State of the Science for Multipurpose Use of the Lower Mississippi River to achieve sustainability

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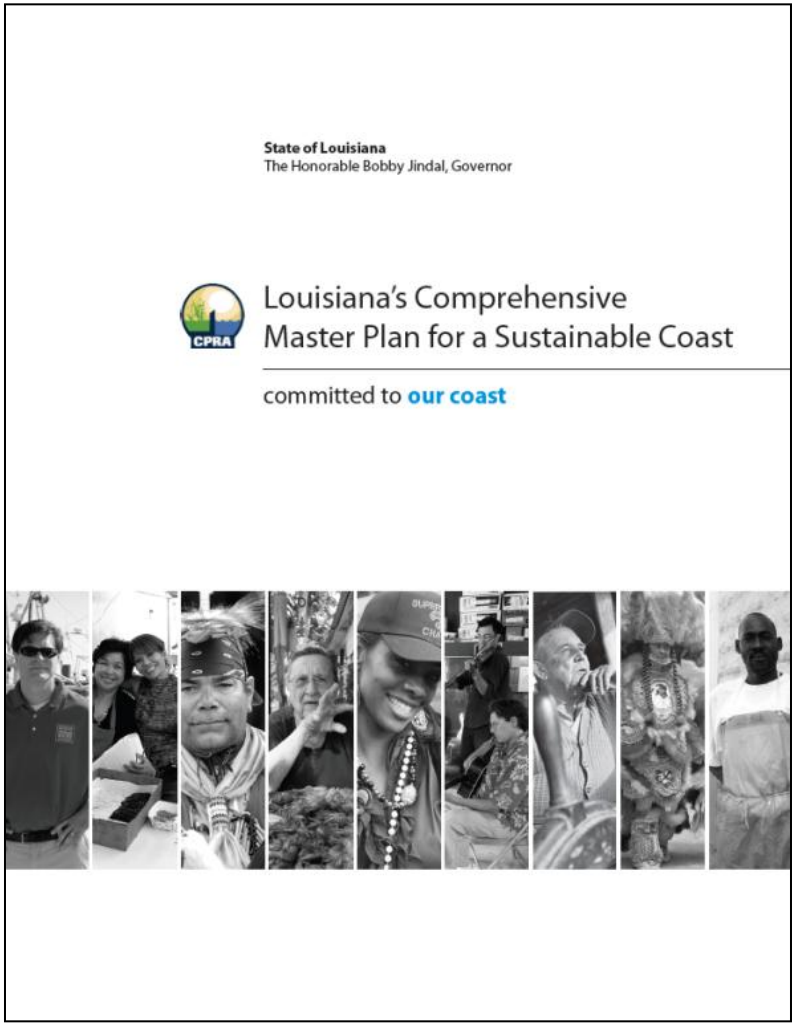
Louisiana Applied Coastal Engineering & Science (LACES) Division
9th INTECOL International Wetlands Conference:
Wetlands in a Complex World
June 8, 2012

CPRA
Coastal Protection and Restoration Authority of Louisiana

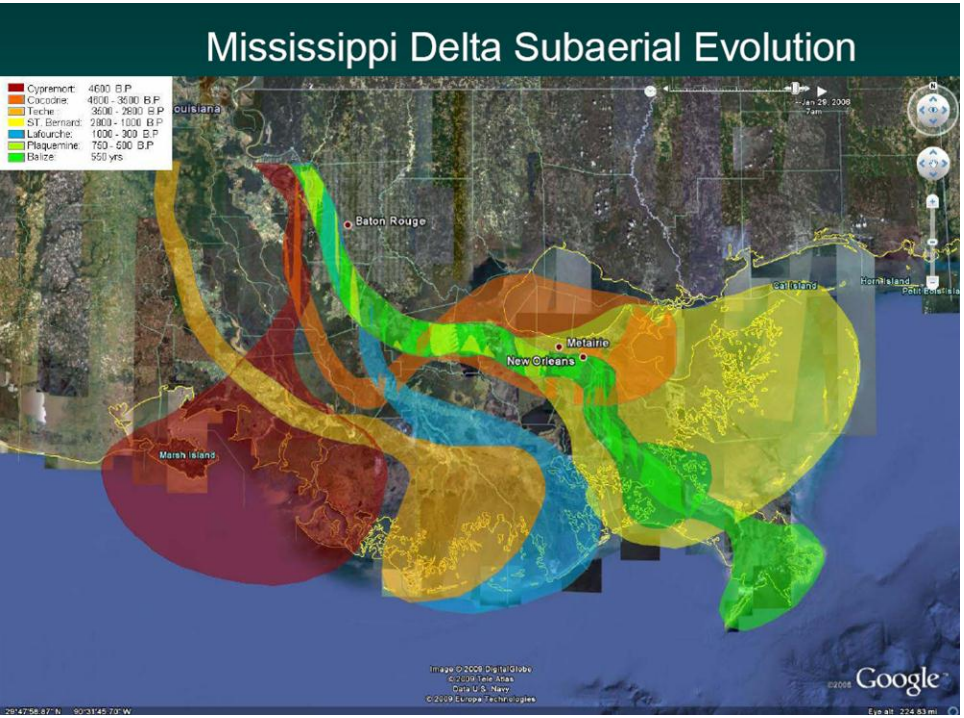
committed to **our coast**

Objectives

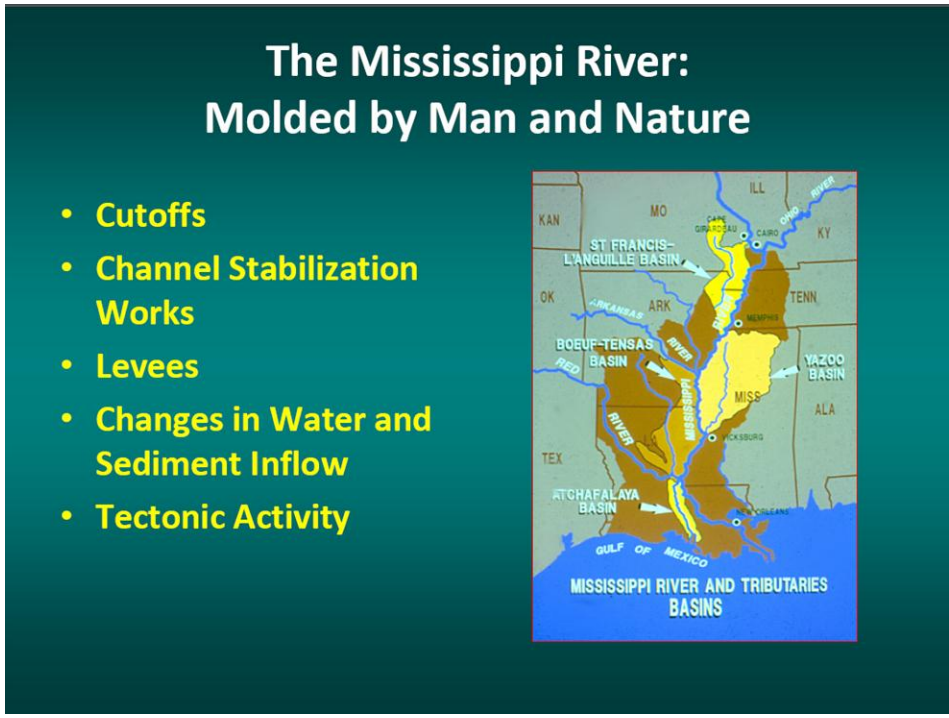
- Describe the state of the science and technical investigations regarding the benefits, uncertainties, and risks associated with river diversions.



Mississippi Delta History



Natural Processes



Artificial (and Natural) Processes

Sustainability?

Value of Louisiana's coast

Oil & Gas Production

- Highest crude oil production in nation
- Second highest rate of natural gas production in nation
- 19% of nations refining capacity

Waterborne Commerce

- 450 Million tons annually (20% of nation)
- Largest port in the nation in terms of tonnage
- 3,000 miles of deep and shallow draft navigation channels

Fish & Wildlife

- 26% of total commercial fishing catch in lower 48 states
- Largest fur harvest in the nation
- >5 Million migratory waterfowl winter in Louisiana's marshes

Other

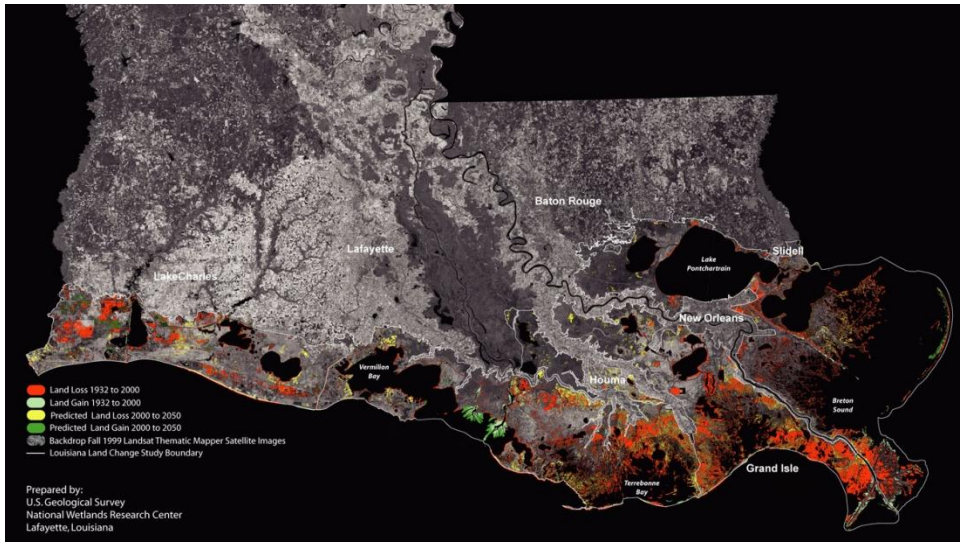
- 11 National Wildlife Refuges
- 2 Million residents in coastal zone
- 25 Million domestic and international visitors/year adding $9.3B to the economy

How do we reconnect the river and re-establish deltaic processes to maintain the environment while maintaining sustainability of the coast, it's cultural heritage and the economic resources and transportation corridors that support the Nation?

Land Loss

Historic:

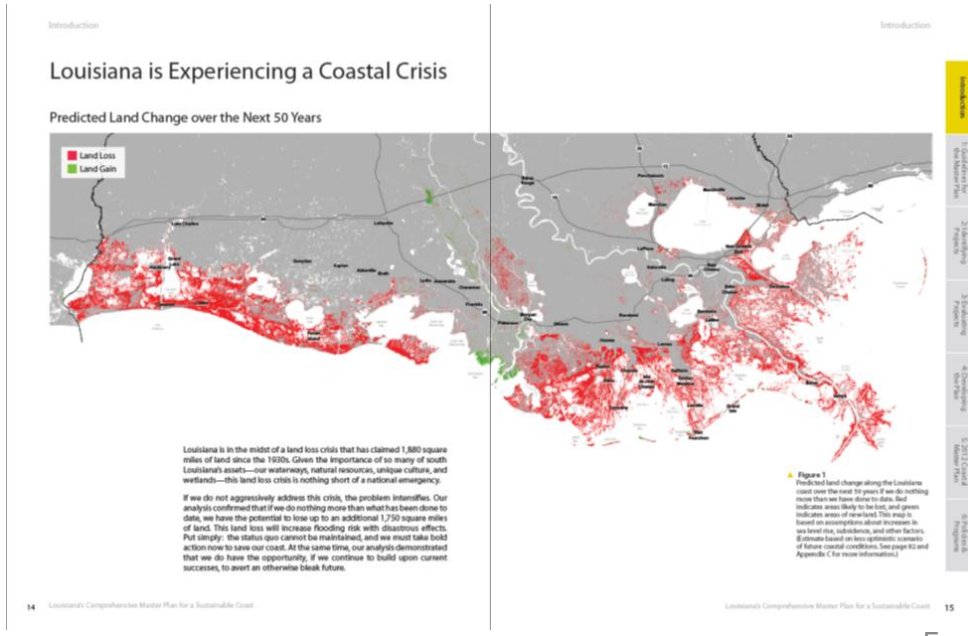
1,883 square miles lost (1932-2010) (USGS)



Possible future land loss over the next 50 years if no additional action is taken:

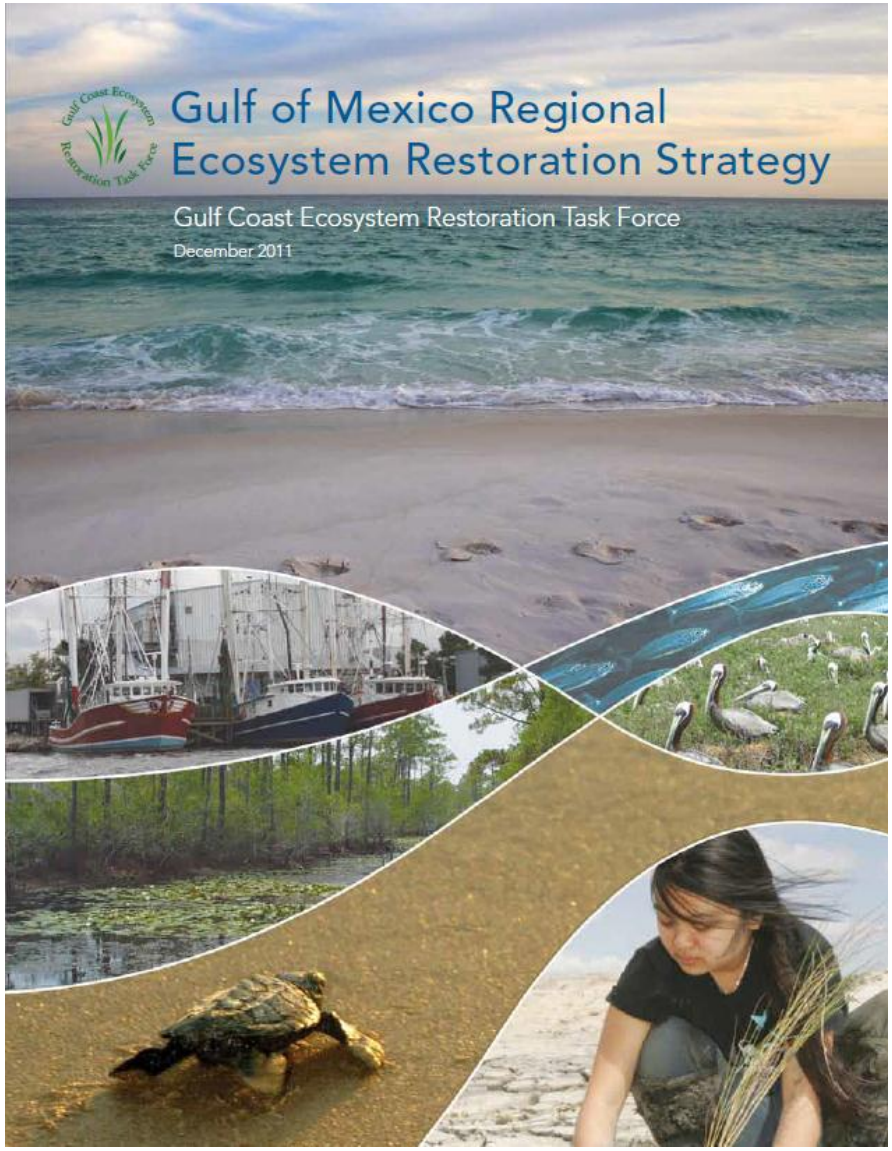
1,750 square miles of additional loss

(CPRA Master Plan 2012)



Doing nothing is NOT an option

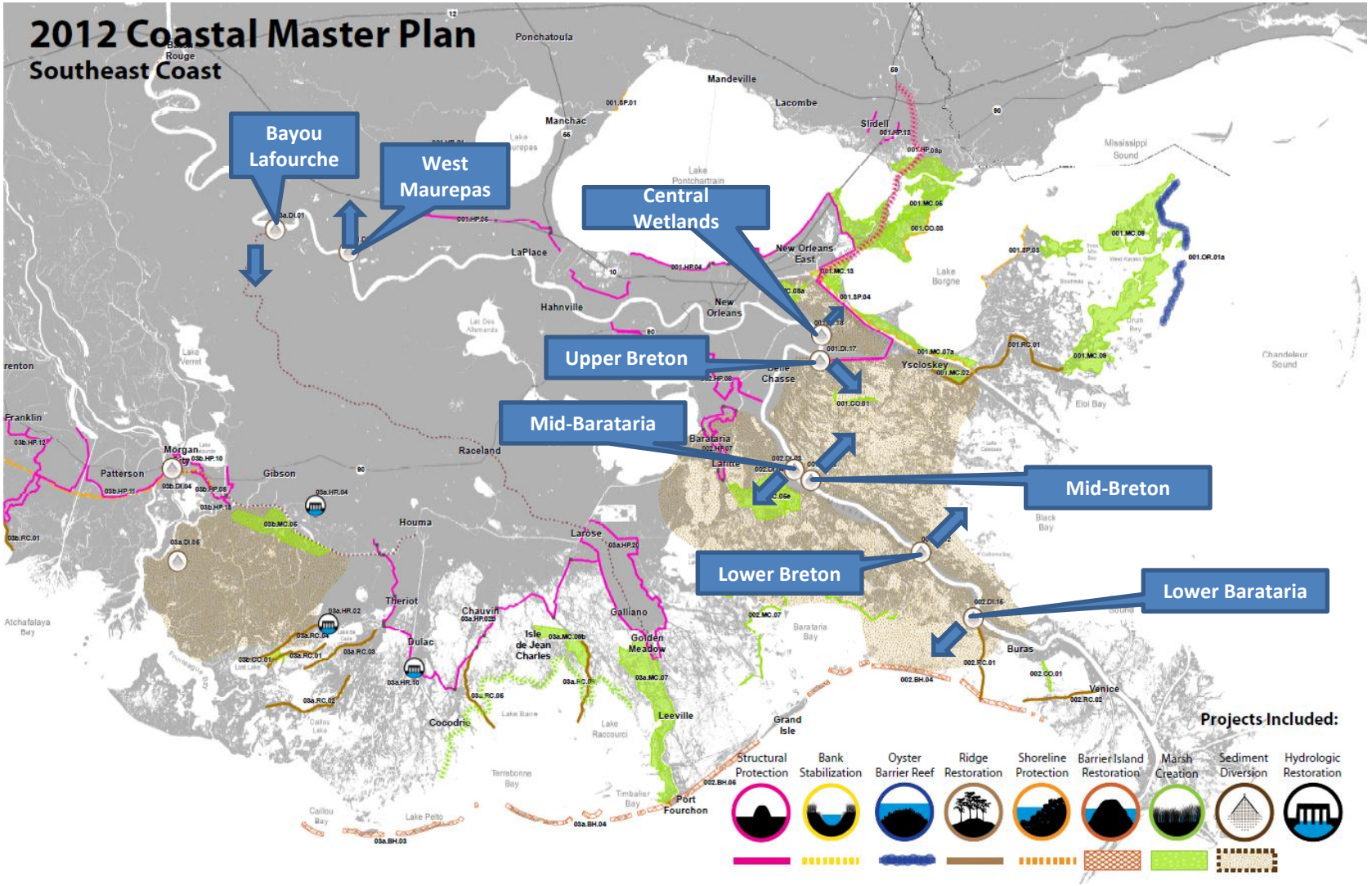
Support for River Diversions



"Without reconnecting the river system to its deltaic plain, Louisiana's coast will remain unsustainable and the Gulf ecosystem will degrade further."
(GCERTF 2011)

2012 Coastal Master Plan

Diversions



Uncertainties

- identifying the best locations for diversions and navigation channel realignments to maximize delta benefits and minimize in-river impacts
  - Water and sediment budgets
  - Induced shoaling

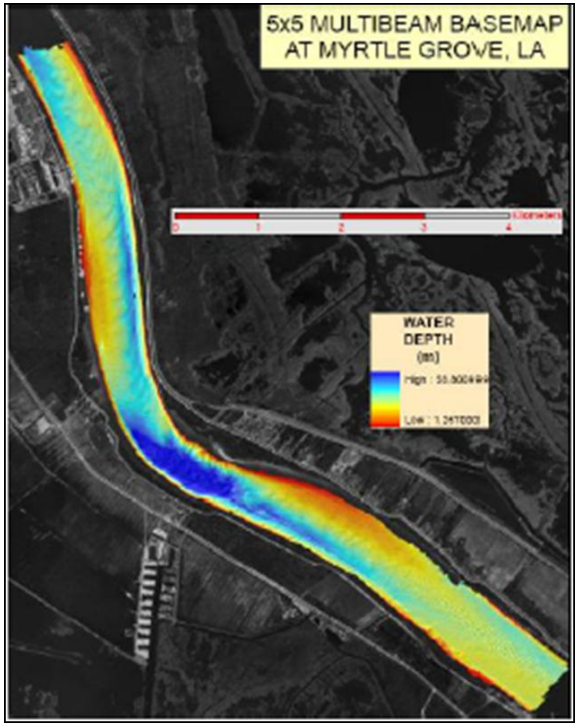
Priority Riverside Technical Topics

Sediment and Freshwater Availability

Ongoing Activities:
Medium Diversion with Dedicated Dredged at Myrtle Grove Feasibility Study

- Designing the structure to maximize sediment transport per unit water, minimizing potential shoaling and over-freshening

- Initial work prior to the cost-share performed cooperatively between CPRA and Environmental Defense Fund



Priority Riverside Technical Topics

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Ongoing Activities:
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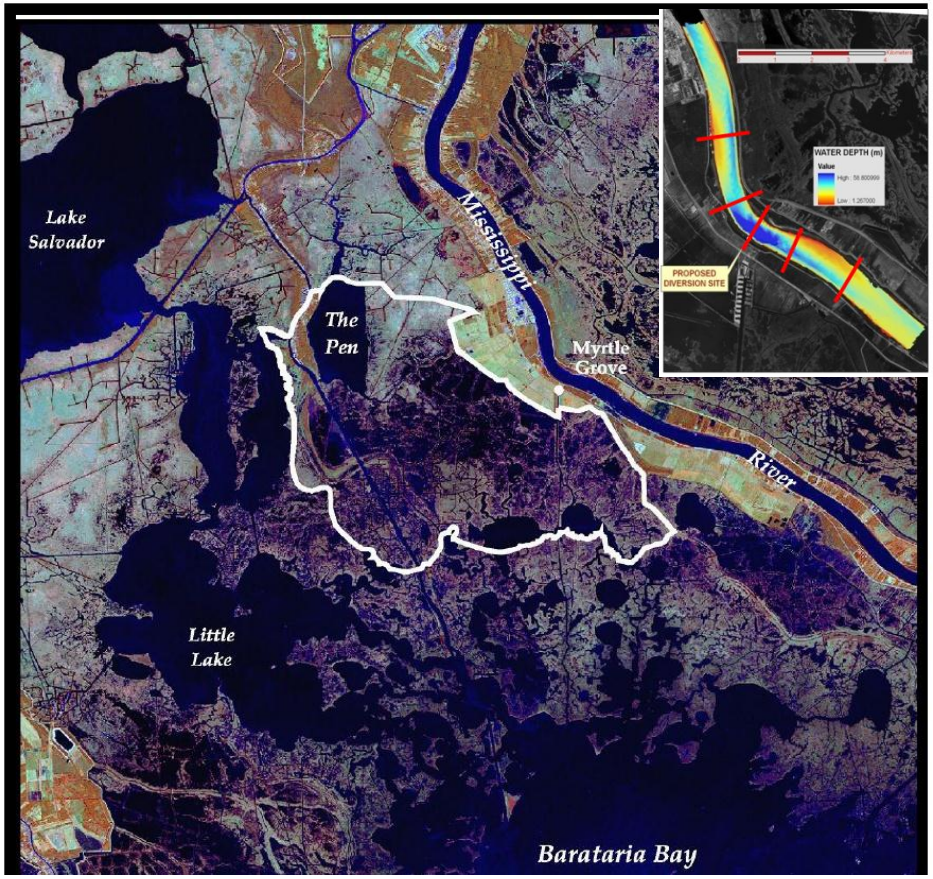
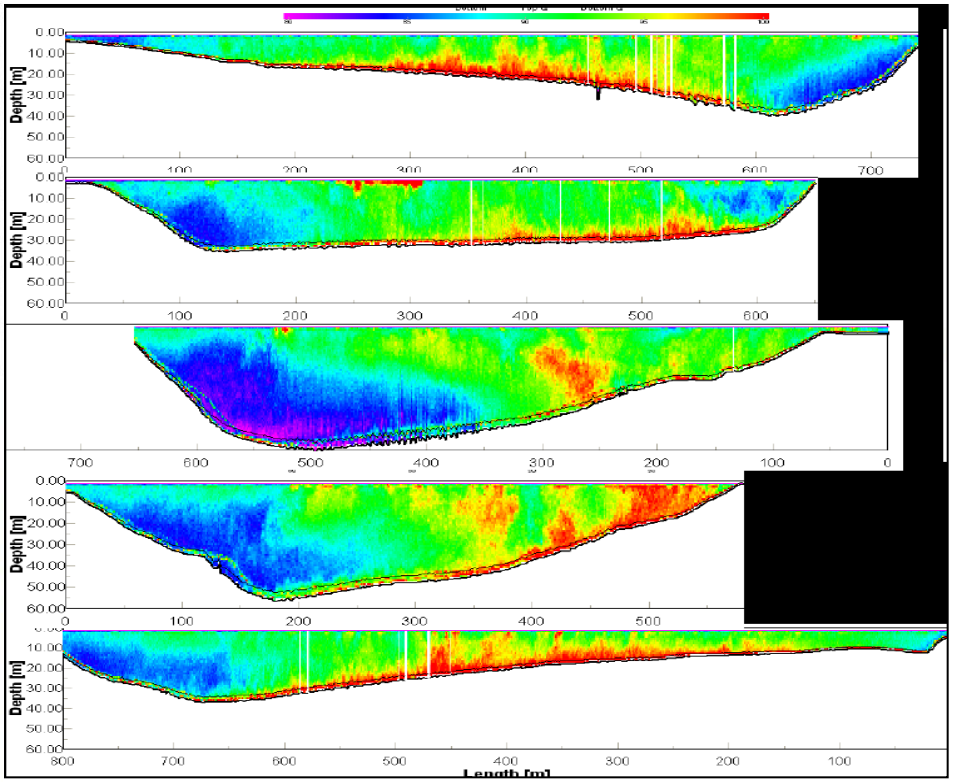




ADCP Backscatter Intensity (Surrogate for sediment load)

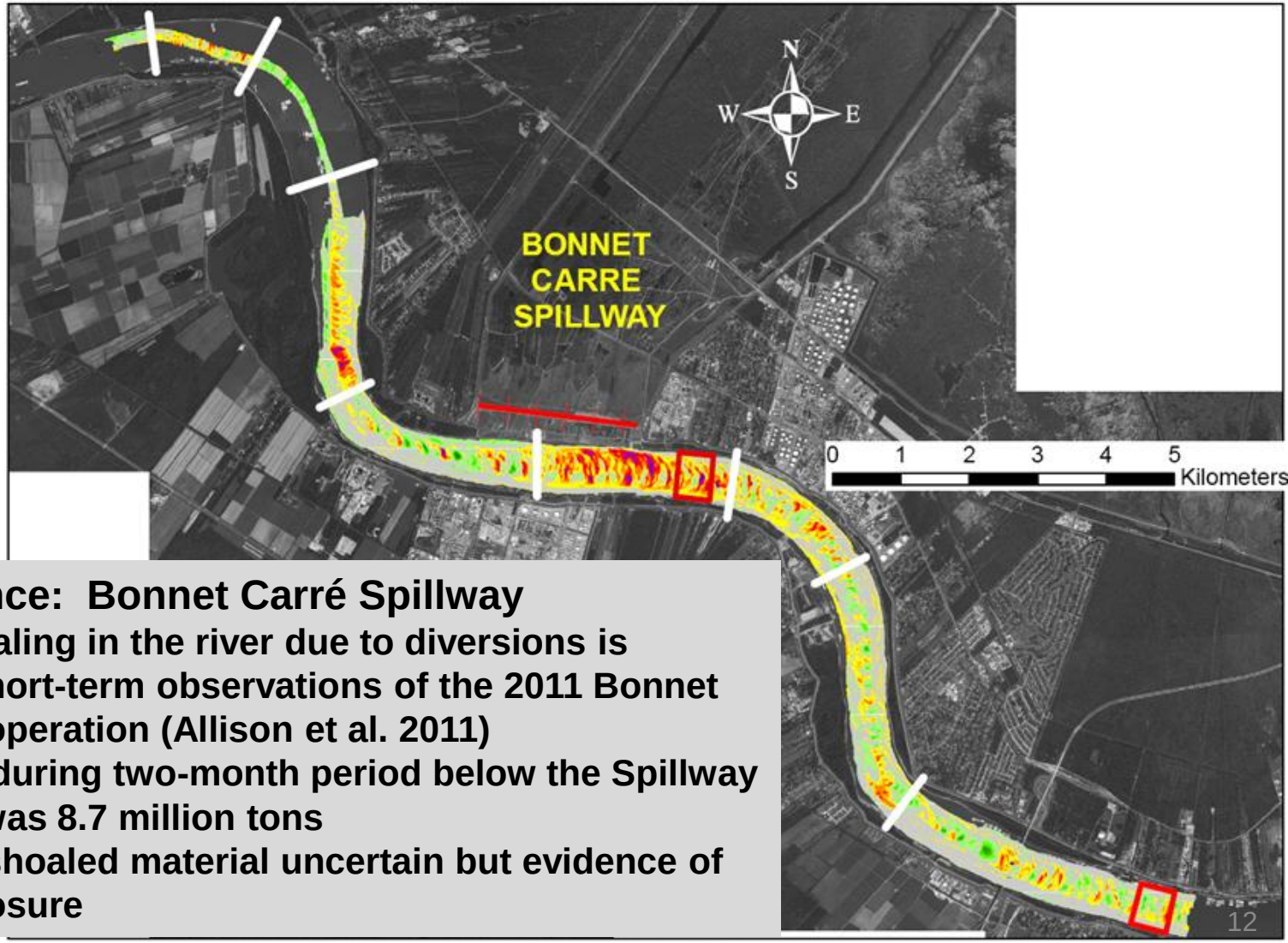
Priority Riverside Technical Topics

Induced Shoaling

Question:
Does the removal of large amounts of freshwater from the river lead to downstream deposition of suspended sediment?

Priority Riverside Technical Topics

Induced Shoaling



State of the Science: Bonnet Carré Spillway

- **Theoretical shoaling in the river due to diversions is supported by short-term observations of the 2011 Bonnet Carré Spillway operation (Allison et al. 2011)**
- **Total accretion during two-month period below the Spillway in the channel was 8.7 million tons**
- **Persistence of shoaled material uncertain but evidence of erosion after closure**

Uncertainties

- identifying the best locations for diversions and navigation channel realignments to maximize delta benefits and minimize in-river impacts
- determining the most appropriate size and operational strategy for controlled diversions to maximize land building and land sustaining benefits
  - Capture sediment
  - Build and sustain land

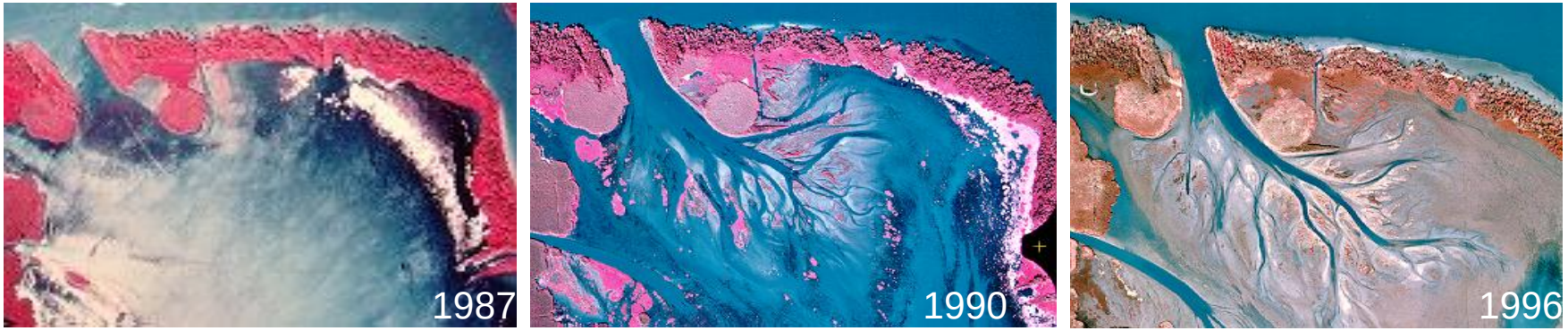
Priority Bayside Technical Topics

Land-building Potential

State of the Science

- Sediment diversions must fill the subaqueous portion of the receiving coastal embayment before subaerial expression
  - Filling may not be visually noticeable during early stages
- Land-building is slow and episodic, but more energy efficient than wetland creation via dredged sediment placement
- Expectations for diversion-related land building can be informed by a robust understanding of river sediment dynamics and monitoring of past projects

Pass-a-Loutre Crevasse

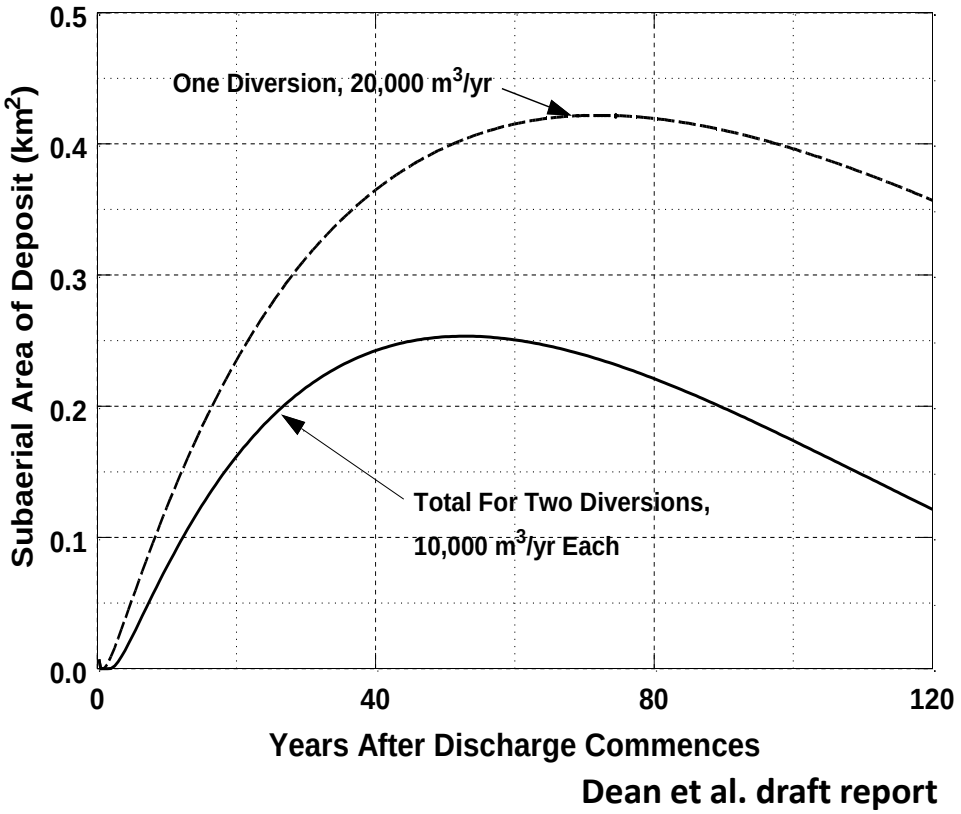


Priority Bayside Technical Topics

Land-building Potential

Question:
Are Fewer Larger Diversions Better than Multiple Smaller Diversions?

- LCA Science Board model predicts that while two diversions could transport same volume of sediment as large diversion, predicted subaerial land area is much greater for single diversion

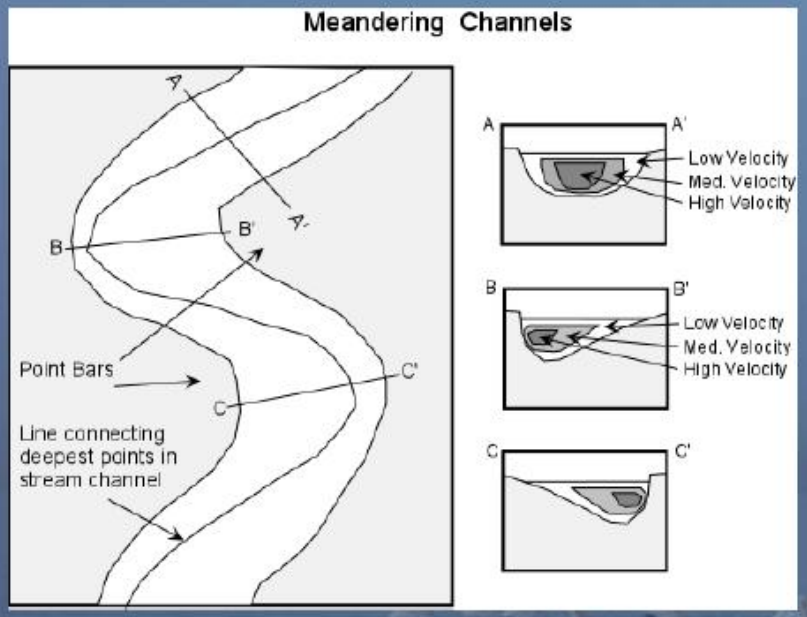


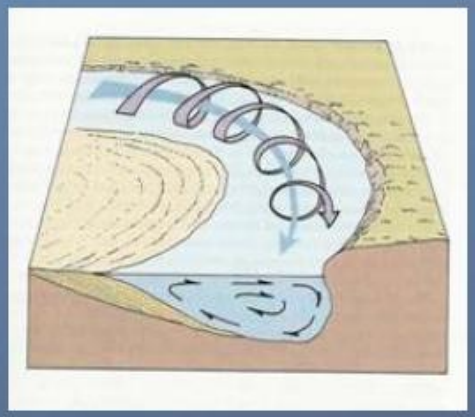
Dean et al. draft report

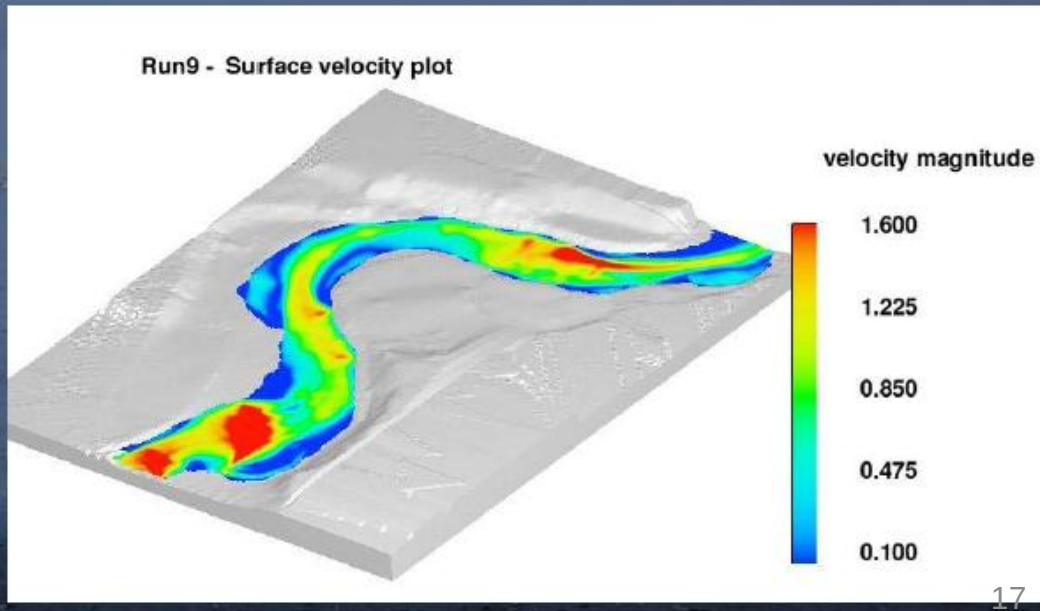
Uncertainties

- identifying the best locations for diversions and navigation channel realignments to maximize delta benefits and minimize in-river impacts
- determining the most appropriate size and operational strategy for controlled diversions to maximize land building and land sustaining benefits
- improving our understanding of the complexity of water and sediment dynamics in the river and developing water and sediment budgets,
  - Multidimensional flow of water and sediment

Multidimensional flow of water and sediment







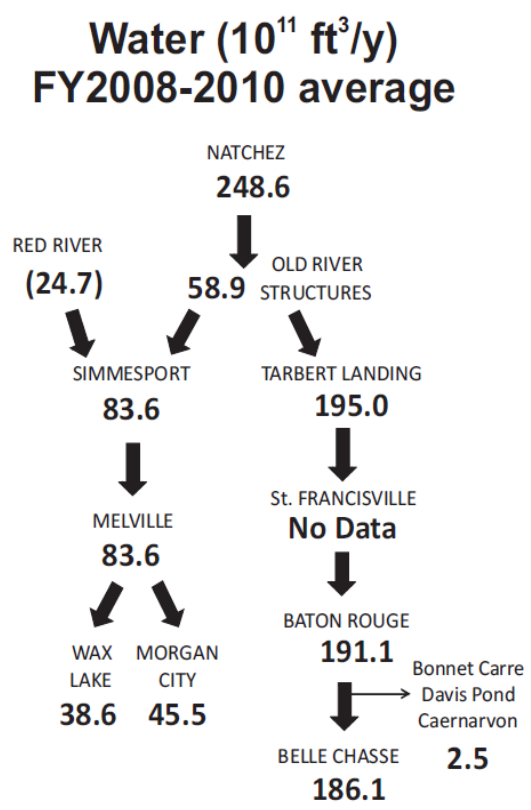
Priority Riverside Technical Topics

Sediment and Freshwater Availability

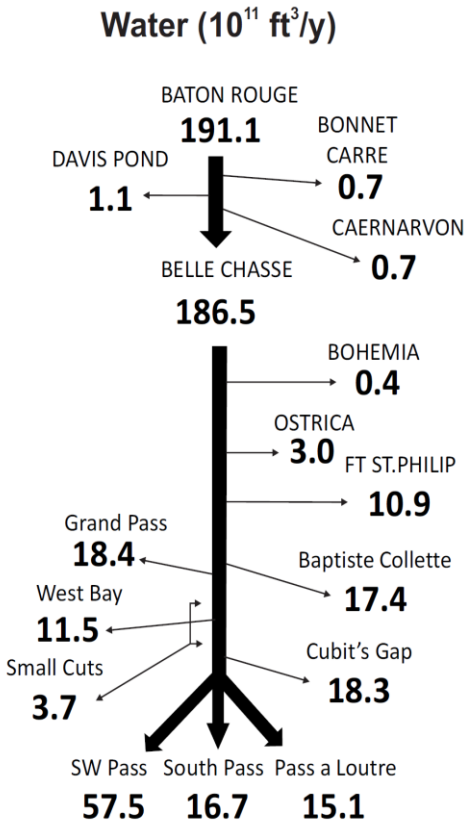
Question:

How much freshwater can we remove from the river, and when?

- State of the Science: Mississippi and Atchafalaya River Sediment Budget
- Approximately 25% of the water discharge in the Mississippi River is removed through Baptiste Collette and Tiger Pass.
- There is no significant loss of water from the Mississippi River channel above Baptiste Collette.



Allison et al. 2012



Uncertainties

- identifying the best locations for diversions and navigation channel realignments to maximize delta benefits and minimize in-river impacts
- determining the most appropriate size and operational strategy for controlled diversions to maximize land building and land sustaining benefits
- improving our understanding of the complexity of water and sediment dynamics in the river and developing water and sediment budgets,
- balancing the water needs (flow and volume) for in-river uses with the needs of the delta,
  - Municipal Uses
  - Industrial Uses
  - Navigation

Priority Riverside Technical Topics

Sediment and Freshwater Availability

Question:

How much freshwater can we remove from the river, and when?

- Minimum flows needed to ensure stakeholder activities can continue
  - Industrial freshwater supplies
  - Municipal drinking water supplies
  - Navigation needs
- Most guidelines (Coast Guard, Master Plan, etc.) assume a minimum flow from which we could not divert between 200,000-300,000 cfs.
- Record low flows in the Mississippi River are around 100,000cfs.

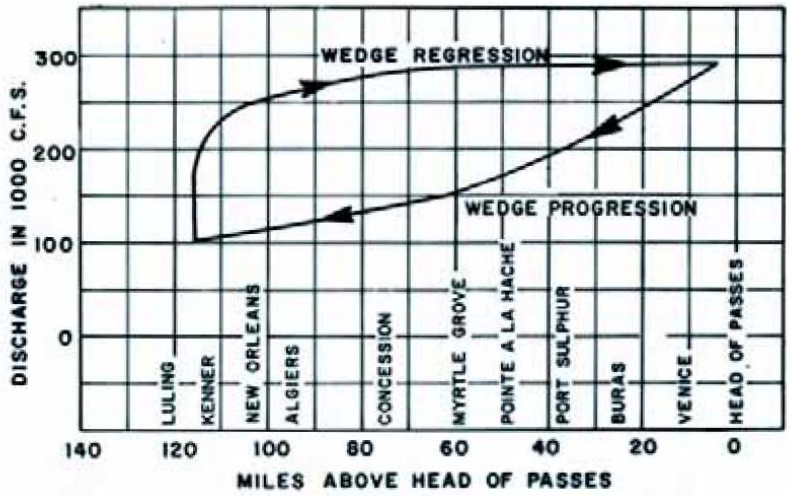
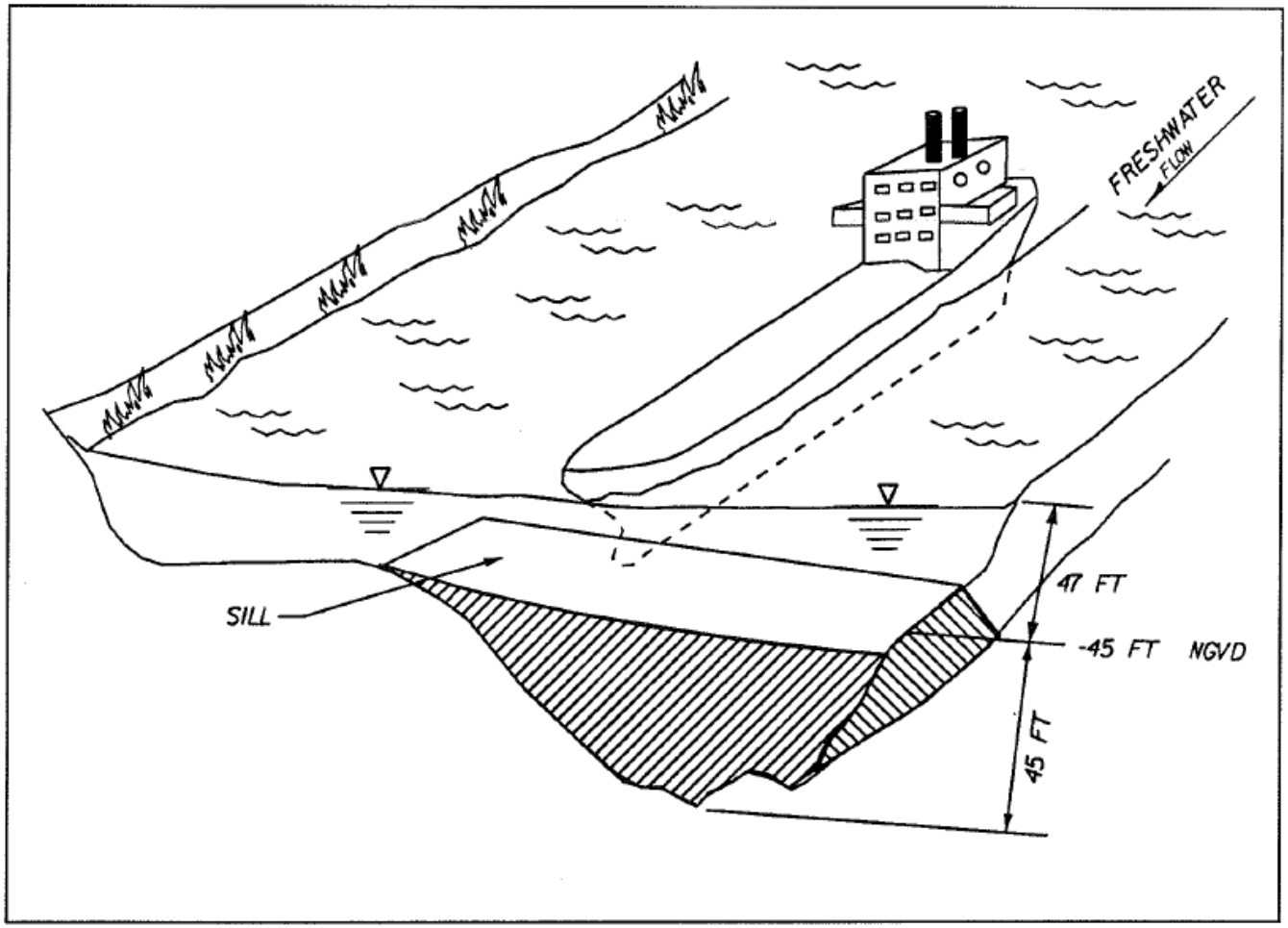


Figure 4 - Position of toe of saltwater wedge above Head of Passes versus flow in the Mississippi River (from Soileau et. al., 1989).

13 municipal and 15 industrial water supply facilities in the New Orleans vicinity, drawing and treating 468 MGD of water from the Mississippi River.

Saltwater Barrier in the Mississippi River



Uncertainties

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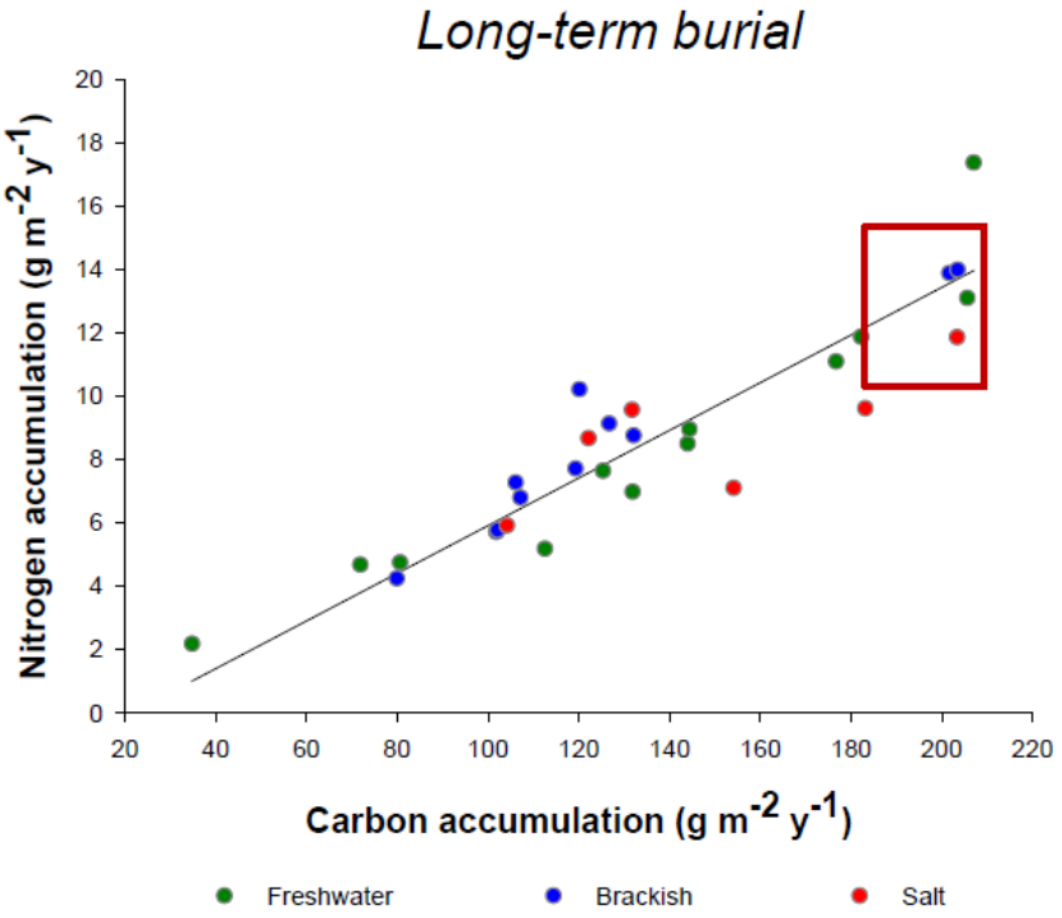
- improving our understanding of the complexity of water and sediment dynamics in the river and developing water and sediment budgets,
- balancing the water needs (flow and volume) for in-river uses with the needs of the delta
- improving our understanding of the linkage of water quality, wetland nutrient assimilation, and Gulf hypoxia,
    - Nutrient assimilation from diversion projects

Wetland Nutrient Removals:

Scientific Basis

- Significant removals occur in our coastal wetlands
- Soil burial and denitrification inform us about the *CAPACITY* of wetlands to remove nutrients
- Actual ecosystem level fluxes have been hard to quantify, especially for diversions



137 Cs cores: S&T Task II Hurricane study; Piazza et al. in press

Wetland Nutrient Removals:

Predicting Removals for Diversions

- Model output was compared to loading and removal estimates based on Hyfield (2008) budget of Caernarvon diversion
- Conservative removal efficiency

TN = 23 - 34%

TP = 21 - 58 %

Caernarvon - 1998

Caernarvon - 2006

Uncertainties

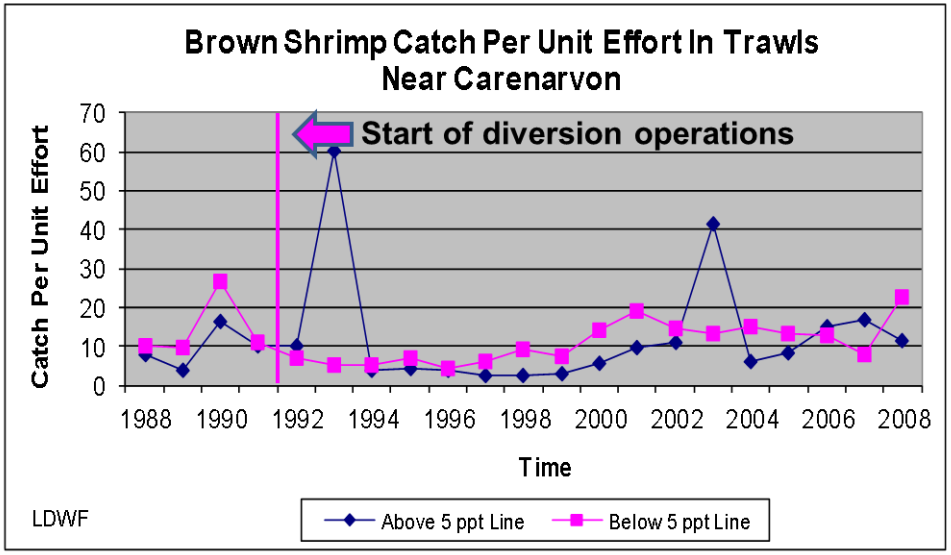
- identifying the best locations for diversions and navigation channel realignments to maximize delta benefits and minimize in-river impacts
- determining the most appropriate size and operational strategy for controlled diversions to maximize land building and land sustaining benefits
- improving our understanding of the complexity of water and sediment dynamics in the river and developing water and sediment budgets,
- balancing the water needs (flow and volume) for in-river uses with the needs of the delta
- improving our understanding of the linkage of water quality, wetland nutrient assimilation, and Gulf hypoxia, and
- balancing water flowing into the estuary to maintain the high fish and wildlife productivity characteristic of Louisiana's coastal wetlands.

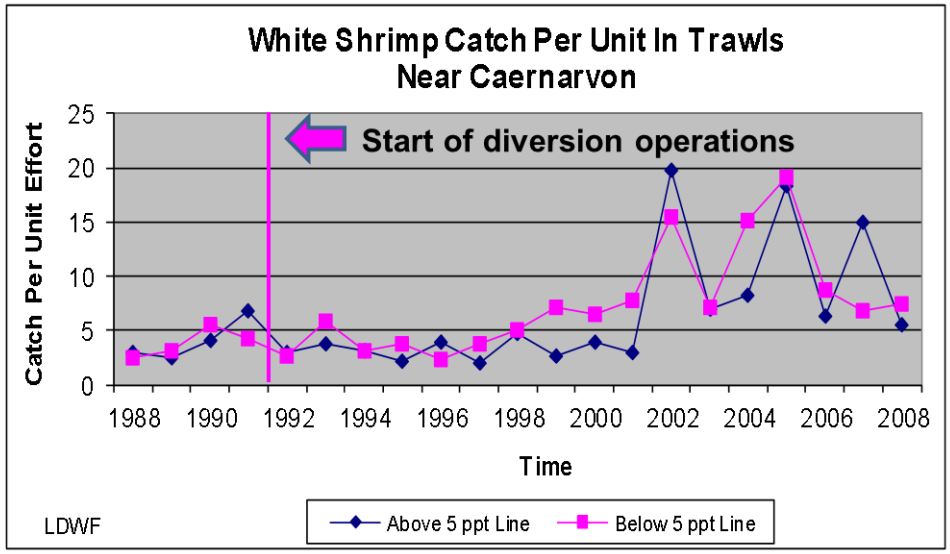
Priority Bayside Technical Topics

Fisheries and Wildlife

State of the Science:

- Local stakeholders have expressed concern that the construction and operation of diversions will impact the ability to commercially fish for economically-important species of finfish and shellfish.
- Some seaward shifts in species distribution may occur, but to date, relevant investigations do not document widespread loss of economic opportunities

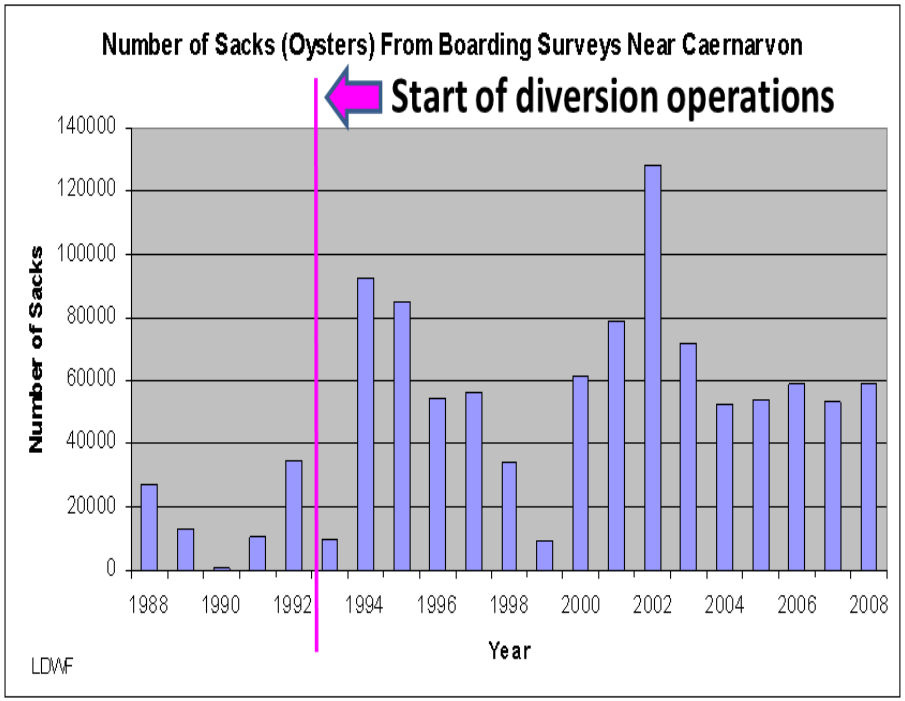


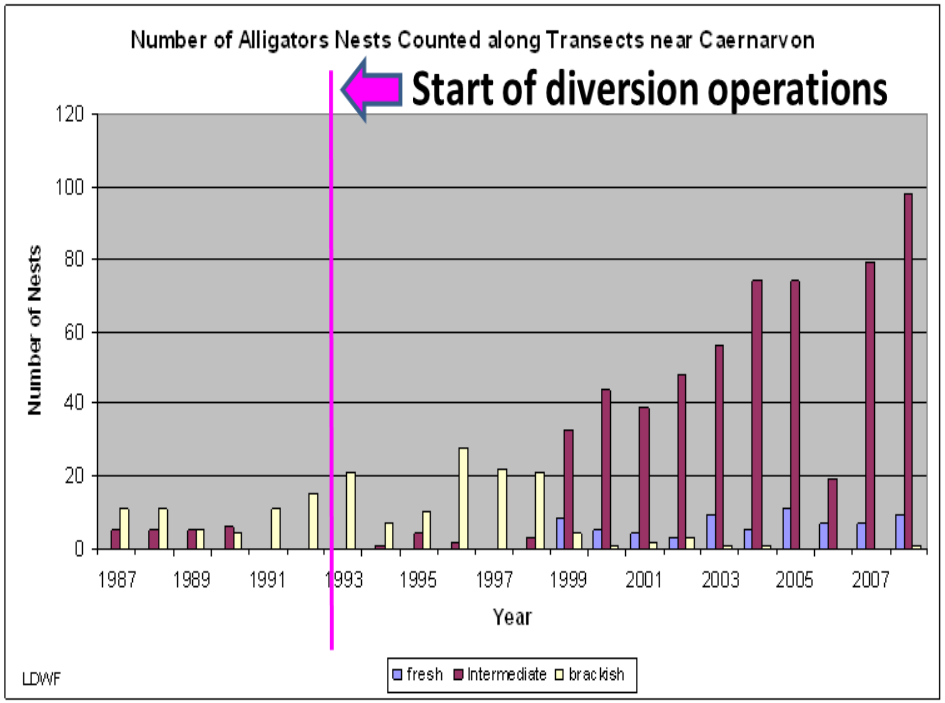


Priority Bayside Technical Topics

Fisheries and Wildlife

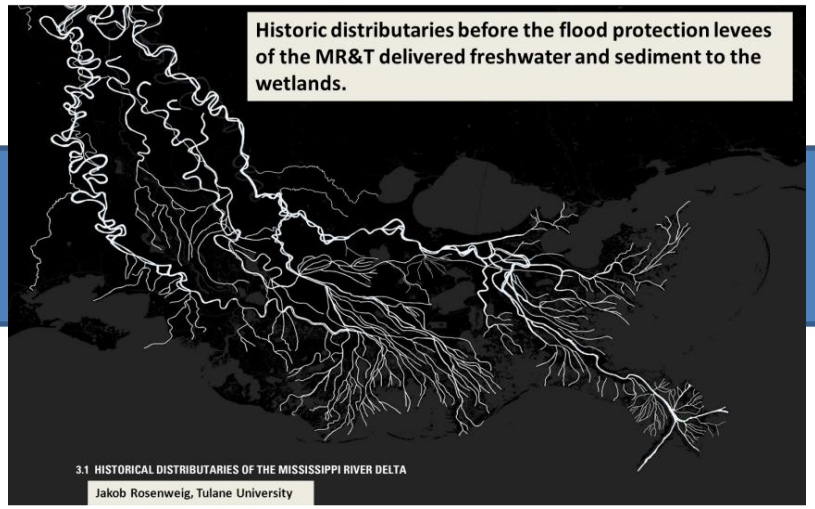
State of the Science:

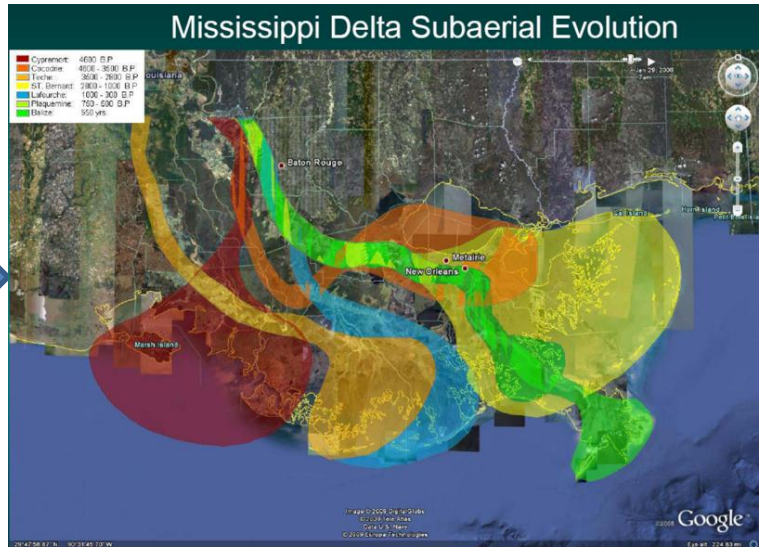




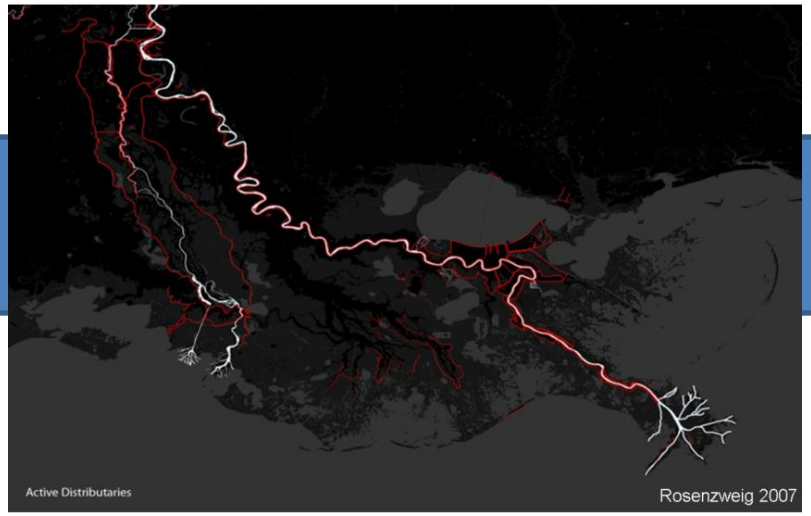
Reconsidering River Management

Historic Distributary Flow Paths

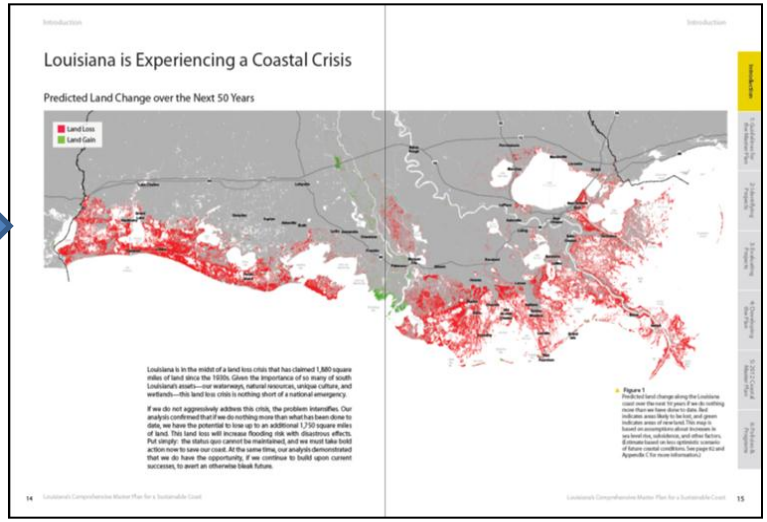




Contemporary Distributary Flow Paths



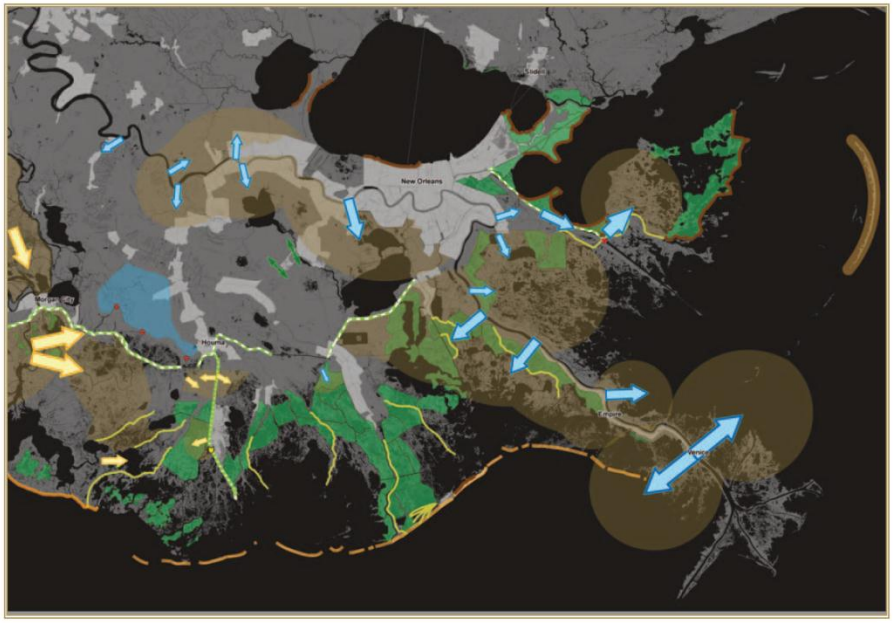
Predicted Land Loss

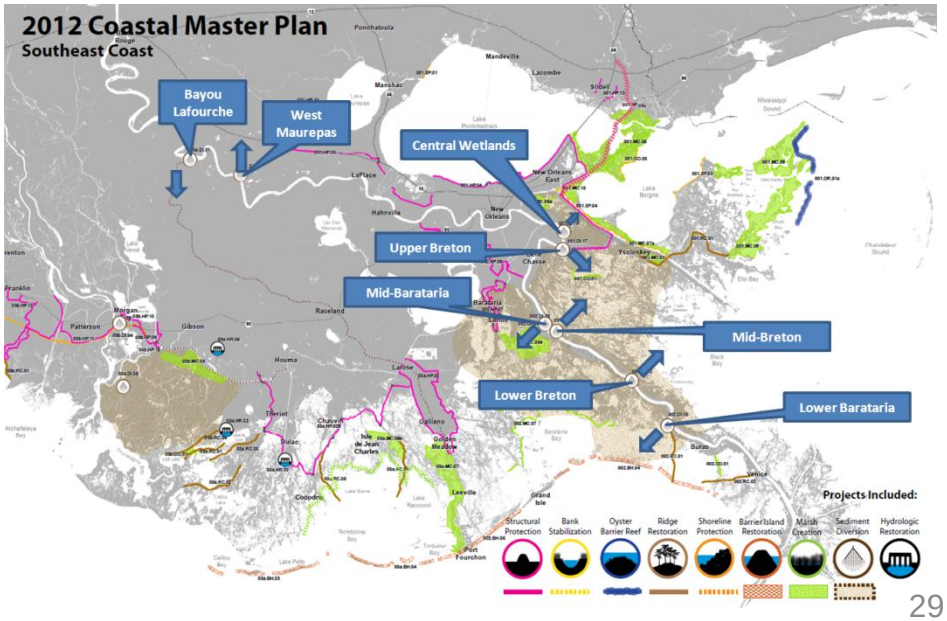


Summary

State of the Science:

- Diversions have been recognized as a critical component of most recent comprehensive coastal restoration plans
- We have learned much information during past decade that can be applied to our use of diversions
- We have become more strategic in the location and operation as a system of planned diversions
- Balancing multiple uses of the river resources is critical





CPRA
Coastal Protection and Restoration Authority of Louisiana

Thank You

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committed to **our coast**