Use of Dredged Materials for Contaminated Sediment Source Control

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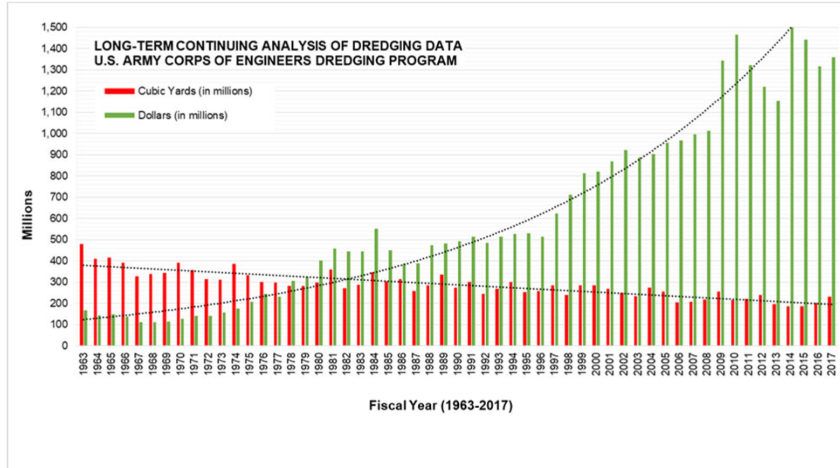
Impact of Sediment Contamination on Navigation Dredging

- Nav. infrastructure (channels, turning basins, berths, etc.) can be repositories for contaminated sediment.
- Often contaminated sediments adjacent to or up gradient of nav. infrastructure are significant ongoing/recurring sources.
- Around 5 to 10% of material dredged on an annual basis is "contaminated"
- Managing contaminated sediment represents a significant cost burden to the USACE's nav. dredging budget



Opportunity

- Each year the USACE ocean disposes approximately 50 Mcyds of clean dredged material.
- A significant portion of this material has a higher percentage of fines and TOC in 1-4% range.
- Limited opportunities for beneficial use.
- Material could be used to stabilize/cap/control contaminated sediment sources to adjacent nav. infrastructure.
- Potentially reducing cost of O&M program (reduced management/disposal cost).

Challenges

Contaminant sediment sources are often:

- Fine grain
- net erosional
- Shallow – challenging accessibility
- May have uncontrolled/ongoing contaminant inputs (inputs from adjacent landside sources)

Questions

Can TLP of clean DM be used as an effective control strategy?

- How effective is TLP of clean DM in reducing contaminant bioavailability? (see presentations B3 @ 2:15pm; D4@8:00am)
- How stabile are thin lifts of clean DM?
- What engineering controls might be required?
- Do resident infauna survive TLP?

Approach

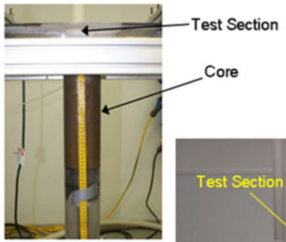
Bench scale evaluation of representative dredged materials;

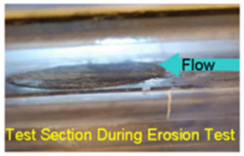
- Gulf Coast – Pascagoula, Pascagoula with 10% sand
- Hawaii – West Loch (wet), West Loch (dry from CDF)
- Pascagoula with a biopolymer addition

Materials added as a 6” lift over a consolidated base layer (Pascagoula w/ 10% sand) to simulate TLP

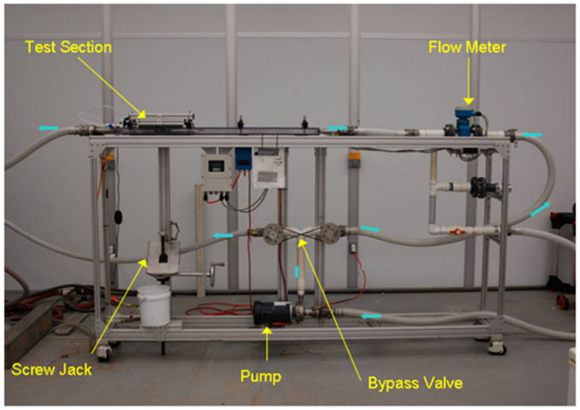
Examined survival of representative species added to consolidated base layer 30 days post-placement

Evaluated cohesive sediment erosion of material at 2, 7, and 30 days post placement using laboratory SedFlume.





Shear stress t (Pa)	Flow Rate (GPM)
0.1	6.1
0.2	9.1
0.4	13.5
0.6	17.0
0.8	20.1
1.2	25.3
1.6	29.8
2.4	37.4
3.2	44.0
4	49.9
5	56.6
6.4	65.0
8	73.7
10	83.5
12	92.5
13	96.7
14	100.8



Approach cont.

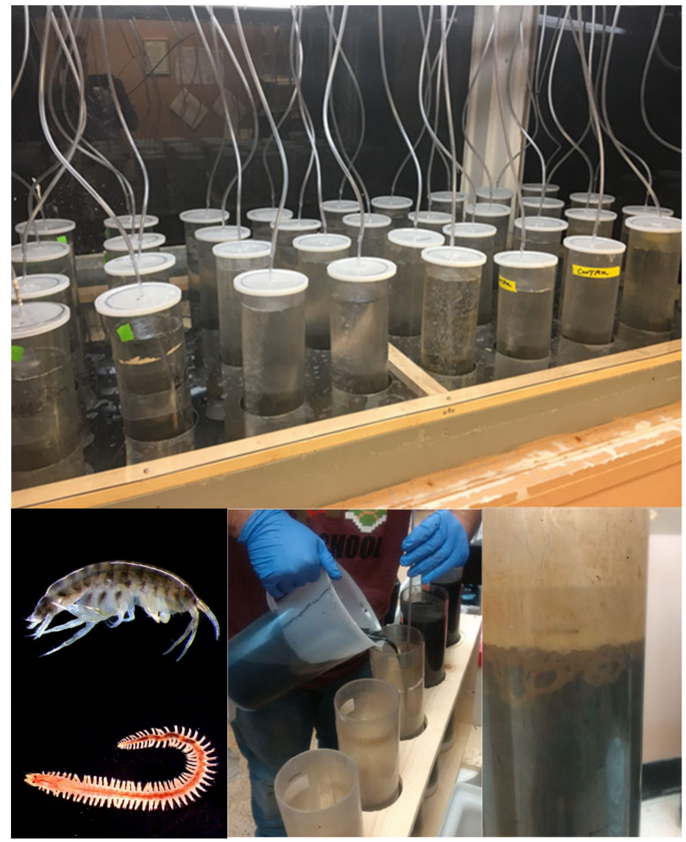
32 core tubes (3 ¾” ID) set-up with 6” of Pascagoula sediment and 14.5” of 25ppt (artificial seawater) placed under gentle airation in water bath and allowed to consolidate for 30d.

20 amphipods (*L. plumulosus*) and 10 polychaetes (*N. arenaceodentata*) were added to the consolidated base layer and allowed to acclimate for 7 days.

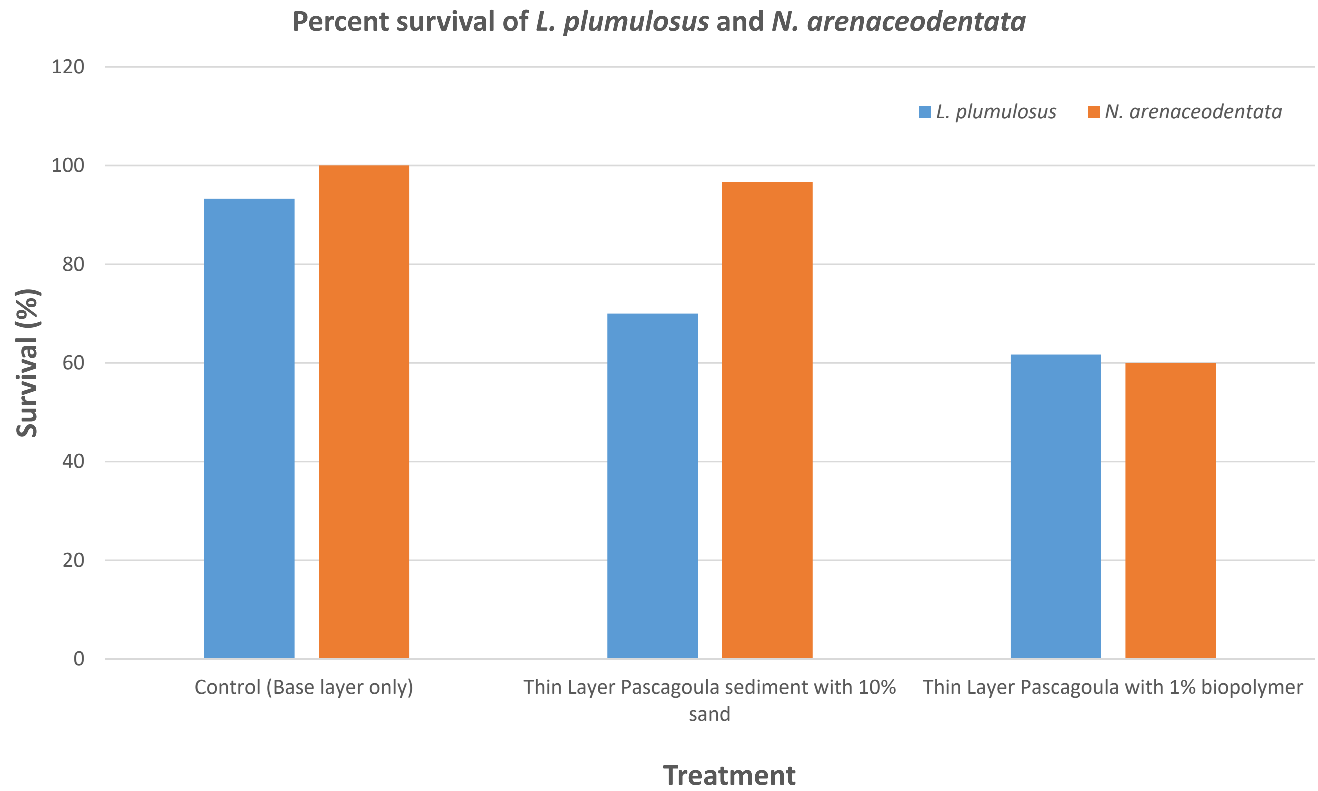
Dredged material treatments were added as a slurries (200 to 400 g/L) to achieve a targeted 6” lift; dry dredged material (West Loch from CDF) was added dry.

2 cores from each treatment were sampled at days 2, 7, and 30days and subjected to erosion experiments using a laboratory Sedflume

Observation of organism activity was recorded throughout the 30 day experiment and on day 30 organism survival was quantified.



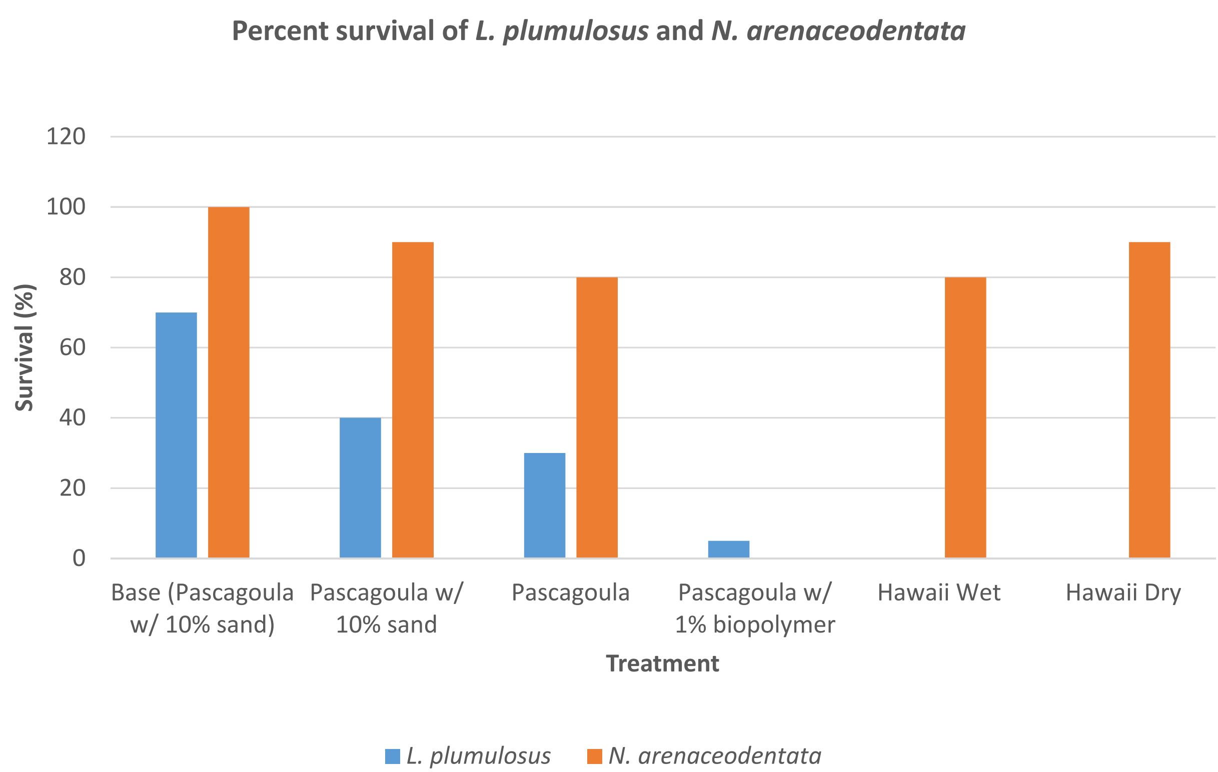
Results – Preliminary survival test



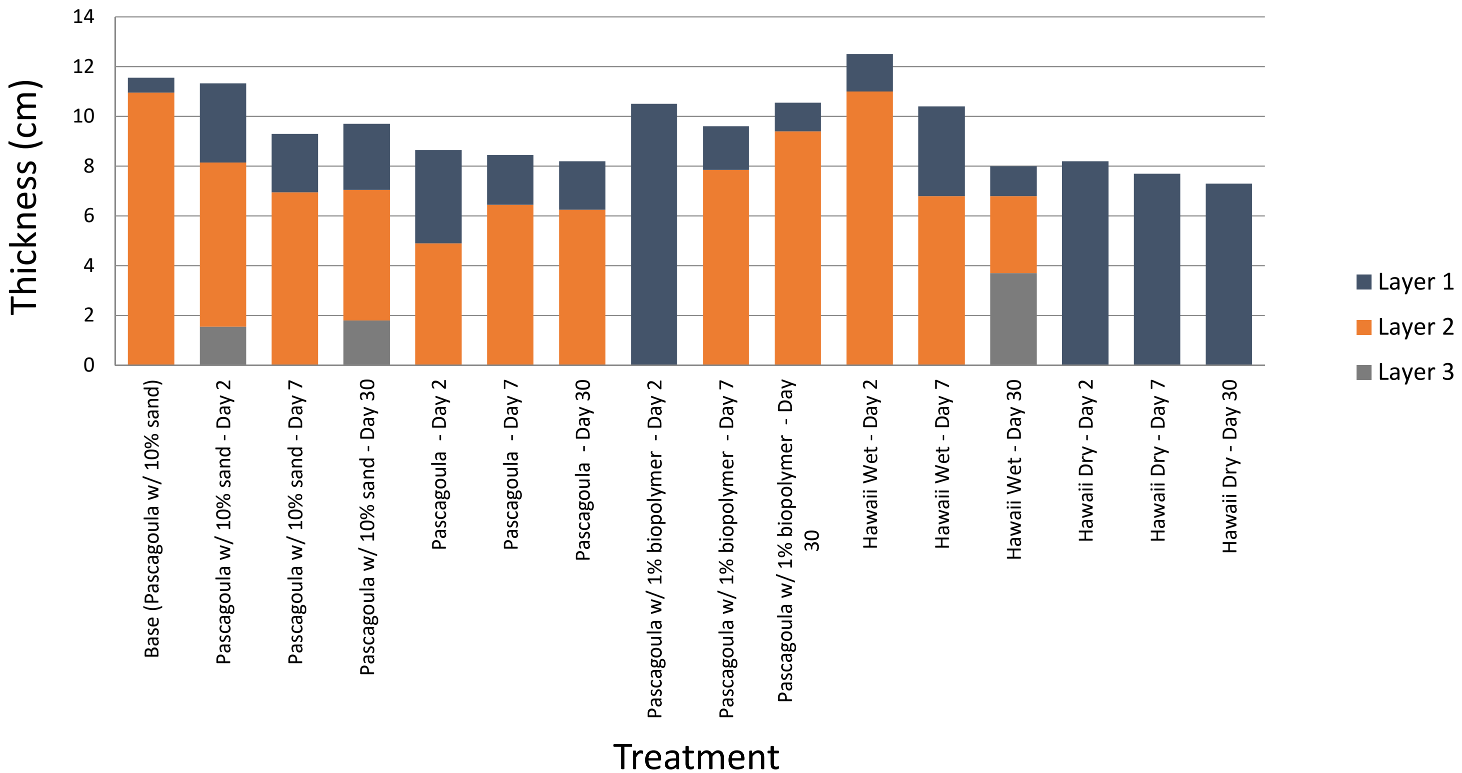
Results – Physical characteristics of treatments

Property	Base (Pascagoula w/ 10% sand)	Pascagoula w/ 10% sand	Pascagoula	Hawaii Wet	Hawaii Dry
Salinity (g/L)	28	25.4	25.4	39.7	3.9
% OM (Wt Organic /Wt Total)	7.6	8.1	8.1	14.1	11.4
% TOC			0.1	2.1	1.8
Total Solids (g/L)	451.3	194.0	194.0	579.8	1830.7
Moisture Content, %	64.6	82.9	82.9	57.3	13.9
% Fines	86.7	86.7	96.7	86.2	84.64
% Sand	13.4	13.4	3.4	14.8	15.35

Results – 30 day survival test



Results – Sedflume analysis



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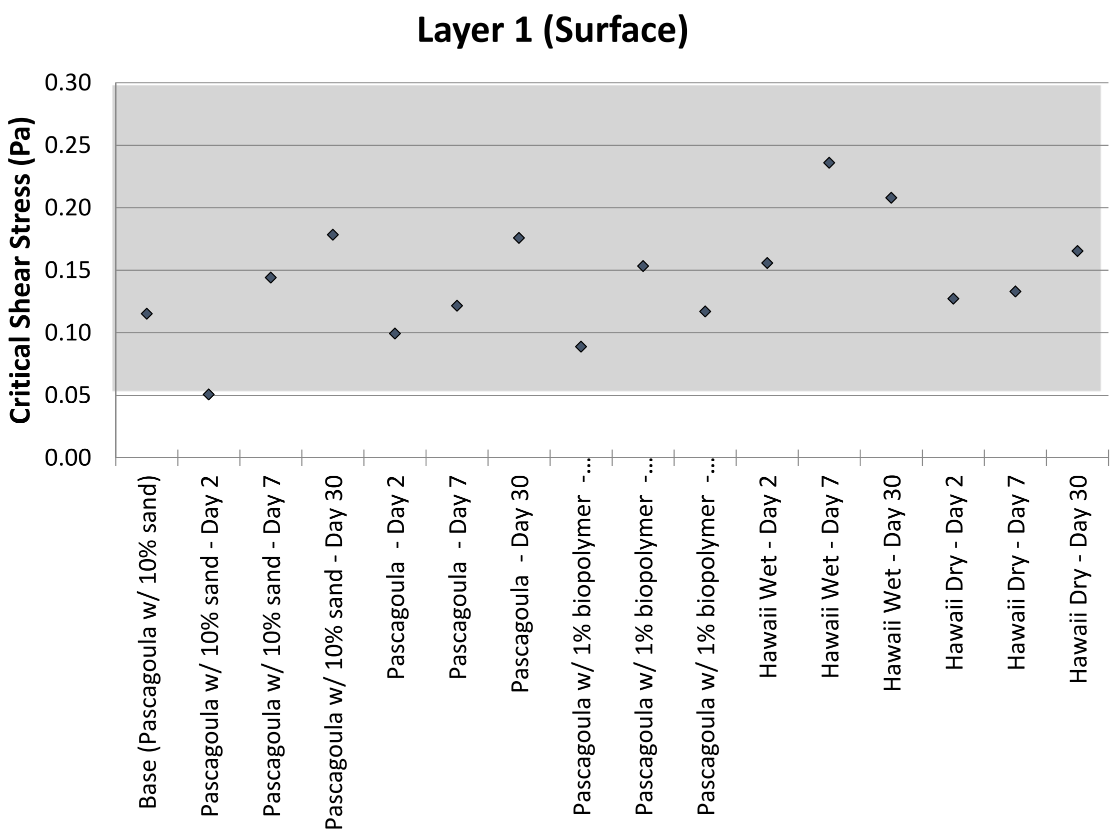
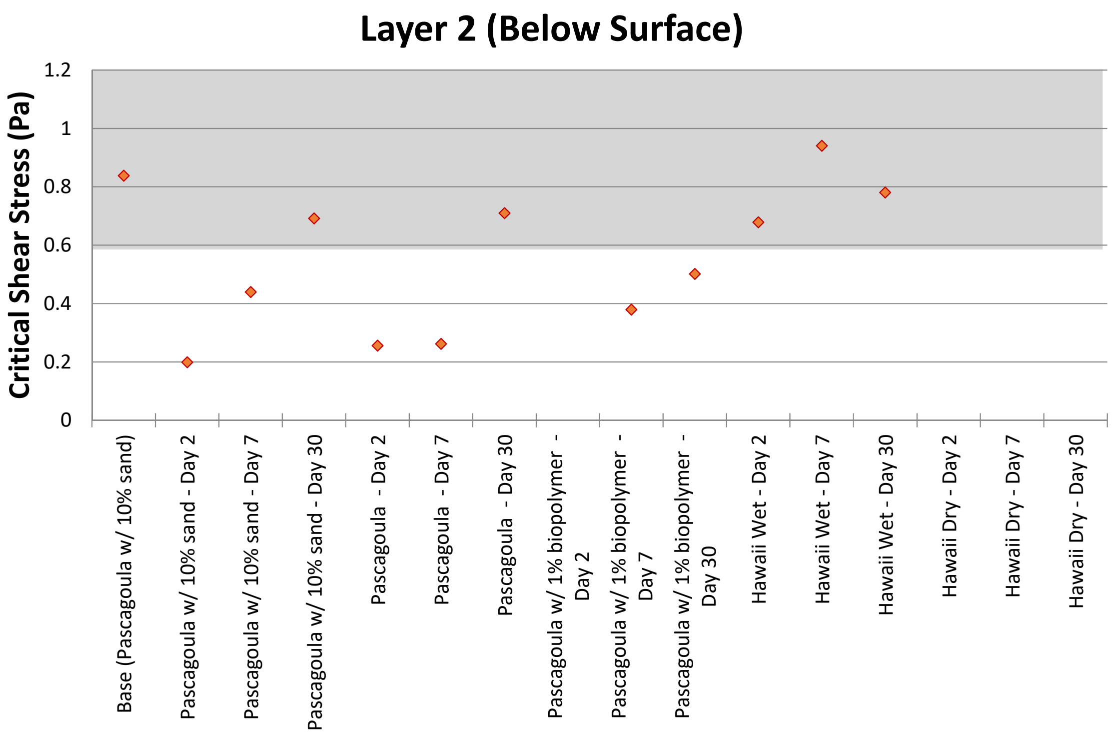


Shaded box indicates range of critical shear stress for control cores @ 95% CI

Results – Sedflume analysis



Shaded box indicates range of critical shear stress for control cores @ 95% CI

Summary and Conclusions

- Representative resident infaunal organisms (amphipod and polycheate) appear to tolerate TLP (amphipods less so than polycheates)– likely a function of DM type and placement density.
- Benthic community recovery post TLP is probably a combination of survival of resident infauna and subsequent recruitment.
- Critical shear stress for surface layer of all sediment treatments and time points evaluated were within the 95% CI of the control (surface of consolidated base layer control).
- Critical shear stress for underlying layer of the Pascagoula and Pascagoula 10% sand after 30 days consolidation and the Hawaii Wet sediment for all time points (2, 7 and 30d) were with the 95% CI of the control (underlying layer of consolidated base layer control).
- Although addition of biopolymer reduced initial turbidity, it generated significant BOD resulting in toxicity and actually reduced stability of cap material (via generation of gas).
- None of the treatments provided enhanced stability relative to the consolidated base layer.
- Absent additional engineering controls (berms) periodic re-application may be required to ensure long-term source control.

Next steps

- Survival of resident infauna using a variety of placement conditions (material types, densities, and lift heights).
- Exploration of other potential stabilizing techniques for fine grain seds. (microbial induced $CaCO_3$ precipitation).
- Expanded examination of contaminant sequestration using a broader range of material types with varying TOC.

THANK YOU!

QUESTIONS?

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