



**HAMLET OF GRAFTON  
PRODUCTION WELL MONITORING PROGRAM  
2016 ANNUAL REPORT  
PERMIT TO TAKE WATER - NUMBER 5086-9BPM4A**

**PREPARED FOR:  
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## 1.0 INTRODUCTION

The Hamlet of Grafton is serviced by two Production Wells both completed to depths of about 77.7 metres below ground level (commissioned between 1995 and 1996). Only one Production Well is in service at a time with the other well serving as backup and the wells are located within 100 meters of each other. Well water from the wells is distributed to the Hamlet of Grafton through a reservoir/water works system located within 100 metres from the wells.

On behalf of the Corporation of the Township of Haldimand, Geo Kamp Limited undertook a Production Well Monitoring Program as per the Permit to Take Water (PTTW) requirements for the Hamlet of Grafton Production Wells. The following report constitutes the 2016 Annual Report regarding the groundwater monitoring program as per PTTW Number 5086-9BPM4A.

All supporting figures and tables referred to in this report are provided in Appendix C, located at the end of this report.

## 2.0 SCOPE OF PRODUCTION WELL MONITORING PROGRAM

According to PTTW Number 5086-9BPM4A, The Corporation of the Township of Haldimand is permitted to take water from PW1 and PW2 at rates up to 870 litres per minute for a maximum daily taking of 1,252,800 litres per day. The two wells are not to operate simultaneously. The PTTW expires on September 30, 2023.

PTTW Number 5086-9BPM4A includes seven Monitoring Conditions, which generally outline the scope of an annual groundwater and surface water monitoring program as well as trigger levels and contingency plans. The Monitoring Conditions include:

### Monitoring 4.1

- The Permit Holder shall maintain a record of all the water takings.

### Monitoring 4.2

- Annual sampling of three sentinel/monitoring wells located between Production Wells and Closed Grafton Landfill for the following general water quality:

Chloride	PH	TKN
Sodium	Alkalinity	Ammonia
Calcium	Iron	Organic Nitrogen
Magnesium	Conductivity	Dissolved Reactive Phosphorous
Potassium	Nitrate	TOC
Hardness	Nitrite	BTEX

### Monitoring 4.3

- Quarterly water level monitoring of groundwater locations
  - The test well near the Production Wells
  - Six local wells
  - Three closed Grafton Landfill monitoring well nests
  - Three monitoring wells



#### **Monitoring 4.4**

- Quarterly water level monitoring of three Cranberry Lake locations.

#### **Monitoring 4.5**

- If water level monitoring with respect to Monitoring Conditions 4.3 and 4.4 indicates a potential for flow from the Closed Grafton Landfill towards the Production Wells, the following contingency monitoring program would be implemented:
  - Notify Township and the MOE
  - Increase monitoring to monthly of the three monitoring wells with regard general water chemistry and BTEX.

#### **Monitoring 4.6**

- If the water quality testing with respect to Monitoring Conditions 4.2 and 4.5 detects BTEX or chloride greater than 125 mg/L, the following contingency monitoring program would be implemented:
  - Notify Township and MOE
  - Increase monitoring to weekly sampling of the three monitoring wells with regard to general water chemistry, total organic carbon and BTEX
  - Interpretative report to be submitted to the Township and MOE within two months of occurrence

#### **Monitoring 4.7**

- Preparation of an annual report that includes the following details:
  - Summary and assessment of annual water level data
  - Summary and assessment of annual water quality data

### **3.0 WATER LEVEL MONITORING RESULTS**

Hydrographs of the water level data collected from 1996 to 2016 are included in Appendix A, Figures A1 to A5. The hydrographs are grouped into five categories for comparison purposes such as the Landfill, Cranberry Lake, Shallow Wells, Intermediate Wells and Deep Wells. Water level data is summarized in Table A1 in Appendix A.

Noticeable water level fluctuations, relative to well depth, are apparent in all the shallow domestic wells, Cranberry Lake and the Landfill Observation Wells with the lowest levels observed in the months of September and October. There is also a noticeable water level fluctuation in the deeper aquifer (aquifer in which Grafton wells are developed), however, these fluctuations are not as significant as the shallow and intermediate aquifer wells relative to well depths. The water level increasing and decreasing trends in the monitoring locations are generally consistent with the historical data and the water level fluctuations are attributed seasonal fluctuations with high levels in the spring to seasonal lows in the fall. The shallower wells exhibit more noticeable seasonal fluctuations with the Ingram well exhibiting the greatest fluctuation.

The water levels at Cranberry Lake are monitored at three locations:  
SW1 – Lake Outlet  
SW2 – Lake Inlet  
SW3 – The Lake near the Production Wells.

The culvert measuring point of SW1 changed in September 2003 when the culvert was replaced with two new culverts and an examination of water levels pre and post water culvert improvements indicates that there has been no water level decline. The staff gauge at SW3 is prone to frost heaving and the stick up should be adjusted to 1.36 metres stick up every spring. Beavers dammed the Cranberry Lake outlet (near SW1) from 2002 to 2005 which resulted in elevated lake levels (the beavers were removed in approximately 2005). Overall, the water level trends at Cranberry Lake have remained relatively steady over the monitoring program.

The water levels in the deep aquifer suggest a relatively steady trend since the water level monitoring commenced in 1996. There were two lower than normal water levels measured at the MRF in 2012 but there does not appear to be a decreasing trend as water levels are higher before and after the low 2012 readings. There are noticeable water level fluctuations that occur per year and these oscillations are attributed the increased summer water taking from the aquifer. However, the aquifer appears to recover over the winter season with the aquifer recovering to near start up (1996) water levels. In view of the available drawdown in the wells completed within the developed aquifer zone and the minor seasonal influence observed, it is considered that no significant interference has occurred within the deep aquifer as a consequence of the continued operation of the Grafton Well.

Water disruption concerns were reported to the Township of Alnwick/Haldimand in October 1999 from the Johnston and Fearn residents. Based on the historical water level data collected, the water levels in Johnston and Fearn wells in September and October 1999 were the lowest water levels reported since water level monitoring commenced in 1996. The wells have recovered since October 1999 and the decreases in water levels are attributed to seasonal fluctuations. No water disruption concerns have been received from 1996 to 2016, except for the Johnston and Fearn 1999 reported concerns.

The projected drawdown after 36 hours of continuous pumping of PW2 at 870 L/min resulted in 2.34 metres drawdown at MW-deep. Based on an average static water level elevation of 144.03 metres amsl from the 1998 to 2001 water level data plus 2.34 metres of drawdown, a trigger water level elevation of 141 metres above sea level at MW-Deep was suggested (static water level not pumping level). The ground elevation at OW10 is 163.55 and represents a relatively high point at the Closed Landfill. Based on the ground elevation at OW10, a trigger water level elevation of 164 metres amsl was suggested for MW-shallow and MW-Intermediate (point at which groundwater level is lower than the ground level at the landfill). Based on water level elevation data provided in Figure 3, the water levels for 2016 were above the trigger elevations.

#### **4.0 WATER QUALITY MONITORING RESULTS**

Water samples were collected from the three monitoring wells (shallow, intermediate and deep) in March, June, September and December of every year since the wells were commissioned, except for a period in 1997 and 1998. The water quality monitoring was scaled back to two times per year (June and December) when PTTW Number 1306-68JPQL was issued. The water quality monitoring is now annually (December) with PTTW Number 5086-9BPM4A.

The monitoring wells are located upgradient of Highway #401 and approximately half way between the landfill and the Production Wells. The locations of the wells are indicated in Figure 2 and completion details are summarized in Table 1.

Monitoring Well-Deep (MW-Deep) is fitted with a dedicated submersible water well pump in order to facilitate the collection of representative water samples. MW-Shallow and MW-Intermediate were initially fitted with Waterra inertia pumps for the collection of water samples. The Waterra pumps were not used from July 1998 to September 2002 and a peristaltic pump was used instead. The peristaltic pump was unavailable following the September 2002 sampling and the Waterra inertia pumps were used for the December 2002 and March 2003 water samples. A dedicated small suction pump was used from 2003 to 2007. The small suction pump failed in 2008 and was replaced with a submersible sampling pump to ensure the wells were gently purged in order to avoid agitating the well (used for sampling from 2008 to 2016).

Prior to sample collection, MW-Deep is generally pumped for a minimum of four hours at 26 litres per minute (6240 litres purged) where as MW-Shallow and MW-Intermediate are pumped for 2 hours each (approximately 200 litres purged per well). The water was observed to be very turbid at the onset of the program in 1998 (inferred to be from incomplete well development and agitation from Waterra pump), however, the monitoring wells now generally produce clean sediment free water at start up. The shallow and intermediate wells were observed to be producing turbid water with the reuse of the Watter inertia pumps in December 2002 and March 2005. The shallow and intermediate wells were observed to be producing turbid free water with the dedicated sampling pump in 2016.

A summary of the water quality analyses is presented in Table B1 in Appendix B. Over the entire monitoring period, the concentrations of parameters for which analyses were completed are within the Ontario Drinking Water Standards (ODWS, 2006) with the exception of iron, aluminum, hardness, turbidity and organic nitrogen. These exceedances are common in groundwater and are not considered a problem. The parameter concentrations are generally consistent between sampling dates and the analytical results for this sampling period do not reveal any additional issues.

The parameters of concern from the closed Grafton Landfill have been established as chloride, alkalinity, hardness, iron and TDS. A graphical comparison of the monitoring well water chemistry since 1996 is included in Figures B1 to B5 in Appendix B along with Landfill water quality for OW6-II, OW10-II and OW16-II. Water levels in these Landfill observation wells are measured semi-annual along with the other monitored locations and according to previous CRA reports, OW6-II and OW16-II are influenced by landfill leachate and OW10-II is influenced by road salting activities. (CRA was acquired by GHD and now the reports are prepared under GHD as of 2015.)

The following is a summary of the trigger concentration guidelines for the monitoring wells along Edwardson Street:

<b>Parameter</b>	<b>Trigger Guideline</b>	<b>Notes</b>
Chloride	125 mg/L	From PTTW
Alkalinity	364	MABC from Conor Pacific 1998 Monitoring Report
Hardness	422	MABC from Conor Pacific 1998 Monitoring Report
Iron	1.7 mg/L	About 10% of average iron in OW2 and OW3
TDS	500 mg/L	ODWS
BTEX	Detection of	From PTTW

A graphical comparison of the landfill parameters of concern of the monitoring well water chemistry since 1996 (Figures B1 to B5 in Appendix B) does not suggest any water quality degradation trends with regard to these parameters. The concentrations are less than the trigger levels for the samples collected in 2016. The iron levels at MW-Intermediate can sometimes be elevated. This sometimes elevated iron is consistent with MW-Intermediate samples and the iron is attributed to turbidity.

## 5.0 CONCLUSIONS AND RECOMMENDATIONS

The Hamlet of Grafton is serviced by two Production Wells both completed to depths of about 77.7 metres below ground level (commissioned between 1995 and 1996). Only one Production Wells in service at a time with the other well serving as backup and the wells are located within 100 meters of each other. Well water from the wells is distributed to the Hamlet of Grafton through a reservoir/water works system located about 100 metres from the wells.

According to Permit to Take Water (PTTW) Number 5086-9BPM4A, The Corporation of the Township of Haldimand is permitted to take water from Production Well #1 (PW1) and Production Well #2 (PW2) at rates up to 870 litres per minute for a maximum daily taking of 1,252,800 litres per day. The PTTW includes eight Monitoring Conditions, which generally outline the scope of an annual groundwater and surface water monitoring program as well as trigger levels and contingency plans. The Monitoring Conditions generally include:

- Quarterly water level monitoring of 18 groundwater locations (local wells, Closed Grafton Landfill, and three monitoring wells).
- Quarterly water level monitoring of Cranberry Lake (3 surface water monitoring locations).
- Annual sampling of three monitoring wells for general water chemistry and BTEX

The primary purpose of the PTTW special conditions is to ensure that the operation of the Grafton wells do not captured leachate from the Closed Grafton Landfill located south of Highway #401.

The trigger water level elevations for the three monitoring wells are established as:

Location	Water Level Elevation
Monitoring Well – Deep	141 m amsl
Monitoring Well – Intermediate	164 m amsl
Monitoring Well – Intermediate	164 m amsl

The water levels in the monitoring wells along Edwardson Road were above the trigger elevations for 2016. As such, there were no exceedances.

The following is a summary of the water quality trigger concentrations for the monitoring wells along Edwardson Street:

Parameter	Trigger Guideline
Chloride	125 mg/L
Alkalinity	364
Hardness	422
Iron	1.7 mg/L
TDS	500 mg/L
BTEX	Detection of

The concentrations are less than the trigger levels for all the samples collected in 2016. Based on the water quality data collected in the Groundwater Monitoring program as per PTTW special conditions, the degradation of water quality as observed in some of the Closed Grafton Landfill groundwater monitors is not observable in the Monitoring Wells along Edwardson Road. There are no obvious water quality impacts or changes such as elevated salt to suggest road salting impacts or leachate migration from the nearby Closed Grafton Landfill in these wells.

If residents are connected to a municipal water supply system, the Ontario Water Resources Act (O. Reg. 903) requires that well owners' abandon their wells if a well is not being used or maintained for future use. Unused wells should be abandoned in accordance with Ministry of the Environment Guidelines to ensure the protection of aquifers.

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