The Giving Delta

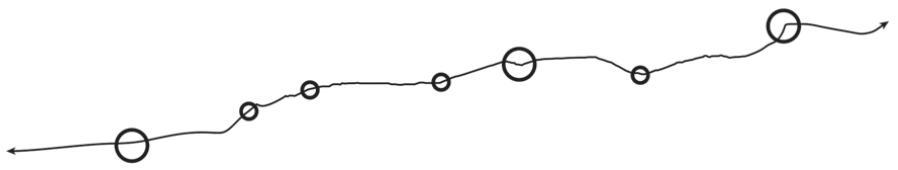
Changing Course Phase 1
Moffatt & Nichol | West 8 | LSU CSS
Deltares | RAND | Ioannis Georgiou | Headland & Associates

THE GIVING DELTA:
AN OPTIMISTIC AND PRAGMATIC FUTURE

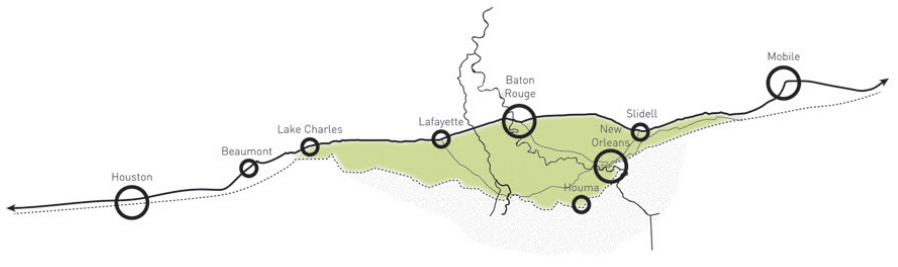
Most coastal settlements occupy a tenuous line at the edge of water and land. They maximize this edge condition but have to deal with the consequences of coastal storms and increasingly the effects of climate change.

However, the Louisiana Coast has an opportunity that most other coastal settlements do not: a dynamic river that can continuously replenish this edge into a rich zone benefitting from sediment capture and flooding. While other cities are exposed to rising seas on fixed coastal edges, Louisiana and the nation can leverage the Mississippi River to sustain a thriving wetland zone that protects and promotes its industrial economy, sustains ecosystem productivity, and nourishes human occupation.

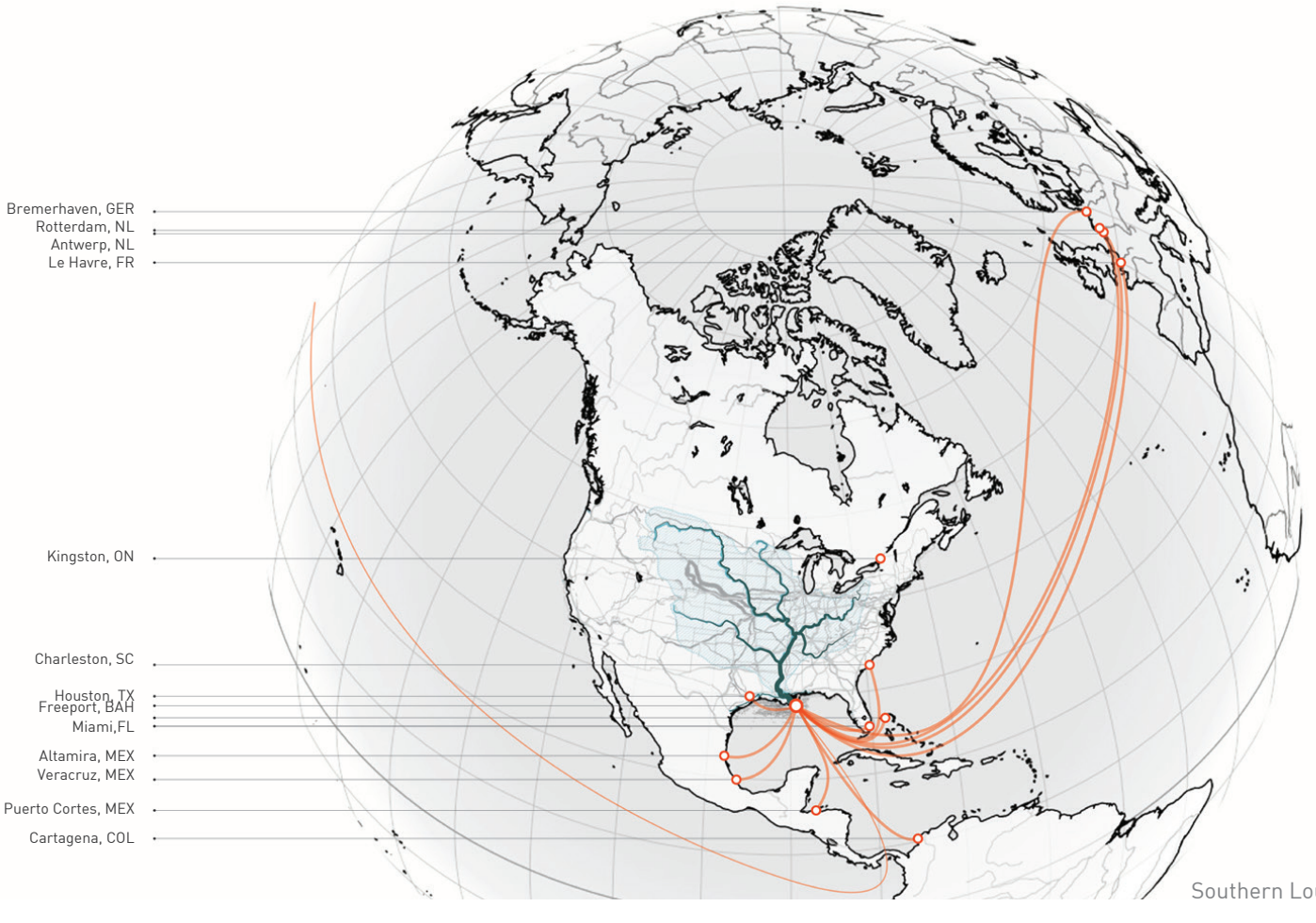
Civilization belongs in this Delta, with all of its associated risks and rewards. With a clear 100-year vision and actionable human time horizon phases, we are optimistic about an inspired, pragmatic, and sustainable future for Coastal Louisiana and its future generations.



Most Coastal Settlements Occupy a Line



Southern Louisiana Has the Resources of the River to Create a Thriving Delta Buffer



Southern Louisiana is a Nexus of Commerce and Industry

OUR OBJECTIVES FOR THIS COMPETITION:

1. Highlight Economic Relevance
We will address the importance of the lower Mississippi River and surrounding coastal area to the local, national, and global economies. The Louisiana coastal zone is worth roughly $140 Billion annually to the United States the same as the US Auto Industry. Economically speaking, this is not a local problem, but one of national import. The River at New Orleans is at the center of an infrastructural network that connects the country and feeds the world.

2. Plan for the Diversity of Stakeholders
Transform the current conflicts tht transform the river into a vision for a shared resource to meet the needs of local stakeholders.

3. Address Varying Timescales
We will examine the long term environmental timeline and the short term human planning horizons. This approach allows for incremental adaptation to minimize individual uncertainty and costs within each human generation, but keeps clear environmental and societal objectives as the primary target.

4. Bridge Disciplines
Success in this competition, and our approach to this multi-scale problem, hinges on the ability to develop a clear, commonly understood message that bridges entrenched disciplinary languages and local jargon. The complexity of the problems will only be adequately addressed if there is a clear story for all to understand.

The Mississippi River is an Incredible Resource:
Huge Sediment Opportunity + Best Linked Seaport in the Country

WHAT ARE WE TRYING TO ACHIEVE?

- Empower the River to nourish the human, economic, and ecological systems that depend on the River as a shared resource

- Build and sustain wetlands to mitigate the effects of climate change and subsidence and to slow the inevitable marine transgression of the Delta

- Strengthen the Living Culture of Coastal Louisiana to remain and to thrive

- Secure the economic indispensibility of the working coast, which is indispensable for the nation

- Integrate Investments in every dollar spent to yield multiple benefits for cultural, infrastructural, economic, and ecological systems

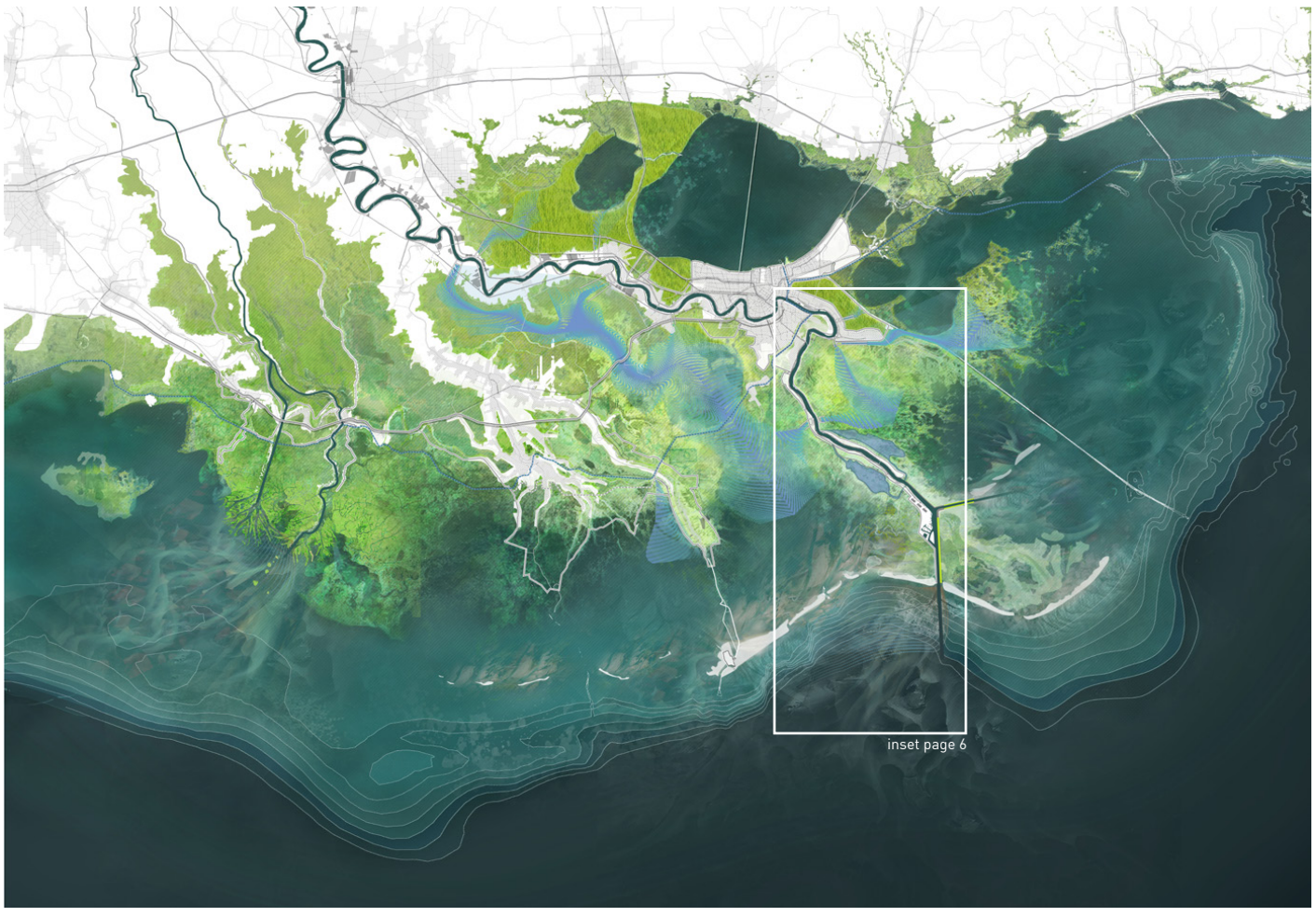
- Embrace change as an underlying condition and benefit of living in the delta

THE TEAM

Moffatt & Nichol, one of the premiere coastal engineering firms in the world, built a diverse team eminently suited to develop an innovative approach to map out the bold decisions and framework necessary for a sustained and prosperous future for the Mississippi River. M&N is dedicated to the complex, interdisciplinary issues surrounding the area where land meets water, and the firm enjoys a strong reputation throughout Louisiana and the world for planning, designing and successfully executing large-scale coastal engineering and ecosystem restoration projects.

Our highly focused team members include: West 8 Urban Design and Landscape Architecture, an award-winning international design and landscape architecture firm composed of multi-disciplinary practitioners of large-scale master planning and design and landscape interventions; Louisiana State University Coastal Sustainability Studio, a leading voice bridging the efforts of scientists, engineers, architects and landscape architects working to envision a better future for coastal Louisiana; Deltares, a leading research institute for water and coastal issues known for applying proven expertise to make sound and independent assessments of the physical condition of deltas, coastal areas and river basins; as well as the RAND Corporation, Ioannis Georgiou, PhD, and Headland and Associates.

A Status Quo Approach to River Management Would be Catastrophic



The Giving Delta project offers a future where economies, ecosystems, and communties can thrive in the Delta.

WHAT IF WE MAINTAINED THE STAUS QUO?

The iconic map of the Louisiana Boot represents the pride and living culture of a people who have for centuries worked and lived in an unforgiving and unpredictable landscape. Through generations of backbreaking work, the people of Coastal Louisiana transformed this harsh environment into an indispensable working landscape. The icon seen on road signs across the state shows a solidified coastal boundary set defiantly against the Gulf of Mexico. Today more than ever, the static icon of the State belies the true appearance of a rapidly transforming landscape. As wetlands erode into open water and are carved up to make way for infrastructure, we are witnessing the profound dissolution of the Louisiana wetlands despite targeted efforts to protect them. Attempts by past generations to fix a static boundary in this shifting landscape have eliminated the essential dynamism that nourishes and supports the Delta's health.

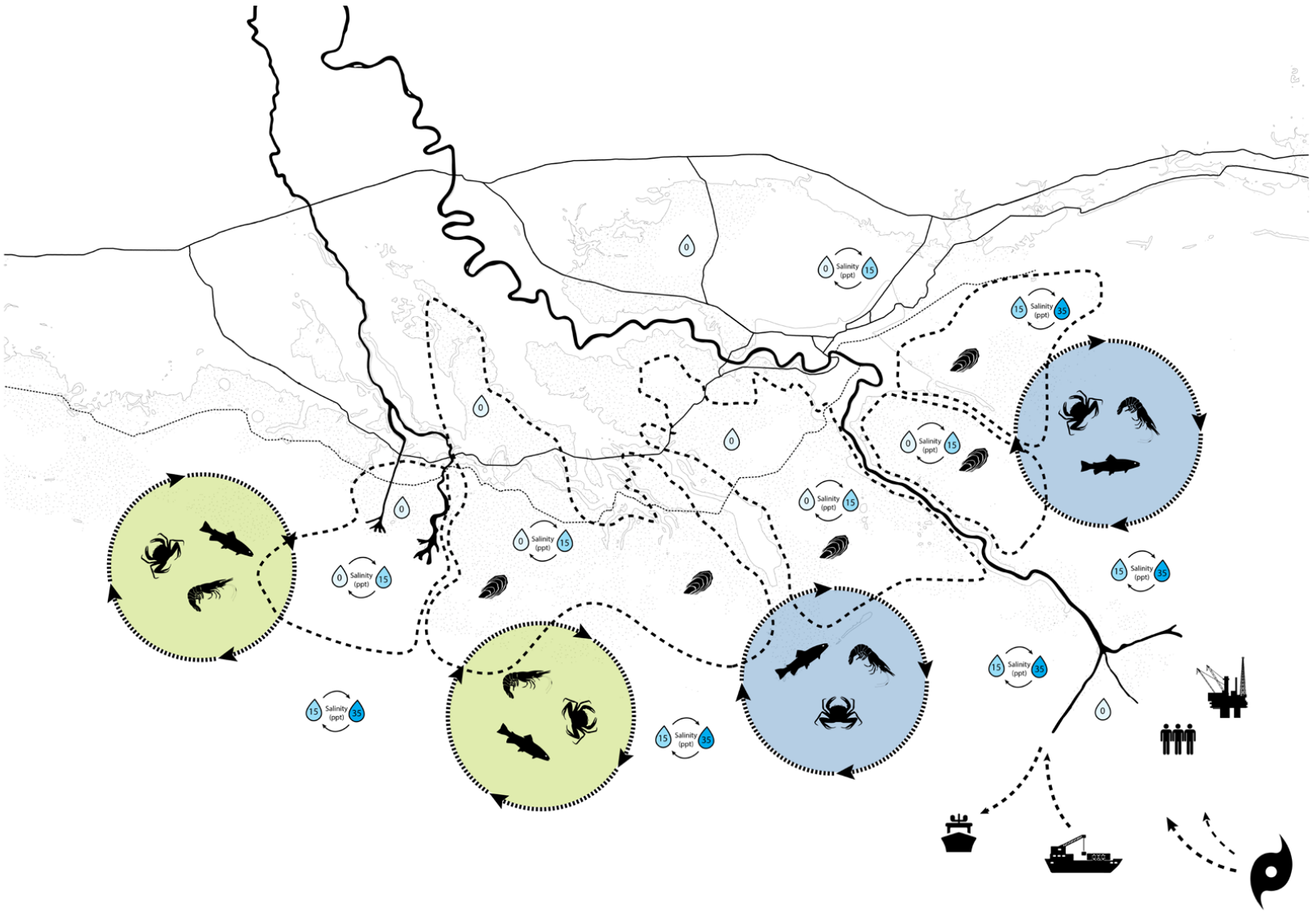
As we look towards solutions, we must clearly and unequivocally recognize that the severe constriction of the river through a levees-only approach starves the deltaic wetlands of needed pulses of sediment and freshwater. On the other hand, letting the River go without control is not a viable option. It is almost certain that the Mississippi River would transition its primary flow to the Atchafalaya River, causing sudden and calamitous effects for stakeholders locally, nationally and globally. We have invested far too much in the Mississippi River at its present location to consider this option. Certain levels of control are essential to maintain the valuable economic and public infrastructure that supports the working coast.

THE REALITY OF IMPLEMENTATION

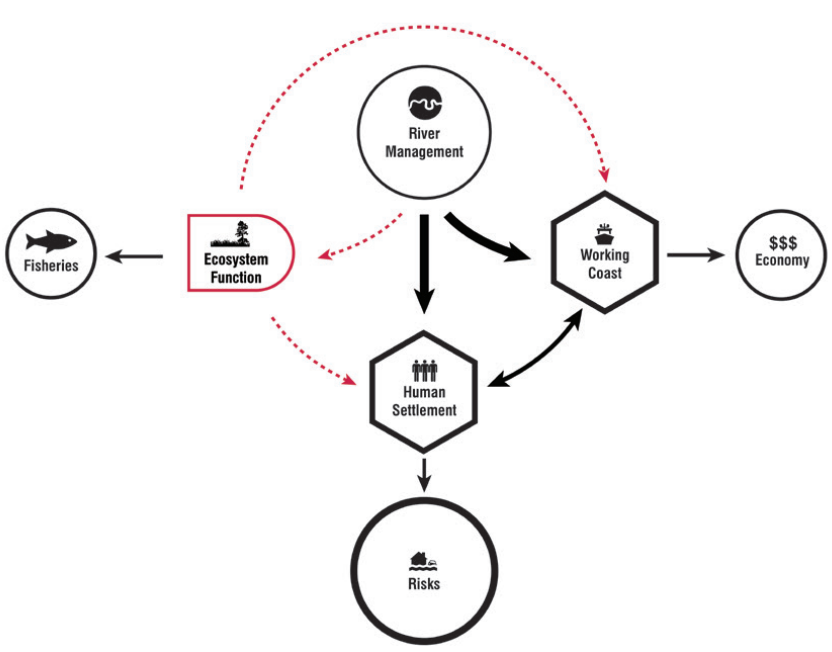
This competition asked us to think outside the box. This charge has led us to the bold ideas that we have developed as part of The Giving Delta. However, over the arc of this competition we have been reminded time and again that there is no single silver bullet idea. Coastal Louisiana has seen its fair share of bold ideas that have withered on the vine due to interminable discussions over individual projects without focusing on the greater need for a comprehensive framework where projects must work in concert to achieve the ultimate goals.

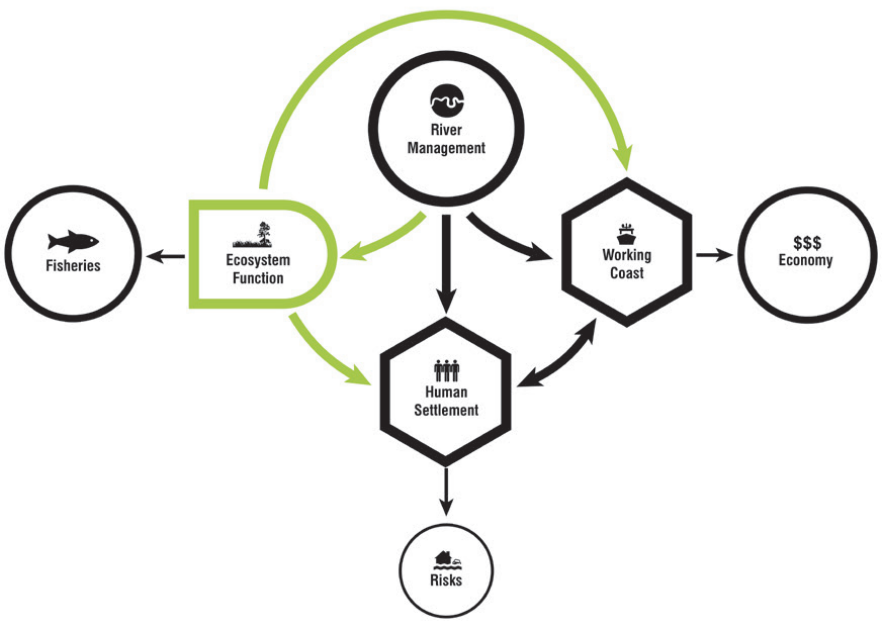
We have presented a vision of a 100-year future for the Mississippi River Delta, the Louisiana Coast, the communities that live here, and the economy that sustains all of us. We have matched our bold vision with a strategy of implementation that will benefit each generation as we move forward towards this vision.

So the question we ask is not, how can we get this done?, it is: how can we muster the political will to get it started? The ability to implement bold ideas is far more difficult than conceiving of the ideas themselves. We see this as THE major challenge, and it is our sincere hope that this proposal, in the spirit of this competition, can be a part of galvanizing a political and public process that marries big ideas with equally bold strides towards implementation.



Five Individual Basins Combine To Form The Delta:
System-Wide Processes Cross Political And Project Boundaries



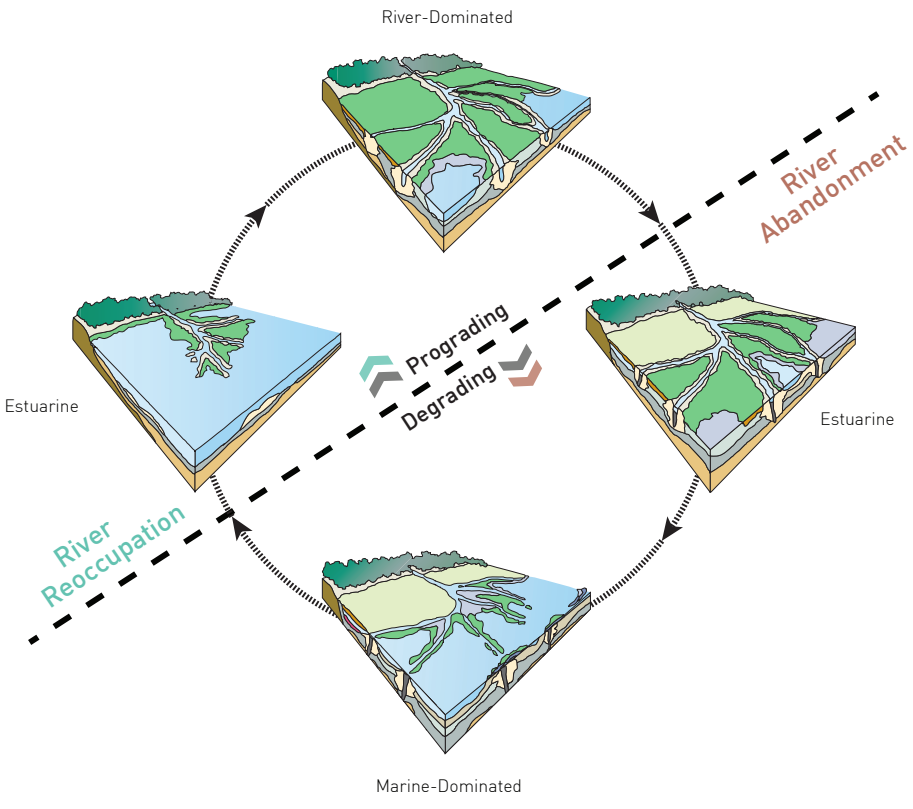


Left:Today the System Does Not Function Because Critical linkages Have Been Severed
Right: The Giving Delta Reestablishes These Crucial Connections, Offering Multiple Benefits to All

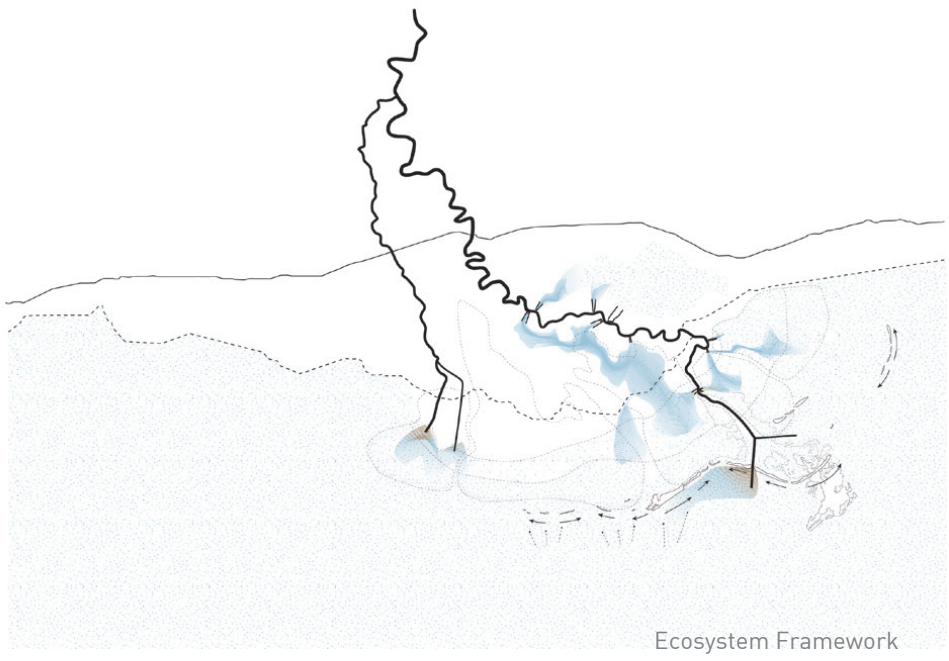
A SYSTEMS APPROACH TO THE DELTA

Tradeoffs in complex systems of large landscape require a systems analysis of interacting natural and social infrastructure that involves the flows of water, energy, materials, and money. This analysis establishes values that appropriately steer management and planning options related to present and future risks. These risks can be to both natural and social systems and are usually determined by costs and benefits. The problem has always been that non-market values of natural systems, particularly those in large dynamic landscapes such as coastal deltas, are not realized until some major disturbance makes us aware of the true long-term cumulative impacts. Such is the case of the Mississippi River Basin where a history of alternative designs to control floods and promote the economic development associated with navigation have eclipsed the long-term value of the entire system in all its complexity.

Our team uses this systems analysis to link multi-purpose needs of the diverse services and stakeholders that a large river system and coastal network provides. There have been 150 years of intense discussions and designs to accommodate the economic values of flood control and navigation to support agriculture, human settlement, manufacturing, refining, energy production, and transport, largely at the expense of the natural systems. With present evidence of future risks to both the flood control, navigation, and delta resources of the coast, we are searching for innovation using a systems approach on how to move forward to accommodate a new future for the Mississippi River Delta.



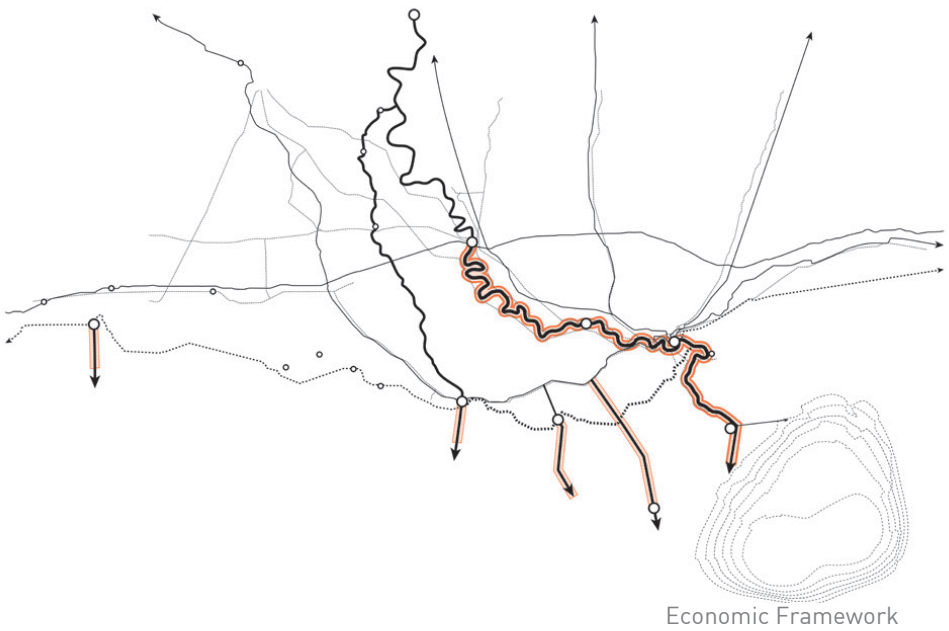
The Delta Cycle



Ecosystem Framework

ECOSYSTEM FRAMEWORK

The goal of the ecological system framework is to connect the River's natural flood pulse to the coastal landscape. Controlled flood-pulses will build and maintain wetlands with augmented sediment delivery and provide seasonal salinities gradients that promote fisheries and retain nutrients to reduce offshore hypoxia. Diverting freshwater and sediment from the Mississippi River into the coastal basins is a fundamental approach of our controlled flood-pulse design. Our framework uses hydraulic residence time in the basin, and system response tolerance as a design and operation criteria, in order to determine the magnitude of the peak flows possible without intolerable salinity suppression in the receiving basins. It is key to note that the controlled flood-pulse design will not completely rebuild wetlands that have been lost over the last century in the Mississippi River Delta. This design provides sediment and reduces salinity to promote wetland adaptation to accelerated sea level rise in these coastal basins. Allowing controlled basin occupation by the Mississippi River, the basins are allowed to adapt to a more intimate relationship with the River and allows for the basin ecologies to self organize.



Economic Framework

ECONOMY FRAMEWORK

Southern Louisiana sits at one of the most powerful strategic positions in the Nation. Controlling the mouth of the Mississippi River and bridging the I-10 corridor, this region has potential to advance and innovate in the way it moves and processes goods by water, rail, pipeline and road. In order to capitalize on a strategically advantageous location, the ports of Southern Louisiana need to look ahead to what physical measures are needed to stay competitive such as a 55' deep draft channel to accommodate post Panamax shipping. Providing access to the Eastern Gulf and future oil and gas exploration potential would also be a competitive advantage for this region. Maintaining a strong connection to the Gulf of Mexico for international trade and development of offshore oil and gas resources will provide critical links for the nation's economy for many decades to come. Providing easier access and job security will have positive impacts on the tax base, local communities, and allow the vibrant cultures of Coastal Louisiana to remain and thrive. By providing for seasonal salinity gradients the fisheries industry can also adapt to the inevitable change, or face complete industry collapse.

Communities Framework

COMMUNITY FRAMEWORK

Human settlement in the Louisiana Gulf Coast is framed by two overlapping systems of the I-10 corridor and the traditional linear bayou developments that reach deep into the Delta. These systems of development share a core principle of continuous access to transportation along an infrastructural spine, both highway and river, that supports over 2 million people who call this region home. Our proposal retools these linear communities concentrating development on the I-10 and US-90 corridors bisected by the industrial river corridor and ridgeline settlements stretching to the South. Emerging at the intersections of these systems are dense urban nodal cities, "Delta Cities," that thrive behind and within a renewed marsh zone. As seas rise and much of the Delta continues to transgress, communities will have to consolidate behind protection and elevate in areas with increased risk. However, this does not mean that Coastal Louisiana must be abandoned. Human culture can and must continue to thrive in the Gulf but its sustained future will depend on its willingness to adapt to a changing landscape.

Illustration of the Lower River Spine, which integrates Ecological, Economic, and Community Benefits

MAJOR TACTICS

1. Controlled Flood-Pulse Structures
Controlled flood-pulse structures will be constructed upriver and just downstream of New Orleans. These structures will provide increased flood control capacity for New Orleans, and provide freshwater and sediment delivery to upper coastal basins. The location of these structures in an upstream location will provide more effective delivery of freshwater at generational periods as climate change will alter the patterns of floods in the Lower River.

2. GIWW allows Inter-basin management
The Delta is a collection of hydrologic basins that are each at various levels of growth and decay. Some of the most critically stressed parts of the deltaic-estuarine complex are also furthest away from the sustaining properties of the Mississippi and Atchafalaya Rivers and as such would not directly realize the benefits of a strategy of controlled floods into the upper reaches of the individual hydraulic basins. The GIWW will be used to intercept approximately 5,000-cfs and conveyed westward along the GIWW.

3. Multi-height spillways
Below English Turn, at locations that coincide with the currently proposed Mid-Barataria and Whites Ditch Diversion Projects, the existing Mississippi River levees will be degraded to multiheight spillways at approximately RM 60 AHP, to make maximum use of relic alternate point bar deposits as dynamic sediment sources. The timing and amount of flow through these structures will be controlled by the crest elevations and widths of the spillways notches and the level of the river.

4. Sediment Traps and Dedicated Dredging
As evidenced by the flood control operation of the Bonnet Carre spillway, significant sediment deposition occurs in the River channel immediately downstream from these structures. By strategically locating sediment traps to coincide with the zones of induced shoaling, what once was a negative secondary impact of spillway operations is now an opportunity to fix locations of sediment interception, collection and mining. Additionally, two sediment traps with a combined capacity sufficient to accommodate the current dredged volumes will be constructed in Southwest Pass in order to intercept as much sediment as possible from being transported into deep water and lost from the littoral zone.

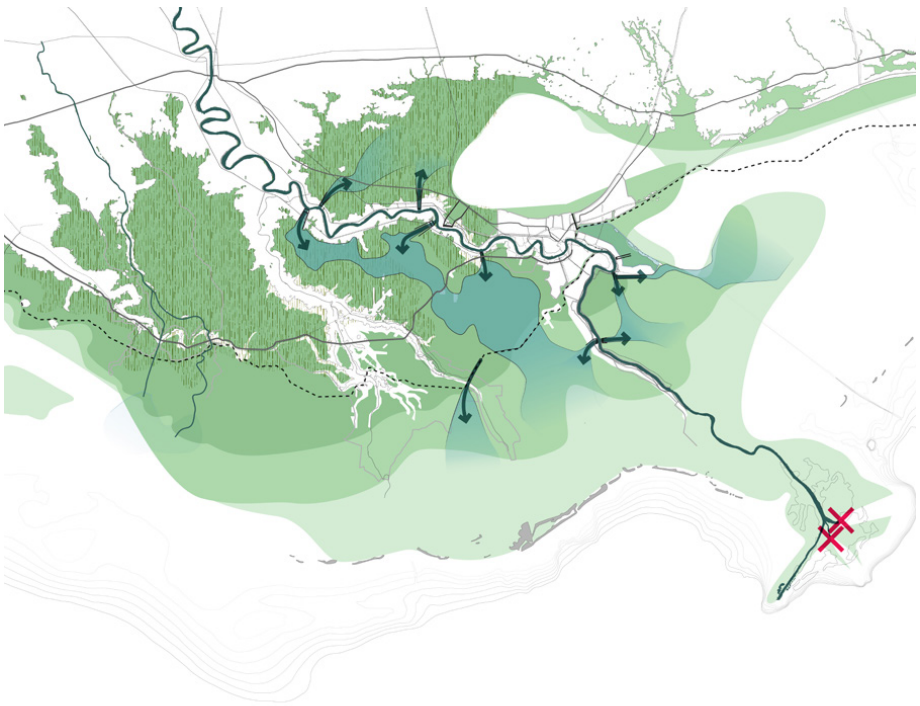
5. Settling Basins
The construction and operation of two Settling Basins off of the main stem of the River and adjacent to the back levees are designed to divert and then return river water to the main channel, with the function of allowing the sediments to settle out. The basins are then used as extraction mines for large volumes of fine-grained sediment.

6. Align the River Mouth to Intercept the Littoral Zone
Maintaining deep draft navigation through the Birds Foot delta will become unsustainable in the future. Fundamentally threatening to the entire region, the design and operation of the navigation infrastructure results in the deposition of millions of tons of sediment into deep water that is lost to the system. By configuring the new channel to intercept the littoral zone, the reduction of the lost opportunity in sediment losses beyond the littoral zone can be drastically reduced. The new navigation channel will provide a more direct route from the lower Mississippi River to the Gulf of Mexico.

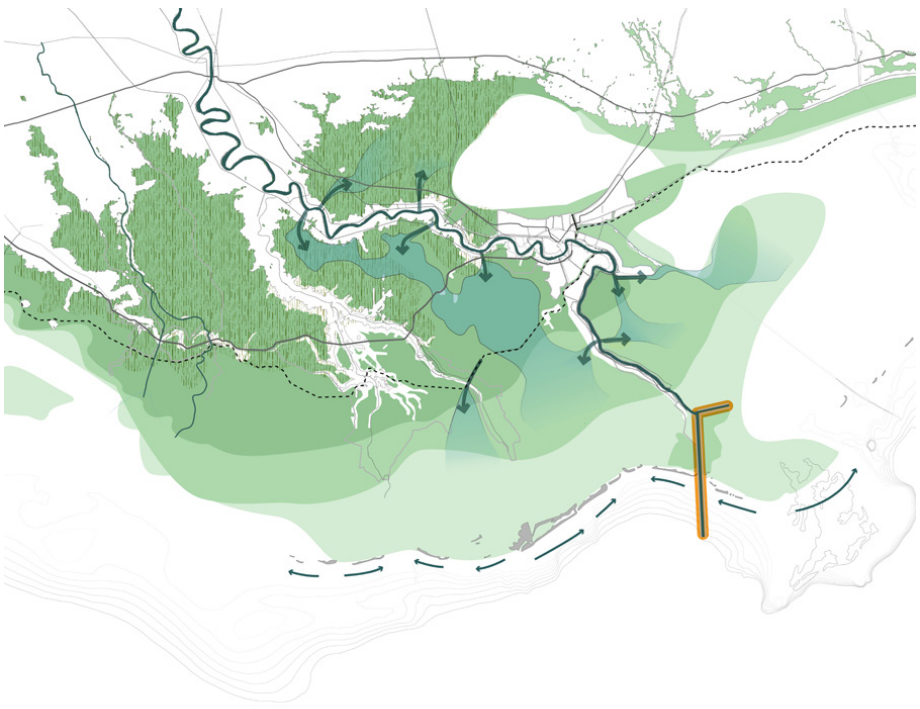
7. Port Sulphur
Focused investment in the area near Port Sulphur, which would be adjacent to the new cut of the River to the Gulfs will offer an economic opportunity zone for industry, and support facilities would be encouraged to develop or relocate to this area. By concentrating these economic assets, it will be easier to justify a more robust levee system, and adjacent wetland restoration projects, to provide the required protection from storm and flooding events that such facilities will require. Furthermore, it is proposed that a new shallow draft channel will be constructed eastward from this area to provide direct access to the Eastern Gulf without having to transit around the birdsfoot delta.

8. Sand Engines
The sand-engine harnesses the natural processes of wave energy within the littoral zone, to locally distribute the dredged sediment placed, and over time nourishing and accreting down drift shorelines, at a fraction of the cost of mechanically placed material. A sand engine is especially attractive where there is an abundant source of sand, proximal to the placement site. It is for this reason that we have selected a location near the new channel where material will be available for dredging, and placement sites nearby. Our analysis revealed that net longshore transport trends will naturally move the material away from the channel gradually westward, and nourish shorelines for ~ 13 miles to the west.

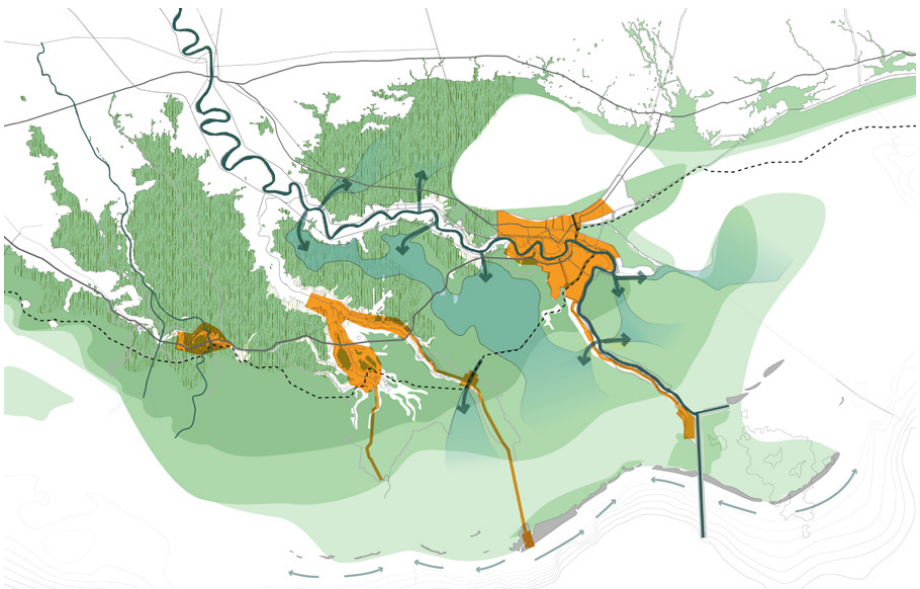
100 Year Plan for the Lower River



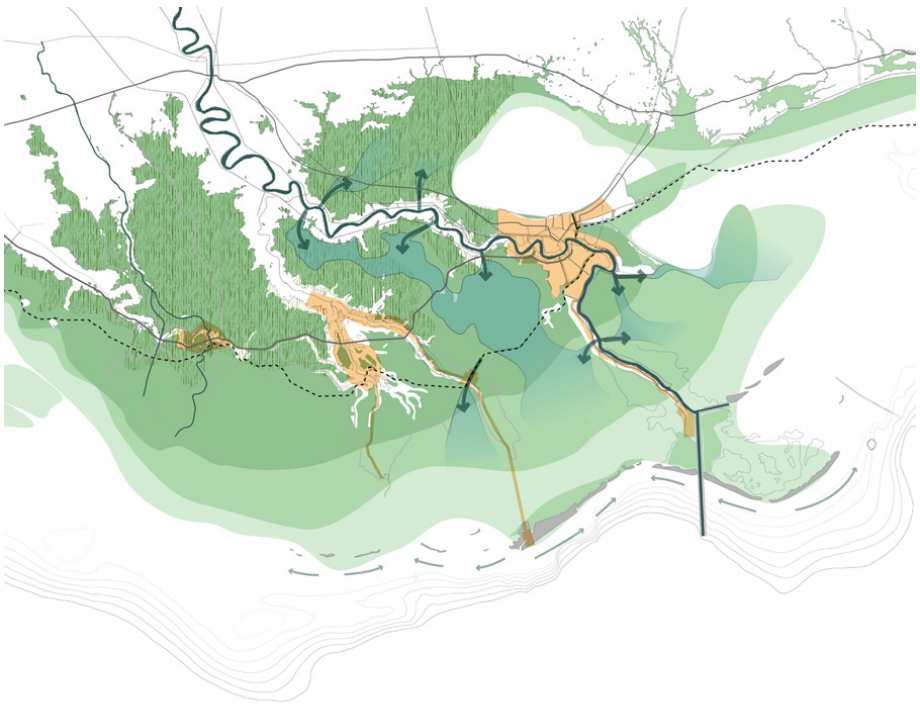
1st Generation: Connect



2nd Generation: Align



3rd Generation: Adapt



4th Generation: Positioned for Change

PHASING

An 1897 National Geographic article outlined today's predicament plainly: "No doubt the great benefit to the present and two or three following generations accruing from a complete system of absolutely protective levees, excluding flood waters entirely from the great areas of the lower delta country, far outweighs the disadvantages to future generations from the subsidence of the lower Gulf delta lands below the level of the sea." Thus, a decision was made, one that generated great prosperity for four generations but whose time has come to adjust. The consequences of that choice for this and future generations are now apparent and the negative impacts will soon outweigh the positive benefits, if they have not done so already. The framework plan lays out a vision for restoring the environment and reintroducing the natural river dynamics into parts of Louisiana's coast. However, by stretching this plan across the next four generations, we leverage the natural ability of human settlement to adapt and change to this long-term vision.

1st Generation: Connect - From Flood Control to Controlled Flood-Pulses

Connecting the Mississippi River and re-establishing historic and surrogate freshwater and sediment pathways back to the delta / estuarine complex is of critical importance and the first order of business. During the first generation, the controlled flood and multi-height spillway structures will be constructed as well as the settling basins and sediment traps. In addition the GIWW will be utilized for inter-basin management of flows. The power of controlled flooding will allow the deltaic coast to adapt to sea level rise through input of sediment into the system and as salinity gradients are expanded through increased upriver controlled flooding into the upper basins. The Delta Cycle of river reoccupation and river abandonment is then harnessed to enhance diverse levels of estuarine productivity across the coastal basins by allowing river floods to organize ecosystem development.

2nd Generation: Align - Transform the Lower River

An alternative deep draft navigation channel entrance into the Mississippi River and the inland waterways of the nation is constructed at Port Sulphur during the 2nd Generation. The Southwest Pass navigation channel is abandoned a process the Mississippi River has already begun and which will continue to increase in rate with increasing relative sea level rise; thereby transforming the Lower Mississippi River and its mouth from what we know today. Establishment of sediment traps in the new navigation channel will fuel sand engines located at the intersection of the new navigation channel and littoral zone allowing littoral processes to transport deltaic deposited sediments to sustain the Barataria Bay rim.

3rd Generation: Adapt - Consolidation and Economic Dividends

By the commencement of the 3rd generation, the strategies and tactics implemented in order to change the way the Lower Mississippi River is operated and maintained are now fully operational. The natural and human systems are responding and adapting to the implementation of the new paradigm. The basins are adapting seasonal salinity gradients as a result of the implementation of a closer relationship of the basins to the dynamic state of the river. A broad dynamic wetland zone has been established across a significantly concentrated delta zone. Port infrastructure and the economic activity and associated support infrastructure is consolidated and solidified, providing for a globally competitive port region, centered on Port Sulphur and aligned along a zone of economic concentration along the Mississippi River, north of Port Sulphur. The footprints of the more vulnerable communities located on the extremes of the buffer zone are reduced. There is strategic development of dense communities, concentrated along current and future areas of high ground and infrastructure.

4th Generation: Poistioned for Change

Seventy-five to 100 years from now, the Mississippi River Delta and Louisiana Coastal zone will look very different from today. If we act boldly, we can turn the risks of the delta into our greatest asset and return the Delta landscape into a protective, sheltering environment for generations to come. The 4th generation of this plan depicts a place that has adapted to change and is poised to keep adapting in the face of changing climate and economies. We have adapted to increased fluctuation in the Mississippi River. We have shortened the River and increased the flow of sediment into our wetlands while improving the dependability and capacity of navigation. We have provided a clear future for communities, industry and the workforce.