W.F. Baird & Associates Coastal Engineers Ltd.

Office | 1267 Cornwall Road, Suite 100, Oakville, Ontario L6J 7T5, Canada
Phone | +1 905 845 5385 Email | oakville@baird.com

Memorandum

Reference # 13267.201

Status: Final

September 18, 2020

Attention:	**Hamilton Conservation Authority**
CC:	34 West Avenue North (Hamilton) Inc.
From:	W.F. Baird & Associates Coastal Engineers Ltd.

RE: LiUNA Gardens Shore Protection – Design Brief

Introduction

The site is located on the shore of Lake Ontario at 526 Winona Road, Hamilton. The shoreline frontage is approximately 230 m, extending from Winona Road to East Street. The existing shoreline protection consists of a stacked concrete block seawall.

Basis of Design

Design life: 50 years, provided that the structure is properly maintained throughout the design life.

Maintenance access: 6 m wide behind the structure crest and to the shoreline from municipal road.

Downcutting: The total estimated profile recession at the end of the design life (after 50 years) is 15 m at an average rate of 0.3 m/year. The average nearshore profile slope is 1:35 to 1:40 (based on nearshore bathymetric survey completed by Monteith & Southerland Ltd. on July 7, 2020). The existing lakebed elevation in front of the concrete seawall is 73.8 m IGLD85 at the middle section (deepest). The estimated increase in water depth due to nearshore lakebed erosion is approximately 0.4 m at the toe of the shore protection structure (based on shifting MNR profile O-020-030 at Winona Rd by 15 m, which corresponds to a shift of 15 m of a 1:37 uniform slope profile).

Water Levels

- 10 year return period monthly average lake level = 75.5 m IGLD85
- 100 year return period peak instantaneous water level = 76.4 m IGLD85.

Waves at the structure toe (accounting for downcutting):

AEP	Return Period	Hm0 [m]	Lower Estimate	Upper Estimate
1e+02%	1	1.53	1.52	1.54
50%	2	1.61	1.58	1.64
20%	5	1.70	1.66	1.74
10%	10	1.77	1.71	1.82
4%	25	1.86	1.78	1.93
2%	50	1.92	1.82	2.02
1%	100	1.98	1.86	2.10
0.5%	200	2.04	1.90	2.19
0.4%	250	2.06	1.91	2.22
0.2%	500	2.13	1.94	2.31

Design limit states:

- Serviceability limit state (negligible damage to armour): 10 year return period monthly average lake level (75.5 m IGLD85) combined with 2 year return period wave conditions (H_{m0} = 1.61 m).
- Design limit state (tolerable damage to armour): 100 year return period instantaneous lake level (76.4 m IGLD85) combined with 100 year return period wave conditions (H_{m0} = 1.98 m).

Tolerable wave overtopping:

- Mean overtopping discharge q_1 < 1.0 l/s/m and maximum overtopping volume V_{max} < 600 l/m, for the Serviceability Limit State.
- Mean overtopping discharge q_{100} < 5.0 l/s/m and maximum overtopping volume V_{max} < 3000 l/m, for the Design Limit State.

Design Development

Stone Gradation

Heavy gradings: Armour (Class A) placed on a slope 1.8(h):1(v) is designed to develop tolerable damage (Damage parameter S_d < 2) under design limit state. Toe stones (Class A+) are selected large armour stones forming a toe berm to limit slippage (flattening) of armoured slope. Class S stones are required at the east end transition, as shown on the Drawings.

Class	Class Designation	Grading limits (kg)				Mem (kg)	
		ELL	NLL	NUL	EUL	Lower Limit	Upper Limit
S	Selected with high blockiness (> 75%)	4000	4200	8000	9000	4200	8000
A+	Toe Stone (5 t Min)	5000	5000	6000	8500	5000	6000
A	Armour (2.6-5.7) t	1800	2600	5700	8300	3800	4600

Light gradings: Designed to be geometrically retained under the heavy grading stones.

Class	Class Designation	Grading limits (kg)				Mem (kg)	
		ELL	NLL	NUL	EUL	Lower Limit	Upper Limit
B	Riprap (100–250) kg	50	100	250	300	150	200

Coarse gradings: Class C is required as a foundation for geotextile filter fabric. Class D is required as a bedding for concrete blocks.

Class	Class Designation	Grading limits (kg)			
		0 – 15 %	40 – 55 %	70 – 90 %	100 %
C	Riprap R50	2.5	25	50	75

Class	Class Designation	Grading limits (mm)				Sieve size below which no more than 50% of total mass is permitted (mm)
		0 – 2 %	0 – 15 %	90 – 100 %	100%	
D	Clear Stone 53 mm	0.075	19	53	63	26.5

Toe Elevation and Design

Downcutting estimate at the location of the structure toe = 0.4 m.

Estimated future profile elevation at the structure toe = 73.8 m IGLD85 (existing elevation) – 0.4 m = 73.4 m IGLD85.

Native profile material will be excavated and replaced with stones down to elevation 73.1 m IGLD85, allowing for additional downcutting.

The final toe design includes a double layer of horizontally-placed armour stones (Class A+, 5 tonne min) forming a 3.6 m wide toe berm at the base, placed above riprap that extends down to elevation 73.1 m IGLD85. This toe detail provides section stability and is sufficiently deep to account for future downcutting.

Crest Elevation

A crest elevation of 79 m IGLD85 is selected to meet the wave overtopping criteria and to allow for surface drainage of stormwater.

Structure Maintenance

- Toe protection: As the beach profile erodes, it is anticipated that the toe stones may be exposed towards the end of the structure's design life. Should toe stones be exposed earlier due to unforeseen accelerated lakebed erosion, Class B stones should be added lakeward of the toe stones to add protection to the structure toe.
- Damage to armour layer: The armour layer may develop tolerable damage (intermediate damage with damage parameter $S_d < 4$) during the second half of the design life due to repeated wave exposure. In case intermediate damage cannot be tolerated, additional armour stones could be added to the eroded areas on the armoured slope.
- Drainage notches: Blocked drainage notches (due to accumulation of debris) should be cleaned as needed regularly. Concrete crack should be filled as needed with mortar cement.

- Wave overtopping: Minor damage to soft landscaping areas and utilities behind the wall may be developed during the design life of the structure. Maintenance to these utilities and/or landscaping features should be done as needed.