Greater New Orleans Hurricane and Storm Damage Risk Reduction System

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US Army Corps of Engineers
BUILDING STRONG®
New Orleans Topography

City of New Orleans Ground Elevations

From Canal St. at Mississippi River to the Lakefront at U.N.O.

LONDON AVENUE CANAL FLOODWALL
HURRICANE LEVEE / FLOODWALL (14.0 FEET)

FLOODWALL ALONG MISSISSIPPI RIVER
MR&T PROJECT DESIGN FLOWLINE (18 FEET)
Hurricane Katrina
Aug 29, 2005

- One of America’s largest natural disasters
- Cat 5 less than 12 hrs before landfall
- 127 MPH wind at Louisiana landfall
- Maximum surge of 28 to 30 feet along Mississippi coast
- 80 percent of the city of New Orleans flooded

Hurricane Rita
Sep 24, 2005

- Cat 4 less than 12 hrs before landfall
- 175 MPH max sustained winds in Gulf of Mexico
- 120 MPH max sustained winds at landfall
- Cat 3 strength at landfall
New Orleans
Depth of Flooding

8 to 15 feet
10 to 13 feet
12 to 15 feet
9 to 11 feet

Breach Locations

Max Flood Depth
High: 15 Ft.
Low: 0 Ft.
Katrina Floodwall Breaches

Inner Harbor Navigational Canal

London Ave. Canal

Inner Harbor Navigational Canal

17th St. Canal
Effects of Hurricane Katrina

Levee Erosion

Transition Erosion
4th Emergency Supplemental (June 2006)

...authorized to raise, as appropriate, levee heights and otherwise enhance the existing Lake Pontchartrain and Vicinity project and the existing West Bank and Vicinity project to provide the levels of protection necessary to achieve certification required for participation in the National Flood Insurance Program...
HSDRRS: Our Mission and Commitment

- Repair the damages, making what was there before whole again.

- By 1 June 2011, strengthen and improve the system and provide 100-year level of risk reduction capable of withstanding the effects of a storm having a 1% chance of occurring each year.

- Current funding level $14.48 B (fully funded).
Deliver the Greater New Orleans HSDRRS Mission

Challenges
- Mandate to deliver $14.6B construction program within budget and on schedule
- Form design criteria, program cost estimate, acquire funding
- Intense scrutiny / oversight
- New governances
- **NEPA compliance**
- Deliver a comprehensive system

Enablers
- Administration / Congressional commitment
- **Fully funded program**
- National / Regional Corps capabilities
- Local partners and stakeholders capabilities
- **NEPA Alternate Arrangements**
- Full suite of acquisition strategies
- Favorable bidding climate
## HSDRRS Funding Breakdown

**TOTAL APPROPRIATED FUNDS: $14.48 B**

<table>
<thead>
<tr>
<th>COMPONENT</th>
<th>$ (M)</th>
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<tbody>
<tr>
<td>SELA (Interior Drainage)</td>
<td>1,253</td>
</tr>
<tr>
<td>WBV 100-year Level of Protection</td>
<td>1,610</td>
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<tr>
<td>LPV 100-year Level of Protection</td>
<td>1,997</td>
</tr>
<tr>
<td>Repair Existing System</td>
<td>1,475</td>
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<tr>
<td>Restore to Design Height</td>
<td>1,132</td>
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<tr>
<td>Complete Authorized System</td>
<td>1,619</td>
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<td>Permanent Pump Stations</td>
<td>804</td>
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<tr>
<td>IHNC</td>
<td>1,743</td>
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<td>Selective Armoring</td>
<td>89</td>
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<tr>
<td>Storm-proof Existing Pump Stations</td>
<td>340</td>
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<tr>
<td>Incorporate non-Fed Levees in Plaquemines Parish</td>
<td>671</td>
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<tr>
<td>Reinforce or Replace Floodwalls</td>
<td>1,626</td>
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<tr>
<td>Other</td>
<td>130</td>
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</tbody>
</table>

as of 6 May 11
NEPA Alternative Arrangements

- Alternative Arrangements Approved by CEQ – to facilitate expedited construction of the 100-year level HSDRRS to abate extreme risk to life and property

- NEPA Environmental Review – achieved through concurrent development of multiple Individual Environmental Reports (IERs) for segments of the system in lieu of comprehensive Environmental Impact Statement (EIS)

- Consolidated Environmental Document – compilation of IERs into a single document assessing cumulative environmental impacts of HSDRRS
NEPA Compliance Schedule Impact

Estimated NEPA Compliance and Construction Times

100-yr Completion Operational Goal

~3-5 years saved in completion of 100-yr System

Total spent on achieving NEPA compliance: ~$20 million.

38 Individual Environmental Reports (IER), 22 Supplemental IERs.

Hosted 200+ public meetings.

IER A
IER B
IER C
IER D
IER E
LPV Polder A Construction
LPV Polder B Construction
LPV Polder C Construction
LPV Polder D Construction
LPV Polder E Construction

Traditional NEPA

Procedures

1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4
5 Parishes
350 Miles of Levee/Floodwall
200 Miles of 100-yr Perimeter
78 Pumping Stations (Fed & Non-Fed)
Proximity of Environmental Resources

GREATER NEW ORLEANS HURRICANE AND STORM DAMAGE RISK REDUCTION SYSTEM (HSDRRS)
Environmental Resources Proximity: 1 April 2014

LABRANCHE WETLANDS

BAYOU SALVAGE NATIONAL WILDLIFE REFUGE

CENTRAL WETLANDS

JEAN LAFITTE NATIONAL HISTORICAL PARK AND PRESERVE

BAYOU AUX CARPES 404(c) AREA
Environmental Impacts
Objective: Avoid, Minimize, Mitigate

Initial estimates (5,000+ acres)
Current Impacts (2,295 acres)
- LPV – 1,179 acres
- WBV – 1,116 acres

Current Plan
- 3 Mitigation Banks
- 10 Corps constructed projects

Bottomland Hardwoods Wet

Swamp

Marsh

Bottomland Hardwoods Dry
Bayou aux Carpes Wetland

- One of only 13 sites in the US protected as an important National asset under provisions of SEC 404(c) of the Clean Water Act

- 404(c) - Authorizes EPA to prohibit discharge of dredged or fill materials at so designated sites

- Bayou aux Carpes is a 3,000 acre site characterized by unique wetlands including rare flotant marsh

- May 2009 – EPA approved the modification of the 1985 Bayou aux Carpes 404(c) designation to allow construction of the West Closure Complex
West Closure Complex Alternatives

Alternative 1: Floodgate on GIWW
- Floodgate and permanent bypass channel in the GIWW below the confluence of the Algiers and Harvey Canals to the 100-yr level of protection
- Lapalco Floodgate and Cousins PS Discharge Channel Walls at previously authorized level of protection
- Proposed Floodgate and pump station at 100-yr level of protection
- GIWW permanent bypass channel
- Levees and Floodwalls to the previously authorized level of protection or greater
- Levees and Floodwalls to the 100-yr level of protection
- Pump Stations
- Bayou Aux Carpes 404 (c) Site

Alternative 2: Floodgate on GIWW
- Floodgate and permanent bypass channel in the GIWW below the confluence of the Algiers and Harvey Canals to the 100-yr level of protection
- Lapalco Floodgate and Cousins PS Discharge Channel Walls at previously authorized level of protection
- Proposed Floodgate and pump station at 100-yr level of protection
- GIWW permanent bypass channel
- Levees and Floodwalls to the previously authorized level of protection or greater
- Levees and Floodwalls to the 100-yr level of protection
- Pump Stations
- Bayou Aux Carpes 404 (c) Site

Alternative 3: Floodgate on Algiers Canal
- Sector floodgate in the Algiers Canal to the 100-yr level of protection
- Lapalco Floodgate and Cousins PS Discharge Channel Walls (raised to provide 100-yr level of protection)
- Proposed Floodgate and pump station at 100-yr level of protection
- Levees and Floodwalls to the previously authorized level of protection or greater
- Levees and Floodwalls to the 100-yr level of protection
- Pump Stations
- Bayou Aux Carpes 404 (c) Site

Alternative 4: Parallel Protection
- Lapalco Floodgate and Cousins PS Discharge Channel Walls (raised to provide 100-yr level of protection)
- Levees and Floodwalls to the 100-yr level of protection
- Pump Stations
- Bayou Aux Carpes 404 (c) Site
West Closure Complex

- Bayou aux Carpes 404(c) area
- Largest drainage pump station in the world – 19,140 cfs
- Largest sector gates in US – 225 ft clear width
- Removed 26 miles of levees and floodwalls from the first line of defense
- ~$1 B Delivery cost
- Early Contractor Involvement (ECI)
West Closure Complex

Pump Station

5400 hp diesel engines drive 11 flowerpot pumps
New Orleans East Deep Soil Mixing

- Largest ever deep soil mixing application in US
- 1.7 million cubic yards of land treated
- 500,000 tons of cement used
- 5.3 mile stretch
- ECI
New Orleans East Levee

- 2 ft. thick sand blanket with 9 in. layer of gravel on top
- 1,000,000 total cubic yards of sand

Bayou Sauvage National Wildlife Refuge

Over 1 Superdome of Clay (4.9 mil cy) Required
Wick Drains

- Largest ever wick drain application in USA
- 250,000 wicks
- ECI
IHNC Lake Borgne Surge Barrier

- 36 in dia steel pipe battered piles (240 ft long)
- 66 in dia spun cast concrete soldier piles (140 ft long)
- Precast and cast in place deck and parapet wall

$1.3 B Delivery cost
Design-Build Cost Reimbursable

- 1.8 mile span
- 150 ft sector gate and barge gate
- 54 ft vertical lift gate
St. Bernard T-walls vs. Levees

Option 1: Earthen Levee
Est. ROW = 1,350 ft.

Option 2: Earthen Levee and T-Wall Floodwall / Cap within existing ROW

- 23-mile perimeter provides storm surge risk reduction for St. Bernard Parish
- Pre-Katrina elevation ~20 feet
- Post-Katrina 100-year design elevations ~30 feet
St. Bernard Floodwall

- 3 contracts
- ~$1 B
- 23 miles (2 mi completed per month at peak of construction)
- ECI
St. Bernard Floodwall Construction – Southern Reach
A Stronger System Than Ever Before

- Developed new HSDRRS hydraulic, geotechnical and structural design criteria.
- Floodwalls and hardened structures built for 2057 hydraulic conditions
- Pre-Katrina system: 200 miles
- Post-Katrina 100-yr system: 130 miles
  - 35% shorter perimeter exposed to surge

**Total System Openings: 493**
- Navigable Openings: 11
- Roadway Openings: 144
- Railroad Openings: 45
- Access Openings: 134
- Drainage Openings: 159
New Orleans East

Surge Barrier Tie-In
St. Bernard Floodwall, near the IHNC Tie-In

Top of Floodwall: EL +32’

Katrina Storm Surge: EL +25’

500-yr Still Water Elevation*: EL +22’

100-yr Still Water Elevation*: EL +18’

Still water elevation does not include waves.

DESIGNED FOR A 100-YR STORM SURGE EVENT
Seabrook Gate Complex

- 95 ft sector gate
- Two 50 ft vertical lift flow control gates
- ~$200 M Delivery cost
- Early Contractor Involvement (ECI)
Bayou Segnette Pump Station

Completed Safe House

- 5 new safe houses built
- 5 existing safe houses improved / hardened
HSDRRS Remaining Work

**SELA Interior Drainage**
- ~$1.38 B
- ~$460 M unobligated

**Permanent Pump Stations**
- ~$850 M
- ~$160 M unobligated

**Mississippi River / HSDRRS Co-located Levees**
- ~$300 M
- ~$40 M unobligated

**Armoring**
- $414 M
- ~$340 M unobligated

**Environmental Mitigation**
- $280 M
- ~$240 M unobligated

**New Orleans to Venice / Non-Federal Levees**
- ~$1.1 B
- ~$760 M unobligated
In 2007, you had a 1% chance every year of flooding this deep from Hurricanes.

**Notes:**
- The depth map tool is a relative indicator of progress, over time, demonstrating risk reduction as a function of construction progress.
- The water surface elevations are mean values.
- The scale sensitivity of the legend is +/- 2 feet.
- The info does not depict interior drainage modeling results.
- The storm surge is characterized as the result of a probabilistic analysis of 5 to 6 storm parameters of a suite of 152 storms and not a particular event.

Assumes 50% Pumping Capacity.
With the 100-year level of protection, you have a 1% chance every year of flooding this deep from Hurricanes.

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Assumes 50% Pumping Capacity
With the 100-year level of protection, you have a 0.2% chance every year of flooding this deep from Hurricanes

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Assumes 50% Pumping Capacity
Discussion / Questions