IMPROVING CALCULATION OF ELEVATION OF CONTAMINATION USING V-SAM INSTEAD OF CONVENTIONAL VIBRACORE METHODOLOGY:

Portland Harbor Superfund Site Case Study

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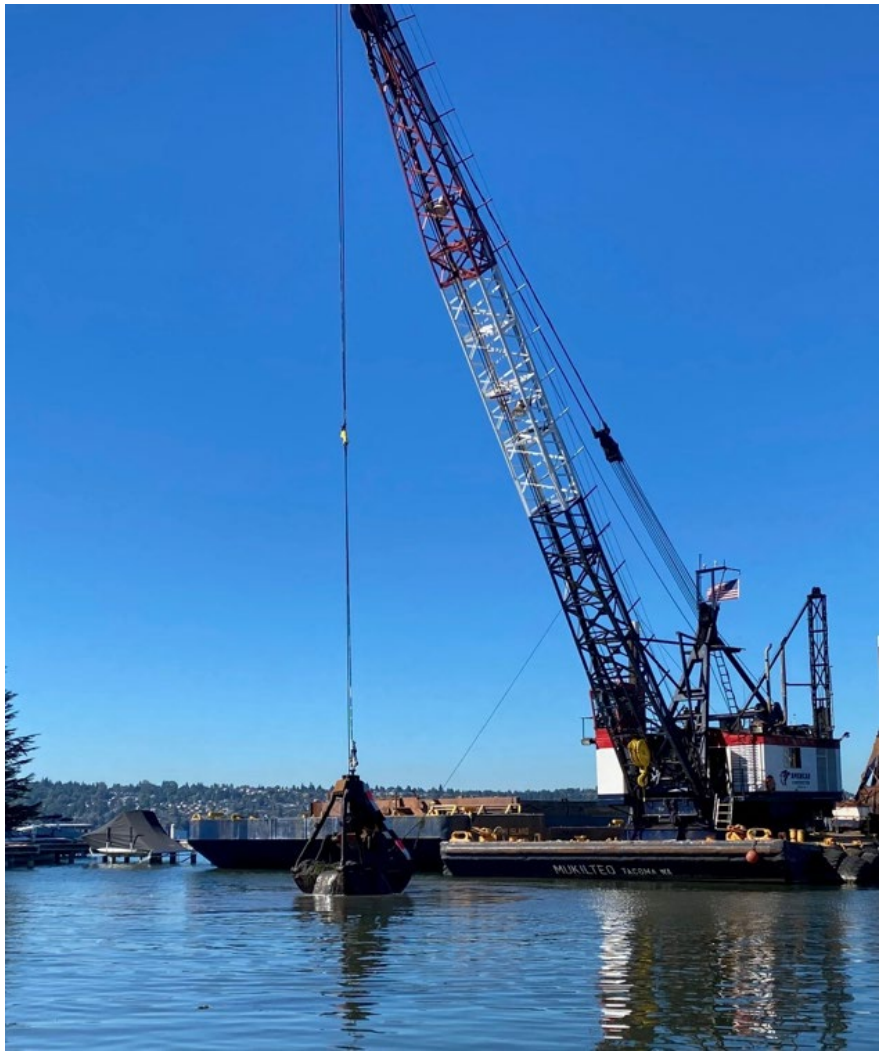
Importance of Accurate Data

- Sediment characterization data is used to calculate extent and depth of contamination
- Calculated elevation of contamination is basis for design decisions and dredge prism
- Estimating the correct extent of contamination is crucial for a successful project
  - Missed contaminated material can result in additional sampling and dredging
  - Excess removal is costly for the project
- With marine projects, everything is blind



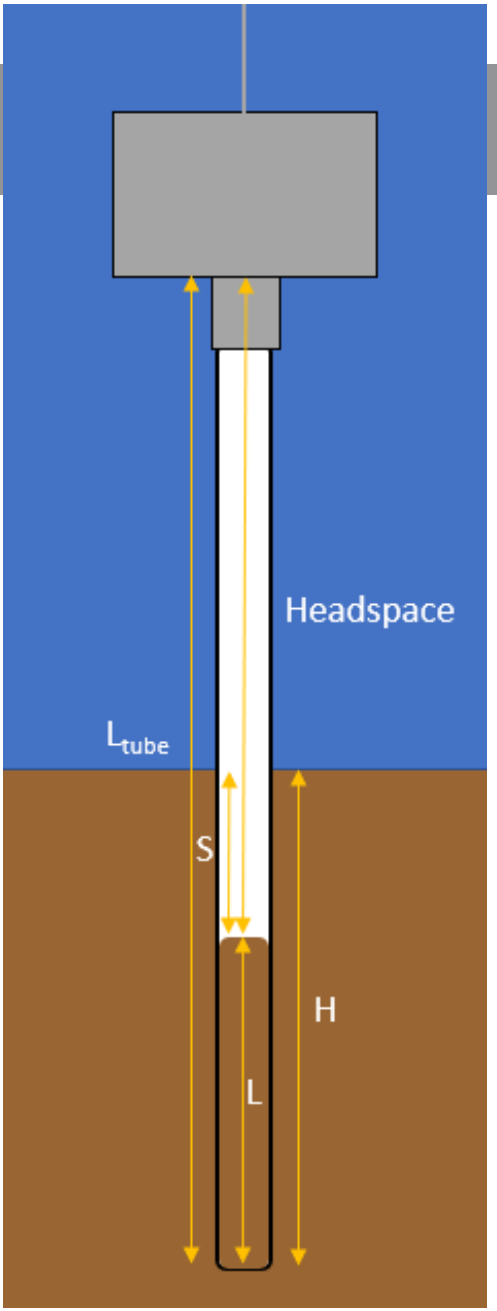
Potential Implications on Cost and Schedule

- The uncertainty associated with estimating in-situ DOC bml can limit the efficacy of precision remediation dredging, which can affect the cost, schedule, and overall success of remedial actions

Vibracore Measurements

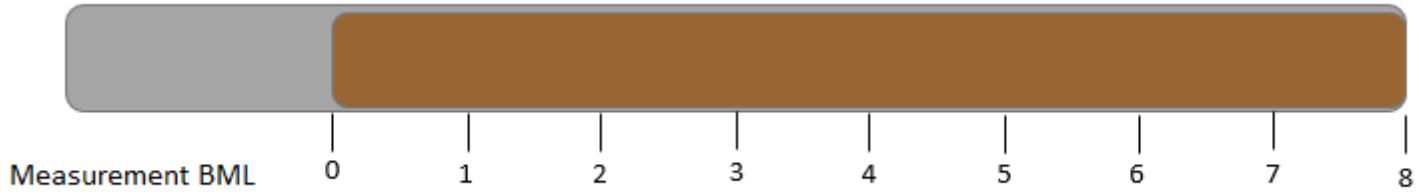
- Length of core tube (L_{tube}) – Headspace = recovered sediment (L)
- H is depth of penetration (field measured)
- For full penetration, H = L_{tube} and S = Headspace
- Percent Recovery (%R) = L / H * 100

- **S measurement is where uncertainty lies in conventional vibracoring!**

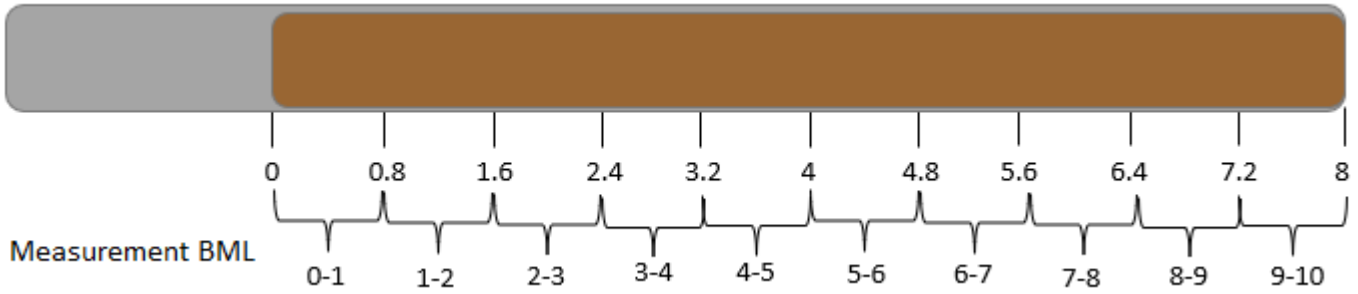


Uncertainty in Conventional Techniques

- Static Method
  - Assumes all material loss is from bottom of core upon retrieval

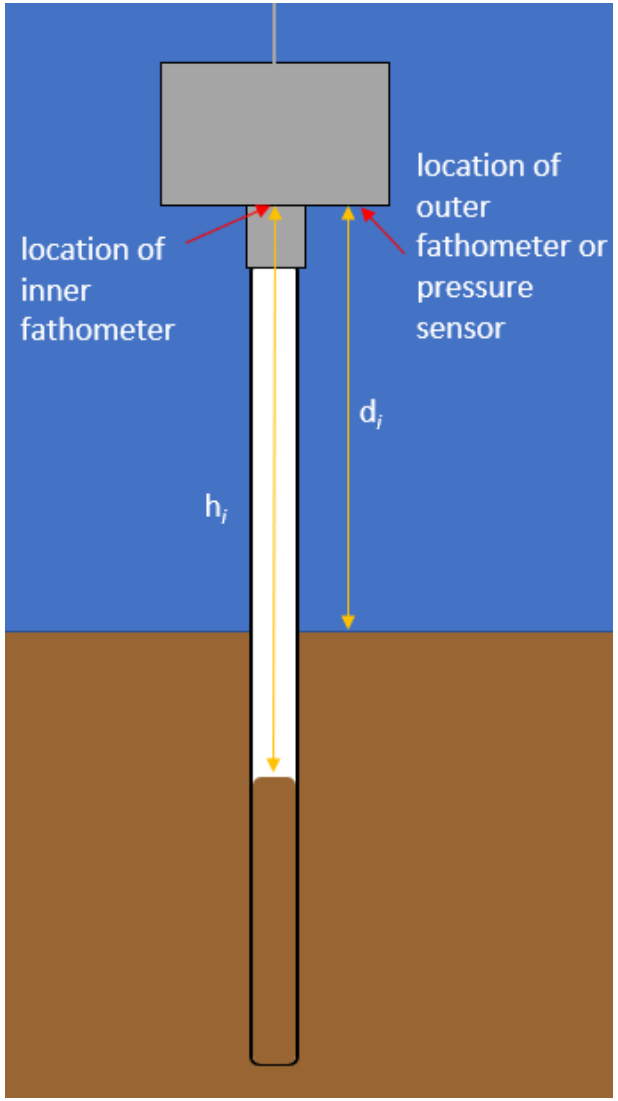


- Stretch Method
  - Assumes uniform recovery throughout drive



Vibracoring Sediment Acquisition Monitoring (V-SAM)

- Measures incremental depth to mudline inside and outside of core tube
- Incremental depth of penetration (d_i) and incremental headspace (h_i) are recorded at various stages through the drive, typically in 1’ to 3’ intervals
- At start of drive, $h_i = L_{tube}$ with adjustments for location of fathometer
- Incremental L and H are calculated from obtained values



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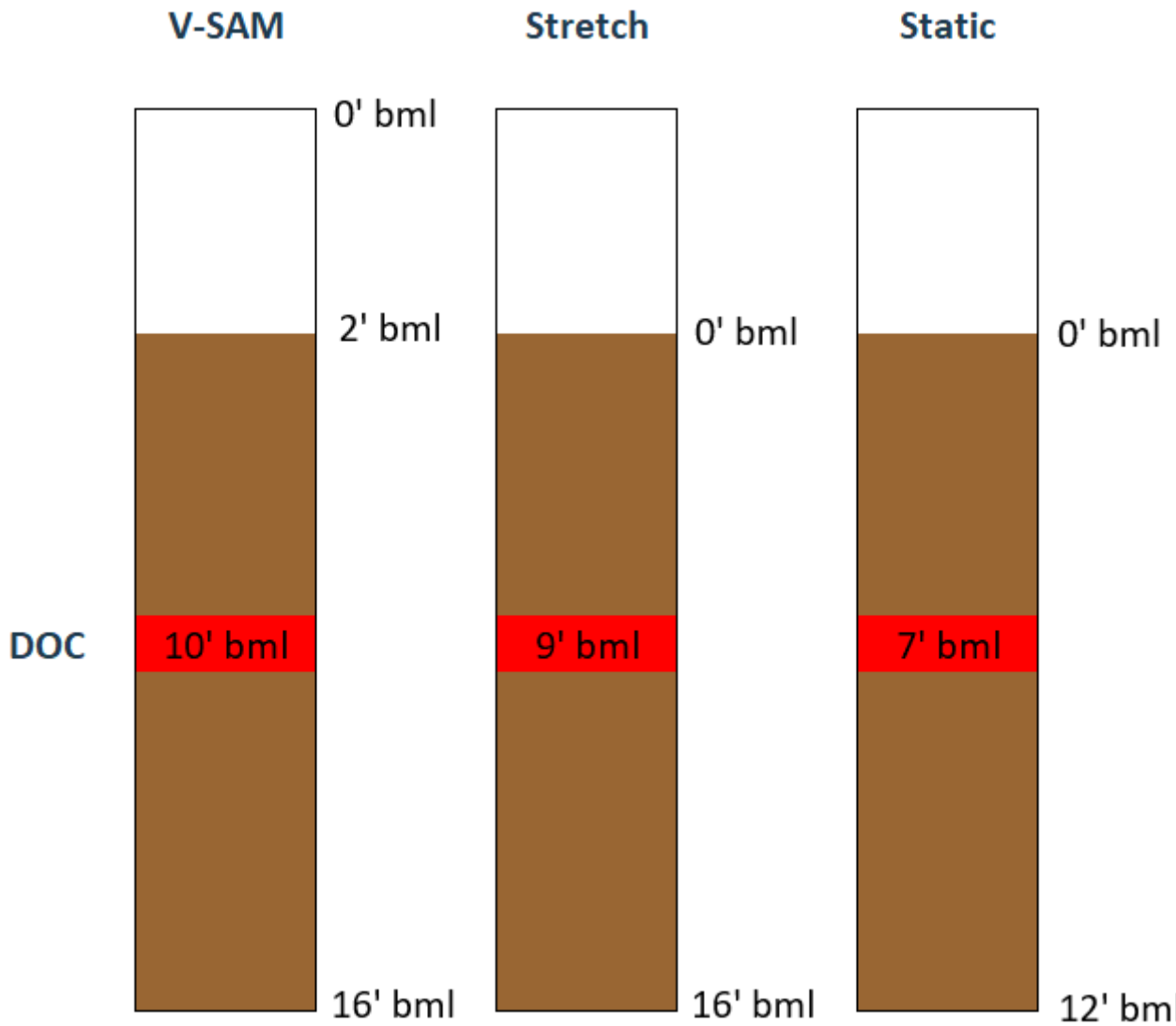
Example DOC Calculation Using All 3 Methods

- Assumes 16’ drive with 12’ of recovered sediment
- V-SAM shows 2 feet of missed material at start of drive and then uniform recovery throughout drive
- Sample from the 6-7’ interval is bottom of contamination



Case Study: Portland Harbor Superfund Site

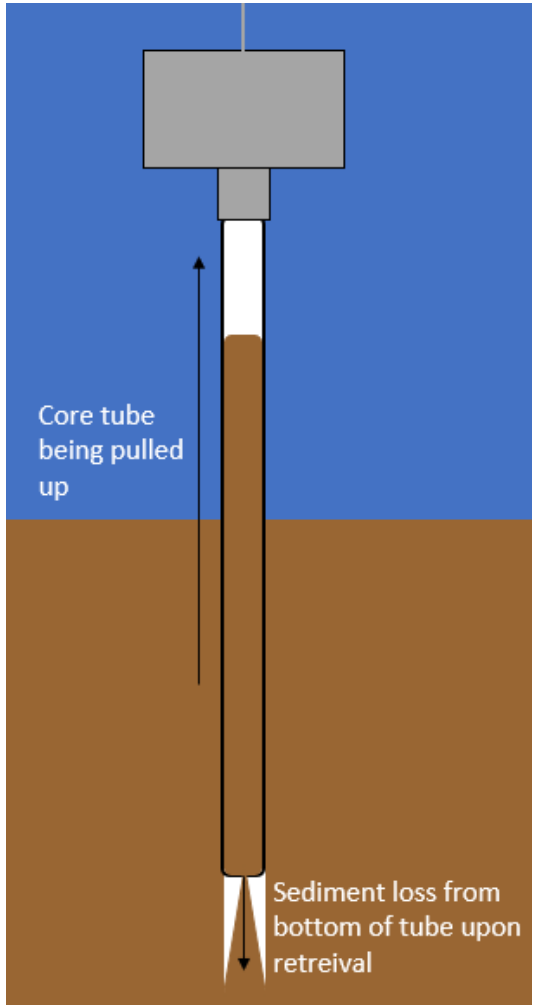
- Project area along the PHSS was selected for study
- Comparison between historical subsurface sediment data that used conventional vibracore methods and more recent data that used V-SAM
- Project area includes an off-channel slip and an area along the main channel of the Willamette Waterway

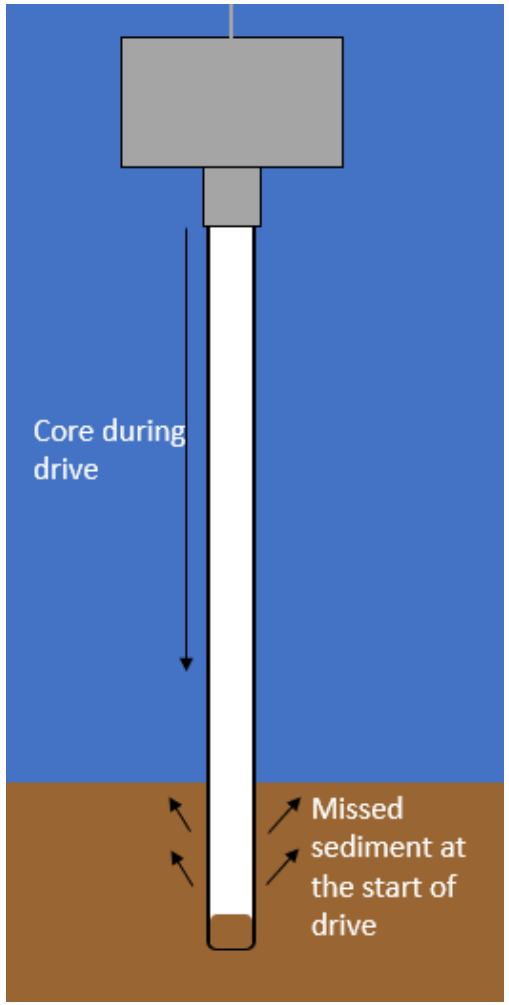
Data Used for Case Study

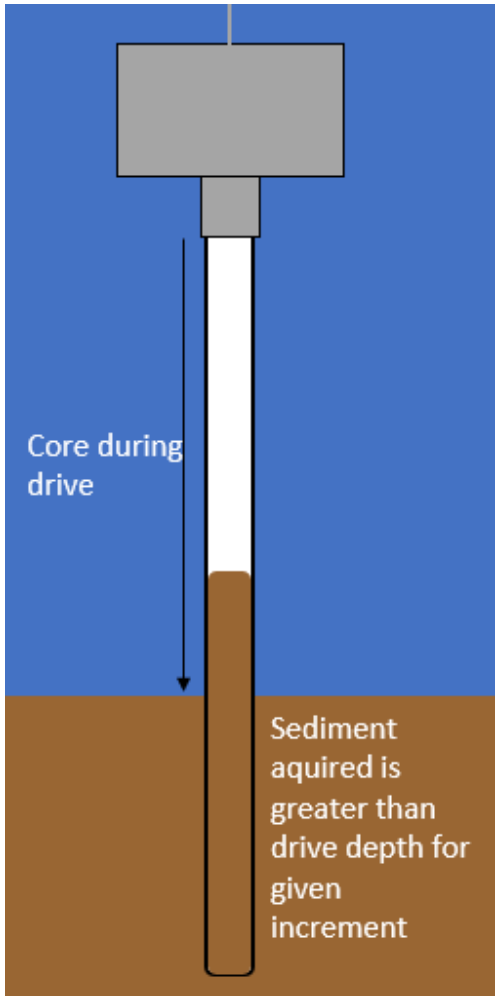
- Historical Data
  - 56 subsurface cores collected between 1997 and 2018
  - All used conventional vibracore methods for determining uncertainty within core
- 2021 PDI Data
  - 74 sampling stations, all used V-SAM during core collection

NUMBER OF CORES	AVERAGE INCREMENT OF DATA COLLECTION (FT)	AVERAGE PERCENT RECOVERY, TOTAL
74	1.9	83%

Observed Sediment Trends using V-SAM







- Losses from bottom of core tube during retrieval
- Missed sediment at start of drive
- Increments with greater than 100% recovery

Observed Sediment Trends using V-SAM

DRIVE INCREMENT	AVERAGE PERCENT RECOVERY	MEDIAN PERCENT RECOVERY	PERCENT OF INTERVALS WITH LESS THAN 50% RECOVERY	PERCENT OF INTERVALS WITH GREATER THAN 100% RECOVERY
FIRST	51%	56%	45%	1%
MIDDLE	84%	85%	9%	19%
END	122%	100%	3%	49%

Methodology

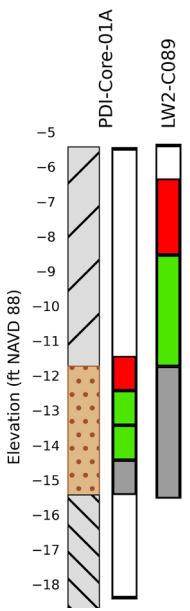
- Core pairs for comparison of historical vs. recent data
  - Historical core had to meet following criteria:
    - Have PCB contamination above the PHSS Remedial Action Level (75 ug/kg)
    - Vertically delineated by at least one underlying clean sample
    - Located within 75 feet of a 2021 PDI sample

- 14 historical cores met criteria and were used for comparison
  - 11 locations located within the slip
  - 3 locations located along the main channel

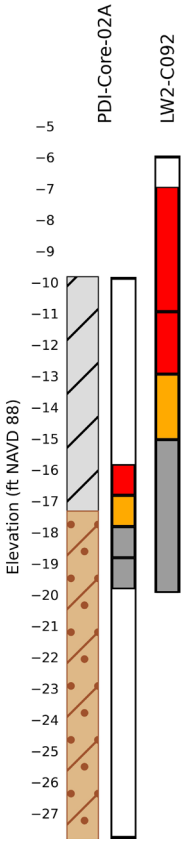
Comparison of EOC within the Slip

2021 PDI SAMPLE	HISTORICAL SAMPLE	DISTANCE BETWEEN CORES (FT)	DIFFERENCE IN EOC (FT)
PDI-01A	LW2-C089-B	21	-3.9
PDI-02A	LW2-C092-D	67	-2.9
PDI-03A	LW2-C094	11	2.5
PDI-04A	LW2-C093	16	-2.9
PDI-04B	SC-S031	59	-1.1
PDI-05B	LW2-C084	46	-2.4
PDI-06A	LW2-C091	1	-3.1
PDI-08A	LW2-C090	18	-5.5
PDI-10A	LW2-C086	38	-3.5
PDI-10A	LW2-C087	56	-3.7
PDI-12A	LW2-C088	54	-3.2

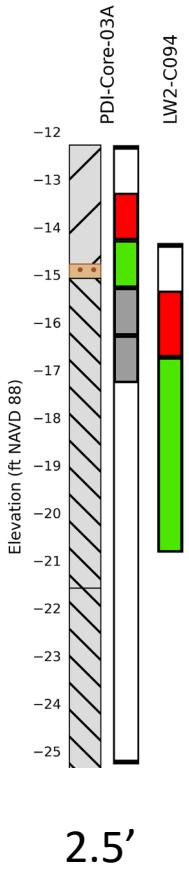
Comparison of EOC within the Slip



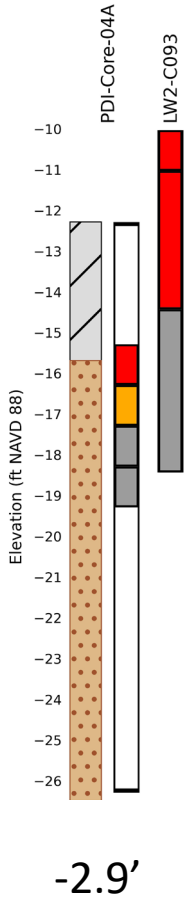
-3.9’



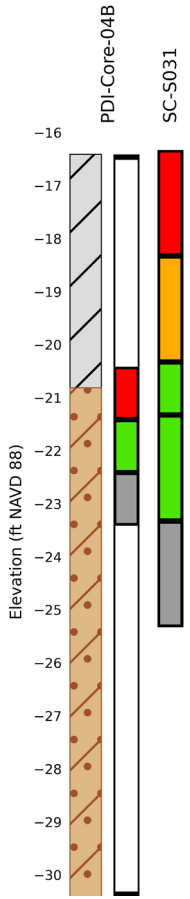
-2.9’



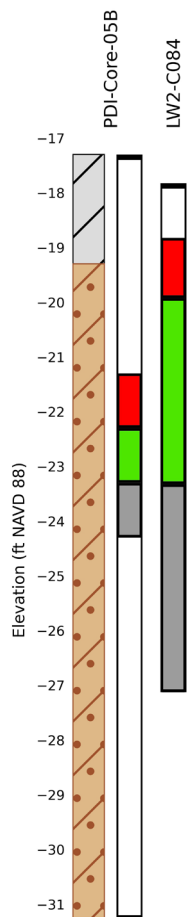
2.5’



-2.9’

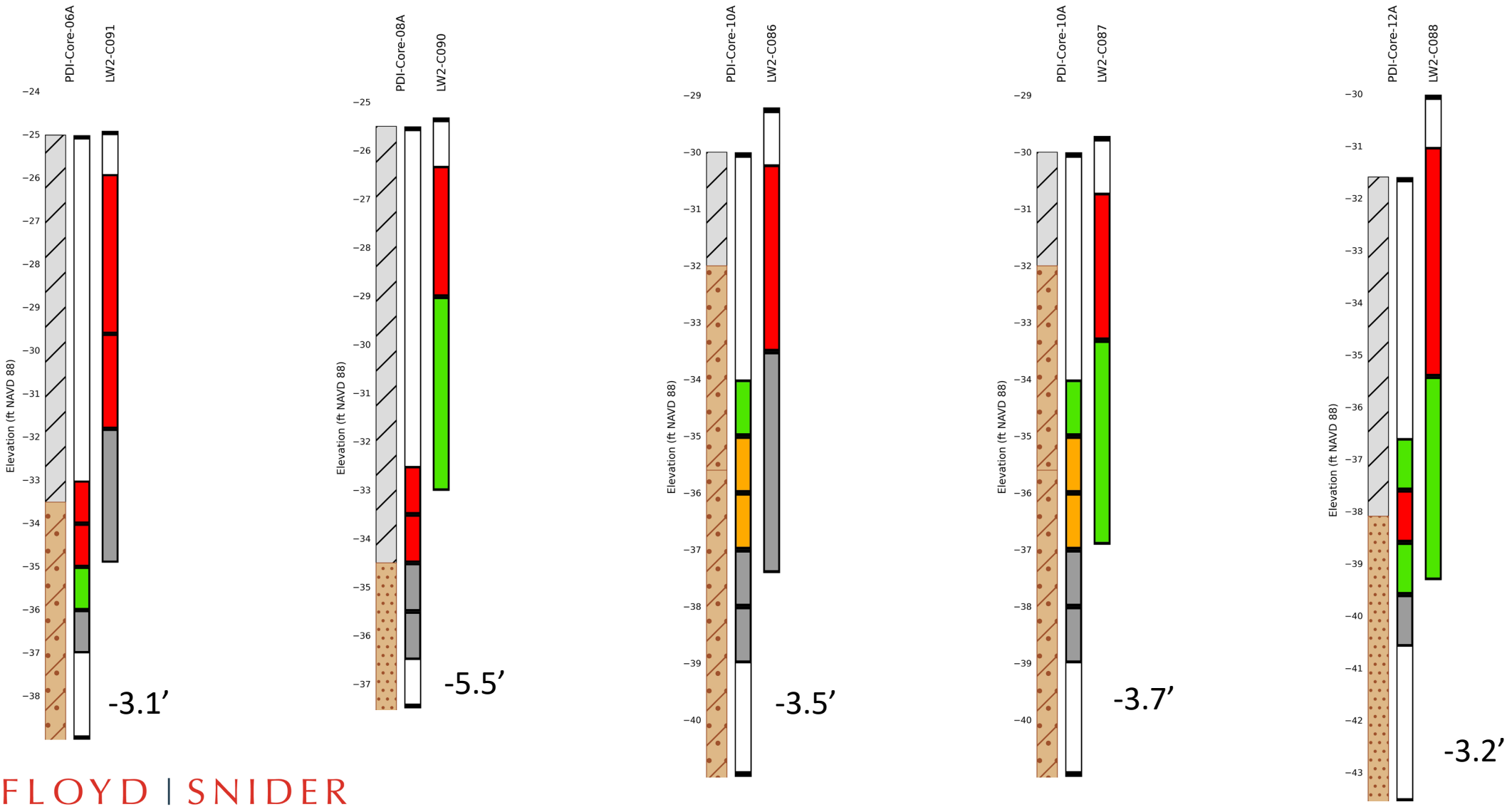


-1.1’

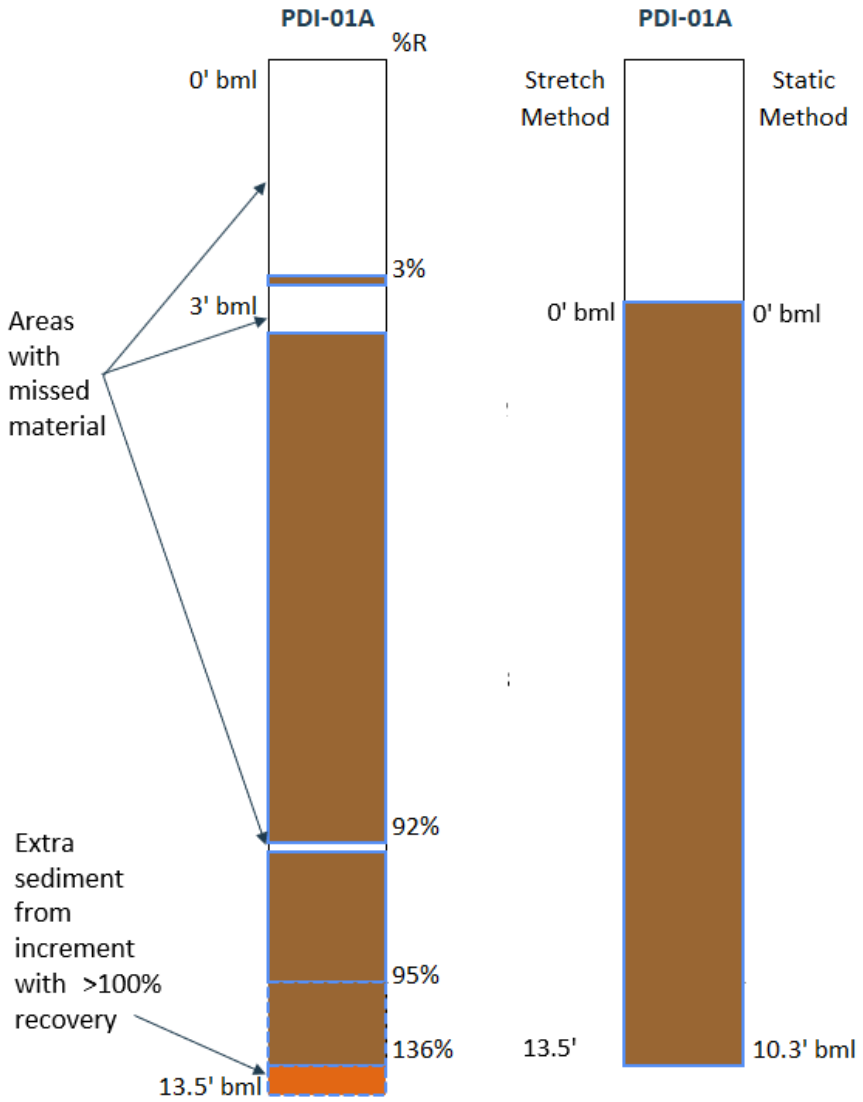


-2.4’

Comparison of EOC within the Slip



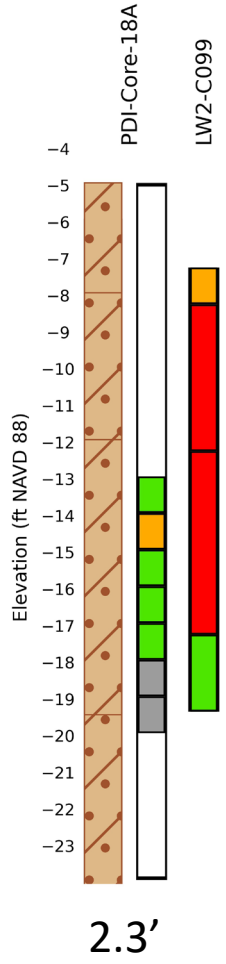
Comparison of EOC within the Slip



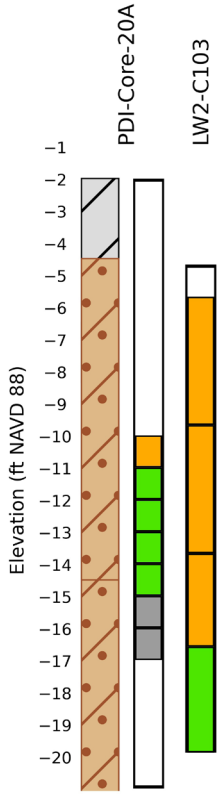
Comparison of Along the Waterway

2021 PDI SAMPLE	HISTORICAL SAMPLE	DISTANCE BETWEEN CORES (FT)	DIFFERENCE IN EOC (FT)
PDI-18A	LW2-C099	10	2.3
PDI-20A	LW2-C103	11	5.6
PDI-21A	LW2-C106	28	4.3

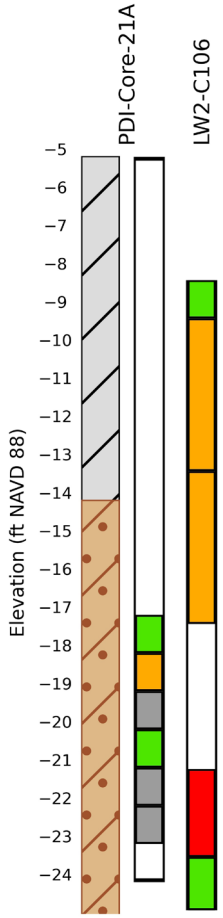
Comparison of EOC Along the Waterway



2.3’



5.6’



4.3’

Discussion of Differences in EOC

- 10 out of 11 samples in slip underestimated the EOC
  - More unconsolidated fine sediment at surface
  - The one sample that deviated from this was primarily classified as clay
- All 3 samples along the channel overestimated the EOC
  - More bed shear; less unconsolidated fine sediment
  - Potentially a greater impact of the intervals with >100% recovery

Potential Effects on Remedial Design and Costs

- Assume each sample represents a 150'x150' area (~ 0.5 acre)
- Total of 7.2 acres represented by samples

AREA	AREA (ACRES)	MISSED SEDIMENT (CY)	OVERDREDGED SEDIMENT (CY)
SLIP	5.7	26,700	2,100
MAIN CHANNEL	1.5	0	10,200

- Extrapolating to cover project area…

AREA	AREA (ACRES)	MISSED SEDIMENT (CY)	OVERDREDGED SEDIMENT (CY)
SLIP	17	80,000	6,300
MAIN CHANNEL	28	0	184,000

Potential Effects on Remedial Design and Costs

- 80,000 CY of missed sediment…
  - Recharacterization of project area
  - Redesign/re-mobilization
  - 40 barges of sediment
  - SCHEDULE!

- 184,000 CY of overdredged sediment…
  - At $160 per CY for transload, transport and disposal at Subtitle D landfill, ~$29M

Summary

- Accurate data matters!

- V-SAM can greatly improve uncertainty in site characterization as opposed to vibracoring with conventional methods

Thank you

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