WORKING WITH NATURE TRAINING SERIES

OCT. 20, 2021

Introduction to working with nature and Vermilion River case study

LOUISIANA WATERSHED INITIATIVE

working together for sustainability and resilience

WELCOME AND OPENING REMARKS

Matthew Weigel

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Matthew Weigel represents LDWF as part of the Louisiana Watershed Initiative. In his 16 years at LDWF, he has overseen Environmental Investigations, Fish and Wildlife Coordination, Scenic Rivers, Mitigation Banking and Coastal Restoration programs.

AGENDA

- Nature-Based Solutions Program overview
- Introduction to working with nature
- Vermilion River case study
- Questions

NATURE-BASED SOLUTIONS PROGRAM OVERVIEW

MAXIMIZE NATURAL FUNCTIONS OF THE FLOODPLAIN

- Fund projects that harness natural features to reduce flood risk and improve water quality
- Provide training and technical resources to advance understanding and adoption of nature-based solutions
- Prioritize nature-based solutions across state programs and projects
- Use tools to quantify benefits and measure performance of nature-based projects

INTRODUCTION TO WORKING WITH NATURE

Steve Picou

CHIEF VISIONARY OFFICER | ADAPTATION STRATEGIES

Steve Picou’s work and research focus on climate change, resource efficiency, blue/green infrastructure and resilience in the effort to build a circular economy, which uses nature as a guide to close the loop on waste and pollution.

WHAT ARE NATURE-BASED SOLUTIONS?

- NBS are sustainable planning, design, environmental and engineering practices that weave natural features or processes into the built environment to create more resilient communities.
- By combining natural and engineered processes, NBS can also go beyond flood risk reduction to deliver ecological benefits, such as improved water quality, natural habitat restoration, nutrient retention and carbon capture.
- NBS can deliver community benefits as well, including added recreational space, cooler summer temperatures, increased property values and job growth.

TYPES OF NBS STRATEGIES

WATERSHED SCALE: Large-scale projects involving interconnected systems of natural areas and open space

- Land conservation
- Wetland restoration and protection
- Floodplain and stream restoration
- Detention/retention basins
- Upstream land management and conservation
- Greenways
- Natural channel design

NEIGHBORHOOD OR SITE SCALE: Distributed stormwater management practices often built into a site, corridor or neighborhood

- Rain gardens
- Green roofs
- Permeable pavement
- Tree trenches
- Vegetated swales
- Rainwater harvesting
- Tree canopies
- Stormwater parks

COASTAL AREAS: Efforts designed to stabilize the shoreline, reducing erosion and buffering the coast from storm impacts

- Coastal wetlands
- Dunes
- Living shorelines
- Oyster reefs
- Waterfront parks

NBS STRATEGIES

LAND CONSERVATION

CANE BAYOU MITIGATION BANK, MANDEVILLE

NBS STRATEGIES

STREAM RESTORATION

FALLS PARK, GREENVILLE, SOUTH CAROLINA

NBS STRATEGIES

GREENWAYS DESIGNED TO FLOOD

PERKINS FERRY PARK, LAKE CHARLES

NBS STRATEGIES

STORMWATER PARK

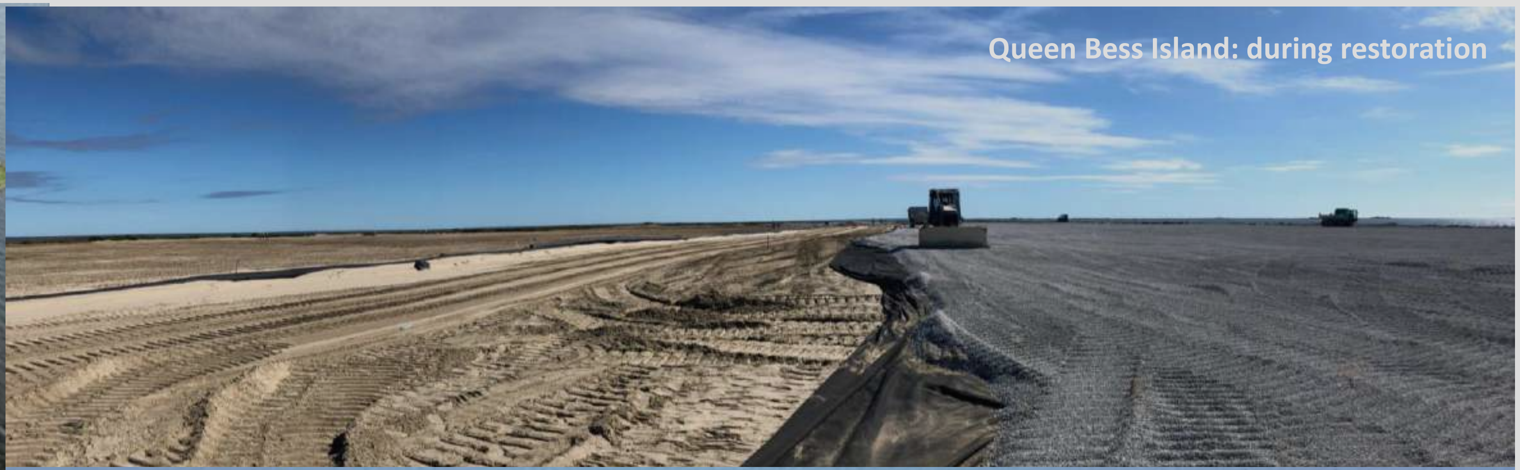
HISTORIC FOURTH WARD PARK, ATLANTA

NBS STRATEGIES

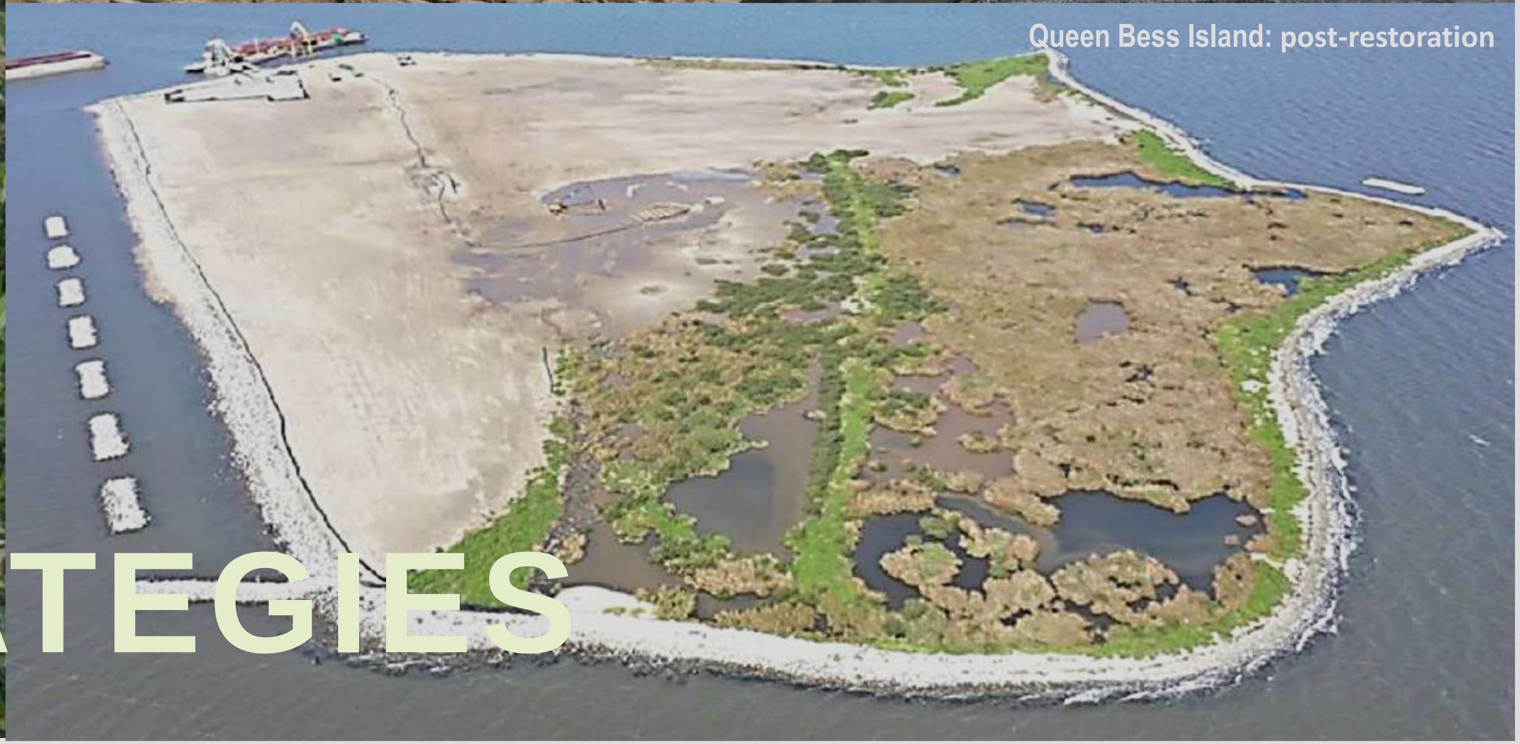
PERMEABLE PAVEMENT AND RAIN GARDENS

LOMBARD, ILLINOIS


Queen Bess Island: pre-restoration


Queen Bess Island: during restoration


Pelican chicks on Queen Bess Island: post-restoration


Queen Bess Island: post-restoration

NBS STRATEGIES

COASTAL RESTORATION

QUEEN BESS ISLAND

TYPES OF BENEFITS

HAZARD MITIGATION: NBS can help reduce loss of life and property from natural hazards, which are increasingly common due to land development and climate change.

- Riverine and coastal flooding
- Urban drainage flooding
- Drought
- Extreme heat

COMMUNITY CO-BENEFITS: NBS can provide environmental, economic and social advantages that improve quality of life and attract residents and businesses.

- Environmental: improved air/water quality, wildlife habitats, migration corridors
- Economic: increased property values, tax base, green jobs
- Social: improved public health, recreational space, cooler temperatures

COST SAVINGS: NBS can cost less than alternative investments, avoid the need for certain infrastructure altogether and reduce disaster recovery costs.

- Reduced stormwater management and water treatment costs
- Avoided flood losses
- NFIP Community Rating System benefits

NBS BENEFITS

ENVIRONMENTAL

NBS BENEFITS

ECONOMIC

NBS BENEFITS

RECREATION AND PUBLIC HEALTH

WATERSHED-SCALE EXAMPLE

MOLLICY FARMS, MOREHOUSE PARISH

The $4.5 million Mollicy Farms project is an example of large-scale floodplain restoration using natural channel design. The project reconnected 25 square miles of former floodplain forest to the Ouachita River.

- Restores hydrology of a former farm back to its natural landscape
- Enhances stormwater management in the watershed
- Protects water quality and fosters biodiversity
- Reduces regional flood risk

SOURCE: WATER WISE GULF SOUTH COMPENDIUM, DANA BROWN AND ASSOCIATES

NEIGHBORHOOD-SCALE EXAMPLE

WALLY PONTIFF JR. PLAYGROUND, METAIRIE

The Wally Pontiff Jr. Playground in Jefferson Parish is a 42-acre playground, featuring baseball and football fields, a jogging track, tennis courts, a gymnasium and more.

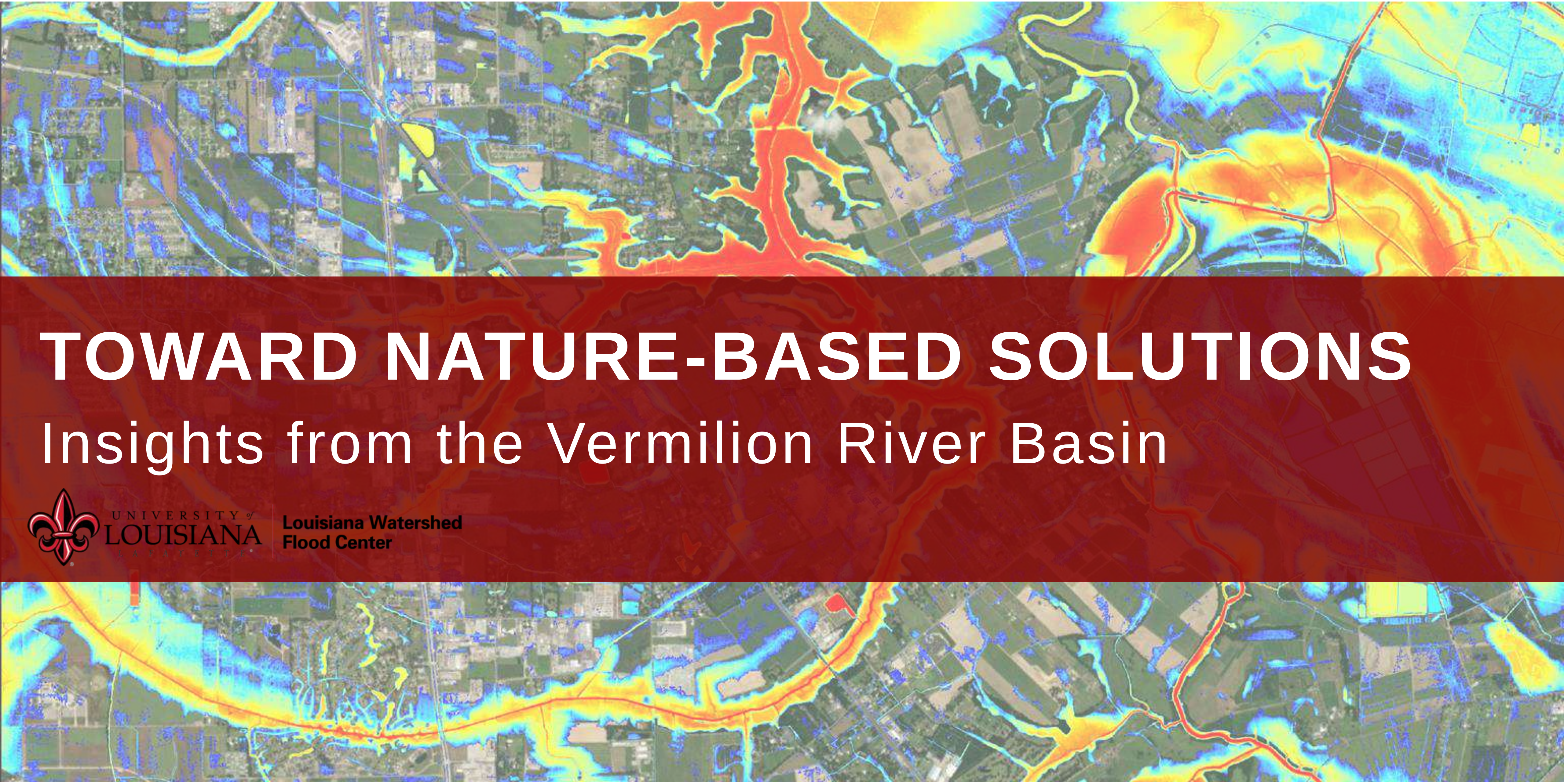
- Provides floodwater storage during heavy rainfall
- Protects water quality and fosters biodiversity
- Offers recreational and economic benefits
- Preserves land for ecosystem services

VERMILION RIVER CASE STUDY

Emad Habib, Ph.D.

PROFESSOR | UNIVERSITY OF LOUISIANA AT LAFAYETTE

Emad Habib’s expertise lies in surface hydrology, flood prediction, hydrometeorology, precipitation analysis, extreme events and water systems management.



TOWARD NATURE-BASED SOLUTIONS

Insights from the Vermilion River Basin

University of Louisiana Lafayette | Louisiana Watershed Flood Center

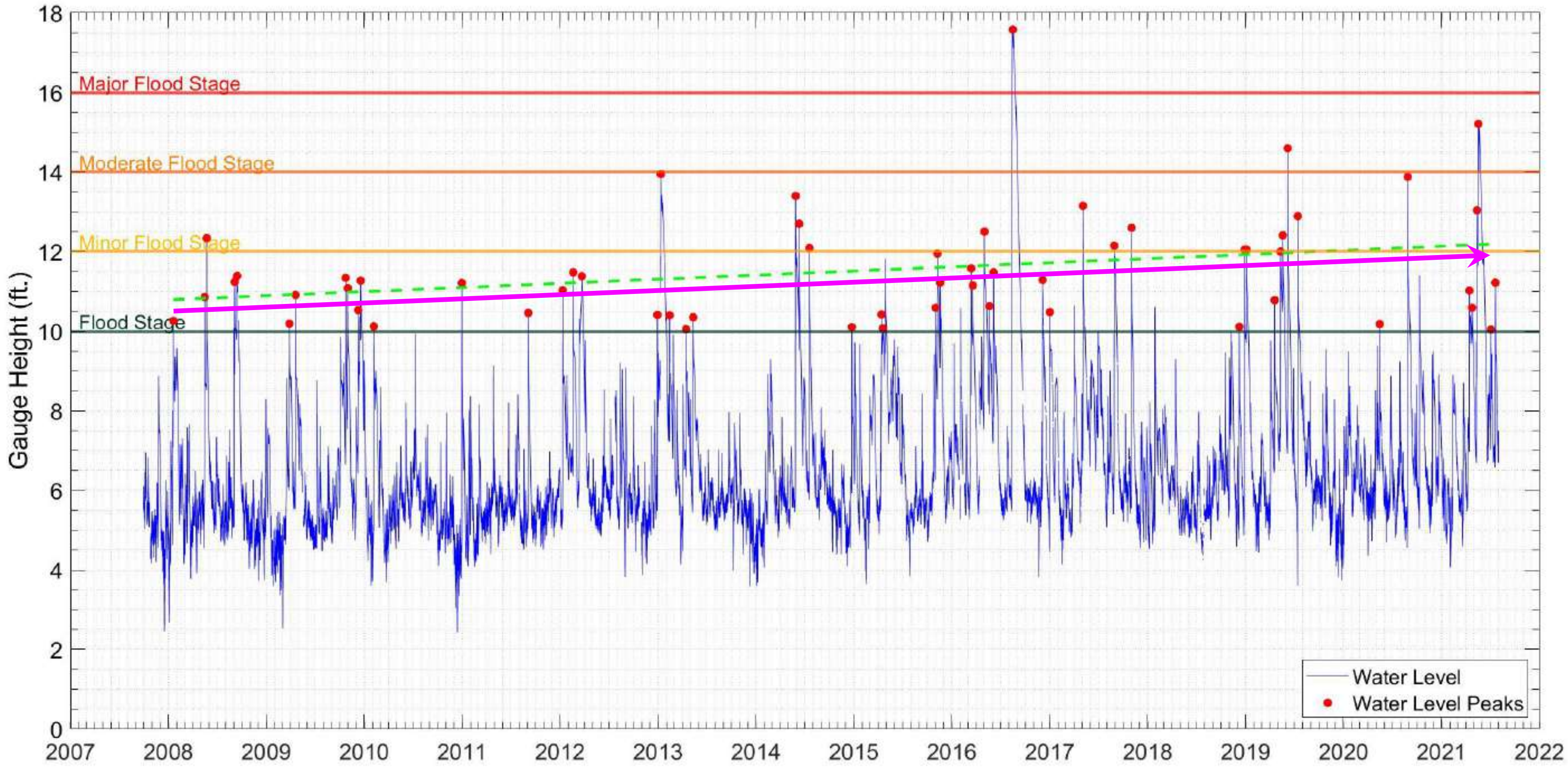
Outline

1. Flood risk in Vermilion River Watershed
   - What is driving flood risk?
   - Modeling tools
2. Conventional solutions
   - Riverine dredging
3. Nature-based solutions
   - Strategic detention
   - Maximizing natural functions

VERMILION RIVER WATERSHED FLOOD RISK

University of Louisiana Lafayette | Louisiana Watershed Flood Center

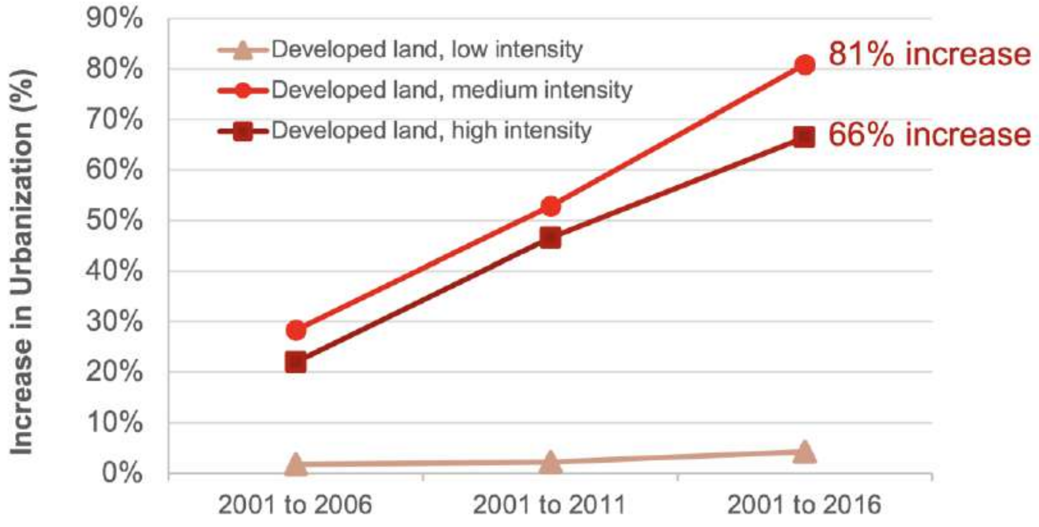
Vermilion River Basin: Increasing flood risk

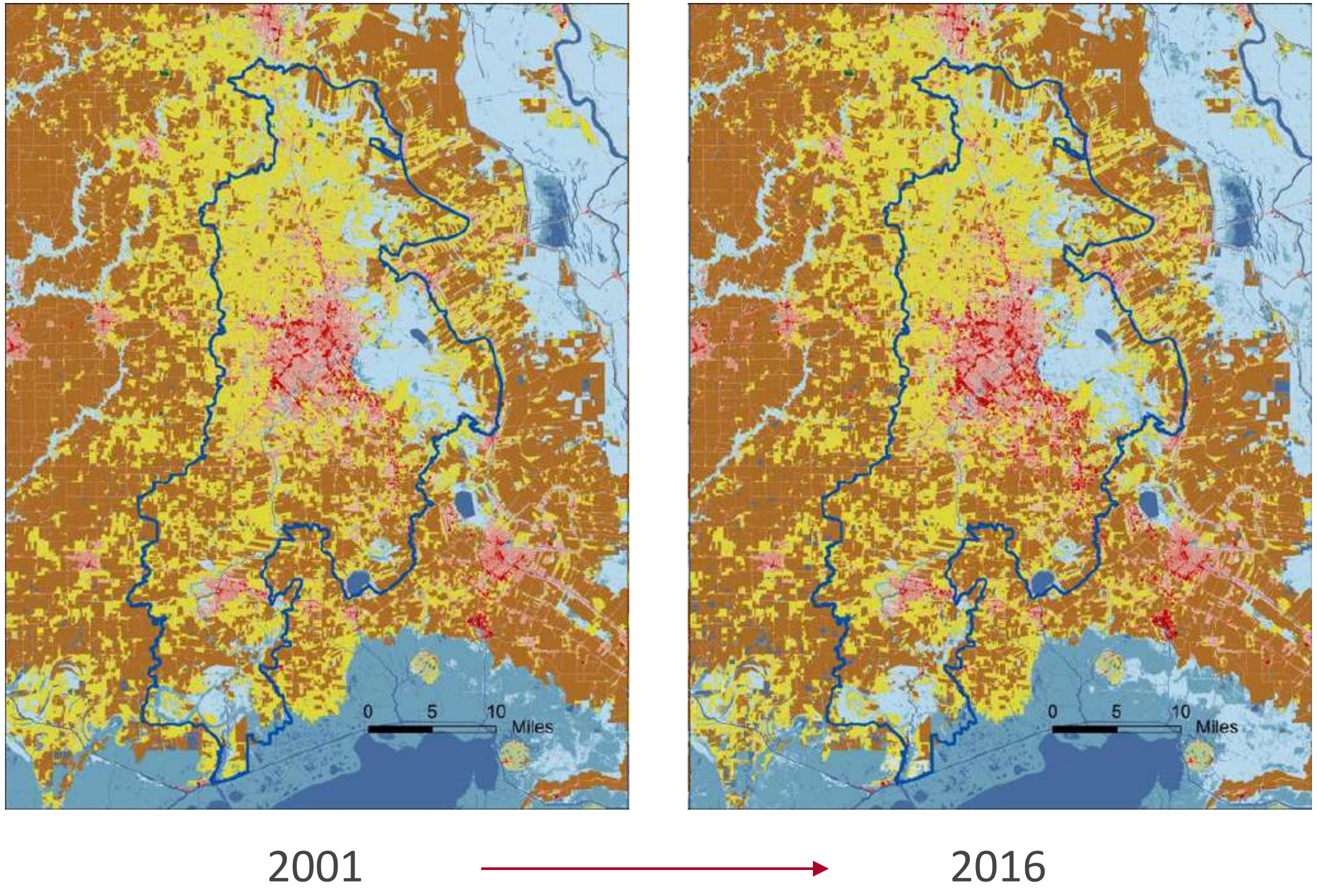


Louisiana Watershed Flood Center

What is driving flood risk?

- Growth in urbanization
- Channel sedimentation
- Climate change
- Other factors





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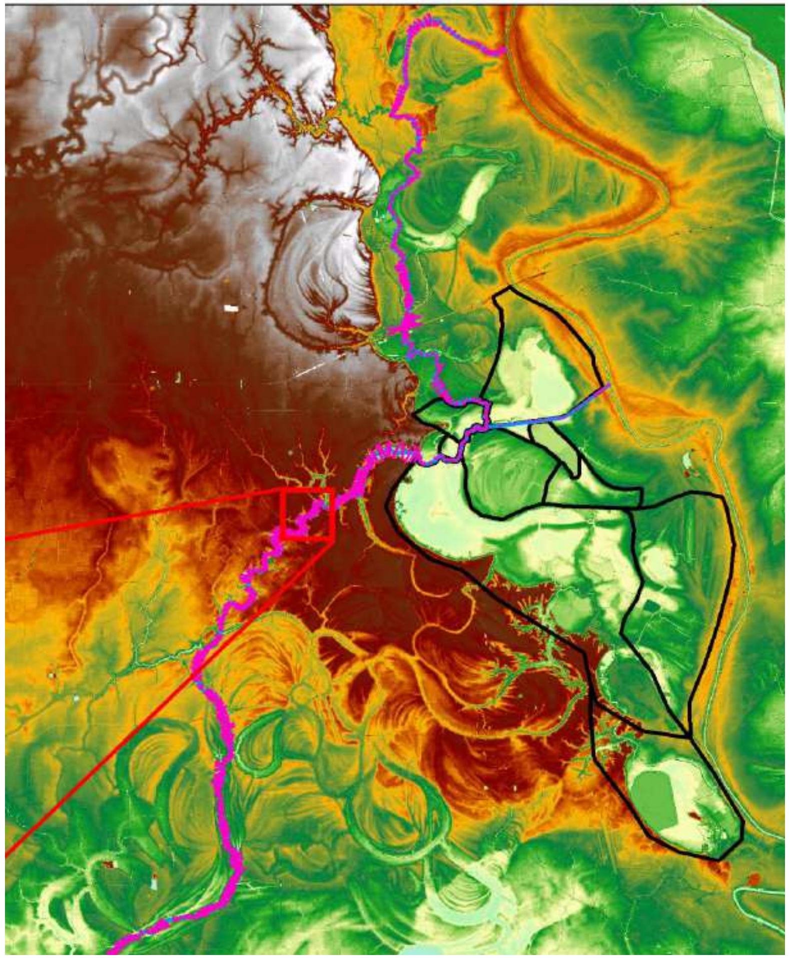
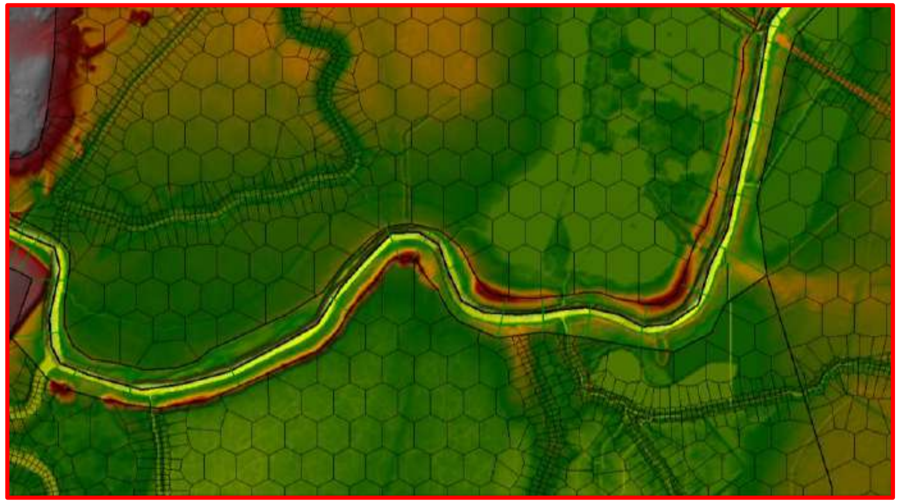
Modeling with purpose in mind

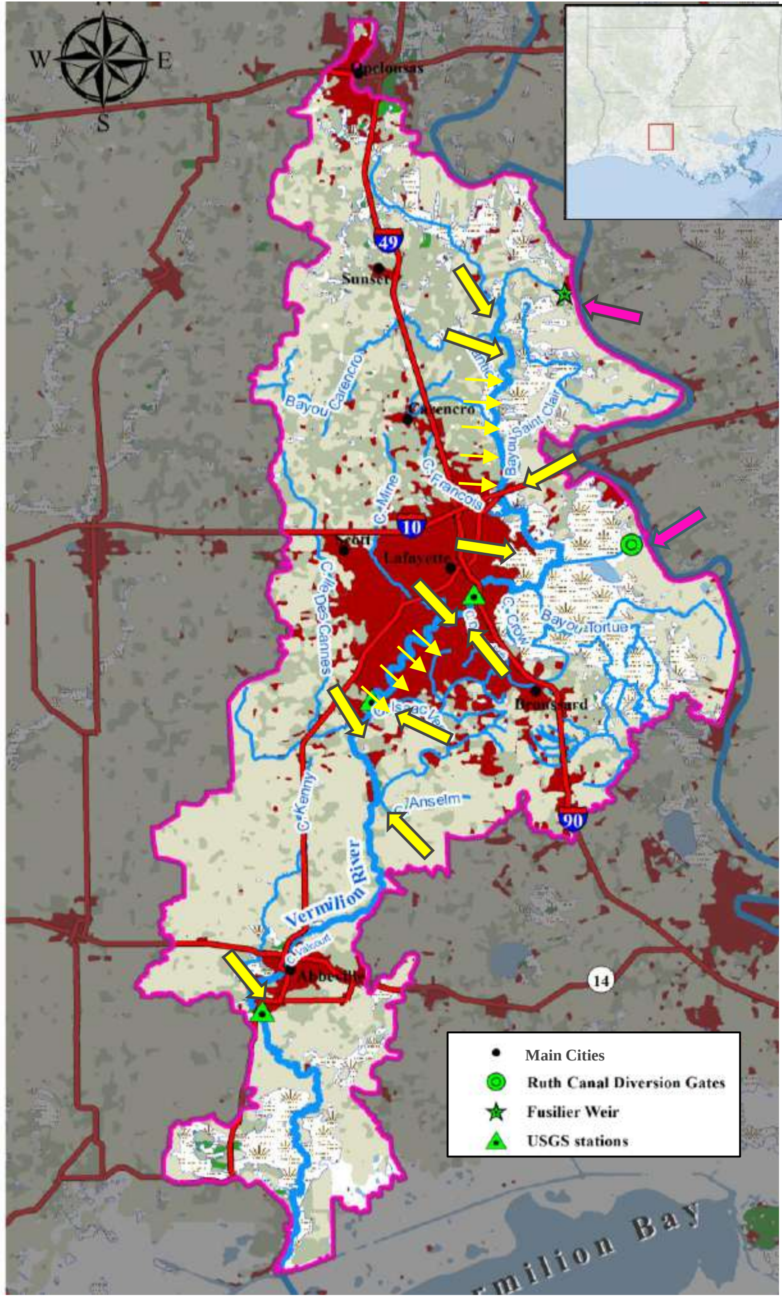
High-resolution lidar topography merged with surveys to accurately represent flow patterns



High-resolution 2D grid to better simulate complex flow areas



Simulation of hydraulic structures to study their impacts on flooding



Possible flood management solutions

Conventional Solutions

- Riverine dredging
- Channel modifications
- Channel clearing and snagging
- Levees and dams
- Concrete-lined channels

Nature-Based Solutions

- Floodplain restoration
- Stream and hydrologic restoration
- Detention and retention basins
- Swamps as natural detention
- Flood monitoring and early warning systems
- Community flood awareness and preparedness

Hybrid Solutions

CONVENTIONAL SOLUTIONS

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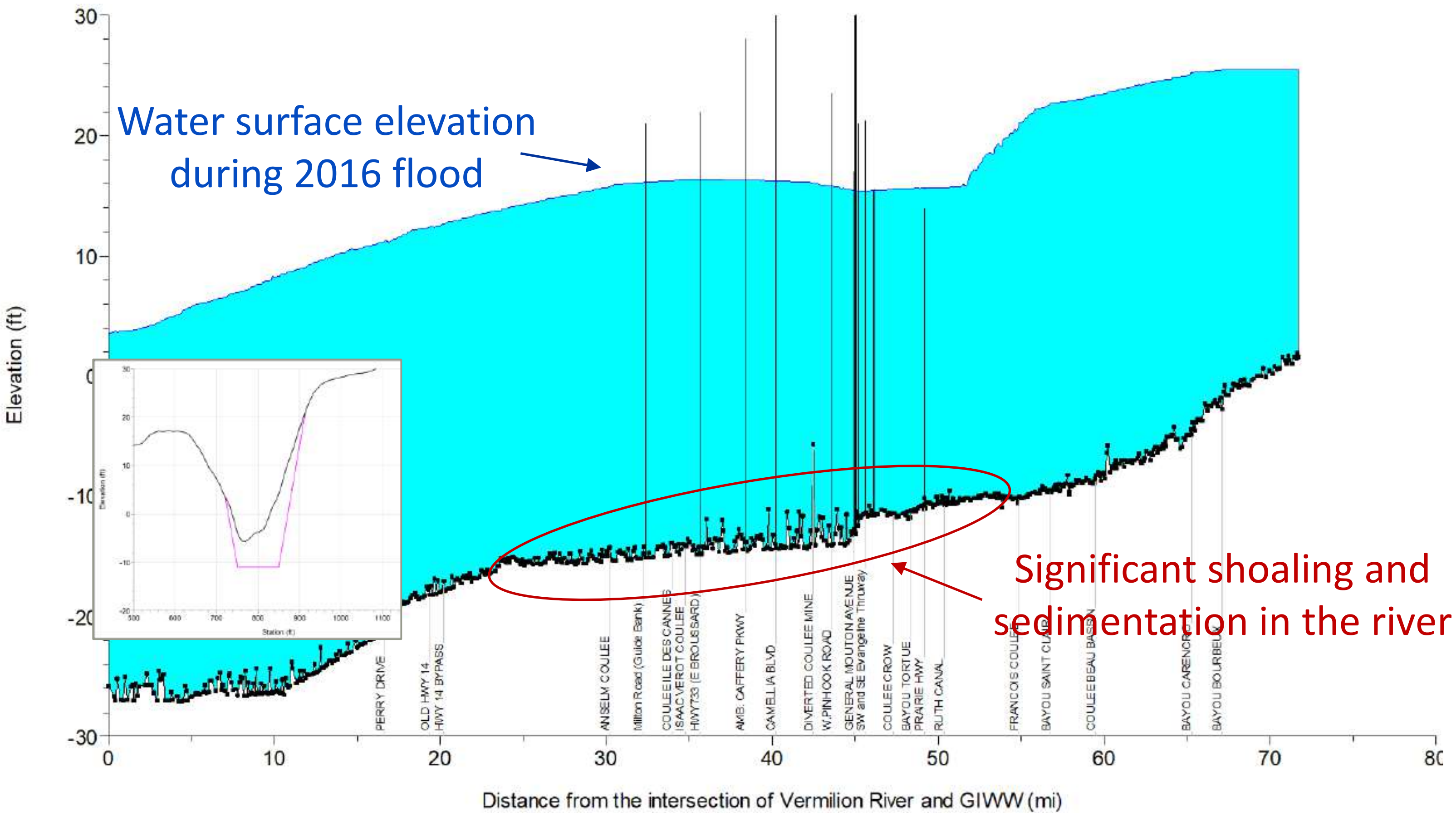
River dredging: Benefits and consequences

TABLE 1 | The four dredging scenarios considered for evaluation.

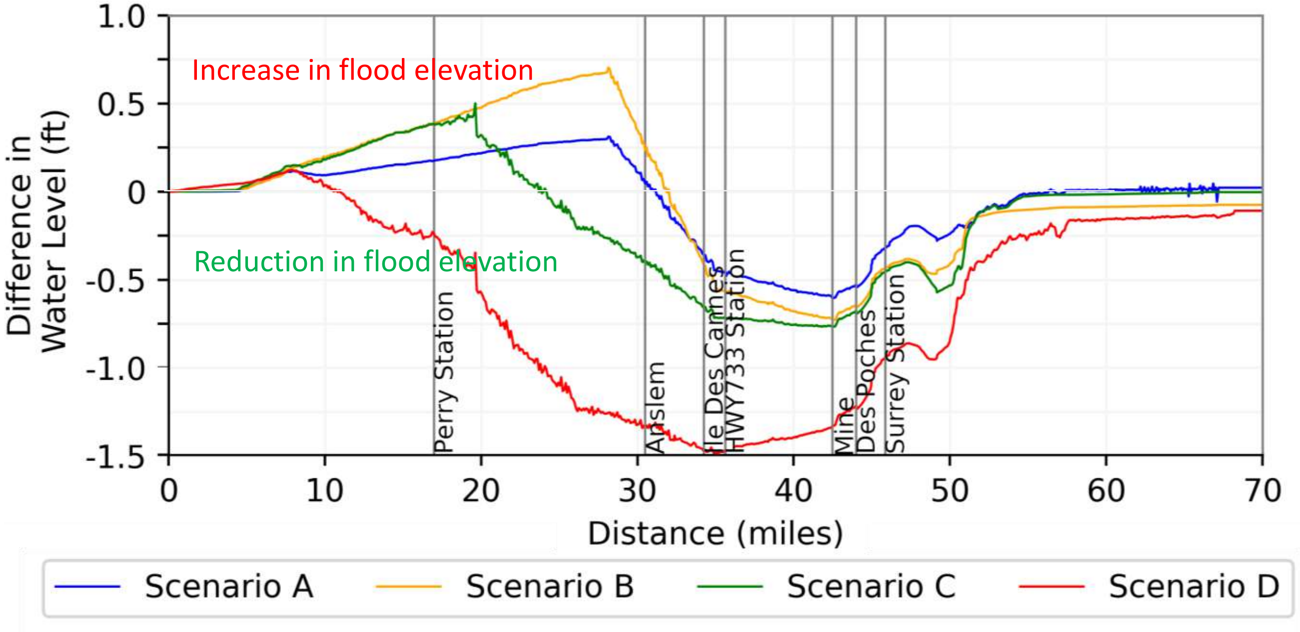
Modifications to river capacity	Spatial extent of modifications	
	Partial	Full
Modify channel dimensions	Scenario (A) 27 km; 1.7 mm[3]	Scenario (C) 81.1 km; 3.0 mm[3]
Modify channel dimensions and bed slope	Scenario (B) 27 km; 2.9 mm[3]	Scenario (D) 81.1 km; 7.5 mm[3]

The numbers reported for each scenario represent the length of the dredged reach (km) and the volume of bed material that needs to be dredged (million cubic meters, mm[3]).



River dredging: Benefits and consequences

- Significant reductions in water surface elevations can only be achieved via large-scale dredging.
- Limited or moderate dredging approaches can reduce water surface profiles but may increase downstream water levels.
- Dredging impacts natural functions and services (e.g., water quality, channel stability, fish propagation, outdoor recreation, etc.).



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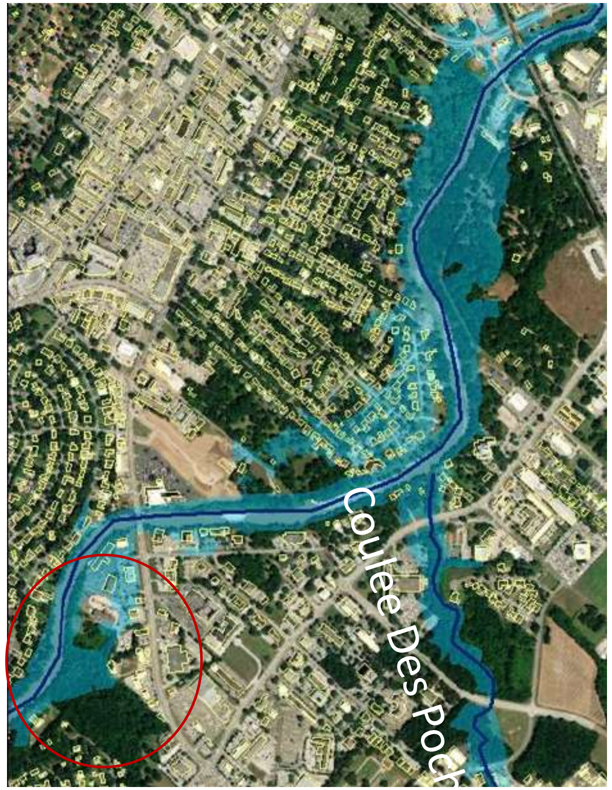
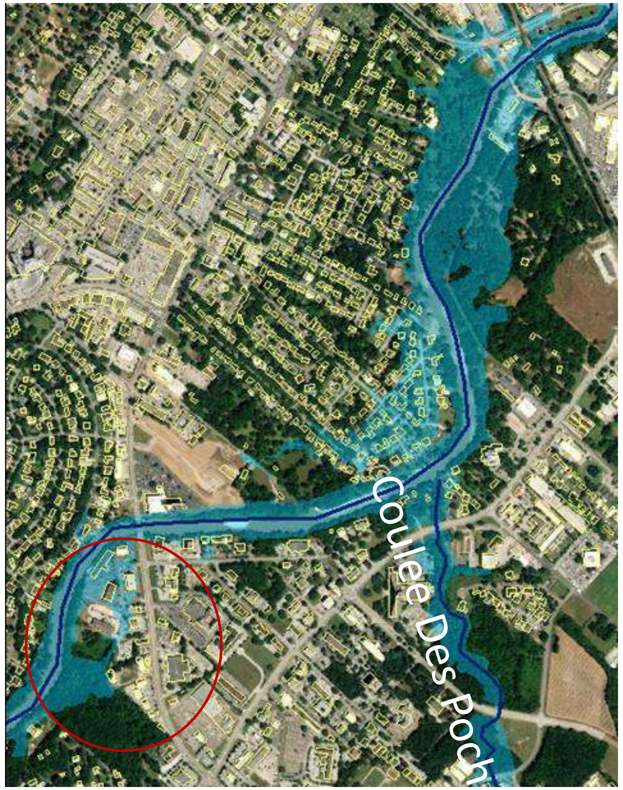
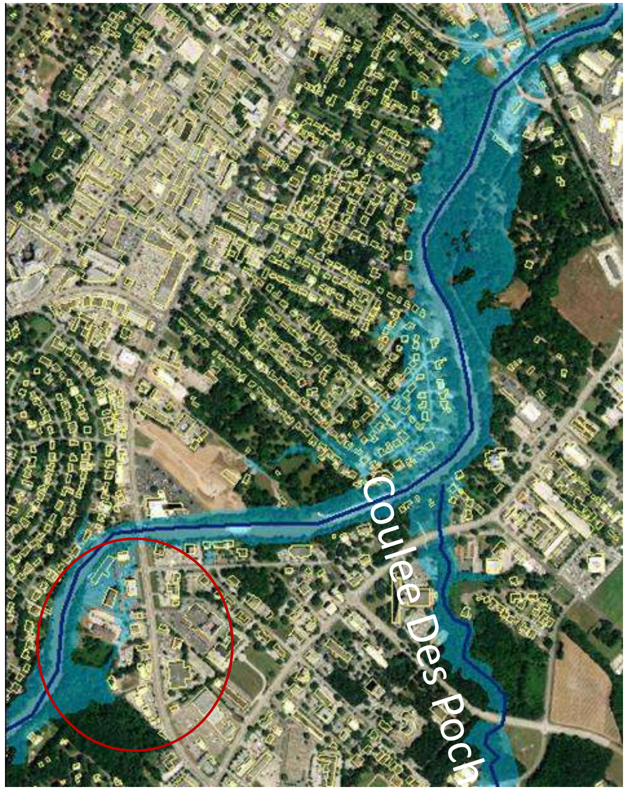
Flood inundation: 2016 storm

No Dredging	Partial Dredging	Full Dredging







	Number of structures flooded under baseline conditions	Number of structures removed from flooding	
		Partial dredging	Full dredging
Lafayette Parish	5461	240	273
Vermilion Parish	571	48	54

Full dredging

- Maximum stage reduction = 0.74 feet
- Average stage reduction = 0.6 feet

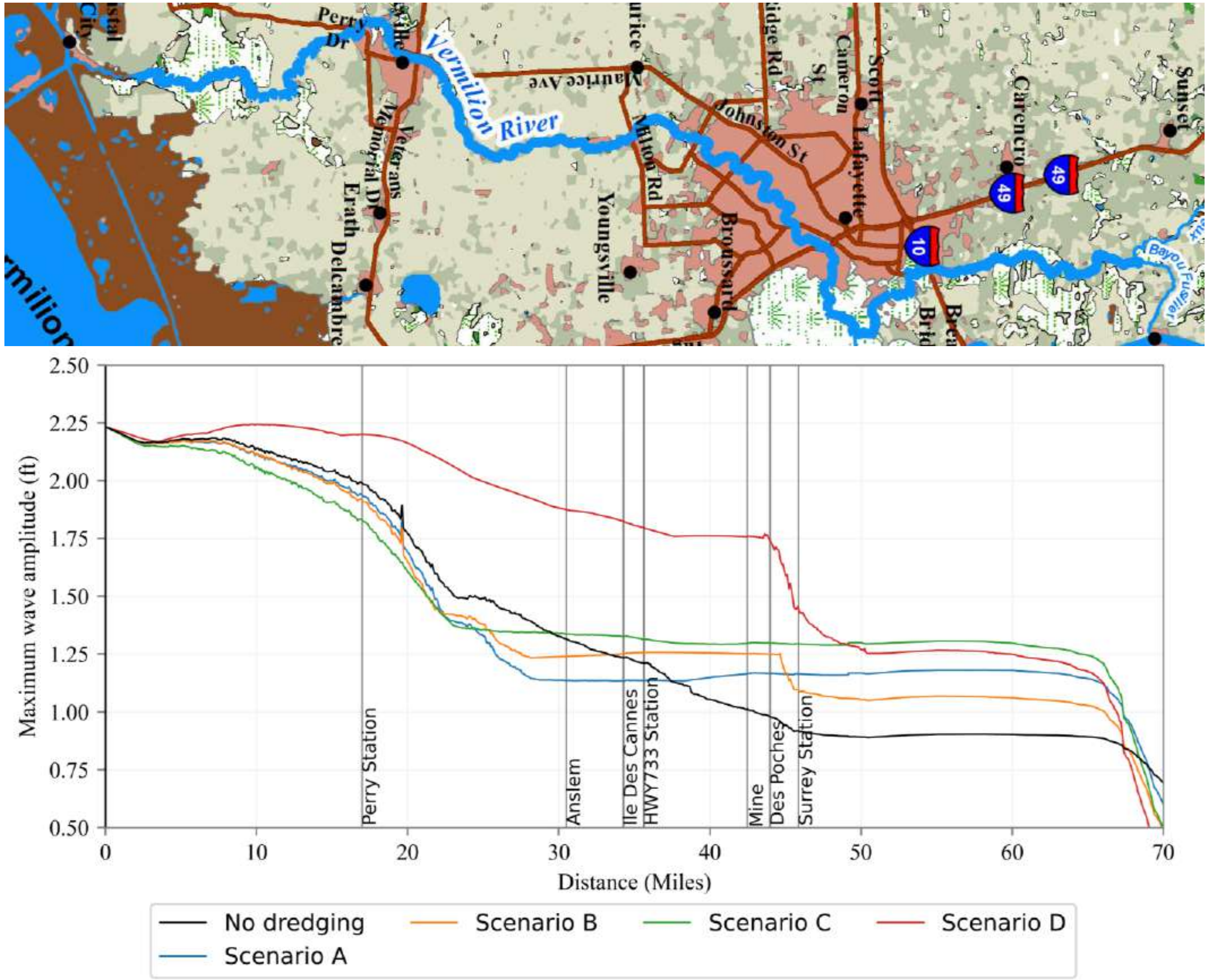
Partial dredging

- Maximum stage reduction = 0.62 feet
- Average stage reduction = 0.48 feet

Vermilion River between railway bridge and Pinhook bridge

Dredging consequences: Increased storm surge exposure

- Regardless of which alternative, dredging can increase tidal wave range along the river.
- Extensive dredging scenarios can lead to increasing landward penetration of tidal signal into the river.
- This has implications for saltwater intrusion, especially for agricultural practices.



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NATURE-BASED SOLUTIONS TO FLOODING

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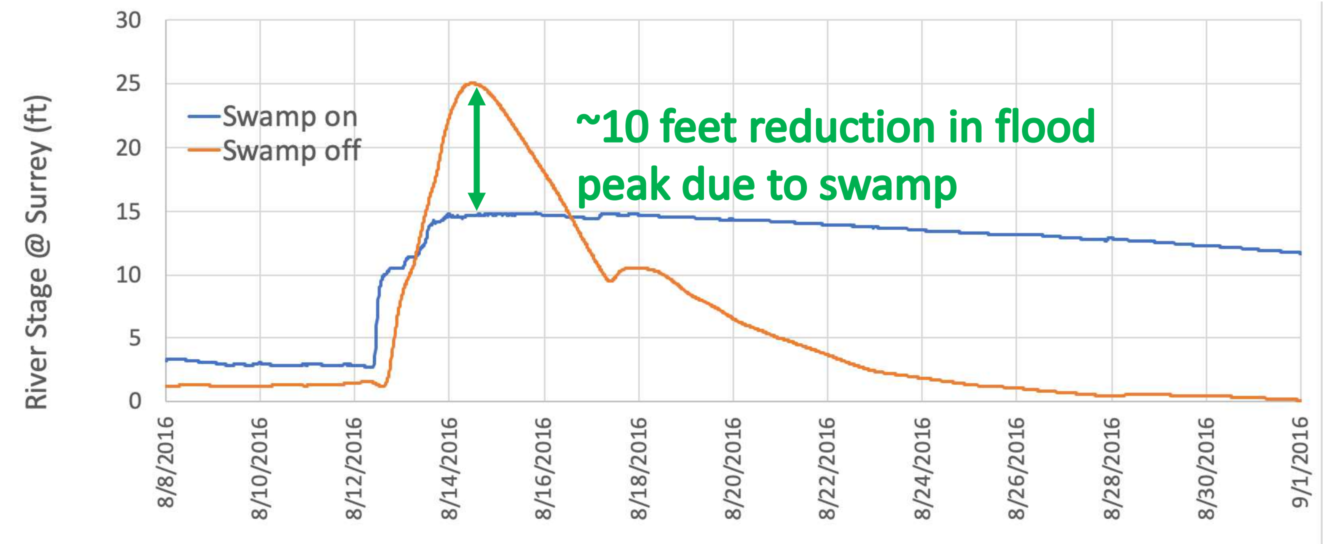
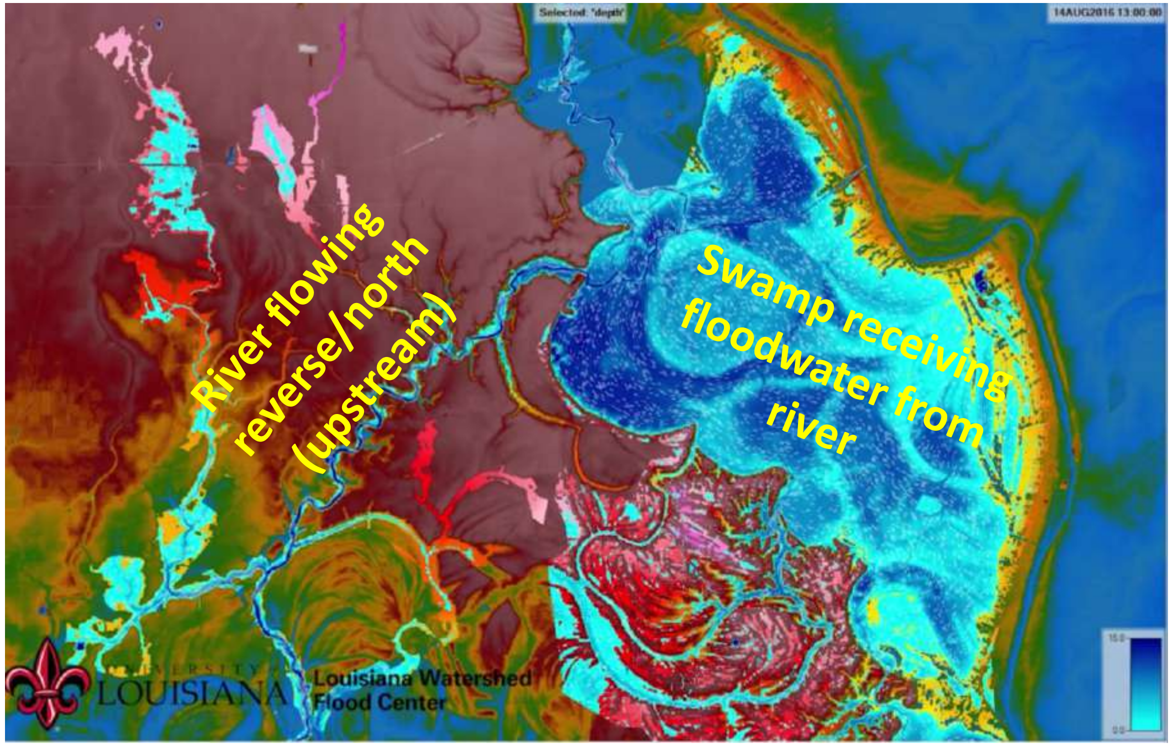
Maximizing benefits of natural features and processes





- Enhance flow exchanges between river and swamp
- Enhance storage capacity of swamp

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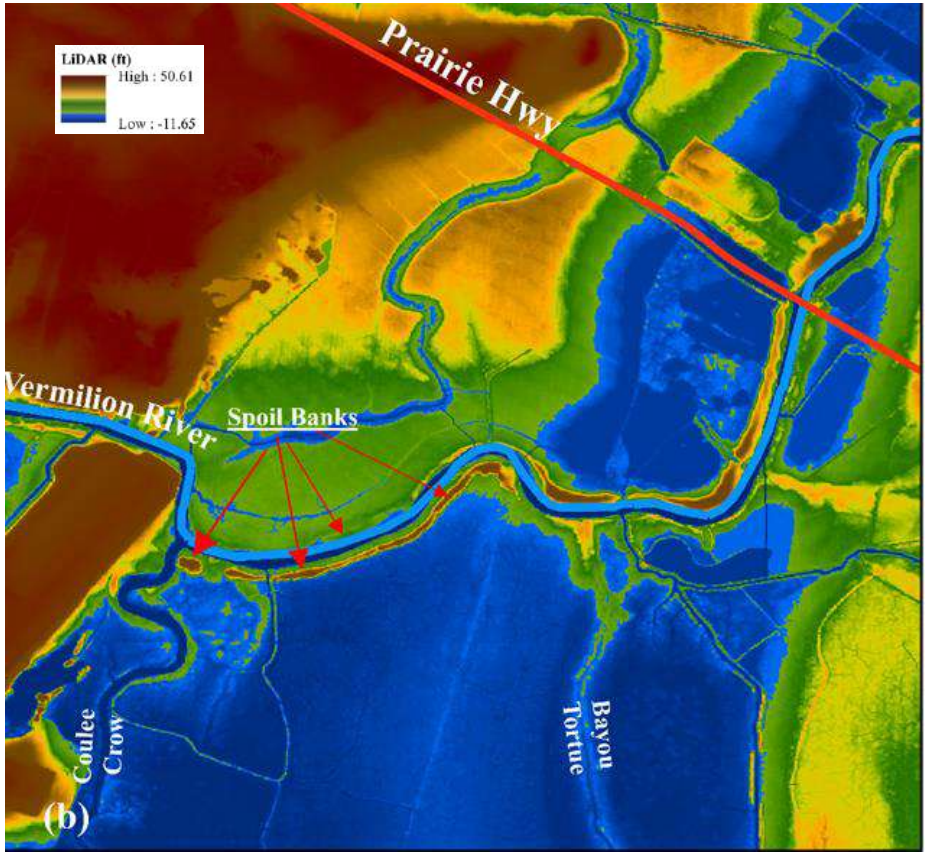
Enhance river-to-swamp flow exchanges:

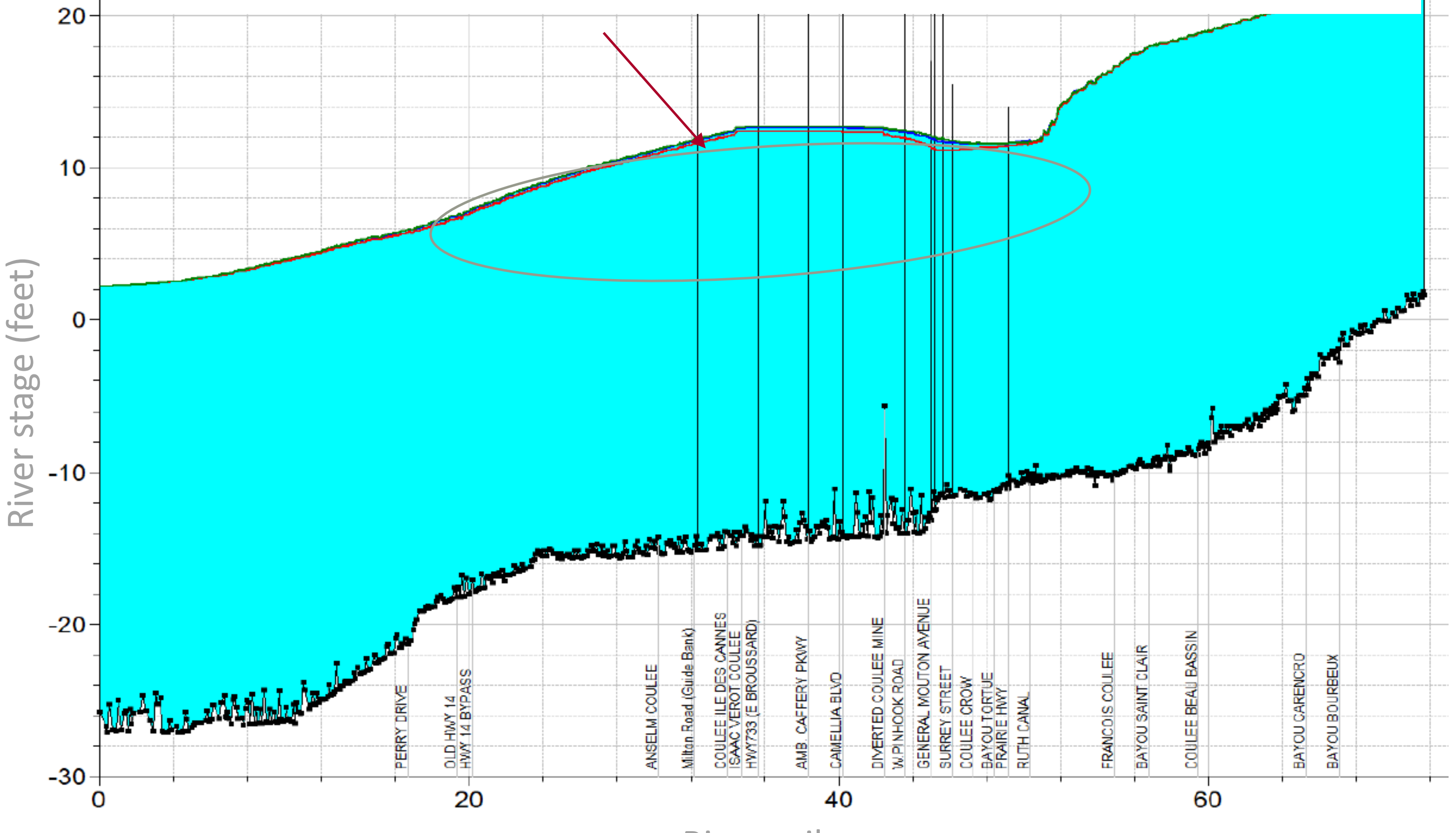
Remove spoil banks to provide relief for the river to flow into the swamp

Volume of cut needed to remove spoil banks: 140,572 yards^3

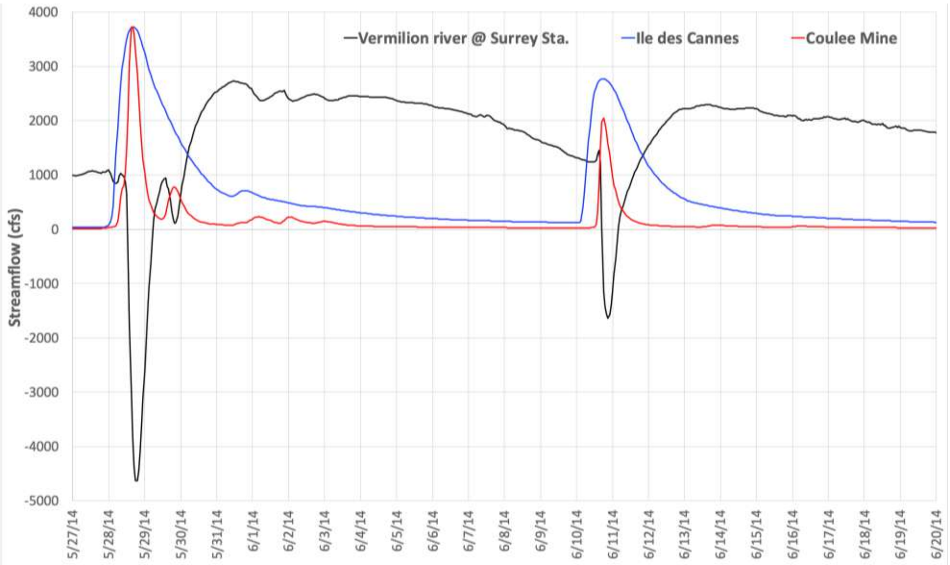
(Recall: dredging required millions of yard^3)

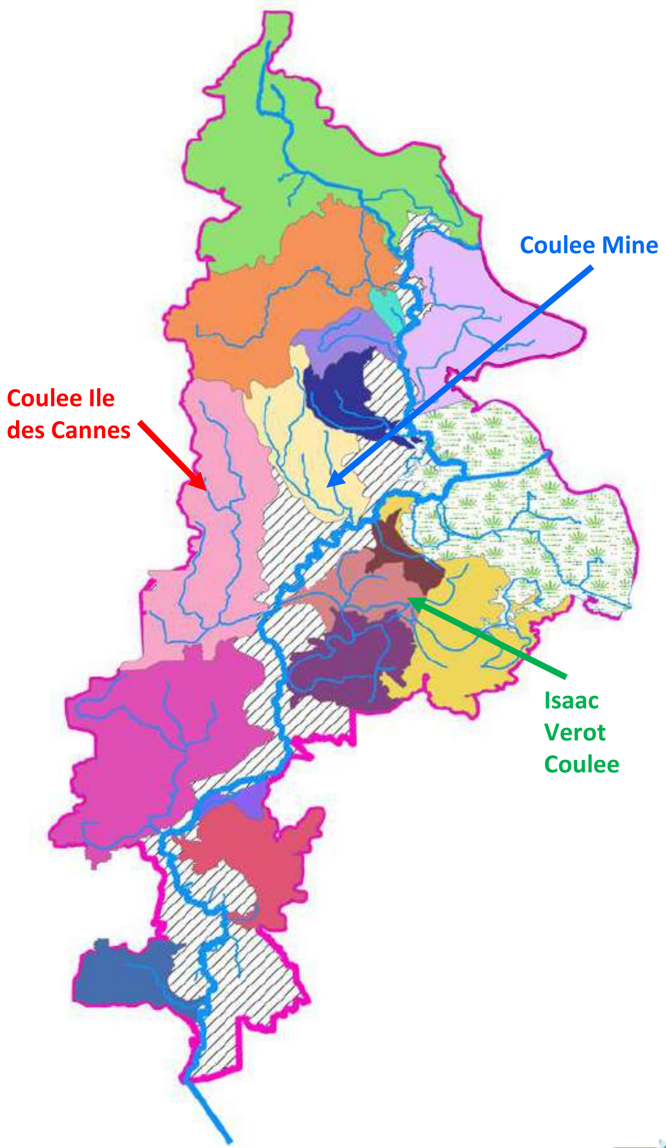


Spoil bank removal dropped river stage by 0.65 ft and provided relief over distance of 29.2 miles.



Strategic detention in tributaries





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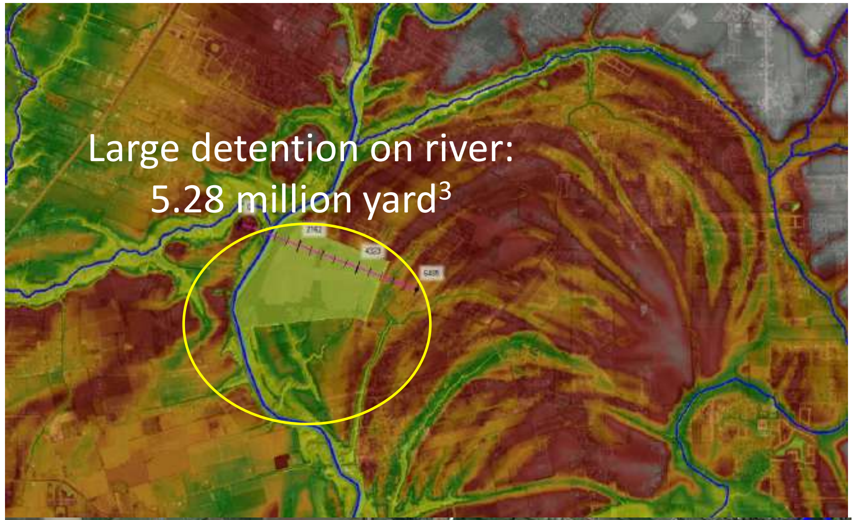
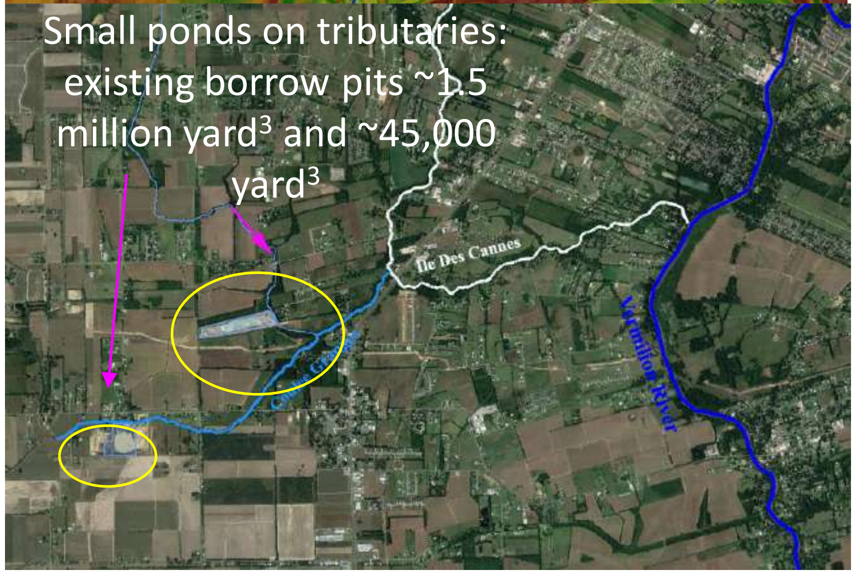
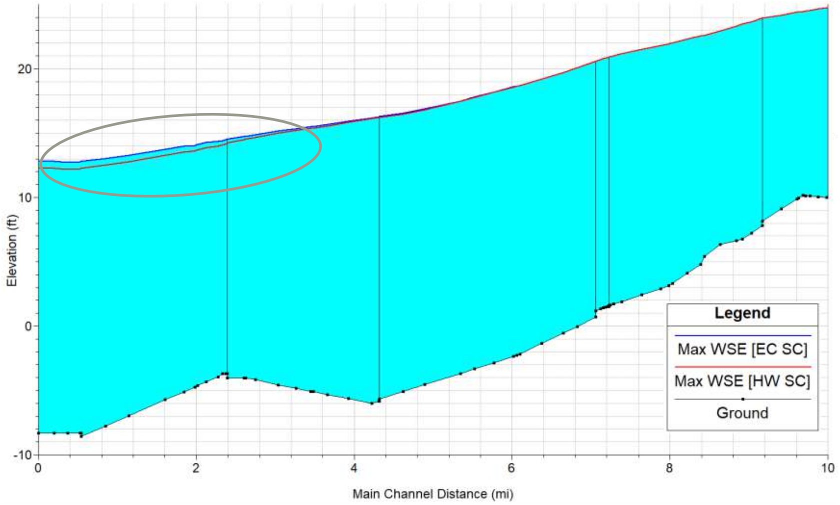
Strategic detention

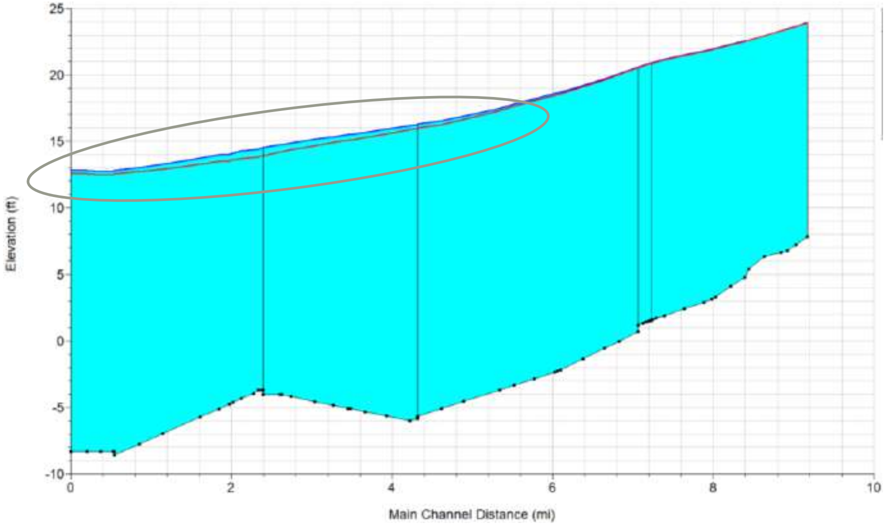






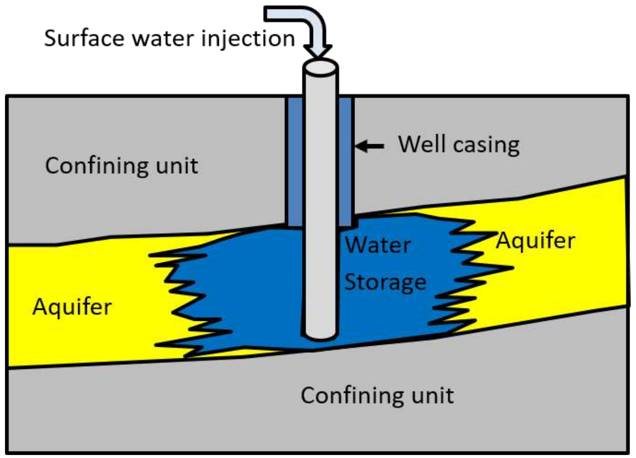
Drop in tributaries: 0.52 feet

Smaller interventions can make large impacts if put in the right place.

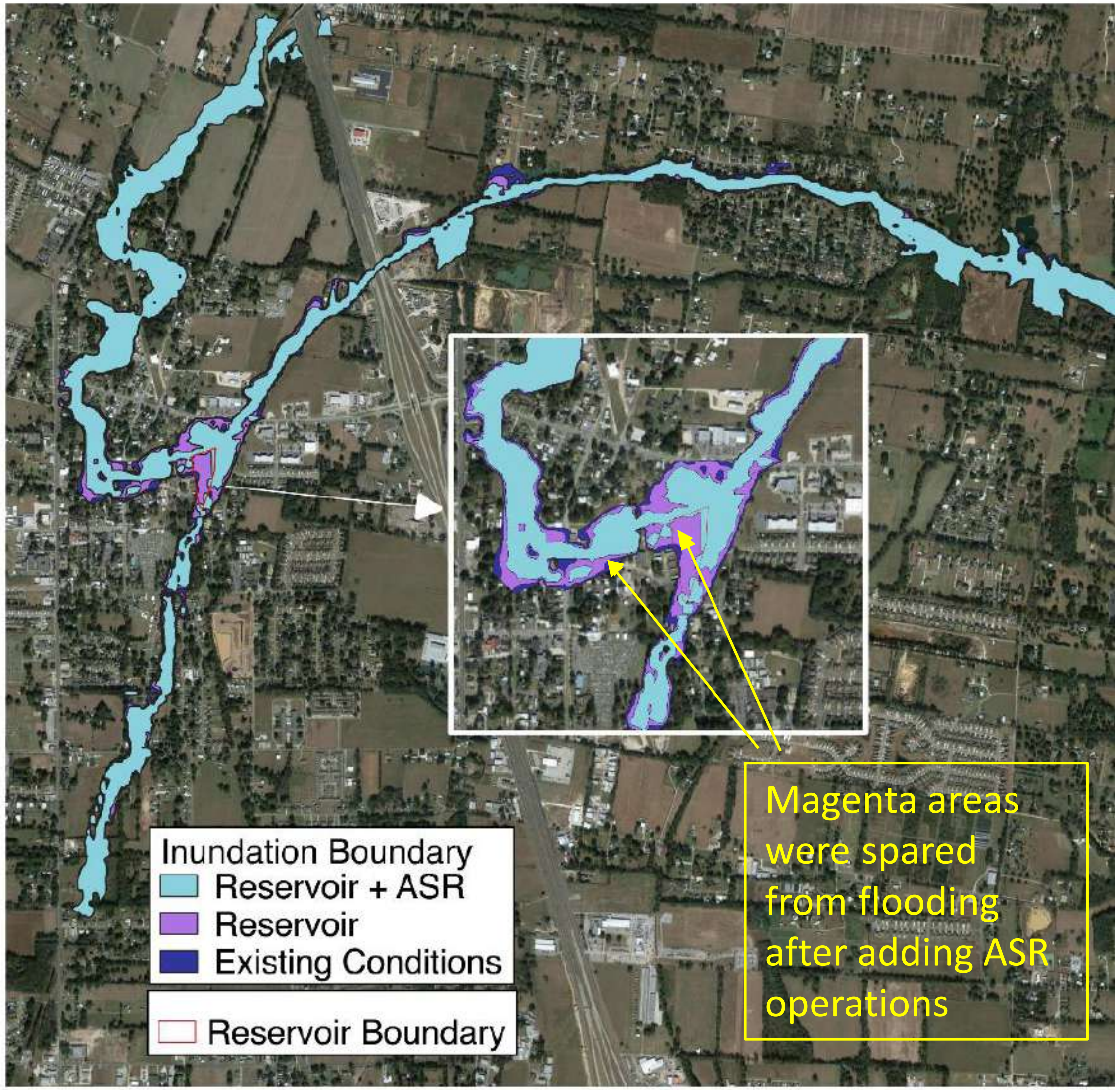


Drop in tributaries: 0.71 feet

Floodwater for aquifer sustainability



- Aquifer Storage and Recovery is an effective strategy for recharging stressed groundwater aquifers (e.g., Chicot Aquifer).
- Can we harvest floodwater, treat it, and inject it into the aquifer using ASR?
- An analysis showed that adding ASR units alongside detention ponds can result in additional flood mitigation benefits.



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Closing remarks

- Complex watersheds require open-minded approaches.
- Impacts of interventions are not trivial.
- Dredging:
  - Reduces local water surface elevations, but has possible downstream impacts
  - Helps main river, but not tributaries
  - Can increase tidal propagation and saltwater intrusion further inland
- Natural detention features provide invaluable flood risk reduction that can be maximized by reconnecting to rivers.
- Rerouting coulees through floodplains can alleviate flooding while enhancing natural functions.
- Detention is not necessarily the most effective solution, but smaller, strategically placed detention can be quite effective.
- ASR can lead to further flood risk reduction if incorporated into detention ponds.

	Partial dredging	Full dredging	Strategic detention	Swamp management
Reduced flood elevation	+	++	++	+
Impact on downstream	--		++	++
Increased tidal signal	-	--	++	++
Cost	$$$	$$$$	$$	$

-- - + ++

negative impacts → positive impacts

QUESTIONS?

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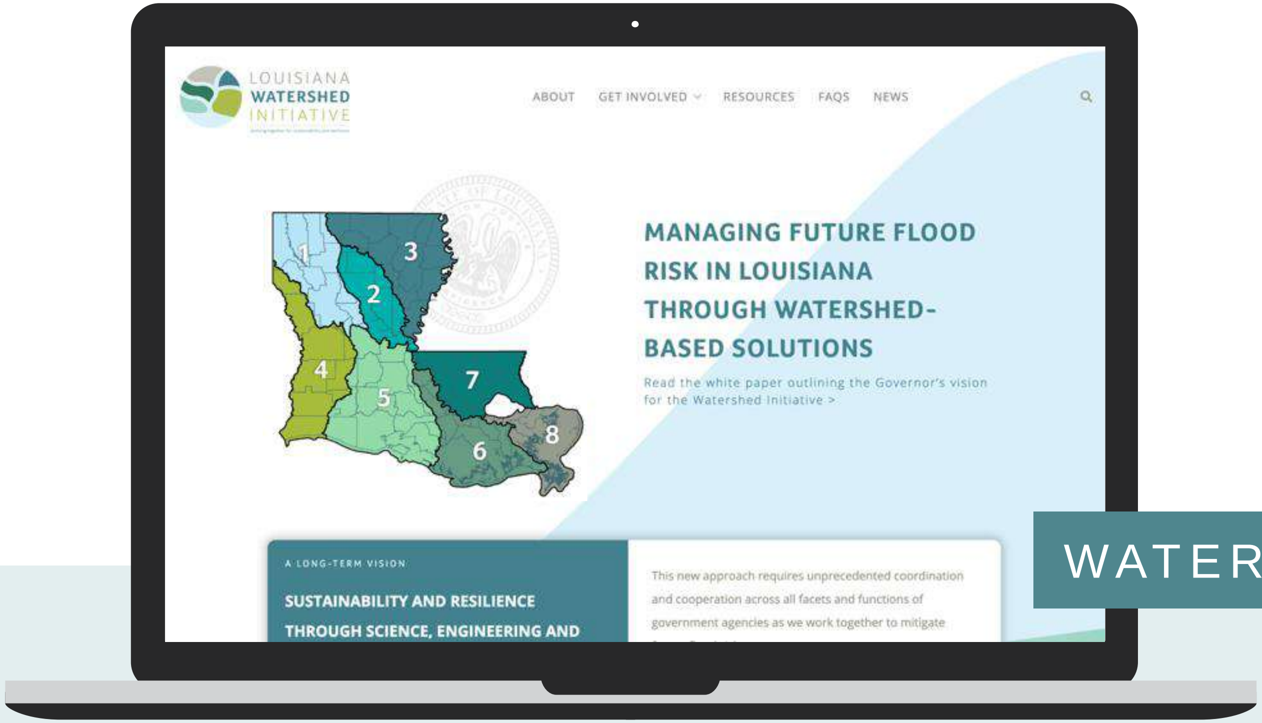
THANK YOU



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