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December 01, 2022 Project Number: 1474(03)

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Attention: **Kevin Murphy, P.Eng**

Subject: **BCDC Phase 5 – Preliminary HGL Analysis**

Introduction

Phase 5 of the Barrhaven Conservancy Development is located in Barrhaven, Ontario, north of the Jock River, east of the Foster Creek and West of Borrisokane Road. The proposed development is approximately **13.17 ha** that will primarily comprise of single and townhouse residential lots along with a **0.64 ha** park. The following outlines the preliminary hydraulic grade line (HGL) assessment for the site, to ensure that the proposed minor system within the development is adequately sized to safely convey flows to the Jock River under various conditions. As such the following memo outlines the approach taken in assessing the development's HGL and summarises the findings of this analysis.

Analysis Approach

Preliminary hydraulic grade line calculations for the proposed BCDC Phase 5 development were completed using PCSWMM modelling software. Pipe data, trunk storm sewer layout and Rational Method flows in the storm sewer are as provided by DSEL. The Rational Method flows were calculated based on the 2-, 5- or 10-year level of service requirements, and the 100-year flows in the hydraulic grade line calculations were estimated as 14% greater than the Rational Method flows, to account for the additional flows captured by catchbasin grates, lead pipes and/or inlet control devices under the higher surface water depths of the 100-year storm.

The 14% increase in flows for the 100-year event is based on the assumption that the head on a lead pipe/ICD will increase by 35 cm (maximum allowable major system ponding depth) during the 100-Year event. Taking a typical 250 mm lead pipe and assuming that the head on the pipe is just below the top of the grate (assumed at 1.38 m) results in a peak flow of 209 L/s, then assuming that the head is increased by 35 cm during the 100-Year (head of 1.730m) the flow through the lead pipe would increase to 234.5 L/s, which results in a 12% increase in peak flows. It is important to note that a 12% increase is observed when the same calculations are applied to the various lead pipe and ICD sizes. An additional 2% is added as a safety factor to allow some flexibility in the design, as it is likely that not all lead pipes will have a head of 1.38 m (just below the top of MH) for the level of service specified.

The proposed storm sewer infrastructure data was extracted from DSEL's drawings and incorporated into a PCSWMM model, and flows derived by DSEL's Rational Method calculations were then applied to each Maintenance Hole (MH) in the model as steady flows (using the baseflow option). Exit losses were applied to all storm sewer pipes in the system based on the angle of the downstream connection.

As in line with all other works completed for the BCDC development phases, the preliminary HGL analysis was completed under two conditions:

- 100-year rainfall event on the development and a 5-year spring water level on the Jock River
- Level of service (2/5/10-year) rainfall event on the development and a 100-year spring water level on the Jock River

Note that the water level along the Jock River through the length of this development varies, and as such the nearest corresponding upstream water surface elevation calculated by RVCA's HEC-RAS floodplain mapping model of the Jock River was applied at each of the respective storm sewer outlets. Also, note that assuming a 5-year spring water level on the Jock River for a 100-year rainfall event on the development is an inherently conservative assumption, as the critical storm for the proposed development is a summer (intense rainfall) event while the critical storm for the Jock River is a spring (snowmelt + rainfall) event. A preliminary Single Station Flood Frequency analysis was completed by JFSA using only summer flows (from May 15 to October 31) based on historical flow data recorded at the Moodie Drive Water Survey Canada gauge. This analysis found that the 100-year summer flow on the Jock River is around **99 m^3/s**, while the 5-year spring flow is around **123 m^3/s**, therefore the downstream boundary condition applied is conservative.

Within the proposed development Oil and Grit Separators (OGS) units in conjunction with LID measures will be implemented to ensure the site meets quality control requirements. Preliminary OGS units and associated by-pass weir elevations have also been included in the model, based on similar drainage areas and imperviousness seen in BCDC Phase 2.

Trunk Sewer 9 will have a drainage area of **7.21 ha** at **75%** imperviousness, Trunk Sewer 10 has a drainage area of **6.56 ha** at **80%** imperviousness. In a preliminary consultation with the OGS manufacturer, it was suggested that the closest match to the detailed OGS sizing for BCDC Phase 2 is **OGS 3**, which used a **PMSU 4045-8** OGS unit with a weir height of **0.65m**, this unit had a drainage area of **6.77 ha** at **64%** imperviousness.

Results

The maximum HGL obtained at each MH has been extracted from the level of service (2/5/10-year) event / 100-year Jock River water level scenario and the 100-year event / 5-year Jock River water level scenario, with the results from this analysis provided in Tables 1 & 2, respectively. As all proposed units within this development will have sump pumps, the simulated HGL was compared against the top of MH elevation to ensure that all storm sewers infrastructure is sufficiently sized and is not surcharging to the major system during the assessed events.

From this analysis, it was found that the critical scenario for HGL within the development was the level of service development event and 100-year water level on the Jock River scenario. Based on this scenario, no MHs will have an HGL elevation above the top of MH (minimum freeboard of **0.64 m** at **MH-514** to **MH-516** and **MH-521**), with an average freeboard of **0.74 m** from the top of MH throughout the proposed development.

For the 100-year event and 5-year water level on the Jock River, no MHs will have HGL elevations above the top of MH (minimum freeboard of **1.22 m** at **MH-514** and **MH-515**), with an average freeboard of **1.38 m** from the top of MH throughout the proposed development. As such it can be concluded that the proposed storm sewer infrastructure is sufficiently sized, to safely convey minor system flows from the development under various extreme conditions.

Conclusion

A preliminary HGL analysis for Phase 5 of the Barrhaven Conservancy Development was completed using PCSWMM based on storm sewer and flow details provided by DSEL. From this analysis, it was found that the proposed storm sewer infrastructure is sufficiently sized to convey all minor system flows to the Jock River and will not result in any MHs surcharging to the street under extreme events such as 100-year rainfall events on the development and a 5-year spring water level on the Jock River and a level of service (2/5/10 Year) rainfall event on the development and a 100-year spring water level on the Jock River, with the former being the more critical scenario for the HGL within the development.

Yours truly,
J.F Sabourin and Associates Inc.

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Director of Water Resources Projects

Figures

Figure 1: PCSWMM Model Overview

Tables

Table 1: HGL Result Tables - Level of service (2/5/10-year) BCDC Development & 100-Year Jock River

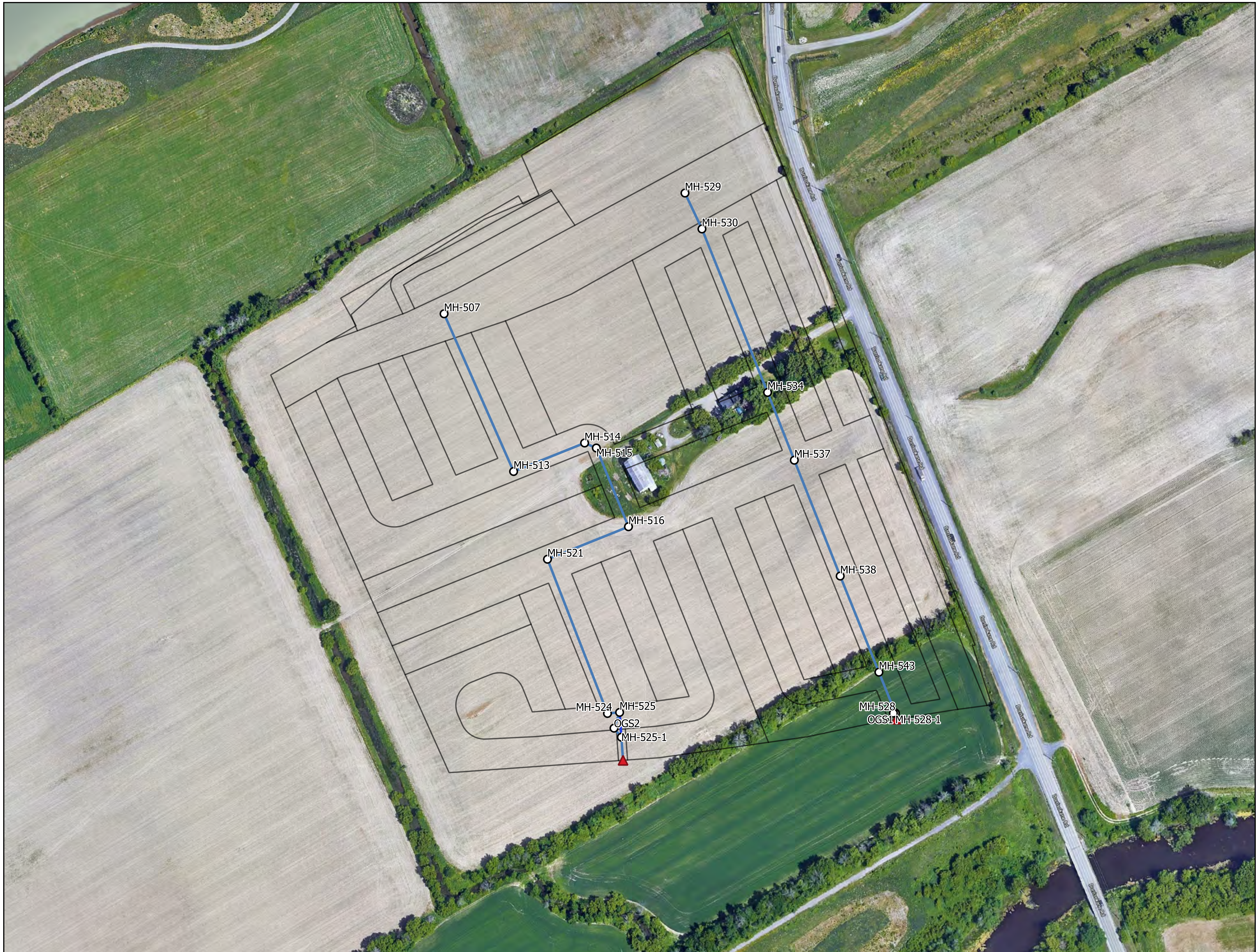
Table 2: HGL Result Tables - 100-Year BCDC Development & 5-Year Jock River

Attachments

Attachment A: DSEL Rational Method Calculations

Modelling Files - Provided Electronically

PCSWMM: BCDC-P5_HGL_v01.1-2-5-10-YrDev-100YrJock.inp
BCDC-P5_HGL_v01.1-100-YrDev-5YrJock.inp



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Legend

- Junctions
- Outfalls
- Conduits
- Weirs
- Site Plan

SCALE: 1:2500

0 50 100 150 m

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DSEL

Barrhaven Conservancy Development
Phase 5

Figure 1: Preliminary HGL Analysis
Model Overview

PROJECT	1474(03)-21
DRAWN	JB
DATE	December 2022

C:\OneDrive\J.F. Sabourin and Associates Inc\JFSA-OTTAWA-SERVER - Documents\PROJ\1474(03)-21\202212-BCDC Phase 5 - Prelim Design\Design\GIS\20221021-Preliminary HGL Analysis Figures

Table 1: BCDC Phase 5 - Preliminary HGL Analysis
Level of Service (2/5/10 Year) BCDC Development & 100-Year Jock River

MH-ID	Invert Elevation	Top of MH (m)	Max HGL (m)	Freeboard (m)
MH-507	90.62	93.26	92.54	0.72
MH-513	90.42	93.10	92.43	0.67
MH-514	90.34	93.02	92.38	0.64
MH-515	90.30	93.00	92.36	0.64
MH-516	90.17	92.91	92.27	0.64
MH-521	90.05	92.83	92.19	0.64
MH-524	89.71	92.66	91.99	0.67
MH-525	89.64	92.65	91.93	0.72
MH-525-1	89.63	92.64	91.88	0.76
MH-528	89.63	92.67	91.89	0.78
MH-528-1	89.63	92.67	91.83	0.84
MH-529	90.43	93.01	92.23	0.78
MH-530	90.37	93.01	92.20	0.81
MH-534	90.17	92.99	92.11	0.88
MH-537	90.02	92.91	92.07	0.84
MH-538	89.87	92.91	92.01	0.90
MH-543	89.69	92.65	91.96	0.69
			Min	0.64
			Max	0.90
			Average	0.74

Note: Analysis assumes 100 year spring water level on the Jock River

Model Name:BCDC-P5_HGL_v01.1-2-5-10-YrDev-100YrJock.inp

Table 2: BCDC Phase 5 - Preliminary HGL Analysis
100-Year BCDC Development & 5-Year Jock River

MH-ID	Invert Elevation	Top of MH (m)	Max HGL (m)	Freeboard (m)
MH-507	90.62	93.26	92.02	1.24
MH-513	90.42	93.10	91.87	1.23
MH-514	90.34	93.02	91.81	1.22
MH-515	90.30	93.00	91.78	1.22
MH-516	90.17	92.91	91.67	1.24
MH-521	90.05	92.83	91.56	1.27
MH-524	89.71	92.66	91.29	1.37
MH-525	89.64	92.65	91.22	1.43
MH-525-1	89.63	92.64	91.16	1.48
MH-528	89.63	92.67	91.19	1.48
MH-528-1	89.63	92.67	91.12	1.55
MH-529	90.43	93.01	91.63	1.38
MH-530	90.37	93.01	91.59	1.42
MH-534	90.17	92.99	91.47	1.52
MH-537	90.02	92.91	91.42	1.49
MH-538	89.87	92.91	91.34	1.57
MH-543	89.69	92.65	91.27	1.38
			Min	1.22
			Max	1.57
			Average	1.38

Note: Analysis assumes 5 year spring water level on the Jock River

Model Name:BCDC-P5_HGL_v01.1-100-YrDev-5YrJock.inp

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Attachment A

DSEL Rational Method Calculations