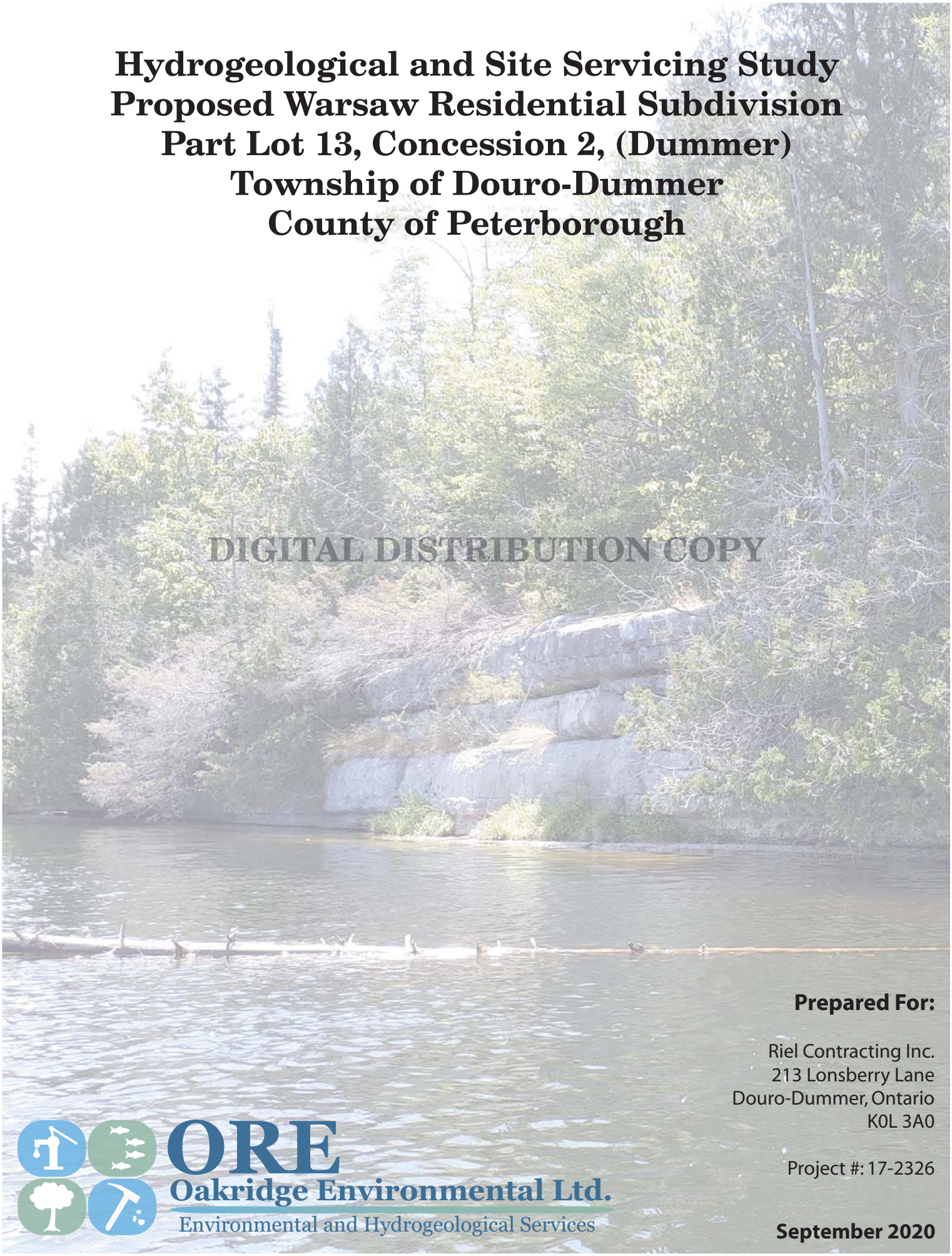
Hydrogeological and Site Servicing Study
Proposed Warsaw Residential Subdivision
Part Lot 13, Concession 2, (Dummer)
Township of Douro-Dummer
County of Peterborough



DIGITAL DISTRIBUTION COPY

Prepared For:

Riel Contracting Inc.
213 Lonsberry Lane
Douro-Dummer, Ontario
K0L 3A0

Project #: 17-2326

September 2020

ORE
Oakridge Environmental Ltd.
Environmental and Hydrogeological Services

ORE
Oakridge Environmental Limited
Environmental and Hydrogeological Services

September 25, 2020

Riel Contracting Inc.
213 Lonsberry Lane
Douro-Dummer, ON
K0L 3A0

Attention: **Mr. Jason Riel**, President/Owner

Re: Hydrogeological and Site Servicing Study
Proposed Warsaw Residential Subdivision
Part Lot 13, Concession 2, (Dummer)
Township of Douro-Dummer, County of Peterborough
ORE File No. 17-2326

Dear Mr. Riel:

We are pleased to present this Hydrogeological and Site Servicing Study in support of the above referenced Plan of Subdivision application.

Our report provides an overview and characterization of the site conditions, focussing on constraints and opportunities related to private water supply and sewage treatment, in accordance with the Ministry of the Environment, Conservation and Parks' Procedures D-5-4 and D-5-5. The study has successfully confirmed that private wells and sewage systems will be practical and sustainable at this site.

Despite challenging groundwater conditions related to a karstic aquifer on the site, this report outlines a strategy for future lot owners to guide them in obtaining a sufficient quantity of acceptable quality groundwater.

Our report provides a series of recommendations intended to assist future purchasers in regards to establishing those services.

Should you have any questions, please contact the undersigned.

Yours truly,
Oakridge Environmental Ltd.

ORIGINAL SIGNED BY

Brian R. King, P. Geo.
Principal

Hydrogeological and Site Servicing Study
Proposed Warsaw Residential Subdivision
Part Lot 13, Concession 2, (Dummer)
Township of Douro-Dummer, County of Peterborough

Prepared on behalf of the applicant for:

Riel Contracting Inc.
213 Lonsberry Lane
Douro-Dummer, ON
K0L 3A0

Prepared By:

Oakridge Environmental Ltd.
647 Neal Drive, Suite #3
Peterborough, Ontario
K9J 6X7

September 25, 2020

APGO ASSOCIATION OF PROFESSIONAL GEOSCIENTISTS OF ONTARIO

Authorized by the Association of Professional Geoscientists of Ontario to offer professional geoscience services.

Table of Contents

List of Figures

List of Appendices

Hydrogeological and Site Servicing Study
Proposed Warsaw Residential Subdivision
Part Lot 13, Concession 2, (Dummer)
Township of Douro-Dummer, County of Peterborough

1.0 Introduction

The subject development site consists of 11.78 ha (~29.1 acres), situated within the northeastern part of the Hamlet of Warsaw, overlooking the Indian River valley (Figure 1). A multi-lot residential development is proposed for the site. As Warsaw does not have municipal services available, the proposed development will need to rely on private potable water supplies and individual wastewater servicing.

To support the development application, a hydrogeological and site servicing study is required to verify that there is a sufficient quantity of acceptable quality water available to supply the future residences and to determine the allowable density by completing an impact assessment based on effluent loading for the site.

The hydrogeological study requirements for development applications are described in Ministry of the Environment, Conservation and Parks (MOE) Procedures "D-5-4" and "D-5-5". Briefly, Procedure D-5-4 pertains to evaluating the site's capacity to handle septic effluent and environmental impact, whereas D-5-5 pertains to the various tests needed to demonstrate an adequate water supply. Our study also has regard for Part 8 of the Ontario Building Code.

The hydrogeological work has been conducted in tandem with an Environmental Impact Study, provided by our firm under separate cover. For the most up to date plans and drawings, the reader is referred to the submissions by D.M. Wills and Associates, Planner for the applicant.

2.0 Previous Investigations

It is understood that there had been a previous attempt at developing a subdivision on the subject site in the early 1990s. A Hydrogeologic Assessment Report was prepared by Geo - Logic Inc., in May of 1990 and was subsequently revised in February of 1992. The report included a shallow soil and groundwater characterization, nitrate impact assessment and the construction and testing of three (3) test wells. The report is included in Appendix A for reference. At that time, the development property was considerably larger, covering an area of approximately 24 ha. Since then, two lots in the western part of the property have been severed. It is also understood that a portion of land in the northern part of the subject property and the large wetland/recharge area occupying the eastern and southeastern part of the site are planned to be severed, leaving a total development site area of 11.78 ha (Figure 2).

Subsequent to those reports, it is understood that Geo-Logic Inc. prepared a number of letters in response to Peer Review comments provided by the MOE. On April 7, 1994, the MOE provided a clearance letter for the proposed eighteen (18) lot subdivision, stating the

following:

> "*The consultant has determined a background groundwater nitrate concentration of 0.71 mg/L, and the revised groundwater nitrate impact assessment presented has been found to be acceptable.*"

and...

> "*With respect to water supply, the consultant has demonstrated that a water supply of acceptable quality and quantity will be available for the proposed development.*"

The clearance letter requested some minor changes to the application. However, for all intents and purposes, it appeared that the hydrogeological study was acceptable and would allow the proponent to proceed with the eighteen (18) lot subdivision. A copy of that correspondence is also included in Appendix A.

Based on the available information, it is unclear why the proposed subdivision was never completed. However, it is expected that factors other than the hydrogeological study contributed to the development not moving forward.

At the time of the original application, the MOE reviewed and was the approval agency for plan of subdivision applications. Since that time, the Ministry has delegated that responsibility to the local municipalities which are now responsible for ensuring that Procedures D-5-4 and D-5-5 are followed. Based on the current guidelines, it is our opinion that the original hydrogeological study completed by Geo-Logic Inc. would be deemed incomplete, as it does not include the requisite number of test wells for the size of the development area.

As a result, this hydrogeological and site servicing study builds on the work done by others to provide an assessment that conforms to the current standards. As the site is proximal to the Warsaw Caves Conservation Area, this report will also address issues related to karst, which is known to occur in the area. The scope of work for the hydrogeological and site servicing study is provided below.

3.0 Scope of Work

Based on the above guidelines, the following scope of work has been completed:

- Relevant available background data associated with the site and surrounding lands have been compiled and reviewed.

- A geo-referenced base plan has been prepared from recent aerial photography,

incorporating our field data, based on mapping-grade differential GPS data.

- Site inspections have been conducted to assess the terrain and hydrogeological conditions.
- MOE well record data for the site area have been obtained and reviewed using our Groundwater Information System (GWIS). Cross sections have been prepared to illustrate aquifer distribution in the area.
- A survey of neighbouring wells near the site has been completed to obtain information regarding local groundwater supply conditions.
- Shallow soil explorations have been conducted about the site by excavating test pits for the purpose of characterizing soil conditions.
- An assessment of the site's potential capacity for sewage disposal has been conducted following MOE Procedure D-5-4 procedures for impact assessments of individual on-site sewage systems.
- A review of local groundwater supply conditions, based on existing data, has been conducted.
- Four (4) new test wells have been constructed to augment existing on-site test wells.
- The test wells were subjected to pumping tests and water quality sampling in accordance with MOE Procedure D-5-5 guidelines.
- A conceptual servicing plan was prepared to illustrate how each proposed lot can be serviced while satisfying the constraints determined herein and by the Environmental Impact Study (under separate cover).
- All data have been assessed and interpreted.
- This report has been prepared.

Our findings are presented in the following sections.

4.0 Physical Setting

4.1 Site Description and Access

The subject site is situated within the Hamlet of Warsaw, approximately 22 km northeast of Peterborough, Ontario (Figure 1). The property is described as being Part of Lot 13,

Concession 2 (Dummer), in the Township of Douro-Dummer. The site can be accessed from the eastern terminus of River Lane or from County Road 4 (Figure 2).

The total area of the development site is approximately 11.78 ha (~26.7 acres). The development site excludes the recommended buffer area situated adjacent to the site's southeastern boundary, consisting of approximately 11.56 ha, as recommended in our accompanying EIS. Two (2) existing lots of record occur on the north and south sides of the proposed internal road, connecting to County Road 4. The development site also excludes 0.52 ha situated adjacent to the northwestern part of the development and is understood to be joined with the retained lot north of the internal subdivision road.

4.2 Existing Property Use

The subject site is vacant, lacks any improvements and is for all intents and purposes, un-used (other than as open space). We expect the site was once utilized for agriculture, as there are remnants of stony hedgerows and fence lines. Given the stony soils, we expect that the site would have been utilized primarily for cattle grazing. Today, the site would best be described as "scrub land".

The remnant of a small sand and gravel pit occurs in the western part of the site, near the boundary shared with the Warsaw Public School property (Figure 3). Aggregate appears to have been extracted from an embankment. It is unlikely that the pit was of any commercial consequence.

A small excavation into the bedrock was also observed east of the development, adjacent to Indian River/Quarry Lake, within the wetland/recharge area planned to be severed (Figure 3). It appears that blocks of limestone were historically removed from this area, although it is not known to have been a recorded quarry operation. Currently, blocks of limestone litter the floor of the opening. Similar to the gravel pit described above, this possible quarry was not likely of any commercial consequence.

The site is crossed by several ATV/walking trails and is frequented by hikers. Adjacent to the site, the waterfront along Indian River/Quarry Lake contains limestone escarpments, many swimmers/boaters have been observed using the site to access the shoreline in the summer for cliff diving.

4.3 Adjacent Land Use

The site occurs immediately northwest of the Warsaw Caves (Provincially Significant Wetland) Complex and Quarry Lake, a flooded part of the Indian River. The wetland and an associated recharge area defines most of the eastern boundary of the development property. Other lands immediately south of the site consist of residential properties along

River Lane. Lands immediately west of the site consist of the Warsaw Public School and County Road 4. North of the site, land use is a mix of residential and former agricultural. The Warsaw Caves Conservation Area is situated approximately 750 m north-northeast of the site.

All of the surrounding uses are serviced by individual wells and private sewage systems.

4.4 Site Topography and Drainage

Topographic relief across the site is approximately 12 m, as measured from the northern property boundary to River Lane (Figure 2). The topography slopes steeply from the north to a flat plain associated with the river valley. The slopes are dominated by stony soils whereas the bottom lands near the river consist of organic matter and limestone bedrock outcrop and subcrop.

Drainage across the site is generally from north to south, ultimately discharging to the wetland and Quarry Lake, an artificial lake created by the damming of Indian River at the nearby village. The flooded area extends northward, into the Warsaw Caves Conservation Area.

No other watercourses exist on the property. However, a roadside ditch associated with a recently constructed driveway entrance in the northwest corner of the property conveys runoff southward along County Road 4.

No springs have been identified on the upland part of the site, but occur seasonally at the base of the overburden deposits near the mapped extent of the Warsaw Caves Complex Provincially Significant Wetland (PSW).

5.0 Geology

5.1 Bedrock Geology

The majority of the site is underlain by Ordovician age Paleozoic bedrock of the Bobcaygeon Formation (Figure 4). This formation occurs in a broad belt that crosses through the north-central part of Peterborough County. The lower part of the formation consists of fine- to medium-grained nodular limestone ranging in colour from grey dark to grey-brown. The upper part of the formation is fine- to medium-grained, bioclastic limestone, and is more easily weathered than the lower part of the formation.

Underlying the Bobcaygeon Formation is the Gull River Formation. This formation consists of grey to brown-grey, very fine-grained (cryptochristalline) to fine-grained limestone and dolostone, forming 20 cm to 30 cm thick beds. In the lower part of the

formation, bedding is defined by shaly partings. Near the top of the formation, thicker beds (separated by stylolites) are common. Locally, black chert nodules are common in the uppermost beds of the Gull River Formation and can also occur in the lower part of the overlying Bobcaygeon Formation. Abundant coral fossils are also common in the uppermost part of the Gull River Formation.

Outcrops of the Bobcaygeon and Gull River Formations are visible along the shoreline of Quarry Lake. Large vertical scarp faces along the length of the lake provide great vantage points for observing these limestone formations.

At the base of the Paleozoic sequence is the Shadow Lake Formation, consisting of red and green dolomitic and sandy shale, unconformably resting on Precambrian basement. The thickness of this formation is known to be approximately 8 m to 9 m, based on published mapping. In some areas, the thickness can reach 15 m (Armstrong and Carter, 2010). The Shadow Lake Formation is not known to outcrop within the study area and can often yield highly mineralized water if encountered during water well construction.

5.2 Surficial Geology

Published mapping (Figure 5) indicates that the subject site's overburden is dominated by soils of the Dummer Complex (till). Dummer Complex sediments have a sandy matrix supporting a coarse stony component. The coarse component is typically composed of large and angular (broken) blocks of Paleozoic limestone. The stone composition primarily reflects the underlying bedrock lithology, although can contain some granitic materials.

The Dummer Complex (often referred to as the "Dummer Moraine") has a massive, unstratified, unsorted structure suggesting a subglacial environment of deposition, rather than the traditional moraine interpretation. The rough alignment of the Dummer Complex hummocks with ice-flow, as well as the cross-cutting by subglacial or englacial eskers, supports the sedimentological evidence of a subglacial depositional environment. The pitted, hummocky morphology of the Dummer Complex, separated by expanses of bare or boulder strewn bedrock plains is the result of large scale ice stagnation when meltwaters are assumed to have washed the areas between hummocks clean of debris.

Although not occurring on the site, the western portion of the study area contains areas underlain by Newmarket Till. The Newmarket Till is a massive, carbonate-derived silty sand diamicton with up to 15% coarse sand to pebble content. This till represents a regional aquitard that extends throughout much of central Ontario. The Peterborough drumlin field is composed of Newmarket Till.

Drumlins were long thought to be the result of the sculpting action of the ancient glaciers as they overrode the till. This is no longer the universally accepted interpretation. Some drumlins are now thought to be the result of subglacial erosion by water in features that

are referred to as "tunnel channels" or "tunnel valleys". This theory of their formation calls for an origin by subglacial meltwater erosion during periods of catastrophic channelized floods.

As proposed by Brennand and Shaw (1994), these channels also extend through the Dummer (Moraine) Complex and include a channelized landscape. They are up to 90 km long and 4.2 km wide in southeastern Ontario. Channels contain or expose Paleozoic and Precambrian bedrock, Dummer Moraine, till, eskers, transverse ridges, glaciolacustrine sediments, organic sediments, and modern alluvium.

The Warsaw Esker occurs immediately west of the subject site. Near the site, the esker is a narrow, sinuous ridge of poorly stratified "ice-contact" sand and gravel. The Warsaw Esker is approximately 6 km long, with the northernmost 1.5 km occurring within the western part of the study areas.

These post-glacial erosional channels may also have played a role in the formation of karst features in the area, wherever the meltwater could contact and flow through the limestone bedrock.

5.3 Karst

Indian River near Warsaw is a well known karst occurrence area that includes the Warsaw Caves (Conservation Area). This is reflected in the local Earth Science ANSI identified on Schedule A4-2 of the Township's OP, which recognizes the presence of the karst features.

Karst conditions can affect (positively and negatively) groundwater resources, as karstic aquifers can yield an abundant supply of groundwater. Karst conditions can also be challenging with regard to sensitivity.

Figure 6 illustrates the provincial karst hazard mapping, based largely on the work of Brunton and Dodge (2008). A major belt of "known karst" occurs along the Indian River valley. Two other local occurrences are also mapped, one being northwest of the site and the other related to the Warsaw Caves Conservation Area. Well developed karst terrain areas in Southern Ontario (such as the Warsaw Caves) tend to occur in fairly distinctive settings. These include proximity to major river systems, (especially where there is an abrupt direction change), proximity to buried bedrock valleys or channels, and associations with certain stratigraphic and/or lithological controls.

Based on the above relationships, the mapping provides the inferred locations where karst may be possible, based on extrapolation. The mapped karst occurrences are directly related to the Paleozoic bedrock geology and stratigraphy. As such, the limit of the potential karst area coincides closely with the mapped limit of the Bobcaygeon Formation

(as illustrated by Figure 4) and with the areas mapped as having little to no overburden, as shown by Figure 5. The correlation between these features on Figure 4 and Figure 5 is obvious.

Since karstic features can include comparatively minor enlargement of surface fractures, it is not unreasonable to expect some karst-related features to occur wherever the bedrock is at or close to the surface. However, this does not imply that large scale karst features such as caves or karst aquifers will be present. Therefore, it is important to not place too much emphasis on the karst hazard mapping. The mapping is best viewed as a general guide for investigators to assist in identifying areas that could potentially exhibit karst features, as opposed to being definitive.

Much of the study area is confined within the remnant of an ancient glacial spillway system. During the post-glacial period, the spillway conveyed enormous quantities of meltwater that flooded the adjacent lands, likely including most of the study area. Based on the current topography, it is expected that much of Warsaw is located in an ancient river channel that conveyed rapid moving post-glacial flows. As a result, much of the overburden was eroded away within the channel, exposing the limestone to the high flows. The limestone was variably submerged throughout the area.

During these periods, karst weathering of the limestone exposed to the flows occurred, likely along pre-existing channels. The weathering opened and expanded the rock fractures, greatly enhancing its permeability. Once the waters receded, the exposed and highly weathered limestone remained, forming a localized karstic aquifer system.

The extent of the karst is expected to be highly dependant on several factors, including distance from river valley (former spillway) and the elevation corresponding to ancient flooding adjacent to the spillway. Beyond that critical distance and above that elevation, karstic weathering is expected to be less pronounced. There is also likely a lower critical elevation, where the karst weathering was not active, either due to absence of the right conditions to promote weathering (such as absence of an outlet) or due to the rock composition.

The importance of these karstic conditions with regard to groundwater supply cannot be over-stated.

5.4 Site Geology and Shallow Soil Conditions

The on-site soil and shallow groundwater conditions on the site are known from previous test pit investigations completed in 1990 (Appendix A). In addition, we have completed numerous site inspections and have excavated a series of 9 shallow test pits about the site, primarily for the purpose of confirming the previous consultant's observations. The compiled test pit locations are illustrated on Figure 7. The historical soils data are

provided in Appendix A. Test pit logs and photographs representing our current investigations are presented in Appendix B.

The soil conditions revealed by the 1990 boreholes are consistent with those expected from the published regional geological mapping and our site observations. The on-site stratigraphy generally consists of Dummer Till with slightly varying compositions.

As reported in 1990/1992, the surficial soils consist of gravelly silty sand or gravelly sandy silt. Although the previous consultant reported a mantle of gravelly sand separating the till from the topsoil layer over 75% of the site, it is our interpretation that this represents slightly coarser till that had been subjected to surficial weathering. Regardless, the sandy soils can be fairly thick, as revealed at TW-3, where a thickness of 8.8 m (29 ft) was observed. Finer sediments of sand and silt till occur with depth on the site as demonstrated by the grain size curve for T-5 in Appendix A.

The underlying till contains occasional lenses of sand, silt or clay. A clayey lense, more than 0.9 m thick was encountered at SIS-B-3, below a depth of 3.7 m. Similarly, a thin sand lense was encountered at SIS-B-2, between 3.4 m and 3.5 m depth.

Grain size distribution analyses were conducted on representative soils from the 1990/1992 test pits (Appendix A), illustrating the typical variations in the Dummer Till. Based on the grain size curves, the estimated hydraulic conductivities of these soils range from 1.5×10^{-3} cm/s to 8×10^{-6} cm/s. The corresponding percolation rates are expected to be in the 8 min/cm to 20 min/cm range. The 1990/1992 study recommended in-ground tile bed systems for the development.

Our test pits also revealed conditions dominated by gravelly silty sand till of varying compositions, consistent with the Dummer Moraine topography. Slight differences in silt content with depth were noted but did not represent a contrasting soil type on the test pit logs. This varies slightly from the previous consultant's observations, which may have been influenced by the presence of an elevated shallow water table and frost in the late winter of 1990.

Although our findings vary slightly from the previous investigations, we concur with the previous interpretations of the local soil conditions. Given the localized variability of the native soil conditions, each lot will need to be assessed individually at the time of application for approval of a private sewage system in conjunction with the Township of Douro-Dummer.

Inspections for surface expressions of karstic features were conducted throughout the hydrogeological study. Additional inspections by our firm were also conducted during the concurrent Environmental Impact Study (EIS) for the site. One (1) potential karst hazard was identified within 30 m of Indian River/Quarry Lake, on the parcel to be severed, as illustrated on Figure 3. While this feature may represent remnants of a historical bedrock

extraction area (i.e., small quarry), some of the bedrock debris observed inside the open cut is similar to that which could be found in a doline (i.e., sinkhole) feature. Since the edges of a doline feature may make primitive extraction easier, it is possible that the doline was "enhanced" by the extraction of material. Regardless of whether this feature is or is not a karst feature, it is well separated (i.e., >30 m) from the proposed development area and is not situated within the proposed development site. Therefore, it is not expected to represent a constraint on future development.

Minor expressions of karst (i.e., shallow fractures representing "epikarst") were observed throughout the eastern area to be severed (Figure 3), adjacent to Quarry Lake. This area is almost completely devoid of overburden, with vegetation being supported by soil that collects in the fractures of the limestone bedrock. As a result, this area likely enhances groundwater recharge, as surface water runoff would infiltrate readily into the underlying bedrock before finally discharging into the river/lake. The proposed development will be setback considerably from this area.

Photographs representing the contrasting terrains on the site and potential karst related features are presented in Appendix B.

6.0 Hydrogeology

6.1 Shallow Groundwater Conditions

The 1990/1992 study interpreted the shallow groundwater flow pattern to reflect the general topography of the site, implying that groundwater would flow southerly towards Quarry Lake (Appendix A). As only two (2) historical test pits encountered shallow groundwater, the previous investigations also recognized that shallow groundwater mostly occurred within deeper sediments or within the bedrock on the site. This condition was reflected in shallow water table depth measurements at T-1 and T-13 (February 1990).

To supplement on-site data, it is understood that the previous consultant utilized nearby domestic dug wells to obtain additional shallow groundwater data. Unfortunately, the location of the wells were not provided and since that time, many of the dug wells in the area have been abandoned and replaced with drilled wells (based on local well record data). Therefore, those resources are no longer available.

Shallow groundwater was not encountered in any of our test pits. Although our test pits were excavated in the spring (at the end of May 2018), it is anticipated that the shallow water table would have peaked earlier (likely in April). As a result, the shallow water table may have retreated into the underlying bedrock by the time of our inspections.

Since the source of the shallow water table information in the 1990/1992 report does not explicitly provide all the sources used to formulate the plot of "Plate 5" of their report, we

utilized water table indicators (dug out ponds, Quarry Lake, etc.) in conjunction with the shallow piezometer water levels from February 1990 to re-interpret the groundwater flow patttern.

While the contour intervals used by the previous consultant do not conform to the known elevations in the area, we agree with the previous consultant's assessment of the general groundwater flow pattern. The water table surface illustrated on Plate 5 of the previous consultant's report (Appendix A), has been re-plotted on Figure 7 but has been corrected using elevation data obtained from the Ministry of Natural Resources and Forestry's (MNRF's) South Central Ontario Orthophoto Project (2013).

As illustrated on Figure 7, the shallow water table flow pattern is generally from northwest to southeast, toward Quarry Lake. Generally, the shallow water table occurs approximately 4 m below the ground surface over the majority of the site. In lower elevations on the site (i.e., in the river valley), the shallow water table is within approximately 2 m of the ground surface. Shallow groundwater discharge occurs in the PSW, opposite the southeastern extent of the site.

The average shallow water table gradient across the site is approximately 0.019 m/m or 1.9 cm/m.

Sampling of the shallow groundwater was conducted as part of the 1990/1992 study, as reviewed by the MOE (Appendix A). At that time, the consensus was that a background nitrate (as N) concentration of 0.71 mg/L would be appropriate for this site. This value is not expected to have changed, as new development in the area (especially upgradient of the site) has been minimal and agricultural uses appear to have remained similar.

6.2 MOE Well Record Database

The 1990/1992 study highlighted 50 recorded wells near the site, interpreting that wells in the area generally draw water from two (2) distinct aquifers. One aquifer was said to consist of a saturated zone within the surficial granular mantle that supplies bored and dug wells. The other aquifer was said to occur in the saturated fracture network in the underlying bedrock.

According to the previous study, bored and dug wells were reported to occasionally experience supply interruptions during hot, dry summer periods. The previous report also mentions that five (5) dug wells were replaced by deeper drilled wells and states that the shallow aquifer "will not provide reliable long term supplies of potable water". The previous study also suggested that deeper drilled wells in the underlying bedrock were able to produce moderate yields, averaging 0.74 L/s (9.8 gpm), generally exceeding the minimum requirements for domestic use.

As part of our study, we have compiled an updated database of MOE well records representing the site area (within approximately 1 km). In total, 137 local well records have been incorporated into our Groundwater Information System (GWIS), representing conditions in the site area (Appendix C). The locations of these wells, based on the co-ordinates provided, are illustrated by Figure 8.

Most of the recorded wells occur south of the site, in the northern part of Warsaw. As the Warsaw community area is entirely privately serviced, there is a high density of wells in that area. North of Warsaw, wells tend to be associated with widely spaced farm residences. The site occurs on the northern edge of Warsaw, thus wells tend to be spaced further apart as a consequence of the adjacent public school and larger rural lots in this area.

All but two (2) of the well records in the local database represent small diameter drilled wells. Dug wells are likely under-reported. Shallow aquifers are expected to occur locally above or within the fractured limestone bedrock.

The majority of the recorded wells (i.e., 122) are described as being for domestic or livestock use. Of the total, three (3) are listed for public or municipal use, two (2) well records describe wells for commercial use, two (2) records indicate that the well is "not used" and eight (8) records do not indicate a use.

Of the total number of well records, the majority (i.e., 128) are described as being intended for "water supply". Three (3) well records indicate well abandonment due to water supply issues, two (2) were abandoned due to water quality concerns related to "sulphur" and one (1) record indicating the well was "unfinished".

Water quality is generally described as "fresh", however, thirteen (13) well records indicate *sulphur* (presumably H_2S) in the groundwater.

The average (mean) reported test rate is approximately 7.1 gpm, with most wells achieving a yield between 1 gpm and 5 gpm (Figure 9), similar to the findings of the 1990/1992 study. However, we note that the reported test yields range up to a maximum of 80 gpm, somewhat skewing the average. Nevertheless, these statistical results predict that an adequate quantity of water supplies should be generally available in the study area. These data also indicate that groundwater supply conditions are variable, as would be expected from the geological setting.

According to the well record data, local wells mostly encounter groundwater within an elevation range of 200 masl to 226 masl (mean = 213 masl). Within that range, the distribution is somewhat normal, with the largest concentration of wells intersecting water between 207 masl and 215 masl (Figure 9). Below the subject site, the average aquifer elevation would correspond to a depth of roughly 10 m (~33 ft).

6.3 Regional Aquifer Distribution

Regional cross sections illustrating the distribution of aquifers through the site is presented in Figure 10 and 11. From the cross sections, we have identified four (4) principal aquifers that occur in the site area. For simplicity, these aquifers are labelled as the "Shallow Aquifer", the "Basal/ Upper Limestone Bedrock Aquifer", the "Intermediate Limestone Bedrock/Karst Aquifer" and the "Deep Bedrock Aquifer". Each aquifer is briefly described below:

Shallow Aquifer

In areas of sufficient overburden thickness, dug wells would typically be utilized to tap a shallow aquifer occurring just above or within the till stratum. This aquifer can be comprised of granular materials mantling the till or may consist of granular interbeds. Both of these occur in the western portion of the study area but are comparatively rare near the subject site due to the contrast between the silt-rich Newmarket Till to the west and the comparatively sandy Dummer Till beneath the subject site. However, where sufficiently thick, the Dummer Complex soils can be somewhat layered with silt and clay, restricting the downward movement of water, producing shallow and/or perched aquifers.

Regardless, these water bearing zones are variable and tend to be highly dependent on seasonal local recharge. As these wells are rarely recorded, an example of the shallow aquifer does not appear on the regional cross section.

Basal Overburden / Upper Limestone Bedrock Aquifer

Although similar to the shallow aquifer described above, wells that utilize an aquifer comprised of granular material occurring just above the underlying bedrock (within the "basal" zone or just within a few metres of the bedrock surface) could be exploited by either drilled or dug wells. In areas of relatively thin overburden cover (i.e., typically <3 m), dug wells in the study area are known to utilize (or previously utilized) this aquifer. In some instances, the dug wells may also penetrate the bedrock, as the limestone tends to be highly fractured in places and is easily removed by mechanical and/or manual excavations.

Although the dug wells are still highly dependent on recharge, wells located in areas of continuous overburden cover tend to fair better than those in areas that contain bedrock outcroppings.

In contrast to the dug wells that utilize the basal aquifer, drilled wells constructed in areas with sufficient overburden cover (i.e., >6 m) tend to be more reliable, as described in the 1990/1992 hydrogeological study. According to the available well records and our

knowledge of the area, drilled wells that utilize this aquifer tend to be located on the esker to the west of the subject site or within thick overburden sediments related to the river valley.

Despite being the dominant aquifer within the study area, only wells constructed in areas of the subject site that are known to contain sufficient overburden thickness (i.e., >6 m) should target this aquifer. As the proposed development area contains relatively thick, continuous overburden sediments, the basal overburden/upper limestone bedrock aquifer represents an appropriate target for future well drilling on the site.

Intermediate Limestone / Karst Aquifer

Albeit not unrelated to the basal/shallow limestone bedrock aquifer described above, the second aquifer within the study area is related to fractures deeper within the limestone bedrock. Typically, water bearing zones in this aquifer appear to occur within 5 m to 20 m of the top of the limestone sequence. The driller's reported test rate for wells utilizing this aquifer vary considerably, from 3 gpm to 80 gpm. The yield variability is likely an indicator that the water bearing fractures comprising this aquifer are also highly variable, typical of karstic aquifers.

Although rare, some local well records indicate "porous" limestone, "loose" limestone or limestone with stones, possibly indicative of karst aquifers in the area. This is not unexpected given the subject site's proximity to well known karst occurrences. Although the term "karst aquifer" summons visions of large caverns or caves, karst aquifers do not need to contain these larger aperture features. Rather, karst aquifers in the subject site area are more likely to be characterized by slightly enlarged bedrock fractures, rather than large-scale conduits arising from collapse features (such as those that occur in the Warsaw Caves Conservation Area). Given the absence of significant karst occurrences within the development site, it is apparent that the aquifer is peripheral to the main karst area associated with the river valley.

Although the previous 1990/1992 hydrogeological study identified high yield wells on the subject site, it does not appear that these were recognized as being related to a karst aquifer. At that time, this may not have appeared to be an important consideration. In contrast, our investigation has revealed that this is an important distinction and that the karst aquifer conditions are relevant to future water supplies, as described in following sections.

Deep Bedrock Aquifer

A deeper water bearing zone is indicated in a few wells within the study area. It is anticipated that these wells utilize an aquifer located near the base of the Paleozoic

sequence. Often well drillers describe intersecting "sandstone", "granite" or "quartz" with depth, likely representing the Shadow Lake Formation. The Shadow Lake Formation can consist of shale and conglomerate that may appear as mineral sands and/or mineral clasts (especially quartz pebbles) in drill cuttings.

According to the descriptions provided by some drillers, groundwater in these deeper wells can exhibit a strong sulphur (H_2S) odour. From our own experience with aquifers associated with the Shadow Lake Formation, the groundwater can also contain elevated mineral content (including salt). However, none of the well records indicated mineralized water in the study area. Since drillers do not typically have access to equipment to measure the dissolved solids content in groundwater and rarely taste the groundwater, it is anticipated that the occurrence of mineralized water is under-reported in the study area.

In addition, wells utilizing this aquifer tend to have relatively low yields, likely contributing to the increased mineral content. As a result of the poor yield and water quality characteristics associated with the Shadow Lake Formation, future wells will need to avoid intersecting the characteristically red/purple shale associated with this formation.

6.4 Well Survey

In order to better define local aquifer conditions, a door-to-door well survey was completed within 500 m of the subject site on March 9, 2018. Prospective respondents were asked to provide basic information on their well, sewage system and occupancy in order to assess local servicing conditions. Residents were left a letter explaining the purpose of the survey and provided with our contact information if they chose to participate. Prior to commencing the survey, the Township of Douro-Dummer was advised (by email) of the date and time the survey would be taking place. A copy of the well survey questionnaire and letter have been included in Appendix D.

In total, questionnaires were provided to 42 residences, the public works yard and the public school (Kawartha Pine Ridge District School Board). Unfortunately, only three (3) completed survey responses were received from neighbouring well owners.[1] The Kawartha Pine Ridge District School Board kindly provided information about the supply well and sewage system at the Warsaw Public School. The general locations of the well survey respondents are presented on Figure 12.

Despite the low response rate, the information provided by respondents adjacent to the subject site highlight the variable groundwater characteristics in the study area. One well owner (W-2) indicated that they regularly run out of water in the summer months (usually August), while the Warsaw Public School well (W-1) has never run dry.

[1] Low response rates to this type of survey are becoming increasingly common.

Regular Total Coliform and occasional E.Coli. bacteria was indicated to occur in the raw (untreated) water from W-1. The school's large subsurface disposal bed is located approximately 65 m directly upgradient of the well. As a result, it is unknown whether this is a contributing factor to the bacteria occurrences. In contrast, the well owner for W-2 indicated that bacteria testing results completed every few years revealed no issues. While the well owner for W-3 indicated the presence of faecal bacteria and E. Coli. in their raw water, their treatment system (i.e., UV light) effectively eliminates this issue with bacteriological testing results indicating 0 cfu/100mL for both parameters

6.5 Existing Test Wells

6.5.1 General

In accordance with MOE Procedure D-5-5, hydrogeological studies of this type require the construction and testing of test wells to demonstrate the viability of obtaining water supplies from a target aquifer. The number of test wells required is determined partly by the size of the site. Procedure D-5-5 requires the following:

The minimum number of test wells will be:

- *3 for sites up to 15 hectares in area;*
- *4 for more than 15 and up to 25 hectares;*
- *5 for more than 25 and up to 40 hectares, and*
- *for more than 40 hectares, one additional test well for each additional 20 hectares or portion thereof.*

The original subject site has a total area of approximately 24 ha. As such, a minimum of four (4) test wells were required at the onset of the recent hydrogeological investigations to comply with the Procedure.

Three (drilled) test wells were constructed and tested as part of the 1990/1992 hydrogeological study. Those wells are still present on the property (Figure 12) and were made available for follow-up testing and monitoring as part of this investigation. As a result, to comply with D-5-5, only one (1) additional test well was required for this investigation.

As the development area now consists of 11.78 ha, only three (3) test wells are required to comply with the Procedure.

Well records for the pre-existing test wells are presented in Appendix E.

General descriptions and preliminary pumping test results for the pre-existing test wells are provided below. A summary table containing each test well's depth, stick-up, static water level, driller's recommended rate and status is also provided in Appendix E.

6.5.2 TW-1

Test Well #1 (TW-1) is located on an adjacent Lot of Record owned by the proponent (Figure 12). Although this well is located on a separate parcel from the proposed subdivision, Procedure D-5-5 allows for the inclusion of nearby representative wells as part of the groundwater supply assessment. Given that this well was initially constructed to be included as part of the original Plan of Subdivision described by the 1990/1992 hydrogeological study, it was deemed suitable for inclusion into this hydrogeological study.

TW-1 was constructed by Dennis Debbler Drilling and a record for the well was included as part of the previous hydrogeological study.[2] According to the well record, the driller encountered a relatively thick (4.88 m) sequence of Dummer Till ("sand with cobbles") on top of the underlying limestone bedrock. The well was advanced to a total depth of 10.67 m (35 ft), encountering water at a depth of 9.75 m (32 ft). The well was constructed with 6.1 m (20 ft) of casing. It is not clear whether the annular space around the casing was properly grouted at the time of construction.

The driller's recommended pumping rate at the time of construction was 5 gpm (0.32 L/min) with a recommended pump setting of 6.1 m (20 ft), despite the drillers test rate of "10+" gpm.

According to the 1990/1992 hydrogeological study, TW-1 was subjected to short-term "step" pumping at increasing pumping rates to "assess the aquifer response" in May of 1990. According to the data provided, TW-1 was pumped at a rate of 5.7 igpm (0.43 L/s) for 20 minutes, 9.2 igpm (0.7 L/s) for 20 minutes and 12.5 igpm (0.95 L/s) for 6-hours (360 minutes). The well exhibited a maximum observed drawdown of only 0.1 m during the testing.

Preliminary pumping of TW-1 was conducted as part of this investigation on January 20, 2018. A temporary submersible pump and generator were supplied by Holmes Hydrofracturing to facilitate the testing. The test was conducted as a series of increasing pumping rates (steps), with a maximum pumping rate of 17.1 igpm (1.29 L/s). The maximum observed drawdown in the well was 0.12 m. Despite exhibiting slightly more drawdown, these results were determined to be reasonably consistent with the previous hydrogeological study.

During the preliminary test, the discharge water was observed to be clear, with a field measured turbidity of 1.3 NTU. The field measured conductivity was 588 μS, well within the expected range for potable groundwater.

Based on the preliminary test results, it was determined that TW-1 would be suitable for testing in accordance with MOE Procedure D-5-5.

[2] although does not appear to be present in the current MOE database.

6.5.3 TW-2

TW-2 was constructed by Dennis Debbler Drilling in the central portion of subject site for the purpose of the 1990/1992 hydrogeological study (Figure 12). Similar to TW-1, TW-2 encountered a relatively thick (i.e., 8.84 m) of Dummer Till above the underlying bedrock. The well was completed to a depth of 13.72 m (45 ft), encountering water at 12.8 m (42 ft). The well was constructed with 8.84 m (29 ft) of casing. It is not clear whether the annular space around the casing was properly grouted at the time of construction.

The driller's recommended pumping rate at the time of construction was 5 gpm (0.32 L/min) with a recommended pump setting of 12.2 m (40 ft), despite the drillers test rate of "10+" gpm.

Similar to TW-1, according to the 1990/1992 hydrogeological study, TW-2 was subjected to "step" pumping in May of 1990. According to the data provided, TW-2 was pumped at a maximum rate of 12.0 igpm (0.91 L/s). The well exhibited a maximum observed drawdown of 5 cm during the testing.

Preliminary pumping of TW-2 was conducted as part of this investigation on January 29, 2018. A temporary submersible pump and generator were supplied by Holmes Hydrofracturing to facilitate the testing. The test was conducted as a series of increasing pumping rates (steps), with a maximum pumping rate of 16.9 igpm (1.28 L/s). The maximum observed drawdown in the well was measured to be 4 cm. These results were determined to be reasonably consistent with the previous hydrogeological study.

During the preliminary test, the discharge water was observed to be clear, with a field measured turbidity of 0.3 NTU. The field measured conductivity was 573 μS, well within the expected range for potable groundwater.

Based on the preliminary test results, it was determined that TW-2 would be suitable for testing in accordance with MOE Procedure D-5-5.

6.5.4 TW-3

TW-3 was constructed by Dennis Debbler Drilling in the eastern extent of the site for the purpose of the 1990/1992 hydrogeological study (Figure 12). Differing somewhat from the previous test wells, TW-3 encountered a relatively thin (i.e., 1.83 m) sequence of Dummer Till above the underlying bedrock. The well was completed to a depth of 10.67 m (35 ft), encountering water at 9.75 m (32 ft). The well was constructed with 6.1 m (20 ft) of casing. It is not clear whether the annular space around the casing was properly grouted at the time of construction.

The driller's recommended pumping rate at the time of construction was 5 gpm

(0.32 L/min) with a recommended pump setting of 6.1 m (20 ft), despite the drillers test rate of "10+" gpm.

Similar to the other test wells, according to the 1990/1992 hydrogeological study, TW-3 was subjected to "step" pumping in May of 1990. Based on the data provided, TW-3 was pumped at a maximum rate of 5.6 igpm (0.42 L/s). The well exhibited a maximum observed drawdown of 8 cm during the testing.

Preliminary pumping of TW-3 was conducted as part of this investigation on January 29, 2018. A temporary submersible pump and generator were supplied by Holmes Hydrofracturing to facilitate the testing. The test was conducted as a series of increasing pumping rates (steps), with a maximum pumping rate of 14.5 igpm (1.1 L/s). The maximum observed drawdown in the well was measured to be 0.22 m. These results were determined to be reasonably consistent with the previous hydrogeological study.

During the preliminary test, the discharge water was observed to be clear, with a field measured turbidity of <0.2 NTU. The field measured conductivity was 452 μS, well within the expected range for potable groundwater.

Based on the preliminary test results, it was determined that TW-3 would be suitable for testing in accordance with MOE Procedure D-5-5.

6.6 Current Test Well Construction

6.6.1 General

General descriptions and preliminary pumping test results for test wells that were constructed by W.M. Burgess and Son Well Drilling for the purpose of this study have been included below. A summary table containing each test well's depth, stick-up, static water level, driller's recommended rate and status have been provided in Appendix E.

Well records for the newly constructed test wells are presented in Appendix E.

6.6.2 TW-4

A new well was constructed by W.M. Burgess and Son Well Drilling in May 2018 using a rotary drill rig at the request of the proponent. The well was intentionally located proximal to W-2 in an attempt to determine if the site contained any areas that may be challenging with respect to obtaining a sufficient quantity of potable groundwater (Figure 12).

According to the well record, the driller encountered a relatively thick (i.e., 7.01 m)

sequence of Dummer Till over the limestone bedrock. The well was completed to a depth of 24.38 m (80 ft), encountering groundwater between 12.19 m (40 ft) and 18.29 m (60 ft). The well was constructed with 7.01 m (23 ft) of casing and grouted using a bentonite slurry.

Following construction, the driller tested the well at a rate of 15 gpm (0.95 L/s) for a duration of 1-hour. The maximum observed drawdown during this test was 0.1 m. The driller's recommended rate was stated to be 10 gpm (0.63 L/s), despite the driller stating the well was capable of "15+" gpm. The recommended pump setting stated by the driller is 22.86 m (75 ft).

A subsequent preliminary pumping test on TW-4 was conducted on August 1, 2018. A temporary submersible pump and generator were supplied by Holmes Hydrofracturing to facilitate the testing. Initially, the well was pumped at a rate of 0.63 L/s (10 gpm), however, rapid drawdown was observed. As a result, the pumping rate was lowered to approximately 0.13 L/s (2 gpm). Subsequently, the water level in the well dropped to the intake of the pump after only eleven (11) minutes. Recovery in the well was observed to be extremely slow following the test. During the test, cascading was briefly heard in the well to occur at a depth of 10.83 m below the top of casing (btoc).

Clearly, the results of our preliminary pumping test differed from those of the driller's observations and 1-hour pumping test, only a few months earlier. At the time of the preliminary test, there were no known major water takings in the general area[3], essentially ruling out well interference as the cause for the discrepancy.

Based on these results, it was postulated that TW-4 had somehow lost connection to the aquifer.

To determine if similar conditions were present at the other existing wells on the property, a small sampling pump was utilized to determine if each well had maintained connection to the aquifer. While TW-1 and TW-2 did not exhibit any drawdown, TW-3 exhibited precipitous drawdown at a pumping rate of just 0.06 L/s (1 gpm). Therefore, it was determined that TW-3 and TW-4 had likely lost connection to the aquifer in the late summer of 2018.

These observations at TW-3 and TW-4 were the first indication that the aquifer might be affected by seasonal karst drainage effects. Following these results, recommendations to drill and test additional wells, and to extend the groundwater level monitoring program were presented to, and subsequently accepted by the Project Team.

[3] Courtesy calls were made to the consultant for the Township of Douro-Dummer and the MOE to confirm there were no known major dewatering projects in the area at the time of the testing.

6.6.3 TW-5

Our staff was informed of a newly constructed test well (TW-5) on the property, located just south of TW-4 on August 16, 2018 (Figure 12). It is understood that the well was constructed with a rotary drill rig and at the time of construction, the driller described the well as being "dry". Despite this observation, our staff attended the site soon afterward to obtain groundwater level and depth measurements on the new test well.

TW-5 was constructed to a total depth of 35.6 m (117 ft), with a water level of 12.55 m at the time of inspection. Drill cuttings observed near the well bore revealed green shale and purple/pink detritus, characteristic of the Shadow Lake Fm. A sample of the groundwater was collected with a small sampling pump. Field observations/testing revealed a sulphur odour and an extremely high TDS concentration of 9,130 mg/L (9.13 ppt), well over the Ontario Drinking Water Quality Standard (ODWQS) of 500 mg/L. As a result of these observations, it was recommended that the well be immediately abandoned in accordance with Ontario Regulation 903 (O.Reg. 903), as amended.

Despite requesting the well/abandonment record for TW-5, it is understood that a record is not available/required, as the test well ("test hole") was abandoned within thirty (30) days of construction.

6.6.4 TW-6

It is understood that TW-6 was constructed with a rotary drill rig on or about August 30, 2018. Unlike TW-5, it is understood that the driller had encountered groundwater and estimated the yield to be "5+ gpm".

On September 10, 2018, TW-6 was measured to have been drilled to a depth of 25.46 m (83.5 ft) and had a static water level of 6.07 m (~20 ft). Similar to TW-5 (above), the drill cuttings observed around the wellhead of TW-6 revealed bedrock characteristic of the Shadow Lake Fm. From anecdotal information provided by the well contractor, it is understood that drilling ceased soon after intersecting the pink/purple bedrock, however, the exact depth was not provided.

A formal pumping test of TW-6 was attempted on September 21, 2018. A temporary submersible pump and generator were supplied by W.M. Burgess and Son Well Drilling to facilitate the testing. The test was halted after only thirty (30) minutes of pumping as the TDS concentration was observed to rise quickly to 1,470 mg/L (1.47 ppt). Based on observations made during the pumping test, it was determined that TW-6 may have intersected two (2) water bearing fractures, consisting of a shallow fracture (i.e., <40 ft) and a deeper fracture in the Shadow Lake Fm. Based on these observations, it was recommended that the test well be abandoned immediately in accordance with O. Reg. 903, as amended.

Despite requesting the well/abandonment record for TW-6, it is understood that a record is not available/required, as the test well ("test hole") was abandoned within thirty (30) days of construction.

6.6.5 TW-7

Similar to TW-6 (above), TW-7 was constructed with a rotary drill rig on or about August 30, 2018. Upon completion, the driller noted that the well was "dry" and recommended hydrofracturing to improve the well yield.

TW-7 was subjected to hydrofracturing on September 12, 2018 by Holmes Hydrofracturing. During the hydrofracturing procedure, water pressure built up to 2,000 psi. A sudden release of pressure was observed, suggesting that the hydrofracturing had successfully cleaned out and/or opened a fracture in the limestone bedrock. The well was subsequently pumped to clear out the water used in the hydrofracturing process.

A preliminary pumping test, using a temporary submersible pump and generator provided by W.M. Burgess and Son Well Drilling, was conducted on September 13, 2018. At the time of testing, the well was measured have been constructed to a depth of 39.93 m (131 ft) and had a static water level of 8.59 m (28 ft). Similar to TW-6, drill cuttings characteristic of the Shadow Lake Fm. were observed around the wellhead.

The preliminary pumping test commenced at a rate of 0.98 L/s (13 igpm), completely draining the well after only two (2) minutes. Subsequent pumping was conducted in the afternoon, at a comparatively low rate of 0.15 L/s (2 igpm). The water level in the well was observed to drawdown to the intake of the pump after only fifteen (15) minutes. Recovery was observed to be extremely slow.

Given the relatively short duration of the testing, field water quality analysis was not possible. Regardless, it was recommended that TW-7 be abandoned in accordance with O. Reg. 903, as amended.

Despite requesting the well/abandonment record for TW-7, it is understood that a record is not available/required, as the test well ("test hole") was abandoned within thirty (30) days of construction.

6.6.6 TW-8

Based on the results from the well drilling program described above, it is understood that a different approach was considered for subsequent wells constructed in September 2019. Rather than utilizing a rotary drill, W.M. Burgess and Son Well Drilling utilized a cable-tool drill rig for the remaining wells. In addition, the location of each additional well was

"witched" by the well contractor prior to construction (not under our direction).

TW-8 was constructed in proximity to a former aggregate pit on the subject site on September 5, 2019 (Figure 12). According to the well record, the driller encountered a relatively thick (i.e., 5.5 m) sequence of Dummer Till overlying fractured limestone and shale bedrock. The well was completed to a depth of 7.92 m (26 ft), encountering groundwater between 7.01 m (23 ft) and 7.92 m (26 ft). The well was constructed with 6.1 m (20 ft) of casing, a 2.13 m (7 ft) length of #14 slot well screen and was grouted using a bentonite slurry.

Following construction, the driller tested the well at a rate of 15 gpm (0.95 L/s) for a duration of 1-hour. There was no observed drawdown during this test. The driller's recommended pumping rate was stated to be 10 gpm (0.63 L/s), despite the driller stating the well was capable of "15+" gpm. The recommended pump setting stated by the driller is 7.92 m (26 ft).

Based on the driller's test results, it was determined that TW-8 would be suitable for testing in accordance with MOE Procedure D-5-5. A copy of the well record for TW-8 is included in Appendix E.

6.6.7 TW-9

TW-9 was constructed using a cable-tool drill rig September 6, 2019. The well was drilled approximately 125 m northeast of TW-8, occurring just south of a sandy linear ridge (assumed to be a buried limestone scarp) that occurs on the property. According to the well record, the driller encountered a relatively thick (i.e., 7.62 m) sequence of Dummer Till overtop of fractured limestone and shale bedrock. The well was completed to a depth of 10.97 m (36 ft), encountering groundwater between 8.53 m (28 ft) and 10.97 m (36 ft). The well was constructed with 8.53 m (28 ft) of casing and grouted using a bentonite slurry.

Following construction, the driller tested the well at a rate of 7 gpm (0.44 L/s) for a duration of 1-hour. The maximum observed drawdown during the test was 2.5 cm. The driller's recommended pumping rate was indicated to be 5 gpm (0.32 L/s), despite the driller stating the well was capable of 10 gpm. The recommended pump setting stated by the driller is 10.36 m (34 ft).

Based on the driller's test results, it was determined that TW-9 would be suitable for testing in accordance with MOE Procedure D-5-5. A copy of the well record for TW-9 is included in Appendix E.

6.6.8 TW-10

TW-10 was constructed using a cable-tool drill rig on September 4, 2019. The well was drilled in proximity to the former location of TW-6 (Figure 12). According to the well record, the driller encountered a relatively thick (i.e., 8.23 m) sequence of Dummer Till overtop of limestone bedrock. The well was completed to a depth of 11.58 m (38 ft), encountering groundwater between 11.28 m (37 ft) and 11.58 m (38 ft). The well was constructed with 8.23 m (27 ft) of casing and grouted using a bentonite slurry.

Following construction, the driller tested the well at a rate of 10 gpm (0.63 L/s) for a duration of 1-hour. The maximum observed drawdown during the test was 0.91 m (3 ft). The driller's recommended pumping rate was stated to be 10 gpm (0.63 L/s). The recommended pump setting stated by the driller is 10.97 m (36 ft).

Based on the driller's test results, it was determined that TW-10 would be suitable for testing in accordance with MOE Procedure D-5-5. A copy of the well record for TW-10 is included in Appendix E.

6.6.9 Discussion

Clearly, the data from the above pumping tests are challenging to interpret, as the well/aquifer drawdown response to pumping at the test rates is minimal, suggesting very high yield conditions. Unfortunately, to force a greater (and more easily measurable) response, pumping at higher rates would likely be required, resulting in the need to obtain a Permit to Take Water (PTTW) from the MOE. While conducting higher rate testing might be of academic interest, such testing is not required under Procedure D-5-5, especially considering that future domestic water demand would represent only a small fraction of the water abstracted during the pumping tests.

Despite the interpretation challenges resulting from the minimal responses, based on our analysis of observation well data, the average aquifer transmissivity is substantial, likely between 500 m^2/day and 1,000 m^2/day. Near-well transmissivities are much lower due to inefficiencies, however, are still substantial (i.e., generally exceeding 100 m^2/day). These conditions are typical of a karstic aquifer. Based on the results of test well construction, it is clear that future domestic wells in the development will need to utilize a high yield (karst) aquifer that occurs within the upper 6.1 m (20 ft) of the underlying bedrock.

Despite the presence of a high yield aquifer on the site, the drilling contractor did not note any voids or fractures during well construction that would normally be associated with significant karstic features. Moreover, our site inspections revealed no evidence of karst topography that would normally be associated with significant karst effects (e.g., caves, caverns, dolines, disappearing streams or collapse structures) within or near the proposed development area. Instead, we expect that the main karst features will be more closely

associated with Indian River, similar to the conditions at the Warsaw Caves Conservation Area situated north of the site. Therefore, it is expected that the karst aquifer identified on the site is comprised of epikarst and minor fracture enhancement that occurs peripherally to the main karst features. It is also important to note that everywhere on the site, the aquifer is covered by a continuous layer of Dummer Complex overburden.

Typically, groundwater flow through a karst aquifer system can be classified as matrix flow (i.e., similar to groundwater flow through a sand aquifer), conduit flow (i.e., groundwater flow through fractures or voids in the bedrock) or a combination of both[4]. Based on the recent test well drilling, it is anticipated that conduit flow likely dominates. Conditions associated with wells TW-1, TW-2 and TW-10 are especially characteristic of conduit flow, having intersected the aquifer below competent limestone "cap rock". However, the fracture patterns can be complex, consisting of restrictions and discontinuities that affect well responses. As a result of these variable conditions, some wells respond sharply to recharge, whereas others exhibit much more subdued responses.

For a karst aquifer to be "active", it must have an outlet (otherwise the hydrochemical weathering would cease). In this instance, the aquifer drains to the Quarry Lake/Indian River system where the majority of the karst features occur (fluviokarst). As a result of this natural drainage (recession), wells on the site can lose connection to the karst aquifer seasonally and become essentially dry. This appears to have occurred at TW-3 and TW-4. We also expect that a similar situation occurs regularly at a neighbouring private well (i.e., W-2).

To examine this phenomena in greater detail and to examine the overall characteristics of the karst aquifer, long-term monitoring of water levels, temperature and conductivity was completed.

6.7 Long-term Monitoring

6.7.1 General

As presented above, during the test well construction phase of the project, it was recognized that groundwater level variability could be considerable and that an assessment of the range of variability would help in our understanding of the aquifer system. As a result, four (4) wells (TW-1, TW-2, TW-3 and TW-4) were selected for long-term monitoring of water levels. Seasonal (i.e., ice-free) monitoring of the water level in Quarry Lake/Indian River was also included as part of the monitoring program. Each well was outfitted with a programmable water level pressure transducer ("datalogger") to facilitate automatic water level and temperature measurements. One (1) of the dataloggers also included water conductivity logging to track water quality changes in the

[4] Asante, Dotson, Hart and Kreamer, 2017

aquifer. A barometric logger was utilized to compensate the well dataloggers for variations in barometric pressure.

The monitoring period extended from June 2018 to November 2019. As the late summer of 2018 was also considered a comparatively dry period (i.e., *Level II Low Water Status* - Otonabee Region Conservation Authority), this period was especially instructive.

A summary of the data and brief interpretation is presented below.

6.7.2 Water Level Monitoring

Figures 13 and 14 present long-term hydrographs illustrating the compiled groundwater level data from the monitored wells for 2018 and 2019 respectively. As illustrated, the water level variations can be quite dramatic with some wells exhibiting as much as 6 m of variation. As would be expected, water levels were observed to be highest during the spring freshet period and lowest during the late summer/early fall (relatively dry) period.

The hydrographs clearly demonstrate how the aquifer drains after the spring recharge, following a general recession curve throughout the summer. Water levels in wells that maintain a connection to this aquifer (TW-1 and TW-2) show a gentle recession towards the end of the summer/early fall, until the next major recharge event (or series of events) take place in October/November (when daytime heating, thus evaporative effects are reduced).

Although following a gentle recession curve, the water levels in TW-1 and TW-2 appear to "level off" toward early September 2018 and remain relatively "flat" in late September/early October. This is not uncommon in karst aquifers, as the decline in water level may be mitigated by nearby surface water bodies. The water levels will simply decline until they reach some sort of equilibrium with the water level in the nearby surface water body, maintaining a gentle gradient towards the water body.

Data collected in 2018 clearly show relatively stable water levels during a relatively dry summer. During this same period Otonabee Region Conservation Authority had issued a *Level II Low Water Advisory*, indicating near-drought conditions in the local watersheds, further supporting the interpretation provided above.

Analysing the hydrograph for TW-2, it is possible that this equilibrium may occur at or just above the water level elevation of Quarry Lake/Indian River. However, the water level in TW-1 appears to be reaching an equilibrium that is at least 1 m above the lake/river elevation. As a result, the dominant groundwater flow pattern is expected to be towards the lake/river. A potentiometric surface of water levels in the test wells is presented on Figure 15, to show the expected gradient during the late September (near equilibrium) period.

The compiled historical water level data plus our monitoring in 2018 and 2019 has revealed that groundwater levels in the test wells exhibit significant variation over time. Some of that variation is related to short-term recharge events. However, most of the variability appears to be seasonal, with major changes occurring year to year. Table 1 presents the range of variation in water level measurements in each of the test wells.

Table 1: Static Water Level Variation

Well No.	Lowest Observed Static Water Level (m)	Highest Observed Water Level (m)	Difference (m)	% of Available Drawdown
TW-1	6.52	0.86	5.66	58%
TW-2	8.73	5.60	3.13	41%
TW-3	6.50	1.71	4.79	57%
TW-4	10.87	6.78	4.09	21%
TW-8	3.87	2.54	1.33	15%
TW-9	5.15	3.31	1.84	39%
TW-10	7.86	4.30	3.56	54%

This type of variability is not unusual for a karstic aquifer. In fact, water level variability is a common signature of karst aquifers (in addition to changeable water quality). Karst aquifers can exhibit challenging conditions that often defy reason. As reported by Bonacci (1993), karst systems typically have a low capacity for water retention. However, karst aquifers can appear to have a high storage capacity because of the very high flow velocity and propensity for high yield conditions. Instead, karst systems often rely on external storage (e.g., overburden or other, interconnected aquifers) for their storage. As a result, water level fluctuations tend to be extreme.

In comparison, the water level in Quarry Lake/Indian River is relatively stable. As the river is controlled by dams downstream of the site, this is not unexpected.

Water level data obtained from TW-3 and TW-4 show responses to recharge events in the winter, early spring and late fall months. During the summer to early fall period, the water levels in both of these wells are essentially "flat" (stable). This pattern is repeated in both the 2018 and 2019 data, illustrating the water level elevations that both of these wells drain to before losing connection with the karst aquifer.

These conditions do not mean that a karst aquifer cannot be successfully utilized. Karstic aquifers can be reliable.

In this instance, the data clearly shows that connection with the aquifer is lost at a certain

water level elevation in TW-3 and TW-4. Based on the water level data, the elevation of the seasonal water-bearing fractures in these wells occur at 219.6 masl and 218 masl respectively. Both these elevations occur well above the elevation of Quarry Lake adjacent to the site (at approximately 214 masl). In contrast, according to the well driller, TW-2, TW-8, TW-9 and TW-10 all encountered the aquifer at depths below the lake level.

Presumably, the water-bearing fractures utilized by TW-2, TW-8, TW-9 and TW-10 represent the main karst aquifer, which has some hydraulic connection with Quarry Lake. The fractures utilized seasonally by TW-3 and TW-4 can be considered somewhat similar to a "perched" aquifer, which maintains a connection with the main aquifer only when water levels are elevated enough to fill these fractures. When water levels are low, these fractures remain dry or simply drain quickly as recharge travels towards the main part of the karst aquifer.

A local schematic cross section through the on-site test wells and Quarry Lake is presented by Figure 16. The cross section illustrates the relationship between the "water found" elevation in each well with the controlled water level of Quarry Lake.

6.7.3 Temperature Monitoring

Temperature data obtained from the test well dataloggers (i.e., representing groundwater), the datalogger installed in Quarry Lake and the barometric datalogger (i.e., ambient air temperature) on the site is presented in Appendix F. The temperature data have been plotted over the same time period shown in the hydrographs on Figures 13 and 14.

As illustrated, the ambient air temperature fluctuates as would be expected with seasonal and daily fluctuations. In contrast, the groundwater appears to be mostly unaffected. A seasonal, gradual warming and cooling trend is observable in the data from TW-1 and TW-3, however, this trend is muted in comparison to the ambient temperature and temperature data obtained from Quarry Lake. Despite large variations in water levels (as shown on Figures 13 and 14), the temperature response in the wells suggest that aquifer recharge is sufficiently distant to allow the infiltrating waters' temperature to equilibrate. In other words, the recharge has time to warm (in the case of spring runoff) or cool (in the case of summer storms). Characteristic of groundwater, the water temperature in the wells remains relatively stable throughout the year.

It is also interesting to note that the temperature in Quarry Lake seems unaffected by groundwater inputs, with the surface water temperature mirroring the ambient air temperature (Appendix F). These data suggest that groundwater from the subject site is not a major component of flows entering the Quarry Lake/Indian River system. If the system were strongly dominated by groundwater flux, we would expect to observe less correlation between the air temperature, as the surface water temperature would be

somewhat regulated by groundwater inputs, thereby muting the temperature response from daytime heating and cooling. According to the temperature data collected over 2018 and 2019, this is not occurring in Quarry Lake, suggesting the river/lake is mostly comprised of runoff and upstream inputs adjacent to the site.

6.7.4 Conductivity Monitoring

Continuous water level, temperature and conductivity measurements were collected with a calibrated Solinst LTC Levelogger Edge. The datalogger was initially installed in TW-3 as part of the original scope of the hydrogeological study. This datalogger was later moved to TW-1, once it was determined that TW-3 seasonally loses connection with the main aquifer.

The conductivity data collected by this datalogger are presented in Appendix F. As illustrated, the 2018 data shows monitoring for both TW-3 and TW-1, while the 2019 data is entirely from TW-1. The conductivity data clearly demonstrate how the water quality in the aquifer is affected by recharge, with the conductivity (a proxy for dissolved mineral concentration) fluctuating between 200 μS/cm and 500 μS/cm in the spring. In contrast, the conductivity rises sharply in the late summer/early fall and becomes somewhat stable at around 1,000 μS/cm, as recharge is less prevalent. This rise in conductivity could be associated with minor leakage through the aquitard from a deeper bedrock aquifer or increased influence from nearby wells that are constructed into the deeper aquifer.

However, caution is needed when reviewing this data, as stagnant water in the well bore may simply stratify when flow-through conditions cease. As a result, the denser (more saline) water would collect toward the bottom of the well bore, where the dataloggers are typically placed. To help avoid this effect, the datalogger in TW-1 was raised off the bottom of the well in the winter of 2018. However, based on the data, it appears the datalogger would require more frequent adjustments.

Interestingly, when major recharge events are observed, the initial conductivity concentration seems to rise slightly before eventually returning to a normal range of fluctuation between 200 μS/cm and 500 μS/cm. This seems to support observations and hypotheses made by Asante et al, 2017, whereby recharge is stored in the soil and epikarst zone until a major recharge event forces the water into the karst aquifer (i.e., “piston flow”). The result of this effect would suggest there is not an instantaneous injection of recharge directly into the aquifer. Rather, this storage of recharge would cause a delayed effect that can only be observed in the water chemistry (i.e., conductivity and temperature data).

Although karst aquifers themselves do not typically have a large filtration capacity, there may be secondary filtration that occurs as recharge is stored in the soil and epikarst zone, thereby protecting water quality in the karst aquifer.

6.8 Pumping Tests

6.8.1 General

Based on the driller's short-term pumping tests and data from preliminary pumping tests, six (6) on-site test wells were subjected to test pumping in accordance with MOE Procedure D-5-5. The non-pumping wells and a neighbouring well (W-1) were utilized as observation wells.

Domestic water usage is typically split into two main daily usage periods, one demand period in the morning and one in the evening. MOE Procedure D-5-5 states that the average per-person water demand is 450 L per day[5]. This is equivalent to a peak demand rate of 3.75 litres/minute for each person. The occupancy is generally considered to be *the number of bedrooms "plus one"*.

Taking into consideration the above, a four (4) bedroom home would theoretically have an occupancy of five (5) persons, resulting in a daily average water demand of 5 X 450 L/day = 2,250 L/day. If the day is split according to a morning and evening peak usage period, each period would require approximately 1,125 L. These higher usage periods would most often occur within a relatively short time frame of 1 to 2 hours.

To comply with this minimum requirement of Procedure D-5-5, the test wells should be capable of meeting the above criteria. For wells capable of meeting the average daily demand but not able to meet the peak, short-term demand, lower pumping rates can be acceptable, provided supplementary water storage is available in the system.
An alternate interpretation of the D-5-5 guidelines suggests that a test well should be tested at a rate that is three times (3x) greater than the daily demand described above (6,750 L/day). Therefore, as a conservative approach, the target duration and flow rate utilized for each pumping test was based on extracting a minimum volume of 6,750 L within a single 24-hour period.

Prior to the pumping tests, the pumped well and the observation wells were outfitted with dataloggers to help facilitate frequent (i.e., every minute) water level readings. To supplement the logger measurements, manual measurements were collected periodically throughout the pumping tests.

A detailed description of the formal well testing program has been included below. The pumping test curves are presented in Appendix G.

[5] It is important to recognize that MOE Procedure D-5-5 was developed prior to the wide-scale use of low flow fixture units. As a result, water demand rates are anticipated to be much lower than suggested by the guidelines.

6.8.2 TW-1

TW-1 was originally subjected to a pumping test at a rate of 1.39 L/s (18.3 igpm) for 365 minutes on July 10, 2018. The total volume of water extracted during the test was approximately 30,375 Litres (~6,682 igal), substantially exceeding the minimum daily domestic requirement.

During the pumping test, the well exhibited a maximum drawdown of 0.3 m, exhibiting a test curve typical of a semi-confined aquifer (Appendix G). At the time of the test, TW-1 had a total available drawdown of approximately 3.98 m based on the difference between our measured static level (5.77 m) and the driller's water found depth (9.75 m). The well recovered to within 95% of the initial static water level within 237 minutes of the cessation of pumping.

The observation well data indicate no discernable interference effects, with water levels generally following a regional recession curve.

Based on the drawdown measured in the pumped well, the transmissivity is estimated at approximately 229 m^2/day, utilizing a Cooper-Jacob analysis on the drawdown portion of the test. Analysis of the recovery data for TW-1 suggests a slightly higher transmissivity of approximately 407 m^2/day, based on a Theis analysis. As pumped well data typically under-estimate the formation loss component of drawdown, the recovery analysis is likely more representative.

A subsequent pumping test was conducted on TW-1 on September 13, 2019, during the seasonal low water level period as shown on Figure 14. The pumping test was completed at a constant rate of 0.68 L/s (9 igpm) for 362 minutes, utilizing equipment supplied by the well owner.

During the pumping test, the well exhibited a maximum drawdown of 0.16 m, exhibiting a test curve typical of a semi-confined aquifer. At the time of the test, TW-1 had a total available drawdown of approximately 3.65 m based on the difference between our measured static level (6.1 m) and the driller's water found depth (9.75 m). The well recovered to within 95% of the initial static water level within 237 minutes of the cessation of pumping.

The observation well data indicate no discernable interference effects, with water levels generally flat, with the exception of possible interference effects from neighbouring wells at TW-8 and TW-9.

Based on the drawdown measured in the pumped well, the transmissivity is estimated at approximately 126 m^2/day, utilizing a Cooper-Jacob analysis on the drawdown portion of the test. Analysis of the recovery data for TW-1 suggests a slightly higher transmissivity of approximately 373 m^2/day, based on a Theis Recovery analysis. As pumped well data

typically under-estimate the formation loss component of drawdown, the recovery analysis is likely more representative. These results are similar to those obtained in July of 2018.

During the 1990/1992 hydrogeological study, TW-1 was subjected to a similar 6-hour pumping test. As reported at that time, the computed transmissivities from the constant rate portion of the drawdown and recovery phases of the test were 362 m^2/day and 273 m^2/day, respectively.

Based on the worst-case (September 2019) 6-hour specific capacity (i.e., 4.26 L/s/m) and the total available drawdown at the time of our test (i.e., ~3.65 m), the theoretical yield of TW-1 is on the order of 15.55 L/s (~205 igpm). In reality, the achievable yield would be lower, as a result of well losses (inefficiency), equipment limitations and any negative boundary effects.

The pumping test data confirm that the yield of TW-1 substantially exceeds the D-5-5 criteria, without the need for supplementary water storage. In addition, despite a reduction in available drawdown between the data collected in July 2018 versus September 2019, there is a comparatively small effect on the specific capacity.

6.8.3 TW-2

The pumping test of TW-2 was conducted on September 18, 2019 using equipment supplied by the well owner. TW-2 was pumped at an average rate of 0.63 L/s (8.3 igpm) for 364 minutes. The total volume of water extracted during the test was approximately 13,781 litres (~3,031 igal). At the time of the test, TW-2 had a total available drawdown of about 3.76 m based on the difference between our observed static level (8.43 m) and the driller's recommended pump setting (12.19 m).

TW-2 had minimal drawdown (i.e., 8 cm) followed by a rapid recovery upon cessation of pumping. The test curve is consistent with a semi-confined aquifer condition (Appendix G).

The observation well data indicate almost imperceptible interference effects (i.e., <0.02 m) at TW-8 and TW-9. However, it is important to note that these wells may have been affected by neighbouring wells over the same time period. For instance, the Warsaw Public School well (W-1) would have seen regular use over a period similar to the duration of our pumping test (i.e., 9:41 to 15:45). It is also important to recognize that the range of measurements is similar to the resolution of the datalogger.

Based on the drawdown measured in the pumped well, the transmissivity is estimated at approximately 414 m^2/day, utilizing a Cooper-Jacob analysis of the drawdown portion of the test. Analysis of the recovery data for TW-2 suggests a significantly higher transmissivity of approximately 1,003 m^2/day, based on a Theis analysis.

Analysis of the observation well data at TW-8 yields a transmissivity of 1,000 m^2/day, while TW-9 observation data indicates a value of 1,430 m^2/day. The average storativity (S) value calculated based on the observation data was 1.4 x 10^{-4} (unitless). Caution is needed when using these results, given the minimal aquifer response and possible influence from neighbouring wells.

During the 1990/1992 hydrogeological study, TW-2 was subjected to a series of pumping test, with the longest duration of pumping occurring over 240 minutes at 0.26 L/s (3.4 igpm). It's not clear why lower pumping rates were initially used for testing this well. As reported at that time, the computed average transmissivity from all available data was approximately 580 m^2/day. This result is similar to the near-well drawdown transmissivity presented above.

Based on the 6-hour specific capacity (i.e., 7.89 L/s/m) and the total available drawdown at the time of our test (i.e., ~3.76 m), the theoretical yield of TW-2 is on the order of 29.7 L/s (~391 igpm). In reality, the achievable yield would be lower, as a result of well losses (inefficiency), equipment limitations and any negative boundary effects.

The pumping test data confirm that the yield of TW-2 substantially exceeds the D-5-5 criteria, without the need for supplementary water storage.

6.8.4 TW-3

The pumping test of TW-3 was conducted on March 28, 2018 using equipment supplied by Holmes Hydrofracturing. TW-3 was pumped at an average rate of 0.88 L/s (11.6 igpm) for 367.5 minutes. The total volume of water extracted during the test was approximately 19,375 litres (~4,262 igal). At the time of the test, TW-3 had a total available drawdown of about 5.42 m based on the difference between our observed static level (4.33 m) and the driller's recommended pump setting (9.75 m).

TW-3 had minimal drawdown (i.e., 0.16 m) followed by a rapid recovery upon cessation of pumping. The test curve is consistent with a semi-confined aquifer condition (Appendix G). The observation well data indicate no discernable interference effects.

Based on the drawdown measured in the pumped well, the transmissivity is estimated at approximately 737 m^2/day, utilizing a Cooper-Jacob analysis on the drawdown portion of the test. Analysis of the recovery data for TW-3 suggests a similar transmissivity of approximately 655 m^2/day, based on a Theis Recovery analysis.

During the 1990/1992 hydrogeological study, TW-3 was subjected to a series of pumping tests, with the longest duration of pumping occurring over 325 minutes at 0.33 L/s (4.3 igpm). As reported at that time, the computed average transmissivity from all available data was >400 m^2/day. This result is similar to the most recent well testing

presented above.

However, as described above, TW-3 was observed to lose connection with the main part of the karst aquifer in the late summer of 2018. Subsequent water level monitoring suggests this well loses connection with the aquifer annually, as the water level declined below the elevation of the bedrock fracture that seasonally supplies this well (i.e., 219.6 masl).

As a result, it is expected that TW-3 will need to be abandoned in accordance with O. Reg. 903, as amended.

6.8.5 TW-8

Based on the results of the driller's pumping test, TW-8 was subjected to a constant rate test on September 17, 2019, using equipment supplied by the well owner. TW-8 was pumped at a rate of 0.49 L/s (6.5 igal) for 360 minutes. The total volume of water extracted during the test was approximately 10,629 L (~2,338 igal).

TW-8 had minimal drawdown (i.e., 3.5 cm) followed by rapid recovery upon cessation of pumping. The observation well data indicate almost imperceptible interference effects (i.e., <0.02 m) at TW-9. However, it is important to note that this well may have also been affected by neighbouring wells over the same time period and these measurements are similar to the resolution of the datalogger.

Due to the minimal drawdown exhibited by TW-8 during the pumping test, curve fit analysis of the pumping test is challenging (Appendix G). As a result, manual data and datalogger data have been analysed separately. Based on the drawdown measured in the pumped well, the average transmissivity from the manual and datalogger data is estimated to be approximately 827 m^2/day, utilizing a Cooper-Jacob analysis on the drawdown portion of the test.

Analysis of the manual observation well data at TW-9 yields a transmissivity of 862 m^2/day. The storativity (S) value calculated based on the observation well data was 1.6×10^{-4} (unitless). Caution is needed when using these results, given the minimal aquifer response and possible influence from neighbouring wells.

Based on the 6-hour specific capacity (i.e., 14.1 L/s/m) and the total available drawdown at the time of our test (i.e., ~3.99 m), the theoretical yield of TW-8 is on the order of 56.3 L/s (~742 igpm). In reality, the achievable yield would be lower, as a result of well losses (inefficiency), equipment limitations and any negative boundary effects.

The pumping test data confirm that the yield of TW-8 substantially exceeds the D-5-5 criteria, without the need for supplementary water storage.

6.8.6 TW-9

Based on the results of the driller's pumping test, TW-9 was subjected to a constant rate test on September 16, 2019, using equipment supplied by the well owner. TW-9 was pumped at a rate of 0.49 L/s (6.5 igal) for 360 minutes. The total volume of water extracted during the test was approximately 10,692 L (~2,352 igal).

TW-9 exhibited minimal drawdown (i.e., 2 cm) followed by a rapid recovery upon cessation of pumping (Appendix G). The observation well data indicate almost imperceptible interference effects (i.e., <0.02 m) at TW-8 and TW-2. However, it is important to note that this well may have also been affected by neighbouring wells over the same time period and these measurements are similar to the resolution of the datalogger.

Due to the minimal drawdown exhibited by TW-9 during the pumping test, curve fit analysis of the pumping test was difficult (Appendix G). As a result, manual data and datalogger data have been analysed separately. Based on the drawdown measured in the pumped well, the average of transmissivity values estimated from the manual and datalogger data is approximately 846 m^2/day, utilizing a Cooper-Jacob analysis.

Analysis of the observation well data at TW-8 yields an average transmissivity of 630 m^2/day, while data from TW-2 yields 549 m^2/day. The average storativity (S) value calculated based on the observation data was 1.3×10^{-3} (unitless). Caution is needed when using these results, given the minimal aquifer response and possible influence from neighbouring wells.

Based on the 6-hour specific capacity (i.e., 24.7 L/s/m) and the total available drawdown at the time of our test (i.e., ~4.24 m), the theoretical yield of TW-9 is on the order of 105 L/s (>1,000 igpm). In reality, the achievable yield would be lower, as a result of well losses (inefficiency), equipment limitations and any negative boundary effects.

The pumping test data confirm that the yield of TW-9 substantially exceeds the D-5-5 criteria, without the need for supplementary water storage.

6.8.7 TW-10

Based on the results of the driller's pumping test, TW-10 was subjected to a constant rate test on September 12, 2019, using equipment supplied by the well owner. TW-10 was pumped at a rate of 0.58 L/s (7.7 igal) for 373 minutes. The total volume of water extracted during the test was approximately 13,080 L (~2,877 igal).

TW-10 exhibited minimal drawdown (i.e., 1.14 m) followed by a rapid recovery upon cessation of pumping, achieving 95% recovery 257 minutes after the cessation of pumping (Appendix G). The observation well data indicate no discernable interference effects.

Based on the drawdown measured in the pumped well, the transmissivity is estimated at approximately 63.8 m^2/day, utilizing a Cooper-Jacob analysis on the drawdown portion of the test. Analysis of the recovery data for TW-10 suggests a similar transmissivity of approximately 58 m^2/day, based on a Theis Recovery analysis.

Based on the 6-hour specific capacity (i.e., 0.51 L/s/m) and the total available drawdown at the time of our test (i.e., ~4.07 m), the theoretical yield of TW-10 is on the order of 2.08 L/s (~27 igpm). In reality, the achievable yield would likely be lower, as a result of well losses (inefficiency) and any negative boundary effects.

The pumping test data confirm that the yield of TW-10 substantially exceeds the D-5-5 criteria, without the need for supplementary water storage.

6.8.8 Discussion

The results obtained from the well testing program clearly demonstrates that a sufficient quantity of groundwater is available on the subject site to support the proposed residential subdivision (exceeding the minimums required by Procedure D-5-5), provided the wells are able to "tap" into the main shallow/intermediate limestone (karst) aquifer.

Long-term water level data obtained from the test wells suggests that future production wells should be completed at or just below approximately 214 masl to take full advantage of the aquifer. We also note that wells collared in the lower part of the site (i.e., where the ground surface is below approximately 224 masl) are most likely to intersect the target aquifer. To illustrate, the area most likely to contain wells with sufficient connection to the aquifer is illustrated on Figure 17.

It is anticipated that most of the proposed wells will be located inside the preferred area shown on Figure 17. Any future wells constructed outside of this area would require multi-year water level monitoring and a pumping test during a seasonal low water level period (i.e., in August/September) to verify that the well can maintain a connection to the main aquifer.

Our long-term monitoring data shows that Quarry Lake maintains a stable water level at approximately 214 masl due to control structures (dams) located down-stream of the site. Our long-term monitoring has also demonstrated that water levels in the on-site wells utilizing the Intermediate Limestone/Karst Aquifer also seasonally reach an equilibrium slightly above the lake level, even during extreme drought conditions. This is evidenced by the Warsaw Public School well, which is not known to have ever run out of water despite regular, comparatively higher usage.

Alternative supply aquifers were not identified on the site. A water bearing zone was identified within the Shadow Lake Formation limestone and shale, greater than 6 m

below the top of the bedrock (Deep Bedrock Aquifer). However, this deep zone contains saline water with field measurements of TDS indicating concentration well above the ODWQS objective of 500 mg/L. For all intents and purposes, the Deep Bedrock Aquifer beneath the site is considered non-potable and future well drilling should avoid intersecting this aquifer.

Construction of the test wells via cable tool method appeared to have a greater likelihood of intersecting the aquifer on the site than conventional rotary drilling. Although debatable, it is expected that future lot owners will want to instruct their drilling contractor to use the cable tool method for well construction on this site to increase the likelihood of intersecting the shallow limestone and/or intermediate limestone (karst) aquifers.

Table 2 presents a summary of test well compliance with the yield requirements of D-5-5, based on the results of the pumping tests.

Table 2: Well Test Data Summary

Well No.	Average Test Pumping Rate (L/s)	Percentage Available Drawdown Utilized for Test	Total Volume Pumped (L)	Water Found Elevation (masl)	Average Static Water Level Elevation (masl)	Compliance with D-5-5 (yield)
TW-1	0.68	4%	14,767	211.31	216.79	yes
TW-2	0.63	2%	13,781	209.59	218.16	yes
TW-3	0.88	3%	19,375	216.01	220.11	no*
TW-4	0.38	100%	251	215.89	218.52	no
TW-8	0.49	<1%	10,629	208.20	214.33	yes
TW-9	0.49	<1%	10,692	211.11	214.67	yes
TW-10	0.58	28%	13,080	211.23	216.39	yes

*TW-3 was successfully tested prior to the seasonal low water level period and was subsequently observed to lose connection to the supply aquifer. Therefore, this well would not comply with Procedure D-5-5.

Any test wells not meeting the yield requirements of Procedure D-5-5 should be abandoned in accordance with O. Reg. 903, as amended.

Given the age of the pre-existing test wells (TW-1 and TW-2) and lack of grouting indicated on the corresponding well record, it is anticipated that these wells will need to be inspected by a licensed well contractor before they can be utilized for potable supply. The well contractor should ensure that the well complies with O. Reg. 903, as amended prior to the well being put into use. In both cases, it is expected that the well will need to be upgraded. Alternatively, it may be beneficial and cost effective for the lot owner to

simply abandon and replace the existing well.

In addition, although the newly constructed test wells (TW-8, TW-9 and TW-10) were constructed in accordance with O. Reg. 903, the well records for each of these wells indicate that it was constructed as a "test hole". As a result, a well contractor should be contacted with regards to whether a new well record needs to be issued before these wells are put into service.

Given the various constraints and challenges associated with the target aquifer, it will likely be beneficial to implement a well testing program to ensure that all lots have a viable water supply.

6.9 Interference Assessment

Monitoring data obtained during the pumping tests indicate that domestic water takings within the proposed subdivision will likely create almost imperceptible drawdown interference effects in the closest neighbouring wells. During the pumping tests, possible measurable interference was noted in the test wells near the southern extent of the site (TW-2, TW-8 and TW-9). However, this magnitude of the interference (i.e., < 0.02 m) is similar to the accuracy range of the dataloggers and was (at times) imperceptible in the manual water level measurements. It is also possible that these potential effects resulted from water usage at neighbouring wells.

Although a datalogger was installed in the Warsaw Public School well (W-1) for the testing periods in 2018 and 2019, data obtained during the 2019 testing period was lost due to a equipment malfunction. Regardless, these data would have shown many regular on/off pump cycles typical of regular water usage at the Warsaw Public School, as illustrated by the data collected in the winter/spring of 2018 (Appendix H). Despite this comparatively high usage, mutual interference was not observed during our pumping tests (also at a comparatively high rate). These results further indicate that groundwater use within the proposed development will not cause significant interference with other wells in the area.

Notwithstanding the above, we can simulate the potential long-term interference effects among wells using a simple Cooper-Jacob approximation, based on the following expression:

$$s = (Q/4\,\Pi\,T)\ \ln\ (2.2459\ (Tt/r^2\ S))$$

where, s = projected drawdown at distance r (m)
Q = pumping rate (m^3/day)

T = transmissivity (m^2/day)
t = time (days)
r = radial distance (m)
S = storativity

In this instance we note that the pumping tests provide a range of T values ranging from a low of 58 m^2/day to a high of over 1,000 m^2/day. While it could be argued that a mid-point of say, 529 m^2/day could be a reasonable representation of the near-well conditions, we feel that a more conservative T value of 100 m^2/day would be appropriate in this setting, given the variability in water levels. A conservative S value of 1×10^{-4} would also be reasonably applicable in this environment, based on the observation well data and a similar range of values presented by Baedke and Krothe (2001).

By substituting the relevant coefficients into the above expression, the resultant projected drawdown at a radial distance of 30 m (i.e., assumed minimum well separation in development) is approximately 2.3 cm, after continuous pumping at 2,250 L/day for one year.[6] The assessment does not incorporate recharge, thus is highly conservative.

As drawdown is additive, interference effects from other subdivision wells will increase the total drawdown somewhat, however, at diminishing amounts according to the distance. As a worst case scenario, if all 12 future wells could theoretically cause a similar mutual interference effect, this would result in <30 cm drawdown, in this scenario. As such, the simulation results confirm that any mutual interference effects among future subdivision wells will be manageable and imperceptible to the average groundwater user.

7.0 Water Quality

Water quality samples were collected from each of the test wells at the approximate mid-point and just prior to the end of each pumping test. Samples were forwarded to Caduceon Environmental Laboratories in Ottawa/Kingston for chemical and bacteria analysis. In addition, field water quality measurements for pH, conductivity, temperature, total dissolved solids (TDS) and turbidity were taken periodically throughout the pumping tests. Additional water quality samples were collected from TW-1 and TW-2 using a low-flow sampling pump to establish the expected range of seasonal fluctuations in water quality parameters.

Appendix I presents a summary table of the water quality data from the current testing. Data from the 1990/1992 hydrogeological study have been included in the summary table, for comparison. The current laboratory certificates are also presented in Appendix I.

[6] Note: 1,000 L/day is typically the assumed average rate as per D-5-4 impact assessment.

Overall, water quality in all of the test wells is reasonably good and within the expected range of values for groundwater in the study area. All of the test wells meet the *health related* quality criteria of D-5-5 and the Ontario Drinking Water Quality Standards (ODWQS). This is consistent with the findings of the 1990/1992 hydrogeological studies, which found that all tested chemical and bacteriological parameters were within the required or desirable limits at that time.

All of the wells exhibit elevated hardness, occurring above the Ontario Drinking Water Standards (ODWQS) ideal range of 80 mg/L to 100 mg/L. Hardness is an aesthetic parameter and does not pose any threat to human health, however, at elevated concentrations could cause staining of fixtures. At the reported concentrations, the hardness is within the range considered reasonably treatable with a conventional water softener. Treatment to reduce hardness is not mandatory.

Nitrate (+nitrite) concentrations are low in all of the test wells, indicating no evidence of contamination by sewage systems or legacy effects of former agricultural uses. The baseline nitrate concentration in the target aquifer is approximately 0.75 mg/L, based on the average values from the most recent data for TW-1, TW-2, TW-3, TW-8, TW-9 and TW-10. The low (detectable) concentrations suggest that groundwater in the target aquifer is oxic.

Sodium occurs substantially below the ODWQS objective of 200 mg/L. However, most wells exhibit a sodium concentration over the warning level of 20 mg/L. The warning level refers to water with sodium levels exceeding 20 mg/L, where persons on sodium restricted diets should be advised to consult with their physician regarding water consumption.

Similar to sodium, the chloride concentration increases seasonally as the dilution effects of recharge move through the karst aquifer and the wells become more reliant on deeper groundwater. Despite the seasonal variations, the concentration of sodium and chloride remained lower than the respective ODWQS limits. During the pumping tests, these concentrations were relatively stable throughout the testing period, suggesting that pumping the wells has no effect on the concentration of these parameters.

Sulphate and sulphide concentrations are low in the target aquifer, in comparison to the elevated concentrations in the deeper aquifer. No significant H_2S odours or methane gas were detected during any of the pumping tests. These conditions are also confirmed by the laboratory H_2S data. Dissolved organic carbon (DOC) concentrations in all of the test wells are within the D-5-5 limit of 5.0 mg/L, indicating no significant effects related to surface water.

Iron and manganese concentrations are highly variable among the test wells and is variable seasonally. For example, iron at TW-1 is very low in September, whereas the concentration in June exceeds the aesthetic objective of 0.30 mg/L. In contrast, TW-10 exhibits high concentrations of total iron in September. When the iron and manganese

concentrations are elevated, they will likely form precipitates that can cause staining of fixtures and produce a slight bitter taste in the water. Iron precipitates can also contribute to turbidity and to water colour. This relationship is especially exhibited at TW-10 where the laboratory-reported turbidity is elevated. Turbidity measured in the field, however, was observed to be acceptable at the wellhead.

Based on the test data, it is likely that the iron concentration will be problematic at most wells in the proposed development, despite the seasonal variations. Elevated manganese concentrations may also be present at times. As iron and manganese are aesthetic parameters, the need for treatment will be determined on a lot-by-lot basis. Iron and manganese are generally treatable through a combination of aeration and filtration.

The total dissolved solids (TDS) concentration also exceeds the ODWQS aesthetic objective of 500 mg/L when the sodium, chloride, iron and manganese concentrations are elevated. It is expected that aeration and filtration to treat iron and manganese would also mitigate these effects.

Bacteriological samples were also collected during the pumping tests. Prior to sampling, an in-field test was conducted to verify the absence of residual chlorine. In some instances, aggressive chlorination of the well and re-sampling was needed to rule out elevated bacteria related to the supplied pumping equipment. Regardless, the laboratory results indicate acceptable bacteria counts for all of the test wells.

As illustrated by the compiled summary table in Appendix I, water quality reported for TW-1, TW-2 and TW-3 in the 1990/1992 study are in the expected range of variation observed in the most recent analyses, suggesting that the seasonal range of concentrations in key parameters (i.e., chloride, nitrate, iron, manganese, TDS and DOC) is predicable and relatively stable long-term. For example, water quality analysis in May 1990 appears to reasonably correlate with the water quality analysis completed on TW-1 in July 2018. The only deviation may be slightly higher sodium and chloride concentrations, which could be influenced by long-term application of road salt, given TW-1's proximity to County Road 4.

Despite the seasonal variations in certain water quality parameters, the groundwater quality representing the target karst aquifer at the site is generally good and satisfies the requirements of MOE Procedure D-5-5. Furthermore, the expected range of concentrations of key parameters is predictable and relatively stable long-term.

8.0 Impact Assessment

8.1 Historical Perspective

It is apparent that the 1990/1992 hydrogeological study was accepted by MOE, following

an exhaustive review process in regards to a nitrate impact assessment based on guidelines which pre-dated Procedure D-5-4. Based on our review of the 1990/1992 study, it appears that the MOE's principal concerns at that time related to the impact assessment and lot density, rather than water supply. Through their review, the hydrogeological study eventually supported 18 residential lots on the then larger site, incorporating a reduction from the originally proposed 24. Ultimately, the Draft Plan appears to have been approved based on 18 residential lots.

The various factors considered during MOE's early 1990s review are similar to those which we would include in a D-5-4 compliant nitrate impact assessment, if prepared today. Notwithstanding, there are some differences with respect to the calculation methodology and some of the input parameters. Most importantly, the development now consists of 12 lots and no longer includes any waterfront. Therefore, a recalculation of the impact assessment has been conducted as part of this update to reflect the currently proposed density. The calculations are outlined in the following sections.

8.2 Methodology

The principal impact of the proposed development on groundwater resources is related to the introduction of septic effluent into the shallow flow zone from the proposed tile bed systems.

Within the effluent, nitrate is considered the critical contaminant as elevated nitrate concentrations are linked to infant methaemoglobinaemia (nitrate poisoning). To protect groundwater resources, the MOE's Procedure D-5-4 sets the maximum allowable nitrate concentration at the site boundary to be 10 mg/L (also the Ontario Drinking Water Quality Standard). The nitrate impact assessment is therefore conducted to verify that this limit is not exceeded.

Naturally occurring bacteria and soil interaction mechanisms can, and usually do result in nitrate being renovated. However, Procedure D-5-4 acknowledges ***dilution*** as the principal attenuation mechanism[7] to be used to predict future nitrate concentrations as a result of subdivision development.

8.3 Development Area Available Dilution

The total available on-site dilution is estimated by evaluating the following expression:

[7] Procedure D-5-4 also acknowledges monitoring-based assessments and other specialized assessment forms, primarily for use in areas where there is scientific precedent.

$$D_w = A \times W_s \times I_f,$$

where,

D_w= Available dilution water — A = Net contributing area
W_s= Water surplus — I_f = Infiltration factor[8]

Based on the soils data from the 1990/1992 hydrogeological study, as confirmed by our own explorations, we note that the site is dominated by a thick substrate of Dummer Till. Although variable, the Dummer Till is mostly comprised of a silty sand and would be classified as an SM type soil, according to the Unified Soil Classification system. Thus, the theoretical percolation rate would be in the range of 8 min/cm to 20 min/cm, based on Table 2 of the Supplementary Guide to the 1997 Ontario Building Code (Code and Guide for Sewage Systems).

Therefore, I_f is estimated from the following:

Soil factor	=	0.28 (silty sand)
Slope factor	=	0.10 (gently sloping terrain)
Cover factor	=	0.15 (post-development grass and tree covering)
Infiltration factor	=	0.53 (combination of above)

The average precipitation rate for the closest meteorological station (Peterborough at Trent University, 1981 to 2010 norms, Appendix J) is 882.1 mm/yr. From those data, the Thornthwaite adjusted potential evapotranspiration rate is 590 mm/yr, yielding a theoretical Water Surplus (W_s) of 292.1 mm/yr. By applying the above infiltration factor (I_f) to the water surplus value, the net infiltration rate is 155 mm/yr.

In comparison to Table 3, Chapter 4 of the manual "MOEE Hydrogeological Technical Information Requirements for Land Development Applications" (1995), our estimated infiltration appears overly conservative, as silty sand soils typically have infiltration rates in the range 150 mm/yr to 200 mm/yr.

It is important to note that the infiltration rates recommended by the consultant in the 1990/1992 hydrogeological study ranged from 150 mm/yr to 200 mm/yr (mean = 175 mm/yr), varying from place to place on the site. Those values were also consistent with the typical range values outlined in the 1995 MOEE manual. It appears this methodology was accepted by the MOE at the time. As such, our conservative estimate of 155 mm/yr is considered reasonable.

[8] Infiltration factor calculation method: From MOEE Hydrogeological Technical Information Requirements for Land Development Applications, April 1995

Our estimated dilution availability is, therefore:

Total development area	=	11.78 ha
Less	-	1.28 ha (allowance for road, driveways and other impermeable surfaces)
Effective area	=	10.5 ha
Infiltration rate	=	0.155 m/yr
Total dilution	=	16,275 m^3/yr (44.6 m^3/day)

8.4 Impact Evaluation

8.4.1 Septic Effluent

It is reasonable to anticipate that each of the proposed development lots will generate an average discharge of 1,000 L/day of septic effluent, as indicated by D-5-4. Previous studies by the MOE have indicated that septic effluent migrating from residential sewage disposal systems may be expected to contain an average concentration of 40 mg/L nitrate. This is equivalent to a nitrate (as N-Nitrogen) input of $40\ g/day$.

8.4.2 Background Nitrate Concentrations

As outlined previously, the baseline nitrate concentration in the shallow receiving zone was established to be 0.71 mg/L based on the 1990/1992 hydrogeological study and subsequent correspondence with the MOE. As the area has not experienced a boom of new development nor have there been increased agricultural activity in the area, this assumption seems reasonable. Notwithstanding, we have assumed the background concentration to be 1.0 mg/L, as a conservative approach.

The assessment also needs to consider the baseline nitrate concentration in the supply aquifer. Based on the most recent data representing TW-1, TW-2, TW-3, TW-8, TW-9 and TW-10 (see summary table in Appendix I), the average nitrate concentration is estimated to be 0.75 mg/L.

8.4.3 Residential Use Assessment

For this type of assessment, lot density is determined through a simple mass-balance calculation which considers the following factors:

- available dilution (44.6 m^3/day)
- total volume of septic effluent (1,000 L/day/lot)
- background nitrate concentration in receiving groundwater zone (1 mg/L)*
- baseline nitrate concentration in supply aquifer (0.75 mg/L)*
- nitrate input from septic systems (40 g/day)
- maximum allowable nitrate concentration (10 mg/L less background = 9.0 mg/L)

  * see discussion in previous section

For purposes of determining the maximum number of supportable privately serviced lots (septic systems) for the site, the following equation is evaluated, based on the total dilution availability:

$$[\text{Nitrate}] = \frac{(\text{septic input } NO_3 + \text{supply aquifer input } NO_3) \bullet \text{No. of Lots}}{\text{available dilution + volume of septic effluent}}$$

Thus,

$$\frac{(40 \text{ g/day} + 0.75 \text{ g/day}) \bullet 12 \text{ lots}}{44.6 \text{ m}^3\text{/day} + 12 \text{ m}^3\text{/day}}$$

$$= 8.64 \text{ mg/L} (< 9.0 \text{ mg/L})$$

Our assessment is also based on conventional sewage systems (without denitrification) and dilution as the only nitrate attenuation mechanism. Based on the above analysis (utilizing current MOE guidelines), it is clear that the site can sustain the currently proposed 12 lots.

9.0 Servicing Considerations

9.1 General

Figure 18 (Conceptual Servicing Plan) illustrates the proposed/recommended locations for future private wells and sewage systems within the proposed residential development. The plan is conceptual in nature and assumes the need for worst-case scenario (i.e., fully-raised) sewage disposal beds.

The recommended conceptual residential servicing arrangements have been determined partly on the basis of maximizing separation distances between wells and sewage systems, the juxtaposition of services and building envelopes, and by having regard for sensitive environmental features on the site. Figure 18 is intended to illustrate that the proposed services are viable on each lot. Other arrangements may also be viable, based on a lot-by-lot assessment.

9.2 Private Wells

The results of this study support the construction and sustainable use of private, individual wells to supply potable water for each of the subdivision lots. Although the conditions may be challenging for some lots, our study has demonstrated that wells constructed in the southern portion of the site should be able to obtain a sufficient quantity of acceptable quality groundwater. Five (5) test wells were subjected to and successfully tested in accordance with MOE Procedure D-5-5. In addition, although long-term monitoring showed seasonal variability in water levels and water quality, these fluctuations appear to occur within acceptable ranges.

The target aquifers for drilled well construction in the proposed subdivision are the Basal/Shallow Limestone Aquifer and the Intermediate/Karst Aquifer. The expected average depth for those wells is approximately 12 m below ground level. While a deeper aquifer occurs on the site within the Shadow Lake Formation limestone and shale, this characteristically pink/purple and/or green bedrock should be avoided during well construction to prevent the intrusion of saline water into the supply aquifer. Dug/bored wells are not suitable for the proposed development.

It is anticipated that future wells that encounter groundwater at or below the approximate elevation of Quarry Lake (i.e., 214 masl) will be sustainable during drought conditions. Water level monitoring during a *Level II Low Water Advisory* in the summer of 2018 verified that groundwater levels in wells utilizing the main aquifer will eventually reach an equilibrium at an acceptable level. This is also evident at the Warsaw Public School, where W-1 has never run dry, despite its comparatively high usage.

Prospective purchasers should be advised that water treatment to reduce hardness, iron and manganese may be desirable, especially in the late summer/early fall periods. The need for treatment should be assessed on a lot-by-lot basis. It may be necessary to consult with a qualified water treatment specialist with respect to the best system to meet the specific conditions at each lot. Recommendations regarding water supply wells for the development are provided in a following section.

9.3 Private Sewage Systems

The results of this study support the construction and sustainable use of individual sewage systems for each of the (residential) subdivision lots. The example tile bed systems illustrated on Figure 18 are presented as fully raised, conventional bed systems to demonstrate that the worst-case scenario is viable for all proposed lots. It is anticipated that in-ground systems may be applicable on most lots, given the relatively thick sandy till that dominates the site. The shallow water table should not be a significant factor at this site. Although karst features are present in the area, no karst hazards, that could affect sewage systems, are evident within the development site.

As a conservative measure, the bed systems illustrated on Figure 18 are based on a flow rate of 3,000 L/day, substantially exceeding the expected flows.

Recommendations with regard to construction of private sewage systems are provided in the following section.

10.0 Conclusions and Recommendations

10.1 This Hydrogeological and Site Servicing Study has been prepared in support of a proposed residential development within the Hamlet of Warsaw, Ontario. Although a development had been historically approved by the Ministry of the Environment, Conservation and Parks (MOE) in the 1990's, the proposed development application has been updated to meet current guidelines and standards.

The primary objectives of our report are to present a summary of the site conditions, provide an evaluation of groundwater supply potential and present an impact assessment to verify the sustainability of privately serviced lots while complying with MOE Procedures D-5-4 and D-5-5.

10.2 Despite variable groundwater conditions on the site, our study demonstrates that the proposed 12 lot subdivision will have a reliable source of acceptable quality groundwater. Although two potentially suitable aquifers are present, potential lot purchasers should be made aware that more than one (1) attempt may be required to construct a well on this site.

10.3 Three (3) drilled wells were historically constructed on the subject property as part of a previous hydrogeological assessment. During the current study, seven (7) new test holes were drilled. Of those, five (5) test wells were successfully tested in accordance with MOE Procedure D-5-5, complying with the yield and water quality criteria requirements.

Based on the test well data, it is clear that an ample supply of acceptable quality groundwater can be obtained from individual drilled wells tapping the Basal Overburden/Upper Limestone Bedrock Aquifer and/or the Intermediate Limestone/Karst Aquifer on the site. These aquifers should be considered the “target aquifers” for all future wells in this development. A deeper bedrock aquifer within the limestone and shale of the Shadow Lake Formation occurs on the property, however, is for all intents and purposes non-potable. Well contractors should be made aware of this and be instructed to drill no further than 10 m below the top of the bedrock sequence.

If the drilling contractor encounters limestone and shale that appears to be pink, purple and/or green in colour, the well should be abandoned immediately in accordance with

O.Reg. 903, as amended.

Dug wells are <u>not</u> appropriate future water sources for this development.

10.4 Long-term water level and water quality monitoring was completed on select test wells to determine the range of variability in the Intermediate Limestone/Karst Aquifer. In general, water levels were found the fluctuate by as much as 6 m. However, as indicated by the monitoring hydrographs, water levels in wells completed in this aquifer eventually stabilize at a predictable elevation above Quarry Lake.

10.5 The test well water quality data indicate moderately hard water will likely be encountered at most lots. Conventional water softener systems will be capable of ameliorating this condition. Given the expected need for water softening, for all proposed lots, the following notification and warning shall be registered on title in accordance with MOE Procedure D-5-5:

> *"If a water softening system is to be utilized to reduce hardness, a separate tap (which by-passes the softener) must be installed to supply unsoftened drinking water."*

Since each new well is likely to exhibit somewhat different quality conditions, prospective purchasers may need to consult with a water treatment expert to determine the best approach for their individual needs. Treatment to reduce aesthetic parameters (i.e., hardness, iron and manganese) is not mandatory, but will likely be desirable in most instances.

10.6 Although all of the test wells have sodium concentrations below the ODWQS limit of 200 mg/L, the sodium concentration was shown to consistently exceed the warning limit of 20 mg/L. Normally, this is not a significant issue. Notwithstanding, the persons on sodium restricted diets and the local Medical Officer of Health should be made aware of the potential for wells in the proposed subdivision to encounter groundwater with sodium concentrations exceeding the warning limit of 20 mg/L.

10.7 Our study has revealed that water quality can vary seasonally in the Intermediate Limestone/Karst Aquifer. Chloride, sodium, iron and manganese concentrations were all observed to increase during the low water level period (in late summer/early fall). This would also increase the concentration of total dissolved solids (TDS). Despite the increased concentrations, only iron, manganese and TDS were shown to exceed the Ontario Drinking Water Quality Standards (ODWQS) aesthetic objective. Therefore, the water quality variations are expected to be manageable with conventional treatment to

reduce the concentrations of these parameters.

10.8 All of the tested wells demonstrated 0 cfu/100 mL Total Coliform and 0 cfu/100 mL through initial sampling or following chlorination and re-sampling. However, as the aquifer appears to respond rapidly to recharge and as indicated by neighbouring well owners, bacteria may occur in the raw water supply from time-to-time. As a result, it is recommended that primary disinfection using ultra violet light treatment systems be utilized at each lot within the proposed development.

Each future well owner should have their treated water tested regularly to verify potable conditions persist.

10.9 Based on the test well data, interference effects among or between future subdivision wells and existing nearby wells are expected to be minimal and are likely to be imperceptible to the average well owner.

10.10 Since TW-3 and TW-4 are unable to maintain a connection to the main aquifer, it is recommended that these wells be abandoned in accordance with Ontario Regulation 903 (O. Reg. 903), as amended.

All of the test wells on the site were constructed as "test holes" under O. Reg. 903. As a result, each of the wells should be inspected by a licenced well contractor prior to being utilized for domestic use. The well contractor should ensure that the well is constructed in accordance with the current well regulations and upgrade or abandon any wells not meeting the standards. The well contractor may also need to issue a new well record for the well indicating the change in use.

It is anticipated that TW-1 and TW-2 will need to be upgraded or abandoned and replaced due to the age of the wells and lack of grouting information on the well record.

10.11 As a result of the variable groundwater conditions at the subject site, we are recommending that a limited *Well Certification Program* be implemented at this site. The program will require that prior to issuance of a building permit, a well be constructed under the supervision of, and tested by, a Qualified Person (P. Geo. or P. Eng.) who will certify in writing that a drilled well has been constructed, meeting the minimum construction, water demand and water quality requirements as set forth herein. The well "certification report" shall be submitted to the municipality as part of the Building Permit application. The requirements of the Program are outlined in Appendix K.

As a general guide, unless the Qualified Person recommends otherwise, new drilled wells

should be constructed at the locations illustrated on the accompanying Conceptual Servicing Plan, Figure 18. Other configurations may be possible, however, the Qualified Person should attempt to maximize the separation distance between the well location and sewage systems within the development.

Notwithstanding the contents of this report, well certification reports will be required for future owners of the existing test wells (i.e., TW-1, TW-2, TW-8, TW-9 and TW-10), as they may benefit from the recommendations provided for their respective water supply. Alternatively, the well owner may prefer to have the test well properly abandoned and replaced with a newly constructed well.

10.12 Based on the nitrate impact assessment presented herein, the site can support the proposed development consisting of twelve (12) residential lots, while complying fully with current MOE guidelines.

10.13 Shallow soil conditions are reasonably consistent across the site, consisting primarily of a variable silty sand till of the Dummer Complex. Percolation rates in the silty sand are expected to be moderate, in the range 8 min/cm to 20 min/cm, varying from lot to lot. As such, fully in-ground tile bed systems should be acceptable at most lots. However, at those lots where a seasonal "perched" water table is encountered, a raised bed system may be necessary.

10.14 Locations for future building envelopes, private drilled wells and conventional tile bed systems are illustrated on the Conceptual Servicing Plan (Figure 18). The intent of Figure 18 is to illustrate that conventional servicing is viable on all lots.

Figure 18 illustrates bed systems that are fully raised, to demonstrate that the worst-case scenario is viable. Given the generally large lot sizes, ample space is available on each lot for the required services and dwellings.

Based on the native soil and shallow groundwater conditions, each lot will need to be assessed individually at the time of application for approval of a private sewage system in conjunction with the approval authority. The design of each system should be assessed in accordance with the requirements of the Ontario Building Code.

10.15 The feasibility of open loop heat pump systems at this site has not been assessed and is not recommended. Any such heat pump installations should only be considered if a Qualified Person (P. Geo. or P. Eng.) has determined that such systems can be utilized without compromising groundwater availability and quality.

10.16 It is recommended that prospective purchasers be provided with a copy of this hydrogeological report and all pertinent supporting information, including agency technical reviews, so that they can be made aware of the local conditions and the details and/or limitations of the work completed.

* end of report *

Oakridge Environmental Limited

ORIGINAL SIGNED BY

Dan MacIntyre, BSc.
Project Manager

ORIGINAL SIGNED BY

Brian R. King, P. Geo.
Principal

Selected References

Asante, Joseph et al, *"Water Circulation in Karst Systems: Comparing Physiochemical and Environmental Isotopic Data Interpretation"*. Environmental Earth Sciences, Springer-Verlag GmbH, Germany, 2018.

Baedke, S.J. and Krothe, N.C., *"Derivation of Effective Hydraulic Parameters of a Karst Aquifer from Discharge Hydrograph Analysis"*. Water Resources Research, Vol. 37, No. 1, p. 13-19, January 2001.

Barnett, P.J., *"Quaternary Geology of Ontario" in* Geology of Ontario, Ontario Geological Survey, Special Volume 4 (Part 2), Ministry of Northern Development and Mines, 1992.

Bonacci, Ognjen, "*Karst Hydrology*". Springer Series in Physical Environment. Springer-Verlag GmbH, Germany, 1987.

Brennand, Tracy A., and John Shaw, "*Tunnel Channels and Associated Landforms, South-central Ontario: Their Implications for Ice-sheet Hydrology*". Canadian Journal of Earth Sciences 31 (1994): 505-22.

Brunton, F.R. and Dodge, J.E.P., *"Karst of Southern Ontario and Manitoulin Island"*. Ontario Geological Survey, Groundwater Resources Study 5, 2008.

Canada Department of Transport, *"Average Annual Climatic Water Surplus for Stations in Ontario"*; Table 8 - Climatological Studies No. 9, Climatology Division, Meteorological Branch, 1967 (pub).

Carson, D.M., *"Paleozoic Geology of the Burleigh Falls - Peterborough Area";* District of Southern Ontario; Ontario Geological Survey Preliminary Map P. 2337; Geology: 1979. Geological Series, Scale: 1:50 000, 1980.

Carson, D.M., *"Preliminary Report on the Paleozoic Geology of the Peterborough-Campbellford Area, Southern Ontario";* OFR 5331, Ontario Geological Survey, 1981.

Chapman, L.J. & Putnam D.F., "*The Physiography of Southern Ontario"*; Map 2226, Ontario Department of Mines, 1984 (Rev).

Fetter, C.W., *"Applied Hydrogeology"*; 2nd Edition, Collier Macmillan Publishing Company, Toronto, 1988.

Freeze, R. A. & Cherry, J.A., *"Groundwater"*; Prentice-Hall Inc., New Jersey, 1979.

Gao, C. et al., *"Bedrock Topography and Overburden Thickness Mapping, Southern Ontario"*; Ontario Geological Survey, Miscellaneous Release - Data 207. 2006.

Gravenor, C.P., *"Surficial Geology of the Lindsay-Peterborough area, Ontario"*. Geological Survey of Canada, Memoir No. 288, p. 60. 1957.

Marich, A.S.; *Quaternary geology of the Lindsay and Peterborough Areas, Southern Ontario*. Ontario Geological Survey, Open File Report 6321, 59p. 2016.

Mihychuck, Maryann, *"The Surficial Geology, Sedimentology and Geochemistry of the Late Glacial Sediments and Paleozoic Bedrock in the Campbellford Area, Ontario, with Special Reference to the Dummer Complex"*. Thesis. Brock University, 1984.

Ontario Geological Survey; *Aggregate Resources Inventory of Dummer Township, Peterborough County, Southern Ontario*. Aggregate Resources Inventory, Paper 25. 1980.

Ontario Ministry of Environment and Energy - Technical Support Section, *"Hydrogeological Technical Information Requirements for Land Development Applications"*; April, 1995.

Ontario Ministry of Environment, *"Procedure D-5-4 Technical Guideline for Individual On-site Sewage Systems: Water Quality Impact Risk Assessment*; Last Revision August, 1996.

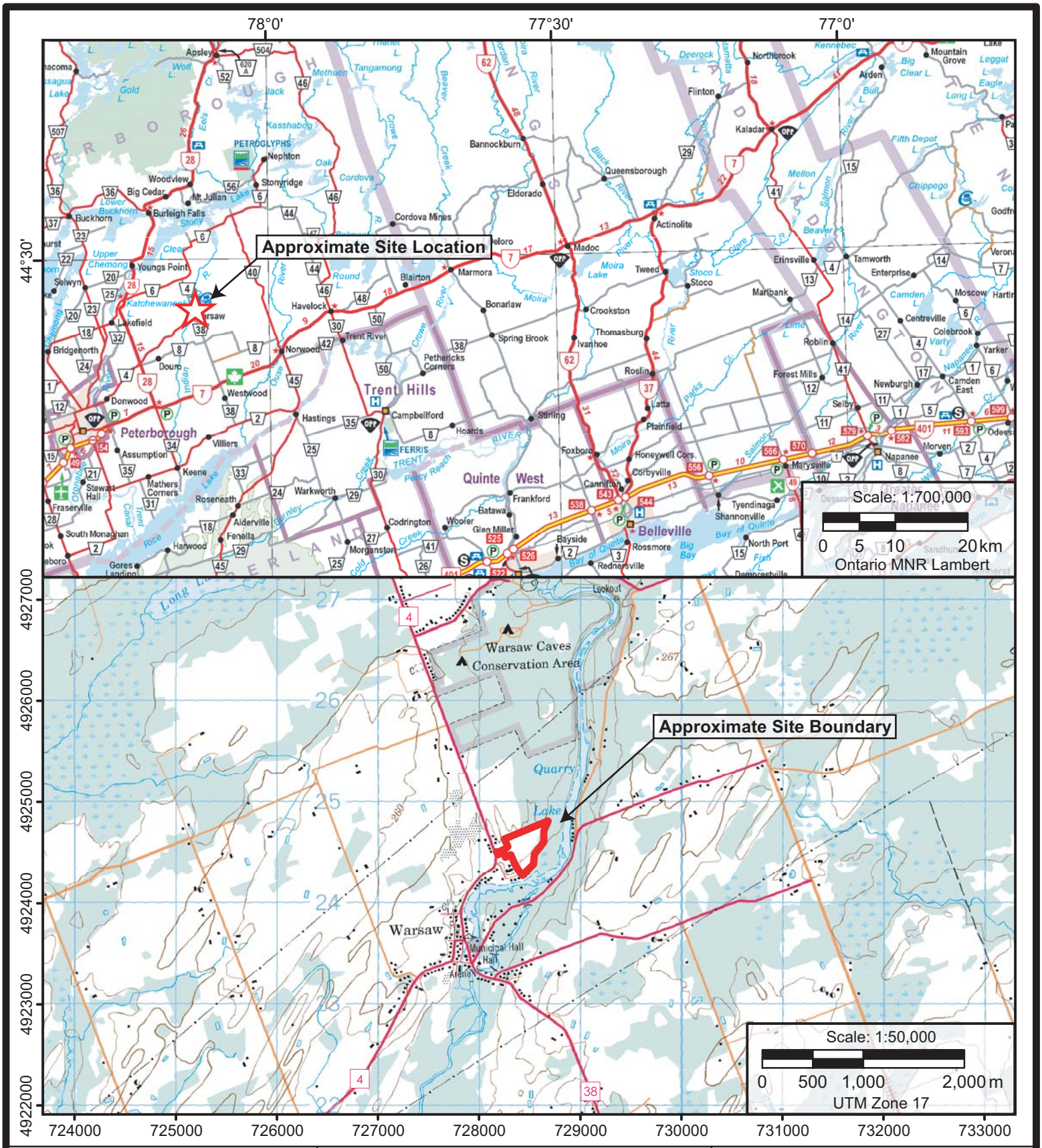
Ontario Ministry of Environment, *Procedure D-5-5 Technical Guideline for Private Wells: Water Supply Assessment*; Last Revision August, 1996.

Tagne, G. V., and C. Dowling; *Inferring Groundwater Flow and Recharge from Time Series Analysis of Storm Responses in a Karst Aquifer of Southeastern Kentucky (USA).* Hydrogeology Journal, 6 Aug. 2018, doi.org/10.1007/s10040-018-1837-8.

Williams, L.D.; *A Guide to the Geology of Warsaw Caves Conservation Area*. July, 1974.

Wolf, R.R.; *An Inventory of Inactive Quarries in the Paleozoic Limestone and Dolostone Strata of Ontario*. Ontario Geological Survey, Open File Report 5863, 272p. 1993.

FIGURES



N

Hydrogeological and Site Servicing Study
Proposed Warsaw Residential Subdivision

Part of Lot 13, Concession 2 (Dummer)
Township of Douro-Dummer, County of Peterborough

North American Datum 1983

TITLE
General Location

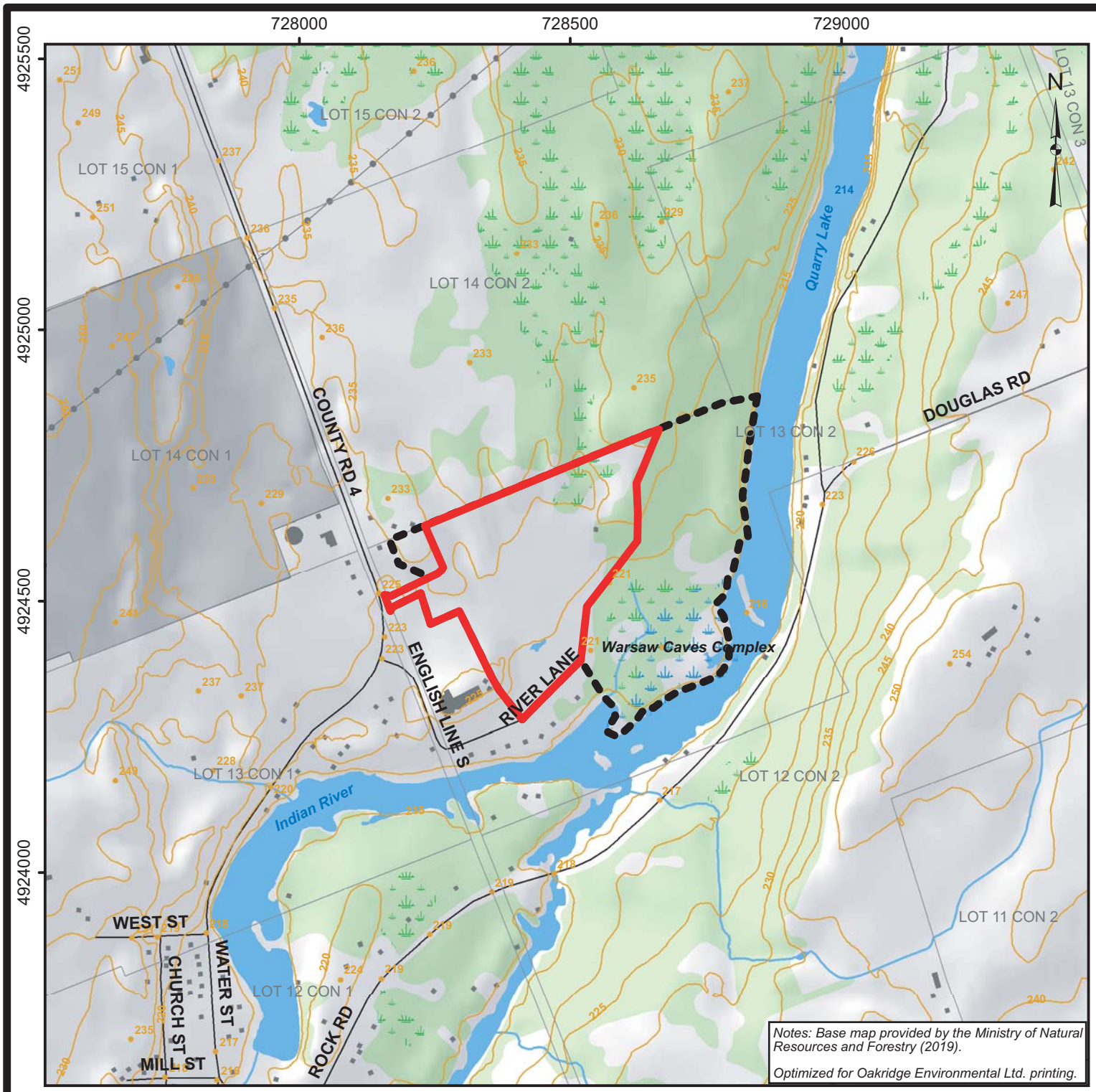
Notes: Base maps from the Official Road Map of Ontario, Ministry of Transportation (2018), and National Topographic System map 31/D-8, Natural Resources Canada (1999).
Optimized for Oakridge Environmental Ltd. printing.

ORE Oakridge Environmental Ltd.
Environmental and Hydrogeological Services

PROJECT # 17-2326

DATE September 2020

FIGURE NO. 1



North American Datum 1983 UTM Zone 17

Hydrogeological and Site Servicing Study
Proposed Warsaw
Residential Subdivision
Part of Lot 13, Concession 2 (Dummer)
Township of Douro-Dummer,
County of Peterborough

LEGEND

- Approximate Site Boundary
- Approximate Property Boundary
- Wetland
- Provincially Significant Wetland
- Watercourse
- Waterbody
- Wooded Area
- Spot Height
- Contour
- Building (symbol; to scale)
- Utility Line
- Road
- Active Aggregate Site
- Lot Fabric

Scale: 1:10,000

0 100 200 400 m

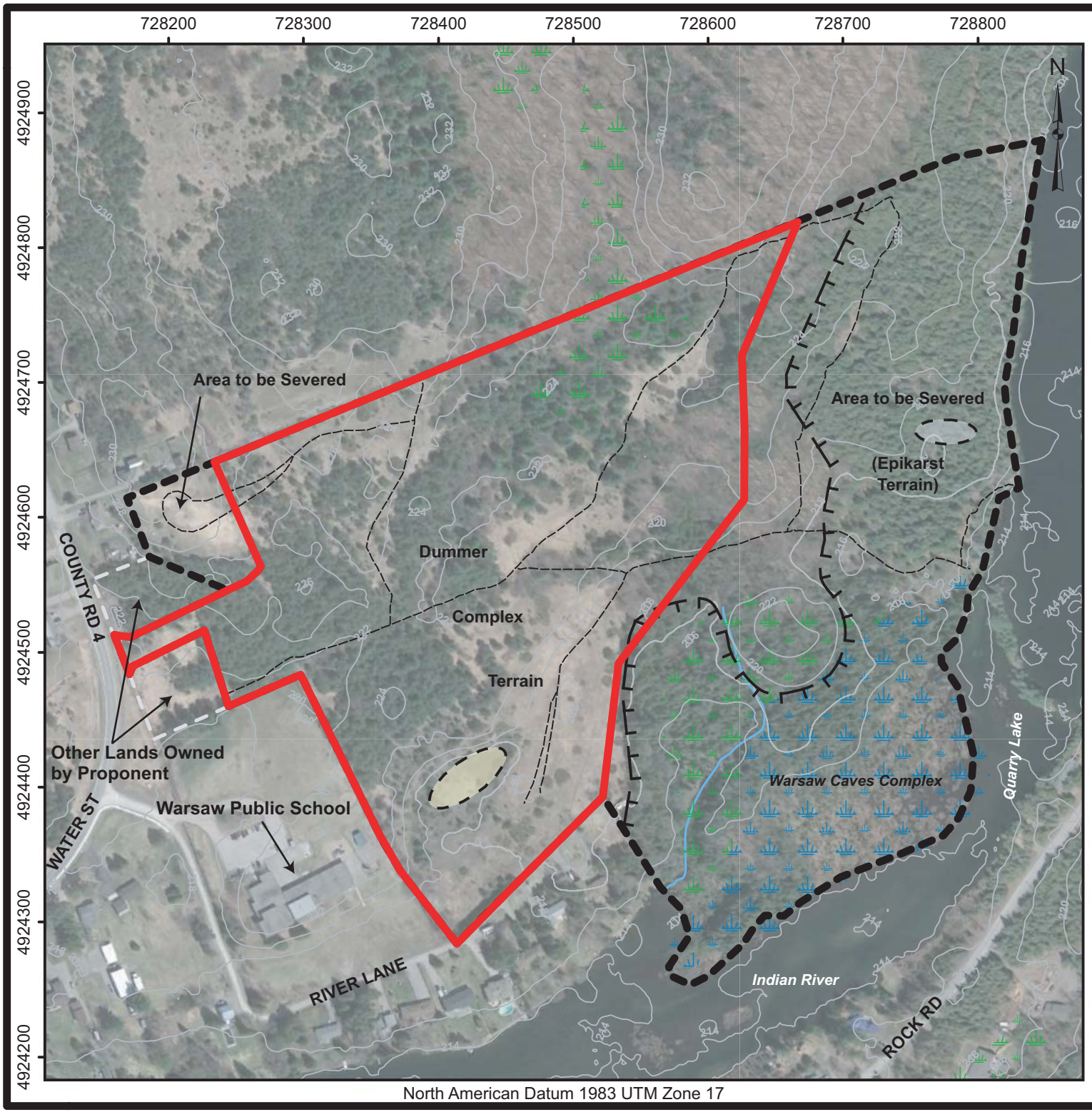
Contour Interval: 5 m
Elevations in m asl

TITLE

Topography and Drainage

ORE Oakridge Environmental Ltd.
Environmental and Hydrogeological Services

PROJECT #	FIGURE NO.
17-2326	2
DATE: September 2020	



North American Datum 1983 UTM Zone 17

Hydrogeological and Site Servicing Study
Proposed Warsaw
Residential Subdivision
Part of Lot 13, Concession 2 (Dummer)
Township of Douro-Dummer,
County of Peterborough

LEGEND

- Approximate Site Boundary
- Approximate Property Boundary
- Approximate Historical Quarry / Potential Doline
- Approximate Historical Pit
- Approximate Limit of Dummer Complex Terrain
- Wetland (MNRF)
- Provincially Significant Wetland (MNRF)
- Watercourse (MNRF)
- Topographic Contour (SCOOP)
- Existing Trail

Scale: 1:4,000

0 50 100 200 m

Contour Interval: 2 m
Elevations in m asl

Notes: Base map provided by the Ministry of Natural Resources and Forestry (MNRF, 2019).

Topographic contours derived from the South Central Ontario Orthophotography Project (SCOOP), Ministry of Natural Resources and Forestry (2013).

Imagery provided by Google Earth, DigitalGlobe (2017).

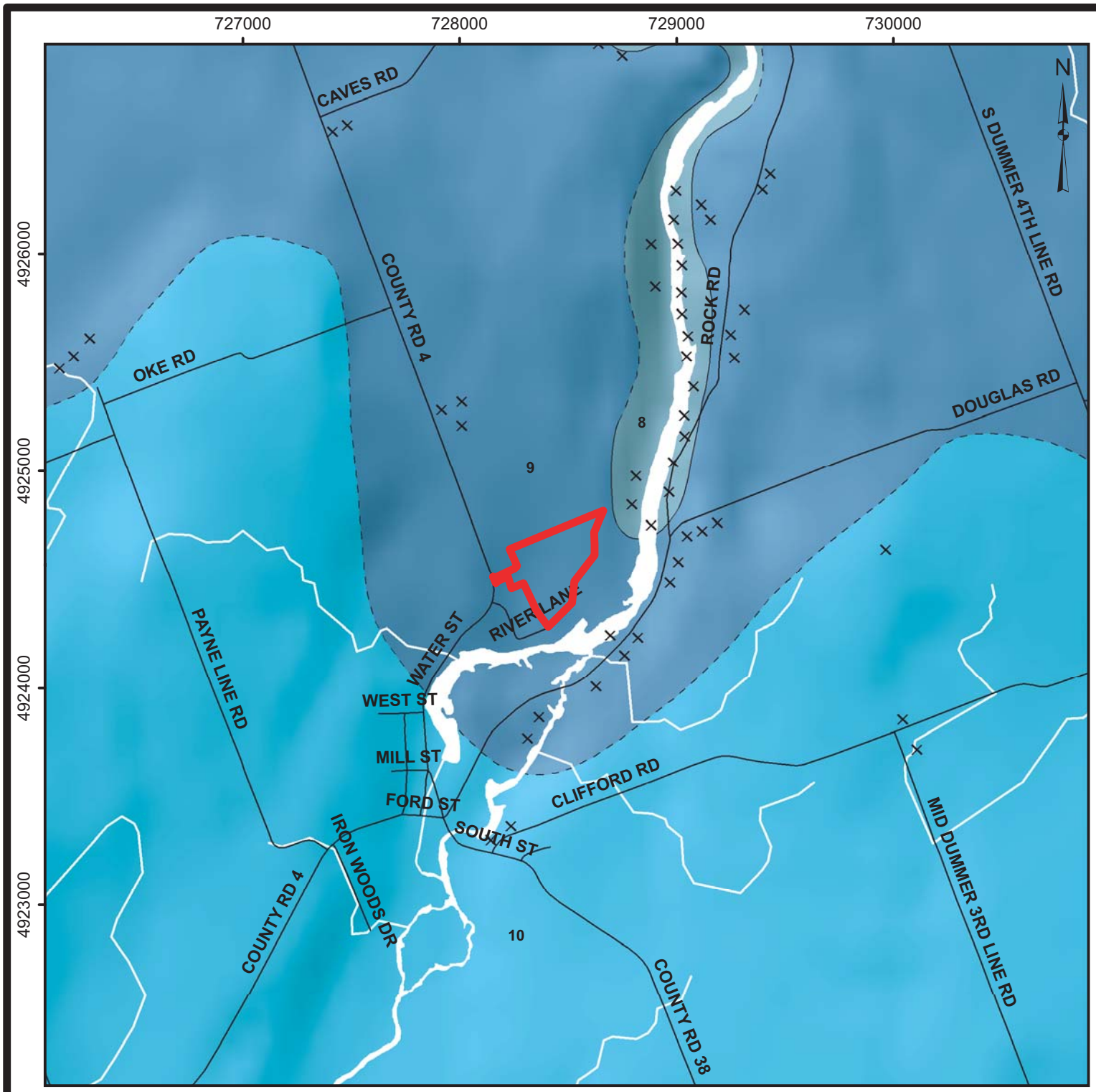
Optimized for Oakridge Environmental Ltd. printing.

TITLE

Site Features

ORE Oakridge Environmental Ltd.
Environmental and Hydrogeological Services

PROJECT #	FIGURE NO.
17-2326	3
DATE: September 2020	



North American Datum 1983 UTM Zone 17

Hydrogeological and Site Servicing Study
Proposed Warsaw
Residential Subdivision
Part of Lot 13, Concession 2 (Dummer)
Township of Douro-Dummer,
County of Peterborough

LEGEND

- Approximate Site Boundary
- × Outcrop
- Contact (approximate)
- Contact (observed)
- 10 Verulam Formation
- 9 Bobcaygeon Formation
- 8 Gull River Formation

Scale: 1:25,000

0 250 500 1,000 m

Notes: Geology from Paleozoic Geology of Southern Ontario, Armstrong, D.K. and Dodge, J.E.P. (2007). Copyright the Queen's Printer for Ontario.

Base map provided by the Ministry of Natural Resources and Forestry (2019).

Optimized for Oakridge Environmental Ltd. printing.

TITLE

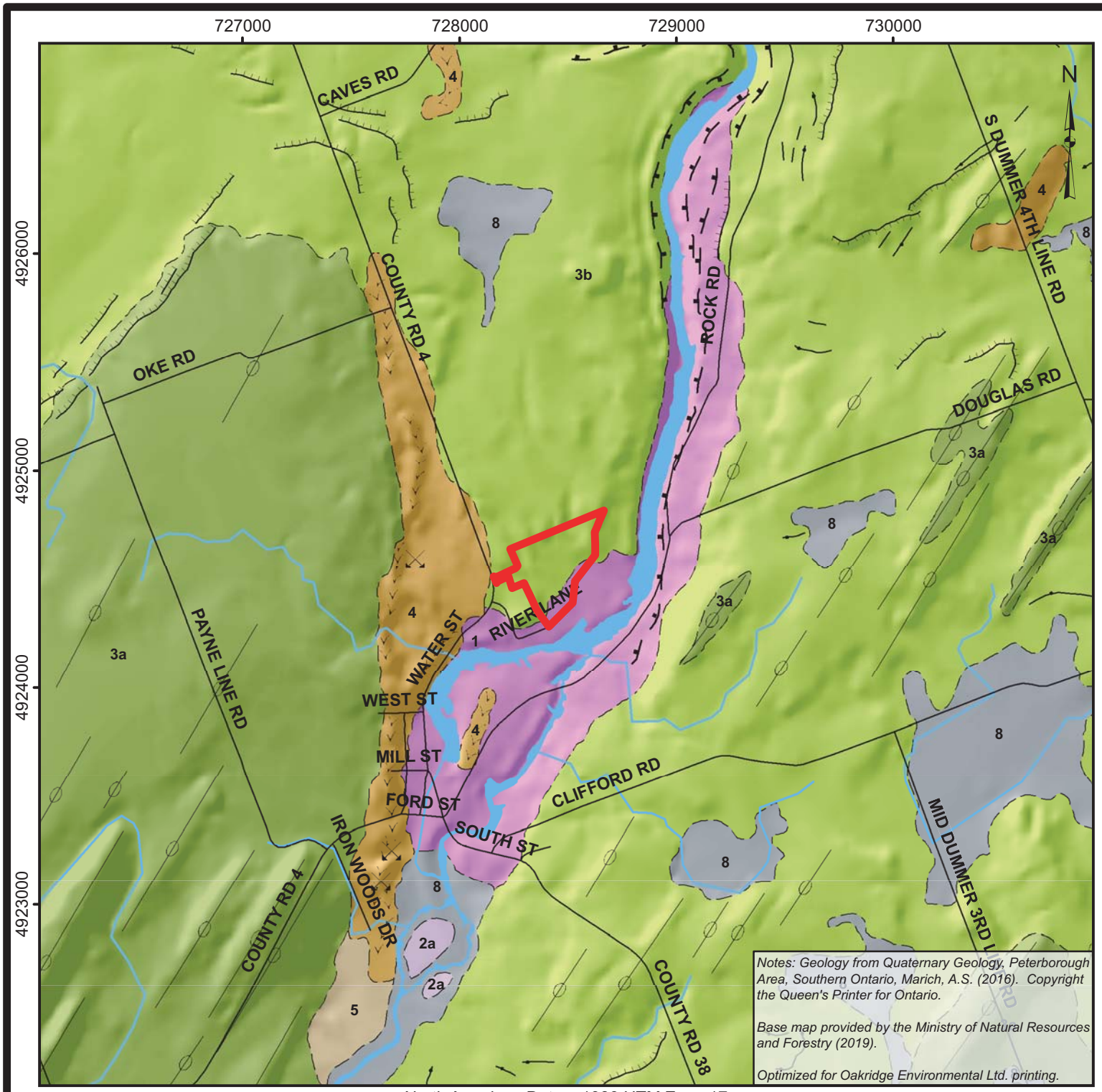
Bedrock Geology

ORE Oakridge Environmental Ltd.
Environmental and Hydrogeological Services

PROJECT #	FIGURE NO.
17-2326	4
DATE: September 2020	

Hydrogeological and Site Servicing Study
Proposed Warsaw
Residential Subdivision

Part of Lot 13, Concession 2 (Dummer)
Township of Douro-Dummer,
County of Peterborough



Notes: Geology from Quaternary Geology, Peterborough Area, Southern Ontario, Marich, A.S. (2016). Copyright the Queen's Printer for Ontario.

Base map provided by the Ministry of Natural Resources and Forestry (2019).

Optimized for Oakridge Environmental Ltd. printing.

North American Datum 1983 UTM Zone 17

LEGEND

- Approximate Site Boundary
- Sand and Gravel Pit
- Drumlin
- Bedrock Escarpment
- Esker (direction of flow known)
- Minor Moraine
- Terrace
- Geological Contact (approximate)
- 1 Bedrock
- 2 Bedrock–Drift Complex
  2a Mainly till veneer

3 Till

- 3a Newmarket till
- 3b Dumer till
- 4 Ice-contact Stratified Deposits
- 5 Glaciofluvial Outwash Deposits
- 8 Organic and Swamp Deposits

Scale: 1:25,000

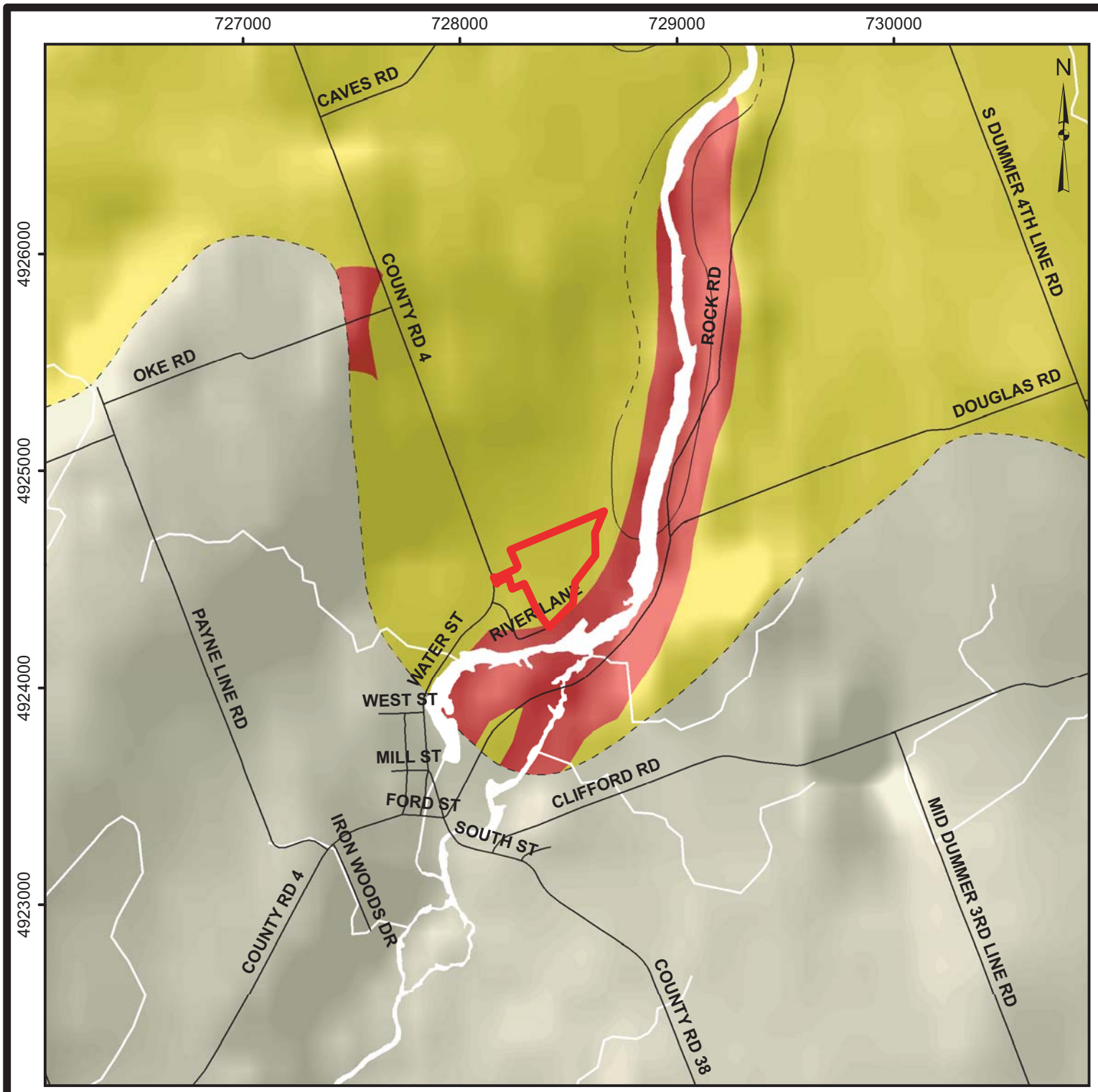
0 250 500 1,000 m

TITLE

Surficial Geology

ORE Oakridge Environmental Ltd.
Environmental and Hydrogeological Services

PROJECT #	FIGURE NO.
17-2326	**5**
DATE: September 2020	



North American Datum 1983 UTM Zone 17

Hydrogeological and Site Servicing Study
Proposed Warsaw
Residential Subdivision

Part of Lot 13, Concession 2 (Dummer)
Township of Douro-Dummer,
County of Peterborough

LEGEND

- Approximate Site Boundary
- Contact (approximate)
- Contact (observed)
- Known Karst
- Potential Karst
- Unknown / No Observed Evidence of Karstification

Scale: 1:25,000

0 250 500 1,000 m

Notes: Geology from Karst of Southern Ontario and Manitoulin Island, Brunton, F.R. and Dodge, J.E.P. (2008). Copyright the Queen's Printer for Ontario.

Base map provided by the Ministry of Natural Resources and Forestry (2019).

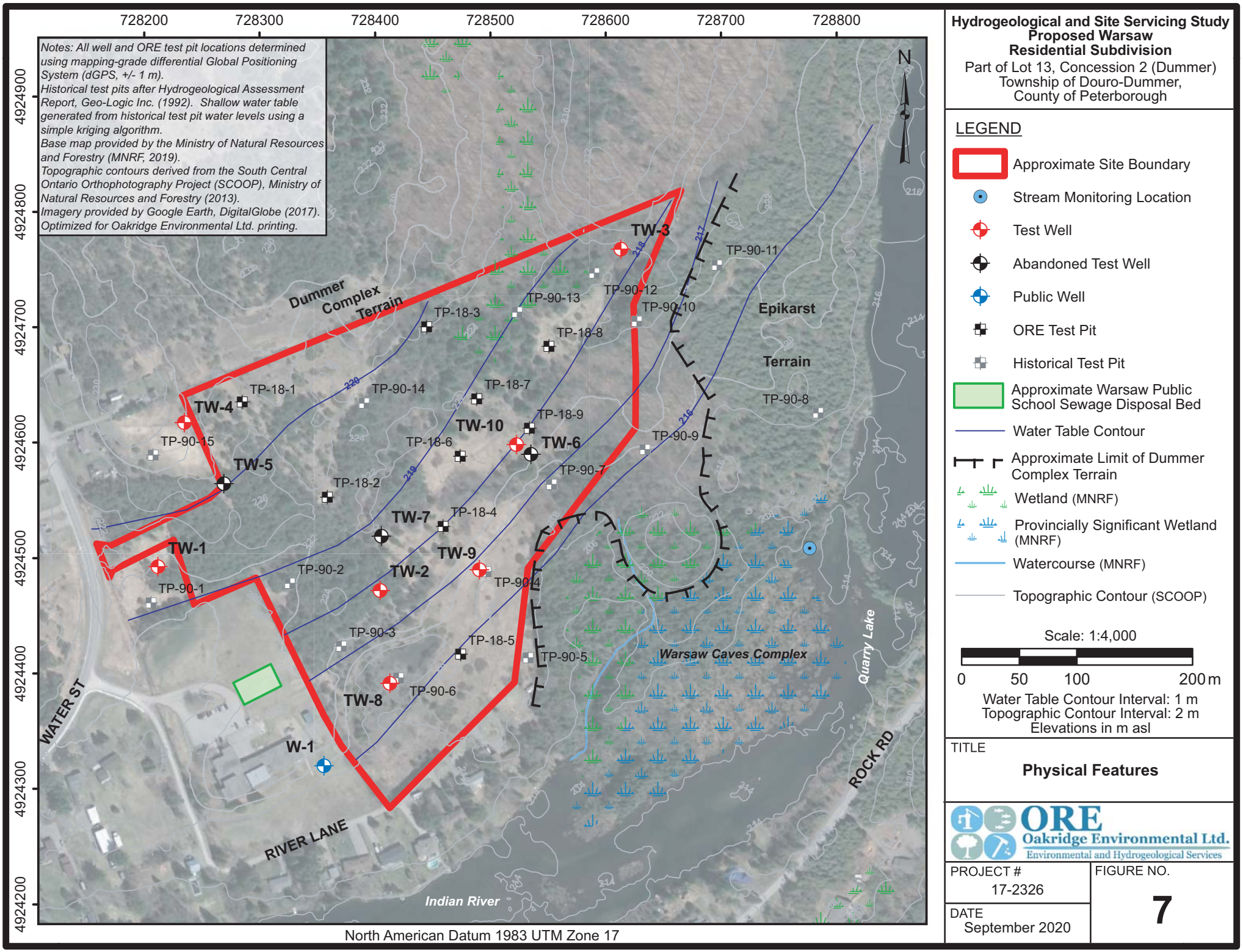
Optimized for Oakridge Environmental Ltd. printing.

TITLE

OGS Karst

ORE Oakridge Environmental Ltd.
Environmental and Hydrogeological Services

PROJECT #	FIGURE NO.
17-2326	6
DATE: September 2020	



Hydrogeological and Site Servicing Study
Proposed Warsaw Residential Subdivision
Part of Lot 13, Concession 2 (Dummer)
Township of Douro-Dummer,
County of Peterborough

LEGEND

- Approximate Site Boundary
- Stream Monitoring Location
- Test Well
- Abandoned Test Well
- Public Well
- ORE Test Pit
- Historical Test Pit
- Approximate Warsaw Public School Sewage Disposal Bed
- Water Table Contour
- Approximate Limit of Dummer Complex Terrain
- Wetland (MNRF)
- Provincially Significant Wetland (MNRF)
- Watercourse (MNRF)
- Topographic Contour (SCOOP)

Scale: 1:4,000

0 50 100 200 m

Water Table Contour Interval: 1 m
Topographic Contour Interval: 2 m
Elevations in m asl

TITLE

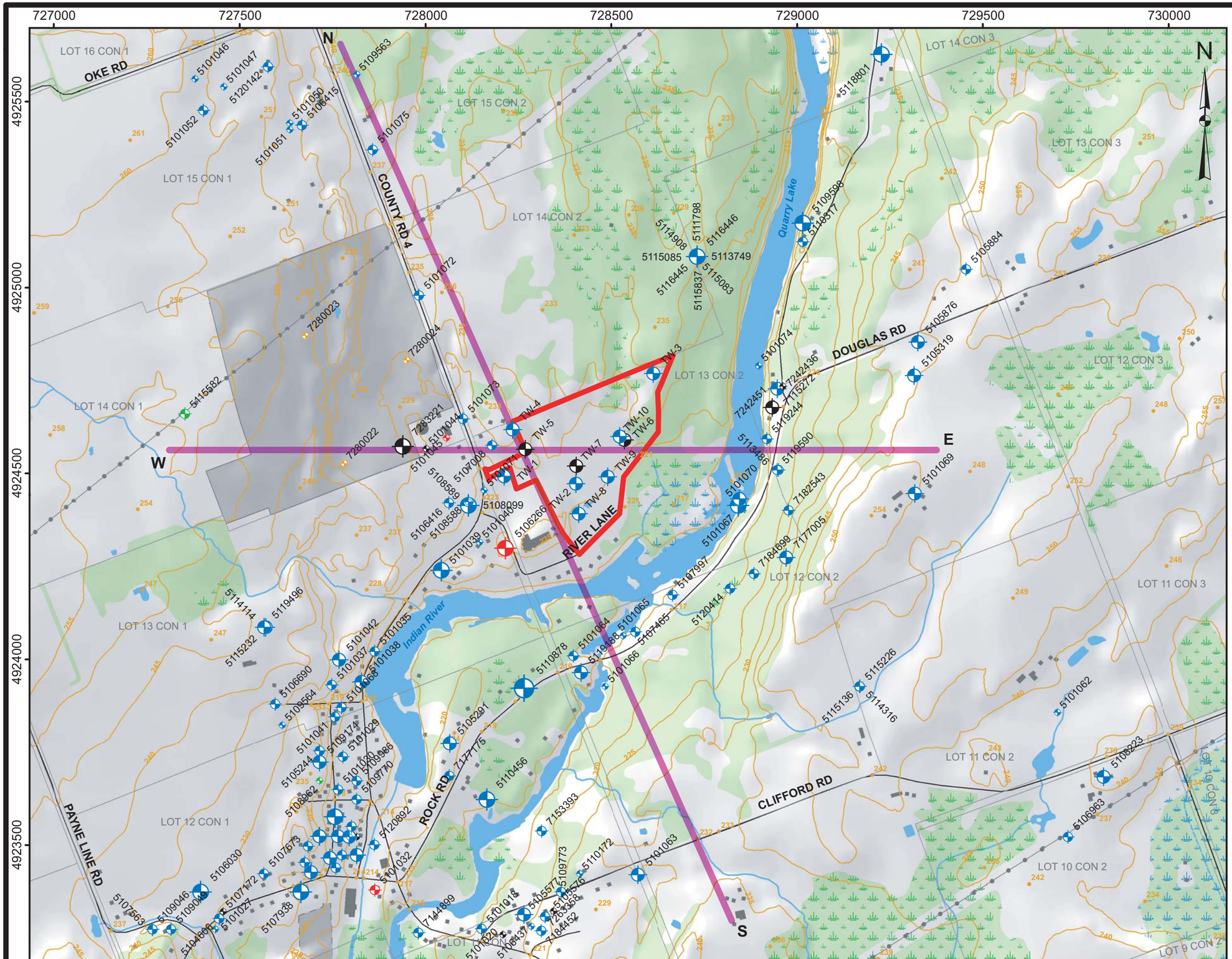
Physical Features

ORE Oakridge Environmental Ltd.
Environmental and Hydrogeological Services

PROJECT #	FIGURE NO.
17-2326	7
DATE: September 2020	

Hydrogeological and Site Servicing Study
Proposed Warsaw Residential Subdivision

Part of Lot 13, Concession 2 (Dummer)
Township of Douro-Dummer,
County of Peterborough



North American Datum 1983 UTM Zone 17

LEGEND

- Approximate Site Boundary
- Line of Section (see Figures 10 & 11)
- 5106266 Well ID*

Well Use

- Domestic / Livestock
- Commercial
- Municipal / Public
- Monitoring / Test Hole
- Abandoned / Unknown

Driller's Test Rate

- ≤ 1 GPM / Unknown
- > 30 GPM

* Due to the density of wells, not all well record numbers were plotted. Refer to Appendix C for the full list of MOE well records in the search area.

Scale: 1:10,000

0 100 200 400 m

Contour Interval: 5 m
Elevations in m asl

Notes: Test well locations determined using mapping-grade differential Global Positioning System (dGPS, +/- 1 m).

All other wells from the Water Well Information System, Ministry of the Environment, Conservation and Parks (MOE, 2018).

Base map provided by the Ministry of Natural Resources and Forestry (2019).

Optimized for Oakridge Environmental Ltd. printing.

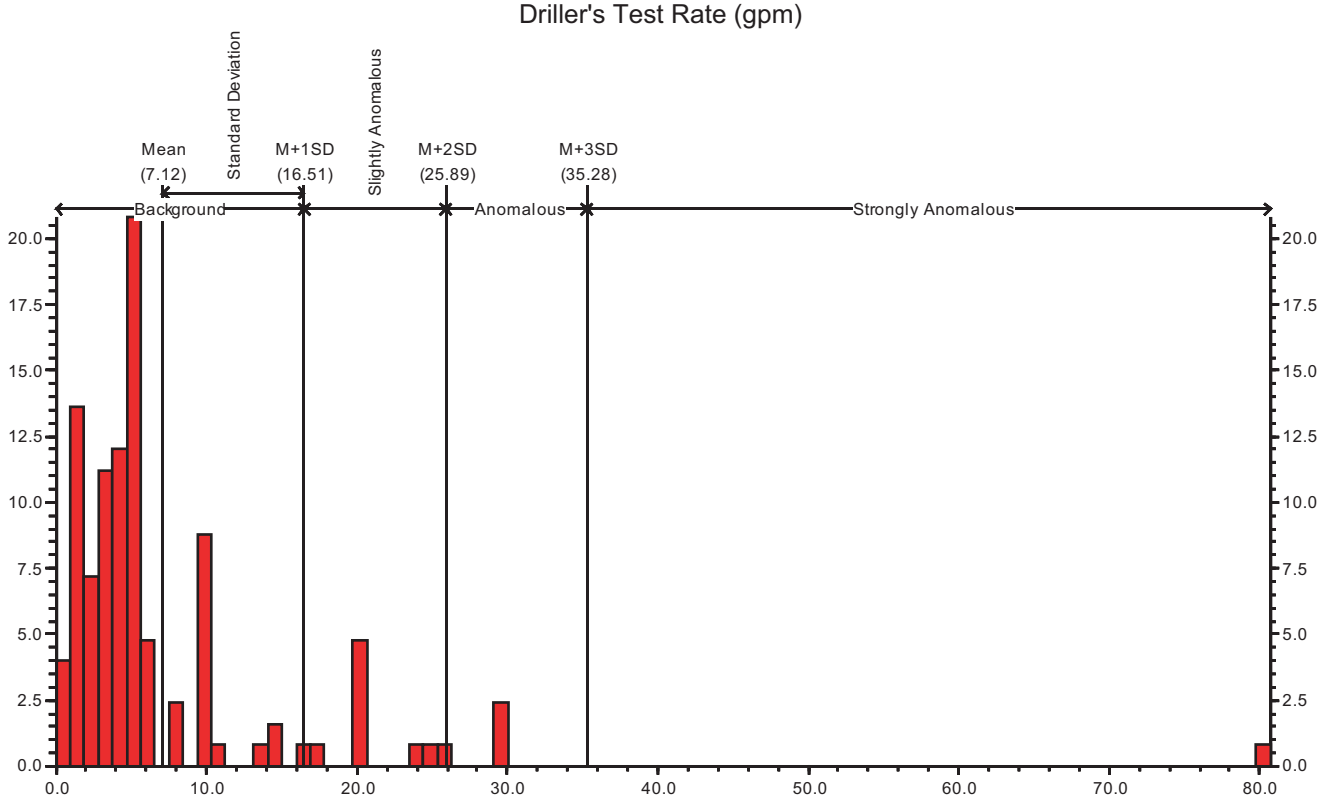
TITLE

MOE Well Locations

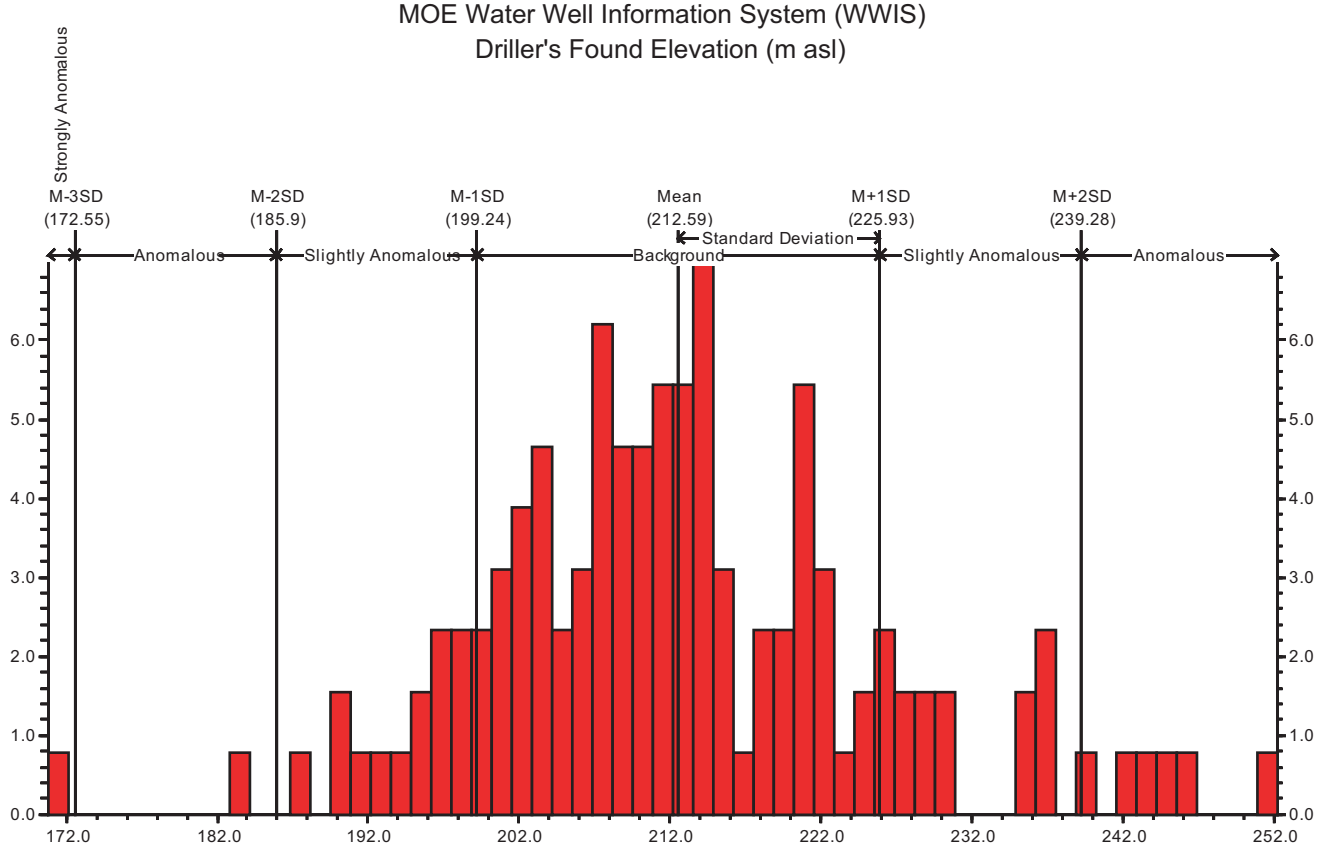
ORE Oakridge Environmental Ltd.
Environmental and Hydrogeological Services

PROJECT #	FIGURE NO.
17-2326	8
DATE: September 2020	

MOE Water Well Information System (WWIS)
Driller's Test Rate (gpm)



MOE Water Well Information System (WWIS)
Driller's Found Elevation (m asl)



ORE Oakridge Environmental Ltd.
Environmental and Hydrogeological Services

Notes: Data from the Water Well Information System, Ministry of the Environment, Conservation and Parks (MOE, 2018).

Optimized for Oakridge Environmental Ltd. printing.

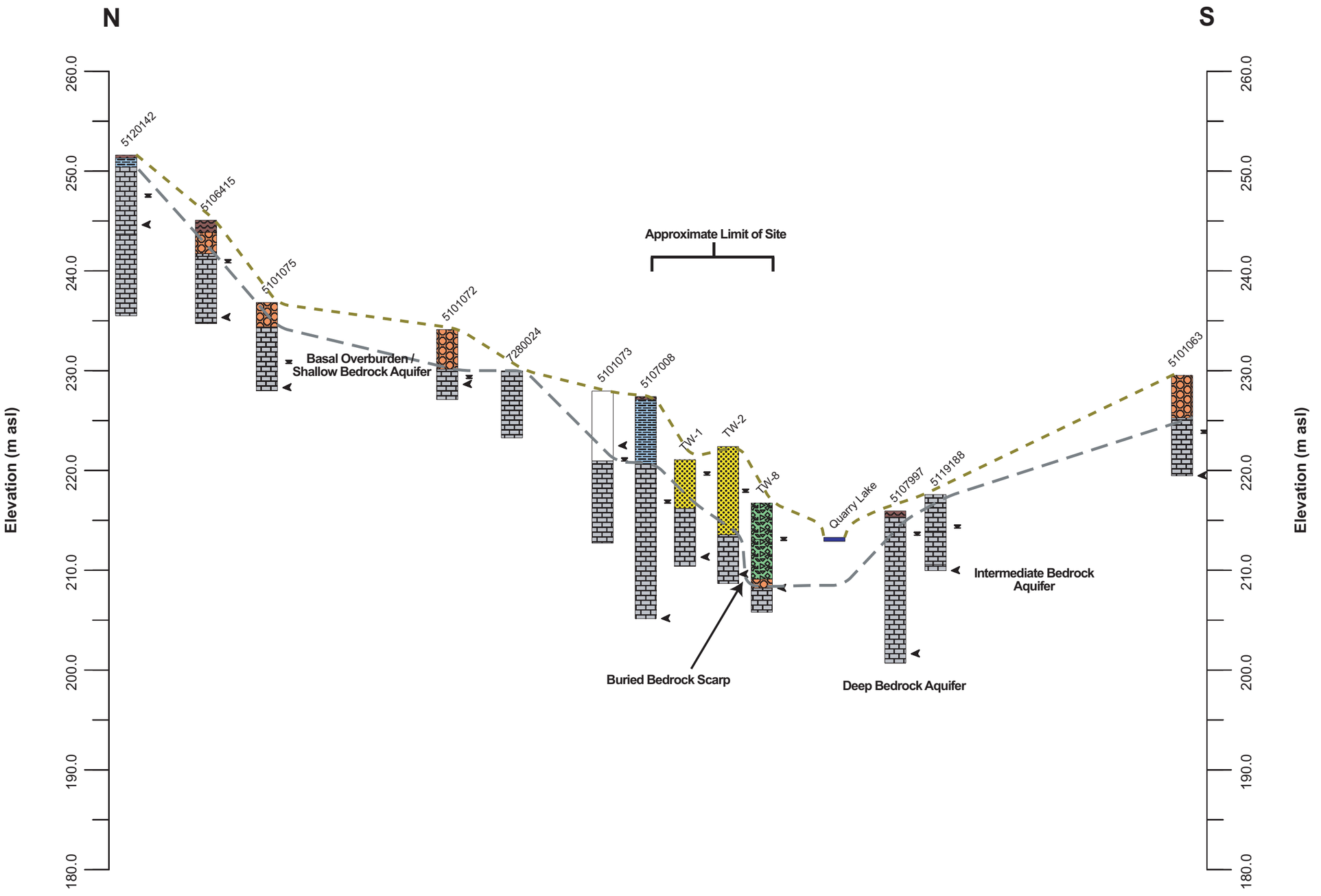
Hydrogeological and Site Servicing Study
Proposed Warsaw Residential Subdivision
Part of Lot 13, Concession 2 (Dummer)
Township of Douro-Dummer, County of Peterborough

TITLE
Well Statistics

PROJECT # 17-2326

DATE September 2020

FIGURE NO. **9**



Hydrogeological and Site Servicing Study
Proposed Warsaw
Residential Subdivision
Part of Lot 13, Concession 2 (Dummer)
Township of Douro-Dummer,
County of Peterborough

LEGEND

- Static Water Level
- Water Found Depth
- Approximate Location of Waterbody
- Clay
- Gravel / Cobbles
- Limestone / Sandstone
- Prev. Dug or Drilled
- Sand
- Till / Hardpan
- Topsoil
- Approximate Ground Surface
- Approximate Bedrock Surface

Horizontal Scale (approx.)

0 100 200 400 m

Vertical Exaggeration (approx.): 22.5

Notes: Wells projected along N-S Line of Section (see Figure 8).

Test well features located using mapping-grade differential Global Positioning System (dGPS, +/- 0.3 m).

All other well features from the Water Well Information System, Ministry of the Environment, Conservation and Parks (2018).

Optimized for Oakridge Environmental Ltd. printing.

TITLE

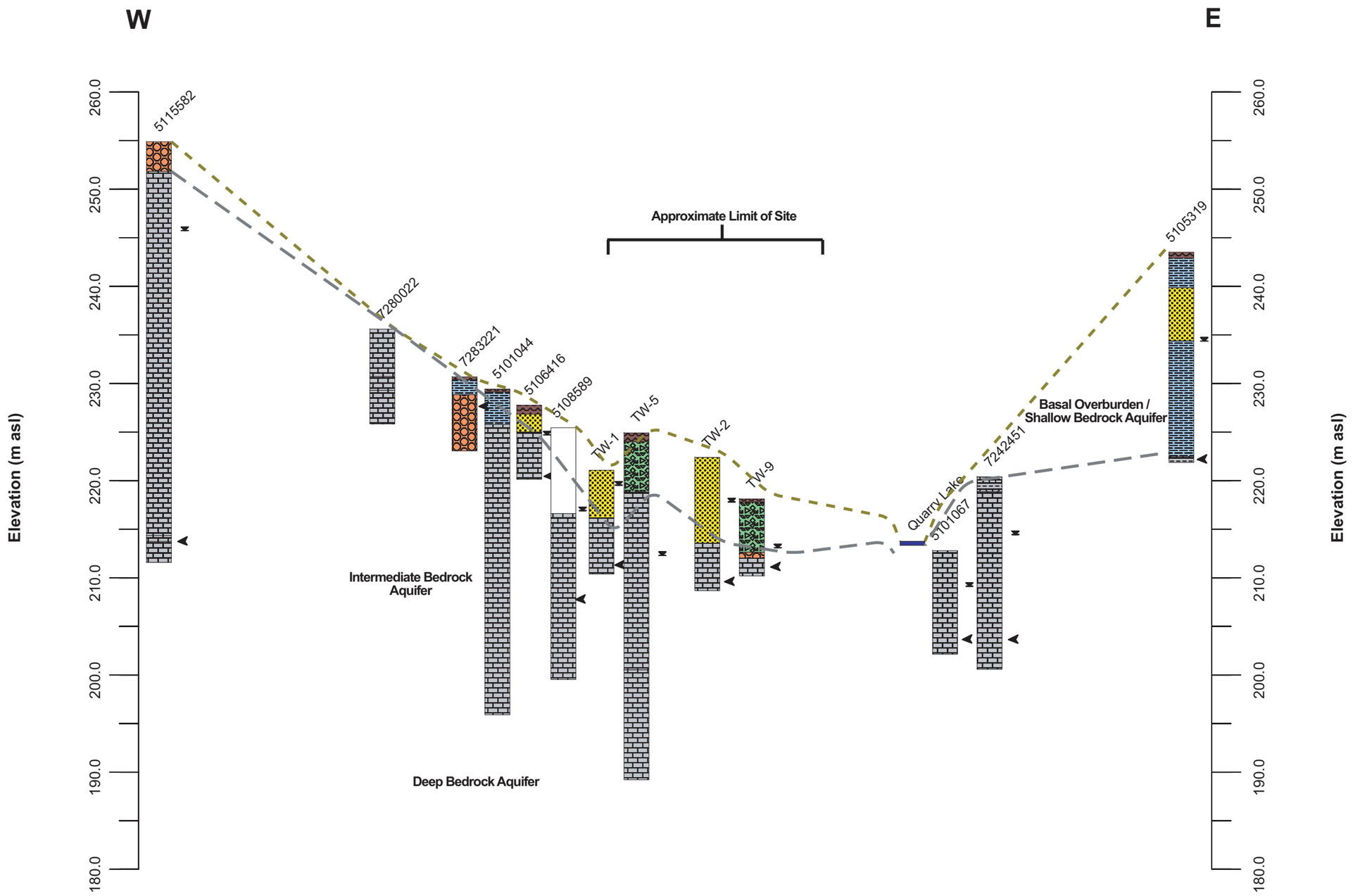
N-S Regional Cross Section

ORE Oakridge Environmental Ltd.
Environmental and Hydrogeological Services

PROJECT # 17-2326

DATE September 2020

FIGURE NO. **10**



Hydrogeological and Site Servicing Study
Proposed Warsaw
Residential Subdivision
Part of Lot 13, Concession 2 (Dummer)
Township of Douro-Dummer,
County of Peterborough

LEGEND

- Static Water Level
- Water Found Depth
- Approximate Location of Waterbody
- Clay
- Gravel / Cobbles
- Limestone / Sandstone
- Prev. Dug or Drilled
- Sand
- Till / Hardpan
- Topsoil
- Approximate Ground Surface
- Approximate Bedrock Surface

Horizontal Scale (approx.)

0 100 200 400 m

Vertical Exaggeration (approx.): 18.5

Notes: Wells projected along W-E Line of Section (see Figure 8).

Test well features located using mapping-grade differential Global Positioning System (dGPS, +/- 0.3 m).

All other well features from the Water Well Information System, Ministry of the Environment, Conservation and Parks (2018).

Optimized for Oakridge Environmental Ltd. printing.

TITLE

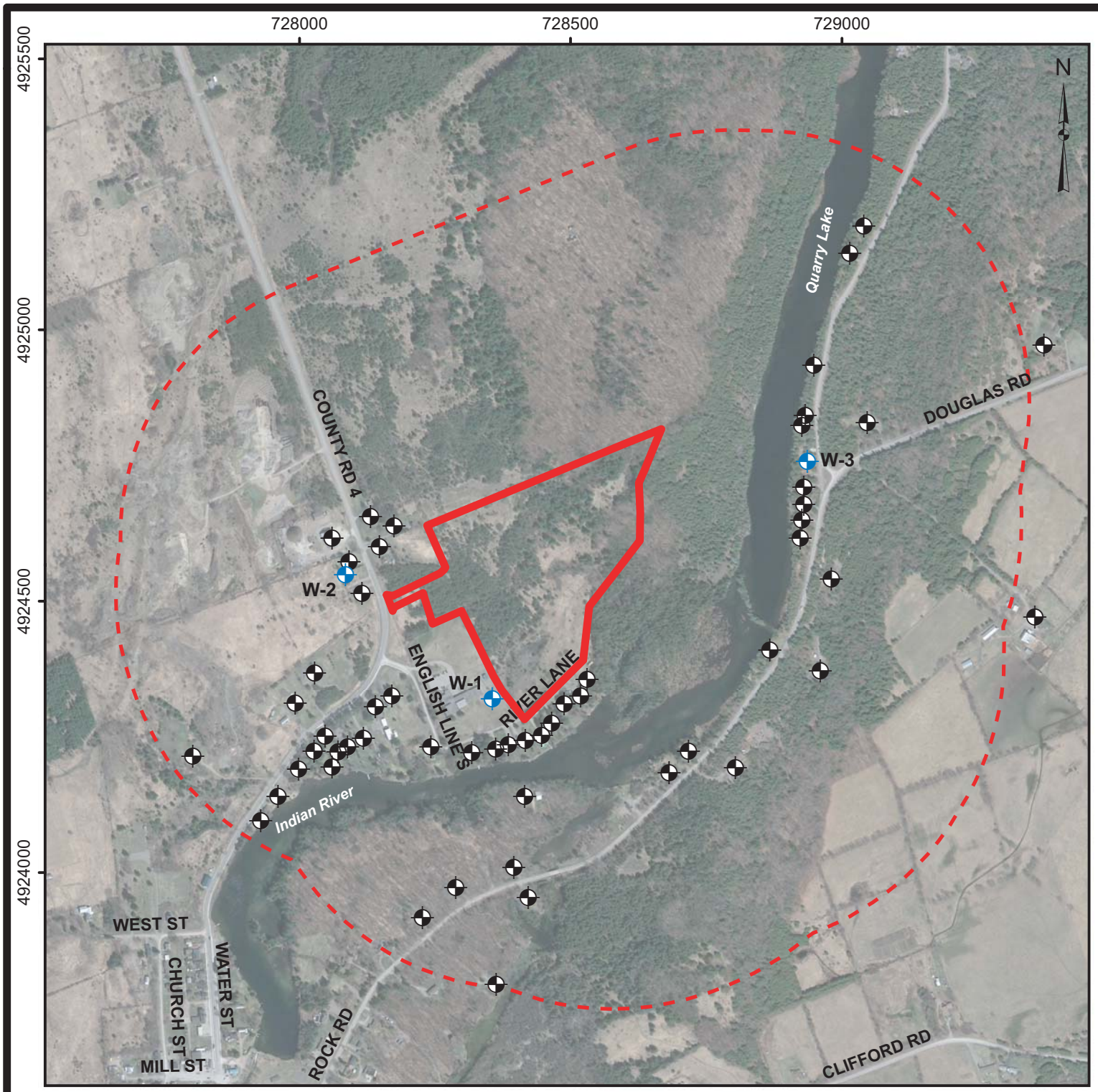
W-E Regional Cross Section

ORE Oakridge Environmental Ltd.
Environmental and Hydrogeological Services

PROJECT # 17-2326

DATE September 2020

FIGURE NO. **11**



North American Datum 1983 UTM Zone 17

Hydrogeological and Site Servicing Study
Proposed Warsaw
Residential Subdivision
Part of Lot 13, Concession 2 (Dummer)
Township of Douro-Dummer,
County of Peterborough

LEGEND

- Approximate Site Boundary
- Study Area
- Private Drilled Well (with ORE ID)
- Unknown Well (well survey form dropped off, no response received)

Scale: 1:10,000

0 100 200 400 m

Notes: Location of known wells are approximate, based on well survey response letters.

Location of unknown wells are for reference purposes only, and are based on the civic address.

Imagery provided by Google Earth, DigitalGlobe (2017).

Optimized for Oakridge Environmental Ltd. printing.

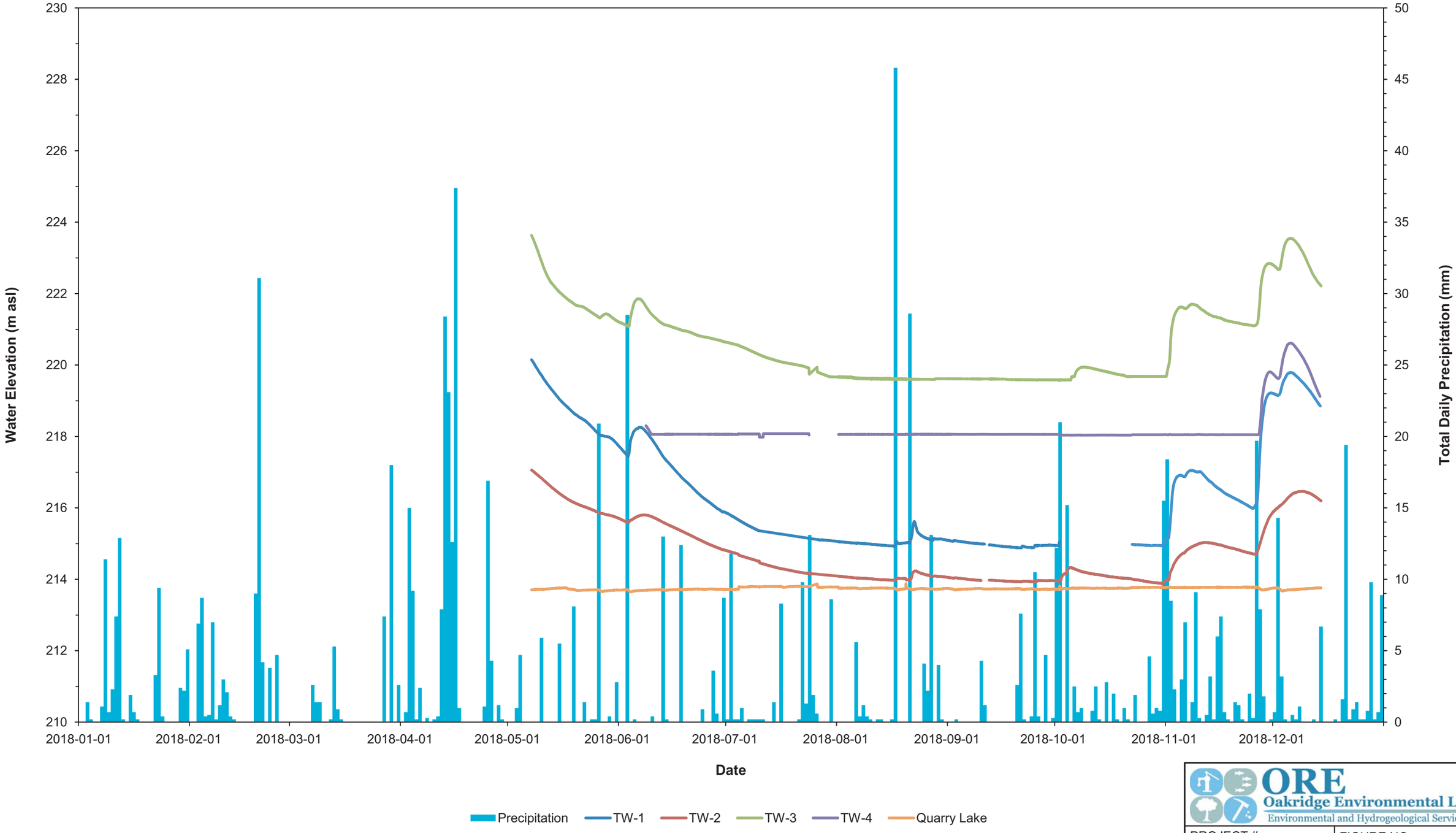
TITLE

Well Survey

ORE Oakridge Environmental Ltd.
Environmental and Hydrogeological Services

PROJECT #	FIGURE NO.
17-2326	12
DATE: September 2020	

Proposed Warsaw Residential Subdivision
Compiled Hydrograph 2018



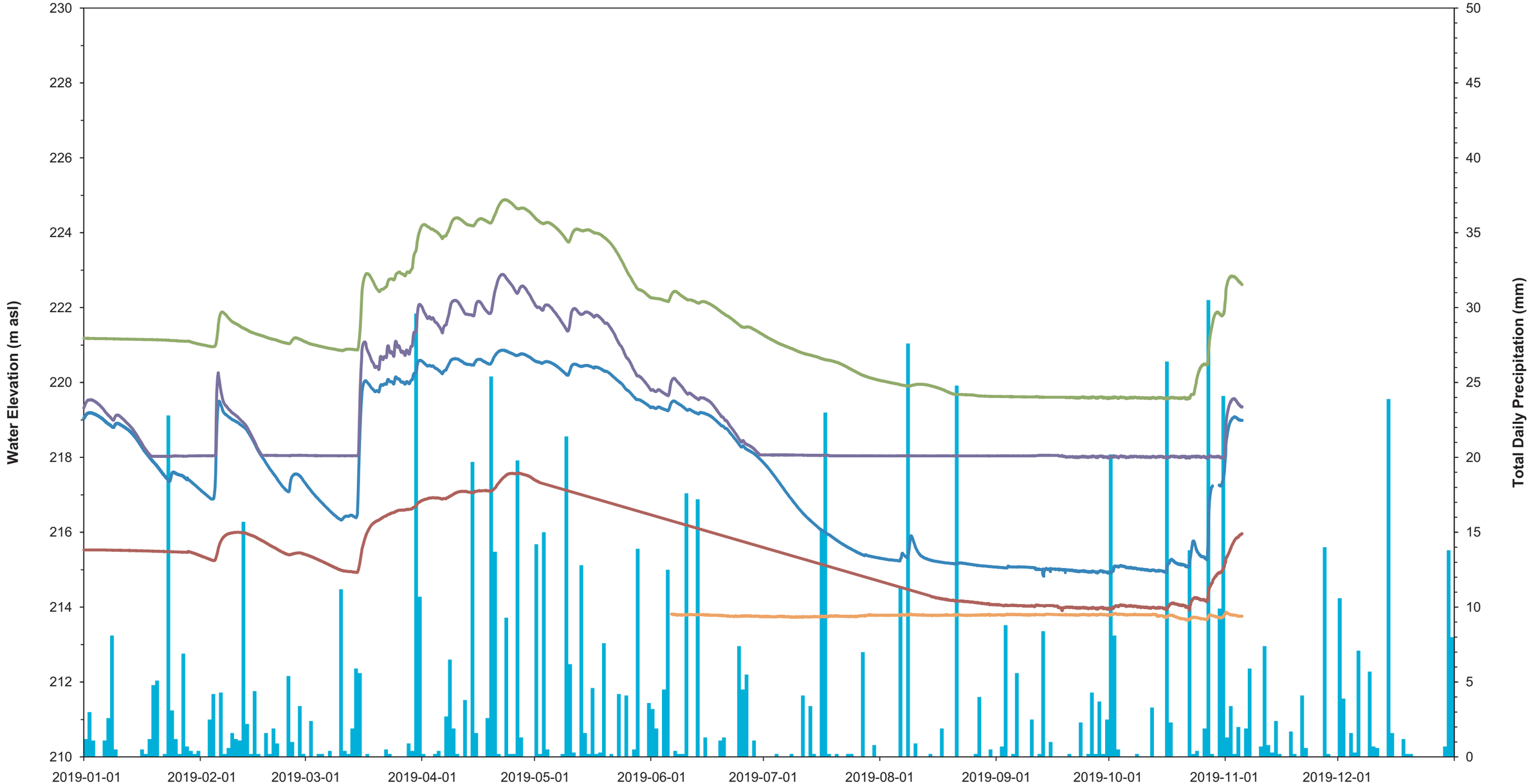
Notes: Water level elevations determined using mapping-grade differential Global Positioning System (dGPS, +/- 1 m).

Precipitation data from the Environment Canada station at Trent University, Peterborough, Ontario.

ORE Oakridge Environmental Ltd.
Environmental and Hydrogeological Services

PROJECT #	FIGURE NO.
17-2326	13
DATE: September 2020	

Proposed Warsaw Residential Subdivision
Compiled Hydrograph 2019

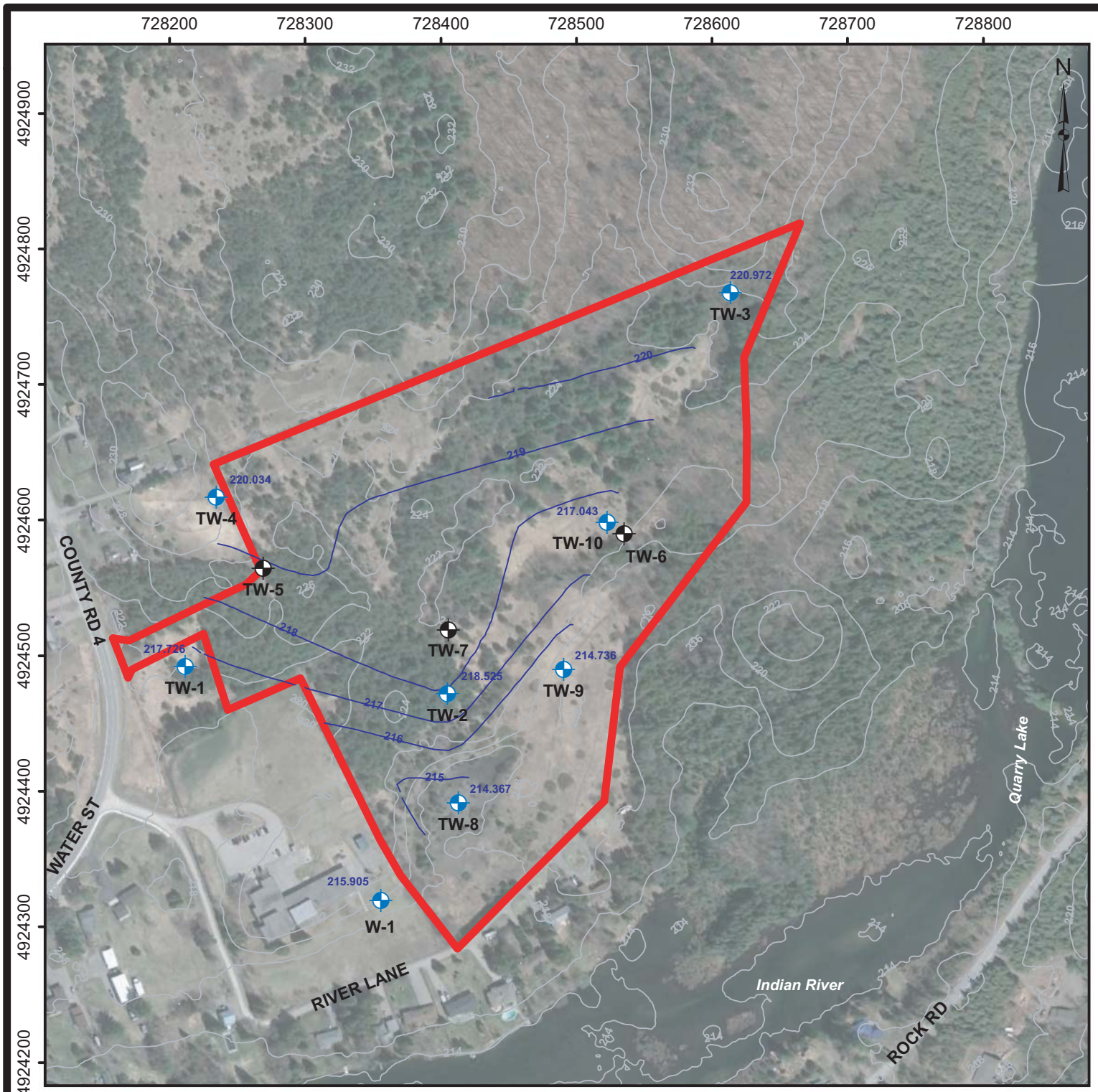


Notes: Water level elevations determined using mapping-grade differential Global Positioning System (dGPS, +/- 1 m).

Precipitation data from the Environment Canada station at Trent University, Peterborough, Ontario.

ORE Oakridge Environmental Ltd.
Environmental and Hydrogeological Services

PROJECT #	FIGURE NO.
17-2326	14
DATE: September 2020	



North American Datum 1983 UTM Zone 17

Hydrogeological and Site Servicing Study
Proposed Warsaw
Residential Subdivision
Part of Lot 13, Concession 2 (Dummer)
Township of Douro-Dummer,
County of Peterborough

LEGEND

- Approximate Site Boundary
- Representative Well (with mean static water level elevation)
- Other On-site Well (not representative of target aquifer)
- Potentiometric Surface Contour
- Topographic Contour (SCOOP)

Scale: 1:4,000

0 50 100 200 m

Potentiometric Surface Contour Interval: 1 m
Topographic Contour Interval: 2 m
Elevations in m asl

Notes: Test well locations determined using mapping-grade differential Global Positioning System (dGPS, +/- 1 m).

Potentiometric surface generated using a simple triangulation method, based on the mean of static water level elevations of each representative well.

Topographic contours derived from the South Central Ontario Orthophotography Project, Ministry of Natural Resources and Forestry (2013).

Imagery provided by Google Earth, DigitalGlobe (2017).

Optimized for Oakridge Environmental Ltd. printing.

TITLE

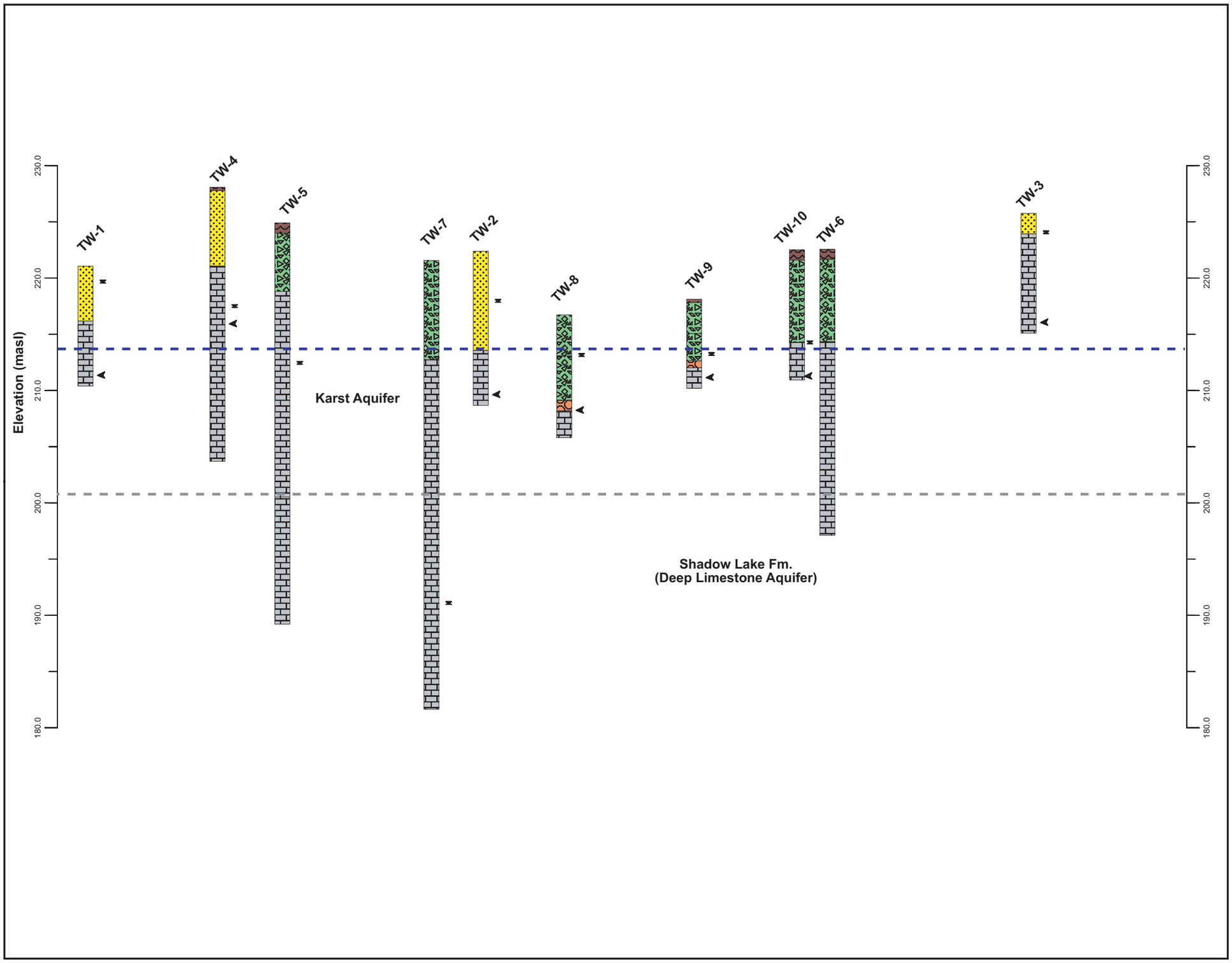
Local Potentiometric Surface

ORE Oakridge Environmental Ltd.
Environmental and Hydrogeological Services

PROJECT # 17-2326

DATE September 2020

FIGURE NO. **15**



Hydrogeological and Site Servicing Study
Proposed Warsaw
Residential Subdivision

Part of Lot 13, Concession 2 (Dummer)
Township of Douro-Dummer,
County of Peterborough

LEGEND

- Topsoil
- Sand
- Gravel
- Till
- Limestone
- Water Found Depth
- Static Water Level
- Quarry Lake (approximate)
- Shadow Lake Contact (approximate)

Notes: Hole-to-hole cross section as illustrated on Figure 17 (for conceptual purposes only)

Optimized for Oakridge Environmental Ltd. printing.

TITLE

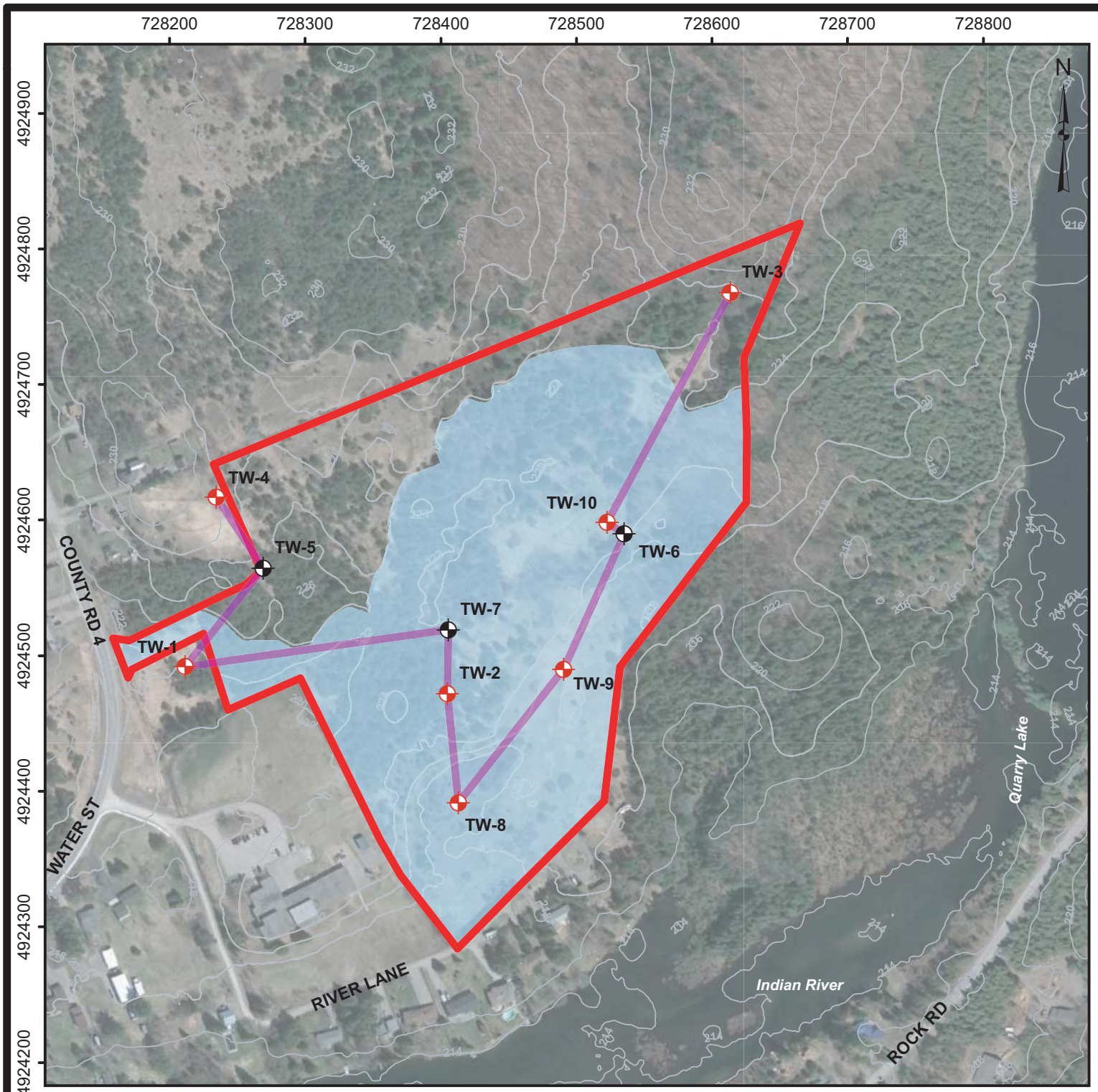
Schematic Cross Section

ORE Oakridge Environmental Ltd.
Environmental and Hydrogeological Services

PROJECT # 17-2326

DATE September 2020

FIGURE NO. **16**



North American Datum 1983 UTM Zone 17

Hydrogeological and Site Servicing Study
Proposed Warsaw
Residential Subdivision
Part of Lot 13, Concession 2 (Dummer)
Township of Douro-Dummer,
County of Peterborough

LEGEND

- Approximate Site Boundary
- Test Well
- Abandoned Test Well
- Schematic Line of Section (see Figure 16)
- Preferred Area
- Topographic Contour (SCOOP)

Scale: 1:4,000

0 50 100 200 m

Topographic Contour Interval: 2 m
Elevations in m asl

Notes: Test well locations determined using mapping-grade differential Global Positioning System (dGPS, +/- 1 m).

Topographic contours derived from the South Central Ontario Orthophotography Project, Ministry of Natural Resources and Forestry (2013).

Imagery provided by Google Earth, DigitalGlobe (2017).

Optimized for Oakridge Environmental Ltd. printing.

TITLE

Test Well Locations

ORE Oakridge Environmental Ltd.
Environmental and Hydrogeological Services

PROJECT #	FIGURE NO.
17-2326	17
DATE: September 2020	

Hydrogeological and Site Servicing Study
Proposed Warsaw Residential Subdivision

Part of Lot 13, Concession 2 (Dummer)
Township of Douro-Dummer,
County of Peterborough

728100 728200 728300 728400 728500 728600 728700 728800 728900

4924900 4924800 4924700 4924600 4924500 4924400 4924300 4924200

N

COUNTY RD 4

ROCK RD

WATER ST

ENGLISH LINE S

RIVER LANE

Quarry Lake

Indian River

To be Severed

Lands to be Severed

Existing Lots of Record
Owned by Proponent

TW-1
TW-3*
TW-4*
TW-8
TW-9
TW-10

W-1
W-2
W-3

1 2 3 4 5 6 7 8 9 10 11 12

Scale: 1:3,000

0 50 100 200 m

Contour Interval: 2 m
Elevations in m asl

North American Datum 1983 UTM Zone 17

LEGEND

- Approximate Development Site
- Approximate Property Boundary
- Conceptual Lot Boundary
- Existing Lot Boundary
- Preferred Area
- Existing Drilled Test Well (with 15 m OBC clearance)
- Existing Drilled Domestic Well (with 15 m OBC clearance)
- Conceptual Drilled Domestic Well (with 15 m OBC clearance)
- 1 Conceptual Residence (3,000 sq. ft., with proposed sublot number)
- Conceptual Conventional Class 4 Sewage System (fully-raised with 4:1 side slopes, based on 3,000 L/day, T = 10 min/cm)
- Conceptual Road
- Conceptual Retained Green Space
- Approximate Warsaw Public School Sewage System
- Contour (SCOOP)

* indicates test well to be abandoned

Notes: OBC - Ontario Building Code

Test well locations determined using mapping-grade differential Global Positioning System (dGPS, +/- 1 m).

Base plan after Draft Plan of Subdivision, D.M. Wills Associates Limited (received September 24, 2020).

Imagery provided by Google Earth, DigitalGlobe (2017).

Optimized for Oakridge Environmental Ltd. printing.

TITLE

Conceptual Servicing Plan

ORE Oakridge Environmental Ltd.
Environmental and Hydrogeological Services

PROJECT # 17-2326

DATE September 2020

FIGURE NO. **18**

APPENDIX A

Previous Hydrogeological Study Report (1990 rev. 1992)
and Correspondence (1994)

Geo-Logic Inc.

HYDROGEOLOGIC ASSESSMENT REPORT

PROPOSED RESIDENTIAL DEVELOPMENT
PART OF LOT 13, CONCESSION 2
TOWNSHIP OF DUMMER, PETERBOROUGH COUNTY
PROJECT NO. 89-G-831

GEO-LOGIC INC.

347 Pido Road
Unit 29
P.O. Box 694
Peterborough, Ontario
K9J 6Z8

May, 1990
Revised: February, 1992

TABLE OF CONTENTS

PLATES

APPENDICES

GEO — LOGIC INC.

347 Pido Road, Unit 29
P.O. Box 694
PETERBOROUGH, ONT
K9J 6Z8

TEL (705) 749-3317
FAX (705) 749-9248

HYDROGEOLOGIC ASSESSMENT REPORT
PROPOSED RESIDENTIAL DEVELOPMENT
TOWNSHIP OF DUMMER

1.0 INTRODUCTION

This report presents the results of a hydrogeologic assessment that has been carried for a proposed residential development near the urban area of Warsaw. The site fronts onto County Road No.4 near the north end of Warsaw and is bound to the east by the Indian River. The property is situated on Part of Lot 13, Concession 2, in the Township of Dummer, County of Peterborough. The location of the site relative to local roads, water courses, and Warsaw is shown on the Geologic Plan, Plate 1.

2.0 BACKGROUND

A detailed hydrogeologic assessment was carried out by Geo-Logic Inc. during the spring of 1990. The study was undertaken at the request of Mr. Randy Cullimore in accordance with the scope of work outlined in our written proposal dated November 1, 1989.

Since that time, refinements to the planned development were carried out as a result of discussions with the Township. In addition, new interim guidelines were circulated by the Ministry of the Environment (M.O.E.) dated August 6, 1991 regarding privately serviced development proposals. The following report has been subsequently revised to reflect the recent revisions to the proposed development.

3.0 PURPOSE AND SCOPE

The project site encompasses an area of approximately 24.0 ha (59.2 acres). It is proposed that the property be developed into twenty-four (24) individual residential lots. The layout of the proposed development is presented on the Plot Plan, Plate 3. It is proposed each lot will be privately serviced for water supply and waste disposal.

This report describes the prevailing hydrogeologic conditions at the site, including pattern of groundwater movement, availability of recharge, and suitability of potable groundwater supplies. An assessment has also been carried out regarding the suitability of the development and associated impacts on the shallow groundwater regime and down-gradient functions.

To accomplish these purposes, the following scope of work has been carried out:

1. Compile and review background information including geologic, physiographic and water resources reports and maps relevant to the site;
2. Site reconnaissance to interview neighbouring well owners and carry out a well inventory of existing M.O.E. well records;
3. Obtain representative water samples for baseline water quality analyses;
4. Explore subsurface soil and groundwater conditions by excavating fifteen (15) test pits and installing standpipe piezometers to monitor stable groundwater levels;

5. Carry out a controlled pumping test and water quality analysis of three drilled test wells to evaluate the quantity and quality of water available for the proposed development; and

6. Compilation of acquired background, field and laboratory test data including office engineering analyses and preparation of this report which outlines our conclusions and recommendations.

4.0 SITE CONDITIONS

4.1 GEOLOGY

The site is situated on sloping terrain within the physiographic region known as the Peterborough Drumlin Field. This region is typically comprised of an extensive rolling till plain. The till plain (glacial drift) generally consists of a heterogeneous mixture of clay, silt, sand and gravel. Drumlins are common to the landscape. As illustrated on the Geologic Plan, Plate 1, the neighbouring terrain which occurs south of the project site is dominated by drumlinized hills that are generally oriented in a northeast to southwest direction.

Locally, the project site is situated within the Indian River Valley. The surficial geology is comprised of spillway deposits related to a large drainage course that occurred after the period of late Wisconsian glaciation. Esker formations are present within the general area and numerous pits are presently operating from these local deposits.

Bedrock underlying the site consists of limestone belonging to the Lindsay Formation. The bedrock is part of the Trenton-Black River Group and is of Middle Ordovician age. Bedrock underlies the development site at depths that vary from near surface along the banks of the Indian River to about 10m near the central portion of the property.

4.2 SURFACE CONDITIONS

The project site is generally irregular in shape, as illustrated by the Plot Plan, Plate 3. The western half of the property was generally covered with unmaintained grass at the time of this investigation. The eastern portion of the project site is densely covered with a mature growth of mixed coniferous and deciduous trees. Surficial features indicate that the property was formerly used for agricultural purposes as pastureland.

There is evidence that a former borrow pit was mined near the south-central portion of the site. The surrounding grade slopes radially away from a topographic high occurring in the northwest corner of the property. In general, the surrounding grade slopes eastward towards the Indian River. Local relief across the site is on the order of 15m.

4.3 SUBSURFACE CONDITIONS

4.3.1 General

Shallow subsurface soil and groundwater conditions were explored by excavating fifteen (15) test pits at the locations shown on the Plot Plan, Plate 3. The results of the field explorations including detailed descriptions of the materials encountered are presented in Appendix A.

The revealed stratigraphy generally consists of a surficial layer of topsoil underlain by a glaciofluvial deposit of gravelly sand and then a basal stratum of glacial drift (till). Bedrock encroaches the surface along the banks of the Indian River and near the east-central portion of the property. A brief description of the subsurface stratigraphy is presented in the following sections.

4.3.2 Soil Stratigraphy

A relatively thin veneer of silty topsoil covers the project site. The topsoil varies in thickness from 50mm (T-8) to 410mm (T-1) and averages 240mm thick. The topsoil generally increases in thickness toward the southern portion of the property.

The surficial topsoil is underlain by a layer of gravelly sand for the majority of the site. It is estimated that the sand deposit occurs over 75% of the site area. Where penetrated, the sand layer varies in thickness from 1.1m (T-6) to 2.6m (T-5) and averages 1.7m.

Based on the results of a grain size distribution analysis, the sand layer is comprised of about 19% gravel, 73% sand and 8% silt size particles (see Plate A-4). The coefficient of permeability is estimated to be approximately 1.5 x 10^{-3} cm/sec. The related percolation rate (T-time) is considered to be on the order of 8 min/cm.

A basal stratum of glacial till was found to underlie the majority of the project site. The till was encountered by eight of the fifteen test pits. The till was found to exist directly below the surficial topsoil or below the gravelly sand layer.

The till is comprised of a full range of soil particles from clay through to gravel. A representative sample of the native till was subjected to a grain size distribution analysis (see Plate A-4). The texture may be classed as well graded. The predominate soil particles are sand and silt. The sand content represents 52% by weight. The silt and clay content is approximately 41%. The gravel content is typically 7%. Based on grain size distribution data (presented in Appendix A), the coefficient of permeability is assessed to be on the order of 8 x 10^{-6} cm/sec. The related percolation rate is assessed to be on the order of 20 min/cm.

4.3.3 Groundwater

Groundwater seepage was only observed in Test Pits T-1 and T-7 during the excavating procedure. The remainder of the test pits were dry on completion. Stable groundwater levels measured three weeks after completion of the test pits ranged from 1.96m (T-1) to below 2.82m (T-13).

The average depth to the shallow water table at the time of our investigation was 2.3m below existing grade. Seasonal fluctuations are expected to be about 1m.

4.4 HYDROGEOLOGY

4.4.1 General

Information regarding groundwater resources of the immediate area was obtained from an inventory of well record data on file with the M.O.E., a survey of neighbouring wells, and the construction of three drilled test wells installed on the project site for this investigation.

In total, 50 representative water wells have been identified within 1 km of the site for the purpose of this study. The distribution of the wells about the development site is presented on the Site Plan, Plate 2. Physical and hydraulic data for these wells have been summarized in Appendix B. A summary of the well record data and the results of a water well survey is presented on Plates 4A and 4B.

The available hydrogeologic data suggests the presence of two principal aquifer systems:

1. The saturated zone within the surficial granular mantle that supplies the existing bored and dug wells; and
2. Saturated fracture networks in the underlying bedrock.

4.4.2 Existing Water Supplies

The majority (90%) of private water wells in the immediate vicinity obtain domestic water supplies from drilled wells and to a lesser extent (10%) from shallow bored or dug wells. A summary of water well information of the drilled wells is presented in Table 1.

In general, the shallow bored/dug wells are reported to occasionally experience supply problems during periods of low summer water levels: e.g. W-4. In addition, five of the shallow wells have been replaced with deeper drilled wells: i.e. W-11, W-15, W-24, W-41, and W-43. Based on this information, it is concluded that the shallow aquifer will not provide reliable long term supplies of potable water. Shallow bored/dug wells are also susceptible to shallow sources of contamination. For example, well W-5 has been reported to experience bacterial contamination.

Areal drilled wells constructed in the underlying bedrock produce moderate yields averaging 0.74 L/s (9.8 gpm). The maximum reported yield is 6.06 L/s (80 gpm) from well W-27 situated less than 0.5 km south of the project site. It is also significant that only one well (W-12) was reported as "dry" at the time of completion by the drilling contractor. Additionally, 30% of the drilled wells produce yields greater than 0.76 L/s (10 gpm).

Sulphur odour was reported by the well drilling contractors at the completion of 4 (9%) of the drilled wells. However, sulphur odour was not evident at the completion of the three test wells constructed for this study. The drilled wells generally extend to an average depth of 15.1m. The average static water level is 5.6m.

TABLE 1: WELL DATA SUMMARY

TOTAL NUMBER INVENTORIED - 50 BORED - 5 (10%) DRILLED (BEDROCK) - 45 (90%)	
PARAMETERS	DRILLED WELLS
WELL YIELDS Average Range	 0.74 L/s (9.8 GPM) 0.08 to 6.06 L/s (1 to 80 GPM)
NO. OF WELLS Dry 0 to 1 GPM 2 to 4 GPM 5 to 9 GPM >10 GPM	 1 (3%) 5 (13%) 11 (28%) 11 (28%) 12 (30%)
STATIC WATER LEVELS Average Range	 5.6m 0.9 to 15.2m
WATER ENCOUNTERED Average Range	 11.3m 1.2 to 46.6m
DEPTH Average Range	 15.1m 4.0 to 46.6m

Interviews with a representative number of residences indicate that the drilled wells currently provide satisfactory supplies. This was confirmed by the well records (see Appendix B). It appears that the aquifer systems that occur below the project site can provide adequate groundwater resources to meet the needs for the proposed residential development.

4.4.3 Groundwater Flow Pattern

The potentiometric contours of the shallow groundwater table normally approximates the ground surface topography. A potentiometric map was developed to illustrate the water table configuration of the shallow flow zone beneath the proposed development (see Water Table Configuration Plan, Plate 5).

The potentiometric map was based on stable groundwater levels measured in the standpipe piezometers installed during the soil exploration program. The potentiometric contours confirm that shallow groundwater movement through the property generally conforms to the ground surface topography and flows eastward toward the Indian River.

4.4.4 Hydrology

The regional evapotranspiration is estimated to be on the order of 510mm based on information published by the M.O.E. (Water Quantity Resources of Ontario, MNR-PUB-5932, 1984). A meterological station located at Norwood indicates an annual precipitation of 785 mm/year. Accordingly, 275mm of annual precipitation is expected to be available for infiltration recharge on the proposed development area.

The precipitation is expected to occur as runoff and as shallow flow through the glaciofluvial deposit of sand and the upper zones of the native till. The subsurface soil conditions suggest that about 200 mm/year will occur as infiltration in areas covered by the gravelly sand deposit. In comparison, it is estimated that approximately 150 mm/year of infiltration will be experienced by areas covered by glacial till.

5.0 TEST WELL

5.1 WELL CONSTRUCTION

Three test water wells were constructed by Dennis Debler Drilling Ltd. (M.O.E. Licence No. 1748) in May, 1990. The purpose of the test wells is to confirm the availability of suitable groundwater resources for the proposed development. The location of the test wells relative to the property limits is shown on the Plot Plan, Plate 3. The records of the three test wells are presented in Appendix D.

The test wells, labelled as TW-1, TW-2, and TW-3 were advanced to depths of 10.7m, 13.7m, and 10.7m, respectively. The wells were constructed using conventional air percussion techniques. The wells encountered water in saturated fracture networks within the underlying bedrock formation. Schematic drawings of the test well construction are illustrated on Plates D-2A through to D-2C in Appendix D.

5.2 AQUIFER PERFORMANCE TESTING

A test pumping program was carried out at each test well to assess aquifer response. For each testing program, a submersible pump was installed in the wells with the intake set at 7.3m (TW-1), 12.2m (TW-2), and 8.2m (TW-3). The short term capacity of each well was evaluated by carrying out a step drawdown followed by a constant rate test. At the conclusion of the pumping, each well was allowed to recover. The Pump Test History and Time Versus Drawdown curves are graphically depicted in Appendix D.

The computed coefficients for each test well are presented on the Time Versus Drawdown curves on Plates D-4A through to D-4C and are summarized in tabular form in Table 2. The results of the pump tests indicate that leaky, confined aquifer was tapped by all three test wells.

During each pump testing program the remaining two test wells were monitored in order to assess potential well interference. In addition, standpipe piezometers constructed within the test pits were also monitored during each pump test. The monitoring wells were not affected by the pump tests. Therefore, interference with neighbouring existing wells or wells for the planned development is not expected.

TABLE 2 - AQUIFER TESTING SUMMARY

TEST No.	STEP	YIELD (igpm)	TYPE	DURATION (Minutes)	MAXIMUM DRAWDOWN (Feet)	AVAILABLE DRAWDOWN (Feet)	SPECIFIC CAPACITY (igpm/ft)	TRANSMISSIVITY (igpd/ft)
TW-1	0	0	Static	0	0	17.50	---	---
	1	5.7	Drawdown	20	0.13	17.37	45	---
	2	9.2	Drawdown	20	0.25	17.25	37	16,700
	3	12.5	Constant	360	0.35	17.15	36	24,300
	4	0	Recovery	10	---	---	---	18,300
TW-2	0	0	Static	0	0	19.50	---	---
	1	2.9	Drawdown	20	0.02	19.48	80	32,500
	2	5.4	Drawdown	20	0.04	19.46	67	36,900
	3	3.4	Constant	240	0.06	19.44	58	36,500
	4	12.0	Drawdown	120	0.15	19.35	82	51,100
	5	0	Recovery	10	---	---	---	37,300
TW-3	0	0	Static	0	0	20.50	---	---
	1	2.6	Drawdown	20	0.04	20.46	66	17,900
	2	4.2	Drawdown	20	0.17	20.33	25	26,800
	3	5.6	Drawdown	85	0.25	20.25	16	32,100
	4	4.3	Constant	325	0.21	20.29	20	---
	5	0	Recovery	5	---	---	---	43,700

The test pumping data for each well indicate a relatively high transmissivity characteristic of the bedrock aquifer. Based on the acquired data, it is recommended that test well TW-1 be rated for a long term yield of 1.52 L/s (20 gpm) assuming a 30% reduction in well efficiency over time.

In comparison, test well TW-2 is rated for a long term yield of 1.90 L/s (25 gpm). Test well TW-3 is rated at 1.52 L/s (20 gpm). Short term capacities are expected to be greater. Based on the pump test data, it is concluded that the bedrock aquifer complex underlying the project site should supply a sufficient quantity of water for the proposed development.

5.3 WATER QUALITY

All well records submitted by well drillers indicated fresh water supplies. This was confirmed during conversations with local well owners while conducting our well survey. Groundwater samples were collected from the test wells and three accessible neighbouring wells for purposes of water quality analyses. In addition, a sample of water obtained from the Indian River was submitted for chemical analysis.

The test wells were sampled after a minimum period of one hour into the pump test. Test wells TW-2 and TW-3 were also sampled near the conclusion of the pump test. Certificates of chemical and bacteriological analyses are presented in Appendix C. These data are summarized in Table 2.

TABLE 3 - WATER QUALITY SUMMARY

PARAMETERS	TEST WELLS			PRIVATE WELLS				PROVINCIAL DRINKING WATER OBJECTIVES
	TW-1	TW-2	TW-3	W-1	W-2	W-5	INDIAN RIVER	
Minutes (*)	120	360	390					
Alkalinity mg CaCO3/l	227	207	205	211	219	218	103	---
Conductivity mhos/cm	539	469	442	564	520	560	270	---
Chloride mg/l	20.6	12.4	2.8	26.8	13.5	24.7	7.9	250
pH	7.7	7.7	7.5	7.7	7.6	7.9	7.9	6.5-8.5
Ammonia mg NH3-N/L	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	---
Nitrate mg NO3-N/L	0.89	0.25	0.32	1.61	1.60	<0.05	0.14	10
Turbidity NTU	0.7	<0.3	<0.3	<0.3	<0.3	<0.3	2.4	1.0
Calcium mg/l	94.4	87.7	88.1	93.9	92.0	94.0	43.0	---
Iron mg/l	0.03	<0.02	<0.02	<0.02	0.29	<0.02	0.17	0.3
Magnesium mg/l	3.70	2.20	1.70	3.20	3.40	4.10	3.80	---
Manganese mg/l	<0.01	<0.01	<0.01	<0.01	0.01	0.01	0.04	0.05
Sodium mg/l	8.1	4.7	1.2	13.2	6.9	11.2	4.5	20
Sulphate mg/l	12.0	12.1	13.9	18.5	17.2	17.7	15.6	500
Bacteriological:								
Total	4	0	2	0	---	0	32	---
Faecal	0	0	0	0	---	0	21	---

(*) Note: Time indicates period within the pump test at which the samples were obtained.

All parameters analyzed in the water samples from the test wells meet the provincial drinking water objectives. In addition, the water samples acquired from adjacent neighbouring wells indicate good water quality. Areal water supplies are moderately hard with low concentrations of nitrates, chlorides, sodium, and sulphates. It is concluded that the water quality of the principal aquifer formation offers no constraint with regard to the proposed residential development.

6.0 CONCLUSIONS AND RECOMMENDATIONS

6.1 GENERAL

Based on this hydrogeologic assessment, it is our opinion that the project site is suitable for the proposed residential development. The existing site is characterized by sloping topography covered with unmaintained grass. The surficial drainage is well defined in an eastward direction toward the Indian River. The subsurface stratigraphy is dominated by a surficial layer of topsoil underlain by a glaciofluvial deposit of gravelly sand and then a basal stratum of glacial drift (till).

Examination of local well information indicates the majority of persons obtain domestic water supplies from drilled wells into bedrock aquifer systems. Three test wells were installed and pump tested as part of this study. The wells encountered water in fracture systems within the underlying bedrock. The aquifer tapped by the three test wells exhibited high transmissivity and permeability characteristics. The water from the underlying aquifer is potable and conforms to the Provincial Drinking Water Objectives for the parameters that were tested.

Based on a pump testing program, the test wells have been rated with safe long term yields that vary from 1.52 L/s (20 gpm) to 1.90 L/s (25 gpm). The available well data suggests that adequate water resources are available for the proposed development.

On-site waste disposal is possible using Class 4 systems with in-ground leaching beds. The calculated impact of the proposed development on the off-site groundwater regime meets M.O.E. guidelines. Detailed conclusions and recommendations are presented in the following sections.

6.2 WATER SUPPLY

6.2.1 Availability

In accordance with the interim guidelines, the development must be capable of providing 2,700 L/day/lot. Therefore, the existing aquifer complexes must be able to supply a total of 64,800 L/day. This quantity is equivalent to a continuous flow of 0.75 L/s (9.9 gpm).

The three test wells constructed for this study are capable of providing a combined long term yield of 4.94 L/s (65 gpm). Thus, it is our opinion that ample groundwater supplies are available to meet the developmental requirements.

6.2.2 Production Well Requirements

Based on the results of this investigation, it is recommended that the proposed development be serviced by drilled wells. The wells should be extended into the underlying bedrock aquifer. It is expected that drilled wells will encounter water within fracture systems at depths of around 10m to 12m below existing grade. Large diameter (300mm or greater) wells are not considered suitable as a primary source of water supply for this site.

Each well installed should meet the following design criteria.

1. Drilled wells are suitable for water supplies for the proposed development. The wells must be continuously cased through non water yielding formations. At least the upper 6m of the casing must be sealed and grouted, in accordance with Regulation 612/84 of the Water Resources Act. The grout material should be tremmied into place between the borehole wall and the casing.

2. Bedrock wells may be constructed as open holes into bedrock below the casing shoe. The casing must be securely seated into rock and the annular space grouted in accordance with 612/84 of the Water Resources Act. Any well into bedrock should be properly developed to clean any silt or clay seams from the fracturing network.

3. Each well must be developed by conventional techniques to obtain a minimum 70% efficiency.

4. A water sample should be collected from each new well and analyzed for the following minimum test parameters to meet the provincial drinking water objectives.

   - Alkalinity
   - Bacteria
   - Chloride
   - Iron
   - Manganese
   - Nitrate
   - Sodium

5. It is suggested that properly constructed wells be pump tested by qualified hydrogeologic personnel prior to issuance of a building permit by the local building inspector. The well of each respective lot should be pump tested to determine a safe long term yield and short term capacity to ensure uninterrupted water supply for the proposed development.

The use of properly constructed drilled wells that are adequately sealed and certified by qualified hydrogeological personnel should be sufficient to provide ample quantities of potable water while preserving the long term water quality of the underlying aquifer complexes.

6.3 WASTE DISPOSAL

6.3.1 General

Based on the results of this assessment, it is our opinion that the site is suitable for Class 4 type waste disposal systems. The subsurface soil and groundwater conditions are suitable for the use of conventional in-ground leaching beds.

The primary impact of the proposed development is related to the increase in nitrate concentration due to septic effluent loading. The degradation of the local and shallow flow zones are viewed to be concerns of impact for the proposed development. A detailed review of the expected waste disposal impacts and recommendations are presented in the following sections.

6.3.2 Developmental Impact

For the purposes of calculating impact of the planned residential development, the M.O.E. considers 1000 L/day/household to be an acceptable effluent loading rate. Therefore, the proposed development is expected to generate about 24,000 L/day (24 m^3/day) of septic effluent. While most constituents in septic effluent are usually renovated within a short distance of movement within soil, mobile constituents such as chlorides and nitrates will require sustained dilution to meet the drinking water objectives of 10mg/l N for nitrate.

For the purpose of assessing the impact of potential nitrate loading, the dilution requirement of 4:1 was used over the area of the development site (excluding impervious surfaces). Therefore, the anticipated septic effluent from the planned subdivision will require a sustained dilution of at least 96,000 L/day (96 m^3/day) to reduce the mobile constituents to within acceptable levels.

In addition, a background nitrate level has been determined from the water quality data obtained from the on-site test wells. The average nitrate level from these wells was 0.49 mg/l N.

The following parameters were considered in the waste disposal evaluation:

1. Total Precipitation :		- 785 mm/year
2. Recharge Available :		- 275 mm/year
3. Infiltration Available for Dilution :		
	- Sand Subsoil :	- 200 mm/year
	- Till Subsoil :	- 150 mm/year
4. Development Area :		- 24.0 ha
5. Impervious Surfaces :	- Access Road :	- 1.5 ha
	- Roofs :	- 0.3 ha
6. Development Area Available for Dilution :		- 22.2 ha
7. Available On-Site Dilution:		- 114 m^3/day
8. Minimum Dilution Required:		- 98 m^3/day

Based on the above parameters, the projected long term resultant nitrate level will be 8.6 mg/l. Considering that the measured background nitrate level is 0.49 mg/l, the overall projected value is 9.09 mg/l. This level is less than the provincial drinking water standard of 10 mg/l for nitrate and therefore conforms to the present interim guidelines developed by the M.O.E.

In addition, effluent flow from the proposed development will be in the direction of the Indian River which acts as the major receiving watercourse. The flow for the Indian River is not monitored by the M.O.E. However, the river is one of several major drainage courses of the Kawartha Lakes system. The daily flow of this river is considered to be substantial. The existing nitrate level of the Indian River at the time of our study was 0.14 mg/l, indicating a very low background level. It is concluded that the potential impact of nitrate loading from septic effluent on the adjacent Indian River will be negligible due to the substantial daily flows and related dilution potential.

6.3.3 Waste Disposal Requirements

Based on the results of this assessment, it is our professional opinion that the site is suitable for class 4 private waste disposal systems. The design of individual leaching beds should be adjusted to suit local site conditions for each lot location.

The subsurface soil and groundwater conditions at the project site are suitable for the use of conventional in-ground tile beds. However, tile beds constructed in areas where the bedrock is less than 1.1m below the invert of the proposed tile bed, a partly raised or fully raised bed will be required.

For in-ground beds, it is recommended that the total length of distribution pipe be calculated using the formula L = QT/200, where:

L = length of the distribution pipe in metres
Q = daily sewage flow rate in litres/day
T = soil percolation rate below the pipe

For Gravelly Sand: T = 8 min/cm
For Silty Sand Till: T = 20 min/cm

The proposed waste disposal systems should meet Ontario Regulation 374/81 and incorporate the following design features:

1. All organics should be stripped from the area of the leaching bed.

2. The exposed subgrade below the tile beds should be trimmed and scarified, and provided with a gentle slope of 0.5%.

3. Should raised leaching type beds be constructed, the building material used should consist of clean, granular fill such as Granular 'B', Type I (OPSS Form 1010).

4. A mantle should be placed along the down-gradient margin of the raised beds. The mantle should extend along the full width of the bed, and for 15m down-gradient from the bed. The mantle should consist of similar granular fill raised to a minimum height of 250mm above the surrounding grade. An impermeable barrier should be installed at any location where possible breakouts may occur.

5. All surface runoff should be diverted away from the leaching beds by means of proper site drainage.

6. The waste disposal systems should be kept clear of surface drainage swales, roof leader drains, and other sources of surface water.

7. The tile beds should be kept away from shade trees, and a healthy cover of vegetation should be developed and maintained over the beds to promote evapotranspiration.

8. The waste disposal systems should have an adjacent reserve area, equal in area to the planned leaching bed.

9. Minimum set back distances from septic tank:

    a) Building - 1.5m
    b) Property line - 3m
    c) Well - 15m
    d) Open water course - 15m

10. Minimum set back distances from septic tile bed:

    a) Building - 5m
    b) Property line - 3m
    c) Drilled well, properly sealed - 15m
    d) Shallow well - 30m
    e) Open water course - 15m

11. The layout, design and construction of each waste disposal bed should be subject to inspection of experienced personnel.

In summary, provided the waste disposal systems are properly constructed in targeted areas, no significant impact is anticipated on down-gradient baseline water quality functions. The proposed development is expected to have negligible impact on existing baseflow conditions, and on the water quality of the principal aquifer system.

The use of properly constructed drilled wells that are certified and adequately sealed, should be sufficient to provide ample quantities of potable groundwater while preserving the long term water quality of the deep aquifer complex.

Sincerely yours,

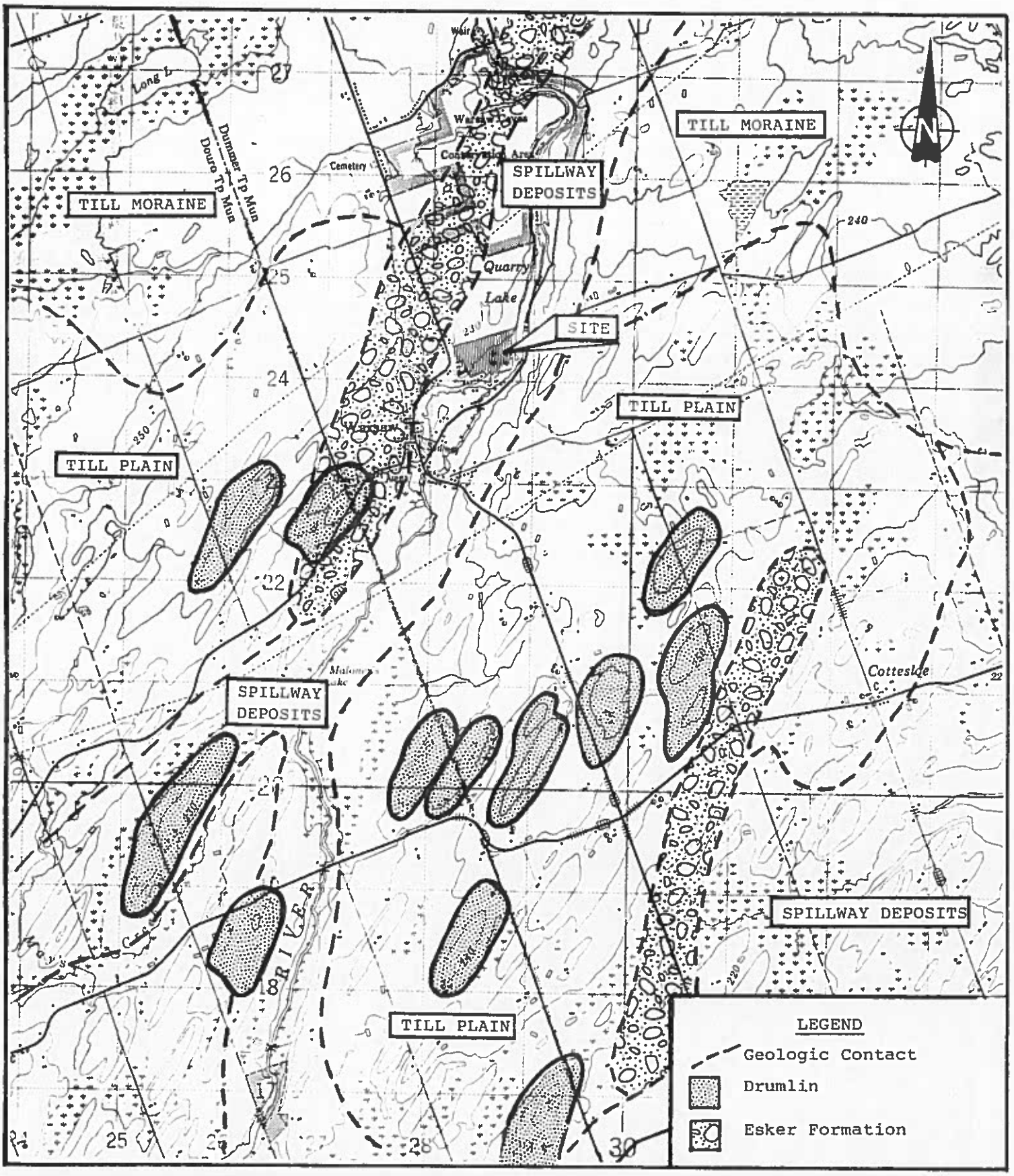
GEO-LOGIC INC.
GEOTECHNICAL ENGINEERS

David L. Workman, H.B.Sc.
Hydrogeologist

Nyle C. McIlveen, P.Eng.
Project Engineer

LICENSED PROFESSIONAL ENGINEER
N. C. McILVEEN
PROVINCE OF ONTARIO

/dw



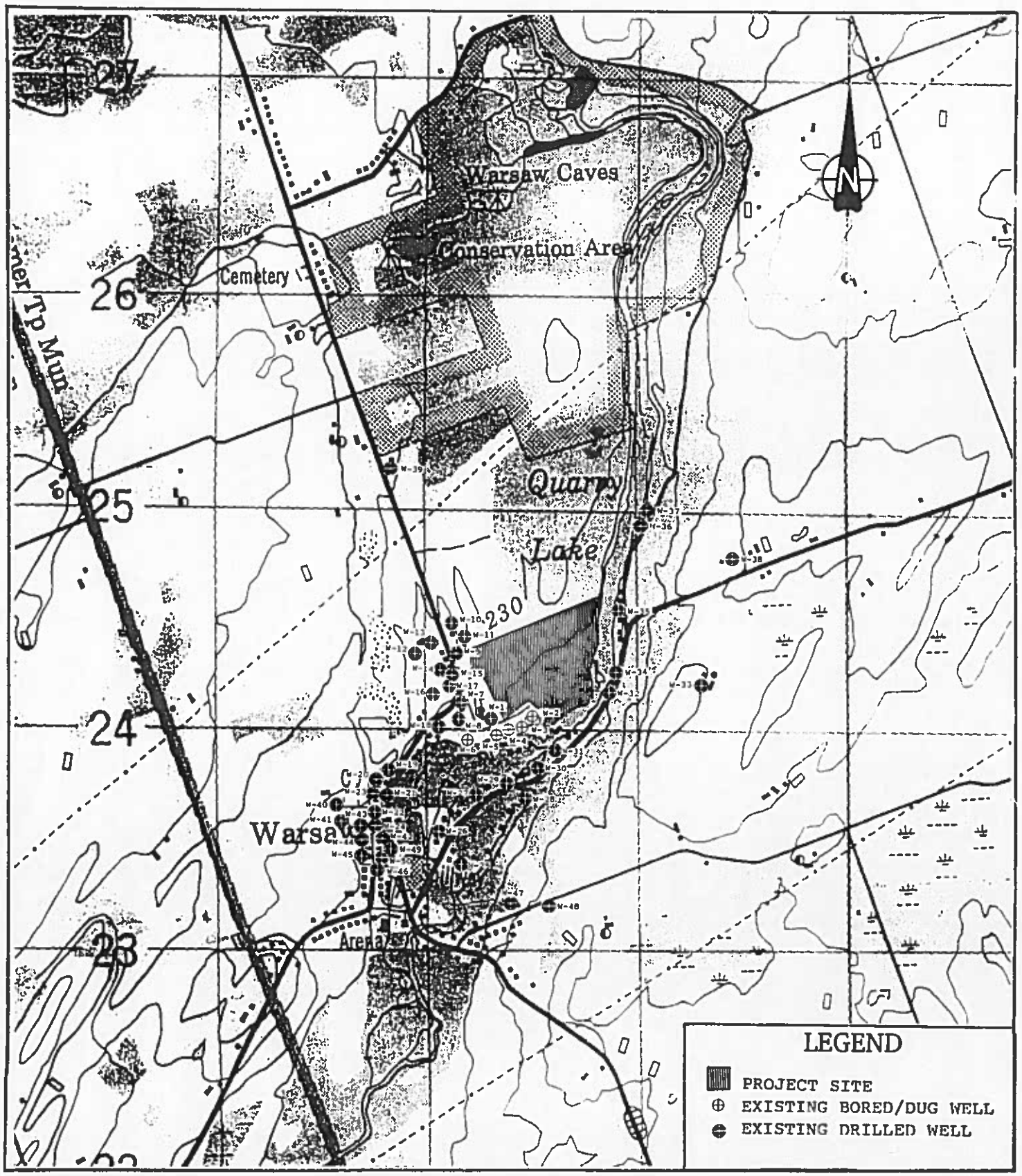
GEOLOGIC PLAN

TOWNSHIP OF DUMMER
PETERBOROUGH COUNTY

DATE:	May, 1990
CLIENT:	Mr. R. Cullimore
JOB NUMBER:	89-G-831
DRAWING NUMBER:	1

GEOLOGIC INC.
375 PIDO ROAD UNIT 107
BOX 694 PETERBOROUGH, ONTARIO
K9J 6Z8
(705) 749-3317

Plate 1



SITE PLAN

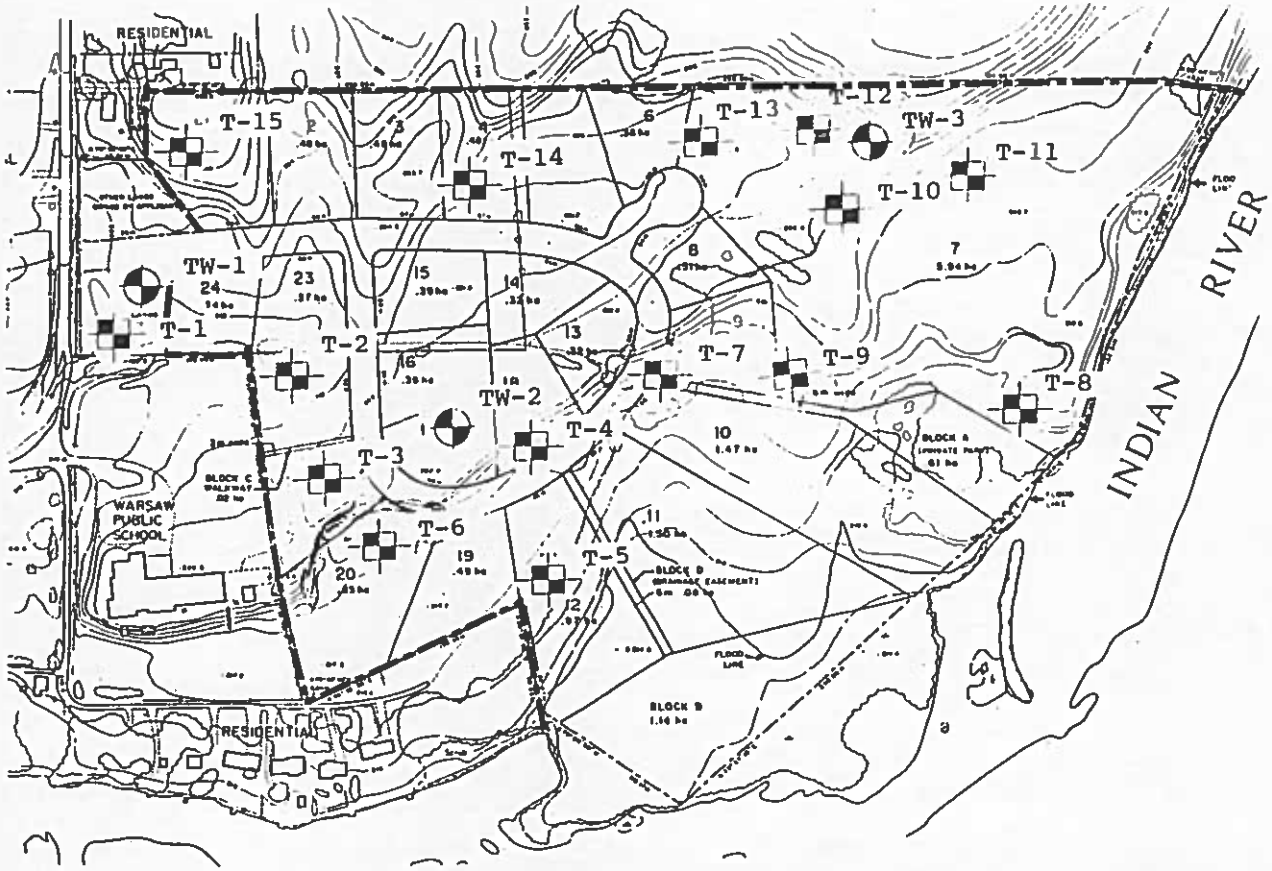
PROPOSED RESIDENTIAL SUBDIVISION

PART OF LOT 13, CONCESSION 2

TOWNSHIP OF DUMMER

DATE:	January, 1990
SCALE:	1:25,000
JOB NUMBER:	89 - G - 831
DRAWING NUMBER:	2

GEO-LOGIC INC.
375 PIDO ROAD UNIT 107
BOX 694 PETERBOROUGH, ONTARIO
K9J 6Z8
(705) 749-3317



LEGEND

Test Pit for this Investigation

Test Well Location

PLOT PLAN

PROPOSED RESIDENTIAL SUBDIVISION
PART OF LOT 13, CONCESSION 2
TOWNSHIP OF DUMMER

DATE:	Feb., 1992
SCALE:	1:5,000
JOB NUMBER:	89 - G - 831
DRAWING NUMBER:	3

GEO-LOGIC INC.
375 PIDO ROAD UNIT 107
BOX 694 PETERBOROUGH, ONTARIO
K9J 6Z8
(705) 749-3317

Plate 3

GEO – LOGIC INC.

WATER WELL SURVEY

Job No. 89-G-831
Client R. Cullimore
Location Warsaw
Sheet 1 of 2

WELL NO.	MOE NO.	OWNER	WELL DESCRIPTION					COMMENTS
			Dia.	Depth	Water Level	Well Head	M.P. Above Ground	
W-1	6266	Warsaw Public Scho	150	7.3	3.0	Conc.	—	Hard water reported.
W-2		Gay	900	4.6	—	Conc.	—	No problems reported.
W-3		Prest	900	4.6	—	Conc.	—	Good water reported.
W-4		Jacobs	900	4.6	—	Conc.	0.15	Reported dry, 10 years ago.
W-5		Nelson	900	4.6	—	Conc.	0.15	Bacteria problems-corrected by purifie
W-6		Payne	900	4.6	—	Conc.	0.15	No problems reported.
W-7	1040	Rodenham	150	15.2	11.3	—	B.G.	Hard water reported.
W-8	7997	Dowhan	150	15.2	2.5	—	—	Hard water reported.
W-9	1071	Fades	150	12.2	9.1	Conc.	0.13	Const. with cistern; fluctuates.
W-10	7008	Dracup	150	22.3	10.7	Conc.	0.15	Has Cistern; periodic shortages.
W-11	1073	Hawkins	150	15.2	7.0	Conc.	—	Previously drilled to 7.0m.
W-12	1044	Twp. Dummer	150	33.5	Dry	—	—	
W-13	1045	Twp. Dummer	150	18.3	5.5	—	—	
W-14	8598	Birkedhead	150	24.4	7.6	Steel	0.13	Seasonal supply problems.
W-15	8599	Sharp	150	25.9	9.5	Steel	0.13	Good water reported.
W-16	6416	Edwards	150	7.6	3.0	—	—	
W-17	8099	Edwards	150	8.8	3.0	—	—	
W-18	1039	Freeburn	150	15.5	3.7	—	—	
W-19	1035	Drain	125	7.9	2.4	—	—	
W-20	1042	Cook	150	6.40	4.3	—	—	
W-21	1038	Clairmont	200	7.6	3.0	—	—	
W-22	1041	Bell	125	5.8	4.0	—	—	
W-23	1037	Nelson	150	17.4	6.1	—	—	
W-24	1068	Brady	125	8.8	2.7	—	—	Previously dug to 3.0m.
W-25	10456	Brock	150	14.0	4.6	—	—	
W-26	5291	Castle	150	10.1	0.9	—	—	
W-27	10878	Cochrane	150	46.6	2.4	—	—	
W-28	1066	Douglas	150	7.0	2.7	—	—	
W-29	1064	Henriren	150	10.7	6.1	—	—	
W-30	1065	Douglas	150	33.2	10.9	—	—	Sulphur odour reported
W-31	4465	Castle	150	15.8	2.4	—	—	
W-32	1067	Castle	150	10.7	3.7	—	—	
W-33	1069	Douglas	150	34.1	8.6	—	—	
W-34	1070	Castle	125	4.0	2.2	—	—	
W-35	1074	Killingbeck	125	11.0	5.2	—	—	
W-36	10317	Bell	150	15.2	7.6	—	—	

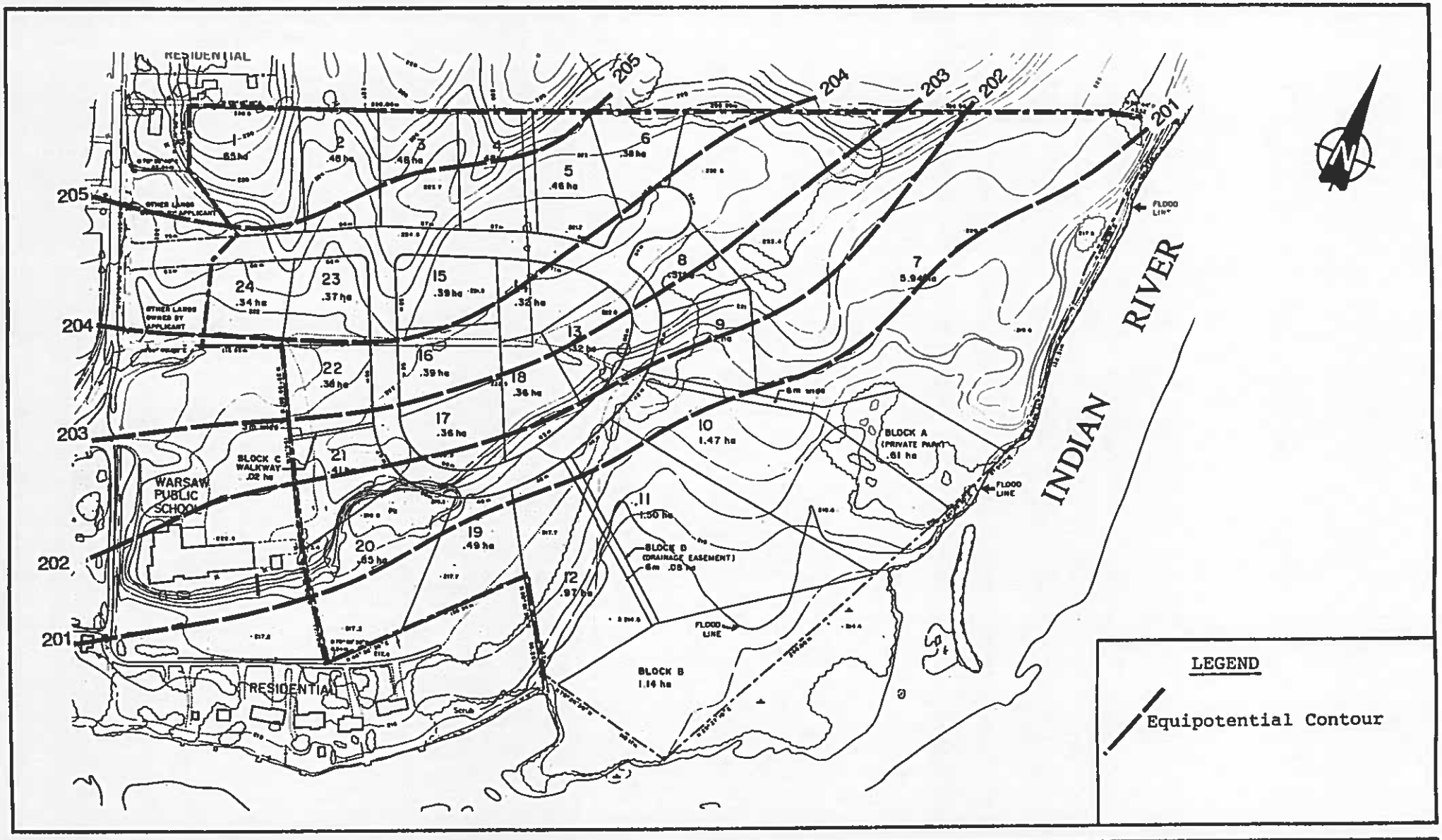
GEO – LOGIC INC.

WATER WELL SURVEY

Job No. 89-G-831
Client R. Cullimore
Location Warsaw
Sheet 2 of 2

WELL NO.	MOE NO.	OWNER	WELL DESCRIPTION					COMMENTS
			Dia	Depth	Water Level	Well Head	M.P. Above Ground	
W-37	9598	Simmonds	150	15.8	10.4	—	—	
W-38	5884	Henry	150	16.8	2.4	—	—	
W-39	1075	Hawthorne	125	8.8	6.1	—	—	Sulphur odour reported by driller.
W-40	6690	McMullen	150	22.3	6.7	—	—	
W-41	9564	Preston	—	22.9	9.1	—	—	Previously drilled to 10.4m.
W-42	1029	Payne	125	7.9	1.8	—	—	
W-43	9174	Hampton	150	25.0	15.2	—	—	Previously drilled to 15.2m.
W-44	5244	Payne	125	9.8	1.5	—	—	
W-45	8962	Hamilton	150	14.9	—	—	—	Sulphur odour reported by driller.
W-46	1030	Lonsberry	125	5.8	1.8	—	—	
W-47	10172	Freeburn	150	16.8	6.1	—	—	Sulphur odour reported by driller.
W-48	1063	Lonsberry	125	10.1	5.8	—	—	
W-49	9986	Taylor	150	7.6	1.5	—	—	
W-50	9770	Twist	150	7.6	2.1	—	—	

Plate 4B



WATER TABLE CONFIGURATION PLAN

PROPOSED RESIDENTIAL SUBDIVISION

TOWNSHIP OF DUMMER

DATE:	Feb., 1992
SCALE:	1:4,000
JOB NUMBER:	89-G-831
DRAWING NUMBER:	4

GEO-LOGIC INC.
375 PIDO ROAD UNIT 107
BOX 694 PETERBOROUGH, ONTARIO
K9J 6Z8
(705) 749-3317

Plate 5

APPENDIX A

SOILS EXPLORATION

APPENDIX A

SOILS EXPLORATION

FIELD EXPLORATION

Subsurface conditions at the site were explored by excavating fifteen (15) test pits at the locations shown on the Plot Plan, Plate A-1. The test pits ranged in depth from 0.05m (T-8) to 2.82m (T-13) below grade. The test pits were excavated on January 24, 1990, using a tractor mounted backhoe.

The field exploration was carried out under the direct supervision of experienced geotechnical personnel who obtained representative samples and maintained continuous logs of the soils encountered. The detailed description of the soils encountered is presented on each individual log, Plates A-2A through to A-2P. The soils have been classified according to the Unified Soil Classification System depicted on Plate A-3.

Prior to backfilling, a 19mm diameter standpipe piezometer was installed in representative test pits to facilitate the monitoring of stable groundwater levels. The water level monitoring data are presented on each respective test pit log. The location of each test pit was surveyed at the conclusion of the field work.

All samples were returned to our laboratory for further detailed examination, testing and classification. Field moisture content determinations were conducted on all acquired samples to aid in their classification and analysis. The moisture test data are graphically presented on the individual test pit logs.

Laboratory grain size distribution analyses were carried out on two representative samples of the native subsoil. The results of the grain size tests are summarized on the corresponding test pit log and are graphically illustrated on Plate A-4.

SUBSURFACE CONDITIONS

General

Based on the field exploration, the site is underlain by relatively uniform subsurface conditions. The revealed stratigraphy consists of a surficial layer of topsoil underlain by a glaciofluvial deposit of gravelly sand and then a basal stratum of glacial drift (till). Bedrock encroaches the surface near the east-central portion of the property and consists of fractured limestone exhibiting shale partings. The subsurface soil units are briefly described below.

Topsoil

The site is veneered by a mantle of silty topsoil. The topsoil ranges in thickness from 50mm (T-8) to 410mm (T-1) and averages 240mm thick. The topsoil contains fine rootlets and substantial organic matter and is therefore considered to be devoid of any structural engineering value.

Gravelly Sand

The surficial topsoil is underlain by a layer of gravelly sand along the majority of the site. Near the northern and central areas the gravelly sand layer is interbedded within a glacial till deposit. Where penetrated, the sand layer varies in thickness from 1.1m (T-6) to 2.6m (T-5) and averages 1.7m thick. The sand is generally brown in colour and exhibits a well graded texture.

A representative sample of the sand deposit was subjected to a grain size distribution analysis (see Plate A-4). The test results indicate that the soil is comprised of 19% gravel, 73% sand and 8% silt size particles by weight (Unified Soil Classification System). The coefficient of permeability is estimated to be approximately 1.5×10^{-3} cm/sec. The related percolation rate (T-time) is 8 min/cm.

The relative density is considered to be compact based on probing techniques carried out in the completed test pits. Field moisture contents of the gravelly sand varied from 2% to 9% and normally averaged 4.5%. Consequently, the moisture test data indicate that the sand layer exists in a damp to moist state.

Sand and Silt Till

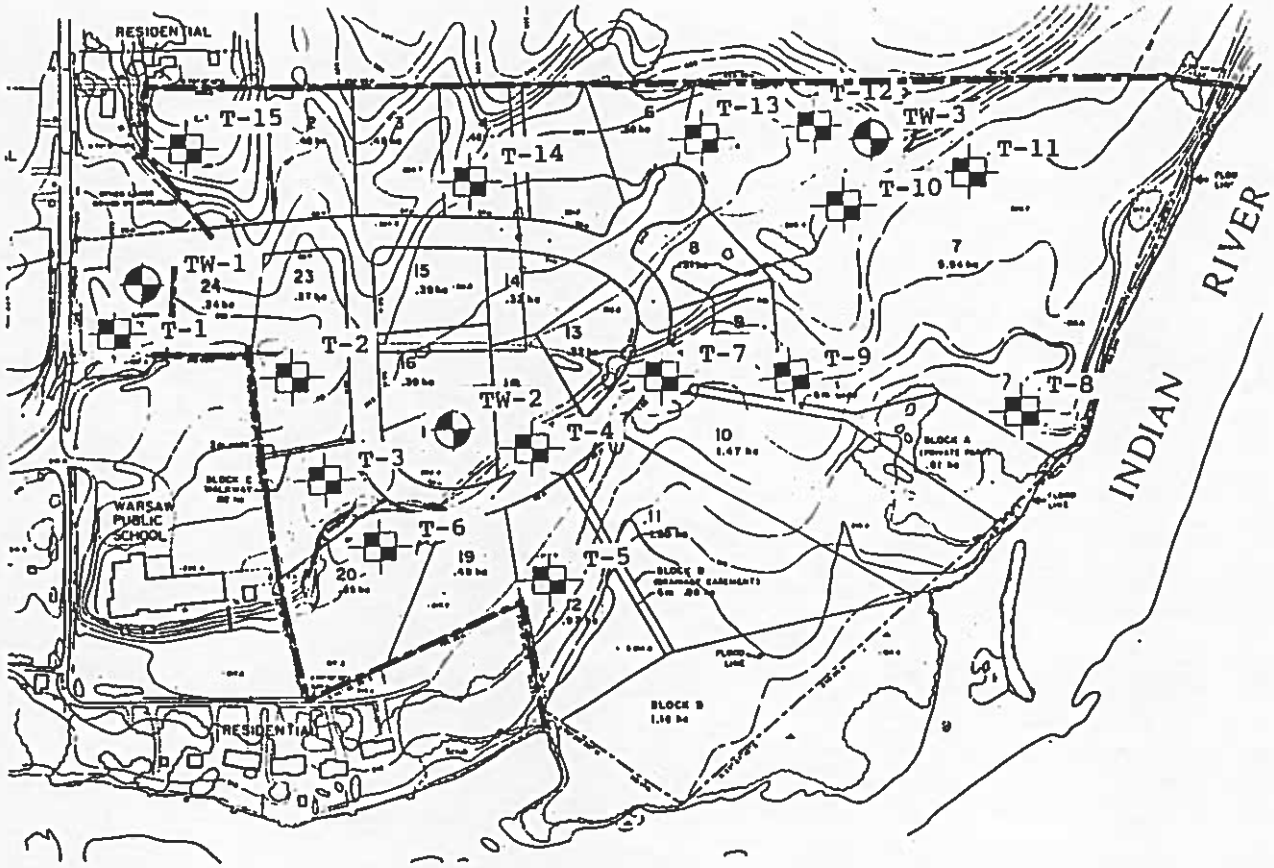
A basal stratum of glacial till was found to underlie the majority of the project site. The till was encountered by eight of the fifteen test pits. The till exists below the topsoil (T-4, T-13, and T-14) and below the gravelly sand (T-1, T-5 to T-7, and T-12).

The textural characteristics of the glacial till were assessed by conducting a grain size distributional analysis of a representative sample (see Plate A-4). The test data indicate that the till is comprised of a full range of soil particles from clay through to gravel. The predominate soil particles are sand and silt. The sand represents 52% by weight (Unified Soil System). The silt and clay comprise approximately 41% of the soil by weight. The gravel content is approximately 7%. The texture may be generally classed as well graded.

The till was noted to be fissured when exposed in the test pits. The relative density is considered to be compact to dense based on probing techniques carried out in the completed test pits. In-situ moisture contents normally averaged 13%. The coefficient of permeability is estimated to be on the order of 8×10^{-6} cm/sec. The related percolation rate is assessed to be on the order of 20 min/cm.

Groundwater

Groundwater seepage was only observed in Test Pits T-1 and T-7 during the excavating procedure. Other test pits were dry upon completion. Groundwater monitoring data are presented on the corresponding test pit logs. Stable groundwater levels at the project site measured three weeks after completion of the test pits ranged from 1.96m (T-1) to greater than 2.82m (T-13) and averaged 2.3m. Seasonal fluctuations in the groundwater table are expected to be about 1m.



LEGEND

Test Pit for this Investigation

Test Well Location

PLOT PLAN

PROPOSED RESIDENTIAL SUBDIVISION
PART OF LOT 13, CONCESSION 2
TOWNSHIP OF DUMMER

DATE:	Feb., 1992
SCALE:	1:5,000
JOB NUMBER:	89 - G - 831
DRAWING NUMBER:	3

GEO-LOGIC INC.
375 PIDO ROAD UNIT 107
BOX 694 PETERBOROUGH, ONTARIO
K9J 6Z8
(705) 749-3317

Plate A-1

ELEVATION	DEPTH	PROFILE	DESCRIPTION	WATER LEVEL	SAMPLE TYPE and NO.
			Dark Brown Sandy TOPSOIL		
	0.41		Brown Gravelly SAND, Trace Silt, Well Graded, Moist, Compact	19mm Standpipe	CS-1
					CS-2
	1.60		Brown SAND and Silt TILL, Trace Gravel, Well Graded, Non-Plastic, Moist, Dense		CS-3
	2.06		Test Pit Completed at a Depth of 2.06m. Test Pit wet on completion.		

MOISTURE CONTENT %

W_P □ W_N ○ W_L ▲

0 10 20 30 40

DEPTH IN METERS

0

REMARKS

19mm Standpipe Piezometer Installed to a Depth of 2.06m

Water Levels

-1.96m on Feb. 12, 1990

*Water seepage encountered @ 2.0m depth

-Presumed Bedrock at Point of Termination

VERTICAL SCALE: 1:30

LOG OF TEST PIT T-1

PROJECT NO.: 89-G-831

PROJECT: Proposed Subdivision

CLIENT: Mr. R. Cullimore

LOCATION: Warsaw

DATUM: ----------

DATE: February, 1990

DRILLING DATA

METHOD: Backhoe

DEPTH OF HOLE: 2.06m

TOP OF HOLE ELEVATION: ----------

GEO-LOGIC INC.
375 PIDO ROAD UNIT 107
BOX 894 PETERBOROUGH, ONTARIO
K9J 6Z8
(705) 749-3317

Plate A-2A

ELEVATION	DEPTH	PROFILE	DESCRIPTION	WATER LEVEL	SAMPLE TYPE and NO.
	0.30		Dark Brown Sandy TOPSOIL		
			Brown Gravelly, SAND, Trace Silt, Well Graded, Moist, Compact -occas. Cobbles and Boulders		CS-1
					CS-2
	2.03		Test Pit Completed at a Depth of 2.03m. Test Pit Dry on completion.		

MOISTURE CONTENT %

W_P □ W_R ○ W_L ▲

0 10 20 30 40

DEPTH IN METERS

0

REMARKS

VERTICAL SCALE: 1:30

LOG OF TEST PIT T-2		DRILLING DATA
PROJECT NO.: 89-G-831	LOCATION: Warsaw	METHOD: Backhoe
PROJECT: Proposed Subdivision	DATUM: ----------	DEPTH OF HOLE: 2.03m
CLIENT: Mr. R. Cullimore	DATE: February, 1990	TOP OF HOLE ELEVATION: ----------

GEO-LOGIC INC.
375 PIDO ROAD UNIT 107
BOX 894 PETERBOROUGH, ONTARIO
K9J 6Z8
(705) 749-3317

ELEVATION	DEPTH	PROFILE	DESCRIPTION	WATER LEVEL	SAMPLE TYPE and NO.
			Dark Brown Sandy, TOPSOIL		
	0.13		Brown Gravelly SAND, Trace Silt, Well Graded, Moist, Compact -Occas. Cobbles and Boulders		CS-1
					CS-2
	1.52		Test Pit completed at a Depth of 1,52m. Caving in at a Depth of 0.9m. Test Pit Dry on completion.		

MOISTURE CONTENT %

Wp □ Wn ○ Wl ▲

0 10 20 30 40

DEPTH IN METERS

REMARKS

VERTICAL SCALE: 1:30

LOG OF TEST PIT T-3		DRILLING DATA
PROJECT NO: 89-G-831	LOCATION: Warsaw	METHOD: Backhoe
PROJECT: Proposed Subdivision	DATUM: ----------	DEPTH OF HOLE: 1.52m
CLIENT: Mr. R. Cullimore	DATE: February, 1990	TOP OF HOLE ELEVATION: ----------

GEO-LOGIC INC.
375 PIDO ROAD UNIT 107
BOX 694 PETERBOROUGH, ONTARIO
K9J 6Z8
(705) 749-3317

Plate A-2C

ELEVATION	DEPTH	PROFILE	DESCRIPTION	WATER LEVEL	SAMPLE TYPE and NO.
			Dark Brown Sandy TOPSOIL		
	0.28		Brown SAND And Silt TILL, Trace Gravel, Well Graded, Non-Plastic, Moist, Dense	19mm Standpipe	CS-1
	1.78		Brown Gravelly SAND, Trace Silt, Well Graded, Moist, Compact		CS-2
	2.18		Test Pit Completed at a Depth of 2.18m. Test Pit Dry on completion		

MOISTURE CONTENT %

Wp □ Wn ○ WL ▲

0 10 20 30 40

DEPTH IN METERS

REMARKS

19mm Standpipe Piezometer Installed to a Depth of 2.18m.

Water Levels

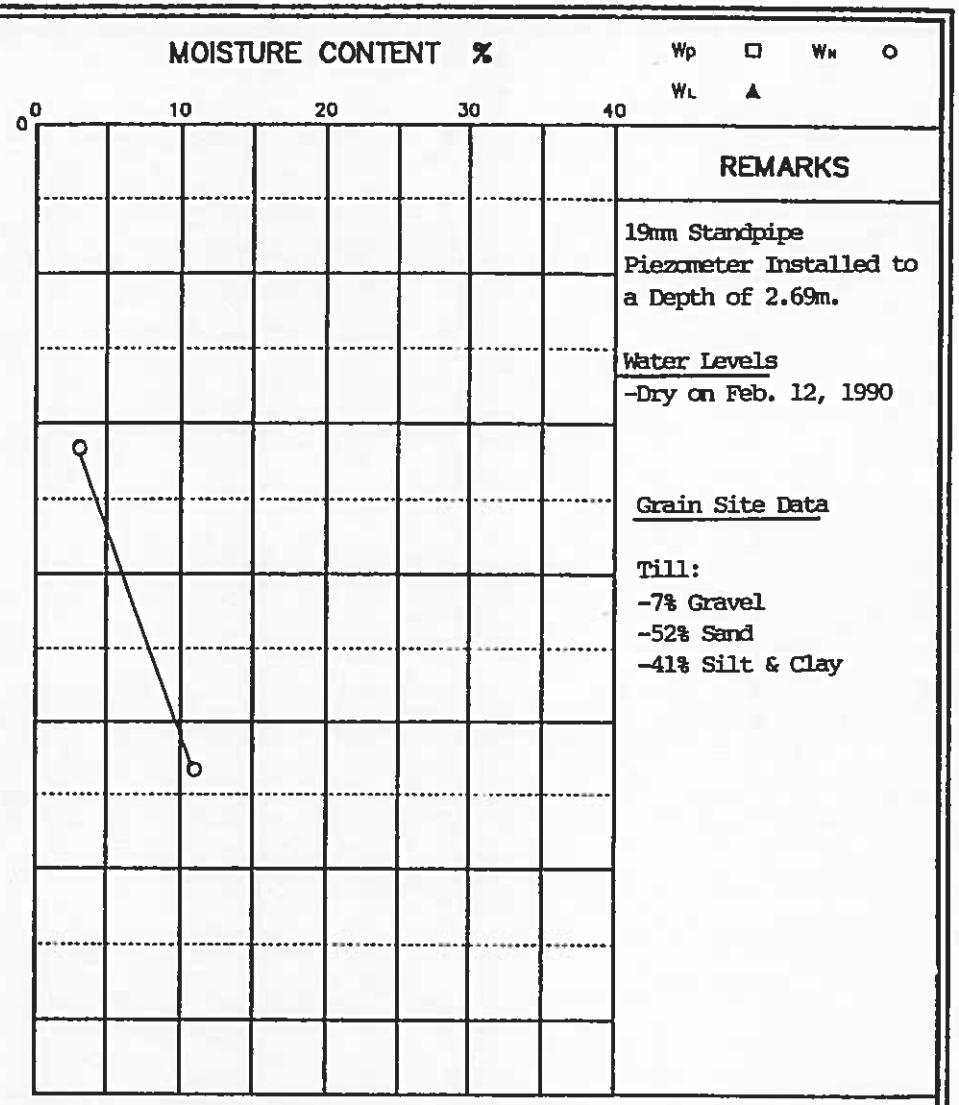
-Dry on Feb. 12, 1990

VERTICAL SCALE: 1:30

LOG OF TEST PIT T-4		DRILLING DATA
PROJECT NO.: 89-G-831	LOCATION: Warsaw	METHOD: Backhoe
PROJECT: Proposed Subdivision	DATUM: ----------	DEPTH OF HOLE: 2.18m
CLIENT: Mr. R. Cullimore	DATE: February, 1990	TOP OF HOLE ELEVATION: ----------

GEO-LOGIC INC.
375 PIDO ROAD UNIT 107
BOX 694 PETERBOROUGH, ONTARIO
K9J 6Z8
(705) 749-3317

ELEVATION	DEPTH	PROFILE	DESCRIPTION	WATER LEVEL	SAMPLE TYPE and NO.
			Dark Brown Sandy TOPSOIL		
	0.25		Brown Gravelly, SAND, Trace Silt, Well Graded, Moist, Compact	19mm Standpipe	CS-1
	2.36		Brown SAND and Silt TILL, Trace Gravel, Well Graded, Non-Plastic, Moist, Dense		CS-2
	2.69		Test Pit Completed at a Depth of 2.69m. Test Pit Dry on Completion.		



REMARKS

19mm Standpipe Piezometer Installed to a Depth of 2.69m.

Water Levels
-Dry on Feb. 12, 1990

Grain Site Data

Till:
-7% Gravel
-52% Sand
-41% Silt & Clay

VERTICAL SCALE: 1:30

LOG OF TEST PIT T-5		DRILLING DATA
PROJECT NO.: 89-G-831	LOCATION: Warsaw	METHOD: Backhoe
PROJECT: Prosposed Subdivision	DATUM: ----------	DEPTH OF HOLE: 2.69m
CLIENT: Mr. R. Cullimore	DATE: February, 1990	TOP OF HOLE ELEVATION: ----------

GEO-LOGIC INC.
375 PIDO ROAD UNIT 107
BOX 894 PETERBOROUGH, ONTARIO
K9J 6Z8
(705) 749-3317

Plate A-2E

ELEVATION	DEPTH	PROFILE	DESCRIPTION	WATER LEVEL	SAMPLE TYPE and NO.
			Dark Brown Sandy TOPSOIL		
	0.25		Brown Gravelly, SAND, Trace Silt, Well Graded, Moist, Compact		
					CS-1
	1.35		Brown SAND and Silt TILL, Trace Gravel, Well Graded, Non-Plastic, Moist, Dense	19mm Standpipe	
					CS-2
	2.29		Test Pit Completed at a Depth of 2.29m. Test Pit Dry on Completion. Caving in at Depth of 0.9m.		

MOISTURE CONTENT %

W_P □ W_N ○ W_L ▲

0 10 20 30 40

DEPTH IN METERS

REMARKS

19mm Standpipe Piezometer Installed to a Depth of 2.29m

Water Levels

-Dry on Feb. 12, 1990

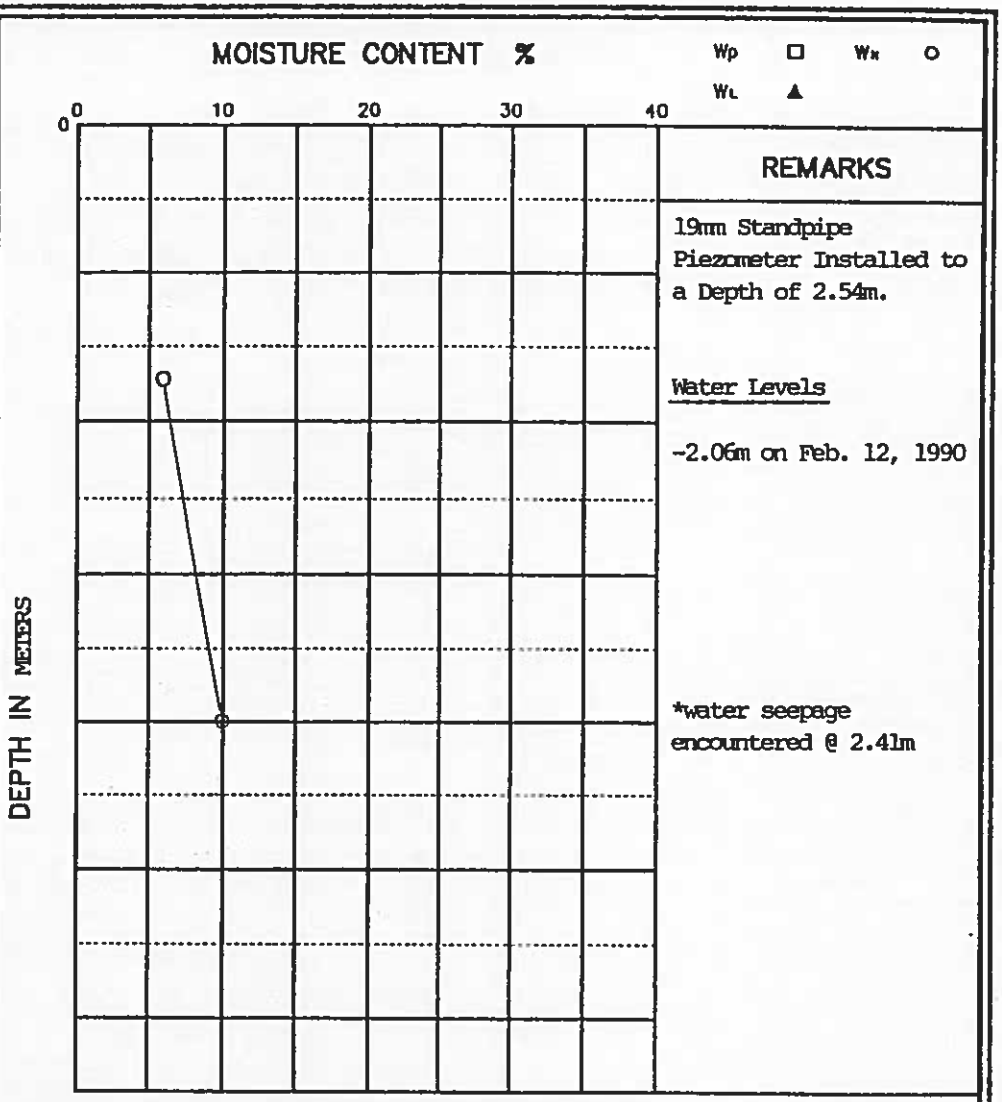
VERTICAL SCALE: 1:30

LOG OF TEST PIT T-6		DRILLING DATA
PROJECT NO.: 89-G-831	LOCATION: Warsaw	METHOD: Backhoe
PROJECT: Proposed Subdivision	DATUM: ----------	DEPTH OF HOLE: 2.29m
CLIENT: Mr. R. Cullimore	DATE: February, 1990	TOP OF HOLE ELEVATION: ----------

GEO-LOGIC INC.
375 PIDO ROAD UNIT 107
BOX 694 PETERBOROUGH, ONTARIO
K9J 6Z8
(705) 749-3317

Plate A-2F

ELEVATION	DEPTH	PROFILE	DESCRIPTION	WATER LEVEL	SAMPLE TYPE and NO.
			Dark Brown Sandy TOPSOIL		
	0.28		Brown Gravelly SAND, Trace Silt, Well Graded, Moist, Compact	19mm Standpipe	CS-1
	2.29		Brown SAND And Silt TILL, Trace Gravel, Well Graded, Non-Plastic, Moist, Dense		CS-2
	2.54		Test Pit Completed at a Depth of 2.54m. Test Pit Wet on Completion		



REMARKS

19mm Standpipe Piezometer Installed to a Depth of 2.54m.

Water Levels

-2.06m on Feb. 12, 1990

*water seepage encountered @ 2.4lm

VERTICAL SCALE: 1:30

LOG OF TEST PIT T-7		DRILLING DATA
PROJECT NO.: 89-G-831	LOCATION: Warsaw	METHOD: Backhoe
PROJECT: Proposed Subdivision	DATUM: ----------	DEPTH OF HOLE: 2.54m
CLIENT: Mr. R. Cullimore	DATE: February, 1990	TOP OF HOLE ELEVATION: ----------

GEO-LOGIC INC.
375 PIDO ROAD UNIT 107
BOX 694 PETERBOROUGH, ONTARIO
K9J 6Z8
(705) 749-3317

ELEVATION	DEPTH	PROFILE	DESCRIPTION	WATER LEVEL	SAMPLE TYPE and NO.
	0.05		Silty TOPSOIL		
			Test Pit Completed at 0.05m.		
			Bedrock at a Depth of 0.05m.		

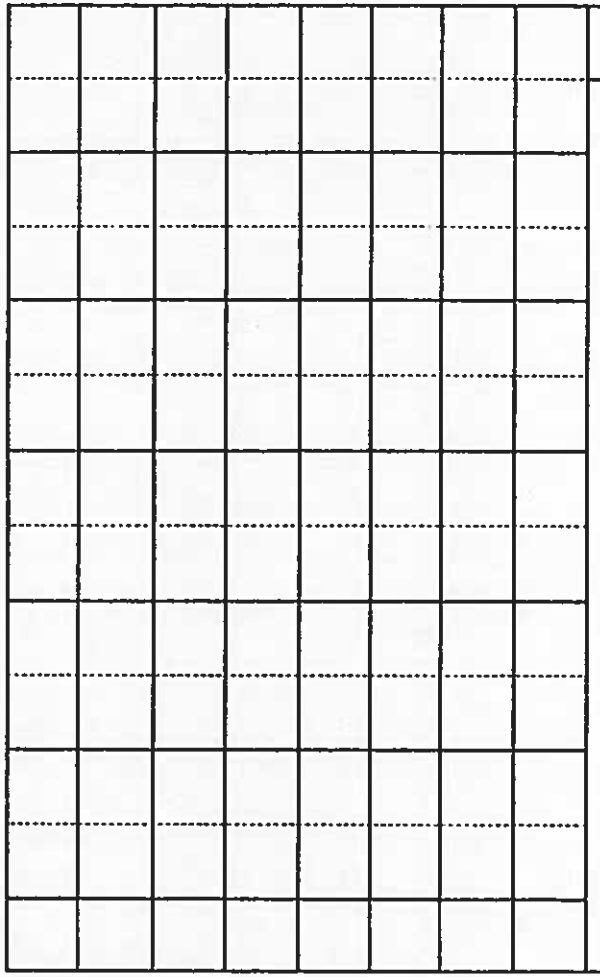
MOISTURE CONTENT %

W_P □ W_N ○ W_L ▲

0 10 20 30 40

DEPTH IN METERS

0



REMARKS

-Presumed Bedrock at Point of Termination

VERTICAL SCALE: 1:30

LOG OF TEST PIT T-8		DRILLING DATA
PROJECT NO.: 89-G-831	LOCATION: Warsaw	METHOD: Backhoe
PROJECT: Proposed Subdivision	DATUM: ----------	DEPTH OF HOLE: 0.05m
CLIENT: Mr. R. Cullimore	DATE: February, 1990	TOP OF HOLE ELEVATION: ----------

GEO-LOGIC INC.
375 PIDO ROAD UNIT 107
BOX 894 PETERBOROUGH, ONTARIO
K9J 6Z8
(705) 749-3317

Plate A-2H

ELEVATION	DEPTH	PROFILE	DESCRIPTION	WATER LEVEL	SAMPLE TYPE and NO.
	0.30		Dark Brown Silty TOPSOIL		
			Test Pit Completed at a Depth of 0.30m. Bedrock at a Depth of 0.30m.		

MOISTURE CONTENT %

W_P □ W_N ○ W_L ▲

0 10 20 30 40

DEPTH IN METERS

0

REMARKS

-Presumed Bedrock at Point of Termination

VERTICAL SCALE: 1:30

LOG OF TEST PIT T-9		DRILLING DATA
PROJECT NO.: 89-G-831	LOCATION: Warsaw	METHOD: Backhoe
PROJECT: Proposed Subdivision	DATUM: ----------	DEPTH OF HOLE: 0.30m
CLIENT: Mr. R. Cullimore	DATE: February, 1990	TOP OF HOLE ELEVATION: ----------

GEO-LOGIC INC.
375 PIDO ROAD UNIT 107
BOX 694 PETERBOROUGH, ONTARIO
K9J 6Z8
(705) 749-3317

Plate A-2I

ELEVATION	DEPTH	PROFILE	DESCRIPTION	WATER LEVEL	SAMPLE TYPE and NO.
	0.30		Dark Brown Silty TOPSOIL	19mm Standpipe	CS-1
			Brown Gravelly, SAND, Trace Silt, Well Graded, Moist, Compact		CS-2
	1.98		Test Pit Completed at a Depth of 1.98m. Test Pit Dry on completion Caving in at a Depth of 0.6m.		

MOISTURE CONTENT %

W_P □ W_N ○ W_L ▲

0 10 20 30 40

DEPTH IN METERS

0

1

2

REMARKS

19mm Standpipe Piezometer Installed to a Depth of 1.98m.

Water Levels
-Dry on Feb. 12, 1990

Grain Size Data:

Gravelly Sand:
-19% Gravel
-73% Sand
-8% Silt

VERTICAL SCALE: 1:30

LOG OF TEST PIT T-10		DRILLING DATA
PROJECT NO.: 89-G-831	LOCATION: Warsaw	METHOD: Backhoe
PROJECT: Proposed Subdivision	DATUM: ----------	DEPTH OF HOLE: 1.98m
CLIENT: Mr. R. Cullimore	DATE: February, 1990	TOP OF HOLE ELEVATION: ----------

GEO-LOGIC INC.
375 PIDO ROAD UNIT 107
BOX 694 PETERBOROUGH, ONTARIO
K9J 6Z8
(705) 749-3317

ELEVATION	DEPTH	PROFILE	DESCRIPTION	WATER LEVEL	SAMPLE TYPE and NO.
	0.20		Dark Brown Silty TOPSOIL		
			Brown Gravelly, SAND, Trace Silt, Well Graded, Moist, Compact		CS-1
					CS-2
	1.98		Test Pit Completed at a Depth of 1.98m. Test Pit Dry on completion.		

MOISTURE CONTENT %

Wp □ Wn ○ WL ▲

0 10 20 30 40

DEPTH IN METERS

REMARKS

VERTICAL SCALE: 1:30

LOG OF TEST PIT T-11		DRILLING DATA
PROJECT NO.: 89-G-831	LOCATION: Warsaw	METHOD: Backhoe
PROJECT: Proposed Subdivision	DATUM: ----------	DEPTH OF HOLE: 1.98m
CLIENT: Mr. R. Cullimore	DATE: February, 1990	TOP OF HOLE ELEVATION: ----------

GEO-LOGIC INC.
375 PIDO ROAD UNIT 107
BOX 694 PETERBOROUGH, ONTARIO
K9J 6Z8
(705) 749-3317

Plate A-2K

ELEVATION	DEPTH	PROFILE	DESCRIPTION	WATER LEVEL	SAMPLE TYPE and NO.
			Dark Brown Silty TOPSOIL		
	0.23		Brown Gravelly, SAND, Trace Silt, Well Graded, Moist, Compact		CS-1
	1.83		Brown SAND And Silt TILL, Trace Gravel, Well Graded, Non-Plastic, Moist, Dense		CS-2
	2.16		Test Pit Completed at a Depth of 2.16m. Test Pit Dry on Completion		

MOISTURE CONTENT %

Wp □ Wx ○ WL ▲

0 10 20 30 40

DEPTH IN METERS

0

REMARKS

VERTICAL SCALE: 1:30

LOG OF TEST PIT T-12		DRILLING DATA
PROJECT NO.: 89-G-831	LOCATION: Warsaw	METHOD: Backhoe
PROJECT: Proposed Subdivision	DATUM: ----------	DEPTH OF HOLE: 2.16m
CLIENT: Mr. R. Cullimore	DATE: February, 1990	TOP OF HOLE ELEVATION: ----------

GEO-LOGIC INC.
375 PIDO ROAD UNIT 107
BOX 894 PETERBOROUGH, ONTARIO
K9J 6Z8
(705) 749-3317

ELEVATION	DEPTH	PROFILE	DESCRIPTION	WATER LEVEL	SAMPLE TYPE and NO.
			Bark Brown Silty TOPSOIL		
	0.20		Brown SAND And Silt TILL Trace Gravel, Well Graded, Non-Plastic, Moist, Dense		
					CS-1
	1.52		Brown Gravelly SAND, Trace Silt, Well Graded, Moist, Compact	19mm Standpipe	
					CS-2
	2.82		Test Pit Completed at a Depth of 2.82m. Test Pit Dry on completion		

MOISTURE CONTENT %

Wp □ Wn ○ WL ▲

0 10 20 30 40

DEPTH IN METERS

0

REMARKS

19mm Standpipe Piezometer Installed to a Depth of 2.82m.

Water Levels

-Dry on Feb. 12, 1990

VERTICAL SCALE: 1:30

LOG OF TEST PIT T-13		DRILLING DATA
PROJECT NO.: 89-G-831	LOCATION: Warsaw	METHOD: Backhoe
PROJECT: Proposed Subdivision	DATUM: ----------	DEPTH OF HOLE: 2.82m
CLIENT: Mr. R. Cullimore	DATE: February, 1990	TOP OF HOLE ELEVATION: ----------

GEO-LOGIC INC.
375 PIDO ROAD UNIT 107
BOX 894 PETERBOROUGH, ONTARIO
K9J 6Z8
(705) 749-3317

ELEVATION	DEPTH	PROFILE	DESCRIPTION	WATER LEVEL	SAMPLE TYPE and NO.
			Dark Brown Silty TOPSOIL		
	0.25		Brown SAND And Silt TILL, Trace Gravel, Well Graded, Non-Plastic, Moist, Dense		CS-1
	0.61		Brown Gravelly SAND, Trace Silt, Well Graded, Moist, Compact		
	2.74		Test Pit Completed at a Depth of 2.74m. Test Pit Dry on Completion		CS-2

MOISTURE CONTENT %

Wp □ Wn ○ WL ▲

0 10 20 30 40

DEPTH IN METERS

REMARKS

VERTICAL SCALE: 1:30

LOG OF TEST PIT T-14		DRILLING DATA
PROJECT NO.: 89-G-831	LOCATION: Warsaw	METHOD: Backhoe
PROJECT: Proposed Subdivision	DATUM: ----------	DEPTH OF HOLE: 2.74m
CLIENT: Mr. R. Cullimore	DATE: February, 1990	TOP OF HOLE ELEVATION: ----------

GEO-LOGIC INC.
375 PIDO ROAD UNIT 107
BOX 694 PETERBOROUGH, ONTARIO
K9J 6Z8
(705) 749-3317

ELEVATION	DEPTH	PROFILE	DESCRIPTION	WATER LEVEL	SAMPLE TYPE and NO.
			Dark Brown Silty TOPSOIL		
	0.23		Brown Gravelly SAND, Trace Silt, Well Graded, Moist, Compact		CS-1
					CS-2
	2.46		Test Pit Completed at a Depth of 2.46m. Caving in at a Depth of 0.3m.		

MOISTURE CONTENT %

W_P □ W_N ○ W_L ▲

0 10 20 30 40

DEPTH IN METERS

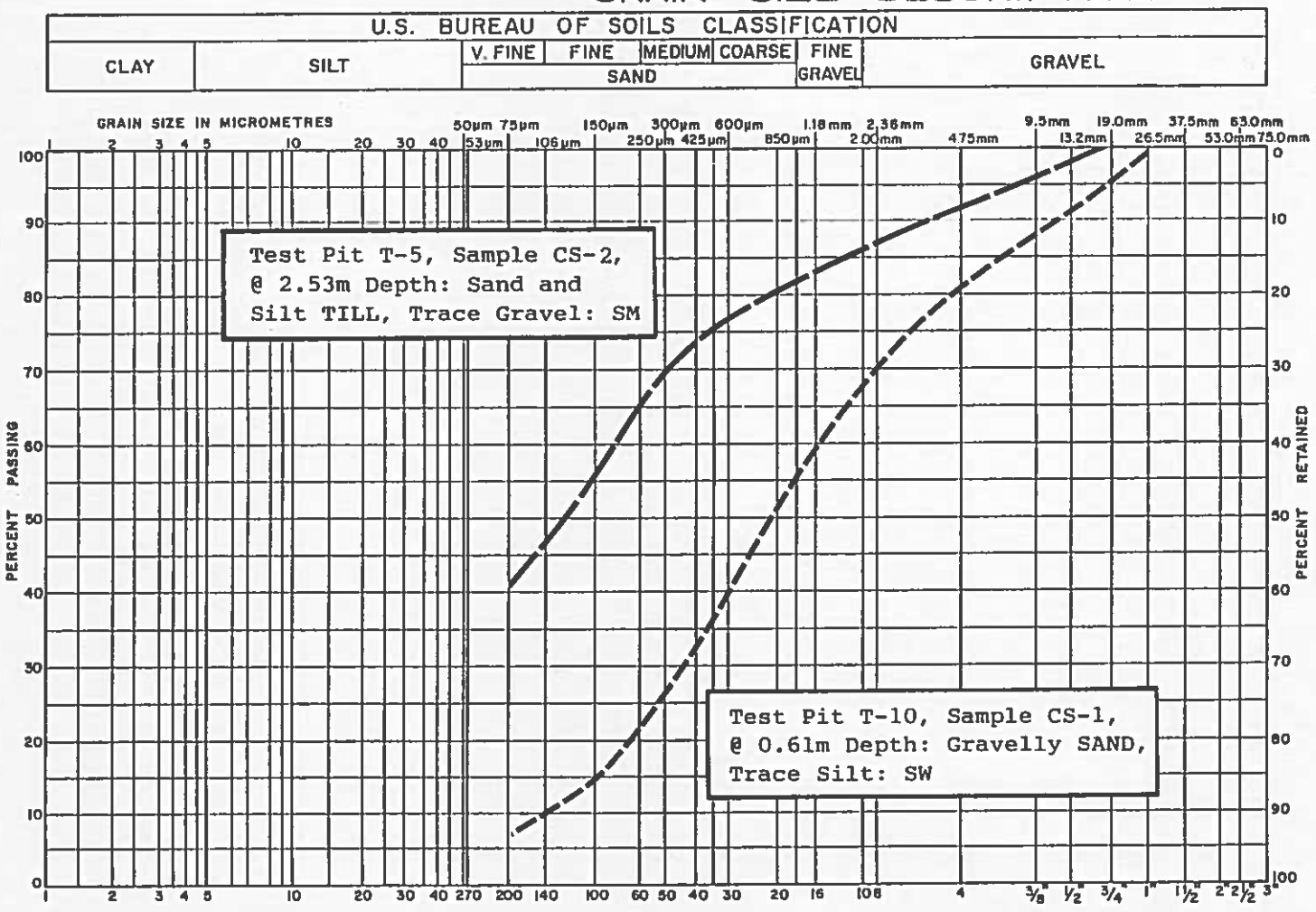
REMARKS

VERTICAL SCALE: 1:30

LOG OF TEST PIT T-15		DRILLING DATA
PROJECT NO.: 89-G-831	LOCATION: Warsaw	METHOD: Backhoe
PROJECT: Proposed Subdivision	DATUM: ----------	DEPTH OF HOLE: 2.46m
CLIENT: Mr. R. Cullimore	DATE: February, 1990	TOP OF HOLE ELEVATION: ----------

GEO-LOGIC INC.
375 PIDO ROAD UNIT 107
BOX 694 PETERBOROUGH, ONTARIO
K9J 6Z8
(705) 749-3317

GRAIN SIZE DESCRIPTION



U.S. BUREAU OF SOILS CLASSIFICATION

% FINE GRAVEL	--
% COARSE AND MEDIUM SAND	--
% FINE AND VERY FINE SAND	--
% SILT	--
% CLAY	--
% VERY FINE SAND AND SILT	--
TEXTURAL CLASS	--

UNIFIED SOIL CLASSIFICATION

% PASSING # 4	--
% PASSING # 200	--
$C_u = \frac{D_{60}}{D_{10}} =$	--
$C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}} =$	--
LIQUID LIMIT	-- %
PLASTIC LIMIT	-- %
PLASTICITY INDEX	-- %
CLASSIFICATION	--
GROUP SYMBOL	--

DENSITY

SPECIFIC GRAVITY	--
MAXIMUM WET	--
MAXIMUM DRY	--
OPTIMUM MOISTURE CONTENT	-- %
FIELD WET	--
FIELD DRY	--
FIELD MOISTURE CONTENT	-- %
% COMPACTION	--

CLIENT Mr. R. Cullimore PROJECT No. 89-G-831 DATE April, 1990

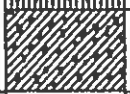
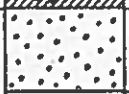
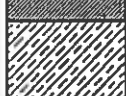
PROJECT Proposed Residential Subdivision TEST HOLE No. As Shown DEPTH As Shown

DESCRIPTION As Shown SAMPLE No. As Shown DWG. No. A-3

GEO-LOGIC INC.
375 PIDO ROAD
UNIT 107
BOX 694
PETERBOROUGH, ONT
K9J 6Z8

Plate A-3

UNIFIED SOIL CLASSIFICATION SYSTEM

MAJOR DIVISIONS			GRAPH SYMBOL	LETTER SYMBOL	TYPICAL DESCRIPTION
COARSE GRAINED SOILS More than half of material is larger than No. 200 (75 um) sieve size.	GRAVELS More than half of gravel fraction is smaller than No. 4(4.75mm) sieve	CLEAN GRAVELS (Little or no fines)		GW	Well-graded gravels, gravel-sand mixtures, little or no fines.
				GP	Poorly-graded gravels, gravel-sand mixtures, little or no fines.
		GRAVELS WITH FINES		GM	Silty gravels, gravel-sand-silt mixtures.
				GC	Clayey gravels, gravel-sand-clay mixtures.
	SANDS More than half of coarse fraction passing No.4(4.75mm) sieve.	CLEAN SANDS (Little or no fines)		SW	Well-graded sands, gravelly sands, little or no fines.
				SP	Poorly-graded sands, gravelly sands, little or no fines.
		SANDS WITH FINES		SM	Silty sands, sand-silt mixtures.
				SC	Clayey sands, sand-clay mixtures.
FINE GRAINED SOILS More than half of material is smaller than No. 200 sieve size.	SILTS AND CLAYS Liquid limit less than 50			ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity.
				CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.
				OL	Organic silts and organic silty clays of low plasticity.
	SILTS AND CLAYS Liquid limit less than 50			MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts.
				CH	Inorganic clays of high plasticity, fat clays.
				OH	Organic clays of medium to high plasticity, organic silts.
HIGHLY ORGANIC SOILS				PT	Peat and other highly organic soils.

FIELD SAMPLING TERMINOLOGY	PROPORTION	RELATIVE DENSITY		CONSISTENCY	
		N-VALUE		SHEAR STRENGTH	
AS Auger Sample	Trace <10%	Very Loose	0-4	Very Soft	<12kPa
CS Chunk Sample	Little 10-20%	Loose	4-10	Soft	12-25kPa
RC Rock Core	Some 20-35%	Compact	10-30	Firm	25-50kPa
SS Split Spoon Sample	And 35-50%	Dense	30-50	Stiff	50-100kPa
ST Slotted Tube Sample		Very Dense	>50	Very Stiff	100-200kPa
TW Thin Walled Open				Hard	>200kPa
TP Thin Walled Piston					

GEO-
LOGIC INC.

PLATE A-4

APPENDIX B

WELL INVENTORY DATA

INVENTORY OF REPRESENTATIVE WELLS
WITHIN 1 KM OF SITE

W-1 MOE No: 6266 Date Drilled: 1972
Orig.Owner: Bord. of Ed. Static Level: 3.0 m
Diameter: 150 mm Test Rate: 2.28 L/S (30gpm)
Depth: 7.3 m Water Encountered 7.3 m
Geologic Log:
Stony Gravel 7.0, Limestone 7.3

W-7 MOE No: 1040 Date Drilled: 1963
Orig.Owner: C. Bodenham Static Level: 3.7 m
Diameter: 150 mm Test Rate: 0.08 L/S (1 gpm)
Depth: 15.2 m Water Encountered: 11.3 m
Geologic Log:
Topsoil 0.3, Stony Clay 2.7, Limestone 15.2

W-8 MOE No: 7997 Date Drilled: 1976
Orig.Owner: L.Dowhan Static Level: 2.5 m
Diameter: 150 mm Test Rate: 0.38 L/S (5 gpm)
Depth: 15.2 m Water Encountered: 14.3 m
Geologic Log:
Topsoil 0.6, Porous Limestone 15.2

W-9 MOE No: 1071 Date Drilled: 1961
Orig.Owner: I.Eadie Static Level: 9.1 m
Diameter: 150 mm Test Rate: 0.08 L/S (1 gpm)
Depth: 12.2 m Water Encountered: 9.14 m
Geologic Log:
Gravel 3.4, Limestone 12.2

W-10 MOE No: 7008 Date Drilled: 1974
Orig.Owner: G.Dracup Static Level: 10.7 m
Diameter: 150 mm Test Rate: 0.23 L/S (3 gpm)
Depth: 22.3 m Water Encountered:15.2,22.3 m
Geologic Log:
Topsoil 0.3, Gravelly Clay 6.7, Limestone 22.3

W-11 MOE No: 1073 Date Drilled: 1959
Orig.Owner: G.Hawkins Static Level: 7.0 m
Diameter: 125 mm Test Rate: 0.23 L/S (3 gpm)
Depth: - 15.2 m Water Encountered: 5.5 m
Geologic Log:
Previously Drilled 7.0, Limestone 15.2

INVENTORY OF REPRESENTATIVE WELLS
WITHIN 1 KM OF SITE

W-12 MOE No: 1044 Date Drilled: 1967
Orig.Owner: Twp of Dummer Static Level: Dry m
Diameter: 150 mm Test Rate: - L/S (- gpm)
Depth: 33.5 m Water Encountered - m
Geologic Log:
Topsoil 0.3, Stony Clay 3.7, Limestone 33.5

W-13 MOE No: 1045 Date Drilled: 1967
Orig.Owner: Twp.of Dummer Static Level: 5.5 m
Diameter: 150 mm Test Rate: 0.08 L/S (1 gpm)
Depth: 18.3 m Water Encountered 10.1 m
Geologic Log:
Topsoil 0.3, Stony Clay 2.4, Limestone 18.3

W-14 MOE No: 8588 Date Drilled: 1976
Orig.Owner: L. Edwards Static Level: 7.6 m
Diameter: 150 mm Test Rate: 0.15 L/S (2 gpm)
Depth: 24.4 m Water Encountered: 10.7 m
Geologic Log:
Sand fill 0.6, Stony Clay 3.0, Shale 4.9,
Limestone 24.4

W-15 MOE No: 8589 Date Drilled: 1976
Orig.Owner: B.Thompson Static Level: 8.5 m
Diameter: - mm Test Rate: - L/S (- gpm)
Depth: 25.9 m Water Encountered 17.7 m
Geologic Log:
Previously Drilled 8.8, Limestone 25.9

W-16 MOE No: 6416 Date Drilled: 1972
Orig.Owner: L.Edwards Static Level: 3.0 m
Diameter: 150 mm Test Rate: 0.38 L/S (5 gpm)
Depth: 7.6 m Water Encountered: 7.3 m
Geologic Log:
Topsoil 0.9, Gravelly Sand 2.7, Limestone 7.6

W-17 MOE No: 8099 Date Drilled: 1975
Orig.Owner: L.Edwards Static Level: 3.0 m
Diameter: 150 mm Test Rate: 2.28 L/S (30 gpm)
Depth: 8.8 m Water Encountered: 4.0 m
Geologic Log:
Fill 1.8, Gravel 3.0, Shale 4.0, Limestone 8.8

INVENTORY OF REPRESENTATIVE WELLS
WITHIN 1 KM OF SITE

W-18 MOE No: 1039 Date Drilled: 1963
Orig.Owner: K.Freeburn Static Level: 3.7 m
Diameter: 150 mm Test Rate: 2.28 L/S (30 gpm)
Depth: 15.5 m Water Encountered 12.2 m
Geologic Log:
Topsoil 0.3, Bouldery Clay 1.5, Clayey Shale 2.4, Limestone 15.5

W-19 MOE No: 1035 Date Drilled: 1967
Orig.Owner: E.Drain Static Level: 2.4 m
Diameter: 125 mm Test Rate: 0.38 L/S (5 gpm)
Depth: 7.9 m Water Encountered 5.5 m
Geologic Log:
Stony Topsoil 5.8, Limestone 7.9

W-20 MOE No: 1042 Date Drilled: 1956
Orig.Owner: J.CooK Static Level: 4.3 m
Diameter: 150 mm Test Rate: 1.29 L/S (17 gpm)
Depth: 6.4 m Water Encountered 6.1 m
Geologic Log:
Gravel 4.3, Limestone 6.4

W-21 MOE No: 1038 Date Drilled: 1954
Orig.Owner: A.Clairmont Static Level: 3.0 m
Diameter: 200 mm Test Rate: 0.61 L/S (8 gpm)
Depth: 7.6 m Water Encountered: 7.6 m
Geologic Log:
Stony Sandy Clay 3.0, Limestone 7.6

W-22 MOE No: 1041 Date Drilled: 1964
Orig.Owner: A.Bell Static Level: 4.0 m
Diameter: 125 mm Test Rate: 0.30 L/S (4 gpm)
Depth: 5.8 m Water Encountered: 4.9 m
Geologic Log:
Stony Topsoil 3.4, Limestone 5.8

W-23 MOE No: 1037 Date Drilled: 1967
Orig.Owner: C.Nelson Static Level: 6.1 m
Diameter: 150 mm Test Rate: 0.30 L/S (4 gpm)
Depth: 17.4 m Water Encountered: 17.4 m
Geologic Log:
Topsoil 0.60, Stony Clay 12.2, Limestone 17.4

INVENTORY OF REPRESENTATIVE WELLS
WITHIN 1 KM OF SITE

W-24 MOE No: 1068 Date Drilled: 1964
Orig.Owner: R.Brady Static Level: 2.7 m
Diameter: 125 mm Test Rate: 0.15 L/S (2 gpm)
Depth: 8.8 m Water Encountered 8.2 m
Geologic Log:
Previously Dug 3.0, Limestone 8.8

W-25 MOE No: 10456 Date Drilled: 1982
Orig.Owner: E.Brock Static Level: 4.6 m
Diameter: 150 mm Test Rate: 1.51 L/S (20 gpm)
Depth: 14.0 m Water Encountered: 12.2, 14.0m
Geologic Log:
Bouldery Stones 7.9, Gravelly Shale 8.5,
Limestone 14.0

W-26 MOE No: 5291 Date Drilled: 1968
Orig.Owner: E.Castle Static Level: 0.9 m
Diameter: 150 mm Test Rate: 0.76 L/S (10 gpm)
Depth: 10.1 m Water Encountered 9.8 m
Geologic Log:
Topsoil 0.3, Limestone 10.1

W-27 MOE No: 10878 Date Drilled: 1983
Orig.Owner: D.Cochrane Static Level: 2.4 m
Diameter: 150 mm Test Rate: 6.08 L/S (80 gpm)
Depth: 46.6 m Water Encountered: 46.6 m
Geologic Log:
Stony Gravel 0.9, Porous Limestone 36.6,
Limestone 46.6

W-28 MOE No: 1066 Date Drilled: 1957
Orig.Owner: J. Douglas Static Level: 2.7 m
Diameter: 150 mm Test Rate: --- L/S (-- gpm)
Depth: 7.0 m Water Encountered 7.0 m
GeoLogic Log:
Gravelly Topsoil 2.5, Grey Limestone 7.0

W-29 MOE No: 1064 Date Drilled: 1956
Orig.Owner: B. Hendren Static Level: 6.1 m
Diameter: 150 mm Test Rate: 0.30 L/S (4 gpm)
Depth: 10.7 m Water Encountered: 7.6 m
GeoLogic Log:
Sandy Topsoil 3.7, Grey Limestone 10.7

INVENTORY OF REPRESENTATIVE WELLS
WITHIN 1 KM OF SITE

W-30 MOE No: 1065 Date Drilled: 1957
Orig.Owner: J. Douglas Static Level: 10.9 m
Diameter: 150 mm Test Rate: --- L/S (-- gpm)
Depth: 33.2 m Water Encountered: 24.1 m
GeoLogic Log:
Gravelly Topsoil 11.0, Limestone 33.2

W-31 MOE No: 7465 Date Drilled: 1975
Orig.Owner: H. Castle Static Level: 2.4 m
Diameter: 150 mm Test Rate: 0.15 L/S (2 gpm)
Depth: 15.8 m Water Encountered: 15.8m
GeoLogic Log:
Hard Layered Grey Limestone 15.8

W-32 MOE No: 1067 Date Drilled: 1964
Orig.Owner:F.Castle Static Level: 3.7 m
Diameter: 150 mm Test Rate: 1.51 L/S (20 gpm)
Depth: 10.7 m Water Encountered: 9.1 m
Geologic Log:
Limestone 10.7

W-33 MOE No: 1069 Date Drilled: 1967
Orig.Owner:P.Douglas Static Level: 8.6 m
Diameter: 150 mm Test Rate: 0.76 L/S (10 gpm)
Depth: 34.1 m Water Encountered: 9.1 m
Geologic Log:
Topsoil 0.6, Sandy Clay 4.6, Shaley Clay 8.2,
Gravel 11.0, Limestone 34.1

W-34 MOE No: 1070 Date Drilled: 1960
Orig.Owner: E.Castle Static Level: 2.1 m
Diameter: 125 mm Test Rate: 0.76 L/S (10 gpm)
Depth: 4.0 m Water Encountered: 1.2 m
Geologic Log:
Limestone 4.0

W-35 MOE No: 1074 Date Drilled: 1960
Orig.Owner:H.Killingbeck Static Level: 5.2 m
Diameter: 125 mm Test Rate: 0.08 L/S (1 gpm)
Depth: 11.0 m Water Encountered: 8.3 m
Geologic Log:
Limestone/Topsoil 0.9, Limestone 11.0

INVENTORY OF REPRESENTATIVE WELLS
WITHIN 1 KM OF SITE

W-36 MOE No: 10317 Date Drilled: 1981
Orig.Owner: K.Bell Static Level: 7.6 m
Diameter: 150 mm Test Rate: 0.38 L/S (5 gpm)
Depth: 15.2 m Water Encountered: 15.2 m
Geologic Log:
Limestone 15.2

W-37 MOE No: 9598 Date Drilled: 1979
Orig.Owner: E.Simmonds Static Level: 10.4 m
Diameter: 150 mm Test Rate: 1.51 L/S (20 gpm)
Depth: 15.8 m Water Encountered: 15.8 m
Geologic Log:
Stony Gravel 0.9, Limestone 16.0

W-38 MOE No: 5884 Date Drilled: 1972
Orig.Owner: R.Henry Static Level: 2.4 m
Diameter: 150 mm Test Rate: 0.15 L/S (2 gpm)
Depth: 16.8 m Water Encountered: 9.1 m
Geologic Log:
Topsoil 0.3, Bouldery Clay 3.7, Sandy Clay 9.1,
Gravelly Sand 10.7, Clay 13.7, Limestone 16.8

W-39 MOE No: 1075 Date Drilled: 1966
Orig.Owner: I.Hawthorne Static Level: 6.1 m
Diameter: 125 mm Test Rate: 0.38 L/S (5 gpm)
Depth: 8.8 m Water Encountered: 8.5 m
Geologic Log:
Stony Gravel 2.4, Limestone 8.8

W-40 MOE No: 6690 Date Drilled: 1973
Orig.Owner:G.McMullen Static Level: 6.7 m
Diameter: 150 mm Test Rate: 0.15 L/S (2 gpm)
Depth: 22.3 m Water Encountered: 19.8 m
Geologic Log:
Clay 3.4, Limestone 22.3

W-41 MOE No: 9564 Date Drilled: 1979
Orig.Owner: M. Preston Static Level: 9.1 m
Diameter: --- mm Test Rate: ---- L/S (- gpm)
Depth: 22.9 m Water Encountered: 22.6 m
Geologic Log:
Previously Drilled 10.4, Limestone 22.9

INVENTORY OF REPRESENTATIVE WELLS
WITHIN 1 KM OF SITE

W-42 MOE No: 1029 Date Drilled: 1961
Orig.Owner: V. Payne Static Level: 1.8 m
Diameter: 125 mm Test Rate: 0.23 L/S (3 gpm)
Depth: 7.9 m Water Encountered 4.0 m
Geologic Log:
Clayey Topsoil 4.6, Limestone 7.9

W-43 MOE No: 9174 Date Drilled: 1978
Orig.Owner: G. Hampton Static Level: 15.2 m
Diameter: 150 mm Test Rate: 0.46 L/S (6 gpm)
Depth: 25.0 m Water Encountered: 25.0 m
Geologic Log:
Previously Dug 15.2, Limestone 25.0

W-44 MOE No: 5244 Date Drilled: 1970
Orig.Owner: R. Payne Static Level: 1.5 m
Diameter: 125 mm Test Rate: 0.38 L/S (5 gpm)
Depth: 9.8 m Water Encountered: 9.1 m
Geologic Log:
Stony Gravel 6.4, Limestone 9.8

W-45 MOE No: 8962 Date Drilled: 1978
Orig.Owner: V. Hamilton Static Level: ----- m
Diameter: 150 mm Test Rate: ---- L/S (-- gpm)
Depth: 14.9 m Water Encountered: 4.0,14.0m
Geologic Log:
Stony Clay 1.5, Gravelly Clay 4.0,
Limestone 14.9

W-46 MOE No: 1030 Date Drilled: 1961
Orig.Owner: M. Lonsberry Static Level: 1.8 m
Diameter: 125 mm Test Rate: 0.38 L/S (5 gpm)
Depth: 5.8 m Water Encountered: 4.6 m
Geologic Log:
Gravel 4.3, Limestone 5.8

W-47 MOE No: 10172 Date Drilled: 1981
Orig.Owner: W. Freeburn Static Level: 6.1 m
Diameter: 150 mm Test Rate: 0.08 L/S (1 gpm)
Depth: 16.8 m Water Encountered: 13.4 m
Geologic Log:
Topsoil 0.6, Gravelly Clay 1.5, Shale 4.3,
Limestone 16.8

INVENTORY OF REPRESENTATIVE WELLS
WITHIN 1 KM OF SITE

W-48 MOE No: 1063 Date Drilled: 1956
Orig.Owner: S. Lonsberry Static Level: 5.8 m
Diameter: 125 mm Test Rate: 0.76 L/S (10 gpm)
Depth: 10.1 m Water Encountered: 10.1 m
GeoLogic Log:
Bouldery Gravel 4.3, Grey Limestone 10.1

W-49 MOE No: 9986 Date Drilled: 1980
Orig.Owner: R. Taylor Static Level: 1.5 m
Diameter: 150 mm Test Rate: 0.38 L/S (5 gpm)
Depth: 7.6 m Water Encountered: 7.6 m
Geologic Log:
Bouldery Clay 1.5, Shale 4.6, Limestone 7.6

W-50 MOE No: 9770 Date Drilled: 1979
Orig.Owner: D. Twist Static Level: 2.1 m
Diameter: 150 mm Test Rate: 0.38 L/S (5 gpm)
Depth: 7.6 m Water Encountered 3.0, 6.1 m
Geologic Log:
Topsoil 0.6, Gravelly Shale 2.1, Limestone 7.6

APPENDIX C

WATER QUALITY DATA

MANN AQUA LABORATORIES LTD.
400 MATHESON BOULEVARD EAST, UNIT 6
MISSISSAUGA, ONTARIO L4Z 1N8
PHONE: (416) 890-9272 · FAX: (416) 890-0370

----------RAPID CHEMICAL ANALYSIS PROGRAM (RCAP)----------

Methodology: Samples were analyzed as recommended in APHA Standard Methods for the Examination of Water and Wastewater, 16th Edition, 1985 and in EPA Methods for Chemical Analysis of Water and Wastes, 1983, unless otherwise noted.

Preparation: Rapid Chemical Analysis program (RCAP)

All results are based on the sample centrifuged for 30 minutes except for pH, turbidity, conductivity and 'total metals' (iron, manganese, copper and zinc).

All results are based on the unpreserved water sample as submitted except for iron, manganese, copper, zinc, calcium and magnesium which are preserved with nitric acid to pH <2.

Drinking Water Standards : The standards listed on the report are from the Ontario Drinking Water Objectives, Ontario Ministry of the Environment, 1983 revised, except calcium, magnesium, alkalinity, ortho phosphate and ammonia which are from Guidelines for Canadian Drinking Water Quality, Health and Welfare Canada, 1987.

Glossary : mg/L = milligrams per litre (1 mg/L = 1 ppm)

< = less than method detection limit

> = greater than method detection limit

Note : If you require further information, please contact Nora Macnee at (416) 890-9272.

GEO-LOGIC INC.

Plate C1-A

MANN AQUA LABORATORIES

REPORT TO:
GEO-LOGIC
MR. PAUL CUTMORE
#107 - 375 PIDO ROAD
PETERBOROUGH, ONTARIO
K9J 6Z8

LAB ....# 2474
SAMPLE .# W1 - WARSAW PUBLIC SCHOOL
PROJECT # 89-G-831
SAMPLED.. JANUARY 9, 1990
COLLECTOR MA03913
SOURCE... DRINKING WATER

DETERMINATION	METHOD DETECTION LIMIT		SAMPLE RESULT	DRINKING WATER STANDARD
Sodium	0.5	mg/L	13.2	20.0
Potassium	0.1	mg/L	1.4	-----
Calcium	0.005	mg/L	93.9	200
Magnesium	0.001	mg/L	3.20	150
Hardness (CaCO3)	0.05	mg/L	247	-----
Alkalinity (CaCO3)	1.0	mg/L	211	500
Carbonate (CaCO3)	1.0	mg/L	< 1.0	-----
Bicarbonate (CaCO3)	1.0	mg/L	210	-----
Sulphate	1.0	mg/L	18.5	500
Chloride	1.0	mg/L	26.8	250
Silica (SiO2)	0.5	mg/L	4.9	-----
Ortho Phosphate (P)	0.01	mg/L	< 0.01	0.20
Nitrate+Nitrite (N)	0.05	mg/L	1.61	10.0
Ammonia (N)	0.05	mg/L	< 0.05	0.50
Color (true)	3.0	TCU	4.8	5.0
Turbidity	0.3	NTU	< 0.3	1.0
Conductivity (25C)	0.1	umho/cm	564	-----
pH	0.0	units	7.7	-----
Total Organic Carbon	1.0	mg/L	2.5	5.0
Iron (total)	0.02	mg/L	< 0.02	0.30
Copper (total)	0.01	mg/L	0.01	1.00
Manganese (total)	0.01	mg/L	< 0.01	0.05
Zinc (total)	0.01	mg/L	0.02	5.00

Cation Sum	meq/L	5.56
Anion Sum	meq/L	5.47
%Difference	%	0.81
Ion Ratio		1.02
TDS (ion sum, calculated)	mg/L	295
Conductivity (calc.)	umho/cm	566
Saturation pH 5°C		7.6
Langelier Index 5°C		0.1

COMMENT: WELL WATER BEFORE SOFTENER

COPY TO:

CERTIFIED BY

Jim Dale, M.Sc. Jan 18, 1990

MANN AQUA LABORATORIES LTD.

W-1

GEO-LOGIC INC.

Plate C1-B

MANN AQUA LABORATORIES

REPORT TO:
GEO-LOGIC
MR. PAUL CUTMORE
#107 - 375 PIDO ROAD
PETERBOROUGH, ONTARIO
K9J 6Z8

LAB ....# 2475
SAMPLE .# W2 - GAY
PROJECT # 89-G-831
SAMPLED.. JANUARY 9, 1990
COLLECTOR MA03913
SOURCE... WELL WATER

DETERMINATION	METHOD DETECTION LIMIT		SAMPLE RESULT	DRINKING WATER STANDARD
Sodium	0.5	mg/L	6.9	20.0
Potassium	0.1	mg/L	1.0	-----
Calcium	0.005	mg/L	92.0	200
Magnesium	0.001	mg/L	3.40	150
Hardness (CaCO3)	0.05	mg/L	244	-----
Alkalinity (CaCO3)	1.0	mg/L	219	500
Carbonate (CaCO3)	1.0	mg/L	< 1.0	-----
Bicarbonate (CaCO3)	1.0	mg/L	218	-----
Sulphate	1.0	mg/L	17.2	500
Chloride	1.0	mg/L	13.5	250
Silica (SiO2)	0.5	mg/L	4.7	-----
Ortho Phosphate (P)	0.01	mg/L	< 0.01	0.20
Nitrate+Nitrite (N)	0.05	mg/L	1.60	10.0
Ammonia (N)	0.05	mg/L	< 0.05	0.50
Color (true)	3.0	TCU	< 3.0	5.0
Turbidity	0.3	NTU	< 0.3	1.0
Conductivity (25C)	0.1	umho/cm	520	-----
pH	0.0	units	7.6	-----
Total Organic Carbon	1.0	mg/L	2.4	5.0
Iron (total)	0.02	mg/L	0.29	0.30
Copper (total)	0.01	mg/L	0.22	1.00
Manganese (total)	0.01	mg/L	0.01	0.05
Zinc (total)	0.01	mg/L	0.14	5.00

Cation Sum	meq/L	5.20
Anion Sum	meq/L	5.24
%Difference	%	0.41
Ion Ratio		0.99
TDS (ion sum, calculated)	mg/L	277
Conductivity (calc.)	umho/cm	524
Saturation pH 5°C		7.5
Langelier Index 5°C		0.1

COMMENT:

COPY TO:

CERTIFIED BY

Jan 18, 1990

Jim Dale, M.Sc.

MANN AQUA LABORATORIES LTD.

W-2

GEO-LOGIC INC.

Plate C1-C

MANN AQUA LABORATORIES

REPORT TO:
GEO-LOGIC
MR. PAUL CUTMORE
#107 - 375 PIDO ROAD
PETERBOROUGH, ONTARIO
K9J 6Z8

LAB ....# 2476
SAMPLE .# W5 - EADES
PROJECT # 89-G-831
SAMPLED.. JANUARY 10, 1990
COLLECTOR MA03913
SOURCE... WELL WATER

DETERMINATION	METHOD DETECTION LIMIT		SAMPLE RESULT	DRINKING WATER STANDARD
Sodium	0.5	mg/L	11.2	20.0
Potassium	0.1	mg/L	1.7	-----
Calcium	0.005	mg/L	94.0	200
Magnesium	0.001	mg/L	4.10	150
Hardness (CaCO3)	0.05	mg/L	251	-----
Alkalinity (CaCO3)	1.0	mg/L	218	500
Carbonate (CaCO3)	1.0	mg/L	1.55	-----
Bicarbonate (CaCO3)	1.0	mg/L	217	-----
Sulphate	1.0	mg/L	17,7	500
Chloride	1.0	mg/L	24.7	250
Silica (SiO2)	0.5	mg/L	5.2	-----
Ortho Phosphate (P)	0.01	mg/L	0.01	0.20
Nitrate+Nitrite (N)	0.05	mg/L	2.00	10.0
Ammonia (N)	0.05	mg/L	< 0.05	0.50
Color (true)	3.0	TCU	< 3.0	5.0
Turbidity	0.3	NTU	< 0.3	1.0
Conductivity (25C)	0.1	umho/cm	560	-----
pH	0.0	units	7.9	-----
Total Organic Carbon	1.0	mg/L	2.7	5.0
Iron (total)	0.02	mg/L	< 0.02	0.30
Copper (total)	0.01	mg/L	0.87	1.00
Manganese (total)	0.01	mg/L	0.01	0.05
Zinc (total)	0.01	mg/L	0.05	5.00

Cation Sum	meq/L	5.56
Anion Sum	meq/L	5.57
%Difference	%	0.13
Ion Ratio		1.00
TDS (ion sum, calculated)	mg/L	298
Conductivity (calc.)	umho/cm	569
Saturation pH 5°C		7.5
Langelier Index 5°C		0.3

COMMENT:

COPY TO:

CERTIFIED BY

Jim Dale, M.Sc. Jan 18, 1990

MANN AQUA LABORATORIES LTD.

W-5

GEO-LOGIC INC.

Plate C1-D

MANN AQUA LABORATORIES

REPORT TO:
GEO-LOGIC
MR. PAUL CUTMORE
#107 - 375 PIDO ROAD
PETERBOROUGH, ONTARIO
K9J 6Z8

LAB ....# 2477
SAMPLE .# W13 - RIVER
PROJECT # 89-G-831
SAMPLED.. JANUARY 10, 1990
COLLECTOR MA03913
SOURCE... RIVER WATER - WARSAW

DETERMINATION	METHOD DETECTION LIMIT		SAMPLE RESULT	DRINKING WATER STANDARD
Sodium	0.5	mg/L	4.5	20.0
Potassium	0.1	mg/L	1.0	-----
Calcium	0.005	mg/L	43.0	200
Magnesium	0.001	mg/L	3.80	150
Hardness (CaCO3)	0.05	mg/L	123	-----
Alkalinity (CaCO3)	1.0	mg/L	103	500
Carbonate (CaCO3)	1.0	mg/L	< 1.0	-----
Bicarbonate (CaCO3)	1.0	mg/L	102	-----
Sulphate	1.0	mg/L	15.6	500
Chloride	1.0	mg/L	7.9	250
Silica (SiO2)	0.5	mg/L	1.9	-----
Ortho Phosphate (P)	0.01	mg/L	< 0.01	0.20
Nitrate+Nitrite (N)	0.05	mg/L	0.14	10.0
Ammonia (N)	0.05	mg/L	< 0.05	0.50
Color (true)	3.0	TCU	8.3	5.0
Turbidity	0.3	NTU	2.4	1.0
Conductivity (25C)	0.1	umho/cm	270	-----
pH	0.0	units	7.9	-----
Total Organic Carbon	1.0	mg/L	6.6	5.0
Iron (total)	0.02	mg/L	0.17	0.30
Copper (total)	0.01	mg/L	< 0.01	1.00
Manganese (total)	0.01	mg/L	0.04	0.05
Zinc (total)	0.01	mg/L	0.02	5.00

Cation Sum	meq/L	2.68
Anion Sum	meq/L	2.61
%Difference	%	1.30
Ion Ratio		1.03
TDS (ion sum, calculated)	mg/L	140
Conductivity (calc.)	umho/cm	269
Saturation pH 5°C		8.2
Langelier Index 5°C		-0.3

COMMENT:

COPY TO:

CERTIFIED BY

Jan 18, 1990

Jim Dale, M.Sc.

MANN AQUA LABORATORIES LTD

RIVER

GEO - LOGIC INC.

Plate C1-E

MANN AQUA LABORATORIES

REPORT TO:
GEO-LOGIC INC.
MR. DARIN CLEATOR
#107 - 375 PIDO ROAD
PETERBOROUGH, ONTARIO
K9J 6Z8

LAB ....# 4610
SAMPLE .# TW-1
PROJECT # 90-G-831
SAMPLED.. MAY 17, 1990
COLLECTOR MA04425
SOURCE... WARSAW, GROUNDWATER

DETERMINATION	METHOD DETECTION LIMIT		SAMPLE RESULT	DRINKING WATER STANDARD
Sodium	0.5	mg/L	8.1	20.0
Potassium	0.1	mg/L	1.6	-----
Calcium	0.005	mg/L	94.4	200
Magnesium	0.001	mg/L	3.70	150
Hardness (CaCO3)	0.05	mg/L	251	-----
Alkalinity (CaCO3)	1.0	mg/L	227	500
Carbonate (CaCO3)	1.0	mg/L	< 1.0	-----
Bicarbonate (CaCO3)	1.0	mg/L	226	-----
Sulphate	1.0	mg/L	12.0	500
Chloride	1.0	mg/L	20.6	250
Silica (SiO2)	0.5	mg/L	4.8	-----
Ortho Phosphate (P)	0.01	mg/L	< 0.01	0.20
Nitrate+Nitrite (N)	0.05	mg/L	0.89	10.0
Ammonia (N)	0.05	mg/L	< 0.05	0.50
Color (true)	3.0	TCU	3.0	5.0
Turbidity	0.3	NTU	0.7	1.0
Conductivity (25C)	0.1	umho/cm	539	-----
pH	0.0	units	7.7	-----
Total Organic Carbon	1.0	mg/L	1.5	5.0
Iron (total)	0.02	mg/L	0.03	0.30
Copper (total)	0.01	mg/L	< 0.01	1.00
Manganese (total)	0.01	mg/L	< 0.01	0.05
Zinc (total)	0.01	mg/L	< 0.01	5.00

Cation Sum	meq/L	5.41
Anion Sum	meq/L	5.43
%Difference	%	0.17
Ion Ratio		1.00
TDS (ion sum, calculated)	mg/L	285
Conductivity (calc.)	umho/cm	545
Saturation pH 5°C		7.5
Langelier Index 5°C		0.1

COMMENT:

COPY TO:

CERTIFIED BY

May 28, 1990

Jim Dale, M.Sc.

TW-1

(SAMPLED 120 min. INTO TEST)

GEO-LOGIC INC.

Plate C1-F

MANN AQUA LABORATORIES

REPORT TO:
GEO-LOGIC INC.
MR. DARIN CLEATOR
#107 - 375 PIDO ROAD
PETERBOROUGH, ONTARIO
K9J 6Z8

LAB ....# 4611
SAMPLE .# TW-2 #1
PROJECT # 90-G-831
SAMPLED.. MAY 16, 1990
COLLECTOR MA04425
SOURCE... WARSAW, GROUNDWATER

DETERMINATION	METHOD DETECTION LIMIT		SAMPLE RESULT	DRINKING WATER STANDARD
Sodium	0.5	mg/L	4.8	20.0
Potassium	0.1	mg/L	1.0	-----
Calcium	0.005	mg/L	86.2	200
Magnesium	0.001	mg/L	2.20	150
Hardness (CaCO3)	0.05	mg/L	224	-----
Alkalinity (CaCO3)	1.0	mg/L	206	500
Carbonate (CaCO3)	1.0	mg/L	2.95	-----
Bicarbonate (CaCO3)	1.0	mg/L	203	-----
Sulphate	1.0	mg/L	12.2	500
Chloride	1.0	mg/L	12.2	250
Silica (SiO2)	0.5	mg/L	3.8	-----
Ortho Phosphate (P)	0.01	mg/L	< 0.01	0.20
Nitrate+Nitrite (N)	0.05	mg/L	0.24	10.0
Ammonia (N)	0.05	mg/L	< 0.05	0.50
Color (true)	3.0	TCU	5.0	5.0
Turbidity	0.3	NTU	0.9	1.0
Conductivity (25C)	0.1	umho/cm	466	-----
pH	0.0	units	8.2	-----
Total Organic Carbon	1.0	mg/L	2.7	5.0
Iron (total)	0.02	mg/L	0.02	0.30
Copper (total)	0.01	mg/L	< 0.01	1.00
Manganese (total)	0.01	mg/L	< 0.01	0.05
Zinc (total)	0.01	mg/L	< 0.01	5.00

Cation Sum	meq/L	4.72
Anion Sum	meq/L	4.73
%Difference	%	0.14
Ion Ratio		1.00
TDS (ion sum, calculated)	mg/L	247
Conductivity (calc.)	umho/cm	473
Saturation pH 5°C		7.6
Langelier Index 5°C		0.6

COMMENT:

CERTIFIED BY

May 28, 1990

Jim Dale, M.Sc.

COPY TO:

TW-2

(SAMPLED 60 min. INTO TEST)

GEO-LOGIC INC.

Plate C1-G

MANN AQUA LABORATORIES

REPORT TO:
GEO-LOGIC INC.
MR. DARIN CLEATOR
#107 - 375 PIDO ROAD
PETERBOROUGH, ONTARIO
K9J 6Z8

LAB ....# 4612
SAMPLE .# TW-2 #2
PROJECT # 90-G-831
SAMPLED.. MAY 16, 1990
COLLECTOR MA04425
SOURCE... WARSAW, GROUNDWATER

DETERMINATION	METHOD DETECTION LIMIT		SAMPLE RESULT	DRINKING WATER STANDARD
Sodium	0.5	mg/L	4.7	20.0
Potassium	0.1	mg/L	1.0	-----
Calcium	0.005	mg/L	87.7	200
Magnesium	0.001	mg/L	2.20	150
Hardness (CaCO3)	0.05	mg/L	228	-----
Alkalinity (CaCO3)	1.0	mg/L	207	500
Carbonate (CaCO3)	1.0	mg/L	< 1.0	-----
Bicarbonate (CaCO3)	1.0	mg/L	206	-----
Sulphate	1.0	mg/L	12.1	500
Chloride	1.0	mg/L	12.4	250
Silica (SiO2)	0.5	mg/L	3.8	-----
Ortho Phosphate (P)	0.01	mg/L	< 0.01	0.20
Nitrate+Nitrite (N)	0.05	mg/L	0.25	10.0
Ammonia (N)	0.05	mg/L	< 0.05	0.50
Color (true)	3.0	TCU	4.0	5.0
Turbidity	0.3	NTU	< 0.3	1.0
Conductivity (25C)	0.1	umho/cm	469	-----
pH	0.0	units	7.7	-----
Total Organic Carbon	1.0	mg/L	1.9	5.0
Iron (total)	0.02	mg/L	< 0.02	0.30
Copper (total)	0.01	mg/L	< 0.01	1.00
Manganese (total)	0.01	mg/L	< 0.01	0.05
Zinc (total)	0.01	mg/L	< 0.01	5.00

Cation Sum	meq/L	4.79
Anion Sum	meq/L	4.76
%Difference	%	0.28
Ion Ratio		1.01
TDS (ion sum, calculated)	mg/L	249
Conductivity (calc.)	umho/cm	476
Saturation pH 5°C		7.6
Langelier Index 5°C		0.1

COMMENT:

COPY TO:

CERTIFIED BY

May 28, 1990

Jim Dale, M.Sc.

TW-2

(SAMPLED360 min. INTO TEST)

GEO-LOGIC INC.

Plate C1-H

MANN AQUA LABORATORIES

REPORT TO:
GEO-LOGIC INC.
MR. DARIN CLEATOR
#107 - 375 PIDO ROAD
PETERBOROUGH, ONTARIO
K9J 6Z8

LAB ....# 4613
SAMPLE .# TW-3 #1
PROJECT # 90-G-831
SAMPLED.. MAY 15, 1990
COLLECTOR MA04425
SOURCE... WARSAW, GROUNDWATER

DETERMINATION	METHOD DETECTION LIMIT		SAMPLE RESULT	DRINKING WATER STANDARD
Sodium	0.5	mg/L	1.3	20.0
Potassium	0.1	mg/L	0.4	-----
Calcium	0.005	mg/L	87.2	200
Magnesium	0.001	mg/L	1.70	150
Hardness (CaCO3)	0.05	mg/L	225	-----
Alkalinity (CaCO3)	1.0	mg/L	202	500
Carbonate (CaCO3)	1.0	mg/L	< 1.0	-----
Bicarbonate (CaCO3)	1.0	mg/L	202	-----
Sulphate	1.0	mg/L	13.7	500
Chloride	1.0	mg/L	2.9	250
Silica (SiO2)	0.5	mg/L	3.9	-----
Ortho Phosphate (P)	0.01	mg/L	< 0.01	0.20
Nitrate+Nitrite (N)	0.05	mg/L	0.30	10.0
Ammonia (N)	0.05	mg/L	< 0.05	0.50
Color (true)	3.0	TCU	4.0	5.0
Turbidity	0.3	NTU	2.7	1.0
Conductivity (25C)	0.1	umho/cm	443	-----
pH	0.0	units	7.6	-----
Total Organic Carbon	1.0	mg/L	2.2	5.0
Iron (total)	0.02	mg/L	0.18	0.30
Copper (total)	0.01	mg/L	< 0.01	1.00
Manganese (total)	0.01	mg/L	< 0.01	0.05
Zinc (total)	0.01	mg/L	< 0.01	5.00

Cation Sum	meq/L	4.56
Anion Sum	meq/L	4.44
%Difference	%	1.35
Ion Ratio		1.03
TDS (ion sum, calculated)	mg/L	234
Conductivity (calc.)	umho/cm	443
Saturation pH 5°C		7.6
Langelier Index 5°C		-0.1

COMMENT:

COPY TO:

CERTIFIED BY

May 28, 1990

Jim Dale, M.Sc.

TW-3

(SAMPLED 60 min. INTO TEST)

GEO-LOGIC INC.

MANN AQUA LABORATORIES

REPORT TO:
GEO-LOGIC INC.
MR. DARIN CLEATOR
#107 - 375 PIDO ROAD
PETERBOROUGH, ONTARIO
K9J 6Z8

LAB ....# 4614
SAMPLE .# TW-3 #2
PROJECT # 90-G-831
SAMPLED.. MAY 15, 1990
COLLECTOR MA04425
SOURCE... WARSAW, GROUNDWATER

DETERMINATION	METHOD DETECTION LIMIT		SAMPLE RESULT	DRINKING WATER STANDARD
Sodium	0.5	mg/L	1.2	20.0
Potassium	0.1	mg/L	0.4	-----
Calcium	0.005	mg/L	88.1	200
Magnesium	0.001	mg/L	1.70	150
Hardness (CaCO3)	0.05	mg/L	227	-----
Alkalinity (CaCO3)	1.0	mg/L	205	500
Carbonate (CaCO3)	1.0	mg/L	< 1.0	-----
Bicarbonate (CaCO3)	1.0	mg/L	204	-----
Sulphate	1.0	mg/L	13.9	500
Chloride	1.0	mg/L	2.8	250
Silica (SiO2)	0.5	mg/L	3.9	-----
Ortho Phosphate (P)	0.01	mg/L	< 0.01	0.20
Nitrate+Nitrite (N)	0.05	mg/L	0.32	10.0
Ammonia (N)	0.05	mg/L	< 0.05	0.50
Color (true)	3.0	TCU	3.0	5.0
Turbidity	0.3	NTU	< 0.3	1.0
Conductivity (25C)	0.1	umho/cm	442	-----
pH	0.0	units	7.5	-----
Total Organic Carbon	1.0	mg/L	2.0	5.0
Iron (total)	0.02	mg/L	< 0.02	0.30
Copper (total)	0.01	mg/L	< 0.01	1.00
Manganese (total)	0.01	mg/L	< 0.01	0.05
Zinc (total)	0.01	mg/L	< 0.01	5.00

Cation Sum	meq/L	4.60
Anion Sum	meq/L	4.48
%Difference	%	1.25
Ion Ratio		1.03
TDS (ion sum, calculated)	mg/L	236
Conductivity (calc.)	umho/cm	447
Saturation pH 5°C		7.6
Langelier Index 5°C		-0.1

COMMENT:

COPY TO:

CERTIFIED BY

May 28, 1990

Jim Dale, M.Sc.

TW-3

(SAMPLED 390 min. INTO TEST)

GEO-LOGIC INC.

Plate C1-J

Ministry of Health / Ministère de la Santé — Laboratory Services Branch / Service de Laboratoire

Ontario

Date Received / Date Reçue: Jan 10/90 — Lab. No. / N° du Lab.: 531018

Bacteriological Analysis of Water / Analyse Bactériologique de l'eau

W#1

Sample taken by / Echantillon prélevé par	Location of supply (Lot, Con., Twp.) / Lieu de Prélèvement (Lot, Concession, Commune)	County	Date collected / Date du Prélèvement
P. Cutmore	Warsaw School	Pbo	Jan 9/90

Your name and return address must appear on all copies / Votre nom et votre adresse de retour doivent paraître sur toutes les copies

Name / Nom: P. Cutmore Biologiste Lac.

Street, RR, Box No. / Rue, RR, Case Postale: Unit 107 375 Pido Road,

City, Town / Ville: Bay 694 Peterborough

Province: Ontario, Postal Code / Code Postal: K9J 6Z8

☐ Private Citizens: check this box. / Citoyen Privé: cocher cette case.

Drinking water only. See reverse of report for interpretation. / Eau potable seulement. Voir au verso pour interprétation.

Consult your local health unit for further information. / Pour les directives additionel consultez votre unité sanitaire local.

FOLD — SHADED AREAS FOR OFFICIAL AGENCIES ONLY / ZONE OMBRÉE RÉSERVÉE AUX AGENTS OFFICIELS — Non potable samples MUST be received within 6 hours if unrefrigerated or within 24 hours if refrigerated. — FOLD

CHECK APPROPRIATE BOXES / COCHER TOUTES LES CASES APPROPRIÉES

DRINKING WATER: Treated / Non-treated; Municipal / Well; Other Public; Single Household

NON-DRINKING WATER: Recreational; Swimming Pool-Indoor; Hydrotherapy Spa, Whirlpool; Swimming Pool-Outdoor; Wading Pool; Sewage; Other:

COMMENTS

BACTERIAL COUNT / NUMERATION DES BACTÉRIES — Based on 100 ml volume / Base sur un volume de 100 ml

BACTERIAL COUNT Based on 1.0 ml volume

Total coliforms / Totale des Coliformes	Fecal coliforms / Coliformes Fecaux	Fecal Strep / Streptocoques Fecaux	APC
0	0	1	

Background	P. aeruginosa	Presumptive Staphylococci	S. aureus

Checked by:

Regional Public Health Laboratory
Ontario Ministry of Health
P.O. Box 265, 99 Hospital Drive
Peterborough, Ontario K9J 6Y8

JAN 12 1990

W-1

Ministry of Health / Ministère de la Santé — Laboratory Services Branch / Service de Laboratoire

Ontario

Date Received / Date Reçue: Jan. 11 90 — Lab. No. / N° du Lab.: 531107

Bacteriological Analysis of Water / Analyse Bactériologique de l'eau

Sample taken by / Echantillon prélevé par	Location of supply (Lot, Con., Twp.) / Lieu de Prélèvement (Lot, Concession, Commune)	County	Date collected / Date du Prélèvement
P. Cutmore	WAL Warsaw #5	Pbo	Jan 10/90

Your name and return address must appear on all copies / Votre nom et votre adresse de retour doivent paraître sur toutes les copies

Name / Nom: Paul CUTMORE

Street, RR, Box No. / Rue, RR, Case Postale: 375 Pido RD, Unit 107, Box 694,

City, Town / Ville: Peterborough,

Province: Ontario, Postal Code / Code Postal: K9J 6Z8.

☐ Private Citizens: check this box. / Citoyen Privé: cocher cette case.

Drinking water only. See reverse of report for interpretation. / Eau potable seulement. Voir au verso pour interprétation.

Consult your local health unit for further information. / Pour les directives additionel consultez votre unité sanitaire local.

FOLD — SHADED AREAS FOR OFFICIAL AGENCIES ONLY / ZONE OMBRÉE RÉSERVÉE AUX AGENTS OFFICIELS — (Non potable samples MUST be received within 6 hours if unrefrigerated or within 24 hours if refrigerated.) — FOLD

CHECK APPROPRIATE BOXES / COCHER TOUTES LES CASES APPROPRIÉES

DRINKING WATER: ☐ Treated / ☐ Non-treated; ☐ Municipal / ☑ Well; ☐ Other Public; ☑ Single Household

NON-DRINKING WATER: ☐ Recreational; ☐ Swimming Pool-Indoor; ☐ Hydrotherapy Spa, Whirlpool; ☐ Swimming Pool-Outdoor; ☐ Wading Pool; ☐ Sewage; ☐ Other:

COMMENTS

BACTERIAL COUNT / NUMERATION DES BACTÉRIES — Based on 100 ml volume / Base sur un volume de 100 ml

BACTERIAL COUNT Based on 1.0 ml volume

Total coliforms / Totale des Coliformes	Fecal coliforms / Coliformes Fecaux	Fecal Strep / Streptocoques Fecaux	APC
0	0		

Background	P. aeruginosa	Presumptive Staphylococci	S. aureus

Checked by:

Regional Public Health Laboratory
Ontario Ministry of Health
P.O. Box 265, 99 Hospital Drive
Peterborough, Ontario K9J 6Y8

JAN 12 1990

W-5

BACTERIOLOGICAL ANALYSIS

GEO-LOGIC INC.

Plate C2-A

Ontario Ministry of Health / Ministère de la Santé — Laboratory Services Branch / Service de Laboratoire

Date Received / Date Reçue: [illegible] 10 JJ | Lab. No. / N° du Lab.: 006816

Bacteriological Analysis of Water / Analyse Bactériologique de l'eau

Sample taken by / Echantillon prélevé par	Location of supply (Lot, Con., Twp.) / Lieu de Prélèvement (Lot, Concession, Commune)	County	Date collected / Date du Prélèvement
D. CLEATOR	TW-1 WARSAW		May 17/90

Your name and return address must appear on all copies / Votre nom et votre adresse de retour doivent paraître sur toutes les copies

Name / Nom: D. CLEATOR
Street, RR, Box No / Rue, RR, Casier Postal: P.O. Box [illegible]
City, town / Ville: PETERBOROUGH
Province: ONTARIO — Postal Code / Code Postal: K9J 6Z8

Private Citizens: check this box — Drinking water only. See reverse of report for interpretation
Eau potable seulement. Voir au verso pour interprétation

Consult your local health unit for further information. / Pour les directives additionel consultez votre unité sanitaire local

FOLD — SHADED AREAS FOR OFFICIAL AGENCIES ONLY / ZONE OMBRÉE RÉSERVÉE AUX AGENTS OFFICIELS — Non potable samples MUST be received within 6 hours if unrefrigerated or within 24 hours if refrigerated. — FOLD

CHECK APPROPRIATE BOXES / COCHER TOUTES LES CASES APPROPRIÉES

DRINKING WATER	NON-DRINKING WATER	COMMENTS
☐ Treated ☐ Non-treated	☐ Recreational ☐ Swimming Pool-Indoor	
☐ Municipal ☐ Well	☐ Hydrotherapy Spa, Whirlpool ☐ Swimming Pool-Outdoor	
☐ Other Public	☐ Wading Pool ☐ Sewage	
☐ Single Household	☐ Other:	

BACTERIAL COUNT / NUMÉRATION DES BACTÉRIES — Based on 100 ml volume/Base sur un volume de 100 ml

Total coliforms / Totale des Coliformes	Fecal coliforms / Coliformes Fecaux	Fecal Strep / Streptocoques Fecaux	BACTERIAL COUNT Based on 1.0 ml volume: APC
4	0		
Background	P. aeruginosa	Presumptive Staphylococci	S. aureus

Technician | Checked by | Date: MAY 22 1990

Regional Public Health Laboratory
Ontario Ministry of Health
P.O. Box 265, 99 Hospital Drive
Peterborough, Ontario K9J 6Y8

TW-1

Ontario Ministry of Health / Ministère de la Santé — Laboratory Services Branch / Service de Laboratoire

Date Received / Date Reçue: 10 JJ | Lab. No. / N° du Lab.: 006815

Bacteriological Analysis of Water / Analyse Bactériologique de l'eau

Sample taken by / Echantillon prélevé par	Location of supply (Lot, Con., Twp.) / Lieu de Prélèvement (Lot, Concession, Commune)	County	Date collected / Date du Prélèvement
D. CLEATOR	TW-2, Warsaw		May 17/90

Your name and return address must appear on all copies / Votre nom et votre adresse de retour doivent paraître sur toutes les copies

Name / Nom: D. CLEATOR
Street, RR, Box No / Rue, RR, Casier Postal: 375 PIDO RD P.O. Box 694
City, town / Ville: PETERBOROUGH
Province: ONTARIO — Postal Code / Code Postal: K9J 6Z8

Private Citizens: check this box — Drinking water only. See reverse of report for interpretation.
Eau potable seulement. Voir au verso pour interprétation.

Consult your local health unit for further information. / Pour les directives additionel consultez votre unité sanitaire local

FOLD — SHADED AREAS FOR OFFICIAL AGENCIES ONLY / ZONE OMBRÉE RÉSERVÉE AUX AGENTS OFFICIELS — Non potable samples MUST be received within 6 hours if unrefrigerated or within 24 hours if refrigerated. — FOLD

CHECK APPROPRIATE BOXES / COCHER TOUTES LES CASES APPROPRIÉES

DRINKING WATER	NON-DRINKING WATER	COMMENTS
☐ Treated ☐ Non-treated	☐ Recreational ☐ Swimming Pool Indoor	
☐ Municipal ☐ Well	☐ Hydrotherapy Spa, Whirlpool ☐ Swimming Pool-Outdoor	
☐ Other Public	☐ Wading Pool ☐ Sewage	
☐ Single Household	☐ Other:	

BACTERIAL COUNT / NUMERATION DES BACTÉRIES — Based on 100 ml volume/Base sur un volume de 100 ml

Total coliforms / Totale des Coliformes	Fecal coliforms / Coliformes Fecaux	Fecal Strep / Streptocoques Fecaux	BACTERIAL COUNT Based on 1.0 ml volume: APC
0	0		
Background	P. aeruginosa	Presumptive Staphylococci	S. aureus

Technician | Checked by | Date: MAY 22 1990

Regional Public Health Laboratory
Ontario Ministry of Health
P.O. Box 265, 99 Hospital Drive
Peterborough, Ontario K9J 6Y8

TW-2

BACTERIOLOGICAL ANALYSIS

GEO-LOGIC INC.

Plate C2-B

Ontario Ministry of Health / Ministère de la Santé — Laboratory Services Branch / Service de Laboratoires

Bacteriological Analysis of Water / Analyse Bactériologique de l'eau

Sample taken by / Échantillon prélevé par	Location of supply (Lot, Con., Twp.) / Lieu de Prélèvement (Lot, Concession, Commune)	County	Date collected / Date du Prélèvement
D.CLEATOR	TW-3, Warsaw		May 15/90

Your name and return address must appear on all copies / Votre nom et votre adresse de retour doivent paraître sur toutes les copies

Name / Nom: D. CLEATOR

Street, RR, Box No. / Rue, RR, Case Postale: 375 PIDO RD. P.O. Box 694

City, Town / Ville: PETERBOROUGH

Province: ONTARIO — Postal Code / Code Postal: K9J 6Z8

Drinking water only. See reverse of report for interpretation.
Eau potable seulement. Voir au verso pour interprétation.

Consult your local health unit for further information. / Pour les directives additionnelles consultez votre unité sanitaire local.

FOLD

SHADED AREAS FOR OFFICIAL AGENCIES ONLY
ZONE OMBRÉE RÉSERVÉE AUX AGENTS OFFICIELS

Non potable samples MUST be received within 6 hours if unrefrigerated or within 24 hours if refrigerated.

FOLD

CHECK APPROPRIATE BOXES / COCHER TOUTES LES CASES APPROPRIÉES

DRINKING WATER	NON-DRINKING WATER	COMMENTS
☐ Treated ☐ Non-treated	☐ Recreational ☐ Swimming Pool-Indoor	
☐ Municipal ☐ Well	☐ Hydrotherapy Spa, Whirlpool ☐ Swimming Pool-Outdoor	
☐ Other Public Water	☐ Wading Pool ☐ Sewage	
☐ Single Household	☐ Other:	

BACTERIAL COUNT / NUMERATION DES BACTÉRIES Based on 100 ml volume / Base sur un volume de 100 ml			BACTERIAL COUNT Based on 10 ml volume
Total coliforms / Totaux des Coliformes: 2	Fecal coliforms / Coliformes Fécaux: 0	Fecal Strep / Streptocoques Fécaux	APC
Background	P. aeruginosa	Presumptive Staphylococci	S. aureus
Technician	Checked by	Date	

TW-3

Ontario Ministry of Health / Ministère de la Santé — Laboratory Services Branch / Service de Laboratoires

Date Received / Date Reçue: JAN. 12 1990 — Lab No. / N° du Lab.: 90-03115

Bacteriological Analysis of Water / Analyse Bactériologique de l'eau

Sample taken by / Échantillon prélevé par	Location of supply (Lot, Con., Twp.) / Lieu de Prélèvement (Lot, Concession, Commune)	County	Date collected / Date du Prélèvement
Paul	Warsaw #River	PtBo	Jan 10/90

Your name and return address must appear on all copies / Votre nom et votre adresse de retour doivent paraître sur toutes les copies

Name / Nom: PAUL CUTMORE.

Street, RR, Box No. / Rue, RR, Case Postale: 375 PIDO ROAD, Unit 107,

City, Town / Ville: Box 694, Peterborough

Province: Ontario — Postal Code / Code Postal: K9J6Z8

☐ Private Citizens: check this box. Drinking water only. See reverse of report for interpretation.
Citoyen Privé: cocher cette case. Eau potable seulement. Voir au verso pour interprétation.

Consult your local health unit for further information. / Pour les directives additionnelles consultez votre unité sanitaire local.

FOLD

SHADED AREAS FOR OFFICIAL AGENCIES ONLY
ZONE OMBRÉE RÉSERVÉE AUX AGENTS OFFICIELS

Non potable samples MUST be received within 6 hours if unrefrigerated or within 24 hours if refrigerated.

FOLD

CHECK APPROPRIATE BOXES / COCHER TOUTES LES CASES APPROPRIÉES

DRINKING WATER	NON-DRINKING WATER	COMMENTS
☑ Treated ☑ Non-treated	☐ Recreational ☐ Swimming Pool-Indoor	
☑ Municipal ☐ Well	☐ Hydrotherapy Spa, Whirlpool ☐ Swimming Pool-Outdoor	
☐ Other Public Water	☐ Wading Pool ☐ Sewage	
☑ Single Household	☐ Other:	

BACTERIAL COUNT / NUMERATION DES BACTÉRIES Based on 100 ml volume / Base sur un volume de 100 ml			BACTERIAL COUNT Based on 10 ml volume
Total coliforms / Totaux des Coliformes: 32	Fecal coliforms / Coliformes Fécaux: 21	Fecal Strep / Streptocoques Fécaux	APC
Background	P. aeruginosa	Presumptive Staphylococci	S. aureus
Technician	Checked by	Date	

Regional Public Health Laboratory
Ontario Ministry of Health
P.O. Box 265, 99 Hospital Drive
Peterborough, Ontario K9J 6Y8

JAN 12 1990

RIVER

BACTERIOLOGICAL ANALYSIS

Plate C2-B

GEO-LOGIC INC

APPENDIX D

TEST WELL CONSTRUCTION DATA

Ministry of the Environment
Ontario

The Ontario Water Resources Act

WATER WELL RECORD

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

County or District	Township, Borough, City, Town, Village	Con., Block, Tract, Survey, etc.	Lot
HBO	[illegible]	2	13

Owner (Surname First)	Address	Date Completed
Vaillancourt, Randy	% Carl Clarke Realty Ltd. Hw. Queens St. P.O. Box 1500 Haliburton, Ont	Day 9 Mo 05 Yr 90

LOG OF OVERBURDEN AND BEDROCK MATERIALS (SEE INSTRUCTIONS)

General Colour	Most Common Material	Other Materials	General Description	Depth – Feet From	To
Brown	Sand	Pebbles		0	16
Grey	Limestone			16	35

WATER RECORD

Water Found at – Feet	Kind of Water
32	☒ Fresh ☐ Salty ☐ Sulphur ☐ Minerals ☐ Gas

CASING & OPEN HOLE RECORD

Inside Diam Inches	Material	Wall Thickness Inches	Depth – Feet From	To
6¼	☐ Steel ☐ Galvanized ☐ Concrete ☐ Open Hole ☐ Plastic	.188	0	20

SCREEN

Size(s) of Opening (Slot No.)	Diameter	Length
	Inches	Feet
Material and Type	Depth to Top of Screen	Feet

PLUGGING & SEALING RECORD

Depth Set at – Feet From	To	Material and Type (Cement Grout, Lead Packer, etc.)

PUMPING TEST

Pumping Test Method	Pumping Rate	Duration of Pumping
☐ Pump ☒ Bailer	10+ GPM	1 Hours — Mins

Static Level	Water Level End of Pumping	15 Minutes	30 Minutes	45 Minutes	60 Minutes
5 Feet	35 Feet	5 Feet	5 Feet	5 Feet	5 Feet

Water levels during: ☐ Pumping ☒ Recovery

If flowing give rate: GPM
Pump intake set at: 35 Feet
Water at end of test: ☐ Clear ☐ Cloudy
Recommended pump type: ☒ Shallow ☐ Deep
Recommended pump setting: 20 Feet
Recommended pumping rate: 5 GPM

LOCATION OF WELL

In diagram below show distances of well from road and lot line. Indicate north by arrow.

Drillers Remarks

83259

FINAL STATUS OF WELL

☐ Water Supply ☒ Observation Well ☐ Test Hole ☐ Recharge Well ☐ Abandoned, Insufficient Supply ☐ Abandoned, Poor Quality ☐ Unfinished ☐ Dewatering

WATER USE

☒ Domestic ☐ Stock ☐ Irrigation ☐ Industrial ☐ Other ☐ Commercial ☐ Municipal ☐ Public Supply ☐ Cooling or Air Conditioning ☐ Not Used

METHOD OF CONSTRUCTION

☐ Cable Tool ☐ Rotary (Conventional) ☐ Rotary (Reverse) ☐ Rotary (Air) ☒ Air Percussion ☐ Boring ☐ Diamond ☐ Jetting ☐ Driving ☐ Digging ☐ Other

CONTRACTOR

Name of Well Contractor: Harris Noble's Drilling
Well Contractor's Licence Number: 1746
Address: Box 14, Haliburton, Ont
Name of Well Technician: Ronald Dahmer
Well Technician's Licence Number:
Signature of Technician/Contractor: [illegible]
Submission Date: Day ___ Mo ___ 19 ___

OFFICE USE ONLY

OWNER'S COPY

FORM NO. 0506 (11/86) FORM 9

TW-1

GEO-LOGIC INC.

Plate D1-A

Ministry of the Environment
Ontario

The Ontario Water Resources Act

WATER WELL RECORD

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

COUNTY OR DISTRICT	TOWNSHIP, BOROUGH, CITY, TOWN, VILLAGE	CON. BLOCK, TRACT, SURVEY, ETC.	LOT
HPO	Hennessey	2	13

OWNER (SURNAME FIRST)	ADDRESS	DATE COMPLETED
Guilbeault Landy	Box 1510 Tehkummah Ont	DAY 9 MO 05 YR 90

LOG OF OVERBURDEN AND BEDROCK MATERIALS (SEE INSTRUCTIONS)

GENERAL COLOUR	MOST COMMON MATERIAL	OTHER MATERIALS	GENERAL DESCRIPTION	DEPTH FEET FROM	DEPTH FEET TO
Brown	Sand	Cobbles	Loose	0	29
Grey	Limestone			29	45

WATER RECORD

WATER FOUND AT FEET	KIND OF WATER		
42	☒ FRESH ☐ SALTY	☐ SULPHUR ☐ MINERALS ☐ GAS	
	☐ FRESH ☐ SALTY	☐ SULPHUR ☐ MINERALS ☐ GAS	
	☐ FRESH ☐ SALTY	☐ SULPHUR ☐ MINERALS ☐ GAS	
	☐ FRESH ☐ SALTY	☐ SULPHUR ☐ MINERALS ☐ GAS	
	☐ FRESH ☐ SALTY	☐ SULPHUR ☐ MINERALS ☐ GAS	

CASING & OPEN HOLE RECORD

INSIDE DIAM. INCHES	MATERIAL	WALL THICKNESS INCHES	DEPTH FEET FROM	DEPTH FEET TO
12x1	☐ STEEL ☐ GALVANIZED ☐ CONCRETE ☒ OPEN HOLE ☐ PLASTIC	188	0	29
	☐ STEEL ☐ GALVANIZED ☐ CONCRETE ☐ OPEN HOLE ☐ PLASTIC			
	☐ STEEL ☐ GALVANIZED ☐ CONCRETE ☐ OPEN HOLE ☐ PLASTIC			

SCREEN

SIZE OF OPENING (SLOT NO.) | DIAMETER INCHES | LENGTH FEET
MATERIAL AND TYPE | DEPTH TO TOP OF SCREEN FEET

PLUGGING & SEALING RECORD

DEPTH SET AT FEET FROM	TO	MATERIAL AND TYPE (CEMENT GROUT, LEAD PACKER, ETC.)

PUMPING TEST

PUMPING TEST METHOD: ☐ PUMP ☒ BAILER | PUMPING RATE: 10 GPM | DURATION OF PUMPING: 1 HOURS — MINS

STATIC LEVEL	WATER LEVEL END OF PUMPING	WATER LEVELS DURING: ☐ PUMPING ☒ RECOVERY			
		15 MINUTES	30 MINUTES	45 MINUTES	60 MINUTES
15 FEET	45 FEET	15 FEET	15 FEET	15 FEET	15 FEET

IF FLOWING GIVE RATE: — GPM | PUMP INTAKE SET AT: — FEET | WATER AT END OF TEST: ☐ CLEAR ☐ CLOUDY

RECOMMENDED PUMP TYPE: ☐ SHALLOW ☒ DEEP | RECOMMENDED PUMP SETTING: 40 FEET | RECOMMENDED PUMPING RATE: 5 GPM

FINAL STATUS OF WELL	☐ WATER SUPPLY ☐ ABANDONED, INSUFFICIENT SUPPLY ☒ OBSERVATION WELL ☐ ABANDONED, POOR QUALITY ☐ TEST HOLE ☐ UNFINISHED ☐ RECHARGE WELL ☐ DEWATERING
WATER USE	☒ DOMESTIC ☐ COMMERCIAL ☐ STOCK ☐ MUNICIPAL ☐ IRRIGATION ☐ PUBLIC SUPPLY ☐ INDUSTRIAL ☐ COOLING OR AIR CONDITIONING ☐ OTHER ☐ NOT USED
METHOD OF CONSTRUCTION	☐ CABLE TOOL ☐ BORING ☐ ROTARY (CONVENTIONAL) ☐ DIAMOND ☐ ROTARY (REVERSE) ☐ JETTING ☐ ROTARY (AIR) ☐ DRIVING ☒ AIR PERCUSSION ☐ DIGGING ☐ OTHER

LOCATION OF WELL

IN DIAGRAM BELOW SHOW DISTANCES OF WELL FROM ROAD AND LOT LINE. INDICATE NORTH BY ARROW.

2nd line #2.

DRILLERS REMARKS: 83257

CONTRACTOR

NAME OF WELL CONTRACTOR: Verner Cable Drilling | WELL CONTRACTOR'S LICENCE NUMBER: 1746
ADDRESS: PO #2 Walkerton Ont.
NAME OF WELL TECHNICIAN: David Graham | WELL TECHNICIAN'S LICENCE NUMBER:
SIGNATURE OF TECHNICIAN/CONTRACTOR: [signature] | SUBMISSION DATE: DAY — MO — YR —

OFFICE USE ONLY

OWNER'S COPY

FORM NO. 0506 (11/86) FORM 9

TW-2

GEO-LOGIC INC.

Plate D1-B

Ministry of the Environment
Ontario

The Ontario Water Resources Act

WATER WELL RECORD

County or District	Township, Borough, City, Town, Village	Con., Block, Tract, Survey, etc.	Lot
BPD	Alnwick	2	13

Owner (Surname First)	Address	Date Completed
Cullimore, Dardy	Roseneath, Ont	9-05-96

LOG OF OVERBURDEN AND BEDROCK MATERIALS

General Colour	Most Common Material	Other Materials	General Description	Depth From	Depth To
Brown	Sand	Pebbles		2	6
				2	32

WATER RECORD: Water Found at Feet	Kind of Water
32	Fresh

CASING & OPEN HOLE RECORD

Inside Diam Inches	Material	Wall Thickness Inches	Depth From	Depth To
6¼	Steel	188	0	20

SCREEN

PLUGGING & SEALING RECORD

PUMPING TEST

Pumping Test Method	Pump
Pumping Rate	10 GPM
Duration of Pumping	1 hours
Static Level	6 feet
Water Level End of Pumping	35 feet
Water Levels During Recovery: 15 minutes	6 feet
30 minutes	6 feet
45 minutes	6 feet
60 minutes	6 feet
Pump Intake Set At	35 feet
Water at End of Test	Cloudy
Recommended Pump Setting	20 feet
Recommended Pumping Rate	5 GPM

FINAL STATUS OF WELL: Observation Well

WATER USE: Domestic

METHOD OF CONSTRUCTION: Air Percussion

LOCATION OF WELL

In diagram below show distances of well from road and lot line. Indicate north by arrow.

3-1 Well #3

83258

CONTRACTOR

Name of Well Contractor	Hollis Well Drilling Ltd
Well Contractor's Licence Number	1748
Address	RR 2, Haliburton Ont
Name of Well Technician	Donald Graham
Signature of Technician/Contractor	[illegible]

OFFICE USE ONLY

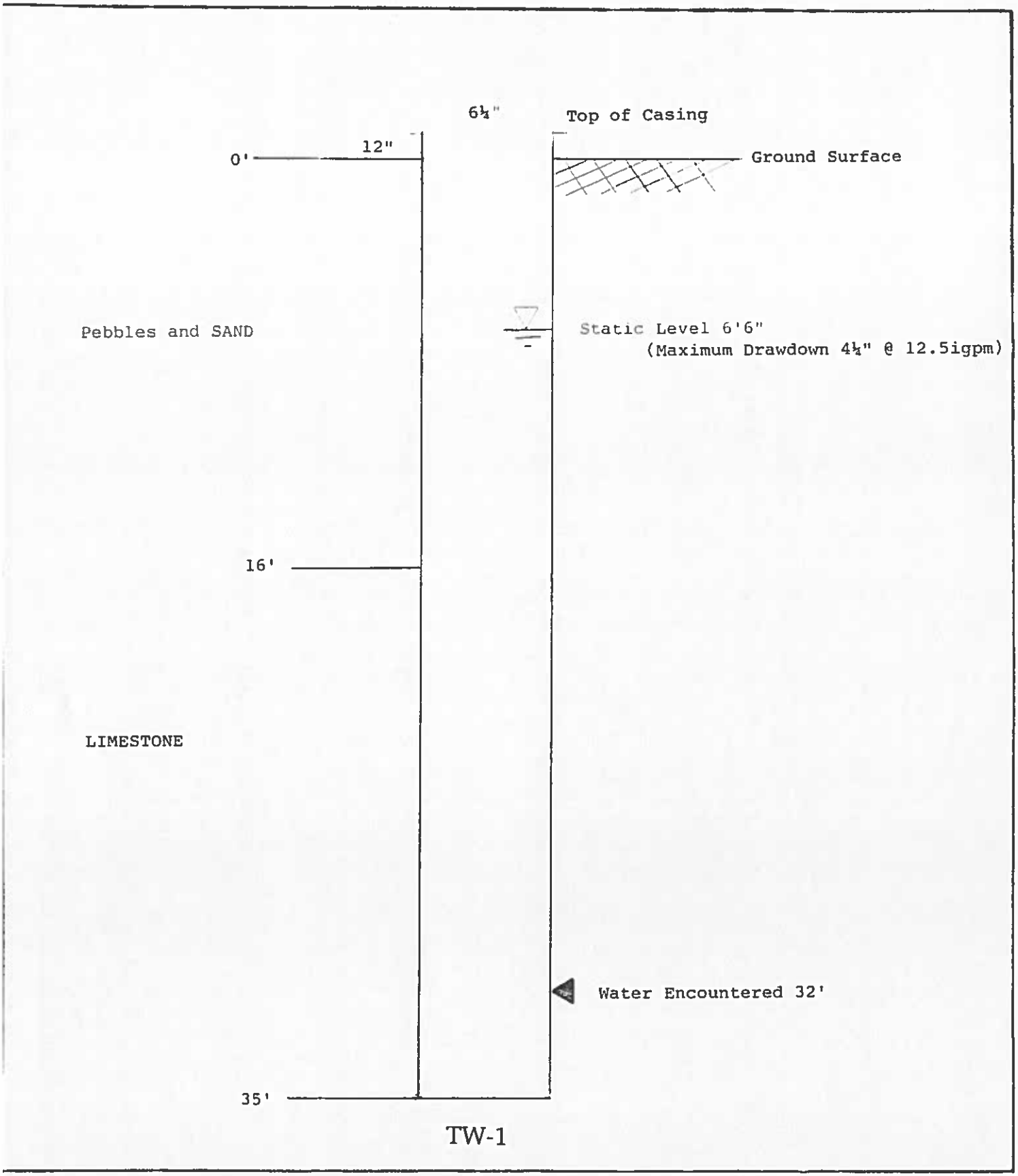
...R'S COPY

FORM NO. 0506 (11/86) FORM 9

TW-3

GEO-LOGIC INC.

Plate D1-C

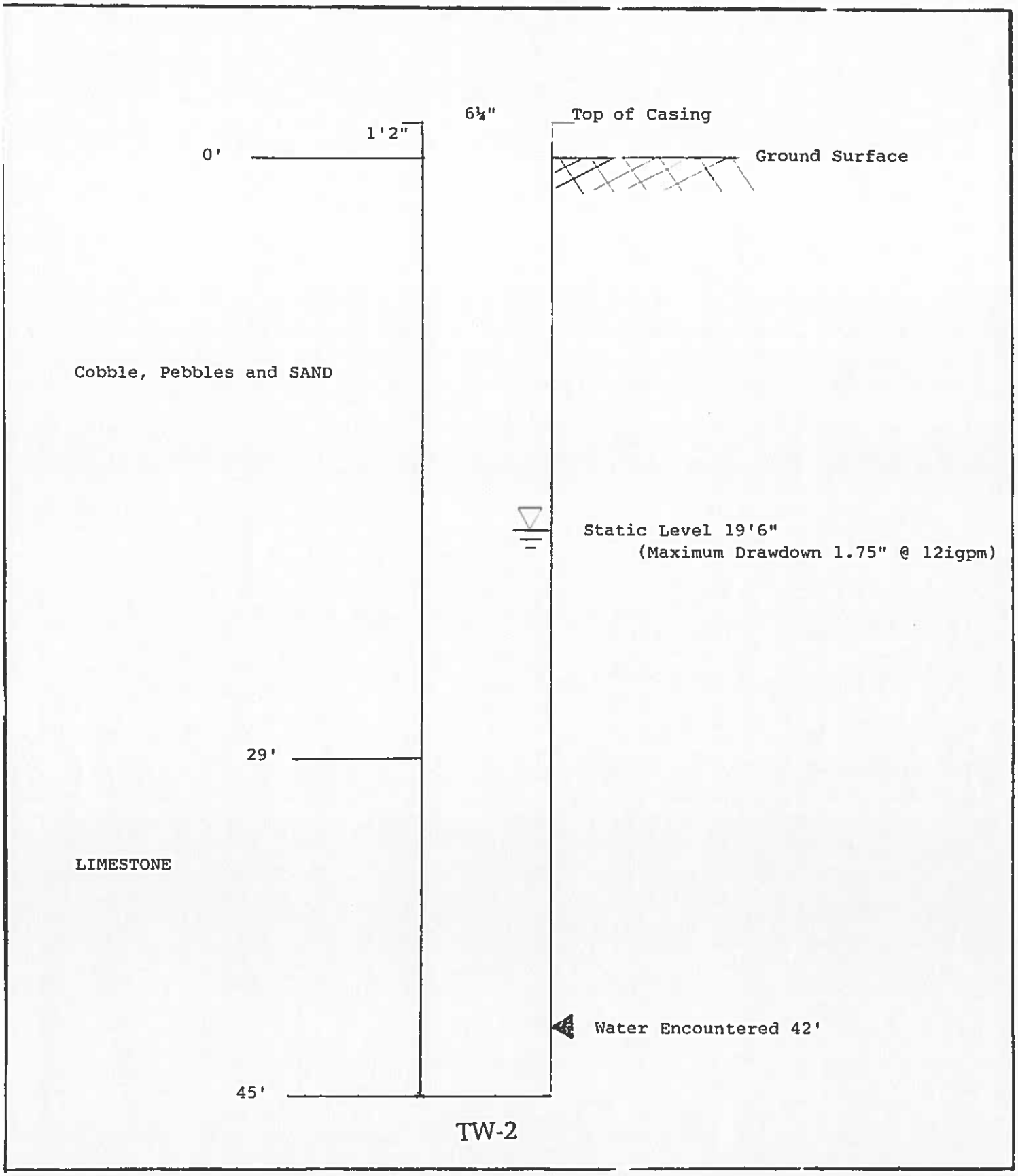


TW-1

SCHEMATIC OF WELL CONSTRUCTION

DATE:	May, 1990
CLIENT:	Mr. Randy Cullimore
JOB NUMBER:	89-G-831
DRAWING NUMBER:	D2-A

GEO LOGIC INC.
175 [illegible] ROAD UNIT 107
BOX [illegible] PETERBOROUGH, ONTARIO
K9J [illegible]
(705) 749-[illegible]

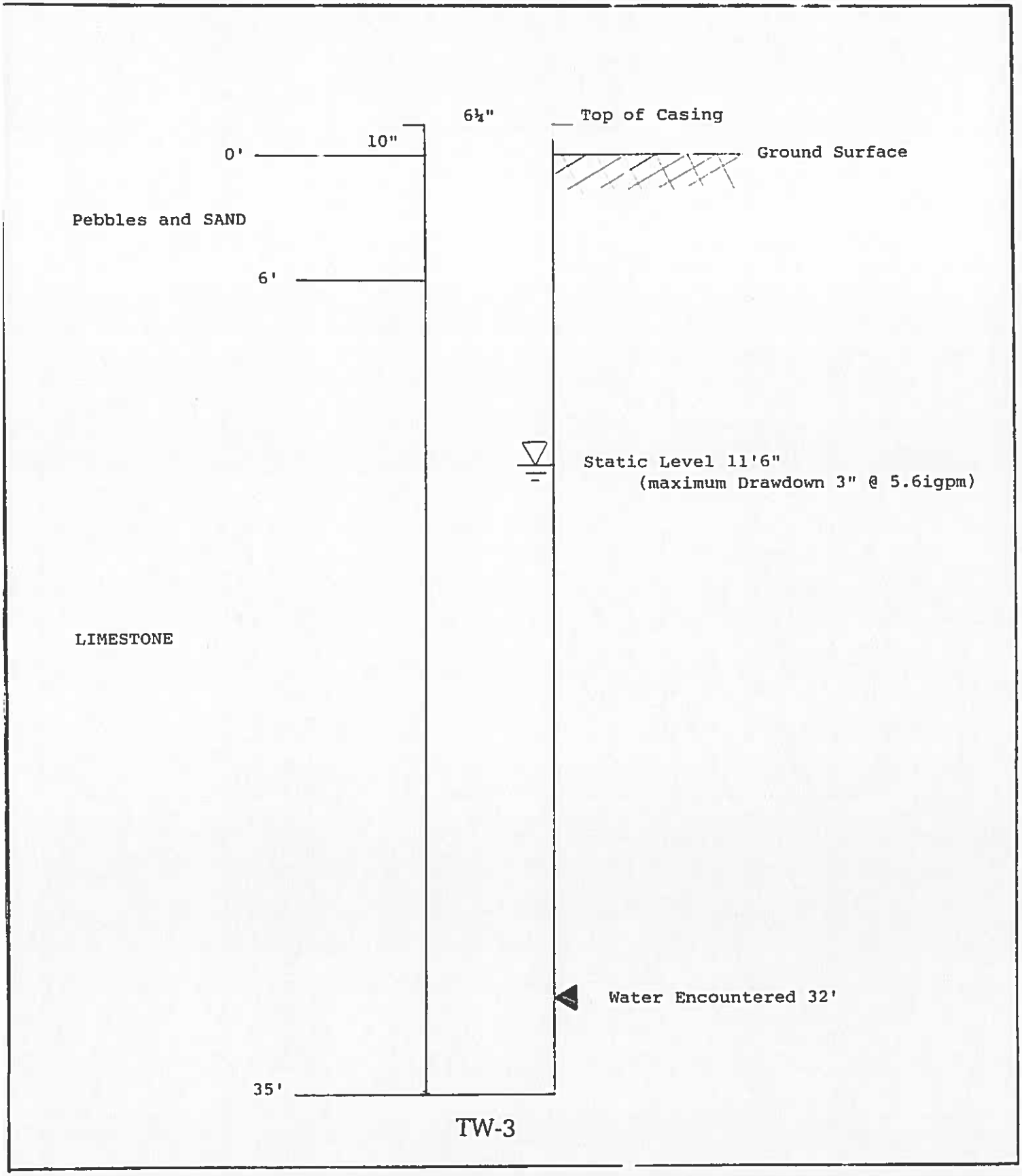


TW-2

SCHEMATIC OF WELL CONSTRUCTION

DATE:	May, 1990
CLIENT:	Mr. Randy Cullimore
JOB NUMBER:	89-G-831
DRAWING NUMBER:	D2- B

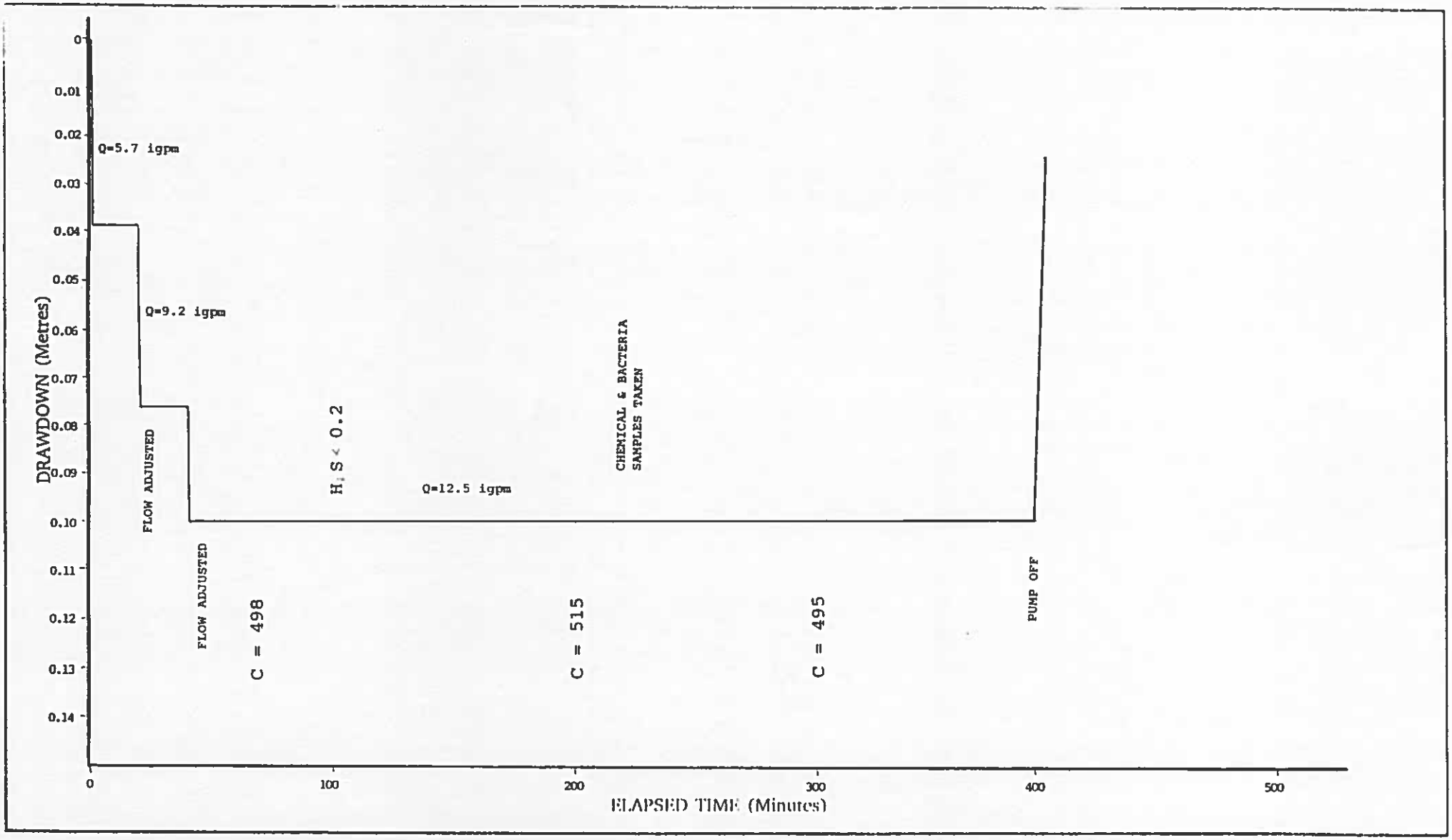
GEO LOGIC INC
375 [illegible] ROAD UNIT 107
BOX [illegible] PETERBOROUGH, ONTARIO
K9J [illegible]
(705) 749- 3317



SCHEMATIC OF WELL CONSTRUCTION

DATE:	May, 1990
CLIENT:	Mr. Randy Cullimore
JOB NUMBER:	89-G-831
DRAWING NUMBER:	D2-C

GEO LOGIC INC.
375 PIDO ROAD UNIT 107
BOX 694 PETERBOROUGH, ONTARIO
K9J 6Z8
(705) 749-1317



1) STATIC WATER LEVEL= 6'6"
2) PUMP INTAKE = 24'
3) 'Q' PUMPING RATE IN IGPM
4) 'C' CONDUCTIVITY IN µmhos/cm

PUMP TEST HISTORY CURVE

TW-1

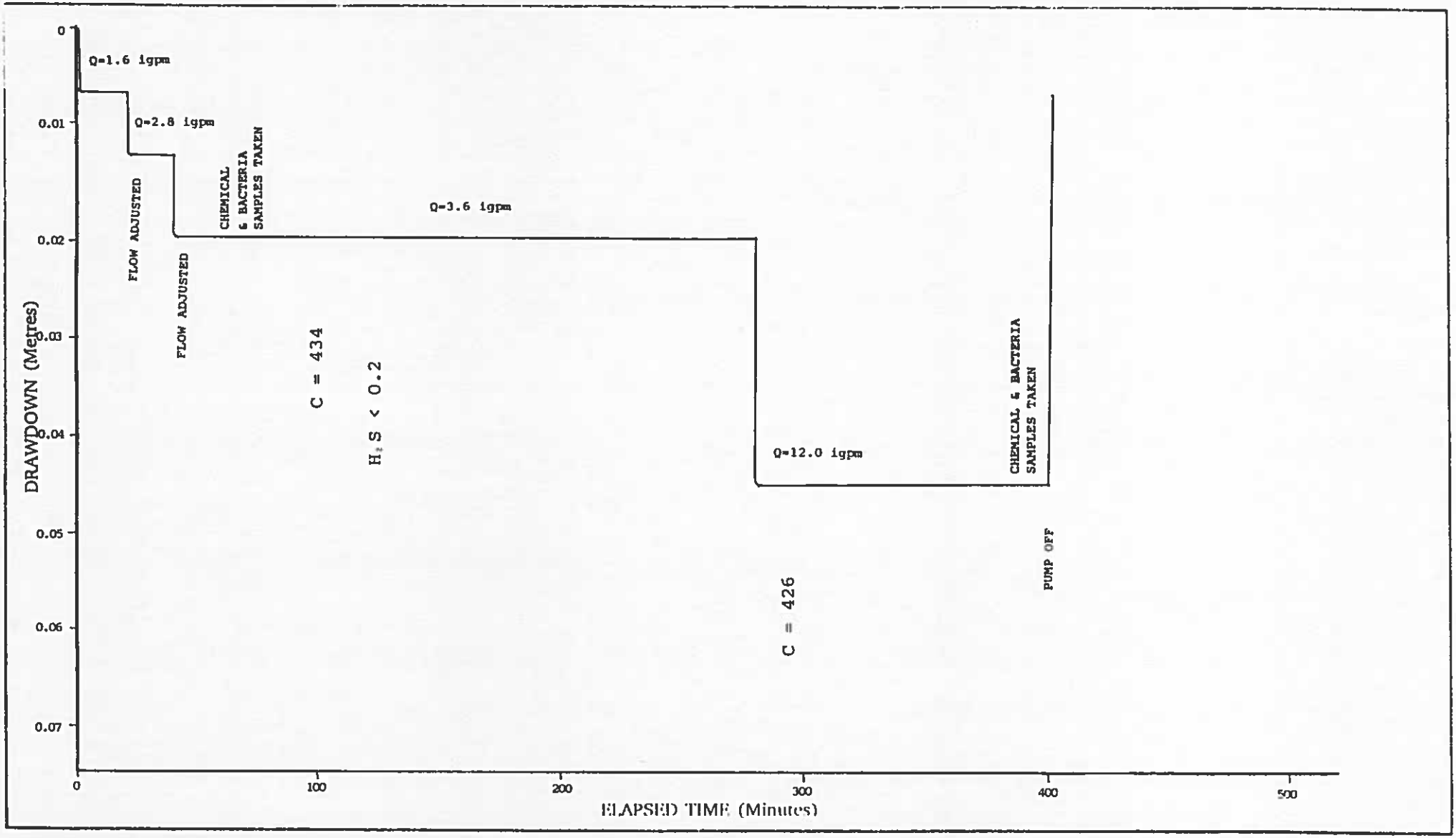
DATE: May, 1990

CLIENT: Mr. Randy Cullimore

JOB NUMBER: 89-G-831

DRAWING NUMBER: D3-A

GEO-LOGIC INC.
375 PIDO ROAD UNIT 107
BOX 694 PETERBOROUGH, ONTARIO
K9J 6Z8
(705) 749-3317



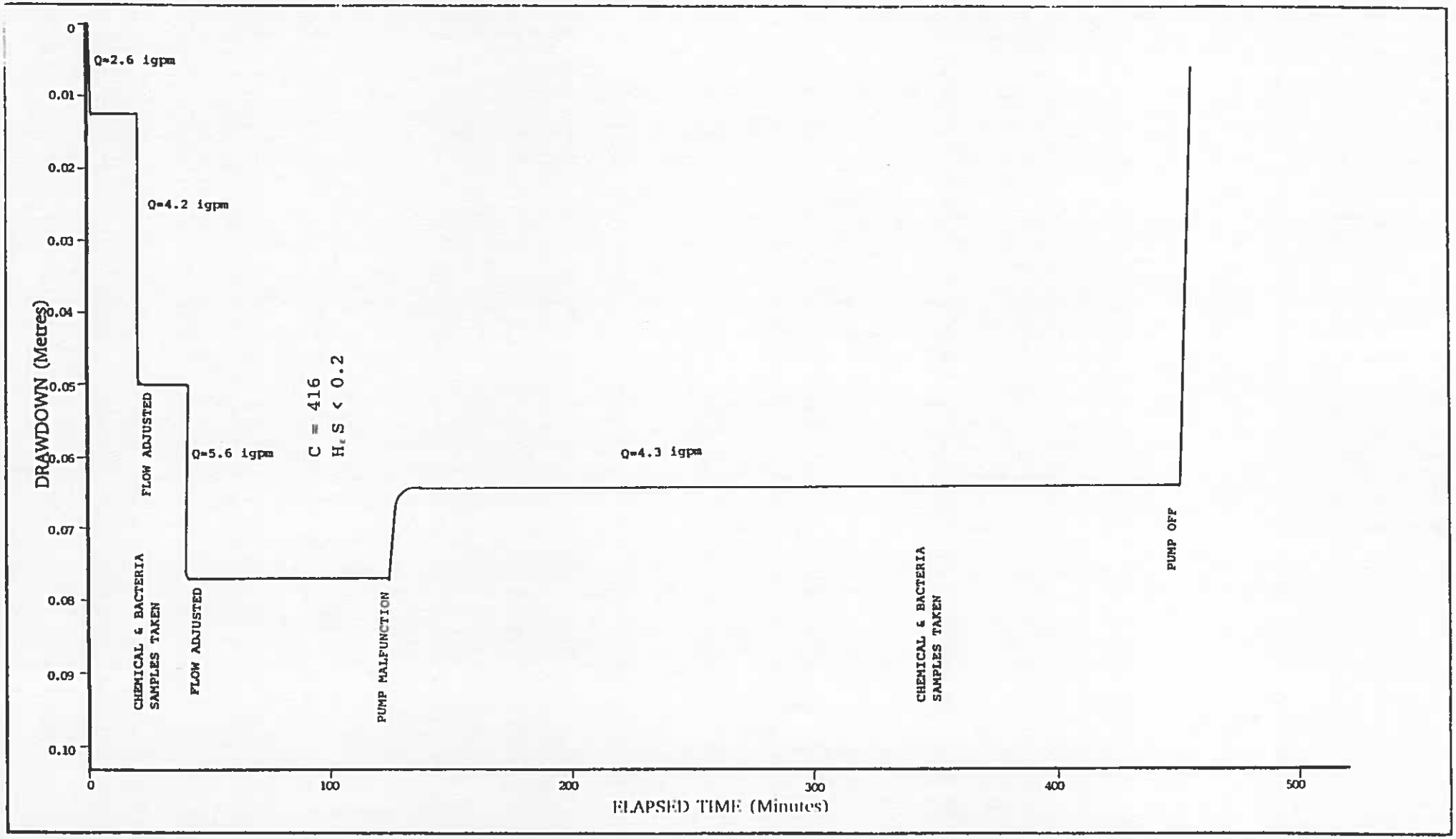
1) STATIC WATER LEVEL= 19'6"
2) PUMP INTAKE = 40'
3) 'Q' PUMPING RATE IN IGPM
4) 'C' CONDUCTIVITY IN µmhos/cm

PUMP TEST HISTORY CURVE

TW-2

DATE: May, 1990
CLIENT: Mr. Randy Cullimore
JOB NUMBER: 89-G-831
DRAWING NUMBER: D3-B

GEO-LOGIC INC.
375 PIDO ROAD UNIT 107
BOX 694 PETERBOROUGH, ONTARIO
K9J 6Z8
(705) 749-3317



1) STATIC WATER LEVEL= 11'6"
2) PUMP INTAKE = 27'
3) 'Q' PUMPING RATE IN IGPM
4) 'C' CONDUCTIVITY IN µmhos/cm

PUMP TEST HISTORY CURVE

TW-3

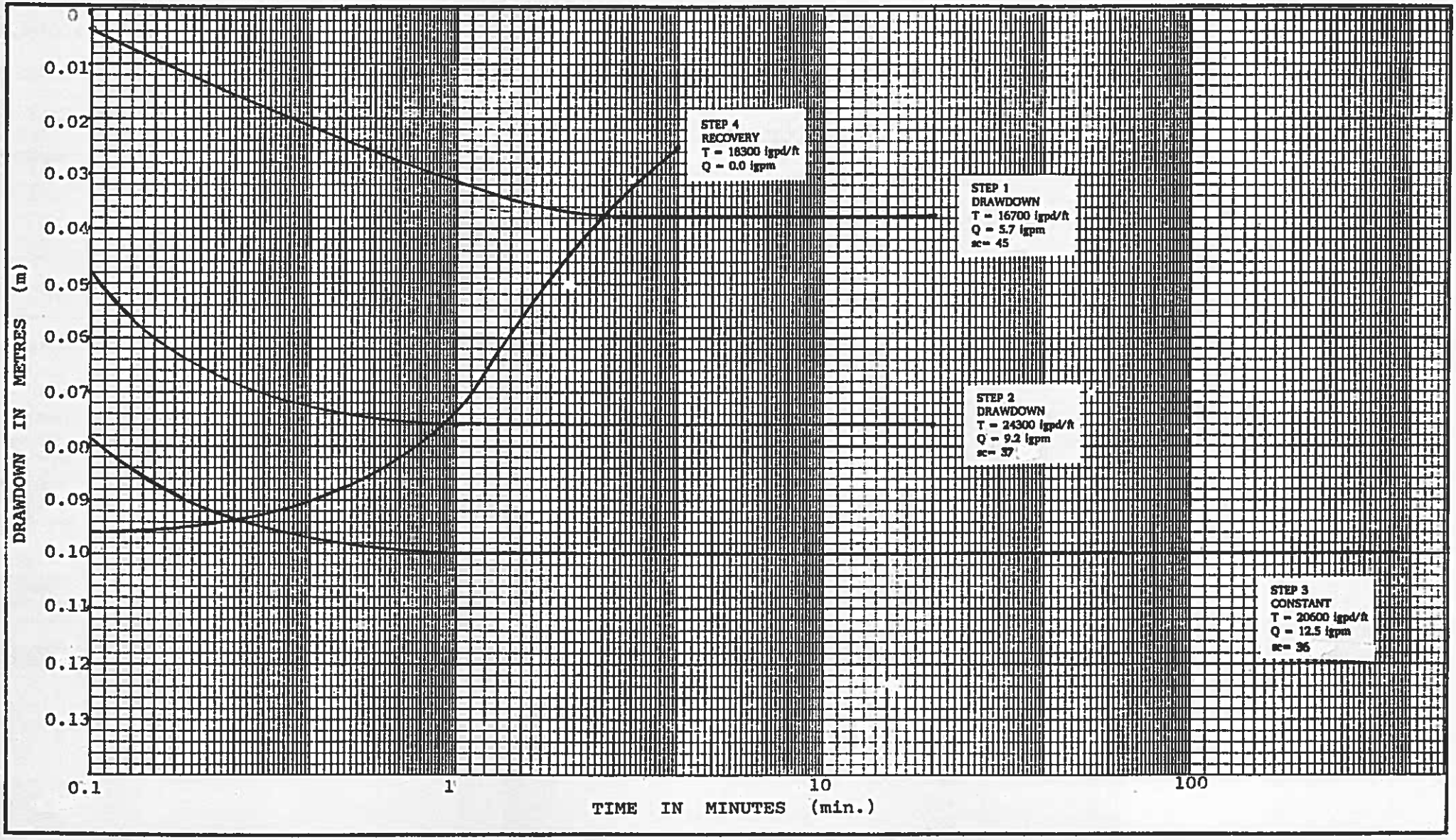
DATE: May, 1990

CLIENT: Mr. Randy Cullimore

JOB NUMBER: 89-G-831

DRAWING NUMBER: D3-C

GEO-LOGIC INC.
375 PIDO ROAD UNIT 107
BOX 694 PETERBOROUGH, ONTARIO
K9J 6Z8
(705) 749-3317

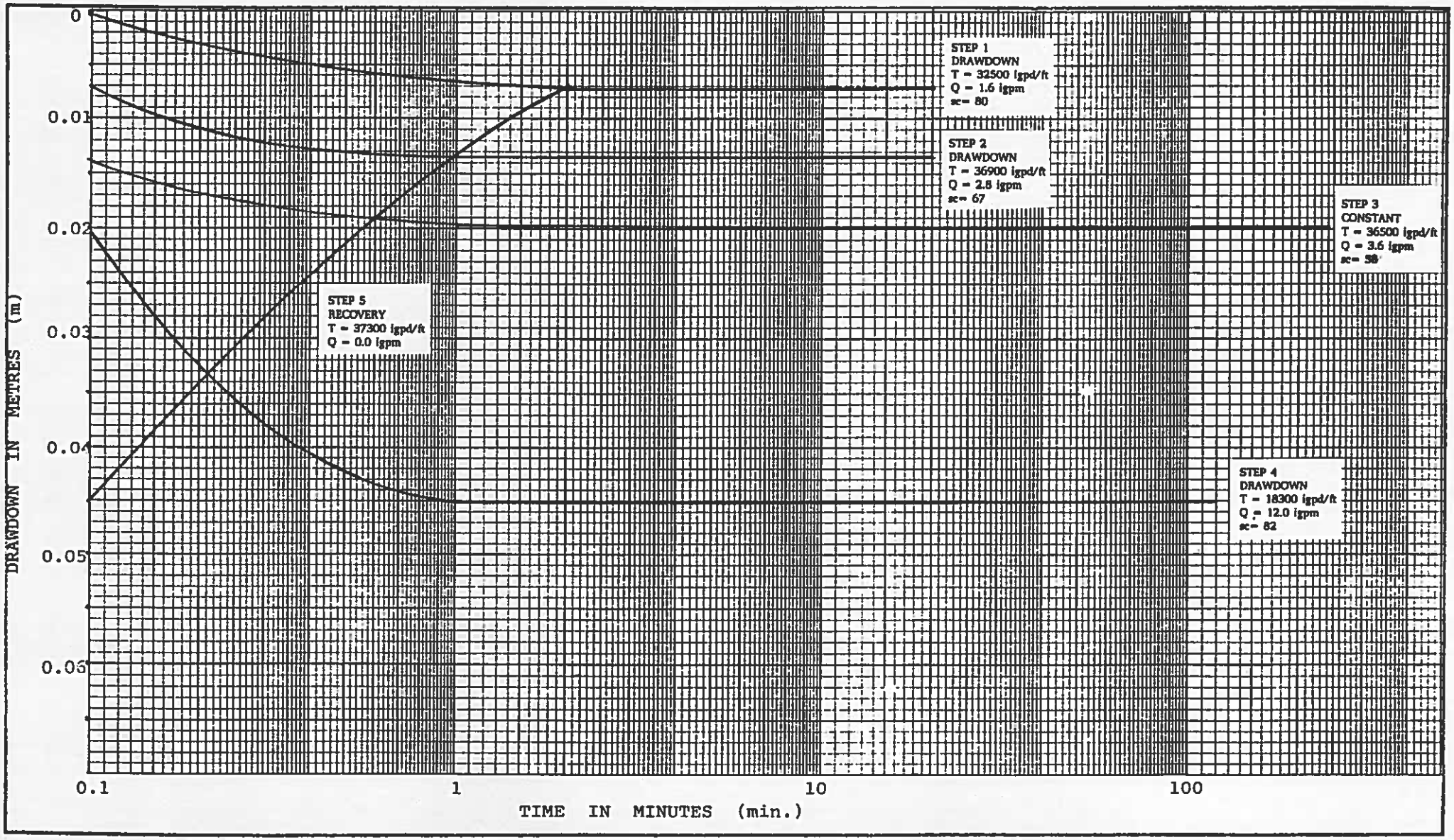


TIME vs DRAWDOWN

TW-1

DATE:	May, 1990
SCALE:	Mr. Randy Cullimore
JOB NUMBER:	89-G-831
DRAWING NUMBER:	D4-A

GEO-LOGIC INC.
375 PIDO ROAD UNIT 107
BOX 694 PETERBOROUGH, ONTARIO
K9J 6Z8
(705) 749-3317



TIME vs DRAWDOWN

TW-2

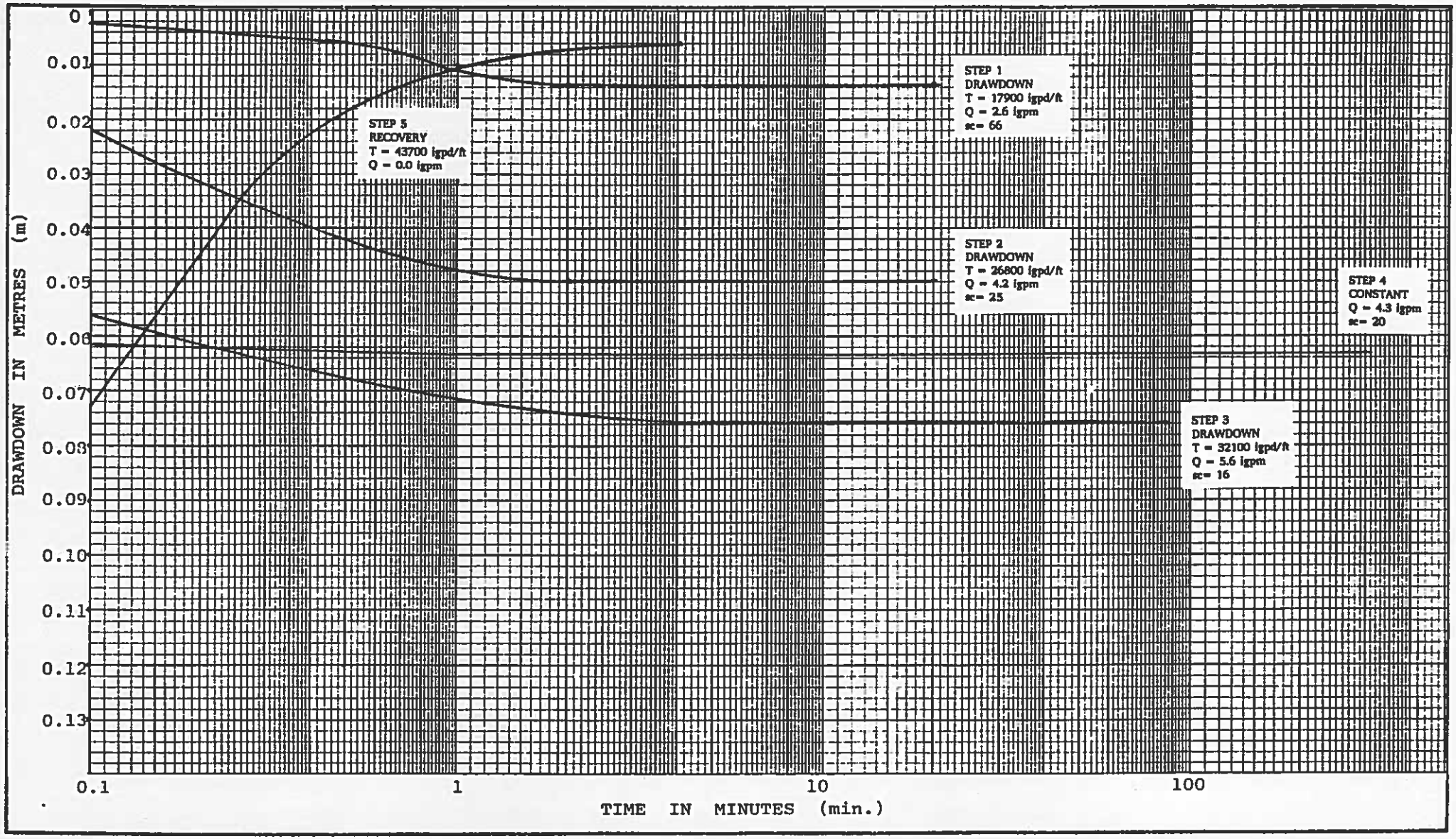
DATE: May, 1990

SCALE: Mr. Randy Cullimore

JOB NUMBER: 89-G-831

DRAWING NUMBER: D4-B

GEO-LOGIC INC.
375 PIDO ROAD UNIT 107
BOX 694 PETERBOROUGH, ONTARIO
K9J 6Z8
(705) 749-3317



TIME vs DRAWDOWN

TW-3

DATE:	May, 1990
SCALE:	Mr. Randy Cullimore
JOB NUMBER:	89-G-831
DRAWING NUMBER:	D4-C

GEO-LOGIC INC.
375 PIDO ROAD UNIT 107
BOX 694 PETERBOROUGH, ONTARIO
K9J 6Z8
(705) 749-3317

GEO — LOGIC INC.

347 Pido Road, Unit 29
P.O. Box 694
PETERBOROUGH, ONT
K9J 6Z8

TEL (705) 749-3317
FAX (705) 749-9248

May 13, 1994

Mr. Randy Cullimore
735 Bethune Street
PETERBOROUGH, Ontario
K9H 4A5

Re: Hydrogeologic Assessment Report
Proposed Residential Development
Township of Dummer, County of Peterborough
Our Project No.89-G-831
M.M.A. File No.15-T-92001
M.O.E.E. File No.CR 15089

Dear Mr. Cullimore:

At your request, we have reviewed the letter from Mr. Stanley Janusas of Ministry of the Environment and Energy (M.O.E.E.) dated April 7, 1994 regarding the above referenced project. As you know, the revised development plan was designed based on minimum lot sizing criteria that was formulated using an accepted M.O.E.E. impact computation. I have repeated the exercise below to illustrate the overall projected impact as a result of septic effluent loading from the subdivision excluding the lands of the "Private Park" (Block A) which encompasses an area of 3.30ha.

Impact Assessment

1. Total Precipitation :	- 785 mm/year
2. Regional Evapotranspiration :	- 275 mm/year
3. Recharge Available :	- 330 mm/year
4. Recharge Available for Dilution :	
Area 1, till subsoil:	- 150 mm/year
Area 2, gravelly sand subsoil:	- 200 mm/year
5. Development Area :	
Area 1:	- 2.7 ha
Area 2:	- 18.0 ha
Total:	- 20.7 ha
6. Impervious Surfaces (roads and roofs) :	
Area 1:	- 0.2 ha
Area 2:	- 1.7 ha
Total:	- 2.0 ha

7. Available On-Site Dilution :

Area 1:	- 10.3 m^3/day
Area 2:	- 93.2 m^3/day
Total:	- 103.5 m^3/day

8. Projected Nitrate Level :

Area 1:	- 9.73 mg/L
Area 2:	- 6.26 mg/L
Overall:	- 6.64 mg/L

Note: Projected Nitrate Level = (background nitrate) + $\frac{\text{(sewage nitrate)}}{\text{(on-site dilution + effluent)}}$

Based on the above parameters and computations, the projected long term resultant nitrate level **between** the lots and along the down-gradient boundary to the site will be less than the provincial drinking water standard of 10 mg/L and is therefore considered to be acceptable. It should be noted again that there are no existing residences down-gradient of the site. Rather, the property bounds the Indian River which is one of several drainage courses within the Kawartha Lakes system. The daily flow of the river is considered to be significant and therefore, the potential impact of the residential subdivision on the river is deemed to be negligible.

We trust that this letter adequately outlines the impact assessment that was conducted on your property. Should you have any additional questions, please contact our office.

Yours very truly,

GEO-LOGIC INC.
GEOTECHNICAL ENGINEERS
AND HYDROGEOLOGISTS

David L. Workman, H.B.Sc.
Hydrogeologist

/dw

Ontario
Ministry of the Environment and Energy
Ministère de l'Environnement et de l'Énergie
Central Region
Région du Centre

7 Overlea Boulevard
4th Floor
Toronto, Ontario
M4H 1A8
416/424-3000
Fax: 416/960-2936

7, boulevard Overlea
4e étage
Toronto (Ontario)
M4H 1A8
416/424-3000
Fax: 416/960-2936

Our new fax number is: 416/325-6345

April 7, 1994

Plans Administration Branch
Ministry of Municipal Affairs
14th Floor
777 Bay Street
Toronto, Ontario
M5G 2E5

Attention: Peter Kakaletris

Dear Mr. Kakaletris:

Re: **Draft Plan of Subdivision**
Township of Dummer
File: 15T-92001

We are in receipt of a letter report dated November 3, 1993 from Geo-Logic Inc. The report was submitted in response to our letter dated February 26, 1993 to you.

The proposed number of lots has been reduced from 24 to 18. The consultant has determined a background groundwater nitrate concentration of 0.71 mg/L, and the revised groundwater nitrate impact assessment presented has been found to be acceptable. The consultant has also demonstrated that groundwater flow is towards the Indian River, and thus there are no downgradient groundwater users.

With respect to water supply, the consultant has demonstrated that a water supply of acceptable quality and adequate quantity will be available for the proposed development.

The draft plan of subdivision, as revised to October 1993, shows proposed Block A has increased in size to 3.3 ha. The draft plan indicates that Block A is to be a "Private Park". In instances where groundwater nitrate impact calculations have used parklands for dilution calculations, we have required that the lands be appropriately designated by the Official Plan as "Open Space". This Ministry typically requires such designation in order to ensure that there will be no potential for additional impact as a result of further development.

In a telephone conversation on March 8, 1994 with Mr. Randy Cullimore, the proponent for this draft plan, Mr. Cullimore advised that he would agree to revise the draft plan so that Lots 6 and 7 would extend to the Indian River, and the private park proposed by Block A would be deleted.

. . . 2 /

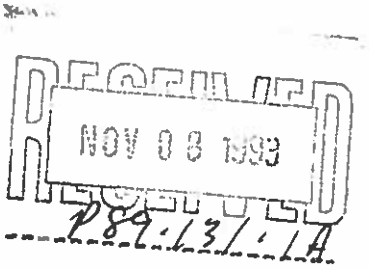
GEO — LOGIC INC.

347 Pido Road, Unit 29
P.O. Box 694
PETERBOROUGH, ONT
K9J 6Z8

TEL (705) 749-3317
FAX (705) 749-9248

November 3, 1993

Mr. Stanley Janusas, Planner
Regional and GTA Planning Unit
Technical Assessment Section
Central Region, Ministry of the Environment and Energy
7 Overlea Boulevard, 4th Floor
TORONTO, Ontario
M4H 1A8



Re: Hydrogeologic Assessment Report
Proposed Residential Development
Township of Dummer, County of Peterborough
Our Project No.89-G-831
M.M.A. File No.15-T-92001
M.O.E.E. File No.CR 15089

Dear Mr. Janusas:

In response to a letter from Mr. Joseph Plutino dated February 26, 1993 regarding the above referenced project, we are pleased to submit additional supportive information required to address concerns identified by your hydrogeologic staff. Mr. Plutino's letter is attached for convenient referencing. Details regarding the hydrogeologic aspects of the planned residential development are presented in our Hydrogeologic Assessment Report dated May, 1990 and revised February, 1992.

Development Impact

In accordance with the recommendations outlined in the aforementioned letter, further investigative work has been carried out on the project site. It is not considered prudent to use shallow wells situated down-gradient of existing septic systems for determining a background nitrate level of the upper aquifer complex at the project site. Therefore, a site reconnaissance inspection was carried out on May 24, 1993 to locate standpipe piezometers that were installed in test pits in conjunction with our hydrogeologic investigation of the property. A piezometer (T-7) was located near the central portion of the property which is considered to be representative of the site on a whole. The water level was measured at a depth of 0.52m below the existing ground surface.

A sample of the groundwater was obtained at this location and submitted to A & L Canada Laboratories East Inc. for chemical testing. The testing was conducted to determine the in-situ nitrate level in the shallow water tables. The Certificate of Analysis is attached to this letter. The analysis determined that the background nitrate level of the existing on-site shallow aquifer complex is 0.71 mg/L (ppm).

With the acquired data pertaining to the actual on-site background nitrate level, a revised impact assessment was carried out. As a result of this revised assessment, the planned subdivision has been reduced from 24 to 18 residential lots. The new subdivision plan is attached to this letter as Plate 2. The plan was developed in accordance with recommendations stemming from the revised hydrogeologic assessment and considers factors such as differences in surficial overburden characteristics. In general, the subdivision area exhibits two distinct subsoils: glacial till (Area 1); and gravelly sand deposits (Area 2). Based on our soil exploration program, the presence of these two soil types are illustrated on the Plot Plan.

A summary of the revised impact assessment is presented below. The assessment has been conducted for each of the two subsoil areas as outlined by the M.O.E.E. letter. As part of the assessment, it is assumed that each household will generate 1,000 L/day of septic effluent. While most constituents in septic effluent are usually renovated within a short distance of movement within the soil, mobile constituents such as chlorides and nitrates will require sustained dilution to meet the drinking water objectives of 10 mg/l N for nitrate. It is normally considered that sewage from a Class 4 waste disposal system will contain 40 mg/L of nitrate. For the purpose of assessing the impact of projected nitrate loading, the dilution requirement of 4:1 was utilized in the impact computations. Therefore, the anticipated septic effluent from the planned residential development will require a sustained dilution of 72,000 L/day (72 m^3/day) to reduce the mobile constituents to within acceptable levels.

Overall Impact Assessment

1. Total Precipitation : - 785 mm/year
2. Regional Evapotranspiration : - 275 mm/year
3. Recharge Available : - 330 mm/year
4. Recharge Available for Dilution :
   - Area 1, till subsoil: - 150 mm/year
   - Area 2, gravelly sand subsoil: - 200 mm/year
5. Development Area :
   - Area 1: - 2.7 ha
   - Area 2: - 21.3 ha
   - Total: - 24.0 ha
6. Impervious Surfaces (roads and roofs) :
   - Area 1: - 0.2 ha
   - Area 2: - 1.7 ha
   - Total: - 2.0 ha

7. Available On-Site Dilution :

Area 1:	- 10.3 m^3/day
Area 2:	- 107.4 m^3/day
Total:	- 117.3 m^3/day

8. Projected Nitrate Level :

Area 1:	- 9.73 mg/L
Area 2:	- 5.51 mg/L
Overall:	- 6.02 mg/L

Note: Projected Nitrate Level = (background nitrate) + $\frac{\text{(sewage nitrate)}}{\text{(on-site dilution + effluent)}}$

Based on the above parameters and computations, the projected long term resultant nitrate level between the lots and along the down-gradient boundary to the site will be less than the provincial drinking water standard of 10 mg/L and is therefore considered to be acceptable. It should be noted again that there are no existing residences down-gradient of the site. Rather, the property bounds the Indian River which is one of several drainage courses within the Kawartha Lakes system. The daily flow of the river is considered to be significant and therefore, the potential impact of the residential subdivision on the river is deemed to be negligible.

We trust that the added information meets with your approval. Should you have any questions regarding this letter, please contact our office.

Yours very truly,

GEO-LOGIC INC.
GEOTECHNICAL ENGINEERS
AND HYDROGEOLOGISTS

David L. Workman, H.B.Sc.
Hydrogeologist

/dw
Attach.(4)
cc: Mr. Peter Kakaletris, Ministry of Municipal Affairs
Mr. Darryl Tighe, M.Sc., Landmark Associates Limited
Mr. Randy Cullimore

Ontario Ministry of the Environment and Energy / Ministère de l'Environnement et de l'Énergie
Central Region / Région du Centre

7 Overlea Boulevard
4th Floor
Toronto, Ontario
M4H 1A8
416/424-3000
~~Facsimile 416/424-3935~~

7, boulevard Overlea
4e étage
Toronto (Ontario)
M4H 1A8
416/424-3000
~~Facsimile 416/424-3935~~

Our new fax number is: 416/325-6345

1993 02 26

Mr. Peter Kakaletris
Ministry of Municipal Affairs
Plans Administration Branch
14th Floor
777 Bay Street
Toronto, Ontario
M5G 2E5

Dear Mr. Kakaletris:

RE: **Draft Plan of Subdivision**
Township of Dummer
MMA File: 15-T-92001
Our File: CR 15089

The draft plan proposes the creation of a 24 lot subdivision (plus 2 lots identified as "other lands owned by applicant") on 23.96 hectares. The subject site is located in Part of Lot 13, Concession 2, Township of Dummer.

Staff have reviewed the hydrogeological report prepared in support of this development by GEO-LOGIC INC. (dated May 1990 and revised February 1992). Staff requires that the following information be submitted in order to complete their review

Development Impact

- The background nitrate concentration for the upper unconfined aquifer must be determined. On page 21 of the above-mentioned report, a background nitrate level of 0.49 mg/L is quoted. Assuming that this value was derived from the water quality analyses for the test wells, this is unacceptable due to the fact that the test wells obtain water from the leaky-confined bedrock aquifer. The water quality analyses for the shallow dug wells W1, W2 and W5, showed nitrate values of 1.61 mg/L, 1.61 mg/L and 2.00 mg/L respectively.

cont'd ...

Plate 1A

- A revised nitrate impact assessment is required. The revised assessment must take into account the large variations in lot size. If the lots are to remain as is, the site area must be divided into at least two separate sections for the purpose of the nitrate impact assessment. The division into the separate nitrate dilution areas should be done on the basis of lot size. Additionally, the variances in overburden material must be taken into account.

With reference to the lands identified on the draft plan as "other lands owned by the applicant" we will require information as to the existing and/or proposed use for such lots in order that an assessment can be made related to any possible conflicts of land use compatibility (i.e. residential/commercial) and need for buffering provisions etc. If such lands are proposed for development the servicing implications of these properties should be incorporated into the revisions required to the hydrogeologic study noted previously.

By way of this letter we are informing the Peterborough County - City Health Unit that we have concerns with respect to the geology of lands within lots 10 and 11 that are adjacent to Indian River. This should be considered in determining the location of septic systems.

In summary, we recommend that pending the receipt and review of an acceptable hydrogeology study by this Ministry and the resolution of our concerns regarding the land use of the two additional lots that will be created and retained by the owner of this development, that draft approval of this plan of subdivision continue to be held in abeyance.

Yours truly,

original signed by

Joseph Plutino, M.C.I.P.
Planner
Regional and GTA Planning Unit
Technical Assessment Section

cc: Peterborough District Office
Peterborough County - City Health Unit
Geo-Logic Inc.
Mr. R. Cullimore

[illegible]

REPORT NUMBER
C146-01R
ACCOUNT NUMBER
99029

A & L CANADA LABORATORIES EAST, INC.

2136 Jetstream Road • London, Ontario N5V 3P5 • TELEPHONE (519) 457-2575

SEND TO: Geo-Logic Inc.
P.O. Box 694
Peterborough, Ontario
K9J 6Z8

DATE RECEIVED: May 25, 1993
SAMPLE TYPE: Water
ANALYSIS REQUESTED: Nitrate-N
IDENTIFICATION: 89-G-831
ATTENTION: Mr. Dave Workman

REPORT OF ANALYSIS

DATE: May 27, 1993

	PARAMETERS	Amounts in Soil (PPM) Sample Identification					CRITERIA** PPM
		146-001					
1	Nitrate-N	0.71					

**For confirmation refer to the MOE Guidelines.
* < = Below MDL of the instrument.

Signature.....
Ravi Kanipayor MSc C.Chem
Director of Laboratories

A & L Canada Laboratories East, Inc. employs a strict QA/QC program at all stages of analysis in order to maintain the principles of good laboratory practices. Valid methodologies are used to the best of our abilities, however, our liabilities are limited to the analytical costs.

GROUNDWATER CHEMICAL ANALYSIS

Background Nitrate Level T-7

GEO-LOGIC INC.

Plate 3

PETERBOROUGH COUNTY -CITY HEALTH UNIT

APPLICATION FOR CONSENT AND INSPECTION FORM FOR SUBDIVISION

File Number: 15T92001 Receipt Number: 53786

Agency through which application is entered: MINISTRY OF MUNICIPAL AFFAIRS

Inspector: K. SHEPHERD Title: C.P.H.I. (C)

Date Received: 03/16/92 Date Reported: 12/09/93 Condominium Proposal?: NO

---------- OWNER & LOCATION ----------

Last Name: CULLIMORE Initial: R Address: 735 BETHUNE STREET

City/Town: PETERBOROUGH Postal Code: K9H-4A5

Home Telephone: (705)741-3961 Office Telephone: ( ) - 0

---------- LEGAL DESCRIPTION OF PROPERTY ----------

County/District: PETERBOROUGH Twnshp/Municipal: DUMMER

Lot: 13 Concession: 2 Plan Number:

Sublot Number: Address:

Town:

---------- MAP DATA ----------

Utm Reference #: Map Reference: Map Date: / /

Number of Lots: 18 Number Recommended for Approval: 18

DESCRIPTION OF PROPOSAL:

THE PROPOSAL CONSISTS OF 18 LOTS AND 2 BLOCKS HAVING 23.96 HECTARES. ACCESS TO THE DEVELOPMENT IS OFF COUNTY RD. 24.

RECOMMENDATIONS:

TWO TEST PITS, 1.8 METRES DEEP WERE DUG ON EACH OF THE PROPOSED LOTS. THE GROUND WATER TABLE AND BEDROCK WAS NOT ENCOUNTERED IN ANY OF THE TEST PITS. THE NATIVE SOILS HAVE A GRANULAR CONSISTANCY RANGING FROM A COARSE SAND WITH AGGREGATE TO A SAND WITH TRACES OF SILT TO THE NORTH WEST OF THE PROPERTY. THE PERCOLATION RATE OF THESE SOILS ARE IN THE RANGE OF FIVE TO TEN MINUTES PER CENTIMETRE. ALL LOT REFERENCES ARE TAKEN FROM A PLAN PREPARED BY LANDMARK ASSOCIATES LIMITED, DATED SEPTEMBER 1992.

ALL LOTS ARE SUITABLE FOR CONVENTIONAL TYPE CLASS 4 PRIVATE SEWAGE DISPOSAL SYSTEMS AND APPROVAL IS RECOMMENDED.

APPENDIX B

Test Pit Logs and Study Area Photos

ORE
Oakridge Environmental Ltd.
Environmental and Hydrogeological Services
647 Neal Drive, Suite 3, Peterborough, Ontario K9J 6X7
Phone: 705-745-1181 | Fax: 705-745-4163 | www.oakridgeenvironmental.com |

TEST PIT I.D.: **TP-18-1**

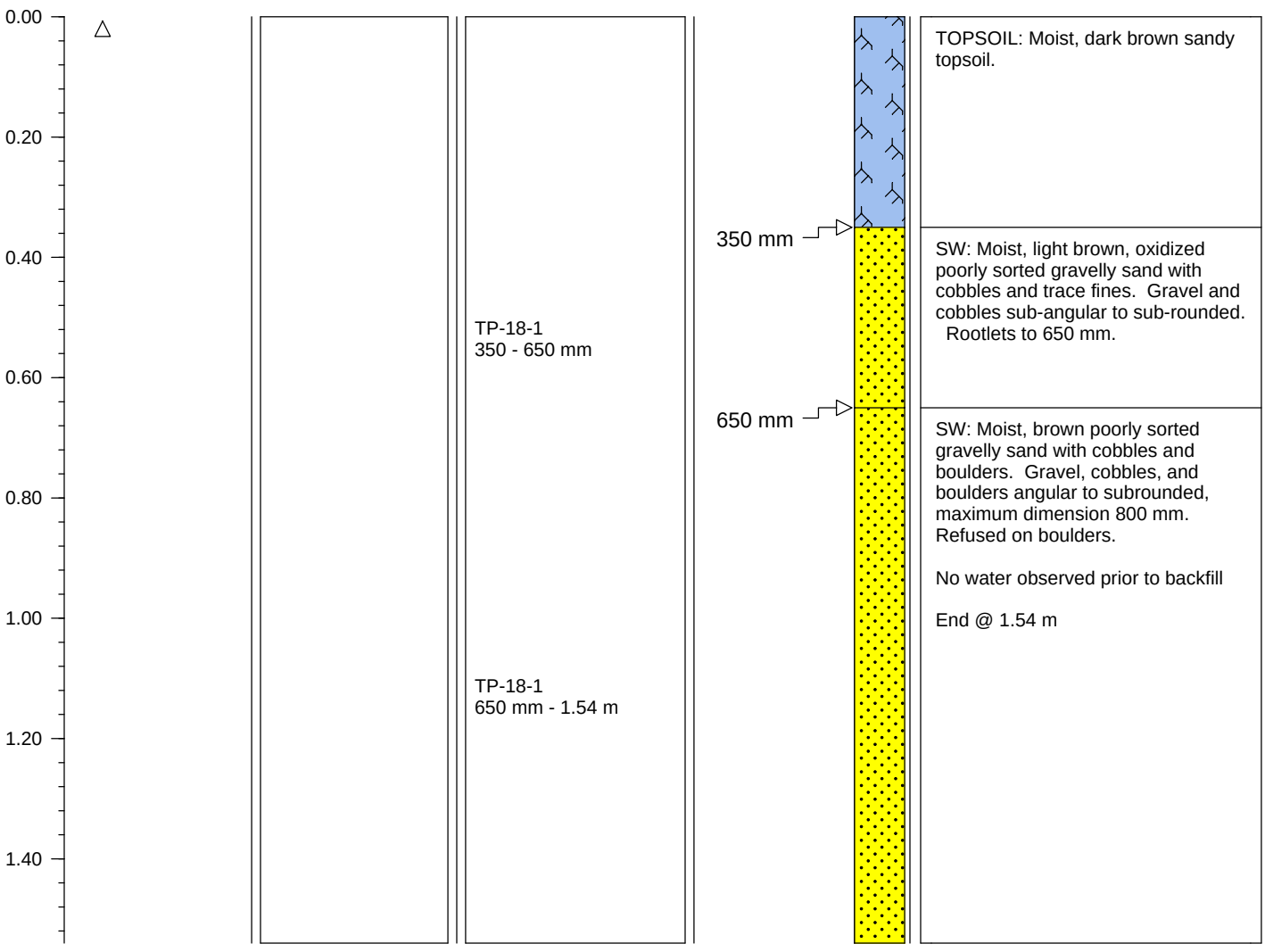
TOTAL DEPTH: **1.54 m**

UTM Coordinates:	Elevation (mASL):
728285, 4924635	223.4

PROJECT INFORMATION	CONTRACTOR INFORMATION
PROJECT NO: **17-2326**	EXCAVATION CO.: **Supplied by client**
SITE LOCATION: **Warsaw, Ontario**	BACKHOE TYPE: **Bobcat E26**
LOGGED BY: **MD**	STANDPIPE/PIEZOMETERS: **Not installed**
DATES ASSESSED: **May 31, 2018**	SAMPLING METHODS: **Composite grab**

▽ Seepage ▼ Water Level △ Moist

FIELD TEST PIT LOG



NOTES: 30 °C / Overcast

ORE
Oakridge Environmental Ltd.
Environmental and Hydrogeological Services
647 Neal Drive, Suite 3, Peterborough, Ontario K9J 6X7
Phone: 705-745-1181 | Fax: 705-745-4163 | www.oakridgeenvironmental.com |

TEST PIT I.D.: **TP-18-2**

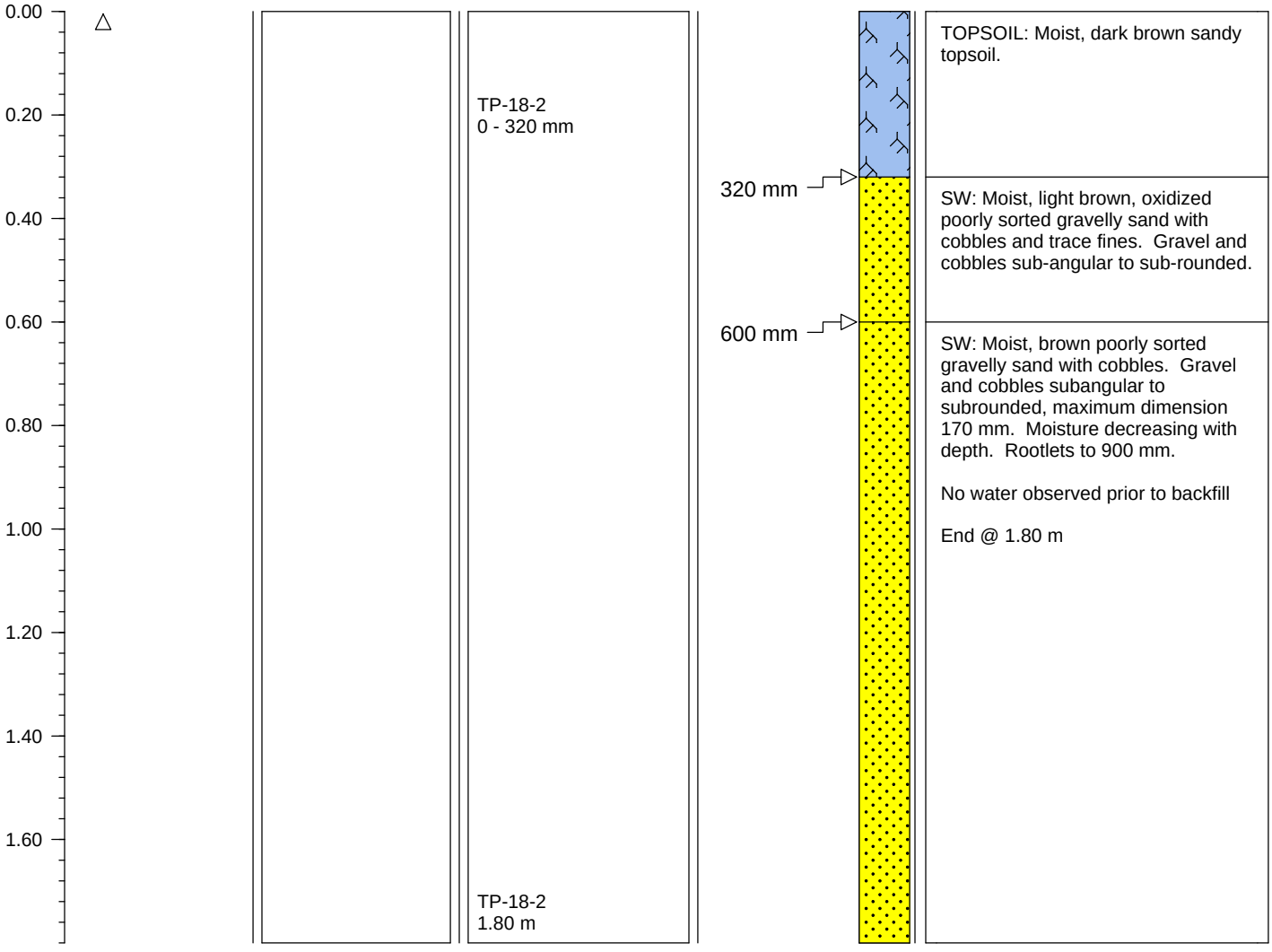
TOTAL DEPTH: **1.80 m**

UTM Coordinates:	Elevation (mASL):
728359, 4924553	223.1

PROJECT INFORMATION	CONTRACTOR INFORMATION
PROJECT NO: **17-2326**	EXCAVATION CO.: **Supplied by client**
SITE LOCATION: **Warsaw, Ontario**	BACKHOE TYPE: **Bobcat E26**
LOGGED BY: **MD**	STANDPIPE/PIEZOMETERS: **Not installed**
DATES ASSESSED: **May 31, 2018**	SAMPLING METHODS: **Composite grab**

▽ Seepage ▼ Water Level △ Moist

FIELD TEST PIT LOG



NOTES: 30 °C / Overcast

ORE
Oakridge Environmental Ltd.
Environmental and Hydrogeological Services
647 Neal Drive, Suite 3, Peterborough, Ontario K9J 6X7
Phone: 705-745-1181 | Fax: 705-745-4163 | www.oakridgeenvironmental.com |

TEST PIT I.D.: **TP-18-3**

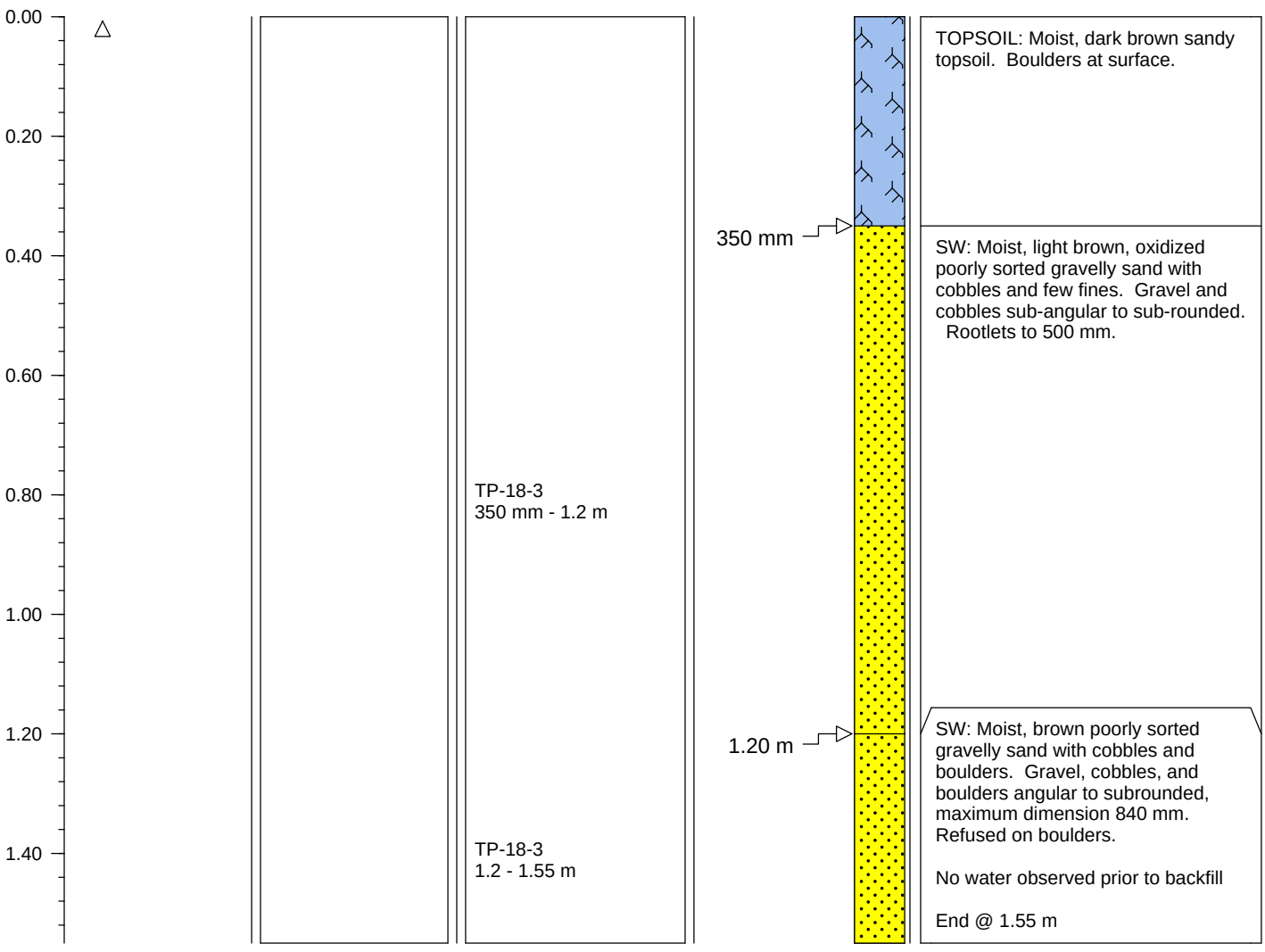
TOTAL DEPTH: **1.55 m**

UTM Coordinates:	Elevation (mASL):
728445, 4924700	222.8

PROJECT INFORMATION	CONTRACTOR INFORMATION
PROJECT NO: **17-2326**	EXCAVATION CO.: **Supplied by client**
SITE LOCATION: **Warsaw, Ontario**	BACKHOE TYPE: **Bobcat E26**
LOGGED BY: **MD**	STANDPIPE/PIEZOMETERS: **Not installed**
DATES ASSESSED: **May 31, 2018**	SAMPLING METHODS: **Composite grab**

▽ Seepage ▼ Water Level △ Moist

FIELD TEST PIT LOG



NOTES: 30 °C / Overcast / Heavy rain

ORE
Oakridge Environmental Ltd.
Environmental and Hydrogeological Services
647 Neal Drive, Suite 3, Peterborough, Ontario K9J 6X7
Phone: 705-745-1181 | Fax: 705-745-4163 | www.oakridgeenvironmental.com |

TEST PIT I.D.: **TP-18-4**

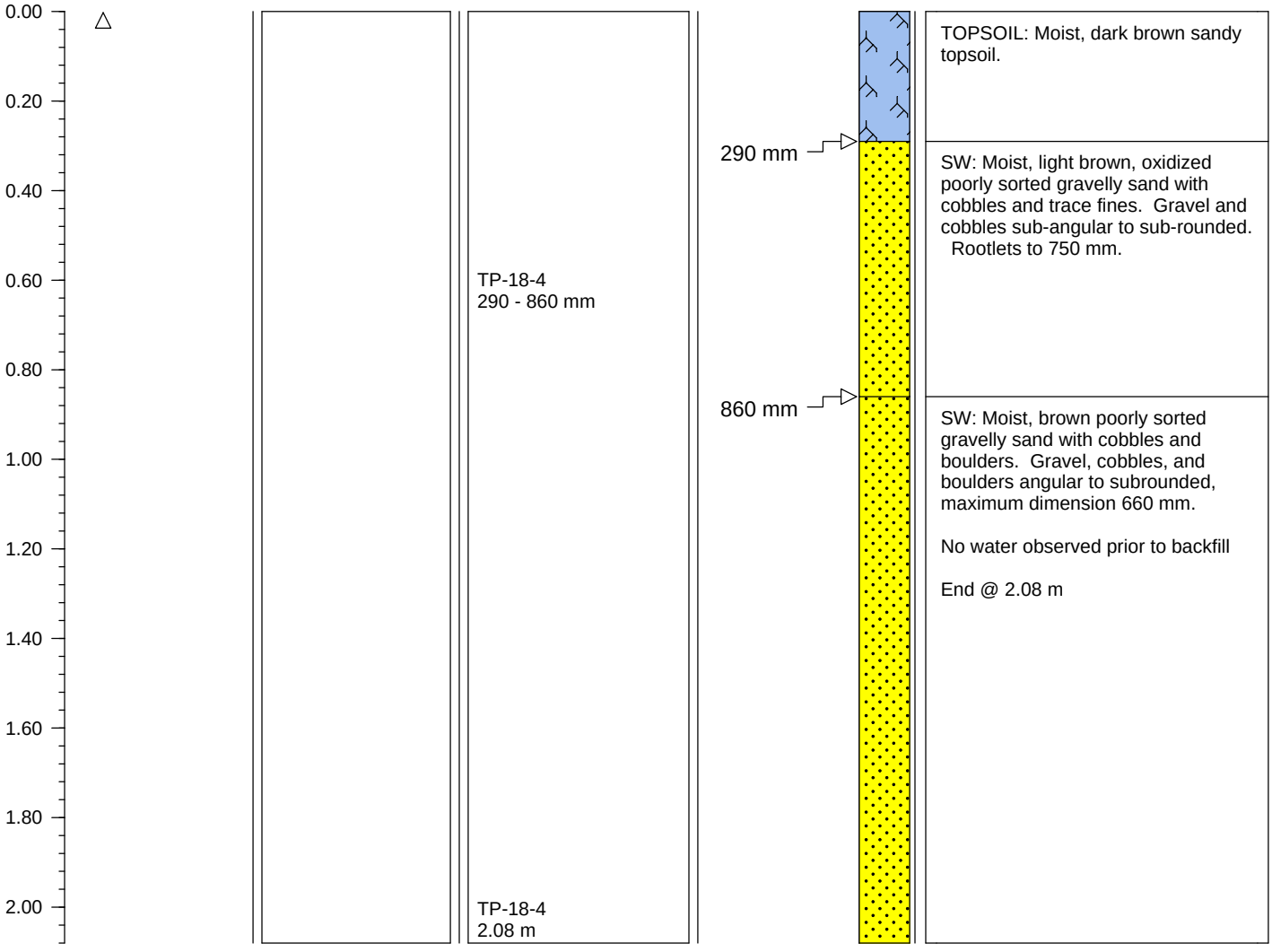
TOTAL DEPTH: **2.08 m**

UTM Coordinates:	Elevation (mASL):
728459, 4924527	222.1

PROJECT INFORMATION	CONTRACTOR INFORMATION
PROJECT NO: **17-2326**	EXCAVATION CO.: **Supplied by client**
SITE LOCATION: **Warsaw, Ontario**	BACKHOE TYPE: **Bobcat E26**
LOGGED BY: **MD**	STANDPIPE/PIEZOMETERS: **Not installed**
DATES ASSESSED: **May 31, 2018**	SAMPLING METHODS: **Composite grab**

▽ Seepage ▼ Water Level △ Moist

FIELD TEST PIT LOG



NOTES: 30 °C / Overcast / Light rain

ORE
Oakridge Environmental Ltd.
Environmental and Hydrogeological Services
647 Neal Drive, Suite 3, Peterborough, Ontario K9J 6X7
Phone: 705-745-1181 | Fax: 705-745-4163 | www.oakridgeenvironmental.com |

TEST PIT I.D.: **TP-18-5**

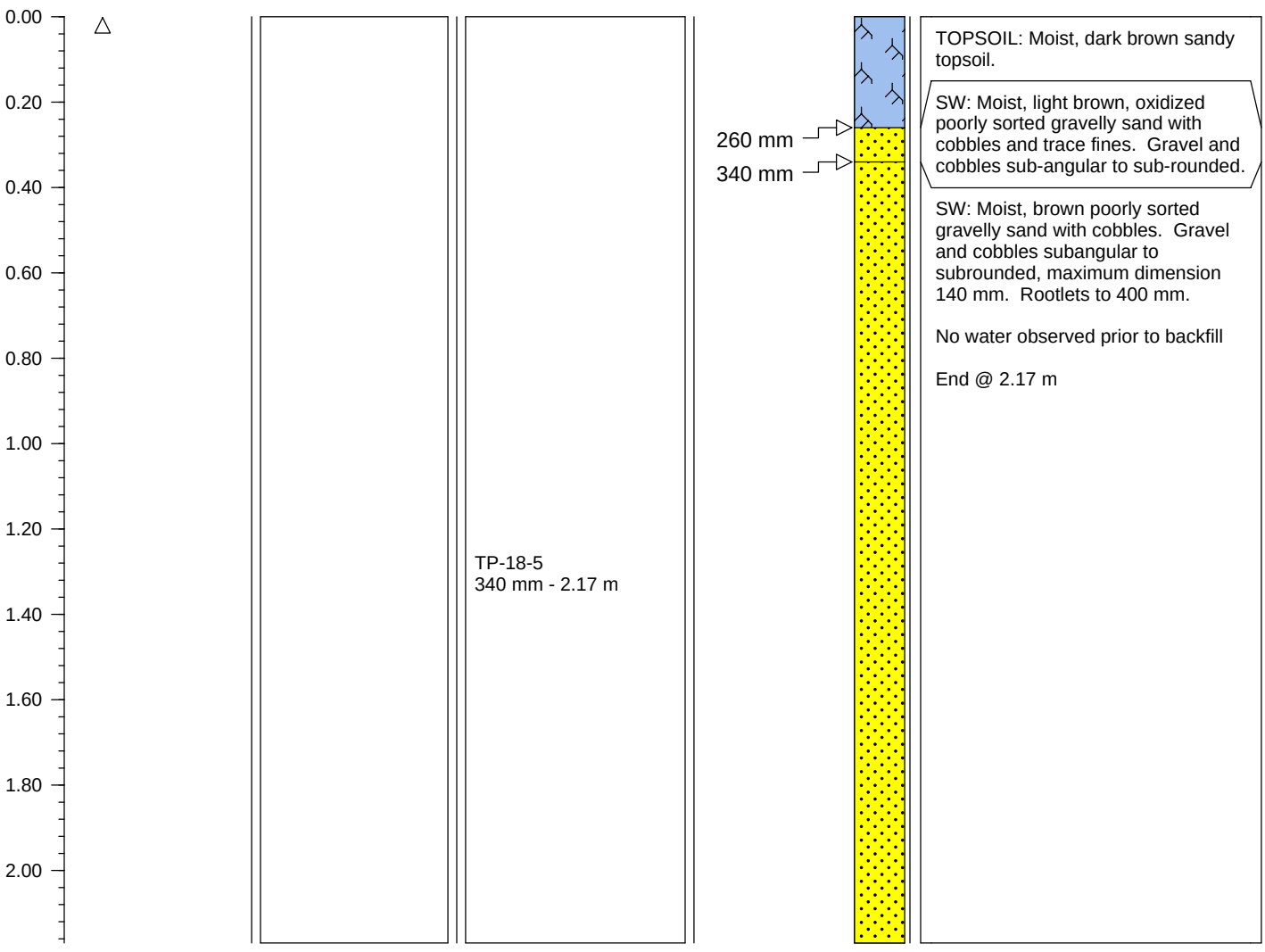
TOTAL DEPTH: **2.17 m**

UTM Coordinates:	Elevation (mASL):
728474, 4924416	217.3

PROJECT INFORMATION	CONTRACTOR INFORMATION
PROJECT NO: **17-2326**	EXCAVATION CO.: **Supplied by client**
SITE LOCATION: **Warsaw, Ontario**	BACKHOE TYPE: **Bobcat E26**
LOGGED BY: **MD**	STANDPIPE/PIEZOMETERS: **Not installed**
DATES ASSESSED: **May 31, 2018**	SAMPLING METHODS: **Composite grab**

▽ Seepage ▼ Water Level △ Moist

FIELD TEST PIT LOG



NOTES: 30 °C / Overcast

ORE
Oakridge Environmental Ltd.
Environmental and Hydrogeological Services
647 Neal Drive, Suite 3, Peterborough, Ontario K9J 6X7
Phone: 705-745-1181 | Fax: 705-745-4163 | www.oakridgeenvironmental.com |

TEST PIT I.D.: **TP-18-6**

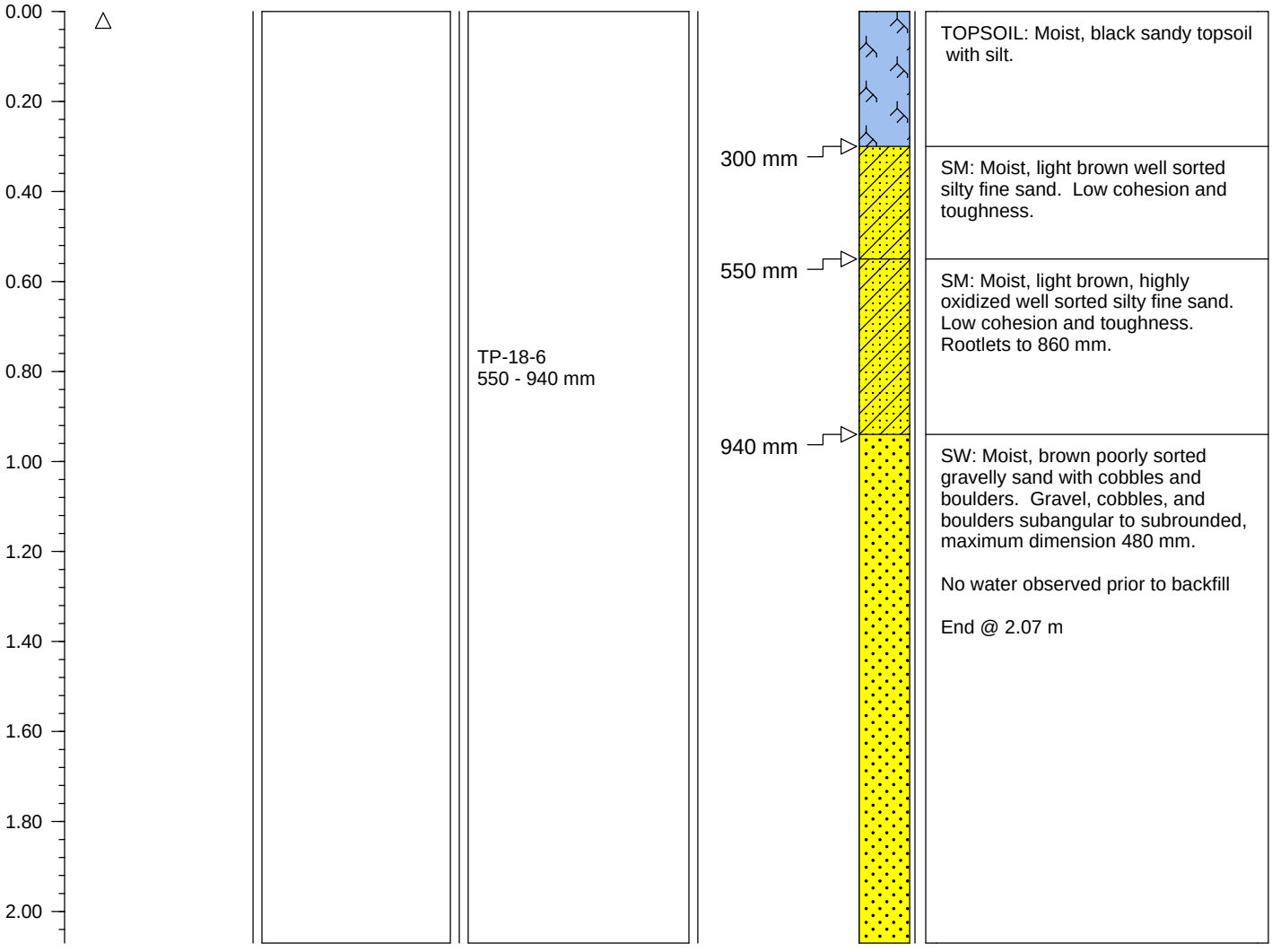
TOTAL DEPTH: **2.07 m**

UTM Coordinates:	Elevation (mASL):
728474, 4924588	221.7

PROJECT INFORMATION	CONTRACTOR INFORMATION
PROJECT NO: **17-2326**	EXCAVATION CO.: **Supplied by client**
SITE LOCATION: **Warsaw, Ontario**	BACKHOE TYPE: **Bobcat E26**
LOGGED BY: **MD**	STANDPIPE/PIEZOMETERS: **Not installed**
DATES ASSESSED: **May 31, 2018**	SAMPLING METHODS: **Composite grab**

▽ Seepage ▼ Water Level △ Moist

FIELD TEST PIT LOG



NOTES: 30 °C / Overcast

ORE
Oakridge Environmental Ltd.
Environmental and Hydrogeological Services
647 Neal Drive, Suite 3, Peterborough, Ontario K9J 6X7
Phone: 705-745-1181 | Fax: 705-745-4163 | www.oakridgeenvironmental.com |

TEST PIT I.D.: **TP-18-7**

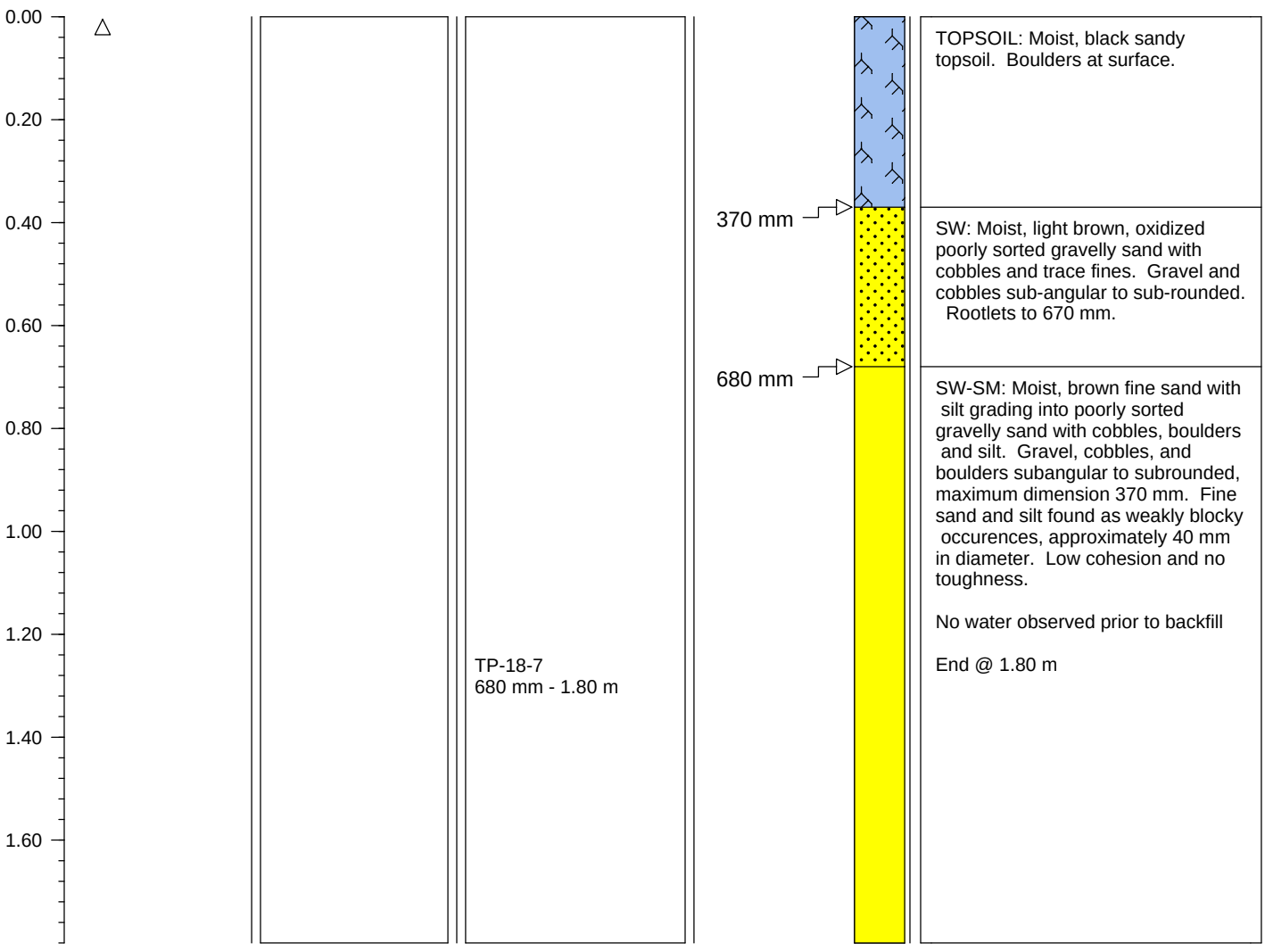
TOTAL DEPTH: **1.80 m**

UTM Coordinates:	Elevation (mASL):
728488, 4924638	221.0

PROJECT INFORMATION	CONTRACTOR INFORMATION
PROJECT NO: **17-2326**	EXCAVATION CO.: **Supplied by client**
SITE LOCATION: **Warsaw, Ontario**	BACKHOE TYPE: **Bobcat E26**
LOGGED BY: **MD**	STANDPIPE/PIEZOMETERS: **Not installed**
DATES ASSESSED: **May 31, 2018**	SAMPLING METHODS: **Composite grab**

▽ Seepage ▼ Water Level △ Moist

FIELD TEST PIT LOG



NOTES: 30 °C / Overcast

ORE
Oakridge Environmental Ltd.
Environmental and Hydrogeological Services
647 Neal Drive, Suite 3, Peterborough, Ontario K9J 6X7
Phone: 705-745-1181 | Fax: 705-745-4163 | www.oakridgeenvironmental.com |

TEST PIT I.D.: **TP-18-8**

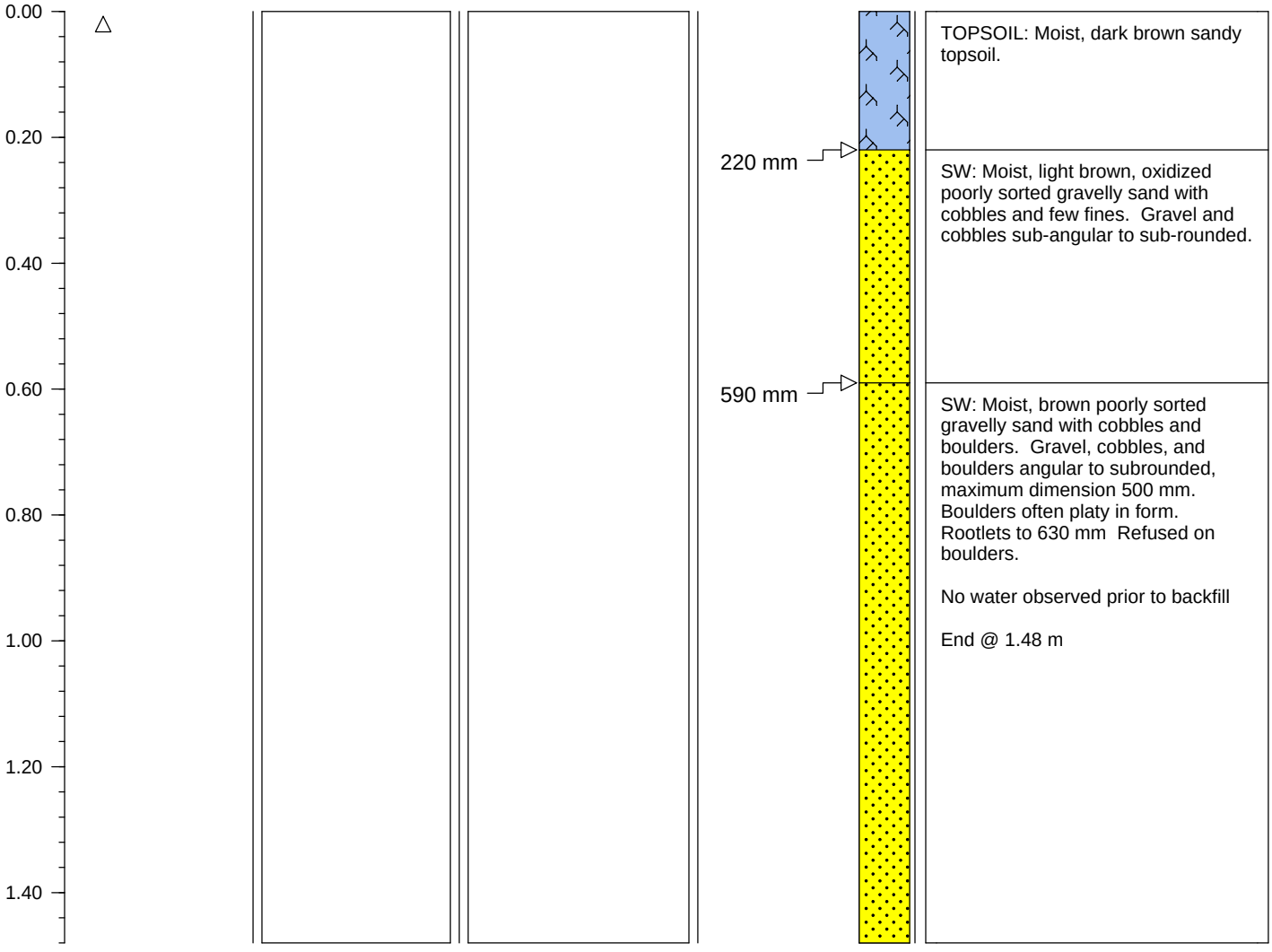
TOTAL DEPTH: **1.48 m**

UTM Coordinates:	Elevation (mASL):
728551, 4924683	222.3

PROJECT INFORMATION	CONTRACTOR INFORMATION
PROJECT NO: **17-2326**	EXCAVATION CO.: **Supplied by client**
SITE LOCATION: **Warsaw, Ontario**	BACKHOE TYPE: **Bobcat E26**
LOGGED BY: **MD**	STANDPIPE/PIEZOMETERS: **Not installed**
DATES ASSESSED: **May 31, 2018**	SAMPLING METHODS: **Composite grab**

▽ Seepage ▼ Water Level △ Moist

FIELD TEST PIT LOG



NOTES: 30 °C / Overcast

ORE
Oakridge Environmental Ltd.
Environmental and Hydrogeological Services
647 Neal Drive, Suite 3, Peterborough, Ontario K9J 6X7
Phone: 705-745-1181 | Fax: 705-745-4163 | www.oakridgeenvironmental.com |

TEST PIT I.D.: **TP-18-9**

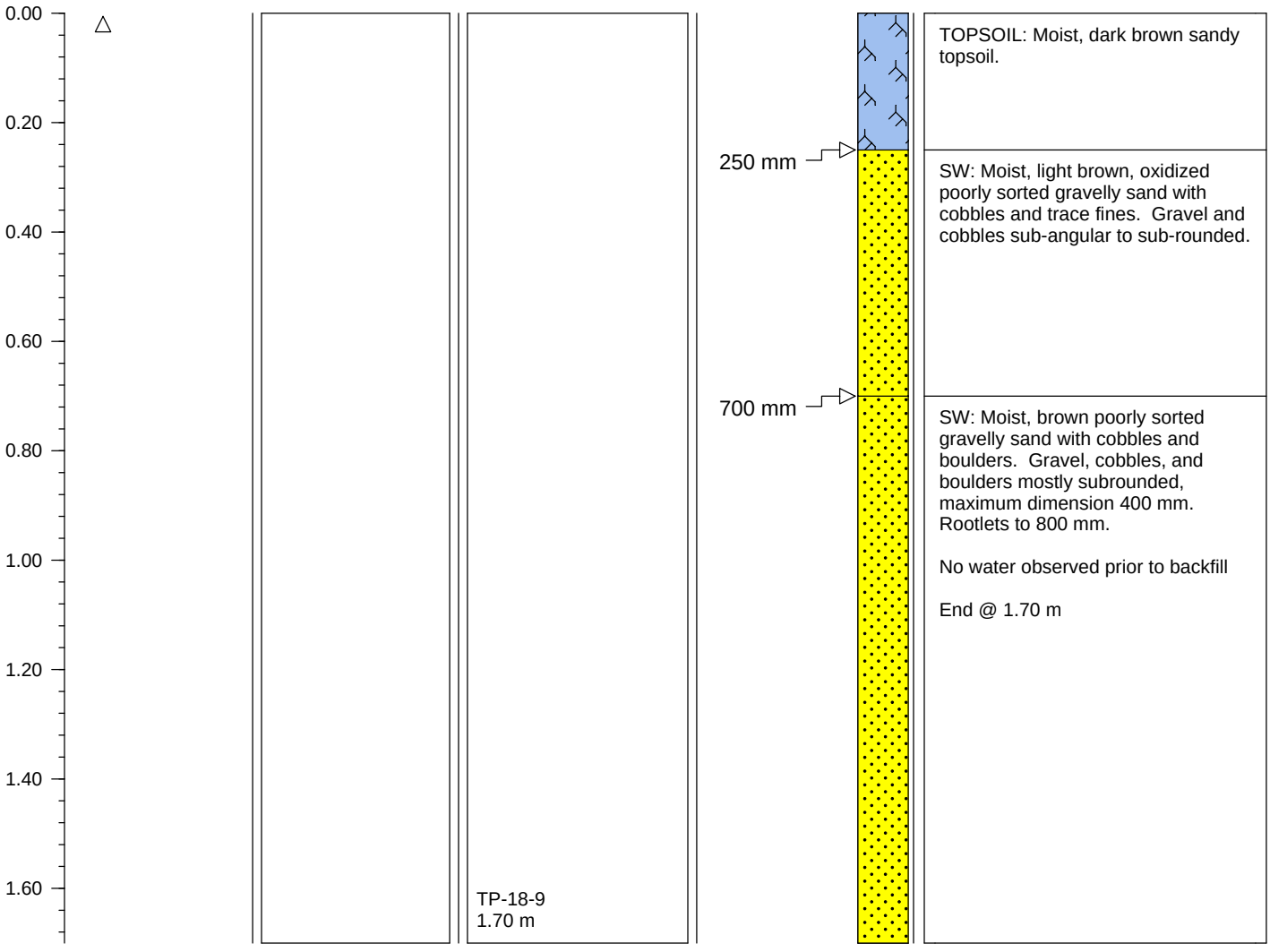
TOTAL DEPTH: **1.70 m**

UTM Coordinates:	Elevation (mASL):
728534, 4924612	222.2

PROJECT INFORMATION	CONTRACTOR INFORMATION
PROJECT NO: **17-2326**	EXCAVATION CO.: **Supplied by client**
SITE LOCATION: **Warsaw, Ontario**	BACKHOE TYPE: **Bobcat E26**
LOGGED BY: **MD**	STANDPIPE/PIEZOMETERS: **Not installed**
DATES ASSESSED: **May 31, 2018**	SAMPLING METHODS: **Composite grab**

▽ Seepage ▼ Water Level △ Moist

FIELD TEST PIT LOG



NOTES: 30 °C / Overcast

Photo A: Dummer Complex Topography

Photo B: Epikarst Terrain

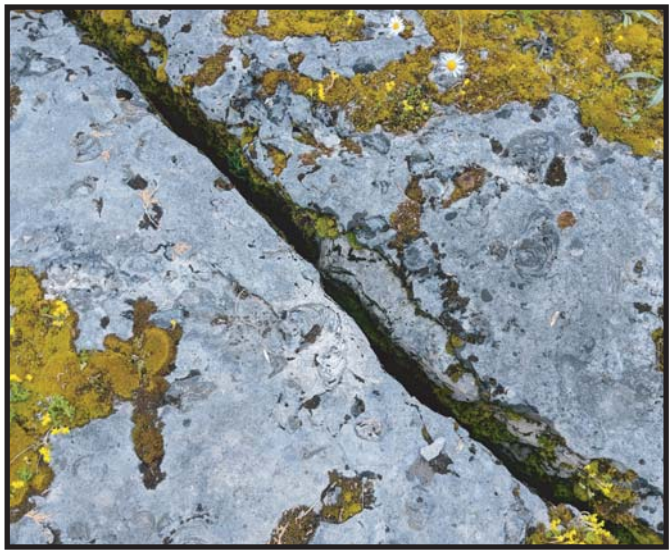


Photo C: Exposed epikarst fracture near waterfront

Photo D: Enlarged fracture along shoreline

Photo E: Sandy ridge / buried scarp

Photo F: Former aggregate pit

APPENDIX B

ORE
Oakridge Environmental Ltd.
Environmental and Hydrogeological Services

APPENDIX C

MOE Well Records

Water Well Records

November 20, 2019

16:15:45

TOWNSHIP CON LOT	UTM	DATE CNTR	CASING DIA	WATER	PUMP TEST	WELL USE	SCREEN	WELL	FORMATION
DUMMER TOWNSHIP	17 727677 4924870 W	2016-12 7241	1.36			MT	0022 10	7280023 (Z238157) A190947	BRWN SAND GRVL 0002 GREY LMSN FCRD 0032
DUMMER TOWNSHIP	17 727781 4924527 W	2016-12 7241	1.36			MT	0022 10	7280022 (Z238158) A190951	GREY LMSN FCRD 0016 GREY LMSN CGRD 0021 GREY LMSN 0032
DUMMER TOWNSHIP	17 727756 4923576 W	2017-03 1455	6.25	UT 0020	11/23/24/1:	DO		7289097 (Z243420) A213316	BRWN SAND 0004 BRWN CLAY GRVL BLDR 0010 GREY SHLE GRVL SAND 0014 GREY LMSN ROCK SHLE 0020 GREY LMSN 0025
DUMMER TOWNSHIP	17 727862 4923500 W	2006-10 6593	0.36	FR 0010	//1/1:0	DO		5120892 (Z47765) A042672	BLCK LOAM 0001 YLLW STNS CLAY 0008 BLUE CLAY 0010
DUMMER TOWNSHIP CON 01 011	17 728312 4923269 W	2012-05 3367	6.25 6.25	SU 0063	37/54/4/1:0	DO		7184452 (Z150005) A123287	BRWN LOAM STNS PCKD 0002 GREY CLAY FILL STNS 0008 GREY CLAY STNS PCKD 0014 GREY LMSN HARD 0037 GREY LMSN HARD 0063 GREY LMSN LYRD 0065
DUMMER TOWNSHIP CON 01 011	17 728208 4923259 W	1958-08 2404	6 6	SU 0029	35///:	NU		5101020 () A	GRVL BLDR 0028 BRWN LMSN 0031 GREY LMSN 0086 BLCK LMSN 0089
DUMMER TOWNSHIP CON 01 011	17 728265 4923313 W	1970-07 1918	6	SU 0051	31/45/6/2:0	DO		5105577 ()	BRWN MSND 0017 GREY LMSN 0054
DUMMER TOWNSHIP CON 01 011	17 728322 4923307 W	2016-01 7560	6.25 6	SU 0087	32/73/5/1:	DO		7263358 (Z213990) A187547	GREY CLAY STNS PCKD 0006 GREY LMSN SAND SHLE 0018 GREY LMSN HARD 0062 GREY LMSN SAND SHLE 0081 BLCK LMSN HARD 0088
DUMMER TOWNSHIP CON 01 011	17 727981 4923264 W	2010-01 3367	6.25	FR 0025	11/23/5/1:0	DO		7144899 (Z103792) A090129	GREY BLDR CLAY SAND 0010 GREY LMSN LYRD 0032
DUMMER TOWNSHIP CON 01 011	17 728285 4923282 W	1973-06 2104	6 6	FR 0083	30/80/1/2:10	DO		5106437 ()	LOAM 0001 BRWN CLAY STNS 0008 GREY LMSN 0085
DUMMER TOWNSHIP CON 01 011	17 728151 4923274 W	1952-09 2113	6 6	FR 0045	10/30/5/2:0	DO		5101018 ()	CLAY MSND STNS 0013 LMSN 0052
DUMMER TOWNSHIP CON 01 011	17 728365 4923373 W	1975-07 1921		FR 0010	10/56/4/1:0	DO		5109773 ()	PRDG 0008 GREY SHLE 0010 GREY LMSN 0057
DUMMER TOWNSHIP CON 01 011	17 728345 4923323 W	1970-07 1918	6	SU 0037		NU		5105576 () A	BRWN SHLE MSND 0015 GREY LMSN 0038
DUMMER TOWNSHIP CON 01 012	17 727715 4923673 W	1978-01 1904	6	FR 0013 SU 0046	///:	CO DO		5108962 ()	BRWN CLAY STNS 0005 BRWN CLAY GRVL 0013 GREY LMSN 0049
DUMMER TOWNSHIP CON 01 012	17 727315 4923273 W	1977-07 4814	6 6	FR 0020	12/56/4/1:0	DO		5109049 ()	PRDG 0018 GREY CLAY HPAN STNS 0020 GREY LMSN SHLE 0021 GREY LMSN 0060
DUMMER TOWNSHIP CON 01 012	17 727565 4923423 W	1975-10 5102	6	SU 0102	55/85/5/1:30	DO		5107673 ()	PRDR 0015 UNKN 0102

TOWNSHIP CON LOT	UTM	DATE CNTR	CASING DIA	WATER	PUMP TEST	WELL USE	SCREEN	WELL	FORMATION
DUMMER TOWNSHIP CON 01 012	17 727265 4923273 W	1975-08 5102	6	FR 0070	20/65/5/1:40	DO		5107563 ()	BRWN CLAY GRVL 0035 GREY CLAY BLDR GRVL 0058 UNKN 0073
DUMMER TOWNSHIP CON 01 012	17 727456 4923321 W	1974-09 5102						5107172 () A	BRWN CLAY BLDR 0012 GREY LMSN 0050
DUMMER TOWNSHIP CON 01 012	17 727665 4923373 W	1976-04 5102	6		39/42/25/1:40	DO		5107938 ()	PRDR 0035 GREY LMSN 0057
DUMMER TOWNSHIP CON 01 012	17 727715 4923523 W	1978-07 5102	6	UK 0059	15/45/10/1:40	DO		5109107 ()	BRWN CLAY BLDR 0008 GREY LMSN 0060
DUMMER TOWNSHIP CON 01 012	17 727715 4923723 W	1978-10 5102	6	UK 0082	50/73/6/1:40	DO		5109174 ()	PRDG 0050 GREY LMSN 0082
DUMMER TOWNSHIP CON 01 012	17 727815 4923623 W	1979-08 1904	6	FR 0010 FR 0020	7/20/5/2:0	DO		5109770 ()	LOAM DKCL 0002 GREY SHLE GRVL 0007 BRWN LMSN 0025
DUMMER TOWNSHIP CON 01 012	17 727765 4923523 W	1979-08 1904	6	FR 0010 FR 0022	4/20/6/2:0	DO		5109777 ()	GRVL SAND 0002 GREY SHLE GRVL 0007 GREY LMSN 0016 BRWN LMSN 0025 GREY LMSN 0027
DUMMER TOWNSHIP CON 01 012	17 727815 4923473 W	1979-12 1904	6	FR 0015	4/10/8/2:0	DO		5109784 ()	LOAM 0002 GREY CLAY STNS 0006 BRWN LMSN 0015 GREY LMSN 0019
DUMMER TOWNSHIP CON 01 012	17 727815 4923673 W	1980-04 5102	6	UK 0025	5/20/5/1:40	DO		5109986 ()	BRWN CLAY BLDR 0005 GREY SHLE 0015 GREY LMSN 0025
DUMMER TOWNSHIP CON 01 012	17 727815 4923523 W	1980-07 1904	5	SU 0042 SU 0070 SA 0090				5110034 ()	PRDR 0022 GREY LMSN LTCL 0125 RED LMSN LTCL 0127
DUMMER TOWNSHIP CON 01 012	17 728415 4923423 W	1981-02 2104	6	SU 0044	20/53/1/5:0	DO		5110172 ()	BRWN LOAM SOFT 0002 BRWN CLAY GRVL PCKD 0005 GREY SHLE STNS HARD 0014 GREY LMSN LYRD 0055
DUMMER TOWNSHIP CON 01 012	17 728165 4923623 W	1982-05 2104	6	FR 0040 FR 0046	15/25/20/6:30	DO		5110456 ()	BRWN STNS BLDR HARD 0026 BRWN SHLE GRVL MGRD 0028 BRWN LMSN MGRD 0046
DUMMER TOWNSHIP CON 01 012	17 727615 4923823 W	1979-09 5102		UK 0074	30/72//1:40	DO		5109564 ()	PRDR 0034 GREY LMSN 0075
DUMMER TOWNSHIP CON 01 012	17 727692 4923426 W	1967-06 4713	6 6	FR 0027	6/18/10/2:0	DO		5101036 ()	GRVL 0018 GREY LMSN 0027
DUMMER TOWNSHIP CON 01 012	17 727759 4923438 W	1956-11 2404	6 6	FR 0009	8/17/4/0:5	DO		5101022 ()	STNS LOAM 0006 GREY LMSN 0017
DUMMER TOWNSHIP CON 01 012	17 727743 4923465 W	1958-08 2404	6 6	FR 0017	12/12/10/1:0	DO		5101025 ()	GRVL BLDR 0007 GREY LMSN 0020
DUMMER TOWNSHIP CON 01 012	17 727676 4923452 W	1958-08 2404	6 6	FR 0017	9/25/1/2:0	DO		5101026 ()	GRVL BLDR 0006 GREY LMSN 0025
DUMMER TOWNSHIP CON 01 012	17 727434 4923273 W	1958-10 2404	6 6	FR 0015	11/28/0/0:15	DO		5101027 ()	GRVL LOAM 0012 GREY LMSN 0028
DUMMER TOWNSHIP CON 01 012	17 727691 4923433 W	1960-12 2404	5	FR 0029	23/35/1/0:30	DO		5101028 ()	GRVL 0035

TOWNSHIP CON LOT	UTM	DATE CNTR	CASING DIA	WATER	PUMP TEST	WELL USE	SCREEN	WELL	FORMATION
DUMMER TOWNSHIP CON 01 012	17 727777 4923737 W	1961-08 2404	5 5	FR 0013	6/24/3/3:0	DO		5101029 ()	LOAM CLAY 0015 GREY LMSN 0026
DUMMER TOWNSHIP CON 01 012	17 727765 4923649 W	1961-09 2404	5 5	FR 0015	6/16/5/1:0	DO		5101030 ()	GRVL 0014 GREY LMSN 0019
DUMMER TOWNSHIP CON 01 012	17 727683 4923497 W	1961-12 2404	5 5	FR 0016	6/12/5/0:30	DO		5101031 ()	GRVL BLDR 0008 GREY LMSN 0022
DUMMER TOWNSHIP CON 01 012	17 728065 4923773 W	1968-08 2104	6 6	FR 0032	3/25/10/2:0	DO		5105291 ()	LOAM 0001 GREY LMSN 0033
DUMMER TOWNSHIP CON 01 012	17 727863 4924021 W	1967-02 2404	5 5	FR 0018	8/8/5/0:30	DO		5101035 ()	LOAM STNS 0019 LMSN 0026
DUMMER TOWNSHIP CON 01 012	17 727395 4923373 W	1972-06 5102	6	FR 0022 FR 0038	8/10/20/1:30	DO		5106030 ()	LOAM 0001 GREY CLAY 0006 GREY SHLE 0012 GREY LMSN 0040
DUMMER TOWNSHIP CON 01 012	17 727748 4923930 W	1967-10 4713	6 6	FR 0057	20/55/4/2:0	DO		5101037 ()	LOAM 0002 CLAY STNS 0040 GREY LMSN 0057
DUMMER TOWNSHIP CON 01 012	17 727774 4923869 W	1964-10 2404	5 5	FR 0027	9/29/2/0:30	DO		5101068 ()	PRDG 0010 GREY LMSN 0029
DUMMER TOWNSHIP CON 01 012	17 727445 4923303 W	1968-06 4713	6 6	FR 0025	12/25/3/1:0	DO		5104606 ()	LOAM 0002 GRVL MSND 0010 CLAY STNS 0014 GREY LMSN 0025
DUMMER TOWNSHIP CON 01 012	17 727775 4923473 W	1970-09 2404	5 5	FR 0017	7/19/2/0:30	DO		5105169 ()	CLAY STNS 0010 LMSN 0026
DUMMER TOWNSHIP CON 01 012	17 727675 4923453 W	1970-09 2104	6	FR 0054	45/64/3/1:3	DO		5105223 ()	BRWN LOAM 0001 BRWN CSND STNS 0011 GREY LMSN SHLE 0012 GREY LMSN 0066
DUMMER TOWNSHIP CON 01 012	17 727265 4923273 W	1977-05 4814	6 6	FR	8/54/4/2:0	DO		5109046 ()	BRWN LOAM 0001 BRWN CLAY STNS 0006 BRWN CLAY GRVL 0020 GREY FGVL 0024 GREY LMSN 0060
DUMMER TOWNSHIP CON 01 012	17 727715 4923753 W	1970-11 2404	5 5	FR 0030	5/27/5/0:30	DO		5105244 ()	GRVL STNS 0021 LMSN 0032
DUMMER TOWNSHIP CON 01 012	17 727715 4923523 W	1982-07 2104	6 6	SU 0009	3/14/10/2:0	DO		5110536 ()	BRWN LOAM SOFT 0001 BRWN GRVL STNS HARD 0006 GREY LMSN STNS LYRD 0018
DUMMER TOWNSHIP CON 01 012	17 727864 4923379 W	1963-05 2404	5 5	FR 0025	11/25/4/0:30	MN		5101032 ()	GRVL BLDR 0018 LMSN 0030
DUMMER TOWNSHIP CON 01 012	17 728064 4923686 W	2011-12 1455	6.25	0068	30/58/5/1:	DO		7177175 (Z139946) A111146	BRWN CLAY BLDR 0031 GREY CLAY STNS 0038 GREY SHLE CLAY 0042 GREY LMSN ROCK 0070
DUMMER TOWNSHIP CON 01 012	17 727797 4923521 L	1993-09 2104	6	UK 0060	20/50/5/5:30	DO		5116335 (134247)	BRWN SAND FILL 0001 BRWN CLAY STNS 0003 GREY CLAY SNDS 0057 GREY SAND GRVL CLAY 0060
DUMMER TOWNSHIP CON 01 012	17 727795 4923523 L	2003-10 6564	6	FR 0022	16/70/1/1:0	DO		5119616 (261059)	BLCK LOAM 0001 GREY CLAY STNS 0007 GREY SAND STNS 0013 GREY SAND 0015 GREY LMSN 0075
DUMMER TOWNSHIP CON 01 012	17 727801 4923549 W	2006-06 3367	6.25	FR 0036	-2/22/3/1:0	DO		5120792 (Z44042) A042168	GREY CLAY STNS PCKD 0006 GREY SHLE SAND LYRD 0008 GREY LMSN LYRD 0041

TOWNSHIP CON LOT	UTM	DATE CNTR	CASING DIA	WATER	PUMP TEST	WELL USE	SCREEN	WELL	FORMATION
DUMMER TOWNSHIP CON 01 012	17 728313 4923537 W	2010-09 6578	6.61 6.11	UT 0091	15/39/5/1:0	DO		7153393 (Z122423) A108295	GREY CLAY BLDR HARD 0004 GREY LMSN HARD 0091 GREY LMSN PORS 0100
DUMMER TOWNSHIP CON 01 012	17 727797 4923521 L	1994-10 6851	6	SU 0094	30/100/5/2:0	DO		5116771 (152232)	BRWN SAND 0018 BRWN LMSN 0100
DUMMER TOWNSHIP CON 01 012	17 727797 4923521 L	1993-11 3367	6 6	FR 0014 SU 0052	33/98/1/1:30	DO		5116418 (137214)	BRWN LOAM LOOS 0001 BRWN SAND STNS PCKD 0006 BRWN SHLE LMSN LYRD 0014 GREY LMSN MGRD HARD 0101
DUMMER TOWNSHIP CON 01 012	17 727797 4923521 L	1994-10 6851	6	FR 0070	20/70/4/2:0	DO		5116772 (152233)	BRWN SAND 0016 BRWN LMSN 0075
DUMMER TOWNSHIP CON 01 012	17 727798 4923522 L	1999-01 1455	6	FR 0077	42/96/4/2:0	DO		5118374 (190872)	BRWN LOAM 0002 BRWN CLAY SAND 0041 GREY CLAY STNS 0072 GREY SHLE ROCK GRVL 0075 GREY LMSN ROCK 0105
DUMMER TOWNSHIP CON 01 012	17 728265 4923923 W	1983-10 2104	6	UK 0153	8/103/80/1:0	DO		5110878 ()	BRWN GRVL STNS HARD 0003 GREY LMSN PORS HARD 0080 BRWN LMSN PORS HARD 0120 BLUE LMSN LYRD 0126 RED LMSN LYRD 0153
DUMMER TOWNSHIP CON 01 012	17 727797 4923521 L	1987-07 2104	6	UK 0064 UK 0072	45/70/3/2:0	DO		5112501 (12768)	GREY FILL MGRD 0064 GREY LMSN PORS 0086
DUMMER TOWNSHIP CON 01 012	17 727797 4923521 L	1987-04 2104	6	UK 0027	6/22/4/3:0	DO		5112278 (08070)	BRWN LOAM MGVL 0003 BRWN SHLE GRVL LOOS 0027
DUMMER TOWNSHIP CON 01 012	17 727794 4923522 L	2003-07 6578	6 6	FR 0029	2/20/6/5:0	DO		5119530 (262749)	BLCK LOAM SOFT 0002 GREY LMSN HARD 0027 BRWN LMSN PORS 0029
DUMMER TOWNSHIP CON 01 012	17 727797 4923521 L	1985-03 4923	6	FR 0085	32/60/4/2:30	DO		5111393 ()	BLCK LOAM 0001 GREY CLAY STNS 0006 GREY LMSN SHLE 0012 GREY LMSN LYRD 0085
DUMMER TOWNSHIP CON 01 013	17 728115 4924413 W	1975-05 1904	6	FR 0013	10/19/30/2:0	DO		5108099 ()	FILL 0006 GRVL 0010 WHIT SHLE 0013 BRWN LMSN 0029
DUMMER TOWNSHIP CON 01 013	17 727595 4923879 W	1973-11 5102	6 6	FR 0065	22/70/2/1:40	DO		5106690 ()	BRWN CLAY 0011 GREY LMSN 0073
DUMMER TOWNSHIP CON 01 013	17 728115 4924423 W	1976-09 1904		FR 0058	28/85/0/3:0	DO		5108589 ()	PRDR 0029 GREY LMSN 0085
DUMMER TOWNSHIP CON 01 013	17 728146 4924315 W	1963-07 2113	6 6	FR 0037	12/48/1/3:0	DO		5101040 ()	LOAM 0001 BRWN CLAY STNS 0009 GREY LMSN 0050
DUMMER TOWNSHIP CON 01 013	17 727566 4924085 L	2003-06 6564	6 6	FR 0052 FR 0069	23/59/14/1:0	DO		5119496 (261032)	GREY CLAY STNS 0003 GREY SHLE 0007 GREY LMSN LYRD 0017 GREY LMSN 0072
DUMMER TOWNSHIP CON 01 013	17 728042 4924239 W	1963-07 2113	6 6	FR 0040	12/16/30/1:30	DO		5101039 ()	LOAM 0001 BRWN CLAY BLDR 0005 GREY SHLE CLAY 0008 GREY LMSN 0051
DUMMER TOWNSHIP CON 01 013	17 728063 4924420 W	1972-06 4811	6 6	FR 0024	10/12/5/0:30	DO		5106416 ()	LOAM 0003 SAND GRVL 0009 GREY LMSN 0025
DUMMER TOWNSHIP CON 01 013	17 727570 4924085 L	1989-10 1921	6	FR 0011	14/48/3/2:30	DO		5114114 (63200)	BRWN CLAY SNDY STNS 0002 BRWN SHLE GRVL STNS 0011 GREY LMSN ROCK 0052
DUMMER TOWNSHIP CON 01 013	17 728115 4924423 W	1976-09 1904	6 6	UK 0035	25/76/2/2:0	DO		5108588 ()	SAND FILL 0002 BRWN CLAY STNS 0010 GREY SHLE 0016 GREY LMSN 0080

TOWNSHIP CON LOT	UTM	DATE CNTR	CASING DIA	WATER	PUMP TEST	WELL USE	SCREEN	WELL	FORMATION
DUMMER TOWNSHIP CON 01 013	17 727827 4923939 W	1954-02 2113	8 8	FR 0025	10/15/8/2:0	DO		5101038 ()	CLAY MSND STNS 0010 LMSN 0025
DUMMER TOWNSHIP CON 01 013	17 727570 4924085 L	1991-04 2104	6	UK 0023	3/15/8/4:0	DO		5115232 (098623)	BRWN BLDR FILL HARD 0008 BRWN SHLE LYRD MGRD 0022 BRWN LMSN 0028
DUMMER TOWNSHIP CON 01 013	17 727756 4923845 W	1964-08 2404	5 5	FR 0016	13/16/4/0:30	DO		5101041 ()	LOAM STNS 0011 GREY LMSN 0019
DUMMER TOWNSHIP CON 01 014	17 727352 4924659 L	1991-11 2104	6	UK 0057 UK 0135	30/125/2/1:0	CO		5115582 (110300)	BRWN GRVL SAND CLAY 0010 GREY LMSN 0133 GREN LMSN 0135 RED LMSN 0137 GREY LMSN 0142
DUMMER TOWNSHIP CON 01 014	17 727939 4924572 W	2017-03 6593	36	FR 0010	/14/26/1:			7283221 (Z226583) A199593	BLCK LOAM STNS 0001 GREY CLAY STNS 0006 GREY STNS HARD 0025
DUMMER TOWNSHIP CON 01 014	17 727949 4924804 W	2016-12 7241	1.36			MT	0012 10	7280024 (Z238156) A190942	GREY LMSN LYRD 0022
DUMMER TOWNSHIP CON 01 014	17 727767 4923998 W	1956-09 2404	6 6	FR 0020	14/14/17/8:0	DO		5101042 ()	GRVL 0014 GREY LMSN 0021
DUMMER TOWNSHIP CON 01 014	17 728002 4924567 W	1967-05 2113	6					5101044 () A	LOAM 0001 CLAY STNS 0012 GREY LMSN 0110
DUMMER TOWNSHIP CON 01 014	17 728056 4924596 W	1967-05 2113	6 6	FR 0033	18/60/1/1:0	MN		5101045 ()	LOAM 0001 CLAY STNS 0008 GREY LMSN 0060
DUMMER TOWNSHIP CON 01 015	17 727402 4925476 W	1964-09 2404	5 5	FR 0040	35/43/3/1:0	ST		5101052 ()	LOAM 0004 GREY LMSN SHLE 0045
DUMMER TOWNSHIP CON 01 015	17 727635 4925426 W	1961-11 2404	6 6	FR 0031	12/31/1/0:30	DO		5101051 ()	GREY LMSN 0031
DUMMER TOWNSHIP CON 01 015	17 727634 4925442 W	1961-09 2404	5 5	FR 0030	15/31/1/0:30	ST		5101050 ()	GRVL LOAM 0006 GREY LMSN 0031
DUMMER TOWNSHIP CON 01 015	17 727379 4925561 W	1956-11 2404	6 6	FR 0020	20/35/0/0:5	ST		5101046 ()	LOAM GRVL 0006 GREY LMSN 0035
DUMMER TOWNSHIP CON 01 015	17 727576 4925594 W	2004-11 6578	6.61	FR 0023	14/39/4/3:	DO		5120142 (Z23645) A023382	BLCK LOAM SOFT 0001 GREY CLAY STNS HARD 0004 GREY LMSN HARD 0023 BRWN LMSN PORS FCRD 0026 GREY LMSN HARD 0053
DUMMER TOWNSHIP CON 01 015	17 727667 4925437 W	1972-06 4811	6 6	FR 0032	14/19/5/0:30	DO		5106415 ()	LOAM 0004 GRVL CLAY 0011 SHLE 0012 LMSN 0034
DUMMER TOWNSHIP CON 01 015	17 727457 4925540 W	1956-11 2404	6 6	FR 0025	18/35/0/0:10	DO		5101047 ()	LOAM 0004 GREY LMSN 0035
DUMMER TOWNSHIP CON 02 010	17 729729 4923522 W	1974-03 2104	6 6	FR 0120	30/120/3/3:10	DO		5106963 ()	LOAM 0001 GREY LMSN SHLE 0006 GREY LMSN 0127
DUMMER TOWNSHIP CON 02 010	17 729825 4923683 W	1976-10 2104	6	FR 0127	50/95/15/2:0	DO		5108223 ()	PRDR 0127 GREY LMSN HARD 0145
DUMMER TOWNSHIP CON 02 011	17 729701 4923857 W	1961-02 2404	5 5	FR 0026	6/27/1/1:0	DO		5101062 ()	PRDG 0008 GREY LMSN 0027

TOWNSHIP CON LOT	UTM	DATE CNTR	CASING DIA	WATER	PUMP TEST	WELL USE	SCREEN	WELL	FORMATION
DUMMER TOWNSHIP CON 02 011	17 728572 4923420 W	1956-01 2404	5 5	FR 0033	19/19/10/9:0	DO		5101063 ()	GRVL BLDR 0014 GREY LMSN 0033
DUMMER TOWNSHIP CON 02 012	17 728933 4924677 W	2008-05 6564	6.25		13/45/6/1:			7115272 (Z77746) A070115	BLCK LOAM 0000 GREY LMSN FCRD 0004 GREY LMSN 0060
DUMMER TOWNSHIP CON 02 012	17 728947 4924727 W	2015-03 3367	6.25 6	FR 0055 UT FR 0065 UT	20/42/6/1:	DO		7242451 (Z204167) A175889	BRWN SHLE LMSN LYRD 0005 BRWN LMSN LYRD 0026 GREY LMSN HARD 0065
DUMMER TOWNSHIP CON 02 012	17 728971 4924274 W	2011-12 3367	6.25 6.25	FR 0024 FR 0064	14/48/10/1:0	DO		7177005 (Z139605) A123332	BRWN LOAM SOFT 0001 GREY LMSN HARD 0065
DUMMER TOWNSHIP CON 02 012	17 728962 4924735 W	2015-03 3367	5	UT 0027	17///:	DO NU		7242436 (Z204168) A	
DUMMER TOWNSHIP CON 02 012	17 728884 4924230 W	2012-06 6578	6.61 6.11	UT 0074	16/52/3/1:	DO		7184699 (Z140015) A123095	BLCK LOAM SOFT 0004 GREY LMSN HARD 0074
DUMMER TOWNSHIP CON 02 012	17 728398 4924009 W	1956-11 2404	6 6	FR 0025	20/35/4/0:4	DO		5101064 ()	STNS LOAM 0012 GREY LMSN 0035
DUMMER TOWNSHIP CON 02 012	17 728532 4924063 W	1957-01 2404	6 6	SU 0036	79///:	DO		5101065 ()	LOAM GRVL 0036 LMSN 0109
DUMMER TOWNSHIP CON 02 012	17 728484 4923927 W	1957-01 2404	6 6	FR 0023	9/23/0/:	ST		5101066 ()	LOAM GRVL 0008 GREY LMSN 0023
DUMMER TOWNSHIP CON 02 012	17 728842 4924413 W	1964-07 2113	6 6	FR 0030	12/30/20/3:0	DO		5101067 ()	GREY LMSN 0035
DUMMER TOWNSHIP CON 02 012	17 728820 4924190 W	2005-08 6578	6.61	FR 0120	8/100/5/1:	DO		5120414 (Z34932) A032346	GREY LMSN HARD 0110 BRWN SNDS SOFT PORS 0125
DUMMER TOWNSHIP CON 02 012	17 728565 4924073 W	1975-06 2104	6	FR 0052	8/47/2/1:0	DO		5107465 ()	GREY LMSN LYRD HARD 0052
DUMMER TOWNSHIP CON 02 012	17 729169 4923927 L	1989-12 2661	6	SU 0055	50/80/5/2:0	DO		5114316 (74660)	BRWN OBDN 0002 GREY LMSN 0080
DUMMER TOWNSHIP CON 02 012	17 729169 4923927 L	1991-02 6398	6	FR 0135	33/106/2/1:30	DO		5115136 (89167)	BRWN SAND 0006 GREY LMSN 0140
DUMMER TOWNSHIP CON 02 012	17 729169 4923927 L	1991-02 6398	6	FR 0135	33/106/2/1:30	DO		5115226 (89167)	BRWN SAND 0006 GREY LMSN 0140
DUMMER TOWNSHIP CON 02 012	17 728919 4924592 W	2002-08 6564	6 6	FR 0035 FR 0061	17/65/4/1:0	DO		5119244 (243549)	GREY LMSN CLAY LYRD 0006 GREY LMSN 0046 GREN LMSN 0054 GREY LMSN FCRD 0065
DUMMER TOWNSHIP CON 02 012	17 729317 4924445 W	1967-04 2104	6 6	FR 0028	30/33/10/4:0	DO		5101069 ()	LOAM 0002 BRWN CLAY MSND 0015 GREY CLAY SHLE 0027 GRVL 0036 GREY LMSN 0112
DUMMER TOWNSHIP CON 02 013	17 729015 4925123 W	1981-10 2104	6	FR 0050	25/46/5/5:0	DO		5110317 ()	GREY LMSN PORS 0050

TOWNSHIP CON LOT	UTM	DATE CNTR	CASING DIA	WATER	PUMP TEST	WELL USE	SCREEN	WELL	FORMATION
DUMMER TOWNSHIP CON 02 013	17 728950 4924509 L	1988-12 2104	6	UK 0081	45/100/3/2:30	DO		5113486 (50053)	GREY LMSN LOOS 0018 GREY LMSN PORS 0105
DUMMER TOWNSHIP CON 02 013	17 728977 4924400 W	2012-05 6578	6.61 6.11	UT 0070	92/148/1/1:	DO		7182543 (Z140019) A123089	BLCK LOAM SOFT 0002 GREY LMSN HARD 0070 GREY LMSN FCRD 0075
DUMMER TOWNSHIP CON 02 013	17 729015 4925173 W	1979-10 2104	6	FR 0052	34/37/20/3:0	DO		5109598 ()	BRWN GRVL STNS HARD 0003 BRWN LMSN STNS HARD 0009 GREY LMSN STNS HARD 0052
DUMMER TOWNSHIP CON 02 013	17 728665 4924173 W	1976-06 2104	6	FR 0047	8/42/5/1:20	DO		5107997 ()	BRWN LOAM CLAY SOFT 0002 GREY LMSN PORS HARD 0050
DUMMER TOWNSHIP CON 02 013	17 728215 4924298 W	1972-09 2104	6	FR 0024	10/20/30/2:30	PS		5106266 ()	GREY GRVL STNS 0023 GREY LMSN SHLE 0024
DUMMER TOWNSHIP CON 02 013	17 728845 4924431 W	1960-03 2404	5 5	FR 0004	7/13/10/2:0	DO		5101070 ()	GREY LMSN 0013
DUMMER TOWNSHIP CON 02 013	17 728158 4924455 W	1961-09 2404	6 6	FR 0030	30/40/1/0:30	DO		5101071 ()	GRVL 0011 GREY LMSN 0040
DUMMER TOWNSHIP CON 02 013	17 729227 4925627 W	2001-07 6564	6 6	UK 0115	57/105/20/1:0	DO		5118801 (228026)	GREY LMSN 0055 GREY LMSN 0095 GREN LMSN 0100 BRWN LMSN 0105 GREN LMSN 0115
DUMMER TOWNSHIP CON 02 013	17 728947 4924509 L	2003-10 6578	6 6	FR 0033	6/25/5/3:25	DO		5119590 (262750)	BLCK LOAM SOFT 0002 BRWN SAND GRVL SOFT 0013 GREY CLAY SOFT 0017 GREY CLAY STNS HARD 0025 GREY CGVL SAND 0032 GREY LMSN PORS FCRD 0033
DUMMER TOWNSHIP CON 02 013	17 729455 4925048 W	1972-05 5102	6	FR 0030	8/51/2/3:30	DO	0028 27	5105884 ()	BLCK LOAM 0001 BRWN CLAY BLDR 0012 GREY CLAY SAND 0030 BRWN FSND GRVL 0035 GREY CLAY 0045 GREY LMSN 0055
DUMMER TOWNSHIP CON 02 013	17 728897 4924791 W	1960-11 2404	5 5	FR 0027	17/19/1/0:30	DO		5101074 ()	LOAM LMSN 0003 GREY LMSN 0036
DUMMER TOWNSHIP CON 02 014	17 728731 4925083 L	1990-05 1455	6	FR 0035	25/90/4/1:0	DO		5115085 (75052)	BRWN LOAM 0001 BRWN SHLE CLAY 0010 GREY LMSN ROCK 0100
DUMMER TOWNSHIP CON 02 014	17 728731 4925083 L	1986-05 2104	6	UK 0055 UK 0065	7/65/3/3:0	DO		5111798 ()	GREY ROCK CLAY HARD 0001 GREY LMSN ROCK PORS 0071
DUMMER TOWNSHIP CON 02 014	17 728731 4925083 L	1989-04 2104	6	FR 0096	81/100/5/1:30	DO		5113749 (56905)	GREY LMSN 0100 GREY GRNT 0105
DUMMER TOWNSHIP CON 02 014	17 727982 4924979 W	1959-05 2404	5 5	FR 0018	16/19/3/0:20	DO		5101072 ()	GRVL BLDR 0013 LMSN 0023
DUMMER TOWNSHIP CON 02 014	17 728101 4924647 W	1959-07 2404	5 5	FR 0018	23/40/3/0:30	DO		5101073 ()	PRDR 0023 GREY LMSN 0050
DUMMER TOWNSHIP CON 02 014	17 728731 4925083 L	1990-08 1748	6	FR 0075	20/80/5/1:0	DO		5114908 (88366)	GREY CLAY STNS 0012 GREY LMSN 0080
DUMMER TOWNSHIP CON 02 014	17 728731 4925083 L	1993-11 1455	6	FR 0020 FR 0065	30/50/10/4:0	DO		5116445 (128959)	BRWN LOAM 0001 BRWN CLAY SHLE 0011 GREY LMSN ROCK 0070
DUMMER TOWNSHIP CON 02 014	17 728731 4925083 L	1990-10 1455	6	FR 0018	18//1/1:0	DO		5115083 (75100)	BRWN LOAM 0001 BRWN CLAY STNS 0007 GREY LMSN ROCK 0018 GRVL ROCK 0019 GREY LMSN ROCK 0045

TOWNSHIP CON LOT	UTM	DATE CNTR	CASING DIA	WATER	PUMP TEST	WELL USE	SCREEN	WELL	FORMATION
DUMMER TOWNSHIP CON 02 014	17 728731 4925083 L	1991-11 4814	6 6	FR 0060	52/62/11/2:0	DO		5115837 (110209)	GREY LMSN SHLE 0004 GREY LMSN ROCK 0060 GREY LMSN ROCK 0080 GREY LMSN ROCK 0084 GREY LMSN ROCK 0102 RED GRNT 0110 WHIT QTZ 0116 GREY QTZ 0122
DUMMER TOWNSHIP CON 02 014	17 728731 4925083 L	1993-05 1455	6	FR 0040	-1/20/20/2:0	DO		5116446 (128919)	BRWN LOAM 0001 BRWN CLAY STNS 0014 GREY CLAY STNS 0038 BRWN SAND GRVL 0042
DUMMER TOWNSHIP CON 02 014	17 728179 4924575 W	1974-06 5102	6 6	FR 0050 FR 0073	35/68/3/1:45	DO		5107008 ()	BLCK LOAM 0001 BRWN CLAY GRVL 0022 GREY LMSN 0073
DUMMER TOWNSHIP CON 02 015	17 727858 4925371 W	1966-05 2404	5 5	SU 0028	20/20/5/0:30	DO		5101075 ()	GRVL STNS 0008 GREY LMSN 0029
DUMMER TOWNSHIP CON 02 015	17 727815 4925573 W	1979-10 5102		UK 0060	24/67/1/1:40	DO		5109563 ()	PRDR 0029 GREY LMSN 0069
DUMMER TOWNSHIP CON 03 003	17 728418 4923963 W	2002-10 6578	6 6	FR 0025	11/15/16/4:0	DO		5119188 (244289)	GREY LMSN BLDR SAND 0012 BRWN LMSN HARD 0023 RED LMSN PORS 0025
ENNISMORE TOWNSHIP CON 08 012	17 729315 4924763 W	1970-04 2104	6	FR 0012 FR 0070	30/60/10/1:30	DO		5105319 ()	BRWN LOAM 0002 BRWN CLAY MSND 0012 BRWN CSND GRVL 0030 GREY CLAY MSND STNS 0069 GREY SHLE LMSN 0071
ENNISMORE TOWNSHIP CON 08 012	17 729325 4924853 W	1972-03 5102	6	FR 0086	38/70/15/2:30	DO		5105876 ()	BLCK LOAM 0001 BRWN CLAY 0026 GREY CLAY 0082 GREY CLAY GRVL 0086 GREY LMSN 0090

TOWNSHIP CON LOT UTM DATE CNTR CASING DIA WATER PUMP TEST WELL USE SCREEN WELL FORMATION

Notes:
UTM: UTM in Zone, Easting, Northing and Datum is NAD83; L: UTM estimated from Centroid of Lot; W: UTM not from Lot Centroid
DATE CNTR: Date Work Completedand Well Contractor Licence Number
CASING DIA: .Casing diameter in inches
WATER: Unit of Depth in Fee. See Table 4 for Meaning of Code
PUMP TEST: Static Water Level in Feet / Water Level After Pumping in Feet / Pump Test Rate in GPM / Pump Test Duration in Hour : Minutes
WELL USE: See Table 3 for Meaning of Code
SCREEN: Screen Depth and Length in feet
WELL: WEL (AUDIT #) Well Tag . A: Abandonment; P: Partial Data Entry Only
FORMATION: See Table 1 and 2 for Meaning of Code

1. Core Material and Descriptive terms

Code	Description	Code	Description	Code	Description	Code	Description	Code	Description
BLDR	BOULDERS	FCRD	FRACTURED	IRFM	IRON FORMATION	PORS	POROUS	SOFT	SOFT
BSLT	BASALT	FGRD	FINE-GRAINED	LIMY	LIMY	PRDG	PREVIOUSLY DUG	SPST	SOAPSTONE
CGRD	COARSE-GRAINED	FGVL	FINE GRAVEL	LMSN	LIMESTONE	PRDR	PREV. DRILLED	STKY	STICKY
CGVL	COARSE GRAVEL	FILL	FILL	LOAM	TOPSOIL	QRTZ	QUARTZITE	STNS	STONES
CHRT	CHERT	FLDS	FELDSPAR	LOOS	LOOSE	QSND	QUICKSAND	STNY	STONEY
CLAY	CLAY	FLNT	FLINT	LTCL	LIGHT-COLOURED	QTZ	QUARTZ	THIK	THICK
CLN	CLEAN	FOSS	FOSILIFEROUS	LYRD	LAYERED	ROCK	ROCK	THIN	THIN
CLYY	CLAYEY	FSND	FINE SAND	MARL	MARL	SAND	SAND	TILL	TILL
CMTD	CEMENTED	GNIS	GNEISS	MGRD	MEDIUM-GRAINED	SHLE	SHALE	UNKN	UNKNOWN TYPE
CONG	CONGLOMERATE	GRNT	GRANITE	MGVL	MEDIUM GRAVEL	SHLY	SHALY	VERY	VERY
CRYS	CRYSTALLINE	GRSN	GREENSTONE	MRBL	MARBLE	SHRP	SHARP	WBRG	WATER-BEARING
CSND	COARSE SAND	GRVL	GRAVEL	MSND	MEDIUM SAND	SHST	SCHIST	WDFR	WOOD FRAGMENTS
DKCL	DARK-COLOURED	GRWK	GREYWACKE	MUCK	MUCK	SILT	SILT	WTHD	WEATHERED
DLMT	DOLOMITE	GVLY	GRAVELLY	OBDN	OVERBURDEN	SLTE	SLATE		
DNSE	DENSE	GYPS	GYPSUM	PCKD	PACKED	SLTY	SILTY		
DRTY	DIRTY	HARD	HARD	PEAT	PEAT	SNDS	SANDSTONE		
DRY	DRY	HPAN	HARDPAN	PGVL	PEA GRAVEL	SNDY	SANDYOAPSTONE		

2. Core Color

Code	Description
WHIT	WHITE
GREY	GREY
BLUE	BLUE
GREN	GREEN
YLLW	YELLOW
BRWN	BROWN
RED	RED
BLCK	BLACK
BLGY	BLUE-GREY

3. Well Use

Code	Description	Code	Description
DO	Domestic	OT	Other
ST	Livestock	TH	Test Hole
IR	Irrigation	DE	Dewatering
IN	Industrial	MO	Monitoring
CO	Commercial	MT	Monitoring TestHole
MN	Municipal		
PS	Public		
AC	Cooling And A/C		
NU	Not Used		

4. Water Detail

Code	Description	Code	Description
FR	Fresh	GS	Gas
SA	Salty	IR	Iron
SU	Sulphur		
MN	Mineral		
UK	Unknown		

APPENDIX D

Well Survey Letter & Questionnaire

ORE
Oakridge Environmental Limited
Environmental and Hydrogeological Services

Dear Homeowner or Occupant:

Oakridge Environmental Ltd. (ORE) has been commissioned to conduct a door-to-door well and septic survey in your area. The purpose of the survey is to obtain information about local water supply and septic system conditions. The information is being collected as part of our hydrogeological study for a neighbouring property (see Key Map), to characterize the general hydrogeological conditions of the area.

Your water supply and sewage system information is an important part of our study and is needed to ensure that we will have an accurate database. The information will be included in the hydrogeological study and will only be used for scientific purposes. Personal information (i.e., contact information) will not be disseminated and will only be utilized in the event we need to contact you directly.

We have a brief questionnaire that we can complete with you by telephone, fax, e-mail, or through our website (whichever is most convenient for you). A copy of the survey questionnaire is attached. If you wish to complete the well survey questionnaire online through our website, please visit www.oakridgeenvironmental.com. At the bottom of the page, click on "well survey" and enter Reference Number **172326**. This number must be entered for the well survey to be successfully completed.

As part of the study, we will also be conducting pumping tests on drilled wells located on the subject property. We would like to provide you with our contact information (found at the end of this letter) in the event that you experience any interference with your water supply. Should you wish to have your well monitored during these tests, please contact our office. Please note, only a select number of representative wells will be monitored during the tests.

The success of our survey depends on obtaining accurate information. You are under no obligation to participate in our survey, however, if you are interested in participating please contact our office at your earliest convenience. We would appreciate receiving your response on or before March 16, 2018.

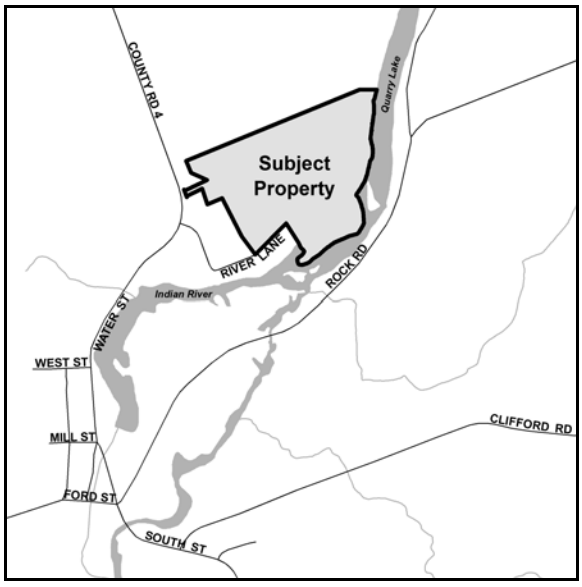
If you have any questions, please feel free to contact our office at the contact information found below. We thank you for your time.

Christa Lemelin, BSc.

Oakridge Environmental Ltd.
647 Neal Drive, Suite 3
Peterborough, Ontario
K9J 6X7

telephone: (705) 745-1181
1-888-OAKRIDGE (625-7434)
fax: (705) 745-4163
1-877-796-7781

Email: christa@oakridgeenvironmental.com
Website: www.oakridgeenvironmental.com



Key Map

WATER SUPPLY SUMMARY

For Office Use Only

By:_____

Project No:_____

MOEE #:_____

Ref. No:_____

Township:_____

Hamlet/Town:_____

Lot:_____ Concession:_____

Well Owner:_____

Mailing Address:_____

Phone: _____ Date:_____

Type of Residence: (house, seasonal cottage, business, etc.)_____

WATER SUPPLY SOURCE

Dug Well: ❑ Drilled Well: ❑ Lake/River: ❑ Other:_____

Well Depth:_____ Diameter: _____

Well Construction:_____

Well Drilled by: _____Date:_____

WATER QUANTITY

Never Dry: ❑ Occasionally Dry: ❑ Often Dry: ❑ Last Date:_____

Ever hauled water? _____ Last Date:_____ Contractor:_____

WATER QUALITY

Odour Problems (describe):_____

Taste Problems (describe):_____

Turbidity Problems (describe):_____

Staining (describe):_____

Bacteria Problems (describe): _____

Other:_____

Ever had water sampled? Bacteria? ❑ Chemical? ❑ Last Date:_____

WATER TREATMENT

Water Softener:_____

Chlorinator:_____

Filter:_____

Other:_____

PROPERTY AND WATER USE

Lot Size:_____ No. of Residents:_____ No. of Washrooms:_____

No. of Bedrooms:_____

SEWAGE DISPOSAL

Tile Bed: Raised: ❑ In-ground: ❑

Problems: Odours: ❑ Breakouts: ❑ No problems: ❑

System Age:_____ Constructed By:_____

Distance to Well:_____ Direction: (eg. Upgradient) _____

Distance to Building:_____

PROPERTY SKETCH

(showing house, well, and tile bed locations)

Interested in participating in well testing or monitoring? Yes No

APPENDIX E

Test Well Construction Summary and Records

Proposed Warsaw Residential Subdivision
Test Well Construction Summary

Well	Depth (m bgs)	Stickup (m ags)	Static Water Level (m bgs)	Driller's Recommended Rate (US gpm)	Status
TW-1	10.26	0.35	1.52	5	Test well
TW-2	12.93	0.30	4.57	5	Test well
TW-3	9.85	0.32	1.83	5	To be abandoned
TW-4	25.38	0.78	10.73	10	To be abandoned
TW-5	35.65	0.05	10.76	-	Abandoned
TW-6	25.46	0.65	6.32	-	Abandoned
TW-7	39.93	0.17	8.78	-	Abandoned
TW-8	10.81	0.84	5.06	10	Test well
TW-9	7.18	0.85	3.75	5	Test well
TW-10	10.31	0.61	8.41	10	Test well

Notes:
m bgs - metres below ground surface; m ags - metres above ground surface; gpm - gallons per minute

Ministry of the Environment
Ontario

The Ontario Water Resources Act

WATER WELL RECORD

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

County or District	Township, Borough, City, Town, Village	Con. Block, Tract, Survey, etc.	Lot
HBO	[illegible]	2	13

Owner (Surname First)	Address	Date Completed
Vallimore, Randy	% Carl Hake Realty Ltd. 10 Queen St P.O. Box 1500 Haliburton, Ont	Day 9 Mo 05 Yr 90

LOG OF OVERBURDEN AND BEDROCK MATERIALS (SEE INSTRUCTIONS)

General Colour	Most Common Material	Other Materials	General Description	Depth – Feet From	To
Brown	Sand	Pebbles		0	16
Grey	Limestone			16	35

WATER RECORD

Water Found at – Feet	Kind of Water
32	☒ Fresh ☐ Salty ☐ Sulphur ☐ Minerals ☐ Gas
	☐ Fresh ☐ Salty ☐ Sulphur ☐ Minerals ☐ Gas
	☐ Fresh ☐ Salty ☐ Sulphur ☐ Minerals ☐ Gas
	☐ Fresh ☐ Salty ☐ Sulphur ☐ Minerals ☐ Gas
	☐ Fresh ☐ Salty ☐ Sulphur ☐ Minerals ☐ Gas

CASING & OPEN HOLE RECORD

Inside Diam. Inches	Material	Wall Thickness Inches	Depth – Feet From	To
6¼	☐ Steel ☐ Galvanized ☐ Concrete ☐ Open Hole ☐ Plastic	.188	0	20
	☐ Steel ☐ Galvanized ☐ Concrete ☐ Open Hole ☐ Plastic			
	☐ Steel ☐ Galvanized ☐ Concrete ☐ Open Hole ☐ Plastic			

SCREEN

Size(s) of Opening (Slot No.)	Diameter (Inches)	Length (Feet)

Material and Type — Depth to Top of Screen (Feet)

PLUGGING & SEALING RECORD

Depth Set at – Feet From	To	Material and Type (Cement Grout, Lead Packer, etc.)

PUMPING TEST

Pumping Test Method: ☐ Pump ☐ Bailer (Air)		Pumping Rate: 10+ GPM	Duration of Pumping: 1 Hours — Mins		
Static Level	Water Level End of Pumping	Water Levels During ☐ Pumping ☐ Recovery			
		15 Minutes	30 Minutes	45 Minutes	60 Minutes
5 Feet	35 Feet	5 Feet	5 Feet	5 Feet	5 Feet
If Flowing Give Rate: GPM		Pump Intake Set at: 35 Feet	Water at End of Test: ☐ Clear ☐ Cloudy		
Recommended Pump Type: ☒ Shallow ☐ Deep		Recommended Pump Setting: 20 Feet	Recommended Pumping Rate: 5 GPM		

LOCATION OF WELL

In diagram below show distances of well from road and lot line. Indicate north by arrow.

Drillers Remarks:

83259

FINAL STATUS OF WELL

☐ Water Supply ☒ Observation Well ☐ Test Hole ☐ Recharge Well ☐ Abandoned, Insufficient Supply ☐ Abandoned, Poor Quality ☐ Unfinished ☐ Dewatering

WATER USE

☒ Domestic ☐ Stock ☐ Irrigation ☐ Industrial ☐ Other ☐ Commercial ☐ Municipal ☐ Public Supply ☐ Cooling or Air Conditioning ☐ Not Used

METHOD OF CONSTRUCTION

☐ Cable Tool ☐ Rotary (Conventional) ☐ Rotary (Reverse) ☐ Rotary (Air) ☒ Air Percussion ☐ Boring ☐ Diamond ☐ Jetting ☐ Driving ☐ Digging ☐ Other

CONTRACTOR

Name of Well Contractor: [illegible] Drilling	Well Contractor's Licence Number: 1746
Address: [illegible] Haliburton, Ont	
Name of Well Technician: Ronald [illegible]	Well Technician's Licence Number:
Signature of Technician/Contractor: [illegible]	Submission Date: Day __ Mo __ Yr __

OFFICE USE ONLY

OWNER'S COPY

FORM NO. 0506 (11/86) FORM 9

TW-1

GEO-LOGIC INC.

Plate D1-A

Ministry of the Environment
Ontario

The Ontario Water Resources Act

WATER WELL RECORD

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

COUNTY OR DISTRICT	TOWNSHIP, BOROUGH, CITY, TOWN, VILLAGE	CON. BLOCK, TRACT, SURVEY, ETC.	LOT
HPO	Hennessey	2	13

OWNER (SURNAME FIRST)	ADDRESS	DATE COMPLETED
Guilbeault Landy	Box 1510 Tehkummah Ont	DAY 9 MO 05 YR 90

LOG OF OVERBURDEN AND BEDROCK MATERIALS (SEE INSTRUCTIONS)

GENERAL COLOUR	MOST COMMON MATERIAL	OTHER MATERIALS	GENERAL DESCRIPTION	DEPTH FEET FROM	DEPTH FEET TO
Brown	Sand	Cobbles	Loose	0	29
Grey	Limestone			29	45

WATER RECORD

WATER FOUND AT FEET	KIND OF WATER		
42	☒ FRESH ☐ SALTY	☐ SULPHUR ☐ MINERALS ☐ GAS	
	☐ FRESH ☐ SALTY	☐ SULPHUR ☐ MINERALS ☐ GAS	
	☐ FRESH ☐ SALTY	☐ SULPHUR ☐ MINERALS ☐ GAS	
	☐ FRESH ☐ SALTY	☐ SULPHUR ☐ MINERALS ☐ GAS	
	☐ FRESH ☐ SALTY	☐ SULPHUR ☐ MINERALS ☐ GAS	

CASING & OPEN HOLE RECORD

INSIDE DIAM. INCHES	MATERIAL	WALL THICKNESS INCHES	DEPTH FEET FROM	DEPTH FEET TO
12x1	☐ STEEL ☐ GALVANIZED ☐ CONCRETE ☒ OPEN HOLE ☐ PLASTIC	188	0	29
	☐ STEEL ☐ GALVANIZED ☐ CONCRETE ☐ OPEN HOLE ☐ PLASTIC			
	☐ STEEL ☐ GALVANIZED ☐ CONCRETE ☐ OPEN HOLE ☐ PLASTIC			

SCREEN

SIZE OF OPENING (SLOT NO.) | DIAMETER INCHES | LENGTH FEET
MATERIAL AND TYPE | DEPTH TO TOP OF SCREEN FEET

PLUGGING & SEALING RECORD

DEPTH SET AT FEET FROM	TO	MATERIAL AND TYPE (CEMENT GROUT, LEAD PACKER, ETC.)

PUMPING TEST

PUMPING TEST METHOD: ☐ PUMP ☒ BAILER | PUMPING RATE: 10 GPM | DURATION OF PUMPING: 1 HOURS — MINS

STATIC LEVEL	WATER LEVEL END OF PUMPING	WATER LEVELS DURING: ☐ PUMPING ☒ RECOVERY			
		15 MINUTES	30 MINUTES	45 MINUTES	60 MINUTES
15 FEET	45 FEET	15 FEET	15 FEET	15 FEET	15 FEET

IF FLOWING GIVE RATE: — GPM | PUMP INTAKE SET AT: — FEET | WATER AT END OF TEST: ☐ CLEAR ☐ CLOUDY

RECOMMENDED PUMP TYPE: ☐ SHALLOW ☒ DEEP | RECOMMENDED PUMP SETTING: 40 FEET | RECOMMENDED PUMPING RATE: 5 GPM

FINAL STATUS OF WELL	☐ WATER SUPPLY ☐ ABANDONED, INSUFFICIENT SUPPLY ☒ OBSERVATION WELL ☐ ABANDONED, POOR QUALITY ☐ TEST HOLE ☐ UNFINISHED ☐ RECHARGE WELL ☐ DEWATERING
WATER USE	☒ DOMESTIC ☐ COMMERCIAL ☐ STOCK ☐ MUNICIPAL ☐ IRRIGATION ☐ PUBLIC SUPPLY ☐ INDUSTRIAL ☐ COOLING OR AIR CONDITIONING ☐ OTHER ☐ NOT USED
METHOD OF CONSTRUCTION	☐ CABLE TOOL ☐ BORING ☐ ROTARY (CONVENTIONAL) ☐ DIAMOND ☐ ROTARY (REVERSE) ☐ JETTING ☐ ROTARY (AIR) ☐ DRIVING ☒ AIR PERCUSSION ☐ DIGGING ☐ OTHER

LOCATION OF WELL

IN DIAGRAM BELOW SHOW DISTANCES OF WELL FROM ROAD AND LOT LINE. INDICATE NORTH BY ARROW.

2nd line #2.

DRILLERS REMARKS: 83257

CONTRACTOR

NAME OF WELL CONTRACTOR: Verner Cable Drilling | WELL CONTRACTOR'S LICENCE NUMBER: 1746
ADDRESS: PO #2 Walkerton Ont.
NAME OF WELL TECHNICIAN: David Graham | WELL TECHNICIAN'S LICENCE NUMBER:
SIGNATURE OF TECHNICIAN/CONTRACTOR: [signature] | SUBMISSION DATE: DAY — MO — YR —

OFFICE USE ONLY

OWNER'S COPY

FORM NO. 0506 (11/86) FORM 9

TW-2

GEO-LOGIC INC.

Plate D1-B

Ministry of the Environment
Ontario

The Ontario Water Resources Act

WATER WELL RECORD

County or District	Township, Borough, City, Town, Village	Con.	Lot
BRD	[illegible]	2	13

Owner	Address	Date Completed
Cullimore [illegible]	[illegible] Ont	9-05-[illegible]

LOG OF OVERBURDEN AND BEDROCK MATERIALS

General Colour	Most Common Material	Other Materials	General Description	Depth From	Depth To
[illegible]	Sand	Pebbles		0	6
[illegible]	[illegible]			6	32

WATER RECORD

Water Found at Feet	Kind of Water
32	Fresh

CASING & OPEN HOLE RECORD

Inside Diam. Inches	Material	Wall Thickness	Depth From	Depth To
6 1/4	Steel	.188	0	20

SCREEN

PLUGGING & SEALING RECORD

PUMPING TEST

Pumping test method	Pump
Pumping rate	10 GPM
Duration of pumping	1 hours
Static level	6 feet
Water level end of pumping	35 feet
Water levels during recovery: 15 minutes	6 feet
30 minutes	6 feet
45 minutes	6 feet
60 minutes	6 feet
Pump intake set at	35 feet
Water at end of test	Cloudy
Recommended pump setting	20 feet
Recommended pumping rate	5 GPM

LOCATION OF WELL

In diagram below show distances of well from road and lot line. Indicate north by arrow.

[illegible] Well #3

83258

FINAL STATUS OF WELL

Observation well

WATER USE

Domestic

METHOD OF CONSTRUCTION

Air percussion

CONTRACTOR

Name of well contractor	[illegible] Drilling Ltd
Well contractor's licence number	1748
Address	[illegible] Ont.
Name of well technician	[illegible]

OFFICE USE ONLY

[illegible]'S COPY

FORM NO. 0506 (11/86) FORM 9

TW-3

GEO-LOGIC INC.

Plate D1-C

Ontario

Ministry of the Environment and Climate Change

Measurements recorded in: ☐ Metric ☐ Imperial

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

Tag#: A 239783

Well Record

Regulation 903 Ontario Water Resources Act

Page _____ of _____

Well Owner's Information

First Name	Last Name / Organization	E-mail Address	☐ Well Constructed by Well Owner
JASON	LIEL		

Mailing Address (Street Number/Name)	Municipality	Province	Postal Code	Telephone No. *(inc. area code)*
LONSBERRY. CRES.	WARSAW.	ONT.		

Well Location

Address of Well Location (Street Number/Name)	Township	Lot	Concession
COUNTY. RD. 38	DUMMER		

County/District/Municipality	City/Town/Village	Province	Postal Code
PETERBOROUGH.	WARSAW.	Ontario	

UTM Coordinates	Zone	Easting	Northing	Municipal Plan and Sublot Number	Other
NAD 83	17	782548	4924567		

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

General Colour	Most Common Material	Other Materials	General Description	Depth (*m/ft*) From	To
BROWN	TOPSOIL			0	1
GRAVEL,	BOULDERS,	SAND,	LAYERS. OF ROCK	1	23.
GREY	LIMESTONE	ROCK		23	80'

Annular Space

Depth Set at (*m/ft*) From	To	Type of Sealant Used *(Material and Type)*	Volume Placed (*m³/ft³*)
0	20+	3 bgs. 3lb hole plug. 2 barrels. mixed grout.	

Method of Construction

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

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	To
6 1/4	STEEL	188W	0	23.
			+	2.

Construction Record - Screen

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

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 (*m/ft*)	Kind of Water	
40-60'	☐ Fresh ☑ Untested	☐ Gas ☐ Other, *specify*
	☐ Fresh ☐ Untested	☐ Gas ☐ Other, *specify*
	☐ Fresh ☐ Untested	☐ Gas ☐ Other, *specify*

Hole Diameter

Depth (*m/ft*) From	To	Diameter (*cm/in*)
0	23.	10"
23.	80	6 1/4

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*) 75'

Pumping rate (*l/min / GPM*) 15 G.P.M.

Duration of pumping 1 hrs + 0 min

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

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

Recommended pump depth (*m/ft*) 75'

Recommended pump rate (*l/min / GPM*) 10 G.P.M.

Well production (*l/min / GPM*) 15+ G.P.M

Disinfected? ☑ Yes ☐ No

Draw Down Time (*min*)	Water Level (*m/ft*)	Recovery Time (*min*)	Water Level (*m/ft*)
Static Level	35-2		
1	35-5	1	35-3
2	"	2	
3	"	3	
4	"	4	35-3.5
5	"	5	
10	"	10	35-2
15	"	15	
20	35-6	20	
25	"	25	
30	"	30	
40	"	40	
50	"	50	
60	"	60	

Map of Well Location

Please provide a map below following instructions on the back.

Ontario — Ministry of the Environment, Conservation and Parks

Measurements recorded in: ☐ Metric ☑ Imperial

Well Tag No. *(Place Sticker and/or Print Below)* A234802

Well Record

Regulation 903 Ontario Water Resources Act

Page ___ of ___

Well Owner's Information

First Name	Last Name / Organization	E-mail Address	☐ Well Constructed by Well Owner
STASON	KIEL.		

Mailing Address (Street Number/Name)	Municipality	Province	Postal Code	Telephone No. (Inc. area code)
213 Lonsberry Cres.	PETERBOROUGH.	ONT.		

Well Location

Address of Well Location (Street Number/Name)	Township	Lot	Concession
Chemong RD #4.	Dover-Dummer	14	1

County/District/Municipality	City/Town/Village	Province	Postal Code
PETERBOROUGH.	WARSAW	Ontario	

UTM Coordinates	Zone	Easting	Northing	Municipal Plan and Sublot Number	Other
NAD 83	17	729501	4924600		

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	TOPSOIL	STONES, BOULDERS		0	3.
GREY	CLAY, STONES.	BOULDERS.		3	10
GREY	CLAY,	"		10	27
GREY	LIMESTONE	ROCK.		27	38

* NOTE ORIGINAL WELL WITH THIS TAG ABANDONED
QUICK GROUT MIX, 3/8 HOLE PLUG - 0-80
* TRACE OF SALT.

Annular Space

Depth Set at (m/ft) From	Depth Set at (m/ft) To	Type of Sealant Used (Material and Type)	Volume Placed (m³/ft³)
0	25.	QUICK GROUT MIX. 3/8 HOLE PLUG.	40 GALS. 14 BAGS.

Method of Construction

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

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
6¼	STEEL	18SW	0	27

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

Construction Record - Screen

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

Water Details

Water found at Depth	Kind of Water	Hole Diameter Depth From	Depth To	Diameter (cm/in)
37-38 (m/ft) ☐ Gas	☑ Fresh ☑ Untested ☐ Other, specify	0	25	8"
(m/ft) ☐ Gas	Water found at Depth: Kind of Water: ☐ Fresh ☐ Untested ☐ Other, specify	0	27	6¼
(m/ft) ☐ Gas	Water found at Depth: Kind of Water: ☐ Fresh ☐ Untested ☐ Other, specify	27	37	OPEN

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): 36'

Pumping rate (l/min / GPM): 10 G.P.M

Duration of pumping: 1 hrs + 0 min

Final water level end of pumping (m/ft): 30-6

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

Recommended pump depth (m/ft): 36

Recommended pump rate (l/min / GPM): 10 G.P.M

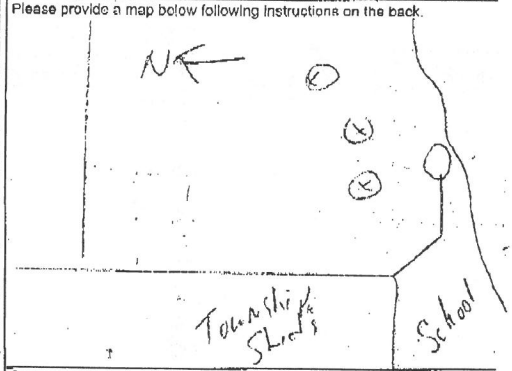
Well production (l/min / GPM): 10 + G.P.M

Disinfected? ☑ Yes ☐ No

	Draw Down Time (min)	Draw Down Water Level (m/ft)	Recovery Time (min)	Recovery Water Level (m/ft)
Static Level		27-6		
1	20-2		1	28-7
2	28-6		2	28-4
3	29-5		3	"
4	30		4	28-3
5	30-2		5	28-2
10	30-5		10	28-1
15	30-6		15	27-9
20	"		20	
25	"		25	
30	"		30	27-6
40	"		40	
50	"		50	
60	"		60	

Map of Well Location

Please provide a map below following instructions on the back.



Comments: WARSAW.

Well Contractor and Well Technician Information

Business Name of Well Contractor	Well Contractor's Licence No.
BURGESS WELL DRILLING	14155

Business Address (Street Number/Name)	Municipality	Province	Postal Code	Business E-mail Address
467 Emily Park RD	Omemee	ONT.	K0L2W0	

Bus. Telephone No. (Inc. area code)	Name of Well Technician (Last Name, First Name)	Well Technician's Licence No.	Signature of Technician and/or Contractor	Date Submitted
7058799587	BURGESS RYAN	4122		

Well owner's information package delivered: ☐ Yes ☐ No

Date Package Delivered: Y Y Y Y M M D D

Date Work Completed: Y Y Y Y M M D D

Ministry Use Only

Audit No: Z311350

Received

05083E (2018/12)

Contractor's Copy

Ontario — Ministry of the Environment, Conservation and Parks

Measurements recorded in: ☐ Metric ☐ Imperial

Well Tag No. (Place Sticker and/or Print Below): **Tag#:A269170**

Well Record

Regulation 903 Ontario Water Resources Act

Page ____ of ____

Well Owner's Information

First Name	Last Name / Organization	E-mail Address	☐ Well Constructed by Well Owner
JASON	RIEL		

Mailing Address (Street Number/Name)	Municipality	Province	Postal Code	Telephone No. (inc. area code)
LONG BERRY LANE	PETER BOROUGH	ONT.		

Well Location

Address of Well Location (Street Number/Name)	Township	Lot	Concession
	Douro-Dummer	14	1

County/District/Municipality	City/Town/Village	Province	Postal Code
PETERBOROUGH	WARSAW	Ontario	

UTM Coordinates	Zone	Easting	Northing	Municipal Plan and Sublot Number	Other
NAD 83	17	723409	4924391		

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	CLAY, STONE,	BOULDERS	HARD PACKED	0	12
GREY	" "	"	" "	12	25
GREY	SHALE, GRAVEL		WATER BEARING	25	28
GREY	LIMESTONE			28	36

Annular Space

Depth Set at (m/ft) From	Depth Set at (m/ft) To	Type of Sealant Used (Material and Type)	Volume Placed (m³/ft³)
0	20	quick grout mix	40 gal
		3/8 hole plug	14 bags.

Method of Construction

☑ Cable Tool ☐ Rotary (Conventional) ☐ Rotary (Reverse) ☐ Boring ☐ Air percussion ☐ Other, specify ____

☐ Diamond ☐ Jetting ☐ Driving ☐ Digging

Well Use

☐ Public ☑ Domestic ☐ Livestock ☐ Irrigation ☐ Industrial ☐ Other, specify

☐ Commercial ☐ Municipal ☑ Test Hole ☐ Cooling & Air Conditioning

☐ Not used ☐ Dewatering ☐ Monitoring

Construction Record - Casing

Inside Diameter (cm/in)	Open Hole OR Material (Galvanized, Fibreglass, Concrete, Plastic, Steel)	Wall Thickness (cm/in)	Depth (m/ft) From	Depth (m/ft) To
6 1/4	STEEL	188W	0	28

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

Construction Record - Screen

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

Water Details

Water found at Depth (m/ft)	Kind of Water	Gas	Other, specify
28-36	☑ Fresh ☐ Untested	☐	
	☐ Fresh ☐ Untested	☐	
	☐ Fresh ☐ Untested	☐	

Hole Diameter

Depth (m/ft) From	Depth (m/ft) To	Diameter (cm/in)
0	20	8"
0	36	6 1/4

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): 34'

Pumping rate (l/min / GPM): 76, P.M

Duration of pumping: 1 hrs + 0 min

Final water level end of pumping (m/ft): 12-4

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

Recommended pump depth (m/ft): 34

Recommended pump rate (l/min / GPM): 56, P.M

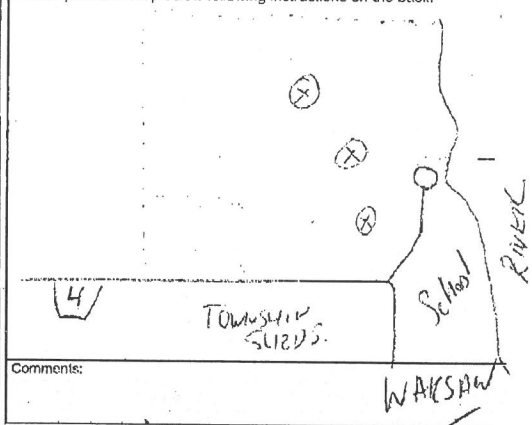
Well production (l/min / GPM): 10 G.P.M

Disinfected? ☑ Yes ☐ No

Draw Down Time (min)	Draw Down Water Level (m/ft)	Recovery Time (min)	Recovery Water Level (m/ft)
Static Level	12-3		
1	12-4	1	12-3
2		2	
3		3	
4		4	
5		5	
10		10	
15		15	
20		20	
25		25	
30		30	
40		40	
50	↓	50	
60	12-4	60	

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.
BURGESS WELL DRILLING	14155

Business Address (Street Number/Name)	Municipality	Province	Postal Code	Business E-mail Address
462 EMILY PARK RD	OMEMEE	ONT.	K0L2W0	

Bus. Telephone No. (inc. area code)	Name of Well Technician (Last Name, First Name)	Well Technician's Licence No.	Signature of Technician and/or Contractor	Date Submitted
705 799 5871	BURGESS, RYAN	4122		2019/09/10

Well owner's information package delivered	Date Package Delivered	Date Work Completed
☑ Yes ☐ No	2019/09/06	2019/09/08

Ministry Use Only

Audit No: Z311351

Tag #:

0506E (2010/12)

Contractor's Copy

Ontario — Ministry of the Environment, Conservation and Parks

Measurements recorded in: ☐ Metric ☐ Imperial

Well Tag No. *(Place Sticker and/or Print Below)*: Tag#:A269169

Well Record

Regulation 903 Ontario Water Resources Act

Page ____ of ____

Well Owners' Information

First Name	Last Name / Organization	E-mail Address	☐ Well Constructed by Well Owner
JASON	RICE		

Mailing Address (Street Number/Name)	Municipality	Province	Postal Code	Telephone No. *(inc. area code)*
LOOSELEY LANE	PETERBOROUGH	ONT.		

Well Location

Address of Well Location (Street Number/Name)	Township	Lot	Concession
	DOURO-DUMMER	14	1

County/District/Municipality	City/Town/Village	Province	Postal Code
PETERBOROUGH	WARSAW.	Ontario	

UTM Coordinates	Zone	Easting	Northing	Municipal Plan and Sublot Number	Other
NAD 83	17	726493	4924490		

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	TOPSOIL			0	1
GREY	CLAY, BOULDERS, SAND			1	10
GREY	" "			10	18
GREY	SHALE, GRAVEL			18	20
GREY	LIMESTONE, LAYERS SAND GRAVEL			20	26

Annular Space

Depth Set at (m/ft) From	To	Type of Sealant Used (Material and Type)	Volume Placed (m³/ft³)
0	20	QUICK GROUT MIX	40 gal
		3/8 HOLE PLUG	10 bags

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): 26'

Pumping rate (l/min / GPM): 15 G.P.M

Duration of pumping: 1 hrs + 0 min +

Final water level end of pumping (m/ft): 16-6

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

Recommended pump depth (m/ft): 26

Recommended pump rate (l/min / GPM): 10 G.P.M

Well production (l/min / GPM): 15 AVG G.P.M

Disinfected? ☑ Yes ☐ No

	Draw Down Time (min)	Draw Down Water Level (m/ft)	Recovery Time (min)	Recovery Water Level (m/ft)
Static Level		16-6		
1			1	16-6
2			2	
3			3	
4			4	
5			5	
10			10	
15			15	
20			20	
25			25	
30			30	
40			40	
50		↓	50	
60		16-6	60	

Method of Construction

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

Well Use

☐ Public ☐ Commercial ☐ Not used ☐ Domestic ☐ Municipal ☐ Dewatering ☑ Test Hole ☐ Monitoring ☐ Livestock ☐ 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 1/4	STEEL	16 GA	0	20'

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

Construction Record - Screen

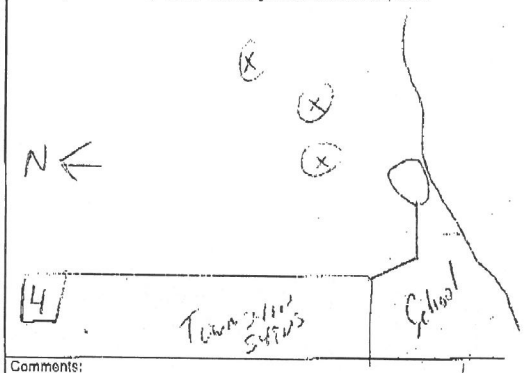
Outside Diameter (cm/in)	Material (Plastic, Galvanized, Steel)	Slot No.	Depth (m/ft) From	Depth (m/ft) To
5 1/4	S. STEEL	14	26 -	19'
TOP OF SCREEN		19'		

Water Details

Water found at Depth	Kind of Water	Hole Diameter Depth From	Depth To	Diameter (cm/in)
23-26 (m/ft) ☐ Gas	☑ Fresh ☐ Untested ☐ Other, specify			
(m/ft) ☐ Gas	☐ Fresh ☐ Untested ☐ Other, specify	0	20	8"
(m/ft) ☐ Gas	☐ Fresh ☐ Untested ☐ Other, specify	20 -	26	5 1/4"

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.
BURGESS WELL DRILLING	1455

Business Address (Street Number/Name)	Municipality	Province	Postal Code	Business E-mail Address
467 EMILY PARK RD	OMEMEE	ONT.	K0L2W0	

Bus. Telephone No. *(inc. area code)*	Name of Well Technician (Last Name, First Name)	Well Technician's Licence No.	Signature of Technician and/or Contractor	Date Submitted
705 799 5871	BURGESS, EVAN	41212		2019 09 20

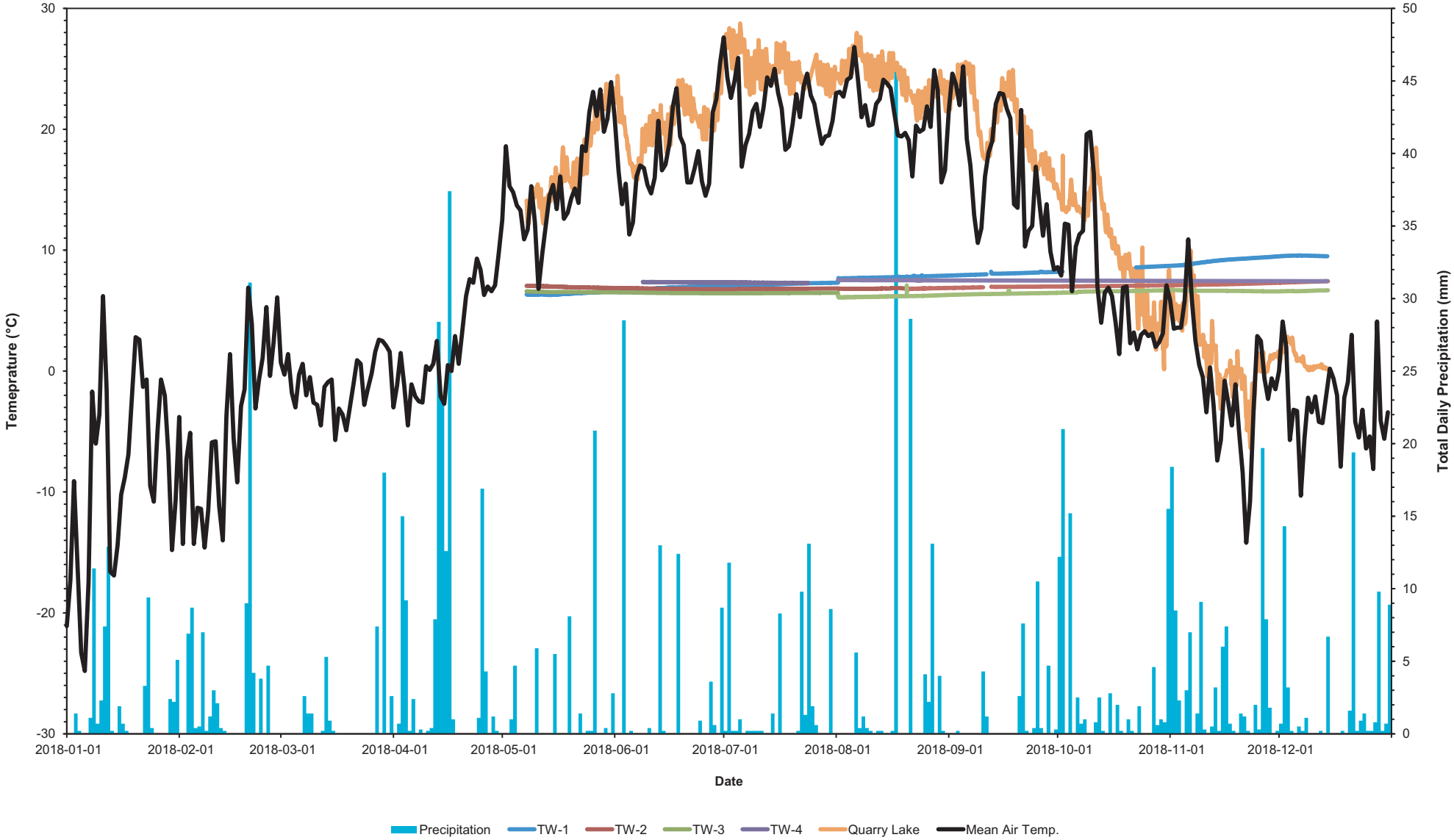
Well owner's information package delivered	Date Package Delivered	Date Work Completed	Ministry Use Only
☑ Yes ☐ No	2019 09 06	2019 09 05	Audit No. Z 31352

0506E (2018/12) Contractor's Copy

APPENDIX F

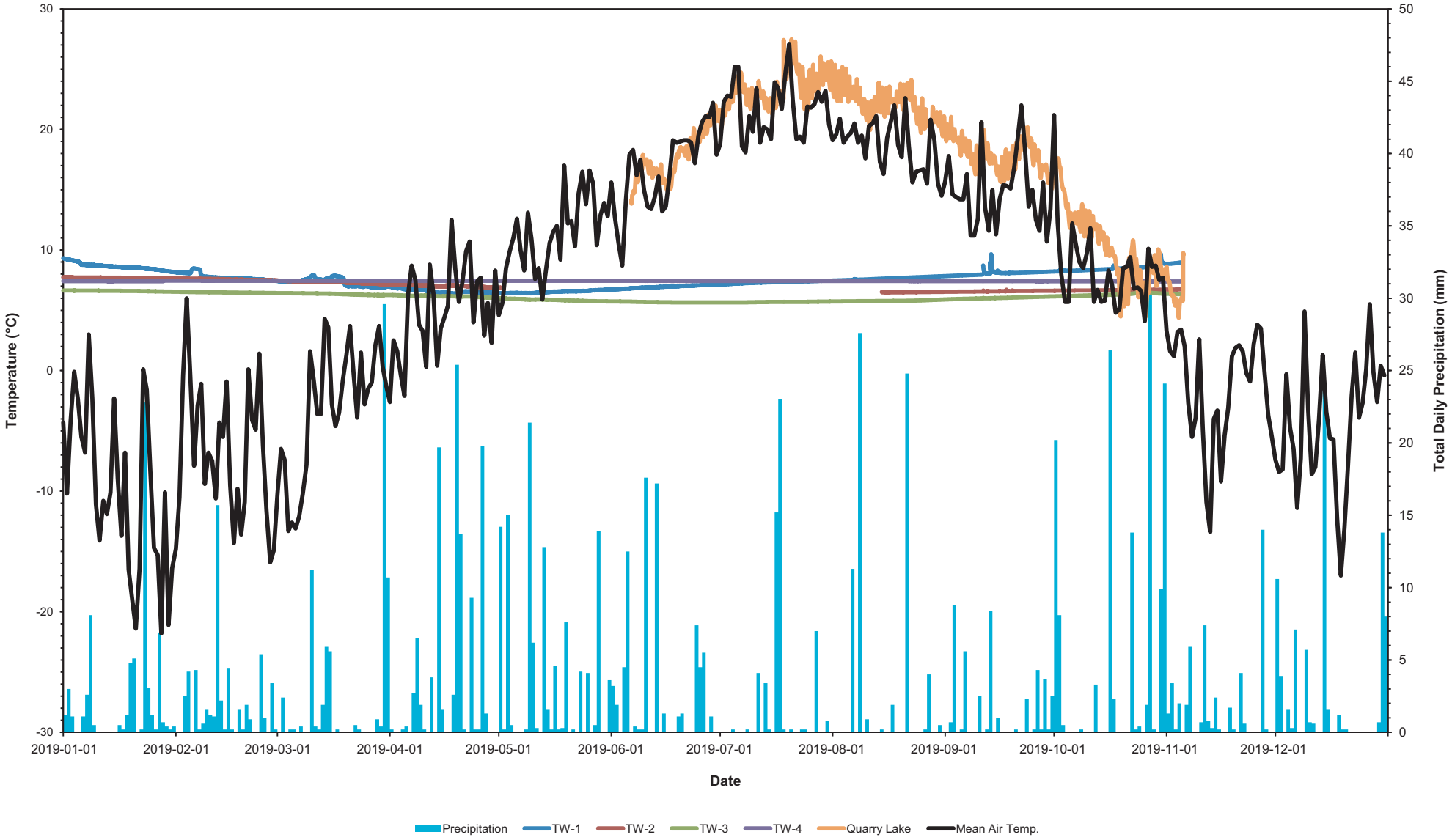
Compiled Temperature and Conductivity Summary

Proposed Warsaw Residential Subdivision
Compiled Temperature Summary 2018



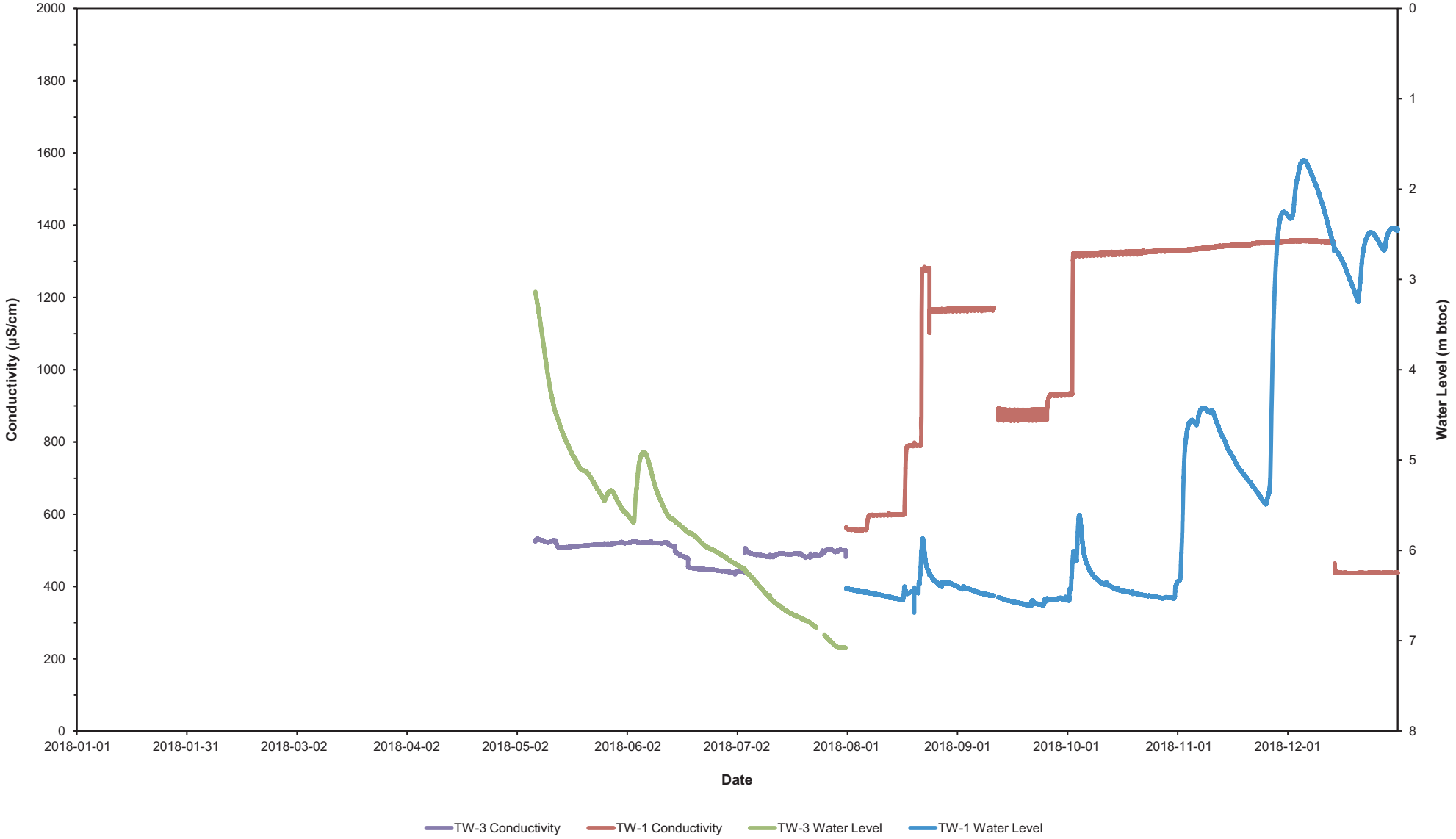
Notes: Precipitation data from the Environment Canada station at Trent University, Peterborough, Ontario.

Proposed Warsaw Residential Subdivision
Compiled Temperature Summary 2019



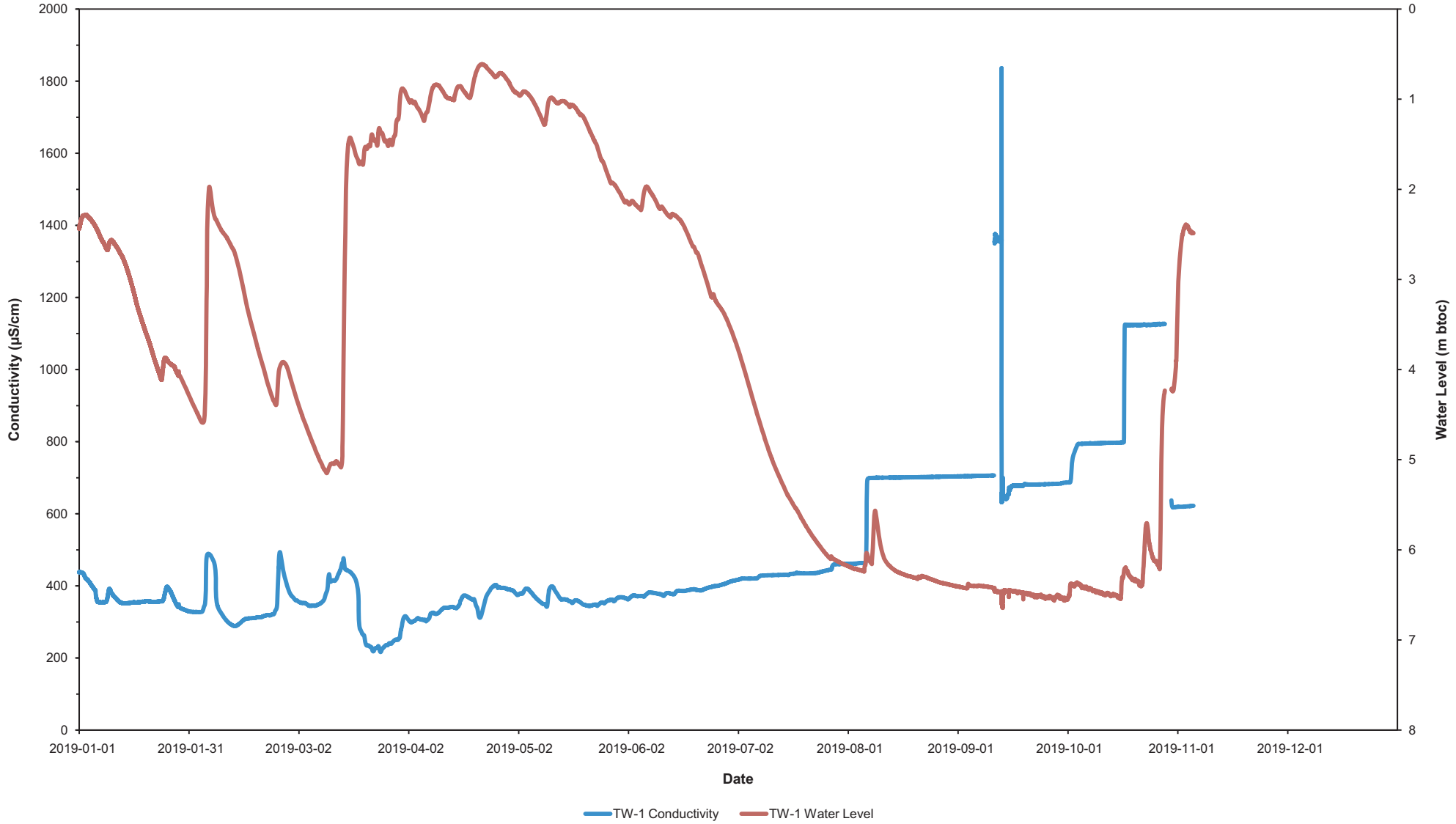
Notes: Precipitation data from the Environment Canada station at Trent University, Peterborough, Ontario.

Proposed Warsaw Residential Subdivision
Compiled Conductivity Summary 2018



Notes: Conductivity measured and recorded with a Solinst LTC Levelogger Edge, normalized to specific conductance at 25°C.

Proposed Warsaw Residential Subdivision
Compiled Conductivity Summary 2019



Notes: Conductivity measured and recorded with a Solinst LTC Levelogger Edge, normalized to specific conductance at 25°C.

APPENDIX G

Pumping Test Curves

Oakridge Environmental Ltd.
647 Neal Drive, Suite #3
Peterborough, Ontario
K9J 6X7

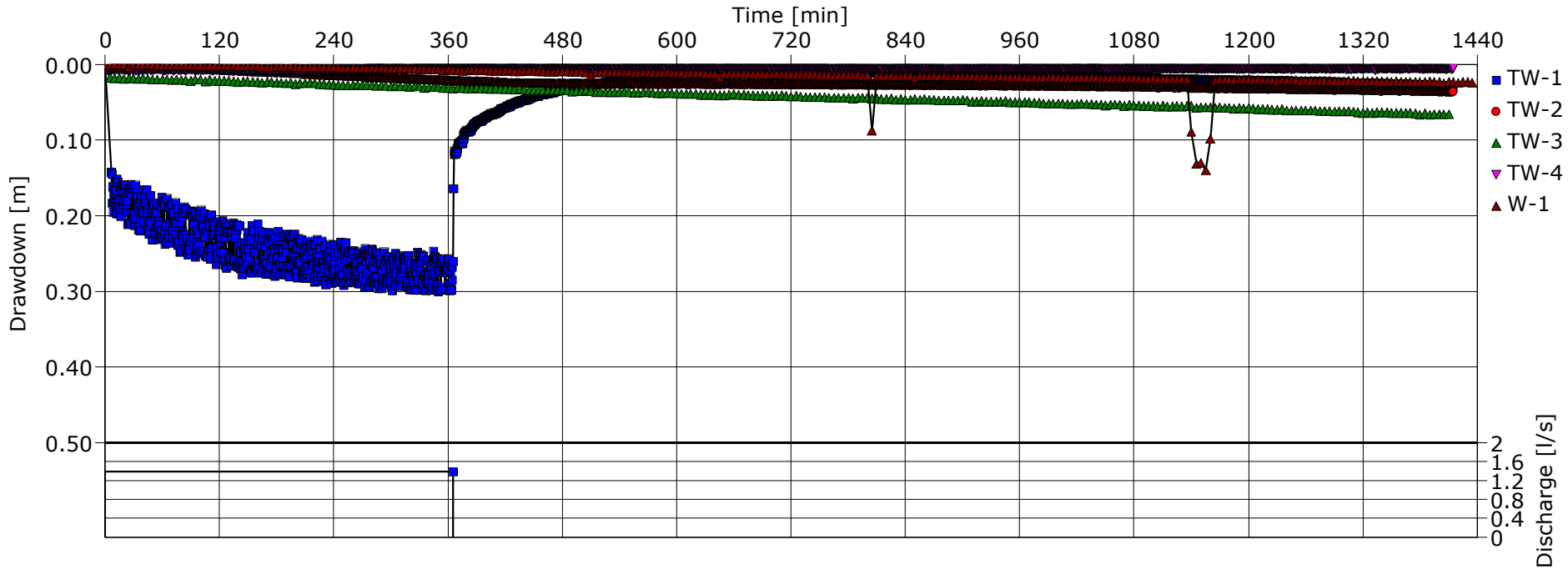
Pumping Test Analysis Report

Project: Proposed Warsaw Residential Subdivision

Number: 17-2326

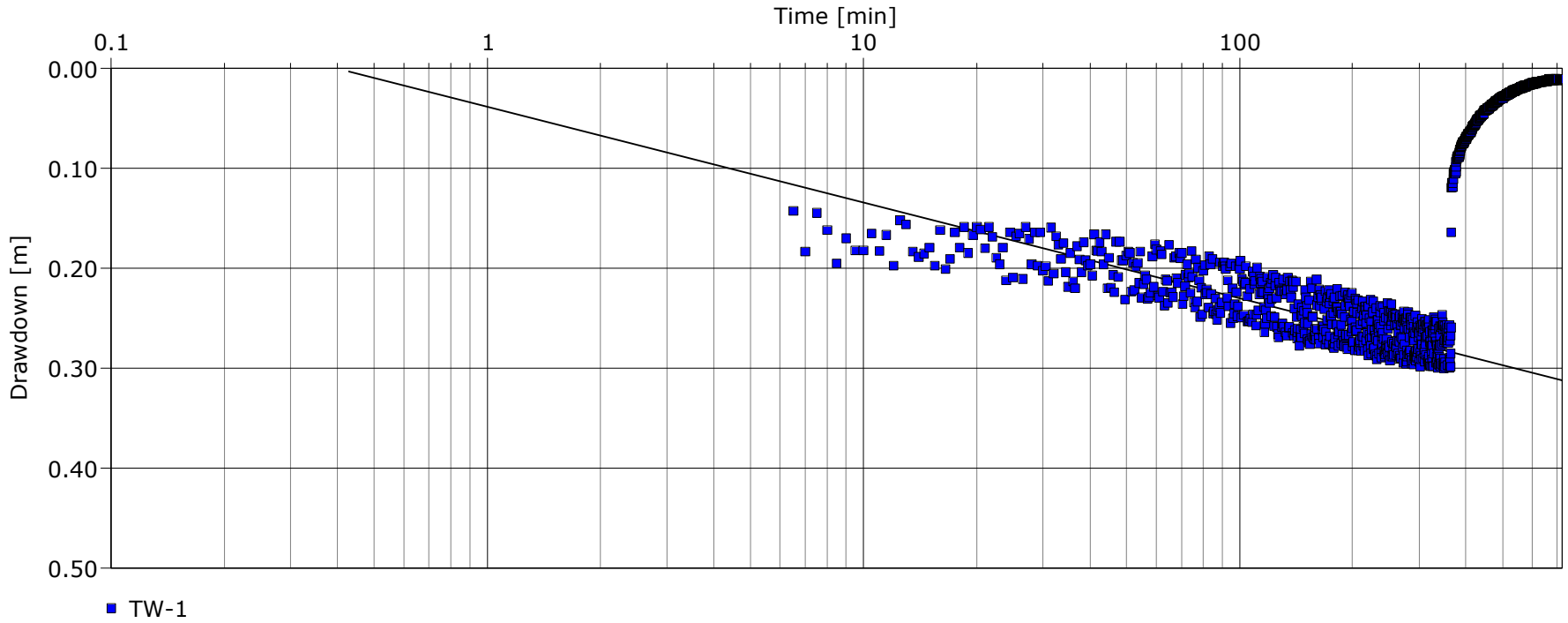
Client: J. Riel

Location: Warsaw, Ontario	Pumping Test: TW-1 (July 2018)	Pumping Well: TW-1
Test Conducted by: MD		Test Date: 7/10/18
Analysis Performed by: DM/BK	TW-1 Time-Drawdown (all wells)	Analysis Date: 7/17/18
Aquifer Thickness: 1.00 m	Discharge: variable, average rate 1.387 [l/s]	



Oakridge Environmental Ltd. 647 Neal Drive, Suite #3 Peterborough, Ontario K9J 6X7	**Pumping Test Analysis Report**
	Project: Proposed Warsaw Residential Subdivision
	Number: 17-2326
	Client: J. Riel

Location: Warsaw, Ontario	Pumping Test: TW-1 (July 2018)	Pumping Well: TW-1
Test Conducted by: MD		Test Date: 7/10/18
Analysis Performed by: DM/BK	TW-1, Cooper-Jacob (pumped well)	Analysis Date: 2/05/20
Aquifer Thickness: 1.00 m	Discharge: variable, average rate 1.387 [l/s]	



Calculation using COOPER & JACOB

Observation Well	Transmissivity [m²/d]	Hydraulic Conductivity [m/d]	Storage coefficient	Radial Distance to PW [m]	
TW-1	2.29×10^{2}	2.29×10^{2}		0.08	

Oakridge Environmental Ltd.
647 Neal Drive, Suite #3
Peterborough, Ontario
K9J 6X7

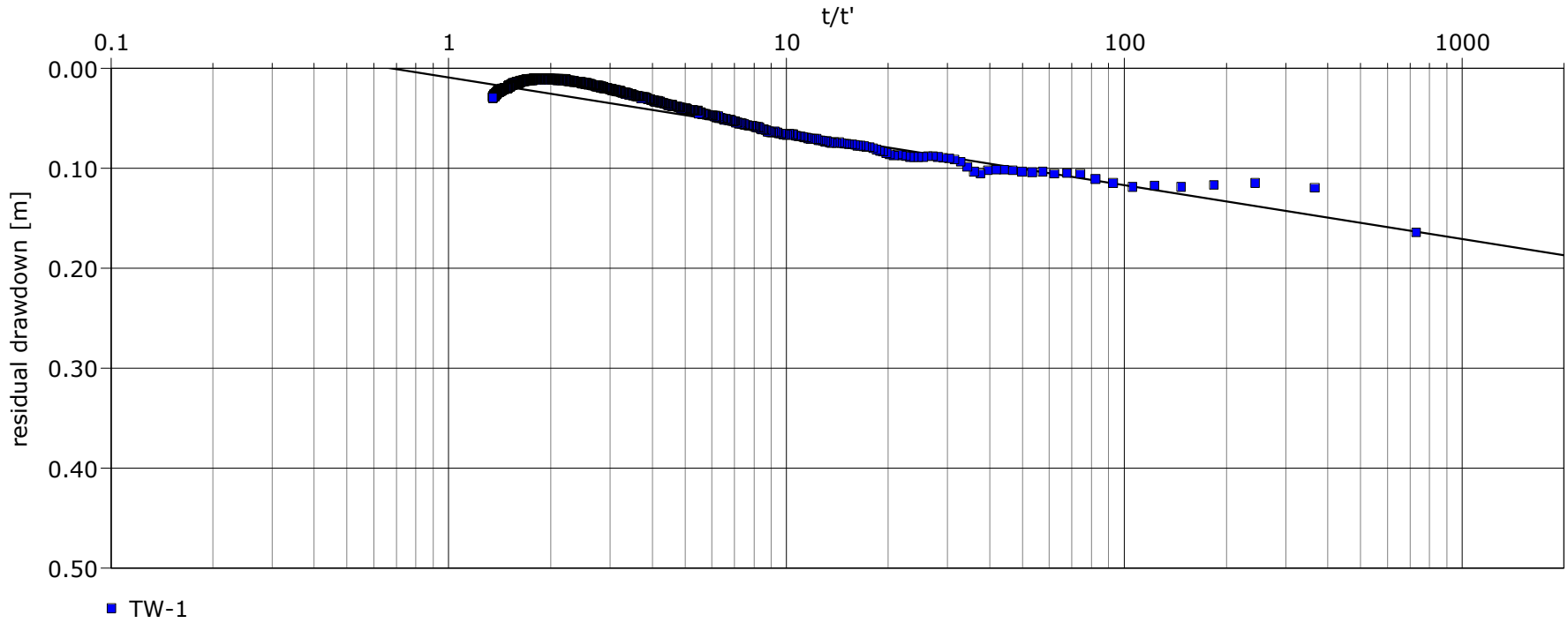
Pumping Test Analysis Report

Project: Proposed Warsaw Residential Subdivision

Number: 17-2326

Client: J. Riel

Location: Warsaw, Ontario	Pumping Test: TW-1 (July 2018)	Pumping Well: TW-1
Test Conducted by: MD		Test Date: 7/10/18
Analysis Performed by: DM/BK	TW-1, Theis Recovery (pumped well)	Analysis Date: 2/05/20
Aquifer Thickness: 1.00 m	Discharge: variable, average rate 1.387 [l/s]	

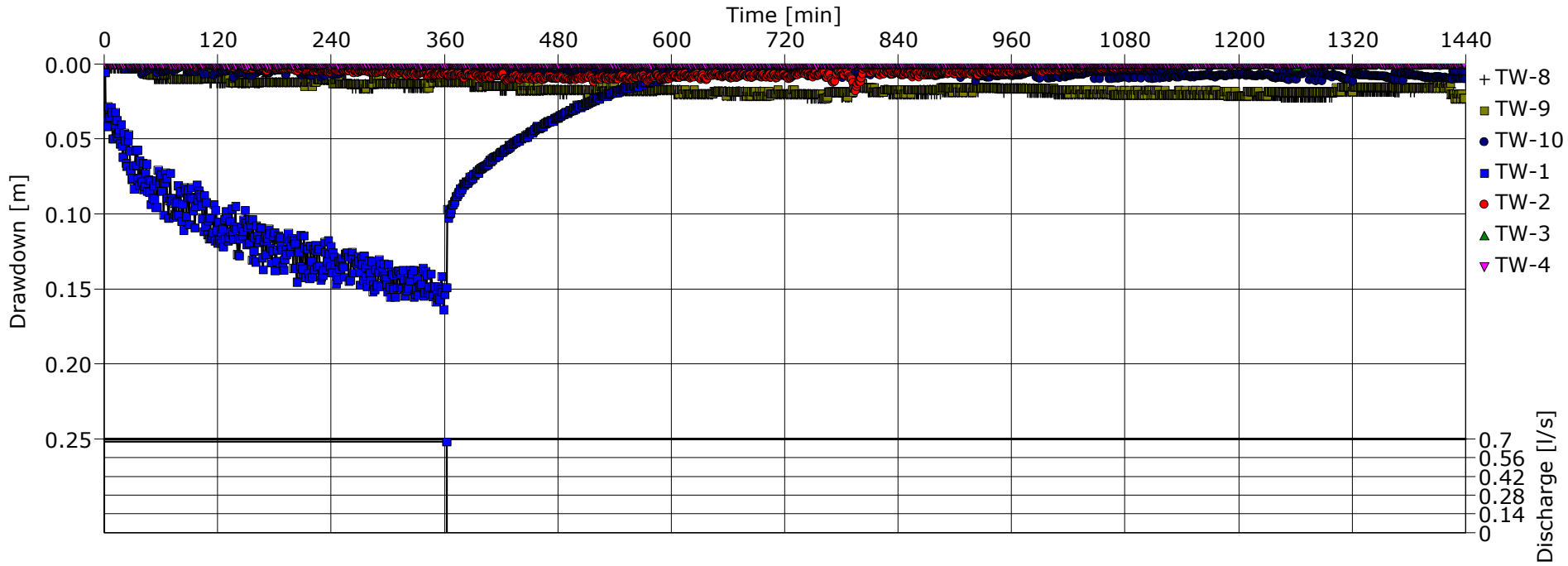


Calculation using THEIS & JACOB

Observation Well	Transmissivity [m²/d]	Hydraulic Conductivity [m/d]	Radial Distance to PW [m]
TW-1	4.07×10^2	4.07×10^2	0.08

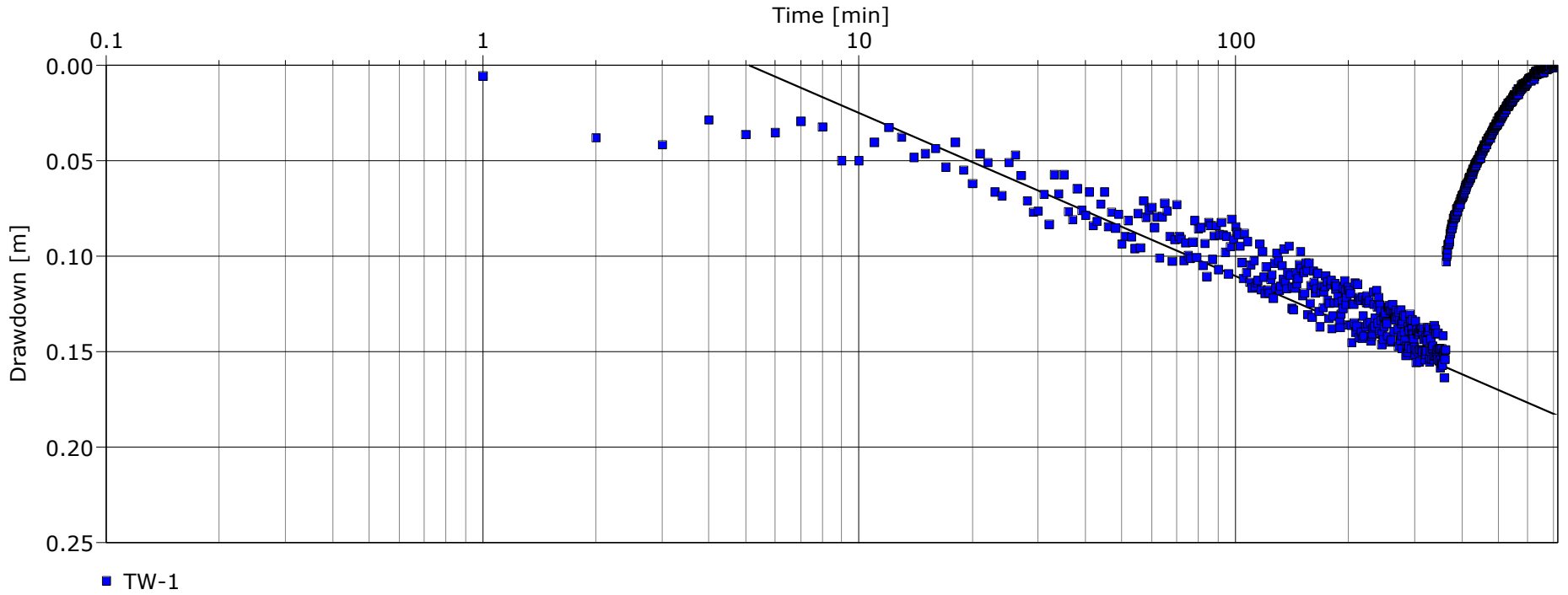
Oakridge Environmental Ltd. **647 Neal Drive, Suite #3** **Peterborough, Ontario** **K9J 6X7**	**Pumping Test Analysis Report** Project: Proposed Warsaw Residential Subdivision Number: 17-2326 Client: J. Riel

Location: Warsaw, Ontario	Pumping Test: TW-1 (Sept. 2019)	Pumping Well: TW-1
Test Conducted by: DM		Test Date: 9/13/19
Analysis Performed by: DM/BK	TW-1, Time-Drawdown (all wells)	Analysis Date: 1/29/20
Aquifer Thickness: 1.00 m	Discharge: variable, average rate 0.6814 [l/s]	



Oakridge Environmental Ltd. 647 Neal Drive, Suite #3 Peterborough, Ontario K9J 6X7	**Pumping Test Analysis Report**
	Project: Proposed Warsaw Residential Subdivision
	Number: 17-2326
	Client: J. Riel

Location: Warsaw, Ontario	Pumping Test: TW-1 (Sept. 2019)	Pumping Well: TW-1
Test Conducted by: DM		Test Date: 9/13/19
Analysis Performed by: DM/BK	TW-1, Cooper & Jacob (pumped well)	Analysis Date: 1/29/20
Aquifer Thickness: 1.00 m	Discharge: variable, average rate 0.6814 [l/s]	



Calculation using COOPER & JACOB

Observation Well	Transmissivity [m²/d]	Hydraulic Conductivity [m/d]	Storage coefficient	Radial Distance to PW [m]	
TW-1	1.26×10^{2}	1.26×10^{2}		0.08	

Oakridge Environmental Ltd.
647 Neal Drive, Suite #3
Peterborough, Ontario
K9J 6X7

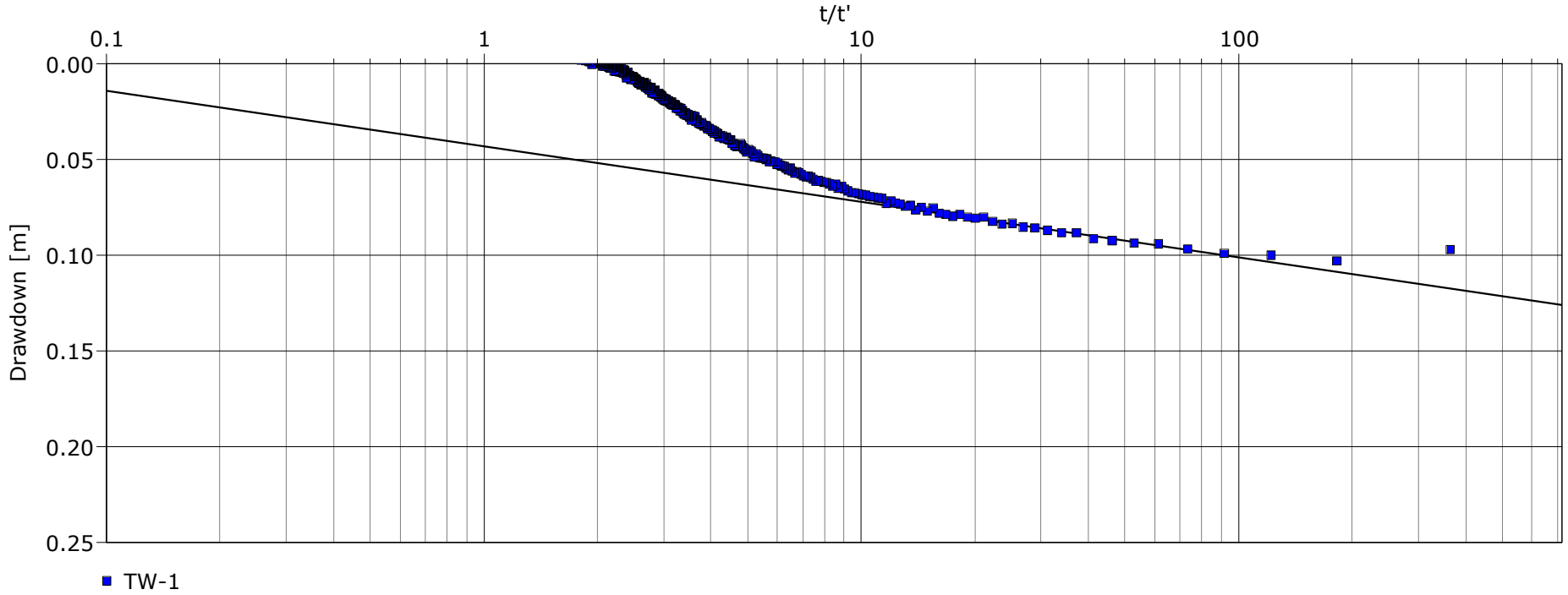
Pumping Test Analysis Report

Project: Proposed Warsaw Residential Subdivision

Number: 17-2326

Client: J. Riel

Location: Warsaw, Ontario	Pumping Test: TW-1 (Sept. 2019)	Pumping Well: TW-1
Test Conducted by: DM		Test Date: 9/13/19
Analysis Performed by: DM/BK	TW-1, Theis Recovery (pumped well)	Analysis Date: 1/29/20
Aquifer Thickness: 1.00 m	Discharge: variable, average rate 0.6814 [l/s]	



Calculation using THEIS & JACOB

Observation Well	Transmissivity [m²/d]	Hydraulic Conductivity [m/d]	Radial Distance to PW [m]
TW-1	3.73×10^{2}	3.73×10^{2}	0.08

Oakridge Environmental Ltd.
647 Neal Drive, Suite #3
Peterborough, Ontario
K9J 6X7

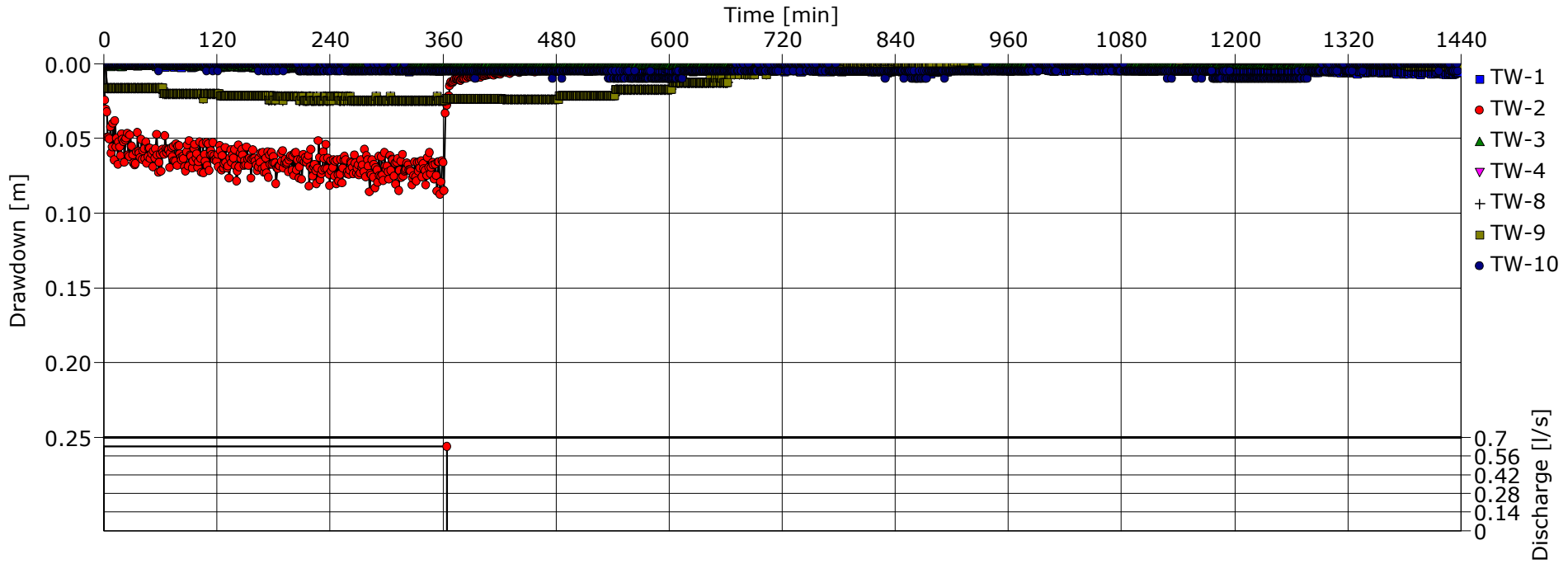
Pumping Test Analysis Report

Project: Proposed Warsaw Residential Subdivision

Number: 17-2326

Client: J. Riel

Location: Warsaw, Ontario	Pumping Test: TW-2	Pumping Well: TW-2
Test Conducted by: MD/SR		Test Date: 9/18/19
Analysis Performed by: DM/BK	TW-2, Time-Drawdown (all wells)	Analysis Date: 1/29/20
Aquifer Thickness: 1.00 m	Discharge: variable, average rate 0.6309 [l/s]	



Oakridge Environmental Ltd.
647 Neal Drive, Suite #3
Peterborough, Ontario
K9J 6X7

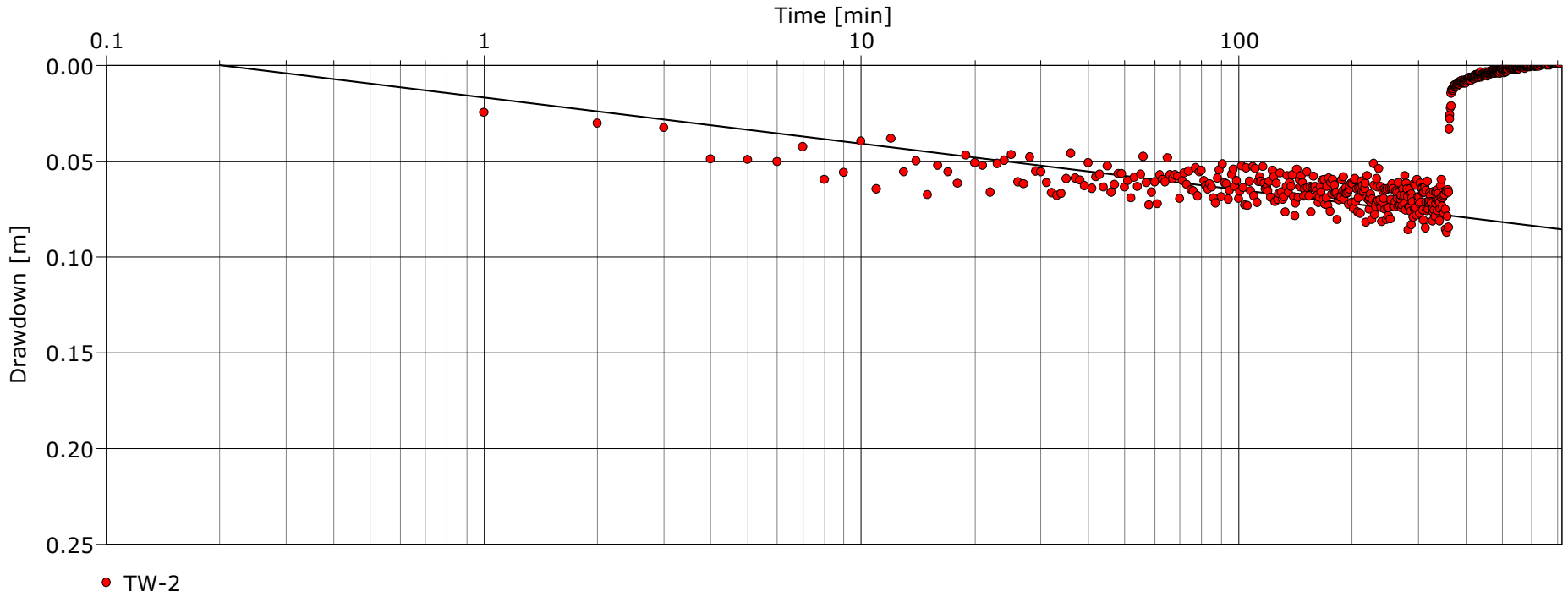
Pumping Test Analysis Report

Project: Proposed Warsaw Residential Subdivision

Number: 17-2326

Client: J. Riel

Location: Warsaw, Ontario	Pumping Test: TW-2	Pumping Well: TW-2
Test Conducted by: MD/SR		Test Date: 9/18/19
Analysis Performed by: DM/BK	TW-2, Cooper-Jacob (pumped well)	Analysis Date: 1/29/20
Aquifer Thickness: 1.00 m	Discharge: variable, average rate 0.6309 [l/s]	



Calculation using COOPER & JACOB

Observation Well	Transmissivity [m²/d]	Hydraulic Conductivity [m/d]	Storage coefficient	Radial Distance to PW [m]	
TW-2	4.14×10^{2}	4.14×10^{2}		0.08	

Oakridge Environmental Ltd.
647 Neal Drive, Suite #3
Peterborough, Ontario
K9J 6X7

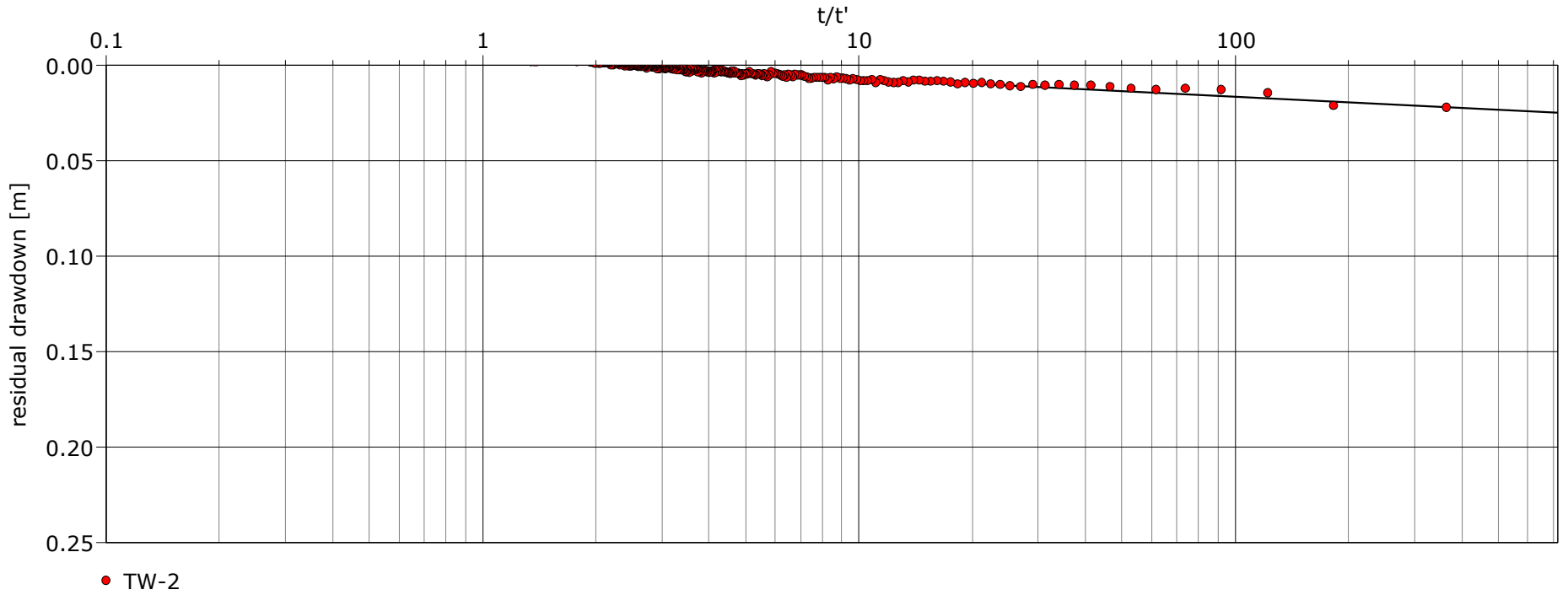
Pumping Test Analysis Report

Project: Proposed Warsaw Residential Subdivision

Number: 17-2326

Client: J. Riel

Location: Warsaw, Ontario	Pumping Test: TW-2	Pumping Well: TW-2
Test Conducted by: MD/SR		Test Date: 9/18/19
Analysis Performed by: DM/BK	TW-2, Theis Recovery (pumped well)	Analysis Date: 1/29/20
Aquifer Thickness: 1.00 m	Discharge: variable, average rate 0.6309 [l/s]	



Calculation using THEIS & JACOB

Observation Well	Transmissivity [m²/d]	Hydraulic Conductivity [m/d]	Radial Distance to PW [m]
TW-2	1.03×10^{3}	1.03×10^{3}	0.08

Oakridge Environmental Ltd.
647 Neal Drive, Suite #3
Peterborough, Ontario
K9J 6X7

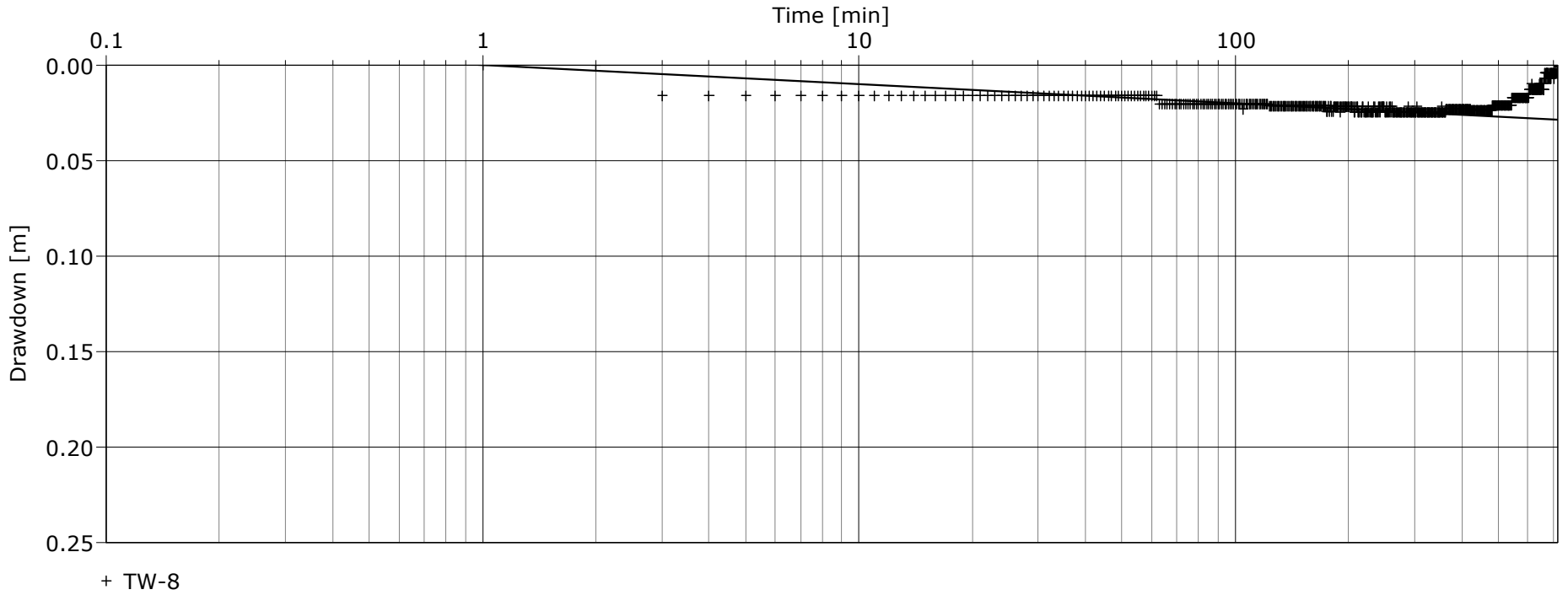
Pumping Test Analysis Report

Project: Proposed Warsaw Residential Subdivision

Number: 17-2326

Client: J. Riel

Location: Warsaw, Ontario	Pumping Test: TW-2	Pumping Well: TW-2
Test Conducted by: MD/SR		Test Date: 9/18/19
Analysis Performed by: DM/BK	TW-2, Cooper-Jacob (obs TW-8)	Analysis Date: 1/29/20
Aquifer Thickness: 1.00 m	Discharge: variable, average rate 0.6309 [l/s]	

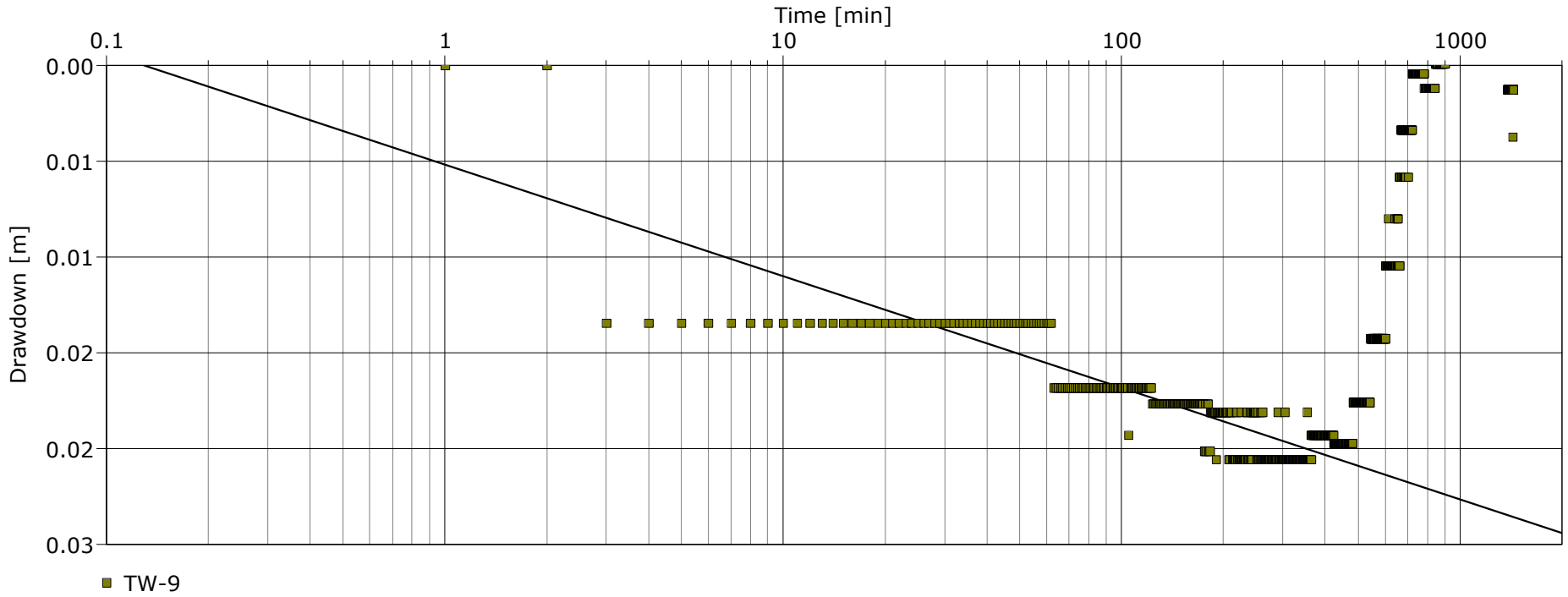


Calculation using COOPER & JACOB

Observation Well	Transmissivity [m²/d]	Hydraulic Conductivity [m/d]	Storage coefficient	Radial Distance to PW [m]	
TW-8	1.00×10^{3}	1.00×10^{3}	2.36×10^{-4}	80.64	

Oakridge Environmental Ltd. 647 Neal Drive, Suite #3 Peterborough, Ontario K9J 6X7	**Pumping Test Analysis Report**
	Project: Proposed Warsaw Residential Subdivision
	Number: 17-2326
	Client: J. Riel

Location: Warsaw, Ontario	Pumping Test: TW-2	Pumping Well: TW-2
Test Conducted by: MD/SR		Test Date: 9/18/19
Analysis Performed by: DM/BK	TW-2, Cooper-Jacob (obs. TW-9)	Analysis Date: 2/05/20
Aquifer Thickness: 1.00 m	Discharge: variable, average rate 0.6309 [l/s]	

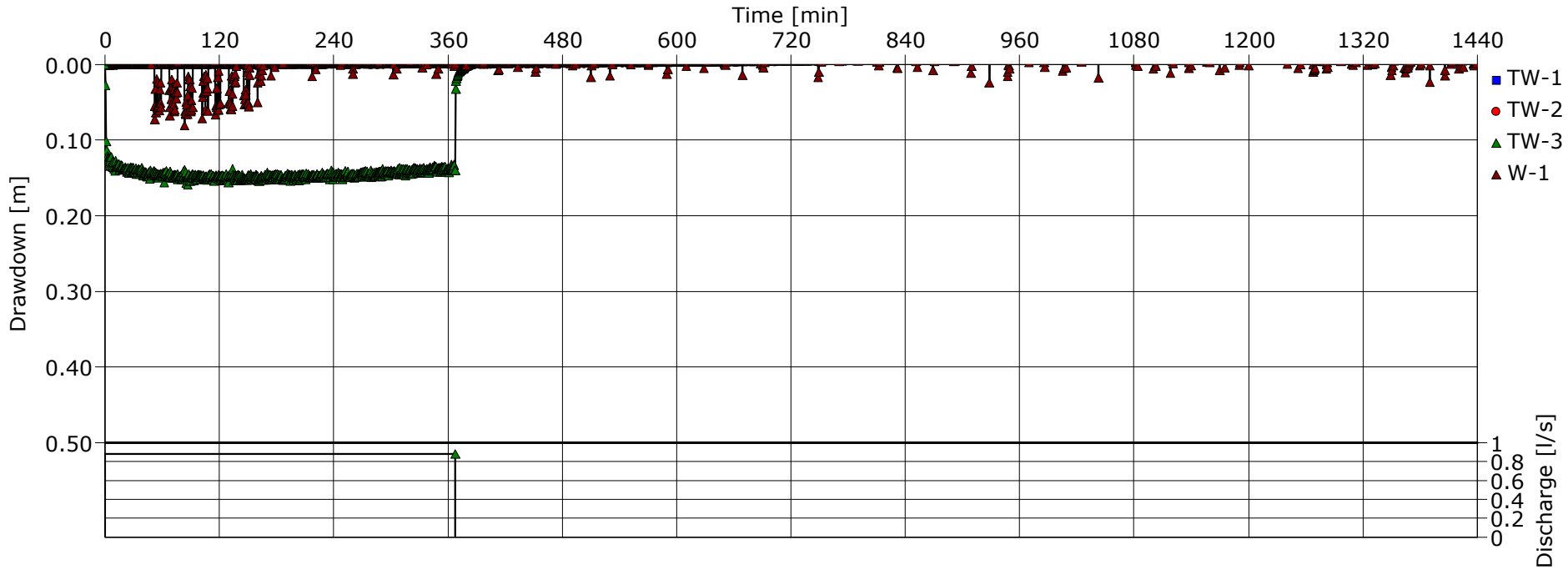


Calculation using COOPER & JACOB

Observation Well	Transmissivity [m²/d]	Hydraulic Conductivity [m/d]	Storage coefficient	Radial Distance to PW [m]
TW-9	1.43×10^{3}	1.43×10^{3}	3.75×10^{-5}	87.52

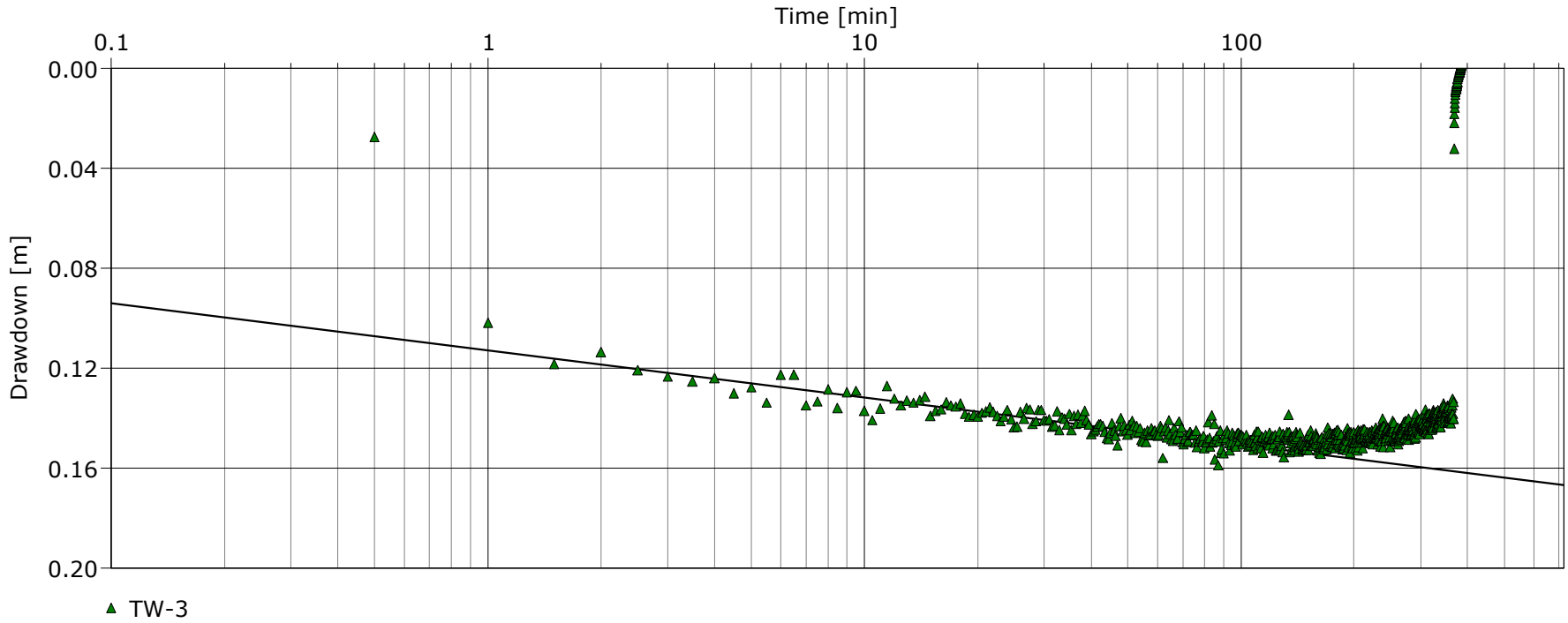
Oakridge Environmental Ltd. **647 Neal Drive, Suite #3** **Peterborough, Ontario** **K9J 6X7**	**Pumping Test Analysis Report** Project: Proposed Warsaw Residential Subdivision Number: 17-2326 Client: J. Riel

Location: Warsaw, Ontario	Pumping Test: TW-3	Pumping Well: TW-3
Test Conducted by: MD		Test Date: 3/28/18
Analysis Performed by: DM/BK	TW-3, Time-Drawdown (all wells)	Analysis Date: 1/30/20
Aquifer Thickness: 1.00 m	Discharge: variable, average rate 0.8787 [l/s]	



Oakridge Environmental Ltd. 647 Neal Drive, Suite #3 Peterborough, Ontario K9J 6X7	**Pumping Test Analysis Report**
	Project: Proposed Warsaw Residential Subdivision
	Number: 17-2326
	Client: J. Riel

Location: Warsaw, Ontario	Pumping Test: TW-3	Pumping Well: TW-3
Test Conducted by: MD		Test Date: 3/28/18
Analysis Performed by: DM/BK	TW-3, Cooper-Jacob (pumped well)	Analysis Date: 2/05/20
Aquifer Thickness: 1.00 m	Discharge: variable, average rate 0.8787 [l/s]	

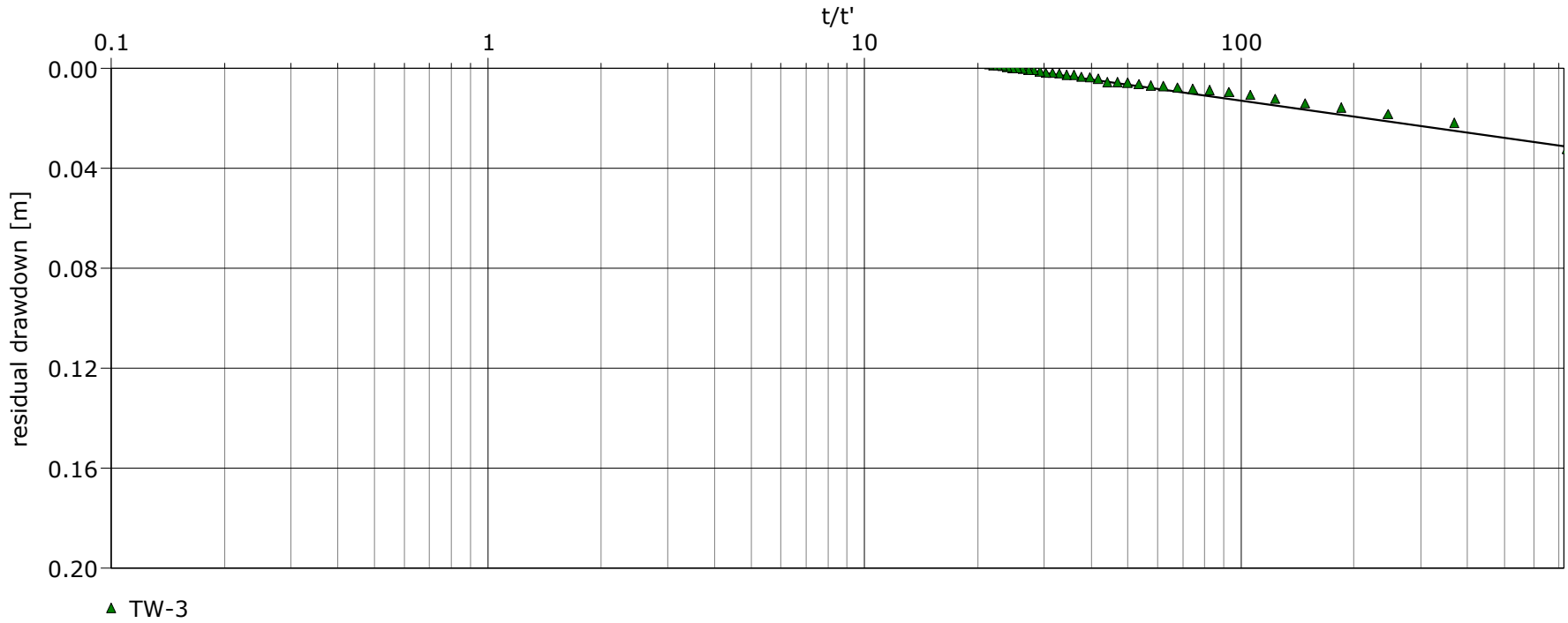


Calculation using COOPER & JACOB

Observation Well	Transmissivity [m²/d]	Hydraulic Conductivity [m/d]	Storage coefficient	Radial Distance to PW [m]	
TW-3	7.37×10^{2}	7.37×10^{2}		0.08	

Oakridge Environmental Ltd. 647 Neal Drive, Suite #3 Peterborough, Ontario K9J 6X7	**Pumping Test Analysis Report**
	Project: Proposed Warsaw Residential Subdivision
	Number: 17-2326
	Client: J. Riel

Location: Warsaw, Ontario	Pumping Test: TW-3	Pumping Well: TW-3
Test Conducted by: MD		Test Date: 3/28/18
Analysis Performed by: DM/BK	TW-3, Theis Recovery (pumped well)	Analysis Date: 2/05/20
Aquifer Thickness: 1.00 m	Discharge: variable, average rate 0.8787 [l/s]	

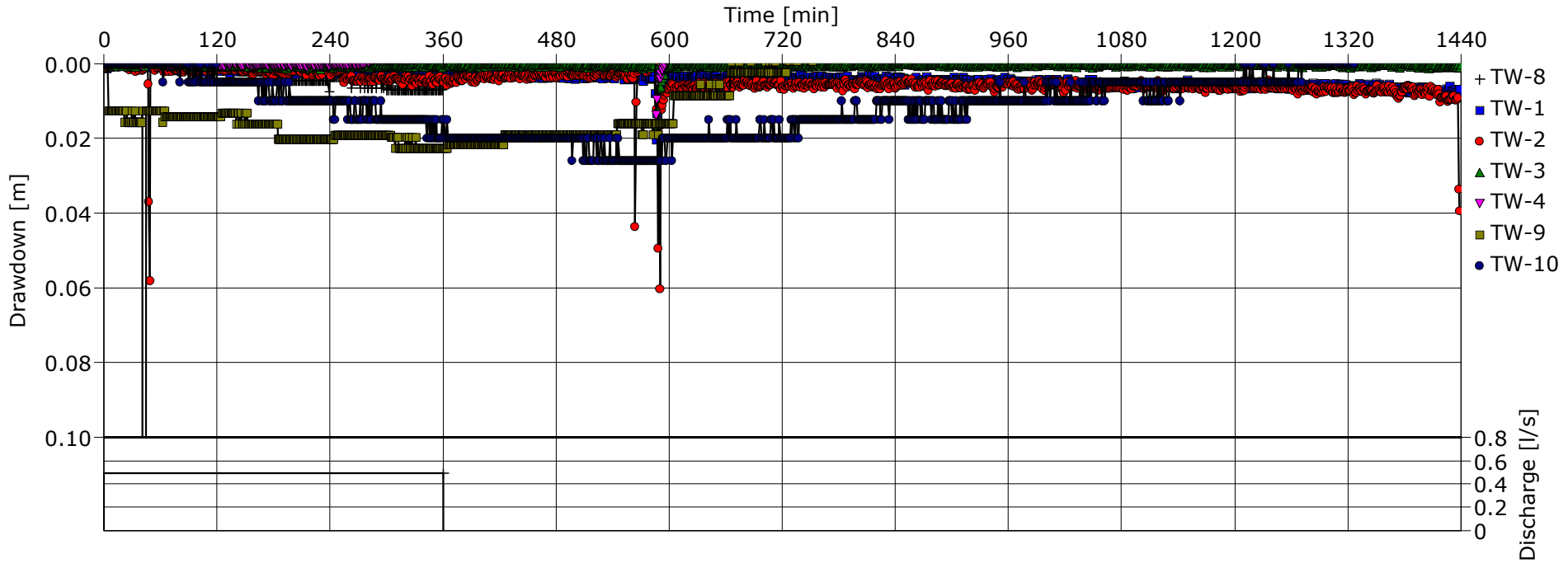


Calculation using THEIS & JACOB

Observation Well	Transmissivity [m²/d]	Hydraulic Conductivity [m/d]	Radial Distance to PW [m]
TW-3	6.55×10^{2}	6.55×10^{2}	0.08

Oakridge Environmental Ltd. **647 Neal Drive, Suite #3** **Peterborough, Ontario** **K9J 6X7**	**Pumping Test Analysis Report** Project: Proposed Warsaw Residential Subdivision Number: 17-2326 Client: J. Riel

Location: Warsaw, Ontario	Pumping Test: TW-8 Logger Data	Pumping Well: TW-8
Test Conducted by: SR		Test Date: 9/17/19
Analysis Performed by: DM/BK	TW-8, Time-Drawdown (all wells)	Analysis Date: 1/29/20
Aquifer Thickness:	Discharge: variable, average rate 0.4921 [l/s]	



Oakridge Environmental Ltd.
647 Neal Drive, Suite #3
Peterborough, Ontario
K9J 6X7

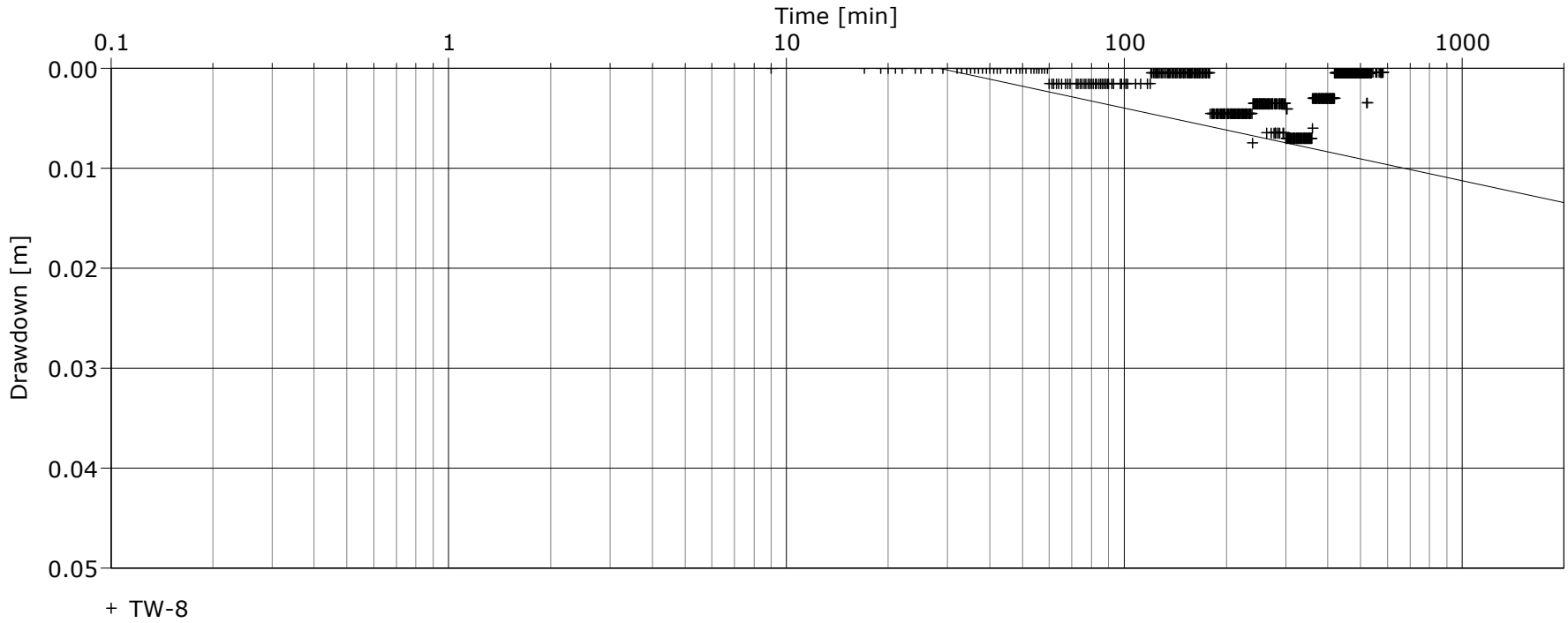
Pumping Test Analysis Report

Project: Proposed Warsaw Residential Subdivision

Number: 17-2326

Client: J. Riel

Location: Warsaw, Ontario	Pumping Test: TW-8 Logger Data	Pumping Well: TW-8
Test Conducted by: SR		Test Date: 9/17/19
Analysis Performed by: DM/BK	TW-8, Cooper-Jacob (pumped well)	Analysis Date: 2/05/20
Aquifer Thickness:	Discharge: variable, average rate 0.4921 [l/s]	



Calculation using COOPER & JACOB

Observation Well	Transmissivity [m²/d]	Storage coefficient	Radial Distance to PW [m]	
TW-8	1.07×10^{3}		0.07	

Oakridge Environmental Ltd.
647 Neal Drive, Suite #3
Peterborough, Ontario
K9J 6X7

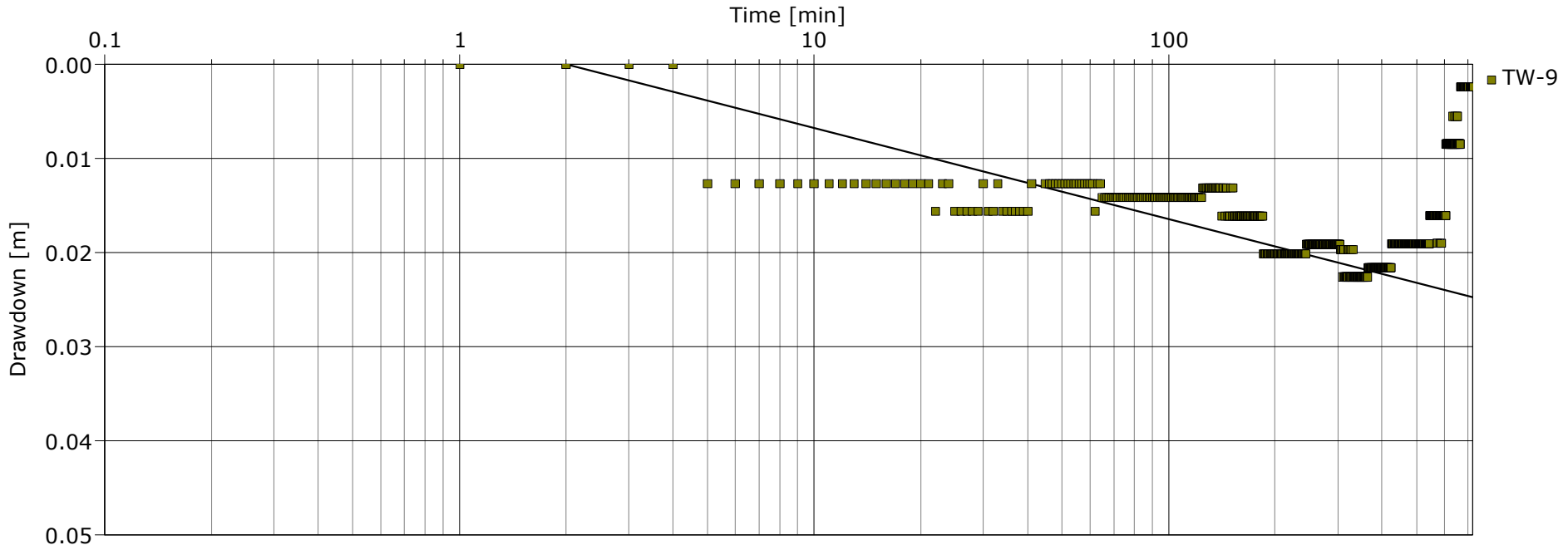
Pumping Test Analysis Report

Project: Proposed Warsaw Residential Subdivision

Number: 17-2326

Client: J. Riel

Location: Warsaw, Ontario	Pumping Test: TW-8 Logger Data	Pumping Well: TW-8
Test Conducted by: SR		Test Date: 9/17/19
Analysis Performed by: DM/BK	TW-8, Cooper-Jacob (obs. TW-9)	Analysis Date: 2/05/20
Aquifer Thickness:	Discharge: variable, average rate 0.4921 [l/s]	

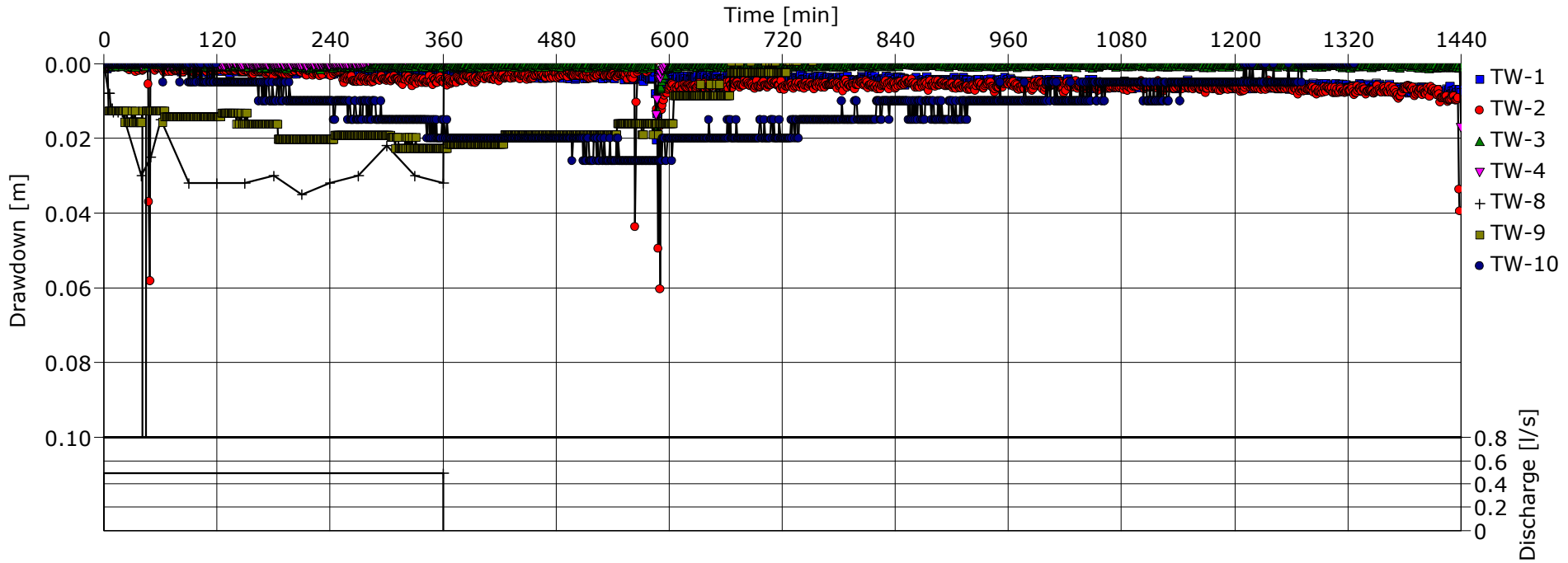


Calculation using COOPER & JACOB

Observation Well	Transmissivity [m²/d]	Storage coefficient	Radial Distance to PW [m]	
TW-9	8.05×10^{2}	1.59×10^{-4}	125.51	

Oakridge Environmental Ltd. **647 Neal Drive, Suite #3** **Peterborough, Ontario** **K9J 6X7**	**Pumping Test Analysis Report**
	Project: Proposed Warsaw Residential Subdivision
	Number: 17-2326
	Client: J. Riel

Location: Warsaw, Ontario	Pumping Test: TW-8 Manual Data	Pumping Well: TW-8
Test Conducted by: SR		Test Date: 9/17/19
Analysis Performed by: DM/BK	TW-8, Time-Drawdown (all wells)	Analysis Date: 1/29/20
Aquifer Thickness: 1.00 m	Discharge: variable, average rate 0.4921 [l/s]	



Oakridge Environmental Ltd.
647 Neal Drive, Suite #3
Peterborough, Ontario
K9J 6X7

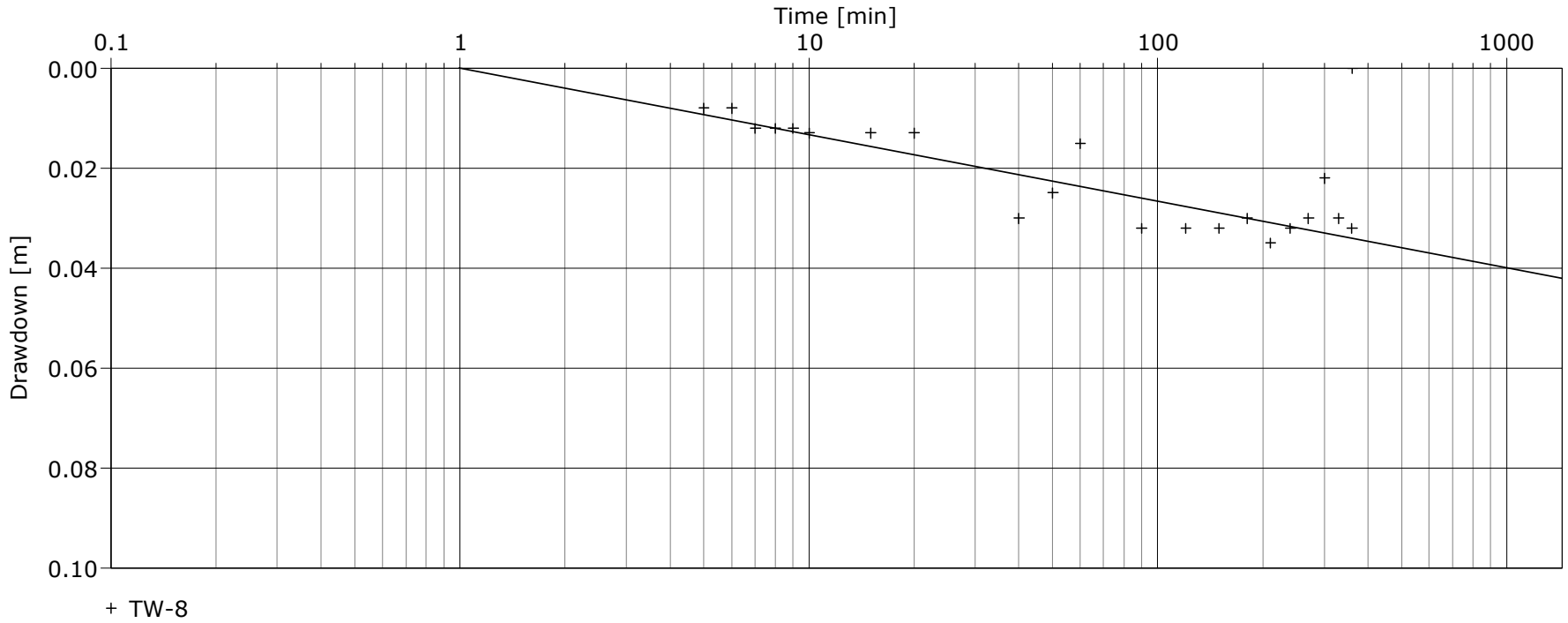
Pumping Test Analysis Report

Project: Proposed Warsaw Residential Subdivision

Number: 17-2326

Client: J. Riel

Location: Warsaw, Ontario	Pumping Test: TW-8 Manual Data	Pumping Well: TW-8
Test Conducted by: SR		Test Date: 9/17/19
Analysis Performed by: DM/BK	TW-8, Cooper-Jacob (pumped well)	Analysis Date: 2/05/20
Aquifer Thickness: 1.00 m	Discharge: variable, average rate 0.4921 [l/s]	



Calculation using COOPER & JACOB

Observation Well	Transmissivity [m²/d]	Hydraulic Conductivity [m/d]	Storage coefficient	Radial Distance to PW [m]	
TW-8	5.85×10^{2}	5.85×10^{2}		0.07	

Oakridge Environmental Ltd.
647 Neal Drive, Suite #3
Peterborough, Ontario
K9J 6X7

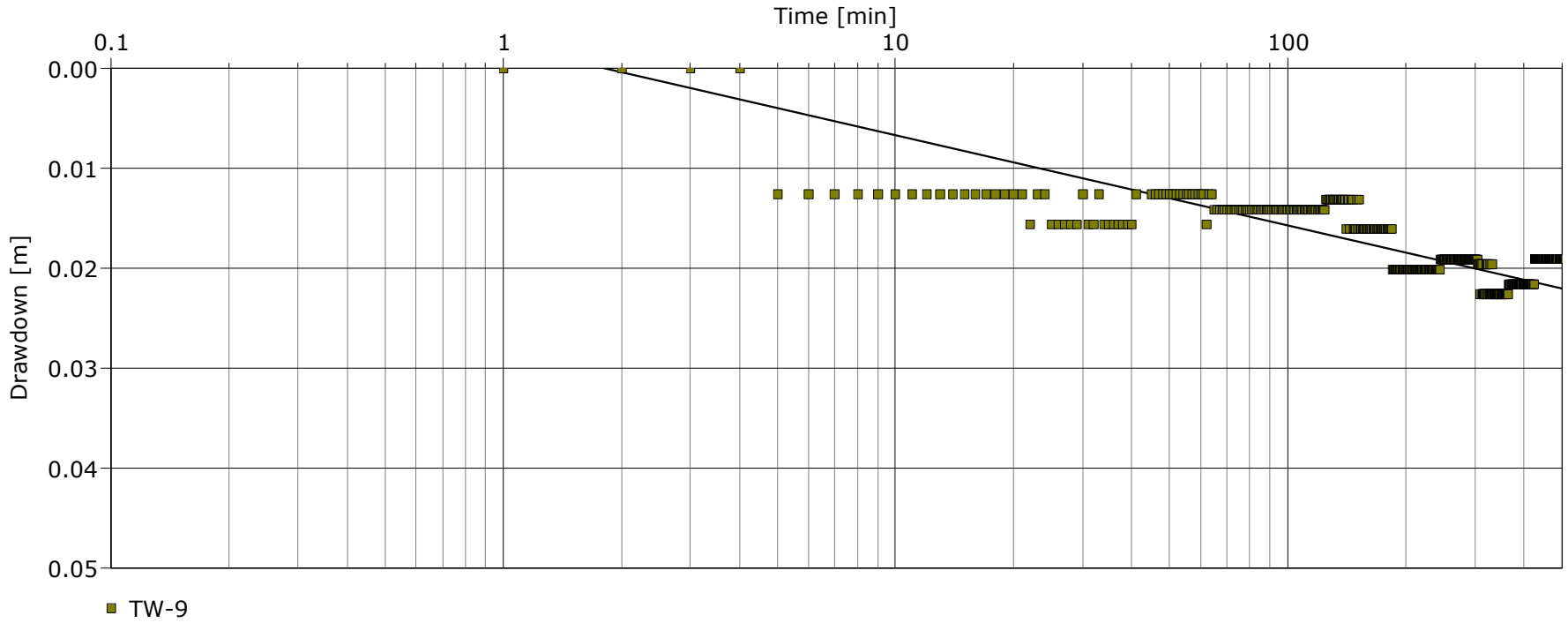
Pumping Test Analysis Report

Project: Proposed Warsaw Residential Subdivision

Number: 17-2326

Client: J. Riel

Location: Warsaw, Ontario	Pumping Test: TW-8 Manual Data	Pumping Well: TW-8
Test Conducted by: SR		Test Date: 9/17/19
Analysis Performed by: DM/BK	TW-8, Cooper-Jacob (obs. TW-9)	Analysis Date: 2/05/20
Aquifer Thickness: 1.00 m	Discharge: variable, average rate 0.4921 [l/s]	

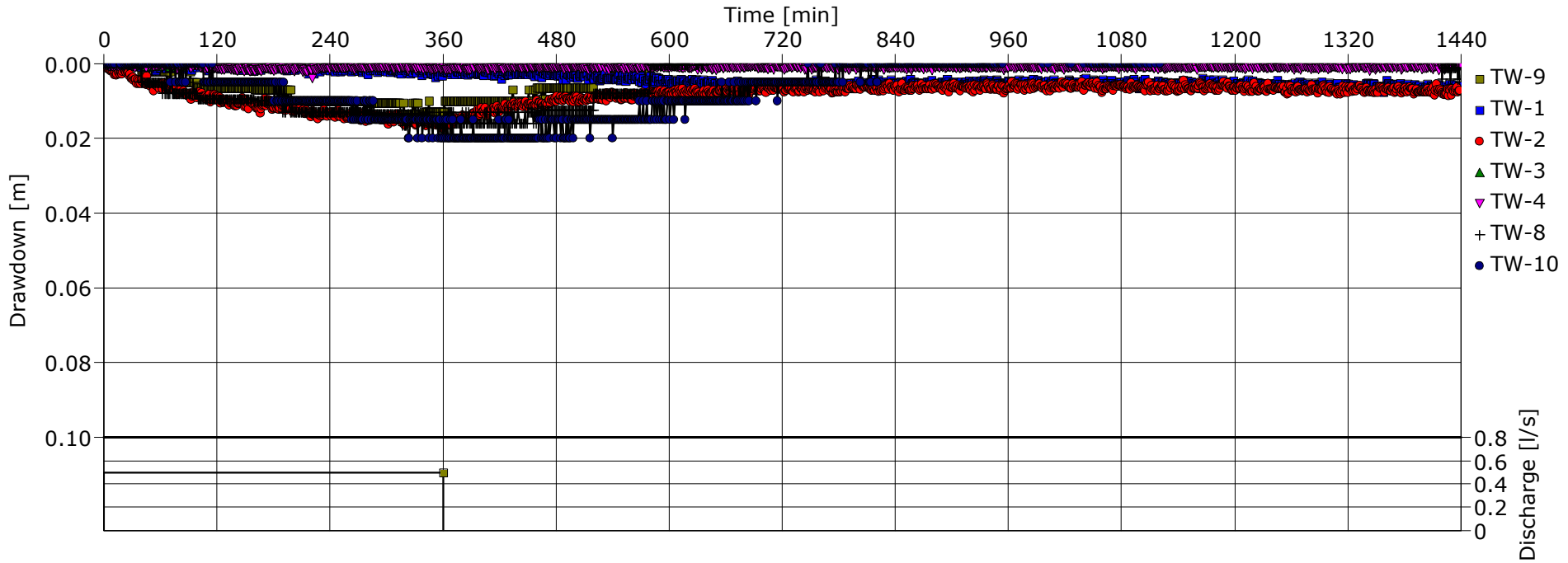


Calculation using COOPER & JACOB

Observation Well	Transmissivity [m²/d]	Hydraulic Conductivity [m/d]	Storage coefficient	Radial Distance to PW [m]	
TW-9	8.62×10^{2}	8.62×10^{2}	1.54×10^{-4}	125.51	

Oakridge Environmental Ltd. **647 Neal Drive, Suite #3** **Peterborough, Ontario** **K9J 6X7**	**Pumping Test Analysis Report** Project: Proposed Warsaw Residential Subdivision Number: 17-2326 Client: J. Riel

Location: Warsaw, Ontario	Pumping Test: TW-9 Logger Data	Pumping Well: TW-9
Test Conducted by: SR		Test Date: 9/16/19
Analysis Performed by: DM/BK	TW-9, Time-Drawdown (all wells)	Analysis Date: 1/29/20
Aquifer Thickness:	Discharge: variable, average rate 0.4946 [l/s]	



Oakridge Environmental Ltd.
647 Neal Drive, Suite #3
Peterborough, Ontario
K9J 6X7

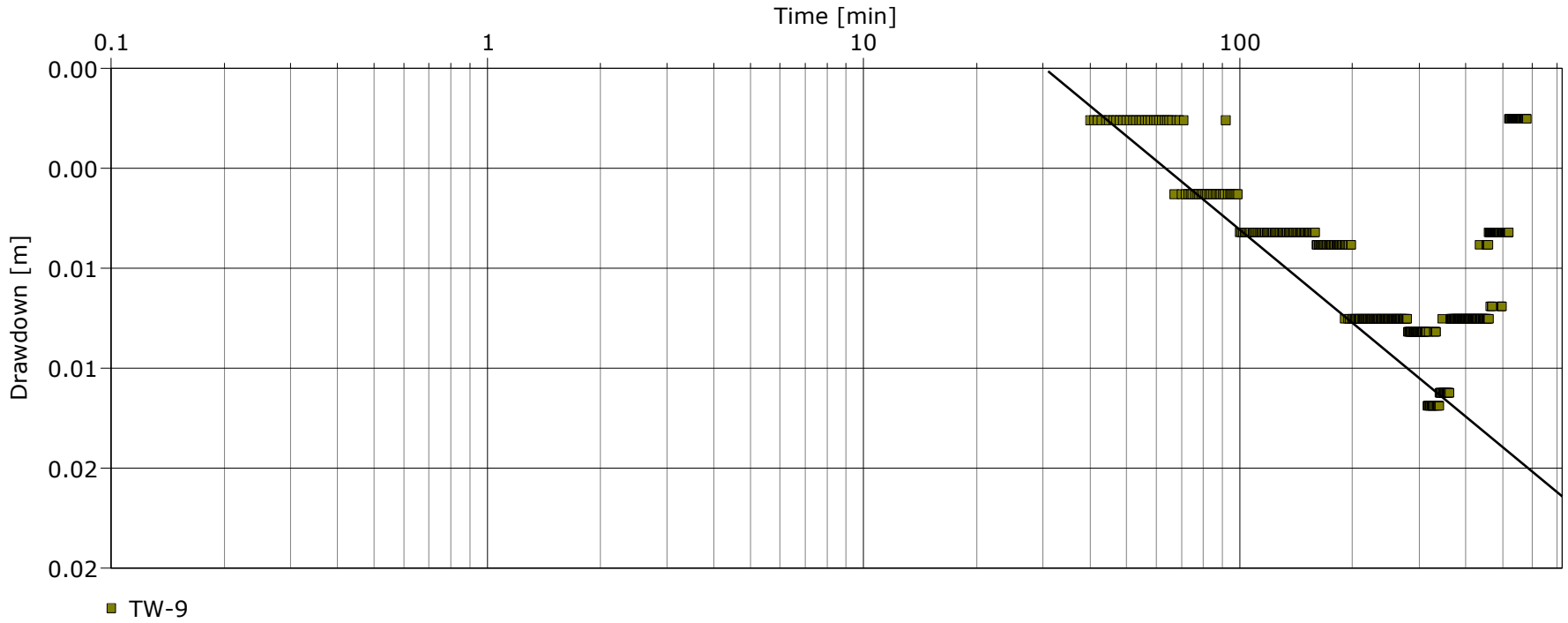
Pumping Test Analysis Report

Project: Proposed Warsaw Residential Subdivision

Number: 17-2326

Client: J. Riel

Location: Warsaw, Ontario	Pumping Test: TW-9 Logger Data	Pumping Well: TW-9
Test Conducted by: SR		Test Date: 9/16/19
Analysis Performed by: DM/BK	TW-9, Cooper-Jacob (pumped well)	Analysis Date: 2/05/20
Aquifer Thickness:	Discharge: variable, average rate 0.4946 [l/s]	

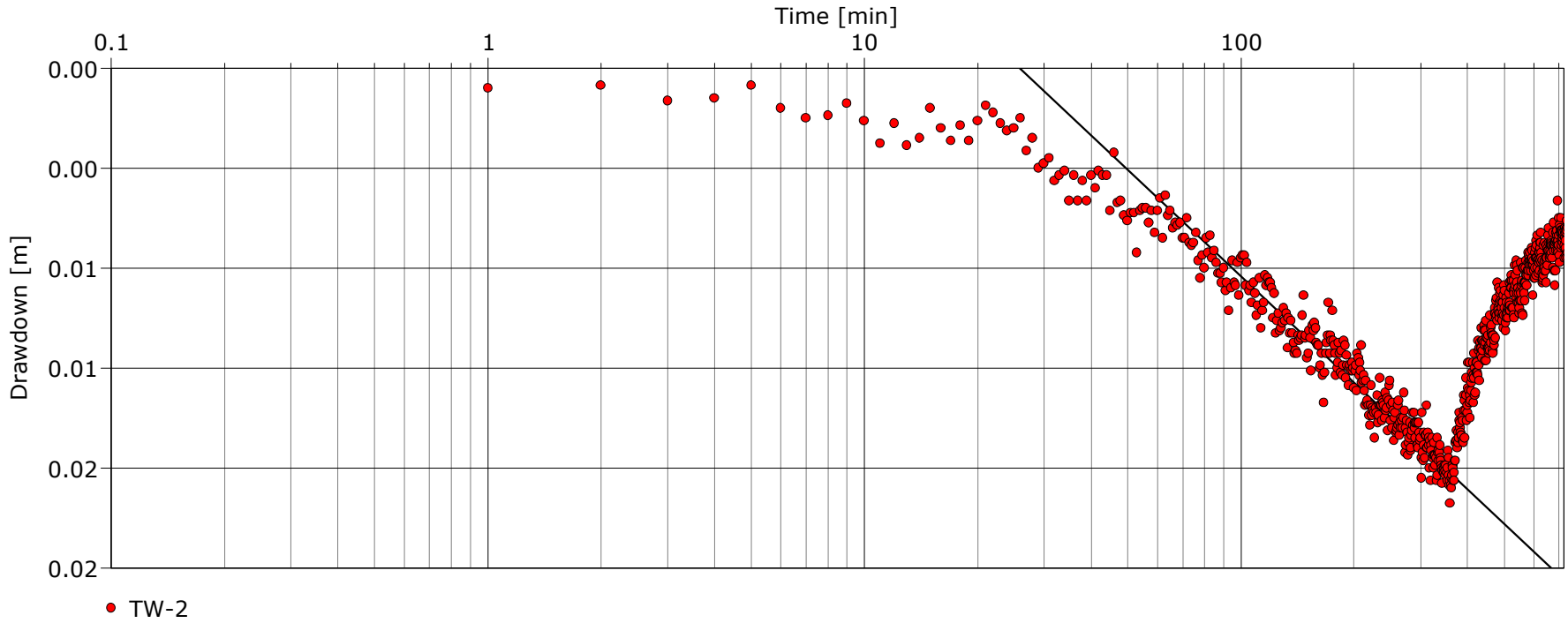


Calculation using COOPER & JACOB

Observation Well	Transmissivity [m²/d]	Storage coefficient	Radial Distance to PW [m]	
TW-9	5.81×10^{2}		0.07	

Oakridge Environmental Ltd. 647 Neal Drive, Suite #3 Peterborough, Ontario K9J 6X7	**Pumping Test Analysis Report**
	Project: Proposed Warsaw Residential Subdivision
	Number: 17-2326
	Client: J. Riel

Location: Warsaw, Ontario	Pumping Test: TW-9 Logger Data	Pumping Well: TW-9
Test Conducted by: SR		Test Date: 9/16/19
Analysis Performed by:	TW-9, Cooper-Jacob (obs.	Analysis Date: 2/05/20
Aquifer Thickness:	Discharge: variable, average rate 0.4946 [l/s]	



Calculation using COOPER & JACOB

Observation Well	Transmissivity [m²/d]	Storage coefficient	Radial Distance to PW [m]
TW-2	5.52×10^{2}	2.91×10^{-3}	87.52

Oakridge Environmental Ltd.
647 Neal Drive, Suite #3
Peterborough, Ontario
K9J 6X7

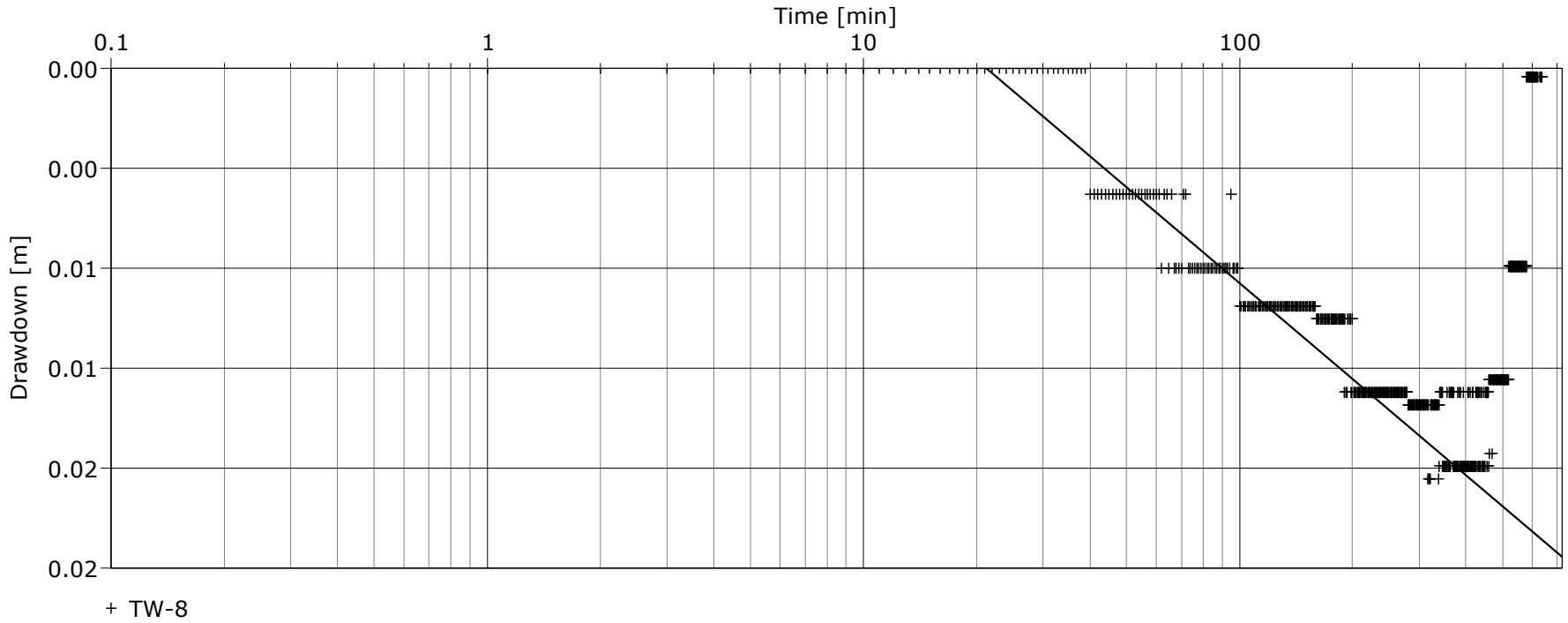
Pumping Test Analysis Report

Project: Proposed Warsaw Residential Subdivision

Number: 17-2326

Client: J. Riel

Location: Warsaw, Ontario	Pumping Test: TW-9 Logger Data	Pumping Well: TW-9
Test Conducted by: SR		Test Date: 9/16/19
Analysis Performed by: DM/BK	TW-9, Cooper-Jacob (obs. TW-8)	Analysis Date: 2/05/20
Aquifer Thickness:	Discharge: variable, average rate 0.4946 [l/s]	

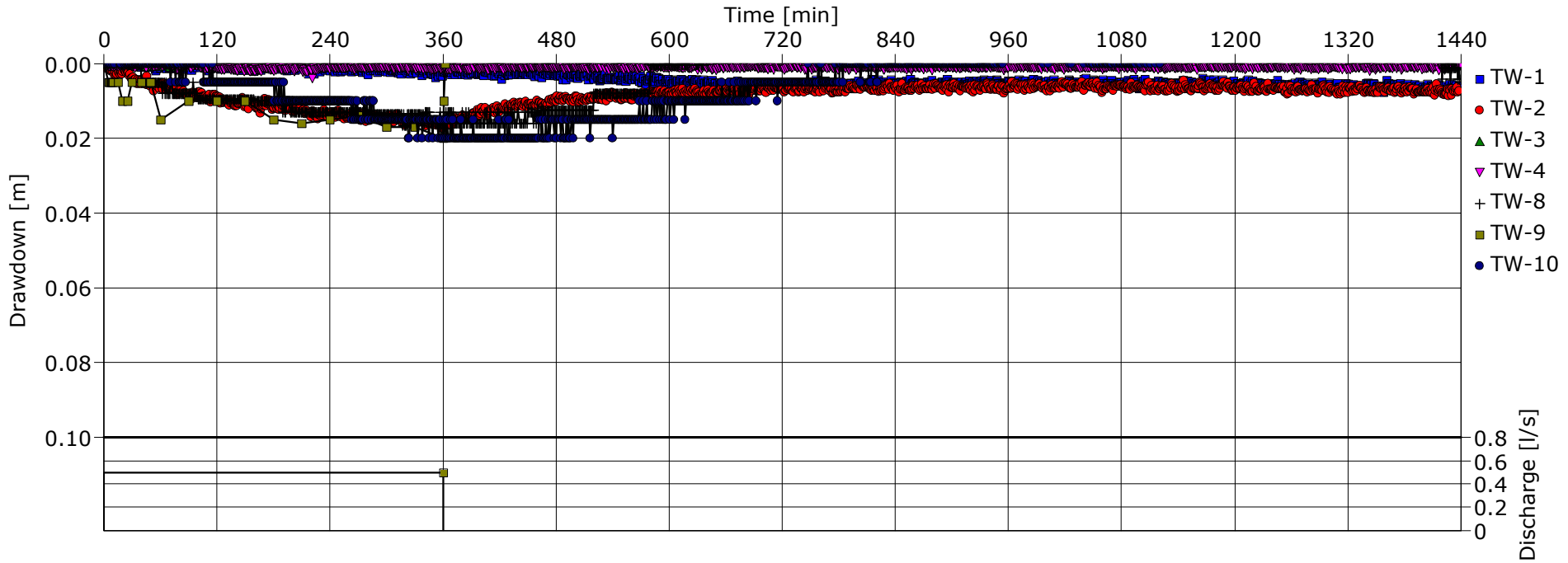


Calculation using COOPER & JACOB

Observation Well	Transmissivity [m²/d]	Storage coefficient	Radial Distance to PW [m]	
TW-8	6.12×10^{2}	1.29×10^{-3}	125.51	

Oakridge Environmental Ltd. **647 Neal Drive, Suite #3** **Peterborough, Ontario** **K9J 6X7**	**Pumping Test Analysis Report** Project: Proposed Warsaw Residential Subdivision Number: 17-2326 Client: J. Riel

Location: Warsaw, Ontario	Pumping Test: TW-9 Manual Data	Pumping Well: TW-9
Test Conducted by: SR		Test Date: 9/16/19
Analysis Performed by: DM/BK	TW-9, Time-Drawdown (all wells)	Analysis Date: 1/29/20
Aquifer Thickness: 1.00 m	Discharge: variable, average rate 0.4946 [l/s]	



Oakridge Environmental Ltd.
647 Neal Drive, Suite #3
Peterborough, Ontario
K9J 6X7

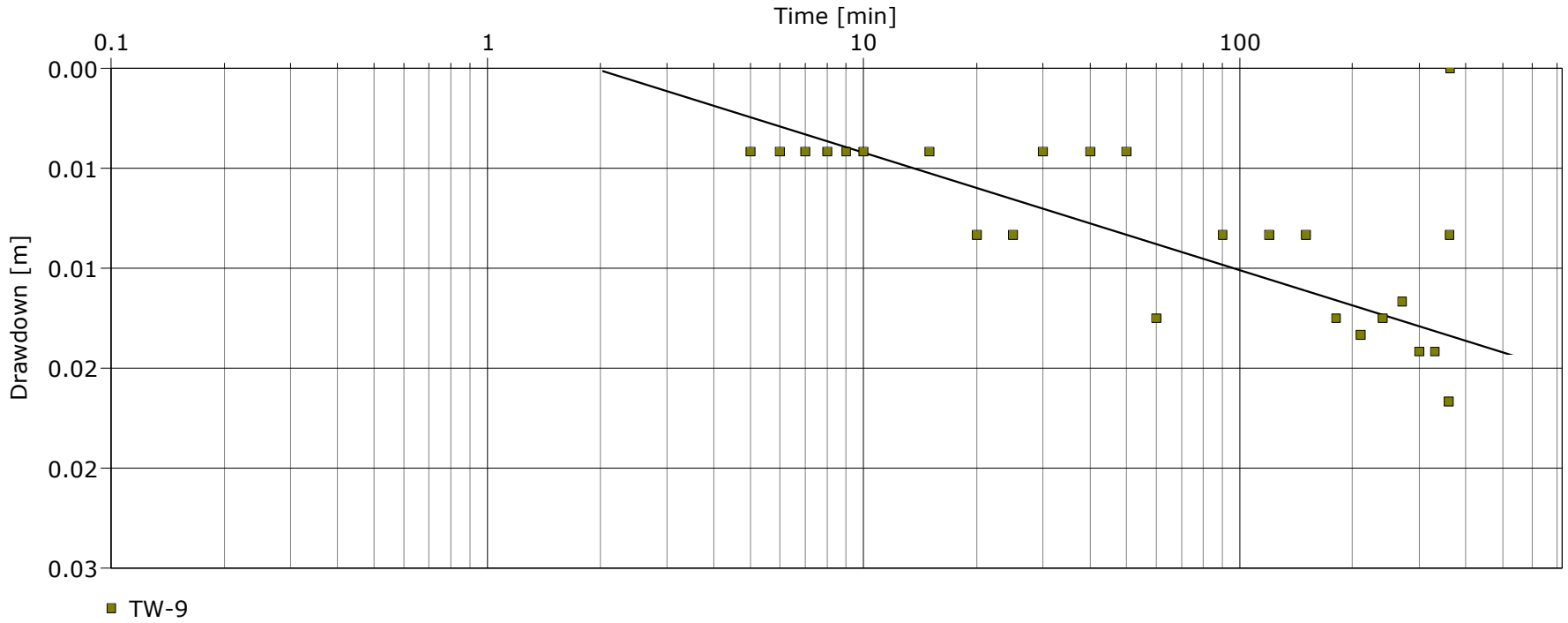
Pumping Test Analysis Report

Project: Proposed Warsaw Residential Subdivision

Number: 17-2326

Client: J. Riel

Location: Warsaw, Ontario	Pumping Test: TW-9 Manual Data	Pumping Well: TW-9
Test Conducted by: SR		Test Date: 9/16/19
Analysis Performed by: DM/BK	TW-9, Cooper-Jacob (pumped well)	Analysis Date: 1/29/20
Aquifer Thickness: 1.00 m	Discharge: variable, average rate 0.4946 [l/s]	



Calculation using COOPER & JACOB

Observation Well	Transmissivity [m²/d]	Hydraulic Conductivity [m/d]	Storage coefficient	Radial Distance to PW [m]	
TW-9	1.11×10^{3}	1.11×10^{3}		0.07	

Oakridge Environmental Ltd.
647 Neal Drive, Suite #3
Peterborough, Ontario
K9J 6X7

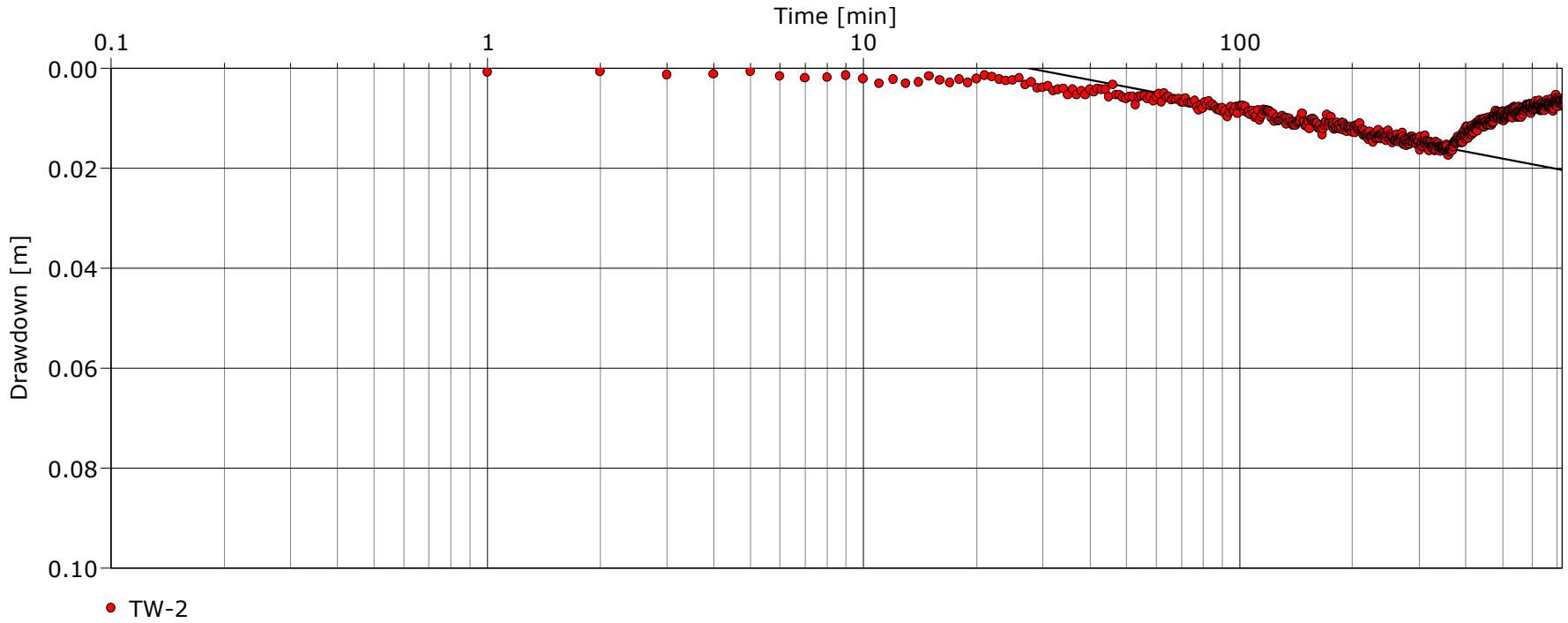
Pumping Test Analysis Report

Project: Proposed Warsaw Residential Subdivision

Number: 17-2326

Client: J. Riel

Location: Warsaw, Ontario	Pumping Test: TW-9 Manual Data	Pumping Well: TW-9
Test Conducted by: SR		Test Date: 9/16/19
Analysis Performed by: DM/BK	TW-9, Cooper-Jacob (obs. TW-2)	Analysis Date: 2/05/20
Aquifer Thickness: 1.00 m	Discharge: variable, average rate 0.4946 [l/s]	



Calculation using COOPER & JACOB

Observation Well	Transmissivity [m²/d]	Hydraulic Conductivity [m/d]	Storage coefficient	Radial Distance to PW [m]	
TW-2	5.46×10^{2}	5.46×10^{2}	3.04×10^{-3}	87.52	

Oakridge Environmental Ltd.
647 Neal Drive, Suite #3
Peterborough, Ontario
K9J 6X7

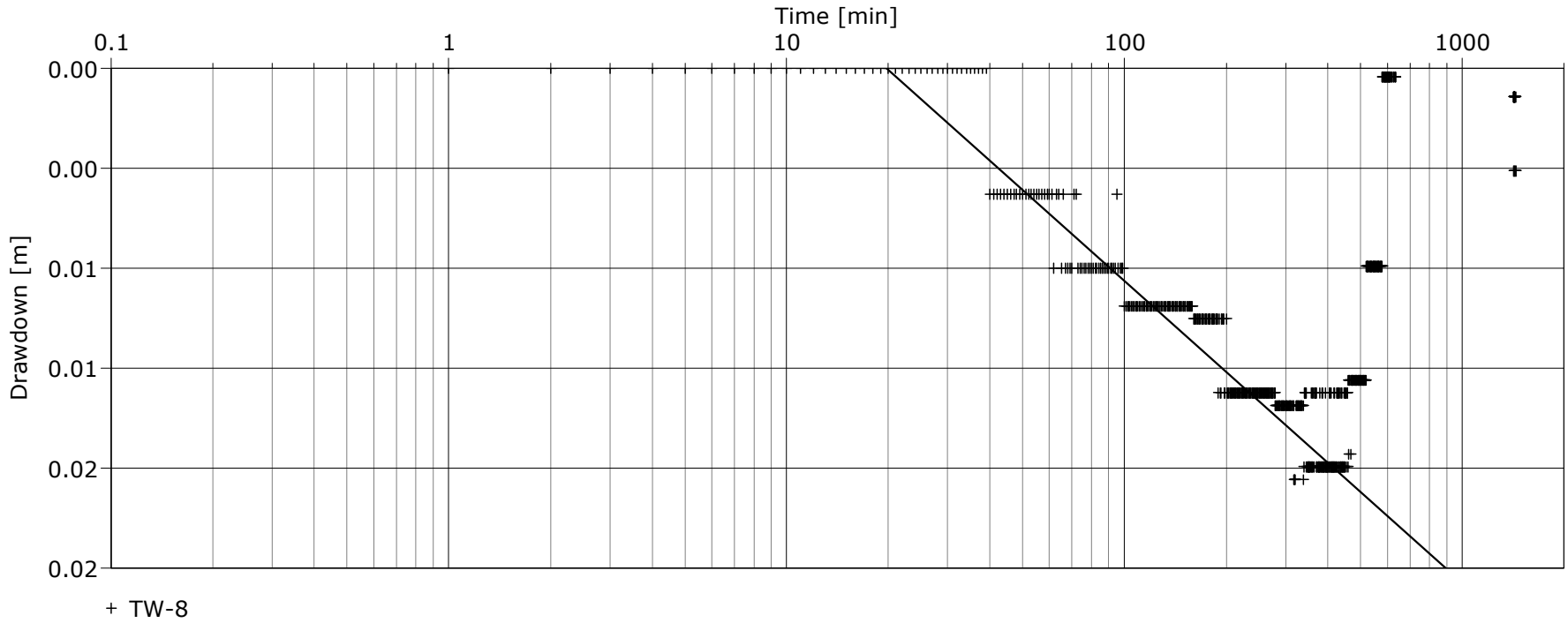
Pumping Test Analysis Report

Project: Proposed Warsaw Residential Subdivision

Number: 17-2326

Client: J. Riel

Location: Warsaw, Ontario	Pumping Test: TW-9 Manual Data	Pumping Well: TW-9
Test Conducted by: SR		Test Date: 9/16/19
Analysis Performed by: DM/BK	TW-9, Cooper-Jacob (obs. TW-8)	Analysis Date: 2/05/20
Aquifer Thickness: 1.00 m	Discharge: variable, average rate 0.4946 [l/s]	

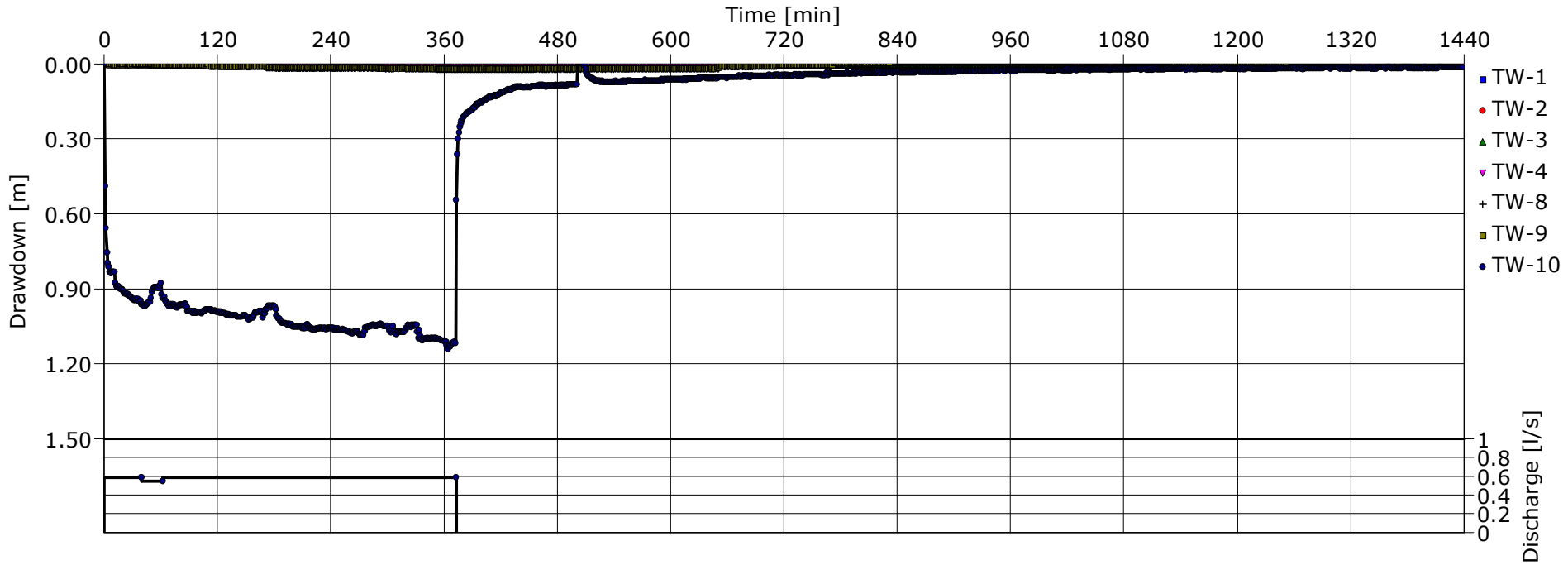


Calculation using COOPER & JACOB

Observation Well	Transmissivity [m²/d]	Hydraulic Conductivity [m/d]	Storage coefficient	Radial Distance to PW [m]	
TW-8	6.48×10^{2}	6.48×10^{2}	1.26×10^{-3}	125.51	

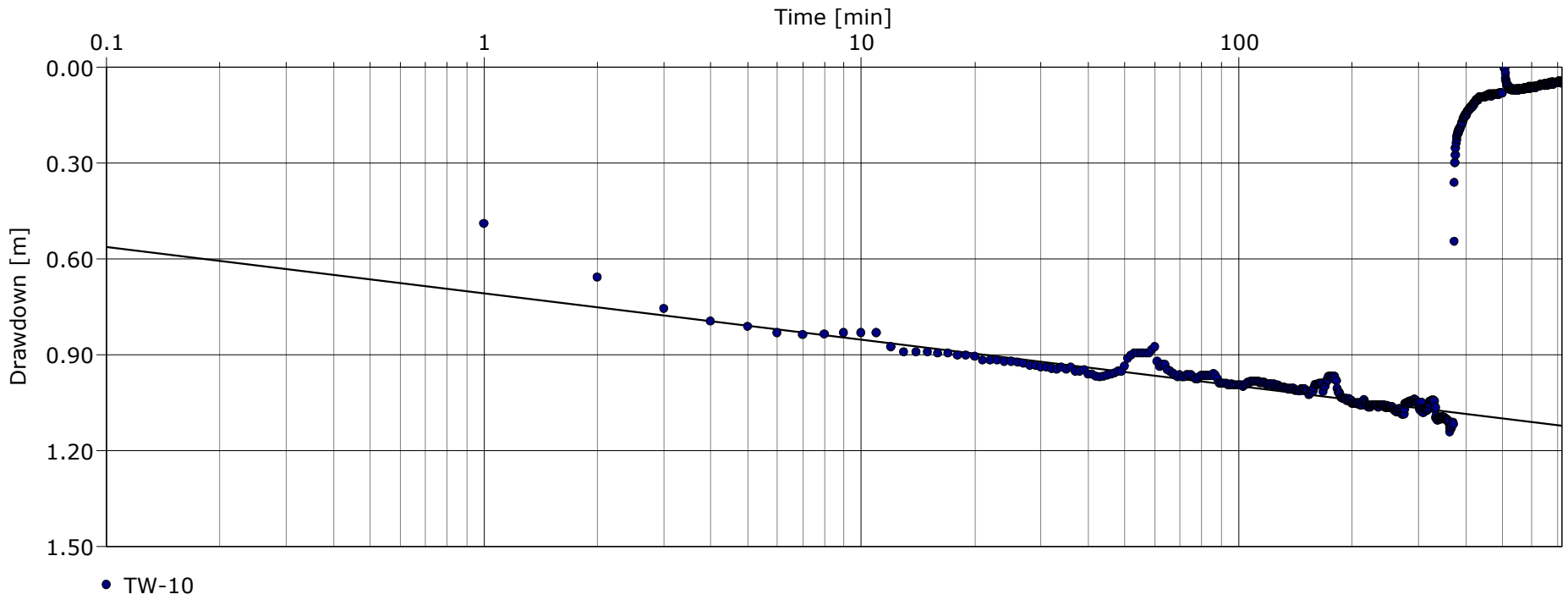
Oakridge Environmental Ltd. **647 Neal Drive, Suite #3** **Peterborough, Ontario** **K9J 6X7**	**Pumping Test Analysis Report** Project: Proposed Warsaw Residential Subdivision Number: 17-2326 Client: J. Riel

Location: Warsaw, Ontario	Pumping Test: TW-10	Pumping Well: TW-10
Test Conducted by: DM		Test Date: 9/12/19
Analysis Performed by: DM/BK	TW-10, Time-Drawdown (all wells)	Analysis Date: 1/29/20
Aquifer Thickness:	Discharge: variable, average rate 0.58447 [l/s]	



Oakridge Environmental Ltd. 647 Neal Drive, Suite #3 Peterborough, Ontario K9J 6X7	**Pumping Test Analysis Report**
	Project: Proposed Warsaw Residential Subdivision
	Number: 17-2326
	Client: J. Riel

Location: Warsaw, Ontario	Pumping Test: TW-10	Pumping Well: TW-10
Test Conducted by: DM		Test Date: 9/12/19
Analysis Performed by: DM/BK	TW-10, Cooper-Jacob (pumped well)	Analysis Date: 1/29/20
Aquifer Thickness:	Discharge: variable, average rate 0.58447 [l/s]	

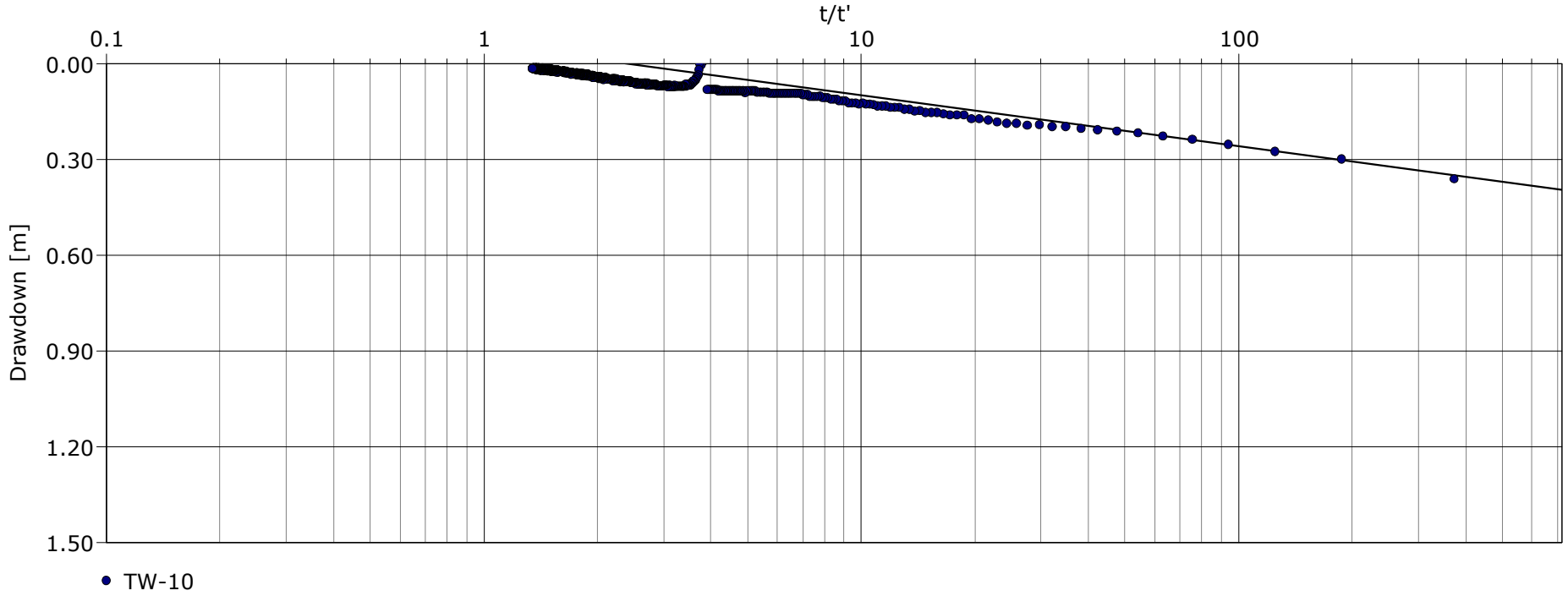


Calculation using COOPER & JACOB

Observation Well	Transmissivity [m²/d]	Storage coefficient	Radial Distance to PW [m]	
TW-10	6.38×10^{1}		0.08	

Oakridge Environmental Ltd. 647 Neal Drive, Suite #3 Peterborough, Ontario K9J 6X7	**Pumping Test Analysis Report**
	Project: Proposed Warsaw Residential Subdivision
	Number: 17-2326
	Client: J. Riel

Location: Warsaw, Ontario	Pumping Test: TW-10	Pumping Well: TW-10
Test Conducted by: DM		Test Date: 9/12/19
Analysis Performed by: DM/BK	TW-10, Theis Recovery (pumped well)	Analysis Date: 1/29/20
Aquifer Thickness:	Discharge: variable, average rate 0.58447 [l/s]	

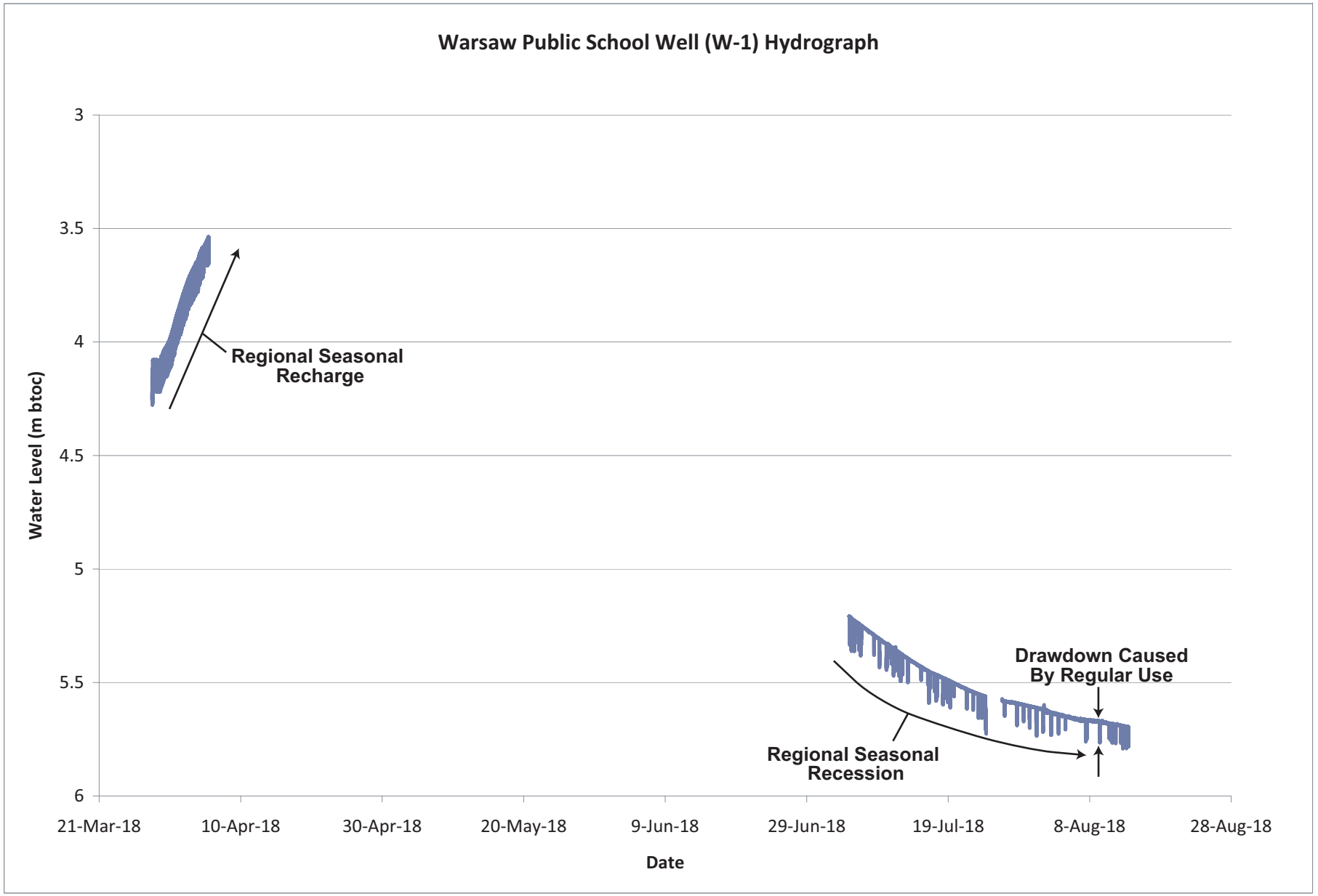


Calculation using THEIS & JACOB

Observation Well	Transmissivity [m²/d]	Radial Distance to PW [m]
TW-10	5.80×10^{1}	0.08

APPENDIX H

W-1 Hydrograph


Warsaw Public School Well (W-1) Hydrograph
Water Level (m btoc)
3
3.5
4
4.5
5
5.5
6
Regional Seasonal Recharge
Drawdown Caused By Regular Use
Regional Seasonal Recession
21-Mar-18
10-Apr-18
30-Apr-18
20-May-18
9-Jun-18
29-Jun-18
19-Jul-18
8-Aug-18
28-Aug-18
Date

APPENDIX I

Water Quality Summary and
Laboratory Certificates

Proposed Warsaw Residential Subdivision
Water Quality Summary

Parameter	Units [a]	TW-1	TW-1 (3hrs)	TW-1 (6hrs)	TW-1	TW-1 (3hrs)	TW-1 (6hrs)	TW-1	TW-2 (1 hr)	TW-2 (6 hrs)	TW-2	TW-2 (3 hrs)	TW-2 (6 hrs)	TW-2	ODWQS [b]
		1990-05-17	2018-07-10	2018-07-10	2019-06-06	2019-09-13	2019-09-13	2019-10-30	1990-05-16	1990-05-16	2019-06-06	2019-09-18	2019-09-18	2019-10-22	
Hardness ($CaCO_3$)		251	284	285	265	339	334		224	228	283	331	327		80–100 [OG]
Alkalinity ($CaCO_3$) to pH 4.5		227	235	236	233	260	269		206	207	236	256	258		30–500 [OG]
Bicarbonate (as $CaCO_3$)		226	235	236	233	260	269		203	206	236	256	258		-
Carbonate (as $CaCO_3$)		< 1.0	< 5	< 5	< 5	< 5	< 5		2.95	< 1.0	< 5	< 5	< 5		-
Conductivity @ 25°C	µmho/cm	539	691	721	567	953	966		466	469	847	978	990		-
Conductivity (Field)	µS		690	696		997	994					1044	1045		-
pH @ 25°C	pH Units	7.7	8.04	8.08	7.99	7.74	7.76		8.2	7.7	7.84	7.91	7.9		6.5–8.5 [OG]
pH (Field)	pH Units		7.01	7.01		6.9	7.11					7.22	7.28		6.5–8.5 [OG]
Colour	TCU	3	< 2	3	3	< 2	< 2		5	4	6	< 2	3		5 [AO]
Turbidity	NTU	0.7	0.2	0.2	2.1	0.2	0.2		0.9	< 0.3	43.9	0.3	0.2		5 [AO]
Turbidity (Field)	NTU		0.22	0.23		< 0.2	< 0.2					0.54	0.35		5 [AO]
Chloride		20.6	66.9	67.3	36.7	149	155		12.2	12.4	115	167	170		250 [AO]
Fluoride			< 0.1	< 0.1	< 0.1	< 0.1	< 0.1				< 0.1	< 0.1	< 0.1		1.5
Nitrite (N)			< 0.1	< 0.1	< 0.1	< 0.1	< 0.1				< 0.1	< 0.1	< 0.1		1 [c]
Nitrate (N)			0.5	0.5	0.2	1.2	1.2				< 0.1	1.2	1.2		10 [c]
Nitrate + Nitrite (N)		0.89							0.24	0.25					10 [c]
Sulphate		12	6	6	4	13	13		12.2	12.1	7	14	14		500 [AO d)]
Calcium		94.4	107	107	100	128	126		86.2	87.7	106	127	123		-
Magnesium		3.7	4.12	4.15	3.75	4.62	4.53		2.2	2.2	4.36	4.9	4.93		-
Sodium		8.1	37	37.8	27.6	69	69.2		4.8	4.7	67.4	78.1	80.7		200 [AO] / 20 [e)]
Potassium		1.6	1.3	1.3	1.8	1.4	1.3		1	1	2.3	1.9	1.9		-
Iron			< 0.005	< 0.005	0.166	< 0.005	< 0.005				2.52	< 0.005	< 0.005		0.3 [AO]
Iron (Total)		0.03		< 0.005	0.332	0.013	0.019		0.02	< 0.02	3.36	0.08	0.025		0.3 [AO]
Copper			< 0.002	< 0.002	0.002	< 0.002	< 0.002				< 0.002	< 0.002	< 0.002		1 [AO]
Copper (Total)		< 0.01		< 0.002	< 0.002	< 0.002	< 0.002		< 0.01	< 0.01	< 0.002	< 0.002	< 0.002		1 [AO]
Manganese			< 0.001	< 0.001	0.013	< 0.001	< 0.001				0.292	< 0.001	< 0.001		0.05 [AO]
Manganese (Total)		< 0.01		< 0.001	0.013	< 0.001	< 0.001		< 0.01	< 0.01	0.278	< 0.001	< 0.001		0.05 [AO]
Zinc			< 0.005	< 0.005	< 0.005	< 0.005	< 0.005				< 0.005	0.005	0.008		5 [AO]
Zinc (Total)		< 0.01		< 0.005	< 0.005	0.005	< 0.005		< 0.01	< 0.01	< 0.005	0.007	0.013		5 [AO]
Ammonia (N)-Total		< 0.05	< 0.01	0.01	< 0.01	< 0.01	< 0.01		< 0.05	< 0.05	2.38	0.02	0.02		-
o-Phosphate (P)		< 0.01	< 0.01	< 0.01	0.012	0.009	0.011		< 0.01	< 0.01	0.005	0.017	0.011		-
Dissolved Organic Carbon			1.5	1.5	3.5	2	2				3.7	1.6	1.8		5 [AO]
Total Organic Carbon		1.5							2.7	1.9					5 [AO]
Sulphide				< 0.01			< 0.01						< 0.01		0.05 [AO]
Total Coliforms	cfu/100 mL	4	6	6	36	5	9	0		0	1	3	6	0	0
E. coli	cfu/100 mL		0	0	4	1	1	0			0	0	1	0	0
Heterotrophic Plate Count	cfu/mL		10	10	320	16	32	10			280	10	10	< 10	[f) OG]
Fecal Coliforms	cfu/100 mL	0								0					0
TDS (ion sum calc.)		285	366	368	294	526	537		247	249	447	521	528		500 [AO]
TDS (field)	ppm		345	347		496	498					524	521		500 [AO]

Notes:
Blue-highlighted values indicate that levels exceed the ODWQS.
a) All units are in mg/L unless specified otherwise.
b) ODWQS - Ontario Drinking-water Quality Standards, Objectives and Guidelines; OG - Operational Guideline; AO - Aesthetic Objective
c) When both nitrate and nitrite are present, the sum of both should not exceed 10 mg/L.
d) When sulphate levels exceed 500 mg/L, water may have a laxative effect on some people.
e) Yellow-highlighted values indicate that sodium levels exceed the 20 mg/L warning level for sodium restricted diets.
f) Increases in HPC concentrations above baseline levels are considered undesirable.
g) Acid-stabilized sample analyzed

Proposed Warsaw Residential Subdivision
Water Quality Summary

Parameter	Units [a]	TW-3 (1 hr) 1990-05-15	TW-3 (6.5 hrs) 1990-05-15	TW-3 (3hrs) 2018-03-28	TW-3 (6 hrs) 2018-03-28	TW-8 (3 hrs) 2019-09-17	TW-8 (6 hrs) 2019-09-17	TW-8 2019-10-22	TW-9 (3 hrs) 2019-09-16	TW-9 (6 hrs) 2019-09-16	TW-10 (3 hrs) 2019-09-12	TW-10 (6 hrs) 2019-09-12	Indian River 1990-01-10	W-1 1990-01-09	ODWQS [b]
Hardness ($CaCO_3$)		225	227	200	201	328	328		260	270	269	277	123	247	80–100 OG
Alkalinity ($CaCO_3$) to pH 4.5		202	205	224	201	253	256		228	230	223	224	103	211	30–500 OG
Bicarbonate (as $CaCO_3$)		202	204	224	201	253	256		228	230	223	224	102	210	-
Carbonate (as $CaCO_3$)		< 1.0	< 1.0	< 5	< 5	< 5	< 5		< 5	< 5	< 5	< 5	< 1.0	< 1.0	-
Conductivity @ 25°C	µmho/cm	443	442	448	446	895	892		529	548	505	508	270	564	-
Conductivity (Field)	µS			473	472	965	946		581	587	498	491			-
pH @ 25°C	pH Units	7.6	7.5	8.11	8.1	7.97	7.96		7.8	7.81	7.83	7.81	7.9	7.7	6.5–8.5 OG
pH (Field)	pH Units			6.9	7.4	7.26	7.64		7.35	7.56	7.04	7.1			6.5–8.5 OG
Colour	TCU	4	3	< 2	< 2	< 2	< 2		< 2	< 2	< 2	< 2	8.3	4.8	5 AO
Turbidity	NTU	2.7	< 0.3	0.3	0.2	0.6	0.3		0.3	0.2	17.4	23.9	2.4	< 0.3	5 AO
Turbidity (Field)	NTU			0.51	0.33	0.24	0.29		0.23	0.8	4.89	1.51 [g]			5 AO
Chloride		2.9	2.8	14.7	14.8	142	140		31.5	36.9	22.2	23	7.9	26.8	250 AO
Fluoride				< 0.1	< 0.1	< 0.1	< 0.1		< 0.1	< 0.1	< 0.1	< 0.1			1.5
Nitrite (N)				< 0.1	< 0.1	< 0.1	< 0.1		< 0.1	< 0.1	< 0.1	< 0.1			1 [c]
Nitrate (N)				0.3	0.3	1	1		0.3	0.4	0.4	0.4			10 [c]
Nitrate + Nitrite (N)		0.3	0.32										0.14	1.61	10 [c]
Sulphate		13.7	13.9	5	6	14	14		10	10	7	8	15.6	18.5	500 AO [d]
Calcium		87.2	88.1	77.6	77.7	123	123		100	104	104	107	43	93.9	-
Magnesium		1.7	1.7	1.55	1.53	4.96	4.93		2.32	2.48	2.1	2.19	3.8	3.2	-
Sodium		1.3	1.2	8.4	8.4	66.5	66.5		15.7	18.2	11.1	11.3	4.5	13.2	200 AO / 20 [e]
Potassium		0.4	0.4	0.6	0.6	2.2	2.1		0.9	1	0.7	0.7	1	1.4	-
Iron				< 0.005	< 0.005	0.036	0.015		0.009	< 0.005	0.096	0.16			0.3 AO
Iron (Total)		0.18	< 0.02		< 0.005	0.07	0.037		0.062	0.022	0.34	0.572	0.17	< 0.02	0.3 AO
Copper				< 0.002	< 0.002	< 0.002	< 0.002		0.002	< 0.002	0.006	0.006			1 AO
Copper (Total)		< 0.01	< 0.01		< 0.002	< 0.002	< 0.002		0.002	0.002	0.011	0.01	< 0.01	0.01	1 AO
Manganese				< 0.001	< 0.001	0.005	0.004		0.001	0.001	0.015	0.027			0.05 AO
Manganese (Total)		< 0.01	< 0.01		< 0.001	0.006	0.004		0.002	0.001	0.019	0.028	0.04	< 0.01	0.05 AO
Zinc				< 0.005	< 0.005	< 0.005	< 0.005		0.005	< 0.005	0.013	0.007			5 AO
Zinc (Total)		< 0.01	< 0.01		< 0.005	0.005	0.043		0.119	0.006	0.023	0.013	0.02	0.02	5 AO
Ammonia (N)-Total		< 0.05	< 0.05	< 0.01	< 0.01	0.01	0.01		0.01	< 0.01	< 0.01	< 0.01	< 0.05	< 0.05	-
o-Phosphate (P)		< 0.01	< 0.01	< 0.01	< 0.01	0.003	< 0.002		0.011	0.006	0.004	0.006	< 0.01	< 0.01	-
Dissolved Organic Carbon				4.1	4.1	2	2.2		3	2.9	3.2	3.2			5 AO
Total Organic Carbon		2.2	2										6.6	2.7	5 AO
Sulphide					< 0.01		< 0.01			< 0.01		0.01			0.05 AO
Total Coliforms	cfu/100 mL		2	2	0	19	4	0	0	0	0	0	32		0
E. coli	cfu/100 mL			0	0	0	0	0	0	0	0	0			0
Heterotrophic Plate Count	cfu/mL			< 2	< 2	< 10	10	< 10	< 10	20	190	70			[f] OG
Fecal Coliforms	cfu/100 mL		0										21		0
TDS (ion sum calc.)		234		244	238	474	472		274	284	283	288	140	295	500 AO
TDS (field)	ppm			236	236	483	473		290	295	249	246			500 AO

Notes:
Blue-highlighted values indicate that levels exceed the ODWQS.
a) All units are in mg/L unless specified otherwise.
b) ODWQS - Ontario Drinking-water Quality Standards, Objectives and Guidelines; OG - Operational Guideline; AO - Aesthetic Objective
c) When both nitrate and nitrite are present, the sum of both should not exceed 10 mg/L.
d) When sulphate levels exceed 500 mg/L, water may have a laxative effect on some people.
e) Yellow-highlighted values indicate that sodium levels exceed the 20 mg/L warning level for sodium restricted diets.
f) Increases in HPC concentrations above baseline levels are considered undesirable.
g) Acid-stabilized sample analyzed

CADUCEON ENVIRONMENTAL LABORATORIES
Client committed. Quality assured.

CERTIFICATE OF ANALYSIS

Final Report

C.O.C.: G74791 **REPORT No. B18-07935**

Report To:

Oakridge Environmental
PO Box 431 ,
Peterborough ON K9J 6Z3 Canada
Attention: Dan MacIntyre

Caduceon Environmental Laboratories
2378 Holly Lane
Ottawa Ontario K1V 7P1
Tel: 613-526-0123
Fax: 613-526-1244

DATE RECEIVED: 29-Mar-18
DATE REPORTED: 03-Apr-18
SAMPLE MATRIX: Groundwater

JOB/PROJECT NO.: Warsaw
P.O. NUMBER: 17-2326
WATERWORKS NO.

			Client I.D.		TW-3 (3 hrs)	TW-3 (6 hrs)		
			Sample I.D.		B18-07935-1	B18-07935-2		
			Date Collected		28-Mar-18	28-Mar-18		
Parameter	**Units**	**R.L.**	**Reference Method**	**Date/Site Analyzed**				
Hardness (as CaCO3)	mg/L	1	SM 3120	02-Apr-18/O	200	201		
Alkalinity(CaCO3) to pH4.5	mg/L	5	SM 2320B	02-Apr-18/O	224	201		
Bicarbonate(as CaCO3)	mg/L	5	SM 2320B	02-Apr-18/O	224	201		
Carbonate (as CaCO3)	mg/L	5	SM 2320B	02-Apr-18/O	< 5	< 5		
Conductivity @25°C	µmho/cm	1	SM 2510B	02-Apr-18/O	448	446		
pH @25°C	pH Units		SM 4500H	02-Apr-18/O	8.11	8.10		
Colour	TCU	2	SM 2120C	29-Mar-18/O	< 2	< 2		
Turbidity	NTU	0.1	SM 2130	02-Apr-18/O	0.3	0.2		
Fluoride	mg/L	0.1	SM4110C	29-Mar-18/O	< 0.1	< 0.1		
Chloride	mg/L	0.5	SM4110C	29-Mar-18/O	14.7	14.8		
Nitrite (N)	mg/L	0.1	SM4110C	29-Mar-18/O	< 0.1	< 0.1		
Nitrate (N)	mg/L	0.1	SM4110C	29-Mar-18/O	0.3	0.3		
Sulphate	mg/L	1	SM4110C	29-Mar-18/O	5	6		
Calcium	mg/L	0.02	SM 3120	02-Apr-18/O	77.6	77.7		
Calcium - Total	mg/L	0.02	SM 3120	02-Apr-18/O		85.7		
Magnesium	mg/L	0.02	SM 3120	02-Apr-18/O	1.55	1.53		
Magnesium - Total	mg/L	0.01	SM 3120	02-Apr-18/O		1.59		
Sodium	mg/L	0.2	SM 3120	02-Apr-18/O	8.4	8.4		
Sodium - Total	mg/L	0.2	SM 3120	02-Apr-18/O		8.4		
Potassium	mg/L	0.1	SM 3120	02-Apr-18/O	0.6	0.6		
Potassium - Total	mg/L	0.1	SM 3120	02-Apr-18/O		0.6		
Copper	mg/L	0.002	SM 3120	02-Apr-18/O	< 0.002	< 0.002		
Copper - Total	mg/L	0.002	SM 3120	02-Apr-18/O		< 0.002		
Iron	mg/L	0.005	SM 3120	02-Apr-18/O	< 0.005	< 0.005		
Iron - Total	mg/L	0.005	SM 3120	02-Apr-18/O		< 0.005		
Manganese	mg/L	0.001	SM 3120	02-Apr-18/O	< 0.001	< 0.001		
Manganese - Total	mg/L	0.001	SM 3120	02-Apr-18/O		< 0.001		

Greg Clarkin , BSc., C. Chem
Lab Manager - Ottawa District

R.L. = Reporting Limit
Test methods may be modified from specified reference method unless indicated by an *
Site Analyzed=K-Kingston,W-Windsor,O-Ottawa,R-Richmond Hill,B-Barrie

CADUCEON ENVIRONMENTAL LABORATORIES
Client committed. Quality assured.

CERTIFICATE OF ANALYSIS

Final Report

C.O.C.: G74791 **REPORT No. B18-07935**

Report To:

Oakridge Environmental
PO Box 431 ,
Peterborough ON K9J 6Z3 Canada
Attention: Dan MacIntyre

Caduceon Environmental Laboratories
2378 Holly Lane
Ottawa Ontario K1V 7P1
Tel: 613-526-0123
Fax: 613-526-1244

DATE RECEIVED: 29-Mar-18
DATE REPORTED: 03-Apr-18
SAMPLE MATRIX: Groundwater

JOB/PROJECT NO.: Warsaw
P.O. NUMBER: 17-2326
WATERWORKS NO.

			Client I.D.		TW-3 (3 hrs)	TW-3 (6 hrs)		
			Sample I.D.		B18-07935-1	B18-07935-2		
			Date Collected		28-Mar-18	28-Mar-18		
Parameter	**Units**	**R.L.**	**Reference Method**	**Date/Site Analyzed**				
Zinc	mg/L	0.005	SM 3120	02-Apr-18/O	< 0.005	< 0.005		
Zinc - Total	mg/L	0.005	SM 3120	02-Apr-18/O		< 0.005		
Ammonia (N)-Total	mg/L	0.01	MOEE 3364	03-Apr-18/O	< 0.01	< 0.01		
o-Phosphate (P)	mg/L	0.01	MOEE 3366	03-Apr-18/O	< 0.01	< 0.01		
Dissolved Organic Carbon	mg/L	0.2	EPA 415.1	29-Mar-18/O	4.1	4.1		
Sulphide	mg/L	0.01	SM4500-S2	02-Apr-18/K		< 0.01		
Total Coliform	cfu/100mL	1	MOE E3407	29-Mar-18/O	2	0		
E coli	cfu/100mL	1	MOE E3407	29-Mar-18/O	0	0		
Heterotrophic Plate Count	cfu/mL	2	SM 9215C	29-Mar-18/O	< 2	< 2		
Anion Sum	meq/L		Calc.	02-Apr-18/O	5.03	4.57		
Cation Sum	meq/L		Calc.	02-Apr-18/O	4.38	4.77		
% Difference	%		Calc.	02-Apr-18/O	6.89	2.20		
Ion Ratio	AS/CS		Calc.	02-Apr-18/O	1.15	0.957		
Sodium Adsorption Ratio	-		Calc.	02-Apr-18/O	0.259	0.234		
TDS(ion sum calc.)	mg/L	1	Calc.	02-Apr-18/O	244	238		
Conductivity (calc.)	µmho/cm		Calc.	02-Apr-18/O	444	447		
TDS(calc.)/EC(actual)	-		Calc.	02-Apr-18/O	0.545	0.534		
EC(calc.)/EC(actual)	-		Calc.	02-Apr-18/O	0.992	1.00		
Langelier Index(25°C)	S.I.		Calc.	02-Apr-18/O	0.918	0.903		

R.L. = Reporting Limit
Test methods may be modified from specified reference method unless indicated by an *
Site Analyzed=K-Kingston,W-Windsor,O-Ottawa,R-Richmond Hill,B-Barrie

Greg Clarkin , BSc., C. Chem
Lab Manager - Ottawa District

CADUCEON ENVIRONMENTAL LABORATORIES
Client committed. Quality assured.

CERTIFICATE OF ANALYSIS

Final Report

C.O.C.: G74762

REPORT No. B18-20369 (i)

Rev. 1

Report To:

Oakridge Environmental
PO Box 431 ,
Peterborough ON K9J 6Z3 Canada
Attention: Mathew Dimitroff

Caduceon Environmental Laboratories
285 Dalton Ave
Kingston Ontario K7K 6Z1
Tel: 613-544-2001
Fax: 613-544-2770

DATE RECEIVED: 12-Jul-18
DATE REPORTED: 31-Jul-18
SAMPLE MATRIX: Groundwater

JOB/PROJECT NO.: Warsaw
P.O. NUMBER: 17-2326
WATERWORKS NO.

			Client I.D.		TW-1 (3 hrs)	TW-1 (6 hrs)		
			Sample I.D.		B18-20369-1	B18-20369-2		
			Date Collected		10-Jul-18	10-Jul-18		
Parameter	**Units**	**R.L.**	**Reference Method**	**Date/Site Analyzed**				
Total Coliform	cfu/100mL	1	MOE E3407	12-Jul-18/K	6	6		
E coli	cfu/100mL	1	MOE E3407	12-Jul-18/K	0	0		
Heterotrophic Plate Count	cfu/mL	10	SM9215D	12-Jul-18/K	10	10		
Alkalinity(CaCO3) to pH4.5	mg/L	5	SM 2320B	16-Jul-18/O	235	236		
Bicarbonate(as CaCO3)	mg/L	5	SM 2320B	16-Jul-18/O	235	236		
Carbonate (as CaCO3)	mg/L	5	SM 2320B	16-Jul-18/O	< 5	< 5		
pH @25°C	pH Units		SM 4500H	16-Jul-18/O	8.04	8.08		
Conductivity @25°C	µmho/cm	1	SM 2510B	16-Jul-18/O	691	721		
Colour	TCU	2	SM 2120C	16-Jul-18/O	< 2	3		
Turbidity	NTU	0.1	SM 2130	16-Jul-18/O	0.2	0.2		
Fluoride	mg/L	0.1	SM4110C	16-Jul-18/O	< 0.1	< 0.1		
Chloride	mg/L	0.5	SM4110C	16-Jul-18/O	66.9	67.3		
Nitrite (N)	mg/L	0.1	SM4110C	16-Jul-18/O	< 0.1	< 0.1		
Nitrate (N)	mg/L	0.1	SM4110C	16-Jul-18/O	0.5	0.5		
Sulphate	mg/L	1	SM4110C	16-Jul-18/O	6	6		
o-Phosphate (P)	mg/L	0.01	MOEE 3366	18-Jul-18/O	< 0.01	< 0.01		
Ammonia (N)-Total	mg/L	0.01	SM4500-NH3-H	12-Jul-18/K	< 0.01	0.01		
Dissolved Organic Carbon	mg/L	0.2	EPA 415.1	16-Jul-18/O	1.5	1.5		
Sulphide	mg/L	0.01	SM4500-S2	12-Jul-18/K		< 0.01		
Hardness (as CaCO3)	mg/L	1	SM 3120	13-Jul-18/O	284	285		
Calcium	mg/L	0.02	SM 3120	13-Jul-18/O	107	107		
Copper	mg/L	0.002	SM 3120	13-Jul-18/O	< 0.002	< 0.002		
Iron	mg/L	0.005	SM 3120	13-Jul-18/O	< 0.005	< 0.005		
Magnesium	mg/L	0.02	SM 3120	13-Jul-18/O	4.12	4.15		
Manganese	mg/L	0.001	SM 3120	13-Jul-18/O	< 0.001	< 0.001		
Potassium	mg/L	0.1	SM 3120	13-Jul-18/O	1.3	1.3		
Sodium	mg/L	0.2	SM 3120	13-Jul-18/O	37.0	37.8		

Revised to correct Client sample I.D.

R. Lecompte

Richard Lecompte
Lab Supervisor

R.L. = Reporting Limit
Test methods may be modified from specified reference method unless indicated by an *
Site Analyzed=K-Kingston,W-Windsor,O-Ottawa,R-Richmond Hill,B-Barrie

CADUCEON™ ENVIRONMENTAL LABORATORIES
Client committed. Quality assured.

CERTIFICATE OF ANALYSIS

Final Report

C.O.C.: G74762

REPORT No. B18-20369 (i)

Rev. 1

Report To:

Oakridge Environmental
PO Box 431 ,
Peterborough ON K9J 6Z3 Canada
Attention: Mathew Dimitroff

Caduceon Environmental Laboratories
285 Dalton Ave
Kingston Ontario K7K 6Z1
Tel: 613-544-2001
Fax: 613-544-2770

DATE RECEIVED: 12-Jul-18
DATE REPORTED: 31-Jul-18
SAMPLE MATRIX: Groundwater

JOB/PROJECT NO.: Warsaw
P.O. NUMBER: 17-2326
WATERWORKS NO.

			Client I.D.		TW-1 (3 hrs)	TW-1 (6 hrs)		
			Sample I.D.		B18-20369-1	B18-20369-2		
			Date Collected		10-Jul-18	10-Jul-18		
Parameter	**Units**	**R.L.**	**Reference Method**	**Date/Site Analyzed**				
Zinc	mg/L	0.005	SM 3120	13-Jul-18/O	< 0.005	< 0.005		
Anion Sum	meq/L		Calc.	17-Jul-18/O	6.75	6.78		
Cation Sum	meq/L		Calc.	17-Jul-18/O	7.32	7.37		
% Difference	%		Calc.	17-Jul-18/O	4.06	4.14		
Ion Ratio	AS/CS		Calc.	17-Jul-18/O	0.922	0.920		
Sodium Adsorption Ratio	-		Calc.	17-Jul-18/O	0.955	0.922		
TDS(ion sum calc.)	mg/L	1	Calc.	17-Jul-18/O	366	368		
Langelier Index(25°C)	S.I.		Calc.	17-Jul-18/O	0.988	1.04		

Revised to correct Client sample I.D.

R. Lecompte

Richard Lecompte
Lab Supervisor

R.L. = Reporting Limit
Test methods may be modified from specified reference method unless indicated by an *
Site Analyzed=K-Kingston,W-Windsor,O-Ottawa,R-Richmond Hill,B-Barrie

CADUCEON™ ENVIRONMENTAL LABORATORIES
Client committed. Quality assured.

CERTIFICATE OF ANALYSIS

Final Report

C.O.C.: G74762

REPORT No. B18-20369 (ii)

Rev. 1

Report To:

Oakridge Environmental
PO Box 431 ,
Peterborough ON K9J 6Z3 Canada
Attention: Mathew Dimitroff

Caduceon Environmental Laboratories
285 Dalton Ave
Kingston Ontario K7K 6Z1
Tel: 613-544-2001
Fax: 613-544-2770

DATE RECEIVED: 12-Jul-18
DATE REPORTED: 31-Jul-18
SAMPLE MATRIX: Groundwater

JOB/PROJECT NO.: Warsaw
P.O. NUMBER: 17-2326
WATERWORKS NO.

			Client I.D.		TW-1 (6 hrs)			
			Sample I.D.		B18-20369-2			
			Date Collected		10-Jul-18			
Parameter	**Units**	**R.L.**	**Reference Method**	**Date/Site Analyzed**				
Calcium	mg/L	0.02	SM 3120	13-Jul-18/O	109			
Copper	mg/L	0.002	SM 3120	13-Jul-18/O	< 0.002			
Iron (Total)	mg/L	0.005	SM 3120	13-Jul-18/O	< 0.005			
Magnesium	mg/L	0.02	SM 3120	13-Jul-18/O	4.02			
Manganese (Total)	mg/L	0.001	SM 3120	13-Jul-18/O	< 0.001			
Potassium	mg/L	0.1	SM 3120	13-Jul-18/O	1.2			
Sodium	mg/L	0.2	SM 3120	13-Jul-18/O	36.0			
Zinc	mg/L	0.005	SM 3120	13-Jul-18/O	< 0.005			

1 . This page contains Total Metals results.

Revised to correct Client sample I.D.

R. Lecompte

Richard Lecompte
Lab Supervisor

R.L. = Reporting Limit
Test methods may be modified from specified reference method unless indicated by an *
Site Analyzed=K-Kingston,W-Windsor,O-Ottawa,R-Richmond Hill,B-Barrie

CADUCEON™ ENVIRONMENTAL LABORATORIES
Client committed. Quality assured.

CERTIFICATE OF ANALYSIS

Final Report

C.O.C.: G80850 **REPORT No. B19-16530 (i)**

Report To:

Oakridge Environmental
PO Box 431 ,
Peterborough ON K9J 6Z3 Canada
Attention: Chad Rachwalski

Caduceon Environmental Laboratories
285 Dalton Ave
Kingston Ontario K7K 6Z1
Tel: 613-544-2001
Fax: 613-544-2770

DATE RECEIVED: 07-Jun-19
DATE REPORTED: 24-Jun-19
SAMPLE MATRIX: Groundwater

JOB/PROJECT NO.: Warsaw
P.O. NUMBER: 17-2326
WATERWORKS NO.

			Client I.D.		TW-1	TW-2		
			Sample I.D.		B19-16530-1	B19-16530-2		
			Date Collected		06-Jun-19	06-Jun-19		
Parameter	**Units**	**R.L.**	**Reference Method**	**Date/Site Analyzed**				
Total Coliform	cfu/100mL	1	MOE E3407	07-Jun-19/K	36	1		
E coli	cfu/100mL	1	MOE E3407	07-Jun-19/K	4	0		
Heterotrophic Plate Count	cfu/mL	10	SM9215D	07-Jun-19/K	320	280		
Alkalinity(CaCO3) to pH4.5	mg/L	5	SM 2320B	10-Jun-19/O	233	236		
Carbonate (as CaCO3)	mg/L	5	SM 2320B	10-Jun-19/O	< 5	< 5		
Bicarbonate(as CaCO3)	mg/L	5	SM 2320B	10-Jun-19/O	233	236		
pH @25°C	pH Units		SM 4500H	10-Jun-19/O	7.99	7.84		
Conductivity @25°C	µmho/cm	1	SM 2510B	10-Jun-19/O	567	847		
Colour	TCU	2	SM 2120C	11-Jun-19/O	3	6		
Turbidity	NTU	0.1	SM 2130	11-Jun-19/O	2.1	43.9		
Fluoride	mg/L	0.1	SM4110C	21-Jun-19/O	< 0.1	< 0.1		
Chloride	mg/L	0.5	SM4110C	21-Jun-19/O	36.7	115		
Nitrite (N)	mg/L	0.1	SM4110C	21-Jun-19/O	< 0.1	< 0.1		
Nitrate (N)	mg/L	0.1	SM4110C	21-Jun-19/O	0.2	< 0.1		
Sulphate	mg/L	1	SM4110C	21-Jun-19/O	4	7		
Ammonia (N)-Total	mg/L	0.01	SM4500-NH3-H	17-Jun-19/K	< 0.01	2.38		
o-Phosphate (P)	mg/L	0.002	PE4500-S	17-Jun-19/K	0.012	0.005		
Dissolved Organic Carbon	mg/L	0.2	EPA 415.1	17-Jun-19/O	3.5	3.7		
TDS (Calc. from Cond.)	mg/L	1	Calc.	11-Jun-19	294	447		
Hardness (as CaCO3)	mg/L	1	SM 3120	14-Jun-19/O	265	283		
Calcium	mg/L	0.02	SM 3120	14-Jun-19/O	100	106		
Copper	mg/L	0.002	SM 3120	14-Jun-19/O	0.002	< 0.002		
Iron	mg/L	0.005	SM 3120	14-Jun-19/O	0.166	2.52		
Magnesium	mg/L	0.02	SM 3120	14-Jun-19/O	3.75	4.36		
Manganese	mg/L	0.001	SM 3120	14-Jun-19/O	0.013	0.292		
Potassium	mg/L	0.1	SM 3120	14-Jun-19/O	1.8	2.3		
Sodium	mg/L	0.2	SM 3120	14-Jun-19/O	27.6	67.4		

R. Lecompte

Richard Lecompte
Laboratory Supervisor

R.L. = Reporting Limit
Test methods may be modified from specified reference method unless indicated by an *
Site Analyzed=K-Kingston,W-Windsor,O-Ottawa,R-Richmond Hill,B-Barrie

CADUCEON™ ENVIRONMENTAL LABORATORIES
Client committed. Quality assured.

CERTIFICATE OF ANALYSIS

Final Report

C.O.C.: G80850 **REPORT No. B19-16530 (i)**

Report To:

Oakridge Environmental
PO Box 431 ,
Peterborough ON K9J 6Z3 Canada
Attention: Chad Rachwalski

Caduceon Environmental Laboratories
285 Dalton Ave
Kingston Ontario K7K 6Z1
Tel: 613-544-2001
Fax: 613-544-2770

DATE RECEIVED: 07-Jun-19
DATE REPORTED: 24-Jun-19
SAMPLE MATRIX: Groundwater

JOB/PROJECT NO.: Warsaw
P.O. NUMBER: 17-2326
WATERWORKS NO.

			Client I.D.		TW-1	TW-2		
			Sample I.D.		B19-16530-1	B19-16530-2		
			Date Collected		06-Jun-19	06-Jun-19		
Parameter	**Units**	**R.L.**	**Reference Method**	**Date/Site Analyzed**				
Zinc	mg/L	0.005	SM 3120	14-Jun-19/O	< 0.005	< 0.005		
Anion Sum	meq/L		Calc.	22-Jun-19/O	5.80	8.09		
Cation Sum	meq/L		Calc.	22-Jun-19/O	6.11	8.61		
% Difference	%		Calc.	22-Jun-19/O	2.63	3.13		
Ion Ratio	AS/CS		Calc.	22-Jun-19/O	0.949	0.939		
Sodium Adsorption Ratio	-		Calc.	22-Jun-19/O	0.749	1.69		
Langelier Index(25°C)	S.I.		Calc.	22-Jun-19/O	0.876	0.754		

R. Lecompte

Richard Lecompte
Laboratory Supervisor

R.L. = Reporting Limit
Test methods may be modified from specified reference method unless indicated by an *
Site Analyzed=K-Kingston,W-Windsor,O-Ottawa,R-Richmond Hill,B-Barrie

CADUCEON ENVIRONMENTAL LABORATORIES
Client committed. Quality assured.

CERTIFICATE OF ANALYSIS

Final Report

C.O.C.: G80850 **REPORT No. B19-16530 (ii)**

Report To:

Oakridge Environmental
PO Box 431 ,
Peterborough ON K9J 6Z3 Canada
Attention: Chad Rachwalski

Caduceon Environmental Laboratories
285 Dalton Ave
Kingston Ontario K7K 6Z1
Tel: 613-544-2001
Fax: 613-544-2770

DATE RECEIVED: 07-Jun-19
DATE REPORTED: 24-Jun-19
SAMPLE MATRIX: Groundwater

JOB/PROJECT NO.: Warsaw
P.O. NUMBER: 17-2326
WATERWORKS NO.

			Client I.D.		TW-1	TW-2		
			Sample I.D.		B19-16530-1	B19-16530-2		
			Date Collected		06-Jun-19	06-Jun-19		
Parameter	**Units**	**R.L.**	**Reference Method**	**Date/Site Analyzed**				
Calcium (Total)	mg/L	0.02	SM 3120	17-Jun-19/O	91.5	101		
Copper	mg/L	0.002	SM 3120	17-Jun-19/O	< 0.002	< 0.002		
Iron (Total)	mg/L	0.005	SM 3120	17-Jun-19/O	0.332	3.36		
Magnesium (Total)	mg/L	0.01	SM 3120	17-Jun-19/O	3.86	4.52		
Manganese (Total)	mg/L	0.001	SM 3120	17-Jun-19/O	0.013	0.278		
Potassium	mg/L	0.1	SM 3120	17-Jun-19/O	1.6	2.1		
Sodium (Total)	mg/L	0.2	SM 3120	17-Jun-19/O	26.9	64.1		
Zinc	mg/L	0.005	SM 3120	17-Jun-19/O	< 0.005	< 0.005		

This page contains Total Metals results.

R. Lecompte

Richard Lecompte
Laboratory Supervisor

R.L. = Reporting Limit
Test methods may be modified from specified reference method unless indicated by an *
Site Analyzed=K-Kingston,W-Windsor,O-Ottawa,R-Richmond Hill,B-Barrie

CADUCEON™ ENVIRONMENTAL LABORATORIES
Client committed. Quality assured.

CERTIFICATE OF ANALYSIS

Final Report

C.O.C.: G77578 **REPORT No. B19-29117 (i)**

Report To:

Oakridge Environmental
PO Box 431 ,
Peterborough ON K9J 6Z3 Canada
Attention: Dan MacIntyre

Caduceon Environmental Laboratories
285 Dalton Ave
Kingston Ontario K7K 6Z1
Tel: 613-544-2001
Fax: 613-544-2770

DATE RECEIVED: 13-Sep-19
DATE REPORTED: 01-Oct-19
SAMPLE MATRIX: Groundwater

JOB/PROJECT NO.: Warsaw
P.O. NUMBER: 17-2326
WATERWORKS NO.

			Client I.D.		TW-10 (3 hrs)	TW-10 (6 hrs)		
			Sample I.D.		B19-29117-1	B19-29117-2		
			Date Collected		12-Sep-19	12-Sep-19		
Parameter	**Units**	**R.L.**	**Reference Method**	**Date/Site Analyzed**				
Total Coliform	cfu/100mL	1	MOE E3407	13-Sep-19/K	0	0		
E coli	cfu/100mL	1	MOE E3407	13-Sep-19/K	0	0		
Heterotrophic Plate Count	cfu/mL	10	SM9215D	13-Sep-19/K	190	70		
Alkalinity(CaCO3) to pH4.5	mg/L	5	SM 2320B	16-Sep-19/O	223	224		
Bicarbonate(as CaCO3)	mg/L	5	SM 2320B	16-Sep-19/O	223	224		
Carbonate (as CaCO3)	mg/L	5	SM 2320B	16-Sep-19/O	< 5	< 5		
pH @25°C	pH Units		SM 4500H	16-Sep-19/O	7.83	7.81		
Conductivity @25°C	µmho/cm	1	SM 2510B	16-Sep-19/O	505	508		
Colour	TCU	2	SM 2120C	18-Sep-19/O	< 2	< 2		
Turbidity	NTU	0.1	SM 2130	18-Sep-19/O	17.4	23.9		
Fluoride	mg/L	0.1	SM4110C	16-Sep-19/O	< 0.1	< 0.1		
Chloride	mg/L	0.5	SM4110C	16-Sep-19/O	22.2	23.0		
Nitrite (N)	mg/L	0.1	SM4110C	16-Sep-19/O	< 0.1	< 0.1		
Nitrate (N)	mg/L	0.1	SM4110C	16-Sep-19/O	0.4	0.4		
Sulphate	mg/L	1	SM4110C	16-Sep-19/O	7	8		
Ammonia (N)-Total	mg/L	0.01	SM4500-NH3-H	16-Sep-19/K	< 0.01	< 0.01		
o-Phosphate (P)	mg/L	0.002	PE4500-S	16-Sep-19/K	0.004	0.006		
TDS (Calc. from Cond.)	mg/L	1	Calc.	17-Sep-19	261	263		
Dissolved Organic Carbon	mg/L	0.2	EPA 415.1	19-Sep-19/O	3.2	3.2		
Sulphide	mg/L	0.01	SM4500-S2	16-Sep-19/K		0.01		
Hardness (as CaCO3)	mg/L	1	SM 3120	25-Sep-19/O	269	277		
Calcium	mg/L	0.02	SM 3120	25-Sep-19/O	104	107		
Copper	mg/L	0.002	SM 3120	17-Sep-19/O	0.006	0.006		
Iron	mg/L	0.005	SM 3120	17-Sep-19/O	0.096	0.160		
Magnesium	mg/L	0.02	SM 3120	25-Sep-19/O	2.10	2.19		
Manganese	mg/L	0.001	SM 3120	17-Sep-19/O	0.015	0.027		

R. Lecompte

Richard Lecompte
Laboratory Supervisor

R.L. = Reporting Limit
Test methods may be modified from specified reference method unless indicated by an *
Site Analyzed=K-Kingston,W-Windsor,O-Ottawa,R-Richmond Hill,B-Barrie

CADUCEON ENVIRONMENTAL LABORATORIES
Client committed. Quality assured.

CERTIFICATE OF ANALYSIS

Final Report

C.O.C.: G77578 **REPORT No. B19-29117 (i)**

Report To:

Oakridge Environmental
PO Box 431 ,
Peterborough ON K9J 6Z3 Canada
Attention: Dan MacIntyre

Caduceon Environmental Laboratories
285 Dalton Ave
Kingston Ontario K7K 6Z1
Tel: 613-544-2001
Fax: 613-544-2770

DATE RECEIVED: 13-Sep-19
DATE REPORTED: 01-Oct-19
SAMPLE MATRIX: Groundwater

JOB/PROJECT NO.: Warsaw
P.O. NUMBER: 17-2326
WATERWORKS NO.

	Client I.D.	TW-10 (3 hrs)	TW-10 (6 hrs)		
	Sample I.D.	B19-29117-1	B19-29117-2		
	Date Collected	12-Sep-19	12-Sep-19		

Parameter	Units	R.L.	Reference Method	Date/Site Analyzed				
Potassium	mg/L	0.1	SM 3120	25-Sep-19/O	0.7	0.7		
Sodium	mg/L	0.2	SM 3120	25-Sep-19/O	11.1	11.3		
Zinc	mg/L	0.005	SM 3120	17-Sep-19/O	0.013	0.007		
Anion Sum	meq/L		Calc.	18-Sep-19/O	5.26	5.31		
Cation Sum	meq/L		Calc.	18-Sep-19/O	5.86	6.03		
% Difference	%		Calc.	18-Sep-19/O	5.46	6.35		
Ion Ratio	AS/CS		Calc.	18-Sep-19/O	0.896	0.881		
Sodium Adsorption Ratio	-		Calc.	18-Sep-19/O	0.295	0.296		
TDS(ion sum calc.)	mg/L	1	Calc.	18-Sep-19/O	283	288		
Conductivity (calc.)	µmho/cm		Calc.	18-Sep-19/O	533	544		
TDS(calc.)/EC(actual)	-		Calc.	18-Sep-19/O	0.560	0.567		
EC(calc.)/EC(actual)	-		Calc.	18-Sep-19/O	1.06	1.07		
Langelier Index(25°C)	S.I.		Calc.	18-Sep-19/O	0.752	0.747		

R. Lecompte

Richard Lecompte
Laboratory Supervisor

R.L. = Reporting Limit
Test methods may be modified from specified reference method unless indicated by an *
Site Analyzed=K-Kingston,W-Windsor,O-Ottawa,R-Richmond Hill,B-Barrie

CADUCEON ENVIRONMENTAL LABORATORIES
Client committed. Quality assured.

CERTIFICATE OF ANALYSIS

Final Report

C.O.C.: G77578 **REPORT No. B19-29117 (ii)**

Report To:

Oakridge Environmental
PO Box 431 ,
Peterborough ON K9J 6Z3 Canada
Attention: Dan MacIntyre

Caduceon Environmental Laboratories
285 Dalton Ave
Kingston Ontario K7K 6Z1
Tel: 613-544-2001
Fax: 613-544-2770

DATE RECEIVED: 13-Sep-19
DATE REPORTED: 01-Oct-19
SAMPLE MATRIX: Groundwater

JOB/PROJECT NO.: Warsaw
P.O. NUMBER: 17-2326
WATERWORKS NO.

			Client I.D.		TW-10 (3 hrs)	TW-10 (6 hrs)		
			Sample I.D.		B19-29117-1	B19-29117-2		
			Date Collected		12-Sep-19	12-Sep-19		
Parameter	**Units**	**R.L.**	**Reference Method**	**Date/Site Analyzed**				
Calcium - Total	mg/L	0.02	SM 3120	18-Sep-19/O	117	118		
Copper - Total	mg/L	0.002	SM 3120	18-Sep-19/O	0.011	0.010		
Iron - Total	mg/L	0.005	SM 3120	18-Sep-19/O	0.340	0.572		
Magnesium - Total	mg/L	0.02	SM 3120	18-Sep-19/O	2.28	2.28		
Manganese - Total	mg/L	0.001	SM 3120	18-Sep-19/O	0.019	0.028		
Potassium - Total	mg/L	0.1	SM 3120	18-Sep-19/O	0.7	0.7		
Sodium - Total	mg/L	0.2	SM 3120	18-Sep-19/O	11.0	11.3		
Zinc - Total	mg/L	0.005	SM 3120	18-Sep-19/O	0.023	0.013		

This page contains Total Metals results.

R. Lecompte

Richard Lecompte
Laboratory Supervisor

R.L. = Reporting Limit
Test methods may be modified from specified reference method unless indicated by an *
Site Analyzed=K-Kingston,W-Windsor,O-Ottawa,R-Richmond Hill,B-Barrie

CADUCEON™ ENVIRONMENTAL LABORATORIES
Client committed. Quality assured.

CERTIFICATE OF ANALYSIS

Final Report

C.O.C.: G77579 **REPORT No. B19-29222**

Report To:

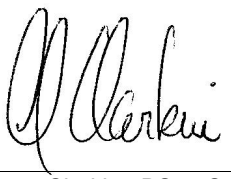
Oakridge Environmental
PO Box 431 ,
Peterborough ON K9J 6Z3 Canada
Attention: Dan MacIntyre

Caduceon Environmental Laboratories
2378 Holly Lane
Ottawa Ontario K1V 7P1
Tel: 613-526-0123
Fax: 613-526-1244

DATE RECEIVED: 14-Sep-19
DATE REPORTED: 24-Sep-19
SAMPLE MATRIX: Groundwater

JOB/PROJECT NO.: Warsaw
P.O. NUMBER: 17-2326
WATERWORKS NO.

			Client I.D.		TW-1 (6 hrs)	TW-1 (3 hrs)		
			Sample I.D.		B19-29222-1	B19-29222-2		
			Date Collected		13-Sep-19	13-Sep-19		
Parameter	**Units**	**R.L.**	**Reference Method**	**Date/Site Analyzed**				
Hardness (as CaCO3)	mg/L	1	SM 3120	20-Sep-19/O	334	339		
Alkalinity(CaCO3) to pH4.5	mg/L	5	SM 2320B	16-Sep-19/O	269	260		
Bicarbonate(as CaCO3)	mg/L	5	SM 2320B	16-Sep-19/O	269	260		
Carbonate (as CaCO3)	mg/L	5	SM 2320B	16-Sep-19/O	< 5	< 5		
Conductivity @25°C	µmho/cm	1	SM 2510B	16-Sep-19/O	966	953		
TDS(ion sum calc.)	mg/L	1	Calc.	20-Sep-19/O	537	526		
pH @25°C	pH Units		SM 4500H	16-Sep-19/O	7.76	7.74		
Colour	TCU	2	SM 2120C	18-Sep-19/O	< 2	< 2		
Turbidity	NTU	0.1	SM 2130	18-Sep-19/O	0.2	0.2		
Fluoride	mg/L	0.1	SM4110C	18-Sep-19/O	< 0.1	< 0.1		
Chloride	mg/L	0.5	SM4110C	18-Sep-19/O	155	149		
Nitrite (N)	mg/L	0.1	SM4110C	18-Sep-19/O	< 0.1	< 0.1		
Nitrate (N)	mg/L	0.1	SM4110C	18-Sep-19/O	1.2	1.2		
Sulphate	mg/L	1	SM4110C	18-Sep-19/O	13	13		
Calcium	mg/L	0.02	SM 3120	20-Sep-19/O	126	128		
Calcium - Total	mg/L	0.02	SM 3120	19-Sep-19/O	126	128		
Magnesium	mg/L	0.02	SM 3120	20-Sep-19/O	4.53	4.62		
Magnesium - Total	mg/L	0.02	SM 3120	19-Sep-19/O	4.53	4.62		
Sodium	mg/L	0.2	SM 3120	20-Sep-19/O	69.2	69.0		
Sodium - Total	mg/L	0.2	SM 3120	19-Sep-19/O	69.2	69.0		
Potassium	mg/L	0.1	SM 3120	20-Sep-19/O	1.3	1.4		
Potassium - Total	mg/L	0.1	SM 3120	19-Sep-19/O	1.3	1.4		
Copper	mg/L	0.002	SM 3120	20-Sep-19/O	< 0.002	< 0.002		
Copper - Total	mg/L	0.002	SM 3120	19-Sep-19/O	< 0.002	< 0.002		
Iron	mg/L	0.005	SM 3120	20-Sep-19/O	< 0.005	< 0.005		
Iron - Total	mg/L	0.005	SM 3120	19-Sep-19/O	0.019	0.013		
Manganese	mg/L	0.001	SM 3120	20-Sep-19/O	< 0.001	< 0.001		



Greg Clarkin , BSc., C. Chem
Lab Manager - Ottawa District

R.L. = Reporting Limit
Test methods may be modified from specified reference method unless indicated by an *
Site Analyzed=K-Kingston,W-Windsor,O-Ottawa,R-Richmond Hill,B-Barrie

CADUCEON™ ENVIRONMENTAL LABORATORIES
Client committed. Quality assured.

CERTIFICATE OF ANALYSIS

Final Report

C.O.C.: G77579 **REPORT No. B19-29222**

Report To:

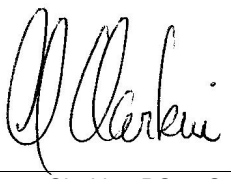
Oakridge Environmental
PO Box 431 ,
Peterborough ON K9J 6Z3 Canada
Attention: Dan MacIntyre

Caduceon Environmental Laboratories
2378 Holly Lane
Ottawa Ontario K1V 7P1
Tel: 613-526-0123
Fax: 613-526-1244

DATE RECEIVED: 14-Sep-19
DATE REPORTED: 24-Sep-19
SAMPLE MATRIX: Groundwater

JOB/PROJECT NO.: Warsaw
P.O. NUMBER: 17-2326
WATERWORKS NO.

			Client I.D.		TW-1 (6 hrs)	TW-1 (3 hrs)		
			Sample I.D.		B19-29222-1	B19-29222-2		
			Date Collected		13-Sep-19	13-Sep-19		
Parameter	**Units**	**R.L.**	**Reference Method**	**Date/Site Analyzed**				
Manganese - Total	mg/L	0.001	SM 3120	19-Sep-19/O	< 0.001	< 0.001		
Zinc	mg/L	0.005	SM 3120	20-Sep-19/O	< 0.005	< 0.005		
Zinc - Total	mg/L	0.005	SM 3120	19-Sep-19/O	< 0.005	0.005		
Ammonia (N)-Total	mg/L	0.01	SM4500-NH3-H	17-Sep-19/K	< 0.01	< 0.01		
o-Phosphate (P)	mg/L	0.002	PE4500-S	17-Sep-19/K	0.011	0.009		
Dissolved Organic Carbon	mg/L	0.2	EPA 415.1	20-Sep-19/O	2.0	2.0		
Sulphide	mg/L	0.01	SM4500-S2	18-Sep-19/K	< 0.01			
Total Coliform	cfu/100mL	1	MOE E3407	14-Sep-19/O	9	5		
E coli	cfu/100mL	1	MOE E3407	14-Sep-19/O	1	1		
Heterotrophic Plate Count	cfu/mL	2	SM 9215C	14-Sep-19/O	32	16		
Anion Sum	meq/L		Calc.	20-Sep-19/O	10.1	9.75		
Cation Sum	meq/L		Calc.	20-Sep-19/O	9.73	9.80		
% Difference	%		Calc.	20-Sep-19/O	1.94	0.254		
Ion Ratio	AS/CS		Calc.	20-Sep-19/O	1.04	0.995		
Sodium Adsorption Ratio	-		Calc.	20-Sep-19/O	1.65	1.63		
Conductivity (calc.)	µmho/cm		Calc.	20-Sep-19/O	993	978		
TDS(calc.)/EC(actual)	-		Calc.	20-Sep-19/O	0.555	0.552		
EC(calc.)/EC(actual)	-		Calc.	20-Sep-19/O	1.03	1.03		
Langelier Index(25°C)	S.I.		Calc.	20-Sep-19/O	0.817	0.800		



Greg Clarkin , BSc., C. Chem
Lab Manager - Ottawa District

R.L. = Reporting Limit
Test methods may be modified from specified reference method unless indicated by an *
Site Analyzed=K-Kingston,W-Windsor,O-Ottawa,R-Richmond Hill,B-Barrie

CADUCEON ENVIRONMENTAL LABORATORIES
Client committed. Quality assured.

CERTIFICATE OF ANALYSIS

Final Report

C.O.C.: G77580 **REPORT No. B19-29775 (i)**

Report To:

Oakridge Environmental
PO Box 431 ,
Peterborough ON K9J 6Z3 Canada
Attention: Matthew Dimitroff

Caduceon Environmental Laboratories
285 Dalton Ave
Kingston Ontario K7K 6Z1
Tel: 613-544-2001
Fax: 613-544-2770

DATE RECEIVED: 18-Sep-19
DATE REPORTED: 26-Sep-19
SAMPLE MATRIX: Groundwater

JOB/PROJECT NO.: Warsaw
P.O. NUMBER: 17-2326
WATERWORKS NO.

			Client I.D.		TW-9 (3 Hours)	TW-9 (6 Hours)	TW-8 (3 Hours)	TW-8 (6 Hours)
			Sample I.D.		B19-29775-1	B19-29775-2	B19-29775-3	B19-29775-4
			Date Collected		16-Sep-19	16-Sep-19	17-Sep-19	17-Sep-19
Parameter	**Units**	**R.L.**	**Reference Method**	**Date/Site Analyzed**				
Total Coliform	cfu/100mL	1	MOE E3407	18-Sep-19/K	0	0	19	4
E coli	cfu/100mL	1	MOE E3407	18-Sep-19/K	0	0	0	0
Heterotrophic Plate Count	cfu/mL	10	SM9215D	18-Sep-19/K	< 10	20	< 10	10
Alkalinity(CaCO3) to pH4.5	mg/L	5	SM 2320B	19-Sep-19/O	228	230	253	256
Carbonate (as CaCO3)	mg/L	5	SM 2320B	19-Sep-19/O	< 5	< 5	< 5	< 5
Bicarbonate(as CaCO3)	mg/L	5	SM 2320B	19-Sep-19/O	228	230	253	256
pH @25°C	pH Units		SM 4500H	19-Sep-19/O	7.80	7.81	7.97	7.96
Conductivity @25°C	µmho/cm	1	SM 2510B	19-Sep-19/O	529	548	895	892
Colour	TCU	2	SM 2120C	20-Sep-19/O	< 2	< 2	< 2	< 2
Turbidity	NTU	0.1	SM 2130	19-Sep-19/O	0.3	0.2	0.6	0.3
Fluoride	mg/L	0.1	SM4110C	20-Sep-19/O	< 0.1	< 0.1	< 0.1	< 0.1
Chloride	mg/L	0.5	SM4110C	20-Sep-19/O	31.5	36.9	142	140
Nitrite (N)	mg/L	0.1	SM4110C	20-Sep-19/O	< 0.1	< 0.1	< 0.1	< 0.1
Nitrate (N)	mg/L	0.1	SM4110C	20-Sep-19/O	0.3	0.4	1.0	1.0
Sulphate	mg/L	1	SM4110C	20-Sep-19/O	10	10	14	14
Ammonia (N)-Total	mg/L	0.01	SM4500-NH3-H	19-Sep-19/K	0.01	< 0.01	0.01	0.01
o-Phosphate (P)	mg/L	0.002	PE4500-S	19-Sep-19/K	0.011	0.006	0.003	< 0.002
TDS (Calc. from Cond.)	mg/L	1	Calc.	20-Sep-19	274	284	474	472
Dissolved Organic Carbon	mg/L	0.2	EPA 415.1	20-Sep-19/O	3.0	2.9	2.0	2.2
Sulphide	mg/L	0.01	SM4500-S2	20-Sep-19/K		< 0.01		< 0.01
Hardness (as CaCO3)	mg/L	1	SM 3120	25-Sep-19/O	260	270	328	328
Calcium	mg/L	0.02	SM 3120	25-Sep-19/O	100	104	123	123
Copper	mg/L	0.002	SM 3120	25-Sep-19/O	0.002	< 0.002	< 0.002	< 0.002
Iron	mg/L	0.005	SM 3120	25-Sep-19/O	0.009	< 0.005	0.036	0.015
Magnesium	mg/L	0.02	SM 3120	25-Sep-19/O	2.32	2.48	4.96	4.93
Manganese	mg/L	0.001	SM 3120	25-Sep-19/O	0.001	0.001	0.005	0.004

R. Lecompte

Richard Lecompte
Laboratory Supervisor

R.L. = Reporting Limit
Test methods may be modified from specified reference method unless indicated by an *
Site Analyzed=K-Kingston,W-Windsor,O-Ottawa,R-Richmond Hill,B-Barrie

CADUCEON ENVIRONMENTAL LABORATORIES
Client committed. Quality assured.

CERTIFICATE OF ANALYSIS

Final Report

C.O.C.: G77580 **REPORT No. B19-29775 (i)**

Report To:

Oakridge Environmental
PO Box 431 ,
Peterborough ON K9J 6Z3 Canada
Attention: Matthew Dimitroff

Caduceon Environmental Laboratories
285 Dalton Ave
Kingston Ontario K7K 6Z1
Tel: 613-544-2001
Fax: 613-544-2770

DATE RECEIVED: 18-Sep-19
DATE REPORTED: 26-Sep-19
SAMPLE MATRIX: Groundwater

JOB/PROJECT NO.: Warsaw
P.O. NUMBER: 17-2326
WATERWORKS NO.

			Client I.D.		TW-9 (3 Hours)	TW-9 (6 Hours)	TW-8 (3 Hours)	TW-8 (6 Hours)
			Sample I.D.		B19-29775-1	B19-29775-2	B19-29775-3	B19-29775-4
			Date Collected		16-Sep-19	16-Sep-19	17-Sep-19	17-Sep-19
Parameter	**Units**	**R.L.**	**Reference Method**	**Date/Site Analyzed**				
Potassium	mg/L	0.1	SM 3120	25-Sep-19/O	0.9	1.0	2.2	2.1
Sodium	mg/L	0.2	SM 3120	25-Sep-19/O	15.7	18.2	66.5	66.5
Zinc	mg/L	0.005	SM 3120	25-Sep-19/O	0.005	< 0.005	< 0.005	< 0.005
Anion Sum	meq/L		Calc.	25-Sep-19/O	5.67	5.86	9.43	9.43
Cation Sum	meq/L		Calc.	25-Sep-19/O	5.89	6.21	9.50	9.49
% Difference	%		Calc.	25-Sep-19/O	1.89	2.91	0.350	0.309
Ion Ratio	AS/CS		Calc.	25-Sep-19/O	0.963	0.943	0.993	0.994
Sodium Adsorption Ratio	-		Calc.	25-Sep-19/O	0.424	0.482	1.60	1.60
Langelier Index(25°C)	S.I.		Calc.	25-Sep-19/O	0.715	0.745	1.00	0.996

Richard Lecompte
Laboratory Supervisor

R.L. = Reporting Limit
Test methods may be modified from specified reference method unless indicated by an *
Site Analyzed=K-Kingston,W-Windsor,O-Ottawa,R-Richmond Hill,B-Barrie

CADUCEON™ ENVIRONMENTAL LABORATORIES
Client committed. Quality assured.

CERTIFICATE OF ANALYSIS

Final Report

C.O.C.: G77580 **REPORT No. B19-29775 (ii)**

Report To:

Oakridge Environmental
PO Box 431 ,
Peterborough ON K9J 6Z3 Canada
Attention: Matthew Dimitroff

Caduceon Environmental Laboratories
285 Dalton Ave
Kingston Ontario K7K 6Z1
Tel: 613-544-2001
Fax: 613-544-2770

DATE RECEIVED: 18-Sep-19
DATE REPORTED: 26-Sep-19
SAMPLE MATRIX: Groundwater

JOB/PROJECT NO.: Warsaw
P.O. NUMBER: 17-2326
WATERWORKS NO.

			Client I.D.		TW-9 (3 Hours)	TW-9 (6 Hours)	TW-8 (3 Hours)	TW-8 (6 Hours)
			Sample I.D.		B19-29775-1	B19-29775-2	B19-29775-3	B19-29775-4
			Date Collected		16-Sep-19	16-Sep-19	17-Sep-19	17-Sep-19
Parameter	**Units**	**R.L.**	**Reference Method**	**Date/Site Analyzed**				
Iron (Total)	mg/L	0.005	SM 3120	25-Sep-19/O	0.062	0.022	0.070	0.037
Calcium	mg/L	0.02	SM 3120	25-Sep-19/O	95.9	97.2	124	121
Copper	mg/L	0.002	SM 3120	25-Sep-19/O	0.002	0.002	< 0.002	< 0.002
Magnesium	mg/L	0.02	SM 3120	25-Sep-19/O	2.19	2.30	4.94	4.72
Manganese (Total)	mg/L	0.001	SM 3120	25-Sep-19/O	0.002	0.001	0.006	0.004
Potassium	mg/L	0.1	SM 3120	25-Sep-19/O	0.8	0.9	2.0	2.0
Sodium	mg/L	0.2	SM 3120	25-Sep-19/O	14.8	16.7	63.6	61.8
Zinc	mg/L	0.005	SM 3120	25-Sep-19/O	0.119	0.006	0.005	0.043

This page contains Total Metals results.

R. Lecompte

Richard Lecompte
Laboratory Supervisor

R.L. = Reporting Limit
Test methods may be modified from specified reference method unless indicated by an *
Site Analyzed=K-Kingston,W-Windsor,O-Ottawa,R-Richmond Hill,B-Barrie

CADUCEON™ ENVIRONMENTAL LABORATORIES
Client committed. Quality assured.

CERTIFICATE OF ANALYSIS

Final Report

C.O.C.: G77582 **REPORT No. B19-29938 (i)**

Report To:

Oakridge Environmental
PO Box 431 ,
Peterborough ON K9J 6Z3 Canada
Attention: Scott Robertson

Caduceon Environmental Laboratories
285 Dalton Ave
Kingston Ontario K7K 6Z1
Tel: 613-544-2001
Fax: 613-544-2770

DATE RECEIVED: 19-Sep-19
DATE REPORTED: 26-Sep-19
SAMPLE MATRIX: Groundwater

JOB/PROJECT NO.: Warsaw
P.O. NUMBER: 17-2326
WATERWORKS NO.

	Client I.D.				TW-2 (3 Hours)	TW-2 (6 Hours)		
	Sample I.D.				B19-29938-1	B19-29938-2		
	Date Collected				18-Sep-19	18-Sep-19		
Parameter	**Units**	**R.L.**	**Reference Method**	**Date/Site Analyzed**				
Total Coliform	cfu/100mL	1	MOE E3407	19-Sep-19/K	3	6		
E coli	cfu/100mL	1	MOE E3407	19-Sep-19/K	0	1		
Heterotrophic Plate Count	cfu/mL	10	SM9215D	19-Sep-19/K	10	10		
Alkalinity(CaCO3) to pH4.5	mg/L	5	SM 2320B	19-Sep-19/O	256	258		
Carbonate (as CaCO3)	mg/L	5	SM 2320B	19-Sep-19/O	< 5	< 5		
Bicarbonate(as CaCO3)	mg/L	5	SM 2320B	19-Sep-19/O	256	258		
pH @25°C	pH Units		SM 4500H	19-Sep-19/O	7.91	7.90		
Conductivity @25°C	µmho/cm	1	SM 2510B	19-Sep-19/O	978	990		
Colour	TCU	2	SM 2120C	20-Sep-19/O	< 2	3		
Turbidity	NTU	0.1	SM 2130	19-Sep-19/O	0.3	0.2		
Fluoride	mg/L	0.1	SM4110C	20-Sep-19/O	< 0.1	< 0.1		
Chloride	mg/L	0.5	SM4110C	20-Sep-19/O	167	170		
Nitrite (N)	mg/L	0.1	SM4110C	20-Sep-19/O	< 0.1	< 0.1		
Nitrate (N)	mg/L	0.1	SM4110C	20-Sep-19/O	1.2	1.2		
Sulphate	mg/L	1	SM4110C	20-Sep-19/O	14	14		
Ammonia (N)-Total	mg/L	0.01	SM4500-NH3-H	20-Sep-19/K	0.02	0.02		
o-Phosphate (P)	mg/L	0.002	PE4500-S	20-Sep-19/K	0.017	0.011		
TDS (Calc. from Cond.)	mg/L	1	Calc.	20-Sep-19	521	528		
Dissolved Organic Carbon	mg/L	0.2	EPA 415.1	20-Sep-19/O	1.6	1.8		
Sulphide	mg/L	0.01	SM4500-S2	20-Sep-19/K		< 0.01		
Hardness (as CaCO3)	mg/L	1	SM 3120	25-Sep-19/O	331	327		
Calcium	mg/L	0.02	SM 3120	25-Sep-19/O	127	123		
Copper	mg/L	0.002	SM 3120	25-Sep-19/O	< 0.002	< 0.002		
Iron	mg/L	0.005	SM 3120	25-Sep-19/O	< 0.005	< 0.005		
Magnesium	mg/L	0.02	SM 3120	25-Sep-19/O	4.90	4.93		
Manganese	mg/L	0.001	SM 3120	25-Sep-19/O	< 0.001	< 0.001		

R. Lecompte

Richard Lecompte
Laboratory Supervisor

R.L. = Reporting Limit
Test methods may be modified from specified reference method unless indicated by an *
Site Analyzed=K-Kingston,W-Windsor,O-Ottawa,R-Richmond Hill,B-Barrie

CADUCEON™ ENVIRONMENTAL LABORATORIES
Client committed. Quality assured.

CERTIFICATE OF ANALYSIS

Final Report

C.O.C.: G77582 **REPORT No. B19-29938 (i)**

Report To:

Oakridge Environmental
PO Box 431 ,
Peterborough ON K9J 6Z3 Canada
Attention: Scott Robertson

Caduceon Environmental Laboratories
285 Dalton Ave
Kingston Ontario K7K 6Z1
Tel: 613-544-2001
Fax: 613-544-2770

DATE RECEIVED: 19-Sep-19
DATE REPORTED: 26-Sep-19
SAMPLE MATRIX: Groundwater

JOB/PROJECT NO.: Warsaw
P.O. NUMBER: 17-2326
WATERWORKS NO.

	Client I.D.				TW-2 (3 Hours)	TW-2 (6 Hours)		
	Sample I.D.				B19-29938-1	B19-29938-2		
	Date Collected				18-Sep-19	18-Sep-19		
Parameter	**Units**	**R.L.**	**Reference Method**	**Date/Site Analyzed**				
Potassium	mg/L	0.1	SM 3120	25-Sep-19/O	1.9	1.9		
Sodium	mg/L	0.2	SM 3120	25-Sep-19/O	78.1	80.7		
Zinc	mg/L	0.005	SM 3120	25-Sep-19/O	0.005	0.008		
Anion Sum	meq/L		Calc.	25-Sep-19/O	10.2	10.3		
Cation Sum	meq/L		Calc.	25-Sep-19/O	10.2	10.1		
% Difference	%		Calc.	25-Sep-19/O	0.108	1.15		
Ion Ratio	AS/CS		Calc.	25-Sep-19/O	1.00	1.02		
Sodium Adsorption Ratio	-		Calc.	25-Sep-19/O	1.85	1.94		
Langelier Index(25°C)	S.I.		Calc.	25-Sep-19/O	0.949	0.929		

R.L. = Reporting Limit
Test methods may be modified from specified reference method unless indicated by an *
Site Analyzed=K-Kingston,W-Windsor,O-Ottawa,R-Richmond Hill,B-Barrie

Richard Lecompte
Laboratory Supervisor

CADUCEON ENVIRONMENTAL LABORATORIES
Client committed. Quality assured.

CERTIFICATE OF ANALYSIS

Final Report

C.O.C.: G77582 **REPORT No. B19-29938 (ii)**

Report To:

Oakridge Environmental
PO Box 431 ,
Peterborough ON K9J 6Z3 Canada
Attention: Scott Robertson

Caduceon Environmental Laboratories
285 Dalton Ave
Kingston Ontario K7K 6Z1
Tel: 613-544-2001
Fax: 613-544-2770

DATE RECEIVED: 19-Sep-19
DATE REPORTED: 26-Sep-19
SAMPLE MATRIX: Groundwater

JOB/PROJECT NO.: Warsaw
P.O. NUMBER: 17-2326
WATERWORKS NO.

			Client I.D.		TW-2 (3 Hours)	TW-2 (6 Hours)		
			Sample I.D.		B19-29938-1	B19-29938-2		
			Date Collected		18-Sep-19	18-Sep-19		
Parameter	**Units**	**R.L.**	**Reference Method**	**Date/Site Analyzed**				
Calcium	mg/L	0.02	SM 3120	23-Sep-19/O	125	123		
Copper	mg/L	0.002	SM 3120	23-Sep-19/O	< 0.002	< 0.002		
Iron (Total)	mg/L	0.005	SM 3120	23-Sep-19/O	0.080	0.025		
Magnesium	mg/L	0.02	SM 3120	23-Sep-19/O	4.57	4.65		
Manganese (Total)	mg/L	0.001	SM 3120	23-Sep-19/O	< 0.001	< 0.001		
Potassium	mg/L	0.1	SM 3120	23-Sep-19/O	1.7	1.8		
Sodium	mg/L	0.2	SM 3120	23-Sep-19/O	73.9	76.1		
Zinc	mg/L	0.005	SM 3120	23-Sep-19/O	0.007	0.013		

This page contains Total Metals results.

R. Lecompte

Richard Lecompte
Laboratory Supervisor

R.L. = Reporting Limit
Test methods may be modified from specified reference method unless indicated by an *
Site Analyzed=K-Kingston,W-Windsor,O-Ottawa,R-Richmond Hill,B-Barrie

CADUCEON ENVIRONMENTAL LABORATORIES
Client committed. Quality assured.

CERTIFICATE OF ANALYSIS

Final Report-Microbiology

C.O.C.: G77590 **REPORT No. B19-34320**

Report To:

Oakridge Environmental
PO Box 431 ,
Peterborough ON K9J 6Z3 Canada
Attention: Dan MacIntyre

Caduceon Environmental Laboratories
285 Dalton Ave
Kingston Ontario K7K 6Z1
Tel: 613-544-2001
Fax: 613-544-2770

DATE RECEIVED: 23-Oct-19
DATE REPORTED: 28-Oct-19
SAMPLE MATRIX: Groundwater

JOB/PROJECT NO.: Warsaw
P.O. NUMBER: 17-2326
WATERWORKS NO.

	Parameter		Total Coliform	E coli	Heterotrophic Plate Count		
	Units		cfu/100mL	cfu/100mL	cfu/mL		
	R.L.		1	1	10		
	Reference Method		MOE E3407	MOE E3407	SM9215D		
	Date Analyzed/Site		23-Oct-19/K	23-Oct-19/K	23-Oct-19/K		
Client I.D.	Sample I.D.	Date Collected					
TW-2	B19-34320-1	22-Oct-19	0	0	< 10		
TW-8	B19-34320-2	22-Oct-19	0	0	< 10		

E. Livermore

R.L. = Reporting Limit
Test methods may be modified from specified reference method unless indicated by an *
Site Analyzed=K-Kingston,W-Windsor,O-Ottawa,R-Richmond Hill,B-Barrie

Evan Livermore
Senior Microbiology Analyst

CADUCEON ENVIRONMENTAL LABORATORIES
Client committed. Quality assured.

CERTIFICATE OF ANALYSIS

Final Report-Microbiology

C.O.C.: G77591 **REPORT No. B19-35328**

Report To:

Oakridge Environmental
PO Box 431 ,
Peterborough ON K9J 6Z3 Canada
Attention: Dan MacIntyre

Caduceon Environmental Laboratories
285 Dalton Ave
Kingston Ontario K7K 6Z1
Tel: 613-544-2001
Fax: 613-544-2770

DATE RECEIVED: 31-Oct-19
DATE REPORTED: 04-Nov-19
SAMPLE MATRIX: Groundwater

JOB/PROJECT NO.: Warsaw
P.O. NUMBER: 17-2326
WATERWORKS NO.

	Parameter		Total Coliform	E coli	Heterotrophic Plate Count		
	Units		cfu/100mL	cfu/100mL	cfu/mL		
	R.L.		1	1	10		
	Reference Method		MOE E3407	MOE E3407	SM9215D		
	Date Analyzed/Site		31-Oct-19/K	31-Oct-19/K	31-Oct-19/K		
Client I.D.	Sample I.D.	Date Collected					
TW-1	B19-35328-1	30-Oct-19	0	0	10		

E. Livermore

Evan Livermore
Senior Microbiology Analyst

R.L. = Reporting Limit
Test methods may be modified from specified reference method unless indicated by an *
Site Analyzed=K-Kingston,W-Windsor,O-Ottawa,R-Richmond Hill,B-Barrie

APPENDIX J

Climate Data

The minimum number of years used to calculate these Normals is indicated by a code for each element. A "+" beside an extreme date indicates that this date is the first occurrence of the extreme value. Values and dates in bold indicate all-time extremes for the location.

Data used in the calculation of these Normals may be subject to further quality assurance checks. This may result in minor changes to some values presented here.

PETERBOROUGH TRENT U
ONTARIO

Latitude:
44°22'00.000" N
Longitude:
78°18'00.000" W
Elevation:
198.10 m
Climate ID:
6166455
WMO ID:
TC ID:

Related Data

Calculation Information Station / Element Metadata 1971-2000 Climate Normals

Additional Search Options

Nearby Stations with Data

Download Data

Normals Station Data
(all elements)
CSV XML
Temperature

1981 to 2010 Canadian Climate Normals station data

Temperature

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year	Code
Daily Average (°C)	-8.4	-6.5	-1.3	6.3	12.8	18.0	20.7	19.4	15.0	8.4	2.4	-4.0	6.9	C
Standard Deviation	3.3	2.7	2.0	1.5	1.8	1.4	1.2	1.3	1.3	1.3	1.4	3.1	1.4	C

1981 to 2010 Canadian Climate Normals station data

Temperature

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year	Code
Daily Maximum (°C)	-3.7	-1.5	3.7	11.7	18.7	24.0	26.8	25.4	20.6	13.4	6.3	-0.0	12.1	C
Daily Minimum (°C)	-13.0	-11.4	-6.4	0.8	6.8	11.9	14.6	13.3	9.4	3.4	-1.5	-7.9	1.7	C
Extreme Maximum (°C)	12.0	12.0	25.0	30.5	33.0	34.5	**36.5**	36.0	34.0	28.3	21.1	18.5		
Date (yyyy/dd)	1995 / 14	1984 / 23	1998 / 30	1990 / 28	2006 / 30	1988 / 14	**1988 / 07**	2006 / 01	2002 / 09	1971 / 02	1974 / 01	1982 / 03		
Extreme Minimum (°C)	**-35.5**	-33.0	-29.0	-15.6	-3.5	0.0	5.0	2.0	-3.5	-8.9	-17.2	-33.0		
Date (yyyy/dd)	**1994 / 16**	1979 / 18	1984 / 08	1972 / 07	1984 / 03	1980 / 12	1968 / 30	1986 / 28	1980 / 29	1975 / 31	1977 / 27	1980 / 25		

Precipitation

1981 to 2010 Canadian Climate Normals station data

Precipitation

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year	Code
Rainfall (mm)	22.4	23.1	34.0	60.9	88.7	83.0	73.6	87.0	92.4	75.7	73.3	35.0	749.0	C
Snowfall (cm)	38.9	28.8	23.7	6.1	0.0	0.0	0.0	0.0	0.0	1.4	13.9	34.3	147.2	C
Precipitation (mm)	57.3	48.8	56.5	66.4	88.7	83.0	73.6	87.0	92.4	77.0	85.5	66.0	882.1	C
Snow Depth at Month-end (cm)	19	14	2	0	0	0	0	0	0	0	2	12	4	D
Extreme Daily Rainfall (mm)	44.6	46.1	51.1	36.8	41.5	68.4	**239.8**	60.0	60.8	57.3	47.6	36.6		
Date (yyyy/dd)	1995 / 15	1985 / 23	1980 / 21	1984 / 04	2006 / 11	2002 / 11	**2004 / 14**	1995 / 31	1996 / 11	1995 / 05	1999 / 02	1972 / 12		
Extreme Daily	22.8	30.0	**35.2**	24.1	4.3	0.0	0.0	0.0	0.0	14.5	25.7	33.0		

1981 to 2010 Canadian Climate Normals station data

Precipitation

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year	Code
Snowfall (cm)														
Date (yyyy/dd)	1982 / 31	2003 / 22	**1985 / 04**	1975 / 03	1977 / 08	1968 / 01	1968 / 01	1968 / 01	1968 / 01	1976 / 22	1971 / 29	1983 / 06		
Extreme Daily Precipitation (mm)	45.0	46.1	62.4	36.8	41.5	68.4	**239.8**	60.0	60.8	57.3	47.6	51.3		
Date (yyyy/dd)	1979 / 24	1985 / 23	1980 / 21	1984 / 04	2006 / 11	2002 / 11	**2004 / 14**	1995 / 31	1996 / 11	1995 / 05	1999 / 02	1972 / 12		
Extreme Snow Depth (cm)	50	**55**	45	18	0	0	0	0	0	7	23	53		
Date (yyyy/dd)	1984 / 31	**2001 / 09**	2001 / 06	1987 / 02	1982 / 01	1982 / 01	1982 / 01	1982 / 01	1982 / 01	1992 / 19	1997 / 16	1992 / 12		

Thornthwaite Estimates of Potential Evapotranspiration

Site: Peterborough Trent

Latitude: 44.4
Hemisphere: N

month	mean monthly air temp °F	mean monthly air temp °C	unadj PET mm	adj coeff	Thornthwaite estimates adj PET mm	Thornthwaite estimates adj PET in
Jan		-8.4	0	0.76	0	0.00
Feb		-6.5	0	0.87	0	0.00
Mar		-1.3	0	0.99	0	0.00
Apr		6.3	29	1.12	32	1.28
May		12.8	62	1.23	76	3.00
June		18.0	89	1.30	115	4.54
July		20.7	103	1.27	131	5.18
Aug		19.4	96	1.18	113	4.46
Sept		15.0	73	1.05	77	3.02
Oct		8.4	39	0.92	36	1.42
Nov		2.4	10	0.80	8	0.33
Dec		-4.0	0	0.74	0	0.00
	Annual Total	-	502	-	**590**	**23.23**

annual heat index I = 36.11
constant a = 1.07

APPENDIX K

Well Certification Program

Well Certification Program

1.0 Introduction

All future development lots, including lots containing the test wells, are subject to this *Well Certification Program*. The lots containing TW-1 and TW-2 (i.e., historical wells), will require an inspection by a licensed well contractor who will provide (in writing) an opinion as to whether the well's annular seal meets the requirements of O. Reg. 903, as amended. It is the responsibility of each lot owner to ensure that this program is undertaken.

For all lots, the Program requires that prior to issuance of a Building Permit for the lot, a Qualified Person is to be retained to provide assistance with respect to the placement and testing of private wells. A Qualified Person (QP) is a Hydrogeologist who is a licensed Professional Geoscientist in the Province of Ontario (APGO) or a licensed Professional Engineer with appropriate hydrogeological training and experience.

This Program draws upon the results of the hydrogeological study submitted in support of the development, County of Peterborough peer review, the Ontario Building Code, MOE Procedure D-5-5 and/or the Ontario Drinking Water Quality Standards. Nothing in this Program should limit the Qualified Person from modifying the requirements as needed to suit the site conditions.

2.0 Water Wells

The Program requires that a water well is to be constructed under the supervision of, and tested by, a Qualified Person who will certify as part of a written report that a drilled well has been constructed, meeting the minimum construction, water demand and water quality requirements as set forth herein. The report shall be submitted to the municipality as part of the Building Permit application. The Qualified Person is to ensure that the following tasks are completed:

- As a general guide, unless the Qualified Person recommends otherwise, new drilled wells are to be constructed at the locations illustrated on the accompanying Conceptual Servicing Plan - Figure 18, from the Hydrogeological and Site Servicing Study, Oakridge Environmental Ltd., February 2020.

- Wherever possible, the distance separating wells and sewage systems is to be maximized, while complying with all required setbacks of O. Reg. 903, as amended, and the Ontario Building Code.

- Once the preceding constraints have been accommodated, a location for the new wells shall be staked-out in the field. The lot owner and/or the QP shall ensure that the prospective well location occurs within the recommended area shown on the Conceptual Servicing Plan - Figure 18, from the Hydrogeological and Site Servicing Study, Oakridge Environmental Ltd., February 2020. Any well constructed outside this area must be monitored over a period of at least 2 years. Following the 2 year monitoring period, a building permit shall be issued only in the instance where a

QP has verified the reliability and provided a clearance letter.

- All wells are to be drilled, constructed and sealed in accordance with O. Reg. 903, as amended at the location staked-out in the field.

- The target aquifers for this development are the Basal/Shallow Limestone Aquifer and/or the Intermediate Limestone/Karst Aquifer. Previous test well construction (during the hydrogeological study) has indicated that this aquifer is suitable. A deeper non-potable aquifer occurs on the site. As a result, well drilling contractors shall be instructed not to drill into the deeper aquifer. The deeper aquifer is clearly identifiable in the drill cuttings, as the cuttings will appear pink/purple and/or green in colour. This is characteristic of the Shadow Lake Formation limestone and shale in the area.

- If the drilling contractor intersects the saline water associated with the Shadow Lake Formation described above, the well shall be abandoned immediately in accordance with O. Reg. 903, as amended.

- The Qualified Person shall conduct a pumping test of the new well and provide a report on the test results. The pumping test shall be conducted anytime between August 15th and October 15th in order to verify the connection with the main aquifer identified on site. The pumping test shall have a 3-hour minimum duration at a predetermined pumping rate as per the anticipated peak demand requirement referenced in MOE Procedure D-5-5 (i.e., typically 18.75 L/min for a 4 bedroom residence). Following the pumping test there must be at least 95% water level recovery within 12 hours. The pumping test is to be conducted to determine if the well has an adequate and sustainable yield and whether supplemental water storage is required. A longer pumping test may be required in the case of a low yield well. The testing may be modified by the Qualified Person to suit the individual conditions, provided the rationale for such modifications is provided in the report.

- The pumping test is to include water sampling and analysis of the parameters listed in MOE Procedure D-5-5. Further well development may be necessary to demonstrate that turbidity is acceptable (i.e., not to exceed 5 NTU, in the absence of a bacteria issue). Note: wellhead turbidity measurements can be more representative than laboratory reported data in some instances.

- The Qualified Person shall provide a recommendation with regard to the appropriate treatment requirements to ensure a safe water supply. An opinion from a water treatment specialist may be required.

- Upon completion of the pumping test, the Qualified Person should advise the lot owner as to whether or not the well is acceptable for future use.

- In the event that any well is found to produce insufficient supply for domestic use, the Qualified Person shall instruct the lot owner as to the requirements of O. Reg. 903, as amended, with respect to the requirement for proper well abandonment. The Qualified Person supervising the well construction shall also

ensure that the driller's contract includes appropriate stipulations concerning well abandonment. The lot owner should be aware that additional costs for well abandonment may be incurred, in the event that a well is not successful. The abandonment water well record shall be retained by the well owner and a copy included in the Qualified Person's report.

- In the event that a well is found to be unacceptable, a second attempt to construct a new well can be undertaken if desired. The Qualified Person shall ensure that the testing procedures outlined above are conducted on all new wells. While there is no limit to the number of attempts that may be undertaken, the Qualified Person may provide recommendations for an alternative water supply, should well construction on the lot be deemed "unlikely to succeed" (see below).

3.0 Alternative Water Supply

In the event that a minimum of three attempts to obtain a suitable water source for the lot are not successful, the Qualified Person may recommend any of the following alternatives, subject to obtaining permission from the municipality.

Shared Wells

- In the event that a suitable well, with sufficient excess yield is available on an immediately adjacent lot, the subject lot owner may enter into a private agreement with that lot owner for the sharing of the adjacent lot well. The owner of the subject lot will be responsible for arranging any legal agreements, contracts and/or easements necessary to facilitate the well sharing, sharing of water treatment (if applicable) sharing of well maintenance tasks/costs and sharing of wellhead protection tasks/costs.

- Prior to any such connection to a neighbouring well, the Qualified Person must either:

  a) review an existing *Well Certification Program* report to verify that the neighbouring well has the needed yield and quality to support the combined water demands, or

  b) conduct a new pumping test as outlined above, modified as needed to be applicable to the combined water demands, and

  c) shall prepare the *Well Certification Program* report for the subject lot (see additional requirements, below) indicating how the subject lot will be serviced for water supply by the neighbouring well.

- Although there is no specific prohibition with regard to the sharing of private wells, the lot owner should be discouraged from utilizing this alternative unless absolutely necessary.

- Under no circumstances should a single well be connected to more than five (5) residences.

4.0 Report

A *Well Certification Program* report is to be prepared by a Qualified Person and submitted to the municipality in support of the application for a Building Permit for each lot. The report shall include the following.

- A description of the subject lot with regard to size, topography, drainage, soil conditions and any sensitive environmental features. Information may be obtained from a combination of in-field observations and descriptions provided in the hydrogeological study.

- A recent survey of the lot boundaries.

- The location of the on-site water well (or alternative supply, in exceptional circumstances). The location (footprint) of the on-site sewage system (existing or proposed).

- A copy of the well record(s).

- A description of the required pumping test and water quality data.

- A professional opinion indicating that the source and treatment system (as outlined in the report), will provide an adequate and sustainable supply of acceptable quality water for the subject lot. A summary of any unknowns or limitations on that opinion shall also be provided.

- Recommendations regarding, but not limited to: water treatment; supplemental water storage; wellhead protection; regular testing; maintenance; water conservation, and any other matters deemed appropriate by the Qualified Person.

***