REDUCING ENVIRONMENTAL EXPOSURES FROM DREDGING CONTAMINATED SEDIMENT

ROBERT S. WEBB, P.E., PAUL FUGLEVAND, P.E. & TEAL DREHER P.E.
(DOF - DALTON, OLMSTED & FUGLEVAND, INC.)

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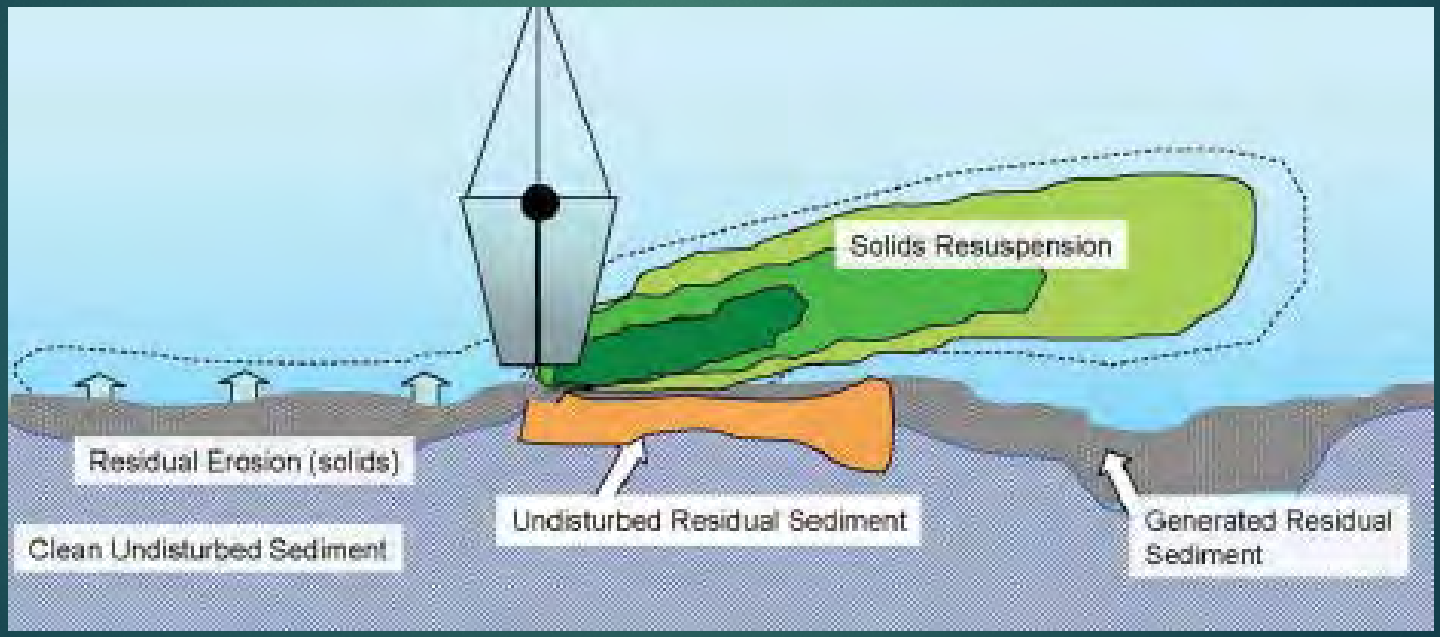
Residuals, Resuspension & Release

- Defined as contaminated sediment found at the post-dredging surface of the sediment profile
- Classified as either
  - Undisturbed residuals
  - Generated residuals
- Resuspension & Releases = Downstream Risk



Residuals
Two Approaches

- **APPROACH #1:** Residuals Happen
  - Residual concentration = average of cut
  - Need sand cover after dredging

- **APPROACH #2:** Residuals Can Be Significantly Reduced and Potentially Eliminated
  - Apply Lessons Learned
  - Do Better
  - Engineer

Approach #2: Method Development & Implementation

- **Head of Hylebos: 2004-2006**
- **Duwamish Waterway Early Action Area: 2012-2015**

- Specific Client Risk Drivers and Objectives for Both Projects
  - Once and Done!
  - Reduce Risks
    - Residuals
    - Releases - Down Stream Losses
    - Volume Uncertainty
    - Eliminate Containment

Approach #2: Common Characteristics

- Remediation Dredging Methods (RDMs)
  - Accurate DTM
- Method Specifications
- Best Value Contractor Selection
- Competitively sourced T&M
  - Qualifications
  - Costs
- Active Construction Management
  - Daily Adaptive Management
  - On board Dredge Engineer

“Keep It Neat and Tidy”

Remediation Dredging Methods (RDMs)

1. Accurate EoC Mapping
2. Precision Dredge Plan DTM
3. Engage Contractor Staff
4. Dredge to Design Grade
5. Precision Excavator
6. Double Arc Closing Bucket
7. RTK-GPS 3D Positioning
8. No Overfilled Buckets
9. Derrick for Debris Removal
10. Stair-step Cuts on Slopes
11. Dredge Slopes with Excavator
12. Manage Water – No Barge Overflow
13. Active Technical Oversight
14. Place Initial Backfill

Engineer on Dredge

- Full time Observer on Dredge (DOF)
- Located in Excavator Cab next to Operator
- Observe Material Types in Bucket
- Generate Electronic Logs
  - Cause & Effect!

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Ongoing Refinements

- **Productivity**
  - Dredge Time
    - Effective Working Time - Dredging
    - Non Effective Working Time – Everything Else!
  - Reduce NEWT as Practicable!
  - Electronic Logs by Observer
  - Adaptive Management

Dredge Time

	1st year	Subsequent Years
% of Dredging Time (EWT¾)	46.9%	64.0%
Non-Effective Work Time (NEWT) Category		
Waiting for Sediment Scow	15.5%	14.8%
Other	11.1%	6.7%
Moving Dredge	12.0%	6.7%
Water Management	16.0%	2.3%
Repairs	12.1%	2.6%
Computers and Positioning Electronics	4.5%	3.6%
Maintenance	3.0%	0.8%
Weather/Tides	0.2%	1.8%
Tug Delay	0.1%	2.0%
Water Quality	0.0%	0.2%
Traffic	0.3%	0.3%

Data from Hylebos, Duwamish & Hudson River

Ongoing Refinements

- **Cycle Time**
  - Efficient Precision (60 to 90 seconds)
  - 100,000 CY @ 5 CY per cycle = 20,000 cycles
  - Inefficiencies add up quickly

- **Bucket Fill Factor (FF)**
  - Overfilled buckets are significant source of residuals
  - Fuller buckets = higher production = more overfilled buckets and increased residuals
  - Typically 50% FF over project, Target 80% Max.

- **Balance Production Rate with Quality**

Method Specifications

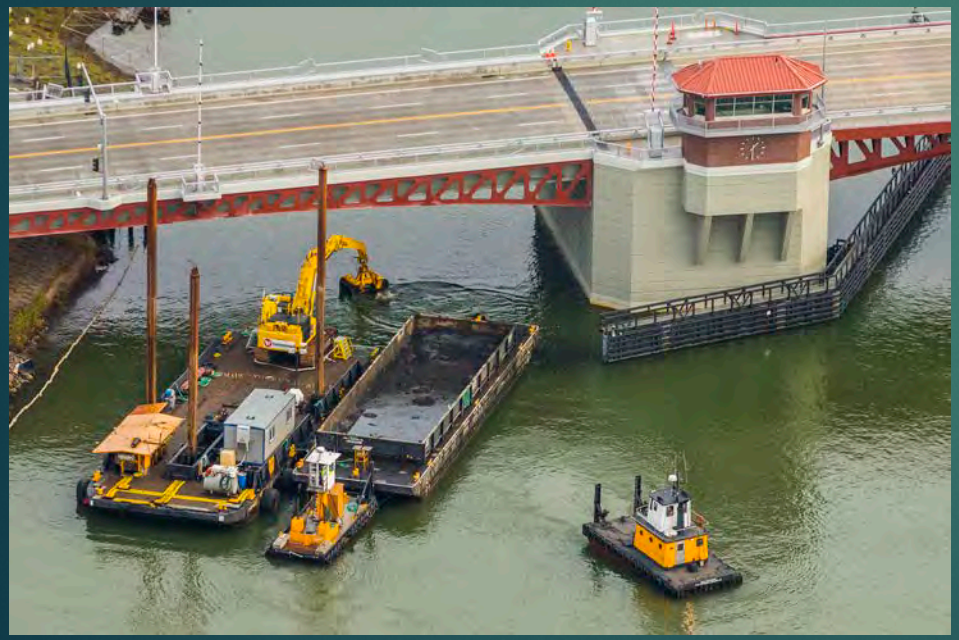
- Prescriptive Specifications
  - Typically Avoided
  - Sediment Remediation is Non-Typical Work
  - Technology Transfer & Lessons Learned
  - Understanding of Construction and Contracting Necessary

Best Value Contractor Selection

- Not the Time or Place for Low Bid Lump Sum
- Competitively Sourced T&M
  - Qualifications
  - Costs
    - Competitive Cost Selection for All Resources Potentially Needed.
    - Up-Front Pricing
      - No “Bid it to Win It, Change Order to Margin It”
      - Change Management More Efficient
    - Contractor Creativity to Owners Benefit

Duwamish Waterway Sediment Remediation Project

- Industrial/Residential waterway located in Seattle, WA
- 3 dredging seasons (2013-2015)
- 161,392 cy of sediment removed
- **MOB, DREDGING AND LANDFILLING - $295 per CY**



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Duwamish Outcomes

- Releases Controlled
  - 2 exceedances of WQ over 3 years of dredging
- Resuspension Controlled
  - Turbidity exceed 5 NTU over background on 14 events
  - Exceedances ranges from 5 to 18 NTU's above background
- Generated Residuals Controlled
  - 19 ug/kg PCBs post dredge average
  - 2% of dredged material concentration
- Undisturbed Residuals Controlled
  - No Undisturbed Residuals 1-2 ft. below post dredge
  - Less than 15 ug/kg PCBs

Summary

- Proper Use of Remedial Dredging Methods (RDM's) Can Reduce or Eliminate Residuals
- Team Effort
- Avoid Costly Re-dredging
- Schedule Certainty

Questions?

Contact Information:
Rob Webb (DOF)
rwebb@dofnw.com

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