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GHD Reference No: 12575389-LTR-4-Spence

16 November 2022

Mr. David Spence
Hydro One Networks Inc.
230 Bayview Drive
Barrie, Ontario
L4N 4Y8

Hydrogeological Assessment – Amendment
Final Groundwater Level Monitoring
Orleans Operations Centre (OC)
3440 Frank Kenny Road, Navan, Ontario

Dear Mr. Spence,

1. Introduction

GHD Limited (GHD) provide the following long term groundwater level monitoring data and assessment as part of the Hydrogeological Assessment for the proposed construction of the Orleans Operations Centre (OC) located at 3440 Frank Kenny Road in Navan, Ontario (Site or Property) (GHD June 24, 2022)¹. GHD presented the initial groundwater level monitoring data collected on April 19th, 2022 in the Hydrogeological Assessment and groundwater monitoring letter². This letter presents completion of the groundwater level monitoring over the spring freshet into the fall months from April 2022 to November 2022 for the Site.

This Hydrogeological Assessment Letter presents the completed long term groundwater level monitoring performed on the Site and contains all previous groundwater monitoring data. The hydrogeological interpretations and conclusions presented in this letter supersede and override the understanding of the Site stated in previous reports. It is noted that the updated data does not significantly alter the previous interpretation of the Site.

1.1 Groundwater Level Monitoring

Groundwater level monitoring was undertaken on a seasonal basis to assess the “high” groundwater levels through a wet season (spring) and to determine stable levels and seasonal fluctuations. Groundwater monitoring was observed between April 2022 and November 2022. Manual groundwater level measurements were collected using a water level meter (Solinst Model 101) and DBW003 was equipped with a water level data logger (Solinst Model 3001 – Levellogger Edge). The data logger continuously recorded water levels and

¹ Hydrogeological Assessment – Proposed Development – Orleans Station Yard 3440 Frank Kenny Road, Navan, Ontario. Prepared for Hydro One Networks Inc. Dated June 24, 2022.

² Hydrogeological Assessment – Amendment, Groundwater Level Monitoring Orleans OC 3440 Frank Kenny Road, Navan, Ontario. Prepared for Hydro One Networks Inc. Dated August 5, 2022.

provide a detailed record of the response of groundwater to climatic conditions throughout the monitoring period.

2. Monitoring Results

2.1 Groundwater Level Monitoring

The high seasonal groundwater levels were observed in April 2022, based on the seasonal groundwater monitoring. The groundwater level contours from the April monitoring event are presented on **Figure 1.0**. The most recent round of groundwater level contours are presented on **Figure 2.0**. Groundwater levels collected from the monitoring wells are presented in **Tables 1 and 2**, and a hydrograph of the groundwater levels alongside precipitation data is presented in **Attachment A1**. The highest and lowest observed groundwater levels recorded by the data logger are presented in **Table 3**.

Groundwater levels measured in metres below ground surface (mBGS) are presented in **Table 1**. Review of the groundwater monitoring data indicates that the groundwater table fluctuated during the monitoring period with seasonal highs occurring during the month of April. The groundwater table was on average 0.85 mBGS at all monitoring wells, ranging from 0.12 mBGS at DBW002 to 1.86 mBGS at DBW001.

Groundwater levels measured in metres above mean sea level (mAMSL) are presented in **Table 2**. Based on review of the groundwater levels collected, the groundwater levels ranged from 84.22 mAMSL at DBW004 to 85.62 mAMSL at DBW001. Based on **Figure 1**, the groundwater flow direction on Site is south to southwest.

Precipitation data collected from the nearby Environment Canada weather station (Ottawa CDA RCS Climate ID: 6105978) was plotted alongside the manual groundwater level measurements and long-term data logger data for the Site (**Attachment A1**). The hydrograph data logger groundwater elevation fluctuations show some correlation with the precipitation data illustrating that the groundwater table on Site is sensitive to and responses to precipitation events.

The seasonal high-water table occurred during the spring period of April 2022, with a high of 85.64 mAMSL at DBW003 based on the data logger data (**Table 3**). The seasonal low occurred during November 2022 with a groundwater level of 84.22 mAMSL at DBW004, according to data logger data and manual measurements.

2.2 Groundwater Elevations – Detailed Design

The manual and electronic (data logger) data was reviewed to determine the high groundwater levels measured over the monitoring period. Based on review of the data, the groundwater table was observed to be very close to ground surface during the spring freshet. Groundwater elevations in April were observed to be within 0.1 m to 0.4 m of the ground surface.

The spring freshet typically begins in late February to early March and the manual and electronic (data logger) data for this Site were not initiated until April, not capturing the full extent of the spring thaw and snowpack melt. A hydrograph of the projected groundwater levels to the early spring period based on the groundwater monitoring trend lines is presented in **Attachment A2**. Based on the 'trend' of the measured groundwater levels, the projected early spring groundwater levels on the site would range from approximately 85 to 86 mAMSL.

To be conservative, a groundwater elevation at ground surface should be considered during detailed design to account for the potential high groundwater elevations during the early part of the spring freshet for each structure. For reference, the table below outlines the surveyed ground elevations at each of the monitoring wells installed in proximity to the proposed Orleans Operations Centre structures.

Structure	Monitoring Well	Ground Surface (mAMSL)
Septic tank	DBW001	85.53*
Fire storage tanks	DBW002	85.58
Building foundation	DBW003	85.64
Stormwater Management facility	DBW004	85.11

*Note – Due to DBW001 being located in a built-up area of fill material, the elevation of the native material is utilized as ground surface

The highest design groundwater level would be 86 mAMSL over the majority of the Site based on the projected groundwater level monitoring (see **Attachment A2**). The stormwater management pond ground surface is at a lower elevation. Based on review of the topography, borehole logs, and measured and projected groundwater levels, a high groundwater level of 85.1 mAMSL in the area of the stormwater management pond is appropriate for design.

Based on our completed monitoring through the spring freshet into the fall months of 2022, the updated monitoring does not significantly alter the previous hydrogeological interpretations for the Site. The highest groundwater elevations occurred during the spring freshet and the detailed design groundwater elevations are considered to be reasonable extrapolated elevations based on the long-term monitoring completed for the Site.

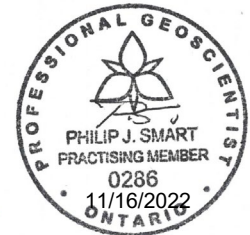
Please do not hesitate to contact us, should you have any question or require clarification.

Regards,

GHD



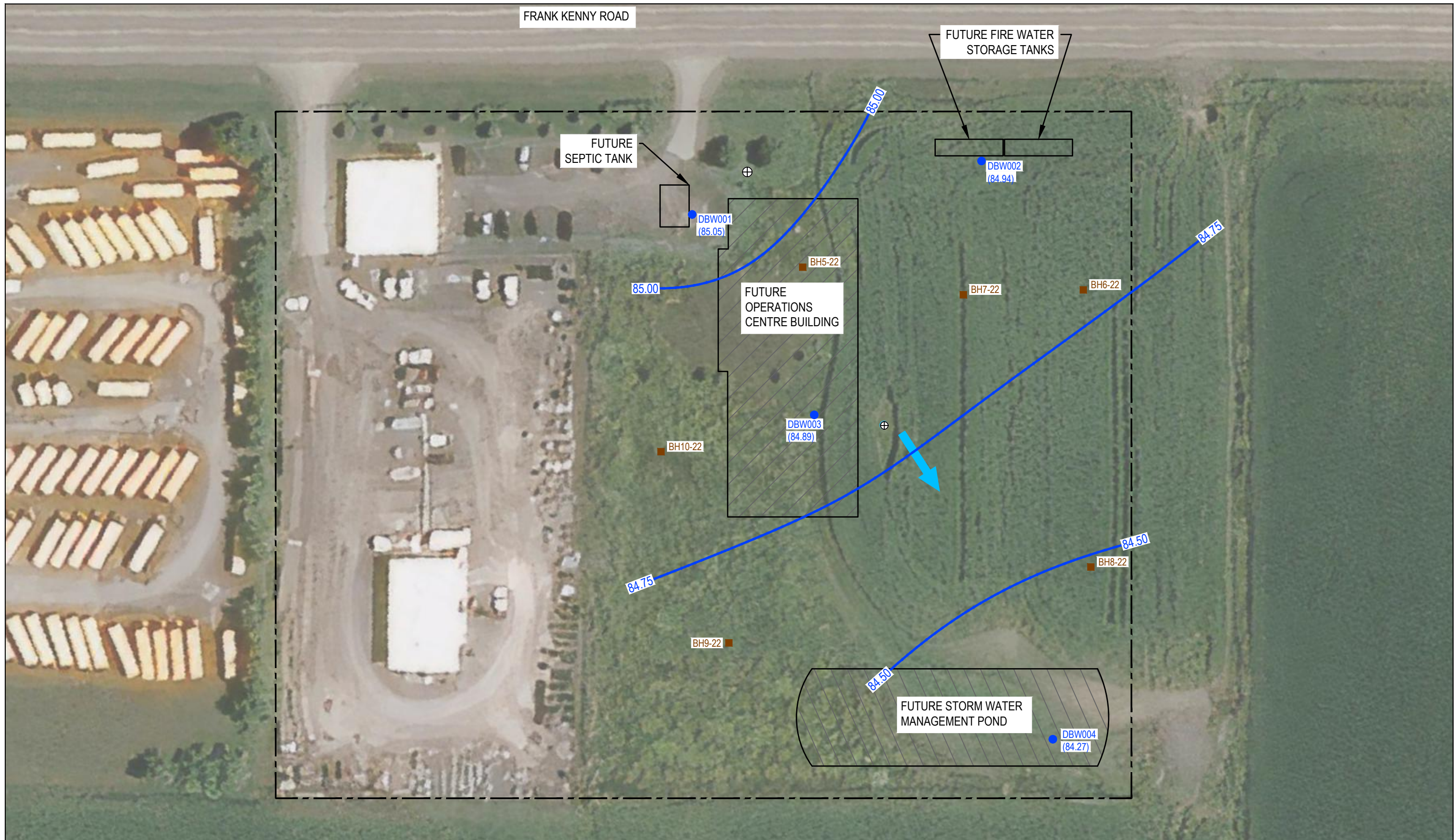
Michael McKerrall, P. Geo.



Philip Smart, MSc., P. Geo.

Encl.

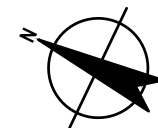
Figures



- LEGEND**
- MONITORING WELL
 - BOREHOLE LOCATIONS
 - ⊕ POTABLE/SUPPLY WELL

(85.22)
 85.25 ——— GROUNDWATER ELEVATION (mAMS) L
 GROUNDWATER ELEVATION CONTOUR (mAMS) L
 → GROUNDWATER FLOW DIRECTION
 mAMS L METRES ABOVE MEAN SEA LEVEL

0 7.5 15 22.5m
 1:750
 Coordinate System:
 UTM83-18

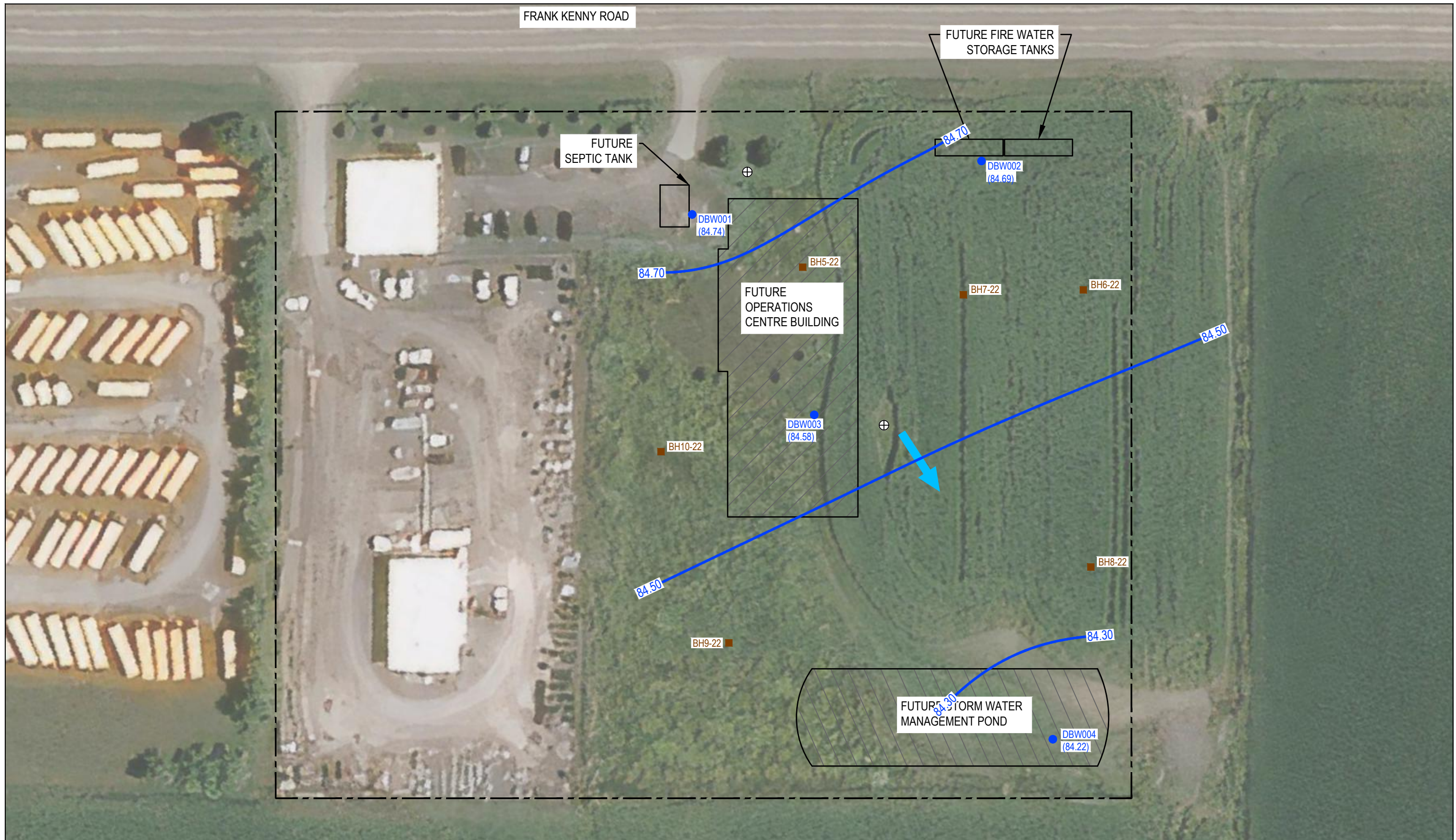


HYDRO ONE NETWORKS INC.
 3440 FRANK KENNY DR, NAVAN, ONTARIO
 HYDROGEOLOGICAL ASSESSMENT

GROUNDWATER ELEVATION CONTOURS
 JULY 7, 2022

Project No. 12575389
 Date July 2022

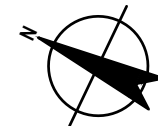
FIGURE 1.0



- LEGEND**
- MONITORING WELL
 - BOREHOLE LOCATIONS
 - ⊕ POTABLE/SUPPLY WELL

(84.74) GROUNDWATER ELEVATION (mAMS L)
 84.50 ——— GROUNDWATER ELEVATION CONTOUR (mAMS L)
 → GROUNDWATER FLOW DIRECTION
 mAMS L METRES ABOVE MEAN SEA LEVEL

0 7.5 15 22.5m
 1:750
 Coordinate System:
 UTM83-18



HYDRO ONE NETWORKS INC.
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 HYDROGEOLOGICAL ASSESSMENT

GROUNDWATER ELEVATION CONTOURS
 NOVEMBER 1, 2022

Project No. 12575389
 Date November 2022

FIGURE 2.0

Tables

Table 1

**Groundwater Elevations (mBGS)
Hydrogeological Assessment
3440 Frank Kenny Road, Navan, Ontario
Hydro One Networks Inc.**

	DBW001	DBW002	DBW003	DBW004
Top of Riser (mAMSL)	86.47	86.51	86.54	86.10
Ground Surface (mAMSL)	86.60	85.58	85.64	85.11
19-Apr-22	0.98	0.12	0.22	0.38
7-Jul-22	1.55	0.64	0.75	0.84
1-Nov-22	1.86	0.89	1.06	0.89

Notes:

- No data available
- mBGS metres below ground surface
- mAMSL metres above mean sea level

Table 2

**Groundwater Elevations (mAMS�)
Hydrogeological Assessment
3440 Frank Kenny Road, Navan, Ontario
Hydro One Networks Inc.**

	DBW001	DBW002	DBW003	DBW004
Top of Riser (mAMS�)	86.47	86.51	86.54	86.10
Ground Surface (mAMS�)	86.60	85.58	85.64	85.11
19-Apr-22	85.62	85.46	85.42	84.73
7-Jul-22	85.05	84.94	84.89	84.27
1-Nov-22	84.74	84.69	84.58	84.22

Notes:

- No data available
- mBGS metres below ground surface
- mAMS� metres above mean sea level

Table 3

**Logger Elevations (mAMSL)
Hydrogeological Assessment
3440 Frank Kenny Road, Navan, Ontario
Hydro One Networks Inc.**

Highest / Lowest	Monitoring Well ID	Date	Groundwater Elevation (mAMSL)
Highest recorded logger groundwater elevation during the monitoring period (April 19th to November 1st, 2022)	DBW003	Friday, April 22, 2022	85.64
Lowest recorded logger groundwater elevation during the monitoring period (April 19th to November 1st, 2022)	DBW003	Wednesday, August 31, 2022	84.43

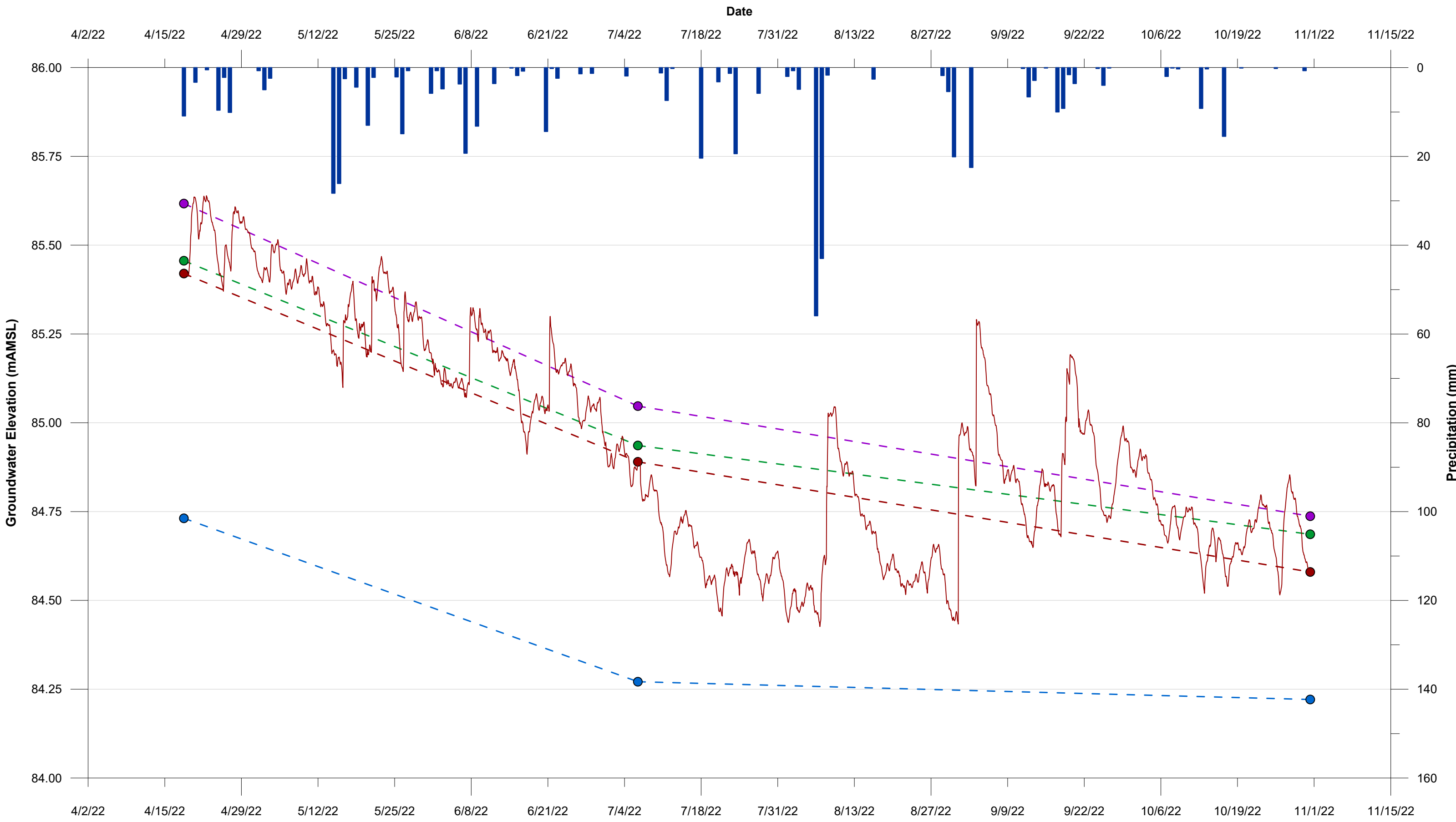
Notes:

mAMSL meters above mean sea level

Attachments

Attachment A1

Hydrograph



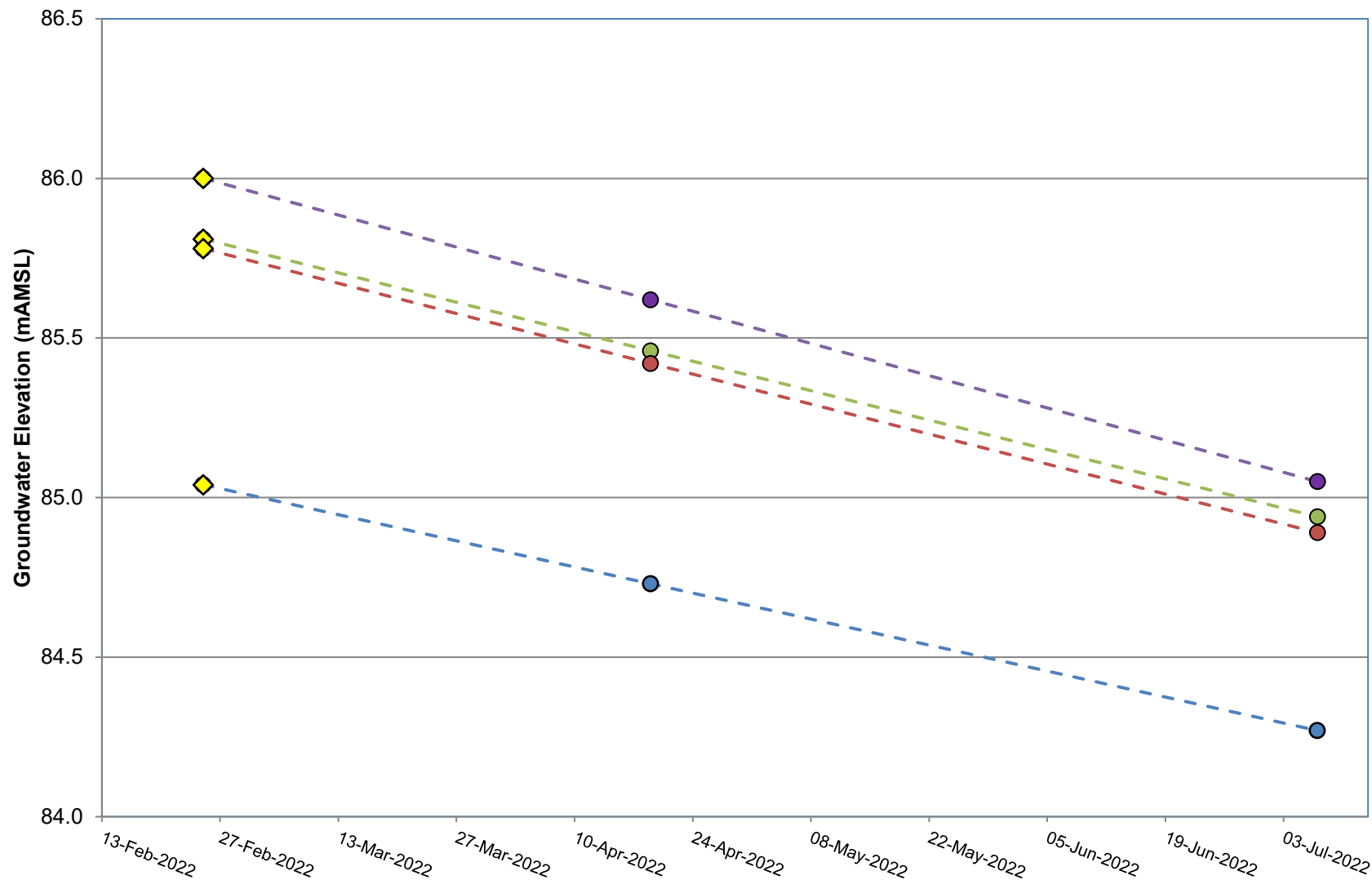
Note:
 - Precipitation data collected from the Ottawa CDA RCS (Climate ID: 6105978)
 Environment Canada Weather Station.

- - - ● - - - DBW001
- - - ● - - - DBW002
- - - ● - - - DBW003
- - - ● - - - DBW004
- ● — DBW003 Logger Data
- Precipitation

Groundwater Elevation Hydrograph
 Hydrogeological Assessment
 3440 Frank Kenny Road, Navan, Ontario
 Hydro One Networks Inc.

Attachment A2

Projected Early Spring Freshet Groundwater Elevations



- DBW001
- DBW002
- DBW003
- DBW004
- Projected DBW001 Elevation
- Projected DBW002 Elevation
- Projected DBW003 Elevation
- Projected DBW004 Elevation



Projected Early Spring Freshet Groundwater Elevations

Hydrogeological Assessment
 3440 Frank Kenny Road, Navan, Ontario
 Hydro One Networks Inc.