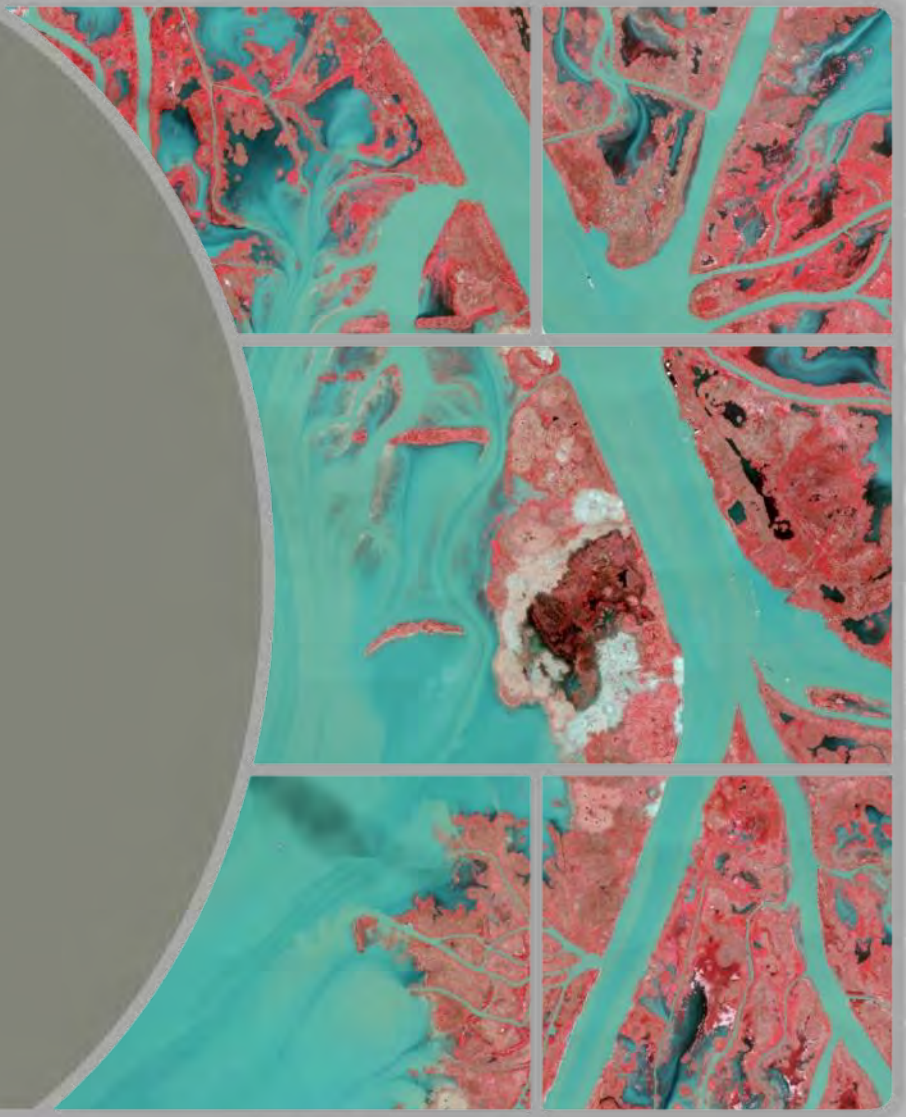
Utilizing a Dredge + Divert Strategy for Restoring Coastal Marsh in West Bay, Louisiana



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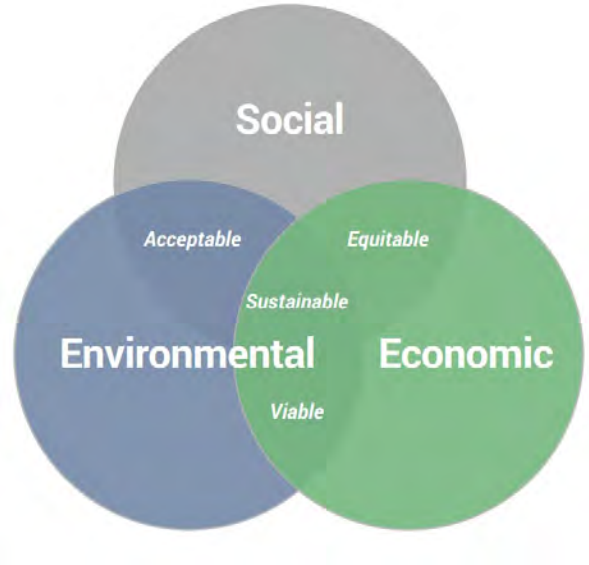
…the intentional alignment of natural and engineering processes to efficiently and sustainably deliver economic, environmental and social benefits through collaborative processes.

- **Key Elements:**
- Science and engineering that produces operational efficiencies
- Using natural process to maximum benefit
- Broaden and extend the benefits provided by projects
- Science-based collaborative processes to organize and focus interests, stakeholders, and partners



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Introduction: Coastal Louisiana

- **Economic**
  - Critical Infrastructure Worth Billions of Dollars
  - Navigation and Port Infrastructure
    - 300 million tons of cargo – **1st in US**
    - **60%** of nation's grain: **17.2 Billion USD**
    - Commercial Fisheries – **2nd in US**

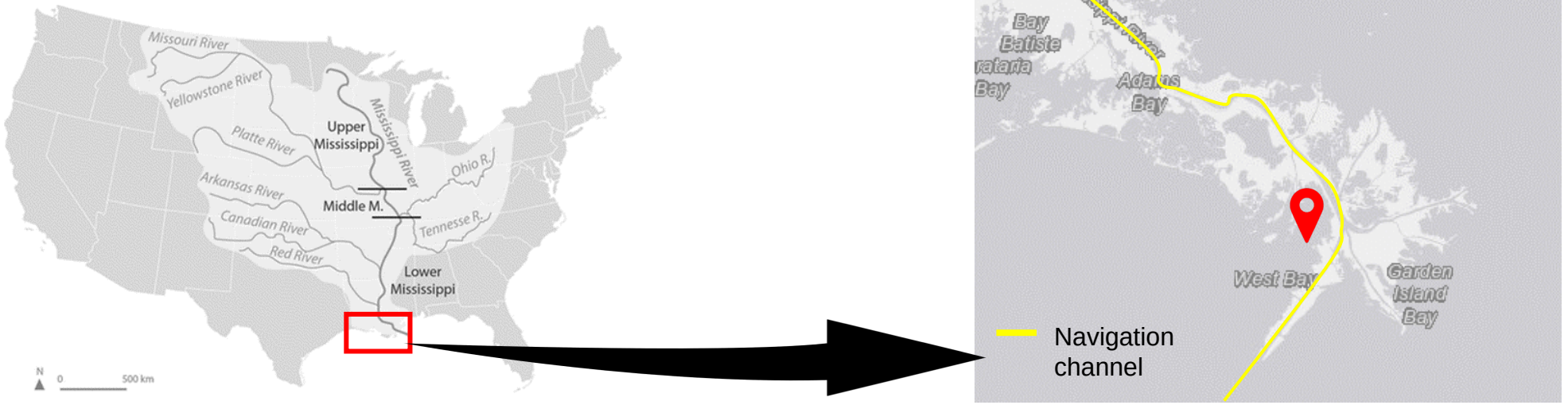
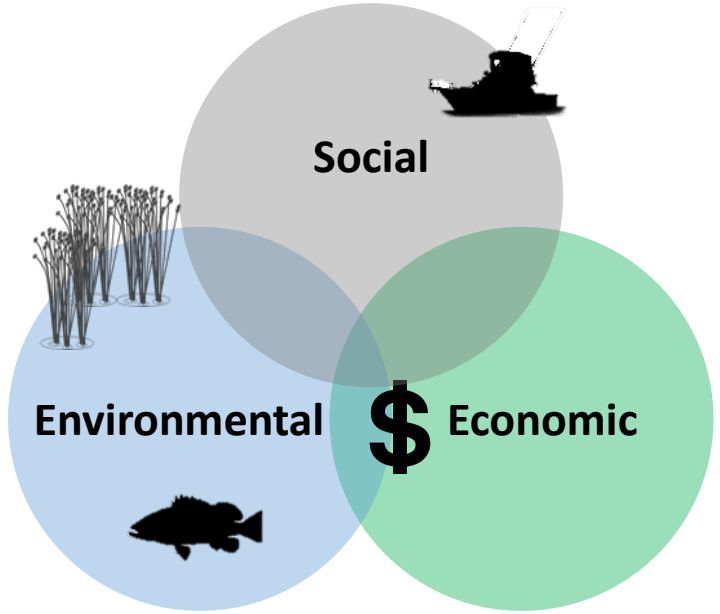
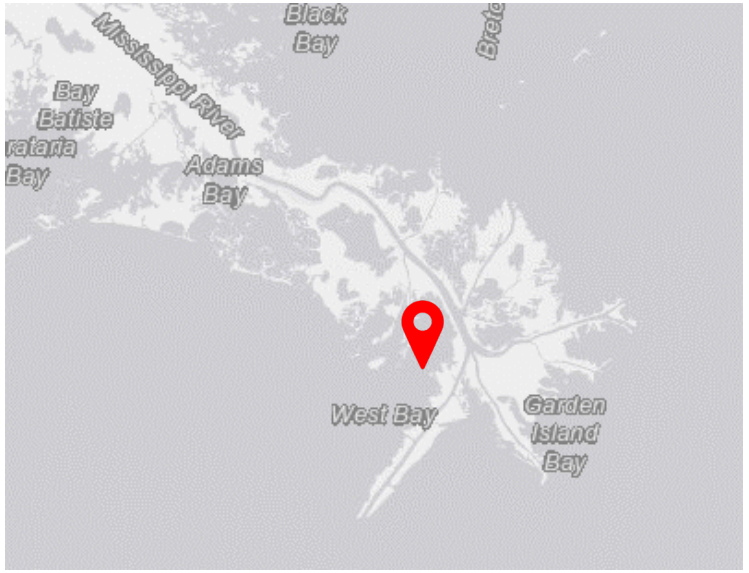


Image from Shadie et al. 2018

Introduction: Coastal Louisiana

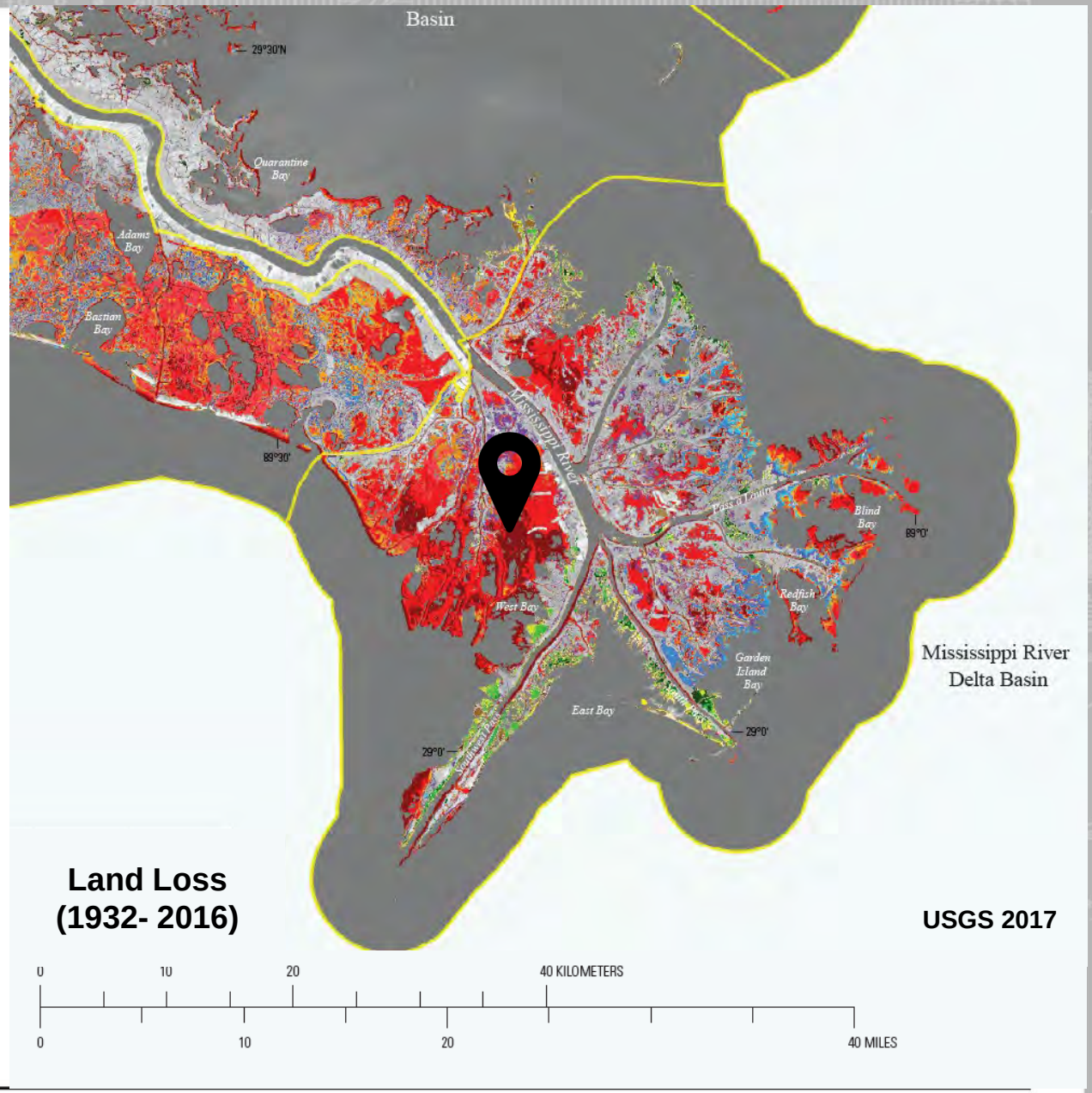
- **Environmental**
  - Marsh Habitat is a Critical Resource
  - **75%** of commercial fin and shellfish depend of marsh for habitat
  - **12 - 47 Billion USD annual** asset value of Mississippi delta (Batker et al. 2014)
- **Social**
  - Storm Surge and Flood Risk Protection
  - Recreation
    - Hunting/ Fishing/ Boating





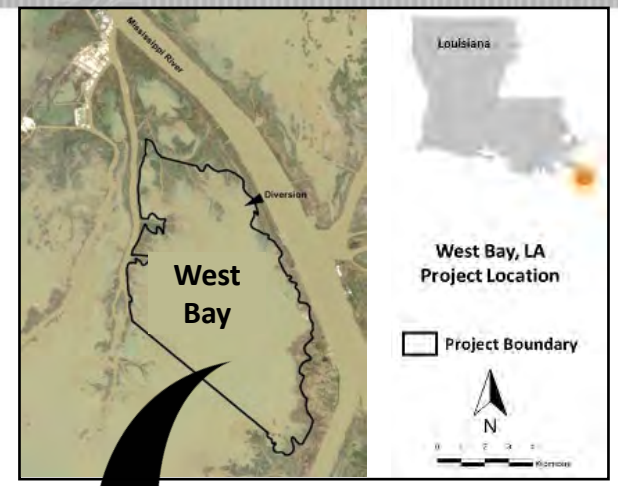
But… Land Losses

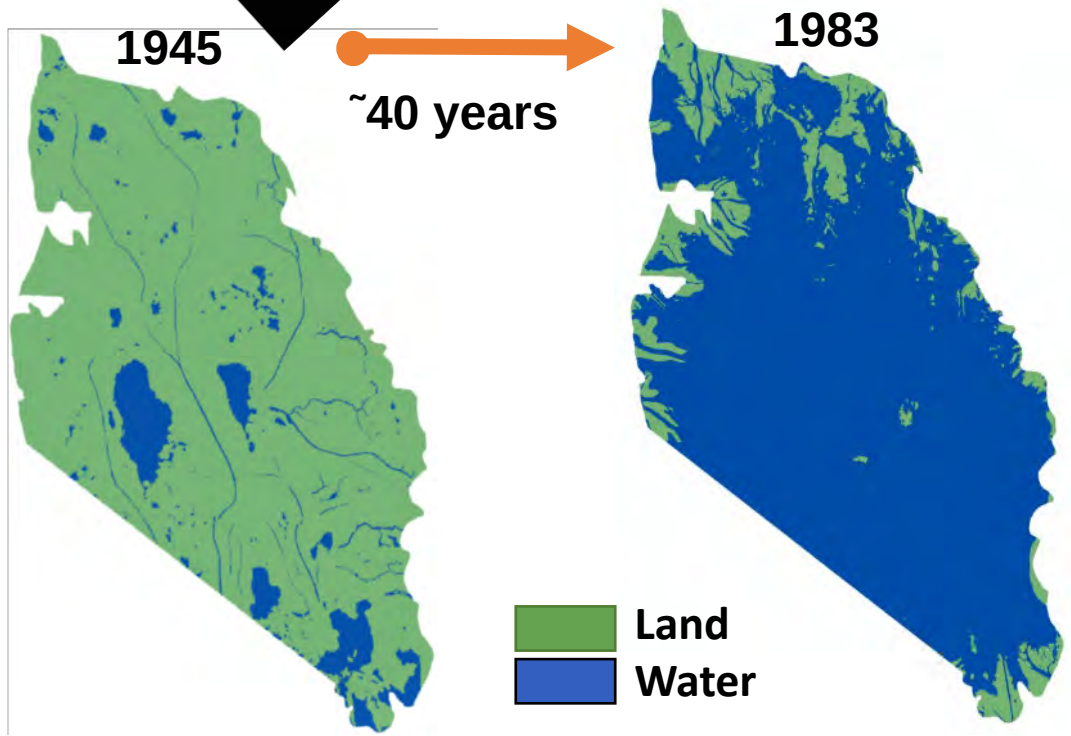
- Coastal Louisiana has sustained immense coastal land losses
- Erosion, subsidence, sea level rise
- ˜16 sq miles lost/year since 1985 (USGS 2017)
- **West Bay** is an example of this…



Introduction: West Bay

- **12,000 acre** sub-delta
- Lost **>70%** of land since the 1940's
- Stability of Federal navigation **bankline was threatened**
- In 2003 – approved for restoration under the **Coastal Wetlands Planning, Protection, and Restoration Act (CWPPRA)**
- **Restoration goals:**
  - 1) increase the land:water ratio
  - 2) increase mean elevation in the wetlands
  - 3) promote marsh habitat
- **Restoration at these scales require a different way of thinking….**





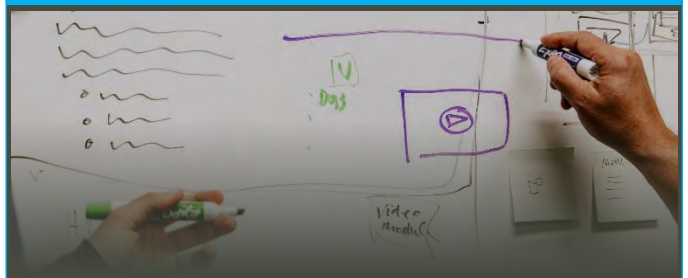
Objectives

1. Document restoration strategies used in West Bay:
   a) Uncontrolled sediment diversion
   b) Sediment Retention Enhancement Devices (SREDs)
   c) Strategic and direct dredged sediment placement

2. Document changes in **land:water ratios** and **land classifications**

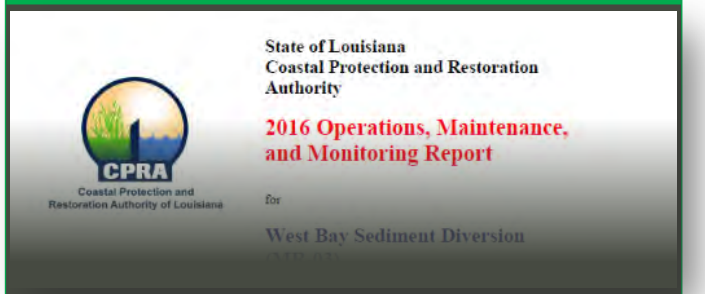
3. Identify **EWN concepts and principles** applied during the project with the goal of **informing future projects**

Methods



Stakeholders

Meetings with stakeholders and researchers to provide historical context of restoration



Literature Review

Peer-reviewed and grey literature of restoration actions

Data from CWPRRA sponsored field vegetation surveys

GIS Analysis

Land:water analysis and land cover classifications

Image classification of Landsat satellite imagery using ENVI® software

Acreage totals using the ArcGIS® zonal statistics tool

Results: Uncontrolled Diversion of Mississippi River

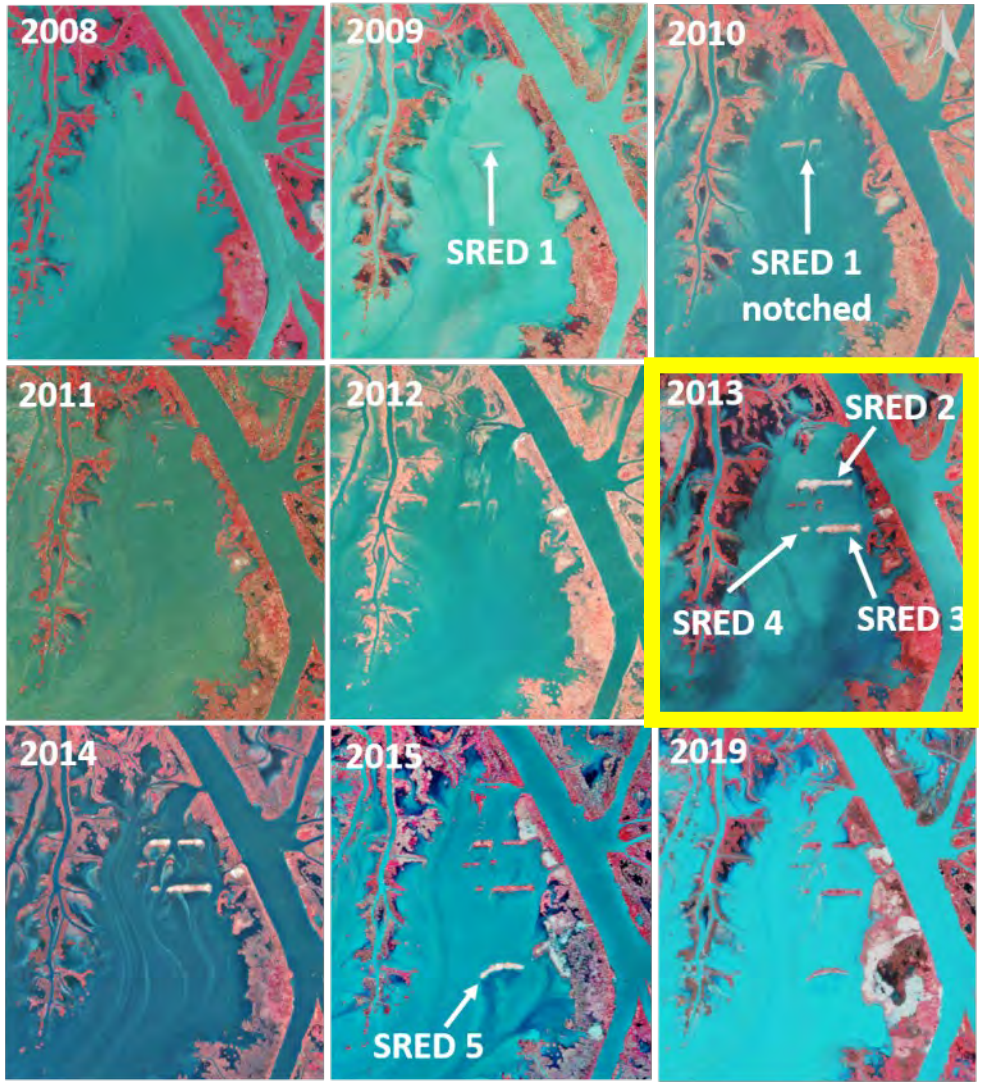
- Diversion strategy informed by:
  - Loss and Marsh Creation (LLMC) study determined that sediment diversions were potentially viable methods for marsh creation (USACE 1984)
  - Smaller scale diversions created in the 1980s and 90s in the lower Mississippi River delta region

- Bank notched in 2003 – target 20,000 cfs flow
  - Notch location was aimed to mimic a natural crevasse splay document circa 1838 (Allison et al. 2017)
  - The sand fraction is important to land building processes (Dean et al. 2014)
- First 5 years – evidence of land building was minimal…

Results: Sediment Retention Enhancement Devices (SREDs)

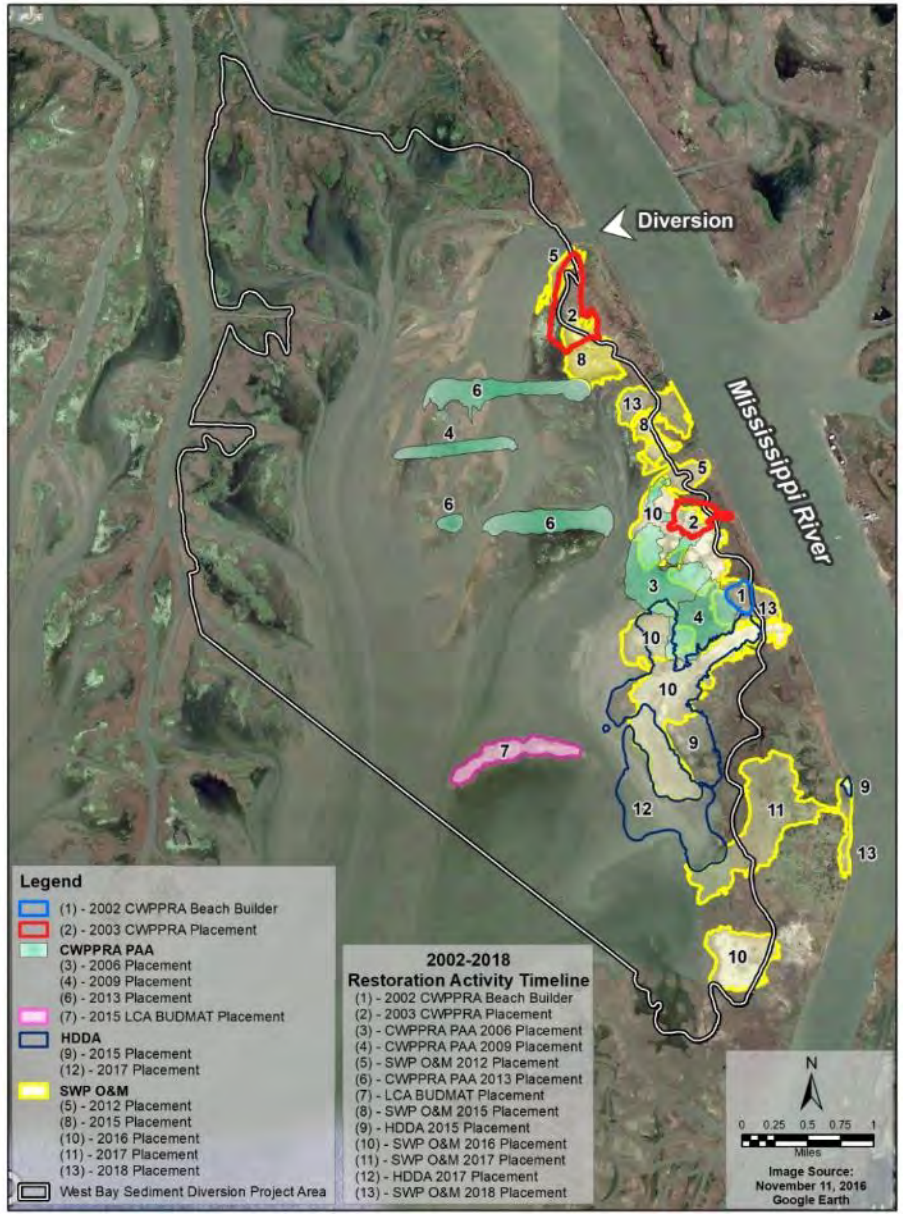
- Dynamic berms: Goal to increase sediment deposition
- **10 years post-diversion** - hydrodynamic and sediment transport modeling data indicated that the diversion shifted from **erosional processes** to **depositional processes** (Yuill et al. 2016)

Year	SRED	Cubic Yards of Dredged Sediment	Land Created (Acres)
2009	1	386,233	35
2013	2	1,325,614	97
	3	1,308,435	86
	4	328,567	13
2015	5	2,299,295	80

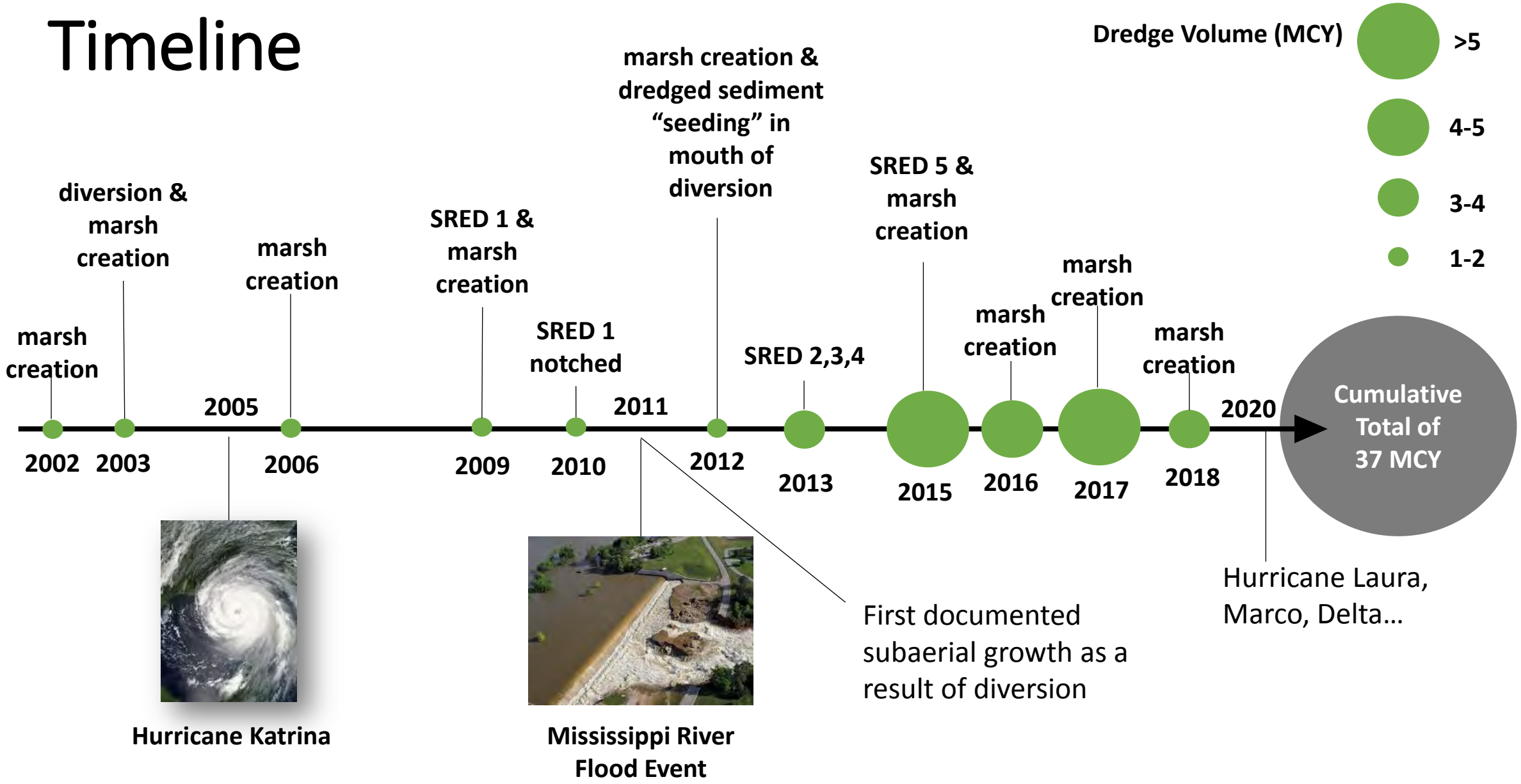


Results: Dredged Sediment Placement

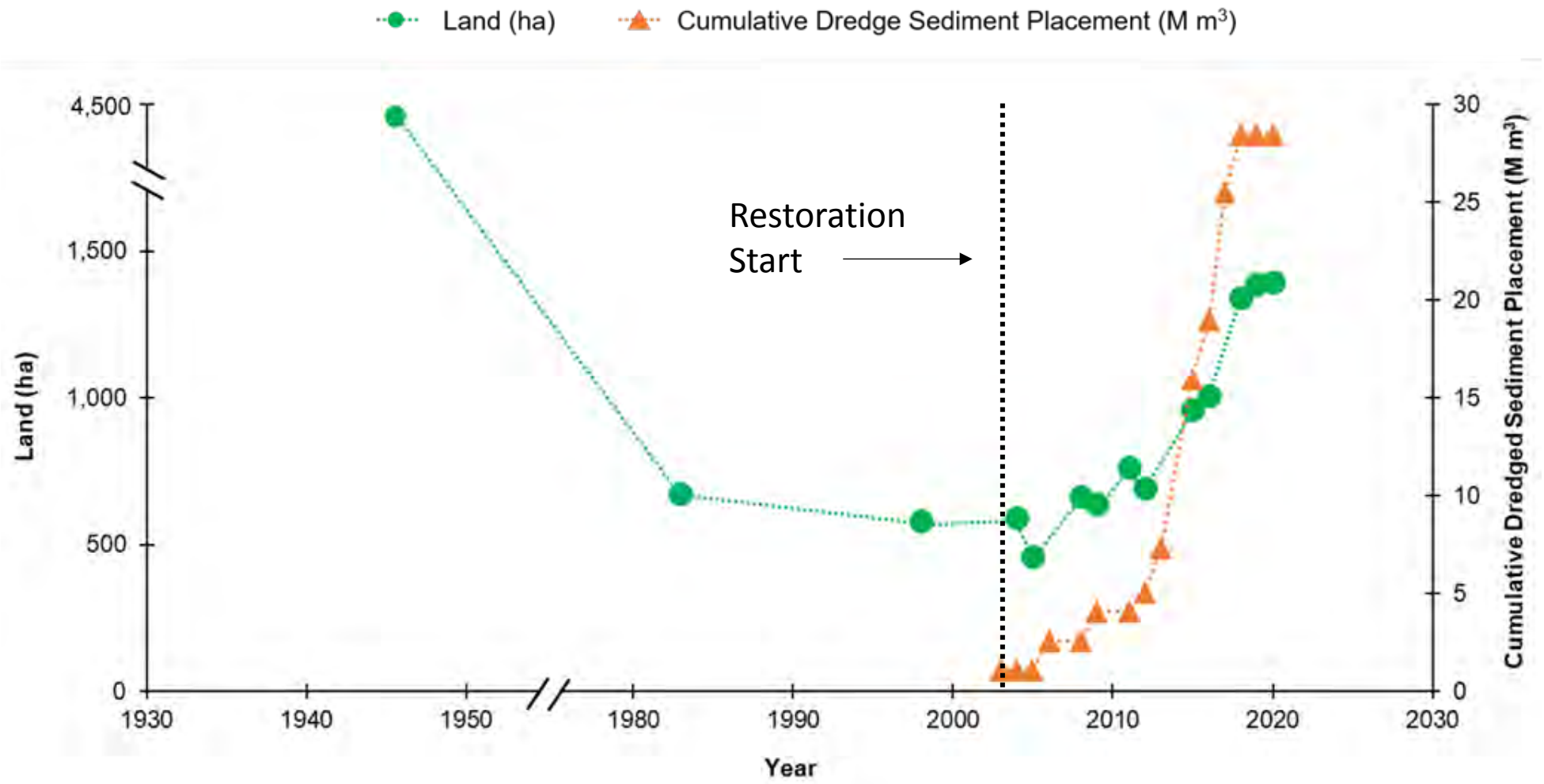
- Strategic Placement into the Diversion (2012)
  - Hydraulic pumping to mouth of diversion
  - Semi-confined using existing landforms
  - **600,000 CY**
  - Cost effective
  - **Goal to 'seed' bay**
- Direct Placement on Eastern Bank (2003 – 2019)
  - **37 MCY** of dredged sediment
  - **Estimated 2,300 acres of land created**



Timeline


Dredge Volume (MCY)
>5
4-5
3-4
1-2
marsh creation
2002
diversion & marsh creation
2003
2005
marsh creation
2006
SRED 1 & marsh creation
2009
SRED 1 notched
2010
2011
marsh creation & dredged sediment "seeding" in mouth of diversion
2012
SRED 2,3,4
2013
SRED 5 & marsh creation
2015
marsh creation
2016
marsh creation
2017
marsh creation
2018
2020
Cumulative Total of 37 MCY
Hurricane Katrina
Mississippi River Flood Event
First documented subaerial growth as a result of diversion
Hurricane Laura, Marco, Delta…

Results: Land:Water Analysis



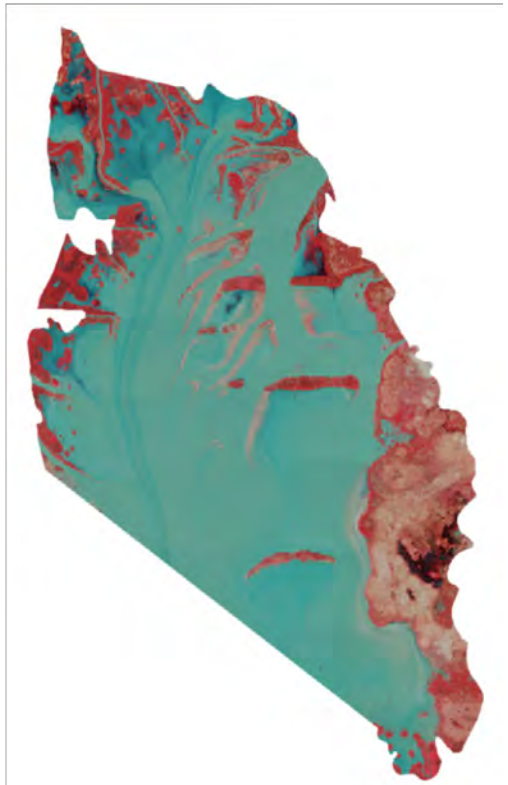
2005

	Acres
Land	**1,133**
Water	11,132

Land Gain

+ 2,300 ac

2020

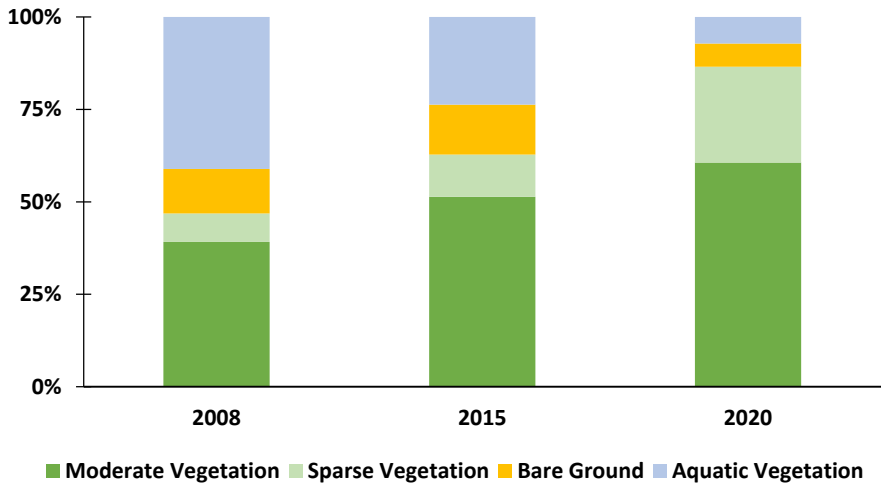


	Acres
Land	**3,457**
Water	8,808

Edge Habitat Gain: from 47 to 258 linear mi (+211 mi)

Results: Land Classification and Vegetation

- Ground vegetation surveys (Plitsch 2017)
  - New land vegetated quickly
  - Newly created (bare ground) shifting to sparse to moderate cover vegetation
- Fresh to Intermediate Marsh
  - Floristic Quality Index (FQI) indicate better than region average habitat quality
- Dominate species:
  - Common reed (*P. australis*); delta bulrush (*S. deltarum*); wildrice (*Z. aquatic*)



Results: Land Classification and Vegetation

2008

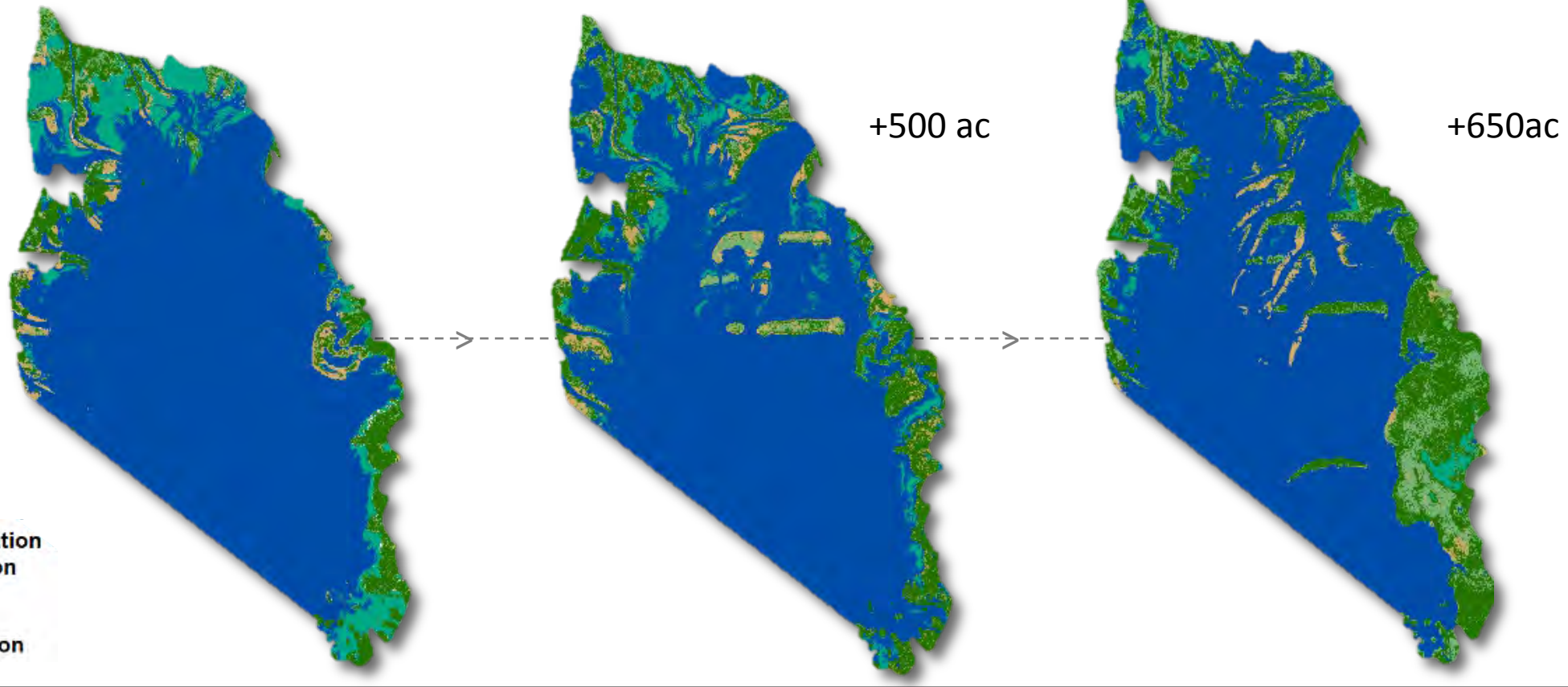
1,091 ac moderate vegetation ground cover

2015

1,595 ac moderate vegetation ground cover

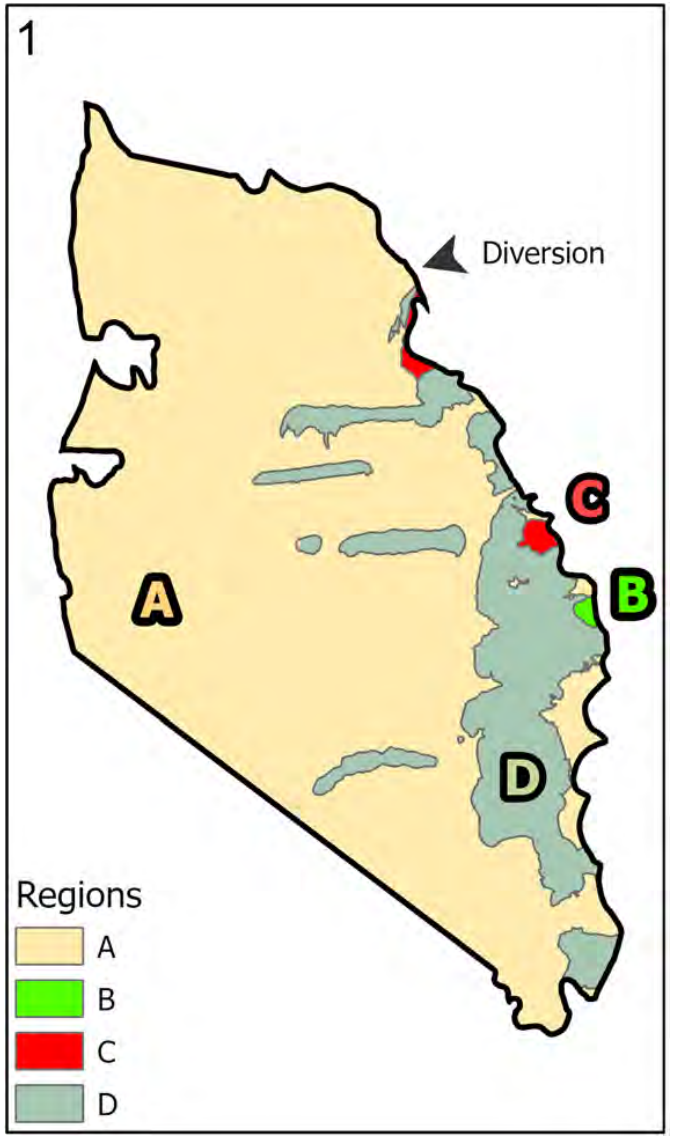
2020

2,252 ac moderate vegetation ground cover



Results: Uncontrolled Diversion

- No DM placement in this area
- Sediment-laden flows from MS River
- Trapping sediment by SREDs
- Diversion Benefits (2005-2020)
  - 700 ac (292 ha) diversion (A)
  - 1,600 ac (646 ha) DM placement (B, C, D)
  - Total combined land area: 2,300 (938 ha)
- For every 2 acre of land created by DM placement, 1 acre land created by the diversion



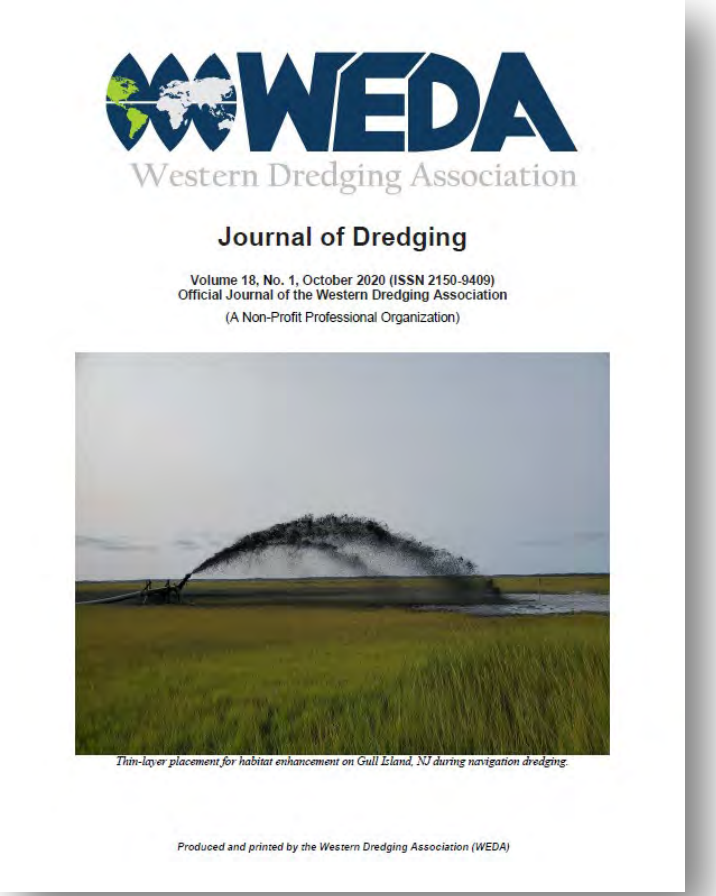
Summary

- Uncontrolled diversions can take decades before subaerial creation of land is fully realized - future project goals should reflect these realities
- SREDs constructed using strategic and direct placement of dredge sediment directly contributed to increase the rate and extent of sediment retention
- Strategic and beneficial use of dredged sediment were ecologically meaningful contributions to land restoration
- Utilizing a Dredge + Divert strategy for restoring coastal marsh in West Bay successfully applying EWN principles, achieving multiple benefits
- Coastal Louisiana is poised to invest **billions of dollars on restoration**, thus lessons learned from projects like West Bay are critical to inform future work

Resources

WEDA Journal of Dredging
"Restoring Marsh Habitat with Beneficial Use of Dredged Sediment from a Riverine Environment."
WEDA Journal of Dredging. 18(1):1-19.
https://www.westerndredging.org/journal

Integrated Environmental Assessment and Management (IEAM)
"Beneficial Use of Dredged Sediment as a Sustainable Practice for Restoring Coastal Marsh Habitat."
Integr. Environ. Assess. Manage. DOI: 10.1002/ieam.4501.



EWN THE ENGINEERING WITH NATURE PODCAST

Episode 2

Using Natural Forces and Sediment to Restore Coastal Marsh Habitat

Guest: **Jeff Corbino,** Chief, Environmental Function, Operations Division - Technical Support Branch, New Orleans District, US Army Corps of Engineers

EWN website: www.engineeringwithnature.org

Apple Podcast link: https://podcasts.apple.com/ca/podcast/ewn-engineering-with-nature/id1528233207

Dredging Partners

- Coastal Wetlands Planning, Protection, and Restoration Act (CWPPRA) partnered with
  - **Weeks Marine, Bean Dredging, and Mike Hooks**
  - Initial construction of diversion, SRED construction, and maintenance of the Pilottown Anchorage site
- Hydraulic Dredging Disposal Area (HDDA) maintenance dredging and Federal O&M of Southwest Pass dredging
  - **Great Lakes Dredge and Dock, Weeks Marine, and Manson Construction**

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