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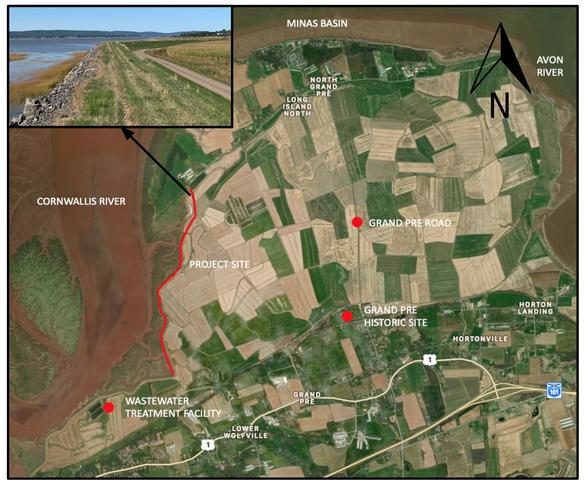
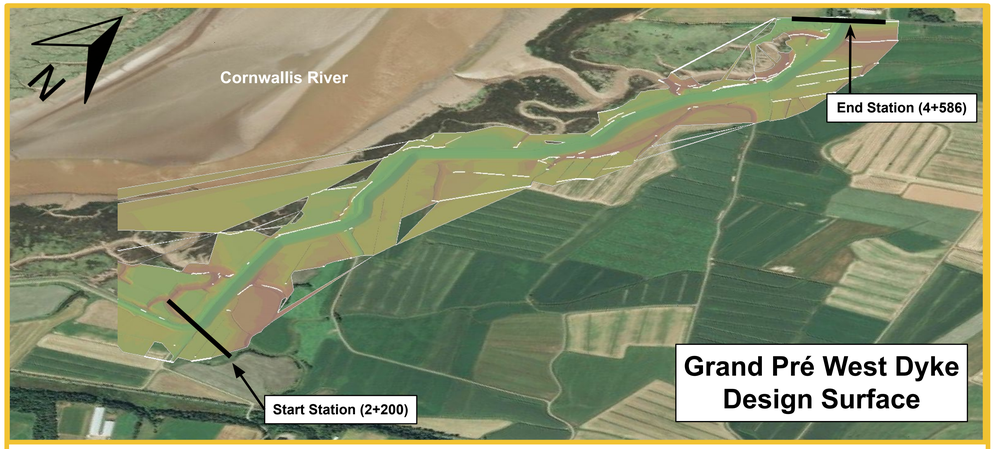
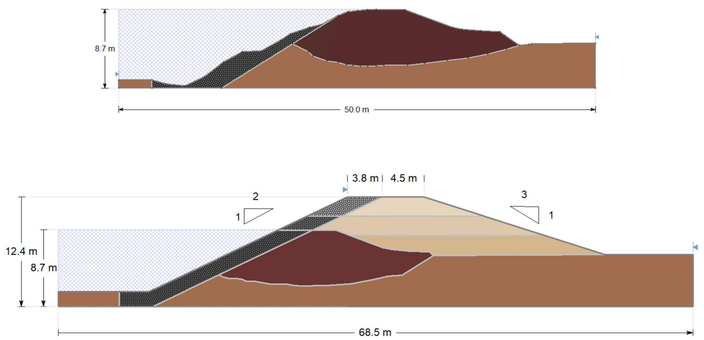
Grand Pré Western Dyke Rehabilitation

Project Overview

- The Grand Pré dyke system resides along the shores of the Southern Minas Basin in Kings County, Nova Scotia and is responsible for protecting 2745 acres of agricultural land along with various forms of public and private infrastructure.
- Existing dyke conditions have been deemed insufficient for combating the implications of climate change and sea level rise.
- A complete rehabilitation is required to ensure dyke infrastructure is capable of withstanding increased tidal range and storm severity.
- The project includes 2.4 km of dyke structures running midway between Wolfville and the west end of Long Island.







Existing Cross Section

Material Name	Color
Approved Engineered Fill Stage 3	
Approved Engineered Fill Stage 2	
Approved Engineered Fill Stage 1	
Dyke Fill	
Foundation Soil	
Riprap Stage 3	
Riprap Stage 2	
Riprap Stage 1	

Proposed Cross Section

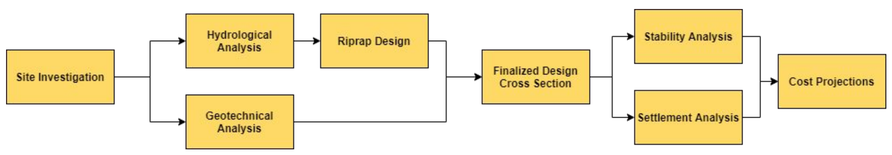
Acknowledgements

- **Dr. Craig Lake P.Eng** - Dalhousie University
- **Mr. Chris Gräpel P.Eng, Mr. Kurt Tomblin P.Eng** - Klohn Crippen Berger
- **Carl Esau, Chris Ross P.Eng, David Smith** - Nova Scotia Department of Agriculture, Land Protection Section

7. Cost Projections

Equipment/Construction	$2,894,800
Aggregate Materials	$1,335,000
Environmental Protection	$110,300
Engineering Inspection and Oversight	$150,000
SUBTOTAL	**$4,490,100**
Class D Contingency (30%)	$1,347,000
TOTAL PROJECT COST	**$5,837,000**

1. Design Process



3. Geotechnical Analysis: Soil Parameters

Soil Property	Foundation Soil	Dyke Fill
Angle of Friction, ϕ	30.7	27.4
Undrained Shear Strength, C_u (kPa)	10	25
Specific Gravity, G_s	2.70	2.70
Coefficient of Permeability, *k* (m/s)	1×10^{-8}	1×10^{-7}
Unit Weight, *y* (kN/m^3)	18.8	18.1
Moisture Content, *w* (%)	32.0	37.3
Void Ratio, *e*	0.864	1.01
Compression index, C_c	0.315-0.378	0.315-0.378
Coefficient of Consolidation, C_v (m^2/yr)	1.26	0.26

- Soil properties were correlated from a geotechnical investigation conducted by the NSDA.

6. Settlement Analysis

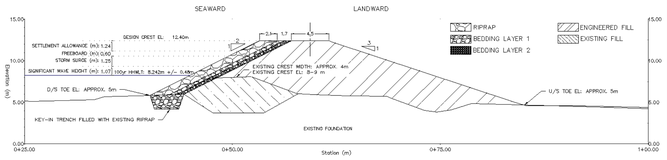
- Assuming two-way drainage and a coefficient of consolidation of 1.26 m^2/yr.
- Total settlement is estimated to be approximately 1.3 m.
- 50% of total settlement is expected to occur within the first 25 years following construction completion.

2. Hydrotechnical Review: Final Crest Height

- It is projected that tide levels in the Bay of Fundy will rise to a level of 8.242 +/- 0.45m in 100 years. This alone will result in an overtopping of the existing dyke structure. When combined with significant weather events, settlement, and freeboard, the final required crest elevation was determined to be 12.40 m.

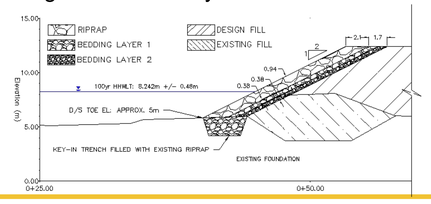
HHWLT* + Projected SLR for 100 years	8.24 ± 0.48 m
Storm Surge	1.25 m
Freeboard	0.73 m
Significant Wave Height	1.07 m
Settlement Assumption	1.16 m
Required Crest Elevation	12.45 m

*Higher high water large tide



4. Erosion Protection: Riprap

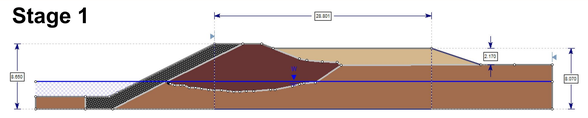
- Riprap armour will be placed on the seaward slope to protect from wave impact erosion.
- The armour will be 1.7 m thick, consisting of:
  - 2 bedding layers, each 380 mm thick, and
  - A stone layer 914 mm thick.
- Correct placement of material is critical to ensuring armour stability.



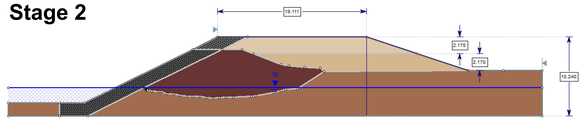
5. Slope Stability: Staged Construction

- Due to the low hydraulic conductivity of the foundation and dyke fill materials, excess pore water pressure will trigger a slope stability failure during short term immediate undrained soil conditions.
- To ensure safe construction, a 3 stage approach must be considered.
- Excess pore water pressure must be allowed time to completely dissipate between stages.

Stage 1



Stage 2



Stage 3