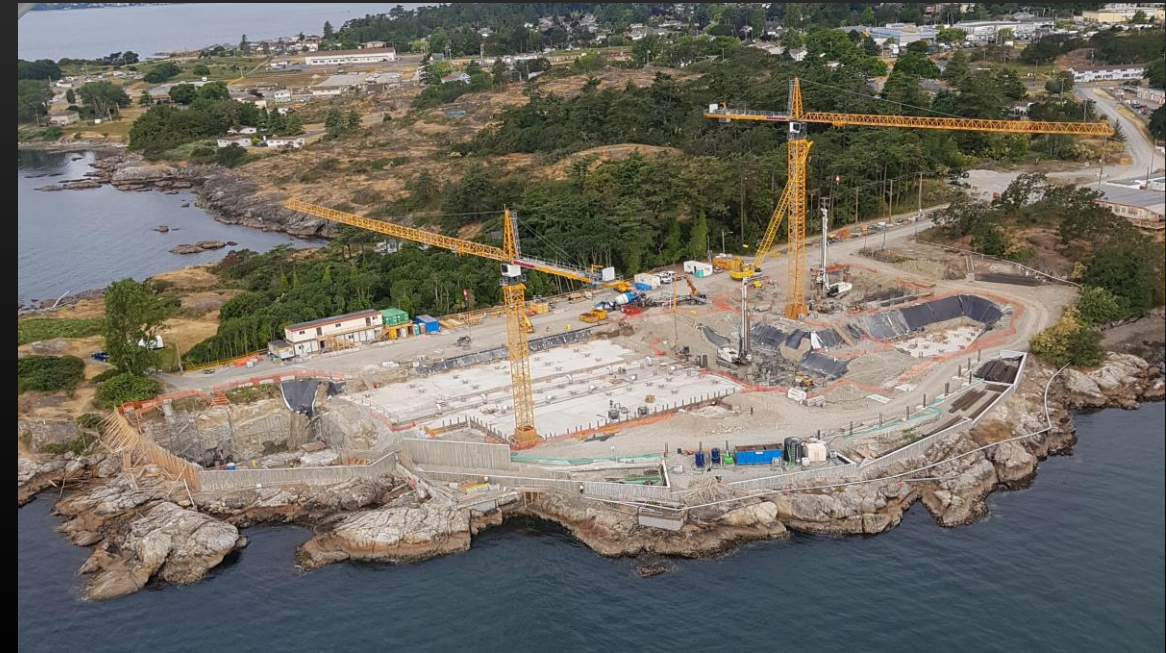


McLoughlin Point Wastewater Treatment Plant and 100 Years of Fuel Storage

What could go wrong?

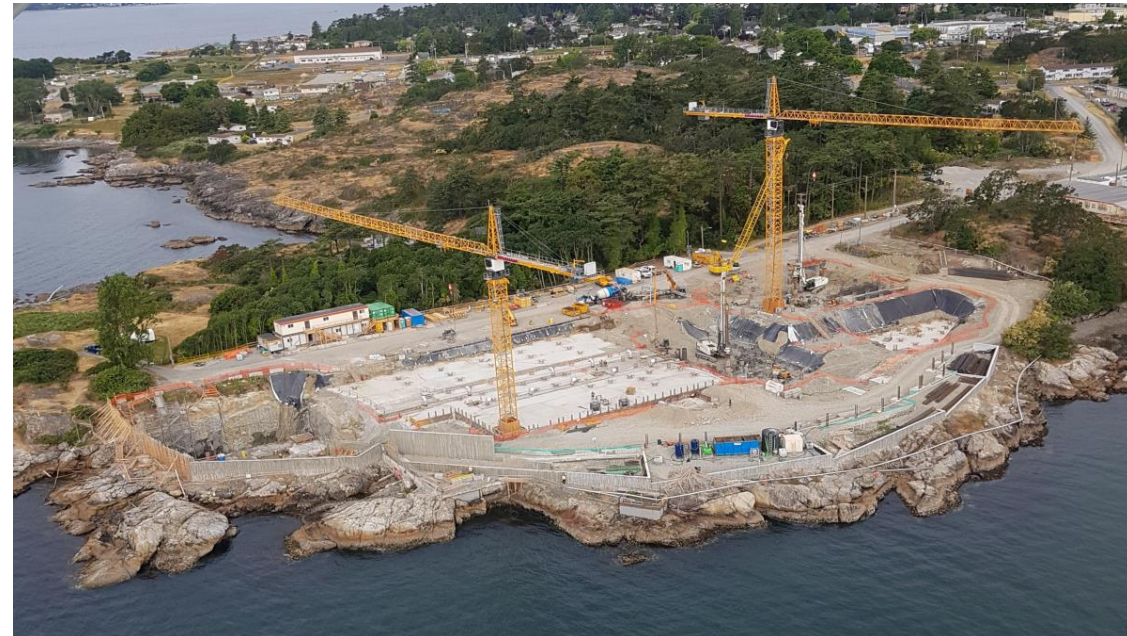
Craig Harris, M.Sc., P. Geo., R.P. Bio.

Environmental Services Association of Alberta
Remediation Technology (Rem Tech) 2025



Outline

- Project Structure / Roles
- Case Study: Design & build a WWTP on Victoria's marine fuel terminal
 - Historical, early investigations and remediation
 - Approval in Principle
 - Photo timeline: construction while investigation
 - Hydrogeological Conceptual Site Model
 - Marine seepage exposure assessment
 - Certificate of Compliance
- Acknowledgements



Design Build Joint Venture: Contamination

DND, Work Point



Government
of Canada

Owner



Making a difference...together

Owner's Engineer



Design/ Build JV



Investigation/ Remediation

Geology, Hydrogeology and
Risk Assessment



ISLANDER
ENGINEERING



TRI Environmental
Consulting Inc.
6961 Russell Avenue
Burnaby, BC V5J 4R8
t 604.436.3384
f 604.436.3388
e info@tri.bc.ca
w tri.bc.ca

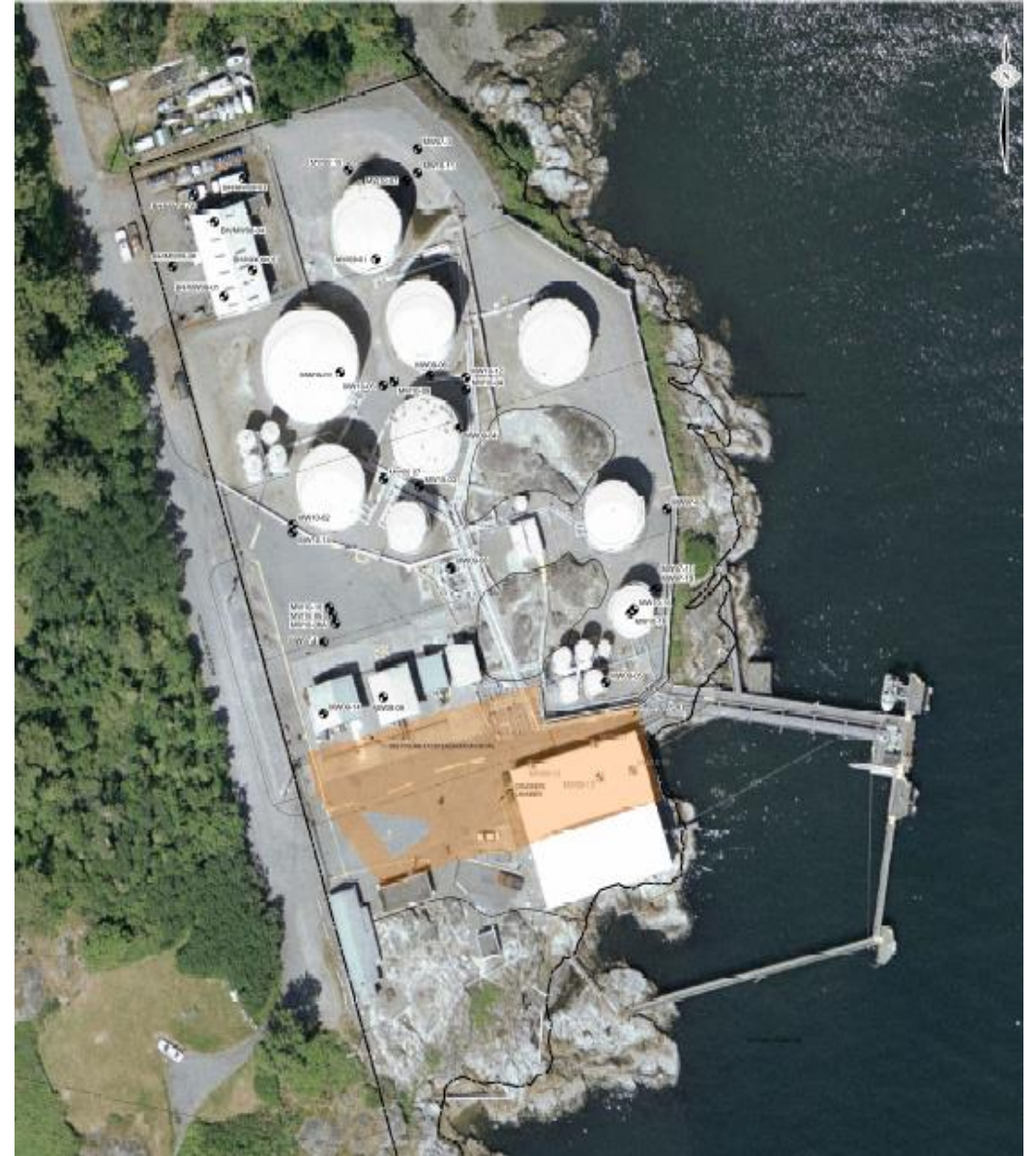
Historical

Victoria's former bulk fuel distribution terminal and marine fuel jetty

Owned and Operated by Imperial Oil
1915 - 2009

Volumes stored fluctuated between
 $\frac{1}{4}$ million and 3 million L

Diesel, gasoline, aviation, lubricating
oils and limited solvents





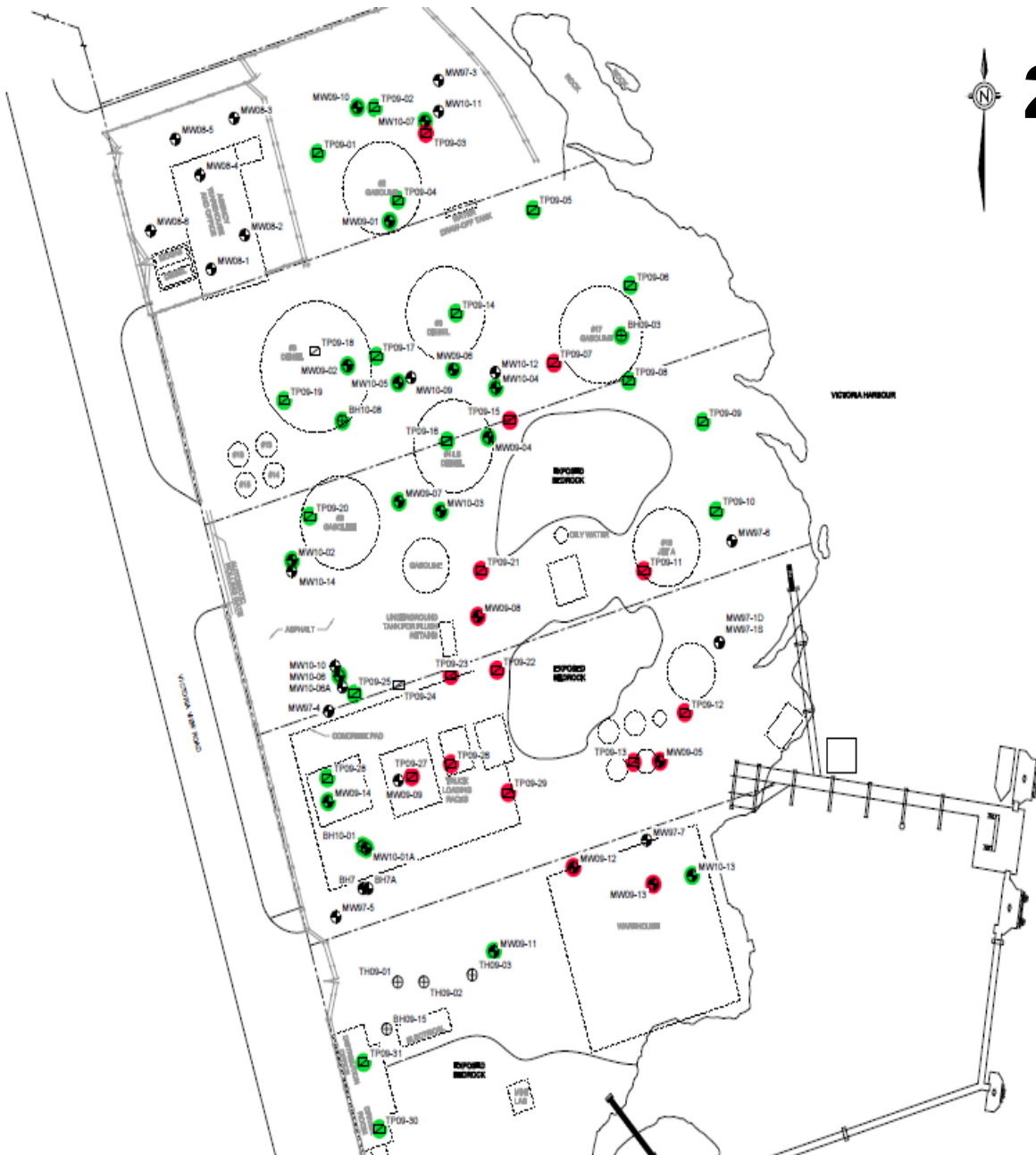
2009 & 2010 Investigations

– Geology/ Hydrogeology

- Sandy fill over firm silty clay (Capilano).
- Bedrock contact 4 to 9 m bgs under north central area
- Water table in silty clay, 2 and 4 m bgs
- Flow east and south (south end) and due east (north end)

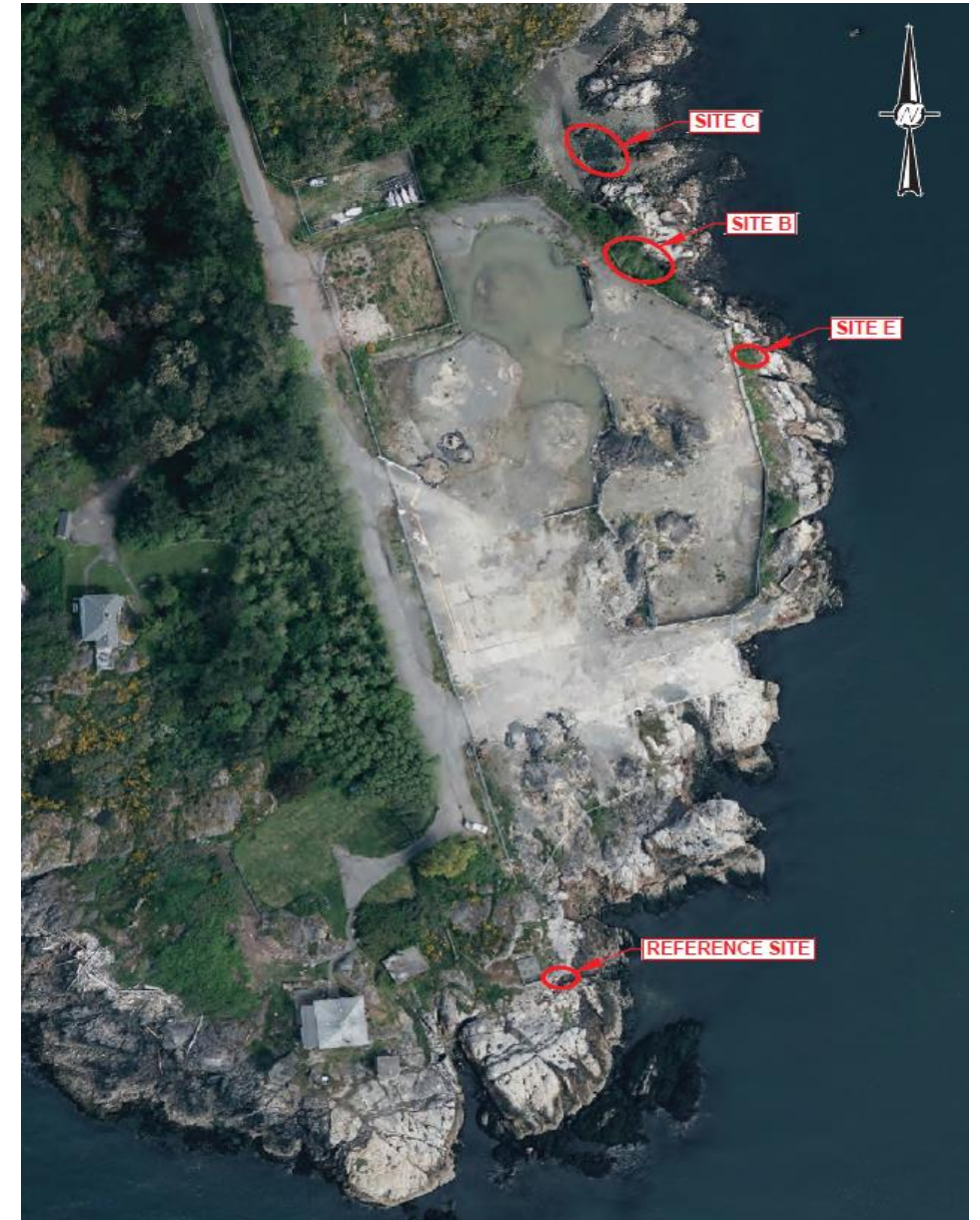
– Contamination

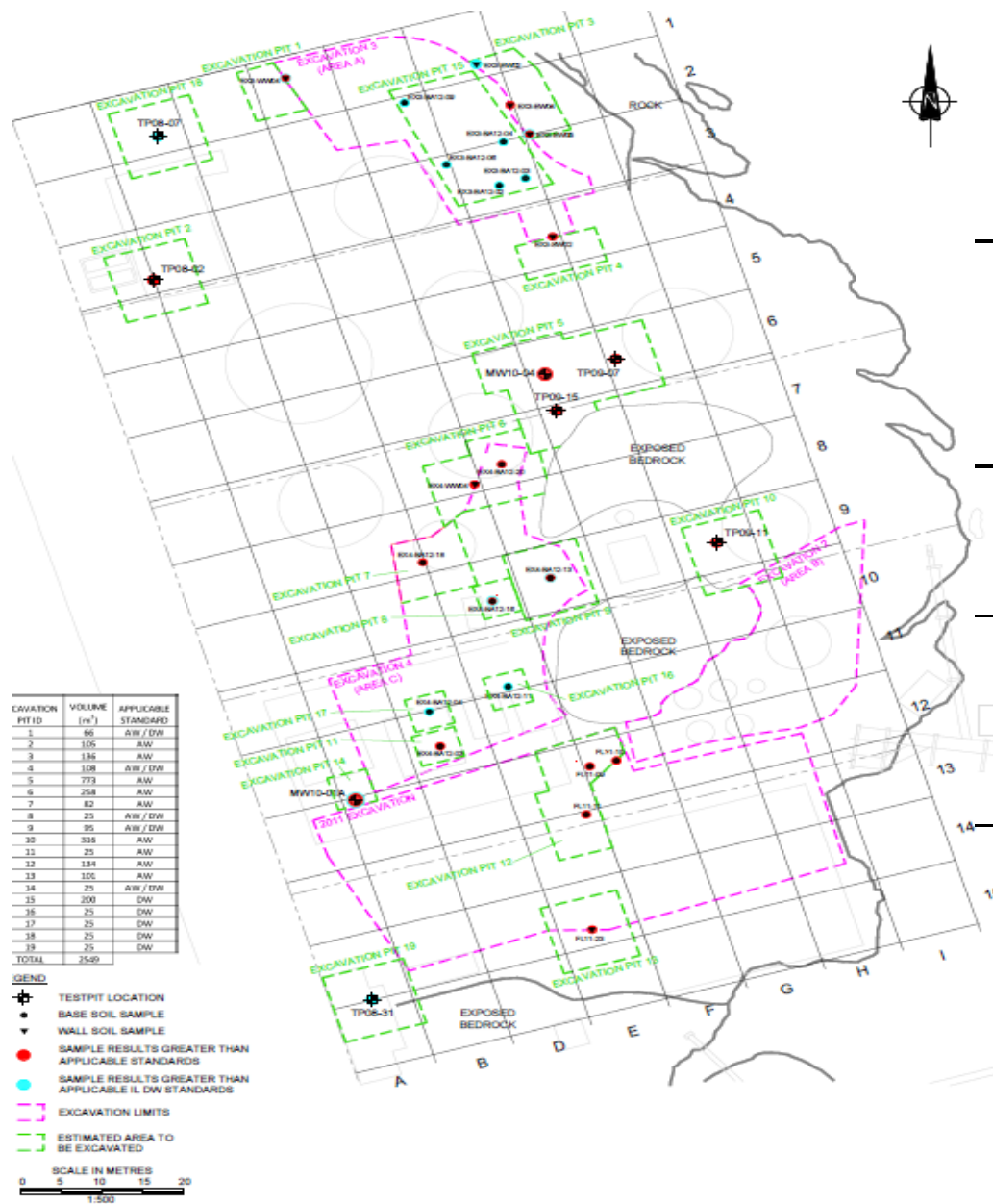
- Sheen as indirect evidence of free product
- VPH, LEPH, HEPH, naphthalene
- Arsenic, chromium, cobalt



2013 Waterlot PSI, DSI, Risk Assessment

- Sediment Chemistry
 - PAH pattern of fuel impact near NE beach.
 - PAH pattern near Jetty confounded by creosote and harbour wide impacts
- Sediment Toxicity
 - Polychaete, amphipod and bivalve responses in offshore sediment (non-toxic)
- Pathways
 - Sediment leach – less important
 - **Upland migration** – (i) geological structure assessment; and (ii) seepage analysis
- Biology
 - Epibenthic communities comparable to reference areas





2014 RP & Approval in Principle

– Remedial Plan and AiP

- Solely based on past investigations /remediation
- Waterlot not an APEC

– Assumption in Remedial Plan

- Remaining soil above IL estimated to be ~ 5000 MT

– AiP Key Condition

- QP to identify, characterize and manage environmental media that may be encountered

– AiP Schedule C: Numerical Standards

- In soil: VPH, LEPH, HEPH, arsenic, chromium, benzene, ethylbenzene and xylene.
- In GW: LEPHw, naphthalene, cobalt and copper

Early Works and Concurrent Investigation (2017)



Early Works and Concurrent Investigation (2018)



Geological Mapping / Coring

Geological Units

1. Altered Granodiorite
2. Altered Gabbro
3. *Mafic & Felsic Dikes

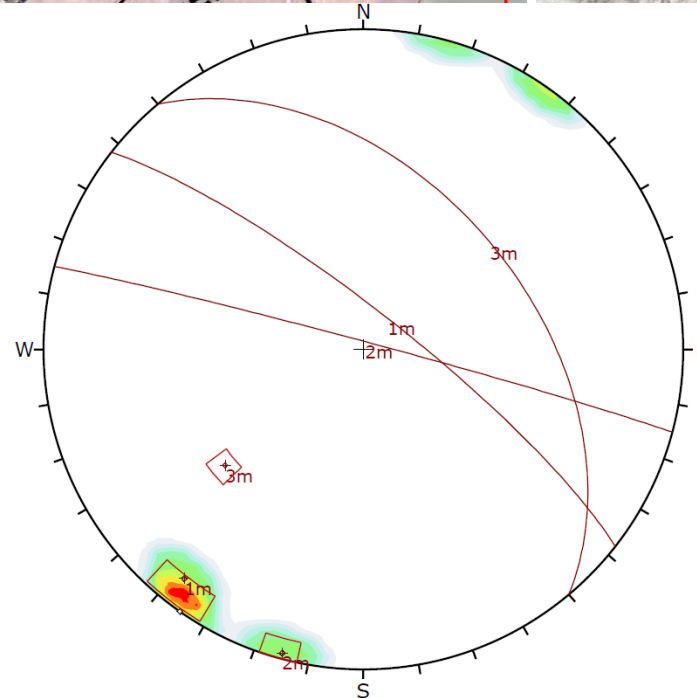
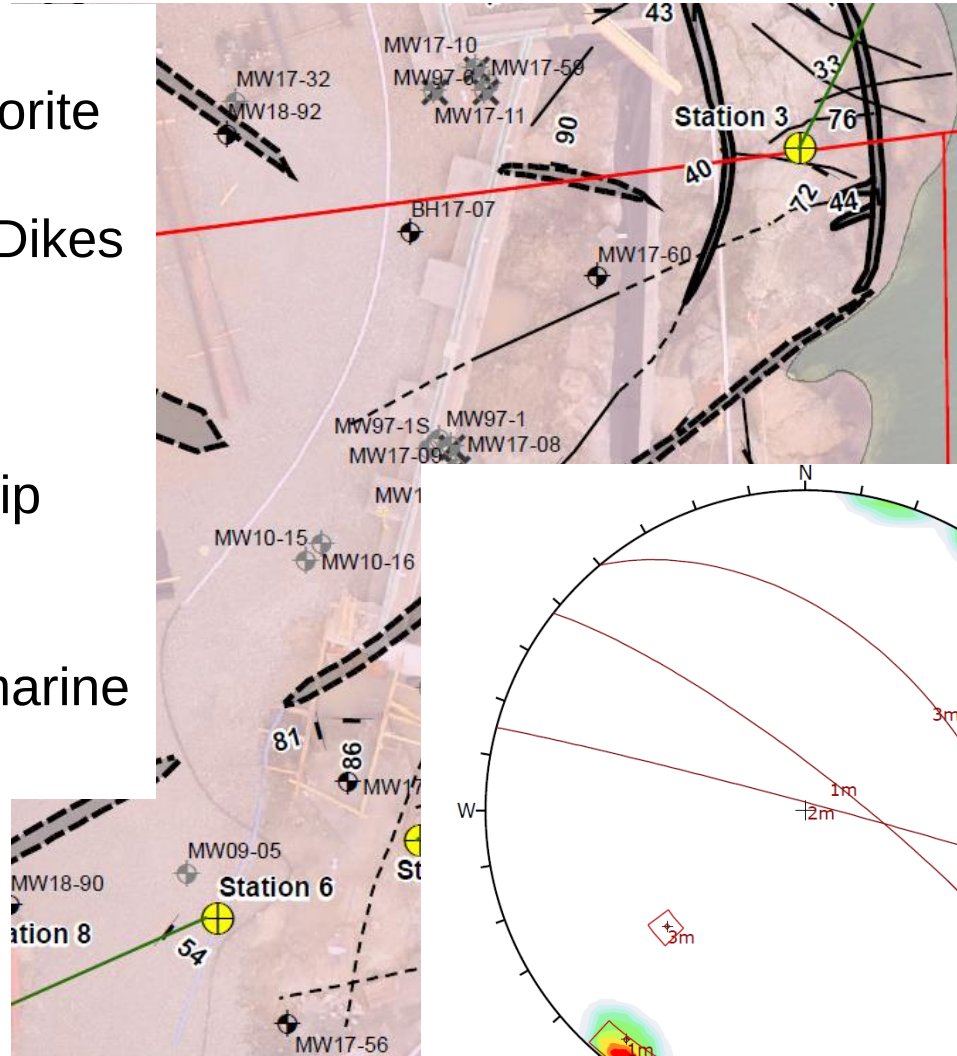
Dominant Planes

*NE strike, steep dip

N - NW strike, shallow dip

North strike, steep dip

* Likely contribution to marine migration



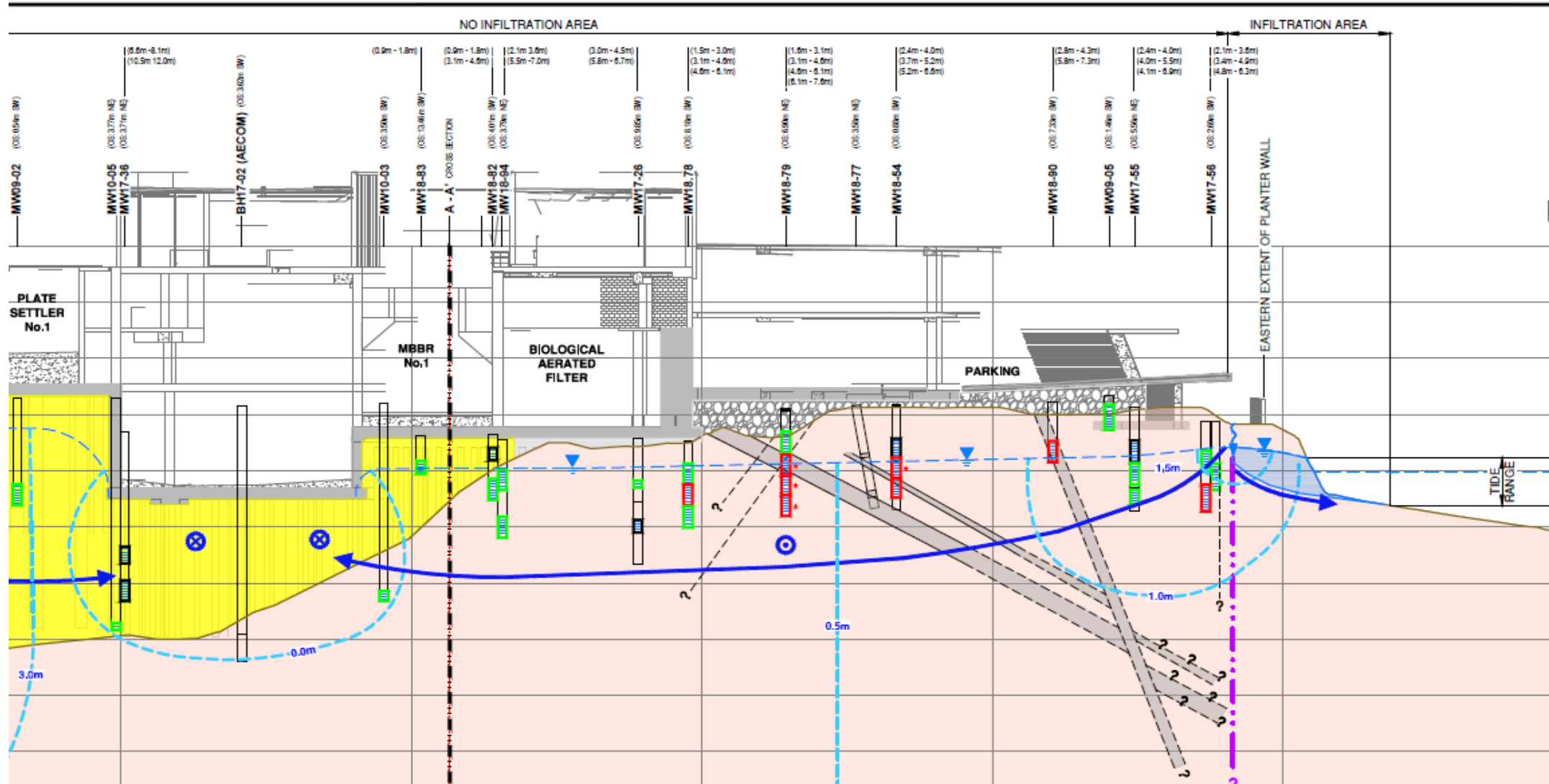
WWTP Construction and Monitoring/ Remediation (2019)



Photo 1: Looking down and east toward Victoria Harbour across the Site (May 7, 2019)



Hydrogeological CSM: Post Construction



SPME Exposure Assessment: October 2019

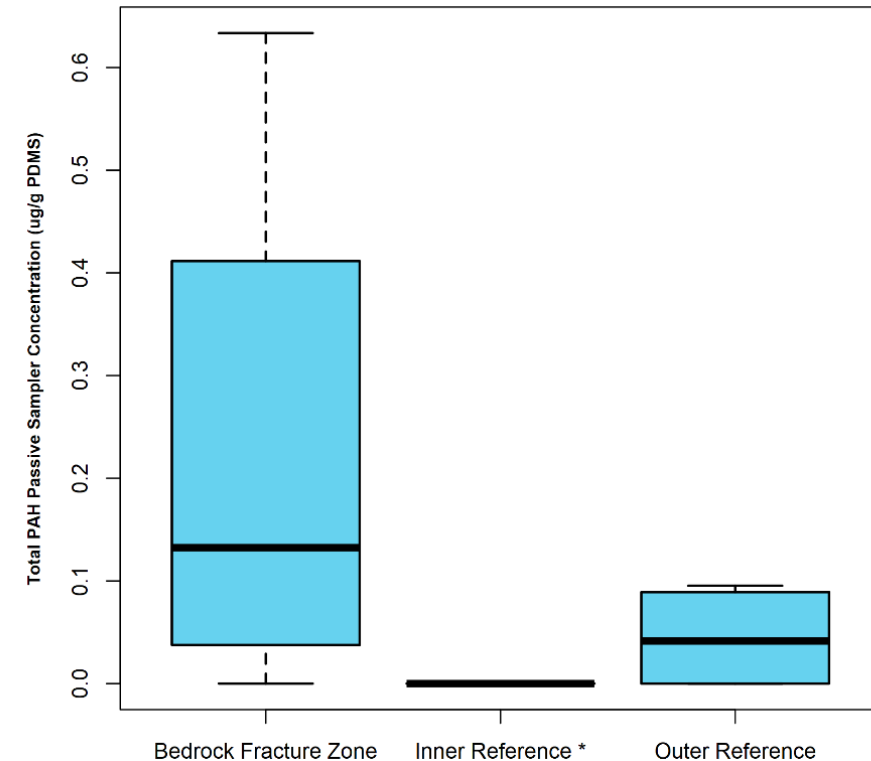


AREA E	SPME-706-E
FLUORENE	0.1503
FLUORANTHENE	0.1757 (ug/g PDMS)
PYRENE	< 0.0755
CHRYSENE	0.1318
BENZO(E)PYRENE	0.1757
CCME F2	< 54.46
CCME F3	13545
CCME F4	2515

AREA D	SPME-582-D
FLUORENE	< 0.0802
FLUORANTHENE	0.1085
PYRENE	0.081
CHRYSENE	< 0.0807
BENZO(E)PYRENE	< 0.1264
CCME F2	< 54.49
CCME F3	< 54.49
CCME F4	< 27.245

AREA G	SPME-583-G
FLUORENE	< 0.078
FLUORANTHENE	< 0.0916
PYRENE	0.0753
CHRYSENE	< 0.0786
BENZO(E)PYRENE	< 0.1231
CCME F2	< 55.97
CCME F3	1935
CCME F4	< 27.985

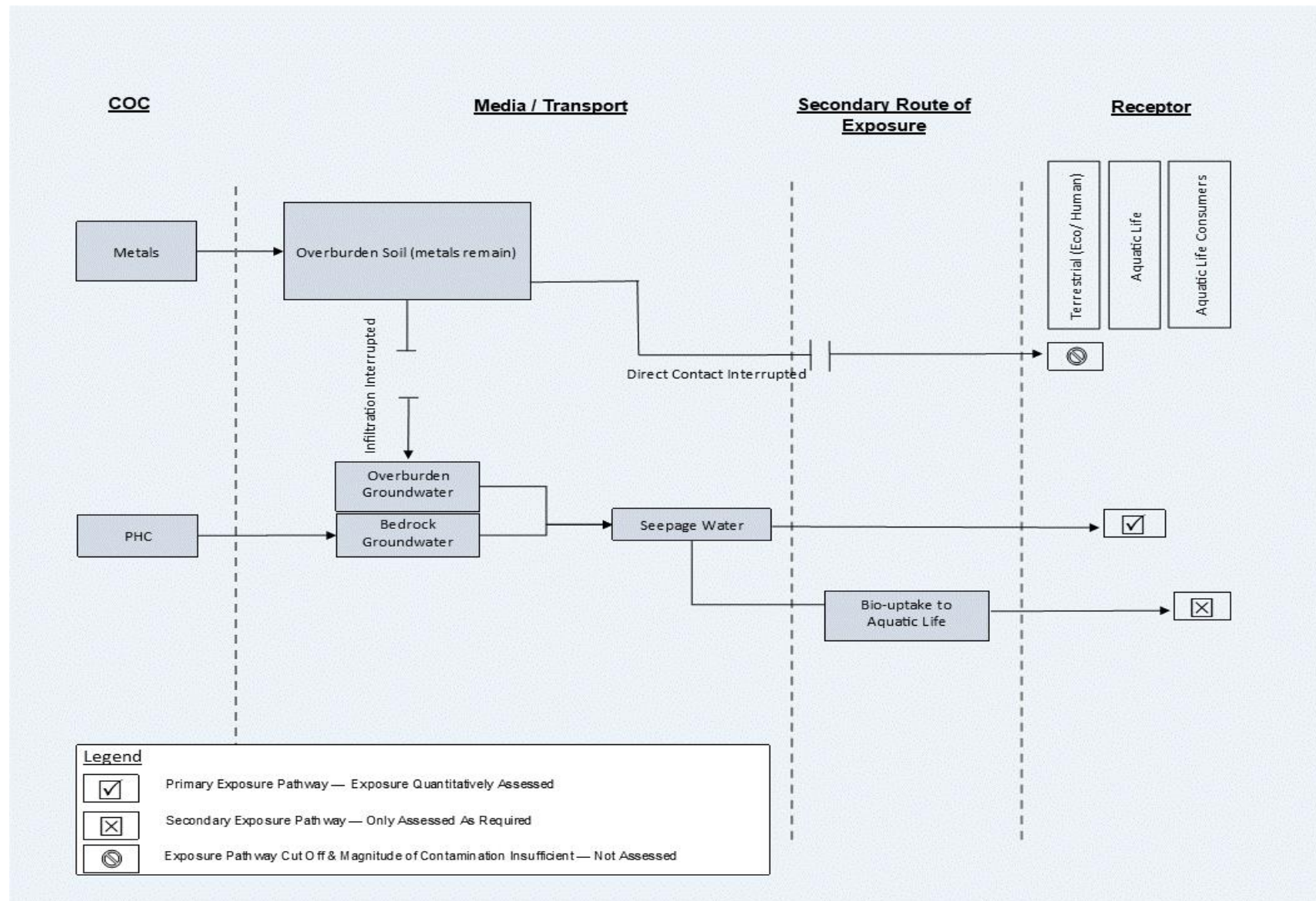
AREA H	SPME-701-H
FLUORENE	< 0.0792
FLUORANTHENE	< 0.0929
PYRENE	< 0.0745
CHRYSENE	< 0.0797
BENZO(E)PYRENE	< 0.1248
CCME F2	< 55.19
CCME F3	< 55.19
CCME F4	< 27.595



WWTP Final Construction (2020)



Problem Formulation and Aquatic Risk Assessment



Certificate of Compliance



Ministry of
Environment and
Climate Change Strategy

CERTIFICATE OF COMPLIANCE

(Pursuant to Section 53 of the *Environmental Management Act*)

Numerical soil – benzene, ethylbenzene, lead, naphthalene, selenium, xylene, zinc, HEPH, LEPH, VPH

Risk-based soil – arsenic, chromium, copper, nickel

Numerical (marine water) – cobalt, copper and nickel

Risk-based (marine water) – EPHw₁₀₋₁₉, LEPHw, naphthalene, phenanthrene, pyrene, uranium, VPHw and xylene

Acknowledgements

- Ryan Mills, P. Geo., Hydrogeology Lead
 - Mike Sanborn, R.P. Bio., SPME Sampling
 - Nicholas Bueckert, Geologist
-
- Islander Engineering & Lori Larsen
 - Graham Construction
 - Reidar Zapf-Gilje (CSAP AP)



Questions

AECOM

Imagine it.
Delivered.