SLOPE STABILITY REVIEW
DRAKE DEVONSHIRE HOTEL ADDITION

June 10, 2021

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1 Background

Jewell Engineering Inc. (Jewell) was retained by Drake Hotel Properties (Drake) to assist with the site plan application to merge the properties at 20 and 24 Wharf Street in Wellington, Ontario (Figure 1). The Drake intends to expand their hotel capacity by constructing a building addition. As part of the planning approval submission, Prince Edward County has requested a slope stability analysis be completed for the property currently known as 20 Wharf Street.

Figure 1-1: Project Location

Slope stability is a component of the Erosion Hazard as defined by Section 3.1 of the Provincial Policy Statement, 2020.

1.1 Current Conditions

The Drake and the adjacent structure are situated on the north shore of Lake Ontario, south of Wellington Main Street. Jewell completed a topographic survey of the slope from the existing structure at 20 Wharf Street to the water's edge (Appendix B).

The slope is comprised of the upper table land, a gabion basket retaining wall, and the rocky beach. It is vegetated with a maintained lawn and shows no signs of surface erosion or instability. The gabion stone wall is approximately 1m high and positioned approximately 15m from the dwelling. The Wharf Street municipal sewage pumping station is also situated behind the retaining wall. The wall is in good repair with no sign of degradation (see photos in Appendix C). The level of Lake Ontario was approximately 74.7m when the site was surveyed in June 2021. This is below the annual high water level of 75.07m normally experienced during spring peaks in late May or early June (IJC, 2021). The toe of the gabion retaining wall is generally above the 76.0m contour and would not be subject to frequent wetting from wave action (see Appendix B).

The shoreline is exposed to waves from the south; however, it is well-protected by cobble- to boulder-sized material. The rock material provides protection for the slope and gabion basket retaining wall. West of the retaining wall, Lane Creek empties into Lake Ontario just west of the Drake. This area experiences accretion from Lake Ontario which indicates deposition is more likely than erosion along the shoreline.

1.2 Erosion Hazard

The Erosion Hazard Limit is the area of the shoreline that is susceptible to erosion over a 100-Yr period and consists of the *stable slope allowance* and the *erosion allowance*. The stable slope is determined by extending a 3:1 line from the toe of the bank inland until it reaches the ground surface. The erosion allowance is the distance that erosion may progress inland within 100 years. Figure 1-2 shows a graphic published in the technical guidelines that illustrates the Erosion Hazard that may be assumed in regions of Lake Ontario where there are not good records of the shoreline recession rate. The 30m allowance shown on Figure 1-2 is based on a conservative allowance of 0.3m/yr recession rate over 100 years.

Given that the shoreline is not eroding along this reach, Jewell reviewed several shoreline studies in consideration of a closer estimate of the shoreline movement.

Figure 4.16: Erosion Hazard Limit: Stable Slope Allowance plus 30 metre Erosion Allowance

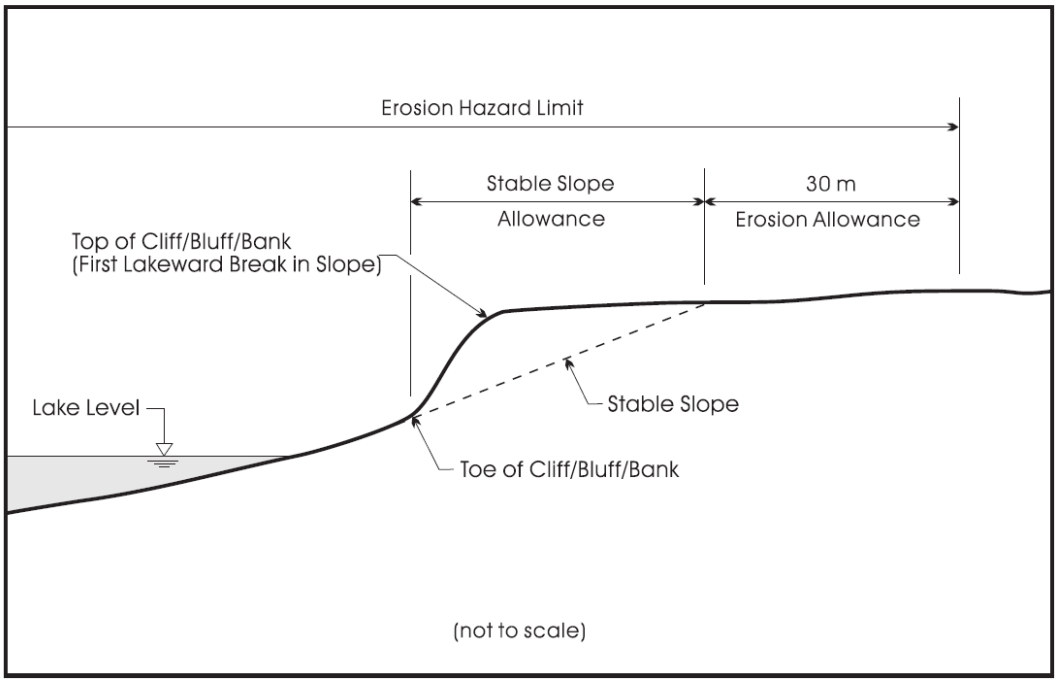

Figure 1-2: Erosion Hazard Limit (MNR Technical Guidance, 2002)

2 Erosion Hazard Limit

The position of the erosion hazard limit was established for each of the three profiles as a sum of the stable slope allowance and the erosion allowance. The erosion hazard limit has been depicted on the drawing in Appendix B. Sections 2.1 and 2.2 describe how the erosion hazard limit was estimated.

2.1 Stable Slope Allowance

Jewell reviewed the slope at three discrete cross sections shown in Appendix B using MNR's Slope Stability Rating System (2002). The rating system scores different characteristics of the slope and determines its level of stability. A completed field inspection form is included within Appendix A. A total score of 17 was assigned as per the detailed discussion below.

Slope Inclination and Height

A maximum slope inclination of 15% was recorded in the middle cross section with a height of 3.00 m. A score of 0 was assigned for the slope inclination and a score of 2 was assigned for the slope height.

Soil Stratigraphy

Geotechnical data was not available during the production of this analysis. The soil appears to be a sandy silt. Due to the uncertainty of the soils, a rating of 9 was applied.

Seepage from Slope Face

There are no watercourses along the face of the slope, thus no seepage was observed. Lake Ontario is located at the toe of slope. A rating of 0 was applied for slope seepage.

Vegetation and Cover on Slope Face

The slope is mostly grass with some weeds, and no trees or shrubs can be seen in the immediate area. It was noticed during the inspection that there are several mature trees located on the slope in close proximity to the site. A rating of 4 was applied to the slope for this category.

Tableland Drainage

The inspection of the slope revealed no active erosion or gullies present. The site has a small portion of overland drainage towards Lake Ontario. The small discharge over the studied slope

is not expected to encourage the activation of erosional processes. A score of 2 was selected for tableland drainage.

Previous Landslide Activity

The studied slope does not have any history of landslides and there are no signs of previous landslides. Future landslide events are not expected. A score of 0 was applied.

2.2 Erosion Allowance

In a report prepared by the Department of Fisheries and Oceans, entitled *Great Lakes Erosion Monitoring Programme 1973-1980* (1981 - Unpublished), we found the Wellington shoreline (Reach 140) was characterized as a Group 1 beach that was typically shallow-sloped and relatively stable in the long term. Seasonally, the beach may experience general loss of material in the winter months and regain material in the summer months. Reach 140 was found to have an overall annual accumulation rate of 0.2-1.0 cm/year (p. 119).

In the same document, the erosion rate of the bluff between Port Hope and Prince Edward County was measured to be 0.1m/yr. To be very conservative, Jewell used an erosion rate of 0.1m/year for the shoreline in front of the Drake, which results in a 100-yr erosion allowance of 10m.

3 Discussion

The rating system used above yields a slope instability rating of 17. As per the MNR slope instability rating system, a slope with a value of less than 24 is considered to have low potential to erode. A slope stability analysis for Low Potential slopes may be completed with a site inspection. No borehole investigation or slope stability analysis is required (Table 4.2, MNR Technical Guidance, 2002).

Based on the Guidance, the rate of erosion for a stable, well-supported slope (low risk of erosion) is approximately 0.15m/Yr (Table 4.4, MNR Technical Guidance, 2002). However, that rate is more appropriately applied to bluffs and does not reflect the shoreline behind the Drake that is generally very stable. Jewell instead has applied a conservative erosion allowance of 0.1m/yr for a 100-yr allowance of 10m.

The proposed building will be located further inland than the existing dwelling and beyond the erosion hazard limit.

4 Conclusion

The position of the Erosion Hazard was identified following established protocols from MNR Technical Guidelines. The slope in front of the proposed addition was determined to have low potential for instability and the shoreline is generally stable. A conservative 100-yr erosion allowance of 10m was applied.

For each of the three profiles studied by Jewell, the erosion hazard is illustrated in Appendix B and the proposed building will be outside of the erosion hazard limit. Thus, the development is consistent with the policy direction given for Natural Hazards (Erosion Hazard) by the Provincial Policy Statement.

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DRAKE MIDTOWN AND WHARF ST SITE PLANS 210-4911\SLOPE ANALYSIS\DRAKE SLOPE STABILITY REVIEW 2021 JUNE 10.DOCX

5 References

- Boyd, G.L. (1981 – Unpublished Manuscript). *Great Lakes Erosion Monitoring Programme 1973-1980 Final Report.* Federal Science Libraries Network.
- IJC Lake Ontario-St. Lawrence River Board (2021, June 9). *Water Levels.* https://ijc.org/en/loslrb/watershed/water-levels.
- Ministry of Municipal Affairs and Housing (2020). *Provincial Policy Statement, 2020: Under the Planning Act*. Queen's Printer for Ontario.
- Trent University Watershed Science Centre, MNR (2002). *Great Lakes – St. Lawrence River System and Large Inland Lakes: Technical Guides for Flooding, Erosion and Dynamic Beaches in Support of Natural Hazards Policies 3.1 of the Provincial Policy Statement (1997) of the Planning Act.* The Queen's Printer for Ontario.

APPENDIX A
SLOPE STABILITY RATING CHART

Table 4.2 Slope Stability Rating Chart

Site Location: 20 WHARF ST. WELLINGTON, ON — File No.

Property Owner: DRAKE HOTEL PROPERTIES — Inspection Date:

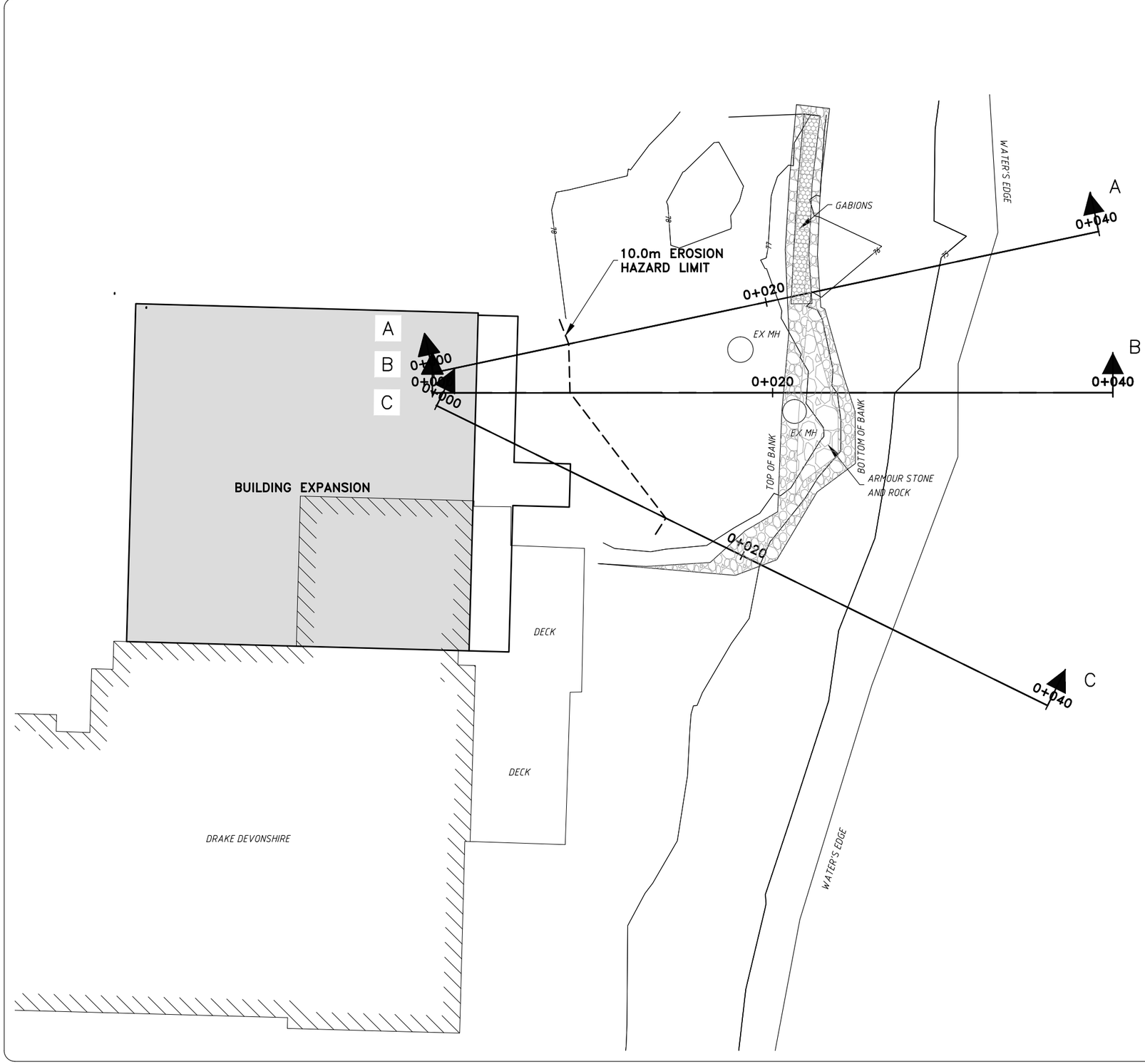
Inspected By: — Weather:

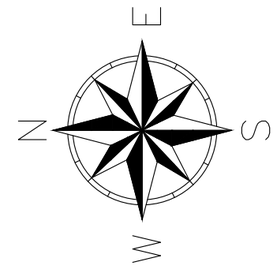
			EAST	MID	WEST	Rating Value circle one
1. SLOPE INCLINATION	degrees	horz. : vert.				
a)	less than 18	3:1 or flatter	14%	15%	15%	(0) 6 16
b)	18 to 27	2:1 to 3:1				
c)	more than 27	steeper than 2:1				
2. SOIL STRATIGRAPHY						
a)	Shale, Limestone (Bedrock)					0 6 (9) 12 16
b)	Sand Gravel					
c)	(Till)					
d)	Clay, Silt					
e)	Fill					
3. SEEPAGE FROM SLOPE FACE						
a)	None or Near bottom only ←					(0) 6 12
b)	Near mid-slope only					
c)	Near crest only or, From several levels					
4. SLOPE HEIGHT			EAST	MID	WEST	
a)	2 m or less					0 (2) 4 8
b)	(2.1 to 5 m)		2.91	3.00	2.93	
c)	5.1 to 10 m					
d)	more than 10 m					
5. VEGETATION COVER ON SLOPE FACE						
a)	Well vegetated; heavy shrubs or forested with mature trees					0 (4) 8
b)	Light vegetation; Mostly grass, weeds, occasional trees, shrubs ←					
c)	No vegetation, bare					
6. TABLELAND DRAINAGE						
a)	Tableland flat, no apparent drainage over slope					0 (2) 4
b)	Minor drainage over slope, no active erosion ←					
c)	Drainage over slope, active erosion, gullies					
7. PREVIOUS LANDSLIDE ACTIVITY						
a)	(No)					(0) 6
b)	Yes					
						TOTAL 17

	SLOPE INSTABILITY RATING	RATING VALUES TOTAL	INVESTIGATION REQUIREMENTS
1.	Low potential	(< 24)	Site Inspection only, confirmation, report letter.
2.	Slight potential	25 - 35	Site Inspection and surveying, preliminary study, detailed report
3.	Moderate potential	> 35	Borehole Investigation, piezometers, lab tests, surveying,detailed report.

Notes:
a) This chart does not apply to rock slopes or to Leda Clay slopes (e.g., Ottawa area)
b) Choose only one from each category by circling rating value; compare total rating value with above requirements.
c) If there is a water body (i.e., stream, creek, river, pond, bay, lake) at the slope toe: the potential for toe erosion and undercutting should be evaluated in detail and, protection provided if required.
d) Refer to Section 2 for information on identifying soil types.

APPENDIX B
SLOPE DIAGRAM





GENERAL NOTES:

ALL INFORMATION TO BE VERIFIED ON SITE PRIOR TO COMMENCING ANY WORK. ANY DISCREPANCIES ARE TO BE REPORTED TO THE CONSULTANT IMMEDIATELY.

ALL UTILITY LOCATIONS SHOWN ON THE DRAWINGS ARE APPROXIMATE. THE CONTRACTOR SHALL CONFIRM THE LOCATION ON SITE AND ASSUME ALL LIABILITY FOR DAMAGE TO ALL UTILITIES.

EXCLUDING THE BENCHMARK AND DESCRIPTION PROVIDED FOR THIS PROJECT, NO OTHER ELEVATIONS ARE TO BE USED AS A REFERENCE ELEVATION FOR ANY PURPOSE.

METRIC NOTE:

ALL DIMENSIONS SHOWN ARE IN METRES OR MILLMETRES, UNLESS OTHERWISE NOTED.

* * DRAWINGS ARE NOT TO BE SCALED * *

REVISIONS

NO.	DATE	DESCRIPTION	BY

JEWELL ENGINEERING

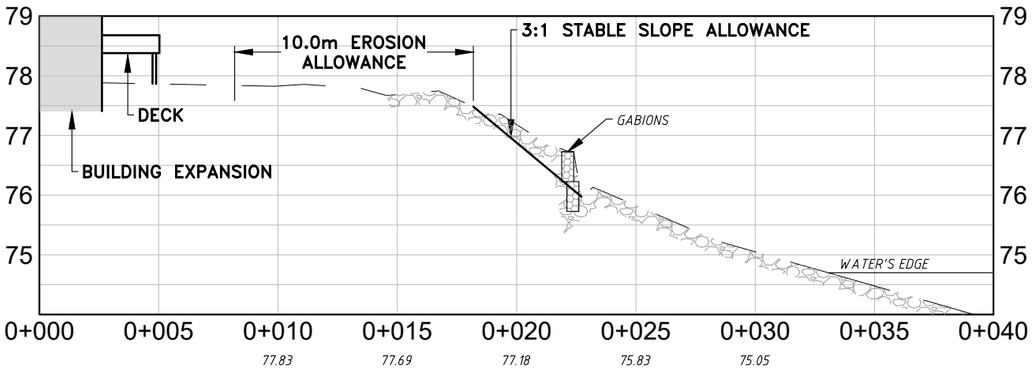
DRAKE HOTEL PROPERTIES WHARF STREET AND

MIDTOWN SPA

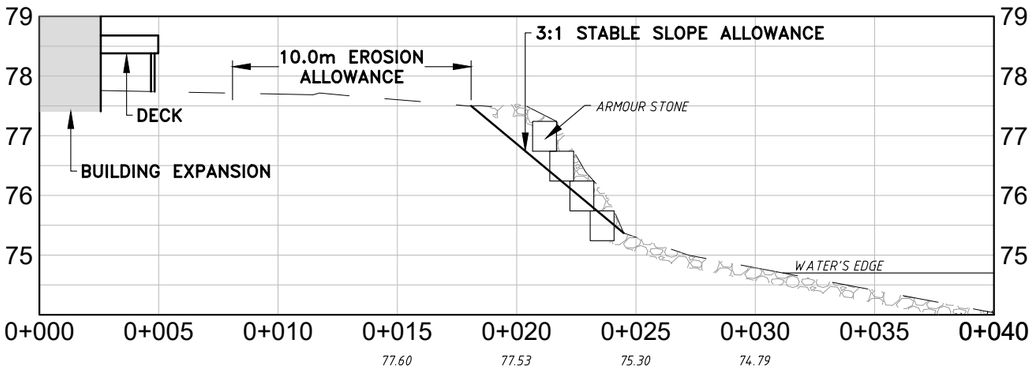
EROSION HAZARD LIMIT

DRAWN BY: DFM	PROJECT NO: 2104911	
DESIGNED BY: DFM	DATE: June 2021	
CHECKED BY: NG/AR	SCALE: HORIZONTAL -1:250 VERTICAL -	
APPROVED BY: BK	CONTRACT NO:	DRAWING NO: UP-1

Profile A-A 0+000 to 0+040



Profile B-B 0+000 to 0+040



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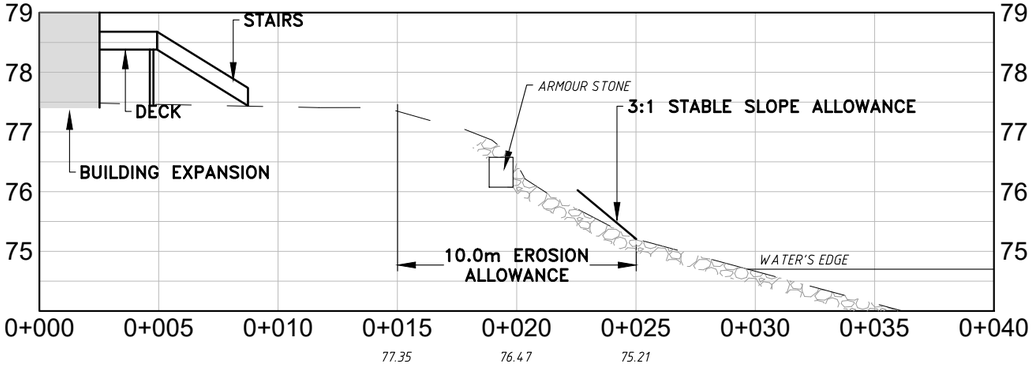

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REVISIONS

NO.	DATE	DESCRIPTION	BY

JEWELL ENGINEERING

DRAKE HOTEL PROPERTIES
WHARF STREET AND MIDTOWN SPA

PROFILES

DRAWN BY: DFM	PROJECT NO: 2104911
DESIGNED BY: DFM	DATE: June 2021
CHECKED BY: NG/AR	SCALE: HORIZONTAL -1:250 VERTICAL -1:100
APPROVED BY: BK	CONTRACT NO:
	DRAWING NO: UP-2

APPENDIX C
IMAGES – JUNE 2021

Figure C1 – West end of gabion wall facing Drake Devonshire rear beach.

Figure C2 – West end of gabion wall facing northwest, with manhole and culvert.

Figure C3 – Centre of gabion wall facing west.