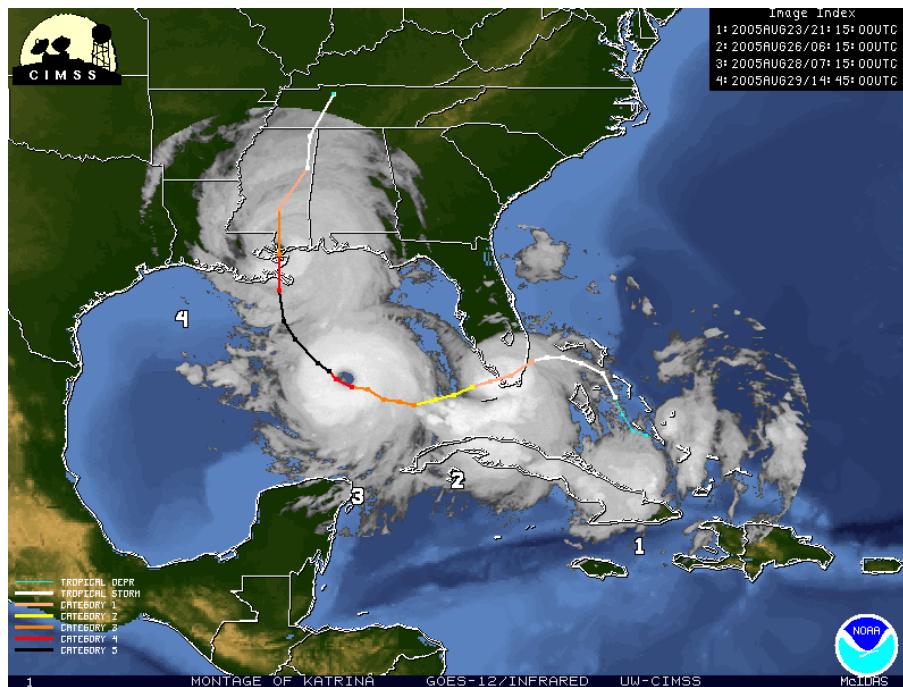


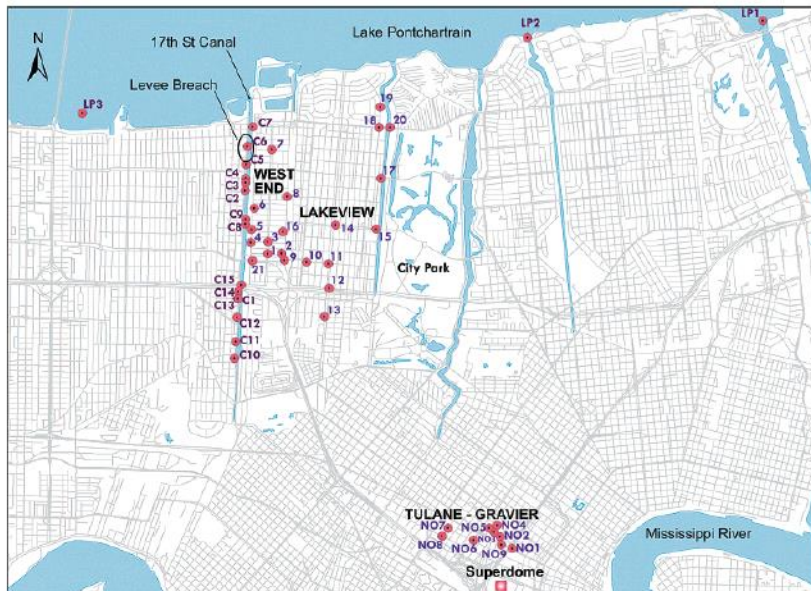
# Flood control, risk reduction and preparedness 10 years after Katrina

John H Pardue

Louisiana State University



- Conducted early environmental sampling of Katrina floodwaters/sediments
- Air sampling adjacent to debris piles
- Analysis of debris handling procedures and techniques
- Analysis and prediction of bulk chemical storage problems during flooding events



# Where are we?

- Flood control and surge attenuation
  - Structural elements (Greater New Orleans Hurricane and Storm Damage Risk Reduction System)
  - Non-structural elements (Louisiana Coastal Master Plan 2012)
- Environmental Risk
  - Debris removal, landfills and contaminated soil





US Army Corps  
of Engineers

# GREATER NEW ORLEANS HURRICANE AND STORM DAMAGE RISK REDUCTION SYSTEM (HSDRRS) June 2013



17th St. Outfall Canal  
Interim Closure Structure



Seabrook Floodgate  
Complex



New Orleans East  
I-10 Crossing



Bonabel Pump Station  
Lakefront Levee



IHNC Surge  
Barrier Wall



St. Bernard  
Floodwall



Harvey Canal Floodwall



West Closure Complex



Eastern Tie-In

Total cost: 14.6 billion





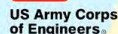
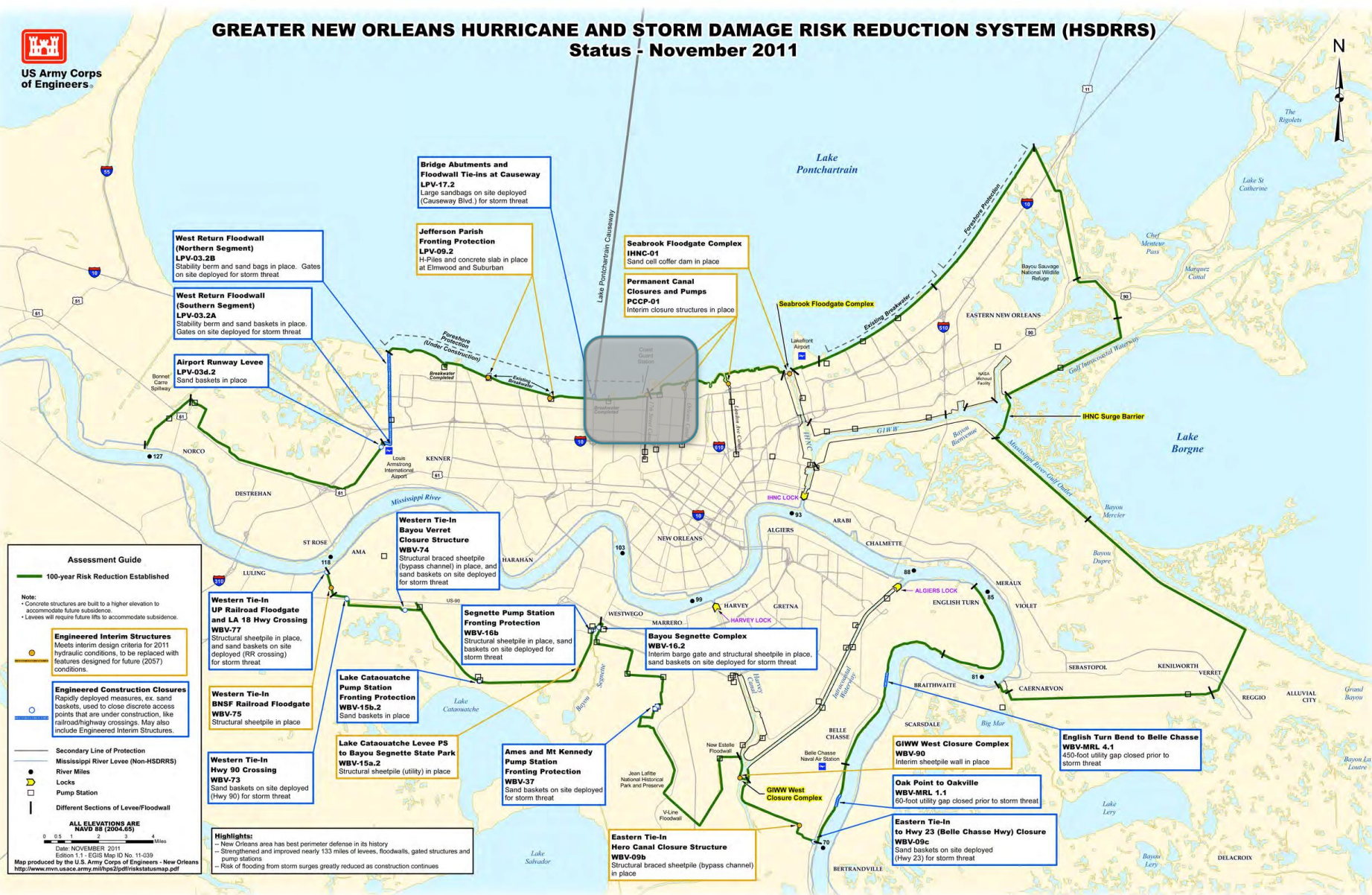


IHNC Surge Barrier



# The criteria for commencing IHNC gate closure operations are:

- Water elevations of 3 ft or greater in Lake Borgne
- A storm is predicted to make landfall in the 'area' within three days
- The general procedure is as follows:
  - Closure of the Seabrook Gate by USACE, approximately 20 min;
  - Closure of the Bayou Bienvenue Gate by USACE, approximately 20 min
  - Closure of the GIWW Sector Gate by USACE, approximately 2 hours for sector gate and 7 hours for barge gate.
  - Closure of the IHNC Navigation Lock by USACE.
- Storm occurs
  - GIWW Sector gate opened first (when maximum water elevation differential is ~3 ft) by USACE, approximately 2 hrs.
  - Bayou Bienvenue Gate is opened by USACE, approximately 2 hrs.
  - Once Lake Pontchartrain has drained, Seabrook Gate opened by USACEG, approximately 2 hrs.

**Status - November 2011****Status - November 2011**





US Army Corps  
of Engineers

# GREATER NEW ORLEANS HURRICANE AND STORM DAMAGE RISK REDUCTION SYSTEM (HSDRRS) June 2013



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Eastern Tie-In

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# 17<sup>th</sup> Street Canal Interim Closure Structure

7,600 cfs

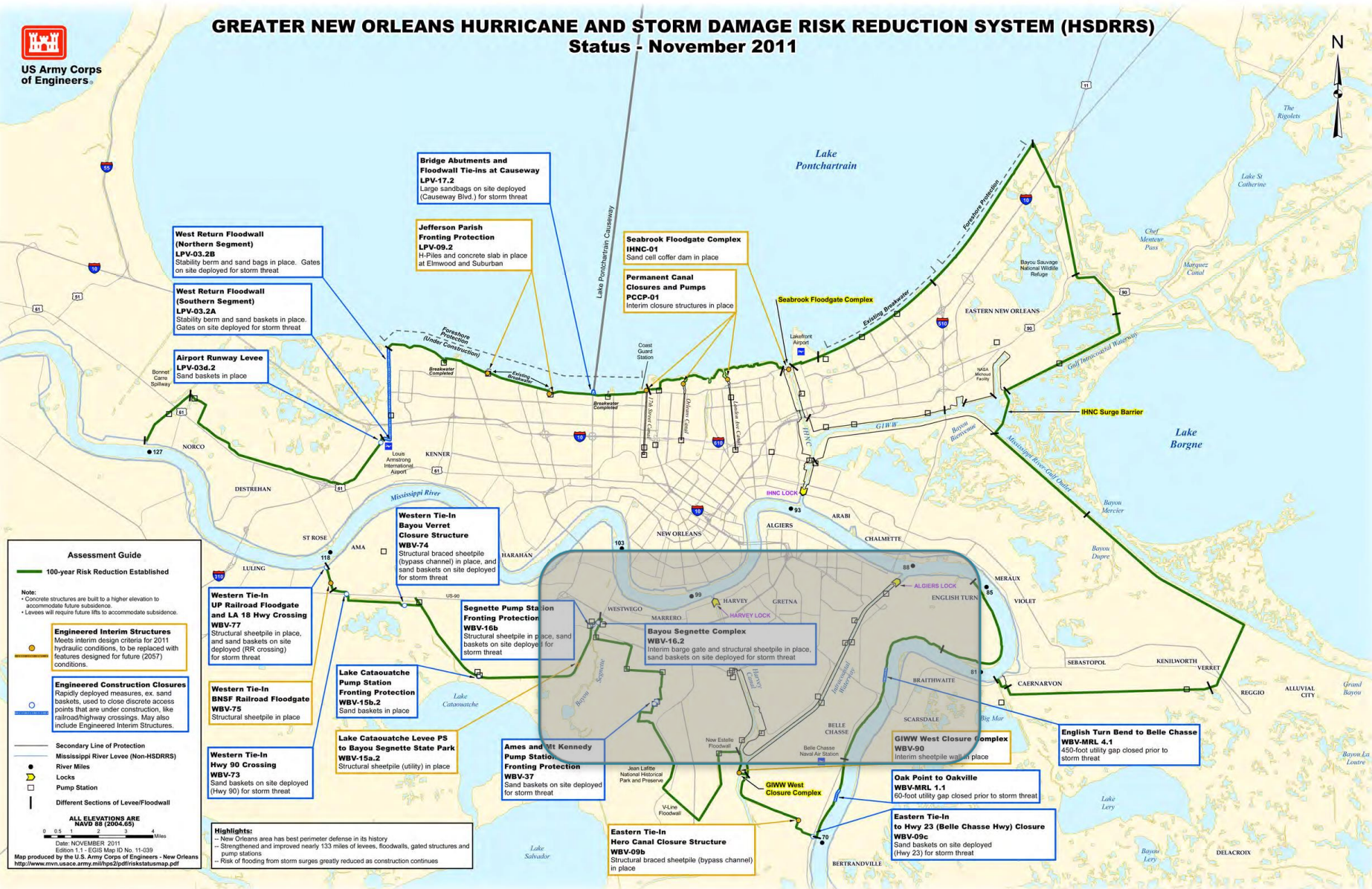






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# GREATER NEW ORLEANS HURRICANE AND STORM DAMAGE RISK REDUCTION SYSTEM (HSDRRS) Status - November 2011



## Assessment Guide

100-year Risk Reduction Established

Note:  
• Concrete structures are built to a higher elevation to accommodate future subsidence.  
• Levees will require future lifts to accommodate subsidence.

**Engineered Interim Structures**  
Meets interim design criteria for 2011 hydraulic conditions, to be replaced with features designed for future (2057) conditions.

**Engineered Construction Closures**  
Rapidly deployed measures, ex. sand baskets, used to close discrete access points that are under construction, like railroad/highway crossings. May also include Engineered Interim Structures.

Secondary Line of Protection  
Mississippi River Levee (Non-HSDRRS)  
River Miles  
Locks  
Pump Station  
Different Sections of Levee/Floodwall

ALL ELEVATIONS ARE  
NAVD 88 (2004.65)

0 0.5 1 2 Miles

Date: NOVEMBER 2011  
Edition: 1.1 - EGIS Map ID No. 11-039  
Map produced by the U.S. Army Corps of Engineers - New Orleans  
<http://www.mvn.usace.army.mil/hgs/pdf/risksystemmap.pdf>

## Highlights:

- New Orleans area has best perimeter defense in its history
- Strengthened and improved nearly 133 miles of levees, floodwalls, gated structures and pump stations
- Risk of flooding from storm surges greatly reduced as construction continues

**Bridge Abutments and Floodwall Tie-ins at Causeway LPV-17.2**  
Large sandbags on site deployed (Causeway Blvd.) for storm threat

**Jefferson Parish Fronting Protection LPV-09.2**  
H-Piles and concrete slab in place at Elmwood and Suburban

**Seabrook Floodgate Complex IHNC-01**  
Sand cell coffer dam in place

**Permanent Canal Closures and Pumps PCCP-01**  
Interim closure structures in place

**West Return Floodwall (Northern Segment) LPV-03.2B**  
Stability berm and sand bags in place. Gates on site deployed for storm threat

**West Return Floodwall (Southern Segment) LPV-03.2A**  
Stability berm and sand baskets in place. Gates on site deployed for storm threat

**Airport Runway Levee LPV-03d.2**  
Sand baskets in place

**Western Tie-In Bayou Verret Closure Structure WBV-74**  
Structural braced sheetpile (bypass channel) in place, and sand baskets on site deployed for storm threat

**Segnette Pump Station Fronting Protection WBV-15b**  
Structural sheetpile in place, sand baskets on site deployed (RR crossing) for storm threat

**Bayou Segnette Complex WBV-15.2**  
Interim barge gate and structural sheetpile in place, sand baskets on site deployed for storm threat

**Lake Cataouatche Pump Station Fronting Protection WBV-15b.2**  
Sand baskets in place

**Western Tie-In BNSF Railroad Floodgate WBV-75**  
Structural sheetpile in place

**Western Tie-In Hwy 90 Crossing WBV-73**  
Sand baskets on site deployed (Hwy 90) for storm threat

**Lake Cataouatche Levee PS to Bayou Segnette State Park WBV-15a.2**  
Structural sheetpile (utility) in place

**Ames and Mt Kennedy Pump Station Fronting Protection WBV-37**  
Sand baskets on site deployed for storm threat

**Eastern Tie-In Hero Canal Closure Structure WBV-09b**  
Structural braced sheetpile (bypass channel) in place

**GIWW West Closure Complex WBV-90**  
Interim sheetpile wall in place

**Oak Point to Oakville WBV-MRL 1.1**  
60-foot utility gap closed prior to storm threat

**Eastern Tie-In to Hwy 23 (Belle Chasse Hwy) Closure WBV-09c**  
Sand baskets on site deployed (Hwy 23) for storm threat

**English Turn Bend to Belle Chasse WBV-MRL 4.1**  
450-foot utility gap closed prior to storm threat







# How do you build a system in 5 years?

- NEPA (allowed USACE to break up comprehensive Environmental Impact Statements (EISs) into smaller units of assessment)
- Contracts (Design-build; early contractor involvement)
- Non-traditional techniques (deep soil mixing, wick drains)

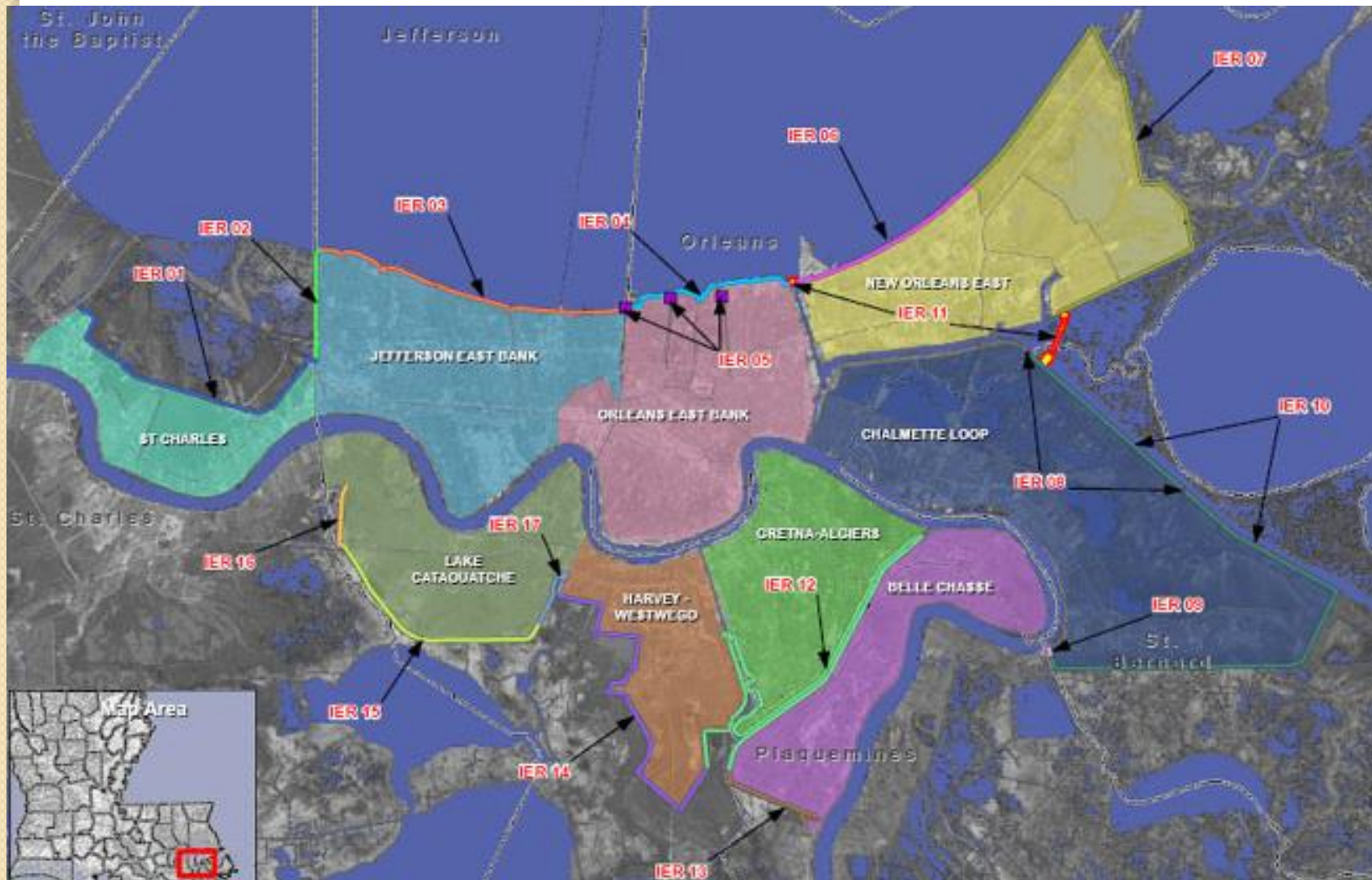
# NEPA

- National Environmental Policy Act
  - Establishes environmental review processes that apply to governmental actions
  - Seek reasonable alternatives to actions that harm the environment
  - An Environmental Impact Statement is prepared, public comment and review, followed by review by the Environmental Protection Agency
  - Very long process



# NEPA (alternative arrangement)

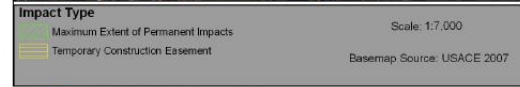
- In an emergency, an alternative arrangement is possible for compliance with NEPA
  - Implemented in consultation with the Council on Environmental Quality, state and federal resource agencies
  - Breaks impact studies up into smaller pieces directed at each individual action
  - Still substantial alternatives discussed and mitigation efforts, still a significant public comment period



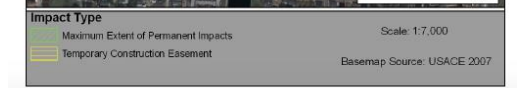




**2. 17<sup>th</sup> Street Canal Proposed Action, Layout Alternative A**



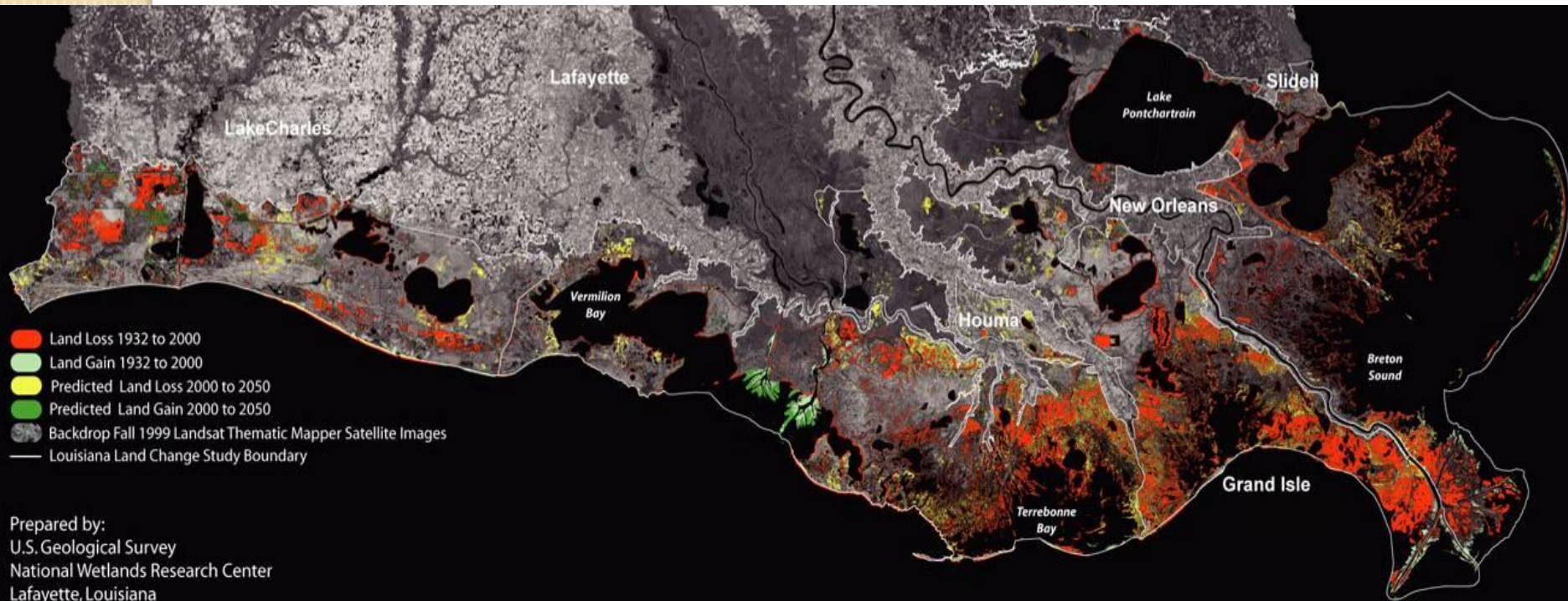
**Figure 5. 17<sup>th</sup> Street Canal Layout Alternative B**



**Figure 6. 17<sup>th</sup> Street Canal Layout Alternative C**

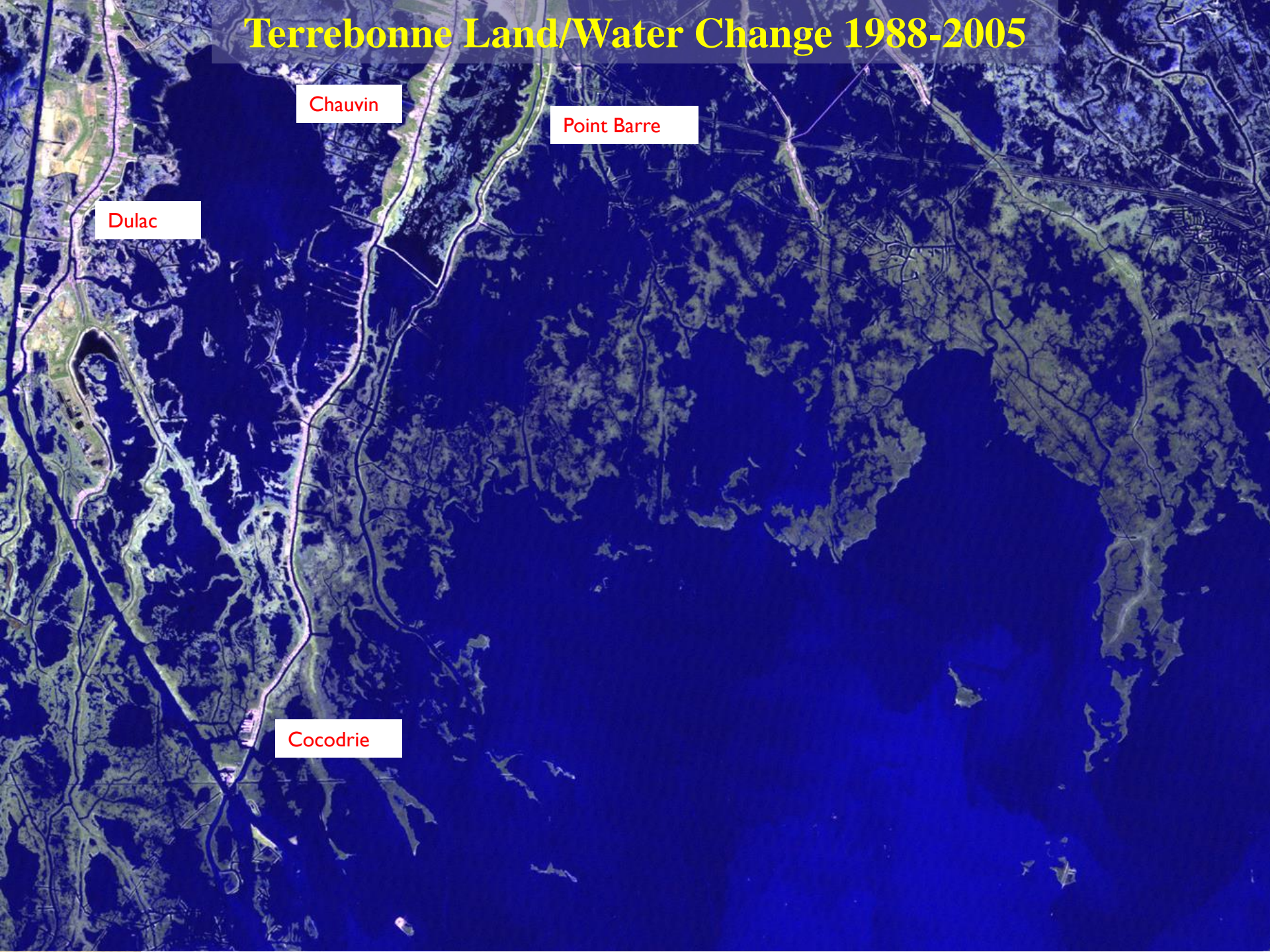


# Coastal Land Loss





# Terrebonne Land/Water Change 1988-2005



Chauvin

Point Barre

Dulac

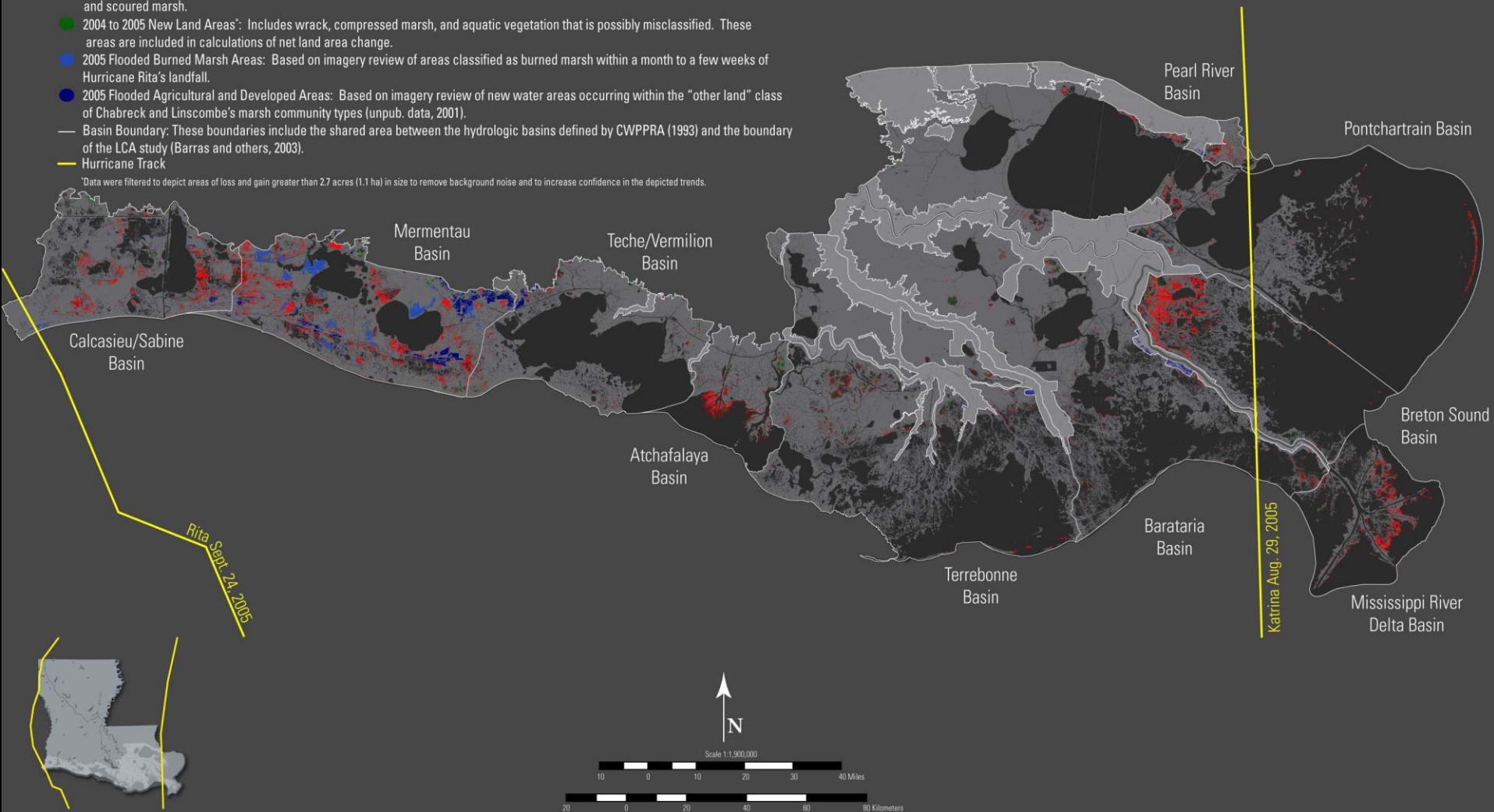
Cocodrie



# Land Area Change in Coastal Louisiana After the 2005 Hurricanes: Overview

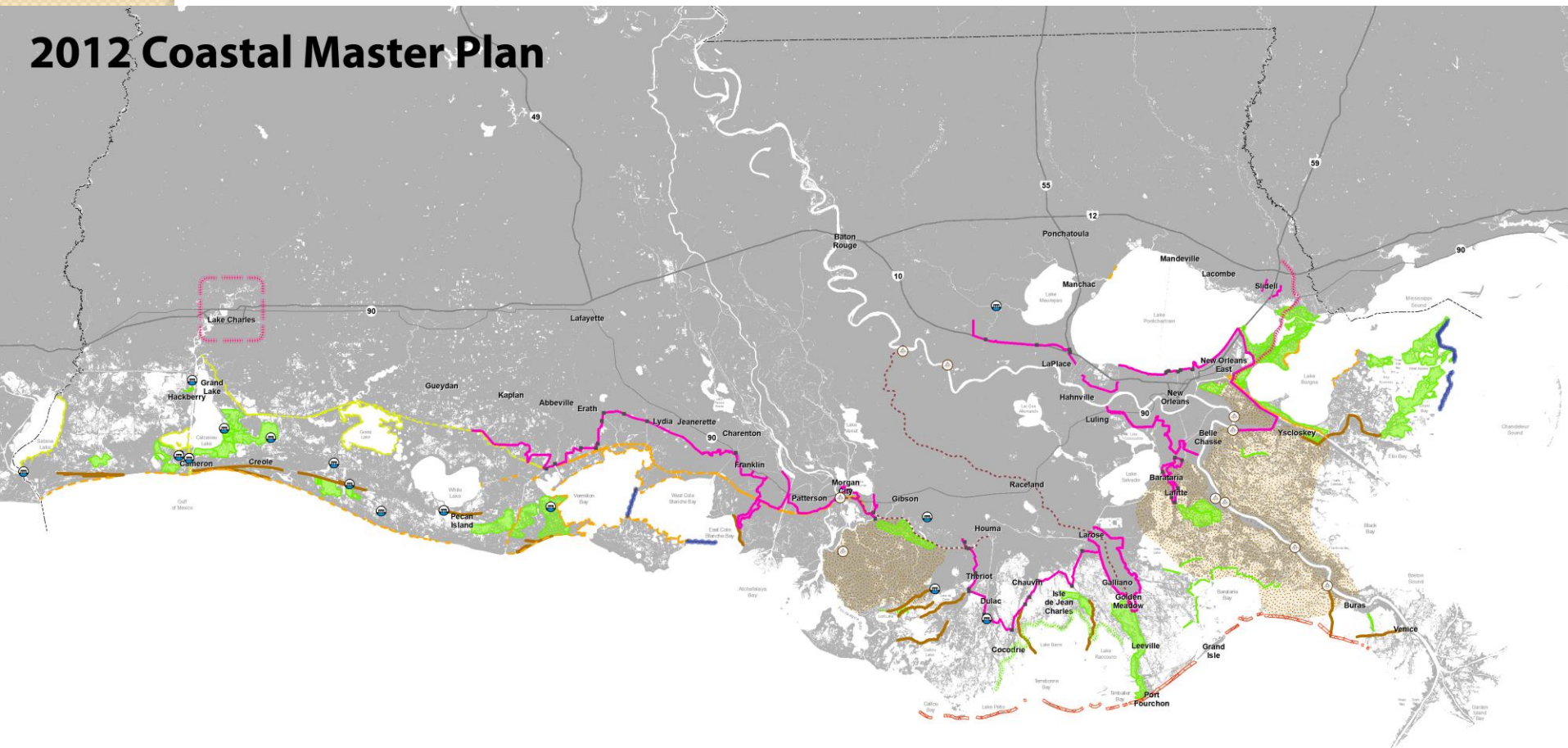
- 2005 Land
- 2005 Water
- Fastlands: Agricultural, developed, and upland areas surrounded by levees that are generally considered non-wetlands (LOSR, 2002) and that are excluded from calculations of net land area change.
- 2004 to 2005 New Water Areas (Decreased Land Areas): Includes flooded marsh, sheared marsh, eroded marsh, and scoured marsh.
- 2004 to 2005 New Land Areas: Includes wrack, compressed marsh, and aquatic vegetation that is possibly misclassified. These areas are included in calculations of net land area change.
- 2005 Flooded Burned Marsh Areas: Based on imagery review of areas classified as burned marsh within a month to a few weeks of Hurricane Rita's landfall.
- 2005 Flooded Agricultural and Developed Areas: Based on imagery review of new water areas occurring within the "other land" class of Chabreck and Linscombe's marsh community types (unpub. data, 2001).
- Basin Boundary: These boundaries include the shared area between the hydrologic basins defined by CWPPRA (1993) and the boundary of the LCA study (Barras and others, 2003).
- Hurricane Track

\*Data were filtered to depict areas of loss and gain greater than 2.7 acres (1.1 ha) in size to remove background noise and to increase confidence in the depicted trends.





# 2012 Coastal Master Plan



## Projects Included:

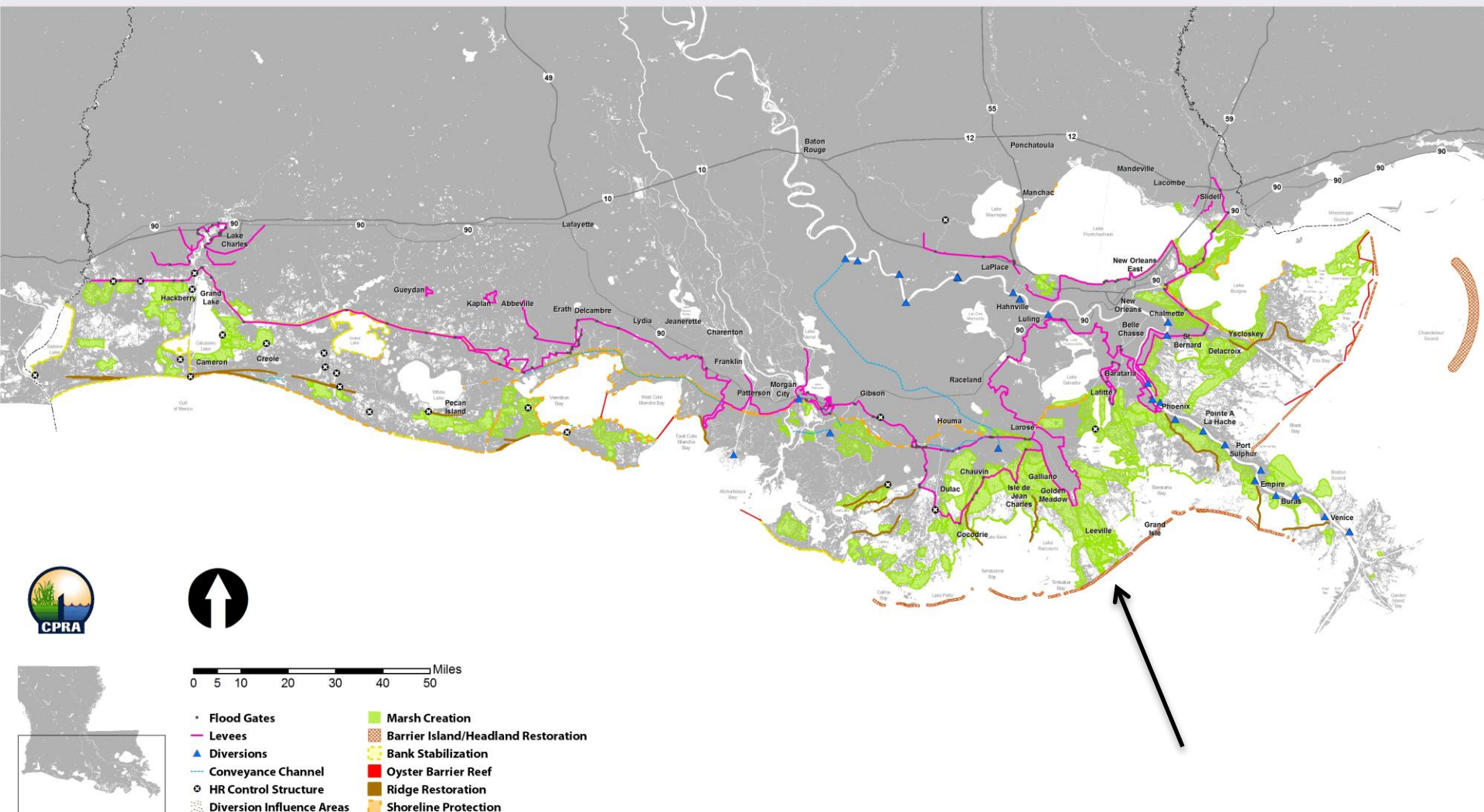


## Projects for Further Planning:



# Louisiana's 2012 Coastal Master Plan

## Projects Under Evaluation for Inclusion in Louisiana's 2012 Coastal Master Plan



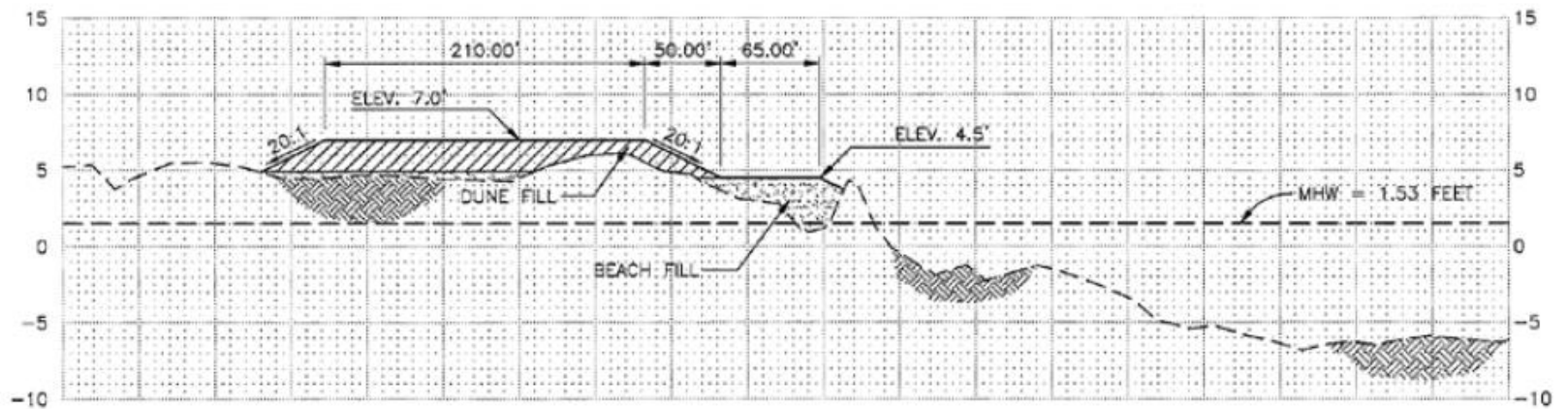
50 million dollar—estimated costs of all projects



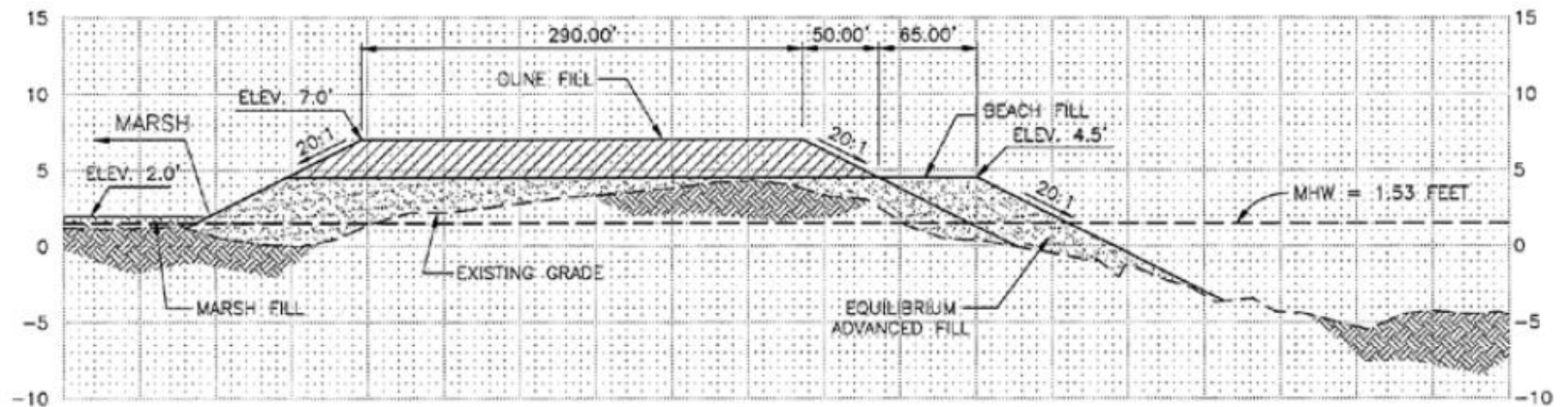


Caminada Headland Beach  
(Fourchon Beach and Elmer's Island)





ALTERNATIVE 5, 6, AND 7  
AT TRANSECT A

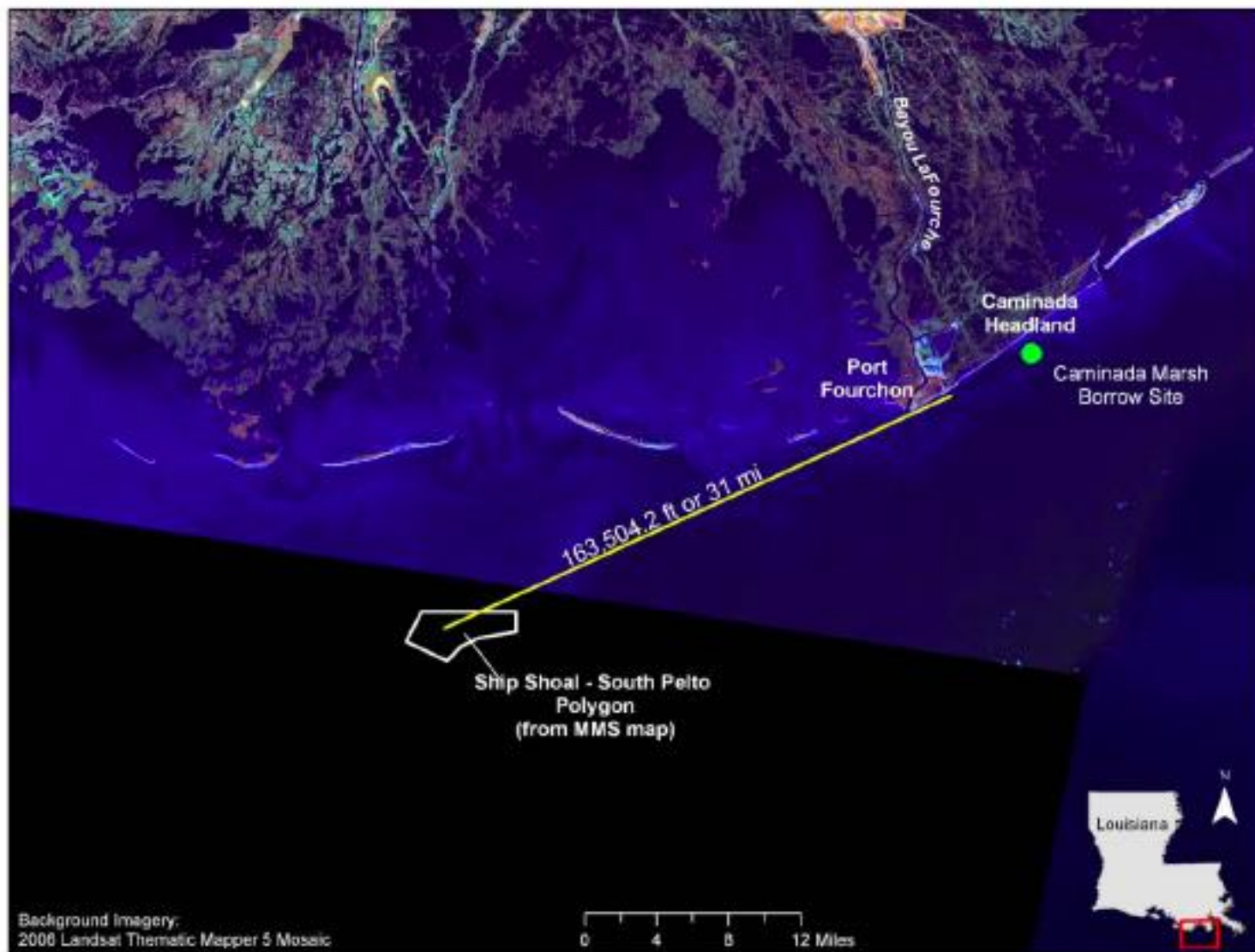


SCALES: HORIZONTAL: 1"=100'  
VERTICAL: 1"=10'  
ELEVATIONS ARE NAVD88 FEET

ALTERNATIVE 5, 6, AND 7  
AT TRANSECT D

5.1 million cubic yards for the beach/dune  
5,36 million cubic yards for the marsh







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A SDAV owned small busi  
985.788.3458













# Data and knowledge gaps

- How do structural and non-structural flood control/surge attenuation work together as a system to minimize damage?
- How do non-structural elements of the system mitigate surge?
- How resilient are the non-structural elements after storm impacts?



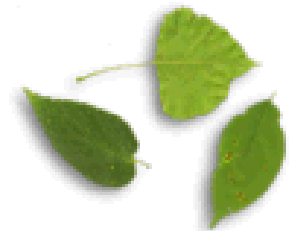
# Depth-dependent roughness



- Cypress-tupelo and bottomland hardwood forest dominated by vegetation that is on the scale of relevant surges, marshes by vegetation much shorter than relevant storm surges



© C C Lockwood





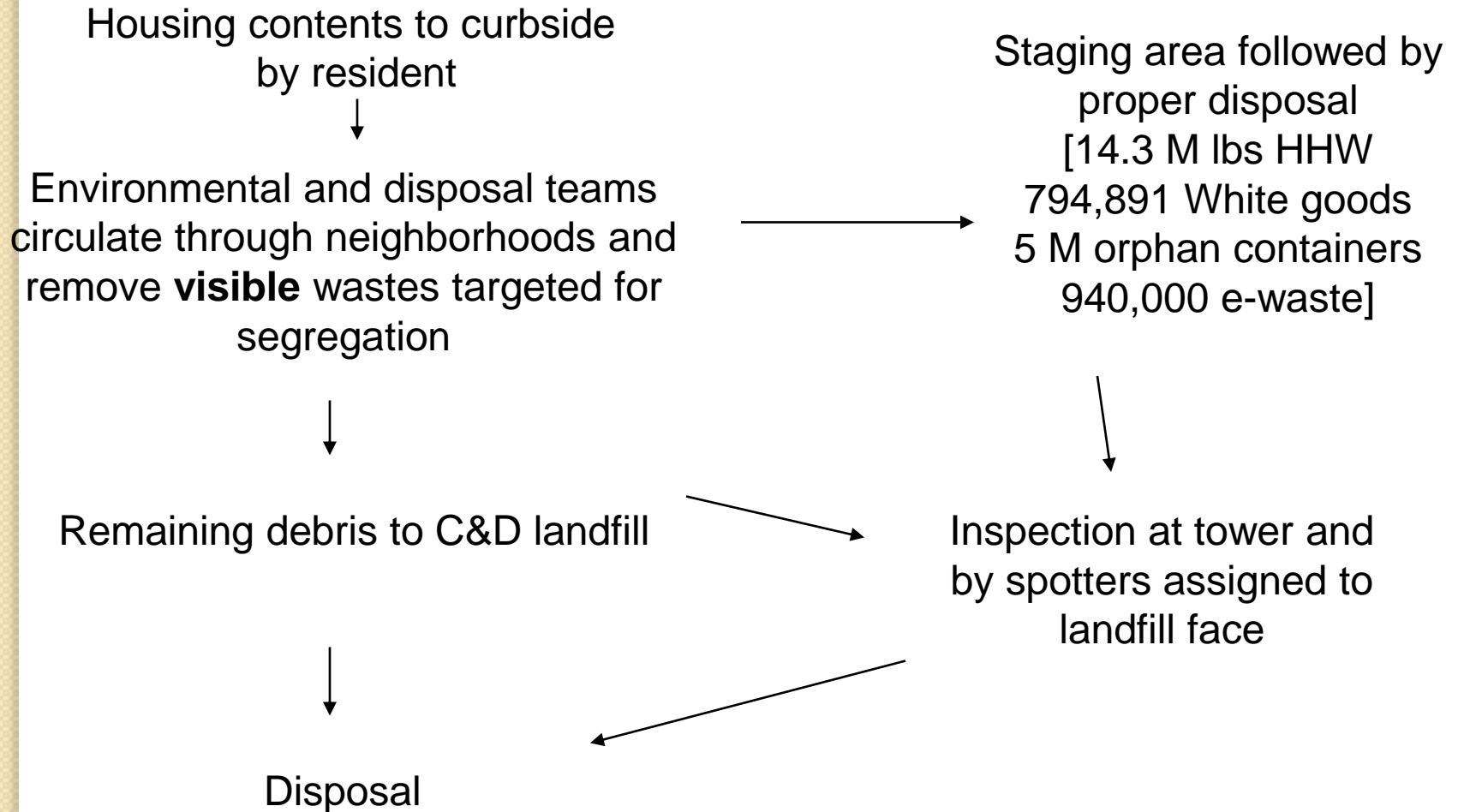


Chris Granger, The Times-Picayune archive

> 100 million cubic yards of debris



# Debris Handling System



# Analysis and critique of Katrina debris-handling system

- No diversion of arsenic-treated lumber
  - Potential impacts: arsenic contamination of groundwater
  - LWRRI White Paper “Anticipating environmental problems in landfills in New Orleans East ”
  - Quantities of Arsenic-Treated Wood in Demolition Debris Generated by Hurricane Katrina; B. Dubey, H. M. Solo-Gabriele, and Timothy G. Townsend; *Environ. Sci. Technol.*; 2007; 41(5) pp 1533 – 1536
- No diversion of wallboard
  - Potential impacts: generation of H<sub>2</sub>S in landfill
  - SWANA analysis of Katrina debris plan (2005)
  - LWRRI White Paper



# Analysis and critique of Katrina debris handling system

- Inefficient household hazardous waste diversion
  - Potential impacts: contamination of groundwater by HHW
  - LWRRI White Paper “Anticipating environmental problems in landfills in New Orleans East ”
  - LSU pile sampling and air sampling
- Utilization of C&D landfills for disposal
  - Potential impacts: groundwater contamination
  - NISTAC (FEMA) Draft Report, 2006
  - Criticized by a very wide range of constituencies

# Old Gentilly Monitoring Well Data



Maximum metal concentrations:

As: 1.4 mg/L

Zn: 6,850 mg/L

Ni: 0.97 mg/L



# “Old Gentilly Landfill Not the Disaster Once Feared” 2012

- Limited sampling for limited set of analytes
- No air sampling for  $\text{H}_2\text{S}$  (of primary concern due to deposition of very large volumes of gypsum wallboard)
- Nearly zero information to inform future events (Joplin tornado using very similar debris handling methodology)

# Soil contamination issues continue

- Lead, PAH contamination remain extremely common
- Katrina dropped blood lead levels in children (Mielke, ES&T) presumably due to a fresh layer of soil covering
- Very large soil removal action underway at B.F. Cooper housing development



# Questions??

