high waters. In turn, the sea dikes are protected from damages that would occur otherwise. One example of this phenomenon can be seen during cyclone Damery in 2005, in the Kien Thuy district. The mangroves planted along the sea dikes reduced wave heights from 4 meters to 0.5 meters (13 feet to 1.6 feet).[82] This, paired with the ecological benefits of reforestation, supports Vietnams substantial efforts to reforest their lost mangrove forests.

The people living in the Mekong Delta seem to adapt well to the adverse conditions. A study in 2013 looked at three sites within the Mekong Delta, and gave a questionnaire to determine how the residents felt about their resiliency towards flood events. The study found three categories that define how residents feel about their safety and security during flood season. First, household capacity to secure food, income, and health during extreme flood events. Second, household capacity to secure homes during large floods. And third, interest in learning new flood-based livelihoods during the flooding season.[83] The study found that if these categories were met, the community felt less worried about flooding season.

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[80] Powell, Neil, and Maria Osbeck. 2011. "Mangrove Restoration and Rehabilitation for Climate Change Adaptation in Vietnam." *World Resources Report*. https://www.researchgate.net/publication/235602091_Mangrove_restoration_and_rehabilitation_for_climate_change_adaptation_in_Vietnam.

[81] Ibid. 4

[82] Ibid. 5

[83] Nguyen, V., and Helen James. "Measuring Household Resilience to Floods: A Case Study in the Vietnamese Mekong River Delta." *Ecology and Society* 18, no. 3 (2013).

The resiliency and self-organization of these communities was revealed through interviews with residents that have lived through multiple floods. One woman remarked that when 2000 houses were submerged in a flood, one local resident used his boat to ferry food and clothes to people in need.[84] This highlights the need for a supply logistic strategy, and how individual community members provide such services individually in Vietnam.

Another anecdote details a mans strategy to increase his income during flooding season. During flooding season, this farmer uses his motorboat to collect snails and sell them, allowing him to supplement his income by about 480 USD during flooding season.[85] This is common practice for many farmers in the region to help sustain their families when they are unable to sell crops. Seeing floodwaters as an opportunity, rather than an obstacle, is a prominent mentality in Vietnamese delta communities.

## Netherlands

The Netherlands is another country that has undertaken the challenge of living within a river Delta. Located at the intersection of the Rhine, Meuse, and Scheldt rivers, this Delta causes 50 percent of the country to be vulnerable to flooding.[86] To make use of this hazardous land, the Dutch began to reclaim areas that would naturally be underwear. Using dikes, they built around segments of land to create "polders", which allowed for the cultivation of low-lying land.[87] This system allowed for more cropland to support the growing population.

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[84] Ibid, 13.
[85] Ibid,
[86] Gerritsen, Herman. 2005. "What Happened in 1953? The Big Flood in the Netherlands in Retrospect." *Philosophical Transactions: Mathematical, Physical and Engineering Sciences* 363, no. 1831: 1271–91.
[87] Wesselink, Anna J, Wiebe E Bijker, Huib J. de Vriend, and Maarten S. Krol. 2007. "Dutch Dealings with the Delta." *Nature and Culture* 2, no. 2: 188–209.

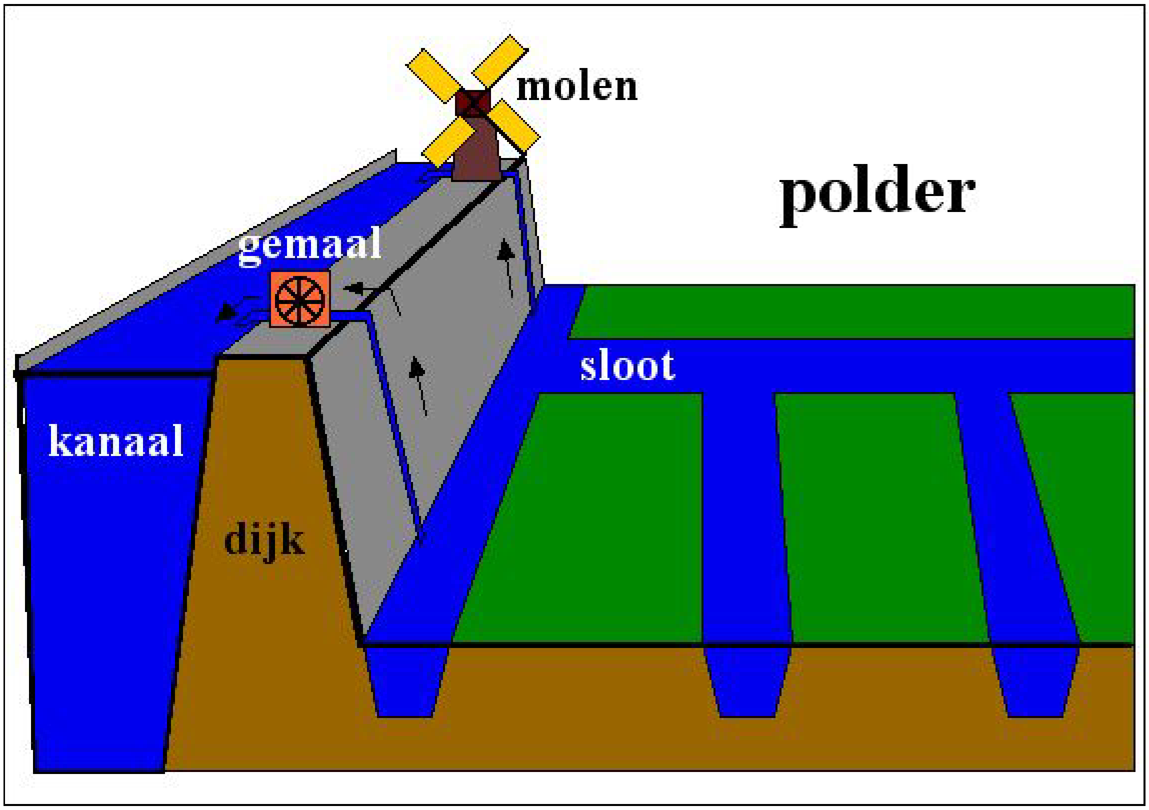



*Figure 10: Diagram of the Polder System (Source:https://www.heardutchhere.net/duoutdoors.html)*

The Dutch had many methods of draining their polders. One of the more unique methods was the use of windmills. To fight against the force of gravity, the Dutch would use wind energy to pump water out. These powerful windmills first appeared in the 16th century and allowed for lower-lying areas to be drained and settled upon.[88] While the infrastructure is modernized today, it is a great example of using a natural, renewable source of energy to support a large, complicated land engineering endeavor.

Like any other delta settlement, their infrastructure was frequently tested by the unforgiving hydrology. A flood in in 1953 caused 2,000 square kilometers of land to become inundated, and drowned 1,835 people.[89] This disaster caused the Dutch to spring into action,

[88] Ibid. 191
[89] Ibid. 195

where their current infrastructure went under heavy re-evaluation. Updates were made, such as an increase in safety standards for sea dikes, a reliance on science to judge potential damages, and a new focus on ecological concerns.[90] Water management became one of the most paramount concerns, becoming an integral part of not only Dutch politics, but Dutch culture as well.

The shift towards addressing ecological concerns should be noted. One plan, Plan Stork, had the goal of redeveloping land into its original floodplain environment. Another plan , called “Room for the River”, carved out space for rivers to naturally flood and change course.[91] These new policies started to address the natural landscape, creating a closer unity between engineered flood infrastructure projects, and the natural environment of the delta.

## Building Typologies of Flood Prone Areas

### New Orleans Housing Typology

There were lessons learned after the destruction of Hurricane Katrina. One lesson was that building construction in the 20th century was not sufficient in terms of withstanding disaster. Many post war houses were built upon inexpensive, concrete slabs in low lying areas, putting an incredible amount of faith on the large scale flood prevention strategies.[92] This practice was called into question when many of these neighborhoods suffered catastrophic damage when the levee walls failed.

Oddly enough, this was a lesson that the city had already learned, and seemingly forgot. New Orleans has a history of elevating homes in an effort to protect peoples homes from flooding events. One typology that was an early example of a raised house was the French-

[90] Wesselink, Anna J. “Dutch Dealings with the Delta.” 196.
[91] Ibid. 198
[92] *The History of Building Elevation in New Orleans* (FEMA, 2012),

Creole plantation house. These houses were notable as the main living areas were elevated up to the second level, where the above ground basement serving as storage or a working area.[93] These houses were well suited for their harsh, wet environment, and became a popular housing typology for the residents of New Orleans.

This housing typology mostly stood in large plantation fields, but could be adapted to a more urban setting. Madame Johns Legacy is one example. Built in the late 1700s, the living areas of this house were elevated off of street level, and the first floor basement built of brick and stucco.[94] The house still stands today as an example of the old New Orleans practice of elevating houses.


*Figure 11 : Madame Johns Legacy in New Orleans (Source: FEMA)*

[93] Ibid, 31
[94] Ibid, 32

In the 1800s, a raised cottage typology became popular in New Orleans, particularly the garden district. Often featuring a large front gallery, these houses not only protected residents from floods, but was easily adaptable to the current architectural stylings of the time.[95] These houses were followed up by the raised basement house type of the early 20th century. Characterized by a first floor basement and ornamental stairs, this house typology was often combined with the traditional shotgun house styling to create a unique New Orleans style of house.[96] The versatility of this styling of house, its stylistic and environmental adaptability, proves this to be a successful typology of housing in the dela environment in New Orleans.

*Figure 12: Raised basement shotgun house (Source: FEMA)*

[95] Ibid, 40
[96] Ibid, 41

In recent years, the viability of this strategy has made a resurgence. The federal government has introduced programs to help homeowners raise and floodproof their homes. One program is the Hazard Mitigation Grant program (HMGP). This program is under FEMA, and provides grants in order to elevate living areas and equipment, while also strengthening doors, windows and roofs to withstand disaster.[97] Many elevated houses have been successfully funded by this program, and have helped to individualize flood prevention strategies to the household scale.

The roof construction is important in the hot Louisiana climate. A critical component are the porches and large roof overhangs, as they allow for adequate shading of the house. Also common in the area are 12-foot-high ceilings which allow hot air to rise away from the occupants. This is much higher than the standard 8-foot ceiling height.[98] These details not only reflect a Louisiana housing vernacular, but also provide critical passive cooling strategies that reduce energy consumption, and increase comfort.

[97] Ibid. 21
[98] "LOUISIANA SPEAKS: PATTERN BOOK." 2006. Louisiana Recovery Authority. 21

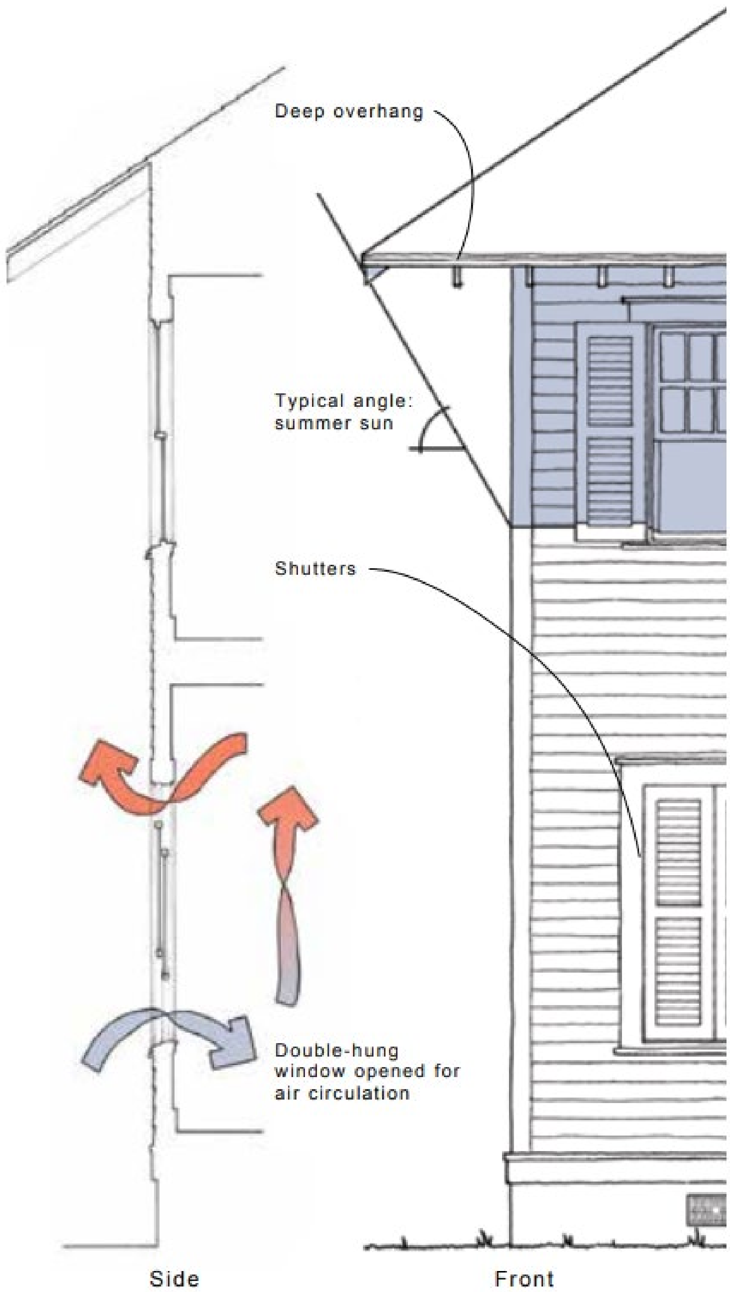



*Figure 13: Diagram of passive strategies used in a typical house in Louisiana (Source: Louisiana Speaks Pattern Book)*


*Figure 14: Examples of elevated housing strategies common in Louisiana (Source: Louisiana Speaks Pattern Book)*

## Green Spaces and Parks

Well designed green spaces can be a major asset to any city. One such asset they can provide is water retention. The Chulalongkorn University Centennial Park in Bangkok, Thailand, is a prime example of how an urban park can handle stormwater successfully. Along with providing much needed green space, the park can hold one million gallons of water during storms.[99] The large square footage of the park allows for a successful water management plan that can service the larger metropolitan area of Bangkok.

[99] D'Aarcy, Patrick. "When Bangkok Floods (and It Floods a Lot), This Park Does Something Amazing." *Ideas.Ted.Com*. Last modified 2018.

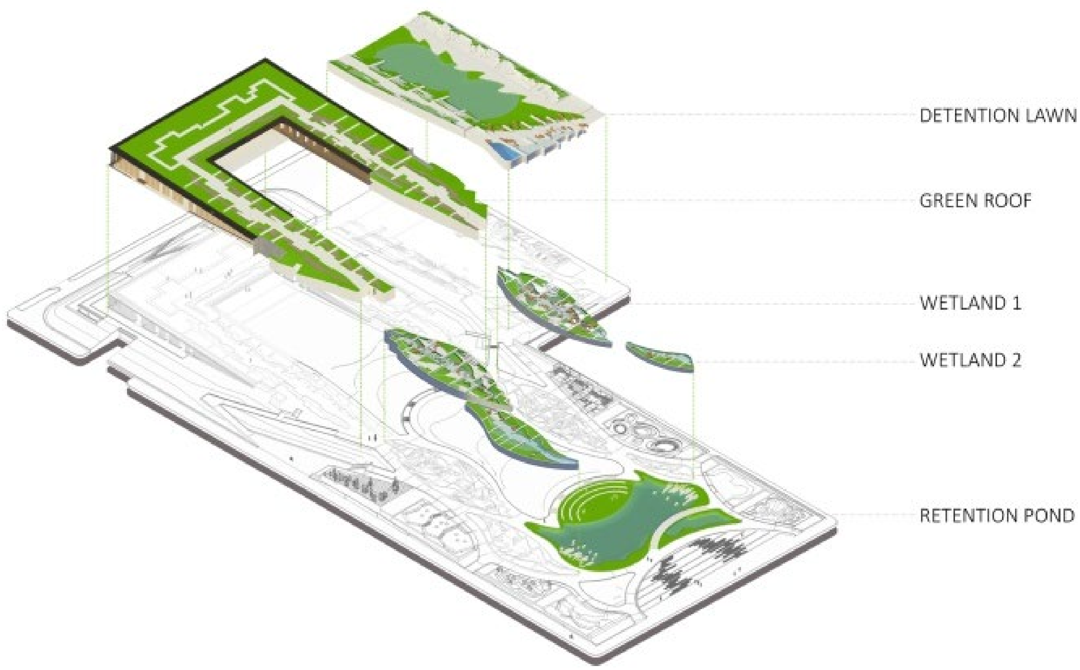



*Figure 15 : Diagram of Centennial Park (Source: World Landscape Architecture)*

This concept can be a large intervention, or a more threaded throughout within a neighborhood. The Haute Deûle River Banks Eco District in France encapsulates this idea of incorporating rainwater management strategies into the city fabric. It includes a large raingarden, but a series of canals along the public streets as well. Incorporating water management within the public realm can be done in a way that makes an infrastructure into a public amenity.

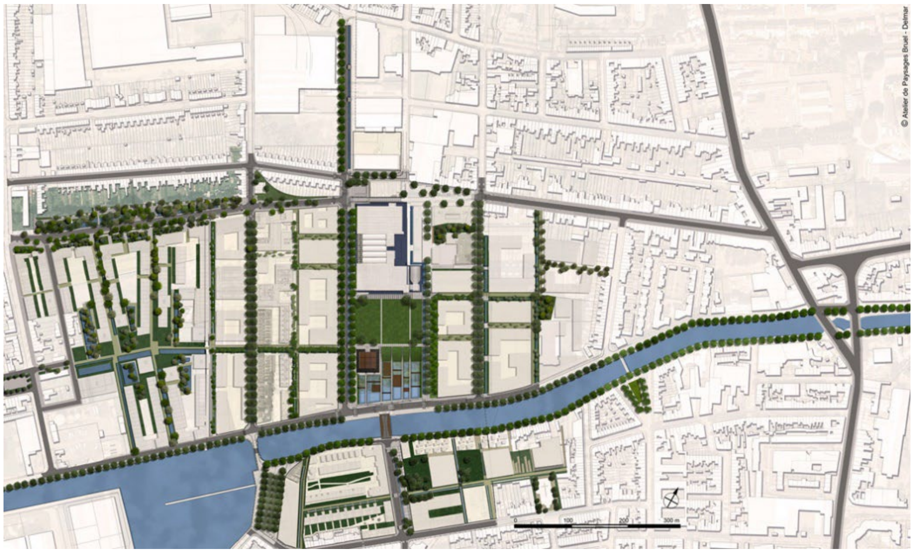


*Figure 16: Plan of Haute Deûle River Banks (Source: Bruel-Delmar)*

## Site Documentation and Program

This thesis aims to respond to the development patterns in east new Orleans in a way which integrates water infrastructure more effectively within the public realm, while providing an adequate neighborhood plan that both individualizes flood protection while keeping a sound urban environment. The plan also aims to provide a wide variety of housing typologies, all which are more in line with the environmental realities of the site.

### Site Selection and Analysis

This thesis was chosen to be located on the site of an abandoned amusement park in East New Orleans. The site was chosen based on criteria that may support a community development plan. There were a few contenders, though the East New Orleans site had more available land, at a higher elevation, with potential to improve the water infrastructure within the site.

| Site 1<br>Villiage DLest, East New Orleans | | Site 2<br>Algiers, South New Orleans | |
|---|---|---|---|
| Elevation<br>-4 to -6 feet | 3/5 | Elevation<br>-6 to -8 feet | 1/5 |
| Infrastructural Improvement<br>Multiple canals with potential to expand | 5/5 | Infrastructural Improvement<br>Canals mostly established | 1/5 |
| Distance From Downtown<br>30 minutes from Downtown | 1/5 | Distance From Downtown<br>10 Minutes from Downtown | 3/5 |
| Public Transportation Acess<br>Limited bus acess | 1/5 | Public Transportation Acess<br>Limited Bus acess | 3/5 |
| Available Site Area<br>Plenty of abandoned lots to develop | 5/5 | Available Site Area<br>Few substantial land areas to develop | 1/5 |
| Institutional Adjacencies<br>Few Institutions surrounding the area | 1/5 | Institutional Adjacencies<br>Variety of parks, hospitals, and community assets | 4/5 |
| Total | 15/30 | Total | 13/30 |

1 - Very Weak
3- Average
5- Very Strong

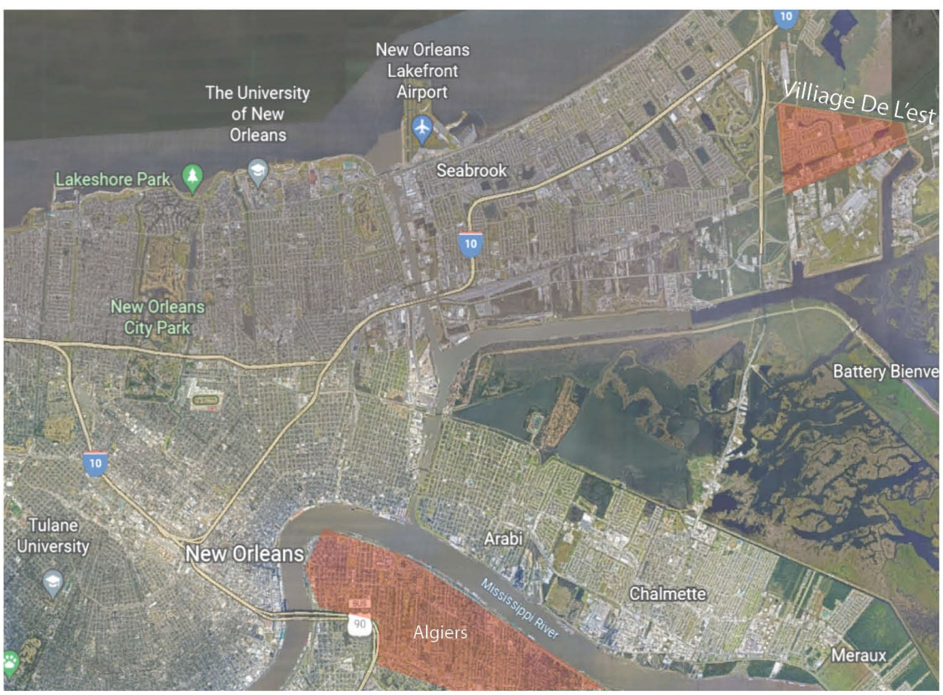



*Figure 17: Site selection Matrix detailing criteria and point system. (Source: Author)*

Once the site was selected, the topography of the site became critical to understand. The contour map, along with a flood risk map, was analyzed. Initial thoughts on development was centered around using all available high ground for development. The strategy began by placing development on the relatively highest points of the site, avoiding the lower lands along the levee and eastern road. Some initial program blocks were then tested on the site to begin understanding how the block layout would fit within the site topography. Finally, a programmatic blocking scheme was developed for a rough idea of the program of the community. The program could be broken up into three types of structures, residential, commercial, and civic. Green infrastructure was also within the programming of the scheme.

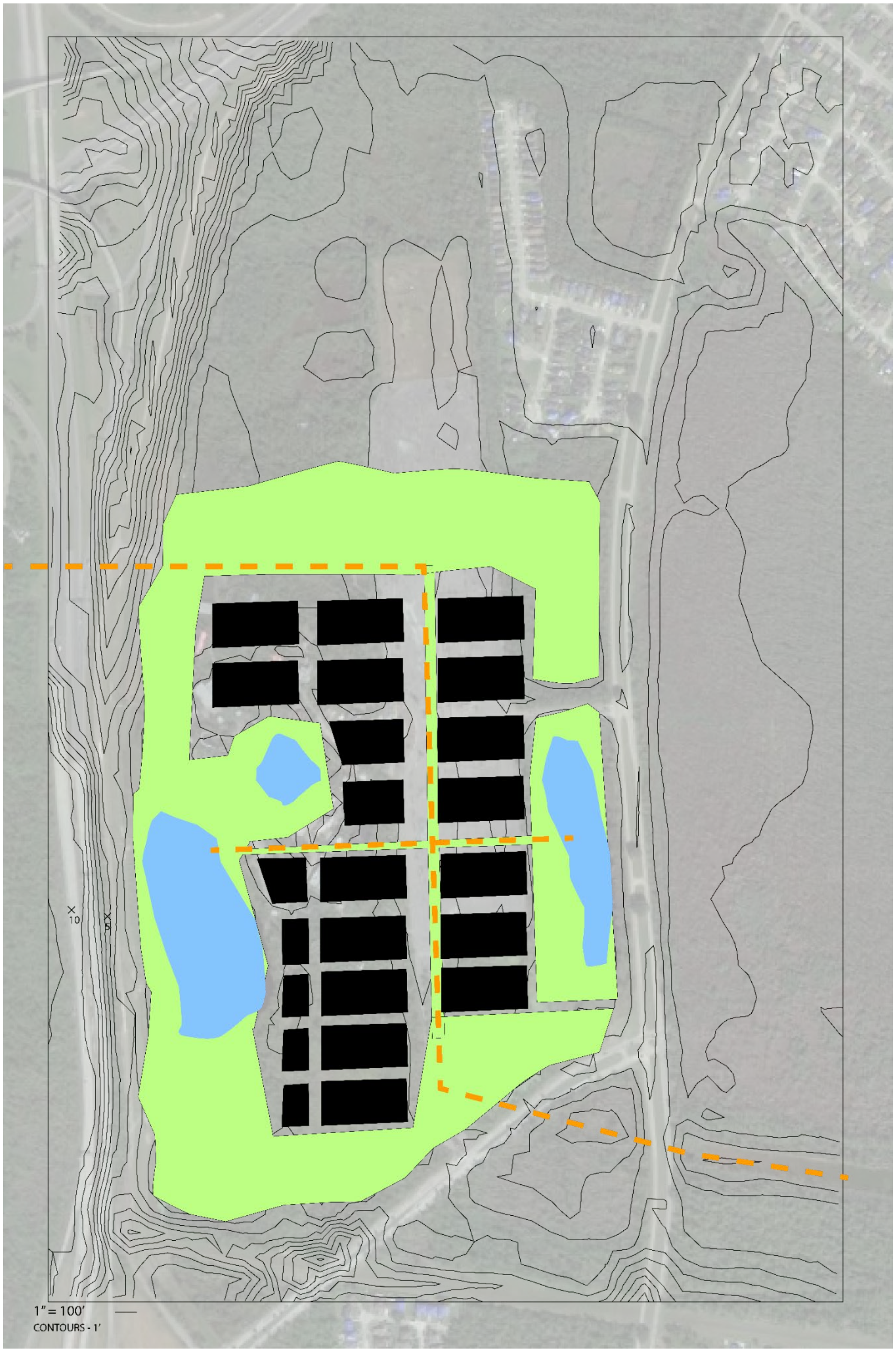



*Figure 18: Preliminary block layout around the site. (Source: Author)*

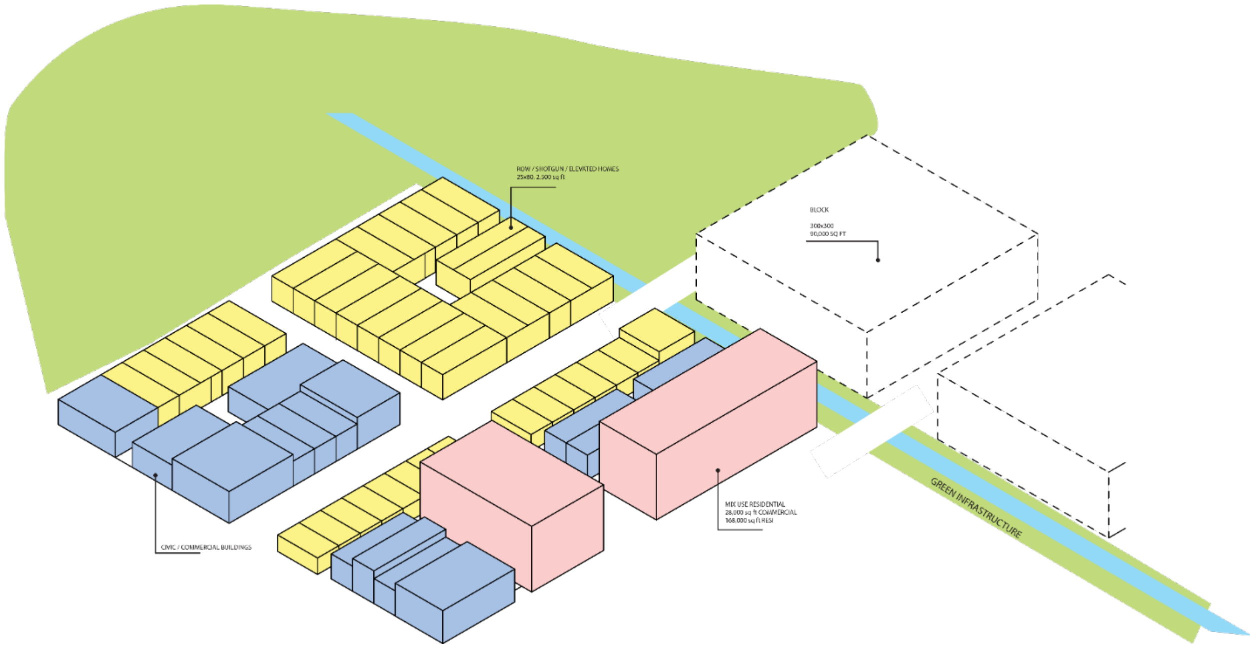



*Figure 19: Preliminary block layout, program and square footage of the Community Plan (Source: Author).*

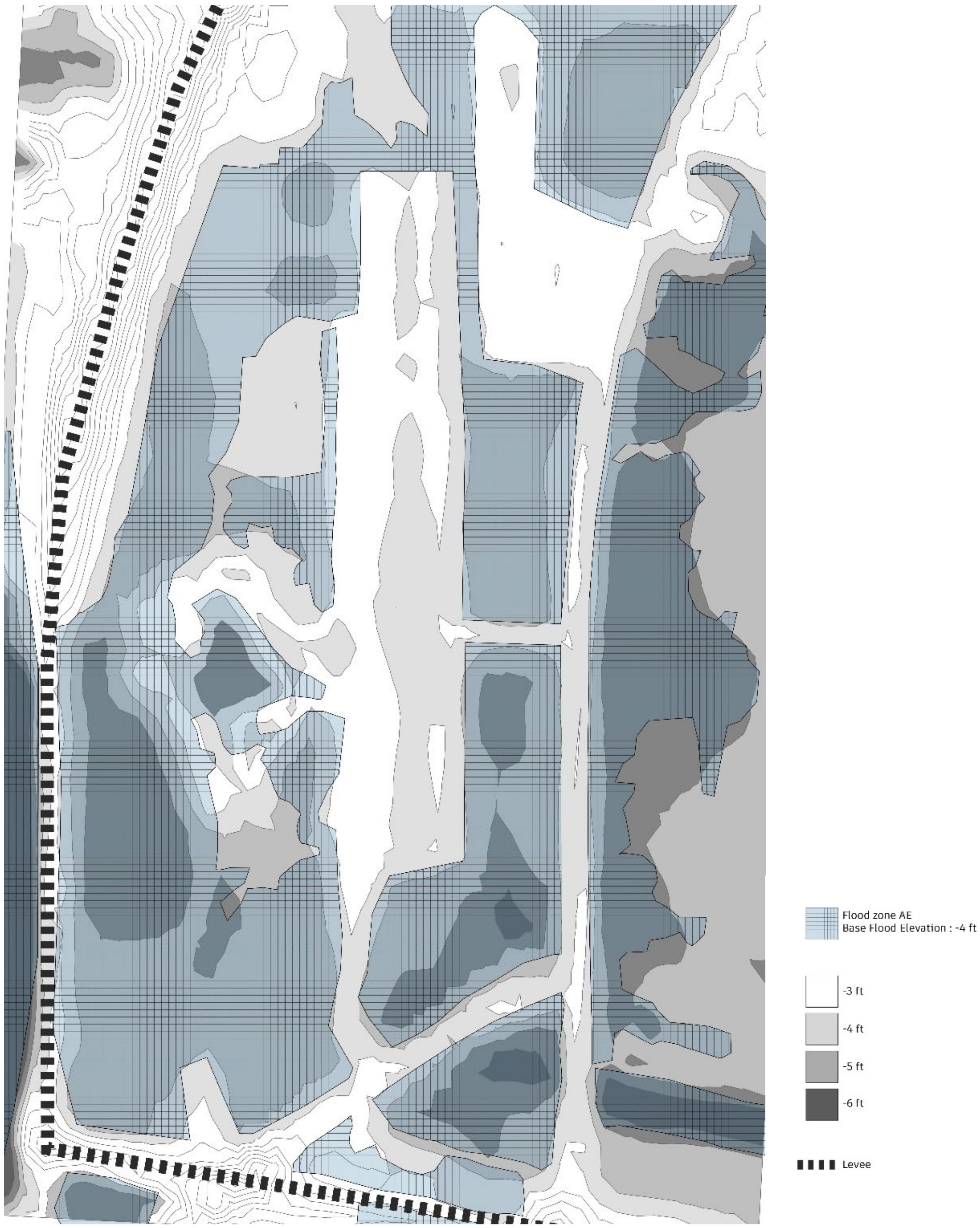



*Figure 20: Site topography, overlayed with Flood Insurance Rate Map. The base flood elevation sits at -4 ft.(Source: Author)*

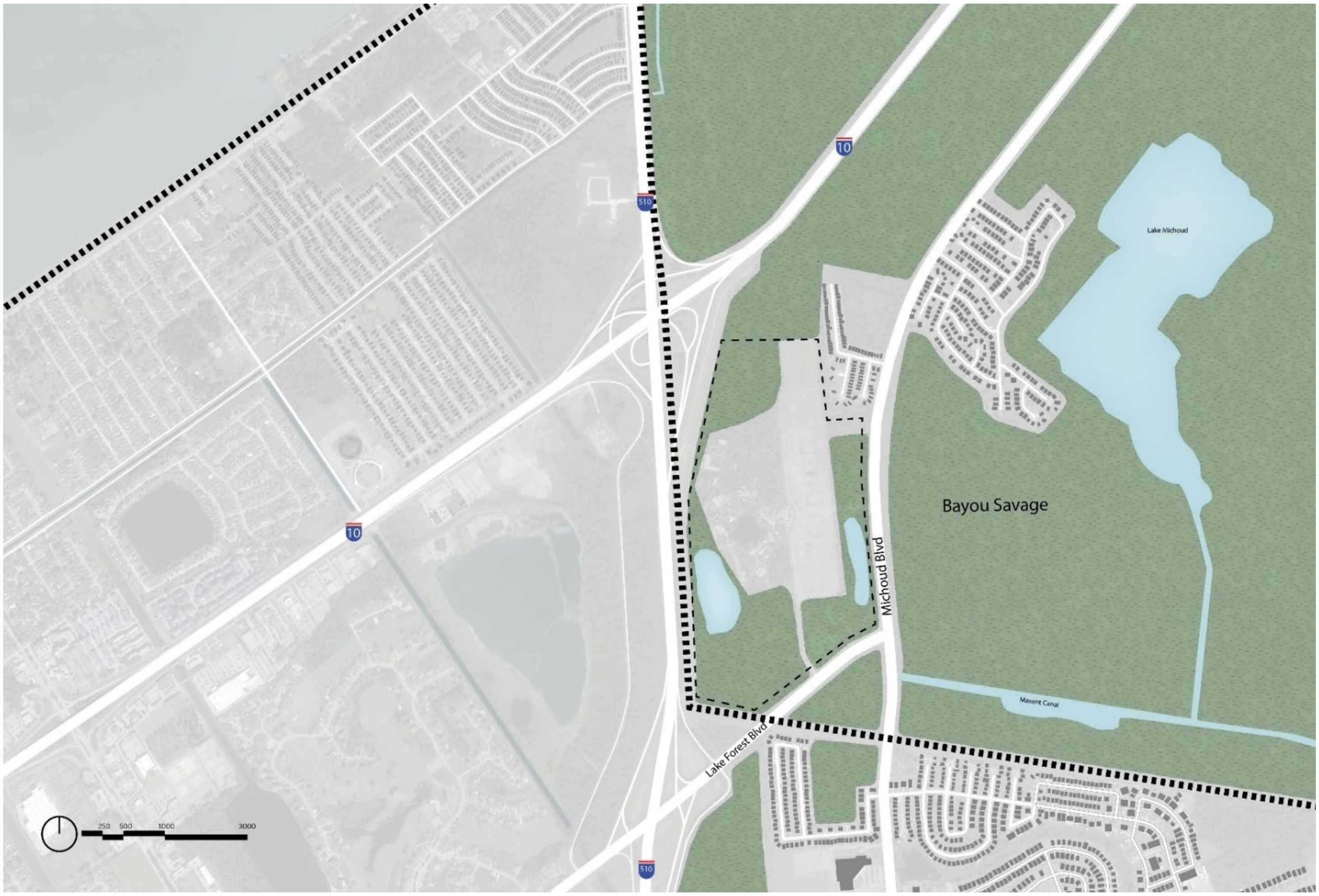



*Figure 21:Site context plan of the amusement park. (Source:Author)*

Surrounding the site are a series of isolated, single family suburbs. These houses are mostly constructed on flat, on grade concrete pads. Highway 10 and 510 are defining the western and northern boarders of the site. A protected wetland, Bayou Savage, is located to the east of the site. The Maxent canal is the main channel of which rainwater is channeled out from the site.

## Design Solution

The neighborhood plan aims to create a neighborhood layout that better integrates water infrastructure into the public realm, while also keeping the houses themselves safe from possible flood events. A secondary goal would be to help connect the isolated neighborhoods together through park infrastructure. Finally, there is an effort to make the site an attraction to visitors through park design and a retail corridor.

*Figure 22: Site Plan of proposed neighborhood scheme.*

The neighborhood is made up of a series of blocks oriented along the highest ground on the site. The lots within the block are 20 by 80 feet to introduce a density twice that of the surrounding suburbs. This is important for two reasons. One, allows the surrounding land to act as water retention gardens that can hold excess rainwater as it gets pumped out. Two, the density of the plan creates a more walkable neighborhood, with the central retail corridor within a quarter mile of all housing developments. There is a mid block pedestrian path that allows residents to walk through the neighborhoods separate from the cars.


*Figure 23: Areal Site view of the proposed neighborhood*

Within the plan, there is a series of designed swales that puncture the existing parking pad, allowing for water to more easily drain out of the site. The existing Maxent Canal is also extended up Michoud boulevard to service these swales.

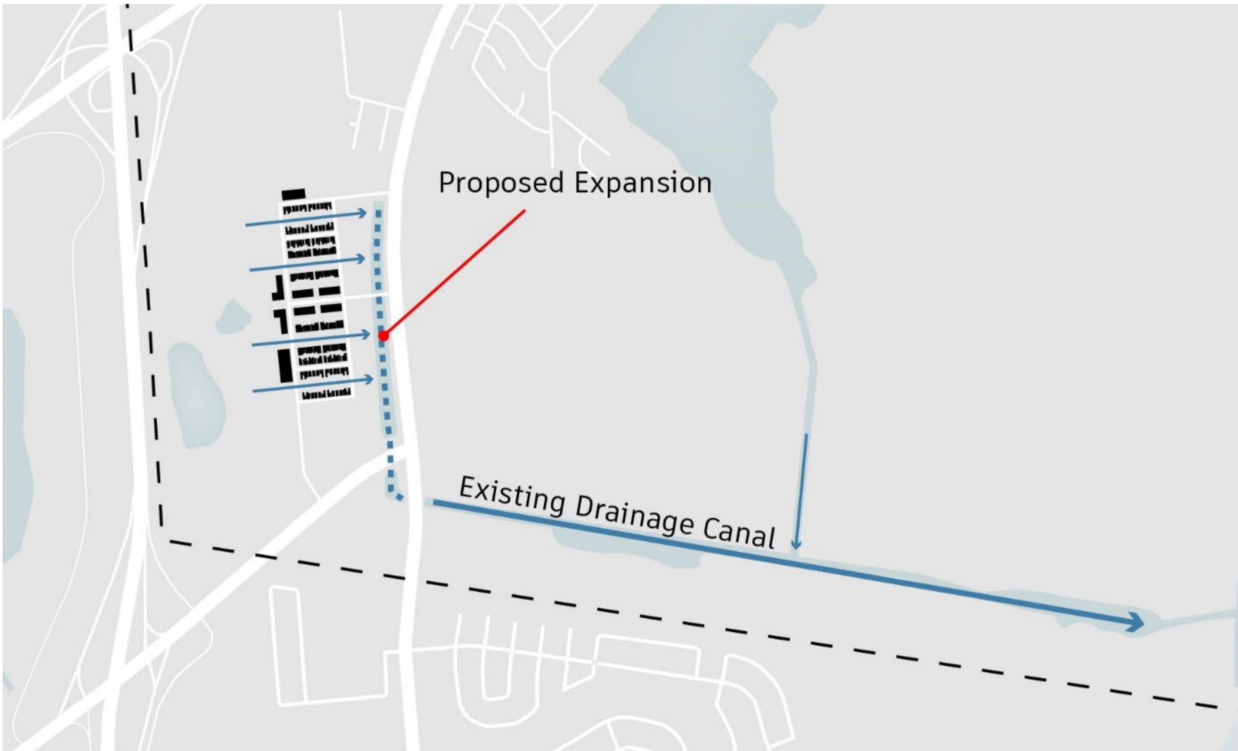



*Figure 24: Proposed drainage additions to the plan. (Source: Author)*

These swales are not designed for a purely infrastructural purpose. They can be designed in a way that allows residents and visitors to use them as parks and gardens. A proposed Michoud park has a purpose to act as the critical connecting piece between the isolated suburbs to the north, and the larger neighborhood to the south. The amusement park is intentionally left alone, to allow for a possible destination park to be developed there if there is demand.


*Figure 25: Diagram of the two parks on site. (Source: Author)*

The swales within the community will be designed to act as smaller, pedestrian parks or community gardens. They are located strategically to serve both front facing, public park, or a back facing private garden space.

*Figure 26: Rendition of a neighborhood swale. (Source: Author)*

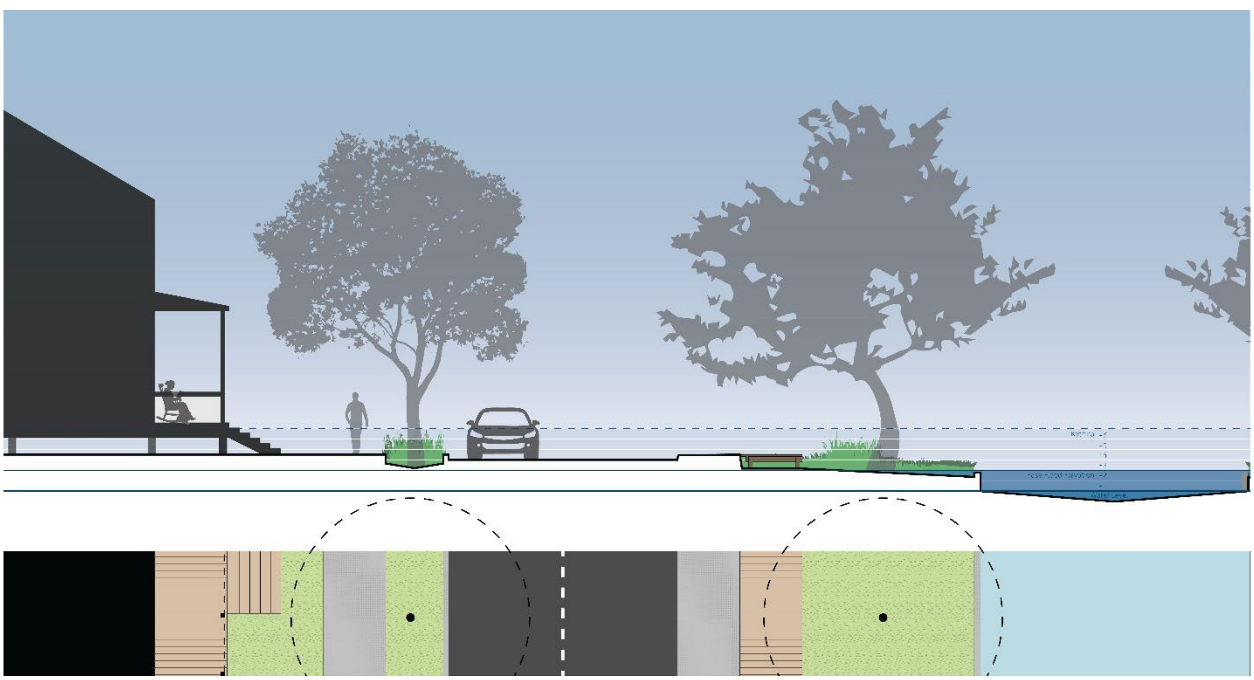


*Figure 27: Section and street plan of a neighborhood swale. (Source: Author)*


*Figure 28: Zoning map and statistics of the community plan (Source: Author)*

The community is made up of blocks of neighborhoods around the swales, with the mixed use retail corridor in the center of the plan. There is space put aside for a structured above ground parking garage if the amount of visitors requires it. Two surface parking areas are located behind the mixed-use corridor to support the higher density of the core. A civic plaza is at the terminus of the central entrance road, allowing for a view into the old amusement park.

*Figure 29: Rendition of the civic plaza. (Source: Author)*

*Figure 30: Rendition of the mixed use retail corridor (Source: Author)*

Three buildings on the plan are identified as possible locations for a stronger building type that can withstand even the worst disaster events. Conceptually, these buildings will have adequate structure and systems to stay operational even in the event of overwhelming floods. This is not a scenario that will happen on a regular basis, but it should be understood that these three buildings should be able to serve as a base of operations to organize the recovery effort. The first floor should be designed ideally to be able to accept and reject floodwater with minimal damage to critical structures.

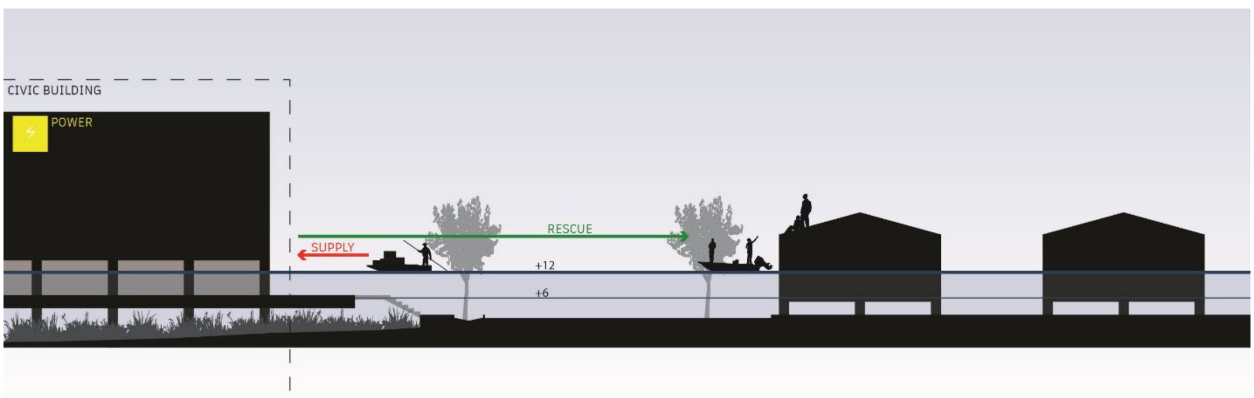



*Figure 31: Conceptual diagram of civic buildings acting as a basis for recovery operations. (Source: Author)*

The plan can support a variety of housing typologies. The shotgun house is the smallest most affordable housing type within the plan. The typology is rooted in New Orleans tradition, able to sit on narrower lots easily. The shotgun house can be a basis for additional variations of the layout, adding a second story for more bedrooms and square footage. Combining lots together at a 40x80 dimension will allow for larger single family houses to be built, while still sticking within the dense plan. Town houses can also be supported easily within the lots for a more condense neighborhood. Finally, at its densest near the corridor, double loaded apartment buildings can be built. Porches and balconies are added to each plan, allowing for a covered outdoor area for each household. These houses are proposed to have the living areas elevated at least three feet above the ground, well above the -4 base flood elevation. Though not required by law, the extra elevation will significantly reduce the risk of flood damages during less common, but more intense rainfalls.

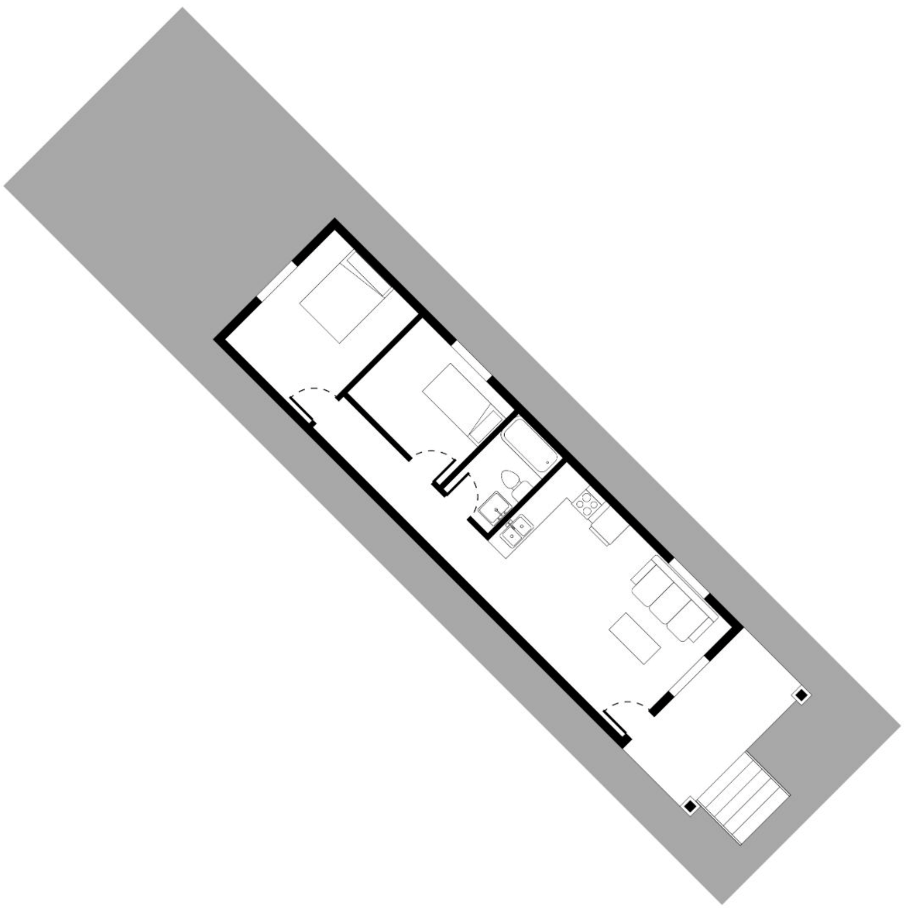


*Figure 32: Floor plan for a shotgun house (Source: Author)*

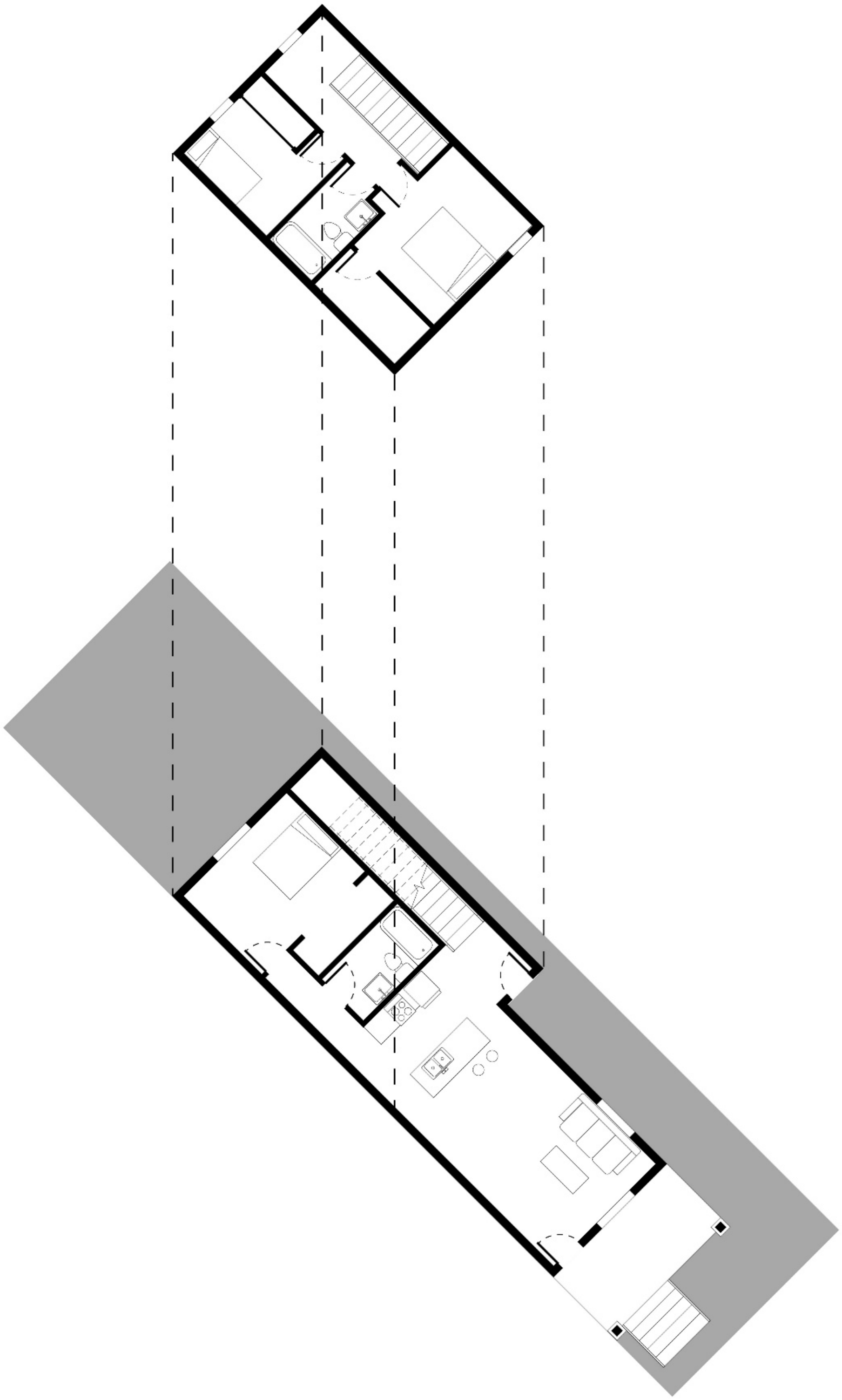


*Figure 33: Camelback variation of the shotgun house (Source: Author)*

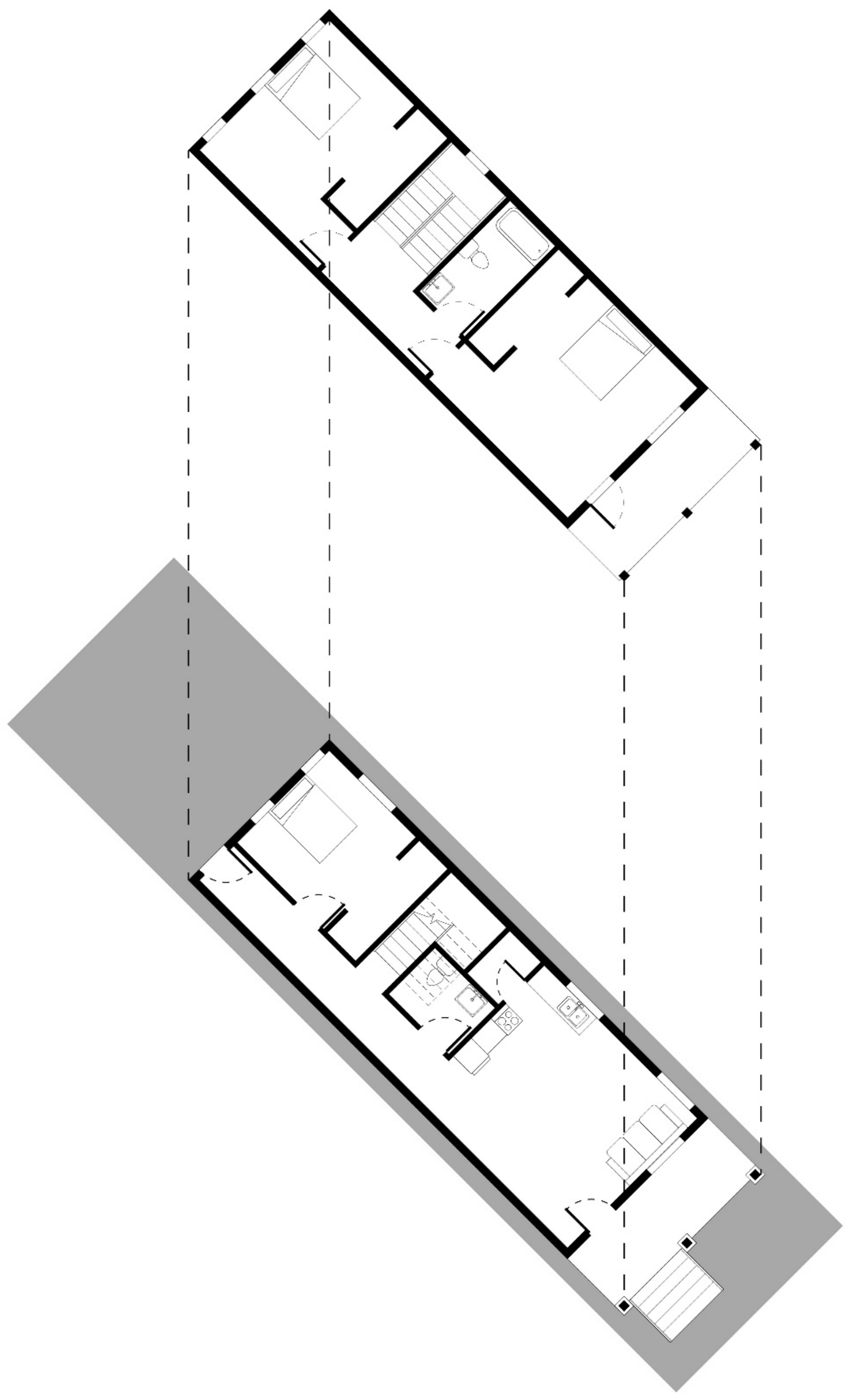
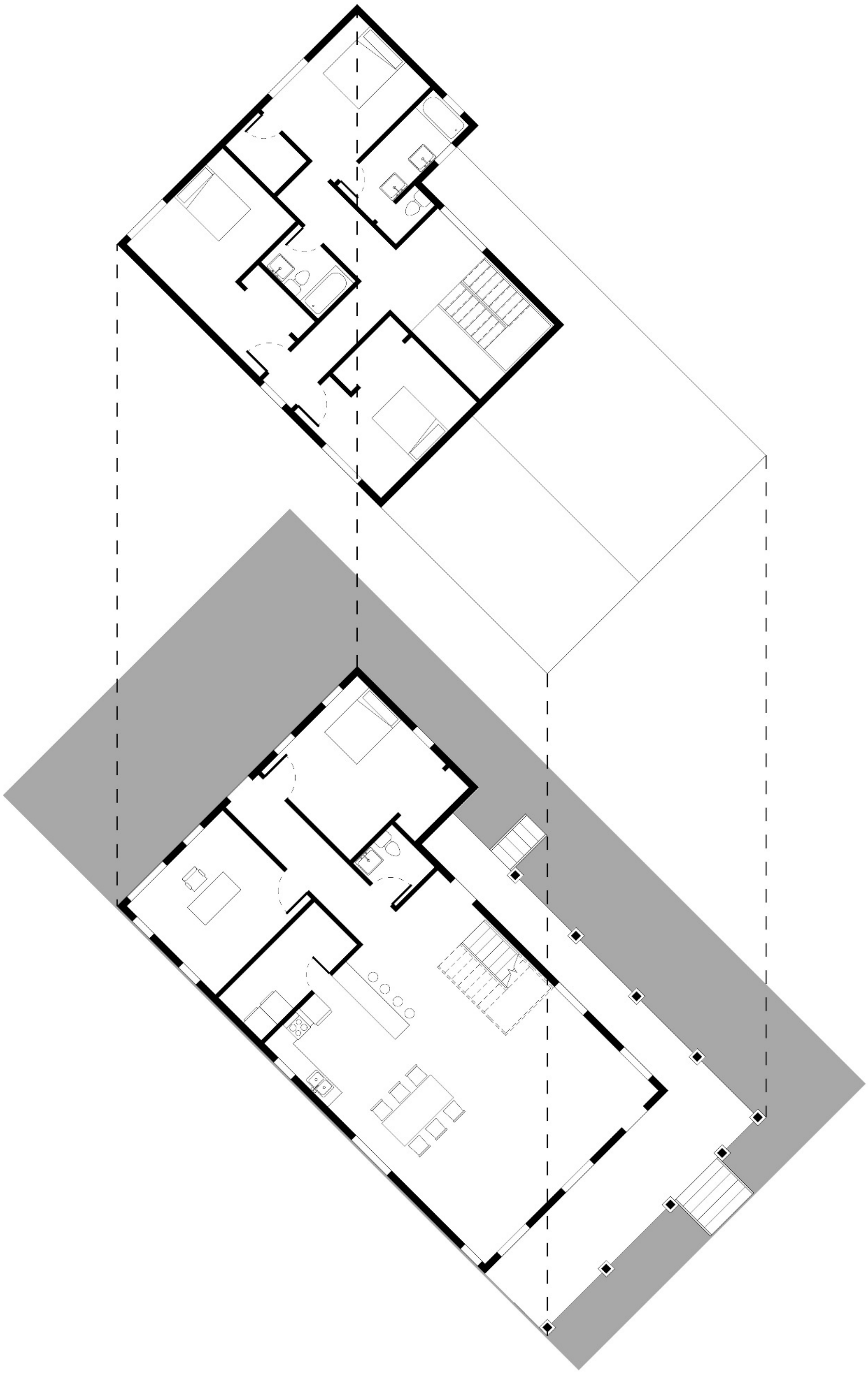


*Figure 34: Second floor variation of the shotgun house (Source: Author)*



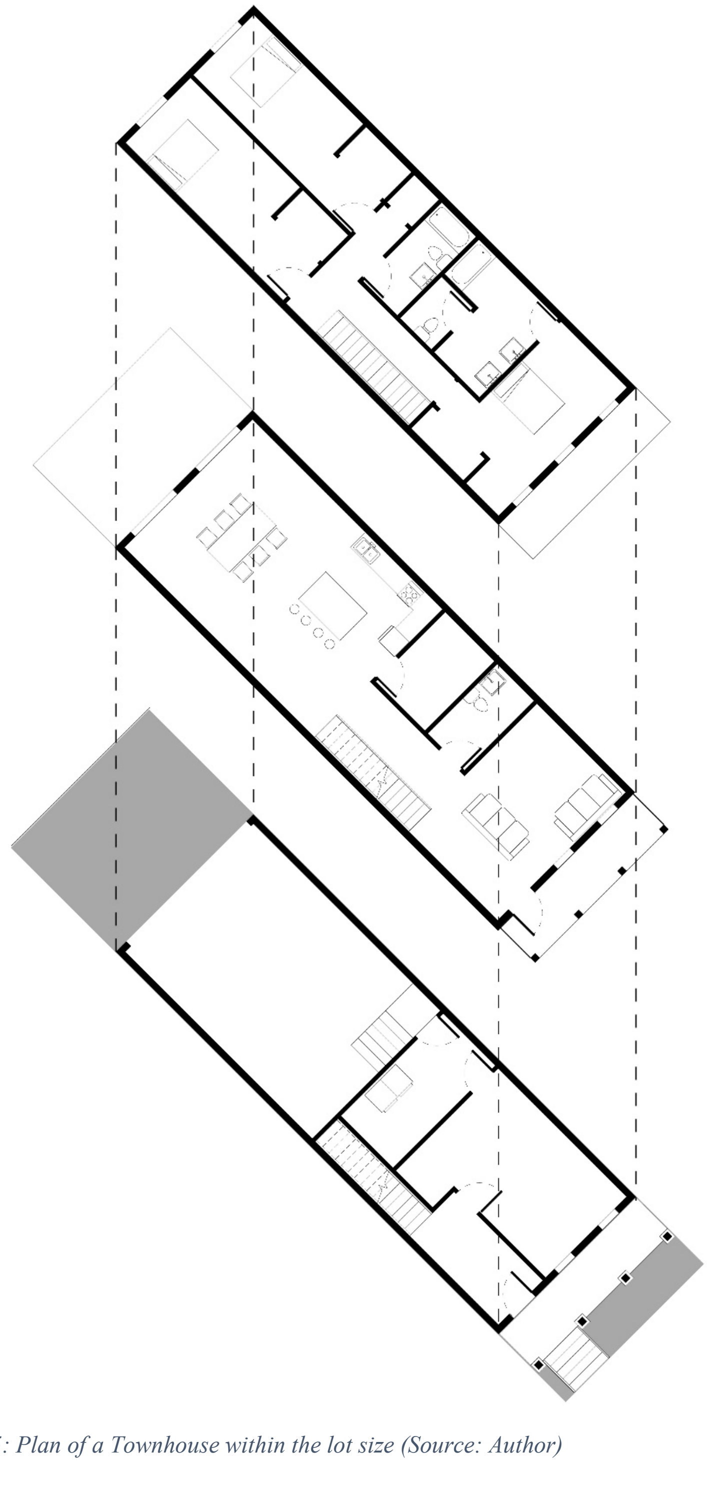


*Figure 35: Plan of a Townhouse within the lot size (Source: Author)*

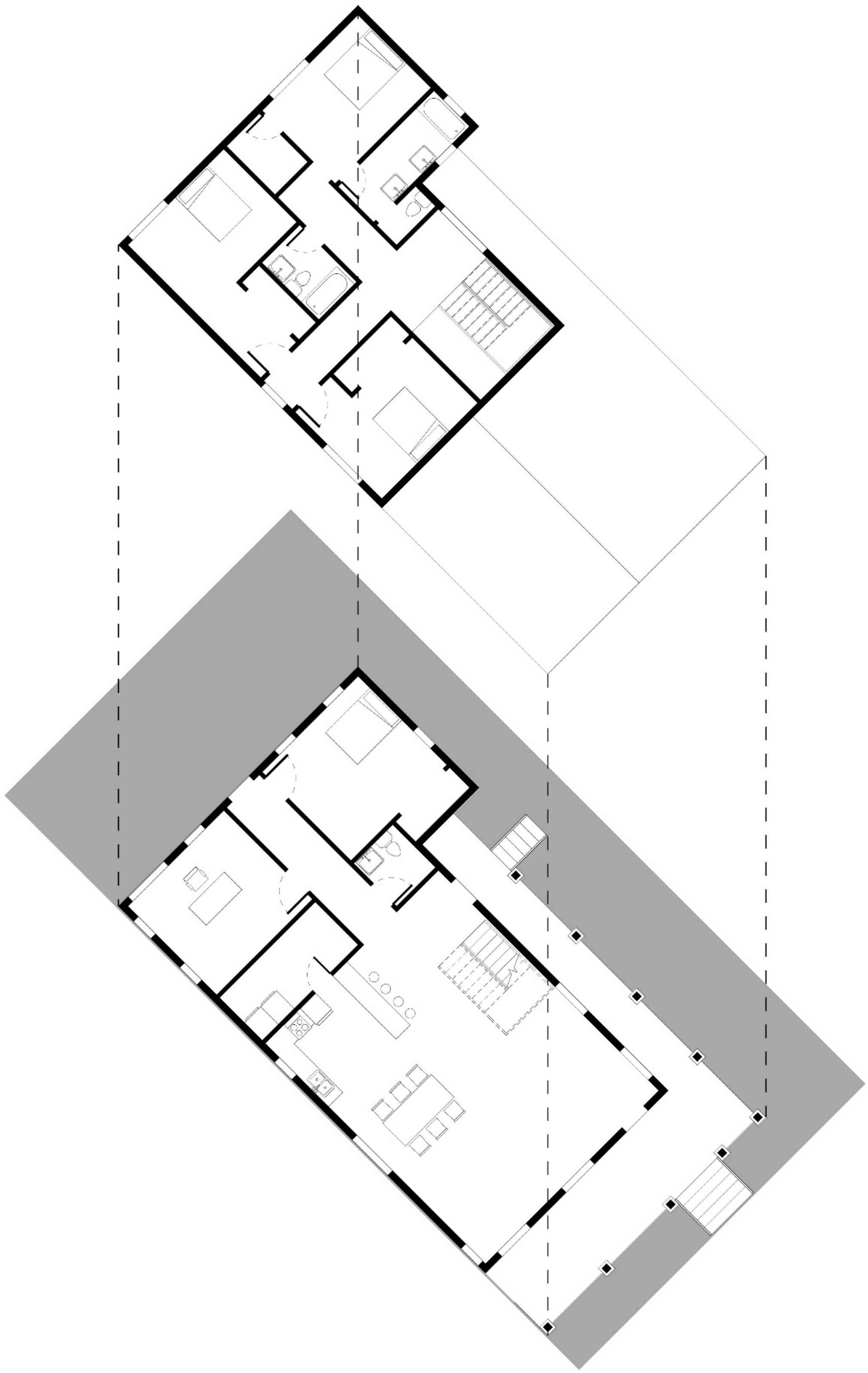


*Figure 36: Example of a single family house on a 40 by 80 feet lot size (Source: Author)*

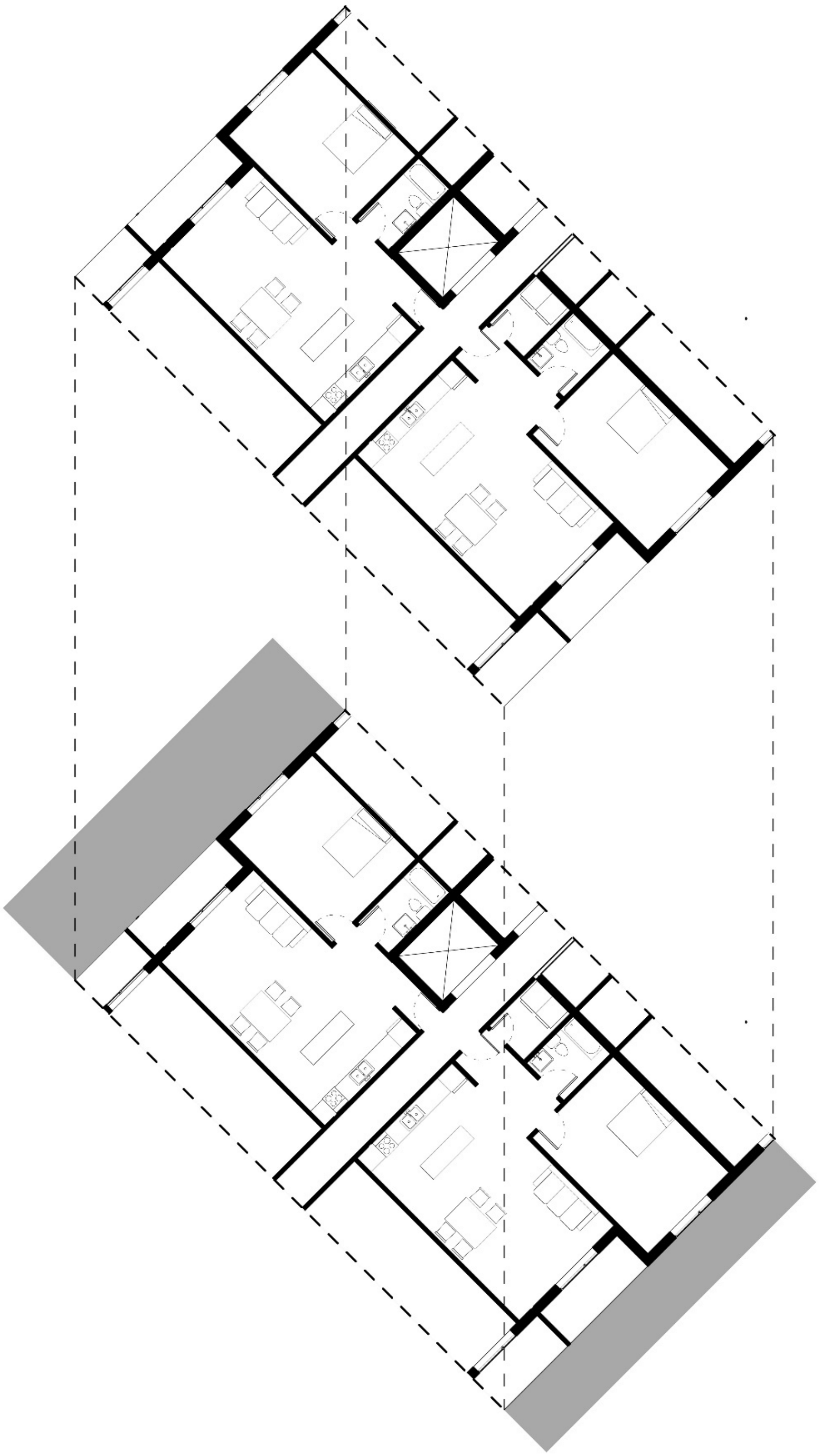


*Figure 37: Plan of two apartment units in a double loaded corridor (Source: Author)*

*Figure 38: Elevations of the various housing types. From left to right- Shotgun , Camelback, Two story shotgun, double lot single family house, town house. (Source: Author)*

The retail street along the west of the site has a different treatment when it comes to raised structures. The buildings are placed on a raised pad, and that pad is then elevated three feet above the ground. At 60 foot intervals, stairs connect the lower sidewalk adjacent to the street to the raised, pededtrian experence along the storefronts. The elevated pad allows water to flow over the road, down into a drainage swale in the middle of the two platforms.

*Figure 39: Retail street section and street plan (Source: Author)*

*Figure 40: Conceptual drawing of the neighborhood (Source: Author)*

*Figure 41: Longitudinal Section of the neighborhood, showcasing the various housing typologies and their relationship to the street and swales (Source: Author)*

Because of previous development patterns, much of the natural systems that kept New Orleans safe have been eroded. This requires us to engineer the sponge back into our neighborhoods. Current suburban development patterns are ill equipped for not only climate, but community as well. Though it is challenging, there are precedents and examples to draw on around the globe to help inform our developments. East New Orleans is an area in desperate need of this strategy. This thesis aims to create a community plan that not only addresses the climate challenges of the city, while also creating a place to help connect a disjointed neighborhood.

# Bibliography


Bruel-Delmar, Atelier. 2012. "Haute Deûle River Banks." Landezine. 2012. https://landezine.com/haute-deule-river-banks-new-sustainable-district-by-bruel-delmar/.

Buuren, Arwin van, Gerald Jan Ellen, and Jeroen F Warner. 2016. "Path-Dependency and Policy Learning in the Dutch Delta: Toward More Resilient Flood Risk Management in the Netherlands?" *Ecology and Society* 21, no. 4. https://www.jstor.org/stable/26270023?searchText=Netherlands+flood+management&searchUri=%2Faction%2FdoBasicSearch%3FQuery%3DNetherlands%2Bflood%2Bmanagement&ab_segments=0%2FSYC-6646_basic_search%2Fcontrol&refreqid=fastly-default%3Ae27a7a8026de855520fe6bee5fea4201#metadata_info_tab_contents.

Campanella, Richard. 2010. *Delta Urbanism - New Orleans*. American Planning Association.

Chavez, Robby. 2022. "How Rising Sea Levels Threaten the Lives of Louisiana's Coastal Residents." PBS. 2022. https://www.pbs.org/newshour/nation/difficult-conversations-how-rising-sea-levels-threaten-the-lives-of-louisianas-coastal-residents.

Coleman, James, Harry Roberts, and Gregory Stone. 1998. "Mississippi River Delta: An Overview." *Journal of Coastal Research* 14, no. 3: 698–713. https://www.jstor.org/stable/4298830#metadata_info_tab_contents.

"Community-Based Mangrove Reforestation and Management in Da Loc, Vietnam." 2011. Ecosystems and Livelihoods Adaptation Network. https://www.preventionweb.net/publication/community-based-mangrove-reforestation-and-management-da-loc-vietnam.

D'Aarcy, Patrick. 2018. "When Bangkok Floods (and It Floods a Lot), This Park Does Something Amazing." Ideas.Ted.Com. 2018. https://ideas.ted.com/when-bangkok-floods-and-it-floods-a-lot-this-park-does-something-amazing/.

Danh, Vo Thanh. 2012. "Adaptation to Sea Level Rise in the Vietnamese Mekong River Delta: Should a Sea Dike Be Built?" 2011-RR13. Economy and Environment Program for Southeast Asia. https://idl-bnc-idrc.dspacedirect.org/bitstream/handle/10625/49037/IDL-49037.pdf?sequence=1&isAllowed=y.

Donaldson, Gary A. 1987. "Bringing Water to the Crescent City: Benjamin Latrobe and the New Orleans Waterworks System." *Louisiana History: The Journal of the Louisiana Historical Association* 28: 381–96. https://www.jstor.org/stable/4232609?seq=4#metadata_info_tab_contents.

Dunn, Katherine Jollif. 2020. "The Pumps That Built (and Sank) the City of New Orleans." The Historic New Orleans Collection. 2020. https://www.hnoc.org/publications/first-draft/pumps-built-and-sank-city-new-orleans.

Gerritsen, Herman. 2005. "What Happened in 1953? The Big Flood in the Netherlands in Retrospect." *Philosophical Transactions: Mathematical, Physical and Engineering Sciences* 363, no. 1831: 1271–91. https://www.jstor.org/stable/30039653?searchText=Netherlands+flood&searchUri=%2Faction%2FdoBasicSearch%3FQuery%3DNetherlands%2Bflood&ab_segments=0%2FSYC-6646_basic_search%2Fcontrol&refreqid=fastly-default%3A503f9f8d46f2320b97034969ea11e849&seq=2#metadata_info_tab_contents.

Hardee, T.S. 1878. "Topographical and Drainage Map of New Orleans and Surroundings."

Heerden, Ivor van. 2007. “The Failure of the New Orleans Levee System Following Hurricane Katrina and the Pathway Forward.” *Public Administration Review*, Special Issue on Administrative Failure in the Wake of Hurricane Katrina, 67. https://www.jstor.org/stable/4624679?searchText=KAtrina+levee&searchUri=%2Faction%2FdoBasicSearch%3FQuery%3DKAtrina%2Blevee%26efqs%3DeyJjdHkiOlsiYW05MWNtNWhiQT09Il19&ab_segments=0%2Fbasic_search_gsv2%2Fcontrol&refreqid=fastly-default%3A3f561bba959d1872cc29832daa4db1c5#metadata_info_tab_contents.

Henkel, Theryn. 2018. “What Is Needed to Protect and Restore One of the Gulf Coast’s Largest Swamps?” Restore the Mississippi River Delta. 2018. https://mississippiriverdelta.org/what-is-needed-to-protect-and-restore-one-of-gulf-coasts-largest-swamps/.

“History of the Lower Mississippi Levee System.” n.d. USACE. https://www.mvd.usace.army.mil/About/Mississippi-River-Commission-MRC/Mississippi-River-Tributaries-Project-MR-T/Levee-Systems/.

“How The Delta Formed.” n.d. Restore the Mississippi River Delta. https://mississippiriverdelta.org/our-coastal-crisis/how-the-delta-formed/.

Howie, Charles. 2005. “High Dikes in the Mekong Delta, Vietnam, Bring Social Gains and Environmental Pains.” *Aquaculture News* 32. https://www.researchgate.net/publication/280715781_High_Dikes_in_the_Mekong_Delta_Vietnam_bring_social_gains_and_environmental_pains.

Kendall, John. 1922a. *History of New Orleans*. Vol. 2. 3 vols. Chicago : The Lewis Publishing Co. https://babel.hathitrust.org/cgi/pt?id=wu.89081205270&view=1up&seq=13.

———. 1922b. *History of New Orleans*. Vol. 1. 3 vols. Chicago : The Lewis Publishing Co. https://babel.hathitrust.org/cgi/pt?id=uc1.31822019473388&view=1up&seq=50.

Lamb, Zachary. 2020. “Connecting the Dots: The Origins, Evolutions, and Implications of the Map That Changed Post-Katrina Recovery Planning in New Orleans.” *Louisiana’s Response to Extreme Weather*, 65–91. https://www.researchgate.net/publication/337225537_Connecting_the_Dots_The_Origins_Evolutions_and_Implications_of_the_Map_that_Changed_Post-Katrina_Recovery_Planning_in_New_Orleans.

“LOUISIANA: EUROPEAN EXPLORATIONS AND THE LOUISIANA PURCHASE A SPECIAL PRESENTATION FROM THE GEOGRAPHY AND MAP DIVISION OF THE LIBRARY OF CONGRESS.” n.d. Library of Congress. https://www.loc.gov/collections/louisiana-european-explorations-and-the-louisiana-purchase/articles-and-essays/louisiana-as-a-spanish-colony/.

“LOUISIANA SPEAKS: PATTERN BOOK.” 2006. Louisiana Recovery Authority. https://www.cpex.org/louisiana-speaks

Maygarden, Benjamin. 1999. “National Register Evaluation of New Orleans Drainage System, Orleans Parish, Louisiana.” EARTH SEARCH INC. https://apps.dtic.mil/sti/citations/ADA374262.

Mittal, Anu K. 2007. “Coastal Wetlands: Lessons Learned from Past Efforts in Louisiana Could Help Guide Future Restoration and Protection.” GAO-08-130. U.S. Government Accountability Office. https://www.gao.gov/products/gao-08-130.

Mizell-Nelson, Catherine. 2013. “Alejandro O’Reilly.” 64 Parishes. 2013. https://64parishes.org/entry/oreilly-alejandro.

Nguyen, V., and Helen James. 2013. “Measuring Household Resilience to Floods: A Case Study in the Vietnamese Mekong River Delta.” *Ecology and Society* 18, no. 3.

https://www.jstor.org/stable/26269346?searchText=vietnam+flood+elevation&searchUri=%2Faction%2FdoBasicSearch%3FQuery%3Dvietnam%2Bflood%2Belevation&ab_segments=0%2FSYC-6744_basic_search%2Ftest-2&refreqid=fastly-default%3A32a3728497798d1f2e27a138f9259e7c&seq=11#metadata_info_tab_contents.

Nguyen Van Khanh Triet, Nguyen Viet Dung, Hideto Fujii, and Matti Kummu. 2017. "Has Dyke Development in the Vietnamese Mekong Delta Shifted Flood Hazard Downstream?" *Hydrology and Earth System Sciences* 21: 3991–4010. https://hess.copernicus.org/articles/21/3991/2017/hess-21-3991-2017.pdf.

O'Neill, K.M. 2008. "Broken Levees, Broken Lives, and a Broken Nation after Hurricane Katrina." *Southern Cultures* 14, no. 2: 89–108. http://www.jstor.org/stable/26391665.

Perrin, Grissom. 1957. "The Mississippi Delta Region." *Yearbook of Agriculture*, 524–31.

Powell, Neil, and Maria Osbeck. 2011. "Mangrove Restoration and Rehabilitation for Climate Change Adaptation in Vietnam." *World Resources Report*. https://www.researchgate.net/publication/235602091_Mangrove_restoration_and_rehabilitation_for_climate_change_adaptation_in_Vietnam.

Rentschler, Jun, Sophie de Vries Robbé, and Johannes Braese. 2020. "Resilient Shores : Vietnam's Coastal Development Between Opportunity and Disaster Risk." World Bank. https://openknowledge.worldbank.org/handle/10986/34639.

Rodgers, J. David. 2006. "CHAPTER FOUR: HISTORY OF THE NEW ORLEANS FLOOD PROTECTION SYSTEM." https://www.researchgate.net/publication/237543570_CHAPTER_FOUR_HISTORY_OF_THE_NEW_ORLEANS_FLOOD_PROTECTION_SYSTEM.

Rodgers, J.D. 2008. “Development of the New Orleans Flood Protection System Prior to Hurricane Katrina.” *Journal of Geotechnical and Geoenvironmental Engineering* 134, no. 5. https://ascelibrary.org/doi/10.1061/%28ASCE%291090-0241%282008%29134%3A5%28602%29.

Rodi, Rachel. 2013. “Dredging of Pilottown Anchorage Begins, Benefitting the CWPPRA West Bay Diversion.” US Army Corps of Engineers. 2013. https://www.mvn.usace.army.mil/Media/News-Releases/Article/473968/dredging-of-pilottown-anchorage-begins-benefitting-the-cwppra-west-bay-diversion/.

“The History of Building Elevation in New Orleans.” 2012. FEMA. https://www.crt.state.la.us/Assets/OCD/hp/uniquely-louisiana-education/Disaster-Recovery/The%20History%20of%20Building%20Elevation%20in%20New%20Orleans%2012-21-12.pdf.

“The Pontchartrain Basin.” n.d. The Louisiana Coastal Wetlands Planning Protection and Restoration Act. https://lacoast.gov/new/About/Basin_data/po/Default.aspx.

Tuan Anh, Tran. 2014. “Community Consultation for Long-Term Climate-Resilient Housing in Vietnamese Cities: A Comparative Case Study between Hue and Da Nang.” https://www.climatelearningplatform.org/community-consultation-long-term-climate-resilient-housing-vietnamese-cities-comparative-case-study.

Walmsley, R.M., J.C. Dennis, Albert Baldwin, B.M. Harrod, B.M. Richardson, and Rudolph Hering. 1895. “1895 Advisory Board Report on the Drainage of the City of New Orleans.” 1. New Orleans City Council. https://penelope.uchicago.edu/Thayer/E/Gazetteer/Places/America/United_States/Louisiana/New_Orleans/_Texts/1895_Advisory_Board_Report/1*.html.

“War and Play: The Civil War in New Orleans.” n.d. https://www.jstor.org/stable/26474008?seq=1#metadata_info_tab_contents.

Wesselink, Anna J, Wiebe E Bijker, Huib J. de Vriend, and Maarten S. Krol. 2007. “Dutch Dealings with the Delta.” *Nature and Culture* 2, no. 2: 188–209. https://www.jstor.org/stable/43304104?searchText=dutch+delta&searchUri=%2Faction%2FdoBasicSearch%3FQuery%3Ddutch%2Bdelta&ab_segments=0%2FSYC-6646_basic_search%2Fcontrol&refreqid=fastly-default%3Ac22eb3ddaaa5d83eadef62ad54d6bf4a#metadata_info_tab_contents.