BEST PRACTICES MANUAL FOR DEVELOPMENT

in Coastal Louisiana

A LOCAL PLANNING GUIDE FOR BUILDING AND DEVELOPMENT IN COASTAL LOUISIANA:
PRESERVATION, RESILIENCY, RESTORATION, ADAPTATION, SUSTAINABILITY, AND SAFETY

ACKNOWLEDGEMENTS

Authors

Nadine Appenbrink, *Fregonese Associates*
Glen Bolen, *Fregonese Associates*
Camille Manning-Broome, *Center for Planning Excellence*
Michele Deshotels, *Office of Coastal Protection and Restoration*
Jeannette Dubinin, *Center for Planning Excellence*
John Fregonese, *Fregonese Associates*
C.J. Gabbe, *Fregonese Associates*
Stijn Koole, *Bosch Slabbers*
Sarah Logiudice, *Fregonese Associates*
Oneil Malbrough, *Shaw Group*
Douglas Meffert, *Tulane University*
Jack Milazzo, *Center for Planning Excellence*
Tommy Pacello, *Code Studio*
Janet Tharp, *Kimley-Horn*

Graphic Designer

Sonya Bastendorff, *Fregonese Associates*

Foreword Author

Richard Campanella, *Tulane University*

Best Practices Advisory Committee

Louis Buatt, *Chair*
Lynne Carter
Marco Cocito-Monoc
Sidney Coffee
John Costonis
Tim Creswell
Todd Davidson
Mark Davis
Jori Erdman
Nina Lam
Shirley Laska
Simone Maloz
Michael Medick
King Milling
Linda Pace
Steven Peyronnin
Rosina Phillipe
Mayor Mark Piazza
Christopher Pulaski
Margaret Reams
Sherrill Sagrera
Heidi Stiller
Kerry St. Pe'
Elizabeth "Boo" Thomas
David Waggonner
Patty Whitney
Jim Wilkins

A special thanks to individuals that assisted in the coastal research tour:

Patty Whitney, *BISCO*
Nicole Cotton, *LUMCON*
Mayor Mark Piazza, *Abbeville, LA*
Charlene Beckett, *Abbeville, LA*
Reverend Edwards, *Phoenix, LA*
Pointe Aux Chene, *LA community*
Bayou Dulac, *LA community*
Isle de Jean Charles, *LA community*

BEST PRACTICES MANUAL FOR DEVELOPMENT *in Coastal Louisiana*

CONTENTS

IMAGE: US ARMY CORPS OF ENGINEERS (USACE)

Tulane geographer Richard Campanella is the author of *Bienville's Dilemma, Delta Urbanism, Geographies of New Orleans,* and other books. He may be reached at rcampane@tulane.edu.

The time to adapt to changes is now. While state and federal agencies oversee large-scale restoration and protection projects, key roles must also be played by local government, developers and individuals. The Best Practices Manual for Development in Coastal Louisiana inventories and explains these approaches, techniques, tools and policies toward the long-term stewardship of this dynamic delta.

Foreword

by Richard Campanella

If its myriad uses are any indication, the word "delta" seems to cast a spell over humans. We apply it to riverine places that intrigue us, that bear a certain mystique. Arkansans call the swampy eastern flanks of their State "the Arkansas Delta." Music aficionados use "delta" to describe the original form of the blues, adding the adjective "deep" to describe its grittiest variation. Mathematicians use "delta" to mean "change," a usage coincidentally germane to its scientific meaning.

Scientists reserve the word for more restricted circumstances: "deltas" are depositions of sediment at or near the mouths of rivers. Though this definition is a simple one, deltas are complex, dynamic and relatively rare, and the significance they play in natural and human history is disproportionate.

Most rivers do not form deltas at all, either for lack of water volume or sediment load, but rather estuaries—admixtures of fresh and salt water—as they discharge into the sea. Two-thirds of the world's thirty-two most populous cities abut estuaries, including New York City on the Hudson River.

Larger sediment-bearing rivers that do form deltas are still usually at the mercy of waves or tides in shaping their alluvial deposits. A number of great cities adjoin or occupy these features, which are called "wave-" and "tide-dominated deltas." Alexandria, for example, sits on Egypt's Nile River Delta, which is dominated by waves. Tides affect China's Yangtze Delta, home to eighty million people, one-quarter of who live in Shanghai. Dhaka in Bangladesh abuts the immense Ganges River Delta, also dominated by tides, with well over a hundred million residents.

On the other hand, "river-dominated deltas" occur in those rare circumstances where rivers bear enough water and sediment to overpower the dynamics of the receiving lake or sea. River-dominated (or fluvial) deltas are more common in lakes than in seas, because few of the world's rivers are large enough to overpower coastal currents.

Louisiana's Mississippi River Delta ranks as one of the world's best examples of exactly that: a river-dominated multi-lobe delta prograding into the sea. So great was the Mississippi's water volume and sediment load, particularly vis-à-vis relatively calm waters and weak tides of the Gulf of Mexico, that for seven millennia the River built new land at the Gulf's expense, creating and shaping not only today's delta, but the

coastal marshes of the southcentral part of the State and the cheniers of the southwest. New Orleans and other Louisiana coastal communities rank among the world's best examples of delta urbanism—of the benefits and costs, and triumphs and tragedies, of humanizing this truly exceptional landscape.

The unsettlingly aqueous geography of Louisiana's coast has perplexed and fascinated humans since the beginning of recorded history. "All this land is a country of reeds and brambles and very tall grass," noted Iberville in 1699; "I climbed to the top of a nut tree…but saw nothing other than canes and bushes…inundated [by] 4 feet…." Wrote Benjamin H. B. Latrobe of New Orleans a century later, "Mud, mud, mud… this is a floating city, floating below the surface of the water on a bed of mud." American geographer John McPhee described the lowermost River as jumping "here and there within an arc about two hundred miles wide, like a pianist playing with one hand—frequently and radically changing course, surging over the left or the right bank to go off in utterly new directions." Mark Twain was characteristically more pointed, calling the Mississippi River Delta "the youthfulest batch of country that lies around there anywhere."

All this geological dynamism seemed anathema to settlement. Over three centuries, humans proceeded to engineer rigidity upon deltaic fluidity and impose hard lines across soft systems. We built levees to prevent seasonal floods. We channelized the River and severed its distributaries. We excavated waterways to improve shipping access. We dug canals to extract resources. We drained wetlands to build subdivisions. We cut forests faster than they could re-grow, and introduced exotic species to native ecosystems.

These actions were not irrational at the time, and frankly aided New Orleans and southern Louisiana to play critical roles in the national economy. But they came at a price. The levees succeeded in reducing floods, but also starved the wetlands of fresh water and sediment. The man-made canals aided industry, but allowed salt water to intrude and erode. The drainage systems turned marshes into neighborhoods, but allowed their soils to subside below sea level. The sea, meanwhile, rose at increasing rates.

As a result, coastal Louisiana is being swept away by the rising waters of the Gulf of Mexico. Human activity is, in effect, steadily converting a river-dominated delta system into a wave-dominated delta—and what those waves are eroding is the land base of an entire society.

Chapter 1
INTRODUCTION

Why Is a Best Practices Manual Necessary for Coastal Louisiana?

Communities of the Louisiana coast face unique challenges that threaten their safety, property and continuation of ways of life. Using the information in this Manual is vital to ensure the State engages in more proactive comprehensive land use and transportation planning, coastal restoration and levee protection. The goal is to ensure sustainable prosperity for future generations of Louisianans.

Coastal Louisiana is a rich region. From the diversity of cultural heritages to globally important ecosystems, plentiful bayous and natural resources, coastal Louisiana's assets help drive the nation's economy. It has been treasured for centuries by peoples who are known for their resiliency and who have survived many environmental, economic and social challenges. Its communities are made up of original Native American inhabitants and descendants of a variety of settlers, including the French, Spanish, English, German, Acadian, West Indian, African, Vietnamese, Irish and Italian, as well as Croatians, who made a success of oyster harvesting along the Gulf Coast. It is one of the premier centers of fishing, hunting and oil and gas extraction for the Western Hemisphere. Visitors from around the world are attracted to Louisiana, from the streets of New Orleans to the State's unique bayous that sustain a strong tourism economy.

However, Louisiana's valuable coastal ecosystem is being destroyed. This same coastal ecosystem functions as a nursery ground to many species of marine life and also reduces the destructiveness of hurricanes. Life here is precarious, as the

IMAGE: INFROGMATION OF NEW ORLEANS

CH1-1: Flood silt covering a residential side street after Hurricane Katrina. The street was blocked by houses knocked off of their foundations at either end.

Implementing a Best Practices Manual for Development in Coastal Louisiana that emphasizes designing for resiliency can help prevent what happened in the Lower 9th Ward in New Orleans.

IMAGE: BOSCH SLABBERS LANDSCAPE + URBAN PLANNING

CH1-2: Louisianans have a long history of living with water. Long-term solutions will help make coastal Louisiana viable and sustainable for future generations.

world witnessed in 2010 during the Deepwater Horizon disaster that impacted the environment, livelihoods and cultures of coastal Louisiana. Climate change is bringing both rising seas and potentially more frequent floods and intense storms to the Gulf of Mexico and its ecosystems, making the Mississippi River Delta one of the most threatened delta systems in the world. These challenges mean that, without action, many of the places, people and lifestyles along the coast are in peril.

Therefore, the Louisiana Coastal Protection and Restoration Authority (CPRA) and Center for Planning Excellence (CPEX), a non-profit that provides best-practice planning models, innovative policy ideas and technical assistance to communities that wish to create and enact master plans, partnered to create The Best Practices Manual for Coastal Development.

"Living with Water" vs. "Fighting the Water"

This Manual goes beyond the status quo approach for coastal development in Louisiana. Past federal, State and local policies have led decision-makers, planners and residents to concentrate on fighting the water and ignoring its assets, as opposed to living with the water and capitalizing on its abundance. Yet, for centuries, coastal inhabitants from across the globe, including Louisianans, have lived with water—both benefitting from their proximity to water and also preparing for high water when it might come. In recent decades however, parts of the coast are in more frequent flood danger. Louisiana is returning to the synergy between resources that the State's success is founded upon to help its residents live with water.

The "living with water" approach is fundamentally based on understanding the confluence of Louisiana's culture, history and natural systems, and then developing informed design solutions that promote best practices. It is also imperative to evaluate local, regional, national and international examples of successful solutions to challenging problems.

What Are the Key Objectives of a Best Practices Manual?

Creating a New Regional Resource

This Manual is constructed to meet the objectives of the Master Plan by the CPRA. It is designed to be a timely, informative, easy-to-use platform to make the latest practices accessible and to inform current settlement and development trends in Louisiana's coastal regions. This Manual focuses on the natural and built environments. Specifically, it focuses on the role people and communities (buildings, neighborhood patterns, infrastructure investments and city and regional plans and designs) can play in creating sustainable and resilient long-term solutions.

Understanding Coastal Louisiana

The State's current environmental, cultural and economic conditions provide the context for the best practices and proposed strategies withn this Manual. These unique assets are at risk but should remain the fundamental building blocks for future development.

Compiling Current, Relevant Data

A list of agency and web resources are provided in Chapter 6 and throughout the document. Because data and statistics regarding Louisiana's coast are as dynamic as the ecosystems themselves, the Manual's users are encouraged to seek out the most current information. The CPRA is working on making this changing information easily available in one place. The resources provided in this Manual are intended as a starting point.

Providing Relevant Strategies

This Manual recommends strategies based on international best practices that make sense for Louisiana's unique cultures and geographies.

Providing Planning Tools

This Manual presents the framework needed to guide future building development and outlines the necessary steps for community planning in coastal Lousiana.

How Is the Manual Organized?

This Manual first presents general information and strategies, and then progresses to information and strategies that are specific to Louisiana and its individual communities. Chapter 1 orients users to the benefits and objectives of the Manual.

Chapter 2, "Looking at Water Abroad," highlights delta and coastal regions in Africa, Australia, Asia, Europe and South America. Just as coastal Louisiana practices some successful methods for living with the water, these case studies showcase international solutions that can be considered and adapted to fit coastal Louisiana's unique circumstances.

Next, the Manual outlines our unique circumstances—the historic and contemporary conditions and challenges that shape coastal Louisiana. Chapter 3, entitled "Coastal Louisiana," reviews historic land use and land development patterns and their impact on today's patterns; economic conditions, including industries that thrive and are evolving in response to our landscape; environmental conditions specific to our coast and lastly, restoration efforts that have arisen due to these circumstances.

Narrowing the focus further, Chapter 4, "Understanding Geotypes," guides users through the numerous geographic types, or "geotypes" that exist in coastal Louisiana. The geotypes are defined by their natural, cultural and economic characteristics, and they are named according to their dominant natural feature, such as "chenier plain" and "alluvium." Each geotype location is shown on a map, and the development pattern within each geotype is illustrated in a cross section. Louisiana cities and townships present within each geotype are also noted.

Chapter 5 contains strategies and best practices that can be implemented in coastal Louisiana's six geotypes. In some cases, one strategy will work within several geotypes; in other cases one strategy is highly specific to only one geotype. A matrix helps users chart the many strategies that individual communities might employ in order to live with water in ways that promote long-term resilience and safety to individuals, their culture and their economy. Following the matrix is a thorough explanation of every suggested strategy found within the matrix. If a strategy is already in practice somewhere in coastal Louisiana, this best practice is highlighted as a reference point for users.

Lastly, because implementation is key to success, Chapters 6 and 7 detail methods for realistic implementation of the suggested strategies and best practices. Chapter 6 focuses on how communities can develop plans that are pertinent to their individual circumstances while also coordinating with existing plans at the state and federal level.

Chapter 7 focuses on how to make plans reality by creating and adopting regulatory ordinances. Specifically, this chapter provides an overview of the ordinances found in the Louisiana Coastal Land Use Toolkit that supports this Manual and the strategies recommended herein.

IMAGE: BOSCH SLABBERS LANDSCAPE + URBAN PLANNING

CH1-3: With a changing environment, both the people and settlements of coastal Louisiana are at risk.

IMAGE: GOVERNOR'S OFFICE OF HOMELAND SECURITY & EMERGENCY PREPAREDNESS (GOHSEP)

CH1-4: Projects like LSU AgCenter's *Marsh Maneuvers* help educate the next generation about the challenges our region faces and provide hands-on opportunities to get involved. These kinds of programs develop long-term stewardship and encourage new ideas about "living with water" that are vital to Louisiana's future.

Who Should Use the Manual?

This Manual is designed for a diverse mix of users: local governments, State and federal agencies, tribal organizations, private real estate developers and builders, realtors, non-profit organizations, real estate professionals (e.g. hospitals, emergency services, social service providers, and affordable housing developers), insurance and financial services industries, and individuals that live and build in coastal areas. Coastal communities that plan where and how they want to develop are able to take charge of shaping their futures by using this information to help inform their planning and development decisions. In addition, residents in coastal areas may find that the Manual helps their future investment decisions.

What Other Work Has Been Done?

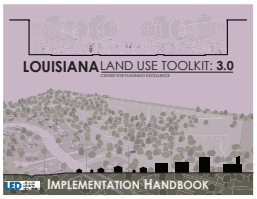
This Manual results from a recommendation of the *Louisiana Speaks Regional Plan* and *Louisiana's Comprehensive Master Plan for a Sustainable Coast,* prepared under the oversight of CPRA. The Master Plan is a reference that must be considered before establishing appropriate best practices in any coastal area. In addition, the Manual is designed to be used in conjunction with these previous publications: *Louisiana Speaks: Planning Toolkit, Louisiana Speaks: Pattern Book*, and the *Land Use Toolkit*. The content within this Manual supports and is consistent with these documents.

CHAPTER REFERENCES

Coast 2050: Toward a Sustainable Coastal Louisiana. http://www.coast2050.gov/

Coastal No Adverse Impact Handbook. National Oceanic and Atmospheric Administration and Association of State Flood Plain Managers. 2007. http://www.floods.org/NoAdverseImpact/CNAI_Handbook/CNAI_Handbook.pdf <http://www.floods.org/NoAdverseImpact/CNAI_Handbook/CNAI_Handbook.pdf>

Louisiana's Comprehensive Master Plan for a Sustainable Coast, first approved unanimously by the legislature in 2007, is currently scheduled to be updated every five years.



LOUISIANA SPEAKS
Our Voice. Our Plan. Our Future

Chapter 2
LOOKING AT WATER ABROAD

In preparing the Manual, best practices from around the world have been considered along with strategies already in practice in Louisiana. The following case studies feature six coastal regions that contain river deltas and six coastal regions that contain flood-prone areas. The communities within and near these areas are facing some of the same challenges that we are experiencing in coastal Louisiana.

CASE STUDY

Rhine River Delta, The Netherlands

The Netherlands has a successful history of adapting to and living with water. If not for the dams, sluices and storm surge barriers that shorten the Dutch coastline, most of the country would be under water today. The Netherlands sees great value in living and working in the Rhine River Delta, as it is home to 9 million people and the center of their economy. However, the reality of climate change and rising global sea levels requires their future efforts to be flexible and offer both short and long-term implementation actions. The Dutch government is continuing to ensure safety from flooding through Rijkswaterstaat, a centralized public works and water management entity. This national focus on safety helps to ensure that the Netherlands remains an attractive place to live, work and invest while remaining a tourist destination. The Netherlands recognizes the value of an integrative approach, understanding that water issues are linked to the landscape, economy, nature,and urban development. Policy makers have adopted a philosophy they term as "living with water" which means working with nature whenever possible.

RHINE RIVER DELTA BEST PRACTICES

- Systematically increase flood protection in areas protected by levees.
- Secure fresh water supply.
- Conduct cost-benefit analysis before building in flood-prone areas.
- Innovative use of spatial planning for water storage, water plazas, green roofs.

LIFE Environment: Living with Water

http://tinyurl.com/Netherlands-livingwithwater

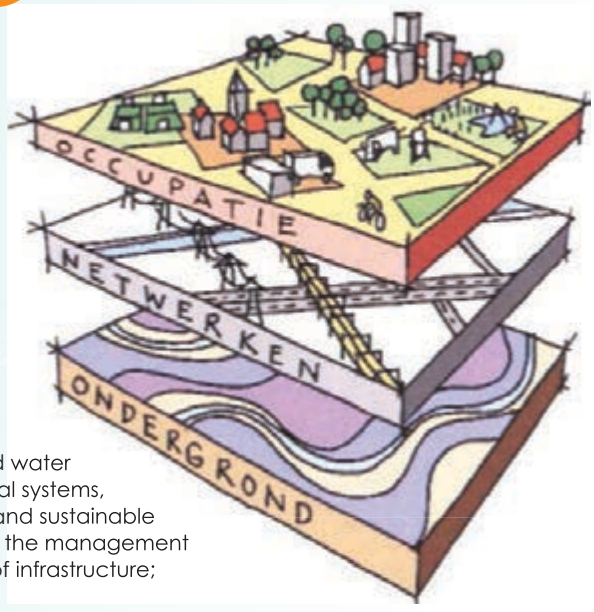


IMAGE:WWW.RUIMTEXMILIEU.NL/?NID=920

CH2-1: The Dutch use an integrated approach to spatial planning and water management involving three layers. The Layer model recognizes natural systems, infrastructure, and land/water use. A clear vision promoting resilience and sustainable development based on this model results in three response themes: (1) the management and restoration of natural systems; (2) the extension and revitalization of infrastructure; and (3) the development and adaptation of land/water use.

IMAGE: HTTP://WWW.MULTIMEDIA-PUBLISHING.COM

CH2-2: Egyptians embrace floods by turning to water as a means for transportation during flood seasons.

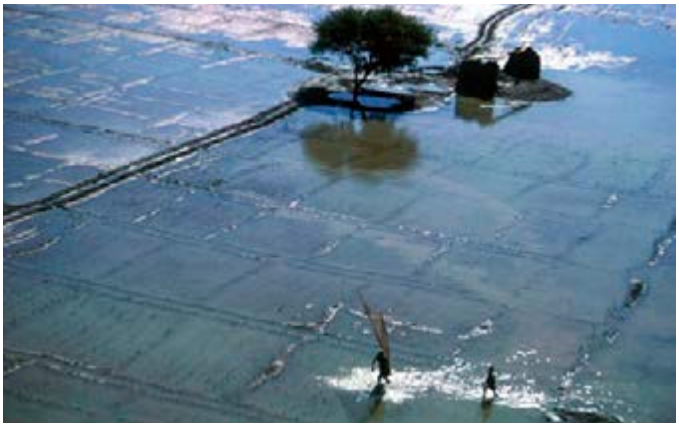


IMAGE: PUBLIC DOMAIN

CH2-3: The silt deposited by floods makes the soil of the Nile Delta region very rich, supporting the agriculture base of the area.

CASE STUDY

Nile River Delta, Egypt

The Nile River Delta is the most recognizable delta in the World. It is inhabited by some 50 percent of the Egyptian population and fed by the 4,000 mile-long Nile River.

In the past, the seasonal floods of the Nile River have replenished the fertile soils by depositing silt and resulting in a strong agriculture base in the Delta region. Agriculture comprises a substantial part of the export GDP for the area. Crop patterns are based on the seasonal flooding patterns but were often wiped out by floods or drought. To control the amount of water brought to this area, the Aswan High Dam was constructed and completed in 1970. This dam stretches across the Nile 600 miles south of Cairo and has effectively stopped the river's annual floods by catching its waters in the reservoir. During the dry season, the water is slowly released for irrigation.

Control of the water also requires coordination with the countries the Nile River runs through. In recent years, due to increased disagreements over water management, national and international agencies have developed an integrated decision support system to manage the Nile River in a sustainable way. This decision support system incorporates the complex factors of water management, from weather dynamics to river hydraulics to human demand and assists policy makers and river basin planners on how best to manage the Nile fairly for years to come.

NILE RIVER DELTA BEST PRACTICES

- Slowly release water during dry season.
- Use waters as means of transportation.
- Rotate seasonal planting of crops in relation to flooding patterns.
- Implement an integrated decision support system to manage River water.

Nile Basin Initiative
http://www.nilebasin.org

IMAGE: PUBLIC DOMAIN

CH2-4: The Vietnamese government has begun relocating flood-prone, high-risk communities to residential clusters on higher ground.

IMAGE: PUBLIC DOMAIN

CH2-5: Not just a means of personal transportation, boats are used as floating markets to bring food and other goods to residents during a flood.

CASE STUDY

Mekong River Delta, Vietnam

The Mekong River Delta is located in the southern part of Vietnam and has a population of 17 million people. Though this region has been living with floods for generations, the severity of floods is increasing. The Vietnamese government has resolved to both live with floods and to provide flood control. Flood control structures employed include dams, dikes, sluices and canals to protect crops and houses. In an effort to protect homes, residential clusters are created. Residential clusters are located on higher ground and protected by dikes.

Agriculture is an integral part of the economy in the Mekong Delta, and the government is helping to shift the thinking about floods towards an understanding of how to live with floods. Through the government's efforts, farmers have found that floods are able to provide benefits. The An Giang's local policy encourages people to adapt their way of life by diversifying agriculture and finding alternative incomes during the flood season. Other strategies include shifting crop calendars, changing crop patterns and planting trees along roads and dikes to reduce flood damage. The policy and education around the concept of "living with the flood" helps local people sustain their livelihoods during flood season.

MEKONG RIVER DELTA BEST PRACTICES

- Cluster residential development on raised mound foundations.
- Disaster-resistant house design and provision of wind/storm buffers.
- Explore benefits of "Living With the Flood" for farming and restoration.
- Adapt and diversify farming practice to work with seasonal flood cycle.
- Implement land use strategies.
- Create demonstration sites as educational sessions for citizens.

Mekong River Commission

http://tinyurl.com/MekongRiver

IMAGE: FREGONESE ASSOCIATES

CH2-6: Riverboats provide transportation and access to goods in Tigre.

IMAGE: FREGONESE ASSOCIATES

CH2-7: Residents of Tigre adapt to occasional flooding in action and attitude.

CASE STUDY

Parana River Delta, Argentina

Parana River Delta is home to Tigre, Argentina, approximately 30 miles north of Buenos Aires. It is the world's only delta that is in contact with another river—not the sea. As a result, the area experiences frequent and rapid flooding. Argentina has had to explore alternative strategies to costly structural flood-control mechanisms. This has resulted in the absence of levees, particularly in more rural areas, so the sediment is deposited in the alluvium, or lower delta, at a rate of 6.5 feet per century.

Residents of Tigre have adapted to the delta conditions by elevating their homes on pilings, reinforced concrete columns, Leca stone and iron frames. New homes are built to a standard elevation of 8.5 feet, which is 2.5 feet above the general flood height. Floating stores and a water-based transportation system are other local solutions that accommodate water. Within the home, people also showcase a willingness to adapt their lives to live with water by moving furniture to higher levels in the house and creating floor drains or holes.

PARANA RIVER DELTA BEST PRACTICES

- Elevate homes well above the expected flood height.
- Adapt ways of life to accommodate occasional floodwaters, using floating stores and water-based transportation.
- Explore affordable alternatives to levees in rural and agricultural areas to preserve the natural functions of flooding (sediment deposition, nutrient recharge).

Tigre Delta Studio

http://tinyurl.com/Tigre-Studio

IMAGE: PUBLIC DOMAIN

CH2-8: Venetians elevate walkways during flooding to continue functioning as usual.

IMAGE: PUBLIC DOMAIN

CH2-9: Venetians continuing with daily activities using waterproof clothing.

CASE STUDY

Venice, Italy

Venice is best known for its extensive canal system, not only adding charm to the city but also serving as a transportation network. Despite this unique asset, the problem of high waters has distressed Venice since ancient times. The increase in the frequency and intensity of high waters is a result of port activity and the construction of a navigable channel connecting the sea to the lagoon. An effective sea defense system became a priority following a destructive flood in 1966 in which the tide reached the highest level ever recorded in Venice. In response, Venicians made structural and behavioral adaptations.

The largest structural modification in the city is the construction of a system of retracting oscillating buoyancy flap gates. The project, named MOSE (Modulo Sperimentale Elettromeccanico), provides a flexible framework that limits interruption to lagoon morphology, water quality, navigation, port activity, fishing and the landscape context.

The city has had to find ways to continue functioning as usual, despite the floodwaters. Public mentality has shifted to accommodate water through behavioral adaptations like allowing for floodwaters to occasionally enter buildings and public spaces.

VENICE BEST PRACTICES

- Balance innovative design and limited environmental impact through a systems approach.
- Demonstrate water as an asset with a unique system of canals that add charm and serve as a transportation network.
- Accommodate floodwaters through structural and behavioral adaptations.
- Elevate walkways allowing for "business as usual" in flooded urban areas.

PBS NOVA "Saving the Sinking City"
http://tinyurl.com/savingvenice

IMAGE: WWW.VATTENRIKET.KRISTIANSTAD.SE/ENG/INDEX.PHP

CH2-10: Kristianstad is surrounded by wetlands, water bodies and the River Helge.

IMAGE: WWW.VATTENRIKET.KRISTIANSTAD.SE/ENG/INDEX.PHP

CH2-11: The naturum Vattenriket visitor centre, on the banks of the River Helge.

CASE STUDY

Kristianstad, Sweden

Kristianstad, Sweden is below mean sea level and threatened by sea level rise and wetland erosion. Its communities were severely flooded in 2002 before a substantial program to upgrade their existing levees was completed. As a result, the local mentality of regarding the wetlands as an asset has been gaining momentum.

In 2005, local citizens initiated Kristianstad's Vattenrike Biosphere Reserve, which includes the greater part of the Municipality of Kristianstad. Kristianstad's Vattenrike is loosely translated as "the Kristianstad Water Realm." In order to preserve the vast wetlands that surround the town, Sweden has been helped by the Biosphere Programme of the United Nations Educational, Scientific,and Cultural Organization (UNESCO).

The groundwater and the entire system of water in the River Helge, with its lakes, watercourses and wetlands, gives the area a series of natural agrarian values. These values are dependent on cultivation (i.e. grazing and hay-making) and on the annual flooding. The people of Kristianstad's Vattenrike strive to protect and conserve the natural and cultural heritage associated with this water system and re-establish natural water related values that have vanished over the years.

KRISTIANSTAD BEST PRACTICES

- Perceive water in the area as a resource to be purposed in a way that preserves its intrinsic values.
- Conservation and restoration of sandy grasslands and wetlands as a main focus.
- Focus on education of the general public while promoting conservation and eco-tourism.
- Demonstrate how to approach the challenges of combining conservation and development through the Biosphere Reserve.

Kristianstad, Visitor Center
http://www.vattenriket.kristianstad.se/eng

IMAGE: WWW.YOURBDNEWS.COM

CH2-12: The national mentality about climate change is adaptation instead of fleeing.

IMAGE: WWW.YOURBDNEWS.COM

CH2-13: Rice fields, full of brackish water, are now used by farmers to raise shrimp or crab.

CASE STUDY

Bangladesh

A recent study of 136 port cities world-wide found that climate change threatened the largest populations in port cities in developing countries. Bangladesh contains the top two cities, Dhaka and Chittagong, with the largest proportional increase in people exposed to climate extremes by 2070. This means that 164 million residents face issues of an increasing population combined with the effects of climate change along the coast of the Bay of Bengal.

The Bangladesh government is making climate adaptation a key part of its national development strategy. The mentality is adaptation instead of fleeing. Public education is focused on population control which results in individual economic improvement. Additionally, low-tech adaptation and innovation is supported by industrialized countries and implemented by non-governmental organizations. Bangladesh serves as a laboratory for innovative solutions in the developing world. Some low-tech adaptation strategy examples include using floating wood platforms instead of mud for home foundations; building homes in sections that can be dismantled, moved and reassembled quickly; and using rice fields, full of brackish water, to raise shrimp or crab.

BANGLADESH BEST PRACTICES

- Climate adaptation as a National development strategy.
- Public education programs.
- Low-tech adaptive building strategies.
- Adaptive agriculture that works with increased salinity levels.

Organisation for Economic Co-operation and Development "Development and Climate Change in Bangadesh"

http://tinyurl.com/Bangladesh-ClimateChange

IMAGE: WWW.WN.COM

CH2-14: Jakarta experiences annual flooding during the rainy season.

IMAGE: WWW.WN.COM

CH2-15: Process-oriented disaster planning and awareness-raising programs are essential government initiatives to reduce risk associated with flooding.

CASE STUDY

Jakarta, Indonesia

Jakarta, Indonesia experiences annual flooding. During the rainy season, residents expect anywhere from several inches to over a foot of water. In the years of highest flooding, up to 70% of the city is flooded, displacing many residents and shutting down roads and transit systems. In response, Jakarta has made many structural improvements to lessen the impact of flooding. These include dredging and cleaning local waterways, improving and maintaining technical infrastructure and increasing the discharge capacity of rivers and water retention capacity of the soil.

In addition to infrastructure changes, other strategies employed are process-oriented and based in public education. These include public awareness-raising programs, early warning systems and emergency management, law enforcement, regular disaster drills and a focus on intervention. Finally, environmental planning plays an important role in flood prevention and management, including protection of mangroves, upper watershed planning and management, strategic policies for disaster management and implementation, and regulation of land use to preserve the integrity of spatial planning, water supply, food protection and local economic development.

JAKARTA BEST PRACTICES

- Improved maintenance of waterways and urban water infrastructure.
- Public education, disaster planning and emergency drills.
- Planning for upper watersheds.
- Land use regulation to preserve spatial planning, water supply, food protection, and local economic development.

Worldbank Case study: Jakarta

http://tinyurl.com/JakartaResilience

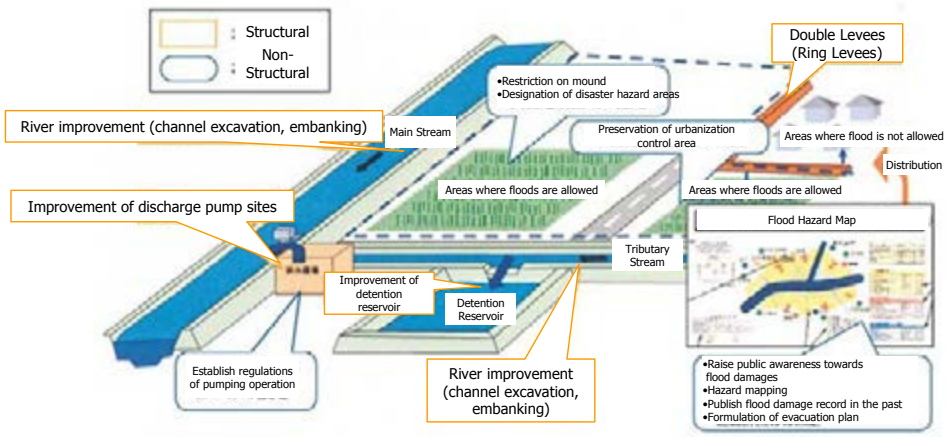


IMAGE: HTTP://WWW.MLIT.GO.JP/RIVER/BASIC_INFO/ENGLISH/PDF/CONF_02.PDF

CH2-16: Japan employs structural and non-structural measures to adapt to sea level rise, higher river levels, flood and storm surge.

IMAGE: HTTP://CHANGESONTHEEARTH.COM

CH2-17: Japanese citizens carry on their daily routines during flood seasons.

CASE STUDY

Japan

Japan is a mountainous nation with more than half of its population and three-fourths of its property existing in areas at or below sea level. Due to its geography and topography, Japan faces floods, tsunamis, storm surge and other disasters. In response, Japan has been developing ways to protect both its citizens and its economic assets.

To control the disaster-prone conditions, Japan has been continuously implementing flood control projects, including the construction of continuous levees and flood-storage structures such as dams and reservoirs. However, the effects of anthropogenic and natural activities are expected to increase risk, and current measures to control flood and storm surge are becoming insufficient. In response and anticipation, Japan is taking an approach of adaptation and mitigation.

To adapt to environmental changes and mitigate associated risks, Japan has developed policy frameworks that provide adaptation options and strategies for water, infrastructure and settlement. Additionally, Japan continues to invest in levees, dams, reservoirs and other structural and non-structural protection measures.

JAPAN BEST PRACTICES

- Develop national policies that integrate climate change considerations and water resource management into design, land-use policies, building codes and insurance.
- Integrate levees into city development patterns.
- Live with water by adapting agricultural seasons to flooding seasons.
- Use multipurpose retarding basins.
- Establish easements to accomodate retarding basins.
- Use regulating reservoirs to temporarily store excess water before discharge into rivers.
- Conduct extensive outreach and education programs.
- Implement a strategically integrated combination of structural and nonstructural measures as comprehensive disaster mitigation measures.

Japan Ministry of Land, Infrastructure, Transport and Tourism
http://mlit.go.jp

IMAGE: WWW.ASIANWAVEMAG.COM

CH2-18: Residents of the state of Queensland adapt to seasonal flooding by raising their homes.

IMAGE: WWW.CHIEFSCIENTIST.QLD.GOV.AU/PUBLICATIONS/ASSETS/UNDERSTANDING-FLOODS.PDF

CH2-19: The "Queenslander House" is a model home that is flood resistant. The Government promotes this type of design for those living in at risk areas.

CASE STUDY

Queensland, Australia

Queensland, Australia is a low-lying coastal state on the east side of Australia. Queensland developed ways to deal with its susceptibility to flooding. These include practices such as monitoring flood patterns to anticipate at-risk areas and also monitoring the movement, pattern and direction of water flow. The state has devised a Flood Risk Management Plan to guide proactive and reactive decision making and to protect their citizens and infrastructure.

Land use planning to manage and prepare for flooding has been an effective resource in preventing large amounts of collateral damage from flooding. Queensland is also implementing its land use plan via local zoning ordinances that reduce risk and include raising homes and preventing new development in areas most susceptible to flooding. Queensland utilizes dams, lakes and levees to control the flow and behavior of water.

QUEENSLAND BEST PRACTICES

- Build using the "Queenslander House" type of design.
- Build above specific flood levels for habitable rooms.
- Build road evacuation routes above flood levels.
- Include a land use table in the draft flood constraint code.
- Use zoning to regulate development.
- Maintain local floodplain processes including water storage and flows; river discharge and capacity; banks of river, streams and water bodies protected from erosion.

Queensland Government State Planning Policy
http://preview.tinyurl.com/Queensland-FloodMitigation

Chapter 3
COASTAL LOUISIANA

Following the events of Hurricanes Katrina and Rita, many questioned why Louisianans live in and around flood-prone areas. As the previous chapter demonstrates, cities and towns throughout the world have developed along deltas and flood-prone areas. There are legitimate reasons why humans settled along these areas. This chapter summarizes the historic reasons for land use and land development patterns in coastal Louisiana as well as the current challenges we face if we are to remain in these areas. Next, industries that are reliant upon our coastal landscape and have been essential to the State economy are summarized. In addition, the ways in which the State's economy is shifting in response to both Louisiana's changing role in the global economy and to our changing coastal environment is noted. Finally, this chapter provides an overview of environmental conditions and the current environmental challenges we face, from flooding to extreme storms to land loss—challenges that can directly impact our cultural land use and development patterns and our major economies.

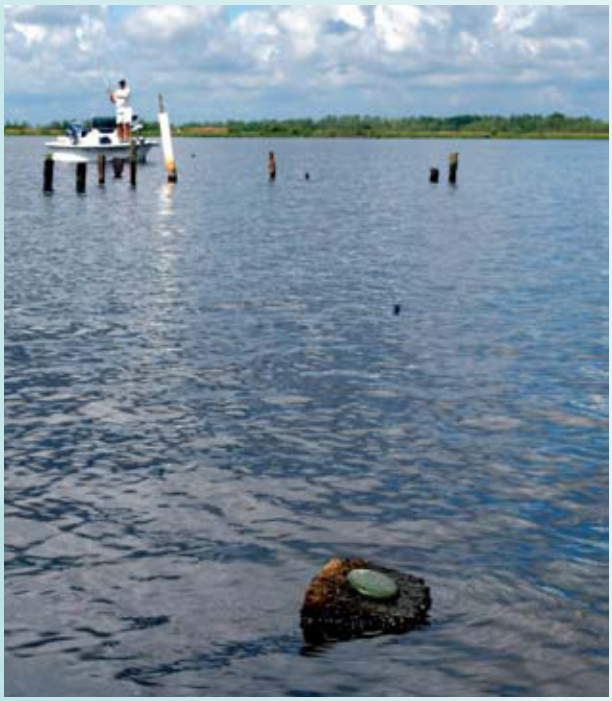


IMAGE: US GEOLOGICAL SURVEY (USGS)

CH3-1: The USGS elevation marker in the foreground measures Louisiana's water level rise and land loss.

"The loss of these coastal habitats would be tragic in itself, but it assumes apocalyptic proportions for the people who live in and near them. Coastal land loss literally unravels the very foundation of life in the coastal areas, not only because of the direct loss of places to live, but also because it magnifies the intensity of the hurricanes' effects so that much more damage results."

Hazard Mitigation and Land Use Planning in Coastal Louisiana: Recommendations For The Future, 2007. Louisiana Sea Grant College Program, Louisiana State University. http://www.lsu.edu/sglegal/pdfs/CompPlanningReport.pdf

History of Land Use and Land Development in Coastal Louisiana

Subsequent to Native American habitation, Louisiana's early settlers came from many unique cultures, each bringing traditions that impacted the land and built the coastal Louisiana landscape. For example, the French tradition of arpent land division helped define land ownership in coastal Louisiana.

In Louisiana, land division arpents predate the U.S. Public Land Survey System (PLSS) and were incorporated into the PLSS. Initiated under French rule and retained by both the Spanish and U.S., arpent land divisions are long narrow parcels of land along rivers and navigable waterways, with the narrow side of the parcel fronting the waterway. Because land in the delta landscape of Louisiana tended to slope down to the rear of the property from the higher ground adjacent to the waterway, the land away from the river near the rear boundary or "40 arpent line" was frequently low lying wetlands, either swamp or bottomland hardwoods and unsuitable for cultivation. "The 40 arpent line" is a term that continues to be used to describe land that is wetlands and unsuitable for cultivation or development.

Use of the arpent land divisions served to maximize the number of land owners with access to both river frontage (the major transportation network of the period) and cultivable land. It continues today to have an impact on ownership and development patterns. One of the modern day effects of the arpent has been a pattern of real estate developments that are linear, perpendicular to the waterway and yet disconnected from one another.

Historically, Louisiana was settled along the highest land, which is frequently a natural levee that runs along a navigable waterway. Louisiana's rich natural resources of fertile soils, abundant freshwater and a premier network of navigable waterways provided economic prosperity. Access deep into the middle of the continent, via the Mississippi River, also served as incentive for the Louisiana Purchase.

In the U.S. Census of 1810, the first national census after the purchase of Louisiana, New Orleans was the 7th largest city in the United States. Because of its strategic port location, New Orleans remained on the list of the top ten most populous cities in the U.S. until 1880, despite limited suitable landscape for expansion and periodic disasters, including a major Mississippi River levee crevasse and numerous yellow fever epidemics.

IMAGE: WILLIAM HENRY JACKSON, CA. 1880-1897, COURTESY LIBRARY OF CONGRESS

CH3-2: New Orleans boomed because of its strategic location at the mouth of the mighty Mississippi River.

IMAGE: PUBLIC DOMAIN

CH3-3: Systematic control of the Mississippi River began in 1879 with the establishment of the Mississippi River Commission. Priorities were navigation, flood prevention and expanded settlement in the floodplains.

IMAGE: USDA FARM SERVICE AGENCY

CH3-4: Aerial image near Parks, LA. Use of the arpent land divisions served to maximize the number of land owners with access to river frontage (the major transportation network of the period) and continues to impact Louisiana's development patterns.

Beginning in 1849, with the passage of the Swamp and Overflowed Lands Act, and the subsequent passage of the Swamp Lands Acts of 1850 and 1855, the federal government began actively encouraging the draining of swamps for agriculture and development, then placing this formerly federally held land in private ownership. These legislative acts, along with the 1879 federal establishment of the Mississippi River Commission, which began the massive undertaking to control the Mississippi River to benefit navigation and prevent destructive flooding, also actively encouraged settlement in lower lands. This had a significant influence in changing not only Louisiana's traditional settlement patterns, but also Louisiana's previously symbiotic relationship with water.

Remaining in Coastal Areas

Historic legislative efforts directly and indirectly led to some challenges citizens face today. One challenge is that residents must weigh whether it is more cost effective to stay in flood prone areas or to relocate. Affordability is a major factor in relocation decisions. After a flood or storm event, the cost of rebuilding can be immense. There are structural rebuilding costs that follow more stringent building codes, such as elevating homes above a "1% chance storm" (likely more expensive than original construction costs and general construction) and increased insurance premiums in flood-prone areas. Additionally, temporary closures of commercial buildings for rebuilding or relocation interrupts families' steady incomes. These closures and relocation of needed services, including grocery stores, schools and churches, require residents to travel greater distances and expend more time, energy and money to acquire basic needs. Many places that were previously working communities are becoming too costly for local residents and are now used primarily by people seeking second homes or recreational "camps." For the residents and communities who do remain, affordability will continue to be a major challenge.

This Manual has been designed with environmental justice in mind and is intended to promote equitable practices by encouraging development that does not disproportionally or negatively impact any population group.

Promoting Equity and Environmental Justice Across the Coast

Another challenge in coastal Louisiana is related to equity and environmental justice. Environmental justice is the fair treatment and meaningful involvement of all people regardless of race, color, national origin or income. It seeks to ensure that no population is forced to bear a disproportionate burden of negative environmental impact. Important in Louisiana, environmental justice also recognizes populations with different patterns of consumption of fish and wildlife.

Environmental justice studies in Louisiana have identified a relationship between many of Louisiana's traditional industries and environmental stressors located in the areas occupied by these industries. Due to environmental stressors in the coastal parishes, where traditional industries are necessarily located, local populations face a disproportionately greater risk of being negatively impacted economically, socially or physically. The presence of heavy industrial facilities has shown strong correlation to the marginalization of populations in these same locations.

IMAGE: HTTP://EN.WIKIPEDIA.ORG/WIKI/FILE:PHOENIXLAZIONTRAVELERSBAPTISTFRONTSIGN.JPG

CH3-5: Phoenix, LA, a large African-American fishing community in Plaquemines Parish, was able to rebuild after Hurricane Katrina by leveraging limited resources and helping each other. The Zion Travelers Baptist Church and Community Center is a place for the community to gather and organize rebuilding efforts.

Economic Conditions

Traditionally, the fishing, hunting, agriculture, lumber, shipping, and oil and gas industries have made up Louisiana's coastal economy. South Louisiana developed into one of the nation's and world's largest shipping complexes. Since the 1920s, oil and gas have become the major economic drivers for the state. In 1947, a consortium of companies developed the state's first offshore well. Communities in coastal Louisiana, including Morgan City, Houma-Thibodaux, Lafayette and New Orleans expanded to serve this oil economy. Manufacturing is Louisiana's biggest industry by value, making up about forty-three percent of the State's receipts. Within this category, the largest manufacturing sectors are petroleum, coal production and manufacturing, and chemical manufacturing. All of these traditional industries depend upon and take advantage of their proximity to our coast and water. Yet Louisiana's economic landscape is shifting in response to combined technological, environmental and global pressures.

Changing Economic Landscape

The state is a key producer in many industries of national significance including seafood, agriculture, manufacturing, petroleum extraction and refining, and chemical. However, many of these industries are changing, and as a result, Louisiana's role may change. For example, a 2005 Louisiana Public Broadcasting program looked at how the State's economy is increasingly bound to the global economy and to the impacts of rising energy costs on the petrochemical industry. As technology advances and near-shore fields are exhausted or technologically difficult to access, oil and gas exploration has moved farther and deeper into the Gulf of Mexico, where federal management of the Outer Continental Shelf has resulted in royalties being diverted from the State to the federal government. The potential volatility of the oil and gas industry was demonstrated during the BP/Deepwater Horizon spill, when the moratorium on deepwater oil and gas drilling was feared to drive oil and gas producers to "friendlier" waters. The movement of many producers out of Louisiana means that local businesses who supply direct support to offshore Gulf drilling operations and their workers suffer.

The changing coastal environment is also leading to changes in the ability of industries to adapt. For example, saltwater intrusion into coastal parishes is changing the definition of viable agriculture. According to the LSU AgCenter, sugarcane is the highest valued row crop grown in Louisiana. After Hurricanes Katrina and Rita in 2005, almost 40,000 acres of sugarcane fields were inundated with salt water. The LSU AgCenter estimated the cumulative economic impact on sugarcane from Hurricanes Katrina and Rita at $286.5 million; cattle impacts at $44.5 million; and rice, citrus, and alligator aquaculture impacts ranging from $12.2 million to $13.3 million each. The economic impact from both hurricanes to agriculture, forestry, fisheries and related wildlife harvests (hunting leases and charter fishing) approached $1.6 billion statewide. Commercial fishing in the State is also facing increasing competition from foreign markets, particularly farm-raised aquaculture imports from Asia.

IMAGE: USDA

CH3-6: Fishing is not only an important industry in Louisiana, but also a cultural mainstay of the region.

Global economics, technology, rising petroleum prices and the changing coastal environment are all shaping Louisiana's economy and industries.

IMAGE: FEDERAL EMERGENCY MANAGEMENT AGENCY (FEMA)

CH3-7: Oil refineries, such as this one in St. Bernard Parish, have been an important source of employment in Louisiana.

Attracting New Investment

In response to changing economic conditions, parishes in Louisiana are trying to diversify their economies. In 2010, the State officially identified sectors around which it sees its economic future: advanced manufacturing; agriculture, food and wood products; digital media; nuclear and renewable energy; entertainment; headquarters and shared services; life science; logistics and transportation; and technology (e.g. biotechnology). Some of these are new versions of traditional industries, while others reflect a new way of thinking about the State's economy in response to global shifts. A common element is that they will benefit from increased certainty and safety around coastal land development.

Global competition, the movement of jobs and industry overseas and the increasing risk in coastal Louisiana, have all lead to economic challenges. Louisiana is now aggressively courting the types of investments that have been going to other states and overseas, which is a long-term challenge for Louisiana. While encouraging safer, more sustainable development alone cannot attract investments in the State, it will create additional certainty, reduce risks and send a strong message that Louisiana wants to be viable in the future. To send this message, several strategies are being employed.

For instance, placemaking, the practice of creating vibrant, successful places, is becoming an increasingly important economic development strategy for attracting educated, creative professionals and businesses. Related to placemaking, recreation and tourism are fast growing economic sectors that rely on the unique culture, natural environment and recreational opportunities available in coastal Louisiana. In order for these strategies to succeed, there must be little risk associated with them.

Insurability and Risk Reduction

While the coastal landscape cannot remain the same, this Manual intends to provide tools with which communities can decrease risks in order to encourage employers and employees to continue to invest in Louisiana. The need to decrease risk became clear in 2005 after Hurricanes Katrina and Rita.

Following Hurricanes Katrina and Rita, insurance premiums increased, and insurance companies raised rates, reduced coverage and, in some cases, pulled out of the market entirely. Reinsurers who provide "back up" insurance to most major national insurers to cover catastrophic events raised premiums, which increased costs to the consumer and impeded redevelopment for lack of affordable coverage. Insurance is a central component of resilience. Because of the centrality of insurance coverage to business activity and development, the insurance industry faces consumer pressure and regulation from states to keep rates low, often pushing rates below the level of risk. When this happens, price signals are skewed and greater development occurs in high risk areas.

Local governments have a major role to play in reducing risk in regards to rebuilding. Land use planning, zoning and development review are all tools communities may employ to ensure safety and economic stability. Given coastal Louisiana's challenging environmental conditions, these tools are worthy of consideration.

"Insured US weather-related losses are growing 10 times faster than premiums and the over-all economy, and even faster when compared with population."

Ceres, Climate Adaptation, Insurance & Public Finance (2010)

Environmental Conditions

The Mississippi River is the largest river system in North America, with the River's watershed extending throughout most of the interior United States. The formation of the delta occurred over many millennia, and most of the current land area of Louisiana was built by a constantly changing active delta area. As the River's course changed over time, sediment deposits built land all along the coast. However, human interventions, in the form of dams, levees and other large- scale infrastructure for navigation and flood protection, have confined the River to its current course and led to the decline of sedimentation that historically protected coastal communities. This has major implications, as the deposition of sediments are no longer able to replenish what is lost from erosion and relative sea level rise.

Land Loss

Land loss is a serious environmental threat to the ecosystems, human communities and economies of Louisiana. Although land loss can occur during storm events, (from beach erosion and vegetative marsh loss), it is often attributed to human activity, such as dredging canals, oil and gas exploration and the loss of sediment deposition from the construction of the Mississippi River levees. With global sea level rises, subsidence and erosion, Louisiana is faced with a serious land loss crisis.

IMAGE: NASA

CH3-8: Historically, the Mississippi River Delta was an ever-changing ecosystem with a deltaic cycle that lasted 1000 years.
A = Mississippi River confinement
B = Sediment falls off of the continental shelf

CREATION OF THE MISSISSIPPI RIVER DELTA

The Mississippi River Delta is the modern area of land built up by alluvium the Mississippi River deposited as it slowed down and entered the Gulf of Mexico.

Each deltaic cycle (about 1000 years long) was initiated by a gradual capture of the Mississippi River by a distributary with a shorter and steeper route to the Gulf of Mexico. After abandonment of an older delta lobe, which would cut off the primary supply of fresh water and sediment, an area would undergo compaction, subsidence, and erosion. The old delta lobe would begin to retreat as the gulf advanced, forming bayous, lakes, bays, and sounds.

IMAGE: NASA

CH3-9: Satellite imagery shows the large amount of sediment that has been deposited along the coastline and wetlands of Louisiana during the flooding events of May 2011.

Sea Level Rise

Long-term, relative sea level rise, which is the combination of sea level rise and land subsidence, is a serious threat to coastal Louisiana and coastal areas globally. Sea level rise may result in flooded coasts, beach erosion, saltwater intrusion into freshwater environments (both surface and groundwater) and wetland loss. According to the International Panel on Climate Change (IPCC) 2007 report, there is strong evidence of sea level rise during the 20th century, and the rate is expected to increase in the 21st century. Globally, the average sea level is predicted to rise 7 to 23 inches in this century. NOAA measured sea level trends vary across the Gulf, with the highest readings being in the vicinity of southeast Louisiana.

Subsidence

In Louisiana, land is subsiding from the lack of new sedimentation that would naturally occur during periodic flooding of the Mississippi River and natural delta compaction and subsidence. In the western parts of the State and in the City of New Orleans, subsidence is also caused by groundwater pumping.

IMAGE: USGS

CH3-11: Land loss in Cameron Parish following Hurricane Rita. Communities such as Cameron and Holly Beach, situated along the coastline, are protected from the full force of major storms only by their beaches, marshes and elevation on the chenier ridges. Communities and settlements all along the coast were devastated in the 2005 hurricane season and again suffered damages in 2008.

IMAGE: ISTOCK PHOTOGRAPHY

CH3-10: Coastal wetlands, which offer natural storm protection, vital habitat and a variety of livelihoods to coastal residents, are undergoing staggering losses.

COASTAL WETLAND FACTS

- 90% of the coastal wetland loss in the lower 48 states occurs in Louisiana.
- 95% of marine species in the Gulf of Mexico spend all or part of their life cycle in Louisiana wetlands.
- Louisiana's coastal wetland provides habitat for more than 5 million waterfowl and is home to more than 70 rare, threatened and endangered species. It is America's largest wintering habitat for migratory waterfowl and songbirds.
- More than 30% of the nation's commercial fishery catch comes from Louisiana coastal areas.
- More than 25% of oil and gas consumed in the nation travels through Louisiana wetlands.

Louisiana Agricultural Magazine Spring 2007.

The USGS estimates that Louisiana has lost 1,900 square miles of coastal wetlands since 1932. While there is no single cause of the wetland and land loss, human actions are a primary factor.

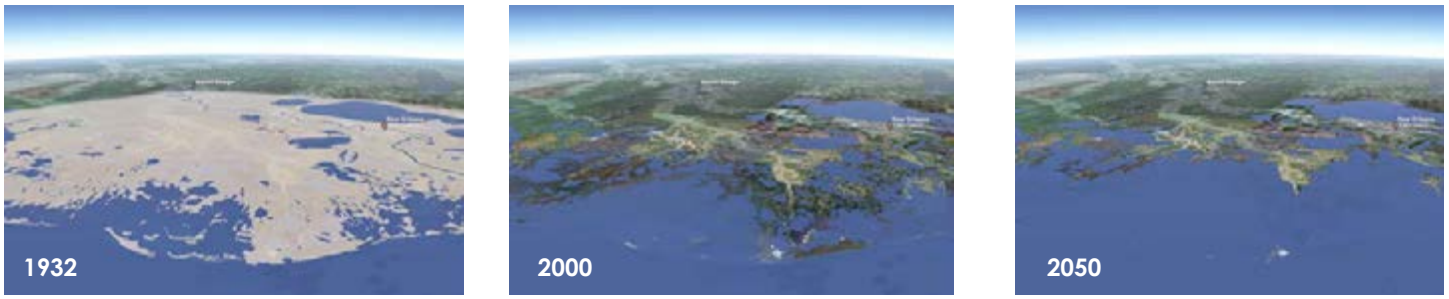


IMAGE: FREGONESE ASSOCIATES

CH3-12: Coastal Louisiana's land loss over time showing how major population centers like Baton Rouge and New Orleans might be affected if no action is taken.

Erosion

In the last century, levees along the Mississippi River have been built to protect human settlements and agriculture from riverine flood danger. In doing so, the expansive lower delta has been deprived of freshwater nutrients and river sediments that replenish its marshes and rebuild its land mass. The soils and marshes that need this periodic input of material to maintain their elevations are no longer replenished. Other factors, such as the introduction and rapid expansion of the non-native nutria, with its voracious appetite for vegetation, have only heightened marsh loss. As a result, there has been a remarkable loss of wetland marshes, increased areas of open water, and higher rates of erosion and subsidence. Ecosystem restoration in coastal wetland marshes—both freshwater and saline—is critical to the safety of Louisiana's coastal communities. Coastal wetlands provide the first line of defense against storm events for many coastal communities and for industrial infrastructure such as pipelines. Additionally, healthy coastal marshlands provide major economic benefits to Louisiana's fish, shrimp and seafood industries.

Flooding

Flooding is a pervasive problem facing coastal Louisiana communities and is caused by a variety of conditions such as heavy rains, high ocean waves, tides, river level rise, and dam or levee failure. Flooding may last days, weeks or months and may occur very quickly as a flash flood. Although flooding may come from rivers and bayous when abundant rain and upland snowmelt in the Northeast and Midwest cause water levels to rise, it most frequently occurs during heavy rain events when water cannot drain fast enough. Backwater flooding, caused by impeded downstream flow, is a common occurrence in Louisiana's flat landscape.

Louisiana's statewide average annual precipitation of approximately 60 inches is the second highest in the country. The highest average annual precipitation in Louisiana is in the Houma-Thibodaux area and approaches 70 inches a year. In 1991, New Orleans received over 113 inches of rain.

Extreme Storms

The Gulf Coast is known for severe weather, including tropical storms and hurricanes. Major storms, like the 2005 Hurricanes Katrina and Rita, cost homeowners, businesses, industry, municipalities and insurance companies many billions of dollars. Major gulf coast storms are massive storm systems that leave paths of destruction that often extend across many states. Not only do these storms cause significant property damage due to wind, rain, storm surge and flooding, they are also responsible for injuries and fatalities.

Storm surges are among the most dangerous aspects of these storms. A storm surge is the temporary rise in water level due to winds and pressure within a hurricane. Storm surges can overtop and erode levees, cause major flooding and wash away buildings, infrastructure and soil. Coastal wetlands and forests function as buffers because they help absorb the energy of a storm surge by reducing its height and blunting its velocity. However, the extensive land loss along Louisiana's coast has left communities and the land on which they have been built with less protection from storms.

Besides flooding and water damage, wind is a major concern during storms. Wind force can destroy building components (roof, siding, communications equipment), and wind-borne (as well as water-borne) debris poses a serious hazard for nearby structures. Coastal forests, in addition to reducing the force of storm surge, can also buffer winds.

IMAGE: PUBLIC DOMAIN

CH3-13: The Mississippi River delta is home to major navigation channels. These channels were built to serve local, state and national economic interests but did so at cost to the coastal environment.

CONSEQUENCES OF INDUSTRY

Canals and banks that bisect the coast allow salt water to reach further inland and pose a threat to freshwater wetlands, marshes and water bodies. The construction of canals has also severed natural ridges that run parallel to the coast. These ridges were created by the Mississippi River over time and separate freshwater marshes from saline water and marshes. For example, the La Loutre Ridge, severed during the middle of the 20th century with the construction of the Mississippi River Gulf Outlet, was recently reconstructed because of the negative consequences its breaching had on the marsh and wetlands behind it.

IMAGE: LORI WASELCHUK

CH3-14: Coastal marshlands are home to many petroleum industry facilities, including exploration, processing, and distribution.

Oil, Gas, and Shipping

Louisiana is home to many industries of national significance, including commercial shipping, fishing, petroleum extraction and refining industries. These industries are dominant economic drivers and sources of livelihood in coastal Louisiana. The effects of energy exploration and production of the vast fossil fuel reserves in coastal Louisiana have harmed delicate ecosystems.

Three primary processes harm wetland ecosystems: canal dredging, saltwater intrusion and habitat fragmentation. In order to navigate the wetland marshes and swamp forests for oil and gas exploration, channels were dredged and soils were piled in "spoilbanks" along the edges of the canal. The spoilbanks are often host to invasive species and, in some cases, act as barriers that alter the hydrology and connectivity of the system, prevent drainage and threaten many species of plants and animals. The channel edges are vulnerable to erosion, creating wider and wider channels as the marsh is exposed to higher wave energies from wind and vessel traffic and saltwater intrusion from the Gulf of Mexico. Sudden salinity increases shock the system, kill freshwater plants and speed conversion of marsh to open water. Finally, channels that are cut into the marshes cause fragmentation of habitat and increase the edge area where plants and wildlife are more vulnerable.

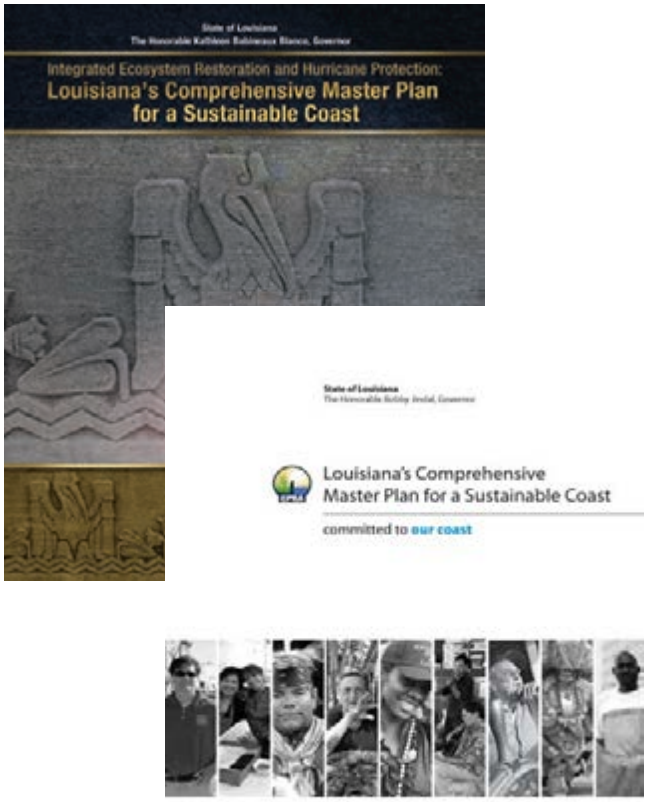
Like the oil and gas industry, shipping and navigation have had widespread, detrimental effects on the coastal environment. The long-term ecological impacts of channelization include salinization and ecosystem change (shifting wetland systems from fresh to brackish to saline), introduction of invasive species of plants and animals and advancement of erosion and land loss.

Current Restoration Efforts and Federal and State Initiatives

While the ecological situation in Louisiana is unquestionably dire, the State is working to slow and reverse land loss and restore the natural environment. Louisiana is implementing an ambitious plan to rebuild its lost land. Unprecedented in the nation, Louisiana's 2007 Comprehensive Master Plan for a Sustainable Coast offered a coast-wide and regional framework for future resiliency. The 2012 update of the Master Plan builds on and advances this work. Some of the issues and strategies outlined in the Master Plan follow. The latest version of the State's Master Plan is available at http://www.coastalmasterplan.la.gov/.

Since the 1930s, the Mississippi River has been controlled by federally built levees. Reducing river flood risks and providing reliable navigation, the levees have allowed agriculture, trade and communities throughout the river's nationwide watershed to thrive. But the levees have also deprived Louisiana's wetlands of the sediment and fresh water that once built and sustained them. The State recognizes that more river water and sediment must be allowed to spread across the delta if a sustainable future is to be provided for the ecosystem, navigation and communities. The State also recognizes that this water and sediment must be reintroduced carefully. Millions of citizens and nationally important industries depend on the current uses and configuration of the river, and their needs must be addressed.

The Master Plan notes that this leaves Louisiana's citizens with an interesting dilemma: "How do we protect our communities and nationally significant infrastructure while also providing for the long-term sustainability of the ecosystem?" Levees are a crucial aspect of providing for a sustainable coast, given that many south Louisiana communities are situated in the largest delta system in North America, the product of one of the world's great rivers. These communities, due to proximity to the Gulf of Mexico, are subject not just to riverine flooding, but also to relatively high levels of storm surge and wave energy. Many of these communities are historic and integral to the delivery of essential services to the nation, but they would not exist without levees. In recognition of the need for structural protection, levees are recommended in high risk areas that must be protected to avoid severe consequences for the State and nation. Yet, as traditionally constructed, levees are frequently in conflict with a healthy ecosystem. The Master Plan recognizes that this presents science and engineering challenges to ensure that future levees allow for the sustainability of wetlands on both sides of the levees.



CH3-15: *Louisiana's Comprehensive Master Plan for a Sustainable Coast* is currently scheduled to be updated every five years.

IMAGE: GOHSEP

CH3-16: The LSU AgCenter involves young people in coastal restoration activities including Marsh Maneuvers and Coastal Roots. In addition, the LSU AgCenter has inaugurated a Youth Wetlands Week for schools, which will occur every year in April.

BENEFITS OF COASTAL WETLANDS

Wetlands are the transition area between land and aquatic ecosystems. Healthy wetlands buffer communities from the impacts of hurricanes and other gulf storms. Various wetlands, including both forested wetlands and marshes, can provide a buffer against storm surge by physically slowing oncoming waves (up to a certain height and volume, beyond which the plants will be overtopped). They can also provide water storage by slowly releasing high volumes of stormwater. Studies by Louisiana State University and Texas A&M researchers showed that levees with wetland buffers had a much greater chance of withstanding Hurricane Katrina than those levees without wetland buffers. Additionally, models showed that the coastal wetlands reduced the surge in some New Orleans neighborhoods by two to three feet. If wetlands are to provide a defense against flooding in coastal Louisiana, efforts must be taken to rebuild lost wetlands and protect the remaining wetlands.

IMAGE: USACE

CH3-17: Dredged material from the construction of the West Bay Diversion channel is utilized to create new wetlands near the mouth of the Mississippi River.

The Master Plan merges near-term solutions to address immediate needs with long-term goals to reach system sustainability. Altered processes must be restored by mimicking, to the extent possible, natural processes to reconnect and maintain linkages to sediment and nutrient delivery while reducing sediment loss to offshore environments. In addition to restoring barrier islands and land bridges, these goals include a combination of river diversions and pipeline conveyance of dredged sediment to rebuild and maintain the coastal landscape.

As the State commences this task, it is up to local communities to do their part to use this effort to their advantage and build on it. Working within the State's Master Plan there is opportunity for communities to make a difference for their residents both now and in the future. Good land use planning and implementing appropriate ordinances tailored to meet their community's unique situation are essential first steps for any community intent on making the most of its precious land, preserving its heritage and establishing its future vitality and economic health.

CHAPTER THREE REFERENCES

Benedict. Saving Louisiana's Coastal Wetlands. LSU AgCenter. Louisiana Agriculture, 2007.

Buskey. Area could flood half of every year. Houma Today, 2010.

Cantrell. Ecology of Louisiana's Gulf Coast Oil and Gas Infrastructure. Visual Logic, LLC.

Researchers Study Hurricane Protection Offered by Marsh Vegetation. LUMCON News, 2010.

The Public Land Survey System. US Department of Interior.
http://www.nationalatlas.gov/

Louisiana Speaks: Planning Toolkit. Louisiana Recovery Authority.
http://lra.louisiana.gov/assets/docs/searchable/LA%20Speaks/LouisianaToolKit_printonly.pdf

Environmental Justice. US Environmental Protection Agency.
http://www.epa.gov/compliance/ej/index.html

Emmer, Wilkins, Schiavinato, Davis, and Wascom. Hazard Mitigation and Land Use Planning in Coastal Louisiana: Recommendations for the Future. Louisiana Sea Grant College Program - Louisiana State University, 2007.
http://www.lsu.edu/sglegal/pdfs/CompPlanningReport.pdf

Environmental Justice Considerations in Lafourche Parish, Louisiana. Louisiana State University and US Department of the Interior, 2004.
http://www.gomr.boemre.gov/PI/PDFImages/ESPIS/2/3024.pdf

History of the Offshore Oil and Gas Industry in Southern Louisiana: Interim Report. Louisiana State University and US Department of the Interior, 2004.
http://www.gomr.boemre.gov/PI/PDFImages/ESPIS/2/2994.pdf

National Security/World Trade: Jobs in a Global Economy. Louisiana Public Square Louisiana Public Broadcasting, 2004.
http://www.lpb.org/programs/LApublicsquare/topic005.html

Key Industries. Louisiana Economic Development.
http://www.louisianaeconomicdevelopment.com/opportunities/key-industries.aspx?src=hp_stat

Lyles and Namwamba. Louisiana Coastal Zone Erosion: 100+ years of land use and land loss using GIS and remote sensing." Southern University - Baton Rouge.

St. Petersburg Coastal and Marine Science Center. USGS.
http://coastal.er.usgs.gov/hurricanes/rita/photo-comparisons/cameron.html

Louisiana's Traditional Cultures. Louisiana Folklife Program. Louisiana Division of the Arts
http://www.louisianafolklife.org/LT/Maidas_Essay/main_introduction_onepage.html

Drawing Louisiana's New Map: Addressing Land Loss in Coastal Louisiana. Ocean Studies Board, 2006.

Will climate change devastate coastal property insurance? South Carolina Sea Grant, 2007.

Louisiana's Comprehensive Master Plan for a Sustainable Coast, 2007.
http://coastal.louisiana.gov

Chapter 4
UNDERSTANDING GEOTYPES

This Manual is designed to guide users through the process of determining best practices for a specific place and scale. To achieve this specificity, it identifies six geographic types or "geotypes" located in coastal Louisiana, and it identifies communities located in each geotype. The geotypes are named according to the dominant natural feature in the area, but they are defined by three key factors: 1) the natural environment of the area, including factors such as water management practices, 2) the cultural identity in each area, including characteristics such as recreation and activities and 3) both traditional and contemporary development patterns that exist in the area, including housing and economic industries. Chapter 5 identifies high priority strategies and best practices that apply to the geotypes.

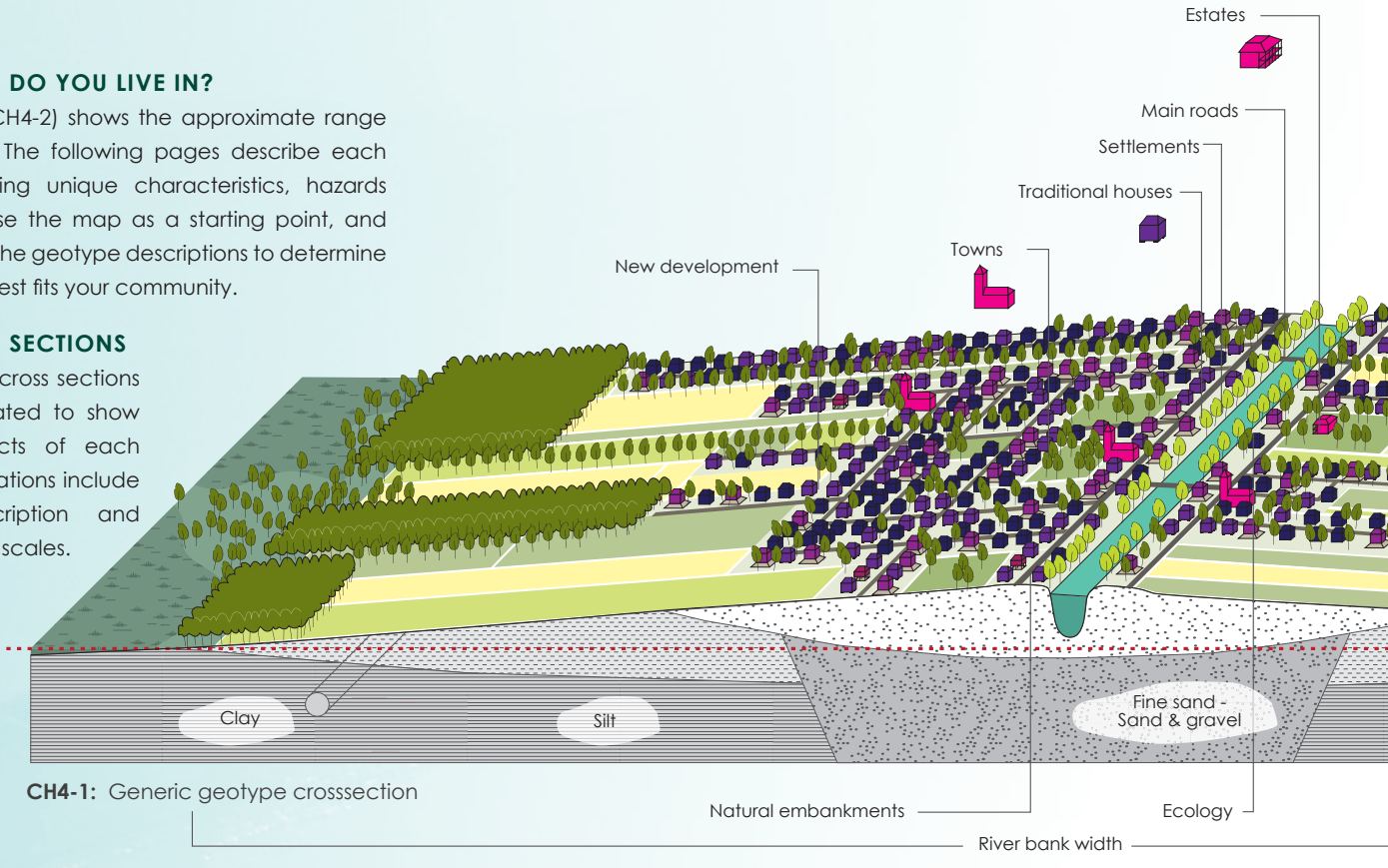
CH4-2: Geotype map of Coastal Louisiana

WHICH GEOTYPE DO YOU LIVE IN?

The above map (CH4-2) shows the approximate range of each geotype. The following pages describe each geotype, highlighting unique characteristics, hazards and challenges. Use the map as a starting point, and then read through the geotype descriptions to determine the geotype that best fits your community.

GEOTYPE CROSS SECTIONS

These generalized cross sections (CH4-1) were created to show the unique aspects of each geotype. The illustrations include a general description and specifics at several scales.



CH4-1: Generic geotype crosssection

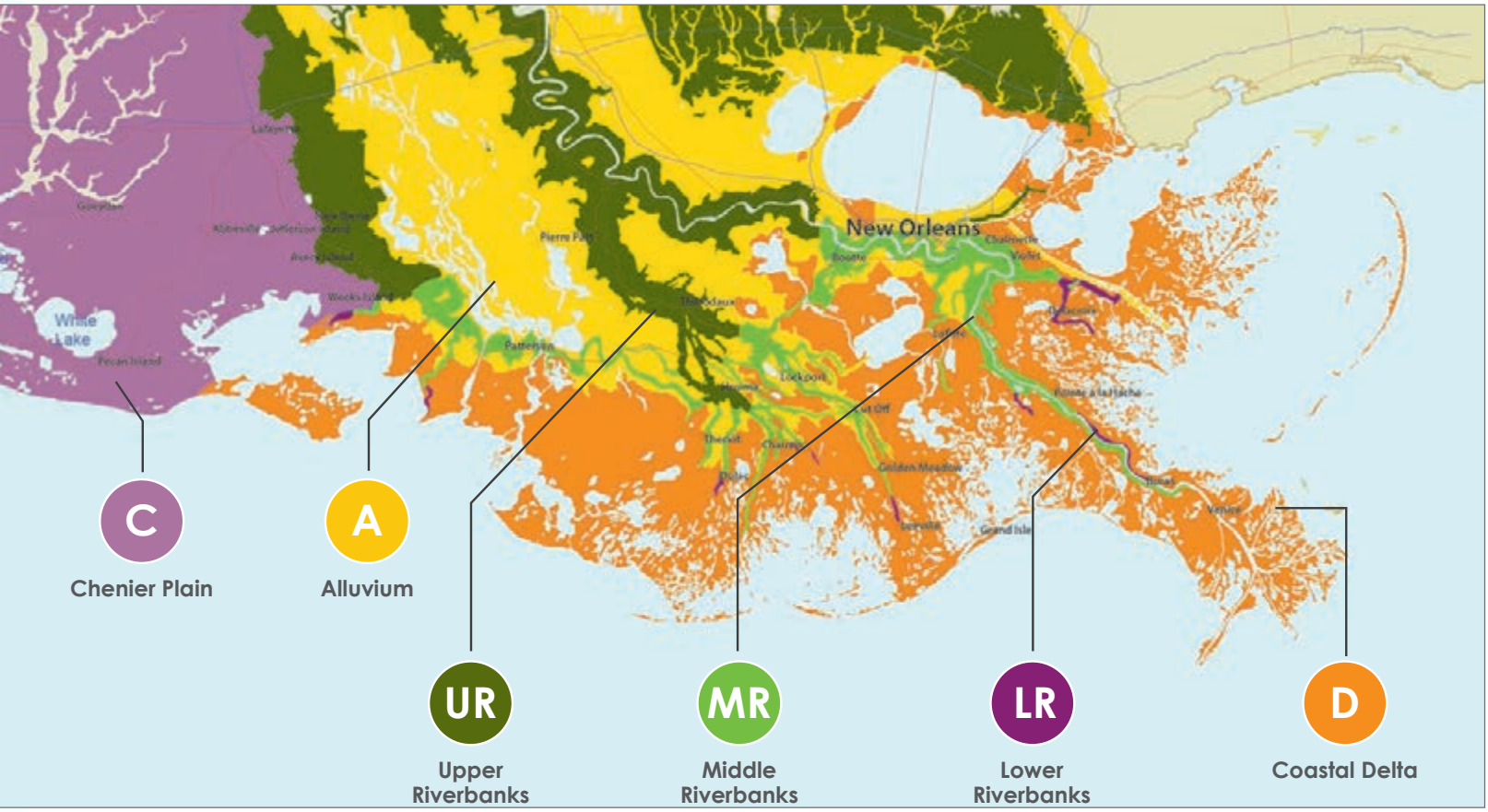


IMAGE: FREGONESE ASSOCIATES

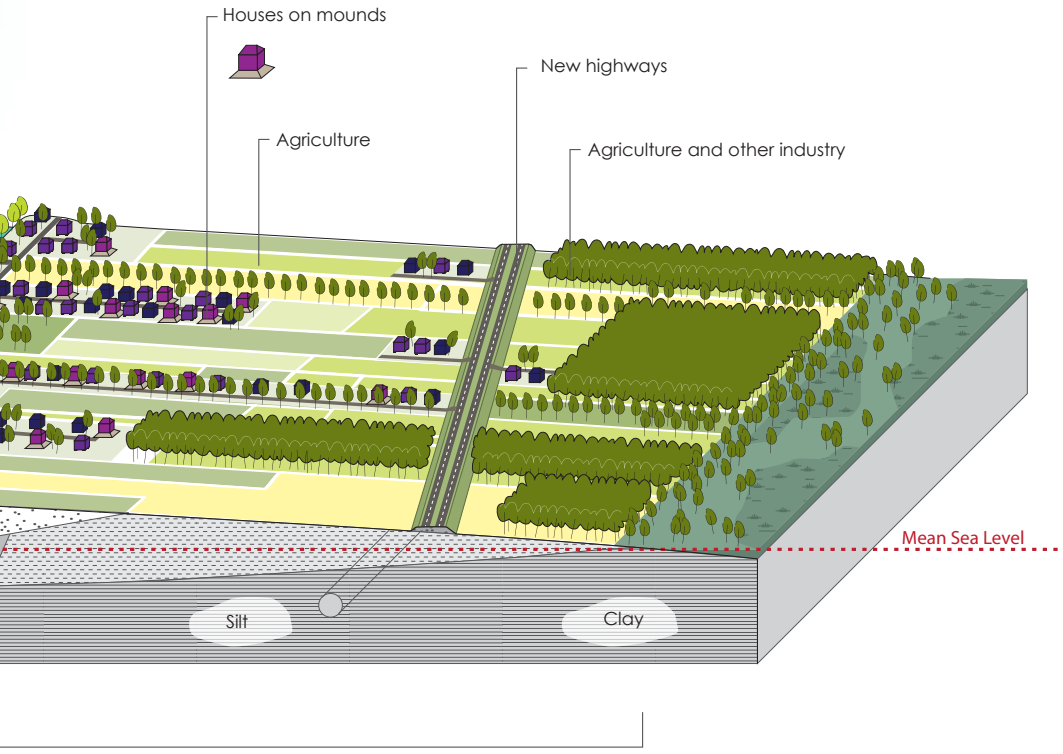


IMAGE: BOSCH SLABBERS LANDSCAPE + URBAN PLANNING

CHAPTER FOUR REFERENCES

Mashriqui, H., Wolcott, M., Bourgeois, D., and Hymel, T. The Next Storm Surge? Storm Surge Vulnerability Report for Terrebonne Parish. Louisiana Sea Grant and LSU Ag Center, 2008.

Louisiana Hurricane Resources. Louisiana Sea Grant. http://www.laseagrant.org/hurricane/archive/wetlands.htm

Parish History: Cameron Parish, Louisiana. Parish of Cameron. http://parishofcameron.net/

Coastal Zones and Sea Level Rise. US Environmental Protection Agency. http://www.epa.gov/climatechange/effects/coastal/index.html

Mississippi River Alluvial Plain. Nature Conservancy. http://www.nature.org/wherewework/northamerica/states/louisiana/preserves/art6867.html

Atchafalaya Delta. Audubon Louisiana Coastal Initiative, 2011. http://louisianacoast.audubon.org/birds-science-education/important-bird-areas/atchafalaya-delta

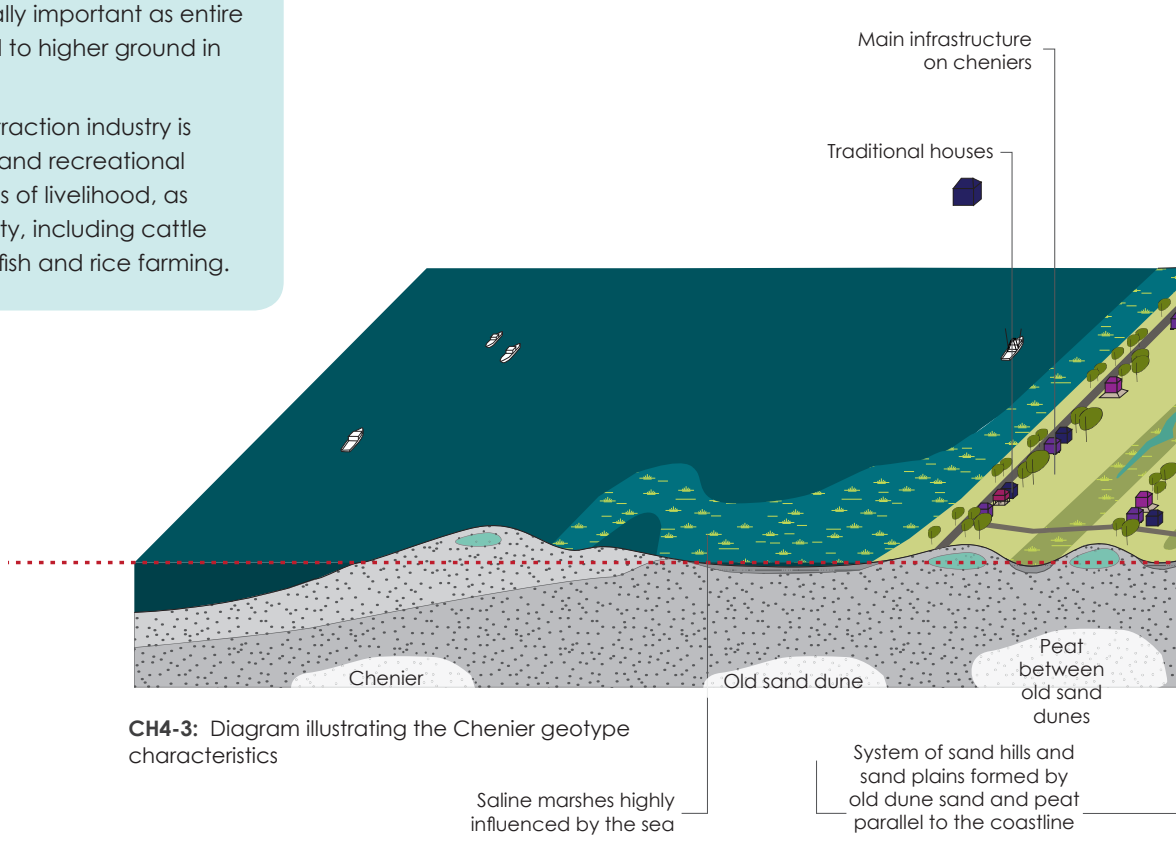
Chenier Plain

Unique Characteristics

- Located in the western region of the Louisiana coast and created by the longshore drift of riverine processes. Named for the distinctive, forested live oak habitat, cheniers (French for oak) are ridges that occur along the beachfront parallel to the coast, interspersed with marsh lands (saline and freshwater depending on the location) between the ridges. The upland prairie terrace, located inland and on higher ground, is the other landform that characterizes this area.
- Saltwater marshes along the coast provide a natural barrier against hurricane surges and eroding wave action.
- Along the sandy cheniers, which are unique geologic formations, settlement is sparse and linear and occurs on the ridges. Homes were traditionally elevated several feet or less, though some may be elevated one level or more.
- Most cities and towns are found upland on the prairie terrace. Other residential development is sparse.
- Few roadways in the chenier plain make transportation connectivity and maintenance vitally important as entire communities must evacuate inland to higher ground in the event of a storm.
- The oil and gas exploration and extraction industry is a major employer. Fishing, hunting and recreational activities also provide major sources of livelihood, as well as significant agricultural activity, including cattle ranching and aquaculture of crawfish and rice farming.

COMMUNITIES WITHIN CHENIER PLAIN

Lake Charles, Holly Grove, Cameron, Lake Arthur, Bridge City, Sulphur, Iowa, Jennings, Kaplan, Abbeville, Erath, Youngsville, Rayne, Crowley



CH4-3: Diagram illustrating the Chenier geotype characteristics

IMAGE: USGS

CH4-4: Chenier ridges near the community of Cameron are visible in this aerial image.

IMAGE: BOSCH SLABBERS LANDSCAPE + URBAN PLANNING

CH4-5: Multiple crops are cultivated on the same land, depending on the flooding and water levels.

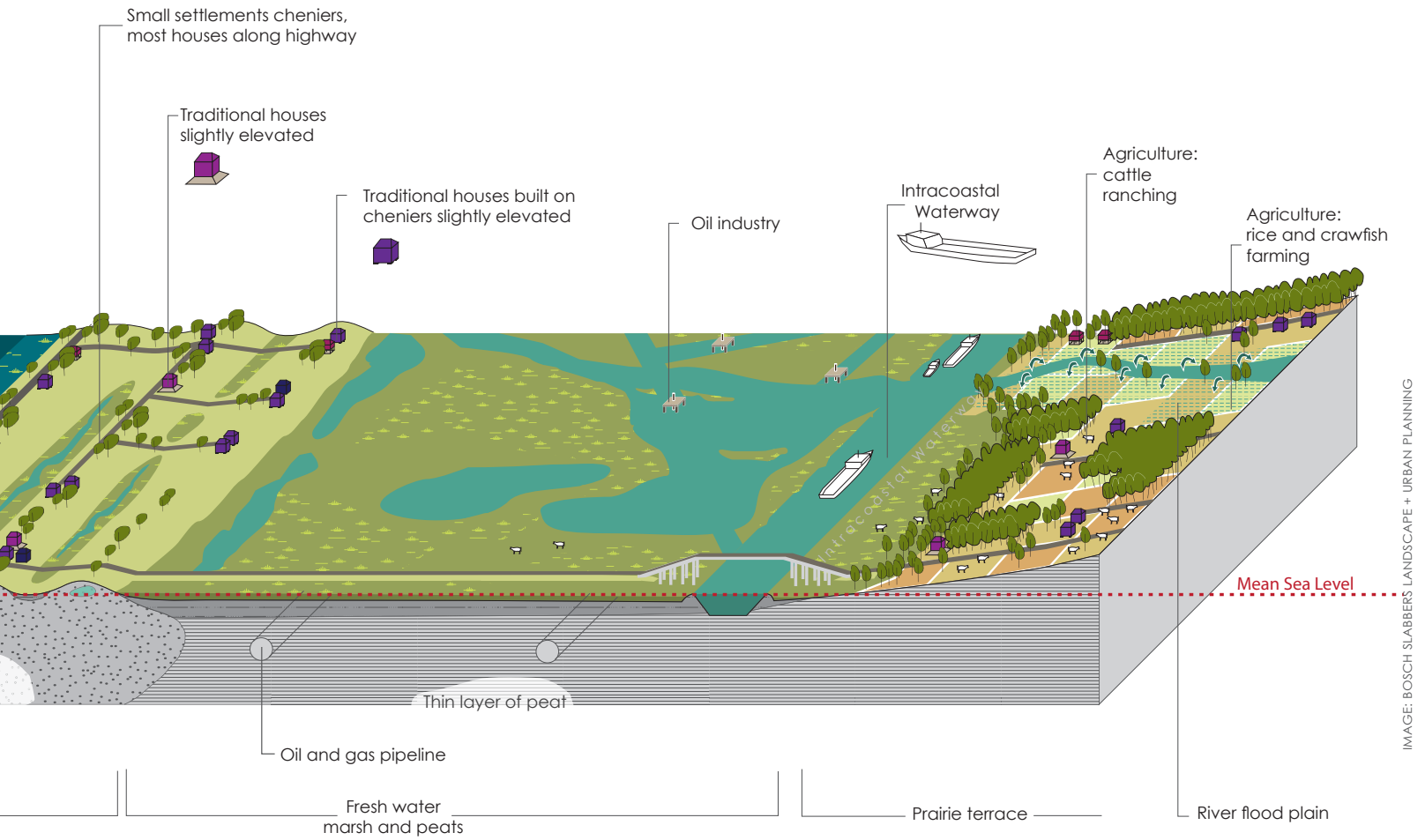


IMAGE: BOSCH SLABBERS LANDSCAPE + URBAN PLANNING

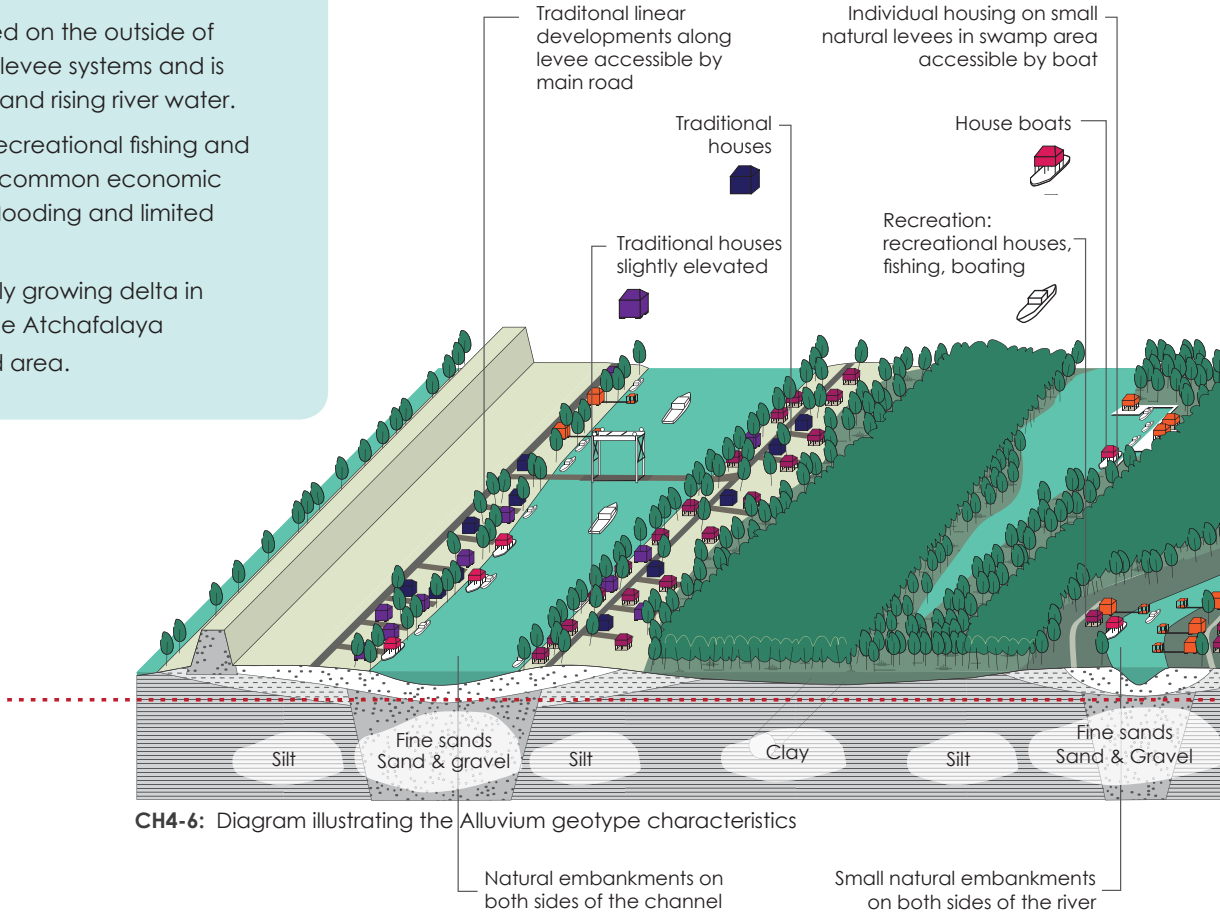
Alluvium

Unique Characteristics

- Located in the low-lying floodplains of the Mississippi and Atchafalaya basins. The Atchafalaya Basin is the dominant feature in much of the alluvium, and it is unique because it is a growing delta system where land area is being built and wetlands are generally stable.
- The alluvium exists in the expanses between fresh waterways, and it is leveed on either side of the floodplains.
- Agriculture is difficult because of frequent inundation by fresh and/or salt water, but there is limited farming and cattle raising. Much of this area is forested.
- Houses and communities are often elevated on pilings, although some older homes may not be elevated.
- Roads typically follow ridges of higher ground located at the banks of flow channels that cut through the alluvium. Large, regional roadways are typically elevated on pilings and may cross over a regional levee to connect to larger centers of population located outside the levee.
- Development is typically located on the outside of community and regional-scale levee systems and is unprotected from storm surges and rising river water.
- Tourism, wild crawfish harvest, recreational fishing and vacation housing are the most common economic activities because of frequent flooding and limited road infrastructure.
- The Atchafalaya Basin is the only growing delta in Louisiana with sediment from the Atchafalaya River gradually building up land area.

COMMUNITIES WITHIN ALLUVIUM

Henderson, Cecilia, Grosse Tete, Pierre Part, Chackbay



CH4-6: Diagram illustrating the Alluvium geotype characteristics

IMAGE: TRULIA.COM

CH4-7: Most housing is located above grade in the Alluvium.

IMAGE: BOSCH SLABBERS LANDSCAPE + URBAN PLANNING

CH4-8: Major roadways are elevated above floodplains and open water.

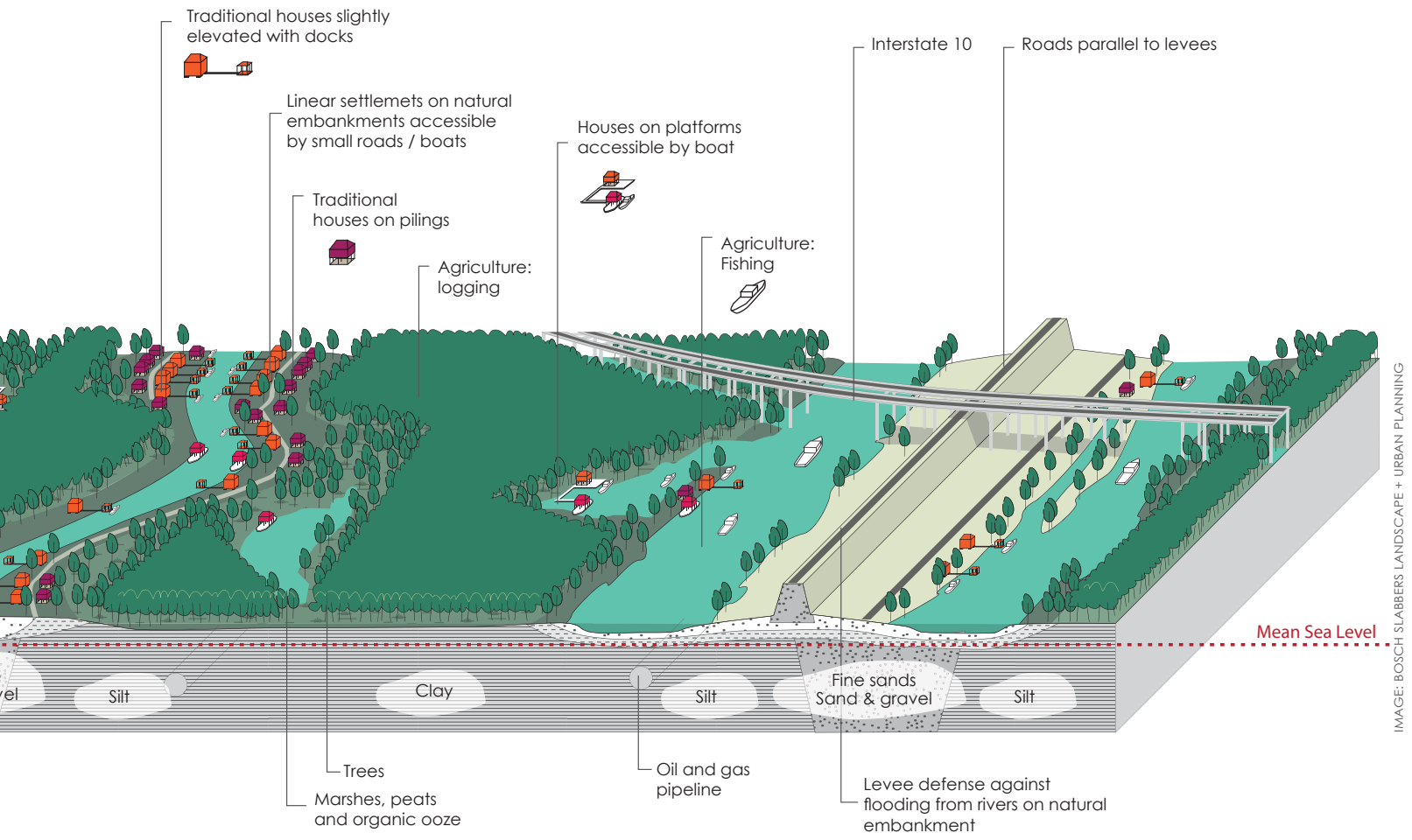
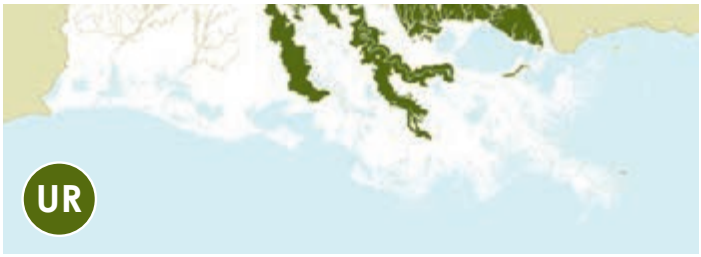


IMAGE: BOSCH SLABBERS LANDSCAPE + URBAN PLANNING

Upper Riverbanks

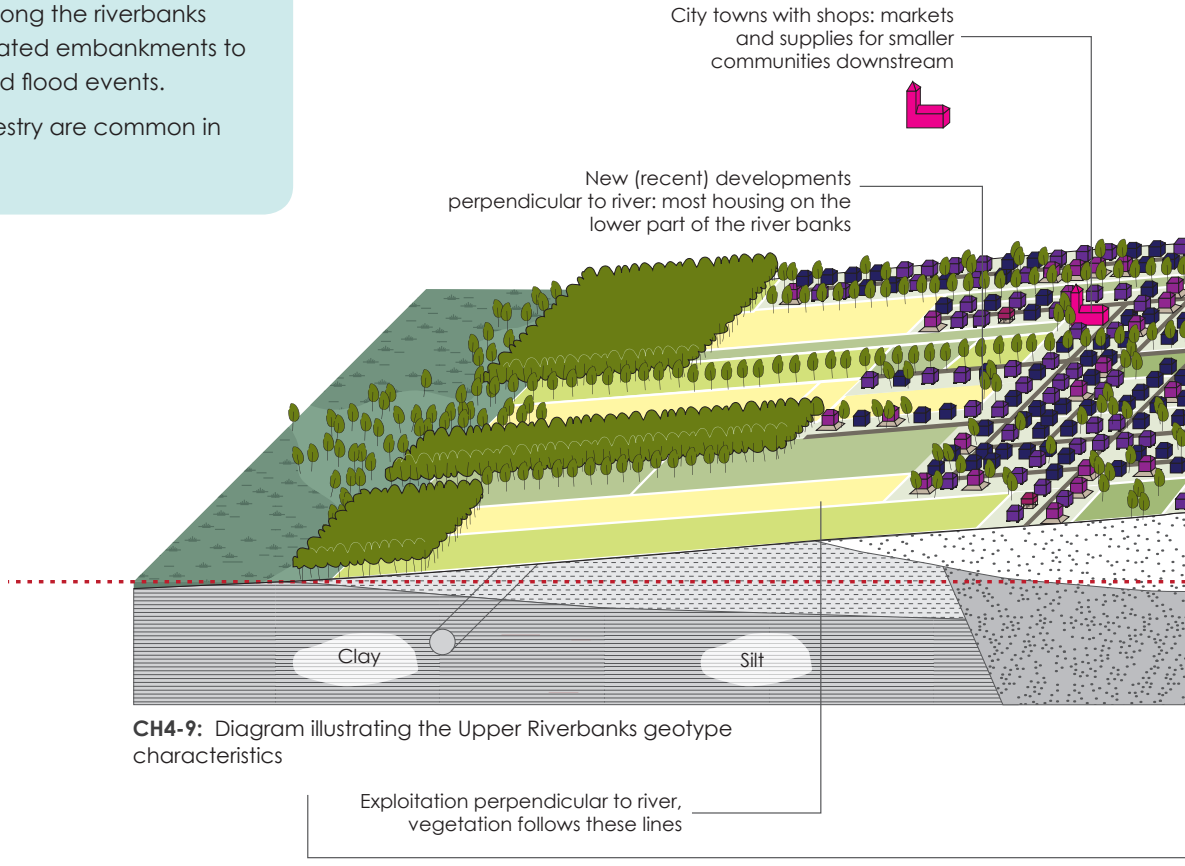
Unique Characteristics

- Located farthest inland and upriver within the coastal area along the Mississippi River and its tributaries and distributaries (bayous).
- Natural levees provide high ground for safer settlements and productive agriculture. As such, they are home to many of the largest (and oldest) cities and towns of coastal Louisiana, providing regional services, including emergency response, medical and social services.
- Land area stretches up to 5 miles across or more.
- Settlements are located adjacent to the river because this land is typically the most stable, driest and widest. Older, traditional houses are generally elevated one to four feet or more above the ground surface.
- The historic parcels, neighborhood streets and significant housing developments that were laid upon them typically extend out perpendicular to the river.
- Automobiles are the predominant mode of transportation. Though water travel is present, it is less common.
- Major roadways often run along both sides of the main waterway. Newer roadways not along the riverbanks are often built on man-made elevated embankments to maintain functionality during limited flood events.
- Agriculture, cattle grazing and forestry are common in rural areas.



COMMUNITIES WITHIN UPPER RIVERBANKS

Destrehan, Luling, New Sarpy, Hahnville, Boutte, Norco, Taft, Montz, Killona, LaPlace, Edgard, Reserve, Garyville, Wallace, Lutcher, North Vacherie, South Vacherie, Mt. Airy, Paulina, Vacherie, Hester, St. James, Convent, Donaldsonville, Darrow, Marchand, McCall, Belle Rose, Magnolia, Brusly St. Martin, Paincourtville, Plattenville, Napoleonville, Bertie, Cancienne, Supreme, Labadieville, Morvant, Thibodaux, St. Charles, Theriot, Schriever, Modeste, White Castle, Geismar



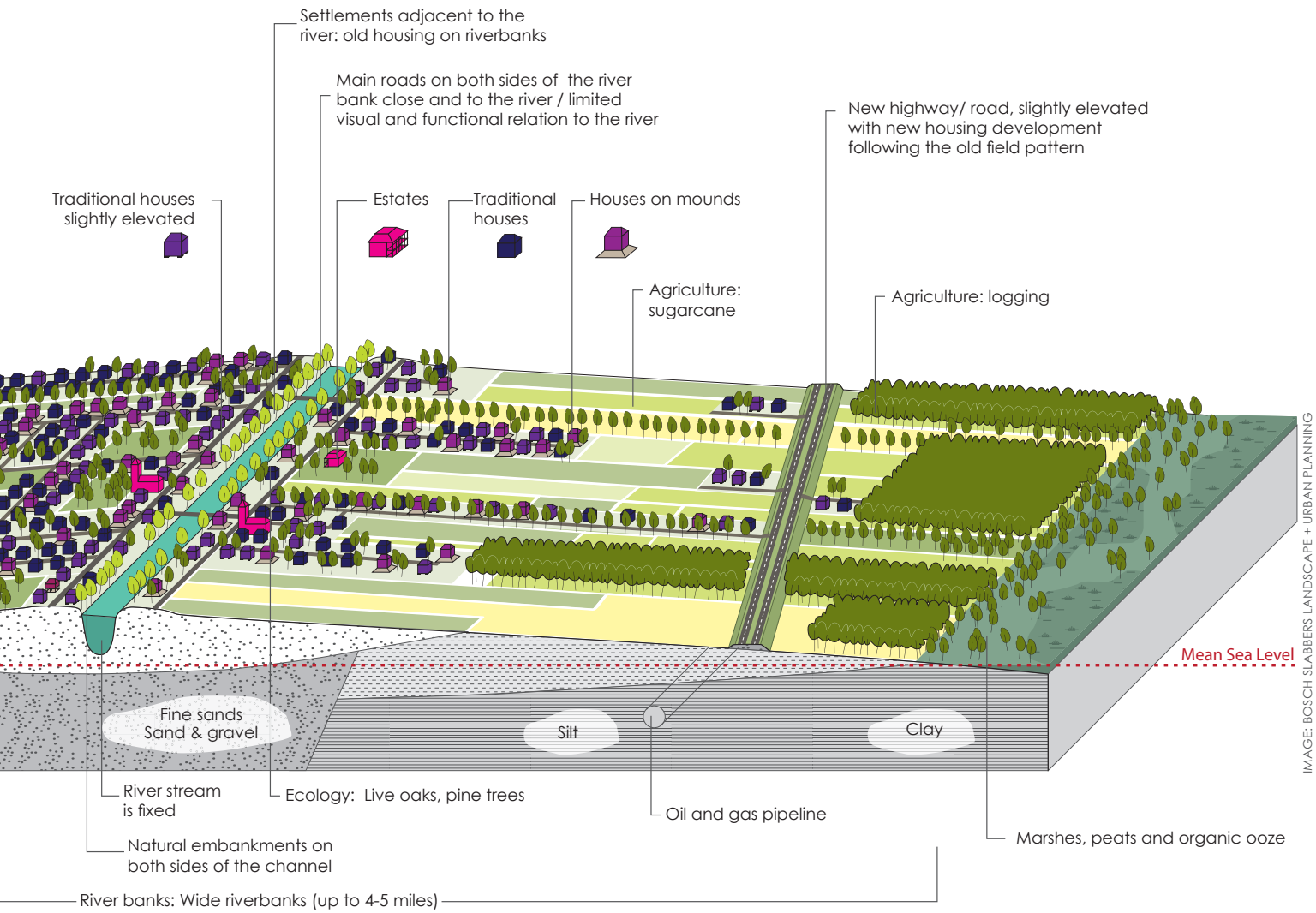
CH4-9: Diagram illustrating the Upper Riverbanks geotype characteristics

IMAGE: BOSCH SLABBERS LANDSCAPE + URBAN PLANNING

CH4-10: Upper Riverbanks are home to many of the largest (and oldest) cities and towns of coastal Louisiana.

COMMON RIVERBANK CHARACTERISTICS

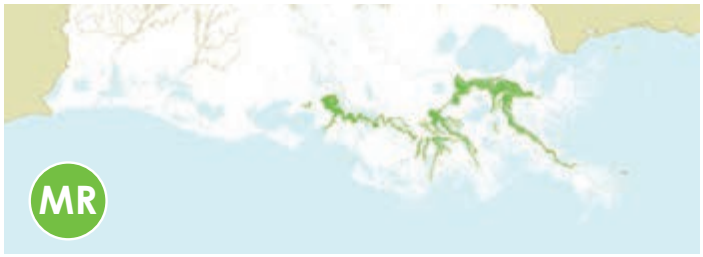
Throughout Louisiana's Mississippi River delta, the highest ground is directly adjacent to the waterway. Historically, bayous and rivers have gradually built up land in the water channel through sediment deposition from seasonal, periodic flooding. Land gently slopes downward, moving away from the channel, before giving way to wetlands and marsh. Because of human intervention and settlement, the riverbanks are fixed and no longer shifting. Narrow properties, shaped by the arpent system, typically extend out from the riverbank to include farm and timber land.



Middle Riverbanks

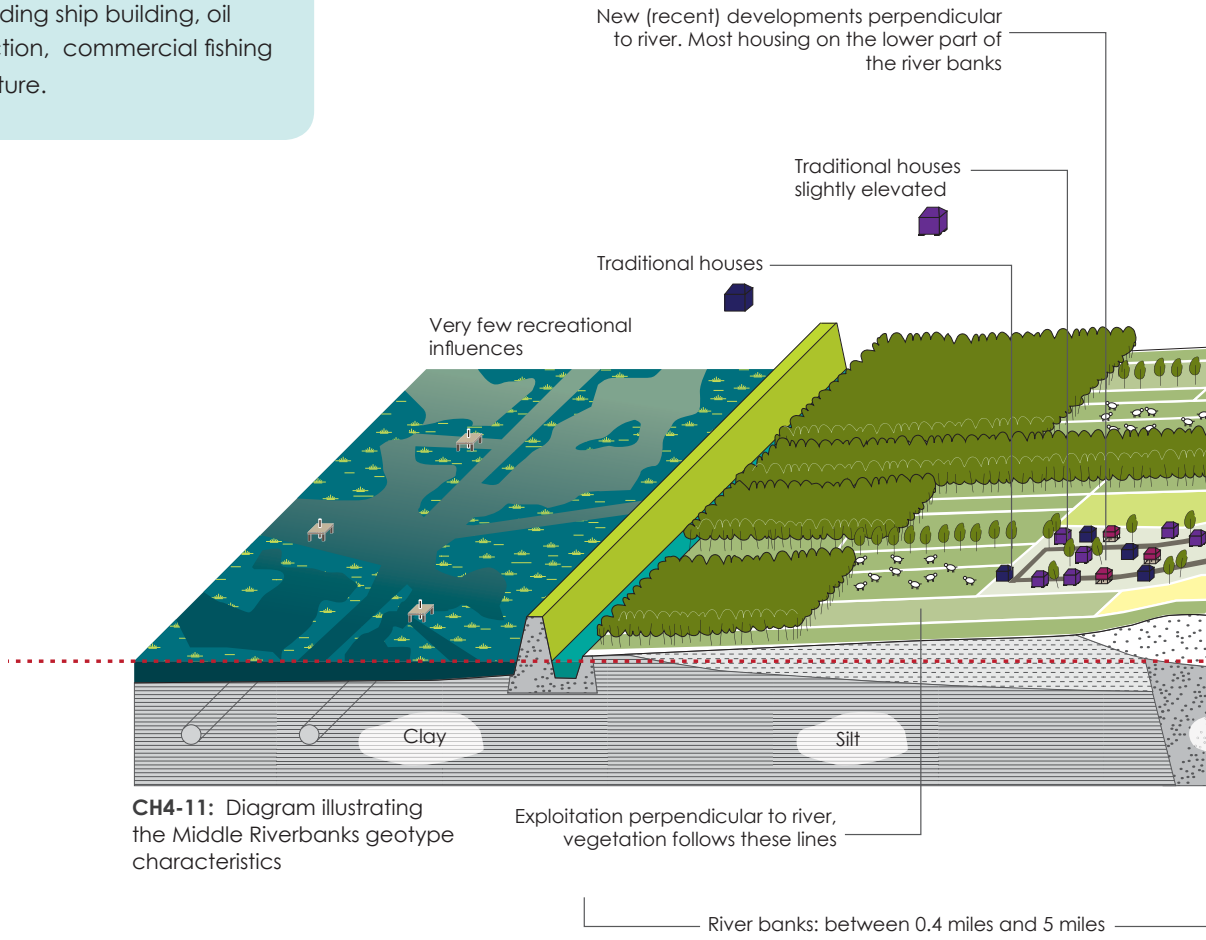
Unique Characteristics

- An area of transition located between Upper Riverbanks and Lower Riverbanks, Alluvium, and Delta Plain geotypes.
- Presence of flood protection levees at outer edge of land area, referred to as "back levees."
- Highest ground adjacent to waterway.
- Land area is between 0.4 miles and 5 miles across.
- Development takes a linear form, parallel to the bayou.
- Houses may or may not be elevated, depending on age of structures. Historic housing may be several feet above grade. Structures built after community adoption of the National Flood Insurance Program (NFIP) are most likely elevated to NFIP standards in place at time of construction.
- Major roadways are located along riverbanks.
- Heavy boat traffic; large vessels are common requiring major bridges to accommodate large boats.
- Variety of coastal industries including ship building, oil and gas exploration and production, commercial fishing operations, shipping and agriculture.



COMMUNITIES WITHIN MIDDLE RIVERBANKS

St. Bernard, Poydras, Old Aurora, Meraux, Chalmette, Arabi, Holy Cross, Tall Timbers, Brechtel, Timberlane, Woodmere, Estelle, Belle Chasse, West Pointe à la Hache, Magnolia, Potash, Buras-Triumph



CH4-11: Diagram illustrating the Middle Riverbanks geotype characteristics

IMAGE: BOSCH SLABBERS LANDSCAPE + URBAN PLANNING

CH4-12: Earthen barriers are used to keep water away from urban and agricultural areas.

IMAGE: BOSCH SLABBERS LANDSCAPE + URBAN PLANNING

CH4-13: Large boats and bridges and floodwalls along the banks of the bayou are common in Middle Riverbank communities.

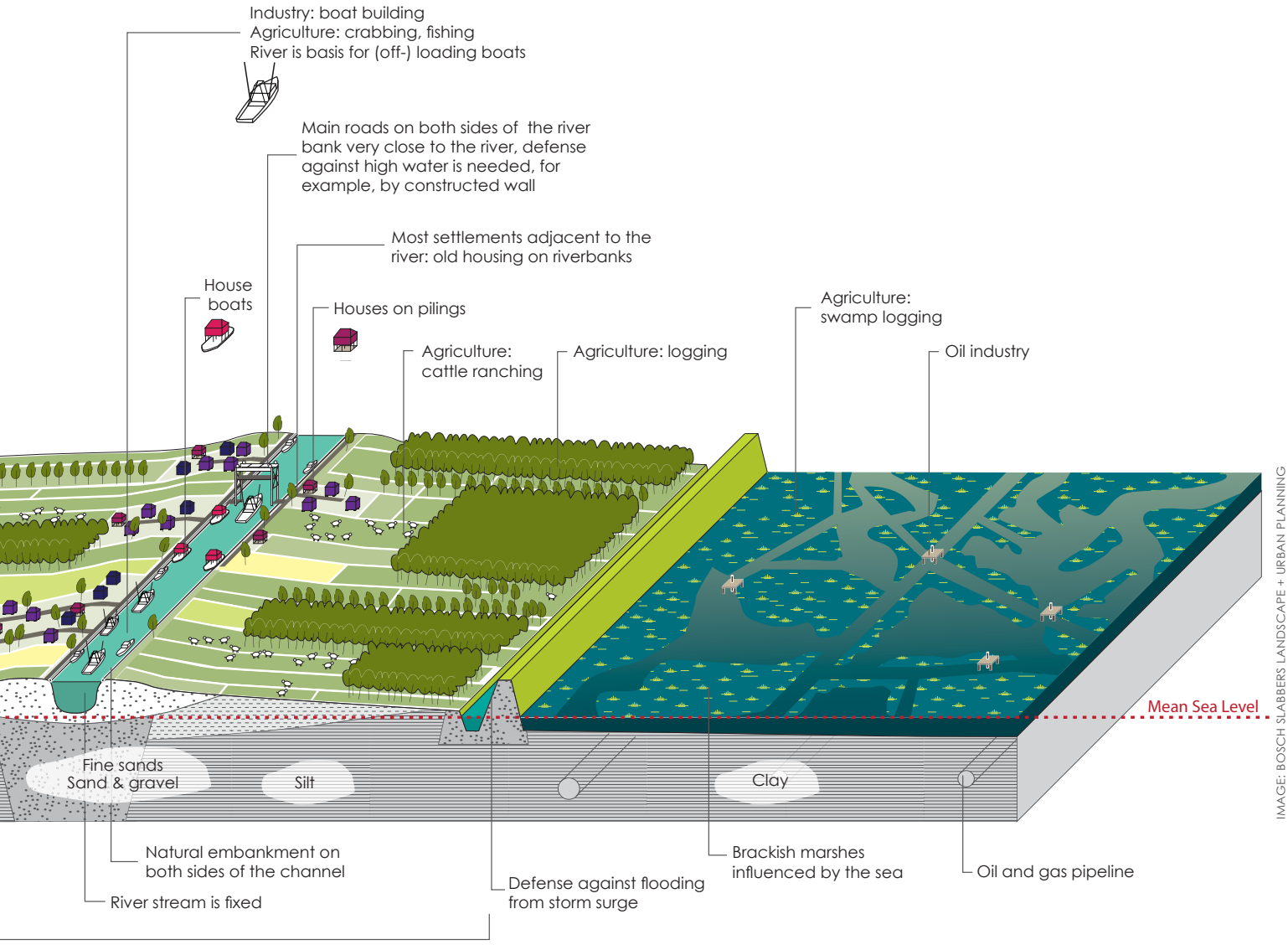


IMAGE: BOSCH SLABBERS LANDSCAPE + URBAN PLANNING

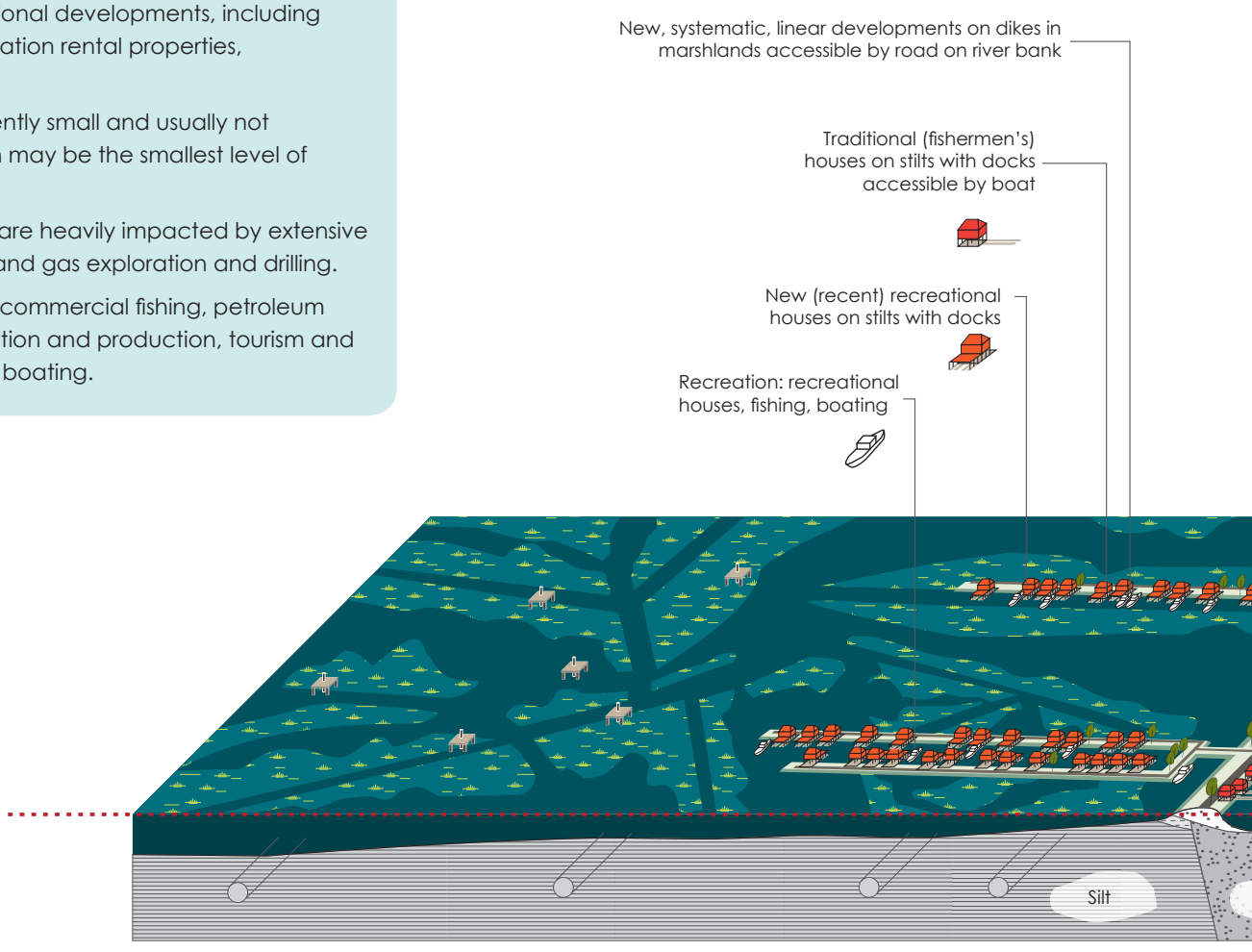
Lower Riverbanks

Unique Characteristics

- Transition area from freshwater to brackish and saline waters.
- Distinguished by the absence of man-made, community-scale levees because the land is generally not wide enough to host a man-made levee.
- Natural levees are comprised of the small ridge of dry ground directly adjacent to the waterway
- Total land area is typically less than 0.5 miles wide.
- Development and roads take a linear pattern that runs parallel to the waterway because this is the only available stable dry land. Newer communities are often built on fill material and arranged in clusters or in long, linear developments. Recreational developments, including second homes and vacation rental properties, are found here.
- Communities are frequently small and usually not incorporated; the parish may be the smallest level of local governance.
- Most of the marshlands are heavily impacted by extensive channelization from oil and gas exploration and drilling.
- Major industries include commercial fishing, petroleum and natural gas exploration and production, tourism and recreational fishing and boating.

COMMUNITIES WITHIN LOWER RIVERBANKS

Ostrica, Bohemia, Pointe à la Hache, Davant, Phoenix, Carlisle, Delacroix, Reggio, Alluvial City, Shell Beach, Hopedale



CH4-14: Diagram illustrating the Lower Riverbanks geotype characteristics

IMAGE: BOSCH SLABBERS LANDSCAPE + URBAN PLANNING

CH4-15: Traditional housing in the Lower Riverbanks is parallel to waterway, surrounded by marsh and open water.

IMAGE: BOSCH SLABBERS LANDSCAPE + URBAN PLANNING

CH4-16: Elevated housing, located on the high ground along ridges built by sediment.

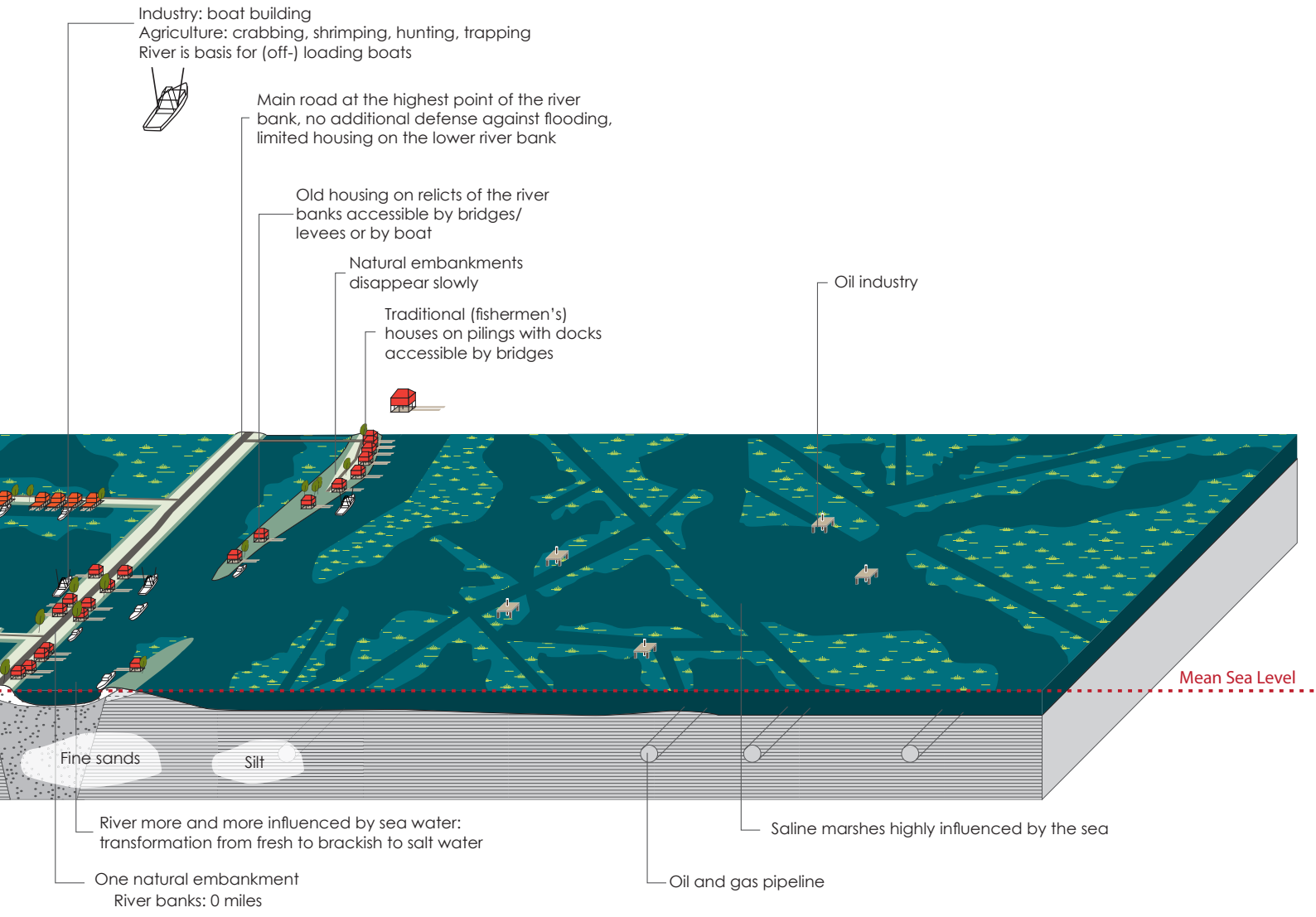


IMAGE: BOSCH SLABBERS LANDSCAPE + URBAN PLANNING

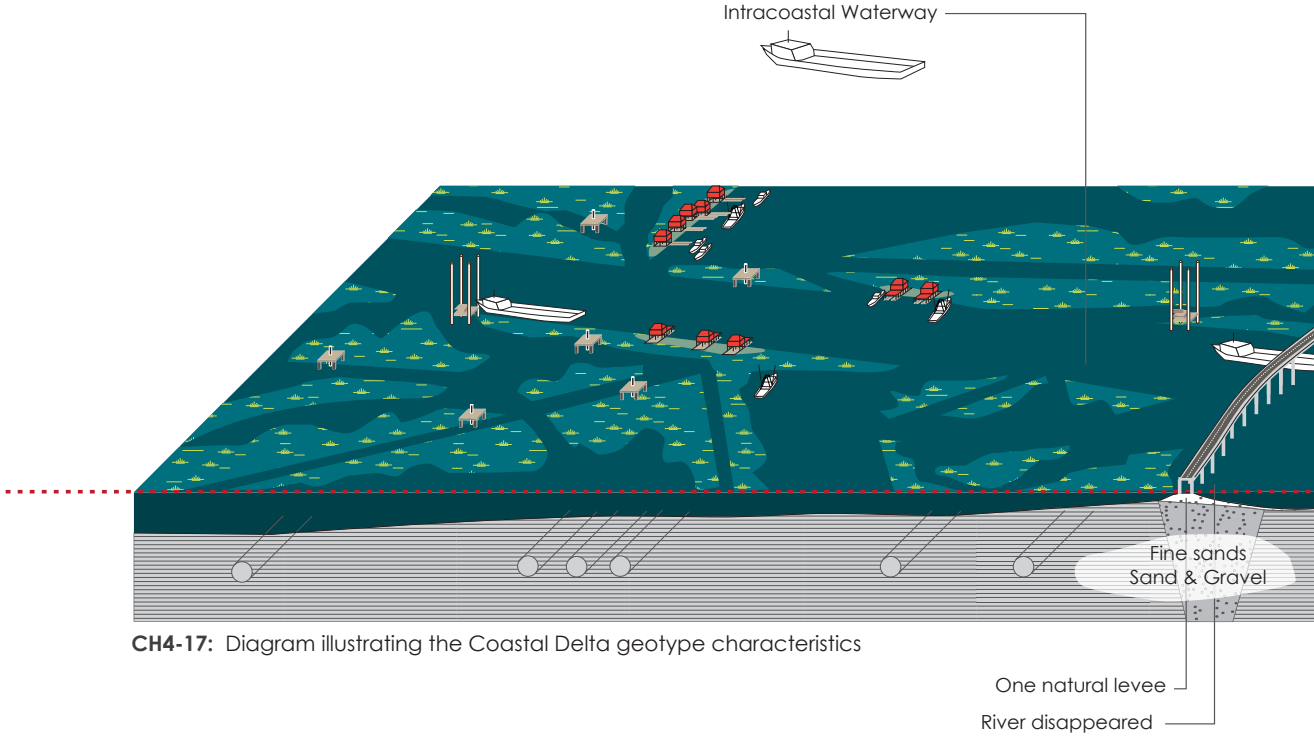
Coastal Delta

Unique Characteristics

- Located at the boundary between land and sea and created by riverine processes, the landscape is dominated by coastal wetlands, open water and estuarine systems; little solid ground exists.
- Settlement is sparse and may be seasonal rather than year-round; fishing cabins and camps are common. These settlements are located on natural levees or ridges and on small islands surrounded by saline marshland. Most are accessible by roadway, but some are most easily reached by boat.
- Houses and other structures are typically built on pilings and have a dock or pier to provide boat access.
- Grand Isle, Louisiana's only inhabited barrier island with recreation and tourism economies.
- Because of extensive land loss, older roadways may require elevation improvements to ensure a safe evacuation route in advance of a severe gulf storm.
- Coastal marsh provides some protective benefits to settlements and extensive pipeline systems.
- Maritime industries are dominant: fishing, shipping, navigation, and oil and gas exploration and extraction.

COMMUNITIES WITHIN COASTAL DELTA

Patterson, Morgan City, Berwick, Amelia, Gray, Bayou Cane, Houma, Lockport, Mathews, Raceland, Des Allemands, Bayou Gauche, Paradis, Larose, Cut Off, Bayou Perot, Lafitte, Dulac, Chauvin, Montegut, Grand Isle, Golden Meadow, Boothville, Venice, Port Sulphur, Barataria, Jean Lafitte, Poydras, Violet, Chalmette, Empire



CH4-17: Diagram illustrating the Coastal Delta geotype characteristics

IMAGE: BOSCH SLABBERS LANDSCAPE + URBAN PLANNING

CH4-18: Communities of the Coastal Delta are faced most frequently with the challenges of rebuilding after flooding and extreme storms.

IMAGE: BOSCH SLABBERS LANDSCAPE + URBAN PLANNING

CH4-19: Boats are a major form of transportation as well as livelihood.

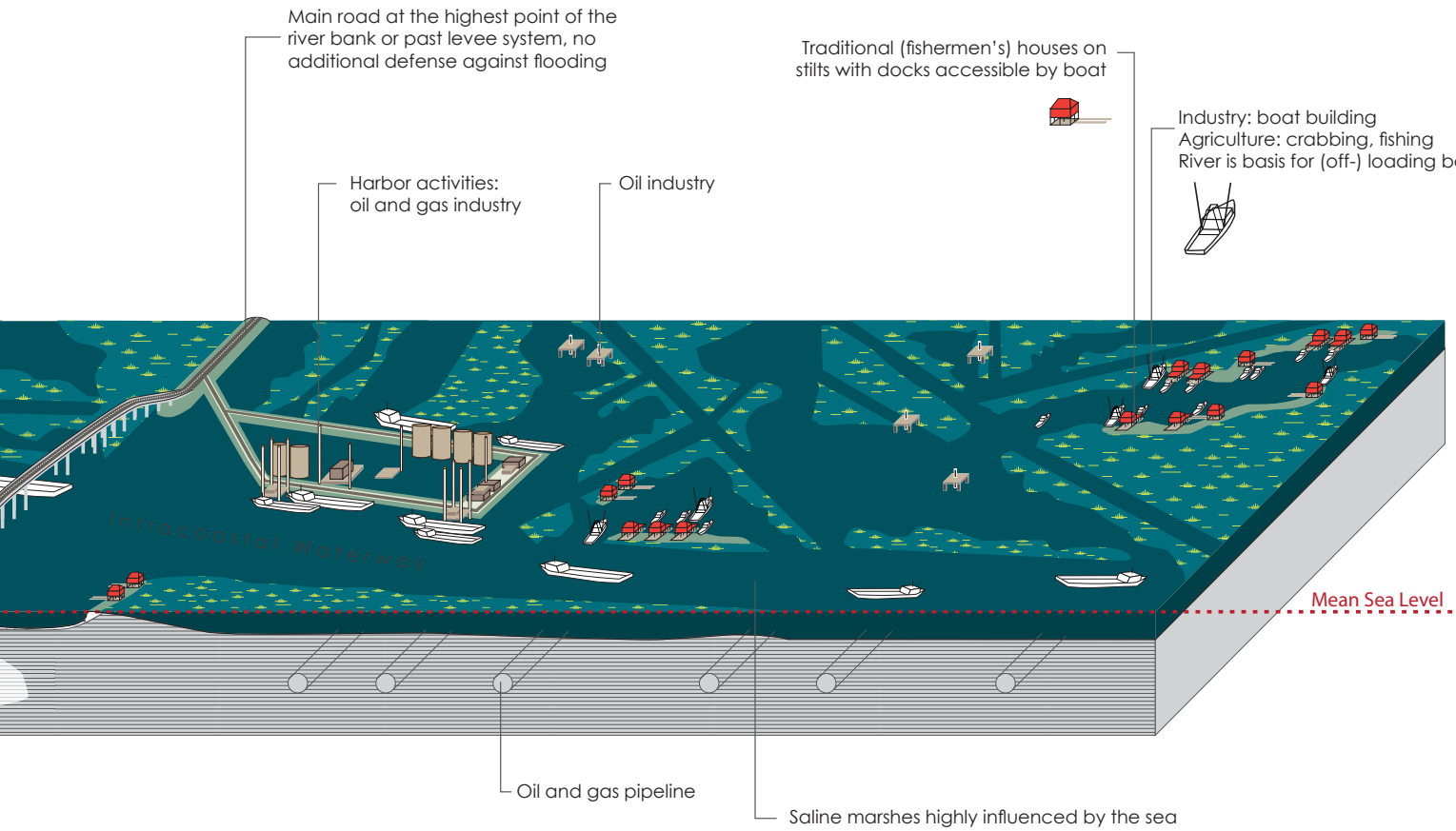


IMAGE: BOSCH SLABBERS LANDSCAPE + URBAN PLANNING

Chapter 5
STRATEGIES AND BEST PRACTICES

Flood protection comes from both natural and man-made solutions. The strategies in the Manual are best used in combination. The application and combination, presented in the matrix on page 48, will be unique for each community. Not every strategy is appropriate in every scale and location, so the matrix proposes a suite of strategies for the community scale, site and building scale, and each geotype to ensure there are cumulative protection measures to increase resiliency and redundancy. Following the matrix, users will find detailed description of each strategy listed on the matrix.

Multiple Lines of Defense

The concept of "multiple lines of defense," originally promoted by the Lake Pontchartrain Basin Foundation, has been adopted by the US Army Corps of Engineers, the CPRA Master Plan and the local New Orleans Comprehensive Master Plan. This strategy includes reinforcing and rebuilding natural and coastal features, such as wetlands, shorelines and barrier islands, to help protect man-made structures, such as levees, and help decrease the impact of storm surge. The "lines of defense" include establishing evacuation routes and making wiser choices about how and where we build—making our communities more resilient by building stronger structures in less risky locations.

A multiple lines of defense strategy ties levee protection and coastal restoration together with land development, coordinated transportation investments, evacuation corridors, stronger building codes and a strategic approach to land regulation. The strategies recommended in the Manual represent lines of defense. In combination with one another, they significantly reduce the risk that individuals and communities bear.

Most, but not all elements, are applicable in every geotype. The multiple lines of defense approach highlights the importance of considering strategies as a suite to select tools to be used together to address the unique conditions and hazards of coastal development.

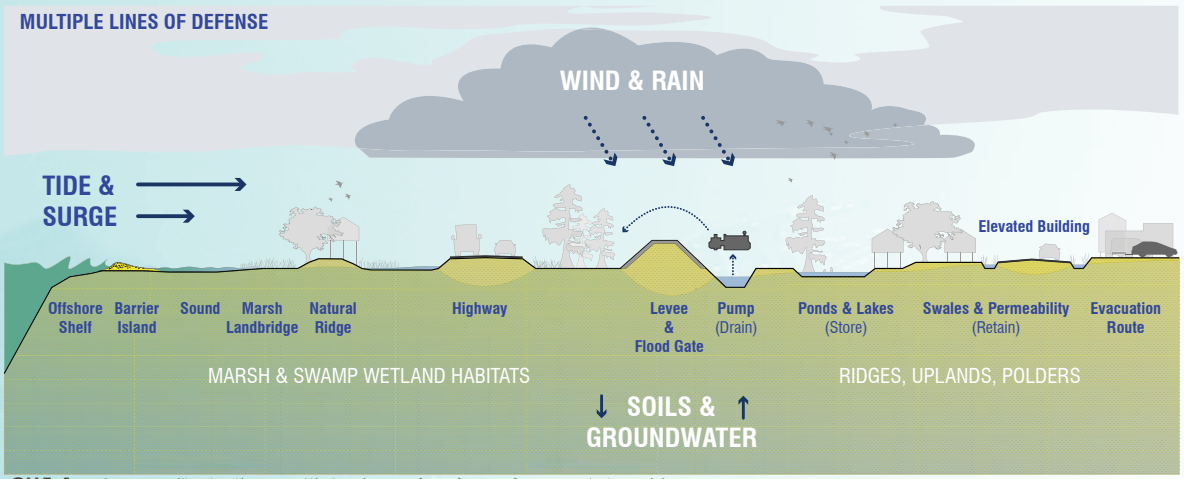


IMAGE: WAGGONNER & BALL ARCHITECTS

CH5-1: Diagram illustrating Multiple Lines of Defense for coastal Louisiana

Understanding the Strategy Matrix

The matrix on page 48 provides an interface between the geotypes, community scale strategies, and site and building scale strategies. All of the strategies are either essential or have some utility, regardless of the geotype in which you are working. The Manual rates each of the strategies in terms of being essential, encouraged, or optional in development of plans and interventions for each geotype; therefore, planning and implementation resources may be allocated strategically.

COMMUNITY SCALE

The community strategies are intended for parish and municipal governments and for neighborhood or subdivision scale developments. They include discussions about how a community might plan for the future. It is important for users of the Manual to begin with an understanding of the potential, or lack thereof, for growth, new development, restoration and revitalization in the community. This will strongly influence which strategies are most appropriate.

PLANNING AND EDUCATION STRATEGIES

Community planning, organization and citizen education are imperative to successfully dealing with disasters. The strategies explore ways that a community can begin this planning effort and the minimum plans required to prepare for a disaster.

INFRASTRUCTURE DESIGN STRATEGIES

The best way to protect infrastructure is to locate it above the flood elevation. If infrastructure is located below flood elevation, these strategies are used to survive occasional flooding. Those areas vulnerable to wind must weigh the costs of effective strategies that protect from both flooding and high winds.

WATER MANAGEMENT STRATEGIES

"Living with Water" is a central theme of the Manual. Accommodating water is imperative for long-term resilience. Water management strategies allow coastal residents, businesses, and entire communities to maintain their ways of daily life. A good reference to begin with is the Coastal No Adverse Impact (NAI) Handbook by the Association of State Floodplain Managers.

SITE DESIGN STRATEGIES

One of the most important community-level strategies is focusing on safer development by starting with good planning and design. Site design strategies are useful for guiding not only decision-makers, but also property owners and developers.

SITE AND BUILDING SCALE

There are many ways to make existing buildings safer, whether by improving structural integrity, strengthening the building envelope, including armoring to stave off floodwaters or locating the building above the floodplain. Many buildings in storm-prone communities in Louisiana have endured minimal damage from hurricanes due to construction techniques that are designed to withstand hurricane-strength gusts of wind, wind-driven rain and flooding. This will become more common as buildings are built (or rebuilt) to the improved state-wide building codes (IBC, adopted in 2006). Communities in coastal Louisiana face serious challenges but may carefully consider their options and make choices that reduce risk; for example, site selection is an important component of community resiliency.

PLANNING AND EDUCATION STRATEGIES

Planning and education strategies are about anticipating future scenarios and educating the public about their various options.

SITE DESIGN STRATEGIES

There are strategies at the individual building level that offer flood protection in areas that are prone to milder floods (less than three feet in depth) that do not require elevation of the living quarters. There are many factors that can improve the building's ability to be sealed and flood-proofed. Other strategies ensure the building's structural integrity and protect the property from storms.

STRATEGIES AND BEST PRACTICES FOR COASTAL LOUISIANA

STRATEGY MATRIX KEY

- **Essential** = Critical strategy that must be implemented where possible
- **Encouraged** = Useful strategy that should be examined for relevance and efficacy
- **Optional** = Not a critical strategy but could be of use in some circumstances

RELATING EACH STRATEGY TO GEOTYPES

Each strategy is tied to geotypes for which it is essential, encouraged, optional or not applicable. In this example, the strategy is essential in the Delta, encouraged in Alluvium, Upper, Middle and Lower Riverbanks and not applicable in the Chenier.

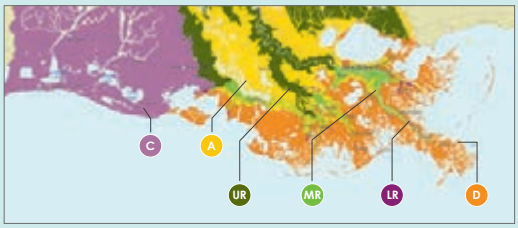
EXAMPLE STRATEGY

Essential — D

Encouraged — A, UR, MR, LR

Optional

N/A *Not applicable* — C



GEOTYPES

STRATEGIES AND BEST PRACTICES	C CHENIER PLAIN	A ALLUVIUM	UR UPPER RIVERBANKS	MR MIDDLE RIVERBANKS	LR LOWER RIVERBANKS	D COASTAL DELTA
COMMUNITY SCALE						
PLANNING AND EDUCATION						
Create a Community Resiliency Plan	●	●	●	●	●	●
Create Emergency Response Plans	●	●	●	●	●	●
Ensure Safe Evacuation Routes	●	●	●	●	●	●
INFRASTRUCTURE DESIGN						
Assess Infrastructure	◡	●	●	●	●	●
Protect Roads and Street Networks	◡	●	●	●	●	●
Protect Electrical Networks	◡	●	●	●	●	●
Elevate Critical Infrastructure	◡	●	●	●	●	●
Protect Water and Sewer Infrastructure	◡	●	●	●	●	●
STORM WATER MANAGEMENT						
Use Sustainable Water Capture Systems	●	●	●	●	●	●
Conserve and Restore Wetlands	●	●	●	●	●	●
Build Low Earthen Barriers	◡	◡	◡	◡	◡	●
SITE DESIGN						
Preserve Community Character	◡	●	◡	◡	◡	◡
Elevate Multiple Buildings	◡	◡	◡	◡	◡	◡
SITE AND BUILDING SCALE						
PLANNING AND EDUCATION						
Educate Home and Business Owners	●	●	◡	●	●	●
Relocate Strategically	◡	◡	◡	◡	●	●
SITE DESIGN						
Secure the Structure in Flood	●	◡	◡	●	●	●
Secure the Building In Wind	●	●	◡	●	●	●
Prepare the Property Before a Storm	●	●	◡	●	●	●
Elevate Living Space Above BFE	●	●	◡	●	●	●
Utilize Innovative and Adaptive Buildings	◡	◡	◡	◡	●	●
Utilize Floating Homes	◡	◡	N/A	◡	◡	◡
Strategic Site Development	●	◡	●	●	●	◡
Use Native Plants for Protection	●	●	●	●	●	●

PLANNING AND EDUCATION STRATEGY

Create a Community Resiliency Plan

● *Essential* C A UR MR LR D

◒ *Encouraged*

◡ *Optional*

N/A *Not applicable*

Planning is the foundation for developing community-wide strategies. Planning may be conducted by local governments, other public departments or agencies, or by community groups. Planning is useful at several scales: city, parish and regional. Community plans may include disaster planning, land use planning, and future growth planning. Communities with emergency and post-disaster plans in place may rebound quicker after a disaster due to a better inventory of their immediate needs and priorities within their planning boundary. Partnerships among parishes, state and federal agencies, non-profits, local governments, and private developers are fostered by community planning strategies. The planning process is a multi-step process, based upon future scenarios of the coastal landscape that should include public input and involvement of stakeholders at each stage. A base reference is *Louisiana's Comprehensive Master Plan for a Sustainable Coast*, available at http://coastal.louisiana.gov/.

Disaster redevelopment and risk reduction plans may include the strategic decision for individuals or a community to relocate. Community leaders are a resource to local residents and business owners as they assist in weighing the costs and benefits of whether to fortify buildings and stay or relocate to higher ground. Local governments may also distribute information about places to relocate that are not as flood-prone. Relocation can refer to moving a building away from flood threats, rebuilding destroyed structures in safer areas, or a person's, family's or community's choosing to move to a different area.

IMAGE: LOUISIANA SPEAKS

CH5-2: Public workshops are a way to engage the community around potential solutions.

TERREBONNE PARISH
Best Practice Case Study: Terrebonne Parish
Scale of Project: Community level

The *Comprehensive Coastal Restoration Plan for Terrebonne Parish* was prepared following *Louisiana's Comprehensive Master Plan for a Sustainable Coast*. Encompassing the "multiple lines of defense" concept, Terrebonne ensures community resilience through proper planning, design, and construction. The plan provides a flexible framework that will be updated and prioritizes projects for implementation.

The Planning and Zoning Department implements these projects through the *Terrebonne Flood Protection Strategy*. Projects are split into three sections: structural protection projects, non-structural protection projects, and restoration projects.

Terrebonne Parish Consolidated Government
www.tpcg.org

Comprehensive Coastal Restoration Plan for Terrebonne http://tinyurl.com/TPCPCR

PLANNING AND EDUCATION STRATEGY

Create Emergency Response Plans

● *Essential* C A UR MR LR D

◒ *Encouraged*

◡ *Optional*

N/A *Not applicable*

Preparedness is crucial to a community's survival of any disaster. Parishes and municipalities, community leaders and residents, and churches and organizations will all be involved in implementing and leading emergency response efforts.

Create a Parish Emergency Plan

When creating a community emergency response plan, find approaches that protect lives and property in an equitable manner. Federal law requires that emergency response plans be periodically updated; if a community has a plan, it will need to be revisited and reviewed. Also, plans need to be tested and emergency exercises conducted in the community. Every plan should specify what is to be done in what order and who is responsible for carrying out tasks.

Distribute Emergency Check-Lists

Using resources from The Governor's Office of Homeland Security (GOHSEP), Federal Emergency Management Agency (FEMA) and other agencies, community and parish officials should prepare emergency check-lists that can be distributed to businesses, homes and individuals. Special considerations should be made for sight-impaired or non-English speaking residents (e.g., through the use of radio and translators).

Teach Preparation at Schools

Schools provide an important forum to convey emergency information. If children hear and understand this information at a young age, their responses at the time of emergency will be more natural. Additionally, teaching children important strategies means the information also reaches their parents.

IMAGE: FLORIDA PDRP

CH5-3: PDRP guides communities through pre-disaster planning and post-disaster implementation ensuring resiliency.

POST-DISASTER REDEVELOPMENT PLANNING

Best Practice Case Study: Florida

Scale of Project: Regional level

Very few places have a pre-event disaster recovery plan. The Florida Post-Disaster Redevelopment Planning (PDRP) Initiative requires that all coastal counties and municipalities have a disaster recovery plan. PDRP identifies policies, operational strategies and roles and responsibilities for implementation that will guide decisions that affect long-term recovery and redevelopment of the community after a disaster. Recovery topics addressed include sustainable land use, housing repair and reconstruction, business resumption and economic redevelopment, infrastructure restoration and mitigation, long-term health and social services support, environmental restoration, financial considerations, and short-term recovery actions that affect long-term redevelopment and other long-term recovery issues identified by the community.

Florida Division of Emergency Management (guidebook)
http://tinyurl.com/florida-PDRP

Hazard Mitigation: Integrating Best Practices into Planning
http://tinyurl.com/apa-hazardmitigation

THE SPECIFICS OF EMERGENCY RESPONSE PLANS

Emergency plans can be used to:

- Activate an emergency operations center
- Make evacuation decisions
- Hold or release children from schools—depending on safety

Emergency plans can describe how to:

- Close openings in flood walls, levees
- Change traffic flow on evacuation routes
- Close hazardous bridges and streets
- Provide transportation to evacuate people without vehicles
- Monitor water levels
- Provide security and policing for evacuated areas
- Coordinate agencies with shared responsibility

EMERGENCY RESPONSE RESOURCES

The Federal Emergency Management Agency's (FEMA) Guide for All-Hazards Emergency Operations Planning is a detailed resource for communities to look to when creating a disaster response plan.
http://www.fema.gov

Ready is a national public service advertising (PSA) campaign designed to educate and empower Americans to prepare for and respond to emergencies.
http://www.ready.gov

Get a Gameplan by the Louisiana Governor's Office of Homeland Security and Emergency Preparedness (GOHSEP) provides guidance and resources for emergency planning.
http://www.gohsep.la.gov

The Louisiana Business Emergency Operations Center (LA BEOC) works with businesses and industry to improve their preparedness during and after disaster events.
http://www.labeoc.org

The Coastal Resilience Index Critical Facilities Tool provides an initial assessment of a community's critical facilities and road miles within the FEMA 1% annual chance flood zone.
http://www.csc.noaa.gov/criticalfacilities/

IMAGE: LA BEOC

CH5-4: While promoting innovative products, LA BEOC has also identified the businesses and industries that are important during an emergency and helps them before, during and after a disaster.

IMAGE: FEMA

CH5-5: As part of the Ready Georgia program, 5th graders entered an art and essay contest on how they would prepare for a variety of disasters.

IMAGE: FEMA

CH5-6: Emergency response plans should include transportation for people who cannot drive or evacuate themselves.

PLANNING AND EDUCATION STRATEGY

Ensure Safe Evacuation Routes

● *Essential* C A UR MR LR D

◒ *Encouraged*

◡ *Optional*

N/A *Not applicable*

Every property should have access to a safe evacuation route out of an area threatened by flooding and storms. Communities should note instances where evacuation routes would benefit from additional signage and implement it in coordination with the appropriate authorities. Evacuation routes, as well as contraflow lane reversal, should be clearly marked routes with signage that does not require knowing the evacuation route in advance. Visitors and neighboring communities may be using these same routes for evacuation. Each community should spend time identifying the safest route on the highest ground. Consider a requirement or baseline for evacuation capacity and preparedness in the approval process of any new developments. Developers, in coordination with local government, should analyze the current capacity of existing evacuation routes and provide for added capacity where existing routes may not be sufficient to meet future needs. Communities should make emergency transportation available to evacuate the elderly, those who cannot drive and residents without vehicles.

IMAGE: FEMA

CH5-7: Hurricane evacuation routes should be clearly marked.

GET A GAMEPLAN

Best Practice Case Study: South Louisiana
Scale of Project: Regional level

Communities should coordinate with Phased Evacuation by the Governor's Office of Homeland Security and Emergency Preparedness (GOHSEP). During a threat of a hurricane, a phased evacuation will be based on geographic location and time in which tropical storm winds are forecasted to reach the affected areas. Note that phased evacuation procedures are for traffic management purposes only.

The Governor's Office of Homeland Security and Emergency Preparedness
http://www.getagameplan.org
http://www.gohsep.la.gov

INFRASTRUCTURE DESIGN STRATEGY

Assess Infrastructure

- ● *Essential* — A, UR, MR, LR, D
- ◒ *Encouraged* — C
- ◡ *Optional*
- N/A *Not applicable*

Knowledge is power when preparing for and recovering from damaging coastal storms. Local governments should assure utility infrastructure and facilities (i.e. power, gas, telecommunications and water) are surveyed and assessed for vulnerability to storm damage. Some communities have used GIS to compile data concerning public and private infrastructure, as well as utility facilities. Various agencies are responsible for the infrastructure, including energy, drainage, traffic signals, and communication lines. This can be useful in identifying and prioritizing system upgrades and improvements before a storm hits and can also assist in efficient post-storm recovery. Consider making hazard mitigation upgrades when doing routine or occasional system repairs. By having a prioritized recovery plan in place, local governments and private utilities can quickly restore vital services after a major storm.

IMAGE: FEMA

CH5-8: Routine repairs and scheduled maintenance offer an opportunity to evaluate and upgrade vital infrastructure and utilities.

ST. CHARLES PARISH GOVERNMENT

Best Practice Case Study: St. Charles Parish
Scale of Project: Community level

St. Charles Parish provides an exemplary interface where public officials, GIS analysts and the general public may assess an extensive collection of information. From the latest Parish news and ordinances to viewable map queries from the Parish GIS database, the website is designed for multiple user types and provides transparency of information.

St. Charles Parish Government
http://www.stcharlesparish-la.gov

INFRASTRUCTURE DESIGN STRATEGY

Protect Roads and Street Networks

● *Essential* A UR MR LR D

◒ *Encouraged* C

◡ *Optional*

N/A *Not applicable*

Local streets and roads are often susceptible to flooding. Raising roads on fill can protect them from local flooding. However, raised roads on fill can also act as barriers to hydrologic systems such as sheet flow and natural drainage patterns. Elevating roadways on pilings is another effective option. Pilings allow water to flow freely under the road and ensure that roads have good drainage.

In some cases, raising roads may not be an option. It is essential that day to day drainage for street networks remain functional and free from obstructions. Beyond regular monitoring of drainage systems, stormwater can be managed at its source before entering the drainage system. Green streets accomplish this by reducing pressure on drainage systems.

Additionally, local roads and streets may be monitored for potential debris that may impede traffic flow or damage utility lines. An example of potential debris are tree limbs that may be susceptible to wind damage. Qualified arborists can determine street tree weaknesses and eliminate hazards beforehand.

IMAGE: DANA BROWN

CH5-9: Residential roadway in Orleans Parish with stormwater curb extensions that absorb and treat runoff before it enters the drainage system.

GREEN STREETS

Best Practice Case Study: Storm Water Best Management Practices for East Baton Rouge Parish

Scale of Project: Site specific to community level

The integrity and function of roads and street networks rely on being water free, yet storm water runoff from streets can hasten the backup of drainage infrastructure. A Green Street uses natural processes to manage storm water runoff at its source versus relying on drainage infrastructure. Parks can be designed as adjacent green space to accept storm water runoff. The natural systems approach can not only alleviate pressure on storm drains, but can also provide an eco-service and aesthetics. A natural systems approach reduces storm water flow, improves water quality, reduces urban heating, enhances pedestrian safety, reduces carbon footprints and beautifies neighborhoods.

EPA Green Streets
http://tinyurl.com/epa-greenstreets

Stormwater BMP's for EBR Parish
http://tinyurl.com/brgov-stormwater

IMAGE: TBD.COM

CH5-10: Keeping trees trimmed near power lines can minimize the risk of outages during storms.

ENTERGY NEW ORLEANS

Best Practice Case Study: New Orleans

Scale of Project: Community level

Entergy has won top awards from the Edison Electric Institute for emergency response or emergency assistance ten years in a row. The company prepared for the 2008 hurricane season by undertaking a series of actions to protect the system from a potential hurricane:

- Enhanced circuits throughout New Orleans by adding fuses and replacing cross arms to improve reliability;
- Trimmed miles of power lines to reduce storm-induced power outages;
- Used infrared technology to evaluate and repair points of customer and Entergy facilities;
- Performed detailed hurricane and tabletop drills to test all functions of the company's emergency-response teams.
- Educated Louisiana customers with hurricane preparedness bill inserts.

Entergy Louisiana, L.L.C.
http://www.entergy-louisiana.com/

INFRASTRUCTURE DESIGN STRATEGY

Protect Electrical Networks

Essential A UR MR LR D

Encouraged C

Optional

N/A *Not applicable*

In the event of a storm or flooding, uninterrupted access to electricity is vitally important for the safety and well-being of communities.

Bury Utility Lines Adjacent to Roadways

Burying electric lines and other utilities, especially those running parallel to a roadway that is sited on an embankment, can provide more consistent connectivity by reducing outages due to storm damage. Each community must evaluate risks and take into account potential damage from wind, flooding and other hazards, such as Formosan termites.

Conduct Inspections and Maintenance

Regular pole inspections help to ensure that communities are ready for a storm. Communities, in partnership with utility companies, can organize these maintenance checks and work together to fund replacements or repairs when necessary.

Upgrade Materials

Upgrading the poles and structures with stronger materials, such as concrete, steel or a composite material, is an effective strategy. This strategy will be useful in areas prone to flooding or wind damage. Prolonged flooding may result in water intrusion and corrosion in the underground network or serve to weaken soils and the support system for the above ground network.

Manage Surrounding Vegetation

Managing the vegetation within the transmission line rights-of-way is an effective storm-resiliency activity. A community vegetation management plan should include the clearing of all potentially damaging tree limbs and vegetation from power line rights-of-way.

INFRASTRUCTURE DESIGN STRATEGY

Elevate Critical Infrastructure

● *Essential* A UR MR LR D

◒ *Encouraged* C

◡ *Optional*

N/A *Not applicable*

Elevate electrical substations, control rooms, flood control pump stations and other essential infrastructure hubs to keep them protected and operable during flooding. Ensure that they are properly secured and anchored from wind. Requiring the floor of all new substations to be one foot or more above the annual 1% flood (base flood) is a recommended metric to use in selecting a height. Other strategies include relocating facilities to less flood-prone areas and structurally strengthening existing facilities with stronger materials.

IMAGE: GIBBS CONSTRUCTION

CH5-11: Critical facilities and the protection of operating personnel are designed for resiliency, especially during and after a storm event.

JEFFERSON PARISH PUMP STATION SAFE HOUSES

Best Practice Case Study: Jefferson Parish
Scale of Project: Community level

The Jefferson Parish Pump Station Safe Houses consist of seven concrete structures located on the East and West Banks of Jefferson Parish at Jefferson Parish Flood Control Pumping Facilities. Creating and supporting self-contained concrete living units for pump operators during major storm events, these structures consist of elevated slabs on concrete columns and drill shafts. Rated to withstand up to 250 mph winds, their purpose is to provide a safe haven for drainage department operating personnel during the major force of a passing storm. By safely manning the pump stations and effectively pumping out the rain water or storm surge brought in by major storm events, citizens and parish property will be better protected from flooding.

USACE Jefferson Parish Pump Station EA# 454
http://tinyurl.com/jefferson-pumphouses

INFRASTRUCTURE DESIGN STRATEGY

Protect Water and Sewer Infrastructure

●	*Essential*	A UR MR LR D
◒	*Encouraged*	C
◡	*Optional*	
N/A	*Not applicable*	

Interruption to the fresh water supply—whether by damage to infrastructure or contamination—is one of the most serious issues communities face after a major storm. Functioning sewer systems are critical to basic health, safety and livability. Preparing water supply and sewage treatment systems is a vital step toward community resilience.

The Sustainable Infrastructure Initiative guides EPA's efforts in changing how the nation views, values, manages and invests in its water infrastructure. The EPA is working with the water industry to identify best practices that have helped many of the nation's utilities address a variety of management challenges.

Wastewater treatment plants are typically found in larger communities. These facilities should be located strategically and should have backup power sources (e.g. generators) available to provide power when electric service is interrupted.

Low-density and rural residential developments that meet minimum lot size requirements often use on-site septic systems for each home, rather than a centralized, community-wide wastewater system. While distributed systems like this are often more resilient to flooding and storm damage, they rely heavily on individual homeowners to ensure they are functioning properly and that regular maintenance and repairs are completed. Enforcement typically rests with the State Department of Health and Hospitals, but some parish governments are stepping in to ensure against wastewater contamination.

IMAGE: CENTER FOR PLANNING EXCELLENCE

CH5-12: Wetland assimilation can provide savings by further treating effluent while also nourishing a wetland area.

THIBODAUX WETLAND ASSIMILATION

Best Practice Case Study: City of Thibodaux
Scale of Project: Community level

The City of Thibodaux designed a wastewater treatment system that helps restore and preserve native ecosystems while providing a critical service. The project is economically sustainable as it eliminates costs associated with tertiary wastewater treatment and has been monitored with more than 15 years of positive effects. Wetland assimilation of municipal effluent restores wetlands, improves water quality, increases organic matter decomposition and increases wetland surface elevation.

Communities using wetland wastewater assimilation in Louisiana include Breaux Bridge, Broussard, St. Martinville, Iberia Parish, Franklin, Amelia, Luling, Thibodaux, Hammond, Guste Island, Tchefuncte Estates, Mandeville and St. Bernard. This use of treated effluent may not work in all wetland situations.

US EPA Emergency Preparedness
http://water.epa.gov/drink/emerprep/

Louisiana DEQ Wetland Assimilation Projects
http://tinyurl.com/deq-assimilation

WATER MANAGEMENT STRATEGY

Use Sustainable Water Capture Systems

● *Essential* C A UR MR LR D

◒ *Encouraged*

◡ *Optional*

N/A *Not applicable*

Locations that capture and retain excess surface water contribute to natural flood mitigation and can be cost effective. Strategies to increase water storage capacity at the neighborhood or municipal scale include design features related to buildings, sites, roads and public areas, while others work to enhance existing natural systems. Ecologically-based storm water management favors soft engineering to manage rainfall on site through a vegetated treatment network. When a hurricane or other storm hits the coastal area, retaining rainwater, even in the flat coastal landscape, may be beneficial to residents.

Sustainable water capture systems mimic a site's pre-development hydrologic regime by using techniques that infiltrate, filter, store and evaporate storm water runoff close to its source. Unlike conventional conveyance infrastructure that channels runoff through pipes, catchment basins, and curbs and gutters, a sustainable water capture system remediates polluted runoff through a network of distributed treatment landscapes.

IMAGE: PUBLIC DOMAIN

CH5-13: Bio-swales in parking lots can treat storm water on site through native vegetative plantings.

STORM WATER MANAGEMENT

Best Practice Case Study: Louisiana Department of Environmental Quality

Scale of Project: Site specific to community level

Storm water best management practices are used to intercept, retain and filter local runoff and storm water that originates on the site. During site design and planning for any development or redevelopment, it is necessary to define where storm water is coming from, determine how much storm water is expected and prepare to manage that storm water. Resilient storm water capture systems include, but are not limited to rain gardens, rain groves, circular depressions, planted storm water buffers, infiltration trenches, sand filters, bio-swales, porous paving, above ground cisterns, underground storm water chambers, preserved wetlands, tree protection areas, habitat protection areas, riparian buffers, constructed wetlands, parking lot detentions and vegetated ditches.

LA DEQ Non-Point Pollution Program
http://tinyurl.com/deq-stormwater

THE SPECIFICS OF SUSTAINABLE WATER CAPTURE SYSTEMS

ENHANCE WETLANDS AND FLOODPLAINS

Communities should consider increasing the health and size of wetlands and undeveloped floodplain areas and using existing canals and roadside water storage facilities as a flood protection strategy. Wetlands and other low areas play an integral role in flood protection by providing water storage for excess water that would otherwise flow onto adjacent developed property.

INCREASE WATER STORAGE CAPACITY

Road Design and Vegetated Ditch

By designing boulevards and roads with bio-swales, storm water is managed at its source, which is beneficial on a neighborhood and community scale. These road designs must allow enough room to include shallow systems that employ native plants, primarily grasses. These plantings mimic wetlands and produce similar water storage benefits. Swales gather and absorb water into the groundwater system over time, rather than running off onto other properties. The Louisiana DOTD Transportation Enhancement Program funded by the Federal Highway Administration may be a source of funding for eligible roadside detention basins. Louisiana vegetated ditches along roadsides are a low-cost way to both act as stormwater management entities, known as bio-retention, and to provide passers-by with beautiful natural landscape.

http://www.dotd.louisiana.gov/planning/tep/

http://www.abbey-associates.com/splash-splash/blue_component/vegetated_ditch.html

Building Site Design

Building sites should use materials that lessen the amount of impervious surfaces, such as native plantings, pervious paving materials, reduced street widths, reduced parking requirements and clustered development.

Parks and Open Space Design

Parks, playgrounds and other open spaces can be designed to store or slow the flow of water. The designs are similar to the site planning process for detention and retention. The Netherlands has created significant neighborhood-scale water storage, like underground parking garages, which helps to control water and encourage people to "live with water."

IMAGE: JACK MILAZZO

CH5-14: Zuider Park in Rotterdam is designed to act as a detention area for the surrounding neighborhoods.

IMAGE: NOLA

CH5-15: Pervious paving allows water to infiltrate on a site level. Because different areas have different soil composition, design needs to be site specific.

IMAGE: PUBLIC DOMAIN

CH5-16: Bioswales provide pleasing landscape while capturing stormwater, helping it to absorb into the ground and clean the water.

WATER MANAGEMENT STRATEGY

Conserve and Restore Wetlands

● *Essential* C A UR MR LR D

◒ *Encouraged*

◡ *Optional*

N/A *Not applicable*

Benefits of Wetland and Marsh Restoration

As mentioned throughout the Manual, wetlands provide multiple benefits to coastal communities, especially those at the farthest reaches of the coast where wetlands may be one of the few available lines of defense against severe storms. They also work to minimize land loss and soil erosion. Wetland building/rebuilding can be undertaken either as a public or private program and implemented at a variety of scales and levels.

Challenges of Wetland and Marsh Restoration

Often, the construction of levees or flood protection measures has not been compatible with maintaining healthy wetland ecosystems. As long as the Mississippi River is confined, wetlands will continue to struggle. Wetland restoration requires a long-term investment of effort, funding, monitoring and evaluation.

Wetland and Marsh Restoration Opportunities

Existing programs ranging in scale and participation include public, private and individual participation programs. Public programs include river and sediment diversions, dredging and placing sediment, shoreline stabilization, hydrologic modification through weirs and sloughs, herbivory prevention, invasive prevention, and artificial oyster reefs. Additionally, public programs can provide financial support for species protection, conservation grants, restoration cost-share agreements, tax incentives, and support for private and individual scale programs. Private participation programs include mitigation banking, carbon sequestration, and creative leasing arrangements. Programs for individual participation include cypress tree and vegetation plantings and wetland education.

IMAGE: PLAQUEMINES PARISH GOVERNMENT

CH5-17: Forested ridge improvements result in the reduction of the wave action on top of tidal surge to a level below levee height.

RIDGE PLANTING IN PLAQUEMINES PARISH

Best Practice Case Study: Plaquemines Parish
Scale of Project: Community level

The Plaquemines Parish Coastal Restoration Plan focuses on constructing a forested ridge immediately outside the back levees. Unlike other parishes with levee protection in only some areas, Plaquemines Parish is bordered by levees on all sides of its habitable land.

The Parish's Plan involves a long-term lease of dredging equipment that would pump sediment from the Mississippi River through pipes across the levee, under LA 23 and over the back levee into the adjacent marshes. The aim is to create elevated ridges 75 to 100 feet wide leading up to the back levee and to plant a series of marsh plants and large cypress trees along the ridge to serve as a speed bump for waves and flooding from storm surges.

Plaquemines Parish Master Plan
http://www.plaqueminesmasterplan.com

ADDITIONAL BEST PRACTICE CASE STUDIES FOR CONSERVING AND RESTORING WETLANDS

FLOATING ISLANDS

Best Practice Case Study: Terrebonne Parish
Scale of Project: Community level

As sea level rises and subsidence persists, shorelines in coastal areas are facing intense erosion. One tool that has been developed to prevent further erosion and aid restoration of shorelines is the use of floating islands. Floating islands consist of recycled plastic base with native plants woven into them. Floating islands have been shown to improve water quality in test sites in New Zealand; provide nesting habitat in California; and potentially lower energy wave attenuation and reduce erosion in Massachusetts. A floating island is now being installed in Isle de Jean Charles, Louisiana to reduce day to day wave action and encourage silt deposit.

Floating Islands Environmental Solutions
http://www.floatingislandes.com

IMAGE: FLOATING ISLANDS ENVIROMENTAL SOLUTIONS

CH5-18: Floating islands are man-made islands designed to restore growth and vegetation to shoreline.

MANGROVE RESTORATION

Best Practice Case Study: Fifi Island in Grand Isle
Scale of Project: Community level to State level

The Coalition to Restore Coastal Louisiana, its partners and volunteers planted over 800 mangrove plants. Mangroves help stabilize the barrier island and provide structure and refuge for a variety of aquatic species. The planting will reduce sediment loss due to erosion by wind and wave action, and will protect interior marshes and bays. Mangroves are often associated with the Florida Everglades and tropical regions, however, the black mangrove is found in both Florida and Louisiana. The black mangrove is the only mangrove plant that grows in Louisiana.

Coalition to Restore Coastal Louisiana
http://www.crcl.org

IMAGE: THE COALITION TO RESTORE COASTAL LOUISIANA

CH5-19: Mangroves are a habitat and nursery ground for a wide variety of marine organisms as well as storm buffers that reduce wind and wave action.

IMAGE: PUBLIC DOMAIN

CH5-20: The Water Hyacinth, first introduced to North America in 1884, impacts water flow, blocks sunlight from reaching native aquatic plants and starves the water of oxygen.

IMAGE: PUBLIC DOMAIN

CH5-21: The Chinese Tallow Tree is also referred to as the Chicken Tree or the Popcorn Tree, and it competes with native species.

IMAGE: THE NATURE CONSERVANCY

CH5-22: Oyster rings made from concrete attract fish, shrimp, crab, oysters and other marine species.

CONSERVING AND RESTORING WETLANDS CONTINUED

HERBIVORY AND INVASIVE PREVENTION PROGRAMS

Best Practice Case Study: Coastwide Nutria Control Program and Louisiana Aquatic Invasive Species Management Plan
Scale of Project: Community level to State level

Nutria herbivory damage is ongoing, and many damaged sites are not likely to recover naturally. Without comprehensive management of nutria herbivory damage, the stability of the Louisiana coastal ecosystem is threatened. The goal of the program is to encourage the harvest of up to 400,000 nutria annually from coastal Louisiana.

Invasive aquatic plants are listed in the Louisiana Aquatic Invasive Species Management Plan. The goal of this State management plan is to prevent and control the introduction of new nonindigenous species and existing invasive species. The goal is also to eradicate locally established invasive species wherever possible. Invasive terrestrial plants in Louisiana include the Chinese Tallow Tree (*Sapium sebiferum*) and the Privet Hedge (*Ligustrum spp.*) to name a few. The stability of the Louisiana coastal ecosystem is dependent on herbivory and invasive prevention programs.

Coastwide Nutria Control Program
http://www.nutria.com

Louisiana Aquatic Invasive Species Management Plan
http://tinyurl.com/LA-invasives

MAN-MADE OYSTER REEFS

Best Practice Case Study: Grand Isle, St. Bernard Marsh, Vermilion Bay
Scale of Project: Community level to State level

The Nature Conservancy and partners began restoring 3.4 miles of oyster reefs off the coast of Louisiana that border some 350 acres of marshland. Funding for the project is provided by the American Recovery and Reinvestment Act through the National Oceanic and Atmospheric Administration. The effort involves building and implementing structures made of welded steel, mesh bags of oyster shells or concrete rings. Oyster larvae then attach to the structures and grow. Oyster reefs not only provide valuable habitat for many marine species, they serve as a breakwater and can slow coastal erosion.

The Nature Conservancy - Louisiana
http://tinyurl.com/oyster-reefs

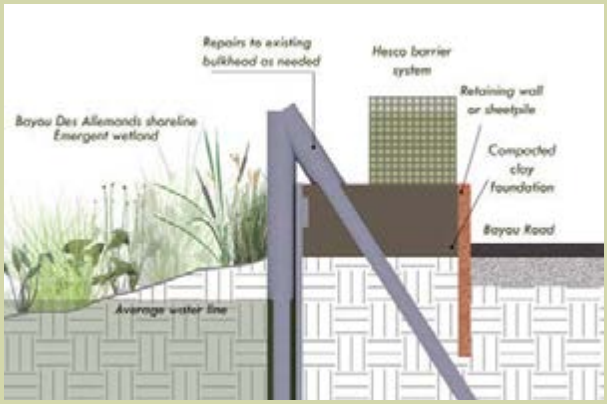


IMAGE: BRUCE SHARKY, JACK MILAZZO

CH5-23: During the onset of storm seasons, temporary flood protection is overlaid on a compacted earthen base.

LAND BARRIERS

Best Practice Case Study: Des Allemands, LA
Scale of Project: Community level

During tropical storm events, the Des Allemands community is subject to flooding. St. Charles Parish is considering one potential solution that addresses flood protection while also creating a community asset. Bank stabilization along Bayou des Allemands will provide interior protection, as well as a proper foundation for temporary flood barrier installation during storm events. It consists of an elevated compacted clay foundation on the land side of the bulkhead and a gradual sloping wetland buffer on the bayou side. Bank stabilization allows for the community to continue living and fishing along the Bayou while preserving the scenic waterway and cultural significance of Bayou des Allemands. It also creates an opportunity for recreation and a trail system along the waterfront.

Sharky, Milazzo, 'Flood Mitigation Planning for Bayou des Allemands, St. Charles Parish,' February 2010
http://tinyurl.com/sea-grant-des-allemands

WATER MANAGEMENT STRATEGY

Build Low Earthen Barriers

●	*Essential*	D
◡	*Encouraged*	C MR LR
◡	*Optional*	A UR
N/A	*Not applicable*	

A low earthen barrier prevents water intrusion. This type of barrier may be landscaped with plants, trees or grass; it may surround a single house and yard or a small grouping of homes. It is designed to protect structures from up to three foot floods.

It is important to note, especially in the case of an earthen barrier around a building or multiple buildings, that these types of barriers can trap water on the internal side of the barrier. Drainage is not allowed when water makes it to the inside of the barrier. Therefore, a pumping system is required to move water out from the building side of the barrier. In cases of a storm and loss of power the pump would need a backup power source. In heavy rainfall events, low earthen barrier systems may require active attention from the landowner, individual or neighborhood to ensure that they function as intended.

When planning for earthen barriers at the individual or neighborhood level, it is essential to coordinate with the larger community to ensure that they do not have unintended consequences. Berms are fundable under federal hazard mitigation grant programs (e.g. the Hazard Mitigation Planning Grant).

A Caution Related to Low Earthen Barriers

Structural flood protection is built to a specific level of protection, but can give residents a false sense of security. These types of barriers may reduce flood risk, but do not protect against events greater than their engineered capacity.

SITE DESIGN STRATEGY

Preserve Community Character

Essential A

Encouraged C UR MR LR D

Optional

N/A *Not applicable*

One of the most important community-level strategies is to start with good planning and design. There are a number of considerations when designing the uses in an urban area, in a subdivision, in a rural area or on a site. This Manual focuses on recommendations that specifically make development safer and more resilient, while retaining the existing community character. The *Louisiana Land Use Toolkit* has several recommendations related to desired design characteristics:

- Strive for zero impact on natural systems through best management practices and low-impact development principles.
- Take inventory and evaluate all site features before altering the landscape.
- Design to protect natural and cultural features.
- Develop a grading and drainage plan that retains all increased run-off on site.
- Use cultural patterns of "design to climate," such as planting shade trees, using trees as windbreaks, designing for passive solar energy and encouraging cross ventilation in outdoor spaces.

In *Coastal Hazards and Smart Growth*, John Jacob and Tommy Pacello describe critical considerations for site planning: lot size, lot coverage, street setbacks, landscaping amounts and types, parking standards and design requirements.

IMAGE: JEANNE MARQUEZ, DIVISION OF HISTORIC PRESERVATION

CH5-24: 20th century bungalow in Bywater Historic District retains historic character after elevating structure.

CITY OF NEW ORLEANS

Best Practice Case Study: Bywater neighborhood, New Orleans, LA

Scale of Project: Site specific to community level

Historical construction in New Orleans is being preserved even though strict building regulations bring new changes. When a substantial improvement is made to a building, the owner of a historic structure and the City must consider the historic impact of elevating the structure. However, if an appropriate design can be found, the structure will have additional protection during future flood events. It is in the best interest of the community to provide long-term security to its historic structures and neighborhoods while at the same time preserving the historic character that makes these neighborhoods admired and sought after.

When elevating a historic house, consideration must be given to the house type and style. Improper elevation will affect the house's historic designation and eligibility for the National Register of Historic Places, as well as denying any benefits, tax credits or grants that this listing or eligibility would bring.

Division of Historic Preservation
http://www.crt.state.la.us/hp/

SITE DESIGN STRATEGY

Elevate Multiple Buildings

- ● *Essential*
- ◒ *Encouraged* C A UR MR LR D
- ◡ *Optional*
- N/A *Not applicable*

In other countries, flood proofing examples exist on a district scale by elevating several buildings on mounds of compacted fill. This strategy is only a best practice in certain circumstances, only on sites not in FEMA's designated V-zone, and in conjunction with detailed environmental analysis. In Western Europe, this strategy is designed for new development and is used in certain dense, urban environments or in small clusters within coastal communities.

Again, this is only a best practice as part of greater community wide planning because without careful planning, negative impacts could occur. Building on compacted fill material encourages the continued development and filling of sensitive wetland areas, which may exacerbate flooding, property damage and habitat degradation. Elevated mounds can place greater flooding pressure on immediate surrounding areas by altering the floodplain elevation. Such developments would also need to address the water that would be displaced. Raising structures on compacted fill requires developers to obtain the material, which may harm the source area.

IMAGE: FEMA

CH5-25: The City sponsored a series of projects, using new technology to elevate concrete slab structures with the slab attached.

MANDEVILLE ACQUISITION AND ELEVATION PROJECT

Best Practice Case Study: Golden Glen neighborhood, Mandeville, LA

Scale of Project: Site specific to community level

In the City of Mandeville, approximately 80 percent of the incorporated area is within a Special Flood Hazard Area. In May 1995, the southeastern portion of Louisiana experienced a significant flood. One subdivision in particular, Golden Glen, experienced substantial floodwater damage to homes. The Mayor and a local hazard mitigation team developed a local hazard mitigation plan to pursue acquisition, elevation and dry flood proofing of residential structures. The City used new technology to elevate concrete slab structures with the slab attached. The technology, the development of an effective dry flood proofing technique, and the technical expertise of local mitigation consultants have been successful in eliminating the cost of flood damage in Golden Glen.

National Flood Insurance Program
http://www.floodsmart.gov/floodsmart/

FEMA, 'Mandeville Acquisition and Elevation Project'
http://tinyurl.com/fema-golden-glen

PLANNING AND EDUCATION STRATEGY

Educate Home and Business Owners

- *Essential* — C A MR LR D
- *Encouraged* — UR
- *Optional*
- N/A *Not applicable*

A key strategy for local communities is to serve as a resource to community members in order to "bring everyone up to speed" on disaster preparedness.

Encourage Businesses to Develop Business Disaster Plans

A business disaster preparedness plan should include measures to protect the organization's staff, building, data and inventory during a damaging event. This includes damage from wind, water, fire or other damaging events. A good plan typically includes a pre-identified site where the business can temporarily relocate; off-site storage of critical electronic data and a means to retrieve data, including employee, customer and vendor records; a method for operating effectively with a smaller staff of key individuals; as well as addressing post-event communication methods.

Promote Hurricane Preparedness

GOHSEP and FEMA have a wealth of resources for advising homeowners on how to prepare for an oncoming hurricane. Communities should decide which resources are applicable for them and make sure they end up in the right hands.

Develop Demonstration Projects

Typically housed within a university or other public space, demonstration centers can showcase "best practices" in building development and storm preparedness. One example, the BeauSoleil Home, is designed to withstand hurricane force winds and to be elevated in areas vulnerable to flooding. Additionally, the home is solar powered, making it ideal for coastal environments.

IMAGE: LAHOUSE

CH5-26: LaHouse is a demonstration center showcasing "best practices" in building development and storm preparedness.

LAHOUSE

Best Practice Case Study: The Louisiana House - Home and Landscape Resource Center
Scale of Project: Site level

LSU AgCenter's demo project, the LaHouse, is designed to be resistant to many hazards and showcases a variety of flood- and wind-proofing measures. These include building elevation (it is elevated three feet above BFE using several methods), dry flood proofing and wet flood proofing techniques, and structural and building envelope fortification methods.

The center's goal is to display a variety of ways to achieve resiliency and stimulate consumer demand and industry adoption of sustainable, safe housing and landscapes. LaHouse includes educational outreach to consumers, professionals and youth that address national and regional challenges.

Louisiana Business Emergency Operations Center
http://www.labeoc.org

LaHouse - Home and Landscape Resource Center
http://www.LSUAgCenter.com/LaHouse

PLANNING AND EDUCATION STRATEGY

Relocate Strategically

- ● *Essential* — LR, D
- ◒ *Encouraged* — C, A, MR
- ◡ *Optional* — UR
- N/A *Not applicable*

The decision for individuals or a community to relocate is a strategic decision that depends on a variety of factors. In Louisiana communities, where families have lived for many generations, it is often seen as a "last resort" strategy. For many residents in coastal Louisiana, their connection is not only to the land but also to their jobs.

Because South Louisiana residents have a profound connection to their land, many people may opt to stay, since living with water is a way of life. Others will choose to relocate if other family members or friends move with them, or they may choose to relocate to a safer structure in the same community. When community anchors such as grocery stores, churches and schools leave a community, residents are more likely to leave and create a new community where services are available.

Local governments work with homeowners willing to reduce their risk and move out of the floodplain. FEMA offers relocation assistance programs. In many cases the same assistance programs created to mitigate flood risk by providing grants for elevating structures also provide assistance for relocation. Structures insured by the National Flood Insurance Program may be eligible for these grants in an effort to reduce the number of repetitive loss structures.

IMAGE: JACK MILAZZO

CH5-27: The Missouri Buyout Program was funded in part by FEMA's Hazard Mitigation Grant Program (HMGP).

THE MISSOURI BUYOUT PROGRAM

Best Practice Case Study: Multiple counties in Missouri
Scale of Project: Site specific to community level

Since the floods in 1993, the Federal Emergency Management Agency (FEMA) and Missouri State Emergency Management Agency (SEMA) partnered with local governments to help thousands of willing homeowners move out of the floodplain. People across the state of Missouri took pride in taking responsibility for the safety of their families, homes and businesses. In the process, they spared taxpayers the expense of additional federal disaster assistance, which they no longer need to weather the storms. One of the hallmarks of the buyout program is that it is a voluntary program. Once the local government acquired a property, the land was dedicated in perpetuity for open space and recreational uses or simply returned to natural wetlands.

FEMA, 'Missouri Flood Buyout Saves Lives, Heartache, and Money' http://tinyurl.com/fema-missouri

Resource Record Details Missouri Buyout Program
http://tinyurl.com/buyout-details

SITE DESIGN STRATEGY

Use Native Plants for Protection

		C	A	UR	MR	LR	D
●	*Essential*	C	A	UR	MR	LR	D
◒	*Encouraged*						
◡	*Optional*						
N/A	*Not applicable*						

The plants native to coastal Louisiana are accustomed to the unique climate of the region and offer not only aesthetic amenities, but also protection from wind and erosion once they become established. Trees, shrubs and grasses all stabilize land area and protect buildings. Some native trees are more tolerant of wet soils, higher salinity, and are more resistant to high winds than others. Exotics, or nonnative plants, pose threats to native plants. For instance, when left unmanaged, the Chinese Tallow can change the habitat and compete with native plants. Data collected by the University of Florida and observations made by LSU indicate that Cypress trees and Live Oaks are among the best choices to be considered for wind resistance.

Community-Scale Solutions

Cities, towns, and parishes can adopt policies that facilitate the use of landscaping with native plant species that are adapted to local climate. Local governments or community groups can provide guidance about the best use of plants plus guidelines for native landscaping and rain gardens. Bulk buying programs for selected coastal seeds or seedlings could secure lower prices for residents.

Site-Scale Solutions

Landowners in coastal Louisiana can use a mix of native plant species for landscaping. Native species of grass and trees can provide aesthetic benefit immediately, and once established, they can provide an additional line of defense against wind and water damage. Carefully sited trees can also provide summer time shade. Municipalities may wish to create a native plant demonstration garden or institute a native plant policy for landscaping on government properties and along public rights of way.

IMAGE: FRIENDS OF PALMETTO STATE PARK

CH5-28: Volunteering on a community scale for wetland plantings promotes education, community bonds, and protection.

URBAN FORESTRY

Best Practice Case Study: Friends of Palmetto Island State Park, Abbeville, LA
Scale of Project: Community scale

A donation of 225 trees by the State of Louisiana to the Coalition to Restore Coastal Louisiana was planted in Palmetto Island State Park. Sherrill Sagrera, founding member of Friends of Palmetto Island State Park, also happens to be a member of the Coalition, and recognized the opportunity to reforest areas of the Park's property where trees were lost because of Hurricanes Rita and Ike. Sagrera worked in cooperation with LSU AgCenter Vermilion Extension Offices.

Louisiana Department of Agriculture and Forestry
http://tinyurl.com/ldaf-treesale

Coalition to Restore Coastal Louisiana
http://www.crcl.org/

IMAGE: GLOBAL GREEN

CH5-29: The project consists of 5 single-family homes, an 18-unit apartment building, and a community / climate action center.

HOLY CROSS PROJECT

Best Practice Case Study: Lower Ninth Ward, New Orleans

Scale of Project: Site specific to community level

As a centerpiece of Global Green's ongoing presence in New Orleans, the project is a "Center of Excellence" for the rebuilding of the Gulf Coast that demonstrates aspects of green building appropriate for the climate zone, while providing opportunities for sharing knowledge across the United States and the world. This will also be a gathering place for information, knowledge and leadership generated by the sustainable design and green building activity in and around New Orleans after Hurricane Katrina.

The Lower Ninth Ward has become a testing ground for innovative and energy efficient design through the Make it Right Foundation. Many cutting edge technologies are being implemented promoting resiliency in coastal Louisiana.

Global Green, Holy Cross Project
http://www.globalgreen.org/neworleans/

Make It Right, Helping to Rebuild New Orleans and the Lower Ninth Ward http://www.makeitrightnola.org/

SITE DESIGN STRATEGY

Secure the Structure in Flood

- ● *Essential* — C MR LR D
- ◡ *Encouraged* — A UR
- ◡ *Optional*
- N/A *Not applicable*

Owners of existing buildings that are not being elevated should focus on anchoring the buildings so that they can resist flotation and strengthening walls so they can withstand the pressures of flood waters and the impacts of flood-borne debris. The community should regularly inspect buildings to check that structure modifications to exterior walls and interior spaces do not compromise a building's structural integrity.

Smart Building Practices in Use

Balloon construction, a historic building practice that was common in New Orleans and other hurricane-prone areas during the late 1800s and early 1900s, offers an alternative to platform framing, the current standard practice. Balloon construction works by extending the studs the full height of the building, from the foundation to the rafters. It fortifies the structure as a single unit, contrasted with platform framing, in which each floor is framed separately. Balloon framing works best for one-story houses and is not typically practical for two-story houses.

A local contractor in Baton Rouge has applied balloon construction methods not only to wall studs, but also to foundational columns, connecting the foundation, wall structure and roof rafters securely. These methods can also be applied to additional building components, like covered porches, and they can be readily integrated with elevated buildings on pilings.

SITE DESIGN STRATEGY

Secure the Building in Wind

Essential C A MR LR D

Encouraged UR

Optional

N/A *Not applicable*

Homeowners should first focus on fortifying their homes against high winds. A house is stronger against wind if it can act as a unit, instead of as a set of isolated components. A well-designed house in a coastal wind zone is streamlined and guides wind around the house smoothly. Major remodeling, retrofits or new construction should seriously consider incorporating elements like hipped roofs with a medium slope, short overhangs and reducing turbulence-producing obstructions, such as dormers and open porches. Use of hurricane clips at the roof-wall connection, as required by current state and local construction code, also significantly improves the integrity of the roof structural system and helps to prevent failure.

When a building envelope is damaged, the fluctuation in internal air pressure can cause ceilings to be pulled down and walls to be pushed out. Wind-driven rain can also enter the building and lead to structural damage. Lack of ventilation in the building envelope can allow unhealthy mold to develop when a building is not dried out immediately after a storm. In buildings that provide critical community services during a disaster, building envelope failure and rain water intrusion are key reasons for widespread loss of building function.

IMAGE: WWW.HURRICANEFABRIC.COM

CH5-30: Homeowners fasten hurricane fabric that is fitted to window frames, a safety and time-saving measure that allows prompt evacuation.

MAKE IT RIGHT

Best Practice Case Study: Lower Ninth Ward, New Orleans

Scale of Project: Site specific to community level

Beyond building new homes for residents who lost everything in Hurricane Katrina, Make It Right is a unique laboratory for testing and implementing new construction techniques, technologies and materials that will make green, storm-resistant homes affordable and broadly available to working families in communities across America.

All of the homes designed and built for Make It Right feature a suite of storm-resistant features, materials and building processes to help the residents, homes and community survive the next natural disaster.

Make It Right, Helping to Rebuild New Orleans and the Lower Ninth Ward
http://www.makeitrightnola.org/

Global Green, Holy Cross Project
http://www.globalgreen.org/neworleans/

THE SPECIFICS OF SECURING THE BUILDING IN WIND

ROOFING SYSTEMS

Where current codes do not already require retrofitting, as a voluntary strategy, homeowners should be encouraged to anchor roofing components and to reinforce the roof's critical corner sections.

SOFFITS

In an effort to improve soffit installation methods, outreach and certification of home builders should increase.

EXTERIOR MECHANICAL AND ELECTRICAL EQUIPMENT

Exhaust fans, HVAC units and communications equipment should be checked and maintained frequently by qualified professionals.

WINDOWS AND DOORS

Strengthen requirements for homeowners to properly install rated watertight shutters or laminated glazing systems over doors, windows and other openings.

BUILDING SIDING

Communities should provide information on alternative techniques for other mitigation methods such as securing siding or applying a waterproof coating or membrane on the exterior building walls.

IMAGE:INFROGMATION OF NEW ORLEANS

CH5-31: Lack of building ventilation can lead to mold problems in damp environments.

IMAGE:PUBLIC DOMAIN

CH5-32: Soffits are some of the most vulnerable elements of a home and are susceptible to wind damage.

IMAGE:KING PRINCE

CH5-33: High-quality, storm resistant siding can protect the contents of a home.

SITE DESIGN STRATEGY

Prepare the Property Before a Storm

● *Essential* C MR LR D

◒ *Encouraged* A UR

◡ *Optional*

N/A *Not applicable*

Some of the most important actions to prevent storm damage involve preparing a home and property to weather the storm. These strategies do not involve structural changes to the building but are designed to safeguard the contents of a house and prevent airborne and waterborne objects from damaging neighboring houses. Some measures require the help of a professional which will require some lead time. Other measures should be taken when the homeowner learns of an approaching hurricane. To minimize damage to the house, precautions should be taken in conjunction with other flood- and wind-proofing strategies.

IMAGE: WWW.FLASH.COM

CH5-34: Visual inspections around the property should identify items that could become airborne projectiles.

FLASH

Best Practice Case Study: The Federal Alliance for Safe Homes, Inc.

Scale of Project: Site specific to community level

The Federal Alliance for Safe Homes, Inc - FLASH® is a non-profit, 501(c)3 organization dedicated to promoting disaster safety and property loss mitigation. FLASH partners with like-minded organizations from the public, private and non-profit sector to demonstrate leadership through creation of useful and reliable disaster safety education programs. The organization also sponsors ongoing outreach initiatives to encourage citizens to build, buy and use buildings that are constructed or retrofitted with disaster safety in mind.

The Federal Alliance for Safe Homes, Inc
http://www.flash.org/index.php

FEMA, 'Protect Your Property or Business from Disaster'
http://tinyurl.com/fema-howto

THE SPECIFICS OF PREPARING THE PROPERTY BEFORE A STORM

ADVANCED FLOOD PROOFING MEASURES

- Install backflow valves in sanitary and storm sewer lines.
- Raise utility system components, machinery and other pieces of equipment above the flood level.
- Anchor fuel tanks and other storage tanks to prevent flotation.
- Install a sump pump and foundation drain system.

ADVANCED WIND PROOFING MEASURES

- Install straps or additional clips to securely fasten your roof to the frame structure. This will reduce roof damage.
- Consider building a securely anchored "safe room" that can serve double duty as a tornado shelter. A safe room should not be used in hurricane conditions as an alternative to evacuation.

OTHER MEASURES TO TAKE BEFORE A HURRICANE

- Have materials ready to secure windows: permanent storm shutters offer the best protection for windows. Another option is to board up windows with 5/8" marine plywood, cut to fit and ready to install; tape does not prevent windows from breaking.
- Clear loose or clogged rain gutters and downspouts.
- Be sure trees and shrubs around your home are well trimmed and maintained.
- Remove large trees near the structure that are unhealthy or pose a threat in storms.
- Anchor or stow trash cans, patio furniture, barbecues, yard tools, etc. so that the wind cannot pick them up.
- Determine how and where to secure your boat.
- Use the straps and ground anchors also used for manufactured homes to anchor outbuildings, especially small garden sheds that are usually not placed on a permanent foundation.

IMAGE: WWW.VOBB.COM

CH5-35: Hurricane straps are able to withstand winds of more than 100 miles per hour. The easiest way to install hurricane straps is during the construction of the home.

IMAGE: WWW.FLORIDASHUTTERSINC.COM

CH5-36: Hurricane shutters remain the most economical solution for most homeowners to protect window openings in a storm, although hurricane resistant glass is increasingly popular.

IMAGE: MICHELE DESHOTELS

CH5-37: Elevated on a platform above expected flood water, an outdoor condenser unit is securely attached to the platform and will not become damaging flood-borne debris.

SITE DESIGN STRATEGY

Elevate Living Space Above Base Flood Elevation

●	*Essential*	C A MR LR D
◒	*Encouraged*	UR
◡	*Optional*	
N/A	*Not applicable*	

One way to reduce risk of flooding to an existing house is to elevate habitable areas of the house above the 1% (100 year) flood level, or Base Flood Elevation (BFE). The BFE is the regulatory requirement for the elevation or flood proofing of structures. It is the computed elevation to which floodwater is anticipated to rise during the base flood. The relationship between the BFE and a structure's elevation helps determine the flood insurance premium.

There are several ways to elevate an existing house, but regardless of the technique used, the home's foundation must be able to handle significant hydrostatic pressure, hydrodynamic pressure and debris impact. Homeowners should aim to raise the lowest occupied floor level at least one foot above the BFE of their property to reduce flood risk and to decrease the flood insurance rate. Many homeowners in Louisiana have chosen to elevate substantially more than one foot above the BFE.

There is a flood insurance discount to build above the BFE. In most cases, it can be proven that the higher cost to build above the BFE will pay off. The homeowner saves over the course of a mortgage by not having to pay the greater insurance premiums had the house never been elevated.

Additionally, FEMA has implemented a Community Rating System as part of the National Flood Insurance Program. Communities that participate in this voluntary program and exceed the minimum NFIP standards are eligible to get flood insurance discounts for everyone in the community. Stronger best practices regulations are eligible for higher discounts. Implementing some CRS activities can also help projects qualify for other federal assistance programs.

http://www.floods.org/

IMAGE: CENTER FOR PLANNING EXCELLENCE

CH5-38: This home in Jean Lafitte, Louisiana has multiple entrances and created recreational space underneath its raised living quarters.

RECOMMENDED RESIDENTIAL CONSTRUCTION FOR COASTAL AREAS

Best Practice Case Study: FEMA

Scale of Project: Site specific to community level

Good design and construction, while not able to completely eliminate risk, can significantly reduce the risk to life and damage to property. This Manual provides recommended designs and guidance for rebuilding homes destroyed by hurricanes in the Gulf Coast. The Manual also provides guidance in designing and building less vulnerable new homes that reduce the risk to life and property.

The city of Mandeville has implemented a model ordinance that requires new structures to be elevated one foot or more above the BFE. This addition of freeboard has reduced property owners' insurance premiums. Premiums have been reduced in direct proportion to how high above BFE the structure has been elevated.

FEMA, 'Recommended Residential Construction for Coastal Areas: Building on Strong and Safe Foundations'
http://tinyurl.com/fema-recommended

City of Mandeville Dept. of Planning and Development
http://www.cityofmandeville.com

THE SPECIFICS OF ELEVATING LIVING SPACE ABOVE BASE FLOOD ELEVATION

TECHNIQUES THAT CAN BE USED TO ELEVATE A HOUSE:

1. Extend walls, build a "false floor" and then raise lowest floor. This is best suited to houses with concrete or masonry walls, but not for houses with other types of walls, such as those framed with wood studs and covered with wood or brick veneer, which would be more vulnerable to flood damage. This technique is appropriate when the depth of the base flood at the house is less than 4 or 5 feet above grade.
   - The first step is removing the roof.
   - The walls are raised by adding concrete blocks to both the tops of the walls and the bottoms of the window openings.
   - Openings are created in the walls near the ground.
   - A new wood-frame lowest floor is constructed above the flood level, and the roof, windows and doors are reinstalled.
   - An alternative to building an elevated wood-frame floor is installing a new, elevated concrete slab floor on fill placed over the old slab.

2. Convert existing lower area to non-habitable space. This is best suited to houses with concrete or masonry walls, but not for houses with other types of walls, such as those framed with wood studs and covered with brick veneer, which would be more vulnerable to flood damage. This technique is appropriate when the depth of the base flood at the house is more than 4 or 5 feet above grade.
   - The new second-story floor and walls are built on top of the existing lower story.
   - The new second-story walls are covered with siding or stucco.

3. Lift entire house and build a new foundation. The new or extended foundation can consist of continuous walls or separate piers, posts, columns or piles. This is best suited for frame or masonry houses, homes built on crawl space, open foundations or slab-on-grade foundations with a variation that lifts the slab. This technique is appropriate for a range of flood levels. This method is a frequent choice in Louisiana.

FEMA, 'Homeowner's Guide to Retrofitting Second Edition'
http://tinyurl.com/fema-retrofitting

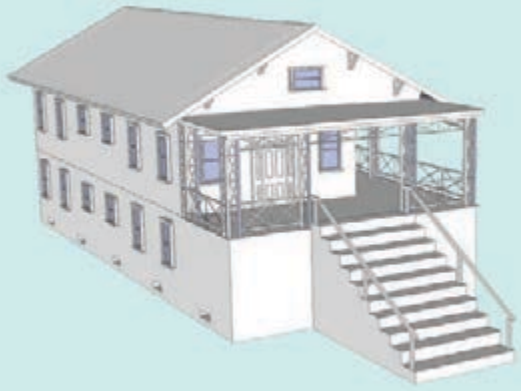


IMAGE: FREGONESE ASSOCIATES

CH5-39: Extend the walls of the house to raise the first floor and build a "false" floor.

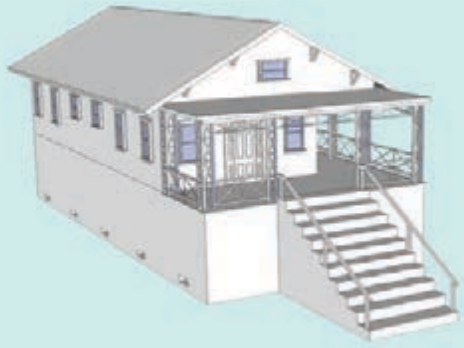


IMAGE: FREGONESE ASSOCIATES

CH5-40: Convert existing lower floor(s) of the house to non-habitable space and living above.

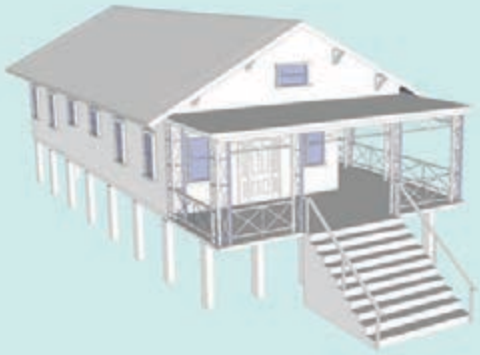


IMAGE: FREGONESE ASSOCIATES

CH5-41: Lift the entire house, with the floor slab attached, and build a new foundation to elevate the house.

SITE DESIGN STRATEGY

Utilize Innovative and Adaptive Buildings

- *Essential* — LR D
- *Encouraged* — C A MR
- *Optional* — UR
- N/A *Not applicable*

Many coastal communities around the world use innovative buildings to better live with water. Coastal communities should explore alternatives that come from vernacular Louisiana styles as well as international solutions.

Adaptive Reuse Buildings

Many historic buildings that still stand in south Louisiana can inform today's development decisions. Time tested methods that date back to early settlers in Louisiana's hot and humid climate display empathetic reverence for place and work with local systems. Traditional building techniques have worked for decades and feature raised homes, functional storm shutters, local materials including timber and brick, and breezeways. Adaptive reuse of these building styles, materials and methods can accommodate future development needs.

Temporary Buildings

Temporary and semi-permanent structures include short-term, temporary shelters, portable and modular-component structures, and seasonally inhabited permanent structures. This category of construction can offer specific benefits when building in high-risk areas. Temporary structures can inexpensively meet community needs in many situations where frequent hazards mean frequent replacement, and rebuilding costly structures is not financially feasible.

Modular and Manufactured Buildings

Modular and manufactured structures can combine traditional, local design concepts with the latest innovation. The advantage is usually affordability, mass production and fast installation.

IMAGE: WWW.BEAUSOLEILHOME.ORG

CH5-42: The BeauSoleil home is designed to withstand hurricane-force winds and to be totally self-sufficient, which makes it especially ideal for coastal environments.

INNOVATIVE PRACTICES: MANUFACTURED RESIDENCES

Best Practice Case Study: BeauSoleil Home
Scale of Project: Site specific to community level

One example of innovation is the University of Louisiana's BeauSoleil Home, designed for the 2009 Solar Decathlon, a biennial international competition sponsored by the U.S. Department of Energy and held on the National Mall. The BeauSoleil Home, with its design roots in Louisiana vernacular architecture, utilizes the latest in energy and building technology. In addition to meeting the competition's design criteria, the house was engineered to withstand hurricane-force winds and to be elevated in areas vulnerable to flooding. Winner of both the 2009 Solar Decathlon's Market Viability Award and People's Choice Award, the house was developed to be manufactured at an affordable price.

BeauSoleil - Louisiana Solar Home
http://www.beausoleilhome.org/

SITE DESIGN STRATEGY

Utilize Floating Homes

Essential C A MR LR D

Encouraged UR

Optional

N/A *Not applicable*

The Netherlands pioneered the use of floating houses, where architects and developers are working to address an increased demand for housing in the face of rising sea levels associated with climate change. Louisiana faces these issues as well, but any floating houses built in coastal Louisiana also need to be able to withstand the dangers of strong Gulf Coast storms, including high winds, high water, storm surges and other factors related to such conditions. Exposure to storm surge or other high velocity conditions and wave action may require combining this strategy with a second layer of defense.

This strategy is the cornerstone of the Buoyant Foundation Project. Homes with buoyant foundations remain close to the ground and are supported on pilings, however they will float to stay above the water. Flotation blocks are held by a structural frame, which is attached to the underside of the house. When flooding occurs the flotation blocks lift the house, which is guided by 4 posts near each corner. Utility lines have breakaway connections or are coiled to extend with the floating house.

http://www.buoyantfoundation.org/

IMAGE: UCLA SCHOOL OF ARCHITECTURE

CH5-43: In the case of a flood, the FLOAT house acts as a raft, raising up to 12 feet on guide posts.

FLOAT HOUSE

Best Practice Case Study: Lower Ninth Ward, New Orleans

Scale of Project: Site specific

Located in New Orleans, the FLOAT House was built in the Lower Ninth Ward as a partnership between Morphosis Architects and the UCLA School of Architecture for the Make it Right Foundation. In case of a flood, the base of the house acts as a raft allowing the house to rise vertically up to 12 feet on guide posts, securely floating as water levels rise. The intent is to minimize catastrophic damage. This approach also allows for the early return of occupants in the aftermath of a hurricane or flood. While this house is elevated to accommodate the depth of the floating base, this alternative could be used with a ramp and may be particularly well-suited for families who cannot manage a long flight of stairs.

Make It Right, Helping to Rebuild New Orleans and the Lower Ninth Ward
http://www.makeitrightnola.org/

SITE DESIGN STRATEGY

Strategic Site Development

●	*Essential*	C UR MR LR
◒	*Encouraged*	A D
◡	*Optional*	
N/A	*Not applicable*	

Deciding where to locate new development has many implications for its safety, livability and resilience. Location based decisions can influence design, construction methods, building materials, size and building use, all of which influence cost. Ideally, when planning a new public building of community or regional importance (for example, hospitals, fire stations, emergency response headquarters, schools, libraries, civic centers, social service offices, etc.), governments and service providers should consider the safest sites possible. The result of strategic site development, innovative design and common sense can result in reduced risk, reduced down-time, and increased functionality during a community disaster.

IMAGE: WWW.EVIAGALVESTON.COM

CH5-44: Evia was designed with elevated neighborhoods and recessed streets to protect homes.

TEXAS SUCCESS STORY: MITIGATING STORM DAMAGE WITH SITE SELECTION, DESIGN AND CONSTRUCTION

Best Practice Case Study: Evia Subdivision, Galveston, TX

Scale of Project: Site specific to community level

The community of Evia in Galveston, Texas survived Hurricane Ike in 2008 nearly unscathed, when much of the rest of the island community faced significant damage. Evia fared well because of careful planning by developers. The interior location is behind the Galveston Seawall. Developers dug out three lakes, elevated the entire neighborhood and then carved in streets. The recessed roads, lakes, and a 5-acre, man-made wetland serve as a secondary water detention system that helped ameliorate flooding. These design features offer aesthetic benefits while providing protection.

FEMA, 'Galveston Neighborhood Gets High Marks in Hurricane Test'
http://tinyurl.com/fema-evia

http://www.eviagalveston.com

THE SPECIFICS OF STRATEGIC SITE DEVELOPMENT

SELECTING THE SITE

Site selection is a critical step. Poor decisions at the siting phase cannot be overcome with design or construction solutions.

1. Begin with a clear understanding of the intended uses and requirements of the proposed building.
2. Develop a comprehensive set of project-specific criteria to guide the site selection process.
3. Conduct a thorough site selection process that considers project-specific criteria, and the following:
   - What are the available properties in the desired region?
   - Function and use of the facility: Is the facility public? Does the use require a location in a particular jurisdiction?
   - Safety and accessibility of the facility: How far will users travel to access the services offered?
4. Identify locations of potential coastal hazards and environmental and regulatory factors (such as land elevation, floodplain types, soil types, erosion potential, saltwater intrusion, access)
5. Consider all life-cycle costs:
   - Capital costs (land, design, construction).
   - Operation and maintenance costs (utilities, insurance).
   - Additional life-cycle costs (periodic repairs due to normal use, age, upgrades, storm damage or flooding, demolishing and rebuilding).

WHERE TO BUILD ON THE SITE

Deciding where to build on a property is just as important as the property selection. Consider the following:

- Identify coastal hazards relative to site location.
- Determine floodplain zone (based on FIRM, DFIRM, and NFIP latest floodplain mapping) base flood elevation, climate and soil type.
- Consider solar orientation and prevailing wind patterns to take advantage of opportunities for natural heating and cooling through passive or active solar design and/or geothermal systems.
- Locate the building on the highest available ground.

  Buildings elevated by pilings require additional design solutions to be fully accessible for people of all abilities. All public buildings, particularly elevated or multi-floor buildings, should consider accessibility issues if the structure loses power, particularly in an emergency situation.

SITE DEVELOPMENT CONSIDERATIONS

- Consider raising the structure not only above the base flood level, but to an elevation that effectively removes the building from the floodplain. This may increase the cost of construction, but the potential of reduced insurance costs with increased safety and reliability of use after a flood event must also be factored into the economics of the decision.
- Use high quality construction materials and methods. Investigate utilization of the latest building technology.
- In the event of a major storm or hurricane, civic buildings will be heavily relied upon when evacuees return, during clean up and rebuilding. These buildings house functions, services, and records that are vitally important during and after an emergency.
- Consider building or installing technology that is not grid-dependent (on-site energy generation, on-site water sources, wastewater processing) that can provide secure and reliable utilities that will function when regional infrastructure may be damaged or not functioning.

BUSINESS DEVELOPMENT RELOCATION

Louisiana Economic Development has many resources for business and industry locating in the state. Geospatial data, parish and community profiles, and a database of available buildings and properties are among the current offerings of the Louisiana Site Selection Center. The program is currently developing a GIS-based geographic suitability index for businesses that answer questions such as, "What location in this region is best suited to site business and industry based on proximity to infrastructure and resources?" The index can also be a tool for communities to assess their strengths and weaknesses, as well as to identify the most appropriate types of business to target.

THE SPECIFICS OF SITE DESIGN

LOT SIZE

Compact, well-designed development patterns help to create more resilient and tightly-woven communities. Smaller minimum lot sizes in zoning codes are a useful tool for creating more compact neighborhoods. One benefit of compact neighborhoods is that the areas requiring protection from flooding are smaller than comparable development spread across the landscape.

LOT COVERAGE

Maximum lot coverage is another important regulatory consideration that must be addressed if compact development is to occur. The tendency in some coastal areas is to discourage compact development by applying low lot coverages (approximately 20 to 40%). The idea is that by spreading development out, the large pervious lot areas will absorb storm water. While this approach may at first seem reasonable, there is no amount of pervious lot area that can absorb the storm surge associated with a major storm event. The "safe" land is too valuable for this approach. A more effective approach is to allow much higher lot coverage (70 to 90%) in areas of high resiliency. By building compactly in the high resiliency areas, communities are able to leave the less resilient land open for storm water.

STREET SETBACKS

As with lot size and lot coverage, large minimum setbacks can lead to difficulties in building compactly and vibrantly. Allowing, or in some conditions requiring, a built environment where the buildings are placed at the street can help in two ways. It makes building compactly more efficient and helps activate the streetscape by reorienting the street toward the pedestrian. The elevation height of the structure, entry staircase, and a comfortable width sidewalk as "public space" should all be taken into account.

LANDSCAPING AMOUNTS AND TYPES

Open space is an important part of any livable area. To create lively, active coastal communities, there are ways to design and regulate natural amenities that make both financial and urban design sense. For example, encouraging wind resistant native plants is critical for landscaped areas. This is described further in the "using native plants for protection" strategy.

PARKING STANDARDS AND DESIGN REQUIREMENTS

It is important to differentiate between parking standards for auto-oriented and pedestrian-oriented districts. High parking standards not only eliminate the potential for compact, walkable communities, but also create excessive impervious surface on a site. Reduced parking standards, along with pervious surfaces, help minimize the impacts of surface parking.

IMAGE: FREGONESE ASSOCIATES

CH5-45: Smaller lot sizes help encourage more walkable, compact neighborhoods.

IMAGE: FREGONESE ASSOCIATES

CH5-46: Development is clustered to reduce the amount of area vulnerable to storm damage.

IMAGE: FREGONESE ASSOCIATES

CH5-47: Well-designed, elevated homes can still be conducive to walkable communities.

COMMUNITY SCALE STRATEGIES REFERENCES

Coastal No Adverse Impact (NAI) Handbook. Association of State Floodplain Managers. 2007. http://www.floods.org/NoAdverseImpact/CNAI_Handbook/CNAI_Handbook.pdf

State of Louisiana Hazard Mitigation Strategy, Volume II. Federal Emergency Management Agency. 2008.

Samet, M. and Wu, J. Unnatural Disasters, Natural Solutions: Lessons from the Flooding of New Orleans. American Rivers. 2006. http://www.americanrivers.org/assets/pdfs/reports-and-publications/Katrina_Publication-take25a19.pdf

Creating an Emergency Response Plan. StormSmart Coasts. http://al.stormsmartcoasts.org/before/emergency-services/emergency-response-plan/

http://www.floods.org/index.asp?menuid=340

INFRASTRUCTURE

Hardening and Resiliency: U.S. Energy Industry Response to Recent Hurricane Seasons http://www.oe.netl.doe.gov/docs/HR-Report-final-081710.pdf

Infrastructure Security and Energy Restoration. Office of Electricity Delivery and Energy Reliability. U.S. Department of Energy, 2010.

Kovarik, B. Hurricanes: Reporting environmental disasters. Radford University. http://www.radford.edu/wkovarik/misc/Resources.hurricane.html

http://water.epa.gov/infrastructure/sustain

LEVEES

Dikes and Levees. US Army Corps of Engineers. http://chl.erdc.usace.army.mil/chl.aspx?p=s&a=ARTICLES!142

BIOSWALES

Bioswales absorb and transport large runoff events. Natural Resources Conservation Service. US Department of Agriculture, 2007.

SITE SELECTION

How Do Siting and Design Decisions Affect the Owner's Costs? Federal Emergency Management Agency.

Standard for the Design and Construction of Storm Shelters (ICC-500). International Code Council (ICC), 2008.

WATER MANAGEMENT

Dijkman, J. (ed) A Dutch perspective on coastal Louisiana flood risk reduction and landscape stabilization: Second Interim Report. US Army Corps of Engineers, 2007. http://www.dtic.mil/cgi-bin/GetTRDoc?Location=U2&doc=GetTRDoc.pdf&AD=ADA470397

Design and Construction Guidance for Community Safe Rooms. FEMA 361. 2008. http://www.fema.gov/library/viewRecord.do?id=1657

State of Louisiana Model Landscape Code: Appendix A: Model Storm Water Based Landscape Code. Louisiana Department of Environmental Quality, 2009.

Storm water Best Management Practices. East Baton Rouge Master Development Program. 2007. http://brgov.com/dept/planning/pdf/StormwaterManual.pdf

Storm Water Technology Fact Sheet: On-site Underground Retention/Detention. US Environmental Protection Agency. http://www.epa.gov/owm/mtb/runoff.pdf

SITE AND BUILDING STRATEGIES REFERENCES

BUILDING STRATEGIES

Unnatural Disasters, Natural Solutions: Lessons from the flooding of New Orleans. American Rivers, 2006.
http://www.americanrivers.org/assets/pdfs/reports-and-publications/Katrina_Publication-take25a19.pdf

Coastal Contractor Online
http://www.coastalcontractor.net/article/131.html

Coastal Construction Manual, Vol. 1. Federal Emergency Management Agency, 2000.

Galveston neighborhood gets high marks in hurricane test. Mitigation Best Practices. Federal Emergency Management Agency.
http://www.fema.gov/pdf/hazard/hurricane/2008/ike/evia.pdf

Mitigation Best Practices Search Tool: Case Studies. Federal Emergency Management Agency.
http://www.fema.gov/mitigationbp/

Homeowner's Guide to Retrofitting. Federal Emergency Management Agency, 2009.
http://www.fema.gov/rebuild/mat/fema312.shtm

Summary Report on Building Performance - 2004 Hurricane Season. Federal Emergency Management Agency, 2005.

Above the Flood: Elevating your Flood prone House. Federal Emergency Management Agency, 2000.
http://www.fema.gov/library/viewRecord.do?id=1424

Local Officials Guide for Coastal Construction. Federal Emergency Management Agency, 2009.
http://www.fema.gov/library/viewRecord.do?id=3647

How Do Siting and Design Decisions Affect the Owner's Costs? Federal Emergency Management Agency, 2005.
http://www.fema.gov/library/viewRecord.do?id=1570

Hurricane Ike Nature's Force versus Structural Strength. Institute for Business and Home Safety
http://www.disastersafety.org/resource/resmgr/pdfs/hurricane_ike.pdf

About LaHouse. LSU Ag Center, 2009.
http://www.lsuagcenter.com/en/family_home/home/la_house/about_lahouse/

Palca, J. Dutch Architects Plan for a Floating Future. National Public Radio, 2008.
http://www.npr.org/templates/story/story.php?storyId=18480769

A Residential Construction Method for NORA's Consideration. Quad Shelter Building System. Signet.

A Residential Construction Method for NORA's Consideration. Signet.

Morphosis FLOAT House Completed for Make It Right. UCLA Architecture, 2009.
http://www.aud.ucla.edu/pdfs/FLOAT_HOUSE.pdf

Hurricane Resistant Homes on Texas Gulf Coast Survive Ike's Worst. Texas Gulf Coast Online.
http://www.texasgulfcoastonline.com/News/tabid/86/ctl/ArticleView/mid/466/articleId/117/Default.aspx

Louisiana Solar Home - BeauSoleil
http://beausoleilhome.org

Wilkins, J.,Emmer, R., Hwang, D., Kemp, G., Kennedy, B., Mashriqui, H., Sharky, B. Louisiana Coastal Hazard Mitigation Handbook. 2008.

BUSINESS PREPAREDNESS

Business Disaster Preparedness Plan Important. Federal Emergency Management Agency, 2010.
http://www.fema.gov/news/newsrelease.fema?id=50356

HURRICANE PREPAREDNESS

Before a Hurricane. Federal Emergency Management Agency, 2010.
http://www.fema.gov/hazard/hurricane/hu_before.shtm

Remove Trees and Potential Windborne Missiles. Federal Emergency Management Agency, 2008.
http://www.fema.gov/library/viewRecord.do?id=2462

http://www.gohsep.la.gov

TEMPORARY STRUCTURES

Placement of Temporary Structures in the Special Flood Hazard Areas (Sfha) in Response to the Gulf Oil Spill. Federal Emergency Management Agency, 2010.
http://www.lamappingproject.com/_pdfs/SFHA%20Temp%20Structure%20Recommendations%20HQ1%20_4_.pdf

WIND DAMAGE

Leatherman, S., Chowdhury, A., and Robertson, C. Wall of Wind Full-Scale Destructive Testing of Coastal Houses and Hurricane Damage Mitigation. Journal of Coastal Research, 2007.
http://www.bama.ua.edu/~jcsenkbeil/gy4570/structure%20mitigation.pdf

NATIVE PLANTS

Lady Bird Johnson Wildflower Center: Louisiana Recommended Species
http://www.wildflower.org

Louisiana Native Plant Initiative
http://www.la.nrcs.usda.gov

Wetland Plants for Site Engineering and Design
http://www.mrgo.gov

LSU AgCenter
http://www.lsuagcenter.com

Longue Vue House and Garden
http://www.longuevue.com

Chapter 6
STRATEGIC IMPLEMENTATION

A number of strategies that support safe, long-term coastal development are recommended in the previous chapter. It has been noted that not every strategy is appropriate in every scale and location, so the Manual also suggests which strategies are suited to different coastal environments in Louisiana. But implementing such strategies can seem daunting. The Manual advocates the creation of community-driven plans so that the recommended strategies, or other strategies, are not chosen and implemented piece-meal, but rather, as intentional, incremental steps toward a cohesive vision. Plans act as a type of "roadmap" to help communities determine where they are headed. In Chapter 6, users are guided through a step-by-step approach for creating plans and implementing the kinds of strategies recommended in Chapter 5.

Implementation Requires Coordination Across Scales

Successful community planning, response to emergencies, protection of sensitive and critical lands and waterways, and management of potential risks require partnership and coordination across jurisdictions and easily accessible, shared data.

Coordination and communication are required at all levels: State and regional, parish and community-wide, and site scales. Coordination among and within State agencies, regions and parishes will help ensure that future changes in the coastal landscape are clearly understood and sensitive areas are protected. This coordination also ensures that future development is aligned with anticipated changes in the landscape.

IMAGE: FEMA

CH6-1: Working together, Louisiana's communities can coordinate across scales to achieve long-term resiliency.

Plans at the State and regional level should be taken into account when planning community-scale adaptations. Likewise, community decisions and plans may affect subdivisions or specific building sites, so strategies for individual sites should always be evaluated within the context of larger community wide plans.

Implementation Starts with an Understanding of the Regulatory Framework

Employing best practices requires an understanding of state and federal processes at work in Louisiana today; well-informed community and individual decisions cannot be made without knowledge of other actions. Historically, federal and State agencies have coordinated several key large-scale water management and land rebuilding initiatives.

Federal Regulations

One element of the coastal regulatory framework that spans many levels is the Coastal Zone Management Act (CZMA). At the federal level, the CZMA encourages coastal states to create policies for the management and protection of their coastal resources. It also requires federal agencies to act in accordance with those states' coastal management plans. Through the Louisiana Department of Natural Resources, Louisiana has responded with the Louisiana Coastal Resources Program which is dedicated to protecting, developing, restoring and enhancing coastal resources and serving as a coastal resource knowledge base for State and local governments. Louisiana's Coastal Resources Program is also in charge of the Coastal Use Permit Program, which assesses all proposed projects and determines if uses are of State or local coastal concern and if these uses are consistent with the State's coastal master plan. Individual parishes in the coastal zone develop and manage an approved Local Parish CZM program that can more quickly and efficiently address applications for uses of local concern in the Coastal Use Permit process.

Another wide-reaching element of the coastal regulatory framework is FEMA's National Flood Insurance Program (NFIP). This voluntary program allows communities to purchase federally-backed flood insurance if the local government regulates development within floodplains. Digital Flood Insurance Rate Maps published by FEMA provide communities with crucial information for floodplain management, as well as establishing flood insurance rates.

Base Flood Elevations are defined by FEMA as the elevation with a 1 percent chance of being reached by flood waters in a given year, and they are key NFIP building standards. The Base Flood Elevations are periodically updated. Communities can lower their flood insurance premiums by setting standards that exceed NFIP minimum elevation requirements.

Several other federal-level regulations affect coastal development. One, the Coastal Barrier Resources Act, encourages the conservation of hurricane-prone, biologically-rich coastal barriers by designating undeveloped coastal barriers and restricting federal expenditures that would encourage development, such as insurance through the NFIP. This approach allows development of the areas, but without federal assistance.

Section 404 of the Clean Water Act and the Rivers and Harbors Act are other important Federal regulations. The Clean Water Act regulates the discharge of dredged or fill material into U.S. waters, restricting it if it will cause significant water degradation or if a reasonable alternative is available. The Rivers and Harbors Act makes it a misdemeanor to discharge refuse of any kind into waters or to excavate, fill or alter the course of navigable waters without a permit.

One more critical piece of Federal regulation under the Clean Water Act is the EPA's National Pollutant Discharge Elimination System (NPDES), which regulates water pollution discharged from point sources. Homes connected to a municipal system, using a septic system, or otherwise not discharging directly to surface waters do not need a NPDES permit. The Louisiana Department of Environmental Quality's stormwater management program administers NPDES permits at the State level and requires stormwater to be treated to the maximum extent practicable. Stormwater runoff is usually managed through best practices, but a NPDES permit may be necessary for construction sites or industrial activities.

State and Regional Regulations and Guidance

In addition to the federal regulatory framework, the State of Louisiana also provides guidance in relation to the Manual's best practices. CPRA's *Comprehensive Master Plan for a Sustainable Coast*, first approved in 2007 by the Legislature, strengthens hurricane and flood protection as well as natural resource and habitat conservation and restoration by promoting sustainable coastal preservation, restoration and management. Large scale protection and restoration projects are identified in this plan. One of the first executive orders of Governor Bobby Jindal (E.O.- B.J. 2008-7) requires, "All State agencies shall administer their regulatory practices, programs, contracts, grants and all other functions vested in them in a manner consistent with the Master Plan and public interest to the maximum extent possible."

The Louisiana Uniform Construction Code, a statewide building code implemented in 2006 after the storms of 2005, is based on a full suite of the international building codes, including the International Residential Code (IRC). It creates strong, consistent construction permit requirements across Louisiana with mandatory local enforcement.

At the local level in Louisiana, zoning codes, local building codes (which can be more but not less stringent than the Louisiana Uniform Construction Code), subdivision codes and comprehensive local plans provide additional development regulations. Finally, other groups such as federally- or State-recognized Native American Tribes or private insurers may also influence and help regulate development along Louisiana's coast.

FEDERAL, STATE AND LOCAL AGENCIES INVOLVED IN COASTAL DEVELOPMENT

Overseeing coastal development and water management is a shared responsibility among federal, state and local governments. Many agencies at all three levels of government have roles in managing water and coastal development. In addition, non-governmental organizations and private landowners and businesses are involved with managing Louisiana's coastal communities and natural areas. (Please note, this is intended to be a comprehensive list of federal, state and local agencies, however, there may be additional agencies and organizations not listed here that participate in coastal development.)

OTHER ORGANIZATIONS INVOLVED IN COASTAL DEVELOPMENT:

NGOs:

America's Wetlands
Audubon Society
Barataria - Terrebonne National Estuary Program
Center for Planning Excellence
Coalition to Restore Coastal Louisiana
Ducks Unlimited
Environmental Defense Fund
Lake Pontchartrain Basin Foundation
The Nature Conservancy
National Wildlife Federation
Restore or Retreat

Key Institutions:

Sea Grant
LSU Ag Center Cooperative Extension
LSU
UNO CHART
Tulane

AGENCIES	ACT, REGULATION, OR PROGRAM
FEDERAL AGENCIES	
Department of Agriculture:	
Natural Resources Conservation Service	
Department of Commerce:	
National Oceanic and Atmospheric Agency (NOAA)	• Coastal Zone Management Act
NOAA Weather Service and River Forecast Center	
Department of Defense:	
U.S. Army Corps of Engineers	
Department of Homeland Security:	
Federal Emergency Management Agency (FEMA)	• National Flood Insurance Program (NFIP)
U.S. Coast Guard	
Department of the Interior:	
U.S. Bureau of Reclamation	
U.S. Fish and Wildlife Service	• Coastal Barrier Resources Act
U.S. Geological Survey (USGS) Wetlands Research Center	
Council on Environmental Quality	
U. S. Environmental Protection Agency (EPA):	• Clean Water Act: National Pollutant Discharge Elimination System (NPDES); Section 404 (permits administered by US Army Corps of Engineers) • Gulf of Mexico Program
STATE AGENCIES AND ENTITIES	
Governor's Office of Coastal Activities	
Coastal Protection and Restoration Authority (CPRA)	• *Louisiana's Comprehensive Master Plan for a Sustainable Coast*
Department of Environmental Quality	• State stormwater management program
Department of Wildlife and Fisheries	
Department of Natural Resources (DNR)	• Louisiana Coastal Zone Management • Coastal Use Permit Program
Department of Health & Hospitals	
Department of Transportation and Development	
Department of Insurance	
Economic Development	
Department of Agriculture and Forestry	
Department of Culture, Recreation and Tourism	
Department of Public Safety	• Louisiana Uniform Construction Code
NATIVE AMERICAN TRIBES	
Federal and State recognized Native American Tribes	
REGIONAL AND LOCAL AGENCIES	
Regional Planning Districts Levee Districts Parish Governments Municipal Governments	• Parish or Municipal Comprehensive Plans* • Parish or Municipal Zoning Code* • Parish or Municipal Subdivision Regulations* • Parish Coastal Zone Management Programs* • Parish or Municipal Building Code ** if applicable*

WHAT KINDS OF GIS DATA ARE AVAILABLE?

DATA TYPE	AGENCY	ONLINE?
REFERENCE LAYERS		
Aerial photography	Communities, Esri, Geocomm.com	Sometimes
Transportation network (road, railroads, airports)	Communities, State, Esri	Yes
Parcels	Communities	Sometimes
Urbanized areas	Communities, Census TIGER Files	Yes
POLITICAL		
Zoning	Communities	Sometimes
Land use	Communities	Sometimes
Political boundaries	Communities, Census	Yes
Population (historic, present, forecasts)	US Census, State	Yes
LOCAL, PARISH AND STATE PLANNING		
Louisiana Speaks (2007)	Louisiana Statewide Data Catalog	No
Parish plans	Communities	Yes, if applicable
Transportation plans	State, Communities	Yes
Coastal Master Plan	OCPR, DNR "SONRIS"	Yes
Coastal resilience	Coastal Resilience Gulf of Mexico Decision Support Tool	Yes
Hazard mitigation	State, Communities	Yes
Levees (large and small scale)	OCPR, DNR "SONRIS"	Yes
Planned and completed state and federal restoration projects	OCPR, DNR "SONRIS"	Yes
NATURAL SYSTEMS		
Land cover	Atlas	Yes
Rivers and waterways	FEMA, LOSCO	Yes
Advisory Base Flood Elevations (ABFEs)	FEMA	Yes
Floodplains/DFIRM (where available)	FEMA	Yes
Land loss	USGS	Yes
Geology	USGS	Yes

The information in this chapter represents data and resources available at the time of this publication. Please note new resources and updated data may become available.

Implementation Requires Up-to-Date Data

Federal, State and Regional Data

The Federal, State and local agencies listed at left have gathered data about coastal conditions, building requirements, existing and proposed structures, and environmental and water management practices. Because integrated water management is important, it is critical that governmental agencies and non-governmental organizations share data with each other, as well as coordinate within jurisdictions. Sharing data ensures that coastal users have consistent access to the most current and best available data.

Community-Level Data

Because coastal Louisiana is a dynamic, changing area, access to the latest and most comprehensive geospatial data sets is crucial to informed decision-making and planning. Data sets useful for community planning come from a variety of government agencies and departments. Collecting and sharing data represents a major undertaking but should be of principal importance for communities. A Geographic Information System, or GIS, is a computer-based system that organizes, stores, analyzes and presents geospatial data. It is an efficient way for communities to collect and share data sets such as existing land uses and parcel-level data including real market value, transportation networks and environmental constraints.

Planners, developers and community advocates can use this data to see how their current land use patterns interact with potential hazards and projected population changes. They can make informed decisions about future policies based on objective criteria, for example environmentally sensitive areas and areas where business clusters could best take advantage of transportation corridors.

IMAGE: FREGONESE ASSOCIATES

CH6-2: Planners, developers and community advocates can use data to see how their current land use patterns interact with potential hazards.

There is currently no single GIS data repository for Louisiana, but there are a variety of agencies that have data available to communities and the public. Though data is officially available, accessing it can sometimes require an extensive approval process. Louisiana has an opportunity to create a culture of open data sharing and transparency. Parish offices may track parcels, transportation and other datasets. Parishes also have copies of existing plans, codes (including zoning and subdivision, if applicable), and policy documents.

Depending on the community's needs, State-level datasets are available through the Louisiana Department of Natural Resources and Louisiana Department of Transportation and Development. Communities can slso inquire with local academic institutions about available GIS data.

ONLINE RESOURCES FOR IMPLEMENTATION

COMMUNITY SCALE

Louisiana Geospatial Metadata Catalog
http://lagic.lsu.edu/datacatalog/search.asp

Louisiana GIS Council
http://lagic.lsu.edu/lgiscweb/

Atlas: The Louisiana Statewide GIS
http://atlas.lsu.edu/

FEMA Hurricane Katrina Data
http://www.fema.gov/hazard/flood/recoverydata/katrina

Coastal Resilience Gulf of Mexico Decision Support Tool
http://gulfmex.coastalresilience.org/

Louisiana Oil Spill Coordinator's Office Data Catalog
http:// http://lagic.lsu.edu/loscoweb/

Louisiana Geographic Information Center Hurricane Response Mapping
http://lagic.lsu.edu/hurricanes

"SONRIS" Lousiana Department of Natural Resources
http://sonris-www.dnr.state.la.us/www_root/sonris_portal_1.htm

Census TIGER Files
http://www.census.gov/geo/www/tiger

USGS Louisiana Data
http://sdms.cr.usgs.gov/pub/la.html

USGS Land Cover data
http://seamless.usgs.gov/

U.S. Maps and Data
http://gos2.geodata.gov/wps/portal/gos

SITE AND BUILDING SCALE

International Code Council
http://www.iccsafe.org/

Flood Insurance Maps and Requirements
http://www.msc.fema.gov/

Local Zoning and Land Use Codes
http://cpex.org/work/louisiana-land-use-toolkit

Louisiana State Uniform Construction Code Council
http://lsuccc.dps.louisiana.gov/

PLANS

GOHSEP: Governor's Office of Homeland Security and Emergency Preparedness
http://www.gohsep.la.gov/planning.aspx

Emergency Operations Plan (EOP), 2009 Update
http://www.gohsep.la.gov/plans/EOP200961509.pdf

State Hazard Mitigation Plan, 2011 Draft
http://www.gohsep.la.gov/hazmitigatpln_08.aspx

CPRA 2012 Coastal Master Plan
http://coastalmasterplan.louisiana.gov

IMAGE: FREGONESE ASSOCIATES

CH6-3: Study area maps, like this example from Pointe Coupee, show transportation networks, land development patterns, and natural systems. They make it easier for the public and stakeholders to understand the dynamics of their communities.

CREATING STUDY AREA MAPS:

- If available, communities can gather local data from their parish including road networks, political boundaries, parcels, land use, environmental layers and zoning (if applicable).
- Data-sharing agreements often build stronger relationships between agencies. If there is data for a community that is missing from the parish repository, the community can offer local data collection in exchange for technical assistance or data.
- It is important to consider the "unit of analysis" at which data is collected. State-level datasets may not be appropriate to use at a neighborhood scale. Review the data, understand its collection process and check for accuracy at the scale at which it will be used.
- Communities with no GIS capacity have the option to hire consultants to assist with mapping activities. They can also check if their parish is willing to offer technical assistance.

Implementation Requires a Plan

Understanding Large-Scale Context

The first step in implementing best practices is to understand the large-scale coastal improvements that are underway or planned and then to evaluate the likely impacts of those changes on coastal development. While some of the planned projects will not be built for decades, their potential regional impacts need to be considered.

Assessing Existing Assets

Coastal communities have a long history of working together to survive and capitalize on the rigor of living in and adapting to the coastal environment. By assessing existing assets to gain a more comprehensive understanding of a community's unique environmental, cultural and economic assets, solutions and best practices will be grounded in local context, providing a solid foundation for change.

A number of methods are available to identify community assets. Many of these processes can be organized and managed by residents and local leaders. Interviews, focus groups, surveys, public meetings and workshops that encourage open brainstorming about what residents value in their community are all methods that provide an understanding of key assets.

No matter what the methodology, it is important to systematically go through this process to identify key strengths of a community, to build an understanding of why and what change may be needed in the future, and to achieve shared buy-in on selected courses of action.

IMAGE: FREGONESE ASSOCIATES

CH6-4: Residents, property owners and stakeholders get the chance to help prioritize specific community goals during the small area planning process.

Comprehensive and Small Area Planning

The goal of a planning process is to develop an understanding of a community's current assets and challenges and to produce a guide for increasing resiliency and sustainability into the future. A willing community or property owner can initiate a strategic planning process. Developing a plan is a partnership between cities, parishes, residents, builders, businesses and institutions. Through this process, the community or property owner will be able to better understand the regional and state context, identify local assets, articulate a community's or property owner's vision, make a technical assessment of issues and prioritize implementation strategies. When planning to build anything, the local environment and ecosystems should always be taken into account as part of the initial community assessment.

The following steps outline the creation of a comprehensive or small area plan for a group or community in a coastal area. The process engages residents, property owners and stakeholders to identify changes that will improve their long-term sustainability, to tailor the tools contained in this Manual to the community's specific needs and to ensure successful implementation of best practices.

The Manual represents one of the few comprehensive planning guides for coastal communities. In their most simple form, community plans provide two things: a cohesive vision for the future and the codes and implementation strategies to ensure the community develops in the form they desire. Plans will be used to define the need for public facilities or physical improvements, the best places to build, smart building strategies and infrastructure plans.

WHAT IS A SMALL AREA PLAN?

A small area plan is any plan that addresses the issues of a portion of a city or parish. Small area plans can cover as little as 10 acres to as much as thousands. The advantage of a small area plan is its ability to engage issues and people at an intimate scale. The result can be a richly detailed plan that addresses the area's unique issues with tailored solutions. Small planning areas usually have a cohesive set of characteristics, such as similar ecosystems, flood threats or other elements.

AN EXAMPLE COMMUNITY PLAN: DESIRE COMMUNITY DEVELOPMENT PLAN

During the Unified New Orleans Plan (UNOP) process, the Upper Ninth Ward Desire Area expressed interest in planning for redevelopment and revitalization. The planning process that ensued is an example of a successful community planning process. The process began with an understanding of Desire's history as a neighborhood and assessment of assets, resources, issues and concerns. The process used community meetings to understand the needs of the community and to ensure the recommendations and plan adequately addressed those needs. Ultimately, the recommendations centered around the community priorities of housing, health care, education, economics and safety and were organized by short, medium and long term. The process of beginning with an assessment of where a community is in the present, understanding their vision for the future and translating that into actionable implementation is one that coastal Louisiana communities can replicate.

STEPS TO CREATE A SMALL AREA PLAN

STEP 1:
COLLECT BACKGROUND INFORMATION, DEVELOP A COMMUNITY PARTICIPATION PROCESS

Step 1 will provide a context, data and the framework for conducting small area planning.

1. Define the planning area.

The planning area should cover the community/property and all contiguous areas. However, attention should be paid to potential influences from outside the study area (such as drainage from upper watersheds) and how community decisions might affect other communities adjacent or below them. Additionally, take the opportunity to connect and work with adjacent communities.

2. Develop a community participation program.

A robust program to engage community leaders, key stakeholders, businesses, property owners and residents should be developed to ensure a final product that both meets community needs and has active community support. Community participation will define guiding principles that shape the successful desired outcomes. Successful community participation can be achieved through one or more of several outreach methodologies:

- Citizen advisory committee
- Charrettes or workshops
- Strengths, weaknesses, opportunities and threats (SWOT) analysis
- Newsletters, often including surveys
- Interactive website
- Open houses

3. Conduct an existing conditions assessment.

To ensure that strategies are based on facts and are technically sound, it is important to collect and analyze the existing conditions and data. This includes developing a map for reference and for future use in workshops and design charrettes. Analyzing existing conditions will reveal the opportunities and constraints, community demographics, housing conditions and infrastructure. This step also assesses plans for the future and their impacts on existing conditions and issues. An important mapping component is using a combination of existing data sources and on-the-ground knowledge to map areas of resiliency. This information will begin to delineate potential future growth areas that could be reflected in context area land use maps, as detailed in the Land Use Toolkit.

STEP 2:
DEVELOP A VISION

A vision captures the community's hopes for the future and guides the projects, programs and plans that will be identified to make the Vision a reality.

1. Prepare a vision for the community.

Engage the public in helping to develop a vision for the community. Visions often answer the following types of questions:

- Does the community want to continue growing in the current development patterns?
- If not, how do people want it to look and feel in the future?
- Are certain parts of the community less desirable because of increased flood and storm risk?
- Are all socioeconomic and cultural groups treated fairly and equitably?

2. Present a graphic, written and pictorial vision of the community's aspirations.

A vision statement describes what the future of the community will look and feel like. The vision statement can be supported and illustrated by a map and visualizations.

STEP 3:
PREPARE A PLAN THAT MOVES THE COMMUNITY TOWARDS THE VISION

Plans contain goals, objectives and strategies and should identify ways to create resilient, sustainable communities and achieve the vision identified in Step 2. A strategy and implementation element of a plan with goals and timelines for reaching them will ensure the community moves towards achieving the vision. The tools and best practices in this Manual can help inform the community's vision and plan.

STEP 4:
IDENTIFY APPROPRIATE IMPLEMENTATION STRATEGIES AND CREATE AN IMPLEMENTATION PLAN

1. Examine circumstances.

Look at the desired vision, review the range of potential strategies provided in the Land Use Toolkit and the Coastal Best Practices Manual and pick community and structural strategies that work within the context of the community and that move the community towards its vision and goals.

2. Prioritize implementation strategies.

Select strategies that are appropriate in the short term versus long term and identify those that are most important to the community's vision.

3. Develop an action plan.

Identify four to six high priority, short-term actions.

4. Identify issues.

Identify issues that require conversation and partnership with other communities and regions.

5. Begin implementation.

Implementation tools cover a range of issues, including:

- Facilities
- Transportation
- Public investment tools
- Regulatory tools to shape, encourage or discourage future land uses, and may include development regulations such as zoning and subdivision regulations
- Environmental tools that deal with sensitive lands and waters, such as floodplain and flood damage prevention, open space protection, resource extraction, steep slopes, stormwater management, stream buffers, tree protection, water supply reservoirs, watershed protection and wetland protection.

STEP 5:
IDENTIFY FUNDING SOURCES

Funding can come from a mixture of private and public sources. Private sources may include developers and investors. Public sources may include redevelopment agency funding, federal grants such as Community Development Block Grants, infrastructure funding, FEMA, EPA and other federal agency programs. For each implementation strategy selected, identify potential funding sources.

Chapter 7
LOCAL ORDINANCE IMPLEMENTATION

This chapter provides an overview of the local ordinances available in the Coastal Louisiana Land Use Toolkit. These ordinances can help communities with the implementation of many of the strategies found in this Best Practices Manual. These ordinances touch on a wide array of development regulations, including zoning, subdivision, stormwater management, hazard mitigation and natural resource protection specifically designed for coastal communities.

Regulations as a Coastal Development Best Practice

The most direct path to the implementation of any plan—hazard mitigation, comprehensive or small area—is through the adoption of regulations. Effective development regulations must closely track the vision established in the plan and respond to the unique tolerances of each community. When properly written and enforced, development regulations can increase predictability and certainty, which has the effect of reducing risk from both economic and natural hazards. Reduced risk makes it easier for people to invest in your community.

The call for coastal communities to adopt modern development regulations is not new. The *Louisiana Speaks Regional Plan*, as well as CPRA's *Louisiana's Comprehensive Master Plan for a Sustainable Coast* both call for coastal communities to adopt and enforce development codes as non-structural tools to protect natural lines of defense and reduce the risks associated with hurricanes and storm-induced flooding.

Further, many of the strategies in this Manual are enhanced by locally adopted ordinances that either mandate or set standards for how the strategies are conducted. Tools such as stormwater management, elevation of structures, natural resource protection or strategic site development are most effective when the community commits to using these tools together. The ordinances function like the conductor of an orchestra; they keep everyone playing from the same page to ensure that the entire community benefits.

IMAGE: CODE STUDIO

CH7-1: The Louisiana Land Use Toolkit: Implementation Handbook guides communities through the development regulation process.

What Are Development Regulations?

Development regulations cover many of the topics essential to resilient coastal development patterns. They provide the framework for how a community is organized and set the standards and rules that shape the built environment. This framework often takes the form of zoning districts, subdivision regulations and development standards.

In November of 2010, the Center for Planning Excellence (CPEX) and Louisiana Economic Development (LED) released the Louisiana Land Use Toolkit. The goal of the Toolkit was to provide local governments with a set of Louisiana-specific model development regulations as a free resource. The Toolkit is supportive of a community's planning goals and growth management strategies and allows a community to tailor the regulations to meet its needs.

The Louisiana Coastal Land Use Toolkit (Coastal Toolkit) was created in 2011 by CPEX and CPRA to address the unique circumstances of coastal communities. The Coastal Toolkit operates using the same framework as the original, but it is written especially to assist local governments along the Louisiana coast. It presents regulatory options that can help meet the challenges these communities face to more sustainably and resiliently live with water.

Like the original Toolkit, the Coastal Toolkit may be adopted incrementally or combined to create a complete development code. For example, a community may choose to adopt the full Coastal Toolkit or only select ordinances (flood damage reduction, stormwater management or natural resource protection). This flexibility allows a community to build its regulations up to its level of comfort.

LOUISIANA LAND USE TOOLKIT: IMPLEMENTATION HANDBOOK

The Implementation Handbook was written to help communities use the Louisiana Land Use Toolkit to generate more resilient and sustainable development patterns. It walks communities step-by-step through the plan preparation, rule calibration and ordinance adoption process. The Handbook was developed from the lessons learned in implementing the Louisiana Land Use Toolkit.

The Handbook explains why and how designated growth sectors and context areas help communities get the right rules in the right places. It uses Louisiana-specific case studies to guide communities through the adoption process and uses graphic examples to show how many common developments are built using the rules in the Toolkit.

The Coastal Toolkit is organized on the same themes and principals as the original Toolkit, and coastal communities thinking of adopting new development regulations are strongly encouraged to download and review this free resource. www.landusetoolkit.com

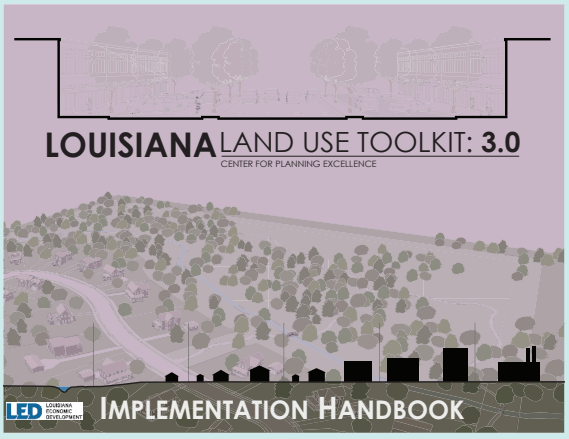


IMAGE: CENTER FOR PLANNING EXCELLENCE

CH7-2: The Implementation Handbook for the Louisiana Land Use Toolkit is a helpful resource for communities updating their development regulations.

Why Do We Need More Rules?

Coastal Louisiana is as independent as any place in the country. The people are strongly rooted in self-resiliency and have a deep respect for personal property rights. As a result, many coastal communities shy away from new rules—especially rules that are perceived as telling people what they can and cannot do on their property.

Despite this independence, there must be some coordination of efforts, or the environmental resiliency of the coast will continue to erode, and coastal communities will decline. Local ordinances provide the regulatory framework for this coordination and establish a minimum threshold of predictability and risk reduction.

There are also economic reasons communities should begin to think differently about development regulations. Communities that maintain the status quo will be at a financial disadvantage. Federal requirements and funding availability for local communities are changing; so changing approaches to local ordinances makes environmental *and* economic sense.

Current Approaches Are No Longer Effective

This Manual is full of examples of how changing environmental and economic conditions demand a different response from coastal communities. The current "hands-off" approach will no longer work. Allowing property owners to build wherever and however they want is proving too costly for both property owners and for the community as a whole. As sea levels rise, storms intensify and natural storm defense systems erode, the business as usual approach will not lead to sustainable results.

This does not mean that the culture and character of coastal Louisiana must change. New development regulations must capture the traits that make this region unique, while at the same time making coastal communities stronger and more resilient.

Federal Requirements Are Changing

Two federal agencies that control how development occurs across the entire U.S. are changing what is required of local communities. These changes will demand rethinking how municipalities approve development in coastal areas.

FEMA, the agency responsible for the Federal Flood Insurance Program, is reviewing changes to the model flood damage prevention ordinances and to the Community Rating System. This may require communities to update their local ordinances to maintain the same level of insurance coverage and premium discounts.

WHAT IS THE COMMUNITY RATING SYSTEM?

FEMA's community rating system (CRS) is a voluntary incentive program that recognizes community efforts beyond those minimum standards required by the National Flood Insurance Program. The program operates in a manner similar to the private insurance industry's programs that grade communities on the effectiveness of their fire suppression and building code enforcement.

CRS currently provides discounts on flood insurance premiums from 5% to 45% for communities that take certain steps to reduce flood damage. Communities can score points for a wide array of measures, including enhanced mapping and regulatory standards, access to public information, flood damage reduction and flood preparedness.

For example, in 2011 Livingston Parish made modest enhancements to its basic program requirements and homeowner's will save 5% on their flood insurance premiums, resulting in community-wide savings of more than $260,000. For more information on this program visit: www.fema.gov/business/nfip/crs.shtm.

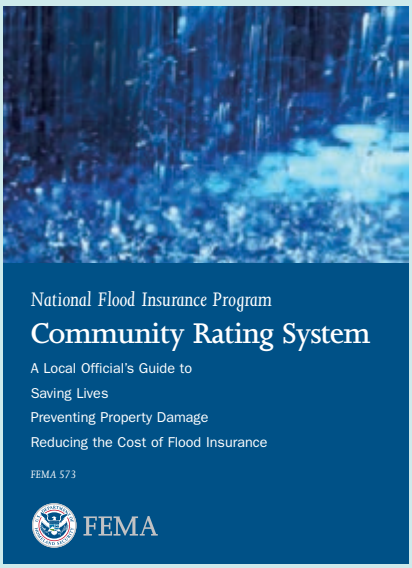


IMAGE: FEMA

CH7-3: Many Community Rating System Resources are available from FEMA.

Additionally, the EPA is in the process of implementing the next phase of the Clean Water Act. These new rules will require previously exempt communities to adopt new measures that control both the amount of water that is allowed to run off from a development, and the quality of post-construction stormwater runoff.

Communities can respond to these rule changes in one of two ways: with a conventional, highly-engineered approach to physical improvements, or by implementing an approach that encourages more holistic and cost-effective natural solutions that leverage existing resources.

Makes Good Economic Sense

Regardless of how good a new approach to development in the coast might be, it will only catch on if it makes sound economic sense. The strategies and recommendations in this Manual, accompanied by the ideas in the Coastal Toolkit , make sound economic sense for a variety of reasons:

- Clear development regulations "level the playing field" and reduce the risk associated with the development process.
- When written to take advantage of FEMA's CRS program, development regulations can result in reductions in a community's flood insurance premiums.
- Installation and maintenance of a Light Imprint approach to stormwater management typically costs 30% less than conventional approaches.
- Integrating green infrastructure along with conventional approaches to stormwater management and maintaining a community-wide tree canopy improves property values throughout the community.

Makes Good Environmental Sense

This Manual highlights the environmentally sensitive nature of the coast and the importance of coastal ecosystems. The oil and gas industry, along with agricultural and urban pollutants, impact the quality of the natural habitat, including recreational fishing and hunting grounds. The 2010 Louisiana Water Quality Inventory, prepared by DEQ, notes that 67.2 percent of Louisiana's water bodies have impaired water quality impacting wildlife propagation and fishing.

IMAGE: BRANDIEHOPSTEIN.BLOGSPOT.COM

CH7-4: The community of Grand Isle was damaged by Hurricane Katrina.

IMAGE: CODE STUDIO

CH7-5: New construction is elevated in the coastal area.

IMAGE: BOSCH SLABBERS LANDSCAPE + URBAN PLANNING

CH7-6: Residences can be located safely on the waterfront.

IMAGE: WAGGONNER & BALL ARCHITECTS

CH7-7: The lighter colors show areas with lower insurance rates due to less risk of flooding.

CASE STUDY: JEAN LAFITTE COMPREHENSIVE RESILIENCY PLAN

To test strategies and best practices found throughout this Manual, CPEX partnered with Office of Community Development to assist the Town of Jean Lafitte with the development of a comprehensive resiliency plan. The Jean Lafitte Tomorrow resiliency plan process assesses environmental, economic, and social risks, and then develops strategies and key implementation measures to assist the community in adapting to the changing coastal environment. Strategies include targeted development in areas that are most capable of supporting it; encouragement of development patterns that reduce sprawl; concentration of assets to increase economic gain and mitigate environmental impact; and development of engineering solutions to combat challenges and side-effects inherent to structural protection measures.

The Jean Lafitte community identified that development in the town center, where flood risk is lower, can decrease the community's risk of repetitive flooding and enable citizens to remain in the area.

In Jean Lafitte, the team identified that replacing the existing drainage system with closely spaced pumps, each with a lower capacity, allows for more adaptability in day-to-day usage. More pumps can be turned on or off depending on local conditions and water levels can be maintained in the sump area, which reduces the risk of subsidence.

IMAGE: DOVER, KOHL & PARTNERS

CH7-8: The existing center of Jean Lafitte contains available space for future development.

IMAGE: DOVER, KOHL & PARTNERS

CH7-9: This image shows possible future development in the center of Jean Lafitte.

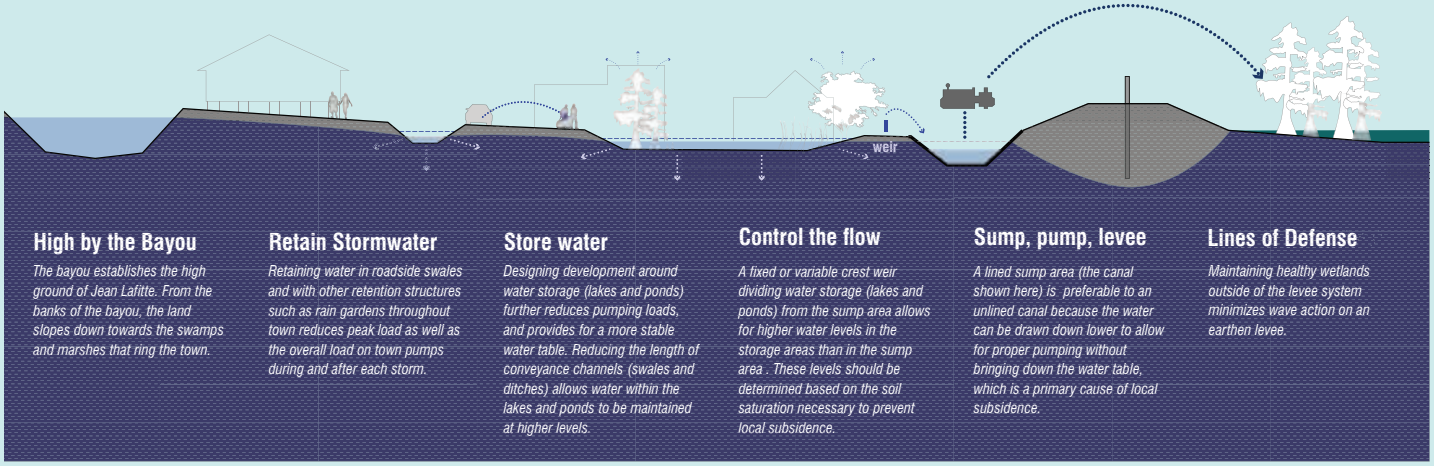


IMAGE: WAGGONNER & BALL ARCHITECTS

CH7-10: Planning space for water and distributing water storage throughout the landscape allows for higher water levels, a more stable water table, reduced subsidence, and greater control and safety in responding to rain events of different magnitudes.

A COASTAL CASE STUDY

For the Coastal Toolkit to be effective, it had to be "right-sized" to reflect the unique attributes of Coastal Louisiana. To "right-size" the Coastal Toolkit, the authors worked with the cities of Abbeville and Thibodaux to refine many of the concepts and to create a set of stand-alone ordinances referred to as the "Living with Water" ordinances.

The Living with Water ordinances focused on hazard mitigation, stormwater management and natural resource protection and greatly influenced the development of the full Coastal Toolkit. The end result was a set of non-zoning development regulations that would help these two communities better live with water.

The communities of Abbeville and Thibodaux are exemplary pilot communities for the Coastal Toolkit project. Both cities are positioned in the upper riverbank geotype. While historically they have not been impacted by as much storm damage as communities further to the south, sea level rise, subsidence and shifting storm patterns are changing this.

CPEX and CPRA led a team of consultants to tour and meet with local leaders. During these initial trips the consultant teams studied the current planning and regulatory approaches to hazard mitigation and natural resource protection and interviewed local development professionals.

The consultant team then prepared an initial draft of the Living with Water ordinances. These ordinances integrated traditional and innovative approaches to:

- Flood Damage Reduction
- Stormwater Management
- Sedimentation and Erosion Controls
- Tree Protection
- Riverine and Wetland Buffers
- Resource Extraction

While both communities had regulations that addressed some of these issues, they recognized that their regulations were disconnected from each another and took a conventional approach to mitigating impacts on natural resources. Both communities know they were missing opportunities to generate better results without hampering development.

CPEX, CPRA and the consultant team held workshops and conference calls with local advisory committees to refine the initial Living with Water ordinances to fit the needs of each community. This process allowed CPEX and CPRA to test regulatory concepts and approaches based on national and international best practices on real Louisiana communities. The result is a Coastal Toolkit that has been tailored for Louisiana. It provides regulatory techniques that are easy for the individual community to customize and administer, generate better results, and are cost-effective for the developer.

IMAGE: CODE STUDIO

CH7-11: St. Mary Magdalen Catholic Church in Abbeville

IMAGE: CODE STUDIO

CH7-12: Fremin's restaurant in downtown Thibodaux

IMAGE: CENTER FOR PLANNING EXCELLENCE

CH7-13: Typical single-family construction in Thibodaux

Further, trees serve an important role in managing stormwater and eliminating pollutants from the air and water. For example, one large bald cypress tree can transpire up to 60,000 gallons of water a year. Trees help with hazard mitigation too. When properly planted along drainage canals and wetlands, trees and understory canopy can create a "bioshield" that serves as a natural line of defense to reduce storm surge, provide a vegetative comb that filters storm debris from floodwaters and protect investment.

Local development regulations play an integral role in mitigating the environmental impacts of development and in protecting investments from natural hazards. When carefully implemented, they provide a system that allows local communities to:

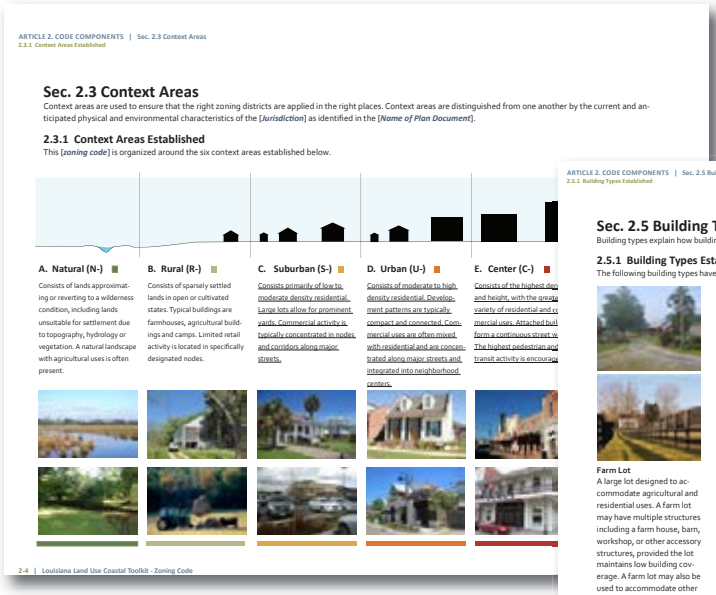
- Target development toward those areas that are most capable of supporting it
- Encourage development patterns that reduce sprawl
- Protect existing tree coverage and mitigate the environmental impact of new development on water quality
- Leverage infrastructure investments in ways that improve environmental performance and turn infrastructure into community assets.

What Does the Coastal Toolkit Address?

As with the original Toolkit, the Coastal Toolkit can be used to create an intuitive regulatory system for a community-wide development code. It contains regional growth sectors, context areas, zoning districts and building types that—when properly applied—help communities manage growth and strengthen the character of their neighborhoods and commercial corridors. Unlike the original Toolkit, the Coastal Toolkit contains new thinking about the intricacies of developing in the coastal region and responds to the unique building types and development patterns not found in other parts of the State.

The Louisiana Land Use Toolkit: Implementation Handbook provides communities with a step-by-step overview of how the Toolkit can be used to plan for and generate a complete development code. These same steps should be used to generate a coastal development code. The Implementation Handbook can be downloaded from www.landusetoolkit.com to guide coastal communities looking to use the Coastal Toolkit to generate a complete development code.

This section examines the methodology and application of select elements of the Coastal Toolkit that most directly address changing how coastal communities "live with water." These sections can be integrated into a complete development code or adopted as stand alone ordinances. Additionally, they can be used by communities with a modern zoning system or with communities that may not have adopted a zoning ordinance.


ARTICLE 2. CODE COMPONENTS | Sec. 2.3 Context Areas
2.3.1 Context Areas Established

Sec. 2.3 Context Areas

Context areas are used to ensure that the right zoning districts are applied in the right places. Context areas are distinguished from one another by the current and anticipated physical and environmental characteristics of the [*Jurisdiction*] as identified in the [*Name of Plan Document*].

2.3.1 Context Areas Established

This [*zoning code*] is organized around the six context areas established below.

A. Natural (N-)
Consists of lands approximating or reverting to a wilderness condition, including lands unsuitable for settlement due to topography, hydrology or vegetation. A natural landscape with agricultural uses is often present.

B. Rural (R-)
Consists of sparsely settled lands in open or cultivated states. Typical buildings are farmhouses, agricultural buildings and camps. Limited retail activity is located in specifically designated nodes.

C. Suburban (S-)
Consists primarily of low to moderate density residential. Large lots allow for prominent yards. Commercial activity is typically concentrated in nodes and corridors along major streets.

D. Urban (U-)
Consists of moderate to high density residential. Development patterns are typically compact and connected. Commercial uses are often mixed with residential and are concentrated along major streets and integrated into neighborhood centers.

E. Center (C-)
Consists of the highest [illegible] and height, with the greatest variety of residential and commercial uses. Attached buildings form a continuous street wall. The highest pedestrian and transit activity is encouraged.

2-4 | Louisiana Land Use Coastal Toolkit - Zoning Code


ARTICLE 2. CODE COMPONENTS | Sec. 2.5 Building Types
2.5.1 Building Types Established

Sec. 2.5 Building Types

Building types explain how buildings and structures relate to their lots, surrounding buildings and structures, street and alley rights-of-way, and the overall public realm.

2.5.1 Building Types Established

The following building types have been established to allow for detailed regulation of form based on the various context areas and zoning districts.

Farm Lot
A large lot designed to accommodate agricultural and residential uses. A farm lot may have multiple structures including a farm house, barn, workshop, or other accessory structures, provided the lot maintains low building coverage. A farm lot may also be used to accommodate other uses with large areas of open space.

Single-Family House
A building type containing one principal dwelling unit typically located on a single lot with private yards on all four sides. Single-family house also includes modular or manufactured homes.

Attached House
A building type containing two principal dwelling units on a single lot with private yards on all four sides. Each unit has its own external entrance. Units can be located on separate floors, side by side, or back-to-back. Often called a duplex.

Row House
A building type consisting of two or more attached structures containing three or more units. Each structure shares a common side wall. Each structure may contain up two principal dwelling units which may be stacked vertically. Each unit has its own external street facing entrance.

Apartment
A building type containing three or more dwelling units consolidated into a single structure. An apartment contains internal common walls. Dwelling units within a building may be situated either wholly or partially over or under other dwelling units. The building often shares a common entrance. Primary entrances are prominent and street facing.

2-12 | Louisiana Land Use Coastal Toolkit - Zoning Code Version 2.0 - 12/30/2011

IMAGE: CENTER FOR PLANNING EXCELLENCE

CH7-14: Sample pages from the Coastal Toolkit model regulations.

Flood Damage Prevention

All communities that participate in the National Flood Insurance Program have adopted a version of FEMA's model Flood Damage Prevention Ordinance. The model ordinance establishes the minimum requirements that apply to development in flood-prone areas if the community wants to remain eligible for federal flood insurance. Since FEMA's model establishes only minimum requirements, it does not position communities to take advantage of FEMA's own CRS program discounts for higher regulatory standards.

The Coastal Toolkit's Flood Damage Prevention regulations are based on FEMA's model, but have been supplemented with editor's notes identifying areas where a community can enhance its regulations in exchange for increased discounts on community-wide flood insurance premiums. Some of the provisions that communities can enhance are:

- Freeboard. Require an extra margin of protection by elevating the primary living space above the Base Flood Elevation.
- Foundation Protection. Require buildings to be built on foundations approved by a licensed engineer or built on compacted fill approved by a licensed engineer.
- Substantial Improvement Rules. Adjust the point at which modifications to a building require compliance with new flood damage prevention standards
- Enclosure Limits. Limit the enclosed area beneath a structure.

Further, the Coastal Toolkit has the ability to link complementary ordinances so that Flood Damage Prevention is enhanced by zoning and subdivision regulations, along with improved approaches to stormwater management and borrow pit regulations.

Stormwater Management & Natural Resource Protection

There is an intrinsic link between stormwater management and natural resource protection. Natural systems serve as the best stormwater management devices and sound stormwater management practices contribute to the health of natural systems. The Coastal Toolkit recognizes this connection and provides communities with the regulatory tools necessary to mitigate the impacts of development on natural systems.

The Coastal Toolkit integrates stormwater management with site planting and tree preservation requirements and borrow pits. The result is a package of local regulations that help to mitigate the impact of development on flooding, water quality, tree preservation and other natural systems.

IMAGE: CITY OF PORTLAND ENVIRONMENTAL SERVICES

CH7-15: Combining new green infrastructure with conventional approaches has proven both cost effective and higher performing.

CHANGING LOUISIANA'S APPROACH TO STORMWATER

For decades, the approach to managing stormwater across Louisiana has been to move water as quickly as possible into the nearest drainage ditch or bayou. Rarely has this water been treated to remove pollutants, and as a result many of the water bodies and wetlands throughout the state have been impacted. Further exacerbating this problem are the low-density development patterns that require a significant amount of impervious area to be dedicated to automobiles.

This conventional approach has proven costly to developers, who have had to invest in on-site improvements such as intakes, culverts, large concrete pipe systems and stormwater ponds. State and local governments are also facing higher costs as they are forced to maintain drainage ways and address the impacts on downstream property owners who are flooded on an increasingly regular basis.

This conventional approach is changing; the EPA will soon release rules that will require previously exempt communities to comply with non-point source pollution requirements. Likewise, developers are finding more cost-effective and higher performing methods to manage stormwater that incorporate green infrastructure. The Coastal Toolkit provides regulatory solutions for these changing requirements.

Stormwater Management

The Coastal Toolkit addresses stormwater management at two phases: during construction and after construction. Construction-phase stormwater management provides rules for a site during the construction process. It replaces typical sedimentation and erosion control requirements with updated standards. Post-construction stormwater management rules apply after the construction phase is complete. They present communities with a new, more sustainable natural approach to managing the rain that falls on a site.

The Coastal Toolkit's approach to stormwater is to establish a performance standard and leave it to the developer to determine how best to meet the standard. The performance standard establishes how much water must be retained on the site and the amount of pollutants that must be removed from the water that leaves the site. The developer may choose a conventional approach that relies on a system of catch basins, concrete pipes, filters and detention ponds, or supplement a conventional system with a more natural approach such as Light Imprint or Low Impact Development. The Coastal Toolkit also provides for consideration of off-site treatment facilities that reduce the need for on-site investment.

The Coastal Toolkit contains a series of stormwater best management practices (BMPs) based on the context of the site. Conventional stormwater management options remain available, but developers may also choose to supplement a conventional system with a contextually-appropriate natural system.

Developments that take a Light Imprint or Low Impact Development approach to projects often see a savings of 30 to 40% in installation and maintenance costs over projects that use a conventional approach to stormwater management. To further encourage these innovative solutions, the Coastal Toolkit offers significant site planting and tree preservation credits when stormwater management is integrated with streetscape or parking lot planting or surfacing requirements.

LIGHT IMPRINT VS. LOW IMPACT DEVELOPMENT

Two recent models for stormwater management that have proven popular for their performance and cost-effectiveness are Low Impact Development and Light Imprint. At first look, these two systems appear similar. Both use BMPs that favor natural systems over heavily engineered mechanical systems, and in some cases, both use similar BMPs. The difference in these two models is how the overall systems are created.

Low Impact Development consists primarily of tools for suburban stormwater problems. There is little variation in the BMPs. There are no tools for urban areas or rural areas, therefore many of the practices are land-intensive and while effective, may compromise walkability in urban neighborhoods.

Light Imprint is more holistic in its approach to BMPs. The system is based on integrating stormwater management, sustainability and community design. The idea is that there are BMPs appropriate in rural areas and others appropriate in suburban, urban and center contexts. Light Imprint includes many conventional BMPs, but organizes them (with more natural BMPs) by the context in which they are most appropriate. For more information on Light Imprint visit: www.lightimprint.org/

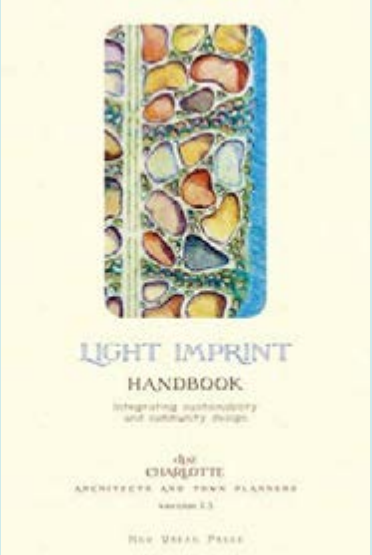


IMAGE: DPZ CHARLOTTE

CH7-16: The Light Imprint Handbook serves as one source of available stormwater BMPs.

Streetscape and Parking Lot Design

The idea of requiring streetscape and parking lot plantings as part of new development is new to many coastal communities. The goal of these requirements is to connect sustainability with community design. Even nominal planting requirements contribute to the resiliency of a community. Parking lot plantings reduce heat island effects; streetscape plantings promote walkability and both types of plantings reduce the impacts of stormwater.

As with stormwater management, the Coastal Toolkit provides both conventional and stormwater-enhanced approaches to streetscape and parking lot planting requirements. The developer may choose from a menu of options. Some options address basic site planting requirements, while other options combine stormwater approaches and planting requirements. This allows a site to meet both stormwater and planting standards with the same physical improvement. Further, as noted above, this combined approach is typically less expensive than a conventional approach to stormwater management.

STRATEGIES APPLIED

- Use Sustainable Water Capture Systems: P.58

IMAGE : DELAWARE CENTER FOR HORTICULTURE

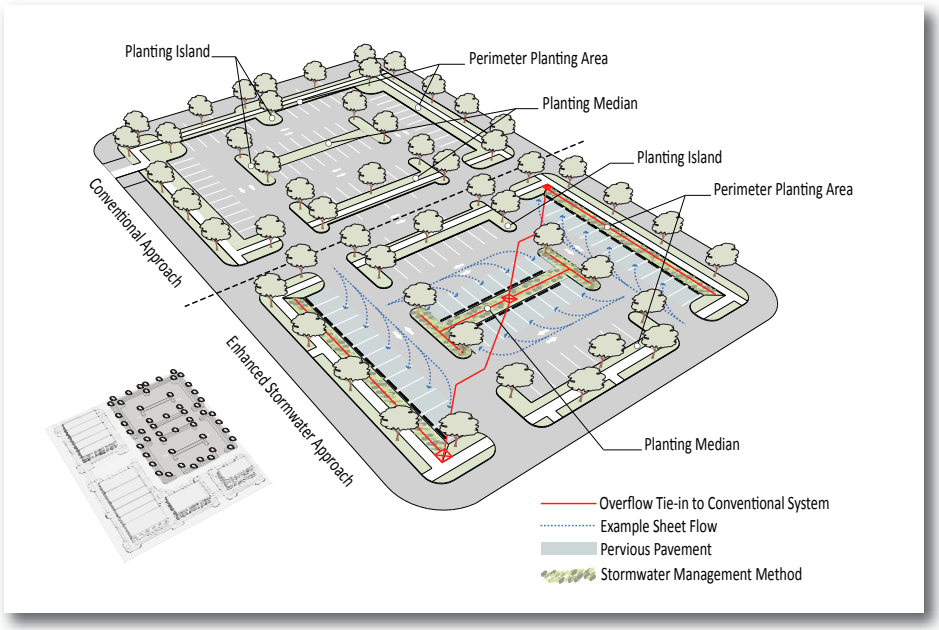


IMAGE : CODE STUDIO

IMAGE : DELAWARE CENTER FOR HORTICULTURE

IMAGE : DELAWARE CENTER FOR HORTICULTURE

IMAGE : DELAWARE CENTER FOR HORTICULTURE

CH7-17: The Coastal Toolkit contains parking lot design standards that encourage new construction to install and design parking lot landscaping so that it stores and filters water as part of a "green hat" on a conventional system. The images above show how a parking lot in Wilmington, DE was retrofitted to capture 70 percent of the site's stormwater runoff on site. The retrofit eliminated flooding problems, made the business more attractive, reduced heat island effect of the large parking lot and saves the business more than $1,500 a year.

IMAGE: BUCK ABBEY

CH7-18: Certain trees perform better during storms than other trees. The Coastal Toolkit gives priority to planting of "storm-strong" trees.

STORM-STRONG TREES

Certain trees that are native to Coastal Louisiana are resilient enough to withstand repeated significant storm events. To the extent possible, these trees should be planted, preserved and protected.

Southern Magnolia, *Magnolia grandiflora*

Coastal Live Oak, Quercus virginiana

Bald Cypress, *Taxodium distichum*

Tree Preservation

The value of tree preservation as a line of defense against storms has been proven repeatedly. When planted or preserved along ridge lines, trees protect the ridge against erosion and serve as a speed bump for any storm surge. When planted or preserved along wetlands and watercourses, trees serve as a bio-shield, filtering storm debris and protecting homes and buildings. Most importantly, trees are highly effective at transpiring water; an important tool in wet conditions.

The Coastal Toolkit addresses tree preservation in three ways: bioshield preservation, heritage tree preservation and tree canopy requirements.

- Bioshield preservation requires large-scale developments to preserve certain trees that abut wetlands, drainage canals and other secondary watercourses.
- Heritage tree preservation allows communities to designate select tree species or certain size trees that must be protected, or if removed, mitigated with additional tree plantings on the site.
- Tree canopy requirements establish minimal canopy requirements for infill and greenfield sites depending on the type of development being generated. The requirements can be met through preservation or through required streetscape or parking lot planting.

STRATEGIES APPLIED

- Conserve and Restore Wetlands: p.60
- Preserve Community Character: p.64
- Use Native Plants for Protection: p.68

Borrow Pits

Clean fill is as valuable in Coastal Louisiana as anywhere in the country. Much of the development in the region is built on fill borrowed from low lying areas of the site or from other sites. When strategically incorporated into the design of a site, borrow pits can serve as a stormwater management device and even be turned into a community asset. When they are not properly managed, borrow pits can permanently scar the landscape and lead to health and safety issues.

In many cases, once the excavation is complete, borrow pits are simply left with little to no remediation to the site. The pits frequently fill with water, and because the steep slopes are not conducive to aquatic life, the water quickly becomes stagnant and a potentially dangerous attractive nuisance.

The Coastal Toolkit provides a simple set of model regulations that help local governments reduce these long-term impacts of borrow pits on the community. The regulations require the developer to file an excavation and reclamation plan prior to receiving a permit for a borrow pit. These plans must comply with standards on the excavation of the borrow pit, and require that after excavation the borrow pit be designed to serve as a stormwater device, lake, pond or other community asset.

Coastal Development Patterns

Outside of coastal Louisiana, the common approach to developing near water bodies is to set back and allow a protective buffer between the development and the water. This allows water bodies to meander without endangering investments and provides a natural filter for stormwater runoff.

In coastal Louisiana, this approach does not often work. There are many bayous, canals and rivers where, due to historic development patterns, embankment types, or the economic or cultural need for access, the highest, safest and most resilient places to build are along these banks. The Coastal Toolkit recognizes this and includes the tools necessary to help communities safely build close to the edge of key water bodies.

The Coastal Toolkit contains a water frontage that functions like an overlay district. When a community designates this frontage along important watercourses the rules change, and development is allowed to occur along the banks, provided it is done so in a safe and environmentally friendly manner.

IMAGE : CENTER FOR PLANNING EXCELLENCE

CH7-19: Clean fill is in high demand in coastal areas.

IMAGE : FREGONESE ASSOCIATES

CH7-20: Coastal resource access means that typical waterfront buffers are often inappropriate in Louisiana.

IMAGE : FREGONESE ASSOCIATES

CH7-21: Many coastal residents combine their homes and workplaces on the water's edge.

STRATEGIES APPLIED

- Relocate Strategically: p. 67
- Strategic Site Development: p. 78

Preserving Coastal Character

Building resilient communities is more than just building elevated and fortified buildings. New construction and reconstruction of existing buildings must also generate results people love and connect to. If people do not feel emotionally connected to a coastal place, the time, energy and money necessary to save it becomes a poor investment. This means that strategies in this Manual must be implemented in a way that is sensitive to preserving or enhancing established community character.

The Coastal Toolkit accounts for the preservation of community character in a number of different ways. It allows local governments to adjust the rules to reflect what is unique about their community.

- Regional growth sectors allow the community to focus growth in those areas where it can be the most resilient and do the best job of protecting the natural and rural character of other areas.
- Context areas allow the community to get the right rules in the right places.
- Coastal zoning districts reflect the mix of uses common in the coastal communities and the relationship between the building and the water.
- Coastal-specific building types allow communities to control how elevated structures relate to the street and to each other.
- Contextual infill standards ensure that incremental changes to existing neighborhoods strengthen the established character.

WHAT ARE CONTEXT AREAS?

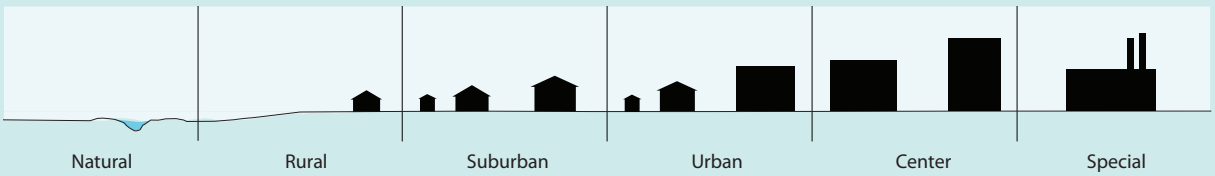


IMAGE: CODE STUDIO

CH7-22: The continuum from the natural environment through urban centers is applied as part of the Coastal Toolkit.

The Toolkit recognizes that rules for the development of urban areas are different than the rules for the development of rural areas. Context areas describe a certain character or feel of an area. The word "rural" elicits an image of a built environment with qualities such as narrow roads with ditch and swale cross-sections, low-density lots and primarily residential or agricultural uses. However, the word "urban" evokes a much different image of neighborhoods with connected streets, short, walkable blocks and compact development with a mix of residential and commercial uses. The guidelines that create rural charm are different from the guidelines that create vibrant, mixed-use neighborhoods. Context areas help communities organize and apply the right rules in the right places.

There are six context areas in the Toolkit: Natural, Rural, Suburban, Urban, Center and Special. Together, these six context areas provide the complete spectrum of the built environment. The Toolkit contains specific rules for each context area. This organization allows rural areas to stay rural, while urban areas become more compact. For more information on this topic please see the Louisiana Land Use Toolkit: Implementation Handbook. All Toolkit documents including the Implementation Handbook may be downloaded free of charge from www.landusetoolkit.com.


IMAGE: CODE STUDIO


IMAGE: CODE STUDIO


IMAGE: CODE STUDIO

CH7-23: The character of Louisiana's communities has always included elevated structures.

ELEVATION & COMMUNITY CHARACTER

One of the most important strategies to building a resilient coast is to elevate existing and new structures above the base flood elevation. The importance of this strategy cannot be overstated. However, where elevation is not done carefully, it may result in new or recently elevated structures appearing out of scale. There are design solutions to mitigate this deviation from the established character. Enclosing the front of the structure with breakaway construction, use of a common elevation device, street facing entrances and activating the street with wide staircases can all help diminish the impact of elevation. The Coastal Toolkit recognizes these design approaches and encourages them to be applied where feasible.

Regional Growth Sectors

An essential part of growing resiliently and protecting community character is focusing growth in those areas that are best positioned to naturally defend development from storms. This means restricting growth in low-lying areas susceptible to storm surges and encouraging compact growth in areas that are easier to protect. Regional growth sectors provide coastal communities with a planning and regulatory tool that helps them to think about where future growth and reinvestment should occur. The Louisiana Land Use Toolkit: Implementation Handbook provides greater detail about understanding and applying regional growth sectors.

Context Areas

Both the original Toolkit and the Coastal Toolkit use a series of six context areas. The context areas range from Natural to Center with one context that accounts for special purpose areas. Context areas are the organizing framework for the zoning districts and development standards of the Toolkit. They allow a community to use the existing and desired character to generate the right development rules in the right places. This allows rural places to remain rural while urban areas become more vibrant over time.

Coastal Zoning Districts

Zoning districts further refine the context areas. They specify the development patterns and uses that are representative of the character of a specific block, street or site. The zoning districts in the Coastal Toolkit reflect water-oriented uses such as ice houses, docks and marinas that are unique to coastal regions, and take into account the different development patterns such as canal and bayou frontage.

Coastal Specific Building Types

The mix of building types available in the Coastal Toolkit are similar to those available in the original Toolkit, but they have been modified to reflect the unique form of coastal buildings—how elevated structures relate to adjacent buildings and the street. This means accounting for ramps, stairs, lifts and enclosures associated with elevated structures.

Contextual Infill Standards

As communities rebuild, either incrementally or after a storm event, there will be instances where new structures are built or existing structures are elevated above revised base flood elevation. When this occurs in established neighborhoods, it is important to ensure that the new or renovated structures continue to complement the character of the neighborhood and the adjacent buildings. If the new structures appear significantly out of scale compared to existing structures, they can have a detrimental impact on the value of existing homes.

The Coastal Toolkit contains a system of contextual infill standards. These standards require certain features of infill development to be based on the precedent established by the surrounding houses. Features such as minimum or maximum setback, foundation treatment, elevation style (fill or stilts) and roof types may all be features that a local community wishes to be consistent along certain streets or neighborhoods.

STRATEGIES APPLIED

- Preserve Community Character: p. 64
- Elevate Living Spaces Above Base Flood Elevation: p. 70

DESIGN SENSITIVE APPROACHES TO ELEVATING SINGLE-FAMILY HOMES

In many coastal communities, single-family homes are elevated six feet or more above the street to keep them safe and dry during storm events. When homes are individually elevated they become more resilient to storm damage; but the elevation that makes homes safer can also isolate the home and detach it from the community. There are several design techniques that can help mitigate the negative impacts of elevated homes and help to strengthen the character of a community. The following images provide examples of some good and bad design approaches. The Coastal Toolkit provides communities with the rules necessary to generate better building forms.

IMAGE: CODE STUDIO

CH7-24: This house is oriented toward the water and turns its back on the street. Street facing entrances, open stairs and front windows can help activate the street.

IMAGE: BOSCH SLABBERS LANDSCAPE + URBAN PLANNING

CH7-25: This house is oriented both toward the water and the street. A portion of the wide staircase is perpendicular to the front facade of the house. This helps the house to better address the street.

IMAGE: CODE STUDIO

CH7-26: This house lacks a front entrance and stairs which has the effect of isolating the house from surrounding homes.

IMAGE: MAKE IT RIGHT

CH7-27: This home is pulled up to the street and uses wide stadium steps oriented perpendicular to the front facade of the house to activate the streetscape.

IMAGE: CODE STUDIO

CH7-28: This mobile home is elevated using fill and stilts and lacks a front-facing entrance.

IMAGE: COTTAGE LIVING

CH7-29: This Katrina Cottage is an alternative to mobile homes. This home is oriented toward the street with a wide perpendicular staircase.

DESIGN SENSITIVE APPROACHES TO ELEVATING COMMERCIAL BUILDINGS

Commercial uses in coastal communities may meet the requirements of the National Flood Insurance Program by raising the ground floor above base flood elevation or by flood proofing the structure to the base flood elevation. As with single-family homes, the elevation or flood proofing of commercial structures increases resiliency but can also discourage walkability and active streetscapes. There are design approaches that can be incorporated to help reduce the negative impact of elevating and flood proofing the ground floor of commercial buildings. The following images provide examples of some good and bad design approaches. The Coastal Toolkit provides communities with the rules necessary to generate better commercial building forms.

IMAGE: CODE STUDIO

CH7-30: This hotel in Galveston, TX has elevated its ground floor using fill, but the elevation lacks articulation and the entrance design presents a blank wall to the pedestrian.

IMAGE: HTTP://AMYASHCRAFT.BLOGSPOT.COM/2010_02_01_ARCHIVE.HTML

CH7-31: The Strand in Galveston, TX elevated both the block and the building. This two tiered approach reduces the overall impact on the street by allowing the building to maintain its active street front and pedestrian scale.

IMAGE: CODE STUDIO

CH7-32: This convenience store is elevated on stilts with access provided through a side ramp and front stairs. The entrance is oriented toward the street with parking provided under the store.

IMAGE: CODE STUDIO

CH7-33: This restaurant is elevated on pillars with the kitchen and dining room located on the second level. The ground floor is used for overflow patio seating. The street wall helps to activate the streetscape.

IMAGE: CODE STUDIO

CH7-34: This post office is elevated on stilts with front steps and a side ramp. An elevator is located under the building. Parking is provided under the structure.

IMAGE: CODE STUDIO

CH7-35: This building is elevated on a platform using fill. A wide staircase helps activate the streetscape. Secondary access is provided by a side ramp. Outdoor seating is provided on the elevated platform.

IMAGE: DELAWARE CENTER FOR HORTICULTURE

CH7-36: Stormwater facility landscaping can be both beautiful and functional.

IMAGE: TRAILSNET.COM

CH7-37: This trail manages stormwater naturally in the adjacent vegetated areas.

IMAGE: HTTP://EN.WIKIPEDIA.ORG/WIKI/FILE:STREETSIDE_SWALE_SEATTLE.JPG

CH7-38: Landscaped beds between sidewalk and street manage stormwater.

The Coastal Toolkit in Practice

The best way to understand how the Coastal Toolkit impacts new development is to look at how current developments might have been different under the rules in the Coastal Toolkit. This section uses graphic displays to show how parking lots can be modified to help communities better live with water.

The first example will look at how large commercial parking lots can integrate landscaping features to reduce the impact of stormwater on the community. In many cases, large parking lots manage their stormwater with one system and may be required to supply parking lot landscaping under a different set of rules. The Coastal Toolkit promotes the integration of these two features allowing developers to use their required landscaping to treat, filter, and store all or a part of the stormwater on the site. This can lead to higher performing stormwater management systems, improved property values and more attractive parking areas. Frequently these integrated landscaping and stormwater management approaches cost considerably less than non-integrated approaches.

The Louisiana Land Use Toolkit: Implementation Handbook outlines many of the concepts in the Toolkit, including how regional growth sectors, context areas and zoning districts can be applied to generate more sustainable development patterns. The Implementation Handbook and the full Coastal Toolkit may be downloaded free of charge at www.landusetoolkit.com.

COMMUNITY WIDE IMPACTS OF STORMWATER

As a community grows, there will be increased demands for impervious surface in the form of streets and surface parking lots. These impervious areas greatly impact both water quality and the amount of storm run-off and floodwaters. The best approach to reduce the impacts of impervious surfaces on stormwater is through planning at the watershed level and encouraging compact and walkable development patterns that require less impervious area on a per capita basis. When surface parking lots or large roads are necessary, communities can mitigate their impacts by incorporating site and development level stormwater management BMPs that use natural features to help channel, store and filter the water.

IMAGE: CODE STUDIO

CH7-39: This image shows the impact of low density development on an already stressed watershed.

The aerial image above shows a suburban section of a coastal Louisiana community. The blue dashed line indicates the flow of stormwater from parking lots, roads and roof tops into the bayous and canals.

As former agricultural lands are developed with low density suburban patterns, there is an increase in impervious surfaces. The current approach is to route the increased runoff directly into the drainage system without treating it or filtering out pollutants. As a result, water bodies become polluted, downstream properties are flooded and tax payer dollars must be used to widen and deepen the canals and drainage ditches.

To mitigate this impact communities can either build more compactly, reducing the amount of impervious surface, or implement stormwater management standards that will reduce the runoff from the site. The Coastal Toolkit provides the tools for communities to do both. The following pages examine some of these tools in practice.

Rethinking Parking Lots

In coastal Louisiana parking lots are typically an afterthought. Big box retail and office or apartment complexes add them as a cost of doing business, and most communities lack any the rules and standards necessary to mitigate their impact.

Parking lots are often built with too much impervious surface, provide little to no landscaping and no stormwater management devices. As a result, most create a "heat island" during the summer, and stormwater runoff is allowed to pick up pollutants (oil, brake dust, other contaminants) before being dumped into a nearby drainage canal or, at best, an expensive and land consuming stormwater pond. This approach increases flooding and further deteriorates the quality of the watershed.

The Coastal Toolkit helps communities think differently about parking lots. It provides the tools necessary to integrate landscaping and stormwater management into a parking lot -- turning it from single use "amenity" (car storage) into a multifunctional stormwater management device and community asset. The following pages detail how an example parking lot might have developed differently under the Coastal Toolkit.

IMAGE: CENTER FOR PLANNING EXCELLENCE

CH7-41: Large trees along the right-of-way were successfully preserved in a stormwater facility.

IMAGE: CENTER FOR PLANNING EXCELLENCE

CH7-42: Stormwater facilities under construction.

IMAGE: CODE STUDIO

CH7-40: The parking lot of this big box is typical of new parking lots built throughout coastal Louisiana. There is limited landscaping and nominal stormwater management measures. This is an example of a good result for a community with no rules for how parking lots and stormwater should be managed.

Example Lot

The coastal Louisiana parking lot seen in this example (CH7-40) is typical. While sparsely landscaped, the lot is a reasonable size, and the developer kept the large trees at the perimeter of the site, incorporating a swale to help manage stormwater runoff. The parking lot also contains a small stormwater detention device that is used before dumping the stormwater into the adjacent canal. However, the typical lot can be vastly improved.

It is important to note that this is the parking lot that the community received with no adopted rules or regulations. Big box developers will provide the nominal level of landscaping and stormwater management outlined in the Coastal Toolkit if the community has the rules in place that ask for it. These types of investments enhance the value of the community and promote economic development.

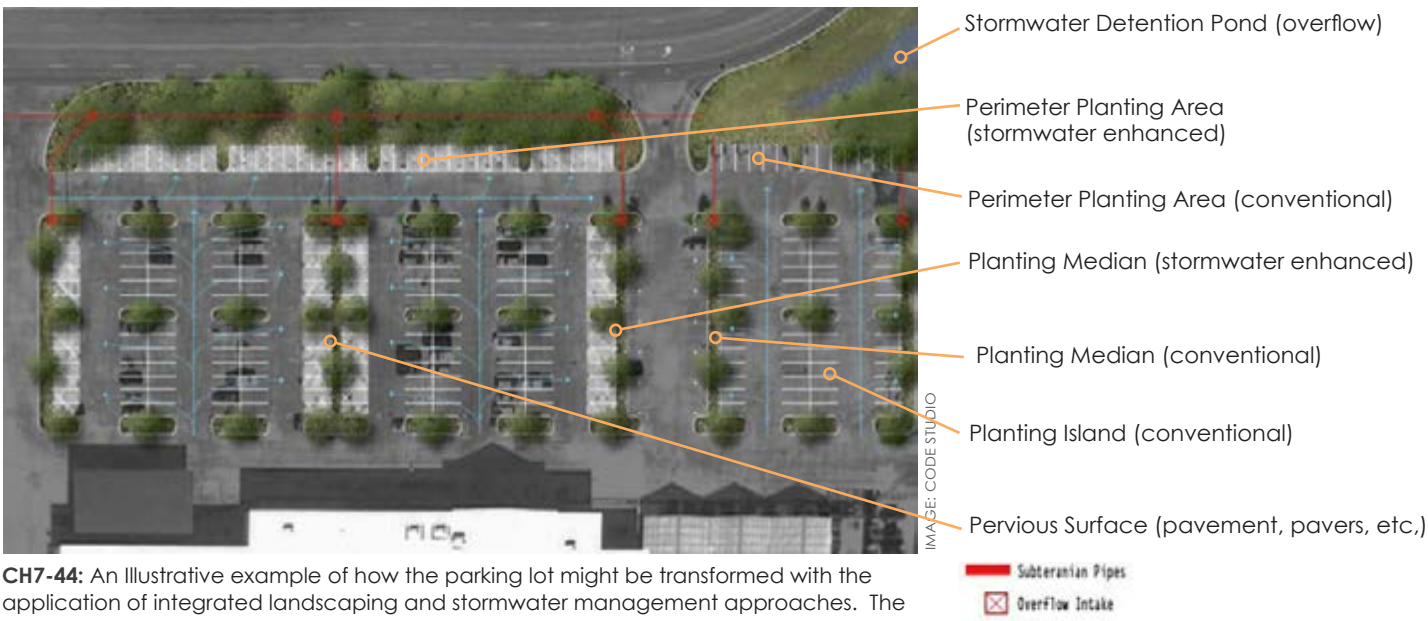
CH7-43: An Illustrative example of how the parking lot might be transformed with the application of conventional landscaping and stormwater management approaches.

Two Approaches

Under the Coastal Toolkit, the parking lot could be built in one of two ways. The image above outlines what the conventional approach might look like. The conventional approach uses separate landscaping and stormwater management systems. By not taking advantage of the landscaping as a stormwater tool, the conventional approach typically requires larger stormwater management system—larger pipes, a bigger stormwater pond—and is typically more expensive.

The image below provides an example of how the enhanced stormwater approach might be designed. While this approach requires more planning on the front end, the integration of landscaping and stormwater management can result in the developer saving money on stormwater management devices, and turning what is otherwise buried infrastructure into a visible, and valuable landscaping feature.

Both approaches rely on three planting areas: Perimeter Planting Area, Planting Medians and Planting Islands to frame the parking lots. The Coastal Toolkit also provides for administrative approval of equivalent alternatives. So if a developer's creativity or the conditions of a site require a different equivalent layout or design, then it can be approved by staff with minimal reporting requirements to the permitting body.



CH7-44: An Illustrative example of how the parking lot might be transformed with the application of integrated landscaping and stormwater management approaches. The example above mixes both conventional and stormwater enhanced approaches.

IMAGE: CODE STUDIO

CH7-45: An Illustrative example of how the parking lot might be transformed with the application of integrated landscaping and stormwater management approaches.

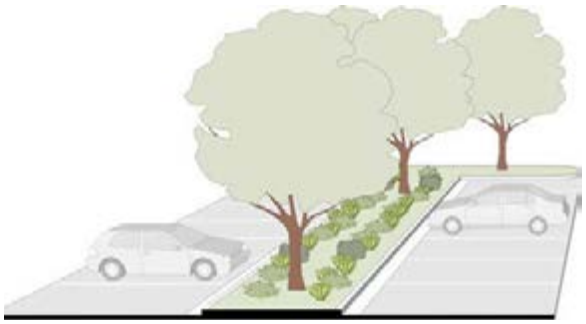


IMAGE: CODE STUDIO

CH7-46: An Illustrative example of a conventional planting median as required by the Coastal Toolkit.

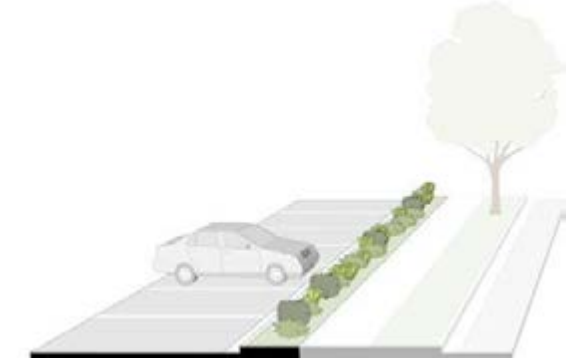


IMAGE: CODE STUDIO

CH7-47: An Illustrative example of a conventional perimeter planting area as required by the Coastal Toolkit.

Conventional Parking Lot

The conventional approach to parking lots is to disconnect the landscaping from the stormwater management. This means isolated systems for both. Landscaping is often curbed and is installed above the grade of the parking surface, making it of little use as a stormwater management device.

Stormwater from the parking surface and the roofs of buildings is captured through intakes and diverted through underground concrete pipes to a stormwater storage pond or dumped directly into nearby water bodies. The rainwater runoff carries suspended solids and other pollutants, and most communities are required to pre-filter the water using engineered sand filters or other devices.

While the conventional approach is capable of meeting the performance standards for water quality and landscaping, it can be an expensive solution.

IMAGE: CODE STUDIO

CH7-48: This image provides an example of how the required perimeter planting area might be designed and constructed to integrate the landscaping and stormwater management together.

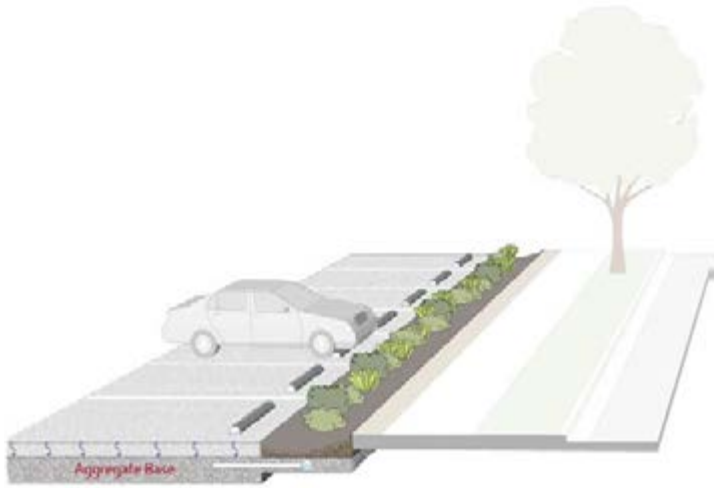


IMAGE: CODE STUDIO

CH7-49: An Illustrative example of a stormwater enhanced perimeter planting area as outlined by the Coastal Toolkit. Depressed planting area, disconnected curbing, pervious pavement and overflow system.

Stormwater Enhanced Parking Lot - Perimeter Planting Area

The perimeter planting area can be designed as a stormwater management device by depressing the landscape area and replacing the typical curb with wheel stops or curbs with gaps that allow rainwater in. Most landscaped areas will need to use amended soils and will need an overflow device to manage heavier rainfalls. Plantings are typically drought and water tolerant grasses and shrubs that help with infiltration and transpiration of the water and assist in the removal of pollutants and suspended solids from the parking area. An optional approach is to install pervious pavement, pavers or other porous material adjacent to the planting area to allow further infiltration.

IMAGE: CODE STUDIO

CH7-50: This image provides an example of how the required planting median area might be designed and constructed to integrate the landscaping and stormwater management together.

IMAGE: CODE STUDIO

CH7-51: An Illustrative example of a stormwater enhanced planting median area as outlined by the Coastal Toolkit. This example shows two optional stormwater management devices where pervious pavement or pavers are placed on top of an aggregate fill or cistern storage system.

Stormwater Enhanced Parking Lot - Planting Median Area

The Coastal Toolkit calls for periodic landscaped medians to be installed every six parking rows. The medians break up the pavement and provide an opportunity to infiltrate stormwater runoff.

Many of the principles discussed in the perimeter planting area apply. Depress the planting areas, disconnect the curbs and install an overflow mechanism. Under the stormwater enhanced approach trees are optional. This is to promote the growth of shrubs and grasses to help with water infiltration.

Pervious pavement or pavers can be used adjacent to the median to help with infiltration. Further, the median can be graded to help channel the water to the desired location while filtering and storing some of it along the way.

IMAGE: CODE STUDIO

CH7-52: This image provides an example of how the required planting island might be designed and constructed to integrate the landscaping and stormwater management together.

IMAGE: CODE STUDIO

CH7-53: The above image is an example of a parking lot perimeter that is enhanced to also function as a stormwater management best practice.

Stormwater Enhanced Parking Lot - Planting Island

The stormwater enhanced planting island is the most similar to the conventional approach. The Coastal Toolkit provides guidance for how they can be integrated as part of the overall stormwater management system.

Developers may choose to provide a mix of conventional and stormwater enhanced planting areas. For example, developers may decide that the perimeter planting areas should be stormwater enhanced, but the planting islands may be conventional. The exact mix of options is up to the developers, provided that they meet the stormwater management standards and incorporate parking lot landscaping that is equivalent to the options in the Coastal Toolkit.

Local Ordinance Implementation

This final chapter of this Best Practices Manual has provided a brief introduction to the importance of local ordinances and the availability of regional resources to help coastal communities develop in a smarter and more resilient way. The Coastal Toolkit provides some of the regulatory answers that coastal communities need. It broadcasts development best practices and supports many of the ideas and strategies identified in this manual.

But the adoption of local ordinances is not easy. It requires difficult discussions, community interest and the tolerance for regulating the property of friends and family members.

If you have questions or are interested in learning more about planning, development codes and smart growth, visit the Louisiana Land Use Toolkit website at www.landusetoolkit.com. Planners and designers with the non-profit organization CPEX are also available to answer questions. Additional information is also available at http://coastal.la.gov.

BEST PRACTICES MANUAL FOR DEVELOPMENT *in Coastal Louisiana*

CPRA
Coastal Protection and Restoration Authority of Louisiana

Center for Planning Excellence