

Design in the face of uncertainty:  
prevent, preserve, and mitigate coastal damage from storm surge and flooding

by

Allyssa Gray

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A REPORT

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MASTER OF LANDSCAPE ARCHITECTURE

Department of Landscape Architecture and Regional and Community Planning  
College of Architecture, Planning and Design

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Approved by:

Major Professor  
Dr. Timothy Keane

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## Abstract

The climate is changing and there is an increase of hurricanes, flood events, and isolated storms. Storm surge and flooding have become a severe and recurring issue affecting Galveston Island, Texas. The impact of said events threatens the economy, culture, and ecology of the Island. The Gulf of Mexico and Galveston Bay are interwoven in the social and economic framework of Galveston Island.

The purpose of the report is a proposed master plan of Galveston Island, Texas that increases the Islands Resiliency to storm surge and flooding. The master plan is informed through a study of literature, precedent studies, interviews with city officials, and an assessment of the Island. The project addresses how hybrid-infrastructure principals may be applied to Galveston Island to reduce the impact of storm surge and flooding.

A photograph of a long, straight concrete pier extending from the foreground into the ocean. The pier is made of large, rectangular concrete blocks. The water is a murky brown color, and there are small waves breaking against the pier. The sky is a pale blue with some light clouds. The horizon is visible in the distance.

# Design in the Face of Uncertainty

Prevention, Preservation, and Mitigation of Coastal  
Damage from Storm Surge and Flooding

By Allyssa Gray



## Acknowledgements

To my family, without your endless encouragement and support this would not be possible. Mom, you are the one who introduced me to landscape architecture and have been such a rock during my studies. You have allowed me to call you at anytime to cry, vent, and bounce ideas off you. I honestly do not know how I would have gotten through many days without you being there for me. Dad and Whitney, you both have been extremely supportive and encouraging even though you don't quite understand what I am going through. You have given me many laughs and kind words to diffuse my frustration during stressful times. You all have watched me follow my dreams for the last 9 years and I am finally here, but I never would have done it without you.

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## Dedication

I dedicate this book to my Uncle Bruce Henderson. Without his constant advocacy for a better Dickinson-Galveston area, I would not have found my passion for designing to protect people from future natural hazards.



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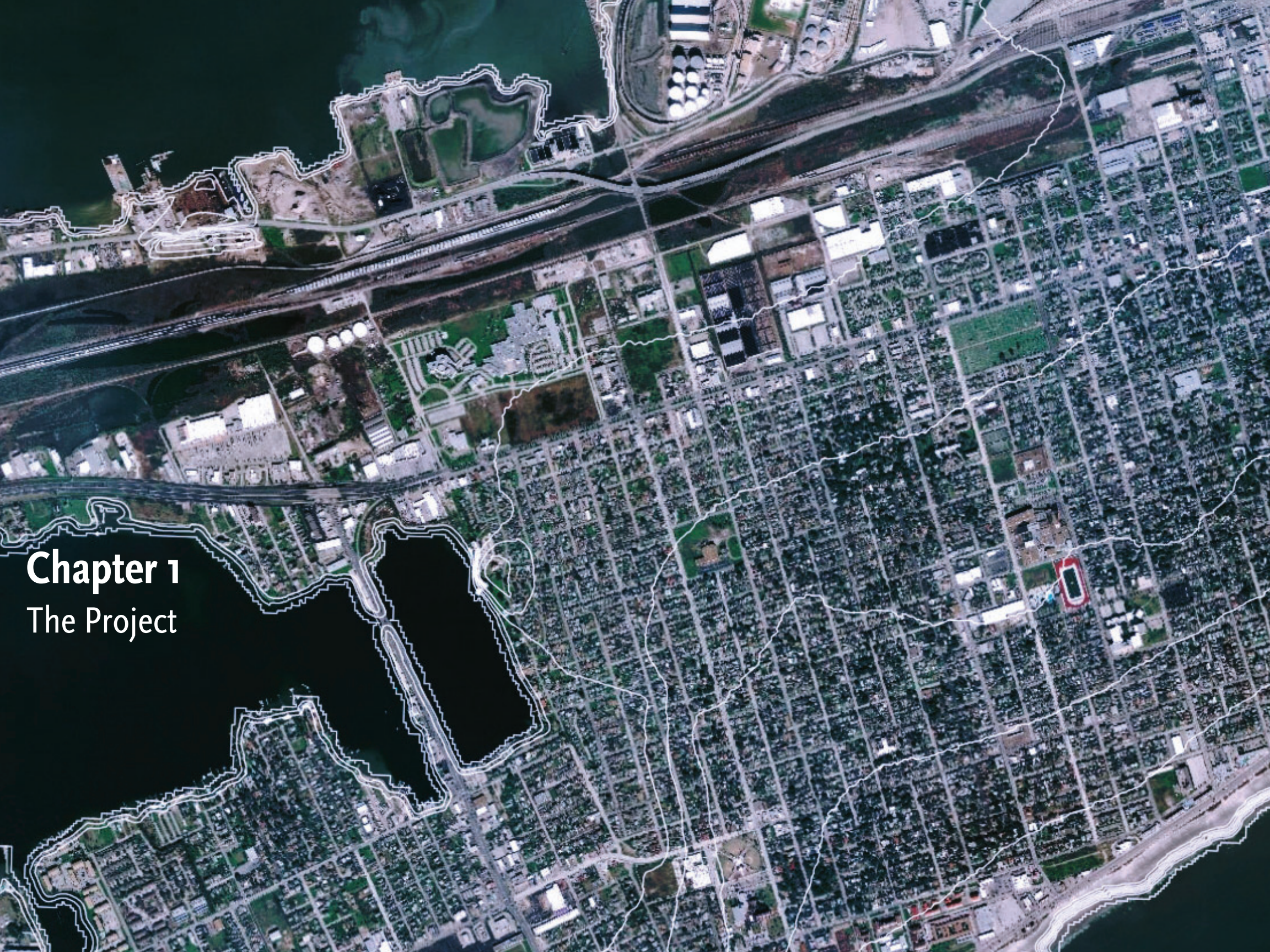
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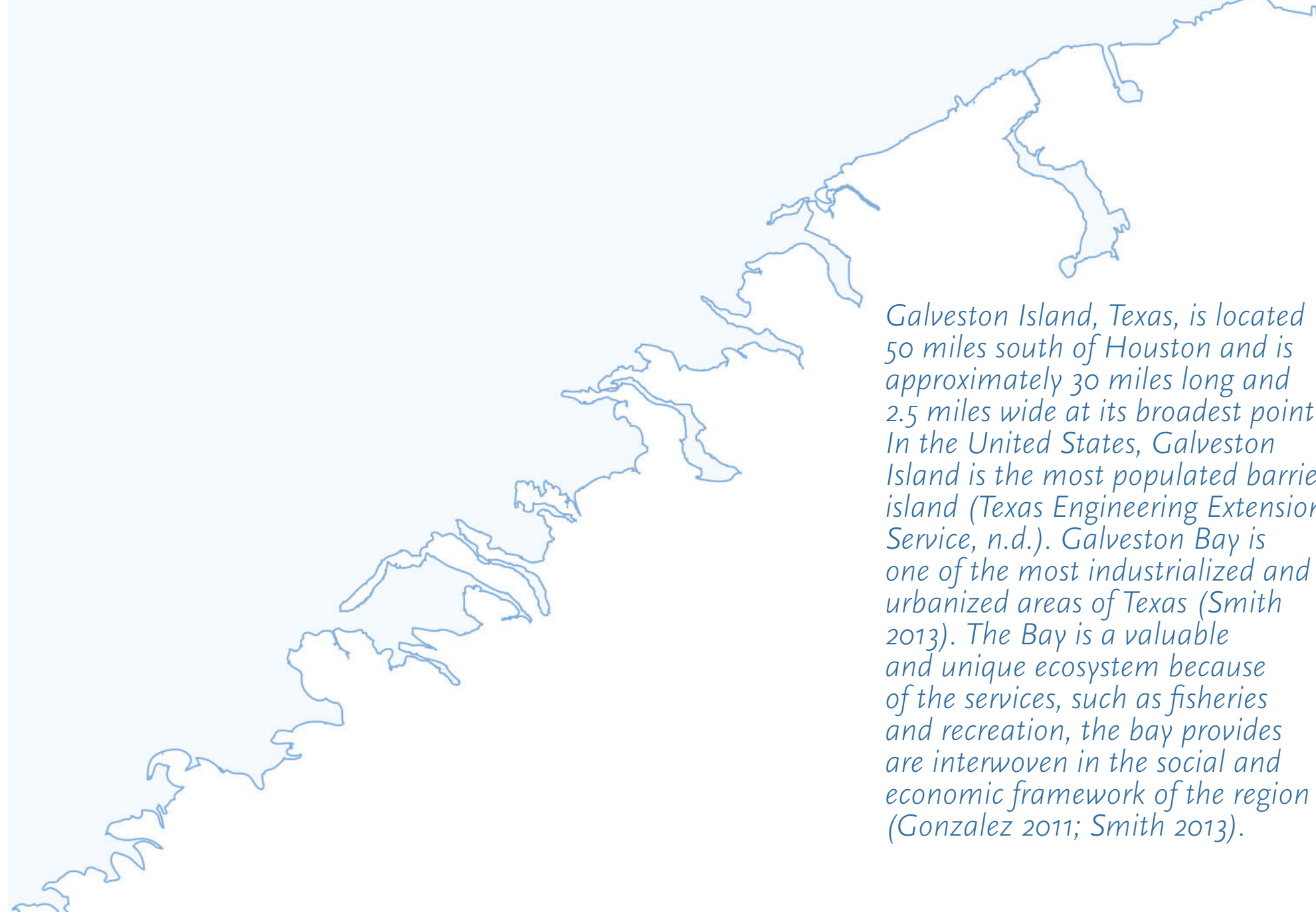




# Chapter 1

## The Project





Galveston Island, Texas, is located 50 miles south of Houston and is approximately 30 miles long and 2.5 miles wide at its broadest point. In the United States, Galveston Island is the most populated barrier island (Texas Engineering Extension Service, n.d.). Galveston Bay is one of the most industrialized and urbanized areas of Texas (Smith 2013). The Bay is a valuable and unique ecosystem because of the services, such as fisheries and recreation, the bay provides are interwoven in the social and economic framework of the region (Gonzalez 2011; Smith 2013).

## Inspiration

Ever since I can remember, I have always been attracted to water. Whether a creek, swimming pool, or ocean, the water has always brought me peace and tranquility. Despite its calming effect on me, on August 25, 2017, a hurricane with 130 mile-per-hour winds and a 6 foot storm surge ripped through the Texas Gulf Coast (Sharp 2018). My uncle lives in Dickinson, Texas and was affected by the hurricane. Shortly after the hurricane, he shared an article on Facebook from the 1970s calling for change that minimizes the impact hurricanes have on communities. When my uncle posted this article, he questioned if hurricane ravaged areas would have to wait another 40 years before government officials enacted change. It was at that moment that I knew my master's project was going to focus on the resiliency of Galveston Island. My passion for helping others and my lifelong love for the water have both deeply influenced my research and assessment within this project.

## Design Process

The purpose of this report is to propose a master plan for Galveston Island that increases its resiliency to flooding and storm surge. A conceptual masterplan of two sites that vary in experience for residents and visitors are completed using design typicals that combat storm surge and flooding. The two sites depict typicals and different uses that would be experienced throughout Galveston Island. The use of precedent studies is analyzed in terms of their infrastructure, location along a bay or ocean, and other relevant factors. Interviews were conducted with 3 individuals who work for the City of Galveston. A site assessment was conducted depicting the different types of development, infrastructure, and vegetation on the Island. The site assessment highlighted areas of opportunities and constraints for conceptual design elements. A projective masterplan is proposed and discussed in further detail in Chapter 5: The Design.

## Anticipated Outcomes

This report has three anticipated outcomes that will be achieved by the implementation of precedent studies, interviews, and site assessment.

### Outcome 1:

Comprehensive understanding of the past, present, and future of Galveston Island

### Outcome 2:

A developed masterplan for Galveston Island that can adapt and grow in the face of uncertainty

### Outcome 3:

The project will be an example for coastal cities and barrier islands among the United States of America

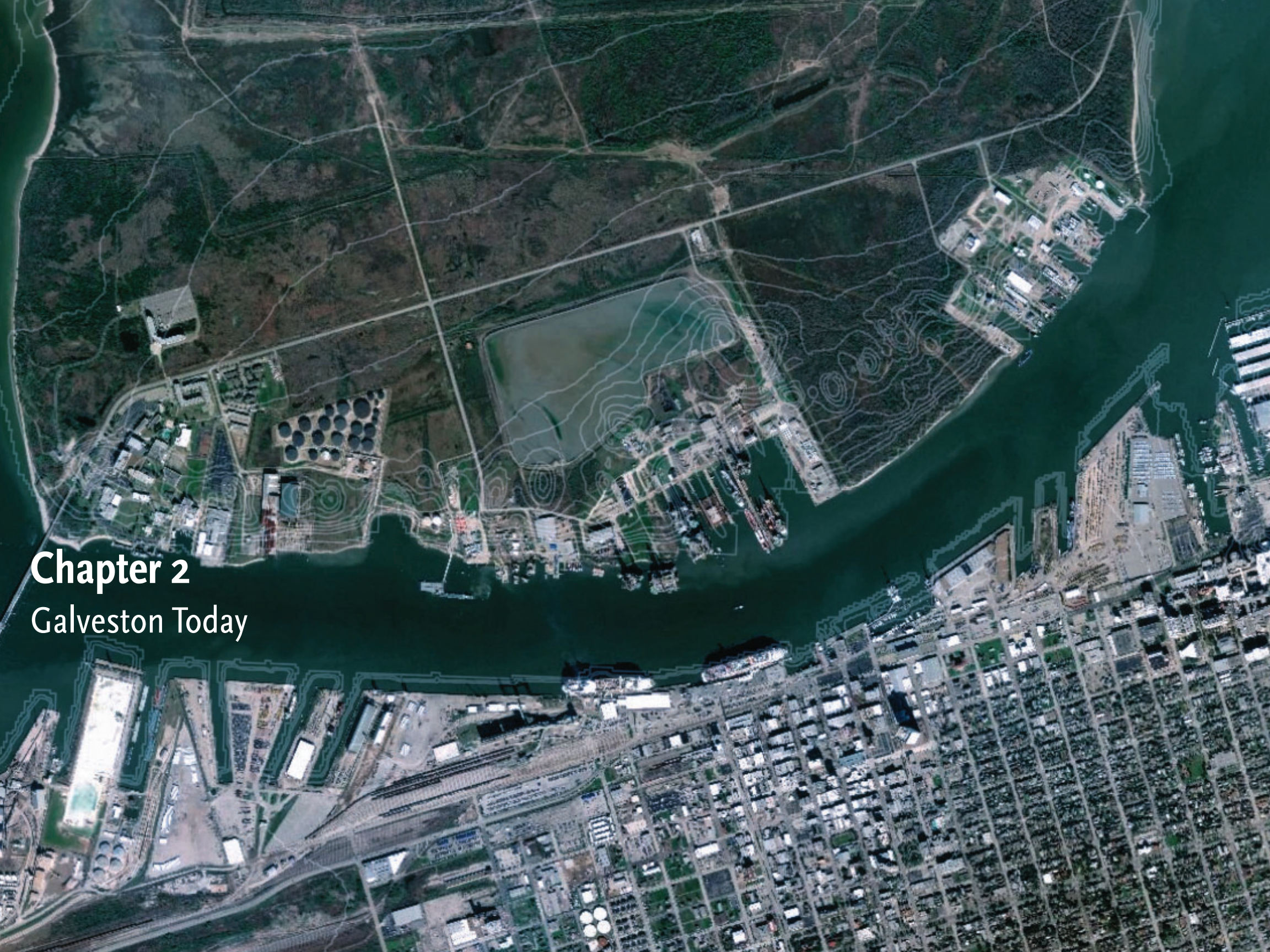
## Importance

This Master's Report informs landscape architects and related fields of practices that can prevent, preserve, and reduce the impact of flooding and storm surge. It educates the reader about the use of hybrid infrastructure over traditional gray infrastructure. This report is valuable to landscape architects and related fields because there will be an increase of hurricanes, flood events, and isolated storms due to climate change. Such events threaten the economy, culture, and ecology of Galveston Island and areas like it. It is vital to design for storm surge and flooding to ensure the longevity of coastal states and countries.

## Research Question

How can landscape architects contribute to the prevention, protection, and mitigation of coastal damage from storm surge and flooding?

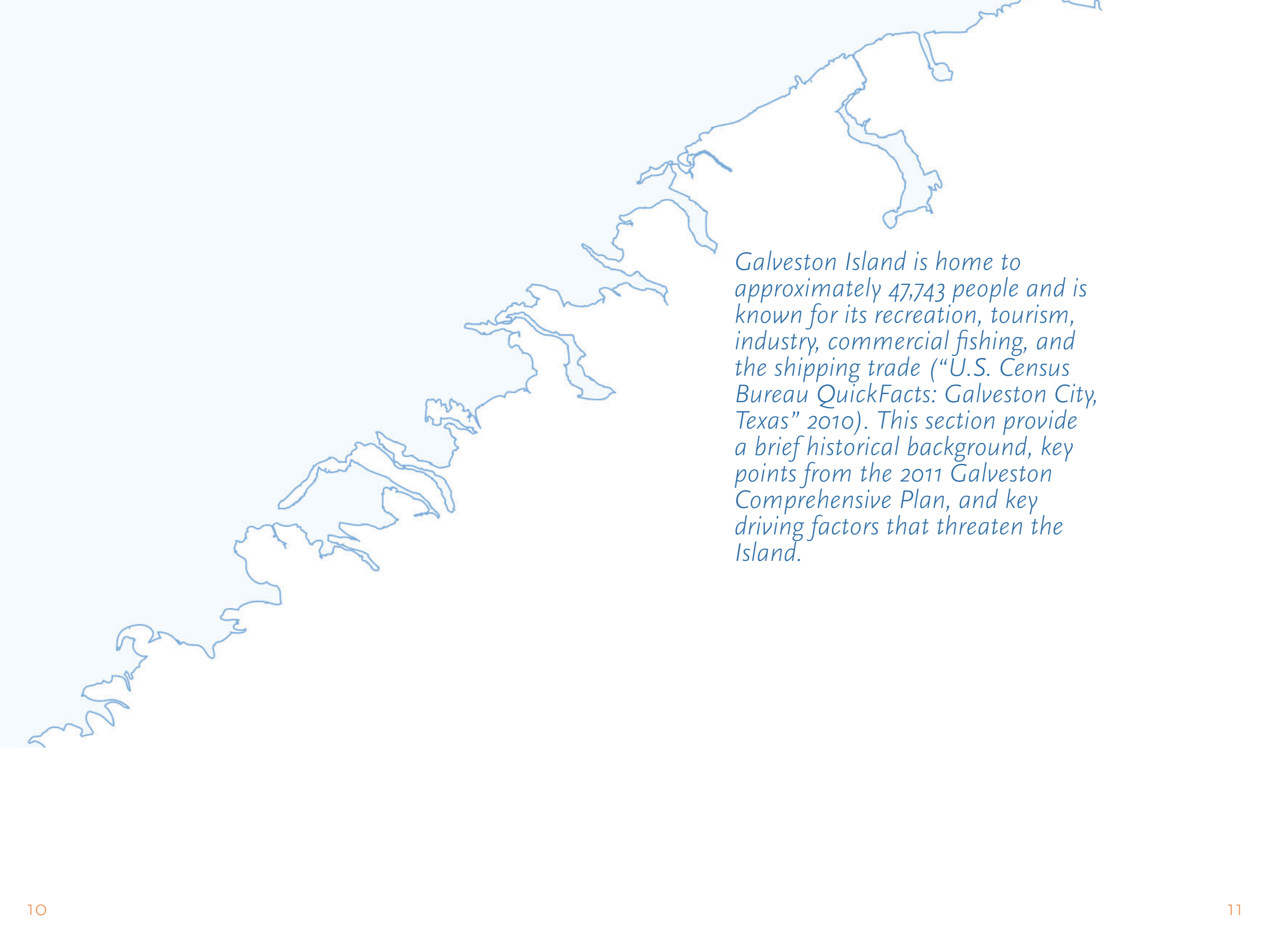




## Chapter 2

### Galveston Today





Galveston Island is home to approximately 47,743 people and is known for its recreation, tourism, industry, commercial fishing, and the shipping trade (“U.S. Census Bureau QuickFacts: Galveston City, Texas” 2010). This section provide a brief historical background, key points from the 2011 Galveston Comprehensive Plan, and key driving factors that threaten the Island.

## History

The Spanish and French arrived at Galveston Island in the fifteenth and sixteenth centuries to explore the new world (Smith 2013). Their arrival pushed the indigenous tribes, the Akokisa and Atakapa tribes, into the Caddoan territories and south into Mexico after Texas became independent from Mexico (Gonzalez 2011). In the late 1700s and into the early 1800s, Galveston harbor began to attract trade ships and more permanent settlements began to form (Gonzalez 2011). After the war in 1838, a group of investors purchased approximately 4,500 acres and plotted the land in gridiron fashion, figure 2.1 (McComb 2010). The investing group sold town lots in 1838 and Galveston was incorporated in 1839 (Gonzalez 2011 and McComb 2010). The industries that made Galveston Island successful in the 1800 and 1900s are still prevalent today.

The Port of Galveston is one of the most important industries that established the city and triggered growth from a small trading post to an economic base that the city relies on ("Port of Galveston" n.d.). Over time, the Island's population grew, and the construction of ports was essential in bringing settlers and supplies to Texas (Gonzalez 2011). The city was used as a transfer point for ship routes to Houston (McComb 2010). This passage through Galveston Bay to

Houston increased and channels were created or enlarged to withstand the amount of traffic (Gonzalez 2011). By the 1900s, the Port of Galveston was the urban center for the Island and was a substantial exporter of goods, and by 1951, the port set a national record for exports ("Port of Galveston" n.d.). In 1989, the first day-cruise set sail from the Port of Galveston and in 2004 a cruise line announced the operation of 11 and 12-day cruises ("Port of Galveston" n.d.). Today, the Port of Galveston relies on shipping, resorts, food processing, and oil refining ("Port of Galveston" n.d.). The shellfish industry in Galveston, Texas is strong because of the freshwater inflow (Gonzalez 2011). In 1885, 500 men worked in the oyster industry, shipping approximately 25,000 oysters daily (Gonzalez 2011). The state of Texas had to intervene in the oyster harvesting because the oysters were heavily harvested which began to diminish the natural reefs and deplete the number of oysters. (Gonzalez 2011). The state leased portions of the bay bottom and taught the oystermen how to raise oysters instead of harvesting the natural reefs (Gonzalez 2011). Over time, there was an effort to preserve the natural reefs, but commercial shelling and dredging up to the 1970s reduced the oyster reefs (Gonzalez 2011). The population began to recover from the 70s but when Hurricane Ike hit, it covered approximately 60% of the oyster reefs in Galveston Bay with sediment which will take years to recover (FEMA 2008).

Petroleum is a significant industry in Texas and accounts for a large portion of the economy in the Houston-Galveston area. The petroleum era started when the first oil refinery was built in the 1900s (Gonzalez 2011; Smith 2018). Cotton and cattle were replaced by oil drilling as a means of revenue (Gonzalez 2011). Once the oil was discovered, plants and distribution centers were built along the Gulf Coast, but it was not until 1914 when the Houston Ship Channel opened that refineries were built (Olien 2010). Many of the refineries that were built in the 1920s and 1930s are those that we recognize today (Gonzalez 2011; Smith 2013).

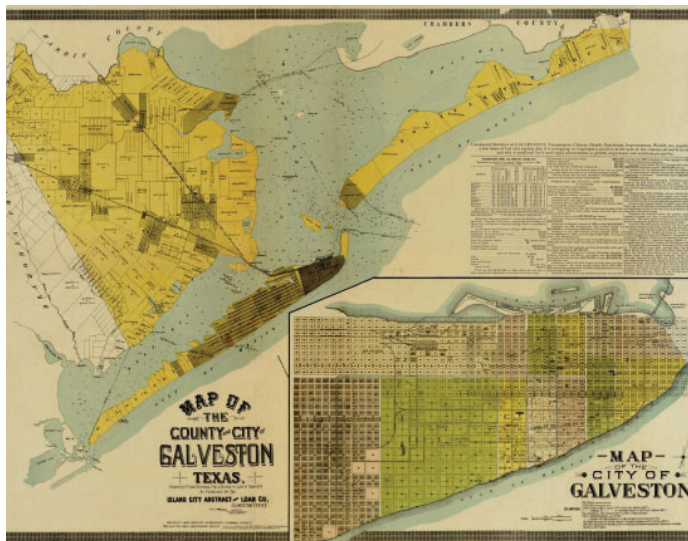


Figure 2.1:  
Galveston County  
Map in 1891  
(Co 1891)

## City of Galveston Comprehensive Plan 2011

All information in this section is obtained from the City of Galveston Comprehensive Plan of 2011.

The 2011 Comprehensive Plan outlines the economic goals for the Island, but the economic goal is to grow and diversify the economy, create and retain jobs, promote fiscal health, and enhance the quality of life. The growth of Galveston should retain and build upon the historical strengths of the community, including tourism, the Port, and the university of Texas A&M at Galveston. Specific areas of growth identified are downtown and key commercial and mixed-use corridors. These include highway I-45, Seawall Boulevard, 61st Street, Harborside Drive, and 25th Street.

A significant improvement the city seeks is a master plan for the Seawall that is a consistent design. The design would include improvements to the Seawall, furnishings, restroom and shower structures, transit shelters, paving, lighting, intersection and crossing improvements, benches, interpretive and wayfinding signage, landscaping, and recycling and trash receptacles. The plan is a significant undertaking and a phasing plan would be necessary. Along the updated Seawall Boulevard, the improved conditions complement and support its function as a visitor destination. Galveston Island wants to become a year-round tourist destination and needs a visitor center and new attractions to sustain a year-round destination for tourists.

As previously mentioned, the Island's goal is to be a sustainable island. To do that, the city should promote sustainable development and explore opportunities to attract "green industry" business development. The plan encourages businesses to be resilient and adopt sustainability practices. The goal for the city of Galveston regarding their natural resources is to "preserve and protect the sensitive natural resources of Galveston Island, the Galveston Bay Estuary, and the Gulf of Mexico." (City of Galveston 2011). The Island has natural resources that the City acknowledges as essential to preserve, protect, and restore for the viability of

the community as well as the character of the Island (figure 2.2). The benefits that come from natural resources are ecotourism, commercial fishing, sport fishing, recreational opportunities, and a higher quality of life for the residents. The natural resources the city is protecting are the beaches, dunes, and bay wetlands. Land loss is a significant threat to Galveston Island and is caused by sea-level rise, erosion, filling, and dredge-and-fill activities that are challenging government agencies and coastal communities. To protect the natural systems, there needs to be flood control, filtering pollutants from the Bay, and providing a habitat for many species of plants, fish, birds, and wildlife.

Figure 2.2:  
Damage after  
Hurricane Ike on  
Bolivar Island  
(City of Galveston  
2011).





## Galveston, Texas Climate

The summers are long and hot while the winters are short, chilly, and windy, but it is wet and partly cloudy year-round (“Average Weather in Galveston, Texas” n.d.). The humidity creates a long muggy period that lasts for approximately 8 months out of the year (“Average Weather in Galveston, Texas” n.d.). The best time of year to visit Galveston is from late March to mid-May and mid-October to mid-November because the temperature is ideal, less hurricanes, figure 2.3, and less tourists are around during these seasons, table 2.1 (“Average Weather in Galveston, Texas” n.d.).

Figure 2.3:  
Visual Representation  
of Peak Hurricane  
Season (Gray 2020)

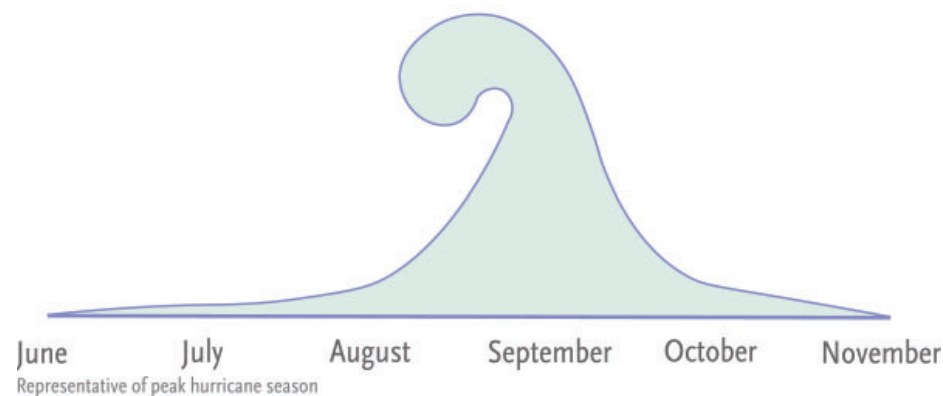


Table 2.1:  
Weather Averages in  
Fahrenheit and Inches  
(Gray 2020)

	Jan	Feb	Mar	Apr	May	Jun
Temperature	52.9	55.4	61.7	69.4	75.7	81.3
Water Temperature	57.6	58.8	64.2	71.2	77.7	83.7
Precipitation	3.20	2.85	2.25	2.70	3.00	4.00

	Jul	Aug	Sep	Oct	Nov	Dec
Temperature	83.3	83.5	80.1	72.3	63.7	56.3
Water Temperature	85.5	86.2	83.8	78.1	69.6	61.7
Precipitation	3.62	4.13	6.00	3.00	3.25	3.60

## Hurricane Season

There has been an increase of significant storms during the Atlantic hurricane season because of the rising sea surface temperatures (“Texas’ Climate Threats” n.d.; Thompson and Kahn 2016). Since 2005, Hurricane Wilma was the country’s last major hurricane, Category 3 or higher, until Hurricane Harvey which was a Category 4 in 2017 (World Vision 2018). There was a hurricane drought from 2005 until Hurricane Harvey, but there was Hurricane Ike in 2008 and Superstorm Sandy in 2012, which were some of the costliest storms on record (Thompson and Kahn 2016). The average number of named hurricanes in the Atlantic basin has increased from 5 to 7 and figure 2.4 depicts the categories of hurricanes. (Thompson and Kahn 2016).

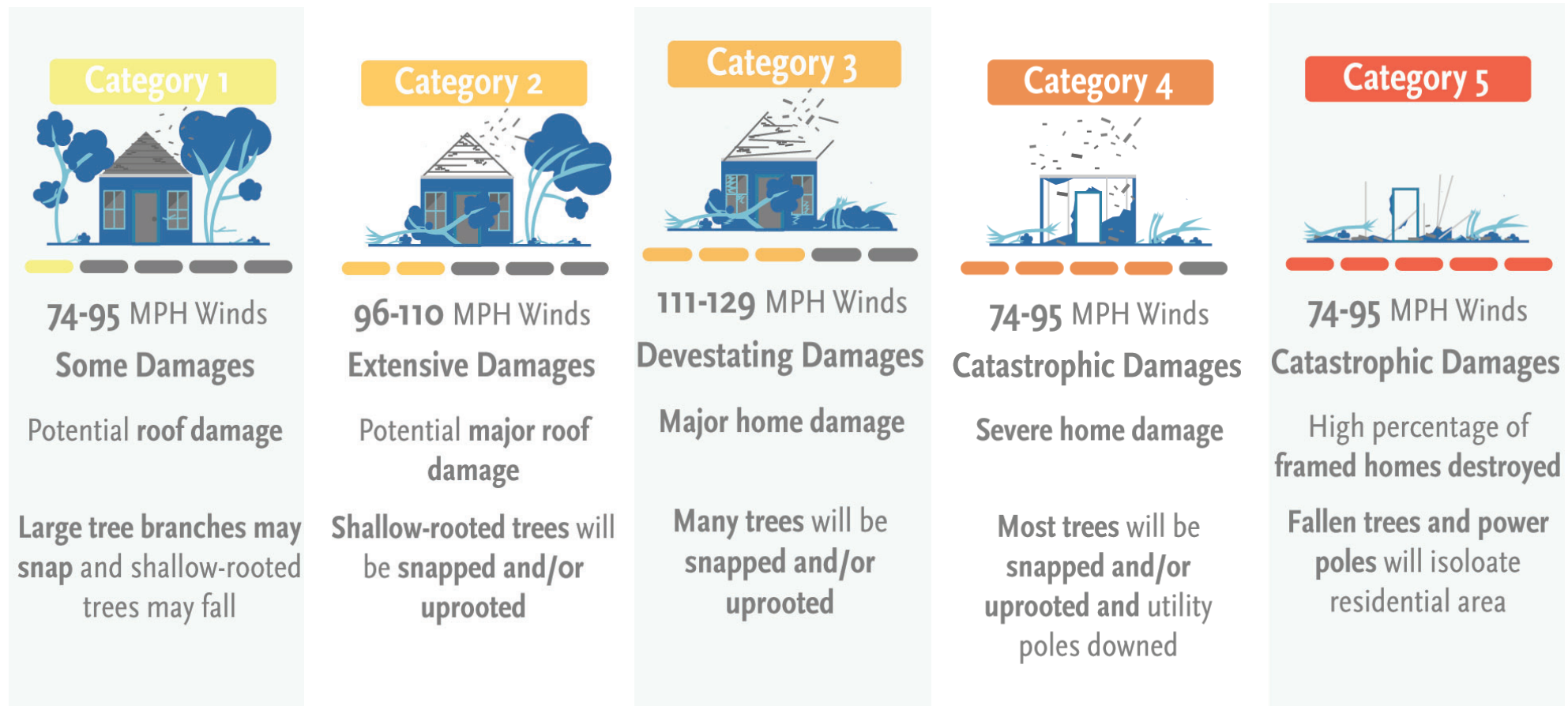


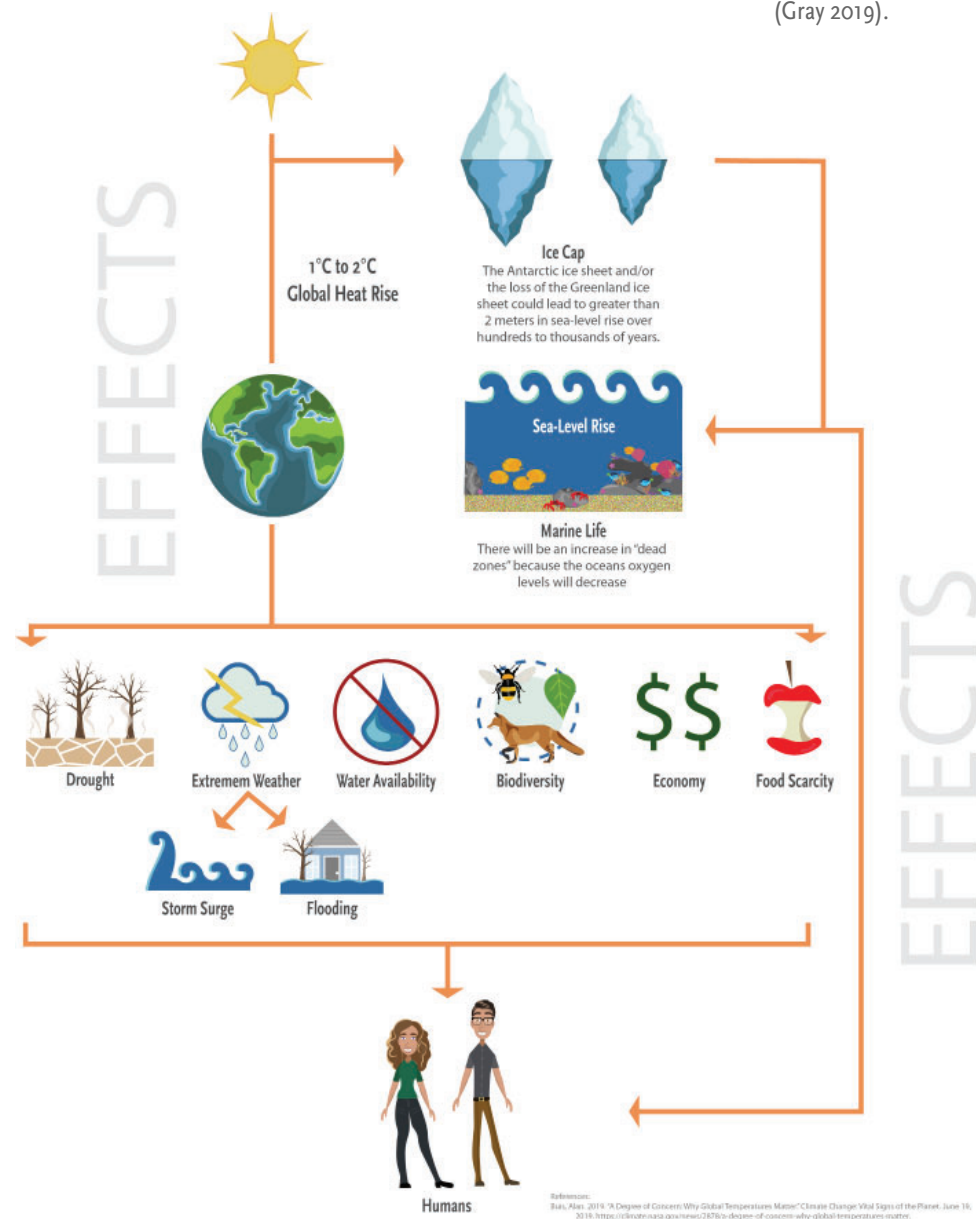
Figure 2.4:  
Hurricane  
Category and  
Effects (Gray  
2019)

## Climate Change

Climate change is said to be human-induced and was reported as a real issue at the Fourth Assessment Report of the IPCC in 2007 (Tong 2015). Prior to the IPCC in 2007, climate change was not acknowledge as an issue to the world. The amount of carbon dioxide has increased by 40 percent since the 1700s, which is due to man-made technologies (EPA 2016). Specifically, greenhouse gases are a significant contributor to the rise in climate change. The greenhouse gases have increased in the lower atmosphere, which has increased evaporation, humidity, average rainfall, and frequency of storms in many places, while simultaneously causing droughts in others (EPA 2016). Greenhouse gases are causing the waters to become more acidic because of the increase in carbon dioxide (EPA 2016). The ocean surface temperature has increased approximately one degree in the past 80 years, causing snowmelt earlier and retreating glaciers (EPA 2016). As a result, the sea is rising. Coastal storms have increased in intensity in the last 20 years, but it is unclear if the intensifying storms will be a long-term trend, figure 2.5 (EPA 2016).

In Texas, the main threats of climate change are extreme heat, drought, wildfires, inland flooding, and coastal flooding. Out of the top 25 hottest and fastest-warming cities, Texas has 9 out of the 25 in the U.S. ("Texas' Climate Threats" n.d.). Since the 1970s the state of Texas has seen a 3.3° increase in the summer heat (Climate Central 2015). Texas is threatened by summer drought more than any of the lower 48 states because of the increasing temperature, which is projected to increase by 75% by 2100 ("Texas' Climate Threats" n.d.). Approximately 18 million people live in Texas and about 72% of the population lives in areas with a high risk of wildfires ("Texas' Climate Threats" n.d.). Texas is expected to be the top state in the nation with the worst overall wildfire threat by 2050 ("Texas' Climate Threats" n.d.). The remaining threats to Galveston are due to climate change, inland flooding and coastal flooding, which will be detailed in later sections.

Figure 2.5:  
Climate Change  
Infographic  
(Gray 2019).

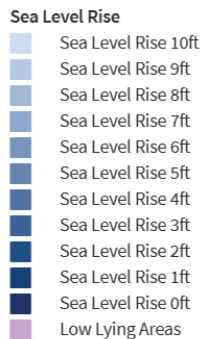


## Sea Level Rise

Climate change can increase hurricane flooding by hurricane intensification and sea-level rise (Mousavi et al. 2011). Sea level rise is defined as an “increase in the average reach of the ocean” (National Geographic Society 2019). Global sea-level rise is the warming of the ocean and the intake of freshwater into the ocean from melting ice (National Oceanic and Atmospheric Administration n.d.). Relative sea-level rise “is affected by global sea-level fluctuations, changes in land elevation, wind, and ocean circulation” (National Oceanic and Atmospheric Administration n.d.). People and infrastructure in low-lying and flat gulf-coastal regions are projected to see an increase in sea level rise (Thatcher, Brock, and Pendleton 2013). The impact that sea-level rise has on the physical coastal landscape is increased shoreline change, increased storm surge and flooding, and wetland inundation (Thatcher, Brock, and Pendleton 2013). It is projected that through the year 2100, sea-level rise will increase from 0.18 meters to 0.59 meters globally (Thatcher, Brock, and Pendleton 2013).

Sea-level rise is higher in the northern portion of the Gulf of Mexico than it is globally due to physical and economic factors (Thatcher, Brock, and Pendleton 2013). Galveston is sinking due to groundwater being pumped in large amounts from deep within the earth, which increases its risk and vulnerability to sea-level rise, figure 2.6 (SeaLevelRise.org n.d.). The increase in sea-level rise increases coastal flooding which can submerge wetlands and drylands (SeaLevelRise.org n.d.). Due to the long-term effects of carbon emissions, Galveston is identified as a city that is locked in by sea-level rise that will submerge the Island by year 2100 (Strauss, Kulp, and Levermann 2015).

Figure 2.6:  
Sea Level Rise Map  
by 2100  
 (“Galveston” n.d.)



## Storm Surge

Storm surge is one of the most dangerous parts of a hurricane. According to the National Oceanic and Atmospheric Administration (NOAA), storm surge is “the abnormal rise in seawater level during a storm, measured as the height of the water above the normal predicted astronomical tide” (2018), and is influenced by the land cover and the depth and shape of the seafloor (Bedient et al. 2012). The wind brings the water into a mounded form out at sea, and as it approaches land, it is seen as storm surge flooding, figure 2.7 (UCAR Center for Science Education 2012). When the water reaches the shore after a surge, it does not have any other place to go but onto the land, causing flooding and other damages to the Island (UCAR Center for Science Education 2012). The weight of water is approximately 1,700 pounds per cubic yard, and when that is combined with continuous wind and storm surge, it can cause severe damage or destroy structures that are not built to handle that force (Sweet et al. 2017). Areas that have bays are more susceptible to storm surge because the mound of water can get funneled into the small area (UCAR Center for Science

Figure 2.7:  
Storm Surge during  
Hurricane Ike  
(Hughes 2008)





Education 2012).

Other impacts from storm surge include property loss, erosion, damaged coastal habitats, and damage to infrastructure.

Because Galveston is an estuary, there is an increase in riverine flow. This can increase water depth near sea outlets, which increases storm surge (Bedient et al. 2012). Higher sea levels increase the damage of hurricanes because it allows the hurricane to push more water onto the land (SeaLevelRise.org n.d.). It is projected that if there were no sea-level rise, then Hurricane Harvey's 11-foot storm surge would have been lower, thus reducing the amount of damages (SeaLevelRise.org n.d.). The state of Texas is the fourth-ranked state for storm surge risk in the nation, with approximately 561,000 homes at risk (CoreLogic 2019). A low-intensity storm will cause more damage to a densely populated community when compared to a high-intensity hurricane in a less populated community (CoreLogic 2019).

## Flooding

To reduce flooding and damages associated to flooding a floodplain should be intact. A floodplain is a relatively flat alluvial depositional landform that borders bodies of water and is periodically inundated by floodwater (Charlton 2008). The biological benefits of a floodplain include biological productivity such as plant growth, biodiversity, maintaining the integrity of the ecosystem and fish and wildlife habitats such as breeding and feeding grounds, creating and enhancing waterfowl habitat, and protecting habitats for rare and endangered species (FEMA, n.d.). The water features that regulate water flow, such as surface water, groundwater, floodplains, wetlands, and other features, function as a single, integrated natural system and not an isolated component of the watershed (FEMA n.d.).

After a storm surge or hurricane, it is typical that flooding will follow and linger. As the United States urbanizes, development encroaches into floodplains and more

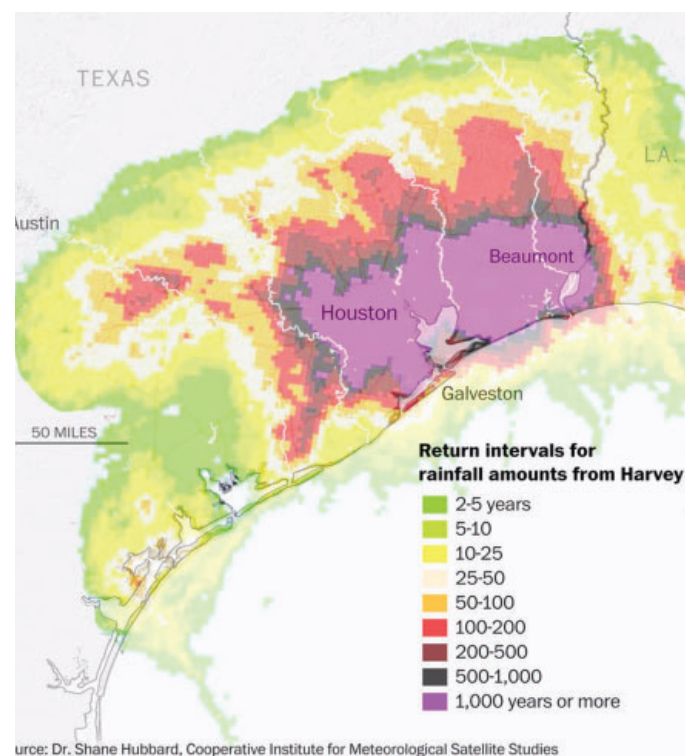


Figure 2.8:  
Houston-Galveston  
Area rainfall map  
during Hurricane  
Harvey  
(Hubbard 2017)

impervious surfaces are constructed, causing an increase of urban flooding (Reja et al. 2017). Many cities are over-developed in areas with minimal to no flood regulations, causing a threat to ecosystems that rely on the floodplain (Helderer and Grubisic 2018).

During Hurricane Harvey, more than 27 inches of rain fell in under 24 hours in Harris County, which incorporates Houston and Galveston, see figure 2.8 (Sharp 2018). The hurricane produced so much rain that the National Weather Service had to adapt their color scale and add a new color to accurately depict the amount of rain the Houston area was receiving (Sharp 2018). The storm produced a 1,000-year flood event in Houston, see Figure 6 (Sharp 2018). Harris County and Galveston County watersheds flooded and reached record levels, causing thousands of high-water rescues (Sharp 2018). Urban flooding was devastating on the Houston-Galveston communities, causing bayous and creeks to reach their capacity and crossing watershed boundaries (Sharp 2018). The floodwaters from the rivers pushed enormous amounts of sediment to the sea, and the Port of Houston reported up to 10 feet of soil deposit in the shipping channel (Sharp 2018).

Port Isabel, TX has encountered 277 floods since 1950 and about 77% of the floods were human-caused ("Texas' Climate Threats" n.d.). Global sea-level rise accounts for two-thirds of coastal flooding in the U.S. ("Texas' Climate Threats" n.d.). There are 127,000 Texans that are at risk of coastal flooding and in 2050, an additional 117,000 people are anticipated to be at risk because of sea-level rise ("Texas' Climate Threats" n.d.).

## Galveston Today Summary

The history and comprehensive plan of the Island are essential to know to understand how the Galveston we know today was shaped. The overview of the four key threats, climate change, sea-level rise, storm surge, and flooding, are vital to shape and plan for the future of Galveston Island. The variety of information combined provides guidance on the strategies that should be implemented to protect and preserve Galveston Island.



## Design Strategies

This section will address the potential infrastructure that can be implemented on the Island, and the impacts the infrastructure could have on the landscape. Gray infrastructure is the use of engineered systems and is most used to combat storm surge and flooding. Green infrastructure, which is the use of natural systems to reduce flooding and storm surge. Finally, hybrid infrastructure, which is the use of natural systems and constructed systems, whether that is using natural materials or hardened structures. All sections will explore in further detail the types of solutions that could be used to protect Galveston from storm surge and flooding.

## Gray Infrastructure

Gray infrastructure refers to constructed structures like treatment facilities, sewer systems, stormwater systems, or storage basins that are typically made of concrete (“Gray Infrastructure | NGICP” n.d.). The engineered structures are typically inserted into watersheds and coastal ecosystems, which interferes with the natural performance of the ecosystems (Sutton-Grier, Wowk, and Bamford 2015).

## Benefits of Gray Infrastructure

Gray infrastructure is the baseline for most coastal projects and is applicable for addressing exposure to storm surge and flooding (Hamin et al. 2018). There is a significant amount of expertise and experience on the gray infrastructure approach which makes it the most used form of infrastructure and is able to withstand a storm event immediately after construction (Sutton-Grier, Wowk, and Bamford 2015).

## Weaknesses of Gray Infrastructure

Gray infrastructure directly changes the wetlands and reduce and/or eliminate tidal waves (Wu et al. 2018). Over time, hardened shorelines have adverse effects on the sustainability of habitats and biological communities (Smith et al. 2016). The hardened structures weaken and break down due to high damage rates, and lack the ability for resilience (Smith et al. 2016). The intentions of gray infrastructure are good but, the intended project can increase greenhouse gas emissions and negatively affect vulnerable communities or create other social issues (Hamin et al. 2018). Communities perceive the use of gray infrastructure as positive and are under false pretense that the community is safe from all disasters (Sutton-Grier, Wowk, and Bamford 2015).

## Types of Infrastructure

### Seawalls (figure 2.9)

One of the most frequently used types of gray infrastructure along coasts are seawalls. Seawalls are used to protect roads, businesses, and homes from storm surge flooding. Seawalls require less space than other defenses which is ideal for development (“Climate-ADAPT: Seawalls and Jetties” 2015). The types of seawalls vary from gravity concrete walls, stone filled cribwork, concrete armor units, or stone rubble (“Seawalls | Coastal Processes, Hazards, and Society” n.d.).



Figure 2.9:  
Galveston Seawall  
(Gray 2019).

### Dikes (figure 2.10)

The primary function of a sea dike is to protect low-lying areas against flooding (“Sea Dikes | Coastal Processes, Hazards, and Society” n.d.). A dike is a structure made of earth or stone that is used to hold back water (Linham and Nicholls 2016). They consist of a sand core and a watertight exterior with toe protection and a drainage channel (Linham and Nicholls 2016). Dikes may be referred to as embankments, levees, floodbanks and stopbanks (Linham and Nicholls 2016).



Figure 2.10:  
Dike along shoreline  
(Klein 2016).

### Jetties (figure 2.11)

The primary use of jetties is to stabilize navigational channels at tidal inlets and river mouths (“Jetties | Coastal Processes, Hazards, and Society” n.d.). Jetties connect to the shore and are perpendicular to the shore, and extend into the ocean. The purpose of this type of gray infrastructure is to decrease dredging which is accomplished when the tidal flow is confined (“Climate-ADAPT: Seawalls and Jetties” 2015).



Figure 2.11:  
Galveston Jetty  
(Gray 2019)

### Groins (figure 2.12)

Groins are used to stabilize the beach from erosion, and are typically straight or perpendicular to the shoreline. A groin system is a series of groins that create a notched shaped shoreline, and the beach level varies between each groin (“Groins | Coastal Processes, Hazards, and Society” n.d.). Groins are typically rock because they are more durable and better absorb the wave energy because of their permeability (“Groynes, Breakwaters and Artificial Reefs — Climate-ADAPT” 2015). Groins can be used in estuaries to decrease tidal flow velocities (“Groynes, Breakwaters and Artificial Reefs — Climate-ADAPT” 2015).

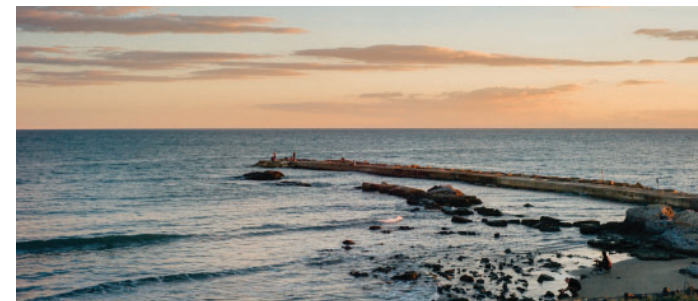


Figure 2.12:  
Groin  
(PxHere n.d.)



### Offshore Breakwaters (figure 2.13)

The function of offshore breakwaters is to reduce beach erosion. They are built parallel to the shore in shallow water depths. Having multiple offshore breakwaters can dissipate wave energy, which reduces wave heights, interrupts material transportation and reduces erosion (“Detached Breakwaters | Coastal Processes, Hazards, and Society” n.d.).

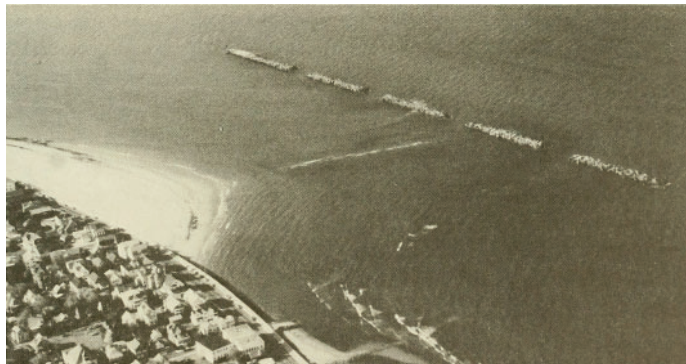


Figure 2.13:  
Offshore  
Breakwater  
(Dally and Pope 1986)

### Green Infrastructure

Green infrastructure preserves, enhances, or restores a natural system to perform ecosystem services and is defined as the use of plants and water to perform ecosystem services (Sutton-Grier, Wowk, and Bamford 2015; Kelly 2016). When development occurs haphazardly, it has the potential to threaten and fragment the coastal ecosystems, exploit resources, and negatively impact the resiliency of a community (Jurionas and Seekamp 2018). Development right along the coasts means it is more susceptible to damage during hurricanes due to the wind, waves, tide, and surge (Pawlukiewicz, Gupta, and Koelbel 2017). Because property along the coast is desirable, the need to protect and stabilize it increases damage to the shoreline. Developments are thought to be a significant contributor to wetland losses. Wetlands are declining, and shoreline communities are more vulnerable during storm surges and flooding because of the decline of wetlands in the shoreline communities (Reja et al. 2017). A way to counteract the adverse effects of gray infrastructure is through green infrastructure.



## Benefits of Green Infrastructure

Natural ecosystems provide habitats for fish, wildlife, mitigate flood impacts, protect coastlines, and improve water quality (Enwright et al. 2016). The natural ecosystems function as ecological buffers between land-based ecosystems and coastal systems, and the deterioration of these ecosystems may increase the coastal hazards and decrease resilience (Kittinger and Ayers 2010). It is important to protect all the natural ecosystems but for Galveston Island its vital to protect coastal ecosystems.

Coastal ecosystems need to remain healthy because they drive the economy through food, jobs, storm protection, transportation, health benefits, and recreation (Moser et al. 2014). Development is inevitable in coastal areas, and we must work to protect the natural ecosystems or find a way to work with them instead of replacing the ecosystems. If the development damages the protection the natural systems provide, the surrounding communities are at risk, and it is essential to ensure the decisions made do not jeopardize the future generations (Pawlukiewicz, Gupta, and Koelbel 2017). These ecosystems that we rely on are in danger because they have been altered by human stresses (Moser et al. 2014). In North Carolina the natural systems outperformed gray infrastructure. During Hurricane Irene, the living shorelines, which included marshes with and without sills, were more durable and protected the shoreline better than the areas with bulkheads (US Department of Commerce n.d.). Around 75 percent of the bulkheads were damaged during the storm, and the living shorelines showed no damage (US Department of Commerce n.d.). In the Hybrid Infrastructure section, marshes with sills will be explained in further detail. Built defenses remain as the primary option for coastal protection, specifically in the Houston-Galveston areas, but natural barriers have the potential to be better than engineered systems because they can move with the sea-level rise and sediment deposits, which will occur over time (Spalding et al. 2014). The natural systems preserve and reestablish shoreline and are adaptable over time.

## Weaknesses of Green Infrastructure

Natural habitats can benefit the coastlands, but it is still under debate whether the habitats can protect communities during severe storm events (Reddy et al. 2015). Natural protection is overlooked by government and developers because there is a lack of understanding of how natural barriers will protect communities and infrastructure (Spalding et al. 2014). Natural systems such as coastal beaches, dunes, and salt marshes all have benefits to the community, yet planners, managers, and the public often fail to recognize these systems as solutions to storm surge and flooding (Burger 2015).

For natural systems to do their job successfully, “large or extensive habitats may be needed to have substantial impacts on hazards and habitats may have no impact on the largest hazards” (Reddy et al. 2015). However, it is difficult to have large areas of land dedicated to natural systems to provide storm surge and flooding protection. The regulations from all government levels make it challenging to implement living shorelines or natural systems compared to hard structures (Pace and Morgan 2017). The government more widely accepts hard structures because they are used to the current permit process, but using natural systems can result in coastal resiliency and simultaneously preserve and restore the shoreline (Pace and Morgan 2017). The following section describes natural systems and the benefits the natural systems have on coastlines.

## Types of Green Infrastructure

### Wetlands (figure 2.14)

Freshwater wetlands are palustrine, are inland from the bay, and may be surrounded by coastal prairie, riparian corridors, and forests (Gonzalez 2011). Tidal Wetlands are in areas where land meets the ocean (Gonzalez 2011). Wetlands are reducing because of human actions such as development, and they are affecting the wetlands over a short-term period (Wu et al. 2018). Tidal saline wetlands support ecosystem goods and services and are estimated to be worth U.S. \$194,000 per hectare per year (Enwright et al. 2016, 1). “Dense vegetation cover reduces water flow velocities, turbulent flows, and shear stress over the seabed, promoting sediment deposition, which can create accretion” (Spalding et al. 2014). Accretion is the growth by gradual buildup such as land increase by natural forces (“Definition of ACCRETION” n.d.). Accretion will assist in stabilizing the eroding land. On the bayside, the wetlands will provide further stabilization, and on the Gulf of Mexico side, the more beach there is, the better the buffer between Gulf and development. The accretion must happen along the coastlines since the sea levels are rising.

The root systems of wetlands and marshes improve soil cohesion and tensile strength, which slows erosion at marsh edges and creates a barrier between water and soil (Spalding et al. 2014). While salt marshes can be capable of erosion control, they are less productive during extreme storms but are beneficial in the long-term modification of sediment dynamics (Spalding et al. 2014).



Figure 2.14:  
Galveston State Park  
Wetland (Gray 2019).

Coastal wetlands have not been researched to the level of hardened infrastructure regarding how they affect wave reduction (Narayan et al. 2016, 4). The research would provide developers and governments evidence that wetlands are solutions to storm surge and flooding. One solution in areas of development is to use living shorelines. “Living shorelines are not suitable for all environments and are best in low wave energy areas. Living shorelines can be highly effective in areas like bays and estuaries” (Pace and Morgann, 2017, 3). Living shorelines would be suitable for Galveston Island since one side of the Island is a bay and a part of an estuary.

The tidal saline wetlands can handle incremental changes in sea level, and some can migrate vertically and keep up with sea-level rise, but when sea levels change quickly, it can result in wetland losses (Enwright et al. 2016). Tidal and swamp marshes are low risk in cost because they can migrate with the water, while the permanent structures like seawalls and jetties, are at a higher risk because they receive more damage during storms (Saha et al. 2011, 93).

Wetlands and marshes are native to Galveston Island are essential to the hydrological and ecological functions of the bay, and range from the submerged bay bottom, intertidal zones, and to the zone above high tide which is flooded regularly (Gonzalez 2011). The three identified wetlands are estuarine emergent wetlands, palustrine emergent wetlands, and palustrine scrub/shrub wetlands. Estuarine wetlands are the largest makeup of the wetlands on the island. An estuarine wetland is “deepwater tidal habitats

and adjacent tidal wetlands that are semi-enclosed by land but have open, partly obstructed, or sporadic access to the open ocean, and in which ocean water is at least occasionally diluted by freshwater runoff from the land” (National Resources Inventory 2000). Estuarine wetlands are made up of salt and brackish marshes. A salt marsh is found in high-salinity areas, brought in by the tides, and protected by the estuarine shorelines (Gonzalez 2011). A brackish marsh is a transitional zone between the salt marsh and the freshwater marsh and is affected by water levels and salinities (Gonzalez 2011). The palustrine system which includes the palustrine emergent and palustrine scrub/shrub wetlands are “[a]ll non-tidal wetlands dominated by trees, shrubs, persistent emergent, emergent mosses, or lichens, and all such wetlands that occur in tidal areas where salinity due to ocean derived salts is below 0.5 percent” (National Resources Inventory 2000).



### Oyster Reefs (figure 2.15)

Oysters live along coasts clustering together on older shells, rock, piers, and any hard, submerged surface and as they grow, they fuse forming rock-like reefs (NOAA n.d.). Historically, the oyster industry has been around since the 1800s, but they are an essential ecological role in the bay. The bay is made up of reefs that are both naturally occurring and manmade (Gonzalez 2011; “Oyster Reefs in Galveston Bay” 2017). In the late nineteenth and early twentieth century, the reefs were commercially fished, but were also harvested for construction material (Gonzalez 2011; “Oyster Reefs in Galveston Bay” 2017).

Worldwide, oyster reefs are the most threatened marine habitat (“Galveston Bay: Oyster Gardening,” n.d.). Before Hurricane Ike, Galveston Bay produced approximately 80% of Texas’s oysters (“Galveston Bay: Oyster Gardening,” n.d.). Post Ike, sediment deposited on 60% of the reefs and smothered the oysters which resulted in the deaths of many reefs (“Galveston Bay: Oyster Gardening,” n.d.)

The reefs provide shelter and food opportunities for a variety of aquatic life, stabilize bay bottom and breaks wave energy, prevent erosion, and provide a natural filter system (“Galveston Bay: Oyster Gardening,” n.d. and “Oyster Reefs in Galveston Bay” 2017).



Figure 2.15:  
Oyster Reef  
(Clark 2019)



### Dunes (figure 2.16)

One of the most iconic features of a sandy beach is a dune, yet they are not protected from human interaction, which weakens and destroys them. The wind, waves, ocean currents, and tides that bring water in and out each day creates dunes (WXY and West 8 2014; “Coastal Sand Dunes | CRD” n.d.). Dunes occur naturally on Galveston Island and provide protection against storm surge. The beach/dune system is organized of the foreshore, backshore, foredune ridge, and back dune (Howard, Laverty, and Ekstrom, n.d.). Dunes and barrier islands dispel waves and are specifically helpful during storm surges, and these structures need vegetation to keep them stable (Spalding et al. 2014, 53). Vegetation is vital to dune health and growth because the root systems strengthen the soil and reduce erosion, dissipate wave energy, and gather sediment (Bessette et al. 2018, 466). While dunes provide inland protection, they also provide a habitat for plants and animals. “Sandy beaches and coastal dunes are among the most damaged coastal ecosystems by human activity, which leads to reduced biodiversity, loss of habitat, destruction of protective vegetation, and increased erosion during storms” (Bessette et al. 2018, 466). Since dunes provide many ecosystem services it is vital to protect and enhance these systems where it is applicable. It should be noted that dunes change over time which means they are never stable. While dunes act as a barrier, the creation of them is a cyclical process of erosion and accretion with wind and waves. It is vital that the existing dunes are protected from human interaction and that they are planted with vegetation to ensure their stability. Dunes are a great first line of defense of storm surge on any coast and used to be a part of Galveston’s natural system until they were removed on the western portion of the island and replaced with the seawall in 1909 (Gonzalez 2011; Howard, Laverty, and Ekstrom, n.d.). Most dunes have disappeared, but some dune development is occurring on the far west and east ends of the island.



Figure 2.16:  
Dunes  
(pxhere 2016)

## Hybrid Infrastructure

Hybrid infrastructure is defined as the combination of a green and gray infrastructure to maximize the resiliency of environmental and the community against hazards (Kelly 2016). Green and gray infrastructure were defined in the section called Physical Impacts under their respective headers. With the direction of coastal protection, the National Oceanic and Atmospheric Administration estimated in 2015 that approximately one-third of the U.S. shoreline would be armored with hard structures around the year 2100 (Pace and Morgan 2017, 1). The downside to armoring the shorelines is the adverse effects the structures have on the coastal ecosystems. Seawalls, dikes, jetties, and groins prevent tidal processes and change the estuarine wetlands to inland wetlands (Wu et al. 2018). The hardened structures prevent material transportation, change physical conditions, and hydrological processes of the wetland ecosystem (Wu et al. 2018).

Living shorelines are not appropriate for every environment and are best in areas with low wave energy, but they can be extremely useful in areas like bays and estuaries (Pace and Morgan 2017). A living shoreline is a connection between land and water through natural materials, and if necessary, human made elements to stabilize shorelines, reduce erosion, and provide a habitat that increases resilience (Fisheries 2019; Pace and Morgan 2017).



Sills, groins, revetments, and offshore breakwaters are types of hybrid techniques. A marsh toe-revetment is a low-profile, freestanding structure made of natural material near shallow water and placed close to eroding marsh (Grabowski et al. 2012 and "Living Shorelines Structural Options" 2017). A sill is also a low-profile structure near low water, but they are placed in areas to create marsh or rebuild existing marsh (Grabowski et al. 2012; "Living Shorelines Structural Options" 2017). A groin is typically stone and placed perpendicular to the shoreline and is used to trap sediment to prevent erosion (Grabowski et al. 2012). Breakwaters are placed offshore in high wave energy areas made of massive stone, but they prevent sediment transport (Grabowski et al. 2012).

Hybrid infrastructure is beneficial because it considers the strengths of green and gray infrastructure and combines them to provide a stronger system with a longer lifespan, figure 2.17. Hybrid infrastructure is on the rise, but is not the first choice due to it being relatively new compared to gray infrastructure (Browder et al. 2019). Current data shows that the hybrid infrastructure improves performance, promotes resilience, and provides multiple benefits to communities (Browder et al.).

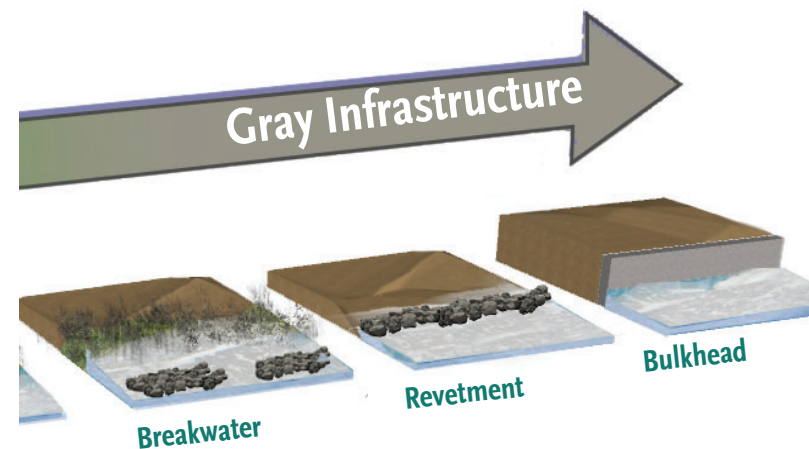


Figure 2.17:  
Gray to Green  
Infrastructure  
Diagram  
(Gray 2020)





## Hurricane Impacts:

### General

This section discusses the costliest hurricane that has ever struck the United States, which also sparked nationwide change. The specific focus here is the socio-economic impacts of the hurricane, and will provide insight into what a major hurricane could look like if it were to occur at Galveston Island. Hurricane Katrina's statistics is applicable to the project since it occurred in the Gulf of Mexico and devastated vulnerable communities. Galveston Island is vulnerable because it is a barrier island which means the land accumulates and dissipates sand. The Island is susceptible to storm surges and floods therefore, Hurricane Katrina is a precedent of what could happen.

## Hurricane Katrina

Hurricane Katrina was the costliest hurricane in U.S. history and occurred in New Orleans, Louisiana (Sharp 2018). There were many deaths and destruction of property associated with storm surge and wind (Pettersen et al. 2006). While the storm was predictable, the changes that came after regarding social changes and the response of the public sector were less than desirable (Peterson et al. 2006). The most vulnerable population were those that were old and ill (Boettke et al., n.d.). Up to this year, 2020, New Orleans is still recovering, especially in the areas with vulnerable populations.

Following Katrina, 390,000 people in the gulf coast region lost their jobs in the first two months after the storm and 200,000 of the 390,000 were low-wage jobs, and were people who could not afford to lose wages (Pettersen et al. 2006). Tourism is a large portion of the economy in New Orleans. Ten months after the hurricane, the tourism sector lost had approximately \$382.7 million (Dolfman and Fortier 2007).

Many people were laid off after the storm, and approximately 90% of the business affected in the southwest region of Louisiana were small businesses with 100 employees or less, and as of March 2006, 25% of the businesses had not reopened (Pettersen et al. 2006). The storm caused a large amount of damage to homes, and without the infrastructure to provide homes for employees, regions experience negative economic impacts, figure 2.18 (Pettersen et al. 2006).

With minimal places to house people, attracting workers is limited (Pettersen et al. 2006). The industries that needed employees raised wages and offered sign on bonuses to attract potential workers (Pettersen et al. 2006). Because of the destruction, new construction will attract buyers, which creates an incentive for gentrification and pushes out the residents with limited resources (Pettersen et al. 2006).



Figure 2.18:  
Hurricane Katrina  
Aftermath  
(Raggio 2005)



## Relevance

This section discusses the largest and costliest hurricanes to hit the Houston-Galveston area. The two hurricanes had two very different results to the Island and are good examples of what to expect in future hurricanes. The magnitude of the storms are likely to occur in the Houston-Galveston area and knowing the history provides insight to future development of the Island.



## Hurricane Ike

Hurricane Ike was the largest storm by size in the Gulf of Mexico, and when the hurricane made landfall, it was a Category 4 at its peak (Bedient et al. 2012). There was little rain associated with the hurricane, but the flooding came from the 17.8 feet of storm surge, figure 2.19 (Bedient et al. 2012). Beachside houses in Galveston were washed away, the beach sand along the seawall vanished, and many oak trees could not be saved from the saltwater damage (Bedient et al. 2012). The estimated economic impact from Hurricane Ike is \$22.16 billion (Texas Engineering Extension Service, n.d.). 50% of Galveston Island was flooded, and the water took 12 hours to recede from Ike's 17-foot storm surge (Texas Engineering Extension Service, n.d.). Bolivar Peninsula had an estimated 3,000 destroyed structures and approximately 140 structures damaged, resulting in a 70% tax revenue loss for the small community (Bedient et al. 2012). The petrochemical industry estimated hundreds of millions of dollars in damages due to saltwater intrusion, agriculture estimated \$93 million in damage to livestock, crop, feed stores, and fencing, and the healthcare industry faced a \$40 million deficit per month since 750,000 square feet of building space was lost (Bedient et al. 2012).



Figure 2.19:  
Hurricane Ike Storm  
Surge (Hughes 2008)



## Hurricane Harvey

The storm prevented the economic activity of the consumption of goods and services because of the lack of availability and access to the products (Stupak 2017). While the storm caused a significant amount of property damage, it did not threaten Houston's economic base (Gilmer 2018). Much of the economic impact came from a large amount of property damage, with an estimated \$42.5 billion to \$65 billion in damage (Stupak 2017). The Gulf Coast has a large portion of the U.S. petroleum refining capacity, and Hurricane Harvey increased the energy prices by 2.8%, as well as caused gasoline to increase by 6.3% in August (Stupak 2017). While Hurricane Harvey was devastating in certain areas of the Houston-Galveston area, the impact to Galveston Island came from the water runoff of the Houston-Galveston area. "Other storms have forced longer closings of the Port, brought much greater damage and disruption to the Ship Channel industries, and severely damaged the Texas Medical Center" (Gilmer 2018). The flooding from the rivers and bayous was more significant than predicted, which made communities and government realize that the local flood infrastructure and management are lacking (Gilmer 2018). Locals describe Hurricane Harvey differently than past hurricanes. They categorize it as a rain event that came faster than they could have predicted. The significant amount of rain and runoff resulted in thousands of people needing rescued from their homes due to flooding, figure 2.20.



Figure 2.20:  
Hurricane Harvey  
Rescue Team  
(CBP 2017)





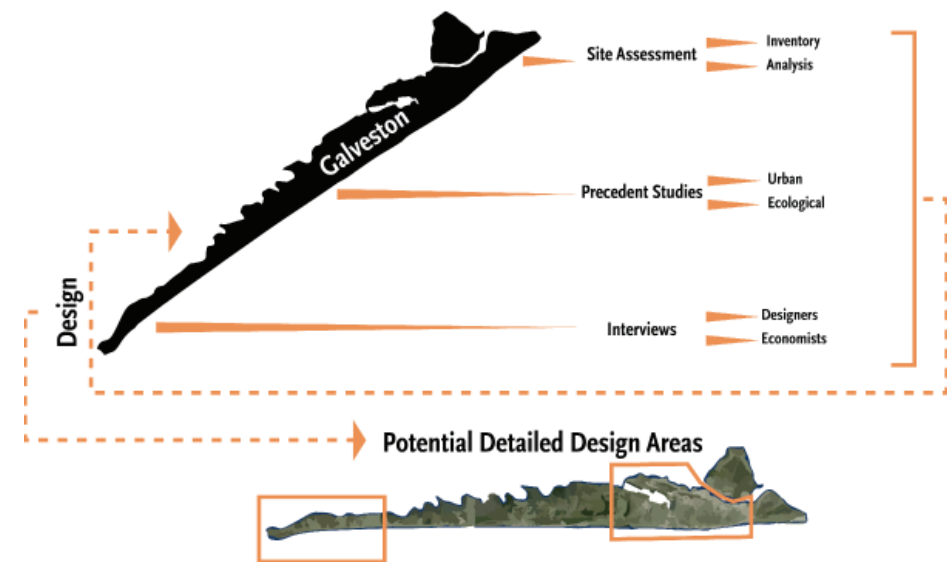
# Chapter 3

## The Methodology



*The methods used to collect data for this project are precedent studies, interviews, and site assessment. All three methods are used to inform the projective design of Galveston Island, figure 3.1.*

Figure 3.1  
Methodology  
Diagram (Gray 2020)



## Site Assessment

Site assessment was completed to evaluate the site's existing condition and to determine how or if the site should or will change. The use of GIS, Google Earth, and a site visit were completed in November 2019. Diagrams and maps are used to depict the strengths, weaknesses, areas of opportunity, and the physical and ephemeral threats of Galveston Island. The purpose of this method is to use maps and diagrams to inform the design decisions for the projective design of the Island. The site assessment includes:

### Site Inventory and Analysis:

1. Hydrology
2. Ecology
3. Recreation
4. Land-Use
5. Coastal Infrastructure

## Precedent Studies

Precedent studies assess existing projects that were designed to preserve communities and natural systems. For this method, sites that are “similar” to Galveston are defined as places that experience frequent hurricanes, flooding, and storm surge. For each precedent study, the programmatic and aesthetic qualities were assessed for each project and assessing strategies used to reduce storm surge and flooding. The following sections explain how each study could contribute to the design of Galveston Island. The criteria for the chosen precedent studies are listed below and the selected studies are briefly noted:

1. The site is adjacent to the ocean or bayside.
2. The design must use green, gray, or mixed infrastructure to solve the problem.
3. The project is in an urban context.
4. The site must be affected by flooding and storm surge.

### Sanya Mangrove Park

Location: Sanya City, Hainan Province, China

Along the Sanya River, a 25-acre lot sat empty and neglected in a tourist town. The concept of the park is a maze of greenery and fingers that are outstretched to the river to connect people to the water. The design team allows users to be integrated with the natural system of mangroves and wetlands without disturbing them.

### Wetland Restoration in the San Francisco Bay Delta

Location: San Francisco, California, United States

The Save the Bay organization created a 2020 Strategic Action Plan and has intentions to restore the bay to a more natural setting. The goal is to balance climate change, future development, and become involved with creating policies.

### Katwijk Coastal Defense

Location: Katwijk, South Holland Province

The town of Katwijk had a long history of problems related to siltation and storm surge, which threatened the residents. It was identified as a weak zone along the Dutch coast. The design concept includes a strong relationship between the community and the beach.

### Hunter's Point South Waterfront Park, Phase II

Location: Queens, New York, United States

The waterfront park is a mixed-use project that encompasses the park and affordable housing. The project is a model for urban ecology and sustainable design. It has a variety of spaces for people to interact with both the landscape water.

### Shenzhen Talent Park

Location: Shenzhen Shi, China

The park is located in an urban setting along a bay. The goal of the project is to provide a park that is light and has an artistic approach. The park is valuable because it is the biggest piece of urban land in the area.

### Puerto Vallarta Seafront

Location: Puerto Vallarta Jalisco

Puerto Vallarta was a car-centric city that revolves around the port. It became a dangerous place for pedestrians to be because it was vehicular focused. The goal of the project was to give the beach back to the people and become pedestrian-focused.

### The Golden Beach

Location: Qinghaung Dao City, Hebei Province, China

Golden Beach was once a desolate, eroded beach. Over time, the tidal processes created small wetlands, which sparked the concept for a nature-based solution. The nature-based solution has provided habitat for various bird species and enhanced recreational opportunities.

### Ike Dike: Coastal Barrier

Location: Galveston County, Texas, United States

The Ike Dike is a conceptual project that is in the works along Bolivar Peninsula and Galveston Island. The purpose is to add a dike covered by a dune along Bolivar Peninsula and Galveston Island. The addition of a flood gate in the passageway of the Houston Ship Channel and San Luis Pass will be included to protect the communities from storm surge.



## Interview

I conducted interviews with individuals that work for the City of Galveston. I interviewed Dustin Henry, the Coastal Resources and Flood Plain Manager, Garrett McLeod, the Economic Development Coordinator for the City of Galveston, and Tim Tietjens, the Executive Director of Development Services. I interviewed the individuals separately through a phone call or video chat. I asked questions based on the prepared list below. The questions revolve around the future planning of natural systems, how the city plans to reduce the impacts of flooding and storm surge, and how these natural hazards and disasters are affecting the community. The answers received address storm surge and flooding and inform the design of Galveston Island.

In Chapter 5, findings, key points and themes are extracted from each interview. Each interview is compared and contrasted and a table with common themes was developed. The table and interviews are analyzed with the remaining methods to impact the master plan design.

## Questions

Previously mentioned under the section Interviews, a prepared list of questions was created and emailed to each interviewee. Each individual chose what questions they wanted to discuss. The interview results are in chapter 5. Below are the two question sets:

### Design Questions

1. Are there any projects the city is currently implementing to protect the community from storm surge and flooding?
2. Have storms like Ike and Harvey made people move to the mainland?
3. What are your views of a coastal spine and moveable sea gates? Do you believe it is a solution that can be sustainable for 100 years?
4. If you were to reimagine coastal protection for Galveston, Island, would you include gray infrastructures like jetties and seawalls, a hybrid approach like sills and groins, or green infrastructure with wetlands and dunes? Or any other type of infrastructure?

### Economic Questions

1. After Hurricane Ike, did the rebuilding spark urban development or was the rebuilding replacing what was existing prior to the storm?
2. After devastating storms, is it more common for small business owners to remain closed or do they typically reopen?
3. As Galveston Island is growing, are you seeing more commercial development or residential? If commercial, what type of business is coming and where are they locating?
4. How have storm surge and flooding changed the economy of Galveston? Is the change promoting growth or is it preventing growth?

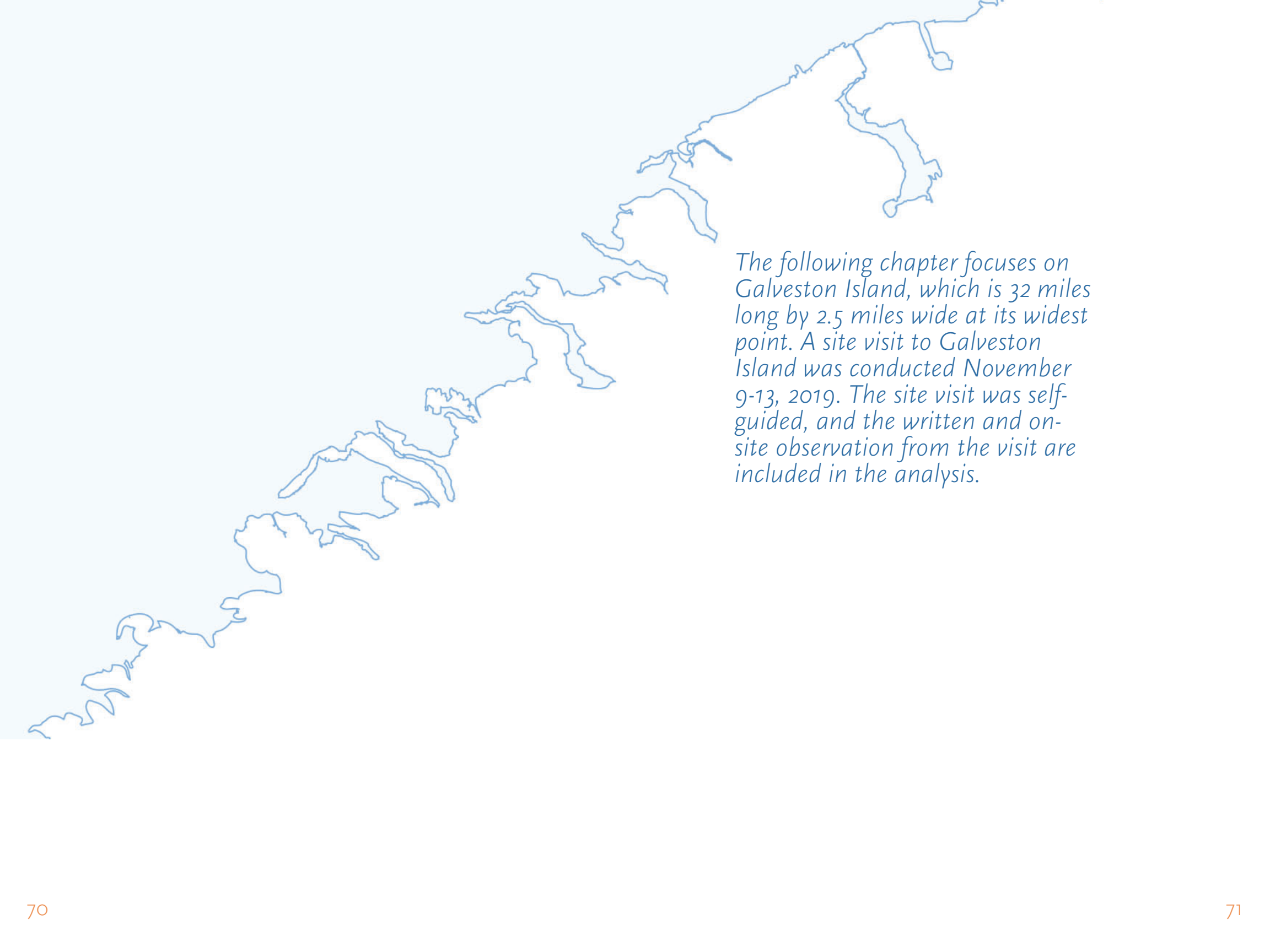




## Chapter 4

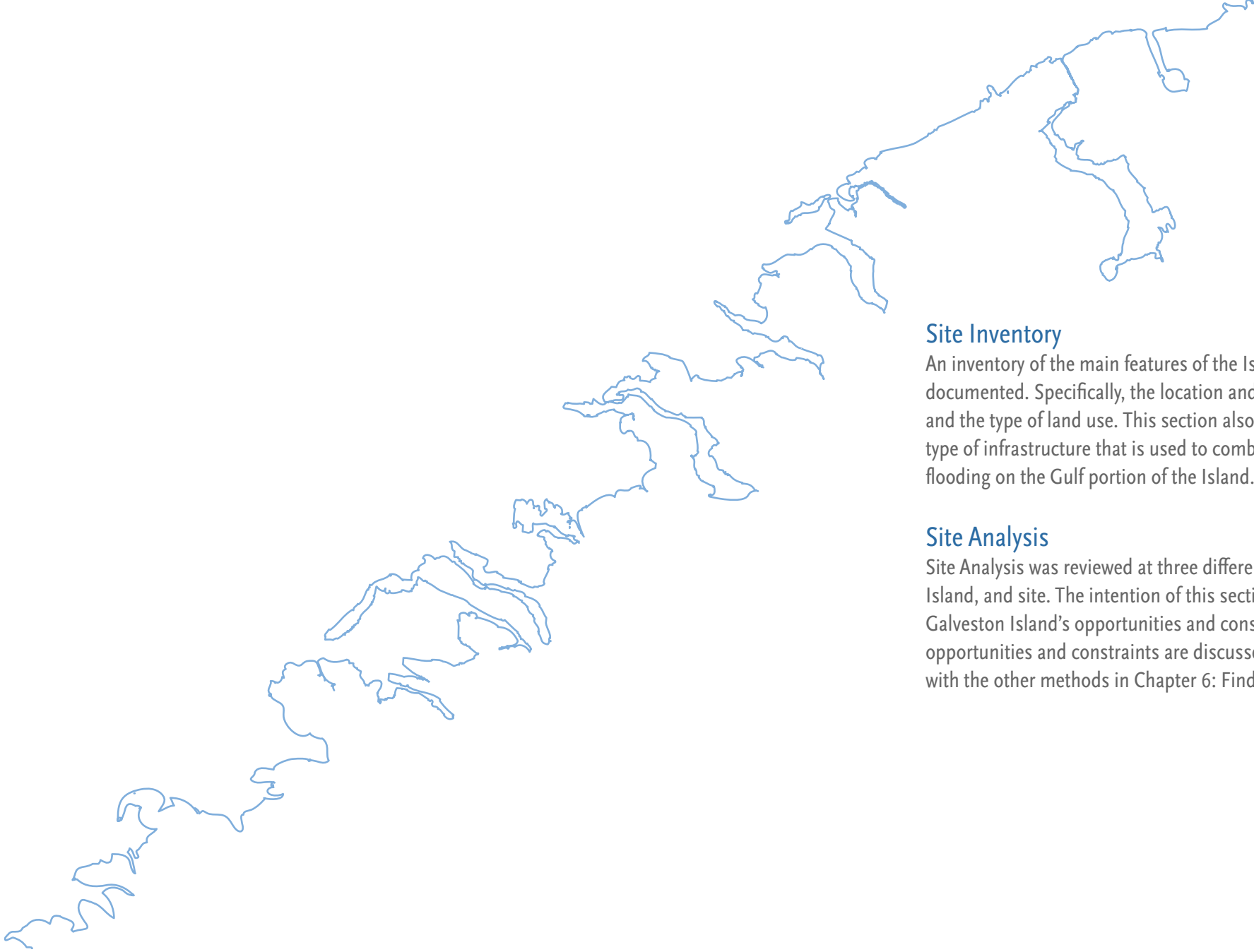
### Site Assessment





*The following chapter focuses on Galveston Island, which is 32 miles long by 2.5 miles wide at its widest point. A site visit to Galveston Island was conducted November 9-13, 2019. The site visit was self-guided, and the written and on-site observation from the visit are included in the analysis.*





### Site Inventory

An inventory of the main features of the Island are documented. Specifically, the location and type of vegetation and the type of land use. This section also documents the type of infrastructure that is used to combat storm surge and flooding on the Gulf portion of the Island.

### Site Analysis

Site Analysis was reviewed at three different scales: regional, Island, and site. The intention of this section is to understand Galveston Island's opportunities and constraints. The opportunities and constraints are discussed in conjunction with the other methods in Chapter 6: Findings.

## Regional

The Houston-Galveston Area is connected by many factors, therefore a regional organization was created to consider and solve area wide problems. The organization is called the Houston-Galveston Area Council (H-GAC) and covers 13 counties, see figure 4.1. The H-GAC addresses citizens and business needs, and the local governments provide leadership to guide regional development (H-GAC n.d.). The local governments and elected officials work together with public and private sectors and volunteers to create a clear guide for future development (H-GAC n.d.).

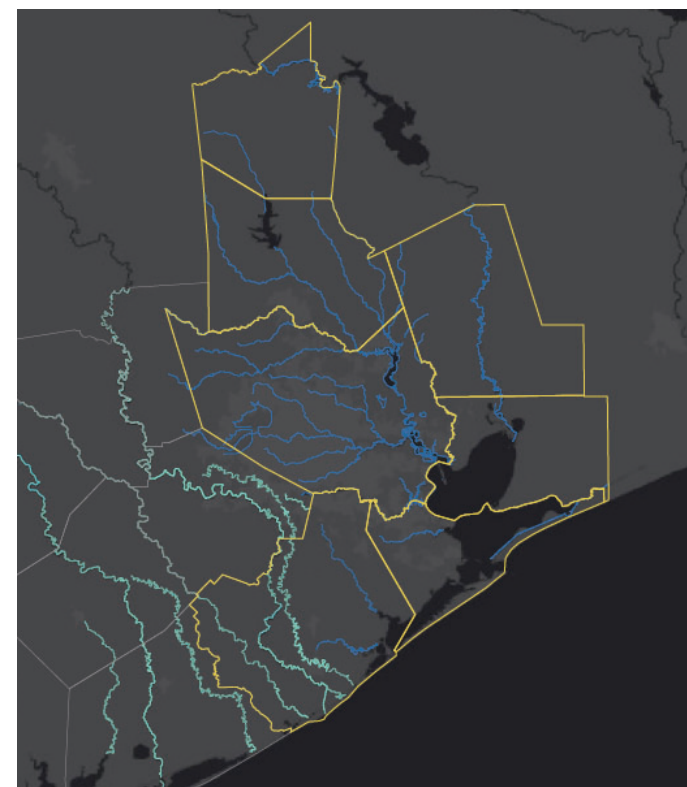


Figure 4.1:  
Houston-Galveston  
Area Map (Gray 2020)

## Hydrology

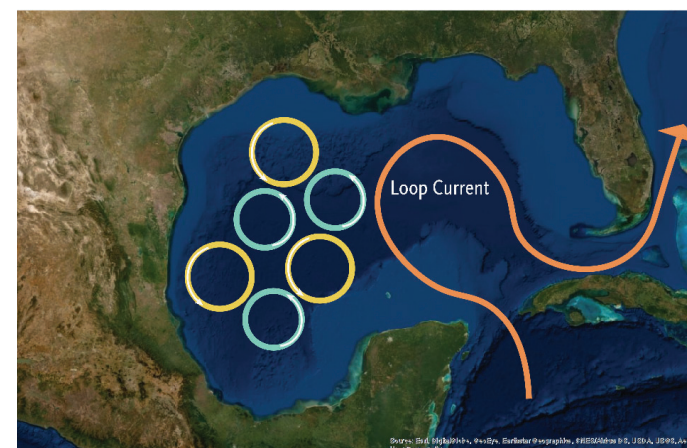
The Houston-Galveston area is comprised of rivers, creeks, bays, and the Gulf of Mexico. The hydrological systems heavily influence the ecology, see figure 4.2. One of the largest hydrological influences to Galveston Island is the Loop Current see figure 4.3. The Loop Current is a warm water current that moves in a clockwise flow that travels up from the Caribbean, past the Yucatan Peninsula and into the Gulf of Mexico (NOAA 2019; Sheinbaum 2002). The Loop Current is variable, the current may have a direct path into the Gulf of Mexico before directing towards the Florida Strait and other times the loop hardly enters the Gulf of Mexico before heading towards the Atlantic (NOAA 2019; Sheinbaum 2002). There are features related to the Loop Current. The feature is known as the “Loop Current ring” or an “Eddy” (Hodne 2013). The feature occurs every 3 to 17 months and have a lifespan up to a year before the feature hits the coast of Texas or Mexico (Hodne 2013). The importance of knowing about the Loop Current and its features is to understand how it impacts the Island. The Loop Current hits the western portion of the Island first and then makes its way up to the east. The erosion of the Island depicts the effects of the Loop Current. The western portion of the Island is more eroded and thinner compared to the eastern portion of the Island.

## Ecology



- Watershed Impacting Galveston Bay
- Watershed Impacting Gulf of Mexico

Figure 4.2:  
Houston-Galveston  
Watershed Map  
(Gray 2020)



- Warm Core Eddy
- Cool Core Eddy

Figure 4.3:  
Loop Current and its  
Features Diagram  
(Gray 2020)



The Houston-Galveston area has a couple of ecological land covers due to the mix of hydrology. The Houston-Galveston Area is comprised of tidal wetlands, freshwater wetlands, and forests. Wetlands will be defined in further detail in the Island Vegetation section.

#### **Forest** (figure 4.4)

The connection to water and the forest is strong. The majority of the forests are riparian, which is a forest that is adjacent to rivers, streams, and bayous.

#### **Wetlands** (figure 4.5)

Freshwater wetlands are palustrine, are inland from the bay, and may be surrounded by coastal prairie and riparian corridors of forests (Gonzalez 2011). Tidal Wetlands are in areas where land meets the ocean (Gonzalez 2011).



Figure 4.4:  
Riparian Forest along  
the Dickinson Bayou  
(Gray 2019)

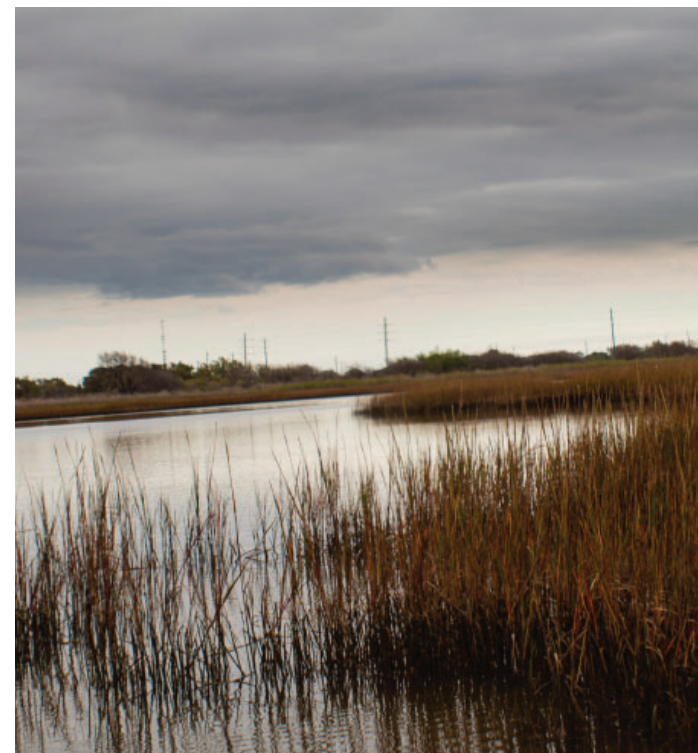


Figure 4.5:  
Wetlands at Galveston  
State Park (Gray 2019)

## Island

### Recreation

There is a variety of recreational activity. Along the Bay and Gulf side, there are opportunities for boating, fishing, kayaking, paddle boarding, canoeing, bird watching, trail walking, camping, and beach recreation. Because of the substantial amount of water in the area, the main recreational use is water activities.

Galveston Island is a tourist destination. The areas of interest to visitors are:

- 1: The Strip
- 2: Pleasure Pier
- 3: Historic District
- 4: East Beach
- 5: Beach along Seawall Boulevard
- 6: Galveston State Park

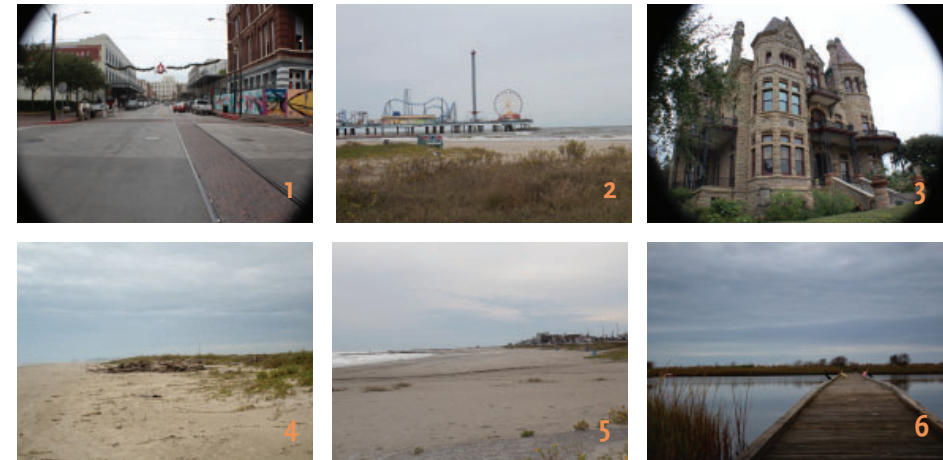
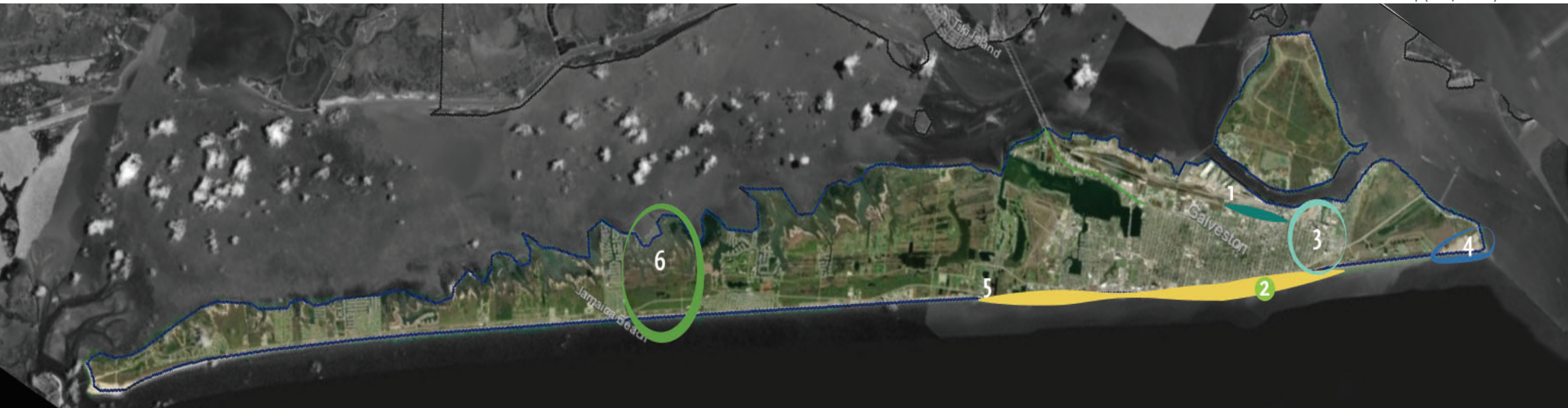


Figure 4.6:  
Recreation and  
Tourism Location  
Map(Gray 2020)

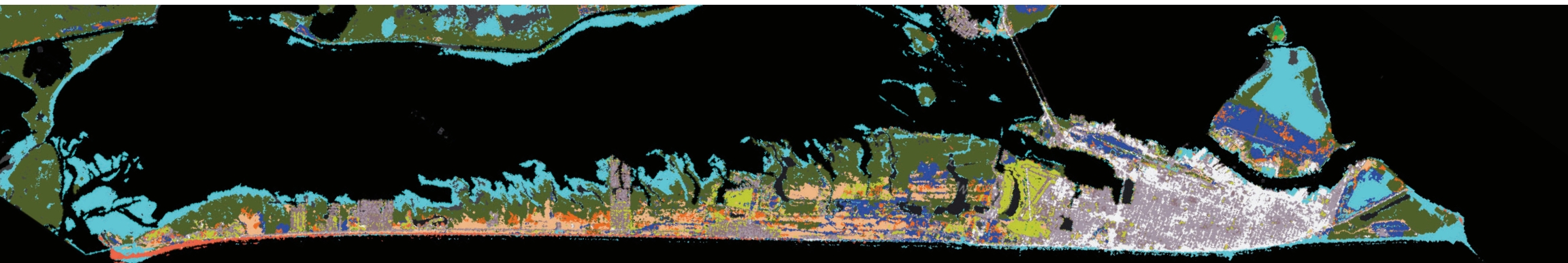




## Land-Use

The Island has a variety of uses, which vary from industrial to residential. The Island has a distinct separation of open space and a dense core (figure 4.7). The section details specific land uses along the Island. The northern end of the Island is where majority of development is located. The middle and southern portions are designed more towards residential. An important land-use to note is the unconsolidated land. It appears that majority of the unconsolidated land is where a severe amount of erosion occurs. Adjacent to the unconsolidated land are wetlands. Wetlands will be discussed further in this chapter.

Figure 4.7:  
Land-Use Map  
(Gray 2020)





## Coastal Infrastructure

Coastal defense is a significant part of Galveston Island. The existing infrastructure and its condition are documented. The document will detail whether the existing infrastructure should be replaced, fixed, or remain as it is. The criteria used to analyze this is:

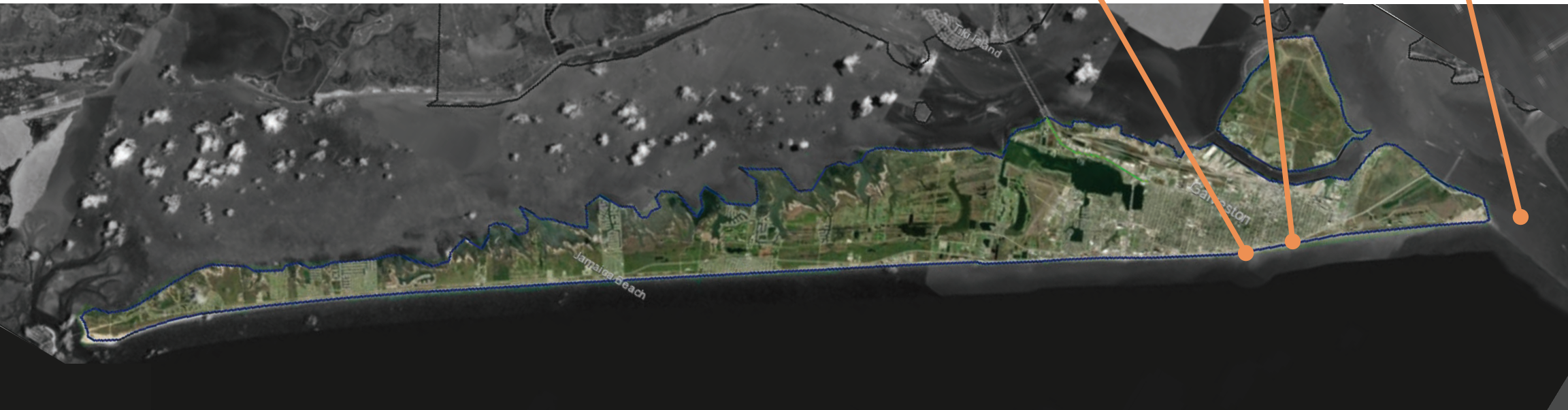
1. Visually broken or damaged
2. Physically stable but not aesthetically pleasing
3. Physically stable but interrupts views and is bad for the ecosystem

Groins are in good condition but obstruct view. Could be replaced.

Seawall is in good condition, but should be updated all at one time.

Jetty is extremely damaged and needs to be replaced.

Figure 4.8:  
Existing  
Infrastructure Map  
(Gray 2020)



## Vegetation

### Estuarine Emergent Wetland

Estuarine wetlands are found in bays where ocean and freshwater runoff meet (National Resources Inventory 2000). Estuarine wetlands are comprised of salt and brackish marshes. A salt marsh is found in high-salinity areas brought in by the tides, and is protected by the estuarine shorelines (Gonzalez 2011). A brackish marsh is a transitional zone between the salt marsh and the freshwater marsh and is affected by water levels and salinities (Gonzalez 2011). Perennial plants typically dominate the wetlands, excluding mosses and lichens (HARC 2011).

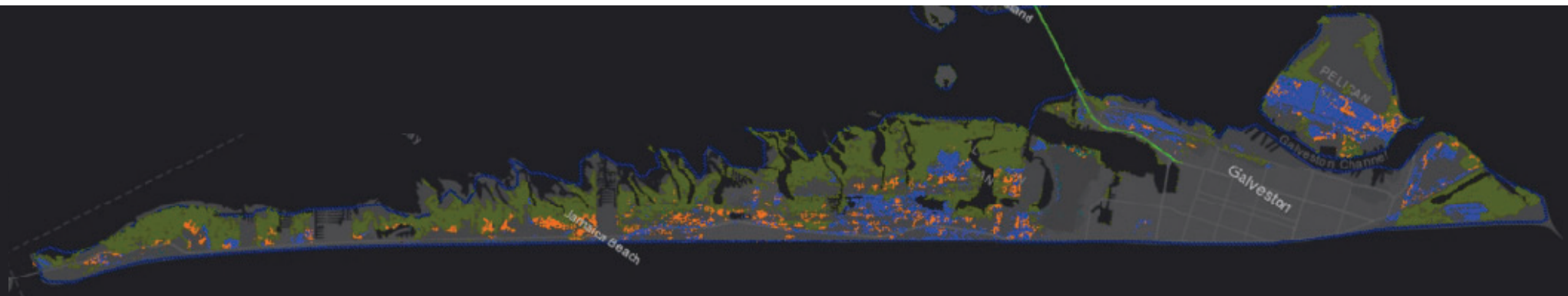
### Palustrine Scrub/Shrub Wetland

The palustrine system includes the palustrine emergent and palustrine scrub/shrub. The palustrine scrub/shrub wetlands are all non-tidal wetlands dominated by woody vegetation less than 16 feet in height and all such wetlands are in tidal areas where salinity due to ocean salts is below 0.5 percent (HARC 2011; National Resources Inventory 2000).

### Palustrine Emergent Wetland

Palustrine emergent wetlands are known for being persistent due to the emergent vascular plants (HARC 2011). The plants typically remain upright until the next growing season (HARC 2011).

Figure 4.9:  
Wetland Map  
(Gray 2020)

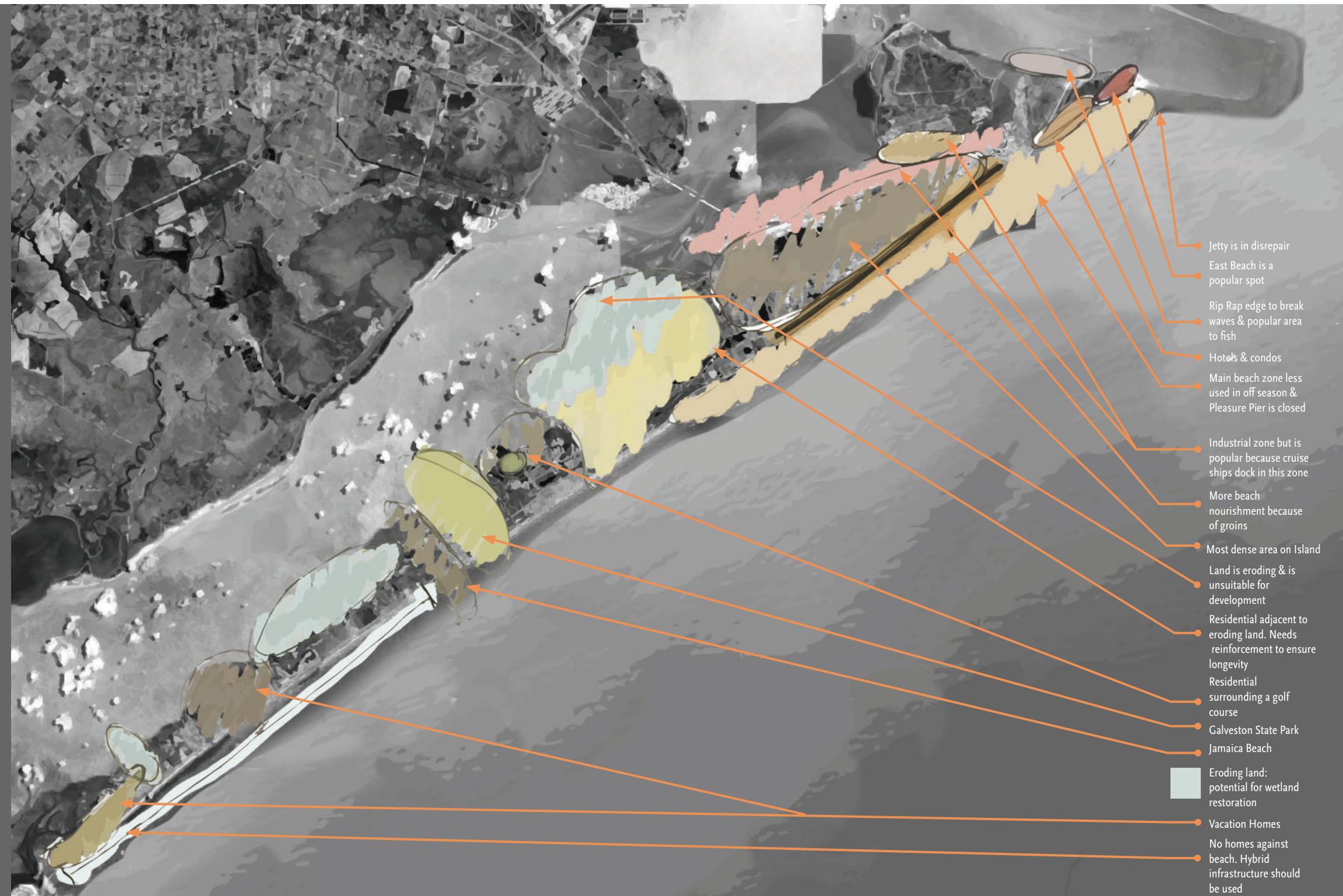




## Island Site Assessment

Combining the regional and Island assessment with the site visit, a summary map was created to identify areas of opportunities and constraints of the Island. First is the Island map and there are two focus areas that are identified and explained in further detail later in the chapter.







### Regional and Island Summary

It is crucial to comprehend the regional context that influences the Island. Analyzing the Island's size, existing conditions, physical qualities, opportunities, and constraints is vital before a masterplan of Galveston Island can be developed.

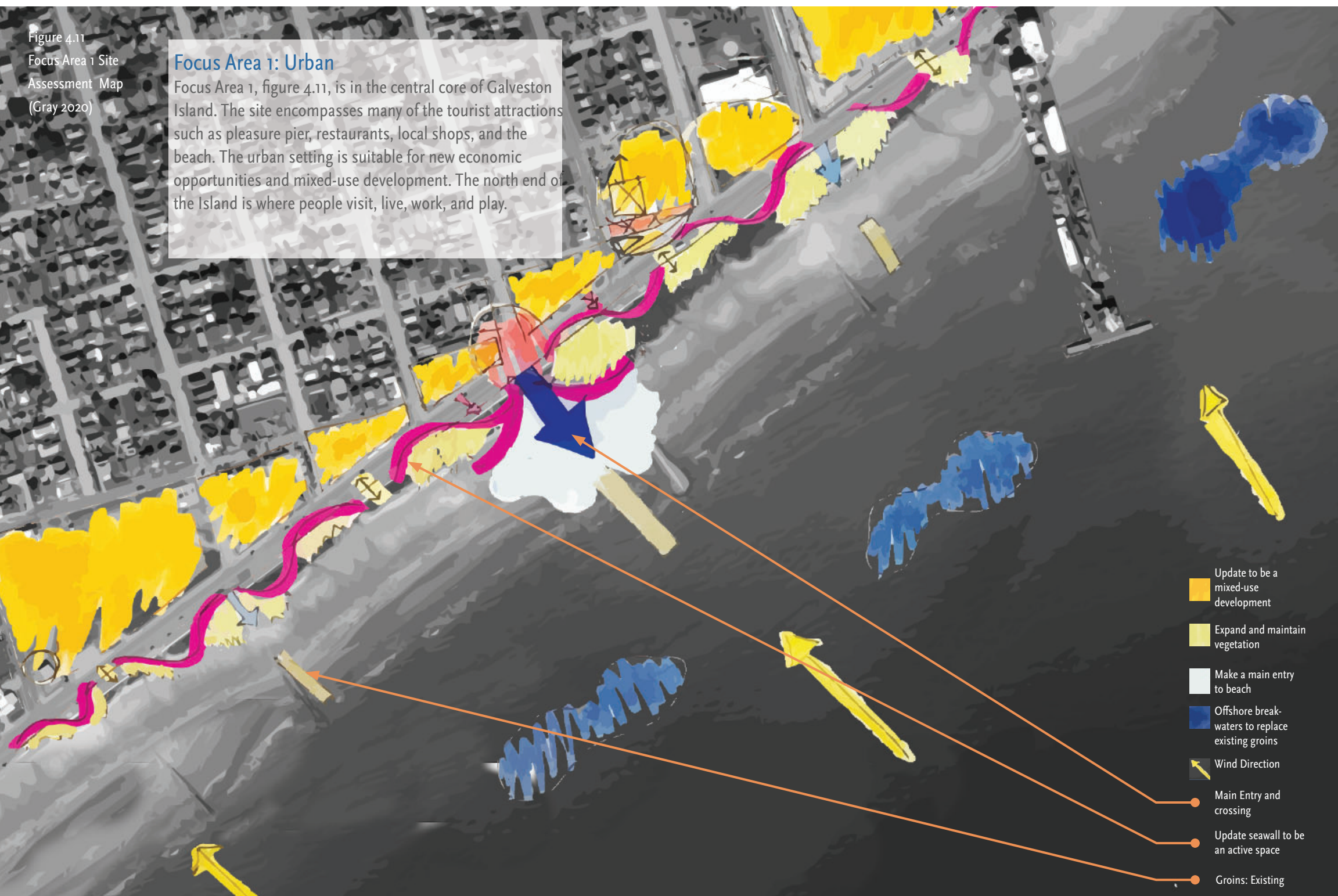
Inventory and analysis at the Island scale contributed to picking two sites to complete a detailed design. Area 1 is action-oriented, and Area 2 is passive oriented. The concepts from both sites are used to detail what the masterplan of Galveston Island could be.



Figure 4.11  
Focus Area 1 Site  
Assessment Map  
(Gray 2020)

### Focus Area 1: Urban

Focus Area 1, figure 4.11, is in the central core of Galveston Island. The site encompasses many of the tourist attractions such as pleasure pier, restaurants, local shops, and the beach. The urban setting is suitable for new economic opportunities and mixed-use development. The north end of the Island is where people visit, live, work, and play.



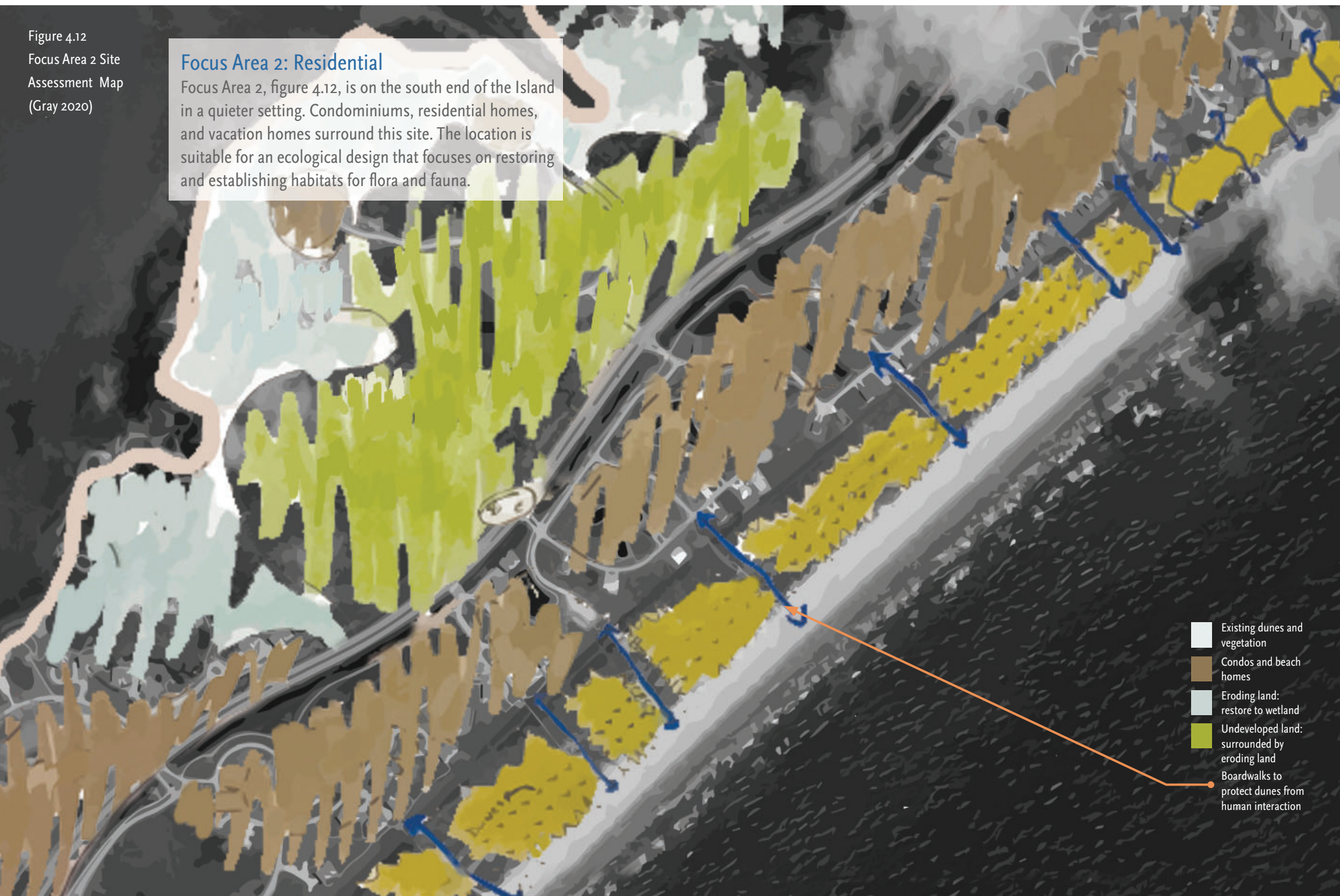
- Update to be a mixed-use development
- Expand and maintain vegetation
- Make a main entry to beach
- Offshore breakwaters to replace existing groins
- Wind Direction
- Main Entry and crossing
- Update seawall to be an active space
- Groins: Existing



Figure 4.12  
Focus Area 2 Site  
Assessment Map  
(Gray 2020)

### Focus Area 2: Residential

Focus Area 2, figure 4.12, is on the south end of the Island in a quieter setting. Condominiums, residential homes, and vacation homes surround this site. The location is suitable for an ecological design that focuses on restoring and establishing habitats for flora and fauna.





## Focus Area Summary

The two focus areas are depicting the design possibilities within the masterplan . The goal of the focused sites is to demonstrate the possibilities that can be applied to Galveston Island. The Island has two distinct areas, urban and residential, and the design strategies to prevent, preserve, and mitigate storm surge and flooding are different for these areas.





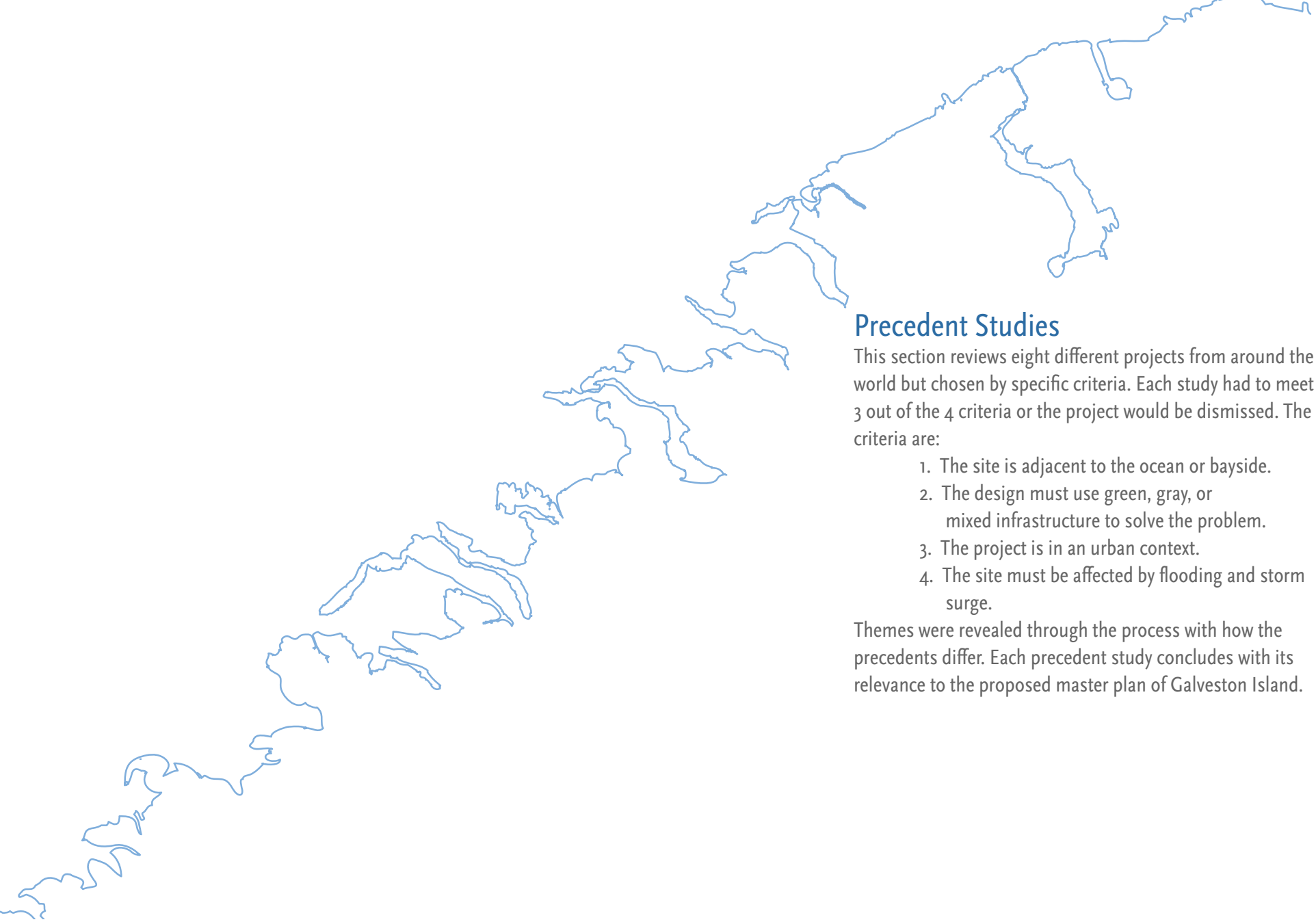
## Chapter 5

### Findings





*The following section details what was revealed during the precedent study search and interviews. The site assessment method was detailed in Chapter 5: Site Assessment. The remaining methods are detailed below. Each method is summarized with an introduction. The information that was collected is explained in further detail in its section analyzed. The information from the methodology is used to guide the projective master plan, which will be detailed in Chapter 7: The Design*



## Precedent Studies

This section reviews eight different projects from around the world but chosen by specific criteria. Each study had to meet 3 out of the 4 criteria or the project would be dismissed. The criteria are:

1. The site is adjacent to the ocean or bayside.
2. The design must use green, gray, or mixed infrastructure to solve the problem.
3. The project is in an urban context.
4. The site must be affected by flooding and storm surge.

Themes were revealed through the process with how the precedents differ. Each precedent study concludes with its relevance to the proposed master plan of Galveston Island.

### Form Follows Processes: Sanya Mangrove Park

The following information was obtained from the Turenscape website as promotional information (figure 5.1)

Location: China Sanya City, Hainan Province

Size: 25 Acres

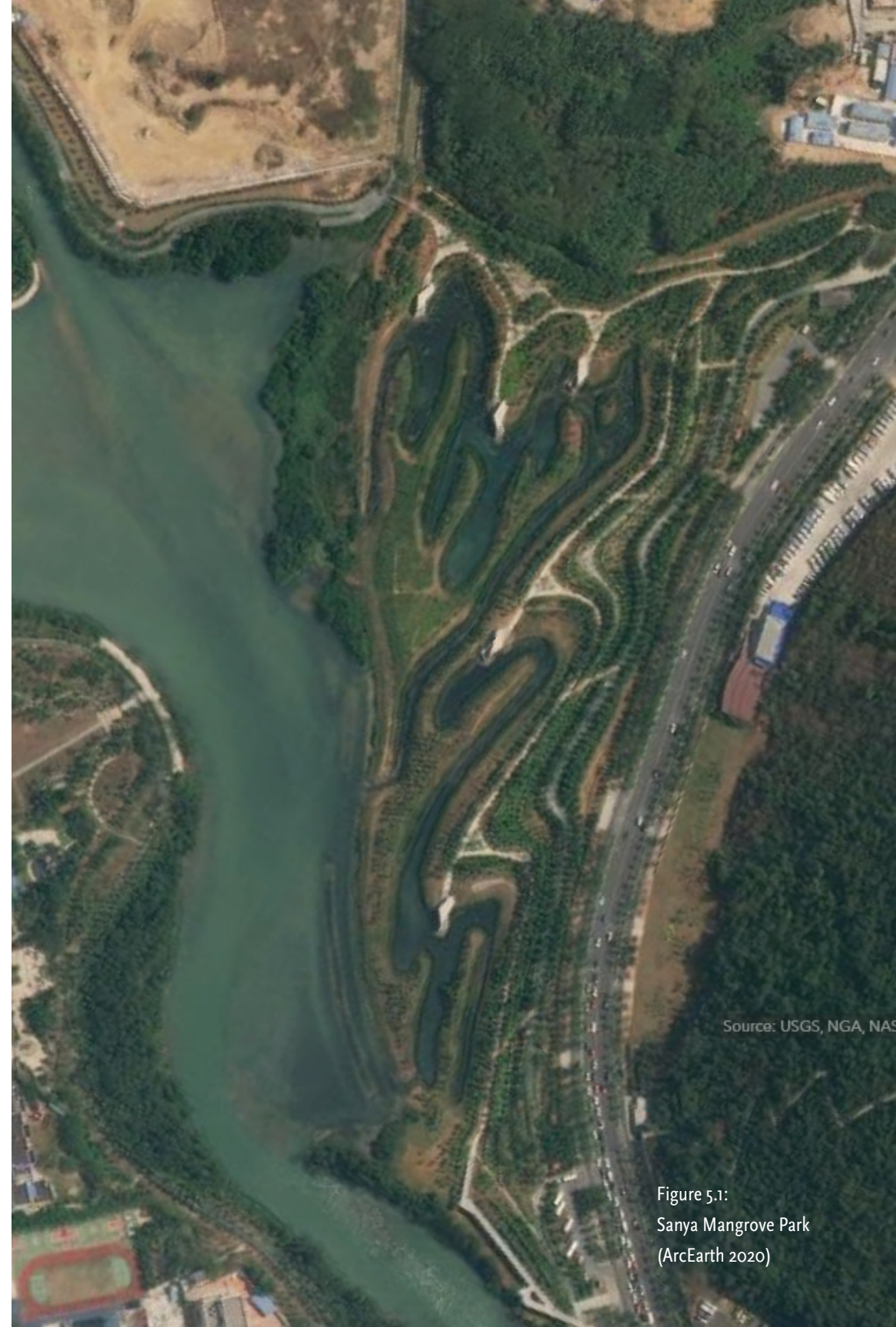
Designer: Turenscape

Client: City of Sanya

The city of Sanya is a tropical tourist island that has put development first and turned its back to the landscape. Concrete floodwalls were built to claim land and in turn, killed the mangrove ecosystem. In 2015, the city decided to turn the polluted waterways and landfill into a park. The mangrove park is situated along the Sanya River, but the tides meet the freshwater daily.

The goal of the project is to rehabilitate the mangroves and display the park as urban renewal and ecological rehabilitation. Turenscape accomplished the design through a cut and fill method, using the existing material on-site and creating various heights of the “fingers” to develop multiple habitats for flora and fauna, and to direct the ocean tides into the sea and the floodwater and pollutants away from the establishing mangroves. The project has successfully changed the landscape of the Sanya River and the city; the mangroves are establishing, and the wildlife is plentiful.

Sanya Mangrove Park is relatable to Galveston Island because of the mixture of ocean water and freshwater. Both cities have problems with tides and flooding. Turenscape made the park ecologically focused first, and then incorporated a series of paths and shelters to immerse people into the landscape.



Source: USGS, NGA, NAS

Figure 5.1:  
Sanya Mangrove Park  
(ArcEarth 2020)



## Wetland Restoration in the San Francisco Bay-Delta

The following information was obtained Save the Bay: 2020 Strategic Action Plan (figure 5.2)

Location: San Francisco Bay

Size: Approximately 1,024,000 Acres – Various projects around the Bay

Designer: Save the Bay

The San Francisco Bay is changing from various forces. The ecological, social, and political factors all have a hand in how the Bay changes, which will accelerate over time. The overarching goal of the organization is to design for climate change now. The 2020 Strategic Action plan focuses on three strategic priorities. The first goal is to restore the Bay habitat through regional and federal funding and demonstration projects.

The second goal is to shape the agenda, which will work with decision-makers and the public. As time progresses, the Bay is transforming due to climate change, population growth, demographic change, income inequality, and new, large-scale development. It is essential to engage the community through volunteer efforts, education, and outreach to engrain the importance of wetland restoration.

Lastly, the plan is to promote bay smart communities for bay health and bay area quality of life. The organization aspires to establish green infrastructure standards and support diverse communities.

The 2020 Strategic Action Plan from Save the Bay aligned with the goals and desired outcomes for the bayside of Galveston Island. The report can be used as a framework for Galveston Bay. The concept can start along the bayside of Galveston Island, but then extrapolate to the rest of the bay.

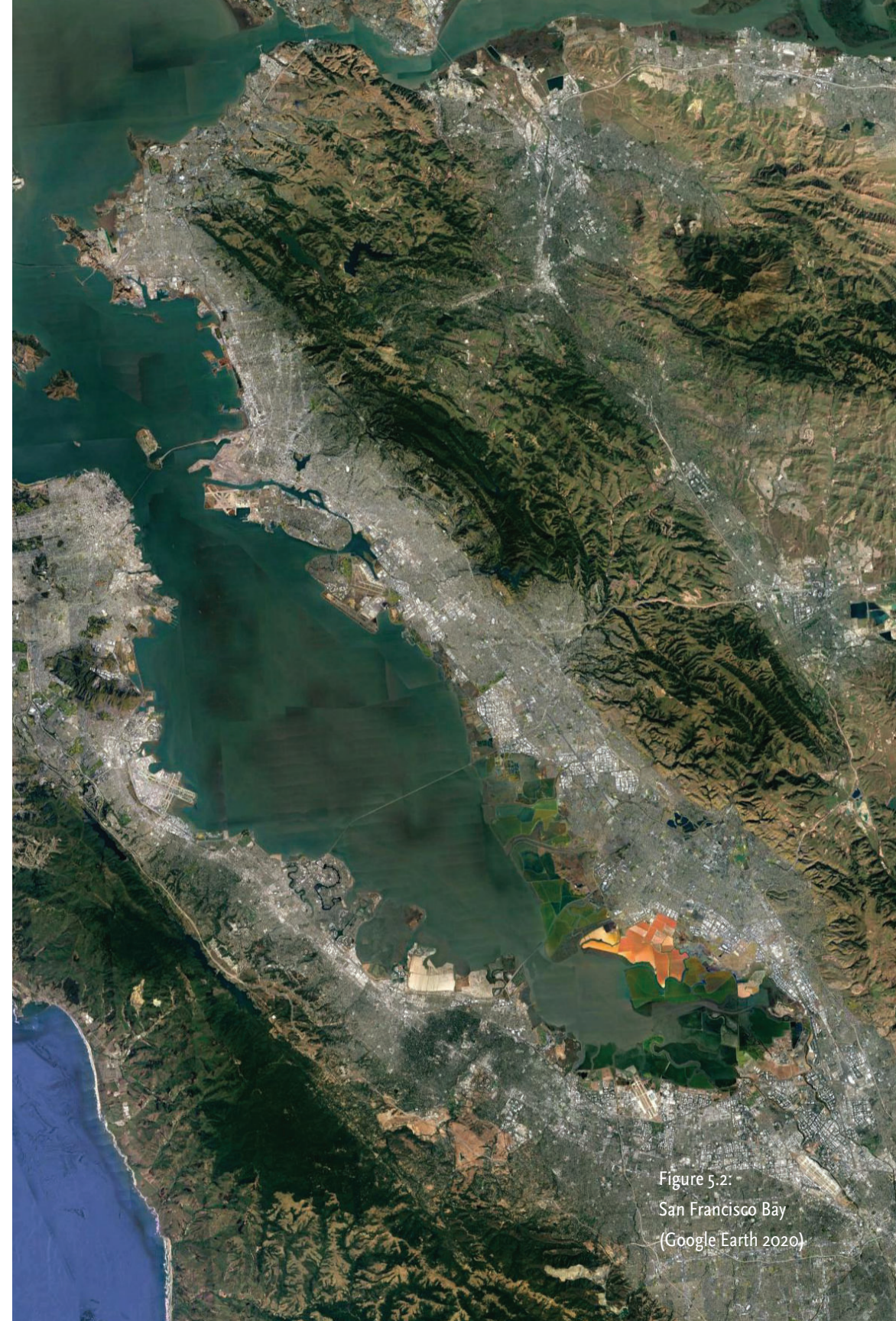


Figure 5.2:  
San Francisco Bay  
(Google Earth 2020)



## Katwijk Coastal Defense

The following information was obtained from OKRA's website as promotional information (figure 5.3)

Location: Katwijk, South Holland Province

Size: 50 Acres

Designer: OKRA

Client: Municipality of Katwijk, District Water Board of Rijnland

Katwijk is a tourist destination that is identified as a weak link in the Dutch coastline. To preserve the local economy and make it stronger, Katwijk enhanced its coastal defense. The relationship between the beach and the community was identified as an essential factor in the design. The designers chose a dike-in-dune coastal defense approach. The dike is lined with stone and is strengthened by dunes. Low dunes were built to keep the visual connection between the town and the beach, reinforcing the importance of the community and beach relationship. The design allowed underground parking to occur behind the dike to provide an uninterrupted landscape. The Katwijk Coastal Defense project was chosen because of the similarities to the Ike Dike proposal from Texas A&M University at Galveston. The Ike Dike idea came from Professor Bill Merrell of Texas A&M University at Galveston after the damage of Hurricane Ike (Texas A&M University Galveston 2019). The Ike Dike: Coastal Barrier is detailed later in the chapter. The Ike Dike proposal is similar to Katwijk because Galveston identified itself as a weak zone, and a dike covered with sand and seagrass is the solution that the city is currently supporting.



Figure 5.3:  
Katwijk Beach  
(Google Earth 2020)



## Hunter's Point South Waterfront Park, Phase II

The following information was obtained from Weiss/Manfredi's website as promotional information (figure 5.4)

Location: Queens, New York, United States

Size: 5.5 Acres (Entire Park: 11 Acres)

Designer: SWA/Balsley and Weiss/Manfredi

Client: City of Queens

Hunter's Point South Park was completed in 2018 as a continuous waterfront park. The park provides active and retreat-like spaces, inviting all people to interact with the water's edge. The designers took the resilient waterfront approach with the park. They used the topography to their advantage by raising the paths and "break-out" spaces, and provided access for a kayak launch. The design around the water is "soft," allowing the landscape to move with the rising waters and introducing 1.5 acres of new wetlands. Before the urban development, the site was marshland, and the designers made sure to make that a priority when converting this land back into a public park.

Hunter's Point South Park was chosen because of the "soft" approach. Many of the projects I have examined are artistically using hardened edges, but are still gray infrastructure. It is encouraging that the designers re-established wetlands that were once a part of the site. The designers were also thoughtful about how the tide and floodwaters would interact with the site.

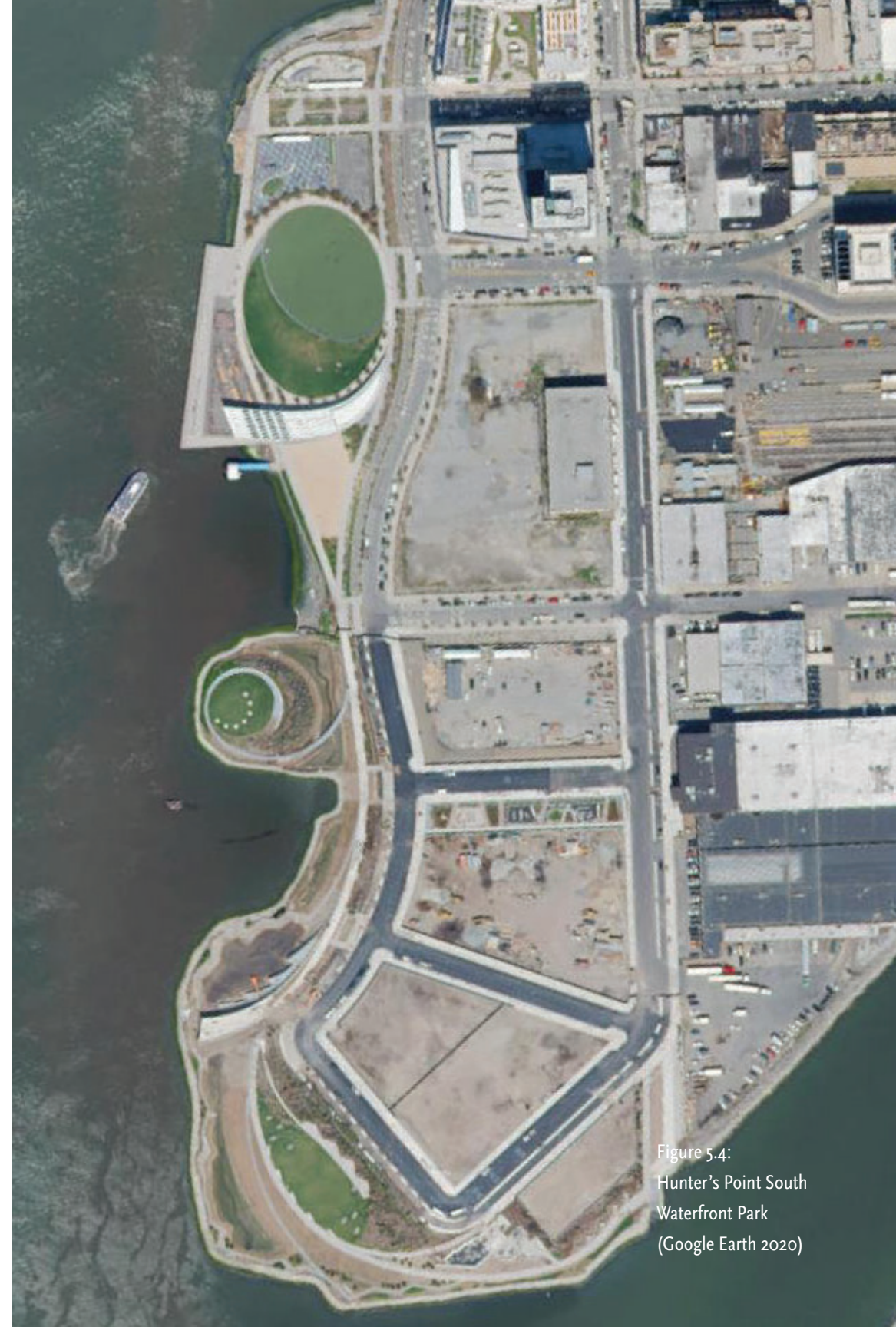


Figure 5.4:  
Hunter's Point South  
Waterfront Park  
(Google Earth 2020)



## Shenzhen Talent Park

The following information was obtained from AUBE's website as promotional information (figure 5.5)

Location: Shenzhen Shi, China

Size: 77 Hectares including 31 hectares of lake

Designer: AUBE

Client: Shenzhen Nanshan District Urban Management Bureau, China Resources Group

Shenzhen Talent Park's lake receives water from the sea and the city center water. The design incorporates freshwater wetlands, rain gardens, and seawater wetlands, creating a diverse water habitat. The verticality of the design allows the park to be adaptable during extreme weather events. The design provides a variety of spaces at different scales so people can experience intimacy with the water.

I chose Shenzhen Talent Park because of its bay like quality. The design uses a hybrid approach to handle weather conditions. They recognize the unique area's ecosystem of freshwater and seawater and made sure to create a diverse ecosystem. The designers discuss people's natural intimacy with water, and I like the way they created a variety of spaces for people to interact with the water.

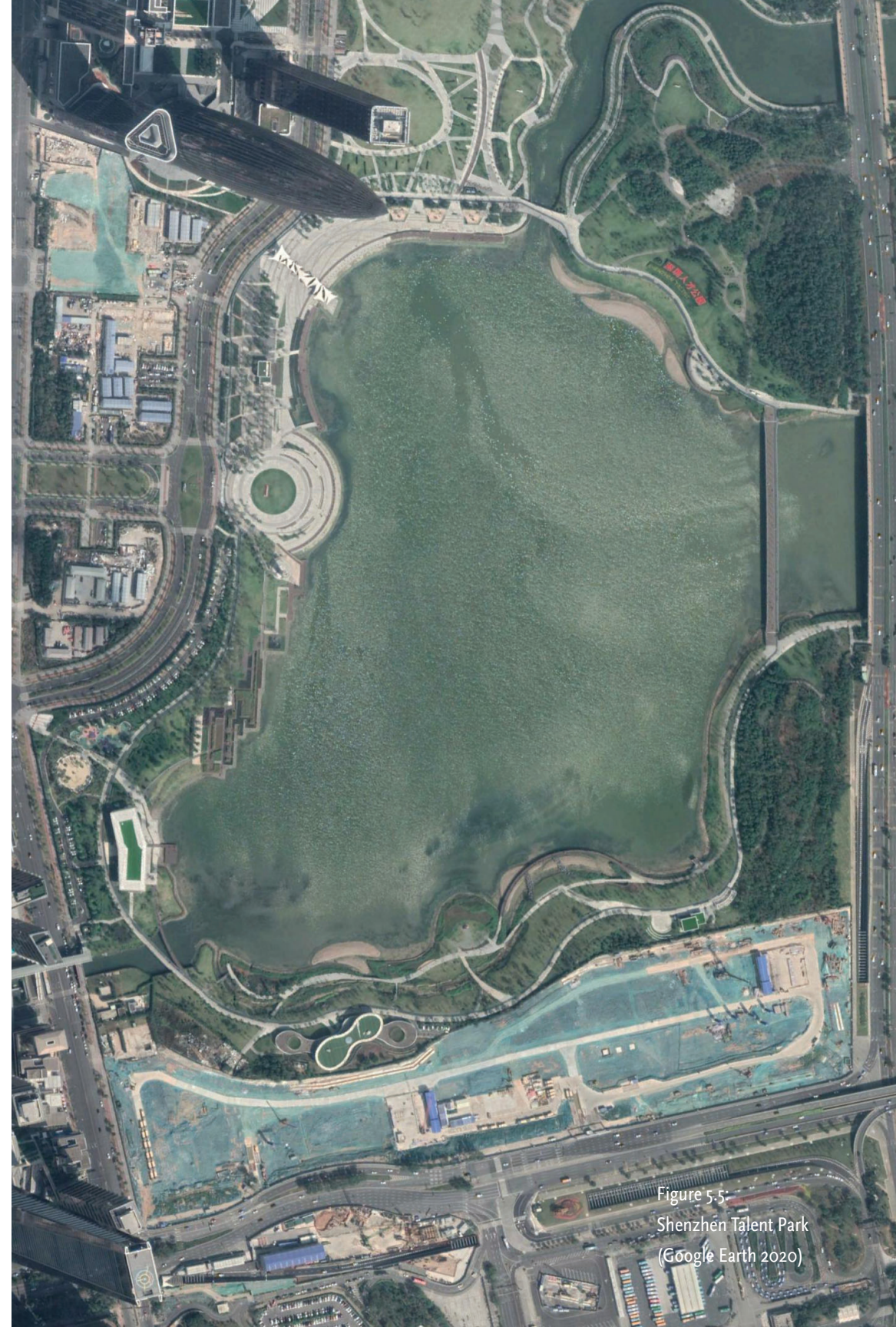


Figure 5.5:  
Shenzhen Talent Park  
(Google Earth 2020)



## Puerto Vallarta Seafront

The following information was obtained from ArchDaily's website as promotional information (figure 5.6)

Location: Puerto Vallarta Jalisco

Size: 5 Acres

Designer: TRAMA Architects

Client: Municipality of Puerto Vallarta Jalisco

The goal of the project is to create an esplanade, which is an area typically adjacent to the sea, and is comprised of one level made for pedestrians. Two key issues that needed to be addressed were stormwater and tropical storms. The stormwater is captured and tunneled to the sea and repair the existing seawall. The seawall was damaged in 2002 by hurricane Kena, so the wall was reinforced by a concrete base that was calculated with projections to last up to 100 years. The first design move was connecting people to the beach and how to transition from the esplanade to the beach. A series of gently sloped ramps were created to provide all users access to the beach.

Like Galveston, Puerto Vallarta has a seawall and is affected by storm surge. I appreciate that they used the existing seawall and transformed the road into a pedestrian-oriented beachfront. The designers have room to implement vegetation along the beach below the seawall but chose not to. Even though the wall was recalculated based on current projections, it does not ensure that it will withstand an extreme event. One thing that I would like to explore is how to reclaim some of the roads in Galveston and convert them to pedestrian use. Puerto Vallarta has had much success, and it is aesthetically pleasing.



Figure 5.6:  
Puerto Vallarta  
Seafront  
(Google Earth 2020)



## The Golden Beach

The following information was obtained from Turenscape's Website as promotional information (figure 5.2)

Location: Qinghuang Dao City, Hebei Province, China

Size: 75 acres

Designer: Turenscape

Client: Landscape Bureau, Qinghuang Dao City, Hebei Province, China

The project inspiration is the natural tide processes that created wetlands on the shallow beach. From this concept, the design team took the barren and eroded beach and reestablished a wetland by using the stormwater from the surrounding environment. Existing gray infrastructure was replaced with an ecologically designed system, and islets were installed as a resting place for birds.

The project has many similarities to Galveston Island, such as accommodating the wetland protection, bird watching, and the beach. The core concept of The Golden Beach is the intended goal for the west end of Galveston Island. The west end of Galveston Island is geared towards second homes and vacation homes. It also has more natural areas that can be converted back to natural habitats.



Figure 5.7:  
Golden Beach Park  
(Gray 2020)

## Ike Dike: A Coastal Barrier

In September 2008, Hurricane Ike caused extensive damage to Galveston Island. The waves and storm surge from the hurricane destroyed about 60% of homes with estimated property damage of \$25 billion in total. Hurricane Ike was the largest storm by size in the Gulf of Mexico, and when the hurricane made landfall, it was a Category 4 at its peak (Bedient et al. 2012). There was little rain associated with the hurricane, but the flooding came from the 17.8 feet of storm surge (Bedient et al. 2012). Beachside houses in Galveston washed away, the beach sand along the Sea Wall vanished, and many oak trees could not be saved from the saltwater damage (Bedient et al. 2012). The estimated economic impact from Hurricane Ike is \$22.16 billion (Texas Engineering Extension Service, n.d.). 50% of Galveston Island was flooded, and the water took 12 hours to recede from Ike's 17-foot storm surge (Texas Engineering Extension Service, n.d.). Bolivar Peninsula had an estimated 3,000 destroyed structures and approximately 140 structures damages resulting in a 70% tax revenue loss for the small community (Bedient et al. 2012).

The petrochemical industry estimated hundreds of millions of dollars in damages due to saltwater intrusion, agriculture estimated \$93 million in damage to livestock, crop, feed stores, and fencing, and the healthcare industry faced \$40 million deficit per month because 750,000 square feet of the building space was lost (Bedient et al. 2012).

The coastal spine shown in figure 5.8 is the location of the spine within Galveston, Harris, and Chambers counties in the southeastern portion of the Texas Gulf Coast. There are two elements in the spine, and they are storm surge barriers and land barriers. The storm surge barriers are in Bolivar Roads and San Luis Pass, and the land barriers are located on Bolivar Peninsula, Galveston Island, and Bluewater.

Bolivar Road's storm surge barrier design is in two sections. The first is a navigational section which allows passage for ships, and the second barrier is for water and environmental flows (Jonkman et al. 2015). The navigational section would need to be sized to withstand a two-way shipping lane to handle

traffic (Jonkman et al. 2015). The storm surge barriers design is a barge gate that is partially floating that "distributes loads towards the sides" (Jonkman et al. 2015, pg. 8). The floating barge gate was chosen because of the automatic gate opening when a higher water level on the bayside occurs (Jonkman et al. 2015). The gate allows the water to top and overflow, and there is space under the gate when it is in a closed position for water to flow through during hurricane conditions (Jonkman et al. 2015). The environmental barrier section had three possible concepts, and the best system is the vertical lifting gates or radial gates.

Further information and design evaluation are needed to determine which gate would be the best. The southern end of the Bay is the San Luis Pass storm surge barrier. Smaller vessels would use this passageway to come into and out of the bay (Jonkman et al. 2015). This area is well suited for the suggestions of the environmental gates at Bolivar Roads (Jonkman et al. 2015). The gate would be semi-close, with 60% of the gate open and 40% of San Luis Pass closed permanently closed (Jonkman et al. 2015). Having barriers at both locations affect the Bay's hydrodynamics in normal conditions (Jonkman et al. 2015). San Luis Pass needs the opening to be 60% open, otherwise the Bay's ecosystem will be negatively impacted (Jonkman et al. 2015). The information about the barge gates is gathered from an interim design report. It is unclear



Figure 5.8:  
Location of the dike  
in dune and proposed  
floodgates  
(The Center for  
Beaches and Shores  
2018)



if the specific types of gates previously discussed will be implemented.

In combination with the sea, barges are a land barrier that run the length of Galveston Island, northeast to Bolivar Peninsula, and southwest to San Luis Pass. The coastal spine and sea gates are a total of 60 miles long at 17 feet above sea level, and the gates are 22 feet high (Sharp 2018). The land barrier is an extension of the existing seawall on Galveston Island (Sharp 2018). The barrier would be concrete but covered to look like a natural dune (Jonkman et al. 2015, Sharp 2018). The downside of the seawall being covered to look like a dune is that when a strong storm hits an area, the “dune” will disappear, leaving the seawall exposed. The spine is seen as a necessity to protect the bay from future hurricanes that are at and above a category 2. The Port of Houston generates \$175 billion a year, which directly contributes to the U.S. economy (Adey 2013). A 500-year designed storm is projected to shut down the petrol and chemical plants for 33 days, resulting in \$7.9 billion in direct losses (The Center for Beaches and Shores 2018). The construction of the spine would reduce or prevent future economic losses and loss of life in relation to a hurricane and storm surge (Adey 2013).

Storm surge is influenced by storm intensity, and within Galveston Bay, peak surge increases from the lower portion along the western shoreline to the upper portion and then into the Houston Ship Channel, where surge tends to be the highest (Ebersole et al. 2015). The main benefit of the Ike Dike is the reduction of the Bay filling from storm surge and then flooding (Ebersole et al. 2015). The dike reduces the amount of storm surge and wave impact against buildings and infrastructures if the dike is not overtopped (Ebersole et al. 2015). While the dike prevents flooding from the Gulf side, it does not prevent the flooding of Galveston Island on the Bayside, but it reduces the amount of flooding (Ebersole et al. 2015). Ebersole et al. (2015) ran four different storm simulations, and the dike limited storm surge levels for each simulated storm. Two of the simulated storms were powerful enough to top and overflow, but the dike still reduced the amount of damage and flooding inland

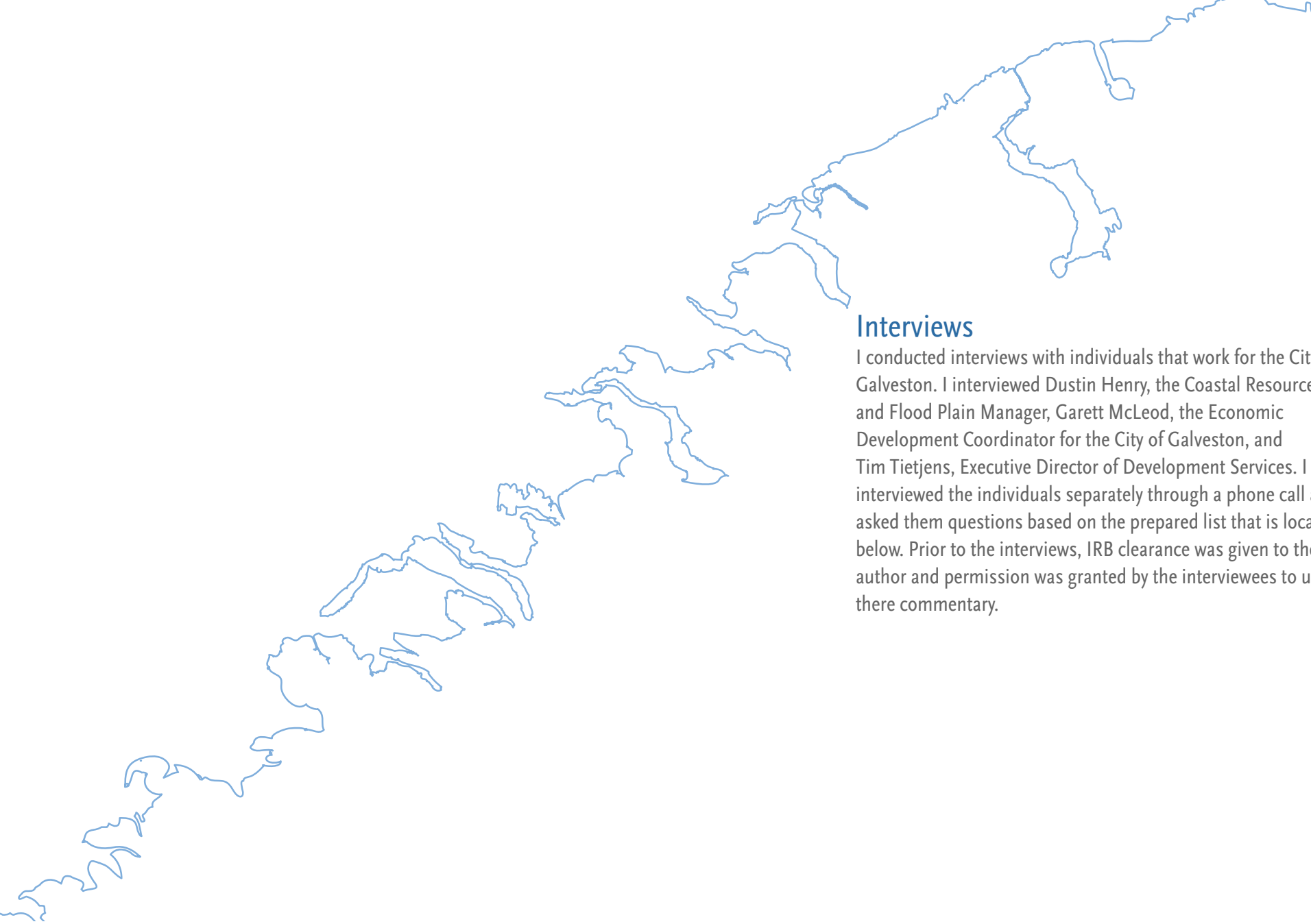
(Ebersole et al. 2015).

The Center for Texas Beaches and Shores (2018) surveyed the public in Harris, Galveston, and Chambers counties about the proposed coastal spine, see Figure 13. The public perception of the coastal spine is positive, and the majority in the three counties feel their houses would be protected (The Center for Beaches and Shores 2018). As for jobs, less than the majority in all three counties felt that jobs were more secure with the coastal spine (The Center for Beaches and Shores 2018). The public perception of the spine failing in Chambers County was 65%, while Galveston and Harris Counties’ perception was about 59% (The Center for Beaches and Shores 2018). Respectively, groups are concerned about the environmental effects the spine and gates would have, which include water flow, salinity, sediment transport, and wildlife (The Center for Beaches and Shores 2018). Overall, there is support for the coastal spine, but there needs to be a balance of community interests and concerns. The cost of the coastal spine and gates would require public and private buy-in, and the majority of the residents believe the government and port industries should be responsible for paying for the system (The Center for Beaches and Shores 2018). While two-thirds of the survey respondents are in support of some tax (The Center for Beaches and Shores 2018). The environmental concerns are linked to a lack of awareness, and the design team believes that education and community engagement could increase community resilience (The Center for Beaches and Shores 2018). Figures 14-17 show Hurricane Ike’s impact on damages and inundation, and the projections of reduced damage and inundation if the coastal spine is in place. Inundation is “the amount of water that occurs above normally dry ground as a result of flooding” (“NOAA Tides & Currents-Coastal Inundation Dashboard,” n.d.).

Table 5.1: Comparison of Precedent Studies (Gray 2020)

	Sanya Mangrove Park	San Francisco Bay-Delta	Katwijk Coastal Defense	Puerto Vallarta Seafront	The Golden Beach	Hunter's Point South Waterfront Park	Shenzhen Talent Park	Ike Dike Coastal Barrier
Location	Sanya City, China	San Francisco, California	Katwijk, South Holland	Puerto Vallarta, Mexico	Qinghaung Dao, China	Queens, New York	Shenzhen Shi, China	Galveston, Texas
Size	25 Acres	Bay	50 Acres	5 Acres	75 Acres	5.5 Acres	190 Acres	60 Miles Long
Designer	Turenscape	Save the Bay	OKRA	TRAMA Architects	Turenscape	SWA/ Balsey and Weiss Manfredi	AUBE	Texas A&M at Galveston
Gray Infrastructure				X				
Green Infrastructure	X	X			X			
Hybrid Infrastructure			X			X	X	X
Key Takeaways	Ecologically Designed  Addresses Flooding and Tides	Report can be used as a Framework for Galveston  Green Infrastructure	Preserve Local Economy  Dike in Dune similar to the Ike Dike	Expanded on Existing Seawall  Pedestrian Focus	Habitat Preservation and Restoration  Removal of Gray Infrastructure	Active and Passive Spaces  Re-establish existing habitats	Diverse Water Habitats  Adaptable in Extreme Weather Events	Protection for Houston-Galveston Area  Reduce Storm Surge and Flooding





## Interviews

I conducted interviews with individuals that work for the City of Galveston. I interviewed Dustin Henry, the Coastal Resources and Flood Plain Manager, Garrett McLeod, the Economic Development Coordinator for the City of Galveston, and Tim Tietjens, Executive Director of Development Services. I interviewed the individuals separately through a phone call and asked them questions based on the prepared list that is located below. Prior to the interviews, IRB clearance was given to the author and permission was granted by the interviewees to use there commentary.

## Garrett McLeod

### Have storms like Ike and Harvey made people move to the mainland?

Ike definitely did. Especially on the public housing side, the city of Galveston had a significant amount of public housing and a lot of that was lost and is still being built back to this day. Harvey affected the Houston suburbs, especially North Galveston County, that being League City, Friendswood, Dickinson, really got hit hard.

The biggest population loss, like I said before, is with the low income. We're actually working with a company right now to bring that housing back, so they're moving forward with that but yeah, that was ... As far as population loss from Ike, the biggest was with the low to moderate income folks that were here. And we have a long waiting list of people that do have the desire to come back to Galveston but either they can't afford to or we just don't have the housing options yet.

### After devastating storms, is it more common for small business owners to remain closed or do they typically reopen?

After Ike, we had a series of neighborhood grocery stores, what you'd expect in 1950s America. They're walkable, easy access but could not afford to build back. The low to moderate income areas are missing the neighborhood grocery stores because we're a tourist town, so of course the grocery stores are located in areas with the highest traffic counts. They are tough to access if you're not using public transit. You can't simply walk to.

As Galveston Island is growing, are you seeing more commercial development or residential? If commercial, what type of business is coming and where are they locating? As of right now, I think we're seeing more residential, folks from Houston that are buying up homes down here, fixing them up with the intention of coming down a couple of times a year and then B&B'ing out the rest of the year. About 30 to 33% of our total housing stock, is short term rentals now.

### How have storm surge and flooding changed the economy of Galveston? Is the change promoting growth or is it preventing growth?

Healthcare education, port operations and tourism are really our three biggest pieces to our economy. Obviously, tourism is the biggest for us. And so, the storm surge and flooding, I wouldn't say it has changed the economy.

Is the change promoting growth or is it preventing growth? I think it's promoting it but it's causing people to get a little bit more creative and to pay more attention on how they construct their commercial operations. We're getting developers that are willing to come in and modify their projects in order to make them fit Galveston and to be more resilient as far as storm protection goes.



## Dustin Henry

### Are there any projects the city is currently implementing to protect the community from storm surge and flooding?

One is a hazard mitigation grant program potentially funded project. The city made an application after Hurricane Harvey in 2017 to design and install a pump system that would cover an area of residences and businesses on the East side of our downtown and it's one of potentially multiple that we would explore putting in. That would essentially help expedite the outflow of storm... Not storm surge but like street flooding.

Historically the city has kind of done things more economically and just resurfaced roads or kind of made any kind of repairs here and there, but our city has really taken it to heart that we need to just go.

### Have storms like Ike and Harvey made people move to the mainland?

We recognized with the decennial census in 2010 that there was a loss in population and those weren't casualties. So those people relocated off of Galveston Island elsewhere, but we couldn't say definitively where on the mainland they moved, but they left the Island and has slowly been returning

After Ike 569 housing units were demolished and so they didn't really start substantially rebuilding those until I think around 2013. So that's five years of being displaced, at least 569 households. So Ike was much more of an impact than Harvey.

### What are your views of a coastal spine and moveable sea gates? Do you believe it is a solution that can be sustainable for 100 years?

I'm not convinced that great infrastructure is the ultimate solution. There needs to be other considerations then.

### As Galveston Island is growing, are you seeing more commercial development or residential? If commercial, what type of business is coming and where are they locating?

It's hard to say. I don't feel like we've seen a significant amount of either in terms of growth, redevelopment of commercial. Like there's not major... We don't have like new major employment sectors that have opened up or chosen to locate here. Just a lot of redevelopment of either old businesses or vacant buildings that are being repurposed and residential, we are seeing more development but not, I would say for primary household it seems a lot more focused on people buying a property to build second homes for either their own use or for rental.

## Tim Tietjens

**If you were to reimagine coastal protection for Galveston, Island, would you include gray infrastructures like jetties and seawalls, a hybrid approach like sills and groins, or green infrastructure with wetlands and dunes? Or any other type of infrastructure?**

I think a combination, to be honest. I think we would go toward things that, whether they're jetties or not, but things that would try to retain the amount of sand. Because in the middle part of the Island is where we're having the most erosion. And at the ends of the Island, both ends is where we're having the accretion. So, it hits the Island and sort of moves its way toward the end. And, especially the North end of the Island, there's been a lot of accretion.

**What are your views of a coastal spine and moveable sea gates? Do you believe it is a solution that can be sustainable for 100 years?**

I don't know that it would be sustainable for a hundred years. It's my understanding that the horizon for it, the time that it was... maybe its design life would be somewhat less than that. Although that went back and forth. The downside to a man-made structure like that, that includes movable parts and metal, and... a sea wall is one thing. You can really build some longevity into something like that.

**How have storm surge and flooding changed the economy of Galveston? Is the change promoting growth or is it preventing growth?**

I think it's had the effect of preventing to some degree, or at least minimizing the population growth. We actually had a good number of folks leave the area, leave the Island after Ike.

I know that there was a group of folks who I think ran on a platform that, let's not bring back some of that affordable housing or subsidized housing that we had. And so, there was an impact on the social justice end of things, with who came back and who felt they could come back.

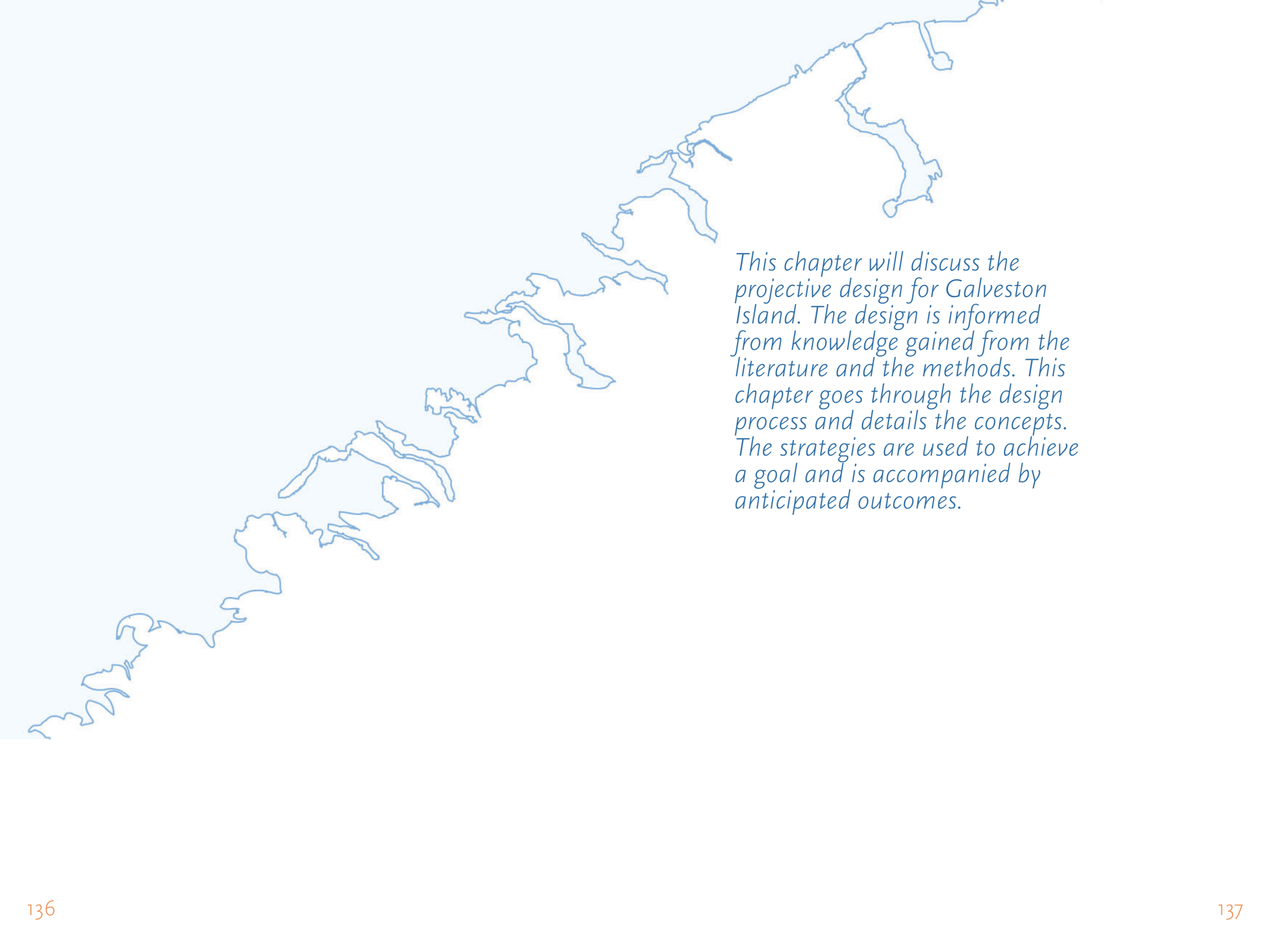


An aerial photograph of a coastal area, likely a golf course or resort, with white contour lines overlaid. A large, rectangular area in the center is filled with a grid pattern, possibly representing a planned development or a specific design area. The surrounding landscape includes water bodies, green fields, and some buildings.

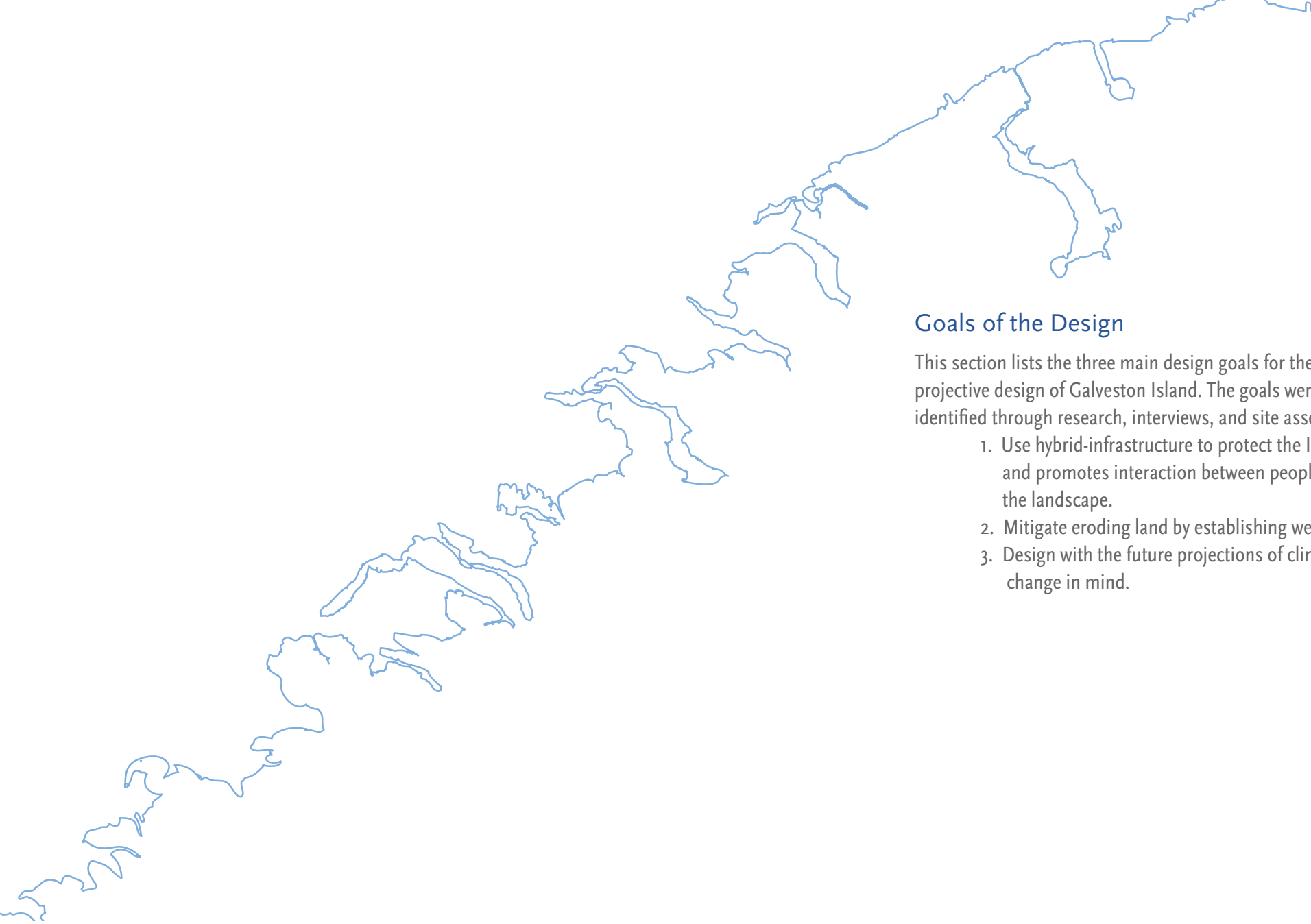
## Chapter 6

### The Design





*This chapter will discuss the projective design for Galveston Island. The design is informed from knowledge gained from the literature and the methods. This chapter goes through the design process and details the concepts. The strategies are used to achieve a goal and is accompanied by anticipated outcomes.*

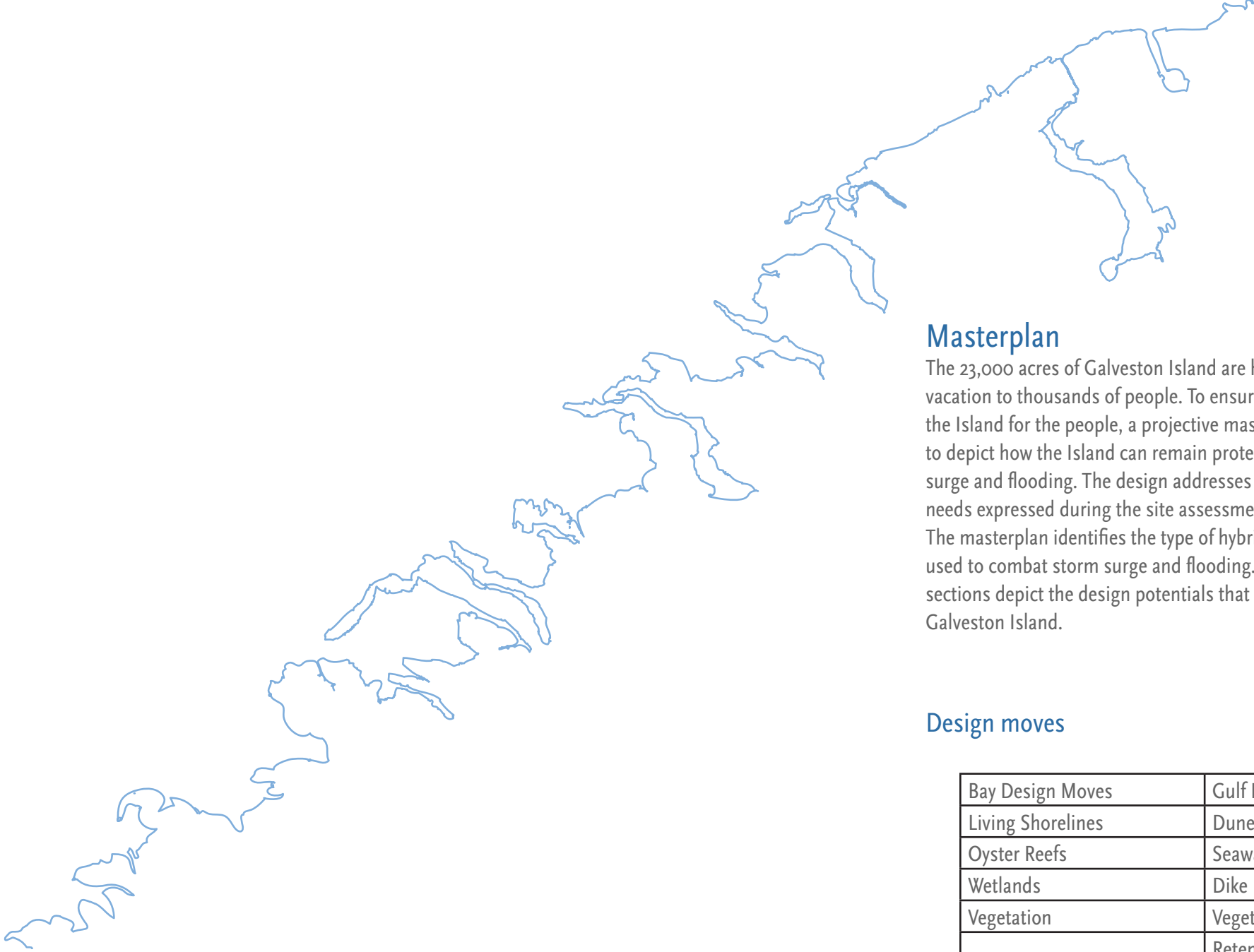


## Goals of the Design

This section lists the three main design goals for the projective design of Galveston Island. The goals were identified through research, interviews, and site assessment.

1. Use hybrid-infrastructure to protect the Island and promotes interaction between people and the landscape.
2. Mitigate eroding land by establishing wetlands.
3. Design with the future projections of climate change in mind.





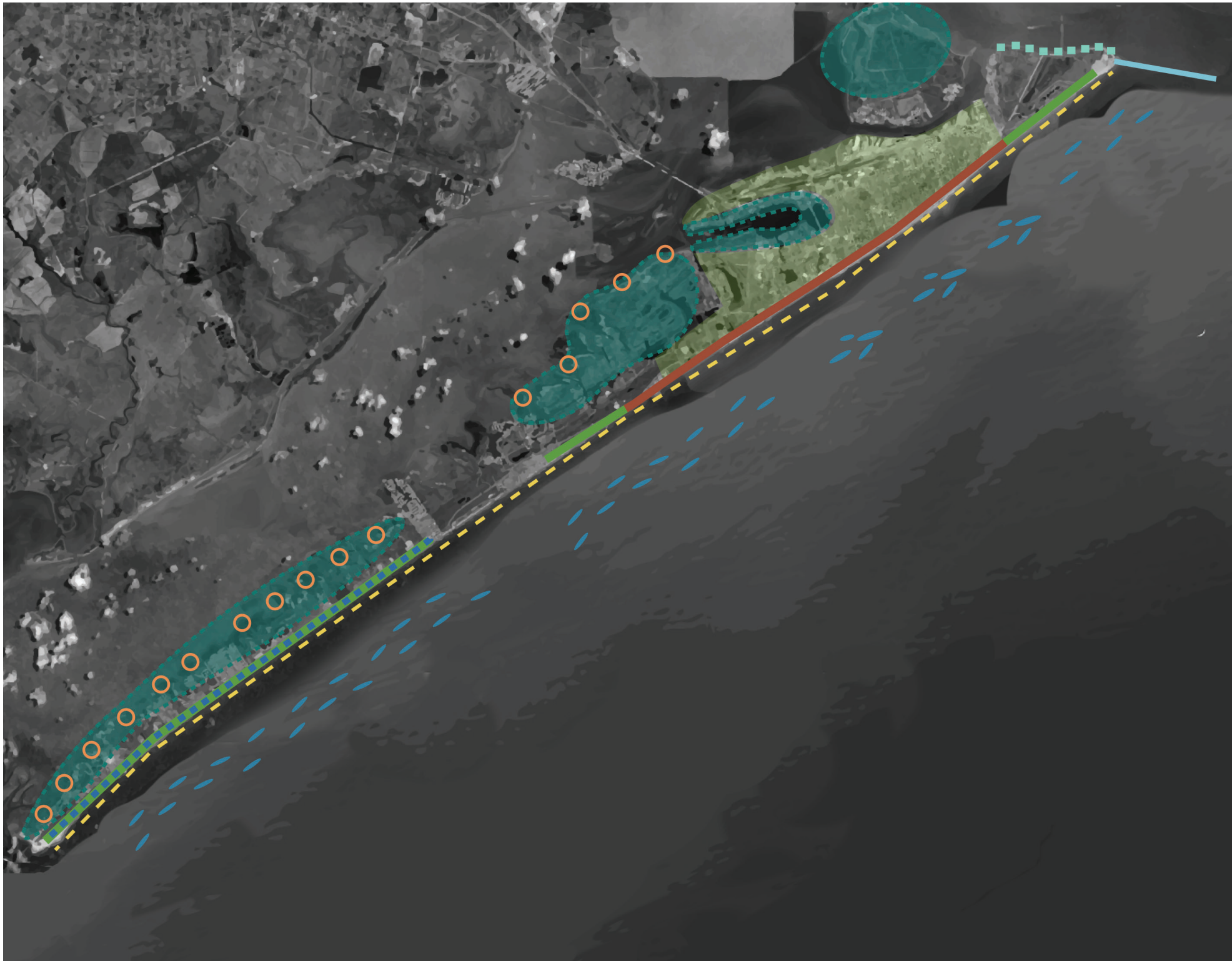
## Masterplan

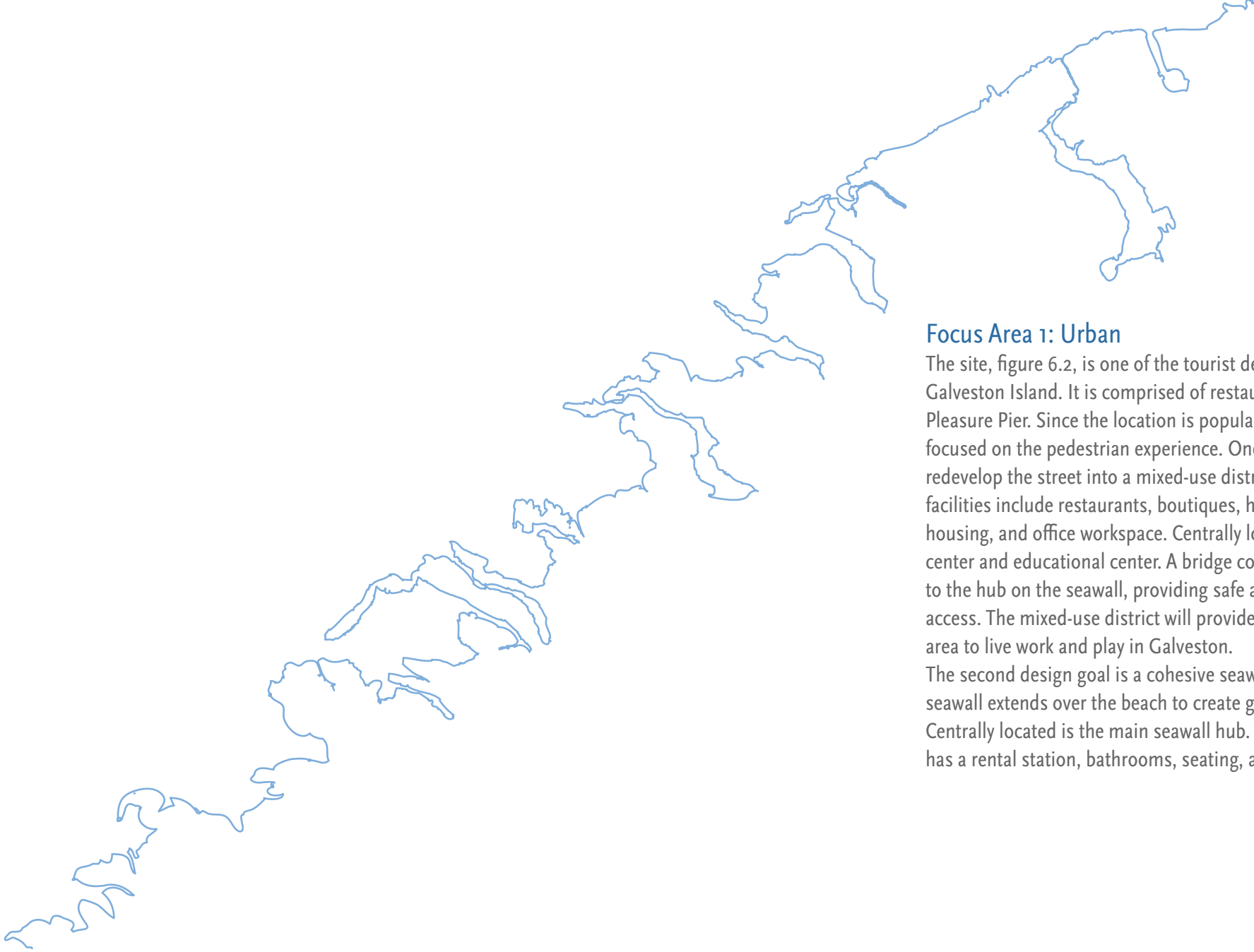
The 23,000 acres of Galveston Island are home, work, and vacation to thousands of people. To ensure the longevity of the Island for the people, a projective masterplan is created to depict how the Island can remain protected from storm surge and flooding. The design addresses the concerns and needs expressed during the site assessment and interviews. The masterplan identifies the type of hybrid infrastructure used to combat storm surge and flooding. The following two sections depict the design potentials that could be applied to Galveston Island.

## Design moves

Table 6.1:  
Design Applications  
to the Bay and Gulf  
(Gray 2020)

Bay Design Moves	Gulf Design Moves
Living Shorelines	Dunes
Oyster Reefs	Seawall
Wetlands	Dike
Vegetation	Vegetation
	Retention Ponds
	Offshore Breakwaters





### Focus Area 1: Urban

The site, figure 6.2, is one of the tourist destinations on Galveston Island. It is comprised of restaurants, shops, and Pleasure Pier. Since the location is popular, the design is focused on the pedestrian experience. One design goal is to redevelop the street into a mixed-use district. The mixed-use facilities include restaurants, boutiques, housing, low-income housing, and office workspace. Centrally located is an expo center and educational center. A bridge connects the building to the hub on the seawall, providing safe and uninterrupted access. The mixed-use district will provide a more central area to live work and play in Galveston.

The second design goal is a cohesive seawall design. The seawall extends over the beach to create gathering places. Centrally located is the main seawall hub. The seawall hub has a rental station, bathrooms, seating, and a splash pad.





- 1 Pleasure Pier
- 2 Mix-Use Development
- 3 2 Way Bicycle Lane and adjacent Exercise Lane
- 4 Beach Level Boardwalk
- 5 Conference and Education Center
- 6 Pedestrian Bridge/Welcome Sign
- 7 Seawall Hub
- 8 Miniature Seawall Hub

Figure 6.2:  
Focus Area 1 Plan  
(Gray 2020)



Figure 6.3:  
Seawall Hub  
(Gray 2020)





One of the goals of the unified seawall design is to have a variety of gathering spaces. Section 1, figure 6.4, of the seawall shows the relationship of the design at the road level and the beach level. A continuous boardwalk along the beach allows people of all abilities to enjoy a walk on the beach. Where the seawall juts out at the road level, allows a covered resting point at the beach level.



Location of Section 1 of Seawall



Figure 6.4:  
Section 1 of Seawall  
(Gray 2020)



Section two, figure 6.5, and three, figure 6.6, show the seawall hubs relationship from the educational and expo center to the beach. There is a variety of seating areas that allow visitors to be more engaged with the landscape and groups of people or to be more observant. An amphitheater provides passive seating for visitors to gaze out to the Gulf while the pavilion provides coverage with chairs and tables. A ramp leads visitors down to the beach to access the boardwalk or the beach.



Location of Section 2 and 3 of Seawall



Figure 6.5:  
Section 2 of Seawall  
Hub (Gray 2020)



Figure 6.6:  
Section 3 of Seawall  
Hub  
(Gray 2020)



## Focus Area 2: Residential

The second site, figure 6.7, is residential and is comprised of vacation homes and condominiums. Based on the analysis, the site is recommended to be restored to a natural setting. The projective design includes restoring land to wetlands and implementing oyster reefs on the bay side. The intent of restoring the bay side to a natural state, is to create a nature preserve that attracts a variety of wildlife and trails for people to observe the wildlife. There is a series of trails and overlooks for visitors to explore and take in the beauty of the natural setting and wildlife.

On the Gulf of Mexico side of the site is condominiums and homes. This side will have a dike that is covered by a dune. This technique is used to stabilize the land and promote resiliency against storm surge and flooding. A series of natural dunes are created to provide extra layers of protection for the community. Before the dunes is a series of retention ponds that are planted with wetland grasses. This purpose of the ponds is to provide a first line of defense to low category storms and to provide habitat for wildlife.





Figure 6.7:  
Focus Area 2 Plan  
(Gray 2020)





Seagrass

Overlook

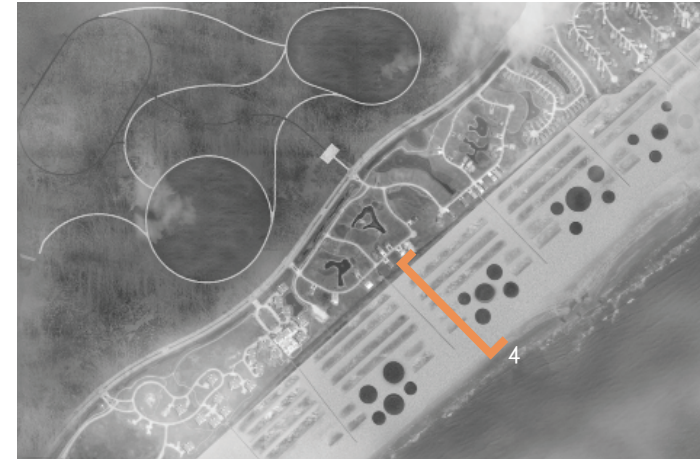
Boardwalk

Wetland

Figure 6.8:  
View of Bay in Nature  
Preserve  
(Gray 2020)



The section for Focus Area 2, figure 6.9, depicts the dike in the dune system. As mentioned in Chapter 4: Site Assessment, the Loop Current has a significant role in the erosion process of the Island. The southern portion of the Island is the first to be affected by the Loop Current. Therefore, a dike in the dune system helps stabilize the land and allows land accretion to occur. The existing dunes would be replaced with a series of dunes and wetland ponds to be the first line of defense to lower category storms. The dunes and wetland ponds would provide habitat for the local flora and fauna.




Location of Section 4 of dike in dune system



Figure 6.9:  
Section 1 of Dike in  
Dune  
(Gray 2020)

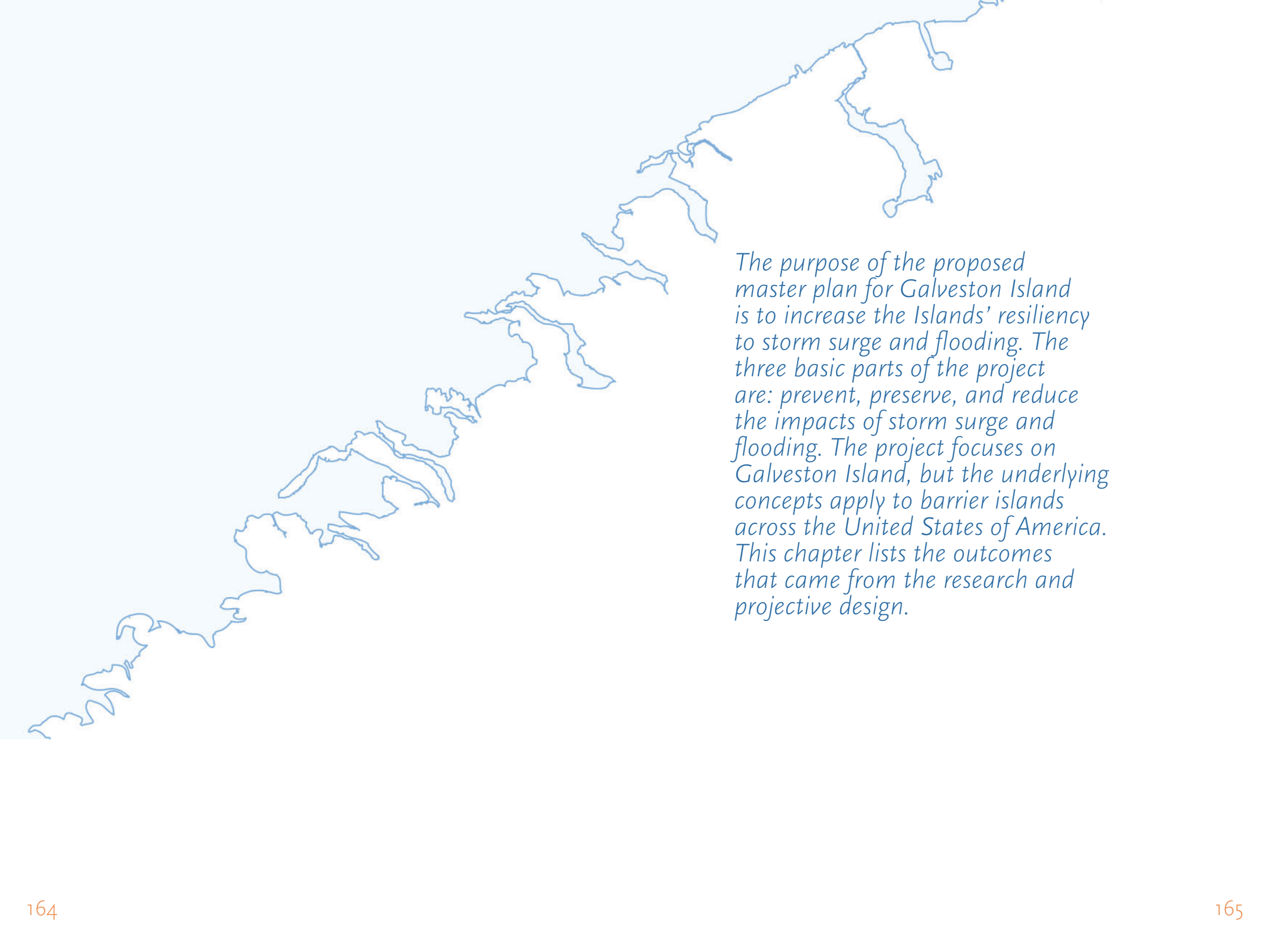


An aerial photograph of a coastal region, likely a bay or estuary, with white contour lines overlaid. The lines represent topographic features, showing a mix of land and water. The land is green, and the water is dark blue. The contour lines are more densely packed in some areas, indicating steeper slopes. The overall shape of the land is irregular, with several inlets and peninsulas. The text "Chapter 7 Conclusion" is in the bottom left corner.

## Chapter 7

### Conclusion





*The purpose of the proposed master plan for Galveston Island is to increase the Islands' resiliency to storm surge and flooding. The three basic parts of the project are: prevent, preserve, and reduce the impacts of storm surge and flooding. The project focuses on Galveston Island, but the underlying concepts apply to barrier islands across the United States of America. This chapter lists the outcomes that came from the research and projective design.*

## Project Significance and outcomes

A project such as this is vital to the future of Galveston Island. The projections for 2100 are concluding that the Island will be underwater. While this project focuses on storm surge and flooding and not sea-level rise, it all works together. There is potential that addressing design strategies for storm surge and flooding can reduce the amount of sea-level rise.

The project's main goal was to answer the research question:

**“How can landscape architects contribute to the prevention, protection, and mitigation of coastal damage from storm surge and flooding?”**

The Galveston Island masterplan answers the question through three design goals:

1. Use hybrid-infrastructure to protect the Island and promotes interaction between people and the landscape.
2. Mitigate eroding land by establishing wetlands
3. Design with the future projections of climate change in mind.

This project provides a different perspective than the Coastal Barrier: Ike Dike. The Coastal Barrier project focuses on seagates and a 60-mile-long dike in dune along the Gulf of Mexico, starting on Bolivar Peninsula and going across Galveston Island. Projects such as that have a history of changing ecosystems. This project provides an alternative solution that focuses on the needs of protecting the Island using multiple hybrid infrastructure approaches that fit the needs of each specific area on the Island.

## Project limitations

Time is the most notable limitation of this project. The amount of information that was collected and the graphics needed to convey the design requires a substantial amount of time. Designing an entire Island alone involves a lot of time, and while the author knew the undertaking was large, it was still more than anticipated. However, with the time allotted, this project is successful in providing relevant answers and design solutions to the research question.

Also, the location of the project is in Galveston, Texas, and the author residing in Manhattan, Kansas. The distance only allowed one visit, and the visit was during a time that was less desirable in terms of tourism season. Visiting in November provided insight into what the Island offers during the off-season but did not allow the author to experience the prime tourism season. Ideally, site visits would have occurred throughout the year to provide a comprehensive understanding of Galveston Island.

Lastly, the project lacks a multidisciplinary team. It is necessary to work with other professionals; urban planners, architects, engineers, oceanographers, soil scientists, biologists, etc. when developing a masterplan for an island. Collaborating with a team of professionals and designers educated in coastal processes would strengthen the project.



## Future Research

The future of Galveston Island is being shaped by the decisions made today. Global climate change is a significant contributing factor to the future of the Island's existence.

The design decisions made today should account for the year 2100s projections. The current design decision is the Coastal Barrier: Ike Dike. A series of community engagement events are underway, and reports are created and updated. The impact of a coastal barrier is in the near future, and research should be done on the effects on the ecosystems if a coastal barrier and seagates were to be implemented.

The background of the project synthesizes gray, green, and hybrid infrastructure for coastal areas. This research could be expanded by future students to study and design a different barrier island in the United States. The variety of hybrid design would strengthen the research that hybrid- infrastructure is suitable for coastal protection and encourage more hybrid-infrastructure designs in the real world.

## Project Reflection

The methodology and extensive research used throughout this project has created a masterplan for Galveston Island that focuses on the prevention, preservation, and mitigation of storm surges and floods. The solution was formed through research in the forms of literature review, precedent studies, interviews, on-site observation, and site assessment.

In hindsight, the location of the project had opportunities and constraints. If the author lived in a closer proximity to Galveston Island then a deeper site assessment could have been conducted providing more depth to the project. However, the project location was chosen because of the need of the community. There has been a call for better infrastructure to combat storm surges and floods for a minimum of forty years. It was the authors personal connection to a family member in the Houston-Galveston area that drove her to choose Galveston Island. Other barrier islands and coastal cities are combating similar issues with climate change, storm surges, and floods and the project shines a light on the importance of protecting those areas. Galveston Island is a perfect area to test innovative design strategies to combat storm surges and floods in the United States.

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Appendices



## Appendix A: Glossary

### Breakwater

Placed offshore in high wave energy areas made of massive stone, but they prevent sediment transport (Grabowski et al. 2012).

### Ecosystems

“The complex living organisms, their physical environment, and all their interrelationships in particular unit of space” (“Ecosystem | Definition, Components, & Structure | Britannica.Com” n.d.).

### Ecology

“A study of relationships between organisms and their environment” (“Ecology” n.d.).

### Estuarine Wetland

“Deepwater tidal habitats and adjacent tidal wetlands that are semi-enclosed by land but have open, partly obstructed, or sporadic access to the open ocean, and in which ocean water is at least occasionally diluted by freshwater runoff from the land” (National Resources Inventory 2000).

### Floodplain

Land that is adjacent to a stream or river that is naturally prone to flooding (“Definition of Floodplain | Dictionary.Com” n.d.).

### Gray Infrastructure

Structures such as treatment facilities, sewer systems, stormwater basins, and storage basins, which are typically made of concrete (“Gray Infrastructure | NGICP” n.d.).

### Green Infrastructure

The use of plants and water to perform ecosystem services (Kelly 2016).

### Groin

Typically, stone and placed perpendicular to the shoreline and is used to trap sediment to prevent erosion (Grabowski et al. 2012).

### Global Sea-level Rise

The warming of the ocean and the intake of fresh water into the ocean from melting ice (National Oceanic and Atmospheric Administration n.d.).

### Hybrid Infrastructure

The combination of green and gray infrastructure to maximize the resiliency of environmental and community hazards (Kelly 2016).

### Inundation

“the amount of water that occurs above normally dry ground as result of flooding” (“NOAA Tides & Currents-Coastal Inundation Dashboard” n.d.)

### Littoral Current

“A current generated by waves breaking at an angle to the shoreline and that usually moves parallel to and adjacent to the shoreline within the surge zone” (“Definition of Littoral Current - Mindat.Org Glossary” n.d.)

### Living Shorelines

a connection between land and water through natural materials, and if necessary, humanmade elements to stabilize shorelines, reduce erosion, and provide a habitat that increases resilience (Fisheries 2019; Pace and Morgan 2017).

### Marsh Toe-revetment

A low-profile, freestanding structure made of natural material near shallow water and placed close to eroding marsh (Grabowski et al. 2012 and “Living Shorelines Structural Options” 2017).

### Midden

“a mound, consisting chiefly of the shells of edible mollusks intermingled with evidence of human occupancy” (“Shell Mound | Anthropology | Britannica.Com” n.d.).

### Palustrine System

“All non-tidal wetlands dominated by trees, shrubs, persistent emergent, emergent mosses, or lichens, and all such wetlands that occur in tidal areas where salinity due to ocean derived salts is below 0.5 percent” (National Resources Inventory 2000).

### Sea-level Rise

“increase in the average reach of the ocean” (National Geographic Society 2019).



### **Sill**

A low-profile structure near low water, but they are placed in areas to create marsh or rebuild existing marsh (Grabowski et al. 2012 and “Living Shorelines Structural Options” 2017).

### **Relative Sea-level Rise**

“is affected by global sea-level fluctuations, changes in land elevation, wind, and ocean circulation” (National Oceanic and Atmospheric Administration n.d.).

### **Resiliency**

“The capacity of a system to absorb the shock and to sustain and develop its fundamental function, structure, identity, and feedbacks through recovery or reorganization in a new context” (Irajifar et al., 2016)

“The ability to absorb disturbances, to be changed and then to reorganize and still have the same identity (retain the same basic structure and ways of functioning)” (Brown, 2016).

“A multi-dimensional construct...the capacity of individuals, families, communities, systems, and institutions to respond, withstand and/or judiciously engage with catastrophic events and experiences; actively making meaning without fundamental loss of identity.” (Brown, 2016).

### **Storm Surge**

“the abnormal rise in seawater level during a storm, measured as the height of the water above the normal predicted astronomical tide” (NOAA 2018).

## Appendix B: Interview Transcript

### Interview Materials Include:

- IRB Approval Letter
- Interview Questions
- Interview Transcript

TO: Dr. Timothy Keane  
Architecture, Planning, and Design  
2103 Seaton Hall

Proposal Number: 9980

FROM: Rick Scheidt, Chair  
Committee on Research Involving Human Subjects

DATE: 12/02/2019

RE: Proposal Entitled, "Design in the Face of Uncertainty: Prevent, Preserve, and Mitigate Coastal Damage from Storm Surge and Flooding"

The Committee on Research Involving Human Subjects / Institutional Review Board (IRB) for Kansas State University has reviewed the proposal identified above and has determined that it is EXEMPT from further IRB review. This exemption applies only to the proposal - as written - and currently on file with the IRB. Any change potentially affecting human subjects must be approved by the IRB prior to implementation and may disqualify the proposal from exemption.

Based upon information provided to the IRB, this activity is exempt under the criteria set forth in the Federal Policy for the Protection of Human Subjects, **45 CFR §46.101, paragraph b, category: 2, subsection: ii.**

Certain research is exempt from the requirements of HHS/OHRP regulations. A determination that research is exempt does not imply that investigators have no ethical responsibilities to subjects in such research; it means only that the regulatory requirements related to IRB review, informed consent, and assurance of compliance do not apply to the research.

Any unanticipated problems involving risk to subjects or to others must be reported immediately to the Chair of the Committee on Research Involving Human Subjects, the University Research Compliance Office, and if the subjects are KSU students, to the Director of the Student Health Center.



## Design Questions

1. Are there any projects the city is currently implementing to protect the community from storm surge and flooding?
2. Have storms like Ike and Harvey made people move to the mainland?
3. What are your views of a coastal spine and moveable sea gates? Do you believe it is a solution that can be sustainable for 100 years?
4. If you were to reimagine coastal protection for Galveston, Island, would you include gray infrastructures like jetties and seawalls, a hybrid approach like sills and groins, or green infrastructure with wetlands and dunes? Or any other type of infrastructure?

## Economic Questions

1. After Hurricane Ike, did the rebuilding spark urban development or was the rebuilding replacing what was existing prior to the storm?
2. After devastating storms, is it more common for small business owners to remain closed or do they typically reopen?
3. As Galveston Island is growing, are you seeing more commercial development or residential? If commercial, what type of business is coming and where are they locating?
4. How have storm surge and flooding changed the economy of Galveston? Is the change promoting growth or is it preventing growth?

## Dustin Henry: Coastal Resources and Flood Plain Manager

Allyssa Gray:

Oh, hi [Dustin 00:00:32], how are you?

Dustin:

Hey Allyssa.

Allyssa Gray:

Yes. This is Alyssa.

Dustin:

Oh good. Excuse, I think your phone might be cutting out a little bit, so we may have to make a quick phone call again but-

Allyssa Gray:

Do you hear me now? Is that better?

Dustin:

Yeah. Perfect.

Allyssa Gray:

Okay. Great.

Dustin:

No, actually you did send your questions and I didn't have a chance to kind of look them over.

Allyssa Gray:

Okay. Perfect.

Dustin:

I didn't have-

Allyssa Gray:

I couldn't remember. I was looking through that thread and I was like, I don't see that I sent him the list of questions. So I just wanted to send them again so you could have them in front of you and quickly look through them.

Dustin:

Yeah. I looked through them. I wish I had time to reply to all eight because they're great questions. Let me just kind of read them in [crosstalk 00:01:18], myself here and I could definitely say... So do you plan to writing anything down or do you want me to just kind of talk with you and then I can reply to the email with more details.

Allyssa Gray:

No. So actually what I'm currently doing is we are being recorded essentially.

Dustin:

Okay.

Allyssa Gray:

I downloaded an app and it merges the calls and it records the call so then I can just transcribe it later. So full attention uninterrupted. So we can just start whenever.

Dustin:

Okay. Well, let the record reflect that I do know for a fact that the Kansas City Chiefs do not reside in Kansas [crosstalk 00:01:57], unlike certain people we know but I do know your



university is nearby, so I assumed you were a fan-

Allyssa Gray:

[crosstalk 00:02:04]. We are two hours away. So we have a huge celebration in our town for-

Dustin:

[crosstalk 00:02:11], to make sure that I was on the record.

Allyssa Gray:

On the record. Yes. I love it.

Dustin:

Anyways. Yeah, my family... My dad has always been a big fan and so I grew up in [crosstalk 00:02:24]. I grew up in Cowboys country [crosstalk 00:02:26], fan so. Anyways, sorry, back to the question [crosstalk 00:02:31]. So for design number one. Yes, there are projects underway. One is a hazard mitigation grant program potentially funded project. The city made an application after Hurricane Harvey in 2017 to design and install a pump system that would cover an area of residences and businesses on the East side of our downtown and it's one of potentially multiple that we would explore putting in. That would essentially help expedite the outflow of storm... Not storm surge but like street flooding water to go-

Allyssa Gray:

Urban flooding for sure.

Dustin:

Yeah, urban flooding. To get the water basically off our streets and into the Bay and I don't know the specific numbered amounts, but I think it's like a potentially \$30 million project and it covers more or less like four blocks wide by from beach to Bay of a chunk of our Island East of downtown and I can email you the specifics if I find them or get them from somebody, but that's one like most recently current project. I know there are a number of capital improvement projects that have been done since Hurricane Ike to today's date and

then moving forward in our capital improvement program, which are like complete street and infrastructure rebuilds.

Dustin:

Historically the city has kind of done things more economically and just resurfaced roads or kind of made any kind of repairs here and there, but our city has really taken it to heart that we need to just go. If we're taking on the surface of a road out to go ahead and fix all the underground infrastructure underneath and modernize storm drains and such and so those are a couple of just off the top of my head project ideas. There's also some like really small scale but kind of incremental things like there's a branch of our government called the Park Board of Trustees. They're an agency that manages our beaches and they're working with a local nonprofit to replant or actually maybe in some cases plant for the first time native dune grasses and vegetation on the beach side of our seawall. Our seawall is like 115 years old and-

Allyssa Gray:

Yes it is.

Dustin:

And some parts of it are newer, but the original part is around 115 or so years and they did this a few years ago. If you look at our seawall on Google earth and you go through the different time periods of aerial photographs you'll see like vegetation kind of taking over right there at the foot of the seawall and that is a green project, not a great project in terms of helping establish root systems and native grasses that will help keep sand from leaving the profile of the beach in terms of from either storm surges or high tides. We also have this issue of the... When the seawall itself was designed everything sheet flows off of that huge five land road [crosstalk 00:06:14], outfalls that then wash off the seawall into the beach.

Dustin:

So there's storm water erosion from that side. There's tide surge erosion on the other side and then even the prevailing winds for most of the year blow from the gulf inland over the Island and so we have a pretty... How would you say? Consistent issue of wind blown sand going up and over the seawall and over that asphalt road and then into our storm water

drains and gutters and that itself creates little dunes in our gutters and drains and makes it difficult for water to evacuate into the Bay. So that's a small, like low cost, low hanging fruit project but we're hoping to see better results on keeping that sand on the beach and out of our gutters.

Allyssa Gray:

Yeah. So I'll kind of let you know I was there in November so I definitely noticed that and have a documentation of that.

Dustin:

Oh, very cool.

Allyssa Gray:

So definitely good to know. Yeah, so I definitely traveled the entire Island. I was there for about four days. So I definitely know the areas that you're talking about and know the situation that you're talking about for sure.

Dustin:

Okay. Very cool.

Allyssa Gray:

Yeah.

Dustin:

Number two on design. I can go through all eight if you want probably since number one was pretty quick.

Allyssa Gray:

Yeah. If you have time, that's great. If not, just hit the ones that you know you want to talk about.

Dustin:

I don't know definitively if anybody has an answer for number two. I know number... So heavy storms like Ike and Harvey made people move to the mainland. I can say yes for Ike, I'm not so sure about Harvey.

Allyssa Gray:

I talked to Garrett and he definitely seemed like he's like, I can't really say much to Ike because I was extremely young at that point obviously. I didn't Work here at the time. I was like that's fair.

Dustin:

Well he's-

Allyssa Gray:

He just gave me some statistics.

Dustin:

Well, here's the funny small world thing. I was in grad school when Hurricane Ike hit and I... Actually, part of my research was on like taking school demographic data and identifying the loss of population and everything and so... Yeah, I actually did some research on that myself in grad school and it was definitely recognized with the decennial census in 2010 that there was a loss in population and those weren't casualties. So those people relocated off of Galveston Island elsewhere but we couldn't say definitively where on the mainland they moved, but they left the Island and has slowly been returning and then we... My research in grad school kind of pointed toward a disparaging... The distribution of people that left was more so socially vulnerable populations, lower-income minorities, single parent households, elderly and there were several hundred low income housing units that our housing authority had that were completely inundated and rendered uninhabitable.

Dustin:

So those 569 housing units were demolished and so they didn't really start substantially



rebuilding those until I think around 2013. So that's five years of being displaced, at least 569 households. So yeah. So Ike was much more of an impact. Harvey was kind of... It's one of those storms they talk about if emergency management people had played bets on where people would choose to evacuate to in a disaster. Nobody would bet money on evacuate to Galveston Island but Harvey was unique in that we were the only community in the region, in our entire County that was virtually unflooded.

Dustin:

We had the only civilian airport open between here and San Antonio. The only grocery store open in the County for a period of days because everybody else was flooded on the mainland and Galveston was high and dry. So I don't know if anybody's done any studying of if people have chosen to relocate to the mainland from Galveston after Harvey, but I mean I know some people coincidentally who lived in the Houston area and they had a second home here and now live here full time because their primary home and Harvey destroyed them in Houston or the Houston region. So it's kind of the opposite effect.

Allyssa Gray:

Yeah. Unexpected?

Dustin:

Yeah. Okay. So number three. My views on a coastal spine or movable Sea gate. So my answer to that is to watch. There's a great series of... Mini series on PBS about rising waters and cities and I forget the name of it, but I'm not an engineer and I won't be here in a hundred years but there was an episode... They did a series, I think it was on New York, Tokyo, London, and I forget what the fourth city is but it was the talk about the floodgates in London were the ones that really struck me because those are built on the Thames like in the '60s and early '70s and the engineers who designed that... The purpose of those Gates are to close when winter storms bring surge up the Thames which would flood the city and they even factored in, in their formulas for building it a prediction of how much those Gates would subside per year and it was like to the tune of a one point something millimeters a year.

Dustin:

And they're observing in recent years that subsidence is almost three times what they

predicted 50 years ago and another revelation was the Gates were designed to close and keep storm surge out, which they to this day continue to do but the unintended consequence is London in recent years has been experiencing massive intensive rainfall events, not unlike we had during Harvey and the problem is when those Gates are closed, the Thames can't empty out and so they're flooding from rainfall events that happen at the same time as storm surge. So the gates are keeping the storms surge out but they're keeping the rain water in and flooding London. So just from learning about that about London, I'm not convinced that great infrastructure is the ultimate solution. There needs to be other considerations then. So my views as a [crosstalk 00:13:44]. Oh, go ahead.

Allyssa Gray:

Did you say what... I can't remember if you said what PBS program that was.

Dustin:

Yeah. Give me just a second. I've got it saved on my phone actually.

Allyssa Gray:

Oh, perfect.

Dustin:

PBS. It's called Sinking Cities.

Allyssa Gray:

Sinking Cities.

Dustin:

You can get it at [pbs.org/show/sinking-cities](https://pbs.org/show/sinking-cities).

Allyssa Gray:

Perfect. That's actually-

Dustin:

I just found that [crosstalk 00:14:16], really amazing series and I point a lot of people to that. Like when they talk about... Like the community meeting I'm going to in about an hour, I bring that up to the engineers and again at another... Like I'm not an engineer but another concern I have is... And I don't know hydrology and such, but I have questions about like, well do water tables ever get affected by a storm surge and hurricanes and the low pressure systems?

Dustin:

Because we've got areas of town where the water table is very close to the surface and I have concerns about is that being factored into these designs of a coastal spine or ring levee. Like they're proposing a ring levee around our old part of Galveston and then a spine that connects to the end of the seawall and then a big floodgate in our ship channel to the East of the Island. That's what the army Corps is contemplating at this time. So we shall see. So that's my number three. Number four, how's the reimagine coastal protection for Galveston? Well I think I've kind of answered that.

Allyssa Gray:

[crosstalk 00:15:30], did. Definitely like-

Dustin:

[crosstalk 00:15:32], approach. I mean it's... But even a hybrid approach isn't necessarily any less expensive than a spray approach or just a green approach. Like there's costs associated with all of them but in some cases I think what communities ought to do to consider being successful is looking for those small low cost approaches. Like what our Park board is doing working with a nonprofit to plant little springs of vegetation that turned into big massive sand dunes and keep all that material from washing away or blowing over the seawall.

Dustin:

You know, that's the kind of low hanging fruit I think we ought to be striving for in many different ways all at once. So that's kind of my take on it is do both, but find a low hanging fruit. Don't always think massive floodgates and ring levees are going to solve your

problems when there could be other solutions, like don't let your landscapers blow all the leaves in the gutters and [crosstalk 00:16:41], and make your streets flood or stop throwing your trash out your car window and put it in the trash bin so that that doesn't block up the storm drains and stuff. Yeah.

Allyssa Gray:

Right.

Dustin:

Okay. So let's see, economics and if I'm going too fast or you want me to [crosstalk 00:17:02], let me know. After Hurricane Ike did rebuilding spark urban development? It's hard to say what sparked redevelopment in Galveston. I mean, I know there was a boost in redevelopment associated with community development block grant disaster recovery funds. There were... I don't know if I remember off the top of my head the grand total, but I think around 3000 homes, which is about 8% of our housing in Galveston was touched on with... That is 8,000 right? Because it's about 32,000 units. So anyways it was about 3000 units were either renovated and rehabbed and modernized or demolished and a new home was built that meets current flood code. Well current as of before our flood maps were adopted last year.

Dustin:

So that was a big boost because that's a significant number of homes that were renovated and those contractors were hired locally and they hired subcontractors that were locally. So that generated quite a bit of redevelopment and I can't really speak so much about private commercial non residential development, but I know kind of coinciding at the same time as Hurricane Ike was the burgeoning industry of short term housing rental and lots of the housing here was available, very inexpensive after Hurricane Ike with property values decreasing due to the economic recession and the natural disaster and it seems like... Anecdotally, I've lived here since 2010.

Dustin:

So I don't know how it was between 2008 and 2010 but my observation has been more often than not, you see housing being snatched up that was maybe in a state of disrepair for some time or a longterm rental unit that was just kind of in need of repair and would



be maybe purchased and a significant amount of money put into it and renovated into a rental unit and added to either individual or organizations pool of rental properties and so I've seen that be a significant element of redevelopment and so I don't know if you could attribute Hurricane Ike alone to that or the economic recession, but it was definitely I think both played part in housing being available on a barrier Island for a very... You know, for a very affordable units the prices that I don't think you could find anywhere else in the Gulf coast of Texas or Florida or Louisiana or Alabama.

Dustin:

Or was the rebuilding replacing what existed prior to the storm? That's also hard to say because Hurricane Ike again coincided with the recession and I know there were projects kind of in the pipeline and in the years leading up to Ike that never realized like multiple lot residential subdivisions that... Like one that comes to mind, they had built the roads and the infrastructure but they didn't start building houses and then the economy bottomed out under them and they sat empty for a while, but then somebody got a clever idea to use all that infrastructure and roads and turn it into an RV park resort. So you know, like... And I've seen several of those pop up here since I've lived here too.

Allyssa Gray:

[crosstalk 00:20:59], done by Jamaica beach area?

Dustin:

Well, that's one of them but there's I think three new, relatively big ones have opened up since I've lived here. The one you're talking about it's been there a while but it's also kind of double in size so and our tourism visitation... We had... I can get you the numbers. I don't have them off the top of my head but it was like around 4 million visitors before Hurricane Ike and that dropped immediately after Ike but by 2010 or 2011, we had rebounded to the number of tourists that have visited before the Hurricane and I don't know what the figures were for last year, but 2018, we had about 7.2 million and so that's almost four... Almost three and a half million more than we had before Hurricane Ike so.

Allyssa Gray:

Yeah, no. If you could get me those numbers that would be very helpful for reasoning as to why we should be doing what we're doing and things like that. So that would be great if I

could get that.

Dustin:

Yeah, that's pretty available data and so that factors into just the number for tourism, which is one of our main industries here. The number of heads in beds and the number of people dining at restaurants and spending money here that it just goes up and up and up as a result of the number of visitors. The raw numbers of visitors. Let's see, so number two about small businesses-

Allyssa Gray:

[crosstalk 00:22:45], talking to somebody about I think small businesses soon. I forget-

Dustin:

Oh, good.

Allyssa Gray:

... her name. She-

Dustin:

Gina Spagnola.

Allyssa Gray:

Yes. Thank you. Yes, I emailed her, so I'm waiting to hear back. So I'm really hoping that she'll be available to talk about all the small business stuff so.

Dustin:

I got you.

Allyssa Gray:

Yeah.

Dustin:

Yeah, I know a little less about that because with the exception of small business owners coming in to get permits and such or to verify... A lot of that was existing businesses that were already kind of grandfathered into rural, so they didn't really need to get like zoning approvals or anything but I... And you know, I could probably point to you to some of my colleagues who... I focused on housing recovery after Hurricane Ike here and some of my colleagues focused on like small business recovery. So I could try to put you in touch with them or find maybe something they've published.

Allyssa Gray:

Yeah.

Dustin:

I know it seems like there's less resources available for small business owners. Like there's-

Allyssa Gray:

Correct.

Dustin:

I mean, there's SBA loans, Small Business Administration, but even though they're loans. They're not forgivable or not just grants. They're... You know, here's a loan but you owe us eventually, but you know not even in taking into consideration devastating storms, but just like nuisance storms and like we've... I mean it's raining right now down here and if you exceed a certain number of inches per hour our streets are underwater and in our downtown side of Galveston that could be enough of a level of water where it starts affecting your storefronts and businesses and so those aren't even named tropical storms. They're just a [crosstalk 00:24:50], storm and it happens to coincide with high tide and parts of our stormwater infrastructure are now tidally influenced from high tide levels.

Dustin:

You know, water going into the storm water drains from below and so if the conditions are right and you get just enough inches of rain per hour and a high tide coming in not going out then we could have streets under water and businesses flood and I think like it happened even just last year or maybe it was two years ago, like back to back within weeks just businesses getting flooded and if it's not a declared disaster, there's no SBA loan and you know. So I don't think there's an SBA loan if that's not a declared disaster. Don't quote me on that. So like it gets... For I think devastating storms in some cases might open up more opportunities for funding than just small day to day nuisance flooding. There was a good study about street flooding in Annapolis, Maryland recently and they quantified like how many economic dollars are lost for every inch of rain on the streets.

Allyssa Gray:

Okay.

Dustin:

It's a really cool study. As Galveston's growing, you're seeing more commercial or residential? It's hard to say. I don't feel like we've seen a significant amount of either in terms of growth [crosstalk 00:26:28], redevelopment of commercial. Like there's not major... We don't have like new major employment sectors that have opened up or chosen to locate here. Just a lot of redevelopment of either old businesses or vacant buildings that are being repurposed and residential, we are seeing more development but not, I would say for primary household it seems a lot more focused on people buying a property to build second homes for either their own use or for rental.

Allyssa Gray:

Yup. Garrett said the same thing so.

Dustin:

Yeah. You see a little bit of infill housing development, which is intended for... And again, even infill in existing neighborhoods, it seems like a lot of it gets bought up for short term rental so. I would hazard to guess we're not too far off a trend but like you've seen in New Orleans or on the islands of Hawaii where... I mean even in the 2010 census, I want to say it was... Was it 12% of our housing was vacant but not available for rent or anything else?



Allyssa Gray:

Right. Crazy.

Dustin:

So I think that number is only going to turn up with the census this year and so that... Yeah, but not like you're not seeing what you would say quote unquote traditional primary housing residential developments popping up left or right as much. Occasionally some town homes are a vinyl department building and renovated into [crosstalk 00:28:22], and then your last question. Storm surge and flooding changed the economy of Galveston? I don't think that has been yet determined.

Allyssa Gray:

Okay.

Dustin:

I mean, if you look at our community historically you know we were a very major factor in the state and regional economy before the 1900 hurricane. We were referred to as the wall street of the West and there was lots of wealth and business development here and that storm really changed the narrative of the economy of this community and region and had a more or less permanent effect on it. You know like back then Galveston was bigger than Houston and now Houston is the fourth largest city in the country. So it's hard to say what the trajectory would have been if there wasn't a big storm like the 1900 hurricane. If the development in Houston would have just stayed here and kind of grown outward or what. But you know that our population never surpassed... As far as I remember right. I don't think our population ever suppressed Houston again after that and then Houston is what it is now.

Allyssa Gray:

Right.

Dustin:

So I know that storm definitely had changed our economy and decisions are made by

industries and business owners to relocate them. I don't know if it has so much now-

Allyssa Gray:

Like more recently. Yeah.

Dustin:

Yeah, and I think because there's been in the past century, just a trend away from the traditional industries of a century before and more into service based tourism supporting economy and that is a little more resilient in terms of services and such I think are easier to relocate and reopen after a disaster than like a textile factory or something.

Allyssa Gray:

Yeah.

Dustin:

So in my wishful thinking and dream world for Galveston as you know we have an academic medical institution here. We've got a very active port for departure for cruises and a very booming hospitality industry with regard to traditional hotels and motels and short term rental units and I wish we could rebrand this place to be a destination for like outpatient care services and stuff. Like a place where you can vacation and take your cruise while you're recovering from a procedure at the hospital or something and kind of support those intangible service industries much more than trying to like bring another plant or something down here to [crosstalk 00:31:32], but that's my own personal observation about the city you know.

Allyssa Gray:

Right.

Dustin:

If you quote me, that's just me as an individual.

Allyssa Gray:

No, yeah. No. I totally understand.

Dustin:

Yeah.

Allyssa Gray:

Yeah, it makes sense. So I mean, I can totally see that and it seems like they're definitely wanting to continue to grow all of those industries as well. So definitely get that from the comprehensive plan from 2011. Yeah. Well, so technically that concludes our interview. You know, I just want to thank you for actually answering all aches. I know it can be hard and the time spans and sometimes it's just a lot of questions to go through so I really appreciate you taking the time to answer all of them.

Dustin:

Yeah, of course.

Allyssa Gray:

Yeah. All right, well, thank you so much.

Dustin:

Not a problem. Yeah, thanks for the call.

Allyssa Gray:

Of course. Have a good evening.

Dustin:

You too. Bye.

Allyssa Gray:

Thank you. Bye.

Page Break

## Garret McLeod: Economic Development Coordinator for the City of Galveston

Speaker 1:

Good morning, I hope you are having a good day. I'm just going to get formal for a second just because of all the recordings and the legalities that I have to go through. I am starting our recording and the beginning of our questions for my interview. I went ahead and sent you the list and you said you would be okay with going with question number two out of the designer section. Have storms like Ike and Harvey made people move to the mainland?

Speaker 2:

I think ... Ike definitely did. Especially on the public housing side, the city of Galveston had a significant amount of public housing and a lot of that was lost and is still being built back to this day. We have a mandated agreement with HUD and the Texas General Land Office to continue to replace a certain amount of rooftops. And Harvey didn't really affect Galveston so much. Galveston actually, was the only regional airport that was not underwater. And so the Coast Guard and the US army was using this as a base to fly people in and out.

Speaker 2:

Harvey affected the Houston suburbs, especially North Galveston County, that being League City, Friendswood, Dickinson, really got hit hard. And I can see it as an economic developer. It's funny, we had a regional meeting with the greater Houston partnership to talk about the regional economy and how Houston needs to continue to try to rebrand itself because you see those videos of Harvey and the devastation and just I10 and I45 and the 60 loop all being under water and no one wants to touch that. And I think we've seen it where ... Our partners in Houston have definitely seen it where headquarters were starting to move either to the North side in the Woodlands area or they're expanding their operations in Dallas or Best Petroleum was another prime example. They had a big campus on the West side of Houston going towards Katy and they have since whittled away at that, they still own the property but they've expanded their population up in their Denver office.

Speaker 2:

We're seeing those effects. Now, don't get me wrong, downtown Houston's doing fantastic. Harvey has had a lasting impact I think, on the greater Houston area as a whole. And it has caused some people to really rethink about where they buy because I know before people will buy houses in this area and you can see, we have a network of bayous and that's how we drain to the Gulf. No one really thought about, "Oh, okay. I should probably check what flood zone I'm in ever before."

Speaker 2:

But now that's actually becoming a priority whenever people are buying houses. It's changed the perspective I think, of potential homeowners in Houston as well.

Speaker 1:

What I know, from my understanding because I do have a family member that is in Harvey or in Dickinson and he had the Texas Harvey but what was it like with Ike and people? Did they tend to move? Did you see a change when Ike hit with people moving off the island at all?

Speaker 2:

Yeah, I did. Actually I was ... Ike hit in 2008. I was a sophomore and I actually grew up in Texas City, just randomly. I was here, I was in high school and we immediately ... Of course, GISD did not bounce back quick. We had kids from Galveston school district in Texas City, Friendswood, Dickinson, La Marque, all sprinkled around. I don't think there was a significant transfer population in general. I think that... Obviously there was the loss, of folks on the West end but the West end ... There's not a lot of primary residents out there. There's a lot of second homes, people that live in Dallas or Houston at beach houses.

Speaker 2:

The biggest population loss, like I said before, is with the low income. North of Broadway, that being ... North of Broadway, West of 25th, East of 54th, that area. And you can see the lasting ... You can get on Google maps and still see that we have a decent amount of vacant parcels over there that were demolished and never brought back. And then there's a big parcel where a housing unit was at 51st and we call it Oleander Homes. We're actually working with a company right now to bring that housing back, so they're moving forward with that but yeah, that was ... As far as population loss from Ike, the biggest was with the low to moderate income folks that were here. And we have a long waiting list of people that do have the desire to come back to Galveston but either they can't afford to or we just don't have the housing options yet. And I know we have give or take 250 rooftops we still have to bring back but we're moving along pretty quick on that now.

Speaker 1:

That's awesome. Okay. We've come to the economics section and I'm going to start with question number two actually. After devastating storms, is it more common for small business owners to remain closed or do they typically reopen?



Speaker 2:

I hate to ... I really cannot stand saying this but it really is a case by case basis. There was a lot that did reopen after Ike and I even saw it in Harvey. I've lived on the mainland my whole life. I actually ... I live in Houston now, so we do see a lot that come back. There are some of those folks that either did not have flood insurance or don't have windstorm, that maybe were in a small business that was not making a lot of profit. And so they just got to the point that they were like, "There's no way we can open."

Speaker 2:

I can give you a good example of that, that we saw on the Island after Ike. We had a series of neighborhood grocery stores, what you'd expect in 1950s America. They're walkable, easy access. They were not huge footprints but they were family owned, fresh food, the whole lot. And I think the market shifting affected it too but we had several of those that closed in Galveston after Ike, that they just could not afford to build back. And as you know, I'm sure, that the grocery business is tough as is. It doesn't make a profit but I think them getting hit with the flood water, that really just knocked them over the edge.

Speaker 2:

And that's something that we've struggled to come back from, especially in the North Broadway neighborhood. That's our heaviest concentration of low to mod income. And they're really missing those neighborhood grocery stores because we're a tourist town, so of course the grocery stores are going to locate in the areas with the highest traffic counts, that being Seawall on 61st and so that's ... It's really tough for them to get access to those grocery stores if they're not using public transit. You can't simply walk to those.

Speaker 2:

That's something that we saw. As far as other small businesses, The Strand, our historic downtown always does really well. And that's a concentration of small businesses. A lot were brought back. We did lose some down there but I think as a state, we've come a long way from Ike as far as business recovery. I know I saw it after Harvey. We had this program you may or may not be familiar with. Through the General Land Office but it was authorized from Congress and it's called Texas Back In Business. And it's a grant program for Texas small business owners and it's the ... I think the range is from 50,000 to 250,000.

Don't have to repay it. It is a 100% grant. Houston area gets affected pretty heavily with just floods in general but it may not make the news.

Speaker 2:

I think that the constant threat of disaster flooding hitting small businesses, it's caused this regional economy in the state to be a little bit more creative on how to help small businesses because it's those guys and ... You lose a lot of character in your downtown and things like that.

Speaker 1:

Yeah, definitely. No, I think that's awesome that you aren't seeing the opposite but yeah, I definitely realized when I was down there, there wasn't any small grocery stores, just reflecting on my time there. I made sure to walk around almost every place that I could.

Speaker 2:

Yeah, yeah. No, that's something that we're trying to hit on right now. [inaudible 00:11:18] makes the most sense because it's a [crosstalk 00:11:21] point and it's not a big footprint and land's as good as gold here for us. We obviously don't have a lot of it. That's who we're trying to make a push for, is to see something like [inaudible 00:11:35] or someone like that maybe push themselves into central Galveston Island to help out our residents.

Speaker 1:

Awesome. You're leading into question three. As the Island is growing, are you seeing more commercial development or are you seeing more residential? And if it is more commercial, what kinds of businesses are coming and where are they wanting to be located?

Speaker 2:

I can touch on both. As of right now, I think we're seeing more residential and that's ... Especially in the grid, it's surprising. Well, it's not surprising because it's the most easily accessible and the easiest to get around but we're seeing a lot of investment in central Galveston on rehabbing these smaller bungalows and a lot of it that I've been able to track down, are folks from Houston that are buying up homes down here, fixing them up with

the intention of coming down a couple of times a year and then B&B'ing out the rest of the year. And then, we've had a decent amount that actually, once they retire they move down here and make it the primary home but B&Bs, just as a side note, it's about 30 to 33% of our total housing stock, is short term rentals now, We're getting [crosstalk 00:13:15].

Speaker 1:

Oh, okay.

Speaker 2:

Yes, it's [inaudible 00:13:16]. Yeah, we're pretty comparable to some municipalities in Florida and ...

Speaker 1:

I knew it would be a lot but I wasn't sure, yeah. Percentage. That's a ... Nice to hear some numbers.

Speaker 2:

Yes. And we have a lot of special events. I'm sure you can see, with Mardi Gras [crosstalk 00:13:42] and biker rally and that actually ... It creates unique problems as well because our residents, they understand they live in a tourist town but they also want to be able to go back home and enjoy the calmness and get away from all that but with the prevalence of B&Bs that we have, then you're getting motorcycles in neighborhoods now and doing a special event. We've got to figure out how we can get creative on prioritizing our residents as well.

Speaker 2:

Especially [inaudible 00:14:19] and brings a lot of money to the city but you have to take care of your taxpayers as well. That's something interesting but yeah, residential right now is going gangbusters. Commercial is doing well, it's weird. It ebbs and flows. I've been with the city coming up on two years because I've only been out of grad school for three and when I first got here, commercial development was hot and heavy and now a lot of it's rehab, in rehabbing old buildings or they're changing up the space in downtown because simply, like I said, we don't have a lot of available land left but any new commercial

development that's going in or ...

Speaker 2:

We're having some growth West of downtown. West of 25th street along Market street, the city invested some sales tax dollars to brand the street scape, widen the road, make it more walkable. And we've seen investment there along that and small business. And then also, we have a gentleman that invested millions into this old brewery that has sat vacant since. I think mid eighties. I think '85. Huge structure and it's really bizarre. It had been built in three or four phases over the course of 60 years. You can only imagine how strange this thing is. The East [inaudible 00:16:02] money into it and made it ... The first phase to get it permitted as an event space. Really cool venue upstairs where you can get the whole view of the Island. And then the second part that he's working on right now, is the hotel. That's West of 25th, been the West market area and that's classified as North of Broadway to us. We're seeing some significant investment as far as commercial there.

Speaker 2:

And then the port obviously, is really ... Since they've moved in the cruise direction and we have so many ... I think we hit ... Annually, we're right over a million cruise passengers. I think we're 1.1 million annual cruise passengers and we're at over 7 million annual visitors. There's a lot of investment. Royal Caribbean, you can see it online, sign an agreement to build and increase terminals. We're working with them on that right now to fund project but then you can even check online if you're curious. The Port of Galveston released their master plan I think formally in December but ...

Speaker 1:

Oh, okay. I did not know that.

Speaker 2:

Yeah, I'd be more than happy to send you that link but it's a lot. It's a lot of information but it shows you where they want to move towards and really shift the Eastern side of the port to make it more entertainment based, cruise based, whatnot. There's a decent amount of commercial investment there. Definitely ...

Speaker 1:

Is that more along the Bolivar Peninsula then? Is that what they're wanting to focus? Or is it still in the Galveston area?

Speaker 2:

Yeah, still in Galveston.

Speaker 1:

Okay.

Speaker 2:

Let me pull up a map just to get a specific street. Right from 20, 25th all the way down to about 11th street, where these B&Bs starts, that whole section, they had the idea of shifting that all to cruise and entertainment style and we have had some more investment along pier 21 and 20th street. There's some new businesses, commercial businesses that have popped up. And then we're really going ... What's going gangbusters right now for us, is along 40th street, we have a pier that unloads wind turbines and we simply do not have the room to store them, there's been so much coming in.

Speaker 2:

The port is working with us right now to expand some storage, lay down yard space along Harbor side. They're doing really well with that, with cargo. That's caused a lot of investment. And I think another thing that we have on our horizon right now, is Pelican Island. It's a unique monster. There's 1100 acres over there that is owned by the Port of Houston, not the port of Galveston.

Speaker 1:

Oh, interesting. Okay.

Speaker 2:

Yeah. It makes for some unique issues and relationships for sure but the biggest thing right now ... I field calls for Pelican Island quite a bit. The issue, there's two, is utility. We

don't have water and sewer over there and Galveston has their own plant that takes care of the campus and then the Pelican Island bridge. And that's a drawbridge that TxDOT has pretty much mandated that needs to be replaced and they put up money and then our metropolitan planning organizations has now put up the money and so the city and the County and the Port of Houston are participating as well. We're trying to get that ball moving forward because that's the last big chunk of land that we have, that's zone heavy industrial.

Speaker 1:

Yeah, [crosstalk 00:20:32] definitely.

Speaker 2:

Yeah, that's what we're looking for in the next 10 years.

Speaker 1:

Okay. Pretty soon. Okay.

Speaker 2:

Definitely. Oh yeah, definitely. We have a feeling that Port of Houston is probably going to keep part of that land for a cargo operation to expand. Obviously they have a huge, huge operation up in Bay Port and then obviously up in Buffalo bayou and so ... But that area makes sense because it's so close to the Gulf.

Speaker 1:

Right. Definitely does. Perfect. Okay. And then do you have the list of questions in front of you?

Speaker 2:

Yes ma'am.

Speaker 1:



Okay. Would you rather talk about number one or four?

Speaker 2:

See here. [inaudible 00:21:27]. Can handle number four.

Speaker 1:

I had a ... Yeah, I had that gut feeling because I ... Knowing where you were during that ... The age.

Speaker 2:

Yes ma'am. Yeah. Storm surge and flooding changed the economy. Just to give you an idea of what we're really about. Healthcare education, port operations and tourism are really our three biggest pieces to our economy.

Speaker 1:

Okay.

Speaker 2:

Traditionally, it was ... Probably the port used to be the biggest historically but now UTMBs made a significant investment in rehabilitating their operation down here. They got hit pretty hard in Ike and our folks were scared that they were just going to pull up and then head to the mainland but they've continued to invest money in their campus and then now we're actually getting small companies that are being born out of UTMB to ... They need incubator space and we're starting to create some for them but it's a lot of biotech focused so that's getting bigger.

Speaker 2:

Obviously tourism is the biggest for us. And so the storm surge and flooding, I wouldn't say it has changed the economy. Tourism I think, is always going to be our biggest money maker and biggest concentration. I see it every day as economic development based on what projects and who calls me. Is it promoting growth or preventing growth? I think it's promoting it but it's causing people to get a little bit more creative and also to pay more

attention on how they construct their commercial operations.

Speaker 1:

Good. That's really good to hear.

Speaker 2:

Yeah. There's two big operations that ... Or two big projects that I'm working on that are on the East end and obviously there's no ... Well, there's not really a Seawall to protect these two developments. And so we're going back and forth on the design for them and obviously we have to work with the Corps quite a bit on these. And so that is nice. We have a pretty good communication with the army Corps now and to work with them. I think we're getting ... I'm trying to think about how to phrase it.

Speaker 2:

We're getting developers that are willing to come in and modify their projects in order to make them fit Galveston and to fit ... In order to be more resilient as far as storm protection goes. Before, it seemed like we were ... And this is years and years and years ago. Galveston was really just settling on what came and that's great and we'll bend over backwards to help you out. And just go with it. They were just satisfied that they were getting investment in general but now we have so much investment that that we can pick and choose and really get creative on how we want things to come in and how it fits with the Island. That's nice. It's been a good shift. And we have backing from our elected officials pretty heavily on council for these types of things because I think everyone understands that it really comes down to resiliency. And it's never ... These issues are never going to go away.

Speaker 1:

Correct. Yeah. Well, perfect. Really, thank you for taking the time. And this concludes our interview officially. I do just have off ... These types of questions. Do you have any other people that you might suggest I talk to because I'm talking to ... Let me open my email up real quick. Next week I believe I'm talking to Dustin Henry but I just didn't know if you had any other thoughts of maybe who I could contact. I ask some of these questions too as well, whether that's more of the economy side or more on the design side.

Speaker 2:

Yeah. Dustin's a good resource. It's funny, he's right on the other side of my wall. Love Dustin. He's a good guy. He's a good Aggie, just like I am. He'll be a good resource for you. I think if you're talking to Dustin ... Tim [Teegens 00:26:57], our director of planning, is an excellent resource. He's a unique guy. He grew up in Iowa and moved straight from Iowa to the Houston area after graduating college and worked in Pasadena, La Porte and then now here in Galveston. He's been in Houston for a while, since '88, so he is seeing the region and how it's changed and then also how the different natural disaster events has affected Houston. And he's also got that unique perspective because Pasadena Port are very heavy, heavy industrial petrochemical operations up there. He's a good resource.

Speaker 1:

Okay.

Speaker 2:

What I plan on doing after we get off this, I'll send you the link for the Port Nashville plan just for your information. Then I'll send you his contact information.

Speaker 1:

Oh, that'd be great. Thank you.

Speaker 2:

How many people are you trying to interview?

Speaker 1:

Ideally, I would like to have four or five. And so [inaudible 00:28:03] really only have you two. What I'm running into is all these people that I could talk to are people that I've read. I've read a lot of their articles. I've read a lot of their thoughts and a lot of their opinions, so I know where they're going to stand. And so I'm struggling with finding people that maybe aren't the published authors from Texas A&M at Galveston from [inaudible 00:28:32] departments.

Speaker 2:

Yeah.

Speaker 1:

Specifically because they have so many different papers published. I'm just trying to find people outside of that realm to get different perspectives. That's what I'm aiming for.

Speaker 2:

Okay. Another one, especially for the small business aspect, our chamber director, she's been in Galveston since the 90s.

Speaker 1:

Okay.

Speaker 2:

I can send you her contact info and when I do this, I'll also send them a note just to tell them, "Hey, heads up, expect to get this email."

Speaker 1:

Okay, perfect.

Speaker 2:

She's a good resource for small business resiliency.

Speaker 1:

Okay.

Speaker 2:

And she's seen the shift of Galveston's economy. She can give you some unique

perspectives on how that's changed. And then also she ... I know when Ike set in, she was a big participant in trying to do small business outreach and figuring out, "What do you need, how can we help you?"

Speaker 2:

And helping with that as well. Gina Spagnola, she'll be a good resource. I have a good relationship with her. We work together a lot. Let's see here. Trying to think. Would one of our elected officials help?

Speaker 1:

Because I'm restricted to these questions, I can't stray from them so they would have to be able to answer some of these questions that are on here. [inaudible 00:30:28] ask all of them. It can be two questions out of this, if you know anybody that could, but legally I can't use any of the interviewing information that is not listed on this. It's really restrictive.

Speaker 2:

Yeah. No, no, not a problem. Do you mind if I take these questions and send it to one of our counselors?

Speaker 1:

No, no. Definitely not. If you think that that would help them and if they can come back and say yes or no, that would be fine. I do not mind that at all.

Speaker 2:

Okay. Yeah, let me do that. There's one of our council members that ... He's been involved in. Let's see ... He's been involved with our park board, which is our tourism marketing [inaudible 00:31:11]. He's also involved with the port. He sits on the wars board now and then he's a council member as well and his wife actually sits on the housing authority.

Speaker 1:

Okay, great.

Speaker 2:

He's pretty, pretty broad. Yeah, let me send these to him.

Speaker 1:

Okay.

Speaker 2:

And if he can ... He's always ... He's more than willing to do these types of things, so I'll rope him in as well and see if I can get that but yeah, definitely that'll give you a good perspective. I think Tim also, from an urban planning ...

Speaker 1:

Yeah.

Speaker 2:

It would be good for you but yeah, let me get those folks in. I'll send those emails out and then I'll get confirmation for you for our council members as well.

Speaker 1:

Okay. That sounds great. Well, thank you so much for all your help and potential people that I can reach out to. That's going to be really, really helpful for me and I definitely appreciate you taking the time to talk with me today.

Speaker 2:

Oh, not a problem. It was enjoyable. I definitely love this kind of stuff. I was an environmental studies undergrad.

Speaker 1:

Oh, okay. You have some knowledge [crosstalk 00:32:25].



Speaker 2:

Oh, yeah. Absolutely.

Speaker 1:

That's good.

Speaker 2:

These things are good and in any way that I can help out for sure. I know I had folks that I had to call whenever I was going through my MPA program and I can appreciate it for sure but yeah. Any way I can help, feel free to send me an email or give me a ring ... Anything but yeah, in the meantime, I'll hit that.

Speaker 1:

Perfect. All right. Well, thank you so much. Look forward to talking to you some more in the future.

Speaker 2:

Awesome. You have a good one. Thank you.

Speaker 1:

Thank you. You too. Bye. Bye.

Page Break

Tim Tietjens

Allyssa Gray:

How are you doing?

Tim:

Say it one more time.

Allyssa Gray:

Hi, this is Allyssa gray. How are you doing?

Tim:

Hi Allyssa. You cut out there for a minute.

Allyssa Gray:

Oh, sorry about that.

Tim:

No problem.

Tim:

Yes, doing good. How about you?

Allyssa Gray:

I'm doing well. Excited that this is happening. I'm glad that I got some good leads from some of the others. So, thank you for taking the time to talk to me today.

Tim:

Oh my pleasure.

Allyssa Gray:

All right, so-

Tim:

I didn't have the time to get into the questions-

Allyssa Gray:

That's fine.

Tim:

... much, but just fire away and I'll help with whatever I can.

Allyssa Gray:

Okay, that sounds great. So I will let you know I am recording the call just so I can be completely here during the conversation, so I don't have to write stuff down as you talk. So, just letting you know about that.

Tim:

Sure.

Allyssa Gray:

So you are the city planner, correct?

Tim:

I'm the director of development services-

Allyssa Gray:

Okay.

Tim:

Yes, basically our department has the planning, the coastal resources, the permit and building inspections-

Allyssa Gray:

Okay.

Tim:

... divisions, and economic development as well.

Allyssa Gray:

Awesome. Okay. So that'll kind of help me guide through some of these questions. So you have a little bit of knowledge. I have the questions broken up into two sections, more of the design standpoint, more of the economics.

Tim:

Okay.

Allyssa Gray:

So I think I'm going to pull a couple of questions from the design and a couple from economics. And how much time do you have? Because I typically just allot the 30 minutes. So-

Tim:

I think I could do 30 minutes.

Allyssa Gray:

Okay, perfect.

Tim:

Yes.

Allyssa Gray:

Just wanting to double check. Okay-

Tim:

Okay.

Allyssa Gray:

Let me see... okay. So I'm going to start with number four. I don't know if you have the questions in front of you? Number four underneath designers. So I will ask, if you were to reimagine coastal protection for Galveston Island, would you include great infrastructure like jetties and seawalls, or a hybrid approach like sills and groins, or more green infrastructure with wetlands and dunes? Or do you have any other types of infrastructure in mind?

Tim:

Well, so in Galveston we've got history.

Allyssa Gray:

Right.

Tim:

And I understand the context of your question is if we were just to start into human occupation of the Island from scratch, I think ideally it would be more of a green approach. However, as you well may know, the 1900 hurricane-

Allyssa Gray:

Oh yes.

Tim:

... that hit Galveston Island is the deadliest natural disaster ever to hit the US.

Allyssa Gray:

Correct.

Tim:

And we had almost 8,000 people that went unaccounted for, and it was very horrific.

Tim:

So when they built the seawall then, in phases over the next 15 or so years-

Allyssa Gray:

Mm-hmm (affirmative).

Tim:

... they did so with the intent of protecting the Island, because at that point in time, Galveston was kind of, Texas big city, and it was a port city and it was very important to connection between inland Texas to other areas outside of Texas, and Gulf coast and other parts of the world.

Tim:

So, they invested all that amount of money in obviously gray infrastructure, a solution that was no doubt man-made, and undeniably a solution that one really impacts the ability of the Island to respond with that physical improvement.

Allyssa Gray:

Right.

Tim:

But yes, I think... on our beaches, we have some accreting beach, we have some eroding beach, and it depends on where you are as to what it's doing. We also have all the jetties that go out [crosstalk 00:05:10], and it's arguable if they really, I guess help, during a



storm. But they almost certainly collect sand, and cause sand to deposit as it moves across the Island.

Tim:

I think we... probably a combination, to be honest.

Allyssa Gray:

Yes.

Tim:

I think we would go toward things that, whether they're jetties or not, but things that would try to retain the amount of sand. Because in the middle part of the Island is where we're having the most erosion. And at the ends of the Island, both ends is where we're having the accretion.

Tim:

So, it hits the Island and sort of moves its way toward the end. And, especially the North end of the Island, there's been a lot of accretion.

Allyssa Gray:

And that's East beach correct?

Tim:

Yes, that's East Beach.

Allyssa Gray:

Okay.

Tim:

Exactly. The North and or East. We're sort of at that 45 degree angle.

Allyssa Gray:

Yes.

Tim:

So, but yes, that's exactly right. I think there's a lot of accretion that's occurred-

Allyssa Gray:

Yes.

Tim:

... and the entire seawall and its composition, is well back from what is now the beach, upland and otherwise.

Allyssa Gray:

Mm-hmm (affirmative) Nice. So, with the coastal projects, that's kind of being suggested, what are your views of the coastal spine and the sea gates, and do you believe that's a solution that could be sustainable for a hundred years?

Tim:

I don't know that it would be sustainable for a hundred years. It's my understanding that the horizon for it, the time that it was... maybe its design life would be somewhat less than that. Although that went back and forth.

Tim:

The downside to a man-made structure like that, that includes movable parts and metal, and... a sea wall is one thing. You can really build some longevity into something like that. But when you start talking about collapsible, closable gates, there's less longevity to it. Although I think it would be effective for most of the storms.

Allyssa Gray:

Mm-hmm (affirmative).

Tim:

I think when they were looking at that concept, I think they were thinking of something that would protect against some of the most severe storms during Ike, for example, I know the Island was close to 13 feet of wave action-

Allyssa Gray:

Right.

Tim:

And 13 feet above sea level. And the worst conceivable storm, at least at this time is sort of that category five-

Allyssa Gray:

Mm-hmm (affirmative).

Tim:

... potentially up to 25 foot surge. Well, if you have a 25 foot surge, those gates wouldn't have... it would overtop them. And then what do you do? And then you are actually withholding water from getting out-

Allyssa Gray:

Right.

Tim:

... with the rest of the seawall that's a land feature. Obviously they'd have the gates open, but... We really saw that during hurricane Harvey, because while it was a hugely tremendous rain event. As it sort of came across and went across the Island, and up into the Houston area, all the rain had dumped on us. We're an Island, it doesn't have too far

to go, each [crosstalk 00:09:46] before it sheds off the Island.

Tim:

And so we actually did relatively well. It was the inland portions of the communities that really did so bad, because it had to find its way [crosstalk 00:09:47], and because of that... while we had rain events while it was coming in, and it shed itself pretty easy. What ended up happening was that huge amount of water that had to make its way to the coast did so in Galveston Bay.

Tim:

And then the entire Bay rose, and it hit us a day and a half after the storm when things were sunny and bright and beautiful. And all of a sudden they're in the Strand and historic district where our wharfs and all that are-

Allyssa Gray:

Mm-hmm (affirmative).

Tim:

... most of the downtown businesses that the water was lapping at their door thresholds.

Allyssa Gray:

Okay.

Tim:

And so for us it's a little different than it might... the solutions might be different... I'm kind of talking a lot of rambling there, but-

Allyssa Gray:

No, it makes sense.

Tim:

Oh. What I'm getting at is, for us, the issues are considerably different than they are for the inland issues.

Allyssa Gray:

Right.

Tim:

So, obviously on the one side, if there were some kind of structural system, it would disproportionately be placed on Galveston. I mean, we would be where that exists, or at least good portions of it exist, and we would be the gateway to keeping the entire region safe.

Allyssa Gray:

Right.

Tim:

And believe me, I understand the risks of that. I used to work for some of the cities in the Eastern part of Harris County, Houston, where I saw the model that would... if we would have had the worst elevation storm with a storm surge that would've hit 25 feet.

Tim:

We would have had several hundred of those tanks floating, and it would have been obviously just a horrible economic catastrophe-

Allyssa Gray:

Mm-hmm (affirmative).

Tim:

... a horrible environmental catastrophe. And it would've probably taken years to clean-up, and who knows how long the Houston Ship Channel would have had to have been closed.

And we've had events before where the Houston Ship Channel was closed because of a boating accident, a freighter or a barge or what have you, having some kind of accident, and they shut down the Houston Ship Channel. And it literally costs business and industry there in the multi, multi millions each day.

Tim:

So, I could not imagine if we would have months long environmental clean-up efforts, that would really radiate to not only that region, but the entire Houston area and all of Texas, and in fact all of the US.

Allyssa Gray:

Yes, exactly.

Tim:

Because we produce 40% of the petrochemical refining capability. And, so if we sneeze here in the Houston area, the whole country gets a cold.

Allyssa Gray:

Right.

Tim:

But not only that, but we've got 70% of the capability of jet fuel, military grade fuel. So, the potential impact on our military is just enormous.

Tim:

So that ultimately was the reason why there's political will. And a lot of folks out there saying, "This is important, it needs to be done."

Tim:

And so, the thought is, obviously, there's industrial, commercial and residential components down here on the Island. But the further you get up into the Galveston Bay



area and then in fact into the Houston Ship Channel where there's just miles and miles of industrial capacity-

Allyssa Gray:

Mm-hmm (affirmative).

Tim:

... it really becomes evident that such a catastrophe would be just devastating to everybody. And so, we understand the notion of having this thing protect the region. We understand the importance of, even being on the Island. And, there were other options that were thrown out about doing an upper Bay sort of alternative. And all those things are worth exploring.

Tim:

And again, I'm kind of continuing to ramble about this issue, but from the standpoint of where the army Corps of engineers settled, and what they're recommending, it is a little bit more the natural option-

Allyssa Gray:

Mm-hmm (affirmative).

Tim:

a little more of the, I guess non-structural, well it's still structural, but it's just not-

Allyssa Gray:

Right.

Tim:

... gray infrastructure, it's green infrastructure.

Allyssa Gray:

Yes. So it's a good mix.

Tim:

You've heard about where they landed on it, right?

Allyssa Gray:

Not necessarily where they've landed. I've just known, and I've been reading some things of like, it's given the nod from the Army Corps of Engineers, but I haven't been able to find anything more recently about it.

Tim:

Well, they're really basically suggesting that several hundred feet of dredge be deposited with a series of extended beach and dune breakwater solutions. Things that might've naturally happened in front of a landmass. Almost like barrier islands affects in and of themselves.

Allyssa Gray:

Right. Now, do you know if those breakwaters are going to be offshore?

Tim:

I don't exactly know, because I think there's still a good deal of fluidity in it there.

Allyssa Gray:

Yes.

Tim:

I know they had a series of recent public hearings just last week-

Allyssa Gray:

I know, I was told by, I think Dustin Henry, and I tried to see if I could get some information about it, but they're like, "Well, it's an open house." So I was like, "Well, I live in Kansas. So, I can't come down for that."

Tim:

Yes. I think they put out some material to look at.

Allyssa Gray:

Okay, I'll double check for that.

Tim:

Yes, you might want to maybe double check back with them. But yes, that component has some good aspects to it, certainly-

Allyssa Gray:

Right.

Tim:

... enhancing the beaches and the dunes is always a good thing, because we lost a great deal of our dune system during Ike.

Allyssa Gray:

Correct.

Tim:

And that was a problem. Some of it's built back up-

Allyssa Gray:

Mm-hmm (affirmative).

Tim:

... but, who knows when the next... we could get a storm next year or whatever. So there's always that risk.

Allyssa Gray:

Yes, there is. So kind of going off of talking about storm surge and how it affects the economy, I know you talked about more of the projective styles and a little bit of the past, but what specifically... how has storm surge and the flooding changed the economy of Galveston? Has it prevented growth or has it kind of promoted it?

Tim:

I think it's had the effect of preventing to some degree, or at least minimizing the population growth. We actually had a good number of folks leave the area, leave the Island after Ike.

Allyssa Gray:

Mm-hmm (affirmative).

Tim:

And not only because of risk, but at the time I think there was a fairly good amount of debate from the powers that be, at that point in time, with how we rebuild, and what we allow to rebuild and what we facilitate, be rebuilt.

Tim:

I know that there was a group of folks who I think ran on a platform that, let's not bring back some of that affordable housing or subsidized housing that we had.

Allyssa Gray:

Mm-hmm (affirmative).

Tim:

And so, there was an impact on the social justice end of things, with who came back and who felt they could come back.

Allyssa Gray:

Right.

Tim:

I mean, if you are of limited means, and that housing has been washed away, finding it physically is one thing, and that's a problem, a problem in and of itself. But then, sort of knowing that there's that perspective out there that you're not wanted back, was, I'm sure, troubling.

Allyssa Gray:

Yes.

Tim:

And so there were a number of people who didn't come back and ended up locating elsewhere. So, as a whole, the population, we've... I think pretty well regained what we've lost in terms of numbers. But I think the Island is different.

Allyssa Gray:

Mm-hmm (affirmative).

Tim:

There's kind of a Renaissance going on with development, and with gentrification, but it's one that we have to really be careful on how that unfolds, because nobody wants this to become just an upper income enclave... well maybe there are some people that do want that.

Tim:

But generally speaking, I think people said, "Hey, we need to have mixed income population base," and that's the right thing to do. So while at this point we have a good amount of upper income folks and a good amount of still some of the lower income folks-

Allyssa Gray:

Mm-hmm (affirmative).

Tim:

... there's not as much availability of middle income housing.

Allyssa Gray:

Mm-hmm (affirmative), Okay.

Tim:

And because of that, a lot of folks that... your teachers, your firefighters, you policemen, your civil servants, whatever, a lot of the middle income kind of occupations are coming from folks who live on the mainland in more readily available housing supplies subdivisions kind of sprawl, and there's a lot of supply of it.

Tim:

Northern Galveston County has been booming, League City and Texas City and other areas there that are North of us. And while we're growing still here... but most of what's being built is West End homes that are quite huge and valued in at least the half a million dollar range and up to a million or more.

Tim:

And we're building 15 homes a year, I'm sorry, a month. And most of those are kind of in that range. So while we've had some multi-family construction, it's not affordable construction. So there'll come a day, if those trends continue, wherein, the... are you still there?

Allyssa Gray:



Yes, I'm still here.

Tim:

Oh, okay. I'm sorry. I thought I heard something.

Allyssa Gray:

No, you're fine.

Tim:

Okay. But anyhow, there'll come a day that there could be an Island that's very different.

Allyssa Gray:

Mm-hmm (affirmative).

Tim:

And, it's really necessary to have that mix, not only just for a good viable city, but, we have a lot of tourist attractions down here and they require people to fill those positions.

Tim:

And so anyhow, I don't know if... you probably know that we get about over seven million visitors here a year.

Allyssa Gray:

Yes. I just got some updated statistics on it, I haven't been able to find myself. So yes, Mr. Henry definitely sent them my way. So I definitely saw some updated numbers from what I've previously read-

Tim:

Right.

Allyssa Gray:

... and it's significant.

Tim:

It definitely is. Yes, it definitely is. So it's important that we facilitate good affordable housing construction. And, in fact, there was a plan called Vision Galveston, which really focused on a lot of those issues, and I was proud to be a part of that.

Tim:

Facilitated by a lot of the philanthropy on the Island, and they funded the effort, and we have a document now that was really collaborative and very grassroots. And.

Tim:

It goes into 71, I think it's 71, different recommendations in five different category areas of things we ought to be doing to get to our vision to achieve that vision.

Tim:

So some good things that have happened recently.

Allyssa Gray:

Definitely. Wow. So yes, I just actually got up on the website. I haven't even heard of this before. All right. Yes, I've gone through some of these guides, and this is something that I've been looking into for actually a couple of years just in general. But yes, I'll definitely have to take a... actually longer peek, and read of this document for sure.

Tim:

Yes. And it was really good in the group of people who were on the steering side of this. We all went up to Detroit... I'll just try to keep this as brief as possible. We went up to Detroit to see how they were managing after they're almost declaring bankruptcy as a city.

Allyssa Gray:

Right.

Tim:

And the role that philanthropy and government and business played all together to get toward a comeback in the Detroit Future Cities initiative and their planning efforts.

Allyssa Gray:

YES.

Tim:

And, so it was really valuable because we learned that, obviously we knew this, but grassroots efforts are the ones that are most likely to eventually occur because it's what the city wants. It's what the people want. And we had a goal of achieving 15% of our population providing input into this plan.

Tim:

And we actually exceeded that slightly. So it was a pretty well done effort.

Allyssa Gray:

Yes?

Tim:

So, if you get a chance to review the document, it's definitely-

Allyssa Gray:

Oh yes, I've just briefly gone through it, and it looks, yes, very well done. Do you know who I could contact if maybe I want to use some of the imagery to get from... like photo permission. Is there somebody specifically I can contact.

Tim:

Yes. There's... by the name of Keath [Jakobi 00:26:59].

Allyssa Gray:

Okay.

Tim:

Keath was the director of Vision Galveston, and it's a girl, so it's a she, but she spells it like K-E-A-T-H.

Allyssa Gray:

Okay.

Tim:

She's a good girl, she's really great. So-

Allyssa Gray:

I think I can see that on here-

Tim:

[crosstalk 00:27:20] ought to get with.

Allyssa Gray:

Okay, that sounds great. Awesome. Well, surprisingly with that one question, you answered a lot of my economic questions, and ironically a good portion of my design section questions. So-

Tim:

Yes.

Allyssa Gray:

Yes. So we actually hit that 30 minute mark pretty well, and you covered almost all eight of my questions, and I love that. So, again, thank you so much for taking the time to talk with me. It's been very valuable to talk to a bunch of different people that work for the city in different time frames that they've been on the Island, and experiences and stuff.

Allyssa Gray:

So, you gave me another great lead for another document to read, which I'm very, very excited about.

Tim:

Yes, you bet. I will say that in terms of action and in our resilience here, we have done some things, especially with regard to our floodplain regulations. We've adopted a free board requirement that requires everybody that's rebuilding to be 18 inches above where they had to be previously.

Allyssa Gray:

Okay.

Tim:

And then we had some new flood plain maps adopted, and our participation in the community rating system, are you familiar with that?

Allyssa Gray:

No, actually not.

Tim:

Okay. So FEMA, obviously puts out the [inaudible 00:28:56] maps-

Allyssa Gray:

Correct.

Tim:

... for floodplain, as a guide to work who has to build it, what elevation, et cetera, et cetera.

Allyssa Gray:

Mm-hmm (affirmative).

Tim:

And then they have a program called the Community Rating System, which is, basically they assign points based upon what things you're doing to go above and beyond the minimum standards in the FEMA regulations, which are floodplain management and your floodplain ordinances. If you go above, you get points that equate to a reduction in the premium rate of your floodplain-

Allyssa Gray:

Oh okay.

Tim:

Of your... oh gosh, I'm slipping with the-

Allyssa Gray:

The premium rate of the insurance?

Tim:

Yes. The insurance-

Allyssa Gray:

Okay.



Tim:

... those that have insurance on the Island, whether or not they're in the flood plain, we get to a level where in that community rating system we were able to achieve a grade six. It's a ten point system, and ten being-

Allyssa Gray:

Oh yes.

Tim:

Ten meaning you're doing very little or nothing more than just the minimum, and one meaning that you're doing any and everything possible-

Allyssa Gray:

Correct. Yes.

Tim:

And so, most cities fall somewhere between five and ten in the range, and we achieved a six. And so that was pretty good news. It works it's way downwards, the lower-

Allyssa Gray:

Mm-hmm (affirmative).

Tim:

... the number, the higher the amount of stuff that you're doing. So we were able to do that this last year based upon... enhance things that we're doing. Which was really kind of nice.

Allyssa Gray:

Yes, definitely is. Something that, it's promising, it seems like it's just going to keep working its way down, so that's amazing. Yes.

Tim:

Let's hope.

Allyssa Gray:

Yes. It seems like everyone's trying and is kind of on board with everything or trying to be on board and understanding.

Allyssa Gray:

Well again, thank you so much. This concludes the interview for [crosstalk 00:31:10].

Tim:

Yes, sure.

Allyssa Gray:

Do you have anything else that you might want to say, or have any other suggestions, or maybe some documents to look up, or any kind of final thoughts?

Tim:

No, I'll just say good luck on your project-

Allyssa Gray:

Thank you.

Tim:

... and thanks for your interest in our Island community.

Allyssa Gray:

Of course.

Tim:

It's a neat place.

Allyssa Gray:

It is.

Tim:

It's a really neat place, and we like it here.

Allyssa Gray:

Good. I like it there too. Well, I hope you have a good rest of your week, and again, thank you very much.

Tim:

Absolutely. My pleasure.

Allyssa Gray:

All right. Bye bye.

Tim:

Nice talking with you.

Allyssa Gray:

You too. Bye.

Tim:

Bye, bye.