



What In The World Is A Water Injection Dredge?

NCBIWA Fall 2024



11/19/2024

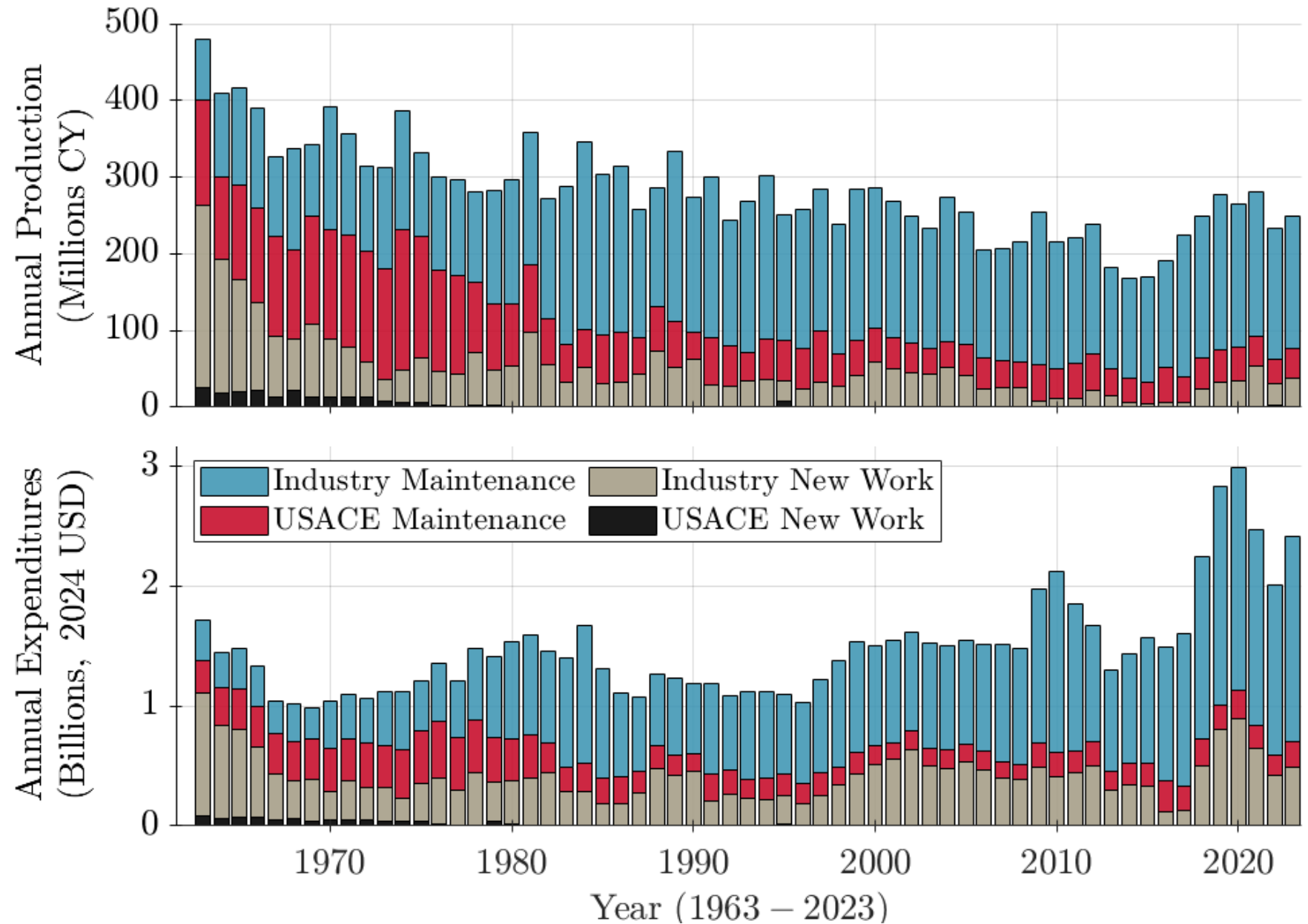
William Fuller, EI (HDR | Wilmington, NC)

Joe Wagner, PE, D.NE, BCEE (Black & Veatch | Jacksonville, FL)

Robert Lewis, EIT (COASTHazar | Santander, Spain)

Fuller, W.P., Wagner, R.J., and Lewis, R.E., (2024). "U.S. Hydrodynamic Dredging Challenges and Opportunities." *Transportation Research Record*, 2678(7), 487-500.

Industry Trends



Bucket Dredge



Cutter Head Dredge



So What?



Cheap

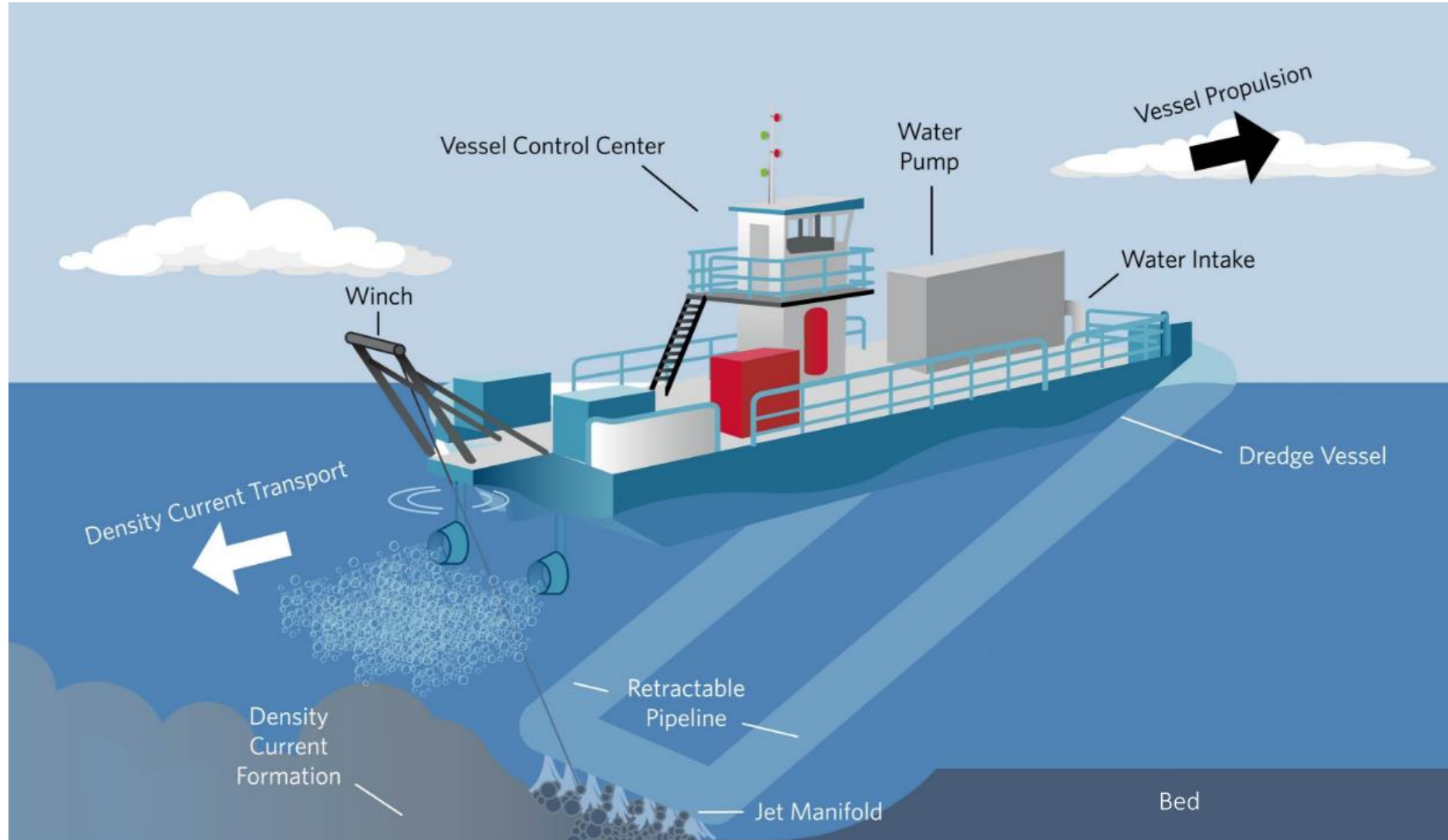


Robust









Resilient

Water Injection Dredge (WID)






Cheap



-  Lower vessel cost
-  Less support equipment
-  Easier mobilization and demobilization
-  Higher production efficiency
-  No material placement necessary
-  No CDF/DMMA maintenance

Robust

-  Small operational footprint
-  Compatible with tight and sensitive spaces
-  Customizable to match operational need



Resilient

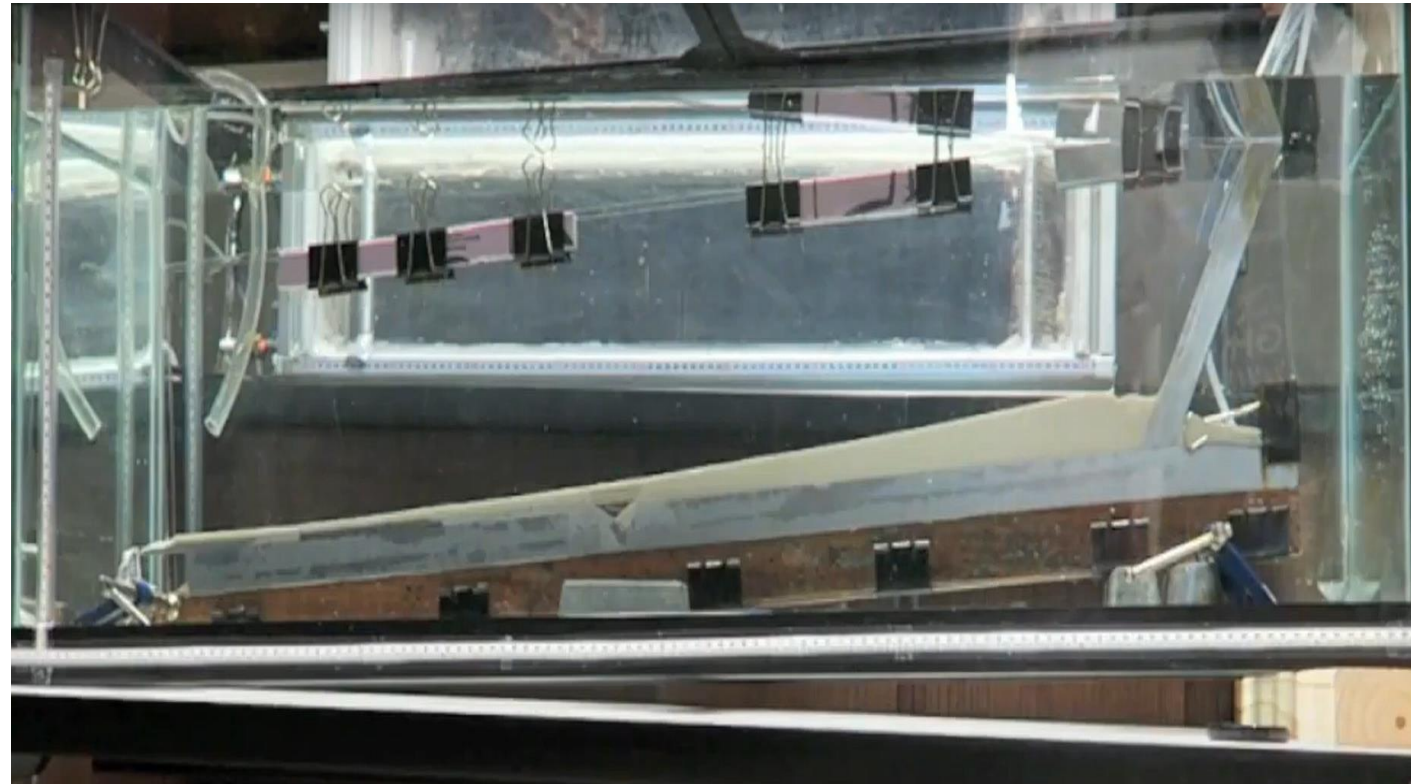


- ④ Regional Sediment Management approach
- ④ Eliminates over dredging
- ④ Eliminates handling and storage impacts
- ④ Provides agency and solution ownership

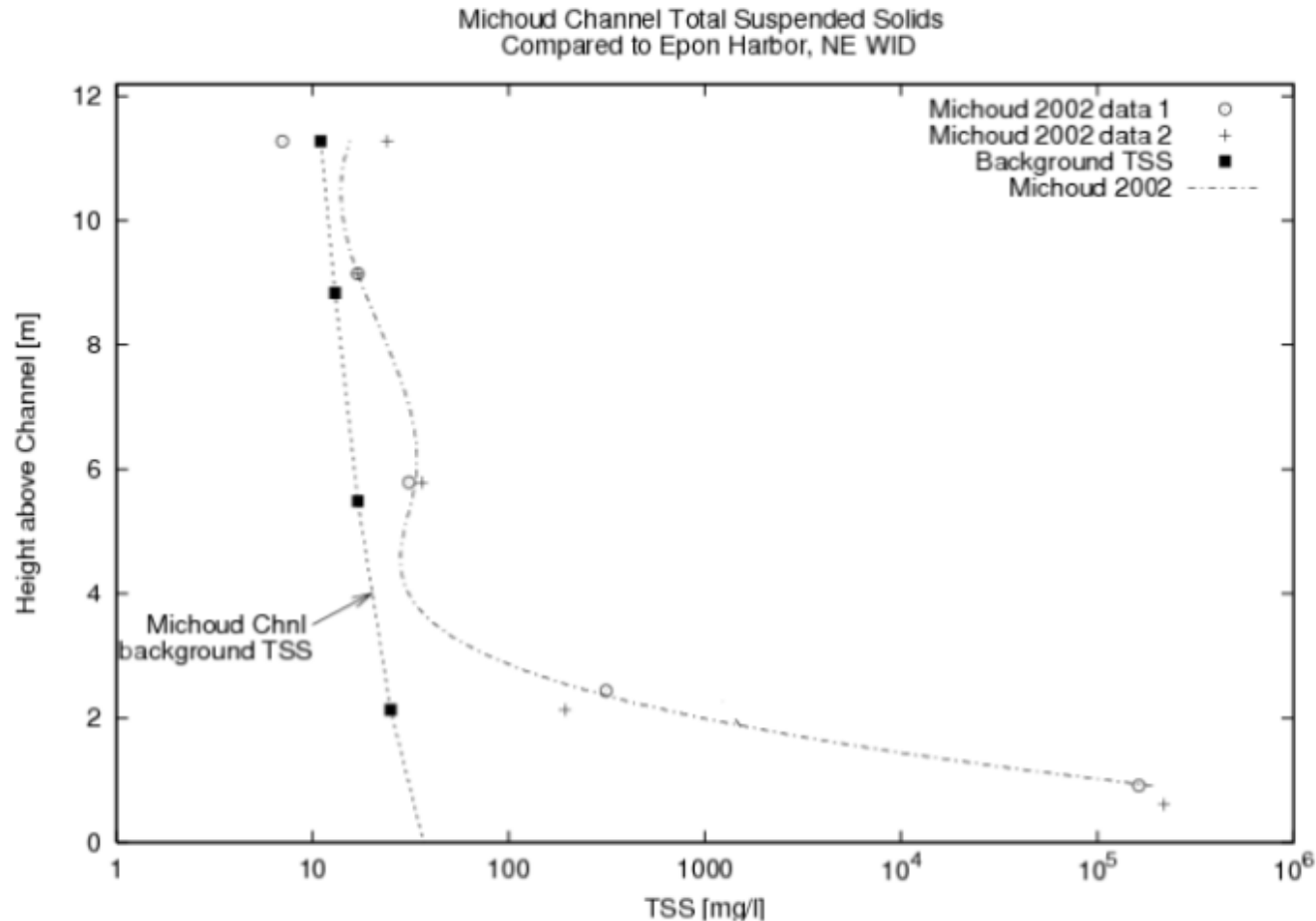
What's The Catch?

We still don't know the full extent of...

- ① Sediment transport
- ① Environmental impacts
- ① Bed morphology impacts
- ① Site compatibilities



Environmental Due Diligence



Water quality



Contaminated sediments



Morphodynamic changes



Benthic communities



Greenhouse gas release

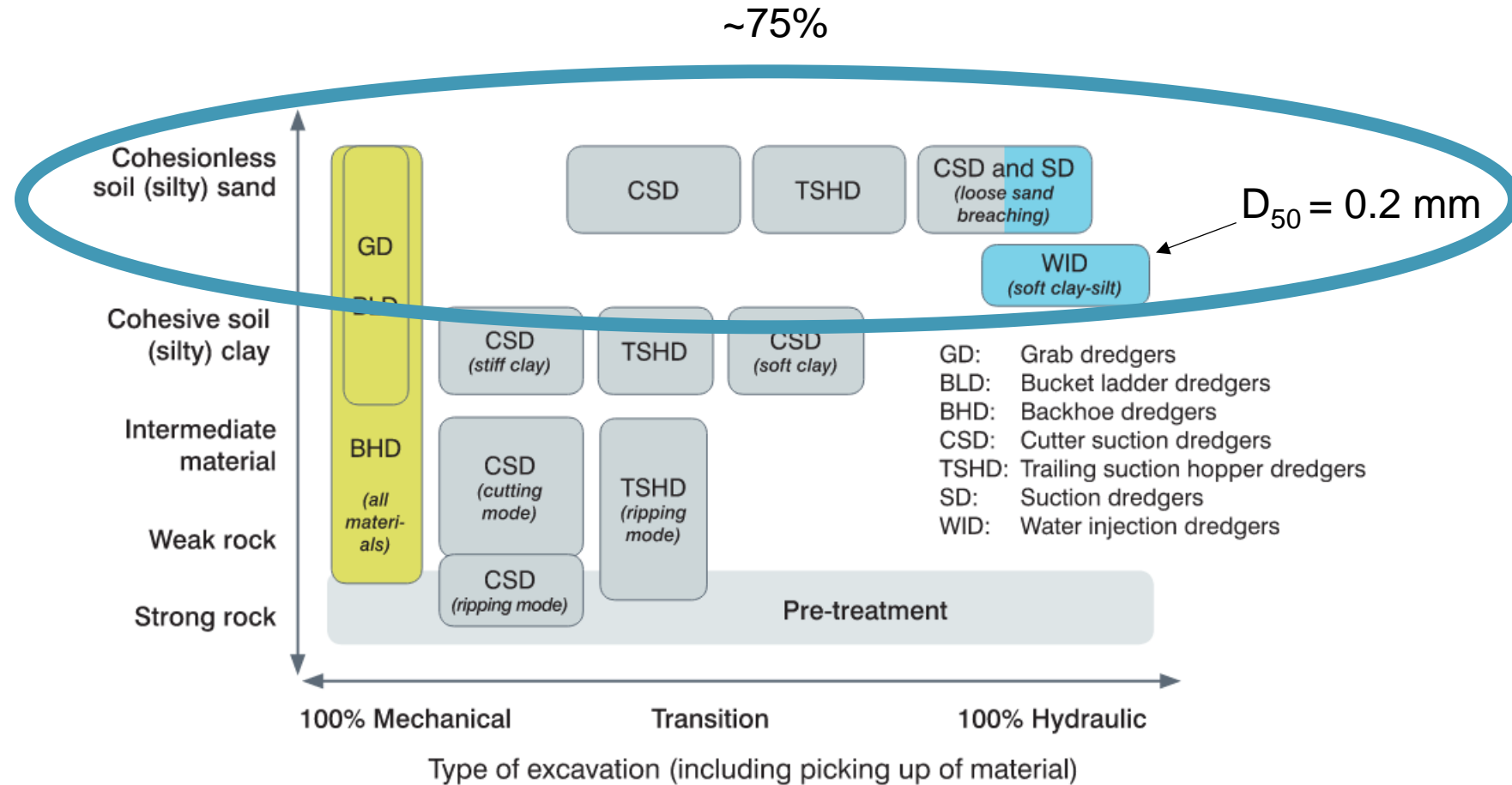
Sediment Feasibility

Richardson Number:

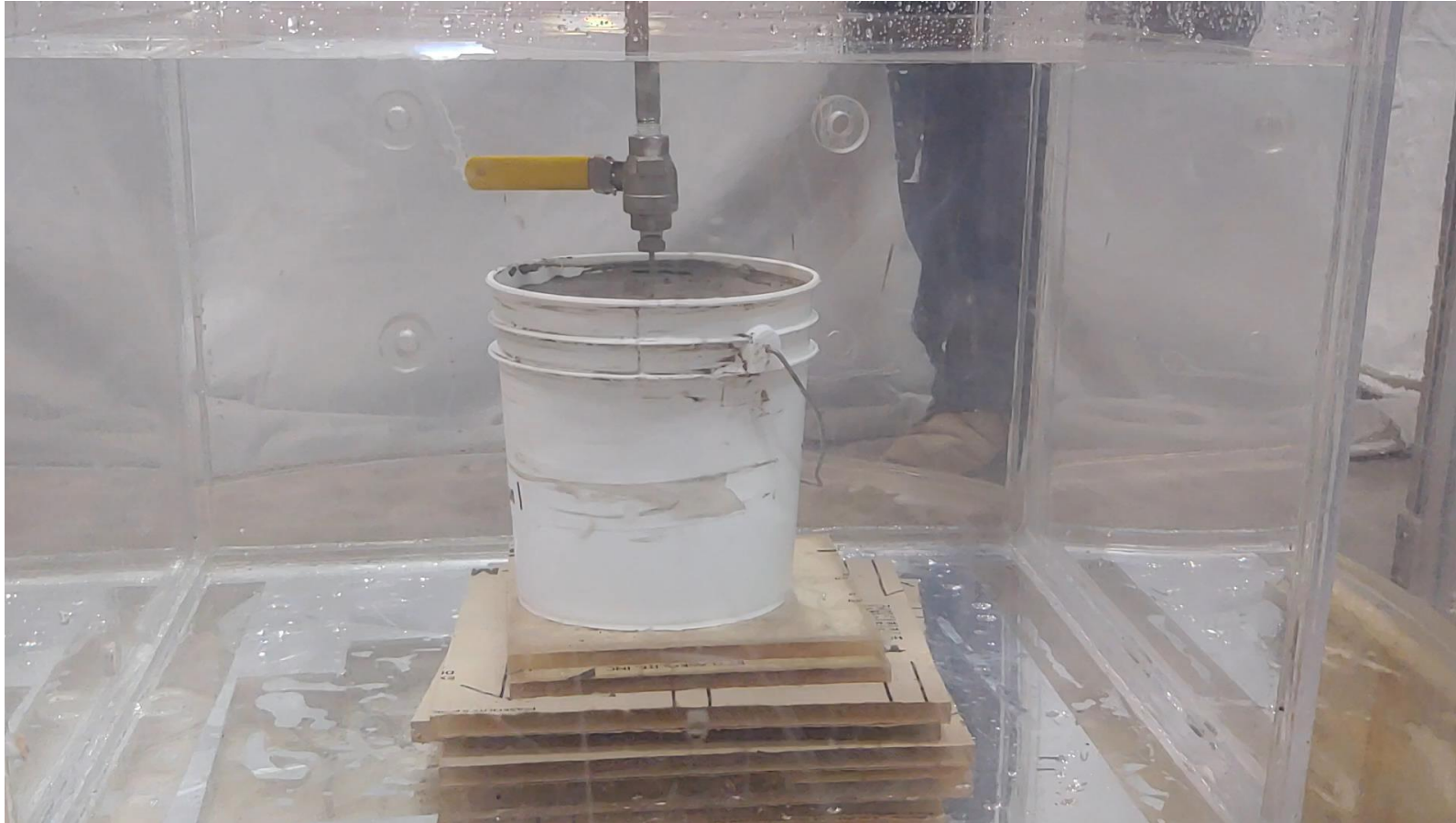
$$R_i = \left(\frac{\rho_m - \rho_f}{\rho_m} \right) \left(\frac{gH \cos \theta}{U^2} \right)$$

Liquidity Index:

$$LI = \frac{(w - PL)}{PI}$$



Production Rates

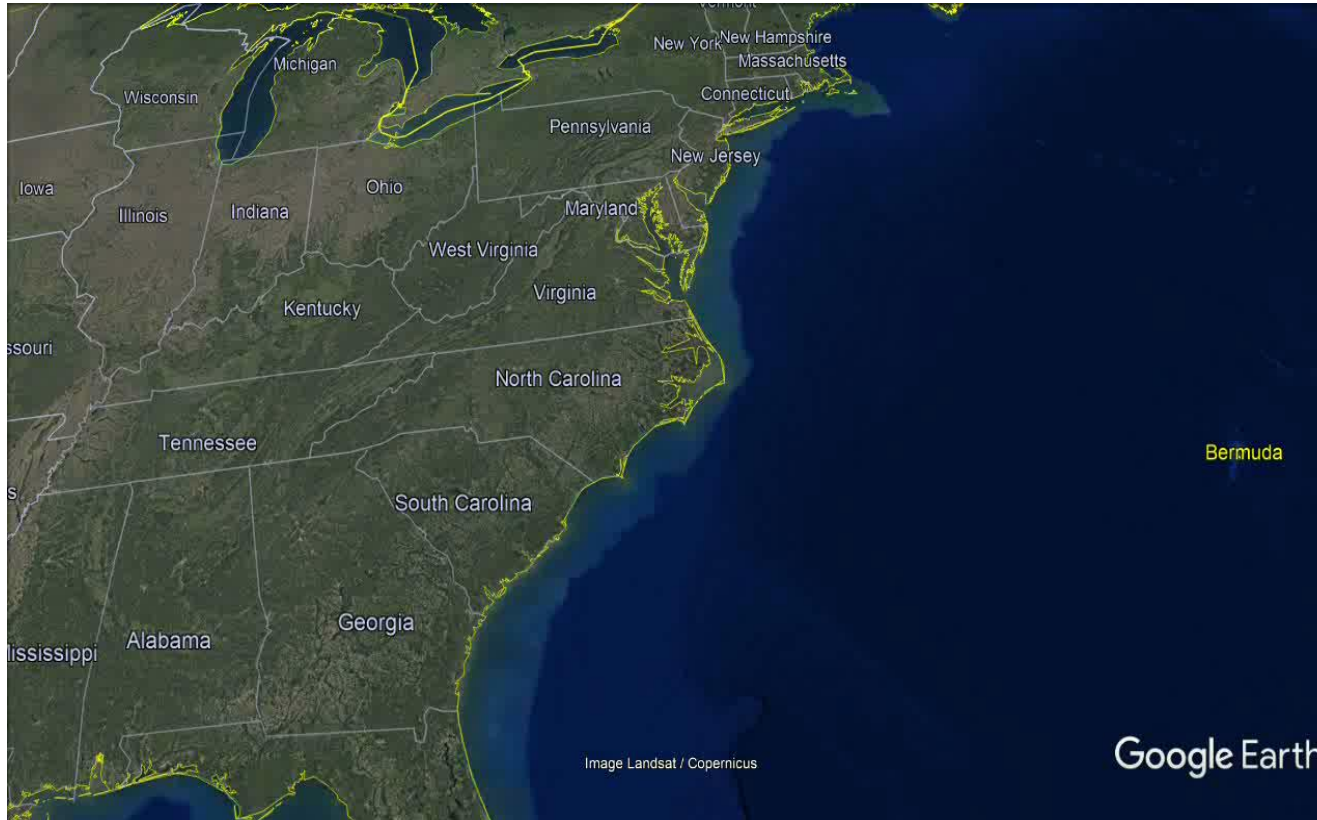


- 🎯 Bed characteristics
- 🎯 Sediment characteristics
- 🎯 Ambient flow conditions
- 🎯 Dredge operator skill

The Osprey



Permitting



Existing permit for hydrodynamic plow



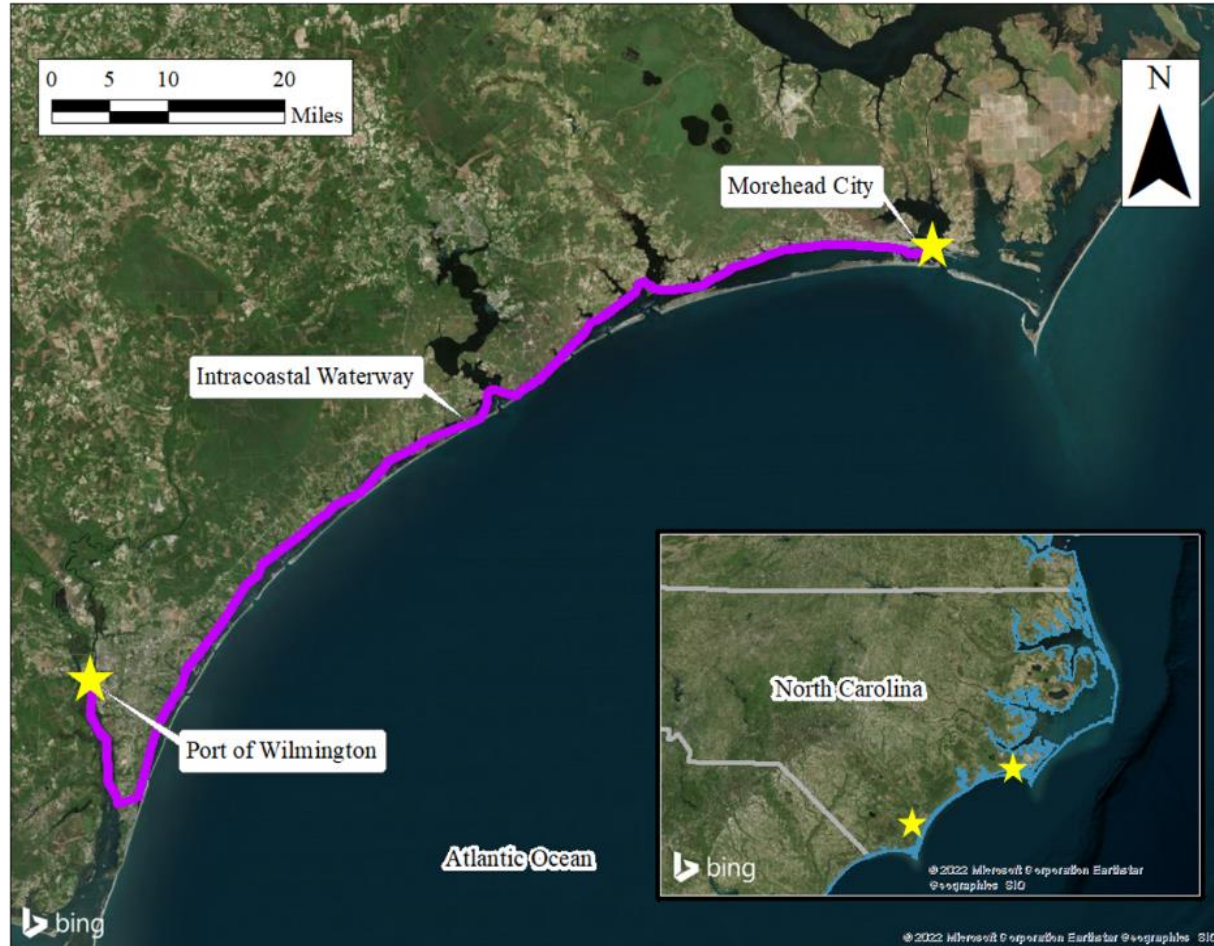
Eagle Island CDF expansion required mitigation









What would it take to switch to WID?

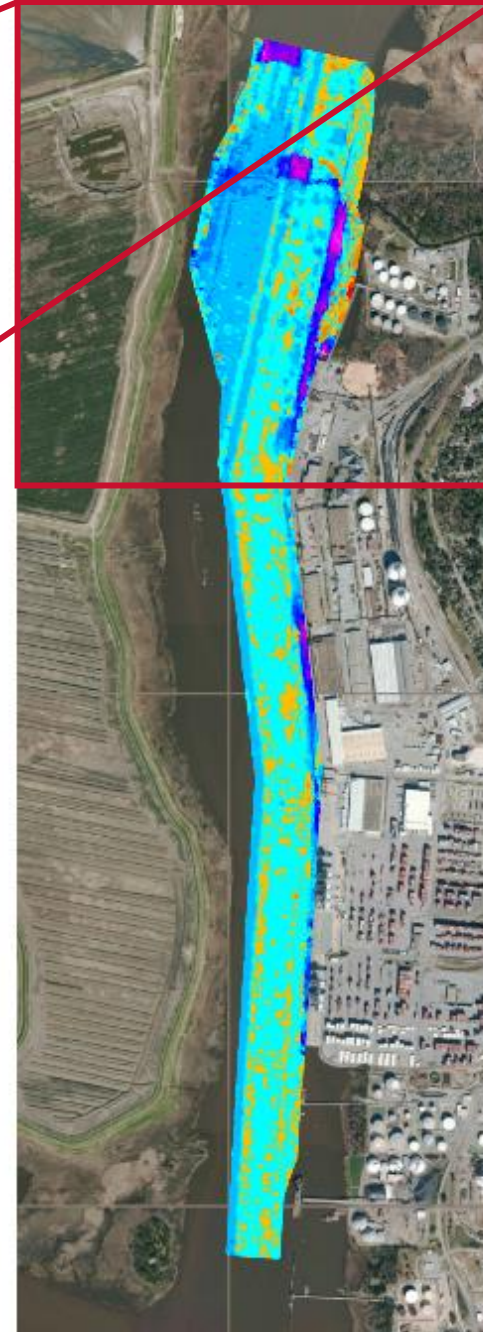
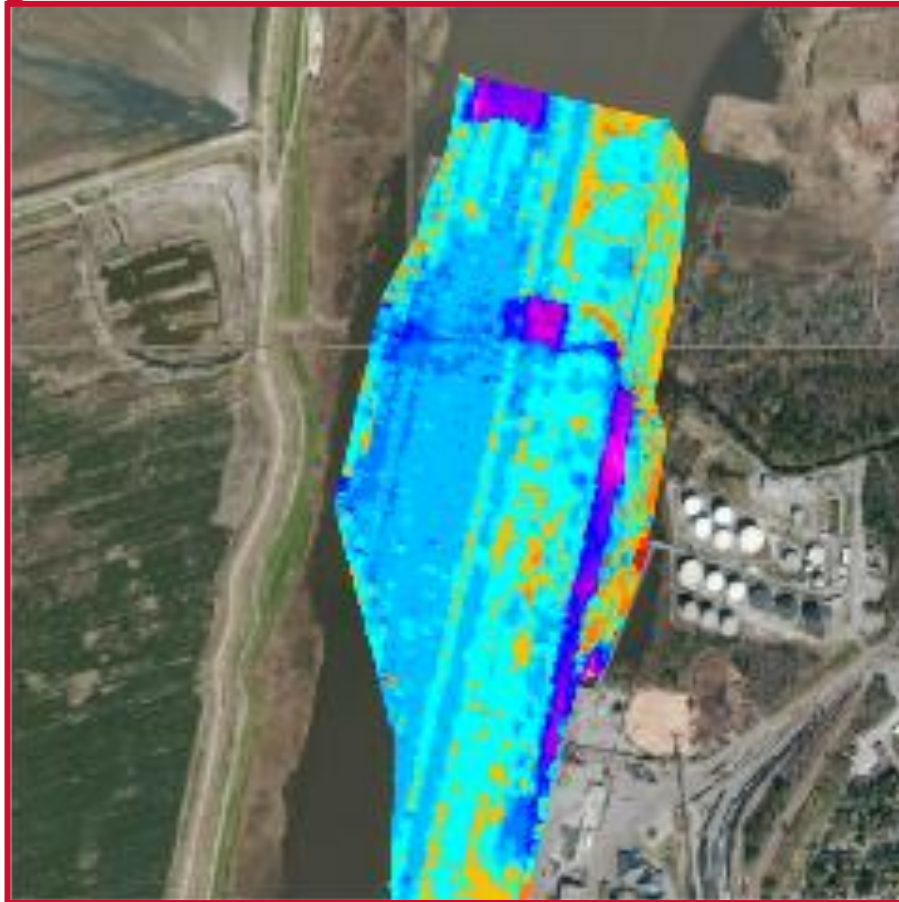
1. Literature review
2. Environmental assessment
3. Pre/post surveys
4. Can't impact federal channel

Acquisition

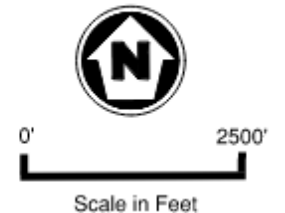


-  Budgeted as equipment expense
-  Built during pandemic, ~8 months delivery
-  Visual software requirement
-  Off-the-shelf parts with US supply chain
-  Manufacturer warranty/training partnership
-  NCDOT Ferry Division tug support

January 2022 Dredge Event



NET-CHANGE ELEVATION TABLE			
MIN ELEV	MAX ELEV	COLOR	PERCENTAGE
-12.00	-11.00		0.00%
-11.00	-10.00		0.03%
-10.00	-9.00		0.17%
-9.00	-8.00		0.41%
-8.00	-7.00		0.67%
-7.00	-6.00		0.88%
-6.00	-5.00		0.82%
-5.00	-4.00		0.87%
-4.00	-3.00		0.87%
-3.00	-2.00		4.66%
-2.00	-1.00		23.71%
-1.00	0.00		49.67%
0.00	1.00		14.64%
1.00	5.00		0.70%
5.00	10.00		0.02%
10.00	20.00		0.01%



NCSPA Comments – Challenges



Cumbersome process regardless of event size



Moratorium window










Areas with larger grain size notably more difficult – Port of Morehead City



In-house usage only

NCSPA Comments – Benefits

-  100% of NCSPA maintenance dredging since delivery
-  \$1.5M maintenance budget, two-thirds cost savings (...cha-ching!!!!)
-  Rented USACE dredge for maintenance, now roles reversed
-  Only 2-man crew, also able to do own surveys and volume calcs in-house
-  Operates on own schedule as needed
-  Regularly dredges in high-traffic areas without impacting operations
-  Partnership with NCDOT Ferry Division

NCSPA Comments – Testimonial

“Great machine, we’re very happy about it”

- Mark Blake, VP,
Engineering & Maintenance

What's Next?

- 🔍 Get good
- 🔍 Beneficial uses?
- 🔍 Regulatory framework?
- 🔍 Contractors?
- 🔍 Bringing in Uncle Sam?



References

- Pollock, C., T. Welp, D. Thompson, and T. Waller, (2005). "Water Injection Dredging used to rapidly remove shoaling, demonstration on the Michoud Canal, Louisiana." *DOER Technical Notes Collection*.
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- Welp, T., M. W. Tubman, D. A. Wilson, and C. E. Pollock. "Water Injection Dredging. ERDC/TN DOER-T14." Vicksburg, MS. U. S. Army Engineer Research and Development Center. U. S. Army Corps of Engineers, 2014, "Procedures to Evaluate Sea Level Change: Impacts, Responses, and Adaptation," ETL 1100-2-1; June 30, 2014.
- Wilson, D. A. Water Injection Dredging in U. S. Waterways, History, and Expectations. *Western Dredging Association Conference Proceedings*, 2007.
- US Army Corps of Engineers (USACE), 2024. "Actual Dredging Cost Data for 1963-2023." Excel spreadsheet.

