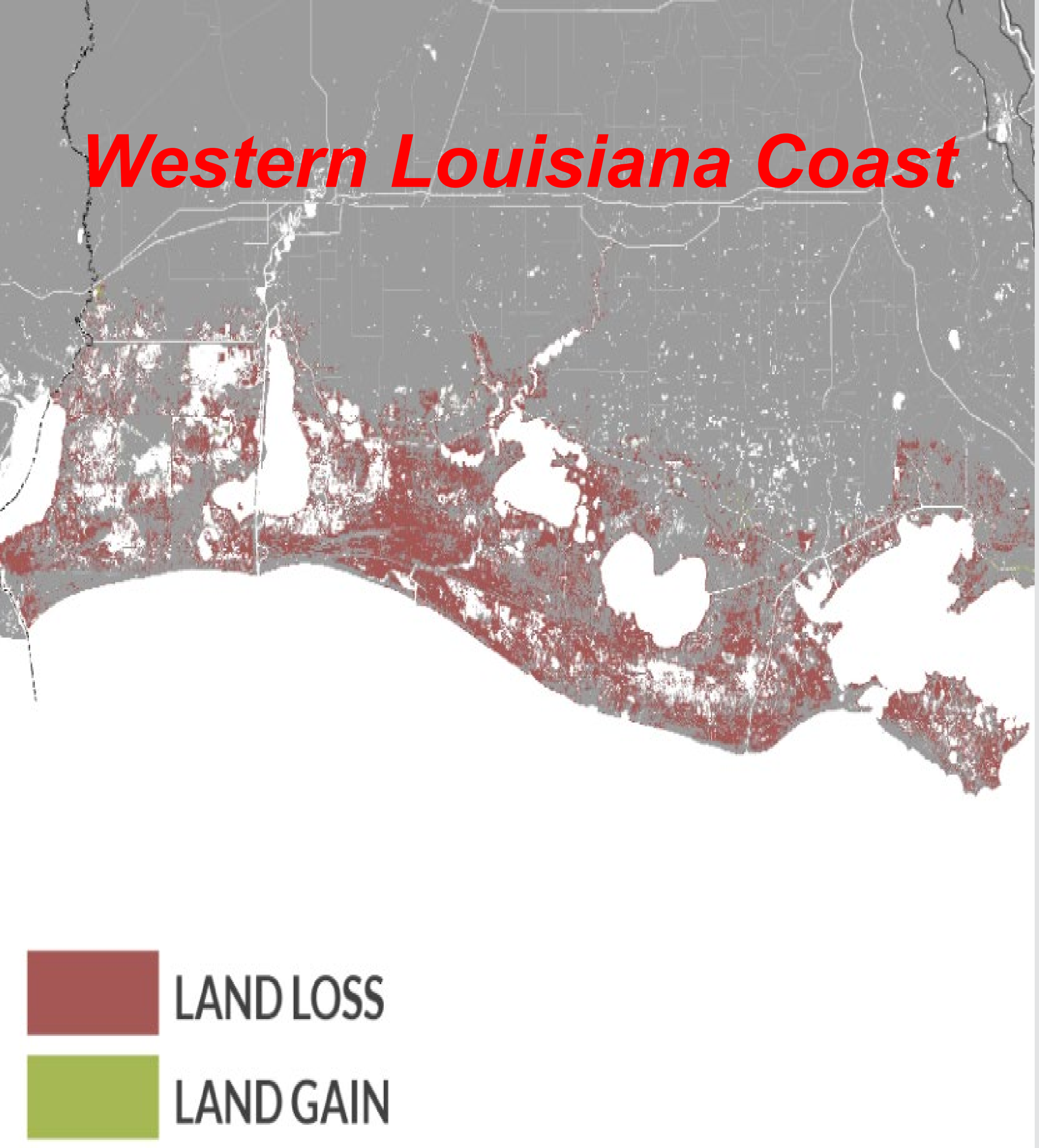
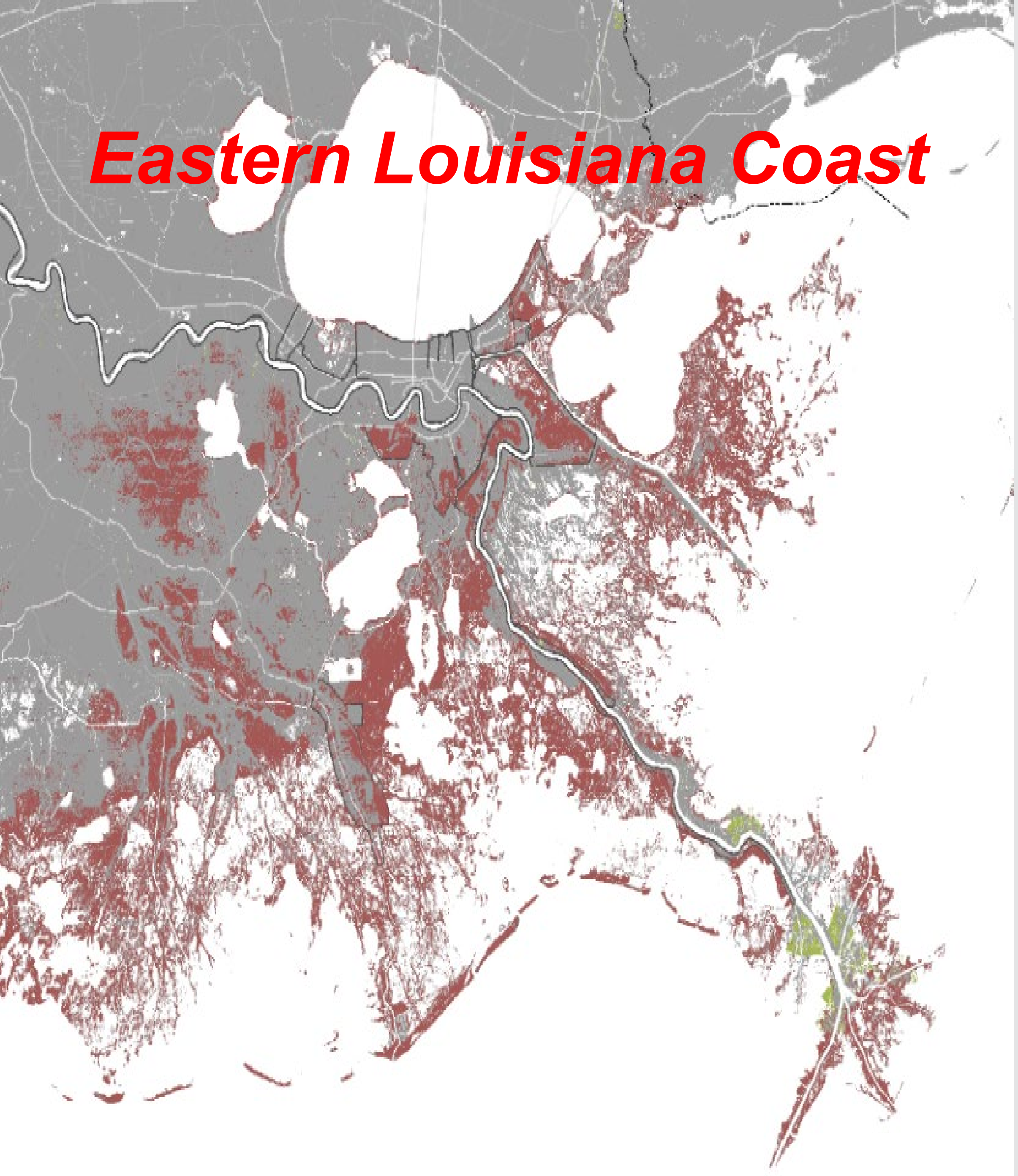


Coastal Protection & Restoration Authority, 2018

Have you heard this story?

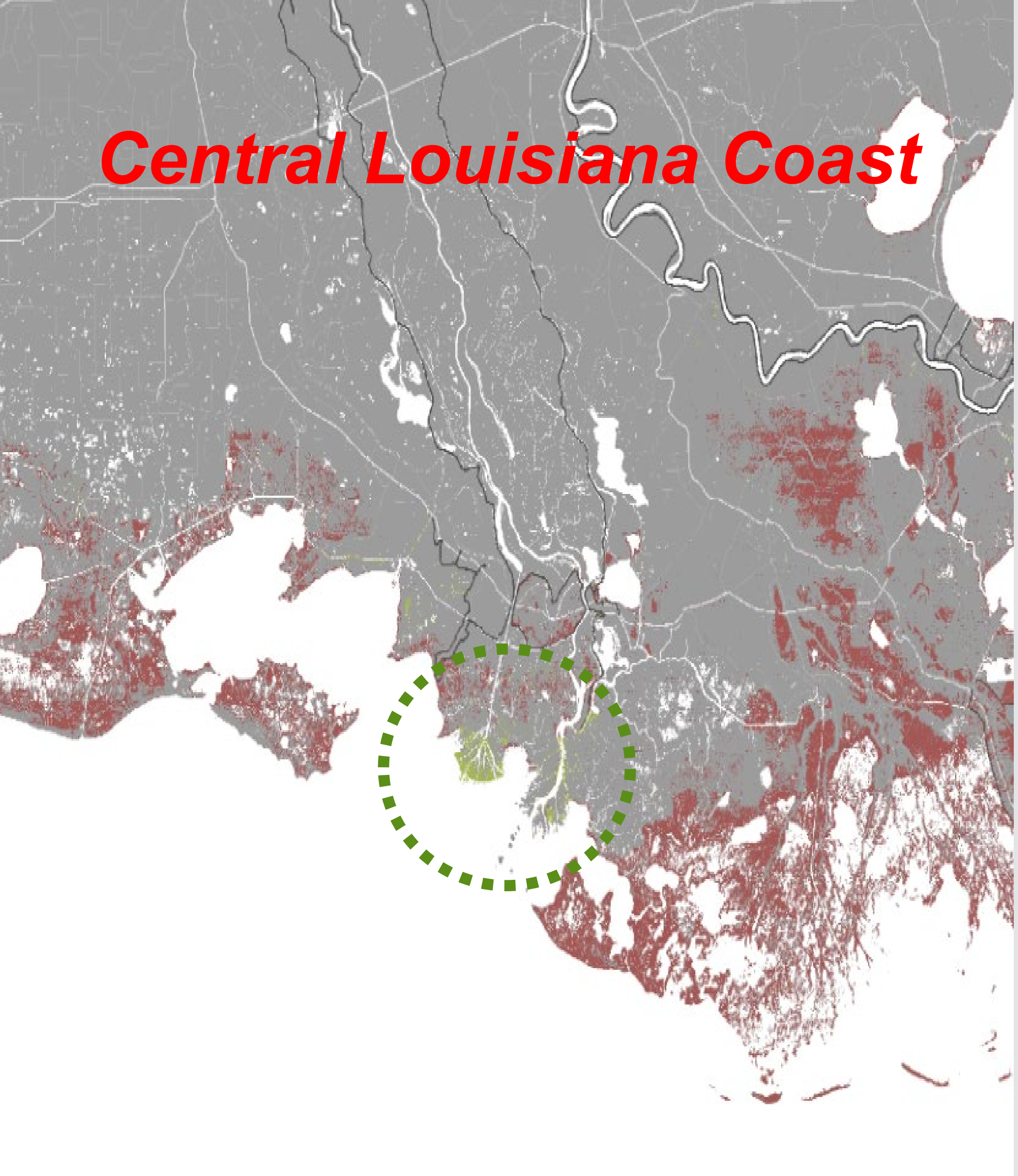
- Coastal Louisiana's fragile wetlands are ***disappearing***
- Massive flood protection levee construction has ***diminished*** healthy wetland growth
- Development & agriculture add to wetland ***deterioration***
- Barrier islands ***disintegrate***, further impacting wetlands



Coastal Protection & Restoration Authority, 2018

As the story worsens…

- Canals for oil & gas production have only ***exacerbated*** this problem
- Louisiana's delta wetlands are left ***exposed*** to
  - wave action,
  - storm surge,
  - salinity intrusion,
  - tidal currents,
  - detrimental sediment transport



Coastal Protection & Restoration Authority, 2018

An unexpected turn?

- These all combine to ***accelerate*** wetlands loss
- Wait, what is all this ***wetland growth*** doing on our ***wetland loss*** map?
- ***Wax Lake Outlet***
  - ***Wax Lake Delta***
  - ***Atchafalaya River Delta***

1984
Wax Lake Outlet
Atchafalaya River
N
5 km

"We've been working on this for a long time, & we haven't come up with a better way to do it, better than what nature figured out billions of years ago." -

Dr. Paul Kemp, Coastal Oceanographer & Geologist Louisiana State University

Wax Lake Outlet: Just about the Greenest Accidental Delta You Ever Saw

"Currently, 30 to 40% of all dredged material from federal navigation channels is used beneficially for such purposes as nourishing beaches & enhancing wetland habitats."

Carol C. Coleman, USACE-ERDC public affairs specialist

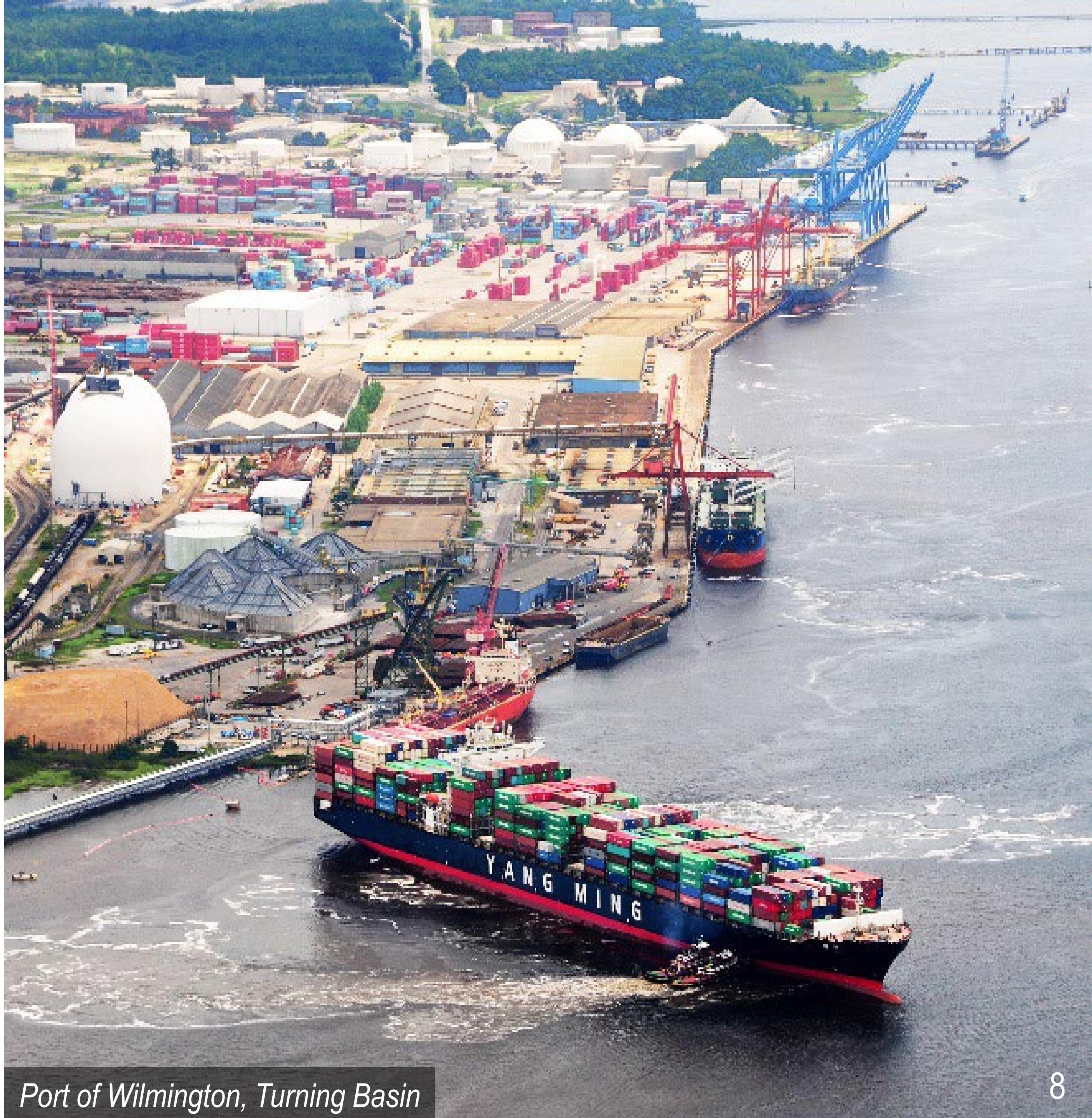
Ongoing R&D is Discovering New Ways to use Dredged Sediments

HDR

Hydrodynamic Dredging in the US - Challenges & Opportunities

February 02, 2023

FLORIDA SHORE & BEACH
PRESERVATION ASSOCIATION
A League of Cities and Counties on Beach and Coastal Issues



Port of Wilmington, Turning Basin

Outline

- **Wax Lake Outlet**
- **Hydrodynamic Dredging**
  - **Water Injection Dredge (WID)**
    - **Environmental Considerations**
    - **Economic Benefits**
- **Case Studies**
  - **North Carolina State Ports Authority (NCSPA)**
  - **Virginia Port Authority (VPA)**
  - **North Carolina Department of Transportation (NCDOT) Ferry Division**
- **Summary**

Port of Morehead City, Ocean Inlet

Dredging Methods - Hydrodynamic Dredges

Water Injection Dredge, Damen, Netherlands

Comparison of Dredging Techniques

Hydraulic & Mechanical Dredging are ***traditional dredging*** techniques that hydraulically or mechanically remove sediments from a waterbody

In comparison, all ***Hydrodynamic Dredging*** techniques horizontally transport the dredged material, ***entirely within the water column***

All ***Hydraulic & Mechanical Dredged*** sediments are ***transported*** using buckets, pipeline, hoppers, barges, etc.

All ***Hydrodynamic Dredging*** sediments ***flow through the water*** from the dredge area to the final disposal area

Water Injection Dredging

WID pumps water into channel bottom sediments at relatively ***high-volume & low pressure***

WID allows sediments to flow horizontally out of a waterbody, while the ***fluidized sediment layer*** remains close to the bottom

The objective is to remove the material from a selected area by taking advantage of the near-bottom ***density current***

- Tides
- Currents
- Gravity
- Other Hydrodynamic Forces

Osprey WID, IHC-America, NCSPA

Environmental Considerations

WID cannot be used where ***unacceptable environmental impacts*** may occur

- Contaminated resuspension
- Suspended solids effects
- Site specific impacts

Sediment transport modelling is required to determine the destination of ***dredged sediments***

WID has the ***ecological advantage*** as it does not disturb the sediment distribution & waterbody balance

All ***WID*** sediments ***must be analyzed*** & most sediments will be appropriate for the dredging technique

Parameters that influence ***WID*** production include:

- Soil characteristics
- Site bathymetry & geometry
- Hydrodynamic conditions
- Geographic location
- Type & level of contamination
- Regulatory agency acceptance

Economic Benefits

Traditionally dredged sediments require more costly transportation, using pipelines, buckets, hoppers, barges, etc.

Traditional dredged sediments require acquiring placement or disposal areas for the storage

Traditional dredging costs:

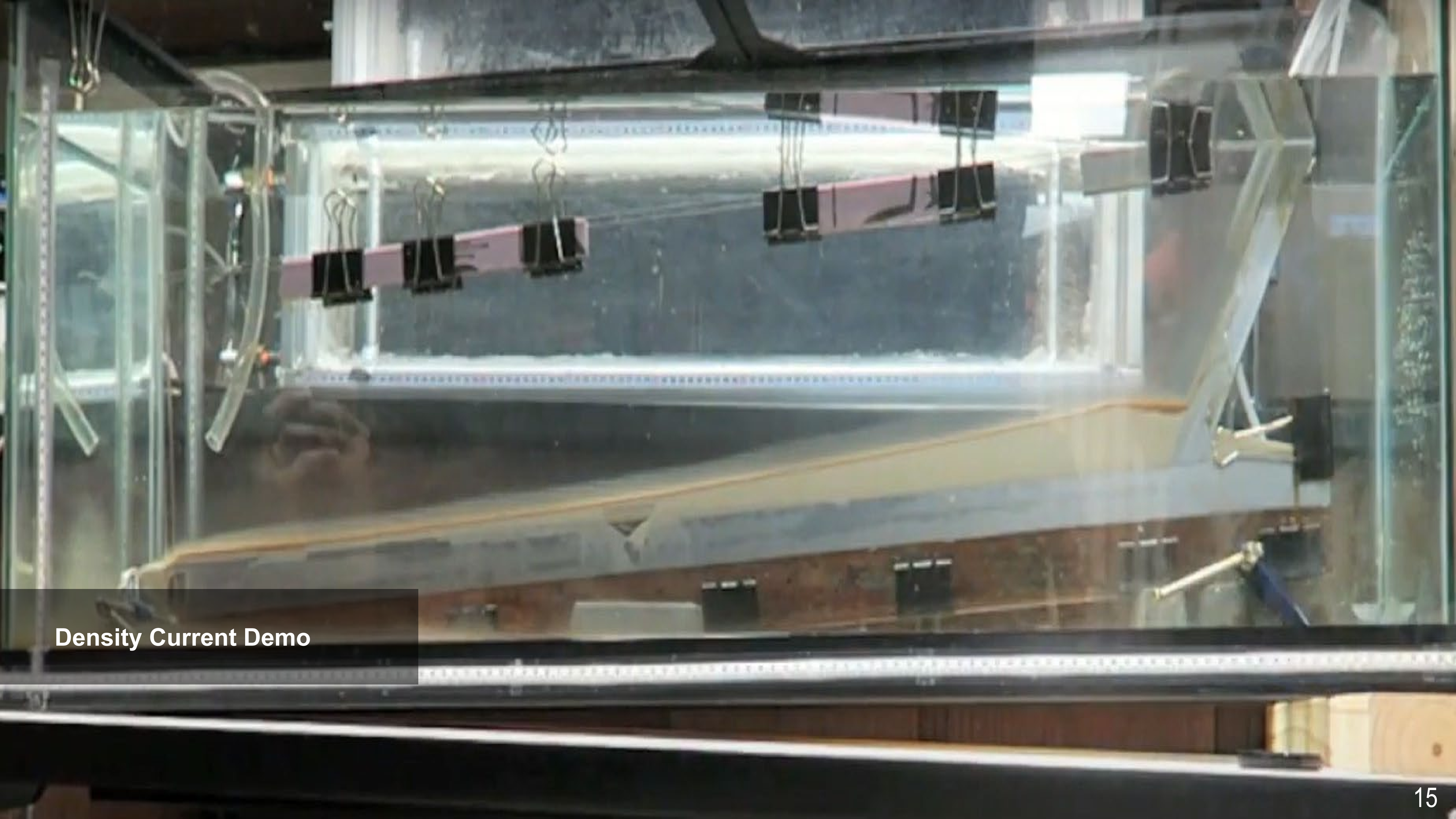
- Mobilization/Demobilization
- Transportation & Storage
- Complex dredge plant O & M
- Lower production rates

In comparison, for all ***hydrodynamic dredging*** (including WID) the dredged material is transported ***entirely within the water column***

In comparison, for all ***hydrodynamic dredging*** (including WID) techniques the sediments ***flow through water***

Optimized hydrodynamic dredging

- Rapidly moved on short notice
- Don't require disposal facilities
- Reduced dredge plant O & M
- Higher production rates


Density Current Demo

Water Injection Dredging (WID)

Courtesy Van Oord

Osprey WID, IHC-America, NCSPA

Case Studies

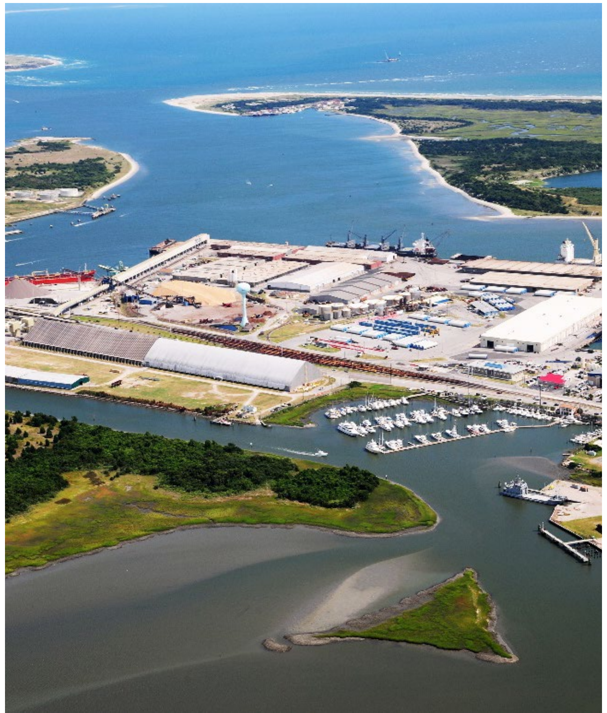
Osprey WID, IHC-America, NCSPA

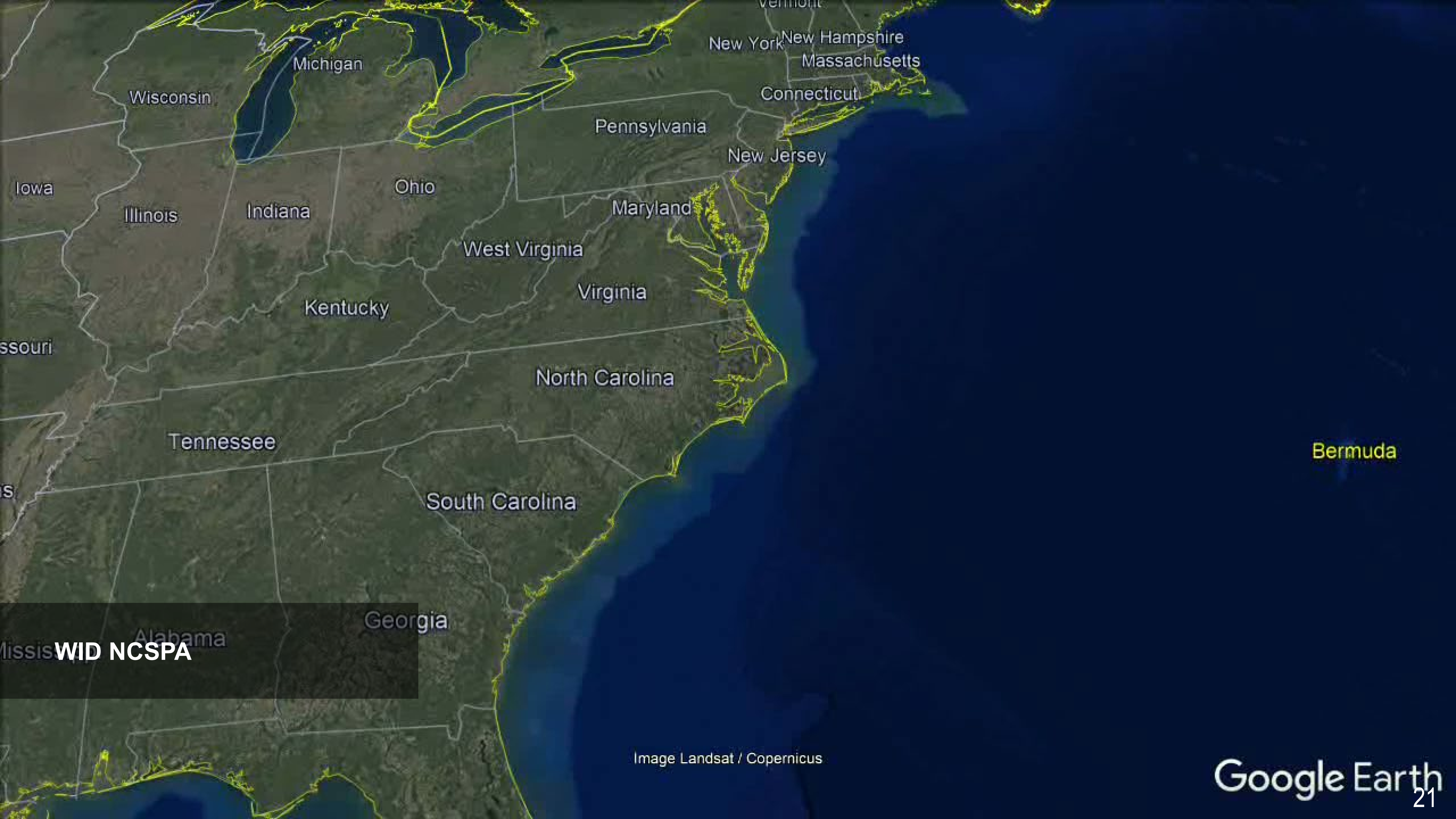
WID NCSPA

Water Injection Dredge (WID)

Design, Permitting, & Purchase

NORTH CAROLINA PORTS®




New York
New Hampshire
Massachusetts
Connecticut
Michigan
Wisconsin
Pennsylvania
New Jersey
Iowa
Illinois
Indiana
Ohio
Maryland
West Virginia
Virginia
Kentucky
North Carolina
Tennessee
South Carolina
Bermuda
Georgia
Alabama
WID NCSPA
Image Landsat / Copernicus
Google Earth

USACE-ERDC Monitoring Event

- Since June 2021
  - Dredged ~580,000 cubic yards (CY)
  - Approximately 195 hours
  - Production rate of ~3,000 CY/hr.
- NCSPA costs include:
  - Annual depreciation of the vessel
  - Annual insurance costs
  - Dredging operations costs
  - Fuel
  - Other O&M costs (repairs, parts, contract services, expendables, training not related to a dredging event, etc.)
  - Pre- & post-dredging surveying
- Estimated $1M/YR in cost savings

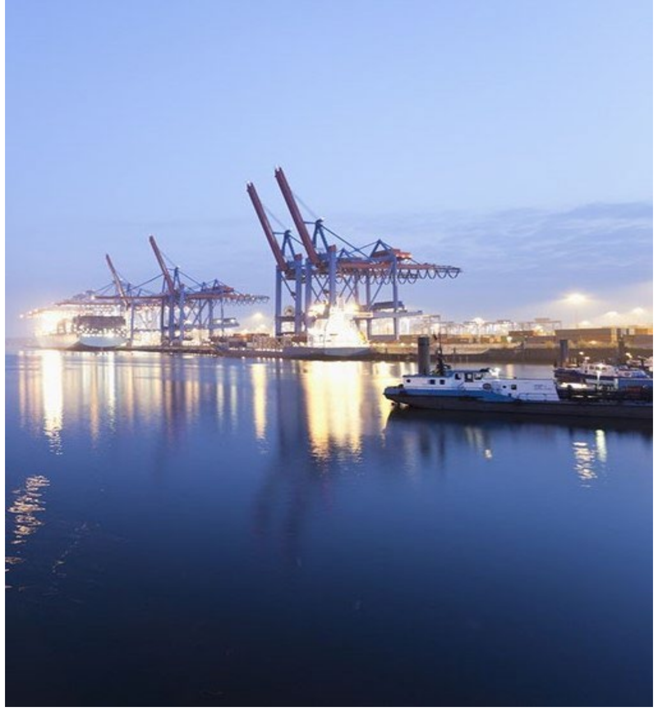
Vessel	
Length Overall (ft)	88
Beam Overall (ft)	28.75
Draft (ft)	3
Max Dredging Depth (ft)	55
Sailing Speed (kts)	6
Dredge System	
Dredging Speed (kts)	1.5
WID Manifold Width (ft)	27.5
Nozzles (Number)	41
Nozzle Diameter I.D (in)	2
Max Rated Pump Pressure (PSI)	35
Max Rated Flow Rate (gal/min)	20,000
Production – January 2022	
Volume Dredged (cu yd)	70,990
Dredging Time (Hrs)	29
Production Rate (cu yd/hr)	2,448
Production – Oct/Nov 2021	
Volume Dredged (cu yd)	113,646
Dredging Time (Hrs)	32.5
Production Rate (cu yd/hr)	3,497

Osprey with jet bar deployed

Osprey with jet bar above water

WID Channel Dredging above the Chesapeake Bay Bridge-Tunnel

Virginia Port Authority (VPA)



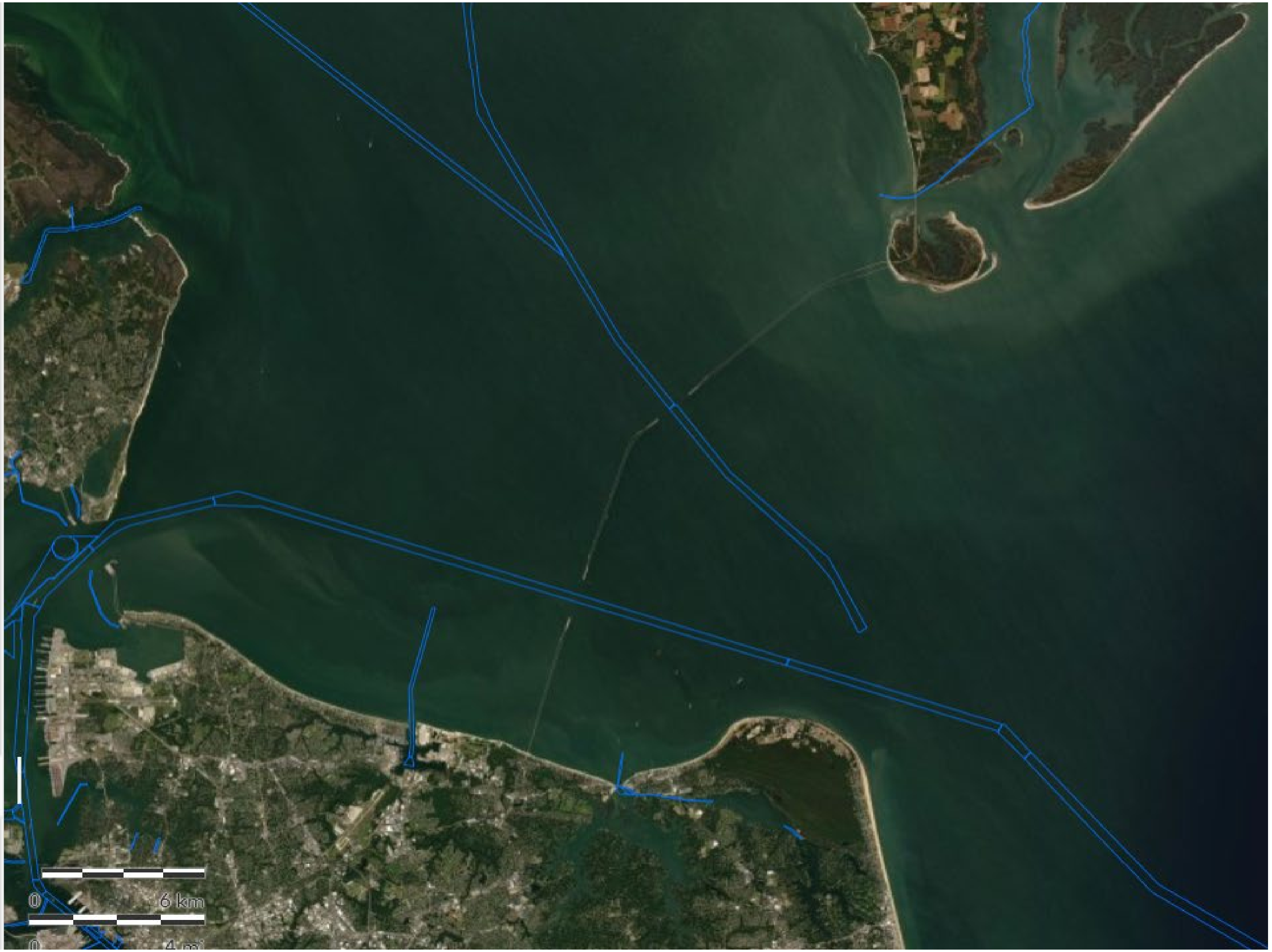
THE PORT OF VIRGINIA

Chesapeake Bay Bridge-Tunnel

USACE District:
Norfolk - NAO

USACE Channel:
All

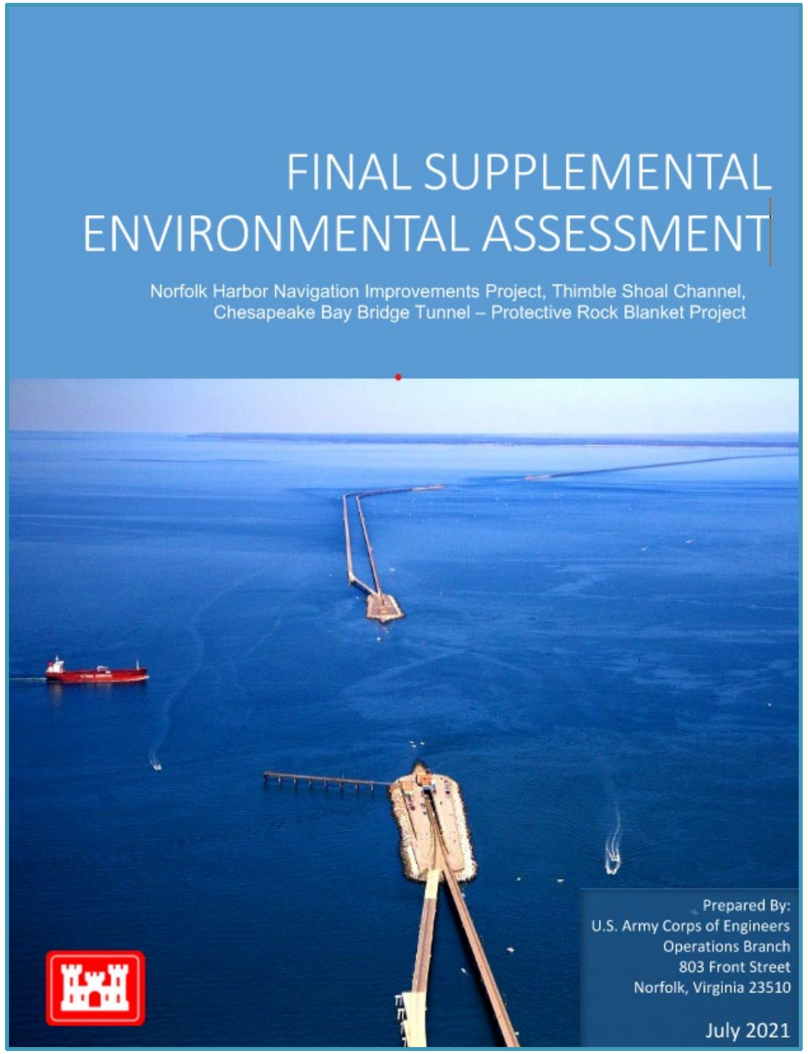
Channel ID:
All



USACE Hydrographic Surveys – eHydro
www.navigation.usace.army.mil/Survey/Hydro

VPA FINAL SUPPLEMENTAL ENVIRONMENTAL ASSESSMENT (SEA)

- Norfolk Harbor Navigation Improvements Project, Chesapeake Bay Bridge-Tunnel (CBBT)
- Preconstruction engineering & design efforts raised concerns about risks to the tunnel structure
- WID ⇔ chosen alternative dredging method
- US Army Corps of Engineers Norfolk District (USACE-NOA) was responsible for preparing the SEA
- Non-federal sponsor (VPA) providing input on the technical aspects of the proposed project

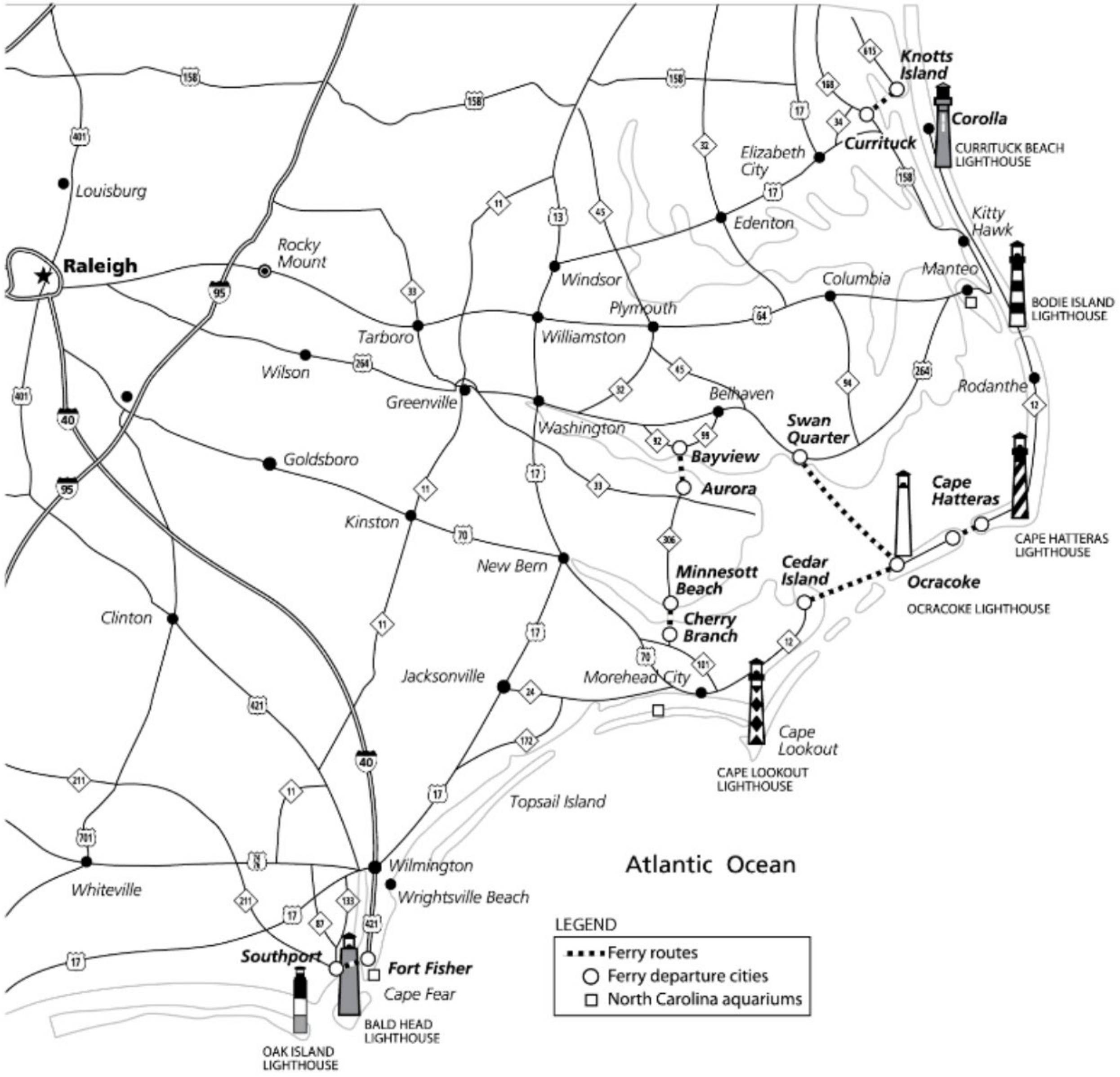


WID Ferry Terminals Demonstration – Southport to Fort Fisher

NCDOT Ferry Division

NORTH CAROLINA FERRY SYSTEM

NCDOT Ferry Division



- *NCDOT Ferry Division: www.ncdot.gov/travel-maps/ferry-tickets-services.aspx*
- *Operates the second-largest state-owned ferry system in the US*
- *Transport more than 1.1 million vehicles & 2.5 million passengers annually*
- *21 ferry vessels serve 7 routes*
- *Operate over 200 trips daily*

NCDOT Ferry Terminals - Southport

- *Annually dredge ferry basin*
- *Place sediment in 4 adjacent DMMAs*
- *Sediment trucked off*
- *In the past, shoaling has caused route termination during low tides*

NCDOT Ferry Terminals – Fort Fisher

- *Annually dredge ferry basin*
- *Place sediment in adjacent DMMA*
- *Sediment trucked off*
- *In the past, shoaling has caused route termination during low tides*

Summary - Takeaways

The key benefit of WID is that horizontal ***transport*** of the dredged material takes place ***entirely within the water column***

Worldwide WID is a ***rapidly evolving field*** & will require educating regulatory agencies & the public

Traditional dredging is often as much about transporting & **handling water** as it is about the removed sediment

Four-part formula for WID success:

- Site conditions (sediment & hydrodynamic forces)
- Technical feasibility
- Legal & regulatory concerns
- Economics (benefits/costs ratio vs cost only)

The ***WID technique*** dilutes & fluidizes the sediments, creating a ***near-bottom density current*** with higher density than the surrounding water

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Ports & Harbors

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