

Memorandum

From: Brendan Cousino
To: Neil Budzinski – MVVA
Date: March 15, 2021
Project: Port Lands Flood Protection (PLFP)
CC: Tim Dekker, Ph.D.

SUBJECT: PLFP – Inundation Studies of the Interim Conditions SDMA and Don Greenway

1. Introduction

The purpose of this memorandum is to document the results of the inundation studies that were performed for the Interim Conditions (IC) Sediment and Debris Management Area (SDMA), and the Don Greenway.

The IC SDMA has an area where the grades will be set to elevation 76.0 metres to support the existing Gardiner highway ramp piers until the Gardiner realignment project is completed. This is above the typical lake level elevations in the Inner Harbour. The inundation frequency of this existing area is of interest for the design of Risk Management Measures (RMM) related to the existing soil contamination in this area.

The Don Greenway is separated from the River Valley by a spillway at elevation 75.8 metres. The DMNP EA contains specific language about the frequency of storm overtopping of the levee separating the River Valley from the Don Greenway. For the purposes of testing the PLFP design for compliance with the requirements of the DMNP EA, the modeling is performed using using the 2-year return period lake level without surge as noted in Appendix N of the DMNP EA. To supplement that analysis and provide additional information that can be used to inform the ongoing management and maintenance of the PLFP, a more robust inundation frequency analysis of the Don Greenway was performed.

The inundation frequency analyses for these specific areas of the PLFP were performed based on combinations of the static lake level return periods based on the Baird Analysis (Baird 2019), and the design storms from the TRCA hydrology model (AECOM 2018). The critical assumption in estimating the return frequency of the combination of static lake levels and rainfall storm events is that they are independent events (e.g. higher lake levels do not change the likelihood of a particular rainfall event occurring in any given year).

The reason for using the static lake levels for this analysis is that the likelihood of the peak hourly water level for any given year occurring simultaneously with the peak flow from a rainfall event is also extremely unlikely, since the peak hourly water level is driven by short-term storm surge. Based on the experiences of 2017 and 2019, elevated static lake levels can occur for months at a time, since they are driven by long-term basin supplies and outflows from Lake Ontario into the St. Lawrence River. These are more likely to occur simultaneously with the peak flow from a rainfall event.

The lake levels and storm flow used for these studies are presented in Table 1.

Table 1. Return Periods for Static Lake Ontario Levels and Don River Flows

Return Period	Stillwater Elevation using Plan 2014 ^{1,2}	Est. Surge (1962-2019) ¹	Static Lake Level Elevation using Plan 2014	Don River Peak Flow [m ³ /s] ³
1-Year	--	--	75.226	91.1
2-Year	75.416	0.19	75.226	138
5-Year	75.716	0.2	75.516	181
10-Year	75.886	0.2	75.686	216
25-Year	76.056	0.21	75.846	283

¹From Baird 2019, converted to project datum (CVGD28:PRE78) from IGLD85
²Elevations in project datum (CVGD28:PRE78)
³From AECOM, 2018

2. Interim Conditions SDMA Inundation Analysis

The location and proposed bathymetry of the Interim Conditions SDMA area that will be graded to elevations 76.0 metres is illustrated in Figure 1. This area will begin to be inundated by flows when the water surface at the upstream end of this area exceeds elevation 76.0 metres.

The following static lake levels and storm flows were used to analyze the conditions under which the elevated area around the Gardiner Piers in the Interim Conditions SDMA is inundated (Table 2).

These results were plotted in Figure 2, which shows that up to the 50-Year recurrence period for the combination of still water levels and storm flows, the inundation frequency of the Interim Conditions SDMA is greater than 50 years. Similar to the Don Greenway frequency analysis, the lake levels dominate the potential for inundation of this area, as even up to the 50-year storm there is relatively little difference in water surface elevation between the upstream end of the Interim Conditions SDMA and the Inner Harbour.



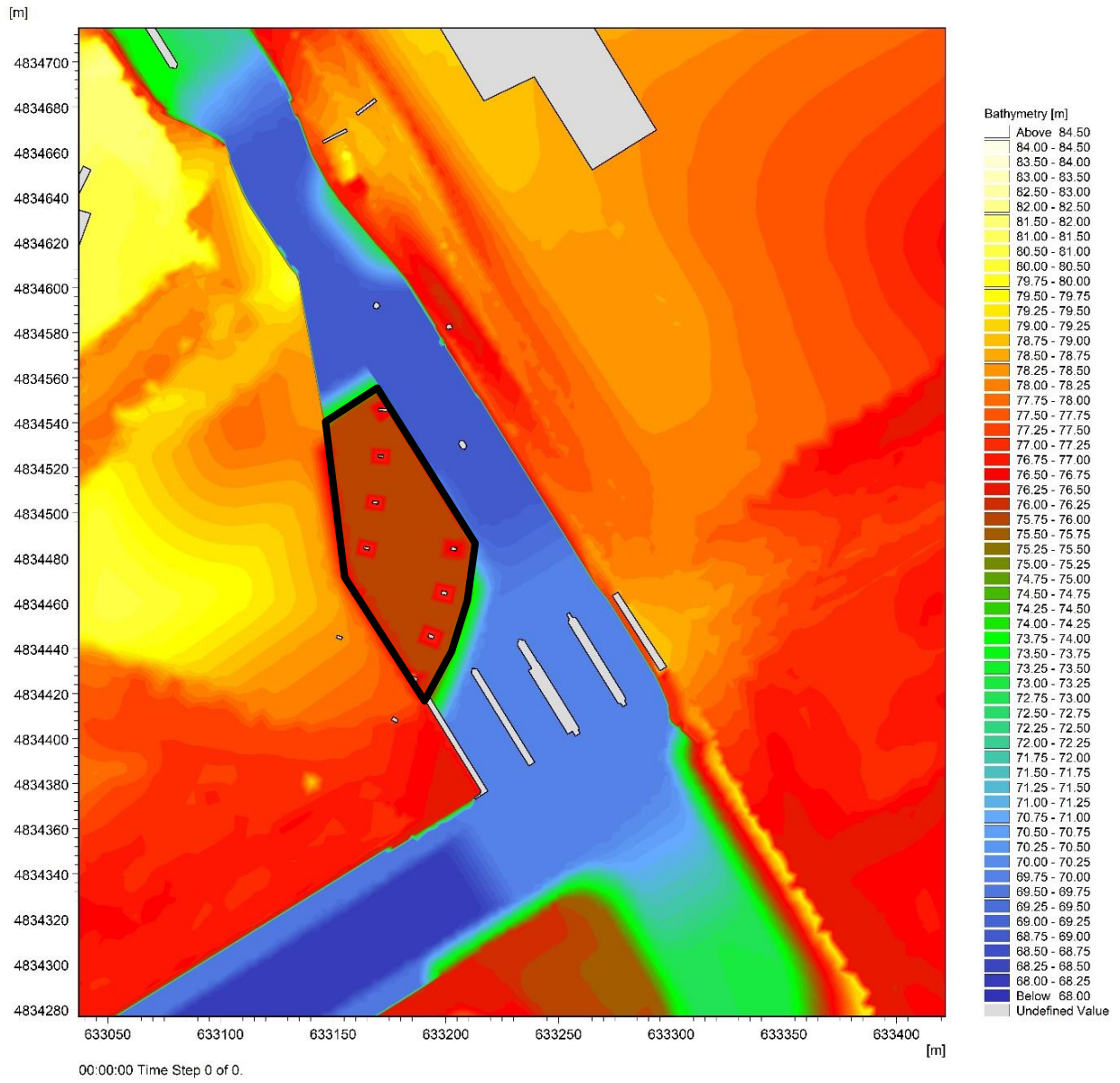


Figure 1. Location of Interim Conditions SDMA at Elevation 76.0 Metres



Table 2. Interim Conditions SDMA Inundation Frequency Analysis Based on Plan 2014 Static Water Levels and Don River Flows

Static Lake Level Return Period	Storm Flow Return Period	Estimated Combined Return Period	Peak WSE adjacent to the upstream end of the Interim Conditions SDMA	Interim Conditions SDMA Overtopping?
2-Year	1-Year	2-Year	75.276	No
2-Year	2-Year	4-Year	75.321	No
2-Year	5-Year	10-Year	75.363	No
2-Year	10-Year	20-Year	75.401	No
2-Year	25-Year	50-Year	75.482	No
5-Year	1-Year	5-Year	75.566	No
5-Year	2-Year	10-Year	75.611	No
5-Year	5-Year	25-Year	75.653	No
5-Year	10-Year	50-Year	75.691	No
10-Year	1-Year	10-Year	75.736	No
10-Year	2-Year	20-Year	75.781	No
10-Year	5-Year	50-Year	75.823	No
25-Year	1-Year	25-Year	75.896	No
25-Year	2-Year	50-Year	75.941	No
50-Year	1-Year	50-Year	75.986	No



Interim Conditions SDMA Inundation Recurrence Analysis Based on Plan 2014 Static WSEs and Don River Flows

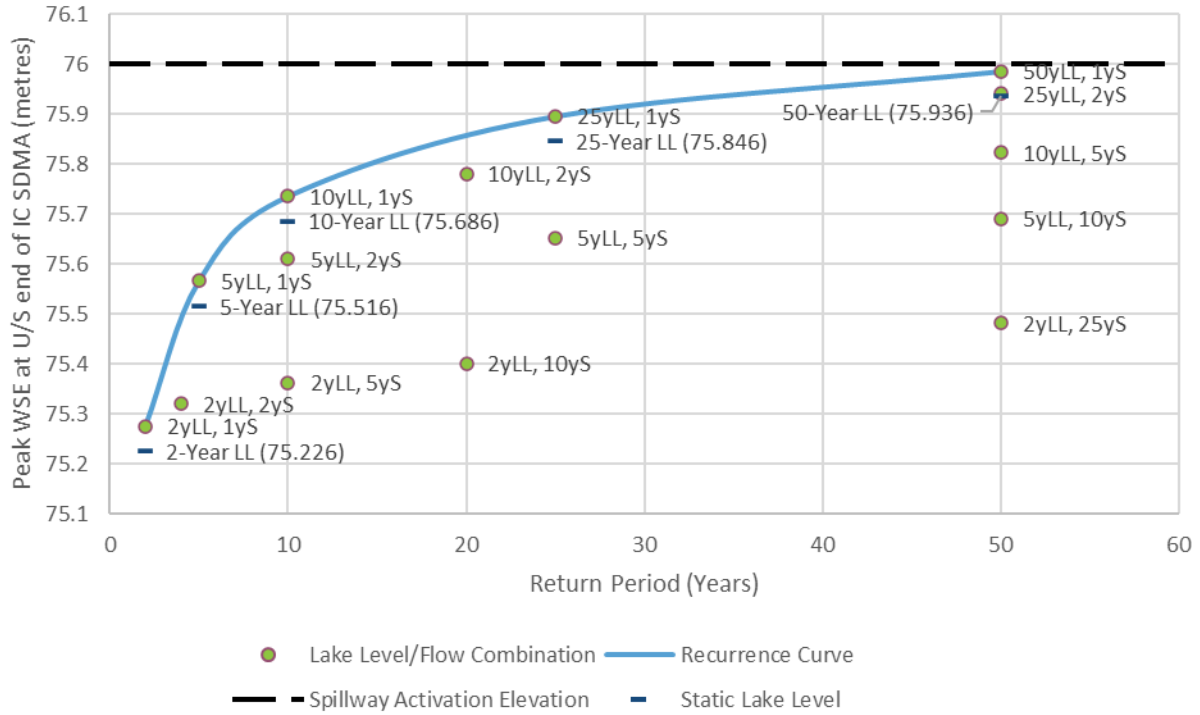


Figure 2. Interim Conditions SDMA Inundation Recurrence Frequency Analysis Results



3. Don Greenway Inundation Analysis Results

The location and proposed bathymetry of the Don Greenway and the spillway at elevation 75.8 metres that controls overflows into it are illustrated in Figure 3. This area will begin to be inundated by flows when the water surface in the adjacent river channel exceeds elevation 75.8 metres.

The result of this analysis shows that the Don Greenway is inundated under three of the lake level and storm flow combinations, and all of them are where the lake levels are above the spillway elevation of 75.8 metres. There is relatively little water surface elevation difference between this location and the Inner Harbour for the range of flows analyzed, so the activation frequency is primarily controlled by the lake level.

For the events modeled in this analysis that had flows through the Don Greenway, the actual flows into the Ship Channel and velocities in the Don Greenway were both relatively low. The peak flow rate in the Don Greenway under the 50-Year recurrence static lake level and 1-Year storm was 1.3 cubic metres per second. This results in velocities within the Don Greenway less than 0.01 metres per second (see Figure 5).

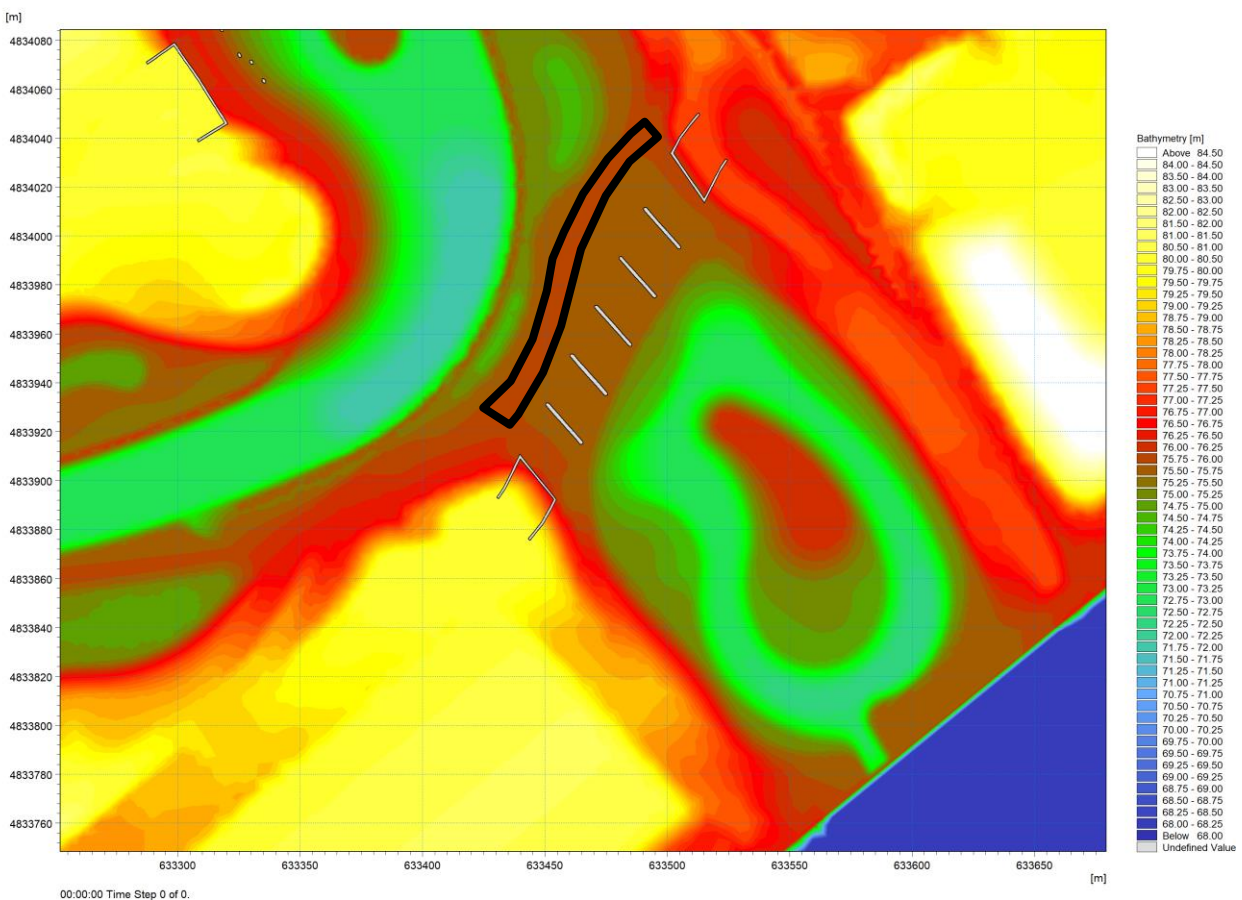


Figure 3. Location of Spillway to the Don Greenway at Elevation 75.8 Metres



Table 3. Don Greenway Inundation Frequency Analysis Based on Plan 2014 Static Water Levels and Don River Flows

Static Lake Level Return Period	Storm Flow Return Period	Estimated Combined Return Period	Peak WSE adjacent to the spillway to the Don Greenway	Don Greenway Spillway Overtopping?
2-Year	1-Year	2-Year	75.247	No
2-Year	2-Year	4-Year	75.265	No
2-Year	5-Year	10-Year	75.287	No
2-Year	10-Year	20-Year	75.308	No
2-Year	25-Year	50-Year	75.358	No
5-Year	1-Year	5-Year	75.535	No
5-Year	2-Year	10-Year	75.550	No
5-Year	5-Year	25-Year	75.571	No
5-Year	10-Year	50-Year	75.588	No
10-Year	1-Year	10-Year	75.704	No
10-Year	2-Year	20-Year	75.717	No
10-Year	5-Year	50-Year	75.738	No
25-Year	1-Year	25-Year	75.862	Yes
25-Year	2-Year	50-Year	75.875	Yes
50-Year	1-Year	50-Year	75.952	Yes



Don Greenway Activation Recurrence Analysis Based on Plan 2014 Static WSEs and Don River Flows

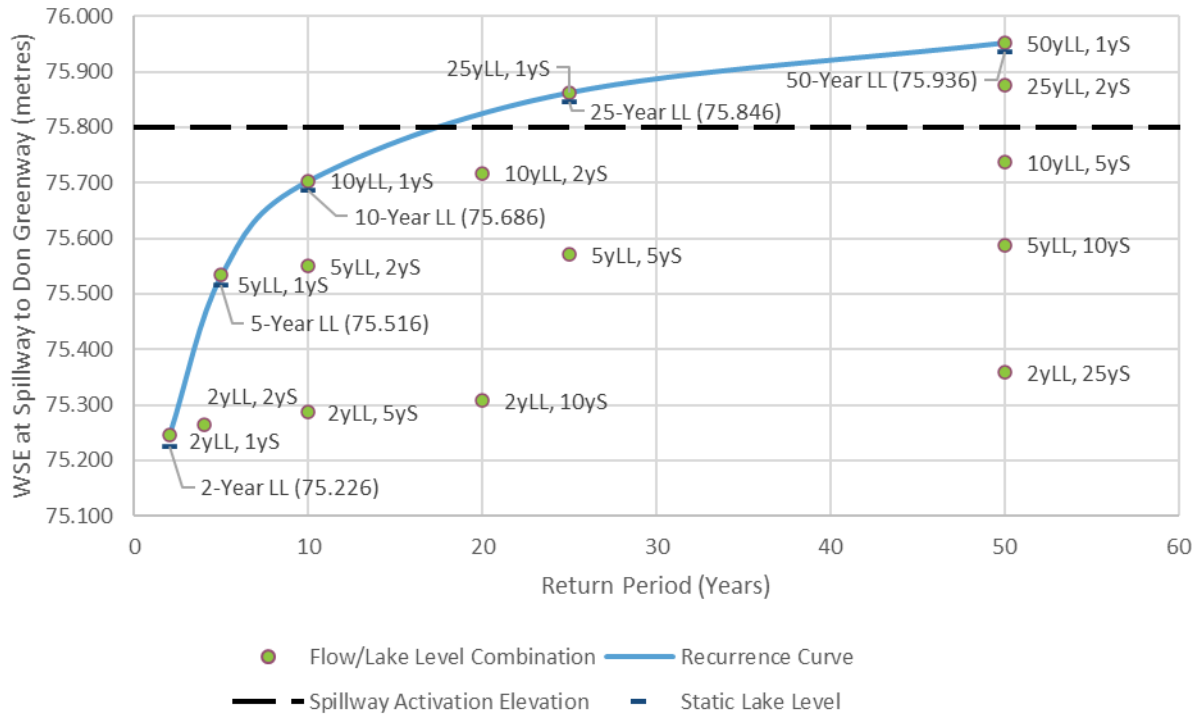


Figure 4. Don Greenway Activation Recurrence Frequency Analysis Results



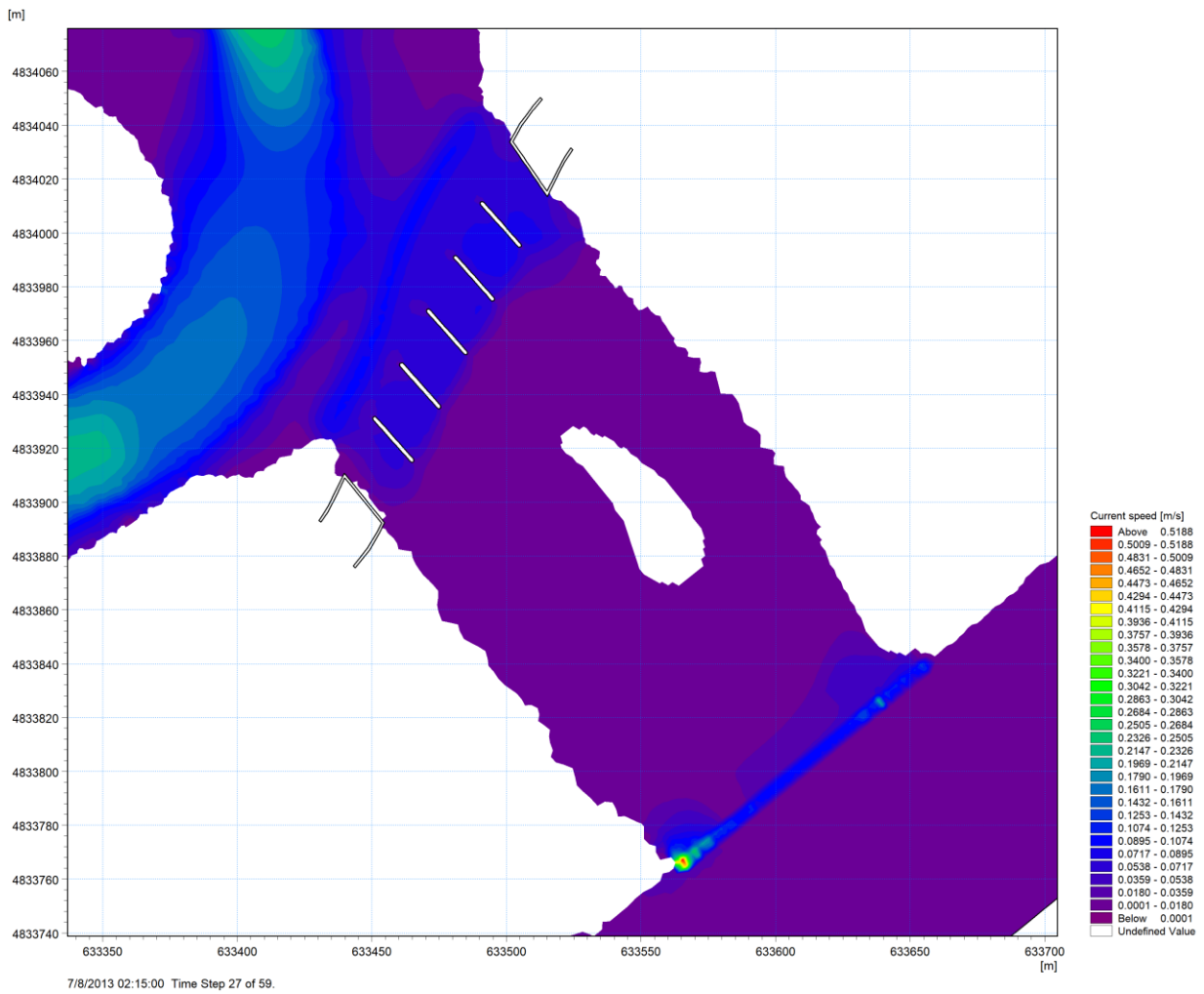


Figure 5. Don Greenway Velocity Results - 50-Year Static Lake Level and 1-Year Storm

4. References

AECOM Canada Ltd. 2018 Don River Hydrology Update Report, December, 2018

W.F. Baird & Associates Coastal Engineers Ltd., Updated Analyses Using 2019 Water Levels [Memorandum], September 7, 2019

