DESIGN(ING) STRATEGIES FOR A SUSTAINABLE AND RESILIENT COASTAL BEACHFRONT COMMUNITY

BY

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THESIS

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ABSTRACT

Coastal beachfront environments are especially vulnerable because of conflict between growing development pressure toward coastal areas, and insufficient protection from natural hazards, particularly storm events and rising tides. Much research concerning that situation has been undertaken and many proposals have been prepared by scholars and professionals. Yet, many of the coastal communities have struggled to implement new ideas on the ground. Among the challenges from the design and planning perspective have been a lack of multi-disciplinary approaches (Booz Allen Hamilton 2010), of applied examples, and of recognizable scale to which stakeholders can relate (Cowley, Gough 2009).

The primary objective of this thesis is to offer guidance to the stakeholders in coastal beachfront communities about how to address environmental and socio-economic factors synthetically. The thesis outlines the principles of a synthetic approach to planning and design and then applies them to a specific site—coastal Harrison County, Mississippi—at a neighborhood scale. That method follows an interpretive strategy model for research, reviewing case studies and investigating site conditions to develop unique design strategies. The outcomes of the research include design strategies developed through the understanding of numerous case studies, the synthetic condition for the coastal area, and specific conditions of the beachfront communities in Harrison County, MS. Proposed design strategies are applied to the coastal beachfront area, and a diagrammatic concept is developed in at neighborhood scale. The value of this thesis comes from its potential to guide stakeholders in coastal contexts design and develop more effective strategies, plans, agendas, and alternatives for improving the overall quality (balance, resilience, and efficiency) of their communities.
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CHAPTER I: INTRODUCTION

1.1 Background, Issues, and Purposes

The American coastal landscape has been impacted and will undoubtedly continue to be impacted by ongoing natural hazards, subtle climate change, and uncontrolled coastal developments. Those have caused a loss of natural structures, ecosystems, and habitats in the coastal areas that leave developments unprotected as well. More than 50% of American people now live in the coastal counties (Bulleri, Chapman 2010; Helvarg 2003), and more people are still moving in every year, encouraging coastal developments. In the meanwhile, scientists predict the intensity of hurricanes is more likely to increase over the next century even though frequency of hurricanes may decrease in the Atlantic Ocean (Bender et al. 2010). A constant rise in sea level occurring for many years is another predicted threat. According to the EPA (2010), sea level has been rising during the past century, especially from 1993 to 2003; the rise in the Gulf Coast has been more significant than other areas, and it is expected to be more dramatic by 2100. In short, two completely different forces--natural and developmental--meet at the coast and create an antagonistic condition, which result in an extremely dynamic, sensitive, and vulnerable coastal environment.

For instance, the Mississippi Gulf Coast has certainly become one of the most altered coastal areas in the United States and, therefore, is vulnerable to natural hazards and loss of natural resources. Like many other coastal areas, climate change and urban development have played a significant role affecting the Mississippi coast. In addition, Hurricane Katrina in 2005,

![Image](http://www.cnn.com/SPECIALS/defining.america/map/index.html)
the most disruptive hurricane in the history of the United States (Czerwinski 2007; Office of Governor Haley Barbour 2008) changed the gulf coast landscape significantly. Hurricane Katrina landed between the Louisiana and Mississippi borders and moved northeastward, passing through the center of Mississippi and affecting approximately 90,000 square miles, an area larger than that of Great Britain (Czerwinski 2007). The entire Mississippi coastline was completely wiped out by the monstrous storm (Office of Governor Haley Barbour 2008).

Soon after that intense event, many people had optimistically thought it would afford an opportunity to rebuild coastal cities better and greater than before (Cowley, Gough 2009). Enthusiastic professionals, sympathetic volunteers, compassionate state and local governments, and resilient residents tirelessly worked together to clean up debris and repair damage on the ground. At the same time, many studies have been produced to understand conditions of post-Katrina coastal areas (Graumann et al. 2005; EPA 2006), impacts of climate change (Booz Allen Hamilton 2010), information about recovery efforts (Czerwinski 2007; The Steps Coalition 2008; Office of Governor Haley Barbour 2008), natural hazard mitigation plans and strategies (NOAA 2009; Booz Allen Hamilton 2010), and various proposals from scholarly disciplines (Cigler 2009) to professionals approaches such as comprehensive plans and revitalization plans (Cowley et al. 2008; Cowell, Scaffer 2008; NOAA 2011). Even though they have been valuable in leading discussions, many of the studies and plans have been unsuccessfully implemented in the coastal area. Some plans have been implemented but failed achieving their goals to protect the coastal communities and others have had difficulties to implement. “We have a wonderful plan created by incredibly talented people, but we are still trying to figure out how we can use it in reality to protect our communities and maintain natural resources” said Dr. John Kelly, Chief Administrative Officer of the city of Gulfport, Mississippi (2010). Many other coastal communities, in Mississippi and elsewhere, face the same challenges after experiencing severe storms.

There are many reasons why studies and plans have not been successfully implemented. From a planning and designing perspective, one of the main reasons is because many studies have been heavily focused on their own study interests instead of a multi-disciplinary approach, and the results are oftentimes contradictory (Booz Allen Hamilton 2010). For instance, beach nourishment and coastal mitigation methods with engineering solutions and short term benefits (Kana 2006; Pompe 1995) may be considered as inappropriate approaches by those more
concerned about preservation and conservation of natural resources and who seek long term benefits (Pilkey 2007; Thom, 2005). On the other hand, approaches proposed by ecologists and environmentalists may not be welcomed by local residents or policy makers, who consider local socio-economic issues (Cigler 2009).

Second, many studies do not illustrate real circumstances on the ground. The studies address issues, impacts, and new ideas, but few provide site specific plans and options to choose from. Stakeholders, who are looking for solutions for their coastal cities, might be interested in some research but often feel it is ‘too much’ to take on its theoretical approaches and risk unsuitability to their area. Even if there are plans and options for ideas, many cases are shown to be difficult in their circumstance. The failure of the U.S Army Corps of Engineers’ buyout program with Bay St. Louis (Cigler 2009) is one example. The intent of the program was very compelling to many people, who understood coastal issues and cared about natural resources, but buying out 17,000 coastal properties to return to nature must have been daunting to many local residents and political leaders, who felt economic and political pressure (Booz Allen Hamilton 2010).

Third, practical plans such as comprehensive plans, master plans, and various ongoing projects are either regional and large scale or fragmentary. A regional comprehensive plan published by Harrison County (Cowell, Scaffer 2008), proposed many good concepts and approaches. However, it focuses more on a regional and large scale urban planning, discussing housing policies and prototypes, economic growth, tourism, safety, and other topics, which many people found difficult to recognize and relate to their everyday life. In contrast, some projects are very site specific and provide representational images dealing with the problems. For instance, the Beach Improvement Master Plan (Cowley et al. 2008) presented an improvement plan for beach users by providing transportation strategies, identifying areas for improvements, and proposing improvement of sidewalks, parking spaces, and plant materials as a short term problem solving approach. Even though it presents a great vision of the study site, it does not address problems of adjacent neighborhoods and potential impacts of natural hazards. In their article “Evaluating New Urbanist Plans in Post-Katrina Mississippi,” Cowley and Gough (2009) argued that some of the proposed plans are picturesque and fail to address real issues. They cited Skellie’s (2007) interview with the Major of the City of Long Beach saying, “he views his
community’s plan is just a ‘pretty picture’ that cannot be implemented because the consultants focused on design priorities instead of listening to interests and needs of the local community.”

Meanwhile, passionate local governments and residents have to continue their efforts in the rebuilding and recovery process with a lack of applicable long-term guidance, like sailors without a compass. The primary purpose of the thesis research presented here is to offer guidance to stakeholders (local governments and residents) in coastal beachfront communities, which is the most valuable area for locals and, at the same time, the most vulnerable area of the region. The second purpose of the thesis is to provide a tool for communication among local governments, residents, and other relevant entities and to help them develop their own agendas. The study presents material for discussion and which can help stakeholders understand what they want, what they need to do to get what they want, or what they can’t have. Third, the study is meant to encourage other researchers, professionals, and government entities to develop progressive coastal mitigation plans and strategies.

1.2 Questions and Strategy

When approaching coastal issues seeking to improve conditions and to find solutions, professionals typically consider their own interests and approach issues from a fixed perspective even when nominally looking at a bigger picture considering more complex conditions and needs. In most cases, outcomes created by that partial approach will not reflect the improvement that coastal environments need. For instance, from the socio-economical point of view, improvement of a coastal area would start with a socio-economical approach, which may or may not represent an improved condition when considering environmental factors. Because of the complexity of the conflict between nature (water/beach) and human involvement (development), a strictly environmental approach to the conflict may not work in the circumstance unless one fully understands the condition embracing both nature and development. Therefore, questions in this thesis ask:

- What is the condition in which both nature and development can coexist and be balanced?
- How can that balanced condition be created?
In order to deal with the issues of the coastal environment, “systems thinking” (Kay 2008) becomes crucial for understanding the complexity of the situation and balancing urban development and protection of natural resources while avoiding a partial point of view, the latter of which could lead to unsuccessful implementation of otherwise good plans. Because of its complexity, the study focus can be easily scattered, misinterpreted, or it can over- or under-utilize data resources. Therefore, this thesis follows a ‘Constructivist Strategy - Interpretive Strategy’ (Deming, Swaffield 2011) through evaluation of case studies. That approach allows understanding of values through case studies and focused investigation of the complex situations and issues to develop design strategies applicable to a site.

In literature review, case studies explore current mitigation and design practices in coastal environments. The review investigates what strategies were considered from the case studies. Furthermore, the study explores advantages and disadvantages of the proposed strategies for the given sites.

1.3 Objectives, Limits, and Contributions

One of the study objectives is to frame and understand existing coastal conditions as necessarily synthetic, with natural and developmental factors and concerns understood not antagonistically but holistically. Synthesis is the only way for both people and nature to survive in coastal areas. The thesis collects site data focused on the synthesis to develop its own design strategies suitable to the coastal environment, which is the second objective of the study. Once design strategies developed, the study applies them to a site (a beachfront community in coastal Mississippi), considering specific site conditions, so that people (stakeholders) can relate to the study. Because the thesis aims to a practical approach, it attempts to be as clear and realistic as possible instead of proposing abstract or conceptual images. The hope is that stakeholders and the general public will understand the proposed design strategies and the applied example, implement information already at their disposal or easily obtained, engage in discussions, and shape their own agenda.

This study recognizes that the proposed strategies do not solve all of the problems that coastal areas face. It could nevertheless contribute the real solutions, particularly when considered alongside other recent studies and projects related to sea level rise, such as “Rising Current: Project for New York’s Waterfront” (The Museum of Modern Art 2010) and “In the
Mississippi Delta: Building with Water” (Mossop, Carney 2010). At the same time, it could be a useful catalyst for communication among stakeholders and for development of long term plans. This thesis study is a part of a larger ongoing effort to address both urban development and natural hazards while trying to make coastal environments sustainable and resilient. Given its focus, it will be especially helpful for communities where natural hazard and climate change is a direct threat, where development is medium density and involves the potential growth of beachfront properties, and where beach-related tourism is a major industry.
CHAPTER II: LITERATURE REVIEW

Studies of coastal areas have been produced by many disciplines with distinct interests: biology, ecology, socio-economy, urban planning, landscape architecture, engineering, architecture, and many others. Given that richness, case studies of shoreline treatments and projects with similar conditions are a valuable tool for focusing research, discerning challenges, and understanding the potentials of different treatments and methods.

Over the past half decade, issues facing coastal area in the U.S. have been approached mostly from a socio-economic perspective, with beachfront considered part of urban improvement. Poignant examples include Waterfront Park, Charleston, SC; Rosemary Beach Community, Rosemary, FL; and Ft. Lauderdale Street Master Plan, Ft. Lauderdale, FL. In recent years, especially after Hurricane Katrina, many scholars and professionals have been interested in rising sea level and its impacts. Problems and possible solutions have been represented in exhibitions such as In the Mississippi Delta: Building with Water, New Orleans, LA, and Rising Currents: Projects for New York’s Waterfront, New York, NY.

2.1 Beach Dune System Susceptibility Assessment, Ocean County, New Jersey

![Ocean County, NJ Beach Dune System Susceptibility Assessment map](http://crcgis.stockton.edu/dune_assessment/noc/index.htm)

The coastal communities of Ocean County, NJ, are one of the most popular in the state, generating economic growth and prosperity throughout the surrounding coastal region (Mihalasky et al. 2007). Ocean County has systemically developed shoreline protection programs including funding, regulation, and development of protection methods, such as using natural rocks, building seawalls, and creating beach systems including dunes with vegetation (The Richard Stockton College of New Jersey Coastal Research Center 2010). Ocean County
Managers have especially acknowledged the importance of the dune system with vegetation because of its ability to protect and sustain the shoreline communities against storm damage (Mihalasky et al. 2007). Their communities have been more protected than those without vegetated dunes. Bare dunes are also costly and require frequent and ongoing maintenance, which places demands on funding (The Richard Stockton College of New Jersey Coastal Research Center 2010). The Beach-Dune System Susceptibility Assessment (B-DSS) introduced computer generated assessment methods with elevations to understand environmental impact (storm events) and existing site conditions (dune condition and elevations) and to identify potential vulnerable areas (Mihalasky et al. 2007). By understanding and identifying the susceptibility and vulnerability of a site, the B-DSS assessment can be used to protect areas of focus, to understand and compare different methodologies, and to define beach preservation areas (Mihalasky et al. 2007).

The narrow and elongated beach condition in Ocean County, NJ is similar to that of the thesis site in Mississippi, for which similar environmental problems are also expected. The B-DSS assessment research offers a good example of how to identify a site’s vulnerability using a computer-based system (GIS). Even though the project is not a design proposal, it gives clear understanding of why and how the study was done. It indicates that analyzing elevation to understand site vulnerability may be necessary. However, the assessment study focused heavily on environmental assessment and did not include further options of study for coastal treatments or a socio-economic perspective with urban development. That is significant because, while much of the Ocean County shoreline is residential with mostly private properties, the thesis site is defined by a major U.S. highway, commercial activities, and connection to downtown Gulfport, Mississippi.

2.2 Rosemary Beach Community, Rosemary Beach, Florida

Rosemary Beach Community is located on the Florida panhandle along the northern Gulf of Mexico, a geographical location and white sand beach condition similar to the thesis study site. Built in 1995, the community was designed by Duany and Plater-Zyberk, adopting principles of new urbanism (Buntin 2002), and has been celebrated as a successfully planned coastal community with architectural characteristics and a well designed town center located beyond the beach dune area. The community development is centralized with smaller lots in close proximity
to the town center and public spaces and it preserves the undeveloped land (Buntin 2002). The coastal area of Rosemary Beach Community is well established with private properties and neighborhood lawns along the shoreline, which has white sand dunes and vegetation. The regional coastal area has one of the tallest dune systems in U.S. with maximum 61 ½ feet height above sea level (Pousner 2004).

The coastal dune system fronting the Rosemary Beach Community is naturally established and protects a pristine condition of diverse beach vegetations and natural landscape, which can hardly be seen in other coastal areas, including Harrison County, Mississippi, where the thesis site is located. It also offers relatively secure protection against natural hazards with sufficient dune width and elevation. The community has a reputation as a desirable community to live in with its own character. It is also a good example of controlled community development in the coastal environment with efficient use of limited land. On the other hand, the coastal condition of the community with private properties along the shoreline is different from the thesis study site, which has US Highway 90 and the beach with a narrow width and low elevation. Rosemary Beach Community also has limited access to the beach through boardwalks instead of continuous vehicle accessibility.

2.3 Beach Master Plan, Harrison County, Mississippi

The proposed Beach Master Plan for Harrison County, Mississippi (Cowley et al. 2008), was produced as part of a recovery effort involving the beach and beach highway. It analyzed the beach areas from mainly a socio-economic perspective and identified areas that are
significant, more often used, and in need of immediate attention. Then, it proposed improvement of the infrastructure, including streetscape (e.g., a bus station, parking spaces, pier area) and proposed new elements in relation to urban development in those identified areas. The plan also provided detailed designs of recreation and mitigation, such as dune planting design, crosswalks, parking spaces, and sitting areas with images of before and after conditions.

Even though images of the before and after conditions effectively represent the intent of the plan and design, the overall proposal does not deal with fundamental issues and could not serve as a reliable long term plan for the area. For instance, one of the major issues in the area is constant sand movement due to the low elevation of US Highway 90 and narrow beach. Yet, some detailed plans proposed aesthetic improvement with nicely trimmed vegetation and a sand-free highway, which would not mitigate the primary issues. Another example is a proposed plan for parking spaces for the public to access the beach. The parking spaces were at a lower elevation than that of U.S. Highway 90, and they were located on the beach itself, taking space from the current narrow beach area, which would become even narrower if the plan were implemented. That would likely cause more problems with implementation and maintenance of the parking spaces, considering environmental issues such as flooding, frequent storms, and rising sea level as well as blowing sand. Overall, the plan proposed good ideas for detail designs and design elements. However, it did not provide sufficient physical and environmental data, which would have helped significantly in developing design concepts. Also, the overall plan did not address how the plan and design engaged in both urban development (city) and nature (ocean).
2.4 Waterfront Park, Charleston, South Carolina

The Waterfront Park project was designed and realized by Sasaki Associates, Inc., as part of a larger revitalization for Charleston, South Carolina. The park is located in between the historical part of downtown Charleston and the final stretch of the Cooper River, emptying into the Atlantic Ocean. The 13-acre project site area was previously used for parking and had suffered from historical industrial activities, declining neighborhoods, and degraded water quality affected by port activity and harsh storms (Sasaki Associates 2007). In 1990, the troubled site was transformed into a symbol of the city by connecting land and water with innovative and integrated, sustainable design in landscape architecture (ArchitectureWeek 2007; Sasaki Associates 2007). The developers of Waterfront Park faced many challenges, such as unstable soil, hurricane damage, flood issues with the low elevation of the site, polluted soil and water, lack of use on site, and disconnection from adjacent streets (Sasaki Associates 2007). However, the park project has successfully shown how waterfront properties can be developed harmonizing nature and urban development. Salt marsh creation along the shoreline provided ecological habitat and, thereby, educational opportunities mitigating low flood elevation, contaminated water quality, and hurricane damage (Sasaki Associates 2007). In the meanwhile,
the plan systemically analyzed adjacent neighborhood and urban structure to reconnect to downtown Charleston. Sasaki Associates (2007) stated that “the city grid extends into the park making physical and visual connections to the Cooper River. This framework creates site lines for landmarks and active areas at the termini of primary streets.” By engaging the adjacent neighborhood and reconnection to the city, the project was successfully transformed and contributed to local economic growth (American Planning Association 2011).

Waterfront Park is a valuable example of how to convert negative shoreline property into an active economic engine. The project suggests the potential of coastal areas to become public parks, which can stimulate the local economy and be part of urban development. However, that approach may not please local residents who oppose beachfront lands being purchased and used as open space because they will not generate as much tax revenue as private developments. Sasaki’s plan also described the use of different design elements to connect development and nature. For instance, tree canopies and gardens adjacent to the city were used to introduce natural elements into human activity zones, and a grand lawn, water fountain, and organic water edge were suggested as transitional natural elements. The “palmetto lined esplanade” (Sasaki Associates 2007) and salt marshes creating and protecting marsh habitats represented a plan deeply engaged in nature.

The characteristics of Waterfront Park are similar in many ways to those of the thesis study site; water edge conditions to the shoreline (salt marsh land/beach), proximity to downtown (declining downtown/damaged and vacant neighborhoods), disconnection of street (Condor Street/US Highway 90), flood issue with low elevation, and hurricane threats. However, there are also significant differences between the two sites, which limit design elements applicable to the thesis site; for example, marsh land mitigation is different from mitigation methods used for the beach. In addition, the Waterfront Park project does not clearly address how to deal with low elevation condition relative to future storm impacts.

2.5 Central Beach Area Plan, Ft. Lauderdale, Florida

The central beach area is the busiest beach promenade area in Fort Lauderdale, FL, with heavy use year round. Revitalization of the area started in the late 1980s with Sasaki’s central beach revitalization plan and eventually went through many planning activities by different entities, including the Community Redevelopment Plan by WRT (1989), the Central Beach
Revitalization Plan and Design by EDSA (1989-1990), the Beach Streetscape Master plan by EDSA (2002-2004), and the Central Beach Master Plan by Sasaki Associates (2009) (City of Fort Lauderdale 2011). With the long history of the revitalization process, Ft. Lauderdale has made great improvements to the central beach area and has attracted private investments and commercial development to it. Yet, factors pertaining to the area as a year round resort town were addressed mainly after the streetscape master plan was completed. Therefore, this review will be largely focused on two later phases: the Beach Streetscape Master Plan by EDSA and the Central Beach Master Plan by Sasaki Associates (2009). The Beach Streetscape Master Plan by EDSA (2004), which significantly improved the aesthetic aspect of the beach streetscape and promenade, addressed economic growth and characteristics of the beach area in the city of Ft. Lauderdale. The Central Beach Master Plan studied by Sasaki Associates (2009) is the most recent and therefore most current proposal, and it adopts a more comprehensive approach for the beach area. As the brief history shows, continuous efforts on improvement of the beachfront have been required for successful revitalization. The process also illustrates the complexity of the urban coastal area relative to planning approaches and different design applications.

EDSA’s beach streetscape master plan addressed aesthetic issues within the rights-of-way of streets, including central beach area and beachfront State highway A1A (EDSA 2004; Sasaki Associate 2009). The proposed plan provided a safe and enjoyable beachfront environment with brick-paved crosswalks, wave walls, and a beach promenade, the latter of which became the signature attraction of the area to local residents and tourists (City of Fort Lauderdale 2011). With the improved beachfront area, Fort Lauderdale Beach transformed from a seasonal tourist spot into a year round, world-class family resort destination (City of Fort Lauderdale 2011). Existing challenges, such as random commercial strips, irregular and sandy roadways, and lack of landmarks were turned into positive attractions by introducing new design elements: wave
walls in the beach promenade, brick crosswalks, palm trees, lighting fixtures, and signage. The wave wall, in particular, became a signature feature of the city, and has also played a significant role in preventing sand from the beach from coming into the street. This could be a successful example of beachfront streetscape reviving beach recreational activities, economic growth with tourism, and more commercial development. However, the plan is particularly focused on an aesthetic point of view and an economic growth perspective and lacks explanation of the characteristics of the beach itself. In addition, the study did not describe how the beach area would deal with environmental impacts.

Almost seven years after the beach streetscape master plan was designed, the city of Fort Lauderdale took a further step to improve the beach area, which has grown significantly. Sasaki Associates’ proposed Central Beach Master Plan (2009) included many valuable data analyses, among them environmental analysis (existing topography, FEMA designated flood zones, climate and prevailing winds, sun shadows, view corridors), regulatory analysis (current zoning
boundaries), land use, and transportation analysis (existing right-of-way designations, public parking facilities, and existing pedestrian/bicycle routes) (City of Fort Lauderdale 2011).

Through the analysis process, Sasaki Associates identified issues such as identity and character, building patterns, sustainability, transportation, and opportunities specific to open space concept plans (Sasaki Associates 2009). One of the advantages of this case study was showing how different data were used in the planning process. For instance, climatic, geographical, and socio-economic information was utilized to identify and develop locations of potential open spaces emphasizing sustainability and considering environmental impacts such as flood and wind. The developed concepts of the open spaces also attempted to connect the city (urban development) and nature (ocean) through application of various design elements. The plan was limited, however, in that it failed to addressed beach improvement relative to potential natural hazards.

2.6 Rising Currents: Projects for New York’s Waterfront, New York, NY


The *Rising Currents* exhibition held in 2010 at the Museum of Modern Art, New York, NY, presented five projects in different locations along New York Harbor assuming a condition of rising sea level in keeping with climate change. Each team of architects, landscape architects, ecologists, and/or environmentalists proposed a zone-specific intervention after understanding the issue and exploring opportunities on a scale to which people could easily relate. The Zone 0 team proposed a new soft and hard infrastructure solution in a coastal area with some porous greenways that act as absorptive sponges for rainwater. Zone 1, which could disappear due to
future sea level rise, was re-envisioned as a landscape defined by water changing the hard edge to soft and utilizing the soft area for recreational and conservation purposes. Zone 2 featured oil tanks to create biofuel from algae fed by wastewater and proposed berms to protect areas and an elevated path for pedestrians and vehicles. Zone 3 created a man-made island with floating piers to protect inland areas from storm waves and to accommodate multi-family residential housing for increasing population. Zone 4 dealt with a polluted canal and proposed an oyster reef with nets of woven rope to support oyster growth, cleanse water, and protect the shoreline (The Museum of Modern Art 2010).

The contributors to the Rising Currents exhibition took creative but idealized approaches addressing the problem of sea level rise and successfully presented their proposals on a scale that brought tremendous recognition from a wide range of disciplines. It was also an opportunity to gauge popular interest in sea level rise and the vulnerability of coastal environments. Each area’s creative approach showed manifold opportunities for coastal transformation, such as greenways, floating piers, and oyster reef construction, and inspired many similar concepts and work related to climate change and sea level rise. However, the projects were generally distanced from real circumstances and did not seem to be systemic in their investigation and framing of their ideas.

2.7 In the Mississippi Delta: Building with Water, New Orleans, LA

This project was proposed in 2010 by CSS (Coastal Sustainability Studio) at Louisiana State University. It recognized the impacts of sea level rise in the Gulf of Mexico and the need for regional-scale alternatives for the future of landscape and communities in the coastal areas of southern Louisiana. The study first addressed existing conditions: “the continent’s most significant inland waterway” and “increasingly vulnerable to flooding and storms” because of loss of wetlands and barrier islands and coastal

Figure 2.9 In the Mississippi Delta: Building with Water, New Orleans, LA, Master Plan, Image source: http://places.designobserver.com/entryprint.html?entry=14938
landscape alteration caused by levee construction, industrial developments, and urban developments (Mossop, Carney 2010). According to the authors, the study was carried out for work “not only speculative in its outlook for a long term future but also community driven and influential in real ways” (Mossop, Carney 2010).

Figure 2.10 In the Mississippi Delta: Building with Water, New Orleans, LA, Master Plan; scenario evaluation against investment and potential return. Image source: http://places.designobserver.com/entryprint.html?entry=14938
The approach taken in *In the Mississippi Delta* considers political and economic conditions as well as research-based investigations, including ecological impacts, sustainability, and socio-economic necessities. Research and analysis led to the development of scenarios with key themes: housing and neighborhoods, wetland regeneration, productive landscapes, urban recreation, and economic development. The project further evaluated the scenarios and developed them into a larger vision plan for the future neighborhood within a restored coastal environment.

The Mississippi Delta project is significantly valuable because its site of concern is the closest among the case study sites to the thesis site. However, the ecological aspect of the Mississippi Delta site is different from the thesis site: loss of wetlands and habitats vs. beach condition. The two projects started with very comparable motives, including recognition of sea level rise, coastal problems, and the necessity of planning for coastal environments and communities. Both studies recognize the importance of understanding political and socio-economic conditions, ecological concerns, and existing communities. The Mississippi Delta project then identified themes related to issues such as housing, productive landscapes, and urban recreation. It also explored scenarios considering those themes and further developed a vision plan. In comparison, the thesis study investigates issues related to the important factors such as socio-economic conditions and environmental impact. The thesis then explores design strategies for the coastal area and develops an alternative plan by applying those strategies.

2.8 Summary of Case Studies

The table below is a summary of the case study projects, comparing their design strategies and evaluating the outcome. By understanding what has been done successfully and what needs improvement, the summary provides insight into how design strategies might be developed for coastal beachfront areas.

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<th>Design Strategies</th>
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<td>• Identify area of focus, methodology to be used, beach preservations</td>
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<td>• Limited to the beach; lack of consideration of adjacent communities</td>
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<td>Location</td>
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| In the Mississippi Delta: Building with Water, New Orleans, Louisiana | Regional scale alternative for the future of landscape and communities in coastal areas of Southern Louisiana | • Speculative for a long term but realistic approach  
• Consideration of political, socio-economic, and ecological conditions  
• Utilize key themes to develop and evaluate scenarios  
• Develop a vision plan for the future neighborhood in a restored coastal environment | • Successfully addressed issues of coastal environment  
• Systemically developed scenarios considering socio-economic and environmental perspective of the communities  
• Provide smooth transition between nature and development  
• Less related to the beachfront condition, which is highly relevant to the local tourism business |

There are some notable design strategies demonstrated in the proposals, which contributed to the project’s success and which may be utilized in developing the design strategies for the coastal environment:

- developing diverse activity programs connecting nature and development
- encouraging accessibility as a place for activities
- connecting to historical and cultural elements of the area
- understanding future environmental change
- providing controlled development
- establishing transitional areas between nature and the development

None of the case study projects fully addresses how to cope with coastal challenges even as they are undoubtedly successful in many ways. Coastal beachfront areas typically face both socio-economic and environmental challenges simultaneously, but, in the case studies, those issues were mostly approached in partial ways. For instance, developers and professionals operating from a socio-economic perspective approached their projects by weighting socio-economic considerations over other concerns, even when they considered environmental issues and attempted to improve environmental conditions. In reverse, environmentalists first addressed environmental concerns and tried to deal with socio-environmental issues afterwards. Because the authors of the different case study projects looked at issues from limited perspectives, some fundamental issues remained unresolved even as improvements were made. Therefore, it is important to understand, first, the condition through which environmental and
socio-economic challenges in the coastal area can be addressed simultaneously, so that resulting proposals deal with fundamental issues regardless of the project authors’ point of view.
CHAPTER III: PROCESS

Until the year 2000, many plans dealing with the coastal environment focused heavily on a socio-economic point of view, although there had been acknowledgements from scientists about environmental issues. In recent years, especially after Hurricane Katrina, people have realized the importance of environmental issues and are seriously taking environmental approaches into account when considering the coastal development. Although much research and numerous proposals have recognized the impact of uncontrolled development and subtle climate change, many still have not successfully addressed fundamental questions, such as ‘What conditions do coastal areas really need in order to be stable and thrive?’ and ‘How can the management of coastal beachfront environments address socio-economic and environmental factors simultaneously?’ This chapter responds to those questions by outlining a synthetic approach to design.

3.1 Synthesis

Synthesis of socio-economic and environmental concerns is especially important for coastal beachfront communities. Many such places 1) are heavily affected by environmental factors, such as sand and water, 2) rely on the beach for economic prosperity, and 3) typically have rich histories with early settlements. Synthetic design in coastal areas depends on three conditions:

• Balance: an important condition for creating growth by stabilizing coastal development instead of allowing unlimited expansion, once considered an ideal of development, and conserving the environment, which becomes a means of protecting the community.

• Resilience: this condition may not seem important in many other areas, but is essential in coastal contexts. The growth of the community depends on how well it is able to accommodate and adapt to changing socio-economic and environmental factors.

• Efficiency: this condition may not apply to many other areas, where there are sufficient lands to work with, but it is necessary in order to achieve growth in coastal areas. Efficiency can be created through densification (socio-economics) and intensification (environment).
Beachfront land (basis) represents a great growth opportunity from both environmental and socio-economic perspectives, but those approaches are typically motivated by disparate understandings of growth. Environmentalists may see beachfront land as a potential habitat in which to catalyze a diverse ecosystem and make the environment healthy so that it can respond to the climate change and protect existing communities. Yet, from the socio-economic point of view, beachfront land may be seen as property for development, through which to energize business activity. Clearly, both environmental and socio-economic points of view want to have some kind of growth (prosperity) for the basis, before it contributes otherwise.

The diagram above presents a process for generating growth in a given basis with a synthetic objective of environmental and socio-economic improvement: diversification and development. In order to achieve such synthetic growth, there should be, first, a system in place that allows for risk-taking process. In order to deal with such a dynamic condition, a system-based process will be essential not only considering connectivity for eco-systems but also reflecting organization of socio-economical relationships. Taking risk is also very important. Without a risk taking process (environment: experiment, socio-economics: investment), there
would be no potential for growth. Risk may cause damage or failure but gives an opportunity for knowledge about the basis and perspective of the growth.

Going through the process, the basis could embrace the conditions of balance, resilience, and efficiency that healthy coastal areas require. By supporting the quality conditions (balance, resilience, and efficiency) for both environment and development, the process will engender healthy environment and clear character for development, both of which constitute ‘value’ in the coastal area. Affiliating environmental health and developmental character in a single coastal community will foster real, positive growth. This thesis explores site conditions and design strategies that have the potential to foster such a condition for the coastal areas.
CHAPTER IV: DATA COLLECTION

Understanding the site condition of a beachfront community plays a significant role in determining appropriate design strategies for the coastal area of which it is part. In this chapter, the condition of the thesis site is discussed in both socio-economic and environmental terms in order to develop synthetic design strategies.

4.1 Socio-Economic Contexts

4.1.1 Location

Harrison County’s coastal area, the most developed portion of the Mississippi coast, is located directly on the northern edge of the Gulf of Mexico and is surrounded by two bays to the north: Bay St. Louis to the northwest and Back Bay of Biloxi to the northeast. The coastal area is surrounded by water both north and south and includes the urban centers of four cities: Pass Christian, Long Beach, Gulfport, and Biloxi, all connected to each other by Highway 90. With over 120,000 residents (U.S. Census Bureau 2010), this coastal zone is the second largest metropolitan area in Mississippi after Jackson, the state capital. Economically, it supports diverse business activities, such as shipping and transportation through MS port, as well as tourism focused on the beach, the Gulf of Mexico, and casinos (Harrison County Development Commission 2009).
Unlike most other coastal areas, the Harrison County coastline includes 26 miles of man-made beach immediately abutting a regional highway. The latter road separates the beach from adjacent neighborhoods. The neighborhoods feature historical homes, diverse forms of architecture, and old growth oak trees. Those unique conditions have raised challenges in previous attempts to apply principles, ideas, and concepts of development, especially when those were part of exclusively text-based documents or conceived at a large scale—in both cases, lacking visualization of the site and different ways to interpret. Given that background, the thesis limits its site study boundary, for practical purposes, to a neighborhood site scale, with the aim of showing how design strategies can be applied at that scale. The thesis study site consists of a stretch of approximately 3.5 miles between downtown Gulfport on the west and the Biloxi on the east, with a regional railroad track defining the north boundary and the Gulf of Mexico the south boundary. Real estate in the study area consists of high rise buildings, commercial buildings, historical neighborhoods, many vacant oceanfront lots, wetlands, open spaces, the oldest golf course in Mississippi, U.S. Highway 90, and a portion of the narrow, 26-mile-long beach. Many properties along the highway are vacant and/or for sale because of the disruption caused by Hurricane Katrina and the current economic crisis. New and stricter state and local regulations established since 2005 and higher insurance premiums also contribute to the lack of property sales and rise of vacancies. The site has great value for study not only because it has various site conditions to consider but also because it has significant potential to utilize the vacant properties before they are fully redeveloped. Although many properties are currently vacant along the beach, the area faces tremendous pressure for development due to its prime location to water-related attractions and convenience to the local cities.

4.1.2 History

Figure 4.2 1721 Biloxi, MS map (Left), 1768 Louisiana and Mississippi gulf coast (Right), Image source: http://www.usgwarchives.org/maps/mississippi/
Settlement of the Gulf Coast of Mississippi by French and Spanish colonists began more than 300 years ago. Colonial administrators considered the Mississippi coastal area strategically important as a location for international relations and political power in the region (Bunn, Williams 2007; 2008) rather than as a permanent location for the settlement. Many colonists traveled northward up the Mississippi River seeking more fertile soils and high bluff areas looking down over the river as ideal locations for permanent settlement; in that way, they came to settle Natchez territory (Bunn, Williams 2007; Haynes 2000; Elliott 2001). In the meanwhile, some colonists and immigrants still lived in the southern, coastal area, maintaining an agricultural lifestyle (Bunn, Williams 2007), but that area was not yet organized as a significant urban location. In later years, the Gulf Coast was considered a remote resort location with mild weather and proximity to water and an ideal location of second homes owned by prosperous residents of New Orleans, Northern Mississippi, and other northern regions (Nuwer 2005).

As railroads were established and automobiles were introduced in the late nineteenth and early twentieth centuries, the coastal area began to prosper as a resort and entertainment area with gambling, hunting, sailing, and fishing; several hotels were also built along the coast (Nuwer 2005; Boudreaux 2011). In 1924, a notable hurricane—following a couple of other hurricanes in the early 1900s—damaged the “Old Spanish Trail,” the coastal road along which one of the first automobiles in Mississippi had been driven and which immediately abutted white sand beach. In 1928, the state government and Harrison County built a 25-mile-long seawall along the beach to protect the beach road. The new road and the adjacent seawall seemed to secure the shore in that area (Sullivan 2007) while providing easy access to the water. As a result, the coastal area was energized for more rapid developments, such as second homes, hotels, and commercial activities along the coast.

Because of its long and rich history, there are significant historical places along the coast, mainly in or around downtown Gulfport and Biloxi. Notable historical sites in the study area include the former Veterans Administration Medical Complex (VAMC) (also known as

Figure 4.3 1947 Sea wall along the MS gulf coast with highway 90. Image source: http://www.cardcow.com/viewall/65516/
Centennial Plaza), the Great Southern Golf Club, a few southern style houses, beach, and the highway. Centennial Plaza is one of the most historical places along the coast. The property was originally purchased in 1917 to host the Mississippi Centennial Exposition in 1919, but that event was cancelled due to World War I. Instead, the site was given over to the federal government during the war for military training (City of Gulfport 2010). One of the very few remaining Spanish style architectural features on the Mississippi coast, Centennial Plaza survived through many natural disasters, including Hurricanes Camille and Katrina, and was repurposed as the VAMC. Hurricane Katrina completely destroyed some buildings on the campus, which were built in later years, but, ironically, most of the original buildings have survived. The surviving buildings are located at an elevated condition of approximately 4’ to 6’ higher than ground level. After Hurricane Katrina, the property was significantly damaged, was unable to operate as a hospital, and was returned from the federal government to the city of Gulfport in 2008 (City of Gulfport 2010). Since then, the building facades, which are the most historically valuable, have been restored to their beautiful original characteristics. The property is along the highway and the narrow beach with low elevation. Protection of the property against the natural hazards, such as rising sea level and other storms, would be necessary to deal with great challenges.

Many of the century-old homes in the study site representing the old planter society have been destroyed through the storms; a few exceptions, situated along the beach, have been partially restored. Those have typical southern characteristics: classical architectural details, a balcony surrounding the house exterior, and old oak trees as part of the property landscape. Those homes could be in great danger when the sea levels rise and/or other storms come through the Mississippi Gulf Coast. Unlike commercial or institutional properties, these homes are small in size and may not be strong enough to survive the wind and storm surge. However, these structures are a part of Mississippi history and local heritage. Improving the resilience of the area may give them the ability to endure.

The Great Southern Golf Club (GSGC), Mississippi’s oldest golf course, was built in 1908 as a nine-hole course to accommodate tourists staying at the Great Southern Hotel, which was owned by the founder of Gulfport, Captain Joseph T. Jones, and was located in downtown Gulfport (Great Southern Golf Club 2010). According to the GSGC’s website (2010), the course was designed by Donald Ross and was built by Charles Nieman, a prominent golf course architect. Although the course was not successful in attracting tourists, it became known for its championship golfing experience and was eventually restored to its original condition in 1996.
architect from New Orleans, at the request of Captain Jones’s son, Bert. The property that became the golf course had at one time been owned by Jefferson Davis, a leader of the Confederacy during the American Civil War. In 1910, the original clubhouse was built in an old English gable style, and the course became known as the Great Southern Golf and Country Club. The clubhouse was surrounded by beautiful old growth oak trees overlooking the Gulf of Mexico until Hurricane Katrina destroyed them in 2005. Land north of the railroad was acquired in 1921 and the amenity was completed as an eighteen-hole golf course with nine new holes on the north side of the tracks (Great Southern Golf Club 2010). The course has been played by many famous golfers and vacationers, such as Woodrow Wilson, President of the United States, who spent his vacations and holidays on the Mississippi Gulf Coast and played the Great Southern Golf Club from time to time while there (Great Southern Golf Club 2010). It was also known as a golfing destination of national significance with famous professionals playing the course as part of the Southeastern States Tour, which predated the official PGA Tour. Since 1962, the golf course changed owners and name several times before being purchased by local residents and members in 1996, at which time the original name, the ‘Great Southern Golf Club’ was restored (Great Southern Golf Club 2010).

4.1.3 Business

The major Harrison County business sectors consist of leisure & hospitality (22.6%), government (21.2%), trade, transportation & utilities (18.0%), business services (10.9%), education & health (8.1%), construction (6.4%), and manufacturing (5%) (Harrison County Development Commission 2009). Tourism accounts for approximately one quarter of Harrison County’s overall industry, including gaming, retail, restaurants, and recreational activities. Many people consider the area as a destination for the beach, sport fishing, boating and other water activities. The tourism employment percentage in Harrison County was 24.7% in 2007 and 24.1% in 2008, according to the Harrison County Development Commission (2009). Growth is expected due to commercial development along the beachfront properties and favorable local economic development policies. Since Hurricane Katrina, the cities of Gulfport and Biloxi have maintained or allowed high density land-use and provided tax credits for commercial developments along the beachfront properties in order to energize the local economy. Although the local economy on the Mississippi Gulf Coast has suffered in the past few years because of
Hurricane Katrina, the recent economic recession, and the BP oil spill, visitors from beyond the region are beginning to return and take advantage of the popular tourism activities, such as beach walking, sunbathing, jet skiing, and kite flying.

As the Gulf of Mexico is one of the areas with the richest fish species in the world, the area is also famous for sport fishing and yachting as well as fish markets and seafood restaurants. Each year, numerous competitive fishing tournaments take place along the Mississippi Gulf Coast, and participants come from all over the country. Uniquely, the Mississippi coast is a year-round destination for tourists because of mild weather and a variety of indoor and outdoor activities. Most tourism-related businesses and their activities occur on the water or at the water’s edge. Many events are held on the coast; some are linked to casinos and others have grown naturally over the years. One of the most famous events within the thesis study area is “Cruisin’ The Coast,” held every year in early October along Highway 90. For this event, car enthusiasts gather to buy, sell, trade, and/or showcase historic cars. The event has long been popular on the Mississippi Gulf Coast, but in recent years it has grown significantly, with the number of participants exceeding 5,000 (Cruisin’ The Coast 2011) while thousands of spectators
line the streets each day to watch the historic cars riding up and down the highway. It would not be hard to imagine a similar scene a decade ago.

Trade and transportation is another industry of economic significance to the area and state. With the expansion of the Panama Canal, shifting trade routes, and overcrowding at other ports in the region, the Port of Gulfport and the State of Mississippi are being positioned for a new era of trade. As the region’s third busiest container port and second largest receiver of imported green fruit (Mississippi State Port Authority 2011), the Port of Gulfport is increasing its size and will be ready to increase its cargo volume by deepening its waters and increasing its temporary storage capacity.

4.1.4 Infrastructure: Highway 90

For over a century, Highway 90 has been a vital route for commerce and recreation along the Mississippi Gulf Coast. From its beginning in the early 1900s, the sandy trail along the coast was known as ‘Beach Drive,’ as well as the ‘Old Spanish Trail,’ and it connected six small cities along the beachfront (Mississippi Department of Transportation 2007). When automobiles began to appear in the early 1900s, the trail was the major transportation path for cars along the beach in the vicinity of Biloxi, and many local residents came out just to watch them driving by. Financial resources in the public and private sector were eventually combined to fund improvements to, and ongoing regular maintenance of, the roadway. Progress was steady but slow due to interruptions caused by periods of war, hurricanes, and a lack of funds in the early 1920s (Mississippi Department of Transportation 2007). Following reconstruction in the wake of a few notable hurricanes and dramatic improvement on the roadway by the late 1920s, it was renamed Highway 90 and accommodated more people traveling through the Southern region. As commercial businesses settled and tourists continued to arrive, Highway 90 became the symbol of the beachfront area with a beautiful scenic view toward the Gulf of Mexico. Even as the burgeoning tourist economy was bringing prosperity to the area, the roadway improvements over time were based on the existing condition of the road with no consideration of future climate change and other environmental factors. In Harrison County the highway itself is fairly low in elevation at approximately average 10ft above the mean sea water level and has a narrow right of way of 100-150ft in width with 2 lanes in each direction along with a narrow beach with approximately average 200ft to 400ft wide.
Because the narrow sand beach lacks vegetation and is constantly being impacted by storms, the highway is in constant threat of shifting sand. With winds from the south in most seasons, the sand tends to move inland but is blocked by the highway, creating a clear barrier between development and nature. When wind has a velocity of approximately 15 mph or more, a sheet of sand inevitably covers the roadway, creating dangerous conditions for the drivers and continuous accumulation of the sand along the median and landscape areas. It is common to find trucks along the highway cleaning up the sand piled on the roadways when even a minor storm comes through. When larger storms, including hurricanes, reached the area previously, the highway was completely destroyed and later rebuilt in the same location. Because it was much more than a simple transportation corridor relative to the local economy, rebuilding the highway became one of the first priorities in the wake of damage, instead of trying to find better alternatives. Some people may say that the highway needs to be moved, but that is easier said than done. It is not only a beachfront connection among the coastal cities; it also represents local history, culture, and the unique character of the Mississippi beachfront, even if it has not
functioned well in recent years. Of course, if it remained as is, the highway would be burdened by safety issues on a daily basis, with inevitable, recurring damage from storm events.

4.1.5 Beach and Beachfront Properties

Among many beachfront treatment methods, beach nourishment is one of the most popular currently employed and is used along the twenty-six miles of white sand beach in Harrison County. Even though Kana (2006) explained effects of sand nourishments as a short-term and reasonable expense solution of the coastal area, beach nourishment has been controversial. Pilkey (2007) argued that “the beach nourishment brings more problems than benefits,” damaging beach ecosystems such as fish and bird habitats by bulldozing and compacting, providing little protection from severe storms, and encouraging high density developments, which have been gone on for years along the Gulf Coast.

Pompe (1995) suggested the establishment of a setback line as a long-term alternative to seawalls, jetties, beach nourishment, and barrier islands, all of which may eventually cause more erosion and little net affect of protection compared to the associated costs. Some scholars, including Owens (1983), have suggested land acquisition (i.e., a buyout program) as a long term, and eventually the most cost-effective, program to secure setback or easement and to protect the coastal area. However, creating a definite buffer along the shoreline with a buyout program may not be accomplished easily, especially in developed urban coastal areas. Owens (1983) discussed the viability of land acquisition saying “philosophical uneasiness with government having anything other than a very limited role in land ownership.” For generations, the federal government has faced criticism concerning the apparent socialization of private resources (Owens 1983). At the state level, those concerns have been exacerbated primarily because of 1) the enormous costs associated with land acquisition, which became harder after the Supreme Court decision, *Lucas vs. South Carolina Coastal Council* (1992), 2) opposition from local government and residents fearing declining economic opportunities along the beach, which has been the engine of their economy and a significant political concern, and 3) opposition from the locals, due to reduction of potential tax revenue from land when it is removed from residential or commercial use (Pompe 1995; Booz Allen Hamilton 2010; Cigler 2009; Owens 1983). In addition, cities such as Gulfport or Biloxi, the downtown and historical neighborhoods of which are located along the coast, would face the possibility of decommissioning and relocation.
resources inland if setback or easement were mandated. Because of the difficulties of implementing the massive buyout program, an analytical and targeted approach to the buyout program should be considered as part of a diversified, long-term strategy.

The analytical and targeted approach could be accomplished by understanding the existing use of the properties and potential properties to transform along the beach as well as recognizing sensitive and significant areas. The map below indicates different types of properties based on availability and flexibility. Light yellow indicates current vacant properties, dark yellow color properties where minor and few building structures exist, which can be negotiated with the land owners. Green shows existing recreational use of the land, magenta indicates government property, and red indicates active use of the properties for residential or commercial use.

![Figure 4.6 Different types of properties along the beach; light yellow-vacant, dark yellow-flexible properties, magenta-local governmental property, green-existing recreational use, and red-active use of land](image)

Obviously, this approach may not completely eliminate concerns about the government’s land ownership and economic burden. However, with the targeted approach, the state and local governments, which have better understanding of the area, could handle the acquisition with limited federal government aids. They may have less economic burden but more opportunity and tax revenue. By repurposing the properties, long-term beach treatments could be found as alternatives to short-term beach nourishment, minimizing concerns of local residents and opening up opportunities for a healthy beach and a resilient beachfront community.
4.1.6 Hurricane Impacts

As the Mississippi coastal area rapidly grew, it became increasingly vulnerable to natural hazards. As detailed in a 1968 U.S. Circuit Court decision (United States Court of Appeals Fifth Circuit 1968), a strong hurricane came through in 1947 and damaged the coastal area, including infrastructure, homes, and other retail buildings, especially in Harrison County. Approximately one third of the seawall was also damaged, leaving no protection from the beach. The former beach had already washed away after the seawall construction and numerous hurricanes. With federal and state government aid, safety barriers along the coast had been reconstructed. That effort included repair of the seawall and construction of the beach along the seawall as part of the mitigation efforts against natural hazards (United States Court of Appeals Fifth Circuit 1968).

Hurricane Camille, one of the most devastating hurricanes ever to hit the Gulf Coast and often compared to hurricane Katrina, struck Mississippi on August 18, 1969, as a category five hurricane, the highest intensity rating. It brought 200 mile per hour winds with a storm surge of up to 23 feet and severely damaged the coastal communities and beach (Godschalk et al. 1989). After the hurricane, opportunities for hazard mitigation were largely ignored with the exception of some limitations introduced through a stricter building code and new elevation requirements. Godschalk and other scholars (1989) explained in the book, *Catastrophic Coastal Storms*, that the recovery efforts were focused on economic factors and development under the slogan “build back bigger and stronger than before” which is ironically very similar to the slogan used by locals in the wake of Hurricane Katrina. Even though the federal and state governments tried to use funds to enforce regulations necessary to protect the communities against future disasters, local governments resented the bureaucratic procedures of the higher government bodies and established their own policies and regulations (Godschalk et al. 1989). For example, in the thesis study area, properties in the hazard area close to the shore were rezoned from low density residential to commercial to prevent permanent settlements there and then to multifamily residential when commercial development failed to materialize, as multifamily residential is considered a lower density category than commercial. Larger hotels and restaurants were built, and many residential areas were rezoned for commercial use along the continuous white sand beach, the longest man-made beach in the U.S.

Even though there was some improvement in addressing natural hazards and recognizing the importance of mitigation policies and strategies in the region after Hurricane Camille, their
implementation of mitigation strategies and plans was not successful there. Without development of appropriate mitigation strategies and plans, similar damage and chaos were realized when Hurricane Katrina struck the area. Initial damage estimates along the Mississippi Gulf Coast were prepared in 2005 by Brian Richard, director of the Economic Development Resource Center (EDRC) at the University of Southern Mississippi, using GIS data provided by Federal Emergency Management Agency (FEMA). In his report, Richard (2005) presented a map (see figure 4.7, below) representing the FEMA estimates of damage levels on the MS Gulf Coast according to categories of intensity:

- **Catastrophic damage**: most solid and all light or mobile structures are destroyed
- **Extensive damage**: some solid structures are destroyed, most sustain exterior and interior damage (e.g., roofs are missing, interior walls exposed), most mobile homes and light structures are destroyed

![Figure 4.7 Hurricane Katrina damage map Image source: Initial estimate of the impacts of hurricane Katrina presented by Richard 2005](image-url)
• Moderate damage: solid structures sustain exterior damage (e.g., missing roofs or roof segments). Some mobile homes and light structures have superficial damage to solid structure (e.g., loss of tiles or roof shingles); some mobile homes and light structures are damaged or displaced

• Flood damage: indicates a separate severe damage category related to the specific effects of flooding

As the map shows, the coastal beachfront area in Harrison County, including the thesis study site, had catastrophic damage in almost 100% of the area. Based on the FEMA data, Richard (2005) estimated the number of household and businesses impacted by the hurricane. He also reported that approximately 37% of the total population of the three coastal counties was impacted, especially many residences near the coast. As this report did not include the number of tourists who spent their vacation in August, which was normally a peak time for the coastal tourism businesses, the actual figure might have been higher. In the business sector, services, finance, government, and retail trade had over 40% of total employment affected in FEMA damage area, followed by transportation with 34.3% (Richard 2005). Many businesses were located along the coastal area and were significantly damaged by the hurricane.

After Hurricane Katrina, the federal government provided approximately $5.5 billion to the State of Mississippi, according to annual reports presented by the Office of Governor Haley Barbour (2008) and by Barksdale (2005). However, as shown in table 4.1, the state ended up spending more than $7 billion with separate funds for federal government entities, including military bases, according to reports from the Governor’s office (Barksdale 2005; Office of Governor Haley Barbour 2008) and other hurricane impact reports presented by The Gulf Coast Business Council Research Foundation (2008) and The Steps Coalition (2008). That figure represented expenditures for public facilities and entities as well as housing supported by the government. Private commercial damage was not included in the total amount, and it is unimaginable how much the private sector had to spend to rebuild their businesses back from the damage. For example, there were fifteen casinos along the coast of Mississippi, and most of them had massive damage since casinos are only allowed to be built on the water’s edge. One of the casinos in Harrison County spent about $180 million to renovate and expand the casino after the storm, according to GulfCoastNews.com (2007). In the meantime, the Hard Rock Casino
was about to have a grand opening at its new Biloxi site when Hurricane Katrina came through, and the storm completely wiped it out. The casino cost millions to build, was never used, and was rebuilt after the hurricane. When considered in both public and private sectors, total amount to rebuild the coast might be significantly higher.

4.2 Environmental Contexts

Due to the adjacency to the beach and water, and because many socio-economic factors are affected, it is important to understand the regular, physical activity of water and sand in the coastal area as well as irregular activity, such as during storms. Tide, wind, and sand movement on the beach influence the coastal area on an everyday basis. Minor and major storms are irregular, but when they occur, they cause noticeable and major damage to the coastal environment. Also, sea level rise is not an immediate threat but will ultimately change the coastal landscape and become a huge issue in the future if the coastal communities ignore current trends.

4.2.1 Tide and Wind

Tide and wind are major forces in moving sand from the water onto the beach, drying the sand on the beach, and creating beach and dunes. Even though major sand movement in the water of the Gulf of Mexico flows in a northeastern direction following the Gulf Stream, sand movement on the beach (wet and dry) is heavily affected by waves and wind on a daily basis. Figure 4.8 shows the average height of tidal current (ft) in each month of 2010 as measured at the Gulfport harbor based on tidal current tables provided by NOAA (2010), with general wind direction indicated. That data indicates that the average high tide in 8 of 12 months was over 1.5 feet above the mean sea level with its wind direction toward north. This shows the energy of the regular tide movement affecting the area. The current man-made beach along the highway in Gulfport, MS is approximately 200 ft. wide in narrow areas and approximately 400 ft. wide in broad areas, based on an aerial image generated in 2007 and provided by MARIS (Mississippi Automated Resource Information System) and a physical measurement, in 2010, of beach areas in Gulfport and Biloxi. Because of the tide and wind, approximately 40 ft. to 80 ft. of the beach width is in a wet and dry circulating condition for most of the time, as represented in figure 4.11. This condition means the dry beach area is approximately 160 ft. to 320 ft. wide, which is
extremely narrow if the ambition is to create dunes on site and to continue supporting beach activities on a regular basis.

4.2.2 Minor and Major Storms

For the purposes of this thesis, minor storms are defined as any storm events, from a regular thunderstorm up to a tropical storm, before being categorized as a hurricane. Such storms will cause a higher tide than normal, but nothing like the direct impact from hurricane force winds and water. Although minor storms come more frequently than do major storms (i.e., hurricanes), less attention is paid to their impacts, compared to those of major storms. Based on NOAA’s tidal currents and tropical storm reports, the average maximum height of the tide for the minor storms in the region reaches approximately 4 to 5 ft. For example, in 2003 when tropical storm Bill came through the Gulf of Mexico, it carried approximately 5 ft. in height from the mean water level, and a storm surge of approximately 3 ft. was observed at some locations in Waveland, Mississippi (NOAA 2003). As the section shows in the figure 4.11, a 5 ft. rise in tide elevation would impact approximately 240 ft. wide of broad beach (average 400 ft. wide) and 120 ft. wide of narrow beach (average 200 ft. wide). That means that more than half of the beach will be impacted by minor storms. As a result, most of the beach area will suffer from massive beach erosion, many of the existing dunes will be washed away, and tremendous amounts of
sand will be removed from the beach and piled up on the highway and in the adjacent communities.

Major storms are not frequent, but when they arrive, they cause catastrophic damage and human fatalities. By knowing the elevation and area affected from previous major storms, the future impact of a major storm can be estimated and prepared for in ways aimed at minimizing damage. Based on previous hurricanes, the average maximum height of a storm surge in a major storm coming through the Mississippi Gulf Coast region is approximately 23 ft. to 24 ft. high. As the section shows in figure 4.11, a 24 ft. storm surge will impact land all the way to the railroad, the north edge of the thesis study site, covering most of the beachfront community. In fact, Hurricane Katrina, with the highest storm surge ever recorded on the Gulf Coast, impacted the entire beachfront community on the south side of the railroad. The coastal communities experienced catastrophic damage. In most areas, concrete slabs of detached houses were all that remained. Dark blue in figure 4.12 shows the area affected by the storm surge from Hurricane Katrina generated by FEMA (2005) while light blue indicates projected future storm impact after 2 ft. increase in sea level.

4.2.3 Sand and Beach

Although Gulf Stream flows along the thesis study site move sand underwater generally to the northeast, direction of beach sand above water level tends to move to the north and northwest, in keeping with wind and wave action, and as represented in figure 4.8. In a typical condition, the sand carried by the wind on the beach accumulates around vegetation, creating a type of berm called a dune. As the dune gets higher, the sand on the top of the dune moves once again according to the wind direction creating another dune, which is typically even higher in elevation. A typical healthy beach features many dunes with diverse vegetation groups, which help to create a diverse beach eco-system and can also help protect a beachfront community.

Unlike many other beachfront areas, that in Harrison County is narrow, lacks vegetation, and has a highway running along it on the inland site, which prevents the beach from moving inland and forming dunes. The beach and the highway are constantly maintained, bulldozed, and flattened. Responsibility for maintenance of the beach and highway is divided between the State of Mississippi and Harrison County. Since Highway 90 is a US Highway, the State (MDOT; Mississippi Department of Transportation) provides maintenance and clean up on the roadway,
including removal of sand, while Harrison County provides maintenance and clean up to the beach. Using a variety of pieces of heavy equipment to maintain the roadway, MDOT can be seen on a regular basis removing sand from the highway. Once the sand reaches the roadway, it becomes somewhat contaminated with roadway materials and residues, and secondary potential uses of the affected sand material is greatly reduced. The Harrison County Sand Beach Department can be seen on a daily basis grading sand and moving it from the seawall towards the water. This maintenance process prevents the beach from developing a naturally healthy condition and is a costly, ongoing process.

In the meantime, beach nourishment programs are introduced to the area, adding new sand to the beach. The most recent beach nourishment program came in the wake of Hurricane Katrina, according to the Harrison County Sand Beach Department (2011). As the beach was completely littered with debris, the U.S. Army Corps of Engineers stepped in and implemented a beach nourishment program, adding fresh sand all the way down the 26-mile beach. Instead of accepting the ongoing maintenance approach, which is much more costly in the long term, the coastal area should consider a long-term approach, which would be costly in the short term but may significantly reduce long-term maintenance costs as well as property damage and human casualties caused by future storms.

4.2.4 Climate; Sea Level Rise

Not only investigating current natural phenomenon within the coastal condition but also understanding potential, future environmental impacts is increasingly important to designing sustainable and resilient coastal communities. Along with the possibility of more frequent and more intense hurricanes (Bender et al. 2010) caused by climate change, rising sea level is one of the major natural hazards threatening our coastal areas. According to the Intergovernmental Panel on Climate Change (IPCC) (Liverman 2007) and the EPA (2010), sea level has been rising.
“approximately 4.8-8.8 inches during the last century based on tide gauge measurements and satellite altimetry.” The rise has been more significant from 1993 to 2003 at the rate of about “0.08 to 0.12 inches per year” in the Gulf Coast area, which is a greater rate of increase than in many other areas. Moreover, it is expected to rise in the future by approximately “7.2 to 23.6 inches” or more by 2100 (EPA, 2010). If manifest, this shift will cause serious erosion and damage to the coastline, especially in the coastal area of Harrison County, Mississippi, which does not have proper protection.

Undoubtedly, sea level is rising along the Gulf Coast. Based on research and scientists’ studies, if there is a maximum rise in sea level of 2 ft. by the year 2100, an estimate shows that the Mississippi Gulf Coast beach would lose approximately 70 – 150 ft. of width from sea level rise alone. When tide, minor storms, and major storms are added to sea level rise, the impact will be dramatically increased. As the section in figure 4.11 suggests, tide after a 2 ft. sea level rise will impact two thirds of the beach area. Minor storms will impact the entire beach causing complete disruption of the beach and carrying a tremendous amount of the sand to the adjacent neighborhoods. In addition, a major storm, like Hurricane Katrina with 2 ft. sea level rise, will cover not only the community south of the railroad but also affect the community beyond the railroad, as represented in figures 4.11 and 4.12. If the community were to remain in its present form, impact from a future storm similar in scale to Hurricane Katrina would be significantly greater, because of sea level rise. Therefore, it is essential to consider likely, future environmental impacts when developing long-term plans and strategies for the coastal area.
CHAPTER V: RESEARCH DESIGN

In this chapter, the thesis develops design strategies for the coastal beachfront area following the process outlined in chapter III. That approach considers strategies pursued in previous projects and current socio-economic and environmental conditions. The design strategies may influence one another and, in some cases, could occur simultaneously. However, regardless of their influence and order, each could be effective if applied independently and be adapted in keeping with changing circumstances.

5.1 Design Strategies
5.1.1 Creating permeable boundary and transitional area

Creating a permeable boundary and thereby producing a transitional area is a large but essential risk-taking process from environmental and socio-economic perspectives alike. It is the very first step toward the quality that the coastal environment seeks. A permeable boundary created by softening the hard edge and eliminating the clear cut and obvious boundary—in this case, Highway 90—allows nature and development to thrive together rather than to work against each other. Removing or relocating the highway would be a big risk for many local people, since the highway has served as a major transportation route for the region and has been there for more than a century. It would also be a costly process. Yet, it would open up tremendous new potentials, which could eventually create new prosperity in the area. Providing a transitional area with a permeable boundary creates enormous opportunities for both nature and development by establishing a system-based process (connectivity and organization) and creating appropriate programs engaging both nature and development.

That design strategy also allows the beach to return to a more natural state without necessarily jeopardizing its role as a socio-economical engine to the community. The flattened and bulldozed beach has served well the tourism industry and related business activities in the region, but not so well much-needed environmental diversification. Through a permeable
boundary and transitional area, the beach could find its own character as both a natural system and a socio-economic attraction.

5.1.2 Promoting environmental diversification

The flattened and bulldozed narrow beach is not adequate for nature to generate diversity and to protect the adjacent neighborhood. In fact, current beach management strategies make the coastal area extremely unstable and vulnerable to storms and other environmental impacts, such as sea level rise. Lacking environmental diversity, the existing condition of the coastal area offers minimal protection from storm events and is damaged even by minor storm events. With a permeable boundary and transitional area, the coast will have more opportunities for nature to diversify. Promoting environmental diversification in the transitional area increases resiliency and balance for both nature and development. Numerous landscape elements or features can help foster diversification, such as dunes with natural vegetation, old growth oak tree groups, wetlands with native plants, retention/detention ponds, and medium-large shrubs or small tree vegetation along the beach. Diversity contributes to environmental conservation efforts to create a healthy condition expanding the natural area and encouraging balance between nature and development. Consequently, by helping to protect the community, a healthy, diversified environment can help stabilize development. Environmental diversification would also foster resilience in the coastal area. A diversified environment can respond effectively to future environmental changes and comfortably adapt them into the diversified environment. Because of the protection by the environment minimizing the threat from the impacts, the community is protected and properly accommodates necessary programs reflecting the changes.
5.1.3 Developing compatible terrain

This strategy is especially important to the coastal area, where the existing condition presents a simple form of terrain. Creating terrain more compatible with socio-economic activities and significance creates balance, resilience and efficiency of the area. Concentrating active development and high-value economic centers on higher elevations will help the community be better protected and more stable during major storms. By accommodating expanded wetlands and ponds in lower elevation areas linked to existing vegetated zones, natural areas can be better conserved and while promoting environmental diversity. Meanwhile, environmental diversification can assist in the creation of compatible terrain. Sand accumulations around medium/large shrubs along the beach could eventually increase its elevation. Oak tree groups behind it stabilize the area with higher elevation, which could be resistant to different types of storms.

Stabilized development and diversified nature help an area become more resilient against future environmental impacts. High ground community will be less negatively impacted by future storms while a healthy, diversified ecosystem can comfortably adapt to environmental challenges, such as intense rainfall or storm surge. Because stabilized development and diversified environment have to co-exist in a balanced way within the narrow coastal area, the efficiency of land use and function is highly important. Creating stabilized community with various programs requires concentration to accommodate the programs while maintaining growth potential. Diversified environment, in the mean time, requires a higher than usual intensity to have healthy conditions in the limited coastal area.

Figure 5.3 Compatible terrain model; existing (Left) and proposed (Right)

5.1.4 Creating diverse programs with Interaction between nature and development

A permeable boundary in the thesis study site would create new opportunities for diverse programs to be developed in ways that increase balance and resilience. The coastal area of the
thesis study site has been dominated by development. By removing or modifying the boundary, nature can overtake areas beyond the existing limit of Highway 90, in keeping with the natural movement tendencies of water and sand toward the north.

Various programs and activities, such as activity fields, open lawns, and beach sport spaces could be developed in the transitional area connecting both nature and development. Also, additional programs supporting nature, such as beach with vegetation, bird nesting areas, and forest, could help nature to increase its area, leading to better balance with development. With balance between nature and development, increasing natural area and giving up some developmental land, the overall resilience of the area would be enhanced. Larger areas adjacent to the shore would then be defined by natural systems and would therefore be better prepared to deal with future environmental challenges. Programs accommodating natural and developmental aspects in balance also help to protect community against the impact. For instance, an activity field between a mixed use area and a wetland can be utilized as a recreational use protecting the mixed use area against the natural hazards and the wetlands against expansion of the development. The area serves as a social gathering place in normal condition and as a buffer protecting many properties when a storm comes.

One may argue that diverse programs are needed in any circumstance. Yet, the diverse socio-economic programs typical in coastal environments are not sufficient to ensure resilience. Those programs must also address, and be in balance with, environmental concerns. To be resilient, coastal landscape must be a transition or buffer zone between nature and development, enhancing each other while fostering flexibility against impact. That is the quality the coastal environment needs most in order to be healthy, and it is accomplished by having various programs engaging nature and development simultaneously.
5.1.5 Increasing efficiency on use of land

To accommodate socio-economic and natural priorities simultaneously within the narrow, linear coastal beachfront area, efficiency is a top priority. Traditional forms of development, in coastal and inland contexts alike, have focused on economic expansion. More, larger, and wider are representative of growth in conventional development. However, in the coastal environment, there is no room to make more, larger, and wider for growth. Efficient development allows for the environment to have its share of the land and to create a balanced coastal area. By facilitating balance between nature and development, efficiency can also increase resilience, since the environmental elements protect the community from future environmental impacts while concentrated development attracts more tourists and promotes business activities. Buildings too spread apart or random developments have higher vulnerability to natural hazards and are more difficult to promote for business activities. Through concentration of development, adjacent open areas can be used as recreational park and/or as natural preserves, which create an environmentally focused use or something inclusive of both.

5.1.6 Encouraging expression of history and culture

The expression of history and culture is related to the character from the socio-economic point of view and to health from the environmental perspective. If historical and cultural context were ignored, maintenance and development strategies could be applied monolithically.
History and culture give identity to the area, which relates directly to the character of the development. Local history and culture can be celebrated throughout the area as part of the southern lifestyle. At the same time, it is very important to understand history of the environment in the area so as to foster environmental characteristics and help the area regain a healthy condition instead of one simple form. Old growth oak trees, which are a representative of the native landscape and are symbol of the region, would contribute to environmental diversity and improved environmental health.

5.1.7 Developing accessibility with various activities  
As compatible terrain is established and more diverse programs are generated, improved accessibility can help connect programs and associated terrains while promoting new activities. Accessibility is not only a tool for connecting different uses, the existing role of the transportation corridor, but can also foster new activity destinations, which could develop a character of their own in the coastal area.

Typically, many coastal areas look at a beach drive as a barrier between the communities and water because they see it only as a transportation method and have developed it that way. Yet, Highway 90, a major transportation route in Harrison County, has also provided beautiful scenic view opportunities while safe guarding the coast by preventing development from taking over the beach area. Highway 90 also generates great interest for beach related activities along the highway. Therefore, accessibility along the beach should be considered not only as a function of transportation connecting different land-uses, such as residential, commercial, and recreational, but also as a place for beach activities in which the public can engage. Along with those activities, it is not difficult to imagine people hanging out along a beach drive, chatting with neighbors, watching street performances, playing, and looking out at the beach and Gulf of Mexico.
The beach drive should be adapted to compatible terrain. Some portions of the beach drive close to the beach can be designed to be covered by water in major storm events while providing easy accessibility to the beach in normal conditions. Other portions of the beach drive, especially those serving residential areas, should be safe from any environmental impact.

5.1.8 Providing flexible connection to existing condition

Flexible connection to existing conditions may not be directly related to nature but has direct connection to socio-economic stabilization of the area, and eventually affects both. Design strategies and ideas applied to the site may seem very new to some local residents, who are used to traditional ideas and fear change. With smooth connections to the existing conditions, the proposed design strategies would be recognized not as something difficult to incorporate but as an innovation exploring new ideas while celebrating and supporting positive aspects of the existing condition. In that way, new strategies could be better accommodated and received, following an easier path to the synthesis of nature and development. This well-perceived process results in accomplishing the growth the coastal area has been seeking: health (environment) and character (socio-economic).

5.2 Site Application

The site application starts with creating a permeable boundary and transitional area, which is accomplished by relocating Highway 90, diminishing its strong linear characteristic. The permeable boundary allows the creation of a transitional area, which provides opportunities for an expansion of nature, providing a place for environmental diversification as well as a smooth transition for activities related to development. Wetland creation, retention/detention ponds, and an extended beach with vegetation are examples of expanded natural areas. Sports fields, recreational uses, and observation piers are representative of a smooth connection between nature and development.
In the meantime, in order to encourage diverse programs and uses on the site, it is important to understand the existing programs. The site application identifies existing active programs, historically and culturally important locations, vacant properties, existing wetlands, and undisturbed areas, giving elevation values as shown in figure 5.9-1. For instance, relatively higher elevation is for historically and culturally important places and high-density development. On the other hand, wetlands and some vacant lands adjacent to the natural areas can be in the lower elevation. Some areas could even be used to make a shoreline change by taking advantage of their low elevation. The plan then develops diverse programs that engage nature and development simultaneously as well as the existing condition. This process may change existing uses or areas by rearranging and modifying existing conditions to accommodate proposed programs, as represented in figure 5.9-2.

The site application creates a compatible terrain in response to both the programs proposed and the estimated future environmental impact including a 2 ft. rise of sea level. The area is broadly divided to four elevation-based categories, with height ranges as shown in figure 5.9-3:

- Areas above any storm (above 26 ft.): active concentrated development with high density including permanent residential, commercial, and mixed use as well as historically and culturally significant areas
- Areas out of minor storm event but affected by major storms (7 ft. to 26 ft.): passive commercial development with some seasonal residential and active recreational use. Structures in the area are to be elevated to stay away from the potential major storms.
- Areas within the minor storms but away from the regular tide impact (4 ft. to 7 ft.): recreational and natural uses with minimal commercial structures related to water and beach activities. Structures in the area are to be elevated to meet the local building code. The structures in the areas could be flooded when a major storm event occurs.
- Areas within any environmental impact (0 ft. to 4 ft.): considered to be natural condition including shoreline eco-system, recreation of the beach and dunes, wetlands, and detention/retention ponds.

With permeability and compatible terrain, environmental diversification of the site (e.g., extensive wooded areas, sand dunes, different types of water bodies utilizing different shape and
types of areas) is encouraged. A diversified environment would help develop a healthier environment, promote the creation of compatible terrain, and even change the shoreline. Stabilized sand dunes create higher elevation around vegetation through natural sand movement. This would be enormously helpful for soil stabilization and increased resistance to beach erosion. In the meantime, the diversified environment attracts other uses/activities, such as boardwalk promenades through areas of old growth oak trees and wetlands, observation piers, recreation centers, sports fields, beach sports, and beach-based commercial activity. Other development-related programs, such as mixed use, residential, commercial, and other public use programs, could be integrated by connecting with the existing land use.

For the coastal area, it is important to increase efficiency of land use by concentrating development programs and intensifying environmental conditions. For instance, mixed use with commercial and residential with a high density is recommended in the coastal area utilizing smaller areas of land and maintaining development activities instead of more widespread development. Dense community with smaller lots also helps to invite the environment into the community. The proposal provides mixed use and dense development adjacent to existing active land-use areas. These areas are away from the shoreline in a higher elevation to provide some natural protection against future storm impacts. It is also important to represent historical and cultural conditions not only at historical sites but also in adjacent areas. In the proposal, the beach drive is one of the places celebrating history and culture, which could easily expand out to the adjacent areas.

Accessibility is addressed by making connections among different programs and by respecting compatible terrains, to minimize the cost of construction. Unlike Highway 90, the proposed beach drive promotes beach activities with its own character. It still maintains its connection to adjacent areas and regional cities but is much more than a simple transportation route. It plays a bigger role as a place to celebrate history and culture, to promote activities related to adjacent programs, and to develop its own, unique identity. As represented in figure 5.10, some portions of the beach drive could be affected by a minor storm event, but others are completely away from any storm impacts. The beach drive connecting the residential and major roadway to the north should stay out of the water in any case even after a 2 ft. rise of sea level.

The diagrammatic concept plan reflects the considerations discussed above and presented in figure 5.10. Numerous sectional drawings show how compatible terrain and anticipated future
major and minor storm impacts organize the proposed site transformation. Figure 5.11 indicates areas affected by different future environmental impacts, from potential major storms to regular tide after 2 ft. sea level rise. On the proposed concept plan, only active development areas and some portion of the beach drive are safe from the major storm impact, while higher ground recreational areas and the majority of the beach drive are not affected by the future minor storm event. The future regular tide after the sea level rise would impact most of the lower areas including the shoreline. More dramatic shoreline changes are possible around proposed pond areas when the area is constantly interacting with the environment. Additional detail diagrams and sketch are provided to assist in understanding of proposed programs (figures 5.12, 5.13, and 5.14).
Figure 5.9 Elevation diagram: elevation changes based on the existing use of land (1-Left), program diagram: proposed programs considering environment and development as well as existing condition (2-Middle), and environmental impact diagram (3-Right)
Figure 5.10 Diagrammatic concept plan (Left) and sections (Right) for the coastal beachfront community
Figure 5.11 Future environmental impact on the proposed plan: major storm event (1-Left), minor storm event (2-Middle), and regular tide (3-Right)
Figure 5.12 Detail diagram of environmental diversification
Figure 5.13 Detail diagram of accessibility with activities
Figure 5.14 Sketch of accessibility with activities
CHAPTER VI: DISCUSSION AND CONCLUSION

6.1 Discussion

The transformation of the beachfront community in Harrison County, Mississippi, proposed in this thesis is based on practical design strategies developed for the coastal beachfront area. The proposed concept describes an alternative approach through which the coastal area could become more sustainable and resilient against future environmental hazards, maintaining its growth in development and promoting environmental diversity. It proposes a variety of programs and uses considering both environmental and socio-economic perspectives, such as concentrated high density development, mixed use, sufficient recreational uses, wetland, wooded areas, ponds, different types of beach vegetation and dunes, shoreline change, and more. In order to implement this concept successfully in the coastal area, several variable factors to be explored:

- **Goals:** It is important for the local stakeholders to define and understand their long-term goals. Many coastal communities set up goals that emphasize recovery from hurricanes and/or socio-economical development but fail to consider environmental factors. Instead of adopting only one perspective when defining goals, communities should think more synthetically with the aim of balancing environmental and developmental factors, in order to achieve quality (balance, resilience, and efficiency) in the coastal area. Without appropriate goals, a plan can be misguided and even incapable of achieving its intended purposes.

- **Buyout program:** Obviously, the coastal area needs to engage in a buyout program to obtain land necessary for productive transformation of the area as a whole. With this study, focused areas can be strategically targeted for acquisition, thereby reducing cost. When coordinated with the proposed plan, a buyout program would have the credibility that previous approaches have lacked.

- **Local policies:** The plan proposes an unconventional approach of development with density concentration in some areas providing wide transitional and natural areas. This is a dramatic change to the existing condition, especially along the shoreline. This plan may not comply with some local regulation or policies. It will therefore be necessary for
local policies to be adapted to support new ideas and to create a viable, long-term plan for the coastal area.

- **Setback:** It is important to have various kinds of setback guidelines. Many other coastal areas have a uniform setback requirement, such as 30 ft. or 50 ft. along the coast, regardless of the existing condition. As this study shows, a uniform setback is not conducive to healthy development in coastal areas, where flexibility is an important factor in addressing uncertainty. The setback limit should vary depending upon the elevation of terrain and surrounding areas. It should also consider different types of setback such as a setback for permanent residential, commercial, and recreational use. This study recommends guidelines for program- and building-type-based setbacks in different elevation-based categories of 0 ft. to 4 ft., 4 ft. to 7 ft., 7 ft. to 26 ft., and above 26 ft., instead of one, unvarying setback dimension.

- **Building code:** Many of the coastal areas have building regulations, such as 24 ft. elevated building structure to be applied to the buildings on the affected area. Sometimes, the affected area could be extremely extensive unless there is a subdivided option. This proposal argues that building recommendations could vary depending on ground elevation or other factors indicating potential to be affected by natural hazard. Most of the buildings in the development area with a higher elevation could maintain their own characteristics, being less likely to suffer damage during future storm events. Buildings in the transitional area are recommended to be elevated above the future storm height, and no structure is to be built in the natural area.

This thesis does not describe the only alternative for coastal areas. Even with the same design strategies and various considerations, there could be many alternatives, depending upon the political will of the stakeholders, land availability, and many other factors. It is very positive thing to explore many alternatives, so that communities find the approach that works best for them.

6.2 Conclusion

In the United States, coastal beachfront environments are especially vulnerable because of growing development pressure and lack of sufficient protections against increasingly frequent
storm events and climate change. Addressing that problem has been a struggle for stakeholders because multidisciplinary approaches are required but few examples exist, either in theory or as applied to real circumstances. Also, earlier proposals often lack recognizable scale in the planning and design perspective. This thesis has approached the complex issues facing coastal beachfront environments by addressing environmental and socio-economic factors synthetically. In prioritizing growth to accommodate increasing environmental and socio-economic value alike, the thesis developed its own design strategies for the coastal area in Harrison County, Mississippi, considering local site conditions and environmental factors. Proposed design strategies include 1) creating permeable boundary and transitional areas, 2) promoting environmental diversification, 3) developing compatible terrains, 4) creating diverse programs with interaction between nature and development, 5) increasing efficiency of land use, 6) encouraging expression of history and culture, 7) developing accessibility with various activities, and 8) providing flexible connections to existing condition.

The proposed design strategies are applied to the site at the neighborhood scale so that stakeholders can more easily relate to the study and understanding how growth (diversification for the environment and development for the socio-economics) can lead to increased value (health + character) in the coastal area. The qualities of balance, resilience, and efficiency are nurtured through systems-based and risk taking processes in the site application. Even though the proposed diagrammatic concept predicts successful improvement of sustainability and resiliency in the coastal area, applying the proposed strategies could be difficult, depending on local regulations, policies, goals, political will, and so on. Therefore, each coastal community should make ongoing efforts to understand and address local variables and to find additional alternatives to fit its specific context.

The approach proposed in this thesis will not solve all of the problems of coastal communities. Yet, the study provides a framework for understanding how new and useful design strategies could be utilized. Accordingly, this thesis offers guidance to stakeholders of all communities with similar conditions, articulating a clear vision of synthesis, and suggesting ways to generate region-specific alternative plans. In that way, this study is part of an ongoing and more widespread effort to address issues of development in a time of rapid environmental change and to propose viable and effective solutions.
REFERENCES


ArchitectureWeek. 2007. ASLA 2007 landscape awards. ArchitectureWeek, 337:0606. p1.1


Harrison County Sand Beach Department, conversation with Day, M., September 2011.


**MAP DATA SOURCES**
