Controlling Recontamination During Phase 2 Sediment Remediation Dredging at the Esquimalt Graving Dock

Dan Berlin, Matt Woltman, P.E., and Tom Wang, P.E., Anchor QEA
N. Healey and R. Hill, Azimuth Consulting Group Partnership
D. McKeown, SLR
C. Major, A. Mylly, and D. Osguthorpe, Public Services and Procurement Canada
D. Kettlewell, SNC Lavalin

WEDA Dredging Summit and Expo 2017
June 26 – 29, 2017

Outline

- Background
- Containment Objectives and Design
- Water Quality Monitoring
- Sediment Assessment
- Discussion

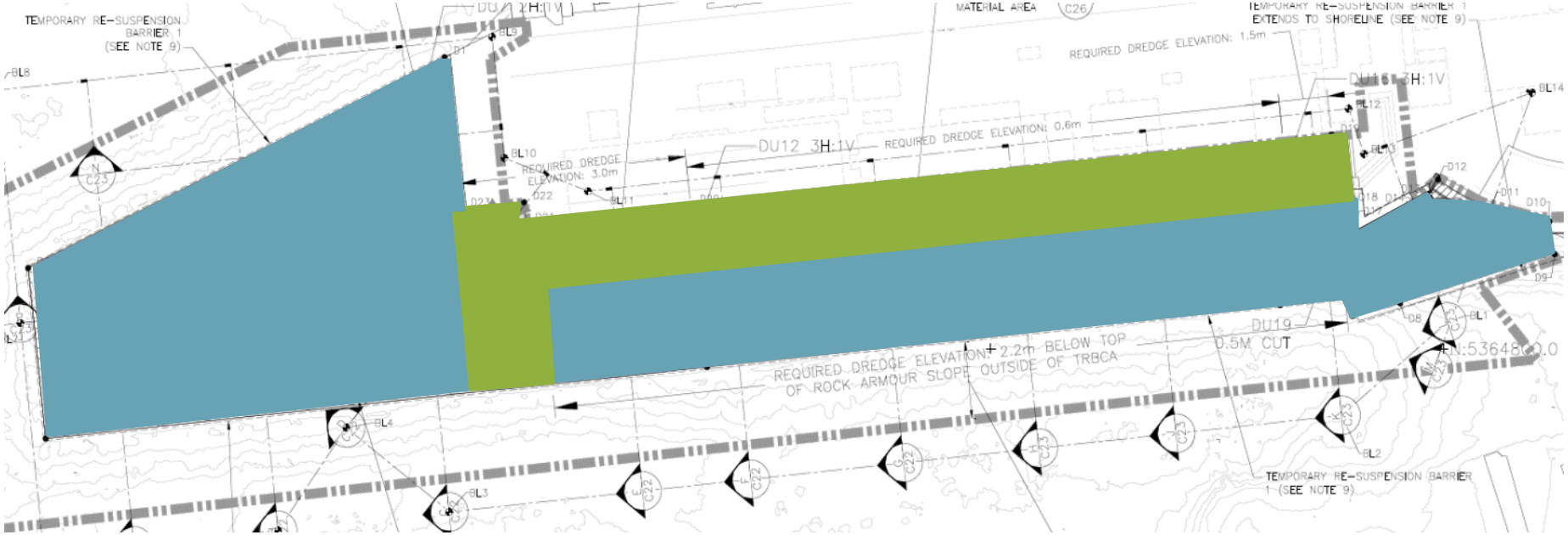
Background – Esquimalt Graving Dock Waterlot Remediation Project

Dan Berlin

ANCHOR QEA

Site Description and Background

Phase 2 – Jetty Demolition

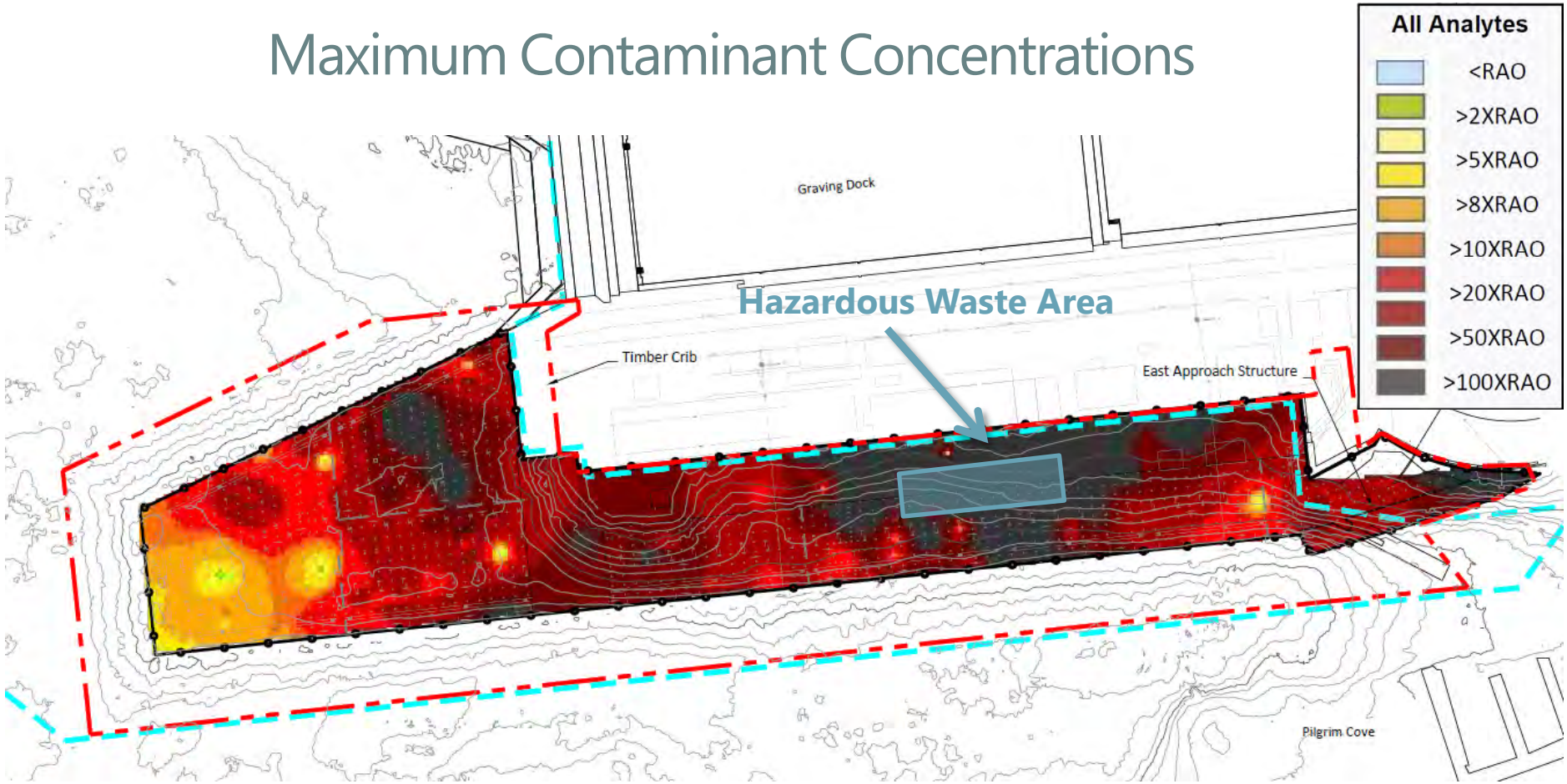


Timber jetty (demolished)

Steel pile supported jetty (retained)

Phase 2 Remediation

Maximum Contaminant Concentrations



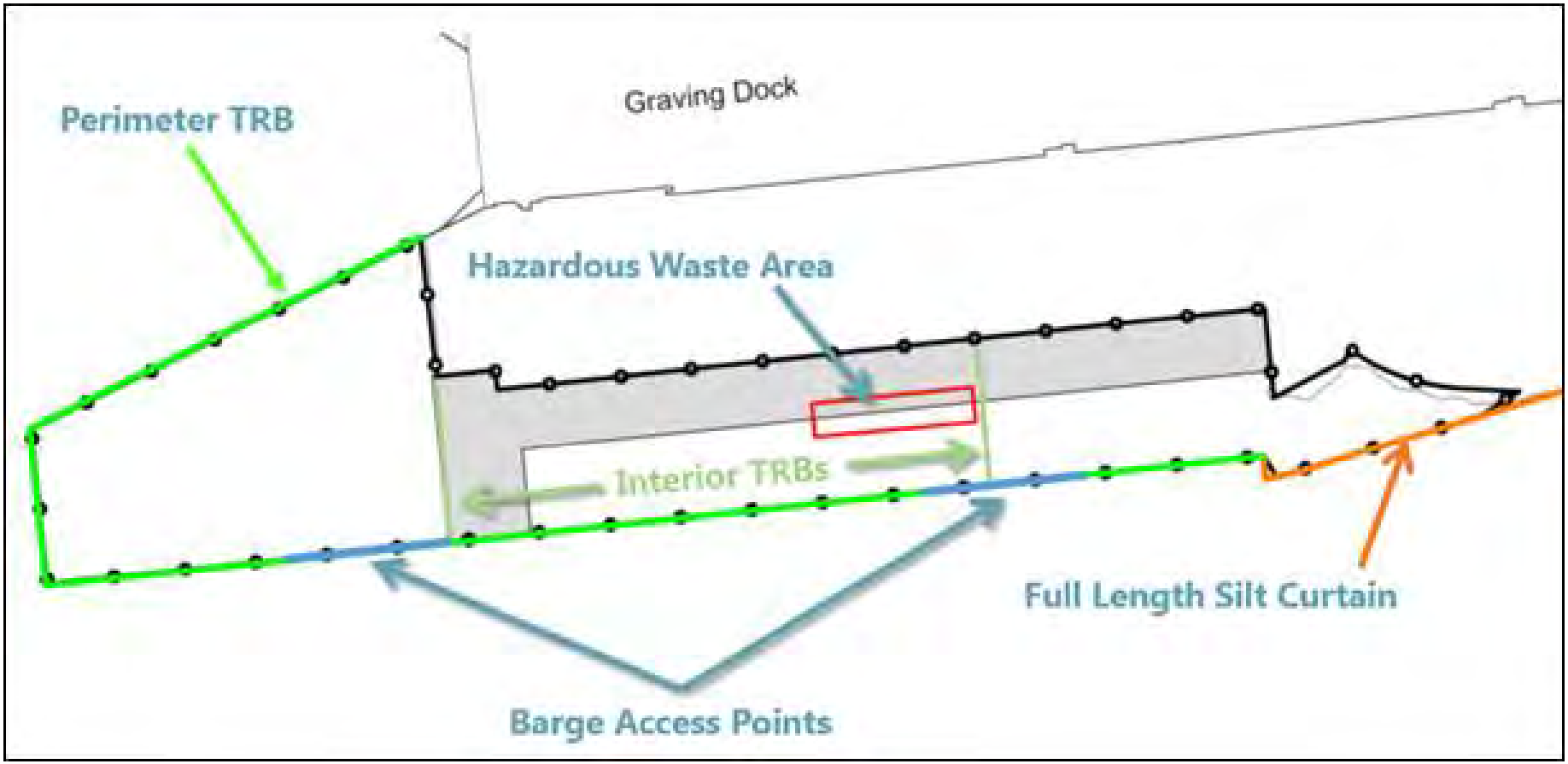
- Contaminants include PAHs, metals, PCBs, and TBT

Sediment Containment

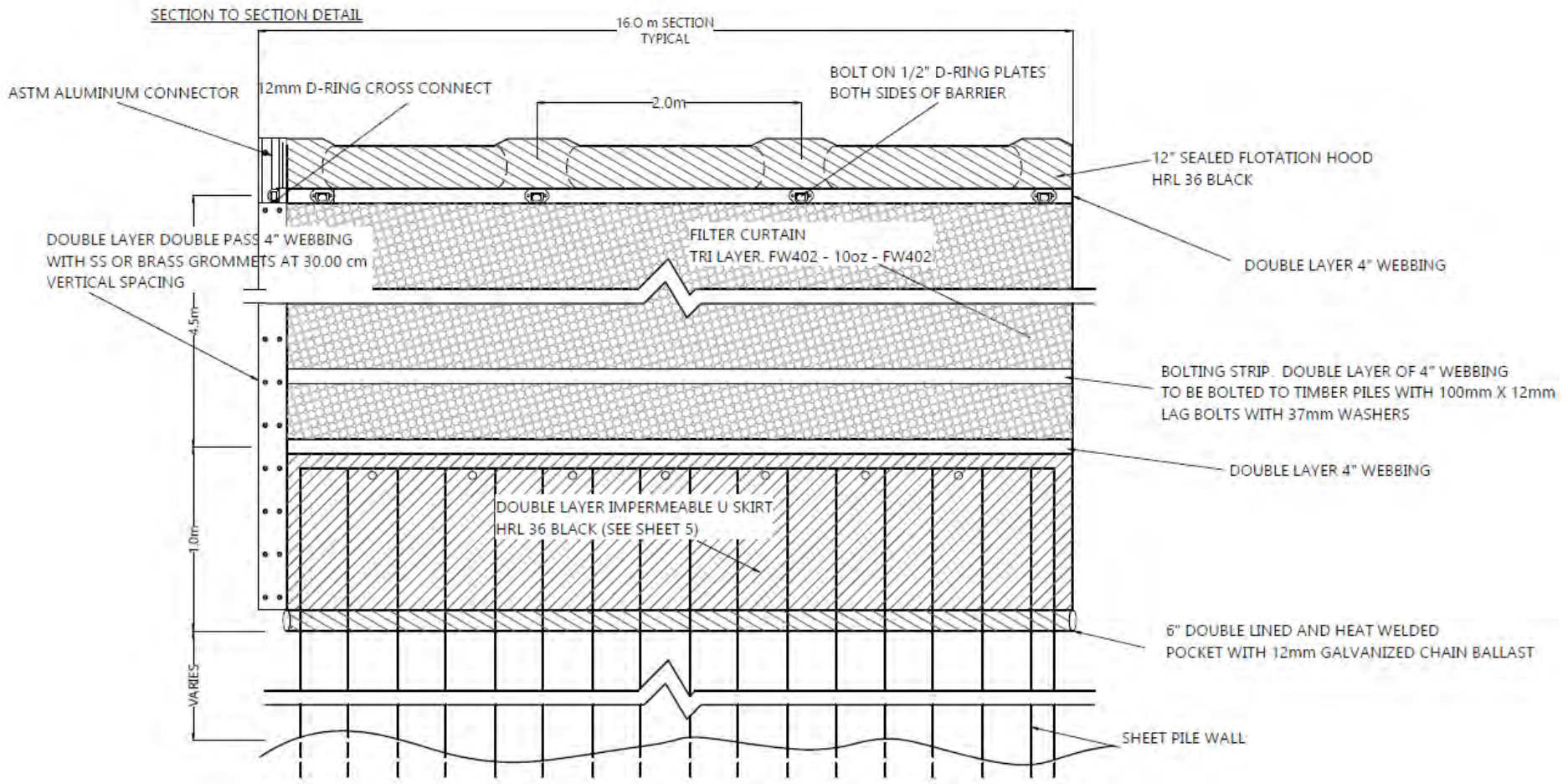
Sediment Containment Objectives

- Temporary resuspension barriers (TRBs)
  - Exterior containment
    - Prevent recontamination of previously remediated sediments (Phase 1B area)
  - Interior containment
    - Contain hazardous-waste-level sediments (Zone 1)
    - Allow for separate activities to occur concurrently (dredging and capping)

Temporary Resuspension Barrier Containment Area (TRBCA)

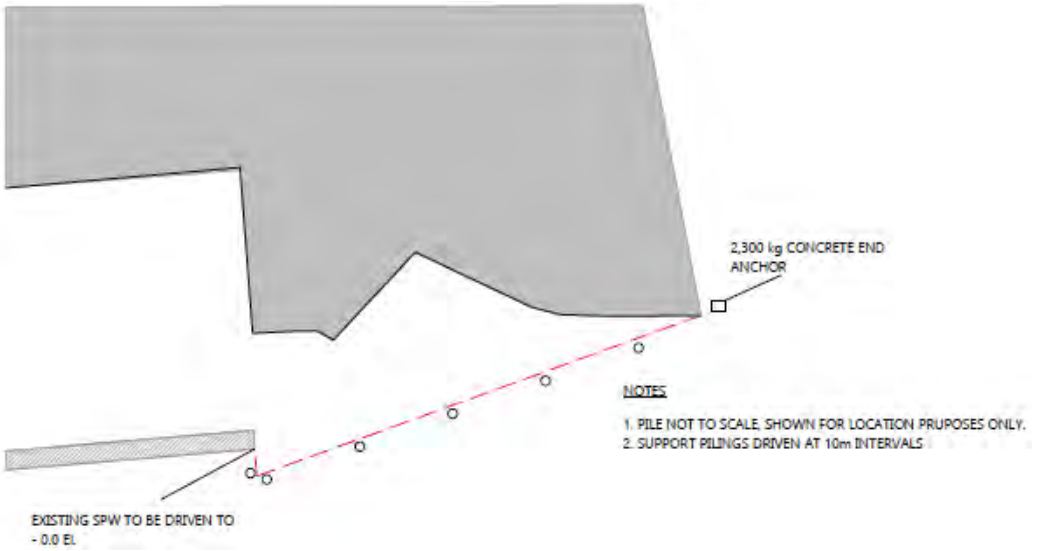


TRB Construction

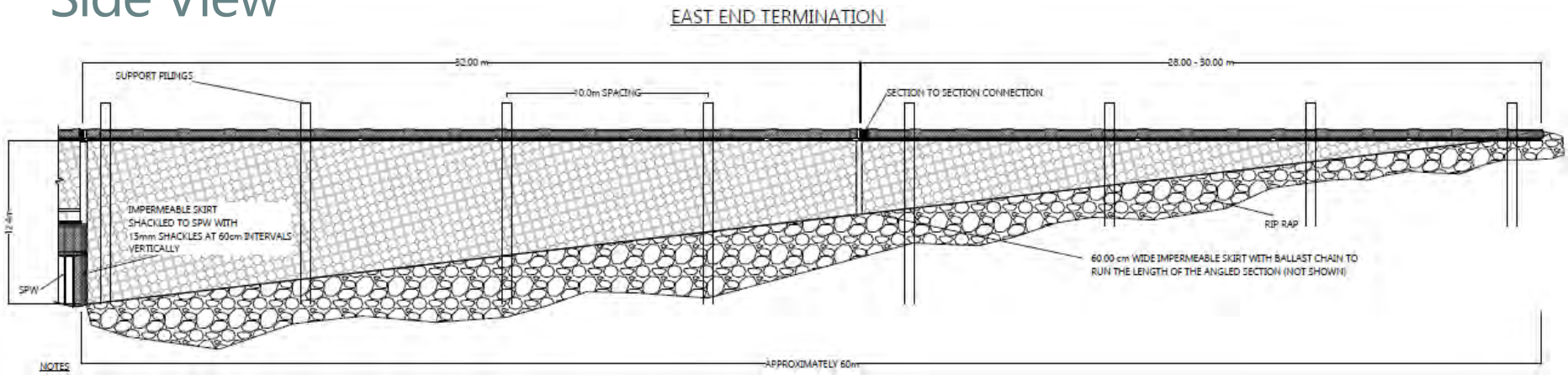


TRB East End Construction

Plan View



Side View



Water Quality Monitoring

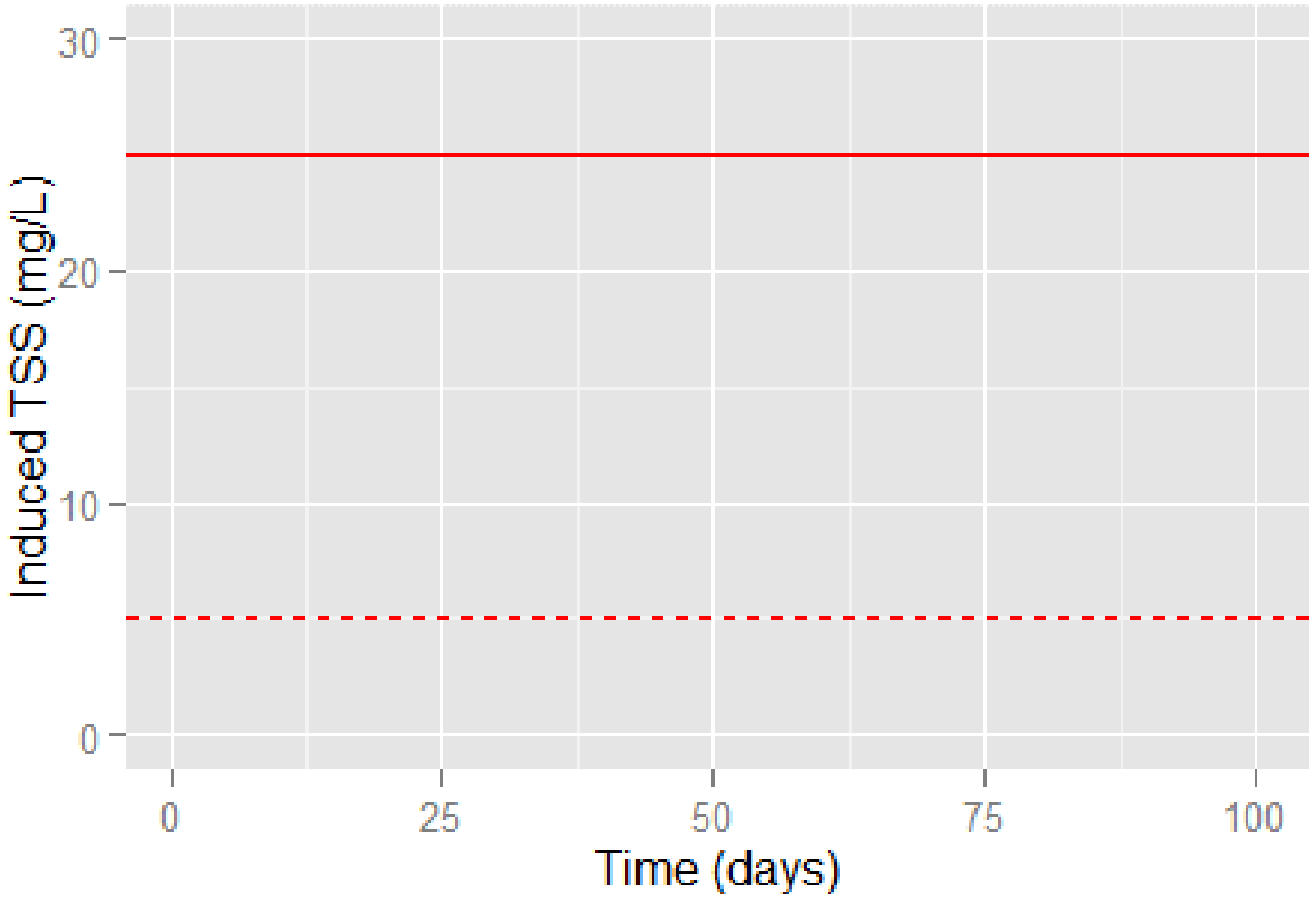
Norm Healey

Water Quality Monitoring Locations

Phase 2 Water Quality Performance Criteria

Parameter	Unit	Early Warning (25 m)	Compliance (100 m)
Turbidity	NTU	2.5 (induced)	
DO	mg/L	5 max; 8 mean	
pH	-	7.0 to 8.7	
TSS	mg/L	5 (induced)	
Total As	µg/L	125	12.5
Total Cu	µg/L	30	3
Total Zn	µg/L	100	10
PAHs	µg/L	1 to 510	0.1 to 51

Phase 2 Water Quality Criteria for TSS



Water Quality Monitoring

Water Quality Monitoring Data

Parameter	Exceedances	Maximum	Criterion
21,934 *In Situ* Measurements of Water Quality			
Turbidity	93 (0.4%)	24 NTUs	2.5 NTUs
583 Laboratory Measurements of Water Quality			
TSS	13 (2%)	16 mg/L	5 mg/L
CU	3 (0.5%)	4.3 µg/L	3 µg/L

Turbidity Spatial Variation

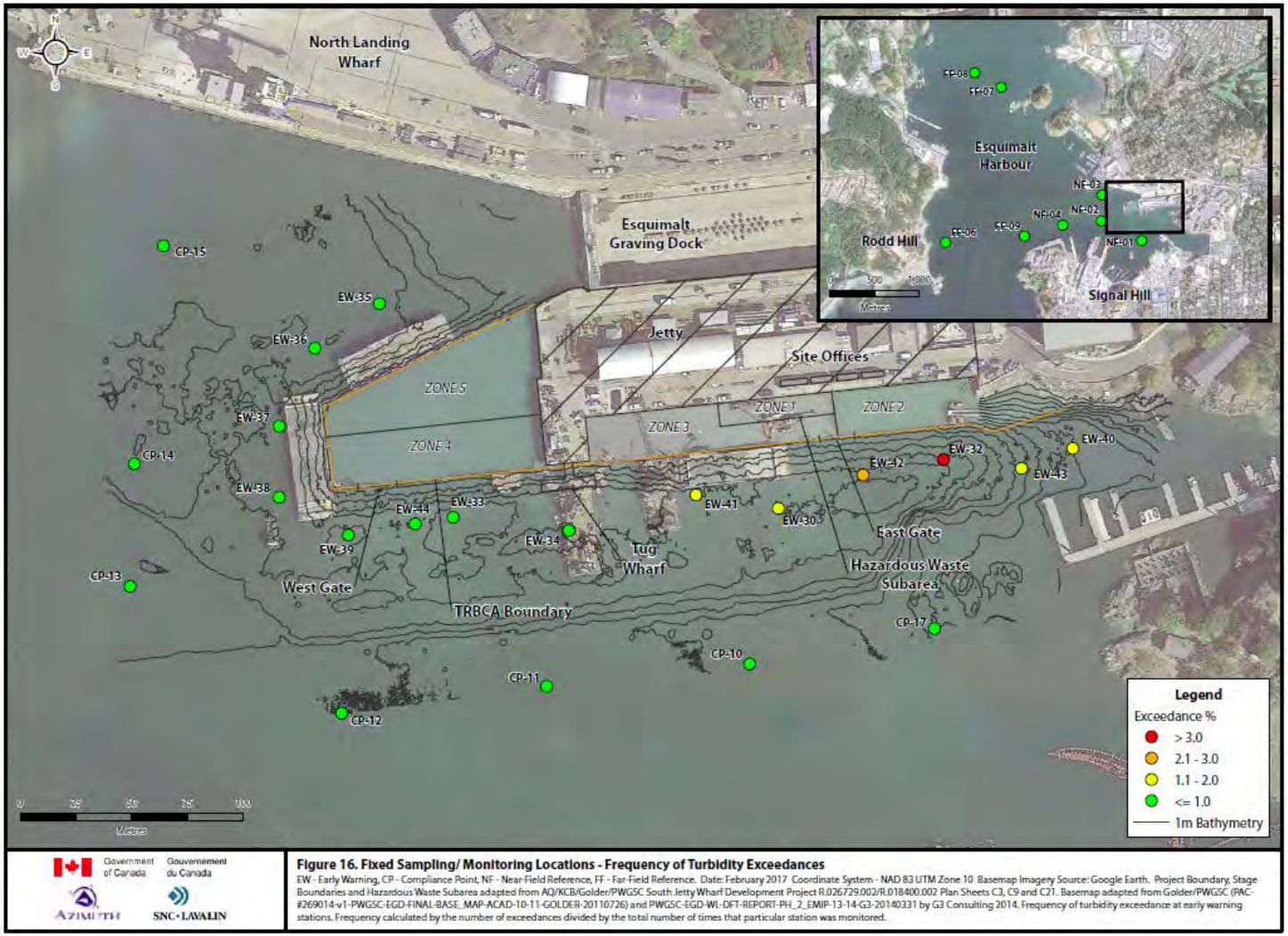


Figure 16. Fixed Sampling/ Monitoring Locations - Frequency of Turbidity Exceedances

EW - Early Warning, CP - Compliance Point, NF - Near-Field Reference, FF - Far-Field Reference. Date: February 2017 Coordinate System - NAD 83 UTM Zone 10 Basemap Imagery Source: Google Earth. Project Boundary, Stage Boundaries and Hazardous Waste Subarea adapted from AQ/KCB/Golder/PWGSC South Jetty Wharf Development Project R.026729.002/R.018400.002 Plan Sheets C3, C9 and C21. Basemap adapted from Golder/PWGSC (PAC-#269014-v1-PWGSC-EGD-FINAL-BASE_MAP-ACAD-10-11-GOLDER-20110726) and PWGSC-EGD-WL-DFT-REPORT-PH_2_EMIP-13-14-G3-20140331 by G3 Consulting 2014. Frequency of turbidity exceedance at early warning stations. Frequency calculated by the number of exceedances divided by the total number of times that particular station was monitored.

Water Quality Monitoring Visual Observations

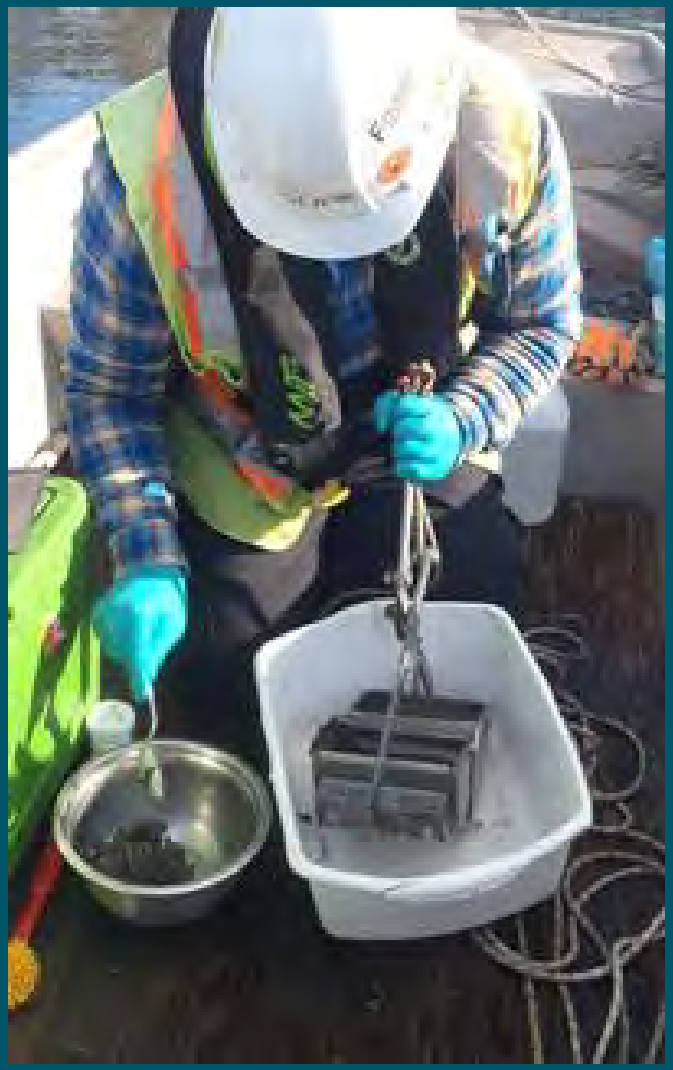
Water Quality Monitoring Summary

- Relatively low Project Water Quality Performance Criteria
- Intensive spatial and temporal monitoring
- Overall
  - Low frequency and magnitude of exceedances of water quality criteria
- Zones 2 and 3
  - More frequent and greater magnitude exceedances of water quality criteria
  - More frequent visual evidence of particulate release

Baseline and Recontamination Sediment Assessment

Sediment Assessment

- Baseline, interim, and at post-completion
- Surface sediment samples collected around perimeter of Phase 2 area
- Results compared to Numeric Remedial Action Objectives (NRAOs)
- Diver inspections of areas outside of TRB

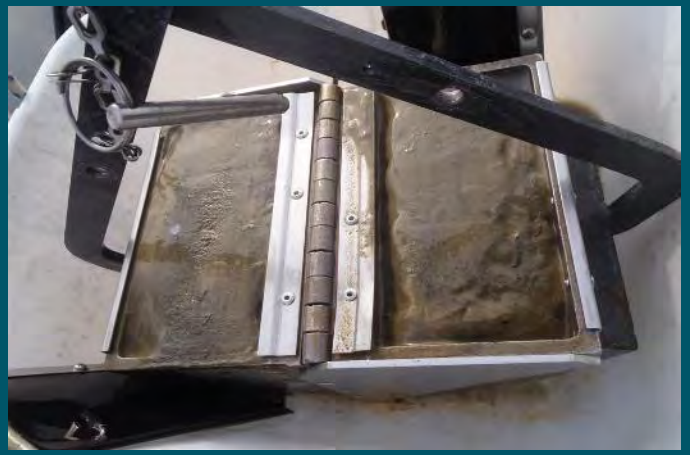


Sediment Processing

Baseline Sediment Sample Results

Post-Completion Sediment Assessment

- Re-sampling conducted at all baseline locations and seven step-out locations following substantial completion (November 2016)
- Results compared to NRAOs and baseline results to determine changes in sediment chemistry during Phase 2 works
- Diver inspections also completed



Grab Sample

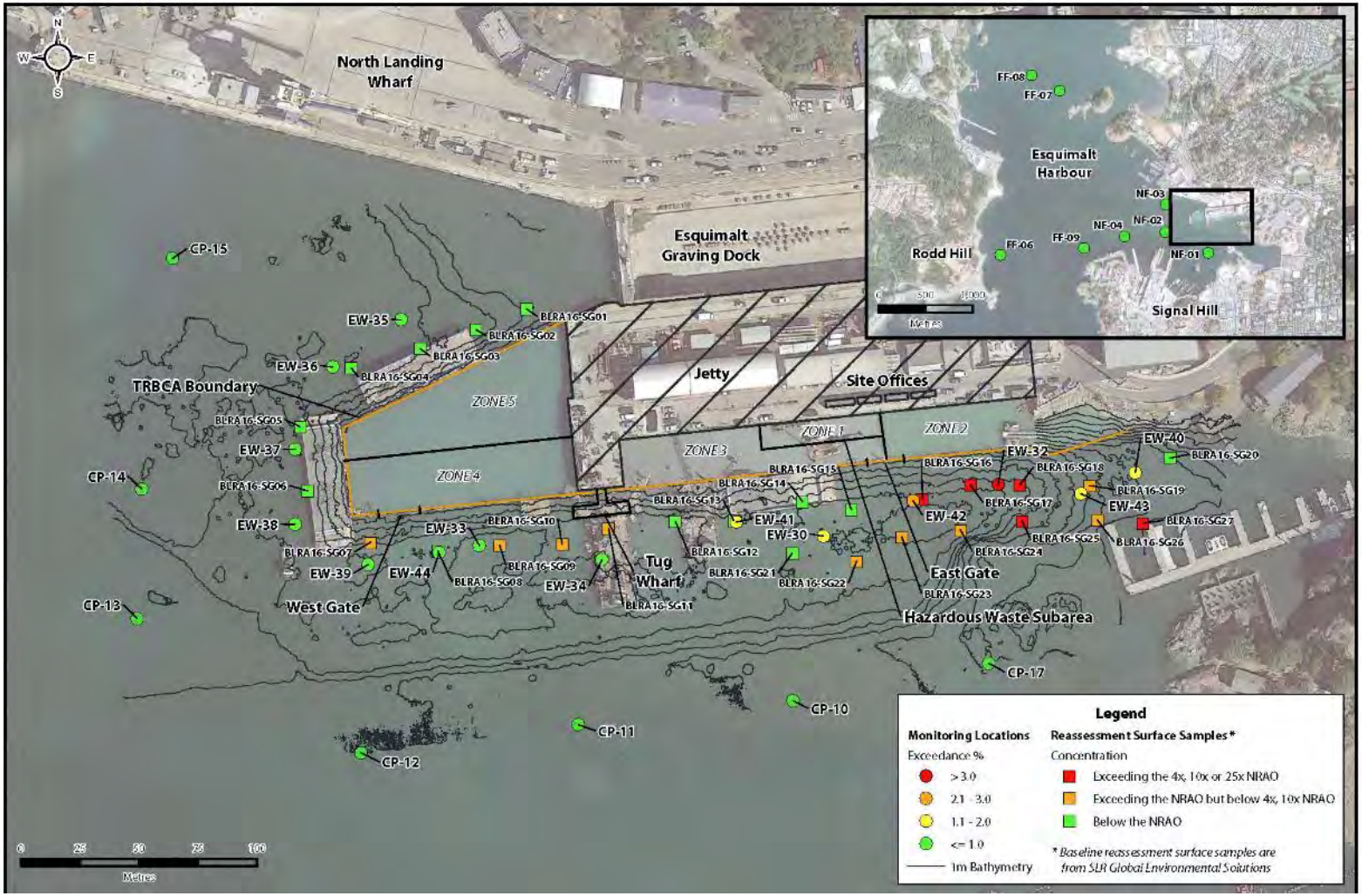
Homogenizing

Sediment Re-Assessment Results

Sediment Quality Summary

- Baseline results below NRAOs, with three exceptions
- Interim resampling indicated elevated levels of select parameters (metals, PAH, PCB) in some locations
  - Prompted additional step-out samples for delineation purposes
- Final post-construction sampling confirmed elevated levels of select parameters in localized area at east end of project
- Source uncertain, but evidence suggests release of suspended sediment from eastern Phase 2 area (corroborated water quality data and lighter material deposits)
- Post-construction diver inspections identified localized sediments brought to surface at perimeter of Zone 5 during SPW extraction

Surface Water and Sediment Summary



Corrective Actions

- Residuals management cover (RMC) placement
  - 0.3-meter-thick RMC layer placed in localized area where elevated surface concentrations noted
  - Based on exceedance of four times the NRAO
  - Provides clean surface at end of construction
  - Anticipated to mix with underlying sediments over time to achieve remedial targets
  - Long-term monitoring of sediment quality planned
- Sheet pile wall extraction
  - Extraction of SPW created exposed sediment noted during final diver inspections
  - Additional armour rock placed to isolate sediments and provide seamless transition between Phase 1B and Phase 2 armour covering

Corrective Actions (cont.)

RMC Placement (0.3-m thickness)

Additional Armour Rock Placement

Discussion

Discussion

- Lessons learned
  - Multiple monitoring lines of evidence are important
  - More frequent sediment testing may be beneficial
  - Water quality monitoring may not be sensitive enough on its own
- Overall, post-construction conditions met remedial objectives of the project, with some minor corrective actions
- Water quality exceedances were infrequent and low, indicating the TRB was generally successful in controlling off-site migration of contaminants
- Monitoring components were intensive and provided data to demonstrate effectiveness of mitigation measures and TRB performance

Questions

- Dan Berlin, dberlin@anchorqea.com
- Norm Healey, nhealey@azimuthgroup.ca