Mapping Dredged Material and a Sand Cap at Douglas Harbor, Juneau, AK, using Sediment-Profile Imaging (SPI) and a Semi-automated Image Processing System

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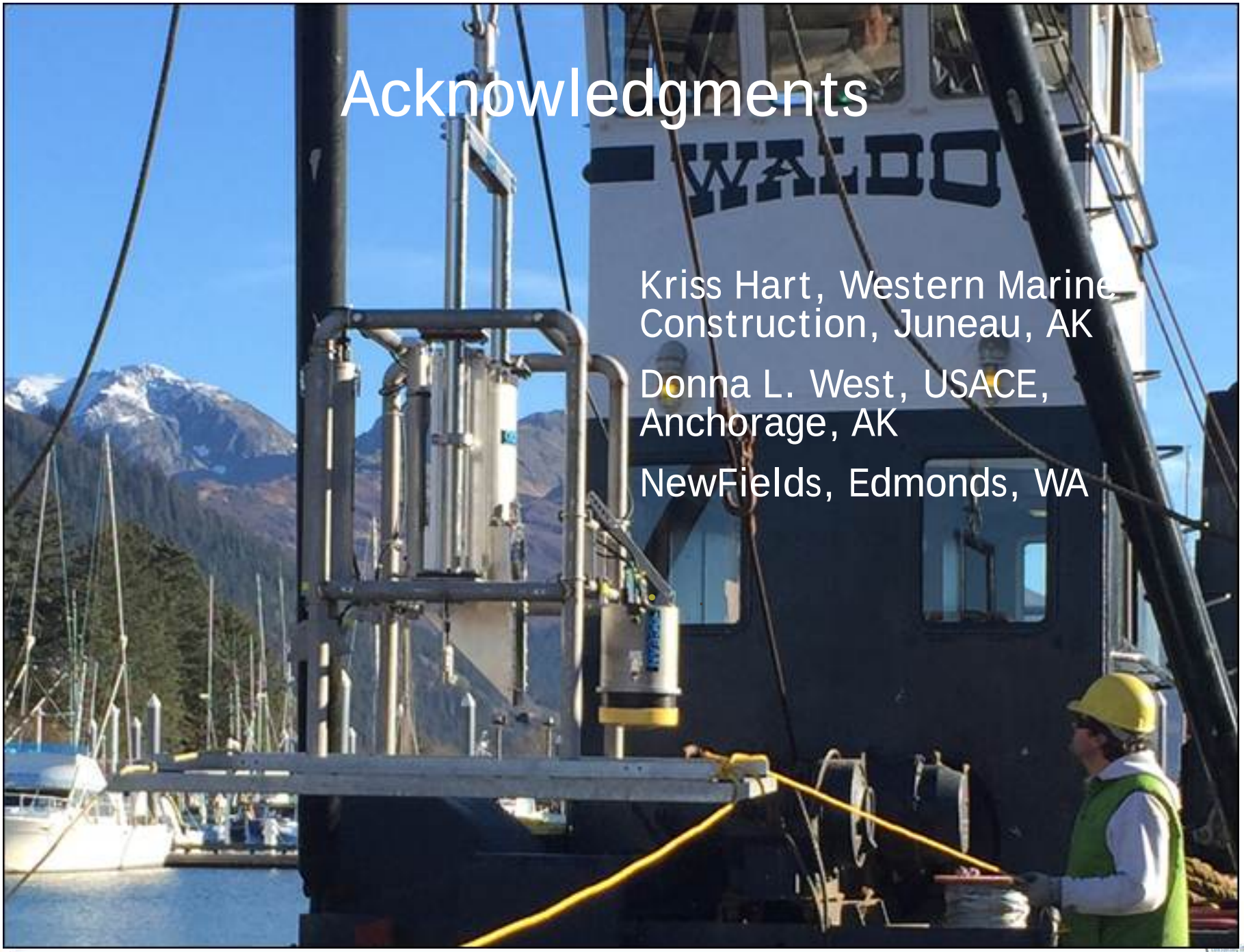
Brandon Sackmann

Integral Consulting Inc.
Olympia, WA

Acknowledgments

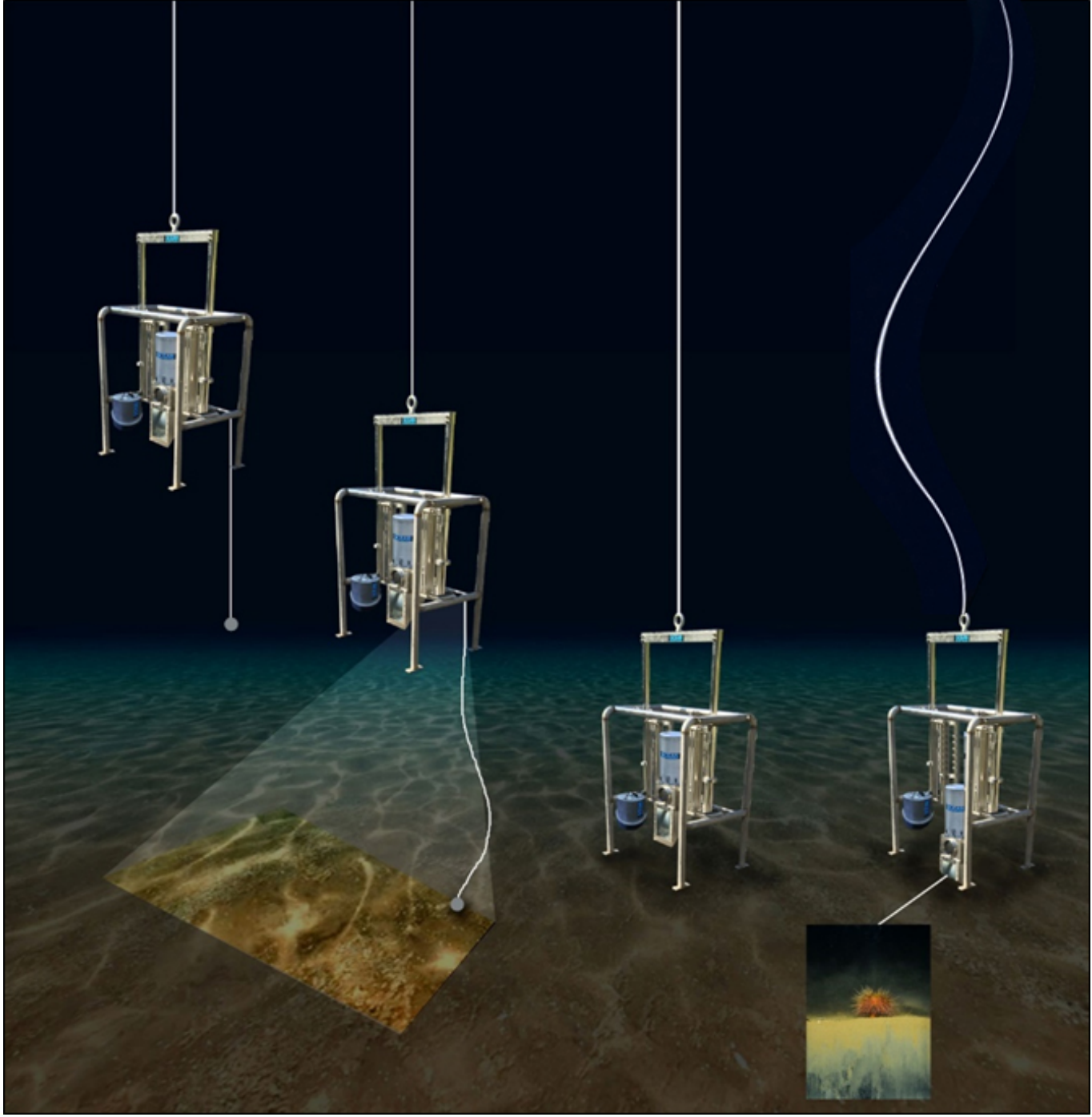


Kriss Hart, Western Marine Construction, Juneau, AK

Donna L. West, USACE, Anchorage, AK

NewFields, Edmonds, WA

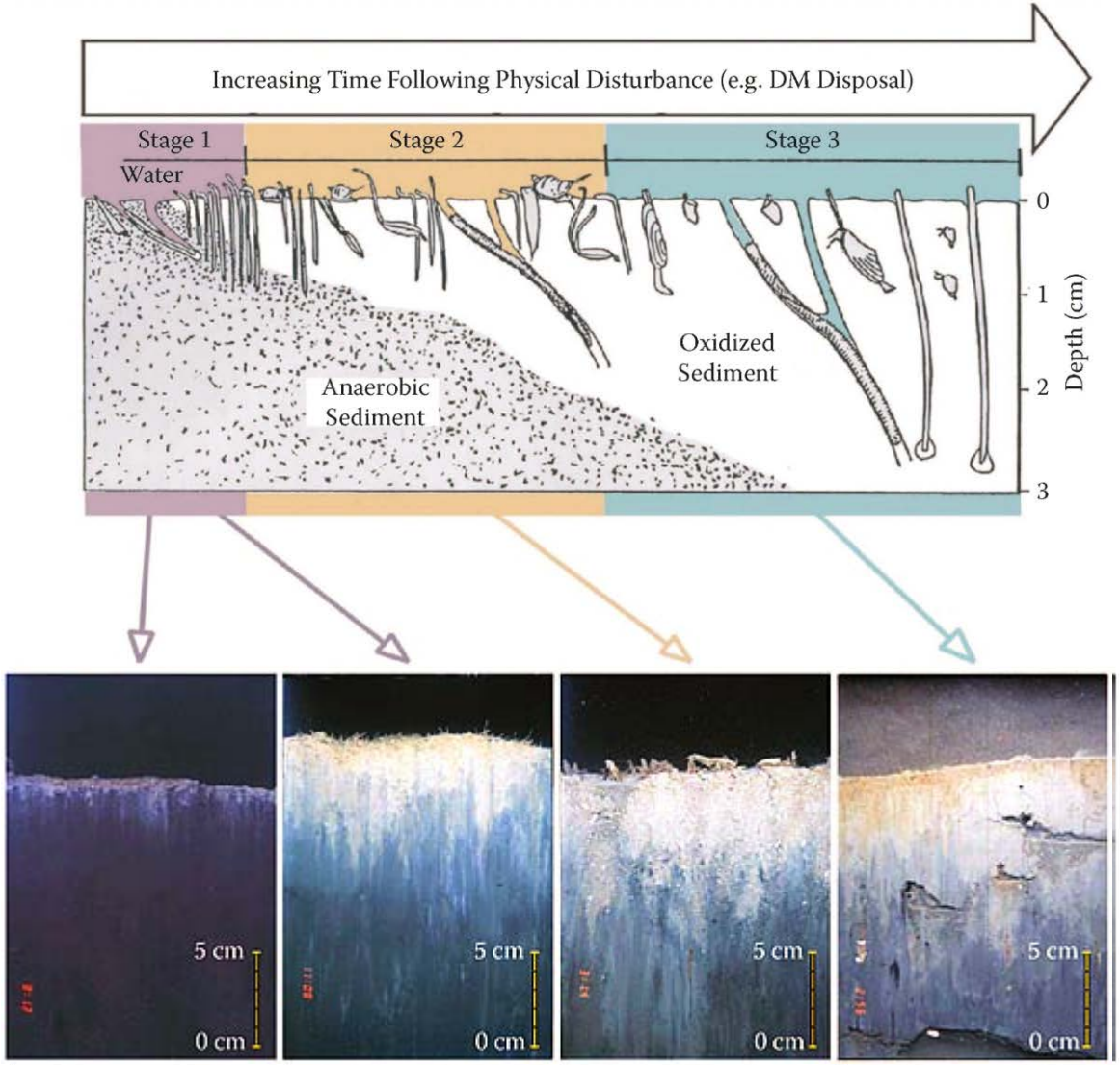
SPI/PV Image Collection



"You can observe a lot just by watching."

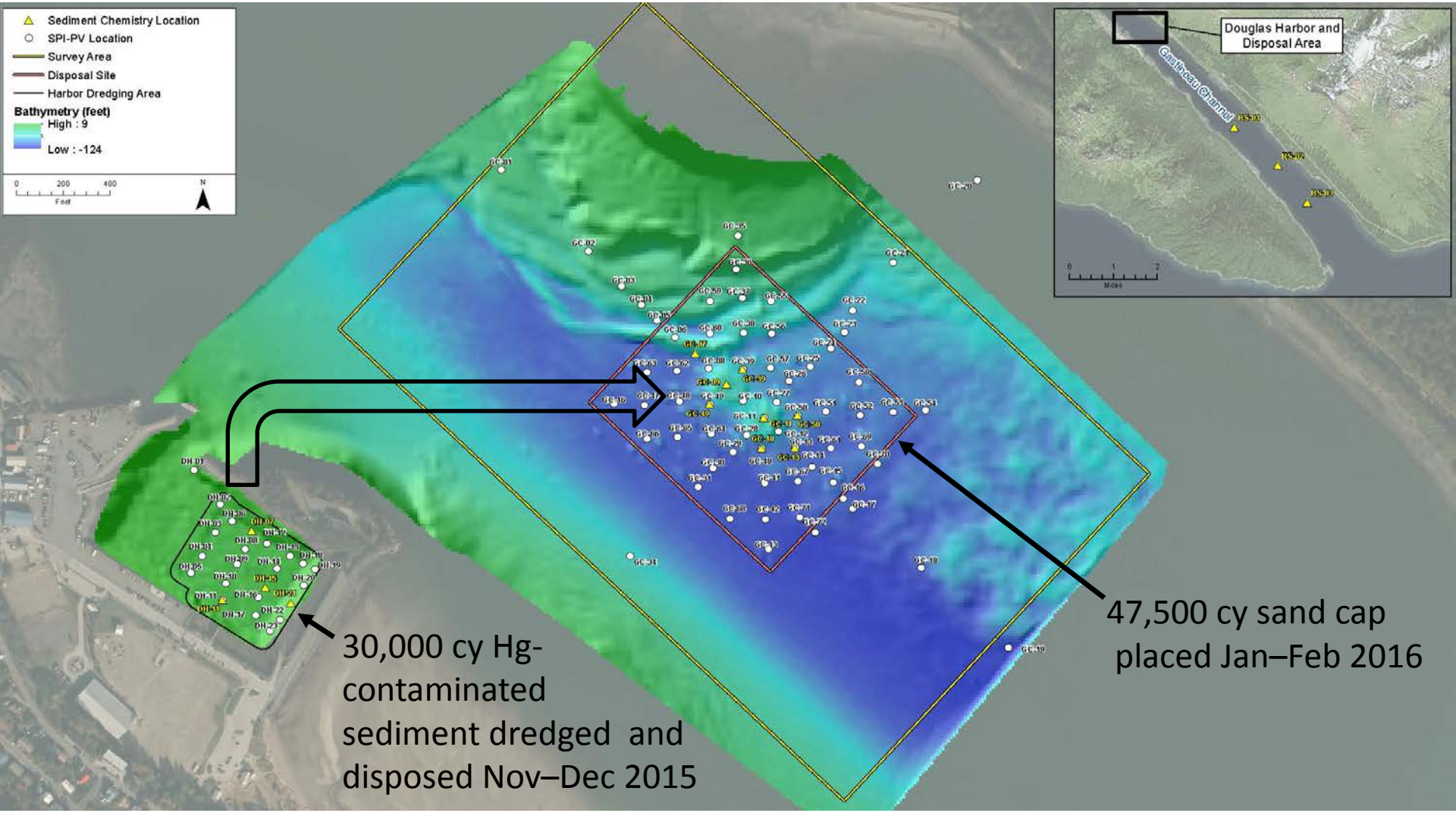
- Yogi Berra

SPI Interpretive Paradigm



From Germano et al. 2011. The use of sediment profile imaging (SPI) for environmental impact assessments and monitoring studies – lessons learned from the past four decades. *Oceanography and Marine Biology: An Annual Review* 49: 247-310.

Douglas Harbor, Juneau, AK—Dredging Project



SPI/PV Surveys and Objectives

1. **Baseline:** Map Benthic Conditions in Douglas Harbor and at Gastineau Channel Disposal Site—October 2015

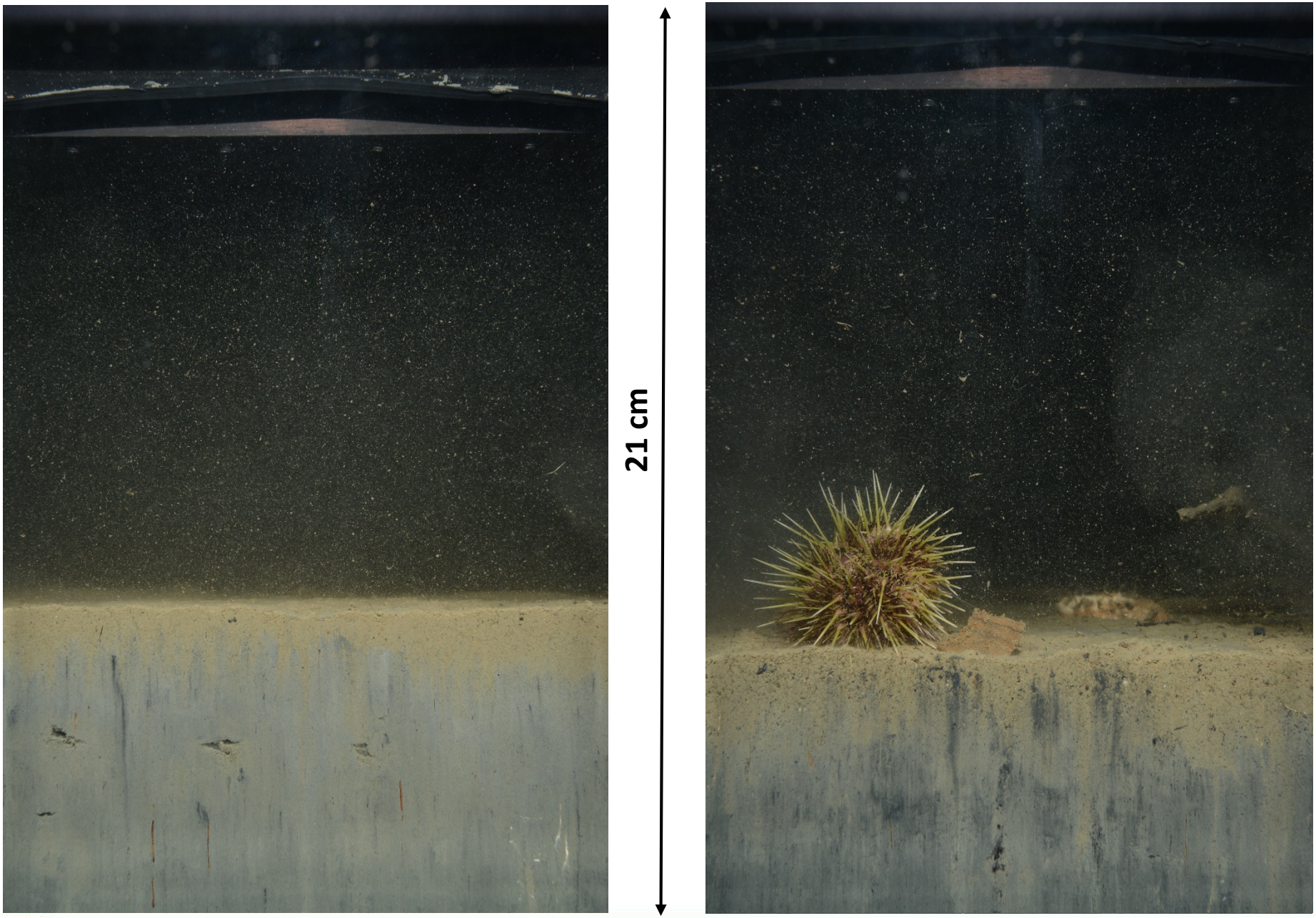
2. **Post Dredged Material Disposal:** Map Benthic Conditions and Dredged Material (DM) Footprint at Disposal Site—January 2016

3. **Interim Sand Cap Placement Survey:** Map Interim Extent and Thickness of Sand Cover at Disposal Site—February 2016

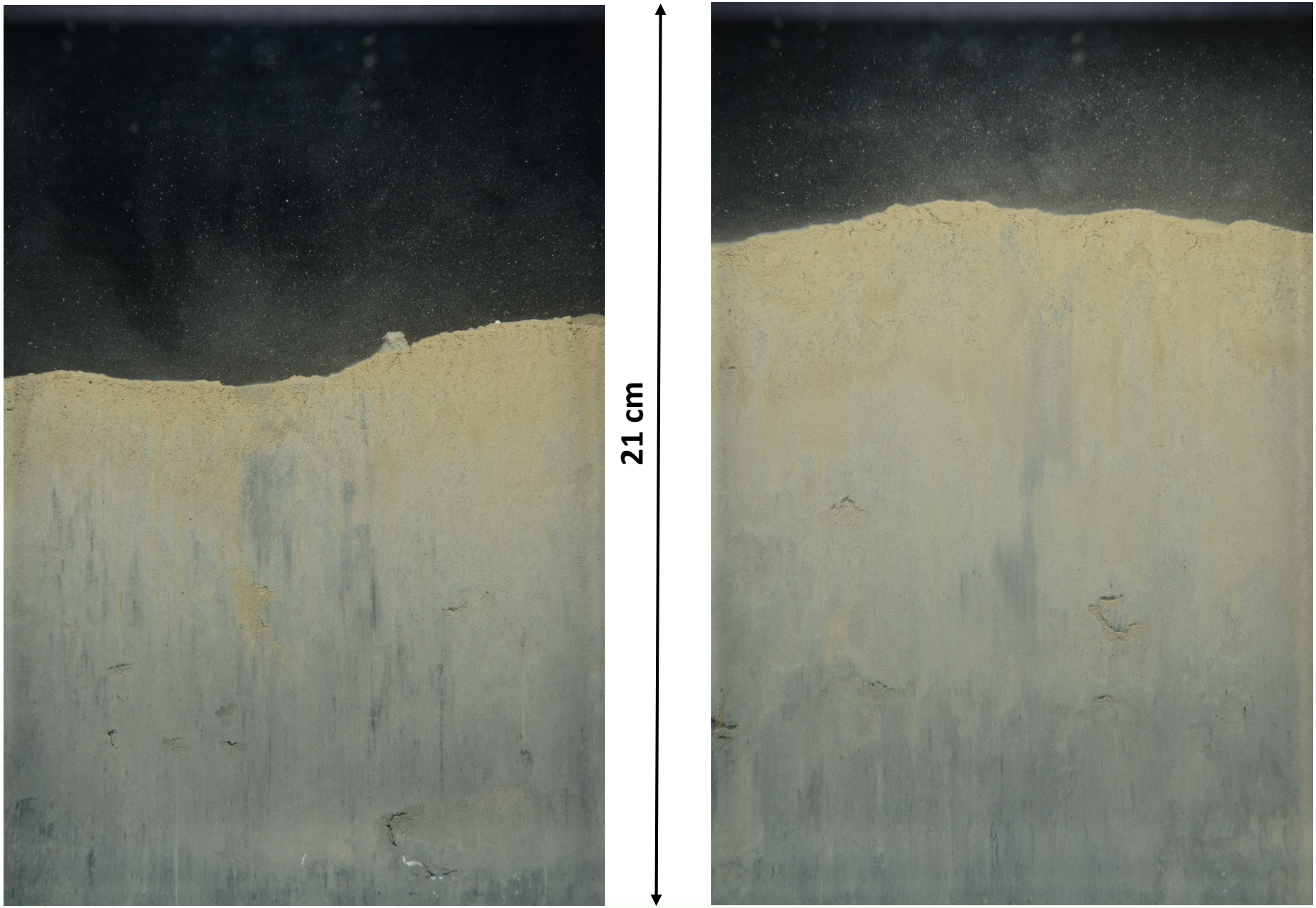
4. **Post-construction Survey:** Map Final Extent and Thickness of Sand Cap—March 2016

5. **One-year Post-construction Survey:** Map Benthic Recovery—scheduled for March 2017

Baseline Conditions—Douglas Harbor

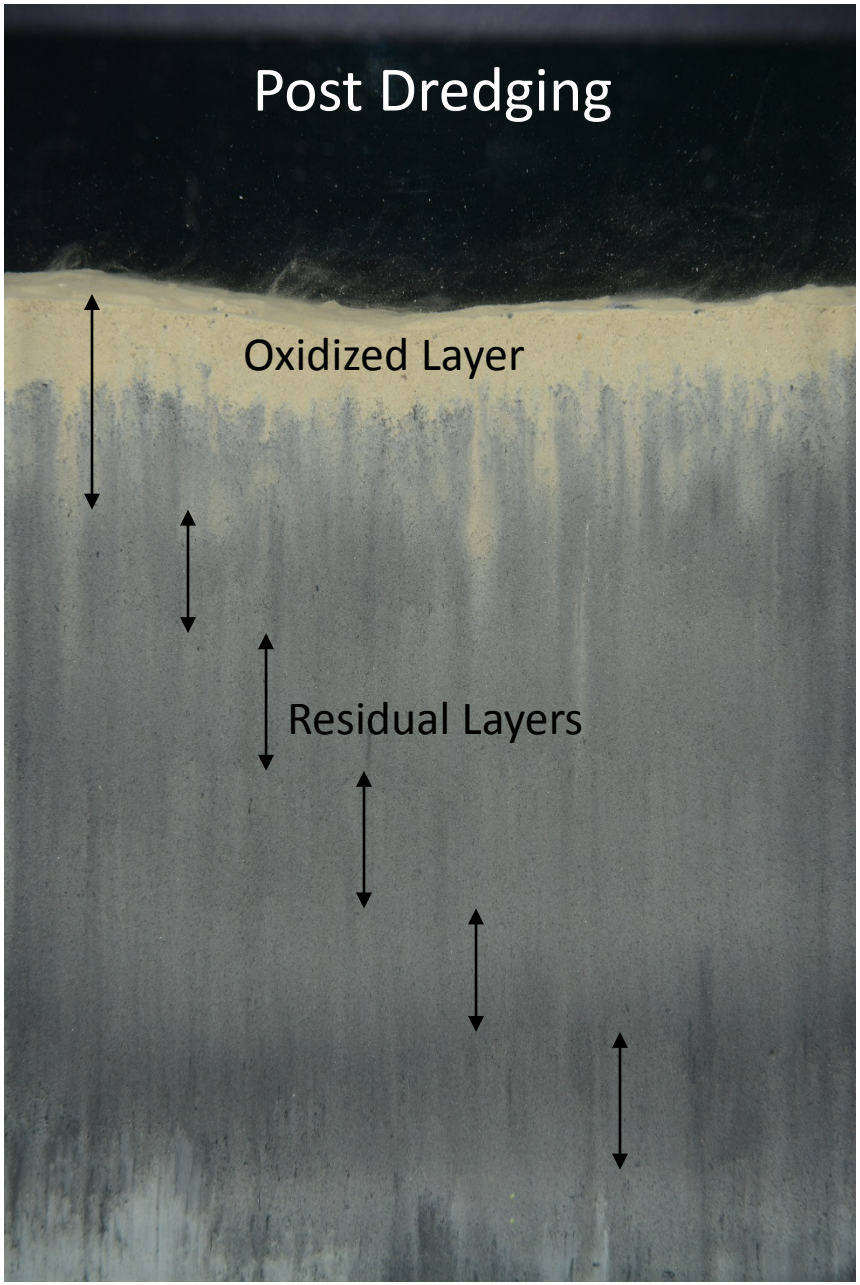


Baseline Conditions—Gastineau Channel Disposal Site

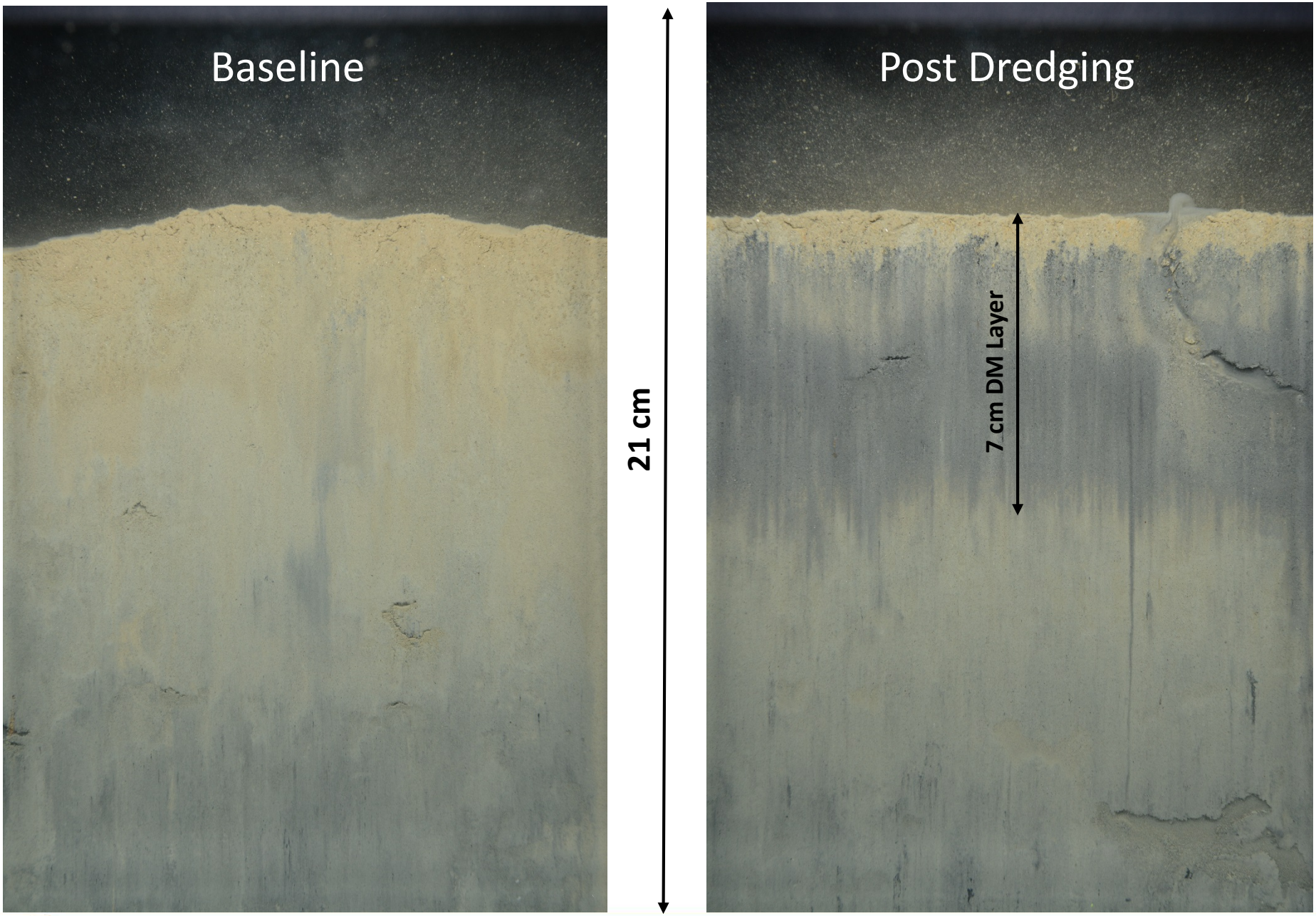


Douglas Harbor—Post-dredge Survey

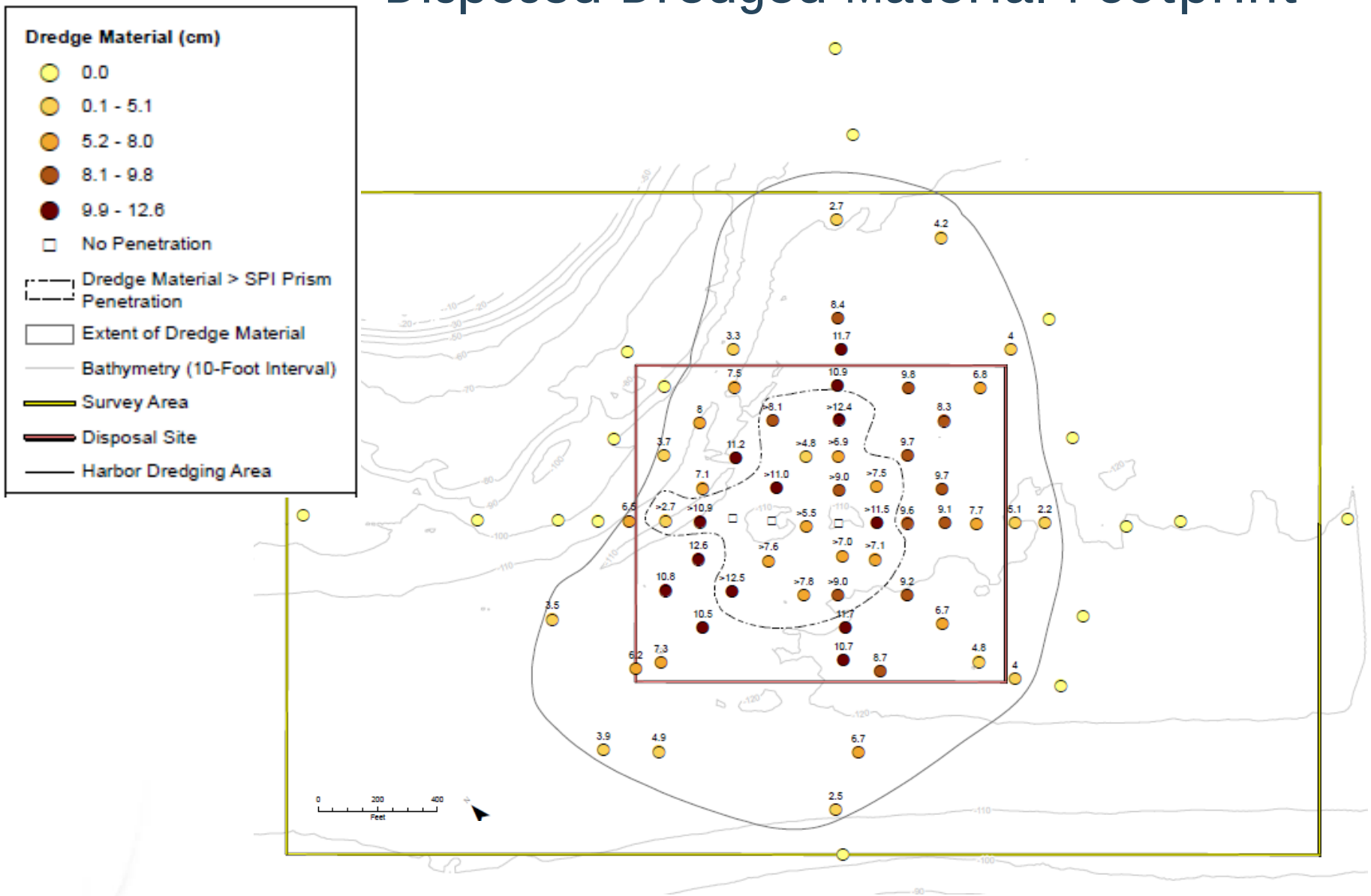
21 cm



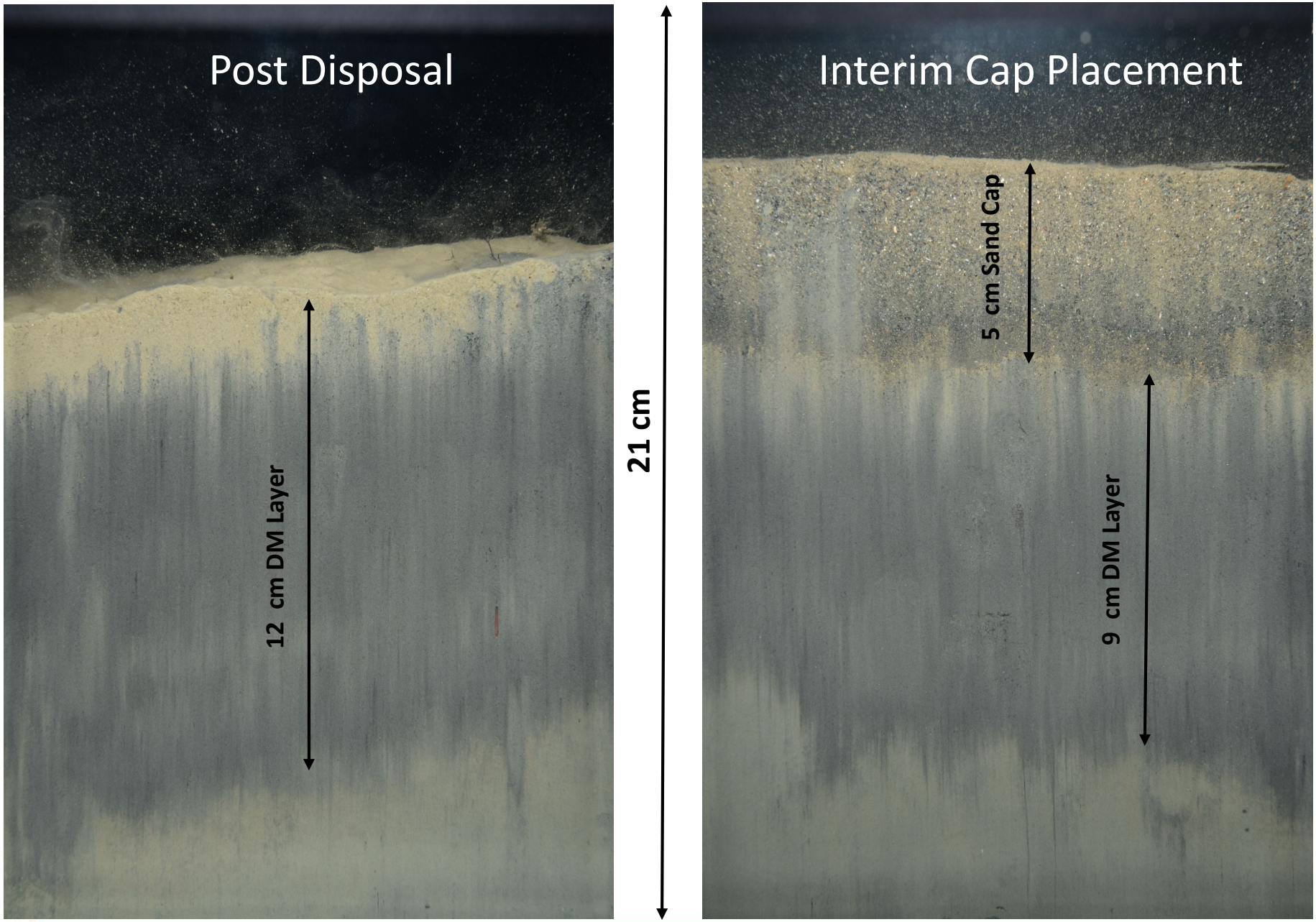
Disposal Site—Post-dredge Survey



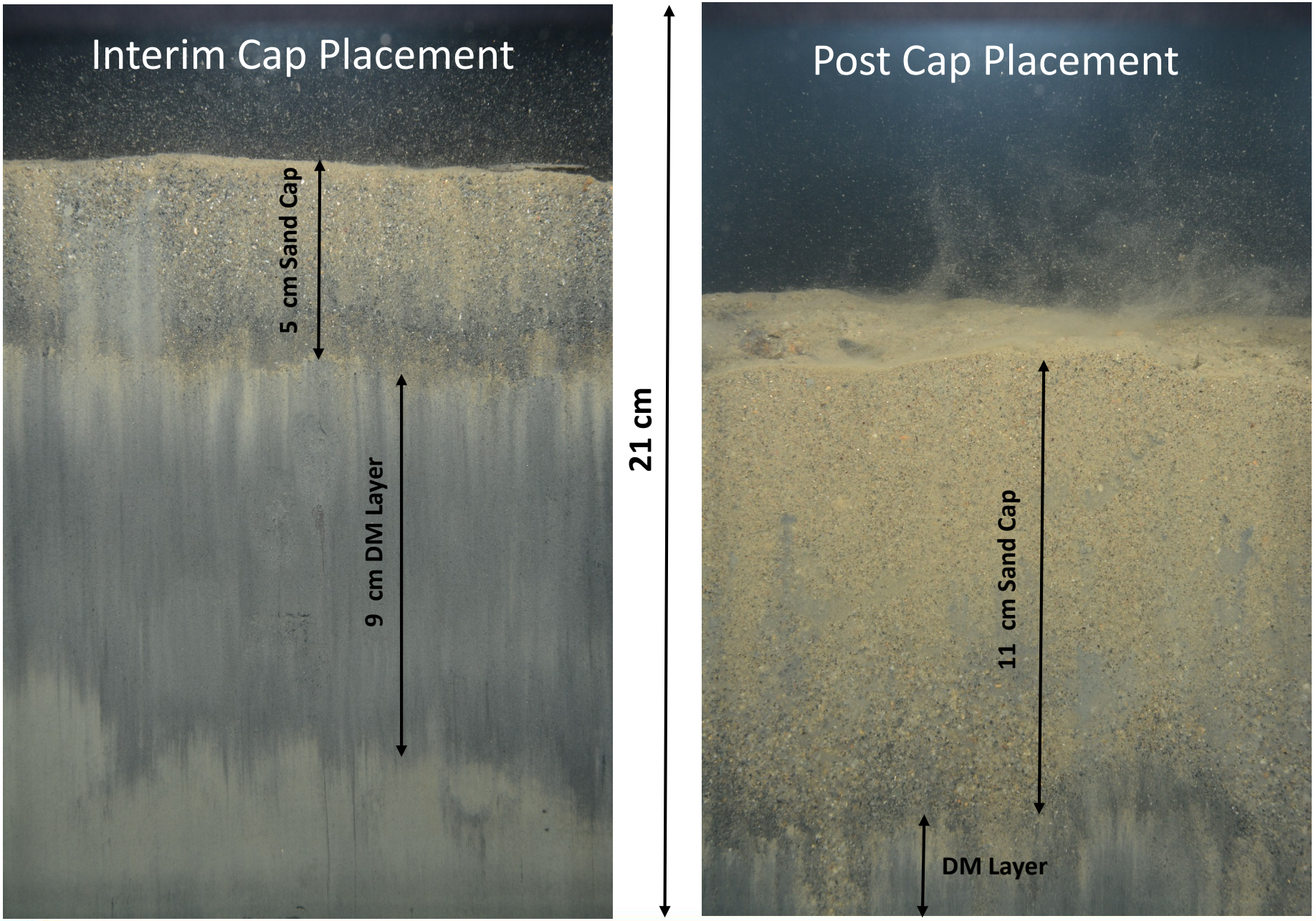
Disposed Dredged Material Footprint



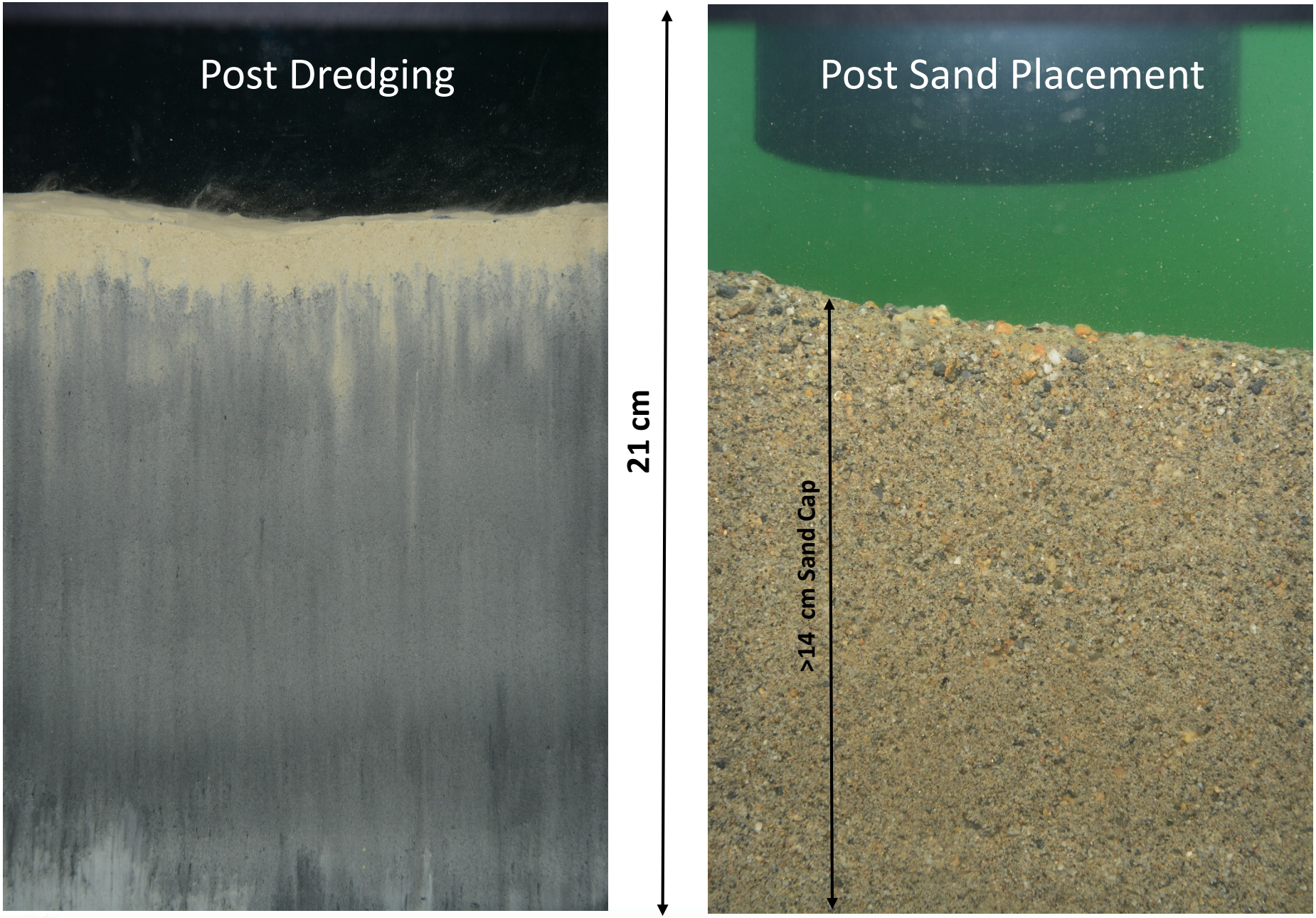
Disposal Site—Interim Cap Survey



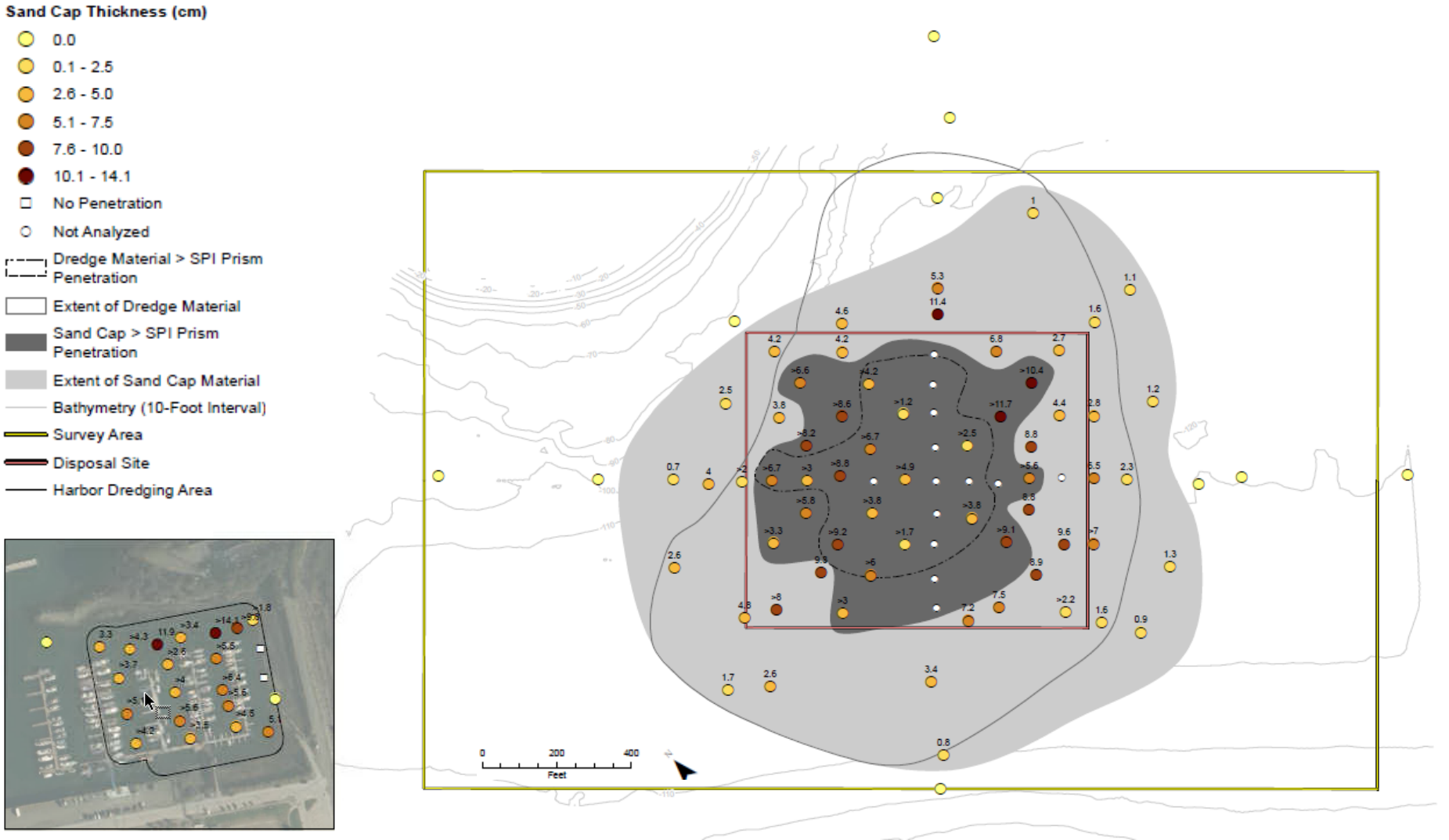
Disposal Site—Post-capping Survey



Douglas Harbor—Post-capping Survey



Post Sand Cap Survey—Disposal Site



iSPI…with my little eye…

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journal homepage: www.elsevier.com/locate/envsoft

Semi-automatic analysis and interpretation of sediment profile images

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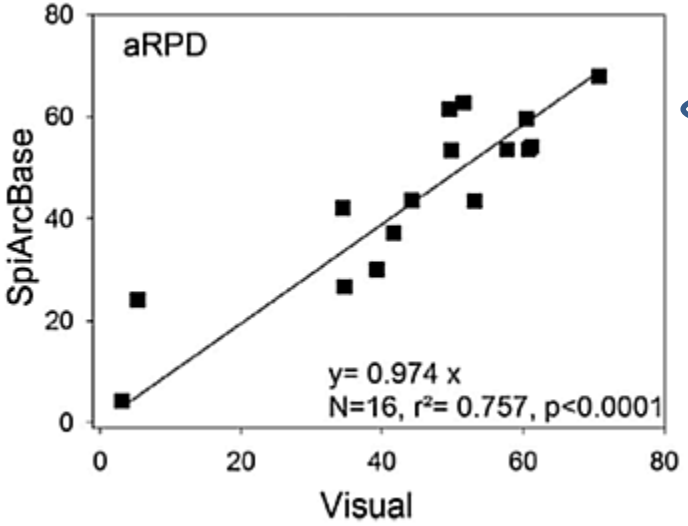
[b] Université de Perpignan, CNRS-EPHE, CRIOBE, USR 3278, F66860 Perpignan, France
[c] CNRS, EPOC, UMR 5805, F33400 Talence, France



ABSTRACT

Sediment Profile Images (SPIs) are widely used for benthic ecological quality assessment under various environmental stressors. The processing of the information contained in SPIs is slow and its interpretation is largely operator dependent. We report here on a new software: SpiArcBase, which allows for a semi-automatic analysis of SPIs and facilitates the interpretation of observed features. SpiArcBase enhances the objectivity of the information extracted from SPIs, especially for the assessment of the apparent Redox Potential Discontinuity (aRPD). This new software also allows the user to create and manage a database containing original SPIs and corresponding derived pieces of information. Examples of the use of SpiArcBase for SPIs collected during a case study carried out within the Rhône River Prodelta are provided. Correlations between: (1) visually and automatically assessed aRPD and Benthic Habitat Quality Index (BHQ), and (2) automatically assessed aRPD and BHQ and surface sediment organic carbon support the use of this new software.

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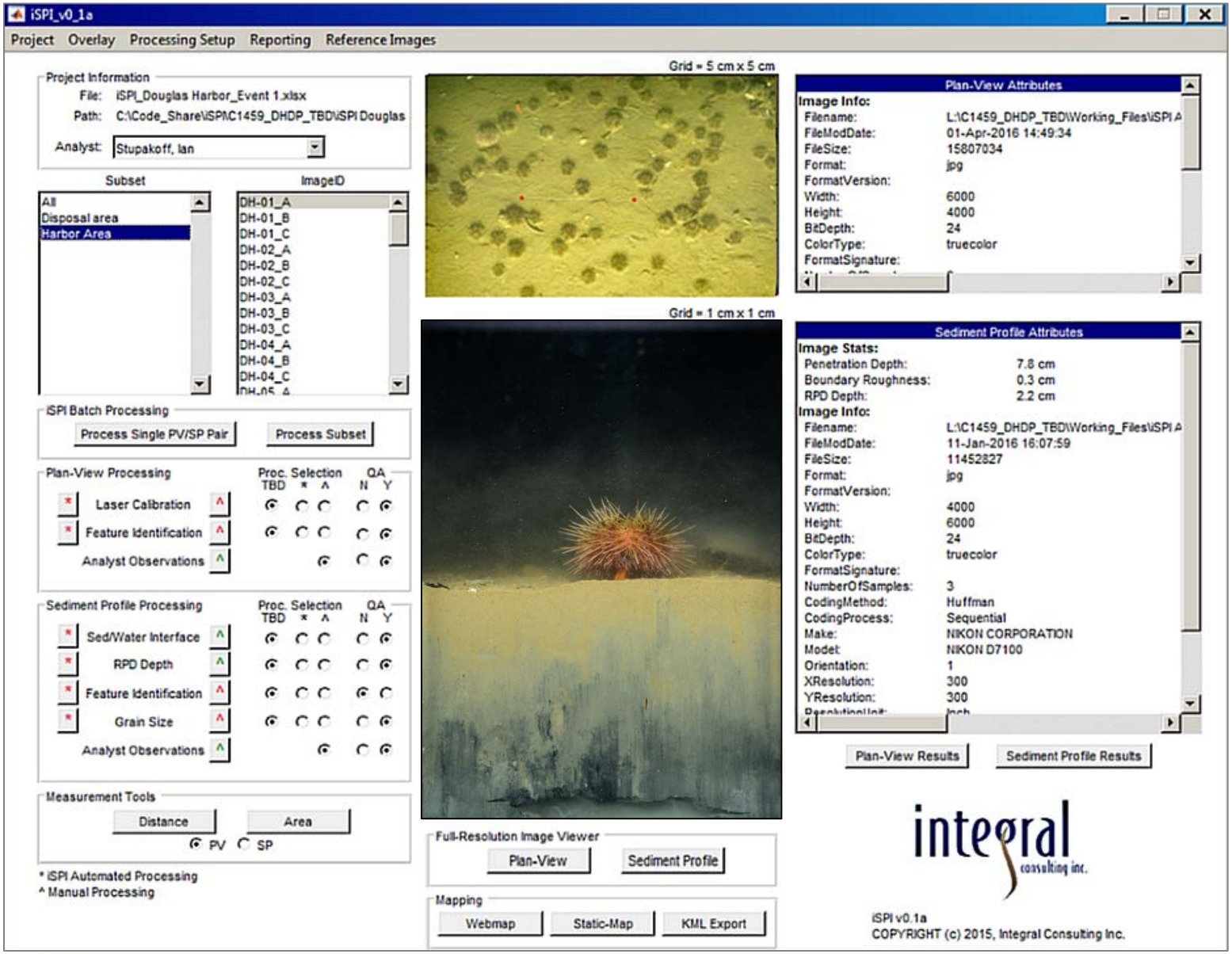
Comparison of the mean depths of aRPD assessed automatically (SpiArcBase) and visually, by two independent operators (Romero-Ramirez et al. 2013)

iSPI Platform Architecture



MATLAB

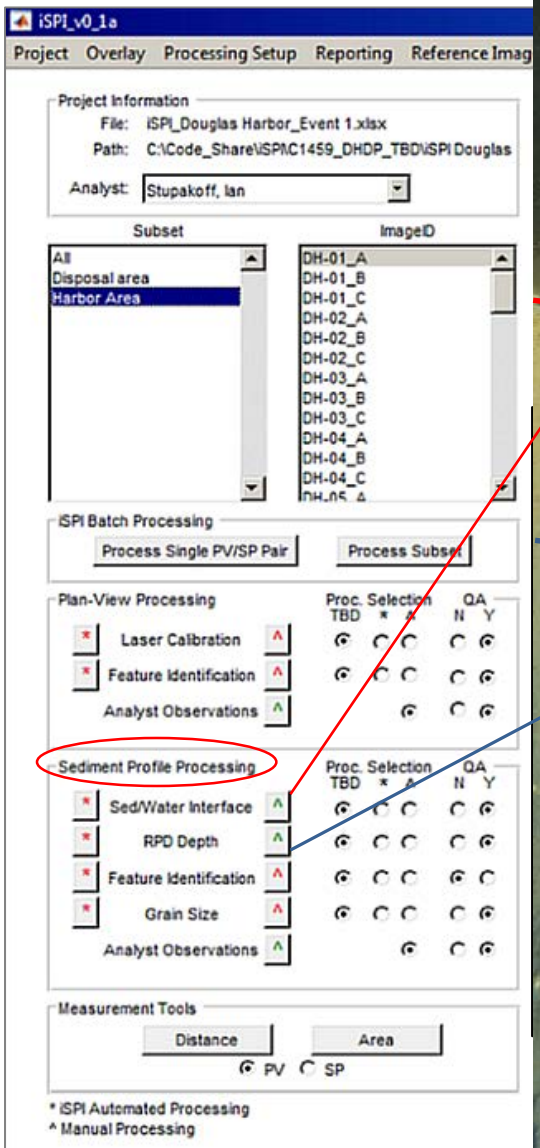
OpenCV

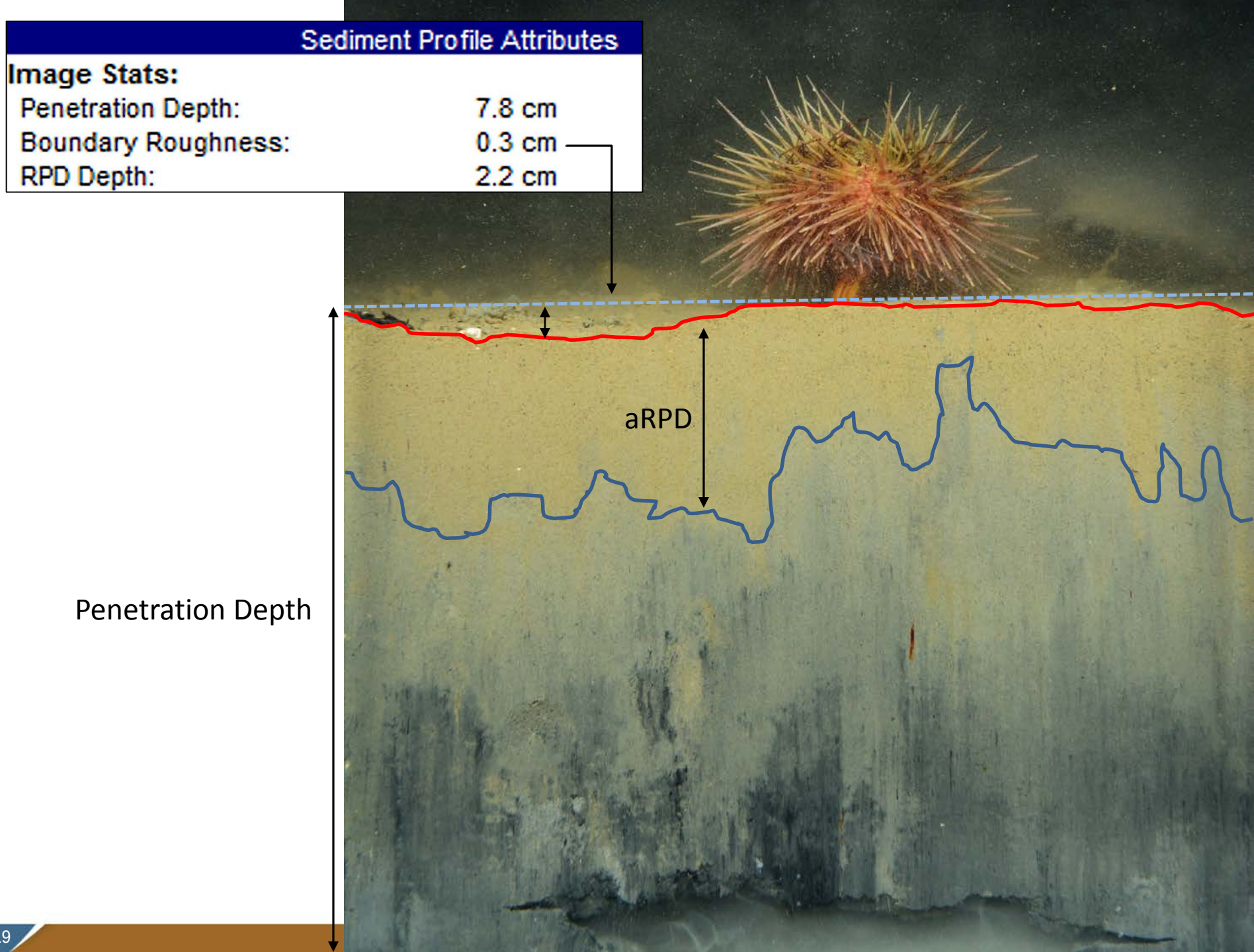
ImageJ
Image Processing & Analysis in Java

Bitbucket

integral consulting inc.

iSPI


iSPI_v0_1a
Project
Overlay
Processing Setup
Reporting
Reference Imag
Project Information
File: iSPI_Douglas Harbor_Event 1.xlsx
Path: C:\Code_Share\iSPI\C1459_DHDP_TBD\iSPI Douglas
Analyst: Stupakoff, Ian
Subset
All
Disposal area
Harbor Area
ImageID
DH-01_A
DH-01_B
DH-01_C
DH-02_A
DH-02_B
DH-02_C
DH-03_A
DH-03_B
DH-03_C
DH-04_A
DH-04_B
DH-04_C
iSPI Batch Processing
Process Single PV/SP Pair
Process Subset
Plan-View Processing
Proc. Selection
TBD * ^
QA
N Y
Laser Calibration
Feature Identification
Analyst Observations
Sediment Profile Processing
Proc. Selection
TBD * ^
QA
N Y
Sed/Water Interface
RPD Depth
Feature Identification
Grain Size
Analyst Observations
Measurement Tools
Distance
Area
PV SP
* iSPI Automated Processing
^ Manual Processing


Sediment Profile Attributes
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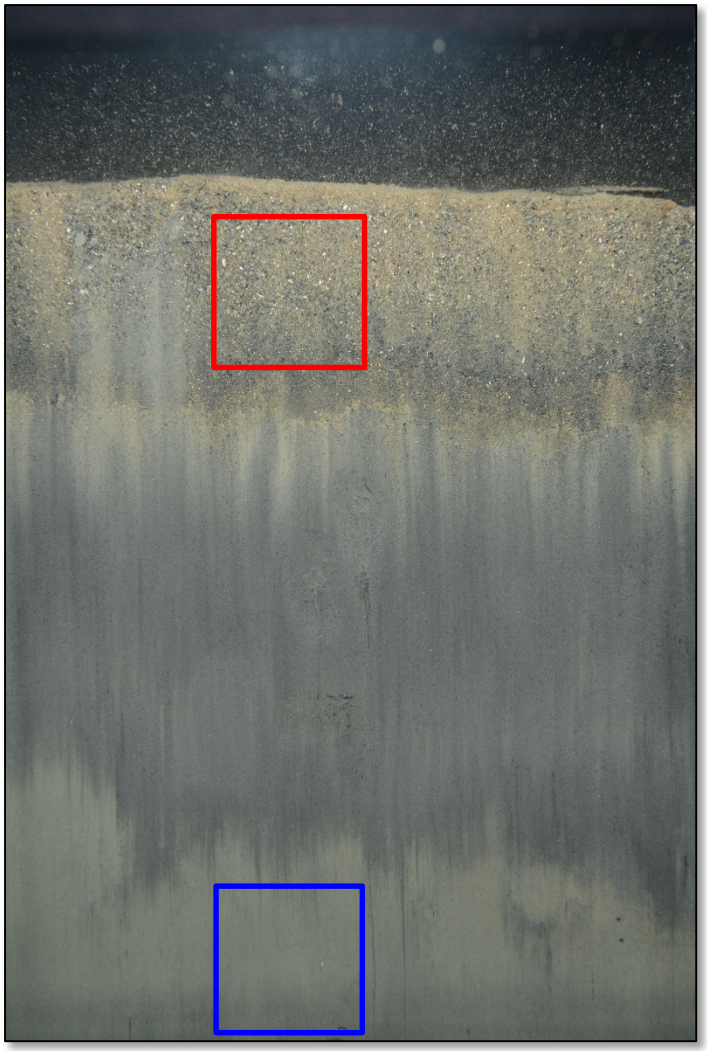
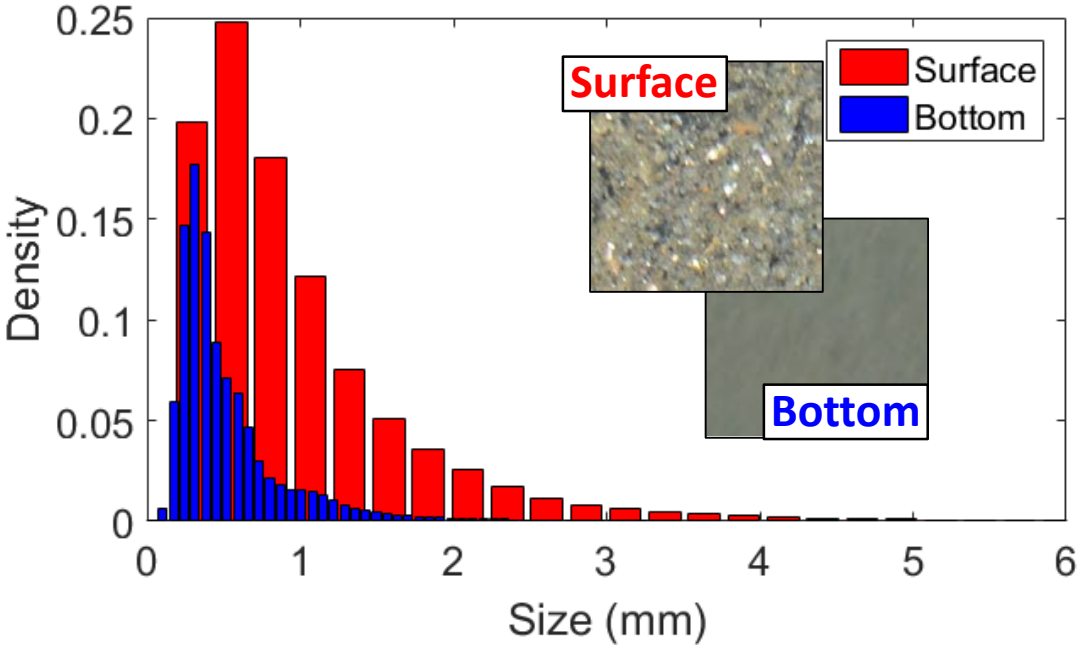
Penetration Depth: 7.8 cm
Boundary Roughness: 0.3 cm
RPD Depth: 2.2 cm
aRPD
Penetration Depth

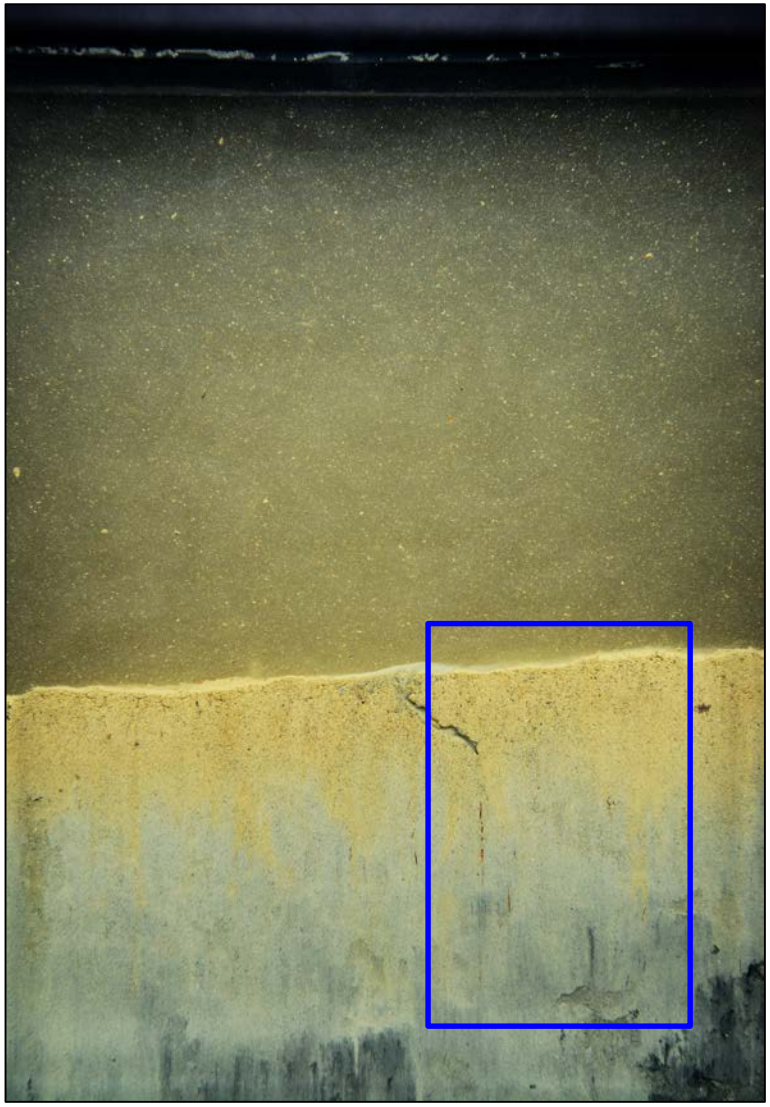
Grain Size Analysis*

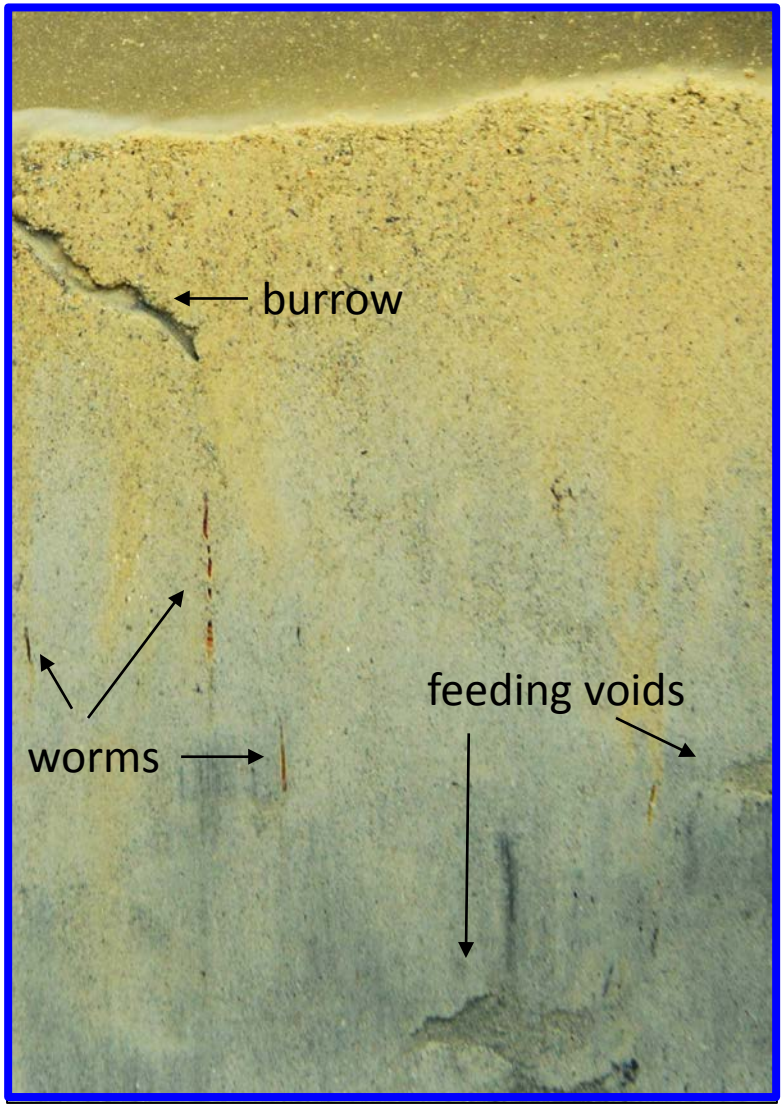




*Buscombe, D. 2013. Transferable wavelet method for grain-size distribution from images of sediment surface and thin sections, and other natural granular patterns. *Sedimentology* 60:1709–1732. http://dbuscombe-usgs.github.io/DGS_Project/

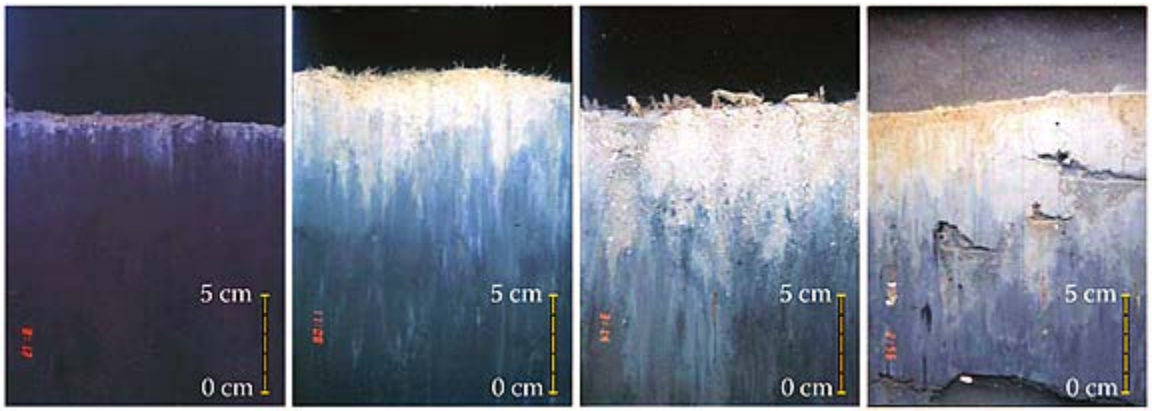
Biological Parameters





iSPI Image Analysis Goals

- Semi-Automate Measurement of basic features in SPI and PV images
- Standardize Data Quality
- Improve Data Management and Analytical Capabilities
- Minimize Subjectivity/BPJ in Image Interpretation



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Questions?