

US Army Corps of Engineers

Research Applications for Improving Navigation

Dr. Ned Mitchell ERDC Coastal and Hydraulics Lab

AAPA Harbors and Navigation Committee Meeting 10 NOV 2022





Atchafalaya River CDR #1-21 alcasieu Bar Channel HDR #1-20 ver Miles 17-36 & Devil's Elbov arious Bar Channels CDR #3-21 ver Southwest Pass CDR #1-21 er Southwest Pass HDR #3-21 er Southwest Pass HDR #4-21 24 Cutterhead BWR 24 Cutterhead BWR 24 Cutterhead BWR 24 Cutterhead BWR MATOC: Ouachita/Black F



FARMER GATE



NEED STATEMENT

- Limited U.S. fleet of hopper and oceancertified pipeline dredges
- Low # of bids on most dredging contracts
 → higher costs
- Very little margin for error within overall schedule; small delays can lead to major, cascading disruptions across the country
- Thousands of project-level environmental restrictions for dozens of species, applied incrementally through the decades
- Theoretical "fleet capacity" (# of plants x nominal production rates) does not capture the *When?* and the *Where?* parts of the dredging question.

Dredge Fleet Scheduling Optimization



3

PROJECT PLAN

Dredge Fleet Scheduling Optimization

What is it?

➤ Capability that assigns the fleet of dredges to specific projects and provides the sequencing of work so as to *maximize* overall productivity while complying with work restrictions and other constraints.

How does it do it?

- Compares project dredging requirements to dredge plant production rates and unit costs
- Considers work window durations relative to time required for specific dredge plants to do the work
- Explores combinations of assignments and sequencing and iterates towards most efficient work plan

Model output:

- > Dredge fleet itineraries \rightarrow minimized mob/demob distances
- Project groupings with regional contracting potential

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practical extent, this optimization shall take into account recessary considerations that can impact design scheckdes, including the availability and plant capatolities of the inclusivy

Implementation of Dredge Schedule Optimization

PROJECT PLAN Dredge Fleet Scheduling Optimization

- Schedules are not coordinated formally
- Inefficiencies due to "wasted travel" between projects
- Contributes to low # of bids on some projects
- Minimize mobilization costs → dredge more projects for same amount of funding and in less time
- Better align schedules with env. work
 windows and dredge plant capabilities



PROJECT PLAN

- Model seeks to dredge as much material as possible within 5-year time horizon→ formulated as a job assignment/scheduling problem, solved via constraint programming using interval variables; IBM CPLEX software.
- Model Data Requirements:
 - ➢ Project dredging requirements (CY min/max, size/type(s) of dredge) → use rolling 5-yr schedule in DIS
 - Project unit costs and effective production rates (\$/CY; CY/day)
 - Dredge fleet specifications
 - Duration and extent of work restrictions (start/end dates, absolute restriction or partial?)
 - Project budget amounts
 - Distance matrix

Dredge Fleet Scheduling Optimization



Credit: J.B. McWilliams, AECOM

INITIAL FINDINGS

Regional Contract Optimization

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#04	FORTP01 FORT PIERCE BEACH FL	Hopper	12/27/2021	1/18/2022	22				
#04	FLAGL01 FLAGLER COUNTY SPP	Hopper	1/19/2022	3/15/2022	55		KBECG01 KINGS BAY ENTRANCE		
#04	DUVAL01 DUVAL CO SPP FL	Hopper	3/16/2022	4/24/2022	39		SAD Hopper 2		
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CHALLENGES Dr

Dredge Fleet Scheduling Optimization

- Data management, QA/QC
- Limits of empirical shoaling projections from CSAT; model sensitivity to assumed vessel dimensions
- Model runtimes and overall turnaround
- Synthesizing model output into actionable guidance for decision makers
- Socializing the capability with dredging CoP → convincing people that this improves upon status quo
- Implementation: capability needs to be formally integrated within USACE business practice and made operational

SBSA Unrestricted

DIS: Daily Demand (CY) by FY



DIS: Daily Demand (CY) by Suggested Dredge Type





1)

Dredge Optimization Strategies



O&M SITE SELECTION, FLEET SCHEDULING, AND REGIONALIZATION

PROBLEMS

- Contracts are not coordinated across
 Districts and MSCs → low # of
 bidders hinders competitive pricing
- Recent increases in NAV budgetary outlays leave little margin for scheduling shifts or delays
- 2)
- Dredging resource outlays are not rigorously matched to dredging needs → difficult to justify decisions and explain our posture under future contingencies





Dredge Optimization Strategies

0&M SITE SELECTION, FLEET SCHEDULING. AND REGIONALIZATION

SOLUTION

- Mathematical optimization to identify scheduling efficiencies, scale and sequence regional contracts, and reduce costs through increased competition
- Data assimilation across multiple disparate systems (DIS, RMS, DQM, Env. work restrictions, fleet composition/production rates)
- Recommendations for project groupings and sequencing that maximize scheduling efficiencies



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- Common geospatial framework for analyzing and visualizing large, enterprise data sets:
 - Hydrographic surveys
 - Dredging Quality Management (DQM)
 - AIS vessel position reports
 - Waterborne Commerce
 - > Many others



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Grand B

Holistic view of Navigation projects and system interdependencies → basis for interactive "dredging work package formulator" to screen alternatives.

Gautier

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Hosted in the USACE Azure L4 Government Cloud



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UNCLASSIFIED

USACE Navigation Portal





Applying IIJA funds towards a "coastal digital twin" that will automatically apply CSAT forecasts indexed to time of last survey and combined with DQM streaming data.

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Questions?

UNCLASSIFIED

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