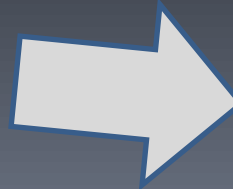


A photograph of a rocky shoreline. The foreground is filled with large, dark, jagged rocks. The middle ground shows a dark, pebbly beach that meets a body of water. In the background, there is a flat, open landscape with some distant structures and a white tent-like object. The sky is overcast.

Using ShoreZone to Estimate Oil Retention on Shorelines

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Estimating Oil Retention from ShoreZone Mapping



Volume of oil retained?

Estimating Oil Retention from ShoreZone Mapping



1. Find upper intertidal sediment type

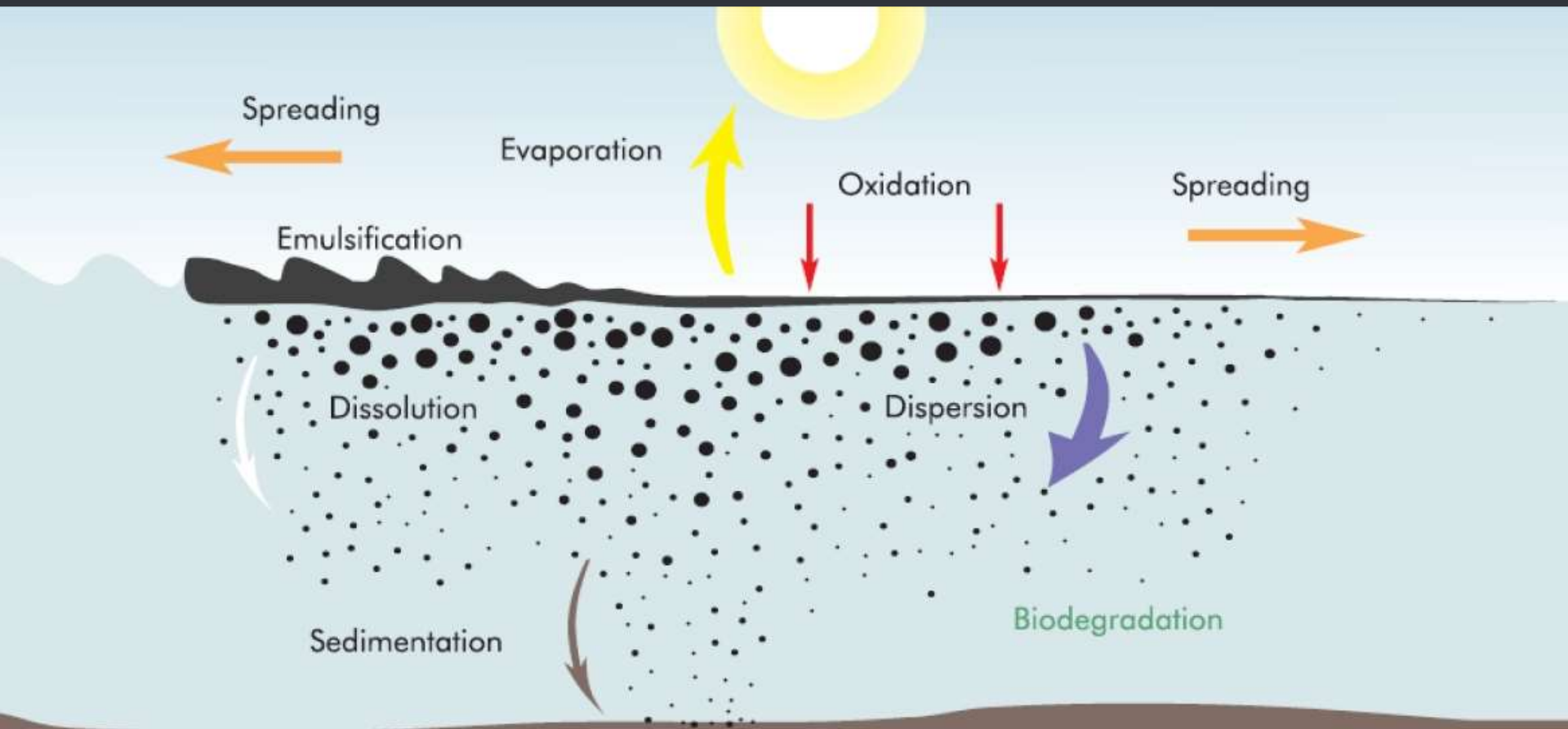
2. Convert to oiling "shore type"

3. Use experimental data to estimate retention

Volume of oil retained?

4. Apply retention to upper intertidal of shore unit

Weathering processes during an oil spill



Modelling an oil spill

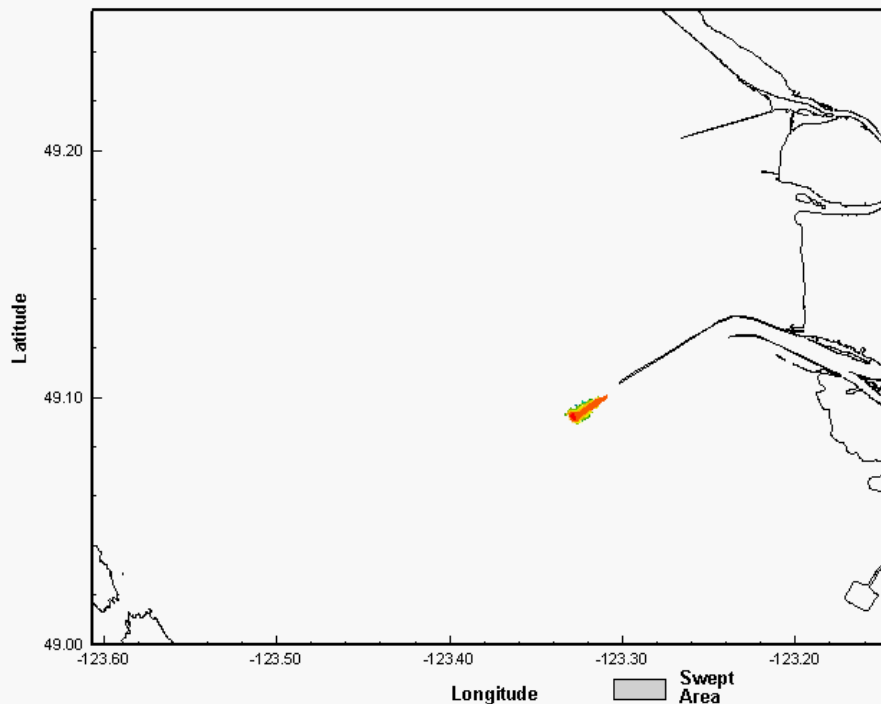
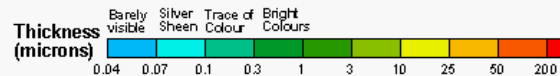
FUEL DELIVERY PROJECT



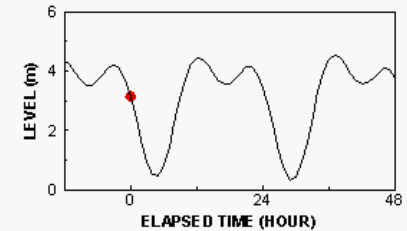
RELEASE AT SAND HEADS

HIGH TIDE JUNE 11
RELEASE : 10,000 BBL
DISCHARGE DURATION: 8 HOURS

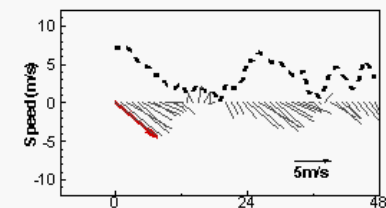
RELEASE TIME: 2002/06/11 07:00
TIME SHOWN : 2002/06/11 08:00
ELAPSED TIME: 1 HOURS



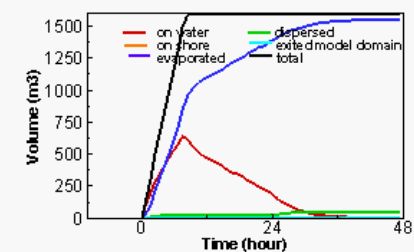
Water Level at Point Atkinson



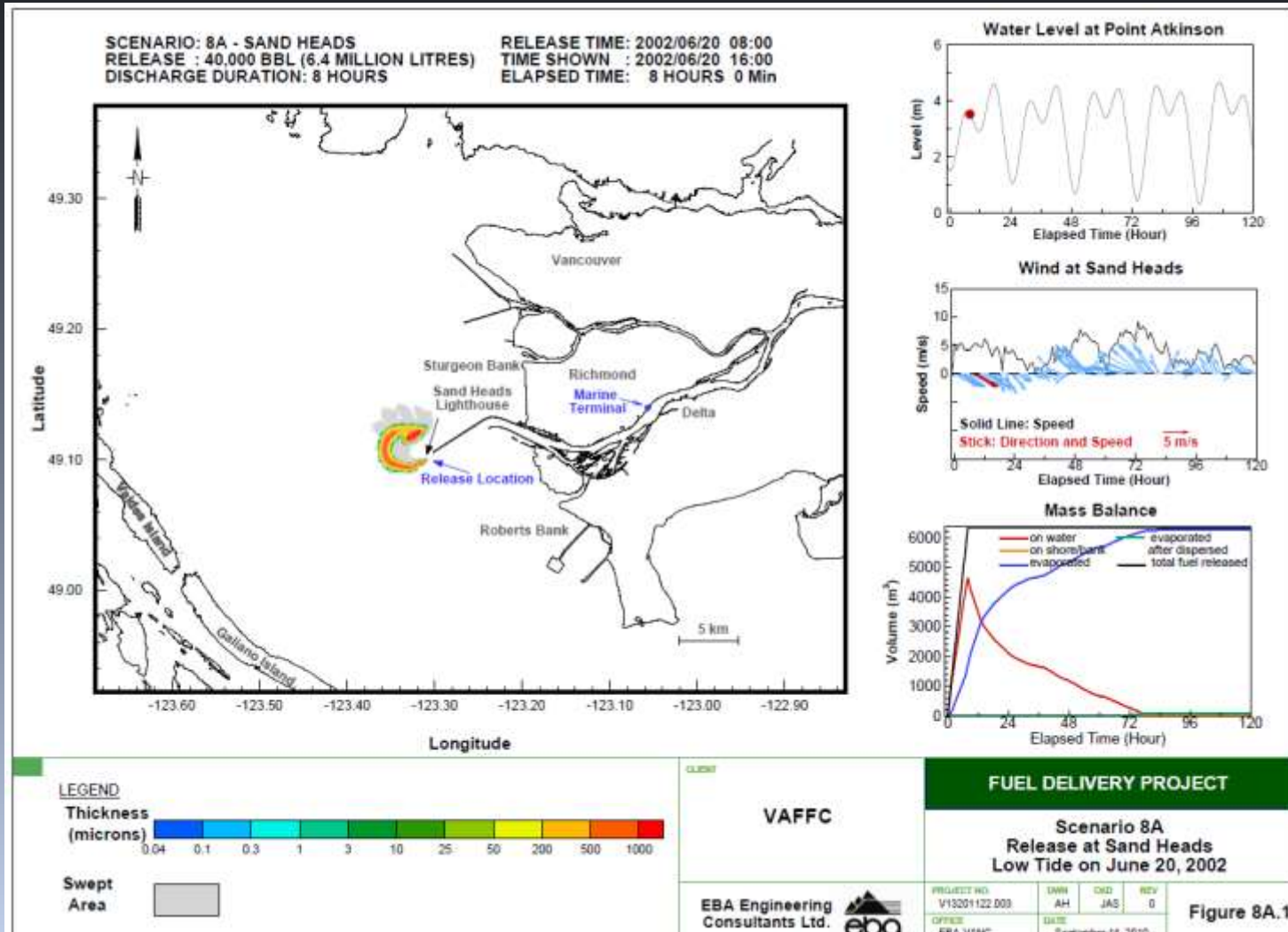
Wind at Sand Heads



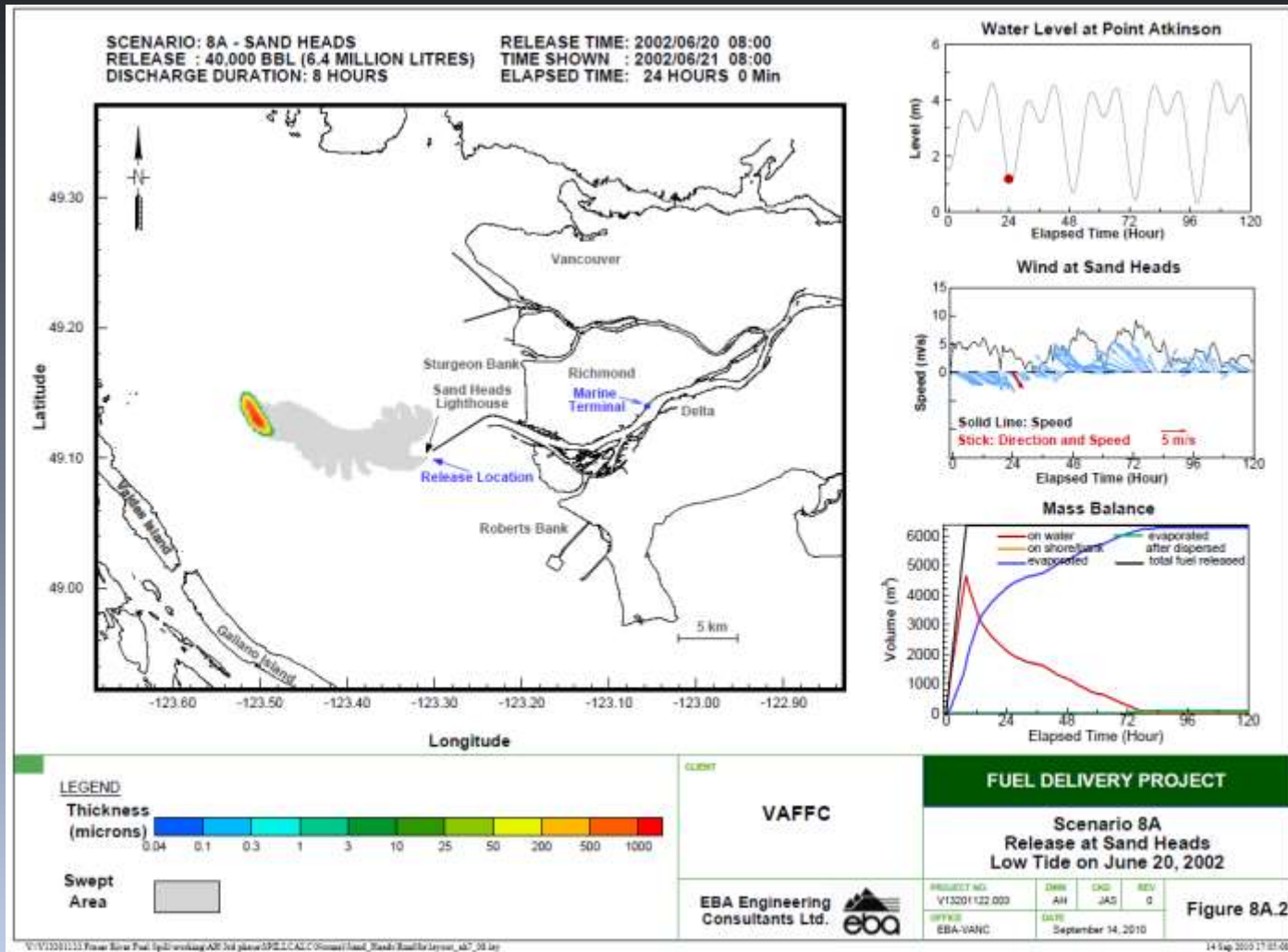
Mass Balance



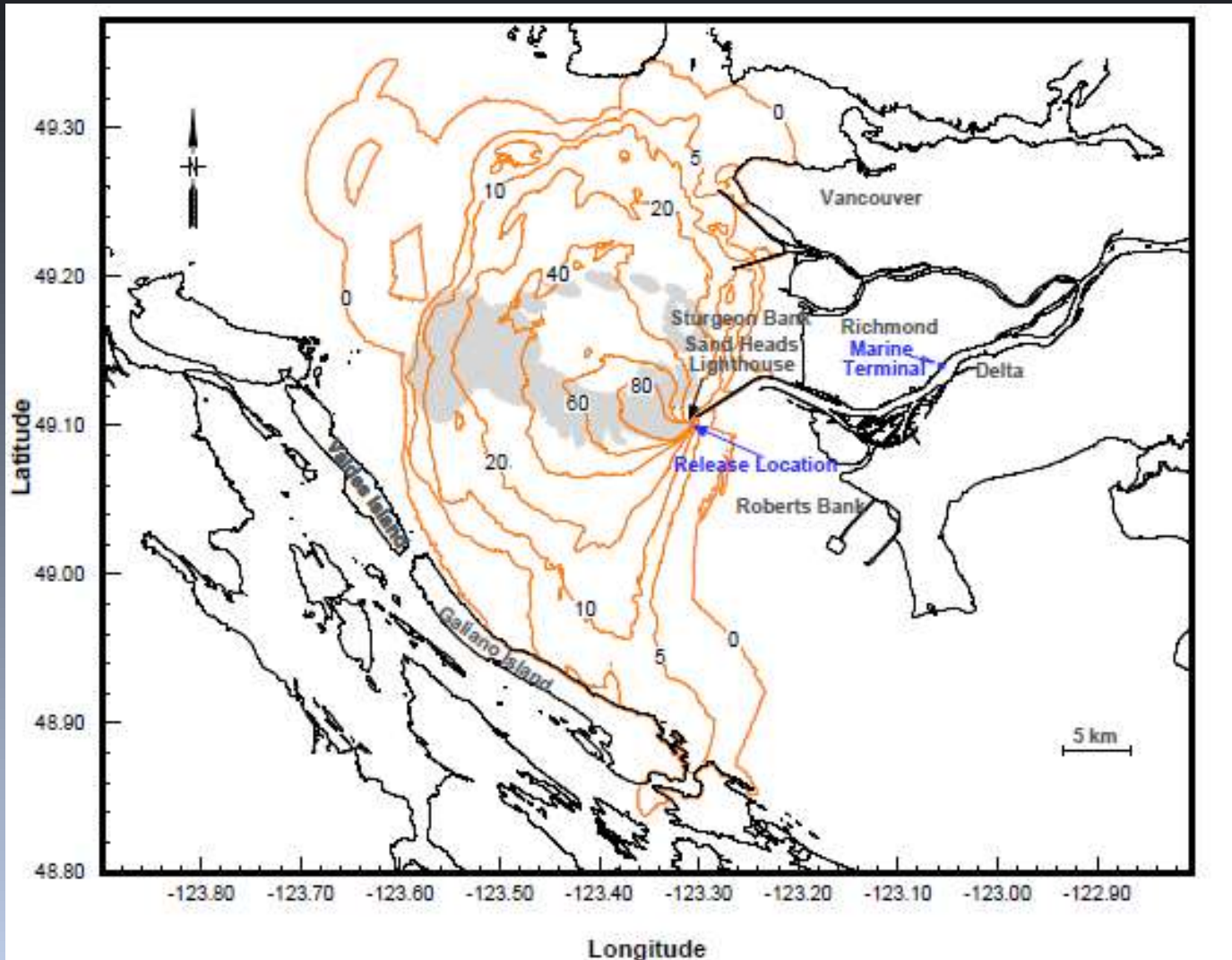
Modelling an oil spill



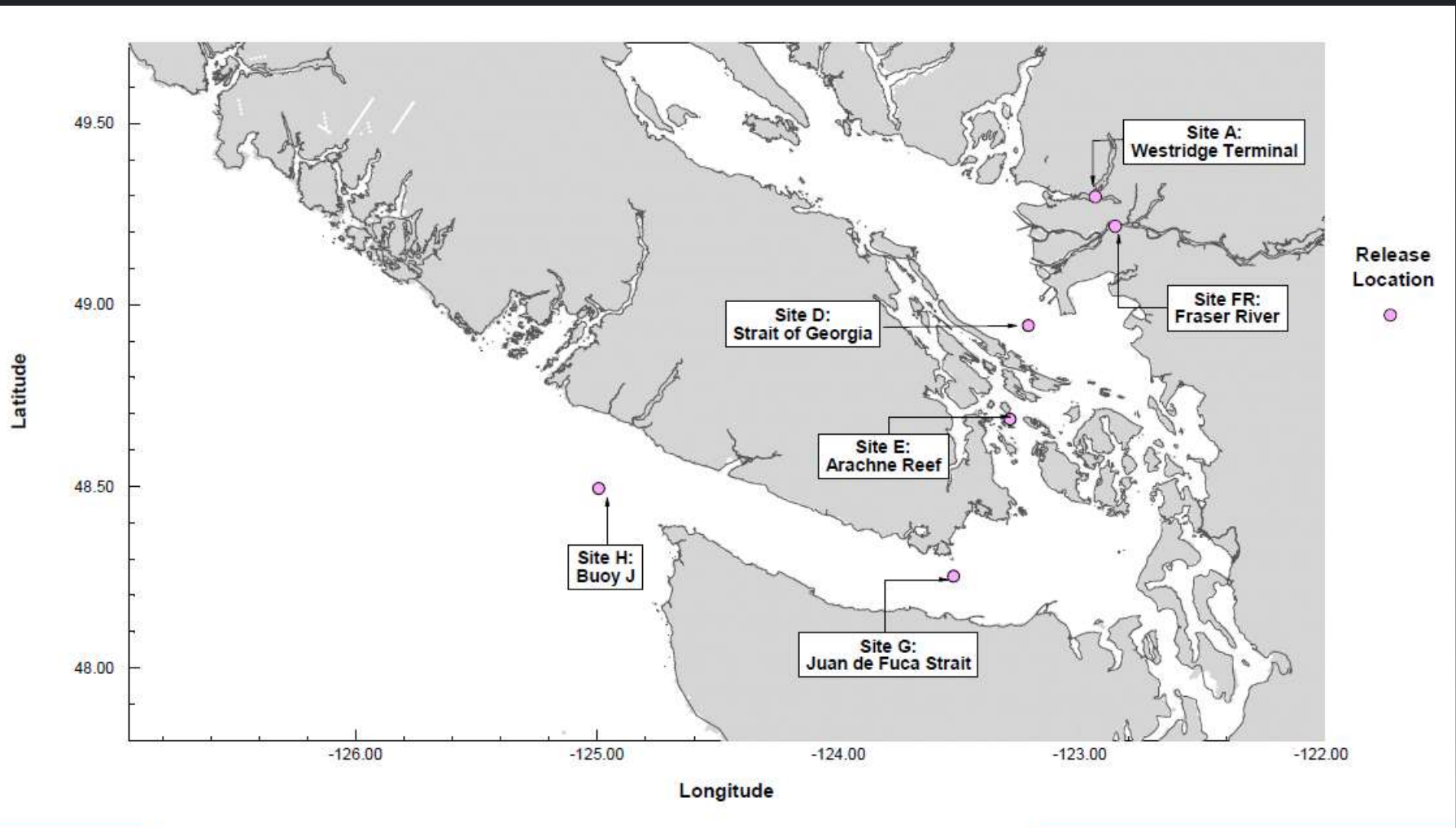
Modelling an oil spill



Modelling an oil spill



Modelling an oil spill



NOTES

- Sites A, D, E, G and H are based on the DNV Quantitative Risk Assessment.
Site FR is based on the Dynamic Risk Assessment.

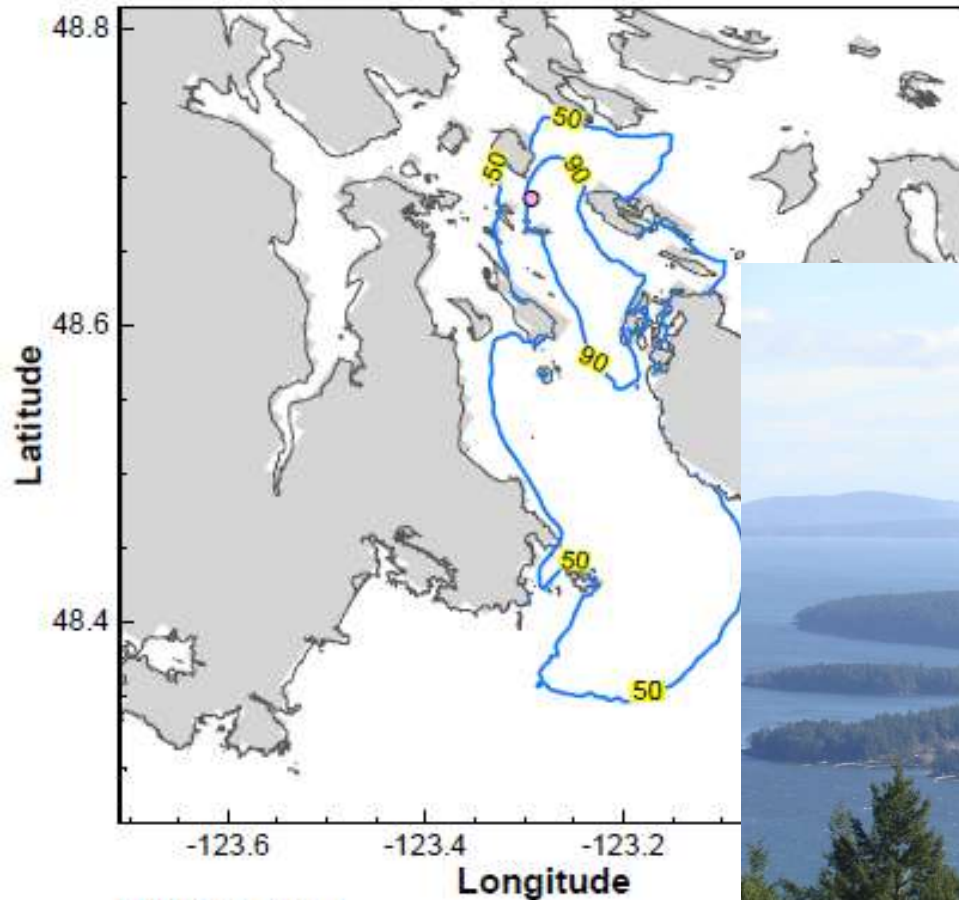
CLIENT



TRANS MOUNTAIN OIL SPILL STUDY

Spill Locations for
the Stochastic Simulations

Modelling an oil spill



Winter 2012

Area within the P_{50} Contour Line:
Area within the P_{90} Contour Line:
Average Thickness within the P_{50} Contour Line:
Average Thickness within the P_{90} Contour Line:
Average Shore Oiled:

DilBit Release: 16,500 m³
100,000 bbl
4 million gallons



Modelling an oil spill

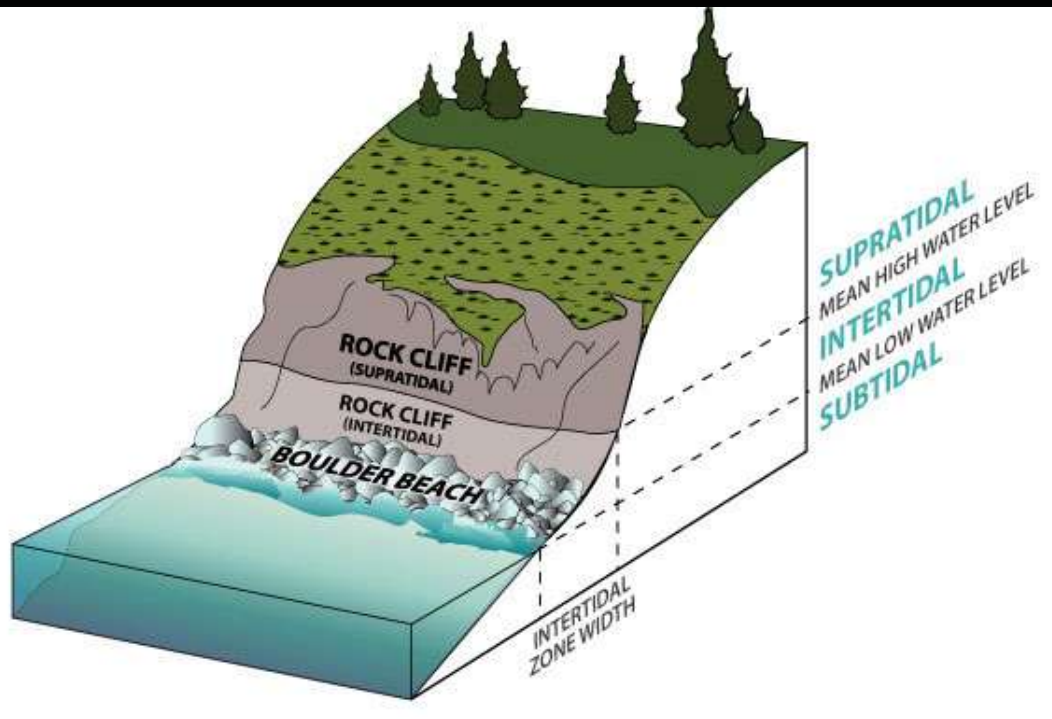
Table 8.7.1: Summary of Stochastic Modelling Results

Property	Strait of Georgia	Arachne Reef	Race Rocks	Buoy J	Group Average
P ₅₀ area at 24 hours (km ²)	364	196	372	261	298
P ₅₀ area at 48 hours (km ²)	1,033	646	674	592	736
Shore oiled at 24 hours (km)	15	36	7	0	15
Shore oiled at 48 hours (km)	78	85	29	< 1	64
Shore oiled at 15 days (km)	279	309	114	81	196
Fraction on shore at 15 days (%)	66.4	69.8	67.1	28.2	57.8
Fraction evaporated 15 days (%)	19.3	18.8	19.7	24.2	20.4

Using ShoreZone mapping data to estimate retention



How is
imagery
converted to
oil
retention?



ShoreZone Data

1. Extract substrate of upper intertidal zone
2. Base on substrate and exposure assign 1 of 12 “spill shore type”

- 16,000 km coastline
- 10 most common “substrates” in upper intertidal (right)

Code for Upper Intertidal Substrate	Translation of Code	Number Shore Units	Spill Shore Type	Spill Shore Type Description
R	Rock, low energy	29,507	LE_R	Rock, low energy
R	Rock, high energy	9,912	HE_R	Rock, high energy
Csp	Sand & pebble, low energy	7,344	LE_V	Pebble veneer over sand, low energy
Cs	Sand, low energy	6,704	LE_S	Sand, low energy
Cps	Pebble & sand, low energy	3,100	LE_V	Pebble veneer over sand, low energy
Cs	Sand, high energy	2,809	HE_S	Sand, high energy
Ar	Rip-rap, low energy	2,654	LE_RR	Rip-rap, low energy
Cp/Cs	Veneer of pebble over sand, low energy	2,373	LE_V	Pebble veneer over sand, low energy
Csp	Sand & pebble, high energy	2,104	HE_S	Sand, high energy
Csg	Sand & gravel, low energy	2,076	LE_V	Pebble veneer over sand, low energy

Experimental Data

Stranded Oil in Coarse
Sediments Experiments
(SOCSEX III) –
Environment Canada



Baffin Island Oil Spill [BIOS]
experiments – multinational
project.



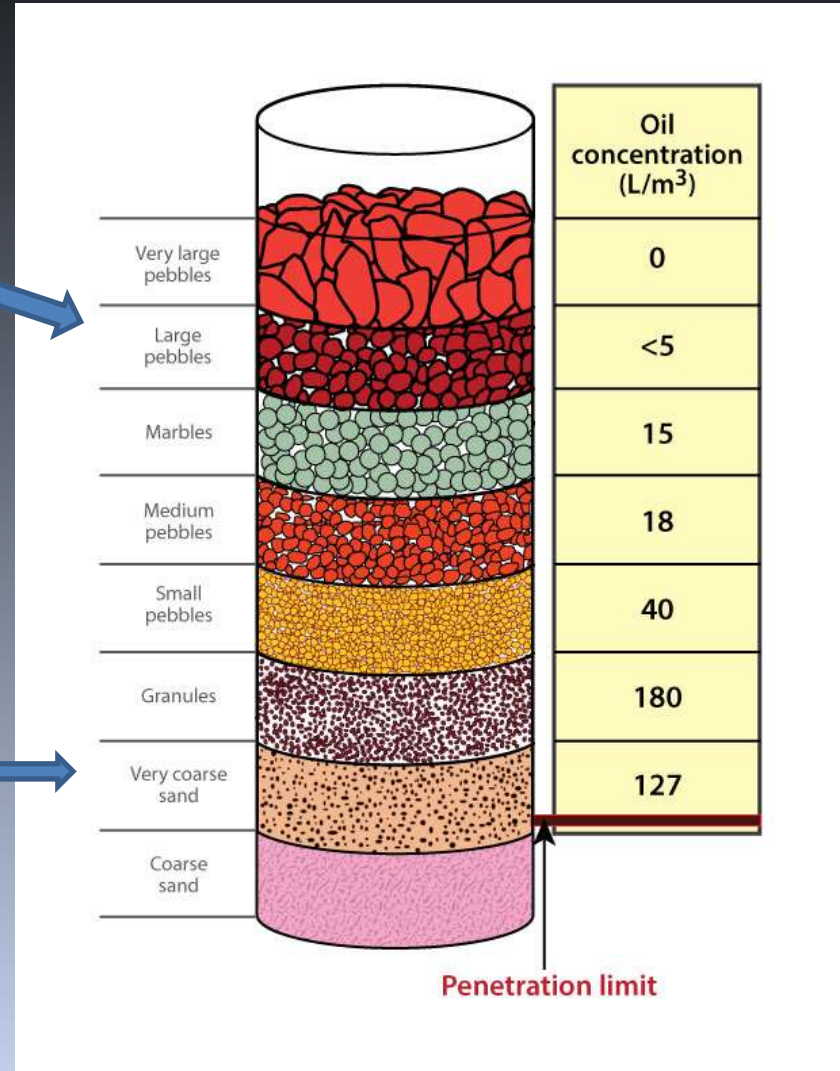
Experimental Data



Crude oil Penetrating pebble



Crude oil penetrating sands



Using ShoreZone mapping data to estimate retention

Upper intertidal
Shore type

Upper intertidal
volume retention

1	2	3	4	5	6	7	8	9
	Shore Type	Description	Penetration (cm)	Conc (L/m3)	Thick- ness (cm)	Vol in Sediment L/m2	Vol in Surface Layer L/m2	Total Volume (L/m2)
1	LE_R	Rock	0	0	0.5	0	5	5
2	LE_VR	Rock w pebble, cobble veneer	1	100	0.5	1	5	6
3	LE_V	Pebble veneer	2	200	0.5	4	5	9
4	LE_CV	Cobble or boulder veneer	10	100	0.5	10	5	15
5	LE_S	Sand or mud	1	300	0.5	3	5	15
6	LE_RR	Rip Rap	30	100	0.5	30	5	35
7	LE_M	Marsh	1	300	1	3	10	13
8	LE_W	Wood	2	300	0.5	6	5	11
9	HE_R	Rock	0	0	0.5	0	5	5
10	HE_VR	Rock with coarse veneer	20	200	0.5	40	5	45
11	HE_C	Boulder, cobble beaches (also includes few rip-rap sections)	30	200	0.5	60	5	65
12	HE_SG	Sand w pebble, cobble or boulder	1	300	0.5	3	5	8
13	HE_S	Sand	1	300	0.5	3	5	8
14	LE_L	Log boom modifier	0	0	1	0	2	2

A highly viscous oil type, like Bunker C, is assumed for penetration and retention estimates

Using ShoreZone mapping data to estimate retention

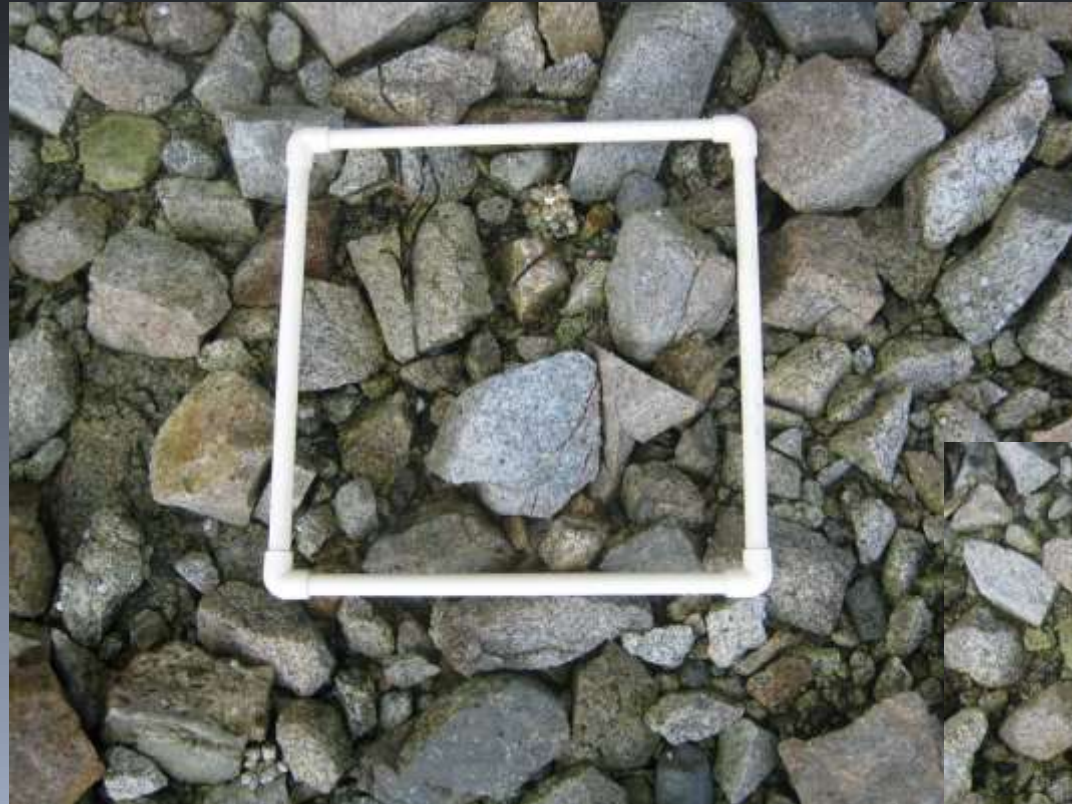
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Using ShoreZone mapping data to estimate retention

Cobble-pebble sediment,
highly permeable

Hypothesis: substrates on
low energy shore have are
sand in the subsurface
regardless of surface cover



- 270 plots examined in 50 shore units
- 82% have low permeability sediment in the subsurface

Conclusions

1. ShoreZone provided the detail required to estimate upper intertidal retention and penetration
2. The ShoreZone data interfaced well with the numerical modelling data
3. Field evaluation of “low permeability on low energy shorelines” assumption validated