A Shore Thing-HCA's Shoreline Management Plan Study 2022

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Hamilton Conservation Authority

A Healthy Watershed for Everyone

Presentation Outline

- Project overview
- Shoreline Observations and Inventory
- Technical Analysis
- Hazard Mapping for Erosion, Flooding, and Dynamic Beaches
- Management Recommendations
- Questions

Project Overview

The responsibilities for regulating natural hazards associated with floodplains and coastal erosion in the Province of Ontario rests with Conservation Authorities and the Ministry of Northern Development, Mines, Natural Resources and Forestry. This mandate is outlined in the Conservation Authorities Act and Ontario Regulation 97/04 which pertain to regulation of development on hazardous lands through Ontario Regulation 161/06 for the Hamilton Region Conservation Authority.

The HCA has retained Zuzek Inc. partnered with SJL Engineering Inc. and DHI Water and Environment Inc. to undertake the Lake Ontario and Hamilton Harbour Shoreline Management Plan.

Sustainable coastal development
Integrated coastal zone management

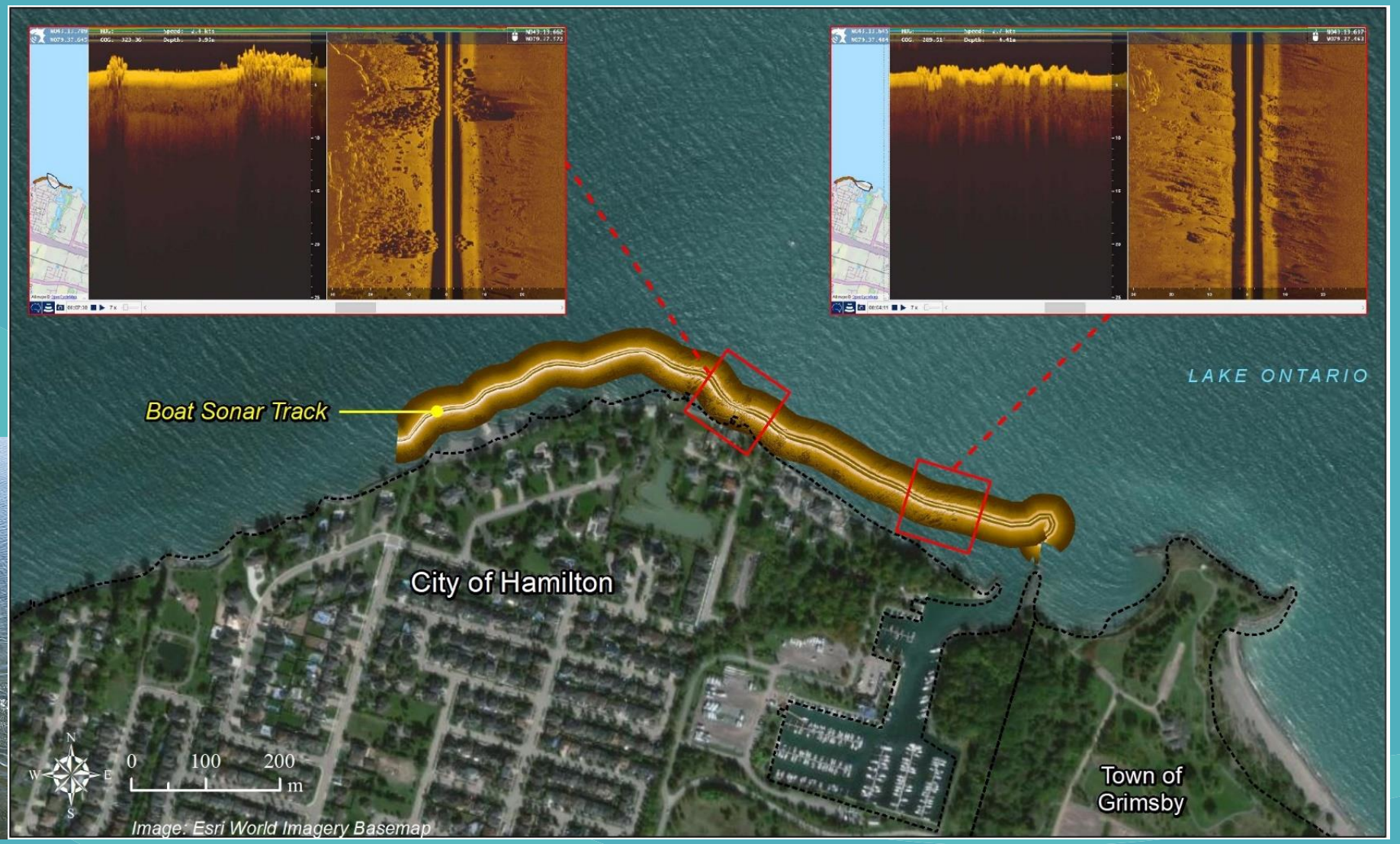
Protect new development from coastal hazards
Increase the resilience of coastal communities
Incorporate nature-based options to reduce coastal hazards

The outcomes from the shoreline management study will help with planning and permitting activities, and provide recommendations on effective approaches for shore protection

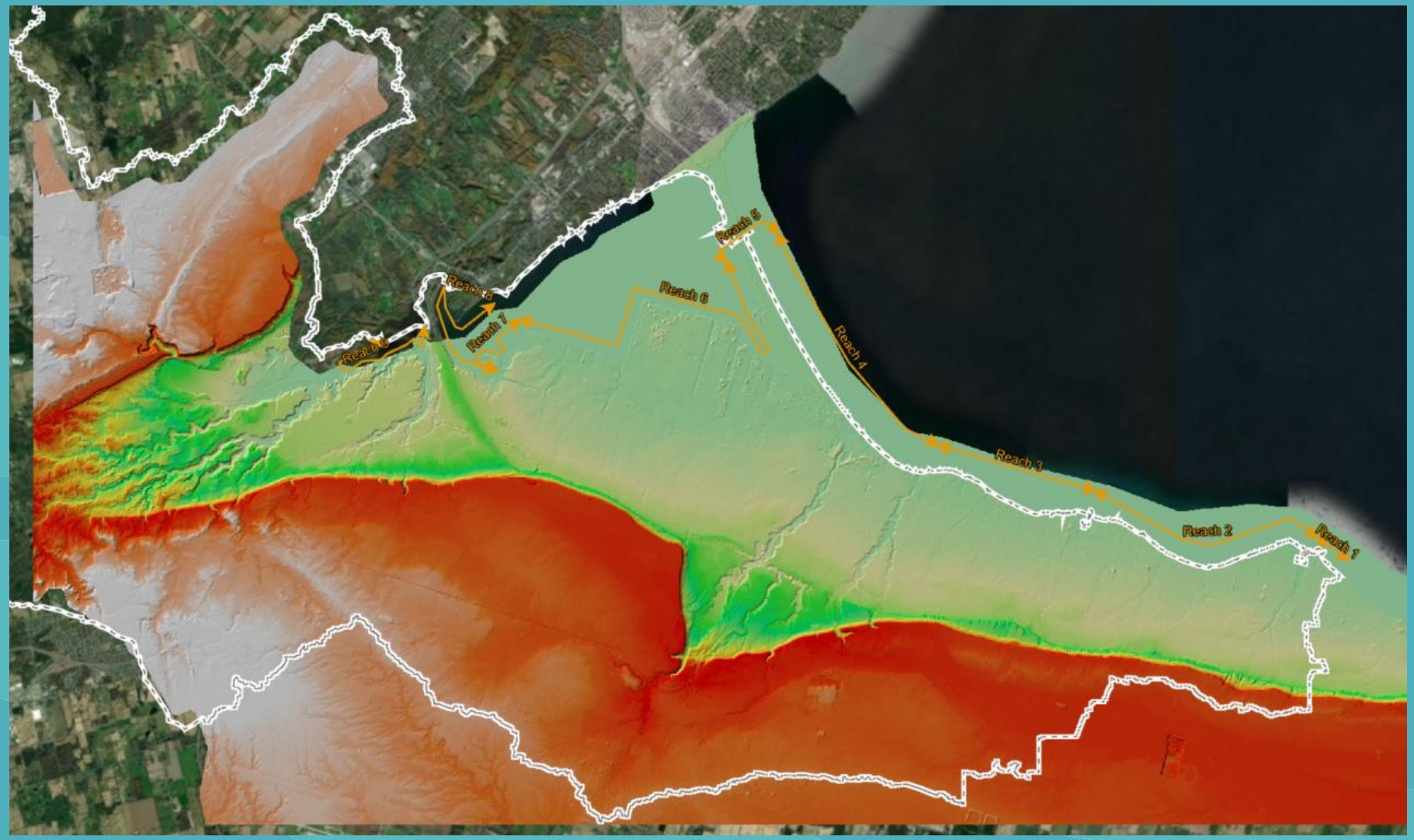
Major Components of the SMP

- Field work
- Technical analysis
- Hazard Mapping (Erosion, Flooding, Dynamic Beaches)
- Public Feedback
- Shoreline Management Plan Report

Bathymetric Survey

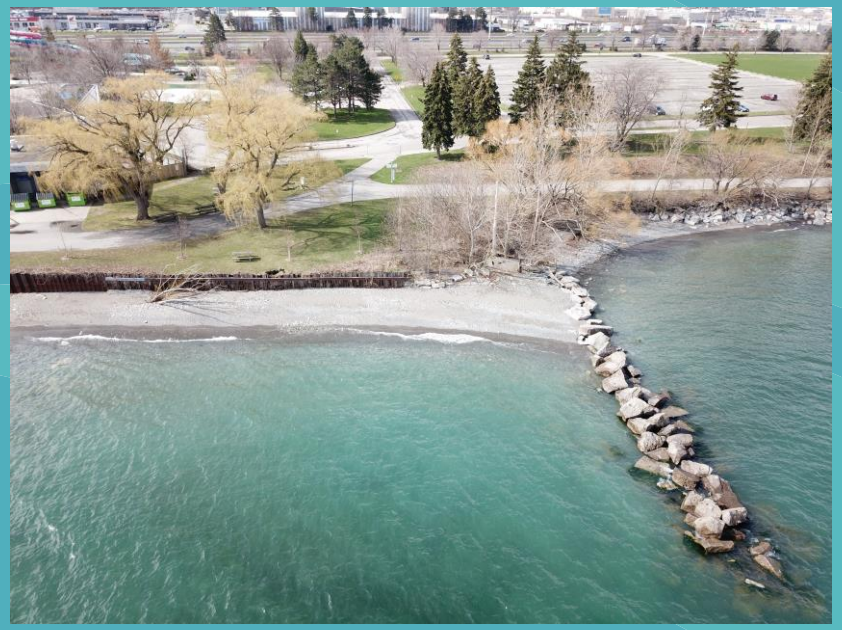
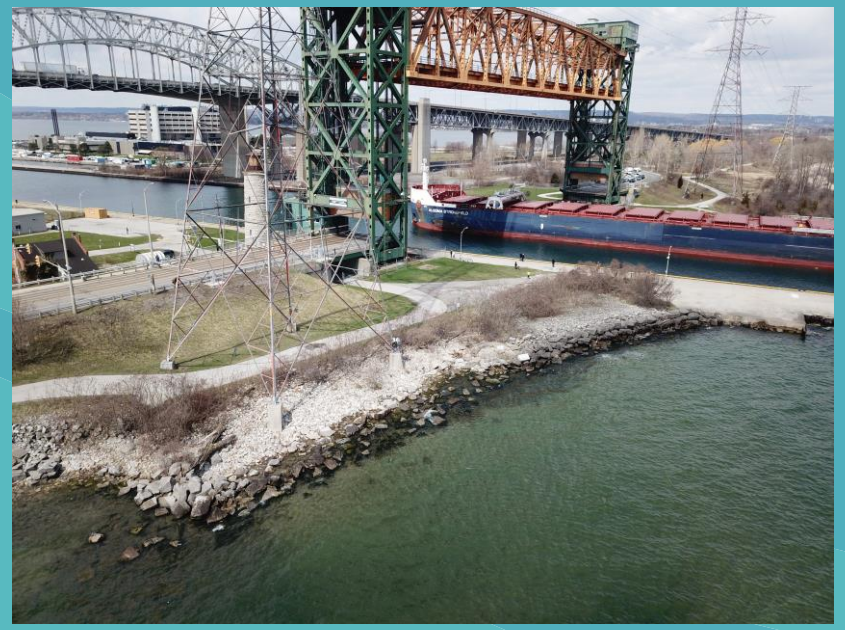


Topographic LiDAR

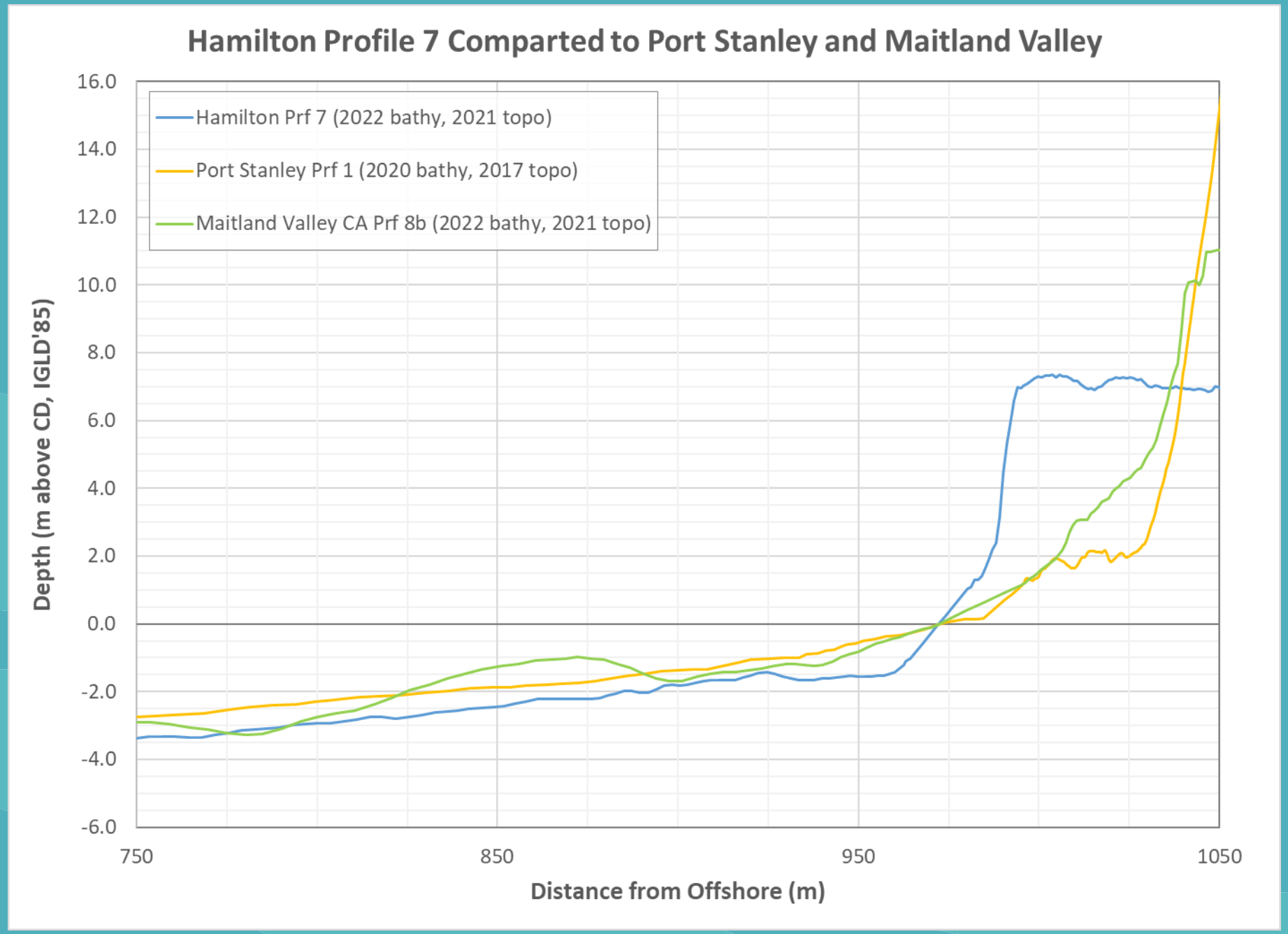


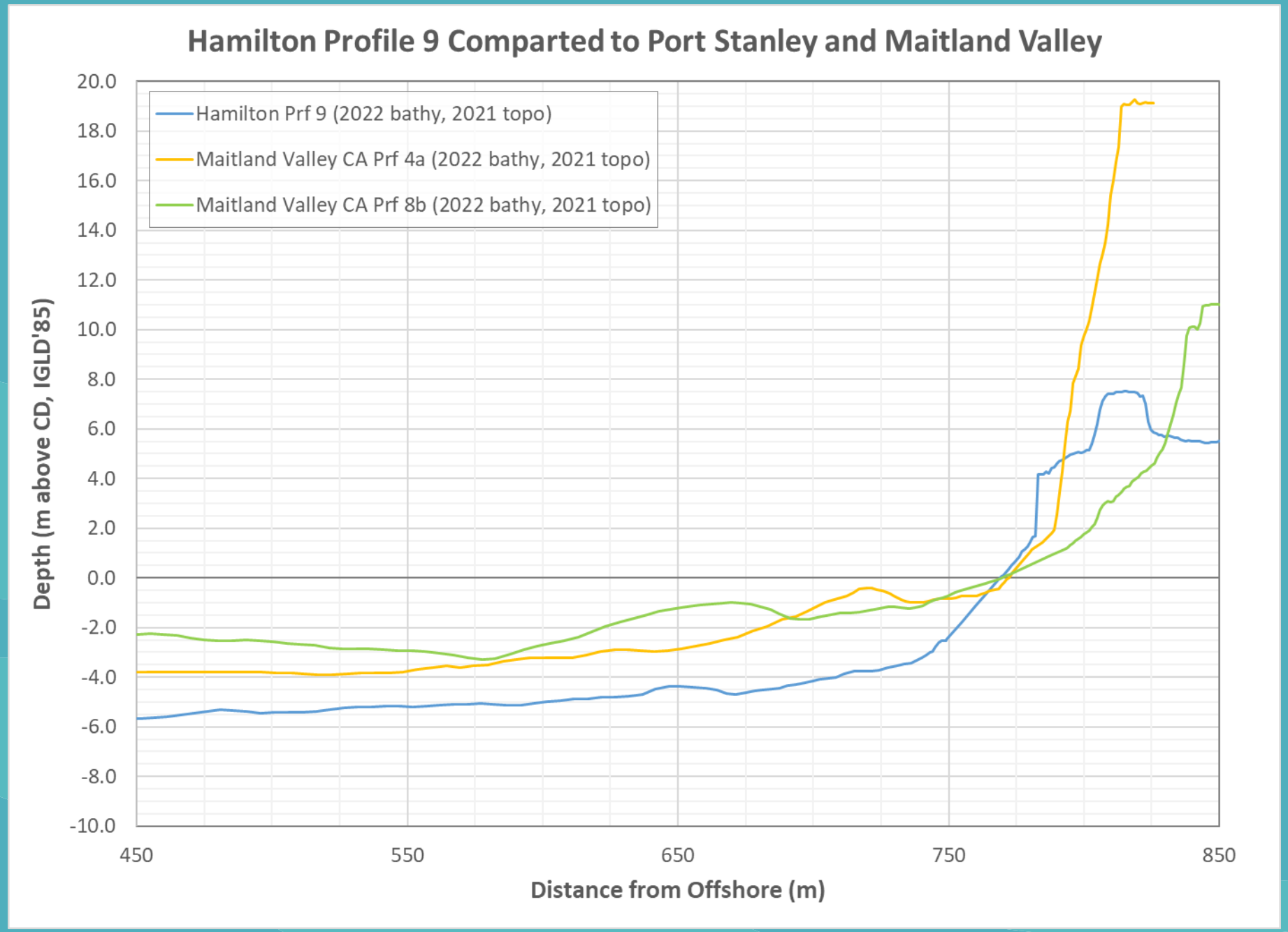
Aerial Oblique Photography




Project Reaches


Hamilton Profile 7 Comparted to Port Stanley and Maitland Valley
Hamilton Prf 7 (2022 bathy, 2021 topo)
Port Stanley Prf 1 (2020 bathy, 2017 topo)
Maitland Valley CA Prf 8b (2022 bathy, 2021 topo)
Depth (m above CD, IGLD'85)
16.0
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
-2.0
-4.0
-6.0
750
850
950
1050
Distance from Offshore (m)


Hamilton Profile 9 Comparted to Port Stanley and Maitland Valley
Hamilton Prf 9 (2022 bathy, 2021 topo)
Maitland Valley CA Prf 4a (2022 bathy, 2021 topo)
Maitland Valley CA Prf 8b (2022 bathy, 2021 topo)
Depth (m above CD, IGLD'85)
20.0
18.0
16.0
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
-2.0
-4.0
-6.0
-8.0
-10.0
450
550
650
750
850
Distance from Offshore (m)

Shoreline Protection Database

Data summarized by reach for:

- Armoured vs natural shoreline
- Structure type
- Structure condition
- Design

Project Reach	Shoreline Type	Public / Private	Significant Natural Feature	Coastal Structure	Crest Protection	Level of Design	Overall Structure Condition	Other Infrastructure
1	Natural	Private	Yes - Beach	Revetment - Stone Random Placement	Yes - Stone	Well-Engineered	Excellent	Outfall
2	Armoured	Public	Yes - Barrier Beach	Revetment - Stone Special Placement	Yes - Concrete	Moderately-Engineered	Good	Permanent Dock
3			Yes - Prominent Headland	Revetment - Concrete Blocks	Yes - Other	Ad-Hoc	Moderate	Marina
4			Yes - Wetland	Seawall - Stacked Stone		Unknown	Poor	Boat Ramp
5			Yes - Tributary	Seawall - Precast Concrete Blocks			Failed	
6			Yes - Emergent Shoal	Seawall - Cast-in-place Concrete				
7				Seawall - Steel Sheetpile				
8				Stone Bank Protection (ad-hoc)				
				Scrap Concrete Bank Protection (ad-hoc)				
				Beach - Armour Stone Beach Curb				
				Beach - Stone Bank Protection				
				Gabion Baskets				
				Wood/Timber				
				Jetty - Stone				
				Jetty - Sheetpile/Concrete				
				Groyne - Stone				
				Groyne - Sheetpile/Concrete				
				Groyne - Timber				
				Other				

Shore Protection Database

			Start Coordinates WGS 84 / Pseudo-Mercator (EPSG: 3857) Decimal Degrees (5 decimals)		End Coordinates					Lakebed ----------> Structure Crest								
ID	Project Reach	Property Address / Street / Landmark	Latitude	Longitude	Latitude	Longitude	Shoreline Length (m)	Shoreline Type	Public / Private	Significant Natural Feature?	Coastal Structure A	Coastal Structure B	Coastal Structure C	Structure Type	Crest Protection	Level of Design	Overall Structure Condition	Shore Perpendicular Structure Length (m) (if applicable)	Other Infrastructure	Notes:
661	8	Waterfront Trail	43.27937	-79.88946	43.27963	-79.88971	35	Natural	Public											
662	8	York Blvd	43.27986	-79.89002	43.28165	-79.88924	225	Natural	Public											
663	8	York Blvd	43.28165	-79.88924	43.28166	-79.89011	170	Natural	Public	Yes - Wetland										
664	8	York Blvd	43.28166	-79.89011	43.28693	-79.88934	600	Natural	Public											
665	8	York Blvd	43.28693	-79.88934	43.28938	-79.88755	310	Natural	Public	Yes - Wetland										
666	8	York Blvd	43.28938	-79.88755	43.28938	-79.88741	10	Armoured	Public		Seawall - Stacked Stone			Seawall - Stacked Stone	Yes - Other	Ad-Hoc	Moderate		Outfall	
667	8	York Blvd	43.28938	-79.88741	43.28933	-79.88707	10	Armoured	Public		Seawall - Stacked Stone			Seawall - Stacked Stone	Yes - Stone Yes - Other	Ad-Hoc	Moderate			
668	8	York Blvd	43.28933	-79.88707	43.28929	-79.88691	15	Natural	Public	Yes - Wetland										
669	8	York Blvd	43.28929	-79.88691	43.28929	-79.88684	10	Armoured	Public		Seawall - Stacked Stone			Seawall - Stacked Stone	Yes - Other	Ad-Hoc	Moderate			
670	8	Spring Gardens Rd	43.28929	-79.88684	43.28188	-79.88291	1325	Natural	Public											
671	8	Spring Gardens Rd	43.28188	-79.88291	43.28076	-79.88438	190	Natural	Public											
672	9	Desjardins Recreation Trail	43.27953	-79.89341	43.27702	-79.89369	285	Natural	Public											
673	9	Desjardins Recreation Trail	43.27702	-79.89369	43.27614	-79.89357	100	Armoured	Public		Stone Bank Protection (ad-hoc	Seawall - Stacked Stone		Composite	Yes - Concrete	Well-Engineered	Excellent			
674	9	Desjardins Recreation Trail	43.27614	-79.89357	43.27448	-79.89357	185	Natural	Public											
675	9	Desjardins Recreation Trail	43.27448	-79.89357	43.27379	-79.89347	75	Natural	Public											
676	9	Desjardins Recreation Trail	43.27379	-79.89347	43.27375	-79.89382	30	Natural	Public	Yes - Tributary										
677	9	Desjardins Recreation Trail	43.27375	-79.89382	43.27376	-79.89389	5	Armoured	Public		Other			Other		Well-Engineered	Good	85		Jetty composed of wires and stakes
678	9	Desjardins Recreation Trail	43.27376	-79.89389	43.27421	-79.89629	230	Natural	Public											
679	9	Desjardins Recreation Trail	43.27421	-79.89629	43.27425	-79.89636	5	Armoured	Public		Seawall - Stacked Stone	Seawall - Stacked Stone	Seawall - Stacked Stone	Composite	Yes - Other	Well-Engineered	Good			
680	9	Macklin St N	43.27425	-79.89636	43.27459	-79.89652	40	Natural	Public	Yes - Wetland										
681	9	Macklin St N	43.27459	-79.89652	43.27456	-79.89785	450	Natural	Public	es - Prominent Headland										
682	9	Macklin St N	43.27456	-79.89785	43.27346	-79.90013	240	Natural	Public											
683	9	Macklin St N	43.27346	-79.90013	43.27327	-79.90047	160	Natural	Public											

Shoreline Protection Database - Statistics Reach 1

Property Type		
Reach 1	Distance (m)	%
Private	25	2
Public	1265	98
Total	1290	100

Shoreline Type		
Reach 1	Distance (m)	%
Natural	605	47
Armoured	685	53
Total	1290	100

Structure Type		
Reach 1	Distance (m)	%
Revetment - Stone Random Placem	285	34
Revetment - Stone Special Placem	175	21
Revetment - Concrete Blocks	0	0
Seawall - Stacked Stone	40	5
Seawall - Precast Concrete Blocks	0	0
Seawall - Cast-in-place Concrete	0	0
Seawall - Steel Sheetpile	0	0
Stone Bank Protection (ad-hoc)	0	0
Scrap Concrete Bank Protection (a	0	0
Beach - Armour Stone Beach Curb	0	0
Beach - Stone Bank Protection	160	19
Gabion Baskets	0	0
Wood/Timber	0	0
Jetty - Stone	25	3
Jetty - Sheetpile/Concrete	0	0
Groyne - Stone	40	5
Groyne - Sheetpile/Concrete	0	0
Groyne - Timber	0	0
Other	0	0
Composite	120	14
Total	845	100

Level of Design		
Reach 1	Distance (m)	%
Well-Engineered	415	49
Moderately-Enginee	425	50
Ad-Hoc	5	1
Unknown	0	0
Total	845	100

Overall Structure Condition		
Reach 1	Distance (m)	%
Excellent	70	8
Good	535	63
Moderate	110	13
Poor	130	15
Failed	0	0
Total	845	100

Composite Structure		
Reach 1	Distance (m)	%
Revetment - Stone Random Placemer	0	0
Revetment - Stone Special Placement	0	0
Revetment - Concrete Blocks	0	0
Seawall - Stacked Stone	165	69
Seawall - Precast Concrete Blocks	0	0
Seawall - Cast-in-place Concrete	0	0
Seawall - Steel Sheetpile	0	0
Stone Bank Protection (ad-hoc)	75	31
Scrap Concrete Bank Protection (ad-h	0	0
Beach - Armour Stone Beach Curb	0	0
Beach - Stone Bank Protection	0	0
Gabion Baskets	0	0
Wood/Timber	0	0
Jetty - Stone	0	0
Jetty - Sheetpile/Concrete	0	0
Groyne - Stone	0	0
Groyne - Sheetpile/Concrete	0	0
Groyne - Timber	0	0
Other	0	0
Total	240	100

Shoreline Protection Database - Statistics Reach 2

Property Type		
Reach 2	Distance (m)	%
Private	5015	83
Public	1000	17
Total	6015	100

Shoreline Type		
Reach 2	Distance (m)	%
Natural	880	14
Armoured	5220	86
Total	6100	100

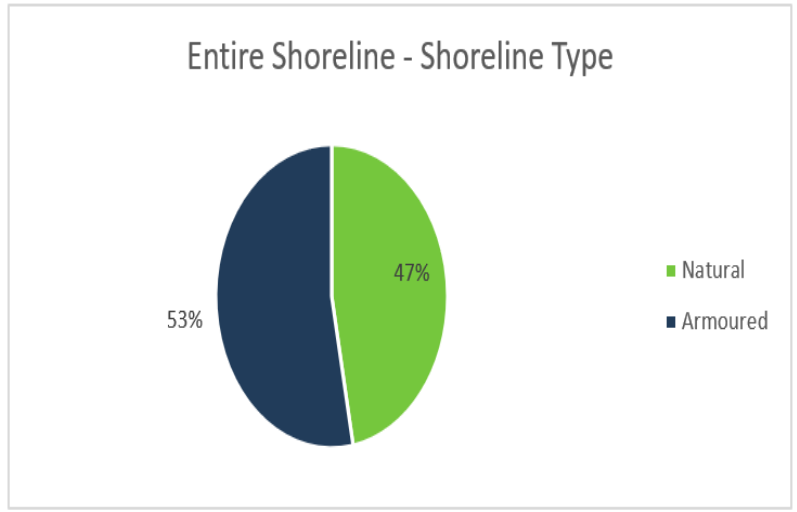
Structure Type		
Reach 2	Distance (m)	%
Revetment - Stone Random Placem	295	6
Revetment - Stone Special Placem	345	7
Revetment - Concrete Blocks	0	0
Seawall - Stacked Stone	555	10
Seawall - Precast Concrete Blocks	185	3
Seawall - Cast-in-place Concrete	180	3
Seawall - Steel Sheetpile	65	1
Stone Bank Protection (ad-hoc)	125	2
Scrap Concrete Bank Protection (a	0	0
Beach - Armour Stone Beach Curb	25	0
Beach - Stone Bank Protection	0	0
Gabion Baskets	0	0
Wood/Timber	0	0
Jetty - Stone	115	2
Jetty - Sheetpile/Concrete	10	0
Groyne - Stone	115	2
Groyne - Sheetpile/Concrete	60	1
Groyne - Timber	0	0
Other	80	2
Composite	3135	59
Total	5290	100

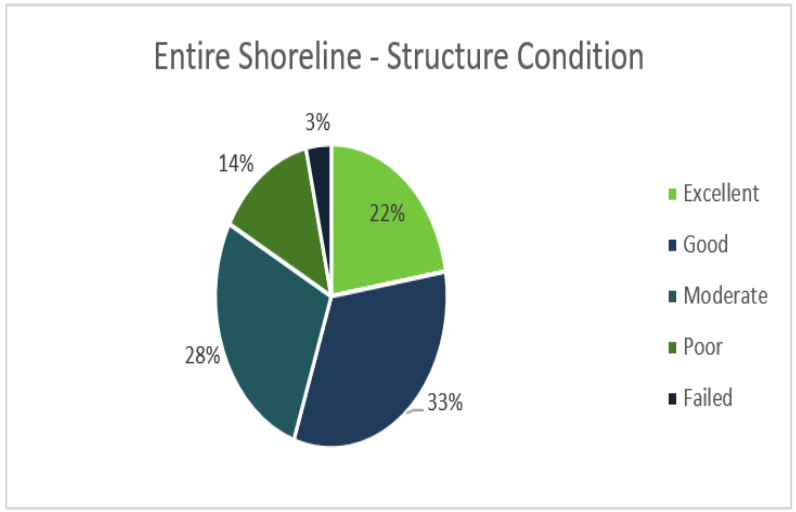
Level of Design		
Reach 2	Distance (m)	%
Well-Engineered	1585	30
Moderately-Enginee	2205	42
Ad-Hoc	1450	28
Unknown	25	0
Total	5265	100

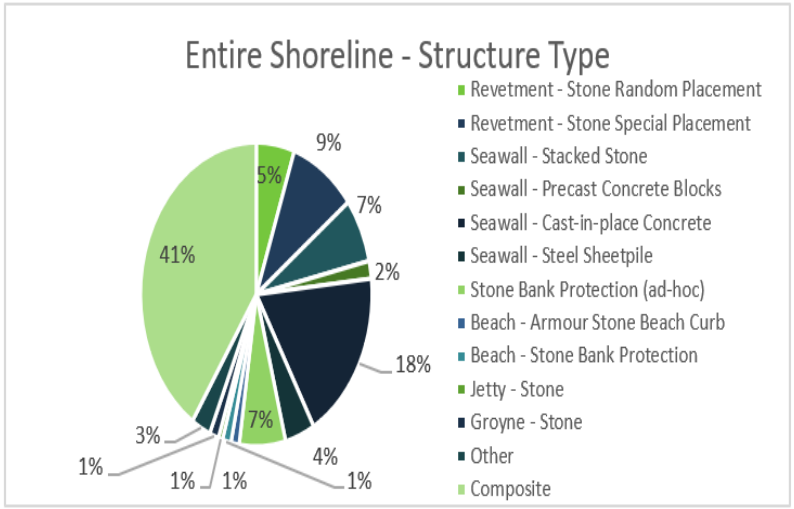
Overall Structure Condition		
Reach 2	Distance (m)	%
Excellent	1055	20
Good	1150	22
Moderate	1345	26
Poor	1340	25
Failed	375	7
Total	5265	100

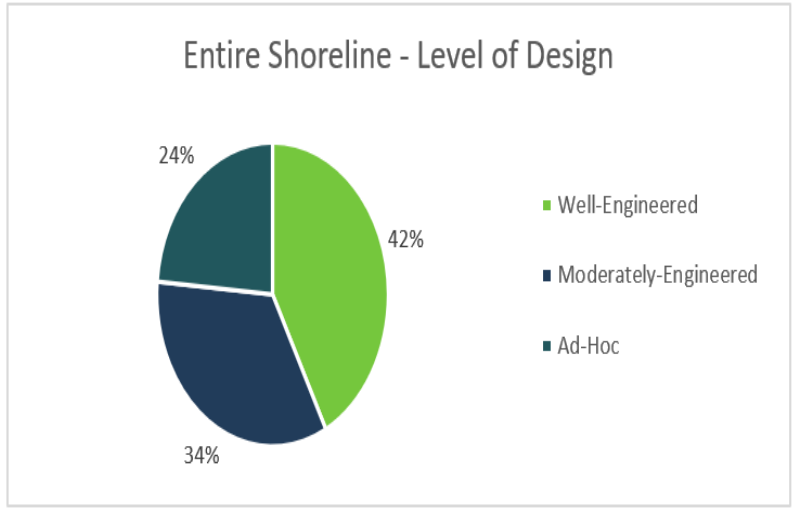
Composite Structure		
Reach 2	Distance (m)	%
Revetment - Stone Random Placemer	125	2
Revetment - Stone Special Placement	535	8
Revetment - Concrete Blocks	75	1
Seawall - Stacked Stone	1245	17
Seawall - Precast Concrete Blocks	1445	20
Seawall - Cast-in-place Concrete	1675	23
Seawall - Steel Sheetpile	670	9
Stone Bank Protection (ad-hoc)	670	9
Scrap Concrete Bank Protection (ad-h	25	0
Beach - Armour Stone Beach Curb	0	0
Beach - Stone Bank Protection	0	0
Gabion Baskets	15	0
Wood/Timber	100	1
Jetty - Stone	0	0
Jetty - Sheetpile/Concrete	0	0
Groyne - Stone	0	0
Groyne - Sheetpile/Concrete	0	0
Groyne - Timber	0	0
Other	550	8
Total	7130	100

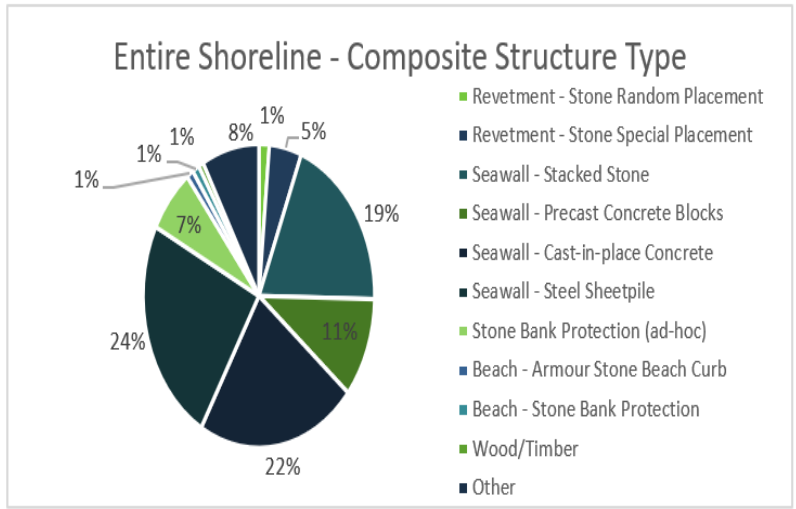
Shoreline Protection Database - Statistics
Entire Shoreline











Shoreline Protection Database - Statistics
Entire Shoreline

Property Type		
Entire Shorelin	Distance (m)	%
Private	20390	38
Public	33710	62
Total	54100	100

Shoreline Type		
Entire Shorelin	Distance (m)	%
Natural	25525	47
Armoured	28750	53
Total	54275	100

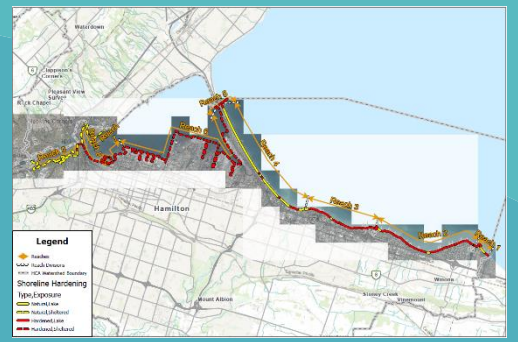
Structure Type		
Entire Shoreline	Distance (m)	%
Revetment - Stone Random Placem	1575	5
Revetment - Stone Special Placem	2740	9
Revetment - Concrete Blocks	0	0
Seawall - Stacked Stone	2020	7
Seawall - Precast Concrete Blocks	555	2
Seawall - Cast-in-place Concrete	5440	18
Seawall - Steel Sheetpile	1230	4
Stone Bank Protection (ad-hoc)	1905	6
Scrap Concrete Bank Protection (ad	0	0
Beach - Armour Stone Beach Curb	340	1
Beach - Stone Bank Protection	355	1
Gabion Baskets	0	0
Wood/Timber	15	0
Jetty - Stone	175	1
Jetty - Sheetpile/Concrete	70	0
Groyne - Stone	380	1
Groyne - Sheetpile/Concrete	110	0
Groyne - Timber	0	0
Other	800	3
Composite	12015	40
Total	29725	100

Level of Design		
Entire Shoreline	Distance (m)	%
Well-Engineered	12565	42
Moderately-Enginee	10065	34
Ad-Hoc	7010	24
Unknown	60	0
Total	29700	100

Overall Structure Condition		
Entire Shoreline	Distance (m)	%
Excellent	6650	22
Good	9760	33
Moderate	8210	28
Poor	4035	14
Failed	1045	4
Total	29700	100

Composite Structure		
Entire Shoreline	Distance (m)	%
Revetment - Stone Random Placemer	380	1
Revetment - Stone Special Placement	1185	4
Revetment - Concrete Blocks	100	0
Seawall - Stacked Stone	5085	19
Seawall - Precast Concrete Blocks	2800	11
Seawall - Cast-in-place Concrete	5850	22
Seawall - Steel Sheetpile	6350	24
Stone Bank Protection (ad-hoc)	1800	7
Scrap Concrete Bank Protection (ad-h	25	0
Beach - Armour Stone Beach Curb	255	1
Beach - Stone Bank Protection	255	1
Gabion Baskets	15	0
Wood/Timber	180	1
Jetty - Stone	0	0
Jetty - Sheetpile/Concrete	0	0
Groyne - Stone	35	0
Groyne - Sheetpile/Concrete	0	0
Groyne - Timber	20	0
Other	2100	8
Total	26435	100

Preliminary Hardening Analysis



Burlington WL Gauge Analysis

- Combined flood level is combination of static lake level & local storm surge

Static Lake Levels (1900 – 2020):

	Predicted Monthly Mean Static Lake Level - Plan2014 (m IGLD85')												
Tr	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	MAX Annual
1.5	74.29	74.27	74.35	74.61	74.73	74.78	74.77	74.68	74.55	74.43	74.32	74.29	74.78
2	74.66	74.68	74.78	74.98	75.09	75.11	75.07	75.00	74.88	74.74	74.65	74.64	75.11
5	74.90	74.94	75.02	75.24	75.36	75.36	75.30	75.20	75.05	74.89	74.82	74.82	75.36
10	75.03	75.07	75.14	75.38	75.50	75.50	75.43	75.30	75.12	74.96	74.89	74.91	75.50
20	75.13	75.17	75.23	75.49	75.61	75.62	75.55	75.39	75.18	75.01	74.94	74.97	75.62
25	75.16	75.20	75.26	75.52	75.65	75.65	75.58	75.41	75.20	75.03	74.96	74.99	75.65
50	75.24	75.28	75.33	75.61	75.74	75.75	75.67	75.48	75.24	75.07	75.00	75.04	75.75
100	75.31	75.36	75.40	75.70	75.83	75.84	75.76	75.54	75.28	75.10	75.04	75.08	75.84
200	75.38	75.42	75.45	75.77	75.91	75.93	75.84	75.59	75.31	75.13	75.07	75.12	75.93
MAX Obs.	75.25	75.30	75.34	75.62	75.80	75.89	75.78	75.52	75.23	75.25	75.18	75.22	75.89
Distribution	Weibull	Weibull	Weibull	Weibull	Weibull	Weibull	Weibull	Weibull	Weibull	Weibull	Weibull	Weibull	
Corr. Coefficient	0.974	0.986	0.992	0.990	0.991	0.989	0.985	0.984	0.993	0.980	0.985	0.979	

Burlington WL Gauge Analysis

Local Storm Surge (1971 – 2020):

	Predicted Monthly Storm Surge Magnitude - Burlington (m)												
(years)	Jan (Dec-Feb)	Feb (Jan-Mar)	Mar (Feb-Apr)	Apr (Mar-May)	May (Apr-Jun)	Jun (May-Jul)	Jul (Jun-Aug)	Aug (Jul-Sep)	Sep (Aug-Oct)	Oct (Sep-Nov)	Nov (Oct-Dec)	Dec (Nov-Jan)	Max Annual
1.5	0.25	0.25	0.24	0.21	0.15	0.10	0.09	0.10	0.12	0.16	0.20	0.23	0.25
2	0.28	0.27	0.26	0.23	0.17	0.11	0.10	0.11	0.14	0.17	0.22	0.26	0.28
5	0.35	0.33	0.31	0.28	0.23	0.15	0.14	0.15	0.18	0.21	0.29	0.34	0.35
10	0.41	0.37	0.36	0.33	0.29	0.19	0.18	0.19	0.21	0.24	0.35	0.39	0.41
20	0.47	0.42	0.43	0.39	0.36	0.24	0.23	0.24	0.24	0.27	0.42	0.45	0.47
25	0.49	0.44	0.46	0.42	0.38	0.26	0.25	0.26	0.24	0.28	0.44	0.47	0.49
50	0.56	0.49	0.55	0.51	0.49	0.33	0.32	0.33	0.27	0.30	0.52	0.52	0.56
100	0.62	0.54	0.68	0.62	0.62	0.43	0.41	0.43	0.30	0.33	0.60	0.58	0.68
200	0.69	0.59	0.85	0.78	0.80	0.55	0.53	0.55	0.32	0.35	0.68	0.63	0.85
MAX Obs.	0.42	0.53	0.40	0.75	0.29	0.25	0.56	0.18	0.23	0.28	0.30	0.60	0.75
Distribution	Pareto (MoM)	Weibull	FTII (Frechet)	FTII (Frechet)	FTII (Frechet)	FTII (Frechet)	FTII (Frechet)	FTII (Frechet)	Pareto (MoM)	Pareto (MoM)	Weibull	Weibull	
Corr. Coefficient	0.992	0.993	0.997	0.985	0.990	0.971	0.955	0.969	0.992	0.992	0.995	0.989	

Burlington WL Gauge Analysis

- Assessing 100-year combined flood level requires Joint Probability Analysis (JPA):

	Predicted Joint Probability Flood Levels - Burlington (m IGLD85')												
(years)	Jan (Dec-Feb)	Feb (Jan-Mar)	Mar (Feb-Apr)	Apr (Mar-May)	May (Apr-Jun)	Jun (May-Jul)	Jul (Jun-Aug)	Aug (Jul-Sep)	Sep (Aug-Oct)	Oct (Sep-Nov)	Nov (Oct-Dec)	Dec (Nov-Jan)	Max Annual
1.1	74.54	74.53	74.60	74.83	74.88	74.87	74.85	74.77	74.68	74.58	74.52	74.52	74.88
2	74.94	74.94	75.03	75.21	75.27	75.21	75.16	75.09	75.01	74.89	74.88	74.89	75.27
5	75.20	75.21	75.29	75.48	75.55	75.48	75.41	75.30	75.18	75.06	75.05	75.09	75.55
10	75.34	75.35	75.43	75.63	75.71	75.62	75.55	75.42	75.26	75.14	75.14	75.19	75.71
20	75.45	75.46	75.54	75.76	75.83	75.76	75.67	75.53	75.33	75.20	75.22	75.28	75.83
25	75.48	75.50	75.57	75.80	75.88	75.80	75.71	75.56	75.35	75.22	75.25	75.30	75.88
50	75.58	75.59	75.67	75.92	76.01	75.92	75.83	75.65	75.41	75.27	75.32	75.37	76.01
100	75.68	75.69	75.79	76.05	76.15	76.04	75.94	75.75	75.46	75.32	75.40	75.45	76.15
200	75.79	75.79	75.97	76.22	76.33	76.17	76.07	75.88	75.51	75.37	75.52	75.53	76.33
MAX Obs.	75.47	75.51	75.55	75.83	76.07	76.03	75.98	75.74	75.46	75.32	75.19	75.37	76.07

- Same result at Port Weller (+76.15 m IGLD85')

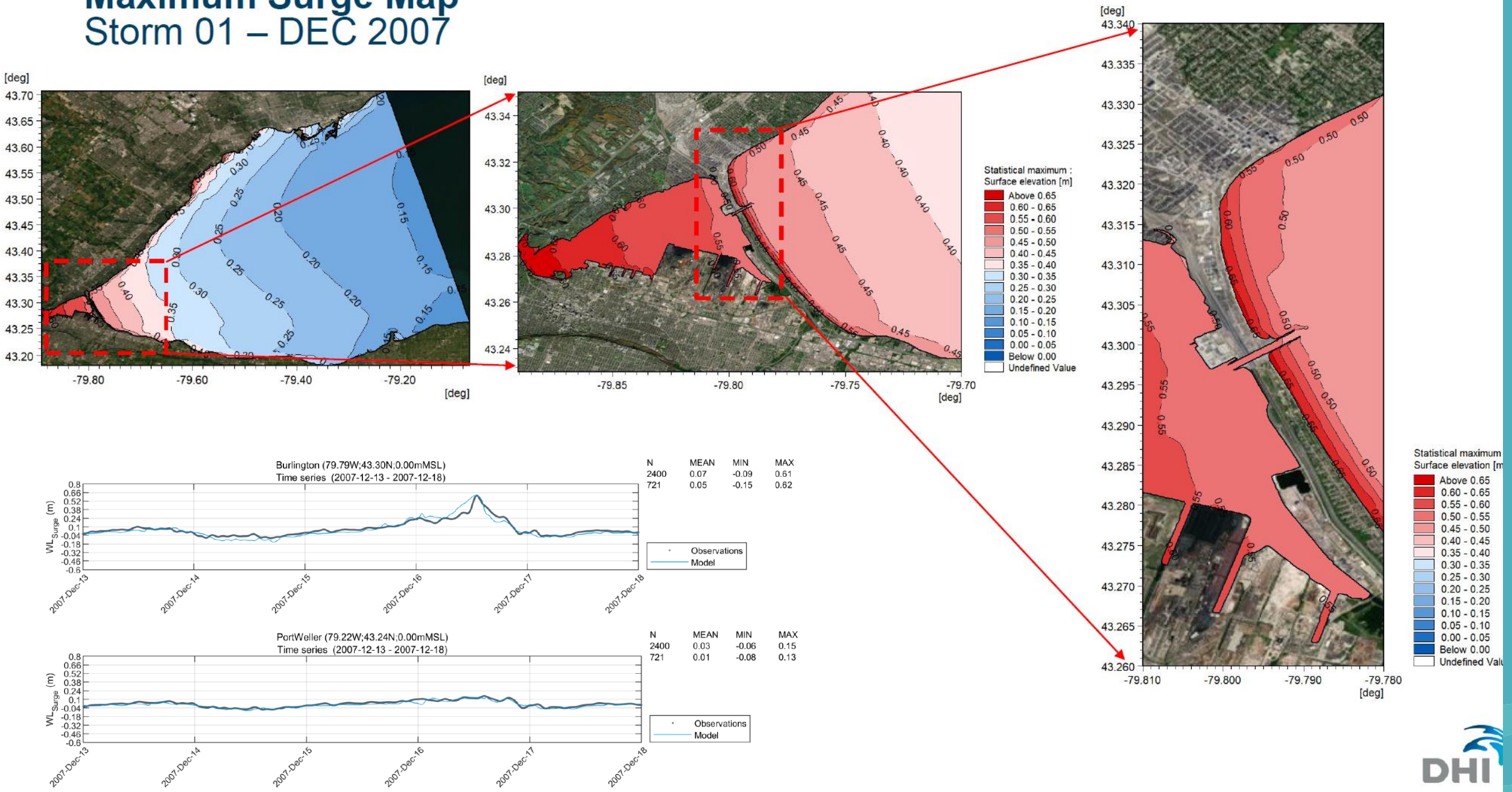
Storm Surge Modelling

- Storm surge modelling completed to determine if surge component is different for other parts of the Hamilton CA shoreline:

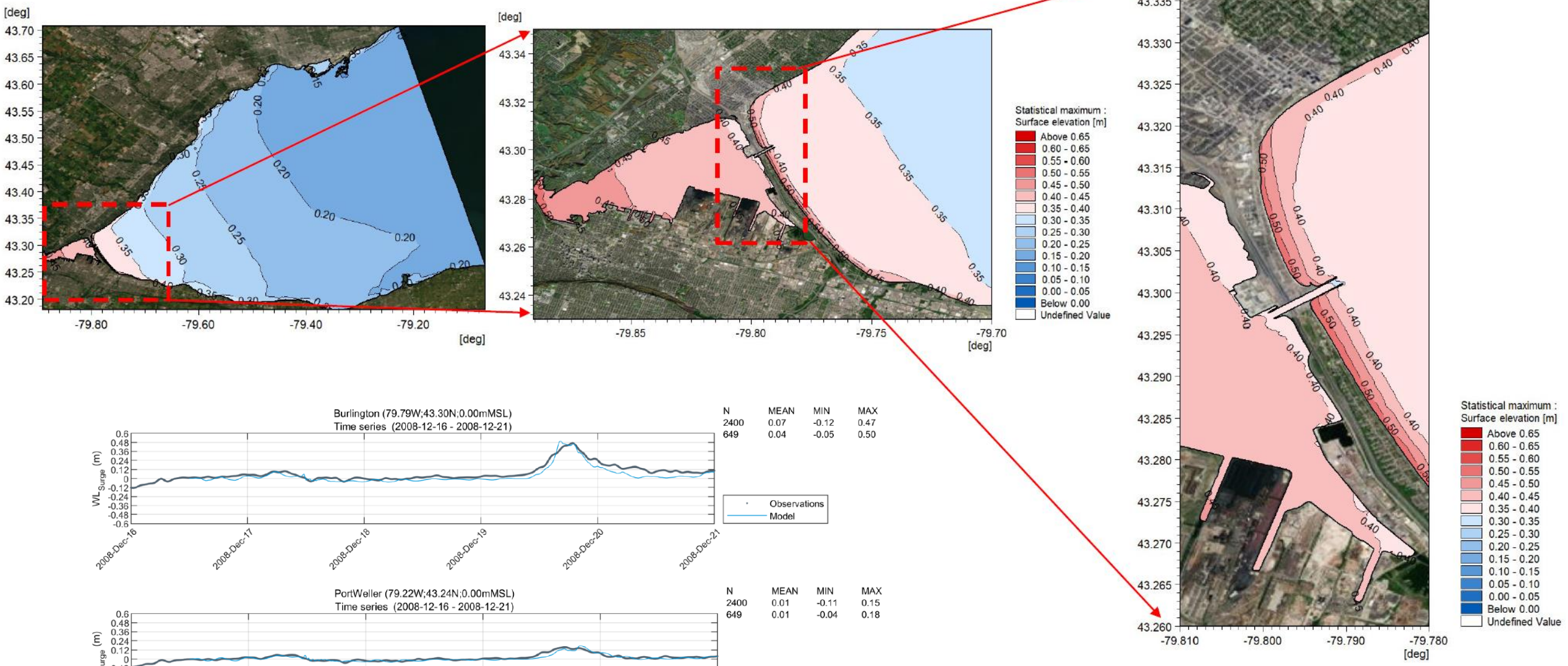
Storm Selection

Storm	Date	Water Level		Surge Residual		Wind Direction at Peak (degrees)	Sustained Wind Speed at Peak km/h	Note
		(m IGLD85')	Approx. RTP (yr)	(m)	Approx. RTP (yr)			
1	**December** 16th, 2007	74.93	~1-yr	**0.60**	~75-yr	70	40	Second largest surge event and largest within CFSR record
2	**February** 13th 2007	75.51	~5-yr	**0.53**	~50-yr	80	48	Third highest total water level, and highest total water level within CFSR record
3	**April** 15th, 2018	75.44	~3-yr	**0.39**	~7.5-yr	60	67	Fifth highest total water level
4	**December** 19th, 2008	75.01	~1.5-yr	**0.44**	~15-yr	80	67	Fifth largest storm surge event
5	**April** 30th 1984	75.91	~ 100-yr	**0.65**	~ 75-yr	250	70	High surge plus high lake level

Maximum Surge Map
Storm 01 – DEC 2007



Maximum Surge Map
Storm 04 – DEC 2008



Hazard Mapping for Erosion, Flooding & Dynamic Beaches

Shoreline hazards are defined in the Conservation Authorities Act & MNRF Technical Guide (2001)

Erosion hazard

- Erosion hazard is defined as “the predicted long term stable slope projected form the existing stable toe of the slope or from the predicted location of the toe of the slope as that location may have shifted as a result of shoreline erosion over a 100-year period.”

Hazard Mapping for Erosion, Flooding & Dynamic Beaches

- Flooding hazard

  Flooding hazard is defined as “the 100-year flood level plus an appropriate allowance for wave uprush (and other water related hazards)”

- Dynamic Beach hazard

  “Where a dynamic beach is associated with the waterfront lands, the appropriate allowance inland to accommodate dynamic beach movement”

Management Recommendations

- Shore Protection Guidance
- Guidance for shoreline protection structure

Questions?

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Thank You

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A Healthy Watershed for Everyone