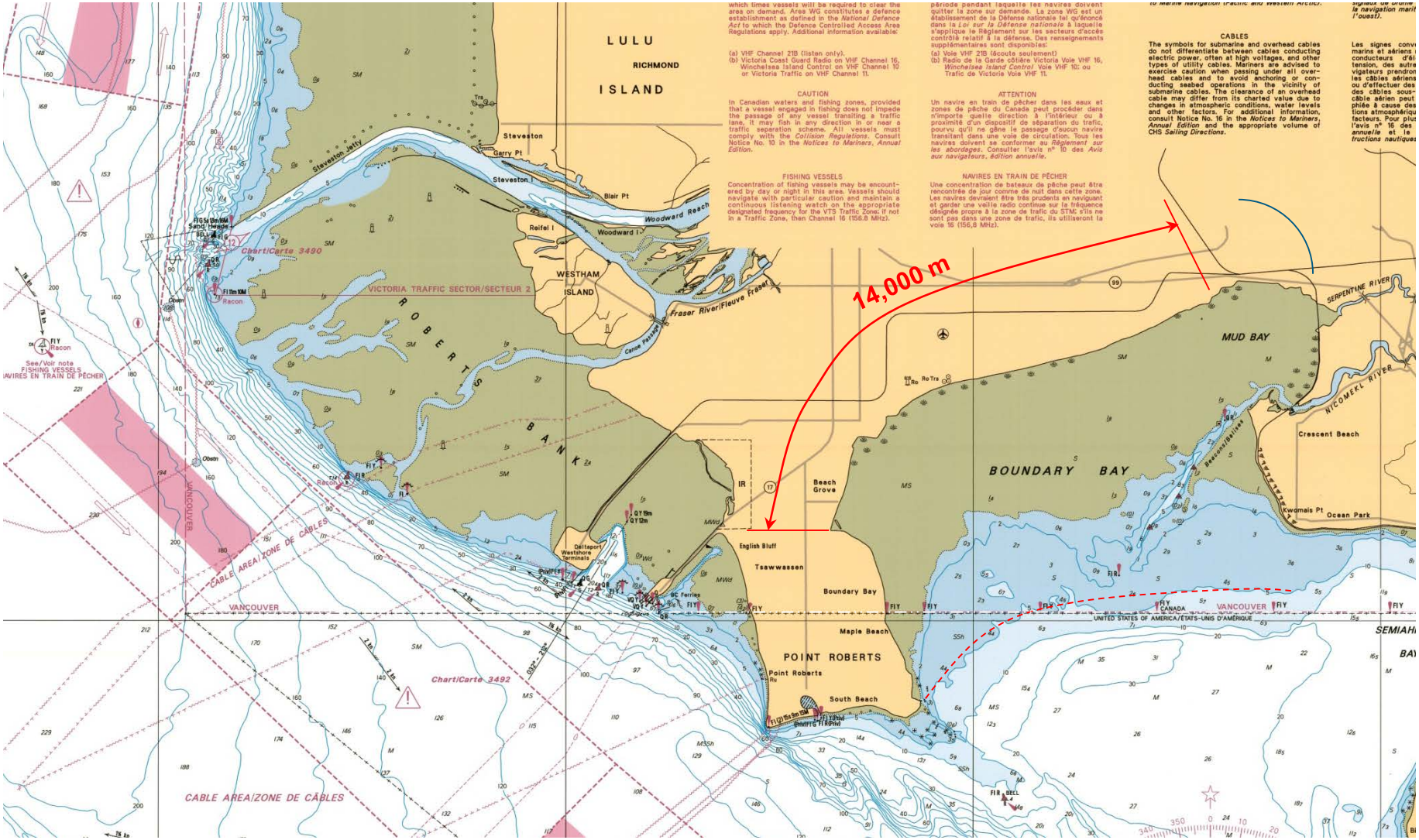
Living Dike Concept

Boundary Bay Site



Upper intertidal Marsh Areas

Upcoming Interaction between existing sea dike and salt marsh

What is a Living Dike?

As Sea Levels rise:

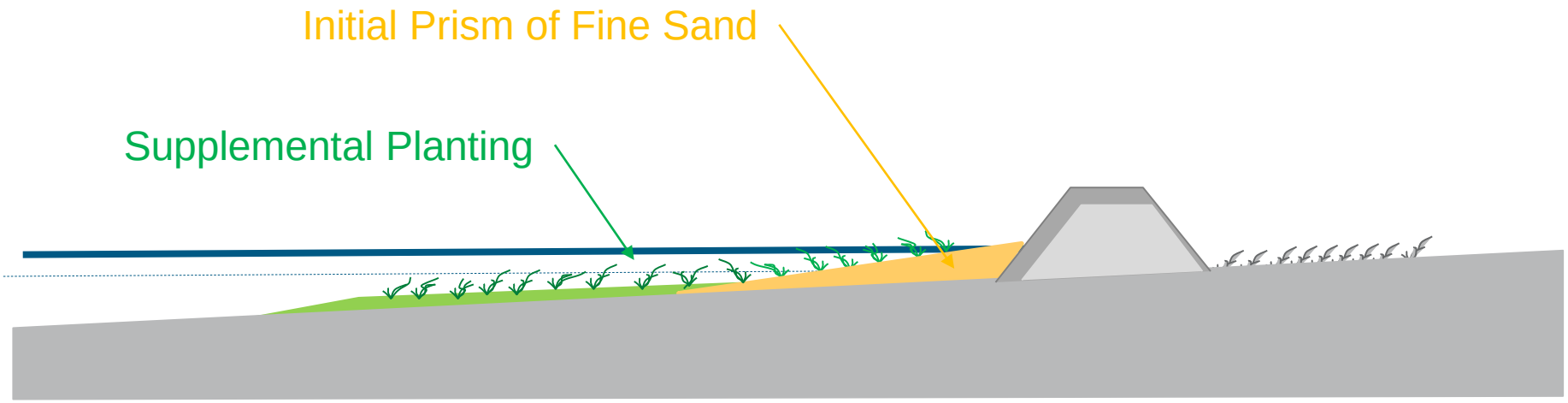
1. Provides the required degree of protection for safety of personnel and property for Coastal Flood Hazard Lands
   - *Defined in BC by Regulation (Local Gov't Act)*
2. Provides or maintains a pre-defined Ecological Function
   - *In simple terms: maintain the functions and objectives of the Migratory Bird Sanctuary legislation and marine (salmon) habitat*
3. Ideally a Living Reef will provide a balance of both and be an economical option

What is a Living Dike?

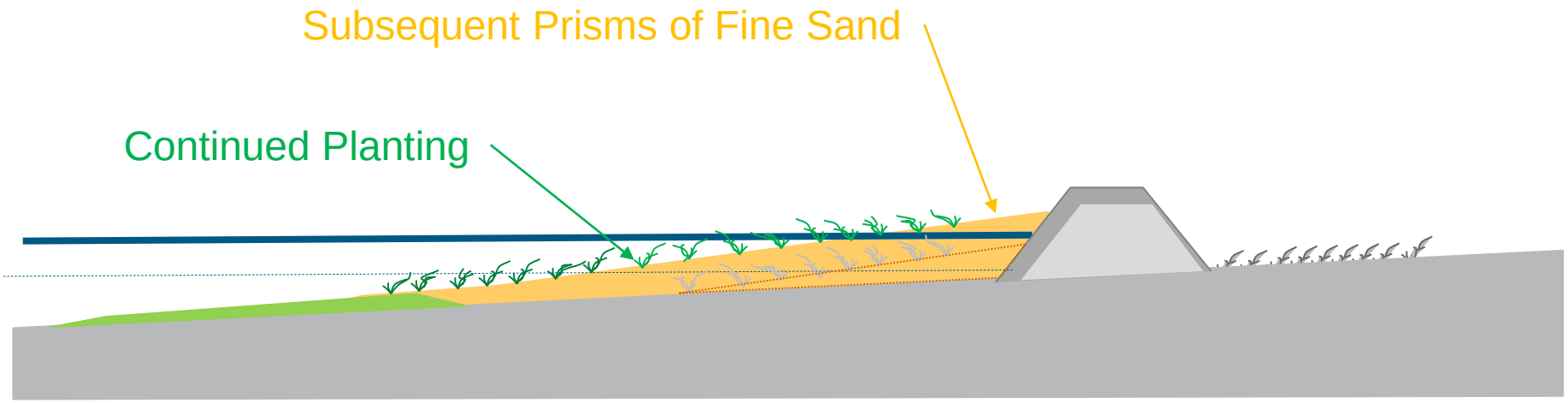
Described in more detail:

1. Sallas Sea Conference (2018)
2. On-line report(s) at:
   - *https://www.wcel.org/publications*

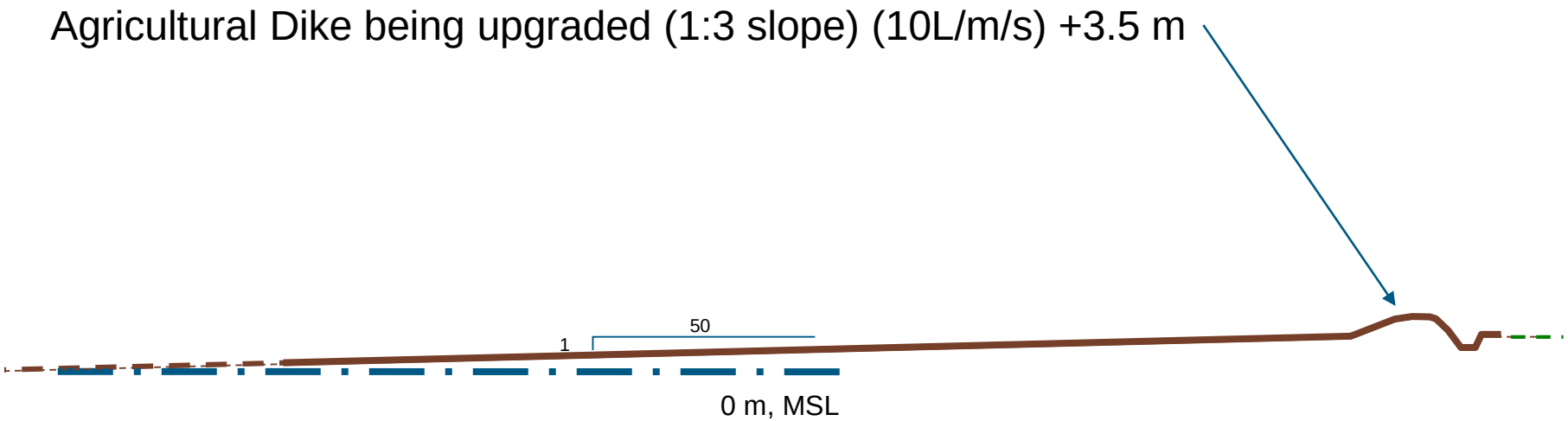
Early Phases of Living Dike Concept (as sea level rises)



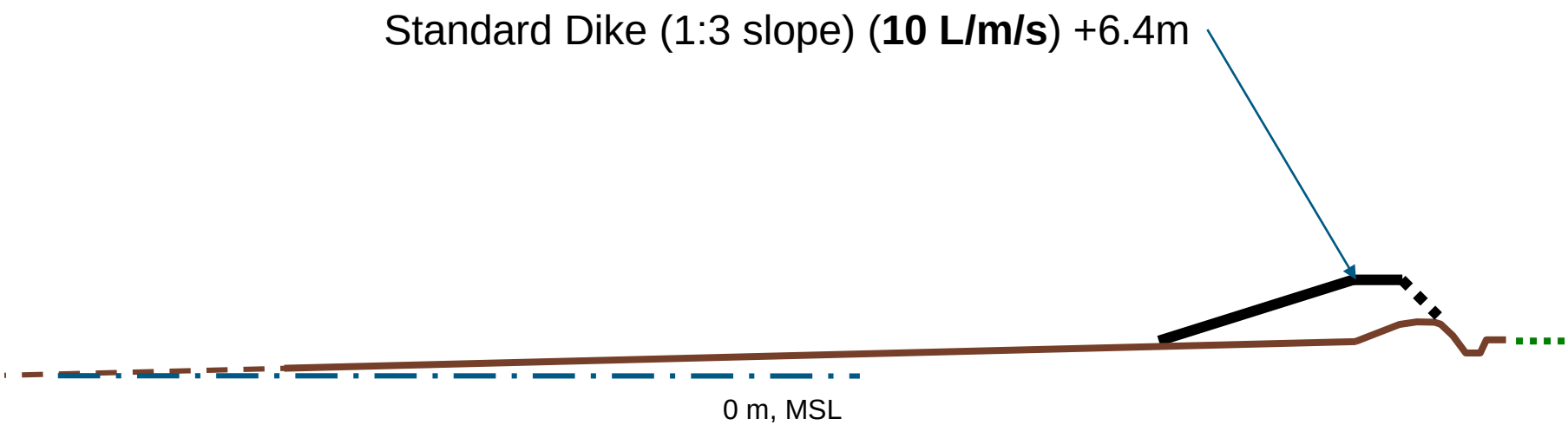
Continuing Phases of Living Dike Concept (to 1 m SLR)



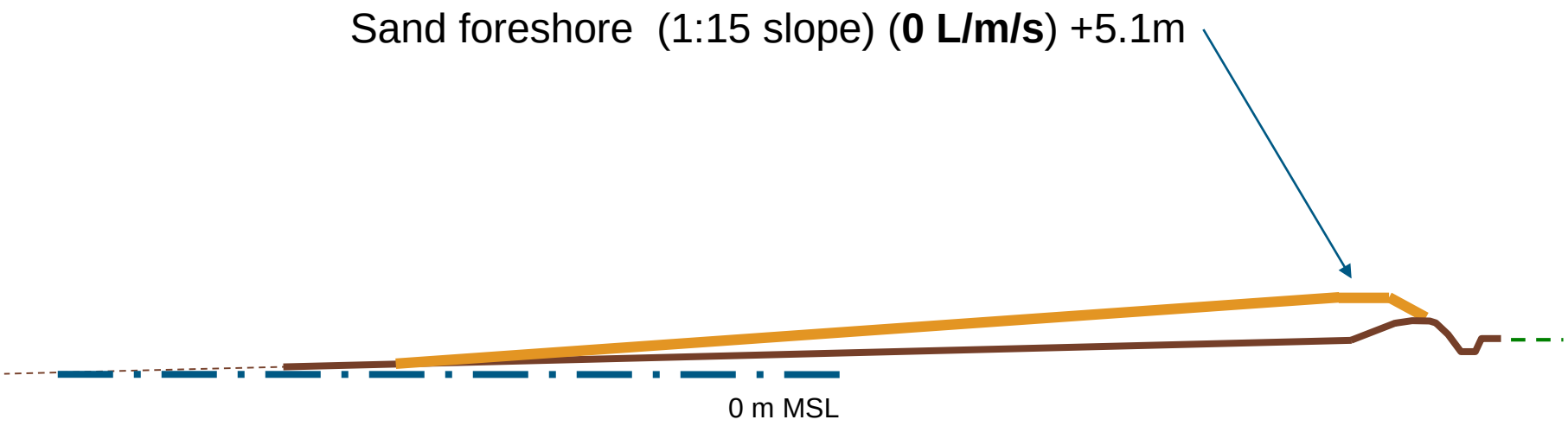
Existing Dike (not including 2015 -2016 upgrades)



1 m SLR - Standard Dike

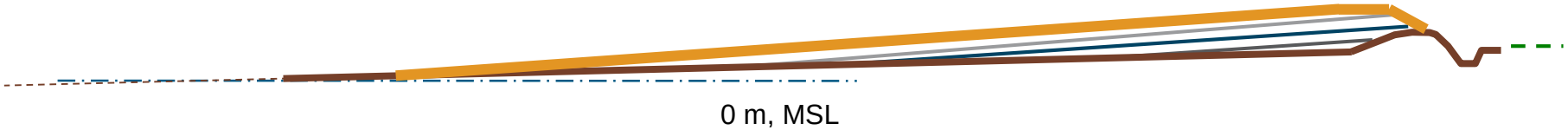


Living Dike Physical Structure – 1 m SLR



100 mm lifts superimposed on a 1:50 slope

Sand foreshore (1:15 slope) (**100 mm lifts**)



How to Implement

Material Source

Fine Sand

Imported Source

- Tidewater quarry (Sechelt)
- Dredged Material from Fraser River

Potential Supply

- 2 – 3 million m^3/yr (Fraser River - sand)

Approximate Required Volume

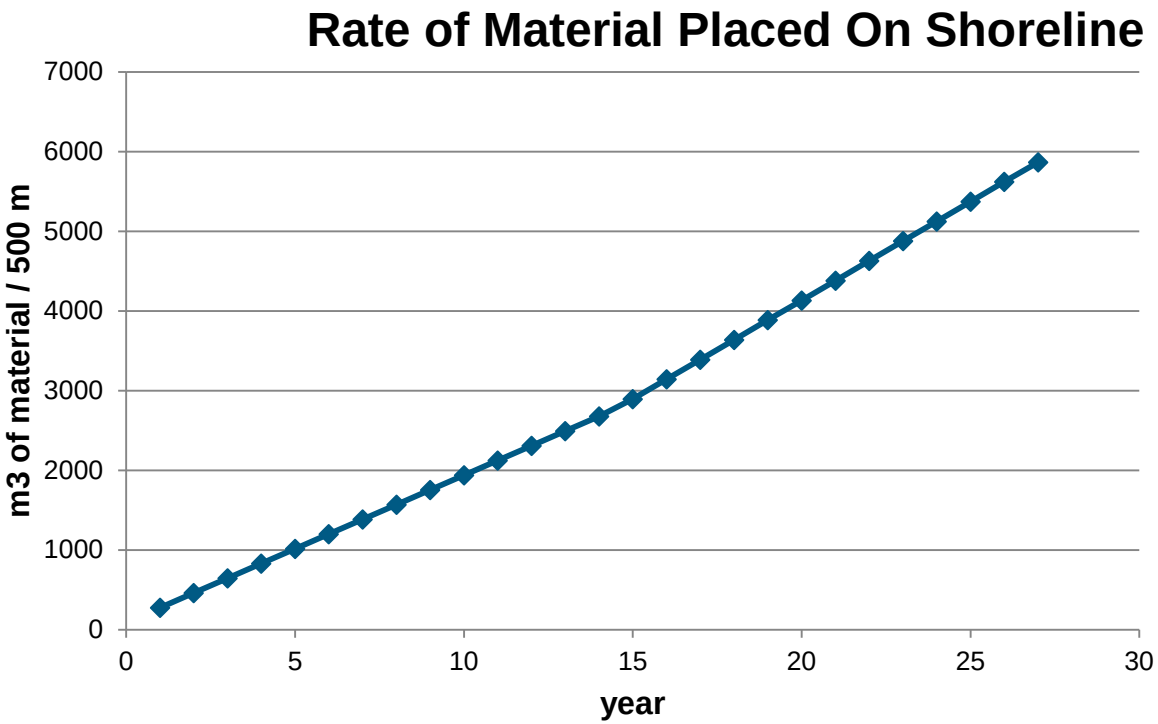
- For 14 km of Living Dike:
  - ≈ 2 – 3 million m^3 (design volume)

Trailing Suction Hopper Dredge

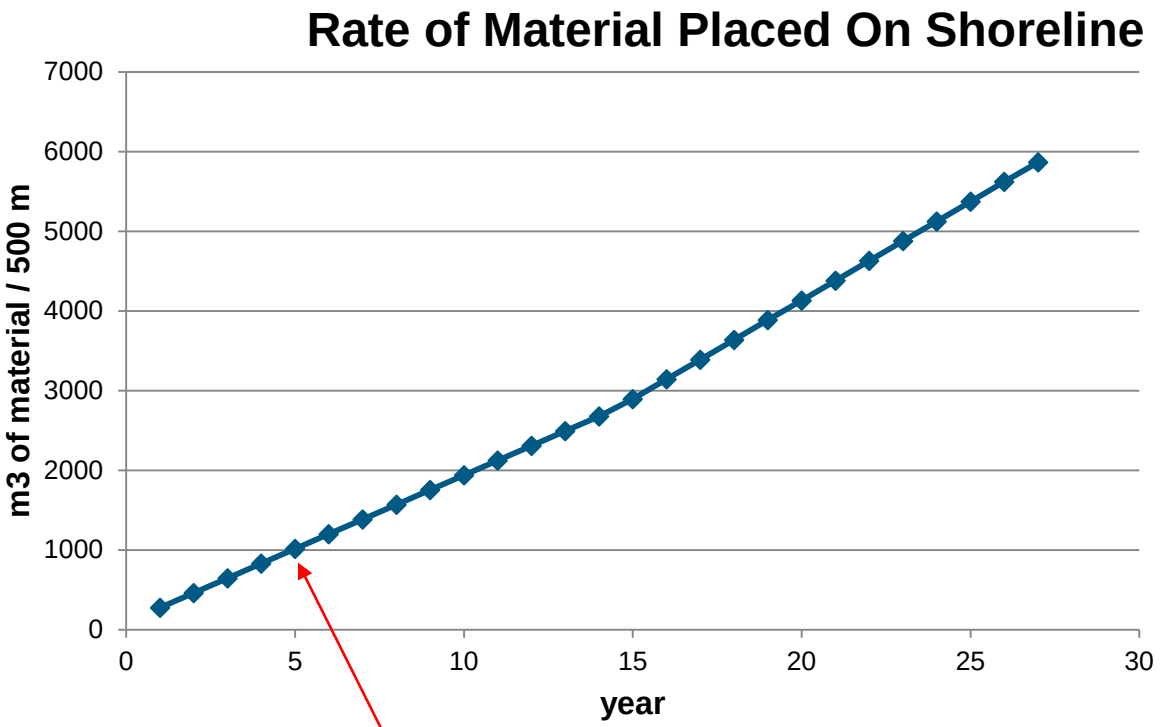
Standing Rainbow Delivery

Rainbow Delivery Underway

Rate of Supply (1:15 slope) 100 mm/yr

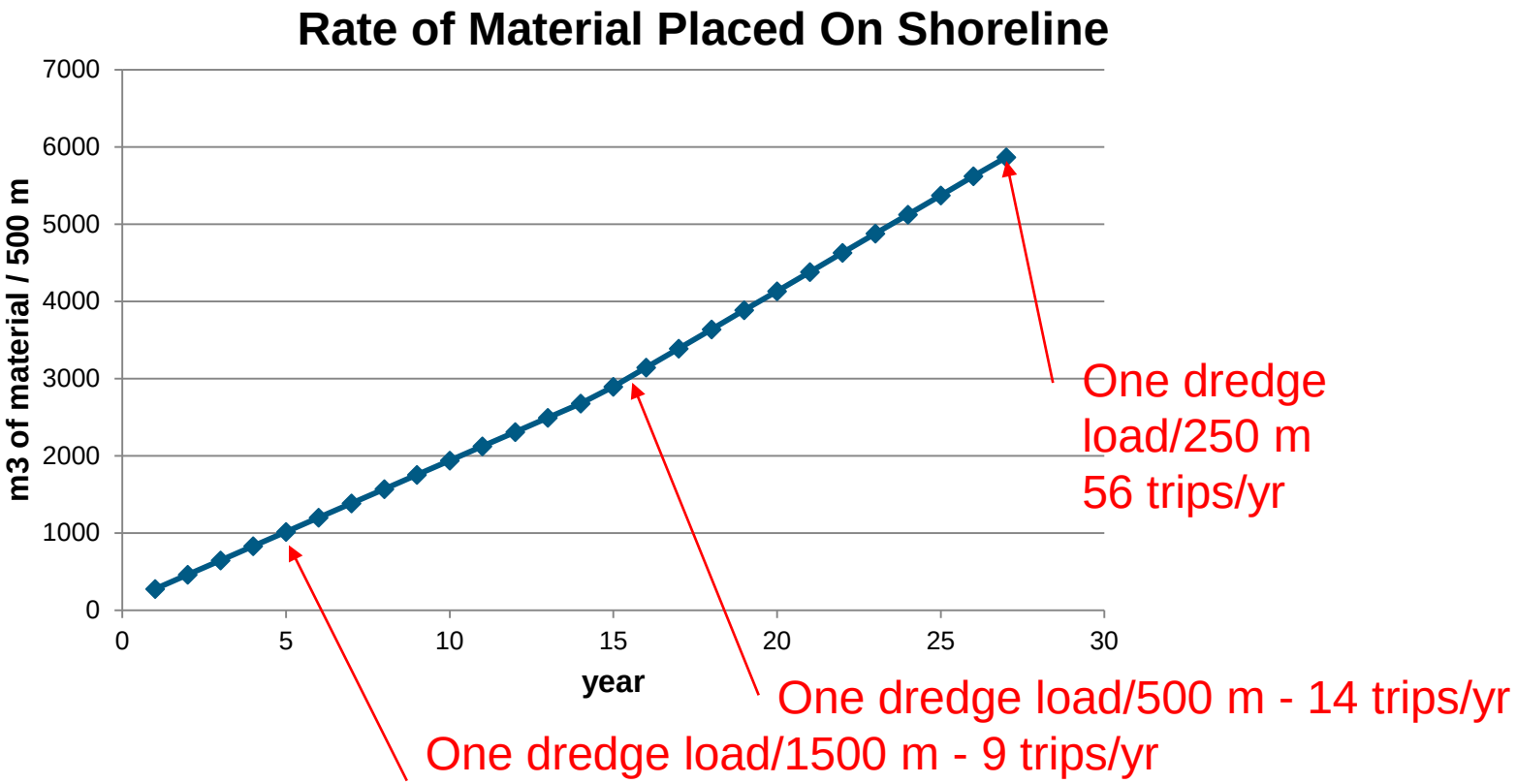


Rate of Supply (1:15 slope) 100 mm/yr

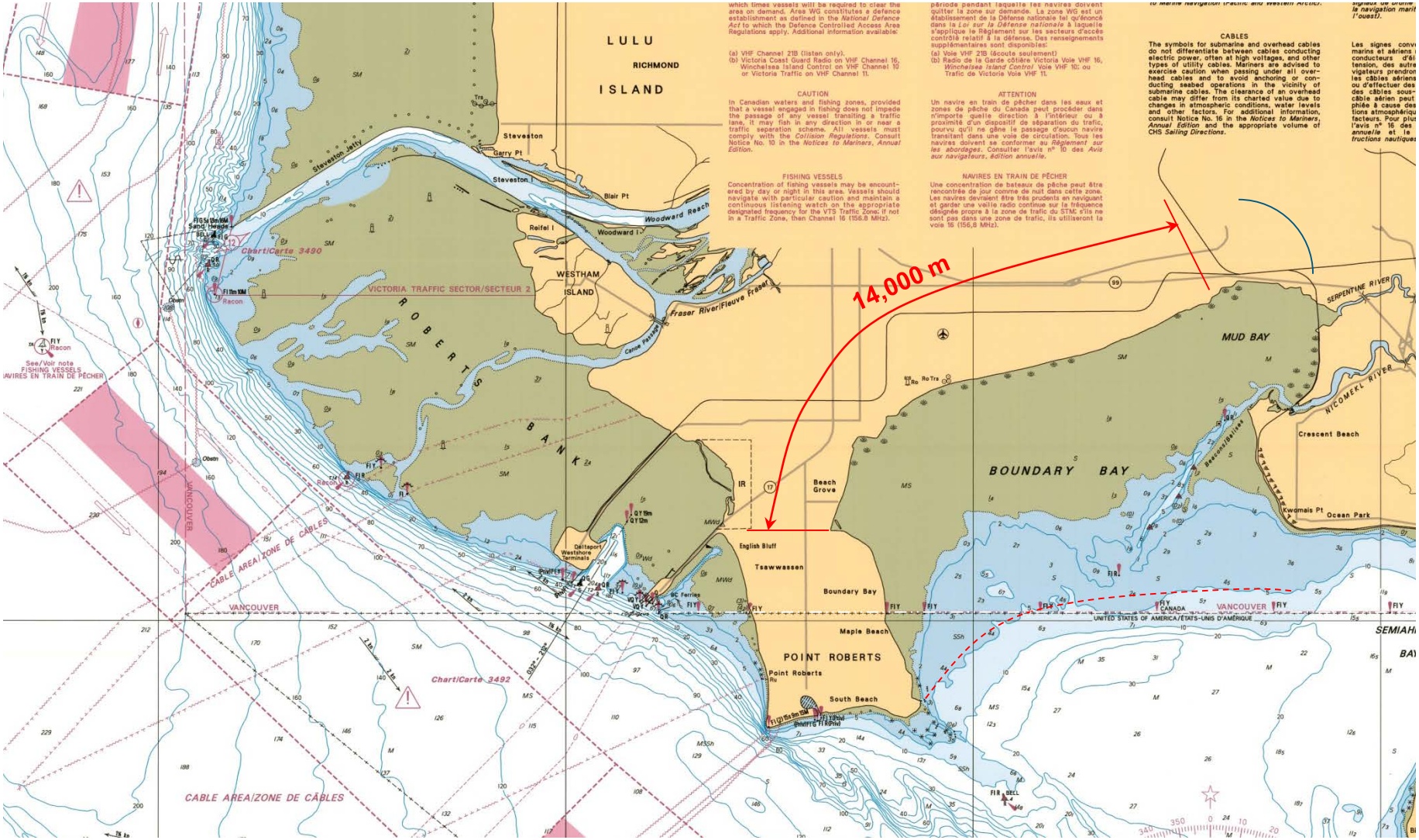


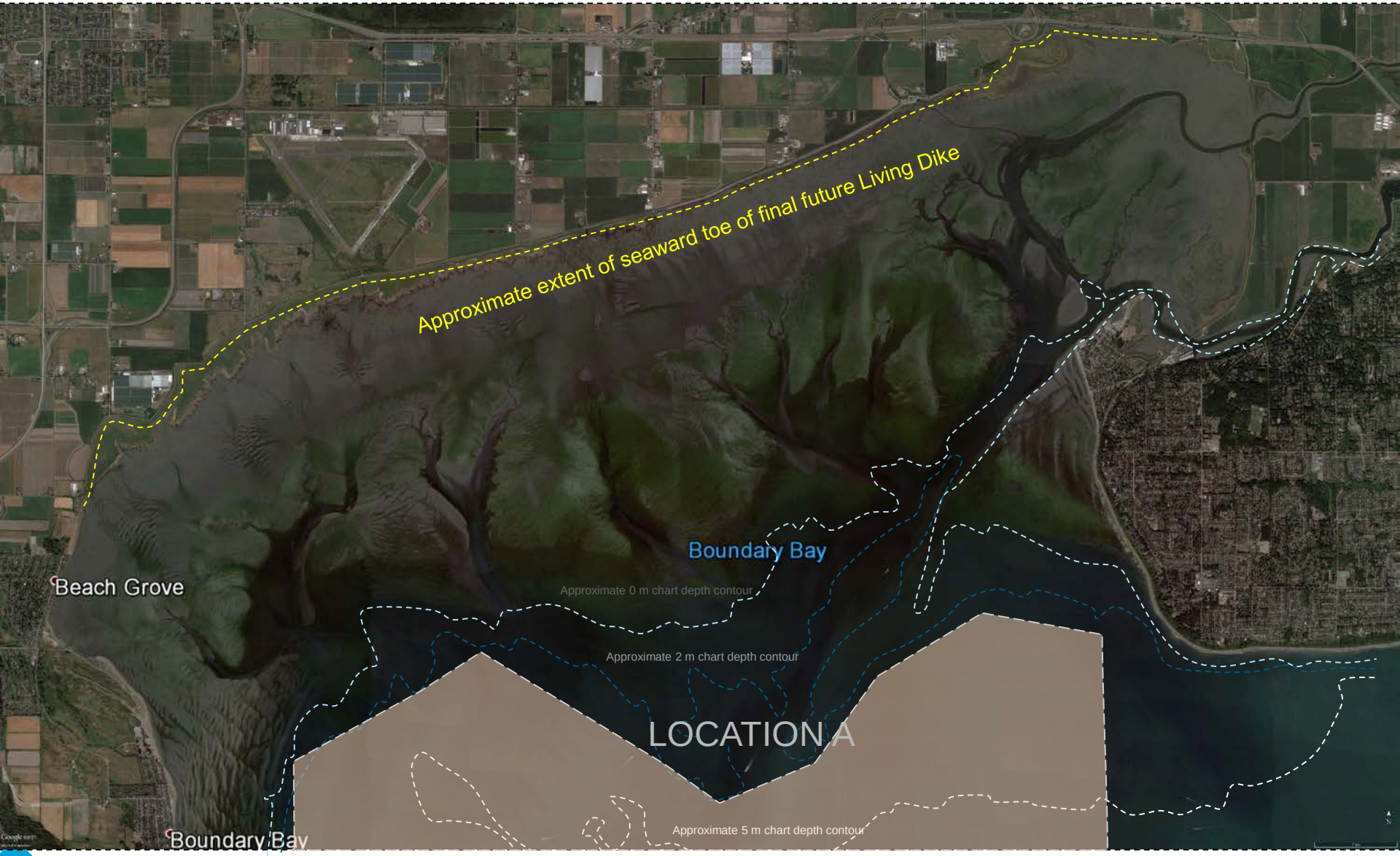
One dredge load/1500 m - 9 trips/yr

Rate of Supply (1:15 slope)



Boundary Bay Site




Approximate extent of seaward toe of final future Living Dike
Boundary Bay
Beach Grove
Approximate 0 m chart depth contour
Approximate 2 m chart depth contour
LOCATION A
Approximate 5 m chart depth contour
Boundary Bay
4 km

Approximate extent of seaward toe of final future Living Dike
LOCATION(S) B
Boundary Bay
Beach Grove
Approximate 0 m chart depth contour
Approximate 2 m chart depth contour
Approximate 5 m chart depth contour
Boundary Bay

4 km

Small dredge and floating line
Small dredge and floating line
Small dredge and floating line
LOCATIONS C
LOCATIONS C
Floating line
Floating line
Boundary Bay
Beach Grove
Approximate 0 m chart depth contour
Approximate 2 m chart depth contour
Approximate 5 m chart depth contour
Boundary Bay
4 km

Class D Cost Estimate

	Delivery Method			Comment
	A Placement in subtidal waters	**B** Placement in intertidal water (Sand Engine concept)	**C** Pumping ashore	
Direct Costs				
Delivery of Sand	$171,000,000	$114,000,000	$135,000,000	Methods A and B assume some loss of sand to adjacent areas of Boundary Bay
Salt Marsh Planting	$23,000,000	$23,000,000	$23,000,000	Assumes planting at a rate of one plant every 0.5 m with supplemental planting in years 2 and 3 of the lift cycle.
Total Direct Costs	$194,000,000	$137,000,000	$158,000,000	
Indirect Costs				
Supporting Investigations and design	$19,400,000	$13,700,000	$15,800,000	Includes front end science and engineering and pilot projects
Contingency	$31,900,00	$22,600,000	$26,000,000	
Total Costs	**$245,000,000**	**$173,000,000**	**$200,000,000**	

Notes:

a. **All cost components rounded up**

b. **Applicable taxes not included**

STANDARD DIKE ALTERNATIVE

	Upgraded (2018) estimate $	Comment
Direct Costs		
Dike Structure	178,175,662	
Environmental Offsets	1,428,947	Only includes planting at the top of the dike. No allowance for any potential scouring seaward of the dike.
Utilities	4,137,000	2012 pricing
Pump Station	2,500,000	2012 pricing
Flood Box	2,000,000	2012 pricing
Land Acquisition	9,670,727	2012 pricing
Indirect Cost	19,791,234	As defined in **Error! Reference source not found.**
Contingency	32,655,535	Reduced to 25% for upgraded estimate
Total Cost	**$250,360,000**	

Pilot Project (pending Federal Government funding approval – April)

Objectives of Pilot Project

Primary

1 Thickness of Marsh Pads

- to allow existing marsh to grow through

2 Need for seaward Marsh Pad temporary protection

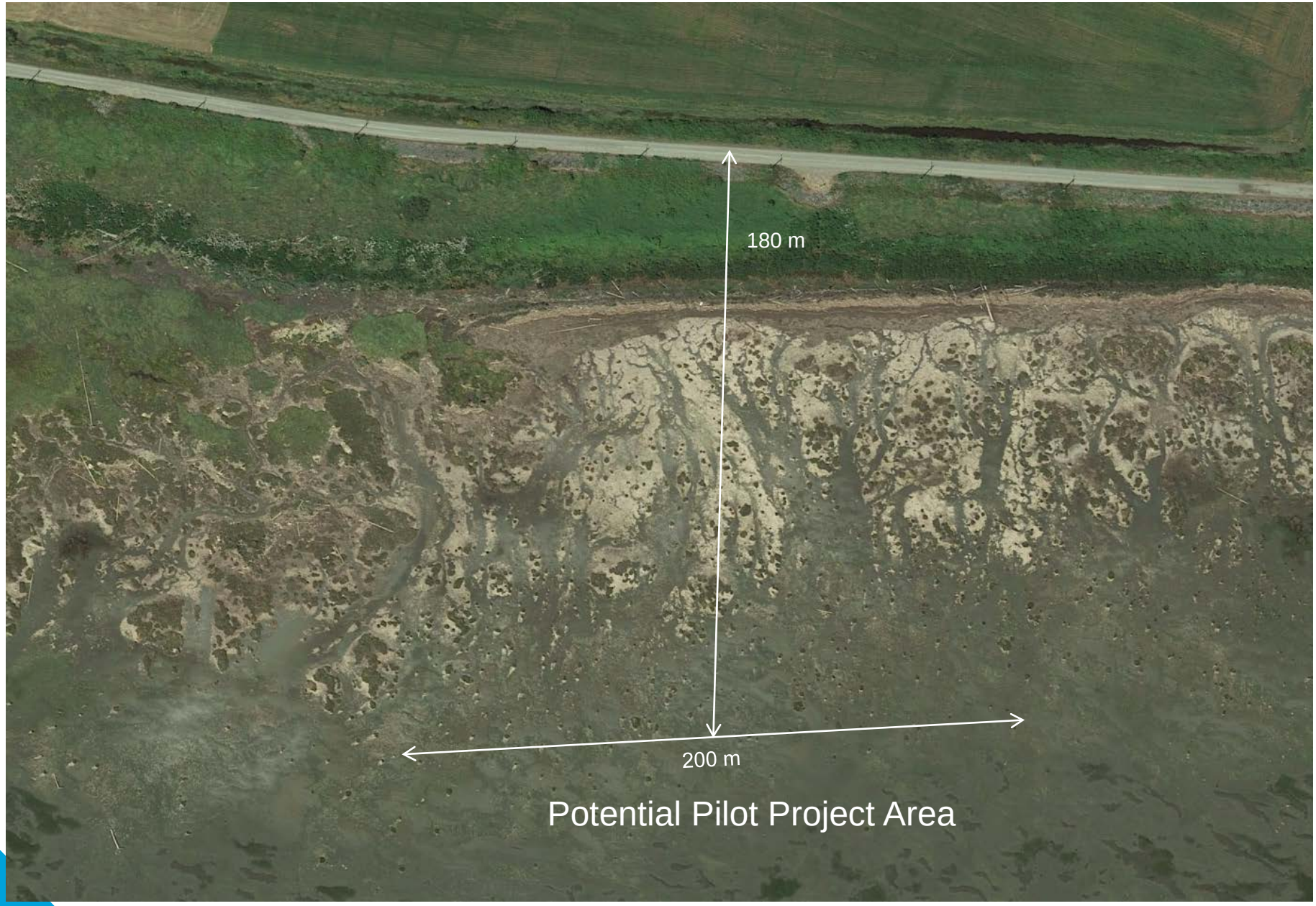
- likely consider oyster shell, sand storm berm or gravel

3 Requirement for supplemental planting after 1st and 2nd storm seasons

Secondary

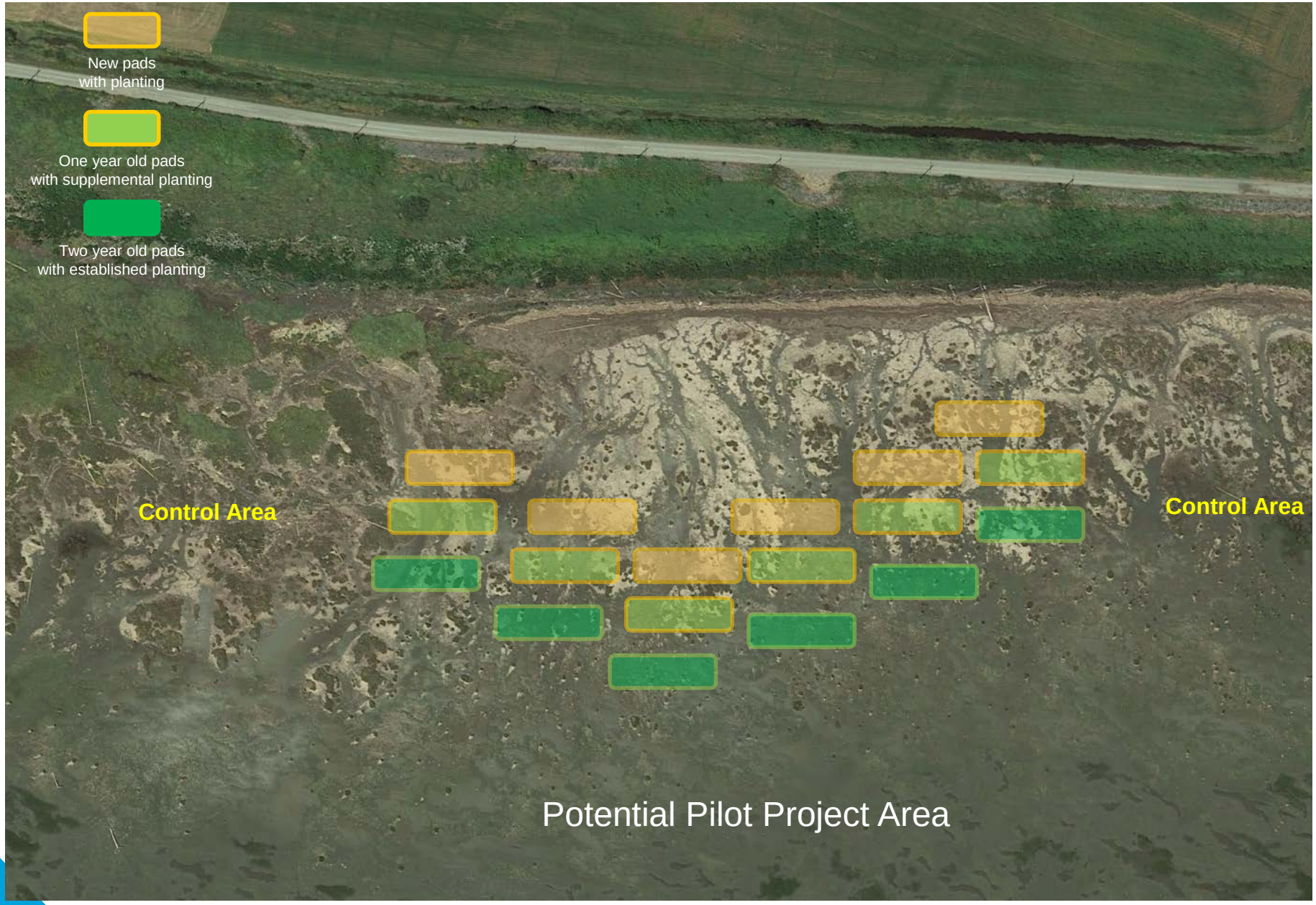
4 Wave energy absorption and flooding protection

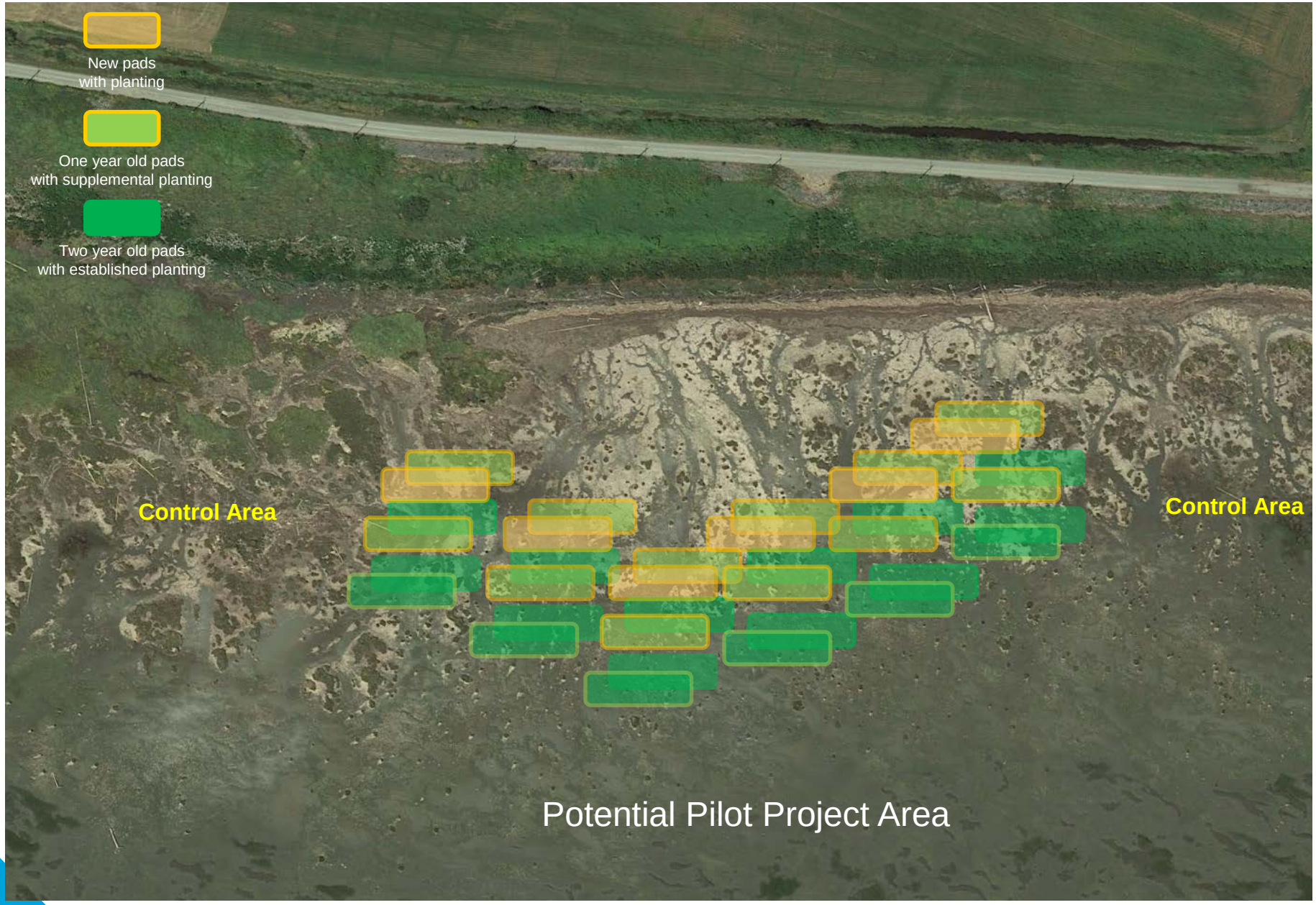
Pilot Project Site – Boundary Bay


180 m
200 m
Potential Pilot Project Area

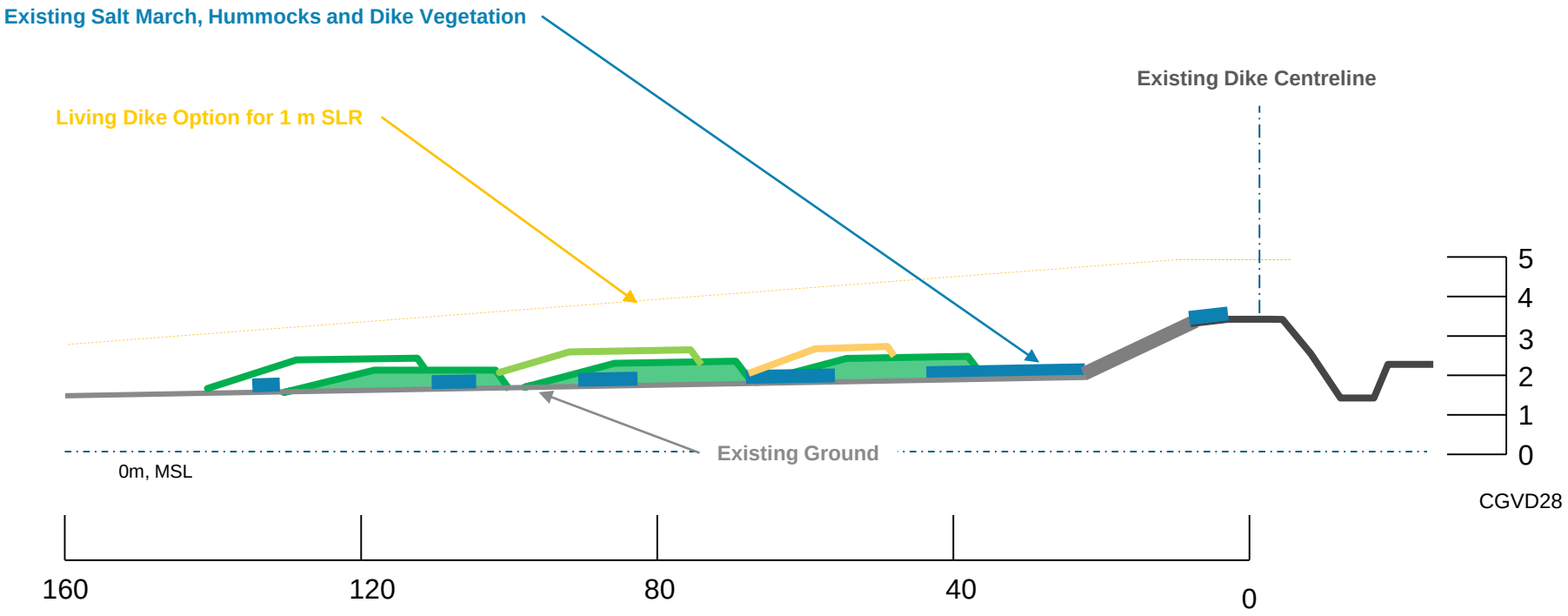
New pads
with planting
One year old pads
with supplemental planting
Two year old pads
with established planting
Marsh Pads typically 10 x 33 m surface area
Control Area
Control Area
Potential Pilot Project Area

New pads
with planting
One year old pads
with supplemental planting
Two year old pads
with established planting
Control Area
Control Area
Potential Pilot Project Area


New pads
with planting
One year old pads
with supplemental planting
Two year old pads
with established planting
Control Area
Control Area
Potential Pilot Project Area


New pads
with planting
One year old pads
with supplemental planting
Two year old pads
with established planting
Control Area
Control Area
Potential Pilot Project Area

Typical Cross Section for Year 4, 5 and 6 succession planting



Summary

At Conceptual Stage of design:

1. Appears to be econmically advantageous:
   - *$173 - $245 Million vs $250 Million*
2. If successful can be expected to provide additional ecological services:
   - *Marine and Wild Bird habitat*
   - *Possible Carbon Source*
3. Delays need to raise existing dikes for 20 – 30 years, which provides low risk pause for certainty to become more established.

Questions?