



**ENGINEERING**  
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**HYDROGEOLOGICAL ASSESSMENT REPORT  
PROPOSED GREEN BURIAL GROUND  
143336 SOUTHGATE ROAD 14  
PART LOT 36, CONCESSION 3 (EGREMONT)  
TOWNSHIP OF SOUTHGATE, GREY COUNTY**

**Prepared for:**

**Lewis Land & Stock  
392242 Grey Road 109  
RR 2  
Holstein, ON N0G 2A0**

**Prepared by:**

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**Project No. 20-044**

**August 2020**

**• GSS Engineering Consultants Ltd. •**

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20-044

August 21, 2020

Lewis Land & Stock  
392242 Grey Road 109  
RR 2  
Holstein, Ontario  
N0G 2A0

Attention: Mr. Don Lewis

RE: Hydrogeological Assessment Report  
Proposed Green Burial Ground  
143336 Southgate Road 14  
Part Lot 36, Concession 3 (Egremont)  
Township of Southgate, Grey County

Dear Sir,

This report provides the results of a hydrogeological assessment carried out in support of a proposed green burial ground to be located in the east portion of the agricultural property located at 143336 Southgate Road 14 in part of Lot 36, Concession 3 in the geographic Township of Egremont, now in the Township of Southgate.

We trust that this report meets your present requirements. If we can be of additional assistance in this regard, please do not hesitate to contact this office.

GSS Engineering Consultants Ltd.

A handwritten signature in blue ink, appearing to read 'WBB', followed by a long horizontal line extending to the right.

W. Brad Benson, P.Eng.  
Senior Hydrogeologist

WBB/bb

cc Genevieve Scott, Cuesta Planning Consultants Inc.

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## 1.0 INTRODUCTION

### 1.1 Background

This report provides the results of a hydrogeological assessment carried out by GSS Engineering Consultants Ltd. (GSS) in support of a proposed green burial ground to be located on an agricultural property located at 143336 Southgate Road 14 in Part of Lot 36, Concession 3, in the geographic Township of Egremont, now in the Township of Southgate (the Site). The property that is municipally identified as 143336 Southgate Road 14 consists of 37.0 hectares (91.4 acres) on the south side of the road, in Lot 36, Concession 3, and 15.1 ha (37.3 ac) on the north side of the road, in Lot 35, Concession 3. In this report, the 37.0-ha parcel on the south side of Southgate Road 14 in Lot 36, Concession 3 is referred to as the Subject Property.

The proposed green burial ground would be located on a 0.4-ha (1.0-ac) parcel to be severed from the eastern portion of the Subject Property, adjacent to the existing Reid's Cemetery located at the southwest corner of Southgate Road 14 and Southgate Sideroad 41. The 0.4-ha parcel to be severed for the proposed green burial ground is referred to in this report as the Site. The location and limits of the Subject Property and the Site are shown on **Figure 1**.

### 1.2 Purpose and Scope of Work

The purpose of the study was to assess the hydrogeological suitability of the Site for the proposed green burial ground and the potential for impacts on groundwater resources. Specifically, the assessment was intended to identify the depth to groundwater at the Site and the separation distance between the bottom of the graves and the water table. The study included the following:

- a reconnaissance visit to observe the Site conditions as well as local topography, land use, and water features;
- water level monitoring in an inactive shallow well located on an adjacent property north of the Site;
- a description of the geological setting for the Site based on a review of available mapping and reports;
- a description of the hydrogeological conditions based on a review of provincial water well records for the vicinity of the Site;
- a review of relevant guidelines for green burial grounds and for the siting of cemeteries; and
- an assessment of the potential impacts from the proposed development on groundwater resources and recommendations for mitigating measures, as appropriate.

The proposed work plan for the hydrogeological assessment was provided in email correspondence to Cuesta Planning Consultants Inc. on June 24, 2020. Authorization to proceed with the work was provided by Lewis Land & Stock (referred to in this report as the Proponent) on June 25, 2020.

## **2.0 SITE CONDITIONS**

### **2.1 Physical Setting**

The Site is 0.4 ha in area and is located at the southeast corner of the Subject Property in what is currently a sheep pasture. A low-lying, wooded area is located approximately 20 m west of the Site. The Site is bordered to the east by an existing cemetery, approximately 1.2 ha in area, referred to on Grey County Maps as Reid's Cemetery. A cemetery was indicated at that location on 1945 topographic mapping (scale 1:63,360) for the Durham area, indicating that the cemetery was more than 75 years old. A historical map of Grey County (1880) indicated the presence of a church near the current cemetery.

The ground surface at the Site is relatively flat and slopes slightly to the west-southwest. Topographic contours on Grey County Maps and Ministry of Natural Resources and Forestry (MNR) topographic mapping indicated that the Site was at approximate elevation 416 m. Northeast of the intersection of Southgate Road 14 and Sideroad 41, the ground surface rises to an elevation between 430 and 435 m. Topographic mapping indicated that the wooded area west of the Site was at approximate elevation 412 m.

The Site and the Subject Property are owned by the Proponent, as are parcels located northwest, northeast, and east of the Site, as indicated on Figure 1. All of those lands are used for agriculture. A cultivated field was located immediately south of the Site, planted with corn at the time of the site visit. A single-family house was located on a 1.0-ha parcel of land located on the northwest corner of the intersection of Southgate Road 14 and Sideroad 14, north of the Site.

### **2.2 Surface Water Features**

The Site is located in the watershed of the Beatty Saugeen River, which is a tributary of the main Saugeen River and generally flows from east to west. Surface drainage in the vicinity of the Site is generally in a west-southwesterly direction.

Grey County Maps topographic mapping indicated that the closest substantial watercourse to the Site was Norman Reeves Creek, which flows from east to west and crosses Sideroad 41 approximately 570 m south of the Site. West of Sideroad 41, that watercourse flows into a dammed pond in the community of Holstein.

Topographic mapping indicated that a small tributary of Norman Reeves Creek crossed Sideroad 41 approximately 250 m south of the Site. On the east side of the road, a small pond associated with that tributary was located on a farm property owned by the Proponent. Topographic mapping also indicated that a small pond was located on the Subject Property, approximately 270 m west of the Site. The Proponent indicated that this was a dugout pond that perennially contained water. GSS inferred that this pond encountered the water table.

Topographic mapping indicated the presence of wetlands located west and east of the Site, on both the north and south sides of Southgate Road 14, as shown on Figure 1. The closest wetland was located approximately 50 m west of the Site, in a low-lying wooded area. MNR mapping of natural heritage areas identified these areas as unevaluated wetlands. Ground surface contours

and spot elevations shown on that mapping indicated that the wetland located on the Subject Property west of the Site was at approximate elevation 412 m, approximately 4 m lower than the ground surface elevation at the Site.

### **3.0 HYDROGEOLOGICAL SETTING**

#### **3.1 Physiography and Geology**

The Site is located in the physiographic region of Ontario identified by Chapman and Putnam (1984) as the Horseshoe Moraines. In an Ontario Geological Survey (OGS) report on the Quaternary Geology of the Durham Area, Sharpe (1990) distinguished four main topographic areas. The area with elevations between 1200 and 1500 feet (365 to 455 m), which encompassed the Site, was described as rugged in character and sloping noticeably to the west, reflecting the combined effects of: a) the southwesterly dip of the underlying Paleozoic bedrock, and (b) the location of the Singhampton Moraine. Aggregate Resources Inventory Paper (ARIP) 85 for the former Egremont Township (OGS, 1984) described the Singhampton Moraine as a massive expanse of kames, and outwash channels and terraces. Sharpe (1990) noted that this feature comprised some of the best morainic topography in Ontario with large kames and kettles, steep ice-contact slopes fronting massive ice-marginal terraces and extensive outwash channels.

Quaternary geology in the vicinity of the Site was shown on OGS Preliminary Map P.1556 (Sharpe and Broster, 1977). The Site was shown to be located within an extensive deposit of glaciofluvial outwash gravel and gravelly sand. Flow within the glacial meltwater channel associated with the deposit was indicated to have been towards the southwest. Soil within the hills located north-northeast and northwest of the Site, as indicated by topographic contours, was shown to consist of Elma Till (stoney, sandy silt till). ARIP 85 (OGS, 1984) for the former Egremont Township identified the Site and adjacent lands to the north, west, south and east, including the mapped wetlands, as sand and gravel resource areas. The only areas excluded were the isolated areas mapped as Elma Till, as noted above.

Review of available bedrock geology mapping and reports (AquaResource, 2008; OGS, 1984) indicated that the Site is located near the eastern limit of the Upper Silurian aged Salina Formation, which is comprised of shale interbedded with grey-brown dolostone. Where the Salina Formation is present, it is underlain by the older, Middle Silurian aged, Guelph Formation dolostone. East of the Site, the mapping indicated that the Guelph Formation forms the upper bedrock. Bedrock contours shown on OGS Map P.1836 (Sharpe and Clue, 1978) indicated that the bedrock was at a depth of approximately 40 m beneath Site, and sloping to the west-southwest. Additional comments on the depth to bedrock are provided in the review of water well records in Section 3.2.

#### **3.2 Groundwater Use**

Water well records for the vicinity of the Site were obtained from the Ministry of the Environment, Conservation and Parks (MECP) water well record (WWR) database. In particular, the WWR database was searched for wells located within approximately 500 m of the perimeter of the Site. In addition to the database search, the Proponent contacted the closest property owners to the Site to obtain information on existing wells.

The locations of the identified wells, based on the information in the WWR database or coordinates recorded in the field by GSS with a hand-held GPS unit, are shown on Figure 1. Copies of the individual water well record sheets are provided in **Appendix A**.

### **On-Site Wells**

No existing water wells were identified on the Site.

### **Off-Site Wells**

Mapping for the MECP WWR database did not indicate any wells located within 500 m of the Site. The closest wells were shown to be located approximately 560 m southeast of the Site (MECP Well ID 2507353) and 750 m northwest of the Site (Well ID 2513654). Copies of the associated water well record sheets are included in Appendix A.

The record for Well ID 2507353 indicated that it was a shallow bored well advanced in 1979 to a depth of 9.1 m (30 feet), encountering 6.7 m of sand and gravel underlain by clay. The static water level was reported at a depth of 4.0 m. The well location was shown to be 300 m east of Sideroad 41. Based on the reported well location, as shown on Figure 1, and aerial imagery for the vicinity of the Site, GSS inferred that the well was likely to be associated with a house located on the south side of Gordon Reeves Creek, approximately 700 m southeast of the Site. Based on the presence of the intervening creek, a shallow well at that location would be considered hydraulically isolated from the Site.

In the WWR database, the location of Well 2513654 was indicated as uncertain and was recorded at the centroid of Lot 35, Concession 3. The associated well record sheet indicated that the well was located 90 m north of the south lot line and 25 m west of Baseline Road, which GSS understood to be a name used locally for Sideroad 41. Based on the description, GSS inferred that the well was located at the residential property located at 412232 Sideroad 41, as shown on Figure 1. Available mapping indicated that the house on that property was located approximately 250 m north of the Site, at an elevation between 5 and 10 m higher than the Site. The record indicated that the well was drilled to a total depth of 49.7 m (163 feet), encountering limestone bedrock at a depth of 39.0 m. The well was completed as an open hole in the bedrock below a depth of 39.6 m. The record also indicated that beneath the surficial topsoil, the well encountered sand and gravel to a depth of 11.9 m, underlain by clayey soils (inferred by GSS to be till) to a depth of 24.4 m.

### **Domestic Well Survey**

In addition to the information obtained from the provincial WWR database, GSS worked with the Proponent to obtain additional information on local domestic wells. As discussed in Section 2.1, properties owned by the Proponent in the vicinity of the Site are indicated on Figure 1. The Proponent indicated that there was one well located on the Subject Property, at a location near the house approximately 820 m west of the Site. The Proponent indicated that well was completed in the bedrock at a depth of approximately 43 to 46 m (140 to 150 feet). The Proponent indicated that there were no wells located on the 15.1-ha parcel of land located on the north side of Southgate Road 14. For the farm property located east of the Site, on the southeast corner of

Southgate Road 14 and Sideroad 41, the Proponent indicated that there was one drilled well, located near the house. The location of this well was recorded by GSS and is shown on Figure 1. The well casing was located within a concrete tile with a concrete lid and was not observed. The Proponent indicated that the well was completed in the bedrock, with occasional flowing artesian conditions. The overflow from the well was reportedly directed to the pond located south of the house. The Proponent indicated that there was one well located on the farm property northeast of the Site, on the northeast corner of Southgate Road 14 and Sideroad 41. This was reported to be a drilled well installed in the late 1990s. The well location recorded by GSS was approximately 240 m northeast of the Site. No provincial well record was identified for this well, although bedrock topography mapping (OGS, 1978) indicated the presence of a well at that approximate location.

On the west side of Sideroad 41, one residential property was located between the Site and Gordon Reeves Creek south of the Site, at 412166 Sideroad 41 in Lot 38, Concession 3. The Proponent contacted the property owner and reported to GSS that there was one drilled well on the property, installed in approximately 1999 or 2000, at the time the house was being constructed. The location of the well recorded by GSS is shown on Figure 1. The well was located approximately 270 m south of the Site. GSS inferred that the record for MECP Well ID 2513892 (Appendix A) was likely to be associated with this well. That record indicated that the well was drilled by Highland Water Wells at the east side of Lot 38, Concession 3 in 1999, although the location recorded in the WWR database was in Lot 39. The record indicated that the well was drilled to a total depth of 66.1 m (217 feet), encountering limestone bedrock at a depth of 48.8 m. The record did not indicate the presence of near-surface sand and gravel at this location; rather, the overburden reportedly consisted entirely of clayey soils.

No well records were identified for the residential property located north of the Site at 143427 Southgate Road 14. The Proponent contacted the property owner and reported to GSS that there were two wells on the property, an inactive, shallow, dug well located near the west side of the property and a drilled well located near the east side of the property. The locations of the wells recorded by GSS are shown on Figure 1. The dug well was located approximately 150 m north of the Site and the drilled was approximately 130 m north-northeast of the Site. The information provided to GSS by the Proponent indicated that the house was constructed in the 1980s and was originally serviced with the dug well, which was reportedly excavated in sand and gravel and constructed using concrete tiles. The dug well reportedly provided insufficient water during a particularly dry year in 1995 and was replaced with the drilled well. That well was reportedly completed in the bedrock at a depth of approximately 54.5 m (180 feet).

#### 4.0 FIELD WORK

GSS made an initial reconnaissance visit to the Site on July 7, 2020. The site visit included a walk-over reconnaissance of the Site, the adjacent cemetery to the east, and the dugout pond located on the Subject Property west of the Site. Surface water features in the vicinity of the Site were also observed at the road crossings. During the July 7 site visit, the Proponent contacted Mr. Brian Stevenson, the chair of the Holstein Cemetery Board and superintendent for the adjacent cemetery to the east. Mr. Stevenson indicated to the Proponent that in his experience the graves were excavated to a depth of approximately 1.5 to 1.8 m (5 to 6 feet), encountering sand and gravel beneath the surficial topsoil and no groundwater.

With the property owner's permission, on July 15, 2020 GSS accessed the inactive dug well identified at a location approximately 150 m north of the Site. The groundwater level was measured at a depth of 1.11 m below the top of the 1.2 m diameter concrete well lid, which was approximately 0.1 m higher than the adjacent ground surface. A local elevation of 100.00 m was assigned to the top of the well lid and that was used as a reference point. The well was sounded to a depth of 2.53 m. GSS placed a pressure transducer and data logger in the well to measure and record the groundwater level at 6-hour intervals. GSS subsequently retrieved the water level data on August 14, 2020 and replaced the data logger in the well. The results of the water level monitoring are discussed in Section 6.1 of this report.

Also on July 15, 2020, GSS surveyed the ground surface elevation at representative locations near the corners and centre of the Site, relative to the assigned elevation of the dug well lid. The ground surface elevation at the Site ranged from approximately 103.0 to 103.6 m, as shown on the Site Plan, **Figure 2**.

## **5.0 DETAILS OF PROPOSED SITE USE**

### **5.1 General**

The Proponent is proposing to establish a green burial ground at the Site. As part of this assessment, GSS reviewed readily available information on the characteristics of green burial grounds. This included information obtained from the websites for the following organizations;

- Natural Burial Association, a non-profit Ontario organization with a stated goal of helping communities across Ontario advocate for and create a sanctuary in nature for those living and dead.
- Green Burial Society of Canada, a national organization with a stated goal, among others, of assisting organizations, businesses, individuals, and governments across Canada to adapt and implement green burial standards and best practices.
- Green Burial Council, an organization based in the United States with the goal of advocating for environmentally sustainable, natural death care through education and certification.

The information reviewed indicated that "green" and "natural" burial were generally used interchangeably. The Green Burial Society of Canada identified the following five principles of green burial:

- no embalming;
- direct earth burial, with the body wrapped in a shroud made of natural, biodegradable fibres or, alternatively, the remains placed in a casket or other form of container made of sustainable and fully biodegradable materials. No outside grave liner or protective vault is used.
- Ecological restoration and conservation.
- Communal memorialization, i.e., the use of individual memorials is discouraged.
- Optimized land use.

These principles were consistent with the information obtained from the other sources. GSS considered the first two principles to be the most relevant for the purpose of this assessment.

### **5.2 Burial Depth**

A 1992 Ontario Ministry of the Environment (MOE, now MECP) document (Soo Chan, et al, 1992) referenced MOE guidelines recommending that a concrete vault containing a casket be placed in the ground at a minimum depth of 0.5 m above the highest water table. A 1998 report by the World Health Organization (WHO) Regional Office for Europe (Ucisik and Rushbrook, 1998) recommended that a minimum clearance of 1 m be maintained between the base of all burial pits and the highest natural water table. That report also recommended that a minimum of 1 m of soil cover at the surface be maintained for burial excavations.

Information obtained by GSS related to the likely burial depth at the Site included the following:

- The Green Burial Council website indicated that the ideal burial depth for optimal decomposition conditions was 3.5 to 4 feet (1.1 to 1.2 m) from the bottom of the grave to the soil surface.
- Ontario Regulation 30/11 for Establishing, Operating and Closing Cemeteries and Crematoria (under the Funeral, Burial and Cremation Services Act) specified that human remains in an in-ground grave shall be buried at least 0.61 m (2 feet) beneath the natural level of the ground surface.
- A 1997 report on cemetery sites by Formanek, citing a reference from Hatch (1995), indicated that graves were typically dug to a depth of 1.5 m, although graves for multiple burials are deeper (about 1.8 m).

For the purpose of this assessment, it was considered that the graves in the proposed green burial ground at the Site would be excavated to a depth of 1.5 m or less below the existing ground surface.

## 6.0 GROUNDWATER CONDITIONS AT THE SITE

### 6.1 Water Level Monitoring

The water table elevation in the vicinity of the Site was monitored at the dug well located approximately 150 m to the north. Manual measurements in the well were made on July 15 and August 14, 2020 and the results are summarized in Table 6-1, below.

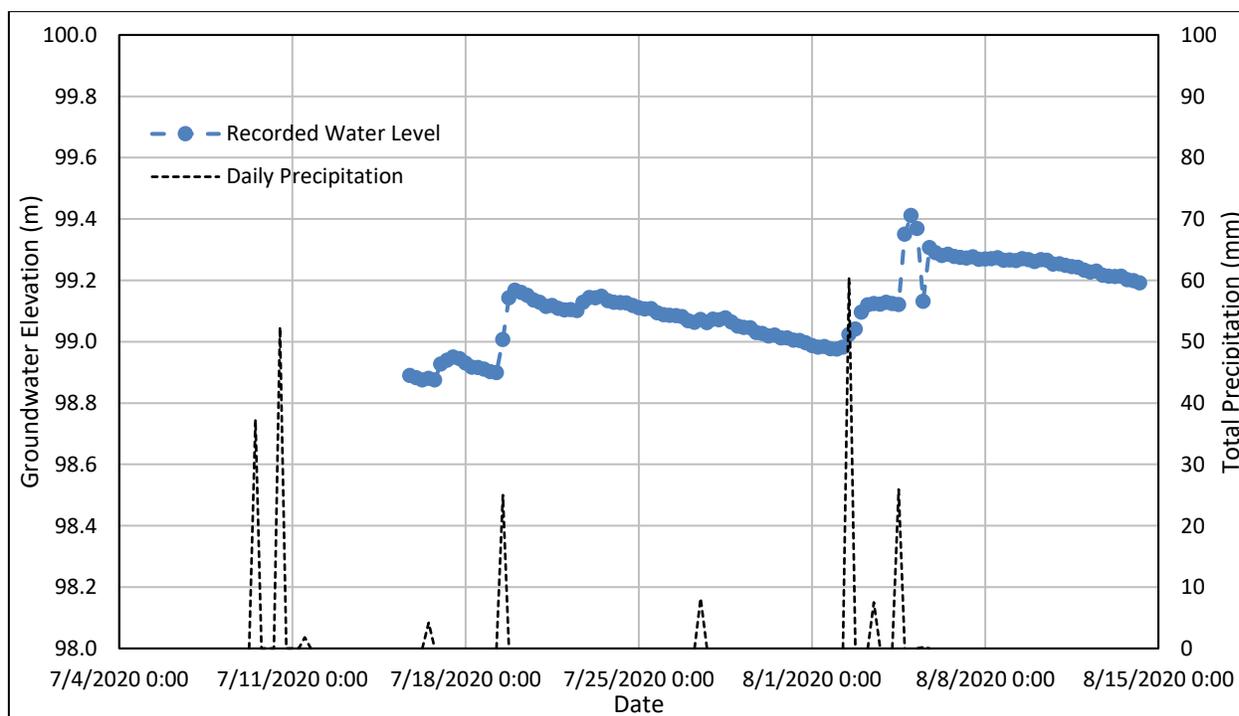
**Table 6-1: Groundwater Level Measurements for the Dug Well Located North of the Site**

<b>Assumed Top of Lid Elevation – Local Datum (m)</b>	100.00	
<b>Ground Elevation (m)</b>	99.90	
<b>Sounded Well Depth (mbmp)</b>	2.53	
<b>Date</b>	<b>Water Level (mbmp)</b>	<b>Water Elevation (m)</b>
July 15, 2020	1.11	98.89
August 14, 2020	0.81	99.19

Note: 1. mbmp – metres below measuring point.

As shown, the groundwater level in the well was 0.3 m higher on August 14 than on July 15. The recorded groundwater elevations for the intervening period are shown on Figure 6-1, below, together with the daily precipitation data for the Environment Canada Mount Forest (Aut) meteorological station.

**Figure 6-1: Recorded Groundwater Levels in the Dug Well (Jul 15 – Aug 14, 2020)**



As indicated by the data, the water level in the well increased in response to significant rainfall events on July 19, August 2, and August 4. GSS considered it likely that the response to rainfall events was enhanced by the proximity of the low-lying wet area located west and north of the dug well, which would act as a large catchment area for precipitation and runoff. Consistent with this interpretation, GSS surveyed the elevation of the surface water level in the wetland near the dug well on August 14 and determined that it was 0.2 m higher than the groundwater level in the dug well. On July 15, that area of the wetland had been dry. GSS considered that the short-term response to precipitation events for the water table elevation at the Site would be muted relative to the recorded response at the dug well.

Available precipitation data for the vicinity of the Site were reviewed to assess the conditions during which the water level data were collected relative to the precipitation in a typical year. The closest Environment Canada meteorological stations to the Site for which 30-year (1981-2010) climate normal data were available were Durham (13.8 km) and Hanover (21.6 km), with average total precipitation values of 1118.5 and 1087.1 mm, respectively. However, daily and monthly precipitation data for these stations were not available for the period after 2008. The closest station to the Site with relatively recent precipitation data was the Mount Forest (Aut) automatic station (9.8 km); however, daily precipitation data for this station were missing for substantial periods of time in 2019 and 2020. The closest station to the Site with a reasonably complete precipitation record for those years (although still missing some data) was Markdale (22.1 km). The 2020 monthly precipitation data for the vicinity of the Site are summarized in Table 6-2, below, with a comparison to the relevant normal precipitation data.

**Table 6-2: Summary of Precipitation Data for Current Year**

Month and Year	Total Precipitation Markdale Station (mm)	1981-2010 Normal Precipitation (mm)	
		Durham	Hanover
Annual Average	N/A	1118.5	1087.1
January 2020	133.4	103.1	109.6
February 2020	125.0	78.5	81.3
March 2020	96.8	71.0	72.0
April 2020	78.8	73.9	73.1
May 2020	110.9	93.9	84.6
June 2020	113.8	85.0	78.3
July 2020	146.2 <sup>1</sup>	83.7	83.1
August 2020	103.1 (to Aug 16) <sup>1</sup>	102.2	95.0

Note: 1. Data for July and August 2020 from Mount Forest (Aut) station.

The data indicated that, to date, 2020 has been a wetter than normal year, with the total precipitation in every month (including August) being greater than the corresponding 30-year normal monthly value. In addition, the total annual precipitation for 2019 was slightly wetter than normal. GSS also noted that prior to the first monitoring event on July 15, 2020, there was 91.5

mm of recorded rainfall at the Mount Forest (Aut) station in the period from July 9 to 11. Under these conditions, it was considered likely that the water table elevation in the vicinity of the Site in July and August 2020 was higher than it would be in a typical year, which would be conservative for the purpose of this assessment.

## **6.2 Groundwater Flow and Depth to Groundwater at the Site**

Based on the local topography, soil conditions, and surface water features in the vicinity of the Site, GSS inferred that the shallow groundwater flow direction at the Site would be to the west-southwest, toward the low-lying wetland located west of the Site, as shown on Figure 2. Within the wetland area west of the Site, the shallow groundwater flow direction was inferred to be toward the southwest, consistent with the topography indicated by the ground surface contours. GSS did not observe a culvert beneath Southgate Road 14 between the wetlands located north and south of the road, suggesting that flow occurred via the shallow groundwater.

As discussed in Section 3.1, the information obtained indicated that near-surface soil at the Site and surrounding area consisted of sand and gravel. That material has a relatively high hydraulic conductivity (permeability) and as a result the corresponding hydraulic gradient is typically relatively low. For three recent groundwater investigations at sites in the southern portion of Grey County with similar soil conditions, GSS identified horizontal hydraulic gradients ranging from 0.001 to 0.006, with an average gradient of approximately 0.003. The average hydraulic gradient (0.003) is equivalent to an increase in the water table elevation of 0.3 m over a horizontal distance of 100 m. Based on the inferred shallow groundwater flow direction to the west-southwest, the Site was considered to be located cross-gradient or slightly downgradient from the location of the dug well. Therefore, the groundwater elevation at the shallow dug well was considered to be indicative of the water table elevation at the Site, with reduced short-term fluctuations resulting from rainfall events at the Site. Therefore, the estimated water table elevation at the Site on July 15, 2020 was 98.9 m, relative to local datum.

As noted in Section 4.0, the surveyed ground surface at representative locations at the Site ranged from approximately 103.0 to 103.6 m, relative to the concrete lid of the dug well. For an assumed maximum burial depth of 1.5 m and a water table elevation at 98.9 m, the corresponding separation distance between the bottom of the graves and the water table would be 2.6 to 3.2 m.

## **6.3 Seasonal Fluctuations**

Shallow groundwater levels vary seasonally in response to climatic conditions, with the highest annual levels typically occurring in the spring when recharge is greatest, as a result of snow melt and rainfall events and minimal losses from evapotranspiration. As the groundwater level monitoring for this assessment occurred in July and August, available data from other monitoring locations in the region were reviewed for an indication of the typical seasonal variation in shallow groundwater levels.

The Provincial Groundwater Monitoring Network (PGMN) is a partnership program between the MECP and the conservation authorities to collect and manage ambient (baseline) groundwater level and quality information for key aquifers located across Ontario. The program was approved

in 2000 and monitoring activities were typically initiated in the early 2000s. GSS examined the available well information for PGMN monitors located in the vicinity of the Site to try and identify a representative well that was constructed in conditions similar to the dug well north of the Site, i.e., a shallow well completed in a surficial (unconfined) sand and gravel aquifer. The closest well with those characteristics was identified to be located 27 km west-southwest of the Site, west of Clifford, in the area managed by the Maitland Valley Conservation Authority. This well (PGMN Well ID W0000343-2) was reportedly screened from a depth of 4.0 to 9.1 m in a surficial sand and gravel aquifer that extended to a depth of 9.4 m. A copy of the associated water well record sheet (MECP Well ID 3007485) is included in **Appendix B**. The static groundwater level was reported at a depth of 3.4 m at the time of drilling in April 2003.

Available groundwater level monitoring data for W0000343-2 for the period from June 2003 to March 2018 are shown graphically on Figure B-1 in Appendix B. Over that span, there were some periods (e.g., Feb. 2004 to Apr. 2006 and Sep. 2011 to Jan. 2013) when no data were recorded. For the purpose of this assessment, the monitoring data from Jan. 2013 to Mar. 2018 were evaluated. During that period, the annual fluctuation in the recorded groundwater level was typically of the order of 0.5 m, with a fluctuation of approximately 1.0 m recorded in 2016. The highest annual water levels were typically recorded in late March or April, although in 2017 the highest level was recorded on June 23. The lowest annual levels were typically recorded in the period from mid-September to mid-November.

For context, available precipitation data over the same period were also reviewed. Annual and semi-annual (January to June) recorded precipitation data for the Mount Forest (Aut) station are summarized in Table 6-3, below, and are compared to the 30-year normal precipitation data for the Hanover station. The data indicated that 2013 was wetter than normal and was followed by drier than normal years in 2014, 2015, and 2016.

**Table 6-3: Comparison of 2013 to 2017 Precipitation Data to 30-Year Normals**

Period	Hanover	Mount Forest (Aut) Station Total Precipitation (mm)				
	1981-2010 Normal	2013	2014	2015	2016	2017
Jan – Jun	498.9	560.7	410.5	385.8	423.7	719.0
Annual	1087.1	1204.5	908.6	773.5	933.5	1044.5

The most recent data from the years 2013 to 2017 were used to assess the variance between the highest recorded annual water level and the water level on July 15, the date that groundwater level monitoring was initiated at the Site. The relevant data are summarized in Table 6.4, on the following page.

**Table 6-4: Comparison of Seasonal High Water Level to July 15 Water Level for PGMN Well**

Year	2013	2014	2015	2016	2017
Highest Recorded Groundwater Level (m) and Corresponding Date	366.35 (April 19)	366.44 (April 9)	366.31 (April 10)	366.52 (March 31)	366.48 (June 23)
Water Level (m) on July 15	366.03 <sup>1</sup>	366.14	366.08	365.89	366.27
Difference in Levels (m)	- 0.32	- 0.30	- 0.23	- 0.63	- 0.21

Note: 1. Result for 2013 was from July 2, as subsequent July data were missing.

For the selected years, the recorded variance between the July 15 groundwater level and the annual high groundwater level ranged from 0.21 to 0.63 m, with the largest variance recorded in 2016 during a drier than normal year, following an even drier year in 2015.

Based on the data, for this assessment GSS considered it reasonably conservative to assume that the typical seasonal high water table elevation at the Site would be 0.6 m higher than the groundwater level measured in the dug well on July 15, 2020. That would equate to a water table elevation of 99.5 m. For an assumed maximum burial depth of 1.5 m and a high water table elevation at 99.5 m, the corresponding separation distance between the bottom of the graves and the water table would be 2.0 to 2.6 m.

## 7.0 ASSESSMENT OF POTENTIAL IMPACTS FROM PROPOSED SITE USE

GSS identified a number of studies that have been carried out to assess the potential impacts of cemeteries on groundwater quality. These studies have included potential impacts from products of body decomposition, products from embalming compounds, and products from man-made artefacts (Formanek, 1997). The information reviewed indicated that a green burial ground would not include embalming compounds or man-made artefacts (primarily caskets) other than those of natural origin, which would reduce the potential for impacts on groundwater quality. No studies or guidelines specific to green burial grounds were identified.

A 1997 intrusive investigation of a 200-year old cemetery in Kingston, Ontario (Formanek, 1997) reportedly demonstrated a subtle impact on the shallow overburden aquifer; however, no major problems were found.

A 1992 investigation of groundwater quality at cemetery sites in Ontario by the MOE (Soo Chan, et al, 1992) included groundwater sampling from existing domestic/irrigation wells at six sites. The selected wells were primarily located in sandy shallow aquifers downgradient of cemeteries. Although the focus of the investigation was on potential impacts from formaldehyde, the sampling also included nitrate and phosphate as well as bacteriological analysis. The report noted that the decompositional product which may be of greatest concern was nitrogen. However, the report also noted that decomposition occurs gradually and thus nitrogen is released at a very insignificant rate. The results of the sampling for nitrate, nitrite, and phosphate reportedly indicated that with the exception of one site only very low concentrations were detected. The nitrate concentration reportedly exceeded the Ontario Drinking Water Quality Standard at one cemetery site; however, the sources of nitrate at that site were not investigated further and the report noted that the elevated nitrate may have been a result of loading from other practices.

Soo Chan, et al, (1992) noted that MOE guidelines recommended that graves be a minimum of 30 m from a well or surface water source being used for drinking purposes. Information related to cemeteries that was reviewed by GSS indicated that elsewhere in Canada, the Cemeteries Regulations (2001) for Saskatchewan specified that cemeteries be located at least 100 m from any watercourse or well and the British Columbia Health Hazards Regulation 216/2011 specified a separation distance of at least 120 m between a well and any cemetery, unless contamination of the well would be impossible because of the physical conformation. A draft condition in a 1998 WHO document (Ucisik and Rushbrook, 1998) identified a minimum separation distance of 250 m between any well, borehole, or spring from which a potable water supply is drawn. The same document noted that the risk of pollution would seem to be greatest for users of wells which access a shallow water-bearing stratum and recommended that safe distances between aquifers and cemeteries in various geological and hydrogeological situations be a topic for future research.

The information obtained from this assessment identified the presence of five (5) active domestic wells located within 500 m of the Site. Two of those wells were located on properties owned by the Proponent. The closest of these wells was located approximately 130 m north-northeast of the Site. All of the wells were reportedly completed in the bedrock at inferred depths of more than 30 m. The information obtained indicated that the depth to bedrock at the Site was approximately 30 m or greater. Further, water well records indicated the presence of relatively low-permeability

clayey soils above the bedrock and below the near-surface sand and gravel. The presence of low-permeability soil would provide protection of the bedrock aquifer from surficial sources of contamination. Bedrock equipotential mapping contained in the Tier One Groundwater Budget and Subwatershed Stress Assessment report (AquaResource, 2008) for the Saugeen Valley, Grey Sauble, Northern Bruce Peninsula source protection region indicated that groundwater flow in the upper bedrock in the vicinity of the Site was primarily in a westerly direction.

All of the identified domestic wells were located more than the minimum separation distance of 30 m identified by the MOE (now the MECP) for cemeteries in Ontario, and also more than the minimum separation distances of 100 and 120 m identified for two other Canadian provinces. Further, based on the indicated groundwater flow direction in the bedrock, all of the identified domestic wells were located either upgradient from, or cross-gradient to, the Site. The closest identified well in a downgradient direction from the Site was the domestic well for the house on the Subject Property, located approximately 820 m west of the Site.

Based on this assessment, no potential for impacts to existing water supply wells from the proposed green burial ground was indicated.

## 8.0 SUMMARY AND CONCLUSIONS

Based on the results of this hydrogeological assessment, the following summary of findings is provided.

- A green burial ground is proposed for a 0.4 ha (1-acre) parcel of land (the Site), currently used as a sheep pasture, to be severed from the east side of a 37.0-ha agricultural property. The proposed burial ground would be located adjacent to (west of) an existing 1.2-ha cemetery that has existed for more than 75 years.
- Available information indicated that the features of a green (or natural) burial ground include interment without embalming, with the bodies wrapped in a shroud made of natural, biodegradable fibres or, alternatively, placed in a casket or container made of sustainable and fully biodegradable materials. The information obtained indicated that a burial depth of 1.1 to 1.2 m from the bottom of the grave to the soil surface was considered to be optimal for decomposition. An assumed maximum burial depth of 1.5 m was used in this assessment for estimating the separation distance from the water table.
- Geological mapping and local water well records indicated that the Site was located within an extensive deposit of glaciofluvial outwash gravel and gravelly sand.
- Topographic mapping indicated that the closest watercourse to the Site was a small tributary of Norman Reeves Creek located 250 m to the south. Norman Reeves Creek flows from east to west and crosses Sideroad 41 at a location approximately 570 m south of the Site. Mapping indicated the presence of unevaluated wetlands at locations east and west of the Site, with the closest wetland located approximately 50 m west of the Site. GSS inferred that the shallow groundwater flow direction at the Site would be to the west-southwest.
- Continuous groundwater level monitoring was carried out between July 15 and August 14 in an inactive, shallow dug well that was identified at a location approximately 150 m north of the Site, on the north side of Southgate Road 14. A local reference elevation of 100.00 m was assigned to the top of the concrete well lid. Based on the soil conditions and groundwater flow direction, GSS considered that the elevation of the groundwater level at the dug well was indicative of the water table elevation at the Site.
- The measured and recorded groundwater elevations in the dug well ranged from approximately 0.6 to 1.1 m below the top of the well lid (elevation 99.4 to 98.9 m). The data indicated that the water level in the well reacted to significant rainfall events, increasing by as much as 0.4 m. The response to rainfall events was likely to have been enhanced by the proximity of the well to a low-lying wet area acting as a large catchment area for precipitation and runoff. GSS considered that short-term fluctuations in the water table elevation at the Site would be less.
- A review of precipitation data for local meteorological stations indicated that the total precipitation in each month of 2020, through August 16, was greater than the 30-year normal monthly precipitation. Further, the total annual precipitation in 2019 was slightly higher than normal. Under these conditions, GSS considered it likely that the measured groundwater

level in the vicinity of the Site in July and August 2020 was higher than it would be in a typical year.

- To account for seasonal variations in the water table elevation, GSS reviewed available long-term data for nearby monitoring wells included in the Provincial Groundwater Monitoring Network (PGMN). A well was identified at a location approximately 27 km west-southwest of the Site that was constructed in conditions similar to the dug well located north of the Site, i.e. a shallow well completed in a surficial (unconfined) sand and gravel aquifer. During the period from 2013 to 2018, the annual fluctuation in the recorded groundwater level in the PGMN well ranged up to 1.0 m and was typically approximately 0.5 m. The highest annual water levels were typically recorded in late March or April and the lowest levels were typically recorded in the period from mid-September to mid-November. GSS compared the water levels recorded on July 15 in each year from 2013 to 2018 to the highest recorded water level in the same year and noted a difference ranging from 0.21 to 0.63 m. Based on this review, GSS considered it reasonably conservative to assume that the typical high water table elevation at the Site would be 0.6 m higher than the groundwater elevation of 98.9 m measured in the dug well on July 15, 2020. This would correspond to a high water table elevation at the Site of 99.5 m relative to the local datum.
- GSS surveyed the ground surface elevation at representative locations at the Site relative to the local datum (i.e., the top of the well lid). The ground surface elevations at the Site ranged from approximately 103.0 to 103.6 m, which was approximately 4.1 to 4.7 m higher than the groundwater elevation in the dug well on July 15, 2020. Allowing for an estimated seasonal variation of 0.6 m, this would indicate that the high water table at the Site would be approximately 3.5 to 4.1 m below ground surface.
- A 1992 report on cemeteries by the Ontario Ministry of the Environment identified a guideline of 0.5 m as the minimum separation between a concrete vault containing a casket and the highest water table. A 1998 report on cemeteries by the World Health Organization recommended that a minimum clearance of 1 m be maintained between the base of a burial pit and the highest natural water table. Based on this assessment, the depth to the typical high water table at the Site was identified to be 3.5 m or greater below ground surface. For an assumed burial depth of 1.5 m or less, this would correspond to a separation of at least 2.0 m between the bottom of the graves and the high water table, which was considered to be adequate based on the information reviewed.
- A review of provincial water well records and a survey of local properties identified five active domestic wells located within 500 m of the Site. Two of these wells were on agricultural properties owned by the Proponent at locations northeast and east of the Site. The closest well was located approximately 130 m north-northeast of the Site. The information obtained indicated that all of the wells were drilled wells completed in the bedrock, with inferred depths of 30 m or more. Water well records indicated the presence of relatively low-permeability clayey soils above the bedrock and below the near-surface sand and gravel, which would provide protection for the bedrock aquifer from surficial sources of contaminants. Based on a westerly groundwater flow direction in the upper bedrock, all of the identified wells were located upgradient from, or cross-gradient to, the Site. A 1992 report on cemeteries by the

Ontario Ministry of the Environment identified a guideline of 30 m as the minimum separation distance between a cemetery and a drinking water well. GSS identified guidelines for two other provinces in Canada that specified minimum separation distances of 100 m and 120 m between a cemetery and a water well. GSS noted that a green burial ground would not include embalming compounds or man-made artefacts (primarily caskets) other than those of natural origin, which would reduce the potential for impacts on shallow groundwater quality relative to a conventional cemetery. Based on this assessment, no potential for impacts to existing water supply wells from the proposed green burial ground was indicated.

In conclusion, based on the results of this hydrogeological assessment, impacts to local groundwater resources from the proposed green burial ground at the Site were not indicated.

Respectfully submitted,

**GSS ENGINEERING CONSULTANTS LTD.**



W. Brad Benson, P.Eng.  
Senior Hydrogeologist



Ross Slaughter, P.Eng.  
Vice President  
Senior Water Resources Engineer

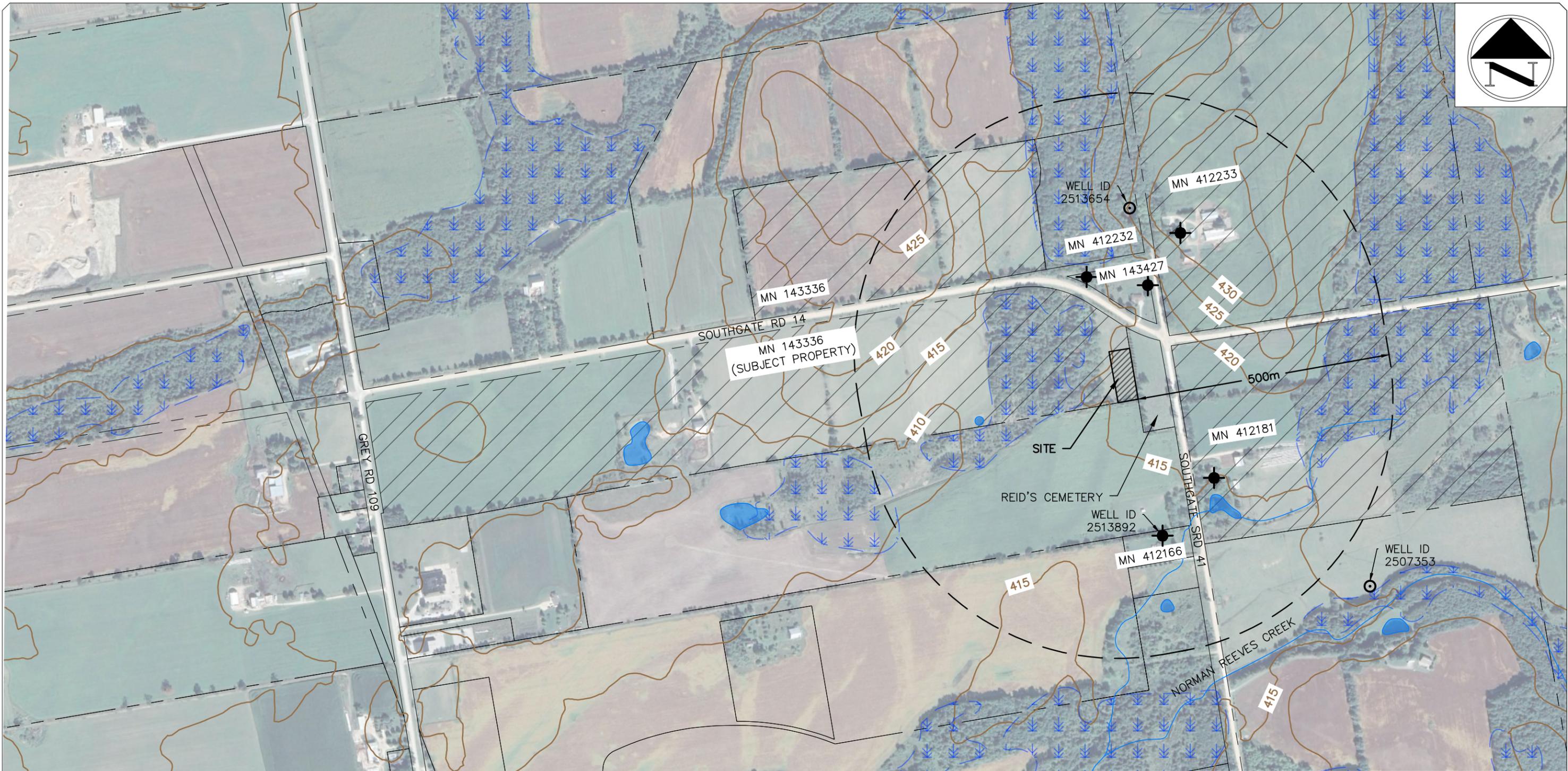
WBB/MRS/bb

## 9.0 REFERENCES

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# FIGURES

Friday, August 21, 2020 3:48:43 PM



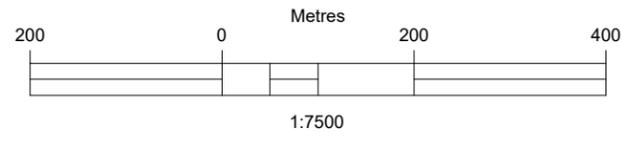
REFERENCES: GREY COUNTY PARCEL MAPPING, GOOGLE EARTH IMAGE SEPT. 16, 2019, MNRF TOPOGRAPHIC MAPPING

**LEGEND**

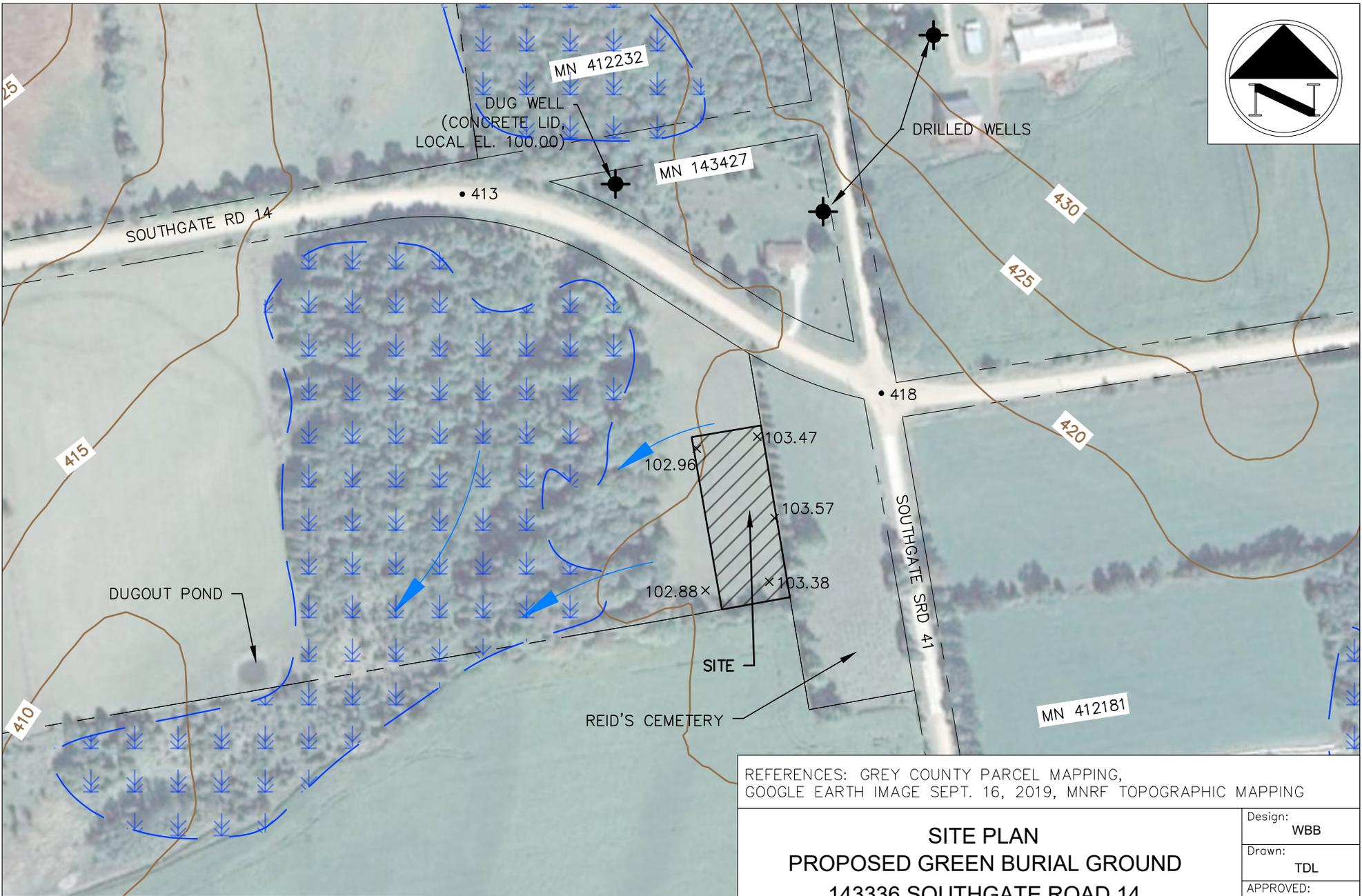
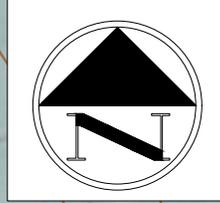
	NEARBY PROPERTIES OWNED BY PROPONENT
MN	MUNICIPAL NUMBER
	WATER WELLS IDENTIFIED FROM MECP DATABASE
	WATER WELLS IDENTIFIED BY GSS

**SITE LOCATION PLAN**  
**PROPOSED GREEN BURIAL GROUND**  
**143336 SOUTHGATE ROAD 14**  
**TOWNSHIP OF SOUTHGATE**

Design:	WBB
Drawn:	TDL
APPROVED:	MRS
Date:	AUG. 2020
Scale:	1:7500
FILE No.	20-044
FIG. No.	1



Friday, August 21, 2020 3:51:24 PM



REFERENCES: GREY COUNTY PARCEL MAPPING,  
 GOOGLE EARTH IMAGE SEPT. 16, 2019, MNRF TOPOGRAPHIC MAPPING

LEGEND	
×	GROUND ELEVATION (LOCAL DATUM)
•	MNRF SPOT ELEVATION
	INFERRED SHALLOW GROUNDWATER FLOW DIRECTION
	WATER WELLS IDENTIFIED BY GSS

<b>SITE PLAN</b> <b>PROPOSED GREEN BURIAL GROUND</b> <b>143336 SOUTHGATE ROAD 14</b> <b>TOWNSHIP OF SOUTHGATE</b>	Design: WBB
	Drawn: TDL
	APPROVED: MRS
	Date: AUG. 2020
	Scale: 1:3000
	FILE No. 20-044
	FIG. No. 2

# **APPENDIX A**

## **MECP Water Well Records**



Ministry of the Environment  
Ontario

The Ontario Water Resources Act

41A/2E

# WATER WELL RECORD

1. PRINT ONLY IN SPACES PROVIDED  
2. CHECK  CORRECT BOX WHERE APPLICABLE

11 2507353 MUNICIP. 25005 CON. CQN 13

COUNTY OR DISTRICT: *Essex* TOWNSHIP, BOROUGH, CITY, TOWN, VILLAGE: *Essex* CON., BLOCK, TRACT, SURVEY ETC.: *13* LOT: *001*

DATE COMPLETED: DAY *06* MO *Nov* YR. *79*

DEPTH: *32.79* ELEVATION: *1380* BASIN CODE: *22*

GENERAL COLOUR	MOST COMMON MATERIAL	OTHER MATERIALS	GENERAL DESCRIPTION	DEPTH - FEET	
				FROM	TO
	<i>Sand + gravel</i>			<i>0</i>	<i>22</i>
	<i>grey clay</i>			<i>22</i>	<i>30</i>

31 0022 2811 9930205

32

41 WATER RECORD

WATER FOUND AT - FEET	KIND OF WATER
<i>0012</i>	<input checked="" type="checkbox"/> FRESH <input type="checkbox"/> SALTY <input type="checkbox"/> SULPHUR <input type="checkbox"/> MINERAL

51 CASING & OPEN HOLE RECORD

INSIDE DIAM. INCHES	MATERIAL	WALL THICKNESS INCHES	DEPTH - FEET
<i>30</i>	<input checked="" type="checkbox"/> STEEL	<i>1.064</i>	<i>0030</i>

SCREEN

SIZE(S) OF OPENING (SLOT NO.)	DIAMETER INCHES	LENGTH FEET

61 PLUGGING & SEALING RECORD

DEPTH SET AT - FEET	MATERIAL AND TYPE

7) PUMPING TEST

TEST METHOD: *Leak* BAILER

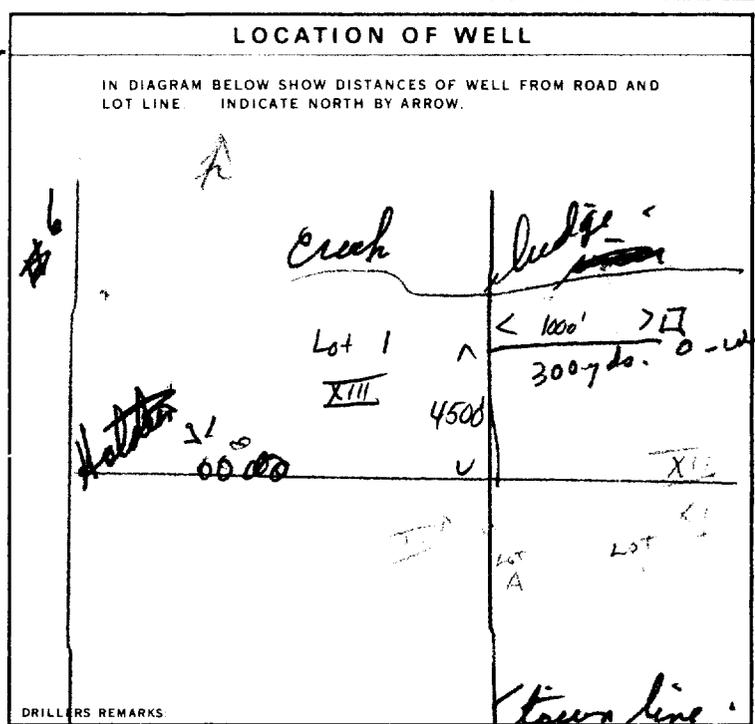
PUMPING RATE: *0005* GPM

DURATION OF PUMPING: *1 hour 10 mins*

STATIC LEVEL	WATER LEVEL END OF PUMPING	WATER LEVELS DURING
<i>013</i>	<i>013</i>	15 MINUTES: <i>007</i>

RECOMMENDED PUMP TYPE:  SHALLOW

RECOMMENDED PUMP SETTING: *025*



FINAL STATUS OF WELL:  WATER SUPPLY

WATER USE: *01* DOMESTIC

METHOD OF DRILLING: *6* BORING

CONTRACTOR: *Leber Water Well* LICENCE NUMBER: *5477*

NAME OF DRILLER OR BORER: *R. R. 2 Breslau* LICENCE NUMBER: *5477*

SIGNATURE OF CONTRACTOR: *[Signature]* SUBMISSION DATE: *21* MO *11* YR. *79*

OFFICE USE ONLY

CONTRACTOR: *5477* DATE RECEIVED: *08 01 80*

DATE OF INSPECTION: *18/6/80* INSPECTOR: *[Signature]*

REMARKS: *\*BRUCE CO. changed from 1405280*

Print only in spaces provided. Mark correct box with a checkmark, where applicable.

11

2513654

Municipality 25005 Con. GR E 03

County or District: **Grey** Township/Borough/City/Town/Village: **Egremont** Con block tract survey, etc.: **CON 3 E 6 R** Lot: **35**  
 Address: **RR #1 Holstein NOG 2 A0** Date completed: **6 10 98**  
 Northing RC Elevation RC Basin Code ii iii iv

LOG OF OVERBURDEN AND BEDROCK MATERIALS (see instructions)					
General colour	Most common material	Other materials	General description	Depth - feet	
				From	To
	Topsoil			0	1
Brown	Sand	stones		1	39
Brown	clay	gravel		39	80
Brown	gravel		wet	80	91
Grey	clay	gravel		91	128
Grey	Limestone			128	163

31 32

**41 WATER RECORD**

Water found at - feet	Kind of water
10-13 <b>139</b>	1 <input checked="" type="checkbox"/> Fresh 3 <input type="checkbox"/> Sulphur 2 <input checked="" type="checkbox"/> Salty 4 <input type="checkbox"/> Minerals
15-18 <b>159</b>	1 <input checked="" type="checkbox"/> Fresh 3 <input type="checkbox"/> Sulphur 2 <input checked="" type="checkbox"/> Salty 4 <input type="checkbox"/> Minerals
20-23	1 <input type="checkbox"/> Fresh 3 <input type="checkbox"/> Sulphur 2 <input type="checkbox"/> Salty 4 <input type="checkbox"/> Minerals
25-28	1 <input type="checkbox"/> Fresh 3 <input type="checkbox"/> Sulphur 2 <input type="checkbox"/> Salty 4 <input type="checkbox"/> Minerals
30-33	1 <input type="checkbox"/> Fresh 3 <input type="checkbox"/> Sulphur 2 <input type="checkbox"/> Salty 4 <input type="checkbox"/> Minerals

**51 CASING & OPEN HOLE RECORD**

Inside diam inches	Material	Wall thickness inches	Depth - feet	
			From	To
6	1 <input checked="" type="checkbox"/> Steel 2 <input type="checkbox"/> Galvanized 3 <input type="checkbox"/> Concrete 4 <input type="checkbox"/> Open hole 5 <input type="checkbox"/> Plastic	1.5K	+1	130
6	1 <input type="checkbox"/> Steel 2 <input type="checkbox"/> Galvanized 3 <input type="checkbox"/> Concrete 4 <input type="checkbox"/> Open hole 5 <input type="checkbox"/> Plastic		130	163
24-25	1 <input type="checkbox"/> Steel 2 <input type="checkbox"/> Galvanized 3 <input type="checkbox"/> Concrete 4 <input type="checkbox"/> Open hole 5 <input type="checkbox"/> Plastic			27-30

**SCREEN**

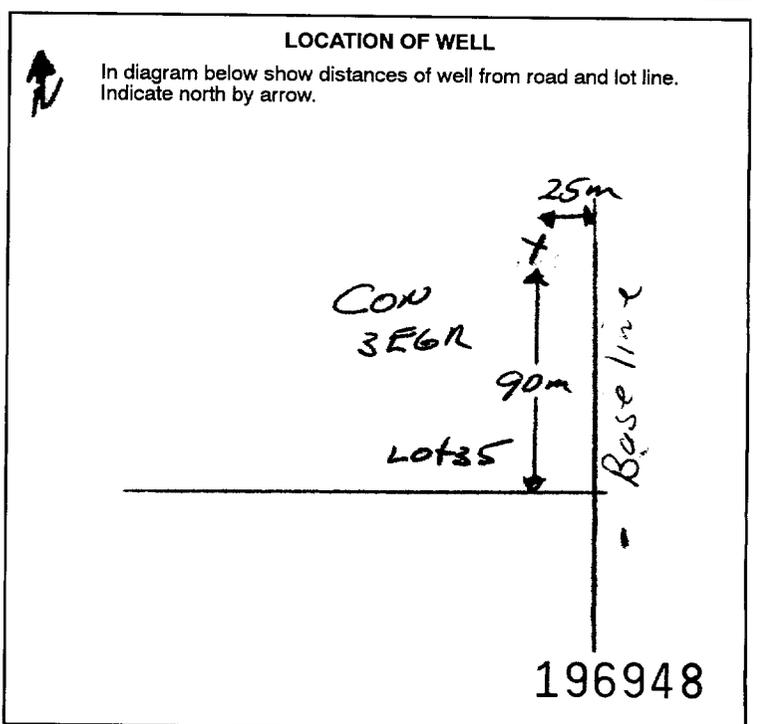
Sizes of opening (Slot No.)	Diameter inches	Length feet
Material and type		Depth at top of screen feet

**61 PLUGGING & SEALING RECORD**

Depth set at - feet		Material and type (Cement grout, bentonite, etc.)
From	To	
0	30	Benseal
18-21	22-25	
26-29	30-33	

**71 PUMPING TEST**

Pumping test method <input type="checkbox"/> Pump <input checked="" type="checkbox"/> Bailor	Pumping rate <b>30 GPM</b>	Duration of pumping ... 1 ... Hours ... Mins
Static level <b>22.6</b> feet	Water levels during 15 minutes <b>22.6</b> feet 30 minutes 45 minutes 60 minutes <b>22.6</b> feet	Water at end of test <input checked="" type="checkbox"/> Clear <input type="checkbox"/> Cloudy
Recommended pump type <input type="checkbox"/> Shallow <input checked="" type="checkbox"/> Deep	Recommended pump setting <b>60</b> feet	Recommended pump rate <b>25 GPM</b>



**FINAL STATUS OF WELL**

1 <input checked="" type="checkbox"/> Water supply	5 <input type="checkbox"/> Abandoned, insufficient supply	9 <input type="checkbox"/> Unfinished
2 <input type="checkbox"/> Observation well	6 <input type="checkbox"/> Abandoned, poor quality	10 <input type="checkbox"/> Replacement well
3 <input type="checkbox"/> Test hole	7 <input type="checkbox"/> Abandoned (Other)	
4 <input type="checkbox"/> Recharge well	8 <input type="checkbox"/> Dewatering	

**WATER USE**

1 <input checked="" type="checkbox"/> Domestic	5 <input type="checkbox"/> Commercial	9 <input type="checkbox"/> Not used
2 <input type="checkbox"/> Stock	6 <input type="checkbox"/> Municipal	10 <input type="checkbox"/> Other
3 <input type="checkbox"/> Irrigation	7 <input type="checkbox"/> Public supply	
4 <input type="checkbox"/> Industrial	8 <input type="checkbox"/> Cooling & air conditioning	

**METHOD OF CONSTRUCTION**

1 <input type="checkbox"/> Cable tool	5 <input type="checkbox"/> Air percussion	9 <input type="checkbox"/> Driving
2 <input type="checkbox"/> Rotary (conventional)	6 <input type="checkbox"/> Boring	10 <input type="checkbox"/> Digging
3 <input type="checkbox"/> Rotary (reverse)	7 <input type="checkbox"/> Diamond	11 <input type="checkbox"/> Other
4 <input checked="" type="checkbox"/> Rotary (air)	8 <input type="checkbox"/> Jetting	

Name of Well Contractor: **Highland Water Wells** Well Contractor's Licence No.: **2576**  
 Address: **Box 141 Durham NOG 1 R0**  
 Name of Well Technician: **Nigel Poppleton** Well Technician's Licence No.: **72130**  
 Signature of Technician/Contractor: *[Signature]* Submission date: **day 14 mo 10 yr 98**

**MINISTRY USE ONLY**

Data source	Contractor <b>2576</b>	Date received <b>OCT 27 1998</b>
Date of inspection	Inspector	
Remarks		

**CSS. ES9**

Print only in spaces provided.  
Mark correct box with a checkmark, where applicable.

11

2513892

Municipality 25005 Con. GR E 03

County or District **Grey** Township/Borough/City/Town/Village **Egremont** Con block tract survey, etc. **COW 3 EGR** Lot **38**

Address **RR #1 Mount Forest NOG 220** Date completed **14** day **5** month **99** year

21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47

LOG OF OVERBURDEN AND BEDROCK MATERIALS (see instructions)					
General colour	Most common material	Other materials	General description	Depth - feet	
				From	To
	Topsoil			0	1
Brown	clay			1	17
Brown	silty clay	soft		17	34
Brown	clay gravel			34	160
Gray	Limestone			160	171
Brown/Gray	Limestone	layers		171	217

31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50

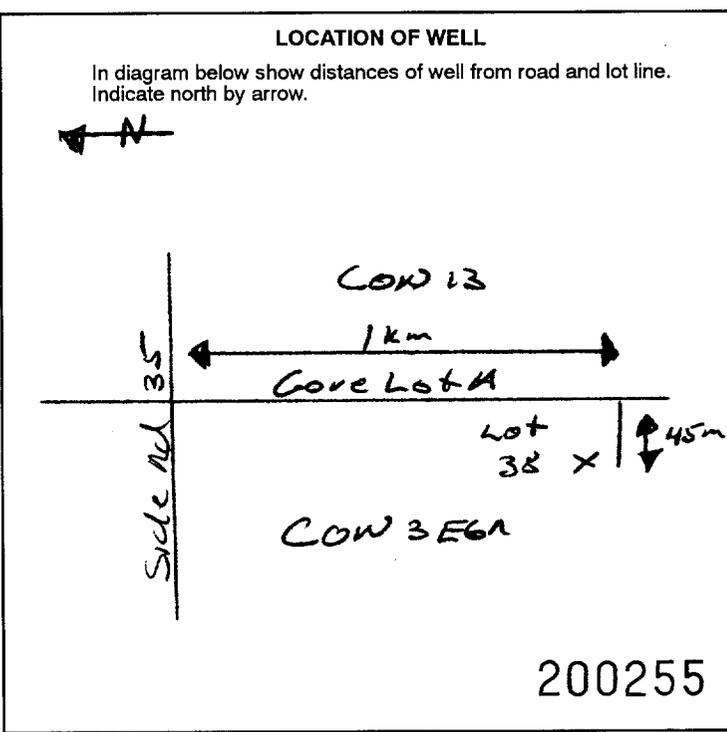
41 WATER RECORD			
Water found at - feet	Kind of water		
10-13 <b>175</b>	1 <input checked="" type="checkbox"/> Fresh 2 <input type="checkbox"/> Salty	3 <input type="checkbox"/> Sulphur 4 <input type="checkbox"/> Minerals 6 <input type="checkbox"/> Gas	14
15-18 <b>210</b>	1 <input checked="" type="checkbox"/> Fresh 2 <input type="checkbox"/> Salty	3 <input type="checkbox"/> Sulphur 4 <input type="checkbox"/> Minerals 6 <input type="checkbox"/> Gas	19
20-23	1 <input type="checkbox"/> Fresh 2 <input type="checkbox"/> Salty	3 <input type="checkbox"/> Sulphur 4 <input type="checkbox"/> Minerals 6 <input type="checkbox"/> Gas	24
25-28	1 <input type="checkbox"/> Fresh 2 <input type="checkbox"/> Salty	3 <input type="checkbox"/> Sulphur 4 <input type="checkbox"/> Minerals 6 <input type="checkbox"/> Gas	29
30-33	1 <input type="checkbox"/> Fresh 2 <input type="checkbox"/> Salty	3 <input type="checkbox"/> Sulphur 4 <input type="checkbox"/> Minerals 6 <input type="checkbox"/> Gas	34

51 CASING & OPEN HOLE RECORD				
Inside diam inches	Material	Wall thickness inches	Depth - feet	
			From	To
10-11 <b>6</b>	1 <input checked="" type="checkbox"/> Steel 2 <input type="checkbox"/> Galvanized 3 <input type="checkbox"/> Concrete 4 <input type="checkbox"/> Open hole 5 <input type="checkbox"/> Plastic	<b>.188</b>	<b>+2</b>	<b>163</b>
17-18 <b>6</b>	1 <input type="checkbox"/> Steel 2 <input type="checkbox"/> Galvanized 3 <input type="checkbox"/> Concrete 4 <input type="checkbox"/> Open hole 5 <input type="checkbox"/> Plastic		<b>163</b>	<b>217</b>
24-25	1 <input type="checkbox"/> Steel 2 <input type="checkbox"/> Galvanized 3 <input type="checkbox"/> Concrete 4 <input type="checkbox"/> Open hole 5 <input type="checkbox"/> Plastic			27-30

SCREEN	Sizes of opening (Slot No.)	Diameter	Length
		inches	feet
	Material and type	Depth at top of screen	
		feet	

61 PLUGGING & SEALING RECORD			
Depth set at - feet		Material and type (Cement grout, bentonite, etc.)	
10-13 <b>0</b>	14-17 <b>40</b>	<b>Benseal</b>	
16-21	22-25		
26-29	30-33		

71 PUMPING TEST	
Pumping test method 1 <input checked="" type="checkbox"/> Pump & T. Pailer	Pumping rate <b>20</b> GPM
Static level <b>30</b> feet	Water level end of pumping 22-24 feet
Water levels during 1 <input type="checkbox"/> Pumping 2 <input type="checkbox"/> Recovery	
15 minutes 26-28 feet	30 minutes 29-31 feet
45 minutes 32-34 feet	60 minutes 35-37 feet
If flowing give rate 38-41 GPM	Pump intake set at feet
Recommended pump type <input type="checkbox"/> Shallow <input checked="" type="checkbox"/> Deep	Recommended pump setting <b>100</b> feet
	Recommended pump rate <b>15</b> GPM



FINAL STATUS OF WELL			
1 <input checked="" type="checkbox"/> Water supply	5 <input type="checkbox"/> Abandoned, insufficient supply	9 <input type="checkbox"/> Unfinished	
2 <input type="checkbox"/> Observation well	6 <input type="checkbox"/> Abandoned, poor quality	10 <input type="checkbox"/> Replacement well	
3 <input type="checkbox"/> Test hole	7 <input type="checkbox"/> Abandoned (Other)		
4 <input type="checkbox"/> Recharge well	8 <input type="checkbox"/> Dewatering		

WATER USE			
1 <input checked="" type="checkbox"/> Domestic	5 <input type="checkbox"/> Commercial	9 <input type="checkbox"/> Not used	
2 <input type="checkbox"/> Stock	6 <input type="checkbox"/> Municipal	10 <input type="checkbox"/> Other	
3 <input type="checkbox"/> Irrigation	7 <input type="checkbox"/> Public supply		
4 <input type="checkbox"/> Industrial	8 <input type="checkbox"/> Cooling & air conditioning		

METHOD OF CONSTRUCTION			
1 <input type="checkbox"/> Cable tool	5 <input type="checkbox"/> Air percussion	9 <input type="checkbox"/> Driving	
2 <input type="checkbox"/> Rotary (conventional)	6 <input type="checkbox"/> Boring	10 <input type="checkbox"/> Digging	
3 <input type="checkbox"/> Rotary (reverse)	7 <input type="checkbox"/> Diamond	11 <input type="checkbox"/> Other	
4 <input checked="" type="checkbox"/> Rotary (air)	8 <input type="checkbox"/> Jetting		

Name of Well Contractor <b>Highland Water Wells</b>	Well Contractor's Licence No. <b>2576</b>
Address <b>Box 141 Durham</b>	
Name of Well Technician <b>Nigel Popperton</b>	Well Technician's Licence No. <b>72130</b>
Signature of Technician/Contractor <i>[Signature]</i>	Submission date day <b>17</b> mo <b>5</b> yr <b>99</b>

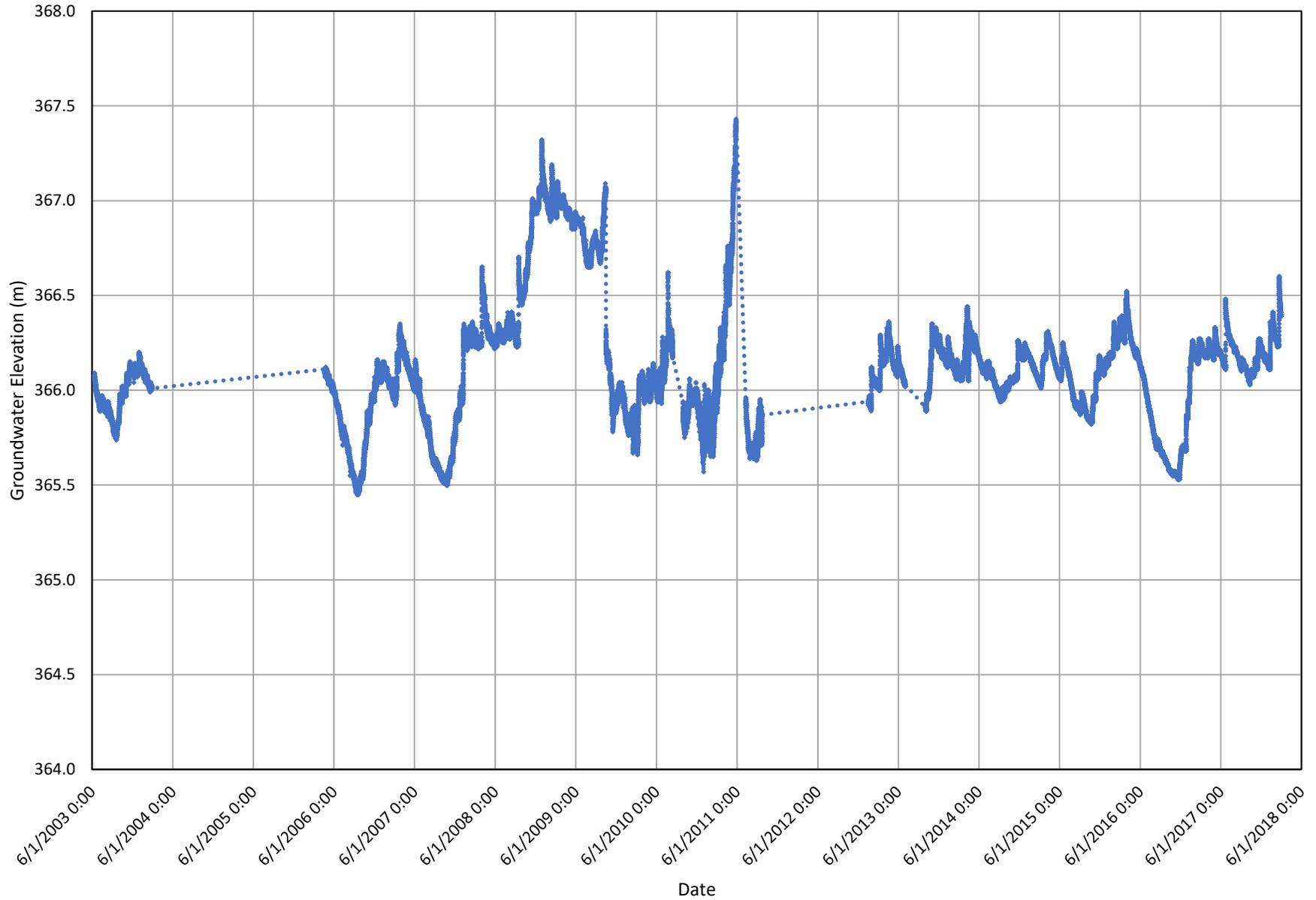
MINISTRY USE ONLY	
Data source <b>2576</b>	Contractor <b>2576</b>
Date of inspection	Date received <b>JUN 09 1999</b>
Inspector	
Remarks	

CSS.ES9

# **APPENDIX B**

## **Provincial Groundwater Monitoring Network (PGMN) Data**

Figure B-1: Recorded Groundwater Level Data for PGMN Well W0000343-2



Print only in spaces provided.  
Mark correct box with a checkmark, where applicable.

11

3007485

Municipality  
30006

Con.  
CON

17

County or District <b>Huron County</b>	Township/Borough/City/Town/Village <b>Howick Twp</b>	Con block tract survey, etc. <b>CON 17</b>	Lot <b>22</b>
Address <b>Box 127, Wraytel, Ontario, N0G 2J0</b>		Date completed <b>02 04 03</b> day month year	

**LOG OF OVERBURDEN AND BEDROCK MATERIALS (see instructions)**

General colour	Most common material	Other materials	General description	Depth - feet	
				From	To
	TOP SOIL			0	1
Brown	SAND	GRAVEL	WET AT 13 FEET - 30 FEET	1	31
Grey	SILTY CLAY			31	49
Grey	SAND	GRAVEL	WET 49 FEET - 55 FEET	49	55
Grey	CLAY			55	56

**41 WATER RECORD**

Water found at - feet	Kind of water			
13-30	1 <input checked="" type="checkbox"/> Fresh	3 <input type="checkbox"/> Sulphur	4 <input type="checkbox"/> Minerals	6 <input type="checkbox"/> Gas
44-55	1 <input checked="" type="checkbox"/> Fresh	3 <input type="checkbox"/> Sulphur	4 <input type="checkbox"/> Minerals	6 <input type="checkbox"/> Gas

**51 CASING & OPEN HOLE RECORD**

Inside diam inches	Material	Wall thickness inches	Depth - feet	
			From	To
4"	1 <input checked="" type="checkbox"/> Steel	188	+ 4	8
4 1/2"	1 <input type="checkbox"/> Steel		A	20-23
4 1/2"	1 <input type="checkbox"/> Steel		B	27-30

**SCREEN**

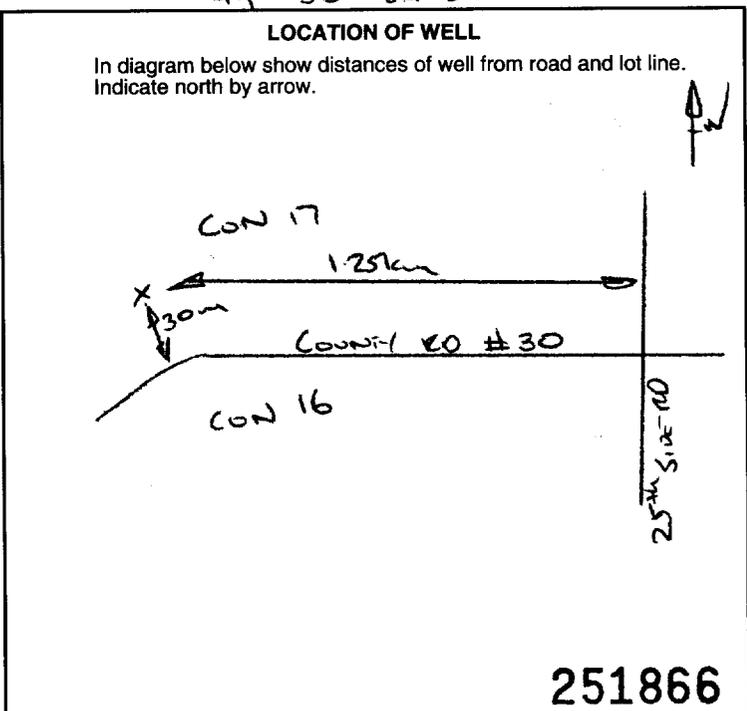
Sizes of opening (Slot No.)	Diameter $\phi 2"$ inches	Length A 17 B 6 feet
Material and type	PLASTIC	

**61 PLUGGING & SEALING RECORD**

Annular space <input checked="" type="checkbox"/>	Abandonment <input type="checkbox"/>
Depth set at - feet	Material and type (Cement grout, bentonite, etc.)
0-13	HOLE PLUG
13-30	SAND
30-49	HOLE PLUG

**71 PUMPING TEST**

Pumping test method <input checked="" type="checkbox"/> Pump <input type="checkbox"/> Bailor	Pumping rate GPM	Duration of pumping Hours Mins
Static level 11 feet	Water level end of pumping 11 feet	Water levels during
15 minutes 26-28 feet	30 minutes 29-31 feet	45 minutes 32-34 feet
60 minutes 35-37 feet	If flowing give rate GPM	



**FINAL STATUS OF WELL**

1 <input type="checkbox"/> Water supply	5 <input type="checkbox"/> Abandoned, insufficient supply	9 <input type="checkbox"/> Unfinished
2 <input checked="" type="checkbox"/> Observation well	6 <input type="checkbox"/> Abandoned, poor quality	10 <input type="checkbox"/> Replacement well
3 <input type="checkbox"/> Test hole	7 <input type="checkbox"/> Abandoned (Other)	
4 <input type="checkbox"/> Recharge well	8 <input type="checkbox"/> Dewatering	

**WATER USE**

1 <input type="checkbox"/> Domestic	5 <input type="checkbox"/> Commercial	9 <input type="checkbox"/> Not use
2 <input type="checkbox"/> Stock	6 <input type="checkbox"/> Municipal	10 <input checked="" type="checkbox"/> Other OBSERVATION WELL
3 <input type="checkbox"/> Irrigation	7 <input type="checkbox"/> Public supply	
4 <input type="checkbox"/> Industrial	8 <input type="checkbox"/> Cooling & air conditioning	

**METHOD OF CONSTRUCTION**

1 <input type="checkbox"/> Cable tool	5 <input type="checkbox"/> Air percussion	9 <input type="checkbox"/> Driving
2 <input type="checkbox"/> Rotary (conventional)	6 <input type="checkbox"/> Boring	10 <input type="checkbox"/> Digging
3 <input type="checkbox"/> Rotary (reverse)	7 <input type="checkbox"/> Diamond	11 <input type="checkbox"/> Other
4 <input checked="" type="checkbox"/> Rotary (air)	8 <input type="checkbox"/> Jetting	

Name of Well Contractor <b>HIGHLAND WATER WELLS</b>	Well Contractor's Licence No. <b>2576</b>
Address <b>Box 141 Huron, Ont. N0G 1P0</b>	
Name of Well Technician <b>Nigel Robertson</b>	Well Technician's Licence No. <b>T2130</b>
Signature of Technician/Contractor	Submission date day <b>23</b> mo <b>04</b> yr <b>03</b>

**MINISTRY USE ONLY**

Data source	Contractor <b>2576</b>	Date received <b>MAY 15 2003</b>
Date of inspection	Inspector	
Remarks <b>CSS.ES3</b>		