COWDEN-WOODS DESIGN BUILDERS LTD.

HYDROGEOLOGICAL IMPACT ASSESSMENT

2741 COUNTY ROAD 42, TOWNSHIP OF CLEARVIEW

FEBRUARY 14, 2019

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COWDEN-WOODS DESIGN BUILDERS LTD.

PROJECT NO.: 181-03105-00
DATE: FEBRURARY 14, 2018

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February 14, 2018

COWDEN-WOODS DESIGN BUILDERS LTD.
249 Saunders Road
Barrie ON L4N 9A3

Attention: **Ms. Anita Stacey**

Dear Ms. Stacey:

Subject: **2741 County Road 42 (Part Lot 10 Concession 2), Township of Clearview**

WSP Canada Inc. (WSP) is pleased to submit the attached report to document the Hydrogeological Impact Assessment prepared for the proposed expansion of an existing marijuana facility at 2741 County Road 42, Township of Clearview, Ontario.

The report describes the hydrogeological conditions on-site and provides an assessment to illustrate the likely changes that would be expected due to the proposed expansion. The report also identifies the potential for impacts on the local groundwater flow system, including adjacent well users.

We trust that this information is sufficient for your current needs. If you have any questions or require further information, please contact us.

Yours truly,

Lloyd Lemon, M.Sc., P.Geo.
Senior Project Geoscientist

LAL/dlw

WSP ref.: 181-03105-00

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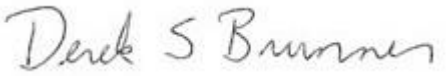

Derek Brunner, M.Sc., P.Geo.
Hydrogeologist, Project Manager, Environmental Management

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1 INTRODUCTION

WSP Canada Inc. (WSP) was retained by Cowden-Woods Design Builders Limited (Cowden-Woods) to prepare a Hydrogeological Impact Assessment as it pertains to the proposed development at 2741 County Road 42, Township of Clearview, County of Simcoe Ontario (Site).

The proposed plan for the property includes the expansion of an existing marijuana facility.

This report documents the work performed to develop an understanding of the hydrogeological conditions at the Site and to anticipate the likelihood that the proposed water supply requirements would impact nearby private wells. The remainder of this report presents the background information and provides the results of our assessment and associated conclusions and recommendations.

1.1 BACKGROUND

The Site is located northeast of the intersection of County Road 42 and Concession 9, east of the community of Creemore, as shown on the attached Site Location Map – **Figure 1**. The existing conditions at the Site are shown in the aerial photograph in **Figure 2**. The Site houses an existing building that is surrounded by an uncultivated area. The southwest corner of the parcel has been developed as a facility for Huron Tractor. The property to the east of the Site is a wooded area. There are currently two (2) production wells located along the southern margin of the developed area which are used to service the existing facility.

1.2 PROPOSED DEVELOPMENT

Based on the plans provided to our office by Cowden Woods, the proposed development comprises a 5,000 square-foot office area, a 26,000 square-foot greenhouse, a 45,000 square-foot addition to the existing building, a proposed 10,000 square foot storage area, a proposed 124,400 square-foot area for proposed hoop houses, and associated paved access and parking (**Figure 2**). The proposed greenhouse is not subject to site plan approval as per documentation provided by the Township.

2 STUDY APPROACH

WSP understands that the existing water supply wells are intended to supply the water requirements for the expanded facility. This study was designed to identify planned changes associated with the proposed development and to identify changes that may have potential to impact neighbouring domestic water supplies or the surrounding environment.

This evaluation consists of a desktop review of published information and mapping (Ontario Water Well Records, soil mapping) and the previous on-site geotechnical investigation (Geospec Engineering Ltd., October 2013) augmented with existing knowledge and familiarity with the area. Information provided by the following sources was utilized in the course of this evaluation:

- A review of available geologic mapping from the Geological Survey of Canada (GSC), Ontario Geological Survey (OGS), Ministry of Natural Resources and Forestry (MNRD) and the Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA);
- Review of local hydrogeological and soils information provided in local study reports:
  - Geotechnical Investigation 2741 County Road 42 Cashtown Farm – GeoSpec Engineering Ltd., Project N° 13-1808, October 23, 2013;
  - Assessment Reports and mapping from the South Georgian Bay Lake Simcoe (SGBLS) Source Protection Area. Chapter 10: Township of Clearview;
- Review of the Ministry of Environment, Conservation and Parks (MECP) Water Well Information System (WWIS) and the Groundwater Information Network (GIN) to obtain an overview of the area stratigraphy and depth to water table; and
- Review of Hydrogeological Assessment Submissions - Conservation Authority Guidelines for Development Applications, June 2013.

3 ENVIRONMENTAL SETTING

3.1 PHYSIOGRAPHY

The proposed development area is situated within the Horseshoe Moraines physiographic region of Chapman and Putnam (1984) as represented in the OGS Earth application accessible through the Ministry of Northern Development and Mines Web Page (http://www.geologyontario.mndm.gov.on.ca). The landforms mapped at the Site are classified as Spillways. Spillways are glacial meltwater drainage channels and may or may not be currently occupied by streams. They can be found entrenched within moraines, and are typically characterized by broad trough gravel bottoms. The spillway extents within the vicinity of the Site are shown on **Figure 3**.

3.2 TOPOGRAPHY AND DRAINAGE

The Site is approximately 15 km south of Georgian Bay and is located within the Nottawasaga River Watershed. **Figure 4** provides an overview of the topography and drainage in the vicinity of the Site. Surface water flow is generally toward the east or southeast prior to changing to the regional northerly drainage.

Ontario Base Maps (OBM) indicate that ground elevation across the Site ranges from approximately 236 – 241 masl. The topographic map shows a small plateau region in the northwest corner of the Site at an elevation of approximately 240 – 241 masl. The land elevation is shown to then steadily decline toward the southwest, reaching an elevation of 236 masl in the southeast corner of the Site area proposed for development.

Regional groundwater flow is toward Georgian Bay to the north. Local, shallow, groundwater flow patterns are expected to mimic local topography and be directed to the east

Previous geotechnical investigations (GeoSpec, 2013) and surveying undertaken at the Site shows that shallow groundwater flow is toward the southeast.

3.3 LAND USE

The Site is located on a parcel of land bordering County Road 42 and Concession Road 9. The Site currently consists of a gravel driveway, a portable office, an existing greenhouse, cultivated farm fields and a forested area in the southeast corner of the Site.

Huron Tractor and a gas bar are located west of the Site and private rural residences are observed to the north, west and south.

3.4 REGIONAL GEOLOGY

The near surface soils are the top unit in a layered sequence of glacial and interglacial sediments that comprise the stratigraphic profile overlying bedrock beneath the region. The distribution of surficial soil types near the Property are shown on **Figure 5**.

The Geological Survey of Canada, under the direction of Dr. David Sharpe, published detailed three-dimensional mapping of stratigraphic profiles in the regional areas to the south of the site. Work is ongoing to extend this basic stratigraphic framework into Simcoe County. The stratigraphic profile beneath the Site is considered to include the equivalents of the following layers, from youngest to oldest:

1 Recent deposits.
2 Newmarket Till.

3 Thorncliffe Formation.
4 Sunnybrook Drift.
5 Scarborough Formation.
6 Don Formation.
7 York Till.
8 Bedrock.

As shown on **Figure 5**, the Site is underlain by sand deposits.

The Newmarket Till represents a regionally extensive stratum that is associated with the most recent period of glaciation. The equivalent of this formation underlies the surficial sand deposits. This till is typically dense to very hard and sandy to silty in texture with relatively low gravel content. The geological materials observed in the Site water wells are consistent with the Newmarket Till layer.

The stratigraphic layers between the Newmarket Till equivalent and the underlying bedrock are commonly grouped as the Lower Sediments. The Lower Sediments are considered to have been formed by similar cycles of earlier glacial advances and retreats and associated meltwater events that resulted in the deposition of the Newmarket Till. Five (5) stratigraphic layers that constitute the Lower Sediments are described below. These units may not be consistently observed beneath the subsurface across Simcoe County.

- The Thorncliffe Formation equivalent is a complex of stratified glaciofluvial and glaciolacustrine deposits. The texture of the Thorncliffe Formation is highly variable and is best described as fine-grained, with interbedded coarse-grained material capable of yielding notable amounts of water.
- The Sunnybrook Drift equivalent is a fine-grained material deposited in glacial and proglacial lacustrine depositional environments (diamicton). The advance of the ice sheet blocked the main drainage from the regional basin, which caused water levels to rise and form a deep lacustrine environment with deposits including varved clays.
- The Scarborough Formation equivalent is a coarsening upward sequence of sediment that ranges from clay/silt rythmites (fine-grained) to channelized cross-bedded sands (coarse-grained). The coarser fractions of this delta are a potential source of groundwater.
- The Don Formation equivalent is only rarely preserved within southern Ontario and consists of alternating beds of fossiliferous sand and mud.
- The York Till equivalent was deposited immediately overlying the bedrock by the preceding Illinoian glaciation. This till occurs only sporadically within the study area and is believed to be preserved in lows upon the bedrock surface. The till is dark grey with a sandy silt matrix and includes clusters of the underlying shale.

The bedrock in the study area is mapped as the Collingwood Member, Georgian Bay Formation of the Simcoe Group (Ontario Geological Survey, 2011) as illustrated on **Figure 6**. The Collingwood Member typically consists of a black shale. Local water well records do not describe intersections with the underlying bedrock. The depth to bedrock is estimated to be in excess of 15 metres below ground surface, based on bedrock topography and overburden thickness mapping (Gao et al, 2006). A map of overburden thickness is provided in **Figure 7**. The depth to bedrock at the Site is greater than 23 m based on the local water well records.

3.5 REGIONAL HYDROGEOLOGY

The movement of groundwater through the subsurface is controlled by the hydraulic gradients and the relative distribution of coarse and fine-grained sediments. In general, water will move laterally through coarse-grained sediments (sands and gravels) and vertically through fine-grained sediments (silts and clays). As such, the geologic units are typically grouped into hydrostratigraphic units that reflect the capacity of the geologic units to transmit water. Hydrostratigraphic units are considered to be either aquifers (with good capacity to transmit water) or aquitards (which typically impede transmission of water). Ultimately the distribution and interconnection of aquifers and aquitards are responsible for observed groundwater movement.

The local stratigraphic profile can be considered as a six-layer hydrostratigraphic profile as follows:

1 Recent Sediments (Aquifer)
2 Newmarket Aquitard.
3 Thorncliffe Aquifer Complex.
4 Sunnybrook Aquitard.
5 Scarborough Aquifer Complex.
6 Bedrock.

The recent deposits create a shallow unconfined aquifer that is present beneath the Site.

The Newmarket Aquitard consists of the Newmarket Till and low permeability deposits that are known to infill the erosional channels. The Newmarket Aquitard is considered to be a leaky confining layer that provides protection from contamination to aquifers within the underlying hydrostratigraphic units.

The Thorncliffe Aquifer Complex consists of fine to coarse-grained sediments of the Thorncliffe Formation. Local sand and gravel deposits within the Thorncliffe Aquifer Complex provide high yield wells. Groundwater in this layer is typically under artesian pressure which can result in flowing wells observed at the Site and in the surrounding area.

The Sunnybrook Aquitard separates the Thorncliffe and Scarborough Aquifer Complexes. This aquitard demonstrates low permeability, provides some resistance to vertical groundwater movement, and protects the underlying aquifer from potential contaminant movement.

The Scarborough Aquifer Complex consists of fine to coarse-grained sediments associated with the Scarborough Formation. In general, these sediments tend to be coarse-grained and thicker where they fill topographic lows and valleys in the underlying bedrock surface. Groundwater within the Scarborough Aquifer Complex is typically under pressure, but only local artesian conditions occur. Locally, the Scarborough Aquifer Complex produces high well yields suitable for municipal or commercial wells. Due to its depth and the presence of shallower aquifers, the Scarborough Aquifer Complex is not exploited extensively for private water supplies.

3.5.1 REGIONAL GROUNDWATER MOVEMENT

In general terms, precipitation infiltrates vertically into the recent surficial glacial lake sediments, or the till layers, where present at ground surface. Groundwater flow patterns can be influenced by established watercourses where there is potential for groundwater discharge to supply baseflow into the watercourses. The rate of groundwater discharge is controlled by the relative permeability of the recent deposits at the base of the streams. Discharge as baseflow is typically low through fine-grained base soils and higher where the streams have eroded down into coarser aquifers. Groundwater will tend to flow up or down through the aquitard units and laterally within the aquifers.

The horizontal groundwater movement through the subsurface aquifers tends to reflect the ground surface topography and the presence of stream channels. Groundwater flow in the upper aquifer system is typically primarily influenced by the local topography and drainage and flow in the lower aquifer systems are influenced by the bedrock topography and the regional hydrogeological features. At the Site location, regional groundwater flow is ultimately toward Georgian Bay, located about 15 km to the north.

Regional groundwater flow patterns for the confined aquifer system are not established in the available dataset.

3.6 SOIL PROFILE

The Site is underlain by a sandy silt to silt material with occasional gravel to a depth of approximately 5 m (GeoSpec Engineers Ltd., October 2013).

The stratigraphic descriptions provided in Well Records for the Site water supply wells acquired from the MECP document that a unit of sandy clay is present to a depth of 3 m (10 ft), underlain by grey clay to 15.2 m (50 feet), and grey silt with gravel (presumably a till) to 18.9m (62 ft). The silt with gravel is underlain by sand from 18.9 m to

23.2 m (76 ft). The texture of the sand is noted to coarsen at 21.9 m (72 ft). The bottom of this aquifer is not noted in the well record.

The sandy clay, clay, and silt with gravel provide a confining layer (aquitard) to the underlying sand aquifer. The thickness of the confining layer is on the order of 15.9 m (52 ft).

3.7 SHALLOW GROUNDWATER

The depth to shallow groundwater in the four (4) boreholes drilled as part of the Geotechnical Investigation (GeoSpec Engineering Ltd., October 2013) was observed to range between 1.2 and 1.6 m bgs. The change in groundwater elevation observed within the boreholes was generally reflected in topographical elevations, with surface water and shallow groundwater flow both flowing toward the descending slope to the southeast.

The water level within the surficial aquifer system will fluctuate with the seasons and will also be influenced by precipitation events.

4 WATER SUPPLY

The Site is currently serviced by two (2) commercial supply wells, capable of yielding at least 36 L/min (2014 installation) and 91 L/min (2016 installation), respectively. Both supply wells are installed to approximately 23 m depth and the static water level is above ground surface (flowing artesian conditions). The water supply wells are capable of meeting the current water supply demand of the facility.

Local MECP well records were reviewed for an area within 500 m of the Site to identify nearby users of the water supply and to identify local conditions of soil and groundwater. There are no municipal water wells located within 500 m of the Site.

4.1 MECP WATER WELL RECORD SEARCH

A list of MECP water well records within 500 m of the proposed Site development area is provided in **Appendix A** and a summary is provided in **Table 4-1**. **Figure 8** illustrates the locations of wells located within 500 m of the Site as per the MECP WWIS. The well record database includes fourteen (14) MECP water well records within a 500-metre radius of the Site. These wells terminate within the overburden.

The records include:

- five (5) domestic wells,
- three (3) livestock wells including one (1) dug / bored well,
- three (3) commercial wells (including both Site supply wells),
- one (1) test hole,
- one (1) abandoned well, and
- one (1) unidentified well (assumed abandoned).

Local water supply wells in the area are considered to be in use as the immediate area surrounding the Site is not municipally-serviced. Investigation of the current status of the identified wells was not within the scope of this work program.

The available records show that wells in the area typically draw water from a confined sand aquifer at depths ranging from 14 to 23 m. Records for the Site wells do not identify the base of this stratum or describe the underlying material. The water-bearing sand layer appears to be protected from surface by a confining clay layer. The water supply wells all appear to be drilled wells with the exception of one (1) dug well, used as a water supply for livestock. It is possible that the MECP WWIS database includes wells that are incorrectly located and there may be some other wells for which well records are not on file at the MECP.

The water well records indicate that the sand aquifer in which the Site wells are screened can provide yields ranging between 32 L/min and 91 L/min (average 60 L/min). These estimates are based on short pumping tests associated with well construction and are not confirmed to have stressed the capacity of the aquifer or the wells. A lower yield of 14 L/min is noted at the dug well. The livestock, domestic, commercial, and supply wells provide estimated average yields of 44, 68, 46 and 64 L/min, respectively.

Based on the review of water well records, the nearest neighbouring domestic (private) well is located about 190 m southwest of the commercial supply wells. The well record for the neighbouring domestic well describes it as being installed to a depth of 21 m bgs in a sand unit with an overlying clay layer. The well is anticipated to be located within the same confined aquifer as the Site supply wells and is noted to have a similar estimated yield. Because the regional groundwater flow is considered to be to the north toward Georgian Bay, the domestic well is considered to be located “upgradient” of the Site supply wells and will likely receive water primarily sourced from the south. Therefore, drawdown effects produced by the supply wells are expected to be minimized at the nearest off-site well.

Table 4-1 Summary of Water Well Records within 500 m radius of the Site Development Boundary (based on MECP WWIS)

WELL TYPE	# OF WELLS	WELL DEPTHS (m bgs)	WELL YIELD (L/min)	WATER LEVEL FOUND (m bgs)	DISTANCE OF LOCAL WELLS RELATIVE TO SUPPLY WELLS (m)
Dug Wells	1	5.5	14	2.1	600
Livestock Wells	2 (excluding Dug / bored Well)	20 - 21	32 – 55	18.3 – 18.9	400 - 660
Domestic Wells	5	14 – 24	46 – 91	12.2 – 21.3	190 - 970
Commercial Wells	1 (excluding Supply Wells)	16	46	15	580
Site Supply Wells	2	23	36 – 91	– 1.8 *	N/A

* static water level (m) above ground surface

4.2 ON-SITE WATER SUPPLY

There are currently two (2) production wells, each 23.2 m deep, servicing the facility and located adjacent the southern Site property boundary. Well 7223301 is a six-inch production well and Well 7266487 is an eight-inch production well. The wells are approximately 10 metres apart with Well 7223301 located furthest to the west, shown on **Figure 2**.

WSP understands that the proposed system design will include the ability to capture and store runoff water from roof structures and to treat and recycle excess irrigation water to off-set groundwater demands. This assessment assumes that the facility is relying solely on groundwater as an initial source. The ability to capture and reuse runoff and to recycle water can be considered an additional factor of safety.

WSP also acknowledges that the proposed upgrades will include facilities to capture and infiltrate stormwater runoff and also to treat and infiltrate domestic wastewater. The assessment of potential well impacts does not consider this potential infiltration.

4.2.1 CURRENT WATER SUPPLY REQUIREMENTS

The average daily water demand for the existing facility is currently 14,500 L/day, divided between crop use (11,400 L/day) and domestic use (3,100 L/day). An estimated 5,400 L/day is process wastewater from crop use. The ratio between water demand and area is 14,500 L / 1,403 m^2 of crops. Wastewater from processing operations is directed to the drainage field.

4.2.2 PROPOSED WATER SUPPLY REQUIREMENTS

The grow-area for the expanded facility is proposed to be increased relative to the current area. Estimates of water demand provided to WSP by Cowden-Woods indicate that the daily water demand to support growth of the proposed crops will be on the order of 92,000 L/day. This estimate includes allowance for flushing the facilities and considers the maximum water demands of the entire crop at all times. In addition, the expanded facilities may see

the domestic use double from 3,100 to 6,200 L/day. With consideration of a factor of safety, the total potential groundwater use could be up to 150,000 L/day (without accounting for potential recycling/reuse).

The proposed operations will use cisterns as a source to irrigate plants. The cisterns will receive water inputs from groundwater, from roof-top runoff and from treated irrigation wastewater. This operation will significantly reduce the actual requirements on the groundwater system. This impact assessment has considered the conservative option that operations would depend only on groundwater use.

As per O.Reg 387/04 Water Taking Regulation, Section 34, governed by the Ontario Water Resources Act (OWRA), anyone taking more than a total of 50,000 litres of water per day, with some exceptions, is required to obtain a Permit To Take Water (PTTW) from the MECP. PTTW's are generally not required for farm use, however are required when used for irrigating crops that are grown for sale. The current facility use does not require a PTTW as the daily water demands are less than the threshold.

WSP understands that some of the water for crop use can be reused/recycled and suggests that additional efficiencies and other options (ie. storage) may be investigated to reduce daily and peak water demands and consumption requirements. If possible, these options may be able to reduce the required daily demand such that a PTTW is not required. There is merit to obtaining a PTTW to ensure that the facility can operate without restrictions, when required.

4.2.3 WATER SUPPLY POTENTIAL

A one-hour pumping test was conducted at each Site supply well by the well driller upon installation to evaluate the potential capacity of the well and to determine a recommended pumping rate. A setting of 36-L/min (51,840 L/day) and 91-L/min (131,040 L/day) was recommended for Well 7223301 and 7266487, respectively.

Based on the anticipated water supply requirements detailed in Section 4.2.2 (150,000 L/day), the available information on the well and pump capacity can potentially meet the needs of the proposed future operations, prior to consideration of benefits from recycling/reuse. WSP understands that the owner wishes to install a third water supply well in a position more suitable for supplying the proposed facilities. This third well will provide additional confidence that the required water is available. The use of a third well will not change the findings of this impact assessment for the proposed groundwater use.

Neighbouring private well supplies (distances of 190 – 400 m) observed to be screened within the same aquifer, were found to report the stabilization of groundwater levels due to pumping after 2 – 15 minutes.

WSP observes that the documentation for the existing capacity of the Site supply wells, while likely providing confidence that the wells can be operated without creating negative impacts, may not fully demonstrate the potential capacity of the existing wells (especially Well 7266487). WSP recommends that a hydraulic testing program can be conducted to first verify existing yield estimates and also to estimate potential maximum capacity. A step-test may be conducted at each Site supply well to estimate the sustainable well yield, to be confirmed by a constant rate pumping test. A larger capacity pump may need to be (temporarily) installed in the Site wells to support this type of hydraulic testing. This type of testing can also evaluate well efficiency and well interference potential for the well system and be used to further assess potential for well operation to affect nearby users.

4.2.4 POTENTIAL HYDRAULIC INFLUENCE

A review of the water well records indicate that there are three (3) water supply wells located within a 500 m radius of the Site water supply wells. The wells range in a distance of 190 m to 400 m and extend to depths between 14 m and 21 m bgs. Given the regional northerly groundwater flow direction towards Georgian Bay, and the positions of the nearest wells to the south, west and northwest relative to the Site supply wells, the nearest neighbouring wells are likely upgradient and likely to be less affected by water taking at the Site.

In the absence of specific data describing aquifer properties, WSP prepared a simple analysis using ranges of typical properties and the Theis Equation to estimate the typical radial distance that groundwater would be affected by

pumping groundwater from a confined aquifer at any given time. For the purpose of this estimate, the aquifer is assumed to be uniformly thick, infinite in extent, homogeneous and isotropic in nature.

For this analysis, WSP assumed:

- Hydraulic Conductivity (K) range (m/s): 10^{-4} to 10^{-3} m/s
- Aquifer Thickness (b) (m): 4.26 m (14 feet)
- Transmissivity (T = K x b) range (m^2/s): 4.26 x 10^{-4} to 4.26 x 10^{-3} or 3.68 to 368 m^2/day
- Storativity: 1 x 10^{-4}
- Pumping Rate (Q) (L/day) 150,000 L/day or 150 m^3/day

The estimates of the estimated drawdown at distances of up to 200 m from the pumping well for durations of continuous pumping of 1 day, 7 days, 14 days and 30 days are provided in **Appendix B.** These estimates show that the range of drawdown expected at a distance of 200 m after continuous pumping for 30 days is between 0.3 and 2.1 m. The hydraulic conductivity range was selected based on review of possible scenarios using the Theis calculation tool to ensure generation of a sustainable drawdown in the pumping well. Additional site-specific information will be required to reduce the uncertainty associated with these estimates. Considering that the supply wells typically have a static water level above or near ground surface and pumps installed at depths greater than 15 m, there is sufficient available drawdown to manage the influence of pumping from the Site wells and the use of the domestic well at 200 m distance.

The analysis presented in **Appendix B** for the 10 m distance indicates that there is potential for some mutual interference between the two Site supply wells if they are operated simultaneously. These estimates indicate that the available drawdown is likely sufficient to support continuous pumping for 30 days. This will require confirmation with site-specific testing.

4.2.5 OTHER GROUNDWATER CONCERNS

During our site visit on March 22, 2018, WSP noted that water was flowing from the Site supply wells due to artesian pressures. This condition was not in conformance with the requirements of O.Reg. 903 (as amended). Well caps at both wells were observed to have cracked from water freezing within the above-ground casing over the winter season.

WSP mailed a letter to Agripharm on March 29, 2018 outlining the issue and a recommended scope of work (**Appendix C**). G. Hart & Sons Well Drilling Ltd. (G. Hart & Sons) was contracted to assess the artesian pressure and to propose suitable mitigation measures to stop the surface flow of groundwater. G. Hart & Sons conducted an initial assessment on April 25, 2018 where the artesian pressures were measured to be 0.5 psi and 1 psi at the 6-inch (7223301) and 8-inch (7266487), respectively. Following the assessment, Well Busters packers were recommended to be installed to stop the flow of groundwater to surface. These devices have been installed by G. Hart and Sons.

5 POLICY AREAS

The following sections discuss specific policy areas that pertain to groundwater resources and measures taken within the proposed development plan to conform to these policies. Wellhead Protection Areas do not apply to this part of the County of Simcoe that is serviced by private wells.

5.1 WELLHEAD PROTECTION AREAS

A wellhead protection area (WHPA) for the wells that service the community of Creemore has been delineated to the southwest of the Site (**Figure 9**). The WHPA illustrates an easterly groundwater flow direction. The WHPA does not extend beneath the Site.

5.2 HIGHLY VULNERABLE AQUIFERS

The Source Protection Plan for the South Georgian Bay Lake Simcoe Source Protection Region contains policies that apply to Highly Vulnerable Aquifers as required by the *Clean Water Act*. **Figure 10** presents the mapping of Highly Vulnerable Aquifers (HVA) from the Assessment Report for the Nottawasaga Valley Source Protection Area. HVA are considered susceptible to contamination of groundwater from activities on the surface or shallow subsurface. The northern and eastern boundaries of the proposed development area are mapped within an area of Highly Vulnerable Aquifer, as shown on **Figure 10**. The proposed land use for the greenhouse expansion is expected to have minimal potential to affect underlying groundwater resources.

5.3 SIGNIFICANT GROUNDWATER RECHARGE AREAS

The Assessment Report for the Nottawasaga Valley Source Protection Area contains mapping of Significant Groundwater Recharge Areas (SGRA). SGRA are local areas that receive more than the average estimated recharge for a watershed area. The southwest portion of the proposed development Site area is mapped within a SGRA with medium risk potential, while the northern and eastern Site boundaries are mapped within a SGRA with high risk potential, as shown on **Figure 11**. The remainder of the parcel area is not within a mapped SGRA.

WSP understands that the stormwater management plan being developed for the site is to include provision to ensure that there is a net water balance between pre-development recharge and post-development recharge and will also consider groundwater removed from the confined aquifer and water returned to the subsurface (surficial aquifer layer) as treated wastewater or as infiltrated stormwater runoff. Treated wastewater will be returned via a private sewage treatment system. Stormwater can be managed and infiltrated using Low Impact Development (LID) technologies.

This target will minimize the potential for the proposed operations to impact the water balance and will also reduce the lateral extent of potential changes in groundwater elevation due to pumping from the Site water supply wells.

6 CONCLUSIONS

The conclusions of our desktop study are:

- There is no municipal water servicing available at the Site.
- The water demands for the proposed expansion of the marijuana facility are estimated to be on the order of 200,000 L/day based demand estimates provided to WSP. These demands to not reflect the potential for use of captured water from rooftop runoff and recycling to off-set potential groundwater demands.
- A Permit To Take Water will be required for water takings that are greater than 50,000 L/day.
- The (two) Site supply wells are each drilled to 23 m depth, and obtain water from a sand layer at depths from 19 to 23 m. The sand aquifer layer is protected from surface influences due to the presence of a relatively thick confining layer described in the well record as clay.
- Regional groundwater flow directions are toward Georgian Bay to the north although local flow may be more east to southeast in conformance with local topography.
- The nearest off-site water supply well is 190 m to the south of the Site;
- The Site supply wells are currently documented to be able to provide between 36 L/min and 91 L/min. The total capacity available from both wells pumping together has not been demonstrated. The remaining private wells are drilled to depths ranging between 14 m and 21 m, and are located a minimum distance of 190 m from the supply wells.
- Available information was used to estimate that the potential drawdown that would be observed 200 m from the Site wells after 30 days of continuous pumping of the Site wells at the proposed future capacity would be between 0.3 and 2.1 m. Review of static water level information and typical pump depths indicates that the potential for pumping to cause a consistent impact to an off-site water supply is low, when hydraulic conductivity values in the confined aquifer are greater than $1x10^{-4}$ m/s.
- The northern and eastern portions of the proposed development area are mapped in a Highly Vulnerable Aquifer area. The proposed land use is considered to have low potential to impact the quality of underlying aquifer resources.
- The northern and eastern portions of the proposed development are mapped in a Significant Groundwater Recharge area with a rating of high risk potential. The southwest portion of the site lies within a medium risk potential for Significant Groundwater Recharge.
- The desk-top review supports the observation that the aquifer resources beneath the Site can support the proposed expansion of the marijuana facility. Additional testing will be required to confirm the capacity and potential influence of existing wells on off-site users and the natural environment.

7 RECOMMENDATIONS

The following tasks are recommended to ensure that the water supply can meet the requirements of the proposed development:

- A hydraulic testing program will be beneficial to confirm the sustainable capacity and the maximum day capacity of the existing Site wells. In the event that hydraulic testing cannot confirm that the existing wells can support the proposed development, additional water supply wells may be required. The testing program can consider:
  - Stepped Rate Pumping Tests, using temporary pumps with greater capacity than existing (if possible), to identify the aquifer response to pumping and identify a sustainable well yield for each supply well for use in constant-rate testing.
  - Constant Rate Pumping Tests, using temporary pumps with greater capacity than existing (if possible), to demonstrate that continuous pumping can be supported for the required time frame (recommended minimum 72 hours).
  - Monitoring of groundwater levels in nearby domestic wells and surface water features during constant rate hydraulic testing.
- In the event that testing shows that a new well is required, ensure that water supply wells, are constructed in compliance with the requirements specified under O. Reg. 903 (as amended to O. Reg. 327/07) of the Ontario Water Resources Act (R.R.O. 1990).
- In the event that testing shows that a new well is required, ensure that the new capacity of the new water supply well is tested in accordance with the above testing program. Additional testing may be required to demonstrate that all installed wells can be operated simultaneously.
- Explore options for measures to reduce pumped water demand, such as: storage, reuse/recycling and minimization of waste.
- Submit an application for a Permit To Take Water (PTTW), to be able to pump at rates in excess of 50,000 L/day.

8 LIMITATIONS

This report is completed as confidential to the addressee. Release to any other company, concern, or individual is solely the responsibility of the addressee. WSP reserves the right to amend and/or supplement this report in the event additional information, documentation or evidence becomes available.

The information and conclusions contained in this report are based upon work undertaken by trained professional and technical staff in accordance with generally accepted engineering and scientific practices current at the time the work was performed. Any use that a third party makes of this report, or any reliance on decisions made based on it, is the responsibility of such third parties. WSP accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made, or actions taken, based on this report.

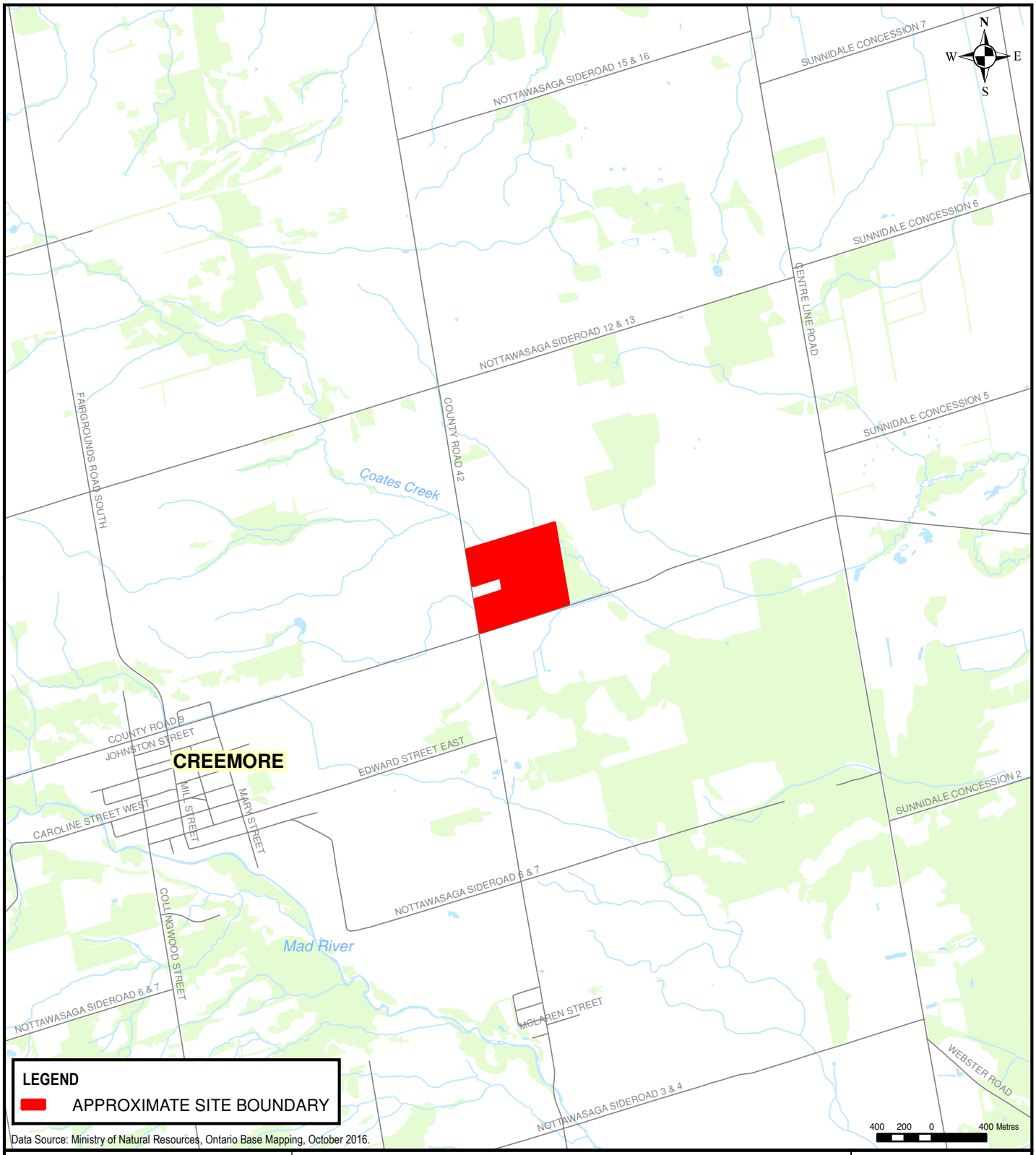
Conclusions presented in this report should not be construed as legal advice and represent the best technical judgment of WSP staff. The conclusions are based on the Site conditions observed by WSP at the time the work was performed at the specific testing and/or sampling locations, and can only be extrapolated to an undefined limited area around these locations. The extent of the limited area depends on the soil and groundwater conditions, as well as the history of the Site reflecting natural, construction and other activities. In addition, analysis has been carried out for a limited number of chemical parameters, and it should not be inferred that other chemical species are not present. Due to the nature of the investigation and the limited data available, WSP cannot warrant against undiscovered environmental liabilities or adverse impacts off-Site.

If any conditions become apparent that differ significantly from our understanding of conditions as presented in this report, we request that we be notified immediately to reassess the conclusions and recommendations provided herein.

9 REFERENCES

- Chapman, L.J. and D.F. Putnam, 1984. The Physiography of Southern Ontario. Ontario Geological Survey, Third Edition. 270 pp. Accompanied by Map P.2715, Scale 1:600,000.
- Gao, C., Shirota, J., Kelly, R.I., Brunton, F.R., and van Haaften, S., 2006. Bedrock Topography and overburden thickness mapping, southern Ontario, Ontario Geological Survey, Miscellaneous Release – Data 207.
- GeoSpec Engineering Ltd., October 2013. Geotechnical Investigation, 2741 County Road 42, Cashtown Farm.
- Ontario Geological Survey, 2011. 1:250,000 Scale Bedrock Geology of Ontario, Ontario Geological Survey Miscellaneous Release – Data 126- Revision 1.

FIGURES



126 DON HILLOCK DRIVE, UNIT 2
AURORA, ONTARIO CANADA L4G 0G9
TEL.: 905-750-3080 | FAX: 905-727-0463 | WWW.WSP.COM

PROJECT:
HYDROGEOLOGICAL IMPACT STUDY
2741 COUNTY ROAD 42, TOWNSHIP OF CLEARVIEW

TITLE:
SITE LOCATION MAP

CLIENT:
COWDEN WOODS DESIGN BUILDERS LIMITED

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CHECKED BY:	LL
PROJECT NO:	181-03105-00
DATE:	FEBRUARY 2019
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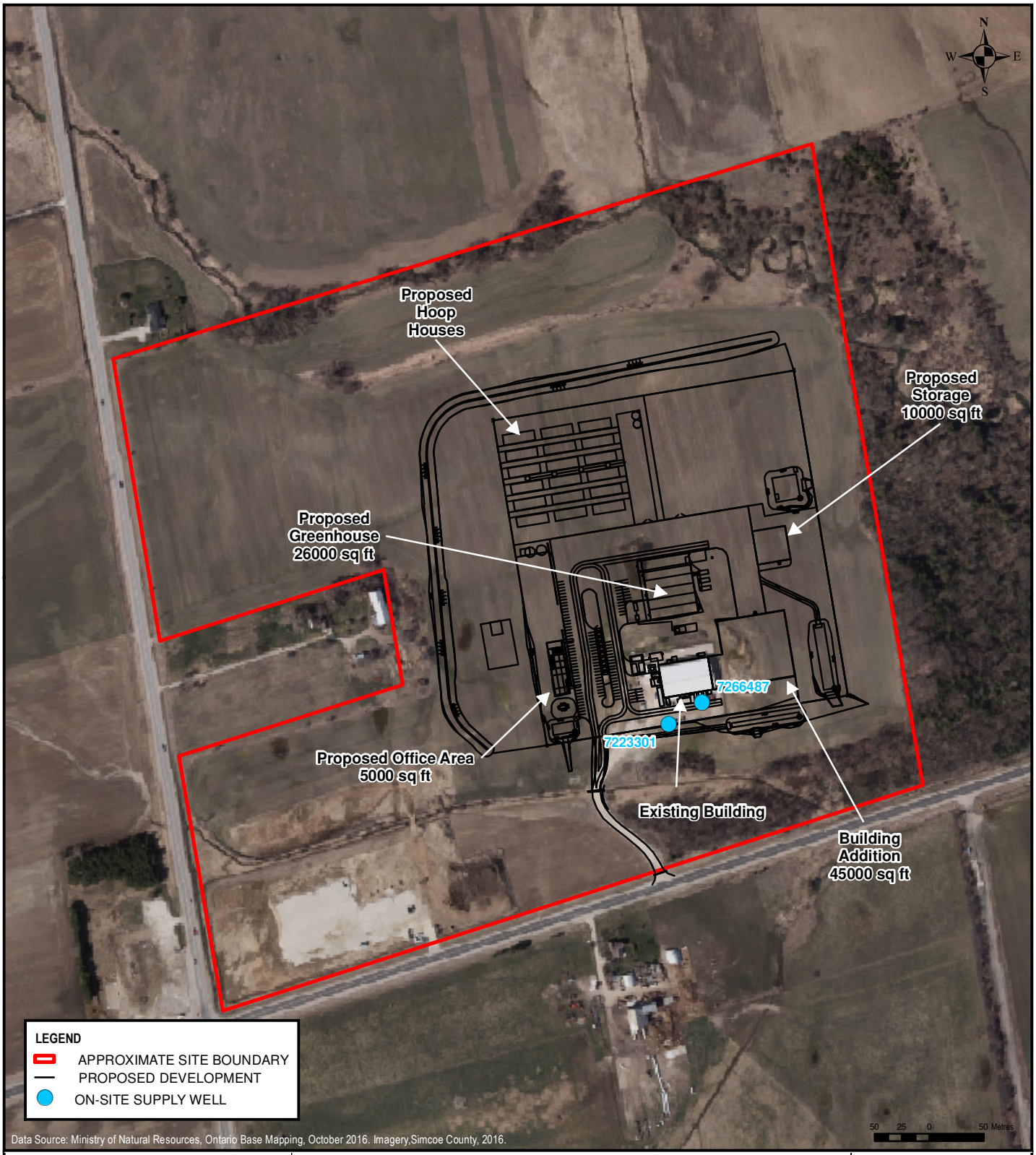

Data Source: Ministry of Natural Resources, Ontario Base Mapping, October 2016. Imagery,Simcoe County, 2016.

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PROJECT: HYDROGEOLOGICAL IMPACT STUDY 2741 COUNTY ROAD 42, TOWNSHIP OF CLEARVIEW	SCALE: 1:5,000
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TITLE: EXISTING CONDITIONS	PROJECT NO: 181-03105-00
	DATE: FEBRUARY 2019
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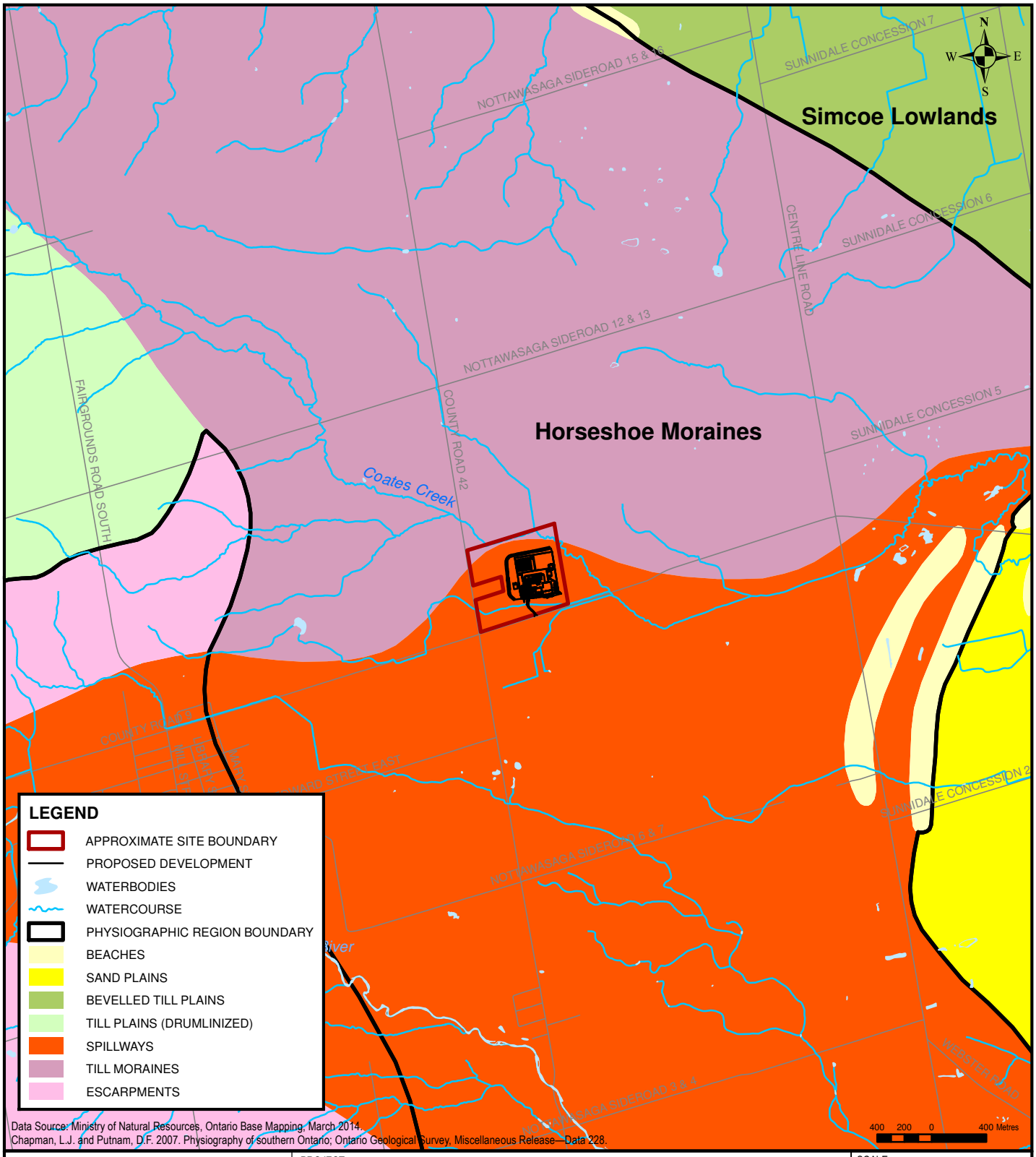

Data Source: Ministry of Natural Resources, Ontario Base Mapping, March 2014.
Chapman, L.J. and Putnam, D.F. 2007. Physiography of southern Ontario; Ontario Geological Survey, Miscellaneous Release—Data 228.

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PROJECT:
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2741 COUNTY ROAD 42, TOWNSHIP OF CLEARVIEW

TITLE:
REGIONAL PHYSIOGRAPHY

CLIENT:
COWDEN WOODS DESIGN BUILDERS LIMITED

SCALE: 1:40,000
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PROJECT NO: 181-03105-00
DATE: FEBRUARY 2019
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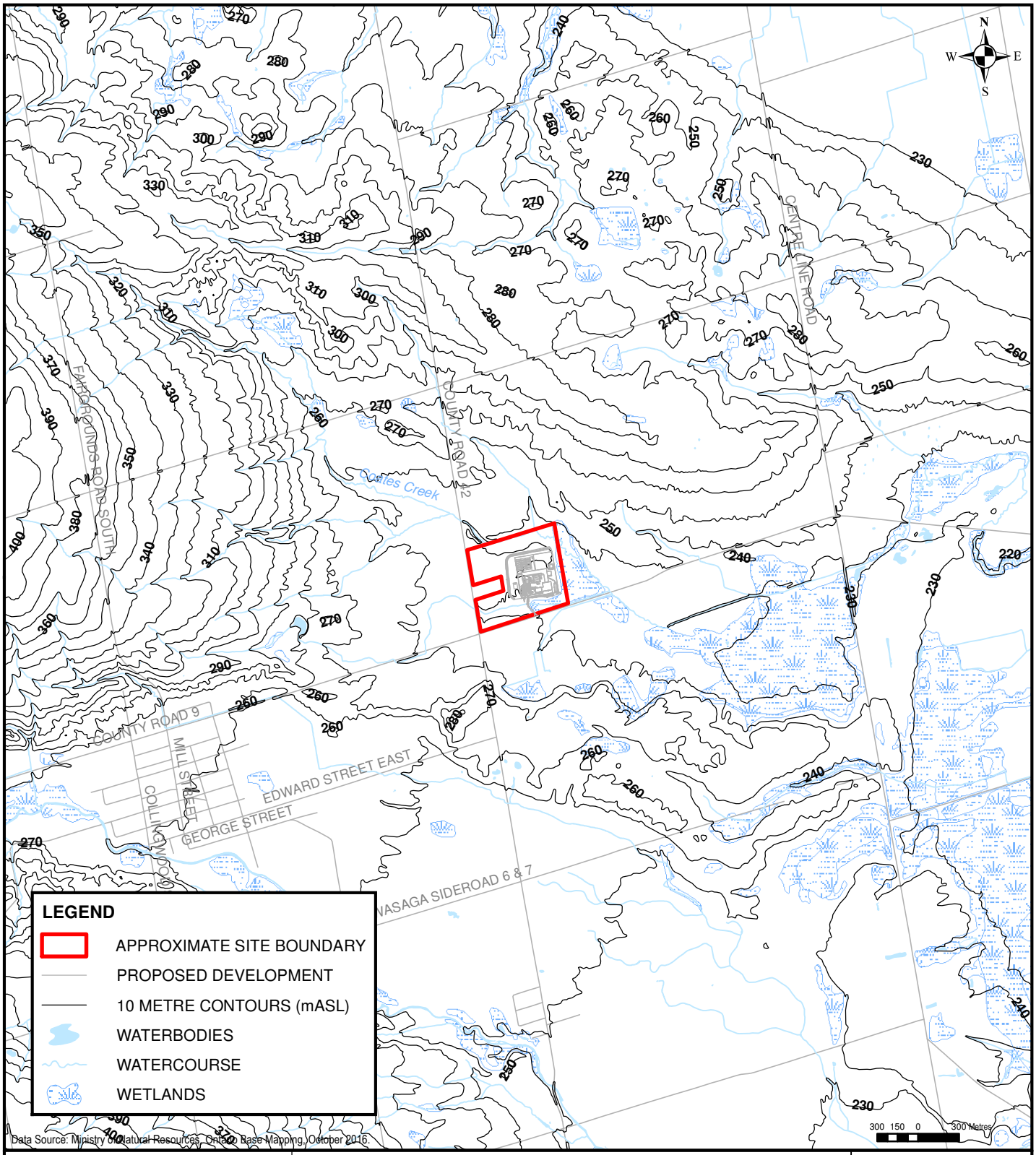

Data Source: Ministry of Natural Resources, Ontario Base Mapping, October 2016.

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	DATE: FEBRUARY 2019
CLIENT: COWDEN WOODS DESIGN BUILDERS LIMITED	FIGURE NO: 4 / REV.:

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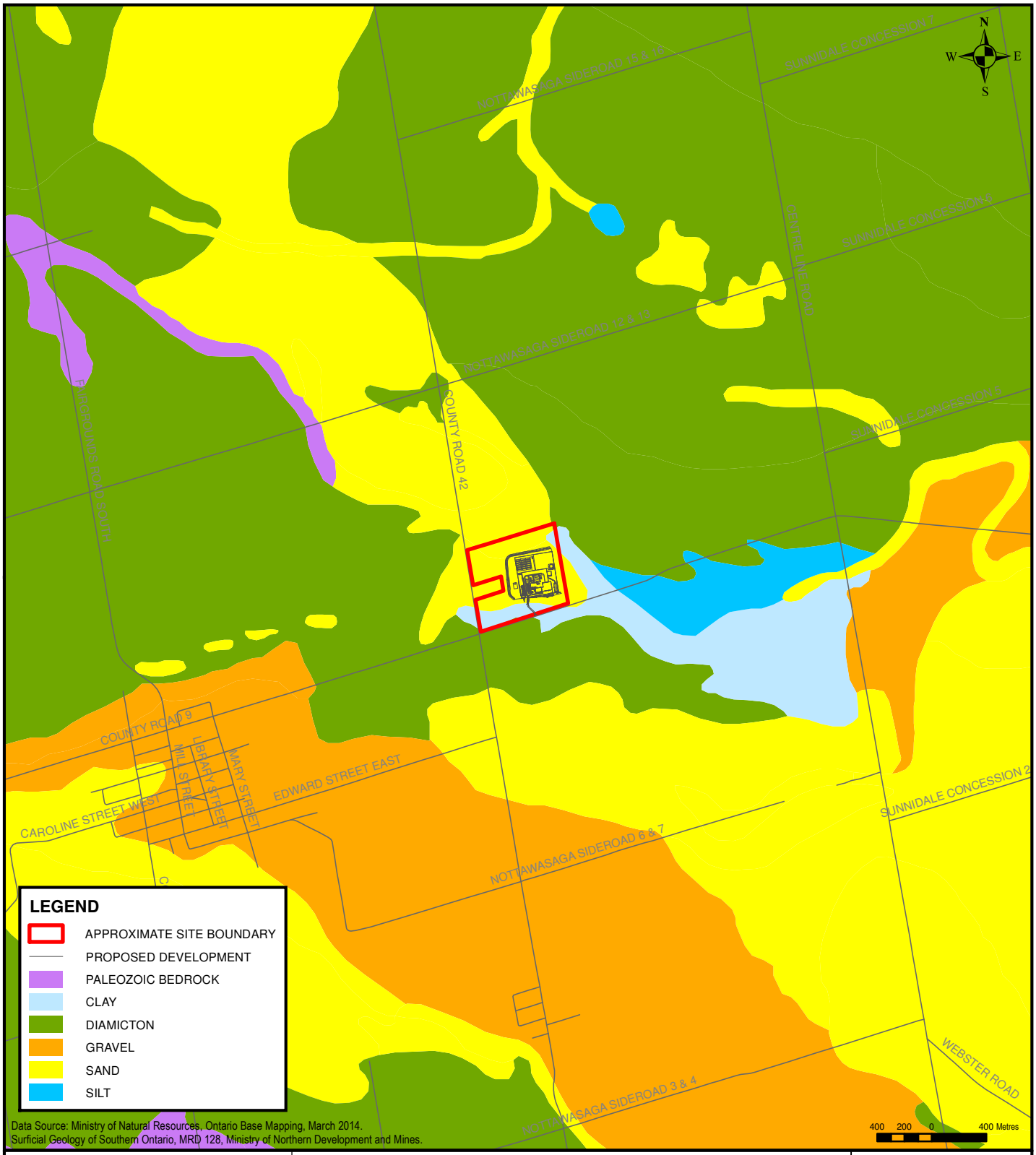

Data Source: Ministry of Natural Resources, Ontario Base Mapping, March 2014.
Surficial Geology of Southern Ontario, MRD 128, Ministry of Northern Development and Mines.

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PROJECT:
HYDROGEOLOGICAL IMPACT STUDY
2741 COUNTY ROAD 42, TOWNSHIP OF CLEARVIEW

TITLE:
SURFICIAL GEOLOGY

CLIENT:
COWDEN WOODS DESIGN BUILDERS LIMITED

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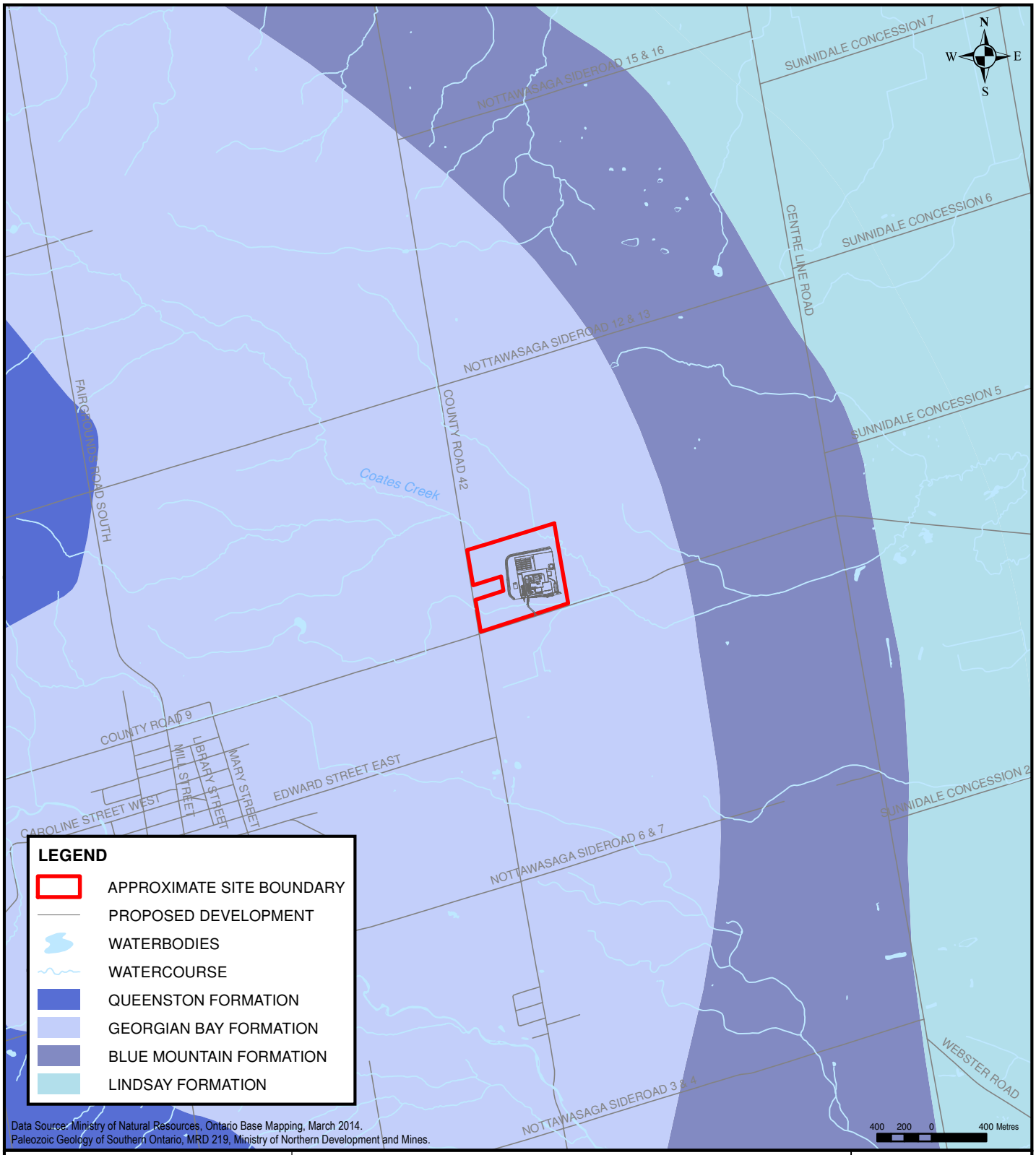

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PROJECT:
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2741 COUNTY ROAD 42, TOWNSHIP OF CLEARVIEW

TITLE:
BEDROCK GEOLOGY

CLIENT:
COWDEN WOODS DESIGN BUILDERS LIMITED

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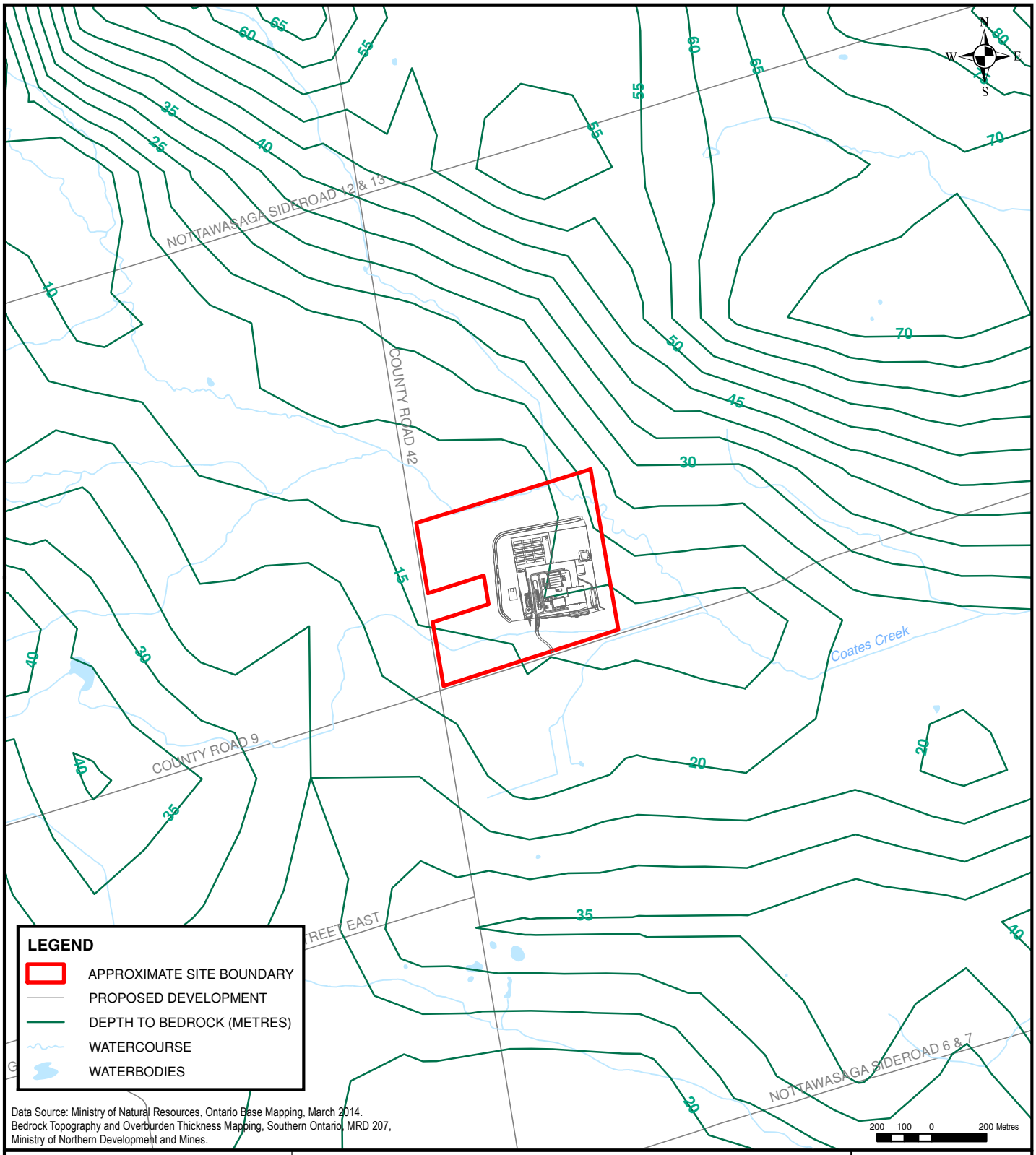

Data Source: Ministry of Natural Resources, Ontario Base Mapping, March 2014.
Bedrock Topography and Overburden Thickness Mapping, Southern Ontario, MRD 207, Ministry of Northern Development and Mines.

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PROJECT:
HYDROGEOLOGICAL IMPACT STUDY
2741 COUNTY ROAD 42, TOWNSHIP OF CLEARVIEW

TITLE:
OVERBURDEN THICKNESS

CLIENT:
COWDEN WOODS DESIGN BUILDERS LIMITED

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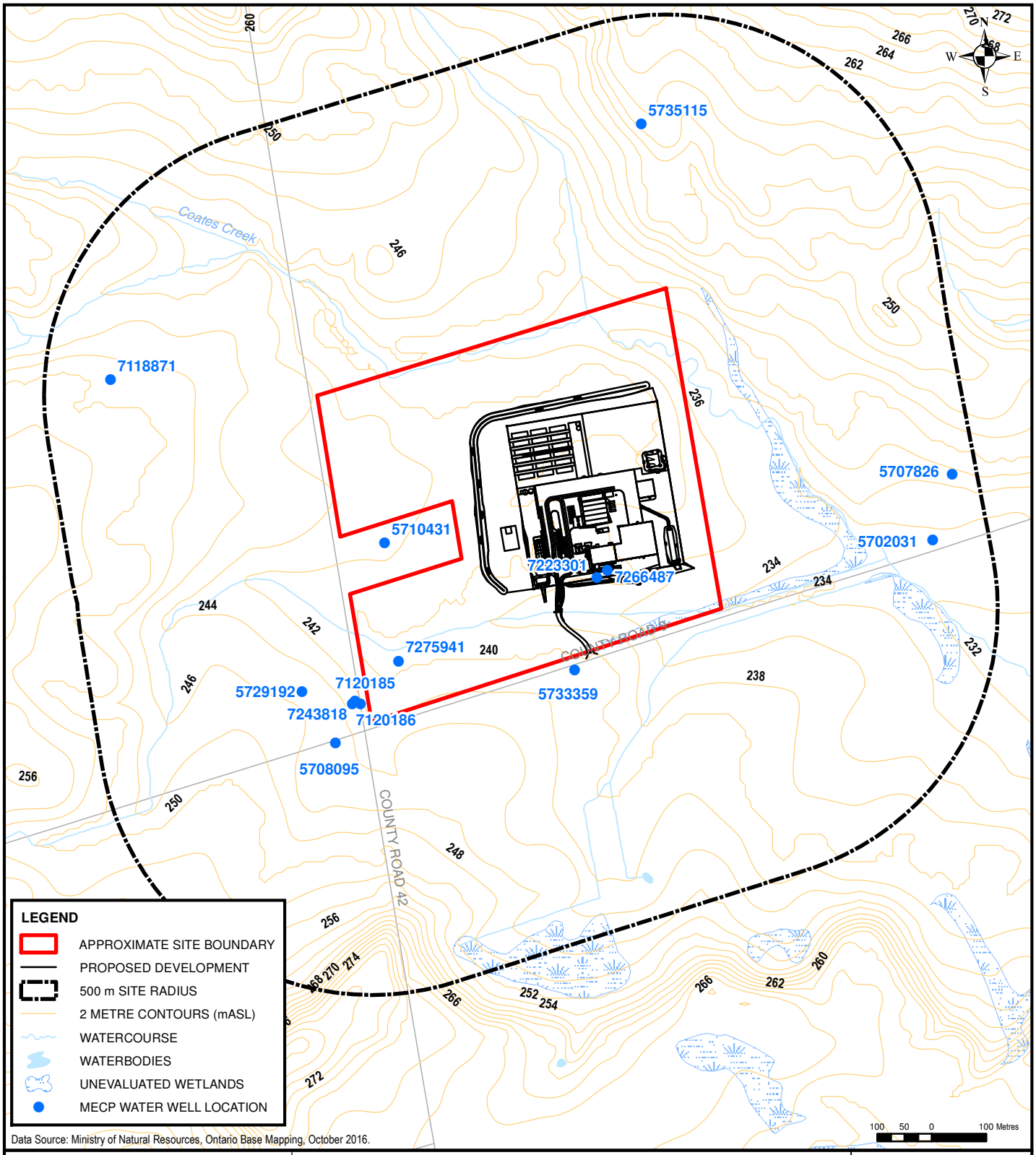

Data Source: Ministry of Natural Resources, Ontario Base Mapping, October 2016.

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PROJECT:
HYDROGEOLOGICAL IMPACT STUDY
2741 COUNTY ROAD 42, TOWNSHIP OF CLEARVIEW

TITLE:
MECP WATER WELLS

CLIENT:
COWDEN WOODS DESIGN BUILDERS LIMITED

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CHECKED BY:	LL
PROJECT NO:	181-03105-00
DATE:	FEBRUARY 2019
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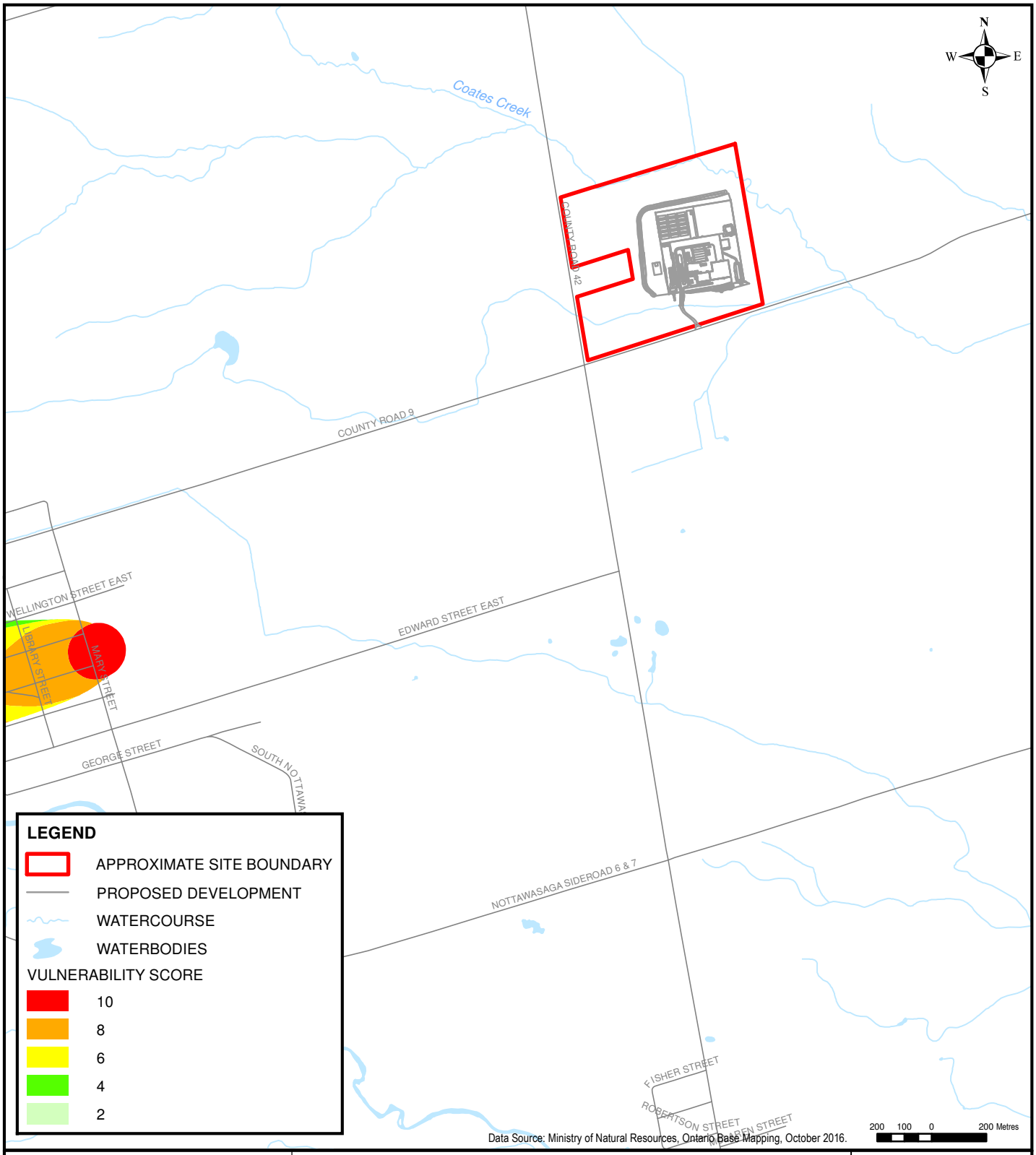

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PROJECT:
HYDROGEOLOGICAL IMPACT STUDY
2741 COUNTY ROAD 42, TOWNSHIP OF CLEARVIEW

TITLE:
WELLHEAD PROTECTION AREAS

CLIENT:
COWDEN WOODS DESIGN BUILDERS LIMITED

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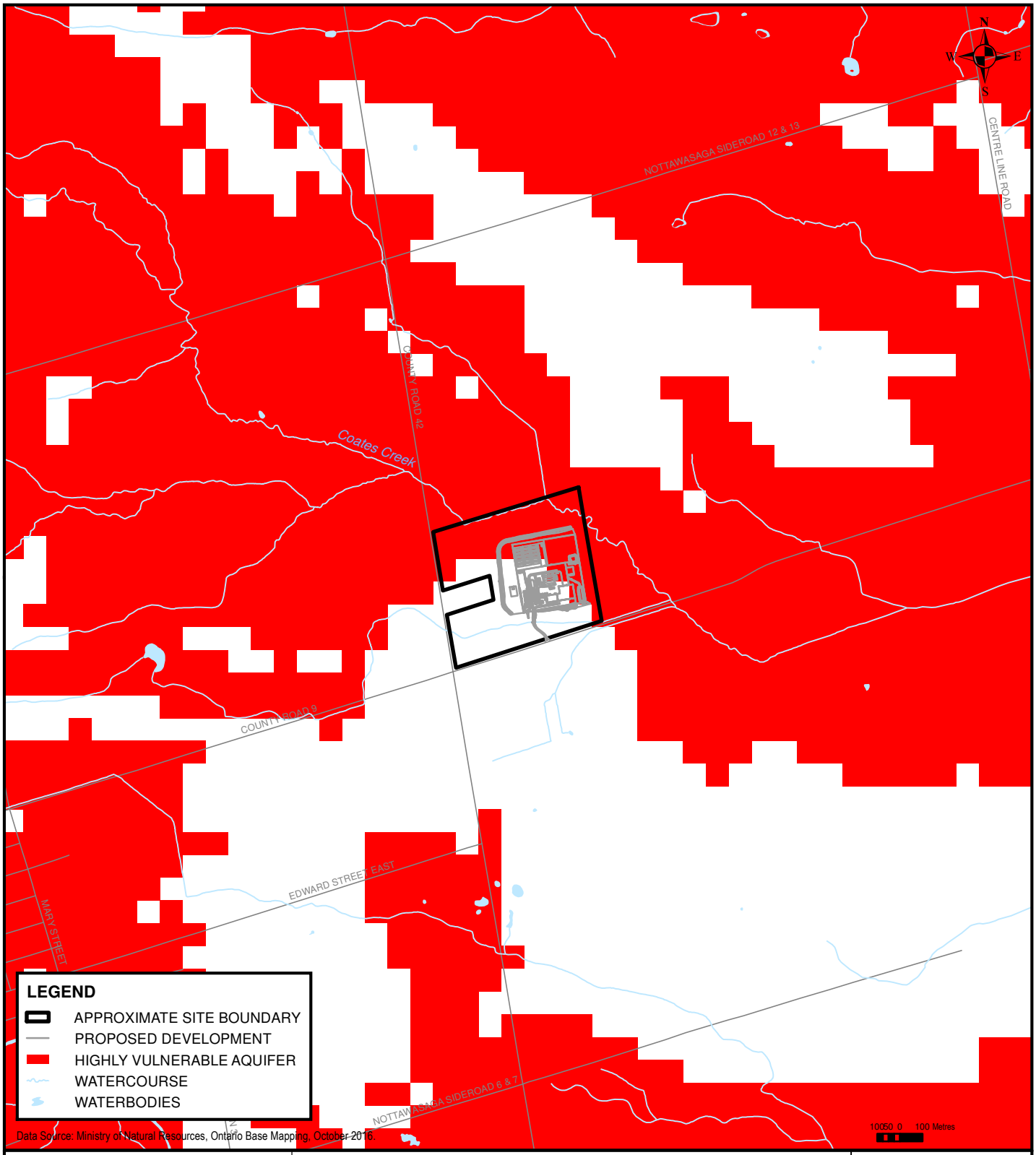

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PROJECT:
HYDROGEOLOGICAL IMPACT STUDY
2741 COUNTY ROAD 42, TOWNSHIP OF CLEARVIEW

TITLE:
HIGHLY VULNERABLE AQUIFERS

CLIENT:
COWDEN WOODS DESIGN BUILDERS LIMITED

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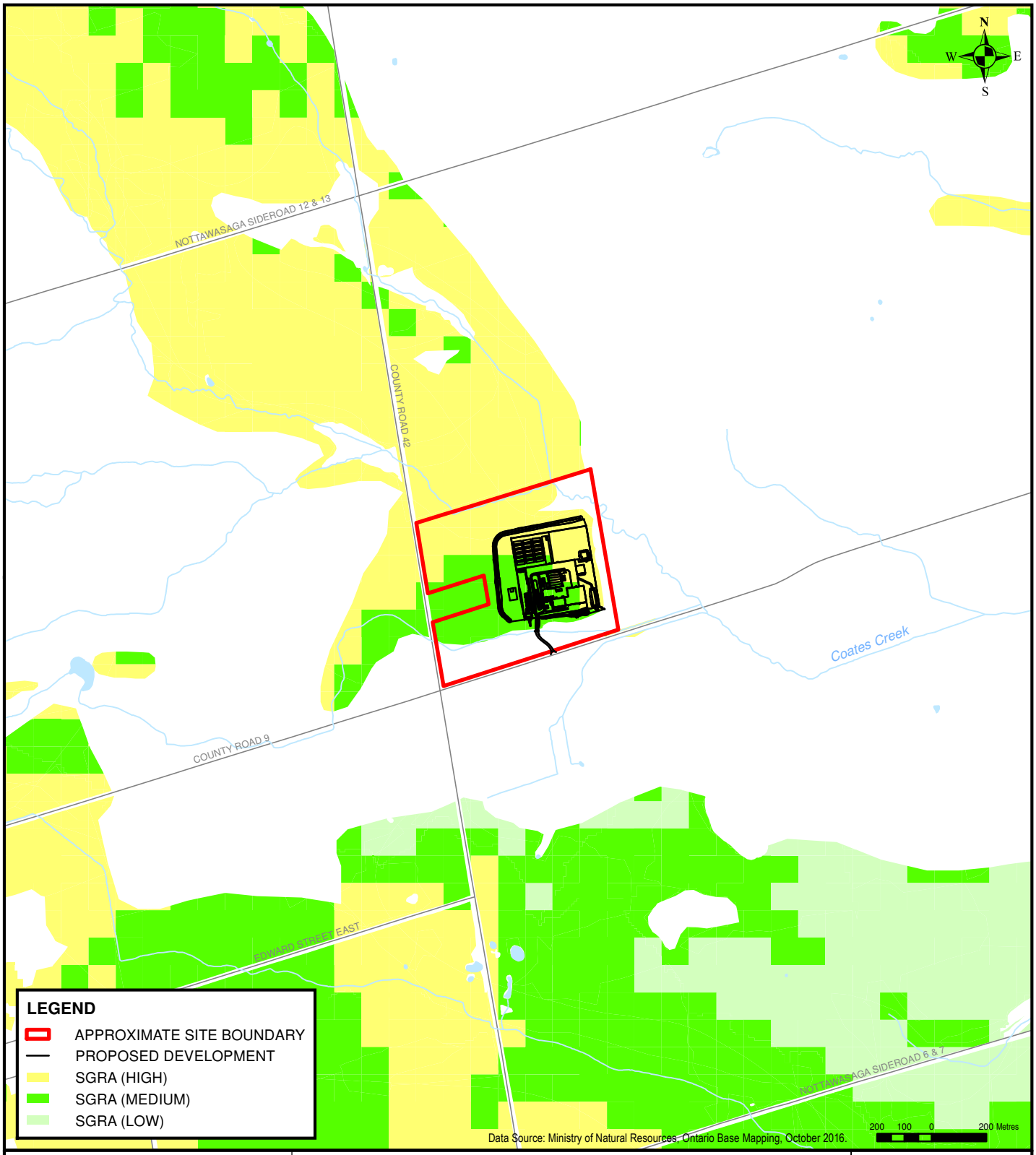

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PROJECT:
HYDROGEOLOGICAL IMPACT STUDY
2741 COUNTY ROAD 42, TOWNSHIP OF CLEARVIEW

TITLE:
SIGNIFICANT GROUNDWATER RECHARGE AREAS

CLIENT:
COWDEN WOODS DESIGN BUILDERS LIMITED

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PROJECT NO:	
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FEBRUARY 2019	
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11	-

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APPENDIX

A MECP WATER WELL RECORDS

Appendix A
MECP Water Well Records - 500 m
Hydrogeological Impact Assessment
2741 County Road 42, Township of Clearview

Well ID	Easting	Northing	Elevation (m)	Well Depth (m)	Well Diameter (inches)	Construction Method	Water Level (m)	Water Yield (IGPM)	Water Yield (L/min)	Water Use	Water Status	Formation Depth (m)	Material Colour	Material 1	Material 2	Material 3
5702031	574528	4910054	233.7	5.5	30	Cable Tool	2.13	3	14	Livestock	Water Supply	2.1	BROWN	CLAY		
												5.5		FINE SAND		
5707826	574564	4910173	237.3	21.0	4	Cable Tool	18.90	12	55	Livestock	Water Supply	0.3	BROWN	TOPSOIL		
												12.2	BROWN	CLAY	MEDIUM SAND	
												18.9	GREY	CLAY		
												21.0	BROWN	MEDIUM SAND		
5708095	573434	4909683	245.1	15.8	4	Cable Tool	14.94	10	46	Commerical	Water Supply	3.0	BLACK	TOPSOIL		
												6.4	BROWN	MEDIUM SAND		
												13.7	GREY	CLAY		
												14.3	GREY	CLAY	MEDIUM SAND	
												14.9	GREY	CLAY		
												15.8	BROWN	MEDIUM SAND		
5710431	573524	4910048	242.3	19.5	4	Cable Tool	18.29	7	32	Livestock	Water Supply	0.6	BROWN	TOPSOIL		
												2.4	BROWN	SAND	CLAY	
												18.3	GREY	CLAY		
												19.5	BROWN	SAND		
5729192	573373	4909776	245.5	14.3	6	Cable Tool	12.19	15	68	Domestic	Water Supply	2.1	BROWN	SAND		
												4.9	BROWN	CLAY	SOFT	LAYERED
												12.2	GREY	CLAY	SOFT	
												14.3	BROWN	SAND	WATER-BEARING	CLEAN
5733359	573872	4909816	240.6	20.7	6	Cable Tool	18.90	15	68	Domestic	Water Supply	1.8	BLACK	TOPSOIL		
												2.7	BROWN	CLAY	SAND	LAYERED
												7.0	GREY	CLAY	SOFT	
												18.9	GREY	CLAY	SAND	
												10.4	GREY	CLAY	STONEY	
												15.5	GREY	CLAY	GRAVEL	CEMENTED
												20.7	BROWN	SAND	CLEAN	WATER-BEARING
5735115	573994	4910814	254.8	19.5	6	Cable Tool	19.51	20	91	Domestic	Water Supply	3.4	BROWN	CLAY		
												11.0	GREY	CLAY	STONES	
												16.2	GREY	CLAY	GRAVEL	CEMENTED
												19.5	BROWN	SAND	CLEAN	WATER-BEARING
7118871	573022	4910347	249.2	23.8	6	Rotary (Convent.)	21.34	15	68	Domestic	Water Supply	9.1	BROWN	CLAY	SILT	
												10.7	BROWN	SAND	CLAY	
												18.3		CLAY		
												21.3	BROWN	SAND		
												23.8		SAND	GRAVEL	
7223301	**573913**	**4909984**	**238.1**	**23.2**	**6**	**Other Method**	**22.56**	**8**	**36**	**Commerical**	**Water Supply**	**0.6**	**BROWN**	**SAND**	**GRAVEL**	**FILL**
												3.0	**BROWN**	**SAND**		
												15.2	**GREY**	**CLAY**		**SOFT**
												18.9	**GREY**	**SILT**	**GRAVEL**	
												21.9	**BROWN**	**SAND**		**FINE SAND**
												23.2	**BROWN**	**SAND**		**COARSE SAND**
7266487	**573932**	**4909998**	**238.4**	**23.2**	**8**	**Other Method**	**21.95**	**20**	**91**	**Commerical**	**Water Supply**	**0.6**	**BROWN**	**SAND**	**GRAVEL**	**FILL**
												3.4	**BROWN**	**CLAY**		
												11.0	**GREY**	**CLAY**		**SOFT**
												21.3	**GREY**	**CLAY**	**GRAVEL**	
												23.2	**BROWN**	**SAND**	**LOOSE**	**WATER-BEARING**
7275941	573550	4909832	239.7	18.6	6	Cable Tool	16.15	10	46	Domestic	Water Supply	3.7	BROWN	SAND	GRAVEL	FILL
												9.4	GREY	CLAY	STONES	CLAY
												16.2	GREY	SAND	GRAVEL	CEMENTED
												18.6	BROWN	SAND		WATER-BEARING
7120185	573465	4909754	243.1	1.4	2	Rotary (Convent.)				Test Hole	Test Hole	0.5	BROWN	SAND	GRAVEL	LOOSE
												1.4	GREY	SILT	CLAY	
7120186	573480	4909753	242.3								Abandoned-Other					
7243818	573470	4909759	242.7													

Notes:
* **BOLD** - Water supply wells at 2741 County Road 42, Township of Clearview
* ***Water Level (m)*** *= water level observed in the open borehole upon completion of drilling activities*

Well ID

Well ID Number: 7223301
Well Audit Number: *Z184279*
Well Tag Number: *A160378*
This table contains information from the original well record and any subsequent updates.

Well Location

Address of Well Location	2741 CTY RD 42
Township	NOTTAWASAGA TOWNSHIP
Lot	010
Concession	CON 02
County/District/Municipality	SIMCOE
City/Town/Village	
Province	ON
Postal Code	n/a
UTM Coordinates	NAD83 — Zone 17 Easting: 573913.00 Northing: 4909984.00
Municipal Plan and Sublot Number	
Other	

Overburden and Bedrock Materials Interval

General Colour	Most Common Material	Other Materials	General Description	Depth From	Depth To
BRWN	SAND	GRVL	FILL	0 ft	2 ft
BRWN	SAND			2 ft	10 ft
GREY	CLAY		SOFT	10 ft	50 ft
GREY	SILT	GRVL		50 ft	62 ft
BRWN	SAND		FSND	62 ft	72 ft
BRWN	SAND		CSND	72 ft	76 ft

Annular Space/Abandonment Sealing Record

Depth From	Depth To	Type of Sealant Used (Material and Type)	Volume Placed
0 ft	20 ft	GROUT	

Method of Construction & Well Use

Method of Construction	Well Use

Other Method

AIR DR

Commercial

Status of Well

Water Supply

Construction Record - Casing

Inside Diameter	Open Hole or material	Depth From	Depth To
5 inch	STEEL	68 ft	71 ft
6 inch	STEEL	2 ft	71 ft

Construction Record - Screen

Outside Diameter	Material	Depth From	Depth To
5 inch	STEEL	71 ft	74 ft

Well Contractor and Well Technician Information

Well Contractor's Licence Number: 2576

Results of Well Yield Testing

After test of well yield, water was	CLEAR
If pumping discontinued, give reason	
Pump intake set at	65 ft
Pumping Rate	8 GPM
Duration of Pumping	1 h:0 m
Final water level	
If flowing give rate	.5 GPM
Recommended pump depth	65 ft
Recommended pump rate	8 GPM
Well Production	
Disinfected?	Y

Draw Down & Recovery

Draw Down Time(min)	Draw Down Water level	Recovery Time(min)	Recovery Water level

SWL	-2 ft FLW		
1		1	
2		2	
3		3	
4		4	
5		5	
10		10	1 ft
15		15	2 ft
20		20	
25		25	
30		30	
40		40	
45		45	
50		50	
60		60	2 ft

Water Details

Water Found at Depth	Kind
74 ft	Fresh

Hole Diameter

Depth From	Depth To	Diameter
0 ft	20 ft	5 inch
20 ft	74 ft	6 inch

Audit Number: Z184279

Date Well Completed: March 14, 2014

Date Well Record Received by MOE: July 07, 2014

Well ID

Well ID Number: 7266487
Well Audit Number: *Z227089*
Well Tag Number: *A200672*
This table contains information from the original well record and any subsequent updates.

Well Location

Address of Well Location	COUNTY RD #9
Township	NOTTAWASAGA TOWNSHIP
Lot	010
Concession	CON 02
County/District/Municipality	SIMCOE
City/Town/Village	
Province	ON
Postal Code	n/a
UTM Coordinates	NAD83 — Zone 17 Easting: 573932.00 Northing: 4909998.00
Municipal Plan and Sublot Number	
Other	

Overburden and Bedrock Materials Interval

General Colour	Most Common Material	Other Materials	General Description	Depth From	Depth To
BRWN	SAND	GRVL	FILL	0 ft	2 ft
BRWN	CLAY			2 ft	11 ft
GREY	CLAY		SOFT	11 ft	36 ft
GREY	CLAY	GRVL		36 ft	70 ft
BRWN	SAND	LOOS	WBRG	70 ft	76 ft

Annular Space/Abandonment Sealing Record

Depth From	Depth To	Type of Sealant Used (Material and Type)	Volume Placed
0 ft	20 ft	GROUT	

Method of Construction & Well Use

Method of Construction	Well Use
Other Method	Industrial

AIR, DR

Status of Well

Water Supply

Construction Record - Casing

Inside Diameter	Open Hole or material	Depth From	Depth To
5 inch	STEEL	71 ft	72 ft
8 inch	STEEL	-2 ft	72 ft

Construction Record - Screen

Outside Diameter	Material	Depth From	Depth To
5 inch	STAINLESS STEEL	72 ft	76 ft

Well Contractor and Well Technician Information

Well Contractor's Licence Number: 2576

Results of Well Yield Testing

After test of well yield, water was	OTHER
If pumping discontinued, give reason	
Pump intake set at	12 ft
Pumping Rate	20 GPM
Duration of Pumping	1 h:0 m
Final water level	7.2 ft
If flowing give rate	1 GPM
Recommended pump depth	30 ft
Recommended pump rate	20 GPM
Well Production	
Disinfected?	Y

Draw Down & Recovery

Draw Down Time(min)	Draw Down Water level	Recovery Time(min)	Recovery Water level
SWL	1 ft FLW		

1		1	
2		2	
3		3	
4		4	
5	0 ft	5	
10	1 ft	10	
15		15	
20		20	7.2 ft
25		25	
30		30	
40		40	
45		45	
50		50	
60		60	7.2 ft

Water Details

Water Found at Depth	Kind
72 ft	Fresh

Hole Diameter

Depth From	Depth To	Diameter
0 ft	20 ft	10 inch
20 ft	76 ft	8 inch

Audit Number: Z227089

Date Well Completed: January 19, 2016

Date Well Record Received by MOE: July 18, 2016

Ontario — Ministry of the Environment

Well Tag No. *(Place Sticker and/or Print Below)*
Tag#: A160378

Well Record
Regulation 903 Ontario Water Resources Act

Measurements recorded in: ☐ Metric ☑ Imperial

Page 1 of 1

Well Owner's Information

First Name	Last Name / Organization	E-mail Address	☐ Well Constructed by Well Owner
COWDEN	WOODS LTD		

Mailing Address (Street Number/Name)	Municipality	Province	Postal Code	Telephone No. *(inc. area code)*
249 SAUNDERS RD.	BARRIE	ONT	L4N 9A3	

Well Location

Address of Well Location (Street Number/Name)	Township	Lot	Concession
2741 CTY RD 42	NOTTAWASAGA	10	2

County/District/Municipality	City/Town/Village	Province	Postal Code
SIMCOE COUNTY		Ontario	

UTM Coordinates	Zone	Easting	Northing	Municipal Plan and Sublot Number	Other
NAD 8 3	17	579913	4909984		

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	Depth (m/ft) To
BROWN	SAND	GRAVEL	FILL	0	2
BROWN	SANDY CLAY			2	10
GREY	CLAY		SOFT	10	50
GREY	SILT	GRAVEL		50	62
BROWN	SAND		FINE	62	72
BROWN	SAND		COARSE	72	76

Annular Space

Depth Set at (m/ft) From	To	Type of Sealant Used (Material and Type)	Volume Placed (m^3/ft^3)
0	20	GROUT	

Method of Construction

☐ Cable Tool ☐ Diamond
☐ Rotary (Conventional) ☐ Jetting
☐ Rotary (Reverse) ☐ Driving
☐ Boring ☐ Digging
☐ Air percussion
☑ Other, *specify* AIR DC

Well Use

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

Construction Record - Casing

Inside Diameter (cm/in)	Open Hole OR Material (Galvanized, Fibreglass, Concrete, Plastic, Steel)	Wall Thickness (cm/in)	Depth (m/ft) From	Depth (m/ft) To
6"	STEEL	.188	+2	71
5"	STEEL	.250	68	71

Construction Record - Screen

Outside Diameter (cm/in)	Material (Plastic, Galvanized, Steel)	Slot No.	Depth (m/ft) From	Depth (m/ft) To
5"	STAINLESS STEEL	16	71	74

Status of Well

☑ 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*

Water Details

Water found at Depth	Kind of Water	
71-74 (m/ft)	☐ Gas	☐ Fresh ☑ Untested ☐ Other, *specify*
(m/ft)	☐ Gas	☐ Fresh ☐ Untested ☐ Other, *specify*
(m/ft)	☐ Gas	☐ Fresh ☐ Untested ☐ Other, *specify*

Hole Diameter

Depth (m/ft) From	To	Diameter (cm/in)
0	20	5"
20	74	6"

Results of Well Yield Testing

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

If pumping discontinued, give reason:

Pump intake set at (m/ft): 65

Pumping rate (l/min / GPM): 8

Duration of pumping: 1 hrs + ____ min

Final water level end of pumping (m/ft)

If flowing give rate (l/min / GPM): 1/2 GPM

Recommended pump depth (m/ft): 65

Recommended pump rate (l/min / GPM): 8

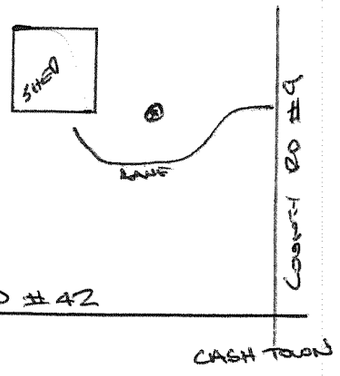
Well production (l/min / GPM): 8-10

Disinfected? ☑ Yes ☐ No

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

Map of Well Location

Please provide a map below following instructions on the back.



Comments:

Well Contractor and Well Technician Information

Business Name of Well Contractor	Well Contractor's Licence No.
HIGHLAND WATER WELLS	2576

Business Address (Street Number/Name)	Municipality
Box 141,	OSHAWA

Province	Postal Code	Business E-mail Address
ONT	N0G1R0	

Bus. Telephone No. *(inc. area code)*	Name of Well Technician (Last Name, First Name)
5193696363	POPPLETON, NIGEL

Well Technician's Licence No.	Signature of Technician and/or Contractor	Date Submitted
2130		20140316

Well owner's information package delivered	Date Package Delivered	Date Work Completed
☐ Yes ☐ No		20140314

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Received

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APPENDIX

B THEIS EQUATION AND DRAWDOWN CALCULATIONS

Appendix B
Predicted Drawdown using Theis Equation
Hydrogeological Impact Assessment
2741 County Road 42, Township of Clearview

Drawdown in Confined Aquifer 1 using K = 1 x 10^{-4} m/s

where u=r^2S/(4Tt) and s= Q*w(u)/(4piT)

Parameter	Model Values
Pumping Rate (L/min)	104.5
K (m/s)	1.00E-04
T (m2/day)	36.8
Sy (aquifer)	1.00E-04
b (m) aquifer	4.26

150 m3/day
150480 L/day
23 igpm

radius, r (m)	Time, t (days)	u	Pumping Rate	drawdwn, s
0.1	1	6.79E-09	150	5.9
1	1	6.79E-07	150	4.4
10	1	6.79E-05	150	2.9
50	1	1.70E-03	150	1.9
100	1	6.79E-03	150	1.4
200	1	2.72E-02	150	1.0
radius, r (m)	Time, t (days)	u	Pumping Rate	drawdwn, s
0.1	7	9.70E-10	150	6.6
1	7	9.70E-08	150	5.1
10	7	9.70E-06	150	3.6
50	7	2.43E-04	150	2.5
100	7	9.70E-04	150	2.1
200	7	3.88E-03	150	1.6
radius, r (m)	Time, t (days)	u	Pumping Rate	drawdwn, s
0.1	14	4.85E-10	150	6.8
1	14	4.85E-08	150	5.3
10	14	4.85E-06	150	3.8
50	14	1.21E-04	150	2.7
100	14	4.85E-04	150	2.3
200	14	1.94E-03	150	1.8
radius, r (m)	Time, t (days)	u	Pumping Rate	drawdwn, s
0.1	30	2.26E-10	150	7.0
1	30	2.26E-08	150	5.5
10	30	2.26E-06	150	4.0
50	30	5.66E-05	150	3.0
100	30	2.26E-04	150	2.5
200	30	9.06E-04	150	2.1

Appendix B
Predicted Drawdown using Theis Equation
Hydrogeological Impact Assessment
2741 County Road 42, Township of Clearview

Drawdown in Confined Aquifer 1 using K = 1 x 10^{-3} m/s

where u=r^2S/(4Tt) and s= Q*w(u)/(4piT)

Parameter	Model Values
Pumping Rate (L/min	104.5
K (m/s)	1.00E-03
T (m2/day)	368.1
Sy (aquifer)	1.00E-04
b (m) aquifer	4.26

150 m3/day
150480 L/day
23.3 igpm

radius, r (m)	Time, t (days)	u	Pumping Rate	drawdwn, s
0.1	1	6.79E-10	150	0.7
1	1	6.79E-08	150	0.5
10	1	6.79E-06	150	0.4
50	1	1.70E-04	150	0.3
100	1	6.79E-04	150	0.2
200	1	2.72E-03	150	0.2
radius, r (m)	Time, t (days)	u	Pumping Rate	drawdwn, s
0.1	7	9.70E-11	150	0.7
1	7	9.70E-09	150	0.6
10	7	9.70E-07	150	0.4
50	7	2.43E-05	150	0.3
100	7	9.70E-05	150	0.3
200	7	3.88E-04	150	0.2
radius, r (m)	Time, t (days)	u	Pumping Rate	drawdwn, s
0.1	14	4.85E-11	150	0.8
1	14	4.85E-09	150	0.6
10	14	4.85E-07	150	0.5
50	14	1.21E-05	150	0.3
100	14	4.85E-05	150	0.3
200	14	1.94E-04	150	0.3
radius, r (m)	Time, t (days)	u	Pumping Rate	drawdwn, s
0.1	30	2.26E-11	150	0.8
1	30	2.26E-09	150	0.6
10	30	2.26E-07	150	0.5
50	30	5.66E-06	150	0.4
100	30	2.26E-05	150	0.3
200	30	9.06E-05	150	0.3

APPENDIX

C FLOWING ARTESIAN WATER SUPPLY WELLS MEMO

March 29, 2018

Mr. Adam Miller
2741 County Road 42
Township of Clearview, ON
L0M 1S0

Dear Mr. Miller:

Subject: Flowing Artesian Water Supply Wells – 2741 County Road 42, Clearview

WSP Canada Inc. (WSP) staff visited at 2741 County Road 42, Clearview on Thursday, March 22, 2018 as part of the work program to prepare the Hydrogeological Impact Study for the proposed development at the property. During the site visit it was noticed that water was overflowing from the casing of the two (2) supply wells and that water and ice were ponded adjacent to the wells. The attached photographs document the observed conditions.

Section 14.7 of Ontario Regulation 903 – Wells (O.Reg. 903), as amended, provides directions for addressing flowing wells:

14.7 (1) If, during construction of a well, the well becomes a flowing well, the person constructing the well,

(a) shall construct the well to accommodate and be compatible with an appropriate device that controls the discharge of water from within the well casing, is capable of stopping the discharge of water from within the well casing, and is capable of withstanding the freezing of water in the well casing;

(b) shall install a device described in clause (a);

(c) shall construct the well and install the device described in clause (a) in a manner that prevents any uncontrolled flow of water from the well or at the well site; and

(d) shall construct the well and install the device described in clause (a) in a manner that prevents backflow of water into the well or well casing. O. Reg. 372/07, s. 15.

(2) Subsection (1) does not apply if the well is abandoned in accordance with section 21.1. O. Reg. 372/07, s. 15.

(3) Every contract for the construction of a well shall be deemed to contain a term that makes the well contractor responsible for,

(a) the cost of complying with subsection (1); and

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1450, 1st Avenue West
Owen Sound, ON, Canada K2B 8K2

T: +1 519 376-7612
F: +1 519 376-8008
wsp.com

(b) if subsection (1) does not apply pursuant to subsection (2), the cost of abandoning the well. O. Reg. 372/07, s. 15.

(4) Subsection (3) does not apply to a written contract that expressly releases the well contractor from the responsibility referred to in that subsection. O. Reg. 372/07, s. 15.

What this means, is that a well that is observed to be flowing is either to be equipped with a device that will stop overflow (and prevent freezing of water within the well casing) or to be abandoned in accordance with the O.Reg. 903 (as amended).

Our observations indicate that these two (2) wells are not currently in compliance with O.Reg. 903. The well records on file with the Ontario Ministry of the Environment and Climate Change (MOECC) indicate that the wells were observed to be flowing during the pumping test at the time of construction.

The observation of flowing wells presents two (2) concerns for our impact assessment:

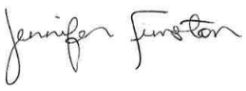
1. Uncontrolled discharge from flowing wells can result in soil/sediment being eroded and potentially carried to nearby surface water bodies.
2. The continuous removal of water from the wells, not only when needed for on-site use, will affect the natural water balance. This may require additional mitigation measures; the simplest of which is to install a device to prevent the wells from overflowing.

The Hydrogeological Impact Study we are working on will identify the flowing well condition. Since the regulation is reasonably clear that wells are not to be allowed to flow without control, WSP believes that approvals for the proposed development will require attention to the well condition.

Work to install a device to control flow must be carried out by a licensed well contractor and a licensed technician (Reg 903). Caution is required to ensure that control devices work effectively and do not create an additional safety hazard, as the wells are under pressure. Where feasible, extension of well casings may provide a safe and practical method of addressing the conditions. Additional effort may also be required to ensure that the casings are not able to freeze when full of water. WSP would be pleased to provide additional advice or to assist in overseeing the work of the contractor to address these conditions.

Please do not hesitate to contact me should you have any questions.

Yours truly,



Jennifer Funston, B.Sc.
Project Hydrogeologist
Encl.

WSP ref.: 181-03105-00

A200672

A160378