5-22-2015

Reducing Coastal Risk – Structural Protection around Greater New Orleans

Rick Luettich
University of North Carolina

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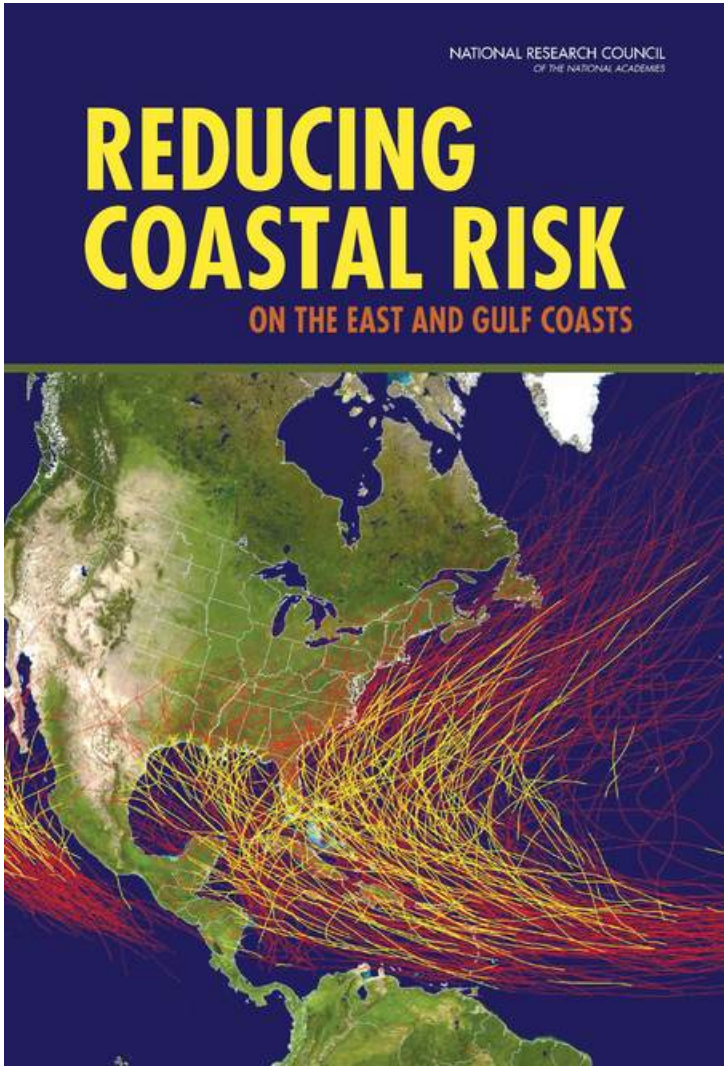
University of North Carolina at Chapel Hill

Hampton Roads Sea Level Rise/Flooding Adaptation Forum
Megaprojects – Protective Structures for Hampton Roads

5/22/2015



Reducing Coastal Risk

Committee on U.S. Army Corps of Engineers Water Resources Science, Engineering, and Planning: Coastal Risk Reduction

National Research Council

Rick Luettich, Committee Chair

Probabilistic Coastal Flood Hazards Mapping Workshop
5/15/2015

Committee Membership

- RICHARD LUETTICH, JR., Chair, University of North Carolina
- GREGORY BAECHER, University of Maryland
- SUSAN BELL, University of South Florida
- PHILLIP BERKE, Texas A&M University
- ROSS COROTIS, University of Colorado
- DANIEL COX, Oregon State University
- ROBERT DALRYMPLE, The Johns Hopkins University
- TONY MACDONALD, Monmouth University
- KARL NORDSTROM, Rutgers University
- STEPHEN POLASKY, University of Minnesota
- SEAN POWERS, University of South Alabama
- DON RESIO, University of North Florida
- AP VAN DONGEREN, Deltares, The Netherlands

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Statement of Task

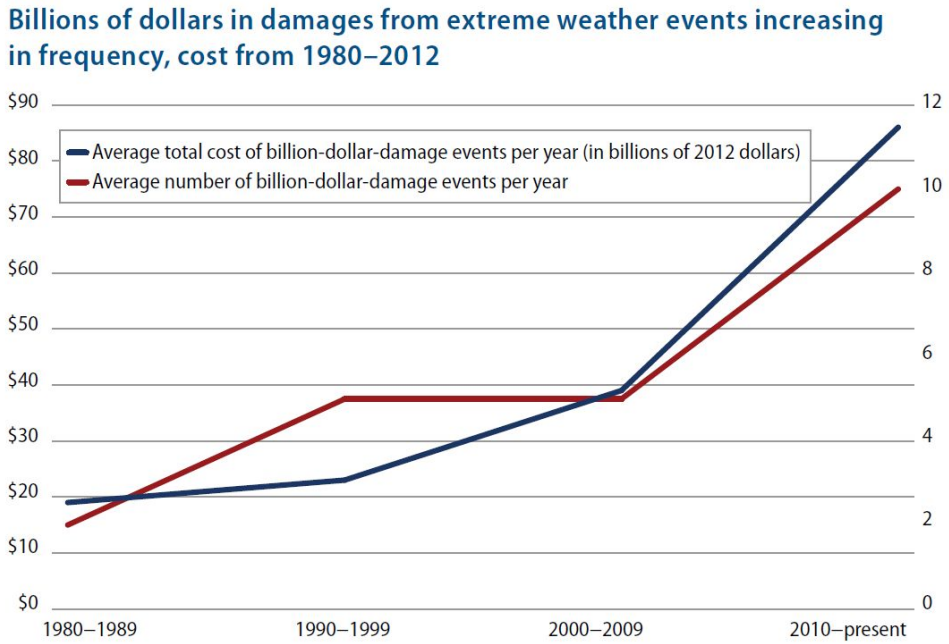
Focus on reducing flood risk from storms along the East and Gulf Coasts:

- To what extent have **coastal risk-reduction** strategies proven **effective** (life safety, economic return)?
- What are the **regional and national implications** of expanded coastal risk reduction?
- How might **risk-related principles** contribute to project design standards and increase community preparedness?
- What **general principles** might be used to guide future U.S. **investments** in coastal risk reduction?

Sponsored by USACE, as the 3rd phase of a 5-year study to provide advice on a range of scientific, engineering, and water resources planning issues

Concern – Coastal Risk is Increasing

- Population in southeastern and southern US coastal areas increasing 2x national average
- Warming climate / sea level rise are increasing hazards
- Tropical storms and floods ~ 50% of all natural disaster losses
- Federal Gov't payout for recovery increased from ~6% in 1950s to ~75% for Sandy



Landscape for Coastal Risk Management

- **No central leadership or unified vision:** Responsibilities spread over multiple levels of government
  - FEMA, USACE, HUD, NOAA, USGS; state, local governments
  - Each driven by different objectives, authorities
  - No coordinating body with singular focus on coastal risk
  - No national priorities (even though the federal government is now paying ~75% of recovery costs)

Image source: NOAA

- **Vast majority of funding for coastal risk-related issues is provided only after a disaster occurs**
  - Mostly for response & recovery
  - Small fraction for mitigation

Landscape for Coastal Risk Management

- **Few comprehensive regional evaluations of coastal risk have been performed**
  - Risk reduction efforts tend to be local, not regional (even though storm response and critical resources, e.g. sand, are often regional)
  - USACE is not authorized to address coastal risk at a national scale.
- **Lack of alignment of risk, reward, resources, and responsibility**
  - Resulted in significant **inefficiencies** and **inappropriate incentives** that ***increase*** the nation's exposure to risk

Image source: NOAA

Risk Reduction Strategies

Image sources: N. Aquino, FEMA, committee

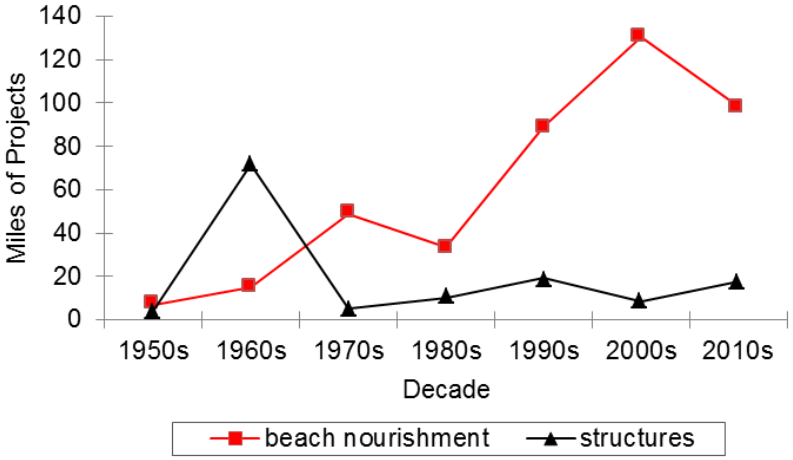
RISK = HAZARD X CONSEQUENCE

- **Reduce the hazard (flooding, wave attack)**
  - Hard structures (seawalls, surge barriers)
  - Nature-based strategies
    - Beach nourishment and dune building
    - Saltmarsh, seagrass, reefs
- **Reduce the consequences**
  - Building elevation and flood proofing
  - Non-structural (e.g., Land-use planning, preparedness, buyouts)

Optimal approaches will be site-specific, may involve multiple strategies

Strategies to Reduce the Hazard: Beach Nourishment and Dune Building

- Short term environmental impacts significant; long-term impacts unknown



Data source: USACE

Image source: NOAA

- Can be designed to reduce short-term impacts and increase ecological value

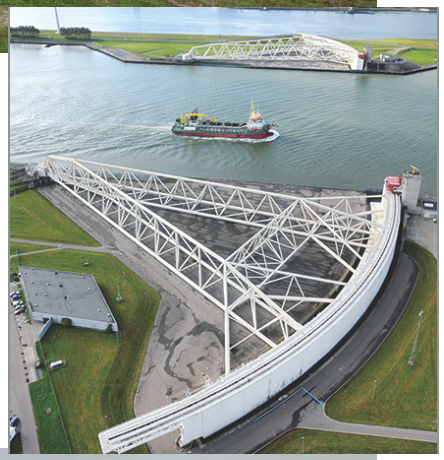
Strategies to Reduce the Hazard: Other Nature-Based "Green" Approaches

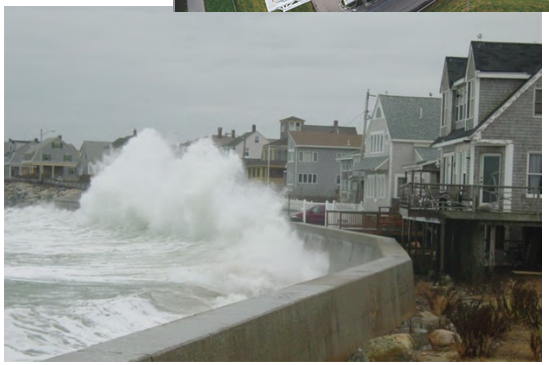
Saltmarsh, seagrass, mangroves, coral or oyster reefs, etc.

- **Provides substantial ecological benefits and varying levels of coastal risk reduction**
  - Low to moderate energy events – can be effective for waves & erosion
  - Moderate to high energy events – more effective for damping waves than surge
  - May require large expanses of habitat
  - Continued research needed to develop design guidance, alone & combined with hard structures
- May motivate conservation and restoration activities

Image sources: NOAA

Strategies to Reduce the Hazard: Hard Structure "Grey" Approaches





- **Hard structures are likely to become increasingly important in densely populated urban areas -** space is limited for nature-based strategies
- Adverse environmental impacts exist, designs can lessen these impacts

Look for ways to couple grey and green approaches

Image sources: Wikipedia, USGCRP, NOAA

Strategies to Reduce the Consequences

- Includes hazard zoning, building elevation, land purchase, and setbacks
- **High documented benefit-cost ratios (5:1 to 8:1)**
- Given less attention by the federal government
- Other than building elevation, these are viewed as difficult to implement by states

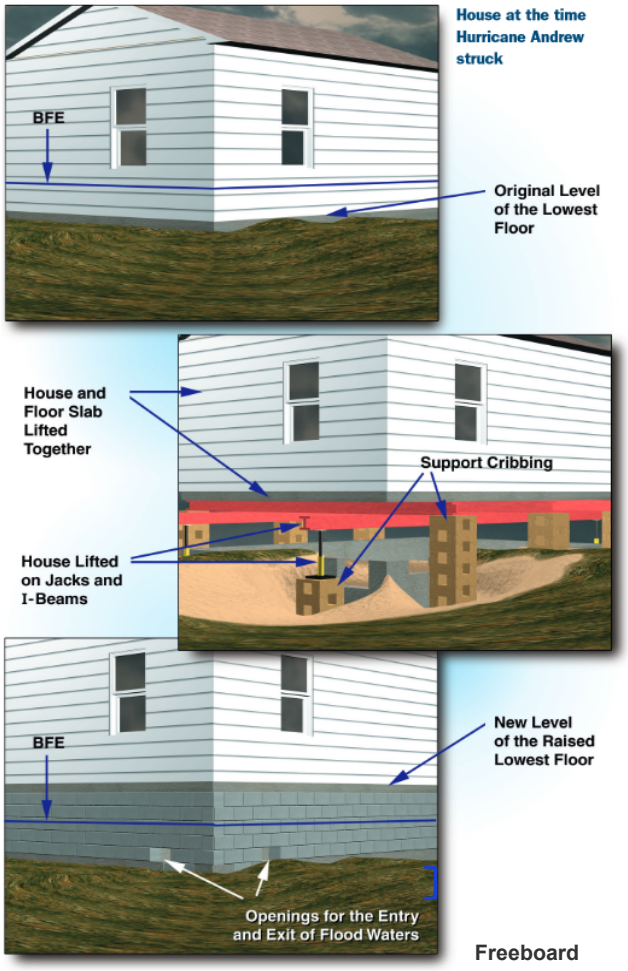


Image source: FEMA

Guiding Investments in Risk Reduction

Two basic approaches for evaluating investments:

1) Risk-standard
2) Benefit-cost

- There is **no basis to justify a default** 1-percent annual chance **(100-year) design level** for coastal risk.
- **Benefit-cost analysis constrained by acceptable risk and social and environmental dimensions** provides a reasonable framework
  - Constraints could include mass casualties or individual risk
  - Costs/benefits that are difficult to measure can also be constraints

Guiding Investments in Risk Reduction

- Capacity to consider different costs and benefits has been limited in USACE decision frameworks
  - National Economic Development (NED) given priority
  - Social / environmental benefits rarely influence decisions
  - Life-safety only recently a consideration for dams & levees.
- ***Principles and Requirements for Federal Investments in Water Resources* (CEQ, 2013)**
  - Provides framework for consideration of broad-based costs and benefits

Guiding Investments in Risk Reduction

- ~~CEQ should expedite efforts to complete accompanying *Guidelines* required to implement the *P&R*.~~
- CEQ released *Guidelines* in 12/2014, enabling implementation of *P&R* which contain explicit instructions to consider
  - Healthy and resilient ecosystems
  - Sustainable economic development
  - Public Safety
  - Environmental Justice
  - Flood Plains
  - Watershed Approach

Vision Toward Coastal Risk Reduction

- **A National Vision for coastal risk management is needed.**
  - Use federal resources to reduce coastal risk vs enabling it to increase
  - Clarify roles and responsibilities of federal, state and local governments for reducing coastal risk
- The federal government should work with states to develop a **national coastal risk assessment**
  - Use this to assess economic, life-safety, social, and environmental costs and benefits under various risk management scenarios

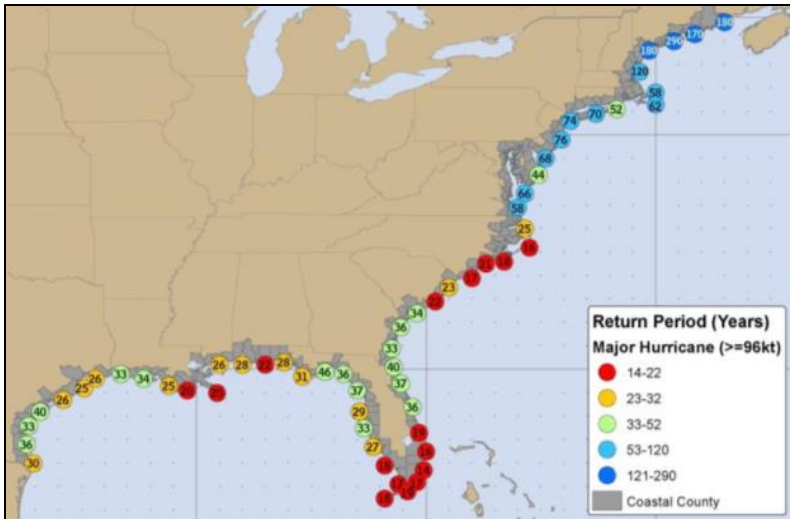


Image source: NOAA

Vision Toward Coastal Risk Reduction

- **Stronger incentives are needed** to improve pre-disaster risk mitigation efforts at the local level
  - Better align risk, rewards, responsibilities

Image source: Wikipedia

- The USACE should **seize opportunities within existing and new authorities** to strengthen coastal risk reduction
  - Evaluate incentives (e.g., cost-share) for sound planning
  - Develop modeling tools, expanded methodologies
  - Re-evaluate 50-yr planning horizon

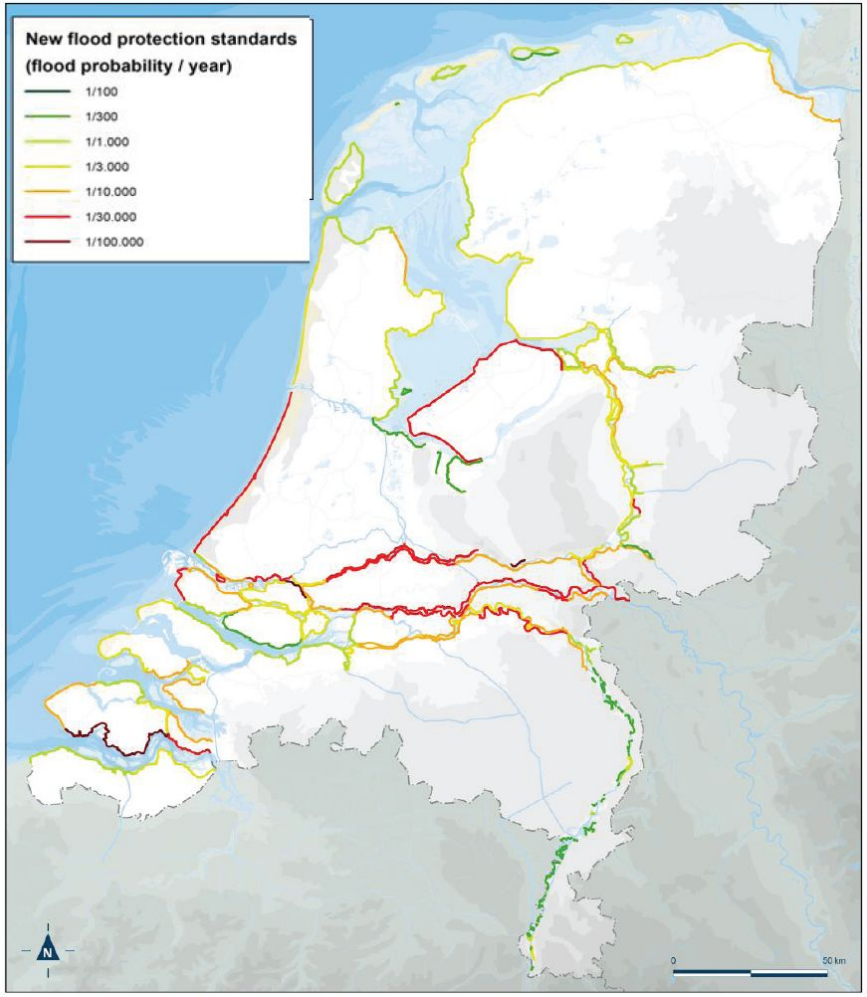
Summary

- ***Coastal risk is increasing***
- Current framework for addressing coastal risk is ***reactive rather than proactive*** and ***encourages risky development***
- ***Full array of risk reduction strategies*** should be considered
- ***Benefit-cost analysis*** (constrained by ***acceptable risk***, social/ environmental considerations) is an appropriate decision framework for investments. *PR&G* provide a framework for this
- A ***national vision*** for coastal risk management is needed
- Federal government, states should develop a ***national coastal risk assessment***
- ***Stronger incentives*** needed to better align risks, rewards, and responsibilities

Epilogue - New Standards for Flood Protection in the Netherlands

- Announced September 2014
- Revision to flood protection standards dating to 1950s, under development since 2006.
- **Risk-based**, flood protection standards to control the probability of flooding from a **national perspective**
  - **Benefit-Cost analysis** - controls 2/3 of country
  - **Local Individual Risk** – individual probability of death by flooding < 10^{-5}
  - **Catastrophic loss of life or economic loss -** resilience
  - **Protect vital and vulnerable infrastructure** – resilience
- Prioritizes protection system upgrades (completed by 2050)
- Results in varying level of protection nationally

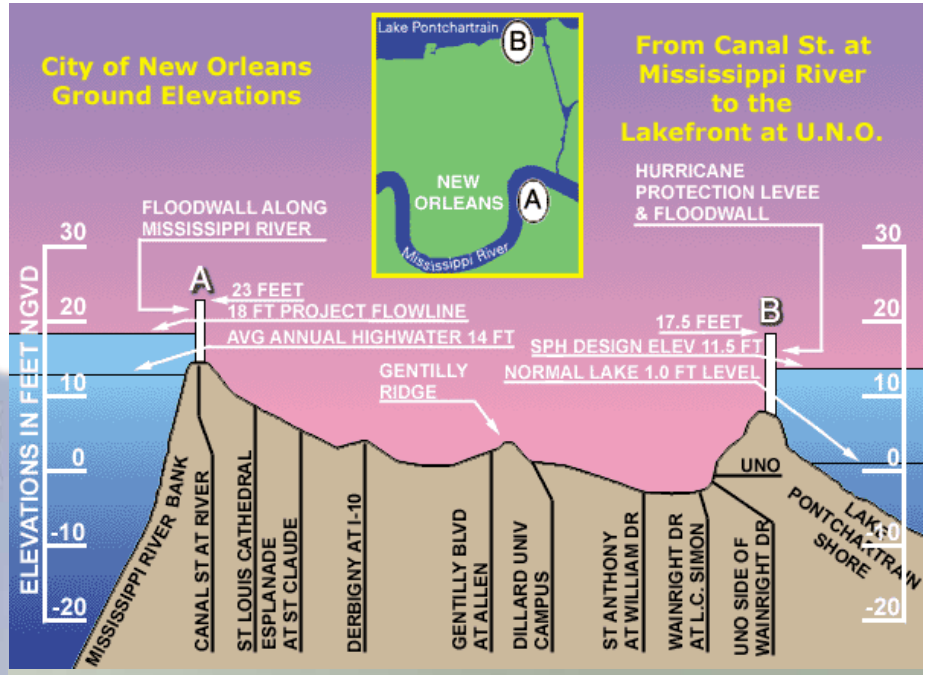
Epilogue - New Standards for Flood Protection in the Netherlands



Epilogue - New US Policy

- "*Guidelines*" to accompany *Principles and Requirements for Federal Investments in Water Resources* released 12/2014
- EO 13690 – *Establishing a Federal Flood Risk Management Standard (FFRMS)* …….1/30/2015
  - Updates Executive Order 11988 – Floodplain Management
  i. the **elevation and flood hazard area** that result from using a **climate informed science approach** that uses the best-available, actionable hydrologic and hydraulic data and methods that **integrate current and future changes in flooding based on climate science**;
  ii. BFE + 2' non-critical, BFE + 3' critical
  iii. area subject to flooding by the 0.2 percent annual chance flood
- North Atlantic Comprehensive Study – step toward National Risk Assessment

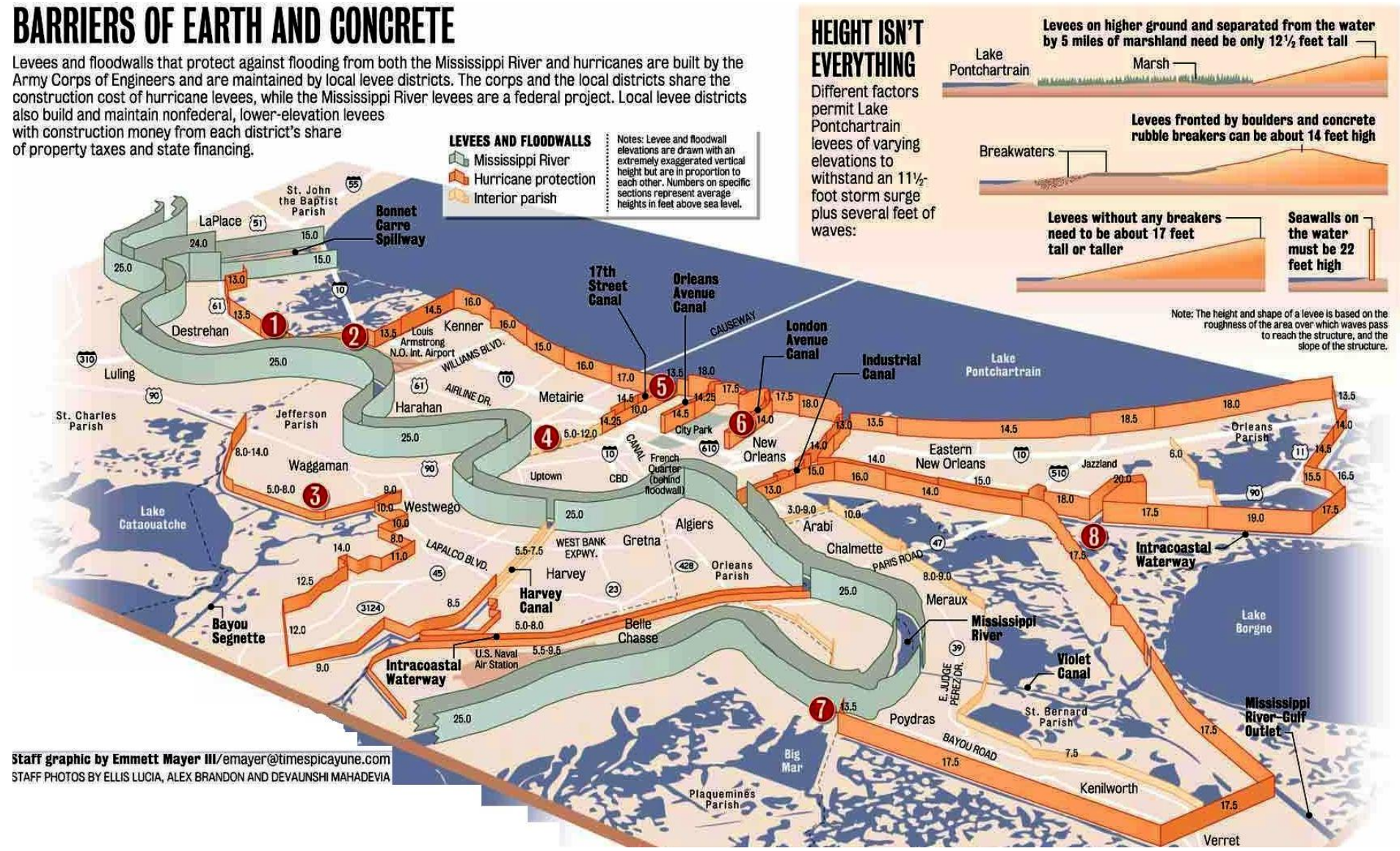
The New Orleans Situation

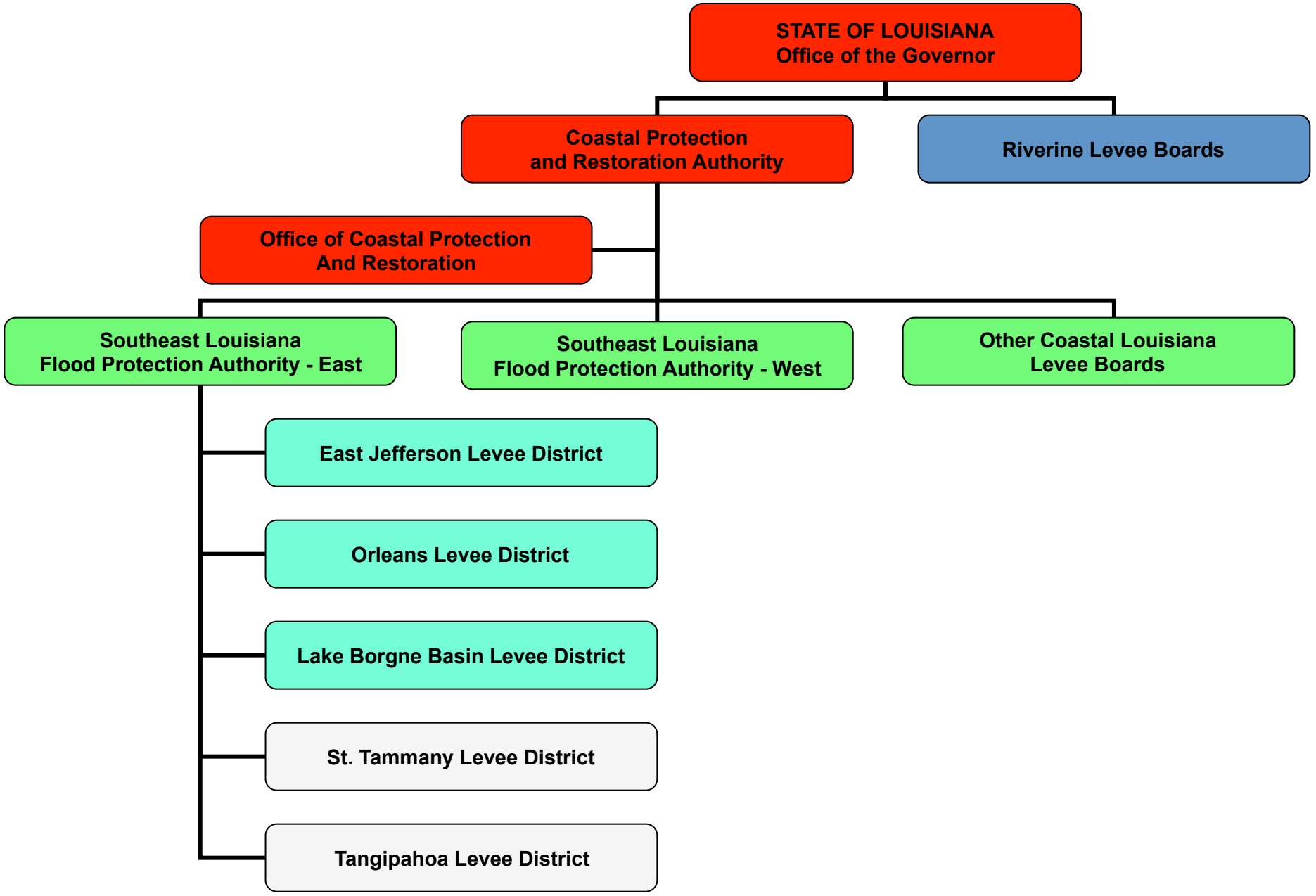


N.O. largely below sea level

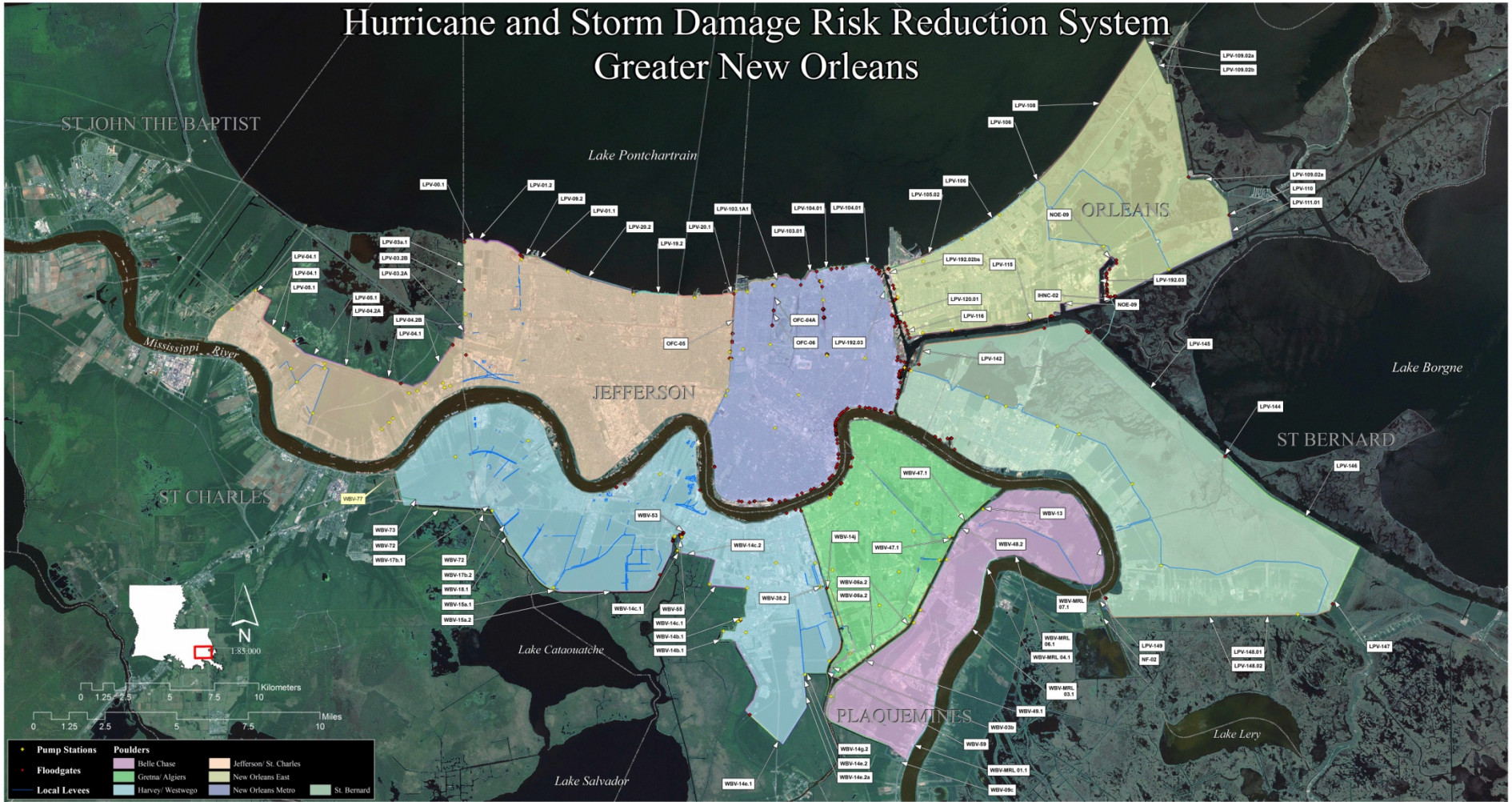
Some areas are sinking >inch/yr

Overview

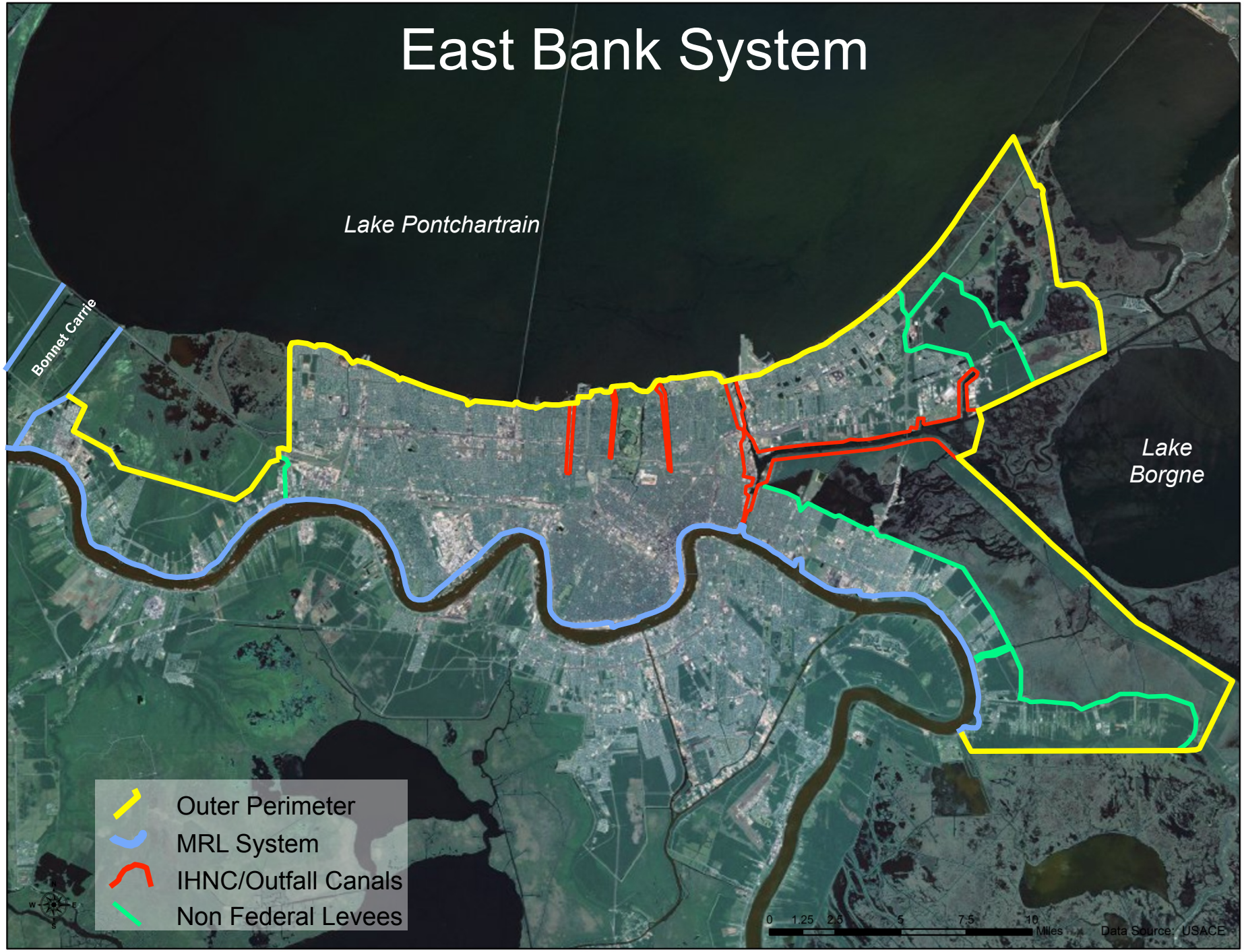

BARRIERS OF EARTH AND CONCRETE
Levees and floodwalls that protect against flooding from both the Mississippi River and hurricanes are built by the Army Corps of Engineers and are maintained by local levee districts. The corps and the local districts share the construction cost of hurricane levees, while the Mississippi River levees are a federal project. Local levee districts also build and maintain nonfederal, lower-elevation levees with construction money from each district's share of property taxes and state financing.
LEVEES AND FLOODWALLS
Mississippi River
Hurricane protection
Interior parish
Notes: Levee and floodwall elevations are drawn with an extremely exaggerated vertical height but are in proportion to each other. Numbers on specific sections represent average heights in feet above sea level.
HEIGHT ISN'T EVERYTHING
Different factors permit Lake Pontchartrain levees of varying elevations to withstand an 11½-foot storm surge plus several feet of waves:
Levees on higher ground and separated from the water by 5 miles of marshland need be only 12½ feet tall
Lake Pontchartrain
Marsh
Levees fronted by boulders and concrete rubble breakers can be about 14 feet high
Breakwaters
Levees without any breakers need to be about 17 feet tall or taller
Seawalls on the water must be 22 feet high
Note: The height and shape of a levee is based on the roughness of the area over which waves pass to reach the structure, and the slope of the structure.
St. John the Baptist Parish
LaPlace
Bonnet Carre Spillway
Destrehan
Luling
St. Charles Parish
Jefferson Parish
Waggaman
Lake Cataouatche
Bayou Segnette
Intracoastal Waterway
U.S. Naval Air Station
Harvey Canal
Harvey
WEST BANK EXPWY.
LAPALCO BLVD.
Westwego
Harahan
Kenner
Louis Armstrong N.O. Int. Airport
WILLIAMS BLVD.
AIRLINE DR.
Metairie
17th Street Canal
Orleans Avenue Canal
London Avenue Canal
CAUSEWAY
Industrial Canal
Lake Pontchartrain
City Park
Uptown
CBD
French Quarter (behind floodwall)
CANAL
New Orleans
Eastern New Orleans
Jazzland
Orleans Parish
Gretna
Algiers
Arabi
Chalmette
PARIS ROAD
Meraux
Belle Chasse
Mississippi River
Violet Canal
E. JUDGE PEREZ DR.
St. Bernard Parish
Poydras
BAYOU ROAD
Kenilworth
Big Mar
Plaquemines Parish
Lake Borgne
Mississippi River-Gulf Outlet
Verret
Staff graphic by Emmett Mayer III/emayer@timespicayune.com
STAFF PHOTOS BY ELLIS LUCIA, ALEX BRANDON AND DEVAUNSHI MAHADEVIA


STATE OF LOUISIANA
Office of the Governor
Coastal Protection
and Restoration Authority
Riverine Levee Boards
Office of Coastal Protection
And Restoration
Southeast Louisiana
Flood Protection Authority - East
Southeast Louisiana
Flood Protection Authority - West
Other Coastal Louisiana
Levee Boards
East Jefferson Levee District
Orleans Levee District
Lake Borgne Basin Levee District
St. Tammany Levee District
Tangipahoa Levee District

Hurricane and Storm Damage Risk Reduction System
Greater New Orleans



ID	Description
0HNC-01	HNC Flood Protection - Seabrook
0HNC-02	HNC Flood Protection - GIWW/MRGO
LPV-00.1	Reach 1 Lakefront Levee - Phase 1
LPV-00.2	Reach 1 Lakefront Levee - Phase 2
LPV-01.1	Reach 2 Lakefront Levee - Phase 1 & 2
LPV-01.2	Fontaine Protection A - Phase 2
LPV-02.1	Reach 3 Lakefront Levee (3rd Lift) - Phase 1
LPV-02.2	Reach 3 Lakefront Levee - Phase 2
LPV-03.2A	West Return Floodwall (Southern Segment) - Phase 2
LPV-03.2B	West Return Floodwall (Northern Segment) - Phase 2
LPV-03a.1	West Return Floodwall - Vintage-Phase 1
LPV-03b.1	West Return Floodwall, Airport Local - Phase 1
LPV-03c.1	West Return Floodwall- I-wall @ I-10 - Phase 1
LPV-03d.2	Airport Runway10 Levee - Phase 2
LPV-04.1	Levee - Reach 1A, 1B & 2A - Phase 1 & 2
LPV-04.2A	Levee - Reach 1A from Cross Bayou to St. Rose and Gulf South Floodwall - Phase 2
LPV-04.2B	Levee - Reach 1B from I-310 to Walker Drainage Structure - Phase 2
LPV-05.1	Levee - Reach 2B (2nd Lift) - Phase 1
LPV-05.2A	Levee - Reach 2A Shell Pipeline to Goodhope and Shell Pipeline Floodwall Replacement - Phase 2
LPV-05.2B	Levee - Reach 2B - from Good Hope to Cross Bayou - Phase 2
LPV-06a.2	Bayou Trepagnier Complex Floodwall - Phase 2
LPV-06b.2	Shell Pipeline Floodwall - Phase 2
LPV-06c.2	Goodhope Floodwall - Phase 2
LPV-06c.1	Floodwall Under I-310 - Phase 1
LPV-06e.2	Floodwall Under I-310 - Phase 2
LPV-06f.2	Illinois Central Railroad Gate - Phase 2
LPV-07.1	St. Charles Drainage Structure Tie-ins - Phase 1
LPV-07b.2	Cross Bayou Drainage Structure - Phase 2
LPV-07c.2	St. Rose Drainage Structure & Levee - Phase 2
LPV-07d.2	Almedia - Walker Drainage Structures - Phase 2
LPV-09.1	PS#1 (Bonnabel) Floodwall Tie ins & Floodwall/Gate at Boat Launch - Phase 1
LPV-09.2	Pumping Stations #1 (Bonnabel), #2 (Suberban), #3 (Elmwood) and #4 (Duncan) Mods, Fronting Protection, + Cutoff and Floodwall Tie-ins - Phase 2
LPV-09b.2	Pumping Station #1 (Bonnabel) Breakwater - Phase 2
LPV-10.1	Pumping Station #2 (Suburban) Floodwall Tie-ins-Phase 1
LPV-101.02	Lakefront Levee OIB - 17th St. Canal to Tepur St.
LPV-101.02A	Advanced Measures
LPV-102.01	Lakefront Levee OEB - Tepue to Orleans Canal
LPV-103.01	Lakefront Levee OEB - Orleans Canal to London Ave
LPV-103.1A1	Lakefront Levee OEB - 17th St. Canal to London Av. Canal - Phase 1A
LPV-103.1A2	Gate Structure Lakefront OEB - Orleans Canal to London Ave.
LPV-104.01	Lakefront Levee OEB - London Avenue Canal to IHNC
LPV-104.01a	Lakefront Levee OEB - London Ave. Canal to IHNC - Phase 1A
LPV-104.02	Lakefront Levee OEB - London Ave Canal to IHNC
LPV-105.01	Lakefront Airport Floodwalls - West
LPV-105.02	T-Wall Existing Alignment- Lakefront Airport - East
LPV-105.03	Interim Measures at Lakefront Airport Floodwall. Completed by Hired Labor
LPV-106	Replace Levee W/T - Citrus Lakefront Levee (West of Paris Road)
LPV-107	Lincoln Beach Levee and Gate Replacement
LPV-108	Raise Levee - Paris Rd. to South Point
LPV-109.02c	New Orleans East Levee - South Point to CSX RR (100 YR)
LPV-109.02b	I-10 Floodwall & Crossing
LPV-110.1	Pumping Station #3 (Elmwood) Floodwall tie-ins- Phase 1
LPV-110	New Orleans East Levee - Modify CSX Railroad Gate
LPV-111.01	New Orleans East Back Levee - CSX RR to Michoud Canal
LPV-113	Citrus Back Levee - Michoud Canal to Michoud Slip to Auth. Elevation
LPV-115	Citrus Back Levee - Michoud Slip to IHNC Completed by Hired Labor
LPV-116	ID IHNC-GIWW/MRGO to Almonaster. Completed by Hired Labor
LPV-117.01	Eastbank IHNC - Almonaster to Lakefront Floodwall
LPV-117.02	IHNC Reach II Emergency Interim Repair
LPV-120.01	Westbank IHNC - Almonaster to Lakefront Floodwall
LPV-12a.2	Pumping Station #4 (Duncan) Breakwater - Phase 2
LPV-142	Interim Measure - South Side of GIWW
LPV-144	Chalmette Loop Levee - Bayou Dupre Floodgate
LPV-145	Chalmette Loop Levee - Bayou Bienvenue to Bayou Dupre.
LPV-146	Chalmette Loop Levee - Bayou Dupre to Hwy 46 Floodwall
LPV-147	Chalmette Loop Levee - Highway 46 Floodgates
LPV-148.01	Chalmette Loop Levee - Hwy 46 to River (Verret to Caernarvon)
LPV-148.02	Chalmette Loop Levee - Hwy 46 to River (Verret to Caernarvon)
LPV-149	Caernarvon Canal at LA 39/Railroad Replace Floodgates
LPV-16.2	Floodwall and Gate at Bonnabel Boat Launch - Phase 2
LPV-17.2	Bridge abutment and Floodwall Tie-ins at Causeway Bridge -Phase 2
LPV-18.2	Floodwall and Gate at Williams Blvd. Boat Launch-Phase 2
LPV-19.2	Reach 4 Lakefront Levee - Phase 2
LPV-192.02	Reach 2, Repair and Restoration of Existing Levees and Floodwalls from Lake Front Floodwall to Michoud Canal Floodwall
LPV-192.02ba	IHNC-01 LFA Restoration Reach II,Bartman Slab
LPV-192.03	Reach 3, Repair and Restoration of Existing Levees and Floodwalls from Lake Front Floodwall to IHNC Lock
LPV-20.1	Reach 5 Lakefront Levee - Phase 1 & 2
LPV-20.2	Foreshore Protection - Phase 2
LPV-201	IHNC - GIWW to Almonaster. Completed by Hired Labor
LPV-IHNC-10	France Road Gate and Road Ramp Inner Harbor Navigational Canal West Side
NF-02	Braithwaite to Scarsdale Non-Federal
NOE-09	Michoud Slip to Michoud Canal. Floodwall Scour Repair
OEB-02	Lake Pontchartrain - 17th St Canal Floodwall Repair, Phase II
OEB-04	Lake Pontchartrain - London Ave Canal Breach at Mirabeau, Phase II
OEB-06	Lake Pontchartrain - London Ave Canal Breach at Robert E Lee. Phase II
OEB-09	Lake Pontchartrain - Interim Closure Structure at 17th St. Canal
OEB-10	Lake Pontchartrain - Interim Closure Structure at London Ave Canal
OEB-11	Lake Pontchartrain - Interim Closure Structure at Orleans Ave Canal
OFC-05	Remediation of Floodwalls on the London Avenue Canal
OFC-04A	Orleans Ave SWE Remediation
OFC-05	17th Street Canal SWE Remediation - Deep Soil Mixing
OFC-06	Outfall Canal SWE Remediation - Earthwork
PCP-01	Outfall Canal Closures
WBV-01	Contract 1, Seccergate to Boomtown Floodwall
WBV-02a	Contract 2a, Boomtown to Floodwalls
WBV-02b	Contract 2b, Boomtown to Hero Pump Station Floodwalls
WBV-05a	Contract 3a, Hero PS to Algiers Canal Floodwall
WBV-05b	Contract 3b, Hero PS to Algiers Canal Floodwall
WBV-06.2	Belle Chasse Hwy to Hero Cutoff-Reach1-Phase 2
WBV-06a.1	Belle Chasse Hwy to Hero Cutoff (West)
WBV-06a.2	Belle Chasse Hwy to Hero Cutoff-Reach2-Phase 2
WBV-05.2	Belle Chasse Hwy to Hero Cutoff-Reach 2 - Phase 2
WBV-06.2	Belle Chasse Hwy to Hero Cutoff-Reach 3 & 4-Phase 2
WBV-06a.1	Belle Chasse Hwy to Hero Cutoff (West)
WBV-06a.2	Belle Chasse Hwy to Hero Cutoff (West) - Phase 2
WBV-07	Planters Pump Station Fronting Protection and Modifications
WBV-08	Sewerage &Water Board Pump Station #13 Fronting Protection and Modifications
WBV-09a	Hero Canal to Oakville - Levees
WBV-09b	Hero Canal to Oakville - Structures
WBV-09c	Hero Canal to Oakville - Highway Structures
WBV-10	Belle Chasse Pump Station #1 (Plaquemines Pump Station) Fronting Protection and Modifications-Phase 1
WBV-11	Belle Chasse Pump Station #2 Fronting Protection and Modifications
WBV-12	Hero Canal Reach 1, 2nd Lift
WBV-13	S&WB PS #11 Fronting Protection and Modifications
WBV-14a.1	Harvey Canal West Bank Levees - 2nd Engh Phase 1
WBV-14a.2	Harvey Canal West Bank Levees - Phase 2 - Estelle PS to Vicinity of Lapalco Ove
WBV-14b.1	Orleans Village to Hwy 45, Levee - Phase 1
WBV-14b.2	Orleans Village to Hwy 45 Levee - Phase 2
WBV-14c.1	New Westwego Pump Station to Orleans Village - 3rd Enlgt - Phase 1
WBV-14c.2	New Westwego Pump Station to Orleans Village - Phase 2
WBV-14d	V-line Floodwall
WBV-14e.1	V-line Levee, East of Vertex - Phase 1
WBV-14e.2	V-line levee, East of Vertex - Phase 2
WBV-14e.2a	V-line levee, East of Vertex - Phase 2
WBV-14f.2	Hwy 45 levee - Phase 2
WBV-14g.1	Old Estelle to New Estelle
WBV-14g.2	Estelle Pump Station Vicinity Floodwalls
WBV-14i	V-Line Levee, LA 3134 Highway Crossing
WBV-14k	Westwego to Harvey Utility Crossings and Miscellaneous Sector Gate Retrofits
WBV-15a.1	Lake Catouatche Pump Station to Segnette State Park - Phase 1
WBV-15a.2	Lake Catouatche Pump Station to Segnette State Park - Phase 2
WBV-15b.1	Lake Catouatche Pump Station Fronting Protection, Modifications
WBV-15b.2	Lake Catouatche Pump Station Fronting Protection, Modifications
WBV-16.1	Segnette PS to New Westwego Pump Station Floodwall - Phase 1
WBV-16.1a	Company Canal Barge Gate Modifications & Channel Dredging
WBV-16.2	Bayou Segnette Complex
WBV-16b	Segnette Pump Station Fronting Protection & Modifications.
WBV-17b.1	Station 160+00 to Hwy 90 - Phase 1
WBV-17b.2	Hwy 90 to Lake Catouatche Pumping Station Levee, Station 125 to 160 - Phase 2
WBV-18.1	Hwy 90 to Lake Catouatche Pump Station - Phase 1
WBV-18.2	Hwy 90 to Lake Catouatche Pump Station - Phase 2
WBV-20	New Westwego Pump Station Fronting Protection and Modifications
WBV-21	Old Westwego Pump Station Fronting Protection and Modifications
WBV-22	Westwego Floodwall
WBV-23	New Estelle Pump Station Fronting Protection and Modifications
WBV-24	Segnette State Park Floodwall
WBV-30	Westminster Pump Station Fronting Protection and Modifications
WBV-33	Old Estelle Pump Station Fronting Protection and Modifications
WBV-37	Ames and Mt. Kennedy Pump Station Fronting Protection and Modifications.
WBV-38.1	Cousins Pump Station - Phase 1
WBV-38.2	Cousins Pump Station and Discharge Channel Floodwalls - Phase 2
WBV-48	Whitney Barataria Pump Station Floodwall Modifications
WBV-46.1	Sector gate Complex - Phase 1
WBV-46.2	Cousins Canal Walls - Destrehan Bridge to Sector Gate
WBV-47.1	Algiers Lock to Belle Chasse Hwy (West) - Phase 1
WBV-48.1	Belle Chasse Hwy to Algiers Lock (East) - Phase 1
WBV-48.2	Belle Chasse Hwy to Algiers Lock (East) - Phase 2
WBV-49.1	Hero Levee to Belle Chasse Hwy (East) - Phase 1
WBV-52	Priority Interim - Contract 1
WBV-53	Priority Interim - Contract 2
WBV-54	Priority Interim - Contract 3
WBV-55	Priority Interim - Contract 4
WBV-56	Priority Interim - Contract 5
WBV-58	35' Priority Interim - Contract 1: V-line floodwall
WBV-59	35' Priority Interim - Contract 2: Estelle PS to Lapalco
WBV-60	35' Priority Interim - Contract 3: Westwego Floodwall
WBV-61	35' Priority Interim - Contract 4: Segnette Park Floodwall
WBV-62	35' Priority Interim - Contract 5: Old and New Estelle PS and PS #13
WBV-71	Western Tie-in Levees (North-South)
WBV-72	Western Tie-in Levees (East-West)
WBV-73	Western Tie-In Highway Crossing
WBV-74	Western Tie-in Closure Structure
WBV-75	Western Tie-In BNSF Railroad Crossing
WBV-76	Western Tie-In Hwy 90 Pump Station
WBV-77	Western Tie-In/UP Railroad and LA-18 Crossing
WBV-90	GIWW - West Closure Complex
WBV-MRL 01.1	Oak Point to Oakville
WBV-MRL 03.1	Belle Chasse Oak Point
WBV-MRL 04.1	English Turn Bend to Belle Chasse
WBV-MRL 06.1	Parish Line to English Turn Bend
WBV-MRL 07.1	West Crossover Pt. to Parish Line


East Bank System
Lake Pontchartrain
Bonnet Carrie
Lake Borgne
Outer Perimeter
MRL System
IHNC/Outfall Canals
Non Federal Levees
0 1.25 2.5 5 7.5 10
Miles
Data Source: USACE

Flood Protection Structures within SLFPA-East

187 Total miles of levee

3,500+ Acres of levee maintenance

8 Navigational structures

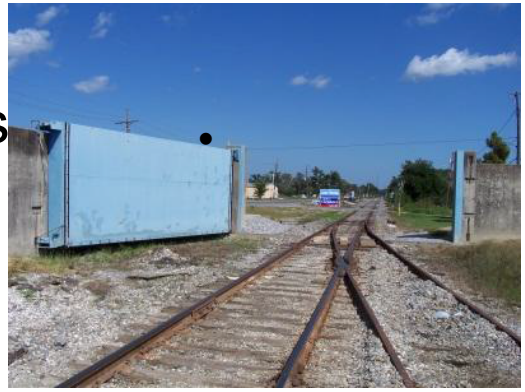
259 Land based floodgates

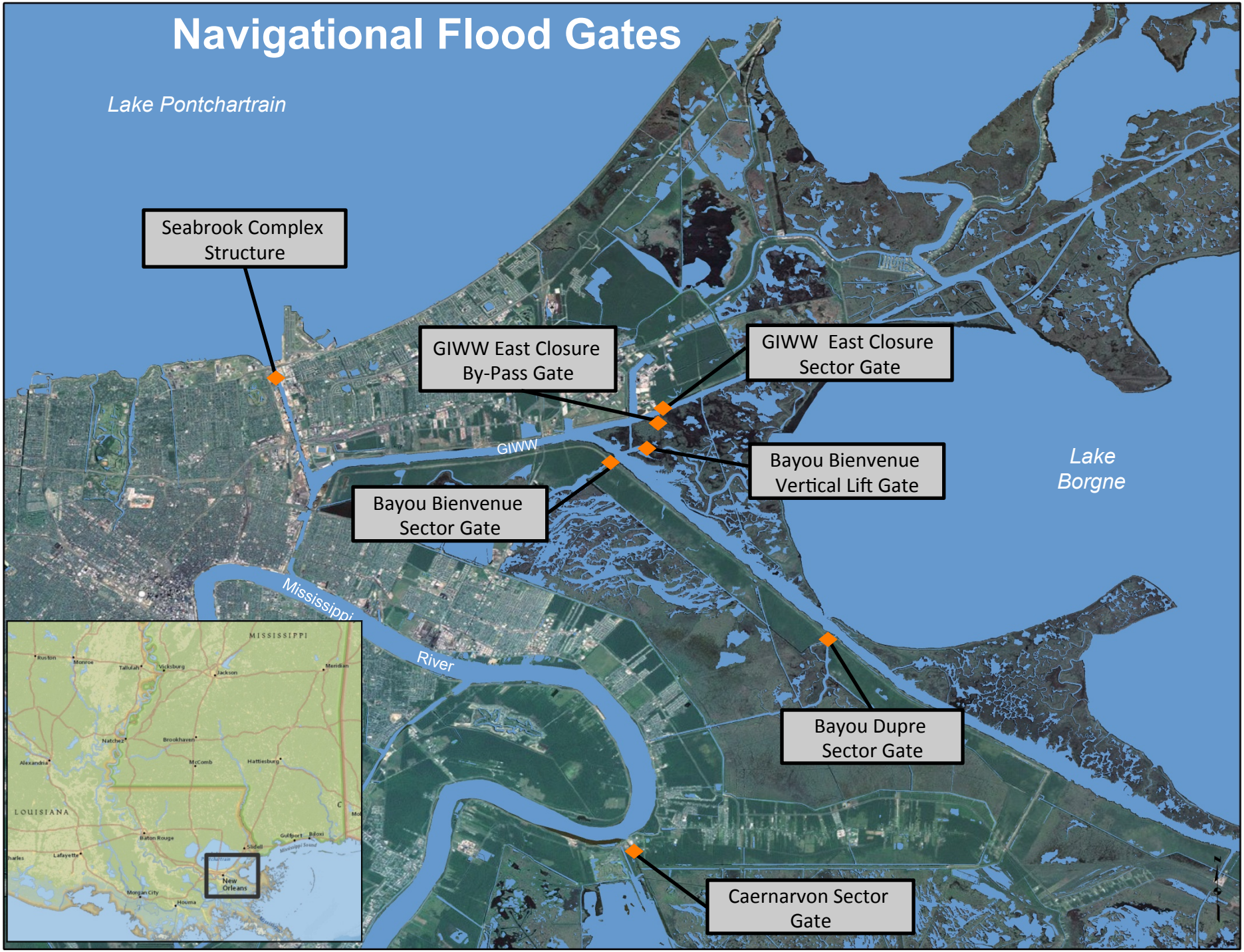
100 Valve gates

56 Total miles of canals

5.4 Miles of seawall

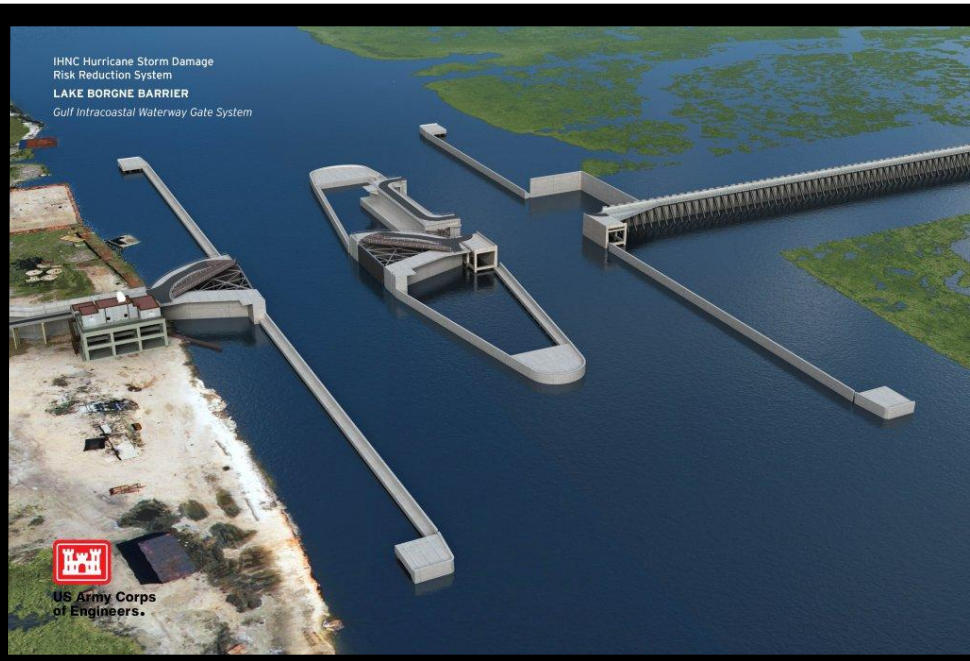
8 Pump stations




Navigational Flood Gates
Lake Pontchartrain
Seabrook Complex Structure
GIWW East Closure By-Pass Gate
GIWW East Closure Sector Gate
GIWW
Bayou Bienvenue Vertical Lift Gate
Bayou Bienvenue Sector Gate
Lake Borgne
Mississippi River
Bayou Dupre Sector Gate
Caernarvon Sector Gate
MISSISSIPPI
LOUISIANA
New Orleans


Bayou Bienvenue Vertical Lift C


IHNC Hurricane Storm Damage
Risk Reduction System
LAKE BORGNE BARRIER
US Army Corps
of Engineers.


IHNC Hurricane Storm Damage
Risk Reduction System
LAKE BORGNE BARRIER
Gulf Intracoastal Waterway Gate System
US Army Corps
of Engineers.


IHNC Hurricane Storm Damage
Risk Reduction System
LAKE BORGNE BARRIER
Bayou Bienvenue Floodgate
US Army Corps
of Engineers.


IHNC Hurricane Storm Damage
Risk Reduction System
SEABROOK SECTOR GATE COMPLEX
View of Open Barrier Gates
US Army Corps
of Engineers


Seabrook Complex Struct

Swing Gate

Roller Floodgate

Funding
(Planning, Design and Construction)

- US Congress
  - Authorization
  - Appropriation
    (Fed Share)

- US Army Corps of Engineers
  - Design and Construct

Project Partnering Agreement

- Local Sponsor
  - Matching Funds
  - LERRDS

Thinking and acting regionally

Operations and Maintenance Activities




- **Levee Maintenance**
  - Vegetation Management
  - Embankment Repairs
  - Floodwall Maintenance
  - Floodgate Operation and Maintenance
- **Drainage Pump Station Operation and Maintenance**
- **Drainage Canal Maintenance**
- **Fleet Maintenance**
- **Permitting**
- **Inspection and Monitoring**
- **Emergency Response and Recovery**

Operations and Maintenance

- Surge Barrier and Seabrook Complex
  - Acquiring Expertise
  - Coordinating with Maritime Interests
  - Funding

EMERGENCY RESPONSE AND RECOVERY

- Floodfight Activities (Response)
  - Monitor Conditions
  - Advise Officials
  - Close Gaps in system
    - Floodgates and Valves
    - Control Structures
    - Sandbagging
  - Initiate Pumping Operations
  - Provide safe havens for employees
- Recover
- After Action Review

Funding Challenges

Water respects no political boundaries – but money does!

Thinking and acting regionally, then there's a taxation

Annual Operations and Maintenance

2016 Projected Annual O&M Revenue / Expenditures:

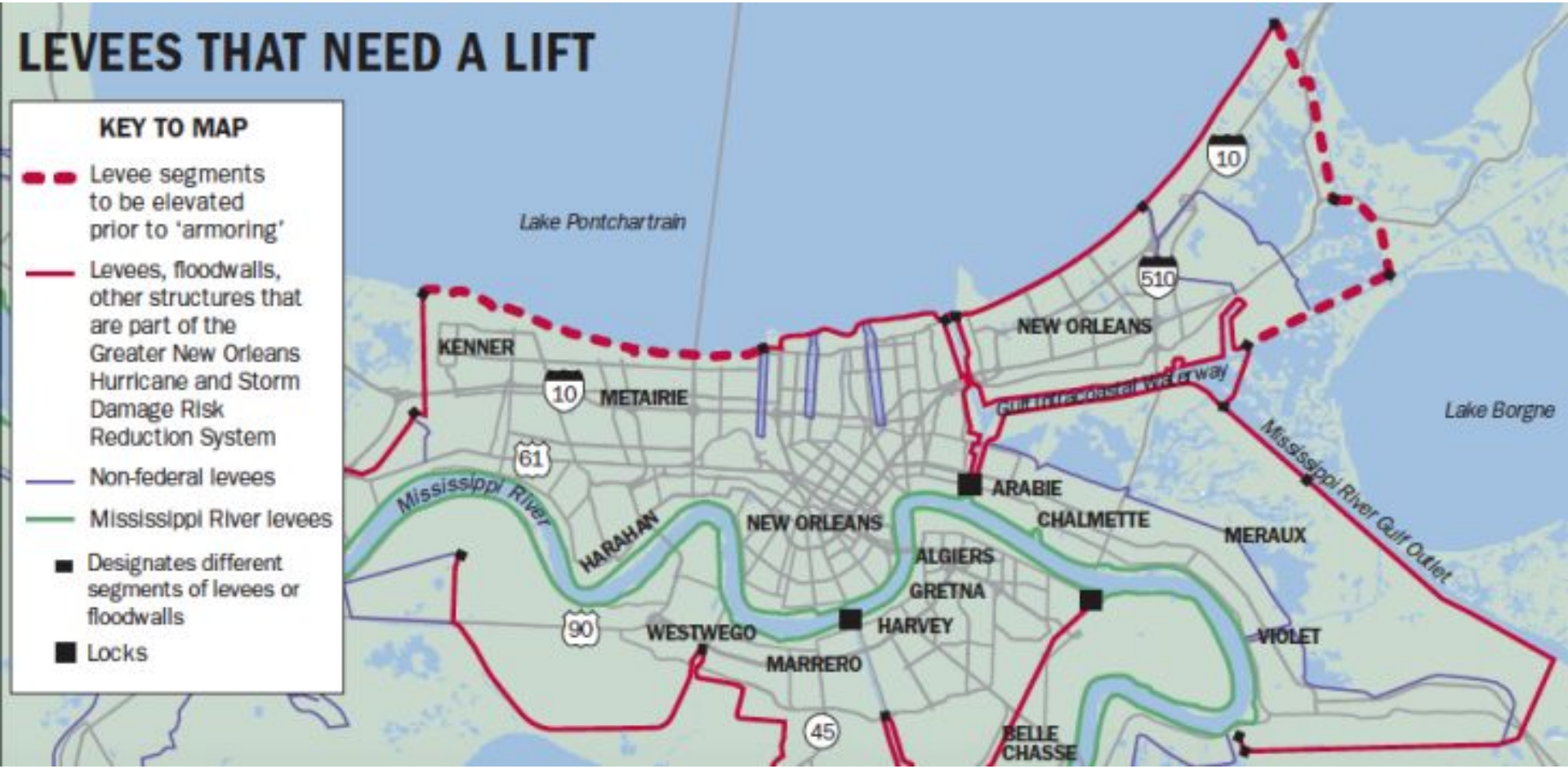
East Jefferson	$ 10 M / $ 10 M

Annual Operations and Maintenance

2016 Projected Annual O&M Revenue / Expenditures:

East Jefferson	$ 10 M / $ 10 M
Orleans - general	$ 20 M / $ 17 M
Orleans – special	$ 18 M / $ 30 M


Lake Pontchartrain
Bonnet Carrie
Lake Borgne
HSDRRS Levees
HSDRRS 1 year from raising
HSDRRS Being Raised
HSDRRS Floodwalls
MRLS
Dashed lines are outside SLFPA-E jurisdiction
5
SOUTHEAST LOUISIANA FLOOD PROTECTION AUTHORITY
STATE OF LOUISIANA
EAST



Lift project's estimated cost = $40 - $50 million.

Annual Operations and Maintenance

2016 Projected Annual O&M Revenue / Expenditures:

East Jefferson	$ 10 M / $ 10 M
Orleans - general	$ 20 M / $ 17 M
Orleans – special	$ 18 M / $ 30 M
Lake Borgne Basin	$ 3.8 M / $ 3.8 M

Annual Operations and Maintenance

2016 Projected Annual O&M Revenue / Expenditures:

East Jefferson	$ 10 M / $ 10 M
Orleans - general	$ 20 M / $ 17 M
Orleans – special	$ 18 M / $ 30 M
Lake Borgne Basin	$ 3.8 M / $ 3.8 M
Lake Borgne Basin (2015)	$ 3.7 M / $ 4.4 M

2014 & 2015 attempted prop tax increase = $2.5 M /yr → $6 M total / yr

A Few Lessons Learned

- FEMA Accreditation (100 – yr protection) does not equal flood safety
- Water respects no political boundaries
- Flood Protection is a shared responsibility
- Flood Protection and Coastal Restoration are not mutually exclusive
- A proactive approach is much less expensive than a reactive approach, (but reaction is often needed to get large $ moving).
- O&M funding challenges are quite different from construction funding challenges….