**REPORT**

# Nestlé Waters Canada - Erin

## *Technical Study for Permit To Take Water Renewal Application*

Submitted to:

**Ministry of the Environment, Conservation and Parks**
West Central Region
119 King St. W., 12th Floor
Hamilton, ON L8P 4Y7

Submitted by:

**Golder Associates Ltd.**
**S.S. Papadopulos & Associates, Inc.**
**C. Portt & Associates**
**Beacon Environmental**

13-1152-0250 (9000)

June 2019

# Distribution List

1 Copy - Nestlé Waters Canada

1 Copy - MECP

1 Copy - Golder Associates Ltd.

# Executive Summary

Nestlé Waters Canada (Nestlé) is submitting this Technical Study Report in support of its Permit To Take Water (PTTW) renewal application. The current PTTW (Number 3716-8UZMCU) was issued in September 2012 and expired on August 31, 2017. The PTTW renewal application was submitted to the Ministry of the Environment, Conservation and Parks (MECP, formerly the Ministry of the Environment and Climate Change) in May 2017. Well TW1-88 continues to operate under the terms of the existing PTTW in accordance with the Ontario Water Resources Act Section 34.1 (6) until a decision is made regarding the renewal. Key facts and findings presented in the Technical Study Report are as follows:

- The supply well, TW1-88, referred to as the Erin well, is used for the purpose of bottling water and is permitted to pump at 773 L/min (1,113,000 L/day). Nestlé proposes to continue using the well for this purpose with no increase in the permitted water taking.
- TW1-88 has been permitted and operating since 2000.
- Comprehensive annual monitoring reports are prepared for the Erin well (TW1-88) under the conditions of the PTTW that remains in effect.
- In 2014 bottled water consumption surpassed carbonated soft drinks in Canada and continues to grow. Nestlé wants to continue to provide a healthy beverage alternative from its water source in Erin.
- In the past four years (2015 – 2018) the daily takings have ranged from 0 L/day to 937,836 L/day.
- The annual water takings have ranged from a minimum of 54.0 million litres in 2007, to a maximum of 282.8 million litres in 2001. Since 2000, the annual groundwater taking has ranged from approximately 13% to 70% of the current permitted annual taking of 406,288,800 L.
- TW1-88 is completed in the dolostone bedrock aquifer that is overlain by a sandy silt/clay aquitard and a surficial sand and gravel aquifer.
- TW1-88 is located outside of municipal water quality wellhead protection areas (WHPA) but within the upper end of the City of Guelph Eramosa Intake water quantity intake protection zone (IPZ-Q). A review by the Source Protection Committee indicates that the consumptive water use within the IPZ-Q is negligible compared to the natural variability in flow of the Eramosa River at the intake and therefore, on an average basis, consumptive water takings are not expected to impact the municipal surface water intake's ability to pump.
- There have been no well interference complaints arising from the water taking from TW1-88.
- The variations in water levels in TW1-88 are due mainly to short-term changes in the pumping rate. The long-term water level fluctuations in TW1-88 are relatively stable. On-going pumping from TW1-88 has not led to a long-term declining trend in water levels in the well.
- Water levels in the bedrock aquifer have been similar over the years with no long-term increasing or decreasing trend. The influence that pumping TW1-88 has on water levels in other wells decreases with distance from TW1-88.

- Water level fluctuations in the overburden are due to natural seasonal changes and recharge and are not due to pumping TW1-88.
- Water levels in the mini-piezometers fluctuate seasonally with higher water levels observed in the spring and lower water levels observed in the late summer. The water levels also show a response to precipitation and melt events. Overall the water levels have been stable.
- Long-term surface water levels are stable and pumping at TW1-88 does not influence the water levels in the surface water features. Water levels in the surface water features respond to precipitation and melt events.
- Surface water flow is influenced by precipitation and/or melt events and is not influenced by pumping at TW1-88.
- Water quality at TW1-88 has not significantly changed over the last 17 years and is characterized as a calcium-magnesium-bicarbonate type, consistent with a carbonate aquifer.
- Portions of the Erin property include high quality terrestrial, wetland, and aquatic habitats, some of which are designated as provincially and regionally significant. Since 2008, Nestlé has regularly monitored these ecosystems. Some changes have been observed in the various ecological parameters monitored over this period; however, these changes are related to natural succession and beaver activity. All of the changes are considered to be within the expected range of natural variation for the types of ecosystems present. The water taking does not influence the terrestrial, wetland and aquatic ecosystems that are supported by the shallow groundwater system and surface water.
- The withdrawal does not result in physical and ecological impacts to the wetlands in the Eramosa River headwaters, which are monitored and assessed annually.
- There are no long-term adverse impacts to other water users and the environment from the historical water taking from TW1-88 (2000-2018). The water taking does not prevent water users from continuing their established pattern of use. The groundwater withdrawal from TW1-88 does not interfere with existing or future municipal uses.

# Table of Contents

**TABLES**

**FIGURES**

**APPENDICES**

# 1.0 INTRODUCTION

Nestlé Waters Canada (Nestlé) has retained Golder Associates Ltd. (Golder), S.S. Papadopulos & Associates, Inc. (SSPA), C. Portt and Associates and Beacon Environmental (Beacon) to prepare this Technical Study Report in support of a Permit To Take Water (PTTW) renewal application for TW1-88 at its Erin facility. The current PTTW (Number 3716-8UZMCU) was issued in September 2012. The PTTW renewal application was submitted to the Ministry of the Environment, Conservation and Parks (MECP, formerly the Ministry of the Environment and Climate Change) in May 2017. The current PTTW expired on August 31, 2017, but in accordance with the Ontario Water Resources Act Section 34.1 (6), Nestlé continues to operate TW1-88 under the terms of the existing PTTW until a decision is made regarding the renewal.

On December 16, 2016, Ontario Regulation 463/16 (Taking Groundwater to Produce Bottled Water) came into effect. The regulation prohibits a Director from issuing a new or amended permit that would authorize the taking of groundwater for the purpose of producing bottled water, unless the old permit already authorized the taking of the same or a greater amount of groundwater from the same location and for the same purpose. The PTTW authorizes water taking from one bedrock well located on the Nestlé property in Erin/Hillsburgh. Water from TW1-88 is taken for the purpose of bottling water and Nestlé proposes to continue using the well for this purpose with no increase in the permitted water taking.

This report provides the technical background in support of the PTTW renewal application. The study conforms to the requirements outlined in the Interim Procedural and Technical Guidance Document for Bottled Water Renewals: Permit to Take Water Applications and Hydrogeological Study Requirements prepared by the MECP in April 2017 to evaluate long-term impacts to other water users and the environment from the water taking. The PTTW renewal process and technical study requirements conform with the MECP's Statement of Environmental Values, which are in place "to protect, conserve and where reasonable, restore the integrity of the environment".

With increased focus on health and wellness, Canadians are actively managing their lifestyles and drinking more water, which is considered the most affordable "healthy" beverage. In 2014 bottled water consumption surpassed carbonated soft drinks in Canada and continues to grow. Nestlé wants to continue to provide a healthy beverage alternative from its water source in Erin.

## 1.1 Setting

The Erin property is located on a 75.5 hectare parcel in the southwest part of Lots 23 and 24, Concession 7, Town of Erin in Wellington County. The well is approximately 4 km west of the Town of Erin (Figure 1), 24 km north-northeast of Guelph, and approximately 35 km north of the Nestlé Aberfoyle bottling facility, to which the water is transported for processing.

The Erin property consists of a water silo, house, barns, paved access drives, ponds, and open fields with wooded areas and wetlands. No pesticides or herbicides are used on the agricultural land owned by Nestlé. Figure 2 is a recent aerial photograph showing the Erin property and land uses on adjacent properties.

## 1.2 Historical Summary

TW1-88 was constructed in August 1988 by Ryor's Drilling for a party other than Nestlé. In 1989, water was permitted to be taken from the well for a 10-year period at a maximum withdrawal rate of 1,112,860.8 L/day. However, the well was only used one day during this initial 10-year period.

In 1999, further testing was completed at TW1-88 and the well was re-permitted by the original owner. Nestlé purchased the property and began pumping for commercial purposes in March 2000; the well has been permitted continuously since that time. The PTTW allows water to be taken as outlined in Table 1. TW1-88 is permitted for a maximum instantaneous pumping rate of 773 L/min for a total maximum daily water taking of 1,113,000 L/day. A copy of the current PTTW (Number 3716-8UZMCU) is provided in Appendix A.

**Table 1: Permitted Water Taking at Erin**

| Source | Maximum Instantaneous Rate | Maximum Number of Hours of Water Taking per Day | Maximum Daily Water Taking | Maximum Number of Days of Water Taking per Year |
|---|---|---|---|---|
| TW1-88 | 773 L/min* | 24 | 1,113,000 L* | 365 |

* The maximum instantaneous rate and maximum daily water taking may increase up to 946 L/min and 1,362,240 L/day ("spike rate") in each month between April 1 and September 30; however, the average daily taking in any month between April 1 and September 30 shall not exceed 1,113,000 L/day.

When water withdrawals for bottling began at the property, tankers were originally filled directly from the well. Starting in 2001, water pumped from TW1-88 has been transferred via pipeline to a 227,305 L stainless steel water storage silo. The silo is used for short-term storage where highway tanker trucks are filled. TW1-88 is located in the northern portion of the property and the loading station is situated in the southern portion of the property.

## 1.3 Previous Studies

Investigations have been conducted over the years to help establish whether the water supply is sustainable and if there are any impacts to the natural environment. Key investigations are summarized in the following reports:

- Well Construction and Testing Investigation (CRA, 1989); and
- Test Pumping Investigation Supply Well TW1-88 – Draft (CRA, 2006).

In 2000, Nestlé initiated a Long-Term Monitoring (LTM) program to evaluate both natural and pumping-induced changes in water resources. Annual reports of the LTM program have been provided to MECP as required by the PTTWs. Terrestrial and aquatic studies are also completed at the property by Beacon Environmental and C. Portt and Associates, respectively.

# 2.0 BACKGROUND

## 2.1 Description of Taking

In the past four years (2015 – 2018), the daily water takings have ranged from 0 L/day to 937,836 L/day which is 84% of the permitted daily water taking of 1,113,000 L/day.

The annual water takings have ranged from a minimum of 54.0 million litres in 2007, to a maximum of 282.8 million litres in 2001. Since 2000, the annual groundwater takings have ranged from approximately 13% to 70% of the current permitted annual taking of 406,288,800 L (Figure 3).

Groundwater withdrawals from Erin well TW1-88 have averaged 362,642 L/day over the last 10 years (2009 – 2018) as shown in Table 2. This rate is 33% of the maximum permitted withdrawal rate of 1,113,000 L/day. In 2018, the equivalent average daily withdrawal rate was 190,152 L/day, 17% of the maximum permitted withdrawal rate. The water takings over the past four years have been lower than the 10-year average.

**Table 2: Erin Annual Withdrawals**

| Year | Total Annual Withdrawal (Litres) | Annual Average Rate (L/day) | Annual Average Percent of PTTW |
|---|---|---|---|
| 2009 | 132,260,857 | 362,359 | 33 |
| 2010 | 157,877,281 | 432,540 | 39 |
| 2011 | 162,774,434 | 445,957 | 40 |
| 2012 | 204,766,809 | 559,472 | 50 |
| 2013 | 223,697,991 | 612,871 | 55 |
| 2014 | 146,030,433 | 400,083 | 36 |
| 2015 | 78,485,480 | 215,029 | 19 |
| 2016 | 82,269,338 | 224,780 | 20 |
| 2017 | 66,074,786 | 181,027 | 16 |
| 2018 | 69,405,417 | 190,152 | 17 |
| 10-year Average (2009-2018) | 132,364,283 | 362,642 | 33 |

As indicated, water withdrawn from TW1-88 is transported to the Aberfoyle facility and used for bottling water purposes. Water is not discharged back to the environment at the Erin property and therefore there are no Environmental Compliance Approvals (ECA) required at the property.

## 2.2 Justification of Bottled Water Taking

According to A.C. Nielsen (2019), the following key points have been identified regarding the value of bottled water:

- In terms of volume, water is the number one consumed beverage in Canada;
- 74% of Canadians are actively managing their health and wellness lifestyles and are trying to drink more water;
- Water is considered as the most affordable “healthy” beverage, with a repeat purchase rate of 80% amongst consumers;
- Over the past three years, the bottled water category grew by 16%;
- Household penetration of bottled water (defined as the number of households who have purchased bottled water) is approximately 74% in Canada; and
- Household penetration for bottled water has been steadily increasing since and in 2014, bottled water consumption exceeded carbonated soft drinks.

In addition, Health Canada recommends water as the preferred drink of choice in Canada’s Food Guide.

Bottled water is not only important from an economic and health perspective, it is essential in time of emergencies. In 2017 and 2018, Nestlé donated over 2 million bottles of water to Canadians in crises during floods and fires, charitable donations and homelessness initiatives. Nestlé also has a partnership with the Canadian Red Cross to support the organization in times of need.

The above information indicates how important the bottled water industry is and based on the current consumer demand Nestlé is requesting that the water taking be kept at the same daily rate and amount as in the current permit. Over the past five years, there have been days when Nestlé has taken 90% or greater of their maximum daily permitted takings to meet peak demands. The volume of water withdrawn fluctuates based on demand. That demand varies from day to day and week to week so having flexibility is key to running an efficient business that enables Nestlé to respond to consumer and customer needs.

Also, Nestlé’s Erin facility is located in an area without municipal water supply; therefore, a portion of the water is also used to run the daily operations (i.e., flushing of silos). Nestlé is committed to continuously improving its water efficiency; however, this needs to be factored in to the overall water usage.

The Erin source currently represents the only source of redundancy for their Aberfoyle operation (i.e. a redundant supply is critical for any business). The Erin maximum permitted capacity can support approximately 50% of the Aberfoyle plant needs and therefore, is essential until a secondary back up source can be brought on-line. The Erin source is also currently the only source that can provide some operational flexibility for their Aberfoyle operation when conducting well maintenance and testing on the Aberfoyle source.

## 2.3 Supply Well TW1-88

The borehole log for TW1-88 is provided in Appendix B. TW1-88 is interpreted to be completed within the Guelph Formation limestone and dolostone. The bedrock is overlain by glacial sediments that are 19.5 m thick at TW1-88. The overburden consists of two general units: the uppermost unit consists of interlayered sand and gravel with varying amounts of silt to a depth of 12.2 m below grade, and the lower unit consists of 7.3 m of sandy silt till/clay till. A 170 mm diameter high-carbon steel casing was drilled through the overburden and into the bedrock, and grouted 1.4 m into the bedrock at a depth of 20.9 m below grade. The well was completed as a 160 mm open borehole in bedrock with a depth of 57.3 m.

In 2010, a downhole video survey revealed that the original high carbon steel casing had some pitting (CRA, 2014). To prevent potential casing failure in the future and to upgrade the well to Nestlé standards, the original casing was overdrilled and removed, and a 200 mm diameter stainless steel casing was installed to a depth of 21.8 m. The new casing was cement grouted in place.

The lower portion of the well was noted to have been completed within a poor production zone (CRA, 2014). The bottom 18.3 m of the well was grouted with cement from 57.3 m to 39 m below grade in 2010. The revised water well record (Well Tag No. A095193) is included in Appendix B, and a schematic of the well is shown on Figure 4.

A nominal 152 mm diameter Grundfos pump (Model 230S200-6) with a 20 hp, 575 V, 3 phase motor, is currently installed in the well. The submersible pump installed in TW1-88 is suspended on 25.8 m of nominal 76 mm diameter schedule 40 stainless steel riser pipe.

## 2.4 Land Use

The Erin property consists of a 75.5 hectare parcel of land with open fields, wooded areas and wetlands (Figure 2). Local land uses surrounding the Nestlé property are illustrated on Figure 5 and include:

- Rural residential;
- Agricultural; and
- Vacant land to the northeast.

The Town of Hillsburgh, approximately 1 km north of TW1-88, consists of a variety of residential, commercial, and institutional uses. The built-up area of Hillsburgh continues southeast along Trafalgar Road, east of the TW1-88 property.

Nestlé is committed to preserving the natural environment and protecting the water supply within the land area that it controls.

## 2.5 Characterization of the Regional Setting

### 2.5.1 Topography

The topography and drainage of the property and surrounding area is shown on Figure 6. The regional topography is characterized by knobby hills surrounded by low-lying wetlands and/or streams with overall ground elevations increasing to the northwest. Ground surface elevations are highest near the middle of the property (450 masl) and decline toward the northwest (430 masl) and southern (410 masl) parts of the property. The topography is relatively flat in the northern part of the property and rolling elsewhere. In general, surface water features occur within the topographic lows.

### 2.5.2 Physiography

The area is situated between the physiographic regions described by Chapman and Putnam (1984) as the Guelph Drumlin Field (to the south) and the Hillsburgh Sandhills (to the north). Chapman and Putman (1984) characterize the Guelph Drumlin Field as drumlins fringed by gravel terraces and separated by swampy valleys in which flow sluggish tributaries of the Grand River. The drumlins are made up of glacial till. Chapman and Putnam (1984) characterize the Hillsburgh Sandhills as a glacial spillway with knobby hills. Surficial soils are generally sandy with swampy valleys.

### 2.5.3 Ecological Setting

The upland portions of the property comprise agricultural fields. The low-lying areas support forest and wetlands (Figure 2). The wetlands on the Grand River watershed portion of the property are part of the Speed Lutteral Swan Creek Wetland Complex. The wetlands on the Credit River watershed portion of the property are part of the West Credit River Wetland Complex. Both wetland complexes are designated as Provincially Significant Wetlands. The wetlands are generally undisturbed and support a diverse range of flora and fauna, including some that are ranked as locally significant.

## 2.6 Geology

The geology in the area has been interpreted based on published mapping, water well records, and detailed stratigraphic logging (CRA, 2014). Borehole logs are included in Appendix B.

### 2.6.1 Overburden Geology

The regional quaternary geology in the area of the property is shown on Figure 7. The surficial overburden of the area is characterized by the following units:

- Organic deposits;
- Glaciofluvial sandy deposits;
- Ice-contact stratified deposits; and
- Silty to sandy till.

The area to the south, southeast and east of the property generally contains silty to sandy till at surface with ice-contact stratified drift and glaciofluvial sand and gravel deposits occurring mainly in the low-lying areas. The area west, northwest and north of the property generally contains ice-contact stratified deposits that make up the surficial soils of the Orangeville Moraine. The property lies between these features, with till deposits occurring through the middle of the property where ground elevation is higher and sand and gravel deposits occurring toward the northwest and southeast parts of the property.

Three cross-sections through the property have been developed (Figures 8 through 10) with the locations shown on Figure 7 (CRA 2014). Two overburden stratigraphic units are interpreted to be present in the vicinity of the property:

- An upper sand and gravel originating from glaciofluvial outwash or ice-contact stratified drift; and
- A lower sandy silt/clay till.

The sand and gravel unit consists of sand, gravel, or sand and gravel, and generally increases in thickness to the northwest of TW1-88, but is generally absent to the south, southeast, and east of TW1-88. The sandy silt/clay till is continuous across the property and is present below the sand and gravel unit or at surface where the sand and gravel unit is not present. The till typically ranges in thickness from about 5 m to 35 m within 1 km of TW1-88.

### 2.6.2 Bedrock Geology

The regional bedrock geology is shown on Figure 11. The uppermost bedrock unit consists of dolostone of the Guelph Formation below the property, and dolostone of the Amabel Formation (the Ontario Geological Survey now identifies the rock of the Amabel Formation as comprising the Eramosa, Goat Island, Gasport or Irondequoit Formations) east of the property. Liberty (1975) describes the Guelph Formation in this area as light brown, fine to medium crystalline sucrosic dolostone. TW1-88 is completed within the Guelph Formation.

## 2.7 Hydrogeology

There are three hydrostratigraphic units present at the property as follows (from top to bottom):

- Surficial sand and gravel aquifer;
- Sandy silt/clay till aquitard; and
- Dolostone bedrock aquifer (Guelph Formation).

The Erin property is located in a regional recharge area of a very large and robust bedrock aquifer system. The water table generally lies within the surficial sand and gravel aquifer. The direction of groundwater flow within the water table aquifer occurs in a southerly to southwesterly direction in the vicinity of TW1-88. Water recharges regionally through the glacial overburden and into the Guelph aquifer on the Orangeville Moraine, generally north and northwest of the Erin property.

The surficial sand and gravel aquifer and bedrock aquifer are separated by a sandy silt/clay till unit which acts as an aquitard. The difference in water levels between the aquifers indicates that the till acts as an aquitard and that a downward vertical gradient exists under both pumping and non-pumping conditions.

The bedrock aquifer does not supply the pond network on the Erin property. The potentiometric surface of the bedrock aquifer is approximately 5 metres below the surface elevation of the on-Site pond. The bedrock aquifer also does not discharge to the tributary of the Eramosa River that flows from the wetland to the pond network. The tributary is supplied almost exclusively by runoff from surrounding topography, precipitation on the wetlands and pond and discharge from the overburden aquifer.

The carbonate units of the Guelph Formation comprise a regional aquifer, utilized by residential, commercial, and municipal water supplies. The bedrock aquifer is the main water supply aquifer in the vicinity of the property for both the Nestlé supply and private wells.

### 2.7.1 Pumping Tests

To better understand the hydraulic characteristics of the aquifers on a larger scale and determine flow within the groundwater system, pumping tests have been conducted on the property. Two pumping tests have been completed at the property as follows:

- TW1-88 - 24-hour initial test in August 1988; and
- TW1-88 – 7 day test in November 2005.

A summary of the testing is as follows. A copy of the original pumping test report is included on CD (attached).

## 1988 Pumping Test

- 24-hour pumping of TW1-88 at 546 L/min;
- Drawdown at TW1-88 stabilized at 6.9 m after 6 hours of pumping;
- Estimated transmissivity of 170 $m^2$/d;
- The fine-grained till provides some degree of protection from surface contaminants which could potentially migrate to the underlying bedrock; and
- A sustained yield of 546 L/min was demonstrated and it was estimated that a yield of 773 L/min could be maintained based on the size of the well.

## 2005 Pumping Test

- Seven (7)-day pumping test of TW1-88 at 1,227 L/min with 12.5 hours of shutdown prior to the test;
- Drawdown at TW1-88 stabilized at 13.7 m after about 8 hours of pumping;
- Groundwater flow in the bedrock aquifer under static conditions is to the southeast;
- Groundwater flow in the bedrock under pumping conditions indicates that although some flow is directed toward TW1-88, the overall flow to the southwest is maintained (pre-pumping flow paths exist at a distance of about 1,000 m to the northwest and southeast of TW1-88);
- The area in the bedrock affected by pumping is elongated to the southwest. Based on the 1 m drawdown contour, the area influenced by pumping extends about 850 m to the northwest, 850 m to the southeast, and 650 m to the northeast of TW1-88. The 1 m drawdown contour is not defined to the southwest;
- Water level changes in the overburden were generally not evident or less than 0.1 m with vertical hydraulic gradients remaining unchanged;
- Surface water flow did not appear to be influenced by pumping;
- No complaints were received during the test; and
- A long-term yield of 1,227 L/min was sustained.

## Transmissivity Estimate

Consistent estimates of the transmissivity of the Guelph Formation in the vicinity of TW1-88 are obtained from the data collected during the controlled pumping tests and from the interpretation of ongoing well performance data.

Step and constant-rate pumping tests have been conducted at TW1-88 in 1988 and 2005 (CRA, 1989; 2006). The results of the testing are summarized graphically on Figure C1, in which the pumping rates are plotted against the observed drawdowns in the well. The data from the 1988 step test and the two constant rate tests approximate closely a straight line, suggesting that nonlinear well losses in TW1-88 are negligible. The data also suggest that the pumped aquifer is effectively confined, with the water level in the well remaining at all times above the top of the primary bedrock flow zones.

The slope of the straight line shown on Figure C1 is designated the specific capacity of TW1-88. The specific capacity is estimated to be 1.53 L/s/m of drawdown as described further in Section 5.2.1.

Following the approach of Driscoll (1986), a preliminary estimate of the transmissivity (T) can be obtained from the specific capacity (SC) as follows:

$$\mathrm{T} \sim 1.3\ SC$$

Therefore, as a first approximation:

$$\mathrm{T} \sim 1.3\ \left(1.53\ \frac{\mathrm{L/s}}{\mathrm{m}}\right)\left|\frac{\mathrm{m}^3}{1000\ \mathrm{L}}\right|\left|\frac{84600\ \mathrm{sec}}{\mathrm{day}}\right| = 170\ \mathrm{m}^2/\mathrm{d}$$

Since the drawdowns plotted on Figure C1 correspond to stable conditions, and the data approximate a straight line, the transmissivity can also be estimated with the steady-state Thiem solution [see Bear (1979), page 304, for example]:

$$T = \mathrm{SC}\ \frac{1}{2\pi}\ \ln\left\{\frac{\mathrm{R}}{\mathrm{r_w}}\right\}$$

Here $r_w$ denotes the radius of TW1-88 and R represents the effective radius of influence. It is not possible to estimate the radius of influence of TW1-88 from only the drawdown data for the pumping well. However, as shown on Figure C2 the estimated transmissivity is not particularly sensitive to its assumed value. Over a relatively wide range of the assumed value of $R/r_w$ the transmissivity is on the order of 200 $m^2$/d, which is consistent with the preliminary estimate.

As discussed further in Section 5.2.1, the historical performance of TW1-88 and the long-term performance data for TW1-88 are consistent with the estimated specific capacity of 1.53 L/s/m. Therefore, these data would also support a transmissivity estimate of about 200 $m^2$/d.

Distributions of drawdowns in the Guelph Formation caused by pumping TW1-88 are presented in CRA (2006) and CRA (2014). The distribution of drawdown interpreted at the end of the 7-day pumping test conducted in 2005 is reproduced on Figure C3. The distribution of drawdown interpreted at the end of 18 hours of pumping in 2001 is reproduced on Figure 13. The distributions of drawdown highlight both the consistency of the responses at different pumping rates, and the relatively smooth nature of the response in the rock. The distributions suggest that it is appropriate to interpret the effects of pumping with an equivalent porous medium conceptualization.

A Cooper Jacob analysis of the drawdowns in TW1-88 during the 1988 constant rate pumping test is shown on Figure C4. The slope of the portion of the response that is representative of the response of the formation yields a transmissivity estimate of about 180 $m^2$/day:

$$\mathrm{T} = 2.303\ \frac{\mathrm{Q}}{4\pi}\frac{1}{\mathrm{SLOPE}}$$

$$= 2.303\ \frac{(9.1\ \mathrm{L/s})}{4\pi}\frac{1}{(0.80\ \mathrm{m})}\left|\frac{\mathrm{m}^3}{1000\ \mathrm{L}}\right|\left|\frac{86\ 400\ \mathrm{sec}}{\mathrm{day}}\right| = 180\ \mathrm{m}^2/\mathrm{day}$$

This transmissivity estimate is similar to the estimates developed from the specific capacity of TW1-88.

The drawdowns at the end of the 7-day constant rate pumping test conducted in 2005 are plotted on Figure C5. The transmissivity estimated from a Cooper Jacob distance drawdown analysis is:

$$\mathrm{T} = 2.303\ \frac{\mathrm{Q}}{2\pi}\frac{1}{\mathrm{SLOPE}}$$

$$= 2.303\ \frac{(270\ \mathrm{Igpm})}{2\pi}\frac{1}{(3.03\ \mathrm{m})}\left|\frac{\mathrm{m}^3}{219.969\ \mathrm{Igal}}\right|\left|\frac{1440\ \mathrm{min}}{\mathrm{day}}\right| = 210\ \mathrm{m}^2/\mathrm{day}$$

This transmissivity estimate is again similar to the estimates developed from the other analyses.

The consistency of the transmissivity estimates, and the regular and reproducible patterns of the interpreted drawdowns suggest that the properties of the Guelph Formation in the vicinity of TW1-88 are predictable and amenable to conventional methods of analyses.

### 2.7.2 Groundwater Flow

The regional bedrock aquifer is inferred to be recharged through the Orangeville Moraine north to northwest of TW1-88. Groundwater flows generally south to southeast in the direction of TW1-88, approximately parallel with the surface water divide between the Grand River and the Credit River watersheds. The bedrock aquifer extends to the south and west toward Guelph and Fergus. The Niagara Escarpment outcrop, which is the abrupt extent of the bedrock aquifer system, is about 12 km east of the property.

The potentiometric surface prior to pumping (January 24, 2000) is shown on Figure 12 (CRA 2014). Groundwater flow in the absence of pumping is to the south-southeast with a horizontal gradient of about 0.015 m/m. CRA (2014) notes that static water levels typically ranged from 6 to 16 m bgs, and the water level at TW1-88 before pumping began was about 10 m bgs (i.e., elevation of 424.3 masl).

A map showing the drawdown in the bedrock aquifer on June 15, 2001, after 18 hours of pumping TW1-88 at 773 L/min, is included on Figure 13 (CRA, 2014). The map shows that the zone of influence at this pumping rate (based on a drawdown of 0.1 m) extends approximately 1,000 m from TW1-88 to the west, north and east; and to the south and southwest, the zone of influence is greater than 700 m from TW1-88.

## 2.8 Surface Water Features

Well TW1-88 is situated in the Grand River watershed, near the surface water divide with the Credit River watershed (Figure 1). Specifically, TW1-88 is located in the Eramosa River subwatershed of the Grand River. The following sections discuss surface water features and flow measured in parts of the regional (Grand River and Credit River) and local (Eramosa River) watersheds.

### 2.8.1 Grand River Watershed

The Grand River flows 290 km through southern Ontario, from its source near the village of Dundalk just south of Georgian Bay, to Port Maitland at Lake Erie. Together with its major tributaries, it drains 6,965 square kilometres and is the largest watershed in southern Ontario. The Grand River traverses through wetlands, gorges, farmlands, gravel moraines, Carolinian Forest, and broad marshes (Grand River Conservation Authority, 2019 and Canadian Heritage Rivers System, 2019).

The nearest Grand River gauging station to Erin is located in Galt, downstream of where the Eramosa River flows into the Speed River which in turn flows into the Grand River. From 2008 through 2018, the average flow at this station was 46,876 L/s and the median flow was 26,850 L/s. The flow has ranged from a minimum flow of 6,441 L/s to a maximum flow of 780,000 L/s.

### 2.8.2 Eramosa River Subwatershed

There are two ponds on the Nestlé property within the watershed, as shown on Figure 6: one pond referred to as the “on-Site Pond” located approximately 135 m southwest of TW1-88, and one pond referred to as the “Wetland

Pond", approximately 265 m south-southeast of TW1-88. The ponds discharge to an unnamed perennial tributary of the Eramosa River that flows in a southwest direction. Flow in the unnamed creek has been measured by Nestlé at a location immediately west of the property (SW1) as shown on Figure 14. Flow has been measured as high as 91 L/s but typically ranges from 10 L/s to 30 L/s (Figure 14).

The Eramosa River originates west of the property and flows generally in a northeast to southwest direction through Wellington County to the City of Guelph, where it joins the Speed River, which then flows into the Grand River in Cambridge. The catchment area of the Eramosa River subwatershed is 275.9 square kilometres (106.5 square miles).

Flow in the Eramosa River is monitored by the GRCA at a station near Guelph (Eramosa River WSC Station 02GA029), approximately 25 km southwest of the property. Data are publicly available for the station and the stream flow record is presented on Figure 15. The average flow near Guelph for the last 10 years (January 2009 through December 2018) is 2,610 L/s and the median flow is 1,710 L/s.

### 2.8.3 Credit River Watershed

The Erin Branch of the Credit River is located east of the property and flows in a general southeasterly direction, ultimately discharging to the Credit River. At its closest point, the creek is located approximately 470 m from TW1-88. Off the property (to the north and east), there are three large on-line ponds located along the Erin Branch of the Credit River. Another large surface water body located within the Credit River watershed, referred to as Roman Lake, is located about 1.2 km southeast of TW1-88. The Credit River ultimately discharges to Lake Ontario near Mississauga, Ontario.

## 2.9 Water Use

Local groundwater use consists of low-capacity residential use, commercial use, and municipal use. The higher water uses are for municipal supply (Hillsburgh and Erin) and bottling water.

### 2.9.1 Private Wells

There are some water takers that use less than 50,000 L/d, including commercial and agricultural use. The majority of wells in the vicinity of TW1-88 are private residential wells for typical household use. These wells are completed within the overburden or bedrock aquifers.

To gain a better understanding of the number of wells in the area, water well records were downloaded from the MECP website and are plotted on Figure 16. There are 60 water well records within 1 km of TW1-88 (Table B1 in Appendix B). The reported uses of those wells include 8 observation wells, 44 water supply wells, 6 abandoned wells and 2 with no use listed. Of the 44 water supply wells, the uses include 39 domestic, 2 commercial and 3 livestock. There are 7 water supply wells completed in the overburden and 37 completed in the bedrock.

Private well surveys are typically conducted to identify existing water users, collect well construction details and well use data and confirm the location of the wells to help assess potential impacts of the proposed water taking. Private well surveys have been conducted in the past around the Erin facility to identify wells for monitoring, as part of pumping tests and/or as part of previous studies. These included an initial survey in 1999, a survey in 2005 as part of the pumping test and a survey in 2007 to identify additional monitoring locations. As part of this study, a private well survey was conducted to update and/or provide additional information on private wells in the area.

Since there are a large number of private wells in the area, and previous surveys have been completed, a subset of the wells was identified and assessed for this study. The approach adopted to identify the subset is described below:

1) Identify water well records within 1 km of TW1-88 (approximate zone of influence);
2) Select water well records that are used for water supply (active wells);
3) Remove wells monitored by Nestlé (already monitored);
4) Remove water well records that plot in the wrong location (unknown reliability);
5) Remove water well records that are located in subdivisions with a water supply (wells likely not used anymore); and
6) Remove water well records constructed prior to 2000 (start of Nestlé water taking).

Following the screening, five (5) wells were selected for the private well survey. The private well survey was conducted on June 21, 2018 during the daytime working hours. At private residential locations, if there was no one home during the day, a letter and survey were left in the door or mailbox (see Appendix B for the letter and survey form). One owner completed the survey, one owner did not want to participate and one location was on the Nestlé property. The two additional locations not on the Nestlé property were gated. Since access could not be achieved, a second attempt to survey the domestic wells was not attempted; however, the letter and survey were left in the mailbox. A summary of the private well survey is included in Table B2 in Appendix B. Of the surveys delivered only one survey was completed for the location with Well ID 6714803.

### 2.9.2 Permitted Water Takings

A search of the MECP database indicates that there are two other water takings within 2 km of TW1-88 with a PTTW. Details of the PTTWs are listed in Table 3.

**Table 3: Permits To Take Water within 2 km of TW1-88**

| Name | PTTW Number | Purpose | Source | Maximum Litres per Day | Maximum Days of Taking per Year |
|---|---|---|---|---|---|
| The Corporation of the Town of Erin | 7740-A9ZNTP | Municipal Water Supply | Well H3 | 655,000 | 365 |
| | 6306-8X5KRY | | Well H2 | 982,000 | 365 |

These PTTWs are for the municipal wells in Hillsburgh (Figure 2). In 2016, the average day pumping at H3 was 86.7 $m^3$/day (13.3% of permitted rate) and increased to 103.5 $m^3$/day (15.8% of permitted rate) in 2017. The average day pumping at H2 was similar in 2016 and 2017 at 75.9 $m^3$/day (7.7% of permitted rate).

## 2.10 Source Water Protection

With the passing of the Clean Water Act (2006), municipalities in Ontario are required to develop source protection plans to protect their municipal sources of drinking water. These plans identify both water quality and water quantity risks to local drinking water sources and develop strategies to reduce or eliminate these risks. Potential and existing risks for a municipal source are identified within wellhead protection areas (WHPAs). A WHPA is an area projected to ground surface that reflects the zone in an aquifer where groundwater is flowing to a municipal drinking water source (pumping well). These areas are defined to protect water quality. The Nestlé Erin property and well TW1-88 are located more than 1.4 km from the closest WHPAs, which include the Hillsburgh WHPA to the north and the Erin WHPA to the east.

In addition to protecting water quality, water quantity is also a concern and is being considered under Water Quantity Protection Plans, which are currently being established. The Water Quantity assessment is completed to ensure that future water needs of a community can be met. It identifies existing water quantity threats and future activities that may limit municipal water supplies. This is important because when more water is taken from an area than can be naturally replenished, water supplies are threatened and water shortages are possible. The Erin property falls within the upper end of a Water Quantity Intake Protection Zone (IPZ-Q) for the City of Guelph Eramosa Intake on the Eramosa River, which has been assigned a significant risk level (Matrix Solutions 2017). The IPZ-Q was assigned a significant risk level because of interconnection through the City of Guelph Arkell Water System. As a result, each of the consumptive water uses within the IPZ-Q are categorized as significant; however, the net consumptive water use within the IPZ-Q is small compared to the natural variability in flow of the Eramosa River at the intake (Matrix 2018a). Therefore, on an average basis, consumptive water taking threats are not expected to affect the municipal surface water intake's ability to obtain water. Further assessment of the threats was carried out as part of the climate changes assessment (Matrix 2018b). The municipal and non-municipal threats were ranked as follows: 1) Arkell Wells, 2) Glen Collector, 3) Non-Municipal PTTWs, and 4) Rockwood Wells. The Nestlé water taking is one of twelve water takings that fall within the third-ranked threat of four threats. The study indicates that the total potential influence of municipal and non-municipal takings on streamflow in the Eramosa River at Gauge 02GA029 is a reduction in flow of 0.287 m$^3$/s; the amount represents approximately 12% of the mean annual flow (2.3 m$^3$/s) (Matrix 2018b). Within this total, the impact of permitted municipal pumping rates represents 85% of the total potential impact of permitted water takings on the Eramosa River intake. The Water Quantity assessment conducted for the Nestlé takings at TW1-88 as described in Section 4.3. The assessment was completed using the Guelph Tier 3 Model, which has been updated and used for this study.

## 2.11 Potential Contaminated Sites

The land use within 1 km of TW1-88 consists of residential, agricultural and vacant land. Based on the land use mapping (Figure 5), there are no potential contaminated properties identified within 1 km of the Nestlé pumping well. Nestlé monitors surrounding land uses to identify potential future concerns that may arise with respect to source water protection. Nestlé purchased a neighbouring property with potential contamination concerns and conducted a clean-up of the site.

Nestlé does not use any pesticides or herbicides on its property (included in an agreement with the farmer) and reduces salt usage for de-icing in the winter as much as possible (i.e., preference to use sand). Further discussion on water quality monitoring (Section 4.2), water quality results (Section 5.5) and potential impacts (Section 6.3) are provided below.

## 2.12 Climate

Daily weather statistics (meteorological data) have been recorded at the Orangeville MOE station (ID #6155790) from 1961 to 2015 and at the Shand Dam station (ID #6142400) from 1939 to present. The weather stations are part of the Environment Canada network.

Climatic normals discussed in the following sections, calculated as statistical averages of weather data from the previous 30 years, are currently based on the 1981 to 2010 period of record.

### 2.12.1 Temperature

The average yearly temperature over the 1981 to 2010 period at Orangeville is 6.3ºC. The average yearly temperature over the 1981 to 2010 period at Shand Dam is 6.7ºC. During the 30-year period, daily average normal temperatures at Orangeville range from -7.5ºC in January to 19.4ºC in July and from -7.4ºC in January to 20ºC in July at Shand Dam. The extreme maximum temperature recorded at the Orangeville station was 35.5ºC in August 1988 and the extreme minimum was -36.5ºC in February 1979. The extreme maximum temperature recorded at the Shand Dam station was 35.5ºC in July 1988 and the extreme minimum was -35ºC in January 1943. The daily average, maximum, and minimum temperatures at Shand Dam are summarized in Table 4.

**Table 4: Average Temperatures at Shand Dam (1981-2010)**

| Month | Daily Average Temperature (ºC) | Daily Average Maximum Temperature (ºC) | Daily Average Minimum Temperature (ºC) |
|---|---|---|---|
| January | -7.4 | -3.6 | -11.1 |
| February | -6.3 | -2.1 | -10.5 |
| March | -1.9 | 2.6 | -6.5 |
| April | 5.7 | 10.4 | 0.9 |
| May | 12.2 | 17.5 | 6.9 |
| June | 17.5 | 22.8 | 12.2 |
| July | 20.0 | 25.2 | 14.7 |
| August | 19.0 | 24.2 | 13.8 |
| September | 14.9 | 19.8 | 9.9 |
| October | 8.3 | 12.7 | 3.9 |
| November | 2.1 | 5.4 | -1.2 |
| December | -3.9 | -0.7 | -7.1 |
| Year | 6.7 | 11.2 | 2.2 |

### 2.12.2 Precipitation

Precipitation recorded at the Orangeville and Shand Dam meteorological stations are used as a component of the LTM program. Prior to 2016, the data were collected from the Orangeville station and augmented with data from the Shand Dam station. From 2016 to present, the data are from the Shand Dam station as precipitation data are no longer recorded at the Orangeville station.

It is recognized that there are differences between the amounts of precipitation recorded at the different stations sometimes due to localized precipitation events such as thunderstorms or snow squalls. It is impossible to obtain a perfectly representative estimate of the annual precipitation over the full extent of the area of contribution for the Nestlé Erin well. What is most important is that adopting a consistent approach from year to year allows an assessment of the differences with respect to long-term average conditions (30-year climate normals). An analysis of precipitation trends is conducted to see if there is a correlation with water level trends. We note that the actual influence on water levels (groundwater) would be due to recharge and not total precipitation, and that recharge is controlled by more than just precipitation. However, in the absence of detailed recharge data in the area, the use of precipitation totals allows for some comparison of long-term changes in water levels, particularly in the shallow monitors (overburden and mini-piezometers).

#### *2.12.2.1 Annual Precipitation*

The annual average (1981-2010) precipitation from the Orangeville Station is 901.5 mm which is slightly higher than the previous average (1971-2000) of 891.7 mm. The annual average (1981-2010) precipitation from the Shand Dam Station is 945.7 mm which is again slightly higher than the previous average (1971-2000) of 938.5 mm. A summary of the total annual precipitation over the past ten years is provided in Table 5. Annual precipitation is also shown graphically on Figure 17 along with the 30-year normal. More than 10% below-average precipitation occurred in 2012 and 2015 with more than 10% above-average precipitation occurring in 2009, 2010, 2011, 2013 and 2017. Total precipitation declined over the period from 2010 to 2012 and again from 2013 to 2015.

**Table 5: Annual Precipitation**

| Year | Precipitation (mm) | Difference Between Actual and Average Precipitation (mm) | % Difference from Average |
|---|---|---|---|
| 2009 | 1044.9 (Orangeville) | 143.4 | 15.9 |
| 2010 | 1113 (Orangeville) | 211.5 | 23.5 |
| 2011 | 1077.7 (Orangeville) | 176.2 | 19.5 |
| 2012 | 803 (Orangeville) | -98.5 | -10.5 |
| 2013 | 1035.7 (Orangeville) | 134.2 | 14.9 |
| 2014 | 954.5 (Orangeville) | 53.0 | 5.9 |

| Year | Precipitation (mm) | Difference Between Actual and Average Precipitation (mm) | % Difference from Average |
|---|---|---|---|
| 2015 | 783.1 (Orangeville) | -118.4 | -13.1 |
| 2016 | 1032 (Shand Dam) | 86.3 | 9.1 |
| 2017 | 1109.6 (Shand Dam) | 163.9 | 17.3 |
| 2018 | 953.3 (Shand Dam) | 7.6 | 0.8 |
| Average (1981-2010) | 901.5 (Orangeville), 945.7 (Fergus Shand Dam) | | |

#### 2.12.2.2 Monthly Precipitation

A summary of the monthly average precipitation is included in Table 6 for Shand Dam. The driest month of the year at the Shand Dam station is February, with an average precipitation of 55.9 mm. The wettest month is August, with an average precipitation of 96.6 mm.

**Table 6: Normal (1981 – 2010) Monthly Precipitation at Shand Dam**

| Month | Rainfall (mm) | Snowfall (cm) | Precipitation (mm) |
|---|---|---|---|
| January | 27.8 | 40.1 | 67.9 |
| February | 25.3 | 30.6 | 55.9 |
| March | 36.7 | 22.9 | 59.6 |
| April | 67.9 | 6.2 | 74.1 |
| May | 86.8 | 0.1 | 86.9 |
| June | 83.8 | 0 | 83.8 |
| July | 89.2 | 0 | 89.2 |
| August | 96.6 | 0 | 96.6 |
| September | 93.1 | 0 | 93.1 |
| October | 75.6 | 1.6 | 72.2 |
| November | 80.5 | 12.5 | 93.0 |

| Month | Rainfall (mm) | Snowfall (cm) | Precipitation (mm) |
|---|---|---|---|
| December | 34.7 | 33.9 | 68.6 |
| Year | 797.8 | 147.8 | 945.7 |

## 3.0 CONSULTATION

There is value in involving those with a potential interest or those who may be affected by the water taking proposal to have opportunities to provide input during the application process. This consultation protects those interested and helps ensure concerns are identified early and addressed where possible. This consultation was conducted during the pre-submission phase of the application process and a summary is included in the application package.

# 4.0 METHODOLOGY

## 4.1 Summary of Long-Term Monitoring Field Program

This section describes the field activities that are performed as per the conditions of PTTW Number 3719-8UZMCU (for TW1-88) or performed per the conditions of previous PTTWs.

### 4.1.1 Groundwater and Surface Water Monitoring Program

Groundwater and surface water monitoring was initiated in 2000 and has evolved over the years with the objectives to 1) characterize the existing hydrogeologic setting, and 2) document potential long-term changes to the groundwater and surface water resources in the area. The monitoring program includes measurement and record-keeping of water takings, groundwater levels, mini-piezometer levels, surface water levels and flows. The monitoring program includes the following instrumentation, with the locations shown on Figure 18:

- Groundwater levels and water takings in the production well (TW1-88);
- Groundwater levels in 15 monitors wells at 9 locations;
- Shallow groundwater levels in 7 piezometer nests with a total of 14 monitors (shallow and deep pair);
- Surface water levels at 6 stations;
- Surface water flow at 3 stations; and
- Water levels at 13 private wells on 9 properties (3 of the 13 are no longer monitored since 2014 due to access restrictions).

Data are recorded at several stations on an hourly basis, and manual groundwater and surface water monitoring are conducted on a monthly basis when the data are collected from the dataloggers.

#### *4.1.1.1 Water Taking*

Water taking from TW1-88 is measured using an Endress & Hauser Promag magnetic flow meter connected to an Allen-Bradley industrial Programmable Logic Controller. The instantaneous flow and volume are recorded every minute. The flow meter was most recently calibrated on November 5, 2018 by Endress & Hauser (per Nestlé).

The water takings from supply well TW1-88 are described in Section 2.1.

#### *4.1.1.2 Groundwater Monitoring Program*

Groundwater levels have been measured at various locations since a monthly water level monitoring program was initiated in January 2000. Changes have been made over time as wells have become inaccessible. The monitoring locations for the groundwater monitoring program are shown on Figure 18 and are summarized as follows:

**Overburden Monitors**

- TW1/99, MW2, MW3A/B, MW5B, MW6B, MW11B-08, MW12B-08, D2B (no longer accessible), D7B, D26C, D27, D36A

**Bedrock Monitors**

- TW1-88, MW5A, MW6A, MW11A-08, MW12A-08, D2A (no longer accessible), D3, D8, D15, D19 (no longer accessible), D24A, D24B, D26A, D26B, D32, D36B

#### 4.1.1.3 Surface Water Monitoring Program

The surface water monitoring program includes the following components, with locations shown on Figure 18:

- Surface water levels;
- Stream flow; and
- Water levels in nested mini-piezometers.

Surface water levels and flow have been measured since a monitoring program was initiated in January 2000.

**Surface Water Levels**

Currently, surface water levels are measured at the following locations:

- ST03-05, SW1, SW3, SW4, SW5, SW7

Water levels are measured at all locations on a monthly basis using a water level meter and hourly using pressure transducer dataloggers.

A new station (SW7B) was established in the Erin Branch of the Credit River by D7B in May 2016. The site was chosen at a location with more favourable hydraulics (i.e., single channel, stable conditions and no backwater). This station will eventually replace SW7, which is located in an area with changing stream conditions and flooding.

**Stream Flow**

Currently, stream flows are measured at the following locations:

- SW1, SW3, SW7

Stream flow velocities are measured using a Valeport electromagnetic flow meter and the surface water flows are calculated using the cross-sectional area-velocity method.

The monthly surface water elevations (“stage”) and stream flow measurements (“discharge”) collected are used to establish the stage-discharge relationships (rating curves) at SW1 and SW7. The rating curves are used to calculate stream flow from the continuous water level measurements at these stations. Flow at SW3 is also measured on a continuous basis using a Stingray Flow Meter.

**Mini-Piezometers**

Currently, water levels are measured in mini-piezometers at seven locations, each containing a shallow and a deep monitor.

- P1A/B-07, P3A/B-05, P6A/B-07, P10A/B-05, P11A/B-05, P12A/B-07, P13A/B-07

The average elevation difference between the middle of the shallow screen and the middle of the deep screen is 1.2 m with actual separation differences ranging from approximately 0.6 to 1.6 m.

#### 4.1.1.4 Monitoring Locations Which Have Become Inaccessible

In 2014, homeowners requested that monitoring be discontinued at three wells.  A list of these wells along with a recommended replacement are provided in Table 7.

**Table 7: Inaccessible Monitoring Locations**

| Monitoring Location | Reason for Inaccessibility | Recommendation | Documented In Letter to MECP |
|---|---|---|---|
| D19 | In October 2014, the resident notified Nestlé that they would no longer like their well monitored. | No additional wells to be monitored in place of D19 as there are other wells in the area that can be monitored. | October 10, 2014 |
| D2A | In December 2014, the resident notified Nestlé that they would no longer like their well monitored. | Install a monitoring well on a neighbouring property in the future if land access is granted. | December 2, 2014 |
| D2B | In December 2014, the resident notified Nestlé that they would no longer like their well monitored. | No additional wells will be monitored in place of D2B as there are no impacts to the overburden aquifer and there are other wells being monitored in the overburden. | December 2, 2014 |

### 4.1.2 Biological Monitoring

Biological monitoring is not a requirement of the PTTW at Nestlé's Erin property.  Nestlé voluntarily undertakes biological monitoring at this property as part of its natural resource management program.  The information collected is used to monitor the state and condition of the aquatic, wetland, and terrestrial ecosystems associated with its source properties to ensure that natural resources are being managed sustainably.  Biological monitoring was initiated at the Erin property in 2008 and is conducted annually. The location of monitoring stations are illustrated on Figure 19. The findings and recommendations for each monitoring year are published in annual monitoring reports provided to Nestlé.

#### 4.1.2.1 Aquatic Resources Monitoring

Electrofishing to assess the fish community was conducted in 2011 and 2014.  A trout spawning survey was conducted from Fifth Line upstream to the source of the branch which originates on the Nestlé property in 2011 and 2014.  Water temperature in the tributary has also been monitored since 2014.

#### 4.1.2.2 Terrestrial Resources Monitoring

Monitoring of terrestrial resources was initiated on the Erin property in 2008 and is focused on documenting the site's vegetation and wildlife resources.  Core terrestrial resources parameters monitored include vegetation, amphibians, birds and reptiles. Supplemental to these key components has been characterization of the ecological communities using the provincial Ecological Land Classification System (ELC), mapping for invasive alien species such as Common Reed (*Phragmites australis*), monitoring endangered or threatened species including Butternut (*Juglans cinerea*) and Bobolink (*Dolichonyx oryzivorus*), as well as occasional specialized surveys for odonates (damselflies and dragonflies).

## 4.2 Water Quality Monitoring

Groundwater quality from well TW1-88 has been monitored by Nestlé since the well has been used as a spring water bottling source, to ensure water quality standards established by Nestlé, the Canadian Food Inspection Agency (CFIA) and the Canadian Bottled Water Association (CBWA)continue to be met. Furthermore, Nestlé is vigilant with respect to the aesthetic character of groundwater, and is very much aligned with the Province’s requirements to preserve water quality in the vicinity of the water source (i.e., source water protection). Nestlé monitors its water supply for changes and/or long-term trends in the water quality.

## 4.3 Tier 3 Modelling

An assessment of the potential cumulative impacts that could be caused by the bottled water takings at the Nestlé facility at Erin is required under the Interim Procedural and Technical Guidance Document for Bottled Water Renewals: Permit to Take Water Applications and Hydrogeological Study Requirements (Ontario Ministry of the Environment and Climate Change Operations Division, April 2017). The following requirements are extracted from the Interim Procedural and Technical Guidance Document:

> *All applications for water bottling shall consider the potential for cumulative effects, under both current conditions and various climate change or drought scenarios. Unless instructed otherwise or agreed to by the Director, the cumulative effects assessment shall use information obtained through watershed water budget evaluations completed under the Clean Water Act, 2006, where available. The highest tier of water budget completed for the location should be used to evaluate the potential for cumulative effects.*

TW1-88 is located within the model area of the City of Guelph and Township of Guelph/Eramosa (GGET) Tier Three Water Budget and Local Area Risk Assessment study area (Matrix Solutions, 2017; Figure 1-1). Following the recommendations of the Interim Procedural and Technical Guidance Document, the groundwater model developed for the GGET Tier Three Assessment has been applied for the analyses to support the PTTW application for TW1-88. The GGET Tier Three model builds on the integrated water budget analysis for the Grand River watershed (AquaResource Inc., 2009). The Tier Three groundwater model is documented in detail in Appendix B of the final Local Area Risk Assessment report (Matrix Solutions, 2014). The GGET Tier Three model has been peer reviewed and has been approved by the Lake Erie Source Protection Region.

The approach to applying the GGET Tier Three groundwater model was discussed during a meeting held on July 10, 2017 between Nestlé, the MECP, GRCA and the City of Guelph. It was agreed that it is appropriate to use the existing GGET Tier Three model to support the impact assessment requirements for the Nestlé PTTW application. During the July 10, 2017 meeting, it was also agreed that the most effective approach for the modeling would be for the developers of the GGET Tier Three model, Matrix Solutions, to be subcontracted to conduct the modeling. This would eliminate the need to address any concerns regarding model ownership and distribution. More importantly, this approach would ensure that any refinements in the representation of conditions around the

Nestlé facilities would be retained in any future analyses. The City of Guelph is the custodian of the GGET Tier Three model. Nestlé contracted with the City, and the City subcontracted Matrix Solutions for the analyses.

The GGET Tier Three groundwater model was designed to encompass the entire hydrogeological system that influences the City of Guelph's municipal water supply wells. The model covers the entire Speed River and Eramosa River watersheds. The model was designed to simulate detailed local groundwater flow conditions around the city's municipal wellfields, and regional-scale conditions outside the city. The model has been refined in the vicinity of TW1-88. The application of the GGET Tier Three model for the Nestlé assessment is documented in a stand-alone report prepared for this study (Matrix Solutions, 2019) and included in Appendix K. The discussion of the modeling methodology here is limited to a summary of the refinements made to the GGET Tier Three model for this study.

To support the refinement of the GGET Tier Three model in the area potentially affected by pumping from TW1-88, Nestlé provided Matrix Solutions with the following data and interpretations.

- Nestlé Annual Monitoring Reports;
- Nestlé pumping test reports (TW1-88);
- Maps of surface water features;
- Hydrographs for Nestlé monitoring wells from the Erin Annual Monitoring Report;
- Groundwater level targets for pumping and non-pumping conditions and interpreted drawdowns (Overburden, Bedrock);
- Interpreted map of drawdowns in the Bedrock Aquifer (Guelph), June 2001; and
- Baseflow targets for SW1 and SW3.

Blackport Hydrogeology worked with Matrix Solutions to revise the structure of the Tier Three model around TW1-88. The GGET Tier Three model was recalibrated to improve the match to the high-quality local data in the area around TW1-88. During the re-calibration, Matrix Solutions improved the match to groundwater levels, drawdowns, and interpreted drawdowns contours with a single groundwater model.

## 4.4 Drought and Cumulative Effects Water Quantity Risk Assessment

Water is vital to health and integrity of ecosystems. Drought, climate change and water needs associated with increases in population have raised concerns related to water security in Ontario, particularly communities that depend on groundwater. For this reason, the potential effects of drought and climate change are considered as part of this assessment. The potential for cumulative effects, under both current and drought conditions and various climate change scenarios has been investigated with the refined GGET Tier Three model.

Cumulative effects are defined here as the potential combined effects of changes in pumping from the Nestlé production well TW1-88, changes in conditions that may arise during sustained periods of below-average precipitation (drought) and the potential effects of long-term changes in the climate of southern Ontario. Cumulative impacts are quantified in terms of potential changes in groundwater levels and groundwater discharge to surface water features with respect to pre-defined baseline conditions.

Pumping from the Hillsburgh municipal wells and TW1-88 has been ongoing for a relatively long time. Nestlé began pumping from the TW1-88 in 2000. The groundwater systems have attained natural equilibria in response to that pumping. No long-term declining trends in either groundwater levels or surface water flows are evident in the continuous records presented in the annual monitoring report for the Erin facility. As shown in Figure 4.1 of the 2017 Annual Report for Erin, the annual takings for 2015 through 2017 have been similar. To establish baseline conditions, TW1-88 is assigned a constant pumping rate corresponding to the average annual takings over this period.

With respect to the potential impacts of an increase in TW1-88 pumping, analyses were conducted with the pumping rate increased from its current average to the maximum rate in the current PTTW.

A long-term hydrologic analysis was conducted for the GGET Tier Three study to assess the variability of precipitation. The results of the analysis indicated that the longest sustained period on record of below-average precipitation occurred in the early to mid-1960s. This is well before Nestlé began pumping from TW1-88. The analysis of cumulative effects during drought is based on the hypothetical condition that current or increased Nestlé pumping continues during a reoccurrence of the period of sustained below average precipitation that was observed in the early to mid-1960s. This is in effect a worst-case scenario.

The approach developed for the Guelph Guelph/Eramosa Water Quantity Policy Study to analyze the potential effects of long-term climate change has been adopted for the present study (Matrix Solutions, 2018b). Following the climate change methodology developed in the Guide for the Assessment of Hydrologic Effects of Climate Change in Ontario (EBNFLO and AquaResource 2010), existing information has been leveraged to achieve the overall outcome of constructing and analyzing an ensemble of future climate projections for temperature and precipitation variables. The effects of changes in Nestlé pumping are added to any changes predicted with the climate change modeling.

# 5.0 MONITORING PROGRAM RESULTS

## 5.1 Water Taking

The water takings from TW1-88 are summarized in Section 2.1. Over the last 10 years (2009 through 2018) the annual water takings have ranged from a minimum of 66.1 million litres in 2017 to a maximum of 223.7 million litres in 2013 (Figure 3). Over that time period, the annual taking increased from 2009 to 2013, then decreased to 2015 and has been relatively constant over the past 4 years. Groundwater withdrawals from TW1-88 have averaged 362,642 L/day over the last 10 years (2009 – 2018). The water takings over the past four years have been lower than the 10-year average (Table 2).

## 5.2 Groundwater Levels

Hydrographs with the manual or transducer water level data for the monitoring wells are included in Appendix D. To support the inference of long-term trends in the groundwater levels and relationship, if any, to variations in pumping and precipitation, hydrographs of average monthly water levels, monthly volume pumped from TW1-88 and monthly precipitation over the past eleven years (2008 through 2018) have been prepared and are included in Appendix E. The average monthly water level data were calculated from the near-continuous record of water levels recorded with pressure transducer dataloggers.

### 5.2.1 TW1-88

The pumping rate and water level in TW1-88 are monitored continuously. Water levels and average daily pumping rates for TW1-88, along with daily precipitation, over the past 11 years (2008 through 2018) are shown on Figure D1 in Appendix D. Water levels since 2008 at TW1-88 range from approximately 414 to 424 masl under pumping and non-pumping conditions.

The estimated non-pumping water levels (partially recovered conditions following temporary shutdown of the pump) observed since 2008 range from 422 to 424 masl (Figure D1). It should be noted that non-pumping water levels do not represent “true” conditions that would be observed if there were no pumping at TW1-88. Instead, they represent partially recovered conditions, with the amount of recovery depending on the average pumping rate before the pumping stopped, how much time has elapsed before pumping resumes and whether there is a background (seasonal) trend in the water levels. CRA (2014) indicated that, based on historical data, static water levels ranged from of 423.5 masl to 424.5 masl. Overall, the water levels have been similar over the past 11-year period. The upper bound on the water level in TW1-88 inferred from Figure D1, 423.5 masl, is within the range of the historic static water levels, which suggests that water levels recover almost completely following temporary stoppages of pumping. This is one line of evidence that the pumping of TW1-88 has been sustainable.

Since 2008 TW1-88 water levels have ranged from approximately 414 masl to 419 masl under pumping conditions (Figure D1). Based on a static water level of 424 masl, the equivalent drawdown has ranged from 5 to 10 m. Overall, the water levels respond to pumping as expected. Changes in total drawdown are related to changes in operation of the well. Since the water taking at TW1-88 decreased in mid-2014, the water levels at TW1-88 have increased an average of approximately 0.5 m. Since pumping has decreased, the seasonal fluctuations in water levels are more evident.

The data collected during controlled pumping tests provide insights into the performance of TW1-88. Step and constant-rate pumping tests have been conducted on TW1-88 in 1988 and 2005 (CRA, 1989; 2006). The results of the testing are summarized graphically on Figure C1, in which the pumping rates are plotted against the inferred drawdowns in the well. As shown on Figure C1, the data from the two constant-rate pumping tests, which represent stabilized conditions, are consistent with the results of the initial step test on TW1-88. A slightly higher well capacity is inferred from the 2005 step test.

The 2005 test was conducted at a rate of 1,227 L/min, which is more than double the rate of the 1988 test, 546 L/min. Despite the difference in the pumping rates, the data from the 1988 step test and the two constant rate tests closely approximate a straight line, suggesting that non-linear well losses are negligible. More significantly with respect to the sustainability of pumping, the linear response indicates that TW1-88 is effectively confined, with the water level in the well remaining at all times above the top of the bedrock aquifer (the top of the bedrock aquifer at TW1-88 is at an elevation of about 410.5 masl).

The slope of the straight line shown on Figure C1 is designated the specific capacity of TW1-88, that is, the yield of the well per metre of drawdown in the pumping well:

Specific capacity = $Q/s_w$ = 1.53 (L/s)/m

Here Q denotes the pumping rate and $s_w$ is the drawdown in TW1-88.

The actual performance of TW1-88 can best be interpreted by considering the well data collected during operations. The continuous records from 2008 through 2019 (Figure D1) show that the cumulative volume pumped from 2015 through 2018 was significantly reduced with respect to previous years in the decade. Although the pumping has declined in recent years, the water levels in TW1-88 have fluctuated within a consistent band between 416.5 masl and 423 masl. This suggests that TW1-88 has been pumped at a relatively constant rate, but for fewer hours each day.

The average monthly water level hydrograph is shown on Figure E1 and extends back to 2008. The data provide important insights into the performance of the well and the long-term sustainability of pumping. The trends in the data are clearer when presented in terms of the monthly average data, as shown on Figure E1 with the performance data presented as the monthly average water level versus the cumulative volume of water pumped each month. The decline in the pumpage from mid-2014 onward is evident as is the similarity in the water takings over the past four years (2015 through 2018). The water levels in the pumping well have fluctuated between similar bounds over the same period. Prior to that, the average water levels (pumping and non-pumping) were lower. The higher water levels in recent years are due to a decrease in the pumping (i.e., the decline in mid-2014 caused the monthly average water level in TW1-88 to rise from about 419.5 masl to a steady level of 422.0 masl, with the water level in the well being stable since the end of 2014). The slight increase in the water taking in 2018 corresponds with a slight decrease in the average water level during the same time period. In general, the water level trend at TW1-88 corresponds to the overall water taking from the well, as suggested on Figure E1. Overall, the water levels appear to be relatively stable under both pumping and non-pumping conditions and the groundwater taking at TW1-88 has not caused a long-term declining trend of the water level in the production well.

Selected points from the monthly average record are plotted on Figure C6. The equivalent constant pumping rate, reported as litres per second, is calculated by dividing the cumulative volume pumped in each month by the number of seconds in a month. The TW1-88 performance data approximate a straight line of the following form:

$$\mathrm{WL} = \mathrm{WL}_0 - \mathrm{SLOPE} \times \mathrm{Q}$$

Here WL represents the monthly average water level in TW1-88, $WL_0$ the non-pumping water level in the well (fully recovered conditions), Q is the monthly average pumping rate and SLOPE is the reciprocal of the specific capacity of TW1-88.

On Figure C6 a line corresponding to the specific capacity inferred from the 1988 and 2005 testing is superimposed on the average monthly TW1-88 performance data. The selected points from the monthly average data are consistent with the specific capacity inferred from controlled tests. The close agreement shown on Figure C6 provides another line of evidence that the pumping is sustainable. The data are sufficient to confirm the general impression that the changes in the water levels in TW1-88 are due to changes in the pumping rate.

The consistent and predictable response from year to year confirms that the pumping from TW1-88 has been sustainable, that is, the pumping has not caused a long-term declining trend in the water level in the well.

### 5.2.2 Bedrock Aquifer

An example of the potentiometric surface of the bedrock aquifer was is shown on Figure 20 based on the water levels measured on August 24, 2018. A review of the potentiometric surface on August 24, 2018, indicates groundwater flow is to the south with influence from pumping around TW1-88.

Hydrographs for wells completed in the bedrock aquifer are included on Figures D2 through D12 in Appendix D and Figures E2 and E3 in Appendix E. A review of the hydrographs indicates the following:

- Water levels in the bedrock aquifer appear stable over the monitoring period;
- For the purpose of this study, water levels in MW12A-08 and D15 are interpreted to represent background conditions. Water levels are measured on a monthly basis in these wells and the measurements show only small water level fluctuations over the past eleven years (i.e., less than 1 m);
- In most years the water levels generally increase in the spring and then decrease through the summer and are relatively constant for the remainder of the year (see Figure D2);
- The amount of influence that pumping TW1-88 has on water levels in other wells declines with distance from TW1-88 (e.g., more pronounced in MW5A-05 compared to MW12A-08);
- The drawdown cone from pumping TW1-88 is localized, especially with the reduced intermittent pumping that is currently occurring;
- In 2016, there was a decline in water levels evident in some of the wells. The decline was likely associated with below-average precipitation recorded during the summer of 2016. Water levels in the south-east part of the Site continue to fluctuate seasonally but remain slightly lower than those observed prior to 2016, which is due to the below normal precipitation recorded during the summer and fall of the past three years (2016 – 2018);
- With only a small amount of fluctuation occurring in the bedrock water levels, the long-term precipitation trends are not evident; and
- Water levels in the private wells may be influenced by pumping at TW1-88; however, fluctuations are mainly due to pumping at the private wells.

### 5.2.3 Overburden (Water Table) Aquifer

Hydrographs for wells completed in the overburden are included on Figures D13 through D15 in Appendix D and Figures E4 and E5 in Appendix E. A review of the hydrographs indicates the following:

- Water levels in overburden show similar trends, with increasing water levels through the spring followed by decreasing water levels through the summer and relatively stable water levels in the fall. The exception to this trend is at well D7B, which has had a relatively consistent water level over the years with little to no fluctuation;
- The timing of the high and low water levels can vary by a month or two from well to well. This may be due to the time for recharge to the aquifer to occur, which is expected to vary across the property based on the variations in surficial geology (i.e., sand and gravel versus glacial till) and topography.
- Water levels also fluctuate more in the southern part of the study areas (Figure E5) compared to the northern part of the study area (Figure E4). This is in response to how quickly water moves through the different aquifers following recharge and reflects their positions in the groundwater flow system, where greater variations in water levels occur at the higher topographic elevations (i.e., recharge areas) compared to the low-lying areas (i.e., discharge areas);
- A response to precipitation or melt events (i.e., increase in water levels) is evident in the wells for which levels are recorded continuously; and
- Overall, the similarity in water level trends, regardless of distance from TW1-88, indicates that water level fluctuations are not due to pumping TW1-88 but due to natural seasonal changes and recharge.

### 5.2.4 Vertical Gradients

Vertical gradients between the overburden and bedrock at monitoring well nests (MW5-05, MW6-05, MW11-08 and MW12-08) are plotted on Figures F1 through F4 in Appendix F. Note that a positive gradient is calculated when the water level in the upper aquifer exceeds the level in the lower aquifer. Under these conditions, the potential groundwater flow is downwards.

A review of the gradient data indicates the following:

- A positive vertical gradient between the overburden and bedrock (potential downward flow) is present at all of the monitoring well nests;
- The vertical gradients fluctuate due to changes in the bedrock water levels that respond to pumping TW1-88 (i.e., a decrease in the bedrock water level) or changes in the overburden water levels that respond to recharge events (i.e., an increase in the overburden water level), but the overall trends remains stable;
- The gradients at MW5-05 and MW6-05 vary in response to pumping TW1-88 and are due to the water level fluctuations in the bedrock aquifer at these sites;
- The gradient at MW11-08 is relatively constant on an annual interval (i.e., no short-term influence from pumping) but shows a slight increase in the positive gradient when pumping is greatest from 2012 to 2014 and a slight decrease in the positive gradient from 2013 through 2017. The gradient at MW11-08 was more variable in 2018, with no influence from pumping but due to higher water levels observed in the overburden in February and lower water levels observed in the bedrock in the late summer and early fall;

- The gradient at MW12-08 increases in the spring and then decreases through the summer, with no influence from pumping. The increase in gradient in the spring is due to a rise in the water levels in the overburden during the spring melt;
- There does not appear to be a measurable hydraulic response in the overburden water levels from pumping the bedrock aquifer at the historical rates of water taking; and
- Vertical gradients at the two wells closest to TW1-88 ranged from approximately 0.4 m/m to 0.8 m/m at MW5-05 and approximately 0.4 m/m to 0.5 m/m at MW6-05. On average, the vertical gradients at the other two wells that are monitored monthly are about 0.1 m/m at MW11-08 and 0.3 m/m at MW12-08. The gradient at MW12-08 increases in the spring and then decreases through the summer (no influence of pumping). The increase in the gradient in the spring is due to the rise in water levels in the overburden during the spring melt.

## 5.3 Surface Water Levels

### 5.3.1 Mini-Piezometer Water Levels and Vertical Gradients

Hydrographs for the mini-piezometer locations extending over the last 11 years (2008 through 2018) are presented on Figures G1 through G7 in Appendix G. The graphs also include the average daily pumpage at TW1-88, precipitation as recorded at the Orangeville and Shand Dam stations and vertical hydraulic gradients. A negative gradient indicates that groundwater may be discharging to the surface water body, while a positive gradient indicates the surface water body is recharging the groundwater.

A review of the hydrographs for the mini-piezometers indicates the following:

- Water levels fluctuate seasonally, with higher water levels observed in the spring and lower water levels observed in the late summer;
- The water levels also show a response to precipitation and melt events;
- Overall the water levels are stable;
- There is no effect of pumping TW1-88 on vertical gradients in the shallow overburden near surface water features;
- The vertical gradients are similar over the years;
- Any slight reversals in gradients observed recently are not related to pumping at TW1-88 since total pumping over the past four and a half years is lower than previous years and a change in gradient was not observed during this change in pumping (i.e., vertical hydraulic gradients were not influenced by the lower daily pumping);
- P11-05 shows a change in gradient around the same time that pumping decreases at TW1-88; however, the change is a reduction in the negative gradient which is the opposite of what would be expected with the reduced pumping at TW1-88; and
- The negative gradient at P12-07 has decreased since mid-2017 due to the rise in water levels caused by the creation of a beaver dam.

Water level fluctuations and vertical gradients in the mini-piezometers are described below:

- P3A/B-05 (east side of on-Site pond) – water level fluctuations are similar in the shallow and deep piezometers with an overall fluctuation of less than 0.3 m. A weak negative gradient is evident, with the gradient occasionally reversed in the past. The gradient reversal generally occurs in the summer when water levels are lowest. Some changes in water levels were due to accumulation and subsequent removal of debris from the outlet of the pond;
- P6A/B-07 (west side of on-Site pond) – water level fluctuations are similar in the shallow and deep piezometers with an overall fluctuation of less than 0.3 m. A weak positive gradient exists that has occasionally reversed in the past. The gradient reversal generally occurs in the spring when water levels are highest. Some changes in water levels were due to accumulation and subsequent removal of debris from the outlet of the pond;
- P1A/B-07 (stream channel downstream of on-Site pond) – water levels have fluctuated just over 0.2 m with the exception of some short-term increases related to precipitation events. The water levels in the stream show less fluctuation than the water levels in the pond. A weak negative gradient exists that has occasionally reversed in the past;
- P11A/B-05 (further downstream from P1-07 at 6th Line) – water levels fluctuate just over 0.1 m. A weak negative gradient has been observed with the occasional positive gradient. The negative gradient decreases around the same time that pumping at TW1-88 decreases. The change is not related to the pumping, as a decrease in pumping would cause the negative gradient to increase if there was a connection between the bedrock aquifer and the shallow ground water system;
- P10A/B-05 (upgradient side of the wetland pond) – water levels have fluctuated by almost 0.8 m over the years and show a distinct seasonal pattern. The decline in water levels typically occurs in the summer and then water levels increase again in the fall. A negative gradient is typically observed with some small reversals;
- P12A/B-07 (stream flowing into Roman Lake) – water levels typically fluctuate 0.2 to 0.3 m and increased to approximately 0.4 m in the shallow piezometer in mid-2017 due to the construction of a beaver dam. There are also some short-term increases in response to spring melt and some precipitation events. A strong negative gradient was observed that decreased to a weak negative gradient after the construction of the beaver dam; and
- P13A/B-07 (Erin Branch of Credit River) – water levels have fluctuated 0.6 m in the shallow and deep piezometers. The vertical gradient is positive most of the time with greater fluctuation than at the other sites. Water levels may be influenced by fluctuations in water levels in the Hillsburgh reservoir.

Water levels observed in the mini-piezometers suggest relatively small fluctuations that are not caused by pumping TW1-88 and weak gradients across the stream beds.

### 5.3.2 Surface Water Levels

Hydrographs for the surface water level monitoring locations are included on Figures H1 through H4 in Appendix H. A review of the hydrographs for the surface water level monitoring locations indicates the following:

- Pumping at TW1-88 does not influence the water levels in the surface water features;
- Water levels in the surface water features respond to precipitation and melt events;

- The long-term fluctuation is generally less than 0.2 m with some seasonal variation evident;
- The long-term water levels are stable;
- Some of the changes in the water levels at SW3 (on-Site pond) are due to the outlet being partially obstructed with debris and then cleared when the debris is removed; and
- Water level changes at SW7 (Erin Branch of Credit River) in the past may be due to upstream work or changes in the Hillsburgh reservoir level. Due to the changing stream conditions at SW7, a new station (SW7A-16) was installed in May 2016. Water levels in the creek at SW7A-16 have shown minimal fluctuation with no increasing or decreasing trend.

## 5.4 Surface Water Flow

Surface water flow is measured at three stations in accordance with the PTTW; SW1 (creek downgradient of the on-Site pond and wetland), SW3 (outlet from the on-Site pond) and SW7 (Erin Branch of Credit River). Surface water flows are also measured at SW7A (Erin Branch of Credit River), which is not a requirement of the PTTW. The surface water flows for the four stations are shown on Figures I1 to I3 in Appendix I.

Flow from the on-Site pond (SW3) is measured with a flow meter while flows at SW1 and SW7 are estimated with stage-discharge curves. The stage-discharge curves for both SW1 and SW7 have been re-evaluated and adjusted in recent years in an attempt to more accurately reflect the monitoring data and stream characteristics. The stage-discharge curves are generally adjusted to account for changing stream conditions and hydraulic controls.

Monitoring data at SW7A-16 have been collected since May 2016 and have been used to generate stage-discharge relationships for this station. Water levels at this station remain constant at most stream discharge levels and therefore development of the stage-discharge curve has been challenging and may require further investigation of the stream geometry in the future.

A summary of flow at the stations is as follows:

- Surface water flows at SW1 (combined flow from on-Site pond and wetland) show seasonal variations with higher flows in the spring (Figure I1). Stream flows during the spring melts are approximately 20 L/s to 100 L/s and are generally less than 20 L/s during the remainder of the year. There is no evidence of a decline in stream flow at SW1. Lower flows were recorded during the summers of 2015 and 2018. It should be noted that some of the logger recordings during the winter months are suspected to be influenced by ice conditions and should be assigned lower reliabilities.
- Flow from the on-Site pond (SW3) also shows seasonal variations with higher flow observed in the spring. The spring flows are typically between 10 L/s to 30 L/s, while the summer low flows are generally less than 10 L/s. There are some spikes in flows related to precipitation events and spring melt.
- Stream flow at SW7 is typically less than at the other stations, with flow less than 10 L/s most of the time. In the past, it has been speculated that increases in flow may be related to changes in the Hillsburgh reservoir or potential work upstream. The flow at SW7 has been similar over the years, with changes related to changing stream conditions. Due to the multiple stream channels in the reach, there have been times when stream station SW7 was dry while other parts of the channel remained flowing.

- Stream flow at the new station (SW7A) has been consistent in 2016 and 2017 around 40 L/s. In 2018, flow was around 30 L/s to 40 L/s during the first half of the year and then increased during the second half of the year with flows up to 60 L/s. The flow at SW7A is approximately 30 L/s to 50 L/s greater than the flow at SW7. This is due to the fact that SW7A is located in a defined channel as opposed to multiple channels at SW7, where only part of the total flow is measured.
- Surface water flow at all the stations is influenced by precipitation and/or melt events and does not appear to be influenced by pumping at TW1-88.

## 5.5 Water Quality

The following section discusses groundwater quality monitoring conducted at Erin. The relative distribution of anions and cations at TW1-88 is presented on a tri-linear Piper plot (Figure J1 in Appendix J) and time series graph (Figure J2 in Appendix J).

Water quality at TW1-88 has been relatively stable over the years and parameters tested have remained below the Ontario Drinking Water Aesthetic Objectives. Groundwater is characterized as a calcium-magnesium-bicarbonate type, consistent with a carbonate aquifer.

Nestlé also monitors TW1-88 annually for volatile organic compounds (VOCs) that are some of the most common environmental contaminants, and the most readily transported through groundwater. To date, no VOCs have been detected in the groundwater at TW1-88.

## 5.6 Biological Monitoring

A summary of the Biological Monitoring findings are summarized below. For results of annual monitoring, refer to the annual biological monitoring reports.

### 5.6.1 Aquatic Resources

Electrofishing has shown that the fish community in the Eramosa River tributary within the Nestlé property includes Creek Chub (*Semotilus atromaculatus*), Brook Stickleback (*Culaea inconstans*), Central Mudminnow (*Umbra limi*), Blacknose Dace (*Rhinichthys atratulus*), Northern Redbelly Dace (*Phoxinus eos*), Pumpkinseed (*Lepomis gibbosus*) and Blacknose Shiner (*Notropis heterolepis*).

No evidence of trout spawning was observed during the spawning surveys conducted through the Nestlé property in 2011 and in 2014. A Brook Trout (*Salvelinus fontinalis*) was observed exhibiting spawning behaviour downstream, at Fourth Line, in 2015 and 2016, confirming that Brook Trout are present and do spawn in this creek. The temperature of the creek is suitable for trout much of the time during the summer and the stream temperature rarely, if ever, reaches levels that are lethal for trout. The warm surface water leaving the on-Site pond increases the creek temperature during the summer.

### 5.6.2 Terrestrial Resources

Monitoring has revealed that the forests and wetlands on the Erin property support a high level of species diversity and many species that are indicators of high-quality habitats and some species that are recognized as provincially and regionally significant.

Monitoring of vegetation since 2008 has identified some minor changes in species composition in the sampled wetland communities. The observed changes are attributable to natural variation, succession, beaver activity, and colonization of some plots by non-native Common Reed.  All of the observed changes are considered to be within the expected range of natural variation for the types of ecosystems present.

# 6.0 IMPACT ASSESSMENT

The Technical Guidance Document notes that a water taking may result in some degree of impact to an established water use or to the natural function of the ecosystem. When the impact affects an established water use, this is also referred to as interference. An unacceptable impact is normally considered to occur when 1) an impact hinders the ability of the water resource to support existing natural functions of the ecosystem, and/or 2) an impact prevents an established water user from continuing their established pattern of use.

Water taking shall not cause unacceptable impacts to the following:

- Natural function of the ecosystem – this includes any function of the aquifer to provide baseflow to streams, maintain water levels in wetlands or lakes, support habitat and species or provide recharge to other aquifers;
- Established pattern of water use – this includes water taking for which a PTTW is required and any uses for which a PTTW is not required; and
- Irreversible impacts – this includes impacts such as those that might occur if an aquifer is over-pumped or a taking that results in the deterioration of groundwater quantity or quality on a neighbouring property.

## 6.1 Impact to Groundwater Users

The Long-Term Monitoring (LTM) program indicates that variations in pumping from TW1-88 cause water levels to fluctuate within the pumped bedrock aquifer around TW1-88. The effects from pumping diminish with distance from the pumping well and no long-term declining trends have been observed.

### 6.1.1 Municipal Groundwater Users

The closest municipal wells to TW1-88 are the Hillsburgh wells (Town of Erin wells H2 and H3). The Hillsburgh wells are located approximately 1.5 km north-northeast of TW1-88 (Figure 2). Data from the monitoring wells between TW1-88 and H2 and H3and from almost 20 years of monitoring at H2 and H3 have shown that the taking from TW1-88 does not impact the municipal water supply under historical pumping conditions.

Maps of the potential additional drawdown caused by an increase in TW1-88 pumping from the current average of 207 $m^3$/d to the maximum permitted rate of 1,113 $m^3$/d are presented in Matrix Solutions (2019; Figures 27 and 28). The additional simulated drawdown is predicted to be 0.3 m at the wells H2 and H3. During the GGET and Region of Waterloo Tier Three water quantity risk assessments, a contour interval of 2 m was specified to delineate the drawdown cones of municipal wells (WHPA-Q1) (Matrix Solutions and S.S. Papadopulos & Associates, 2014). The contour interval of 2 m was selected as a threshold to account for the natural seasonal variability typically observed at monitoring wells located beyond the effects of municipal pumping. The 2 m threshold represents a “detection limit” for the effects of additional declines in groundwater levels caused by increased pumping. The predicted additional drawdown of 0.3 m at the Hillsburgh wells is well below the 2 m threshold, suggesting that it is unlikely that the effects of an increase in Nestlé pumping could be detected.

Plots of simulated water levels in wells H2 and H3 over a 45-year duration climate record are presented in Matrix Solutions (2019; Figures 30 and 31). The additional water level decline in H2 and H3 associated with increased Nestlé pumping is predicted to range between 0.3 m and 0.4 m over the 45-year duration of the simulation. To put these results in perspective, the water levels in the Hillsburgh wells are predicted to vary by more than 4 m in response to normal climate variability over the same period. With the wells pumping at their current average rates the available additional drawdowns in wells H2 and H3 are 48 m and 52 m, respectively. The results of the analysis suggest that an increase in pumping TW1-88 up to its maximum permitted rate is unlikely to limit the yields of the wells.

### 6.1.2 Private Groundwater Users

Nestlé monitors water levels in 10 private wells in the area to track long-term changes or trends in the water level. The monitoring has never shown impacts to private well use. Nestlé has not received any interference complaints from its neighbours that have wells completed in the overburden or bedrock aquifers.

## 6.2 Impact to Surface Water and Natural Functions of the Ecosystem

There does not appear to be an ecologically meaningful hydraulic connection between the surface water features and the pumped aquifer that could result in ecological impacts. Flow in the unnamed creek west of the property is not hydraulically connected to the bedrock aquifer. Similarly, the wetlands on the property are not sustained by the bedrock aquifer. There is no evidence to suggest that the water taking impacts the watercourses or wetlands.

TW1-88 is identified to be within the IPZ-Q for the City of Guelph Eramosa Intake; however, since the influence of pumping does not extend to the surface water system, no impact to the Guelph Eramosa Intake is anticipated.

The analysis of potential cumulative impacts to surface water features has been assessed in terms of the predicted changes in simulated groundwater discharge to Nestlé surface water monitoring station SW1. Referring to Matrix Solutions (2019; Table 12), an increase in pumping to the maximum permitted rate is predicted to cause a reduction of 3% of accumulated groundwater discharge at SW1. This is substantially less than the threshold of 10% of the results for baseline conditions indicated in the Interim Procedural and Technical Guidance Document.

The predicted changes in accumulated groundwater discharge at the SW1 gauge for the drought scenarios are presented in Matrix Solutions (2019; Figures 32 and 33 and Table 13). As shown in Figure 32, the differences in simulated groundwater discharge between average Nestlé pumping and permitted Nestlé pumping are relatively small. For accumulated groundwater discharges that are equal or exceeded 20%, 50% and 80% of the time, the reductions in groundwater discharge are predicted to be 3%, 3% and 4%, respectively. These predicted reductions in the accumulated groundwater discharge are less than the threshold of 10% indicated in the Interim Procedural and Technical Guidance Document. The results suggest that the predicted reductions in groundwater discharge are within the typical error associated with streamflow measurements and that it is unlikely the effects of an increase in pumping could be detected.

Additionally, the MECP indicates that the withdrawal and use cannot result in potential ecological impacts to surface water systems resulting from losses of groundwater input. The surface water system is isolated from the bedrock groundwater system and there are no impacts.

## 6.3 Water Quality Potential Impacts

As discussed in previous sections, well TW1-88 withdraws water from an aquifer in the Guelph Formation, which is composed of dolostone bedrock. Well TW1-88 is cased from the ground surface to 21.8 m below grade, preventing any water in the overlying glacial overburden from locally entering the borehole. Water recharges regionally through the glacial overburden and into the Guelph aquifer on the Orangeville Moraine, generally north and northwest of the Erin property.

Nestlé also constructs its monitoring wells so that the well screens are completed in individual aquifers with the remaining portions of the holes sealed so that water can't move up or down through the borehole. This prevents the movement of water between aquifers.

According to Appendix 2 of the Technical Guidance Document, the bottled water taking shall not result in water quality impacts that unacceptably interfere with existing or future municipal groundwater uses, or with natural functions of the ecosystem. Specific examples of unacceptable water quality impacts cited in the Technical Guidance Document include (1) mixing of groundwater of different (poor) quality that can potentially change the overall water quality, and therefore impact the taste or appearance of the water; and (2) induced migration of contaminated groundwater across nearby properties, such as dissolved-phase organic contaminants related to petroleum releases, or industrial processes.

According to land use mapping, there are no known or potential contaminant sources within 1 km of TW1-88 (the approximate area of influence). Nestlé monitors TW1-88 water quality for volatile organic compounds (VOCs), which are among the most common and mobile of anthropogenic contaminants. No VOCs have been detected at well TW1-88 at any time during its operation as a Nestlé bottled water source. The water quality results presented in Section 5.5 indicate that water quality has been consistent over the years. The water quality at TW1-88 does not show any impacts from mixing of water or capturing contaminated water from surface.

Additionally, the MECP indicates that the withdrawal and use cannot result in physical impacts to surface waters associated with discharge water (i.e., turbidity resulting from erosion or sedimentation). There is no water discharge in Erin.

In order to reduce or eliminate water quality impacts, Nestlé controls the actions that take place on its property (i.e., no pesticide or herbicide use and reduced road salt use). Water quality from this spring water source is regulated by CFIA and CBWA.

## 6.4 Drought and Cumulative Effects Water Quantity Risk Assessment

Environment Canada monitors drought conditions across Canada. In the 16 ½ year record (198 months, November 2002 – April 2019), available on-line, there has never been an "Exceptional Drought (D4)" condition anywhere in Southern Ontario. Additionally, in only 5 of 198 months (2.5%) has an "Extreme Drought (D3)" been reported anywhere in Southern Ontario. Of those five months experiencing "Extreme Drought", two included the area around Erin (September and October of 2007), while the other three included areas to the south of Erin (Figure 21). There have been other drought periods prior to 2002, such as the drought in the 1960's.

A review of stream flow and groundwater levels was conducted for 2012 and 2016 during two of the periods of low-water Level 2 declarations. Some of the lowest flows were observed at SW1 (Figure 14) and at the Eramosa River Above Guelph Station (Figure 15) during these periods. A review of the average water levels in the overburden (Appendix E) indicates that some of the lowest water levels were observed during these periods in recharge areas (elevated topography) but water levels in the discharge areas (lower topography) did not decline significantly. The average water levels in the bedrock aquifer fluctuated in response to pumping TW1-88 and not to the declines in precipitation during the low-water declarations in 2012 and 2016. This indicates that the water levels in the bedrock aquifer fluctuate more in response to pumping at TW1-88 whereas water levels in the overburden aquifer are influenced by precipitation mainly in the recharge areas with higher topographic elevation.

There does not appear to be an ecologically meaningful hydraulic connection between the surface water features and the pumped bedrock aquifer that could result in ecological impacts. Surface water features are affected directly by long-term trends in precipitation but groundwater levels in the bedrock aquifer are not as affected by periods of below-average rainfall.

The results presented in Matrix Solutions (2019; Figures 30 and 31) provide indications of the likely responses of the Hillsburgh municipal wells H2 and H3 if the sustained period of below-average precipitation that was observed in the early to mid-1960s were to reoccur. As shown in the two figures, if the pumping from TW1-88 were to increase from the current average to the maximum permitted rate during drought conditions similar to those observed in the early to mid-1960s, water levels are predicted to decline by approximately 2.3 m. To put these results in perspective, the water levels in the Hillsburgh wells are predicted to vary by more than 4 m in response to normal climate variability over the same 45-year record. With H2 and H3 pumping at their current average rates the available additional drawdowns are 48 m and 52 m, respectively. The modeling predictions suggest that it is unlikely that the cumulative effects of increased pumping and drought conditions would limit the yields of the wells.

Plots of the predicted water levels at the Hillsburgh municipal wells under conditions of long-term climate change are presented in Matrix Solutions (2019; Figures 35 and 36). As shown in the figures, the future climate change simulations predict that for ongoing pumping of TW1-88 at its current average rate, groundwater levels in wells H2 and H3 will increase by between about 0.5 m and 2 m as compared to historical climate.

# 7.0 CONCLUSIONS

The following key facts provide evidence of the sustainability of pumping at TW1-88:

- Water levels in TW1-88 remain above the top of the pumped aquifer during operating conditions.
- Variations in water levels at TW1-88 correspond to pumping in the well and water levels recover to near-static conditions when pumping ceases. The response is consistent and predictable.
- There are no ongoing long-term declining trends in water levels measured in monitoring wells in the bedrock or overburden.
- There have not been any declines in water levels in neighbouring private wells that impaired the ability of the wells to produce water and there have been no well interference complaints.
- There is no apparent correlation between increases in pumping and decreases in stream flow resulting from declines in groundwater discharge to streams that are sufficient to affect the ecology of the stream.

The following conclusions are presented based on the findings of the study and the long-term monitoring:

- The water taking does not hinder the ability of the water resource to support existing natural functions of the ecosystem. The withdrawal does not result in physical and ecological impacts to the wetlands in the Eramosa River headwaters.
- The water taking does not prevent water users from continuing their established pattern of use. The groundwater withdrawal from TW1-88 does not interfere with existing municipal uses or private uses. There have been no well interference complaints at Erin due to the water taking from TW1-88.
- No irreversible impacts have been observed due to over-pumping of the aquifer or deterioration of groundwater quantity or quality on neighbouring properties.

## 8.0 RECOMMENDED MONITORING PLAN

It is recommended that the existing monitoring program be kept in place with the following changes:

1) Surface Water Monitoring changes:

    a. The current SW1 and SW7 stations should be relocated to areas with more favourable hydraulics (i.e., single channel, stable conditions and no backwater). The observed relationship between water level and stream flow at the existing SW1 and SW7 locations is variable or has deteriorated in recent years. Relocation of SW1 and SW7 will achieve a better relationship between water levels and flow (i.e., further development of a stage discharge curve). It is recommended that SW1 be relocated to the northeast side of 6th Line, upstream of the road crossing. A new station has been developed at SW7A in the stream channel by D7B that can be used for flow monitoring to replace SW7. To improve the quality of water level data collected at the on-Site pond, it is also recommended that an additional logger be installed upstream of the pond outlet. This station would improve pond outlet estimates through a stage-discharge relationship. There should be an overlap in the monitoring of the new and existing stations until the stage discharge curves are developed. We note that there has been an overlap in the data recorded at SW7 and SW7A and therefore SW7 should be removed from the monitoring conditions.

2) Mini-piezometer changes:

    a. Monitoring at P06A/B should be discontinued. P06A/B and P03A/B are both located in the on-Site pond and provide similar data. In addition, P01A/B is located in the creek just outside the pond.

3) Overburden Private Well changes:

    a. The monitoring at the private wells in the overburden should be discontinued. The monitoring program has been ongoing for more than 15 years and no impacts to private wells or the surrounding aquifer have been noted. In addition, the monitoring data from these private wells are often influenced by pumping at the private well itself. The following changes to the monitoring program should be implemented:

    b. Discontinue monitoring at overburden wells D2B (homeowner does not want well monitored), D7B, D26C and D27, as there are no impacts to the overburden aquifer. On-site monitoring wells (MW3A/B-00, MW5B-05, MW6B-05, MW11B-08 and MW12B-08) would still be used for monitoring water levels in the overburden including four nested wells. Two new monitoring wells will also be installed by the D24 and D26 wells that will include an overburden monitoring point.

4) Overburden Monitoring Well Changes:

    a. Discontinue monitoring at overburden wells MW2-00, TW1-99 and D36A. There are no impacts to the overburden aquifer and these wells provide similar data to other on-site monitoring wells constructed in the overburden aquifer. On-site monitoring wells (MW3A/B-00, MW5B-05, MW6B-05, MW11B-08 and MW12B-08) would still be used for monitoring water levels in the overburden including four nested wells. Two new monitoring wells will also be installed by the D24 and D26 wells that will include an overburden monitoring point.

5) Bedrock Private Well Changes:

   a. Monitoring at some of the private wells should be discontinued or replaced with dedicated monitoring wells. The monitoring program has been on-going for more than 15 years and no impacts to private wells or the surrounding aquifer have been noted. In addition, the monitoring data from these private wells are often influenced by pumping at the private well itself. The following changes to the monitoring program should be implemented:

   b. Discontinue monitoring at D19 as the homeowner does not want the well monitored. Private well D3 is located in the same direction from TW1-88 and is closer to the pumping well allowing for sufficient monitoring in that area.

   c. Discontinue monitoring at D8 and D15. A new monitoring well (MW1-18A/B) has been completed in the general area of D8 and D15 which can replace the monitoring at the private wells (see well log in Appendix B).

   d. Discontinue monitoring at D24A and D24B and install a new monitoring well in the same area. Note that this monitoring well will be completed with intervals in both the overburden and bedrock.

   e. Discontinue monitoring at D26A and D26B and install a new monitoring well in the same area. Note that this monitoring well will be completed with intervals in both the overburden and bedrock.

   f. Discontinue monitoring at D2A as the homeowner does not want their well monitored. The new monitoring wells to be installed by D24 and D26 would provide sufficient coverage for monitoring at D2A.

6) Bedrock Monitoring Well Changes:

   a. Discontinue monitoring at D32 and D36B as these wells provide similar data to other wells in the area and are outside of the 1 m drawdown area. On-site monitoring wells (MW6A-05 and MW12A-08) are in the same area as these wells and would still be used for monitoring water levels in the bedrock.

7) The PTTW should be updated with the following administrative changes:

   a. MW11B-08 is listed as monthly monitoring under bedrock wells and it should be listed as monthly monitoring under overburden wells.

   b. MW12B-08 is listed as monthly monitoring under bedrock wells and it should be listed as monthly monitoring under overburden wells.

   c. D27 is listed as both continuous and monthly monitoring under overburden wells and it should only be monthly monitoring (note that this well is recommended to be removed from the monitoring conditions).

# 9.0 CONTINGENCY PLAN

The following sub-sections provide contingency plans that provide mitigative measures to be taken in the event that unforeseen or unacceptable impacts occur as a result of the takings from TW1-88.

## 9.1 Low Flow Response Plan

Below-normal rainfall and hot conditions, which increase evapotranspiration, can result in relatively low stream flows and low groundwater levels in the overburden aquifer. The Grand River Conservation Authority (GRCA) coordinates and supports Ontario's Low Water Response Program for the Grand River watershed. The program is directed at those who hold a PTTW to support water conservation for drinking water, agriculture, industry, and the health of the ecosystem during low-water conditions. Nestlé is part of the GRCA Low Water Response Team representing the bottled water industry. The Low Water Response Program has three condition levels which are based on trends in flows and rainfall, which are summarized as follows (from the GRCA website):

- Level 1 – flows are less than 70% of their normal summer low flow and/or precipitation has been less than 80% of average. Water users are asked to voluntarily reduce consumption by 10%;
- Level 2 – flows are less than 50% of their normal summer low flow and/or precipitation has been less than 60% of average. The MECP will send out letters to holders of PTTWs to ask them to voluntarily reduce their consumption by 20%; and
- Level 3 – flows are less than 30% of their normal summer low flow and/or precipitation has been less than 40% of average. There is also potential for economic harm to water takers and/or significant harm to the ecosystem. The Water Response Team may ask the province to impose mandatory restrictions on those holding PTTW.

Trigger levels are reviewed along with other information (e.g., weather forecast, local water use and time of year) by the Low Water Response Team (including the GRCA) to determine if a low-water response should be recommended. The low-water response can occur on the subwatershed level or over the entire watershed.

Level 1 declarations were issued in 2005, 2007, 2012, 2015, 2016, 2017 and 2018. Grand River watershed-wide Level 2 declarations were issued in 2007, 2012, 2016 and 2017. A Level 3 declaration has never been issued for the Eramosa River subwatershed. There are additional times when the low-flow thresholds were exceeded but the Low Water Response was not declared based on the review of other information.

Because the volume of water withdrawn by Nestlé fluctuates daily based on demand and other operational aspects of the bottling facility, there are days when the withdrawal is near the permitted amount and days when it is well below the permitted amount. Nestlé monitors the withdrawals during the summer (including during drought conditions) to ensure that the water taking does not negatively affect groundwater levels in the bedrock and overburden aquifers. These rates were established from testing to determine the maximum water taking allowed in the PTTW.

Nestlé withdraws water from a bedrock aquifer that has been monitored for 19 years, including both dry and wet years. This extensive amount of monitoring has confirmed that the source is being managed for long-term sustainability. The data have shown that the effects of below-average precipitation are more evident in shallow groundwater and surface water compared to the bedrock aquifer where pumping occurs.

As per the conditions of the PTTW, Nestlé is mandatorily required to reduce their taking during drought periods in accordance with the Ontario Low Water Response Protocol and ensure that the reduction is based on the maximum taken per day as outlined in the PTTW.

To allow for some flexibility in operation, Nestlé's commitment to reducing takings during times of drought is to meet the PTTW requirements and reduce by these amounts:

- During a Level 1 Condition Nestlé limits the water taking to 90% of the daily maximum permitted volume;
- During a Level 2 Condition Nestlé limits the water taking to 80% of the daily maximum permitted volume; and
- During a Level 3 Condition Nestlé limits the water taking to 70% of the daily maximum permitted volume.

Nestlé's bottled water products are for human consumption and are essential for human hydration. Bottled water is also essential in time of emergencies. In 2017 and 2018, Nestlé donated over 2 million bottles of water to Canadians in crises during floods and fires, charitable donations and homelessness initiatives. Nestlé also has a partnership with the Canadian Red Cross to support the organization in times of need. Nestlé is a highly efficient water user and only bottles what is needed to meet customer demand. However, that demand varies from day to day and week to week and consequently, Nestlé needs some flexibility in running an efficient business. Since the drought conditions came into effect, Nestlé has been committed to limiting the daily maximum withdrawal by the percentages noted above.

## 9.2 Well Interference Plan

Nestlé has a well interference plan with the Town and is currently working to update the plan. A copy of the current and updated plans are included in Appendix L. The well interference plan details the steps to be taken when a complaint is received.

## 9.3 Other Impacts Identified by the MECP

Should the MECP determine that unacceptable interference is occurring, Nestlé will work with the MECP to investigate the cause of the interference until the problem is resolved.

## 10.0 REFERENCES

AquaResource Inc., 2009. Integrated Water Budget Report, Grand River Watershed, final report prepared for the Lake Erie Source Protection Region, March 2017.

Beacon Environmental, 2019. 2018 Biological Monitoring Program Nestlé Waters Canada Erin Property.

Bear, J., 1979: Hydraulics of Groundwater, McGraw Hill, Inc., New York, New York.

Bird Studies Canada, 2009. Marsh Monitoring Program Participant's Handbook for Surveying Amphibians. 2009 Edition. 13 pages. Published by Bird Studies Canada in cooperation with Environment Canada and the U.S. Environment Protection Agency. February 2009.

Blackport Hydrogeology Inc., 2005. Groundwater Management and Protection Strategies, Groundwater Management Study, Town of Erin, prepared for the Town of Erin through funding by the Ministry of the Environment.

Blackport Hydrogeology Inc. and Golder Associates Ltd., 2010. WHPA Delineation and Vulnerability Assessment, Town of Erin Municipal Wells, Final Report, prepared for the Town of Erin and Credit Valley Conservation, April 2010.

Cadman, M.D., D.A. Sutherland, G.G. Beck, D. Lepage, and A.R. Couturier (eds.) 2007. Atlas of the Breeding Birds of Ontario, 2001 – 2005. Bird Studies Canada, Environment Canada, Ontario Field Ornithologist, Ontario Ministry of Natural Resources, and Ontario Nature, Toronto. Xxii + 706 pp.

Canadian Heritage Rivers System, 2019. http://chrs.ca/the-rivers/grand/

Canadian Wildlife Services. 2006. Forest Bird Monitoring Program: Site Set-up and Bird Survey Instructions. 6p.

Chapman, L.J., and D.F. Putnam, 1984. The Physiography of Southern Ontario. Geological Survey, Special Volume 2.

Conestoga Rovers & Associates Limited, 1989. Well Construction and Testing Investigation, Supply Well TW1-88.

Conestoga Rovers & Associates Limited, 2006. Test Pumping Investigation Supply Well TW1-88 (Draft).

Conestoga Rovers & Associates Limited, 2014. 2013 Annual Monitoring Report, Nestlé Waters Canada.

Cooper, H.H., and C.E. Jacob, 1946: A generalized graphical method for evaluation formation constants and summarizing well field history, Transactions of the American Geophysical Union, vol. 27, no. 4, pp. 526 534.

Cowan, W.R., 1976. Quaternary Geology of the Orangeville Area, Southern Ontario, Ontario Division of Mines, GR141, accompanied by Maps 2326, 2327 and 2328.

Credit Valley Conservation, Aquafor Beech Inc., Blackport Hydrogeology Inc., 2011. Erin Servicing and Settlement Master Plan, Phase 1 – Environmental Component – Existing Conditions Report, May 2011.

Driscoll, F.G., 1986: Groundwater and Wells, Johnson Division, St. Paul, Minnesota.

Ferguson, H.; O'Neill, A.; and Cork, H. (1970). Mean Evapotranspiration over Canada, Water Resources Research, 6(6):1618-1633.

Golder Associates Ltd., 2006. County of Wellington Groundwater Protection Study, September 2006.

Grand River Conservation Authority, 2019. https://www.grandriver.ca/en/our-watershed/Heritage-River-Designation.aspx

Howe, R.W., G.J. Niemi, S.J. Lewis, and D.A. Welsh. 1997. A standard method for monitoring songbird populations in the Great Lakes Region. The Passenger Pigeon 59(3): 189-194.

Lee, H.T., W.D. Bakowsky, J. Riley, J. Bowles, M. Puddister, P. Uhlig and S. McMurray. 1998. Ecological Land Classification for Southern Ontario: First Approximation and Its Application. Ontario Ministry of Natural Resources. SCSS Field Guide FG-02. 225 pp.

Liberty, B.A.; 1975: Map 2339, Paleozoic Geology, Orangeville, Scale 1:50,000. Produced from original mapping by:

-Bond, I.J., 1972: Geology of Orangeville East map-sheet

-Telford, P.G., 1973: Geology of Orangeville West map-sheet

Matrix Solutions Inc., 2019. Groundwater Flow Modelling Report for Renewal of the Permit to Take Water for the Nestlé Waters Canada Aberfoyle and Erin Facilities, prepared for the City of Guelph and Nestlé Waters Canada, February 2019.

Matrix Solutions Inc., 2018a. Guelph-Guelph/Eramosa Water Quantity Policy Development Study: Threats Management Strategy. Prepared for the Lake Erie Source Protection Region.

Matrix Solutions Inc., 2018b. Assessment of Climate Change and Assessment of Water Quantity Threats in the IPZ-Q in Support of the Guelph-Guelph/Eramosa Water Quantity Policy Study. Prepared for the Lake Erie Source Protection Region.

Matrix Solutions Inc., 2017. City of Guelph and Township of Guelph/Eramosa Tier 3 Water Budget and Local Area Risk Assessment. Prepared for the Lake Erie Source Protection Region.

Matrix Solutions Inc., 2014. City of Guelph Tier Three Water Budget and Local Area Risk Assessment, Appendix B: Groundwater Flow Model Report, prepared for the Lake Erie Source Protection Region, July 2014. [Appendix B of the City of Guelph and Township of Guelph/Eramosa Tier Three Water Budget and Local Area Risk Assessment report.]

Matrix Solutions Inc., and S.S. Papadopulos & Associates, 2014. Region of Waterloo Tier Three Water Budget and Local Area Risk Assessment, Appendix B: Selection of Appropriate WHPA Q1 Drawdown Contour, prepared for the Region of Waterloo, September 2014.

Oldham, M.J. and S.R. Brinker, S.R. 2009. Rare Vascular Plants of Ontario. Fourth Edition. Natural Heritage Information Centre, Ontario Ministry of Natural Resources, Peterborough, Ontario. 188 pages.

Ontario Ministry of the Environment and Climate Change, 2017. Interim Procedural and Technical Guidance Document for Bottled Water Renewals: Permit to Take Water Applications and Hydrogeological Study Requirements, Ontario Ministry of the Environment and Climate Change Operations Division, April 2017.

# Signature Page

**Golder Associates Ltd.**

Greg Padusenko, M.Sc., P.Eng., P.Geo.
*Hydrogeologist*

John Piersol, M.Sc., P.Geo.
*Associate/Hydrogeologist*

**S.S. Papadopulos & Associates, Inc.**

CJNeville

Christopher J. Neville, M.Sc., P.Eng.
*Hydrogeologist*

**C. Portt & Associates**

Cam Portt, M.Sc.
*Fisheries Consultant*

**Beacon Environmental**

Ken Ursic

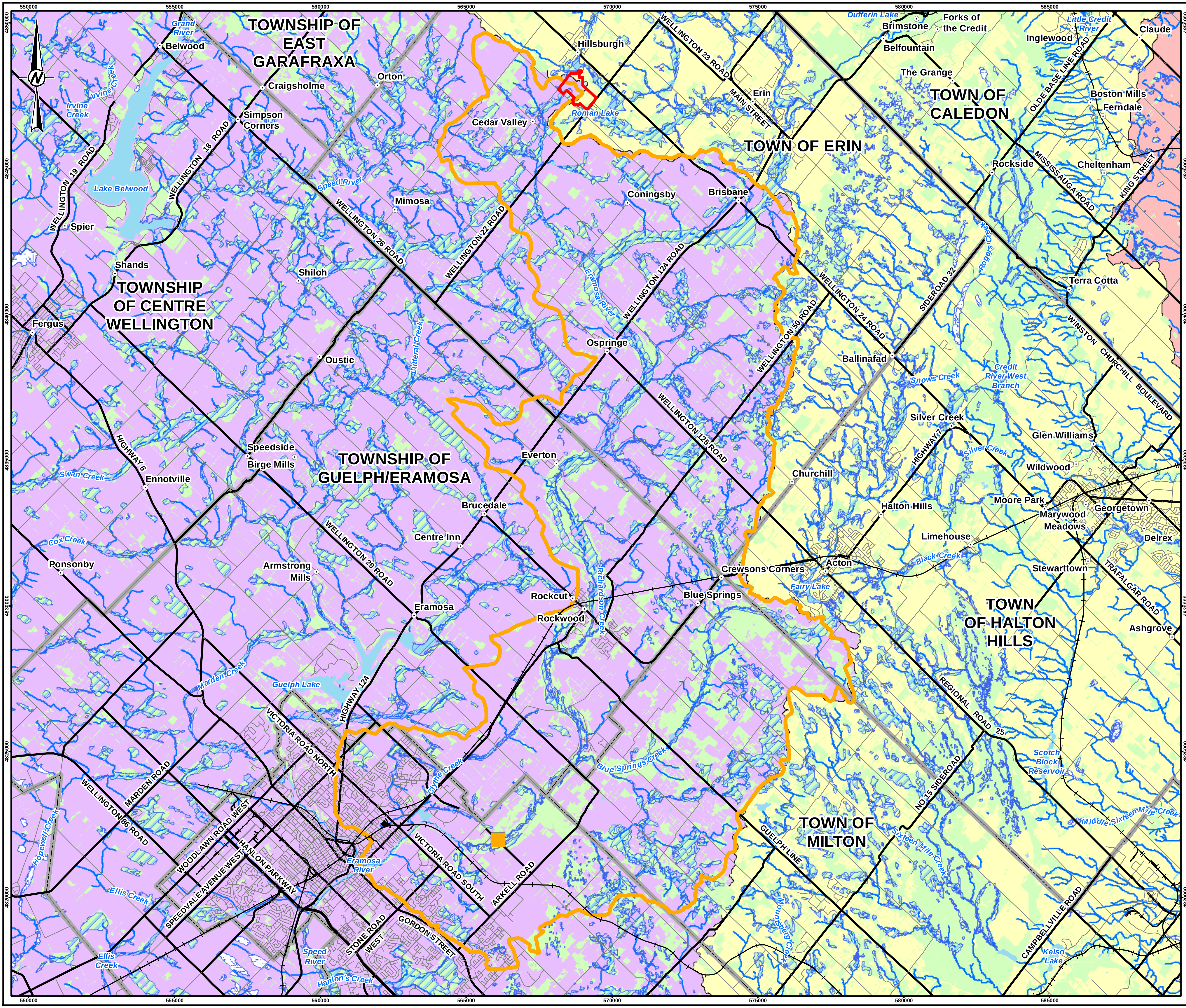
Ken Ursic, M.Sc.
*Senior Ecologist*

GRP/JAP/ll

Golder and the G logo are trademarks of Golder Associates Corporation

\\golder.gds\gal\mississauga\active\2013\1152\13-1152-0250 nestle waters ws s. ontario\erin\pttw renewal\technical study report\final\13-1152-0250 (9000) rpt erin tech. study 19jun2019.docx

# FIGURES



**LEGEND**

- ⊙ City/Town
- 🟧 Surface Water Flow Station
- Main Road
- Local Road
- Railway
- Watercourse
- ▨ Evaluated-Other
- ▨ Evaluated-Provincial
- Waterbody
- Wooded Area
- Provincial Park
- Municipal Boundary
- 🟥 Property Boundary

**Watersheds**

- Credit - 16 Mile
- Humber - Don
- Upper Grand

**Sub-Watersheds**

- Eramosa River Sub-Watershed

0 2 4 6 8

1:130,000 Kilometres

**REFERENCE(S)**

BASE DATA - MNR LIO, OBTAINED 2015
PRODUCED BY GOLDER ASSOCIATES LTD UNDER LICENCE FROM
ONTARIO MINISTRY OF NATURAL RESOURCES, © QUEENS PRINTER 2013
PROJECTION: UTM NAD83 ZONE 17
PROPERTY BOUNDARY FROM CRA FILE 13764-10(017)GN-WA002.DWG.

CLIENT
NESTLE WATERS CANADA

PROJECT
HYDROGEOLOGICAL STUDY

TITLE
**SITE LOCATION**

CONSULTANT
GOLDER

| | |
|---|---|
| YYYY-MM-DD | 2018-07-17 |
| DESIGNED | KD |
| PREPARED | JMC/MM |
| REVIEWED | GP |
| APPROVED | JAP |

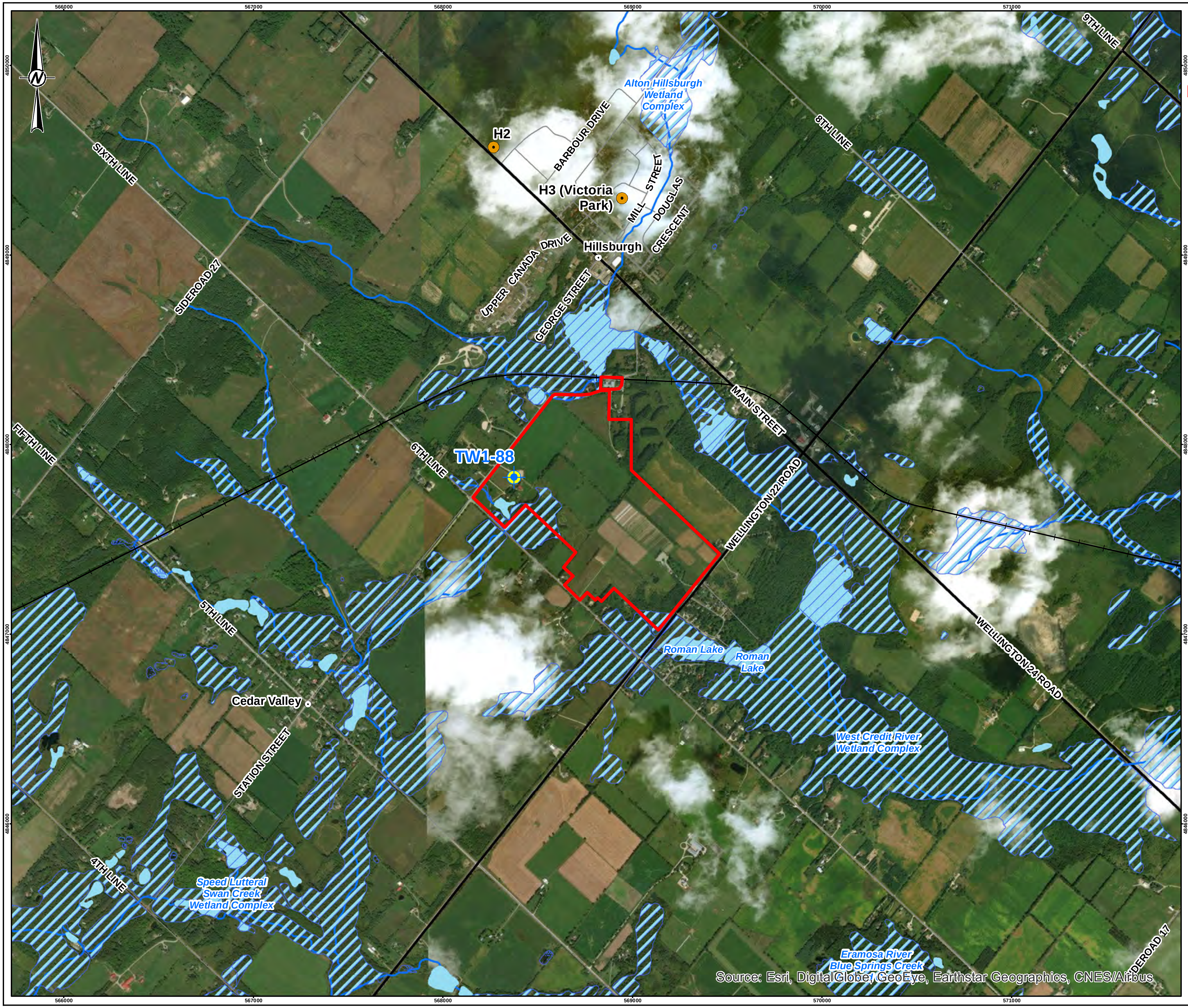
| PROJECT NO. | CONTROL | REV. | FIGURE |
|---|---|---|---|
| 13-1152-0250 (9000) | 0015 | 1.0 | 1 |

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM:

25mm

0

PATH: S:\Clients\Nestle\Erin\99_PROJ\13115202250_Hydro_G\40_PROD\0015_2018_HydrogeoStudy_PTTW_Renewal\13115202250-0015-CH-0001.mxd PRINTED ON: 2018-07-18 AT: 12:22:56 PM



LEGEND

| | |
|---|---|
| ⊕ | Production Well |
| ● | Municipal Production Well |
| — | Watercourse |
| 🟥 | Property Boundary |

0 500 1,000 1,500

1:20,000 Meters

REFERENCE(S)
BASE DATA - MNR LIO, OBTAINED 2015
PRODUCED BY GOLDER ASSOCIATES LTD UNDER LICENCE FROM
ONTARIO MINISTRY OF NATURAL RESOURCES, © QUEENS PRINTER 2013
PROJECTION: UTM NAD83 ZONE 17
PROPERTY BOUNDARY FROM CRA FILE 13764-10(017)GN-WA002.DWG.

CLIENT
NESTLE WATERS CANADA

PROJECT
HYDROGEOLOGICAL STUDY

TITLE
SITE SETTING

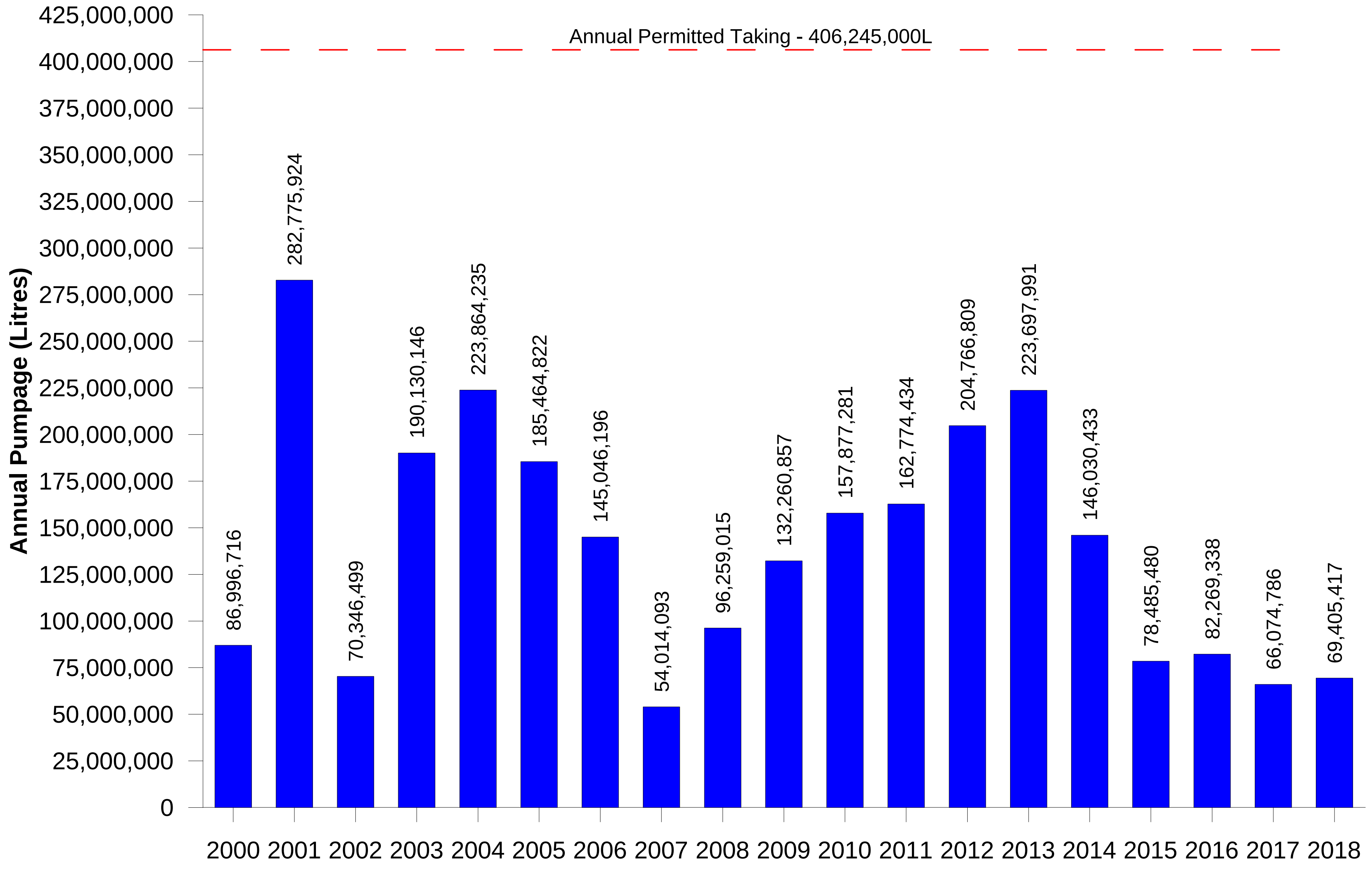
CONSULTANT
GOLDER

| | |
|---|---|
| YYYY-MM-DD | 2018-08-14 |
| DESIGNED | KD |
| PREPARED | JMC |
| REVIEWED | GP |
| APPROVED | JAP |

| PROJECT NO. | CONTROL | REV. | FIGURE |
|---|---|---|---|
| 13-1152-0250 (9000) | 0015 | 1.0 | 2 |

PATH: S:\Clients\Nestle\Erin\99_PROJ\1311520250_Hydro_G\40_PROD\0015_2018_HydrogeoStudy_PTTW_Renewal\1311520250-0015-CH-0002.mxd PRINTED ON: 2018-08-14 AT: 1:27:49 PM

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: 25mm 0



GOLDER

**DATE** DECEMBER 2018
**DESIGN** KS
**REVIEW** GP
**APPROVED** GP

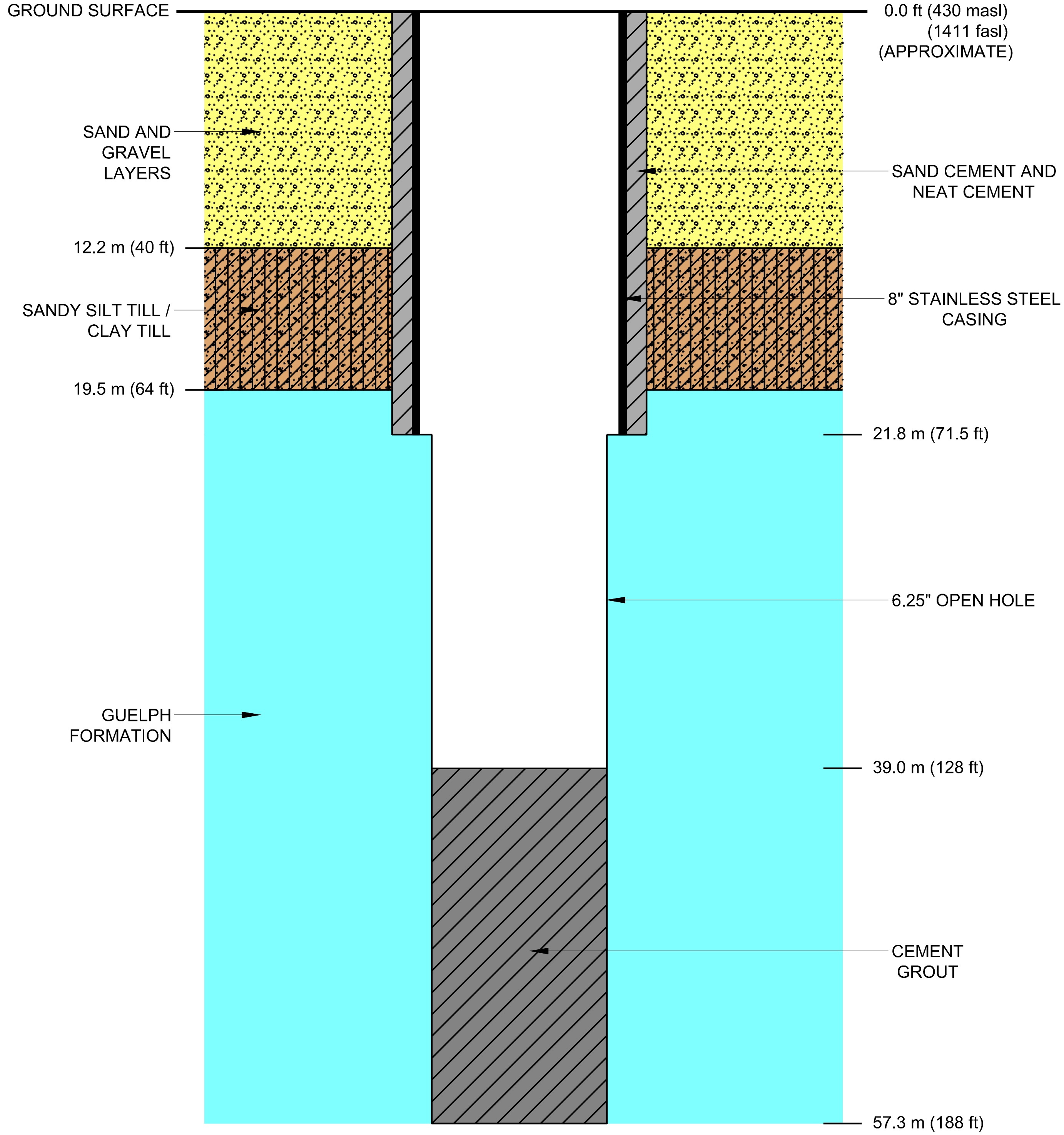
**PROJECT**

**NESTLE WATERS CANADA**
**Town of Erin, Ontario**

**TITLE**

**TW1-88 ANNUAL WATER TAKING (2000 TO 2018)**

| **PROJECT NO.** | **REV** | **FIGURE** |
|---|---|---|
| 13-1152-0250 (9000) | A | 3 |



CLIENT
NESTLE WATERS CANADA

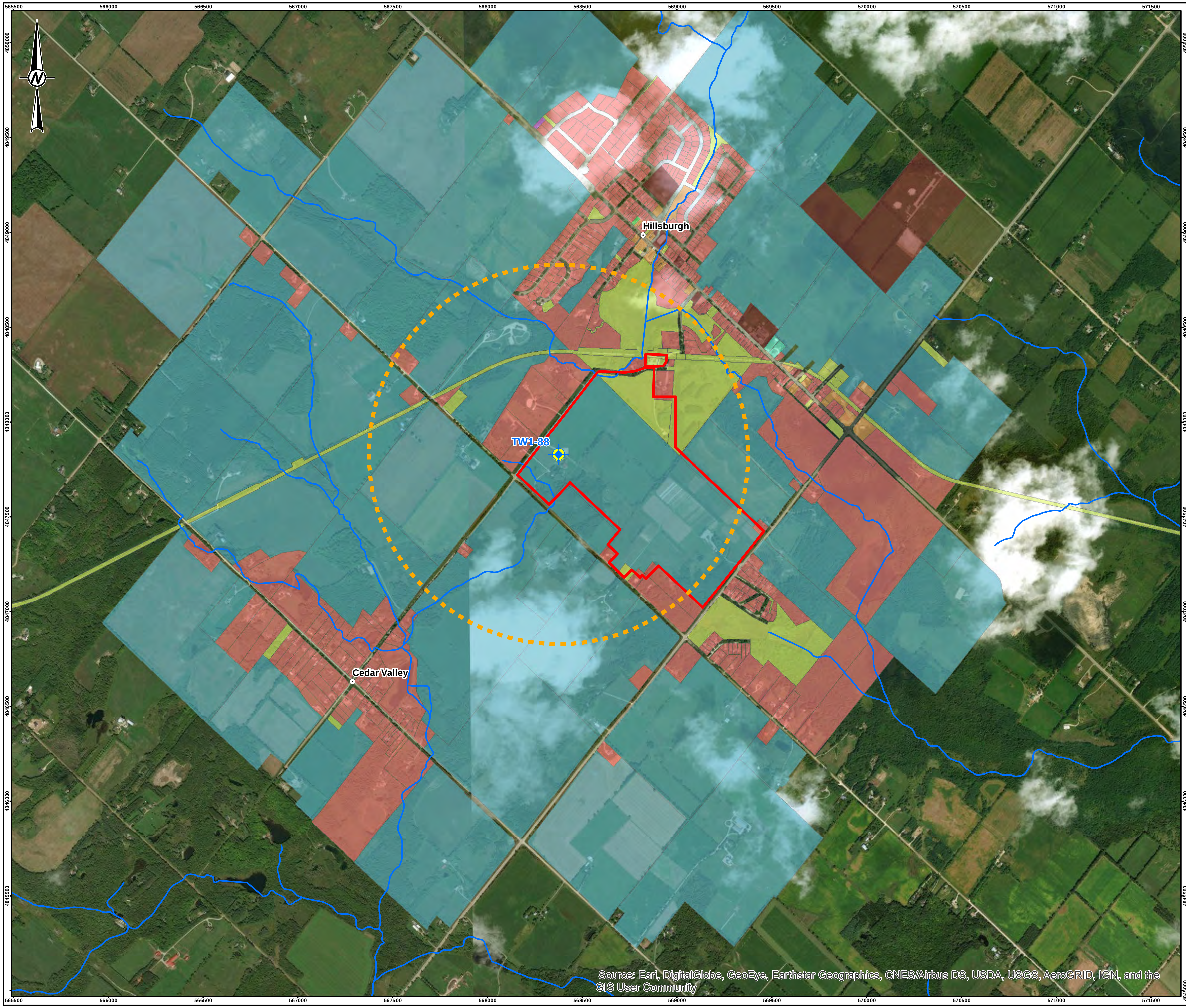
PROJECT
HYDROGEOLOGICAL STUDY

CONSULTANT
GOLDER

| | |
|---|---|
| YYYY-MM-DD | 2017-04-06 |
| PREPARED | MR |
| DESIGN | MR |
| REVIEW | GP |
| APPROVED | GP |

TITLE
**ERIN TW1-88**

| PROJECT No. | PHASE | Rev. | FIGURE |
|---|---|---|---|
| 13-1152-0250 | 9000 | 1.0 | 4 |



Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

**LEGEND**

| | |
|---|---|
| ⊕ | Production Well |
| ⊙ | City/Town |
| — | Watercourse |
| ▨ | TW1-88 1 km Buffer |
| 🟥 | Property Boundary |

**Landuse Category**

| | |
|---|---|
| 🟩 | Automotive or Fuel Station |
| 🟧 | Commercial |
| 🟦 | Farm/Agriculture |
| 🟦 | Industrial |
| 🟫 | Institutional |
| 🟥 | Residential |
| 🟨 | Vacant or Conservation Authority Land |
| 🟪 | Water Supply |

0 200 400 600 800

1:20,000 Meters

**REFERENCE(S)**

BASE DATA - MNR LIO, OBTAINED 2015
PRODUCED BY GOLDER ASSOCIATES LTD UNDER LICENCE FROM ONTARIO MINISTRY OF NATURAL RESOURCES, © QUEENS PRINTER 2013
PROJECTION: UTM NAD83 ZONE 17
PROPERTY BOUNDARY FROM CRA FILE 13764-10(017)GN-WA002.DWG.

CLIENT
NESTLE WATERS CANADA

PROJECT
HYDROGEOLOGICAL STUDY

TITLE
**LAND USE**

CONSULTANT

GOLDER

| | |
|---|---|
| YYYY-MM-DD | 2018-07-17 |
| DESIGNED | JMC |
| PREPARED | JMC |
| REVIEWED | GP |
| APPROVED | JAP |

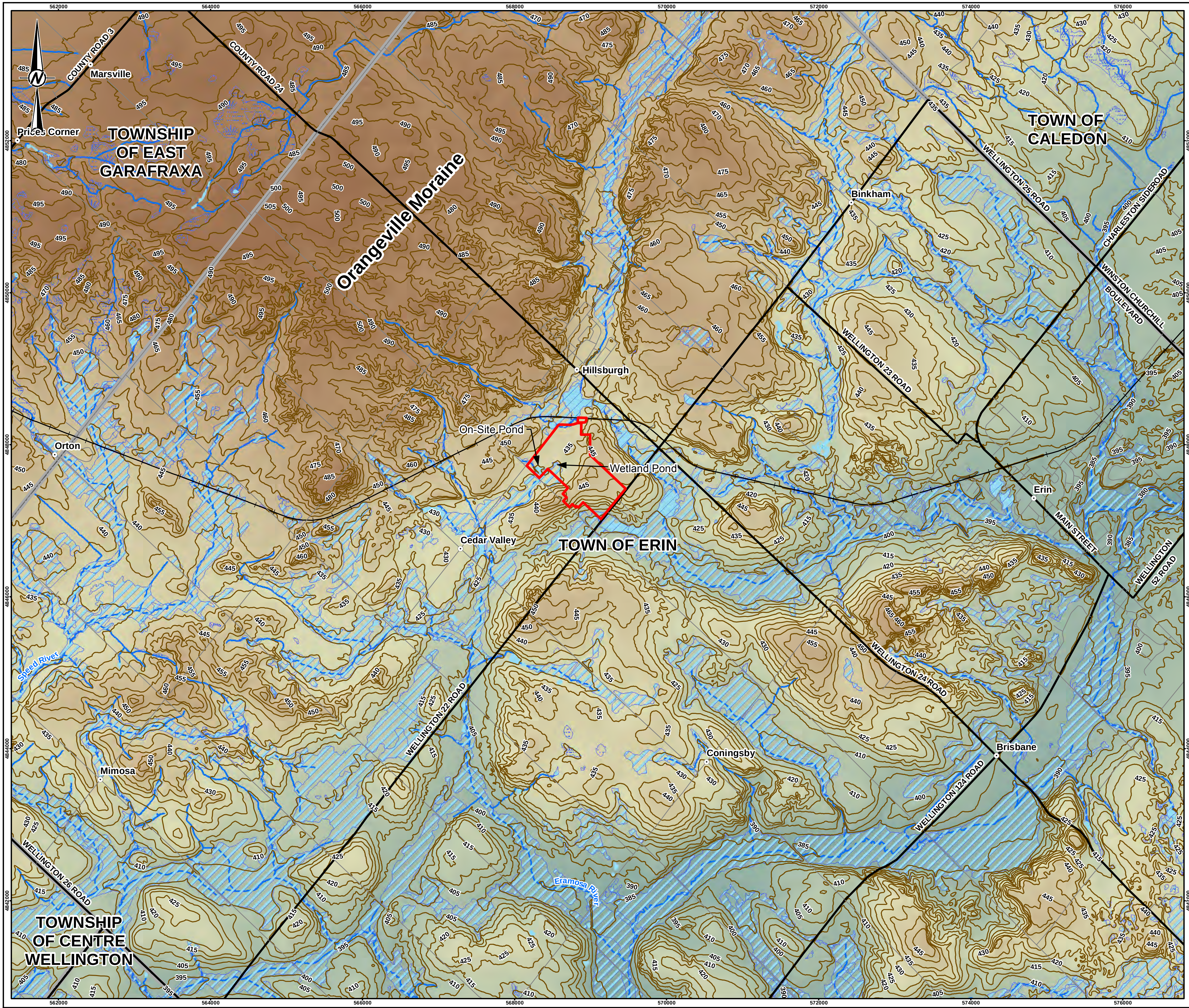
| PROJECT NO. | CONTROL | REV. | FIGURE |
|---|---|---|---|
| 13-1152-0250 (9000) | 0015 | 1.0 | **5** |

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM:

25mm

0

PATH: S:\Clients\Nestle\Erin\99_PROJ\1311520250_Hydro_G\40_PROD\0015_2018_HydrogeoStudy_PTTW_Renewal\1311520250-0015-CH-0004.mxd PRINTED ON: 2018-07-17 AT: 6:20:05 PM



**LEGEND**

- ⊙ City/Town
- Main Road
- Local Road
- Railway
- Topographic Elevation Contour (masl)
- Watercourse
- Wetland
- Provincially Significant Wetland
- Waterbody
- Municipal Boundary
- Property Boundary

**Topographic Elevation (masl)**

High : 505

Low : 307

0 1 2 3 4

1:50,000 Kilometres

**REFERENCE(S)**
BASE DATA - MNR LIO, OBTAINED 2015
PRODUCED BY GOLDER ASSOCIATES LTD UNDER LICENCE FROM
ONTARIO MINISTRY OF NATURAL RESOURCES, © QUEENS PRINTER 2013
PROJECTION: UTM NAD83 ZONE 17
PROPERTY BOUNDARY FROM CRA FILE 13764-10(017)GN-WA002.DWG.

CLIENT
NESTLE WATERS CANADA

PROJECT
HYDROGEOLOGICAL STUDY

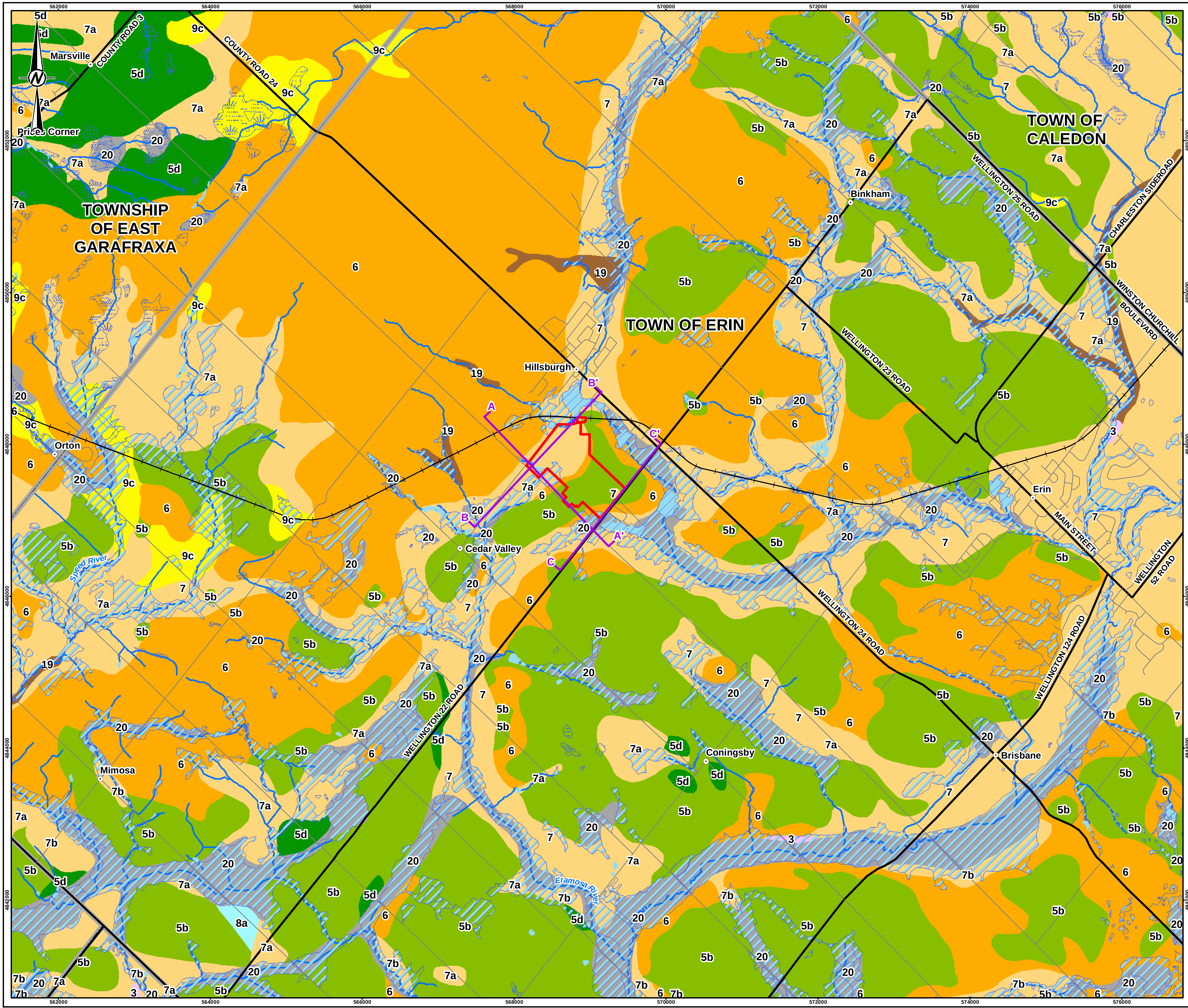
TITLE
**TOPOGRAPHY AND DRAINAGE**

CONSULTANT

GOLDER

| | |
|---|---|
| YYYY-MM-DD | 2018-07-17 |
| DESIGNED | KD |
| PREPARED | JMC |
| REVIEWED | GP |
| APPROVED | JAP |

| PROJECT NO. | CONTROL | REV. | FIGURE |
|---|---|---|---|
| 13-1152-0250 (9000) | 0015 | 1.0 | 6 |



**LEGEND**

- ⊙ City/Town
- Cross-Section Location
- Main Road
- Local Road
- Railway
- Watercourse
- Wetland
- ▨ Provincially Significant Wetland
- Waterbody
- Municipal Boundary
- 🟥 Property Boundary
- 3: Paleozoic bedrock
- 5b: Stone-poor, carbonate-derived silty to sandy till
- 5d: Glaciolacustrine-derived silty to clayey till
- 6: Ice-contact stratified deposits
- 7: Glaciofluvial deposits
- 7a: Sandy deposits
- 7b: Gravelly deposits
- 8a: Massive-well laminated
- 9c: Foreshore-basinal deposits
- 19: Modern alluvial deposits
- 20: Organic deposits

0 1 2 3 4
1:50,000
Kilometres

REFERENCE(S)
BASE DATA - MNR LIO, OBTAINED 2015
PRODUCED BY GOLDER ASSOCIATES LTD UNDER LICENCE FROM
ONTARIO MINISTRY OF NATURAL RESOURCES, © QUEENS PRINTER 2013
PROJECTION: UTM NAD83 ZONE 17
PROPERTY BOUNDARY FROM CRA FILE 13764-10(017)GN-WA002.DWG.

CLIENT
NESTLE WATERS CANADA

PROJECT
HYDROGEOLOGICAL STUDY

TITLE
## REGIONAL QUATERNARY GEOLOGY

CONSULTANT

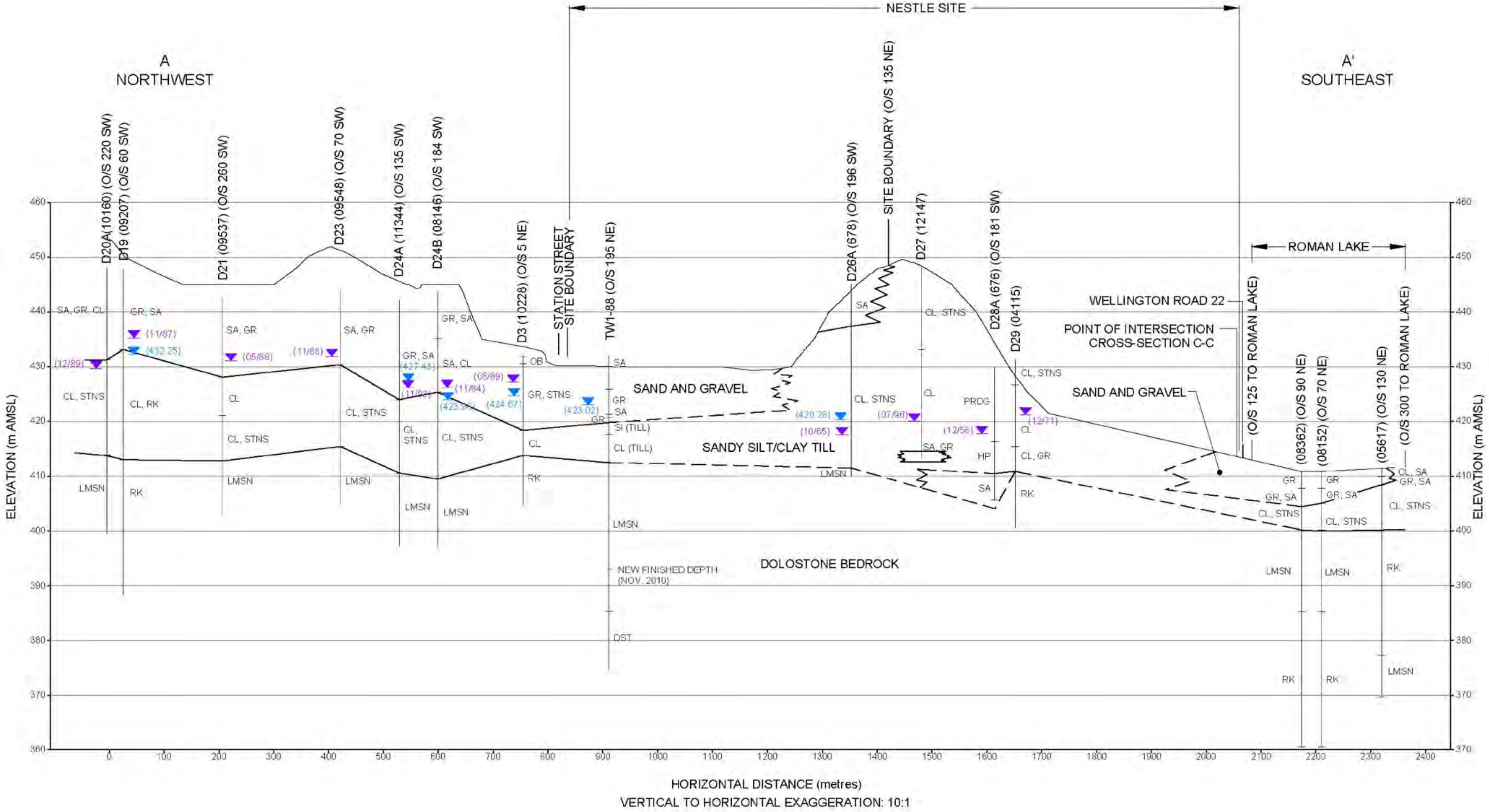
GOLDER

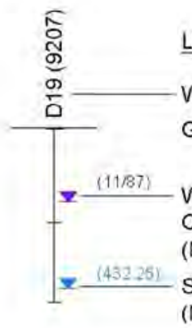
| | |
|---|---|
| YYYY-MM-DD | 2018-07-17 |
| DESIGNED | KD |
| PREPARED | JMC |
| REVIEWED | GP |
| APPROVED | JAP |

| PROJECT NO. | CONTROL | REV. | FIGURE |
|---|---|---|---|
| 13-1152-0250 (9000) | 0015 | 1.0 | 7 |

PATH: S:\Clients\Nestle\Erin\99_PROJ\1311520250_Hydro_G\40_PROD\0015_2018_HydrogeoStudy_PTTW_Renewal\1311520250-0015-CH-0006.mxd PRINTED ON: 2018-07-17 AT: 6:19:56 PM

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM:
25mm
0





**LEGEND**

WELL DESIGNATION
GROUND SURFACE
WATER LEVEL ON WELL COMPLETION (MONTH / YEAR)
STATIC WATER LEVEL (NOV. 3/05)

PRDG - PRE DUG
OB - OVERBURDEN
CL - CLAY
SI - SILT
SA - SAND
GR - GRAVEL
STNS - STONES
HP - HARDPAN
RK - ROCK (BEDROCK)
LMSN - LIMESTONE (BEDROCK)
DST - DOLOSTONE
CL, SA - FIRST COMPONENT IS MOST COMMON MATERIAL

**REFERENCE(S)**
CROSS-SECTION A-A' OBTAINED FROM CRA 2013 ANNUAL MONITORING REPORT, APRIL 2014.

CLIENT
NESTLE WATERS CANADA

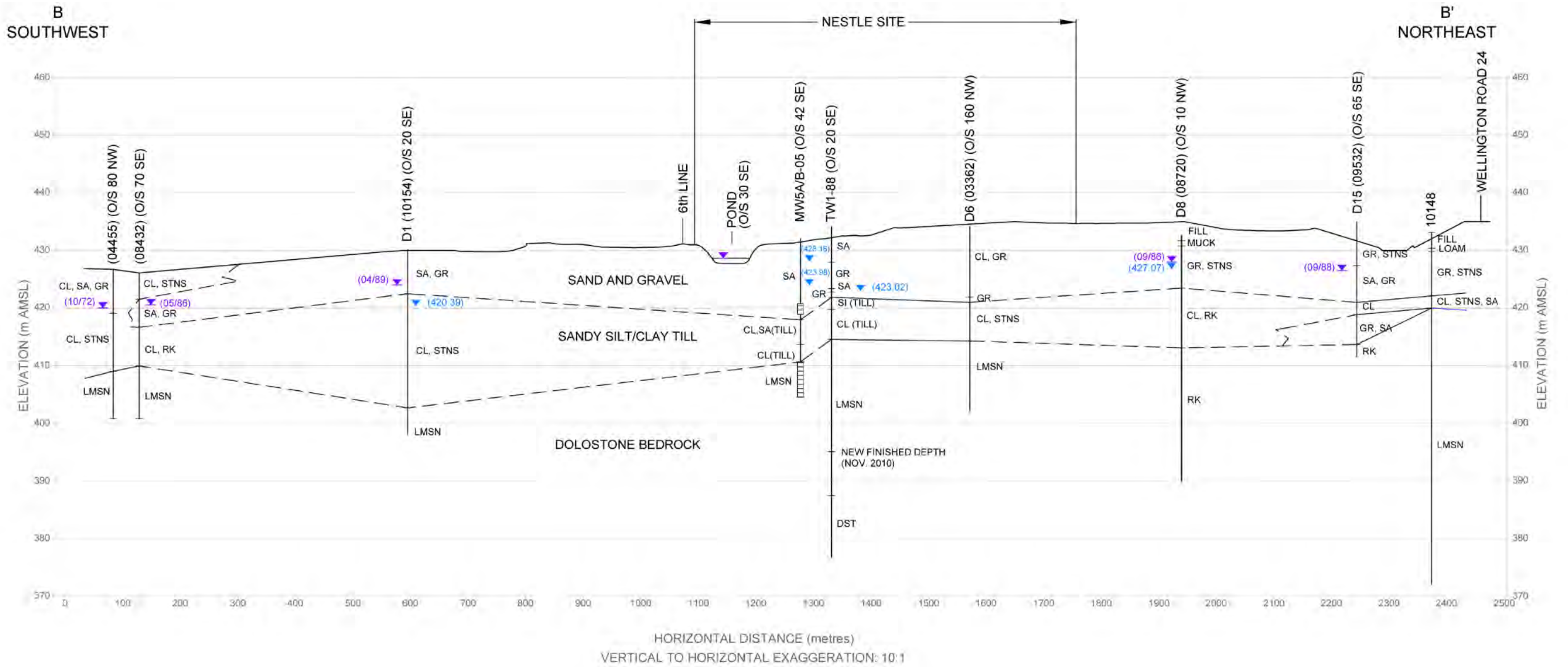
PROJECT
HYDROGEOLOGICAL STUDY

TITLE
**HYDROGEOLOGIC CROSS-SECTION A-A'**

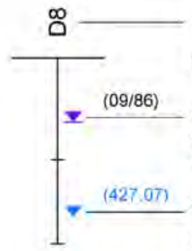
CONSULTANT
GOLDER

| | |
|---|---|
| YYYY-MM-DD | 2018-07-17 |
| DESIGNED | KD |
| PREPARED | JMC |
| REVIEWED | GP |
| APPROVED | JAP |

| PROJECT NO. | CONTROL | REV. | FIGURE |
|---|---|---|---|
| 13-1152-0250 (9000) | 0015 | 1.0 | 8 |



## LEGEND



WELL DESIGNATION
GROUND SURFACE
WATER LEVEL (m AMSL) ON WELL COMPLETION (MONTH / YEAR)
STATIC WATER LEVEL (NOV. 3/05)

PRDG - PRE DUG
CL - CLAY
SI - SILT
SA - SAND
GR - GRAVEL
STNS - STONES
HP - HARDPAN
RK - ROCK (BEDROCK)
LMSN - LIMESTONE (BEDROCK)
DST - DOLOSTONE
CL, SA - FIRST COMPONENT IS MOST COMMON MATERIAL

**REFERENCE(S)**
CROSS-SECTION B-B' OBTAINED FROM CRA 2013 ANNUAL MONITORING REPORT, APRIL 2014.

CLIENT
NESTLE WATERS CANADA

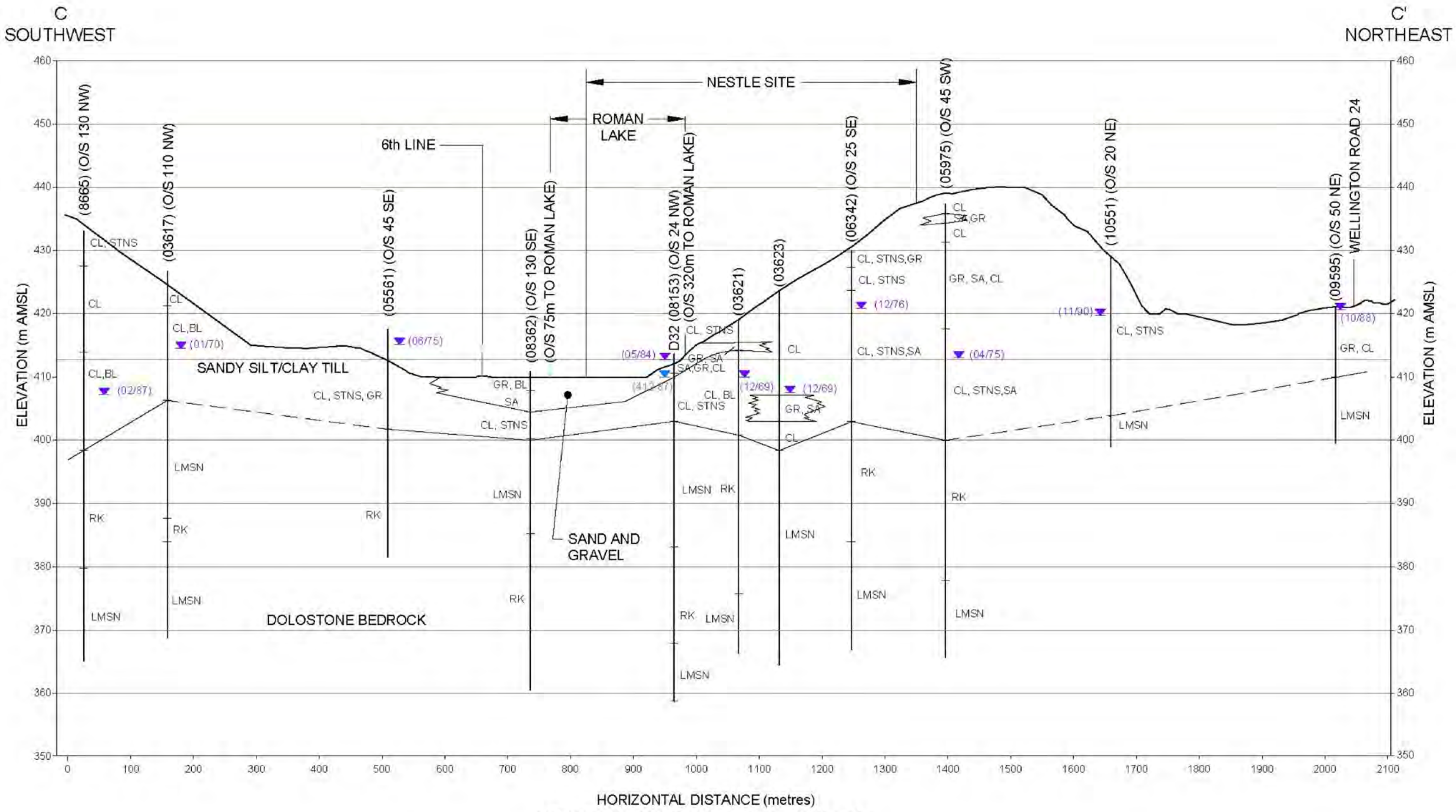
PROJECT
HYDROGEOLOGICAL STUDY

TITLE
**HYDROGEOLOGIC CROSS-SECTION B-B'**

CONSULTANT
GOLDER

| | |
|---|---|
| YYYY-MM-DD | 2017-07-17 |
| DESIGNED | KD |
| PREPARED | JMC |
| REVIEWED | GP |
| APPROVED | JAP |

| PROJECT NO. | CONTROL | REV. | FIGURE |
|---|---|---|---|
| 13-1152-0250 (9000) | 0015 | 1.0 | 9 |



VERTICAL TO HORIZONTAL EXAGGERATION: 10:1

**LEGEND**

D32 — WELL DESIGNATION

GROUND SURFACE

▼ (05/84) WATER LEVEL ON WELL COMPLETION (MONTH / YEAR)

▼ (412.87) STATIC WATER LEVEL (NOV. 3/05)

PRDG - PRE DUG
OB - OVERBURDEN
CL - CLAY
SI - SILT
SA - SAND
GR - GRAVEL
BL - BOULDER
STNS - STONES
HP - HARDPAN
RK - ROCK (BEDROCK)
LMSN - LIMESTONE (BEDROCK)
DST - DOLOSTONE
CL, SA - FIRST COMPONENT IS MOST COMMON MATERIAL

**REFERENCE(S)**
CROSS-SECTION C-C' OBTAINED FROM CRA 2013 ANNUAL MONITORING REPORT, APRIL 2014.

CLIENT
NESTLE WATERS CANADA

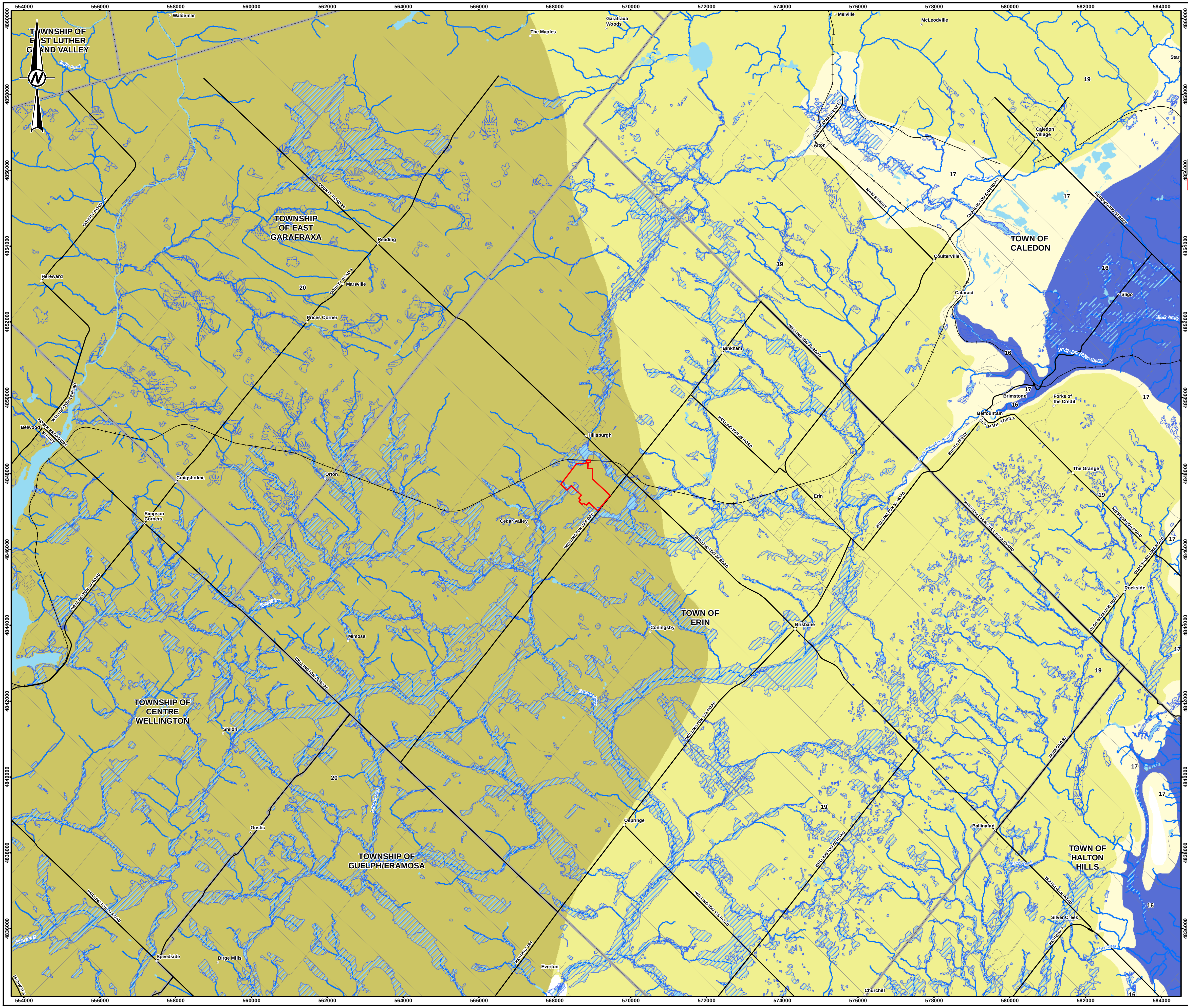
PROJECT
HYDROGEOLOGICAL STUDY

TITLE
**HYDROGEOLOGIC CROSS-SECTION C-C'**

CONSULTANT
GOLDER

| | |
|---|---|
| YYYY-MM-DD | 2018-07-17 |
| DESIGNED | KD |
| PREPARED | JMC |
| REVIEWED | GP |
| APPROVED | JAP |

| PROJECT NO. | CONTROL | REV. | FIGURE |
|---|---|---|---|
| 13-1152-0250 (9000) | 0015 | 1.0 | **10** |



PATH: S:\Clients\Nestle\Erin\99_PROJ\1311520250_Hydro_G\40_PROD\0015_2018_HydrogeoStudy_PTTW_Renewal\1311520250-0015-CH-0010.mxd PRINTED ON: 2018-07-17 AT: 6:19:26 PM

**LEGEND**

| | |
|---|---|
| ⊙ | City/Town |
| ━ | Main Road |
| ─ | Local Road |
| ┼ | Railway |
| ─ | Watercourse |
| ▭ | Wetland |
| ▨ | Provincially Significant Wetland |
| ■ | Waterbody |
| ▭ | Municipal Boundary |
| 🟥 | Property Boundary |
| ■ | 20: Guelph |
| ■ | 19: Amabel |
| ■ | 17: Clinton-Cataract Group |
| ■ | 16: Queenston |

0 1 2 3 4

1:100,000 Kilometres

**REFERENCE(S)**

BASE DATA - MNR LIO, OBTAINED 2015
PRODUCED BY GOLDER ASSOCIATES LTD UNDER LICENCE FROM ONTARIO MINISTRY OF NATURAL RESOURCES, © QUEENS PRINTER 2013
PROJECTION: UTM NAD83 ZONE 17
PROPERTY BOUNDARY FROM CRA FILE 13764-10(017)GN-WA002.DWG.

CLIENT
NESTLE WATERS CANADA

PROJECT
HYDROGEOLOGICAL STUDY

TITLE
# REGIONAL BEDROCK GEOLOGY

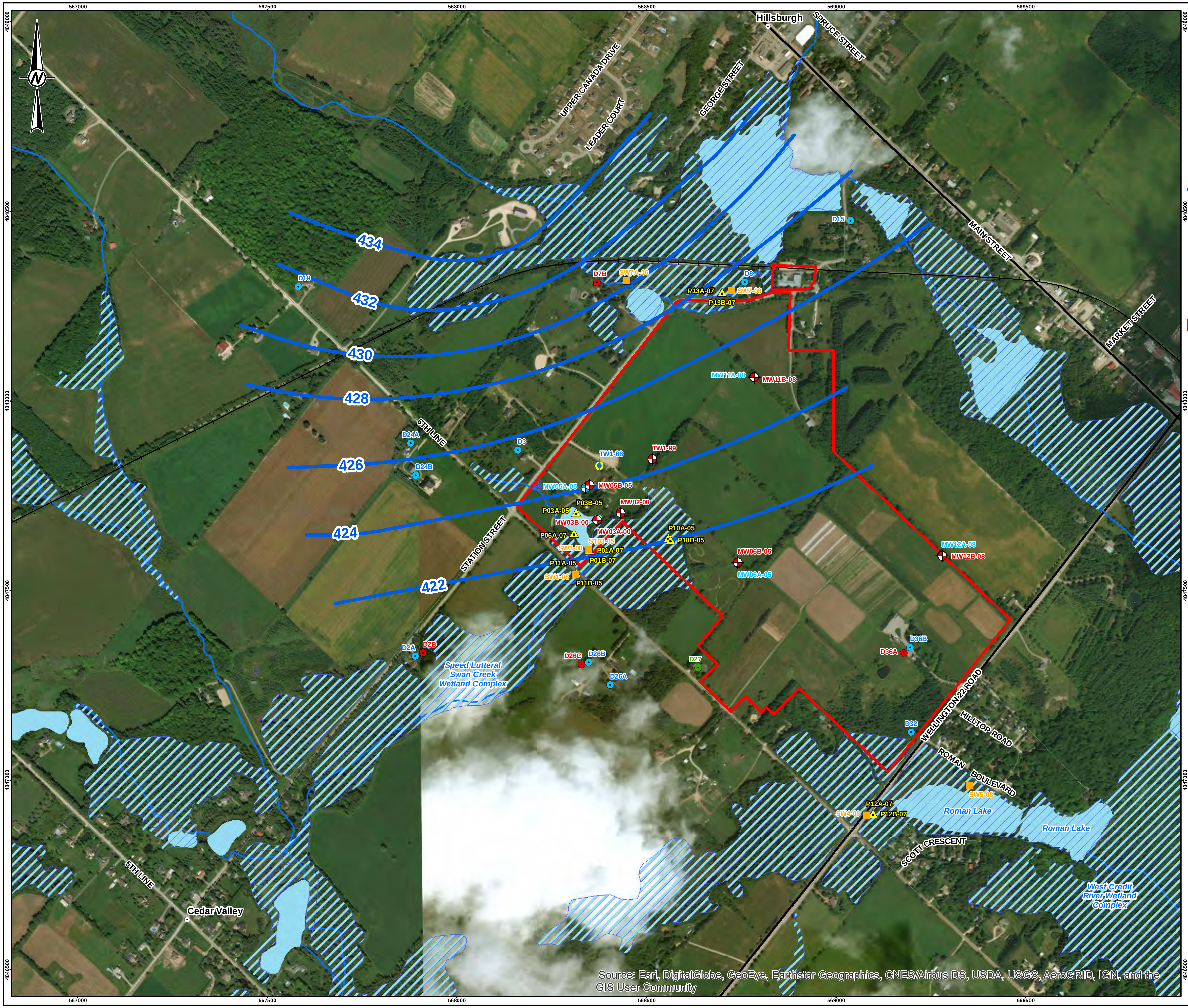
CONSULTANT

GOLDER

| | |
|---|---|
| YYYY-MM-DD | 2018-07-17 |
| DESIGNED | KD |
| PREPARED | JMC |
| REVIEWED | GP |
| APPROVED | JAP |

| PROJECT NO. | CONTROL | REV. | FIGURE |
|---|---|---|---|
| 13-1152-0250 (9000) | 0015 | 1.0 | 11 |

0 25mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM:



**LEGEND**

- ⊙ City/Town
- ⊕ Monitoring Well (Bedrock)
- ⊕ Monitoring Well (Overburden)
- ⊕ Production Well
- ● Private Well (Bedrock)
- ● Private Well (Overburden)
- ● Private Well (Deep Overburden)
- ▲ Piezometer
- ■ Surface Water Station
- ━ Water Level Elevation Contour (Jan. 24, 2000)
- ━ Main Road
- ─ Local Road
- ┼ Railway
- ─ Watercourse
- ▨ Wetland
- ▨ Provincially Significant Wetland
- ■ Waterbody
- □ Property Boundary

0 200 400 600 800

1:10,000

Meters

**REFERENCE(S)**

BASE DATA - MNR LIO, OBTAINED 2015
PRODUCED BY GOLDER ASSOCIATES LTD UNDER LICENCE FROM
ONTARIO MINISTRY OF NATURAL RESOURCES, © QUEENS PRINTER 2013
PROJECTION: UTM NAD83 ZONE 17
PROPERTY BOUNDARY FROM CRA FILE 13764-10(017)GN-WA002.DWG.
WATER LEVEL ELEVATION CONTOUR OBTAINED FROM CRA 2013 ANNUAL MONITORING REPORT, APRIL 2014.

CLIENT
NESTLE WATERS CANADA

PROJECT
HYDROGEOLOGICAL STUDY

TITLE
**POTENTIOMETRIC SURFACE OF BEDROCK AQUIFER (NON-PUMPING CONDITION JANUARY 2000)**

CONSULTANT
GOLDER

| | |
|---|---|
| YYYY-MM-DD | 2018-07-17 |
| DESIGNED | KD |
| PREPARED | JMC |
| REVIEWED | GP |
| APPROVED | JAP |

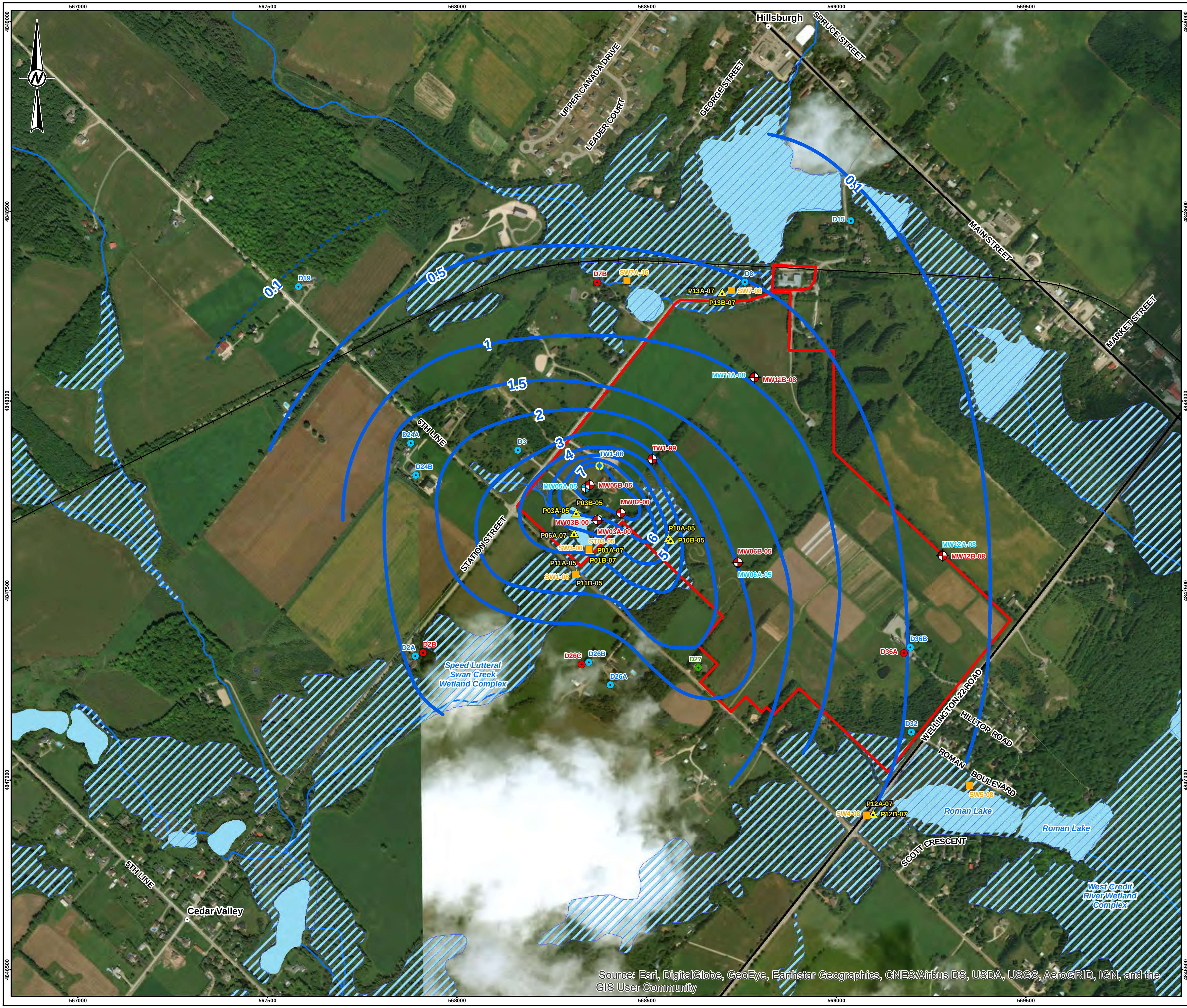
| PROJECT NO. | CONTROL | REV. | FIGURE |
|---|---|---|---|
| 13-1152-0250 (9000) | 0013 | 1.0 | **12** |

PATH: S:\Clients\Nestle\Erin\99_PROJ\1311520250_Hydro_G\40_PROD\0015_2018_HydrogeoStudy_PTTW_Renewal\1311520250-0015-CH-0011.mxd PRINTED ON: 2018-07-17 AT: 6:19:06 PM

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM:

25mm

0



Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

**LEGEND**

- ⊙ City/Town
- ⊕ Monitoring Well (Bedrock)
- ⊕ Monitoring Well (Overburden)
- ⊕ Production Well
- ● Private Well (Bedrock)
- ● Private Well (Overburden)
- ● Private Well (Deep Overburden)
- ▲ Piezometer
- ■ Surface Water Station
- ━ Drawdown Contour (June 13/15, 2001)
- ━ Main Road
- ─ Local Road
- ┼ Railway
- ─ Watercourse
- ▨ Wetland
- ▨ Provincially Significant Wetland
- ■ Waterbody
- □ Property Boundary

0 200 400 600 800

1:10,000

Meters

**REFERENCE(S)**

BASE DATA - MNR LIO, OBTAINED 2015
PRODUCED BY GOLDER ASSOCIATES LTD UNDER LICENCE FROM
ONTARIO MINISTRY OF NATURAL RESOURCES, © QUEENS PRINTER 2013
PROJECTION: UTM NAD83 ZONE 17
PROPERTY BOUNDARY FROM CRA FILE 13764-10(017)GN-WA002.DWG.
DRAWDOWN CONTOURS FROM CRA FIGURE 4.2 FILE 13764-10(017)GN-WA012.DWG.

CLIENT
NESTLE WATERS CANADA

PROJECT
HYDROGEOLOGICAL STUDY

TITLE
**INTERPRETED DRAWDOWN IN BEDROCK AQUIFER (JUNE 2001)**

CONSULTANT

GOLDER

| | |
|---|---|
| YYYY-MM-DD | 2018-07-17 |
| DESIGNED | KD |
| PREPARED | JMC |
| REVIEWED | GP |
| APPROVED | JAP |

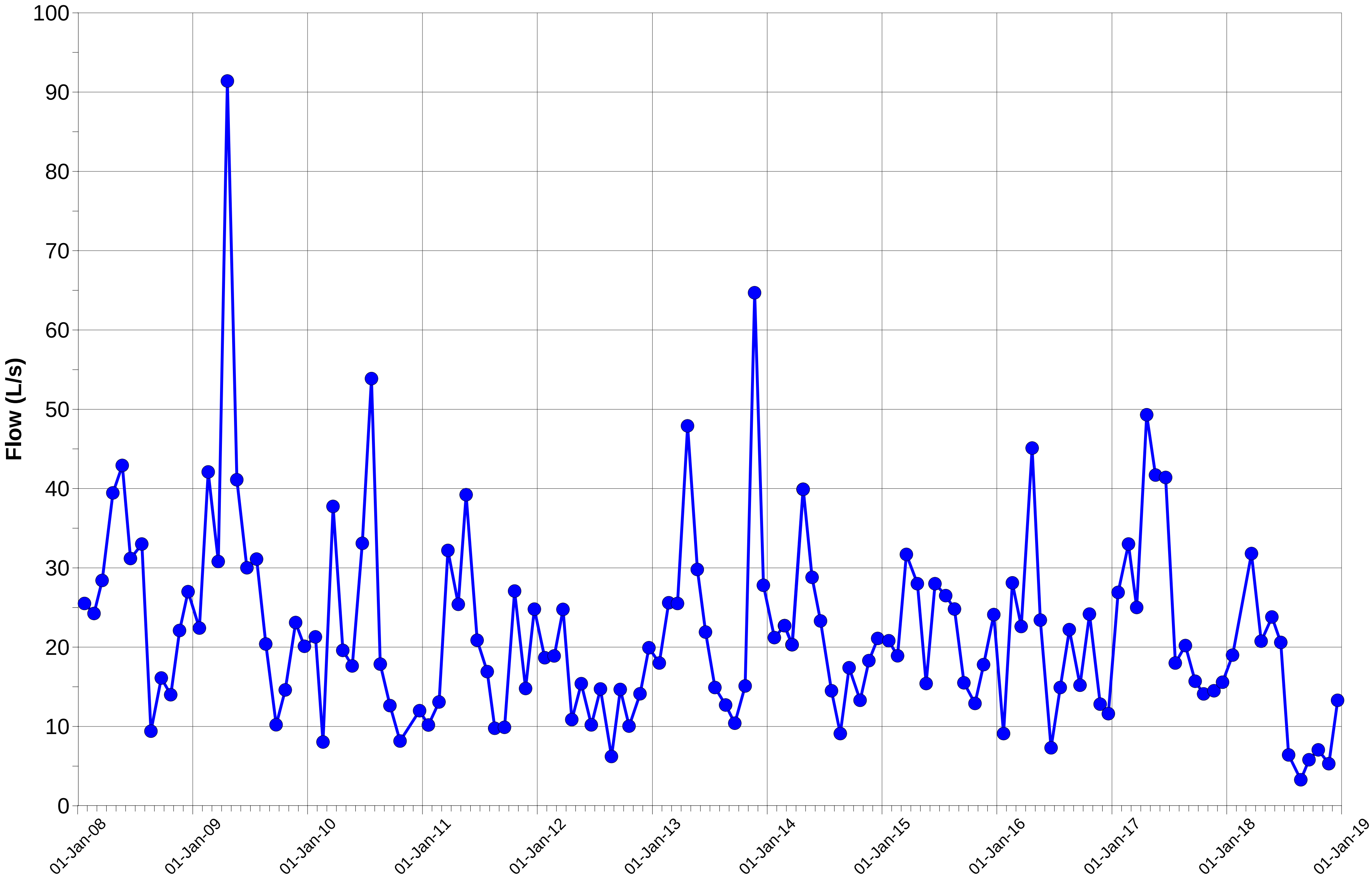
| PROJECT NO. | CONTROL | REV. | FIGURE |
|---|---|---|---|
| 13-1152-0250 (9000) | 0015 | 1.0 | 13 |

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM:

25mm

0

PATH: S:\Clients\Nestle\Erin\99_PROJ\1311520250_Hydro_G\40_PROD\0015_2018_HydrogeoStudy_PTTW_Renewal\1311520250-0015-CH-0012.mxd PRINTED ON: 2018-07-17 AT: 6:18:56 PM
]



GOLDER

| | |
|---|---|
| **DATE** | DECEMBER 2018 |
| **DESIGN** | KJ |
| **REVIEW** | GP |
| **APPROVED** | GP |

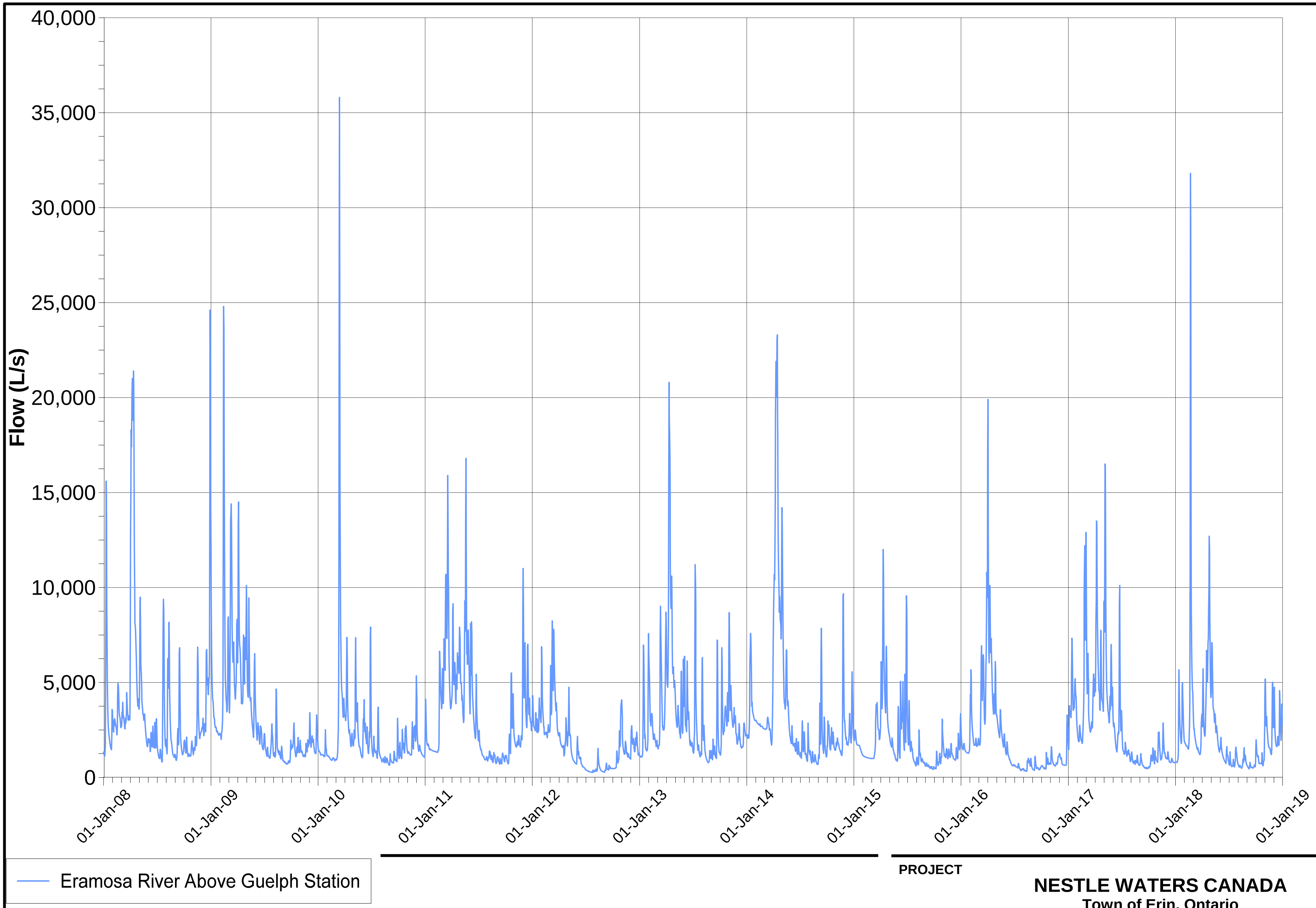
**PROJECT**

**NESTLE WATERS CANADA**
**Town of Erin, Ontario**

**TITLE**

**FLOW IN CREEK AT SW1**
**ON NESTLE PROPERTY IN ERIN**

| **PROJECT NO.** | **REV** | **FIGURE** |
|---|---|---|
| 13-1152-0250 (9000) | A | 14 |



**PROJECT**

**NESTLE WATERS CANADA**
**Town of Erin, Ontario**

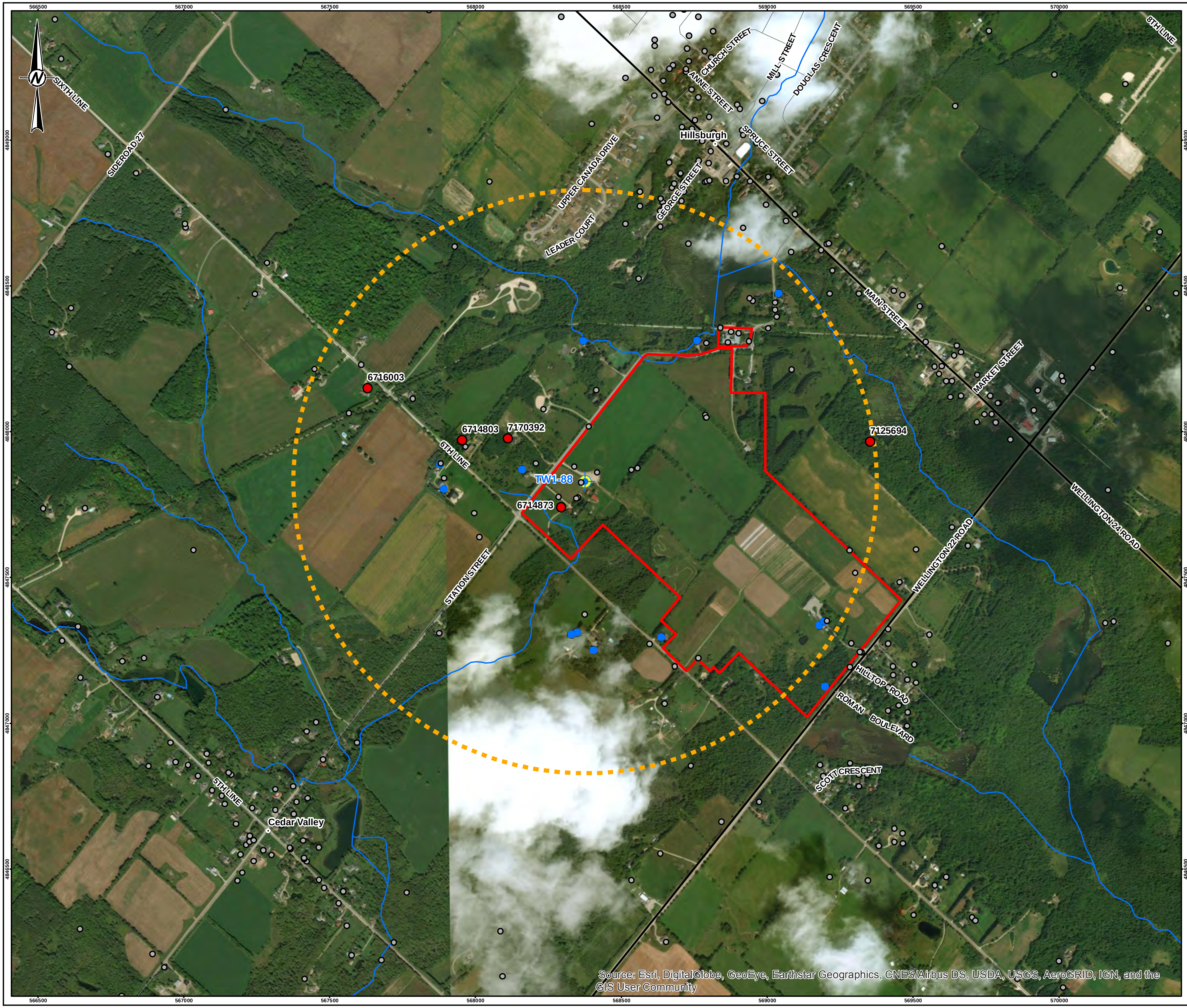
**TITLE**

**FLOW IN THE ERAMOSA RIVER ABOVE GUELPH**

GOLDER

| | |
|---|---|
| **DATE** | DECEMBER 2018 |
| **DESIGN** | KJ |
| **REVIEW** | GP |
| **APPROVED** | GP |

| **PROJECT NO.** | **REV** | **FIGURE** |
|---|---|---|
| 13-1152-0250 (9000) | A | 15 |



Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

LEGEND

- ● 2018 Well Survey Location
- ● Private Wells Monitored by Nestle
- ○ MECP Water Well Location
- ⊕ Production Well
- · City/Town
- — Main Road
- — Local Road
- — Watercourse
- ▭ TW1-88 1 km Buffer
- ▭ Property Boundary

0 200 400 600 800

1:13,000 Meters

**REFERENCE(S)**

BASE DATA - MNR LIO, OBTAINED 2015
PRODUCED BY GOLDER ASSOCIATES LTD UNDER LICENCE FROM
ONTARIO MINISTRY OF NATURAL RESOURCES, © QUEENS PRINTER 2013
PROJECTION: UTM NAD83 ZONE 17
PROPERTY BOUNDARY FROM CRA FILE 13764-10(017)GN-WA002.DWG.
MECP WATER WELL LOCATION - WATER WELL INFORMATION SYSTEM (WWIS) – WELL RECORD DATA, MECP FORMERLY MOECC, 2018

CLIENT
NESTLE WATERS CANADA

PROJECT
HYDROGEOLOGICAL STUDY

TITLE
# MECP WATER WELL RECORDS

CONSULTANT

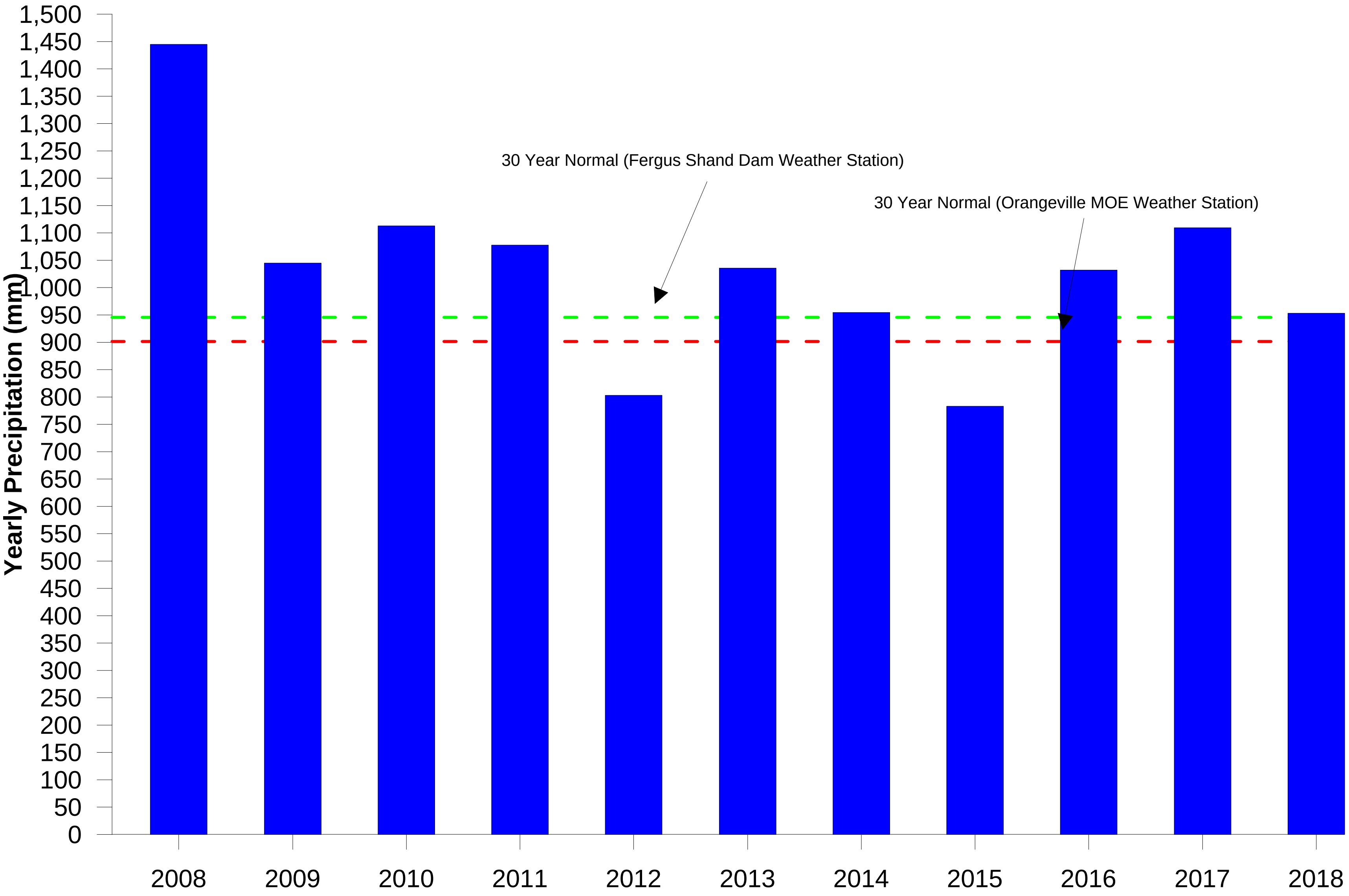
GOLDER

| | |
|---|---|
| YYYY-MM-DD | 2018-08-14 |
| DESIGNED | JMC |
| PREPARED | JMC/PR |
| REVIEWED | GP |
| APPROVED | JAP |

| PROJECT NO. | CONTROL | REV. | FIGURE |
|---|---|---|---|
| 13-1152-0250 (9000) | 0015 | 1.0 | 16 |

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM:
25mm
0

S:\Clients\Nestle\Erin\99_PROJ\1311520250_Hydro_G\40_PROD\0015_2018_HydrogeoStudy_PTTW_Renewal\1311520250-0015-CH-0014.mxd



GOLDER

| | |
|---|---|
| DATE | DECEMBER 2018 |
| DESIGN | KJ |
| REVIEW | GP |
| APPROVED | GP |

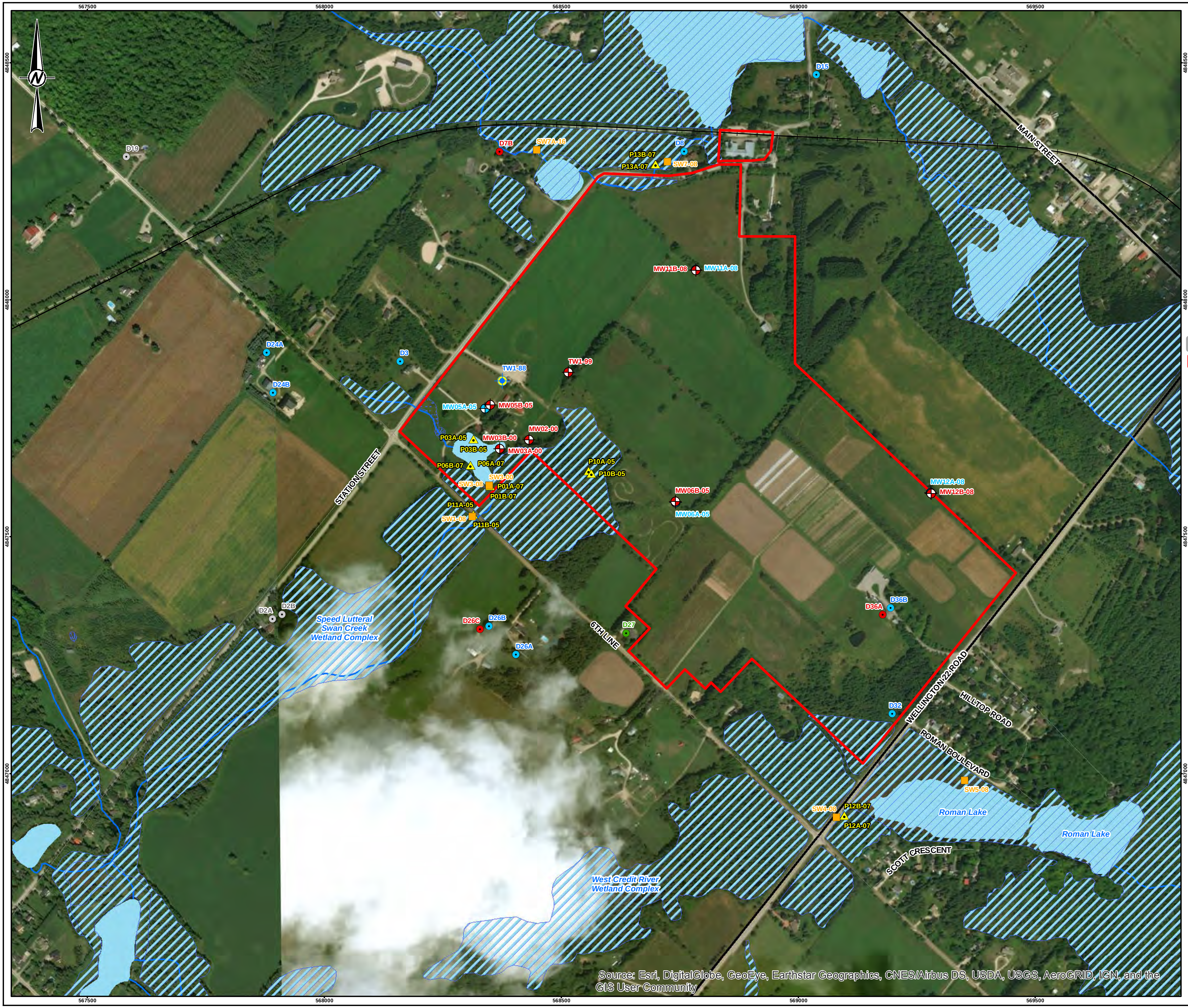
**PROJECT**

**NESTLE WATERS CANADA**
**Town of Erin, Ontario**

**TITLE**

**HISTORICAL ANNUAL PRECIPITATION (2008 TO 2018)**

| PROJECT NO. | REV | FIGURE |
|---|---|---|
| 13-1152-0250 (9000) | A | 17 |



**REFERENCE(S)**
BASE DATA - MNR LIO, OBTAINED 2015
PRODUCED BY GOLDER ASSOCIATES LTD UNDER LICENCE FROM
ONTARIO MINISTRY OF NATURAL RESOURCES, © QUEENS PRINTER 2013
PROJECTION: UTM NAD83 ZONE 17
PROPERTY BOUNDARY FROM CRA FILE 13764-10(017)GN-WA002.DWG.

CLIENT
NESTLE WATERS CANADA

PROJECT
HYDROGEOLOGICAL STUDY

TITLE
**MONITORING LOCATIONS**

CONSULTANT

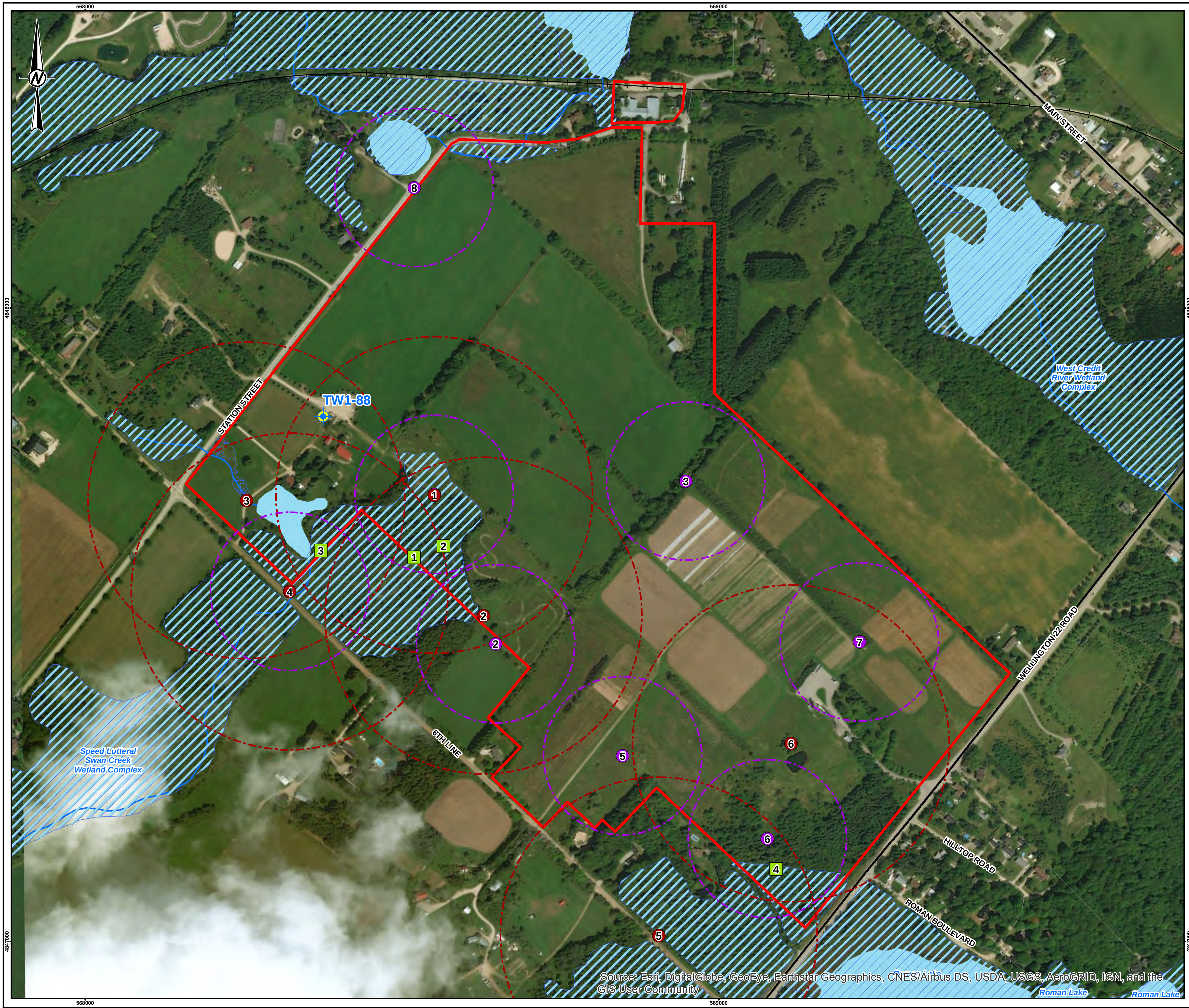
GOLDER

| | |
|---|---|
| YYYY-MM-DD | 2018-07-17 |
| DESIGNED | KD |
| PREPARED | JMC |
| REVIEWED | GP |
| APPROVED | JAP |

| PROJECT NO. | CONTROL | REV. | FIGURE |
|---|---|---|---|
| 13-1152-0250 (9000) | 0005 | 1.0 | **18** |

PATH: S:\Clients\Nestle\Erin\99_PROJ\1311520250_Hydro_G\40_PROD\0015_2018_HydrogeoStudy_PTTW_Renewal\1311520250-0015-CH-0013.mxd PRINTED ON: 2018-07-17 AT: 6:18:46 PM

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM:
25mm
0



Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

S:\Clients\Nestle\Erin\99_PROJ\1311520250_Hydro_G\40_PROD\0015_2018_HydrogeoStudy_PTTW_Renewal\1311520250-0015-CH-0015.mxd

**LEGEND**

⌖ Production Well

— Watercourse

▭ Property Boundary

🟩 Vegetation Monitoring Station

● Amphibian Call Monitoring Station (with 250 m radius)

● Breeding Bird Monitoring Station (with 125 m radius)

0 100 200 300

1:6,000 Meters

**REFERENCE(S)**

BASE DATA - MNR LIO, OBTAINED 2015
PRODUCED BY GOLDER ASSOCIATES LTD UNDER LICENCE FROM
ONTARIO MINISTRY OF NATURAL RESOURCES, © QUEENS PRINTER 2013
PROJECTION: UTM NAD83 ZONE 17
PROPERTY BOUNDARY FROM CRA FILE 13764-10(017)GN-WA002.DWG.

CLIENT
NESTLE WATERS CANADA

PROJECT
HYDROGEOLOGICAL STUDY

TITLE
**NATURAL ENVIRONMENT MONITORING**

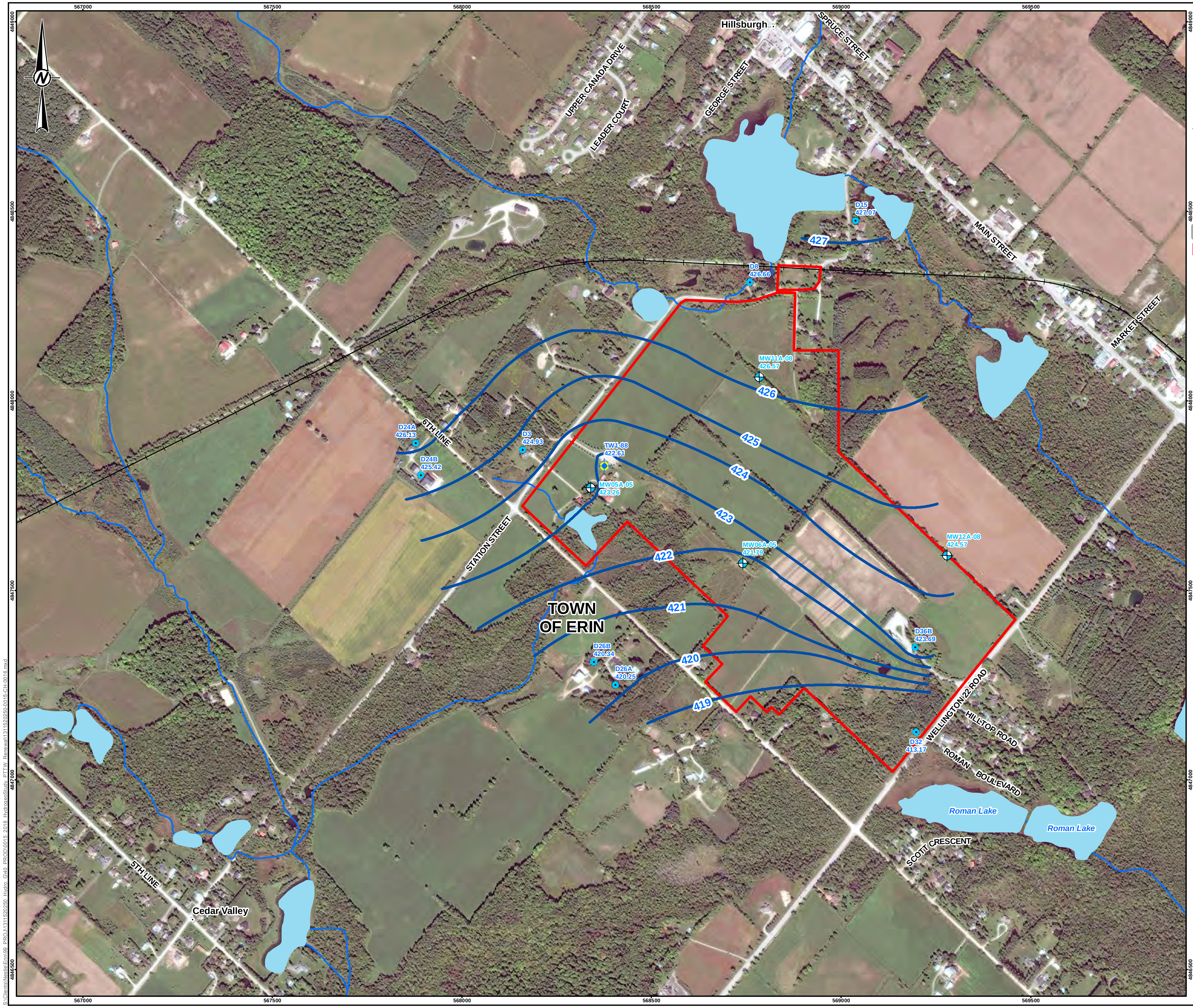
CONSULTANT
GOLDER

| | |
|---|---|
| YYYY-MM-DD | 2018-07-25 |
| DESIGNED | JMC |
| PREPARED | JMC |
| REVIEWED | GP |
| APPROVED | JAP |

| PROJECT NO. | CONTROL | REV. | FIGURE |
|---|---|---|---|
| 13-1152-0250 (9000) | 0015 | 1.0 | **19** |

25mm

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM:



**LEGEND**

| | |
|---|---|
| · | City/Town |
| ⊕ | Production Well |
| ⊕ | Monitoring Well (Bedrock) |
| ● | Private Well (Bedrock) |
| 420.1 | Water Elevation (August, 2018) |
| — | Water Elevation Contour (masl) |
| ┼ | Railway |
| — | Watercourse |
| ▨ | Wetland |
| ▨ | Provincially Significant Wetland |
| ■ | Waterbody |
| □ | Municipal Boundary |
| □ | Property Boundary |

**REFERENCE(S)**
BASE DATA - MNR LIO, OBTAINED 2015
PRODUCED BY GOLDER ASSOCIATES LTD UNDER LICENCE FROM
ONTARIO MINISTRY OF NATURAL RESOURCES, © QUEENS PRINTER 2013
PROJECTION: UTM NAD83 ZONE 17
PROPERTY BOUNDARY FROM CRA FILE 13764-10(017)GN-WA002.DWG.

CLIENT
NESTLE WATERS CANADA

PROJECT
HYDROGEOLOGICAL STUDY

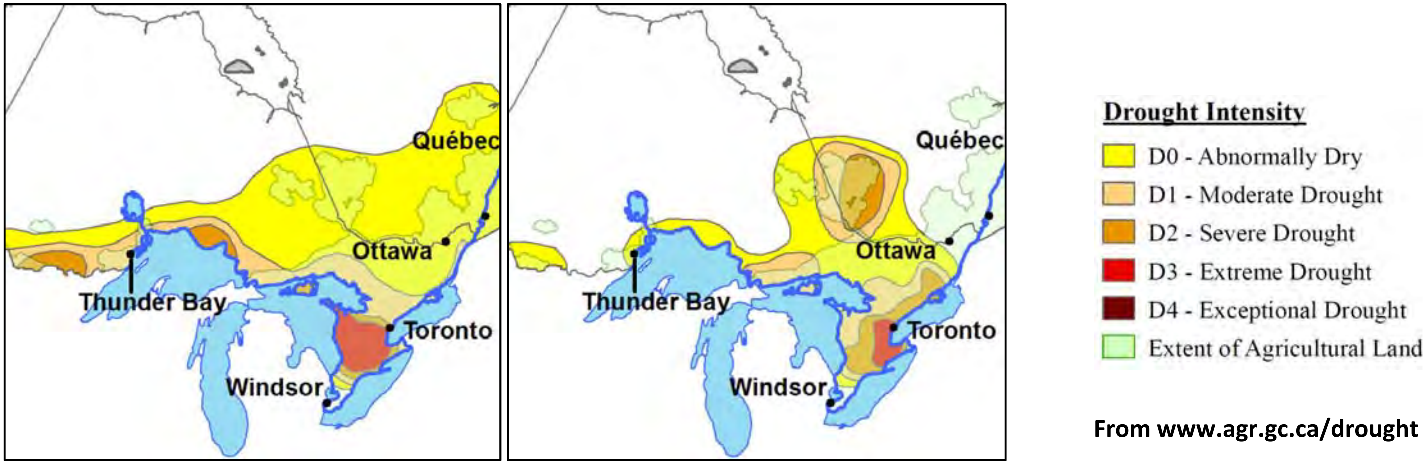
TITLE
**POTENTIOMETRIC SURFACE OF BEDROCK AQUIFER (AUGUST 2018)**

CONSULTANT
GOLDER

| | |
|---|---|
| YYYY-MM-DD | 2019-05-14 |
| DESIGNED | JMC |
| PREPARED | PR |
| REVIEWED | GP |
| APPROVED | JAP |

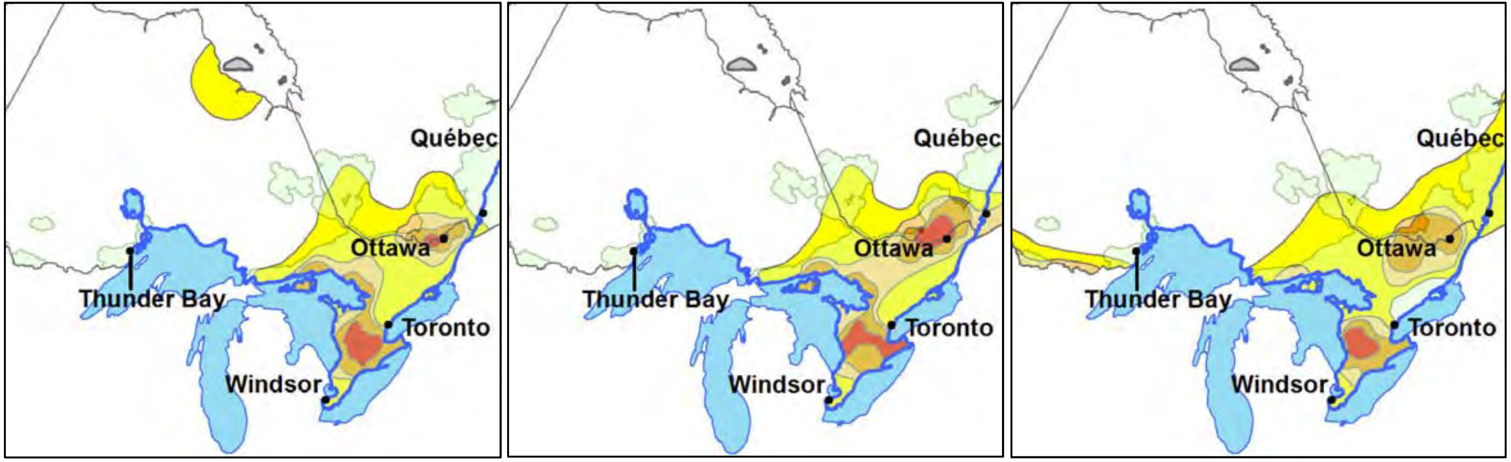
| PROJECT NO. | CONTROL | REV. | FIGURE |
|---|---|---|---|
| 13-1152-0250 (2000) | 0016 | 1.0 | **20** |

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM:
25mm
0



From www.agr.gc.ca/drought

**September 30, 2007** **October 31, 2007**



**July 31, 2012** **August 31, 2012** **September 30, 2012**

Figure 21
Environment Canada
Drought Monitoring

## APPENDIX A

# Permit To Take Water

**Ministry of the Environment**
West-Central Region
Technical Support Section
12th Floor
119 King St W
Hamilton ON L8P 4Y7
Fax: (905)521-7820
Tel: (905) 521-7720

**Ministère de l'Environnement**
Direction régionale du Centre-Ouest
Secteur du Soutien Technique
12e étage
119 rue King W
Hamilton ON L8P 4Y7
Télécopieur: (905)521-7820
Tél:(905) 521-7720

Ontario

February 25, 2014

Nestle Canada Inc.
101 Brock Road S.
Puslinch, Ontario N1H 6H9

Attention: Ms. Andreanne Simard

Dear Ms. Simard:

**RE:** Amendments to monitoring program
Permit to Take Water 3716-8UZMCU
Reference Number 8420-8TAMGM

## NOTICE

Pursuant to s. 100, Ontario Water Resources Act, R.S.O. 1990, c. O.40 as amended, I am issuing notice that, as Director of Section 34 of the Ontario Water Resources Act, I am exercising my discretion to amend Permit to Take Water 3716-8UZMCU part of condition 4.1. All other terms and conditions of Permit to Take Water 3716-8UZMCU shall continue in force.

Per condition 4.4, the Permit Holder notified the Director on July 25, 2013 of inaccuracies in condition 4.1 and certain monitoring locations becoming inaccessible or requiring replacement. The notification included suggested replacements. Further reasoning was provided by the Permit Holder on January 31, 2014. The delay in approving the amendment was due to other processes regarding the Permit. On February 24, 2014 Ms. Simard clarified the monitoring locations of condition 4.1(ii).

This Notice supersedes the Notice issued February 3, 2014. Condition 4.1 is hereby revoked and replaced as follows:

4.1 The Permit Holder shall establish the following monitoring program for the duration of the Permit:

Bedrock Wells

(i) Continuous monitoring of ground water levels at the following locations:

- TW1-88
- D2A
- D3 (MOE #6710228)
- MW5A
- MW6A
- D36B (MOE Tag#A001807)

(ii) Monthly monitoring of ground water levels at the following locations:

- D19 (MOE #6709207)
- MW11A/B-08
- D24B (MOE #6708146) and D24A (MOE #6711344)
- D26A (MOE #6700678) and D26B
- MW12A/B-08
- D8 (MOE#6708720)
- D15 (MOE#6709532)
- D32 (MOE#6708153)

Overburden Wells

(i) Continuous monitoring of ground water levels at the following locations:

- MW3A/B
- D2B
- MW5B
- MW6B
- D26C
- D36A
- D27

(ii) Monthly monitoring of ground water levels at the following locations:

- TW1-99 (MOE #6712960)
- D27 (MOE #6712147)
- D7B
- MW2

Piezometers

i) Continuous monitoring of water level and vertical hydraulic gradients at the following locations:

- P01A/B-07
- P03A/B-05
- P06A/B-07
- P10A/B-05
- P11A/B-05
- P12A/B-07
- P13A/B-07

Surface Water

(i) Continuous monitoring of surface water levels at the following locations:

- ST03-05
- SW1
- SW3
- SW4
- SW5
- SW7

(ii) Monthly monitoring of flow and development of appropriate stage-discharge curves at the following locations:

- SW1
- SW3
- SW7

This Notice now forms part of the current permit and must be attached to the original Permit to Take Water, if available. If the original is no longer available, this letter must be kept attached to a certified copy of the Permit to Take Water.

Any change in circumstances related to this permit should be reported promptly to a Director.

It is your responsibility to ensure that any person taking water under the authority of this permit is familiar with and complies with the terms and conditions.

*In accordance with Section 100 of the Ontario Water Resources Act, R.S.O. 1990, you may by written notice served upon me, the Environmental Review Tribunal and the Environmental Commissioner, **Environmental Bill of Rights**, R.S.O. 1993, Chapter 28, within 15 days after receipt of this Notice, require a hearing by the Tribunal. The Environmental Commissioner will place notice of your appeal on the Environmental Registry. Section 101 of the Ontario Water Resources Act, as amended provides that the Notice requiring a hearing shall state:*

1. The portions of the Permit or each term or condition in the Permit in respect of which the hearing is required, and;
2. The grounds on which you intend to rely at the hearing in relation to each portion appealed.

*In addition to these legal requirements, the Notice should also include:*

3. The name of the appellant;
4. The address of the appellant;
5. The Permit to Take Water number;
6. The date of the Permit to Take Water;
7. The name of the Director;
8. The municipality within which the works are located;

*This notice must be served upon:*

| | | |
|---|---|---|
| *The Secretary*<br>*Environmental Review Tribunal*<br>*2300 Yonge Street, Suite 1700*<br>*Toronto, Ontario M4P 1E4* | *AND* | *The Director, Section 34*<br>*Ministry of the Environment*<br>*12th Floor*<br>*119 King St W*<br>*Hamilton ON L8P 4Y7*<br>*Fax: (905)521-7820* |

***Further information on the Environmental Review Tribunal's requirements for an appeal can be obtained directly from the Tribunal:***

***by telephone at (416) 314-4600*** ***by fax at (416) 314-4506*** ***by e-mail at www.ert.gov.on.ca***

Yours truly,

Carl Slater

Carl Slater
Director, Section 34, Ontario Water Resources Act
West Central Region

File Storage Number: AP28 ERNE

**Ministry of the Environment**
**Ministère de l'Environnement**

# PERMIT TO TAKE WATER
Ground Water
NUMBER 3716-8UZMCU

*Pursuant to Section 34 of the Ontario Water Resources Act, R.S.O. 1990 this Permit To Take Water is hereby issued to:*

Nestle Canada Inc.
101 Brock Road S.
Puslinch, Ontario N1H 6H9

*For the water taking from:* One bedrock drilled well (TW1-88) MOE Well Tag No.: A095193

*Located at:* Lot 24, Concession 7, Geographic Township of Erin
Erin, County of Wellington

*For the purposes of this Permit, and the terms and conditions specified below, the following definitions apply:*

## DEFINITIONS

(a) "Director" means any person appointed in writing as a Director pursuant to section 5 of the OWRA for the purposes of section 34, OWRA.

(b) "Provincial Officer" means any person designated in writing by the Minister as a Provincial Officer pursuant to section 5 of the OWRA.

(c) "Ministry" means Ontario Ministry of the Environment.

(d) "District Office" means the Guelph District Office.

(e) "Permit" means this Permit to Take Water No. 3716-8UZMCU including its Schedules, if any, issued in accordance with Section 34 of the OWRA.

(f) "Permit Holder" means Nestle Canada Inc..

(g) "OWRA " means the *Ontario Water Resources Act,* R.S.O. 1990, c. O. 40, as amended.

*You are hereby notified that this Permit is issued subject to the terms and conditions outlined below:*

## TERMS AND CONDITIONS

### 1. Compliance with Permit

1.1 Except where modified by this Permit, the water taking shall be in accordance with the application for this Permit To Take Water, dated March 22, 2012 and signed by Don DeMarco, and all Schedules included in this Permit.

1.2 The Permit Holder shall ensure that any person authorized by the Permit Holder to take water under this Permit is provided with a copy of this Permit and shall take all reasonable measures to ensure that any such person complies with the conditions of this Permit.

1.3 Any person authorized by the Permit Holder to take water under this Permit shall comply with the conditions of this Permit.

1.4 This Permit is not transferable to another person.

1.5 This Permit provides the Permit Holder with permission to take water in accordance with the conditions of this Permit, up to the date of the expiry of this Permit. This Permit does not constitute a legal right, vested or otherwise, to a water allocation, and the issuance of this Permit does not guarantee that, upon its expiry, it will be renewed.

1.6 The Permit Holder shall keep this Permit available at all times at or near the site of the taking, and shall produce this Permit immediately for inspection by a Provincial Officer upon his or her request.

1.7 The Permit Holder shall report any changes of address to the Director within thirty days of any such change. The Permit Holder shall report any change of ownership of the property for which this Permit is issued within thirty days of any such change. A change in ownership in the property shall cause this Permit to be cancelled.

### 2. General Conditions and Interpretation

2.1 Inspections
The Permit Holder must forthwith, upon presentation of credentials, permit a Provincial Officer to carry out any and all inspections authorized by the OWRA, the *Environmental Protection Act*, R.S.O. 1990, the *Pesticides Act*, R.S.O. 1990, or the *Safe Drinking Water Act,* S. O. 2002.

2.2 Other Approvals
The issuance of, and compliance with this Permit, does not:

(a) relieve the Permit Holder or any other person from any obligation to comply with any other applicable legal requirements, including the provisions of the *Ontario Water Resources Act*, and the *Environmental Protection Act*, and any regulations made thereunder; or

(b) limit in any way any authority of the Ministry, a Director, or a Provincial Officer, including the authority to require certain steps be taken or to require the Permit Holder to furnish any further information related to this Permit.

2.3 Information
The receipt of any information by the Ministry, the failure of the Ministry to take any action or require any person to take any action in relation to the information, or the failure of a Provincial Officer to prosecute any person in relation to the information, shall not be construed as:

(a) an approval, waiver or justification by the Ministry of any act or omission of any person that contravenes this Permit or other legal requirement; or

(b) acceptance by the Ministry of the information's completeness or accuracy.

2.4 Rights of Action
The issuance of, and compliance with this Permit shall not be construed as precluding or limiting any legal claims or rights of action that any person, including the Crown in right of Ontario or any agency thereof, has or may have against the Permit Holder, its officers, employees, agents, and contractors.

2.5 Severability
The requirements of this Permit are severable. If any requirements of this Permit, or the application of any requirements of this Permit to any circumstance, is held invalid or unenforceable, the application of such requirements to other circumstances and the remainder of this Permit shall not be affected thereby.

2.6 Conflicts
Where there is a conflict between a provision of any submitted document referred to in this Permit, including its Schedules, and the conditions of this Permit, the conditions in this Permit shall take precedence.

## 3. Water Takings Authorized by This Permit

3.1 **Expiry**
This Permit expires on **August 31, 2017**. No water shall be taken under authority of this Permit after the expiry date.

3.2 Amounts of Taking Permitted
The Permit Holder shall only take water from the source, during the periods and at the rates and amounts of taking specified in Table A. Water takings are authorized only for the purposes specified in Table A.

**Table A**

| | Source Name / Description: | Source:<br>Type: | Taking Specific Purpose: | Taking Major Category: | Max. Taken per Minute (litres): | Max. Num. of Hrs Taken per Day: | Max. Taken per Day (litres): | Max. Num. of Days Taken per Year: | Zone/ Easting/ Northing: |
|---|---|---|---|---|---|---|---|---|---|
| **1** | TW1-88 | Well<br>Drilled | Bottled Water | Commercial | 773 | 24 | 1,113,000 | 365 | 17<br>568384<br>4847833 |
| | | | | | | **Total Taking:** | 1,113,000 | | |

3.3 Notwithstanding the Maximum Taken per Minute and Maximum Taken per Day specified in the Table A of Condition 3.2, the instantaneous rate and amount of taking may increase up to a maximum of 946 litres per minute (LPM) and 1,362,240 liters per day (LPD) in each month between April 1 and September 30 for the duration of the Permit in order to provide operational flexibility. However, the average daily taking in any month between April 1 and September 30 shall not exceed 1,113,000 (LPD).

3.4 Notwithstanding Conditions 3.2 and 3.3 the maximum daily water taking shall be reduced should the Grand River Low Water Response Team declare a Level 1 or Level 2 drought condition in the watershed in which the taking is located. The reductions shall be in accordance with the Ontario Low Water Response Protocol and ensure that the reduction is based on the maximum taken per day permitted in Table A.

3.5 Nothwithstanding Conditions 3.2, 3.3, and 3.4 should the Ontario Water Directors Committee declare a Level 3 drought condition in the watershed in which the taking is located, the maximum daily water taking shall be reduced in accordance with the Level 3 declaration.

## 4. Monitoring

4.1 The Permit Holder shall establish the following monitoring program for the duration of the Permit:

<u>Bedrock Wells</u>

(i) Continuous monitoring of ground water levels at the following locations:

- TW1-88
- D2A
- D3 (MOE #6710228)
- MW5A
- MW6A
- D36B (MOE Tag#A001807)

(ii) Monthly monitoring of ground water levels at the following locations:

- D19 (MOE #6709207)
- D24A (MOE #6711344)
- D24B (MOE #6708146)

- D26A (MOE #6700678)
- D26D
- D27
- MOE #6714441
- MOE # 6705153
- D7 (MOE#6708388)
- D8 (MOE#6708720)
- D12
- D32 (MOE#6708153)

Overburden Wells

(i) Continuous monitoring of ground water levels at the following locations:

- MW3A/B
- D2B
- MW5B
- MW6B
- D26C
- D36A

(ii) Monthly monitoring of ground water levels at the following locations:

- TW1-99 (MOE #6712960)
- D27 (MOE #6712147)
- new overburden well replacing D5
- MW2

Piezometers

i) Continuous monitoring of water level and vertical hydraulic gradients at the following locations:

- P01A/B-05
- P03A/B-07
- P06A/B-07
- P10A/B-05
- P11A/B-05
- P12A/B-07
- P13A/B-07

Surface Water

(i) Continuous monitoring of surface water levels at the following locations:

- ST03-05
- SW1
- SW3
- SW4
- SW5
- SW7

(ii) Monthly monitoring of flow and development of appropriate stage-discharge curves at the following locations:

- SW1
- SW3

- SW7

4.2 Continuous ground water monitoring shall be datalogged at 60 minute intervals and downloaded monthly; however, daily minimum water levels may be used to evaluate the water level variation with respect to pumping to improve the data handling and presentation. Monthly monitoring shall be conducted in the same week each calendar month for the duration of the Permit.

4.3 The water level data collected in piezometers or multilevel monitoring wells (two wells at one location or multiple wells in one borehole screened at different intervals) shall be plotted as gradient vs. time and interpreted to assess the potential impact of taking on vertical hydraulic gradients (upward/downward) and hydraulic connection of the ground water with the surface water, if any.

4.4 The Permit Holder shall identify to the Director in writing for his or her approval, within 15 days of any monthly monitoring event, any monitoring locations identified in Condition 4.1 which become inaccessible and/or abandoned along with a recommendation for replacement of these monitoring locations. Upon approval of the Director, the monitoring program shall be appropriately modified.

4.5 Under section 9 of O. Reg. 387/04, and as authorized by subsection 34(6) of the Ontario Water Resources Act, the Permit Holder shall, on each day water is taken under the authorization of this Permit, record the date, the volume of water taken on that date and the rate at which it was taken. The daily volume of water taken shall be measured by a flow meter or calculated in accordance with the method described in the application for this Permit, or as otherwise accepted by the Director. The Permit Holder shall keep all records required by this condition current and available at or near the site of the taking and shall produce the records immediately for inspection by a Provincial Officer upon his or her request. The Permit Holder, unless otherwise required by the Director, shall submit, on or before March 31st in every year, the records required by this condition to the ministry's Water Taking Reporting System.

4.6 The Permit Holder shall submit to the Director, an annual monitoring report which presents and interprets the monitoring data to be collected under the Terms and Conditions of this Permit. This report shall be prepared, signed and stamped by a licenced professional geoscientist or a licensed professional engineer specializing in hydrogeology who shall take responsibility for its accuracy. The report shall be submitted to the Director by April 30 of each calendar year or as supporting documentation to any application for renewal of this Permit, and include monitoring data for the 12 month period ending December 31 of the previous year.

4.7 In addition to the requirement of Condition 4.6, the Permit Holder shall provide a letter report to the Director and Town of Erin which includes pumped volumes and water level information within 30 days of the end of each month where the water taking is in accordance with Condition 3.3.

4.8 The Permit Holder shall include as part of the annual monitoring report required under Condition 4.6, the following information:

(i) Location and name of the facilities to which water is delivered in bulk containers greater than 20L from this source.
(ii) Whether or not the bulk water transported is containerized at the receiving location.
(iii) The size of the container(s) into which the water is transferred.
(iv) Total volume of the water transported in bulk in each calendar year to
each
remote facility.

4.9 The Permit Holder shall investigate any complaints received from the public or agency with regard to this water taking in accordance with the interference complaints resolution protocol and notify the District Manager, District Office within two (2) working days of receiving the complaint. Details of any complaints and its resolution shall be outlined to the Director in the annual monitoring report required under Condition 4.6.

## 5. Impacts of the Water Taking

5.1 Notification
The Permit Holder shall immediately notify the local District Office of any complaint arising from the taking of water authorized under this Permit and shall report any action which has been taken or is proposed with regard to such complaint. The Permit Holder shall immediately notify the local District Office if the taking of water is observed to have any significant impact on the surrounding waters. After hours, calls shall be directed to the Ministry's Spills Action Centre at 1-800-268-6060.

5.2 For Groundwater Takings
If the taking of water is observed to cause any negative impact to other water supplies obtained from any adequate sources that were in use prior to initial issuance of a Permit for this water taking, the Permit Holder shall take such action necessary to make available to those affected, a supply of water equivalent in quantity and quality to their normal takings, or shall compensate such persons for their reasonable costs of so doing, or shall reduce the rate and amount of taking to prevent or alleviate the observed negative impact. Pending permanent restoration of the affected supplies, the Permit Holder shall provide, to those affected, temporary water supplies adequate to meet their normal requirements, or shall compensate such persons for their reasonable costs of doing so.

If permanent interference is caused by the water taking, the Permit Holder shall restore the water supplies of those permanently affected.

## 6. Director May Amend Permit

The Director may amend this Permit by letter requiring the Permit Holder to suspend or reduce the taking to an amount or threshold specified by the Director in the letter. The suspension or reduction in taking shall be effective immediately and may be revoked at any time upon notification by the Director. This condition does not affect your right to appeal the suspension or reduction in taking to the Environmental Review Tribunal under the *Ontario Water Resources Act* , Section 100 (4).

*The reasons for the imposition of these terms and conditions are as follows:*

1. Condition 1 is included to ensure that the conditions in this Permit are complied with and can be enforced.

2. Condition 2 is included to clarify the legal interpretation of aspects of this Permit.

3. Conditions 3 through 6 are included to protect the quality of the natural environment so as to safeguard the ecosystem and human health and foster efficient use and conservation of waters. These conditions allow for the beneficial use of waters while ensuring the fair sharing, conservation and sustainable use of the waters of Ontario. The conditions also specify the water takings that are authorized by this Permit and the scope of this Permit.

*In accordance with Section 100 of the* <u>*Ontario Water Resources Act*</u>*, R.S.O. 1990, you may by written notice served upon me, the Environmental Review Tribunal and the Environmental Commissioner,* **Environmental Bill of Rights**, *R.S.O. 1993, Chapter 28, within 15 days after receipt of this Notice, require a hearing by the Tribunal. The Environmental Commissioner will place notice of your appeal on the Environmental Registry. Section 101 of the* <u>*Ontario Water Resources Act*</u>*, as amended provides that the Notice requiring a hearing shall state:*

1. The portions of the Permit or each term or condition in the Permit in respect of which the hearing is required, and;
2. The grounds on which you intend to rely at the hearing in relation to each portion appealed.

*In addition to these legal requirements, the Notice should also include:*

3. The name of the appellant;
4. The address of the appellant;
5. The Permit to Take Water number;
6. The date of the Permit to Take Water;
7. The name of the Director;
8. The municipality within which the works are located;

*This notice must be served upon:*

*The Secretary*
*Environmental Review Tribunal*
*655 Bay Street, 15th Floor*
*Toronto ON*
*M5G 1E5*
*Fax: (416) 314-4506*
*Email:*
*ERTTribunalsecretary@ontario.ca*

<u>*AND*</u>

*The Environmental Commissioner*
*1075 Bay Street*
*6th Floor, Suite 605*
*Toronto, Ontario M5S 2W5*

<u>*AND*</u>

*The Director, Section 34*
*Ministry of the Environment*
*12th Floor*
*119 King St W*
*Hamilton ON L8P 4Y7*
*Fax: (905)521-7820*

***Further information on the Environmental Review Tribunal's requirements for an appeal can be obtained directly from the Tribunal:***

***by telephone at (416) 314-4600*** ***by fax at (416) 314-4506*** ***by e-mail at*** <u>***www.ert.gov.on.ca***</u>

*This instrument is subject to Section 38 of the* **Environmental Bill of Rights** *that allows residents of Ontario to seek leave to appeal the decision on this instrument. Residents of Ontario may seek to appeal for 15 days from the date this decision is placed on the Environmental Registry. By accessing the Environmental Registry, you can determine when the leave to appeal period ends.*

This Permit cancels and replaces Permit Number 6480-74BKR4, issued on 2007/08/24.

Dated at Hamilton this 28th day of September, 2012.

Carl Slater

Carl Slater
Director, Section 34
*Ontario Water Resources Act* , R.S.O. 1990

# Schedule A

This Schedule "A" forms part of Permit To Take Water 3716-8UZMCU, dated September 28, 2012.

**Ministry of the Environment**
**West Central Region**

119 King Street West
12th Floor
Hamilton, Ontario L8P 4Y7
Tel.: 905 521-7640
Fax: 905 521-7820

**Ministère de l'Environnement**
**Direction regionale du Centre-Ouest**

119 rue King ouest
12e étage
Hamilton (Ontario) L8P 4Y7
Tél. : 905 521-7640
Téléc. : 905 521-7820

Ontario

April 28, 2014

Ms. Andreanne Simard
Natural Resource Manager
Nestlè Waters Canada
101 Brock Road South
Guelph, Ontario.
N1H 6H9

Dear Ms. Simard:

Re: Clarification of reporting requirements
Condition 4.7, Permit to Take Water 3716-8UZMCU

This is to clarify ministry expectations with respect the reporting requirements of Condition 4.7 of Permit to Take Water 3716-8UZMCU.

Condition 4.7 states:

"In addition to the requirement of Condition 4.6, the Permit Holder shall provide a letter report to the Director and Town of Erin which includes pumped volumes and water level information within 30 days of the end of each month where the water taking is in accordance with Condition 3.3."

For greater certainty the Letter Report is expected to include the following:

1. Pumped volumes are the total daily volume for each day in the month from the production well TW1-88.
2. Water Level information is the level data for the following locations:
    a. P01A/B-07 pond
    b. P12A/B-07 Roman Lake
    c. P13A/B-07 Erin Branch of the Credit
    d. P10A/B-05
3. No interpretation of the data is expected for the monthly report.
4. Data interpretation is expected in the annual report required by Condition 4.6.

I trust that you find this satisfactory. If you require further information or clarification, please contact Ms. Belinda Koblik at (905)521-7615 or at Belinda.Koblik@ontario.ca.

Yours truly,

Carl Slater

Carl Slater
Technical Support Manager, West Central Region
Director, Section 34, Ontario Water Resources Act.

C: Ms. B. Koblik/Mr. A. Quyum

**Ministry of the Environment and Climate Change**
**West Central Region**

119 King Street West
12th Floor
Hamilton, Ontario L8P 4Y7
Tel.: 905 521-7640
Fax: 905 521-7820

**Ministère de l'Environnement et de l'Action en matière de changement climatique**
**Direction régionale du Centre-Ouest**

119 rue King Ouest
12e étage
Hamilton (Ontario) L8P 4Y7
Tél. : 905 521-7640
Téléc. : 905 521-7820

February 5, 2015

Nestle Canada Inc.
101 Brock Road S.
Puslinch, Ontario
N1H 6H9

Attention: Ms. Andreanne Simard

Dear Ms. Simard:

**RE:** Amendments to monitoring program and well sanitization conditions
Permit to Take Water 3716-8UZMCU

## NOTICE

Pursuant to s. 100, Ontario Water Resources Act, R.S.O. 1990, c. O.40 as amended, I am issuing notice that, as Director of Section 34 of the Ontario Water Resources Act, I am exercising my discretion to amend Permit to Take Water 3716-8UZMCU condition 3.6 and part of condition 4.1. All other terms and conditions of Permit to Take Water 3716-8UZMCU shall continue in force.

An inaccuracy in the monitoring program listed in condition 4.1(ii) of a Notice issued February 25, 2014 was brought to the attention of the ministry in an email from Ms. Andreanne Simard, Natural Resources Manager dated May 29, 2014. In an email dated November 27, 2014, Ms. Simard, requested the sanitation Notice issued on January 20, 2014 be applicable for all years remaining on the permit.

This Notice supersedes the Notices issued on January 20, 2014 and February 25, 2014.

Condition 3.6 is hereby revoked and replaced as follows:

3.6 Notwithstanding Table A, the maximum pumping of water extracted from Source TW1-88 may be increased to 1040 litres per minute (275 U.S. gallons per minute) annually, or as needed, for the sole purpose of sanitization of the well. The maximum amount of water taken shall not exceed 1,113,000 litres/day.

Condition 4.1 is hereby revoked and replaced as follows:

4.1 The Permit Holder shall establish the following monitoring program for the duration of the Permit:

a. Bedrock Wells

(i) Continuous monitoring of ground water levels at the following locations:

- TW1-88
- D2A
- D3 (MOE #6710228)
- MW5A
- MW6A
- D36B (MOE Tag#A001807)

(ii) Monthly monitoring of ground water levels at the following locations:

- D19 (MOE #6709207)
- MW11A/B-08
- D24B (MOE #6708146) and D24A (MOE #6711344)
- D26A (MOE #6700678) and D26B
- MW12A/B-08
- D8 (MOE#6708720)
- D15 (MOE#6709532)
- D32 (MOE#6708153)

b. Overburden Wells

(i) Continuous monitoring of ground water levels at the following locations:

- MW3A/B
- D2B
- MW5B
- MW6B
- D26C
- D36A

(ii) Monthly monitoring of ground water levels at the following locations:

- TW1-99 (MOE #6712960)
- D27 (MOE #6712147)
- D7B
- MW2

c. Piezometers

(i) Continuous monitoring of water level and vertical hydraulic gradients at the following locations:
  - P01A/B-07
  - P03A/B-05
  - P06A/B-07
  - P10A/B-05
  - P11A/B-05
  - P12A/B-07
  - P13A/B-07

d. Surface Water

(i) Continuous monitoring of surface water levels at the following locations:
  - ST03-05
  - SW1
  - SW3
  - SW4
  - SW5
  - SW7

(ii) Monthly monitoring of flow and development of appropriate stage-discharge curves at the following locations:
  - SW1
  - SW3
  - SW7

This Notice now forms part of the current permit and must be attached to the original Permit to Take Water, if available. If the original is no longer available, this letter must be kept attached to a certified copy of the Permit to Take Water.

Any change in circumstances related to this permit should be reported promptly to a Director.

It is your responsibility to ensure that any person taking water under the authority of this permit is familiar with and complies with the terms and conditions.

*In accordance with Section 100 of the Ontario Water Resources Act, R.S.O. 1990, you may by written notice served upon me, the Environmental Review Tribunal and the Environmental Commissioner,* ***Environmental Bill of Rights,*** *R.S.O. 1993, Chapter 28, within 15 days after receipt of this Notice, require a hearing by the Tribunal. The Environmental Commissioner will place notice of your appeal on the Environmental Registry. Section 101 of the Ontario Water Resources Act, as amended provides that the Notice requiring a hearing shall state:*

1. The portions of the Permit or each term or condition in the Permit in respect of which the hearing is required, and;
2. The grounds on which you intend to rely at the hearing in relation to each portion appealed.

*In addition to these legal requirements, the Notice should also include:*

3. The name of the appellant;
4. The address of the appellant;
5. The Permit to Take Water number;
6. The date of the Permit to Take Water;
7. The name of the Director;
8. The municipality within which the works are located;

*This notice must be served upon:*

| | | |
|---|---|---|
| *The Secretary*<br>*Environmental Review Tribunal*<br>*2300 Yonge Street, Suite 1700*<br>*Toronto, Ontario M4P 1E4* | *AND* | *The Director, Section 34*<br>*Ministry of the Environment*<br>*12th Floor*<br>*119 King St W*<br>*Hamilton ON L8P 4Y7*<br>*Fax: (905)521-7820* |

***Further information on the Environmental Review Tribunal's requirements for an appeal can be obtained directly from the Tribunal:***

***by telephone at (416) 314-4600*** ***by fax at (416) 314-4506*** ***by e-mail at www.ert.gov.on.ca***

Yours truly,

Dan Dobrin
Director, Section 34, Ontario Water Resources Act
West Central Region

File Storage Number: AP28 ERNE

## APPENDIX B

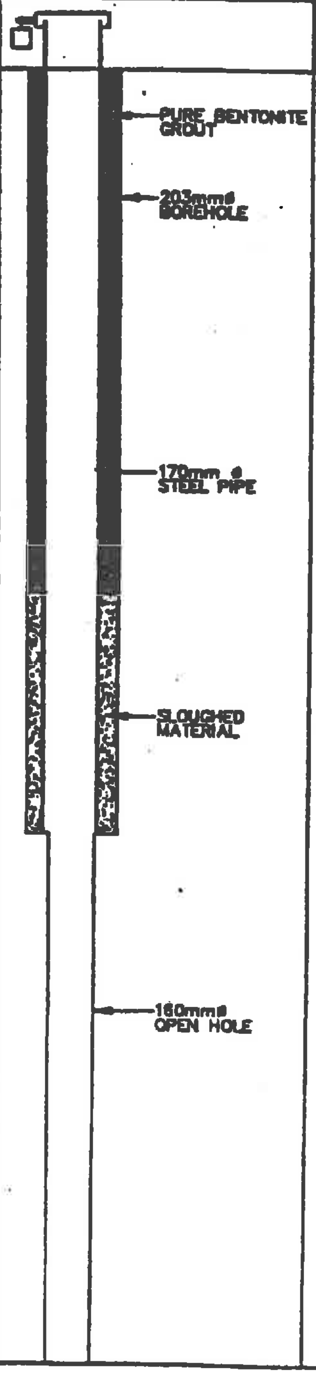
# Well Information

# STRATIGRAPHIC AND INSTRUMENTATION LOG
# (OVERBURDEN)

(L-1)

PROJECT NAME: HILLSBURGH
PROJECT NO.: 2603
CLIENT: IHOR PASHYNSKY
LOCATION: LOT 24, CONCESSION 7, ERIN TOWNSHIP

HOLE DESIGNATION: TW1-88 (Page 1 of 2)
DATE COMPLETED: AUGUST 11, 1988
DRILLING METHOD: WET/AIR ROTARY
CRA SUPERVISOR: S. CROSSMAN

| DEPTH m BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | ELEVATION m AMSL | MONITOR INSTALLATION | SAMPLE | | |
|---|---|---|---|---|---|---|
| | | | | NUMBER | STATE | 'N' VALUE |
| | GROUND SURFACE (Approximate) | 430.0 |  | | | |
| | TOPSOIL–sand, some silt, little gravel, compact, rootlets, humus material, brown, moist | 429.5 | | | | |
| 2.5 | SM (SAND)–some silt, trace of fine gravel, compact, medium grained, poorly graded, brown, moist | | | | | |
| 5.0 | | | | | | |
| | GW (GRAVEL)–some sand, little silt, very dense, well graded, fine to coarse grained, grey–brown water bearing | 423.9 | | | | |
| 7.5 | | | | | | |
| 10.0 | | | | | | |
| | SP (SAND)–trace silt, loose, uniform, medium grained, wet | 419.3 | | | | |
| 12.5 | GW (GRAVEL)–some sand, little silt, dense, well graded, coarse to fine grained, water bearing | 418.7 | | | | |
| | ML (TILL) SILT– some sand, some gravel, trace clay, stiff, low to non–plastic, light brown, wet | 417.8 | | | | |
| 15.0 | CL (TILL) CLAY– some silt, little sand, little gravel, stiff, low plastic, grey–brown, moist | 415.7 | | | | |
| 17.5 | | | | | | |
| 20.0 | LST (LIMESTONE) BEDROCK– soft, friable, fractured, light grey<br>– becomes sound, less fractured, hard | 410.5 | | | | |
| 22.5 | | | | | | |
| 25.0 | – Fracture (152mm dia); brown water in return air with lumps of brown silty clay, fracture infilled; water becomes light grey immediately after passing fracture | | | | | |
| 27.5 | – Fracture (20mm dia.), no change in water colour | | | | | |
| 30.0 | – light grey, fracture | | | | | |
| 32.5 | | | | | | |

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

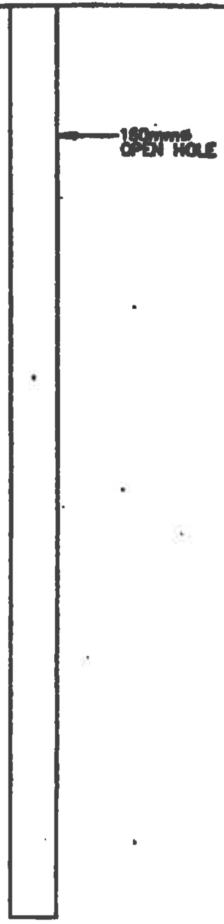
GRAIN SIZE ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

# STRATIGRAPHIC AND INSTRUMENTATION LOG
# (OVERBURDEN)

(L-1)

PROJECT NAME: HILLSBURCH
PROJECT NO.: 2603
CLIENT: IHOR PASHYNSKY
LOCATION: LOT 24, CONCESSION 7, ERIN TOWNSHIP

HOLE DESIGNATION: TW1-88 (Page 2 of 2)
DATE COMPLETED: AUGUST 11, 1988
DRILLING METHOD: WET/AIR ROTARY
CRA SUPERVISOR: S. CROSSMAN

| DEPTH m BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | ELEVATION m AMSL | MONITOR INSTALLATION | SAMPLE NUMBER | SAMPLE STATE | SAMPLE 'N' VALUE |
|---|---|---|---|---|---|---|
| | LST (LIMESTONE) BEDROCK– hard, sound, some fracturing, massive, grey | |  | | | |
| 35.0 | | | | | | |
| 37.5 | | | | | | |
| 40.0 | | | | | | |
| 42.5 | | | | | | |
| 45.0 | | | | | | |
| | Dolostone, dark grey to black | 383.4 | | | | |
| 47.5 | | | | | | |
| | – fracture, clay filled 100 to 150mm, brown | | | | | |
| 50.0 | | | | | | |
| 52.5 | | | | | | |
| | – fracture 100 to 150mm, clay filled | | | | | |
| 55.0 | – fracture 100 to 200mm, unfilled | | | | | |
| 57.5 | – sound, unfractured, crystalline, basal to concoidal fracture, grey. | 372.7 | | | | |
| | END OF HOLE @ 57.30m BGS. | | | | | |
| 60.0 | NOTE: 1. Casing set to 20.88m BGS and grouted into bedrock using a pure bentonite grout.<br>2. All elevations are approximate. | | | | | |
| 62.5 | | | | | | |
| 65.0 | | | | | | |

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

GRAIN SIZE ANALYSIS ○ WATER FOUND ▽ STATIC WATER LEVEL ▼

Ontario Ministry of the Environment

Measurements recorded in: ☐ Metric ☑ Imperial

Well Tag No. *(Place Sticker and/or Print Below)*
A095193
A095193

# Well Record

*Regulation 903 Ontario Water Resources Act*

Page 1 of 1

## Well Owner's Information

First Name:
Last Name / Organization: NESTLE WATERS CANADA
E-mail Address:
☐ Well Constructed by Well Owner

Mailing Address (Street Number/Name): 101 BROCK ROAD
Municipality: GUELPH
Province: ON
Postal Code: N1H6H9
Telephone No. *(inc. area code)*:

## Well Location

Address of Well Location (Street Number/Name): STATION STREET
Township: ERIN
Lot: 24
Concession: 7

County/District/Municipality: WELLINGTON
City/Town/Village: HILLSBURG
Province: Ontario
Postal Code:

UTM Coordinates Zone: 17 Easting: 568362 Northing: 4847825
NAD 8 3
Municipal Plan and Sublot Number:
Other:

## Overburden and Bedrock Materials/Abandonment Sealing Record *(see instructions on the back of this form)*

| General Colour | Most Common Material | Other Materials | General Description | Depth (m/ft) From | To |
|---|---|---|---|---|---|
| BROWN | SAND | SILT GRAVEL | | 0 | 31 |
| BROWN | GRAVEL | | COARSE | 31 | 39 |
| GREY | CLAY TILL | SAND, COBBLES | | 39 | 63 |
| LT GREY | LIMESTONE | | SOFT | 63 | 83 |
| BROWN | LIMESTONE | | HARD | 83 | 103 |
| DK GREY | LIMESTONE | | | 103 | 128 |
| | | | ORIGINAL WELL DRILLED 08/11/68 | | |
| | | | ORIGINAL CASING OVERDRILLED & | | |
| | | | REPLACED | | |

## Annular Space

| Depth Set at (m/ft) From | To | Type of Sealant Used (Material and Type) | Volume Placed (m³/ft³) |
|---|---|---|---|
| 0 | 12 | SAND CEMENT | |
| 12 | 71 5 | NEAT CEMENT PRESSURE GROUT | |

## Results of Well Yield Testing

After test of well yield, water was:
C ☐ Clear and sand free
☐ Other, specify

If pumping discontinued, give reason:
AIRLIFT REDEVELOP

Pump intake set at *(m/ft)*

Pumping rate *(l/min / GPM)*

Duration of pumping
hrs + min

Final water level end of pumping *(m/ft)*

If flowing give rate *(l/min / GPM)*

Recommended pump depth *(m/ft)*

Recommended pump rate *(l/min / GPM)*

Well production *(l/min / GPM)*
150+

Disinfected?
☐ Yes N ☐ No

| Draw Down Time (min) | Water Level (m/ft) | Recovery Time (min) | Water Level (m/ft) |
|---|---|---|---|
| Static Level | 36 | | |
| 1 | NA | 1 | NA |
| 2 | | 2 | |
| 3 | | 3 | |
| 4 | | 4 | |
| 5 | | 5 | |
| 10 | | 10 | |
| 15 | | 15 | |
| 20 | | 20 | |
| 25 | | 25 | |
| 30 | | 30 | |
| 40 | | 40 | |
| 50 | | 50 | |
| 60 | | 60 | |

## Method of Construction

☐ Cable Tool
R ☐ Rotary (Conventional)
☐ Rotary (Reverse)
☐ Boring
☐ Air percussion
☐ Other, specify
☐ Diamond
☐ Jetting
☐ Driving
☐ Digging

## Well Use

☐ Public
☐ Domestic
☐ Livestock
☐ Irrigation
☐ Industrial
☐ Other, specify
C ☐ Commercial
☐ Municipal
☐ Test Hole
☐ Cooling & Air Conditioning
☐ Not used
☐ Dewatering
☐ Monitoring

## Construction Record - Casing

| Inside Diameter (cm/in) | Open Hole OR Material (Galvanized, Fibreglass, Concrete, Plastic, Steel) | Wall Thickness (cm/in) | Depth (m/ft) From | To |
|---|---|---|---|---|
| 8 | STAINLESS 304 | .322 | +3 | 71.5 |

## Construction Record - Screen

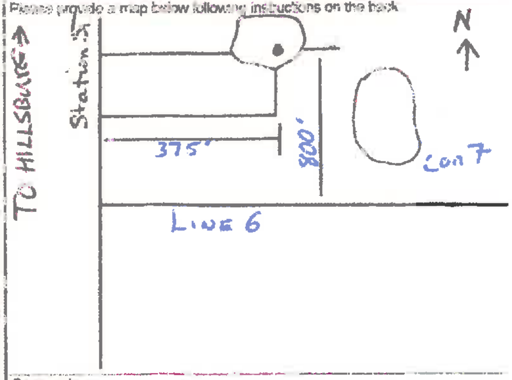
| Outside Diameter (cm/in) | Material (Plastic, Galvanized, Steel) | Slot No. | Depth (m/ft) From | To |
|---|---|---|---|---|
| | | | | |

## Status of Well

W ☐ Water Supply
☐ Replacement Well
☐ Test Hole
☐ Recharge Well
☐ Dewatering Well
☐ Observation and/or Monitoring Hole
☐ Alteration (Construction)
☐ Abandoned, Insufficient Supply
☐ Abandoned, Poor Water Quality
☐ Abandoned, other, specify
☐ Other, specify

## Map of Well Location

Please provide a map below following instructions on the back



Comments:

## Water Details

Water found at Depth 83 *(m/ft)* Kind of Water: F ☐ Fresh ☐ Untested ☐ Gas ☐ Other, specify

Water found at Depth 91 *(m/ft)* Kind of Water: F ☐ Fresh ☐ Untested ☐ Gas ☐ Other, specify

Water found at Depth 103 *(m/ft)* Kind of Water: F ☐ Fresh ☐ Untested ☐ Gas ☐ Other, specify

## Hole Diameter

| Depth (m/ft) From | To | Diameter (cm/in) |
|---|---|---|
| 0 | 71.5 | 14.5 |
| 71.5 | 128 | 6.25 |

## Well Contractor and Well Technician Information

Business Name of Well Contractor: Durl Hopper Ltd.
Well Contractor's Licence No.: 2844

Business Address (Street Number/Name): RR#7
Municipality: St Marys

Province: Ont
Postal Code: N4X1C9
Business E-mail Address: hopper@cyg.net

Bus. Telephone No. *(inc. area code)*: 5192717860
Name of Well Technician (Last Name, First Name): HOPPER, SHAWN

Well Technician's Licence No.: 2315
Signature of Technician and/or Contractor
Date Submitted: 12/8/2010

Well owner's information package delivered: ☐ Yes ☑ No
Date Package Delivered: NA
Date Work Completed: 11/22/2010

**Ministry Use Only**
Audit No. Z115126
Received

0506E (2007/12) © Queen's Printer for Ontario, 2007

Ministry's Copy

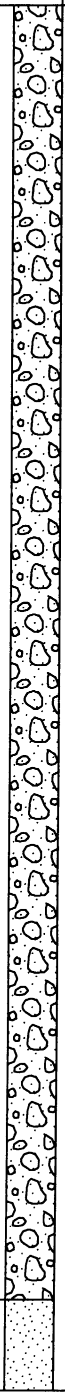
# STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

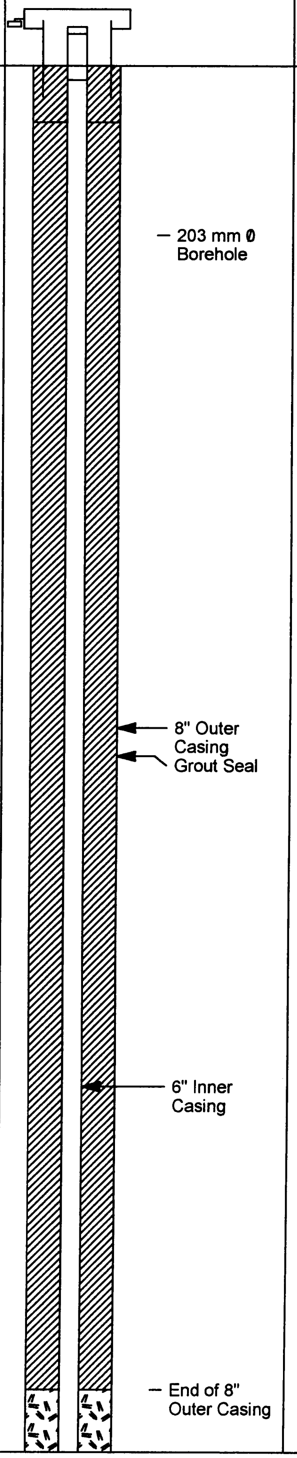
PROJECT NAME: Standard of Identity Investigation
PROJECT NUMBER: 013764-75
CLIENT: Nestle Waters Canada
LOCATION: Town of Erin, Ontario

HOLE DESIGNATION: MW05A-05
DATE COMPLETED: March 23, 2005
DRILLING METHOD: Air Rotary
FIELD PERSONNEL: K. Maurice

| DEPTH m BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | DEPTH m BGS | Observation Well | SAMPLE NUMBER | SAMPLE INTERVAL | SAMPLE REC (%) | SAMPLE 'N' VALUE |
|---|---|---|---|---|---|---|---|
| | SP (SAND) Coarse sand and gravel, angular, gray/brown color | | | | | | |
| | - Increasing fines and water content at 10.67m BGS | | | | | | |
| | - Increased fines, gray color at 13.72m BGS | | | | | | |
| | CL (Till) CLAY - sandy, little gravel, gray/brown color | 14.02 | | | | | |

Depth scale: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14





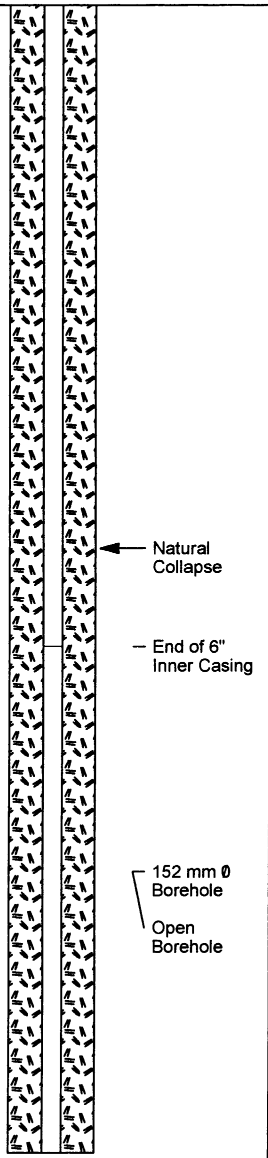
NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

# STRATIGRAPHIC AND INSTRUMENTATION LOG
# (OVERBURDEN)

PROJECT NAME: Standard of Identity Investigation
PROJECT NUMBER: 013764-75
CLIENT: Nestle Waters Canada
LOCATION: Town of Erin, Ontario

HOLE DESIGNATION: MW05A-05
DATE COMPLETED: March 23, 2005
DRILLING METHOD: Air Rotary
FIELD PERSONNEL: K. Maurice

| DEPTH m BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | DEPTH m BGS | Observation Well | SAMPLE NUMBER | INTERVAL | REC (%) | 'N' VALUE |
|---|---|---|---|---|---|---|---|
| 16 | | | | | | | |
| 17 | | | | | | | |
| 18 | | | | | | | |
| | CL (Till) CLAY - with fine angular gravel | 18.29 | | | | | |
| 19 | | | | | | | |
| 20 | | | | | | | |
| 21 | | | | | | | |
| | Limestone - Highly fractured angular fragments with sand and gravel, saturated | 21.34 | | | | | |
| 22 | | | | | | | |
| 23 | | | | | | | |
| 24 | | | | | | | |
| 25 | | | | | | | |
| 26 | | | | | | | |
| 27 | | | | | | | |
| | END OF BOREHOLE @ 27.43m BGS | 27.43 | | | | | |
| 28 | | | | | | | |
| 29 | | | | | | | |



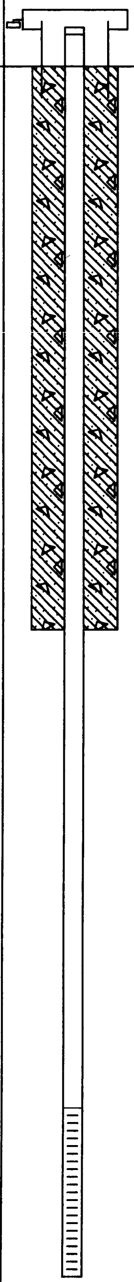
WELL DETAILS
Screened interval:
21.34 to 27.43m BGS
Length: 6.1m
Material: Open Borehole
Seal:
0.15 to 14.33m BGS
Material: Grout
Material: Native

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

# STRATIGRAPHIC AND INSTRUMENTATION LOG
# (OVERBURDEN)

PROJECT NAME: Standard of Identity Investigation
PROJECT NUMBER: 013764-75
CLIENT: Nestle Waters Canada
LOCATION: Town of Erin, Ontario

HOLE DESIGNATION: MW05B-05
DATE COMPLETED: March 23, 2005
DRILLING METHOD: Air Rotary
FIELD PERSONNEL: K. Maurice

| DEPTH m BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | DEPTH m BGS | Observation Well | SAMPLE | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | NUMBER | INTERVAL | REC (%) | 'N' VALUE | |
| 1<br>2<br>3<br>4<br>5<br>6<br>7<br>8<br>9<br>10<br>11<br>12 | Refer to MW05A-05 for stratigraphic details | |  | | | | | |
| 13<br>14 | END OF BOREHOLE @ 13.11m BGS | 13.11 | WELL DETAILS<br>Screened interval:<br>11.28 to 13.11m BGS<br>Length: 1.83m<br>Diameter: 152mm<br>Slot Size: 35<br>Material: Stainless Steel | | | | | |

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

# STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

PROJECT NAME: Standard of Identity Investigation

PROJECT NUMBER: 013764-75

CLIENT: Nestle Waters Canada

LOCATION: Town of Erin, Ontario

HOLE DESIGNATION: MW05B-05

DATE COMPLETED: March 23, 2005

DRILLING METHOD: Air Rotary

FIELD PERSONNEL: K. Maurice

| DEPTH m BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | DEPTH m BGS | Observation Well | SAMPLE | | | |
|---|---|---|---|---|---|---|---|
| | | | | NUMBER | INTERVAL | REC (%) | 'N' VALUE |
| | | | Seal:<br>0.15 to 6.10m BGS<br>Material: Cement<br>Material: Native | | | | |
| 16 | | | | | | | |
| 17 | | | | | | | |
| 18 | | | | | | | |
| 19 | | | | | | | |
| 20 | | | | | | | |
| 21 | | | | | | | |
| 22 | | | | | | | |
| 23 | | | | | | | |
| 24 | | | | | | | |
| 25 | | | | | | | |
| 26 | | | | | | | |
| 27 | | | | | | | |
| 28 | | | | | | | |
| 29 | | | | | | | |

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

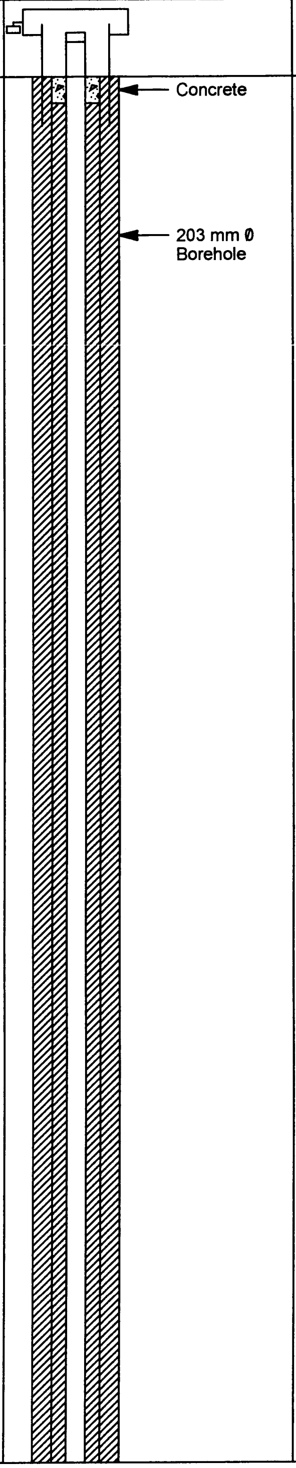
# STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

PROJECT NAME: Nestle Waters Canada
PROJECT NUMBER: 013764-75
CLIENT: Nestle Waters Canada
LOCATION: Town of Erin, Ontario

HOLE DESIGNATION: MW6A-05
DATE COMPLETED: March 8, 2005
DRILLING METHOD: 4 1/4" HSA
FIELD PERSONNEL: M. Acre

| STRATIGRAPHIC DESCRIPTION & REMARKS | DEPTH m BGS |
|---|---|
| TOPSOIL - sand, medium grained, poorly graded, dark brown, damp, roots and rootlets | |
| SM - Silty SAND, trace clay, fine grained, brown, moist | 0.91 |
| SM - SAND and GRAVEL, with silt, fine to coarse grained, well graded, brown, damp<br>- 51mm SW - SAND and GRAVEL, coarse grained, well graded, saturated at 2.29m BGS | 1.52 |
| ML - SILT with sand, with gravel, low plasticity, brown, moist<br>- decrease in sand content, fine to coarse subrounded gravel, trace angular bedrock fragments, moist at 3.05m BGS | 2.31 |
| SW - SAND and GRAVEL, trace silt, fine to coarse grained, well graded, brown, saturated, trace bedrock fragments | 3.81 |
| ML - SILT, with subrounded gravel, trace sand. trace clay, stiff, low plasticity, grey, moist,<br>- with clay, trace angular bedrock fragments at 5.33m BGS<br>- 51mm SW - SAND trace gravel, medium grained, brown, saturated at 6.10m BGS<br>- angular bedrock fragments at 6.35m BGS | 4.57 |
| SW - SAND and GRAVEL, fine to medium grained, well graded, brown, saturated | 6.86 |

Monitoring Well



SAMPLE

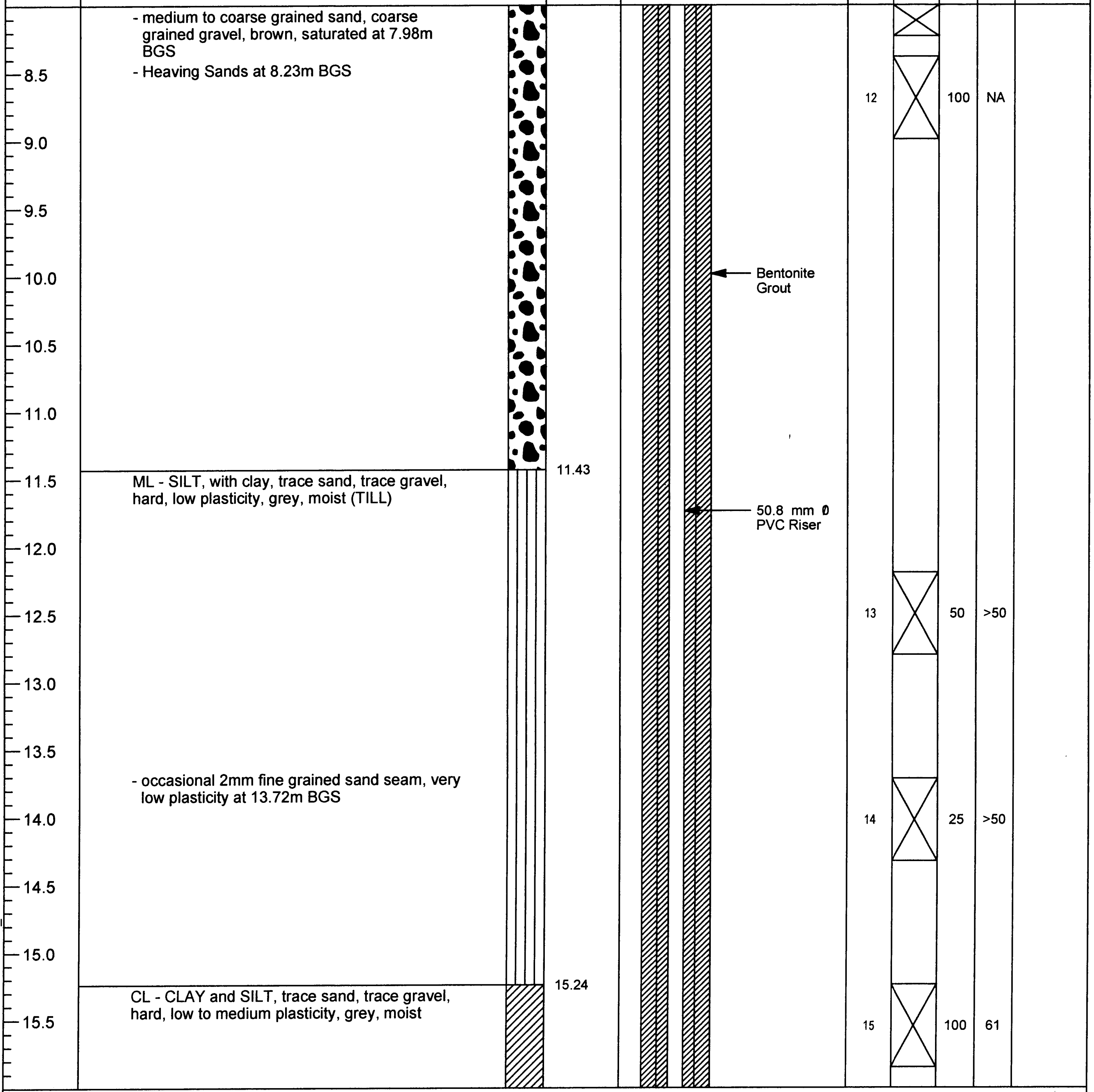
| NUMBER | INTERVAL | REC (%) | 'N' VALUE |
|---|---|---|---|
| 1 | ☒ | 100 | 9 |
| 2 | ☒ | 75 | 3 |
| 3 | ☒ | 50 | 20 |
| 4 | ☒ | 50 | 22 |
| 5 | ☒ | 33 | >50 |
| 6 | ☒ | 33 | 16 |
| 7 | ☒ | 25 | 38 |
| 8 | ☒ | 25 | 43 |
| 9 | ☒ | 50 | 27 |
| 10 | ☒ | 50 | 14 |
| 11 | ☒ | 100 | 35 |

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

# STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

PROJECT NAME: Nestle Waters Canada
PROJECT NUMBER: 013764-75
CLIENT: Nestle Waters Canada
LOCATION: Town of Erin, Ontario

HOLE DESIGNATION: MW6A-05
DATE COMPLETED: March 8, 2005
DRILLING METHOD: 4 1/4" HSA
FIELD PERSONNEL: M. Acre



| DEPTH m BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | DEPTH m BGS | SAMPLE NUMBER | REC (%) | 'N' VALUE |
|---|---|---|---|---|---|
| | - medium to coarse grained sand, coarse grained gravel, brown, saturated at 7.98m BGS<br>- Heaving Sands at 8.23m BGS | | 12 | 100 | NA |
| | ML - SILT, with clay, trace sand, trace gravel, hard, low plasticity, grey, moist (TILL) | 11.43 | 13 | 50 | >50 |
| | - occasional 2mm fine grained sand seam, very low plasticity at 13.72m BGS | | 14 | 25 | >50 |
| | CL - CLAY and SILT, trace sand, trace gravel, hard, low to medium plasticity, grey, moist | 15.24 | 15 | 100 | 61 |

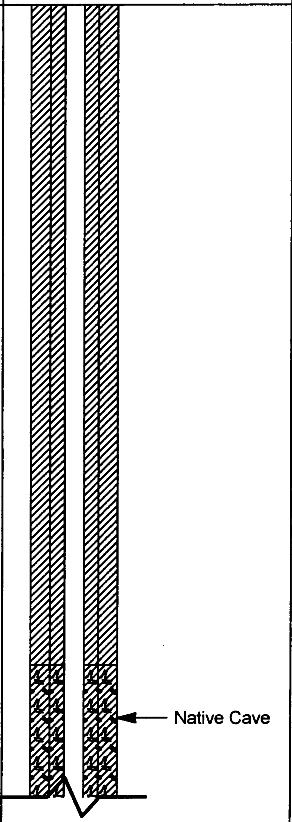
NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

# STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

PROJECT NAME: Nestle Waters Canada
PROJECT NUMBER: 013764-75
CLIENT: Nestle Waters Canada
LOCATION: Town of Erin, Ontario

HOLE DESIGNATION: MW6A-05
DATE COMPLETED: March 8, 2005
DRILLING METHOD: 4 1/4" HSA
FIELD PERSONNEL: M. Acre

| DEPTH m BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | DEPTH m BGS | Monitoring Well | SAMPLE NUMBER | SAMPLE INTERVAL | SAMPLE REC (%) | SAMPLE 'N' VALUE |
|---|---|---|---|---|---|---|---|
| 16.5 | | | | | | | |
| 17.0 | | | | 16 | ☒ | 100 | 60 |
| 17.5 | | | | | | | |
| 18.0 | | | | | | | |
| 18.5 | | | | 17 | ☒ | 50 | >87 |
| 19.0 | | | | | | | |
| 19.5 | | | | | | | |
| 20.0 | LIMESTONE - highly fractured, angular fragments with sand and gravel, trace silt and clay, saturated | 19.81 | Native Cave | 18 | ☒ | 21 | >50 |
| 20.5 | - BEDROCK - Auger Refusal at 20.57m BGS<br>END OF OVERBURDEN HOLE @ 20.57m BGS | | | | | | |
| 21.0 | | | | | | | |
| 21.5 | | | | | | | |
| 22.0 | | | | | | | |
| 22.5 | | | | | | | |
| 23.0 | | | | | | | |
| 23.5 | | | | | | | |



NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

# STRATIGRAPHIC AND INSTRUMENTATION LOG
# (BEDROCK)

PROJECT NAME: Nestle Waters Canada
PROJECT NUMBER: 013764-75
CLIENT: Nestle Waters Canada
LOCATION: Town of Erin, Ontario

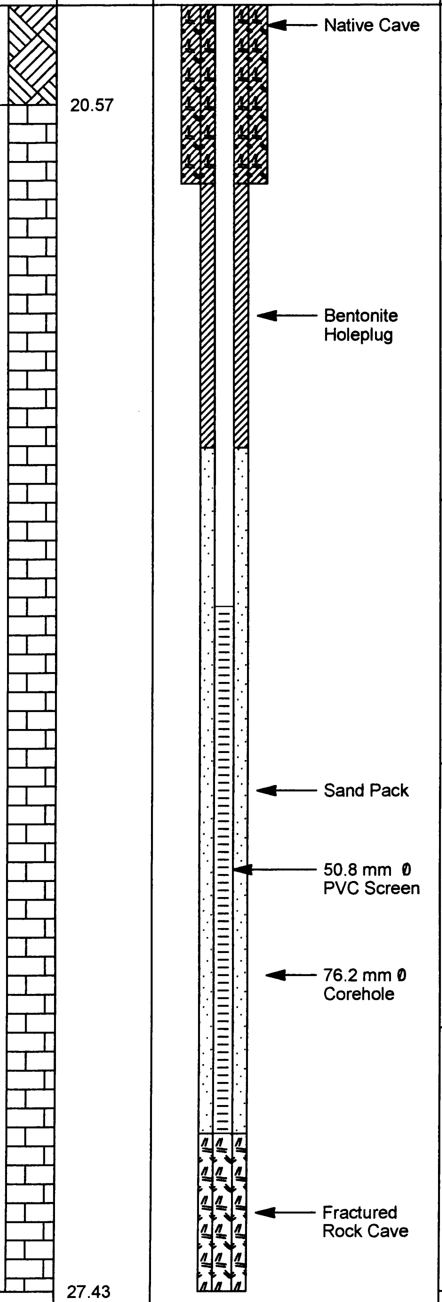
HOLE DESIGNATION: MW6A-05
DATE COMPLETED: March 8, 2005
DRILLING METHOD: 4 1/4" HSA
FIELD PERSONNEL: M. Acre

DEPTH m BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | DEPTH m BGS | Monitoring Well | RUN NUMBER | CORE RECOVERY % | RQD %

- BEDROCK - Auger Refusal at 20.57m BGS

LIMESTONE - grey/brown, fine grained, smooth, moderately weathered, occasional vugs, occasional styolites, occasional fossils

- horizontal fracture, very close, rough, slightly weathered, oxidized staining, trace infilling at 20.67m BGS
- horizontal fracture, very close, rough, slightly weathered, oxidized staining, trace infilling at 20.73m BGS
- horizontal fracture, very close, rough, slightly weathered, oxidized staining, trace infilling at 20.85m BGS
- horizontal mechanical fracture at 20.88m BGS
- 1.5m highly fractured Not-Intact invterval, core barrel dropping through numerous fracture voids, clay infilling, oxidized staining at 21.34m BGS
- horizontal fracture, very close, slightly weathered, rough, trace oxidation, trace mineral infilling at 23.01m BGS
- 45cm vertical fracture, very close, smooth, trace oxidation, trace mineral infilling at 23.16m BGS
- horizontal fracture, very close, smooth, trace mineral infilling at 23.41m BGS
- horizontal fracture, very close, smooth, trace mineral infilling at 23.62m BGS
- horizontal fracture, very close, smooth, trace black mineral infilling at 23.77m BGS
- horizontal fracture, very close, smooth, trace mineral infilling at 23.80m BGS
- horizontal mechanical fracture at 23.98m BGS
- horizontal fracture, close, smooth at 24.18m BGS
- horizontal mechanical fracture at 24.54m BGS
- horizontal fracture, close, smooth, oxidization, mineral infilling at 24.64m BGS
- 10cm vertical mechanical fracture at 24.64m BGS
- horizontal fracture, close, smooth, trace brown clay infilling at 24.92m BGS
- horizontal fracture, close, smooth to rough at 25.22m BGS
- horizontal fracture, very close smooth, oxidized at 25.37m BGS
- horizontal fracture, close, smooth, trace clay infilling at 25.50m BGS
- horizontal fracture, close, smooth, trace clay infilling at 25.63m BGS
- horizontal fracture, close, smooth, trace clay infilling at 25.76m BGS



| RUN NUMBER | CORE RECOVERY % | RQD % |
|---|---|---|
| 1 | 40 | 13 |
| 2 | 60 | 17 |
| 3 | 100 | 72 |
| 4 | 67 | 82 |
| 5 | 97 | 32 |

WELL DETAILS
Screened interval:
23.47 to 26.52m BGS

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

# STRATIGRAPHIC AND INSTRUMENTATION LOG
# (BEDROCK)

PROJECT NAME: Nestle Waters Canada
PROJECT NUMBER: 013764-75
CLIENT: Nestle Waters Canada
LOCATION: Town of Erin, Ontario

HOLE DESIGNATION: MW6A-05
DATE COMPLETED: March 8, 2005
DRILLING METHOD: 4 1/4" HSA
FIELD PERSONNEL: M. Acre

| DEPTH m BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | DEPTH m BGS | Monitoring Well | RUN NUMBER | CORE RECOVERY % | RQD % | |
|---|---|---|---|---|---|---|---|
| | - horizontal fracture, close, smooth, trace clay infilling at 25.86m BGS | | Length: 3.05m<br>Diameter: 51mm<br>Slot Size: 10<br>Material: Schedule 40 PVC<br>Seal:<br>21.03 to 22.56m BGS<br>Material: Bentonite<br>Sand Pack:<br>22.56 to 26.52m BGS<br>Material: #Silica Sand | | | | |
| 28.5 | - horizontal mechanical fracture at 25.98m BGS<br>- 23cm vertical fracture, very close, smooth at 25.98m BGS | | | | | | |
| 29.0 | - 31cm Not-Intact interval at 26.21m BGS<br>- 45° mechanical fracture at 26.57m BGS<br>- horizontal fracture, close, smooth at 26.67m BGS | | | | | | |
| 29.5 | - horizontal fracture, slightly rough, trace oxidation at 26.77m BGS<br>- 33cm vertical fracture, cery close, smooth, trace mineral infilling at 26.77m BGS | | | | | | |
| 30.0 | - horizontal fracture, close, smooth, trace oxidation at 26.90m BGS | | | | | | |
| 30.5 | - horizontal fracture, very close, smooth, trace oxidation, trace mineral infilling at 27.00m BGS<br>- horizontal fracture, very close, smooth, oxidized at 27.20m BGS | | | | | | |
| 31.0 | - horizontal fracture, very close, smooth, mineral infilling at 27.36m BGS<br>END OF BOREHOLE @ 27.43m BGS | | | | | | |
| 31.5 | | | | | | | |
| 32.0 | | | | | | | |
| 32.5 | | | | | | | |
| 33.0 | | | | | | | |
| 33.5 | | | | | | | |
| 34.0 | | | | | | | |
| 34.5 | | | | | | | |
| 35.0 | | | | | | | |
| 35.5 | | | | | | | |

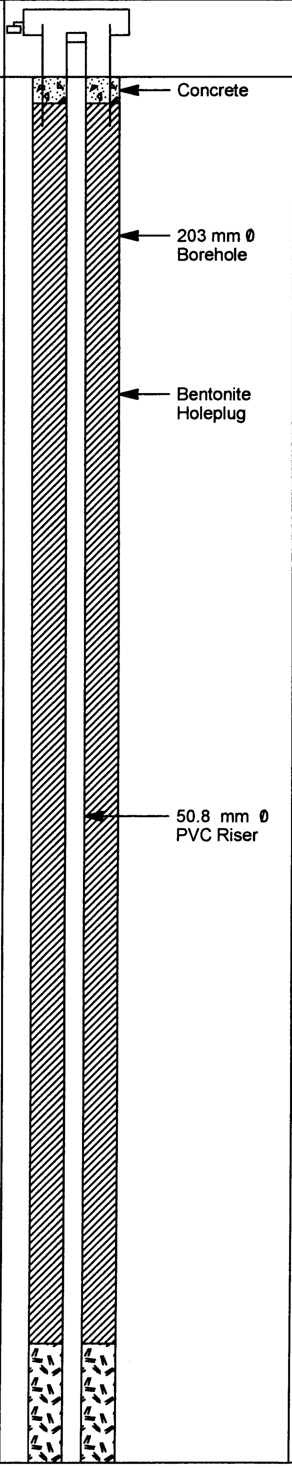
NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

# STRATIGRAPHIC AND INSTRUMENTATION LOG
# (OVERBURDEN)

PROJECT NAME: Nestle Waters Canada
PROJECT NUMBER: 013764-75
CLIENT: Nestle Waters Canada
LOCATION: Town of Erin, Ontario

HOLE DESIGNATION: MW6B-05
DATE COMPLETED: March 9, 2005
DRILLING METHOD: 4 1/4" HSA
FIELD PERSONNEL: M. Acre

| DEPTH m BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | DEPTH m BGS | Monitoring Well | SAMPLE NUMBER | SAMPLE INTERVAL | SAMPLE REC (%) | SAMPLE 'N' VALUE |
|---|---|---|---|---|---|---|---|
| | Refer to MW6A-05 for stratigraphic details | | | | | | |
| 0.5 | | | | | | | |
| 1.0 | | | | | | | |
| 1.5 | | | | | | | |
| 2.0 | | | | | | | |
| 2.5 | | | | | | | |
| 3.0 | | | | | | | |
| 3.5 | | | | | | | |
| 4.0 | | | | | | | |
| 4.5 | | | | | | | |
| 5.0 | | | | | | | |
| 5.5 | | | | | | | |
| 6.0 | | | | | | | |
| 6.5 | | | | | | | |
| 7.0 | | | | | | | |
| 7.5 | | | | | | | |



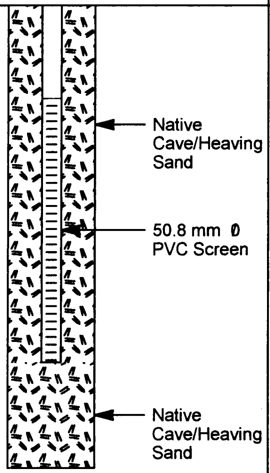
NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

# STRATIGRAPHIC AND INSTRUMENTATION LOG
## (OVERBURDEN)

PROJECT NAME: Nestle Waters Canada
PROJECT NUMBER: 013764-75
CLIENT: Nestle Waters Canada
LOCATION: Town of Erin, Ontario

HOLE DESIGNATION: MW6B-05
DATE COMPLETED: March 9, 2005
DRILLING METHOD: 4 1/4" HSA
FIELD PERSONNEL: M. Acre

| DEPTH m BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | DEPTH m BGS | Monitoring Well | SAMPLE NUMBER | SAMPLE INTERVAL | SAMPLE REC (%) | SAMPLE 'N' VALUE |
|---|---|---|---|---|---|---|---|
| 8.5 | | | | | | | |
| 9.0 | | | | | | | |
| 9.5 | | | | | | | |
| 10.0 | | | | | | | |
| 10.5 | | | | | | | |
| | END OF BOREHOLE @ 10.67m BGS | 10.67 | | | | | |
| 11.0 | | | | | | | |
| 11.5 | | | | | | | |
| 12.0 | | | | | | | |
| 12.5 | | | | | | | |
| 13.0 | | | | | | | |
| 13.5 | | | | | | | |
| 14.0 | | | | | | | |
| 14.5 | | | | | | | |
| 15.0 | | | | | | | |
| 15.5 | | | | | | | |



WELL DETAILS
Screened interval:
8.53 to 10.06m BGS
Length: 1.52m
Diameter: 51mm
Slot Size: 10
Material: Schedule 40 PVC
Seal:
0.15 to 7.32m BGS
Material: Bentonite
Sand Pack:
7.32 to 10.06m BGS
Material: Native Cave/Heaving Sand

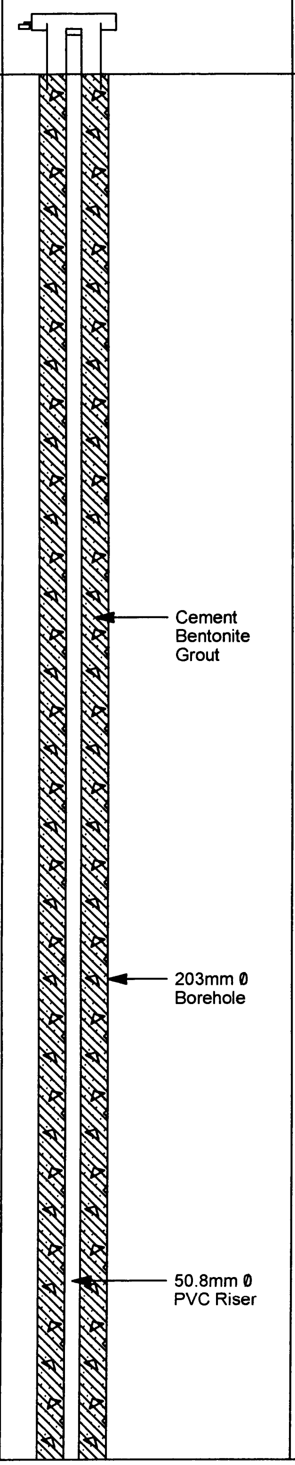
NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

# STRATIGRAPHIC AND INSTRUMENTATION LOG
# (OVERBURDEN)

PROJECT NAME: Nestle Waters
PROJECT NUMBER: 13764-25
CLIENT: Nestle Waters Canada
LOCATION: Station St, Hillsburgh, ON

HOLE DESIGNATION: MW11A-08
DATE COMPLETED: January 22, 2008
DRILLING METHOD: 4 1/4 ID HSA / HQ Wet Core
FIELD PERSONNEL: N.Hinsperger

| DEPTH m BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | DEPTH m BGS |
|---|---|---|
| 0.0 | SM SAND (TOPSOIL) - trace silt, trace clay, medium grained, poorly graded, dark brown, moist, some rootlets | |
| 1.5 | SM SAND - with cobble, trace silt, medium grained, poorly graded, brown to dark brown, moist | 1.52 |
| 3.0 | - light brown, moist to wet at 3.05m BGS | |
| 4.5 | GP GRAVEL AND SW SAND - trace silt, medium to coarse grained, poorly graded, grey to brown, moist | 4.57 |
| 6.5 | - wet at 6.40m BGS | |



| SAMPLE NUMBER | INTERVAL | REC (%) | 'N' VALUE |
|---|---|---|---|
| 1 | | 75 | 2 |
| 2 | | 50 | 10 |
| 3 | | 50 | 26 |
| 4 | | 50 | 20 |
| 5 | | 33 | 18 |

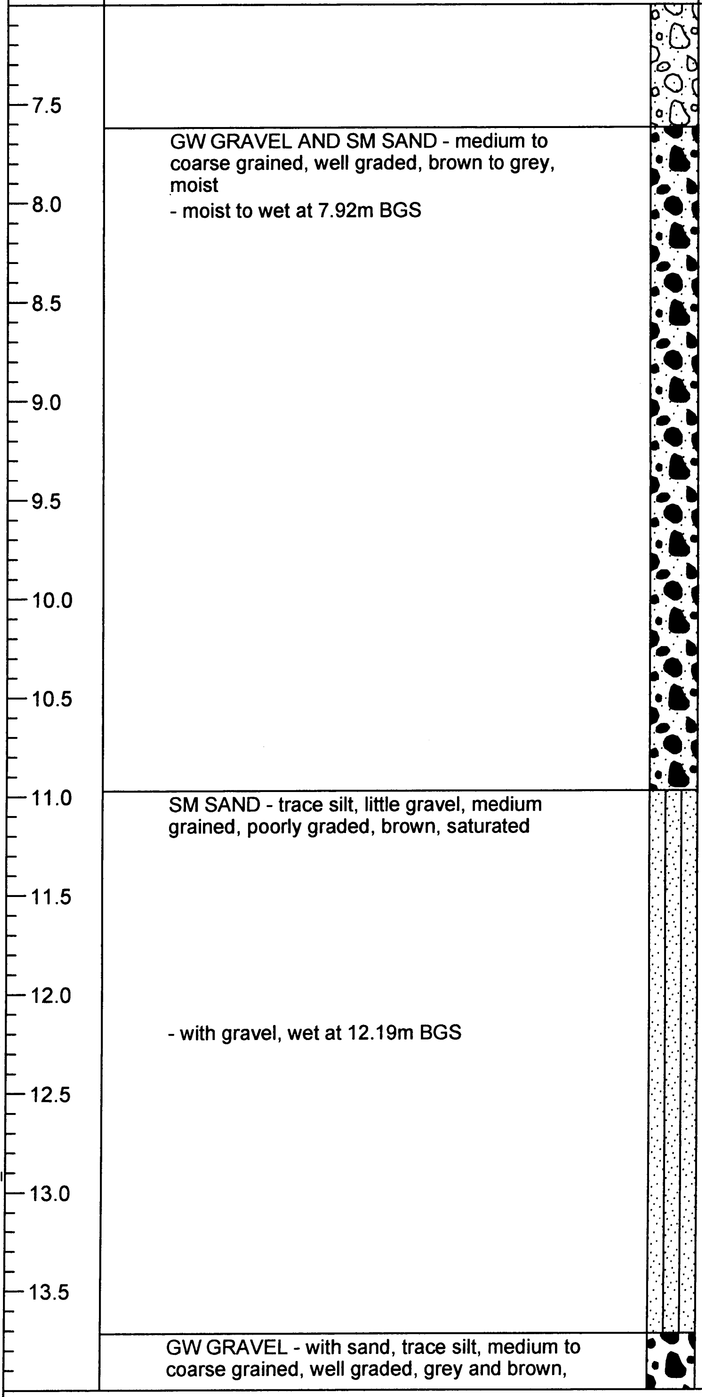
NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

# STRATIGRAPHIC AND INSTRUMENTATION LOG
# (OVERBURDEN)

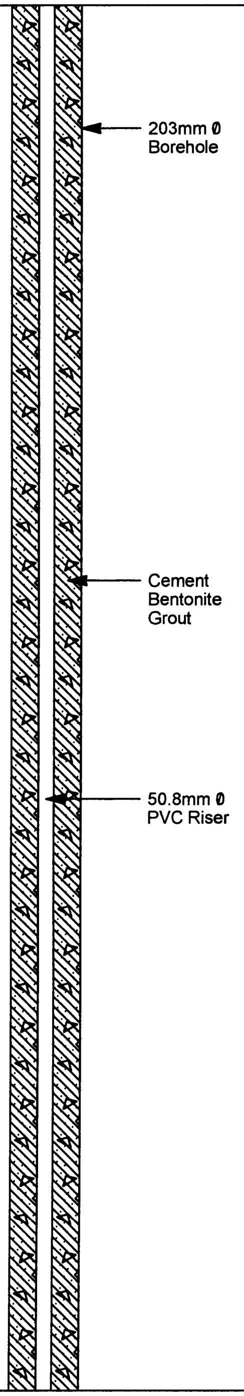
PROJECT NAME: Nestle Waters
PROJECT NUMBER: 13764-25
CLIENT: Nestle Waters Canada
LOCATION: Station St, Hillsburgh, ON

HOLE DESIGNATION: MW11A-08
DATE COMPLETED: January 22, 2008
DRILLING METHOD: 4 1/4 ID HSA / HQ Wet Core
FIELD PERSONNEL: N.Hinsperger

| DEPTH m BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | DEPTH m BGS |
|---|---|---|
| 7.62 | GW GRAVEL AND SM SAND - medium to coarse grained, well graded, brown to grey, moist<br>- moist to wet at 7.92m BGS | 7.62 |
| 10.97 | SM SAND - trace silt, little gravel, medium grained, poorly graded, brown, saturated<br>- with gravel, wet at 12.19m BGS | 10.97 |
| 13.72 | GW GRAVEL - with sand, trace silt, medium to coarse grained, well graded, grey and brown, | 13.72 |



Monitoring Well



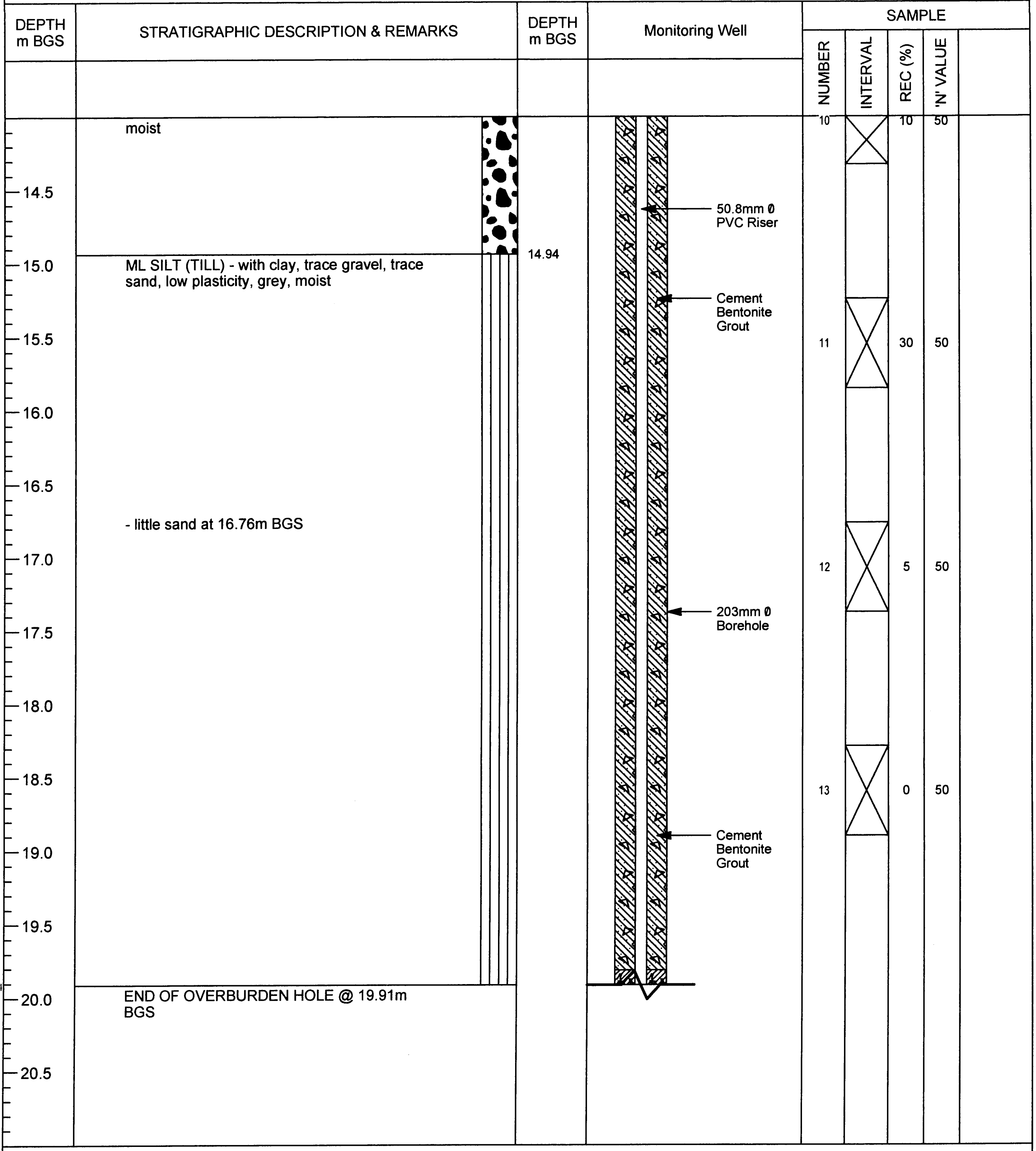
| SAMPLE NUMBER | INTERVAL | REC (%) | 'N' VALUE |
|---|---|---|---|
| 6 | ☒ | 40 | 27 |
| 7 | ☒ | 0 | 50 |
| 8 | ☒ | 70 | 50 |
| 9 | ☒ | 40 | 90 |
|  | ☒ |  |  |

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

# STRATIGRAPHIC AND INSTRUMENTATION LOG
# (OVERBURDEN)

PROJECT NAME: Nestle Waters
PROJECT NUMBER: 13764-25
CLIENT: Nestle Waters Canada
LOCATION: Station St, Hillsburgh, ON

HOLE DESIGNATION: MW11A-08
DATE COMPLETED: January 22, 2008
DRILLING METHOD: 4 1/4 ID HSA / HQ Wet Core
FIELD PERSONNEL: N.Hinsperger



moist

ML SILT (TILL) - with clay, trace gravel, trace sand, low plasticity, grey, moist

- little sand at 16.76m BGS

END OF OVERBURDEN HOLE @ 19.91m BGS

| NUMBER | INTERVAL | REC (%) | 'N' VALUE |
|---|---|---|---|
| 10 | ☒ | 10 | 50 |
| 11 | ☒ | 30 | 50 |
| 12 | ☒ | 5 | 50 |
| 13 | ☒ | 0 | 50 |

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

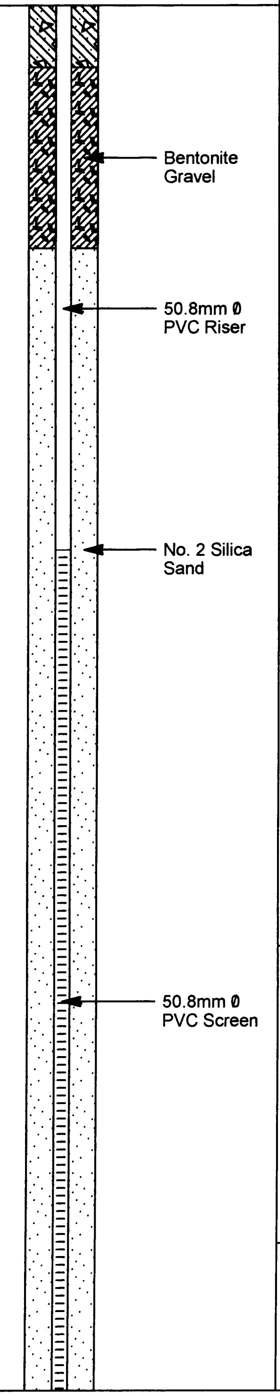
# STRATIGRAPHIC AND INSTRUMENTATION LOG
# (BEDROCK)

PROJECT NAME: Nestle Waters
PROJECT NUMBER: 13764-25
CLIENT: Nestle Waters Canada
LOCATION: Station St, Hillsburgh, ON

HOLE DESIGNATION: MW11A-08
DATE COMPLETED: January 22, 2008
DRILLING METHOD: 4 1/4 ID HSA / HQ Wet Core
FIELD PERSONNEL: N.Hinsperger

| DEPTH m BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | DEPTH m BGS |
|---|---|---|
| 20.0 | DOLOSTONE (GUELPH FORMATION) - moderately weathered, moderately fractured, vuggy, fine grained, microcrystalline, some sand infilling, frequent thin stylolite beds | 19.91 |
| 20.5 | - horizontal fracture with sand infilling at 20.04m BGS | |
| 21.0 | - horizontal fractures at 20.14m, 20.55m, 20.71m and at 21.00m BGS<br>- vertical mechanical fracture at 21.21m BGS | |
| 21.5 | - vertical mechanical fracture, oxidation at 21.34m BGS<br>- horizontal fracture at 21.40m BGS<br>- horizontal fracture, vuggy at 21.67m BGS | |
| 22.0 | - horizontal fracture, some black staining at 21.81m BGS<br>- horizontal fracture and little oxidation at 21.88 at 21.91m BGS | |
| 22.5 | - horizontal fracture, oxidation and sand infilling at 21.97m BGS<br>- vertical fracture at 21.98m BGS | |
| 23.0 | - horizontal fracture, oxidation, frequent stylolite beds at 22.86m BGS<br>- horizontal fracture at 23.16m BGS | |
| 23.5 | - horizontal fracture, slight oxidation at 23.43m BGS<br>- horizontal fracture at 45 degrees at 23.59m BGS | |
| 24.0 | - vuggy at 23.67m BGS<br>- horizontal fracture, trace sand infilling at 23.80m BGS<br>- large vug at 24.10m BGS | |
| 24.5 | - horizontal fracture, some sand infilling at 24.12m BGS<br>- vertical mechanical fracture, moderately weathered at 24.26m BGS | |
| 25.0 | - vuggy at 24.38m BGS<br>- black stylolite bed at 24.59m BGS<br>- vuggy at 24.69m BGS<br>- horizontal fracture at 24.74m BGS | |
| 25.5 | - large vug at 24.85m BGS<br>- horizontal fracture at 45 degrees, white mineralization at 24.87m BGS | |
| 26.0 | - horizontal fracture at 45 degrees, black staining, oxidation, sand infilling at 25.02m BGS<br>- horizontal fracture, sand infilling at 25.17m BGS<br>- horizontal fracture, black staining, white | |

Monitoring Well



| RUN NUMBER | CORE RECOVERY % | RQD % |
|---|---|---|
| 1 | 100 | |
| 2 | 100 | |
| 3 | 100 | 95 |
| 4 | 100 | 85 |
| 5 | 100 | 85 |

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

# STRATIGRAPHIC AND INSTRUMENTATION LOG (BEDROCK)

PROJECT NAME: Nestle Waters
PROJECT NUMBER: 13764-25
CLIENT: Nestle Waters Canada
LOCATION: Station St, Hillsburgh, ON

HOLE DESIGNATION: MW11A-08
DATE COMPLETED: January 22, 2008
DRILLING METHOD: 4 1/4 ID HSA / HQ Wet Core
FIELD PERSONNEL: N.Hinsperger

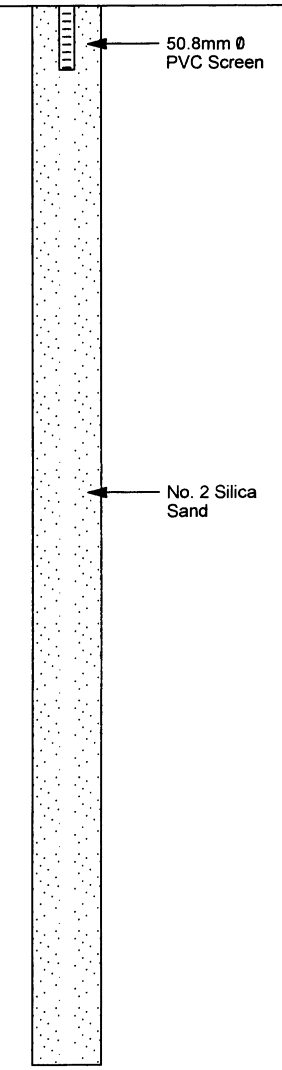
DEPTH m BGS: 27.0, 27.5, 28.0, 28.5, 29.0, 29.5, 30.0, 30.5, 31.0, 31.5, 32.0, 32.5, 33.0

STRATIGRAPHIC DESCRIPTION & REMARKS

mineralization at 25.60m BGS
- highly fractured, moderately weathered, frequent thin stylolite beds at 25.76m BGS
- horizontal fracture, silt infilling at 25.87m BGS
- slightly vuggy at 25.96m BGS
- horizontal fracture at 26.14m BGS
- occasional fossils at 26.26m BGS
- horizontal fracture, sand infilling at 26.29m BGS
- horizontal fractures at 26.34m and at 26.37m BGS
- vertical mechanical fracture at 90 degrees at 26.39m BGS
- horizontal fractures at 26.57m and at 26.69m BGS
- vertical fracture at 45 degrees at 26.75m BGS
- horizontal fracture at 26.82m BGS
- vertical fracture at 26.90m BGS
- horizontal fracture at 26.92m BGS
- vertical fracture at 26.95m BGS
- horizontal fracture at 45 degrees at 27.10m BGS
- horizontal fractures at 27.36m and at 27.40m BGS
- horizontal fracture, sand infilling at 27.62m BGS
- vertical fracture, slightly vuggy at 27.80m BGS
- horizontal fractures at 27.89m and at 28.09m BGS
- horizontal fracture at 20 degrees at 28.12m BGS
- vertical fracture at 28.14m BGS
- horizontal fracture at 28.22m BGS
- horizontal fracture at 20 degrees at 28.35m BGS
- slightly vuggy at 28.47m BGS
- slightly weathered, moderately fractured at 28.50m BGS
- horizontal fracture at 29.06m BGS
- horizontal fracture, some white mineralization at 29.08m BGS
- vertical mechanical fracture at 29.11m BGS
- horizontal fracture at 45 degrees at 29.18m BGS
- horizontal fracture at 29.39m BGS
- horizontal fracture, some black staining at 29.64m BGS
- horizontal fracture at 29.89m BGS
- horizontal fracture, slightly weathered, moderately fractured, frequent thin stylolite beds at 30.02m BGS
- vertical mechanical fractures at 30.04m and at 30.05m BGS
- horizontal fracture at 45 degrees at 30.40m BGS

DEPTH m BGS: 31.85

Monitoring Well



| RUN NUMBER | CORE RECOVERY % | RQD % |
|---|---|---|
| 6 | 100 | 69 |
| 7 | 100 | 92 |
| 8 | 100 | 95 |

WELL DETAILS
Screened interval:
22.25 to 26.82m BGS
Length: 4.57m
Diameter: 51mm
Slot Size: 10
Material: Schedule 40 PVC
Seal:
0.00 to 19.81m BGS
Material: Cement Bentonite Grout
Sand Pack:
20.73 to 31.85m BGS
Material: No. 1 Silica Sand

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

# STRATIGRAPHIC AND INSTRUMENTATION LOG
# (BEDROCK)

PROJECT NAME: Nestle Waters
PROJECT NUMBER: 13764-25
CLIENT: Nestle Waters Canada
LOCATION: Station St, Hillsburgh, ON

HOLE DESIGNATION: MW11A-08
DATE COMPLETED: January 22, 2008
DRILLING METHOD: 4 1/4 ID HSA / HQ Wet Core
FIELD PERSONNEL: N.Hinsperger

| DEPTH m BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | DEPTH m BGS | Monitoring Well | RUN NUMBER | CORE RECOVERY % | RQD % |
|---|---|---|---|---|---|---|
| 34.0 | - horizontal fracture at 45 degrees, white mineralization at 30.53m BGS<br>- horizontal fractures at 30.58m, 30.59m, 30.68m, and at 30.89m BGS<br>- large vug at 31.11m BGS<br>- horizontal fractures at 31.17m and at 31.24m BGS | | | | | |
| 34.5 | END OF BOREHOLE @ 31.85m BGS | | | | | |
| 35.0 | | | | | | |
| 35.5 | | | | | | |
| 36.0 | | | | | | |
| 36.5 | | | | | | |
| 37.0 | | | | | | |
| 37.5 | | | | | | |
| 38.0 | | | | | | |
| 38.5 | | | | | | |
| 39.0 | | | | | | |
| 39.5 | | | | | | |
| 40.0 | | | | | | |

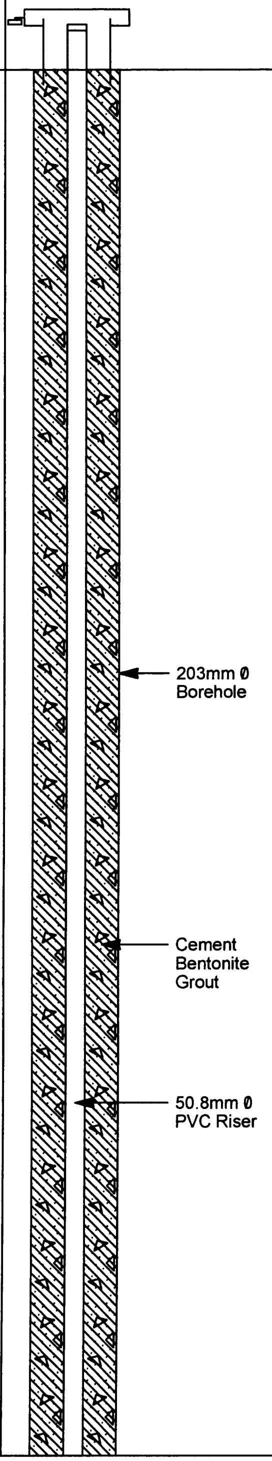
NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

# STRATIGRAPHIC AND INSTRUMENTATION LOG
# (OVERBURDEN)

PROJECT NAME: Nestle Waters
PROJECT NUMBER: 13764-25
CLIENT: Nestle Waters Canada
LOCATION: Station St, Hillsburgh, ON

HOLE DESIGNATION: MW11B-08
DATE COMPLETED: January 24, 2008
DRILLING METHOD: 4 1/4 ID HSA
FIELD PERSONNEL: N.Hinsperger

| DEPTH m BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | DEPTH m BGS | Monitoring Well | SAMPLE NUMBER | SAMPLE INTERVAL | SAMPLE REC (%) | SAMPLE 'N' VALUE |
|---|---|---|---|---|---|---|---|
| | See Stratigraphy from MW11A-08 advanced on January 22, 2008 | | | | | | |
| 0.5 | | | | | | | |
| 1.0 | | | | | | | |
| 1.5 | | | | | | | |
| 2.0 | | | | | | | |
| 2.5 | | | | | | | |
| 3.0 | | | | | | | |
| 3.5 | | | | | | | |
| 4.0 | | | | | | | |
| 4.5 | | | | | | | |
| 5.0 | | | | | | | |
| 5.5 | | | | | | | |
| 6.0 | | | | | | | |
| 6.5 | | | | | | | |



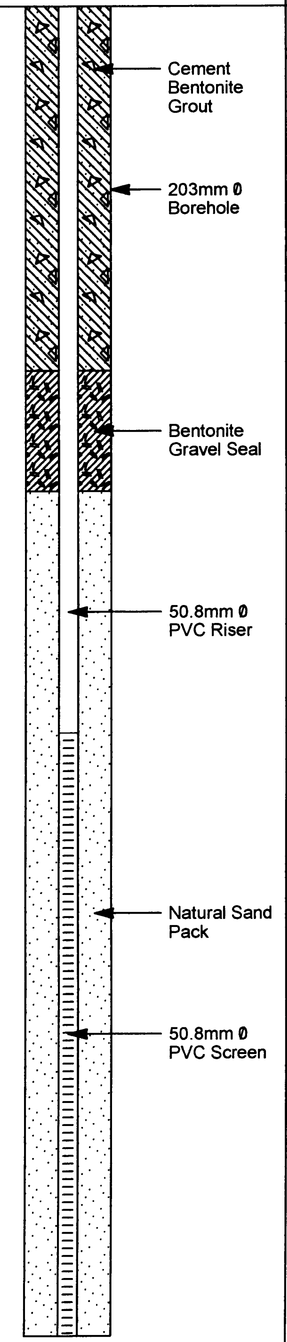
NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

# STRATIGRAPHIC AND INSTRUMENTATION LOG
# (OVERBURDEN)

PROJECT NAME: Nestle Waters
PROJECT NUMBER: 13764-25
CLIENT: Nestle Waters Canada
LOCATION: Station St, Hillsburgh, ON

HOLE DESIGNATION: MW11B-08
DATE COMPLETED: January 24, 2008
DRILLING METHOD: 4 1/4 ID HSA
FIELD PERSONNEL: N.Hinsperger

| DEPTH m BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | DEPTH m BGS | Monitoring Well | SAMPLE NUMBER | SAMPLE INTERVAL | SAMPLE REC (%) | SAMPLE 'N' VALUE |
|---|---|---|---|---|---|---|---|
| 7.5 | | | | | | | |
| 8.0 | | | | | | | |
| 8.5 | | | | | | | |
| 9.0 | | | | | | | |
| 9.5 | | | | | | | |
| 10.0 | | | | | | | |
| 10.5 | | | | | | | |
| 11.0 | | | | | | | |
| 11.5 | | | | | | | |
| 12.0 | | | | | | | |
| 12.5 | | | | | | | |
| 13.0 | | | | | | | |
| 13.5 | | | | | | | |
| | END OF BOREHOLE @ 13.72m BGS | 13.72 | | | | | |



WELL DETAILS
Screened interval:

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

# STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

PROJECT NAME: Nestle Waters
PROJECT NUMBER: 13764-25
CLIENT: Nestle Waters Canada
LOCATION: Station St, Hillsburgh, ON

HOLE DESIGNATION: MW11B-08
DATE COMPLETED: January 24, 2008
DRILLING METHOD: 4 1/4 ID HSA
FIELD PERSONNEL: N.Hinsperger

| DEPTH m BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | DEPTH m BGS | Monitoring Well | SAMPLE | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | NUMBER | INTERVAL | REC (%) | 'N' VALUE | |
| 14.5<br>15.0<br>15.5<br>16.0<br>16.5<br>17.0<br>17.5<br>18.0<br>18.5<br>19.0<br>19.5<br>20.0<br>20.5 | | | 10.67 to 13.72m BGS<br>Length: 3.05m<br>Diameter: 51mm<br>Slot Size: 10<br>Material: Schedule 40 PVC<br>Seal:<br>0.00 to 8.84m BGS<br>Material: Cement Bentonite Grout<br>Sand Pack:<br>9.45 to 13.72m BGS<br>Material: Natural Sand Pack | | | | | |

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

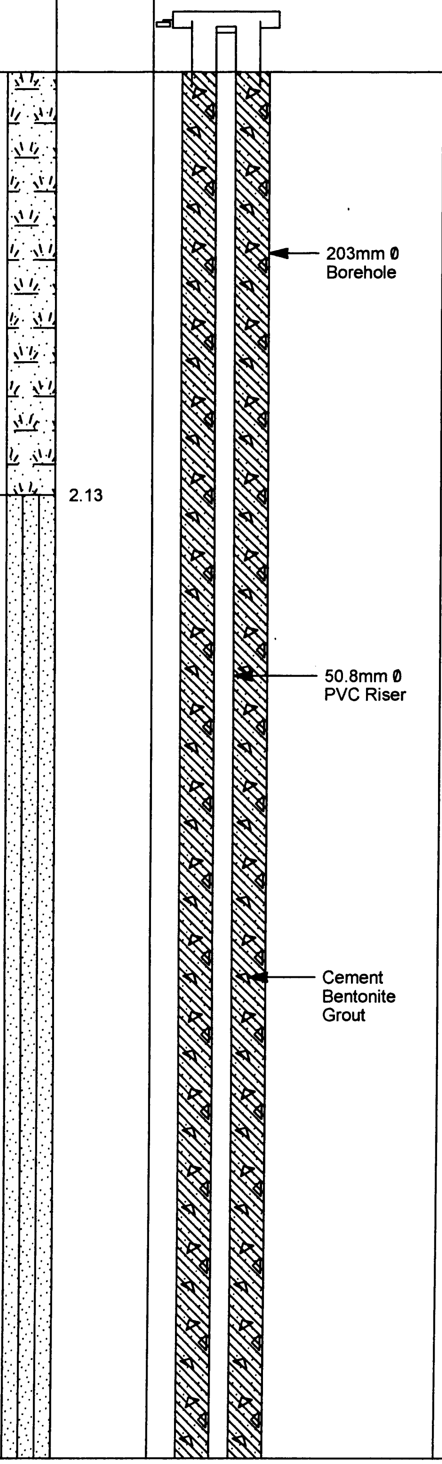
# STRATIGRAPHIC AND INSTRUMENTATION LOG
# (OVERBURDEN)

Page 1 of 7

PROJECT NAME: Nestle Waters
PROJECT NUMBER: 13764-25
CLIENT: Nestle Waters Canada
LOCATION: Station St, Hillsburgh, ON

HOLE DESIGNATION: MW12A-08
DATE COMPLETED: February 5, 2008
DRILLING METHOD: 4 1/4 ID HSA / HQ Wet Core
FIELD PERSONNEL: N.Hinsperger

| DEPTH m BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | DEPTH m BGS |
|---|---|---|
| | SM SAND (TOPSOIL) - trace silt, trace clay, fine to medium grained, poorly graded, dark brown, little oxidation, some rootlets | |
| 0.5 | | |
| 1.0 | | |
| 1.5 | | |
| 2.0 | | |
| | SM SAND - some clay, trace silt, medium grained, poorly graded, dark brown, moist to wet, some rootlets | 2.13 |
| 2.5 | | |
| 3.0 | | |
| 3.5 | | |
| 4.0 | | |
| 4.5 | - trace gravel, little red staining, little black staining at 4.57m BGS | |
| 5.0 | | |
| 5.5 | | |
| 6.0 | - brown, moist at 6.10m BGS | |
| 6.5 | | |



| SAMPLE NUMBER | INTERVAL | REC (%) | 'N' VALUE |
|---|---|---|---|
| 1 | ☒ | 0 | 50 |
| 2 | ☒ | 25 | 26 |
| 3 | ☒ | 5 | 50 |
| 4 | ☒ | 30 | 50 |
| 5 | ☒ | 5 | 50 |

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

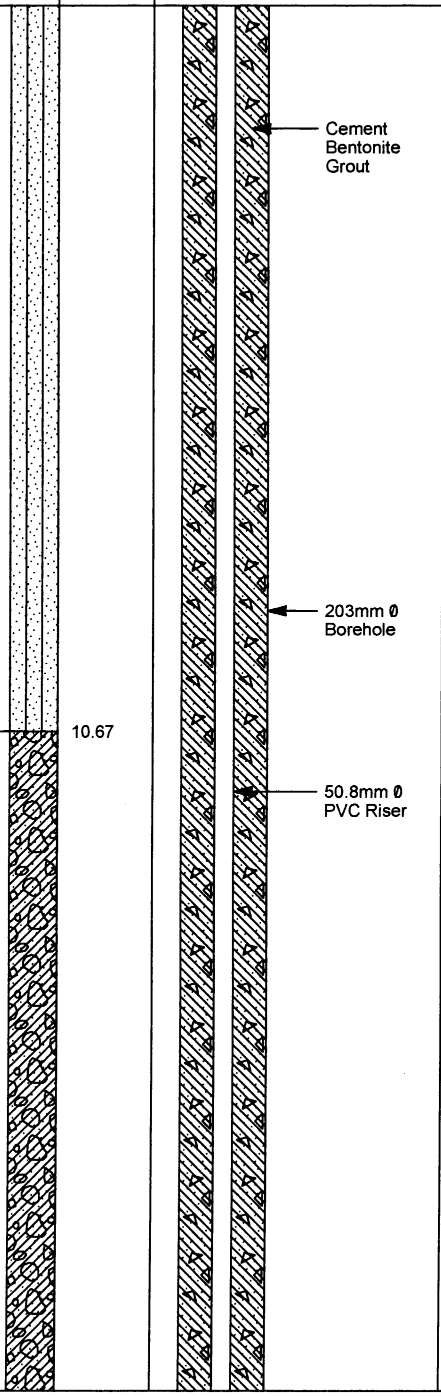
# STRATIGRAPHIC AND INSTRUMENTATION LOG
# (OVERBURDEN)

PROJECT NAME: Nestle Waters
PROJECT NUMBER: 13764-25
CLIENT: Nestle Waters Canada
LOCATION: Station St, Hillsburgh, ON

HOLE DESIGNATION: MW12A-08
DATE COMPLETED: February 5, 2008
DRILLING METHOD: 4 1/4 ID HSA / HQ Wet Core
FIELD PERSONNEL: N.Hinsperger

| DEPTH m BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | DEPTH m BGS |
|---|---|---|
| 7.5 | - with gravel, some oxidation at 7.62m BGS | |
| 8.0 | | |
| 8.5 | | |
| 9.0 | - with gravel at 9.14m BGS | |
| 9.5 | | |
| 10.0 | | |
| 10.5 | ML SILT (TILL) - some clay, trace sand, low plasticity, grey, moist | 10.67 |
| 11.0 | | |
| 11.5 | | |
| 12.0 | - some oxidation, moist to wet at 12.19m BGS | |
| 12.5 | - trace medium sand at 12.50m BGS | |
| 13.0 | | |
| 13.5 | - moist to wet at 13.92m BGS | |

Monitoring Well



SAMPLE

| NUMBER | INTERVAL | REC (%) | 'N' VALUE |
|---|---|---|---|
| 6 | ☒ | 25 | 50 |
| 7 | ☒ | 20 | 50 |
| 8 | ☒ | 50 | 50 |
| 9 | ☒ | 90 | 50 |
| | ☒ | | |

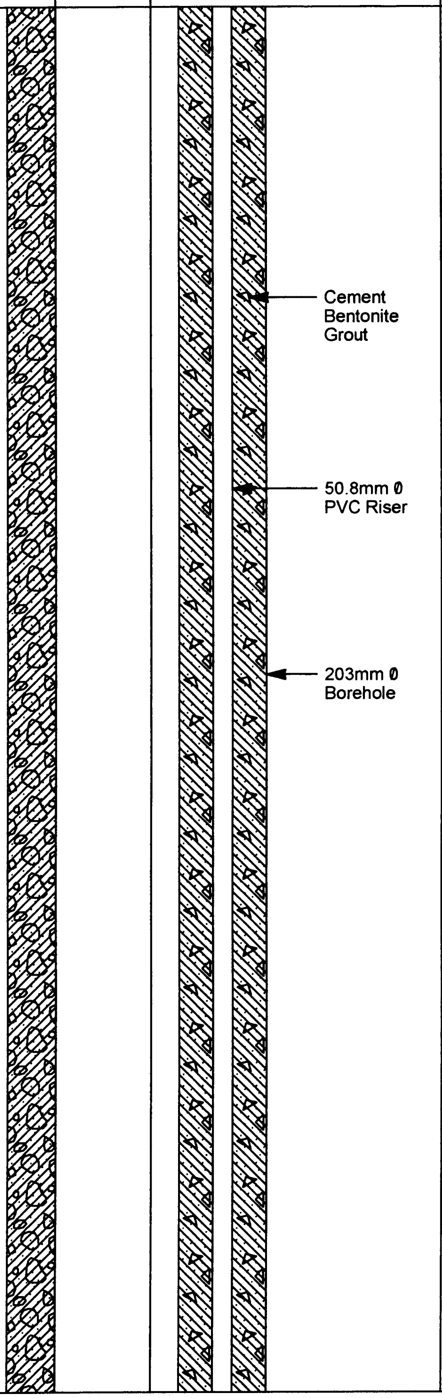
NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

# STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

PROJECT NAME: Nestle Waters
PROJECT NUMBER: 13764-25
CLIENT: Nestle Waters Canada
LOCATION: Station St, Hillsburgh, ON

HOLE DESIGNATION: MW12A-08
DATE COMPLETED: February 5, 2008
DRILLING METHOD: 4 1/4 ID HSA / HQ Wet Core
FIELD PERSONNEL: N.Hinsperger

| DEPTH m BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | DEPTH m BGS | Monitoring Well | SAMPLE | | | |
|---|---|---|---|---|---|---|---|
| | | | | NUMBER | INTERVAL | REC (%) | 'N' VALUE |
| | - some oxidation at 14.20m BGS | | | 10 | ☒ | 80 | 50 |
| 14.5 | | | | | | | |
| 15.0 | | | | | | | |
| | - moist to wet at 15.39m BGS | | | | | | |
| 15.5 | | | | 11 | ☒ | 75 | 50 |
| 16.0 | | | | | | | |
| 16.5 | | | | | | | |
| | - moist to wet at 16.76m BGS | | | | | | |
| 17.0 | | | | 12 | ☒ | 60 | 50 |
| 17.5 | | | | | | | |
| 18.0 | | | | | | | |
| | - moist to wet at 18.29m BGS | | | | | | |
| 18.5 | - with clay at 18.59m BGS | | | 13 | ☒ | 80 | 50 |
| 19.0 | | | | | | | |
| 19.5 | | | | | | | |
| 20.0 | - little oxidation at 20.12m BGS | | | 14 | ☒ | 100 | 50 |
| 20.5 | | | | | | | |



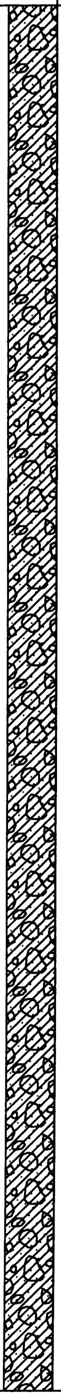
NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

# STRATIGRAPHIC AND INSTRUMENTATION LOG
# (OVERBURDEN)

PROJECT NAME: Nestle Waters
PROJECT NUMBER: 13764-25
CLIENT: Nestle Waters Canada
LOCATION: Station St, Hillsburgh, ON

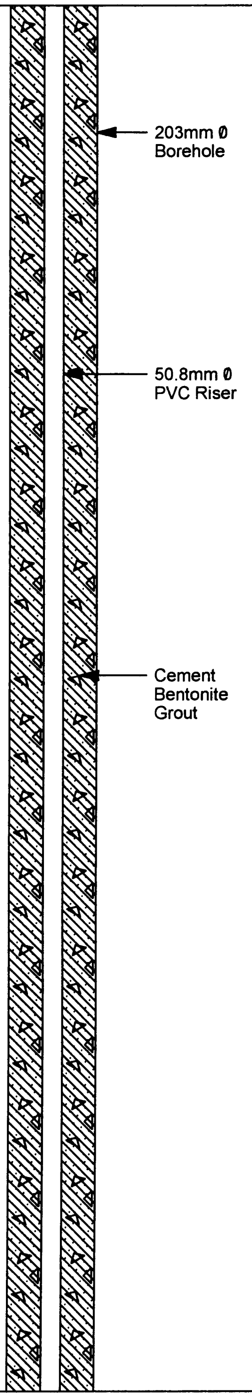
HOLE DESIGNATION: MW12A-08
DATE COMPLETED: February 5, 2008
DRILLING METHOD: 4 1/4 ID HSA / HQ Wet Core
FIELD PERSONNEL: N.Hinsperger

| DEPTH m BGS | STRATIGRAPHIC DESCRIPTION & REMARKS |
|---|---|
| 21.5 | - moist to wet, little red staining at 21.51m BGS |
| 22.0 | |
| 22.5 | |
| 23.0 | - medium grained sand seam at 23.14m BGS |
| 23.5 | |
| 24.0 | |
| 24.5 | - some black and red staining at 24.79m BGS |
| 25.0 | |
| 25.5 | |
| 26.0 | - thin medium sand seam at 26.24m BGS |
| 26.5 | |
| 27.0 | |
| 27.5 | - little oxidation, laminated at 27.84m BGS |



DEPTH m BGS

Monitoring Well



| SAMPLE | | | |
|---|---|---|---|
| NUMBER | INTERVAL | REC (%) | 'N' VALUE |
| 15 | ☒ | 80 | 50 |
| 16 | ☒ | 66 | 50 |
| 17 | ☒ | 66 | 50 |
| 18 | ☒ | 66 | 50 |
| 19 | ☒ | 60 | 50 |

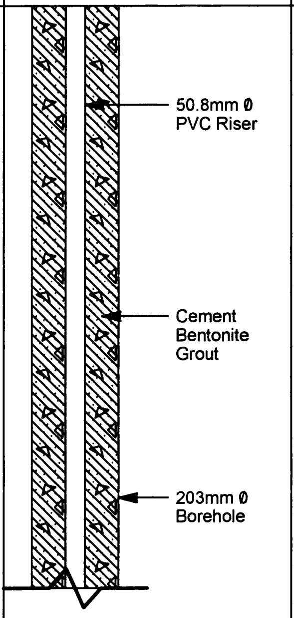
NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

# STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

PROJECT NAME: Nestle Waters
PROJECT NUMBER: 13764-25
CLIENT: Nestle Waters Canada
LOCATION: Station St, Hillsburgh, ON

HOLE DESIGNATION: MW12A-08
DATE COMPLETED: February 5, 2008
DRILLING METHOD: 4 1/4 ID HSA / HQ Wet Core
FIELD PERSONNEL: N.Hinsperger

| DEPTH m BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | DEPTH m BGS | Monitoring Well | SAMPLE NUMBER | SAMPLE INTERVAL | SAMPLE REC (%) | SAMPLE 'N' VALUE |
|---|---|---|---|---|---|---|---|
| 28.5 | | | | | | | |
| 29.0 | - some oxidation at 29.11m BGS | | | 20 | | 50 | 50 |
| 29.5 | | | | | | | |
| 30.0 | | | | | | | |
| 30.5 | - little oxidation at 30.66m BGS<br>- little black staining at 30.76m BGS<br>- trace medium sand at 30.89m BGS | | | 21 | | 66 | 50 |
| 31.0 | END OF OVERBURDEN HOLE @ 30.94m BGS | | | | | | |
| 31.5 | | | | | | | |
| 32.0 | | | | | | | |
| 32.5 | | | | | | | |
| 33.0 | | | | | | | |
| 33.5 | | | | | | | |
| 34.0 | | | | | | | |
| 34.5 | | | | | | | |



NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

# STRATIGRAPHIC AND INSTRUMENTATION LOG
# (BEDROCK)

PROJECT NAME: Nestle Waters
PROJECT NUMBER: 13764-25
CLIENT: Nestle Waters Canada
LOCATION: Station St, Hillsburgh, ON

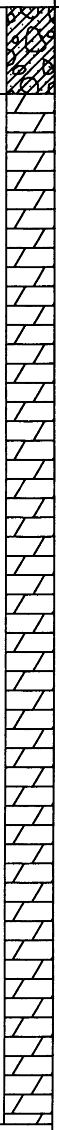
HOLE DESIGNATION: MW12A-08
DATE COMPLETED: February 5, 2008
DRILLING METHOD: 4 1/4 ID HSA / HQ Wet Core
FIELD PERSONNEL: N.Hinsperger

DEPTH m BGS: 31.0, 31.5, 32.0, 32.5, 33.0, 33.5, 34.0, 34.5, 35.0, 35.5, 36.0, 36.5, 37.0

**STRATIGRAPHIC DESCRIPTION & REMARKS**

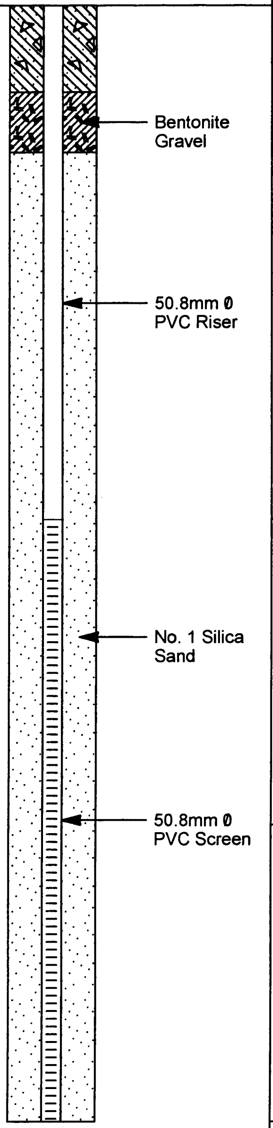
- little oxidation at 30.66m BGS
- little black staining at 30.76m BGS
- trace medium sand at 30.89m BGS

DOLOSTONE (GUELPH FORMATION) - moderately fractured, moderately weathered, frequent thin stylolite beds, slightly vuggy
- horizontal fracture, some sand infilling, some black staining at 31.14m BGS
- horizontal fracture, some sand infilling at 31.29m BGS
- highly fractured, some white mineralization, some calcite nodules at 31.37m BGS
- horizontal fracture, some sand infilling at 31.75m BGS
- horizontal fracture at 31.78m BGS
- vuggy at 31.80m BGS
- horizontal fracture at 31.98m BGS
- horizontal fracture at 32.16m BGS
- horizontal fracture at 32.17m BGS
- vug with sand infilling at 32.21m BGS
- horizontal fracture at 32.41m BGS
- white mineralization at 32.43m BGS
- horizontal fracture at 32.46m BGS
- vuggy at 32.49m BGS
- horizontal fracture at 32.78m BGS
- vuggy from 32.79 to 32.92m BGS
- horizontal fracture at 45° at 32.92m BGS
- horizontal fracture at 33.28m BGS
- vuggy from 33.45 to 33.70m BGS
- horizontal fracture at 33.74m BGS
- horizontal fracture at 33.78m BGS
- horizontal fracture at 33.82m BGS
- horizontal fracture at 33.88m BGS
- horizontal fracture at 34.03m BGS
- verticle fracture with some oxidation from 34.14 to 34.28m BGS
- horizontal fracture at 34.28m BGS
- horizontal fracture with some sand infilling at 34.37m BGS
- highly porous at 34.82m BGS
- highly porous at 34.85m BGS
- highly porous at 34.90m BGS
- horizontal fracture, some sand infilling, some black staining, some white mineralization at 35.20m BGS
- horizontal fracture, some sand infilling, some white mineralization at 35.33m BGS
- horizontal fracture, some sand infilling, some black staining at 35.46m BGS
- horizontal fracture, some sand infilling, white mineralization at 35.51m BGS
- occasional fossils from 35.51 to 35.56m BGS
- highly fractured, white mineralization at 35.61m BGS
- horizontal fracture, some sand infilling at



DEPTH m BGS: 30.94, 36.14

**Monitoring Well**



WELL DETAILS
Screened interval:
33.10 to 36.14m BGS
Length: 3.05m
Diameter: 51mm
Slot Size: 10
Material: Schedule 40 PVC
Seal:
0.00 to 30.94m BGS
Material: Cement Bentonite Grout
Sand Pack:

| RUN NUMBER | CORE RECOVERY % | RQD % |
|---|---|---|
| 1 | 100 | 88 |
| 2 | 100 | 95 |
| 3 | 100 | 87 |
| 4 | 100 | 90 |

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

# STRATIGRAPHIC AND INSTRUMENTATION LOG
# (BEDROCK)

PROJECT NAME: Nestle Waters
PROJECT NUMBER: 13764-25
CLIENT: Nestle Waters Canada
LOCATION: Station St, Hillsburgh, ON

HOLE DESIGNATION: MW12A-08
DATE COMPLETED: February 5, 2008
DRILLING METHOD: 4 1/4 ID HSA / HQ Wet Core
FIELD PERSONNEL: N.Hinsperger

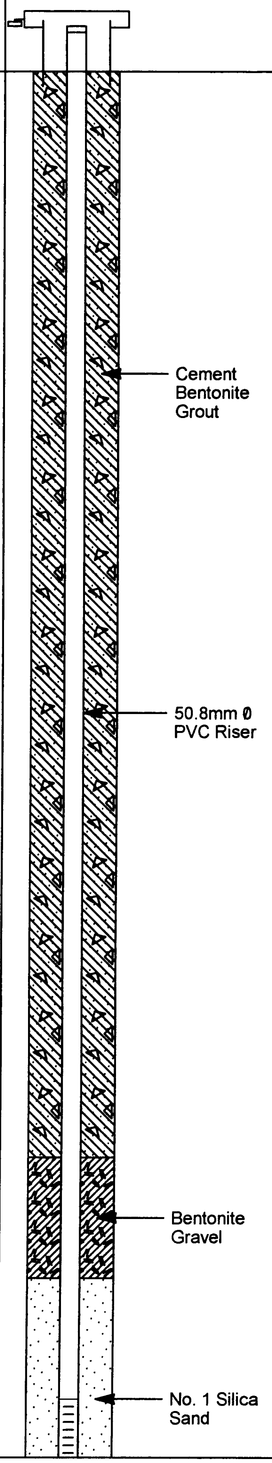
| DEPTH m BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | DEPTH m BGS | Monitoring Well | RUN NUMBER | CORE RECOVERY % | RQD % | |
|---|---|---|---|---|---|---|---|
| | 35.64m BGS<br>END OF BOREHOLE @ 36.14m BGS | | 31.24 to 36.14m BGS<br>Material: No. 1 Silica Sand | | | | |
| 38.0 | | | | | | | |
| 38.5 | | | | | | | |
| 39.0 | | | | | | | |
| 39.5 | | | | | | | |
| 40.0 | | | | | | | |
| 40.5 | | | | | | | |
| 41.0 | | | | | | | |
| 41.5 | | | | | | | |
| 42.0 | | | | | | | |
| 42.5 | | | | | | | |
| 43.0 | | | | | | | |
| 43.5 | | | | | | | |
| 44.0 | | | | | | | |

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

# STRATIGRAPHIC AND INSTRUMENTATION LOG
# (OVERBURDEN)

PROJECT NAME: Nestle Waters
PROJECT NUMBER: 13764-25
CLIENT: Nestle Waters Canada
LOCATION: Station St, Hillsburgh, ON

HOLE DESIGNATION: MW12B-08
DATE COMPLETED: February 6, 2008
DRILLING METHOD: 4 1/4 ID HSA
FIELD PERSONNEL: N.Hinsperger

| DEPTH m BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | DEPTH m BGS | Monitoring Well | SAMPLE |  |  |  |
|---|---|---|---|---|---|---|---|
|  |  |  |  | NUMBER | INTERVAL | REC (%) | 'N' VALUE |
|  | See Stratigraphy from MW12A-08 advanced on January 31, 2008 |  |  |  |  |  |  |
| 0.5 |  |  |  |  |  |  |  |
| 1.0 |  |  |  |  |  |  |  |
| 1.5 |  |  |  |  |  |  |  |
| 2.0 |  |  |  |  |  |  |  |
| 2.5 |  |  |  |  |  |  |  |
| 3.0 |  |  |  |  |  |  |  |
| 3.5 |  |  |  |  |  |  |  |
| 4.0 |  |  |  |  |  |  |  |
| 4.5 |  |  |  |  |  |  |  |
| 5.0 |  |  |  |  |  |  |  |
| 5.5 |  |  |  |  |  |  |  |
| 6.0 |  |  |  |  |  |  |  |
| 6.5 |  |  |  |  |  |  |  |

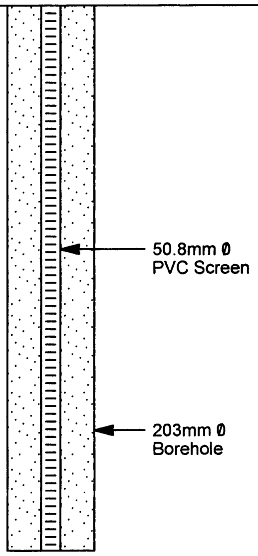
NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

OVERBURDEN LOG 13764-25.GPJ CRA_CORP.GDT 4/7/08

# STRATIGRAPHIC AND INSTRUMENTATION LOG
# (OVERBURDEN)

PROJECT NAME: Nestle Waters
PROJECT NUMBER: 13764-25
CLIENT: Nestle Waters Canada
LOCATION: Station St, Hillsburgh, ON

HOLE DESIGNATION: MW12B-08
DATE COMPLETED: February 6, 2008
DRILLING METHOD: 4 1/4 ID HSA
FIELD PERSONNEL: N.Hinsperger

| DEPTH m BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | DEPTH m BGS | Monitoring Well | SAMPLE NUMBER | SAMPLE INTERVAL | SAMPLE REC (%) | SAMPLE 'N' VALUE |
|---|---|---|---|---|---|---|---|
| 7.5 | | |  | | | | |
| 8.0 | | | | | | | |
| 8.5 | | | | | | | |
| 9.0 | | | | | | | |
| 9.5 | | | | | | | |
| | END OF BOREHOLE @ 9.75m BGS | 9.75 | WELL DETAILS<br>Screened interval:<br>6.71 to 9.75m BGS<br>Length: 3.05m<br>Diameter: 51mm<br>Slot Size: 10<br>Material: Schedule 40 PVC<br>Seal:<br>0.00 to 5.49m BGS<br>Material: Cement Bentonite Grout<br>Sand Pack:<br>6.10 to 9.75m BGS<br>Material: No. 1 Silica Sand | | | | |
| 10.0 | | | | | | | |
| 10.5 | | | | | | | |
| 11.0 | | | | | | | |
| 11.5 | | | | | | | |
| 12.0 | | | | | | | |
| 12.5 | | | | | | | |
| 13.0 | | | | | | | |
| 13.5 | | | | | | | |

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

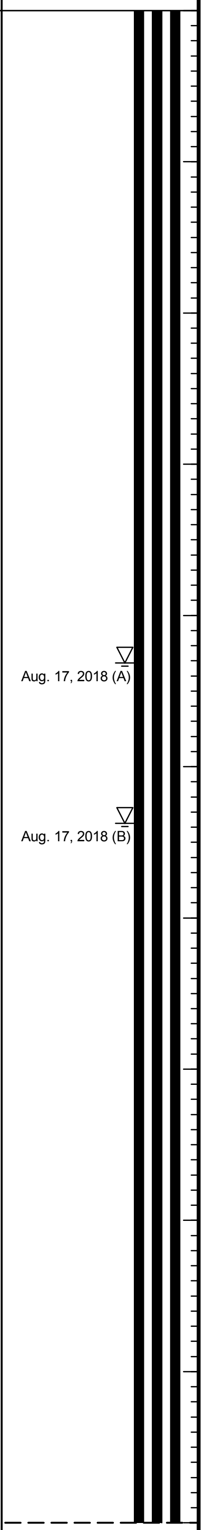
PROJECT: 13-1152-0250
LOCATION: N 4848306; E 568928 (approximate)

# RECORD OF BOREHOLE: MW01-18

BORING DATE: August 12 to 13, 2018

SHEET 1 OF 3
DATUM: Ground
STICKUP: A 0.44 m
B 0.54 m

| DEPTH SCALE METRES | BORING METHOD | SOIL PROFILE DESCRIPTION | STRATA PLOT | ELEV. DEPTH (m) | SAMPLES NUMBER | TYPE | BLOWS/0.3m | DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m 20 40 60 80<br>SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ 20 40 60 80 | HYDRAULIC CONDUCTIVITY, k, cm/s $10^{-6}$ $10^{-5}$ $10^{-4}$ $10^{-3}$<br>WATER CONTENT PERCENT Wp ⊢—○W—⊣ Wl 10 20 30 40 | ADDITIONAL LAB. TESTING | PIEZOMETER OR STANDPIPE INSTALLATION |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | GROUND SURFACE | | | | | | | | | |
| 0 | Mud Rotary Tricone | FILL - CLAYEY SAND | | 0.00 | | | | | | | |
| 2 | | SILTY to SANDY GRAVEL | | 1.83 | | | | | | | |
| 14 | | SILTY SAND with GRAVEL; (TILL) | | 14.02 | | | | | | | |
| 20 | | *CONTINUED NEXT PAGE* | | | | | | | | | |



DEPTH SCALE
1 : 100

GOLDER

LOGGED: PGM
CHECKED: GRP

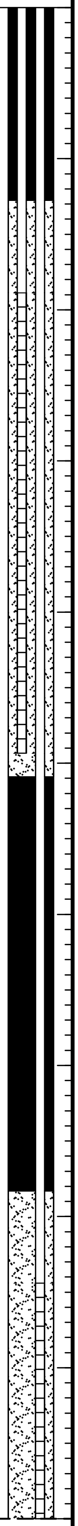
PROJECT: 13-1152-0250
LOCATION: N 4848306; E 568928 (approximate)

# RECORD OF BOREHOLE: MW01-18

BORING DATE: August 12 to 13, 2018

SHEET 2 OF 3
DATUM: Ground
STICKUP: A 0.44 m
B 0.54 m

| DEPTH SCALE METRES | BORING METHOD | SOIL PROFILE: DESCRIPTION | STRATA PLOT | ELEV. DEPTH (m) | SAMPLES: NUMBER | TYPE | BLOWS/0.3m | DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m 20 40 60 80; SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ 20 40 60 80 | HYDRAULIC CONDUCTIVITY, k, cm/s $10^{-6}$ $10^{-5}$ $10^{-4}$ $10^{-3}$; WATER CONTENT PERCENT Wp ⊢—○W—⊣ Wl 10 20 30 40 | ADDITIONAL LAB. TESTING | PIEZOMETER OR STANDPIPE INSTALLATION |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | *--- CONTINUED FROM PREVIOUS PAGE ---* | | | | | | | | | |
| 20 | Mud Rotary Tricone | SILTY SAND with GRAVEL; (TILL) | | | | | | | | | |
| | | DOLOSTONE; brown and grey, interbedded | | 20.73 | | | | | | | |
| 22 | | | | | | | | | | | |
| 24 | Air Rotary Ballistic Carbide Head | Fractures observed from 24.4 to 25.2 m | | | | | | | | | |
| 26 | | DOLOSTONE; medium to dark brown | | 26.21 | | | | | | | Screen B |
| 28 | | | | | | | | | | | |
| 30 | | | | | | | | | | | |
| 32 | | | | | | | | | | | |
| 34 | | Fractures observed at 34.7, 37.2 to 37.8 m | | | | | | | | | |
| 36 | | | | | | | | | | | |
| 38 | | | | | | | | | | | Screen A |
| 40 | | *CONTINUED NEXT PAGE* | | | | | | | | | |



GTA-BHS 001 T:\PROJECTS\2013\13-1152-0250 (NWC, SOUTH ONTARIO)\LOG\13-1152-0250.GPJ GAL-MIS.GDT 02/20/19 KS

DEPTH SCALE
1 : 100

GOLDER

LOGGED: PGM
CHECKED: GRP

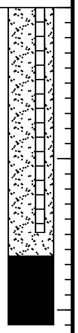
PROJECT: 13-1152-0250
LOCATION: N 4848306; E 568928 (approximate)

# RECORD OF BOREHOLE: MW01-18

BORING DATE: August 12 to 13, 2018

SHEET 3 OF 3
DATUM: Ground
STICKUP: A 0.44 m
B 0.54 m

| DEPTH SCALE METRES | BORING METHOD | SOIL PROFILE: DESCRIPTION | STRATA PLOT | ELEV. DEPTH (m) | SAMPLES: NUMBER | TYPE | BLOWS/0.3m | DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m 20 40 60 80 / SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ 20 40 60 80 | HYDRAULIC CONDUCTIVITY, k, cm/s $10^{-6}$ $10^{-5}$ $10^{-4}$ $10^{-3}$ / WATER CONTENT PERCENT Wp ⊢—○W—⊣ Wl 10 20 30 40 | ADDITIONAL LAB. TESTING | PIEZOMETER OR STANDPIPE INSTALLATION |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | *--- CONTINUED FROM PREVIOUS PAGE ---* | | | | | | | | | |
| 40 | Air Rotary Ballistic Carbide Head | DOLOSTONE; medium to dark brown<br>Vugs observed at 40.8 m | | | | | | | | | Screen A |
| 42 | | DOLOSTONE; dark grey to black | | 42.37 | | | | | | | |
| 44 | | END OF BOREHOLE | | 44.20 | | | | | | | |
| 46 | | | | | | | | | | | |
| 48 | | | | | | | | | | | |
| 50 | | | | | | | | | | | |
| 52 | | | | | | | | | | | |
| 54 | | | | | | | | | | | |
| 56 | | | | | | | | | | | |
| 58 | | | | | | | | | | | |
| 60 | | | | | | | | | | | |



Notes:
- 6” diameter steel casing to 22.56 mbgs
- Screen B 2” diameter schedule 40 PVC 10 slot screen from 23.77 mbgs to 29.87 mbgs
- Screen A 2” diameter schedule 40 PVC 10 slot screen from 36.88 mbgs to 42.98 mbgs
- Sand pack from 22.56 mbgs to 30.18 mbgs and from 35.66 mbgs to 43.28 mbgs
- Bentonite seal to 22.56 mbgs, from 30.18 mbgs to 35.66 mbgs, and from 43.28 mbgs to 44.20 mbgs within the 6” diameter open hole or 6“ diameter steel casing
- Bentonite and cement grout in annular space outside 6” diameter steel casing from 1 mbgs to 22.56 mbgs
- Cement in annular space outside 6” diameter steel casing to 1 mbgs

DEPTH SCALE
1 : 100

GOLDER

LOGGED: PGM
CHECKED: GRP

# TABLE B1
# MECP WATER WELL RECORDS
# WITHIN 1 km OF TW1-88

| Well ID | Date Completed | Depth (metres) | Well Status | Well Use |
|---|---|---|---|---|
| 6700676 | 12/12/1958 | 24.4 | Water Supply | Livestock |
| 6700678 | 10/18/1965 | 35.1 | Water Supply | Livestock |
| 6700679 | 8/22/1966 | 28.3 | Water Supply | Domestic |
| 6700712 | 3/21/1966 | 39.6 | Water Supply | Domestic |
| 6703077 | 4/5/1968 | 32 | Water Supply | Domestic |
| 6703362 | 3/12/1969 | 32 | Water Supply | Domestic |
| 6703528 | 8/5/1969 | 54.9 | Water Supply | Domestic |
| 6703896 | 4/1/1971 | 50.3 | Water Supply | Domestic |
| 6703960 | 7/17/1971 | 38.1 | Water Supply | Livestock |
| 6704115 | 12/10/1971 | 30.5 | Water Supply | Domestic |
| 6705153 | 1/12/1974 | 50.3 | Water Supply | Domestic |
| 6705612 | 10/10/1974 | 41.1 | Water Supply | Domestic |
| 6706900 | 4/29/1978 | 60 | Water Supply | Domestic |
| 6708146 | 11/21/1984 | 44.8 | Water Supply | Domestic |
| 6708346 | 7/24/1985 | 35.4 | Water Supply | Domestic |
| 6708388 | 12/14/1985 | 41.1 | Water Supply | Domestic |
| 6708389 | 5/9/1985 | 41.1 | Water Supply | Domestic |
| 6708720 | 9/18/1986 | 42.7 | Water Supply | Domestic |
| 6709050 | 11/30/1987 | 57 | Water Supply | Domestic |
| 6709207 | 11/28/1987 | 59.4 | Water Supply | Domestic |
| 6709530 | 9/15/1988 | 30.5 | Water Supply | Domestic |
| 6709532 | 9/16/1988 | 23.5 | Water Supply | Domestic |
| 6709533 | 9/14/1988 | 22.9 | Water Supply | Domestic |
| 6709537 | 5/30/1988 | 39.6 | Water Supply | Domestic |
| 6709548 | 11/25/1988 | 39.3 | Water Supply | Domestic |
| 6710154 | 4/18/1989 | 32 | Water Supply | Domestic |
| 6710228 | 8/17/1989 | 27.4 | Water Supply | Domestic |
| 6710806 | 7/24/1991 | 25.6 | Water Supply | Domestic |
| 6711344 | 11/29/1993 | 45.1 | Water Supply | Domestic |
| 6712147 | 7/26/1996 | 35.1 | Water Supply | Domestic |
| 6713603 | 11/22/2000 | 29.6 | Water Supply | Domestic |
| 6714186 | 8/28/2002 | 29.6 | Water Supply | Domestic |
| 6714441 | 3/21/2003 | 38.7 | Water Supply | Domestic |
| 6714803 | 12/17/2003 | 43.3 | Water Supply | Domestic |
| 6714872 | 4/1/2004 | 48.7 | Water Supply | Domestic |
| 6714873 | 4/13/2004 | 24.4 | Water Supply | Domestic |
| 6715290 | 3/22/2005 | 27.4 | Observation Wells | Not Used |
| 6715291 | 3/23/2005 | 13.7 | Observation Wells | Not Used |
| 6715772 | 6/15/2006 | 30.5 | Water Supply | Domestic |
| 6715802 | 6/22/2006 | 0 | Abandoned-Other | NULL |
| 6715910 | 9/6/2006 | 30.5 | Water Supply | Domestic |
| 6716003 | 10/5/2006 | 48.5 | Water Supply | Domestic |

# TABLE B1
# MECP WATER WELL RECORDS
# WITHIN 1 km OF TW1-88

| Well ID | Date Completed | Depth (metres) | Well Status | Well Use |
|---|---|---|---|---|
| 7043354 | 3/26/2007 | 13.7 | Water Supply | Commerical |
| 7105350 | 5/5/2008 | 0 | Abandoned-Other | NULL |
| 7111993 | 2/21/2008 | 36 | Observation Wells | Not Used |
| 7111994 | 1/20/2008 | 32 | Observation Wells | Not Used |
| 7118031 | 9/25/2008 | 44.8 | Water Supply | Domestic |
| 7125694 | 6/2/2009 | 25 | Water Supply | Domestic |
| 7142658 | 11/26/2009 | 15.2 | NULL | Not Used |
| 7142659 | 11/27/2009 | 14.3 | Observation Wells | Not Used |
| 7142660 | 11/30/2009 | 13.1 | Observation Wells | Not Used |
| 7142661 | 12/1/2001 | 11 | Observation Wells | Not Used |
| 7142662 | 12/4/2009 | 52.1 | Observation Wells | Not Used |
| 7156653 | 11/22/2010 | 39 | Water Supply | Commerical |
| 7170392 | 9/2/2011 | 37.2 | Water Supply | Domestic |
| 7179274 | 1/31/2012 | 0 | NULL | NULL |
| 7200165 | 3/25/2013 | 0 | Abandoned-Quality | NULL |
| 7221467 | 4/22/2014 | 6 | Abandoned-Other | NULL |
| 7221469 | 4/22/2014 | 0 | Abandoned-Other | NULL |
| 7221471 | 4/28/2014 | 38.5 | Abandoned-Other | NULL |

# TABLE B2
# PRIVATE WELL SURVEY

| Well ID | Notes From First Visit On June 21, 2018 | Completed Survey |
|---|---|---|
| 6714873 | Nestle Property, no survey | not applicable |
| 7170392 | Gated house - left letter in mailbox | no |
| 6714803 | Left letter in door | yes (mailed) |
| 6716003 | Gated house - left letter in mailbox | no |
| 7125694 | Owner does not want to participate | no |

Note: A second visit was not completed since the houses were gated.

Nestlé Waters
CANADA

June 21, 2018

**RE: NOTICE OF PRIVATE WATER SUPPLY WELL SURVEY
ERIN**

Dear Homeowner,

Nestlé Waters Canada (Nestlé) has retained Golder Associates Ltd. (Golder) to conduct a hydrogeological assessment as part of the Permit To Take Water renewal process for the well located at 9313 Station Street, Erin, Ontario. Nestlé produces bottled water from two sources; one in Aberfoyle and one in Erin. The water takings are governed by Ministry of the Environment and Climate Change (MOECC) Permits to Take Water. As part of the renewal process, a technical study is required to be submitted with the application. The technical study requires a well survey to identify existing water users in the study area. A survey of private wells was completed during previous testing at the site and the objective of this reconnaissance survey is to update previous work by identifying newly constructed wells in the study area. Water levels in some of the private wells are currently monitored as part of Nestlé's monitoring program.

As part of the investigation, Golder Associates Ltd. (on behalf of Nestlé) is conducting a survey of private wells in the area to obtain information on well details and water quality. The attached questionnaire requests basic information about your water well including details of the well construction, observations of water quality and quantity, and any issues or concerns you may have regarding your water supply. Unfortunately we missed you at the time of our door-to-door visits and would still like to offer you the opportunity to contribute. Please find attached to this letter a copy of the questionnaire.

The following options are available to return the completed form to us:

- By Person: Please contact Kurt Stamm of Golder at (647) 280-9463 to arrange a face-to-face meeting;
- By Mail: Please use the self-addressed envelope to mail in the completed form;
- By Phone: Please contact Greg Padusenko of Golder at (519) 620-8182 x6509 or Kurt Stamm at (519) 620-8182 x6524 to complete the questionnaire;
- By E-mail: Please scan your completed form and e-mail it to gpadusenko@golder.com; or
- By Fax: Please fax your completed form to (519) 620-9878, attention Greg Padusenko.

We ask that you return the completed form by July 6, 2018.

If available, please include a copy of your water well record with the questionnaire.

The information will be used as part of an assessment of water well use in the area and will be shared with Nestlé and the MOECC. We thank you for your participation in this exercise. If you have any questions on the questionnaire please feel free to contact Greg Padusenko or Kurt Stamm at the number above.

Should you have any further questions, comments or concerns, please do not hesitate to contact me at your earliest convenience by telephone at (519) 767-6422, Ext. 6422, or via email at andreanne.simard@waters.nestle.com.

Yours truly,

Andreanne Simard, Ph.D.
Natural Resources Manager
Nestlé Waters Canada

# Water Well Reconnaissance Survey

## Owner of Well:

Name: ______________________________ Telephone (Bus.): __________

Address: ______________________________ Telephone (Home): __________

Person Interviewed: ______________________________ Date: __________

Interviewed By: ______________________________ Time: __________

## Occupant of House Served by Well: (if other than owner)

Name: ______________________________ Telephone (Bus.): __________

Address: ______________________________ Telephone (Home): __________

## Well Construction Details:

Date Constructed: ____________________ Use: ____________________

Contractor: ____________________ Type (drilled or dug): ____________________

Diameter: ____________________ Well Depth: ____________________

Is well accessible for direct sampling? Or buried? ______________________________

Screen: Yes / No If yes, length: __________m Depth of top of screen: __________m

## Well Water Levels: (indicate whether measured from ground level or from top of casing)

Original water level depth: ____________m

Subsequent water level measurements (give depths in metres and dates): ____________________

______________________________________________________________

## Pumping Equipment:

Pump type: suction lift / positive submergence / other Age: ____________

Depth of intake setting: __________m Pumping rate: __________L/s

Storage tank type: ____________________ Capacity: ____________

Do you have a: Chlorinator: Yes / No Water Softener: Yes / No Water Filter: Yes / No

Water Use: Domestic: Yes / No Number of people using water from well: __________

Pool: Yes / No Lawn watering: Yes / No

Other uses: ______________________________________________

Private Waste and Water Disposal Type (septic, etc.): ________________________________________

Distance to well: ____________m Well is: uphill / downhill / same grade

## Previous Problems:

How long have you owned, operated or lived on this property? ________________________________

Have you ever experienced any <u>previous</u> problems with your well? ______________________________

If so, when? ________________________________________________________________________

What was the cause of the previous problem? Drought: ____________ Pump Failure:

Increased Usage: ____________ Interference: ____________ Contamination:

If problem was contamination, what water quality changes were apparent? (note any differences in taste, odour, colour or clarity) ________________________________________________________________

What action was taken to overcome the problem? ________________________________________

________________________________________________________________________________

What were the effects of this problem? ______________________________________________

|  |  |  |
|---|---|---|
| Did you ever have your well: | deepened | yes / no |
|  | or cleaned | yes / no |
|  | or a new well constructed | yes / no |

If so, why? _________________________________________________________________________

Outline briefly any previous repairs or changes in pumping equipment and dates:

________________________________________________________________________________

________________________________________________________________________________

________________________________________________________________________________

**Location Sketch:**

**Notes:**

## APPENDIX C

# Transmissivity Analysis

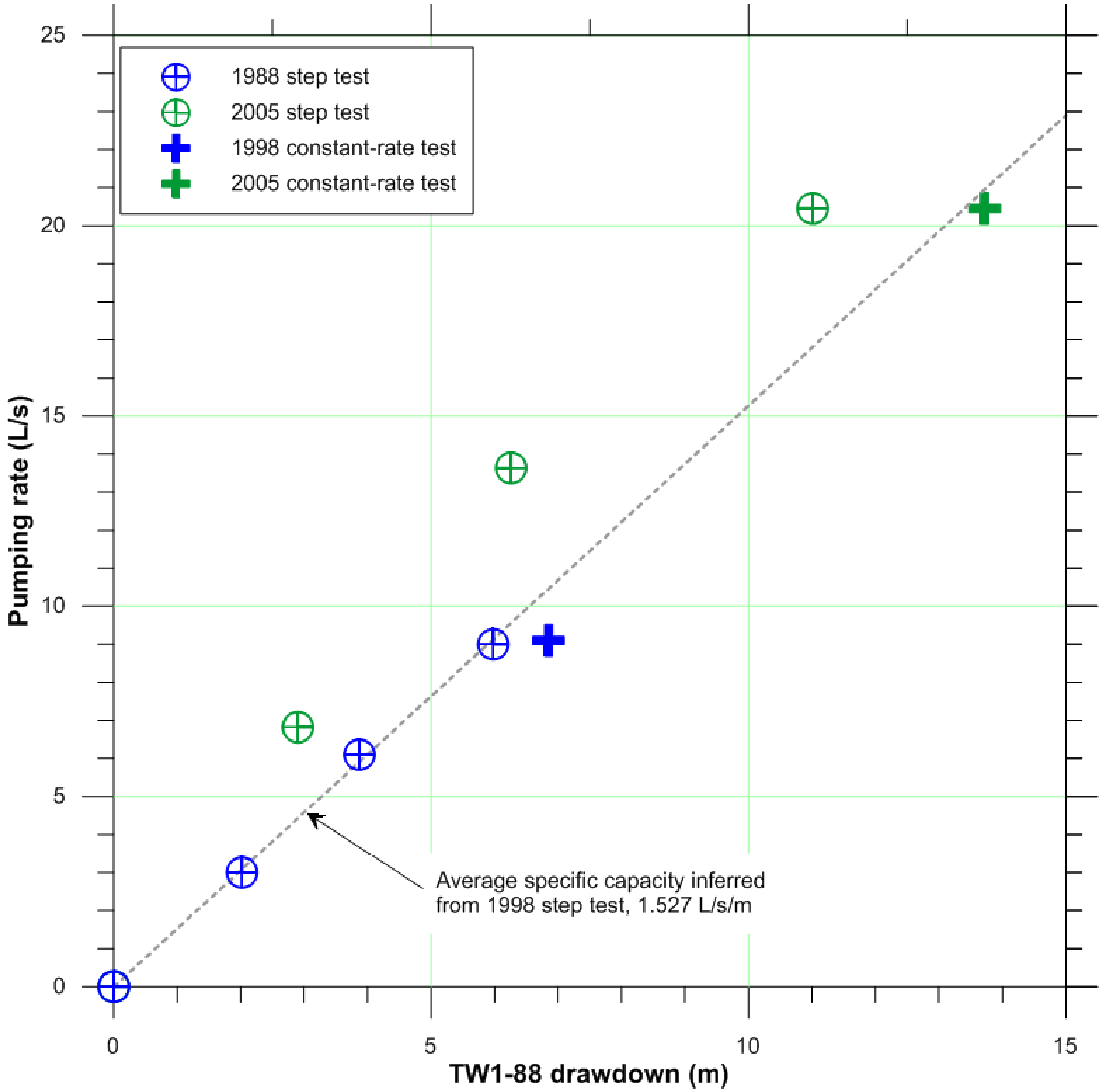
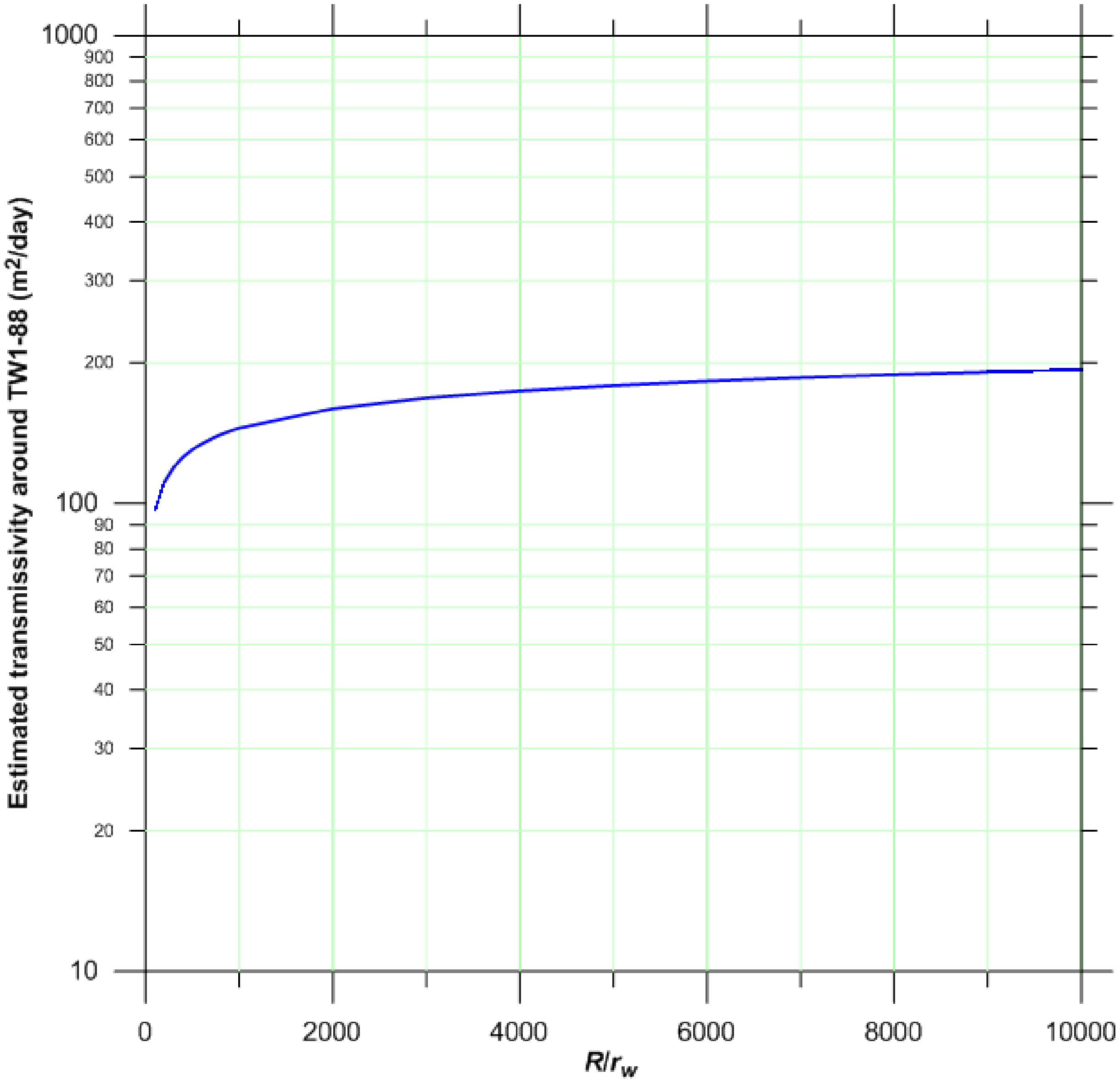


Figure C1

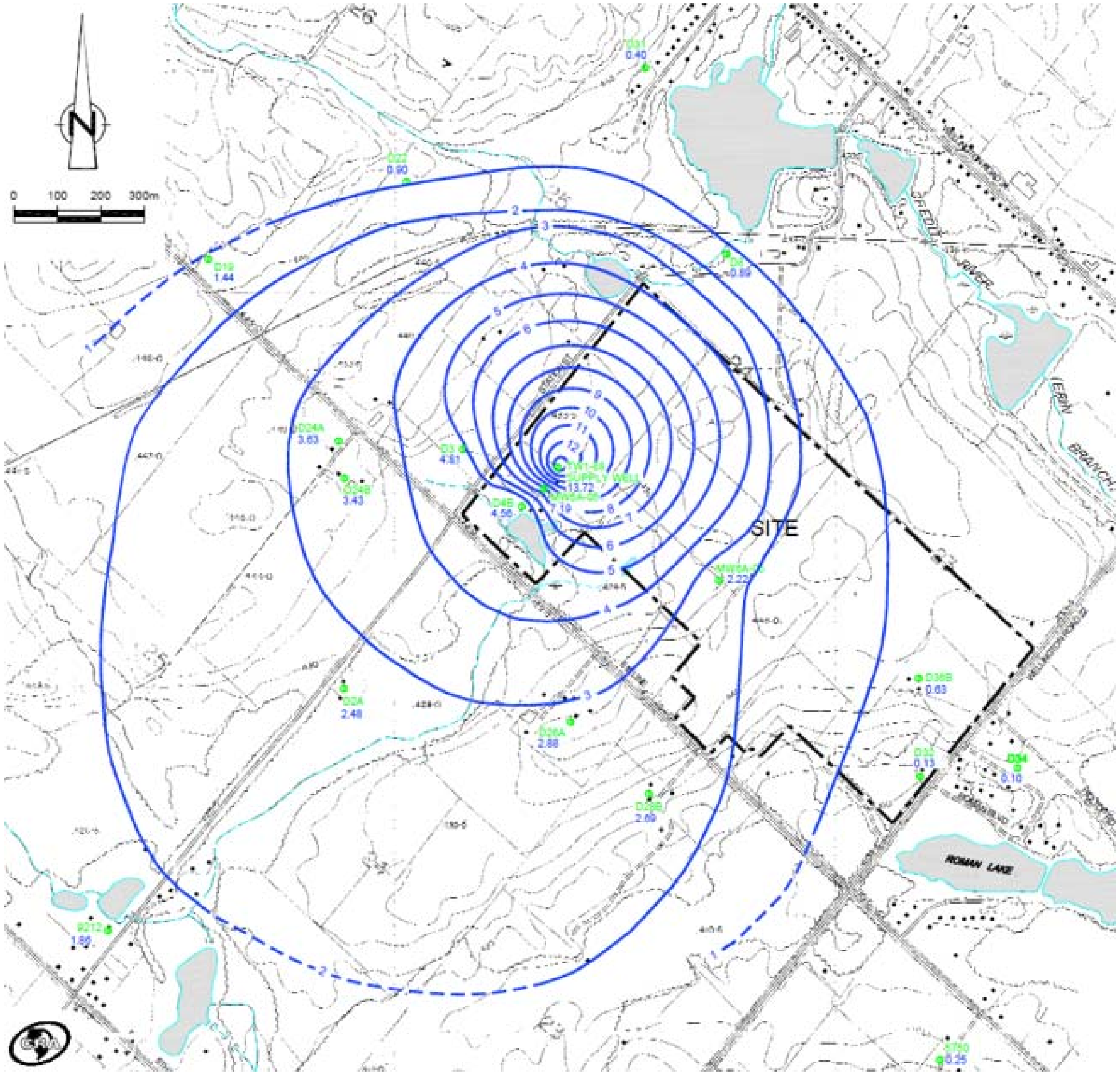
Summary of TW1-88 performance during 1988 and 2005 step and constant-rate pumping tests



GOLDER

Figure C2

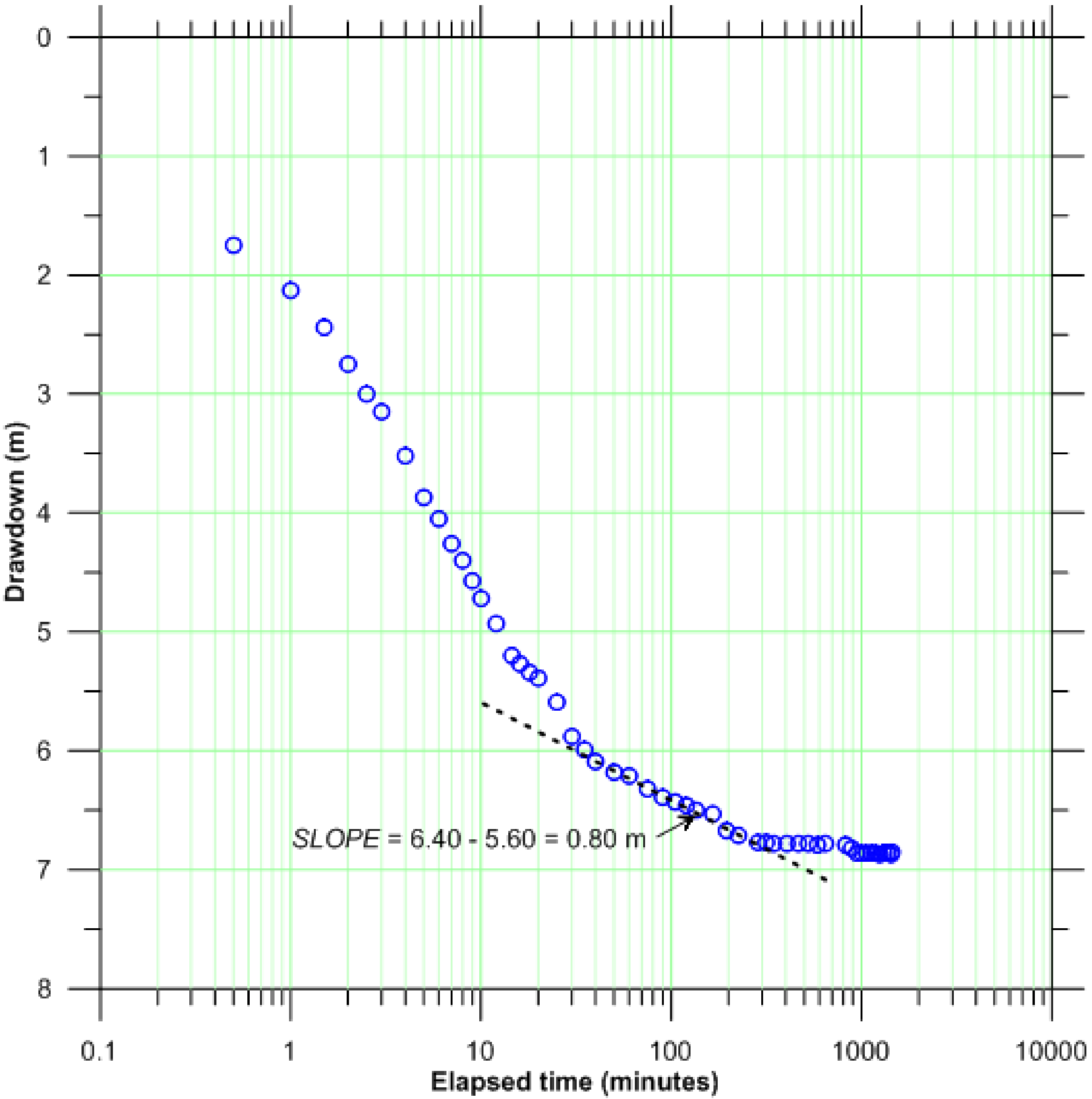
Estimation of transmissivity at
TW1-88 from the Thiem solution



GOLDER

Figure C3

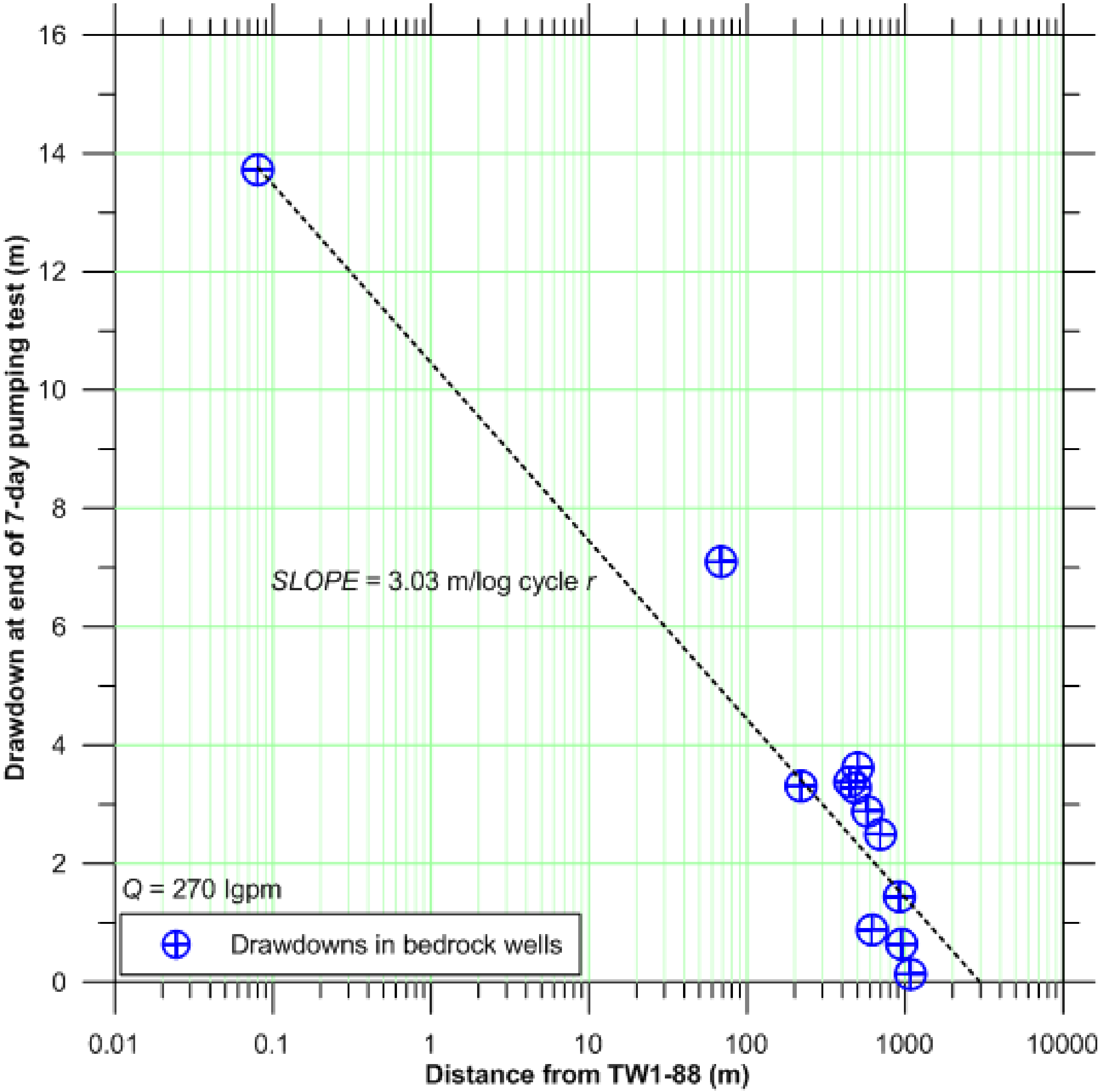
Drawdown in the bedrock after 7 days of pumping at 270 Igpm, November 3-10, 2005 (reproduced from CRA, 2006, Figure 6.7)



GOLDER

Figure C4

Cooper-Jacob analysis of the TW1-88 drawdowns during the 1988 constant-rate pumping test



GOLDER

Figure C5

Cooper-Jacob distance-drawdown analysis at the end of the 2005 7-day constant-rate pumping test

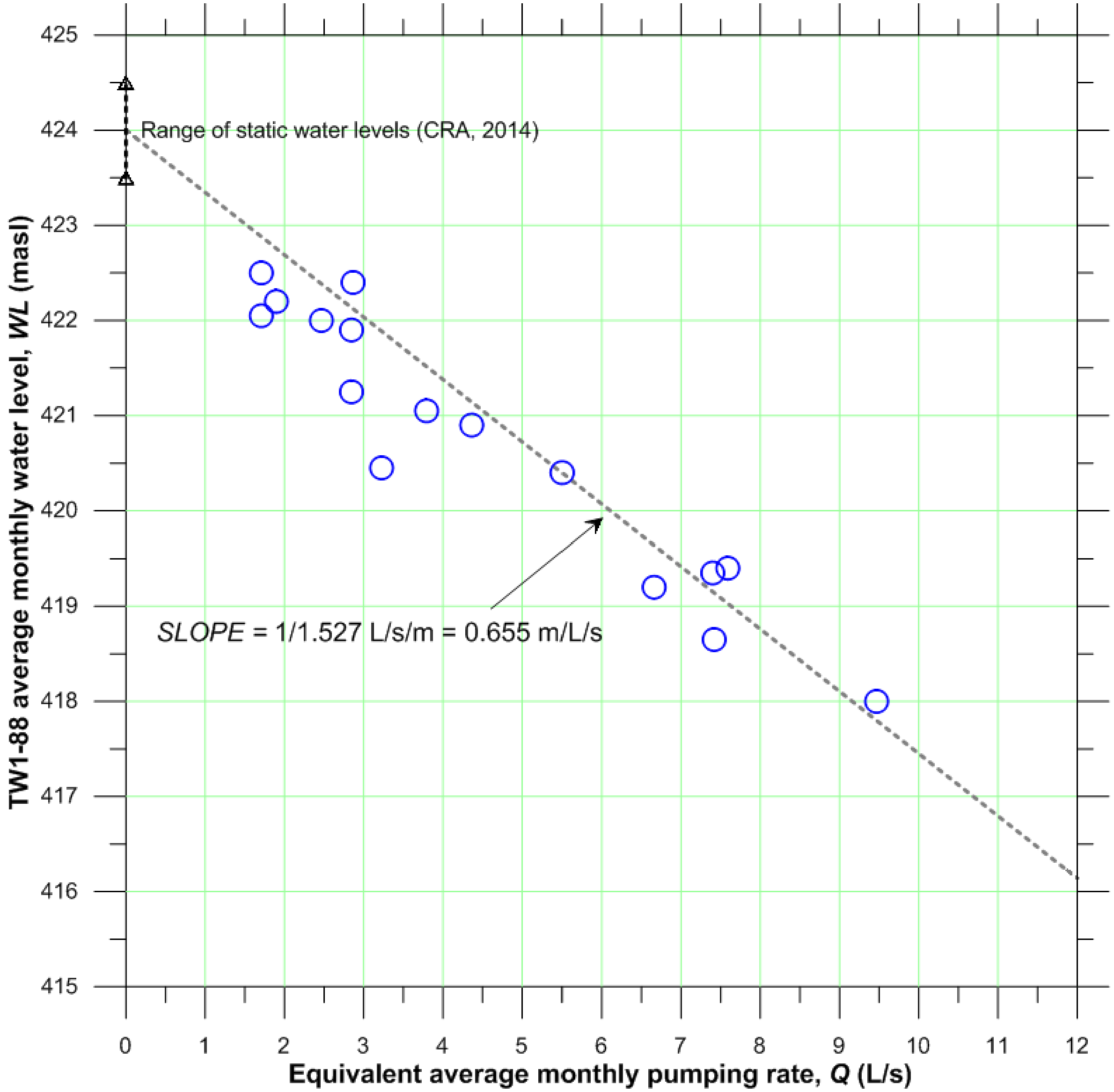
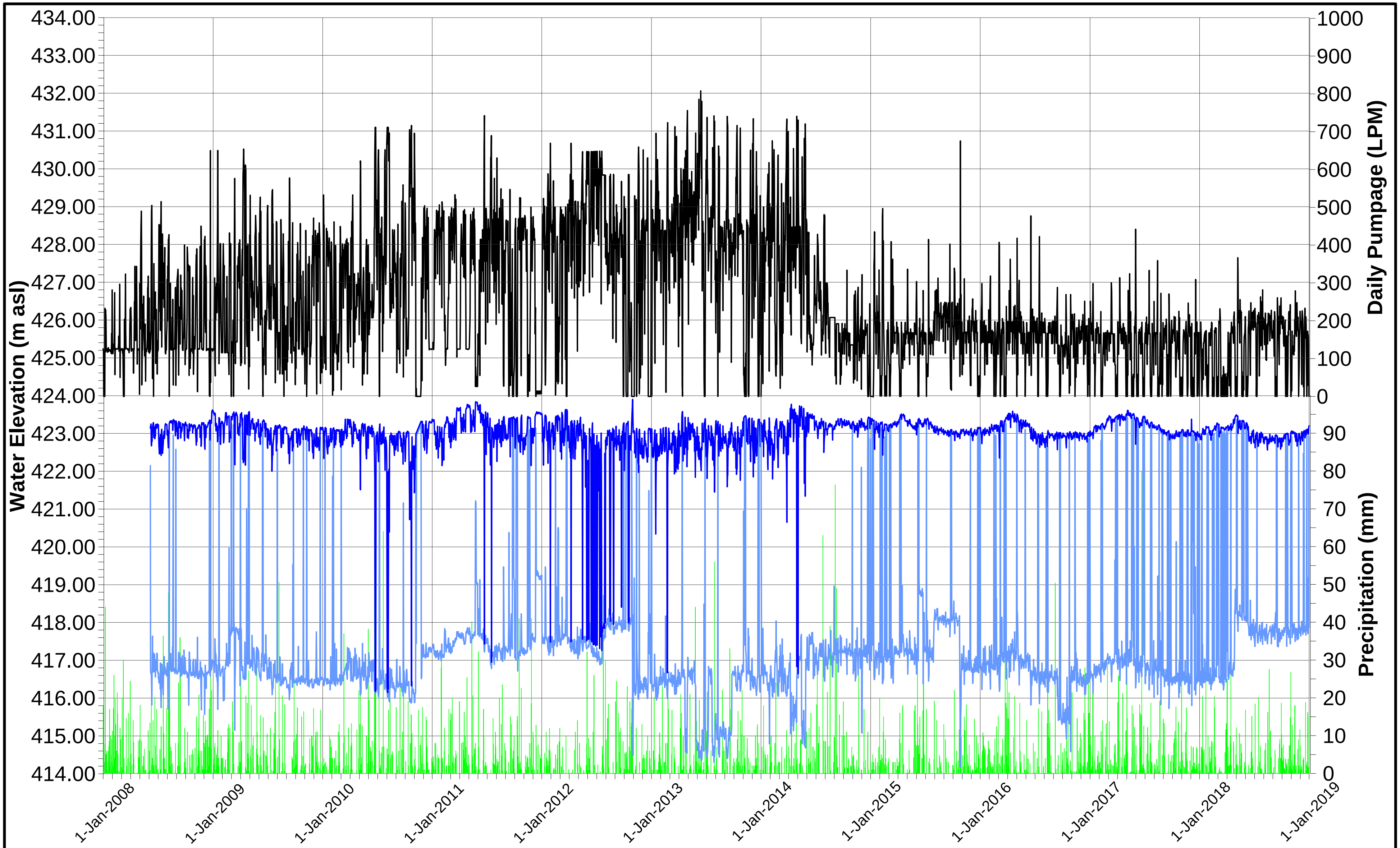


Figure C6

Specific capacity inferred from the 1988 and 2005 testing superimposed on the average monthly TW1-88 performance data

## APPENDIX D

# Groundwater Hydrographs



🟩 Precipitation
— Daily Pumpage (LPM)
— TW1-88 Daily Max
— TW1-88 Daily Min

GOLDER

| | |
|---|---|
| **DATE** | DECEMBER 2018 |
| **DESIGN** | KS |
| **REVIEW** | GP |
| **APPROVED** | GP |

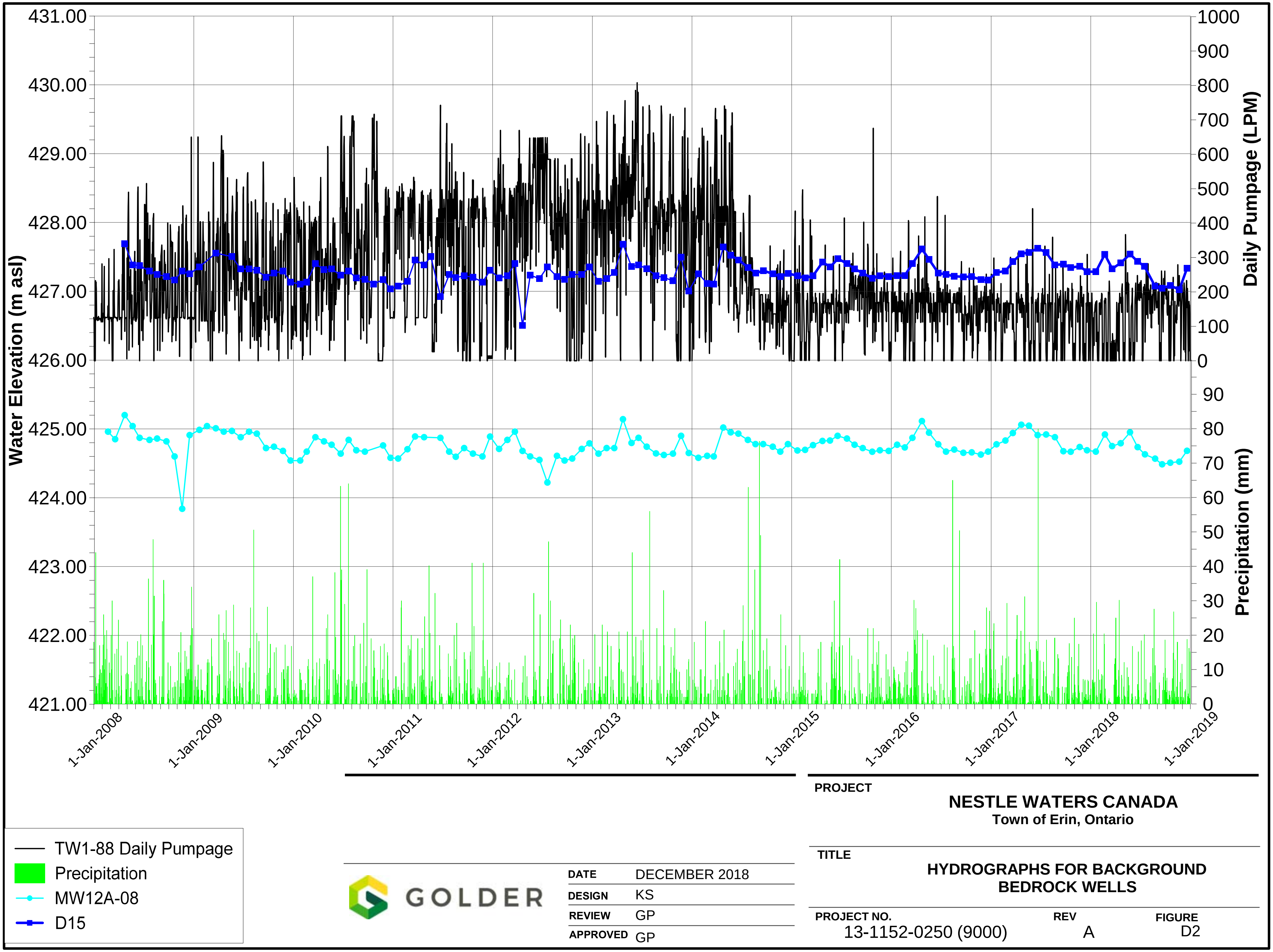
**PROJECT**

**NESTLE WATERS CANADA**
**Town of Erin, Ontario**

**TITLE**

**HYDROGRAPH FOR TW1-88**

| **PROJECT NO.** | **REV** | **FIGURE** |
|---|---|---|
| 13-1152-0250 (9000) | A | D1 |



GOLDER

| | |
|---|---|
| DATE | DECEMBER 2018 |
| DESIGN | KS |
| REVIEW | GP |
| APPROVED | GP |

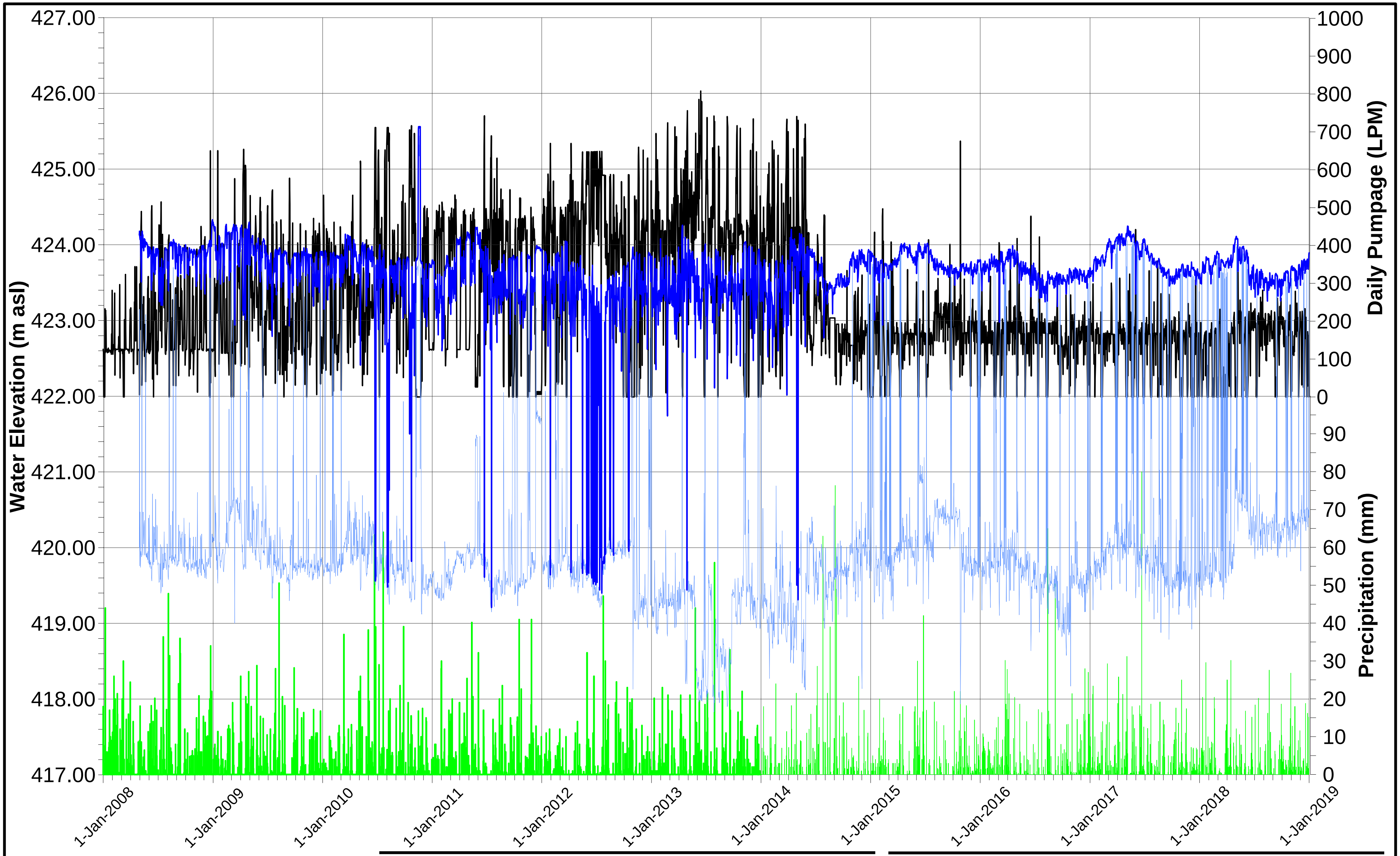
PROJECT

**NESTLE WATERS CANADA**
**Town of Erin, Ontario**

TITLE

**HYDROGRAPHS FOR BACKGROUND BEDROCK WELLS**

| PROJECT NO. | REV | FIGURE |
|---|---|---|
| 13-1152-0250 (9000) | A | D2 |



| | |
|---|---|
| — | TW1-88 Daily Pumpage |
| 🟩 | Precipitation |
| — | MW5A-05 Daily Max |
| — | MW5A-05 Daily Min |

GOLDER

| | |
|---|---|
| DATE | DECEMBER 2018 |
| DESIGN | KS |
| REVIEW | GP |
| APPROVED | GP |

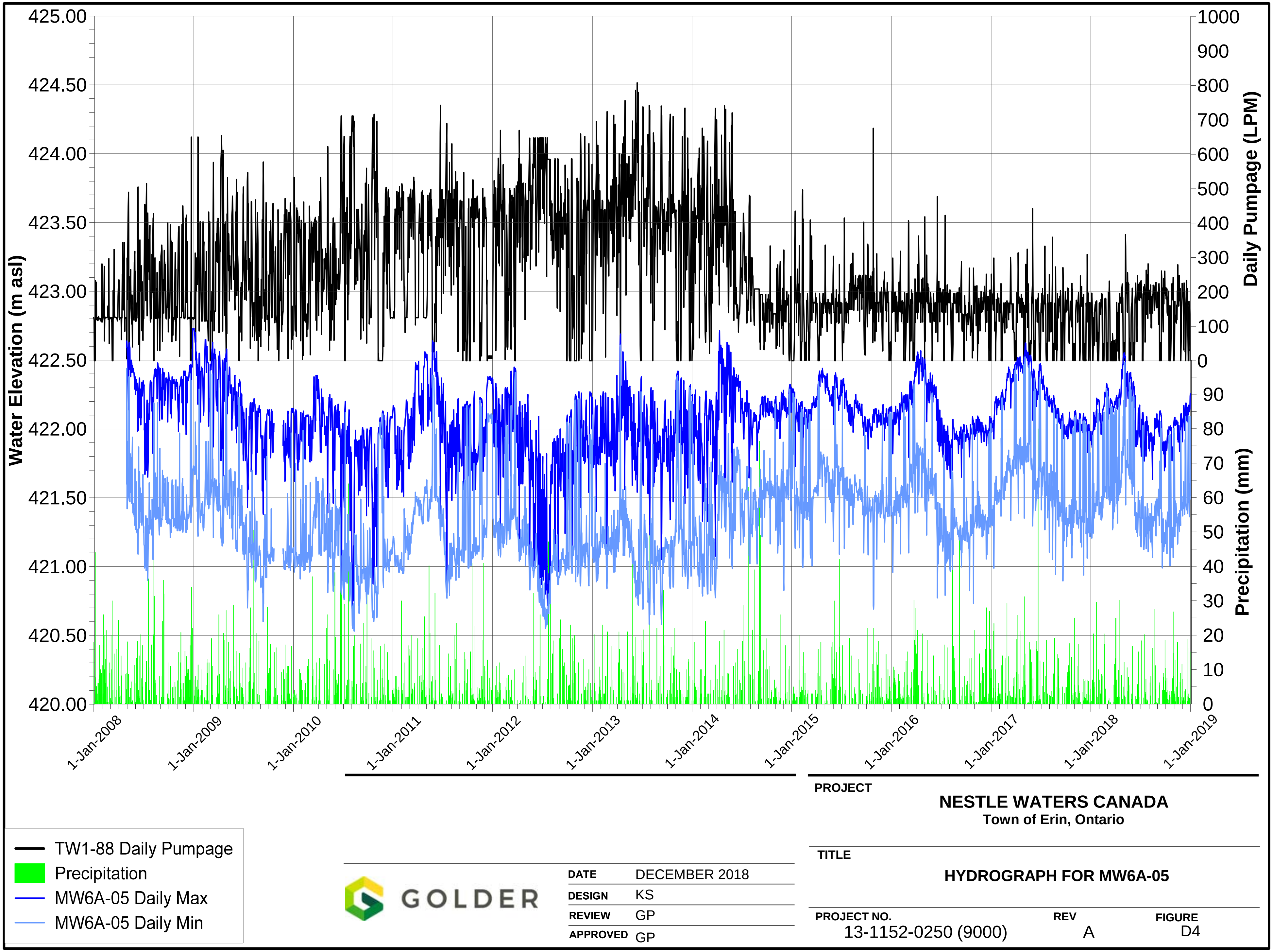
PROJECT

**NESTLE WATERS CANADA**
**Town of Erin, Ontario**

TITLE

**HYDROGRAPH FOR MW5A-05**

| PROJECT NO. | REV | FIGURE |
|---|---|---|
| 13-1152-0250 (9000) | A | D3 |



GOLDER

| | |
|---|---|
| DATE | DECEMBER 2018 |
| DESIGN | KS |
| REVIEW | GP |
| APPROVED | GP |

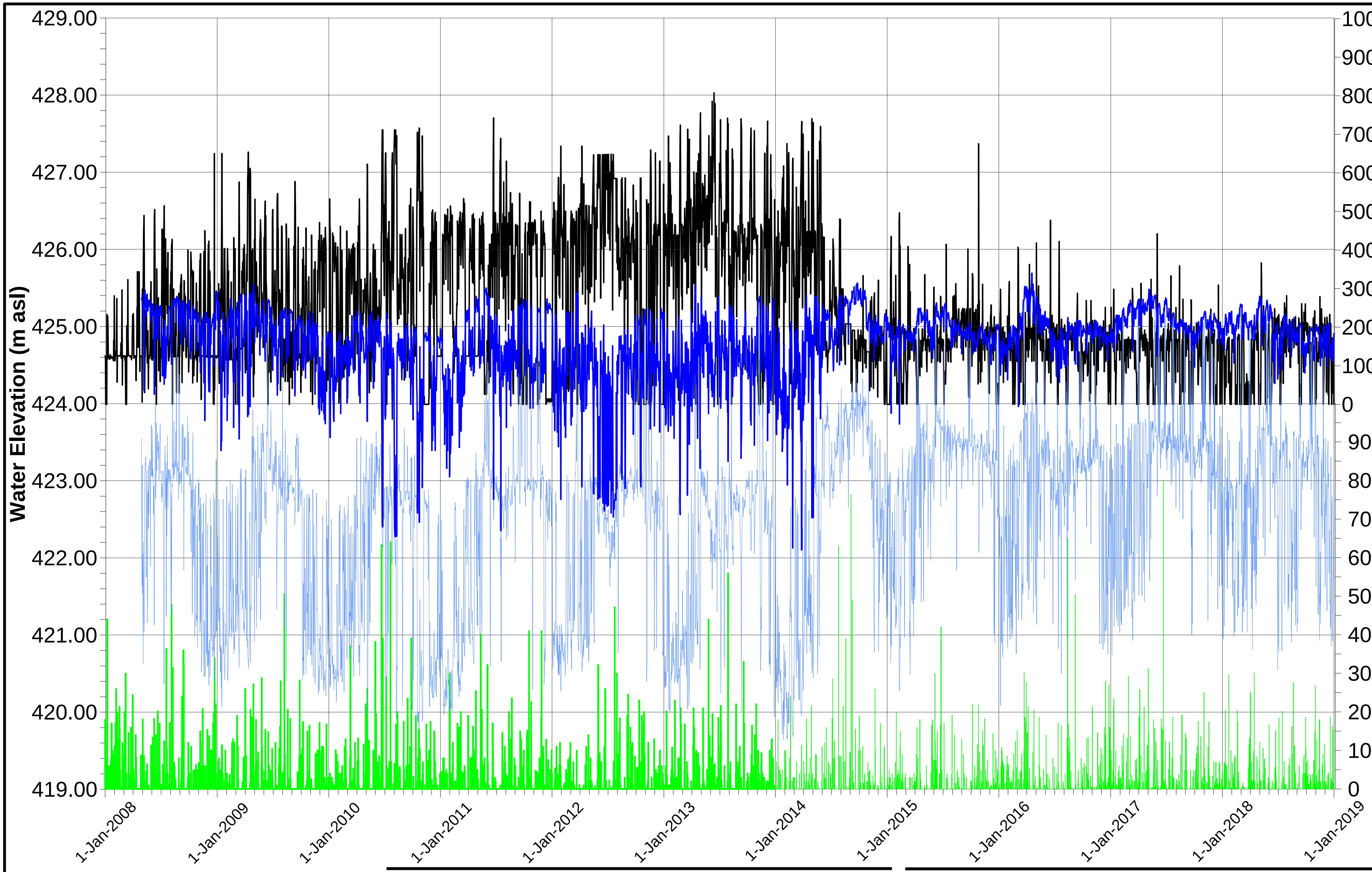
PROJECT

**NESTLE WATERS CANADA**
**Town of Erin, Ontario**

TITLE

**HYDROGRAPH FOR MW6A-05**

| PROJECT NO. | REV | FIGURE |
|---|---|---|
| 13-1152-0250 (9000) | A | D4 |



| | |
|---|---|
| — | TW1-88 Daily Pumpage |
| 🟩 | Precipitation |
| — | D3 Daily Max |
| — | D3 Daily Min |

**PROJECT**

**NESTLE WATERS CANADA**
**Town of Erin, Ontario**

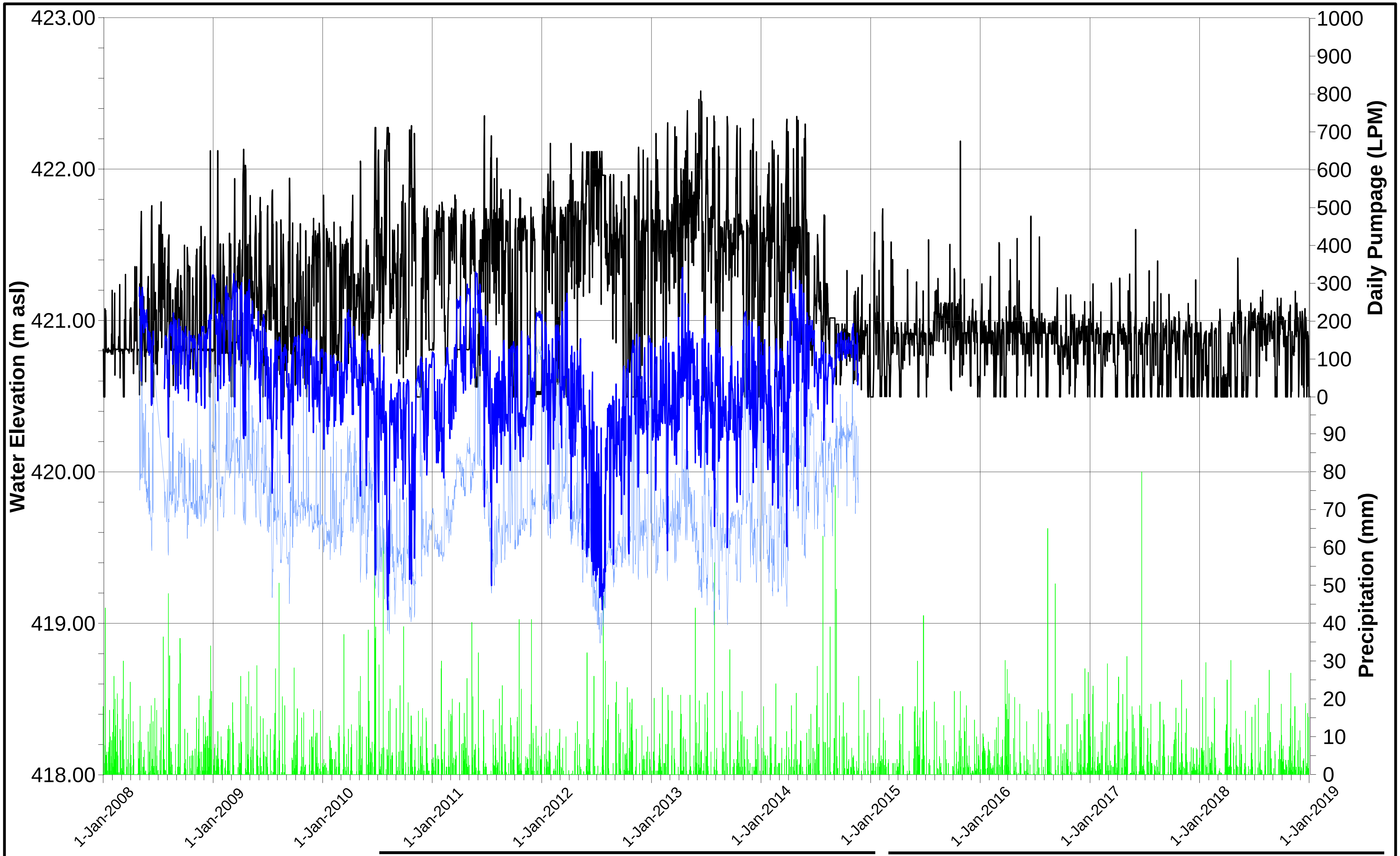
**TITLE**

**HYDROGRAPH FOR D3**

GOLDER

| | |
|---|---|
| **DATE** | DECEMBER 2018 |
| **DESIGN** | KS |
| **REVIEW** | GP |
| **APPROVED** | GP |

| **PROJECT NO.** | **REV** | **FIGURE** |
|---|---|---|
| 13-1152-0250 (9000) | A | D5 |



| | |
|---|---|
| — | TW1-88 Daily Pumpage |
| 🟩 | Precipitation |
| — | D2A Daily Max |
| — | D2A Daily Min |

**NOTE:**
The homeowner at D2A is no longer participating
in the monitoring program.

GOLDER

| | |
|---|---|
| DATE | DECEMBER 2018 |
| DESIGN | KS |
| REVIEW | GP |
| APPROVED | GP |

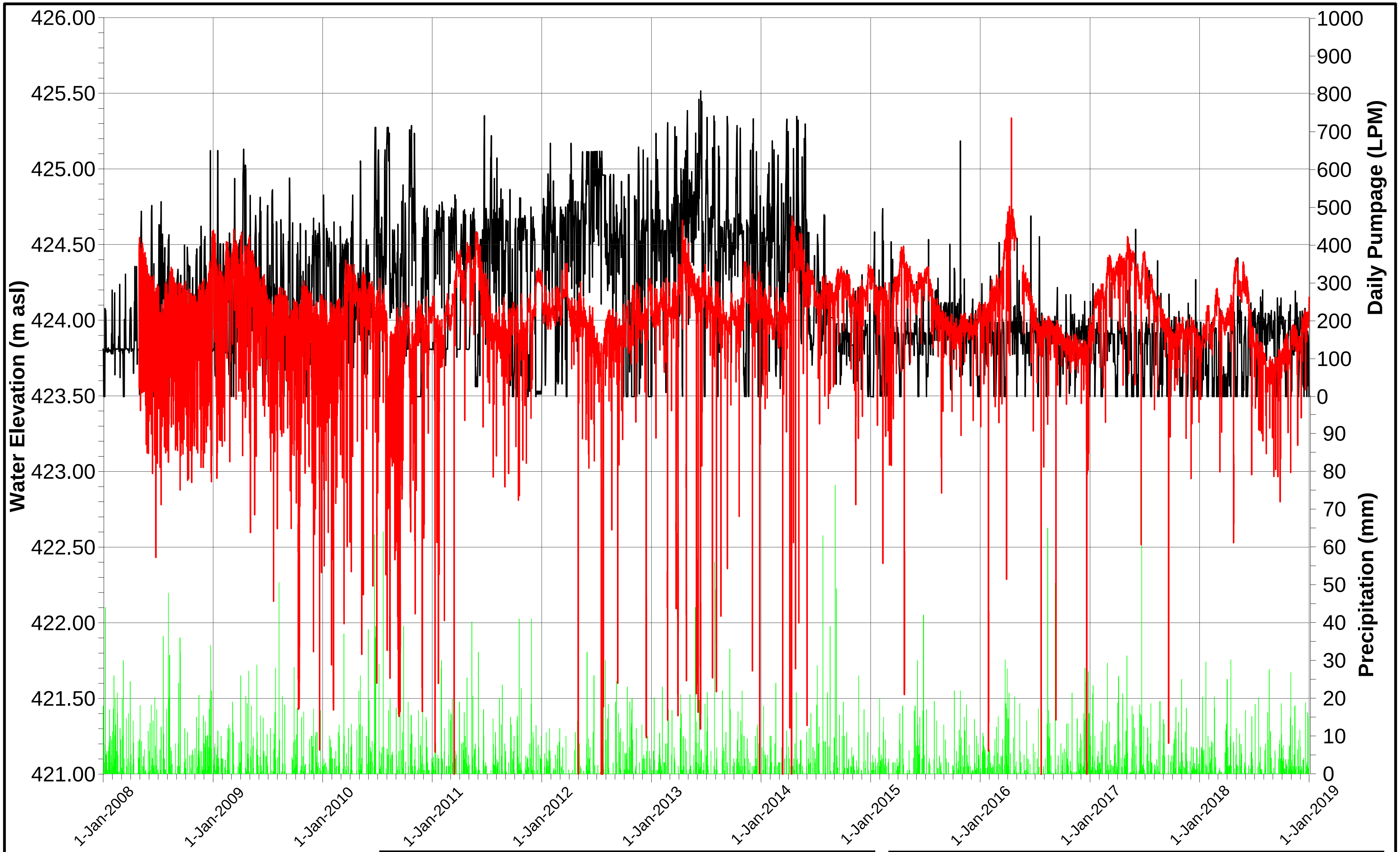
**PROJECT**

**NESTLE WATERS CANADA**
**Town of Erin, Ontario**

**TITLE**

**HYDROGRAPH FOR D2A**

| PROJECT NO. | REV | FIGURE |
|---|---|---|
| 13-1152-0250 (9000) | A | D6 |



— TW1-88 Daily Pumpage
🟩 Precipitation
— D36B

GOLDER

| | |
|---|---|
| **DATE** | DECEMBER 2018 |
| **DESIGN** | KS |
| **REVIEW** | GP |
| **APPROVED** | GP |

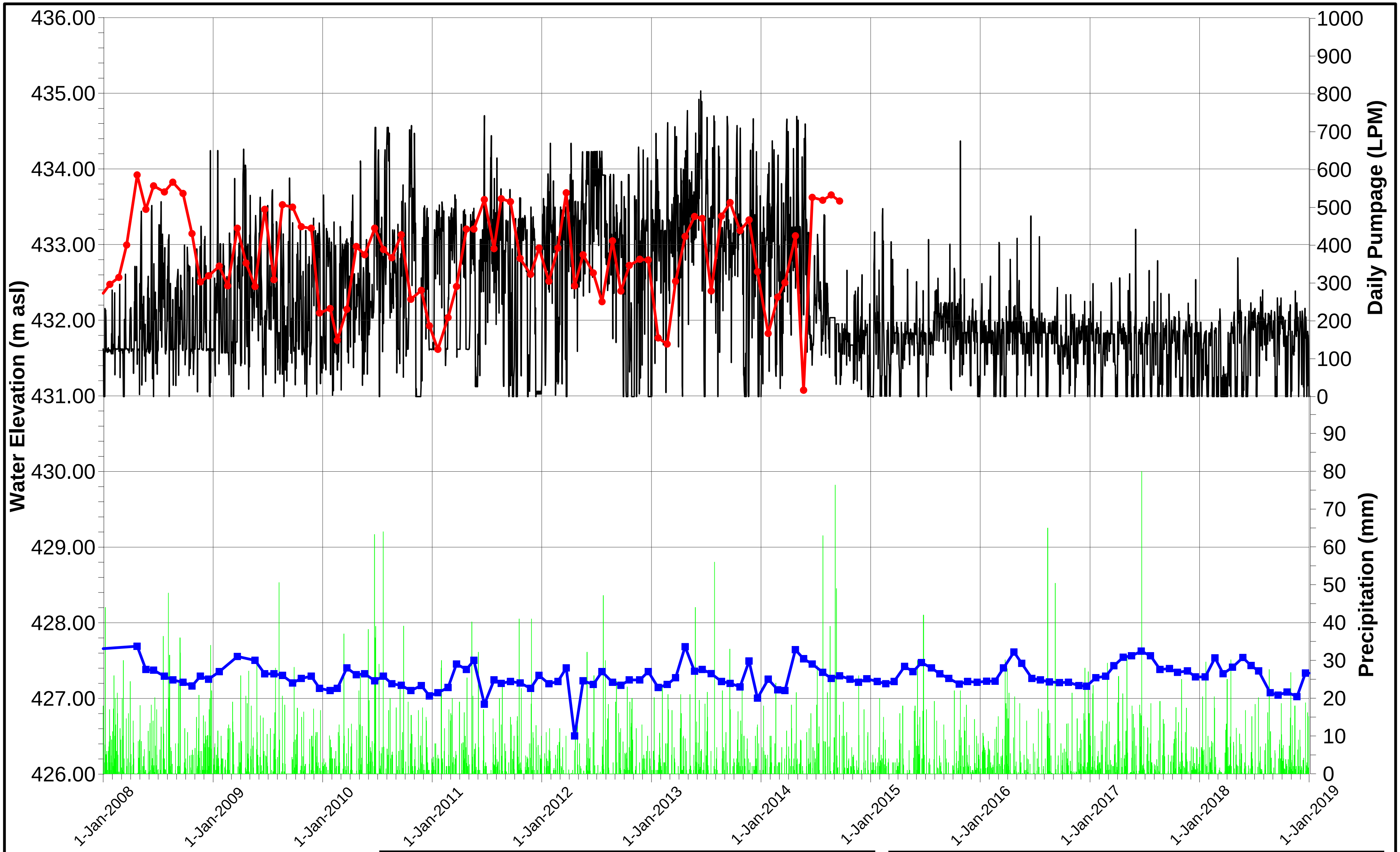
**PROJECT**

**NESTLE WATERS CANADA**
**Town of Erin, Ontario**

**TITLE**

**HYDROGRAPH FOR D36B**

| **PROJECT NO.** | **REV** | **FIGURE** |
|---|---|---|
| 13-1152-0250 (9000) | A | D7 |



**NOTE:**
The homeowner at D19 is no longer participating
in the monitoring program.

GOLDER

| | |
|---|---|
| DATE | DECEMBER 2018 |
| DESIGN | KS |
| REVIEW | GP |
| APPROVED | GP |

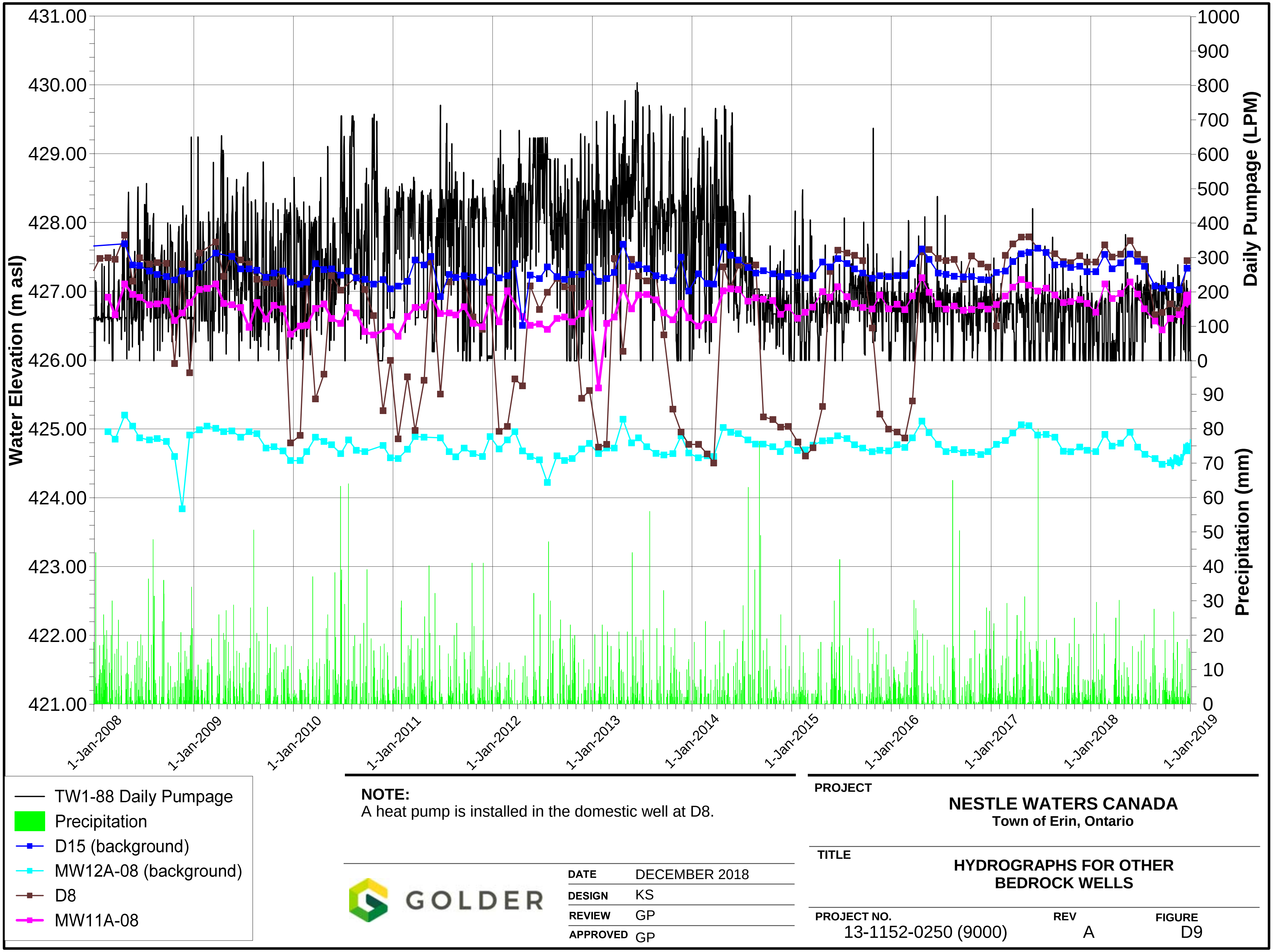
PROJECT

**NESTLE WATERS CANADA**
**Town of Erin, Ontario**

TITLE

**HYDROGRAPHS FOR OTHER**
**BEDROCK WELLS**

| PROJECT NO. | REV | FIGURE |
|---|---|---|
| 13-1152-0250 (9000) | A | D8 |



**NOTE:**
A heat pump is installed in the domestic well at D8.

GOLDER

| | |
|---|---|
| **DATE** | DECEMBER 2018 |
| **DESIGN** | KS |
| **REVIEW** | GP |
| **APPROVED** | GP |

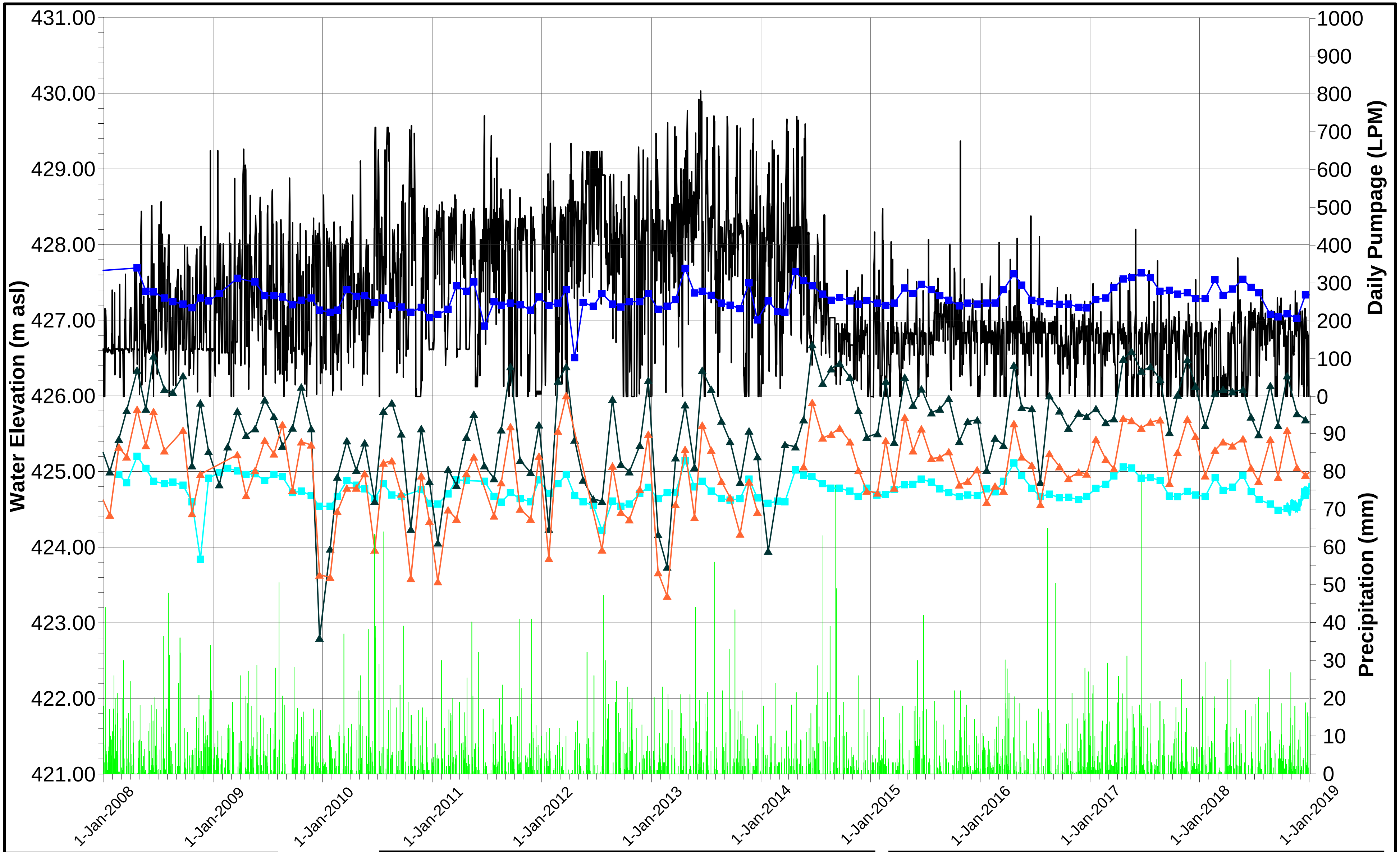
**PROJECT**

**NESTLE WATERS CANADA**
**Town of Erin, Ontario**

**TITLE**

**HYDROGRAPHS FOR OTHER BEDROCK WELLS**

| **PROJECT NO.** | **REV** | **FIGURE** |
|---|---|---|
| 13-1152-0250 (9000) | A | D9 |



**NOTE:**
D24B buried in snow from January to March of 2014

GOLDER

| | |
|---|---|
| **DATE** | DECEMBER 2018 |
| **DESIGN** | KS |
| **REVIEW** | GP |
| **APPROVED** | GP |

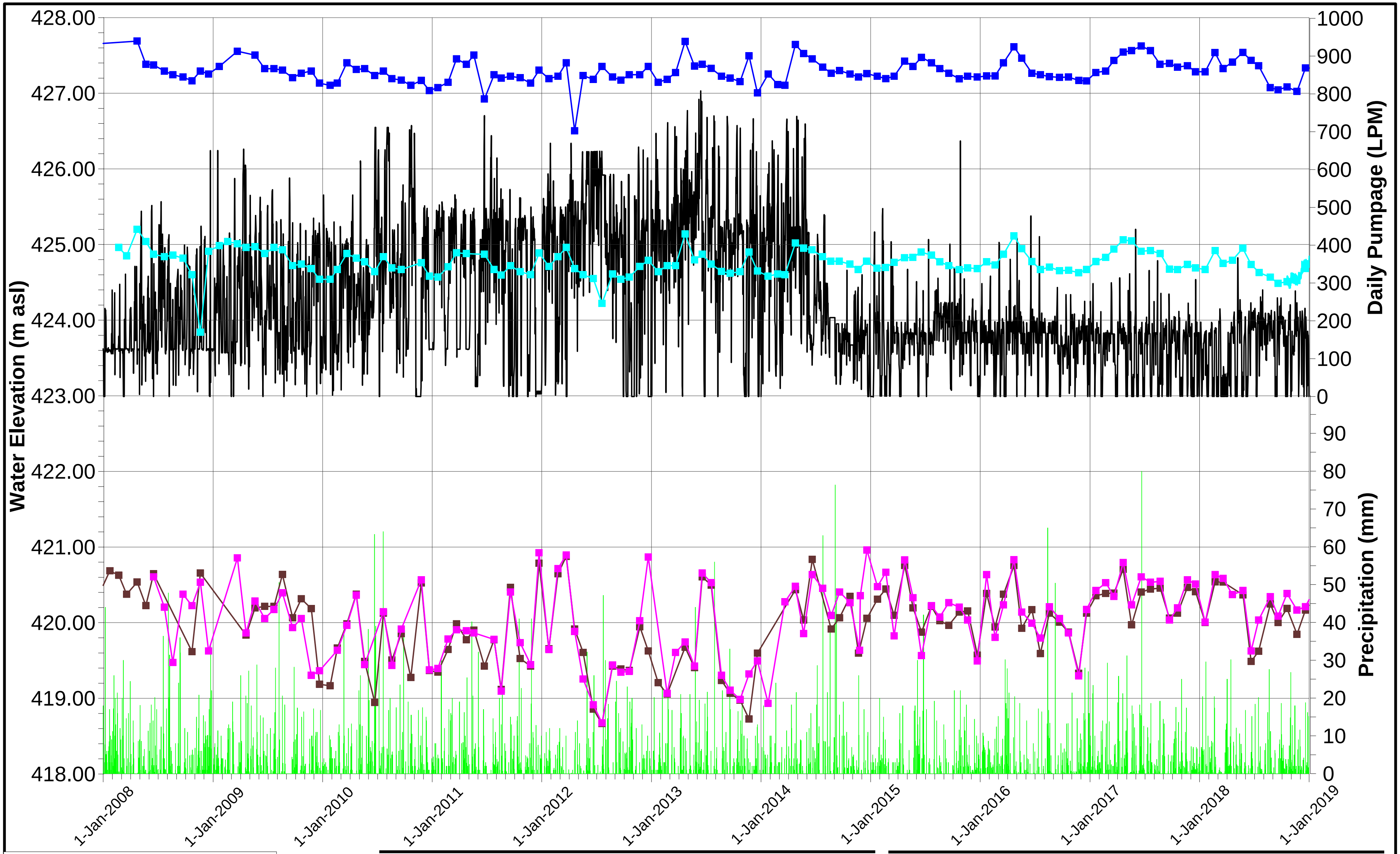
**PROJECT**

**NESTLE WATERS CANADA**
**Town of Erin, Ontario**

**TITLE**

**HYDROGRAPHS FOR OTHER BEDROCK WELLS**

| **PROJECT NO.** | **REV** | **FIGURE** |
|---|---|---|
| 13-1152-0250 (9000) | A | D10 |



GOLDER

| | |
|---|---|
| **DATE** | DECEMBER 2018 |
| **DESIGN** | KS |
| **REVIEW** | GP |
| **APPROVED** | GP |

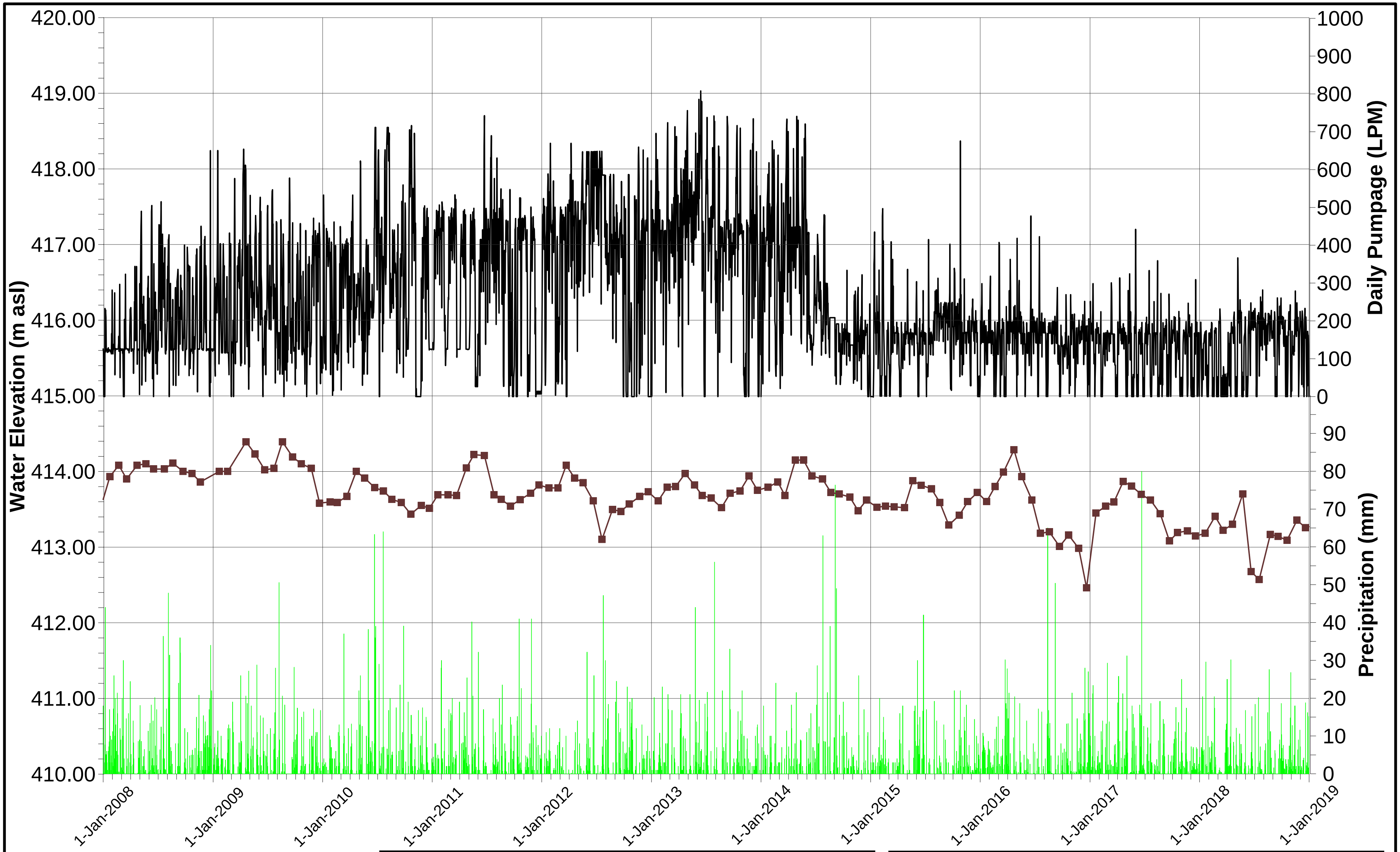
**PROJECT**

**NESTLE WATERS CANADA**
**Town of Erin, Ontario**

**TITLE**

**HYDROGRAPHS FOR OTHER**
**BEDROCK WELLS**

| **PROJECT NO.** | **REV** | **FIGURE** |
|---|---|---|
| 13-1152-0250 (9000) | A | D11 |



PROJECT

**NESTLE WATERS CANADA**

**Town of Erin, Ontario**

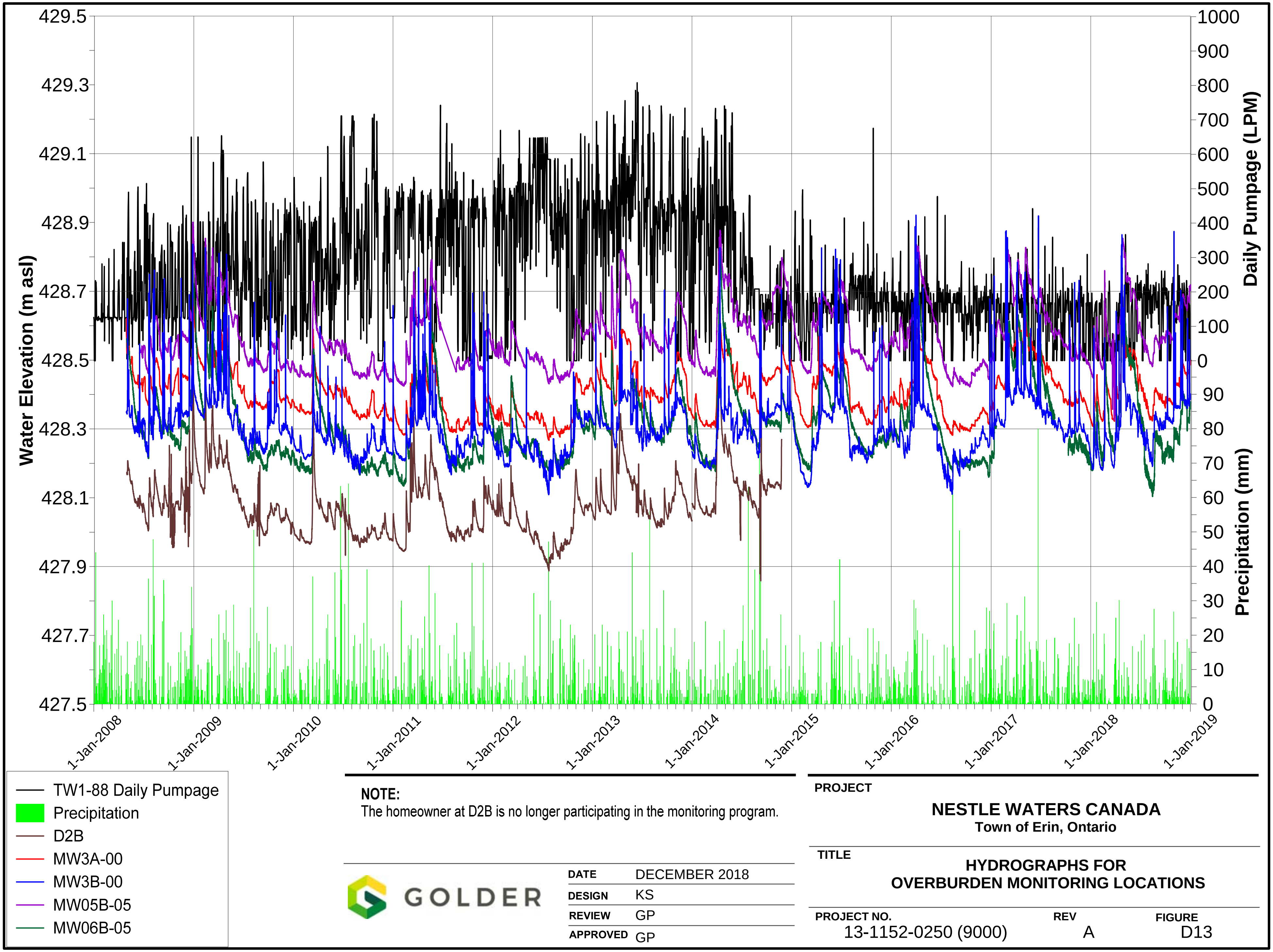
TITLE

**HYDROGRAPHS FOR OTHER BEDROCK WELLS**

GOLDER

| | |
|---|---|
| DATE | DECEMBER 2018 |
| DESIGN | KS |
| REVIEW | GP |
| APPROVED | GP |

| PROJECT NO. | REV | FIGURE |
|---|---|---|
| 13-1152-0250 (9000) | A | D12 |



**NOTE:**
The homeowner at D2B is no longer participating in the monitoring program.

GOLDER

| | |
|---|---|
| **DATE** | DECEMBER 2018 |
| **DESIGN** | KS |
| **REVIEW** | GP |
| **APPROVED** | GP |

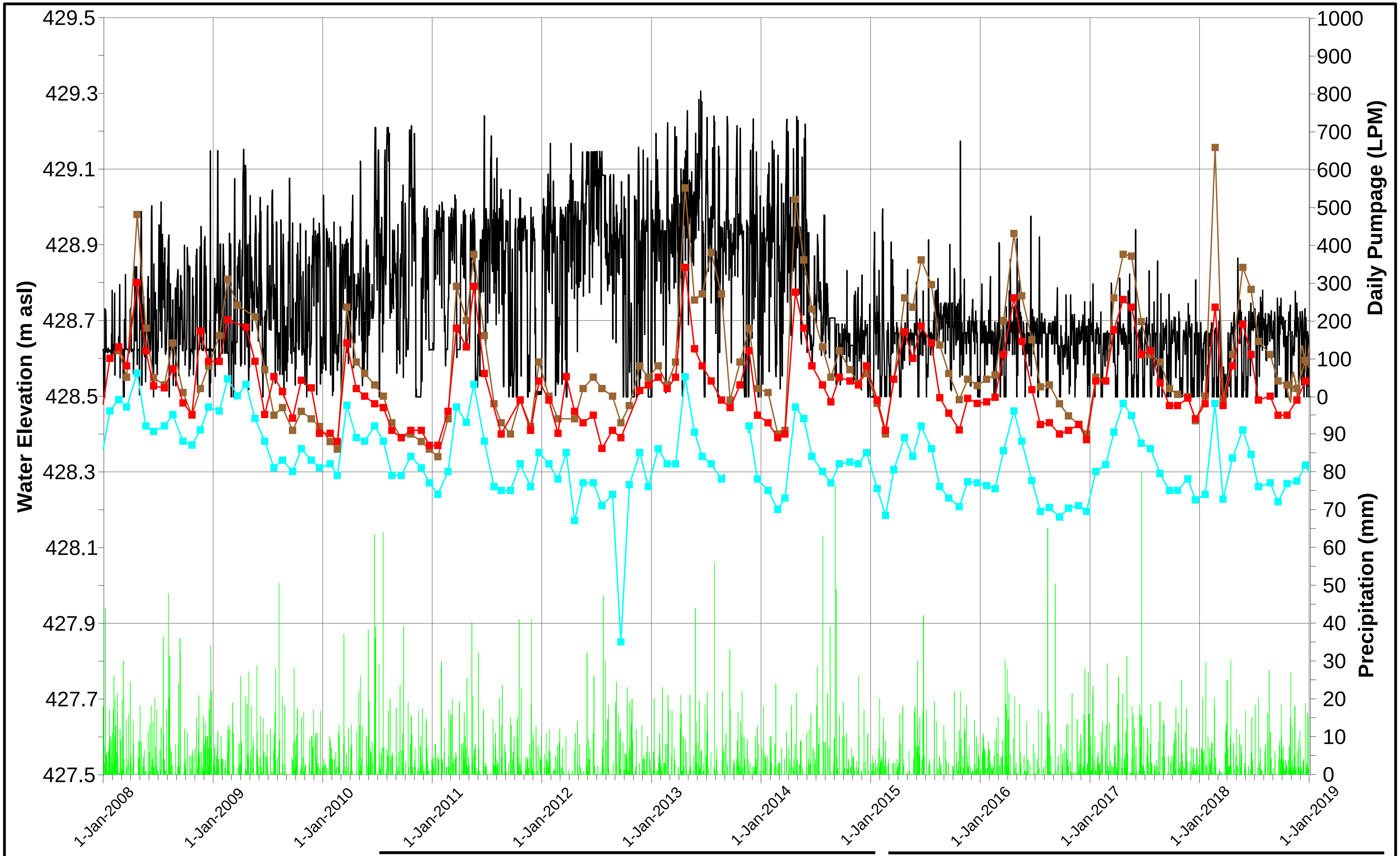
**PROJECT**

**NESTLE WATERS CANADA**
**Town of Erin, Ontario**

**TITLE**

**HYDROGRAPHS FOR**
**OVERBURDEN MONITORING LOCATIONS**

| **PROJECT NO.** | **REV** | **FIGURE** |
|---|---|---|
| 13-1152-0250 (9000) | A | D13 |



GOLDER

| | |
|---|---|
| **DATE** | DECEMBER 2018 |
| **DESIGN** | KS |
| **REVIEW** | GP |
| **APPROVED** | GP |

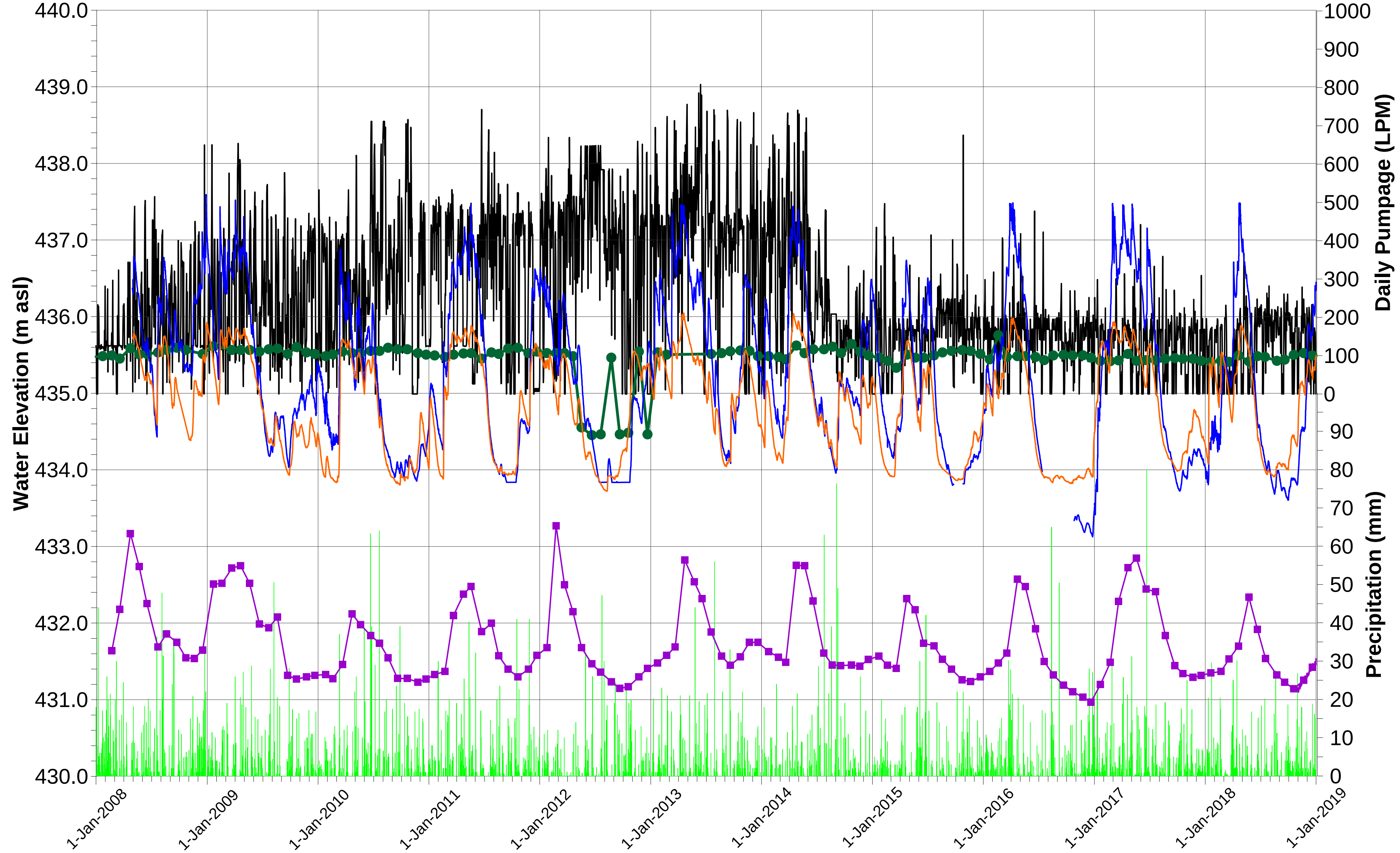
**PROJECT**

**NESTLE WATERS CANADA**
**Town of Erin, Ontario**

**TITLE**

**HYDROGRAPHS FOR OVERBURDEN**
**MONITORING LOCATIONS**

| **PROJECT NO.** | **REV** | **FIGURE** |
|---|---|---|
| 13-1152-0250 (9000) | A | D14 |



**PROJECT**

## NESTLE WATERS CANADA

**Town of Erin, Ontario**

**TITLE**

## HYDROGRAPHS FOR OVERBURDEN MONITORING LOCATIONS

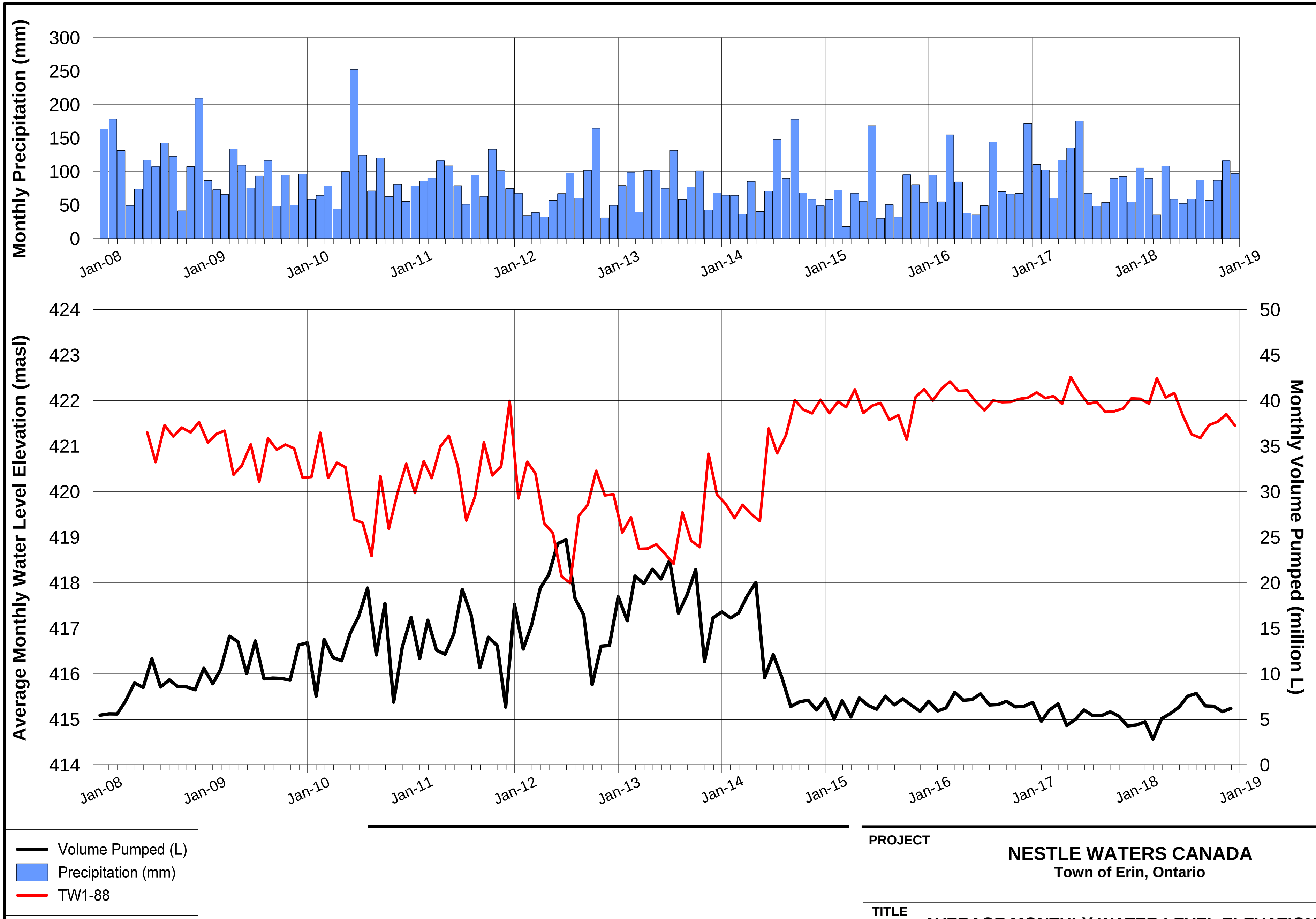
GOLDER

| | |
|---|---|
| **DATE** | DECEMBER 2018 |
| **DESIGN** | KS |
| **REVIEW** | GP |
| **APPROVED** | GP |

| **PROJECT NO.** | **REV** | **FIGURE** |
|---|---|---|
| 13-1152-0250 (9000) | A | D15 |

## APPENDIX E

# Groundwater Hydrographs (Average)



GOLDER

| | |
|---|---|
| **DATE** | DECEMBER 2018 |
| **DESIGN** | KS |
| **REVIEW** | GP |
| **APPROVED** | GP |

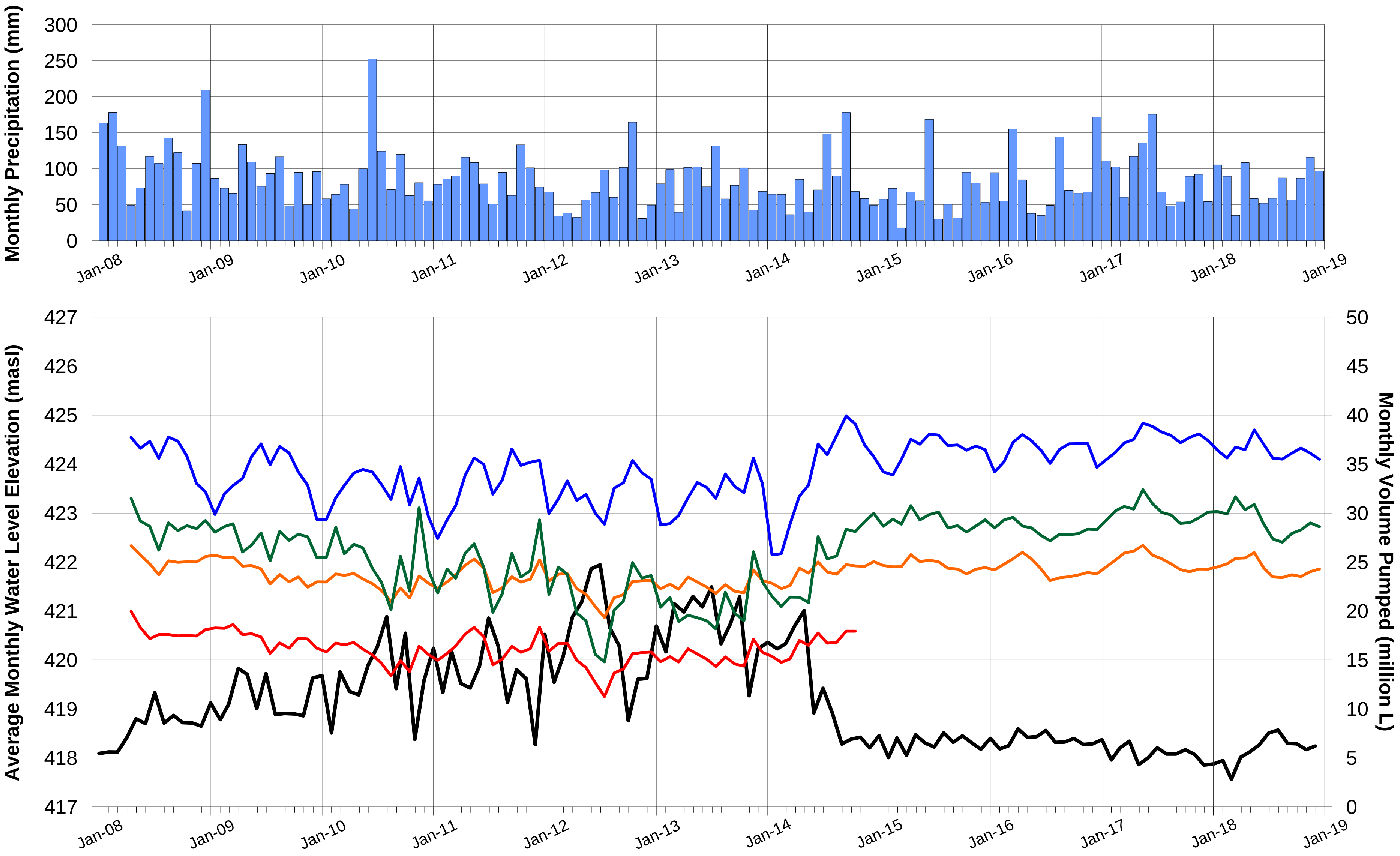
**PROJECT**

**NESTLE WATERS CANADA**
**Town of Erin, Ontario**

**TITLE**

**AVERAGE MONTHLY WATER LEVEL ELEVATIONS**
**TW1-88**

| **PROJECT NO.** | **REV** | **FIGURE** |
|---|---|---|
| 13-1152-0250 (9000) | A | E1 |



GOLDER

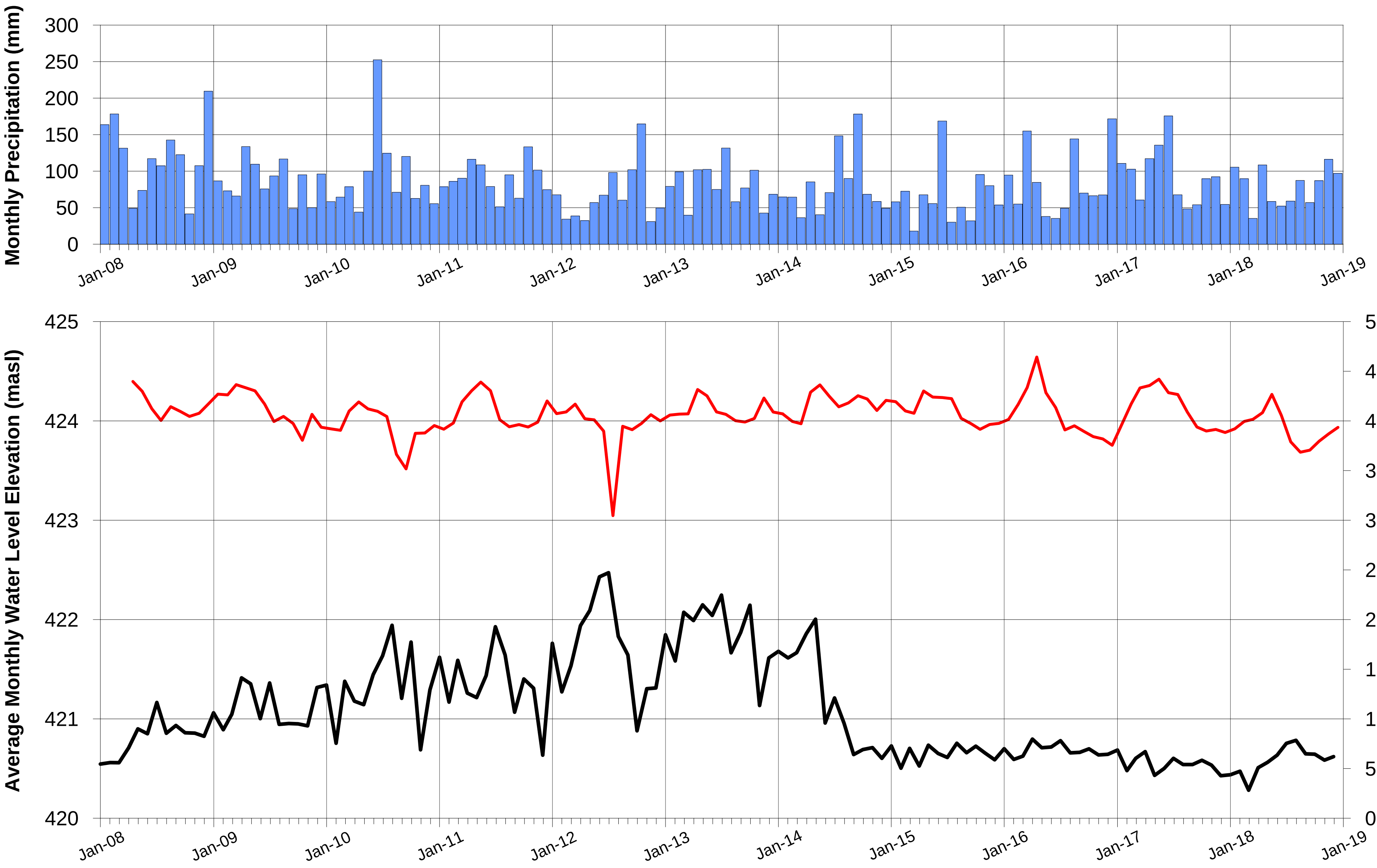
| | |
|---|---|
| **DATE** | DECEMBER 2018 |
| **DESIGN** | KS |
| **REVIEW** | GP |
| **APPROVED** | GP |

**PROJECT**

**NESTLE WATERS CANADA**
**Town of Erin, Ontario**

**TITLE** **AVERAGE MONTHLY WATER LEVEL ELEVATIONS**
**UPPER BEDROCK**
**WELLS WITHIN 500 m of TW1-88**

| **PROJECT NO.** | **REV** | **FIGURE** |
|---|---|---|
| 13-1152-0250 (9000) | A | E2 |



Volume Pumped (L)
🟦 Precipitation (mm)
D36B

GOLDER

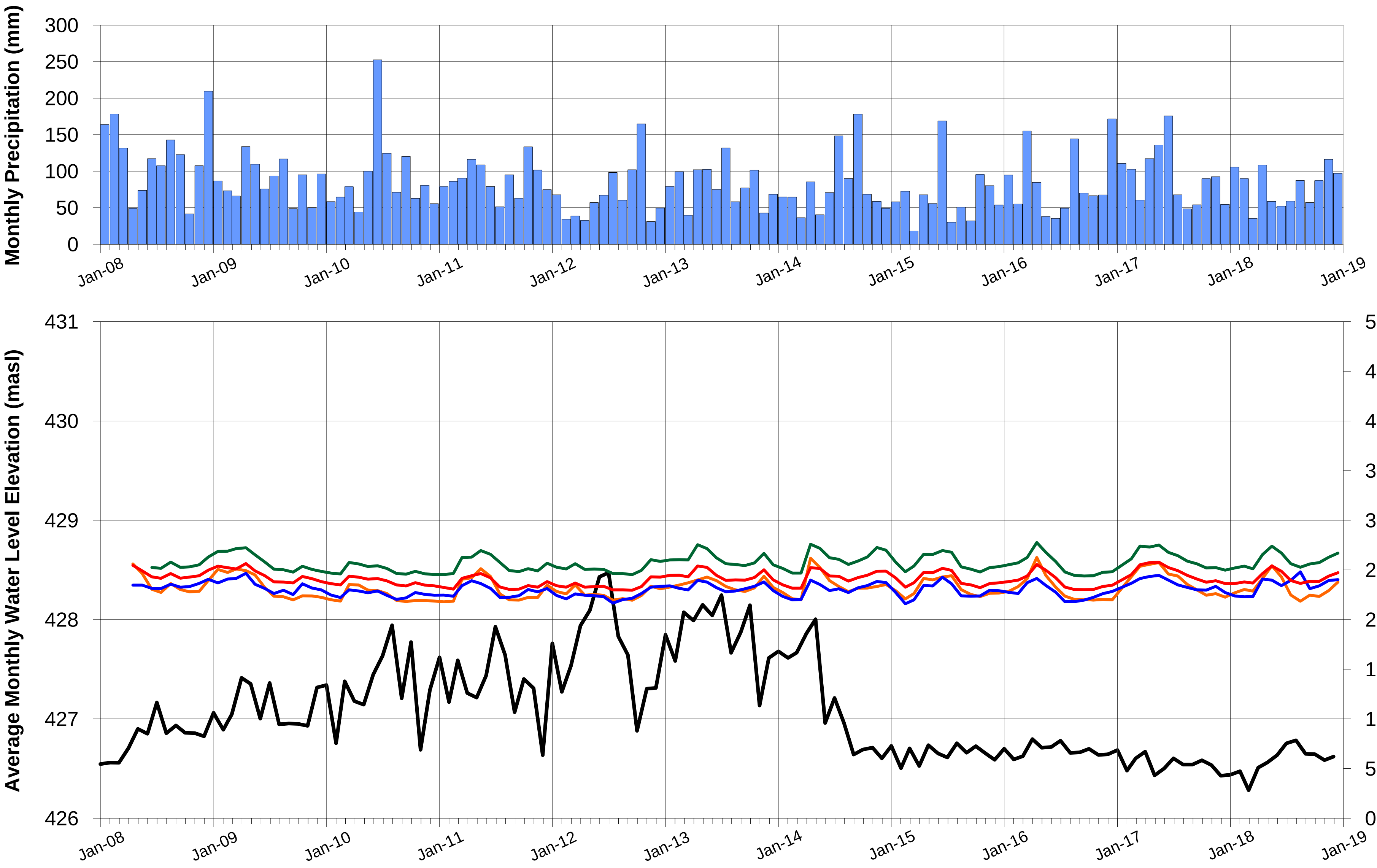
| | |
|---|---|
| **DATE** | DECEMBER 2018 |
| **DESIGN** | KS |
| **REVIEW** | GP |
| **APPROVED** | GP |

**PROJECT**

**NESTLE WATERS CANADA**
**Town of Erin, Ontario**

**TITLE** **AVERAGE MONTHLY WATER LEVEL ELEVATIONS**
**UPPER BEDROCK**
**WELLS OUTSIDE 500 m of TW1-88**

| **PROJECT NO.** | **REV** | **FIGURE** |
|---|---|---|
| 13-1152-0250 (9000) | A | E3 |



| | |
|---|---|
| ▬ | Volume Pumped (L) |
| 🟦 | Precipitation (mm) |
| ▬ | MW3A-00 |
| ▬ | MW3B-00 |
| ▬ | MW5B-05 |
| ▬ | MW6B-05 |

GOLDER

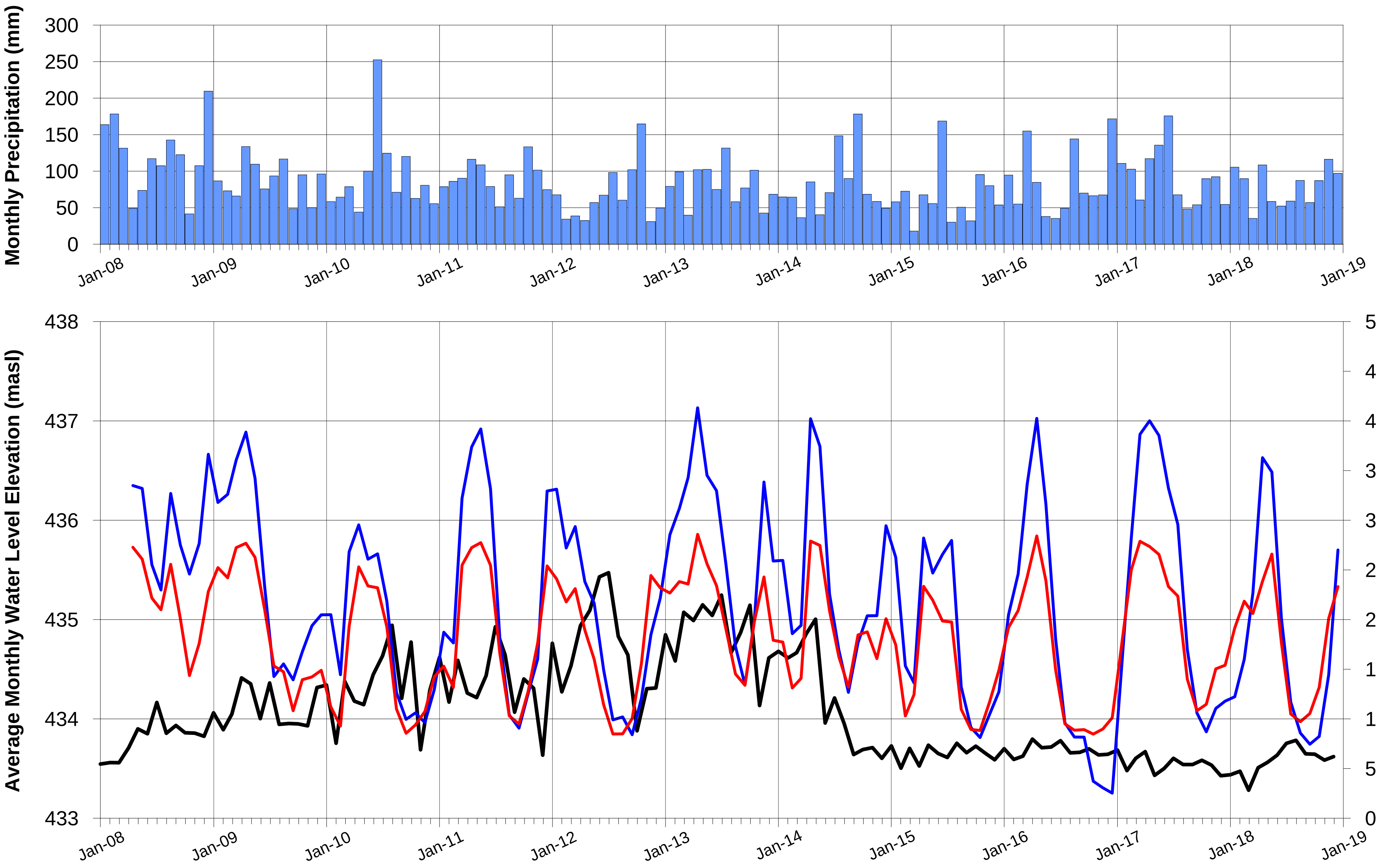
| | |
|---|---|
| **DATE** | DECEMBER 2018 |
| **DESIGN** | KS |
| **REVIEW** | GP |
| **APPROVED** | GP |

**PROJECT**

**NESTLE WATERS CANADA**
**Town of Erin, Ontario**

**TITLE** **AVERAGE MONTHLY WATER LEVEL ELEVATIONS**
**OVERBURDEN**
**WELLS WITHIN 500 m of TW1-88**

| **PROJECT NO.** | **REV** | **FIGURE** |
|---|---|---|
| 13-1152-0250 (9000) | A | E4 |



| | |
|---|---|
| ▬ | Volume Pumped (L) |
| 🟦 | Precipitation (mm) |
| ▬ | D26C |
| ▬ | D36A |

| | |
|---|---|
| **DATE** | DECEMBER 2018 |
| **DESIGN** | KS |
| **REVIEW** | GP |
| **APPROVED** | GP |

**PROJECT**

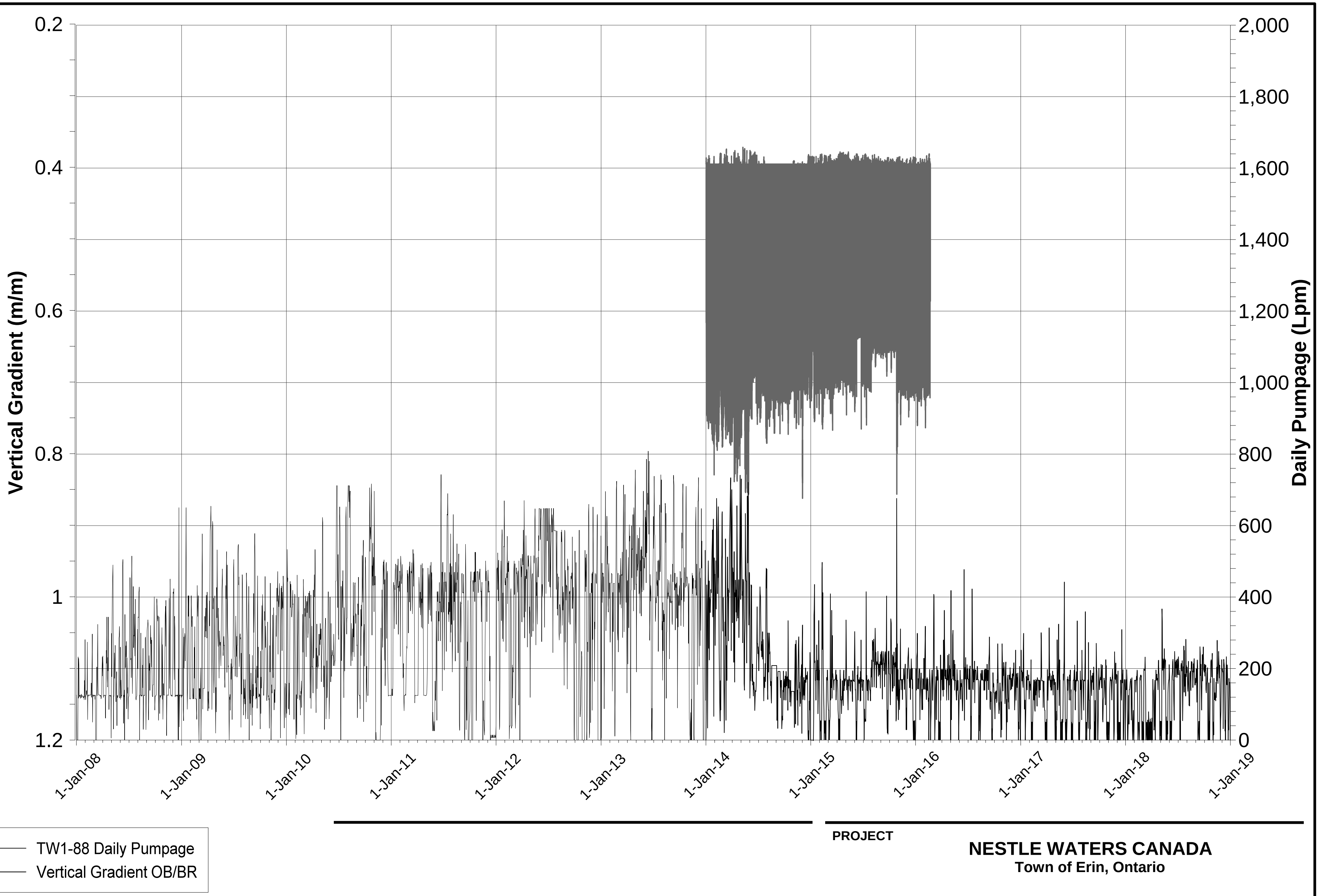
**NESTLE WATERS CANADA**
**Town of Erin, Ontario**

**TITLE** **AVERAGE MONTHLY WATER LEVEL ELEVATIONS**
**OVERBURDEN**
**WELLS OUTSIDE 500 m of TW1-88**

| **PROJECT NO.** | **REV** | **FIGURE** |
|---|---|---|
| 13-1152-0250 (9000) | A | E5 |

## APPENDIX F

# Vertical Gradients (Overburden/Bedrock)



GOLDER

| | |
|---|---|
| **DATE** | DECEMBER 2018 |
| **DESIGN** | KS |
| **REVIEW** | GP |
| **APPROVED** | GP |

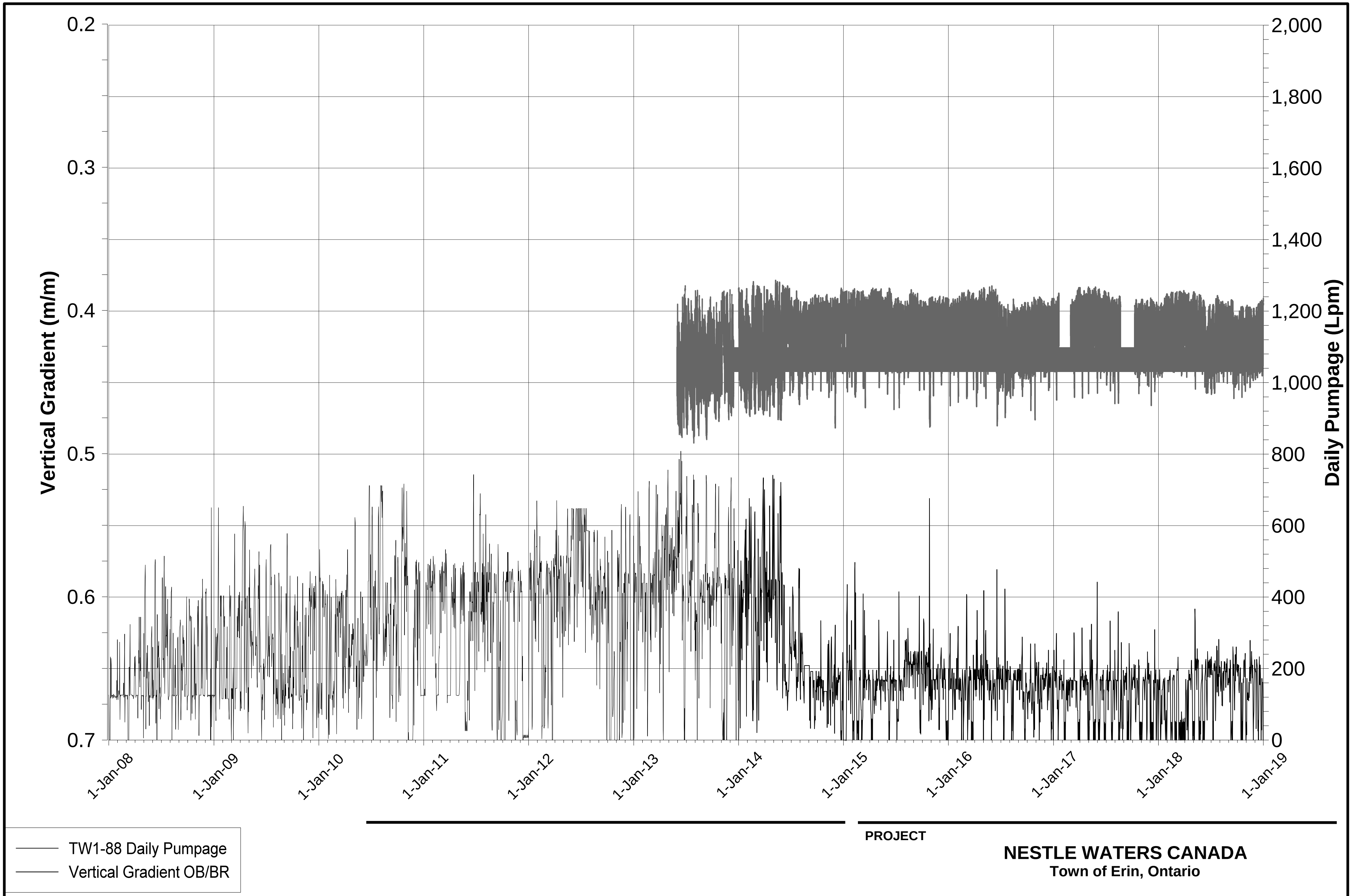
**PROJECT**

**NESTLE WATERS CANADA**
**Town of Erin, Ontario**

**TITLE**

**MW5-05 VERTICAL GRADIENT**

| **PROJECT NO.** | **REV** | **FIGURE** |
|---|---|---|
| 13-1152-0250 (9000) | A | F1 |



GOLDER

**DATE** DECEMBER 2018
**DESIGN** KS
**REVIEW** GP
**APPROVED** GP

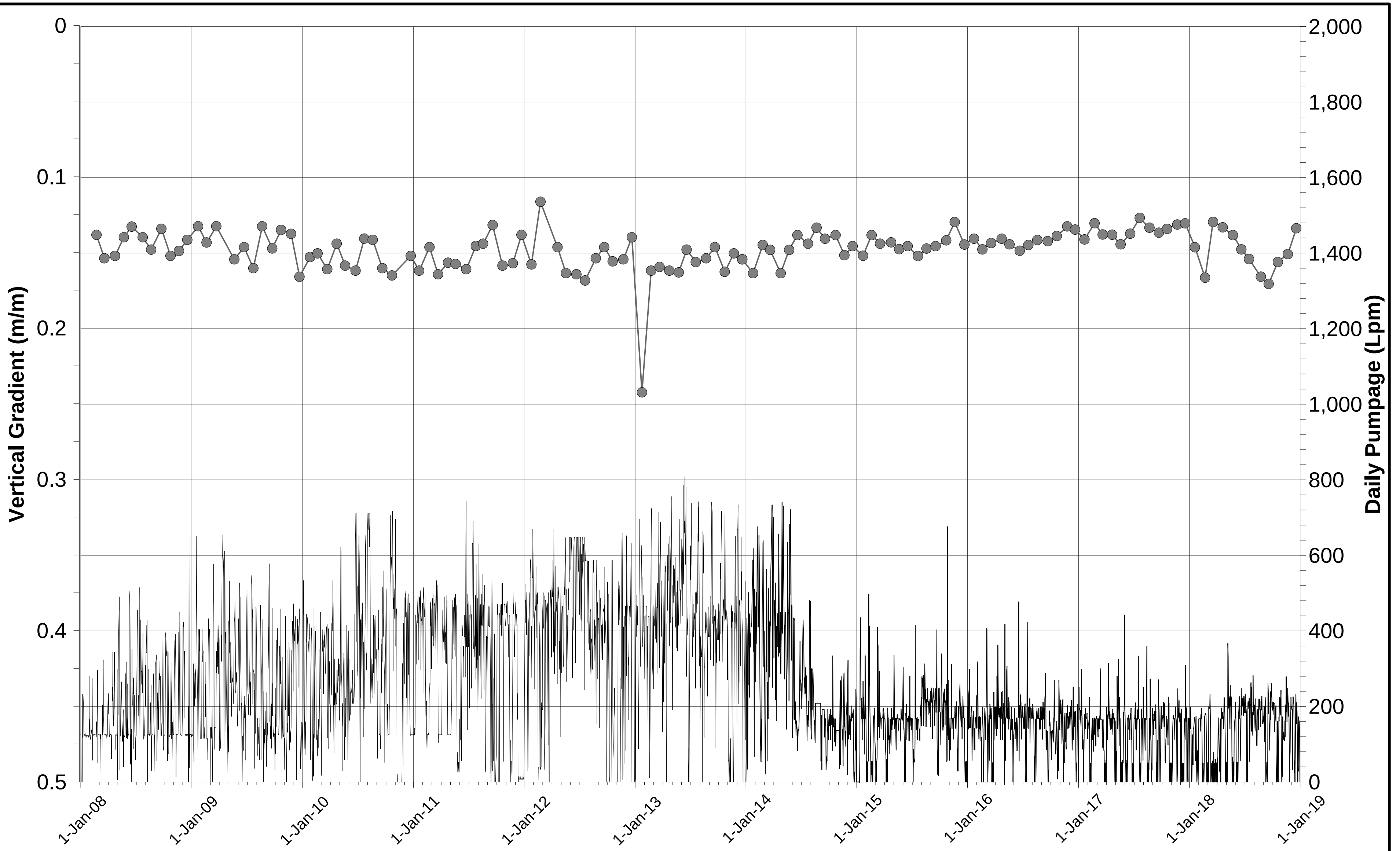
**PROJECT**

**NESTLE WATERS CANADA**
**Town of Erin, Ontario**

**TITLE**

**MW6-05 VERTICAL GRADIENT**

| **PROJECT NO.** | **REV** | **FIGURE** |
|---|---|---|
| 13-1152-0250 (9000) | A | F2 |



**PROJECT**

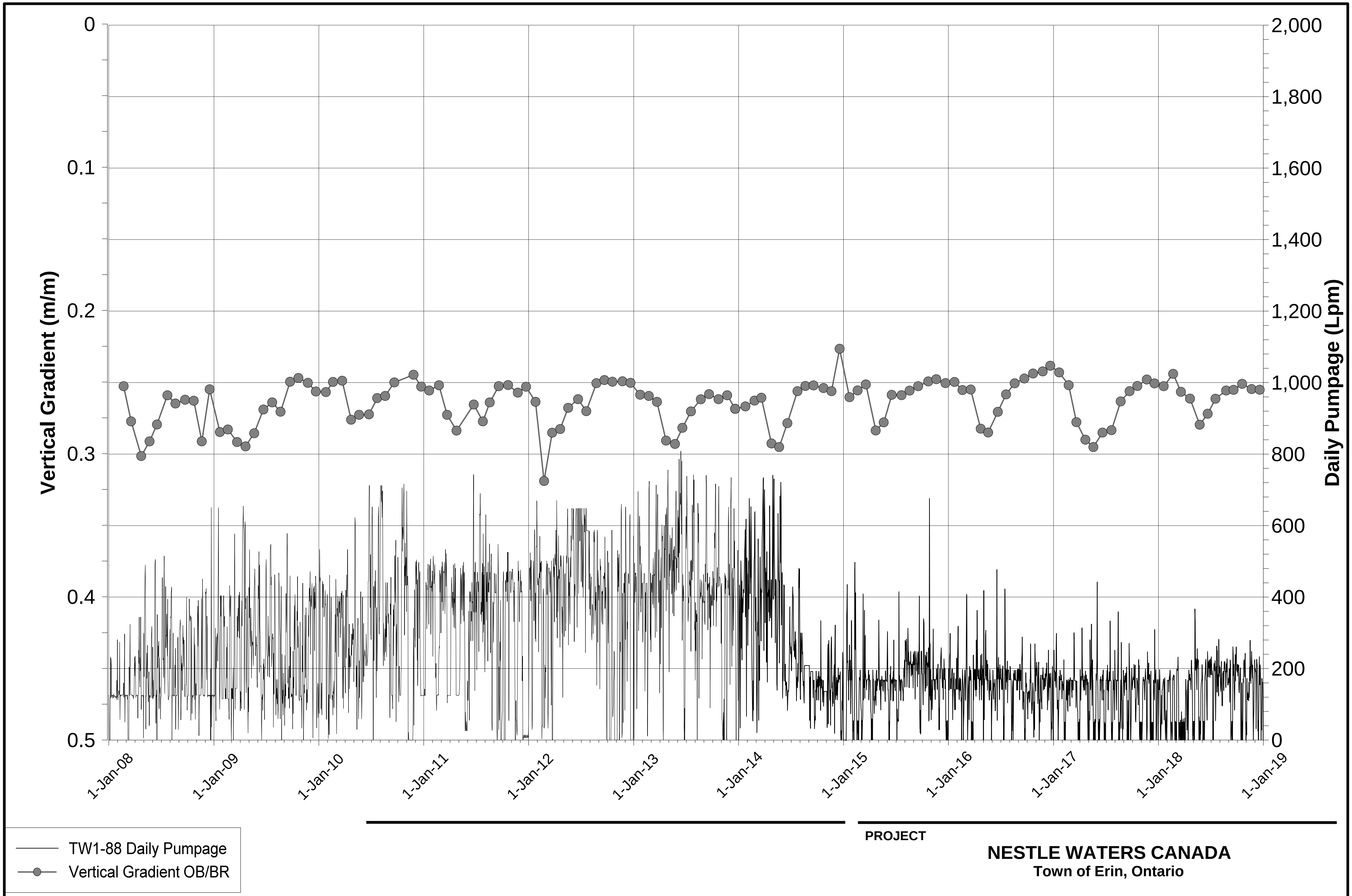
**NESTLE WATERS CANADA**
**Town of Erin, Ontario**

**TITLE**

**MW11-08 VERTICAL GRADIENT**

| | |
|---|---|
| **DATE** | DECEMBER 2018 |
| **DESIGN** | KS |
| **REVIEW** | GP |
| **APPROVED** | GP |

| **PROJECT NO.** | **REV** | **FIGURE** |
|---|---|---|
| 13-1152-0250 (9000) | A | F3 |



GOLDER

| | |
|---|---|
| **DATE** | DECEMBER 2018 |
| **DESIGN** | KS |
| **REVIEW** | GP |
| **APPROVED** | GP |

**PROJECT**

**NESTLE WATERS CANADA**
**Town of Erin, Ontario**

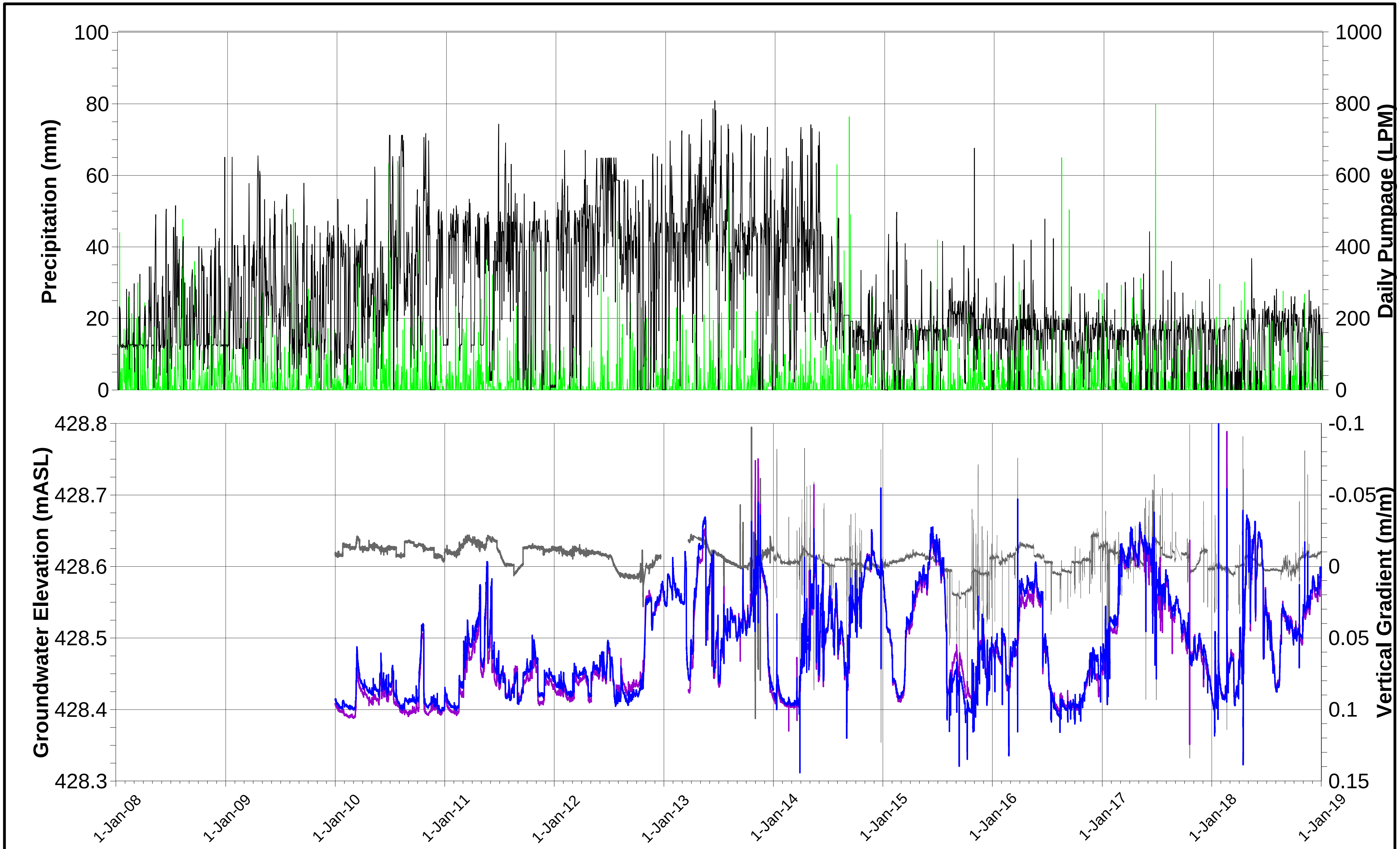
**TITLE**

**MW12-08 VERTICAL GRADIENT**

| **PROJECT NO.** | **REV** | **FIGURE** |
|---|---|---|
| 13-1152-0250 (9000) | A | F4 |

## APPENDIX G

# Mini-Piezometer Hydrographs



**PROJECT**

**NESTLE WATERS CANADA**
**Town of Erin, Ontario**

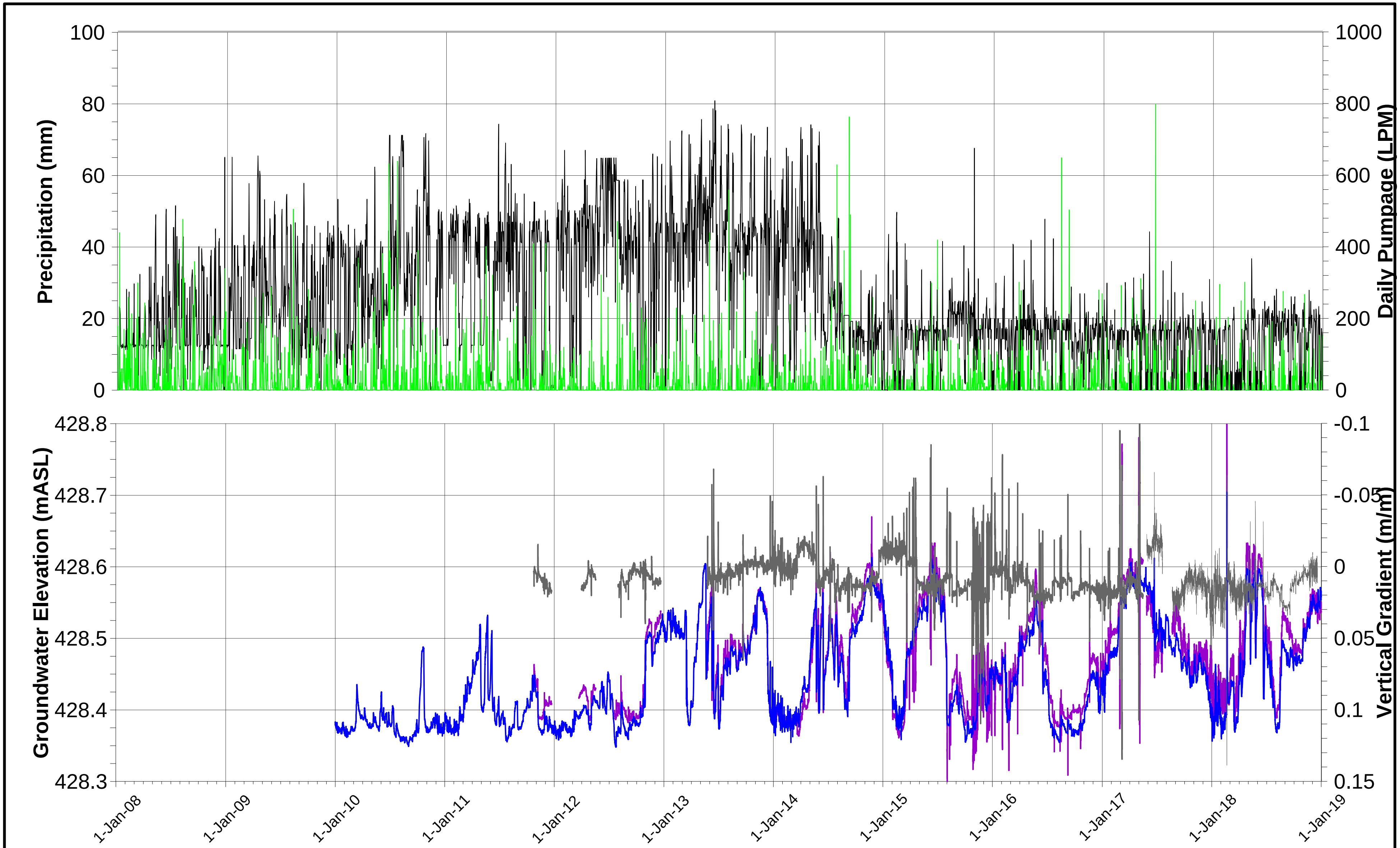
**TITLE**

**P03-05 NEST HYDROGRAPHS AND VERTICAL GRADIENTS**

GOLDER

| | |
|---|---|
| **DATE** | DECEMBER 2018 |
| **DESIGN** | KS |
| **REVIEW** | GP |
| **APPROVED** | GP |

| **PROJECT NO.** | **REV** | **FIGURE** |
|---|---|---|
| 13-1152-0250 (9000) | A | G1 |



GOLDER

| | |
|---|---|
| **DATE** | DECEMBER 2018 |
| **DESIGN** | KS |
| **REVIEW** | GP |
| **APPROVED** | GP |

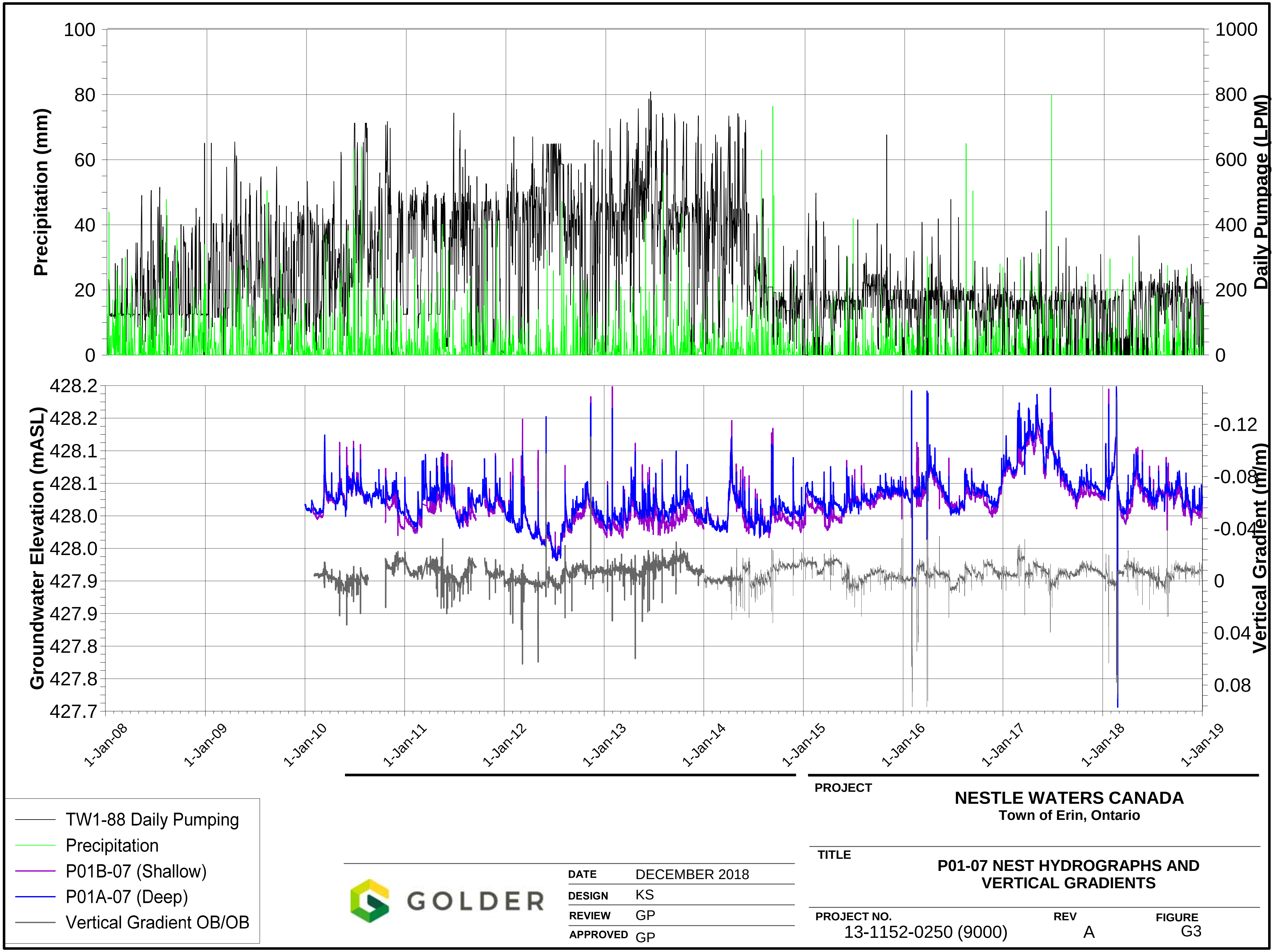
**PROJECT**

**NESTLE WATERS CANADA**
**Town of Erin, Ontario**

**TITLE**

**P06-07 NEST HYDROGRAPHS**
**AND VERTICAL GRADIENTS**

| **PROJECT NO.** | **REV** | **FIGURE** |
|---|---|---|
| 13-1152-0250 (9000) | A | G2 |



GOLDER

| | |
|---|---|
| **DATE** | DECEMBER 2018 |
| **DESIGN** | KS |
| **REVIEW** | GP |
| **APPROVED** | GP |

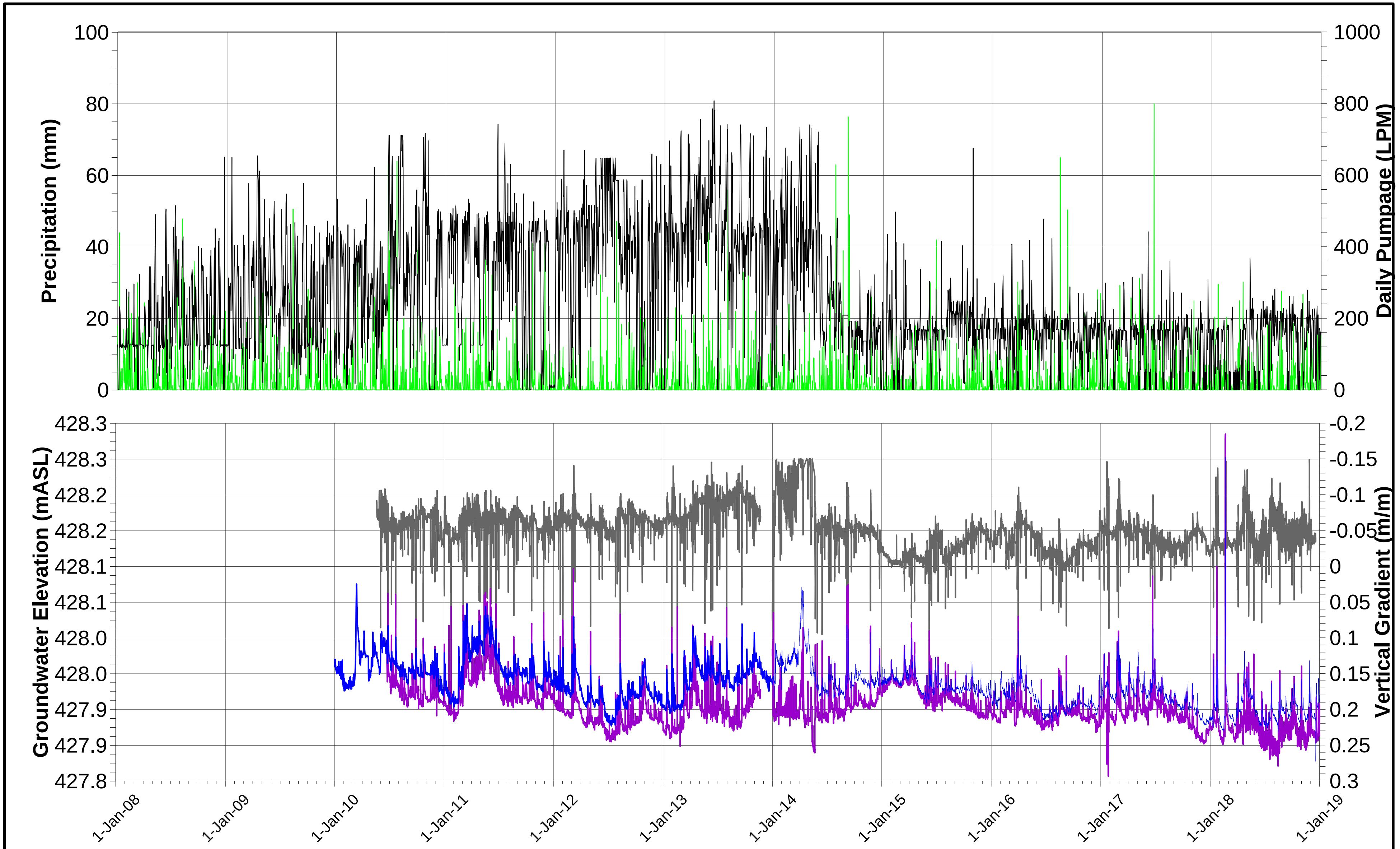
**PROJECT**

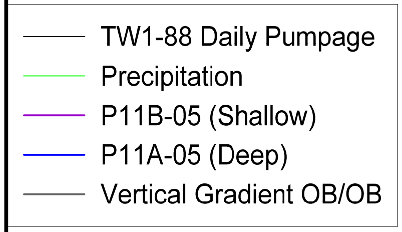
**NESTLE WATERS CANADA**
**Town of Erin, Ontario**

**TITLE**

**P01-07 NEST HYDROGRAPHS AND VERTICAL GRADIENTS**

| **PROJECT NO.** | **REV** | **FIGURE** |
|---|---|---|
| 13-1152-0250 (9000) | A | G3 |





GOLDER

| | |
|---|---|
| **DATE** | DECEMBER 2018 |
| **DESIGN** | KS |
| **REVIEW** | GP |
| **APPROVED** | GP |

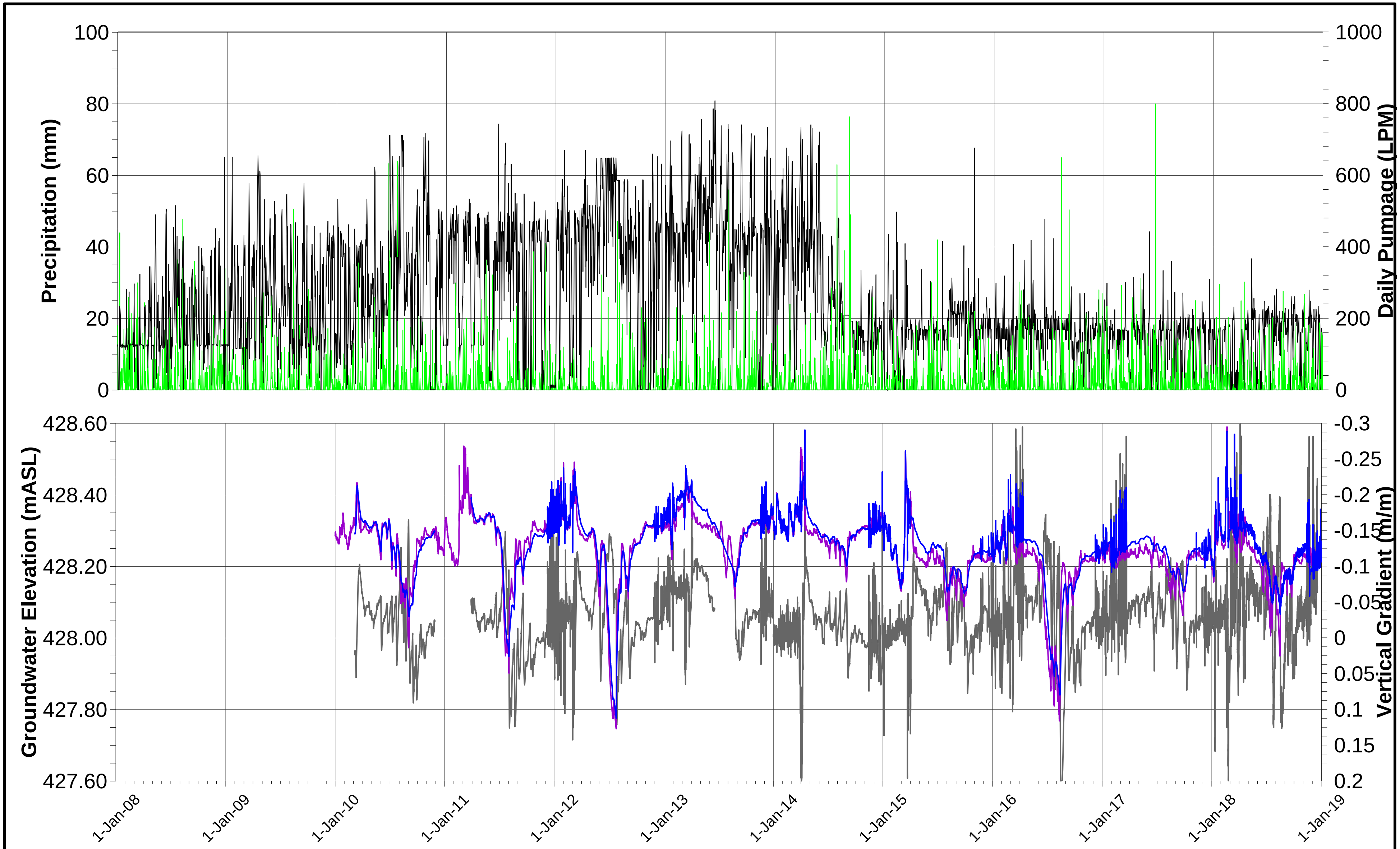
**PROJECT**

**NESTLE WATERS CANADA**
**Town of Erin, Ontario**

**TITLE**

**P11-05 NEST HYDROGRAPHS**
**AND VERTICAL GRADIENTS**

| **PROJECT NO.** | **REV** | **FIGURE** |
|---|---|---|
| 13-1152-0250 (9000) | A | G4 |



| | |
|---|---|
| — | TW1-88 Daily Pumpage |
| — | Precipitation |
| — | P10B-05 (Shallow) |
| — | P10A-05 (Deep) |
| — | Vertical Gradient OB/OB |

GOLDER

| | |
|---|---|
| **DATE** | DECEMBER 2018 |
| **DESIGN** | KS |
| **REVIEW** | GP |
| **APPROVED** | GP |

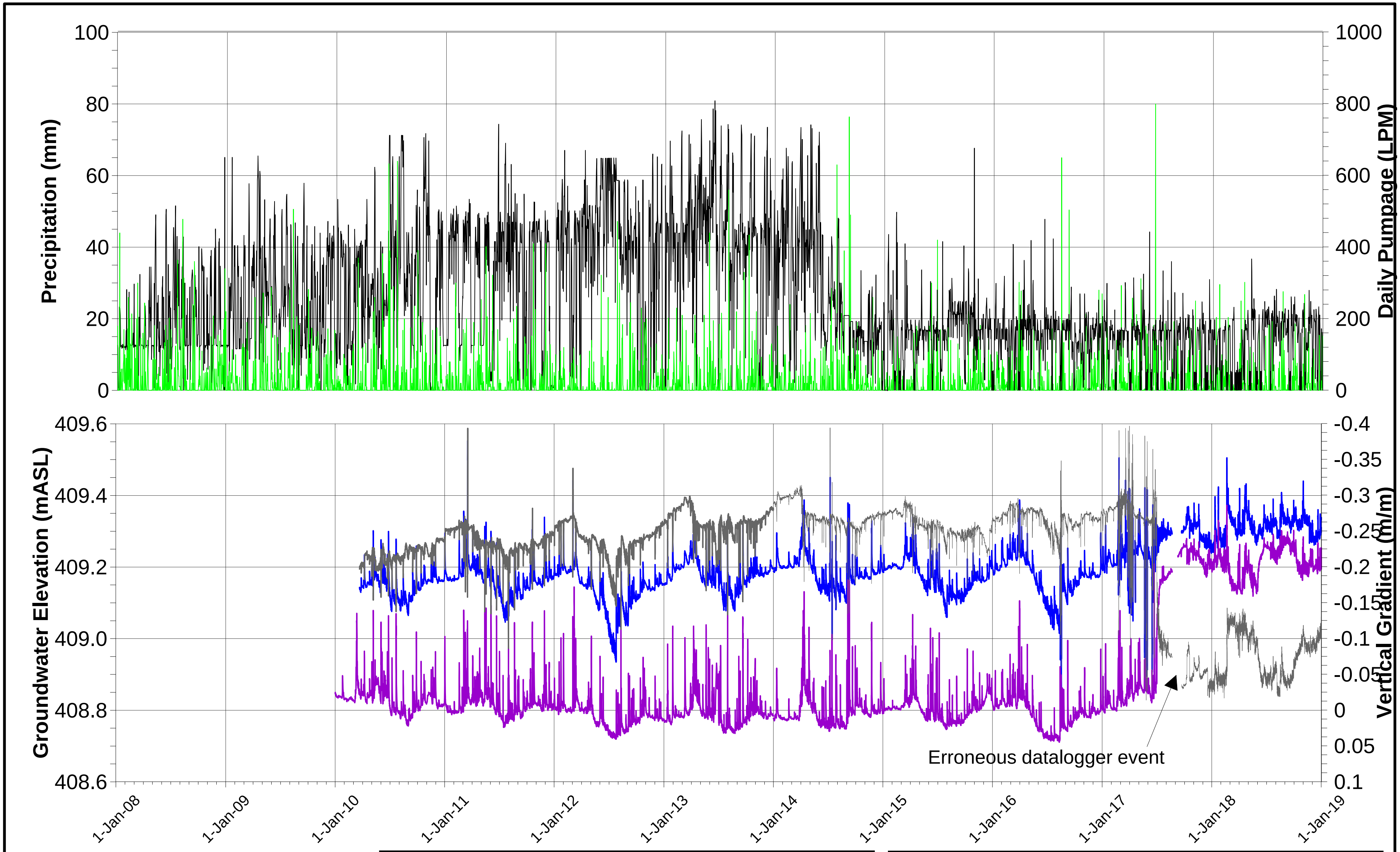
**PROJECT**

**NESTLE WATERS CANADA**
**Town of Erin, Ontario**

**TITLE**

**P10-05 NEST HYDROGRAPHS AND VERTICAL GRADIENTS**

| **PROJECT NO.** | **REV** | **FIGURE** |
|---|---|---|
| 13-1152-0250 (9000) | A | G5 |



| | |
|---|---|
| — | TW1-88 Daily Pumpage |
| — | Precipitation |
| — | P12B-07 (Shallow) |
| — | P12A-07 (Deep) |
| — | Vertical Gradient OB/OB |

GOLDER

| | |
|---|---|
| DATE | DECEMBER 2018 |
| DESIGN | JH |
| REVIEW | GP |
| APPROVED | GP |

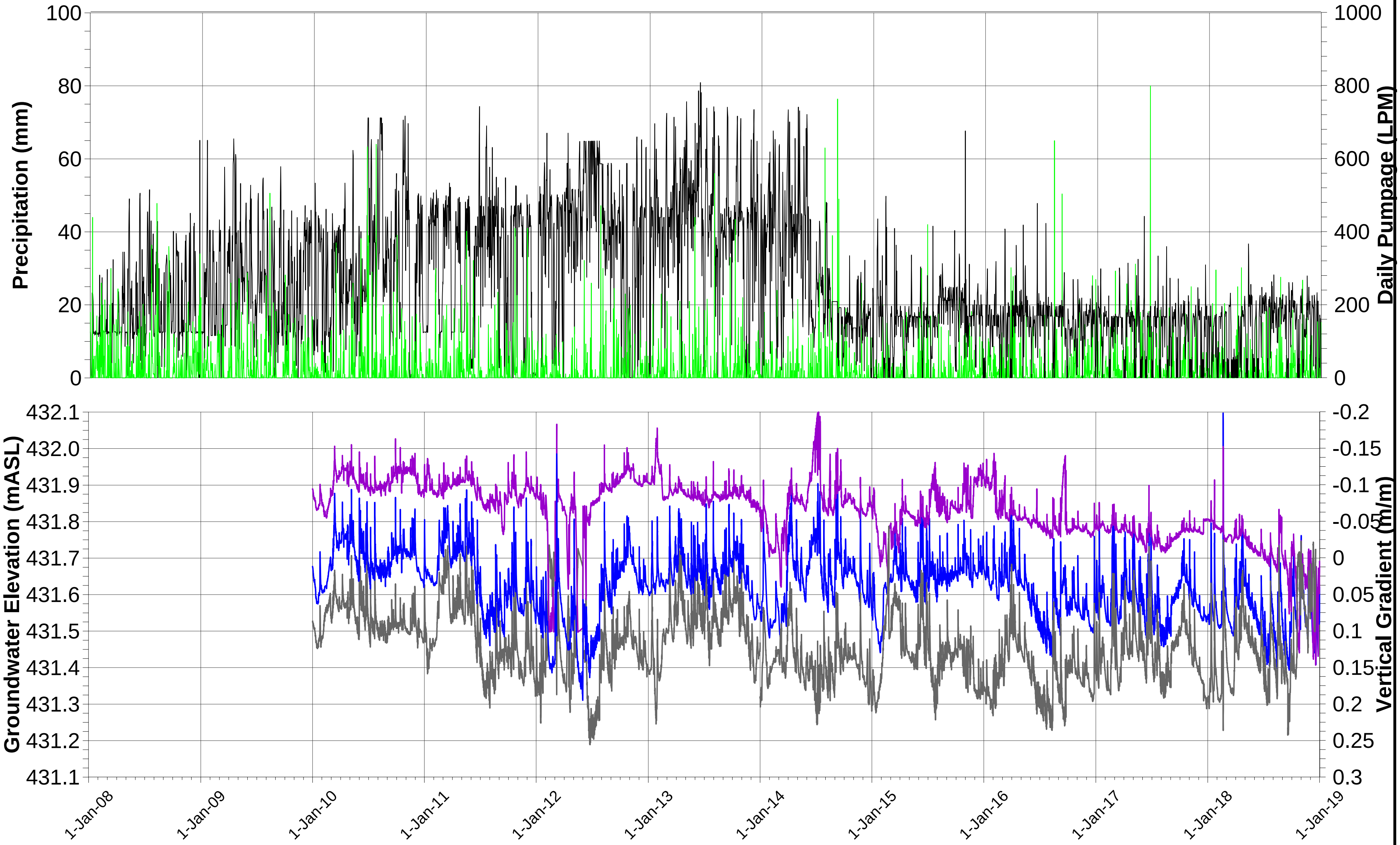
**PROJECT**

**NESTLE WATERS CANADA**
**Town of Erin, Ontario**

**TITLE**

**P12-07 NEST HYDROGRAPHS**
**AND VERTICAL GRADIENTS**

| PROJECT NO. | REV | FIGURE |
|---|---|---|
| 13-1152-0250 (9000) | A | G6 |



| | |
|---|---|
| — | TW1-88 Daily Pumpage |
| — | Precipitation |
| — | P13B-07 (Shallow) |
| — | P13A-07 (Deep) |
| — | Vertical Gradient OB/OB |

GOLDER

| | |
|---|---|
| **DATE** | DECEMBER 2018 |
| **DESIGN** | KS |
| **REVIEW** | GP |
| **APPROVED** | GP |

**PROJECT**

**NESTLE WATERS CANADA**
**Town of Erin, Ontario**

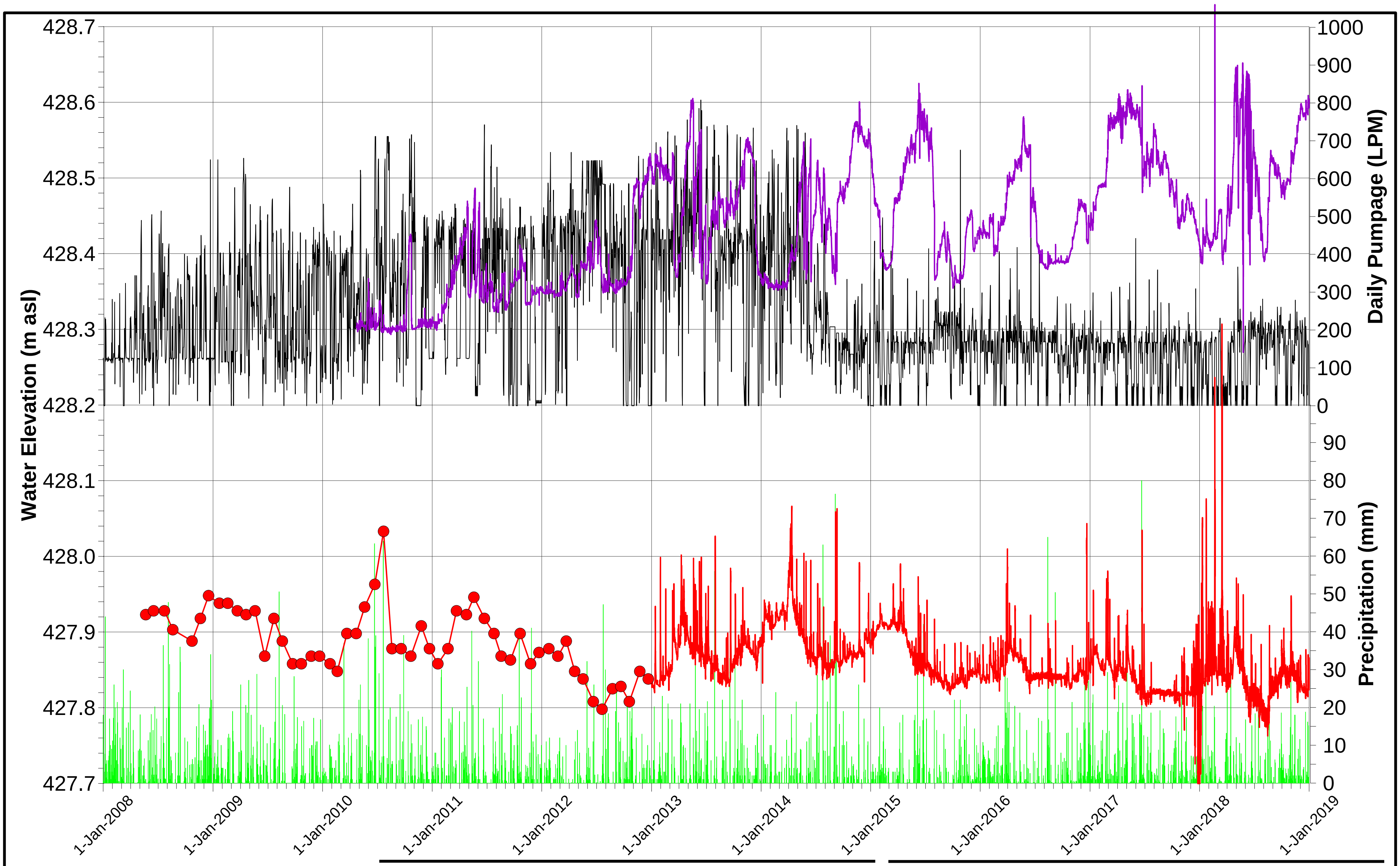
**TITLE**

**P13-07 NEST HYDROGRAPHS AND VERTICAL GRADIENTS**

| **PROJECT NO.** | **REV** | **FIGURE** |
|---|---|---|
| 13-1152-0250 (9000) | A | G7 |

## APPENDIX H

# Surface Water Hydrographs



— TW1-88 Daily Pumpage
🟩 Precipitation
— SW1-08 (Creek d/s of on-Site Pond)
— SW3-08 (on-Site Pond)

GOLDER

| | |
|---|---|
| **DATE** | DECEMBER 2018 |
| **DESIGN** | KS |
| **REVIEW** | GP |
| **APPROVED** | GP |

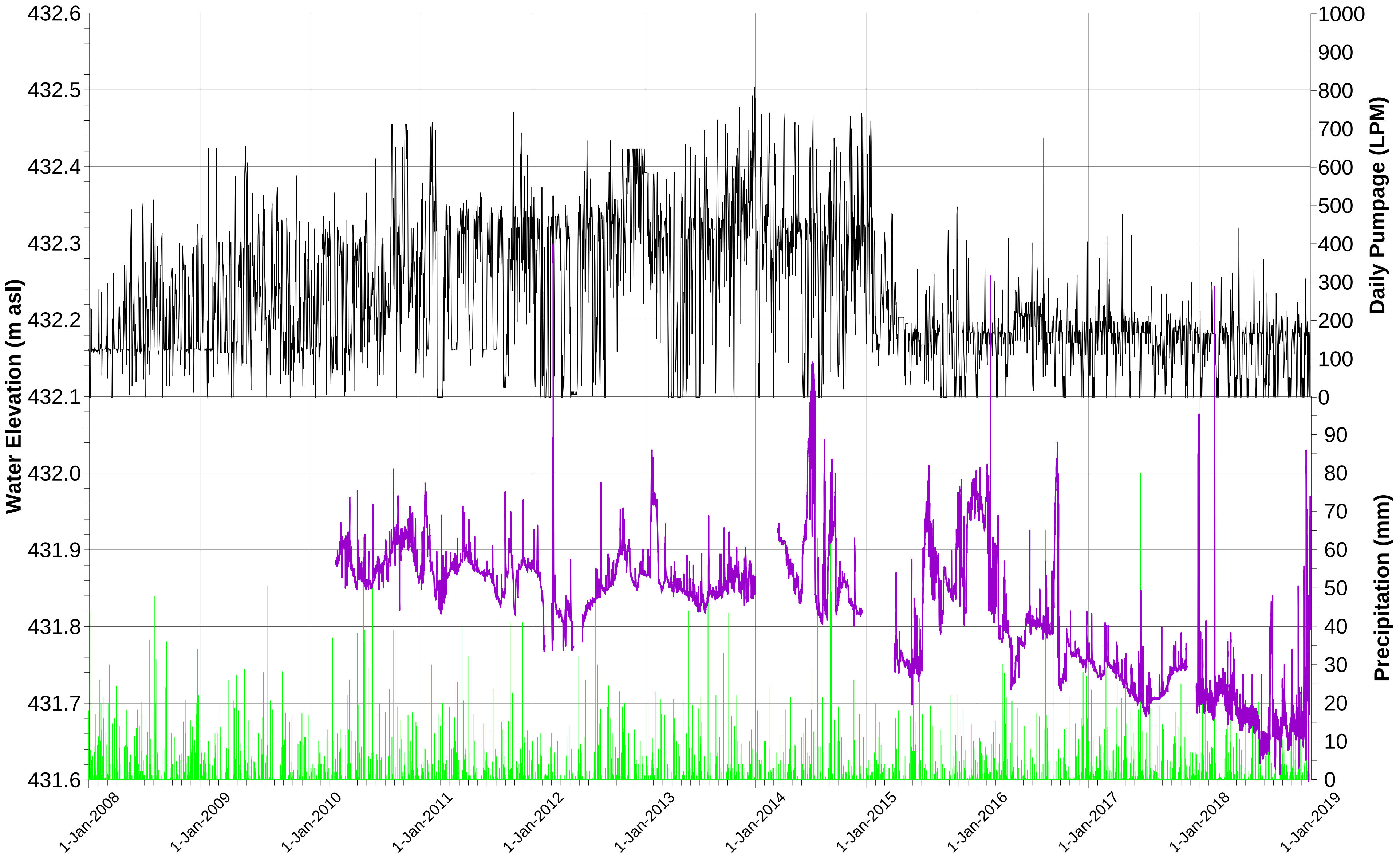
**PROJECT**

**NESTLE WATERS CANADA**
**Town of Erin, Ontario**

**TITLE**

**HYDROGRAPHS FOR SURFACE WATER LEVELS**
**IN VICINITY OF ON-SITE POND**

| **PROJECT NO.** | **REV** | **FIGURE** |
|---|---|---|
| 13-1152-0250 (9000) | A | H1 |



GOLDER

**DATE** DECEMBER 2018

**DESIGN** KS

**REVIEW** GP

**APPROVED** GP

**PROJECT**

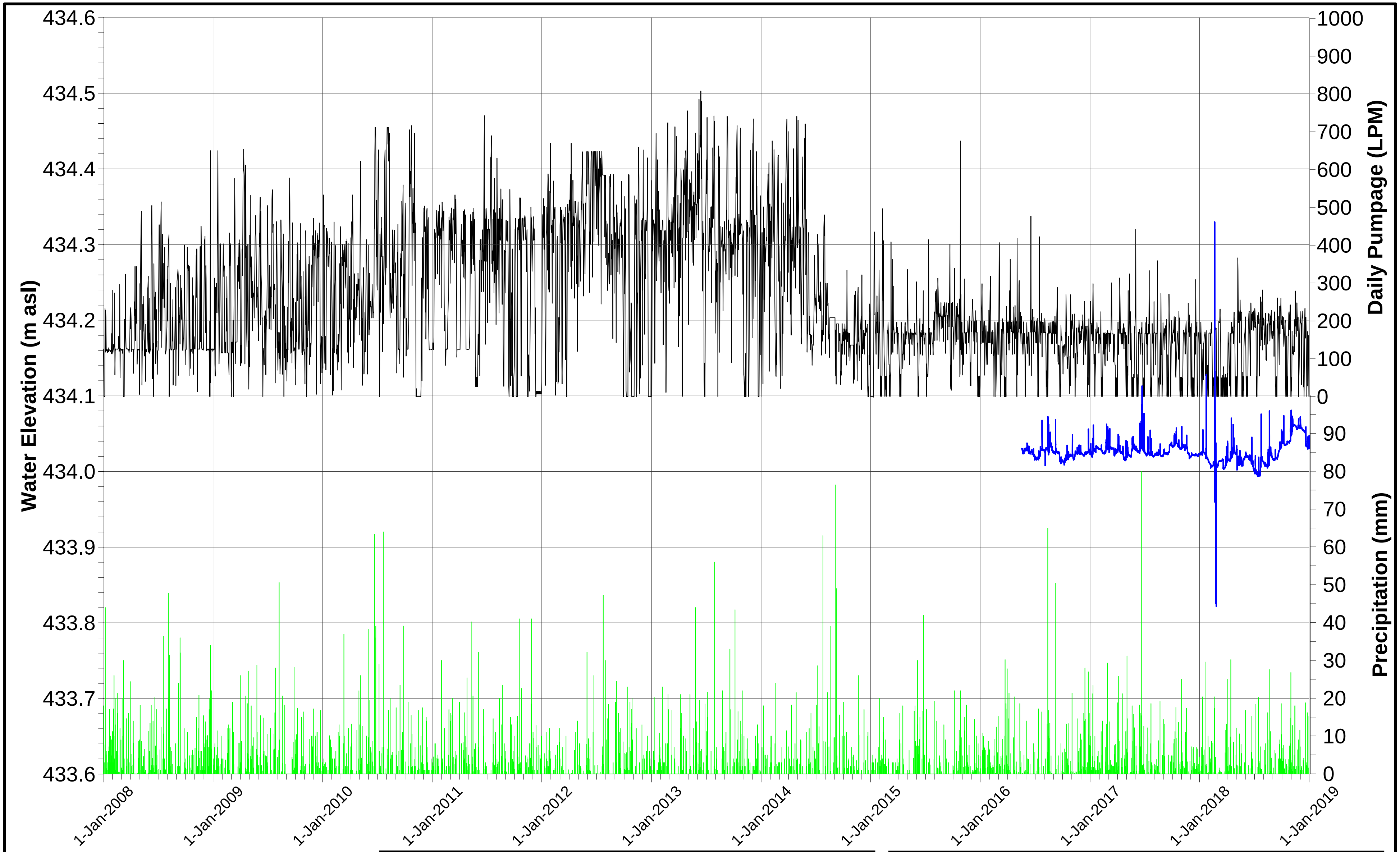
**NESTLE WATERS CANADA**

**Town of Erin, Ontario**

**TITLE**

## HYDROGRAPHS FOR SURFACE WATER LEVELS IN ERIN BRANCH OF CREDIT RIVER

| PROJECT NO. | REV | FIGURE |
|---|---|---|
| 13-1152-0250 (9000) | A | H2 |



GOLDER

**DATE** DECEMBER 2018
**DESIGN** KS
**REVIEW** GP
**APPROVED** GP

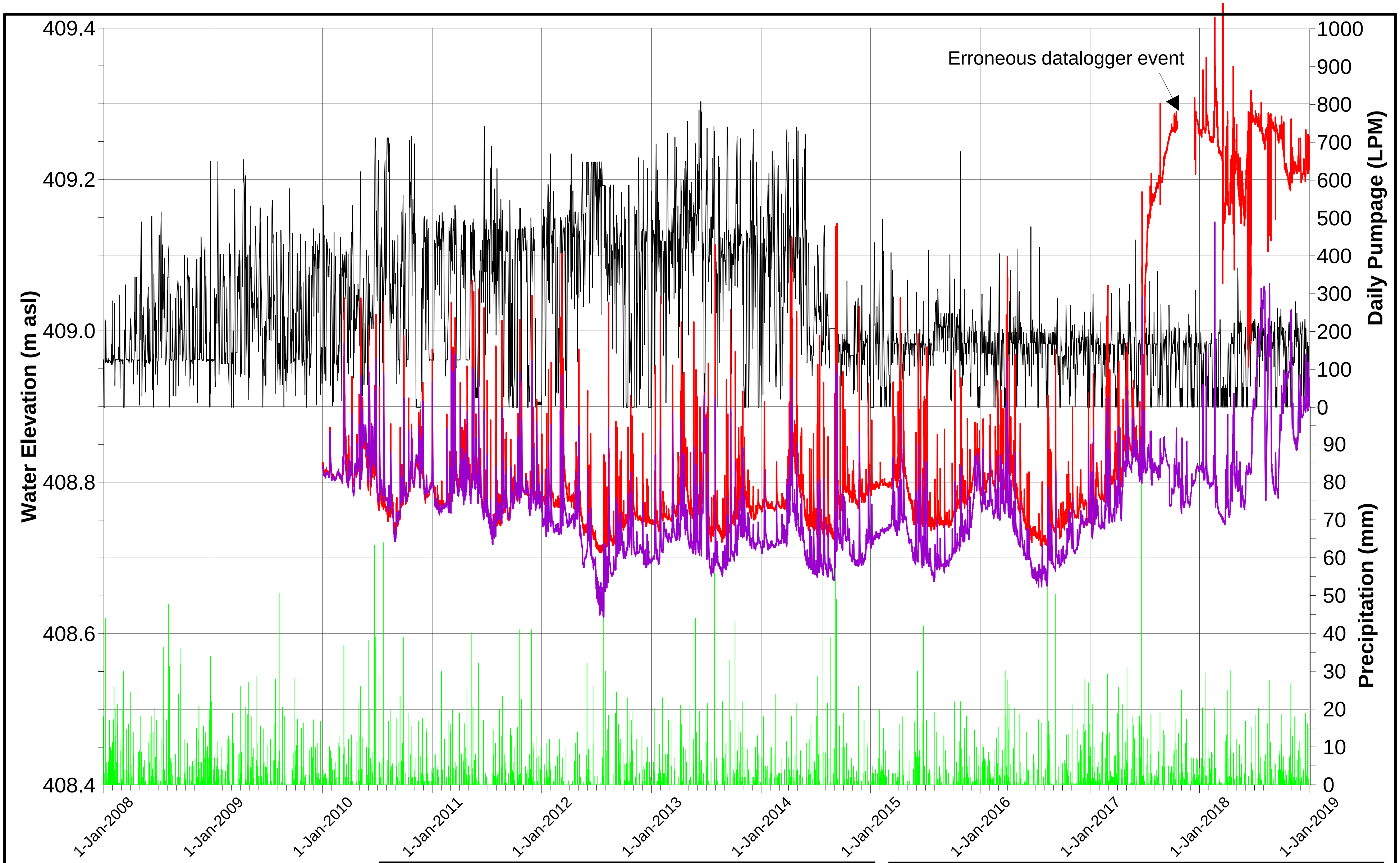
**PROJECT**

**NESTLE WATERS CANADA**
**Town of Erin, Ontario**

**TITLE**

**HYDROGRAPHS FOR SURFACE WATER LEVELS IN ERIN BRANCH OF CREDIT RIVER (2017 DATA)**

| **PROJECT NO.** | **REV** | **FIGURE** |
|---|---|---|
| 13-1152-0250 (9000) | A | H3 |



GOLDER

**DATE** DECEMBER 2018
**DESIGN** KS
**REVIEW** GP
**APPROVED** GP

**PROJECT**

**NESTLE WATERS CANADA**
**Town of Erin, Ontario**

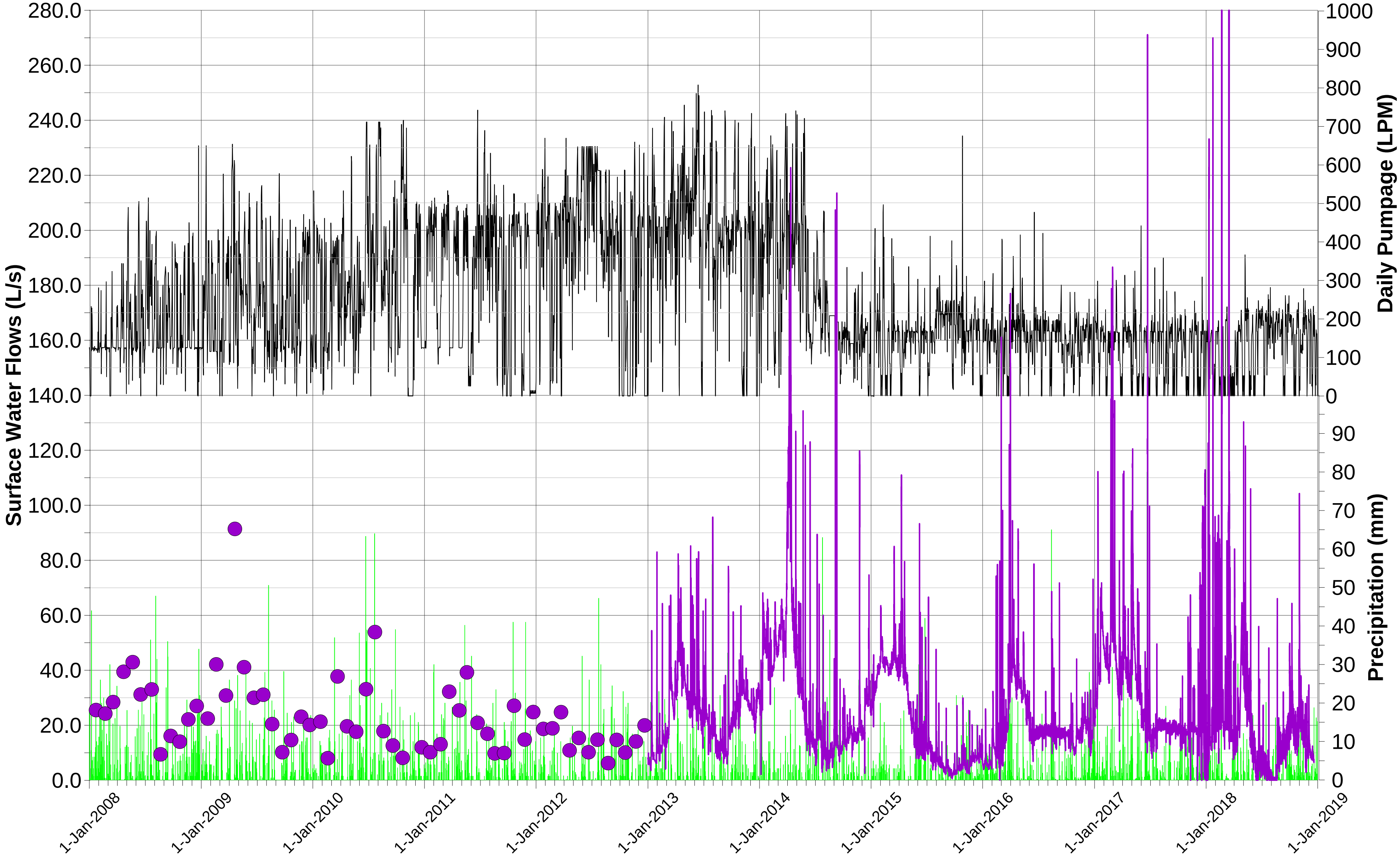
**TITLE**

**HYDROGRAPHS FOR SURFACE WATER LEVELS IN VICINITY OF ROMAN LAKE**

| **PROJECT NO.** | **REV** | **FIGURE** |
|---|---|---|
| 13-1152-0250 (9000) | A | H4 |

# APPENDIX I

# Surface Water Flow



— TW1-88 Daily Pumpage
🟩 Precipitation
● SW1-99
— SW1-08

GOLDER

| | |
|---|---|
| DATE | DECEMBER 2018 |
| DESIGN | KS |
| REVIEW | GP |
| APPROVED | GP |

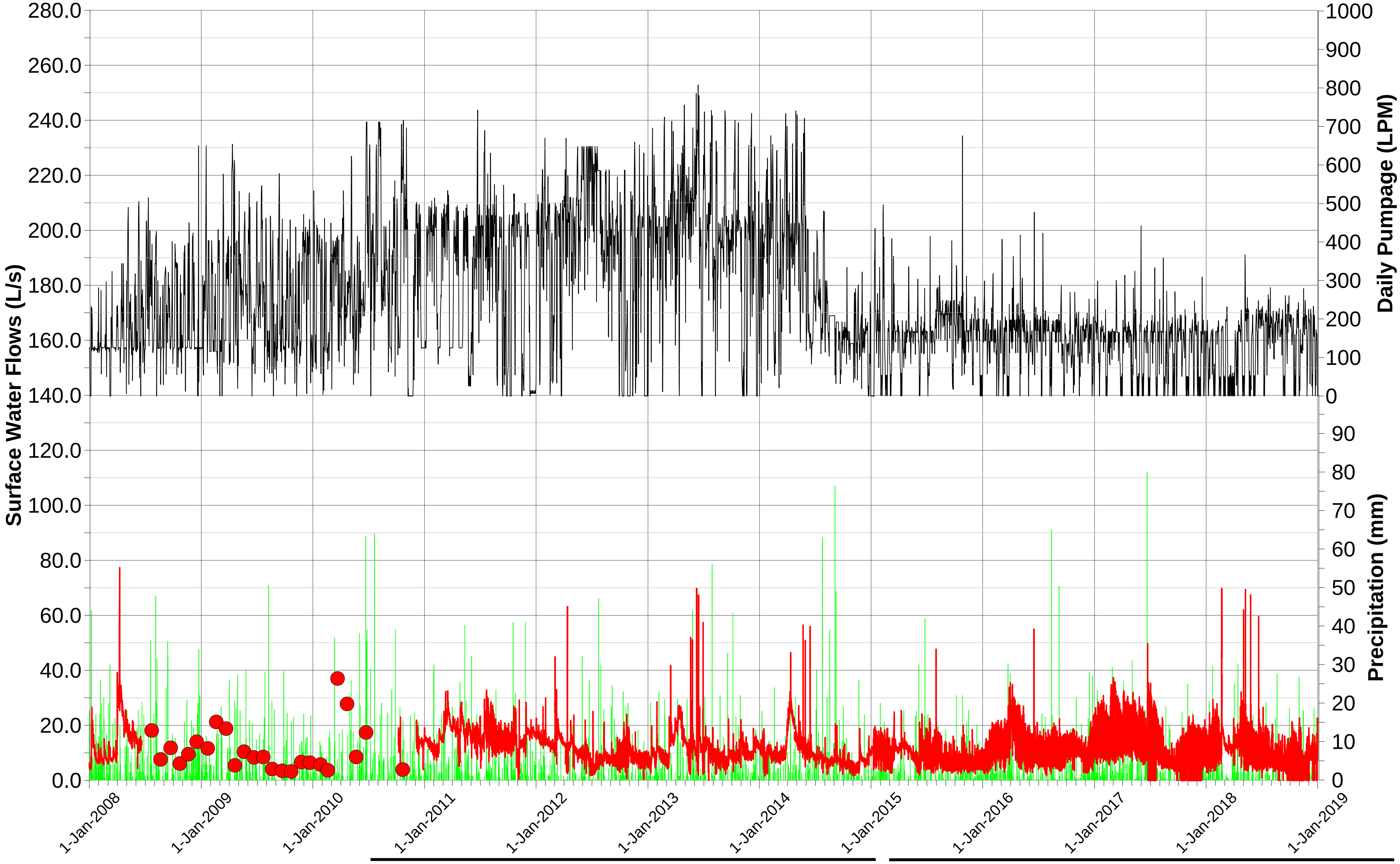
**PROJECT**

**NESTLE WATERS CANADA**
**Town of Erin, Ontario**

**TITLE**

**HYDROGRAPH FOR SW1-08 & SW1-99**

| PROJECT NO. | REV | FIGURE |
|---|---|---|
| 13-1152-0250 (9000) | A | I1 |



| | |
|---|---|
| — | TW1-88 Daily Pumpage |
| 🟩 | Precipitation |
| — | SW3-00 (from on-Site Pond) |

GOLDER

| | |
|---|---|
| **DATE** | DECEMBER 2018 |
| **DESIGN** | KS |
| **REVIEW** | GP |
| **APPROVED** | GP |

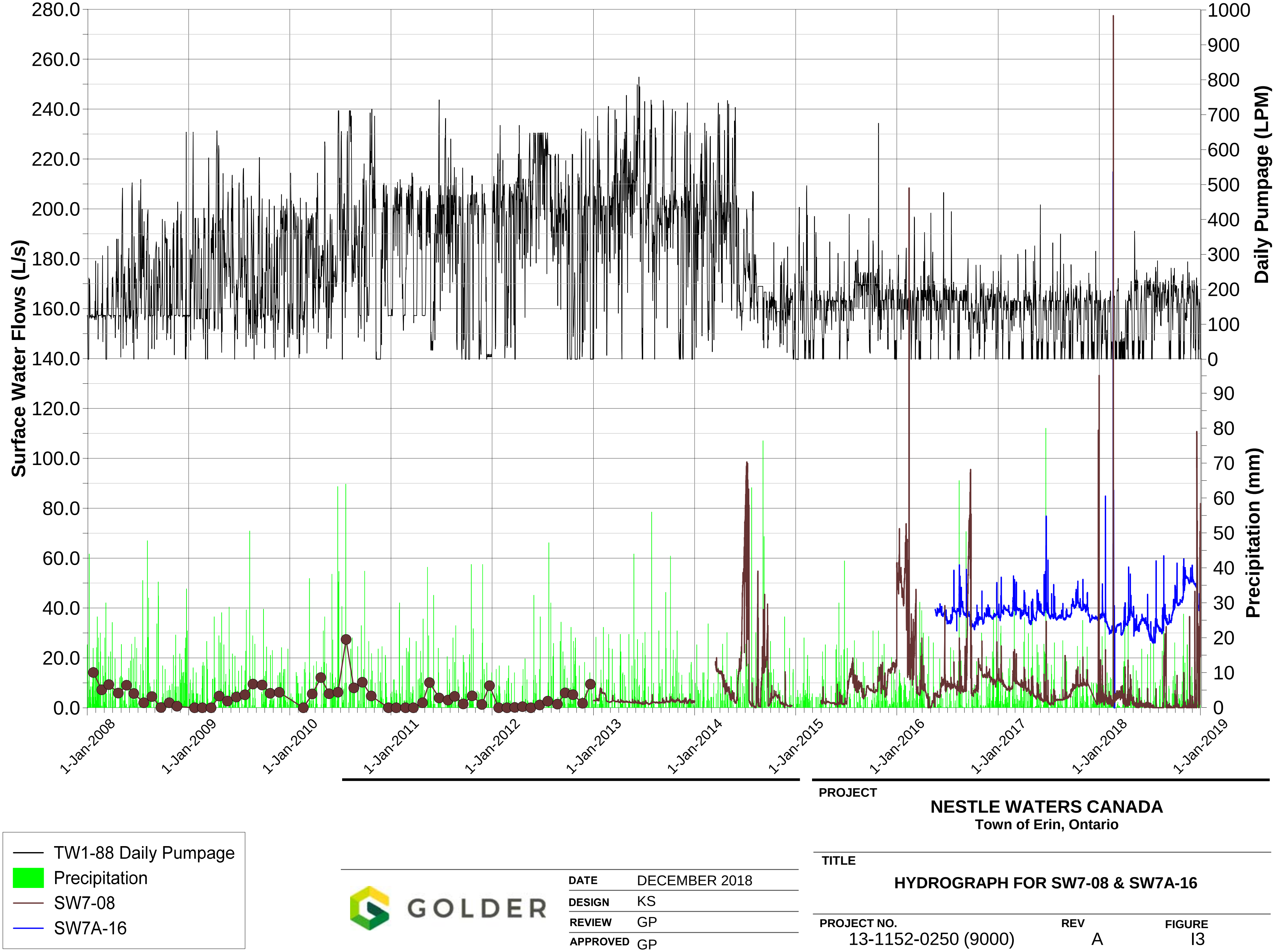
**PROJECT**

**NESTLE WATERS CANADA**
**Town of Erin, Ontario**

**TITLE**

**HYDROGRAPH FOR SW3-00**

| **PROJECT NO.** | **REV** | **FIGURE** |
|---|---|---|
| 13-1152-0250 (9000) | A | I2 |



GOLDER

| | |
|---|---|
| **DATE** | DECEMBER 2018 |
| **DESIGN** | KS |
| **REVIEW** | GP |
| **APPROVED** | GP |

**PROJECT**

**NESTLE WATERS CANADA**

**Town of Erin, Ontario**

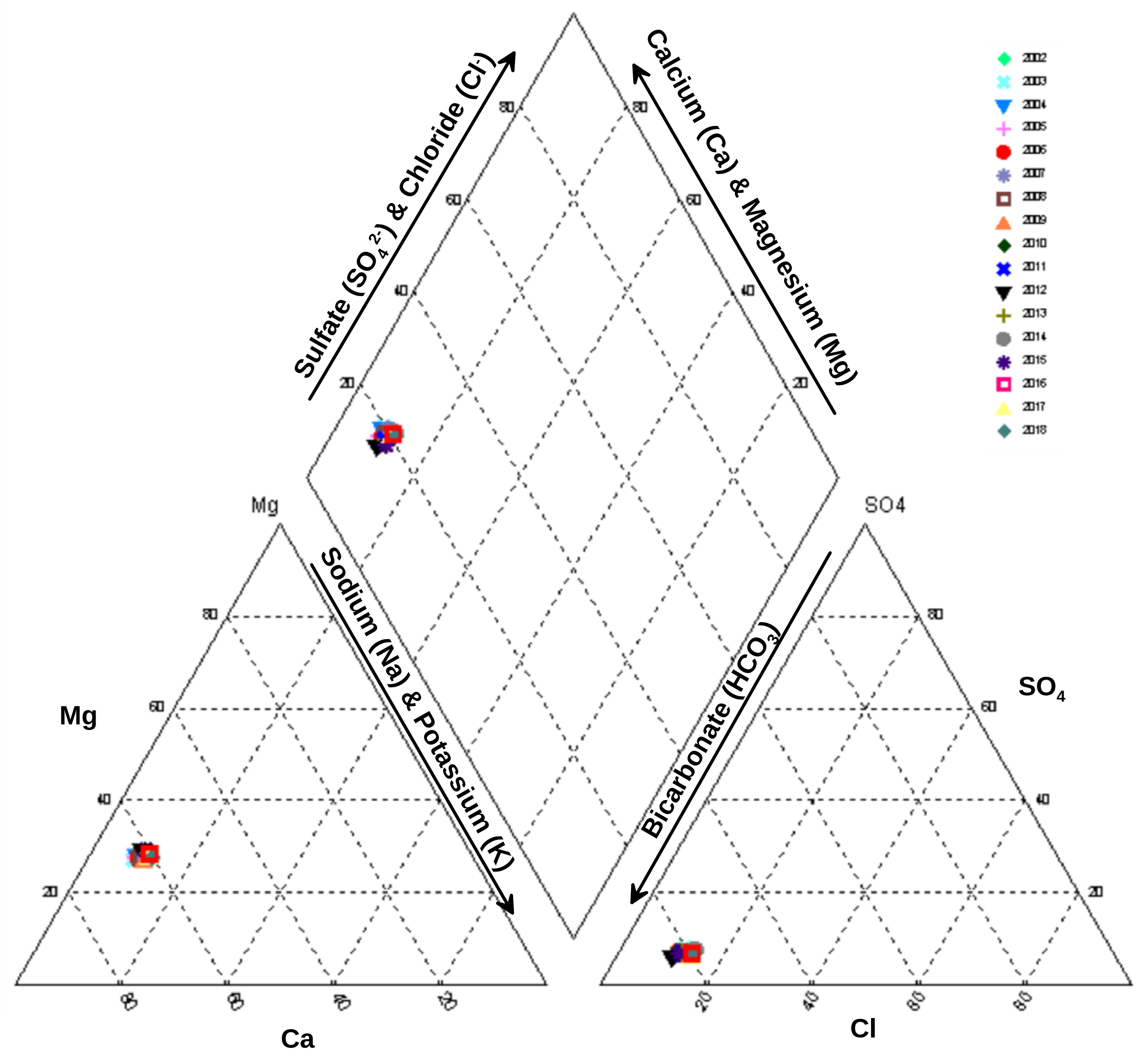
**TITLE**

**HYDROGRAPH FOR SW7-08 & SW7A-16**

| **PROJECT NO.** | **REV** | **FIGURE** |
|---|---|---|
| 13-1152-0250 (9000) | A | I3 |

# APPENDIX J

# Water Quality



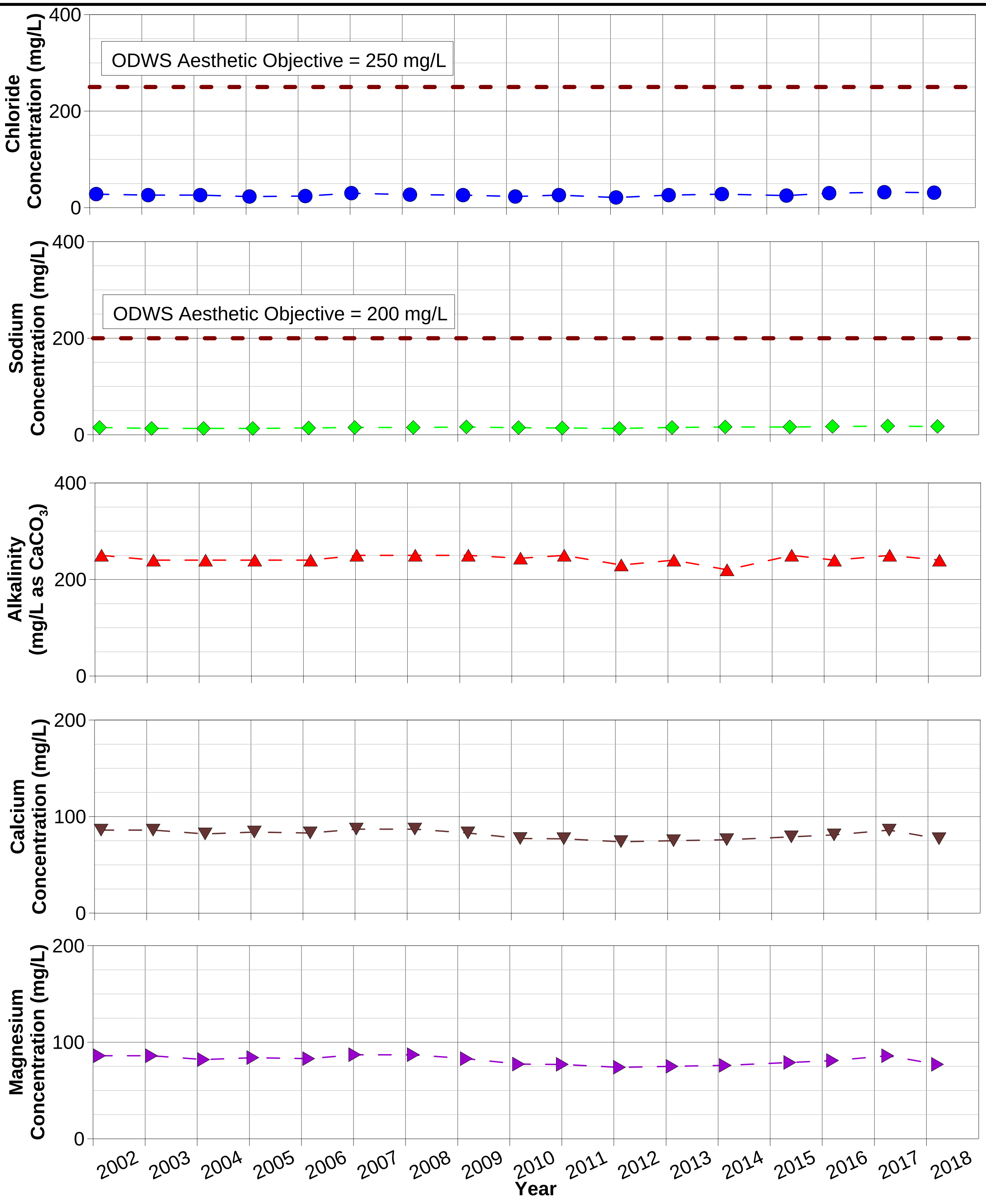
GOLDER

| | |
|---|---|
| DATE | 2018-JUL-10 |
| DESIGN | JLH |
| REVIEW | GRP |
| APPROVED | GRP |

PROJECT
**HYDROGEOLOGICAL STUDY**
**NESTLE WATERS CANADA**

TITLE
**PIPER PLOT**

| PROJECT NO. | REV | FIGURE |
|---|---|---|
| 13-1152-0250 (9000) | A | J1 |



GOLDER

| | |
|---|---|
| **DATE** | 2019-JUN-17 |
| **DESIGN** | JLH |
| **REVIEW** | GRP |
| **APPROVED** | GRP |

**PROJECT**
**HYDROGEOLOGICAL STUDY**
**NESTLE WATERS CANADA**

**TITLE**
**WATER QUALITY - TIME SERIES**

| **PROJECT NO.** | **REV** | **FIGURE** |
|---|---|---|
| 13-1152-0250 (9000) | A | J2 |

## APPENDIX K

# Groundwater Modelling Report

# GROUNDWATER MODELLING REPORT
# FOR RENEWAL OF THE PERMIT TO TAKE WATER FOR THE NESTLÉ WATERS CANADA ABERFOYLE AND ERIN FACILITIES

Report Prepared for:
**CITY OF GUELPH AND NESTLÉ WATERS CANADA**

Prepared by:
**MATRIX SOLUTIONS INC.**

Version 2.0
February 2019
Guelph, Ontario

Unit 7B, 650 Woodlawn Rd. W
Guelph, ON  N1K 1B8
T 519.772.3777   F 226.314.1908
www.matrix-solutions.com

# GROUNDWATER MODELLING REPORT

# FOR RENEWAL OF THE PERMIT TO TAKE WATER FOR THE NESTLÉ WATERS CANADA

# ABERFOYLE AND ERIN FACILITIES

Report prepared for City of Guelph and Nestlé Waters Canada, February 2019

PROFESSIONAL GEOSCIENTISTS
JEFFREY J. MELCHIN
PRACTISING MEMBER
2338
ONTARIO

Jeff Melchin

**Jeffrey Melchin, M.Sc., P.Geo.**
**Hydrogeologist**

February 11, 2019

LICENSED PROFESSIONAL ENGINEER
D. J. VAN VLIET
PROVINCE OF ONTARIO

Dave Van Vliet

reviewed by

**David Van Vliet, M.A.Sc., P.Eng.**
**Senior Vice President, Eastern Canada**

**DISCLAIMER**

Matrix Solutions Inc. certifies that this report is accurate and complete and accords with the information available during the project. Information obtained during the project or provided by third parties is believed to be accurate but is not guaranteed. Matrix Solutions Inc. has exercised reasonable skill, care, and diligence in assessing the information obtained during the preparation of this report.

Matrix Solutions Inc. was retained by the City of Guelph under contract to Nestlé Waters Canada. This report was prepared for the City of Guelph and Nestlé Waters Canada. The report may not be relied upon by any other person or entity without the written consent of Matrix Solutions Inc. and of the City of Guelph and Nestlé Waters Canada. Any uses of this report by a third party, or any reliance on decisions made based on it, are the responsibility of that party. Matrix Solutions Inc. is not responsible for damages or injuries incurred by any third party, as a result of decisions made or actions taken based on this report.

## VERSION CONTROL

| Version | Date | Issue Type | Filename | Description |
|---|---|---|---|---|
| V0.1 | 17-Sep-2018 | Draft | 26435-552 Groundwater Modelling R 2018-09-17 draft V0.1.docx | Issued for review |
| V0.2 | 17-Sep-2018 | Draft Revised | 26435-522 Groundwater Modelling R 2018-09-17 draft V0.2.docx | Issued for review with minor text revisions |
| V0.3 | 19-Dec-2018 | Draft Revised 2 | 26435-522 Groundwater Modelling R 2018-09-17 draft V0.3.docx | Updates throughout; issued for review |
| V1.0 | 22-Jan-2019 | Final | 26435-522 Groundwater Modelling R 2019-01-22 final V1.0.docx | Updates throughout; issued as final |
| V2.0 | 11-Feb-2019 | Final Revised | 26435-552 Groundwater Modelling R 2019-02-11 final V2.0.docx | Updates throughout; issued as final revised |

## TABLE OF ABBREVIATIONS

| | |
|---|---|
| CRA | Conestoga-Rovers and Associates |
| DEM | Digital Elevation Model |
| Earthfx | Earthfx Incorporated |
| FEFLOW | Groundwater Modelling Software |
| GAWSER | Guelph All-Weather Sequential Events Runoff |
| GCM | Global Climate Models |
| GRCA | Grand River Conservation Authority |
| GGET | City of Guelph and Township of Guelph/Eramosa |
| GRIN | Grand River Information Network |
| HSP-F | Hydrologic Simulation Program - Fortran |
| MECP | Ministry of Environment, Conservation, and Parks |
| MNR | Ministry of Natural Resources |
| MNRF | Ministry of Natural Resources and Forestry |
| MOE | Ministry of the Environment |
| MOECC | Ministry of Environment and Climate Change |
| NWC | Nestlé Waters Canada |
| PEST | Parameter ESTimation [Software] |
| PRMS | Precipitation-Runoff Modelling System |
| PTTW | Permit to Take Water |
| SSPA | S.S. Papadopulos and Associates |
| WWIS | Water Well Information System |

# TABLE OF CONTENTS

## LIST OF CHARTS

## LIST OF TABLES

## FIGURES

## APPENDICES

# 1 INTRODUCTION

The Ministry of Environment, Conservation and Parks (MECP) has provided new guidance outlining the requirements for the renewal of Permits to Take Water (PTTWs) for water bottling purposes (MOECC 2017). This guidance requires that an assessment of cumulative effects of renewed takings be completed using the highest tier water budget that has been completed under the *Clean Water Act*, 2006 (Government of Ontario 2018). In response to these requirements, Nestlé Waters Canada (NWC) arranged for the numerical groundwater flow model developed for the City of Guelph and Township of Guelph/Eramosa (GGET), *Tier Three Water Budget and Local Area Risk Assessment* (GGET Tier Three Assessment; Matrix 2017a) be updated in the areas of their Aberfoyle and Erin operations, and applied to assess cumulative effects as part of its PTTW renewal applications.

Matrix Solutions Inc. was retained by the City of Guelph, under contract with NWC, to refine the GGET Tier Three groundwater flow model (Tier Three model), to address the technical requirements of the *Interim Guidance Document* (MOECC 2017). The approach was based on the work plan agreed to by the City of Guelph and NWC (Matrix 2017b). This report outlines the work completed in support of meeting these requirements, including a cumulative effects water quantity risk assessment that considers current and drought conditions. The potential impacts of these conditions on local groundwater levels and municipal groundwater users, as well as the potential impacts on groundwater discharge to surface water features, were assessed using the refined Tier Three model. Finally, the model was applied to evaluate the potential change in groundwater levels and groundwater discharge under future climate conditions following the methodology described by Matrix (2018a).

Matrix worked with NWC and its consultants (S.S. Papadopulos & Associates [SSPA], Golder Associates, and Blackport Hydrogeology Inc.) to complete this numerical modelling project, which included the sharing of data between parties and consultations during data analysis, model refinement, and calibration. The project leveraged the experience and local knowledge of these consultants gained through multiple years of data collection and analysis in the areas of Aberfoyle and Erin. Final model review and model calibration was completed in consultation with SSPA.

This report summarizes the geologic and hydrogeologic settings (Section 2), updates made to the numerical model (Section 3), model calibration data and results (Section 4), and results of the predictive steady-state (long-term average), transient (time-varying), and future climate scenarios for the Aberfoyle and Erin sites (Section 5).

## 1.1 Tier Three Assessment

A Tier Three Assessment was previously completed for municipal drinking water systems of GGET within the Province of Ontario, Canada (Matrix 2017a). As a requirement under the province's *Clean Water Act* (Bill 43; Government of Ontario 2018), the purpose of the Tier Three Assessment was to identify the Water Quantity Threats to municipal drinking water systems, where those systems are located within a subwatershed classified as having a Moderate or Significant potential for water quantity stress during a Tier Two Water Quantity Stress Assessment (AquaResource 2009a; 2009b).

The scope of work completed for the GGET Tier Three Assessment and documented in Matrix (2017a) follows the Province of Ontario's *Technical Rules: Assessment Report, Clean Water Act, 2006* (Technical Rules; MOECC 2016), *Technical Bulletin: Part IX Local Area Risk Level* (Technical Bulletin; MOE and MNR 2010), and the *Memorandum: Assignment of Water Quantity Risk based on the Evaluation of Impacts to Other Water Users* (Technical Guidance Memorandum; MOE 2013). This work included the following tasks:

- Develop the conceptual understanding of the study area.
- Develop and calibrate a groundwater flow model with sufficient detail to simulate groundwater flow near municipal wells and surface water features.
- Develop and calibrate a streamflow-generation model to simulate variable streamflow in the area, and to estimate groundwater recharge rates in the study area.
- Apply the calibrated surface water and groundwater models to assess the water budget components in the Study Area and near municipal wells.
- Complete a Local Area Risk Assessment for the municipal wells located in the Study Area to determine if there is a risk that the municipal wells may not be able to meet current or future demands, while considering population growth, reduced groundwater recharge due to land development, and drought conditions.
- Identify Significant Water Quantity Threats, including consumptive water takings and areas of potential reduced groundwater recharge.

All stages of the GGET Tier Three Assessment, including development of the Tier Three model, were peer reviewed on behalf of the Lake Erie Source Protection Region by a Provincial Peer Review team consisting of hydrogeology and hydrology experts, to ensure that the technical aspects of the study complied with the *Technical Rules*. Municipalities local to the study area also provided technical review for consideration by the project team and Provincial Peer Review team.

### 1.1.1 Tier Three Assessment Groundwater Flow Model

To carry out the GGET Tier Three Assessment, a FEFLOW (version 6.2; Diersch 2014) groundwater flow model was developed based on the detailed conceptual model of the geologic, hydrologic, and hydrogeologic systems of the study area, with particular focus on the areas surrounding the City of Guelph and Rockwood and Hamilton Drive municipal well fields (Figure 1). The approach used to develop the Tier Three model built upon the approach followed to build the Guelph-Puslinch groundwater flow model (Golder 2006). The key advancements made in developing this updated and refined groundwater flow model were as follows:

- The geographic coverage of the Tier Three model was extended to include the Grand River to the west, and the Niagara Escarpment to the east (Figure 1). Carrying the model westward to the Grand River provided a natural boundary condition for groundwater flow. The Niagara Escarpment represents the physical location where the Gasport Formation bedrock aquifer, the main aquifer supplying the municipal water supplies, pinches out.

- The conceptual model was updated based on detailed interpretation of geologic units at numerous high-quality boreholes located throughout the area, whereas the bedrock conceptual model used in the Guelph-Puslinch groundwater flow model was simplified, and represented by layers of constant thickness.

- Groundwater level data from high quality groundwater monitoring wells installed by the City of Guelph and screened in discrete hydrogeologic units provided an improved and enhanced understanding of the bedrock flow system.

- The Township of Guelph/Eramosa conducted additional studies for the municipal systems in Rockwood that improved understanding of the bedrock system in that area.

- The groundwater flow model was refined to include additional surface water features that were not previously represented in the Guelph-Puslinch groundwater flow model.

The approach adopted to calibrate the Tier Three model included a combination of iterative manual and software-assisted (Parameter ESTimation [PEST]; version 12; Doherty 2013) calibration. The model was calibrated to long-term steady-state conditions, and to transient conditions that included the simulation of a long-term pumping test (City of Guelph) and shorter-term pumping tests. Transient model verification was also undertaken to confirm the performance of the model under transient conditions. The steady-state Tier Three model was calibrated to hydraulic head measurements from MOECC domestic water wells records, GGET high-quality monitoring wells, and other high-quality wells that are part of other studies. The model was also calibrated to streamflow targets assumed to be representative of baseflow conditions. These targets were estimated from spot baseflow observations and streamflow gauge data collected by the Grand River Conservation Authority (GRCA), Water Survey of Canada, and others, at locations throughout the study area.

Calibration of the groundwater flow model relied on estimates of groundwater recharge across the landscape represented by the model. Groundwater recharge estimates used in the calibration of the model include the following:

- The Grand River Watershed Guelph All-Weather Sequential Events Runoff (GAWSER) streamflow generation model (version 6.5; Schroeter & Associates 2004, AquaResource 2009a, Matrix 2017a).

- The Credit River Watershed HSP-F model (AquaResource 2009c).

- Halton and Hamilton Region Conservation Authorities Precipitation-Runoff Modelling System (PRMS) model (Earthfx 2009).

Additional information on the development and calibration of the groundwater and streamflow-generation and hydrologic models is provided in Appendices B, D, and E of Matrix (2017a), and references therein.

The version of the Tier Three model used in the update and calibration effort described in the following sections is based on the model developed for GGET Tier Three Risk Assessment Scenario C (Matrix 2017a), which includes consideration of average climate conditions (i.e., average recharge), existing municipal pumping, and existing non-municipal pumping. Non-municipal permits and pumping rates were updated in the model to reflect more recent data within the local groundwater vulnerable area as part of a *Water Quantity Policy Development Study* (Matrix 2018b). Specifically, the PTTW database (September 2017 data release) and Water Taking Reporting System (WTRS; 2009 to 2016) were reviewed to assess if the non-municipal permitted takings represented in the model were still representative of existing conditions. Permits that had expired were removed from the model and the rates were updated using 2016 WTRS data. Consumptive use (i.e., the amount of water removed from a source without being returned to the same source) was estimated using the method used in the GGET Tier Three Assessment. Based on this work, the total consumptive pumping in the local groundwater vulnerable area decreased by 966 $m^3$/day. These refined non-municipal pumping rates were carried forward for use in this project.

## 1.2 Nestlé Waters Canada Operations

### 1.2.1 Aberfoyle

The NWC Aberfoyle property is located within the Grand River Watershed, in the Township of Puslinch, approximately 3 km south of the City of Guelph, and 2 km north of Highway 401 along Wellington Road 46 (Figure 2). NWC is permitted to pump water from bedrock well TW3-80 for water bottling purposes, and bedrock well TW2-11 for miscellaneous purposes under PTTW 1381-95ATPY at a maximum total rate of 3,600 $m^3$/day; however, well TW2-11 has not been used to date. Permitted taking of water has been ongoing at the site since NWC purchased the pre-existing Aberfoyle Springs bottling facility in 2000, and in 2017 annual taking totaled 767,883 $m^3$.

NWC conducts annual environmental monitoring onsite that includes measurement of groundwater levels, mini-piezometer levels, surface water levels, flows, and temperatures. These monitoring locations are shown on Figure 2. A full description of the monitoring program and historical monitoring data is provided in annual monitoring reports prepared on behalf of NWC (e.g., Golder 2018a).

Notable surface water features in the area include Mill Creek, which runs from northeast to southwest just north of the NWC property (Figure 2). A portion of Mill Creek flow is diverted into Aberfoyle Creek in the area of the Mini Lakes community (Figure 2). At this point, Aberfoyle Creek continues south, into Aberfoyle Mill Pond, and then through the NWC property. Aberfoyle Creek rejoins Mill Creek just west of the NWC property (Figure 2).

### 1.2.2 Erin

The NWC Erin bedrock well TW1-88 is located in the Grand River Watershed, close to the surface water divide between the Grand River Watershed and the Credit River Watershed. It is situated in the Town of Erin, approximately 500 m southwest of the Community of Hillsburgh (Figure 1). NWC is permitted to pump water from this well for water bottling purposes, under PTTW 3716-8UZMCU, at a maximum rate of 1,113 $m^3$/day. Permitted water taking has been ongoing at the site since 2000 and in 2017 the annual taking was 66,075 $m^3$.

Similar to the Aberfoyle site, NWC conducts annual environmental monitoring onsite that includes measurement of groundwater levels, mini-piezometer levels, surface water levels and flows. These monitoring locations are shown on Figure 3. A full description of the monitoring program and historical monitoring data is provided in annual monitoring reports prepared on behalf of NWC (e.g., Golder 2018b).

Notable surface water features in the area include tributaries of the Eramosa River and the Erin Branch of the Credit River, which briefly cross into the NWC property along the northwestern and northeastern property corners, respectively (Figure 3). Tributaries and on-line ponds contributing to the Eramosa River originate on and just north of the NWC property before continuing out of the area toward the southwest and south. Similarly, tributaries and ponds associated with the Erin Branch of the Credit River originate north and northeast of the NWC property before entering the Hillsburgh Pond, flowing out of the study area to the south and east. South of the NWC property, a creek originating from Roman Lake drains toward the southeast, where it enters the main branch of the West Credit River.

## 2 GEOLOGIC AND HYDROGEOLOGIC SETTING

Detailed descriptions of the regional geologic and hydrologic settings are provided in Matrix (2017a). Descriptions of the local geologic and hydrogeologic settings near NWC operations are provided in the 2017 annual monitoring reports for Aberfoyle (Golder 2018a) and Erin (Golder 2018b). Summaries of how these local settings are represented in the Tier Three model are presented in the following sections.

## 2.1 Aberfoyle

### 2.1.1 Overburden

The local overburden geology of the Aberfoyle site generally consists of coarse-grained outwash and ice-contact sand and gravel deposits overlying a finer-grained stony, silt Wentworth Till. This till also makes up the Paris and Galt moraines that are mapped toward the north and south of the site, where the till thickens to surface. Overburden thickness near the site ranges from 15 to 20 m and organic deposits are mapped along Aberfoyle Creek as it crosses the NWC property (Golder 2018a).

In the Tier Three model the shallow, coarser-grained deposits are represented as “Overburden A,” upper sand and gravel aquifer. Below this, the finer-grained till deposits are represented as “Overburden B,” a lower till aquitard (Table 1).

### 2.1.2 Bedrock

The bedrock geology of the Aberfoyle site has been historically described (Golder 2018a) using bedrock nomenclature and interpretations made prior to more recent updates made by the Ontario Geological Survey (e.g., Brunton 2009). Under that previous framework, bedrock hydrogeologic units at the Aberfoyle site were described (from shallow to deep) as the Guelph Formation Aquifer overlying the Eramosa Member Aquitard, the Amabel Formation Aquifer, and the Cabot Head Formation Aquitard. This interpretation is consistent with the more regional bedrock interpretation that existed prior to the development of the Tier Three model, as summarized in Table 1. The development of the Tier Three model; however, incorporated the revised nomenclature (after Brunton 2009; Table 1) which included refinement into new and additional bedrock formations and members. Based on this revised framework, modelled hydrostratigraphic units included:

- Guelph Formation Aquifer
- Reformatory Quarry Member Aquifer/Aquitard (Eramosa Formation)
- Vinemount Member Aquitard (Eramosa Formation)
- Goat Island Formation Aquifer/Aquitard
- Upper Gasport Aquifer, Middle Gasport High Permeability Aquifer, and Lower Gasport Aquifer units of the Gasport Formation
- Cabot Head Formation Aquitard

A comparison of these modelled hydrostratigraphic units and how they relate to the current and previous bedrock conceptualizations is presented in Table 1. Additional details on these hydrostratigraphic units are found in Matrix (2017a).

Monitoring well calibration targets are classified with respect to dominant hydrogeological units, including the Upper Bedrock Aquifer (bedrock targets above the Vinemount Aquitard) and Lower

Bedrock Aquifer (bedrock targets below the Vinemount Aquitard). This simplified conceptualization is also provided in Table 1.

**TABLE 1 Aberfoyle - Conceptualization of Stratigraphic Framework**

| Bedrock Conceptualization Previous to GGET Tier Three Study[1] | | Bedrock Conceptualization for GGET Tier Three Study[2] | | GGET Tier Three Model Representation of Hydrostratigraphic Units[3] | | Simplified Conceptualization at NWC Site for Calibration Targets |
|---|---|---|---|---|---|---|
| Formation | Member | Formation | Member | Hydrostratigraphic Unit | Model Layer | |
| Overburden | | Overburden | | Overburden A<br>(Upper Sand/Gravel Aquifer) | 1-2 | Overburden Targets |
| | | | | Overburden B<br>(Lower Till Aquitard) | 3 | |
| Guelph Fm. | | Guelph | Hanlon | Contact Zone (fractured bedrock / basal unconsolidated deposits) | 4 | Upper Bedrock Aquifer Targets |
| | | | Wellington | Guelph Fm. (Aquifer) | 5 | |
| Amabel | Eramosa | Eramosa | Stone Road | | | |
| | | | Reformatory Quarry | Reformatory Quarry Mbr.<br>(Aquifer/Aquitard) | 6 | |
| | | | Vinemount | Vinemount Mbr. (Aquitard) | 7-9 | Middle Bedrock Aquitard |
| | Wiarton / Colpoy / Lions Head | Goat Island | Ancaster / Niagara Falls | Goat Island Fm.<br>(Aquifer/Aquitard) | 10 | Lower Bedrock Aquifer Targets |
| | | Gasport | Gothic Hill | Upper Gasport Unit (Aquifer) | 11 | |
| | | | | Middle Gasport Unit<br>(High Permeability Aquifer) | 12 | |
| | | Rochester / Irondequoit / Rockway / Merritton Fms. | | Lower Gasport Unit (Aquifer) | 13 | |
| Cabot Head/Reynales Fm. | | Cabot Head Fm. | | Cabot Head Fm. (Aquitard) | 14 | Cabot Head Fm. (Aquitard) |

[1] Golder (2006)
[2] After Brunton (2009)
[3] Matrix (2017a)

### 2.1.3 Simulated Hydrostratigraphy and Groundwater Flow

Cross-sections were created to illustrate the GGET Tier Three hydrostratigraphy compared to the interpretation provided in Golder (2018a). Figure 2 shows the locations of Cross-section A-A′ (Figure 4) extending from the northwest to the southeast, and Cross-section B-B′ (Figure 5) extending from the southwest to the northeast. Each cross-section illustrates the horizontal conductivity distribution in the calibrated Tier Three model described in Section 4. The GGET Tier Three hydrostratigraphic layers (elevation and thickness) were assumed to be acceptable for this assessment, and model modifications were made by adjusting hydraulic conductivities locally.

Figures 4 and 5 illustrate the locations of the higher permeability hydrostratigraphic units, including the overburden (Overburden A), Contact Zone, Guelph Formation, Reformatory Quarry Member, and the Middle Gasport Formation aquifers. The other units in the Aberfoyle area are simulated with relatively lower hydraulic conductivity, except for small zones in the Goat Island Formation and overlying Vinemount Member. These localized zones of higher conductivity correspond to areas where there was a stronger water level response during pumping tests, suggesting a greater hydraulic connection to the pumping well. There may be differences in bedrock formations interpreted between the cross-sections provided in Golder (2018a), and the refined interpretations presented in Figures 4 and 5. For example, the Guelph Formation is conceptualized to exist in Cross-section A-A' of Golder (2018a); however, the Reformatory Quarry Member of the Eramosa Formation is conceptualized along the same portion of cross-section in the GGET Tier Three model (Figure 4).

NWC production well TW3-80 is completed within the high conductivity zone of the Goat Island Formation and within this unit groundwater is simulated to flow regionally from the north to the south, with a local low in the potentiometric surface from NWC pumping (Figure 6). The simulated potentiometric surface of Figure 6 is based on a simulated pumping rate of 2,113 $m^3$/day, representing average NWC Aberfoyle pumping conditions from 2015 to 2017. The interpreted observed potentiometric surface of the production aquifer is provided in Figure 4.3 of Golder (2018a).

## 2.2 Erin

### 2.2.1 Overburden

The local overburden geology of the Erin site is similar to that of the Aberfoyle site, with a coarser-grained glaciofluvial outwash or ice-contact stratified drift overlying a deeper, finer-grained clay to sandy silt till, with more recent organic deposits found along watercourses. The shallower sand and gravel deposits generally thicken to the northwest, whereas the deeper finer-grained till is continuous across the site, and in some areas where it thickens it outcrops at surface. The outcrop area includes portions of the NWC property and areas toward the east and south where the till is associated with topographically high areas (Golder 2018b). At NWC production well TW1-88, the overburden is approximately 20 m thick.

In the Tier Three model the shallow, coarser-grained deposits are represented as "Overburden A," an upper sand and gravel aquifer. Below this, the finer-grained till deposits are represented as "Overburden B," a lower till aquitard (Table 2).

### 2.2.2 Bedrock

The bedrock geology of the Erin site has been previously described locally using a bedrock nomenclature that includes the Guelph Formation overlying the Amabel Formation (Golder 2018b). The focus of the GGET Tier Three bedrock conceptualization was the Guelph area, and as a result, there were fewer high quality locations gathered and interpreted for the bedrock conceptualization in the Erin area. As a result, the elevations of the GGET Tier Three bedrock layers did not initially align with the bedrock layers currently conceptualized onsite. The modelled bedrock layer interpretations were refined in the Erin area based on local expertise provided by Blackport Hydrogeology Inc. and examination of local well logs. The revised model hydrostratigraphy for the Erin area is summarized in Table 2, along with the associated model layers and previous interpretation.

Based on the refined conceptualization, the updated modelled bedrock hydrostratigraphic units in the Erin area include a thicker Guelph Formation Aquifer overlying the Vinemount Aquitard, Gasport Formation Aquifer, and Cabot Head Formation Aquitard (Table 2). Similar to the Aberfoyle area, the hydraulic conductivity of simulated hydrostratigraphic units were refined locally, as opposed to introducing new layer elevations. For example, the hydraulic conductivity of model layers 5 to 10, that were previously conceptualized as four different bedrock units, were refined during the calibration process (Section 4) to the same values representing a thicker Guelph Formation.

**TABLE 2 Erin - Conceptualization of Stratigraphic Framework**

| Tier Three Model Representation of Hydrostratigraphic Units[1] | Model Layer | Conceptualization Update for Erin Area |
|---|---|---|
| Overburden A<br>(Upper Sand/Gravel Aquifer) | 1-2 | Overburden A<br>(Upper Sand/Gravel Aquifer) |
| Overburden B<br>(Lower Till Aquitard) | 3 | Overburden B<br>(Lower Till Aquitard) |
| Contact Zone (fractured bedrock / basal unconsolidated deposits) | 4 | Contact Zone (fractured bedrock / basal unconsolidated deposits) |
| Guelph Fm. (Aquifer) | 5 | Guelph Fm. (Aquifer) |
| Reformatory Quarry Mbr. (Aquifer/Aquitard) | 6 | |
| Vinemount Mbr. (Aquitard) | 7-9 | |
| Goat Island Fm. (Aquifer/Aquitard) | 10 | |
| Upper Gasport Unit (Aquifer) | 11 | Vinemount Mbr. (Aquitard) |
| Middle Gasport Unit<br>(High Permeability Aquifer) | 12 | Gasport Fm. (Aquifer) |
| Lower Gasport Unit (Aquifer) | 13 | |
| Cabot Head Fm. (Aquitard) | 14 | Cabot Head Fm. (Aquitard) |

[1] Matrix (2017a)

### 2.2.3 Simulated Stratigraphy and Groundwater Flow

Cross-sections were created to illustrate the GGET Tier Three hydrostratigraphy compared to the interpretation provided in Golder (2018b). Figure 3 shows the locations of Cross-section A-A′ (Figure 7) extending from the northwest to the southeast, and Cross-section B-B′ (Figure 8) extending from the southwest to the northeast. Each of the cross-sections illustrate the final hydraulic conductivity distribution achieved following the calibration effort described in Section 4. Figures 7 and 8 illustrate the hydrostratigraphic units with relatively higher hydraulic conductivity, including the overburden (Overburden A), Contact Zone, Guelph Formation, and the Gasport Formation aquifers. The other units in the Erin area are simulated with relatively lower hydraulic conductivity.

NWC production well TW1-88 is completed within the Guelph Formation, and within this unit groundwater is simulated to flow regionally from northwest to southeast (Figure 9), with a local depression in the potentiometric surface in response to NWC pumping. The simulated hydraulic head contours also show a hydraulic gradient toward the Erin Branch of the Credit River as it flows toward the Town of Erin to the east. The simulated potentiometric surface of Figure 9 is based on a simulated pumping rate of 207 $m^3$/day, representing average NWC Erin pumping conditions from 2015 to 2017. The interpreted observed potentiometric surface of the bedrock aquifer is provided in Figure 4.3 of Golder (2018b).

# 3 TIER THREE MODEL UPDATES

Local refinements to the Tier Three model were carried out in consultation with SSPA, Golder, and Blackport. This section describes the following updates made to the Tier Three model surrounding the NWC Aberfoyle and Erin sites:

- Revisions to the distribution and properties of hydrogeologic units.
- Mesh refinement around local surface watercourses, water bodies, and pumping wells.
- Addition of, and refinements to, boundary conditions representing surface watercourses and water bodies.
- Relocation and refinements to the magnitude of existing pumping well boundary conditions.
- Local model recalibration to account for the above refinements.

These model updates are discussed in the following sections for the Aberfoyle and Erin sites. Model calibration is discussed in Section 4.

## 3.1 Aberfoyle

The development and calibration of the GGET Tier Three model incorporated some local information, specifically in the Goat Island Formation, where NWC production well TW3-80 is completed (Matrix 2017a, Appendix E). Further updates and calibration in the Aberfoyle area as part of this current model refinement effort included a more fulsome examination of data from Lower Bedrock Aquifer units (below the Vinemount Aquitard), Upper Bedrock Aquifer units (above the Vinemount Aquitard), overburden sediments, and surface water features. Key data sources included:

- NWC 2017 Annual Monitoring Report (Golder 2018a).
- NWC 2010 Annual Monitoring Report (CRA 2011).

- Spatial data available from the online GRCA Grand River Information Network (GRIN) - Mapping used included 1 m ground surface topography contours, water bodies, and watercourses (GRCA 2018).

With the availability of long-term average water level data (Golder 2018a) and detailed water level response observations in various hydrostratigraphic units during a 40-day constant rate pumping test at TW3-80 (CRA 2011), refinements were made to the groundwater flow model to improve local, well-field scale response to NWC pumping, including:

- Refining the finite element mesh around TW3-80 and local surface water features.
- Adjusting the simulated horizontal location of TW3-80 following mesh refinement.
- Updating hydraulic conductivity values applied in different hydrostratigraphic units based on calibration to long-term average and pumping conditions (detailed in Section 4).
- Adding new and refining existing boundary conditions representing surface watercourses and water bodies (discussed in greater detail in the following section).

### 3.1.1 Representation of Surface Water Features

Groundwater flow models allow water to move between groundwater and surface water features through surface water boundary conditions. Surface water features are represented in the Tier Three model by assigning a specified head (water elevation) boundary condition to each model node along streams or rivers. The specified head, or water elevation, at each boundary condition was assumed to be the ground surface elevation at that location, as estimated from the 10 m Digital Elevation Model (DEM) of the ground surface available at the time of the GGET Tier Three Assessment. Observed water level elevation data were used for assigning specified head boundaries for larger water bodies in the model (e.g., lakes and reservoirs) where those data were available.

For this model update, the addition of new and refined boundary conditions was important to represent watercourses at a finer scale than was incorporated into the Tier Three model. In particular, Aberfoyle Creek, which runs through the NWC Aberfoyle property (Figure 2) was not previously represented in the Tier Three model due to its small size. NWC has collected water levels and flows along Aberfoyle Creek as part of the annual monitoring program (Golder 2018a). As the predicted change in groundwater discharge to Mill Creek is being assessed as part of this project, and since Aberfoyle Creek feeds into Mill Creek just west of the NWC property, Aberfoyle Creek was represented in the model.

Spatial watercourse mapping from the GRCA's online GRIN dataset (GRCA 2018) was used to approximate the location and path of the creek, and average observed water levels (Golder 2018a) were used to assign specified head boundary conditions at surface water monitoring stations SW01 and SW02 (Figure 2). Boundary conditions along Aberfoyle Creek between these stations were linearly interpolated along the creek from the observed water levels. Other parts of Aberfoyle Creek, as well as other local water bodies (e.g., Aberfoyle Mill Pond and Mini Lakes) and streams were incorporated into the model with assigned specified head values estimated from current topographic mapping available through the GRCA GRIN dataset (GRCA 2018).

## 3.2 Erin

The Erin NWC site is located more than 15 km from the municipal supply wells of the City of Guelph, Town of Rockwood, and community of Hamilton Drive, where the physical characterization and model calibration was focussed. Additional local information was obtained for the site to improve characterization and calibration locally. Key data sources included:

- NWC Annual Monitoring Reports (Golder 2018b and CRA 2014a).
- *Well Construction and Testing Investigations* (CRA 1989).
- Insights from Blackport Hydrogeology Inc., who have considerable local hydrogeological experience.
- Spatial data available from the online GRCA GRIN dataset. Mapping used included 1 m ground surface topography contours, water bodies, and watercourses (GRCA 2018).

The following refinements were made to the Tier Three model using these data sources, and the long-term water level monitoring data contained therein, to support local, well-field scale calibration:

- Refining the finite element mesh around TW1-88 and local surface water features.
- Adjusting the simulated horizontal and vertical locations of TW1-88, Hillsburgh municipal Wells 2 and 3.
- Updating the pumping rates of Hillsburgh Wells 2 and 3 from the original estimates in the Tier Three model (i.e., 216 $m^3$/day [H2] and 216 $m^3$/day [H3]) to more recent (2011 to 2013) average pumping rates (i.e., 67 $m^3$/day [H2] and 101 $m^3$/day [H3] [Blackport Pers. Comm. 2018]). Total pumping from the Hillsburgh municipal wells has remained relatively constant (e.g., 163 to 179 $m^3$/day from 2016 to 2017; Town of Erin 2017, 2018).
- Updating hydraulic conductivity values applied in different hydrostratigraphic units based on the local hydrostratigraphy and calibration to long-term average and pumping conditions (detailed in Section 4).
- Adding new and refining existing boundary conditions representing surface watercourses and water bodies (discussed in greater detail in the following section).

### 3.2.1 Representation of Surface Water Features

Boundary conditions representing interactions between groundwater and surface water were added in the NWC Erin area following the same approach used in Aberfoyle. The location and path of new stream and pond boundary conditions were guided by spatial data from the GRCA GRIN dataset for the Grand River Watershed and from the Ontario Ministry of Natural Resources and Forestry (MNRF) for the Credit River Watershed.

Average observed water levels (Golder 2018b) were used to assign specified head boundary conditions at local surface water monitoring locations SW1-08, SW3-08, SW4-08, SW5-08, SW7-08, and SW7A-16 (Figure 3). Boundary conditions in other areas were assigned based on where 1 m ground surface topography contours cross surface water features. Linear interpolation was used to assign boundary conditions between locations assigned using observed water levels or topography contours, and to link them to surface water features already represented in the model. Blackport Hydrogeology Inc. provided water level data for the pond in Hillsburgh (Blackport Pers. Comm. 2018). Finally, boundary conditions were assigned using the elevation of the existing simulated ground surface in the Credit River Watershed where more detailed information was lacking.

# 4 MODEL CALIBRATION

Given the model updates described in Section 3, and the availability of long-term average and pumping water level monitoring data, local-scale model calibration was completed in the Tier Three model at the NWC Aberfoyle and Erin sites. The calibration effort was carried out in consultation with SSPA, Golder, and Blackport. Following calibration to observed water levels (Appendix A), simulated groundwater discharge to local streams was compared to baseflow and streamflow estimates to verify that the model adequately represents observed streamflow conditions. These calibrations are further discussed in Section 4.1 and 4.2 for the Aberfoyle and Erin sites, respectively.

## 4.1 Aberfoyle

Calibration in the Aberfoyle area involved making local refinements to zones of hydraulic conductivity in different hydrostratigraphic units in the Tier Three model to achieve a match between observed and simulated water levels. Both long-term average water level data, as well as measured recovery following a 40-day constant rate pumping test were used during the calibration process. The objective was to improve agreement with the model against both datasets.

### 4.1.1 Hydraulic Conductivity

Hydraulic conductivity values were adjusted during model calibration within the range of hydraulic conductivity and transmissivity estimates from other studies (e.g., Matrix 2017a, CRA 2014b, CRA 2011, and Golder 2018a) and references therein. Table 3 summarizes the final calibrated range of revised hydraulic conductivity values applied to the update areas in each hydrostratigraphic unit, along with the ranges used prior to the update and values estimated from field data. In general, the refined hydraulic conductivity values were within, or very close to, the estimated ranges derived from field data (Table 3). Figures B1 to B7 (Appendix B) present the final conductivity values applied for the zones that were updated in each hydrostratigraphic unit of the model. No updates were made to the hydraulic conductivity values for the contact zone (Layer 4) or Cabot Head Formation (Layer 14). Changes included the following:

- Addition of multiple, small, high conductivity zones extending from ground surface to the top of the fine-grained till unit (Layers 1 and 2), representing the excavated space and ponds created by sand and gravel aggregate operations (Figure B1).
- The creation of a low conductivity zone in the fine-grained overburden unit (Layer 3; Figure B2).
- The creation of a narrow zone in the Guelph Formation and Reformatory Quarry Member of the Eramosa Formation where the vertical conductivity was increased (Layer 5 and 6; Figure B3). The horizontal conductivity remained the same.
- The creation of a narrow zone in the Vinemount Member of the Eramosa Formation where the conductivity was increased (Layer 7-9; Figure B4).
- The creation of a relatively high conductivity zone within a larger, relatively low conductivity zone in the Goat Island Formation (Layer 10; Figure B5).
- The creation of a conductivity zone in the Upper, Middle, and Lower Gasport Formation, where conductivity was decreased relative to the surrounding regional area (Layer 11, 12, and 13; Figures B6, B7, and B8). This zone was required to match the drawdown cone interpreted from point observations of drawdown.

**TABLE 3 Aberfoyle - Summary of Hydraulic Conductivity Changes**

| Model Layer(s)[1] | Unit | Previous Calibrated Hydraulic Conductivity of Update Areas (m/s) | | Revised Calibrated Hydraulic Conductivity of Update Areas (m/s) | | Estimates of Horizontal Hydraulic Conductivity from Field Data (m/s)[2] | |
|---|---|---|---|---|---|---|---|
| | | Min | Max | Min | Max | Min | Max |
| 1-2 | Overburden A (Coarser-grained) | Kx = 1 × $10^{-4}$<br>Kz =5 × $10^{-5}$ | Kx = 2 × $10^{-4}$<br>Kz =2 × $10^{-4}$ | Kx = 1 × $10^{-1}$<br>Kz = 1 × $10^{-1}$ | Kx = 1 × $10^{-1}$<br>Kz = 1 × $10^{-1}$ | Kx = 4 × $10^{-6}$ | Kx = 2 × $10^{-2}$ |
| 3 | Overburden B (Finer-grained) | Kx = 1 × $10^{-6}$<br>Kz =5 × $10^{-7}$ | | Kx = 2 × $10^{-7}$<br>Kz = 1 × $10^{-7}$ | | Kx = 2 × $10^{-9}$ | Kx = 9 × $10^{-5}$ |
| 5-6 | Guelph Fm. and Eramosa Fm., Reformatory Quarry Mbr. | Kx = 3 × $10^{-6}$<br>Kz = 3 × $10^{-8}$ | | Kx = 3 × $10^{-6}$<br>Kz = 3 × $10^{-7}$ | | Kx = 2 × $10^{-7}$ | Kx = 6 × $10^{-4}$ |
| 7-9 | Eramosa Fm., Vinemount Mbr. | Kx = 1 × $10^{-7}$<br>Kz = 1 × $10^{-9}$ | | Kx = 3 × $10^{-6}$<br>Kz = 3 × $10^{-7}$ | | Kx = 5 × $10^{-7}$ | Kx = 3 × $10^{-5}$ |
| 10 | Goat Island Fm. | Kx =5 × $10^{-6}$<br>Kz = 8 × $10^{-8}$ | Kx =2 × $10^{-4}$<br>Kz =3 × $10^{-6}$ | Kx =8 × $10^{-8}$<br>Kz =1 × $10^{-9}$ | Kx =1 × $10^{-3}$<br>Kz =1 × $10^{-4}$ | Kx = 9 × $10^{-8}$ | Kx = 4 × $10^{-4}$ |

| Model Layer(s)[1] | Unit | Previous Calibrated Hydraulic Conductivity of Update Areas (m/s) | | Revised Calibrated Hydraulic Conductivity of Update Areas (m/s) | | Estimates of Horizontal Hydraulic Conductivity from Field Data (m/s)[2] | |
|---|---|---|---|---|---|---|---|
| | | Min | Max | Min | Max | Min | Max |
| 11 and 13 | Upper and Lower hydrostratigraphic units of the Gasport Fm. | Kx =2 × $10^{-6}$<br>Kz =2 × $10^{-8}$ | Kx =2 × $10^{-6}$<br>Kz =2 × $10^{-7}$ | Kx =1 × $10^{-7}$<br>Kz =1 × $10^{-8}$ | | Kx = 2 × $10^{-8}$ | Kx = 5 × $10^{-4}$ |
| 12 | Middle hydrostratigraphic unit of the Gasport Fm. | Kx = 8 × $10^{-5}$<br>Kz = 4 × $10^{-5}$ | | Kx = 4 × $10^{-6}$<br>Kz = 2 × $10^{-6}$ | | Kx = 2 × $10^{-6}$ | Kx = 1 × $10^{-2}$ |

[1] No hydraulic conductivity changes made to model layer 4 (Contact Zone) and 14 (Cabot Head Fm.)
[2] From (Matrix 2017a), (CRA 2014b), (CRA 2011), and (Golder 2018a)
Kx - Horizontal Hydraulic Conductivity
Kz - Vertical Hydraulic Conductivity

## 4.1.2 Calibration to Pumping Conditions

### *4.1.2.1 Approach*

The calibration to pumping conditions was completed using water level monitoring data collected as part of a long-term constant rate test at NWC well TW3-80 (CRA 2011). The test occurred from August to October 2010, at a rate of 3,542 $m^3$/day, for approximately 40 days, and water levels were measured at monitoring wells completed within the overburden and Upper and Lower Bedrock aquifers. Conestoga-Rovers and Associates (CRA; CRA 2011) reported the maximum measured water level recovery following 3.4 days after pumping ceased. CRA also estimated recoveries at each well that would occur due to pumping at the permitted rate of 3,600 $m^3$/day, assuming "*linear proportionality between an increase in rate and an increase in drawdown*" (CRA 2011). S.S. Papadopulos and Associates (SSPA) assembled these estimated recovery values for use as calibration targets to permitted pumping conditions.

To supplement the calibration data provided by the 40-day pumping test, SSPA estimated additional drawdown values using water level monitoring data collected from five bedrock wells installed after the 2010 pumping test. Calibration targets for these wells were developed using observed drawdown measurements collected during the 2010 Christmas season when NWC pumping operations were shut down. These targets were estimated by scaling the observed drawdown during this time by the ratio of the pre-shutdown pumping rate and 3,600 $m^3$/day (Neville 2018, Pers. Comm.).

In total, 56 drawdown targets were used for monitoring wells completed in the overburden (18), Upper Bedrock Aquifer (18), and Lower Bedrock Aquifer (20). A list of the drawdown targets is provided in Appendix A (Table A1), and the locations are shown on Figures 10, 11, and 12.

The calibration approach consisted of estimating simulated drawdown by subtracting water levels between two steady-state conditions: pumping TW3-80 at 3,600 $m^3$/day and no pumping at TW3-80. The simulated drawdown was then compared to the observed drawdown targets, and the difference between the two were minimized during the calibration process. This is an approximate analysis approach as observed water levels at some well locations may not have fully recovered after 3.4 days. However, the approach is considered appropriate for this application, especially at key monitoring well nests where the water levels were approaching stable levels. Visual inspection of the observed hydrographs of these wells during the 2010 testing (CRA 2011) suggests that the difference in water elevation arising from assuming fully recovered conditions after 3.4 days is a small fraction of the total interpreted drawdown.

Note that while some calibration to the same 40-day test was completed as part of the GGET Tier Three Assessment (Matrix 2017a), that effort focussed on calibration to drawdown in the Lower Bedrock Aquifer. The present effort included calibration to drawdown in the Lower Bedrock, Upper Bedrock, and overburden units.

#### *4.1.2.2 Results*

The approach to assessing the goodness-of-fit between modelled and simulated pumping conditions (drawdown) was to evaluate the calibration results using maps comparing simulated drawdown contours with those interpreted from point drawdown observations. The primary objective of the calibration to pumping conditions was to approximate the general shape and extent of the drawdown contours in the Upper and Lower Aquifer units. Figures 10, 11, and 12 illustrate simulated and interpreted drawdown contours for the Reformatory Quarry Member of the Eramosa Formation (Upper Bedrock) and the Goat Island and Middle Gasport formations (Lower Bedrock), respectively. The observed drawdown contours were interpreted by CRA (2011) and were made using a variety of assumptions based on the hydrogeological formation represented by each monitoring well.

Figure 10 illustrates interpreted and simulated drawdown contours for the Upper Bedrock Aquifer (Simulated Reformatory Quarry Member). In general, the simulated drawdown contours match the trend of the interpreted drawdown contours, with a narrow, elongated shape extending from pumping well TW3-80 to monitoring well MW7B-08.

Figures 11 and 12 illustrate interpreted drawdown for wells completed in the Lower Bedrock Aquifer versus simulated drawdown from the Goat Island Formation and Middle Gasport Formation, respectively. As the Lower Bedrock Aquifer includes all calibration targets below the Vinemount Aquitard, two figures are provided to show the difference between the simulated drawdown of two Lower Bedrock Aquifer units. The figures show simulated contours approximating the circular shape of the interpreted contours. The calibrated model results in an under-prediction of the extent of the 1 m drawdown contour in the Goat Island Formation (Figure 11) and a slight over-prediction in the Middle Gasport Formation (Figure 12).

### 4.1.3 Calibration to Long-term Average Conditions

#### *4.1.3.1 Approach*

Steady-state calibration to long-term average conditions was completed using groundwater level monitoring data collected as part of the annual monitoring program at the Aberfoyle site (Golder 2018a). SSPA used these data to estimate average water levels for the period of 2009 to 2015 (except 2014) for use as steady-state calibration targets. In total, 79 water level targets were estimated for monitoring wells completed in the overburden (21), Upper Bedrock Aquifer (31), and Lower Bedrock Aquifer (27). Well completion elevation details were used to assign water level targets to hydrostratigraphic units under the revised bedrock nomenclature in the model where the unit was not already identified by SSPA. Table 1 was also used to guide translation of bedrock names between the previous and revised bedrock nomenclature where necessary.

Water level calibration targets used in the GGET Tier Three Assessment and derived from the Water Well Information System (WWIS) were used as additional calibration targets for the Aberfoyle area to broaden the coverage of the assessment. In total, 555 targets (i.e., 415 in bedrock and 140 in overburden) from the GGET Tier Three Assessment were used, covering a 3 km radius surrounding the Aberfoyle property. These WWIS static water level observations offer the benefit of having a high number of calibration targets that cover a wide area; however, there can be uncertainty associated with individual observations. These uncertainties may include errors in the reported locations and depths of wells, coarse water level measurement techniques, and water levels that may have been collected in different years or seasons, or under different stages of pumping/non-pumping conditions. Based on professional experience, individual groundwater elevation estimates as calculated from the WWIS dataset may have an average error, or uncertainty, of 5 to 10 metres as compared to actual conditions. Because of these uncertainties, the water level targets derived from WWIS data are considered lower quality than those from annual NWC monitoring activities and higher priority is given to calibrating the higher quality calibration targets.

Details of the calibration targets used in the Aberfoyle area are provided in Appendix A (Table A1).

An average pumping rate of 1,690 $m^3$/day over the calibration period was estimated for TW3-80 using annual water taking data provided in Golder (2018a). This rate was used for the calibration to long-term average conditions, and represents an average for the same 2009 to 2015 (except 2014) period as determined for the water level targets.

#### *4.1.3.2 Results*

The steady-state calibration to long-term average conditions involved comparing simulated hydraulic heads against those measured in high-quality monitoring wells and lower quality WWIS wells completed within overburden and bedrock units. The scatter plot for long-term average conditions at the Aberfoyle site is presented on Chart 1, and a table of the observed and simulated values are provided in Appendix A (Table A1).

The scatter plot (Chart 1) illustrates the goodness-of-fit for hydraulic head targets with model-simulated heads plotted on the vertical axis, and observed hydraulic heads plotted on the horizontal axis. The 1:1 line corresponds to simulated head being equal to observed head, and the objective of the calibration effort is to have the points as close as possible to this line. Deviations of ±5 m are shown on the plot as parallel lines offset from the 1:1 line. Points falling outside of the ±5 m lines represent observation locations where the simulated hydraulic head differs from the observed value by more than 5 m. This difference may be due to model error, assumptions in the conceptual model, or may also be due to errors associated with the field-observed data.

The scatter plot shows that the simulated hydraulic heads are within the ± 5 m bounds for almost all of the higher quality targets. Overall, the calibration error is generally distributed both above and below the 1:1 line. Simulated hydraulic head is somewhat over-simulated in the Lower Bedrock; however, the highest simulated heads from this unit are from private wells (Chart 1), which may indicate gaps in the model-conceptualization of these wells, or an indication that these wells may be lower quality data points. Many of the bedrock domestic wells are completed as open bedrock boreholes and as a result there is uncertainty as to the specific bedrock formation associated with the measured water level.

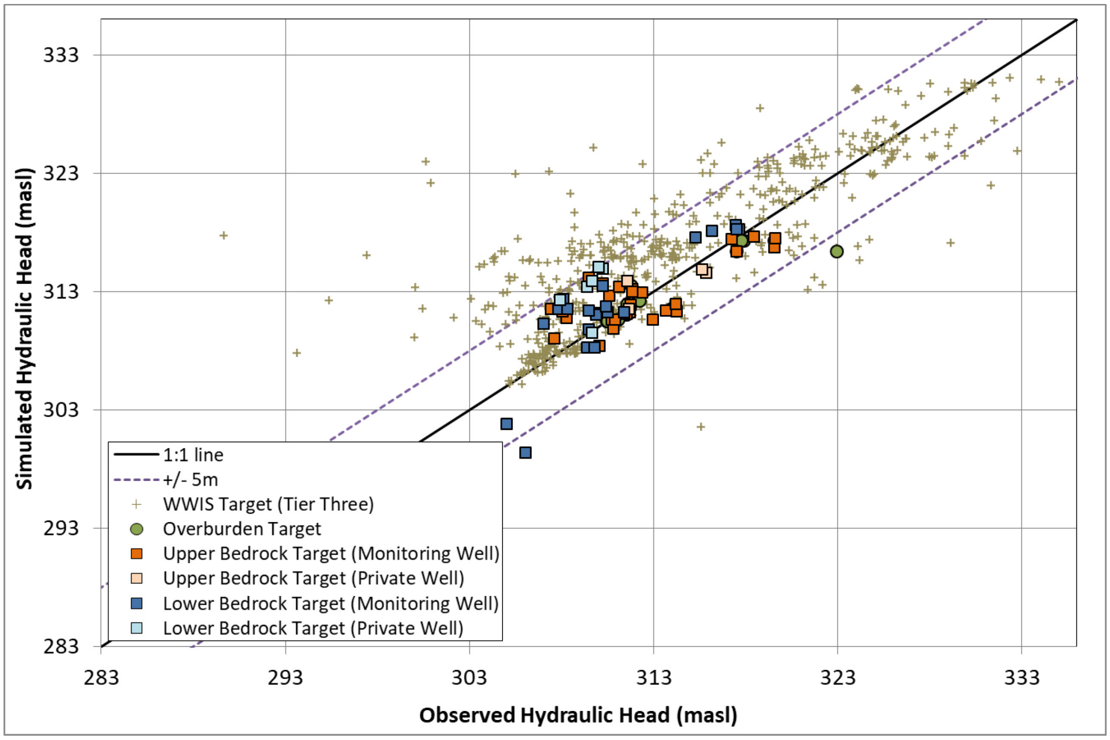


**Chart 1 Aberfoyle Scatter Plot of Average Hydraulic Head (2009 to 2013 and 2015) - All Targets**

Chart 2 illustrates the same data as Chart 1, except for just the higher quality calibration targets. Lines representing ± 2.4 m were added to the chart to illustrate the range of the root mean squared error of these targets. The chart illustrates that the majority of predicted higher quality water levels would fall within 2.4 m of the observed value, which is a smaller range than observed with the WWIS targets (i.e., 4.9 m). Additional information is provided about this calibration statistic later in this section.

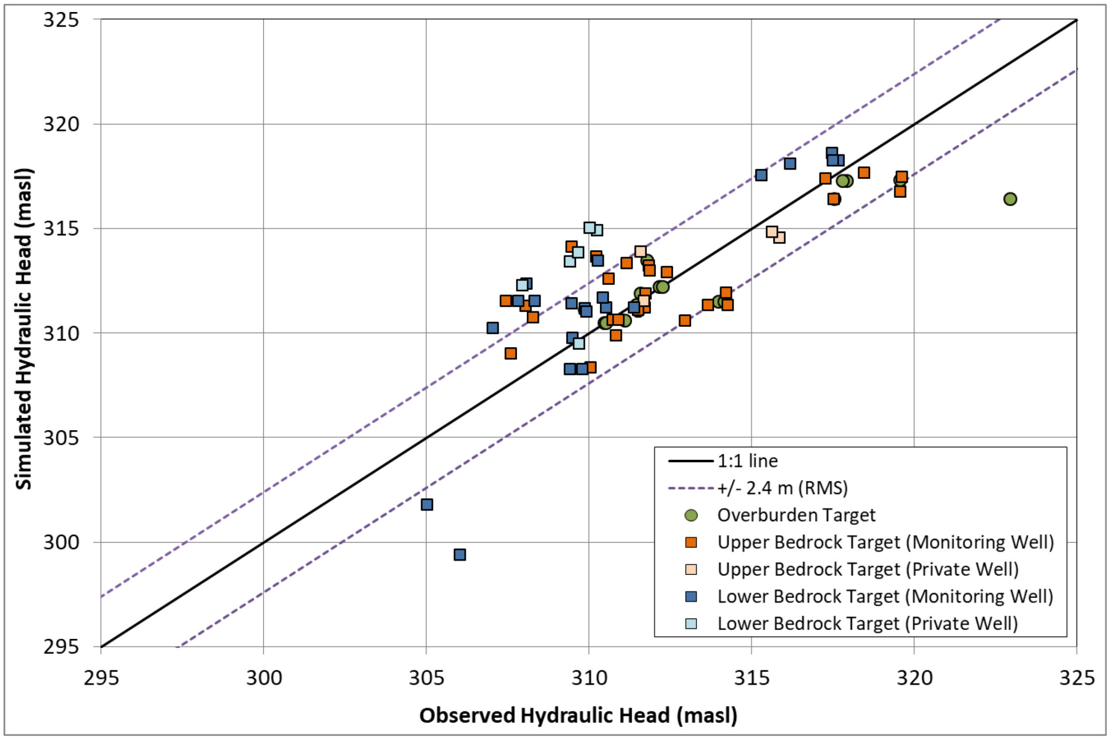


**Chart 2** **Aberfoyle Scatter Plot of Average Hydraulic Head (2009 to 2013 and 2015) - High Quality Targets**

Chart 3 illustrates a cumulative probability plot of the difference between the simulated and observed hydraulic head (i.e., the residual) for the higher quality calibration targets. Following the guidance of Spitz and Moreno (1996, p. 244-245) and Hill (1998), the residuals from a calibration should be normally distributed, confirming that there is no systematic bias in the model results. Where residuals do not follow a normal distribution there may be structural uncertainties in the model, which introduce a limitation to the degree of calibration that is possible. The majority of the residuals in Chart 3 approximate a straight line, following a normal distribution. Two outliers (NWC production well TW3-80 and overburden monitor MW01C-04) fall outside the normal distribution, suggesting that these observed water levels may represent small-scale geological heterogeneities. Achieving a better fit to these points may not be possible given the current model conceptualization.

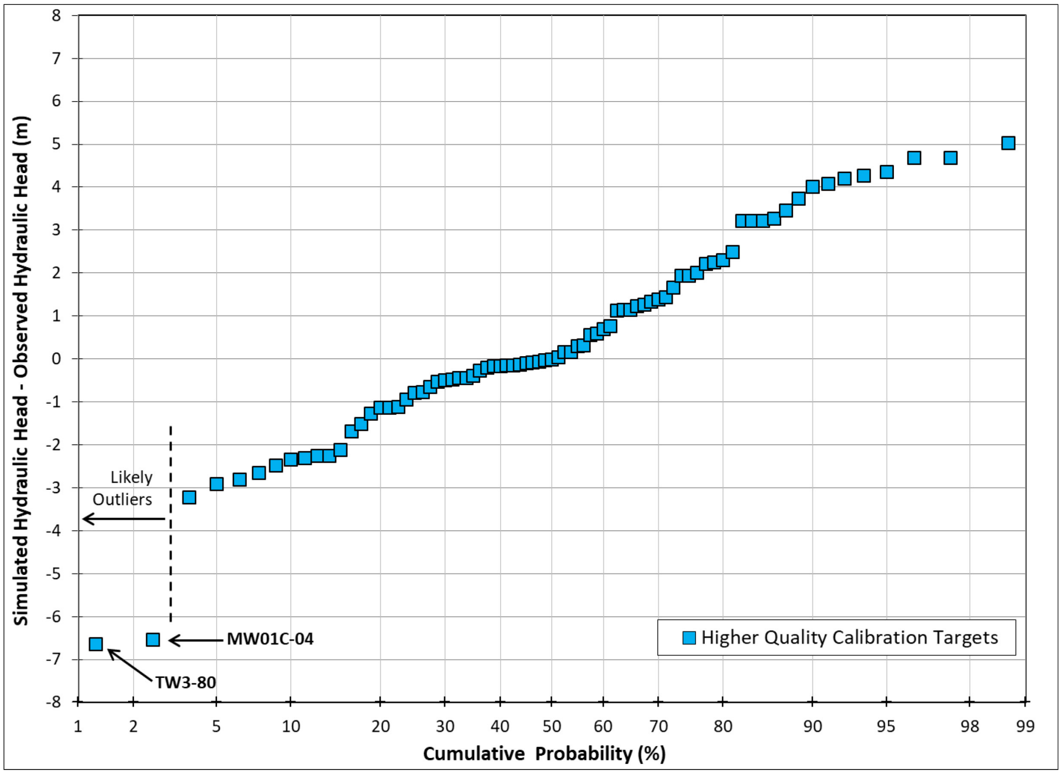


**Chart 3** **Aberfoyle Cumulative Probability Plot of Higher Quality Targets at Aberfoyle**

Chart 4 illustrates the cumulative probability distribution for the calibration targets derived from the WWIS records. Similar to the match to the higher quality targets, the majority of these residuals approximated a straight line when plotted on a normal probability axis. Some targets were identified as potential outliers (Chart 4) and, as discussed previously, these may highlight lower quality targets where there may be errors in the reported well locations and depths, errors in how the water levels were measured, and spatial differences caused by water levels that may have been collected in different years or seasons, or under different stages of pumping/non-pumping conditions.

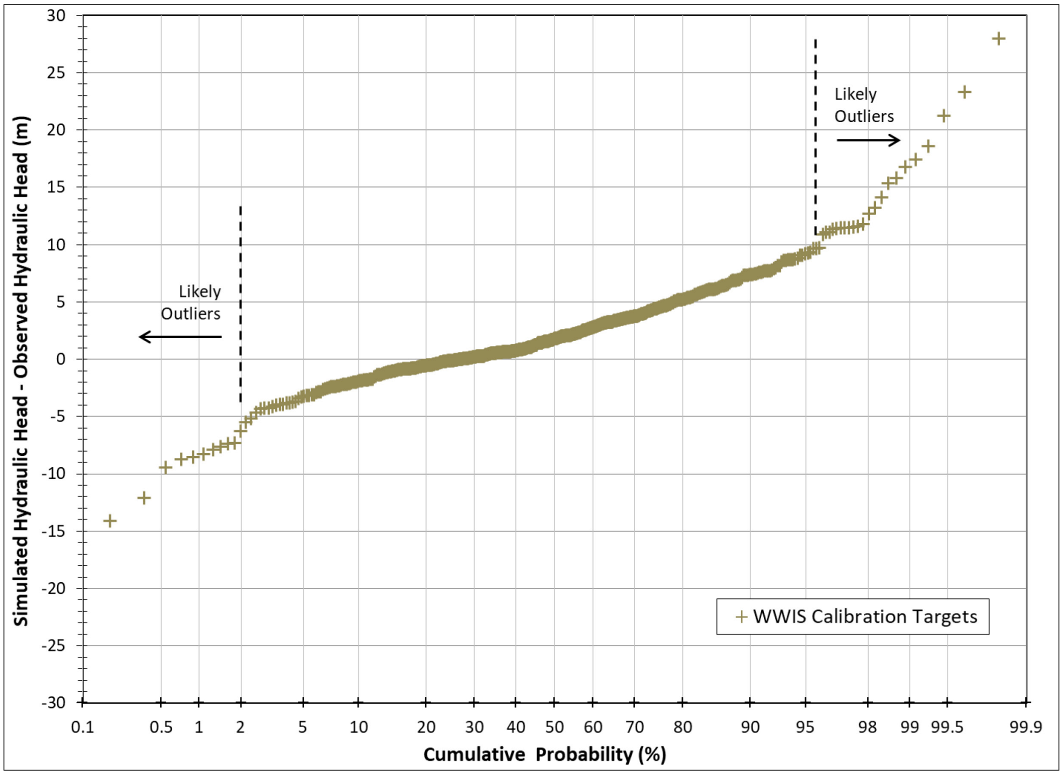


**Chart 4 Aberfoyle Cumulative Probability Plot of Lower Quality (WWIS) Targets at Aberfoyle**

Table 4 summarizes the calibration statistics computed as measures of the goodness-of-fit between model-simulated and observed hydraulic heads for all calibration targets, high quality Upper and Lower Bedrock targets, overburden targets, and targets from the WWIS.

**TABLE 4 Aberfoyle - Hydraulic Head Calibration Statistics**

| Calibration Statistic | All Targets | High Quality Upper Bedrock Targets | High Quality Lower Bedrock Targets | High Quality Overburden Targets | All High Quality Targets | WWIS Targets |
|---|---|---|---|---|---|---|
| Number of Calibration Targets | 634 | 31 | 27 | 21 | 79 | 555 |
| Mean Error (m) | 2.1 | 0.2 | 1.5 | -0.7 | 0.4 | 2.3 |
| Mean Absolute Error (m) | 3.2 | 1.7 | 2.4 | 1.0 | 1.8 | 3.4 |
| Root Mean Squared Error (m) | 4.6 | 2.1 | 3.0 | 1.8 | 2.4 | 4.9 |

The calibration statistics and results, as listed in the above table, are described as follows:

- Mean Error. The mean error is a measure of whether, on average, simulated water levels are higher or lower than those observed. Ideally, the mean error should be as close as possible to zero. This statistic indicates that on average, all the simulated water levels are higher than the observed values by 2.1 m. The mean error is 0.4 m for the high quality calibration targets.

- Mean Absolute Error. The mean absolute error is a measure of the average deviation between simulated and observed water levels. During model calibration, this statistic should be minimized as much as possible. The mean absolute error for the 634 calibration targets is 3.2 m and is equal to 1.8 m for the high quality targets.

- Root Mean Squared Error. The root mean squared error is similar to standard deviation in providing a measure of the degree of scatter about the 1:1 line. This statistic is calculated by averaging the squares of each residual error, and then taking the square root of that average. In squaring the residual errors, the root mean squared error gives higher weighting to larger residuals. The root mean squared error for the full calibration dataset is 4.6 m, meaning that the majority of predicted water levels would fall within 4.6 m of the observed value. The value for the high quality targets is 2.4 m.

### 4.1.4 Groundwater Discharge to Streams

In addition to simulated aquifer water levels and drawdown, the groundwater flow model also estimates the contribution of groundwater discharge to streams toward streamflow. Baseflow is a term given to the portion of streamflow that remains in the absence of direct overland runoff. Baseflow may be a result of groundwater discharge in addition to other contributions, such as sewage treatment plant discharges, water diversion, and the release of water from lakes, reservoirs, or wetlands. In this assessment, a key calibration assumption is that estimated stream baseflow is mostly due to groundwater discharge, and not any other factors. As discussed below, this assumption should be generally valid for Mill Creek; however, measured streamflow in Aberfoyle Creek is likely impacted by the release of water from Aberfoyle Pond.

The refined GGET Tier Three model was assessed on how well simulated groundwater discharge matched estimated baseflows. Surface water flow data from two GRCA flow gauges on Mill Creek (2GAC19 and 3AQ131; Figure 1) and two NWC surface water monitoring stations on Aberfoyle Creek (SW01 and SW02; Figure 2) were assessed for the Aberfoyle area. Baseflow estimates were derived by others using streamflow data, and provide a benchmark range against which simulated groundwater discharge can be compared. Baseflow estimates include those derived for Mill Creek during the GGET Tier Three Assessment (Matrix 2017a) and those derived by SSPA for Mill Creek and Aberfoyle Creek (SSPA 2016, Golder and SSPA 2018). Table 5 summarizes available baseflow estimates, model calibration targets, and the simulated groundwater discharge for each of the four monitoring locations. The model calibration targets for the Mill Creek gauges were selected as the range in the median baseflow values estimated from Matrix (2017a) and SSPA (2016). The model calibration targets for Aberfoyle Creek were selected as the low end of the Golder and SSPA (2018) baseflow estimate range as this range reflects streamflow measurements that include the impacts of Aberfoyle Pond and other upstream factors. The simulated groundwater discharge is based on the long-term average conditions described in Section 4.1.3.1.

**TABLE 5 Aberfoyle - Summary of Estimated and Simulated Groundwater Discharge ($m^3$/day)**

| Locations | Estimated Baseflow | | Model Calibration Target | Simulated Groundwater Discharge |
|---|---|---|---|---|
| | SSPA | Matrix[1] | | |
| Mill Creek Near Aberfoyle (GRCA Gauge 3AQ131) | 17,300[2] | 18,900 | 17,300 to 18,900 | 17,900 |
| Mill Creek @ Side Rd. 10 (GRCA Gauge 2GAC19) | 45,500[2] | 55,500 | 45,500 to 55,500 | 40,000 |
| **Increase from 3AQ131 to 2GAC19** | **n/a** | **n/a** | **26,600 to 38,200** | **22,100** |
| Aberfoyle Creek - SW01 | 5,616 to 14,861[3] | n/a | 5,616 | 3,790[4] |
| Aberfoyle Creek - SW02 | 6,739 to 15,811[3] | n/a | 6,739 | 4,593[4] |
| **Increase from SW01 to SW02** | **n/a** | **n/a** | **1,123** | **803** |

n/a - not available

[1] Matrix (2017a).

[2] SSPA (2016)

[3] Golder and SSPA (2018)

[4] Discharge does not include impacts from Aberfoyle Pond and upstream confluence with Mill Creek

#### *4.1.4.1 Results*

Table 5 shows that simulated groundwater discharge was predicted to be within the estimated baseflow range provided by SSPA for gauge 2GAC19 (Mill Creek at Side Rd. 10), and less than the range from Matrix (2017a). The simulated groundwater discharge was within all estimated baseflow ranges for gauge 3AQ131 (Mill Creek near Aberfoyle).

Simulated groundwater discharge for monitoring stations along Aberfoyle Creek (SW01 and SW02) was found to be slightly under-simulated compared to the estimated baseflow counterparts. Baseflow in Aberfoyle Creek is likely an over-estimate of groundwater discharge due to the effects of Aberfoyle Pond, which contributes to baseflow by the release of surface water from storage.

### 4.1.5 Overall Calibration Summary

Local updates to the calibrated model in the Aberfoyle area largely included refinements of surface water boundary conditions and adjustments to hydraulic conductivity. The calibration results illustrated that:

- **Pumping conditions -** The refined model adequately approximated the trends of the interpreted drawdown contours in the Upper and Lower Bedrock aquifers as delineated using water level recovery data from a long-term pumping test at TW3-80.

- **Long-term average conditions –** The model refinements resulted in improved calibration to local conditions as compared to the GGET Tier Three Assessment. The calibration error for the high quality NWC monitoring targets is improved as compared to the WWIS calibration targets used for the GGET Tier Three Assessment. The results indicate that the model is reflective of groundwater flow conditions in the local Aberfoyle area as well as in the regional area.

- **Streamflow/groundwater discharge -** Simulated groundwater discharge was slightly less than estimated baseflow targets for Aberfoyle Creek but acceptable given that baseflow estimates are not exact representations of groundwater discharge. The results suggest that the overall water balance within the assessment area as reflected by groundwater recharge and discharge is reasonable.

The results suggest that the updated model appropriately represents the hydrogeologic conditions in the area of NWC TW3-80, and is suitable for the assessment of future pumping scenarios.

## 4.2 Erin

Calibration in the Erin area consisted of local and regional refinements to zones of hydraulic conductivity in different hydrostratigraphic units during calibration to average non-pumping and pumping conditions at NWC well TW1-88.

### 4.2.1 Hydraulic Conductivity

Similar to the updates made in the Aberfoyle area, hydraulic conductivity values in the Erin area were refined during model calibration, and the final values assigned were guided by the range of hydraulic conductivity and transmissivity estimates from other studies (e.g., Matrix 2017a, Terraqua 1991, CRA 1989; and Blackport [Pers. Comm. 2018]) and references therein. In some cases, refinements to hydraulic conductivity were made as surrogate to making refinements to modelled hydrostratigraphic unit surface elevations and thicknesses. The final calibrated range of revised hydraulic conductivity values applied to the update areas in each hydrostratigraphic unit is presented in Table 6, along with the ranges used prior to the update and values estimated from field data. The refined hydraulic conductivity values applied in the model for the Guelph Formation were very close to the estimated ranges derived from local and regional estimates (Table 6). Conductivity values applied in the overburden and contact zone units were generally higher than the estimates available from field data; however, field estimates were based on a limited number of data points. The final values applied are still considered reasonable when compared to typical ranges of conductivity for similar materials cited in literature (Freeze and Cherry 1979). Figures B8 to B11 (Appendix B) present the final conductivity values applied for zones that were updated in each hydrostratigraphic unit of the model. No updates were made to the hydraulic conductivity values for the model layers representing the Vinemount Member (Layer 11), or Gasport (Layer 12 and 13) and Cabot Head (Layer 14) formations. Changes included the following:

- The creation of a relatively low conductivity zone within the coarse-grained overburden unit north of the NWC site, and a conductivity zone to the south where vertical conductivity was decreased. The conductivity of zones representing finer-grained tills outcropping in the coarser deposits were refined to be consistent values both north and south of the site (Layer 1 and 2; Figure B8).

- The creation of a relatively lower conductivity northern zone and relatively higher conductivity southern zones in the till overburden (Layer 3; Figure B9).

- The creation of three conductivity zones within the contact zone aquifer unit where conductivity was decreased to the north and increased to the south. The conductivity of a smaller local zone was increased just south of the Erin site (Layer 4; Figure B10).

- The creation of four conductivity zones within the Guelph Formation where conductivity was increased to varying amounts (Layer 5 to 10; Figure B11).

**TABLE 6 Erin - Summary of Hydraulic Conductivity Changes**

| Model Layer(s)[1] | Unit | Previous Calibrated Hydraulic Conductivity of Update Areas (m/s) | | Revised Calibrated Hydraulic Conductivity of Update Areas (m/s) | | Estimates of Horizontal Hydraulic Conductivity from Field Data (m/s)[2] | |
|---|---|---|---|---|---|---|---|
| | | Min | Max | Min | Max | Min | Max |
| 1-2 | Overburden A (Coarser-grained) | Kx =1 × $10^{-4}$<br>Kz = 1 × $10^{-4}$ | Kx =5 × $10^{-4}$<br>Kz = 5 × $10^{-4}$ | Kx = 1 × $10^{-4}$<br>Kz =1 × $10^{-5}$ | Kx = 5 × $10^{-4}$<br>Kz = 5 × $10^{-5}$ | Kx = 2 × $10^{-6}$ | Kx =6 × $10^{-6}$ |
| 3 | Overburden B (Finer-grained) | Kx =1 × $10^{-6}$<br>Kz =3 × $10^{-8}$ | Kx =3 × $10^{-5}$<br>Kz =3 × $10^{-6}$ | Kx =6 × $10^{-8}$<br>Kz =6 × $10^{-9}$ | Kx =1 × $10^{-5}$<br>Kz =5 × $10^{-6}$ | Kx = 7 × $10^{-8}$ | Kx =5 × $10^{-7}$ |
| 4 | Contact Zone | Kx = 3 × $10^{-5}$<br>Kz = 3 × $10^{-6}$ | | Kx = 1 × $10^{-5}$<br>Kz = 1 × $10^{-6}$ | Kx =5 × $10^{-4}$<br>Kz = 5 × $10^{-5}$ | Kx = 2 × $10^{-6}$ | |
| 5-10 | Guelph Fm. | Kx = 2 × $10^{-7}$<br>Kz =2 × $10^{-9}$ | Kx =5 × $10^{-6}$<br>Kz = 2 × $10^{-7}$ | Kx =6 × $10^{-6}$<br>Kz = 6 × $10^{-7}$ | Kx = 8 × $10^{-4}$<br>Kz = 8 × $10^{-5}$ | Kx = 4 × $10^{-7}$ | Kx = 6 × $10^{-4}$ |

[1] No hydraulic conductivity changes made to model layer 11 (Vinemount Member), 12 and 13 (Gasport Fm.), and 14 (Cabot Head Fm.)
[2] From Matrix (2017a), Terraqua (1991), CRA (1989) and (Blackport 2018, Pers. Comm.)
Kx - Horizontal Hydraulic Conductivity
Kz - Vertical Hydraulic Conductivity

### 4.2.2 Calibration to Pumping Conditions

#### *4.2.2.1 Approach*

Calibration to pumping conditions at the Erin site was completed using the 2016 to 2017 average pumping and non-pumping water level data available from the annual monitoring program. SSPA used these data to estimate drawdown at monitoring wells where there was a clear pumping and non-pumping trend. SSPA estimated drawdown for the remainder of the monitoring wells using drawdown data from a constant rate test conducted in 2005 (CRA 2006, Neville 2018, Pers. Comm.). This was completed by linearly scaling the observed drawdown based on the difference between the pumping rate during the constant rate test and the average daily pumping rate estimated during 2016 to 2017. In total, 18 drawdown calibration targets for the overburden (8) and bedrock (10) monitoring wells were provided. A list of these targets is provided in Appendix A (Table A2).

The calibration approach consisted of estimating simulated drawdown by subtracting water levels between two steady-state conditions: no pumping of TW1-88, and pumping at 890 $m^3$/day. This pumping rate was developed by SSPA, using an average (2016 to 2017) daily pumping rate of

195 m$^3$/day, and estimating that this average represents pumping TW1-88 for 5.3 hours at a rate of 890 m$^3$/day, followed by recovery (Neville 2018, Pers. Comm.). The simulated drawdown was then compared to the observed drawdown targets, and the difference between the two was minimized during the calibration process.

#### *4.2.2.2 Results*

The observed and simulated drawdown values for each of the monitoring points are provided in Table A2 (Appendix A). The simulated drawdown at pumping well TW1-88 was 7.49 m, which is 1.09 m larger than the observed drawdown of 6.40 m. The simulated drawdowns at the remaining monitoring wells were within ± 0.5 m of those observed for the bedrock and overburden targets. These results suggest a good fit between observed and simulated values.

An aerial map showing the interpolated simulated drawdown contours for the Guelph Formation Aquifer is provided on Figure 13 to view the simulation results spatially. The figure shows drawdown extending radially away from the pumping well, in a slightly northwesterly direction that is consistent with a simulated regional gradient from the northwest to south and south east (Figure 9).

### 4.2.3 Calibration to Long-term Non-pumping Conditions

#### *4.2.3.1 Approach*

Steady-state calibration to long-term average conditions was completed using groundwater level monitoring data collected as part of the annual monitoring program at the Erin site (Golder 2018b). SSPA used these data to estimate average water levels for the period of 2016 to 2017 when well TW1-88 was not pumping and when it was pumping. Inferred non-pumping data were used as steady-state calibration targets in the Tier Three model where they were available. In total, 25 water level targets were provided for monitoring wells completed in the overburden (11) and bedrock (14). Of these water levels, three non-pumping average water levels were inferred from the available data. A single average water level was reported for the remainder of the wells where it was not possible to infer separate non-pumping versus pumping conditions due to NWC pumping. While it is uncertain whether these water levels explicitly represent pumping or non-pumping conditions, they were used for calibrating to non-pumping conditions in the absence of other high quality data onsite. Well completion elevation details were used to assign water level targets to hydrostratigraphic units under the revised conceptualization in the model where the unit was not already identified by SSPA. Table 2 was also used to guide calibration target assignment where necessary in the model.

Water level calibration targets used in the GGET Tier Three Assessment and derived from the WWIS were used as additional calibration targets for the Erin area to increase the coverage of the calibration area. In total, 289 targets (i.e., 278 in bedrock and 11 in overburden) from the GGET Tier Three Assessment were used, covering a 3 km radius surrounding the Erin site, with additional targets located further upgradient, toward the northwest. Similar to what was described for the WWIS targets near

Aberfoyle (Section 4.1.3.1), the uncertainty of individual groundwater elevation estimates as calculated from the WWIS dataset may have an average error, or uncertainty, of 5 to 10 m as compared to actual conditions. Because of these uncertainties, the water level targets derived from WWIS data are considered lower quality than those from annual NWC monitoring activities.

A list of the calibration targets used in the Erin area is provided in Appendix A (Table A2).

#### *4.2.3.2 Results*

The steady-state calibration to long-term average, non-pumping conditions at NWC TW1-88 involved comparing simulated hydraulic heads against those measured in both higher-quality and lower-quality wells completed within overburden and bedrock units. The scatter plot used to visualize the goodness-of-fit for these hydraulic head targets is presented on Chart 5, and a table of the observed and simulated values are provided in Appendix A (Table A2).

The scatter plot shows that the majority of the simulated hydraulic heads are within the ± 5 m bounds. Further, the calibration error is generally distributed both above and below the 1:1 line.

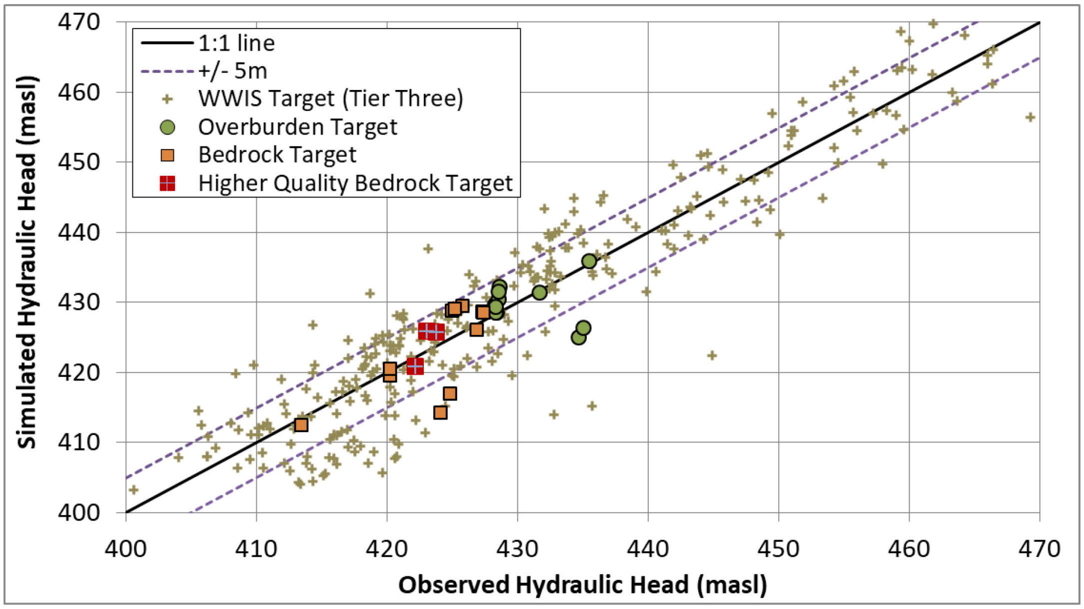


**Chart 5 Erin Scatter Plot of Average Hydraulic Head (0 $m^3$/day NWC Pumping)**

Table 7 lists the calibration statistics that are computed as measures of the goodness-of-fit between model-simulated and observed hydraulic heads for all calibration targets, higher quality bedrock and overburden targets, and targets from the WWIS. Definitions for each calibration statistic can be found in Section 4.1.3.2. The calibration statistics are typical of a regional groundwater flow model and the calibration to higher quality bedrock and overburden monitoring wells onsite is slightly improved over the calibration to water levels from WWIS wells (Table 7).

**TABLE 7 Erin - Hydraulic Head Calibration Statistics**

| Calibration Statistic | All Targets | High Quality Bedrock Targets | High Quality Overburden Targets | WWIS Targets |
|---|---|---|---|---|
| Number of Calibration Targets | 314 | 14 | 11 | 289 |
| Mean Error (m) | 0.1 | -0.2 | -0.7 | 0.2 |
| Mean Absolute Error (m) | 4.5 | 2.9 | 2.8 | 4.6 |
| Root Mean Squared Error (m) | 5.8 | 4.0 | 4.3 | 5.9 |

### 4.2.4 Groundwater Discharge to Streams

Surface water spotflow data from two NWC surface water monitoring stations along a tributary to the Eramosa River (SW1 and SW3; Figure 3) were used to qualitatively assess simulated groundwater discharge in the Erin area. While baseflow estimates have not been derived for these locations, the estimated average spotflows as calculated using 2017 monthly manual flow measurements (Golder 2018b) provide rough estimates for relative magnitude of what the baseflow/groundwater discharge could look like. Table 8 summarizes the average spotflow measurements at NWC stations SW1 and SW3, and the simulated groundwater discharge for each of these monitoring locations. The simulated groundwater discharge is within the range of spotflow measurements at SW1 and SW3 and similar in magnitude to the average values. The simulated groundwater discharge is based on long-term climate conditions, while the spotflow measurements reflect single points in time during 2017.

**TABLE 8 Erin - Summary of Estimated and Simulated Groundwater Discharge ($m^3/d$)**

| Locations | Range of 2017 Spotflow Measurements | Average 2017 Spotflow Measurement[1] | Simulated Groundwater Discharge |
|---|---|---|---|
| SW1 | 1,218 to 4,260 | 2,271 | 1,900 |
| SW3 | 354 to 2,160 | 1,113 | 1,724 |

[1] Estimated using 2017 monthly manual spotflow measurements (Golder 2018b)

### 4.2.5 Overall Calibration Summary

Local updates to the calibrated model in the Erin area largely included refinements of surface water boundary conditions and adjustments to hydraulic conductivity. The calibration results illustrated that:

- **Pumping conditions -** Simulated drawdown at non-pumping monitoring wells were within ± 0.5 m of the observed drawdown targets measured in bedrock and overburden wells.

- **Long-term average, non-pumping conditions** - The model refinements resulted in improved calibration to local conditions as compared to the GGET Tier Three Assessment. The calibration error for the high quality NWC monitoring targets is slightly improved as compared to the WWIS calibration targets used for the GGET Tier Three Assessment. The results indicate that the model is reflective of groundwater flow conditions in the local area as well as in the regional area.

- **Streamflow/groundwater discharge -** Simulated groundwater discharge was similar to the estimated 2017 average spotflow measurements at two surface water monitoring stations, suggesting that the overall water balance within the assessment area as reflected by groundwater recharge and discharge is reasonable.

The results suggest that the updated model appropriately represents the hydrogeologic conditions in the area of NWC TW1-88, and is suitable for the assessment future pumping scenarios.

# 5 MODEL SCENARIOS

The Tier Three model was updated and calibrated locally in the Aberfoyle and Erin areas to better reflect the high-quality data collected from long-term annual monitoring and from a long-term pumping test. The model reflects local groundwater flow under long-term average pumping conditions (Aberfoyle) or non-pumping conditions (Erin), as well as higher rate pumping conditions (Aberfoyle and Erin). As a result, the model is an appropriate tool to estimate the general effects of changes in pumping. The following sections describe the application of the refined model to assess potential changes in groundwater levels and groundwater discharge due to future pumping at the NWC Aberfoyle and Erin sites, as well as potential effects considering drought and climate change. Section 5.1 provides a description of the predictive scenarios, and Sections 5.2 and 5.3 summarize the results for the Aberfoyle and Erin sites, respectively.

## 5.1 Scenario Descriptions

Nine predictive scenarios were developed to compare and assess the potential impacts and cumulative effects associated with NWC pumping. These scenarios assess long-term average conditions, historical climate and drought conditions, and climate change. They are summarized in Table 9, and additional details are presented in the following subsections.

**TABLE 9 Scenario Summary**

| Scenario | Assessment | NWC Pumping Rate | Climate Time Period | Climate Change Scenario | Model Simulation |
|---|---|---|---|---|---|
| 1 (Baseline Average) | Long-term Average | Average<br>TW3-80 = 2,113 m$^3$/day<br>TW1-88 = 207 m$^3$/day | Long-term Average | n/a | Steady-state |
| 2 | Long-term Average | Maximum Permitted<br>TW3-80 = 3,600 m$^3$/day<br>TW1-88 = 1,113 m$^3$/day | Long-term Average | n/a | Steady-state |
| 3 (Baseline Transient) | Historical Climate Variability and Drought | Average<br>TW3-80 = 2,113 m$^3$/day<br>TW1-88 = 207 m$^3$/day | 1960 to 2005 | n/a | Transient |
| 4 | Historical Climate Variability and Drought | Maximum Permitted<br>TW3-80 = 3,600 m$^3$/day<br>TW1-88 = 1,113 m$^3$/day | 1960 to 2005 | n/a | Transient |
| 5a | Climate Change | Average<br>TW3-80 = 2,113 m$^3$/day<br>TW1-88 = 207 m$^3$/day | 1960 to 2005 | 1 | Transient |
| 5b | | | | 2 | |
| 5c | | | | 3 | |
| 5d | | | | 4 | |

n/a - not applicable

### 5.1.1 Scenario 1 - Current Average NWC Pumping (Baseline Average Conditions, Steady-state)

Scenario 1 is the baseline steady-state scenario designed to reflect current, long-term average conditions. The assumptions in this scenario included the following:

- Average (2015-2017) NWC pumping rate at TW3-80 (2,113 m$^3$/day).
- Average (2015-2017) NWC pumping rate at TW1-88 (207 m$^3$/day).
- Average municipal pumping rates, consistent with the existing rates used in the GGET Tier Three Assessment scenarios (Matrix 2017a).
- Non-municipal pumping rates, consistent with those used in the GGET Tier Three Assessment (Matrix 2017a) and updated as part of the *Guelph-Guelph/Eramosa Water Quantity Policy Development Study* (Matrix 2018b).
- Average groundwater recharge rates in the Grand River Watershed estimated from a 45-year surface water modelling scenario (1961 to 2005; Matrix 2017a). Average groundwater recharge rates in the Credit River Watershed were provided by AquaResource (2009c) and recharge within the Halton and Hamilton Region Conservation Authorities was reported in Earthfx (2009).

### 5.1.2 Scenario 2 - Maximum Permitted NWC Pumping (Steady-state)

Scenario 2 was designed to show long-term average conditions considering the same steady-state model setup described for Scenario 1, except for the following assumptions:

- Maximum permitted NWC pumping rate at TW3-80 (3,600 $m^3$/day).
- Maximum permitted NWC pumping rate at TW1-88 (1,113 $m^3$/day).

### 5.1.3 Scenario 3 - Current Average NWC Pumping (Baseline Conditions, Transient)

Scenario 3 is the transient baseline scenario designed to test the response of the system with current average NWC pumping rates, under typical climate variability, and a severe drought represented by the driest period observed in the local contemporary climate record. This drought period was observed locally in the 1960s. The variability of groundwater recharge rates over the simulation period reflects actual historic conditions and is therefore a suitable surrogate for future climate variability. The results of the scenario are hypothetical, as NWC has only been pumping since 2000 (Erin) and 2001 (Aberfoyle).

The setup of this scenario included the following:

- Average (2015-2017) NWC pumping rate at TW3-80 (2,113 $m^3$/day).
- Average (2015-2017) NWC pumping rate at TW1-88 (207 $m^3$/day).
- Average municipal pumping rates, consistent with the existing rates used in the GGET Tier Three Assessment scenarios (Matrix 2017a).
- Non-municipal pumping rates, consistent with those used in the GGET Tier Three Assessment (Matrix 2017a) and updated as part of the *Guelph-Guelph/Eramosa Water Quantity Policy Development Study* (Water Quantity Policy Study; Matrix 2018b).
- Transient historical climate variability and drought conditions represented by estimated monthly recharge (1960 to 2005). This model input was generated using Guelph All-Weather Sequential-Events Runoff (GAWSER) as part of the climate change component of the Water Quantity Policy Study as documented in Matrix (2018a).
- Transient monthly municipal pumping from the Eramosa River and into the Arkell Artificial Recharge System (1960 to 2005). This model input was generated using GAWSER as part of the climate change component of the Water Quantity Policy Study as documented in Matrix (2018a).

### 5.1.4 Scenario 4 - Maximum Permitted NWC Pumping (Transient)

Scenario 4 was designed to show historical climate variability and drought conditions, considering the same transient setup described for Scenario 3a, except for the following:

- Maximum permitted NWC pumping rate at TW3-80 (3,600 $m^3$/day).
- Maximum permitted NWC pumping rate at TW1-88 (1,113 $m^3$/day).

### 5.1.5 Scenario 5 - Current Average NWC Pumping with Climate Change Projections (Transient)

Scenario 5 represents a set of four climate change scenarios (i.e., 5a, 5b, 5c, and 5d) that use the methodology developed for the climate change assessment completed for the GGET municipal water supply systems (Matrix 2018a).

The primary tools used to estimate future climate are Global Climate Models (GCMs). GCMs are complex, physically-based, three-dimensional models that represent the earth's atmosphere, oceans, and land surfaces and simulate, over several decades, the interactions of processes that determine the climate for an area. These tools have evolved since the 1970s to their present level of sophistication. Modelling centres around the world have developed numerous GCMs used for long-term simulations to characterize the evolution of temperature, precipitation, solar radiation, winds, and other parameters well into the future.

There are many uncertainties in future climate predictions relating to unknown future emissions of greenhouse gases and aerosols, the conversion of emissions to atmospheric gases, modelling the response of the climate system, and methods for downscaling GCMs to be representative of local climates. As a result, uncertainties will remain inherent in predicting the hydrologic and hydrogeologic response to future climate change.

Figure 14 illustrates a scatter plot of simulated annual mean change in temperature and precipitation for the 2041-2070 period (2050s), as compared to the 1981-2010 period (current) for the results of 57 GCM scenarios in the Guelph area. This figure displays the level of uncertainty among GCM models as mean annual temperatures range from +1.7 to +4.6 $^{\circ}$C, while annual precipitation changes range from -4 to +20%.

EBNFLO and AquaResource (2010) recommends that practitioners evaluate potential climate change impacts using a large number of future climate scenarios to reflect the uncertainty that exists in individual model results; however, it is not generally feasible to evaluate all of the GCMs available. EBNFLO and AquaResource (2010) describe the 'Percentiles' method used to select a subset of individual GCM results, followed by the application of the 'Change Field' method to estimate climate change impacts using traditional hydrologic methods. Figure 14 illustrates a set of ten individual scenarios (orange squares) selected for the assessment completed for GGET (Matrix 2018a), and a smaller set of four scenarios (circled squares) selected for the groundwater modelling assessment.

The change field method is a methodology for estimating future local climate datasets from larger scale GCM results. This method uses the GCM simulations to estimate monthly changes for each climate variable for a future time period relative to a baseline climate period. These relative changes, termed ‘change fields’, are used to adjust observed climate station data time series to reflect future conditions. This approach results in an altered input climate time series that reflects the average relative change in each parameter and, through the use of local observations, the local climate. Matrix (2018a) describes the application of the Grand River hydrology model, GAWSER, to estimate the hydrologic response to the future climate datasets developed using the ‘change field’ method and the selected GCM results.

Figure 15 illustrates average daily groundwater recharge rates for each month for a silty sand soil in the Guelph area for the four selected future climate scenarios. Each future climate scenario was developed by adjusting the 1950-2005 existing climate dataset by the 2050’s change fields for that scenario. The average daily recharge rate for a given month represents the GAWSER-predicted daily recharge averaged over all days of that month for the entire GAWSER model simulation. As shown on this figure, the average daily rate predicted for the future climate scenarios is higher than baseline conditions during the months of December through March; this is a result of having less frozen soil and increased precipitation. Groundwater recharge during the summer months is generally less than baseline conditions and similar to baseline during spring and fall.

The climate change assessment was completed with the following steps:

1. Select GCMs encompassing the range in projected changes in climate for the 2050s period. There is a great deal of uncertainty in making projections of future climates, and it is common practice to assess impacts of climate change using multiple future climate datasets to reflect the range of variability in potential future conditions.

2. Create a 45-year dataset of hourly temperature and precipitation projections (2050s) for each of the GCMs using the ‘change field’ methodology further described in Matrix 2018a.

3. Create a 45-year time series of groundwater recharge projections (2050s) for each of the GCMs using the temperature and precipitation datasets, and the GAWSER hydrology model.

4. Run the GGET Tier Three groundwater flow model to simulate groundwater levels and groundwater discharge for each of the 2050s groundwater recharge scenarios.

Scenarios 5a, 5b, 5c, and 5d are four 45-year scenarios, each representing a future (2050s) climate projection from a different GCM. These scenarios include the following assumptions:

- Average (2015 to 2017) NWC pumping rate at TW3-80 (2,113 $m^3$/day).

- Average (2015 to 2017) NWC pumping rate at TW1-88 (207 $m^3$/day).

- Average municipal pumping rates, consistent with the existing rates used in the GGET Tier Three Assessment scenarios (Matrix 2017a).

- Non-municipal pumping rates, consistent with those used in the GGET Tier Three Assessment (Matrix 2017a) and updated as part of the Water Quantity Policy Study (Matrix 2018b).

- A 45-year transient monthly recharge time series representing a prediction of future climate made by a GCM for the 2050s period.

- Transient monthly municipal pumping from the Eramosa River and into the Arkell Artificial Recharge System (1960 to 2005), adjusted to incorporate the effects of climate change.

## 5.2 Scenario Results - Aberfoyle

All predictive scenarios were assessed based on simulated changes in water levels and groundwater discharge with respect to current average NWC pumping conditions (i.e., 2015 to 2017). In the Aberfoyle area, simulated impacts to water levels were assessed locally on the NWC property at monitoring well MW2A-07, at the nearest City of Guelph municipal bedrock well (the Burke Well), and also assessed more regionally within the Upper and Lower Bedrock aquifers. Simulated impacts to groundwater discharge were assessed at GRCA gauge 2GAC19 (Mill Creek at Side Rd. 10). Selection of this gauge to evaluate changes in surface water was agreed upon between Ministry of the Environment, Conservation and Parks and NWC.

### 5.2.1 Steady-state Scenario Results

The steady-state scenario results include the simulated average additional drawdown and groundwater discharge associated with the increase in pumping from the current average NWC pumping rate (Scenario 1) to the maximum permitted NWC pumping rate (Scenario 2).

Figures 16, 17, and 18 show the predicted additional drawdown within the simulated Upper and Lower Bedrock Aquifer layers due to increased pumping. The drawdown contours extend in a north to south direction, from MW07-08 to just south of the NWC property for all three figures. The shape of the drawdown contours change with depth, from an elongated shape in the Reformatory Quarry Member (Figure 16) to a slightly wider, oval shape in the Middle Gasport Formation (Figure 18). The maximum extent of the largest 1 m drawdown contour for all three figures is from approximately 1.2 km to the northwest, and approximately 500 m to the southeast.

Locally, the simulated drawdown associated with increasing pumping from average NWC rates to permitted NWC rates was predicted to be 3.7 m in the Lower Bedrock Aquifer at the closest non-pumping monitoring well on the NWC Aberfoyle property (MW2A-07). Drawdown at the closest City of Guelph municipal well, the Burke Well (Figure 19), was estimated to be less than 2 cm.

Groundwater discharge at GRCA gauge 2GAC19 (Mill Creek at Side Rd. 10; Figure 19) in Scenario 1 to 2 is predicted to decrease by 3%, from 39,544 m$^3$/day to 38,271 m$^3$/day due to the increase in pumping (Table 10).

**TABLE 10 Aberfoyle Simulated Groundwater Discharge - Average NWC Pumping to Permitted NWC Pumping**

| Location | Simulated Groundwater Discharge (m$^3$/day) | | Change in Groundwater Discharge (m$^3$/day) | Change in Groundwater Discharge (%) |
|---|---|---|---|---|
| | Average NWC Pumping (Scenario 1) | Permitted NWC Pumping (Scenario 2) | | |
| Mill Creek at Side Rd. 10 - 2GAC19 | 39,544 | 38,273 | -1,271 | -3% |

### 5.2.2 Drought Scenario Results

The drought scenario results include the simulated transient impacts to water levels and groundwater discharge associated with the increase in pumping from average NWC rates (Scenario 3) to permitted NWC rates (Scenario 4), while considering a 45-year climate record (1960 to 2005) that includes drought periods (e.g., the 1960s).

Figures 20 and 21 show the predicted water level variability on NWC property at MW2A-07 and at the Burke municipal well, respectively over the 45-year record. At MW2A-07, water levels are predicted to vary within approximately 0.75 m over the course of the 45-year record. The results indicate that bedrock water levels at or near the NWC property are not significantly impacted by climate variability. Further, additional water level decline associated with increased pumping is predicted to be approximately 3.75 m (Figure 20), which is considerably greater than the impact of climate variability.

In comparison to the NWC property, water levels at the Burke Well (Figure 21) are predicted to be more sensitive to climate variability. Water levels at the Burke Well are predicted to decline by approximately 3 m during the drought period, which is much greater than any potential impact from increased pumping by NWC.

Simulated groundwater discharge variability at Mill Creek at the Side Rd. 10 gauge (2GAC19) is shown on Figure 22 as a time series, and Figure 23 as ranked duration curves for average (Scenario 3) and permitted (Scenario 4) NWC pumping rates. Figure 22 shows simulated groundwater discharge ranging from approximately 7,000 m$^3$/day (during the 1960s drought) to 87,000 m$^3$/day, and a minimal difference between the simulated groundwater discharge between average NWC pumping and permitted NWC pumping. When that same data are graphed as ranked duration curves (Figure 23), the differences between the simulated groundwater discharge of Scenarios 3 and 4 are easier to visualize.

These differences are summarized in Table 11, where the results are grouped into three classifications where groundwater discharge is exceeded 20%, 50%, and 80% of the time. Table 11 summarizes that groundwater discharge is predicted to be decreased by 3% at the 20% and 50% levels, and by 6% at the 80% level.

**TABLE 11 Aberfoyle Simulated Groundwater Discharge Ranked Duration Analysis - Average NWC Pumping to Permitted NWC Pumping**

| Location | % Time where Groundwater Discharge was Equalled or Exceeded | Simulated Groundwater Discharge ($m^3$/day) | | Change in Groundwater Discharge ($m^3$/day) | Change in Groundwater Discharge (%) |
|---|---|---|---|---|---|
| | | Average NWC Pumping (Scenario 3) | Permitted NWC Pumping (Scenario 4) | | |
| Mill Creek at Side Rd. 10 - 2GAC19 | 20 | 53,696 | 52,206 | -1,490 | -3% |
| | 50 | 38,423 | 37,082 | -1,341 | -3% |
| | 80 | 24,992 | 23,532 | -1,460 | -6% |

### 5.2.3 Climate Change Scenario Results

The future climate change scenarios reflect an increase in groundwater recharge rates as compared to historical climate conditions (Figure 15). Figure 24 illustrates an increased range of groundwater elevations predicated at MW2A-07 under the future climate scenarios as compared to the historical climate. The average increase in groundwater elevation is on the order of 0.10 m, which is relatively small when compared to the decrease in groundwater levels associated with increased NWC pumping to the maximum permitted rate (Scenario 4).

The future climate change simulations predict that groundwater levels at the City of Guelph Burke Well will increase by 0.5 m to 1.5 m as compared to historical climate (Figure 25). This increase in groundwater levels is higher than at MW2A-07, as the Burke Well water levels reflect shallower groundwater, and a greater connection to shallow overburden and changes in groundwater recharge.

Figure 26 illustrates that groundwater discharge into Mill Creek, as simulated at the Sideroad 10 gauge (2GAC19), may increase considerably in the future climate. This increase in groundwater discharge is much greater than the anticipated decrease in groundwater discharge in response to an increase in NWC pumping to the maximum permitted rate. The increased discharge is more prominent during the January-June period, and as discussed previously, this is due to greater amounts of precipitation in the winter, less frozen ground, and greater groundwater recharge rates.

## 5.3 Scenario Results - Erin

In the Erin area, simulated impacts to water levels were assessed locally on the NWC property at monitoring well MW05A-05, at the nearest municipal wells (Hillsburgh Well 2 and 3), and also assessed more regionally within the bedrock aquifer. Simulated impacts to groundwater discharge were assessed at NWC surface water monitoring station SW1.

### 5.3.1 Steady-state Scenario Results

Figure 27 shows the predicted additional drawdown in the Guelph Formation due to the increase in pumping from average NWC pumping (Scenario 1) to permitted NWC pumping (Scenario 2). The contours extend away from pumping well TW1-88 in a radial fashion, with a slight preferred orientation toward the northwest.

Locally, the simulated additional drawdown associated with increasing pumping from average NWC rates to permitted NWC rates was predicted to be 4.1 m at the closest non-pumping monitoring well on the NWC Erin property (MW05A-05). The additional simulated drawdown was predicted to be 0.3 m at both Hillsburgh municipal wells (Figure 28).

Groundwater discharge at NWC surface water monitoring station SW1 (Figure 27) in Scenarios 1 and 2 was simulated to decrease by 3%, from 1,880 $m^3$/day to 1,822 $m^3$/day due to the increase in pumping (Table 12).

**TABLE 12 Erin Simulated Groundwater Discharge - Average NWC Pumping to Permitted NWC Pumping**

| Location | 2017 Observed Flow[1] ($m^3$/day) | Simulated Groundwater Discharge ($m^3$/day) | | Change in Groundwater Discharge ($m^3$/day) | Change in Groundwater Discharge (%) |
|---|---|---|---|---|---|
| | | Average NWC Pumping (Scenario 1) | Permitted NWC Pumping (Scenario 2) | | |
| Downstream of Onsite Pond - SW1 | 1,218 to 4,260 | 1,880 | 1,822 | -58 | -3% |

[1] Range from Golder (2018b)

### 5.3.2 Drought Scenario Results

Figures 29, 30, and 31 show the predicted water level variability at NWC monitoring well MW05A-05, and Hillsburgh Well 2 and 3, respectively, over the 45-year record for average NWC pumping (Scenario 3) and permitted NWC pumping (Scenario 4). At MW05A-05, water levels are predicted to vary by up to 3 m over the 45-year record, with the lowest level predicted during the drought of the 1960s (Figure 29). Water levels decline during this time by a magnitude of approximately 1.25 m. The additional water level decline associated with increased pumping from average to permitted NWC rates is predicted to be approximately 4 m (Figure 29).

Water levels at the Hillsburgh Well 2 and 3 (Figures 30 and 31) are predicted to vary by more than 4 m in response to normal climate variability over the 45-year record. If drought conditions similar to those observed in the 1960s were to reoccur, water levels are predicted to decline by approximately 2.3 m. Finally, the additional water level decline at the Hillsburgh Well 2 and 3 associated with increased NWC pumping is predicted to be 0.3 m to 0.4 m on average over the 45-year time frame.

Simulated groundwater discharge variability at the surface water monitoring station SW1 is shown on Figure 32 as a time series, and Figure 33 as ranked duration curves for average (Scenario 3) and permitted (Scenario 4) NWC pumping rates. Figure 32 shows simulated groundwater discharge ranging from less than 1,200 $m^3$/day during the 1960s drought, to a maximum of almost 2,900 $m^3$/day. A minimal difference exists between the simulated groundwater discharge between average NWC pumping and permitted NWC pumping. These differences are examined closer using the ranked duration curves of Figure 33 and the analysis shown in Table 13. Here groundwater discharge is predicted to decrease by 3% at the 20% and 50% levels, and decrease by 4% at the 80% level.

**TABLE 13 Erin Simulated Groundwater Discharge Ranked Duration Analysis - Average NWC Pumping to Permitted NWC Pumping**

| Location | % Time where Groundwater Discharge was Equalled or Exceeded | Simulated Groundwater Discharge ($m^3$/day) | | Change in Groundwater Discharge ($m^3$/day) | Change in Groundwater Discharge (%) |
|---|---|---|---|---|---|
| | | Average NWC Pumping (Scenario 3) | Permitted NWC Pumping (Scenario 4) | | |
| Downstream of Onsite Pond - SW1 | 20 | 2,195 | 2,130 | -65 | -3% |
| | 50 | 1,871 | 1,814 | -58 | -3% |
| | 80 | 1,600 | 1,542 | -57 | -4% |

### 5.3.3 Climate Change Scenario Results

Similar to the Aberfoyle site, the future climate change scenarios for the Erin site reflect an increase in groundwater recharge rates as compared to historical climate conditions. Figure 34 illustrates an increased range of groundwater elevations predicated at MW5A-05 under the future climate scenarios as compared to the historical climate. The average increase in groundwater elevation is on the order of 0.50 m, which is relatively small when compared to the decrease in groundwater levels associated with increased NWC pumping to the maximum permitted rate (Scenario 4).

The future climate change simulations predict that groundwater levels at Hillsburgh Well 2 and 3 will increase between approximately 0.2 m to 1.8 m as compared to historical climate (Figure 35 and 36).

Figure 37 illustrates that groundwater discharge into an unnamed headwater tributary to the Eramosa River, as simulated at SW1, may increase in the future climate. This increase in groundwater discharge is greater than the anticipated decrease in groundwater discharge in response to increased NWC pumping at the maximum permitted rate. The increased discharge is more prominent during the January-June period, and as discussed previously, this is due to greater amounts of precipitation in the winter, less frozen ground, and greater groundwater recharge rates.

# 6 CLOSURE

The groundwater flow model developed for the GGET Tier Three Assessment was refined and applied in the areas of NWC's Aberfoyle and Erin water bottling operations to assess potential cumulative effects associated with NWC's permitted takings. The work was completed in response to the Interim Procedural and Technical Guidance Document for Bottle Water Renewals (MOECC 2017) that requires an assessment of cumulative effects of renewed water bottling takings using the highest tier water budget completed under the *Clean Water Act*.

The Tier Three model was refined in the areas of the Aberfoyle and Erin NWC properties, calibrated to water levels under long-term average and pumping conditions, and was shown to adequately represent the hydrogeologic conditions in these areas. The model was applied to predict the potential impacts of NWC takings on local groundwater levels, on groundwater levels at municipal wells, and on groundwater discharge to surface water features. These impacts were assessed under steady-state (long-term average) and transient (time-varying) conditions, while considering current climate, drought periods, and the potential impacts due to climate change.

The results of the model scenarios completed in this assessment indicate the following:

- Increasing the pumping rates at the NWC Aberfoyle and Erin facilities from current rates to permitted rates will not affect groundwater levels at the closest City of Guelph municipal well (Burke Well) and will have minimal impact to groundwater levels at the Hillsburgh municipal wells.

- Increasing the pumping rate at NWC Aberfoyle and Erin facilities from current rates to permitted rates will result in a 3% reduction in groundwater discharge to the identified surface water features.

- The future climate change scenarios result in greater amounts of groundwater recharge and increased groundwater elevations and groundwater discharge to surface water features.

The modelling results presented in this report are based on the modelling approach employed for the GGET Tier Three Assessment (Matrix 2017a) and Assessment of Climate Change in Support of the Guelph-Guelph/Eramosa Water Quantity Policy Study (Matrix 2018a), and represents the state of the practice at the time of this assessment. This report describes modifications made to the Tier Three model based on data provided by NWC and is assumed correct. The results of the model scenarios reflect the current scientific understanding, but are uncertain due limitations of data and scientific characterization reflected in the model. It is recommended that the numerical model employed to complete this assessment be updated in the future to reflect new data or if observed conditions change as compared to those represented in this assessment.

## 7 REFERENCES

AquaResource Inc. (AquaResource). 2009a. *Integrated Water Budget Report, Grand River Watershed*. Prepared for Grand River Conservation Authority. June 2009.

AquaResource Inc. (AquaResource). 2009b. *Tier 2 Water Quantity Stress Assessment Report, Grand River Watershed*. Prepared for the Grand River Conservation Authority. December 2009.

AquaResource Inc. (AquaResource). 2009c. *Integrated Water Budget Report - Tier 2, Credit Valley Source Protection Area.* Prepared for Credit Valley Conservation Authority. April 2009. https://ctcswp.ca/technical-docs/#1496857206673-baff4eda-f5c3

Blackport R (2018). Personal Communication. Meeting. May 14, 2018.

Brunton F.R. 2009. "Update of Revisions to the Early Silurian Stratigraphy of the Niagara Escarpment: Integration of Sequence Stratigraphy, Sedimentology and Hydrogeology to Delineate Hydrogeologic Units." In: *Summary of Field Work and Other Activities 2009*. Ontario Geological Survey. Open File Report 6240. 25-1 to 25-20.

Conestoga-Rovers and Associates (CRA). 2014a. *2013 Annual Monitoring Report Nestlé Erin Site, Town of Erin, Ontario.* Prepared for Nestlé Waters Canada. Guelph, Ontario.

Conestoga-Rovers and Associates (CRA). 2014b. *2013 Annual Monitoring Report, Nestlé Waters Canada*. Guelph, Ontario.

Conestoga-Rovers and Associates (CRA). 2011. *2010 Annual Monitoring Report.* Prepared for Nestlé Waters Canada. Guelph, Ontario. January 2011.

Conestoga-Rovers and Associates (CRA). 2006. *Test Pumping Investigation Supply Well TW1-88*. Prepared for Nestlé Waters Canada. Town of Erin, Ontario. February 2006.

Conestoga-Rovers and Associates (CRA). 1989. *Well Construction and Testing Investigation*. Township of Erin. January 1989.

Diersch H-J. G. 2014. *FEFLOW Finite Element Modeling of Flow, Mass and Heat Transport in Porous and Fractured Media*. Springer, Verlag Berlin Heidelberg.

Doherty J. 2013. *Addendum to the PEST Manual.* Watermark Numerical Computing. May 2013. www.pesthomepage.org/getfiles.php?file=addendum.pdf

Earthfx Incorporated (Earthfx). 2009. *Final Report, Simulation of Groundwater Flow in the Vicinity of the Cedarvale Wellfield, Georgetown, Ontario: Model Development and Calibration Report.* Prepared for Regional Municipality of Halton.

EBNFLO Environmental and AquaResource Inc. (EBNFLO and AquaResource). 2010. *Guide for Assessment of Hydrologic Effects of Climate Change in Ontario*. Prepared for the Ontario Ministry of Natural Resources and Ministry of the Environment in partnership with Credit Valley Conservation. June 2010.

Freeze R.A. and J.A. Cherry. 1979. *Groundwater*. Prentice Hall. New Jersey. 604 pp.

Golder Associates Ltd. (Golder) and S.S. Papadopulos and Associates, Inc. (SSPA). 2018. Preliminary Estimation of Baseflows at SW1 and SW2. Personal Communication. June 27, 2018.

Golder Associates Ltd. (Golder). 2018a. *2017 Annual Monitoring Report, Nestle Waters Canada Aberfoyle Site.* Final draft report prepared for Nestle Waters Canada. Puslinch, Ontario. February 2018.

Golder Associates Ltd. (Golder). 2018b. *2017 Annual Monitoring Report, Nestle Waters Canada Erin Spring Site.* Final draft report prepared for Nestle Waters Canada. Puslinch, Ontario. February 2018.

Golder Associates Ltd. (Golder). 2006. *Guelph-Puslinch Groundwater Protection Study*. Prepared for the Grand River Conservation Authority. Cambridge, Ontario. May 2006.

Government of Ontario. 2018. *Clean Water Act, 2006.* Ontario Regulation 287/07. Last Amendment: 206/18. Consolidation Period from July 1, 2018, to September 11, 2018. http://www.ontario.ca/laws/regulation/070287

Grand River Conservation Authority (GRCA). 2018. *Geospatial Data, GIS Data Catalogue.* Grand River Information Network (GRIN). https://data.grandriver.ca/downloads-geospatial.html

Hill, M.C. 1998. Methods and Guidelines for Effective Model Calibration, U.S. Geological Survey, Water-Resources Investigation Report 98-4005.

Matrix Solutions Inc. (Matrix) 2018a. *Assessment of Climate Change and Assessment of Water Quantity Threats in the IPZ-Q in Support of the Guelph-Guelph/Eramosa Water Quantity Policy Study*. Prepared for the Lake Erie Source Protection Region. Guelph, Ontario. November 2018.

Matrix Solutions Inc. (Matrix). 2018b. *Guelph-Guelph/Eramosa Water Quantity Policy Development Study: Threats Management Strategy*. Version 1.0. Prepared for the Lake Erie Source Protection Region. Guelph, Ontario. June 2018.

Matrix Solutions Inc. (Matrix). 2017a. *City of Guelph and Township Of Guelph/Eramosa Tier Three Water Budget and Local Area Risk Assessment*. Prepared for the Lake Erie Source Protection Region. Breslau, Ontario. March 2017. https://www.sourcewater.ca/en/source-protection-areas/guelph-and-guelph-eramosa-tier-3.aspx

Matrix Solutions Inc. (Matrix). 2017b. *Cost Estimate for 'Proposed Scope of Groundwater Modeling for Renewal of the Permit To Take Water for the Nestlé Waters Canada Aberfoyle and Erin Facilities*. December 2017.

Neville C. (2018). Hydrogeologist, Associate. S.S. Papadopulos & Associates, Inc. Personal communication. Email. May 25, 2018.

Ontario Ministry of the Environment and Climate Change (MOECC). 2017. *Interim Procedural and Technical Guidance Document for Bottle Water Renewals: Permit to Take Water Applications and Hydrogeological Study Requirements*. Operations Division. April 2017. http://www.downloads.ene.gov.on.ca/envision/env_reg/er/documents/2017/012-9151_d.pdf

Ontario Ministry of the Environment and Climate Change. (MOECC). 2016. *Technical Rules: Assessment Report, Clean Water Act, 2006*. November 20, 2008. Amended on December 12, 2008 (administrative amendments), November 16, 2009 (EBR Posting Number EBRO10-7573), and December 2, 2013 (Technical Bulletin). Updated on May 19, 2016. https://www.ontario.ca/page/technical-rules-assessment-report

Ontario Ministry of the Environment. (MOE). 2013. *Memorandum: Assignment of Water Quantity Risk based on the Evaluation of Impacts to Other Water Users*. Memorandum prepared for Source Protection Regions. Toronto, Ontario. December 2, 2013.

Ontario Ministry of the Environment (MOE) and Ontario Ministry of Natural Resources (MNR). 2010. *Technical Bulletin: Part IX Local Area Risk Level*. April 2010. 15 pp. https://ia601209.us.archive.org/22/items/std01079874.ome/std01079874.pdf

Schroeter & Associates. 2004. *GAWSER: Guelph All-Weather Sequential-Events Runoff Model, Version 6.5, Training Guide and Reference Manual.* Prepared for the Ontario Ministry of Natural Resources and the Grand River Conservation Authority.

Spitz, K., and J. Moreno, 1996: *A Practical Guide to Groundwater and Solute Transport Modeling,* John Wiley & Sons, Inc., New York, New York.

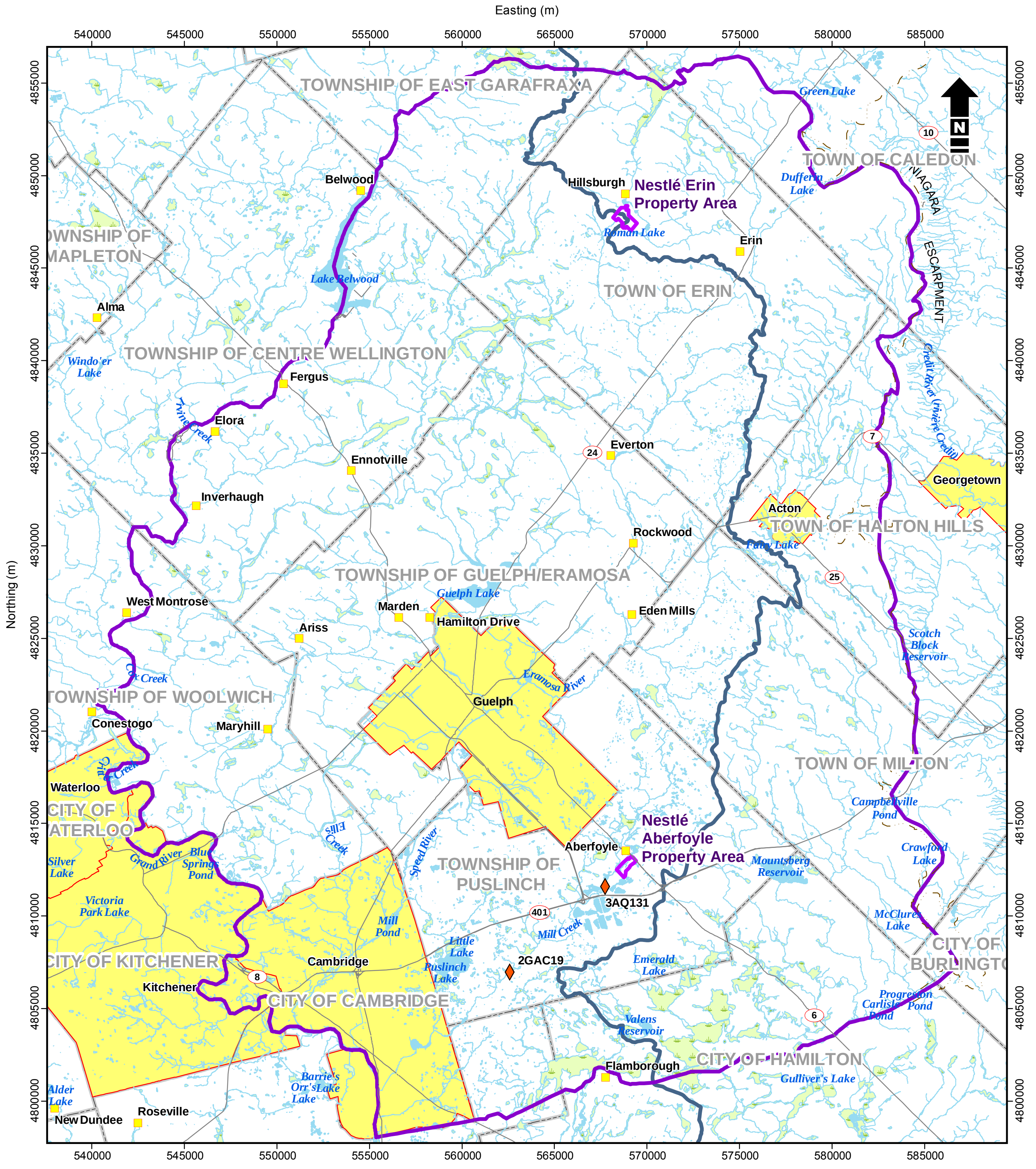
S.S. Papadopulos & Associates, Inc. (SSPA). 2016. *Estimates of Baseflow for Mill Creek.* Memorandum to Charles B. Andrews. February 26, 2016.

Terraqua Investigations Ltd. (Terraqua). 1991. *Hydrogeologic Investigation of a Proposed Residential Development*. Hillsburgh, Ontario. May 1991.

Town of Erin. 2018. *Summary Report.* Town of Erin. Hillsburgh Well Supply. Drinking-Water System No. 220007285. February 2018.

Town of Erin. 2017. *Summary Report.* Town of Erin. Hillsburgh Well Supply. Drinking-Water System No. 220007285. January 2017.

United States Department of Agriculture (USDA). 1994. BFLOW program, available from http://swat.tamu.edu/software/baseflow-filterprogram/.



- ☐ Nestlé Waters Canada Property Boundary
- Tier Three Model Boundary
- Grand River Watershed Boundary
- 🟨 Community
- Wetland
- Water Body
- Watercourse
- Major Road
- Niagara Escarpment
- ◆ GRCA Flow Gauge

1:300,000

metres

3,000 0 3,000 6,000

NAD 1983 UTM Zone 17N

Reference: Contains information licensed under the Open Government Licence – Ontario and information made available under the copyright © of Grand River Conservation Authority Open Data Licence v3.0.

**Matrix Solutions Inc.**
ENVIRONMENT & ENGINEERING

City of Guelph
Groundwater Modelling Report for Renewal of the Permit to Take Water for the Nestle Waters Canada Aberfoyle and Erin Facilities

## City of Guelph and Township of Guelph/Eramosa Tier Three Assessment Model Area

| Date: | Project: | Submitter: | Reviewer: |
|---|---|---|---|
| September, 2018 | 26435 | J. Melchin | D. Van Vliet |

Figure
1

I:\CityofGuelph\26435\FiguresandTables\QHG\2018\Report\Figure-1-City_of_Guelph_and_Township_of_Guelph_Erarmosa_Tier_Three_Assessment_Model_Area.mxd - Letter_P - 13-Sep-18, 01:41 PM - ccurry - TID001

- ☐ Nestlé Waters Canada Property Boundary
- Water Body
- Watercourse
- Highway
- Road
- Cross-section
- Monitoring Well (Bedrock)
- Monitoring Well (Overburden)
- ▲ Piezometer
- ⊙ Private Well (Bedrock)
- ⊕ Production Well
- ▣ Surface Water Station
- 🟩 Surface Water Temperature Station

Reference: Contains information licensed under the Open Government Licence – Ontario and information made available under the copyright © of Grand River Conservation Authority Open Data Licence v3.0. Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

1:13,500

metres

140 0 140 280

NAD 1983 UTM Zone 17N

**Matrix Solutions Inc.**
ENVIRONMENT & ENGINEERING

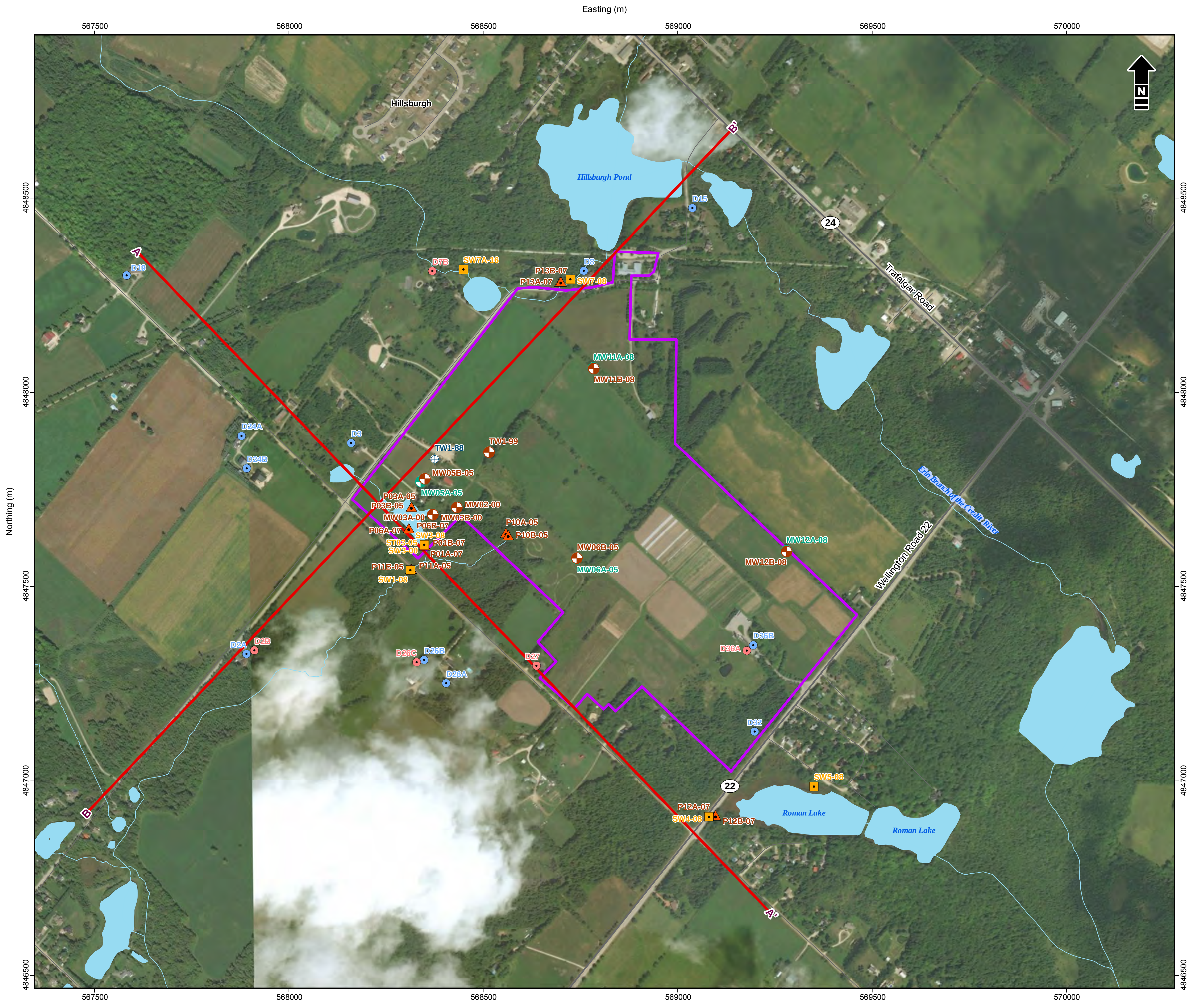
City of Guelph
Groundwater Modelling Report for Renewal of the Permit to Take
Water for the Nestle Waters Canada Aberfoyle and Erin Facilities

# Aberfolye Site Map

| Date: | Project: | Submitter: | Reviewer: |
|---|---|---|---|
| December 2018 | 26435 | J. Melchin | D. Van Vliet |

Figure
2

I:\CityofGuelph\26435\FiguresandTables\QHG\2018\Report\Figure-2-Aberfoyle_Site_Map.mxd - Tabloid_L - 18-Dec-18, 07:08 AM - ccurry - TID005



Nestlé Waters Canada Property Boundary
Water Body
Watercourse
Highway
Road
Cross-section
Monitoring Well (Bedrock)
Monitoring Well (Overburden)
Piezometer
Private Well
Private Well (Bedrock)
Production Well
Surface Water Station

Reference: Contains information licensed under the Open Government Licence – Ontario. Data obtained from Grand River Conservation Authority used under license. Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

1:10,000 metres
100 0 100 200
NAD 1983 UTM Zone 17N

Matrix Solutions Inc.
ENVIRONMENT & ENGINEERING

City of Guelph
Groundwater Modelling Report for Renewal of the Permit to Take Water for the Nestle Waters Canada Aberfoyle and Erin Facilities

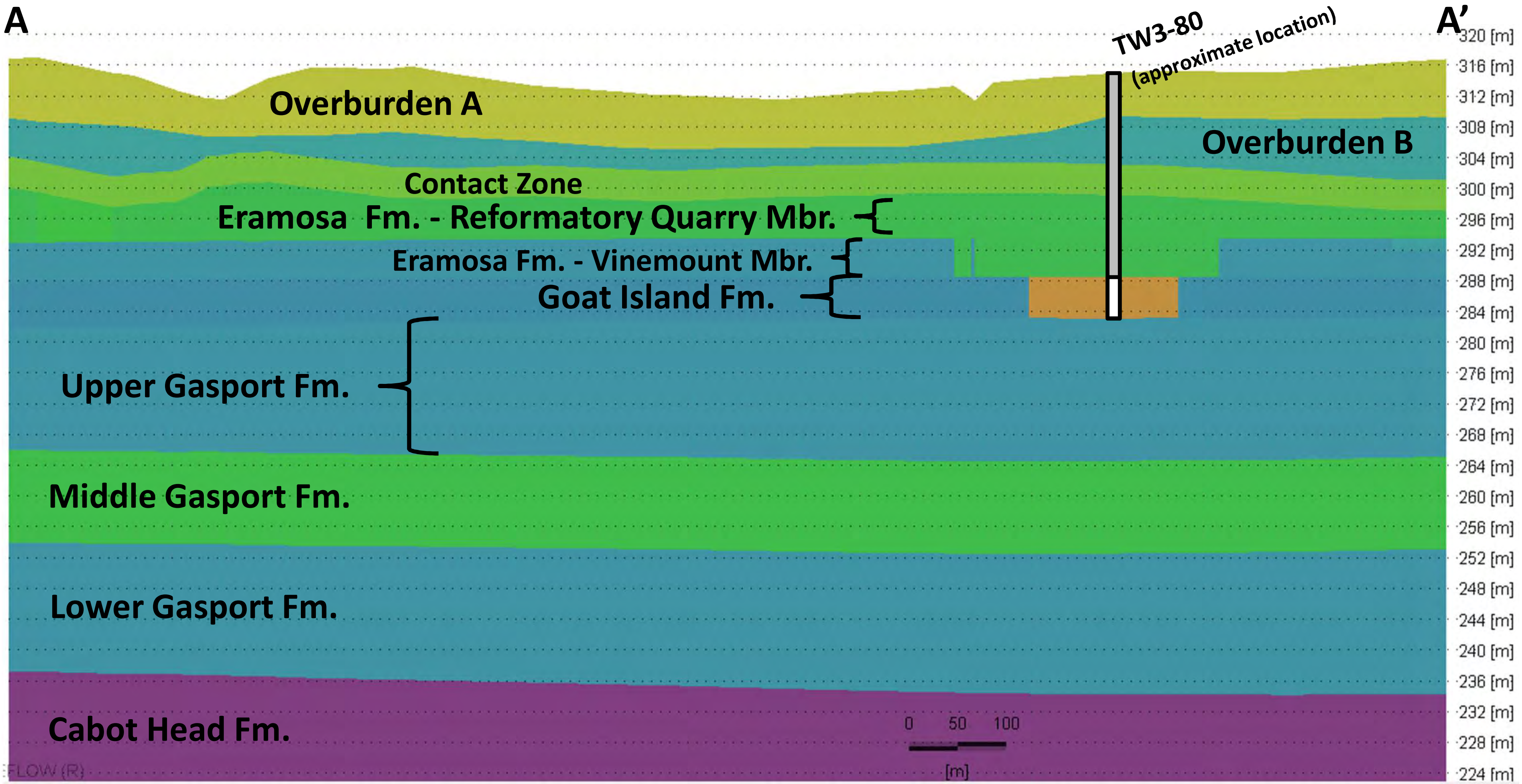
# Erin Site Map

| Date: | Project: | Submitter: | Reviewer: |
|---|---|---|---|
| September 2018 | 26435 | J. Melchin | D. Van Vliet |

Disclaimer: The information contained herein may be compiled from numerous third party materials that are subject to periodic change without prior notification. While every effort has been made by Matrix Solutions Inc. to ensure the accuracy of the information presented at the time of publication, Matrix Solutions Inc. assumes no liability for any errors, omissions, or inaccuracies in the third party material.

Figure
3

I:\CityofGuelph\26435\FiguresandTables\QHG\2018\Report\Figure-3-Erin_Site_Map.mxd - Tabloid_L - 13-Sep-18, 01:42 PM - ccurry - TID005



Note: 8x Vertical Exaggeration

Conductivity: K_xx
- Patches -
[m/s]

🟥 1.0E-02
🟧 1.0E-03
🟨 1.0E-04
🟩 1.0E-05
🟩 1.0E-06
🟦 1.0E-07
🟦 1.0E-08
🟪 1.0E-09
🟪 1.0E-10

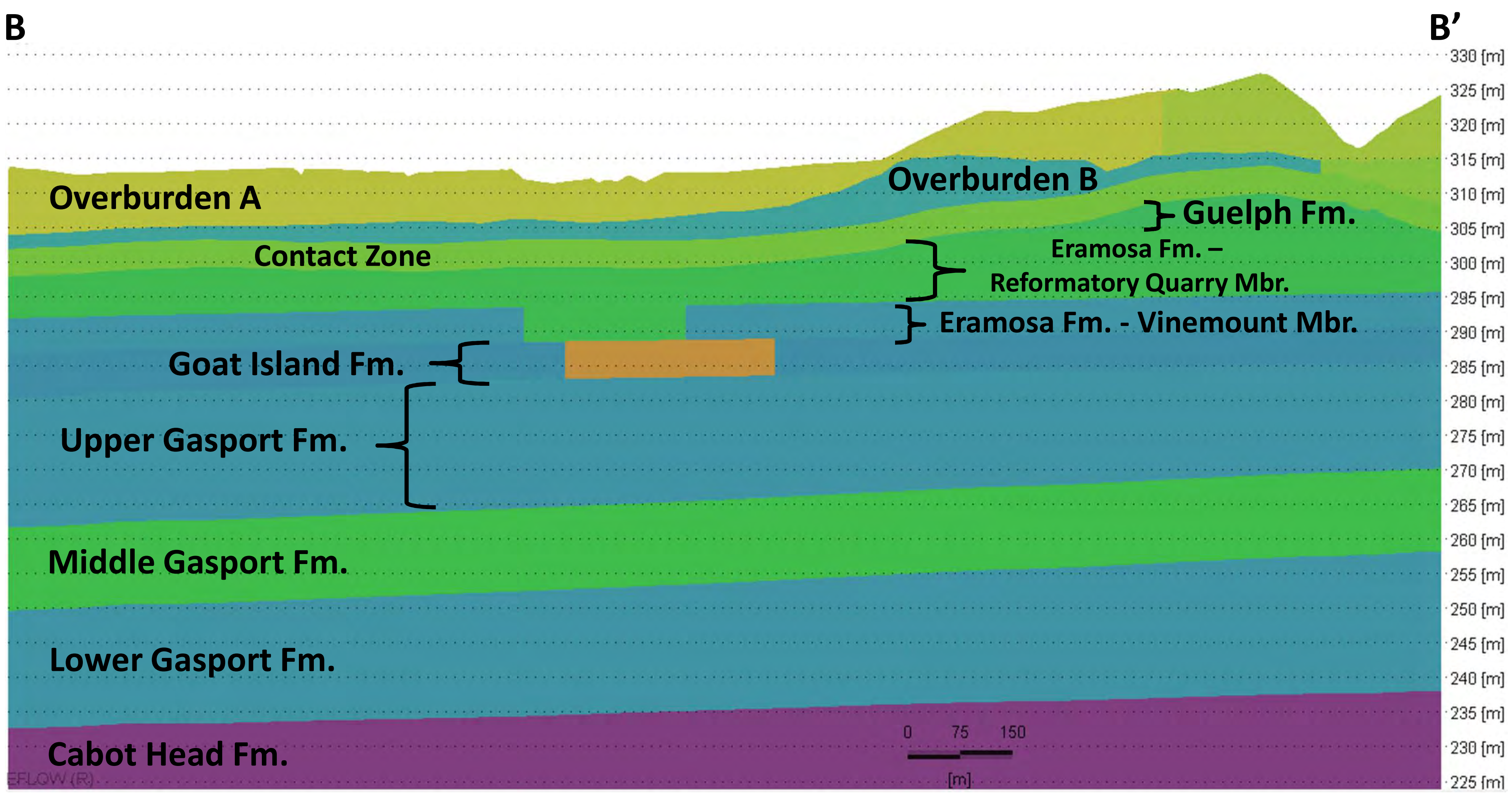
**Matrix Solutions Inc.**
ENVIRONMENT & ENGINEERING

City of Guelph
Groundwater Modelling Report for Renewal of the Permit To Take Water for the Nestlé Waters Canada Aberfoyle and Erin Facilities

## Aberfoyle NW-SE Model Cross-Section (AA’)

| | | | | |
|---|---|---|---|---|
| Date:<br>09 Jan 2019 | Project:<br>26435 | Technical:<br>J. Melchin | Reviewer:<br>D. Van Vliet | Drawn:<br>J. Melchin |

Figure
4



Note: 10x Vertical Exaggeration

Conductivity: K_xx
- Patches -
[m/s]

🟥 1.0E-02
🟧 1.0E-03
🟨 1.0E-04
🟩 1.0E-05
🟩 1.0E-06
🟦 1.0E-07
🟦 1.0E-08
🟪 1.0E-09
🟪 1.0E-10

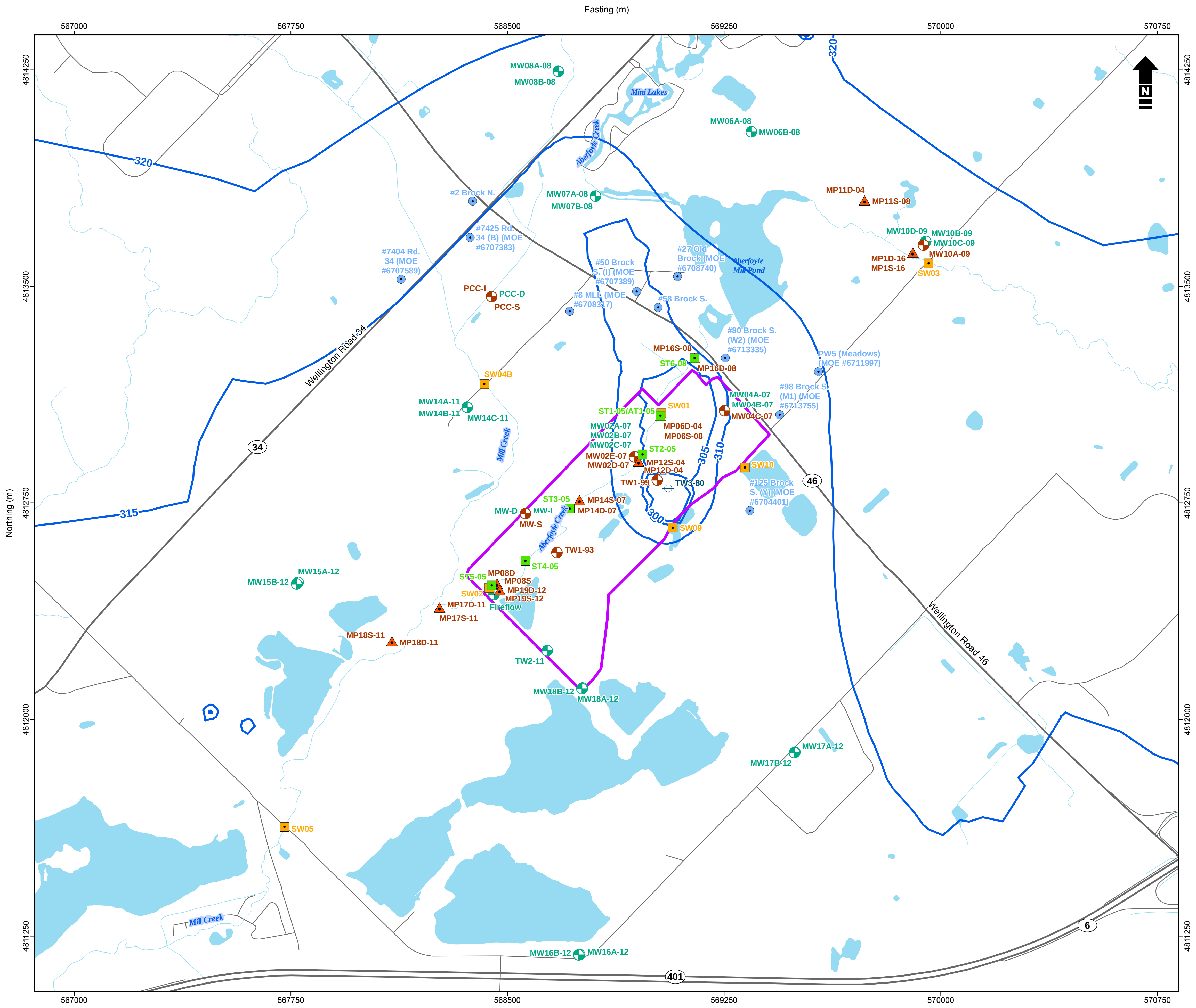
**Matrix Solutions Inc.**
ENVIRONMENT & ENGINEERING

City of Guelph
Groundwater Modelling Report for Renewal of the Permit To Take Water for the Nestlé Waters Canada Aberfoyle and Erin Facilities

## Aberfoyle SW-NE Model Cross-Section (BB’)

| Date: | Project: | Technical: | Reviewer: | Drawn: |
|---|---|---|---|---|
| 09 Jan 2019 | 26435 | J. Melchin | D. Van Vliet | J. Melchin |

Figure
5



- ▢ Nestlé Waters Canada Property Boundary
- Water Body
- Watercourse
- Hydraulic Head Contour | 5m (masl)
- Highway
- Road
- ◐ Monitoring Well (Bedrock)
- ◐ Monitoring Well (Overburden)
- ▲ Piezometer
- ● Private Well (Bedrock)
- ⊕ Production Well
- 🟧 Surface Water Station
- 🟩 Surface Water Temperature Station

Reference: Contains information licensed under the Open Government Licence – Ontario. Data obtained from Grand River Conservation Authority used under license.

Matrix Solutions Inc.
ENVIRONMENT & ENGINEERING

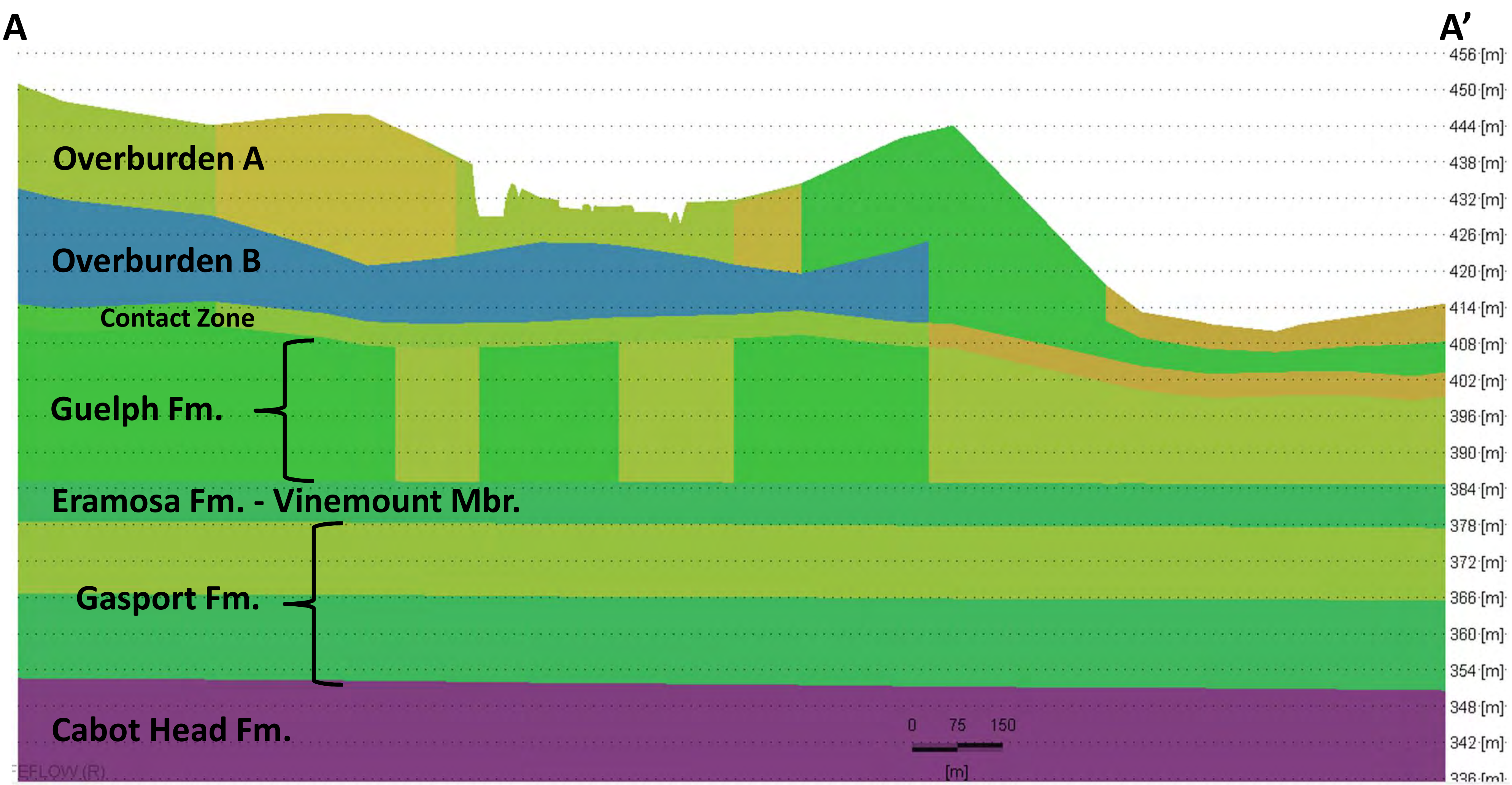
City of Guelph
Groundwater Modelling Report for Renewal of the Permit to Take Water for the Nestle Waters Canada Aberfoyle and Erin Facilities

# Aberfoyle - Simulated Goat Island Fm. Potentiometric Surface (Layer 10)

| Date: | Project: | Submitter: | Reviewer: |
|---|---|---|---|
| December 2018 | 26435 | J. Melchin | D. Van Vliet |

Figure
6

I:\CityofGuelph\26435\FiguresandTables\QHG\2018\Report\Figure-6-Aberfoyle_Simulated_Goat_Island_Fm_Potentiometric_Surface_Layer_10.mxd - Tabloid_L - 07-Dec-18, 12:12 PM - ccurry - TID005



Note: 10x Vertical Exaggeration

Conductivity: K_xx
- Patches -
[m/s]

🟥 1.0E-02
🟧 1.0E-03
🟨 1.0E-04
🟩 1.0E-05
🟩 1.0E-06
🟦 1.0E-07
🟦 1.0E-08
🟪 1.0E-09
🟪 1.0E-10

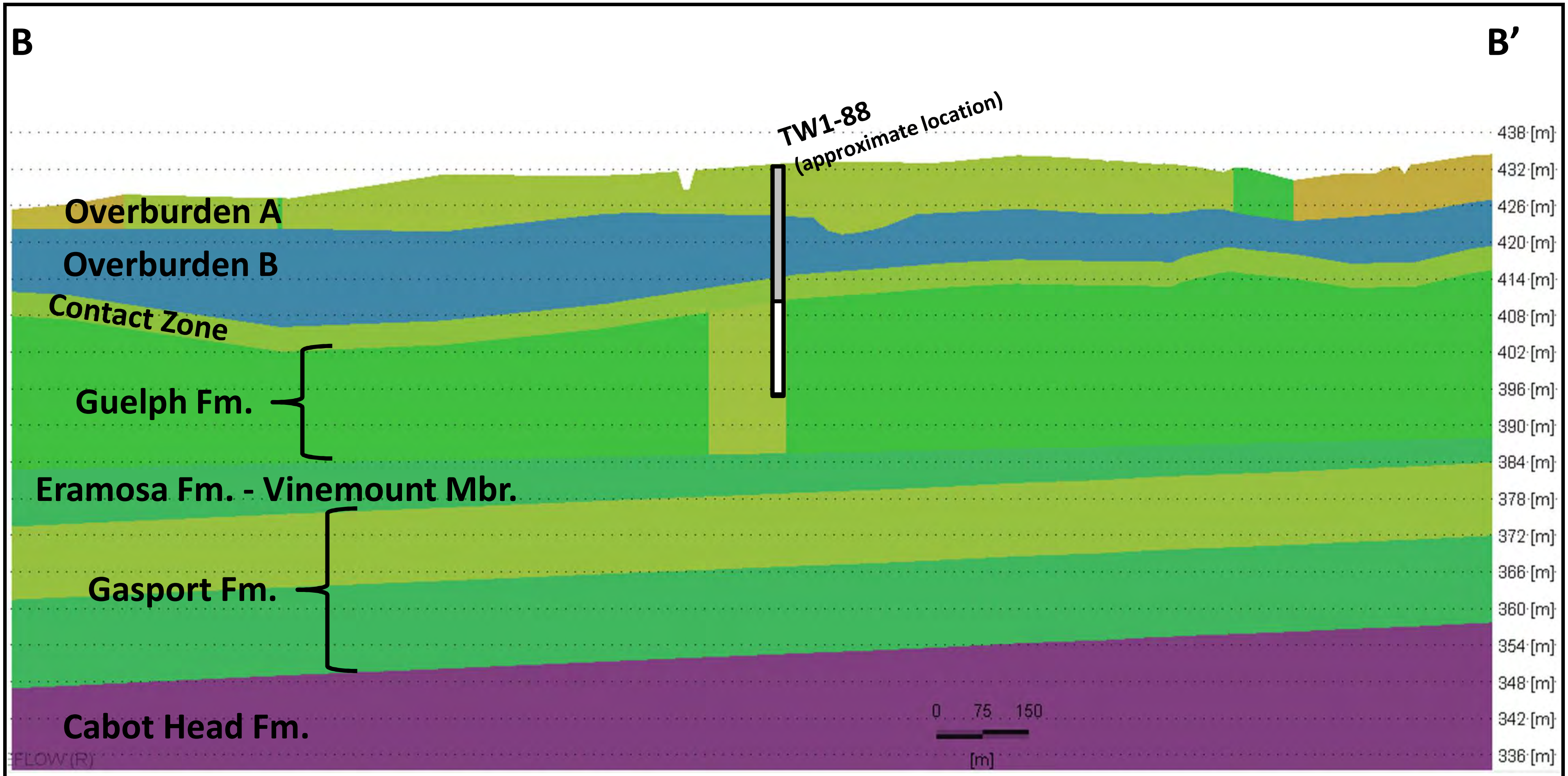
**Matrix Solutions Inc.**
ENVIRONMENT & ENGINEERING

City of Guelph
Groundwater Modelling Report for Renewal of the Permit To Take Water for the Nestlé Waters Canada Aberfoyle and Erin Facilities

# Erin NW-SE Model Cross-Section (AA’)

| Date: | Project: | Technical: | Reviewer: | Drawn: |
|---|---|---|---|---|
| 09 Jan 2019 | 26435 | J. Melchin | D. Van Vliet | J. Melchin |

Figure
7



Note: 10x Vertical Exaggeration

Conductivity: K_xx
- Patches -
[m/s]

- 🟥 1.0E-02
- 🟧 1.0E-03
- 🟨 1.0E-04
- 🟩 1.0E-05
- 🟩 1.0E-06
- 🟦 1.0E-07
- 🟦 1.0E-08
- 🟪 1.0E-09
- 🟪 1.0E-10

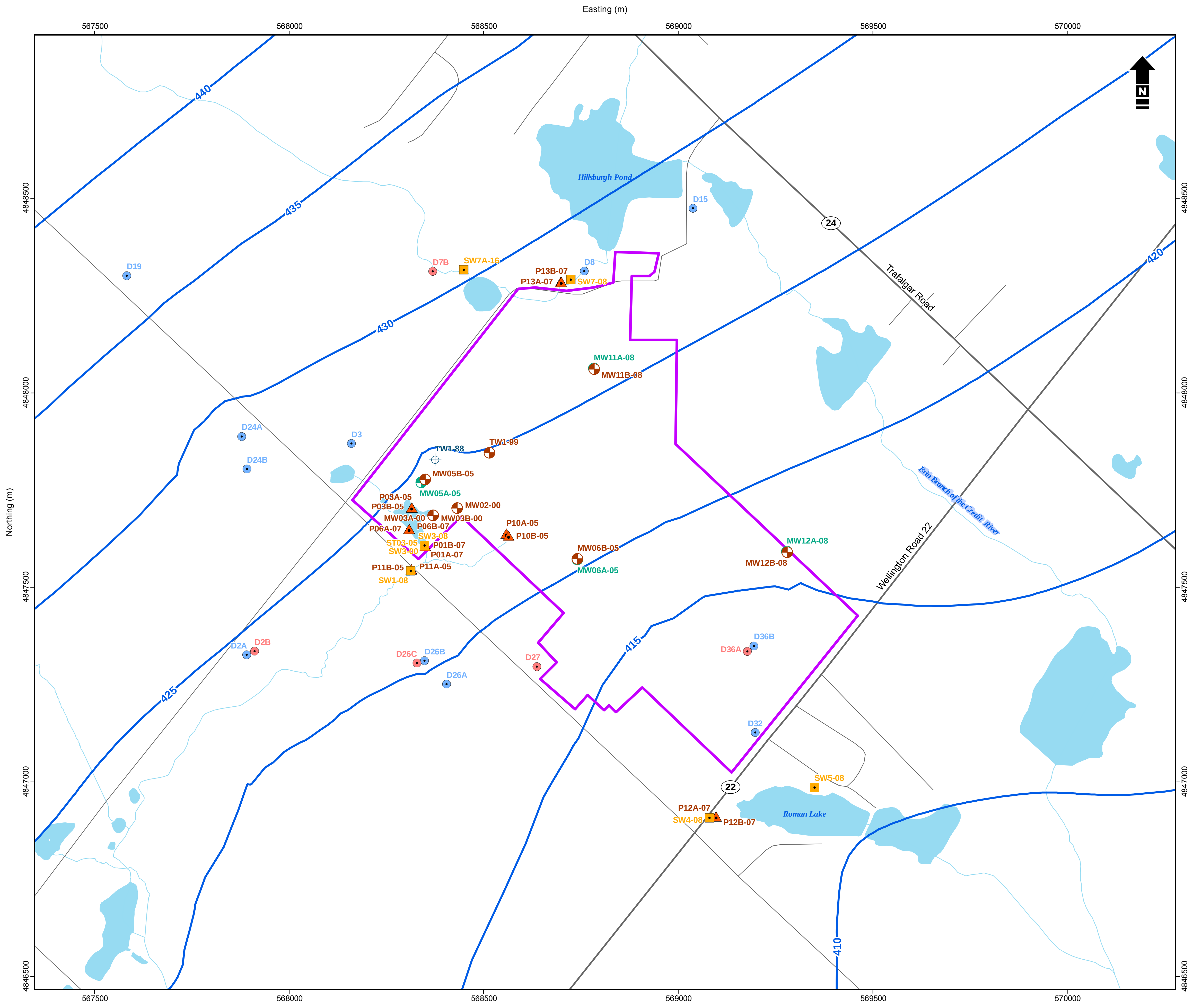
**Matrix Solutions Inc.**
ENVIRONMENT & ENGINEERING

City of Guelph
Groundwater Modelling Report for Renewal of the Permit To Take Water for the Nestlé Waters Canada Aberfoyle and Erin Facilities

## Erin SW-NE Model Cross-Section (BB’)

| Date: | Project: | Technical: | Reviewer: | Drawn: |
|---|---|---|---|---|
| 09 Jan 2019 | 26435 | J. Melchin | D. Van Vliet | J. Melchin |

Figure
8



- ▢ Nestlé Waters Canada Property Boundary
- Water Body
- Watercourse
- Hydraulic Head Contour | 5m (masl)
- Highway
- Road
- Monitoring Well (Bedrock)
- Monitoring Well (Overburden)
- ▲ Piezometer
- ● Private Well
- ● Private Well (Bedrock)
- ⌖ Production Well
- ■ Surface Water Station

1:10,000 metres
100 0 100 200
NAD 1983 UTM Zone 17N

Reference: Contains information licensed under the Open Government Licence – Ontario. Data obtained from Grand River Conservation Authority used under license.

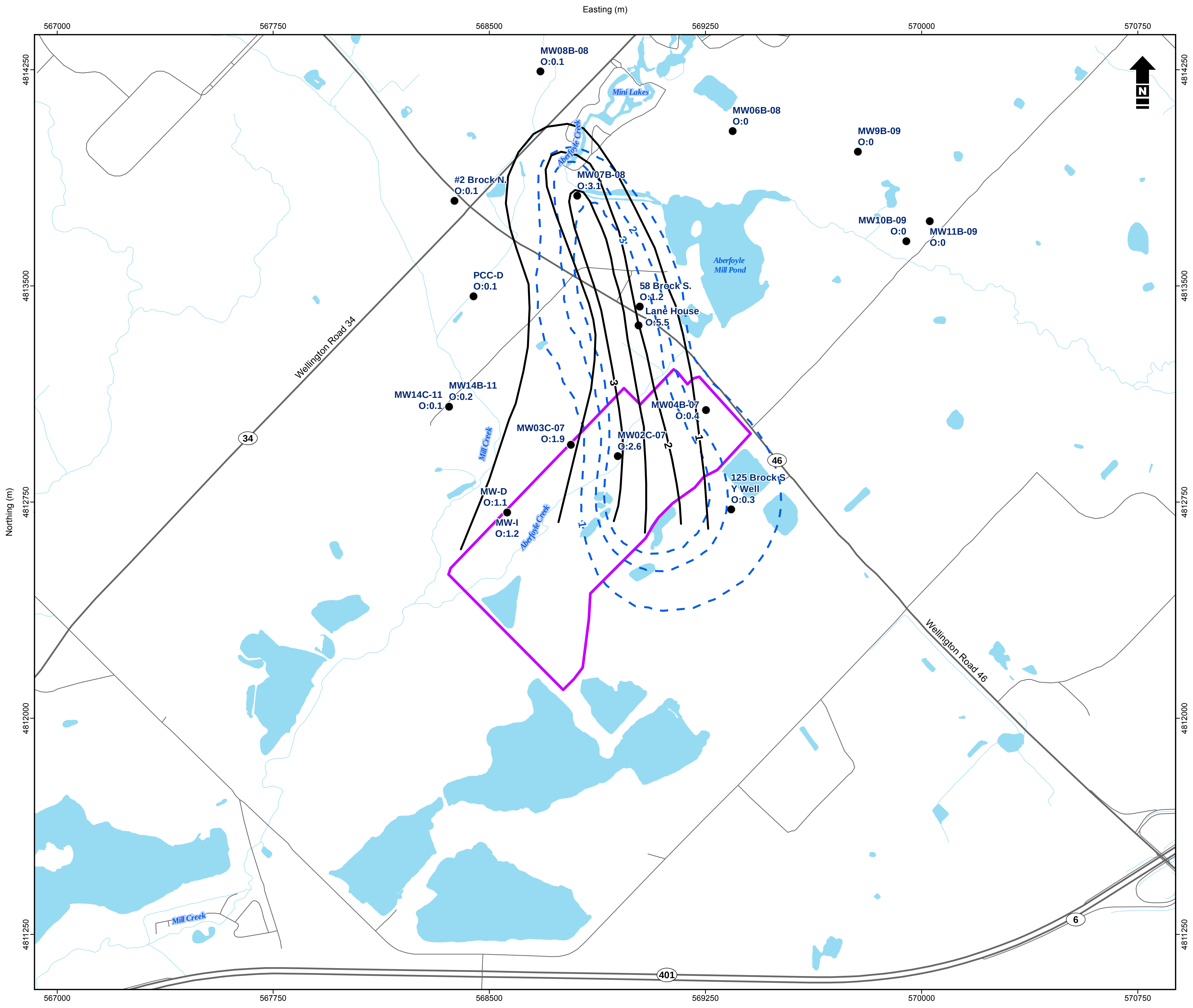
Matrix Solutions Inc.
ENVIRONMENT & ENGINEERING

City of Guelph
Groundwater Modelling Report for Renewal of the Permit to Take
Water for the Nestle Waters Canada Aberfoyle and Erin Facilities

# Erin - Simulated Guelph Fm. Potentiometric Surface (Layer 7)

| Date: | Project: | Submitter: | Reviewer: |
|---|---|---|---|
| September 2018 | 26435 | J. Melchin | D. Van Vliet |

Figure
9



Nestlé Waters Canada Property Boundary

Water Body

Watercourse

Interpreted Drawdown Contour | 1m

Simulated Drawdown Contour | 1m

Highway

Road

● Upper Bedrock Monitoring Well

O: x.x Observed Drawdown Value

1:13,500 metres

140 0 140 280

NAD 1983 UTM Zone 17N

Reference: Contains information licensed under the Open Government Licence – Ontario. Data obtained from Grand River Conservation Authority used under license.

Matrix Solutions Inc.
ENVIRONMENT & ENGINEERING

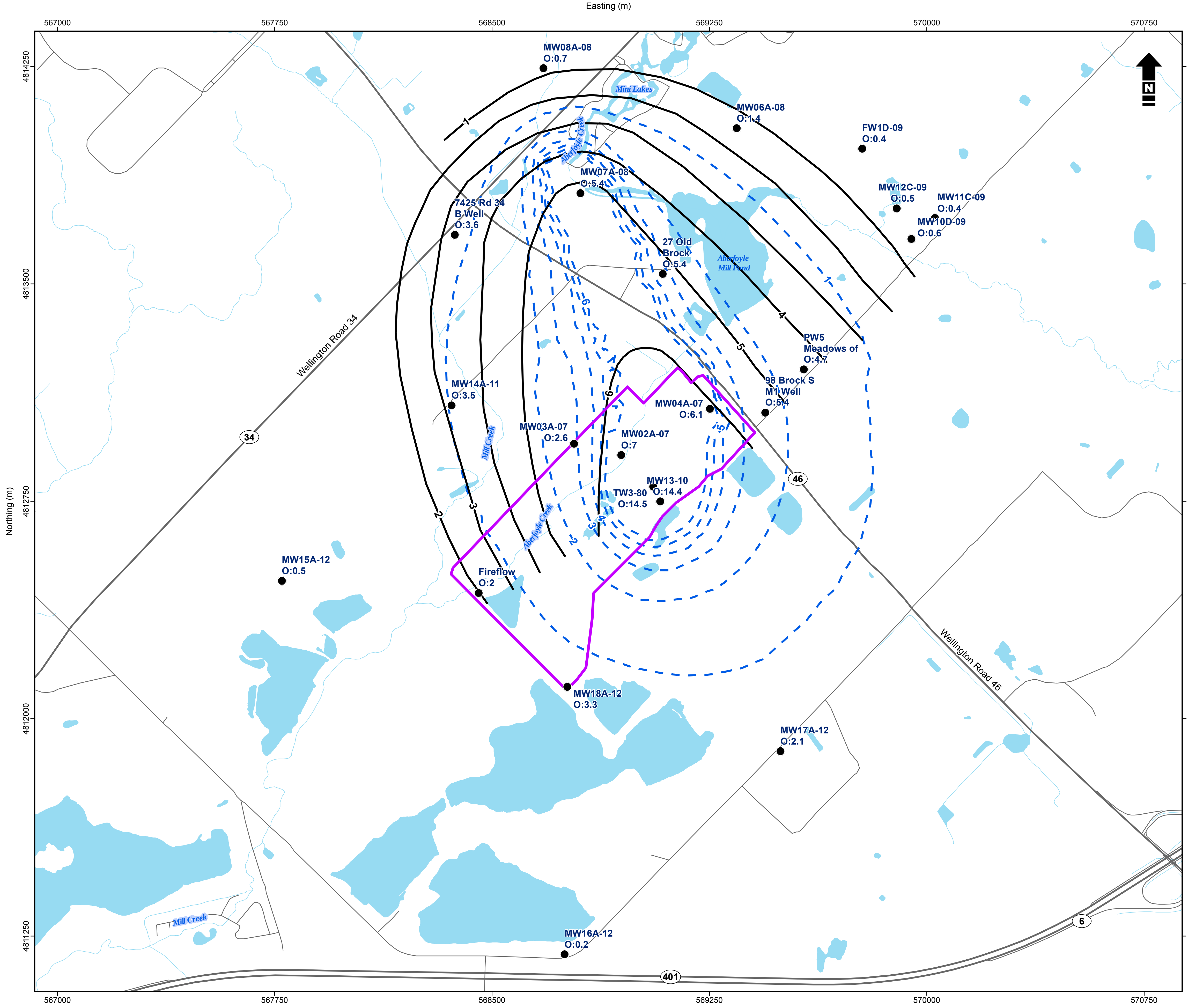
City of Guelph
Groundwater Modelling Report for Renewal of the Permit to Take Water for the Nestle Waters Canada Aberfoyle and Erin Facilities

# Aberfoyle - Simulated vs. Interpreted Drawdown in the Upper Bedrock (Layer 6 - Reformatory Quarry Mbr.) due to 2010 NWC Pumping Test

| Date: | Project: | Submitter: | Reviewer: |
|---|---|---|---|
| December 2018 | 26435 | J. Melchin | D. Van Vliet |

Figure
10

I:\CityofGuelph\26435\FiguresandTables\QHG\2018\Presentation\Figure-10-Aberfoyle_Simulated_vs_Interpreted_Drawdown_int_the_Upper_Bedrock_Layer6_Reformatory_Quarry_Mbr_due_to_2010_NWC_Pumping_Test.mxd - Tabloid_L - 13-Dec-18, 07:33 PM - ccurry - TID005



I:\CityofGuelph\26435\FiguresandTables\QHG\2018\Presentation\Figure-11-Aberfoyle_Simulated_vs_Interpreted_Drawdown_in_the_Lower_Bedrock_Layer_10_Goat_Island_Fm_due_to_2010_NWC_Pumping_Test.mxd - Tabloid_L - 13-Dec-18, 07:35 PM - ccurry - TID005

| | |
|---|---|
| ▢ | Nestlé Waters Canada Property Boundary |
| ▨ | Water Body |
| ~ | Watercourse |
| ～ | Interpreted Drawdown Contour \| 1m |
| ╌ | Simulated Drawdown Contour \| 1m |
| — | Highway |
| — | Road |
| ● | Lower Bedrock Monitoring Well |
| O: x.x | Observed Drawdown Value |

Reference: Contains information licensed under the Open Government Licence – Ontario. Data obtained from Grand River Conservation Authority used under license.

1:13,500 metres
140 0 140 280
NAD 1983 UTM Zone 17N

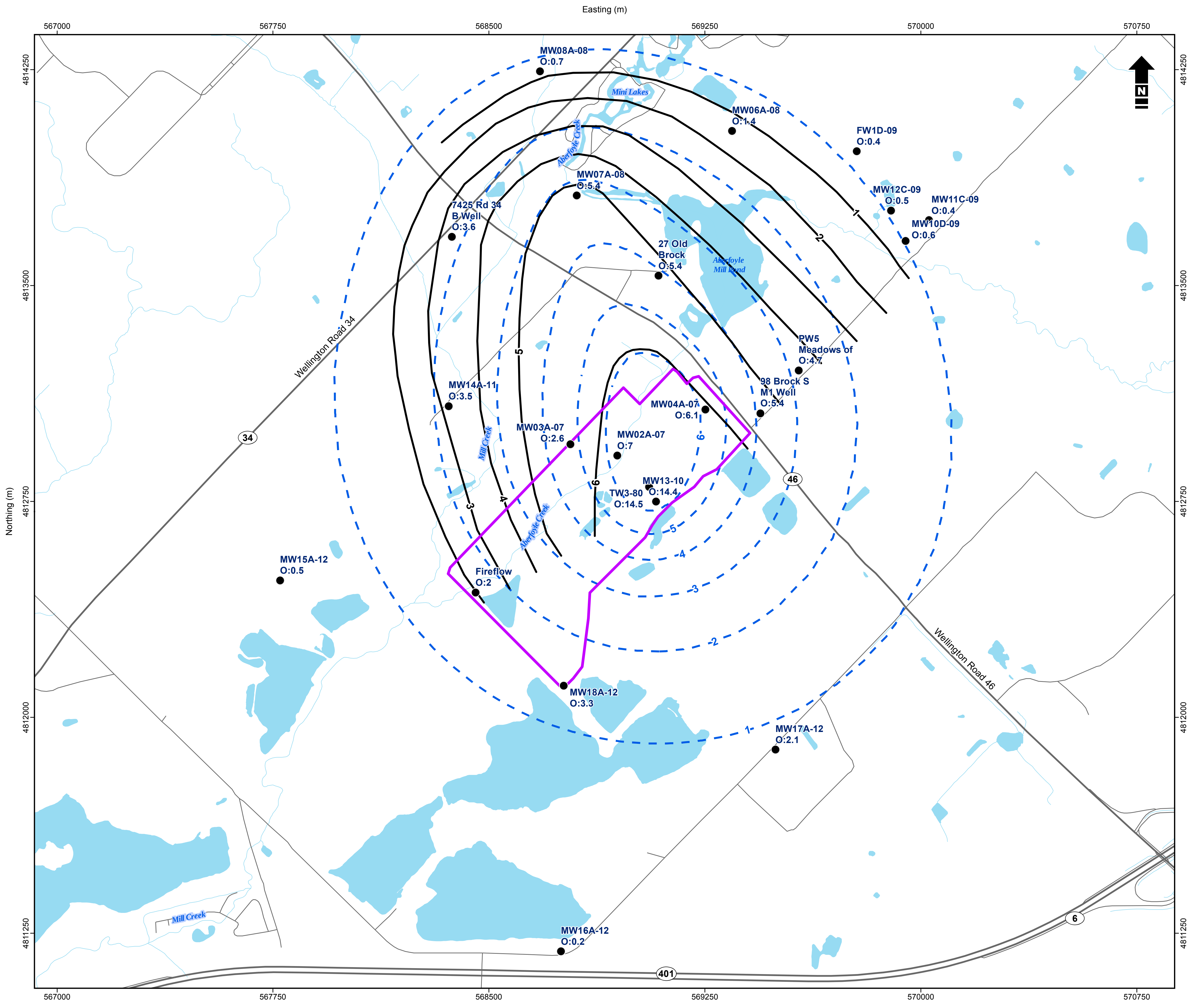
Matrix Solutions Inc.
ENVIRONMENT & ENGINEERING

City of Guelph
Groundwater Modelling Report for Renewal of the Permit to Take
Water for the Nestle Waters Canada Aberfoyle and Erin Facilities

# Aberfoyle - Simulated vs. Interpreted Drawdown in the Lower Bedrock (Layer 10 – Goat Island Fm.) due to 2010 NWC Pumping Test

| Date: | Project: | Submitter: | Reviewer: |
|---|---|---|---|
| December 2018 | 26435 | J. Melchin | D. Van Vliet |

Figure
11



▢ Nestlé Waters Canada Property Boundary
Water Body
Watercourse
Interpreted Drawdown Contour | 1m
Simulated Drawdown Contour | 1m
Highway
Road
● Lower Bedrock Monitoring Well
O: x.x Observed Drawdown Value

1:13,500 metres
140 0 140 280
NAD 1983 UTM Zone 17N

Reference: Contains information licensed under the Open Government Licence – Ontario. Data obtained from Grand River Conservation Authority used under license.

Matrix Solutions Inc.
ENVIRONMENT & ENGINEERING

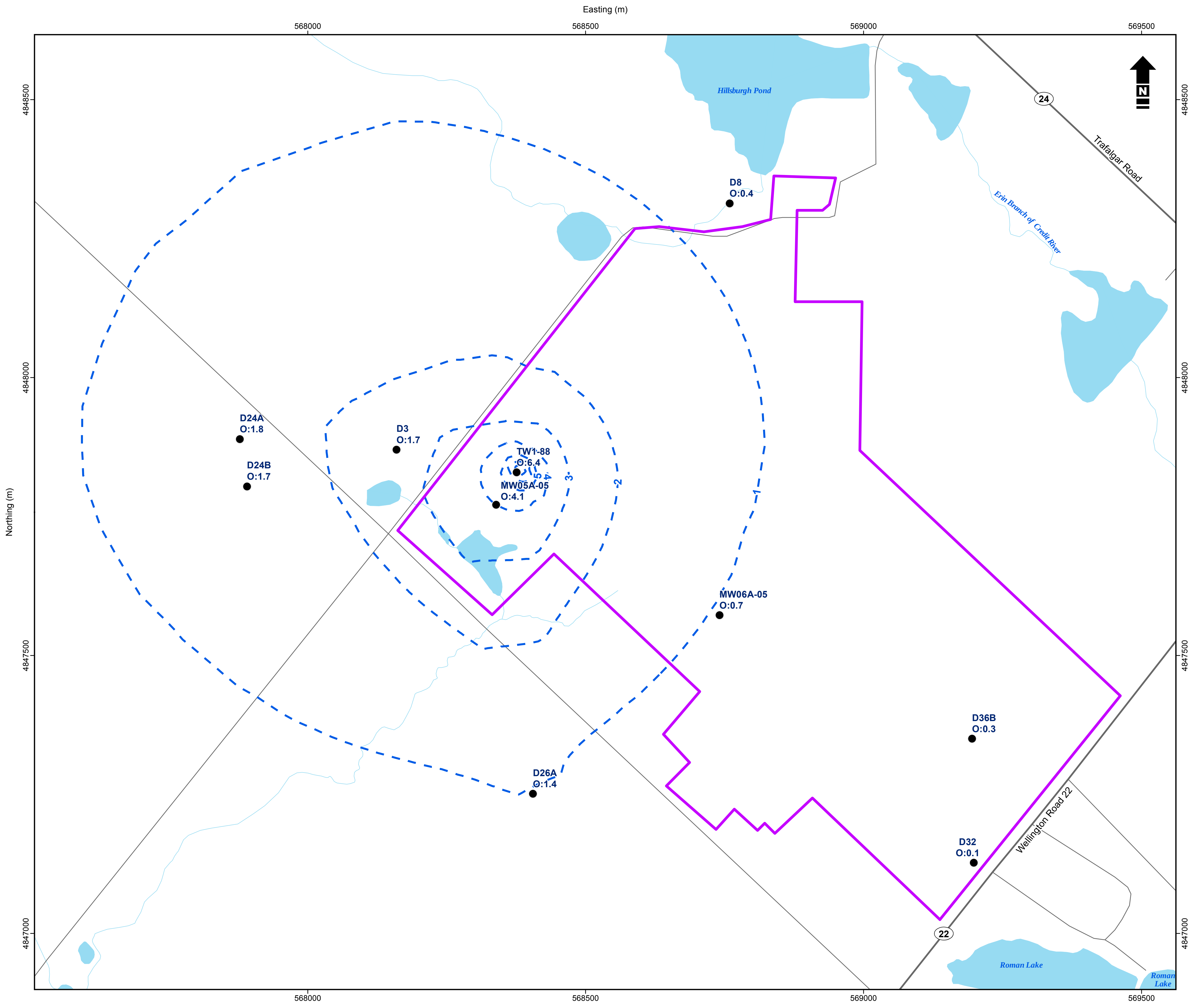
City of Guelph
Groundwater Modelling Report for Renewal of the Permit to Take Water for the Nestle Waters Canada Aberfoyle and Erin Facilities

# Aberfoyle - Simulated vs. Interpreted Drawdown in the Lower Bedrock (Layer 12 – Middle Gasport Fm.) due to 2010 NWC Pumping Test

| Date: | Project: | Submitter: | Reviewer: |
|---|---|---|---|
| December 2018 | 26435 | J. Melchin | D. Van Vliet |

Figure
12

I:\CityofGuelph\26435\FiguresandTables\QHG\2018\Presentation\Figure-12-Aberfoyle_Simulated_vs_Interpreted_Drawdown_in_the_Lower_Bedrock_Layer_12_Middle_Gasport_Fm_due_to_2010_NWC_Pumping_Test.mxd - Tabloid_L - 13-Dec-18, 07:36 PM - ccurry - TID005



Reference: Contains information licensed under the Open Government Licence – Ontario. Data obtained from Grand River Conservation Authority used under license.

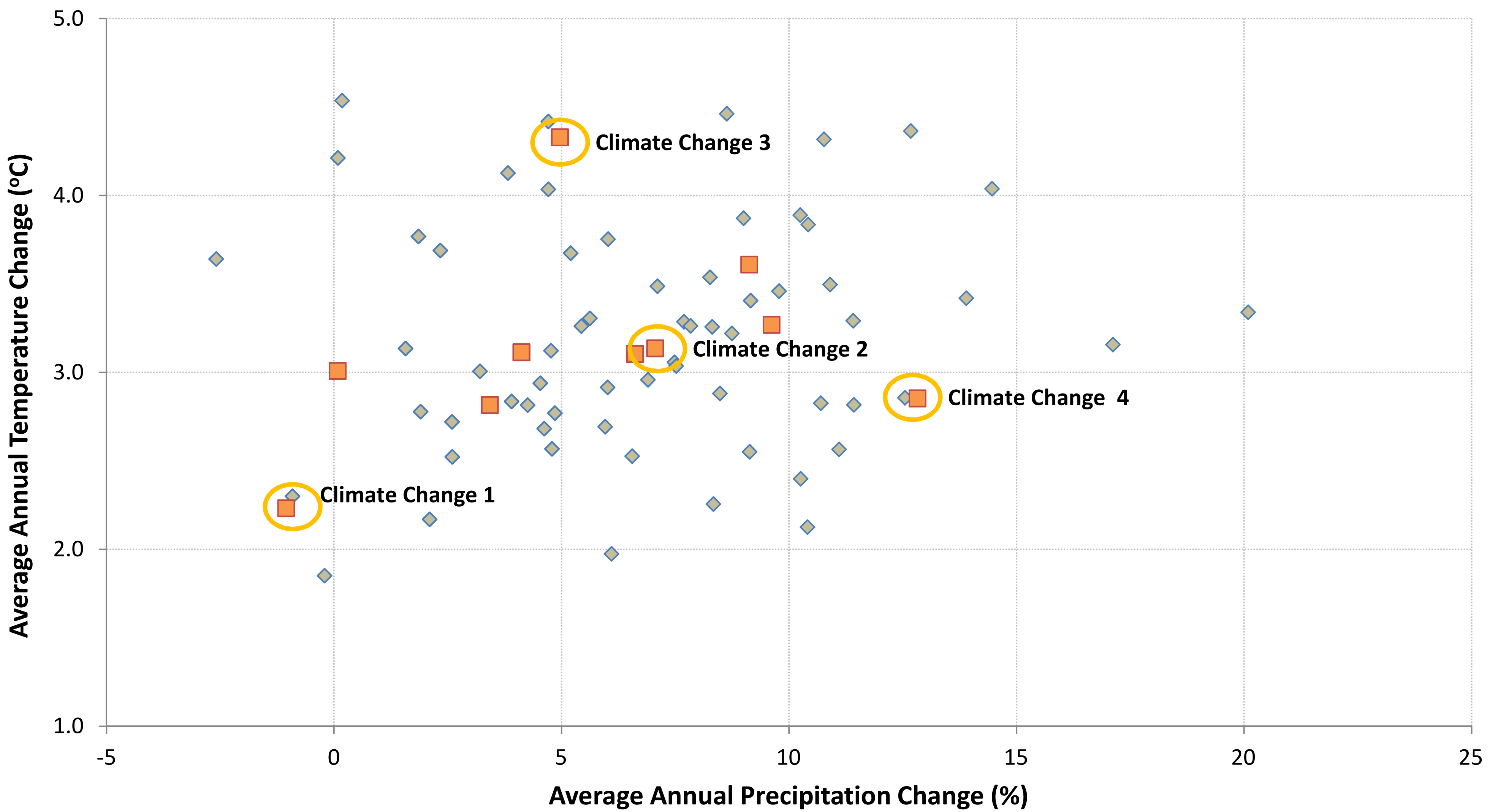
City of Guelph
Groundwater Modelling Report for Renewal of the Permit to Take
Water for the Nestle Waters Canada Aberfoyle and Erin Facilities

# Erin – Simulated Drawdown in the Guelph Fm. (Layer 7) due to NWC Pumping (2016 to 2017)

| Date: | Project: | Submitter: | Reviewer: |
|---|---|---|---|
| December 2018 | 26435 | J. Melchin | D. Van Vliet |

Figure
13

I:\CityofGuelph\26435\FiguresandTables\QHG\2018\Presentation\Figure-13-Erin_Simulated_Drawdown_in_the_Guelph_Fm_Layer_7_due_to_NWC_pumping_2016_to_2017.mxd - Tabloid_L - 13-Dec-18, 07:38 PM - ccurry - TID005



◆ Climate Change Scenarios

🟧 Representative Climate Change Scenarios

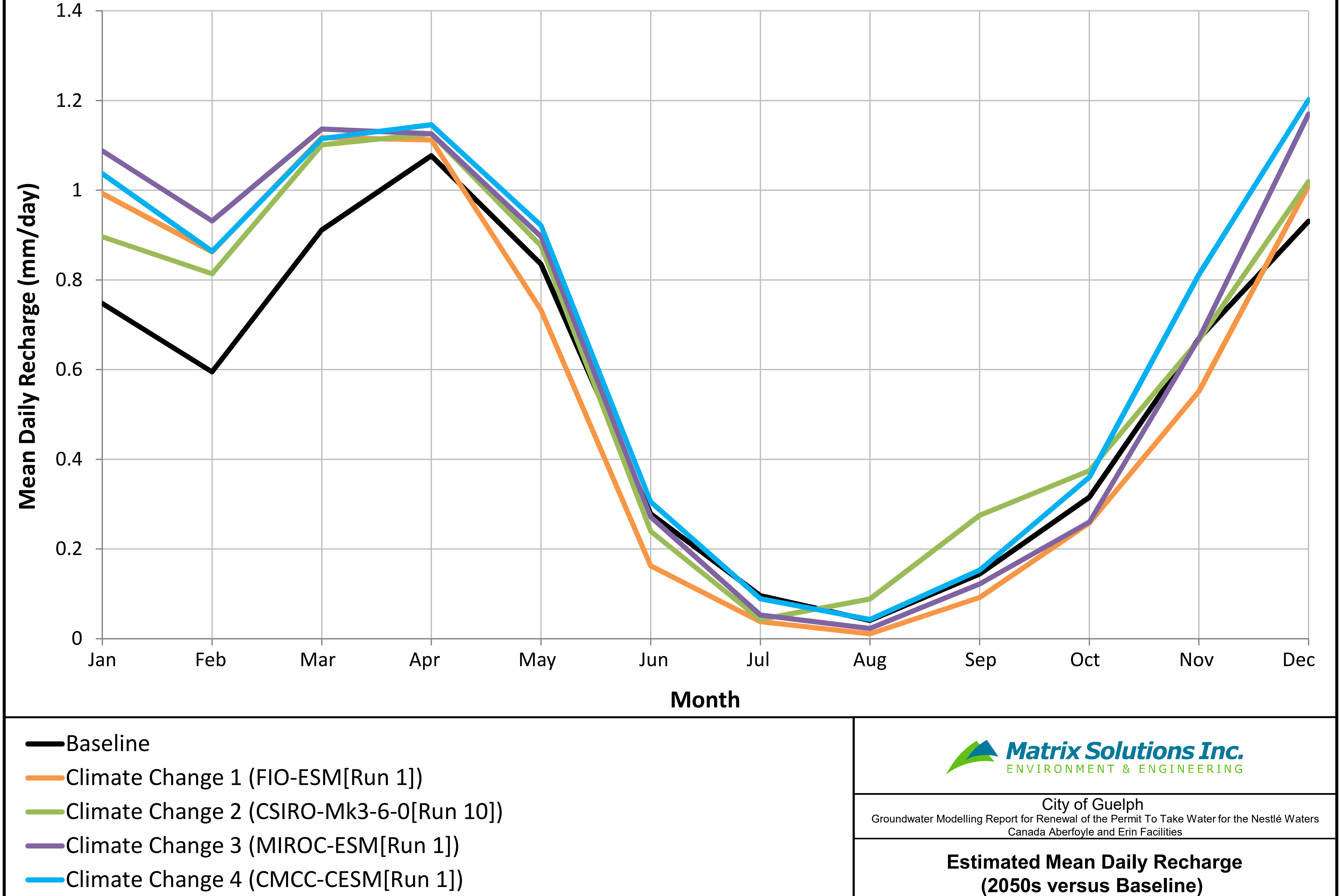
**Matrix Solutions Inc.**
ENVIRONMENT & ENGINEERING

City of Guelph
Groundwater Modelling Report for Renewal of the Permit To Take Water for the Nestlé Waters Canada Aberfoyle and Erin Facilities

## Scatter Plot of Future Climate Models Selected for Hydrologic Modelling (2050s versus Current)

| Date: | Project: | Technical: | Reviewer: | Drawn: |
|---|---|---|---|---|
| 11 Dec 2018 | 26435 | J. Melchin | D. Van Vliet | J. Melchin |

Figure
14



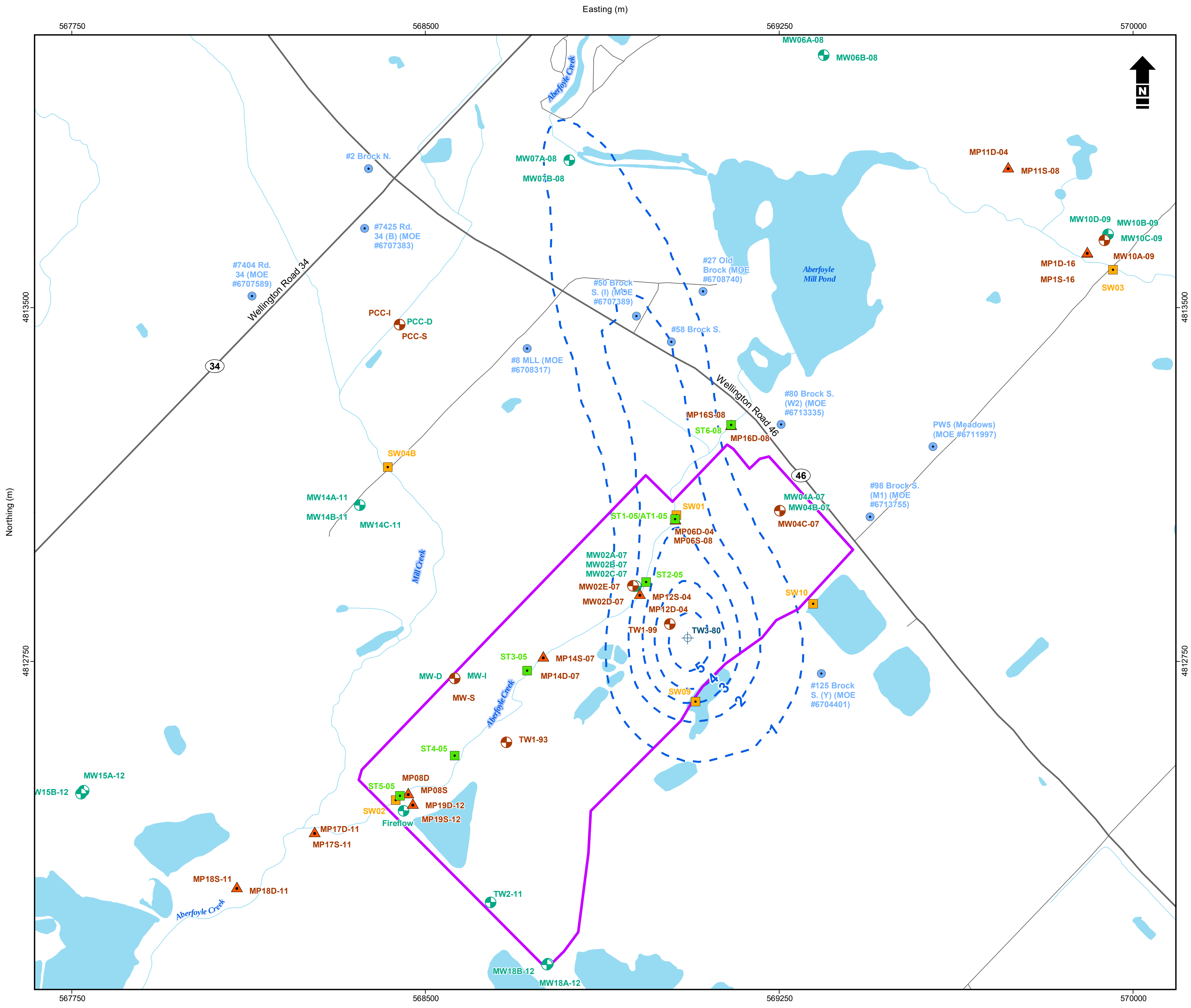
**Matrix Solutions Inc.**
ENVIRONMENT & ENGINEERING

City of Guelph
Groundwater Modelling Report for Renewal of the Permit To Take Water for the Nestlé Waters Canada Aberfoyle and Erin Facilities

## Estimated Mean Daily Recharge (2050s versus Baseline)

| Date: | Project: | Technical: | Reviewer: | Drawn: |
|---|---|---|---|---|
| 11 Dec 2018 | 26435 | J. Melchin | D. Van Vliet | J. Melchin |

Figure
15



- Nestlé Waters Canada Property Boundary
- Water Body
- Watercourse
- Simulated Drawdown | 1m
- Highway
- Road
- Monitoring Well (Bedrock)
- Monitoring Well (Overburden)
- Piezometer
- Private Well (Bedrock)
- Production Well
- Surface Water Station
- Surface Water Temperature Station

1:8,250 metres
80 0 80 160
NAD 1983 UTM Zone 17N

Reference: Contains information licensed under the Open Government Licence – Ontario. Data obtained from Grand River Conservation Authority used under license.

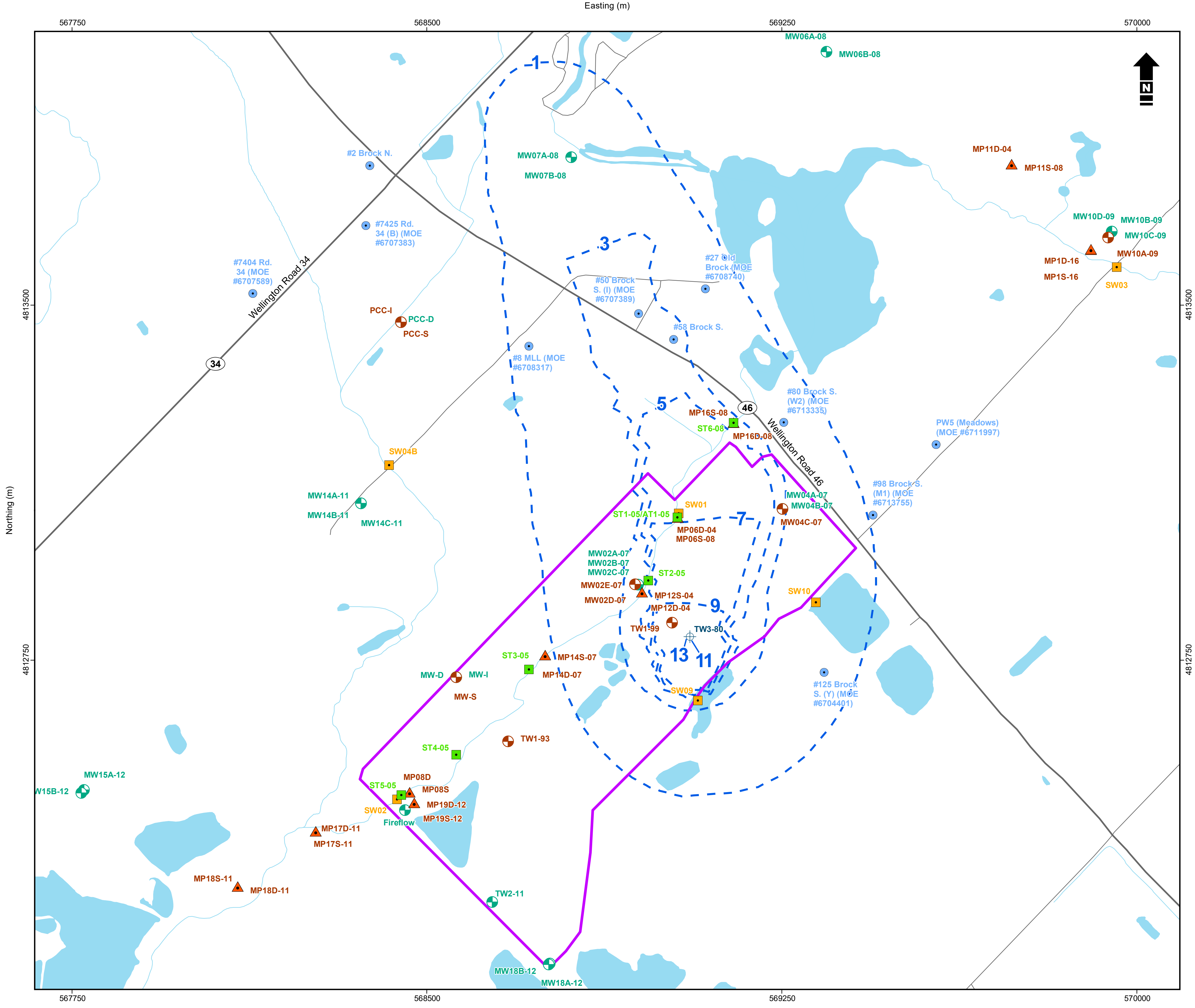
City of Guelph
Groundwater Modelling Report for Renewal of the Permit to Take Water for the Nestle Waters Canada Aberfoyle and Erin Facilities

# Aberfoyle - Simulated Additional Drawdown in Upper Bedrock (Layer 6 – Reformatory Quarry Mbr.) – Average Pumping to Permitted Pumping

| Date: | Project: | Submitter: | Reviewer: |
|---|---|---|---|
| January 2019 | 26435 | J. Melchin | D. Van Vliet |

Figure
16

I:\CityofGuelph\26435\FiguresandTables\QHG\2018\Report\Figure-16-Aberfoyle_Simulated_Additional_Drawdown_in_Upper_Bedrock_Layer_6_Reformatory_Quarry_Mbr_Average_Pumping_to_Permitted_Pumping.mxd - Tabloid_L - 18-Jan-19, 04:18 PM - ehollinger - TID005



- 🟪 Nestlé Waters Canada Property Boundary
- Water Body
- Watercourse
- Simulated Drawdown | 2m
- Highway
- Road
- ● Monitoring Well (Bedrock)
- ● Monitoring Well (Overburden)
- ▲ Piezometer
- ● Private Well (Bedrock)
- ⊕ Production Well
- 🟧 Surface Water Station
- 🟩 Surface Water Temperature Station

1:8,250 metres

80 0 80 160

NAD 1983 UTM Zone 17N

Reference: Contains information licensed under the Open Government Licence – Ontario. Data obtained from Grand River Conservation Authority used under license.

City of Guelph

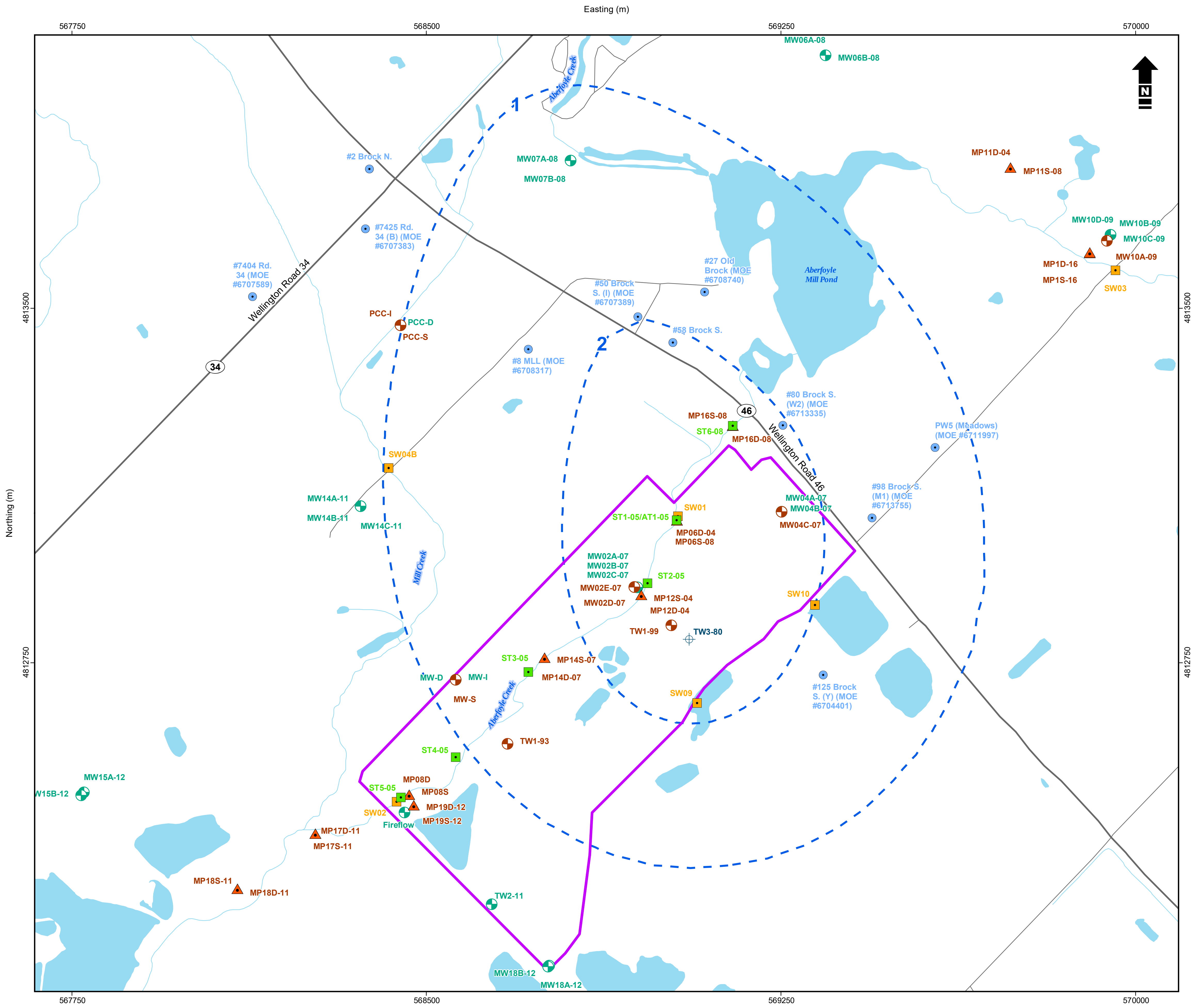
Groundwater Modelling Report for Renewal of the Permit to Take Water for the Nestle Waters Canada Aberfoyle and Erin Facilities

# Aberfoyle - Simulated Additional Drawdown in Lower Bedrock (Layer 10 – Goat Island Fm.) – Average Pumping to Permitted Pumping

| Date: | Project: | Submitter: | Reviewer: |
|---|---|---|---|
| January 2019 | 26435 | J. Melchin | D. Van Vliet |

Figure 17

I:\CityofGuelph\26435\FiguresandTables\QHG\2018\Report\Figure-17-Aberfoyle_Simulated_Additional_Drawdown_in_Lower_Bedrock_Layer_10_Goat_Island_Fm_Average_Pumping_to_Permitted_Pumping.mxd - Tabloid_L - 21-Jan-19, 08:14 AM - ehollinger - TID005



Reference: Contains information licensed under the Open Government Licence – Ontario. Data obtained from Grand River Conservation Authority used under license.

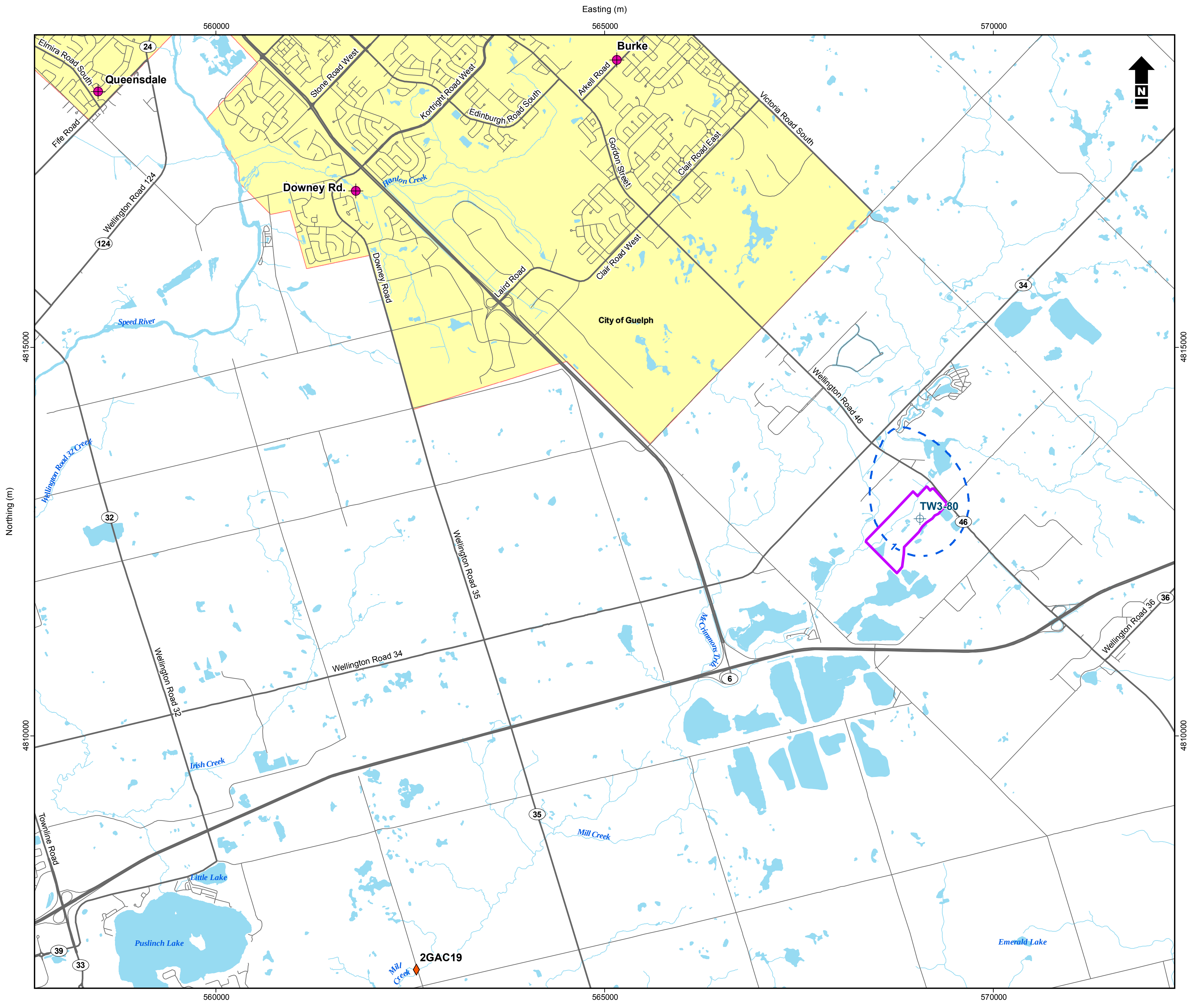
City of Guelph

Groundwater Modelling Report for Renewal of the Permit to Take Water for the Nestle Waters Canada Aberfoyle and Erin Facilities

## Local Aberfoyle Extent - Simulated Additional Drawdown in Lower Bedrock (Layer 12 – Middle Gasport Fm.) – Average Pumping to Permitted Pumping

| Date: | Project: | Submitter: | Reviewer: |
|---|---|---|---|
| January 2019 | 26435 | J. Melchin | D. Van Vliet |

Figure
18



Reference: Contains information licensed under the Open Government Licence – Ontario. Data obtained from Grand River Conservation Authority used under license.

Matrix Solutions Inc.
ENVIRONMENT & ENGINEERING

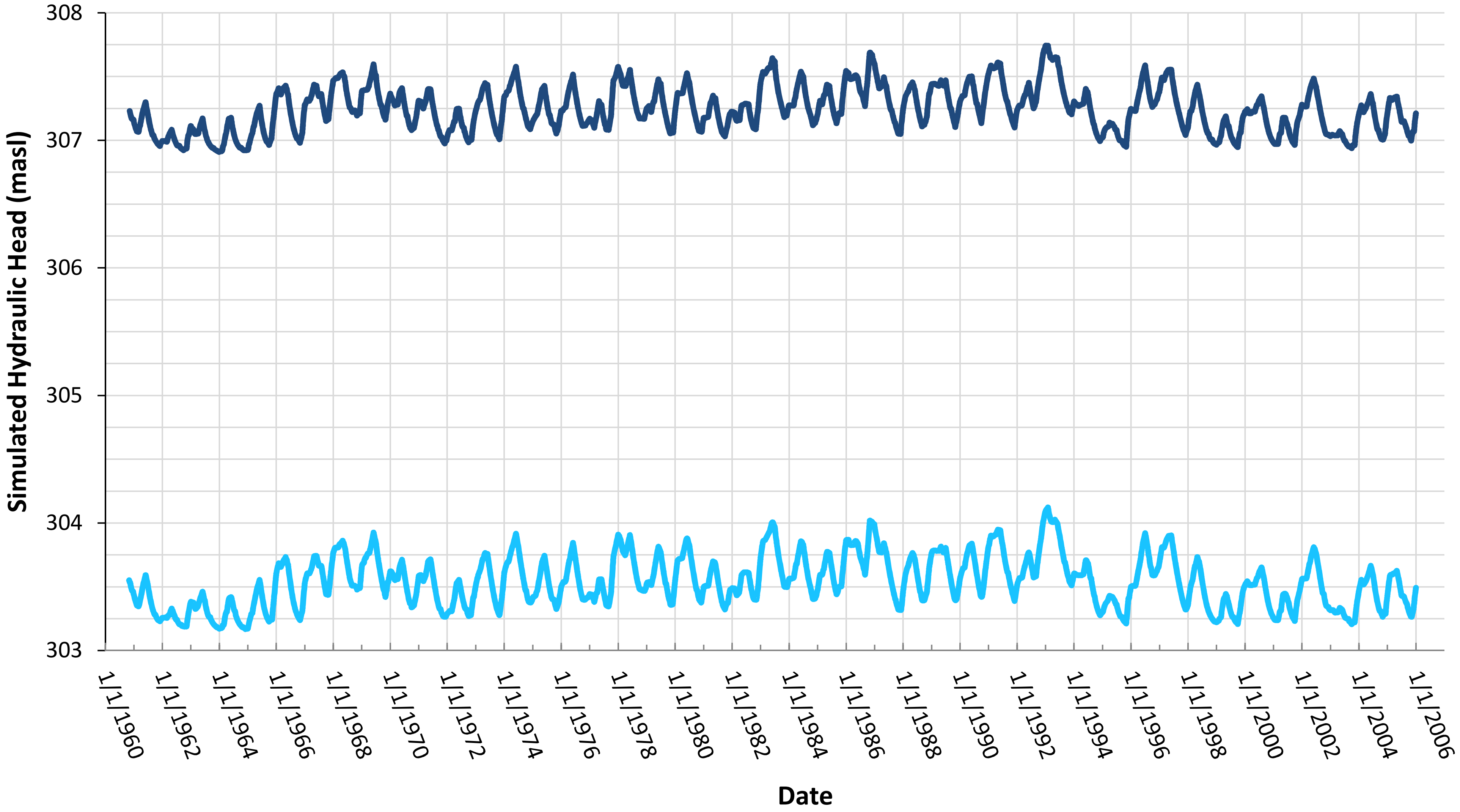
City of Guelph
Groundwater Modelling Report for Renewal of the Permit to Take Water for the Nestle Waters Canada Aberfoyle and Erin Facilities

## Regional Aberfoyle Extent - Simulated Additional Drawdown in Lower Bedrock (Layer 12 – Middle Gasport Fm.) – Average Pumping to Permitted Pumping

| Date: | Project: | Submitter: | Reviewer: |
|---|---|---|---|
| December 2018 | 26435 | J. Melchin | D. Van Vliet |

Figure
19

I:\CityofGuelph\26435\FiguresandTables\QHG\2018\Report\Figure-19-Regional_Aberfoyle_Extent_Simulated_Additional_Drawdown_in_Lower_Bedrock_Layer_12_Middle_Gasport_Fm_Average_Pumping_to_Permitted_Pumping.mxd - Tabloid_L - 18-Dec-18, 08:05 AM - ccurry - TID005



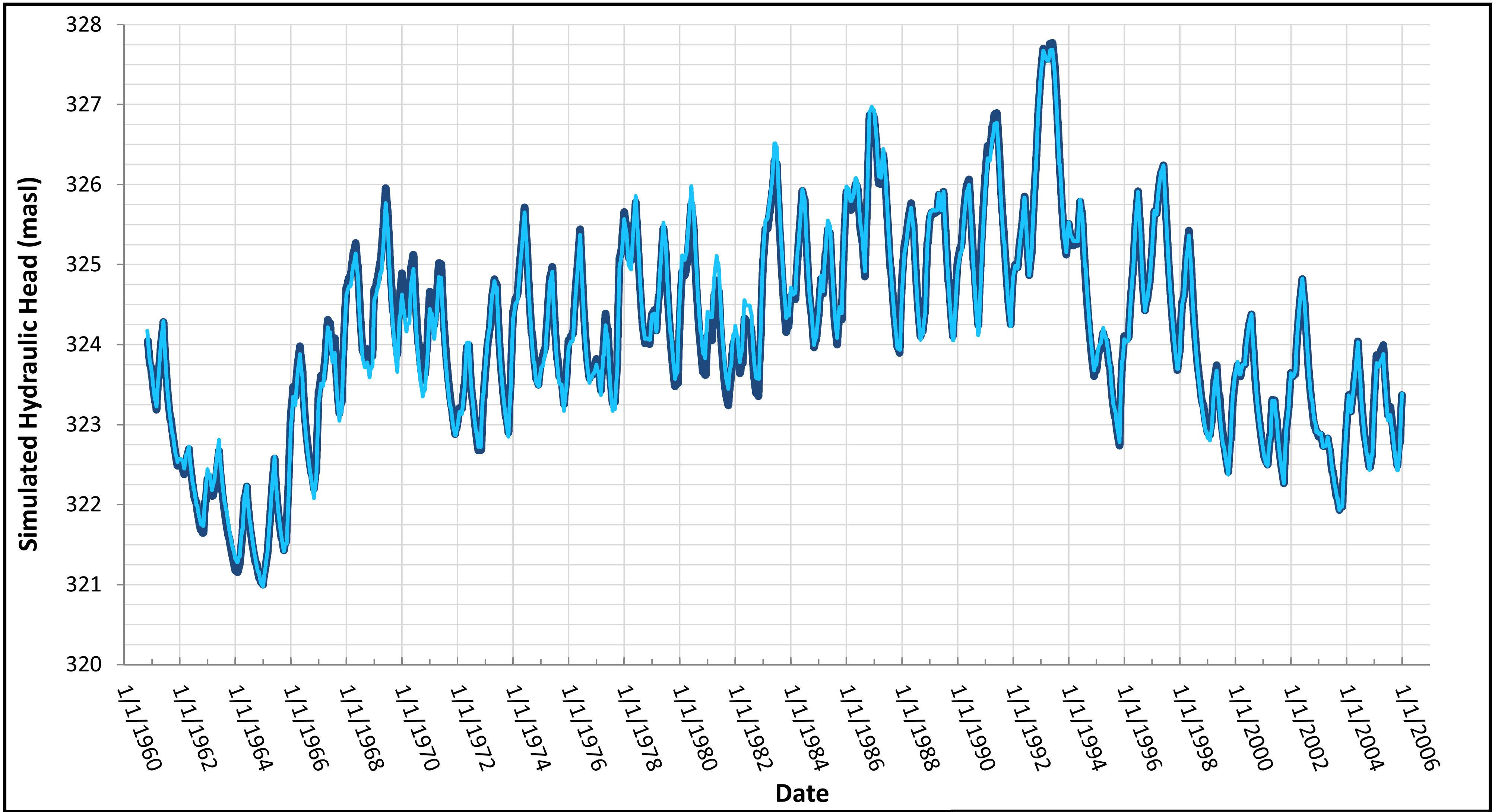
**Matrix Solutions Inc.**
ENVIRONMENT & ENGINEERING

City of Guelph
Groundwater Modelling Report for Renewal of the Permit To Take Water for the Nestlé Waters Canada Aberfoyle and Erin Facilities

## Aberfoyle – Simulated Water Level Variability at MW2A-07 – Drought Scenarios

| Date: | Project: | Technical: | Reviewer: | Drawn: |
|---|---|---|---|---|
| 11 Dec 2018 | 26435 | J. Melchin | D. Van Vliet | J. Melchin |

Figure
20



- Burke Well - Average NWC Pumping (2,113 m³/day: Scenario 3)
- Burke Well - Permitted NWC Pumping (3,600 m³/day; Scenario 4)

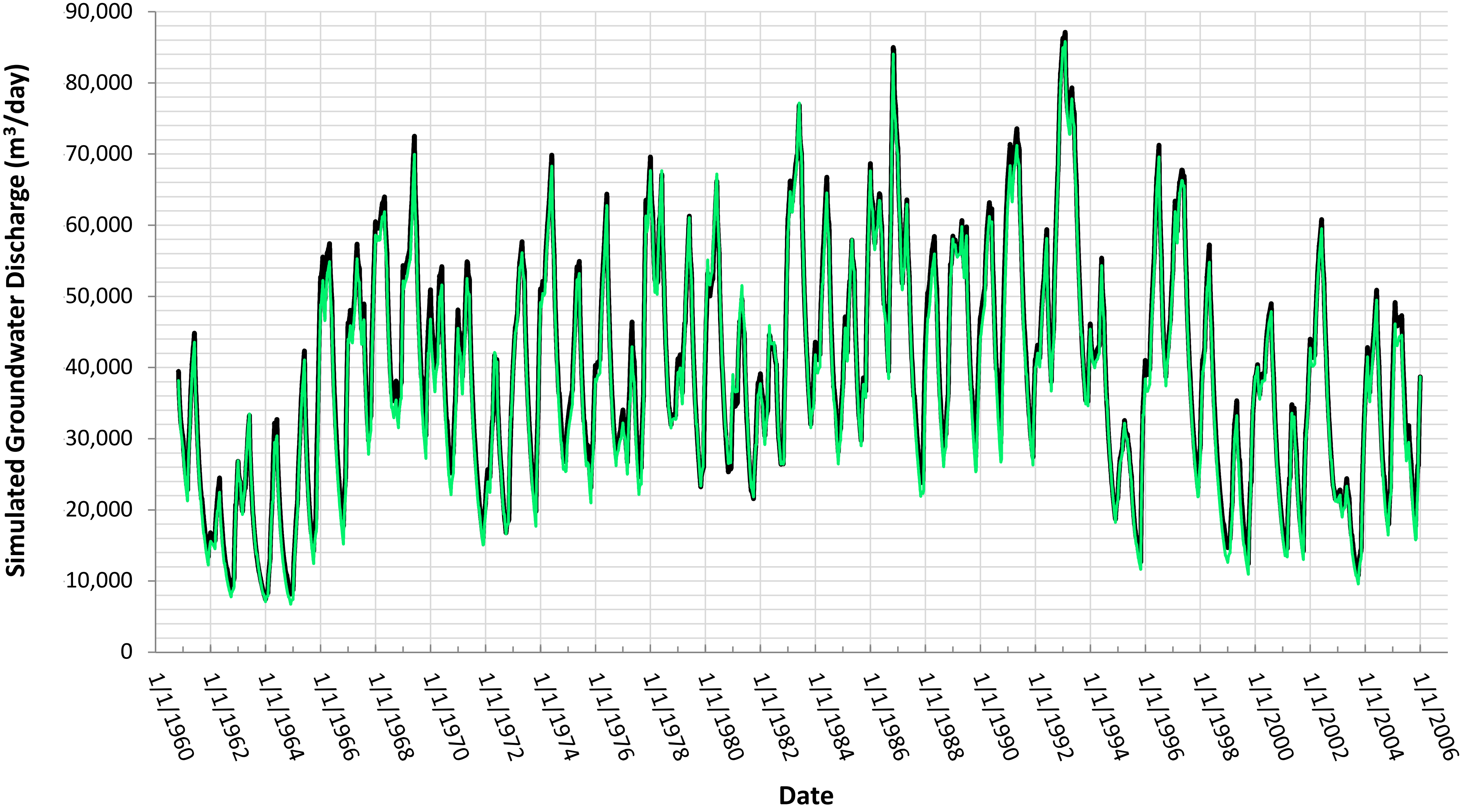
**Matrix Solutions Inc.**
ENVIRONMENT & ENGINEERING

City of Guelph
Groundwater Modelling Report for Renewal of the Permit To Take Water for the Nestlé Waters Canada Aberfoyle and Erin Facilities

## Aberfoyle – Simulated Water Level Variability at Burke Well – Drought Scenarios

| Date: | Project: | Technical: | Reviewer: | Drawn: |
|---|---|---|---|---|
| 11 Dec 2018 | 26435 | J. Melchin | D. Van Vliet | J. Melchin |

Figure
21



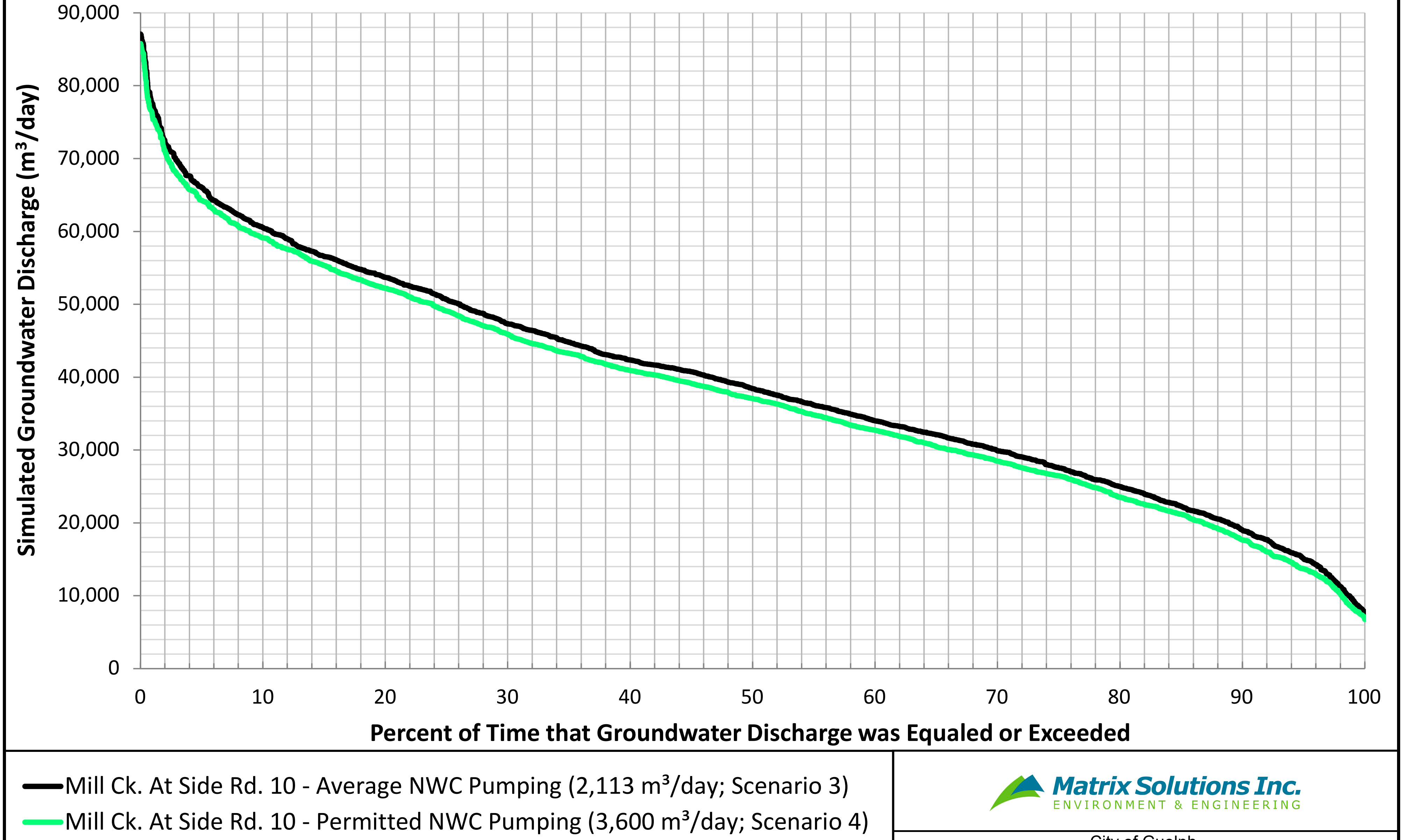
**Matrix Solutions Inc.**
ENVIRONMENT & ENGINEERING

City of Guelph
Groundwater Modelling Report for Renewal of the Permit To Take Water for the Nestlé Waters Canada Aberfoyle and Erin Facilities

## Aberfoyle – Simulated Groundwater Discharge at Mill Creek at Side Rd. 10 Gauge – Drought Scenarios Time Series

| Date: | Project: | Technical: | Reviewer: | Drawn: |
|---|---|---|---|---|
| 11 Dec 2018 | 26435 | J. Melchin | D. Van Vliet | J. Melchin |

Figure
22



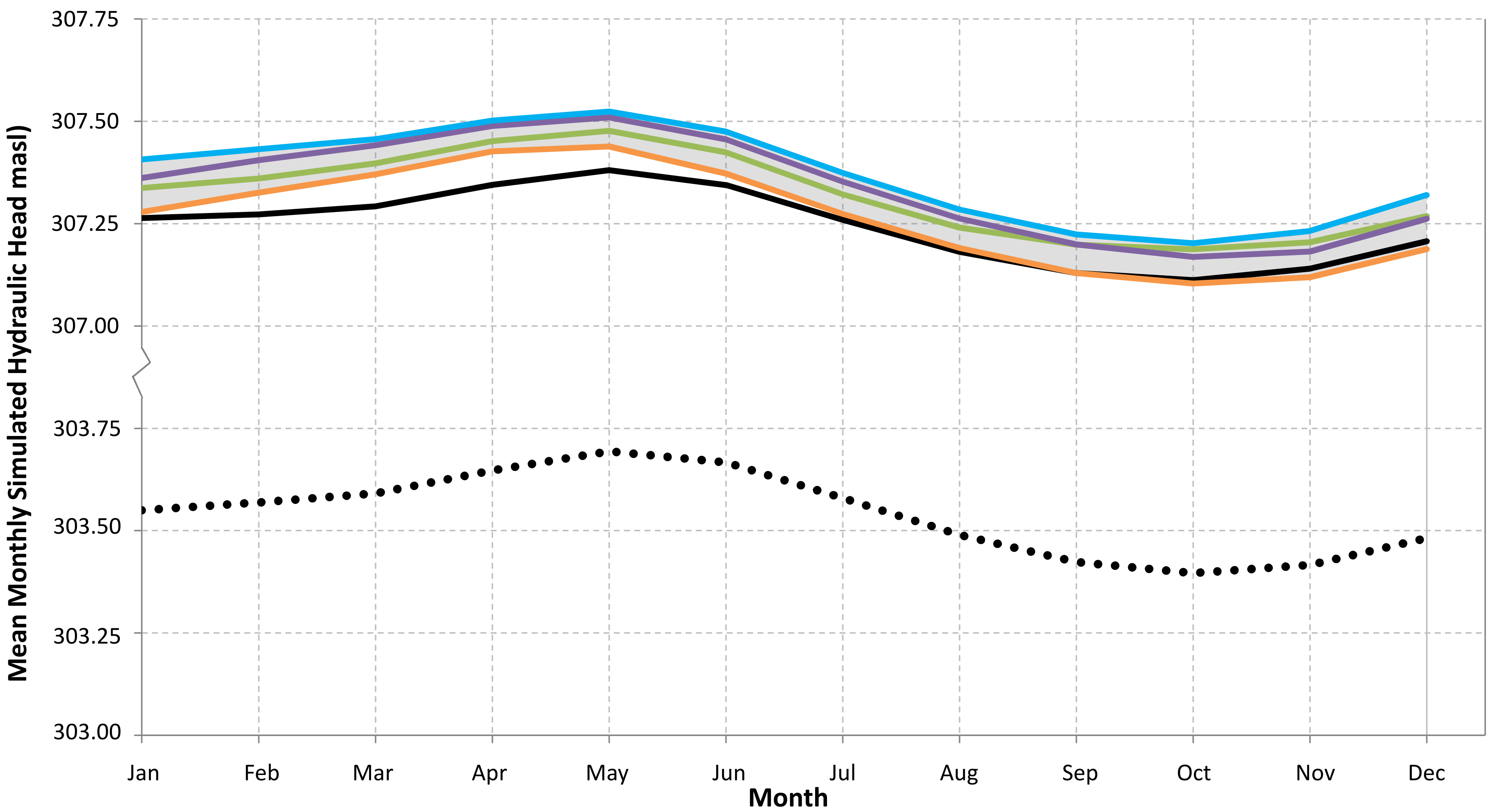
**Matrix Solutions Inc.**
ENVIRONMENT & ENGINEERING

City of Guelph
Groundwater Modelling Report for Renewal of the Permit To Take Water for the Nestlé Waters Canada Aberfoyle and Erin Facilities

## Aberfoyle – Simulated Groundwater Discharge at Mill Creek at Side Rd. 10 Gauge – Drought Scenarios Ranked Duration Curves

| Date: | Project: | Technical: | Reviewer: | Drawn: |
|---|---|---|---|---|
| 11 Dec 2018 | 26435 | J. Melchin | D. Van Vliet | J. Melchin |

Figure
23



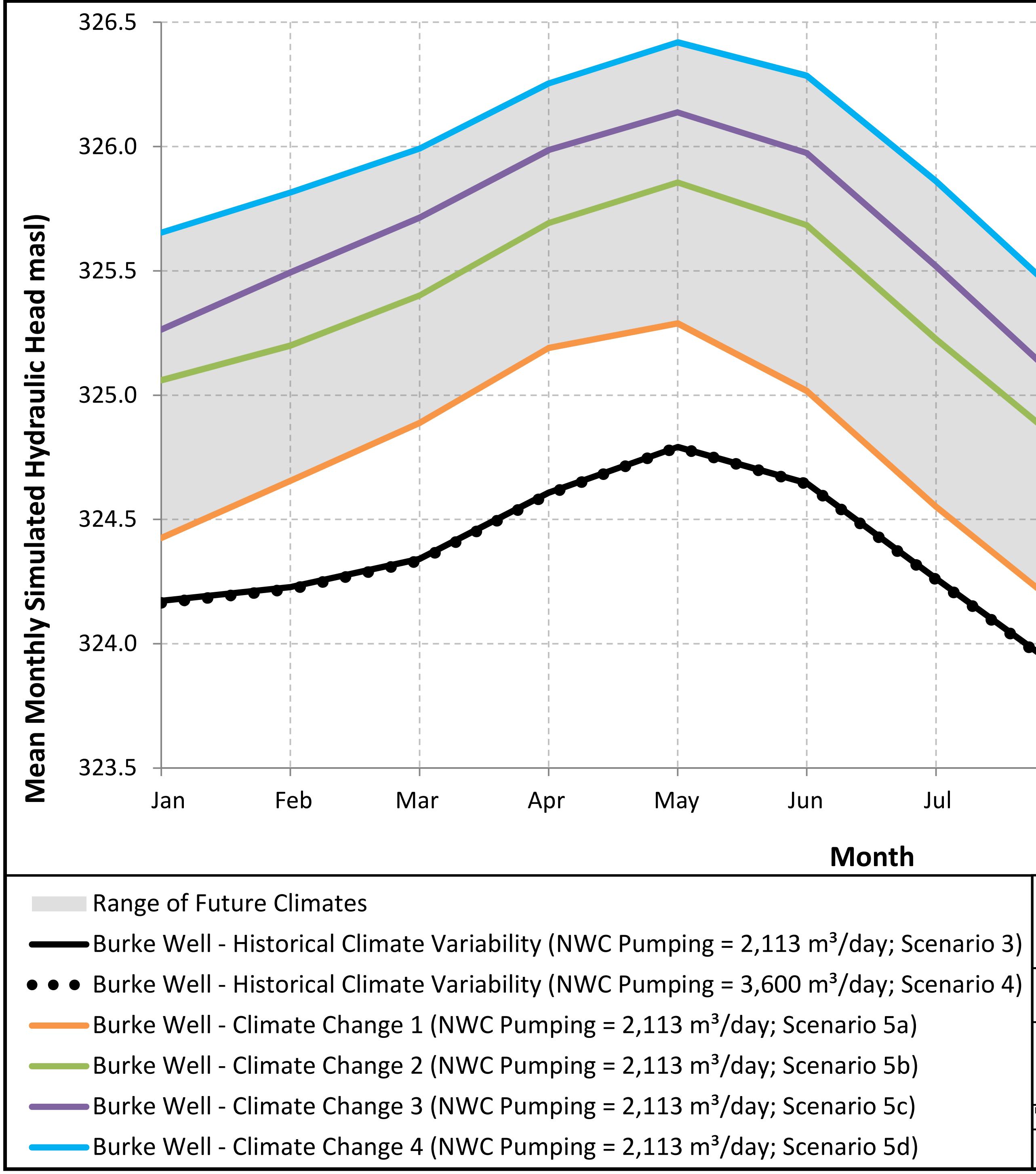
**Matrix Solutions Inc.**
ENVIRONMENT & ENGINEERING

City of Guelph
Groundwater Modelling Report for Renewal of the Permit To Take Water for the Nestlé Waters Canada Aberfoyle and Erin Facilities

## Aberfoyle – Mean Monthly Simulated Water Level Variability at MW2A-07 – Climate Change Scenarios

| Date: | Project: | Technical: | Reviewer: | Drawn: |
|---|---|---|---|---|
| 11 Dec 2018 | 26435 | J. Melchin | D. Van Vliet | J. Melchin |

Figure
24



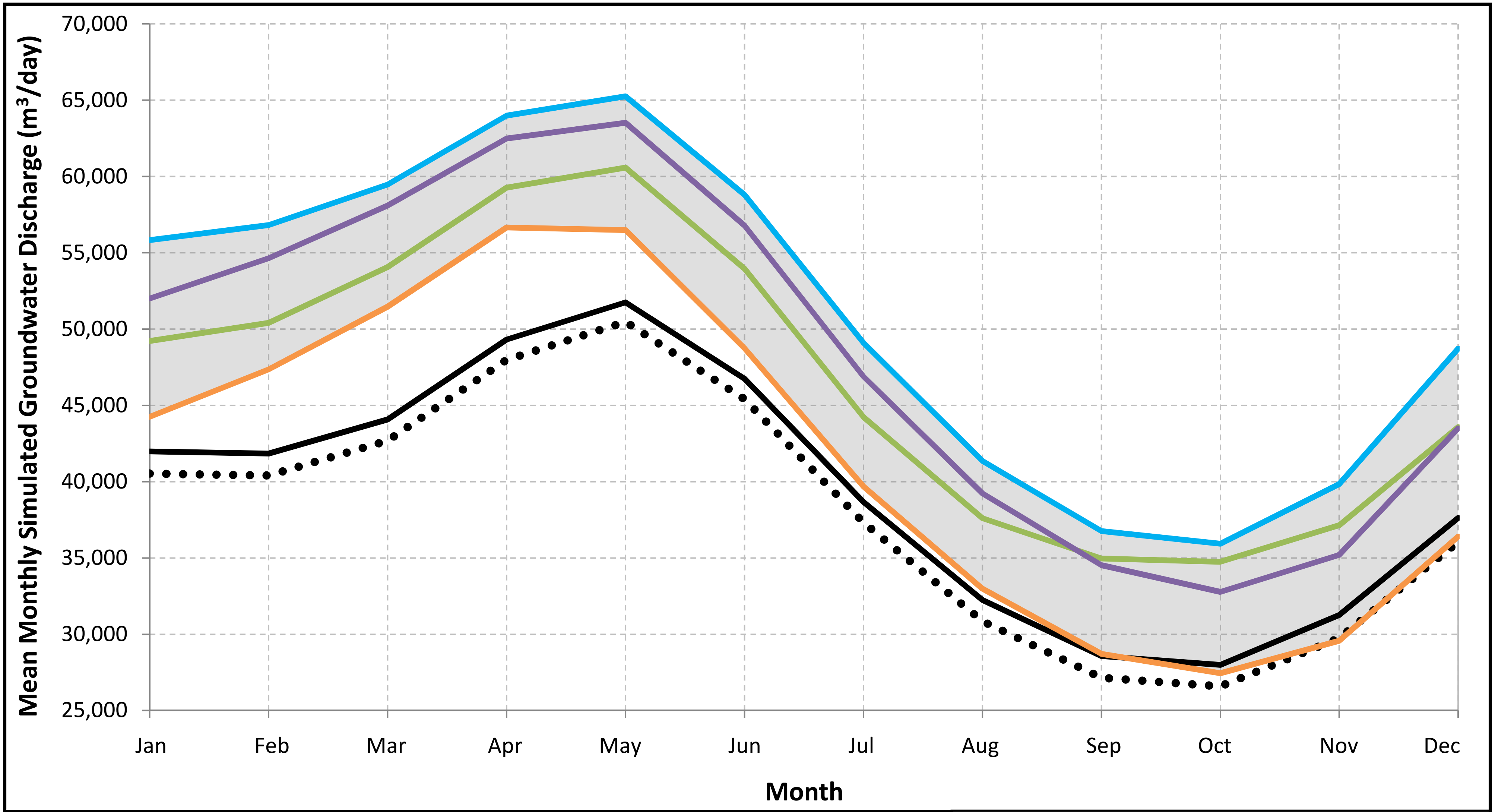
**Matrix Solutions Inc.**
ENVIRONMENT & ENGINEERING

City of Guelph
Groundwater Modelling Report for Renewal of the Permit To Take Water for the Nestlé Waters Canada Aberfoyle and Erin Facilities

# Aberfoyle – Mean Monthly Simulated Water Level Variability at Burke Well – Climate Change Scenarios

Date: 11 Dec 2018
Project: 26435
Technical: J. Melchin
Reviewer: D. Van Vliet
Drawn: J. Melchin

Figure
25



▨ Range of Future Climates

━ Mill Creek - Historical Climate Variability (NWC Pumping = 2,113 $m^3$/day; Scenario 3)

● ● ● Mill Creek - Historical Climate Variability (NWC Pumping = 3,600 $m^3$/day; Scenario 4)

━ Mill Creek - Climate Change 1 (NWC Pumping = 2,113 $m^3$/day; Scenario 5a)

━ Mill Creek - Climate Change 2 (NWC Pumping = 2,113 $m^3$/day; Scenario 5b)

━ Mill Creek - Climate Change 3 (NWC Pumping = 2,113 $m^3$/day; Scenario 5c)

━ Mill Creek - Climate Change 4 (NWC Pumping = 2,113 $m^3$/day; Scenario 5d)

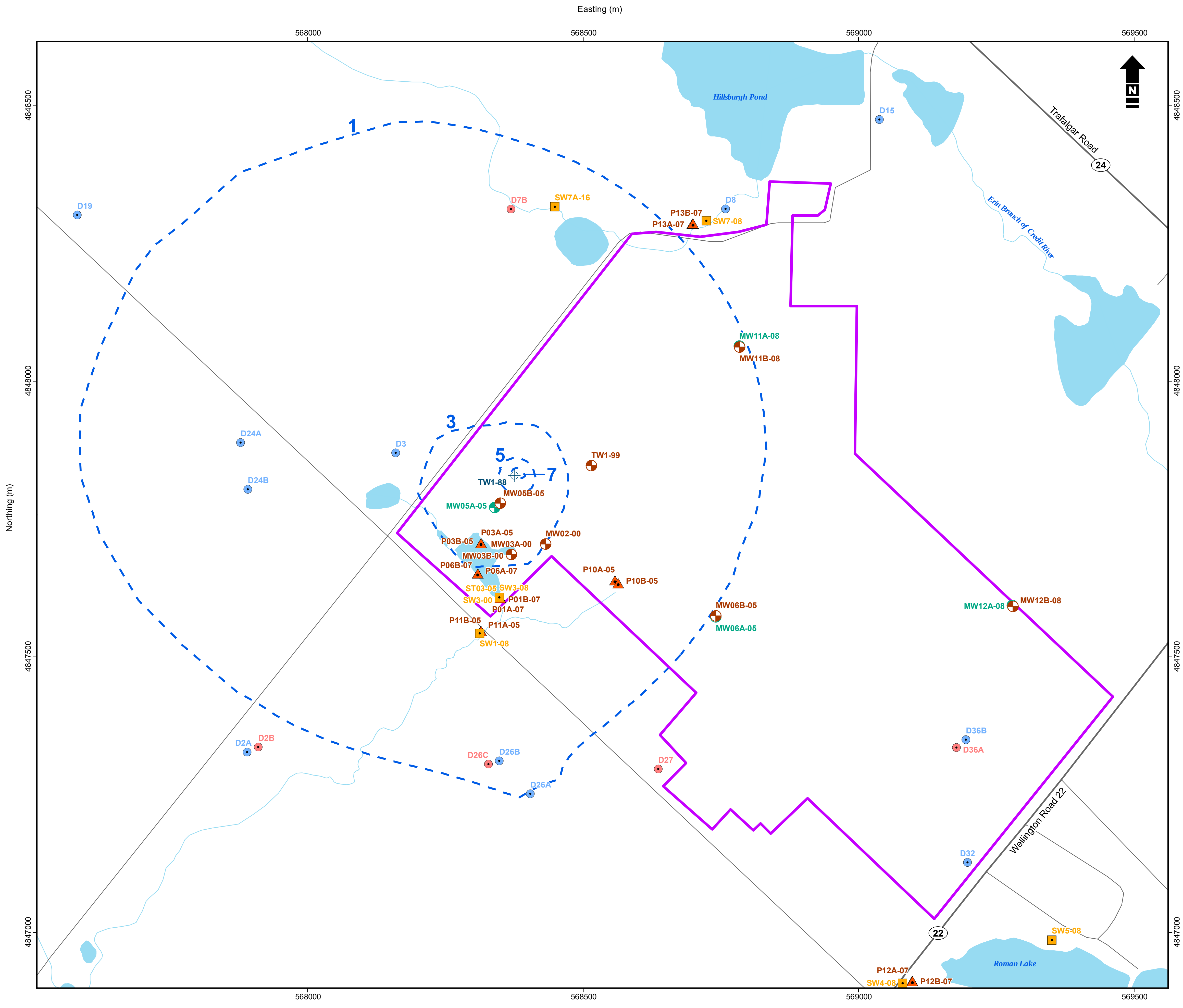
**Matrix Solutions Inc.**
ENVIRONMENT & ENGINEERING

City of Guelph
Groundwater Modelling Report for Renewal of the Permit To Take Water for the Nestlé Waters Canada Aberfoyle and Erin Facilities

# Aberfoyle – Mean Monthly Simulated Groundwater Discharge at Mill Creek at Side Rd. 10 Gauge – Climate Change Scenarios

| Date: | Project: | Technical: | Reviewer: | Drawn: |
|---|---|---|---|---|
| 11 Dec 2018 | 26435 | J. Melchin | D. Van Vliet | J. Melchin |

Figure
26



| | |
|---|---|
| ▭ | Nestlé Waters Canada Property Boundary |
| 🟦 | Water Body |
| ~ | Watercourse |
| - - | Simulated Drawdown \| 2m |
| — | Highway |
| — | Road |
| ⊕ | Monitoring Well (Bedrock) |
| ⊕ | Monitoring Well (Overburden) |
| ▲ | Piezometer |
| ⊙ | Private Well |
| ⊙ | Private Well (Bedrock) |
| ⌖ | Production Well |
| ■ | Surface Water Station |

1:7,000 metres

70 0 70 140

NAD 1983 UTM Zone 17N

Reference: Contains information licensed under the Open Government Licence – Ontario. Data obtained from Grand River Conservation Authority used under license.

Matrix Solutions Inc.
ENVIRONMENT & ENGINEERING

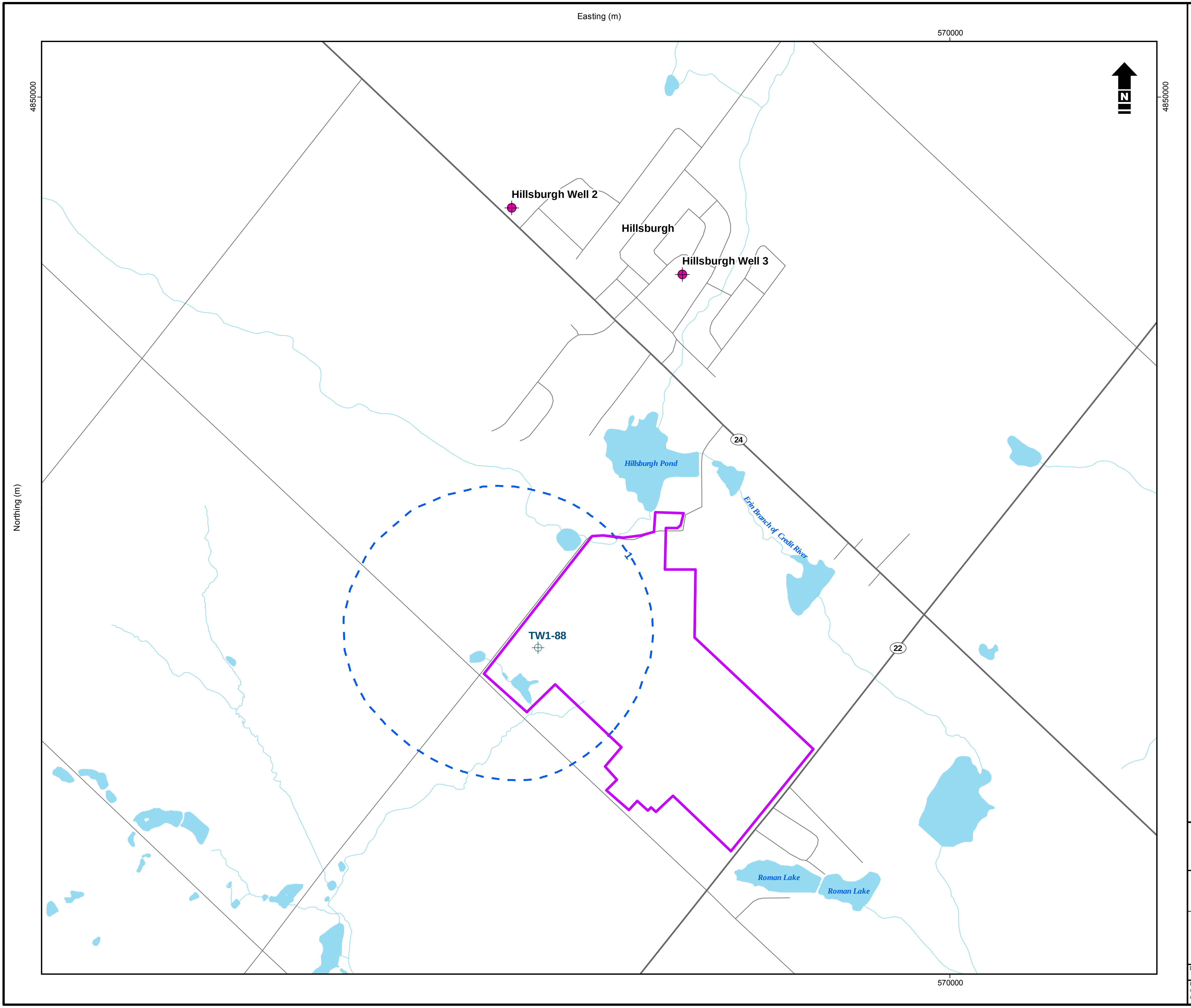
City of Guelph
Groundwater Modelling Report for Renewal of the Permit to Take Water for the Nestle Waters Canada Aberfoyle and Erin Facilities

# Local Erin Extent - Simulated Additional Drawdown in the Guelph Fm. (Layer 7) – Average Pumping to Permitted Pumping

| Date: | Project: | Submitter: | Reviewer: |
|---|---|---|---|
| January 2019 | 26435 | J. Melchin | D. Van Vliet |

Figure
27

I:\CityofGuelph\26435\FiguresandTables\QHG\2018\Report\Figure-27-Local_Erin_Extent_Simulated_Additional_Drawdown_in_the_Guelph_Fm_Layer_7_Average_Pumping_to_Permitted_Pumping.mxd - Tabloid_L - 21-Jan-19, 10:48 AM - ehollinger - TID005



Reference: Contains information licensed under the Open Government Licence – Ontario. Data obtained from Grand River Conservation Authority used under license.

1:15,000 metres
150 0 150 300
NAD 1983 UTM Zone 17N

Matrix Solutions Inc.
ENVIRONMENT & ENGINEERING

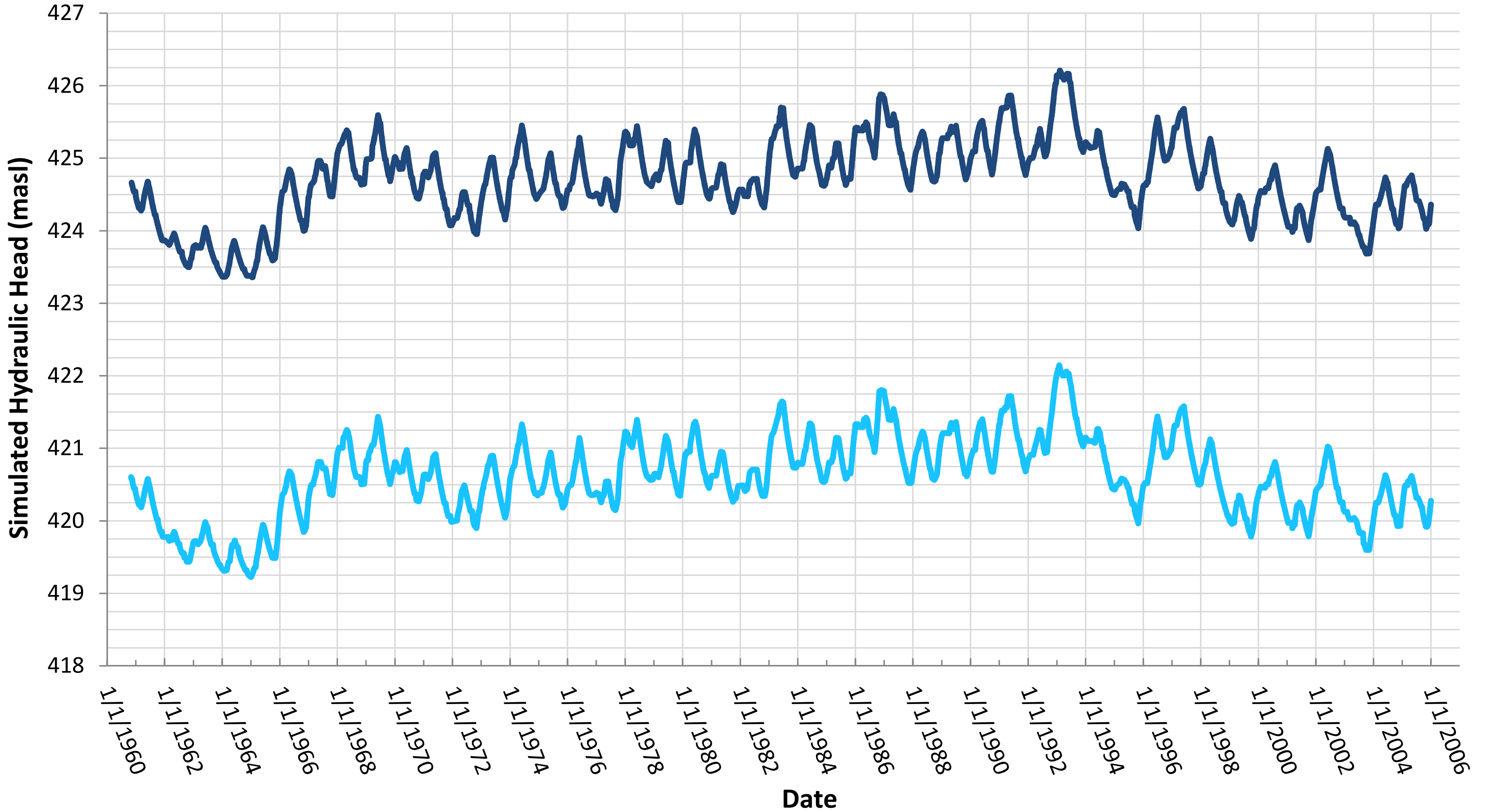
City of Guelph
Groundwater Modelling Report for Renewal of the Permit to Take
Water for the Nestle Waters Canada Aberfoyle and Erin Facilities

# Regional Erin Extent - Simulated Additional Drawdown in the Guelph Fm. (Layer 7) - Average Pumping to Permitted Pumping

| Date: | Project: | Submitter: | Reviewer: |
|---|---|---|---|
| December 2018 | 26435 | J. Melchin | D. Van Vliet |

Figure
28

I:\CityofGuelph\26435\FiguresandTables\QHG\2018\Report\Figure-28-Regional_Erin_Extent_Simulated_Additional_Drawdown_in_Guelph_Fm_Layer_7_Average_Pumping_to_Permitted_Pumping.mxd - Tabloid_L - 18-Dec-18, 01:37 PM - ccurry - TID005



MW05A-05 - Average NWC Pumping (207 m³/day; Scenario 3)
MW05A-05 - Permitted NWC Pumping (1,113 m³/day; Scenario 4)

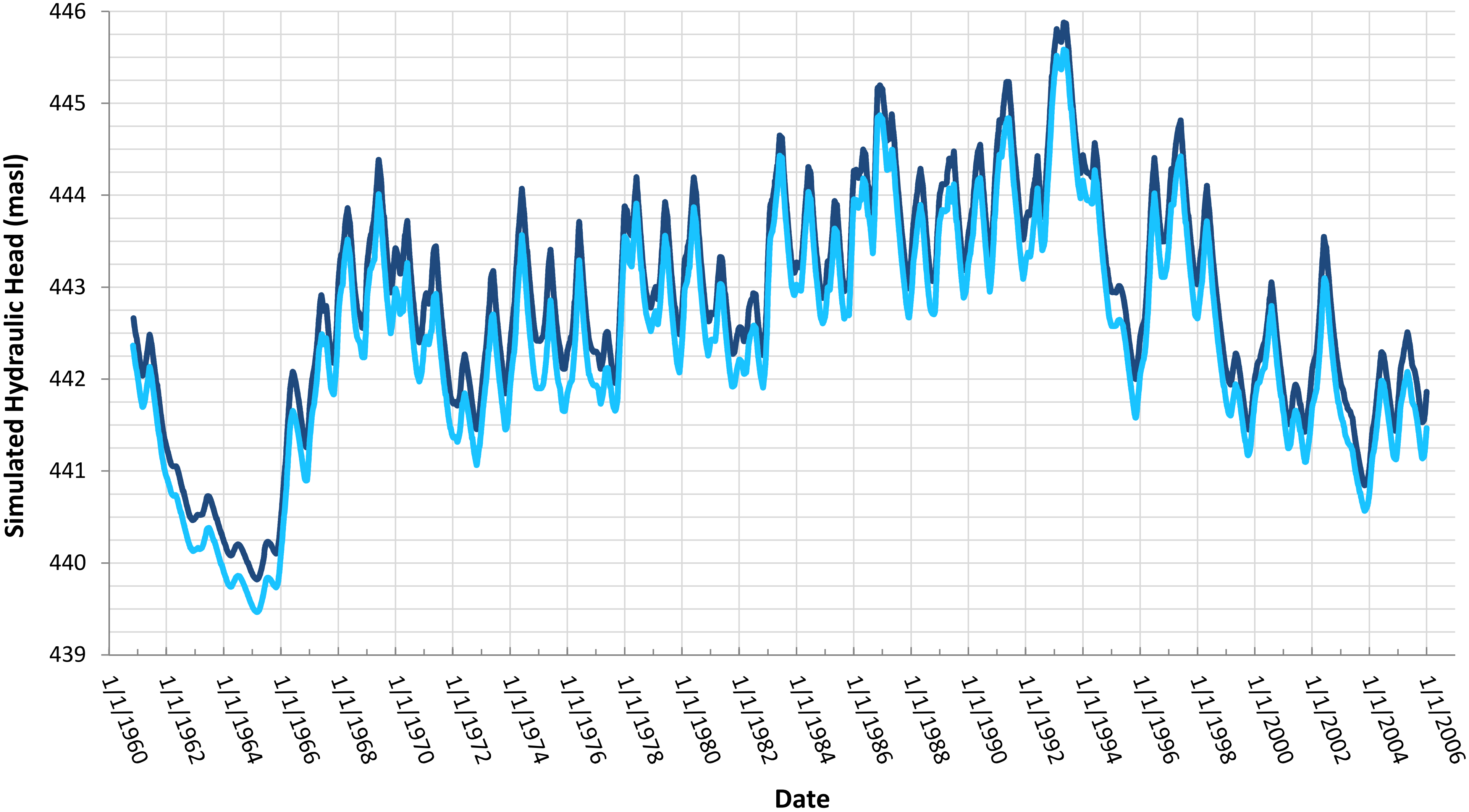
**Matrix Solutions Inc.**
ENVIRONMENT & ENGINEERING

City of Guelph
Groundwater Modelling Report for Renewal of the Permit To Take Water for the Nestlé Waters Canada Aberfoyle and Erin Facilities

## Erin – Simulated Water Level Variability at MW05A-05 – Drought Scenarios

| Date: | Project: | Technical: | Reviewer: | Drawn: |
|---|---|---|---|---|
| 11 Dec 2018 | 26435 | J. Melchin | D. Van Vliet | J. Melchin |

Figure 29



- Hillsburgh Well 2 -Average NWC Pumping (207 m³/day; Scenario 3)
- Hillsburgh Well 2 - Permitted NWC Pumping (1,113 m³/day; Scenario 4)

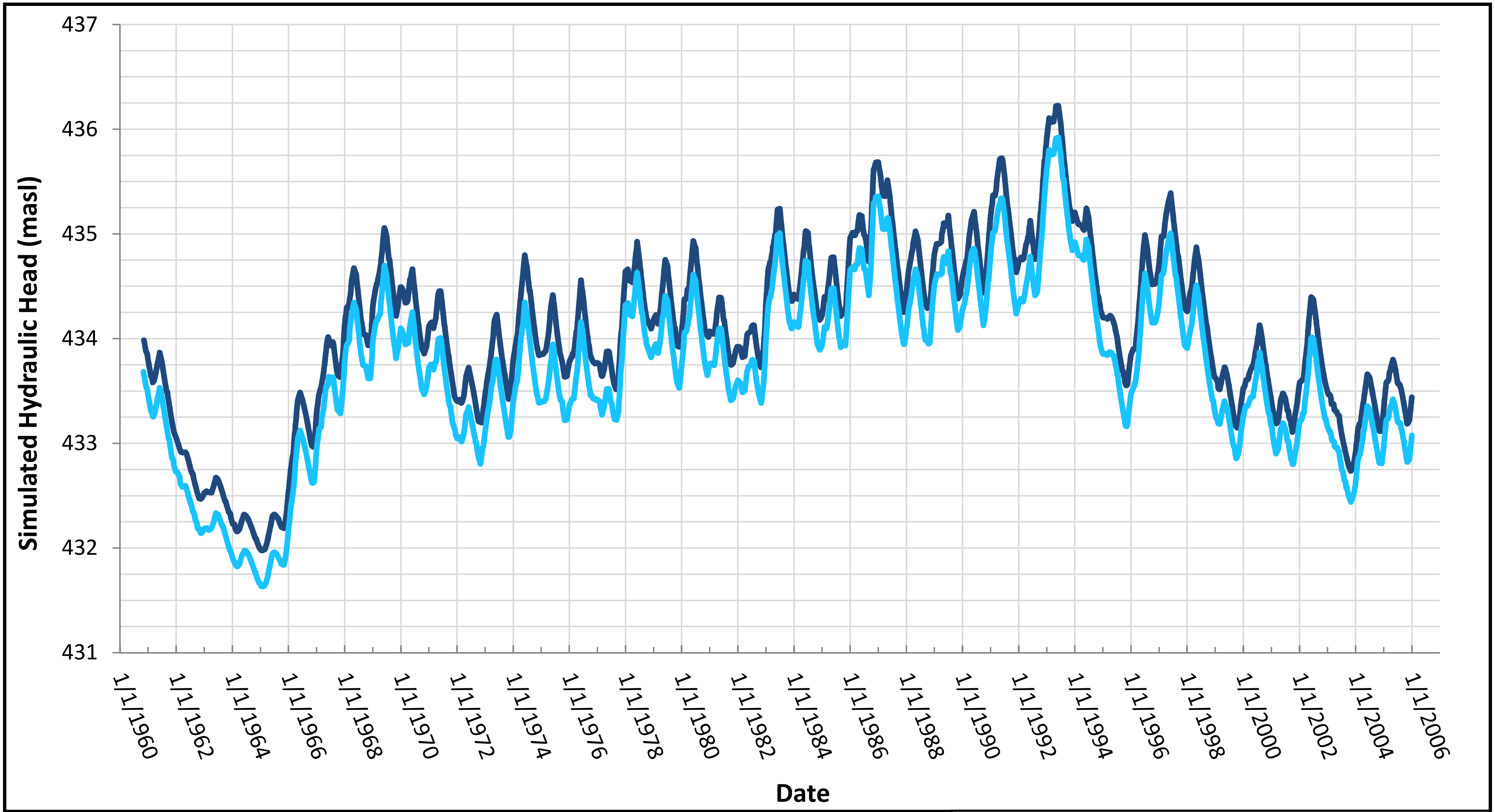
**Matrix Solutions Inc.**
ENVIRONMENT & ENGINEERING

City of Guelph
Groundwater Modelling Report for Renewal of the Permit To Take Water for the Nestlé Waters Canada Aberfoyle and Erin Facilities

## Erin – Simulated Water Level Variability at Hillsburgh Well 2 – Drought Scenarios

| Date: | Project: | Technical: | Reviewer: | Drawn: |
|---|---|---|---|---|
| 11 Dec 2018 | 26435 | J. Melchin | D. Van Vliet | J. Melchin |

Figure
30



- Hillsburgh Well 3 - Average NWC Pumping (207 m³/day; Scenario 3)
- Hillsburgh Well 3 - Permitted NWC Pumping (1,113 m³/day; Scenario 4)

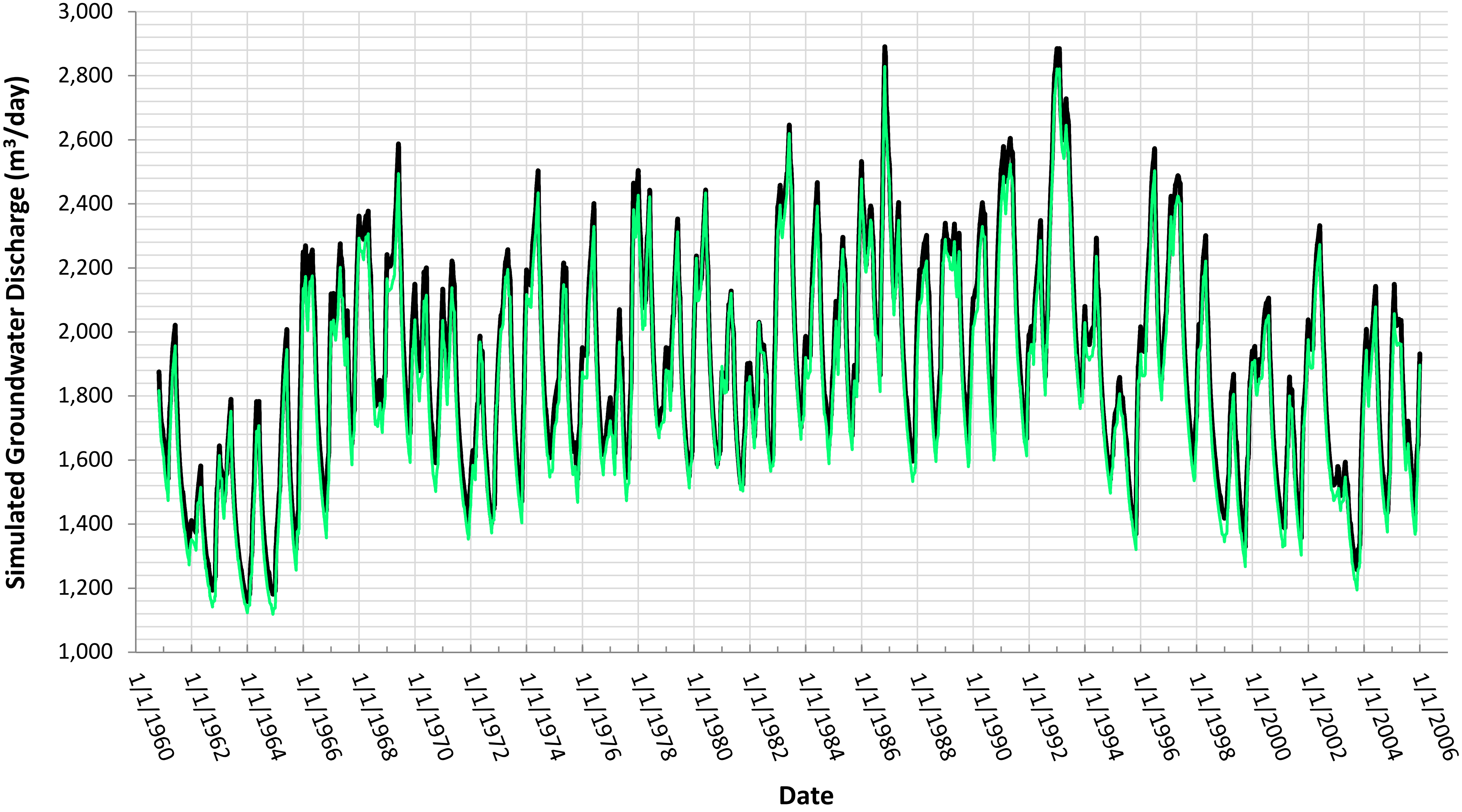
**Matrix Solutions Inc.**
ENVIRONMENT & ENGINEERING

City of Guelph
Groundwater Modelling Report for Renewal of the Permit To Take Water for the Nestlé Waters Canada Aberfoyle and Erin Facilities

## Erin – Simulated Water Level Variability at Hillsburgh Well 3 – Drought Scenarios

| Date: | Project: | Technical: | Reviewer: | Drawn: |
|---|---|---|---|---|
| 11 Dec 2018 | 26435 | J. Melchin | D. Van Vliet | J. Melchin |

Figure
31



**Matrix Solutions Inc.**
ENVIRONMENT & ENGINEERING

City of Guelph
Groundwater Modelling Report for Renewal of the Permit To Take Water for the Nestlé Waters Canada Aberfoyle and Erin Facilities

## Erin – Simulated Groundwater Discharge at SW1 – Drought Scenarios Time Series

| Date: | Project: | Technical: | Reviewer: | Drawn: |
|---|---|---|---|---|
| 11 Dec 2018 | 26435 | J. Melchin | D. Van Vliet | J. Melchin |

Figure
32

▬ SW1 - Average NWC Pumping (207 m³/day; Scenario 3)

▬ SW1 - Permitted NWC Pumping (1,113 m³/day; Scenario 4)

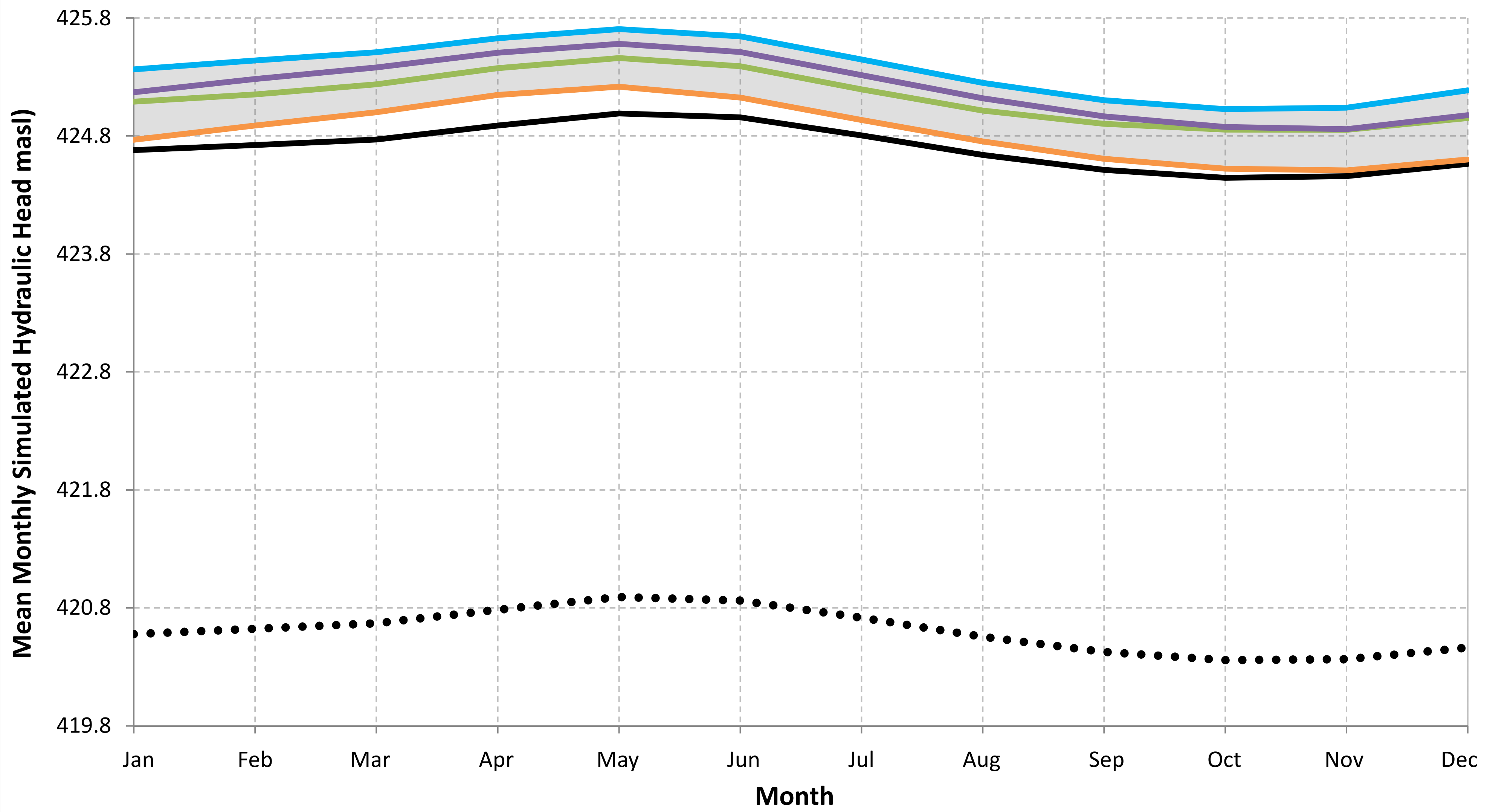
**Matrix Solutions Inc.**
ENVIRONMENT & ENGINEERING

City of Guelph
Groundwater Modelling Report for Renewal of the Permit To Take Water for the Nestlé Waters Canada Aberfoyle and Erin Facilities

## Erin – Simulated Groundwater Discharge at SW1 – Drought Scenarios Ranked Duration Curves

| Date: | Project: | Technical: | Reviewer: | Drawn: |
|---|---|---|---|---|
| 11 Dec 2018 | 26435 | J. Melchin | D. Van Vliet | J. Melchin |

Figure
33



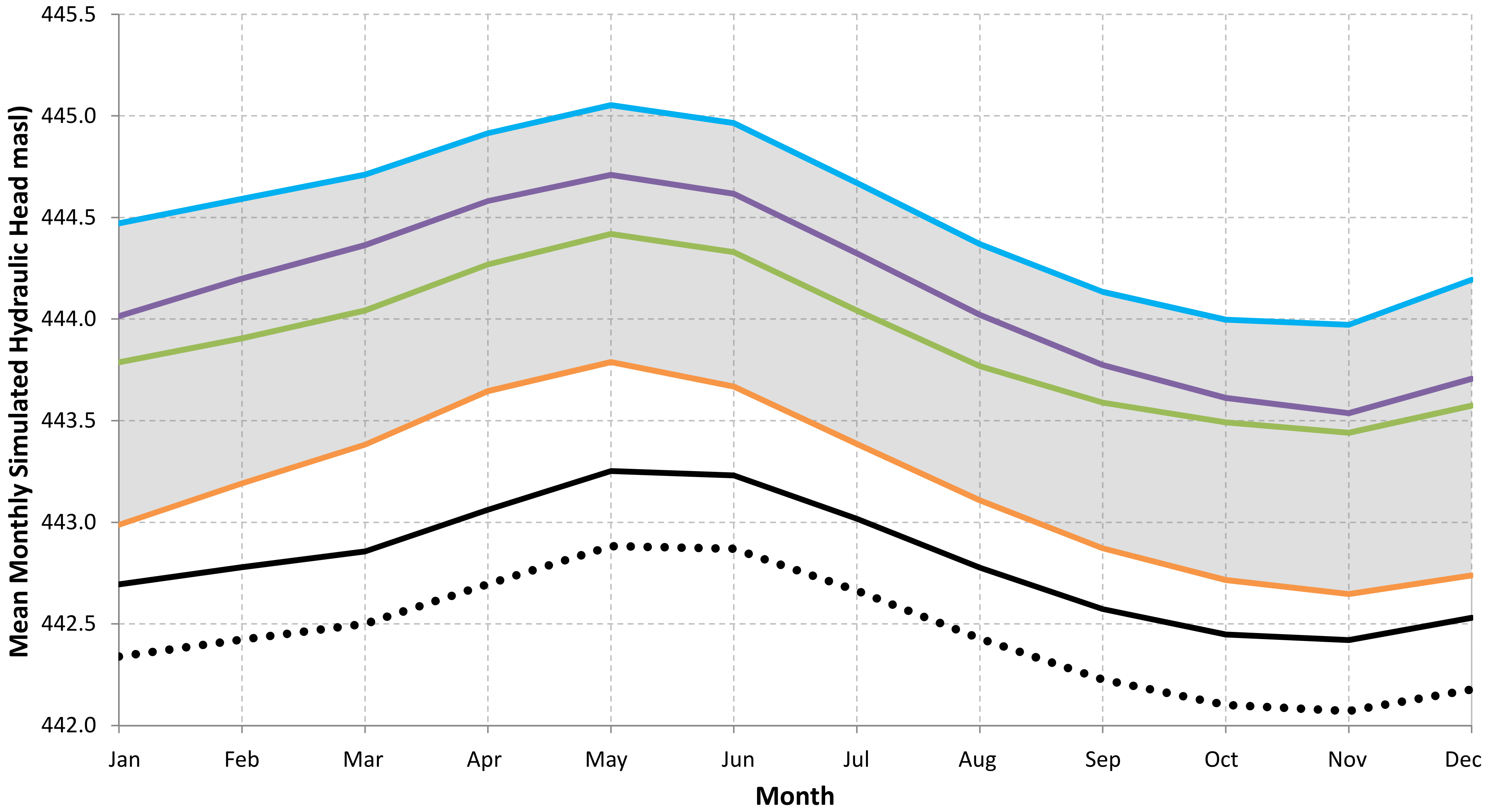
Matrix Solutions Inc.
ENVIRONMENT & ENGINEERING

City of Guelph
Groundwater Modelling Report for Renewal of the Permit To Take Water for the Nestlé Waters Canada Aberfoyle and Erin Facilities

## Erin – Mean Monthly Simulated Water Level Variability at MW05A-05 – Climate Change Scenarios

| Date: | Project: | Technical: | Reviewer: | Drawn: |
|---|---|---|---|---|
| 11 Dec 2018 | 26435 | J. Melchin | D. Van Vliet | J. Melchin |

Figure
34



▨ Range of Future Climates

— Hillsburgh Well 2 - Historical Climate Variability (NWC Pumping = 207 m³/day; Scenario 3)

• • • Hillsburgh Well 2 - Historical Climate Variability (NWC Pumping = 1,113 m³/day; Scenario 4)

— Hillsburgh Well 2 - Climate Change 1 (NWC Pumping = 207 m³/day; Scenario 5a)

— Hillsburgh Well 2 - Climate Change 2 (NWC Pumping = 207 m³/day; Scenario 5b)

— Hillsburgh Well 2 - Climate Change 3 (NWC Pumping = 207 m³/day; Scenario 5c)

— Hillsburgh Well 2 - Climate Change 4 (NWC Pumping = 207 m³/day; Scenario 5d)

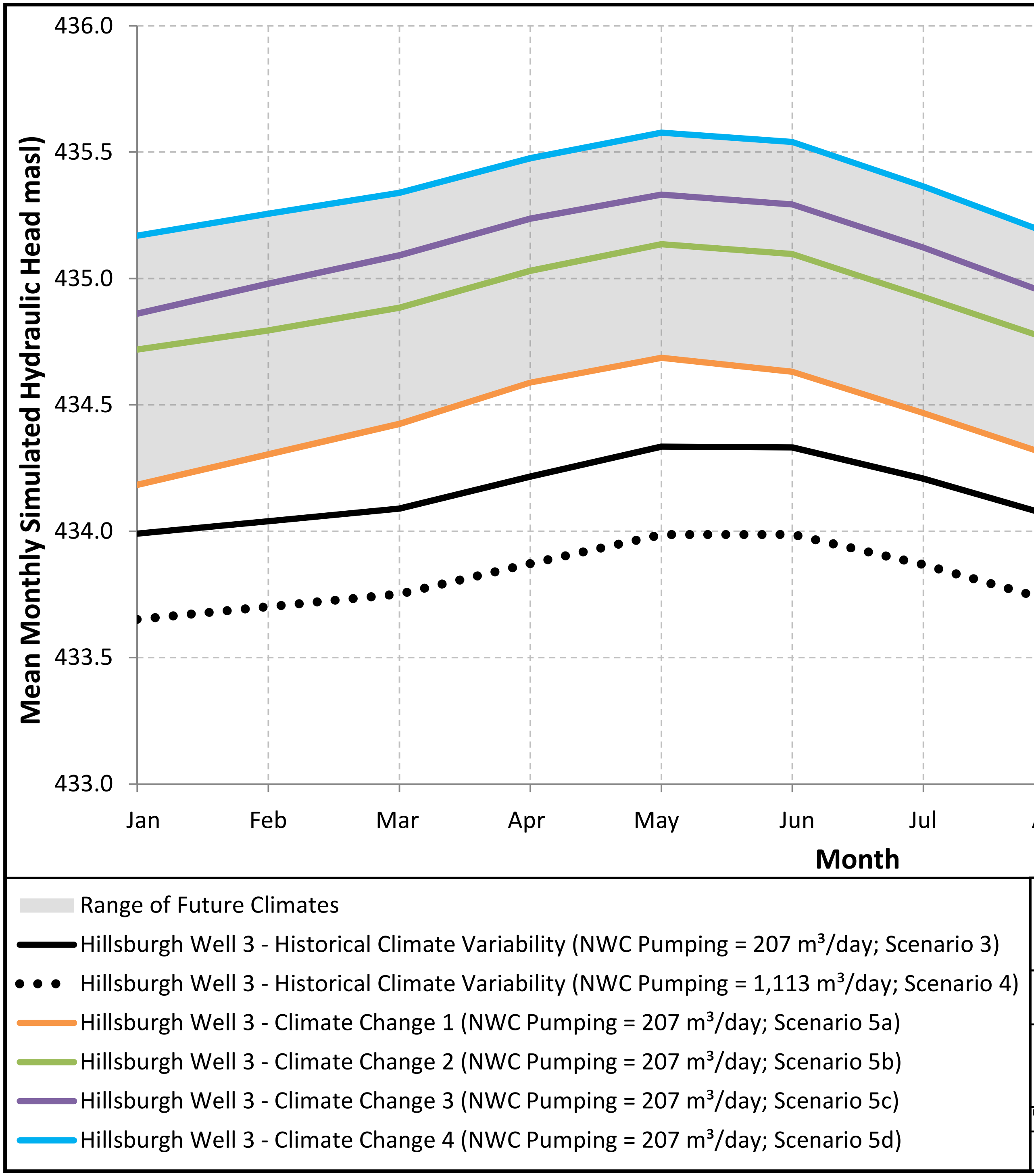
**Matrix Solutions Inc.**
ENVIRONMENT & ENGINEERING

City of Guelph
Groundwater Modelling Report for Renewal of the Permit To Take Water for the Nestlé Waters Canada Aberfoyle and Erin Facilities

## Erin – Mean Monthly Simulated Water Level Variability at Hillsburgh Well 2 – Climate Change Scenarios

| Date: | Project: | Technical: | Reviewer: | Drawn: |
|---|---|---|---|---|
| 11 Dec 2018 | 26435 | J. Melchin | D. Van Vliet | J. Melchin |

Figure
35



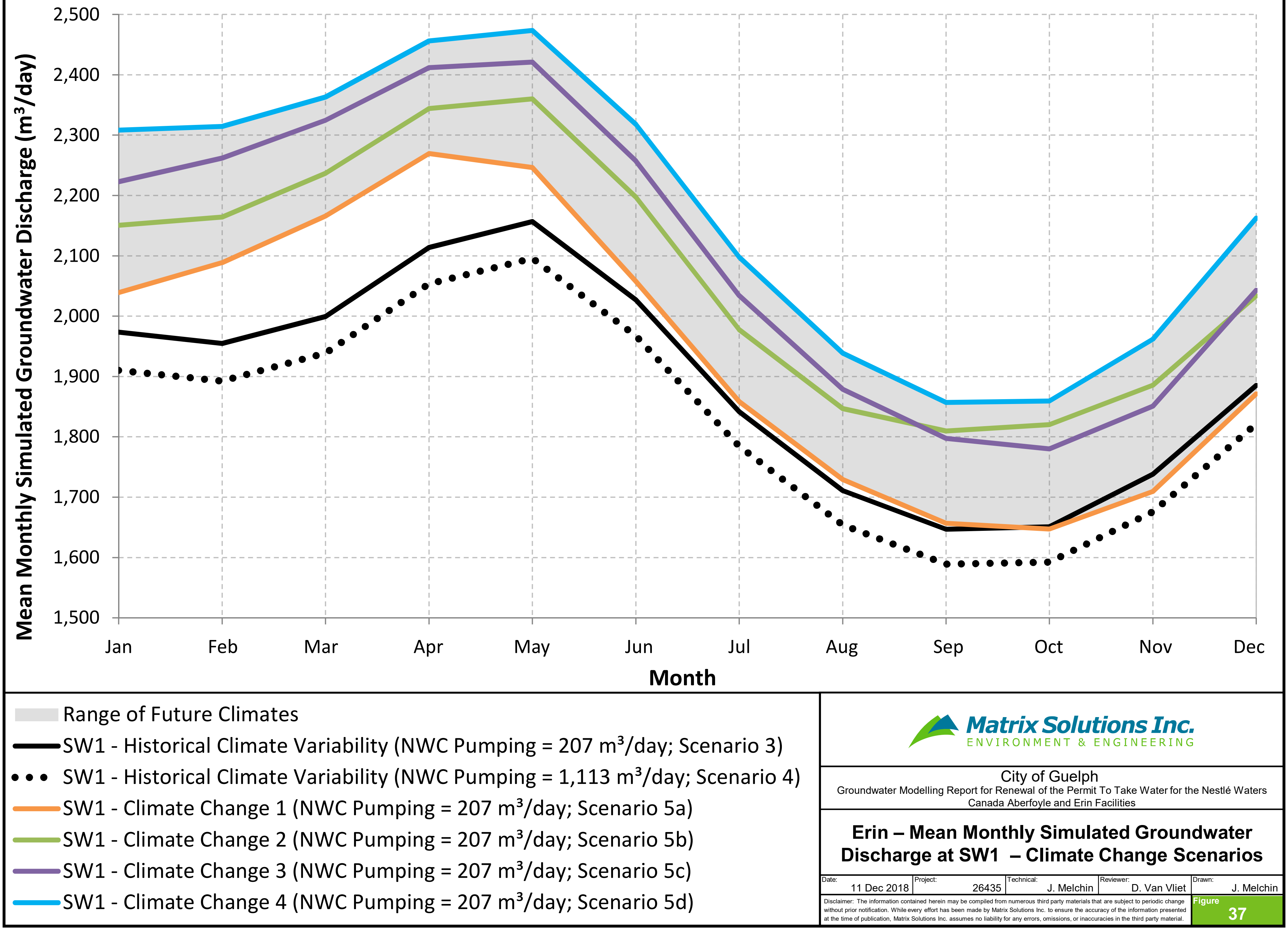
**Matrix Solutions Inc.**
ENVIRONMENT & ENGINEERING

City of Guelph
Groundwater Modelling Report for Renewal of the Permit To Take Water for the Nestlé Waters Canada Aberfoyle and Erin Facilities

# Erin – Mean Monthly Simulated Water Level Variability at Hillsburgh Well 3 – Climate Change Scenarios

| Date: | Project: | Technical: | Reviewer: | Drawn: |
|---|---|---|---|---|
| 11 Dec 2018 | 26435 | J. Melchin | D. Van Vliet | J. Melchin |

Figure
36



Matrix Solutions Inc.
ENVIRONMENT & ENGINEERING

City of Guelph
Groundwater Modelling Report for Renewal of the Permit To Take Water for the Nestlé Waters Canada Aberfoyle and Erin Facilities

# Erin – Mean Monthly Simulated Groundwater Discharge at SW1 – Climate Change Scenarios

| Date: | Project: | Technical: | Reviewer: | Drawn: |
|---|---|---|---|---|
| 11 Dec 2018 | 26435 | J. Melchin | D. Van Vliet | J. Melchin |

Figure
37

# APPENDIX A

# Calibration Dataset and Results

# APPENDIX A - CALIBRATION DATASET AND RESULTS

**Table A1 Calibration Dataset and Results - Aberfoyle**

| Well Name | Easting | Northing | Screen /Open Interval Top (masl) | Screen /Open Interval Bottom (masl) | Observed Average Water Level (2009 to 2013 and 2015) (masl)[1] | Simulated Average Water Level (masl) | Observed Drawdown (0 to 3,600 $m^3$/day) (m) | Simulated Drawdown (0 to 3,600 $m^3$/day) (m) | Interpreted Aquifer System | WWIS Target from Tier Three Assessment (Y/N) |
|---|---|---|---|---|---|---|---|---|---|---|
| 125_Brock_S_Y_Well | 569339 | 4812724 | 297 | 296 | 311.59 | 313.89 | 0.26 | 1.80 | Upper Bedrock | N |
| #2 Brock N. | 568379 | 4813795 | n/a | n/a | 315.84 | 314.56 | 0.11 | 0.04 | Upper Bedrock | N |
| 27_Old_Brock | 569089 | 4813534 | 299 | 282 | 309.41 | 313.41 | 5.38 | 3.36 | Lower Bedrock | N |
| #46 Gilmour | 569848 | 4813550 | n/a | n/a | 319.56 | 316.75 | n/a | n/a | Upper Bedrock | N |
| 50_Brock_S_I_Well | 568947 | 4813482 | 299 | 291 | 309.68 | 309.51 | n/a | n/a | Lower Bedrock | N |
| 58 Brock S. | 569022 | 4813428 | n/a | n/a | 311.67 | 311.52 | 1.21 | 4.47 | Upper Bedrock | N |
| 7404_Rd_34 | 568132 | 4813524 | 300 | 298 | 315.62 | 314.83 | n/a | n/a | Upper Bedrock | N |
| 7425_Rd_34_B_Well | 568371 | 4813669 | 305 | 283 | 310.23 | 314.91 | 3.63 | 0.89 | Lower Bedrock | N |
| 8_MapleLeaf_Lane | 568715 | 4813413 | 303 | 302 | 311.74 | 311.89 | n/a | n/a | Upper Bedrock | N |
| 80_Brock_S_W2_Well | 569254 | 4813252 | 297 | 260 | 307.94 | 312.30 | n/a | n/a | Lower Bedrock | N |
| 98_Brock_S_M1_Well | 569443 | 4813056 | 303 | 281 | 309.66 | 313.86 | 5.37 | 2.34 | Lower Bedrock | N |
| 67-04699 | 569118 | 4813379 | 300 | 284 | 310.60 | 312.61 | n/a | n/a | Upper Bedrock | N |
| 67-08234 | 568172 | 4813388 | 298 | 285 | 310.22 | 313.67 | n/a | n/a | Upper Bedrock | N |
| 67-09385 | 568152 | 4813754 | 304 | 266 | 315.30 | 317.55 | n/a | n/a | Lower Bedrock | N |
| Capital_Paving_Asphalt_Pl | 567511 | 4811895 | 302 | 281 | 307.59 | 309.02 | n/a | n/a | Upper Bedrock | N |
| Fireflow | 568454 | 4812433 | 299 | 261 | 309.86 | 311.19 | 1.97 | 0.74 | Lower Bedrock | N |
| H Well at end of Maple Leaf Ln -- | 568291 | 4812752 | n/a | n/a | 312.94 | 310.59 | n/a | n/a | Upper Bedrock | N |
| Lane Restaurant | 568841 | 4813123 | n/a | n/a | 311.71 | 311.22 | n/a | n/a | Upper Bedrock | N |
| MP8D | 568464 | 4812470 | 310 | 309 | 310.48 | 310.47 | n/a | n/a | Overburden | N |

| Well Name | Easting | Northing | Screen /Open Interval Top (masl) | Screen /Open Interval Bottom (masl) | Observed Average Water Level (2009 to 2013 and 2015) (masl)[1] | Simulated Average Water Level (masl) | Observed Drawdown (0 to 3,600 $m^3$/day) (m) | Simulated Drawdown (0 to 3,600 $m^3$/day) (m) | Interpreted Aquifer System | WWIS Target from Tier Three Assessment (Y/N) |
|---|---|---|---|---|---|---|---|---|---|---|
| MP8S | 568464 | 4812470 | 310 | 309 | 310.51 | 310.47 | n/a | n/a | Overburden | N |
| MP11D | 569736 | 4813798 | 317 | 316 | 317.91 | 317.26 | n/a | n/a | Overburden | N |
| MP11S | 569736 | 4813798 | 318 | 317 | 317.79 | 317.26 | n/a | n/a | Overburden | N |
| MP12D | 568954 | 4812893 | 310 | 309 | 311.60 | 311.39 | 0.19 | 0.12 | Overburden | N |
| MP12S | 568954 | 4812893 | 311 | 310 | 311.55 | 311.39 | 0.15 | 0.12 | Overburden | N |
| MP14D | 568750 | 4812760 | 309 | 309 | 311.51 | 311.06 | n/a | n/a | Overburden | N |
| MP14S | 568750 | 4812760 | 311 | 310 | 311.50 | 311.06 | n/a | n/a | Overburden | N |
| MP16D | 569148 | 4813251 | 310 | 310 | 312.16 | 312.19 | n/a | n/a | Overburden | N |
| MP16S | 569148 | 4813251 | 312 | 311 | 312.25 | 312.19 | n/a | n/a | Overburden | N |
| MW01A-04 | 569636 | 4813476 | 306 | 303 | 317.51 | 316.39 | n/a | n/a | Upper Bedrock | N |
| MW01B-04 | 569636 | 4813476 | 311 | 308 | 317.53 | 316.40 | n/a | n/a | Overburden | N |
| MW01C-04 | 569636 | 4813476 | 320 | 317 | 322.94 | 316.40 | n/a | n/a | Overburden | N |
| MW02A-07 | 568946 | 4812909 | 283 | 280 | 309.41 | 308.28 | 7.00 | 8.86 | Lower Bedrock | N |
| MW02B-07 | 568946 | 4812909 | 292 | 290 | 309.79 | 308.28 | n/a | n/a | Lower Bedrock | N |
| MW02C-07 | 568946 | 4812909 | 300 | 298 | 310.81 | 309.87 | 2.61 | 4.59 | Upper Bedrock | N |
| MW02D-07 | 568940 | 4812910 | 304 | 303 | 311.49 | 311.35 | 0.66 | 0.11 | Overburden | N |
| MW02E-07 | 568940 | 4812910 | 309 | 308 | 311.45 | 311.35 | 0.34 | 0.11 | Overburden | N |
| MW03A-07 | 568783 | 4812949 | 280 | 277 | 310.51 | 311.21 | 2.64 | 2.85 | Lower Bedrock | N |
| MW03B-07 | 568783 | 4812949 | 286 | 284 | 311.38 | 311.21 | n/a | n/a | Lower Bedrock | N |
| MW03C-07 | 568783 | 4812949 | 295 | 293 | 311.51 | 311.12 | 1.88 | 0.62 | Upper Bedrock | N |
| MW04A-07 | 569252 | 4813069 | 283 | 280 | 309.48 | 309.78 | 6.11 | 8.45 | Lower Bedrock | N |
| MW04B-07 | 569252 | 4813069 | 300 | 298 | 311.83 | 313.21 | 0.35 | 1.51 | Upper Bedrock | N |
| MW04C-07 | 569252 | 4813069 | 308 | 306 | 311.78 | 313.44 | 0.01 | 0.99 | Overburden | N |
| MW06A-08 | 569344 | 4814036 | 283 | 280 | 316.18 | 318.11 | 1.41 | 0.71 | Lower Bedrock | N |
| MW06B-08 | 569344 | 4814036 | 299 | 298 | 318.44 | 317.66 | 0.00 | 0.02 | Upper Bedrock | N |
| MW07A-08 | 568805 | 4813813 | 288 | 285 | 309.90 | 311.04 | 5.39 | 6.26 | Lower Bedrock | N |

| Well Name | Easting | Northing | Screen /Open Interval Top (masl) | Screen /Open Interval Bottom (masl) | Observed Average Water Level (2009 to 2013 and 2015) (masl)[1] | Simulated Average Water Level (masl) | Observed Drawdown (0 to 3,600 $m^3$/day) (m) | Simulated Drawdown (0 to 3,600 $m^3$/day) (m) | Interpreted Aquifer System | WWIS Target from Tier Three Assessment (Y/N) |
|---|---|---|---|---|---|---|---|---|---|---|
| MW07B-08 | 568805 | 4813813 | 302 | 300 | 311.15 | 313.36 | 3.11 | 2.68 | Upper Bedrock | N |
| MW08A-08 | 568677 | 4814244 | 284 | 281 | 317.46 | 318.61 | 0.67 | 0.57 | Lower Bedrock | N |
| MW08B-08 | 568677 | 4814244 | 299 | 298 | 317.26 | 317.41 | 0.06 | 0.01 | Upper Bedrock | N |
| MW10A-09 | 569940 | 4813642 | 319 | 316 | 319.57 | 317.31 | 0.00 | 0.00 | Overburden | N |
| MW10B-09 | 569947 | 4813655 | 305 | 302 | 319.61 | 317.48 | 0.02 | 0.01 | Upper Bedrock | N |
| MW10C-09 | 569947 | 4813655 | 263 | 260 | 317.66 | 318.25 | n/a | n/a | Lower Bedrock | N |
| MW10D-09 | 569947 | 4813655 | 248 | 245 | 317.49 | 318.25 | 0.61 | 0.98 | Lower Bedrock | N |
| MW13-10 | 569080 | 4812749 | 287 | 284 | 305.02 | 301.79 | 14.38 | n/a | Lower Bedrock | N |
| MW14A-11 | 568360 | 4813081 | 283 | 279 | 310.26 | 313.47 | 3.54 | 2.19 | Lower Bedrock | N |
| MW14B-11 | 568360 | 4813081 | 297 | 294 | 313.66 | 311.35 | 0.22 | 0.04 | Upper Bedrock | N |
| MW14C-11 | 568360 | 4813081 | 303 | 301 | 314.26 | 311.34 | 0.12 | 0.03 | Upper Bedrock | N |
| MW15A-12 | 567775 | 4812475 | 282 | 250 | 310.43 | 311.69 | 0.50 | 0.18 | Lower Bedrock | N |
| MW15B-12 | 567770 | 4812469 | 301 | 300 | 308.26 | 310.75 | n/a | n/a | Upper Bedrock | N |
| MW16A-12 | 568750 | 4811186 | 262 | 257 | 307.03 | 310.25 | 0.20 | 0.10 | Lower Bedrock | N |
| MW16B-12 | 568747 | 4811185 | 290 | 288 | 307.44 | 311.52 | n/a | n/a | Upper Bedrock | N |
| MW17A-12 | 569495 | 4811887 | 275 | 271 | 308.08 | 312.35 | 2.06 | 0.79 | Lower Bedrock | N |
| MW17B-12 | 569493 | 4811885 | 301 | 300 | 309.47 | 314.15 | n/a | n/a | Upper Bedrock | N |
| MW18A-12 | 568760 | 4812109 | 261 | 256 | 307.82 | 311.55 | 3.34 | 1.37 | Lower Bedrock | N |
| MW18B-12 | 568758 | 4812106 | 297 | 295 | 308.05 | 311.31 | n/a | n/a | Upper Bedrock | N |
| MW-D | 568562 | 4812714 | 301 | 294 | 310.72 | 310.63 | 1.13 | 0.05 | Upper Bedrock | N |
| MW-I | 568562 | 4812714 | 307 | 305 | 310.91 | 310.63 | 1.23 | 0.05 | Upper Bedrock | N |
| MW-S | 568562 | 4812714 | 297 | 295 | 311.10 | 310.60 | 0.00 | 0.03 | Overburden | N |
| Nestle_Farmhouse | 569259 | 4812831 | 304 | 292 | 312.38 | 312.93 | n/a | n/a | Upper Bedrock | N |
| PCC-D | 568445 | 4813464 | 303 | 301 | 314.20 | 311.94 | 0.13 | 0.10 | Upper Bedrock | N |
| PCC-I | 568445 | 4813464 | 308 | 306 | 313.99 | 311.50 | 0.04 | 0.03 | Overburden | N |
| PCC-S | 568445 | 4813464 | 312 | 311 | 314.16 | 311.50 | 0.00 | 0.03 | Overburden | N |

| Well Name | Easting | Northing | Screen /Open Interval Top (masl) | Screen /Open Interval Bottom (masl) | Observed Average Water Level (2009 to 2013 and 2015) (masl)[1] | Simulated Average Water Level (masl) | Observed Drawdown (0 to 3,600 m$^3$/day) (m) | Simulated Drawdown (0 to 3,600 m$^3$/day) (m) | Interpreted Aquifer System | WWIS Target from Tier Three Assessment (Y/N) |
|---|---|---|---|---|---|---|---|---|---|---|
| PW5_Meadows_of_Aberfoyle | 569576 | 4813205 | 302 | 266 | 310.02 | 315.04 | 4.72 | 1.59 | Lower Bedrock | N |
| S Well | 569309 | 4811461 | n/a | n/a | 308.33 | 311.55 | n/a | n/a | Lower Bedrock | N |
| TW1-93 | 568672 | 4812578 | 302 | 302 | 309.87 | 311.09 | 0.36 | 0.06 | Overburden | N |
| TW1-99 | 569018 | 4812829 | 301 | 301 | 311.59 | 311.90 | 0.32 | 1.51 | Overburden | N |
| TW3-80 | 569056.3 | 4812800.2 | 288 | 285 | 306.03 | 299.38 | 14.52 | n/a | Lower Bedrock | N |
| W Well | 569233 | 4813059 | n/a | n/a | 311.85 | 312.98 | n/a | n/a | Upper Bedrock | N |
| TW2-11 | 568638 | 4812238 | 281 | 255 | 309.46 | 311.40 | n/a | n/a | Lower Bedrock | N |
| Lane_House | 569018 | 4813363 | 298 | 277 | 310.05 | 308.36 | 5.54 | 10.79 | Upper Bedrock | N |
| MP4S-04 | 568999 | 4812999 | 311.42 | 310.81 | n/a | n/a | 0.19 | 0.19 | Overburden | N |
| MP4D-04 | 568999 | 4812999 | 310.19 | 309.75 | n/a | n/a | 0.19 | 0.19 | Overburden | N |
| MP6S-04 | 569030 | 4813051 | 310.94 | 310.33 | n/a | n/a | 0.08 | 0.03 | Overburden | N |
| MP6D-04 | 569030 | 4813051 | 309.72 | 309.11 | n/a | n/a | 0.11 | 0.03 | Overburden | N |
| FW1D-09 | 569777 | 4813966 | 244.00 | 241.00 | n/a | n/a | 0.42 | 0.89 | Lower Bedrock | N |
| MW11C-09 | 570028 | 4813727 | 272.10 | 268.00 | n/a | n/a | 0.38 | 0.76 | Lower Bedrock | N |
| MW12C-09 | 569896 | 4813760 | 258.00 | 253.00 | n/a | n/a | 0.48 | 0.96 | Lower Bedrock | N |
| MW9B-09 | 569779 | 4813965 | 297.48 | 296.11 | n/a | n/a | 0.02 | 0.01 | Upper Bedrock | N |
| MW11B-09 | 570028 | 4813724 | 302.63 | 301.94 | n/a | n/a | 0.02 | 0.01 | Upper Bedrock | N |
| MW9A-09 | 569779 | 4813963 | 318.41 | 315.36 | n/a | n/a | 0.00 | 0.01 | Overburden | N |
| MW11A-09 | 570025 | 4813725 | 315.37 | 313.85 | n/a | n/a | 0.00 | 0.01 | Overburden | N |
| MW12A-11 | 569899 | 4813760 | n/a | n/a | n/a | n/a | 0.00 | 0.01 | Overburden | N |
| n/a | 566585 | 4810364 | 308.82 | 303.82 | 305.13 | 305.41 | n/a | n/a | Overburden | Y |
| n/a | 566436 | 4810390 | 309.93 | 304.93 | 305.21 | 305.112 | n/a | n/a | Overburden | Y |
| n/a | 566720 | 4810470 | 309.82 | 304.82 | 305.61 | 305.901 | n/a | n/a | Overburden | Y |
| n/a | 566850 | 4810320 | 309.95 | 304.95 | 305.84 | 306.096 | n/a | n/a | Overburden | Y |
| n/a | 566991 | 4811145 | 310.03 | 305.03 | 306.45 | 306.844 | n/a | n/a | Overburden | Y |

| Well Name | Easting | Northing | Screen /Open Interval Top (masl) | Screen /Open Interval Bottom (masl) | Observed Average Water Level (2009 to 2013 and 2015) (masl)[1] | Simulated Average Water Level (masl) | Observed Drawdown (0 to 3,600 $m^3$/day) (m) | Simulated Drawdown (0 to 3,600 $m^3$/day) (m) | Interpreted Aquifer System | WWIS Target from Tier Three Assessment (Y/N) |
|---|---|---|---|---|---|---|---|---|---|---|
| n/a | 566984 | 4811178 | 310.28 | 305.28 | 306.5 | 306.972 | n/a | n/a | Overburden | Y |
| n/a | 566987 | 4811162 | 310.31 | 305.31 | 306.52 | 306.816 | n/a | n/a | Overburden | Y |
| n/a | 566987 | 4811162 | 309.33 | 304.33 | 306.57 | 306.816 | n/a | n/a | Overburden | Y |
| n/a | 567128 | 4811064 | 311.75 | 306.75 | 306.64 | 307.424 | n/a | n/a | Overburden | Y |
| n/a | 567314 | 4811221 | 310.79 | 305.79 | 306.75 | 307.286 | n/a | n/a | Overburden | Y |
| n/a | 567318 | 4811201 | 310.52 | 305.52 | 306.76 | 307.381 | n/a | n/a | Overburden | Y |
| n/a | 567262 | 4811312 | 308.28 | 303.28 | 306.83 | 307.667 | n/a | n/a | Overburden | Y |
| n/a | 567308 | 4811244 | 310.26 | 305.26 | 306.99 | 307.37 | n/a | n/a | Overburden | Y |
| n/a | 567497 | 4811427 | 308.94 | 303.94 | 307 | 307.726 | n/a | n/a | Overburden | Y |
| n/a | 566987 | 4811162 | 309.16 | 304.16 | 307.07 | 306.816 | n/a | n/a | Overburden | Y |
| n/a | 567314 | 4811221 | 309.89 | 304.89 | 307.12 | 307.286 | n/a | n/a | Overburden | Y |
| n/a | 567680 | 4811443 | 311.47 | 306.47 | 307.15 | 308.129 | n/a | n/a | Overburden | Y |
| n/a | 567605 | 4811440 | 309.74 | 304.74 | 307.21 | 307.806 | n/a | n/a | Overburden | Y |
| n/a | 567710 | 4811492 | 310.78 | 305.78 | 307.34 | 308.392 | n/a | n/a | Overburden | Y |
| n/a | 567726 | 4811623 | 312.11 | 307.11 | 307.66 | 308.345 | n/a | n/a | Overburden | Y |
| n/a | 567726 | 4811623 | 311.88 | 306.88 | 307.67 | 308.345 | n/a | n/a | Overburden | Y |
| n/a | 566640 | 4811326 | 307.65 | 302.65 | 308.72 | 307.698 | n/a | n/a | Overburden | Y |
| n/a | 566720 | 4811756 | 311.28 | 306.28 | 311.69 | 308.556 | n/a | n/a | Overburden | Y |
| n/a | 566553 | 4810406 | 309.03 | 304.03 | 305.28 | 305.385 | n/a | n/a | Overburden | Y |
| n/a | 566744 | 4810530 | 308.94 | 303.94 | 305.85 | 305.991 | n/a | n/a | Overburden | Y |
| n/a | 566640 | 4810110 | 312.71 | 307.71 | 305.85 | 305.165 | n/a | n/a | Overburden | Y |
| n/a | 566804 | 4810572 | 310.14 | 305.14 | 305.94 | 306.219 | n/a | n/a | Overburden | Y |
| n/a | 566879 | 4810152 | 307.4 | 302.4 | 305.96 | 306.101 | n/a | n/a | Overburden | Y |
| n/a | 566750 | 4810142 | 305.8 | 300.8 | 305.99 | 306.091 | n/a | n/a | Overburden | Y |
| n/a | 566823 | 4810603 | 310.15 | 305.15 | 306.24 | 306.307 | n/a | n/a | Overburden | Y |
| n/a | 567017 | 4811031 | 308.53 | 303.53 | 306.31 | 307.051 | n/a | n/a | Overburden | Y |

| Well Name | Easting | Northing | Screen /Open Interval Top (masl) | Screen /Open Interval Bottom (masl) | Observed Average Water Level (2009 to 2013 and 2015) (masl)[1] | Simulated Average Water Level (masl) | Observed Drawdown (0 to 3,600 $m^3$/day) (m) | Simulated Drawdown (0 to 3,600 $m^3$/day) (m) | Interpreted Aquifer System | WWIS Target from Tier Three Assessment (Y/N) |
|---|---|---|---|---|---|---|---|---|---|---|
| n/a | 567311 | 4811129 | 310.94 | 305.94 | 306.49 | 307.699 | n/a | n/a | Overburden | Y |
| n/a | 566940 | 4810390 | 310.51 | 305.51 | 306.7 | 306.139 | n/a | n/a | Overburden | Y |
| n/a | 567158 | 4810745 | 306.6 | 301.6 | 307 | 308.249 | n/a | n/a | Overburden | Y |
| n/a | 567775 | 4811181 | 310.99 | 305.99 | 307.14 | 308.99 | n/a | n/a | Overburden | Y |
| n/a | 566733 | 4811440 | 312.32 | 307.32 | 307.18 | 307.75 | n/a | n/a | Overburden | Y |
| n/a | 567429 | 4810589 | 305.6 | 300.6 | 307.41 | 308.259 | n/a | n/a | Overburden | Y |
| n/a | 567314 | 4811221 | 309.64 | 304.64 | 307.42 | 307.289 | n/a | n/a | Overburden | Y |
| n/a | 566912 | 4811652 | 309.19 | 304.19 | 307.81 | 307.725 | n/a | n/a | Overburden | Y |
| n/a | 566690 | 4811747 | 312.22 | 307.22 | 308.12 | 308.589 | n/a | n/a | Overburden | Y |
| n/a | 566716 | 4811603 | 310.88 | 305.88 | 308.26 | 307.767 | n/a | n/a | Overburden | Y |
| n/a | 566667 | 4811757 | 312.32 | 307.32 | 308.47 | 308.711 | n/a | n/a | Overburden | Y |
| n/a | 566693 | 4811583 | 310.73 | 305.73 | 308.5 | 307.862 | n/a | n/a | Overburden | Y |
| n/a | 566571 | 4811515 | 310.18 | 305.18 | 308.82 | 308.054 | n/a | n/a | Overburden | Y |
| n/a | 566745 | 4811450 | 308.52 | 303.52 | 308.85 | 307.753 | n/a | n/a | Overburden | Y |
| 6702537 | 571380 | 4810889 | 308.59 | 303.59 | 310.39 | 315.796 | n/a | n/a | Overburden | Y |
| n/a | 566957 | 4812381 | 311.43 | 306.43 | 310.39 | 310.112 | n/a | n/a | Overburden | Y |
| 6703373 | 568374 | 4811563 | 312.57 | 307.57 | 313.07 | 311.228 | n/a | n/a | Overburden | Y |
| n/a | 568416 | 4814373 | 321.67 | 316.67 | 318.21 | 320.265 | n/a | n/a | Overburden | Y |
| n/a | 568332 | 4814434 | 322.57 | 317.57 | 319.39 | 321.447 | n/a | n/a | Overburden | Y |
| n/a | 568416 | 4814494 | 324.07 | 319.07 | 319.42 | 321.622 | n/a | n/a | Overburden | Y |
| n/a | 568738 | 4814705 | 332.93 | 327.93 | 331.33 | 321.9 | n/a | n/a | Overburden | Y |
| 6702674 | 571500 | 4810968 | 299.14 | 294.14 | 304.32 | 315.754 | n/a | n/a | Overburden | Y |
| 6702525 | 568110 | 4811385 | 302.38 | 297.38 | 305.57 | 310.963 | n/a | n/a | Overburden | Y |
| 6711403 | 566954 | 4811184 | 298.99 | 293.99 | 305.87 | 307.284 | n/a | n/a | Overburden | Y |
| n/a | 566994 | 4811020 | 298.84 | 293.84 | 306.07 | 306.941 | n/a | n/a | Overburden | Y |
| n/a | 567160 | 4811324 | 300.8 | 295.8 | 306.23 | 307.655 | n/a | n/a | Overburden | Y |

| Well Name | Easting | Northing | Screen /Open Interval Top (masl) | Screen /Open Interval Bottom (masl) | Observed Average Water Level (2009 to 2013 and 2015) (masl)[1] | Simulated Average Water Level (masl) | Observed Drawdown (0 to 3,600 $m^3$/day) (m) | Simulated Drawdown (0 to 3,600 $m^3$/day) (m) | Interpreted Aquifer System | WWIS Target from Tier Three Assessment (Y/N) |
|---|---|---|---|---|---|---|---|---|---|---|
| n/a | 566703 | 4811002 | 306.41 | 301.41 | 306.23 | 306.884 | n/a | n/a | Overburden | Y |
| 6702538 | 571349 | 4810824 | 302.42 | 297.42 | 306.29 | 315.651 | n/a | n/a | Overburden | Y |
| n/a | 567435 | 4811260 | 301.39 | 296.39 | 306.33 | 307.364 | n/a | n/a | Overburden | Y |
| n/a | 566723 | 4811100 | 305.45 | 300.45 | 306.35 | 307.457 | n/a | n/a | Overburden | Y |
| n/a | 566856 | 4810865 | 301.44 | 296.44 | 306.56 | 306.261 | n/a | n/a | Overburden | Y |
| n/a | 566945 | 4811112 | 300.27 | 295.27 | 306.64 | 306.755 | n/a | n/a | Overburden | Y |
| 6703614 | 570804 | 4810123 | 304.75 | 299.75 | 306.87 | 314.21 | n/a | n/a | Overburden | Y |
| n/a | 567058 | 4809760 | 311.53 | 306.53 | 306.97 | 307.635 | n/a | n/a | Overburden | Y |
| n/a | 566985 | 4811023 | 300.88 | 295.88 | 306.98 | 306.882 | n/a | n/a | Overburden | Y |
| n/a | 566788 | 4811094 | 305.15 | 300.15 | 307.03 | 307.569 | n/a | n/a | Overburden | Y |
| n/a | 566742 | 4811279 | 304.4 | 299.4 | 307.06 | 307.697 | n/a | n/a | Overburden | Y |
| 6702326 | 568032 | 4810227 | 305.1 | 300.1 | 307.08 | 309.565 | n/a | n/a | Overburden | Y |
| n/a | 567068 | 4810315 | 306.83 | 301.83 | 307.13 | 306.263 | n/a | n/a | Overburden | Y |
| n/a | 568340 | 4809542 | 305.06 | 300.06 | 307.14 | 310.83 | n/a | n/a | Overburden | Y |
| n/a | 566765 | 4811309 | 305.8 | 300.8 | 307.26 | 307.698 | n/a | n/a | Overburden | Y |
| n/a | 568212 | 4809843 | 306.89 | 301.89 | 307.26 | 310.621 | n/a | n/a | Overburden | Y |
| n/a | 567260 | 4810328 | 303.33 | 298.33 | 307.27 | 307.999 | n/a | n/a | Overburden | Y |
| n/a | 567102 | 4811878 | 311.13 | 306.13 | 307.33 | 309.003 | n/a | n/a | Overburden | Y |
| n/a | 567817 | 4809323 | 303.82 | 298.82 | 307.39 | 308.994 | n/a | n/a | Overburden | Y |
| n/a | 567379 | 4810979 | 300.75 | 295.75 | 307.43 | 308.401 | n/a | n/a | Overburden | Y |
| n/a | 567639 | 4810138 | 307.81 | 302.81 | 307.46 | 308.906 | n/a | n/a | Overburden | Y |
| n/a | 568222 | 4810233 | 308.06 | 303.06 | 307.57 | 310.17 | n/a | n/a | Overburden | Y |
| n/a | 567599 | 4811606 | 303.98 | 298.98 | 307.76 | 307.931 | n/a | n/a | Overburden | Y |
| n/a | 567612 | 4811354 | 301.42 | 296.42 | 307.77 | 307.774 | n/a | n/a | Overburden | Y |
| n/a | 566866 | 4811330 | 302.75 | 297.75 | 307.91 | 307.701 | n/a | n/a | Overburden | Y |
| n/a | 567510 | 4811567 | 299.08 | 294.08 | 307.94 | 307.743 | n/a | n/a | Overburden | Y |

| Well Name | Easting | Northing | Screen /Open Interval Top (masl) | Screen /Open Interval Bottom (masl) | Observed Average Water Level (2009 to 2013 and 2015) (masl)[1] | Simulated Average Water Level (masl) | Observed Drawdown (0 to 3,600 $m^3$/day) (m) | Simulated Drawdown (0 to 3,600 $m^3$/day) (m) | Interpreted Aquifer System | WWIS Target from Tier Three Assessment (Y/N) |
|---|---|---|---|---|---|---|---|---|---|---|
| 6709858 | 571476 | 4810883 | 301.4 | 296.4 | 308.54 | 315.519 | n/a | n/a | Overburden | Y |
| n/a | 566408 | 4811545 | 309.66 | 304.66 | 308.65 | 308.048 | n/a | n/a | Overburden | Y |
| 6711419 | 566472 | 4811544 | 308.28 | 303.28 | 308.72 | 308.161 | n/a | n/a | Overburden | Y |
| n/a | 566410 | 4811537 | 308 | 303 | 308.8 | 308.024 | n/a | n/a | Overburden | Y |
| n/a | 566556 | 4811410 | 303.91 | 298.91 | 308.85 | 307.783 | n/a | n/a | Overburden | Y |
| n/a | 566483 | 4811776 | 307.48 | 302.48 | 308.93 | 309.176 | n/a | n/a | Overburden | Y |
| n/a | 566910 | 4811750 | 305.5 | 300.5 | 309.05 | 308.283 | n/a | n/a | Overburden | Y |
| 6704817 | 571344 | 4810924 | 296.99 | 291.99 | 309.1 | 315.999 | n/a | n/a | Overburden | Y |
| 6708127 | 566934 | 4812403 | 310.96 | 306.69 | 309.91 | 310.326 | n/a | n/a | Overburden | Y |
| 6710043 | 571313 | 4811285 | 302.68 | 297.68 | 310.16 | 317.112 | n/a | n/a | Overburden | Y |
| 6706444 | 568514 | 4810943 | 311.41 | 306.41 | 310.56 | 310.457 | n/a | n/a | Overburden | Y |
| 6710596 | 571092 | 4810988 | 294.14 | 289.14 | 310.57 | 316.642 | n/a | n/a | Overburden | Y |
| 6709780 | 571147 | 4810936 | 291.15 | 286.15 | 310.7 | 316.423 | n/a | n/a | Overburden | Y |
| 6711667 | 571550 | 4811051 | 301.08 | 296.08 | 310.71 | 315.92 | n/a | n/a | Overburden | Y |
| 6711904 | 571161 | 4810840 | 301.31 | 296.31 | 310.75 | 316.119 | n/a | n/a | Overburden | Y |
| n/a | 566756 | 4811894 | 311.59 | 306.59 | 310.87 | 309.334 | n/a | n/a | Overburden | Y |
| 6702539 | 571435 | 4810956 | 298.44 | 293.44 | 311.24 | 315.891 | n/a | n/a | Overburden | Y |
| 6712476 | 568925 | 4812654 | 307.85 | 302.85 | 311.24 | 312.818 | n/a | n/a | Overburden | Y |
| 6709672 | 569076 | 4813331 | 312.41 | 307.41 | 311.71 | 312.511 | n/a | n/a | Overburden | Y |
| 6712277 | 570894 | 4810888 | 301.92 | 296.92 | 311.82 | 316.587 | n/a | n/a | Overburden | Y |
| 6710040 | 571606 | 4811618 | 306.62 | 301.62 | 311.9 | 317.655 | n/a | n/a | Overburden | Y |
| 6705095 | 571306 | 4811126 | 299.94 | 294.94 | 312.9 | 316.694 | n/a | n/a | Overburden | Y |
| 6704136 | 571494 | 4811053 | 301.96 | 296.96 | 313.08 | 316.079 | n/a | n/a | Overburden | Y |
| 6710042 | 571272 | 4811260 | 308.29 | 303.29 | 313.36 | 317.108 | n/a | n/a | Overburden | Y |
| 6712255 | 571732 | 4811523 | 304.08 | 299.08 | 313.77 | 317.169 | n/a | n/a | Overburden | Y |
| 6702532 | 571179 | 4810887 | 297.79 | 292.79 | 314.05 | 316.224 | n/a | n/a | Overburden | Y |

| Well Name | Easting | Northing | Screen /Open Interval Top (masl) | Screen /Open Interval Bottom (masl) | Observed Average Water Level (2009 to 2013 and 2015) (masl)[1] | Simulated Average Water Level (masl) | Observed Drawdown (0 to 3,600 $m^3$/day) (m) | Simulated Drawdown (0 to 3,600 $m^3$/day) (m) | Interpreted Aquifer System | WWIS Target from Tier Three Assessment (Y/N) |
|---|---|---|---|---|---|---|---|---|---|---|
| 6710443 | 570891 | 4810871 | 298.85 | 293.85 | 314.47 | 316.545 | n/a | n/a | Overburden | Y |
| 6712163 | 571677 | 4811143 | 303.62 | 298.62 | 314.79 | 315.905 | n/a | n/a | Overburden | Y |
| 6710720 | 571116 | 4811018 | 297.09 | 292.09 | 314.98 | 316.686 | n/a | n/a | Overburden | Y |
| 6710494 | 571727 | 4811661 | 312.44 | 307.44 | 317.28 | 317.61 | n/a | n/a | Overburden | Y |
| 6702672 | 571516 | 4811036 | 302.25 | 297.25 | 318.02 | 315.962 | n/a | n/a | Overburden | Y |
| 6711290 | 571996 | 4811693 | 305.07 | 300.07 | 318.59 | 317.206 | n/a | n/a | Overburden | Y |
| 6711984 | 571962 | 4811637 | 303.58 | 298.58 | 318.9 | 317.092 | n/a | n/a | Overburden | Y |
| 6702656 | 570223 | 4813802 | 313.89 | 308.89 | 319 | 319.901 | n/a | n/a | Overburden | Y |
| 6712487 | 571865 | 4811680 | 305.76 | 300.76 | 319.6 | 317.427 | n/a | n/a | Overburden | Y |
| 6710657 | 567375 | 4814086 | 312.44 | 307.44 | 319.75 | 323.751 | n/a | n/a | Overburden | Y |
| n/a | 568607 | 4814561 | 325.07 | 320.07 | 321.1 | 321.141 | n/a | n/a | Overburden | Y |
| 6702535 | 570569 | 4809764 | 312.39 | 307.39 | 321.38 | 313.095 | n/a | n/a | Overburden | Y |
| 6702542 | 570564 | 4810063 | 311.52 | 306.52 | 321.76 | 314.159 | n/a | n/a | Overburden | Y |
| 6710785 | 570269 | 4814216 | 321.17 | 316.17 | 323.36 | 322.153 | n/a | n/a | Overburden | Y |
| n/a | 568617 | 4814742 | 329.91 | 324.91 | 323.4 | 322.9 | n/a | n/a | Overburden | Y |
| 6702654 | 570257 | 4813957 | 314.66 | 309.66 | 323.79 | 320.91 | n/a | n/a | Overburden | Y |
| n/a | 569996 | 4815301 | 318.15 | 313.15 | 323.84 | 326.073 | n/a | n/a | Overburden | Y |
| 6705984 | 569665 | 4815661 | 324.09 | 319.09 | 323.93 | 324.974 | n/a | n/a | Overburden | Y |
| n/a | 570334 | 4815022 | 326.02 | 321.02 | 324.5 | 325.927 | n/a | n/a | Overburden | Y |
| n/a | 570622 | 4815502 | 320.29 | 315.29 | 324.64 | 326.35 | n/a | n/a | Overburden | Y |
| 6704730 | 570693 | 4814511 | 320.69 | 315.69 | 324.75 | 324.785 | n/a | n/a | Overburden | Y |
| n/a | 570162 | 4815309 | 314.85 | 309.85 | 325.11 | 326.125 | n/a | n/a | Overburden | Y |
| n/a | 570205 | 4814901 | 322.32 | 317.32 | 325.56 | 324.941 | n/a | n/a | Overburden | Y |
| 6707382 | 570654 | 4814363 | 324.92 | 319.92 | 325.71 | 323.994 | n/a | n/a | Overburden | Y |
| 6703501 | 570694 | 4814383 | 325.58 | 320.58 | 325.94 | 324.168 | n/a | n/a | Overburden | Y |
| n/a | 570825 | 4815022 | 328.34 | 323.34 | 326.06 | 326.918 | n/a | n/a | Overburden | Y |

| Well Name | Easting | Northing | Screen /Open Interval Top (masl) | Screen /Open Interval Bottom (masl) | Observed Average Water Level (2009 to 2013 and 2015) (masl)[1] | Simulated Average Water Level (masl) | Observed Drawdown (0 to 3,600 $m^3$/day) (m) | Simulated Drawdown (0 to 3,600 $m^3$/day) (m) | Interpreted Aquifer System | WWIS Target from Tier Three Assessment (Y/N) |
|---|---|---|---|---|---|---|---|---|---|---|
| n/a | 570387 | 4815749 | 318.69 | 313.69 | 326.21 | 326.125 | n/a | n/a | Overburden | Y |
| 6707995 | 566454 | 4814523 | 320.28 | 315.28 | 326.68 | 328.765 | n/a | n/a | Overburden | Y |
| n/a | 570524 | 4814845 | 327.82 | 322.82 | 327.71 | 325.931 | n/a | n/a | Overburden | Y |
| 6711712 | 570389 | 4815590 | 321.79 | 316.79 | 329.06 | 326.232 | n/a | n/a | Overburden | Y |
| 6710354 | 570568 | 4814580 | 324.72 | 319.72 | 332.78 | 324.879 | n/a | n/a | Overburden | Y |
| 6704042 | 569774 | 4809483 | 301.51 | 296.51 | 303.12 | 312.338 | n/a | n/a | Overburden | Y |
| 6702534 | 570611 | 4810062 | 296.02 | 291.02 | 305.45 | 314.127 | n/a | n/a | Overburden | Y |
| 6704693 | 568214 | 4809488 | 294.41 | 289.41 | 305.57 | 310.514 | n/a | n/a | Overburden | Y |
| 6706874 | 569474 | 4809943 | 304.25 | 299.25 | 306.06 | 313.43 | n/a | n/a | Overburden | Y |
| 6705870 | 567138 | 4812055 | 299.51 | 294.51 | 306.75 | 309.51 | n/a | n/a | Overburden | Y |
| 6703852 | 567734 | 4811693 | 303.25 | 298.25 | 306.77 | 308.59 | n/a | n/a | Overburden | Y |
| n/a | 567000 | 4810090 | 296.97 | 291.97 | 307 | 306.191 | n/a | n/a | Overburden | Y |
| n/a | 568803 | 4809727 | 306.01 | 301.01 | 307.11 | 311.693 | n/a | n/a | Overburden | Y |
| n/a | 568610 | 4809499 | 296.16 | 291.16 | 307.14 | 310.859 | n/a | n/a | Overburden | Y |
| 6709991 | 571435 | 4810814 | 294.68 | 289.68 | 307.25 | 315.384 | n/a | n/a | Overburden | Y |
| 6704038 | 569614 | 4809823 | 306.65 | 301.65 | 307.36 | 313.272 | n/a | n/a | Overburden | Y |
| n/a | 568817 | 4809877 | 305.21 | 300.21 | 307.42 | 312.016 | n/a | n/a | Overburden | Y |
| n/a | 568769 | 4809970 | 297.15 | 292.15 | 307.46 | 311.963 | n/a | n/a | Overburden | Y |
| n/a | 567200 | 4810080 | 303.74 | 298.74 | 307.54 | 306.735 | n/a | n/a | Overburden | Y |
| n/a | 567000 | 4811024 | 295.54 | 290.54 | 307.54 | 306.984 | n/a | n/a | Overburden | Y |
| n/a | 567460 | 4811180 | 301.03 | 296.03 | 307.68 | 307.906 | n/a | n/a | Overburden | Y |
| 6702526 | 568622 | 4810945 | 297.69 | 292.69 | 307.79 | 311.016 | n/a | n/a | Overburden | Y |
| 6707523 | 568974 | 4813383 | 301.73 | 296.73 | 307.9 | 310.633 | n/a | n/a | Overburden | Y |
| 6705877 | 569575 | 4809782 | 304.16 | 299.16 | 307.95 | 313.144 | n/a | n/a | Overburden | Y |
| 6708315 | 568693 | 4813453 | 303.78 | 298.78 | 308.09 | 312.036 | n/a | n/a | Overburden | Y |
| 6711420 | 566825 | 4811417 | 300.5 | 295.5 | 308.32 | 307.718 | n/a | n/a | Overburden | Y |

| Well Name | Easting | Northing | Screen /Open Interval Top (masl) | Screen /Open Interval Bottom (masl) | Observed Average Water Level (2009 to 2013 and 2015) (masl)[1] | Simulated Average Water Level (masl) | Observed Drawdown (0 to 3,600 $m^3$/day) (m) | Simulated Drawdown (0 to 3,600 $m^3$/day) (m) | Interpreted Aquifer System | WWIS Target from Tier Three Assessment (Y/N) |
|---|---|---|---|---|---|---|---|---|---|---|
| 6711905 | 568960 | 4810383 | 299.89 | 294.89 | 308.38 | 312.749 | n/a | n/a | Overburden | Y |
| 6704389 | 569634 | 4809783 | 305.72 | 300.72 | 308.42 | 313.198 | n/a | n/a | Overburden | Y |
| 6710719 | 570928 | 4810921 | 298.39 | 293.39 | 308.47 | 316.639 | n/a | n/a | Overburden | Y |
| 6711008 | 571323 | 4811321 | 301.89 | 296.89 | 308.59 | 317.19 | n/a | n/a | Overburden | Y |
| 6707985 | 569054 | 4813403 | 308.06 | 303.06 | 308.63 | 311.902 | n/a | n/a | Overburden | Y |
| 6711283 | 568747 | 4812709 | 305.53 | 300.53 | 308.77 | 311.296 | n/a | n/a | Overburden | Y |
| 6702533 | 570683 | 4810240 | 297.73 | 292.73 | 308.88 | 314.7 | n/a | n/a | Overburden | Y |
| 6709927 | 571853 | 4811541 | 299.73 | 294.73 | 309.06 | 316.977 | n/a | n/a | Overburden | Y |
| 6709646 | 571359 | 4810949 | 293.65 | 288.65 | 309.15 | 316.044 | n/a | n/a | Overburden | Y |
| 6711908 | 569586 | 4809871 | 305.65 | 300.65 | 309.17 | 313.358 | n/a | n/a | Overburden | Y |
| 6702653 | 569452 | 4813059 | 311.76 | 306.76 | 309.92 | 315.002 | n/a | n/a | Overburden | Y |
| 6710440 | 571892 | 4811504 | 295.99 | 290.99 | 310.31 | 316.754 | n/a | n/a | Overburden | Y |
| 6704325 | 567154 | 4812093 | 300.66 | 295.66 | 310.4 | 309.517 | n/a | n/a | Overburden | Y |
| 6702673 | 571564 | 4811086 | 299.81 | 294.81 | 310.9 | 316.008 | n/a | n/a | Overburden | Y |
| 6712162 | 571452 | 4811385 | 304.45 | 299.45 | 310.99 | 317.181 | n/a | n/a | Overburden | Y |
| 6704046 | 570604 | 4810053 | 299.03 | 294.03 | 311.07 | 314.1 | n/a | n/a | Overburden | Y |
| 6702652 | 569231 | 4813261 | 308.9 | 303.9 | 311.2 | 313.284 | n/a | n/a | Overburden | Y |
| 6711822 | 570969 | 4810622 | 301.25 | 296.25 | 311.22 | 315.749 | n/a | n/a | Overburden | Y |
| 6711985 | 571656 | 4811554 | 303.04 | 298.04 | 311.28 | 317.398 | n/a | n/a | Overburden | Y |
| 6702519 | 568958 | 4813406 | 304.41 | 299.41 | 311.41 | 310.701 | n/a | n/a | Overburden | Y |
| 6710770 | 570979 | 4810976 | 296.64 | 291.64 | 311.57 | 316.735 | n/a | n/a | Overburden | Y |
| n/a | 571139 | 4811499 | 299.53 | 294.53 | 311.59 | 317.755 | n/a | n/a | Overburden | Y |
| 6703873 | 569044 | 4813343 | 303 | 298 | 311.68 | 311.143 | n/a | n/a | Overburden | Y |
| 6707586 | 569534 | 4813063 | 310.86 | 305.86 | 312.07 | 315.568 | n/a | n/a | Overburden | Y |
| 6702520 | 568800 | 4813486 | 304.04 | 299.04 | 312.31 | 311.891 | n/a | n/a | Overburden | Y |
| 6704957 | 569227 | 4813097 | 306.83 | 301.83 | 312.37 | 312.954 | n/a | n/a | Overburden | Y |

| Well Name | Easting | Northing | Screen /Open Interval Top (masl) | Screen /Open Interval Bottom (masl) | Observed Average Water Level (2009 to 2013 and 2015) (masl)[1] | Simulated Average Water Level (masl) | Observed Drawdown (0 to 3,600 $m^3$/day) (m) | Simulated Drawdown (0 to 3,600 $m^3$/day) (m) | Interpreted Aquifer System | WWIS Target from Tier Three Assessment (Y/N) |
|---|---|---|---|---|---|---|---|---|---|---|
| 6707091 | 570294 | 4812123 | 306.56 | 301.56 | 312.48 | 318.589 | n/a | n/a | Overburden | Y |
| 6710415 | 571754 | 4811551 | 304.06 | 299.06 | 312.53 | 317.222 | n/a | n/a | Overburden | Y |
| 6709476 | 569413 | 4811511 | 300.87 | 295.87 | 312.61 | 314.188 | n/a | n/a | Overburden | Y |
| 6711692 | 568922 | 4813430 | 308.5 | 303.5 | 312.9 | 310.92 | n/a | n/a | Overburden | Y |
| 6703850 | 571494 | 4811143 | 300.91 | 295.91 | 312.94 | 316.375 | n/a | n/a | Overburden | Y |
| 6711150 | 568904 | 4813340 | 305.74 | 300.74 | 313.1 | 310.802 | n/a | n/a | Overburden | Y |
| 6711440 | 571456 | 4811452 | 300.09 | 295.09 | 313.13 | 317.367 | n/a | n/a | Overburden | Y |
| 6712223 | 569431 | 4811760 | 306.86 | 301.86 | 313.16 | 313.787 | n/a | n/a | Overburden | Y |
| 6702663 | 571851 | 4811430 | 299.09 | 294.09 | 313.31 | 316.572 | n/a | n/a | Overburden | Y |
| 6707595 | 571674 | 4811183 | 298.85 | 293.85 | 313.38 | 316.067 | n/a | n/a | Overburden | Y |
| 6707588 | 571574 | 4811123 | 300.35 | 295.35 | 313.41 | 316.118 | n/a | n/a | Overburden | Y |
| 6702527 | 569797 | 4812195 | 309.4 | 304.4 | 313.41 | 316.891 | n/a | n/a | Overburden | Y |
| 6708057 | 571514 | 4811043 | 299.18 | 294.18 | 313.44 | 315.991 | n/a | n/a | Overburden | Y |
| 6709100 | 571545 | 4811115 | 301.77 | 296.77 | 313.55 | 316.169 | n/a | n/a | Overburden | Y |
| 6704330 | 569014 | 4813423 | 301.61 | 296.61 | 313.79 | 311.397 | n/a | n/a | Overburden | Y |
| 6702507 | 566824 | 4812988 | 302.69 | 297.69 | 313.91 | 315.861 | n/a | n/a | Overburden | Y |
| 6704401 | 569454 | 4812703 | 298.04 | 293.04 | 314.12 | 314.74 | n/a | n/a | Overburden | Y |
| 6704673 | 567673 | 4813039 | 309.65 | 304.65 | 314.26 | 313.465 | n/a | n/a | Overburden | Y |
| n/a | 568445 | 4813462 | 303.43 | 298.43 | 314.28 | 311.921 | n/a | n/a | Overburden | Y |
| 6704397 | 568954 | 4813403 | 305.89 | 300.89 | 314.7 | 310.674 | n/a | n/a | Overburden | Y |
| 6702511 | 568160 | 4814041 | 307.85 | 302.85 | 314.97 | 318.679 | n/a | n/a | Overburden | Y |
| 6702518 | 567626 | 4812895 | 305.59 | 300.59 | 315.07 | 312.785 | n/a | n/a | Overburden | Y |
| 6711149 | 571502 | 4811438 | 300.67 | 295.67 | 315.27 | 317.263 | n/a | n/a | Overburden | Y |
| 6704843 | 566121 | 4813361 | 305.07 | 300.07 | 315.94 | 324.668 | n/a | n/a | Overburden | Y |
| 6711569 | 571135 | 4811051 | 294.87 | 289.87 | 316.08 | 316.744 | n/a | n/a | Overburden | Y |
| 6702645 | 568170 | 4814121 | 309.4 | 304.4 | 316.49 | 319.37 | n/a | n/a | Overburden | Y |

| Well Name | Easting | Northing | Screen /Open Interval Top (masl) | Screen /Open Interval Bottom (masl) | Observed Average Water Level (2009 to 2013 and 2015) (masl)[1] | Simulated Average Water Level (masl) | Observed Drawdown (0 to 3,600 $m^3$/day) (m) | Simulated Drawdown (0 to 3,600 $m^3$/day) (m) | Interpreted Aquifer System | WWIS Target from Tier Three Assessment (Y/N) |
|---|---|---|---|---|---|---|---|---|---|---|
| 6703857 | 572134 | 4811763 | 311.51 | 306.51 | 316.53 | 317.077 | n/a | n/a | Overburden | Y |
| 6707509 | 569114 | 4814363 | 305.42 | 300.42 | 318.46 | 318.044 | n/a | n/a | Overburden | Y |
| 6702506 | 567307 | 4814740 | 308.77 | 303.77 | 318.8 | 328.474 | n/a | n/a | Overburden | Y |
| 6710735 | 571109 | 4814142 | 310 | 305 | 319.73 | 323.401 | n/a | n/a | Overburden | Y |
| 6707576 | 570434 | 4811983 | 305.77 | 300.77 | 319.75 | 318.631 | n/a | n/a | Overburden | Y |
| 6704395 | 572184 | 4813023 | 304.74 | 299.74 | 320.03 | 320.559 | n/a | n/a | Overburden | Y |
| 6707510 | 569094 | 4814363 | 305.37 | 300.37 | 320.38 | 317.99 | n/a | n/a | Overburden | Y |
| 6712248 | 567476 | 4814168 | 303.69 | 298.69 | 320.64 | 323.788 | n/a | n/a | Overburden | Y |
| 6702659 | 571610 | 4813418 | 308.13 | 303.13 | 320.74 | 321.477 | n/a | n/a | Overburden | Y |
| 6705092 | 570730 | 4814573 | 315.42 | 310.42 | 320.88 | 325.164 | n/a | n/a | Overburden | Y |
| 6704295 | 567674 | 4814563 | 309.24 | 304.24 | 321.48 | 325.774 | n/a | n/a | Overburden | Y |
| 6709773 | 567562 | 4814194 | 302.61 | 297.61 | 321.52 | 323.603 | n/a | n/a | Overburden | Y |
| 6703155 | 571734 | 4813473 | 308.12 | 303.12 | 322.01 | 321.759 | n/a | n/a | Overburden | Y |
| 6710734 | 571141 | 4814193 | 307.3 | 302.3 | 322.16 | 323.598 | n/a | n/a | Overburden | Y |
| 6710250 | 569383 | 4811731 | 309.27 | 304.27 | 322.21 | 313.508 | n/a | n/a | Overburden | Y |
| n/a | 569561 | 4814976 | 312.03 | 307.03 | 322.26 | 321.792 | n/a | n/a | Overburden | Y |
| 6707623 | 570862 | 4814453 | 313.17 | 308.17 | 323.1 | 324.762 | n/a | n/a | Overburden | Y |
| n/a | 570434 | 4815297 | 316.13 | 311.13 | 323.32 | 326.318 | n/a | n/a | Overburden | Y |
| 6705510 | 570975 | 4810584 | 304.74 | 299.74 | 324.19 | 315.622 | n/a | n/a | Overburden | Y |
| 6707664 | 570814 | 4814483 | 315.56 | 310.56 | 324.33 | 324.839 | n/a | n/a | Overburden | Y |
| 6712161 | 569796 | 4815360 | 310.32 | 305.32 | 324.79 | 324.726 | n/a | n/a | Overburden | Y |
| 6704580 | 571307 | 4814015 | 304.91 | 299.91 | 324.92 | 322.763 | n/a | n/a | Overburden | Y |
| n/a | 570861 | 4815176 | 322.17 | 317.17 | 325.49 | 327.497 | n/a | n/a | Overburden | Y |
| 6710980 | 567254 | 4814007 | 310.5 | 305.5 | 325.64 | 323.649 | n/a | n/a | Overburden | Y |
| 6703935 | 570154 | 4815713 | 314.56 | 309.56 | 326.03 | 325.953 | n/a | n/a | Overburden | Y |
| n/a | 570825 | 4815656 | 314.35 | 309.35 | 326.15 | 327.044 | n/a | n/a | Overburden | Y |

| Well Name | Easting | Northing | Screen /Open Interval Top (masl) | Screen /Open Interval Bottom (masl) | Observed Average Water Level (2009 to 2013 and 2015) (masl)[1] | Simulated Average Water Level (masl) | Observed Drawdown (0 to 3,600 $m^3$/day) (m) | Simulated Drawdown (0 to 3,600 $m^3$/day) (m) | Interpreted Aquifer System | WWIS Target from Tier Three Assessment (Y/N) |
|---|---|---|---|---|---|---|---|---|---|---|
| 6703934 | 570084 | 4815693 | 313.98 | 308.98 | 326.71 | 325.865 | n/a | n/a | Overburden | Y |
| 6710357 | 570099 | 4815643 | 311.84 | 306.84 | 326.76 | 325.911 | n/a | n/a | Overburden | Y |
| 6704466 | 566674 | 4814703 | 309.53 | 304.53 | 327.54 | 329.498 | n/a | n/a | Overburden | Y |
| 6703848 | 566424 | 4814763 | 328.71 | 323.71 | 329.01 | 329.839 | n/a | n/a | Overburden | Y |
| 6704043 | 569894 | 4813453 | 316.43 | 311.43 | 329.14 | 317.063 | n/a | n/a | Overburden | Y |
| 6704767 | 570492 | 4815885 | 317.86 | 312.86 | 329.32 | 326.771 | n/a | n/a | Overburden | Y |
| 6703150 | 566514 | 4814783 | 327.58 | 322.58 | 330.06 | 329.896 | n/a | n/a | Overburden | Y |
| 6705005 | 566708 | 4814830 | 326.97 | 321.97 | 330.37 | 330.19 | n/a | n/a | Overburden | Y |
| 6707984 | 567254 | 4815183 | 329.4 | 324.4 | 330.44 | 330.483 | n/a | n/a | Overburden | Y |
| 6702505 | 567352 | 4814883 | 323.68 | 318.68 | 331.61 | 329.317 | n/a | n/a | Overburden | Y |
| 6709138 | 568199 | 4815620 | 323.22 | 318.22 | 334.06 | 330.867 | n/a | n/a | Overburden | Y |
| 6702544 | 570559 | 4809818 | 294.56 | 289.56 | 300.06 | 313.293 | n/a | n/a | Bedrock | Y |
| 6711317 | 568454 | 4809354 | 297.09 | 292.09 | 302.15 | 310.739 | n/a | n/a | Bedrock | Y |
| 6702510 | 567261 | 4812616 | 296.88 | 291.88 | 304.04 | 311.768 | n/a | n/a | Bedrock | Y |
| 6702543 | 571138 | 4810754 | 293.71 | 288.71 | 304.4 | 315.877 | n/a | n/a | Bedrock | Y |
| 6705330 | 568095 | 4809837 | 288.6 | 283.6 | 304.98 | 310.19 | n/a | n/a | Bedrock | Y |
| 6703855 | 570534 | 4809973 | 292.06 | 287.06 | 305.18 | 313.857 | n/a | n/a | Bedrock | Y |
| 6704041 | 567724 | 4811683 | 294.98 | 289.98 | 305.22 | 308.557 | n/a | n/a | Bedrock | Y |
| 6708317 | 568700 | 4813342 | 301.83 | 296.83 | 306.51 | 311.769 | n/a | n/a | Bedrock | Y |
| n/a | 567098 | 4810050 | 295.26 | 290.26 | 307.21 | 306.549 | n/a | n/a | Bedrock | Y |
| 6703151 | 569034 | 4813523 | 300.95 | 295.95 | 307.32 | 312.937 | n/a | n/a | Bedrock | Y |
| 6702512 | 568527 | 4813668 | 303.39 | 298.39 | 307.8 | 312.521 | n/a | n/a | Bedrock | Y |
| 6705008 | 567593 | 4812085 | 294.47 | 289.47 | 307.86 | 309.488 | n/a | n/a | Bedrock | Y |
| 6708493 | 568928 | 4813684 | 303.8 | 298.8 | 308.45 | 313.048 | n/a | n/a | Bedrock | Y |
| 6709413 | 570395 | 4813932 | 292.33 | 287.33 | 308.49 | 321.219 | n/a | n/a | Bedrock | Y |
| 6702662 | 571493 | 4811063 | 298.35 | 293.35 | 308.59 | 316.108 | n/a | n/a | Bedrock | Y |

| Well Name | Easting | Northing | Screen /Open Interval Top (masl) | Screen /Open Interval Bottom (masl) | Observed Average Water Level (2009 to 2013 and 2015) (masl)[1] | Simulated Average Water Level (masl) | Observed Drawdown (0 to 3,600 $m^3$/day) (m) | Simulated Drawdown (0 to 3,600 $m^3$/day) (m) | Interpreted Aquifer System | WWIS Target from Tier Three Assessment (Y/N) |
|---|---|---|---|---|---|---|---|---|---|---|
| 6702354 | 567032 | 4812124 | 300.83 | 295.83 | 308.88 | 309.693 | n/a | n/a | Bedrock | Y |
| 6707579 | 568834 | 4813483 | 303.61 | 298.61 | 308.93 | 311.592 | n/a | n/a | Bedrock | Y |
| 6705773 | 569305 | 4811654 | 300.86 | 295.86 | 309.17 | 313.219 | n/a | n/a | Bedrock | Y |
| 6702521 | 568986 | 4813391 | 300.31 | 295.31 | 310.07 | 310.725 | n/a | n/a | Bedrock | Y |
| 6703496 | 569944 | 4812433 | 304.5 | 299.5 | 310.07 | 317.793 | n/a | n/a | Bedrock | Y |
| 6711545 | 570823 | 4810768 | 299.78 | 294.78 | 310.3 | 316.309 | n/a | n/a | Bedrock | Y |
| 6707386 | 571314 | 4811043 | 292.6 | 287.6 | 310.31 | 316.421 | n/a | n/a | Bedrock | Y |
| 6702523 | 569267 | 4813098 | 304.69 | 299.69 | 310.51 | 313.418 | n/a | n/a | Bedrock | Y |
| 6711281 | 568817 | 4812602 | 301.35 | 296.35 | 310.57 | 311.821 | n/a | n/a | Bedrock | Y |
| 6711762 | 568867 | 4812703 | 301.82 | 296.82 | 310.73 | 311.584 | n/a | n/a | Bedrock | Y |
| 6707381 | 568934 | 4813483 | 301.94 | 296.94 | 310.82 | 311.378 | n/a | n/a | Bedrock | Y |
| 6711879 | 571584 | 4811029 | 296.12 | 291.12 | 310.83 | 315.73 | n/a | n/a | Bedrock | Y |
| 6711101 | 571372 | 4811391 | 300.14 | 295.14 | 310.85 | 317.308 | n/a | n/a | Bedrock | Y |
| 6703314 | 566754 | 4812643 | 310.73 | 305.73 | 310.87 | 311.432 | n/a | n/a | Bedrock | Y |
| 6702522 | 568903 | 4813438 | 302.59 | 297.59 | 310.97 | 310.98 | n/a | n/a | Bedrock | Y |
| 6706916 | 568814 | 4810343 | 292.7 | 287.7 | 311.05 | 311.964 | n/a | n/a | Bedrock | Y |
| 6702508 | 567189 | 4812498 | 303.56 | 298.56 | 311.23 | 311.229 | n/a | n/a | Bedrock | Y |
| 6712002 | 570371 | 4812065 | 304.7 | 299.7 | 311.25 | 318.649 | n/a | n/a | Bedrock | Y |
| 6702658 | 570439 | 4811943 | 301.21 | 296.21 | 311.6 | 318.565 | n/a | n/a | Bedrock | Y |
| 6707587 | 569474 | 4812983 | 304.83 | 299.83 | 311.68 | 315.024 | n/a | n/a | Bedrock | Y |
| 6712021 | 571020 | 4810584 | 299.44 | 294.44 | 311.77 | 315.537 | n/a | n/a | Bedrock | Y |
| 6712203 | 571008 | 4810662 | 293.08 | 288.08 | 311.81 | 315.815 | n/a | n/a | Bedrock | Y |
| 6708922 | 571571 | 4811075 | 296.96 | 291.96 | 311.88 | 315.944 | n/a | n/a | Bedrock | Y |
| 6702509 | 568391 | 4813760 | 304.27 | 299.27 | 311.92 | 314.226 | n/a | n/a | Bedrock | Y |
| 6702647 | 568915 | 4813584 | 304.01 | 299.01 | 312.13 | 311.982 | n/a | n/a | Bedrock | Y |
| 6708590 | 569104 | 4813309 | 300.78 | 295.78 | 312.25 | 311.892 | n/a | n/a | Bedrock | Y |

| Well Name | Easting | Northing | Screen /Open Interval Top (masl) | Screen /Open Interval Bottom (masl) | Observed Average Water Level (2009 to 2013 and 2015) (masl)[1] | Simulated Average Water Level (masl) | Observed Drawdown (0 to 3,600 $m^3$/day) (m) | Simulated Drawdown (0 to 3,600 $m^3$/day) (m) | Interpreted Aquifer System | WWIS Target from Tier Three Assessment (Y/N) |
|---|---|---|---|---|---|---|---|---|---|---|
| 6707590 | 568914 | 4813503 | 301.77 | 296.77 | 312.34 | 311.464 | n/a | n/a | Bedrock | Y |
| 6706258 | 568794 | 4813503 | 302.26 | 297.26 | 312.37 | 311.961 | n/a | n/a | Bedrock | Y |
| 6712204 | 571027 | 4810632 | 294.79 | 289.79 | 312.51 | 315.685 | n/a | n/a | Bedrock | Y |
| 6702665 | 571498 | 4811003 | 294.93 | 289.93 | 312.72 | 315.882 | n/a | n/a | Bedrock | Y |
| 6711006 | 571509 | 4811487 | 299.36 | 294.36 | 313.47 | 317.4 | n/a | n/a | Bedrock | Y |
| 6702529 | 569838 | 4812082 | 305.32 | 300.32 | 313.76 | 316.997 | n/a | n/a | Bedrock | Y |
| 6707591 | 568854 | 4813543 | 302.67 | 297.67 | 313.95 | 311.759 | n/a | n/a | Bedrock | Y |
| 6703313 | 571494 | 4810923 | 292.31 | 287.31 | 314.03 | 315.598 | n/a | n/a | Bedrock | Y |
| 6704790 | 569069 | 4813439 | 300.12 | 295.12 | 314.31 | 312.506 | n/a | n/a | Bedrock | Y |
| 6706778 | 571494 | 4810983 | 294.56 | 289.56 | 315.3 | 315.818 | n/a | n/a | Bedrock | Y |
| 6707593 | 568349 | 4813759 | 303.88 | 298.88 | 315.37 | 314.625 | n/a | n/a | Bedrock | Y |
| 6712276 | 567448 | 4814044 | 300.66 | 295.66 | 315.68 | 323.005 | n/a | n/a | Bedrock | Y |
| 6704519 | 569344 | 4813343 | 304.41 | 299.41 | 316.06 | 315.021 | n/a | n/a | Bedrock | Y |
| 6711416 | 567367 | 4813986 | 303.92 | 298.92 | 316.08 | 322.948 | n/a | n/a | Bedrock | Y |
| 6709634 | 568293 | 4814156 | 305.63 | 300.63 | 316.84 | 318.687 | n/a | n/a | Bedrock | Y |
| 6709001 | 568279 | 4814202 | 306.39 | 301.39 | 317.12 | 319.327 | n/a | n/a | Bedrock | Y |
| 6710981 | 567314 | 4813921 | 305.26 | 300.26 | 318.71 | 322.663 | n/a | n/a | Bedrock | Y |
| 6710777 | 567237 | 4813973 | 310.1 | 305.1 | 318.76 | 323.442 | n/a | n/a | Bedrock | Y |
| 6707678 | 571014 | 4812283 | 304.34 | 299.34 | 318.78 | 319.174 | n/a | n/a | Bedrock | Y |
| 6704032 | 569764 | 4813408 | 310.79 | 305.79 | 318.86 | 316.841 | n/a | n/a | Bedrock | Y |
| 6704534 | 570134 | 4813733 | 302.63 | 297.63 | 318.97 | 319.071 | n/a | n/a | Bedrock | Y |
| 6710919 | 567405 | 4814099 | 303.08 | 298.08 | 319.19 | 323.621 | n/a | n/a | Bedrock | Y |
| 6710737 | 567243 | 4813972 | 310.22 | 305.22 | 319.27 | 323.408 | n/a | n/a | Bedrock | Y |
| 6707517 | 571494 | 4813643 | 304.53 | 299.53 | 319.68 | 321.544 | n/a | n/a | Bedrock | Y |
| 6709238 | 571285 | 4814060 | 301.92 | 296.92 | 319.86 | 322.964 | n/a | n/a | Bedrock | Y |
| 6710282 | 571966 | 4811761 | 301.74 | 296.74 | 320.58 | 317.476 | n/a | n/a | Bedrock | Y |

| Well Name | Easting | Northing | Screen /Open Interval Top (masl) | Screen /Open Interval Bottom (masl) | Observed Average Water Level (2009 to 2013 and 2015) (masl)[1] | Simulated Average Water Level (masl) | Observed Drawdown (0 to 3,600 $m^3$/day) (m) | Simulated Drawdown (0 to 3,600 $m^3$/day) (m) | Interpreted Aquifer System | WWIS Target from Tier Three Assessment (Y/N) |
|---|---|---|---|---|---|---|---|---|---|---|
| 6710281 | 571947 | 4811801 | 302.07 | 297.07 | 320.84 | 317.64 | n/a | n/a | Bedrock | Y |
| 6704691 | 569747 | 4813387 | 310.26 | 305.26 | 321.06 | 316.813 | n/a | n/a | Bedrock | Y |
| 6710353 | 571902 | 4811493 | 294.65 | 289.65 | 322.95 | 316.689 | n/a | n/a | Bedrock | Y |
| 6711129 | 571567 | 4811505 | 300.69 | 295.69 | 324.75 | 317.38 | n/a | n/a | Bedrock | Y |
| 6702753 | 569954 | 4815470 | 310.18 | 305.18 | 324.89 | 325.606 | n/a | n/a | Bedrock | Y |
| 6709879 | 569832 | 4815502 | 309.17 | 304.17 | 324.89 | 325.118 | n/a | n/a | Bedrock | Y |
| 6703163 | 569674 | 4815763 | 311.3 | 306.3 | 325.15 | 325.207 | n/a | n/a | Bedrock | Y |
| 6703250 | 570354 | 4815843 | 313.58 | 308.58 | 328.31 | 326.471 | n/a | n/a | Bedrock | Y |
| 6705404 | 566840 | 4814992 | 308.18 | 303.18 | 329.91 | 330.589 | n/a | n/a | Bedrock | Y |
| 6702504 | 567204 | 4815026 | 310.52 | 305.52 | 329.93 | 330.209 | n/a | n/a | Bedrock | Y |
| 6702755 | 571022 | 4814599 | 317.36 | 312.36 | 330.81 | 325.663 | n/a | n/a | Bedrock | Y |
| 6711016 | 566645 | 4815009 | 307.7 | 302.7 | 335.04 | 330.682 | n/a | n/a | Bedrock | Y |
| 6707457 | 567794 | 4809923 | 283.48 | 278.48 | 304.11 | 309.588 | n/a | n/a | Bedrock | Y |
| 6702325 | 567471 | 4810184 | 291.26 | 286.26 | 304.67 | 308.296 | n/a | n/a | Bedrock | Y |
| 6711087 | 571421 | 4811476 | 297.33 | 292.33 | 305.63 | 317.449 | n/a | n/a | Bedrock | Y |
| 6702287 | 567141 | 4809885 | 292.88 | 287.88 | 306.55 | 307.578 | n/a | n/a | Bedrock | Y |
| 6703552 | 567794 | 4811613 | 292.76 | 287.76 | 306.65 | 308.956 | n/a | n/a | Bedrock | Y |
| 6707762 | 568554 | 4810923 | 291.7 | 286.7 | 306.83 | 310.623 | n/a | n/a | Bedrock | Y |
| 6708266 | 568878 | 4813528 | 299.88 | 294.88 | 307.58 | 311.52 | n/a | n/a | Bedrock | Y |
| 6710473 | 571674 | 4811271 | 295.59 | 290.59 | 308.72 | 316.374 | n/a | n/a | Bedrock | Y |
| 6711745 | 566845 | 4811436 | 295.44 | 290.44 | 308.75 | 307.726 | n/a | n/a | Bedrock | Y |
| 6711288 | 569424 | 4811792 | 298.7 | 293.7 | 308.99 | 313.669 | n/a | n/a | Bedrock | Y |
| 6705091 | 565540 | 4811635 | 293.07 | 288.07 | 309.19 | 316.522 | n/a | n/a | Bedrock | Y |
| 6708578 | 568587 | 4813470 | 301.04 | 296.04 | 309.19 | 311.976 | n/a | n/a | Bedrock | Y |
| 6710441 | 572024 | 4811656 | 296.94 | 291.94 | 309.59 | 316.975 | n/a | n/a | Bedrock | Y |
| 6702516 | 568291 | 4813582 | 301.32 | 296.32 | 310.18 | 313.969 | n/a | n/a | Bedrock | Y |

| Well Name | Easting | Northing | Screen /Open Interval Top (masl) | Screen /Open Interval Bottom (masl) | Observed Average Water Level (2009 to 2013 and 2015) (masl)[1] | Simulated Average Water Level (masl) | Observed Drawdown (0 to 3,600 m$^3$/day) (m) | Simulated Drawdown (0 to 3,600 m$^3$/day) (m) | Interpreted Aquifer System | WWIS Target from Tier Three Assessment (Y/N) |
|---|---|---|---|---|---|---|---|---|---|---|
| 6711378 | 569488 | 4811604 | 301.87 | 296.87 | 310.73 | 314.419 | n/a | n/a | Bedrock | Y |
| 6711936 | 568461 | 4812560 | 299.03 | 294.03 | 310.82 | 310.453 | n/a | n/a | Bedrock | Y |
| 6706256 | 571574 | 4811093 | 295.54 | 290.54 | 311.57 | 315.985 | n/a | n/a | Bedrock | Y |
| 6707592 | 568894 | 4813443 | 300.57 | 295.57 | 311.9 | 310.966 | n/a | n/a | Bedrock | Y |
| 6705876 | 565508 | 4812167 | 295.59 | 290.59 | 312.08 | 319.658 | n/a | n/a | Bedrock | Y |
| 6702528 | 569943 | 4812220 | 299.51 | 294.51 | 312.23 | 317.65 | n/a | n/a | Bedrock | Y |
| 6707589 | 568174 | 4813523 | 300.57 | 295.57 | 312.68 | 314.517 | n/a | n/a | Bedrock | Y |
| 6710048 | 570834 | 4812414 | 306.26 | 301.26 | 313.08 | 319.491 | n/a | n/a | Bedrock | Y |
| 6702671 | 571516 | 4811026 | 293.54 | 288.54 | 313.99 | 315.893 | n/a | n/a | Bedrock | Y |
| 6703544 | 571684 | 4811203 | 292.19 | 287.19 | 314.11 | 316.086 | n/a | n/a | Bedrock | Y |
| 6711543 | 567193 | 4813996 | 303.22 | 298.22 | 316.3 | 323.751 | n/a | n/a | Bedrock | Y |
| 6712390 | 567251 | 4813926 | 308.17 | 303.17 | 317.61 | 322.948 | n/a | n/a | Bedrock | Y |
| 6702530 | 570404 | 4811875 | 298.5 | 293.5 | 317.88 | 318.408 | n/a | n/a | Bedrock | Y |
| 6707241 | 569494 | 4812183 | 301.87 | 296.87 | 318.48 | 314.565 | n/a | n/a | Bedrock | Y |
| 6711000 | 567250 | 4813891 | 306.11 | 301.11 | 319.1 | 322.674 | n/a | n/a | Bedrock | Y |
| 6711206 | 567274 | 4813957 | 306.89 | 301.89 | 319.26 | 323.094 | n/a | n/a | Bedrock | Y |
| 6704637 | 572281 | 4813000 | 302.27 | 297.27 | 320.23 | 320.236 | n/a | n/a | Bedrock | Y |
| 6710452 | 567234 | 4814135 | 300.89 | 295.89 | 321.14 | 324.548 | n/a | n/a | Bedrock | Y |
| 6707585 | 569874 | 4812423 | 301.6 | 296.6 | 321.73 | 317.455 | n/a | n/a | Bedrock | Y |
| 6710453 | 567223 | 4814193 | 298.63 | 293.63 | 321.78 | 324.959 | n/a | n/a | Bedrock | Y |
| 6703384 | 566564 | 4814803 | 307.27 | 302.27 | 323.99 | 329.95 | n/a | n/a | Bedrock | Y |
| 6702502 | 567236 | 4815011 | 303.1 | 298.1 | 324.05 | 330.101 | n/a | n/a | Bedrock | Y |
| 6712462 | 569753 | 4813403 | 302.96 | 297.96 | 324.13 | 316.807 | n/a | n/a | Bedrock | Y |
| 6702500 | 567136 | 4814963 | 304.24 | 299.24 | 324.15 | 330.056 | n/a | n/a | Bedrock | Y |
| n/a | 570861 | 4815146 | 320.99 | 315.99 | 325.11 | 327.427 | n/a | n/a | Bedrock | Y |
| 6703809 | 567204 | 4814973 | 301.14 | 296.14 | 325.77 | 330.031 | n/a | n/a | Bedrock | Y |

| Well Name | Easting | Northing | Screen /Open Interval Top (masl) | Screen /Open Interval Bottom (masl) | Observed Average Water Level (2009 to 2013 and 2015) (masl)[1] | Simulated Average Water Level (masl) | Observed Drawdown (0 to 3,600 $m^3$/day) (m) | Simulated Drawdown (0 to 3,600 $m^3$/day) (m) | Interpreted Aquifer System | WWIS Target from Tier Three Assessment (Y/N) |
|---|---|---|---|---|---|---|---|---|---|---|
| 6710998 | 567210 | 4814155 | 304.81 | 299.81 | 325.94 | 324.771 | n/a | n/a | Bedrock | Y |
| 6702651 | 570745 | 4814449 | 305.97 | 300.97 | 326.01 | 324.552 | n/a | n/a | Bedrock | Y |
| 6710122 | 567268 | 4814965 | 303.1 | 298.1 | 326.28 | 329.942 | n/a | n/a | Bedrock | Y |
| 6704690 | 570503 | 4814793 | 307.74 | 302.74 | 326.57 | 325.636 | n/a | n/a | Bedrock | Y |
| 6702501 | 566936 | 4815030 | 303.33 | 298.33 | 328.02 | 330.542 | n/a | n/a | Bedrock | Y |
| 6710455 | 566870 | 4814987 | 306.19 | 301.19 | 330.26 | 330.514 | n/a | n/a | Bedrock | Y |
| 6707910 | 567314 | 4815423 | 306.38 | 301.38 | 332.38 | 331.041 | n/a | n/a | Bedrock | Y |
| n/a | 569002 | 4812639 | 294.91 | 289.91 | 303.35 | 310.506 | n/a | n/a | Bedrock | Y |
| 6706771 | 567214 | 4812523 | 293.97 | 288.97 | 303.88 | 311.438 | n/a | n/a | Bedrock | Y |
| 6711570 | 570942 | 4810908 | 292.49 | 287.49 | 304.95 | 316.392 | n/a | n/a | Bedrock | Y |
| 6711125 | 570908 | 4810689 | 291.97 | 286.97 | 307.83 | 315.569 | n/a | n/a | Bedrock | Y |
| 6707223 | 569454 | 4811823 | 297.45 | 292.45 | 308.49 | 313.842 | n/a | n/a | Bedrock | Y |
| 6707637 | 568114 | 4814103 | 298.31 | 293.31 | 308.74 | 319.608 | n/a | n/a | Bedrock | Y |
| 6711821 | 570314 | 4812071 | 298.68 | 293.68 | 308.74 | 318.381 | n/a | n/a | Bedrock | Y |
| 6709781 | 570746 | 4810738 | 294.91 | 289.91 | 308.98 | 315.852 | n/a | n/a | Bedrock | Y |
| 6711417 | 570888 | 4810595 | 293.36 | 288.36 | 309.52 | 315.166 | n/a | n/a | Bedrock | Y |
| 6704402 | 571294 | 4810923 | 290.25 | 285.25 | 309.61 | 316.057 | n/a | n/a | Bedrock | Y |
| 6710853 | 567288 | 4814280 | 293.07 | 288.07 | 309.76 | 325.111 | n/a | n/a | Bedrock | Y |
| 6707271 | 569314 | 4811663 | 295.75 | 290.75 | 309.97 | 313.21 | n/a | n/a | Bedrock | Y |
| 6702531 | 570429 | 4811843 | 294.55 | 289.55 | 310.81 | 318.133 | n/a | n/a | Bedrock | Y |
| 6712401 | 571536 | 4811528 | 295.22 | 290.22 | 310.81 | 317.146 | n/a | n/a | Bedrock | Y |
| 6707339 | 569354 | 4813163 | 297.62 | 292.62 | 311.41 | 314.295 | n/a | n/a | Bedrock | Y |
| 6712063 | 570925 | 4810655 | 292.55 | 287.55 | 311.82 | 315.384 | n/a | n/a | Bedrock | Y |
| 6705880 | 568383 | 4813747 | 296.55 | 291.55 | 312.7 | 314.255 | n/a | n/a | Bedrock | Y |
| 6708205 | 567931 | 4813572 | 294.81 | 289.81 | 312.86 | 316.391 | n/a | n/a | Bedrock | Y |
| 6710084 | 571422 | 4811357 | 291.48 | 286.48 | 313 | 316.847 | n/a | n/a | Bedrock | Y |

| Well Name | Easting | Northing | Screen /Open Interval Top (masl) | Screen /Open Interval Bottom (masl) | Observed Average Water Level (2009 to 2013 and 2015) (masl)[1] | Simulated Average Water Level (masl) | Observed Drawdown (0 to 3,600 $m^3$/day) (m) | Simulated Drawdown (0 to 3,600 $m^3$/day) (m) | Interpreted Aquifer System | WWIS Target from Tier Three Assessment (Y/N) |
|---|---|---|---|---|---|---|---|---|---|---|
| 6709102 | 570456 | 4811904 | 296.4 | 291.4 | 313.05 | 318.241 | n/a | n/a | Bedrock | Y |
| 6712259 | 571724 | 4811484 | 295.27 | 290.27 | 313.19 | 316.643 | n/a | n/a | Bedrock | Y |
| 6708700 | 570797 | 4812633 | 297.24 | 292.24 | 314.06 | 319.498 | n/a | n/a | Bedrock | Y |
| 6708415 | 571811 | 4811592 | 295.5 | 290.5 | 314.36 | 316.852 | n/a | n/a | Bedrock | Y |
| 6710918 | 567033 | 4813999 | 298.64 | 293.64 | 315.59 | 324.092 | n/a | n/a | Bedrock | Y |
| 6706624 | 570174 | 4815083 | 301.67 | 296.67 | 316.72 | 325.531 | n/a | n/a | Bedrock | Y |
| 6709101 | 570866 | 4812341 | 299.41 | 294.41 | 317.48 | 319.029 | n/a | n/a | Bedrock | Y |
| 6704850 | 571665 | 4813240 | 300.41 | 295.41 | 319.09 | 321.107 | n/a | n/a | Bedrock | Y |
| 6711802 | 567180 | 4814103 | 294.29 | 289.29 | 319.19 | 324.263 | n/a | n/a | Bedrock | Y |
| 6706667 | 571914 | 4812923 | 298.44 | 293.44 | 319.51 | 320.527 | n/a | n/a | Bedrock | Y |
| 6710454 | 567406 | 4814209 | 293.28 | 288.28 | 320.64 | 324.244 | n/a | n/a | Bedrock | Y |
| 6711298 | 567211 | 4814129 | 294.26 | 289.26 | 322.07 | 324.335 | n/a | n/a | Bedrock | Y |
| 6704962 | 571036 | 4814394 | 304.84 | 299.84 | 323.69 | 324.408 | n/a | n/a | Bedrock | Y |
| 6711077 | 570035 | 4815041 | 301.69 | 296.69 | 324.31 | 324.911 | n/a | n/a | Bedrock | Y |
| 6704018 | 570244 | 4815753 | 304.13 | 299.13 | 325.19 | 326.129 | n/a | n/a | Bedrock | Y |
| 6705873 | 570262 | 4815039 | 302.31 | 297.31 | 325.6 | 325.617 | n/a | n/a | Bedrock | Y |
| 6703154 | 570724 | 4814433 | 300.43 | 295.43 | 326.81 | 324.339 | n/a | n/a | Bedrock | Y |
| 6703431 | 568974 | 4816163 | 300.68 | 295.68 | 331.44 | 330.584 | n/a | n/a | Bedrock | Y |
| 6711488 | 568133 | 4815081 | 303.61 | 298.61 | 331.52 | 327.381 | n/a | n/a | Bedrock | Y |
| 6704794 | 567419 | 4810108 | 284.8 | 279.8 | 308.88 | 308.345 | n/a | n/a | Bedrock | Y |
| 6707389 | 568954 | 4813463 | 295.41 | 290.41 | 310.96 | 310.05 | n/a | n/a | Bedrock | Y |
| 6708407 | 568633 | 4813324 | 293.64 | 288.64 | 311.42 | 312.043 | n/a | n/a | Bedrock | Y |
| 6711675 | 570661 | 4814445 | 298.47 | 293.47 | 312.43 | 323.769 | n/a | n/a | Bedrock | Y |
| 6710485 | 571694 | 4811530 | 290.17 | 285.17 | 313.64 | 315.172 | n/a | n/a | Bedrock | Y |
| 6702517 | 568366 | 4813668 | 293.74 | 288.74 | 314.06 | 314.232 | n/a | n/a | Bedrock | Y |
| 6708577 | 568759 | 4813444 | 295.09 | 290.09 | 314.64 | 311.824 | n/a | n/a | Bedrock | Y |

| Well Name | Easting | Northing | Screen /Open Interval Top (masl) | Screen /Open Interval Bottom (masl) | Observed Average Water Level (2009 to 2013 and 2015) (masl)[1] | Simulated Average Water Level (masl) | Observed Drawdown (0 to 3,600 $m^3$/day) (m) | Simulated Drawdown (0 to 3,600 $m^3$/day) (m) | Interpreted Aquifer System | WWIS Target from Tier Three Assessment (Y/N) |
|---|---|---|---|---|---|---|---|---|---|---|
| 6706980 | 569494 | 4814523 | 296.84 | 291.84 | 321.24 | 318.654 | n/a | n/a | Bedrock | Y |
| 6706156 | 565814 | 4813543 | 290.58 | 285.58 | 324.8 | 322.928 | n/a | n/a | Bedrock | Y |
| 6712077 | 568457 | 4815067 | 293.44 | 288.44 | 325.87 | 325.653 | n/a | n/a | Bedrock | Y |
| 6702650 | 569098 | 4813614 | 292.92 | 287.92 | 305.16 | 314.246 | n/a | n/a | Bedrock | Y |
| 6711394 | 567617 | 4812179 | 289.89 | 284.89 | 307.55 | 311.428 | n/a | n/a | Bedrock | Y |
| 6707577 | 569554 | 4811603 | 289.24 | 284.24 | 307.76 | 314.047 | n/a | n/a | Bedrock | Y |
| 6702327 | 567655 | 4811176 | 286.85 | 281.85 | 309.05 | 310.206 | n/a | n/a | Bedrock | Y |
| 6710177 | 571453 | 4811389 | 290.6 | 285.6 | 310.38 | 313.475 | n/a | n/a | Bedrock | Y |
| 6712209 | 570062 | 4812193 | 292.66 | 287.66 | 311.42 | 317.176 | n/a | n/a | Bedrock | Y |
| 6709785 | 571760 | 4811588 | 291.46 | 286.46 | 311.52 | 313.562 | n/a | n/a | Bedrock | Y |
| 6707584 | 571034 | 4812283 | 290.83 | 285.83 | 313.37 | 317.142 | n/a | n/a | Bedrock | Y |
| 6702515 | 568765 | 4813521 | 292.32 | 287.32 | 315.09 | 311.821 | n/a | n/a | Bedrock | Y |
| 6709499 | 571027 | 4812595 | 292.97 | 287.97 | 319.09 | 317.732 | n/a | n/a | Bedrock | Y |
| 6707298 | 570714 | 4812063 | 291.05 | 286.05 | 319.63 | 316.544 | n/a | n/a | Bedrock | Y |
| 6702660 | 571915 | 4813224 | 295.22 | 290.22 | 320.8 | 318.574 | n/a | n/a | Bedrock | Y |
| 6711280 | 570156 | 4815082 | 297.06 | 292.06 | 326.26 | 324.89 | n/a | n/a | Bedrock | Y |
| 6710562 | 568664 | 4809522 | 277.32 | 272.32 | 293.66 | 307.788 | n/a | n/a | Bedrock | Y |
| 6706619 | 567434 | 4811683 | 283.01 | 278.01 | 305.73 | 311.808 | n/a | n/a | Bedrock | Y |
| 6708234 | 568219 | 4813623 | 291.32 | 286.32 | 305.89 | 315.584 | n/a | n/a | Bedrock | Y |
| 6703309 | 568134 | 4809933 | 280.73 | 275.73 | 306.18 | 308.972 | n/a | n/a | Bedrock | Y |
| 6703158 | 567214 | 4810823 | 279.3 | 274.3 | 306.92 | 310.434 | n/a | n/a | Bedrock | Y |
| 6704719 | 568191 | 4809783 | 280.4 | 275.4 | 307.29 | 308.768 | n/a | n/a | Bedrock | Y |
| 6708472 | 568760 | 4813465 | 291.23 | 286.23 | 308.83 | 312.101 | n/a | n/a | Bedrock | Y |
| 6711486 | 571727 | 4811433 | 287.39 | 282.39 | 309.01 | 311.3 | n/a | n/a | Bedrock | Y |
| 6711282 | 568661 | 4812623 | 285.74 | 280.74 | 309.22 | 311.38 | n/a | n/a | Bedrock | Y |
| 6710111 | 571674 | 4811436 | 287.01 | 282.01 | 309.4 | 311.453 | n/a | n/a | Bedrock | Y |

| Well Name | Easting | Northing | Screen /Open Interval Top (masl) | Screen /Open Interval Bottom (masl) | Observed Average Water Level (2009 to 2013 and 2015) (masl)[1] | Simulated Average Water Level (masl) | Observed Drawdown (0 to 3,600 $m^3$/day) (m) | Simulated Drawdown (0 to 3,600 $m^3$/day) (m) | Interpreted Aquifer System | WWIS Target from Tier Three Assessment (Y/N) |
|---|---|---|---|---|---|---|---|---|---|---|
| 6705029 | 567317 | 4812307 | 283.28 | 278.28 | 310.11 | 313.371 | n/a | n/a | Bedrock | Y |
| 6708075 | 569214 | 4813223 | 290.29 | 285.29 | 310.12 | 310.757 | n/a | n/a | Bedrock | Y |
| 6712352 | 567484 | 4814090 | 289.79 | 284.79 | 313.07 | 320.797 | n/a | n/a | Bedrock | Y |
| 6712370 | 571787 | 4811620 | 292.86 | 287.86 | 313.9 | 311.942 | n/a | n/a | Bedrock | Y |
| 6705438 | 569171 | 4814467 | 292.27 | 287.27 | 314.15 | 320.335 | n/a | n/a | Bedrock | Y |
| 6710409 | 567084 | 4813795 | 287.24 | 282.24 | 314.25 | 319.408 | n/a | n/a | Bedrock | Y |
| 6710484 | 567278 | 4814252 | 287.96 | 282.96 | 314.48 | 321.132 | n/a | n/a | Bedrock | Y |
| 6711969 | 567145 | 4814090 | 286.67 | 281.67 | 316.09 | 320.487 | n/a | n/a | Bedrock | Y |
| 6711289 | 568085 | 4815040 | 292.19 | 287.19 | 320.67 | 324.026 | n/a | n/a | Bedrock | Y |
| 6712112 | 567399 | 4814151 | 287.23 | 282.23 | 321.74 | 320.922 | n/a | n/a | Bedrock | Y |
| 6703965 | 569414 | 4815543 | 293.13 | 288.13 | 323.65 | 325.396 | n/a | n/a | Bedrock | Y |
| 6711574 | 568308 | 4815049 | 287.6 | 282.6 | 325.97 | 324.256 | n/a | n/a | Bedrock | Y |
| 6711126 | 568443 | 4815015 | 287.68 | 282.68 | 328 | 324.331 | n/a | n/a | Bedrock | Y |
| 6711204 | 568392 | 4815115 | 287.4 | 282.4 | 328.25 | 324.428 | n/a | n/a | Bedrock | Y |
| 6711472 | 568504 | 4815648 | 290.7 | 285.7 | 329.01 | 325.277 | n/a | n/a | Bedrock | Y |
| 6711284 | 568429 | 4815087 | 287.49 | 282.49 | 329.91 | 324.418 | n/a | n/a | Bedrock | Y |
| 6703535 | 567884 | 4810143 | 266.42 | 261.42 | 300.02 | 309.094 | n/a | n/a | Bedrock | Y |
| 6705488 | 567634 | 4811560 | 280.22 | 275.22 | 300.46 | 311.515 | n/a | n/a | Bedrock | Y |
| 6711299 | 567755 | 4814391 | 276.5 | 271.5 | 300.91 | 322.136 | n/a | n/a | Bedrock | Y |
| 6705566 | 570354 | 4812050 | 289.48 | 284.48 | 303.53 | 315.065 | n/a | n/a | Bedrock | Y |
| 6707935 | 568334 | 4812943 | 282.24 | 277.24 | 304.85 | 312.831 | n/a | n/a | Bedrock | Y |
| 6708076 | 568354 | 4812983 | 280.72 | 275.72 | 305.08 | 312.885 | n/a | n/a | Bedrock | Y |
| 6711724 | 569957 | 4811308 | 278.16 | 273.16 | 305.13 | 311.239 | n/a | n/a | Bedrock | Y |
| 6709481 | 567941 | 4814561 | 279.05 | 274.05 | 305.5 | 322.9 | n/a | n/a | Bedrock | Y |
| 6708740 | 569075 | 4813762 | 281.21 | 276.21 | 306.76 | 315.415 | n/a | n/a | Bedrock | Y |
| 6706620 | 566474 | 4812183 | 274.74 | 269.74 | 306.98 | 313.765 | n/a | n/a | Bedrock | Y |

| Well Name | Easting | Northing | Screen /Open Interval Top (masl) | Screen /Open Interval Bottom (masl) | Observed Average Water Level (2009 to 2013 and 2015) (masl)[1] | Simulated Average Water Level (masl) | Observed Drawdown (0 to 3,600 $m^3$/day) (m) | Simulated Drawdown (0 to 3,600 $m^3$/day) (m) | Interpreted Aquifer System | WWIS Target from Tier Three Assessment (Y/N) |
|---|---|---|---|---|---|---|---|---|---|---|
| 6709480 | 568005 | 4814603 | 283.21 | 278.21 | 307.32 | 323.101 | n/a | n/a | Bedrock | Y |
| 6707797 | 568974 | 4812563 | 278.56 | 273.56 | 307.74 | 311.377 | n/a | n/a | Bedrock | Y |
| 6711455 | 569561 | 4811898 | 280.09 | 275.09 | 307.86 | 312.901 | n/a | n/a | Bedrock | Y |
| 6703640 | 568574 | 4811553 | 277.35 | 272.35 | 308.03 | 310.696 | n/a | n/a | Bedrock | Y |
| 6711801 | 569167 | 4812847 | 277.23 | 272.23 | 308.21 | 308.1 | n/a | n/a | Bedrock | Y |
| 6712247 | 569167 | 4812847 | 277.23 | 272.23 | 308.21 | 308.1 | n/a | n/a | Bedrock | Y |
| 6704699 | 569078 | 4813573 | 285.18 | 280.18 | 308.89 | 313.758 | n/a | n/a | Bedrock | Y |
| 6709784 | 570964 | 4810635 | 281.46 | 276.46 | 309.13 | 309.211 | n/a | n/a | Bedrock | Y |
| 6710008 | 569484 | 4811644 | 276.74 | 271.74 | 309.17 | 311.996 | n/a | n/a | Bedrock | Y |
| 6703703 | 571414 | 4810853 | 279.93 | 274.93 | 309.75 | 309.378 | n/a | n/a | Bedrock | Y |
| 6711723 | 569656 | 4811874 | 281.91 | 276.91 | 311.16 | 313.168 | n/a | n/a | Bedrock | Y |
| 6707290 | 569194 | 4812803 | 277.63 | 272.63 | 311.24 | 309.959 | n/a | n/a | Bedrock | Y |
| 6707742 | 568714 | 4813583 | 283.63 | 278.63 | 311.31 | 313.547 | n/a | n/a | Bedrock | Y |
| n/a | 568860 | 4812797 | 274.7 | 269.7 | 311.64 | 310.814 | n/a | n/a | Bedrock | Y |
| 6712145 | 568212 | 4813479 | 277.32 | 272.32 | 311.92 | 315.478 | n/a | n/a | Bedrock | Y |
| 6703870 | 568464 | 4811503 | 267.19 | 262.19 | 312.37 | 310.593 | n/a | n/a | Bedrock | Y |
| 6707384 | 568734 | 4813623 | 286.25 | 281.25 | 312.4 | 313.062 | n/a | n/a | Bedrock | Y |
| 6707581 | 568374 | 4813103 | 280.63 | 275.63 | 313.71 | 313.191 | n/a | n/a | Bedrock | Y |
| 6711926 | 567211 | 4813858 | 273.63 | 268.63 | 313.85 | 319.68 | n/a | n/a | Bedrock | Y |
| 6706705 | 568074 | 4813403 | 278.29 | 273.29 | 314.19 | 315.667 | n/a | n/a | Bedrock | Y |
| 6710007 | 569955 | 4813426 | 279.19 | 274.19 | 314.25 | 317.23 | n/a | n/a | Bedrock | Y |
| 6707383 | 568394 | 4813663 | 285.73 | 280.73 | 314.25 | 315.676 | n/a | n/a | Bedrock | Y |
| 6702655 | 570187 | 4813889 | 281.61 | 276.61 | 314.66 | 320.276 | n/a | n/a | Bedrock | Y |
| 6710680 | 570907 | 4812719 | 288.97 | 283.97 | 314.83 | 317.072 | n/a | n/a | Bedrock | Y |
| 6709382 | 571007 | 4812571 | 282.84 | 277.84 | 315.1 | 316.667 | n/a | n/a | Bedrock | Y |
| 6709384 | 570809 | 4812624 | 288.25 | 283.25 | 315.22 | 316.899 | n/a | n/a | Bedrock | Y |

| Well Name | Easting | Northing | Screen /Open Interval Top (masl) | Screen /Open Interval Bottom (masl) | Observed Average Water Level (2009 to 2013 and 2015) (masl)[1] | Simulated Average Water Level (masl) | Observed Drawdown (0 to 3,600 $m^3$/day) (m) | Simulated Drawdown (0 to 3,600 $m^3$/day) (m) | Interpreted Aquifer System | WWIS Target from Tier Three Assessment (Y/N) |
|---|---|---|---|---|---|---|---|---|---|---|
| 6706000 | 568749 | 4814191 | 282.8 | 277.8 | 315.33 | 318.886 | n/a | n/a | Bedrock | Y |
| n/a | 569037 | 4812797 | 277.58 | 272.58 | 315.59 | 301.493 | n/a | n/a | Bedrock | Y |
| 6711669 | 567430 | 4814174 | 280.08 | 275.08 | 316.56 | 320.985 | n/a | n/a | Bedrock | Y |
| 6711923 | 567346 | 4814287 | 280.55 | 275.55 | 316.71 | 321.258 | n/a | n/a | Bedrock | Y |
| 6711270 | 567649 | 4814311 | 276.5 | 271.5 | 316.97 | 321.715 | n/a | n/a | Bedrock | Y |
| 6704352 | 569574 | 4812903 | 281.38 | 276.38 | 317.52 | 314.083 | n/a | n/a | Bedrock | Y |
| 6709478 | 570658 | 4812485 | 282.39 | 277.39 | 317.7 | 316.571 | n/a | n/a | Bedrock | Y |
| 6711473 | 567264 | 4814276 | 275.72 | 270.72 | 317.75 | 321.134 | n/a | n/a | Bedrock | Y |
| 6711544 | 568053 | 4815021 | 285.53 | 280.53 | 318.68 | 323.922 | n/a | n/a | Bedrock | Y |
| 6712192 | 567520 | 4814191 | 278.54 | 273.54 | 318.82 | 321.142 | n/a | n/a | Bedrock | Y |
| 6710341 | 570868 | 4812349 | 281.96 | 276.96 | 318.95 | 316.323 | n/a | n/a | Bedrock | Y |
| 6710997 | 567596 | 4814247 | 277.86 | 272.86 | 320.24 | 321.437 | n/a | n/a | Bedrock | Y |
| 6702657 | 570310 | 4814090 | 283.09 | 278.09 | 320.39 | 321.644 | n/a | n/a | Bedrock | Y |
| 6711713 | 570175 | 4812374 | 280.68 | 275.68 | 320.65 | 316.022 | n/a | n/a | Bedrock | Y |
| 6707693 | 569094 | 4814363 | 285.26 | 280.26 | 320.68 | 320.582 | n/a | n/a | Bedrock | Y |
| 6712399 | 568572 | 4814981 | 279.26 | 274.26 | 320.95 | 324.38 | n/a | n/a | Bedrock | Y |
| 6711439 | 568593 | 4814887 | 285.55 | 280.55 | 321.75 | 324.288 | n/a | n/a | Bedrock | Y |
| 6712473 | 568504 | 4815044 | 279.93 | 274.93 | 322.37 | 324.4 | n/a | n/a | Bedrock | Y |
| 6703907 | 570554 | 4814473 | 291.13 | 286.13 | 325.01 | 322.891 | n/a | n/a | Bedrock | Y |
| 6710952 | 570141 | 4815237 | 277.23 | 272.23 | 325.41 | 324.88 | n/a | n/a | Bedrock | Y |
| 6710387 | 571037 | 4812996 | 276.8 | 271.8 | 289.66 | 317.664 | n/a | n/a | Bedrock | Y |
| 6709669 | 569318 | 4812734 | 269.33 | 264.33 | 295.39 | 312.193 | n/a | n/a | Bedrock | Y |
| 6704969 | 567832 | 4813260 | 271.62 | 266.62 | 297.44 | 316.049 | n/a | n/a | Bedrock | Y |
| 6710603 | 568383 | 4814775 | 272.01 | 267.01 | 300.63 | 323.931 | n/a | n/a | Bedrock | Y |
| 6710009 | 569682 | 4811635 | 272.96 | 267.96 | 304.3 | 311.735 | n/a | n/a | Bedrock | Y |
| 6711474 | 568333 | 4813676 | 269.91 | 264.91 | 304.73 | 316.344 | n/a | n/a | Bedrock | Y |

| Well Name | Easting | Northing | Screen /Open Interval Top (masl) | Screen /Open Interval Bottom (masl) | Observed Average Water Level (2009 to 2013 and 2015) (masl)[1] | Simulated Average Water Level (masl) | Observed Drawdown (0 to 3,600 m$^3$/day) (m) | Simulated Drawdown (0 to 3,600 m$^3$/day) (m) | Interpreted Aquifer System | WWIS Target from Tier Three Assessment (Y/N) |
|---|---|---|---|---|---|---|---|---|---|---|
| 6708923 | 570552 | 4812191 | 273.69 | 268.69 | 306.28 | 315.527 | n/a | n/a | Bedrock | Y |
| 6707273 | 568954 | 4812523 | 266.56 | 261.56 | 309.47 | 311.537 | n/a | n/a | Bedrock | Y |
| 6707289 | 568874 | 4812723 | 274.83 | 269.83 | 310.42 | 311.205 | n/a | n/a | Bedrock | Y |
| 6706694 | 570514 | 4812023 | 271 | 266 | 312 | 314.908 | n/a | n/a | Bedrock | Y |
| 6711997 | 569519 | 4813144 | 269.93 | 264.93 | 312.04 | 313.381 | n/a | n/a | Bedrock | Y |
| 6711715 | 570553 | 4812185 | 271.6 | 266.6 | 312.37 | 315.51 | n/a | n/a | Bedrock | Y |
| 6712159 | 569604 | 4813231 | 274.12 | 269.12 | 312.55 | 314.346 | n/a | n/a | Bedrock | Y |
| 6712321 | 569694 | 4811655 | 272.88 | 267.88 | 312.66 | 311.847 | n/a | n/a | Bedrock | Y |
| n/a | 568870 | 4812485 | 266.96 | 261.96 | 312.85 | 311.596 | n/a | n/a | Bedrock | Y |
| 6709385 | 568151 | 4814028 | 268.73 | 263.73 | 315.19 | 319.384 | n/a | n/a | Bedrock | Y |
| 6711113 | 567229 | 4814364 | 274.68 | 269.68 | 316.06 | 321.31 | n/a | n/a | Bedrock | Y |
| 6710888 | 567417 | 4814097 | 273.45 | 268.45 | 319.81 | 320.68 | n/a | n/a | Bedrock | Y |
| 6710835 | 570259 | 4814207 | 280.02 | 275.02 | 320.01 | 322.183 | n/a | n/a | Bedrock | Y |
| 6709498 | 570997 | 4812491 | 276.77 | 271.77 | 320.37 | 316.452 | n/a | n/a | Bedrock | Y |
| 6710407 | 568248 | 4814779 | 269.79 | 264.79 | 321.03 | 323.761 | n/a | n/a | Bedrock | Y |
| 6712327 | 568166 | 4814755 | 270.14 | 265.14 | 321.22 | 323.609 | n/a | n/a | Bedrock | Y |
| 6712119 | 568471 | 4814862 | 277.07 | 272.07 | 321.24 | 324.137 | n/a | n/a | Bedrock | Y |
| 6707042 | 569414 | 4814423 | 275.79 | 270.79 | 321.81 | 321.783 | n/a | n/a | Bedrock | Y |
| 6708373 | 570422 | 4814251 | 276.25 | 271.25 | 321.82 | 322.348 | n/a | n/a | Bedrock | Y |
| 6710654 | 568635 | 4814877 | 269.52 | 264.52 | 328.13 | 324.322 | n/a | n/a | Bedrock | Y |
| 6711845 | 571043 | 4810933 | 246.6 | 241.6 | 303.69 | 310.223 | n/a | n/a | Bedrock | Y |
| 6708456 | 568504 | 4813622 | 257.84 | 252.84 | 303.83 | 315.281 | n/a | n/a | Bedrock | Y |
| 6708457 | 568528 | 4813674 | 258.67 | 253.67 | 304.36 | 315.471 | n/a | n/a | Bedrock | Y |
| 6711872 | 570240 | 4812553 | 254.95 | 249.95 | 309.59 | 316.061 | n/a | n/a | Bedrock | Y |
| 6712296 | 569007 | 4812634 | 258.98 | 253.98 | 310.9 | 311.195 | n/a | n/a | Bedrock | Y |
| 6712227 | 570996 | 4812571 | 253.51 | 248.51 | 314.11 | 316.613 | n/a | n/a | Bedrock | Y |

| Well Name | Easting | Northing | Screen /Open Interval Top (masl) | Screen /Open Interval Bottom (masl) | Observed Average Water Level (2009 to 2013 and 2015) (masl)[1] | Simulated Average Water Level (masl) | Observed Drawdown (0 to 3,600 $m^3$/day) (m) | Simulated Drawdown (0 to 3,600 $m^3$/day) (m) | Interpreted Aquifer System | WWIS Target from Tier Three Assessment (Y/N) |
|---|---|---|---|---|---|---|---|---|---|---|
| 6711021 | 568494 | 4814422 | 262.68 | 257.68 | 318.46 | 321.682 | n/a | n/a | Bedrock | Y |
| 6708652 | 570683 | 4812236 | 238.12 | 233.12 | 314.39 | 315.805 | n/a | n/a | Bedrock | Y |
| 6711771 | 568413 | 4814821 | 248.63 | 243.63 | 319.52 | 324.015 | n/a | n/a | Bedrock | Y |
| 6712093 | 568506 | 4814893 | 251.34 | 246.34 | 321.15 | 324.203 | n/a | n/a | Bedrock | Y |

n/a information not available

WWIS – Water Well Information System

Masl – meters above sea level

[1] Observed water levels for WWIS wells represent values collected over different time periods and potentially under different regional pumping conditions

## TABLE A2 Calibration Dataset and Results - Erin

| Well Name | Easting | Northing | Screen/ Open Interval Top (masl) | Screen/ Open Interval Bottom (masl) | Estimated Observed Water Level (0 $m^3$/day) (masl)[1] | Simulated Average Water Level (0 $m^3$/day) (masl) | Estimated Observed Drawdown (0 to 890 $m^3$/day) (m) | Simulated Drawdown (0 to 890 $m^3$/day) (m) | Interpreted Aquifer System | WWIS Target from Tier Three Assessment (Y/N) |
|---|---|---|---|---|---|---|---|---|---|---|
| TW1-88 | 568376 | 4847829 | 410.80 | 393.60 | 423.1 | 425.85 | 6.40 | 7.49 | Bedrock | N |
| MW05A-05 | 568339 | 4847771 | 410.56 | 404.47 | 423.78 | 425.63 | 4.08 | 4.02 | Bedrock | N |
| MW06A-05 | 568741 | 4847572 | 411.72 | 408.67 | 422.18 | 420.75 | 0.68 | 0.94 | Bedrock | N |
| MW11A-08 | 568784 | 4848063 | 411.80 | 407.23 | 426.9 | 426.09 | n/a | n/a | Bedrock | N |
| MW12A-08 | 569279 | 4847593 | 407.90 | 404.86 | 424.85 | 416.94 | n/a | n/a | Bedrock | N |
| D3 | 568160 | 4847870 | 418.72 | 410.80 | 425 | 428.78 | 1.67 | 1.96 | Bedrock | N |
| D8 | 568759 | 4848313 | 412.32 | 390.07 | 427.3 | 428.69 | 0.44 | 0.85 | Bedrock | N |
| D15 | 569038 | 4848475 | 408.35 | 406.83 | 427.38 | 428.59 | n/a | n/a | Bedrock | N |
| D24A | 567878 | 4847889 | 409.61 | 400.16 | 425.82 | 429.45 | 1.82 | 1.59 | Bedrock | N |
| D24B | 567891 | 4847804 | 410.93 | 399.04 | 425.2 | 429.13 | 1.72 | 1.61 | Bedrock | N |
| D26A | 568405 | 4847251 | n/a | n/a | 420.22 | 419.57 | 1.45 | 0.96 | Bedrock | N |
| D26B | 568348 | 4847311 | 398.50 | 396.06 | 420.22 | 420.55 | n/a | n/a | Bedrock | N |
| D32 | 569198 | 4847127 | 404.50 | 390.18 | 413.45 | 412.51 | 0.10 | 0.15 | Bedrock | N |
| D36B | 569195 | 4847350 | 399.28 | 384.48 | 424.08 | 414.21 | 0.32 | 0.21 | Bedrock | N |
| MW02-00 | 568432 | 4847705 | 428.07 | 426.66 | 428.29 | 429.56 | 0.00 | 0.06 | Overburden | N |
| MW03A-00 | 568370 | 4847686 | 426.88 | 426.63 | 428.42 | 428.52 | 0.00 | 0.00 | Overburden | N |
| MW03B-00 | 568370 | 4847686 | 428.13 | 427.94 | 428.31 | 428.52 | 0.00 | 0.00 | Overburden | N |
| MW05B-05 | 568350 | 4847778 | 420.68 | 418.85 | 428.58 | 430.50 | 0.00 | 0.06 | Overburden | N |
| MW06B-05 | 568741 | 4847574 | 426.63 | 425.10 | 428.33 | 429.38 | 0.00 | 0.11 | Overburden | N |
| MW11B-08 | 568784 | 4848062 | 423.38 | 420.33 | 428.62 | 432.22 | n/a | n/a | Overburden | N |
| MW12B-08 | 569281 | 4847591 | 434.26 | 431.22 | 431.7 | 431.37 | n/a | n/a | Overburden | N |
| TW1-99 | 568515 | 4847847 | 422.48 | 420.04 | 428.53 | 431.55 | 0.00 | 0.10 | Overburden | N |
| D7B | 568370 | 4848313 | n/a | n/a | 435.5 | 435.90 | 0.00 | 0.01 | Overburden | N |
| D26C | 568329 | 4847305 | n/a | n/a | 434.72 | 425.03 | n/a | n/a | Overburden | N |

| Well Name | Easting | Northing | Screen/ Open Interval Top (masl) | Screen/ Open Interval Bottom (masl) | Estimated Observed Water Level (0 $m^3$/day) (masl)[1] | Simulated Average Water Level (0 $m^3$/day) (masl) | Estimated Observed Drawdown (0 to 890 $m^3$/day) (m) | Simulated Drawdown (0 to 890 $m^3$/day) (m) | Interpreted Aquifer System | WWIS Target from Tier Three Assessment (Y/N) |
|---|---|---|---|---|---|---|---|---|---|---|
| D36A | 569178 | 4847335 | n/a | n/a | 435.06 | 426.30 | 0.00 | -0.17 | Overburden | N |
| 6706674 | 571064 | 4846323 | 390.4 | 385.4 | 400.64 | 403.25 | n/a | n/a | Bedrock | Y |
| 6708665 | 568535 | 4846462 | 362.7 | 357.7 | 405.58 | 414.58 | n/a | n/a | Bedrock | Y |
| 6706591 | 569414 | 4847123 | 368.3 | 363.3 | 405.81 | 412.47 | n/a | n/a | Bedrock | Y |
| 6700710 | 569479 | 4846990 | 395.4 | 390.4 | 406.27 | 410.79 | n/a | n/a | Bedrock | Y |
| 6707233 | 569614 | 4846473 | 354.6 | 349.6 | 406.85 | 409.18 | n/a | n/a | Bedrock | Y |
| 6704921 | 569432 | 4847165 | 376.4 | 371.4 | 408.06 | 412.75 | n/a | n/a | Bedrock | Y |
| 6707351 | 570014 | 4848173 | 401.9 | 396.9 | 408.42 | 419.77 | n/a | n/a | Bedrock | Y |
| 6703622 | 570164 | 4845973 | 369.1 | 364.1 | 408.57 | 406.37 | n/a | n/a | Bedrock | Y |
| 6703617 | 568634 | 4846553 | 368.7 | 363.7 | 409.34 | 414.27 | n/a | n/a | Bedrock | Y |
| 6709574 | 569889 | 4845983 | 366.2 | 361.2 | 409.49 | 407.54 | n/a | n/a | Bedrock | Y |
| 6710155 | 567703 | 4845330 | 378.4 | 373.4 | 409.56 | 411.08 | n/a | n/a | Bedrock | Y |
| 6703960 | 568374 | 4847373 | 400.2 | 395.2 | 409.84 | 421.09 | n/a | n/a | Bedrock | Y |
| 6704991 | 569250 | 4847091 | 394.9 | 389.9 | 410.15 | 412.07 | n/a | n/a | Bedrock | Y |
| 6703808 | 569314 | 4846833 | 381.3 | 376.3 | 410.16 | 411.16 | n/a | n/a | Bedrock | Y |
| 6706588 | 569714 | 4846323 | 365.9 | 360.9 | 410.45 | 408.46 | n/a | n/a | Bedrock | Y |
| 6708632 | 569510 | 4847139 | 373.0 | 368.0 | 410.51 | 412.39 | n/a | n/a | Bedrock | Y |
| 6708725 | 570195 | 4845854 | 366.6 | 361.6 | 410.52 | 406.32 | n/a | n/a | Bedrock | Y |
| 6705561 | 568973 | 4846730 | 382.6 | 377.6 | 410.79 | 412.72 | n/a | n/a | Bedrock | Y |
| 6703704 | 569414 | 4847043 | 381.4 | 376.4 | 411.02 | 411.88 | n/a | n/a | Bedrock | Y |
| 6700677 | 567765 | 4846419 | 402.1 | 397.1 | 411.94 | 418.99 | n/a | n/a | Bedrock | Y |
| 6700676 | 568648 | 4847067 | 409.2 | 404.2 | 412.14 | 415.51 | n/a | n/a | Bedrock | Y |
| 6711066 | 570000 | 4846184 | 371.4 | 366.4 | 412.16 | 407.02 | n/a | n/a | Bedrock | Y |
| 6710535 | 570297 | 4845535 | 378.5 | 373.5 | 412.6 | 405.98 | n/a | n/a | Bedrock | Y |
| 6706403 | 569464 | 4846623 | 386.9 | 381.9 | 412.67 | 409.76 | n/a | n/a | Bedrock | Y |

| Well Name | Easting | Northing | Screen/ Open Interval Top (masl) | Screen/ Open Interval Bottom (masl) | Estimated Observed Water Level (0 m$^3$/day) (masl)[1] | Simulated Average Water Level (0 m$^3$/day) (masl) | Estimated Observed Drawdown (0 to 890 m$^3$/day) (m) | Simulated Drawdown (0 to 890 m$^3$/day) (m) | Interpreted Aquifer System | WWIS Target from Tier Three Assessment (Y/N) |
|---|---|---|---|---|---|---|---|---|---|---|
| 6700711 | 569451 | 4847061 | 381.8 | 376.8 | 412.85 | 411.91 | n/a | n/a | Bedrock | Y |
| 6708631 | 569481 | 4847149 | 372.7 | 367.7 | 413.01 | 412.52 | n/a | n/a | Bedrock | Y |
| 6703621 | 569284 | 4847193 | 375.2 | 370.2 | 413.2 | 413.35 | n/a | n/a | Bedrock | Y |
| 6700708 | 570707 | 4845652 | 381.0 | 376.0 | 413.24 | 404.32 | n/a | n/a | Bedrock | Y |
| 6712435 | 571353 | 4846608 | 384.4 | 379.4 | 413.38 | 403.99 | n/a | n/a | Bedrock | Y |
| 6707864 | 569414 | 4847273 | 372.8 | 367.8 | 413.49 | 413.69 | n/a | n/a | Bedrock | Y |
| 6703647 | 570014 | 4846093 | 371.3 | 366.3 | 413.81 | 406.96 | n/a | n/a | Bedrock | Y |
| 6710528 | 567720 | 4846248 | 392.2 | 387.2 | 413.81 | 417.63 | n/a | n/a | Bedrock | Y |
| 6712437 | 569781 | 4846039 | 361.2 | 356.2 | 413.91 | 408.04 | n/a | n/a | Bedrock | Y |
| 6703623 | 569324 | 4847243 | 373.7 | 368.7 | 414.21 | 413.64 | n/a | n/a | Bedrock | Y |
| 6710144 | 570236 | 4845456 | 370.5 | 365.5 | 414.22 | 406.14 | n/a | n/a | Bedrock | Y |
| 6703186 | 571114 | 4846523 | 409.3 | 404.3 | 414.33 | 404.40 | n/a | n/a | Overburden | Y |
| 6700679 | 568013 | 4847639 | 411.4 | 406.4 | 414.36 | 426.81 | n/a | n/a | Bedrock | Y |
| 6704458 | 566589 | 4845848 | 404.4 | 399.4 | 414.36 | 419.96 | n/a | n/a | Bedrock | Y |
| 6710566 | 566595 | 4845926 | 393.6 | 388.6 | 414.47 | 421.09 | n/a | n/a | Bedrock | Y |
| 6705648 | 570168 | 4847799 | 398.1 | 393.1 | 414.72 | 416.38 | n/a | n/a | Bedrock | Y |
| 6710547 | 570538 | 4845437 | 392.9 | 387.9 | 415.14 | 405.21 | n/a | n/a | Bedrock | Y |
| 6709043 | 570486 | 4845481 | 392.7 | 387.7 | 415.31 | 405.47 | n/a | n/a | Bedrock | Y |
| 6700655 | 568538 | 4844747 | 376.7 | 371.7 | 415.6 | 407.89 | n/a | n/a | Bedrock | Y |
| 6705975 | 569454 | 4847483 | 370.6 | 365.6 | 415.61 | 415.55 | n/a | n/a | Bedrock | Y |
| 6707356 | 569214 | 4845823 | 387.4 | 382.4 | 415.63 | 410.46 | n/a | n/a | Bedrock | Y |
| 6707429 | 569214 | 4846473 | 372.4 | 367.4 | 415.96 | 411.08 | n/a | n/a | Bedrock | Y |
| 6710800 | 569858 | 4846123 | 369.4 | 364.4 | 415.97 | 407.69 | n/a | n/a | Bedrock | Y |
| 6709713 | 567678 | 4846188 | 394.5 | 389.5 | 416.1 | 417.22 | n/a | n/a | Bedrock | Y |
| 6705147 | 569413 | 4844769 | 393.8 | 388.8 | 416.14 | 406.92 | n/a | n/a | Bedrock | Y |

| Well Name | Easting | Northing | Screen/ Open Interval Top (masl) | Screen/ Open Interval Bottom (masl) | Estimated Observed Water Level (0 m$^3$/day) (masl)[1] | Simulated Average Water Level (0 m$^3$/day) (masl) | Estimated Observed Drawdown (0 to 890 m$^3$/day) (m) | Simulated Drawdown (0 to 890 m$^3$/day) (m) | Interpreted Aquifer System | WWIS Target from Tier Three Assessment (Y/N) |
|---|---|---|---|---|---|---|---|---|---|---|
| 6711236 | 570697 | 4847263 | 392.6 | 387.6 | 416.17 | 410.96 | n/a | n/a | Bedrock | Y |
| 6706342 | 569414 | 4847323 | 374.8 | 369.8 | 416.18 | 414.13 | n/a | n/a | Bedrock | Y |
| 6700657 | 567894 | 4845359 | 382.4 | 377.4 | 416.54 | 411.57 | n/a | n/a | Bedrock | Y |
| 6707555 | 567714 | 4845423 | 412.0 | 407.0 | 416.96 | 411.86 | n/a | n/a | Bedrock | Y |
| 6708433 | 567375 | 4846783 | 404.9 | 399.9 | 417 | 424.53 | n/a | n/a | Bedrock | Y |
| 6707831 | 567814 | 4845023 | 372.2 | 367.2 | 417.03 | 409.34 | n/a | n/a | Bedrock | Y |
| 6710326 | 566893 | 4846209 | 370.1 | 365.1 | 417.03 | 422.00 | n/a | n/a | Bedrock | Y |
| 6708353 | 571002 | 4848734 | 391.0 | 386.0 | 417.12 | 418.08 | n/a | n/a | Bedrock | Y |
| 6707564 | 571314 | 4848423 | 401.9 | 396.9 | 417.18 | 415.87 | n/a | n/a | Bedrock | Y |
| 6704164 | 568984 | 4845323 | 397.0 | 392.0 | 417.46 | 410.30 | n/a | n/a | Bedrock | Y |
| 6700656 | 568126 | 4844868 | 391.3 | 386.3 | 417.55 | 408.61 | n/a | n/a | Bedrock | Y |
| 6700658 | 567559 | 4846306 | 383.0 | 378.0 | 417.58 | 419.05 | n/a | n/a | Bedrock | Y |
| 6705643 | 567414 | 4846123 | 390.2 | 385.2 | 417.72 | 417.73 | n/a | n/a | Bedrock | Y |
| 6711073 | 569502 | 4846342 | 395.0 | 390.0 | 417.99 | 409.48 | n/a | n/a | Bedrock | Y |
| 6709053 | 567547 | 4846423 | 397.9 | 392.9 | 418.1 | 420.52 | n/a | n/a | Bedrock | Y |
| 6705908 | 566934 | 4846163 | 390.4 | 385.4 | 418.28 | 420.88 | n/a | n/a | Bedrock | Y |
| 6705623 | 567464 | 4846463 | 400.5 | 395.5 | 418.33 | 421.20 | n/a | n/a | Bedrock | Y |
| 6710544 | 571205 | 4848518 | 395.2 | 390.2 | 418.36 | 416.62 | n/a | n/a | Bedrock | Y |
| 6704175 | 569614 | 4848173 | 387.8 | 382.8 | 418.43 | 422.21 | n/a | n/a | Bedrock | Y |
| 6705150 | 568086 | 4846287 | 388.7 | 383.7 | 418.49 | 416.01 | n/a | n/a | Bedrock | Y |
| 6700675 | 570019 | 4845838 | 386.0 | 381.0 | 418.54 | 407.07 | n/a | n/a | Bedrock | Y |
| 6707836 | 566864 | 4847223 | 406.0 | 401.0 | 418.68 | 431.28 | n/a | n/a | Bedrock | Y |
| 6707559 | 569914 | 4848073 | 382.1 | 377.1 | 418.79 | 419.50 | n/a | n/a | Bedrock | Y |
| 6708163 | 567412 | 4846538 | 402.1 | 397.1 | 418.8 | 422.13 | n/a | n/a | Bedrock | Y |
| 6709026 | 567531 | 4846382 | 398.5 | 393.5 | 418.96 | 420.15 | n/a | n/a | Bedrock | Y |

| Well Name | Easting | Northing | Screen/ Open Interval Top (masl) | Screen/ Open Interval Bottom (masl) | Estimated Observed Water Level (0 $m^3$/day) (masl)[1] | Simulated Average Water Level (0 $m^3$/day) (masl) | Estimated Observed Drawdown (0 to 890 $m^3$/day) (m) | Simulated Drawdown (0 to 890 $m^3$/day) (m) | Interpreted Aquifer System | WWIS Target from Tier Three Assessment (Y/N) |
|---|---|---|---|---|---|---|---|---|---|---|
| 6709566 | 569134 | 4844963 | 395.4 | 390.4 | 419.03 | 408.65 | n/a | n/a | Bedrock | Y |
| 6708168 | 567387 | 4846730 | 403.2 | 398.2 | 419.09 | 424.02 | n/a | n/a | Bedrock | Y |
| 6704176 | 569589 | 4848198 | 388.3 | 383.3 | 419.11 | 422.66 | n/a | n/a | Bedrock | Y |
| 6706651 | 567314 | 4846773 | 404.2 | 399.2 | 419.18 | 424.80 | n/a | n/a | Bedrock | Y |
| 6704455 | 567454 | 4847003 | 405.6 | 400.6 | 419.67 | 425.28 | n/a | n/a | Bedrock | Y |
| 6700709 | 570961 | 4846631 | 387.7 | 382.7 | 419.67 | 405.69 | n/a | n/a | Bedrock | Y |
| 6705479 | 567314 | 4846703 | 403.0 | 398.0 | 419.7 | 424.31 | n/a | n/a | Bedrock | Y |
| 6704704 | 571576 | 4848191 | 394.7 | 389.7 | 419.9 | 413.78 | n/a | n/a | Bedrock | Y |
| 6700660 | 566787 | 4846065 | 397.7 | 392.7 | 420.04 | 421.30 | n/a | n/a | Bedrock | Y |
| 6711773 | 567421 | 4846972 | 401.3 | 396.3 | 420.18 | 425.33 | n/a | n/a | Bedrock | Y |
| 6708432 | 567594 | 4846933 | 405.8 | 400.8 | 420.21 | 423.14 | n/a | n/a | Bedrock | Y |
| 6708719 | 567424 | 4846743 | 404.3 | 399.3 | 420.26 | 423.91 | n/a | n/a | Bedrock | Y |
| 6704432 | 566714 | 4845848 | 410.3 | 405.3 | 420.34 | 419.15 | n/a | n/a | Bedrock | Y |
| 6710223 | 567335 | 4846650 | 403.9 | 398.9 | 420.46 | 423.75 | n/a | n/a | Bedrock | Y |
| 6711808 | 569345 | 4846461 | 377.9 | 372.9 | 420.51 | 410.41 | n/a | n/a | Bedrock | Y |
| 6704447 | 567064 | 4845848 | 398.0 | 393.0 | 420.58 | 417.00 | n/a | n/a | Bedrock | Y |
| 6707572 | 567864 | 4845673 | 393.4 | 388.4 | 420.62 | 413.77 | n/a | n/a | Bedrock | Y |
| 6712044 | 569347 | 4844923 | 394.7 | 389.7 | 420.63 | 407.76 | n/a | n/a | Bedrock | Y |
| 6706395 | 567364 | 4846573 | 404.9 | 399.9 | 420.68 | 422.87 | n/a | n/a | Bedrock | Y |
| 6704910 | 570868 | 4846925 | 383.9 | 378.9 | 420.73 | 407.96 | n/a | n/a | Bedrock | Y |
| 6709530 | 569027 | 4848418 | 405.9 | 400.9 | 420.75 | 428.09 | n/a | n/a | Bedrock | Y |
| 6704182 | 569054 | 4845123 | 388.9 | 383.9 | 420.9 | 409.70 | n/a | n/a | Bedrock | Y |
| 6704988 | 567377 | 4846689 | 404.9 | 399.9 | 420.92 | 423.88 | n/a | n/a | Bedrock | Y |
| 6710218 | 567214 | 4846583 | 404.6 | 399.6 | 421 | 423.80 | n/a | n/a | Bedrock | Y |
| 6708722 | 567235 | 4846710 | 405.3 | 400.3 | 421.07 | 424.81 | n/a | n/a | Bedrock | Y |

| Well Name | Easting | Northing | Screen/ Open Interval Top (masl) | Screen/ Open Interval Bottom (masl) | Estimated Observed Water Level (0 $m^3$/day) (masl)[1] | Simulated Average Water Level (0 $m^3$/day) (masl) | Estimated Observed Drawdown (0 to 890 $m^3$/day) (m) | Simulated Drawdown (0 to 890 $m^3$/day) (m) | Interpreted Aquifer System | WWIS Target from Tier Three Assessment (Y/N) |
|---|---|---|---|---|---|---|---|---|---|---|
| 6709533 | 569032 | 4848393 | 414.8 | 409.8 | 421.19 | 427.87 | n/a | n/a | Bedrock | Y |
| 6705146 | 569719 | 4848033 | 403.4 | 398.4 | 421.24 | 420.30 | n/a | n/a | Bedrock | Y |
| 6709532 | 569027 | 4848442 | 411.9 | 406.9 | 421.25 | 428.36 | n/a | n/a | Bedrock | Y |
| 6706583 | 569214 | 4848473 | 413.9 | 408.9 | 421.28 | 427.56 | n/a | n/a | Bedrock | Y |
| 6707852 | 567164 | 4846823 | 407.6 | 402.6 | 421.35 | 426.11 | n/a | n/a | Bedrock | Y |
| 6710548 | 569791 | 4848098 | 403.4 | 398.4 | 421.75 | 420.50 | n/a | n/a | Bedrock | Y |
| 6707143 | 569764 | 4848123 | 405.1 | 400.1 | 421.79 | 420.95 | n/a | n/a | Bedrock | Y |
| 6709595 | 569834 | 4847973 | 405.4 | 400.4 | 421.84 | 418.89 | n/a | n/a | Bedrock | Y |
| 6704171 | 569634 | 4848173 | 404.7 | 399.7 | 421.85 | 422.21 | n/a | n/a | Bedrock | Y |
| 6710567 | 567154 | 4846831 | 409.3 | 404.3 | 421.99 | 426.24 | n/a | n/a | Bedrock | Y |
| 6710551 | 569634 | 4847672 | 406.3 | 401.3 | 422.01 | 417.28 | n/a | n/a | Bedrock | Y |
| 6707151 | 568414 | 4845723 | 393.7 | 388.7 | 422.19 | 413.10 | n/a | n/a | Bedrock | Y |
| 6709602 | 569745 | 4848059 | 405.3 | 400.3 | 422.31 | 420.42 | n/a | n/a | Bedrock | Y |
| 6706590 | 568614 | 4845323 | 395.2 | 390.2 | 422.92 | 411.39 | n/a | n/a | Bedrock | Y |
| 6708080 | 569664 | 4848123 | 398.5 | 393.5 | 423.2 | 421.53 | n/a | n/a | Bedrock | Y |
| 6706286 | 569574 | 4848223 | 399.5 | 394.5 | 423.36 | 423.03 | n/a | n/a | Bedrock | Y |
| 6707144 | 569664 | 4848273 | 407.3 | 402.3 | 423.63 | 422.99 | n/a | n/a | Bedrock | Y |
| 6710154 | 567876 | 4847308 | 401.4 | 396.4 | 423.65 | 424.37 | n/a | n/a | Bedrock | Y |
| 6710572 | 567085 | 4846863 | 406.5 | 401.5 | 423.68 | 426.95 | n/a | n/a | Bedrock | Y |
| 6710530 | 566954 | 4846933 | 408.5 | 403.5 | 423.85 | 428.34 | n/a | n/a | Bedrock | Y |
| 6709709 | 566879 | 4846853 | 411.0 | 406.0 | 424.18 | 428.20 | n/a | n/a | Bedrock | Y |
| 6704115 | 568764 | 4847223 | 411.1 | 406.1 | 424.49 | 415.23 | n/a | n/a | Bedrock | Y |
| 6709886 | 569405 | 4848417 | 412.5 | 407.5 | 424.59 | 425.92 | n/a | n/a | Bedrock | Y |
| 6700712 | 569004 | 4848354 | 399.3 | 394.3 | 424.68 | 427.61 | n/a | n/a | Bedrock | Y |
| 6703357 | 570184 | 4848273 | 401.0 | 396.0 | 424.99 | 419.49 | n/a | n/a | Bedrock | Y |

| Well Name | Easting | Northing | Screen/ Open Interval Top (masl) | Screen/ Open Interval Bottom (masl) | Estimated Observed Water Level (0 $m^3$/day) (masl)[1] | Simulated Average Water Level (0 $m^3$/day) (masl) | Estimated Observed Drawdown (0 to 890 $m^3$/day) (m) | Simulated Drawdown (0 to 890 $m^3$/day) (m) | Interpreted Aquifer System | WWIS Target from Tier Three Assessment (Y/N) |
|---|---|---|---|---|---|---|---|---|---|---|
| 6705148 | 569795 | 4848098 | 411.4 | 406.4 | 425.1 | 420.50 | n/a | n/a | Bedrock | Y |
| 6709212 | 570116 | 4848219 | 396.4 | 391.4 | 425.15 | 419.44 | n/a | n/a | Bedrock | Y |
| 6708146 | 567881 | 4847890 | 405.2 | 400.2 | 425.37 | 429.44 | n/a | n/a | Bedrock | Y |
| 6711507 | 570228 | 4849191 | 382.5 | 377.5 | 425.39 | 428.30 | n/a | n/a | Bedrock | Y |
| 6706041 | 569314 | 4848473 | 418.8 | 413.8 | 425.42 | 426.99 | n/a | n/a | Bedrock | Y |
| 6705612 | 568840 | 4848356 | 395.6 | 390.6 | 425.47 | 428.59 | n/a | n/a | Bedrock | Y |
| 6709065 | 570567 | 4848720 | 403.2 | 398.2 | 425.63 | 420.90 | n/a | n/a | Bedrock | Y |
| 6704542 | 569434 | 4848483 | 413.8 | 408.8 | 426.07 | 426.37 | n/a | n/a | Bedrock | Y |
| 6707156 | 569814 | 4848273 | 405.2 | 400.2 | 426.12 | 422.06 | n/a | n/a | Bedrock | Y |
| 6710148 | 569082 | 4848616 | 377.3 | 372.3 | 426.22 | 429.55 | n/a | n/a | Bedrock | Y |
| 6703520 | 566584 | 4847283 | 401.5 | 396.5 | 426.32 | 434.04 | n/a | n/a | Bedrock | Y |
| 6703518 | 569004 | 4848873 | 381.5 | 376.5 | 426.66 | 432.37 | n/a | n/a | Bedrock | Y |
| 6709578 | 568859 | 4848859 | 389.2 | 384.2 | 426.83 | 433.08 | n/a | n/a | Bedrock | Y |
| 6705647 | 570514 | 4848673 | 407.2 | 402.2 | 426.89 | 420.79 | n/a | n/a | Bedrock | Y |
| 6706911 | 569064 | 4848723 | 418.4 | 413.4 | 427.63 | 430.68 | n/a | n/a | Bedrock | Y |
| 6710156 | 570480 | 4848893 | 415.9 | 410.9 | 427.78 | 423.48 | n/a | n/a | Bedrock | Y |
| 6700771 | 570664 | 4849203 | 416.1 | 411.1 | 427.79 | 425.77 | n/a | n/a | Bedrock | Y |
| 6700739 | 570583 | 4848804 | 415.2 | 410.2 | 428.07 | 421.65 | n/a | n/a | Bedrock | Y |
| 6700746 | 569464 | 4848468 | 408.0 | 403.0 | 428.15 | 426.01 | n/a | n/a | Bedrock | Y |
| 6708720 | 568791 | 4848303 | 395.1 | 390.1 | 428.19 | 428.38 | n/a | n/a | Bedrock | Y |
| 6700713 | 569185 | 4848623 | 415.5 | 410.5 | 428.22 | 429.11 | n/a | n/a | Bedrock | Y |
| 6703528 | 568634 | 4848703 | 384.7 | 379.7 | 428.4 | 433.10 | n/a | n/a | Bedrock | Y |
| 6706594 | 570714 | 4848973 | 412.7 | 407.7 | 428.49 | 422.67 | n/a | n/a | Bedrock | Y |
| 6710228 | 568207 | 4847890 | 414.7 | 409.7 | 429.31 | 427.31 | n/a | n/a | Bedrock | Y |
| 6711625 | 571312 | 4849051 | 406.2 | 401.2 | 429.57 | 419.55 | n/a | n/a | Bedrock | Y |

| Well Name | Easting | Northing | Screen/ Open Interval Top (masl) | Screen/ Open Interval Bottom (masl) | Estimated Observed Water Level (0 $m^3$/day) (masl)[1] | Simulated Average Water Level (0 $m^3$/day) (masl) | Estimated Observed Drawdown (0 to 890 $m^3$/day) (m) | Simulated Drawdown (0 to 890 $m^3$/day) (m) | Interpreted Aquifer System | WWIS Target from Tier Three Assessment (Y/N) |
|---|---|---|---|---|---|---|---|---|---|---|
| 6712043 | 566646 | 4847156 | 404.9 | 399.9 | 429.7 | 432.28 | n/a | n/a | Bedrock | Y |
| 6710162 | 567449 | 4848214 | 410.7 | 405.7 | 429.79 | 437.17 | n/a | n/a | Bedrock | Y |
| 6704913 | 568918 | 4849017 | 364.8 | 359.8 | 430.24 | 434.23 | n/a | n/a | Bedrock | Y |
| 6708616 | 568719 | 4849027 | 415.1 | 410.1 | 430.36 | 435.31 | n/a | n/a | Bedrock | Y |
| 6707054 | 570814 | 4849023 | 411.7 | 406.7 | 430.75 | 422.41 | n/a | n/a | Bedrock | Y |
| 6703149 | 569034 | 4849223 | 403.3 | 398.3 | 430.8 | 435.23 | n/a | n/a | Bedrock | Y |
| 6711075 | 568765 | 4848930 | 384.1 | 379.1 | 430.94 | 434.40 | n/a | n/a | Bedrock | Y |
| 6710235 | 568896 | 4848874 | 406.2 | 401.2 | 431.28 | 432.96 | n/a | n/a | Bedrock | Y |
| 6708365 | 568793 | 4848858 | 405.3 | 400.3 | 431.34 | 433.40 | n/a | n/a | Bedrock | Y |
| 6709042 | 568731 | 4849270 | 401.1 | 396.1 | 431.46 | 437.95 | n/a | n/a | Bedrock | Y |
| 6707358 | 568714 | 4848823 | 408.5 | 403.5 | 431.46 | 433.54 | n/a | n/a | Bedrock | Y |
| 6709050 | 568646 | 4848767 | 385.8 | 380.8 | 431.56 | 433.63 | n/a | n/a | Bedrock | Y |
| 6700740 | 568722 | 4849233 | 406.5 | 401.5 | 431.68 | 437.67 | n/a | n/a | Bedrock | Y |
| 6707821 | 568814 | 4849473 | 429.3 | 424.3 | 432.07 | 443.42 | n/a | n/a | Overburden | Y |
| 6703077 | 569084 | 4848213 | 412.8 | 407.8 | 432.12 | 425.80 | n/a | n/a | Bedrock | Y |
| 6708174 | 568803 | 4848861 | 416.5 | 411.5 | 432.19 | 433.31 | n/a | n/a | Bedrock | Y |
| 6709537 | 567566 | 4848063 | 410.5 | 405.5 | 432.3 | 434.45 | n/a | n/a | Bedrock | Y |
| 6704915 | 568749 | 4849470 | 404.1 | 399.1 | 432.39 | 439.80 | n/a | n/a | Bedrock | Y |
| 6710806 | 568559 | 4848525 | 415.6 | 410.6 | 432.41 | 431.90 | n/a | n/a | Bedrock | Y |
| 6706282 | 568764 | 4849423 | 422.7 | 417.7 | 432.43 | 439.23 | n/a | n/a | Bedrock | Y |
| 6700742 | 568801 | 4849079 | 413.5 | 408.5 | 432.49 | 435.20 | n/a | n/a | Bedrock | Y |
| 6704716 | 568914 | 4849033 | 394.1 | 389.1 | 432.49 | 434.29 | n/a | n/a | Bedrock | Y |
| 6709156 | 568808 | 4849283 | 394.8 | 389.8 | 432.51 | 437.44 | n/a | n/a | Bedrock | Y |
| 6709207 | 567608 | 4848229 | 392.8 | 387.8 | 432.55 | 435.89 | n/a | n/a | Bedrock | Y |
| 6709548 | 567785 | 4848113 | 410.7 | 405.7 | 432.63 | 432.60 | n/a | n/a | Bedrock | Y |

| Well Name | Easting | Northing | Screen/ Open Interval Top (masl) | Screen/ Open Interval Bottom (masl) | Estimated Observed Water Level (0 m$^3$/day) (masl)[1] | Simulated Average Water Level (0 m$^3$/day) (masl) | Estimated Observed Drawdown (0 to 890 m$^3$/day) (m) | Simulated Drawdown (0 to 890 m$^3$/day) (m) | Interpreted Aquifer System | WWIS Target from Tier Three Assessment (Y/N) |
|---|---|---|---|---|---|---|---|---|---|---|
| 6707813 | 568814 | 4849473 | 417.8 | 412.8 | 432.68 | 439.41 | n/a | n/a | Bedrock | Y |
| 6708153 | 569289 | 4847274 | 378.8 | 373.8 | 432.81 | 413.98 | n/a | n/a | Bedrock | Y |
| 6708360 | 568714 | 4849447 | 419.6 | 414.6 | 432.87 | 439.92 | n/a | n/a | Bedrock | Y |
| 6709702 | 567034 | 4847593 | 425.1 | 420.1 | 432.87 | 434.28 | n/a | n/a | Bedrock | Y |
| 6708388 | 568233 | 4848077 | 405.6 | 400.6 | 432.88 | 429.42 | n/a | n/a | Bedrock | Y |
| 6708347 | 568847 | 4849569 | 416.2 | 411.2 | 433.19 | 440.15 | n/a | n/a | Bedrock | Y |
| 6708346 | 568642 | 4848787 | 407.9 | 402.9 | 433.31 | 433.65 | n/a | n/a | Bedrock | Y |
| 6700738 | 568722 | 4849243 | 403.6 | 398.6 | 433.64 | 437.77 | n/a | n/a | Bedrock | Y |
| 6707860 | 568914 | 4849723 | 415.9 | 410.9 | 433.68 | 441.16 | n/a | n/a | Bedrock | Y |
| 6709157 | 568786 | 4849305 | 417.5 | 412.5 | 433.86 | 437.83 | n/a | n/a | Bedrock | Y |
| 6708154 | 568752 | 4849492 | 432.5 | 427.5 | 434.32 | 444.86 | n/a | n/a | Overburden | Y |
| 6708625 | 568732 | 4849358 | 427.0 | 422.0 | 434.33 | 443.02 | n/a | n/a | Overburden | Y |
| 6708413 | 568828 | 4849519 | 416.3 | 411.3 | 434.65 | 439.81 | n/a | n/a | Bedrock | Y |
| 6709888 | 568876 | 4849608 | 419.1 | 414.1 | 434.87 | 440.33 | n/a | n/a | Bedrock | Y |
| 6704918 | 568725 | 4849314 | 422.5 | 417.5 | 435.02 | 438.53 | n/a | n/a | Bedrock | Y |
| 6711499 | 570182 | 4849736 | 410.2 | 405.2 | 435.72 | 434.39 | n/a | n/a | Bedrock | Y |
| 6705153 | 569302 | 4847515 | 394.2 | 389.2 | 435.72 | 415.21 | n/a | n/a | Bedrock | Y |
| 6703896 | 568514 | 4848713 | 400.2 | 395.2 | 435.78 | 433.87 | n/a | n/a | Bedrock | Y |
| 6712436 | 568623 | 4849076 | 415.0 | 410.0 | 436.1 | 436.80 | n/a | n/a | Bedrock | Y |
| 6704469 | 568174 | 4849553 | 390.6 | 385.6 | 436.36 | 444.28 | n/a | n/a | Bedrock | Y |
| 6707731 | 566614 | 4848423 | 396.3 | 391.3 | 436.59 | 445.32 | n/a | n/a | Bedrock | Y |
| 6700741 | 568764 | 4849146 | 420.3 | 415.3 | 436.75 | 436.38 | n/a | n/a | Bedrock | Y |
| 6707861 | 568664 | 4848923 | 409.6 | 404.6 | 436.82 | 434.84 | n/a | n/a | Bedrock | Y |
| 6706900 | 568564 | 4848773 | 389.7 | 384.7 | 437.27 | 434.15 | n/a | n/a | Bedrock | Y |
| 6707558 | 568814 | 4849723 | 408.1 | 403.1 | 438.42 | 441.80 | n/a | n/a | Bedrock | Y |

| Well Name | Easting | Northing | Screen/ Open Interval Top (masl) | Screen/ Open Interval Bottom (masl) | Estimated Observed Water Level (0 m$^3$/day) (masl)[1] | Simulated Average Water Level (0 m$^3$/day) (masl) | Estimated Observed Drawdown (0 to 890 m$^3$/day) (m) | Simulated Drawdown (0 to 890 m$^3$/day) (m) | Interpreted Aquifer System | WWIS Target from Tier Three Assessment (Y/N) |
|---|---|---|---|---|---|---|---|---|---|---|
| 6708148 | 569542 | 4850082 | 411.8 | 406.8 | 439.05 | 440.72 | n/a | n/a | Bedrock | Y |
| 6710805 | 570293.3 | 4849525 | 406.3 | 401.3 | 439.84 | 431.53 | n/a | n/a | Bedrock | Y |
| 6707164 | 568564.3 | 4848823 | 422.8 | 417.8 | 440.63 | 434.39 | n/a | n/a | Bedrock | Y |
| 6706584 | 568814.3 | 4849373 | 394.6 | 389.6 | 441.5 | 438.28 | n/a | n/a | Bedrock | Y |
| 6708389 | 567929.3 | 4848635 | 412.8 | 407.8 | 441.99 | 437.64 | n/a | n/a | Bedrock | Y |
| 6709580 | 566837.3 | 4848885 | 424.7 | 419.7 | 442.5 | 447.87 | n/a | n/a | Bedrock | Y |
| 6707858 | 568614.3 | 4849323 | 422.0 | 417.0 | 443.05 | 439.51 | n/a | n/a | Bedrock | Y |
| 6710531 | 566141.3 | 4848004 | 418.4 | 413.4 | 443.2 | 443.66 | n/a | n/a | Bedrock | Y |
| 6708826 | 568676.3 | 4849428 | 440.4 | 435.4 | 443.75 | 445.20 | n/a | n/a | Overburden | Y |
| 6704718 | 567064.3 | 4849503 | 385.7 | 380.7 | 444.03 | 451.00 | n/a | n/a | Bedrock | Y |
| 6703364 | 568294.3 | 4849423 | 406.7 | 401.7 | 444.77 | 442.39 | n/a | n/a | Bedrock | Y |
| 6708396 | 570346.3 | 4848685 | 404.4 | 399.4 | 444.91 | 422.35 | n/a | n/a | Bedrock | Y |
| 6709726 | 566740.3 | 4848952 | 420.4 | 415.4 | 445.69 | 448.98 | n/a | n/a | Bedrock | Y |
| 6703961 | 567144.3 | 4849103 | 425.5 | 420.5 | 447.09 | 447.62 | n/a | n/a | Bedrock | Y |
| 6705915 | 567864.3 | 4849643 | 418.3 | 413.3 | 448.1 | 447.42 | n/a | n/a | Bedrock | Y |
| 6709502 | 568399.3 | 4849055 | 452.6 | 447.6 | 448.48 | 444.56 | n/a | n/a | Overburden | Y |
| 6705909 | 568614.3 | 4849343 | 412.2 | 407.2 | 450.12 | 439.69 | n/a | n/a | Bedrock | Y |
| 6703169 | 567474.3 | 4850243 | 426.3 | 421.3 | 450.97 | 454.46 | n/a | n/a | Bedrock | Y |
| 6705933 | 568514.3 | 4849213 | 429.4 | 424.4 | 453.39 | 444.89 | n/a | n/a | Overburden | Y |
| 6708663 | 566580.3 | 4849279 | -112.6 | -117.6 | 454.56 | 449.94 | n/a | n/a | Bedrock | Y |
| 6705633 | 567564.3 | 4850323 | 427.6 | 422.6 | 456 | 454.57 | n/a | n/a | Bedrock | Y |
| 1700164 | 565046.3 | 4851813 | 412.1 | 407.1 | 459.38 | 468.64 | n/a | n/a | Bedrock | Y |
| 1700172 | 565445.3 | 4852268 | 405.0 | 400.0 | 461.84 | 469.78 | n/a | n/a | Bedrock | Y |
| 6700640 | 565813.3 | 4846073 | 404.6 | 399.6 | 426.14 | 426.67 | n/a | n/a | Bedrock | Y |
| 6700641 | 564344.3 | 4847545 | 404.0 | 399.0 | 443.3 | 443.36 | n/a | n/a | Bedrock | Y |

| Well Name | Easting | Northing | Screen/ Open Interval Top (masl) | Screen/ Open Interval Bottom (masl) | Estimated Observed Water Level (0 $m^3$/day) (masl)[1] | Simulated Average Water Level (0 $m^3$/day) (masl) | Estimated Observed Drawdown (0 to 890 $m^3$/day) (m) | Simulated Drawdown (0 to 890 $m^3$/day) (m) | Interpreted Aquifer System | WWIS Target from Tier Three Assessment (Y/N) |
|---|---|---|---|---|---|---|---|---|---|---|
| 6700642 | 563881.3 | 4847890 | 414.9 | 409.9 | 444.62 | 449.33 | n/a | n/a | Overburden | Y |
| 6700659 | 566250.3 | 4845950 | 390.0 | 385.0 | 418.27 | 423.45 | n/a | n/a | Bedrock | Y |
| 6700680 | 565311.3 | 4848647 | 419.0 | 414.0 | 454.22 | 452.09 | n/a | n/a | Bedrock | Y |
| 6700681 | 565157.3 | 4850516 | 408.2 | 403.2 | 460.24 | 463.26 | n/a | n/a | Bedrock | Y |
| 6700715 | 565859.3 | 4850112 | 409.4 | 404.4 | 463.28 | 459.92 | n/a | n/a | Bedrock | Y |
| 6700716 | 566175.3 | 4849703 | 429.4 | 424.4 | 458.96 | 456.76 | n/a | n/a | Bedrock | Y |
| 6700743 | 567632.3 | 4851670 | 434.3 | 429.3 | 454.95 | 461.66 | n/a | n/a | Bedrock | Y |
| 6700744 | 567203.3 | 4850833 | 429.5 | 424.5 | 455.47 | 459.32 | n/a | n/a | Bedrock | Y |
| 6700745 | 566981.3 | 4852503 | 421.0 | 416.0 | 460 | 467.34 | n/a | n/a | Bedrock | Y |
| 6700747 | 565321.3 | 4851775 | 403.6 | 398.6 | 464.22 | 468.17 | n/a | n/a | Bedrock | Y |
| 6700773 | 567955.3 | 4851858 | 421.8 | 416.8 | 454.26 | 460.91 | n/a | n/a | Bedrock | Y |
| 6703203 | 567564.3 | 4851973 | 404.5 | 399.5 | 459.04 | 463.10 | n/a | n/a | Bedrock | Y |
| 6704116 | 566354.3 | 4845803 | 390.3 | 385.3 | 424.23 | 421.02 | n/a | n/a | Bedrock | Y |
| 6704424 | 566064.3 | 4845973 | 404.9 | 399.9 | 428.94 | 424.71 | n/a | n/a | Bedrock | Y |
| 6704723 | 566314.3 | 4851523 | 390.2 | 385.2 | 466.02 | 465.26 | n/a | n/a | Bedrock | Y |
| 6704905 | 566645.3 | 4845263 | 388.3 | 383.3 | 420.29 | 415.69 | n/a | n/a | Bedrock | Y |
| 6705292 | 569160.3 | 4851037 | 421.1 | 416.1 | 441.9 | 449.56 | n/a | n/a | Bedrock | Y |
| 6705636 | 564751.3 | 4851073 | 404.9 | 399.9 | 474.87 | 465.93 | n/a | n/a | Bedrock | Y |
| 6705651 | 569064.3 | 4851203 | 418.8 | 413.8 | 444.56 | 451.24 | n/a | n/a | Bedrock | Y |
| 6705992 | 565614.3 | 4852373 | 419.2 | 414.2 | 464.12 | 470.02 | n/a | n/a | Bedrock | Y |
| 6706037 | 564994.3 | 4849543 | 419.7 | 414.7 | 463.65 | 458.75 | n/a | n/a | Bedrock | Y |
| 6706280 | 568514.3 | 4851073 | 419.7 | 414.7 | 450.93 | 453.83 | n/a | n/a | Bedrock | Y |
| 6706917 | 566364.3 | 4845623 | 394.2 | 389.2 | 416.7 | 418.70 | n/a | n/a | Bedrock | Y |
| 6707158 | 565714.3 | 4847773 | 380.6 | 375.6 | 442.29 | 443.10 | n/a | n/a | Bedrock | Y |
| 6707159 | 566164.3 | 4849373 | 393.8 | 388.8 | 459.55 | 454.63 | n/a | n/a | Bedrock | Y |

| Well Name | Easting | Northing | Screen/ Open Interval Top (masl) | Screen/ Open Interval Bottom (masl) | Estimated Observed Water Level (0 $m^3$/day) (masl)[1] | Simulated Average Water Level (0 $m^3$/day) (masl) | Estimated Observed Drawdown (0 to 890 $m^3$/day) (m) | Simulated Drawdown (0 to 890 $m^3$/day) (m) | Interpreted Aquifer System | WWIS Target from Tier Three Assessment (Y/N) |
|---|---|---|---|---|---|---|---|---|---|---|
| 6707352 | 566614.3 | 4850023 | 424.7 | 419.7 | 457.27 | 456.91 | n/a | n/a | Bedrock | Y |
| 6707355 | 565564.3 | 4846473 | 405.4 | 400.4 | 431.85 | 431.37 | n/a | n/a | Bedrock | Y |
| 6707430 | 565614.3 | 4847523 | 410.1 | 405.1 | 448.34 | 441.47 | n/a | n/a | Bedrock | Y |
| 6707560 | 566014.3 | 4845923 | 395.8 | 390.8 | 422.57 | 424.53 | n/a | n/a | Bedrock | Y |
| 6707561 | 568064.3 | 4851723 | 438.9 | 433.9 | 458.37 | 474.28 | n/a | n/a | Overburden | Y |
| 6707773 | 565314.3 | 4847173 | 389.5 | 384.5 | 444.23 | 438.99 | n/a | n/a | Bedrock | Y |
| 6707819 | 567014.3 | 4845023 | 400.6 | 395.6 | 408.64 | 411.86 | n/a | n/a | Bedrock | Y |
| 6707822 | 564364.3 | 4847173 | 386.7 | 381.7 | 441.02 | 440.18 | n/a | n/a | Bedrock | Y |
| 6708157 | 567474.3 | 4844928 | 391.5 | 386.5 | 404.05 | 407.90 | n/a | n/a | Bedrock | Y |
| 6708352 | 565637.3 | 4848328 | 414.3 | 409.3 | 449.23 | 448.52 | n/a | n/a | Bedrock | Y |
| 6708361 | 567663.3 | 4852044 | 408.4 | 403.4 | 455.75 | 462.96 | n/a | n/a | Bedrock | Y |
| 6708485 | 564282.3 | 4849595 | 393.9 | 388.9 | 451.82 | 458.60 | n/a | n/a | Bedrock | Y |
| 6708605 | 566441.3 | 4845353 | 398.2 | 393.2 | 416.62 | 417.22 | n/a | n/a | Bedrock | Y |
| 6708810 | 568727.3 | 4851931 | 431.3 | 426.3 | 449.54 | 456.94 | n/a | n/a | Bedrock | Y |
| 6708813 | 566764.3 | 4850893 | 406.8 | 401.8 | 466.37 | 461.14 | n/a | n/a | Bedrock | Y |
| 6709022 | 565901.3 | 4851735 | 428.9 | 423.9 | 466.4 | 466.07 | n/a | n/a | Bedrock | Y |
| 6709034 | 565457.3 | 4847352 | 385.8 | 380.8 | 441.3 | 440.27 | n/a | n/a | Bedrock | Y |
| 6709048 | 565230.3 | 4847040 | 369.2 | 364.2 | 423.13 | 437.65 | n/a | n/a | Bedrock | Y |
| 6709218 | 564239.3 | 4850302 | 422.4 | 417.4 | 465.09 | 475.73 | n/a | n/a | Overburden | Y |
| 6709339 | 565376.3 | 4849091 | 431.7 | 426.7 | 469.27 | 456.42 | n/a | n/a | Bedrock | Y |
| 6709340 | 564272.3 | 4847648 | 410.1 | 405.1 | 445.79 | 444.25 | n/a | n/a | Bedrock | Y |
| 6709534 | 566308.3 | 4851112 | 401.7 | 396.7 | 459.4 | 463.56 | n/a | n/a | Bedrock | Y |
| 6709547 | 567166.3 | 4850473 | 429.4 | 424.4 | 458.27 | 457.40 | n/a | n/a | Bedrock | Y |
| 6709550 | 567300.3 | 4850524 | 430.7 | 425.7 | 455.73 | 457.15 | n/a | n/a | Bedrock | Y |
| 6709710 | 565525.3 | 4846488 | 407.9 | 402.9 | 432.88 | 431.77 | n/a | n/a | Bedrock | Y |

| Well Name | Easting | Northing | Screen/ Open Interval Top (masl) | Screen/ Open Interval Bottom (masl) | Estimated Observed Water Level (0 m$^3$/day) (masl)[1] | Simulated Average Water Level (0 m$^3$/day) (masl) | Estimated Observed Drawdown (0 to 890 m$^3$/day) (m) | Simulated Drawdown (0 to 890 m$^3$/day) (m) | Interpreted Aquifer System | WWIS Target from Tier Three Assessment (Y/N) |
|---|---|---|---|---|---|---|---|---|---|---|
| 6709893 | 565049.3 | 4847570 | 412.1 | 407.1 | 449.39 | 443.19 | n/a | n/a | Bedrock | Y |
| 6709978 | 564506.3 | 4847273 | 393.4 | 388.4 | 441.98 | 441.01 | n/a | n/a | Bedrock | Y |
| 6710065 | 564146.3 | 4850498 | 427.5 | 422.5 | 469.29 | 476.52 | n/a | n/a | Overburden | Y |
| 6710067 | 565468.3 | 4848429 | 416.5 | 411.5 | 458 | 449.81 | n/a | n/a | Bedrock | Y |
| 6710546 | 564434.3 | 4850584 | 423.7 | 418.7 | 466 | 464.08 | n/a | n/a | Bedrock | Y |
| 6710799 | 568444.3 | 4851098 | 432.9 | 427.9 | 451.16 | 454.48 | n/a | n/a | Bedrock | Y |
| 6711062 | 566306.3 | 4845341 | 400.5 | 395.5 | 420.22 | 417.98 | n/a | n/a | Bedrock | Y |
| 6711071 | 565510.3 | 4847164 | 396.0 | 391.0 | 436.92 | 438.27 | n/a | n/a | Bedrock | Y |
| 6711385 | 566022.3 | 4846371 | 385.8 | 380.8 | 429.01 | 428.27 | n/a | n/a | Bedrock | Y |
| 6711710 | 565084.3 | 4848643 | 416.0 | 411.0 | 450.78 | 452.29 | n/a | n/a | Bedrock | Y |
| 6711782 | 569686.3 | 4850657 | 402.2 | 397.2 | 447.44 | 444.42 | n/a | n/a | Bedrock | Y |
| 6712042 | 566148.3 | 4845576 | 404.0 | 399.0 | 419.21 | 420.52 | n/a | n/a | Bedrock | Y |
| 6712152 | 567648.3 | 4851940 | 405.2 | 400.2 | 461.75 | 462.60 | n/a | n/a | Bedrock | Y |
| 6712423 | 566797.3 | 4845155 | 403.2 | 398.2 | 412.25 | 414.15 | n/a | n/a | Bedrock | Y |
| 6712438 | 567279.3 | 4844805 | 391.2 | 386.2 | 406.22 | 407.99 | n/a | n/a | Bedrock | Y |

n/a information not available

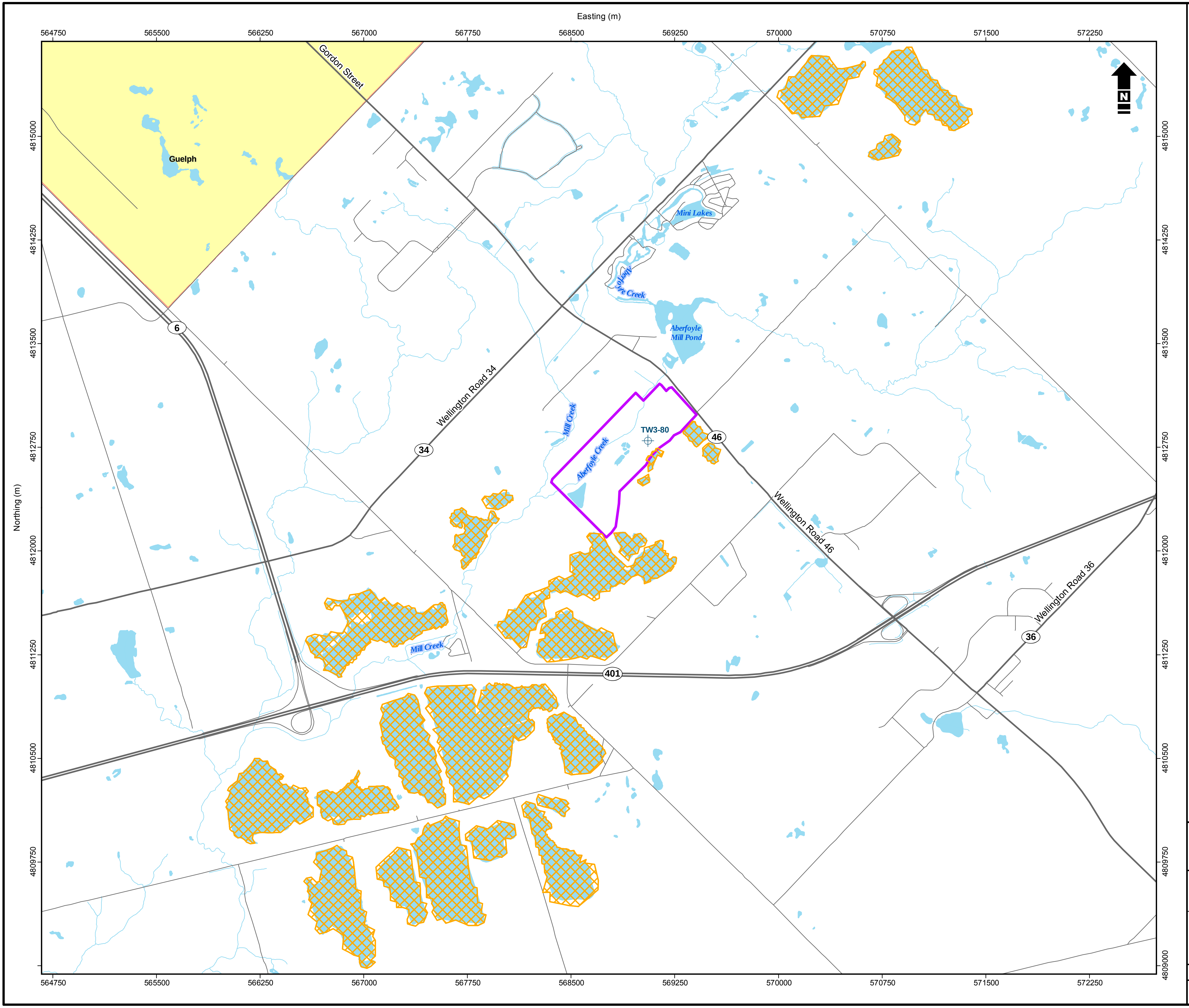
WWIS – Water Well Information System

Masl – meters above sea level

[1] Observed water levels for WWIS wells represent values collected over different time periods and potentially under different regional pumping conditions

# APPENDIX B

# Hydraulic Conductivity Updates



🟪 Nestlé Waters Canada Property Boundary
🟨 Community
Water Body
Watercourse
Highway
Road
⌖ Production Well

**Conductivity Zone Update**

▨ Kx = 1x10$^{-1}$ m/s
▨ Ky = 1x10$^{-1}$ m/s

Reference: Contains information licensed under the Open Government Licence – Ontario and information made available under the copyright © of Grand River Conservation Authority Open Data Licence v3.0. Service Layer Credits:

1:27,500 metres
290 0 290 580
NAD 1983 UTM Zone 17N

**Matrix Solutions Inc.**
ENVIRONMENT & ENGINEERING

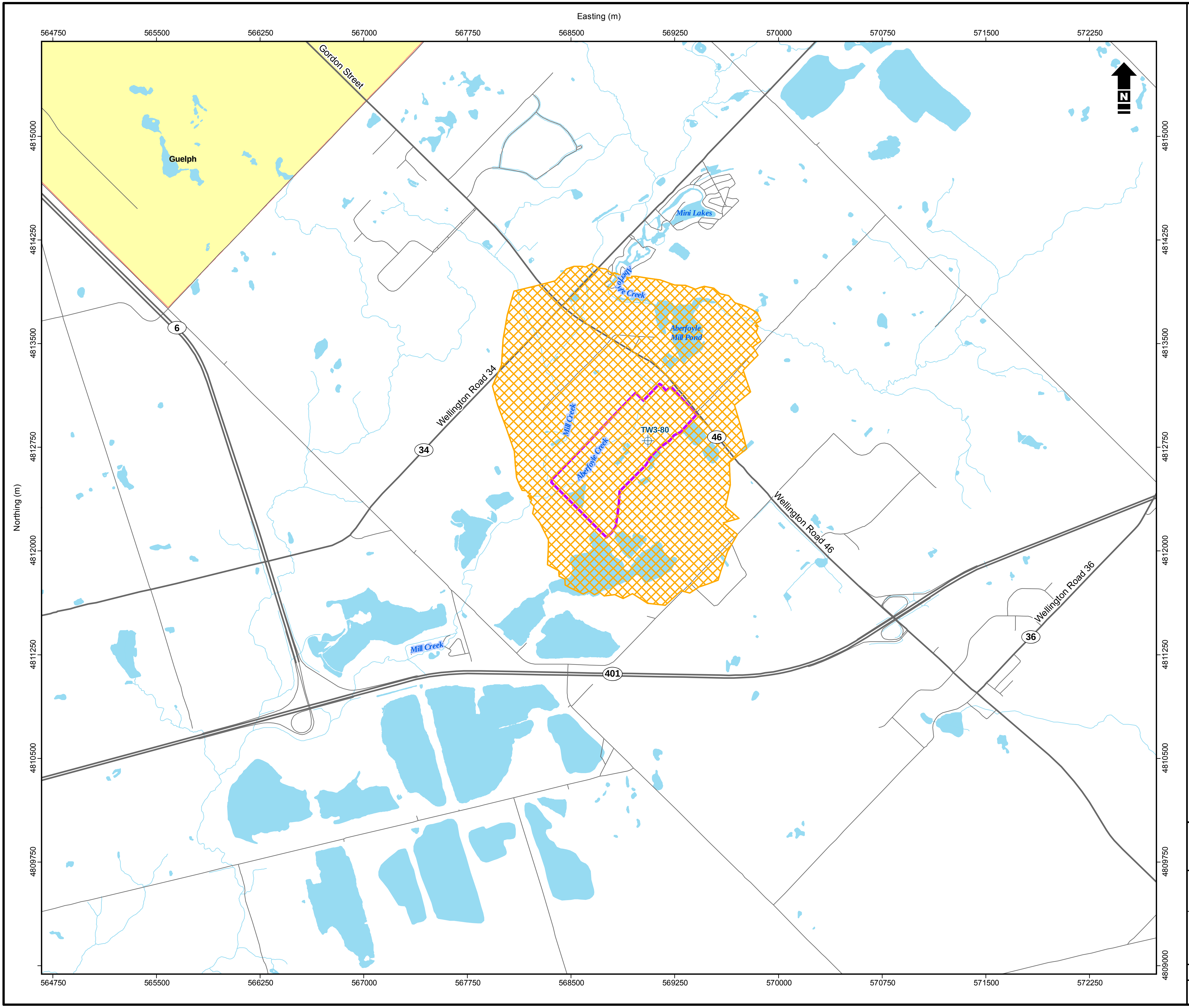
City of Guelph
Groundwater Modelling Report for Renewal of the Permit to Take Water for the Nestle Waters Canada Aberfoyle and Erin Facilities

# Aberfoyle - Hydraulic Conductivity Updates Coarser Grained Overburden Deposits (Layer 1 and 2)

| Date: | Project: | Submitter: | Reviewer: |
|---|---|---|---|
| September 2018 | 26435 | J. Melchin | D. Van Vliet |

Figure
B1

I:\CityofGuelph\26435\FiguresandTables\QHG\2018\Report\Appendix B\Figure-B1-Aberfoyle_Hydraulic_Conductivity_Updates_Coarser_Grained_Overburden_Deposits_Layer_1_and_2.mxd - Tabloid_L - 07-Sep-18, 04:27 PM - ccurry - TID005



🟪 Nestlé Waters Canada Property Boundary
🟨 Community
Water Body
Watercourse
Highway
Road
⌖ Production Well

**Conductivity Zone Update**

▨ Kx = 2x10$^{-7}$ m/s
▨ Ky = 1x10$^{-7}$ m/s

Reference: Contains information licensed under the Open Government Licence – Ontario and information made available under the copyright © of Grand River Conservation Authority Open Data Licence v3.0. Service Layer Credits:

1:27,500 metres
290 0 290 580
NAD 1983 UTM Zone 17N

Matrix Solutions Inc.
ENVIRONMENT & ENGINEERING

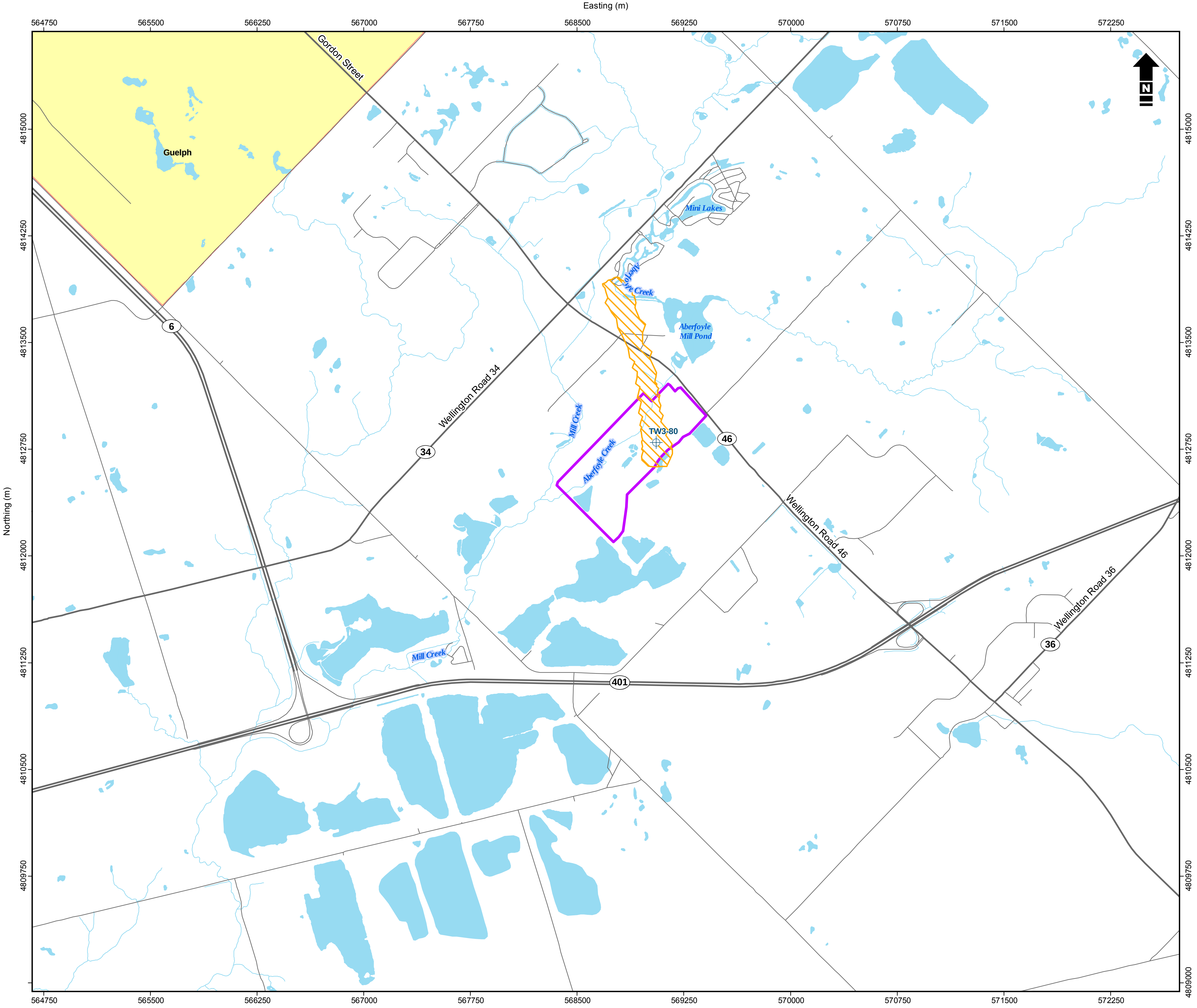
City of Guelph
Groundwater Modelling Report for Renewal of the Permit to Take Water for the Nestle Waters Canada Aberfoyle and Erin Facilities

# Aberfoyle - Hydraulic Conductivity Updates Finer-Grained Overburden Deposits (Layer 3)

| Date: | Project: | Submitter: | Reviewer: |
|---|---|---|---|
| September 2018 | 26435 | J. Melchin | D. Van Vliet |

Figure
B2

I:\CityofGuelph\26435\FiguresandTables\QHG\2018\Report\Appendix B\Figure-B2-Aberfoyle_Hydraulic_Conductivity_Updates_Finer_Grained_Overburden_Deposits_Layer_3.mxd - Tabloid_L - 07-Sep-18, 04:28 PM - ccury - TID005



- ☐ Nestlé Waters Canada Property Boundary
- ☐ Community
- Water Body
- Watercourse
- Highway
- Road
- ⌖ Production Well

**Conductivity Zone Update**

- ▨ Ky = 3x10$^{-7}$ m/s

Reference: Contains information licensed under the Open Government Licence – Ontario and information made available under the copyright © of Grand River Conservation Authority Open Data Licence v3.0. Service Layer Credits:

1:27,500 metres
290 0 290 580
NAD 1983 UTM Zone 17N

Matrix Solutions Inc.
ENVIRONMENT & ENGINEERING

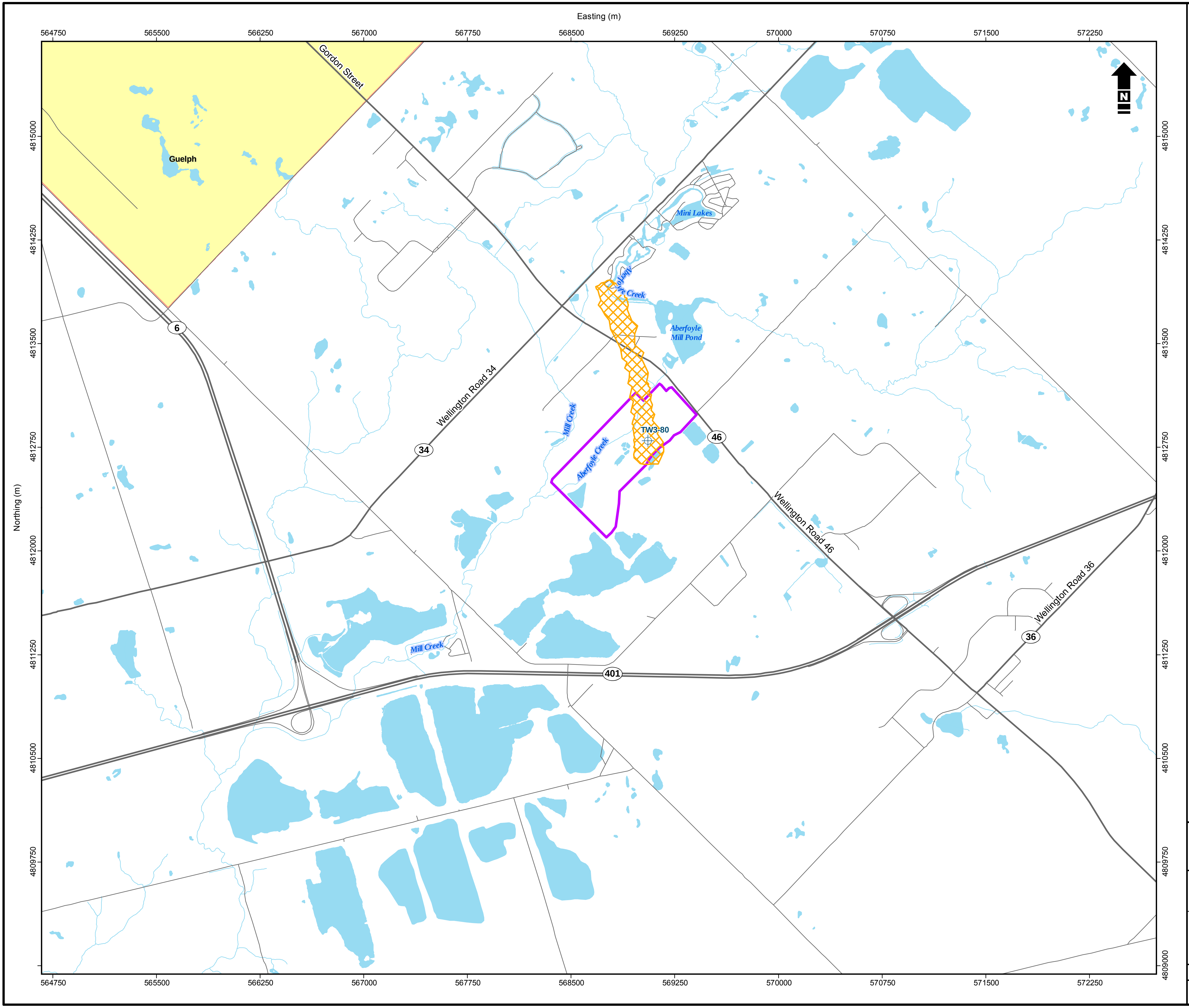
City of Guelph
Groundwater Modelling Report for Renewal of the Permit to Take
Water for the Nestle Waters Canada Aberfoyle and Erin Facilities

# Aberfoyle - Hydraulic Conductivity Updates Guelph Fm and Reformatory Quarry Mbr. of Eramosa Fm. (Layer 5 and 6)

| Date: | Project: | Submitter: | Reviewer: |
|---|---|---|---|
| September 2018 | 26435 | J. Melchin | D. Van Vliet |

Figure
B3

I:\CityofGuelph\26435\FiguresandTables\QHG\2018\Report\Appendix B\Figure-B3-Aberfoyle_Hydraulic_Conductivity_Updates_Guelph_Fm_and_Reformatory_Quarry_Mbr_of_Eramosa_Formation_Layer_5_and_6.mxd - Tabloid_L - 13-Sep-18, 02:37 PM - ccurry - TID005



□ Nestlé Waters Canada Property Boundary
▭ Community
Water Body
Watercourse
Highway
Road
⊕ Production Well

**Conductivity Zone Update**

▨ Kx = 3x10$^{-6}$ m/s
▨ Ky = 3x10$^{-7}$ m/s

Reference: Contains information licensed under the Open Government Licence – Ontario and information made available under the copyright © of Grand River Conservation Authority Open Data Licence v3.0. Service Layer Credits:

1:27,500 metres
290 0 290 580
NAD 1983 UTM Zone 17N

Matrix Solutions Inc.
ENVIRONMENT & ENGINEERING

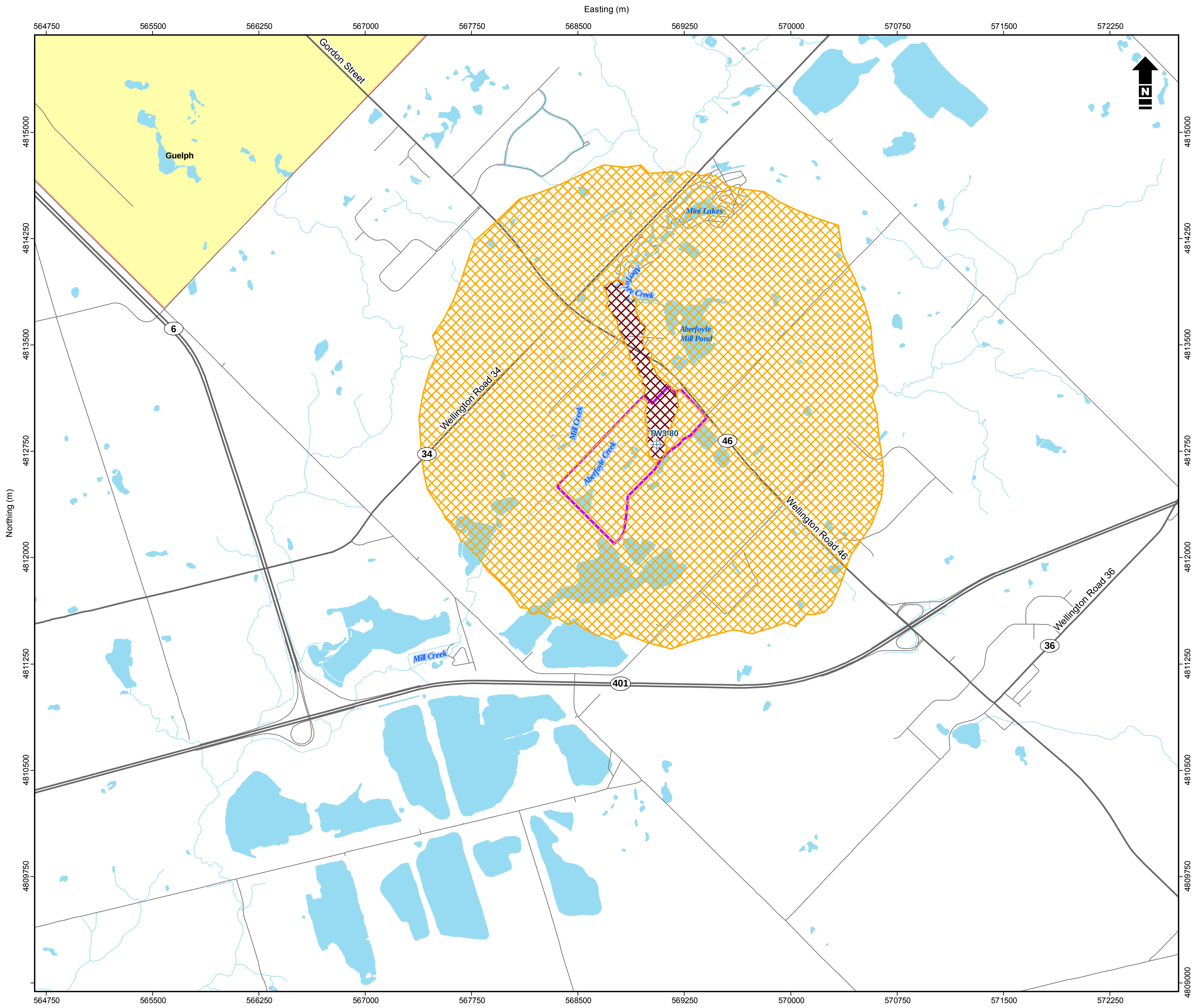
City of Guelph
Groundwater Modelling Report for Renewal of the Permit to Take Water for the Nestle Waters Canada Aberfoyle and Erin Facilities

# Aberfoyle - Hydraulic Conductivity Updates Vinemount Mbr. of Eramosa Fm. (Layers 7 to 9)

| Date: | Project: | Submitter: | Reviewer: |
|---|---|---|---|
| September 2018 | 26435 | J. Melchin | D. Van Vliet |

Figure
B4

I:\CityofGuelph\26435\FiguresandTables\QHG\2018\Report\Appendix B\Figure-B4-Aberfoyle_Hydraulic_Conductivity_Updates_Vinemount_Mbr_of_Eramosa_Fm_Layer_7_to_9.mxd - Tabloid_L - 13-Sep-18, 02:37 PM - ccurry - TID005



Reference: Contains information licensed under the Open Government Licence – Ontario and information made available under the copyright © of Grand River Conservation Authority Open Data Licence v3.0. Service Layer Credits:

Matrix Solutions Inc.
ENVIRONMENT & ENGINEERING

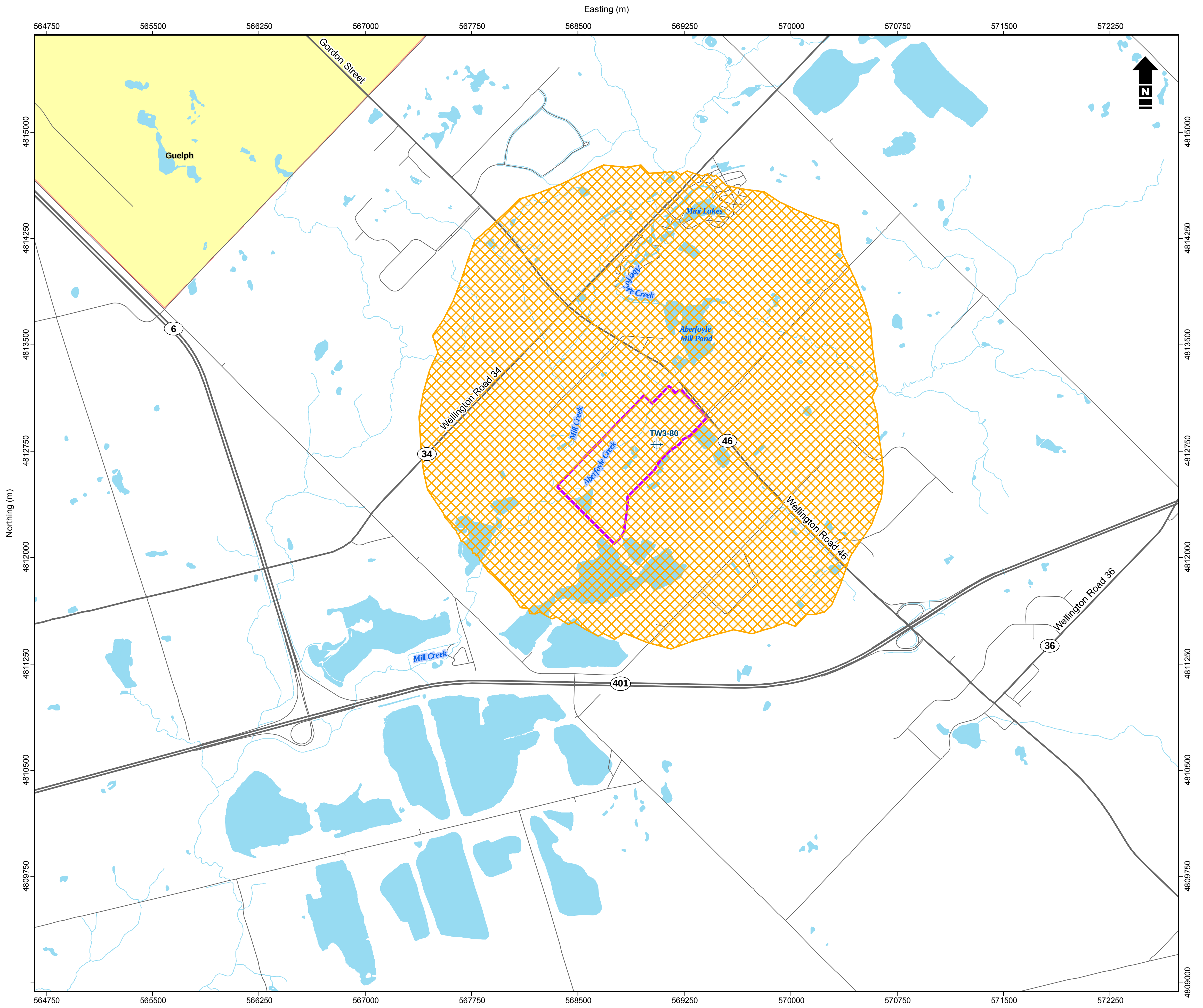
City of Guelph
Groundwater Modelling Report for Renewal of the Permit to Take Water for the Nestle Waters Canada Aberfoyle and Erin Facilities

# Aberfoyle - Hydraulic Conductivity Updates
# Goat Island Fm.
# (Layers 10)

| Date: | Project: | Submitter: | Reviewer: |
|---|---|---|---|
| September 2018 | 26435 | J. Melchin | D. Van Vliet |

Figure
B5

I:\CityofGuelph\26435\FiguresandTables\QHG\2018\Report\Appendix B\Figure-B5-Aberfoyle_Hydraulic_Conductivity_Updates_Goat_Island_Fm.mxd - Tabloid_L - 13-Sep-18, 02:36 PM - ccury - TID005



Reference: Contains information licensed under the Open Government Licence – Ontario and information made available under the copyright © of Grand River Conservation Authority Open Data Licence v3.0. Service Layer Credits:

Matrix Solutions Inc.
ENVIRONMENT & ENGINEERING

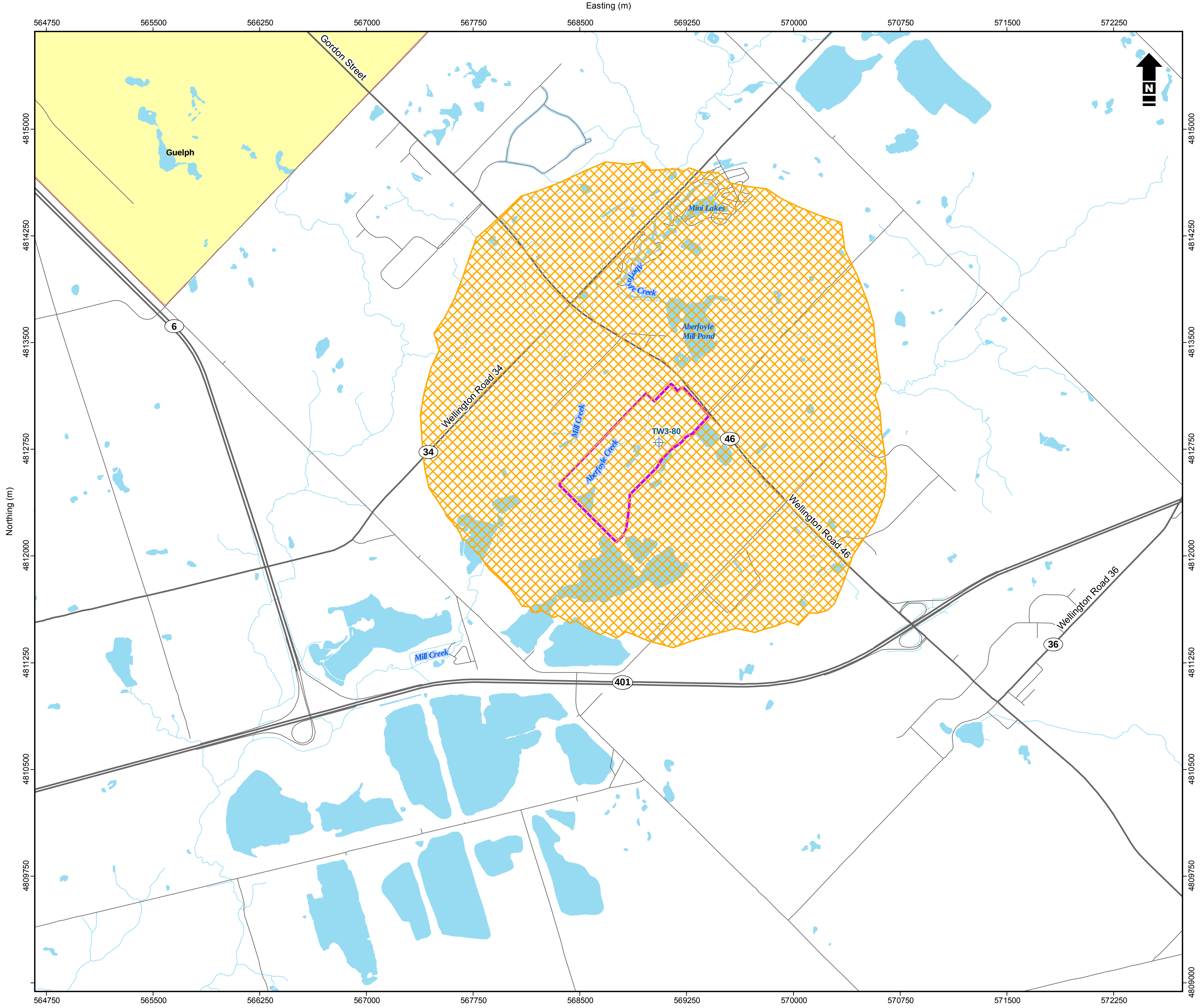
City of Guelph
Groundwater Modelling Report for Renewal of the Permit to Take Water for the Nestle Waters Canada Aberfoyle and Erin Facilities

# Aberfoyle - Hydraulic Conductivity Updates Upper and Lower Gasport Fm. (Layers 11 and 13)

| Date: | Project: | Submitter: | Reviewer: |
|---|---|---|---|
| September 2018 | 26435 | J. Melchin | D. Van Vliet |

Figure
B6

I:\CityofGuelph\26435\FiguresandTables\QHG\2018\Report\Appendix B\Figure-B6-Aberfoyle_Hydraulic_Conductivity_Updates_Upper_and_Lower_Gasport_Fm_Layer_11_and_13.mxd - Tabloid_L - 13-Sep-18, 02:36 PM - ccury - TID005



- 🟪 Nestlé Waters Canada Property Boundary
- 🟨 Community
- Water Body
- Watercourse
- Highway
- Road
- ⌖ Production Well

**Conductivity Zone Update**

- ▨ Kx = 1x10$^{-7}$ m/s
- ▨ Ky = 1x10$^{-8}$ m/s

Reference: Contains information licensed under the Open Government Licence – Ontario and information made available under the copyright © of Grand River Conservation Authority Open Data Licence v3.0. Service Layer Credits:

1:27,500 metres
290 0 290 580
NAD 1983 UTM Zone 17N

Matrix Solutions Inc.
ENVIRONMENT & ENGINEERING

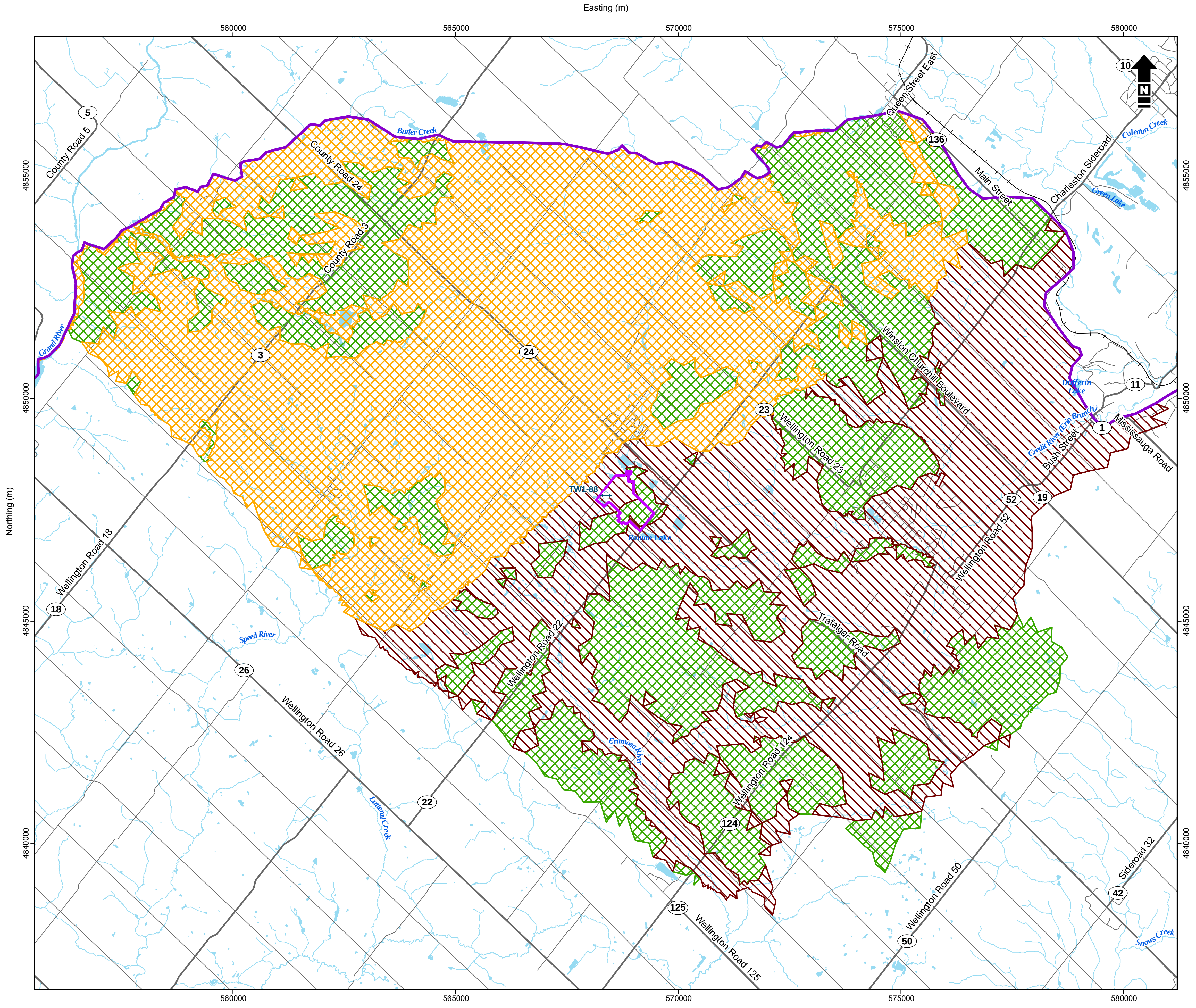
City of Guelph
Groundwater Modelling Report for Renewal of the Permit to Take
Water for the Nestle Waters Canada Aberfoyle and Erin Facilities

## Aberfoyle - Hydraulic Conductivity Updates
## Middle Gasport Fm.
## (Layers 12)

| Date: | Project: | Submitter: | Reviewer: |
|---|---|---|---|
| September 2018 | 26435 | J. Melchin | D. Van Vliet |

Figure
B7

I:\CityofGuelph\26435\FiguresandTables\QHG\2018\Report\Appendix B\Figure-B7-Aberfoyle_Hydraulic_Conductivity_Updates_Middle_Gasport_Fm_Layer_12.mxd - Tabloid_L - 13-Sep-18, 02:36 PM - ccurry - TID005



🟪 Nestlé Waters Canada Property Boundary
Tier Three Model Boundary
Water Body
Watercourse
Highway
Road
Industry Road
Railway
⌖ Production Well

**Conductivity Zone Update**

**Zone 1**

$K_x = 1x10^{-4}$ m/s
$K_y = 1x10^{-5}$ m/s

**Zone 2**

$K_y = 1x10^{-5}$ to $5x10^{-5}$ m/s

**Zone 3**

$K_x = 5x10^{-6}$ m/s
$K_y = 5x10^{-7}$ m/s

Reference: Contains information licensed under the Open Government Licence – Ontario. Data obtained from Grand River Conservation Authority used under license.
Service Layer Credits:

1:87,500 metres
900 0 900 1,800
NAD 1983 UTM Zone 17N

Matrix Solutions Inc.
ENVIRONMENT & ENGINEERING

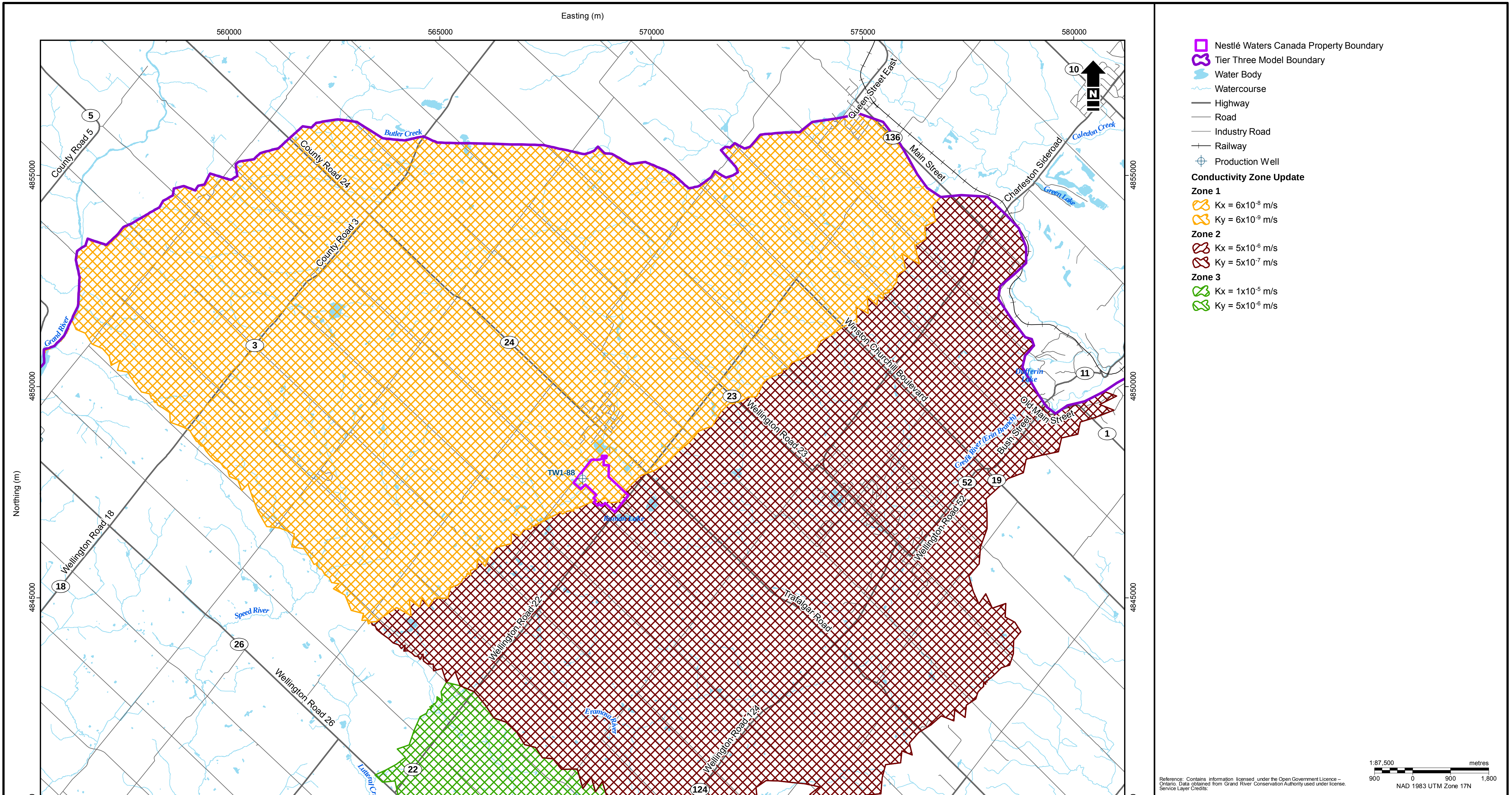
City of Guelph
Groundwater Modelling Report for Renewal of the Permit to Take Water for the Nestle Waters Canada Aberfoyle and Erin Facilities

# Erin Hydraulic Conductivity Updates Coarser-Grained Overburden Deposits (Layer 1 and 2)

| Date: | Project: | Submitter: | Reviewer: |
|---|---|---|---|
| September 2018 | 26435 | J. Melchin | D. Van Vliet |

Figure
B8

I:\CityofGuelph\26435\FiguresandTables\QHG\2018\Report\Appendix B\Figure-B8-Erin_Hydraulic_Conductivity_Updates_Coarser_Grained_Overburden_Deposits_Layer_1_and_2.mxd - Tabloid_L - 12-Sep-18, 08:17 AM - ccurry - TID005



Reference: Contains information licensed under the Open Government Licence – Ontario. Data obtained from Grand River Conservation Authority used under license.
Service Layer Credits:

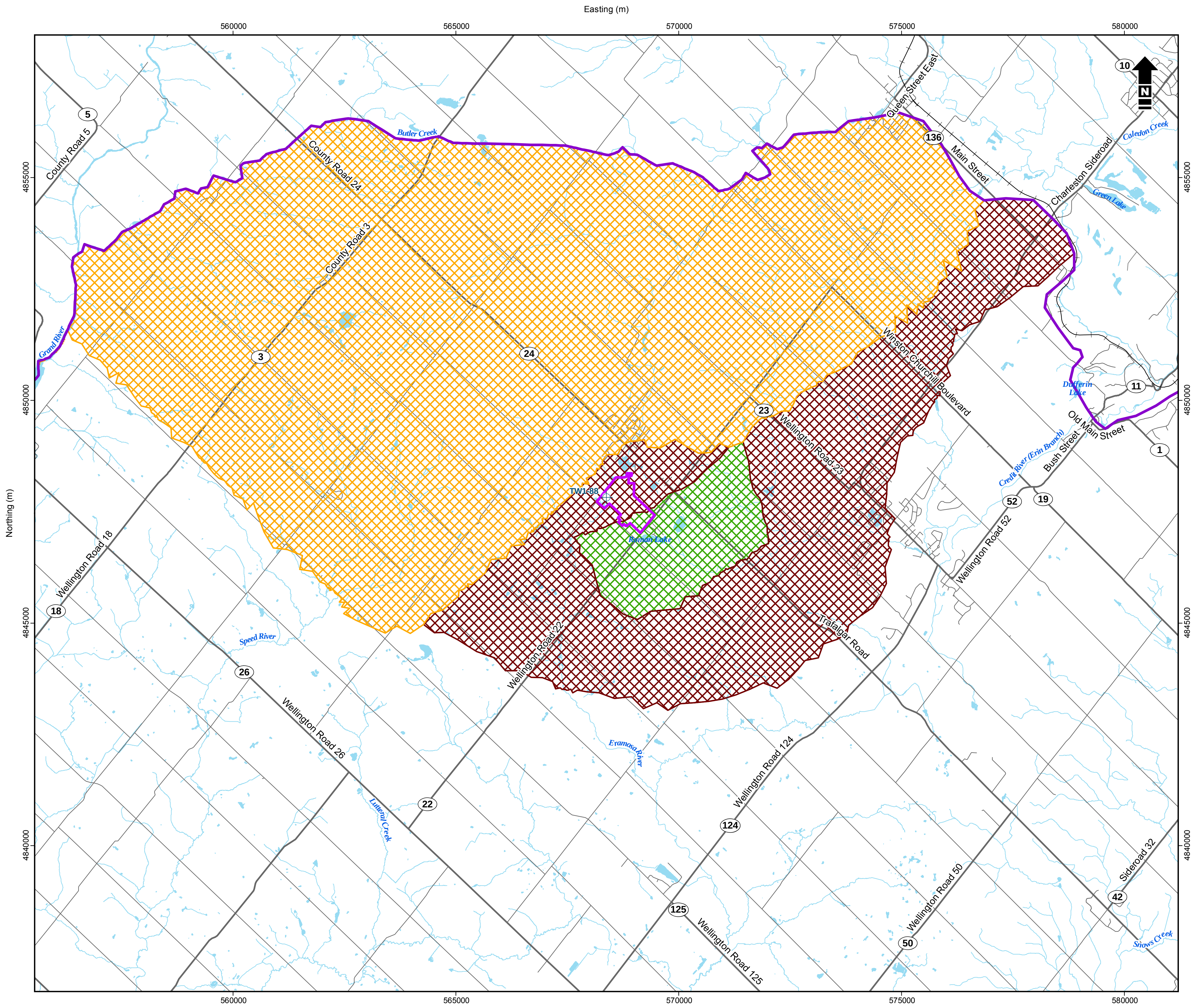
Matrix Solutions Inc.
ENVIRONMENT & ENGINEERING

City of Guelph
Groundwater Modelling Report for Renewal of the Permit to Take
Water for the Nestle Waters Canada Aberfoyle and Erin Facilities

# Erin Hydraulic Conductivity Updates Finer-Grained Overburden Deposits (Layer 3)

| Date: | Project: | Submitter: | Reviewer: |
|---|---|---|---|
| September 2018 | 26435 | J. Melchin | D. Van Vliet |

Figure
B9



Reference: Contains information licensed under the Open Government Licence – Ontario. Data obtained from Grand River Conservation Authority used under license.
Service Layer Credits:

1:87,500 metres
900 0 900 1,800
NAD 1983 UTM Zone 17N

Matrix Solutions Inc.
ENVIRONMENT & ENGINEERING

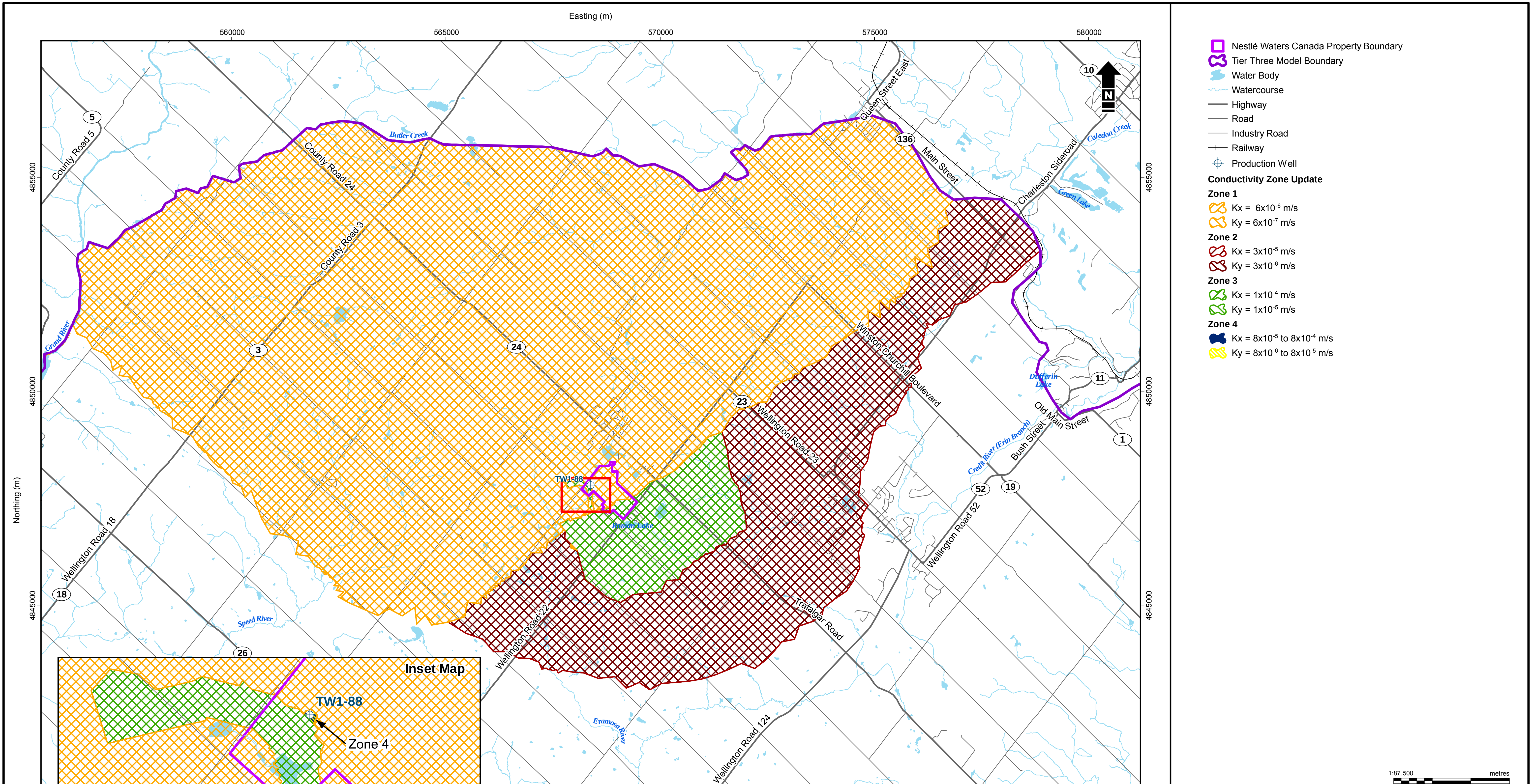
City of Guelph
Groundwater Modelling Report for Renewal of the Permit to Take
Water for the Nestle Waters Canada Aberfoyle and Erin Facilities

# Erin Hydraulic Conductivity Updates
# Contact Zone
# (Layer 4)

| Date: | Project: | Submitter: | Reviewer: |
|---|---|---|---|
| September 2018 | 26435 | J. Melchin | D. Van Vliet |

Figure
B10

I:\CityofGuelph\26435\FiguresandTables\QHG\2018\Report\Appendix B\Figure-B10-Erin_Hydraulic_Conductivity_Updates_Contact_Zone_Layer_4.mxd - Tabloid_L - 12-Sep-18, 08:18 AM - ccury - TID005



Reference: Contains information licensed under the Open Government Licence – Ontario. Data obtained from Grand River Conservation Authority used under license.
Service Layer Credits:

Matrix Solutions Inc.
ENVIRONMENT & ENGINEERING

City of Guelph
Groundwater Modelling Report for Renewal of the Permit to Take Water for the Nestle Waters Canada Aberfoyle and Erin Facilities

# Erin Hydraulic Conductivity Updates
# Guelph Fm.
# (Layer 5 through 10)

| Date: | Project: | Submitter: | Reviewer: |
|---|---|---|---|
| September 2018 | 26435 | J. Melchin | D. Van Vliet |

Figure
B11

I:\CityofGuelph\26435\FiguresandTables\QHG\2018\Report\Appendix B\Figure-B11-Erin_Hydraulic_Conductivity_Updates_Guelph_Fm_Layer_5_through_10.mxd - Tabloid_L - 13-Sep-18, 02:37 PM - ccurry - TID005

## APPENDIX L

# Well Interference Protocol

**TOWN OF ERIN**

5684 Wellington Rd. 24, R.R #2
Hillsburgh, Ontario N0B 1Z0

**Office of the Town Manager**

Telephone: (519) 855-4407 ext. 223
Fax: (519) 855-4821
E-mail: lisa.hass@town.erin.on.ca

June 19, 2009

John B. Challinor ll
Director of Corporate Affairs
Nestle Waters Canada
101 Brock Road South
Guelph, ON N1H 6H9

Dear John:

Re: Well Protection Agreement

Please find enclosed two (2) copies of the Well Protection Agreement between Nestle Waters and the Town of Erin.

Please sign and return one (1) copy to this office.

It has been a pleasure working with you on this matter.

Yours truly,

Lisa Hass

Lisa Hass
Town Manager

# WELL PROTECTION AGREEMENT

**THIS AGREEMENT** is made as of June 16, 2009 between The Corporation of the Town of Erin (the "**Town**") and Nestlé Waters Canada, a division of Nestlé Canada Inc. ("**NWC**").

## RECITAL:

The parties wish to set out in this Agreement the procedure and terms on which complaints, if any, that may be raised by the Well Owners about their wells being affected by NWC Operations may be received, investigated and, if found to be caused by NWC Operations, remedied by NWC.

FOR GOOD AND VALUABLE CONSIDERATION the receipt and sufficiency of which is acknowledged, the parties agree as follows:

## 1. Definitions

In this Agreement, unless the context otherwise requires:

"**Agreement**" means this agreement as it may be amended from time to time.

"**Applicant**" has the meaning given to it in Section 3(3).

"**Assessed Owners**" has the meaning given to it in Section 4(1).

"**Business Day**" means any day except Saturday, Sunday or a statutory holiday in the Province of Ontario.

"**Committee**" has the meaning given to it in Section 2.

"**Cone of Depression**" means such area of influence as may be agreed to between the Town and NWC relating to NWC Operations within the Town.

"**Contractor**" has the meaning given to it in Section 5(1).

"**GRCA**" means the Grand River Conservation Authority.

"**including**" means to include without limitation.

"**NWC Operations**" means the present and future operations by NWC of NWC's production water wells in the Town of Erin, County of Wellington, Ontario.

"**Well Owner**" means such owners from time to time who have a water supply well within the Cone of Depression.

## 2. Well Protection Committee

(1) The parties shall establish a committee called the "Well Protection Committee" (the "**Committee**") comprising of five (5) members, being: (a) two (2) members appointed by NWC (each, a "**NWC Member**"); (b) two (2) members appointed by the Town (each, a "**Town Member**"); and (c) one (1) member appointed by the GRCA who is a member of GRCA's board of directors or professional staff (the "**GRCA Member**") (each such person referred to in subsections (a) to (c) above may be referred to as a "**Member**" and, collectively, as the "**Members**"). The Members should, to the extent reasonably possible, have a strong technical understanding of hydrogeology. The Members shall be appointed for a term up of up to four (4) years and may be re-appointed.

(2) The Committee shall meet monthly unless otherwise determined by it. A quorum for a meeting shall be constituted by the attendance of at least: (a) one (1) NWC Member; (b) one (1) Town Member; and (c) the GRCA Member. Members may participate by telephone or by web-based or video conference call or other electronic means (and as a result be deemed to be in attendance) at a meeting of the Committee.

(3) Decisions of the Committee shall require the approval of a majority of those in attendance at a meeting at which a quorum is constituted.

(4) At meetings of the Committee, the Committee shall review any water use or private water well issues relating to NWC Operations. A long-term meeting schedule shall be decided on by the Committee.

(5) The Committee shall keep an active log of all correspondence and arrange for minutes to be prepared of each meeting.

(6) Any Member may call a meeting of the Committee on ten (10) days' prior written notice to the other Members. Such notice shall set out the reason for the meeting and include any relevant documents or information.

## 3. Well Owners

(1) NWC shall prepare and deliver to the Committee a list of the addresses of all current Well Owners. NWC will update such list from time to time as it learns of changes relating to the Well Owners.

(2) NWC shall send a package, approved by the Committee, to each Well Owner consisting of: (a) a letter to the Well Owner describing this Agreement; (b) a copy of this Agreement; (c) a laminated card outlining the process to follow in case of a claim or problem; (d) contact information; and (e) such other information as may be approved by the Committee.

(3) If an owner of a water well located in the Town but outside of the Cone of Depression (the "**Applicant**") wishes to be treated as a Well Owner, such Well Owner may request

this in writing to the Committee. The Committee will review the request. If the Committee, based on scientific evidence, believes that the Applicant may be affected by NWC Operations, the Committee may, in its absolute discretion, decide to deem the Applicant to be a Well Owner despite being outside of the Cone of Depression. In any event, the Committee will inform the Applicant of the Committee's decision. The Committee's decision shall be final.

## 4. Well Assessment

(1) NWC will at its expense arrange for a residential, agricultural or commercial well assessment to be conducted with respect to each Well Owner's well and for owners of properties in the Town immediately adjacent to the Cone of Depression (collectively, the "**Assessed Owners**"). The assessment will include: well location, type of casing and other well construction details, well depth, water level, depth of pump intake, condition of well and pump, history of water quantity and quality issues, source aquifer and municipal address. In conducting the assessment, account will be taken of public information, information from the Assessed Owners and, where appropriate, from actual testing of the well in question.

(2) NWC shall seek permission to access the well, but no formal written site access agreement will be required by NWC, and NWC shall not be required to pay for access rights. If access to the well is limited or denied by the Assessed Owners, then the assessment will still be conducted to the extent possible, but the parties acknowledge that the assessment may be incomplete.

## 5. Well Contractors

(1) NWC shall enter into a contractual arrangement with up to two (2) professional licensed well contractors (a "**Contractor**") to provide the services contemplated of Contractors under this Agreement on a seven (7)-day-a-week basis.

(2) NWC shall deliver to each Contractor a list of the addresses of the Well Owners and a description of the Cone of Depression and provide updates of such list to each Contractor as necessary from time to time.

## 6. Well Owner Complaints

(1) If a Well Owner in good faith believes that the quantity or quality of the water from its well located within the Cone of Depression is being adversely affected by NWC Operations (the "**Problem**"), then the following procedure shall be followed:

(a) the Well Owner shall contact, as soon as possible, one of the Contractors;

(b) such Contractor, at NWC's cost, will respond to all calls within 24 hours; and

(c) the Contractor will deliver five (5) cases of bottled water (consisting of at least 60 litres in total) to the Well Owner at NWC's cost within 24 hours after the Well Owner's call.

(2) NWC will instruct the Contractor to investigate the cause of the Problem as soon as reasonably possible. NWC will continue to provide a suitable alternate water supply to the Well Owner while the Contractor investigates.

(3) If the Contractor determines that the cause of the Problem is a mechanical issue or otherwise unrelated to NWC Operations (a "**Non-NWC Failure**"), then the Contractor will issue a written report to that effect and deliver it to the Well Owner with a copy to the Committee and NWC. There will be no further action by NWC.

(4) If, however, the Contractor does not determine that the Problem is a Non-NWC Failure, then, NWC, at NWC's cost, and to the extent reasonably possible, within 24 hours after receiving the Contractor's report shall: (a) inform the Committee; (b) take all reasonable steps to arrange for an alternative water supply; and (c) arrange for a qualified independent consultant to undertake a scientific study of the Problem.

(5) The scientific study shall be documented in a written report (the "**Report**"), prepared in a timely manner, which summarizes all relevant information regarding the Problem, its cause, and recommendations regarding possible mitigation. The Report must be signed and stamped by a Professional Geoscientist (P.Geo.) or Professional Engineer (P.Eng.) licensed in the Province of Ontario.

(6) NWC shall promptly deliver a copy of the Report to the Committee and the Well Owner.

(7) If the Report concludes that the Problem was materially caused by NWC Operations, then NWC shall so inform the Committee and the Well Owner and NWC shall also promptly provide a copy of the Report to the appropriate Director of the Ontario Ministry of the Environment ("**MOE**"). Subject to subsection 6(8) below, NWC shall promptly take all reasonable steps to remedy the Problem and shall promptly report the details and results of such remedial action to the Committee, the Well Owner and the Director of the MOE.

(8) If the Report concludes that the Problem was materially caused by NWC Operations, NWC shall be entitled to advise the Committee, the Well Owner and the Director of the MOE, at the time that NWC delivers the first Report, that it intends to arrange for a second scientific study and Report in order to obtain a second opinion. NWC will continue to provide the Well Owner with a suitable alternative water supply while the second opinion is being obtained. If the second Report concludes that the Problem was not materially caused by NWC Operations, then NWC shall promptly inform the Committee, the Well Owner and the Director of the MOE of that conclusion in writing and, unless the Well Owner promptly notifies the Committee that the Well Owner disputes the conclusion of the Report, no further action will be required of NWC.

(9) If, however, the Report concludes that the Problem was not materially caused by NWC Operations, then NWC shall promptly inform the Committee and the Well Owner of that conclusion in writing and, unless the Well Owner promptly notifies the Committee that the Well Owner disputes the conclusion of the Report, no further action will be required of NWC.

(10) If the Well Owner disputes the conclusion of the Report or of a second Report if obtained by NWC, then the Well Owner shall promptly notify in writing the Committee of its dispute. Within five (5) Business Days after receiving such notice and after giving each of the Contractor, NWC and the Well Owner similar opportunities to present their position (or within such longer period as the Committee may require), the Committee shall determine whether NWC materially caused the Problem. The Committee may in its discretion also request the Director of the MOE to provide its opinion to the Committee prior to making any such determination. The Committee shall provide its determination in writing to NWC, the Well Owner and the Director of the MOE and the Committee's decision is final, unless the Director of the MOE notifies the Committee in writing that the Director has made a different determination, in which case the Director's determination shall govern.

(11) If the Committee finds that the Problem was materially caused by NWC Operations, then NWC at its cost shall promptly remedy the Problem, including paying the cost of providing the Well Owner with an alternate water supply during the dispute process and paying the Well Owner's direct costs incurred in relation to the dispute, as determined by the Committee.

(12) If the Committee finds that the Problem was caused by a Non-NWC Failure, the Committee will send a copy of its decision to the Well Owner and no further action will be required of NWC in relation to that matter.

(13) If the Well Owner limits or denies access to the Contractor or to the consultant engaged to do the scientific study contemplated above, then NWC shall not be responsible for remedying the Problem raised by the Well Owner. Such access includes, as necessary or appropriate, such tests as may be required or appropriate to assist in determining the cause of the Problem (such as collecting water samples or conducting pumping tests).

## 7. Term

This Agreement shall remain in full force until NWC is no longer carrying on NWC Operations or the Town and NWC agree in writing to terminate this Agreement (whichever occurs earlier).

## 8. Notices

(1) Any notice required or permitted to be given by either party under this Agreement to the other shall be in writing and shall be delivered or sent by registered mail (except during a postal disruption or threatened postal disruption) or fax or email to the applicable address set out below:

(a) in the case of the Town, to:

The Corporation of the Town of Erin
5684 Trafalgar Rd. (WCR #24), R. R. # 2
Hillsburgh, ON N0B 1Z0

Attention: Ms. Lisa Hass, Town Manager
Telephone: (519) 855-4407
Facsimile: (519) 855-4821
E-mail: lisa.hass@erin.ca

(b) in the case of NWC, to:

Mr. Dennis German, Natural Resources Manager
Nestlé Waters Canada
101 Brock Road South
Guelph, Ontario N1H 6H9
Telephone: (888) 565-1445, Ext. 6376
Facsimile: (519) 763-5046
E-mail: dennis.german@waters.nestle.com

(2) The contact information for the Director of the MOE is:

Director, Permits to Take Water
Ontario Ministry of the Environment, Guelph District Office
1 Stone Road W.
Guelph ON N1G 4Y2
Toll free: (800) 265-8658
Tel: (519) 826-4255
Facsimile: (519) 826-4286

(3) Any notice delivered shall be deemed to have been validly and effectively given on the day of such delivery. Any notice sent by registered mail shall be deemed to have been validly and effectively given on the third (3rd) Business Day following the date of mailing. Any notice sent by fax or email shall be deemed to have been validly and effectively given on the day the fax or email is sent if sent before 4:00 p.m. but if after 4:00 p.m., then on the next Business Day after it was sent.

(4) Either party may from time to time by notice to the other change its address for service under this Agreement.

## 9. General

(1) The parties agree to cooperate in the implementation of this Agreement with the intent that good faith complaints from Well Owners should be addressed promptly, fairly and reasonably on their merits. Each party shall do such further things and execute such

further documents as may be reasonably required by the other party to more fully implement the intent of this Agreement.

(2) This Agreement shall enure to the benefit of, and bind, the parties to it and their respective successors and permitted assigns provided that the Town shall not assign this Agreement (other than to a successor municipality) without the prior written consent of NWC, which consent shall not be unreasonably withheld.

(3) A waiver of any default, breach or non-compliance under this Agreement is not effective unless in writing and signed by the party to be bound by the waiver. No waiver will be inferred from or implied by any failure to act or delay in acting by a party in respect of any default, breach or non-observance or by anything done or omitted to be done by the other party. The waiver by a party of any default, breach or non-compliance under this Agreement will not operate as a waiver of that party's rights under this Agreement in respect of any continuing or subsequent default, breach or non-observance (whether of the same or any other nature).

(4) No amendment of this Agreement will be effective unless made in writing and signed by the parties.

(5) This Agreement is in addition to, and does not replace, or supersede, any rights a Well Owner may have at law or in equity, including under municipal, provincial or federal statutes or regulations.

(6) Despite anything else in this Agreement, this Agreement shall be solely for the benefit of the Town and NWC and no Well Owner is a party to this Agreement and no Well Owner shall have any rights under this Agreement including as a third party beneficiary.

## 10. Interpretation

(1) This Agreement constitutes the entire agreement between the parties with respect to the subject matter of it and cancels and supersedes any prior agreements, undertakings, declarations or representations, written or verbal in respect of it.

(2) Any provision of this Agreement that is prohibited or unenforceable in any jurisdiction will, as to that jurisdiction, be ineffective to the extent of such prohibition or unenforceability and will be severed from the balance of this Agreement, all without affecting the remaining provisions of this Agreement or affecting the validity or enforceability of such provision in any other jurisdiction.

(3) The division of this Agreement into Sections, the insertion of headings, and the provision of any table of contents, are for convenience of reference only and will not affect the construction or interpretation of this Agreement.

(4) Unless the context requires otherwise, words importing the singular include the plural and *vice versa* and words importing gender include all genders.

(5) This Agreement will be governed by and construed in accordance with the laws of the Province of Ontario and the laws of Canada applicable in that Province.

(6) This Agreement may be executed by fax or in counterpart, or both.

The parties have executed and deliver this Agreement as of the date first written above.

**THE CORPORATION OF THE TOWN OF ERIN**

By:

Name: ROD FINNIE
Title: MAYOR

By:

Name: LISA HASS
Title: TOWN MANAGER

I/We have authority to bind the Corporation.

**NESTLÉ WATERS CANADA, a division of NESTLÉ CANADA INC.**

By:

Name:
Title:

By:

Name: Chris McNeil
Title: CFO

I/We have authority to bind the Corporation

# PRIVATE WELL INTERFERENCE COMPLAINTS RESOLUTION AGREEMENT

THIS AGREEMENT is made as of ____________, 20__ (the "**Effective Date**") between the Corporation of the Town of Erin (the "**Town**") and Nestlé Waters Canada, a division of Nestlé Canada Inc. ("**NWC**").

## RECITAL:

The parties wish to set out in this Agreement the procedure and terms on which complaints, if any, that may be raised by the Well Owners about their wells being affected by NWC Operations may be received, investigated and, if found to be caused by NWC Operations, remedied by NWC.

FOR GOOD AND VALUABLE CONSIDERATION the receipt and sufficiency of which is acknowledged, the parties agree as follows:

## 1. Key Definitions

In this Agreement, unless the context otherwise requires:

(1) "**Agreement**" means this Private Well Interference Complaints Resolution Agreement as it may be amended from time to time.

(2) "**Business Day**" means any day except Saturday, Sunday or a statutory holiday in the Province of Ontario.

(3) "**Committee**" has the meaning given to it in Section 2(1).

(4) "**Contractor**" has the meaning given to it in Section 5(1).

(5) "**GRCA**" means the Grand River Conservation Authority.

(6) "**including**" means to include without limitation.

(7) "**NWC Operations**" means the present and future operations by NWC of NWC's production water wells in the Town of Erin, County of Wellington, Ontario.

(8) "**PTTW**" means a Permit to Take Water under the *Ontario Water Resources Act* and any applicable regulations, which is applicable to at least part of the Potential Well Interference Area.

(9) "**Well Owner**" means such owners from time to time who have a water supply well within the Potential Well Interference Area.

(10) "**Potential Well Interference Area**" means the area defined in the attached **Schedule A**.

2. Well Protection Committee

(1) The parties shall establish a committee called the "Well Protection Committee" (the "**Committee**") comprised of five members (the "**Members**") being: (a) two members appointed by NWC (each, a "**NWC Member**"); (b) one member appointed by the Town (each, a "**Town Member**"); (c) one member appointed by the GRCA who is a member of GRCA's board of directors or professional staff (the "**GRCA Member**") and one member appointed by the Ministry of Environment, Conservation, and Parks (the "**MECP**"). The Members should, to the extent reasonably possible, have a strong technical understanding of hydrogeology.

(2) The Committee shall meet quarterly unless otherwise determined by the Committee that an additional meeting is required. A quorum for a meeting shall be constituted by the attendance of at least: (a) one NWC Member; and (b) one Town Member. Members may participate by telephone or by web-based or video conference call or other electronic means (and as a result be deemed to be in attendance) at a meeting of the Committee.

(3) Decisions of the Committee shall require the approval of a majority of those in attendance at a meeting at which a quorum is constituted, subject to the jurisdiction of the MECP, where applicable.

(4) At meetings of the Committee, the Committee may review and discuss any outstanding Complaints (defined in Section 6 below) related to NWC Operations.

(5) The Committee may, if it determines it relevant and beneficial to do so, keep an active log of all correspondence and arrange for minutes to be prepared of each meeting.

(6) Any Member may call a meeting of the Committee on ten days' prior written notice to the other Members. Such notice shall set out the reason for the meeting and include any relevant documents or information.

3. Well Owners

(1) At the Committee's reasonable request, NWC shall prepare and deliver to the Committee a list of the addresses of all current Well Owners. At the Committee's reasonable request, NWC, with the assistance of the Town, will update such list from time to time to reflect changes relating to the Well Owners.

(2) NWC shall make commercially reasonable efforts to, within sixty (60) days of receiving a new PTTW or a renewal of an existing PTTW, send a package to each then-current Well Owner consisting of: (a) a letter to the Well Owner describing this Agreement; (b) a copy of this Agreement; (c) a laminated card outlining the process to follow in case of a claim or problem; (d) contact information; and (e) such other information as may be approved by the Committee,

4. Private Well Survey

(1) As part of its periodic applications for and renewals of its relevant PTTWs, where required by the permitting process, NWC will, at its expense, arrange for a well survey to be

conducted with respect to each Well Owner's well. The assessment may include: well location, type of casing and other well construction details, well depth, water level, depth of pump intake, condition of well and pump, history of water quantity and quality issues, source aquifer and municipal address. In conducting the assessment, account will be taken of public information, information from the Well Owners and, where appropriate, from actual testing of the well in question.

(2) NWC shall seek permission to access the well, but no formal written site access agreement will be required by NWC, and NWC shall not be required to pay for access rights. If access to the well is limited or denied by the Well Owners, then the assessment will still be conducted to the extent possible, but the parties acknowledge that the assessment may be incomplete.

5. Use of Independent Well Contractors

(1) NWC shall enter into a contractual arrangement with up to two professional licensed well contractors (a "**Contractor**") to provide, if necessary, the services contemplated of Contractors under this Agreement on a seven day-a-week basis.

(2) NWC shall deliver to each Contractor a list of the addresses of the Well Owners and a description, including a map, of the Potential Well Interference Area and provide updates of such list to each Contractor as necessary from time to time.

(3) NWC shall also deliver to each Well Owner the contact information for one or more Contractors.

6. Well Owner Complaints

(1) If a Well Owner in good faith believes that the quantity or quality of the water from its well located within the Potential Well Interference Area is being adversely affected by NWC Operations (a "**Complaint**"), then the following procedure shall be followed:

(a) the Well Owner shall contact, as soon as possible, one of the Contractors, who will subsequently notify NWC, to ensure NWC is immediately aware of the issue;

(b) such Contractor, at NWC's cost, will respond to all calls within 24 hours; and

(c) the Contractor will deliver five (5) cases of bottled water (consisting of at least 60 litres in total) to the Well Owner at NWC's cost within 24 hours after the Well Owner's call.

(2) NWC will instruct the Contractor to investigate the cause of the Complaint as soon as reasonably possible. NWC will continue to provide a suitable alternate water supply to the Well Owner while the Contractor investigates.

(3) If the Contractor determines that the cause of the Complaint is a mechanical issue or otherwise unrelated to NWC Operations (a "**Non-NWC Failure**"), then the Contractor will issue a written report to that effect and deliver it to the Well Owner with a copy to the Committee, the Town and NWC. There will be no further action by NWC.

(4) If, however, the Contractor does determine that the water from the well has been adversely affected, and does not determine that the Complaint is a Non-NWC Failure, then, NWC, at NWC's cost, shall: (a) take all reasonable steps to arrange for an alternative water supply; and (b) arrange for a qualified independent consultant (which may in appropriate circumstances be the Contractor) to undertake a scientific study of the Complaint. To the extent reasonably possible, NWC shall take the foregoing steps within twenty-four (24) hours after receiving the Contractor's report.

(5) The scientific study shall be documented in a written report (the "**Report**"), prepared in a timely manner and shall summarize all relevant information regarding the Complaint, its cause, and recommendations regarding possible mitigation. The Report must be signed and stamped by a Professional Geoscientist (P.Geo.) or Professional Engineer (P.Eng.) licensed in the Province of Ontario.

(6) NWC shall promptly deliver a copy of the Report to the Well Owner.

(7) If the Report concludes that the Complaint was caused by NWC Operations, then NWC shall so inform the Committee and the Well Owner and NWC shall also promptly provide a copy of the Report to the appropriate Manager of the MECP. Subject to Section 6(8) below, NWC shall promptly take all reasonable steps to remedy the Complaint and shall promptly report the details and results of such remedial action to the Committee, the Well Owner and the Manager of the MECP.

(8) If the Report concludes that the Complaint was not caused by NWC Operations, then NWC shall promptly inform the Committee and the Well Owner of that conclusion in writing and no further action will be required of NWC.

(9) Any complaints, whether caused by NWC or not, shall be logged by NWC and form part of its annual reporting requirements.

(10) If the Well Owner limits or denies access to the Contractor or to the consultant engaged to do the scientific study contemplated above, then NWC shall not be responsible for remedying the Complaint raised by the Well Owner. Such access includes, as necessary or appropriate, such tests as may be required or appropriate to assist in determining the cause of the Complaint. The MECP shall be so notified.

(11) In managing any Complaints, NWC shall comply with the terms of its applicable PTTWs.

## 7. Term

This Agreement shall commence on the Effective Date and, unless terminated earlier pursuant to the terms of this Agreement, shall remain in effect until NWC ceases to have any valid PTTWs applicable to the Potential Well Interference Area, at which point this Agreement shall immediately expire automatically. Notwithstanding the foregoing, either party may terminate this Agreement at any time, without cause or penalty, upon not less than six (6) months’ prior written notice to the other party.

8. Notices

(1) Any notice required or permitted to be given by either party under this Agreement to the other shall be in writing and shall be delivered or sent by registered mail (except during a postal disruption or threatened postal disruption) or fax or email to the applicable address set out below:

(a) in the case of the Town, to:

The Corporation of the Town of Erin
5684 Trafalgar Rd. (WCR #24), R.R.#2
Hillsburgh, ON
N0B 1Z0
Attention: Nathan Hyde
Tel: (519) 855-4407 ext. 222
Fax: (519) 855-4821
E-mail: Nathan.Hyde@erin.ca

(b) in the case of NWC, to:

Natural Resource Manager, Nestlé Waters Canada
Nestlé Waters Canada, a division of Nestlé Canada Inc.
101 Brock Road,
Puslinch, ON
N0B 2J0
No: 519-767-6422

And

General Counsel
Nestlé Canada Inc.
25 Sheppard Avenue West,
North York, ON
M2N 6S8
No: 1-416-218-2816

(2) The contact information for the Manager of the MECP is:

Dan Dobrin, Manager
Ontario Ministry of the Environment, Conservation, and Parks, Section 34.1
Ontario Water Resources Act, R.S.O. 1990
12th Floor
119 King St W
Hamilton ON L8P 4Y7
Fax: (905) 521-7820

(3) Any notice delivered shall be deemed to have been validly and effectively given on the day of such delivery. Any notice sent by registered mail shall be deemed to have been validly and effectively given on the third Business Day following the date of mailing. Any notice sent by fax or email shall be deemed to have been validly and effectively given on the day the fax or email is sent if sent before 4:00 p.m. but if after 4:00 p.m., then on the next Business Day after it was sent.

(4) Either party may from time to time by notice to the other change its address for service under this Agreement.

9. General

(1) The parties agree to cooperate in the implementation of this Agreement with the intent that good faith complaints from Well Owners should be addressed promptly, fairly and reasonably on their merits. Each party shall do such further things and execute such further documents as may be reasonably required by the other party to more tally implement the intent of this Agreement.

(2) This Agreement shall enure to the benefit of, and bind, the parties to it and their respective successors and permitted assigns provided that the Town shall not assign this Agreement (other than to a successor municipality) without the prior consent of NWC, which consent shall not be unreasonably withheld.

(3) A waiver of any default, breach or non-compliance under this Agreement is not effective unless in writing and signed by the party to be bound by the waiver. No waiver will be inferred from or implied by any failure to act or delay in acting by a party in respect of any default, breach or non-observance or by anything done or omitted to be done by the other party. The waiver by a party of any default, breach or non-compliance under this Agreement will not operate as a waiver of that party's rights under this Agreement in respect of any continuing or subsequent default, breach or non-observance (whether of the same or any other nature).

(4) No amendment of this Agreement will be effective unless made in writing and signed by the parties.

(5) This Agreement is in addition to, and does not replace, or supersede, any rights a Well Owner may have at law or in equity, including under municipal, provincial or federal statutes regulations.

(6) Despite anything else in this Agreement, this Agreement shall be solely for the benefit of the Town and NWC and no Well Owner is a party to this Agreement and no Well Owner shall have any rights under this Agreement including as a third party beneficiary.

10. Interpretation

(1) This Agreement constitutes the entire agreement between the parties with respect to the subject matter of it and cancels and supersedes any prior agreements, undertakings, declarations or representations, written or verbal in respect of it.

(2) Any provision of this Agreement that is prohibited or unenforceable in any jurisdiction will, as to that jurisdiction, be ineffective to the extent of such prohibition or unenforceability and will be severed from the balance of this Agreement, all without affecting the remaining provisions of this Agreement or affecting the validity or enforceability of such provision in any other jurisdiction.

(3) The division of this Agreement into Sections, the insertion of headings, and the provision of any table of contents, are for convenience of reference only and will not affect the construction or interpretation of this Agreement.

(4) Unless the context requires otherwise, words importing the singular include the plural and vice versa and words importing gender include all genders.

(5) This Agreement will be governed by and construed in accordance with the laws of the Province of Ontario and the laws of Canada applicable in that Province.

(6) This Agreement may be executed by fax or in counterpart, or both.

The parties have executed and deliver this Agreement as of the date first written above.

**THE CORPORATION OF THE TOWN OF ERIN**

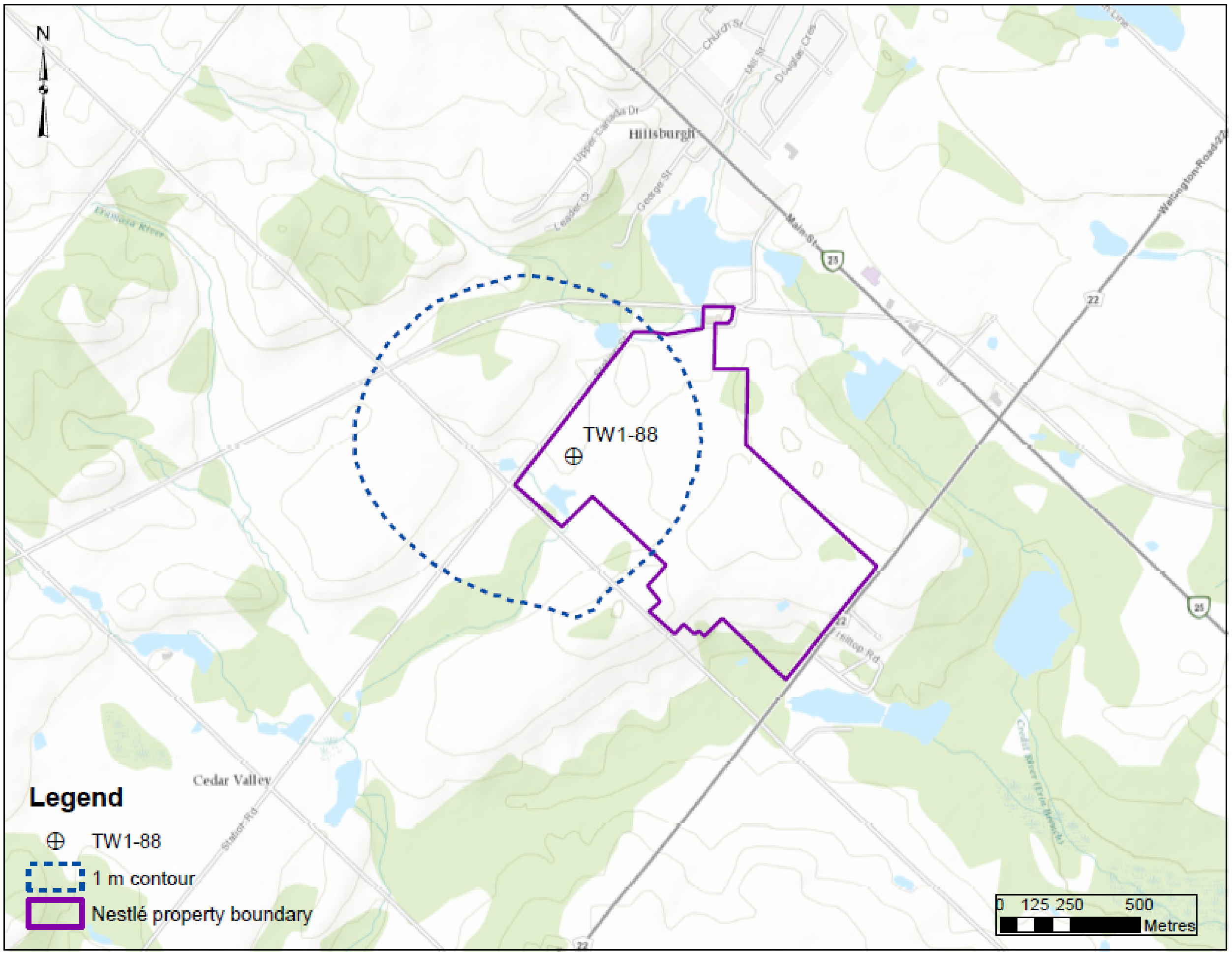
By: ___________________________________
Name:
Title:
Date:
I have the authority to bind the corporation.

**NESTLÉ WATERS CANADA,**
**A DIVISION OF NESTLÉ CANADA INC.**

By: __________________________________
Name:
Title:
Date:
I have the authority to bind the corporation.

# Schedule A

## Potential Well Interference Area



GOLDER

golder.com