REPORT

Proposed Lafarge Pit No. 3 Extension

Level 1 and 2 Hydrogeology and Hydrology Report

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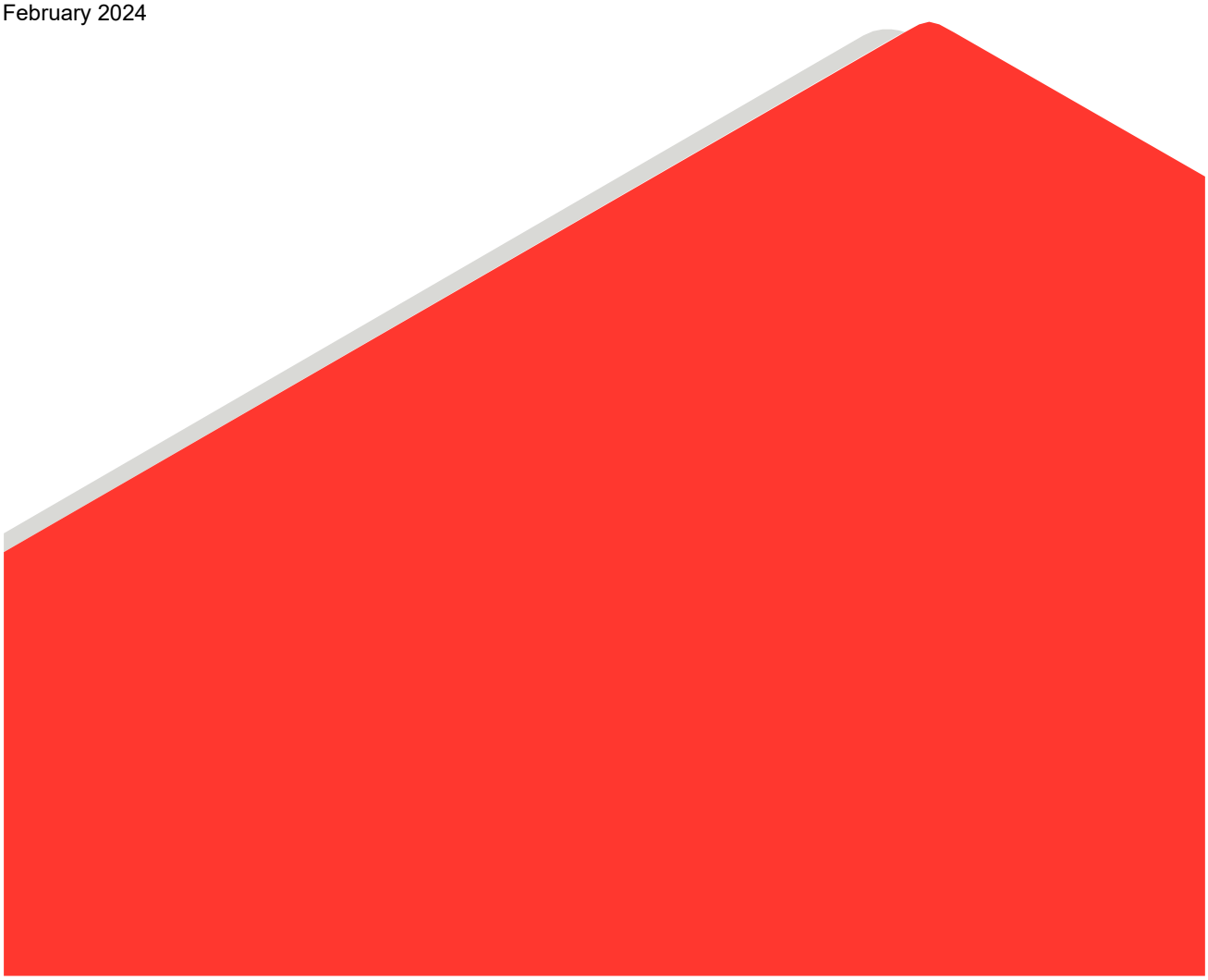

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1.0 INTRODUCTION

WSP Canada Inc. (WSP) was retained by Lafarge Canada Inc. (Lafarge) to prepare a Level 1 and 2 Hydrogeology and Hydrology Study and Report in support of a Class A licence application under the Aggregate Resources Act for the proposed Pit No. 3 Extension lands. The subject property is located at 17923 Shaw's Creek Road, Town of Caledon, Ontario, herein referred to as "the Site" (Figure 1). The Site operation is proposed to be contiguous with the active Lafarge Pit No.3 to the immediate northeast. Extraction will occur above, but within 1.5 metres (m) of, the established water table elevation.

The ultimate objectives of the study are as follows:

1) Characterize the baseline hydrogeological and hydrological conditions in the vicinity of the Site under the Existing Scenario;

2) Assess the potential effects, if any, of the proposed Operations and Rehabilitated Scenarios on groundwater and surface water resources.

2.0 POLICY CONSIDERATIONS

This report has been completed to address the requirements of:

- The Ontario Ministry of Natural Resources and Forestry (MNRF) Provincial Standards;
- The Provincial Policy Statement (2020);
- Credit Valley – Toronto and Region – Central Lake Ontario (CTC) Approved Source Protection Plan (2015);
- Town of Caledon Official Plan (Consolidated April 2018);
- Region of Peel Official Plan (2022);
- The Growth Plan for the Greater Gold Horseshoe (2020); and,
- The Greenbelt Plan (2017).

Key hydrogeologic/hydrologic considerations set out by the above policies include:

- Water resources will be protected, maintained, and, where applicable, enhanced and there will be no unacceptable impacts.
- Identify an appropriate monitoring program to protect water resources;
- Minimize potential negative impacts, including cross-subwatershed impacts, and identify surface water and groundwater features;
- Ensure municipal drinking water supply and designated vulnerable areas are protected;
- Consider the potential impacts of the proposed extension on mapped Highly Vulnerable Aquifers (HVA) and Significant Groundwater Recharge Areas (SGRAs) in the Peel Region Official Plan (2022) Schedule A-2, and schedule A-3 respectively;
- Protect vulnerable surface water and groundwater sensitive features and their hydrogeologic/hydrologic functions;
- Maintain linkages and related functions between surface water features and groundwater features;

- Promote efficient and sustainable use of water resources, including practices for water conservation sustaining water quality;
- Describe how the connectivity between key hydrogeologic/hydrologic features will be maintained before, during and after extraction;
- Describe how private and agricultural water supplies will be protected;
- Confirm that the Site does not constitute a valley and stream corridor draining more than 125 hectares;
- Demonstrate no negative impact to groundwater recharge and discharge;
- Describe measures to protect water resources from contamination from on-Site equipment; and,
- Ensure there are no adverse thermal impacts to sensitive nearby water features.

The Site area is noted as a High Potential Mineral Aggregate Resource Area in both the Town of Caledon and Region of Peel Official Plans.

3.0 PROPOSED DEVELOPMENT

This study considers three development scenarios:

- Existing Scenario;
- Operations Scenario (full pit build-out); and,
- Rehabilitated Scenario (fully rehabilitated).

The Site Plans (MHBC, 2024) are included in Appendix A. The Existing Scenario is the subject of Section 4 and 5 of this report and is described therein. A brief overview of the Operations and Rehabilitated Scenarios is provided below.

3.1 Operations Scenario

The proposed licence area is approximately 25.6 hectares (ha) with a limit of extraction of 20.9 ha. The proposed maximum annual aggregate extraction limit is 1 million tonnes per year.

In the Operations Scenario, aggregate extraction will be completed in four phases beginning with Phase 1 in the east, moving to Phase 2 centrally, moving to Phase 3 to the west, and finishing at Phase 4 in the northwest. The pit floor elevation will be graded in a generally southerly direction with a maximum elevation of 390.4 metres above sea level (masl) in the north to a minimum elevation of 389 masl in the south (consistent with the high groundwater table elevation – see Section 5.3). The impact assessment described herein considers an Operations Scenario “snapshot” wherein all Phases are fully excavated; such an approach is conservative with respect to water impacts.

Setbacks will be as follows: 15 m along the south property boundary, 30 m along the west flank buffering Shaws Creek Road and residential lots, 15 m along the Elora-Cataract Trailway to the north with an additional allowance to preserve on-Site wetland UW3, and no setback along the eastern flank to establish access with the adjacent Pit No.3.

Operations will not require any pumping or active dewatering. However, a spillway into the adjacent Pit No.3 may be required from an operational standpoint to avoid minor pit floor flooding that might occur during wet climatic events.

The Operations Scenario would be serviced by loaders, on site trucks and/or conveyors and shipping trucks, a portable screening plant, and a portable crushing plant. No fuel would be stored on-Site.

3.2 Rehabilitated Scenario

The Rehabilitated Scenario consists of backfilling the pit floor with excess soils ranging in thickness from less than 1 m to approximately 12 m. The Site re-grading has been designed to restore and further enhance drainage to the on-Site wetland "UW3". The Site extraction area will be rehabilitated to agricultural (61%) and forest (39%) land use.

4.0 PHYSICAL SETTING

The following subsections provide a general overview of the Site and surrounding areas physical setting under the Existing Scenario.

4.1 Climate

The Site is located approximately 13.5 kilometres (km) south of the Environment Canada Orangeville climate station (ID: 6155790). The Orangeville station period of record spans 52 years (1962 – 2015) and is considered a representative dataset to characterize average climatological conditions in the vicinity of the Site, particularly for use in water budget analysis (Section 5).

Based on the Orangeville station data, average annual precipitation is 895 millimetres per year (mm/yr) and the average annual temperature is 6.1 degrees Celsius. Based on Site land use, the evapotranspiration is estimated to be 553 mm/yr with a resulting surplus of approximately 342 mm/yr.

4.2 Existing Land Use

The existing Site land use is predominately agricultural with the exception of the triangular sub-parcel to the west which is meadow (Figure 1). This meadow area was an historic aggregate extraction site, creating what is now a basin-like depression that encloses an unevaluated wetland ("UW3").

Northwest of the Site lies the Elora Cataract Trailway, a former rail corridor, and north of that a 15 hectare parcel of land owned by Lafarge. This north parcel consists of a mix of meadow, woodlot, wetlands and dugout ponds which we also understand to be historic aggregate extraction sites.

Northeast of the Site is Lafarge's Pit No.3, an active pit that is licensed for below water extraction. East, southeast and west of the Site are agricultural lands. Immediately south of the Site are rural residences.

4.3 Topography

Site topography consists of undulating, hummocky terrain (Figure 2). Maximum ground elevation occurs at the northeast of the Site at an approximate elevation of 404 masl; ground surface gradually declines to the west and southwest from this high. There are two main depressions within the Site: the previously described meadow along the north-central portion of the Site, which has a topographic minimum of 390 to 391 masl (at UW3), and another depression within the south portion of the Site with a topographic minimum of 390 masl.

4.4 Drainage

The Site is internally drained and there are no permanent surface water features. Surface water drains to depressions within the Site and undergoes either evapotranspiration or infiltration. There are two main depressions within the Site: the meadow along the north-central portion of the Site, which contains wetland UW3, and another depression within the south portion of the Site. Additional information on Site catchments is provided in Section 5 Water Budget.

Regionally, the Site lies within the Credit River watershed (CVC Subwatershed #18), with the West Credit River branch flowing approximately 1.3 km southeast of the Site.

4.5 Wetlands

4.5.1 On-Site

UW3 is the only on-Site wetland (Figure 1). UW3 is observed to be wet after the spring freshet and after significant precipitation events but is otherwise dry. Despite the presence of surface water during wetter climatic periods, water level monitoring at UW3 indicates that the water table remains below ground surface at this location (Section 5.3) and thus the wetland is conceptualized as being supported exclusively by runoff when wet at ground surface.

4.5.2 Off-Site

Local surface water features external to, but within 120 m of, the Site include a series of shallow wetlands to the north, namely: UW1, UW2A, UW2B, and EW1 (Figure 1). The Elora Cataract Trailway acts as a catchment divide between these surface water features and the Site; as such, they do not interact with Site drainage.

EW1 is a Provincially Significant Wetland and is part of the greater Cataract Southwest Wetland Complex. It is understood from conversations with Lafarge staff that UW2A and UW2B are historic below-water aggregate pits; this is consistent with the clarity of the ponded water and gravelly / cobbly substrate material. The origin of UW1 is not known; however, based on its gradually sloping sides, and the abundance of macrophytes relative to UW2A/2B, the wetland appears to be naturally-occurring (or at least naturalized).

These wetlands have no observed inlets or outlets. As such, when ponded, their presence is in part dependent on groundwater flow-through. However, the features are also subject to atmospheric influences from precipitation, runoff, evapotranspiration, and freeze / thaw. As such, water levels at these features may not be directly indicative of groundwater levels. Furthermore, the ponds are often dry for extended periods in both summer and winter months. Nonetheless, when ponded, the wetlands generally indicate water levels greater than those observed on-Site. In other words, these features are considered hydraulically upgradient of the Site. Section 5.3 provides more detail on the hydraulic behaviour of these features in relation to the Site.

4.6 Geology and Hydrostratigraphy

The Site is located within an area of glaciofluvial outwash deposits which form the aggregate resource (Figure 3). These deposits are part of a larger complex of outwash deposits which stretch from north of Orangeville to south of Erin (Cowan, 1976). The complex was deposited by glacier derived melt water during the Port Huron stadial approximately 13,000 years ago. The deposit consists mainly of stratified sand and gravel sized materials with occasional cobbles and thin, discontinuous lenses of finer sand and silt materials. An unconfined aquifer, a principal subject of this report, also resides within this deposit.

In the area of the Site the glaciofluvial outwash deposit ranges in thickness within 7 m to 15 m based on Site borehole logs and local Ministry of Environment, Conservation and Parks (MECP) water well records. Underlying the glaciofluvial outwash deposit is a relatively thick (~ 30 m) sequence of silt and clay-based material down to bedrock. The Goat Island-Gasport (Amabel) Formation dolostone bedrock, a regionally extensive aquifer and source of groundwater for both domestic and municipal water well supplies, is mapped as being present beneath the Site (AquaResource, 2009), although several water well records in the area indicate the upper bedrock may consist of shale.

Based on the geologic characterization, the major hydrostratigraphic units include, from top down:

1) A sand and gravel unconfined aquifer;

2) A silt and clay aquitard; and

3) A bedrock aquifer.

In some localized instances a confined granular subunit may be present within the silt and clay aquitard or at the bedrock contact.

Figure 4 provides a geologic / hydrostratigraphic cross-section based on Site borehole logs and MECP water well records.

4.7 Local Water Use

The MECP water well database includes 15 water well records within 500 m of the Site (see Figure 1 for location, Appendix B contains the well records). According to the records, 10 wells are domestic water use, two are livestock use, two wells are observation wells and one well is abandoned. 12 wells are completed in the bedrock aquifer, two wells are completed within confined overburden units and the remaining well (an observation well) is completed in the unconfined aquifer. No water supply wells are completed within the unconfined aquifer that is the subject of the proposed resource extraction.

According to the MECP Permit To Take Water database, the closest major water taking (over 50,000 litres per day) is the communal water supply for Caledon Ski Club (PTTW No. 1236-83DO27), which lies approximately 1 km east of the Site (Figure 1).

4.8 Source Water Protection Considerations

The Site's location within the Credit Valley Source Protection Area is examined as part of the study. The Site does not lie within any Wellhead Protection Areas (WHPAs) as per the CTC Source Protection Region: Approved Source Protection Plan (CTC Source Protection Committee, 2022).

The Site's relation to other vulnerable area classes is determined based on mapping conducted as part of the Peel Region Official Plan (2022). The Site, like much of the northern portion of the Credit River watershed, appears to lie within a regional Highly Vulnerable Aquifer (HVA) and Significant Groundwater Recharge Area (SGRA) area as per Schedule A-2 and A-3 of the Peel Region Official Plan, respectively. The HVA index is a reflection of the susceptibility of aquifers to sources of surface contamination relative to the degree of protection afforded by overlying materials. It should be noted that aggregate extraction is not a prescribed drinking water threat under the *Clean Water Act* therefore the Site is not considered a water quality threat within these areas.

5.0 FIELD PROGRAM

A field investigation program was initiated at the Site in 2016 with the objectives of characterizing hydrologic and hydrogeologic conditions, including: geologic units, water levels, groundwater temperature, groundwater chemistry and hydraulic conductivity. The monitoring network includes the following stations (Figure 1):

- Seven monitoring wells (07-DH-154, 07-DH-160, 07-DH-169, MW16-01A/B (nest), MW16-02, and an inactive domestic well north of the Site on Lafarge property ("House Well").
- An on-Site wetland piezometer (UW3).
- Four off-Site surface water monitors equipped with staff gauges (UW1, UW2A, UW2B, EW1).

The following subsections describe the methodology and results of the field program in detail.

5.1 Borehole Drilling and Monitoring Well Installation

Site borehole logs are provided in Appendix B and the monitoring well locations are shown on Figure 1. The following is noted:

- **Well Location.** The wells were strategically placed around and within the Site to establish Site-wide water level patterns. The well locations and elevations were surveyed by a professional land surveyor. The UW3 monitor was surveyed by WSP Golder field staff.

- **Completion Date.** The 07-series monitoring wells were installed in 2007 as part of the initial resource evaluation conducted by Lafarge. 07-DH-154 is located in Lafarge lands north of the Site whereas 07-DH-160 and 07-DH-169 are located within the Site. The 16-series monitoring wells were installed in 2016 to provide Site-wide coverage. The UW3 piezometer was installed on May 15, 2019. The House Well, a historic former domestic supply well on Lafarge property, is now used as a monitoring well.
- **Screened Interval.** 07-DH-154, 07-DH-160, 07-DH-169, MW16-1A, MW16-2 and UW3 are completed in the unconfined aquifer. MW16-1B, located adjacent to its nest partner MW16-1A, is completed underneath the unconfined aquifer in the silt and clay aquitard for the purpose of measuring vertical gradients between the two units. The House Well is completed within bedrock.
- **Geology.** The borehole logs support the conceptual hydrostratigraphy of 1) an unconfined sand and gravel aquifer, overlying: 2) a silt and clay aquitard, overlying: 3) a bedrock aquifer. The following descriptions summarize the borehole log observations:
- **Unconfined Sand and Gravel Aquifer:** The unconfined aquifer consists largely of brown fine to coarse sand, often silty, with varying proportions of gravel and cobbles. The observed thickness of this unit ranges from 7.62 m to 14.33 m.
- **Silt and Clay Aquitard**: The transition from the unconfined aquifer to the underling aquitard varies from abrupt to gradual. Typically, the transition to aquitard is denoted by the predominance of grey-brown to grey silt. The presence of clay appears more common at greater depths. Well record 4908398, just off-Site, suggests that the aquitard is present down to top of bedrock with a thickness of approximately 26 m.
- **Bedrock Aquifer:** Well record 4908398 indicates that bedrock near the Site is approximately 39 m below ground surface. The log reports grey shale underlain by grey dolostone underlain by grey sandstone. The dolostone reported in the log is the Goat Island-Gasport (Amabel) Formation.

5.2 Surface Water Monitor Installation

Four ponds / wetlands in the Lafarge lands north of the Site were instrumented with staff gauges in 2016; namely UW1, UW2A, UW2B and EW1 (Figure 1). None of these features are observed to have surficial inlets or outlets; as such, only water levels (i.e., not flow) are monitored.

The UW3 monitor, whereas technically a groundwater piezometer, is utilized to examine the relationship between groundwater and surface water at the UW3 wetland. The piezometer is completed 0.58 m below ground surface within sand and gravel material.

5.3 Water Level Measurements

Water level monitoring at the Site began in 2016 with quarterly frequency but was increased to monthly frequency after June 2017. The period of record for baseline groundwater level monitoring at the Site spans from June 2016 to December 2020. Monitoring wells 16-2 and 07-DH-169 continue to be monitored to present as part of the monthly monitoring program for the existing and adjacent Lafarge Pit No. 3. Monitoring events included both manual readings at wells using a water level probe and taking staff gauge readings at surface water stations.

Water levels are listed in Table 1. Hydrographs for groundwater and surface water monitors are shown on Figures 5A and 5B. Lastly, an inferred water table map for the unconfined sand and gravel aquifer is provided on Figure 6. The following trends are noted:

- The unconfined aquifer groundwater levels vary between +/- 1 m or less annually (Figure 5A). The hydrographs indicate that the highest groundwater elevations typically occur during late spring / early summer and the lowest groundwater elevation typically occur during late fall /early winter. These patterns

are consistent with a fairly deep unconfined system that receives the bulk of its recharge after the freshet. That being said, the highest groundwater elevations across the Site were recorded during May 2019 after a particularly wet spring / early summer. Although the water level measurement at UW3 was also relatively high in March 2020, the conditions recorded in May 2019 represent the most comprehensive estimate of the highest groundwater elevation across the entire Site.

- Depending on the well and time of year, depth to water at wells within the Site can vary from 4.4 m to 13.5 m below ground surface (Table 1).
- The wetlands north of the Site, when ponded, exhibit water level patterns similar to, but greater in elevation, than those of on-Site wells (Figure 5A). Well 07-DH-154, which lies north of UW1, further confirms that water levels are greater north of the Site. As such, the wetlands are considered upgradient of the Site. The wetlands exhibited a typical hydroperiod response: water levels rise during the spring freshet and slowly decline into late summer; thereafter the wetlands are largely dry for the remainder of the year. The 2017 data shares a somewhat similar pattern although the extent of the wet hydroperiod is dominated by an unusually wet June.
- UW3 water level measurements are limited to wet periods during 2019. Access to the wetland during summer was prevented as a result of wild (poison) parsnip overgrowth surrounding the feature. When measured, the groundwater level was consistently below ground surface (within 0.13 to 0.54 m) but raised relative to the groundwater elevation at surrounding wells. This would suggest that the UW3 area, which is in effect a drainage “bowl”, may be an area of increased infiltration resulting in slightly localized water table mounding.
- The difference in water level between unconfined sand and gravel aquifer (MW16-1A) and the underlying silt aquitard (MW16-1B) varies within 0.5 m (Figure 5B). Vertical gradient direction is most frequently observed as downwards; however, upward gradients are observed during late summer into early winter.
- Relatedly, bedrock water levels are at least 3 m lower than those in the overburden (Figure 5B). Furthermore, the bedrock hydrograph is subdued relative to the seasonal behaviour observed in the overburden system.
- An inferred high-water table map was developed using water levels measured during the May 31, 2019 monitoring event (Figure 6). Consistent with other monitoring events, the on-Site flow pattern during this period is from roughly northwest to southeast. On-Site, the high-water table ranges from approximately 390.4 masl in the northwest to 389 masl in the eastern corner.

5.4 Groundwater Temperature

Baseline thermal conditions within the unconfined aquifer were established by taking vertical temperature profiles within each well during each monitoring event (Table 2). The profiles were measured using a water level meter with a built-in temperature probe. The temperature in each well was measured at the bottom of the well to the water table surface at approximately 1 m intervals.

Collectively, groundwater temperatures range from 4.6 to 16.1°C with an average temperature of 9.1°C. For a given well, measurements typically indicate cooler water at greater depth during the summer and warmer water at greater depth during the winter; these patterns are the result of both seasonal climate patterns and the associated temperature of infiltrating water (rain versus snow melt) but are also tempered by the high specific heat capacity of water and the insulating effect of the soil.

Relatedly, the range of temperature fluctuation at a given well over the course of the year is inversely proportional to water table depth. For example, well 07-DH-169 typically has the greatest water table depth and displays the narrowest temperature range (7 to 10°C). Conversely, well 07-DH-154 has the shallowest water

table depth and displays a much broader temperature range (5 to 13°C). These observations are attributed to the buffering effect of the unsaturated zone soil thickness.

The temperature observations at monitoring well MW16-1A are worthy of additional comment. Water table temperatures at this well are often warmer or cooler than wells with similar water table depths further downgradient (for example 07-DH-160). For example, this occurrence is prominent during the period of October 2017 to January 2018, when MW16-1A water table temperatures were observed to be 4 to 8°C greater than those at 07-DH-160. This behaviour is likely attributable to the close proximity of MW16-1A to the wetlands north of the Site; in other words, MW16-1A is in the path of a thermal plume emanating from pond water.

5.5 Water Quality

Baseline water quality conditions were evaluated by taking groundwater samples from the overburden monitoring wells on December 5, 2016. The samples were collected using dedicated Waterra Model D-25 inertial pumps and 16-millimetre (5/8 inch) inside diameter polyethylene tubing. Prior to sampling, the wells were purged of a minimum of three well volumes of groundwater and allowed to recover to their approximate static water level at the time of sampling. The groundwater samples were collected into pre-supplied laboratory bottles, placed in coolers and delivered within twenty-four hours of sampling to AGAT Laboratories in Mississauga, Ontario.

The groundwater samples were analysed by AGAT Laboratories for the following parameters:

- Inorganic water quality parameters including metals;
- Petroleum hydrocarbons (F1 – F4);
- Volatile Organic Compounds (VOCs); and,
- Microbiology (E.Coli and Total Coliforms).

The water quality analysis results are provided in Appendix C. Parameter concentrations were compared to "Table 2: Full Depth Generic Site Condition Standards [SCS] in a Potable Ground Water Condition" from the Ministry of Environment, Conservation and Parks (MECP) *Soil, ground water and sediment standards for use under Part XV.1 of the Environmental Protection Act*, dated July 1, 2011.

- None of the inorganic parameters including metals were detected at concentrations higher than the Table 2 SCS criteria. Chlorides were found in all wells, suggesting impacts from road salting. Nitrates were found in all wells screened within the unconfined sand and gravel aquifer, suggesting impacts from fertilizer application to farm fields. In general, the metals concentrations were considered to be relatively low, except for concentrations of aluminum, barium, and iron; however, these parameters are often found to be naturally elevated in groundwater in southern Ontario. Water quality relative to the Ontario Drinking Water Standards aesthetic and operations guidelines, along with the high calcium and magnesium concentrations, were indicative of hard water.
- No petroleum hydrocarbons were detected.
- Of the VOCs, trace amounts of benzene, toluene, ethylbenzene and xylene (BTEX) compounds and n-hexane were detected in several of the unconfined sand and gravel aquifer monitoring wells. In all cases concentrations were below Table 2 SCS criteria. No VOCs were found in the silt aquitard well (MW16-1B).
- Total coliforms were detected in 07-DH-169, MW16-1A/B and MW16-2. E.Coli was detected in MW16-1B. The presence of bacteria within these wells may suggest impacts from farming operations. In addition, the relatively high concentrations of bacteria found at MW16-1A/B could be a result of their proximity to the

open pond wetlands to the north which may act as a transport pathway for waterfowl or other animal waste in the area.

5.6 Hydraulic Conductivity

Hydraulic conductivity, denoted by the symbol “K”, quantifies the ease with which water may travel through soil. The hydraulic conductivity of course-grained material, such as that found on-Site, may be estimated from the laboratory derived grain size distribution curve using the Hazen Method as follows:

$$K = C\ (d_{10})^2$$

Where:

- K is hydraulic conductivity in m/s;
- C is an empirical coefficient, which takes a value between 0.8 and 1.2 for medium to coarse sands (1.0 is used herein); and
- d_{10} is the diameter of the 10th percentile grain size of the material (effective grain size) in cm.

Grain size distribution curves for Site soils were obtained from the resource evaluation study (Lafarge, 2008) and are supplied in Appendix D. A total of 55 below-water samples are assessed in order to provide an understanding of the saturated hydraulic conductivity of the unconfined sand and gravel aquifer.

In summary, the calculated hydraulic conductivity of the unconfined sand and gravel aquifer material ranges from 6E-5 m/s to 4E-3 m/s with a geometric mean of 3E-4 m/s.

6.0 WATER BUDGET

A Site water budget was conducted to estimate the average annual water balance for the Existing, Operations and Rehabilitated Scenarios.

6.1 Approach

The water budget employs Environment Canada procedures (Johnstone and Louie, 1983) and is governed by the following generalized model:

Rainfall + Snowmelt – ET – Change in Soil Storage = Surplus

The Environment Canada Orangeville MET station data (1962 – 2015) provides monthly water budget summaries used to infer average annual climatic conditions at the Site. These water budgets contain monthly average precipitation, evapotranspiration and surplus values (in mm) for a range of water holding capacities (WHC).

For temperate regions, the change in soil storage is relatively stable year-round and represents a minor component of the annualized water budget; as such, it is ignored in this analysis.

The Site’s average annual precipitation totals approximately 895 mm/year. Whereas precipitation values are independent of the Site’s physical characteristics, evapotranspiration (and thus surplus) depends on the selected WHC for a given catchment. WHCs are specific to the soil type and land use and may be estimated using Table 3.1 of the *Ministry of Environment (MOE) Stormwater Management Planning and Design Manual* (MOE, 2003). WHC inputs for the Site are summarized in Table 3A.

Our approach further proportions surplus into either infiltration or runoff. Infiltration estimates for each land use may be obtained using the factors shown in Table 3A (per MOE, 2003). Land use at the Site is identified as either Crop Land (the farm fields), Light Bush (the hedgerows dividing the farm fields), Meadow (the basin area containing UW3), Forest (implemented during rehabilitation) and Pit (Operations extraction area). The infiltration

factor for each land use is estimated as the sum of the cover, soil type, and topography factors. These factors represent the proportion of surplus becoming infiltration with the remainder of the surplus going to runoff. It is important to note; however, that since the Site is internally draining, any runoff will eventually become infiltration as it reports to the low-lying depression areas. Any infiltration that reaches the saturated groundwater system will not stay within the Site but will instead join the regional groundwater system and flow southeast towards the Credit River.

The Existing Scenario considers relatively high permeability sandy soil whereas the Rehabilitated Scenario considers relatively low permeability silty soil (backfill). The result is a decrease in infiltration under the Rehabilitated Scenario (Table 3A), with the associated expectation of more surplus becoming runoff. As the water budget method described herein is approximate, and neither the native soil or backfilled soil is expected to be entirely uniform, the actual increase in runoff may be greater or less than that reported herein. However, whatever the decrease in infiltration factor, we expect that the majority of surplus will ultimately infiltrate within the Site given that the Rehabilitated Scenario is largely internally draining. In other words, runoff produced during the Rehabilitated Scenario will flow to, and ultimately infiltrate within, the UW3 basin over time.

6.2 Catchment Areas

Site catchment (i.e., drainage) areas are delineated for Existing, Operations and Rehabilitated Scenarios based on topographic mapping provided by MHBC (Appendix A).

6.2.1 Existing Scenario

Under the Existing Scenario the Site is divided into two catchments based on the direction of natural drainage (Figure 7): Catchment 101 drains towards UW3; Catchment 102 drains towards several depressions to the southwest of the Site. Pertinent characteristics of each catchment are summarized in Table 3B.

6.2.2 Operations Scenario

Under the Operations Scenario the Site is subdivided into three catchments reflecting the extraction area (Catchment 201), the intact UW3 and surrounding setback to the north (Catchment 202), and remaining setback area along the southwest and south perimeter (Catchment 203) (Figure 8). Catchment 201 delineates the limit of extraction plus an offset distance of approximately 7.5 m. Pertinent characteristics of each catchment are summarized in Table 3C.

6.2.3 Rehabilitated Scenario

Under the Rehabilitated Scenario the Site is subdivided into two catchment areas. The re-grading has been designed so that the majority of Site runoff will report to UW3 (Catchment 301) whereas a minor amount of runoff will flow to a depression at the south of the Site (Catchment 302) (Figure 9). Pertinent characteristics of each catchment are summarized in Table 3D.

6.3 Results

6.3.1 Existing Scenario

The water budget results for the Existing Scenario catchments are listed in Table 4A in both mm/yr and m^3/yr. As mentioned previously, the Orangeville climate station records an average annual precipitation of 895 mm/yr. Using a WHC of 150 mm, an evapotranspiration rate of 553 mm/yr and corresponding surplus of 340 mm/yr are also obtained from the Environment Canada dataset. Based on the catchment infiltration factors, infiltration rates of 244 mm/yr to 257 mm/yr are calculated with corresponding runoff of 83 mm/yr to 96 mm/yr.

Volumetrically, the Site receives approximately 230,000 m^3/yr of water, of which 141,600 m^3/yr is lost to evapotranspiration whereas the remaining 87,100 m^3/yr remains as surplus. Of this surplus, an estimated

64,100 m^3/yr immediately infiltrates, whereas 23,000 m^3/yr will runoff. Notably, 10,100 m^3/yr of runoff in Catchment 101 will report to UW3.

6.3.2 Operations Scenario

The water budget results for the Operations Scenario catchments are listed in Table 4B. The total Site surplus (81,800 m^3/yr) decreases slightly compared to the Existing Scenario (87,100 m^3/yr) as a result of increased evaporative loss within the pit. With the pit area now contributing exclusively to infiltration, the Operations Scenario infiltration (78,500 m^3/yr) increases by 28% over Existing Scenario infiltration (64,100 m^3/yr).

Existing Scenario Catchment 101 becomes Catchment 202, and decreases in size from 12.2 ha to 2.1 ha during Operations. As a result, the surplus reporting to UW3 is expected to decrease from approximately 10,100 m^3/yr to 1,400 m^3/yr.

6.3.3 Rehabilitated Scenario

The water budget results for the Rehabilitated Scenario catchments are listed in Table 4C. The Site surplus (82,500 m^3/yr) decreases slightly relative to the Existing Scenario (87,100 m^3/yr), due to the surficial soils being modified from sand to silt. Further, the change from sand to silt soils results in reduced infiltration (from 64,100 m^3/yr to 42,300 m^3/yr) and an associated increase in runoff (from 23,000 m^3/yr to 40,200 m^3/yr).

Runoff at UW3 is estimated to increase relative to the existing scenario (from approximately 10,100 m^3/yr to 39,000m^3/yr) as a result of the re-grading directing more overland flow to the wetland. Whereas 44% of the total Site area drained to UW3 under the Existing Scenario, 97% will be directed to UW3 under the Rehabilitated Scenario.

7.0 EFFECTS ASSESSMENT

The hydrogeological and hydrological effects of the Operations and Rehabilitated Scenarios relative to the Existing Scenario are addressed within the following categories:

- Water Quantity
- Water Quality
- Water Temperature

Within the context of these effects the following receptors are considered:

- Private water wells;
- Surface water features such as wetlands and cold-water streams.

7.1 Water Quantity

7.1.1 Groundwater

A key consideration of the project is that it is proposed to be above the established water table; no permanent pit pond will be formed, and no dewatering will be required. As such, no groundwater drawdown or water level decline is expected under the Operations or Rehabilitated Scenarios. No water quantity in surrounding water wells will be adversely impacted. Infiltration rates are expected to increase from the Existing Scenario (250 mm/yr) to Operations Scenario in the area of the pit (315 mm/yr). During periods of high water table (for example early spring), this increase may result in slight, temporary flooding of the pit floor. Lafarge may consider creating a spillway to allow overflow to discharge to the adjacent (below-water) Pit No.3.

Infiltration rates are calculated to decrease from the Existing Scenario (250 mm/yr) to Rehabilitated Scenario (184 mm/yr). This calculated decrease is a trade-off of the increased runoff generated by the relatively low

permeability silty backfill. However, much of this runoff will ultimately still recharge the groundwater system as it reports to, and later infiltrates within, the UW3 depression.

The proposed Pit No. 3 extension will not significantly decrease the infiltration into the aquifer within the Significant Groundwater Recharge area around the pit during the Operations and Rehabilitation Scenario, since the surface water precipitation and runoff will continue to infiltrate through the base of the pit and area around the pit.

7.1.2 Surface Water

No adverse water quantity impacts are expected to occur at the wetlands north (upgradient) of the Site (UW1, UW2A/2B, EW1) as no drawdown is expected under the Operations or Rehabilitated scenarios. Further, and as noted earlier, the catchment areas of these features are separate from, and unaffected by, catchment areas at the Site and are thus unaffected by changes to the Site water budget.

UW3 will theoretically and temporarily lose some runoff contribution during the Operations Scenario as a result of catchment area changes; however, as the majority of surplus water is expected to infiltrate the high hydraulic conductivity materials at the site under all scenarios, the effects on runoff are likely to be seasonal and largely restricted to periods with frozen ground conditions. In the absence of any progressive rehabilitation, the maximum change in catchment area contributing to UW3 would be in the order of an 83% reduction during the Operations Scenario; however, progressive rehabilitation following each phase of extraction (Appendix A) is expected to limit the catchment area changes to approximately a third of the potential maximum change at any time during extraction. The significance of this decrease on natural environment receptors within UW3 is evaluated by an ecological consultant under separate cover.

The UW3 catchment area will be restored and further increased under the Rehabilitated Scenario (an increase of approximately 110% over the Existing Scenario). An increase of this magnitude is likely to result in minor increases in peak springtime water volume and an extended hydroperiod within the UW3 area. The significance of this increase on natural environment receptors within UW3 is evaluated by an ecological consultant under separate cover.

7.2 Water Quality

The Operations Scenario will not involve the on-Site storage of any fuels, oils or potentially hazardous materials that could be released into the groundwater system. Therefore, water quality is not expected to be adversely impacted. Nonetheless, a Best Management Plan will be employed to address any potential spills from equipment on-Site and will minimize the potential for aquifer contamination given the Highly Vulnerable Aquifer classification of the Site area.

The Rehabilitated Scenario represents an opportunity to improve water quality as the additional forested area will negate the potential use of fertilizers and/or pesticides on what would otherwise be crop land.

The extraction of materials is not expected to introduce contaminants into the Highly Vulnerable Aquifer system, since a spill response plan will be implemented by Lafarge to mitigate against any unanticipated releases of contaminants into the aquifer.

7.3 Water Temperature

The reduction of unsaturated zone buffer as a result of aggregate extraction may result in an increased potential for localized groundwater warming during summer. This can occasionally be a concern for species or habitat that require the influx of cool groundwater within a certain temperature range in order to maintain ecological function. However, prior studies in Ontario have indicated that thermal plumes originating from below water pits typically do not migrate farther than 250 m downgradient of the pit pond before their effect becomes negligible (Markle and Schincariol, 2007). In the case of the Site, which is an above water operation (i.e. less impactful),

there are no surface water features within 250 m downgradient of the extraction area with the closest being Dufferin Lake approximately 900 m away. As such, no adverse thermal impacts are expected under the Operations Scenario. During the Rehabilitation Scenario, the potential warming will be further mitigated by restoring the ground surface closer to Existing conditions, therefore increasing the depth to the water table.

7.4 Cumulative Impact

There are several aggregate operations in the vicinity of the Site; the most notable being Lafarge Pit No.3 to the immediate northeast. However, because the only significant hydrogeological / hydrological Site impacts are a result of catchment area changes within, and restricted to, the Site itself, no cumulative impacts are expected to occur.

8.0 CONCLUSIONS

Extraction will occur above, but within 1.5 m of, the established water table elevation. The study involved two main aspects: 1) the establishment of Existing Scenario (baseline) hydrogeological / hydrological conditions through background data review and field program data collection; and 2) an impact assessment for proposed Operations and Rehabilitated Scenarios. The following pertinent conclusions are made:

8.1 Existing Scenario

- Land use consists of crop land with the exception of a triangular sub-parcel to the west which is meadow. This latter parcel contains UW3, a surface-water fed wetland that is typically only wet during spring melt and after significant precipitation events.
- The Site is internally drained and there are no permanent surface water features. There are two main catchments that subdivide the Site; the northern catchment drains to wetland UW3 whereas the southern catchment drains to an enclosed depression.
- There are a series of groundwater-fed wetlands north of the Site. The Elora Cataract Trailway acts as a catchment divide between these surface water features and the Site; as such, they do not interact with Site drainage. These wetlands are frequently dry; however, when wet, they display water levels greater than groundwater levels on-Site. As such, they are considered hydraulically upgradient from the Site.
- The Site is located within an area of glaciofluvial outwash deposits which form the basis of the aggregate resource. An unconfined sand and gravel aquifer, a principal subject of the study, resides within this deposit. The thickness of the deposit ranges from 8 m to 14 m. Underlying the glaciofluvial outwash deposit is a relatively thick (~ 26 m) sequence of silt and clay-based material down to bedrock.
- The Site is mapped as a HVA as per Schedule A-2 of the Peel Region Official Plan (2022). The extraction of materials will not introduce contaminants into the system, therefore, there will be no impacts on the highly vulnerable aquifer related to the extraction of aggregate materials at the Pit 3 extension.
- The Site is mapped as a SGRA as per Schedule A-3 of the Peel Region Official Plan (2022). The Operations and Rehabilitation Scenarios will not significantly decrease the infiltration into the aquifer, therefore, there will be no negative impacts of the Pit No. 3 extension related to its presence within an SGRA.
- There are 15 water well records within 500 m of the Site, most of which are completed in bedrock and used for domestic water supply. No water supply wells are completed within the unconfined aquifer that is the subject of the proposed resource extraction.
- Depending on the well and time of year, depth to water can vary from 4.4 m to 13.5 m below ground surface. The unconfined aquifer groundwater levels vary between +/- 1 m or less annually. The

hydrographs indicate that the highest groundwater elevations typically occur during late spring / early summer and the lowest groundwater elevation typically occur during late fall /early winter.

- The groundwater flow pattern is from roughly northwest to southeast. The high water table ranges from approximately 390.4 masl just northwest of the Site to 389 masl at the eastern corner. The Operations Scenario pit floor elevation is based on the established high water table elevation.
- During wetter periods the UW3 depression may act as a concentrated area of groundwater recharge, resulting in a slightly localized mounding effect.
- Groundwater temperatures may range from 4.6 to 16.1°C over the course of the year with an average temperature of 9.1°C. Cooler water is typically observed at greater depth during the summer and warmer water at greater depth during the winter; these patterns are the result of seasonal climate patterns and the associated temperature of infiltrating water (rain versus snow melt) but are also tempered by the high specific heat capacity of water and the insulating effect of soil.
- Tested water quality met Table 2 SCS for all parameters tested. Chloride, nitrates, total coliforms and E.Coli. were found in several unconfined aquifer wells, suggesting impacts from surficial contaminants. Water quality relative to the Ontario Drinking Water Standards aesthetic and operations guidelines were indicative of hard water.
- Based on grain size analysis the estimated hydraulic conductivity of the unconfined sand and gravel aquifer material ranges from 6E-5 m/s to 4E-3 m/s with a geometric mean of 3E-4 m/s.
- The water balance estimate indicates that the Site on average receives 229,100 m^3/yr of water, of which 141,600 m^3/yr is lost to evapotranspiration whereas the remaining 87,100 m^3/yr remains as surplus. Of this surplus, an estimated 64,100 m^3/yr immediately infiltrates, whereas 23,000 m^3/yr will runoff. Notably, 10,100 m^3/yr of runoff reports to UW3.

8.2 Operations Scenario – Effects Assessment

The hydrogeological and hydrological effects of the Operations Scenario relative to the Existing Scenario are assessed with respect to water quantity, quality and temperature. Impacts to key receptors including private water wells and surface water features such as wetlands are considered. The following conclusions are made:

- The Operations Scenario is above the established water table; no permanent pit pond will be formed, and no dewatering will be required. As such, no groundwater drawdown or water level decline is expected. No water quantity in surrounding water wells or off-Site wetlands will be adversely impacted.
- Infiltration rates are expected to increase from the Existing Scenario (244 mm/yr to 258 mm/yr) to the Operations Scenario in the area of the pit (315 mm/yr). During periods of high-water table (for example early spring), this may result in slight, temporary flooding of the pit floor. A spillway into the adjacent Pit No.3 may be required during Operations to avoid minor pit floor flooding that might occur during wet climatic events.
- UW3 will temporarily lose runoff during the Operations Scenario (a decrease of 8,700 m^3/yr, or 86% relative to Existing Scenario). UW3 resides above the water table and therefore relies on surface water runoff to establish a hydroperiod during spring freshet / significant precipitation events. The significance of this runoff decrease on natural environment receptors within UW3 is evaluated by an ecological consultant under separate cover.
- The Operations Scenario will not involve the on-Site storage of any fuels, oils or potentially hazardous materials that could be released into the groundwater system. Therefore, water quality is not expected to

be adversely impacted. Nonetheless, a Best Management Plan will be employed to address any potential spills from equipment on-Site and will minimize the potential for aquifer contamination.

- The reduction of unsaturated zone buffer as a result of aggregate extraction during the Operations Scenario may result in an increased potential for localized groundwater warming during summer; this effect would be most pronounced during Operations when above water table soil thickness is at a minimum. However, prior studies in Ontario have indicated that thermal plumes originating from below water pits typically do not migrate farther than 250 m downgradient of the pit pond before their effect becomes negligible. In the case of the Site, which is an above water table operation (i.e. less impactful), there are no surface water features within 250 m downgradient of the extraction area and thus no adverse thermal impacts are expected.
- The only significant hydrogeological / hydrological Site impacts are a result of temporary Operations catchment area changes within, and restricted to, the Site itself. As such, no cumulatively impactful interactions with surrounding aggregate operations are expected to occur.

8.3 Rehabilitated Scenario – Effects Assessment

The hydrogeological and hydrological effects of the Rehabilitated Scenario relative to the Existing Scenario is assessed with respect to water quantity, quality and temperature. Impacts to key receptors including private water wells and surface water features such as wetlands are considered. The following conclusions are made:

- The Rehabilitated Scenario is above the established water table; no permanent pit pond will be formed under this scenario. As such, no groundwater drawdown or water level decline is expected. No water quantity in surrounding water wells or off-Site wetlands will be adversely impacted.
- The silty backfill applied during rehabilitation will result in reduced Site infiltration (from 64,100 m^3/yr to 42,300 m^3/yr) and an associated increase in runoff (from 23,000 m^3/yr to 40,200 m^3/yr). However, the majority of this runoff will report to UW3, where it will ultimately recharge the groundwater system.
- Relatedly, UW3 will gain runoff during the Rehabilitated Scenario relative to the Existing Scenario (an increase from 10,100 m^3/yr 40,200 m^3/yr). This increase is likely to result in a more expansive and prolonged presence of surface water within the UW3 area during the wet season. However, most of this runoff is expected to ultimately recharge the groundwater system within the UW3 depression.
- The Rehabilitated Scenario may improve water quality relative to the Existing Scenario due to the increase in forested area.

9.0 RECOMMENDATIONS

The following work is recommended during Operations:

- Conduct monthly water level measurements at the following groundwater and surface water monitors:
  - Six monitoring well locations, seven wells in total; 07-DH-154, 07-DH-160, 07-DH-169, MW16-01A/B (nest), MW16-02, and an inactive domestic well north of the Site on Lafarge property (“House Well”).
  - The on-Site wetland piezometer (UW3).
  - Four off-Site surface water monitors equipped with staff gauges (UW1, UW2A, UW2B, EW1).
- Conduct monthly groundwater temperature profiling at the following groundwater wells: 07-DH-154, 07-DH-160, 07-DH-169, MW16-01A/B, MW16-02.

- Conduct annual water quality sampling at the following wells: 07-DH-154, 07-DH-160, 07-DH-169, MW16-01A, MW16-02. Tested parameters should include inorganics including metals; petroleum hydrocarbons (F1 - F4); volatile organic compounds (VOCs); and microbiology (E.Coli and Total Coliforms).
- No fuels, oils, or potentially hazardous materials, will be stored on-Site. A Best Management Plan (BMP) shall be developed to address any potential spills from equipment on-Site.

During periods of high-water table (for example early spring), temporary flooding may occur within the pit floor. A contingency measure, such as a spillway into the adjacent Pit No.3, may be implemented during Operations to avoid minor pit floor flooding that might occur during wet climatic events.

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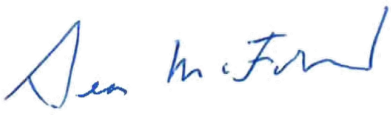

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Tables

TABLE 1: WATER LEVELS

Well ID:	07-DH-154		07-DH-160		07-DH-169		MW16-1A		MW16-1B		MW16-2		House Well		UW1		UW2A		UW2B		UW3		EW1	
East83/North83:	577370	4850375	577748	4850129	578113	4850482	577691	4850571	577691	4850568	577793	4850796	577502	4850303	577428	######	577507	######	577533	######	577730	######	577635	######
Depth (mbgs):	7.62		12.19		15.85		8.69		21.34		12.96		54.60		0		0		0		0.58		0	
Ground (masl):	392.09		394.89		398.67		395.76		395.72		399.71		395.41		389.40		389.44		389.38		390.86		389.55	
Pipe Elev. (masl):	392.90		395.77		399.52		396.62		396.62		400.64		395.92		390.62		390.63		390.74		391.78		390.79	
Date	Water Depth (mbtop)	Water Elev. (masl)	Water Depth (mbtop)	Water Elev. (masl)	Water Depth (mbtop)	Water Elev. (masl)	Water Depth (mbtop)	Water Elev. (masl)	Water Depth (mbtop)	Water Elev. (masl)	Water Depth (mbtop)	Water Elev. (masl)	Water Depth (mbtop)	Water Elev. (masl)	Water Height (m)	Water Elev. (masl)	Water Height (m)	Water Elev. (masl)	Water Height (m)	Water Elev. (masl)	Water Height (m)	Water Elev. (masl)	Water Height (m)	Water Elev. (masl)
28/30-Jun-16	3.10	389.80	7.45	388.32	11.64	387.88	7.05	389.57	7.28	389.34	11.11	389.53	12.34	383.58	0.35	389.75	0.445	389.88	0.465	389.85	-	-	0.36	389.91
26-Jul-16	3.27	389.64	7.57	388.20	11.74	387.78	7.25	389.37	7.38	389.24	11.32	389.32	11.03	384.89	-	-	-	-	-	-	-	-	-	-
30-Sep-16	3.84	389.06	7.98	387.79	12.165	387.36	7.78	388.84	7.58	389.04	11.84	388.80	11.08	384.84	-	-	-	-	-	-	-	-	-	-
24-Oct-16	4.04	388.86	8.13	387.64	12.33	387.19	7.99	388.63	7.68	388.94	12.03	388.61	11.14	384.78	-	-	-	-	-	-	-	-	-	-
05-Dec-16	4.37	388.53	8.43	387.35	12.65	386.87	8.32	388.30	7.84	388.78	12.35	388.29	11.12	384.80	Dry		Dry		Dry		-	-	Dry	
12-Jan-17	4.42	388.48	8.65	387.12	12.93	386.60	8.485	388.14	8.88	387.75	12.53	388.11	-	-	-	-	-	-	-	-	-	-	-	-
30-Mar-17	3.516	389.39	8.06	387.71	12.45	387.07	7.49	389.13	7.95	388.67	11.52	389.12	11.45	384.47	Dry		Dry		Dry		-	-	Dry	
27-Jun-17	2.695	390.21	7.07	388.70	11.26	388.26	6.625	390.00	6.88	389.74	10.73	389.91	10.87	385.05	0.70	390.09	0.81	390.25	0.85	390.23	-	-	0.70	390.25
30-Aug-17	2.90	390.01	7.08	388.69	11.21	388.32	6.85	389.78	6.84	389.78	10.95	389.68	10.82	385.10	0.51	389.91	0.61	390.05	0.63	390.01	-	-	0.55	390.11
22-Sep-17	3.07	389.84	7.23	388.55	11.35	388.18	7.03	389.60	6.96	389.66	11.11	389.53	10.96	384.96	0.39	389.78	0.44	389.88	0.46	389.84	-	-	0.41	389.96
27-Oct-17	3.32	389.59	7.47	388.30	11.59	387.93	7.30	389.33	7.19	389.44	11.37	389.26	10.83	385.09	0.17	389.57	0.18	389.62	0.21	389.60	-	-	0.24	389.80
30-Nov-17	3.55	389.35	7.67	388.10	11.83	387.70	7.51	389.11	7.40	389.22	11.57	389.06	10.79	385.13	Dry		Dry		Dry		-	-	Dry	
11-Dec-17	3.63	389.28	7.75	388.02	11.92	387.61	7.59	389.04	7.48	389.14	11.64	389.00	10.98	384.94	Dry		Dry		Dry		-	-	Dry	
29-Jan-18	3.66	389.24	7.84	387.94	12.07	387.46	7.62	389.01	7.71	388.91	11.68	388.96	10.97	384.95	Frozen/Dry		Dry		Frozen/Dry		-	-	Dry	
26-Feb-18	3.33	389.57	7.51	388.27	11.88	387.64	7.26	389.37	7.65	388.97	11.37	389.27	10.85	385.07	0.26	389.66	0.18	389.62	0.21	389.60	-	-	Dry	389.56
28-Mar-18	3.36	389.54	7.66	388.11	11.92	387.61	7.34	389.28	7.51	389.11	11.39	389.24	10.89	385.03	0.14	389.53	0.16	389.59	0.20	389.58	-	-	Dry	389.56
30-Apr-18	2.91	389.99	7.23	388.55	11.53	388.00	6.87	389.76	7.34	389.29	10.93	389.71	10.89	385.03	0.47	389.87	0.59	390.02	0.61	389.99	-	-	0.28	389.83
31-May-18	2.87	390.04	7.11	388.66	11.24	388.29	6.82	389.81	7.06	389.57	10.91	389.73	11.42	384.50	0.49	389.89	0.65	390.09	0.67	390.05	-	-	0.44	389.99
22-Jun-18	2.96	389.95	7.19	388.59	11.32	388.20	6.92	389.70	7.02	389.60	11.01	389.63	11.08	384.84	0.43	389.83	0.56	390.00	0.58	389.97	-	-	0.40	389.96
27-Jul-18	3.13	389.77	7.37	388.41	11.50	388.02	7.13	389.50	7.11	389.51	11.20	389.44	10.96	384.96	0.31	389.70	0.11	389.55	0.10	389.48	-	-	0.29	389.85
24-Aug-18	3.33	389.57	7.52	388.25	11.83	387.69	7.32	389.30	7.25	389.37	11.38	389.25	11.04	384.88	0.12	389.52	0.21	389.64	0.18	389.57	-	-	0.15	389.70
02-Oct-18	3.64	389.26	7.78	388.00	11.93	387.59	7.63	389.00	7.49	389.14	11.68	388.95	10.94	384.98	Dry		Dry		Dry		-	-	Dry	
31-Oct-18	3.84	389.07	7.95	387.82	12.13	387.39	7.81	388.81	7.68	388.94	11.87	388.76	11.02	384.90	Dry		Dry		Dry		-	-	Dry	
29-Nov-18	3.82	389.09	7.96	387.81	12.16	387.36	7.77	388.86	7.87	388.75	11.83	388.80	10.90	385.02	Dry		Dry		Dry		-	-	Dry	
17-Dec-18	3.72	389.19	7.85	387.93	12.01	387.52	7.67	388.95	7.82	388.80	11.73	388.90	10.88	385.04	Dry		Dry		Dry		-	-	Dry	
28-Jan-19	3.45	389.45	7.69	388.09	12.00	387.53	7.43	389.19	7.69	388.93	11.48	389.16	10.81	385.11	Frozen/Dry		Dry		Dry		-	-	Dry	
26-Feb-19	3.33	389.58	7.49	388.29	11.82	387.71	7.25	389.38	7.53	389.09	11.32	389.32	10.81	385.11	Frozen/Dry		Frozen/Dry		Frozen/Dry		-	-	Frozen/Dry	
28-Mar-18	3.36	389.54	7.66	388.11	11.92	387.61	7.34	389.28	7.51	389.11	11.39	389.24	10.89	385.03	0.14	389.53	0.16	389.59	0.20	389.58	-	-	Dry	
30-Apr-18	2.91	389.99	7.23	388.55	11.53	388.00	6.87	389.76	7.34	389.29	10.93	389.71	10.89	385.03	0.47	389.87	0.59	390.02	0.61	389.99	-	-	0.28	389.83
31-May-18	2.87	390.04	7.11	388.66	11.24	388.29	6.82	389.81	7.06	389.57	10.91	389.73	11.42	384.50	0.49	389.89	0.65	390.09	0.67	390.05	-	-	0.44	389.99
22-Jun-18	2.96	389.95	7.19	388.59	11.32	388.20	6.92	389.70	7.02	389.60	11.01	389.63	11.08	384.84	0.43	389.83	0.56	390.00	0.58	389.97	-	-	0.40	389.96
27-Jul-18	3.13	389.77	7.37	388.41	11.50	388.02	7.13	389.50	7.11	389.51	11.20	389.44	10.96	384.96	0.31	389.70	0.11	389.55	0.10	389.48	-	-	0.29	389.85
24-Aug-18	3.33	389.57	7.52	388.25	11.83	387.69	7.32	389.30	7.25	389.37	11.38	389.25	11.04	384.88	0.12	389.52	0.21	389.64	0.18	389.57	-	-	0.15	389.70
02-Oct-18	3.64	389.26	7.78	388.00	11.93	387.59	7.63	389.00	7.49	389.14	11.68	388.95	10.94	384.98	Dry		Dry		Dry		-	-	Dry	
31-Oct-18	3.84	389.07	7.95	387.82	12.13	387.39	7.81	388.81	7.68	388.94	11.87	388.76	11.02	384.90	Dry		Dry		Dry		-	-	Dry	
29-Nov-18	3.82	389.09	7.96	387.81	12.16	387.36	7.77	388.86	7.87	388.75	11.83	388.80	10.90	385.02	Dry		Dry		Dry		-	-	Dry	
17-Dec-18	3.72	389.19	7.85	387.93	12.01	387.52	7.67	388.95	7.82	388.80	11.73	388.90	10.88	385.04	Dry		Dry		Dry		-	-	Dry	
28-Jan-19	3.45	389.45	7.69	388.09	12.00	387.53	7.43	389.19	7.69	388.93	11.48	389.16	10.81	385.11	Frozen		Dry		Dry		-	-	Dry	
26-Feb-19	3.33	389.58	7.49	388.29	11.82	387.71	7.25	389.38	7.53	389.09	11.32	389.32	10.81	385.11	Frozen		Frozen		Frozen		-	-	Frozen	
25-Mar-19	2.98	389.92	7.10	388.68	11.48	388.05	6.92	389.70	7.34	389.29	11.05	389.59	10.58	385.34	0.47	389.87	0.53	389.96	0.54	389.92	-	-	0.20	389.76
26-Apr-19	2.68	390.23	6.85	388.93	11.12	388.41	6.62	390.00	7.03	389.59	10.74	389.90	10.38	385.54	0.69	390.09	0.82	390.25	0.85	390.23	-	-	0.52	390.07
15-May-19	2.53	390.37	6.62	389.15	10.78	388.74	6.44	390.19	6.82	389.80	10.46	390.18	10.43	385.49	-	-	-	-	-	-	1.06	390.73	-	-
31-May-19	2.50	390.41	6.52	389.25	10.66	388.87	6.40	390.22	6.69	389.94	10.56	390.08	10.40	385.52	Flooded		Flooded		Flooded		1.20	390.58	0.76	390.31
27-Jun-19	2.59	390.32	6.60	389.17	10.75	388.77	6.50	390.13	6.61	390.02	10.65	389.98	10.18	385.74	0.80	390.19	0.93	390.36	0.96	390.34	1.46	390.32	0.69	390.25
29-Jul-19	2.82	390.09	6.82	388.96	10.95	388.57	6.92	389.70	6.98	389.64	10.88	389.76	10.38	385.54	0.56	389.96	0.70	390.14	0.72	390.10	-	-	0.50	390.05
22-Aug-19	3.02	389.89	7.02	388.75	11.16	388.36	-	-	-	-	11.09	389.55	10.57	385.35	0.41	389.80	0.51	389.94	0.52	389.90	-	-	0.32	389.87
28-Oct-19	3.61	389.29	7.60	388.18	11.75	387.77	7.59	389.03	7.37	389.25	11.66	388.98	10.85	385.07	Dry		Dry		Dry		1.34	390.45	Dry	
28-Nov-19	3.85	389.05	7.84	387.93	12.02	387.50	7.79	388.83	7.61	389.01	11.87	388.77	10.80	385.12	Dry		Dry		Dry		1.40	390.38	Dry	
13-Dec-19	3.92	388.98	7.94	387.84	12.15	387.37	7.87	388.76	7.73	388.90	11.93	388.71	11.00	384.92	Dry		Dry		Dry		1.12	390.66	Dry	
24-Feb-20	3.41	389.50	7.62	388.16	11.91	387.62	7.38	389.24	7.65	388.97	11.43	389.21	10.77	385.15	Dry		Dry		Dry		1.27	390.51	Dry	
24-Mar-20	3.06	389.84	-	-	11.61	387.91	7.04	389.59	7.48	389.14	11.11	389.53	10.86	385.05	0.34	389.74	0.45	389.85	0.46	389.97	1.13	390.66	0.13	389.69
30-Apr-20	2.91	390.00	-	-	-	-	-	-	-	-	10.95	389.69	10.57	385.35	Dry		Dry		Dry		-	-	Dry	
19-May-20	2.92	389.98	-	-	-	-	-	-	-	-	10.98	389.66	10.63	385.29	Dry		Dry		Dry		-	-	Dry	
29-Jun-20	-	-	-	-	11.32	388.21	-	-	-	-	11.14	389.50	-	-	Dry		Dry		Dry		-	-	Dry	
31-Jul-20	3.34	389.56	-	-	-	-	-	-	-	-	11.37	389.27	-	-	Dry		Dry		Dry		-	-	Dry	
24-Aug-20	-	-	-	-	11.75	387.77	-	-	-	-	11.54	389.10	-	-	Dry		Dry		Dry		-	-	Dry	
24-Sep-20	-	-	-	-	12.00	387.52	-	-	-	-	11.80	388.84	-	-	Dry		Dry		Dry		-	-	Dry	
28-Oct-20	4.07	388.84	-	-	12.00	387.52	-	-	-	-	12.07	388.57	-	-	Dry		Dry		Dry		-	-	Dry	
11-Nov-20	-	-	-	-	12.53	386.99	8.25	388.37	8.05	388.57	12.30	388.34	-	-	Dry		Dry		Dry		-	-	Dry	
11-Dec-20	-	-	-	-	12.62	386.90	-	-	-	-	12.33	388.31	-	-	Dry		Dry		Dry		-	-	Dry	
08-Feb-21	-	-	-	-	13.04	386.48	-	-	-	-	12.68	387.96	-	-	-	-	-	-	-	-	-	-	-	-
22-Feb-21	-	-	-	-	13.09	386.43	-	-	-	-	12.74	387.90	-	-	-	-	-	-	-	-	-	-	-	-
23-Mar-21	-	-	-	-	13.10	386.42	-	-	-	-	12.59	388.05	-	-	-	-	-	-	-	-	-	-	-	-
20-Apr-21	-	-	-	-	13.17	386.36	-	-	-	-	12.35	388.29	-	-	-	-	-	-	-	-	-	-	-	-
21-May-21	-	-	-	-	13.21	386.32	-	-	-	-	12.14	388.50	-	-	-	-	-	-	-	-	-	-	-	-
15-Jun-21	-	-	-	-	13.24	386.28	-	-	-	-	12.11	388.53	-	-	-	-	-	-	-	-	-	-	-	-
07-Jul-21	-	-	-	-	13.28	386.25	-	-	-	-	12.11	388.53	-	-	-	-	-	-	-	-	-	-	-	-
20-Aug-21	-	-	-	-	13.34	386.19	-	-	-	-	12.38	388.26	-	-	-	-	-	-	-	-	-	-	-	-
16-Sep-21	-	-	-	-	13.41	386.12	-	-	-	-	12.52	388.12	-	-	-	-	-	-	-	-	-	-	-	-
15-Oct-21	-	-	-	-	13.49	386.04	-	-	-	-	12.61	388.03	-	-	-	-	-	-	-	-	-	-	-	-
26-Nov-21	-	-	-	-	13.36	386.16	-	-	-	-	12.59	388.05	-	-	-	-	-	-	-	-	-	-	-	-
09-Dec-21	-	-	-	-	13.39	386.13	-	-	-	-	12.54	388.10	-	-	-	-	-	-	-	-	-	-	-	-
26-Jan-22	-	-	-	-	13.17	386.35	-	-	-	-	12.15	388.49	-	-	-	-	-	-	-	-	-	-	-	-
01-Mar-22	-	-	-	-	12.99	386.53	-	-	-	-	11.73	388.91	-	-	-	-	-	-	-	-	-	-	-	-
22-Mar-22	-	-	-	-	12.57	386.95	-	-	-	-	11.31	389.33	-	-	-	-	-	-	-	-	-	-	-	-
29-Apr-22	-	-	-	-	12.10	387.42	-	-	-	-	11.08	389.56	-	-	-	-	-	-	-	-	-	-	-	-
26-May-22	-	-	-	-	11.92	387.60	-	-	-	-	11.07	389.57	-	-	-	-	-	-	-	-	-	-	-	-
10-Jun-22	-	-	-	-	11.86	387.66	-	-	-	-	11.11	389.53	-	-	-	-	-	-	-	-	-	-	-	-
28-Jul-22	-	-	-	-	11.93	387.59	-	-	-	-	11.41	389.23	-	-	-	-	-	-	-	-	-	-	-	-
25-Aug-22	-	-	-	-	12.06	387.46	-	-	-	-	11.60	389.04	-	-	-	-	-	-	-	-	-	-	-	-
21-Oct-22	-	-	-	-	12.40	387.13	-	-	-	-	12.07	388.57	-	-	-	-	-	-	-	-	-	-	-	-
25-Nov-22	-	-	-	-	12.58	386.95	-	-	-	-	12.38	388.26	-	-	-	-	-	-	-	-	-	-	-	-
31-Dec-22	-	-	-	-	12.82	386.70	-	-	-	-	12.52	388.12	-	-	-	-	-	-	-	-	-	-	-	-

Well ID:	07-DH-154		07-DH-160		07-DH-169		MW16-1A		MW16-1B		MW16-2	
East83/North83:	577370	4850375	577748	4850129	578113	4850482	577691	4850571	577691	4850568	577793	4850796
Depth (mbgs):	7.62		12.19		15.85		8.69		21.34		12.96	
Ground Elev. (masl):	392.09		394.89		398.67		395.76		395.72		399.71	
Pipe Elev. (masl):	392.90		395.77		399.52		396.62		396.62		400.64	
	Depth (mbtop)	Temp C	Depth (mbtop)	Temp C	Depth (mbtop)	Temp C	Depth (mbtop)	Temp C	Depth (mbtop)	Temp C	Depth (mbtop)	Temp C
24-Oct-16	8.3	8.6	12.7	8.2	17.0	8.0	9.8	10.6	17.4	9.7	13.0	7.8
	7.8	8.8	11.7	8.3	16.0	8.1	8.8	10.5	16.4	9.6	12.0	7.7
	7.3	9.0	10.7	8.4	15.0	8.0	8.0	10.4	15.4	9.6		
	6.8	9.2	9.7	8.5	14.0	8.0			14.4	9.4		
	6.3	9.4	8.7	8.9	13.0	8.0			13.4	9.4		
	5.8	9.8	8.1	8.9	12.3	7.9			12.4	9.7		
	5.3	10.1							11.4	10.3		
	4.8	10.4							10.4	10.6		
	4.3	10.6							9.4	10.7		
	4.0	10.6							8.4	10.6		
									7.7	10.5		
05-Dec-16	8.3	8.7	12.7	8.1	17.0	7.7	9.8	11.4	17.4	9.5	13.0	7.4
	7.3	9.0	11.7	8.2	16.0	7.7	8.8	11.2	16.4	9.4	12.4	7.2
	6.3	9.1	10.7	8.2	15.0	7.7	8.4	10.6	15.4	9.4		
	5.3	9.1	9.7	8.4	14.0	7.8			14.4	9.5		
	4.4	8.4	8.7	8.4	13.0	7.7			13.4	9.7		
					12.7	7.4			12.4	10.1		
									11.4	10.7		
									10.4	11.1		
									9.4	11.3		
									8.4	11.2		
									7.9	10.9		
30-Mar-17	8.3	7.5	12.7	8.5	17.0	8.0	9.8	9.6	17.4	-	13.0	8.0
	7.3	7.3	11.7	8.6	16.0	8.1	8.8	9.5	16.4	-	12.0	7.9
	6.3	7.0	10.7	8.6	15.0	8.2	7.8	9.2	15.4	9.9	11.6	7.6
	5.3	6.7	9.7	8.5	14.0	8.2	7.6	8.6	14.4	10.0		
	4.3	6.4	8.7	8.4	13.0	8.1			13.4	9.9		
	3.6	6.0	8.1	7.6	12.5	7.7			12.4	9.9		
									11.4	9.8		
									10.4	9.7		
									9.4	9.7		
									8.4	9.4		
									8.0	9.0		
27-Jun-17	8.3	7.6	12.7	8.3	17.0	7.9	9.8	7.2	15.8	9,5	13.0	7.5
	7.3	7,6	11.7	8.2	16.0	7.9	8.8	7.3	15.4	9,4	12.0	7.6
	6.3	7.5	10.7	8.2	15.0	7.9	7.8	7.3	14.4	9.2	11.0	7.6
	5.3	7.7	9.7	8.1	14.0	7.9	6.7	7.6	13.4	9.0	10.8	7.7
	4.3	8.1	8.7	7.8	13.0	7.8			12.4	8.7		
	3.3	9.1	7.7	7.8	12.0	7.8			11.4	8.2		
	2.7	10.3	7.1	7.9	11.3	7.9			10.4	7.9		
									9.4	7.7		
									8.4	7.6		
									7.4	7.6		
									6.9	7.6		
30-Aug-17	8.3	8.0	12.7	8.0	17.0	7.8	9.8	10.5	15.8	9.2	13.0	7.2
	7.3	8.2	11.7	8.1	16.0	7.8	8.8	10.7	15.4	9.1	12.0	7.3
	6.3	8.6	10.7	8.1	15.0	7.8	7.8	10.9	14.4	8.9	11.0	7.8
	5.3	9.4	9.7	8.2	14.0	7.7	6.9	11.4	13.4	8.8		
	4.3	10.3	8.7	8.5	13.0	7.7			12.4	8.9		
	3.3	11.5	7.7	9.1	12.0	7.8			11.4	9.3		
	3.0	12.4	7.1	10.4	11.2	8.8			10.4	9.7		
									9.4	9.7		
									8.4	9.5		
									7.4	9.6		
									6.9	10.0		
22-Sep-17	8.3	10.3	12.7	8.4	17.0	7.7	9.8	11.8	15.4	9.3	13.0	8.9
	7.3	10.6	11.7	8.5	16.0	7.8	8.8	12.8	14.4	9.4	12.0	9.0
	6.3	10.7	10.7	8.5	15.0	7.8	7.8	13.7	13.4	9.5	11.2	9.2
	5.3	10.7	9.7	8.6	14.0	8.0	7.2	12.8	12.4	9.6		
	4.3	10.9	8.7	8.8	13.0	8.1			11.4	9.8		
	3.3	11.3	7.7	9.0	12.0	8.3			10.4	10.0		
	3.1	11.8	7.3	9.6	11.4	9.9			9.4	10.6		
									8.4	11.0		
									7.4	11.8		
									7.0	12.7		
27-Oct-17	8.3	10.6	12.7	10.5	17.0	10.0	9.8	16.1	15.4	11.3	13.0	9.4
	7.3	10.9	11.7	10.5	16.0	10.0	8.8	16.1	14.4	11.7	12.0	9.6
	6.3	11.3	10.7	10.6	15.0	10.0	7.8	15.9	13.4	12.1	11.4	9.7
	5.3	11.9	9.7	10.8	14.0	10.1	7.3	15.7	12.4	13.2		
	4.3	12.3	8.7	11.2	13.0	10.1			11.4	14.8		
	3.3	13.0	7.7	11.6	12.0	10.1			10.4	15.7		
	3.3	13.0	7.5	11.6	11.6	10.2			9.4	15.7		
									8.4	15.7		
									7.4	15.0		
									7.2	14.9		

Well ID:	07-DH-154		07-DH-160		07-DH-169		MW16-1A		MW16-1B		MW16-2	
East83/North83:	577370	4850375	577748	4850129	578113	4850482	577691	4850571	577691	4850568	577793	4850796
Depth (mbgs):	7.62		12.19		15.85		8.69		21.34		12.96	
Ground Elev. (masl):	392.09		394.89		398.67		395.76		395.72		399.71	
Pipe Elev. (masl):	392.90		395.77		399.52		396.62		396.62		400.64	
	Depth (mbtop)	Temp C	Depth (mbtop)	Temp C	Depth (mbtop)	Temp C	Depth (mbtop)	Temp C	Depth (mbtop)	Temp C	Depth (mbtop)	Temp C
30-Nov-17	8.3	9.1	12.7	8.6	17.0	8.2	9.8	15.4	15.4	10.1	13.0	7.9
	7.3	9.3	11.7	8.6	16.0	8.3	8.8	15.2	14.4	10.6	12.0	8.0
	6.3	9.5	10.7	8.7	15.0	8.3	7.8	14.9	13.4	11.3	11.6	8.0
	5.3	9.6	9.7	8.9	14.0	8.3	7.5	14.7	12.4	12.3		
	4.3	9.4	8.7	9.4	13.0	8.3			11.4	13.8		
	3.6	9.1	7.7	9.6	12.0	8.4			10.4	14.7		
					11.9	8.4			9.4	14.9		
									8.4	14.7		
									7.4	13.7		
11-Dec-17	8.3	6.8	12.7	8.6	17.0	8.2	9.8	15.5	15.4	10.4	13.0	7.9
	7.3	8.3	11.7	8.6	16.0	8.2	8.8	15.2	14.4	11.0	12.0	7.8
	6.3	8.9	10.7	8.7	15.0	8.2	7.8	14.2	13.4	11.7	11.7	7.3
	5.3	9.3	9.7	8.7	14.0	8.3	7.6	15.4	12.4	12.8		
	4.3	9.3	8.7	8.7	13.0	8.2			11.4	14.2		
	3.7	9.2	7.8	7.5	12.0	7.9			10.4	15.0		
									9.4	15.1		
									8.4	14.6		
									7.5	13.3		
29-Jan-18	8.3	8.7	12.7	8.7	17.0	8.2	9.8	14.5	15.4	10.8	13.0	8.3
	7.3	8.2	11.7	8.8	16.0	8.3	8.8	14.4	14.4	11.5	12.0	8.2
	6.3	8.0	10.7	8.8	15.0	8.4	7.8	13.9	13.4	12.0	11.7	7.7
	5.3	7.6	9.7	8.9	14.0	8.4	7.6	12.8	12.4	12.8		
	4.3	6.8	8.7	8.9	13.0	8.3			11.4	13.5		
	3.7	6.0	7.9	8.2	12.1	7.8			10.4	13.9		
									9.4	14.3		
									8.4	14.0		
									7.7	13.5		
26-Feb-18	8.3	7.6	12.7	8.6	17.0	8.1	9.8	12.9	15.4	10.9	13.0	8.3
	7.3	7.6	11.7	8.7	16.0	8.2	8.8	12.9	14.4	11.4	12.0	8.3
	6.3	7.3	10.7	8.7	15.0	8.3	7.8	12.7	13.4	11.8	11.4	7.9
	5.3	7.0	9.7	8.8	14.0	8.4	7.3	12.2	12.4	12.2		
	4.3	6.5	8.7	8.9	13.0	8.3			11.4	12.4		
	3.7	5.8	7.7	8.9	12.0	8.1			10.4	12.6		
			7.5	9.3					9.4	12.9		
									8.4	12.8		
									7.7	12.3		
26-Feb-18	8.3	7.6	12.7	8.6	17.0	8.1	9.8	12.9	15.4	10.9	13.0	8.3
	7.3	7.6	11.7	8.7	16.0	8.2	8.8	12.9	14.4	11.4	12.0	8.3
	6.3	7.3	10.7	8.7	15.0	8.3	7.8	12.7	13.4	11.8	11.4	7.9
	5.3	7.0	9.7	8.8	14.0	8.4	7.3	12.2	12.4	12.2		
	4.3	6.5	8.7	8.9	13.0	8.3			11.4	12.4		
	3.7	5.8	7.7	8.9	12.0	8.1			10.4	12.6		
			7.5	9.3					9.4	12.9		
									8.4	12.8		
									7.7	12.3		
28-Mar-18	8.3	7.4	12.7	8.8	17.0	8.2	9.8	11.1	15.4	10.9	13.0	8.4
	7.3	7.3	11.7	8.8	16.0	8.3	8.8	11.2	14.4	11.3	12.0	8.4
	6.3	7.1	10.7	8.8	15.0	8.4	7.8	11.1	13.4	11.5	11.4	8.3
	5.3	6.5	9.7	8.8	14.0	8.4	7.4	11.0	12.4	11.5		
	4.3	6.4	8.7	8.6	13.0	8.4			11.4	11.3		
	3.4	5.8	7.7	8.1	12.0	8.1			10.4	11.3		
									9.4	11.2		
									8.4	11.5		
									7.5	11.3		
30-Apr-18	8.3	6.9	12.7	8.5	17.0	8.1	9.8	9.0	15.4	10.7	13.0	8.3
	7.3	6.6	11.7	8.6	16.0	8.1	8.8	9.0	14.4	10.8	12.0	8.4
	6.3	6.0	10.7	8.6	15.0	8.2	7.8	9.0	13.4	10.7	11.0	8.7
	5.3	5.7	9.7	8.4	14.0	8.2	6.9	9.3	12.4	10.4		
	4.3	5.8	8.7	8.2	13.0	8.2			11.4	10.0		
	3.4	4.8	7.7	7.9	12.0	8.3			10.4	9.8		
	2.9	4.6	7.3	7.7	11.6	8.6			9.4	9.7		
									8.4	9.7		
									7.4	9.6		
31-May-18	8.3	7.8	12.7	9.1	17.0	8.7	9.8	7.8	15.4	10.9	13.0	8.5
	7.3	7.5	11.7	9.1	16.0	8.7	8.8	7.8	14.4	10.8	12.0	8.7
	6.3	7.2	10.7	9.1	15.0	8.8	7.8	7.8	13.4	10.6	11.0	9.0
	5.3	7.0	9.7	8.9	14.0	8.7	6.9	8.3	12.4	10.2		
	4.3	6.8	8.7	8.5	13.0	8.5			11.4	9.7		
	3.4	7.3	7.7	8.7	12.0	8.7			10.4	9.1		
	2.9	8.4	7.2	9.1	11.2	9.4			9.4	8.9		
									8.4	8.9		
									7.4	9.0		
									7.1	9.2		

Well ID:	07-DH-154		07-DH-160		07-DH-169		MW16-1A		MW16-1B		MW16-2	
East83/North83:	577370	4850375	577748	4850129	578113	4850482	577691	4850571	577691	4850568	577793	4850796
Depth (mbgs):	7.62		12.19		15.85		8.69		21.34		12.96	
Ground Elev. (masl):	392.09		394.89		398.67		395.76		395.72		399.71	
Pipe Elev. (masl):	392.90		395.77		399.52		396.62		396.62		400.64	
	Depth (mbtop)	Temp C	Depth (mbtop)	Temp C	Depth (mbtop)	Temp C	Depth (mbtop)	Temp C	Depth (mbtop)	Temp C	Depth (mbtop)	Temp C
22-Jun-18	8.3	7.4	12.7	8.4	17.0	8.0	9.8	6.5	15.4	10.0	13.0	7.7
	7.3	7.2	11.7	8.4	16.0	8.0	8.8	6.4	14.4	10.6	12.0	7.7
	6.3	7.2	10.7	8.3	15.0	8.0	7.8	6.5	13.4	9.7	11.1	8.0
	5.3	7.2	9.7	8.1	14.0	8.0	7.0	6.8	12.4	9.3		
	4.3	7.7	8.7	7.9	13.0	7.8			11.4	8.6		
	3.3	8.7	7.7	7.9	12.0	7.8			10.4	8.0		
	3.0	9.3	7.2	8.6	11.4	7.9			9.4	7.6		
									8.4	7.6		
									7.4	7.6		
									7.1	8.2		
31-Jul-18	8.3	7.6	12.7	8.3	17.0	7.9	9.8	6.9	15.4	9.6	13.0	7.4
	7.3	7.8	11.7	8.3	16.0	7.9	8.8	7.1	14.4	9.4	12.0	7.5
	6.3	8.1	10.7	8.2	15.0	7.9	7.8	7.3	13.4	9.1	11.3	8.1
	5.3	8.6	9.7	8.1	14.0	7.8	7.2	7.7	12.4	8.3		
	4.3	9.0	8.7	9.0	13.0	7.7			11.4	7.9		
	3.3	11.3	7.7	8.2	12.0	7.7			10.4	7.6		
					11.6	8.0			9.4	7.4		
									8.4	7.3		
									7.4	7.4		
									7.2	8.3		
31-Aug-18	8.3	8.1	12.7	8.2	17.0	7.9	9.8	7.8	15.4	9.3	13.0	7.6
	7.3	8.4	11.7	8.2	16.0	7.8	8.8	8.0	14.4	9.0	12.0	7.4
	6.3	8.9	10.7	8.1	15.0	7.8	7.8	8.2	13.4	8.8	11.5	7.6
	5.3	9.8	9.7	8.1	14.0	7.7	7.4	8.5	12.4	8.3		
	4.3	11.1	8.7	8.2	13.0	7.6			11.4	8.0		
	3.4	12.9	7.7	8.9	12.0	8.0			10.4	7.8		
									9.4	7.8		
									8.4	7.9		
									7.4	8.3		
02-Oct-18	8.3	8.6	12.7	8.3	17.0	7.9	9.8	9.7	15.4	9,4	13.0	7.3
	7.3	9.0	11.7	8.3	16.0	7.9	8.8	9.7	14.4	9.3	12.0	7.3
	6.3	9.5	10.7	8.3	15.0	7.8	7.8	9.7	13.4	9.2	11.7	7.4
	5.3	10.3	9.7	8.5	14.0	7.8			12.4	9.2		
	4.3	11.2	8.7	9.1	13.0	7.7			11.4	9.8		
	3.7	11.5	7.8	10.2	12.0	7.8			10.4	10.0		
									9.4	9.9		
									8.4	9.7		
									8.4	9.7		
31-Oct-18	8.3	8.8	12.7	8.3	17.0	7.9	9.8	11.7	15.4	9.5	13.0	7.4
	7.3	9.3	11.7	8.3	16.0	7.9	8.8	11.5	14.4	9.5	12.0	7.5
	6.3	9.7	10.7	8.4	15.0	7.9	7.9	11.3	13.4	9.7	11.9	7.9
	5.3	10.3	9.7	8.6	14.0	7.9			12.4	10.3		
	4.3	10.7	8.7	9.1	13.0	7.9			11.4	11.2		
	3.9	11.0	8.0	9.5	12.2	8.2			10.4	11.7		
									9.4	11.6		
									8.4	11.4		
									7.7	11.2		
29-Nov-18	8.3	9.0	12.7	8.3	17.0	8.0	9.8	12.8	15.4	9.8	13.0	7.6
	7.3	9.3	11.7	8.4	16.0	8.0	8.8	12.7	14.4	9.9	12.0	7.2
	6.3	9.5	10.7	8.5	15.0	8.0	7.8	12.4	13.4	10.2	11.9	7.2
	5.3	9.2	9.7	8.7	14.0	8.0			12.4	10.8		
	4.3	8.6	8.7	9.3	13.0	7.9			11.4	11.8		
	3.9	8.6	8.0	9.6	12.2	7.6			10.4	12.5		
									9.4	12.6		
									8.4	12.4		
									7.9	11.8		
17-Dec-18	8.3	9.0	12.7	8.4	17.0	8.0	9.8	13.0	15.4	9.9	13.0	7.6
	7.3	9.1	11.7	8.4	16.0	8.0	8.8	12.8	14.4	10.1	12.0	7.1
	6.3	9.0	10.7	8.5	15.0	8.0	7.8	12.7	13.4	10.5	11.8	6.9
	5.3	8.7	9.7	8.6	14.0	8.0			12.4	11.0		
	4.3	8.4	8.7	9.5	13.0	8.0			11.4	11.9		
	3.8	7.7	7.9	10.0	12.1	7.5			10.4	12.5		
									9.4	12.7		
									8.4	12.6		
									7.9	12.3		
28-Jan-19	8.3	8.4	12.7	8.8	17.0	8.3	9.8	12.2	15.4	10.3	13.0	8.1
	7.3	8.1	11.7	8.8	16.0	8.3	8.8	12.0	14.4	10.6	12.0	8.1
	6.3	8.0	10.7	8.8	15.0	8.3	7.5	11.4	13.4	10.8	11.5	7.8
	5.3	7.6	9.7	8.8	14.0	8.4			12.4	11.1		
	4.3	6.7	8.7	8.9	13.0	8.3			11.4	11.4		
	3.5	5.3	7.7	7.9	12.0	7.7			10.4	11.6		
									9.4	12.1		
									8.4	12.1		
									7.7	12.0		

Well ID:	07-DH-154		07-DH-160		07-DH-169		MW16-1A		MW16-1B		MW16-2	
East83/North83:	577370	4850375	577748	4850129	578113	4850482	577691	4850571	577691	4850568	577793	4850796
Depth (mbgs):	7.62		12.19		15.85		8.69		21.34		12.96	
Ground Elev. (masl):	392.09		394.89		398.67		395.76		395.72		399.71	
Pipe Elev. (masl):	392.90		395.77		399.52		396.62		396.62		400.64	
	Depth (mbtop)	Temp C	Depth (mbtop)	Temp C	Depth (mbtop)	Temp C	Depth (mbtop)	Temp C	Depth (mbtop)	Temp C	Depth (mbtop)	Temp C
26-Feb-19	8.3	7.8	12.7	8.5	17.0	8.1	9.8	10.9	15.4	10.3	13.0	8.1
	7.3	7.5	11.7	8.6	16.0	8.1	8.8	10.9	14.4	10.5	12.0	7.9
	6.3	7.2	10.7	8.6	15.0	8.2	7.5	10.6	13.4	10.6	11.4	7.2
	5.3	6.8	9.7	8.7	14.0	8.3	7.3	10.3	12.4	10.7		
	4.3	6.2	8.7	8.7	13.0	8.3			11.4	10.7		
	3.3	5.5	7.5	8.8	11.4	7.7			10.4	10.7		
									9.4	11.0		
									8.4	11.0		
									7.6	10.4		
25-Mar-19	8.3	7.1	12.7	8.5	17.0	8.0	9.8	9.7	15.4	10.2	13.0	8.1
	7.3	6.9	11.7	8.5	16.0	8.0	8.8	9.7	14.4	10.3	12.0	8.0
	6.3	6.7	10.7	8.6	15.0	8.1	7.8	9.6	13.4	10.3	11.1	7.5
	5.3	6.1	9.7	8.6	14.0	8.2	7.0	9.4	12.4	10.4		
	4.3	5.8	8.7	8.5	13.0	8.0			11.4	10.3		
	3.3	5.1	7.1	8.4	12.0	7.7			10.4	10.1		
	3.0	4.8			11.5	7.5			9.4	10.0		
									8.4	10.0		
									7.4	9.6		
26-Apr-19	8.3	6.9	12.7	8.6	17.0	8.1	9.8	7.9	15.4	10.1	13.0	8.1
	7.3	6.6	11.7	8.5	16.0	8.2	8.8	7.9	14.4	10.1	12.0	8.1
	6.3	6.4	10.7	8.5	15.0	8.2	7.8	7.9	13.4	9.9	11.0	8.1
	5.3	5.8	9.7	8.4	14.0	8.2	6.8	7.9	12.4	9.6		
	4.3	5.6	8.7	8.1	13.0	8.1			11.4	9.2		
	3.3	5.2	7.7	7.7	12.0	7.9			10.4	8.9		
	2.7	5.5	6.9	7.6	11.2	7.9			9.4	8.8		
									8.4	8.6		
									7.4	8.5		
									7.10	8.4		
31-May-19	8.3	7.3	12.7	8.4	17.0	8.0	9.8	6.0	15.4	9.5	13.0	7.5
	7.3	7.0	11.7	8.3	16.0	8.0	8.8	5.9	14.4	9.3	12.0	7.6
	6.3	6.8	10.7	8.3	15.0	8.0	7.8	6.0	13.4	9.1	11.0	7.7
	5.3	6.4	9.7	8.0	14.0	8.0	6.8	6.2	12.4	8.4	10.7	8.3
	4.3	6.3	8.7	7.8	13.0	7.9	6.5	6.6	11.4	7.9		
	3.3	6.5	7.7	7.4	12.0	7.8			10.4	7.4		
	2.5	8.2	6.7	7.2	11.0	7.8			9.4	7.1		
					10.8	8.0			8.4	7.0		
									7.4	7.1		
									6.75	7.4		
27-Jun-19	8.3	7.3	12.7	8.2	17.0	7.9	9.8		15.4	9.2	13.0	7.1
	7.3	7.2	11.7	8.2	16.0	7.9	8.8	5.6	14.4	8.8	12.0	7.1
	6.3	7.1	10.7	8.2	15.0	7.9	7.8	5.6	13.4	8.4	11.0	7.4
	5.3	7.1	9.7	7.9	14.0	7.8	6.8	5.8	12.4	7.9	10.7	8.0
	4.3	7.4	8.7	7.8	13.0	7.7	6.5	6.1	11.4	7.1		
	3.3	8.2	7.7	7.8	12.0	7.7			10.4	6.6		
	2.6	9.8	6.6	7.8	11.0	7.9			9.4	6.2		
					10.8	8.6			8.4	6.2		
									7.4	6.4		
									6.65	7.3		
29-Jul-19	8.3	7.4	12.7	8.1	17.0	7.8	9.8	7.4	15.4	8.9	13.0	6.8
	7.3	7.5	11.7	8.1	16.0	7.8	8.8	7.4	14.4	8.2	12.0	7.0
	6.3	7.7	10.7	8.0	15.0	7.7	7.8	7.6	13.4	7.9	11.0	7.3
	5.3	8.3	9.7	7.9	14.0	7.6	7.1	8.0	12.4	7.7		
	4.3	9.3	8.7	7.8	13.0	7.5			11.4	7.6		
	3.3	10.8	7.7	7.9	12.0	7.5			10.4	7.4		
	2.9	12.3	6.9	8.5	11.1	8.0			9.4	7.2		
									8.4	7.2		
									7.4	7.1		
									7.10	7.9		
22-Aug-19	8.3	7.7	12.7	8.1	17.0	7.9	Inaccessible.		Inaccessible.		13.0	7.0
	7.3	8.0	11.7	8.1	16.0	7.8					12.0	7.4
	6.3	8.5	10.7	8.1	15.0	7.7					11.2	8.6
	5.3	9.3	9.7	8.1	14.0	7.6						
	4.3	10.3	8.7	8.1	13.0	7.5						
	3.3	11.8	7.7	8.4	12.0	7.5						
			7.1	9.4	11.2	7.9						
31-Oct-19	8.3	8.9	12.7	8.5	17.0	8.3	9.8	14.7	15.4	9.8	13.0	7.4
	7.3	9.3	11.7	8.5	16.0	8.2	8.8	14.5	14.4	10.0	12.0	7.5
	6.3	9.7	10.7	8.5	15.0	8.1	7.8	14.2	13.4	10.4	11.7	7.6
	5.3	10.0	9.7	8.7	14.0	8.1			12.4	11.6		
	4.3	10.4	8.7	9.0	13.0	8.1			11.4	12.8		
	3.7	10.7	7.7	9.6	11.8	8.3			10.4	13.9		
									9.4	14.1		
									8.4	13.7		
									7.4	13.2		

Well ID:	07-DH-154		07-DH-160		07-DH-169		MW16-1A		MW16-1B		MW16-2	
East83/North83:	577370	4850375	577748	4850129	578113	4850482	577691	4850571	577691	4850568	577793	4850796
Depth (mbgs):	7.62		12.19		15.85		8.69		21.34		12.96	
Ground Elev. (masl):	392.09		394.89		398.67		395.76		395.72		399.71	
Pipe Elev. (masl):	392.90		395.77		399.52		396.62		396.62		400.64	
	Depth (mbtop)	Temp C	Depth (mbtop)	Temp C	Depth (mbtop)	Temp C	Depth (mbtop)	Temp C	Depth (mbtop)	Temp C	Depth (mbtop)	Temp C
28-Nov-19	8.3	8.2	12.7	8.7	16.7	8.4	9.8	15.8	15.4	10.4	13.0	
	7.3	9.4	11.7	8.7	16.0	8.4	8.8	15.6	14.4	10.7	12.8	7.6
	6.3	9.6	10.7	8.8	15.0	8.4	7.8	15.3	13.4	11.3	11.9	6.8
	5.3	9.6	9.7	8.9	14.0	8.3			12.4	12.3		
	4.3	9.3	8.7	9.2	13.0	8.2			11.4	14.0		
	3.9	8.5	7.9	9.0	12.1	7.6			10.4	14.9		
									9.4	15.3		
									8.4	14.9		
									7.7	14.0		
13-Dec-19	8.3	9.2	12.7	8.7	17	8.4	9.8	15.9	15.8		13	7.9
	7.3	9.4	11.7	8.8	16	8.4	8.8	15.6	15.4	10.6	12	7.6
	6.3	9.3	10.7	8.8	15	8.3	7.9	15	14.4	11.1		
	5.3	9	9.7	8.9	14	8.4			13.4	11.7		
	4.3	8.7	8.7	9.3	13	8.3			12.4	12.9		
	4	8.2	8	9.1	12.2	7.9			11.4	14.1		
									10.4	15.1		
									9.4	15.5		
									8.4	15.1		
									7.8	14.5		
24-Feb-20	8.3	8.3	12.7	8.8	17	Bottom	9.8	13.4	15.8		12.8	8.4
	7.3	7.9	11.7	8.9	16	8.4	8.8	13.5	15.4	11.4	11.8	8.4
	6.3	7.6	10.7	8.9	15	8.5	7.8	13.3	14.4	11.8	11.5	8.5
	5.3	7.2	9.7	8.9	14	8.5	7.4	13.2	13.4	12.2		
	4.3	6.8	8.7	8.9	13	8.6			12.4	12.6		
	3.4	6.5	7.7	8.7	12	8.6			11.4	12.9		
			7.7	8.7	11.9	8.6			10.4	12.9		
									9.4	13.4		
									8.4	13.3		
									7.7	13.1		
24-Mar-20	8.3	7.7			17	8.4	9.7	11.5	15.8		13	8.3
	7.3	7.4			16	8.4	8.8	11.5	15.4	11.4	12	8.3
	6.3	7.1			15	8.5	7.8	11.4	14.4	11.7	11.2	8.1
	5.3	6.6			14	8.6	7.1	11.2	13.4	11.8		
	4.3	6.2			13	8.4			12.4	11.8		
	3.3	5.8			12	8.4			11.4	11.7		
	3.1	6.1			11.7	8.3			10.4	11.6		
									9.4	11.6		
									8.4	11.7		
									7.5	11		
30-Apr-20	8.3	7.7									13	8.3
	7.3	7.5									12	8.3
	6.3	7.1									11	8.7
	5.3	6.9										
	4.3	6.5										
	3.3	6.2										
	3	6.3										
	3	6.6										
19-May-20	8.3	7.3									13	7.8
	7.3	7.2									12	7.8
	6.3	6.9									11	8
	5.3	6.7										
	4.3	6.4										
	3.3	6.1										
	3	6.6										
29-Jun-20					17	7.9					13	7.8
					16	7.9					12	7.9
					15	7.9					11.3	8.4
					14	7.9						
					13	7.7						
					12	8.5						
					11.5	8.5						
31-Jul-20	8.3	7.9									13	7.4
	7.3	8									12	7.6
	6.3	8.3									11.4	13
	5.3	8.9										
	4.3	9.8										
	3.39	11.4										
24-Aug-20					17	8					13	7.2
					16	8					12	7.4
					15	7.8					11.5	8.1
					14	7.8						
					13	7.7						
					12	7.9						
					11.75	8.9						
24-Sep-20					17	7.7					13	7.3
					16	7.6					12	7.6
					15	7.8					11.8	
					14	7.7						
					13	7.6						
					12	7.7						

Well ID:	07-DH-154		07-DH-160		07-DH-169		MW16-1A		MW16-1B		MW16-2	
East83/North83:	577370	4850375	577748	4850129	578113	4850482	577691	4850571	577691	4850568	577793	4850796
Depth (mbgs):	7.62		12.19		15.85		8.69		21.34		12.96	
Ground Elev. (masl):	392.09		394.89		398.67		395.76		395.72		399.71	
Pipe Elev. (masl):	392.90		395.77		399.52		396.62		396.62		400.64	
	Depth (mbtop)	Temp C	Depth (mbtop)	Temp C	Depth (mbtop)	Temp C	Depth (mbtop)	Temp C	Depth (mbtop)	Temp C	Depth (mbtop)	Temp C
28-Oct-20	8.3	8.8									13	7.1
	7.3	9.1									12.1	6.9
	6.3	9.5										
	5.3	10										
	4.3	10.1										
	4.07	9.5										
11-Nov-20					17	8					13	7.4
					16	7.9					12.3	7.1
					15	7.9						
					14	7.9						
					13	7.8						
					12.5	7.7						
21-Sep-16					13.5	9.1					12.6	8.7
					14	8.3					13	8.1
					15	8.2						
					16	8.2						
					17	8.2						
21-Oct-15					13.5	8.4					12.7	8.7
					14	8.3					13	8.2
					15	8.2						
					16	8.3						
					17	8.3						
26-Nov-21					13.5	7.3					12.7	7.3
					14	7.7					13	7.5
					15	7.9						
					16	7.9						
					17	7.9						
09-Dec-21					13.5	7.5					12.6	7.5
					14	8.1					13	8
					15	8.3						
					16	8.3						
					17	8.3						
26-Jan-22					13.27	7.61					12.15	7.1
					13.98	8.3					12.96	8.2
					14.98	8.4						
					15.98	8.3						
					16.98	8.3						
01-Mar-22					13.09	8					11.82	7.8
					13.98	8.3					11.96	8.3
					14.98	8.3					12.96	8.3
					15.98	8.4						
					16.98	8.2						
22-Mar-22					12.67	8.3					11.41	8.3
					12.98	8.5					11.96	8.5
					13.98	8.7					12.96	8.5
					14.96	8.5						
					15.98	8.4						
					16.98	8.4						
29-Apr-22					12.2	8.9					11.175	9
					12.98	8.7					11.96	8.7
					13.98	8.7					12.96	8.7
					14.98	8.6						
					15.98	8.5						
					16.98	8.5						
26-May-22					12.02	9.1					11.165	8.9
					12.98	8.7					11.96	8.5
					13.98	8.5					12.96	8.4
					14.98	8.5						
					15.98	8.5						
					16.98	8.4						
10-Jun-22					11.98	8.7					11.205	8.7
					12.98	8.4					11.96	8.4
					13.98	8.5					12.96	8.4
					14.98	8.5						
					15.98	8.5						
					16.98	8.4						
28-Jul-22					11.98	8.6					11.44	8.6
					12.98	8.3					11.96	8.2
					13.98	8.3					12.96	8.1
					14.98	8.4						
					15.98	8.4						
					16.98	8.4						
25-Aug-22					12.16	8.7					11.7	8.2
					12.98	8.2					11.96	8
					13.98	8.3					12.96	8
					14.98	8.3						
					15.98	8.4						
					16.98	8.4						

Well ID:	07-DH-154		07-DH-160		07-DH-169		MW16-1A		MW16-1B		MW16-2	
East83/North83:	577370	4850375	577748	4850129	578113	4850482	577691	4850571	577691	4850568	577793	4850796
Depth (mbgs):	7.62		12.19		15.85		8.69		21.34		12.96	
Ground Elev. (masl):	392.09		394.89		398.67		395.76		395.72		399.71	
Pipe Elev. (masl):	392.90		395.77		399.52		396.62		396.62		400.64	
	Depth (mbtop)	Temp C	Depth (mbtop)	Temp C	Depth (mbtop)	Temp C	Depth (mbtop)	Temp C	Depth (mbtop)	Temp C	Depth (mbtop)	Temp C
21-Oct-22					12.5	8.8					12.17	8.3
					12.98	8.4					12.96	8.1
					13.98	8.3						
					14.98	8.3						
					15.98	8.4						
					16.98	8.4						
21-Oct-22					12.675	8					12.475	7.5
					12.98	8.3					12.96	8
					13.98	8.4						
					14.98	8.4						
					15.98	8.4						
					16.98	8.4						
13-Dec-22					12.98	8.3					12.61	7.5
					13.98	8.4					12.96	7.9
					14.98	8.4						
					15.98	8.4						
					16.98	8.4						

TABLE 3A: WATER HOLDING CAPACITIES AND INFILTRATION FACTORS

SOIL	VEGETATION COVER	WHC (mm)
Sand	Crop Land	150
	Light Bush / Scrubland	150
	Meadow / Fallow Land	150
	Forest	300
	Pit	150
Silt (Rehab Fill)	Meadow / Fallow Land	250
	Forest	400

SOIL	VEGETATION COVER	VEGETATION FACTOR	SOIL FACTOR	SLOPE FACTOR	FINAL INFILTRATION FACTOR
Sand	Crop Land	0.1	0.4	0.2	***0.7***
	Light Bush / Scrubland	0.2	0.4	0.2	***0.8***
	Meadow / Fallow Land	0.2	0.4	0.2	***0.8***
	Forest	0.2	0.4	0.2	***0.8***
	Pit	-	-	-	***1***
Silt (Rehab Fill)	Meadow	0.1	0.1	0.2	***0.4***
	Forest	0.2	0.2	0.2	***0.6***

TABLE 3B: EXISTING SCENARIO LAND USE

CATCHMENT	CROPLAND (HA)	LIGHT BUSH (HA)	MEADOW (HA)	FOREST (HA)	EXTRACTION (HA)	TOTAL AREA (HA)
101: Existing North	5.2	1.8	5.2	-	0	*12.2*
102: Existing South	11.1	2.3	-	-	0	*13.4*
Total	***16.3***	***4.1***	***5.2***	***0***	***0***	***25.6***

TABLE 3C: OPERATIONS SCENARIO LAND USE

CATCHMENT	CROPLAND (HA)	LIGHT BUSH (HA)	MEADOW (HA)	FOREST (HA)	EXTRACTION (HA)	TOTAL AREA (HA)
201: Pit	-	-	-	-	20.8	*20.8*
202: North Setback	-	-	2.7	-	-	*2.7*
203: South Setback	-	-	2.1	-	-	*2.1*
Total	***0***	***0***	***4.8***	***0***	***20.8***	***25.6***

TABLE 3D: REHABILITATED SCENARIO LAND USE

CATCHMENT	CROPLAND (HA)	LIGHT BUSH (HA)	MEADOW (HA)	FOREST (HA)	EXTRACTION (HA)	TOTAL AREA (HA)
301: Rehab North (Sand)	-	-	0.4	3.7	-	*4.1*
301: Rehab North (Silt)	14.5	-	-	6.4	-	*20.9*
302: Rehab South (Sand)	-		-	0.0	-	*0.0*
302: Rehab South (Silt)	0.6	-	-	-	-	*0.6*
Total	***15.1***	***0.0***	***0.4***	***10.1***	***0.0***	***25.7***

TABLE 4A: EXISTING SCENARIO RESULTS

CATCHMENT	TOTAL AREA	PRECIPITATION		EVAPOTRANSPIRATION		SURPLUS		INFILTRATION		RUNOFF	
	(HA)	MM/YR	M^3/YR	MM/YR	M^3/YR	MM/YR	M^3/YR	MM/YR	M^3/YR	MM/YR	M^3/YR
101: Existing North	12.2	895	109,200	553	67,500	340	41,500	257	31,400	83	10,100
102: Existing South	13.4	895	119,900	553	74,100	340	45,600	244	32,700	96	12,900
Total	***25.6***	***895***	***229,100***	***553***	***141,600***	***340***	***87,100***	***250***	***64,100***	***90***	***23,000***

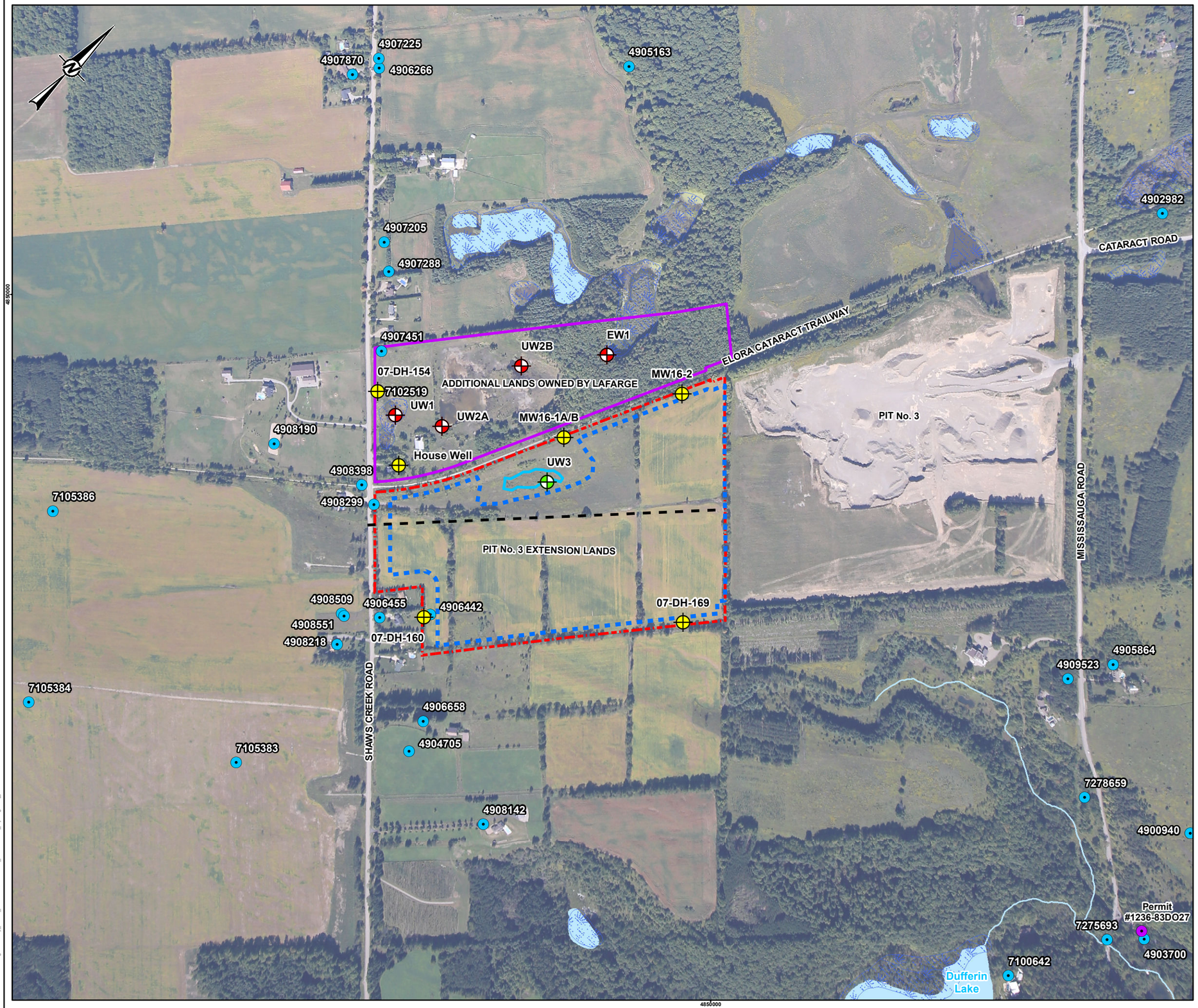
TABLE 4B: OPERATIONS SCENARIO RESULTS

CATCHMENT	TOTAL AREA	PRECIPITATION		EVAPOTRANSPIRATION		SURPLUS		INFILTRATION		RUNOFF	
	(HA)	MM/YR	M^3/YR	MM/YR	M^3/YR	MM/YR	M^3/YR	MM/YR	M^3/YR	MM/YR	M^3/YR
201: Pit	20.8	895	186,200	580	120,600	315	65,500	315	65,500	0	0
202: North Setback	2.7	895	24,200	552	14,900	341	9,200	270	7,300	67	1,800
203: South Setback	2.1	895	18,800	552	11,600	338	7,100	271	5,700	67	1,400
Total	***25.6***	***895***	***229,200***	***575***	***147,100***	***320***	***81,800***	***307***	***78,500***	***8***	***2,100***

TABLE 4C: REHABILITATED SCENARIO RESULTS

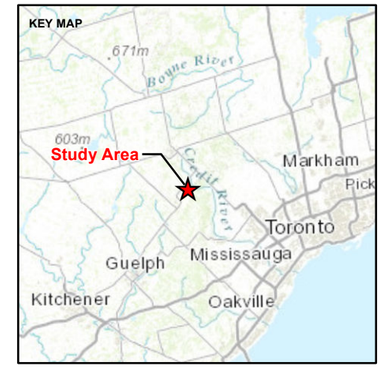
CATCHMENT	TOTAL AREA	PRECIPITATION		EVAPOTRANSPIRATION		SURPLUS		INFILTRATION		RUNOFF	
	(HA)	MM/YR	M^3/YR	MM/YR	M^3/YR	MM/YR	M^3/YR	MM/YR	M^3/YR	MM/YR	M^3/YR
301: Rehabilitated Pit North	24.9	895	222,900	570	142,000	323	80,400	166	41,400	157	39,000
302: Rehabilitated Pit South	0.6	891	5,700	563	3,600	328	2,100	141	900	188	1,200
Total	***25.6***	***895***	***228,600***	***570***	***145,600***	***323***	***82,500***	***166***	***42,300***	***157***	***40,200***

Figures



LEGEND

- Piezometer
- Surface Water Monitors
- Groundwater Monitoring Wells
- MECP Well Record
- MECP Permit To Take Water
- Cross-Section
- Watercourse
- Waterbody
- Wetland
- Unevaluated Wetland
- Additional Lands Owned by Lafarge
- Limit of Extraction
- Proposed Licence Boundary



0 200 400

1:7,500 METRES

REFERENCE(S)
1. IMAGERY: PROVIDED BY MHBC 2019
2. BASE DATA: LIO MNRF 2019
3. PROJECTION: TRANSVERSE MERCATOR NAD 1983 UTM ZONE 17N

CLIENT
LAFARGE CANADA INC.

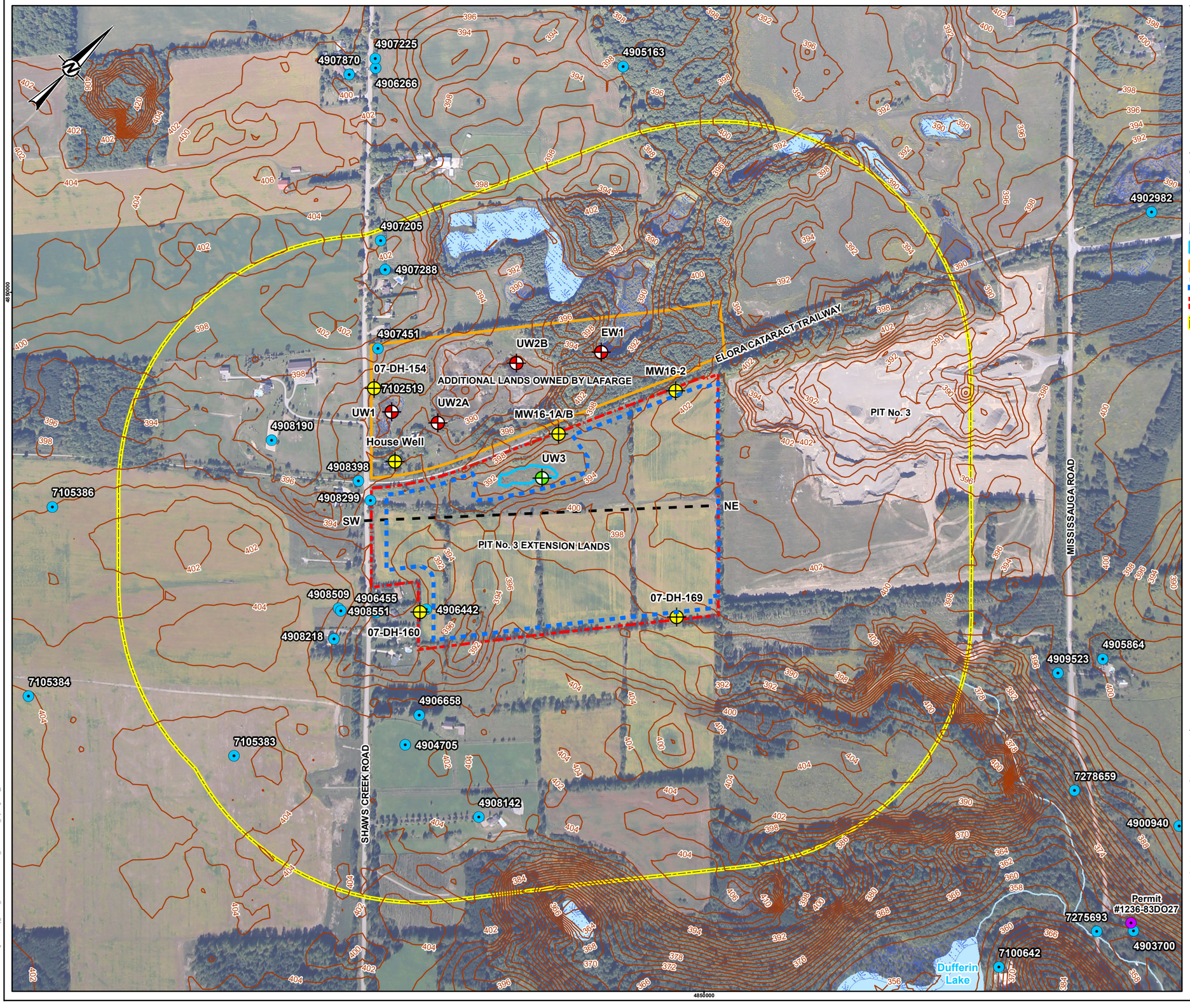
PROJECT
PIT NO.3 EXTENSION

TITLE
SITE PLAN

CONSULTANT

YYYY-MM-DD	2020-02-11
DESIGNED	SO
PREPARED	SO
REVIEWED	DH
APPROVED	DH

PROJECT NO.	CONTROL	REV.	FIGURE
21453896	0001	-	1



LEGEND

- Piezometer
- Surface Water Monitors
- Groundwater Monitoring Wells
- MECP Well Record
- MECP Permit To Take Water
- Contours in masl - 2 m intervals
- Cross-Section
- Watercourse
- Waterbody
- Wetland
- Unevaluated Wetland
- Additional Lands Owned by Lafarge
- Limit of Extraction
- Proposed Licence Boundary
- 500 m Buffer

0 200 400

1:7,500 METRES

REFERENCE(S)

1. IMAGERY: PROVIDED BY MHBC 2019
2. BASE DATA: LIO MNRF 2019
3. PROJECTION: TRANSVERSE MERCATOR NAD 1983 UTM ZONE 17N

CLIENT

LAFARGE CANADA INC.

PROJECT

PIT NO.3 EXTENSION

TITLE

TOPOGRAPHY

CONSULTANT

wsp

YYYY-MM-DD	2019-12-17
DESIGNED	SO
PREPARED	SO
REVIEWED	DH
APPROVED	DH

PROJECT NO.	CONTROL	REV.	FIGURE
21453896	0001	-	2

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

25mm

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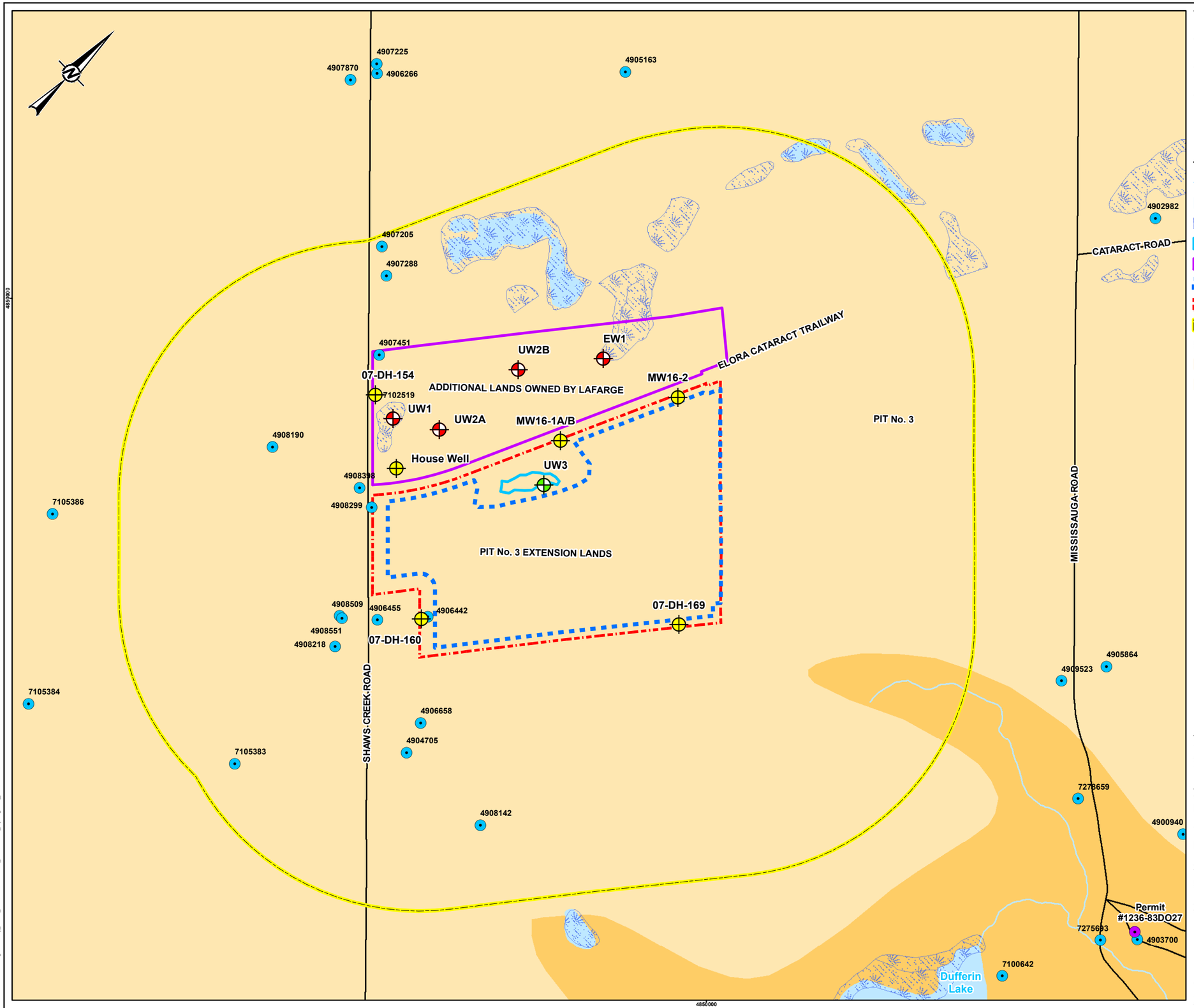


LEGEND

- Piezometer
- Surface Water Monitors
- Groundwater Monitoring Wells
- MECP Well Record
- MECP Permit To Take Water
- Road
- Watercourse
- Waterbody
- Wetland
- Unevaluated Wetland
- Additional Lands Owned by Lafarge
- Limit of Extraction
- Proposed Licence Boundary
- 500 m Buffer

Surficial Geology

- 6: Ice-contact stratified deposits
- 7: Glaciofluvial deposits

0 200 400

1:7,500 METRES

REFERENCE(S)
1. BASE DATA: LIO MNRF 2018
2. SURFICIAL GEOLOGY OBTAINED FROM MNDM
3. PROJECTION: TRANSVERSE MERCATOR NAD 1983 UTM ZONE 17N

CLIENT
LAFARGE CANADA INC.

PROJECT
PIT NO.3 EXTENSION

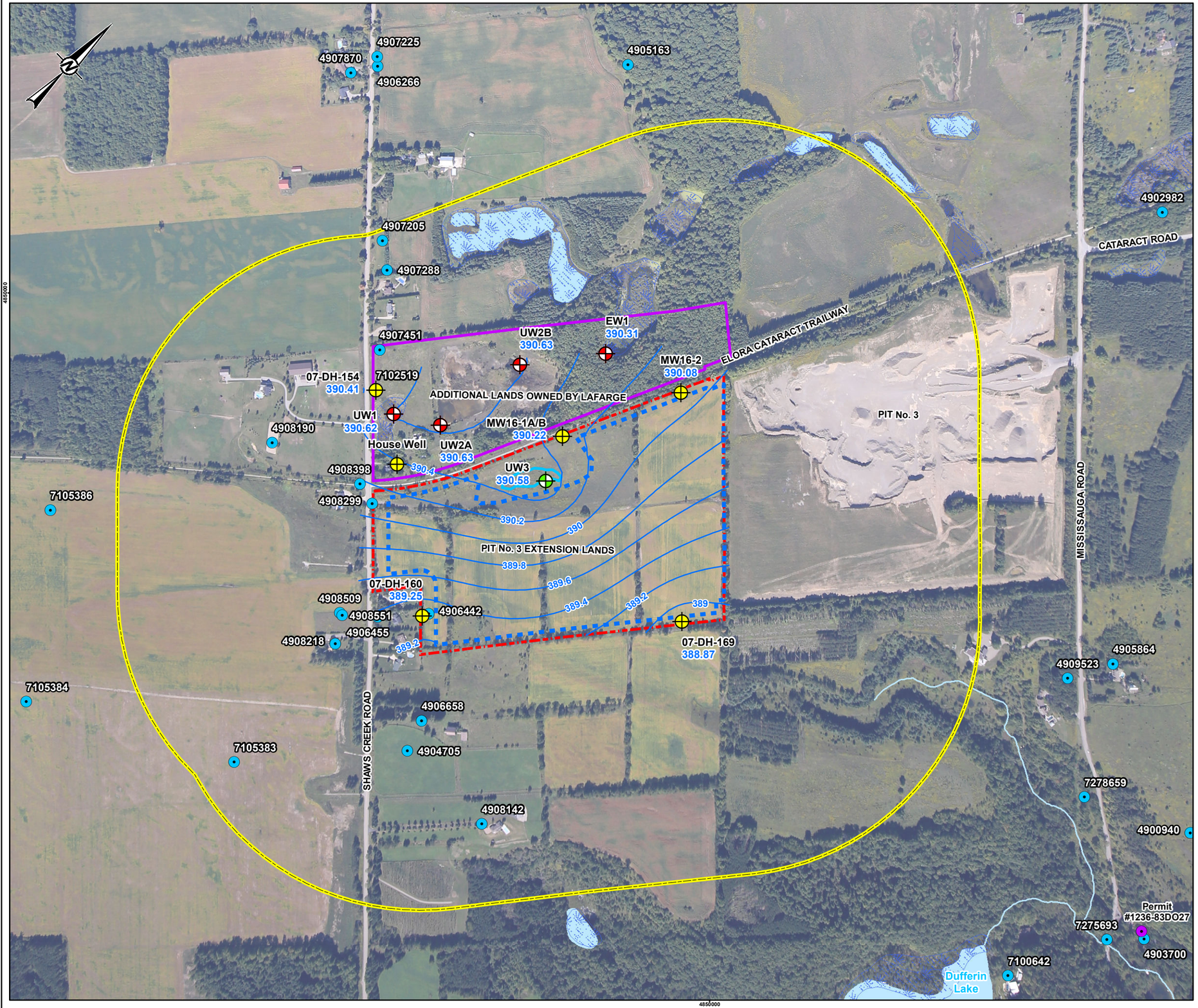
TITLE
SURFICIAL GEOLOGY

CONSULTANT

wsp

YYYY-MM-DD	2019-12-17
DESIGNED	SO
PREPARED	S)
REVIEWED	DH
APPROVED	DH

PROJECT NO.	CONTROL	REV.	FIGURE
21453896	0001	-	3



LEGEND

- Piezometer
- Surface Water Monitors
- Groundwater Monitoring Wells
- MECP Well Record
- MECP Permit To Take Water
- Water Table Contours in masl
- Watercourse
- Waterbody
- Wetland
- Unevaluated Wetland
- Additional Lands Owned by Lafarge
- Limit of Extraction
- Proposed Licence Boundary
- 500 m Buffer

0 200 400

1:7,500 METRES

NOTE(S)

1. INFERRED HIGH WATER TABLE BASED ON WATER LEVELS MEASURED ON MAY 31, 2019.
2. UW1 AND UW2A/B MONITORS FLOODED SLIGHTLY ABOVE STAFF GAUGE DURING HIGH WATER TABLE EVENT AND THUS COULD NOT BE PRECISELY MEASURED. FOR CONTOURING PURPOSES THE WATER LEVEL AT THESE LOCATIONS IS ASSUMED TO COINCIDE WITH THE TOP OF THE STAFF GAUGE ELEVATION.

REFERENCE(S)

1. IMAGERY: PROVIDED BY MHBC 2019
2. BASE DATA: LIO MNRF 2019
3. PROJECTION: TRANSVERSE MERCATOR NAD 1983 UTM ZONE 17N

CLIENT
LAFARGE CANADA INC.

PROJECT
PIT NO.3 EXTENSION

TITLE
ESTABLISHED WATER TABLE

CONSULTANT

wsp

YYYY-MM-DD	2019-12-17
DESIGNED	SO
PREPARED	SO
REVIEWED	DH
APPROVED	DH

PROJECT NO.	CONTROL	REV.	FIGURE
21453896	0001	-	6

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25mm

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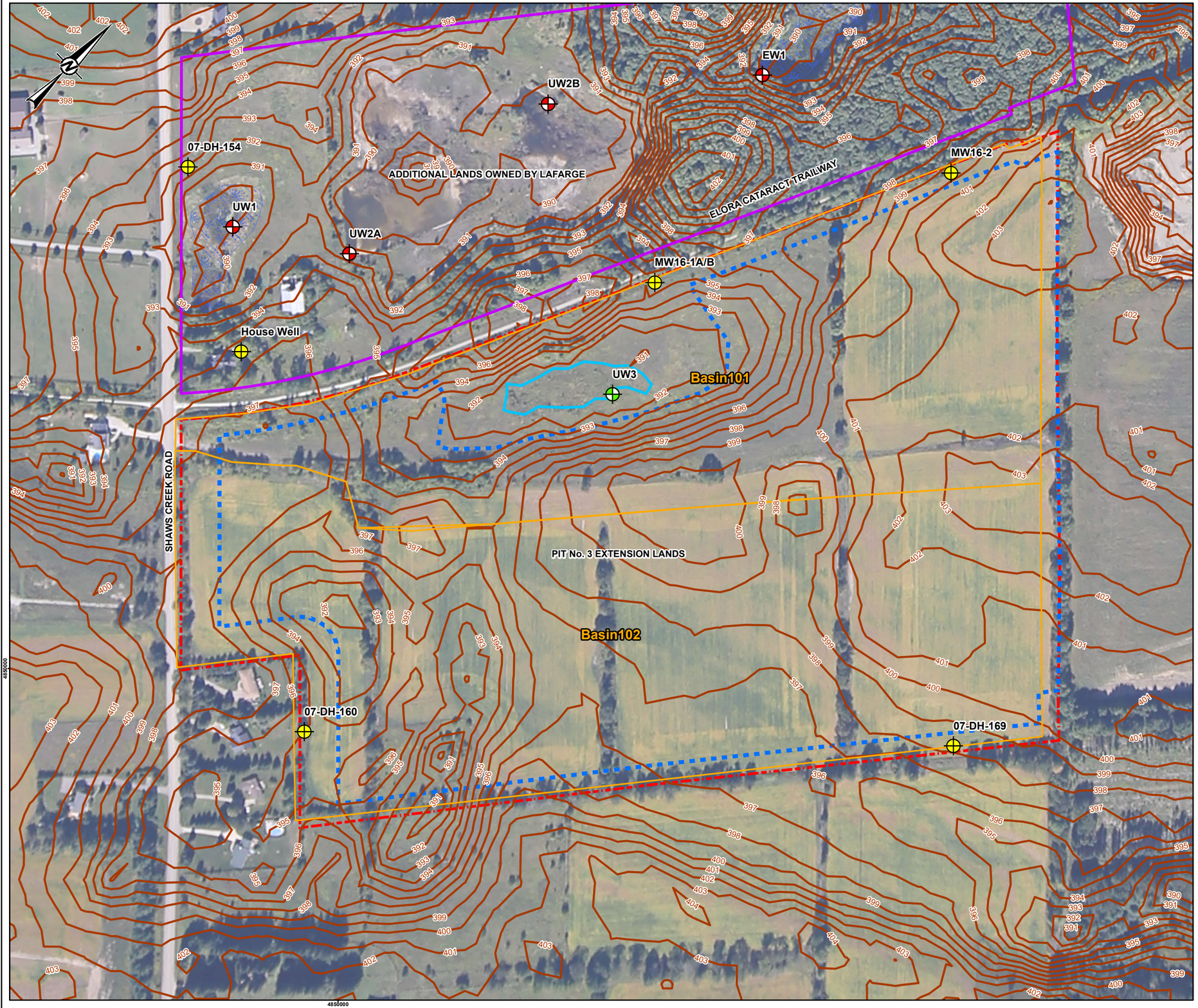


LEGEND

- Piezometer
- Groundwater Monitoring Wells
- Surface Water Monitors
- Contours in masl - 1 m intervals
- Catchment Area
- Watercourse
- Waterbody
- Wetland
- Unevaluated Wetland
- Additional Lands Owned by Lafarge
- Limit of Extraction
- Proposed Licence Boundary
- 500 m Buffer

0 100 200

1:3,000 METRES

NOTE(S)

1. SITE TOPOGRAPHY PROVIDED BY MHBC IN 1-4 EXISTING FEATURES - 2018-12-05.DWG DATED DECEMBER 5, 2018. PIT NO.3 CONTOURS INFERRED BASED ON FLOOR ELEVATIONS IN 2017. REMAINING TOPOGRAPHIC DATA PROVIDED BY LIO MNRF

REFERENCE(S)

1. IMAGERY: PROVIDED BY MHBC 2019
2. BASE DATA: LIO MNRF 2019
3. PROJECTION: TRANSVERSE MERCATOR NAD 1983 UTM ZONE 17N

CLIENT
LAFARGE CANADA INC.

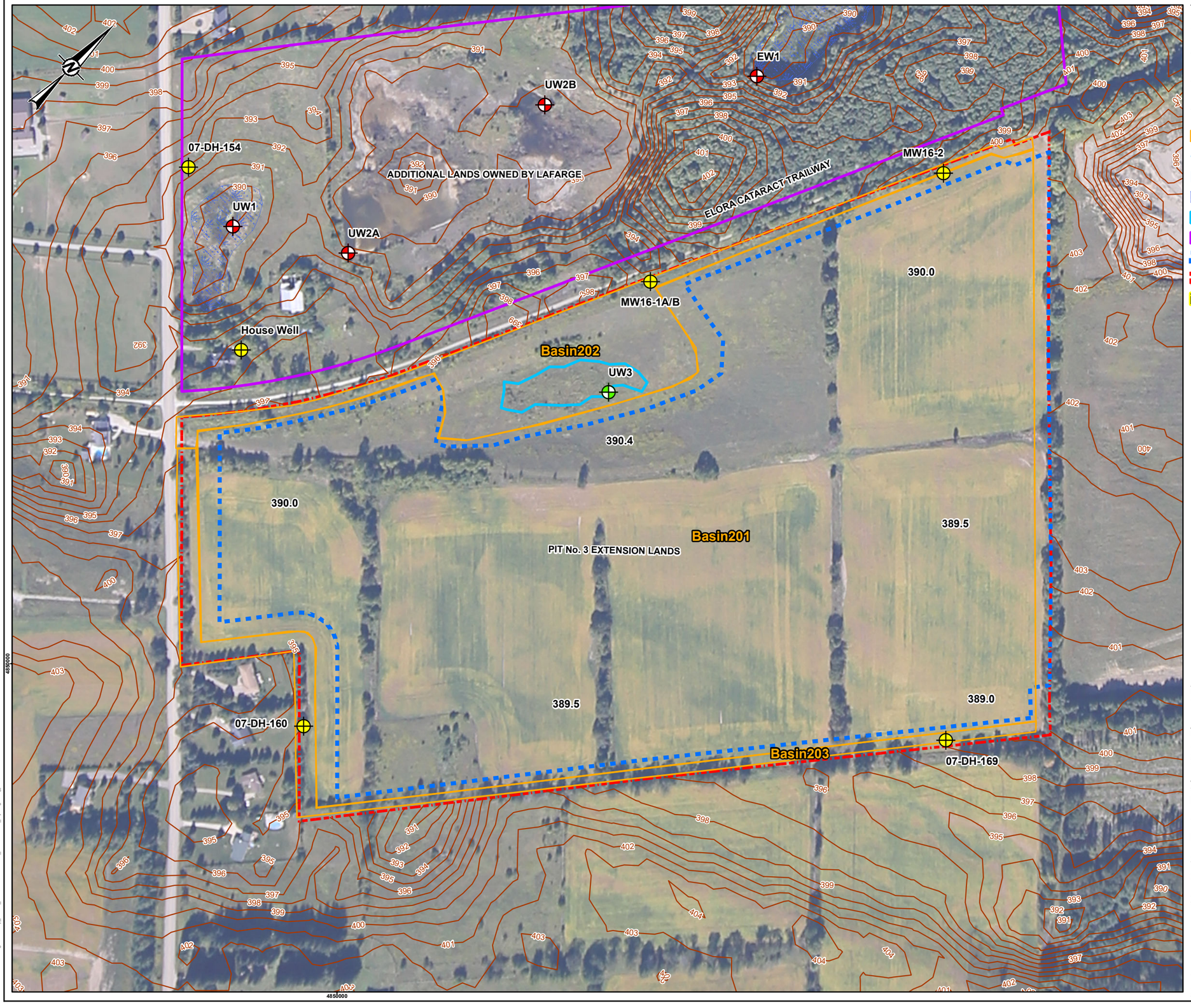
PROJECT
PIT NO.3 EXTENSION

TITLE
EXISTING SCENARIO CATCHMENTS

CONSULTANT

YYYY-MM-DD	2019-12-17
DESIGNED	SO
PREPARED	SO
REVIEWED	DH
APPROVED	DH

PROJECT NO.	CONTROL	REV.	FIGURE
21453896	0001	-	7



LEGEND

- 390.0 Pit Floor Elevation
- Piezometer
- Groundwater Monitoring Wells
- Surface Water Monitors
- Catchment Area
- Watercourse
- Waterbody
- Wetland
- Unevaluated Wetland
- Additional Lands Owned by Lafarge
- Limit of Extraction
- Proposed Licence Boundary
- 500 m Buffer

0 100 200

1:3,000 METRES

NOTE(S)

1. MHBC OPERATIONS PLAN 2 OF 4, DECEMBER 5, 2018.

REFERENCE(S)

1. IMAGERY: PROVIDED BY MHBC 2019
2. BASE DATA: LIO MNRF 2019
3. PROJECTION: TRANSVERSE MERCATOR NAD 1983 UTM ZONE 17N

CLIENT
LAFARGE CANADA INC.

PROJECT
PIT NO.3 EXTENSION

TITLE
OPERATIONS SCENARIO CATCHMENTS

CONSULTANT

wsp

YYYY-MM-DD	2019-12-17
DESIGNED	SO
PREPARED	SO
REVIEWED	DH
APPROVED	DH

PROJECT NO.	CONTROL	REV.	FIGURE
21453896	0001	-	8

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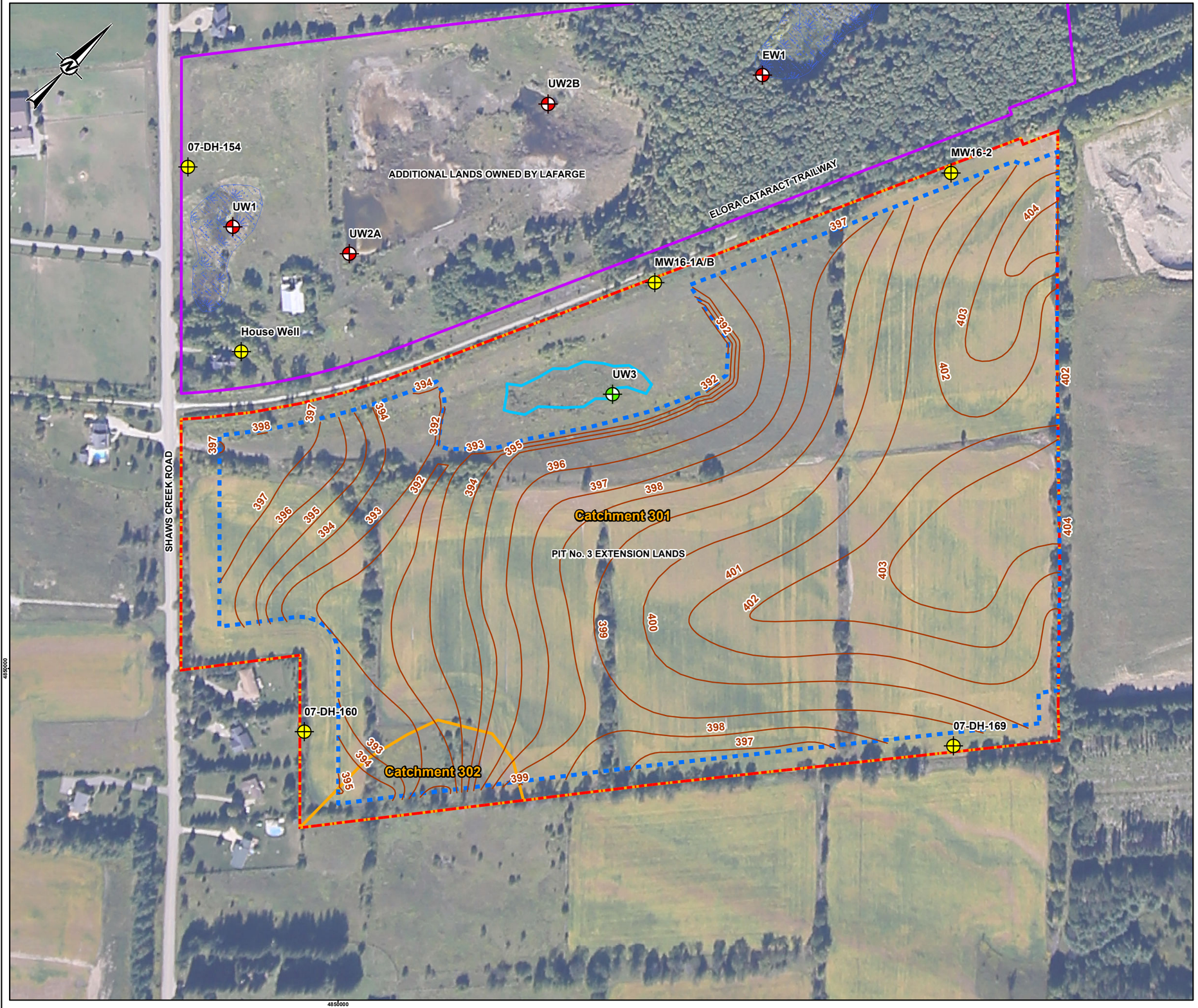


LEGEND

- Piezometer
- Groundwater Monitoring Wells
- Surface Water Monitors
- Contours in masl - 1 m intervals
- Catchment Area
- Watercourse
- Waterbody
- Wetland
- Unevaluated Wetland
- Additional Lands Owned by Lafarge
- Limit of Extraction
- Proposed Licence Boundary
- 500 m Buffer

0 100 200

1:3,000 METRES

NOTE(S)
1. REBABILITATION CONTOURS PROVIDED BY MHBC FEBRUARY 2024 (FILENAME: 9526CO - PIT 3 EXTENSION - DRAFT SITE PLAN - FEBRUARY 27 2024.DWG)

REFERENCE(S)
1. IMAGERY: PROVIDED BY MHBC 2019
2. BASE DATA: LIO MNRF 2019
3. PROJECTION: TRANSVERSE MERCATOR NAD 1983 UTM ZONE 17N

CLIENT
LAFARGE CANADA INC.

PROJECT
PIT NO.3 EXTENSION

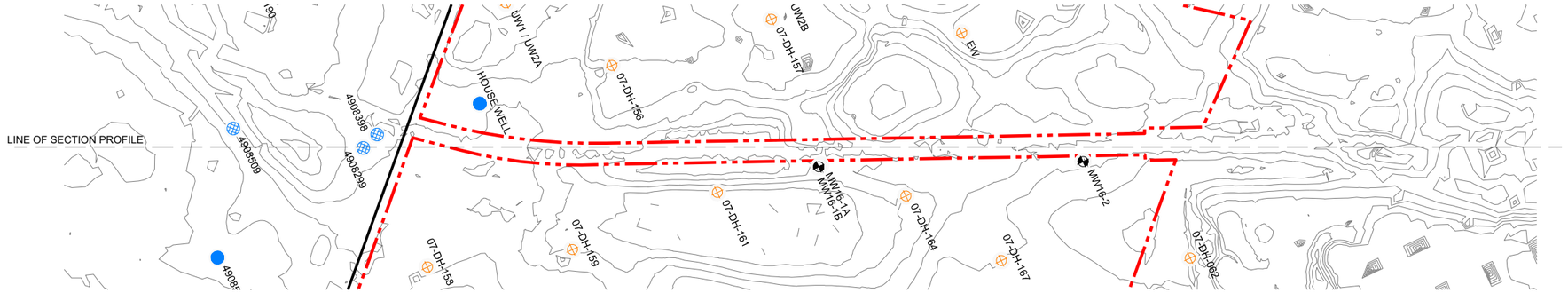
TITLE
REHABILITATED SCENARIO CATCHMENTS

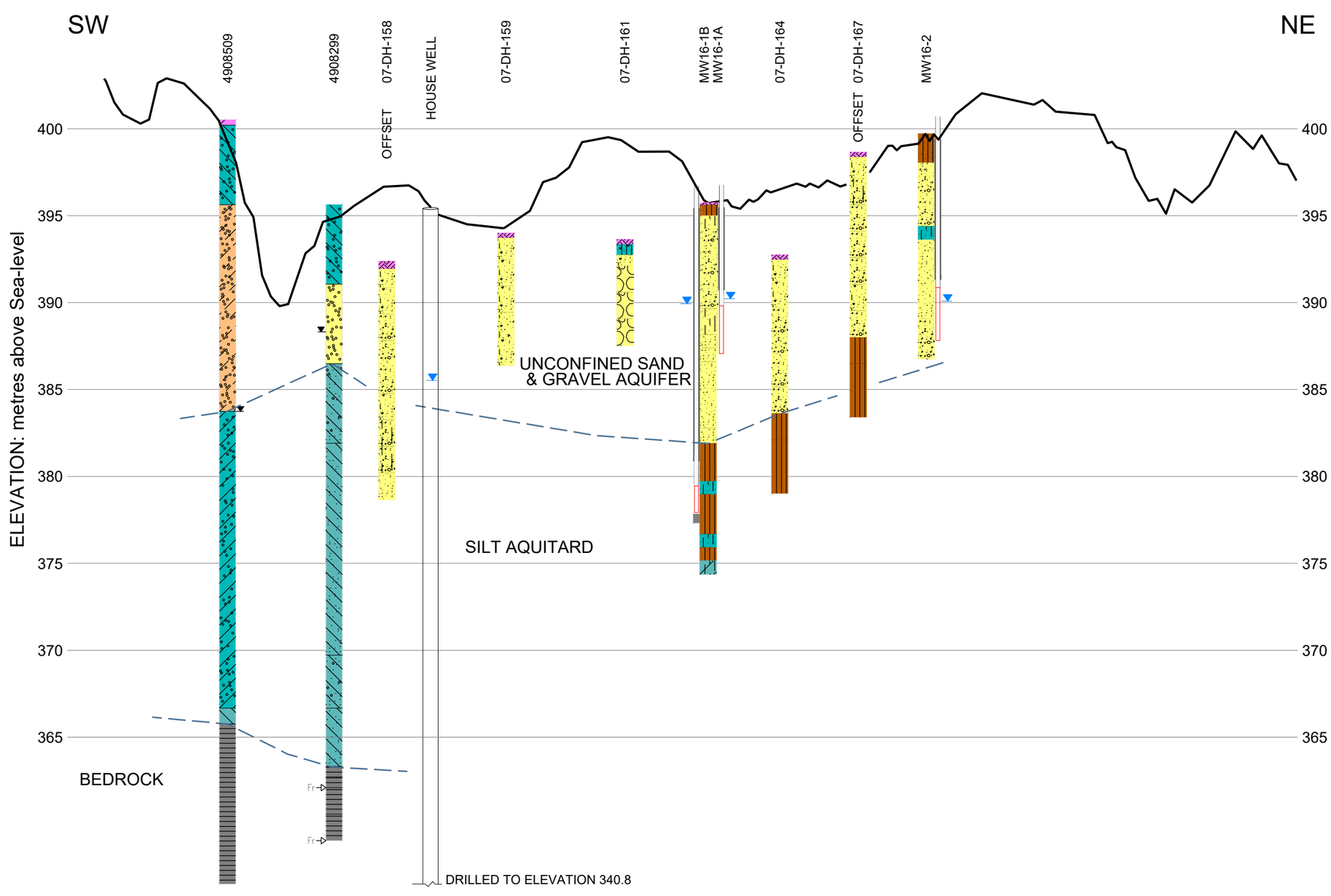
CONSULTANT

wsp

YYYY-MM-DD	2019-12-17
DESIGNED	SO
PREPARED	SO
REVIEWED	DH
APPROVED	DH

PROJECT NO.	CONTROL	REV.	FIGURE
21453896	0001	-	9





PLAN LEGEND

- Drilled Overburden Well
- Test or Observation Well
- Drilled Bedrock Well
- Site Drillhole (07-DH Series)
- Site Monitoring Well

SOIL PATTERN LEGEND AND GENERIC SHADING

- Unoxidized Clay Blue, Grey White, or Undefined
- Oxidized Clay Brown, Red, Yellow
- Silt
- Sand
- Gravel
- Stones, Pebbles
- Cobbles / Boulders
- Till
- Shale
- Unknown
- Peat/loam
- Sands & Gravels
- Granular Till
- Silt
- Silt Clayey
- Clay
- Fined Grained Till
- Shales

SECTION WELL SYMBOLS

- 23453 MOE Recorded Private Well
- As-built Reported Static Water Level
- Measured Static Water Level (31st May 2019 - See Note)
- Water Producing Zone
- Equipotential
- Screen

DRAFT

NOTES:

Ministry of Environment Water Well Records, Queen's Printer.
Location and elevations of field verified wells are subject to revision.

Boundaries between soil strata have been determined only at well and test well locations. Between the wells and test wells, boundaries are not proven but are assumed from geological eveidence.

Monitoring well groundwater elevations correspond to high water level measured May 31, 2019

0 500 1000 1500 m

1:25000

Plotted 11x17" Tabloid

Projection is UTM NAD 83 Zone 17

CLIENT
LAFARGEHOLCIM CANADA

PROJECT
PIT NO.3 EXTENSION

TITLE
SITE SECTION

CONSULTANT
WSP GOLDER

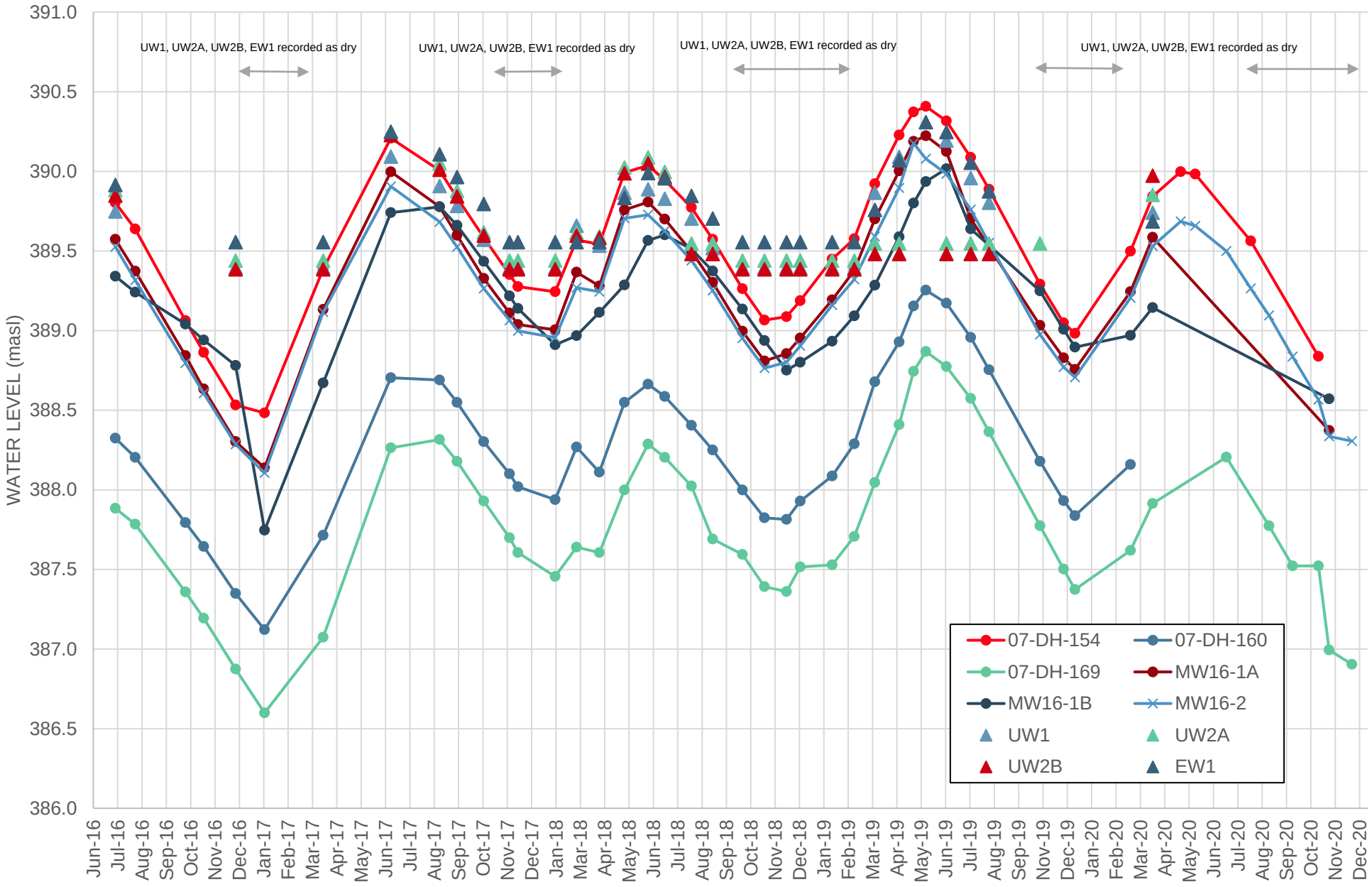
YYYY-MM-DD	2019-12-10
DESIGNED	
PREPARED	JPR
REVIEWED	
APPROVED	DH

PROJECT NO.	CONTROL	REV.	FIGURE
1655070	0001	----	4

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

25 mm

0



NOTES

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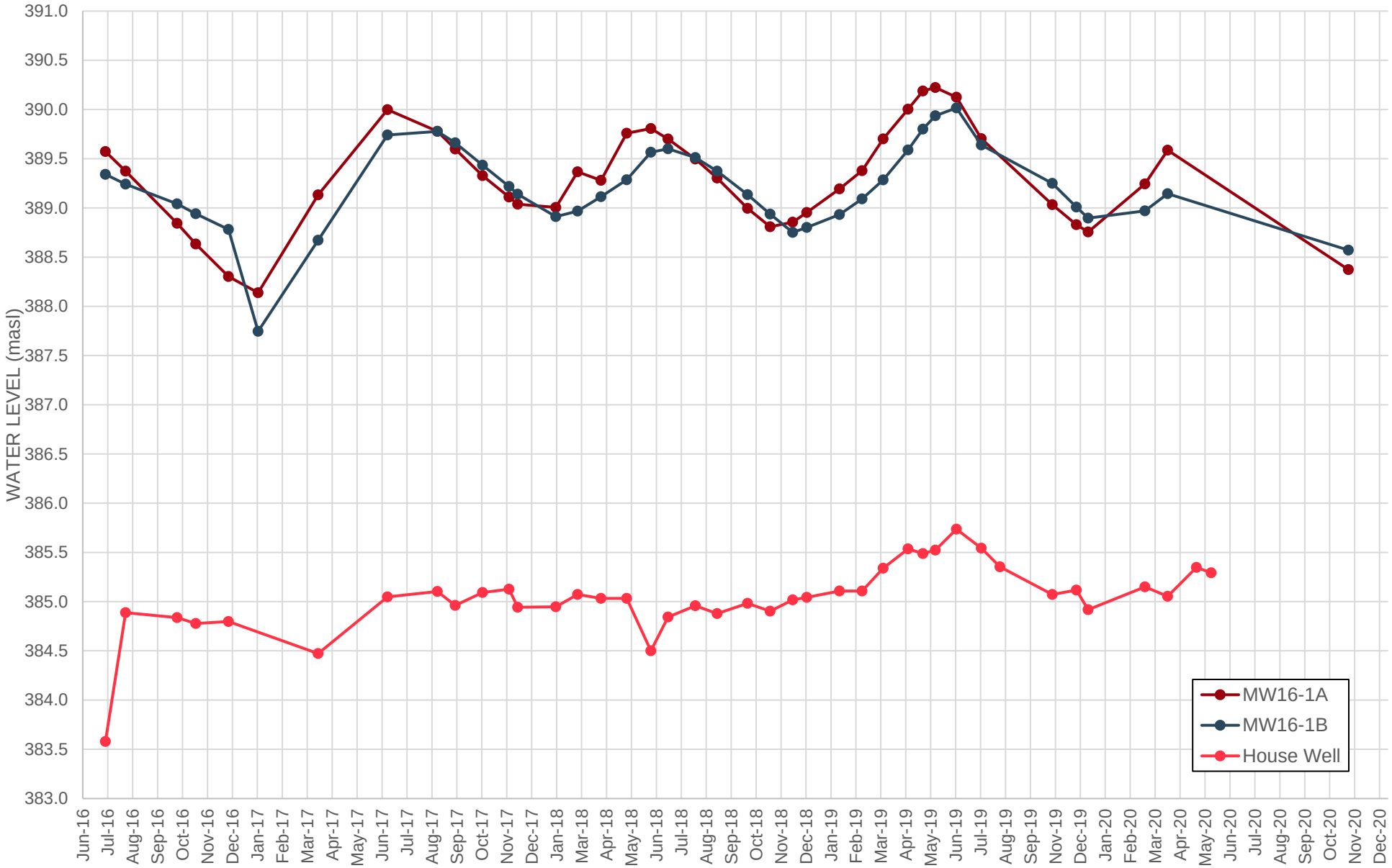
LAFARGE CANADA INC: PIT NO.3 EXTENSION

UNCONFINED AQUIFER HYDROGRAPHS

JULY 2023	PROJECT: 1655070	FIGURE: 5A



NOTES

.

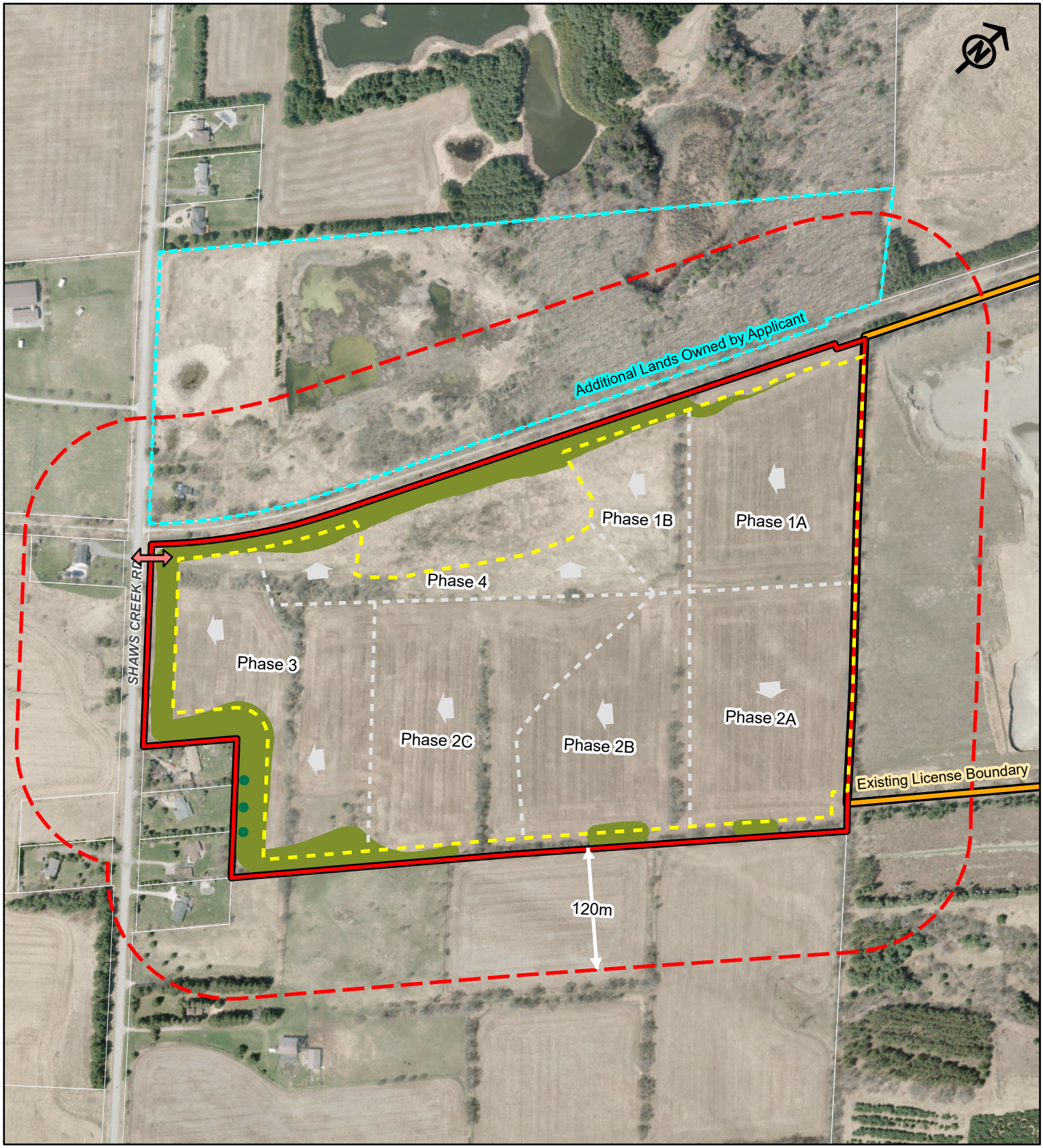
LAFARGE CANADA INC: PIT NO.3 EXTENSION

VERTICAL GRADIENTS

July 2023	PROJECT: 1655070	FIGURE: 5B

APPENDIX A

MHBC Site Plans



PHASING PLAN

Pit 3 Extension

Part of Lot 13, Con 5 WHS
Town of Caledon
Region of Peel

LEGEND

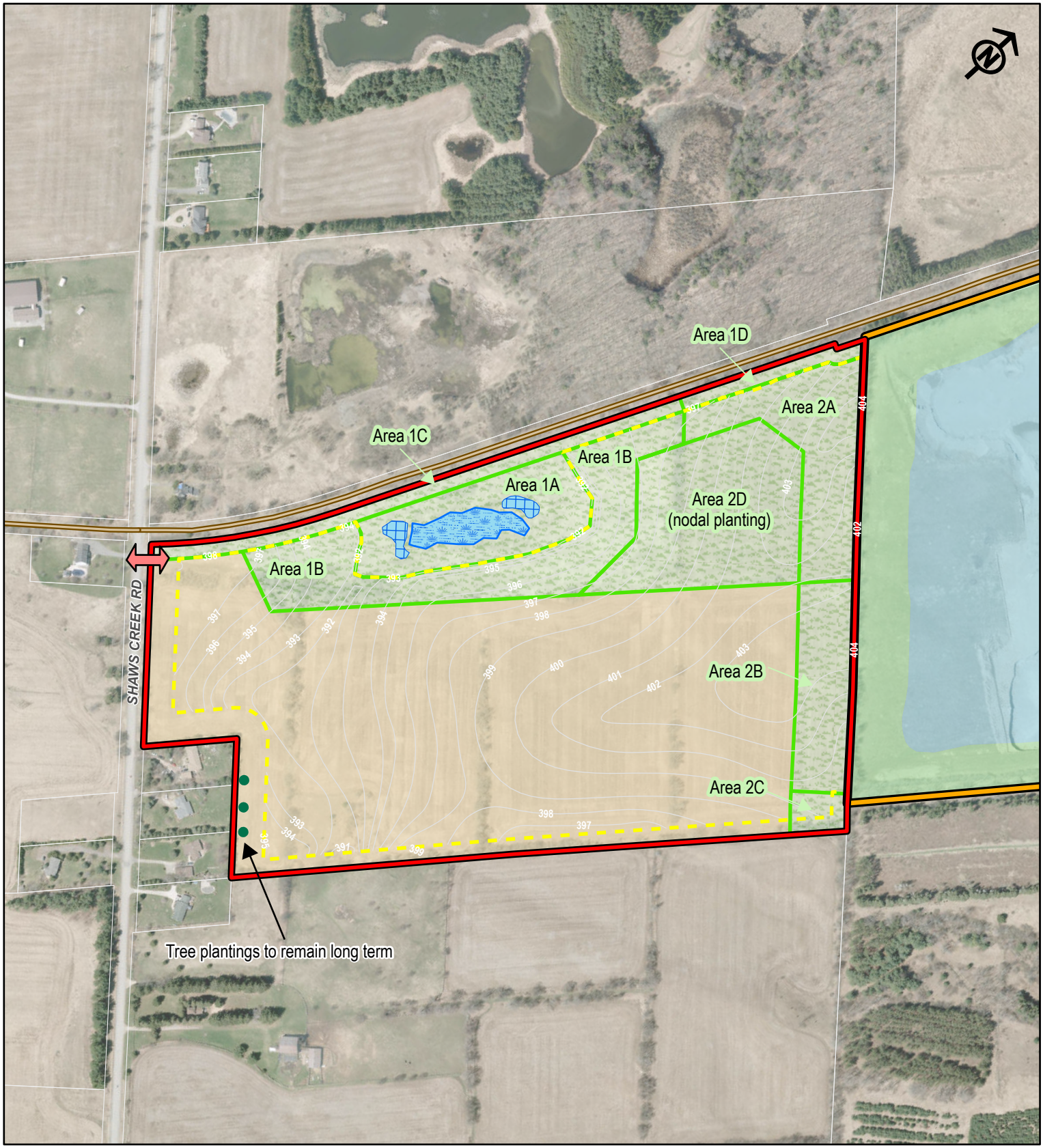
- Proposed Licence Boundary
- Proposed Extraction Limit
- Proposed Phasing Boundary
- Proposed Licence Boundary 120m Offset
- Proposed Acoustic / Visual Berms
- Proposed Tree Plantings

DATE April 2024

SOURCES

0 20 40 80 120 160 200
Meters

MHBC PLANNING URBAN DESIGN & LANDSCAPE ARCHITECTURE



REHABILITATION PLAN

Pit 3 Extension

Part of Lot 13, Con 5 WHS
Town of Caledon
Region of Peel

LEGEND

- Proposed Licence Boundary
- Existing Licence Boundary
- Proposed Extraction Limit
- Public Trail
- Reforestation Areas
- Agricultural Land
- Amphibian Breeding Pool
- Wetland
- Lake
- Woodland
- Vegetated Shoreline

DATE April 2024

SOURCES

0 40 80 160 240 320 400
Meters

MHBC PLANNING URBAN DESIGN & LANDSCAPE ARCHITECTURE

APPENDIX B

Well Records

PROJECT: 1655070

LOCATION: N 4850570.54; E 577690.61

RECORD OF BOREHOLE: MW16-1A

BORING DATE: June 30, 2016

SHEET 1 OF 1

DATUM: -

DEPTH SCALE METRES	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. + Q - ● / rem V. ⊕ U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp — W — Wl) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		395.76							
0	TRACK MOUNTED POWER AUGER 8" O.D. HOLLOW STEM AUGERS	TOPSOIL		0.00							50 mm Monitoring Pipe
		(ML) sandy SILT, trace gravel; brown, rootlets; non-cohesive, dry, loose		0.15 395.00							
1		(SM) SILTY SAND, fine to medium, trace to some gravel; dark brown; non-cohesive, moist, loose		0.76 394.24							
2		(SP/GP) SAND, medium to coarse, and GRAVEL, medium to coarse; some silt, trace cobbles; medium brown; non-cohesive, moist, loose		1.52							Bentonite
3											
4											
5											Silica Sand
6				389.66							
		(SM) SILTY SAND, fine to coarse, trace gravel; grey brown; non-cohesive, moist, loose		6.10							
7				388.14							PVC Screen
		(SP) SAND, fine to medium, trace silt; grey brown; non-cohesive, wet, loose		7.62							
8				387.38							
		(SP) SAND, fine to medium, trace gravel, coarse; grey brown; non-cohesive, wet, loose		8.38 387.07							
		END OF BOREHOLE		8.69							
9		NOTES: 1. Groundwater level measured in open borehole at a depth of 7.08 m below ground surface, June 30, 2016.									
10											

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: DD

CHECKED:

GTA-BHS 001 S:\CLIENTS\LAFARGE\PINKNEY_PIT\02_DATA\GINT\1655070.GPJ GAL-MIS.GDT 11-17-17 STB July 2017

PROJECT: 1655070

LOCATION: N 4850567.95; E 577691.40

RECORD OF BOREHOLE: MW16-1B

BORING DATE: June 29, 2016

SHEET 1 OF 3

DATUM: -

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. + Q - ●, rem V. ⊕ U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp, W, Wl) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		395.72							
0	TRACK MOUNTED POWER AUGER 8" O.D. HOLLOW STEM AUGERS	TOPSOIL		0.00							50 mm Monitoring Pipe
		(ML) sandy SILT, trace gravel; brown, rootlets; non-cohesive, dry, loose		0.15							
				394.96							
1		(SM) SILTY SAND, fine to medium, trace to some gravel; dark brown; non-cohesive, moist, loose		0.76							
				394.20							
2		(SP/GP) SAND, medium to coarse, and GRAVEL, medium to coarse; some silt, trace cobbles; medium brown; non-cohesive, moist, loose		1.52	1	SS					
3											
4					2	SS					
5											Bentonite
6				389.62							
		(SM) SILTY SAND, fine to coarse, trace gravel; grey brown; non-cohesive, moist, loose		6.10	3	SS					
7				388.10							
		(SP) SAND, fine to medium, trace silt; grey brown; non-cohesive, wet, loose		7.62							
8				387.34							
		(SP) SAND, fine to medium, trace gravel, coarse; grey brown; non-cohesive, wet, loose		8.38	4	SS					
9				386.58							
		(SP) SAND, medium to coarse, trace gravel; medium brown; non-cohesive, wet, loose		9.14							
10											
		CONTINUED NEXT PAGE									

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: DD

CHECKED:

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PROJECT: 1655070

LOCATION: N 4850567.95; E 577691.40

RECORD OF BOREHOLE: MW16-1B

BORING DATE: June 29, 2016

SHEET 2 OF 3

DATUM: -

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. + Q - ● / rem V. ⊕ U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp W Wl) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		--- CONTINUED FROM PREVIOUS PAGE ---									
10	TRACK MOUNTED POWER AUGER 8" O.D. HOLLOW STEM AUGERS	(SP) SAND, medium to coarse, trace gravel; medium brown; non-cohesive, wet, loose		385.05							
		(SP) SAND, fine to medium; light brown; non-cohesive, wet, loose		10.67							
11											
					5	SS					
12											Bentonite
				382.77							
13		(SP) SAND, fine to medium, some silt, trace gravel; medium brown; non-cohesive, wet, loose		12.95	6	SS					
				381.90							
14		(ML) SILT; grey brown; non-cohesive, wet, loose		13.82	7	SS					
15				380.48							
		(ML) SILT, trace clay; grey brown; non-cohesive, wet, firm		15.24							Silica Sand
16				379.72							
		(ML/SP) SILT and SAND, very fine; grey; non-cohesive, wet, firm		16.00	8	SS					
				378.96							
17		(ML) SILT, trace sand, very fine, trace clay; grey; non-cohesive, wet, firm		16.76							PVC Screen
											Silica Sand
18											Bentonite
19				376.67							
		(ML/SP) SILT and SAND; grey, varved; non-cohesive, wet, firm		19.05	9	SS					
				375.91							
				19.81							
20		*CONTINUED NEXT PAGE*									

DEPTH SCALE

1 : 50

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PROJECT: 1655070

LOCATION: N 4850567.95; E 577691.40

RECORD OF BOREHOLE: MW16-1B

BORING DATE: June 29, 2016

DATUM: -

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. + Q - ● / rem V. ⊕ U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp — W — Wl) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		--- CONTINUED FROM PREVIOUS PAGE ---									
20	8" O.D. HOLLOW STEM AUGERS	(ML) SILT; grey, interlayed sand, fine, reddish clay seams; non-cohesive, wet, firm		375.15							
		(CL) SILT and CLAY, trace sand; grey to reddish brown; non-cohesive, wet, loose		20.57							
21					10	SS					
				374.38							
		END OF BOREHOLE		21.34							
		NOTES:									
22		1. Groundwater level measured in open borehole at a depth of 7.28 m below ground surface, June 29, 2016.									
23											
24											
25											
26											
27											
28											
29											
30											

DEPTH SCALE

1 : 50

LOGGED: DD

CHECKED:

Golder Associates

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PROJECT: 1655070

LOCATION: N 4850796.42; E 577792.57

RECORD OF BOREHOLE: MW16-2

BORING DATE: June 28, 2016

SHEET 1 OF 2

DATUM: -

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. + Q - ● / rem V. ⊕ U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp W Wl) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		399.71							
0	TRACK MOUNTED POWER AUGER 8" O.D. HOLLOW STEM AUGERS	(ML) sandy SILT, very fine, some gravel; dark brown to light brown, rootlets; non-cohesive, moist, loose		0.00							50 mm Monitoring Pipe
1					1	SS					
				398.03							
		(SP/GP) SAND and GRAVEL, some silt, trace cobbles; brown, iron staining; non-cohesive, moist, loose		1.68							
2					2	SS					
3											
4											Bentonite
5				394.38							
		(SP/ML) SAND, fine, and SILT, some gravel; medium brown; non-cohesive, moist, loose		5.33							
6					3	SS					
				393.61							
		(SP) SAND, medium to coarse, trace gravel, trace silt; brown; non-cohesive, moist, loose		6.10							
7					4	SS					
8											Silica Sand
9											PVC Screen
10											
		CONTINUED NEXT PAGE									

DEPTH SCALE

1 : 50

Golder Associates

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PROJECT: 1655070

RECORD OF BOREHOLE: MW16-2

SHEET 2 OF 2

LOCATION: N 4850796.42; E 577792.57

BORING DATE: June 28, 2016

DATUM: -

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. + Q - ● / rem V. ⊕ U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp ⊖W WI) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
10		*--- CONTINUED FROM PREVIOUS PAGE ---*									
	TRACK MOUNTED POWER AUGER / 8" O.D. HOLLOW STEM AUGERS	(SP) SAND, medium to coarse, trace gravel, trace silt; brown; non-cohesive, moist, loose		389.04							
		(SP/GP) SAND, medium to coarse, and GRAVEL, fine to medium, trace silt; light brown; non-cohesive, wet, loose		10.67							PVC Screen
12				387.52							
		(SP/GP) SAND and GRAVEL, fine to coarse, trace cobbles; grey to light brown; non-cohesive, wet, loose		12.19	5	SS					
13				386.76							
		END OF BOREHOLE		12.95							
		NOTES:									
		1. Groundwater level measured in open borehole at a depth of 11.14 m below ground surface, June 28, 2016.									
14											
15											
16											
17											
18											
19											
20											

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: DD

CHECKED:

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DATE: November 2, 2007.
BOREHOLE # 07-DH-154
LOCATION: Lafarge - Pinkney Farm
UTM Coordinates: N4850374.88 E0577371.16 (moved bh 5 metres east)
ELEVATION: 390.84

DEPTH (m) From	To	MATERIAL DESCRIPTION	SAMPLE NUMBER	% Stone	F.M.	Cum. % Stone	Cum. F.M.
0.00	0.61	Sandy Silt Topsoil, trace gravel, Dark Brown, Moist. <5% Stone content.	-				
0.61	1.52	Fine to Coarse Sand and Gravel, trace Silt, Beige/Brown, Moist. Moderately Graded. 45% Stone content. Stone size 3mm to 50mm. Average size 20mm to 30mm.	07-DH-154-1	46.2	2.25	46.2	2.25
1.52	3.05	Fine to Coarse Sand and Gravel, trace Silt, Beige/Brown, Moist. Moderately Graded. 45% Stone content. Stone size 3mm to 50mm. Average size 20mm to 30mm.	07-DH-154-2	45.3	2.36	45.3	2.36
3.05	3.66	Fine to Coarse Sand and Gravel, trace Silt, Beige/Brown, Moist to Saturated at 3.1 metres. Moderately Graded. 60% Stone content. Stone size 3mm to 100mm. Average size 20mm to 35mm.	07-DH-154-3A	58.1	2.51	51.7	2.44
3.66	4.57	Fine to Medium Sand and Gravel, some Silt, Beige/Brown, Saturated. Moderately Graded. 35% Stone content. Stone size 3mm to 20mm. Average size 3mm to 15mm.	07-DH-154-3B	20.5	2.48	41.3	2.45
4.57	6.10	Gravel, some Cobbles, some Fine to Coarse Sand, (clean), Beige/Brown, Saturated. Moderately Graded. 85% Stone content. Stone size 3mm to 120mm. Average size 20mm to 40mm.	07-DH-154-4	71.4	2.14	48.8	2.37
6.10	7.62	Gravel, some Cobbles, some Fine Sand, trace Silt, Beige/Brown, Saturated. Moderately Graded. 80% Stone content. Stone size 3mm to 110mm. Average size 5mm to 20mm.	07-DH-154-5	53.4	2.57	49.7	2.41
		* Water Table encountered at 3.1 metres (10.0 feet)					

DATE: October 18, 2007.
BOREHOLE # 07-DH-160
LOCATION: Lafarge - Pinkney Farm
JTM Coordinates: N4850129.68 E0577748.42
ELEVATION: 391.23 metres

DEPTH (m) From	To	MATERIAL DESCRIPTION	SAMPLE NUMBER	% Stone	F.M.	Cum. % Stone	Cum. F.M.
0.00	0.27	Sandy Silt Topsoil, trace gravel, Dark Brown, Moist. <5% Stone content.	07-DH-160-1A	Not	Run		
0.27	1.52	Silty Sand and Gravel, Cobbles, Beige/Brown, Moist. Moderately Graded. 55% Stone content. Stone size 3mm to 100mm. Average size 15 mm to 30mm.	07-DH-160-1B	65.1	1.86	65.1	1.86
1.52	3.05	Silty Sand and Gravel, Cobbles Beige/Brown, Moist. Moderately Graded. 70% Stone content. Stone size 3mm to 120mm. Average stone size 100 to 120mm.	07-DH-160-2	56.0	2.42	60.6	2.14
3.05	4.57	Fine to Coarse Sand and Gravel, trace silt, Cobbles, Beige/Brown, Moist. Moderately Graded. 70% Stone content. Stone size 5mm to 100mm. Average stone size 3mm to 20 mm.	07-DH-160-3	59.6	2.92	60.2	2.40
4.57	6.10	Gravel, some Sand, trace Silt, Beige/Brown, Moist. Moderately Graded. 80% Stone content. Stone size 3mm to 85mm. Average stone size 5 to 20 mm.	07-DH-160-4	71.8	3.06	63.1	2.57
6.10	7.62	Silty Sand and Gravel, Cobbles, Beige/Brown, Moist. Moderately Graded. 55% Stone content. Stone size 3mm to 130mm. Average stone size 5 to 120 mm.	07-DH-160-5	64.4	2.71	64.4	2.71
7.62	9.14	Medium to Coarse Sand, some Gravel, (clean), Beige/Brown, *Saturated, Moderately Graded. 20% Stone content. Stone size 3mm to 50mm. Average stone size 5 to 15 mm.	07-DH-160-6	5.6	2.86	35.0	2.79
9.14	10.67	Fine to Coarse Sand and Gravel, Cobbles (clean) Beige/Brown, Saturated, Moderately Graded. 55% Stone content. Stone size 3mm to 120mm. Average stone size 100 to 120 mm.	07-DH-160-7	53.3	2.53	41.1	2.70
10.67	12.19	Fine to Coarse Sand and Gravel, Cobbles, (clean), Beige/Brown, Saturated, Moderately Graded. 55% Stone content. Stone size 3mm to 100mm. Average stone size 10 to 25 mm. * Water Table encountered at 7.62 metres (25.0 feet)	07-DH-160-8	36.3	2.35	39.9	2.61

		Monitoring Well Installation
11.86	9.1135	2" PVC Pipe installed (screened from 11.86 to 9.11m)
11.86	7.32	Silica Sand
7.32	6.25	Bentonite Seal
6.25	2.44	Benseal grout + cuttings
2.44	1.22	Bentonite Seal
0.46	0.00	Cuttings (Sand + Gravel)
0.00	0.00	Protective Stick Up Casing

DATE: October 26 and October 29, 2007.
BOREHOLE # 07-DH-169
LOCATION: Lafarge - Pinkney Farm
UTM Coordinates: N4850483.42 E0578115.93
ELEVATION: 397.05 metres

DEPTH (m) From	To	MATERIAL DESCRIPTION	SAMPLE NUMBER	% Stone	F.M.	Cum. % Stone	Cum. F.M.
0.00	0.30	Sandy Silt Topsoil, trace gravel, Dark Brown, Moist. <5% Stone content.	-				
0.30	1.52	Silty Sand and Gravel, Cobbles, Beige/Brown, Moist. Moderately to Well Graded. 60% Stone content. Stone size 3mm to 90mm. Average size 75 to 90mm.	07-DH-169-1	53.4	1.92	53.4	1.92
1.52	3.05	Gravel, some Sand, trace Silt, Beige/Brown, Moist. Moderately to Well Graded. 75% Stone content. Stone size 3mm to 65mm. Average size 20mm to 40.	07-DH-169-2	68.7	2.72	61.0	2.32
3.05	4.57	Silty Sand and Gravel, Cobbles and Boulders, Beige/Brown, Moist. Well Graded. 60% Stone content. Stone size 3mm to 180mm. Average size 150mm to 180mm.	07-DH-169-3	68.2	2.36	63.4	2.33
4.57	6.10	Fine to Coarse Sand and Gravel, Cobbles, trace Silt Beige/Brown, Moist Well Graded. 70% Stone content. Stone size 3mm to 90mm. Average stone size 10 to 20 mm.	07-DH-169-4	57.2	3.17	61.9	2.54
6.10	7.62	Fine to Coarse Sand and Gravel, (clean) Beige/Brown, Moist Moderately Graded. 40% Stone content. Stone size 3mm to 65mm. Average stone size 10 to 20 mm. Minor Cementation.	07-DH-169-5	43.3	2.83	58.2	2.60
7.62	9.14	Silty Sand and Gravel, Cobbles and Boulders Beige/Brown, Moist Moderately Graded. 65% Stone content. Stone size 3mm to 170mm. Average stone size 170 mm (one stone). Moderate Cementation.	07-DH-169-6	70.0	2.00	60.1	2.50
9.14	10.67	Silty Sand and Gravel, Beige/Brown, Moist Moderately to Well Graded. 70% Stone content. Stone size 3mm to 70mm. Average stone size 10 mm to 20 mm.	07-DH-169-7	56.3	2.37	56.3	2.37
10.67	12.19	Gravel, some Silty Sand, Cobbles and Boulders Beige/Brown, Moist to Saturated at 11.6 metres. Well Graded. 85% Stone content. Stone size 3mm to 120mm. Average stone size 100mm to 120 mm.	07-DH-169-8	60.3	2.21	58.3	2.29
12.19	13.72	Fine to Coarse Sand and Gravel, Cobbles, trace Silt with Sandy Silt layers Beige/Brown, Saturated Moderately Graded. 65% Stone content. Stone size 3mm to 65mm. Average stone size 3mm to 15 mm.	07-DH-169-9	59.8	2.00	58.8	2.19
13.72	14.33	Fine to Coarse Sand, trace Gravel (clean) Beige/Brown, Saturated Poorly to Moderately Graded. <5% Stone content.	07-DH-169-10A	3.6	1.72	45.0	2.08
14.33	15.24	Sandy Silt, Brown and Grey, Saturated Poorly Graded. 0% Stone content.	07-DH-169-10B	Not	Run		
15.24	15.85	Sandy Silt, Brown and Grey, Saturated Poorly Graded. 0% Stone content.	07-DH-169-11	Not	Run		
		* Water Table encountered at 11.6 metres (38.0 feet)					

Monitoring Well Installation

15.85	12.8016	2" PVC Pipe installed
15.85	11.58	Silica Sand
11.58	10.67	Bentonite Seal
10.67	2.44	Benseal grout + cuttings
2.44	1.22	Bentonite Seal
0.46	0.00	Cuttings (Sand + Gravel)
0.00	0.00	Protective Stick Up Casing

MINISTRY OF THE ENVIRONMENT

The Ontario Water Resources Act

WATER WELL RECORD

Ontario

4 of 166

1. PRINT ONLY IN SPACES PROVIDED
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11 | 4904705 | MUNICIP. 49002 | CON. H.S. W | 05

COUNTY OR DISTRICT	TOWNSHIP, BOROUGH, CITY, TOWN, VILLAGE	CON., BLOCK, TRACT, SURVEY, ETC.	LOT
PEEL	CALEDON	5 W.H.S W	012

[redacted] R.R.#1, ALTON.

DATE COMPLETED: DAY 31 MO. JULY YR. 74

UTM 349700 | RC. 5 | ELEVATION 1305 | RC. 5 | BASIN CODE 24

LOG OF OVERBURDEN AND BEDROCK MATERIALS (SEE INSTRUCTIONS)

GENERAL COLOUR	MOST COMMON MATERIAL	OTHER MATERIALS	GENERAL DESCRIPTION	DEPTH - FEET FROM	DEPTH - FEET TO
	GRAVEL-CLAY-Rocks			0	52
	SANDY CLAY-SAND LAYERS			52	85
GREY	CLAY			85	163
GREY	DOLOMITE			163	195

31 | 0052 | 1105 | 12 | 0085 | 0581 | 74 | 0163 | 295 | 0195 | 216

32

41 WATER RECORD

WATER FOUND AT - FEET	KIND OF WATER
0168	1 ☒ FRESH 3 ☐ SULPHUR 2 ☐ SALTY 4 ☐ MINERAL
	1 ☐ FRESH 3 ☐ SULPHUR 2 ☐ SALTY 4 ☐ MINERAL
	1 ☐ FRESH 3 ☐ SULPHUR 2 ☐ SALTY 4 ☐ MINERAL
	1 ☐ FRESH 3 ☐ SULPHUR 2 ☐ SALTY 4 ☐ MINERAL
	1 ☐ FRESH 3 ☐ SULPHUR 2 ☐ SALTY 4 ☐ MINERAL

51 CASING & OPEN HOLE RECORD

INSIDE DIAM. INCHES	MATERIAL	WALL THICKNESS INCHES	DEPTH - FEET FROM	DEPTH - FEET TO
05 11	1 ☒ STEEL 2 ☐ GALVANIZED 3 ☐ CONCRETE 4 ☐ OPEN HOLE	.188	0	0164
05 11	1 ☐ STEEL 2 ☐ GALVANIZED 3 ☐ CONCRETE 4 ☒ OPEN HOLE		164	0195
	1 ☐ STEEL 2 ☐ GALVANIZED 3 ☐ CONCRETE 4 ☐ OPEN HOLE			

SCREEN

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

MATERIAL AND TYPE | DEPTH TO TOP OF SCREEN FEET

61 PLUGGING & SEALING RECORD

DEPTH SET AT - FEET FROM	TO	MATERIAL AND TYPE (CEMENT GROUT, LEAD PACKER, ETC.)

71 PUMPING TEST

PUMPING TEST METHOD	PUMPING RATE GPM	DURATION OF PUMPING HOURS	MINS
1 ☒ PUMP 2 ☐ BAILER	0005	1	00

STATIC LEVEL FEET	WATER LEVEL END OF PUMPING FEET	WATER LEVELS DURING	15 MINUTES FEET	30 MINUTES FEET	45 MINUTES FEET	60 MINUTES FEET
066	120	1 ☒ PUMPING 2 ☐ RECOVERY	138	138	128	138

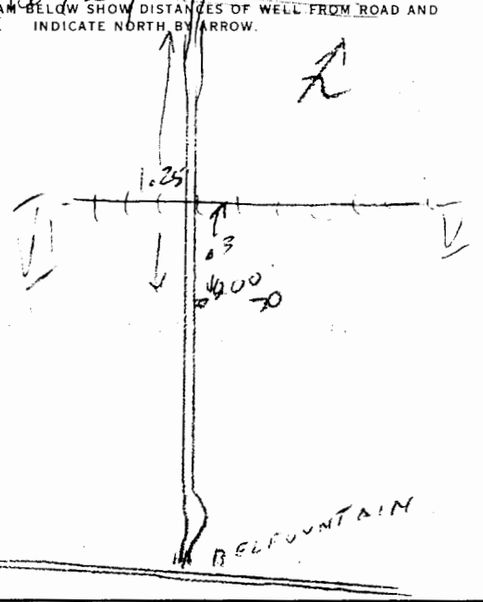
IF FLOWING, GIVE RATE GPM	PUMP INTAKE SET AT FEET	WATER AT END OF TEST	RECOMMENDED PUMP TYPE	RECOMMENDED PUMP SETTING FEET	RECOMMENDED PUMPING RATE GPM
		1 ☒ CLEAR 2 ☐ CLOUDY	☐ SHALLOW ☐ DEEP	150	0005

GPM./FT. SPECIFIC CAPACITY

LOCATION OF WELL 7749

HW 24

IN DIAGRAM BELOW SHOW DISTANCES OF WELL FROM ROAD AND LOT LINE. INDICATE NORTH BY ARROW.



DRILLERS REMARKS:

FINAL STATUS OF WELL 1	1 ☒ WATER SUPPLY 2 ☐ OBSERVATION WELL 3 ☐ TEST HOLE 4 ☐ RECHARGE WELL	5 ☐ ABANDONED, INSUFFICIENT SUPPLY 6 ☐ ABANDONED, POOR QUALITY 7 ☐ UNFINISHED
WATER USE 2	1 ☒ DOMESTIC 2 ☒ STOCK 3 ☐ IRRIGATION 4 ☐ INDUSTRIAL ☐ OTHER	5 ☐ COMMERCIAL 6 ☐ MUNICIPAL 7 ☐ PUBLIC SUPPLY 8 ☐ COOLING OR AIR CONDITIONING 9 ☐ NOT USED
METHOD OF DRILLING 2	1 ☐ CABLE TOOL 2 ☒ ROTARY (CONVENTIONAL) 3 ☐ ROTARY (REVERSE) 4 ☐ ROTARY (AIR) 5 ☐ AIR PERCUSSION	6 ☐ BORING 7 ☐ DIAMOND 8 ☐ JETTING 9 ☐ DRIVING

CONTRACTOR

NAME OF WELL CONTRACTOR	LICENCE NUMBER
LADCO DRILLING	3316

ADDRESS: Hillsburg R.R. #1

NAME OF DRILLER OR BORER	LICENCE NUMBER
THOMAS LAING	3316

SIGNATURE OF CONTRACTOR: T. Laing

SUBMISSION DATE: DAY 31 MO. Aug YR. 74

OFFICE USE ONLY

DATA SOURCE	CONTRACTOR	DATE RECEIVED
1	3316	220875

DATE OF INSPECTION | INSPECTOR

REMARKS: CSS.S8 | P Lfw | WI

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FORM 7 07-091

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Ontario

The Ontario Water Resources Act

WATER WELL RECORD

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11 — 4906455 — MUNICIP — CON.

COUNTY OR DISTRICT	TOWNSHIP, BOROUGH, CITY, TOWN, VILLAGE	CON., BLOCK, TRACT, SURVEY, ETC.	LOT
PEEL	Caledon (CALEDON)	1X/HS C-5	13

[redacted] — Lot 13 Con. Belfountain 5th Line W — DATE COMPLETED: DAY 14 MO 11 YR 86

G — RC — ELEVATION — RC — BASIN CODE — II — III — IV

LOG OF OVERBURDEN AND BEDROCK MATERIALS (SEE INSTRUCTIONS)

GENERAL COLOUR	MOST COMMON MATERIAL	OTHER MATERIALS	GENERAL DESCRIPTION	DEPTH - FEET FROM	DEPTH - FEET TO
BROWN	Clay	STONES	POROUS	0	3
BROWN	SAND - FINE		LOOS	3	84
BROWN	SAND - Coarse		LOOS	84	101
BROWN	SAND - Gravel		LOOS	101	120
GRAY	CLAY	- STONES	DENSE	120	142
RED	CLAY	- STONES	DENSE	142	161
GRAY	DOLOSTITE		HARD	161	180
RED	SHALE		DENSE	180	200

31
32

41 WATER RECORD

WATER FOUND AT - FEET	KIND OF WATER
196	1 ☒ FRESH 3 ☐ SULPHUR / 2 ☐ SALTY 4 ☐ MINERAL
120	1 ☒ FRESH 3 ☐ SULPHUR / 2 ☐ SALTY 4 ☐ MINERAL
	1 ☐ FRESH 3 ☐ SULPHUR / 2 ☐ SALTY 4 ☐ MINERAL
	1 ☐ FRESH 3 ☐ SULPHUR / 2 ☐ SALTY 4 ☐ MINERAL
	1 ☐ FRESH 3 ☐ SULPHUR / 2 ☐ SALTY 4 ☐ MINERAL

51 CASING & OPEN HOLE RECORD

INSIDE DIAM INCHES	MATERIAL	WALL THICKNESS INCHES	DEPTH - FEET FROM	DEPTH - FEET TO
5	1 ☒ STEEL 2 ☐ GALVANIZED 3 ☐ CONCRETE 4 ☐ OPEN HOLE	.188	0	161
5	1 ☐ STEEL 2 ☐ GALVANIZED 3 ☐ CONCRETE 4 ☒ OPEN HOLE		161	200
	1 ☐ STEEL 2 ☐ GALVANIZED 3 ☐ CONCRETE 4 ☐ OPEN HOLE			

SCREEN

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

MATERIAL AND TYPE — DEPTH TO TOP OF SCREEN FEET

61 PLUGGING & SEALING RECORD

DEPTH SET AT - FEET FROM	DEPTH SET AT - FEET TO	MATERIAL AND TYPE (CEMENT GROUT, LEAD PACKER, ETC.)
0	16	clay

71 PUMPING TEST

PUMPING TEST METHOD	PUMPING RATE	DURATION OF PUMPING
1 ☒ PUMP 2 ☐ BAILER	10 GPM	2 HOURS 30 MINS

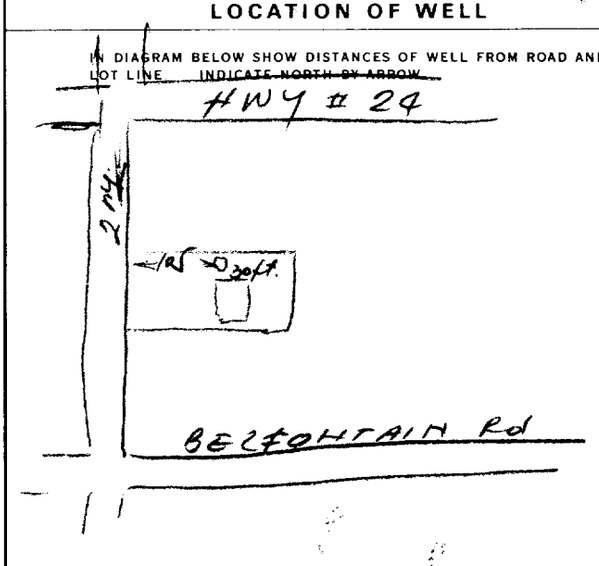
STATIC LEVEL	WATER LEVEL END OF PUMPING	WATER LEVELS DURING (1 ☒ PUMPING 2 ☐ RECOVERY)	15 MINUTES	30 MINUTES	45 MINUTES	60 MINUTES
37 FEET	FEET		45 FEET	60 FEET	60 FEET	60 FEET

IF FLOWING, GIVE RATE	PUMP INTAKE SET AT	WATER AT END OF TEST
GPM	90 FEET	1 ☒ CLEAR 2 ☐ CLOUDY

RECOMMENDED PUMP TYPE	RECOMMENDED PUMP SETTING	RECOMMENDED PUMPING RATE
☐ SHALLOW ☒ DEEP	90 FEET	7.5 GPM

LOCATION OF WELL

IN DIAGRAM BELOW SHOW DISTANCES OF WELL FROM ROAD AND LOT LINE. INDICATE NORTH BY ARROW.



DRILLERS REMARKS: 030 009 162 95

FINAL STATUS OF WELL

1 ☒ WATER SUPPLY 2 ☐ OBSERVATION WELL 3 ☐ TEST HOLE 4 ☐ RECHARGE WELL 5 ☐ ABANDONED, INSUFFICIENT SUPPLY 6 ☐ ABANDONED, POOR QUALITY 7 ☐ UNFINISHED

WATER USE

1 ☒ DOMESTIC 2 ☐ STOCK 3 ☐ IRRIGATION 4 ☐ INDUSTRIAL ☐ OTHER 5 ☐ COMMERCIAL 6 ☐ MUNICIPAL 7 ☐ PUBLIC SUPPLY 8 ☐ COOLING OR AIR CONDITIONING 9 ☐ NOT USED

METHOD OF DRILLING

1 ☒ CABLE TOOL 2 ☐ ROTARY (CONVENTIONAL) 3 ☐ ROTARY (REVERSE) 4 ☐ ROTARY (AIR) 5 ☐ AIR PERCUSSION 6 ☐ BORING 7 ☐ DIAMOND 8 ☐ JETTING 9 ☐ DRIVING

CONTRACTOR

NAME OF WELL CONTRACTOR: M. KIVAC Drilling Co — LICENCE NUMBER: 3132

ADDRESS: Box 148 Caledon - Ont.

NAME OF DRILLER OR BORER: MARKO KIVAC — LICENCE NUMBER: 3132

SIGNATURE OF CONTRACTOR — SUBMISSION DATE: DAY 14 MO 11 YR 86

OFFICE USE ONLY

DATA SOURCE — CONTRACTOR — DATE RECEIVED: 09 04 86

DATE OF INSPECTION — INSPECTOR — REMARKS

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Ministry of the Environment
Ontario

The Ontario Water Resources Act

WATER WELL RECORD

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11 4906658

COUNTY OR DISTRICT	TOWNSHIP, BOROUGH, CITY, TOWN, VILLAGE	CON., BLOCK, TRACT, SURVEY, ETC.	LOT
PEEL	TOWN OF CALEDON (CALEDON) -	CON. 5 WHS	12

[redacted] .DELIVERY BELFOUNTAIN, ONT. LON 1BO

DATE COMPLETED: DAY 9 MO 6 YR 87

UTM ZONE 17 | NORTHING 4976 | EASTING 0403 | BASIN CODE

LOG OF OVERBURDEN AND BEDROCK MATERIALS (SEE INSTRUCTIONS)

GENERAL COLOUR	MOST COMMON MATERIAL	OTHER MATERIALS	GENERAL DESCRIPTION	DEPTH - FEET FROM	DEPTH - FEET TO
BROWN	CLAY	SAND, GRAVEL & BOULDERS	LOOSE	0	45
BROWN	GRAVEL	SAND	LOOSE	45	52
BROWN	CLAY	SAND, GRAVEL & BOULDERS	LOOSE	52	87
GREY	SAND	CLAY	LOOSE	87	105
GREY	SAND	FINE GRAVEL	PACKED	105	126
CASING IS DAMAGED @	49 FEET & HOLE IS IMPASSIBLE DUE TO CASING DAMAGE				
CAUSED BY BOULDERS BUT WELL IS PRODUCING WATER FROM 126 FOOT LEVAL					

31
32

41 WATER RECORD

WATER FOUND AT - FEET	KIND OF WATER
126	1 ☒ FRESH 3 ☐ SULPHUR 2 ☐ SALTY 4 ☐ MINERAL
	1 ☐ FRESH 3 ☐ SULPHUR 2 ☐ SALTY 4 ☐ MINERAL
	1 ☐ FRESH 3 ☐ SULPHUR 2 ☐ SALTY 4 ☐ MINERAL
	1 ☐ FRESH 3 ☐ SULPHUR 2 ☐ SALTY 4 ☐ MINERAL
	1 ☐ FRESH 3 ☐ SULPHUR 2 ☐ SALTY 4 ☐ MINERAL

51 CASING & OPEN HOLE RECORD

INSIDE DIAM INCHES	MATERIAL	WALL THICKNESS INCHES	DEPTH - FEET FROM	DEPTH - FEET TO
6 1/4	1 ☒ STEEL 2 ☐ GALVANIZED 3 ☐ CONCRETE 4 ☐ OPEN HOLE	.188	1	126
	1 ☐ STEEL 2 ☐ GALVANIZED 3 ☐ CONCRETE 4 ☐ OPEN HOLE			
	1 ☐ STEEL 2 ☐ GALVANIZED 3 ☐ CONCRETE 4 ☐ OPEN HOLE			

SCREEN

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

MATERIAL AND TYPE | DEPTH TO TOP OF SCREEN FEET

61 PLUGGING & SEALING RECORD

DEPTH SET AT - FEET FROM	DEPTH SET AT - FEET TO	MATERIAL AND TYPE (CEMENT GROUT, LEAD PACKER, ETC.)

71 PUMPING TEST

PUMPING TEST METHOD: 1 ☐ PUMP 2 ☒ BAILER
PUMPING RATE: 4 GPM
DURATION OF PUMPING: 3 HOURS ____ MINS

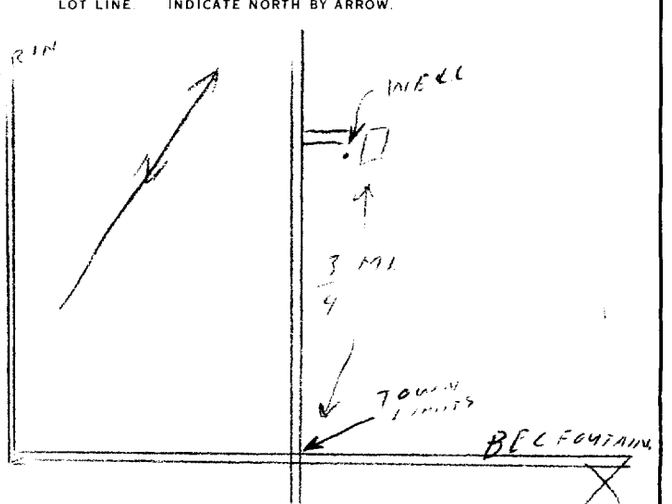
STATIC LEVEL	WATER LEVEL END OF PUMPING	WATER LEVELS DURING: 1 ☐ PUMPING 2 ☒ RECOVERY			
		15 MINUTES	30 MINUTES	45 MINUTES	60 MINUTES
44 FEET	44 FEET	44 FEET	44 FEET	44 FEET	44 FEET

IF FLOWING, GIVE RATE: ____ GPM
PUMP INTAKE SET AT: ____ FEET
WATER AT END OF TEST: 1 ☐ CLEAR 2 ☒ CLOUDY

RECOMMENDED PUMP TYPE: ☐ SHALLOW ☒ DEEP
RECOMMENDED PUMP SETTING: 49 FEET
RECOMMENDED PUMPING RATE: 4 GPM

LOCATION OF WELL

IN DIAGRAM BELOW SHOW DISTANCES OF WELL FROM ROAD AND LOT LINE. INDICATE NORTH BY ARROW.



DRILLERS REMARKS:

FINAL STATUS OF WELL

1 ☒ WATER SUPPLY 2 ☐ OBSERVATION WELL 3 ☐ TEST HOLE 4 ☐ RECHARGE WELL 5 ☐ ABANDONED, INSUFFICIENT SUPPLY 6 ☐ ABANDONED, POOR QUALITY 7 ☐ UNFINISHED

WATER USE

1 ☐ DOMESTIC 2 ☒ STOCK 3 ☐ IRRIGATION 4 ☐ INDUSTRIAL ☐ OTHER 5 ☐ COMMERCIAL 6 ☐ MUNICIPAL 7 ☐ PUBLIC SUPPLY 8 ☐ COOLING OR AIR CONDITIONING 9 ☐ NOT USED

METHOD OF DRILLING

1 ☒ CABLE TOOL 2 ☐ ROTARY (CONVENTIONAL) 3 ☐ ROTARY (REVERSE) 4 ☐ ROTARY (AIR) 5 ☐ AIR PERCUSSION 6 ☐ BORING 7 ☐ DIAMOND 8 ☐ JETTING 9 ☐ DRIVING

CONTRACTOR

NAME OF WELL CONTRACTOR: O'CONNOR WELL DRILLING LTD. | LICENCE NUMBER: 4005
ADDRESS: RR # 1 MILLGROVE, ONT. LOR IVO
NAME OF DRILLER OR BORER: W. HOWE | LICENCE NUMBER:
SIGNATURE OF CONTRACTOR: J. O'Connor | SUBMISSION DATE: DAY ____ MO. ____ YR. ____

OFFICE USE ONLY

DATA SOURCE | CONTRACTOR | DATE RECEIVED: AUG 14 1987
DATE OF INSPECTION | INSPECTOR
REMARKS

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Ministry of the Environment
Ontario

The Ontario Water Resources Act

WATER WELL RECORD

1. PRINT ONLY IN SPACES PROVIDED
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11 — 4907205 — MUNICIP. 49002 — CON. HS W — LOT 14

COUNTY OR DISTRICT: [redacted]
TOWNSHIP, BOROUGH, CITY, TOWN, VILLAGE: Caledon (CALEDON) 18033
CON: V — BLOCK, TRACT, SURVEY ETC: WHS — LOT: 14
[redacted] 103 Dumfries Ave., 5th Line W
BRAMPTON ONT. L6Z 2W6
DATE COMPLETED: DAY 01 MO 11 YR 89
UTM: 5,0,3,6,7 — RC — ELEVATION: 0,4,0,2 — RC — BASIN CODE

LOG OF OVERBURDEN AND BEDROCK MATERIALS (SEE INSTRUCTIONS)

GENERAL COLOUR	MOST COMMON MATERIAL	OTHER MATERIALS	GENERAL DESCRIPTION	DEPTH - FEET FROM	DEPTH - FEET TO
	Gravel	Boulders		0	40
Gr.	Silt	Clay Layers		40	99
Gr/Br.	Dolomite			99	108
Gr.	Shale Ledges			108	112
Red + Grey	Shale			112	116

LINER 5" PVC from 96' to 116' - Perforated

31
32

41 WATER RECORD

WATER FOUND AT - FEET	KIND OF WATER
100' 96' 116'	1 ☒ FRESH 2 ☐ SALTY 3 ☐ SULPHUR 4 ☐ MINERALS 6 ☐ GAS
	1 ☐ FRESH 2 ☐ SALTY 3 ☐ SULPHUR 4 ☐ MINERALS 6 ☐ GAS
	1 ☐ FRESH 2 ☐ SALTY 3 ☐ SULPHUR 4 ☐ MINERALS 6 ☐ GAS
	1 ☐ FRESH 2 ☐ SALTY 3 ☐ SULPHUR 4 ☐ MINERALS 6 ☐ GAS
	1 ☐ FRESH 2 ☐ SALTY 3 ☐ SULPHUR 4 ☐ MINERALS 6 ☐ GAS

51 CASING & OPEN HOLE RECORD

INSIDE DIAM INCHES	MATERIAL	WALL THICKNESS INCHES	DEPTH - FEET FROM	DEPTH - FEET TO
6 1/4	1 ☐ STEEL 2 ☐ GALVANIZED 3 ☐ CONCRETE 4 ☐ OPEN HOLE 5 ☐ PLASTIC	.188	0	100'6"
6 1/8	1 ☐ STEEL 2 ☐ GALVANIZED 3 ☐ CONCRETE 4 ☐ OPEN HOLE 5 ☐ PLASTIC		100'6"	116'
	1 ☐ STEEL 2 ☐ GALVANIZED 3 ☐ CONCRETE 4 ☐ OPEN HOLE 5 ☐ PLASTIC			

SCREEN

SIZE(S) OF OPENING (SLOT NO.)	DIAMETER INCHES	LENGTH FEET
MATERIAL AND TYPE	DEPTH TO TOP OF SCREEN FEET	

61 PLUGGING & SEALING RECORD

DEPTH SET AT - FEET FROM	DEPTH SET AT - FEET TO	MATERIAL AND TYPE (CEMENT GROUT LEAD PACKER, ETC.)

71 PUMPING TEST

PUMPING TEST METHOD	PUMPING RATE	DURATION OF PUMPING
1 ☐ PUMP 2 ☐ BAILER — AIR	15 GPM	1 HOURS 30 MINS

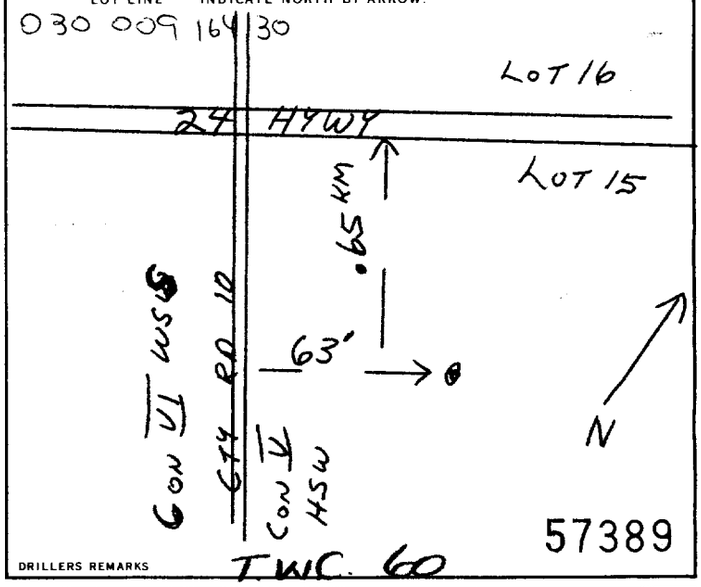
STATIC LEVEL	WATER LEVEL END OF PUMPING	WATER LEVELS DURING	15 MINUTES	30 MINUTES	45 MINUTES	60 MINUTES
47 FEET	54 FEET	1 ☒ PUMPING 2 ☐ RECOVERY	54 FEET	54 FEET	54 FEET	54 FEET

IF FLOWING, GIVE RATE	PUMP INTAKE SET AT	WATER AT END OF TEST
GPM	FEET	1 ☒ CLEAR 2 ☐ CLOUDY

RECOMMENDED PUMP TYPE	RECOMMENDED PUMP SETTING	RECOMMENDED PUMPING RATE
☐ SHALLOW ☒ DEEP	90 FEET	12 GPM

LOCATION OF WELL

IN DIAGRAM BELOW SHOW DISTANCES OF WELL FROM ROAD AND LOT LINE. INDICATE NORTH BY ARROW.



57389

DRILLERS REMARKS: T.W.C. 60

FINAL STATUS OF WELL

1 ☒ WATER SUPPLY 2 ☐ OBSERVATION WELL 3 ☐ TEST HOLE 4 ☐ RECHARGE WELL 5 ☐ ABANDONED, INSUFFICIENT SUPPLY 6 ☐ ABANDONED, POOR QUALITY 7 ☐ UNFINISHED ☐ DEWATERING

WATER USE

1 ☒ DOMESTIC 2 ☐ STOCK 3 ☐ IRRIGATION 4 ☐ INDUSTRIAL ☐ OTHER 5 ☐ COMMERCIAL 6 ☐ MUNICIPAL 7 ☐ PUBLIC SUPPLY 8 ☐ COOLING OR AIR CONDITIONING 9 ☐ NOT USED

METHOD OF CONSTRUCTION

1 ☐ CABLE TOOL 2 ☒ ROTARY (CONVENTIONAL) 3 ☐ ROTARY (REVERSE) 4 ☐ ROTARY (AIR) 5 ☐ AIR PERCUSSION 6 ☐ BORING 7 ☐ DIAMOND 8 ☐ JETTING 9 ☐ DRIVING ☐ DIGGING ☐ OTHER

CONTRACTOR

NAME OF WELL CONTRACTOR: LANG WELL DRILLING LTD — WELL CONTRACTOR'S LICENCE NUMBER: 3317
ADDRESS: RR1 HILLSBURGH ONT
NAME OF WELL TECHNICIAN: ROY LANG — WELL TECHNICIAN'S LICENCE NUMBER: T-0158
SIGNATURE OF TECHNICIAN/CONTRACTOR: R. Lang — SUBMISSION DATE: DAY 31 MO 10 YR 89

OFFICE USE ONLY

DATA SOURCE — CONTRACTOR: 3317 — DATE RECEIVED: NOV 15 1989
DATE OF INSPECTION — INSPECTOR
REMARKS

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FORM NO. 0506 (11/86) FORM 9

Ministry of the Environment
Ontario

The Ontario Water Resources Act

WATER WELL RECORD

PEEL

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11

4907288

MUNICIP 49002 CON. HS W 105

COUNTY OR DISTRICT: CALEDON
TOWNSHIP, BOROUGH, CITY, TOWN, VILLAGE: CALEDON (CALEDON)
CON, BLOCK, TRACT, SURVEY, ETC: CON 5 WHS
LOT: 14
[redacted] 18017 5th Line W BELFOUNTAIN
DATE COMPLETED: DAY 29 MO 12 YR 89
UTM ZONE: 17 NORTHING: 4850332 RC: ELEVATION: 940.2 RC: BASIN CODE:

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	STONES	COARSE	0	22
GREY	GRAVEL		FINE	22	33
BROWN	SAND	STONES		36	60
BROWN	SAND	CLAY	FINE	60	96
GREY	LIMESTONE			96	111
GREY	SHALE			111	112

31
32

41 WATER RECORD

WATER FOUND AT - FEET	KIND OF WATER
110	1 ☒ FRESH 2 ☐ SALTY 3 ☐ SULPHUR 4 ☐ MINERALS 6 ☐ GAS
	1 ☐ FRESH 2 ☐ SALTY 3 ☐ SULPHUR 4 ☐ MINERALS 6 ☐ GAS
	1 ☐ FRESH 2 ☐ SALTY 3 ☐ SULPHUR 4 ☐ MINERALS 6 ☐ GAS
	1 ☐ FRESH 2 ☐ SALTY 3 ☐ SULPHUR 4 ☐ MINERALS 6 ☐ GAS
	1 ☐ FRESH 2 ☐ SALTY 3 ☐ SULPHUR 4 ☐ MINERALS 6 ☐ GAS

51 CASING & OPEN HOLE RECORD

INSIDE DIAM INCHES	MATERIAL	WALL THICKNESS INCHES	DEPTH - FEET FROM	DEPTH - FEET TO
6	1 ☒ STEEL 2 ☐ GALVANIZED 3 ☐ CONCRETE 4 ☐ OPEN HOLE 5 ☐ PLASTIC	188	0	96
6	1 ☐ STEEL 2 ☐ GALVANIZED 3 ☐ CONCRETE 4 ☒ OPEN HOLE 5 ☐ PLASTIC		96	112
	1 ☐ STEEL 2 ☐ GALVANIZED 3 ☐ CONCRETE 4 ☐ OPEN HOLE 5 ☐ PLASTIC			

SCREEN

SIZE(S) OF OPENING (SLOT NO.)	DIAMETER INCHES	LENGTH FEET
MATERIAL AND TYPE	DEPTH TO TOP OF SCREEN FEET	

61 PLUGGING & SEALING RECORD

DEPTH SET AT - FEET FROM	DEPTH SET AT - FEET TO	MATERIAL AND TYPE (CEMENT GROUT, LEAD, PACKER, ETC.)

71 PUMPING TEST

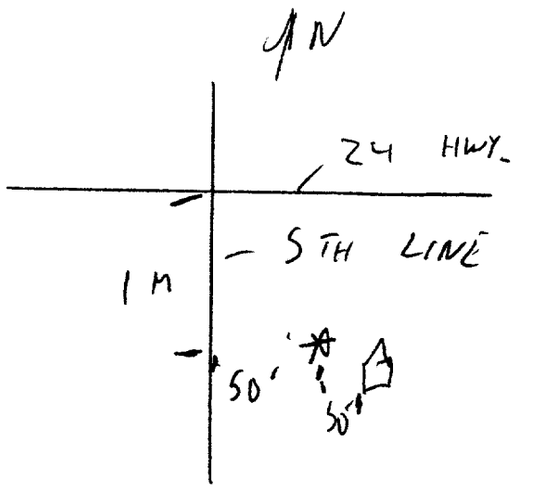
PUMPING TEST METHOD: 1 ☒ PUMP 2 ☐ BAILER
PUMPING RATE: 12 GPM
DURATION OF PUMPING: 24 HOURS 0 MINS

STATIC LEVEL	WATER LEVEL END OF PUMPING	WATER LEVELS DURING: 1 ☒ PUMPING 2 ☐ RECOVERY			
		15 MINUTES	30 MINUTES	45 MINUTES	60 MINUTES
40 FEET	42 FEET	42 FEET	42 FEET	42 FEET	42 FEET

IF FLOWING, GIVE RATE: GPM
PUMP INTAKE SET AT: 95 FEET
WATER AT END OF TEST: 1 ☒ CLEAR 2 ☐ CLOUDY
RECOMMENDED PUMP TYPE: ☐ SHALLOW ☐ DEEP
RECOMMENDED PUMP SETTING: 95 FEET
RECOMMENDED PUMPING RATE: 10 GPM

LOCATION OF WELL

IN DIAGRAM BELOW SHOW DISTANCES OF WELL FROM ROAD AND LOT LINE. INDICATE NORTH BY ARROW.



75003

DRILLERS REMARKS

FINAL STATUS OF WELL: 1 ☒ WATER SUPPLY; 2 ☐ OBSERVATION WELL; 3 ☐ TEST HOLE; 4 ☐ RECHARGE WELL; 5 ☐ ABANDONED, INSUFFICIENT SUPPLY; 6 ☐ ABANDONED, POOR QUALITY; 7 ☐ UNFINISHED; ☐ DEWATERING

WATER USE: 1 ☒ DOMESTIC; 2 ☐ STOCK; 3 ☐ IRRIGATION; 4 ☐ INDUSTRIAL; ☐ OTHER; 5 ☐ COMMERCIAL; 6 ☐ MUNICIPAL; 7 ☐ PUBLIC SUPPLY; 8 ☐ COOLING OR AIR CONDITIONING; 9 ☐ NOT USED

METHOD OF CONSTRUCTION: 1 ☒ CABLE TOOL; 2 ☐ ROTARY (CONVENTIONAL); 3 ☐ ROTARY (REVERSE); 4 ☐ ROTARY (AIR); 5 ☐ AIR PERCUSSION; 6 ☐ BORING; 7 ☐ DIAMOND; 8 ☐ JETTING; 9 ☐ DRIVING; ☐ DIGGING; ☐ OTHER

CONTRACTOR

NAME OF WELL CONTRACTOR: JACKSON CO.
WELL CONTRACTOR'S LICENCE NUMBER: 2918
ADDRESS: 6 VICTORIA AVE ACTON
NAME OF WELL TECHNICIAN: JACK VERHEUL
WELL TECHNICIAN'S LICENCE NUMBER: T-0582
SIGNATURE OF TECHNICIAN/CONTRACTOR
SUBMISSION DATE: DAY 29 MO 12 YR 89

OFFICE USE ONLY

DATA SOURCE
CONTRACTOR: 2918
DATE RECEIVED: APR 23 1990
DATE OF INSPECTION
INSPECTOR
REMARKS

MINISTRY OF THE ENVIRONMENT COPY

FORM NO. 0506 (11/86) FORM 9

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

11

4907451

MUNICIP 49002 | CON. H.S. W | LOT 05

COUNTY OR DISTRICT: DEL

TOWNSHIP, BOROUGH, CITY, TOWN, VILLAGE: CALEDON

CON., BLOCK, TRACT, SURVEY, ETC.: V WHS

LOT: 14

[redacted]
190 ARGYLE ST,
TORONTO ONTARIO

DATE COMPLETED: DAY 12 MO 09 YR 90

RC | ELEVATION | RC | BASIN CODE

LOG OF OVERBURDEN AND BEDROCK MATERIALS (SEE INSTRUCTIONS)

GENERAL COLOUR	MOST COMMON MATERIAL	OTHER MATERIALS	GENERAL DESCRIPTION	DEPTH - FEET FROM	DEPTH - FEET TO
	GRAVEL	~~CLAY, SAND & SILT~~		0	50
	CLAY	SAND, SILIT		50	88
BR	CLAY	STONES		88	94
	DOLOMITE & SHALE LEDGES			94	106

31

32

41 WATER RECORD

WATER FOUND AT - FEET	KIND OF WATER
100 TO 106	1 ☒ FRESH 2 ☐ SALTY 3 ☐ SULPHUR 4 ☐ MINERALS 6 ☐ GAS
	1 ☐ FRESH 2 ☐ SALTY 3 ☐ SULPHUR 4 ☐ MINERALS 6 ☐ GAS
	1 ☐ FRESH 2 ☐ SALTY 3 ☐ SULPHUR 4 ☐ MINERALS 6 ☐ GAS
	1 ☐ FRESH 2 ☐ SALTY 3 ☐ SULPHUR 4 ☐ MINERALS 6 ☐ GAS
	1 ☐ FRESH 2 ☐ SALTY 3 ☐ SULPHUR 4 ☐ MINERALS 6 ☐ GAS

51 CASING & OPEN HOLE RECORD

INSIDE DIAM INCHES	MATERIAL	WALL THICKNESS INCHES	DEPTH - FEET FROM	DEPTH - FEET TO
6	1 ☒ STEEL 2 ☐ GALVANIZED 3 ☐ CONCRETE 4 ☐ OPEN HOLE 5 ☐ PLASTIC	.188	0	96
6 "	1 ☐ STEEL 2 ☐ GALVANIZED 3 ☐ CONCRETE 4 ☒ OPEN HOLE 5 ☐ PLASTIC		96	106
	1 ☐ STEEL 2 ☐ GALVANIZED 3 ☐ CONCRETE 4 ☐ OPEN HOLE 5 ☐ PLASTIC			

SCREEN

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

MATERIAL AND TYPE | DEPTH TO TOP OF SCREEN FEET

61 PLUGGING & SEALING RECORD

DEPTH SET AT - FEET FROM	DEPTH SET AT - FEET TO	MATERIAL AND TYPE (CEMENT GROUT LEAD PACKER ETC.)

71 PUMPING TEST

PUMPING TEST METHOD: 1 ☐ PUMP 2 ☐ BAILER — AIR

PUMPING RATE: 15 GPM

DURATION OF PUMPING: 1 HOURS 30 MINS

STATIC LEVEL	WATER LEVEL END OF PUMPING	WATER LEVELS DURING: 1 ☒ PUMPING 2 ☐ RECOVERY	15 MINUTES	30 MINUTES	45 MINUTES	60 MINUTES
40 FEET	45 FEET		45 FEET	45 FEET	45 FEET	45 FEET

IF FLOWING, GIVE RATE: GPM

PUMP INTAKE SET AT: FEET

WATER AT END OF TEST: 1 ☒ CLEAR 2 ☐ CLOUDY

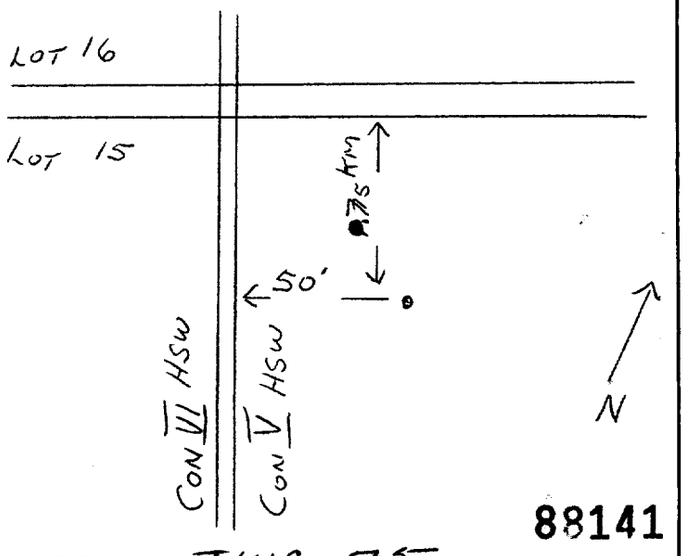
RECOMMENDED PUMP TYPE: ☐ SHALLOW ☒ DEEP

RECOMMENDED PUMP SETTING: 80 FEET

RECOMMENDED PUMPING RATE: 15 GPM

LOCATION OF WELL

IN DIAGRAM BELOW SHOW DISTANCES OF WELL FROM ROAD AND LOT LINE. INDICATE NORTH BY ARROW.



88141

DRILLERS REMARKS: TWC 75

FINAL STATUS OF WELL

1 ☒ WATER SUPPLY 2 ☐ OBSERVATION WELL 3 ☐ TEST HOLE 4 ☐ RECHARGE WELL 5 ☐ ABANDONED, INSUFFICIENT SUPPLY 6 ☐ ABANDONED, POOR QUALITY 7 ☐ UNFINISHED ☐ DEWATERING

WATER USE

1 ☒ DOMESTIC 2 ☐ STOCK 3 ☐ IRRIGATION 4 ☐ INDUSTRIAL ☐ OTHER 5 ☐ COMMERCIAL 6 ☐ MUNICIPAL 7 ☐ PUBLIC SUPPLY 8 ☐ COOLING OR AIR CONDITIONING 9 ☐ NOT USED

METHOD OF CONSTRUCTION

1 ☐ CABLE TOOL 2 ☒ ROTARY (CONVENTIONAL) 3 ☐ ROTARY (REVERSE) 4 ☐ ROTARY (AIR) 5 ☐ AIR PERCUSSION 6 ☐ BORING 7 ☐ DIAMOND 8 ☐ JETTING 9 ☐ DRIVING ☐ DIGGING ☐ OTHER

CONTRACTOR

NAME OF WELL CONTRACTOR: LANG WELL DRILLING LTD. | WELL CONTRACTOR'S LICENCE NUMBER: 3317

ADDRESS: R.R.1 HILLSBURGH ONT.

NAME OF WELL TECHNICIAN: ROY LANG | WELL TECHNICIAN'S LICENCE NUMBER: T-0158

SIGNATURE OF TECHNICIAN/CONTRACTOR: R Lang

SUBMISSION DATE: DAY 29 MO 12 YR 90

OFFICE USE ONLY

DATA SOURCE | CONTRACTOR 3317 | DATE RECEIVED JAN 08 1991

DATE OF INSPECTION | INSPECTOR

REMARKS

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FORM NO. 0506 (11/86) FORM 9

Ministry of Environment and Energy
Ontario

The Ontario Water Resources Act
WATER WELL RECORD

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Mark correct box with a checkmark, where applicable.

11 (1 2) **4908142**

Municipality (10 14) 49002 Con. (15 22 23 24) HS W 05

County or District [redacted]

Township/Borough/City/Town/Village: CALEDON (Caledon)

Con block tract survey, etc.: IV WHS

Lot (25-27): 12

Address: 11 STONEGATE RD. ETOBICOKE ONT. M8Y 1N6

Date completed: 17 day 07 month 96 year

21 (1 2) T M (10) Northing (12 17) RC (18 24) Elevation (25 28) RC (30) Basin Code (31) i ii iii iv (47)

LOG OF OVERBURDEN AND BEDROCK MATERIALS (see instructions)

General colour	Most common material	Other materials	General description	Depth – feet From	Depth – feet To
	GRAVEL			0	58
	CLAY		(SANDY)	58	85
GR.	CLAY	[redacted]		85	215
GR.	CLAY	STONES		215	222
RED	SHALE	(BLUE LAYERS)		222	233
	Perforated Liner 213'-233' (PVC)				

31 (10 14 15 21)

32 (32 43)

41 WATER RECORD

Water found at – feet	Kind of water
227 (20-23)	1 ☐ Fresh 3 ☐ Sulphur 14; 2 ☐ Salty 4 ☐ Minerals; 6 ☐ Gas
233 (20-23)	1 ☐ Fresh 3 ☐ Sulphur 19; 2 ☐ Salty 4 ☐ Minerals; 6 ☐ Gas
20-23	1 ☐ Fresh 3 ☐ Sulphur 24; 2 ☐ Salty 4 ☐ Minerals; 6 ☐ Gas
25-28	1 ☐ Fresh 3 ☐ Sulphur 29; 2 ☐ Salty 4 ☐ Minerals; 6 ☐ Gas
30-33	1 ☐ Fresh 3 ☐ Sulphur 34; 2 ☐ Salty 4 ☐ Minerals; 6 ☐ Gas (60)

51 CASING & OPEN HOLE RECORD

Inside diam inches	Material	Wall thickness inches	Depth – feet From	Depth – feet To
6¼ (10 11)	1 ☒ Steel 12; 2 ☐ Galvanized; 3 ☐ Concrete; 4 ☐ Open hole; 5 ☐ Plastic	.188	0	225 (13 16)
6⅛ (17-18)	1 ☐ Steel 19; 2 ☐ Galvanized; 3 ☐ Concrete; 4 ☐ Open hole; 5 ☐ Plastic		225	233 (20-23)
24-25	1 ☐ Steel 26; 2 ☐ Galvanized; 3 ☐ Concrete; 4 ☐ Open hole; 5 ☐ Plastic			27-30

SCREEN

Sizes of opening (Slot No.) (31-33)	Diameter (34-38) inches	Length (39 40) feet

Material and type	Depth at top of screen (41-44) feet	30

61 PLUGGING & SEALING RECORD

☐ Annular space ☐ Abandonment

Depth set at – feet From	Depth set at – feet To	Material and type (Cement grout, bentonite, etc.)
10-13	14 17	
18-21	22-25	
26-29	30 33 (80)	

71 PUMPING TEST

Pumping test method (10): 1 ☐ Pump 2 ☐ Bailer

Pumping rate (11-14): 8 GPM

Duration of pumping (15 16 Hours 17 18 Mins): 1 Hours 30 Mins

Water levels during (25): 1 ☒ Pumping 2 ☐ Recovery

Static level (19-21)	Water level end of pumping (22-24)	15 minutes (26-28)	30 minutes (29-31)	45 minutes (32-34)	60 minutes (35-37)
105 feet	170 feet	170 feet	170 feet	170 feet	170 feet

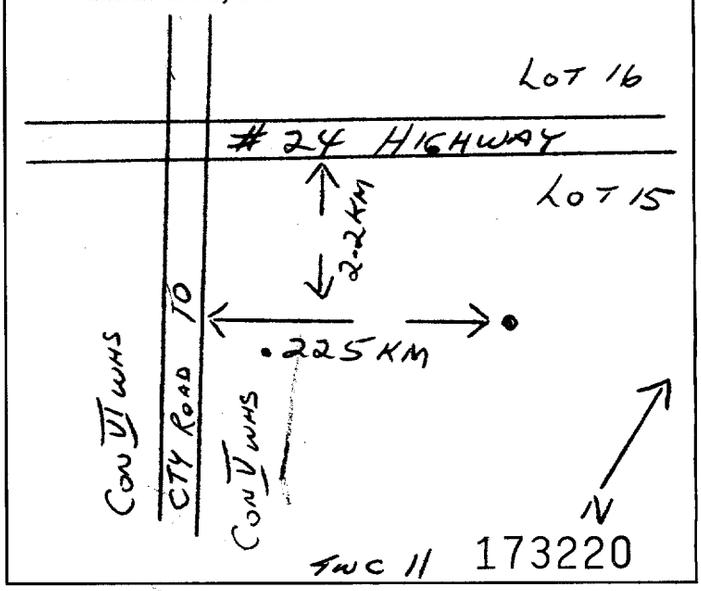
If flowing give rate (38-41)	Pump intake set at	Water at end of test (42)
GPM	feet	☒ Clear ☐ Cloudy

Recommended pump type	Recommended pump setting (43-45)	Recommended pump rate (46-49)
☐ Shallow ☒ Deep	200' feet	8 GPM

(50-53)

LOCATION OF WELL

In diagram below show distances of well from road and lot line. Indicate north by arrow.



FINAL STATUS OF WELL (54)

1 ☒ Water supply; 2 ☐ Observation well; 3 ☐ Test hole; 4 ☐ Recharge well; 5 ☐ Abandoned, insufficient supply; 6 ☐ Abandoned, poor quality; 7 ☐ Abandoned (Other); 8 ☐ Dewatering; 9 ☐ Unfinished; 10 ☐ Replacement well

WATER USE (55-56)

1 ☒ Domestic; 2 ☐ Stock; 3 ☐ Irrigation; 4 ☐ Industrial; 5 ☐ Commercial; 6 ☐ Municipal; 7 ☐ Public supply; 8 ☐ Cooling & air conditioning; 9 ☐ Not used; 10 ☐ Other

METHOD OF CONSTRUCTION (57)

1 ☐ Cable tool; 2 ☒ Rotary (conventional); 3 ☐ Rotary (reverse); 4 ☐ Rotary (air); 5 ☐ Air percussion; 6 ☐ Boring; 7 ☐ Diamond; 8 ☐ Jetting; 9 ☐ Driving; 10 ☐ Digging; 11 ☐ Other

Name of Well Contractor	Well Contractor's Licence No.
Lang Well Drilling Ltd.	3317
Address	
R.R.1 Millbrook Ont.	
Name of Well Technician	**Well Technician's Licence No.**
Roy LANG	T-0158
Signature of Technician/Contractor	**Submission date**
R. Lang	day 25 mo 07 yr 96

MINISTRY USE ONLY

Data source (58)	Contractor (59-62)	Date received (63-68) (80)
	3317	AUG 13 1996
Date of inspection	Inspector	
Remarks		

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0506 (07/94) Front Form 9

Ministry of Environment and Energy
Ontario

The Ontario Water Resources Act
WATER WELL RECORD

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Mark correct box with a checkmark, where applicable.

11 (1 2) **4908190**

Municipality (10 14) 49002 Con. (15) HS W (22 23 24) 06

County or District	Township/Borough/City/Town/Village	Con block tract survey, etc.	Lot (25-27)
[redacted]	CALEDON	VL WHS	N½, 13
	Address 134 MAPLE CRT. SHELBURNE ONT.	Date completed 20 day 11 month 96 year	

21 (1 2) Northing (M 10) RC (12) Elevation (17 18) RC (24) Basin Code (25 26) i (30) ii (31) iii (47)

LOG OF OVERBURDEN AND BEDROCK MATERIALS (see instructions)

General colour	Most common material	Other materials	General description	Depth – feet From	Depth – feet To
	GRAVEL			0	24
	SAND		(COARSE)	24	30
	SILT, CLAY			30	68
	CLAY, STONES			68	78
	LIMESTONE LEDGES			78	80

31
32 (10 14 15 21)

41 WATER RECORD

Water found at – feet (10-13)	Kind of water (14)			
80	1 ☒ Fresh	3 ☐ Sulphur	4 ☐ Minerals	6 ☐ Gas
	2 ☐ Salty			
(15-18)	1 ☐ Fresh	3 ☐ Sulphur (19)	4 ☐ Minerals	6 ☐ Gas
	2 ☐ Salty			
(20-23)	1 ☐ Fresh	3 ☐ Sulphur (24)	4 ☐ Minerals	6 ☐ Gas
	2 ☐ Salty			
(25-28)	1 ☐ Fresh	3 ☐ Sulphur (29)	4 ☐ Minerals	6 ☐ Gas
	2 ☐ Salty			
(30-33)	1 ☐ Fresh	3 ☐ Sulphur (34)	4 ☐ Minerals	6 ☐ Gas (60)
	2 ☐ Salty			

51 CASING & OPEN HOLE RECORD

Inside diam inches	Material	Wall thickness inches	Depth – feet From	Depth – feet To
(10-11) 6"4	(12) 1 ☒ Steel 2 ☐ Galvanized 3 ☐ Concrete 4 ☐ Open hole 5 ☐ Plastic	.188	0	(13-16) 80'6"
(17-18)	(19) 1 ☐ Steel 2 ☐ Galvanized 3 ☐ Concrete 4 ☐ Open hole 5 ☐ Plastic			(20-23)
(24-25)	(26) 1 ☐ Steel 2 ☐ Galvanized 3 ☐ Concrete 4 ☐ Open hole 5 ☐ Plastic			(27-30)

SCREEN

Sizes of opening (Slot No.) (31-33)	Diameter (34-38) inches	Length (39-40) feet
Material and type	Depth at top of screen (41-44) feet	(30)

61 PLUGGING & SEALING RECORD

☐ Annular space ☐ Abandonment

Depth set at – feet From (10-13)	To (14-17)	Material and type (Cement grout, bentonite, etc.)
(18-21)	(22-25)	
(26-29)	(30-33)	(80)

71 PUMPING TEST

Pumping test method (1 ☐ Pump 2 ☐ Bailer) A1E — Pumping rate (11-14) 10 GPM — Duration of pumping (15-16) .1 Hours (17-18) 30 Mins

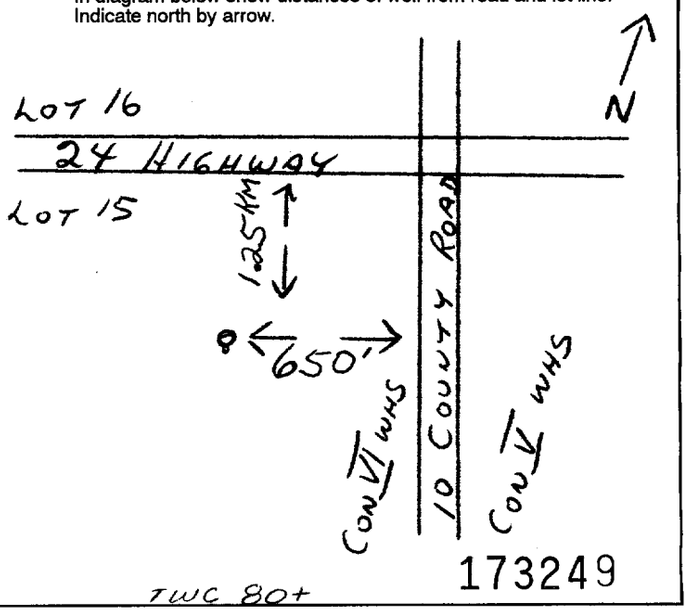
Static level (19-21)	Water level end of pumping (22-24)	Water levels during (25) 1 ☒ Pumping 2 ☐ Recovery	15 minutes (26-28)	30 minutes (29-31)	45 minutes (32-34)	60 minutes (35-37)
26 feet	28 feet		28 feet	28 feet	28 feet	28 feet

If flowing give rate (38-41)	Pump intake set at	Water at end of test (42)
GPM	feet	☒ Clear ☐ Cloudy
Recommended pump type: ☐ Shallow ☒ Deep	Recommended pump setting (43-45): 50 feet	Recommended pump rate (46-49): 10 GPM

(50-53)

LOCATION OF WELL

In diagram below show distances of well from road and lot line. Indicate north by arrow.



FINAL STATUS OF WELL (54)

1 ☒ Water supply; 2 ☐ Observation well; 3 ☐ Test hole; 4 ☐ Recharge well; 5 ☐ Abandoned, insufficient supply; 6 ☐ Abandoned, poor quality; 7 ☐ Abandoned (Other); 8 ☐ Dewatering; 9 ☐ Unfinished; 10 ☐ Replacement well

WATER USE (55-56)

1 ☒ Domestic; 2 ☐ Stock; 3 ☐ Irrigation; 4 ☐ Industrial; 5 ☐ Commercial; 6 ☐ Municipal; 7 ☐ Public supply; 8 ☐ Cooling & air conditioning; 9 ☐ Not used; 10 ☐ Other

METHOD OF CONSTRUCTION (57)

1 ☐ Cable tool; 2 ☒ Rotary (conventional); 3 ☐ Rotary (reverse); 4 ☐ Rotary (air); 5 ☐ Air percussion; 6 ☐ Boring; 7 ☐ Diamond; 8 ☐ Jetting; 9 ☐ Driving; 10 ☐ Digging; 11 ☐ Other

Name of Well Contractor	Well Contractor's Licence No.
LANG WELL DRILLING LTD	3317
Address: R.R.1 HILLSBURGH ONT.	
Name of Well Technician: ROY LANG	Well Technician's Licence No.: T-0158
Signature of Technician/Contractor: R. Lang	Submission date: 22 day 02 mo 97 yr

MINISTRY USE ONLY

Data source (58)	Contractor (59-62)	Date received (63-68) (80)
	3317	APR 0 1 1997
Date of inspection	Inspector	
Remarks		

CSS. S

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Ministry of Environment and Energy
Ontario

The Ontario Water Resources Act
WATER WELL RECORD

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

11 (1 2)

4908218

Municipality 49002 (10 14) Con. HS W (15 22) 06 (23 24)

County or District [redacted]

Township/Borough/City/Town/Village: Caledon

Con block tract survey, etc.: CON 6 WHS

Lot: 13 (25-27)

Address: Box 168 Inglewood LOW1K0

Date completed: 20 day 06 month 97 year (48-53)

21 (1 2) Northing (M 10) RC (12 17) Elevation (18 24) RC (25 26) Basin Code (30 31) ii iii iv (47)

LOG OF OVERBURDEN AND BEDROCK MATERIALS (see instructions)

General colour	Most common material	Other materials	General description	Depth – feet From	Depth – feet To
	Topsoil			0	1
Brown	Gravel	Stones		1	39
Gray	Gravel	Stones		39	46
Brown	Sand	gravel	wet	46	52
Brown	Silty	Sand		52	108
Gray	Quick Sand			108	114
Gray	Clay			114	116
Gray	clay gravel	Broken limestone		116	121
Red	Shale	limestone		121	127
Blue	Shale		soft layers	127	168
Blue/White		limestone		168	180
Gray	limestone			180	203
Red	Shale			203	218

(10 14 15 21 32 43 54 65 75 80)

41 WATER RECORD

Water found at – feet	Kind of water
119 (10-13)	1 ☑ Fresh 3 ☐ Sulphur 14; 2 ☐ Salty 4 ☐ Minerals 6 ☐ Gas — UNTESTED
181 (15-18)	1 ☑ Fresh 3 ☐ Sulphur 19; 2 ☐ Salty 4 ☐ Minerals 6 ☐ Gas — UNTESTED
(20-23)	1 ☐ Fresh 3 ☐ Sulphur 24; 2 ☐ Salty 4 ☐ Minerals 6 ☐ Gas
(25-28)	1 ☐ Fresh 3 ☐ Sulphur 29; 2 ☐ Salty 4 ☐ Minerals 6 ☐ Gas
(30-33)	1 ☐ Fresh 3 ☐ Sulphur 34; 2 ☐ Salty 4 ☐ Minerals 6 ☐ Gas (60)

51 CASING & OPEN HOLE RECORD

Inside diam inches	Material	Wall thickness inches	Depth – feet From	Depth – feet To
6 (10-11)	1 ☑ Steel 12; 2 ☐ Galvanized 3 ☐ Concrete 4 ☐ Open hole 5 ☐ Plastic	.188	+1.5	118.5 (13-16)
6 (17-18)	1 ☐ Steel 19; 2 ☐ Galvanized 3 ☐ Concrete 4 ☑ Open hole 5 ☐ Plastic		118	218 (20-23)
5 (24-25)	1 ☐ Steel 26; 2 ☐ Galvanized 3 ☐ Concrete 4 ☑ Open hole 5 ☐ Plastic		98	218 (27-30)

SCREEN

Sizes of opening (Slot No.) (31-33)	Diameter (34-38)	Length (39-40)
Saw Cut	5 inches	120' feet

Material and type: slotted Plastic 90'

Depth at top of screen (41-44): feet (30)

61 PLUGGING & SEALING RECORD

☑ Annular space ☐ Abandonment

Depth set at – feet From	Depth set at – feet To	Material and type (Cement grout, bentonite, etc.)
0 (10-13)	40 (14-17)	Bensecal
(18-21)	(22-25)	
(26-29)	(30-33) (80)	

71 PUMPING TEST

Pumping test method (10): 1 ☐ Pump 2 ☑ Bailer — AIR

Pumping rate (11-14): 4 GPM

Duration of pumping (15-16) 1 Hours (17-18) ..... Mins

Static level (19-21)	Water level end of pumping (22-24)	Water levels during (25) 1 ☐ Pumping 2 ☐ Recovery: 15 minutes (26-28)	30 minutes (29-31)	45 minutes (32-34)	60 minutes (35-37)
54 feet	feet	feet	feet	86 feet	feet

If flowing give rate (38-41): GPM

Pump intake set at: feet

Water at end of test (42): ☑ Clear ☐ Cloudy

Recommended pump type: ☐ Shallow ☑ Deep

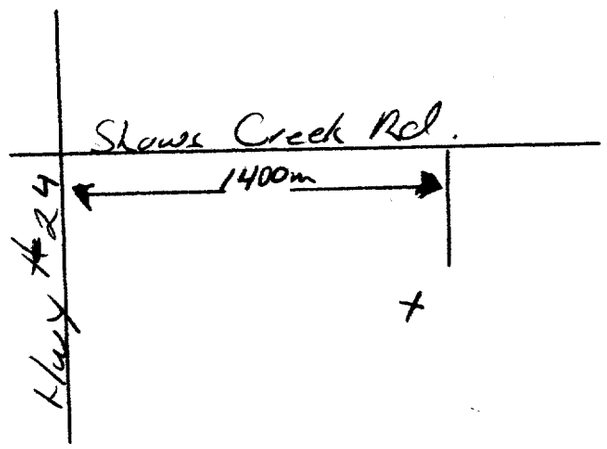
Recommended pump setting (43-45): 200 feet

Recommended pump rate (46-49): 3-4 GPM

(50-53)

LOCATION OF WELL

In diagram below show distances of well from road and lot line. Indicate north by arrow.



177391

FINAL STATUS OF WELL (54)

1 ☑ Water supply
2 ☐ Observation well
3 ☐ Test hole
4 ☐ Recharge well
5 ☐ Abandoned, insufficient supply
6 ☐ Abandoned, poor quality
7 ☐ Abandoned (Other)
8 ☐ Dewatering
9 ☐ Unfinished
10 ☐ Replacement well

WATER USE (55-56)

1 ☑ Domestic
2 ☐ Stock
3 ☐ Irrigation
4 ☐ Industrial
5 ☐ Commercial
6 ☐ Municipal
7 ☐ Public supply
8 ☐ Cooling & air conditioning
9 ☐ Not used
10 ☐ Other .....

METHOD OF CONSTRUCTION (57)

1 ☐ Cable tool
2 ☐ Rotary (conventional)
3 ☐ Rotary (reverse)
4 ☑ Rotary (air)
5 ☐ Air percussion
6 ☐ Boring
7 ☐ Diamond
8 ☐ Jetting
9 ☐ Driving
10 ☐ Digging
11 ☐ Other .....

Name of Well Contractor: Highland Water Wells — Well Contractor's Licence No.: 2576

Address: Box 141 Durham

Name of Well Technician: ERICH Wilson — Well Technician's Licence No.: 70113

Signature of Technician/Contractor — Submission date: day 7 mo 7 yr 97

MINISTRY USE ONLY

Data source (58) — Contractor (59-62): 2576 — Date received (63-68): AUG 0 6 1997 (80)

Date of inspection — Inspector

Remarks: CSS.S8

0506 (07/94) Front Form 9

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Ministry of Environment and Energy
Ontario

The Ontario Water Resources Act
WATER WELL RECORD

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

11

4908299

Municipality 49002 Con. HS W 06

[redacted]

Township/Borough/City/Town/Village: CALEDON

Con / block / tract / survey, etc.: 6

Lot: 13

Address: 5432 KING ST. CALEDON E LOT 160

Date completed: 19 day 09 month 98 year

Northing | RC | Elevation | RC | Basin Code | ii | iii | iv

21

LOG OF OVERBURDEN AND BEDROCK MATERIALS (see instructions)

General colour	Most common material	Other materials	General description	Depth – feet From	Depth – feet To
BROWN	CLAY	STONES		0	15
	GRAVEL			15	30
BROWN	CLAY	SAND / GRAVEL		30	45
BROWN	CLAY	SAND		45	85
BROWN	CLAY	SAND / GRAVEL		85	95
BROWN	CLAY	SAND		95	106
BROWN	CLAY			106	108
BLUE	SHALE			108	110
RED	SHALE			110	115
BLUE	SHALE			115	120
GREY	SHALE		TOTAL = 120' / 6" CASING DRIVE SHOE		

31

32

41 WATER RECORD

Water found at – feet	Kind of water
110	1 ☑ Fresh 2 ☐ Salty 3 ☐ Sulphur 4 ☐ Minerals 6 ☐ Gas
120	1 ☑ Fresh 2 ☐ Salty 3 ☐ Sulphur 4 ☐ Minerals 6 ☐ Gas
	1 ☐ Fresh 2 ☐ Salty 3 ☐ Sulphur 4 ☐ Minerals 6 ☐ Gas
	1 ☐ Fresh 2 ☐ Salty 3 ☐ Sulphur 4 ☐ Minerals 6 ☐ Gas
	1 ☐ Fresh 2 ☐ Salty 3 ☐ Sulphur 4 ☐ Minerals 6 ☐ Gas

51 CASING & OPEN HOLE RECORD

Inside diam inches	Material	Wall thickness inches	Depth – feet From	Depth – feet To
6"	1 ☑ Steel 2 ☐ Galvanized 3 ☐ Concrete 4 ☐ Open hole 5 ☐ Plastic	.188	+3	106
6"	1 ☐ Steel 2 ☐ Galvanized 3 ☐ Concrete 4 ☑ Open hole 5 ☐ Plastic		106	120
5"	1 ☐ Steel 2 ☐ Galvanized 3 ☐ Concrete 4 ☐ Open hole 5 ☐ Plastic	PERFORATED .188	90	120 LINER

SCREEN

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

61 PLUGGING & SEALING RECORD

☑ Annular space ☐ Abandonment

Depth set at – feet From	Depth set at – feet To	Material and type (Cement grout, bentonite, etc.)
0	26	BENSEAL

71 PUMPING TEST

Pumping test method: 1 ☑ Pump 2 ☐ Bailer

Pumping rate: 3 GPM

Duration of pumping: ..... Hours ..... Mins

Water levels during: 1 ☑ Pumping 2 ☐ Recovery

Static level	Water level end of pumping	15 minutes	30 minutes	45 minutes	60 minutes
24 feet	90 feet	47 feet	67 feet	80 feet	90 feet

If flowing give rate: GPM

Pump intake set at: feet

Water at end of test: ☑ Clear ☐ Cloudy

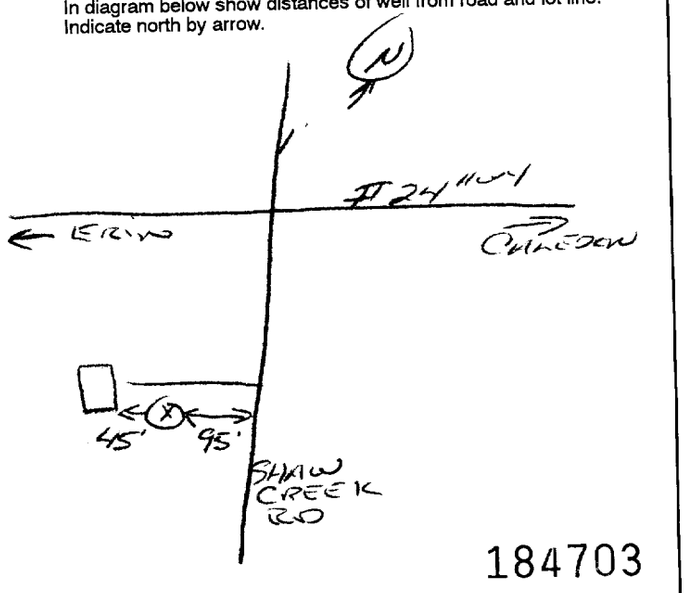
Recommended pump type: ☐ Shallow ☑ Deep

Recommended pump setting: 115 feet

Recommended pump rate: 3 GPM

LOCATION OF WELL

In diagram below show distances of well from road and lot line.
Indicate north by arrow.



184703

FINAL STATUS OF WELL

1 ☑ Water supply
2 ☐ Observation well
3 ☐ Test hole
4 ☐ Recharge well
5 ☐ Abandoned, insufficient supply
6 ☐ Abandoned, poor quality
7 ☐ Abandoned (Other)
8 ☐ Dewatering
9 ☐ Unfinished
10 ☐ Replacement well

WATER USE

1 ☑ Domestic
2 ☐ Stock
3 ☐ Irrigation
4 ☐ Industrial
5 ☐ Commercial
6 ☐ Municipal
7 ☐ Public supply
8 ☐ Cooling & air conditioning
9 ☐ Not used
10 ☐ Other .....

METHOD OF CONSTRUCTION

1 ☐ Cable tool
2 ☐ Rotary (conventional)
3 ☐ Rotary (reverse)
4 ☑ Rotary (air)
5 ☐ Air percussion
6 ☐ Boring
7 ☐ Diamond
8 ☐ Jetting
9 ☐ Driving
10 ☐ Digging
11 ☐ Other .....

Name of Well Contractor: HARRISON WELL DRILLING LTD
Well Contractor's Licence No.: 2663

Address: R.R. #5 GUELPH ONT. N1H 6J2

Name of Well Technician: HENRY ROBINSON
Well Technician's Licence No.: T0590

Signature of Technician/Contractor
Submission date: 6 day 09 mo 98 yr

MINISTRY USE ONLY

Data source | Contractor: 2663 | Date received: FEB 04 1998

Date of inspection | Inspector

Remarks

0506 (07/94) Front Form 9

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Ministry of Environment and Energy
Ontario

The Ontario Water Resources Act
WATER WELL RECORD

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

11 **4908398**

Municipality 49002 Con. HS W 06

County or District	Township/Borough/City/Town/Village	Con block tract survey, etc.	Lot
PEEL	CALEDON	VI WHS	13

[redacted]

Address 17902 SHAWS CREEK RD. | Date completed 30 day 04 month 98 year

TWN. 5432 KING ST. CALEDON EAST LOM1E0

Northing RC Elevation RC Basin Code

21

LOG OF OVERBURDEN AND BEDROCK MATERIALS (see instructions)

General colour	Most common material	Other materials	General description	Depth – feet From	Depth – feet To
BR.	CLAY	STONE		0	3
	GRAVEL	BOULDERS		3	29
	SILT, CLAY	LAYERS		29	34
GR.	CLAY, SILT			34	84
	CLAY	GRAVEL		84	86
GR.	CLAY			86	115
RED	CLAY	STONES		115	128
GR.	SHALE			128	140
GR.	DOLOSTONE	SHALE LEDGES		140	170
GR.	SANDSTONE			170	179

31

32

41 WATER RECORD

Water found at – feet	Kind of water
150 10-13 / 178	1 ☒ Fresh 2 ☐ Salty; 3 ☐ Sulphur 4 ☐ Minerals 6 ☐ Gas 14
15-18	1 ☐ Fresh 2 ☐ Salty; 3 ☐ Sulphur 4 ☐ Minerals 6 ☐ Gas 19
20-23	1 ☐ Fresh 2 ☐ Salty; 3 ☐ Sulphur 4 ☐ Minerals 6 ☐ Gas 24
25-28	1 ☐ Fresh 2 ☐ Salty; 3 ☐ Sulphur 4 ☐ Minerals 6 ☐ Gas 29
30-33	1 ☐ Fresh 2 ☐ Salty; 3 ☐ Sulphur 4 ☐ Minerals 6 ☐ Gas 34 60

51 CASING & OPEN HOLE RECORD

Inside diam inches	Material	Wall thickness inches	Depth – feet From	Depth – feet To
10-11 6¼	1 ☒ Steel 2 ☐ Galvanized 3 ☐ Concrete 4 ☐ Open hole 5 ☐ Plastic 12	.188	+2	13 13-16
5 17-18 3/4 OD PVC Perforated	1 ☐ Steel 2 ☐ Galvanized 3 ☐ Concrete 4 ☐ Open hole 5 ☐ Plastic 19 LINER		129	179 20-23
24-25	1 ☐ Steel 2 ☐ Galvanized 3 ☐ Concrete 4 ☐ Open hole 5 ☐ Plastic 26			27-30

SCREEN

Sizes of opening (Slot No.) 31-33	Diameter 34-38 inches	Length 39-40 feet
Material and type	Depth at top of screen 41-44 feet	50

61 PLUGGING & SEALING RECORD

☐ Annular space ☐ Abandonment

Depth set at – feet From	Depth set at – feet To	Material and type (Cement grout, bentonite, etc.)
10-13	14-17	
18-21	22-25	
26-29	30-33 80	

71 PUMPING TEST

Pumping test method 1 ☐ Pump 2 ☐ Bailer A1C

Pumping rate 2 GPM (11-14) Duration of pumping 1 Hours (15-16) 30 Mins (17-18)

Water levels during 1 ☒ Pumping 2 ☐ Recovery

Static level	Water level end of pumping	15 minutes	30 minutes	45 minutes	60 minutes
19-21 35 feet	22-24 160 feet	25-28 160 feet	29-31 160 feet	32-34 160 feet	35-37 160 feet

If flowing give rate 38-41 GPM

Pump intake set at feet

Water at end of test 42 ☒ Clear ☐ Cloudy

Recommended pump type ☐ Shallow ☒ Deep

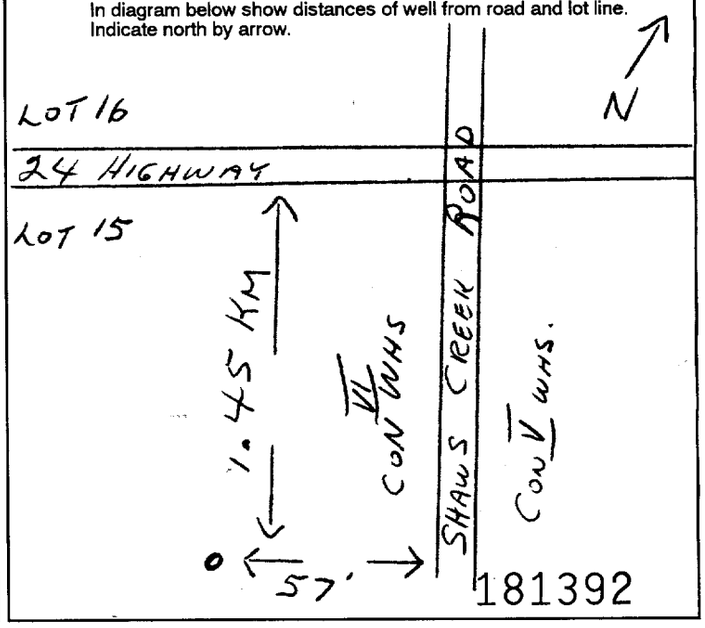
Recommended pump setting 43-45 175 feet

Recommended pump rate 46-49 2 GPM

50-53

LOCATION OF WELL

In diagram below show distances of well from road and lot line. Indicate north by arrow.



FINAL STATUS OF WELL 54

1 ☒ Water supply 2 ☐ Observation well 3 ☐ Test hole 4 ☐ Recharge well
5 ☐ Abandoned, insufficient supply 6 ☐ Abandoned, poor quality 7 ☐ Abandoned (Other) 8 ☐ Dewatering
9 ☐ Unfinished 10 ☐ Replacement well

WATER USE 55-56

1 ☒ Domestic 2 ☐ Stock 3 ☐ Irrigation 4 ☐ Industrial
5 ☐ Commercial 6 ☐ Municipal 7 ☐ Public supply 8 ☐ Cooling & air conditioning
9 ☐ Not used 10 ☐ Other .....

METHOD OF CONSTRUCTION 57

1 ☐ Cable tool 2 ☒ Rotary (conventional) 3 ☐ Rotary (reverse) 4 ☐ Rotary (air)
5 ☐ Air percussion 6 ☐ Boring 7 ☐ Diamond 8 ☐ Jetting
9 ☐ Driving 10 ☐ Digging 11 ☐ Other .....

Name of Well Contractor: LANG WELL DRILLING LTD | Well Contractor's Licence No.: 3317

Address: R.R.1 HILLSBURGH ONT.

Name of Well Technician: ROY LANG | Well Technician's Licence No.: T-0158

Signature of Technician/Contractor: R. Lang | Submission date: 26 day 12 mo 98 yr

MINISTRY USE ONLY

Data source 58 | Contractor 59-62: 3317 | Date received 63-68: JAN 07 1999 | 80

Date of inspection | Inspector

Remarks: CSS.ES9

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Ontario Ministry of the Environment

The Ontario Water Resources Act
WATER WELL RECORD

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

11 | 4908509 | Municipality 49002 | Con. HS W | 06

County or District	Township/Borough/City/Town/Village	Con block tract survey, etc.	Lot
PEEL	CALEDON	VII WHS	13

Address: 17854 SHAWS CREEK RD. BELFOUNTAIN ON L0N1B0

Date completed: 04 (day) 11 (month) 99 (year)

21 | Northing | RC | Elevation | RC | Basin Code | ii | iii | iv

LOG OF OVERBURDEN AND BEDROCK MATERIALS (see instructions)

General colour	Most common material	Other materials	General description	Depth - feet From	Depth - feet To
BLACK	TOPSOIL			0	1
BROWN	CLAY &	STONES		1	16
GR.	GRAVEL &	CLAY		16	55
GR	CLAY	STONES	SOFT	55	111
RED	CLAY			111	114
GR&RED	SHALE			114	149
GR.	DOLSTONE,	SHALE LAYERS		149	187
BR. GR.	SANDSTONE			187	194
	80' OF 5-INCH PERFORATED LINER (PVC) 115'-194'				

31

32

41 WATER RECORD

Water found at - feet	Kind of water
170-194	1 ☐ Fresh 2 ☐ Salty 3 ☐ Sulphur 4 ☐ Minerals 5 ☐ Gas
	1 ☐ Fresh 2 ☐ Salty 3 ☐ Sulphur 4 ☐ Minerals 5 ☐ Gas
	1 ☐ Fresh 2 ☐ Salty 3 ☐ Sulphur 4 ☐ Minerals 5 ☐ Gas
	1 ☐ Fresh 2 ☐ Salty 3 ☐ Sulphur 4 ☐ Minerals 5 ☐ Gas
	1 ☐ Fresh 2 ☐ Salty 3 ☐ Sulphur 4 ☐ Minerals 5 ☐ Gas

51 CASING & OPEN HOLE RECORD

Inside diam inches	Material	Wall thickness inches	Depth - feet From	Depth - feet To
6 1/4	1 ☑ Steel 2 ☐ Galvanized 3 ☐ Concrete 4 ☐ Open hole 5 ☐ Plastic	.188	0	121
	1 ☐ Steel 2 ☐ Galvanized 3 ☐ Concrete 4 ☐ Open hole 5 ☐ Plastic			
	1 ☐ Steel 2 ☐ Galvanized 3 ☐ Concrete 4 ☐ Open hole 5 ☐ Plastic	LINER		

SCREEN

Sizes of opening (Slot No.)	Diameter inches	Length feet

Material and type: | Depth at top of screen feet:

61 PLUGGING & SEALING RECORD

☐ Annular space ☐ Abandonment

Depth set at - feet From	Depth set at - feet To	Material and type (Cement grout, bentonite, etc.)

PUMPING TEST

71 Pumping test method: 1 ☐ Pump 2 ☐ Bailer — AIR

Pumping rate: 2 GPM — Duration of pumping: 1 Hours 30 Mins

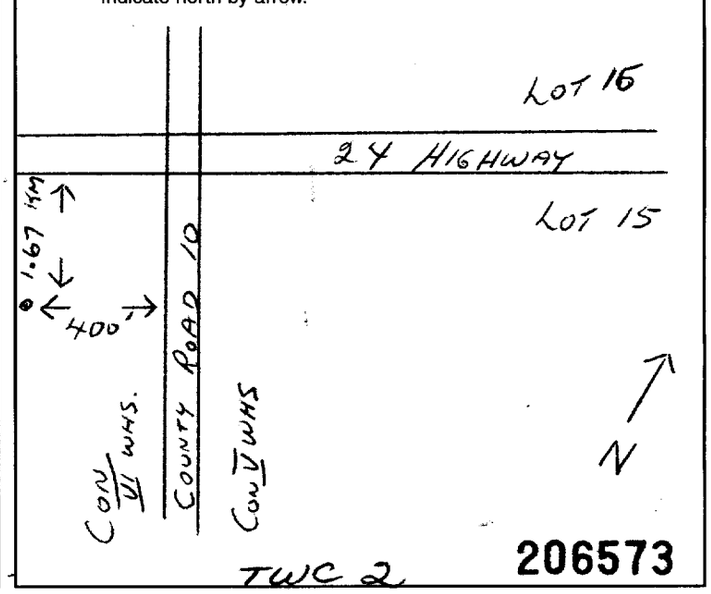
Static level	Water level end of pumping	Water levels during: 1 ☑ Pumping 2 ☐ Recovery			
		15 minutes	30 minutes	45 minutes	60 minutes
55 feet	160 feet	160 feet	160 feet	160 feet	160 feet

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: 190 feet — Recommended pump rate: 2 GPM

LOCATION OF WELL

In diagram below show distances of well from road and lot line. Indicate north by arrow.



206573

FINAL STATUS OF WELL

1 ☑ Water supply 2 ☐ Observation well 3 ☐ Test hole 4 ☐ Recharge well 5 ☐ Abandoned, insufficient supply 6 ☐ Abandoned, poor quality 7 ☐ Abandoned (Other) 8 ☐ Dewatering 9 ☐ Unfinished 10 ☐ Replacement well

WATER USE

1 ☑ Domestic 2 ☐ Stock 3 ☐ Irrigation 4 ☐ Industrial 5 ☐ Commercial 6 ☐ Municipal 7 ☐ Public supply 8 ☐ Cooling & air conditioning 9 ☐ Not use 10 ☐ Other

METHOD OF CONSTRUCTION

1 ☐ Cable tool 2 ☑ Rotary (conventional) 3 ☐ Rotary (reverse) 4 ☐ Rotary (air) 5 ☐ Air percussion 6 ☐ Boring 7 ☐ Diamond 8 ☐ Jetting 9 ☐ Driving 10 ☐ Digging 11 ☐ Other

Name of Well Contractor	Well Contractor's Licence No.
LANG WELL DRILLING LTD.	3317
Address: R.R.1 HILLSBURGH ONT	
Name of Well Technician: JOE LEGGE	Well Technician's Licence No.: T-1817
Signature of Technician/Contractor: R Lang	Submission date: 15 (day) 11 (mo) 99 (yr)

MINISTRY USE ONLY

Data source 58 | Contractor 59-62: 3317 | Date received 63-68: NOV 23 1999

Date of inspection | Inspector

Remarks: CSS.ES0

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Ontario **Ministry of the Environment**

The Ontario Water Resources Act

WATER WELL RECORD

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

11 **4908551** Municipality 49002 Con HS W 06

County or District	Township/Borough/City/Town/Village	Con block tract survey, etc.	Lot
PEEL COUNTY	TOWN OF CALEDON	Con 6	13
[redacted]	Address 17854 Shaws Creek RD.	Date completed 15 day 02 month 2000 year	

21 Northing RC Elevation RC Basin Code

LOG OF OVERBURDEN AND BEDROCK MATERIALS (see instructions)

General colour	Most common material	Other materials	General description	Depth - feet From	Depth - feet To
	TOP SOIL			0	1
BROWN	SANDY CLAY	STONES		1	49
GREY	GRAVEL			49	57
GREY	CLAY	STONES		57	65

31

32

41 WATER RECORD

Water found at - feet	Kind of water
53-56	1 ☑ Fresh 2 ☐ Salty 3 ☐ Sulphur 4 ☐ Minerals 5 ☐ Gas UNTESTED
	1 ☐ Fresh 2 ☐ Salty 3 ☐ Sulphur 4 ☐ Minerals 5 ☐ Gas
	1 ☐ Fresh 2 ☐ Salty 3 ☐ Sulphur 4 ☐ Minerals 5 ☐ Gas
	1 ☐ Fresh 2 ☐ Salty 3 ☐ Sulphur 4 ☐ Minerals 5 ☐ Gas
	1 ☐ Fresh 2 ☐ Salty 3 ☐ Sulphur 4 ☐ Minerals 5 ☐ Gas

51 CASING & OPEN HOLE RECORD

Inside diam inches	Material	Wall thickness inches	Depth - feet From	Depth - feet To
6"	1 ☑ Steel 2 ☐ Galvanized 3 ☐ Concrete 4 ☐ Open hole 5 ☐ Plastic	.188	+1½	53
	1 ☐ Steel 2 ☐ Galvanized 3 ☐ Concrete 4 ☐ Open hole 5 ☐ Plastic			
	1 ☐ Steel 2 ☐ Galvanized 3 ☐ Concrete 4 ☐ Open hole 5 ☐ Plastic			

SCREEN

Sizes of opening (Slot No.)	Diameter	Length
20	6 TEL inches	3 feet
Material and type: S/S	Depth at top of screen: 53 feet	

61 PLUGGING & SEALING RECORD

☑ Annular space ☐ Abandonment

Depth set at - feet From	Depth set at - feet To	Material and type (Cement grout, bentonite, etc.)
0	40	BENSEAL

71 PUMPING TEST

Pumping test method: 1 ☑ Pump 2 ☐ Bailer

Pumping rate: 15 GPM

Duration of pumping: 1 Hours ..... Mins

Static level	Water level end of pumping	Water levels during: 1 ☑ Pumping 2 ☐ Recovery			
		15 minutes	30 minutes	45 minutes	60 minutes
47 feet	47 feet	47.5 feet	47.5 feet	47.5 feet	47.5 feet

If flowing give rate: — GPM

Pump intake set at: 53 feet

Water at end of test: ☑ Clear ☐ Cloudy

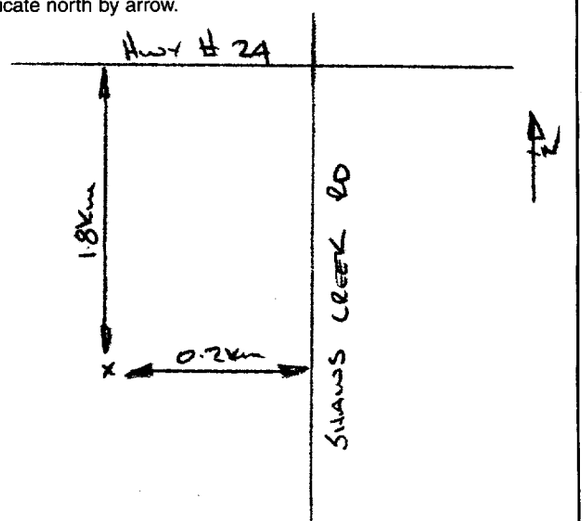
Recommended pump type: ☐ Shallow ☑ Deep

Recommended pump setting: 53 feet

Recommended pump rate: 15 GPM

LOCATION OF WELL

In diagram below show distances of well from road and lot line. Indicate north by arrow.



214101

FINAL STATUS OF WELL 54

1 ☑ Water supply 2 ☐ Observation well 3 ☐ Test hole 4 ☐ Recharge well 5 ☐ Abandoned, insufficient supply 6 ☐ Abandoned, poor quality 7 ☐ Abandoned (Other) 8 ☐ Dewatering 9 ☐ Unfinished 10 ☐ Replacement well

WATER USE 55-56

1 ☑ Domestic 2 ☐ Stock 3 ☐ Irrigation 4 ☐ Industrial 5 ☐ Commercial 6 ☐ Municipal 7 ☐ Public supply 8 ☐ Cooling & air conditioning 9 ☐ Not use 10 ☐ Other .....

METHOD OF CONSTRUCTION 57

1 ☐ Cable tool 2 ☐ Rotary (conventional) 3 ☐ Rotary (reverse) 4 ☑ Rotary (air) 5 ☐ Air percussion 6 ☐ Boring 7 ☐ Diamond 8 ☐ Jetting 9 ☐ Driving 10 ☐ Digging 11 ☐ Other .....

Name of Well Contractor	Well Contractor's Licence No.
HIGHLAND WATER WELLS INC	2576
Address: Box 141, Dundalk, Ont. N0C 1B0	
Name of Well Technician: NIGEL POPPLETON	Well Technician's Licence No.: T2130
Signature of Technician/Contractor	Submission date: day 16 mo 02 yr 00

MINISTRY USE ONLY

Data source 58	Contractor 59-62	Date received 63-68
	2576	MAR 10 2000
Date of inspection	Inspector	
Remarks		

CSS.ES0

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Ontario Ministry of the Environment

Well Tag No. (Pla A 060926
A060926

Well Record

Regulation 903 Ontario Water Resources Act

Page 1 of 1

Well Owner's Information

First Name	Last Name	E-mail Address	☐ Well Constructed by Well Owner
	Lafarge Materials + Construction Inc.		

Mailing Address (Street Number/Name, RR)	Municipality	Province	Postal Code	Telephone No. (inc. area code)
2531 Cawthra Road	Mississauga	ON	L5A 2W7.	

Part A Construction and/or Major Alteration of a Well

Address of Well Location (Street Number/Name, RR)	Township	Lot	Concession
17923 Shaws Creek Rd.	Caledon	W 1/2 13	5

County/District/Municipality	City/Town/Village	Province	Postal Code
Peel		Ontario	

UTM Coordinates	Zone	Easting	Northing	GPS Unit Make	Model	Mode of Operation:
NAD 83	17	577370	4850376	Magellan		☐ Undifferentiated ☒ Averaged ☐ Differentiated, specify

Overburden and Bedrock Materials *(see instructions on the back of this form)*

General Colour	Most Common Material	Other Materials	General Description	Depth (Metres) From	Depth (Metres) To
Dark Brown	TOPSOIL	sand, silt, gravel	moist	0.0	0.27
Beige/Brown	Sand, Gravel	silt, cobbles, stones	moist	0.27	1.52
Beige/Brown	Sand, Gravel	cobbles, silt,	moist	1.52	3.05
Beige/Brown	Sand, Gravel	silt, cobbles	fine to coarse, moist to saturated	3.05	~~11.57~~ 11.89

Annular Space/Abandonment Sealing Record

Depth Set at (Metres) From	To	Type of Sealant Used (Material and Type)	Volume Placed (Cubic Metres)
0.0	~~7.32~~	Bentonite	
~~7.32~~	11.89	Sand	

Method of Construction

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

Water Use

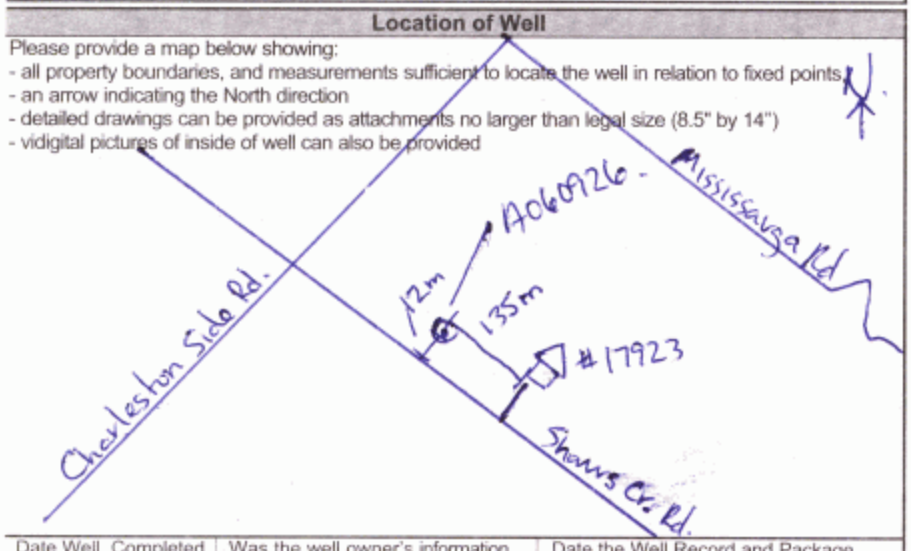
☐ Public ☐ Commercial ☐ Not used ☐ Domestic ☐ Municipal ☐ Dewatering ☐ Livestock ☐ Test Hole ☒ Monitoring ☐ Irrigation ☐ Cooling & Air Conditioning ☐ Industrial ☐ Other, specify

Status of Well

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

Location of Well

Please provide a map below showing:
- all property boundaries, and measurements sufficient to locate the well in relation to fixed points
- an arrow indicating the North direction
- detailed drawings can be provided as attachments no larger than legal size (8.5" by 14")
- vidigital pictures of inside of well can also be provided



Date Well Completed (yyyy/mm/dd)	Was the well owner's information package delivered?	Date the Well Record and Package Delivered to Well Owner (yyyy/mm/dd)
2007/10/18	☐ Yes ☒ No	

Well Contractor and Well Technician Information

Business Name of Well Contractor	Well Contractor's Licence No.
All-Terrain Drilling Ltd.	1129

Business Address (Street No./Name, number, RR)	Municipality
3-661 Colby Dr.	Waterloo

Province	Postal Code	Business E-mail Address
ON	N2V 1C2	allterrain@golden.net

Bus. Telephone No. (inc. area code)	Name of Well Technician (Last Name, First Name)
5198868810	Grant, Don

Well Technician's Licence No.	Signature of Technician	Date Submitted (yyyy/mm/dd)
3311		2008/01/22

Results of Well Yield Testing

Check box if after test of well yield, water was:
☐ Clear and sand free ☐ Cannot develop to sand-free state

If pumping discontinued, give reason:

Pumping test method

Pump intake set at (Metres)

Pumping rate (Litres/min)

Duration of pumping ____ hrs + ____ min

Final water level end of pumping (Metres)

Recommended pump type ☐ Shallow ☐ Deep

Recommended pump depth ____ Metres

Recommended pump rate (Litres/min)

If flowing give rate (Litres/min)

Draw Down Time (Min)	Draw Down Water Level (Metres)	Recovery Time (Min)	Recovery Water Level (Metres)
Static Level		Static Level	
1		1	
2		2	
3		3	
4		4	
5		5	
10		10	
15		15	
20		20	
25		25	
30		30	
40		40	
50		50	
60		60	

Water Details

Water found at Depth	Kind of Water
7.62 Metres ☐ Gas	☒ Fresh ☐ Salty ☐ Sulphur ☐ Minerals
Metres ☐ Gas	☐ Fresh ☐ Salty ☐ Sulphur ☐ Minerals
Metres ☐ Gas	☐ Fresh ☐ Salty ☐ Sulphur ☐ Minerals

Casing Used	Screen Used
☐ Galvanized ☐ Steel ☐ Fibreglass ☒ Plastic 2" ☐ Concrete	☐ Galvanized ☐ Steel ☐ Fibreglass ☒ Plastic 2" ☐ Concrete

No Casing and Screen Used

☐ Open Hole

Disinfected? ☐ Yes ☒ No

Casing and Well Details

Diameter of the Hole (Centimetres) 25

Depth of the Hole (Metres) 11.89

Wall Thickness (Metres) .4 cm

Inside Diameter of the Casing (Metres) 5.0 cm

Depth of the Casing (Metres) Screen 0 - ~~8.83~~ 9.11 ~~8.83~~ - 11.8 9.11

Ministry Use Only

Audit No.	Well Contractor No.
z67579	
Date Received (yyyy/mm/dd) MAR 07 2008	Date of Inspection (yyyy/mm/dd)
Remarks	

0506E (11/2006)

Ministry's Copy

Ontario Ministry of the Environment

Well Tag Number (Place sticker and print number below): A054653 / A054653

Well Record
Regulation 903 Ontario Water Resources Act

Instructions for Completing Form

- For use in the **Province of Ontario** only. This document is a permanent **legal** document. Please retain for future reference.
- All Sections **must** be completed in full to avoid delays in processing. Further instructions and explanations are available on the back of this form.
- Questions regarding completing this application can be directed to the Water Well Management Coordinator at 416-235-6203.
- **All metre measurements shall be reported to 1/10th of a metre.**
- Please print clearly in blue or black ink only.

Ministry Use Only: MUN | CON | LOT

Well Owner's Information and Location of Well Information

First Name	Last Name	Mailing Address (Street Number/Name, RR, Lot, Concession)
James Dick	Construction Ltd	Box 470

County/District/Municipality	Township/City/Town/Village	Province	Postal Code	Telephone Number (include area code)
Peel	~~Caledon~~ Bolton	Ontario	L7E 5T4	905 857 3500

Address of Well Location (County/District/Municipality)	Township	Lot	Concession
Peel	Caledon	14	6 WHS

RR#/Street Number/Name	City/Town/Village	Site/Compartment/Block/Tract etc.
	Caledon	

GPS Reading	NAD	Zone	Easting	Northing	Unit Make/Model	Mode of Operation
	83	17	577692	4849667	Garmin	☐ Undifferentiated ☒ Averaged ☐ Differentiated, specify

Log of Overburden and Bedrock Materials (see instructions)

General Colour	Most common material	Other Materials	General Description	Depth From	Depth To (Metres)
Brown	Sand	Gravel		0	27.1
Grey	Dolostone			27.1	35.5
Grey	Shale			35.5	36.7

Hole Diameter

Depth From (Metres)	Depth To (Metres)	Diameter (Centimetres)
0	36.7	10

Water Record

Water found at ___ Metres / Kind of Water

- ___ m ☐ Fresh ☐ Sulphur ☐ Gas ☐ Salty ☐ Minerals ☐ Other:
- ___ m ☐ Fresh ☐ Sulphur ☐ Gas ☐ Salty ☐ Minerals ☐ Other:
- ___ m ☐ Fresh ☐ Sulphur ☐ Gas ☐ Salty ☐ Minerals ☐ Other:

After test of well yield, water was
☐ Clear and sediment free
☐ Other, specify

Chlorinated ☐ Yes ☐ No

Construction Record

Inside diam centimetres	Material	Wall thickness centimetres	Depth From (Metres)	Depth To (Metres)
Casing				
3.8	☐ Steel ☐ Fibreglass ☒ Plastic ☐ Concrete ☐ Galvanized	0.3	0	~~33~~ 36.7
	☐ Steel ☐ Fibreglass ☐ Plastic ☐ Concrete ☐ Galvanized			
	☐ Steel ☐ Fibreglass ☐ Plastic ☐ Concrete ☐ Galvanized			
Screen				
Outside diam	☐ Steel ☐ Fibreglass ☐ Plastic ☐ Concrete ☐ Galvanized	Slot No.		
4.3		10	36.7	38
No Casing or Screen				
	☐ Open hole			

Test of Well Yield

Pumping test method	Draw Down Time min	Draw Down Water Level Metres	Recovery Time min	Recovery Water Level Metres
Pump intake set at - (metres)	Static Level	16.4		
Pumping rate - (litres/min)	1		1	
Duration of pumping ___hrs + ___ min	2		2	
Final water level end of pumping ___metres	3		3	
Recommended pump type. ☐ Shallow ☐ Deep	4		4	
Recommended pump depth. ___metres	5		5	
Recommended pump rate. (litres/min)	10		10	
	15		15	
If flowing give rate - (litres/min)	20		20	
	25		25	
If pumping discontinued, give reason.	30		30	
	40		40	
	50		50	
	60		60	

Plugging and Sealing Record

☐ Annular space ☐ Abandonment

Depth set at - Metres From	Depth set at - Metres To	Material and type (bentonite slurry, neat cement slurry) etc.	Volume Placed (cubic metres)
0	26.9	Bentonite Slurry	

Method of Construction

☐ Cable Tool ☐ Rotary (air) ☒ Diamond ☐ Digging
☐ Rotary (conventional) ☐ Air percussion ☐ Jetting ☐ Other
☐ Rotary (reverse) ☐ Boring ☐ Driving

Water Use

☐ Domestic ☐ Industrial ☐ Public Supply ☒ Other
☐ Stock ☐ Commercial ☐ Not used
☐ Irrigation ☐ Municipal ☐ Cooling & air conditioning

Final Status of Well

☐ Water Supply ☐ Recharge well ☐ Unfinished ☐ Abandoned, (Other)
☒ Observation well ☐ Abandoned, insufficient supply ☐ Dewatering
☐ Test Hole ☐ Abandoned, poor quality ☐ Replacement well

Well Contractor/Technician Information

Name of Well Contractor	Well Contractor's Licence No.
Harden Environmental	7296

Business Address (street name, number, city etc.): RR1 Moffat ON L0P 1J0

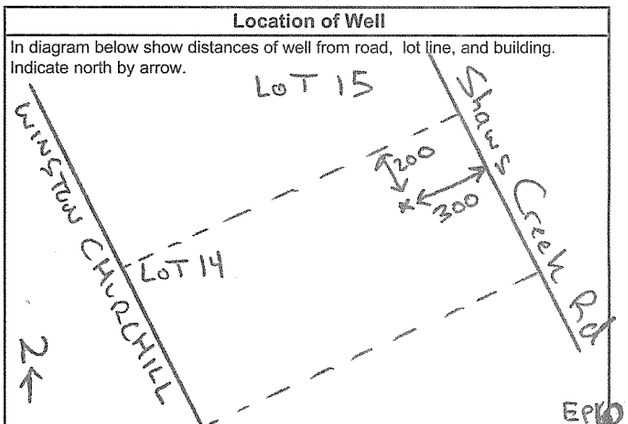
Name of Well Technician (last name, first name)	Well Technician's Licence No.
Jeff Paquette	T-2386

Signature of Technician/Contractor: X

Date Submitted: YYYY 2007 MM 09 DD 19

Location of Well

In diagram below show distances of well from road, lot line, and building. Indicate north by arrow.



Audit No. Z 24121

Date Well Completed: YYYY 2007 MM 07 DD 31

Was the well owner's information package delivered? ☒ Yes ☐ No

Date Delivered: YYYY 2007 MM 08 DD 04

Ministry Use Only

Data Source	Contractor
	7296
Date Received YYYY MM DD: SEP 17 2007	Date of Inspection YYYY MM DD
Remarks	Well Record Number

APPENDIX C

Water Quality Results

AGAT Laboratories

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
http://www.agatlabs.com

CLIENT NAME: **GOLDER ASSOCIATES LTD.**
121 COMMERCE PARK DRIVE, UNIT L
BARRIE, ON L4N8X1
(705) 722-4492

ATTENTION TO: **Devin Hannan**

PROJECT: **1655070 (5000)**

AGAT WORK ORDER: **16T167719**

MICROBIOLOGY ANALYSIS REVIEWED BY: **Elizabeth Polakowska, MSc (Animal Sci), PhD (Agri Sci), Inorganic Lab Supervisor**

TRACE ORGANICS REVIEWED BY: **Neli Popnikolova, Senior Chemist**

WATER ANALYSIS REVIEWED BY: **Mike Muneswar, BSc (Chem), Senior Inorganic Analyst**

DATE REPORTED: **Dec 15, 2016**

PAGES (INCLUDING COVER): **21**

VERSION*: **1**

Should you require any information regarding this analysis please contact your client services representative at (905) 712-5100

*NOTES

All samples will be disposed of within 30 days following analysis. Please contact the lab if you require additional sample storage time.

AGAT Laboratories

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Certificate of Analysis

AGAT WORK ORDER: 16T167719

PROJECT: 1655070 (5000)

CLIENT NAME: GOLDER ASSOCIATES LTD.

ATTENTION TO: Devin Hannan

SAMPLING SITE:

SAMPLED BY:AK/KS

Microbiological Analysis (water)

DATE RECEIVED: 2016-12-06 **DATE REPORTED: 2016-12-15**

				SAMPLE DESCRIPTION:	07-DH-154	07-DH-160	07-DH-169	MW 16-1A	MW 16-1B	MW 16-2
				SAMPLE TYPE:	Water	Water	Water	Water	Water	Water
				DATE SAMPLED:	2016-12-05	2016-12-05	2016-12-05	2016-12-05	2016-12-05	2016-12-05
Parameter	Unit	G / S	RDL		8067963	8068005	8068022	8068038	8068056	8068144
Escherichia coli	CFU/100mL		100		ND	ND	ND	ND	200	ND
Total Coliforms	CFU/100mL		100		ND	ND	200	1200	3200	100

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

8067963-8068144 Note: Samples contain sediment.
RDL >1 indicates dilutions of the sample.
ND - Not Detected.

Certified By: Elizabeth Rolakowska

AGAT Laboratories

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Certificate of Analysis

AGAT WORK ORDER: 16T167719

PROJECT: 1655070 (5000)

CLIENT NAME: GOLDER ASSOCIATES LTD.

ATTENTION TO: Devin Hannan

SAMPLING SITE:

SAMPLED BY:AK/KS

O. Reg. 153(511) - PHCs F1 - F4 (-BTEX) (Water)

DATE RECEIVED: 2016-12-06

DATE REPORTED: 2016-12-15

		SAMPLE DESCRIPTION:		07-DH-154	07-DH-160	07-DH-169	MW 16-1A	MW 16-1B	MW 16-2
		SAMPLE TYPE:		Water	Water	Water	Water	Water	Water
		DATE SAMPLED:		2016-12-05	2016-12-05	2016-12-05	2016-12-05	2016-12-05	2016-12-05
Parameter	**Unit**	**G / S**	**RDL**	**8067963**	**8068005**	**8068022**	**8068038**	**8068056**	**8068144**
F1 (C6 to C10)	µg/L	750	25	<25	<25	<25	<25	<25	<25
F1 (C6 to C10) minus BTEX	µg/L	750	25	<25	<25	<25	<25	<25	<25
F2 (C10 to C16)	µg/L	150	100	<100	<100	<100	<100	<100	<100
F3 (C16 to C34)	µg/L	500	100	<100	<100	<100	<100	<100	<100
F4 (C34 to C50)	µg/L	500	100	<100	<100	<100	<100	<100	<100
Gravimetric Heavy Hydrocarbons	µg/L	500	500	NA	NA	NA	NA	NA	NA
Surrogate	**Unit**	**Acceptable Limits**							
Terphenyl	%	60-140		89	92	91	91	62	90

Certified By:

AGAT Laboratories

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Certificate of Analysis

AGAT WORK ORDER: 16T167719

PROJECT: 1655070 (5000)

CLIENT NAME: GOLDER ASSOCIATES LTD.

ATTENTION TO: Devin Hannan

SAMPLING SITE:

SAMPLED BY:AK/KS

O. Reg. 153(511) - PHCs F1 - F4 (-BTEX) (Water)

DATE RECEIVED: 2016-12-06 **DATE REPORTED: 2016-12-15**

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: Refers to Table 2: Full Depth Generic Site Condition Standards in a Potable Ground Water Condition - Potable Ground Water - All Types of Property Uses - Medium and Fine Textured Soils

8067963-8068038
The C6-C10 fraction is calculated using Toluene response factor.
The C10 - C16, C16 - C34, and C34 - C50 fractions are calculated using the average response factor for n-C10, n-C16, and nC34.
Gravimetric Heavy Hydrocarbons are not included in the Total C16 - C50 and are only determined if the chromatogram of the C34 - C50 Hydrocarbons indicated that hydrocarbons >C50 are present.
The chromatogram has returned to baseline by the retention time of nC50.
Total C6-C50 results are corrected for BTEX contributions.
This method complies with the Reference Method for the CWS PHC and is validated for use in the laboratory.
nC6 and nC10 response factors are within 30% of Toluene response factor.
nC10, nC16 and nC34 response factors are within 10% of their average.
C50 response factor is within 70% of nC10 + nC16 nC34 average.
Linearity is within 15%.
Extraction and holding times were met for this sample.
Fractions 1-4 are quantified with the contribution of PAHs. Under Ontario Regulation 153, results are considered valid without determining the PAH contribution if not requested by the client.

8068056
The C6-C10 fraction is calculated using Toluene response factor.
The C10 - C16, C16 - C34, and C34 - C50 fractions are calculated using the average response factor for n-C10, n-C16, and nC34.
Gravimetric Heavy Hydrocarbons are not included in the Total C16 - C50 and are only determined if the chromatogram of the C34 - C50 Hydrocarbons indicated that hydrocarbons >C50 are present.
The chromatogram has returned to baseline by the retention time of nC50.
Total C6-C50 results are corrected for BTEX contributions.
This method complies with the Reference Method for the CWS PHC and is validated for use in the laboratory.
nC6 and nC10 response factors are within 30% of Toluene response factor.
nC10, nC16 and nC34 response factors are within 10% of their average.
C50 response factor is within 70% of nC10 + nC16 nC34 average.
Linearity is within 15%.
Extraction and holding times were met for this sample.
Fractions 1-4 are quantified with the contribution of PAHs. Under Ontario Regulation 153, results are considered valid without determining the PAH contribution if not requested by the client.
For F2-F4 fraction sample has some sediment on the bottom of the bottle.

8068144
The C6-C10 fraction is calculated using Toluene response factor.
The C10 - C16, C16 - C34, and C34 - C50 fractions are calculated using the average response factor for n-C10, n-C16, and nC34.
Gravimetric Heavy Hydrocarbons are not included in the Total C16 - C50 and are only determined if the chromatogram of the C34 - C50 Hydrocarbons indicated that hydrocarbons >C50 are present.
The chromatogram has returned to baseline by the retention time of nC50.
Total C6-C50 results are corrected for BTEX contributions.
This method complies with the Reference Method for the CWS PHC and is validated for use in the laboratory.
nC6 and nC10 response factors are within 30% of Toluene response factor.
nC10, nC16 and nC34 response factors are within 10% of their average.
C50 response factor is within 70% of nC10 + nC16 nC34 average.
Linearity is within 15%.
Extraction and holding times were met for this sample.
Fractions 1-4 are quantified with the contribution of PAHs. Under Ontario Regulation 153, results are considered valid without determining the PAH contribution if not requested by the client.

Certified By: N Popowich

AGAT Laboratories

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http://www.agatlabs.com

Certificate of Analysis

AGAT WORK ORDER: 16T167719

PROJECT: 1655070 (5000)

CLIENT NAME: GOLDER ASSOCIATES LTD.

ATTENTION TO: Devin Hannan

SAMPLING SITE:

SAMPLED BY:AK/KS

Volatile Organic Compounds in Water

DATE RECEIVED: 2016-12-06

DATE REPORTED: 2016-12-15

		SAMPLE DESCRIPTION:		07-DH-154	07-DH-160	07-DH-169	MW 16-1A		MW 16-1B		MW 16-2
		SAMPLE TYPE:		Water	Water	Water	Water		Water		Water
		DATE SAMPLED:		2016-12-05	2016-12-05	2016-12-05	2016-12-05		2016-12-05		2016-12-05
Parameter	Unit	G / S	RDL	8067963	8068005	8068022	8068038	RDL	8068056	RDL	8068144
Dichlorodifluoromethane	µg/L	590	0.20	<0.20	<0.20	<0.20	<0.20	0.80	<0.80	0.20	<0.20
Chloromethane	µg/L		0.40	<0.40	<0.40	<0.40	<0.40	1.60	<1.60	0.40	<0.40
Vinyl Chloride	µg/L	1.7	0.17	<0.17	<0.17	<0.17	<0.17	0.68	<0.68	0.17	<0.17
Bromomethane	µg/L	0.89	0.20	<0.20	<0.20	<0.20	<0.20	0.80	<0.80	0.20	<0.20
Chloroethane	µg/L		0.20	<0.20	<0.20	<0.20	<0.20	0.80	<0.80	0.20	<0.20
Trichlorofluoromethane	µg/L	150	0.40	<0.40	<0.40	<0.40	<0.40	1.60	<1.60	0.40	<0.40
Acetone	µg/L	2700	1.0	<1.0	<1.0	<1.0	<1.0	4.0	<4.0	1.0	<1.0
1,1 Dichloroethylene	µg/L	14	0.30	<0.30	<0.30	<0.30	<0.30	1.20	<1.20	0.30	<0.30
Methylene Chloride	µg/L	50	0.30	<0.30	<0.30	<0.30	<0.30	1.20	<1.20	0.30	<0.30
trans- 1,2-dichloroethylene	µg/L	17	0.20	<0.20	<0.20	<0.20	<0.20	0.80	<0.80	0.20	<0.20
Methyl tert-butyl ether	µg/L	15	0.20	<0.20	<0.20	<0.20	<0.20	0.80	<0.80	0.20	<0.20
1,1-Dichloroethane	µg/L	5	0.30	<0.30	<0.30	<0.30	<0.30	1.20	<1.20	0.30	<0.30
Methyl Ethyl Ketone	µg/L	1800	1.0	<1.0	<1.0	<1.0	<1.0	4.0	<4.0	1.0	<1.0
cis- 1,2-Dichloroethylene	µg/L	17	0.20	<0.20	<0.20	<0.20	<0.20	0.80	<0.80	0.20	<0.20
Chloroform	µg/L	22	0.20	<0.20	<0.20	<0.20	<0.20	0.80	<0.80	0.20	<0.20
1,2 - Dichloroethane	µg/L	5.0	0.20	<0.20	<0.20	<0.20	<0.20	0.80	<0.80	0.20	<0.20
1,1,1-Trichloroethane	µg/L	200	0.30	<0.30	<0.30	<0.30	<0.30	1.20	<1.20	0.30	<0.30
Carbon Tetrachloride	µg/L	5.0	0.20	<0.20	<0.20	<0.20	<0.20	0.80	<0.80	0.20	<0.20
Benzene	µg/L	5.0	0.20	0.20	<0.20	<0.20	0.21	0.80	<0.80	0.20	0.30
1,2-Dichloropropane	µg/L	5	0.20	<0.20	<0.20	<0.20	<0.20	0.80	<0.80	0.20	<0.20
Trichloroethylene	µg/L	5	0.20	<0.20	<0.20	<0.20	<0.20	0.80	<0.80	0.20	<0.20
Bromodichloromethane	µg/L	16	0.20	<0.20	<0.20	<0.20	<0.20	0.80	<0.80	0.20	<0.20
cis-1,3-Dichloropropene	ug/L		0.20	<0.20	<0.20	<0.20	<0.20	0.80	<0.80	0.20	<0.20
Methyl Isobutyl Ketone	µg/L	640	1.0	<1.0	<1.0	<1.0	<1.0	4.0	<4.0	1.0	<1.0
trans-1,3-Dichloropropene	µg/L		0.30	<0.30	<0.30	<0.30	<0.30	1.20	<1.20	0.30	<0.30
1,1,2-Trichloroethane	µg/L	5	0.20	<0.20	<0.20	<0.20	<0.20	0.80	<0.80	0.20	<0.20
Toluene	µg/L	24	0.20	0.36	0.20	0.39	0.45	0.80	<0.80	0.20	0.32
2-Hexanone	µg/L		1.0	<1.0	<1.0	<1.0	<1.0	4.0	<4.0	1.0	<1.0
Dibromochloromethane	µg/L	25	0.10	<0.10	<0.10	<0.10	<0.10	0.40	<0.40	0.10	<0.10
Ethylene Dibromide	µg/L	0.2	0.10	<0.10	<0.10	<0.10	<0.10	**0.40**	<0.40	0.10	<0.10

Certified By: N Popowich

AGAT Laboratories

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MISSISSAUGA, ONTARIO
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FAX (905)712-5122
http://www.agatlabs.com

Certificate of Analysis

AGAT WORK ORDER: 16T167719

PROJECT: 1655070 (5000)

CLIENT NAME: GOLDER ASSOCIATES LTD.

ATTENTION TO: Devin Hannan

SAMPLING SITE:

SAMPLED BY:AK/KS

Volatile Organic Compounds in Water

DATE RECEIVED: 2016-12-06

DATE REPORTED: 2016-12-15

		SAMPLE DESCRIPTION:		07-DH-154	07-DH-160	07-DH-169	MW 16-1A		MW 16-1B		MW 16-2
		SAMPLE TYPE:		Water	Water	Water	Water		Water		Water
		DATE SAMPLED:		2016-12-05	2016-12-05	2016-12-05	2016-12-05		2016-12-05		2016-12-05
Parameter	**Unit**	**G / S**	**RDL**	**8067963**	**8068005**	**8068022**	**8068038**	**RDL**	**8068056**	**RDL**	**8068144**
Tetrachloroethylene	µg/L	17	0.20	<0.20	<0.20	<0.20	<0.20	0.80	<0.80	0.20	<0.20
1,1,1,2-Tetrachloroethane	µg/L	1.1	0.10	<0.10	<0.10	<0.10	<0.10	0.40	<0.40	0.10	<0.10
Chlorobenzene	µg/L	30	0.10	<0.10	<0.10	<0.10	<0.10	0.40	<0.40	0.10	<0.10
Ethylbenzene	µg/L	2.4	0.10	<0.10	<0.10	<0.10	<0.10	0.40	<0.40	0.10	<0.10
m & p-Xylene	µg/L		0.20	<0.20	<0.20	<0.20	0.26	0.80	<0.80	0.20	0.20
Bromoform	µg/L	25	0.10	<0.10	<0.10	<0.10	<0.10	0.40	<0.40	0.10	<0.10
Styrene	µg/L	5.4	0.10	<0.10	<0.10	<0.10	<0.10	0.40	<0.40	0.10	<0.10
1,1,2,2-Tetrachloroethane	µg/L	1	0.10	<0.10	<0.10	<0.10	<0.10	0.40	<0.40	0.10	<0.10
o-Xylene	µg/L		0.10	<0.10	<0.10	<0.10	0.11	0.40	<0.40	0.10	0.13
1,3-Dichlorobenzene	µg/L	59	0.10	<0.10	<0.10	<0.10	<0.10	0.40	<0.40	0.10	<0.10
1,4-Dichlorobenzene	µg/L	1	0.10	<0.10	<0.10	<0.10	<0.10	0.40	<0.40	0.10	<0.10
1,2-Dichlorobenzene	µg/L	3	0.10	<0.10	<0.10	<0.10	<0.10	0.40	<0.40	0.10	<0.10
1,2,4-Trichlorobenzene	µg/L	70	0.30	<0.30	<0.30	<0.30	<0.30	1.20	<1.20	0.30	<0.30
1,3-Dichloropropene (Cis + Trans)	µg/L	0.5	0.30	<0.30	<0.30	<0.30	<0.30	**1.20**	<1.20	0.30	<0.30
Xylene Mixture (Total)	µg/L	300	0.20	<0.20	<0.20	<0.20	0.37	0.80	<0.80	0.20	0.33
n-Hexane	µg/L	520	0.20	4.0	0.90	4.4	4.3	0.80	<0.80	0.20	1.1
Surrogate	**Unit**	**Acceptable Limits**									
Toluene-d8	% Recovery	60-130		112	103	104	106		109		104
4-Bromofluorobenzene	% Recovery	70-130		88	86	85	88		82		92

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: Refers to Table 2: Full Depth Generic Site Condition Standards in a Potable Ground Water Condition - Potable Ground Water - All Types of Property Uses - Medium and Fine Textured Soils

8068056 Dilution factor=4
The sample was diluted due to the sediment in the sampling vial. The reporting detection limit has been corrected for the dilution factor used.

Certified By: NPopowich

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Certificate of Analysis

AGAT WORK ORDER: 16T167719

PROJECT: 1655070 (5000)

CLIENT NAME: GOLDER ASSOCIATES LTD.

ATTENTION TO: Devin Hannan

SAMPLING SITE:

SAMPLED BY:AK/KS

Water Quality Assessment - Groundwater Samples

DATE RECEIVED: 2016-12-06

DATE REPORTED: 2016-12-15

		SAMPLE DESCRIPTION:		07-DH-154		07-DH-160		07-DH-169	MW 16-1A		MW 16-1B
		SAMPLE TYPE:		Water		Water		Water	Water		Water
		DATE SAMPLED:		2016-12-05		2016-12-05		2016-12-05	2016-12-05		2016-12-05
Parameter	Unit	G / S	RDL	8067963	RDL	8068005	RDL	8068022	8068038	RDL	8068056
Electrical Conductivity	uS/cm		2	1080	2	1150	2	525	695	2	649
pH	pH Units		NA	8.04	NA	7.92	NA	8.11	8.02	NA	8.01
Saturation pH				6.87		6.63		7.10	6.98		7.19
Langelier Index				1.17		1.29		1.01	1.04		0.82
Total Hardness (as CaCO3)	mg/L		0.5	361	0.5	505	0.5	233	283	0.5	216
Total Dissolved Solids	mg/L		20	606	20	634	20	284	380	20	384
Alkalinity (as CaCO3)	mg/L		5	289	5	364	5	228	267	5	217
Bicarbonate (as CaCO3)	mg/L		5	289	5	364	5	228	267	5	217
Carbonate (as CaCO3)	mg/L		5	<5	5	<5	5	<5	<5	5	<5
Hydroxide (as CaCO3)	mg/L		5	<5	5	<5	5	<5	<5	5	<5
Fluoride	mg/L		0.25	<0.25	0.25	<0.25	0.25	<0.25	<0.25	0.25	<0.25
Chloride	mg/L	790	0.50	162	0.50	134	0.50	8.18	49.4	0.50	40.3
Nitrate as N	mg/L		0.25	3.40	0.25	3.78	0.25	7.22	3.95	0.25	<0.25
Nitrite as N	mg/L		0.25	<0.25	0.25	<0.25	0.25	<0.25	<0.25	0.25	<0.25
Bromide	mg/L		0.25	<0.25	0.25	<0.25	0.25	<0.25	<0.25	0.25	<0.25
Sulphate	mg/L		0.50	38.5	0.50	34.5	0.50	12.3	20.4	0.50	61.1
Ortho Phosphate as P	mg/L		0.50	<0.50	0.50	<0.50	0.50	<0.50	<0.50	0.50	<0.50
Reactive Silica	mg/L		0.05	10.1	0.05	11.1	0.05	9.54	7.41	0.05	8.99
Ammonia as N	mg/L		0.02	<0.02	0.02	<0.02	0.02	<0.02	<0.02	0.02	<0.02
Total Phosphorus	mg/L		0.05	<0.05	0.05	1.30	0.05	2.37	3.31	0.05	0.07
Total Organic Carbon	mg/L		1.0	5.9	0.5	1.7	0.5	2.7	7.2	1.0	11.5
Colour	TCU		5	<5	5	<5	5	<5	<5	5	<5
Turbidity	NTU		15	8880	0.5	2430	15	6180	9420	25	324000
Calcium	mg/L		0.05	102	0.10	149	0.05	65.8	84.0	0.05	51.1
Magnesium	mg/L		0.05	25.8	0.10	32.2	0.05	16.8	17.7	0.05	21.4
Sodium	mg/L	490	0.05	63.1	0.10	85.2	0.05	3.43	21.0	0.05	32.0
Potassium	mg/L		0.05	1.63	0.10	2.03	0.05	1.01	1.93	0.05	3.71
Aluminum	mg/L		0.004	0.159	0.004	0.153	0.004	0.445	0.063	0.004	0.012
Antimony	mg/L		0.003	<0.003	0.003	<0.003	0.003	<0.003	<0.003	0.003	<0.003
Arsenic	mg/L	0.025	0.003	<0.003	0.003	<0.003	0.003	<0.003	<0.003	0.003	0.003

Certified By:

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Certificate of Analysis

AGAT WORK ORDER: 16T167719

PROJECT: 1655070 (5000)

CLIENT NAME: GOLDER ASSOCIATES LTD.

ATTENTION TO: Devin Hannan

SAMPLING SITE:

SAMPLED BY:AK/KS

Water Quality Assessment - Groundwater Samples

DATE RECEIVED: 2016-12-06

DATE REPORTED: 2016-12-15

		SAMPLE DESCRIPTION:		07-DH-154		07-DH-160		07-DH-169	MW 16-1A		MW 16-1B
		SAMPLE TYPE:		Water		Water		Water	Water		Water
		DATE SAMPLED:		2016-12-05		2016-12-05		2016-12-05	2016-12-05		2016-12-05
Parameter	Unit	G / S	RDL	8067963	RDL	8068005	RDL	8068022	8068038	RDL	8068056
Barium	mg/L	1.0	0.002	0.157	0.002	0.238	0.002	0.105	0.102	0.002	0.186
Beryllium	mg/L		0.001	<0.001	0.001	<0.001	0.001	<0.001	<0.001	0.001	<0.001
Boron	mg/L	5.0	0.010	0.017	0.010	0.040	0.010	<0.010	0.017	0.010	0.013
Cadmium	mg/L	0.0027	0.001	<0.001	0.001	<0.001	0.001	<0.001	<0.001	0.001	<0.001
Chromium	mg/L	0.05	0.003	<0.003	0.003	<0.003	0.003	<0.003	0.003	0.003	<0.003
Cobalt	mg/L		0.001	0.003	0.001	<0.001	0.001	<0.001	<0.001	0.001	<0.001
Copper	mg/L	0.087	0.003	<0.003	0.003	<0.003	0.003	<0.003	<0.003	0.003	<0.003
Iron	mg/L		0.010	0.063	0.010	0.065	0.010	0.444	<0.010	0.010	<0.010
Lead	mg/L	0.01	0.002	<0.002	0.002	<0.002	0.002	<0.002	<0.002	0.002	<0.002
Manganese	mg/L		0.002	0.003	0.002	0.003	0.002	0.017	<0.002	0.002	0.015
Mercury	mg/L	0.001	0.0001	<0.0001	0.0001	<0.0001	0.0001	<0.0001	<0.0001	0.0001	<0.0001
Molybdenum	mg/L	0.07	0.002	<0.002	0.002	<0.002	0.002	<0.002	<0.002	0.002	0.003
Nickel	mg/L	0.1	0.003	<0.003	0.003	<0.003	0.003	<0.003	<0.003	0.003	<0.003
Selenium	mg/L	0.01	0.004	<0.004	0.004	<0.004	0.004	<0.004	<0.004	0.004	<0.004
Silver	mg/L	0.0015	**0.002**	<0.002	**0.002**	<0.002	**0.002**	<0.002	<0.002	**0.002**	<0.002
Strontium	mg/L		0.005	0.250	0.005	0.282	0.005	0.137	0.206	0.005	0.251
Thallium	mg/L	0.002	**0.006**	<0.006	**0.006**	<0.006	**0.006**	<0.006	<0.006	**0.006**	<0.006
Tin	mg/L		0.002	<0.002	0.002	<0.002	0.002	<0.002	<0.002	0.002	<0.002
Titanium	mg/L		0.002	0.005	0.002	0.003	0.002	0.018	<0.002	0.002	<0.002
Tungsten	mg/L		0.010	<0.010	0.010	<0.010	0.010	<0.010	<0.010	0.010	<0.010
Uranium	mg/L	0.02	0.002	<0.002	0.002	<0.002	0.002	<0.002	<0.002	0.002	<0.002
Vanadium	mg/L	0.0062	0.002	<0.002	0.002	<0.002	0.002	<0.002	<0.002	0.002	<0.002
Zinc	mg/L	1.1	0.005	<0.005	0.005	<0.005	0.005	<0.005	<0.005	0.005	<0.005
Zirconium	mg/L		0.004	<0.004	0.004	<0.004	0.004	<0.004	<0.004	0.004	<0.004
% Difference/ Ion Balance	%		NA	6.52	NA	6.94	NA	6.92	5.88	NA	7.60

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Certificate of Analysis

AGAT WORK ORDER: 16T167719

PROJECT: 1655070 (5000)

CLIENT NAME: GOLDER ASSOCIATES LTD.

ATTENTION TO: Devin Hannan

SAMPLING SITE:

SAMPLED BY:AK/KS

Water Quality Assessment - Groundwater Samples

DATE RECEIVED: 2016-12-06

DATE REPORTED: 2016-12-15

		SAMPLE DESCRIPTION:		MW 16-2
		SAMPLE TYPE:		Water
		DATE SAMPLED:		2016-12-05
Parameter	Unit	G / S	RDL	8068144
Electrical Conductivity	uS/cm		2	708
pH	pH Units		NA	8.02
Saturation pH				7.00
Langelier Index				1.02
Total Hardness (as CaCO3)	mg/L		0.5	278
Total Dissolved Solids	mg/L		20	380
Alkalinity (as CaCO3)	mg/L		5	261
Bicarbonate (as CaCO3)	mg/L		5	261
Carbonate (as CaCO3)	mg/L		5	<5
Hydroxide (as CaCO3)	mg/L		5	<5
Fluoride	mg/L		0.25	<0.25
Chloride	mg/L	790	0.50	50.4
Nitrate as N	mg/L		0.25	3.94
Nitrite as N	mg/L		0.25	<0.25
Bromide	mg/L		0.25	<0.25
Sulphate	mg/L		0.50	22.9
Ortho Phosphate as P	mg/L		0.50	<0.50
Reactive Silica	mg/L		0.05	9.17
Ammonia as N	mg/L		0.02	<0.02
Total Phosphorus	mg/L		0.05	<0.05
Total Organic Carbon	mg/L		0.5	2.7
Colour	TCU		5	<5
Turbidity	NTU		15	25000
Calcium	mg/L		0.05	80.3
Magnesium	mg/L		0.05	18.9
Sodium	mg/L	490	0.05	22.0
Potassium	mg/L		0.05	2.74
Aluminum	mg/L		0.004	0.063
Antimony	mg/L		0.003	<0.003
Arsenic	mg/L	0.025	0.003	<0.003

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PROJECT: 1655070 (5000)

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ATTENTION TO: Devin Hannan

SAMPLING SITE:

SAMPLED BY:AK/KS

Water Quality Assessment - Groundwater Samples

DATE RECEIVED: 2016-12-06

DATE REPORTED: 2016-12-15

		SAMPLE DESCRIPTION:		MW 16-2
		SAMPLE TYPE:		Water
		DATE SAMPLED:		2016-12-05
Parameter	Unit	G / S	RDL	8068144
Barium	mg/L	1.0	0.002	0.125
Beryllium	mg/L		0.001	<0.001
Boron	mg/L	5.0	0.010	0.016
Cadmium	mg/L	0.0027	0.001	<0.001
Chromium	mg/L	0.05	0.003	<0.003
Cobalt	mg/L		0.001	<0.001
Copper	mg/L	0.087	0.003	<0.003
Iron	mg/L		0.010	<0.010
Lead	mg/L	0.01	0.002	<0.002
Manganese	mg/L		0.002	0.008
Mercury	mg/L	0.001	0.0001	<0.0001
Molybdenum	mg/L	0.07	0.002	<0.002
Nickel	mg/L	0.1	0.003	<0.003
Selenium	mg/L	0.01	0.004	<0.004
Silver	mg/L	0.0015	**0.002**	<0.002
Strontium	mg/L		0.005	0.234
Thallium	mg/L	0.002	**0.006**	<0.006
Tin	mg/L		0.002	<0.002
Titanium	mg/L		0.002	0.003
Tungsten	mg/L		0.010	<0.010
Uranium	mg/L	0.02	0.002	<0.002
Vanadium	mg/L	0.0062	0.002	<0.002
Zinc	mg/L	1.1	0.005	<0.005
Zirconium	mg/L		0.004	<0.004
% Difference/ Ion Balance	%		NA	5.78

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: Refers to Table 2: Full Depth Generic Site Condition Standards in a Potable Ground Water Condition - Potable Ground Water - All Types of Property Uses - Medium and Fine Textured Soils

8067963-8068144 Elevated RDLs for Anions & Cations indicate the degree of dilution prior to analysis in order to keep analytes within the calibration range of the instruments and to reduce matrix interferences.

Certified By:

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Quality Assurance

CLIENT NAME: GOLDER ASSOCIATES LTD.

AGAT WORK ORDER: 16T167719

PROJECT: 1655070 (5000)

ATTENTION TO: Devin Hannan

SAMPLING SITE:

SAMPLED BY:AK/KS

Microbiology Analysis

RPT Date: Dec 15, 2016			DUPLICATE			Method Blank	REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD		Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
Microbiological Analysis (water)															
Escherichia coli	8067963	8067963	ND	ND	NA	< 1									
Total Coliforms	8067963	8067963	ND	ND	NA	< 1									

Comments: ND - Not Detected, NA - % RPD Not Applicable

Certified By: Elizabeth Rolakowska

AGAT Laboratories

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Quality Assurance

CLIENT NAME: GOLDER ASSOCIATES LTD.

AGAT WORK ORDER: 16T167719

PROJECT: 1655070 (5000)

ATTENTION TO: Devin Hannan

SAMPLING SITE:

SAMPLED BY:AK/KS

Trace Organics Analysis

RPT Date: Dec 15, 2016			DUPLICATE				REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
Volatile Organic Compounds in Water															
Dichlorodifluoromethane	8086786		< 0.20	< 0.20	NA	< 0.20	92%	60%	130%	105%	60%	130%	108%	60%	130%
Chloromethane	8086786		< 0.40	< 0.40	NA	< 0.40	73%	60%	130%	102%	60%	130%	76%	60%	130%
Vinyl Chloride	8086786		< 0.17	< 0.17	NA	< 0.17	98%	60%	130%	115%	60%	130%	86%	60%	130%
Bromomethane	8086786		< 0.20	< 0.20	NA	< 0.20	68%	60%	130%	75%	60%	130%	75%	60%	130%
Chloroethane	8086786		< 0.20	< 0.20	NA	< 0.20	86%	60%	130%	107%	60%	130%	80%	60%	130%
Trichlorofluoromethane	8086786		< 0.40	< 0.40	NA	< 0.40	94%	60%	130%	126%	60%	130%	104%	60%	130%
Acetone	8086786		< 1.0	< 1.0	NA	< 1.0	108%	60%	130%	84%	60%	130%	103%	60%	130%
1,1 Dichloroethylene	8086786		< 0.30	< 0.30	NA	< 0.30	82%	60%	130%	106%	60%	130%	112%	60%	130%
Methylene Chloride	8086786		< 0.30	< 0.30	NA	< 0.30	84%	60%	130%	97%	60%	130%	112%	60%	130%
trans- 1,2-dichloroethylene	8086786		< 0.20	< 0.20	NA	< 0.20	88%	60%	130%	99%	60%	130%	118%	60%	130%
Methyl tert-butyl ether	8086786		< 0.20	< 0.20	NA	< 0.20	92%	60%	130%	82%	60%	130%	109%	60%	130%
1,1-Dichloroethane	8086786		< 0.30	< 0.30	NA	< 0.30	101%	60%	130%	89%	60%	130%	117%	60%	130%
Methyl Ethyl Ketone	8086786		< 1.0	< 1.0	NA	< 1.0	84%	60%	130%	74%	60%	130%	77%	60%	130%
cis- 1,2-Dichloroethylene	8086786		< 0.20	< 0.20	NA	< 0.20	100%	60%	130%	81%	60%	130%	92%	60%	130%
Chloroform	8086786		< 0.20	< 0.20	NA	< 0.20	110%	60%	130%	89%	60%	130%	93%	60%	130%
1,2 - Dichloroethane	8086786		< 0.20	< 0.20	NA	< 0.20	91%	60%	130%	77%	60%	130%	100%	60%	130%
1,1,1-Trichloroethane	8086786		< 0.30	< 0.30	NA	< 0.30	104%	60%	130%	88%	60%	130%	115%	60%	130%
Carbon Tetrachloride	8086786		< 0.20	< 0.20	NA	< 0.20	111%	60%	130%	98%	60%	130%	117%	60%	130%
Benzene	8086786		< 0.20	< 0.20	NA	< 0.20	98%	60%	130%	86%	60%	130%	96%	60%	130%
1,2-Dichloropropane	8086786		< 0.20	< 0.20	NA	< 0.20	100%	60%	130%	73%	60%	130%	109%	60%	130%
Trichloroethylene	8086786		< 0.20	< 0.20	NA	< 0.20	100%	60%	130%	98%	60%	130%	95%	60%	130%
Bromodichloromethane	8086786		< 0.20	< 0.20	NA	< 0.20	113%	60%	130%	81%	60%	130%	106%	60%	130%
cis-1,3-Dichloropropene	8086786		< 0.20	< 0.20	NA	< 0.20	84%	60%	130%	71%	60%	130%	97%	60%	130%
Methyl Isobutyl Ketone	8086786		< 1.0	< 1.0	NA	< 1.0	90%	60%	130%	77%	60%	130%	88%	60%	130%
trans-1,3-Dichloropropene	8086786		< 0.30	< 0.30	NA	< 0.30	77%	60%	130%	75%	60%	130%	86%	60%	130%
1,1,2-Trichloroethane	8086786		< 0.20	< 0.20	NA	< 0.20	101%	60%	130%	78%	60%	130%	111%	60%	130%
Toluene	8086786		< 0.20	< 0.20	NA	< 0.20	112%	60%	130%	95%	60%	130%	106%	60%	130%
2-Hexanone	8086786		< 1.0	< 1.0	NA	< 1.0	86%	60%	130%	70%	60%	130%	100%	60%	130%
Dibromochloromethane	8086786		< 0.10	< 0.10	NA	< 0.10	94%	60%	130%	75%	60%	130%	92%	60%	130%
Ethylene Dibromide	8086786		< 0.10	< 0.10	NA	< 0.10	87%	60%	130%	73%	60%	130%	102%	60%	130%
Tetrachloroethylene	8086786		< 0.20	< 0.20	NA	< 0.20	118%	60%	130%	97%	60%	130%	109%	60%	130%
1,1,1,2-Tetrachloroethane	8086786		< 0.10	< 0.10	NA	< 0.10	109%	60%	130%	78%	60%	130%	83%	60%	130%
Chlorobenzene	8086786		< 0.10	< 0.10	NA	< 0.10	107%	60%	130%	86%	60%	130%	93%	60%	130%
Ethylbenzene	8086786		< 0.10	< 0.10	NA	< 0.10	106%	60%	130%	85%	60%	130%	92%	60%	130%
m & p-Xylene	8086786		< 0.20	< 0.20	NA	< 0.20	111%	60%	130%	89%	60%	130%	97%	60%	130%
Bromoform	8086786		< 0.10	< 0.10	NA	< 0.10	101%	60%	130%	71%	60%	130%	73%	60%	130%
Styrene	8086786		< 0.10	< 0.10	NA	< 0.10	103%	60%	130%	88%	60%	130%	84%	60%	130%
1,1,2,2-Tetrachloroethane	8086786		< 0.10	< 0.10	NA	< 0.10	95%	60%	130%	78%	60%	130%	99%	60%	130%
o-Xylene	8086786		< 0.10	< 0.10	NA	< 0.10	112%	60%	130%	88%	60%	130%	95%	60%	130%

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Quality Assurance

CLIENT NAME: GOLDER ASSOCIATES LTD.
AGAT WORK ORDER: 16T167719
PROJECT: 1655070 (5000)
ATTENTION TO: Devin Hannan
SAMPLING SITE:
SAMPLED BY:AK/KS

Trace Organics Analysis (Continued)

RPT Date: Dec 15, 2016			DUPLICATE				REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
1,3-Dichlorobenzene	8086786		< 0.10	< 0.10	NA	< 0.10	107%	60%	130%	75%	60%	130%	80%	60%	130%
1,4-Dichlorobenzene	8086786		< 0.10	< 0.10	NA	< 0.10	102%	60%	130%	77%	60%	130%	85%	60%	130%
1,2-Dichlorobenzene	8086786		< 0.10	< 0.10	NA	< 0.10	98%	60%	130%	70%	60%	130%	77%	60%	130%
1,2,4-Trichlorobenzene	8086786		< 0.30	< 0.30	NA	< 0.30	93%	60%	130%	65%	60%	130%	73%	60%	130%
1,3-Dichloropropene (Cis + Trans)	8086786		< 0.30	< 0.30	NA	< 0.30	81%	60%	130%	73%	60%	130%	92%	60%	130%
n-Hexane	8086786		< 0.20	< 0.20	NA	< 0.20	74%	60%	130%	103%	60%	130%	107%	60%	130%
O. Reg. 153(511) - PHCs F1 - F4 (-BTEX) (Water)															
F1 (C6 to C10)	8074215		< 25	< 25	NA	< 25	78%	60%	140%	98%	60%	140%	91%	60%	140%
F2 (C10 to C16)		TW	< 100	< 100	NA	< 100	100%	60%	140%	60%	60%	140%	60%	60%	140%
F3 (C16 to C34)		TW	< 100	< 100	NA	< 100	98%	60%	140%	85%	60%	140%	88%	60%	140%
F4 (C34 to C50)		TW	< 100	< 100	NA	< 100	83%	60%	140%	108%	60%	140%	108%	60%	140%

Comments: Tap water analysis has been performed as QC sample testing for duplicate and matrix spike due to insufficient sample volume.
When the average of the sample and duplicate results is less than 5x the RDL, the Relative Percent Difference (RPD) will be indicated as Not Applicable (NA).

Certified By: N Popnikolof

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Quality Assurance

CLIENT NAME: GOLDER ASSOCIATES LTD.
AGAT WORK ORDER: 16T167719
PROJECT: 1655070 (5000)
ATTENTION TO: Devin Hannan
SAMPLING SITE:
SAMPLED BY:AK/KS

Water Analysis

RPT Date: Dec 15, 2016			DUPLICATE				REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
Water Quality Assessment - Groundwater Samples															
Electrical Conductivity	8068022	8068022	525	511	2.7%	< 2	101%	80%	120%	NA			NA		
pH	8068022	8068022	8.11	8.11	0.0%	NA	100%	90%	110%	NA			NA		
Total Dissolved Solids	8068144	8068144	380	358	6.0%	< 20	96%	80%	120%	NA			NA		
Alkalinity (as CaCO3)	8068022	8068022	228	229	0.4%	< 5	97%	80%	120%	NA			NA		
Bicarbonate (as CaCO3)	8068022	8068022	228	229	0.4%	< 5	NA			NA			NA		
Carbonate (as CaCO3)	8068022	8068022	< 5	<5	NA	< 5	NA			NA			NA		
Hydroxide (as CaCO3)	8068022	8068022	< 5	<5	NA	< 5	NA			NA			NA		
Fluoride	8068144	8068144	< 0.25	<0.25	NA	< 0.05	99%	90%	110%	107%	90%	110%	103%	80%	120%
Chloride	8068144	8068144	50.4	48.9	3.0%	< 0.10	91%	90%	110%	108%	90%	110%	105%	80%	120%
Nitrate as N	8068144	8068144	3.94	3.77	4.4%	< 0.05	99%	90%	110%	105%	90%	110%	104%	80%	120%
Nitrite as N	8068144	8068144	< 0.25	<0.25	NA	< 0.05	NA	90%	110%	97%	90%	110%	98%	80%	120%
Bromide	8068144	8068144	< 0.25	<0.25	NA	< 0.05	103%	90%	110%	101%	90%	110%	106%	80%	120%
Sulphate	8068144	8068144	22.9	24.7	7.6%	< 0.10	93%	90%	110%	103%	90%	110%	107%	80%	120%
Ortho Phosphate as P	8068144	8068144	< 0.50	<0.50	NA	< 0.10	92%	90%	110%	100%	90%	110%	90%	80%	120%
Reactive Silica	8075908		<0.05	<0.05	NA	< 0.05	93%	90%	110%	101%	90%	110%	103%	80%	120%
Ammonia as N	8069904		<0.02	<0.02	NA	< 0.02	95%	90%	110%	98%	90%	110%	99%	80%	120%
Total Phosphorus	8066223		<0.05	<0.05	NA	< 0.05	106%	80%	120%	100%	90%	110%	100%	70%	130%
Total Organic Carbon	8067963	8067963	5.9	5.6	5.2%	< 0.5	91%	90%	110%	101%	90%	110%	95%	80%	120%
Colour	8069904		<5	<5	NA	< 5	100%	90%	110%	NA			NA		
Turbidity	8067963	8067963	8880	8970	1.0%	< 0.5	107%	90%	110%	NA			NA		
Calcium	8068144	8068144	80.3	80.4	0.1%	< 0.05	100%	90%	110%	100%	90%	110%	102%	70%	130%
Magnesium	8068144	8068144	18.9	18.6	1.6%	< 0.05	99%	90%	110%	98%	90%	110%	97%	70%	130%
Sodium	8068144	8068144	22.0	21.6	1.8%	< 0.05	100%	90%	110%	101%	90%	110%	100%	70%	130%
Potassium	8068144	8068144	2.74	2.76	0.7%	< 0.05	98%	90%	110%	98%	90%	110%	103%	70%	130%
Aluminum	8069892		0.031	0.033	6.3%	< 0.004	105%	90%	110%	110%	90%	110%	108%	70%	130%
Antimony	8069892		<0.003	<0.003	NA	< 0.003	99%	90%	110%	93%	90%	110%	95%	70%	130%
Arsenic	8069892		<0.003	<0.003	NA	< 0.003	101%	90%	110%	96%	90%	110%	101%	70%	130%
Barium	8069892		0.014	0.014	0.0%	< 0.002	101%	90%	110%	99%	90%	110%	94%	70%	130%
Beryllium	8069892		<0.001	<0.001	NA	< 0.001	97%	90%	110%	97%	90%	110%	110%	70%	130%
Boron	8069892		0.020	0.018	NA	< 0.010	96%	90%	110%	97%	90%	110%	103%	70%	130%
Cadmium	8069892		<0.001	<0.001	NA	< 0.001	100%	90%	110%	95%	90%	110%	108%	70%	130%
Chromium	8069892		<0.003	<0.003	NA	< 0.003	102%	90%	110%	97%	90%	110%	103%	70%	130%
Cobalt	8069892		<0.001	<0.001	NA	< 0.001	107%	90%	110%	107%	90%	110%	103%	70%	130%
Copper	8069892		0.787	0.762	3.2%	< 0.003	107%	90%	110%	105%	90%	110%	106%	70%	130%
Iron	8069892		0.011	<0.010	NA	< 0.010	106%	90%	110%	99%	90%	110%	109%	70%	130%
Lead	8069892		0.020	0.020	0.0%	< 0.002	104%	90%	110%	102%	90%	110%	98%	70%	130%
Manganese	8069892		<0.002	<0.002	NA	< 0.002	101%	90%	110%	102%	90%	110%	104%	70%	130%
Mercury	8069904		<0.0001	<0.0001	NA	< 0.0001	105%	90%	110%	98%	90%	110%	97%	80%	120%
Molybdenum	8069892		<0.002	<0.002	NA	< 0.002	101%	90%	110%	94%	90%	110%	99%	70%	130%

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Quality Assurance

CLIENT NAME: GOLDER ASSOCIATES LTD.

AGAT WORK ORDER: 16T167719

PROJECT: 1655070 (5000)

ATTENTION TO: Devin Hannan

SAMPLING SITE:

SAMPLED BY:AK/KS

Water Analysis (Continued)

RPT Date: Dec 15, 2016			DUPLICATE				REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
Nickel	8069892		<0.003	<0.003	NA	< 0.003	107%	90%	110%	105%	90%	110%	98%	70%	130%
Selenium	8069892		<0.004	<0.004	NA	< 0.004	99%	90%	110%	96%	90%	110%	101%	70%	130%
Silver	8069892		<0.002	<0.002	NA	< 0.002	103%	90%	110%	103%	90%	110%	78%	70%	130%
Strontium	8069892		0.148	0.144	2.7%	< 0.005	106%	90%	110%	100%	90%	110%	99%	70%	130%
Thallium	8069892		<0.006	<0.006	NA	< 0.006	102%	90%	110%	102%	90%	110%	100%	70%	130%
Tin	8069892		<0.002	<0.002	NA	< 0.002	94%	90%	110%	99%	90%	110%	100%	70%	130%
Titanium	8069892		<0.002	<0.002	NA	< 0.002	101%	90%	110%	99%	90%	110%	99%	70%	130%
Tungsten	8069892		<0.010	<0.010	NA	< 0.010	97%	90%	110%	93%	90%	110%	97%	70%	130%
Uranium	8069892		<0.002	<0.002	NA	< 0.002	102%	90%	110%	103%	90%	110%	102%	70%	130%
Vanadium	8069892		<0.002	<0.002	NA	< 0.002	101%	90%	110%	100%	90%	110%	101%	70%	130%
Zinc	8069892		0.052	0.050	3.9%	< 0.005	106%	90%	110%	105%	90%	110%	113%	70%	130%
Zirconium	8069892		<0.004	<0.004	NA	< 0.004	101%	90%	110%	91%	90%	110%	91%	70%	130%

Comments: NA signifies Not Applicable.
Duplicate Qualifier: As the measured result approaches the RL, the uncertainty associated with the value increases dramatically, thus duplicate acceptance limits apply only where the average of the two duplicates is greater than five times the RL.

Certified By:

AGAT Laboratories

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Method Summary

CLIENT NAME: GOLDER ASSOCIATES LTD.

AGAT WORK ORDER: 16T167719

PROJECT: 1655070 (5000)

ATTENTION TO: Devin Hannan

SAMPLING SITE:

SAMPLED BY:AK/KS

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Microbiology Analysis			
Escherichia coli	MIC-93-7010	EPA 1604	Membrane Filtration
Total Coliforms	MIC-93-7010	EPA 1604	Membrane Filtration

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Method Summary

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AGAT WORK ORDER: 16T167719

PROJECT: 1655070 (5000)

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PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Trace Organics Analysis			
F1 (C6 to C10)	VOL-91-5010	MOE PHC E3421	(P&T)GC/FID
F1 (C6 to C10) minus BTEX	VOL-91-5010	MOE PHC E3421	(P&T)GC/FID
F2 (C10 to C16)	VOL-91-5010	MOE PHC E3421	GC / FID
F3 (C16 to C34)	VOL-91-5010	MOE PHC E3421	GC / FID
F4 (C34 to C50)	VOL-91-5010	MOE PHC E3421	GC / FID
Gravimetric Heavy Hydrocarbons	VOL-91-5010	MOE PHC E3421	BALANCE
Terphenyl	VOL-91-5010		GC/FID
Dichlorodifluoromethane	VOL-91-5001	EPA SW-846 5030 & 8260	(P&T)GC/MS
Chloromethane	VOL-91-5001	EPA SW-846 5030 & 8260	(P&T)GC/MS
Vinyl Chloride	VOL-91-5001	EPA SW-846 5030 & 8260	(P&T)GC/MS
Bromomethane	VOL-91-5001	EPA SW-846 5030 & 8260	(P&T)GC/MS
Chloroethane	VOL-91-5001	EPA SW-846 5030 & 8260	(P&T)GC/MS
Trichlorofluoromethane	VOL-91-5001	EPA SW-846 5030 & 8260	(P&T)GC/MS
Acetone	VOL-91-5001	EPA SW-846 5030 & 8260	(P&T)GC/MS
1,1 Dichloroethylene	VOL-91-5001	EPA SW-846 5030 & 8260	(P&T)GC/MS
Methylene Chloride	VOL-91-5001	EPA SW-846 5030 & 8260	(P&T)GC/MS
trans- 1,2-dichloroethylene	VOL-91-5001	EPA SW-846 5030 & 8260	(P&T)GC/MS
Methyl tert-butyl ether	VOL-91-5001	EPA SW-846 5030 & 8260	(P&T)GC/MS
1,1-Dichloroethane	VOL-91-5001	EPA SW-846 5030 & 8260	(P&T)GC/MS
Methyl Ethyl Ketone	VOL-91-5001	EPA SW-846 5030 & 8260	(P&T)GC/MS
cis- 1,2-Dichloroethylene	VOL-91-5001	EPA SW-846 5030 & 8260	(P&T)GC/MS
Chloroform	VOL-91-5001	EPA SW-846 5030 & 8260	(P&T)GC/MS
1,2 - Dichloroethane	VOL-91-5001	EPA SW-846 5030 & 8260	(P&T)GC/MS
1,1,1-Trichloroethane	VOL-91-5001	EPA SW-846 5030 & 8260	(P&T)GC/MS
Carbon Tetrachloride	VOL-91-5001	EPA SW-846 5030 & 8260	(P&T)GC/MS
Benzene	VOL-91-5001	EPA SW-846 5030 & 8260	(P&T)GC/MS
1,2-Dichloropropane	VOL-91-5001	EPA SW-846 5030 & 8260	(P&T)GC/MS
Trichloroethylene	VOL-91-5001	EPA SW-846 5030 & 8260	(P&T)GC/MS
Bromodichloromethane	VOL-91-5001	EPA SW-846 5030 & 8260	(P&T)GC/MS
cis-1,3-Dichloropropene	VOL-91-5001	EPA SW-846 5030 & 8260	(P&T)GC/MS
Methyl Isobutyl Ketone	VOL-91-5001	EPA SW-846 5030 & 8260	(P&T)GC/MS
trans-1,3-Dichloropropene	VOL-91-5001	EPA SW-846 5030 & 8260	(P&T)GC/MS
1,1,2-Trichloroethane	VOL-91-5001	EPA SW-846 5030 & 8260	(P&T)GC/MS
Toluene	VOL-91-5001	EPA SW-846 5030 & 8260	(P&T)GC/MS
2-Hexanone	VOL-91-5001	EPA SW-846 5030 & 8260	(P&T)GC/MS
Dibromochloromethane	VOL-91-5001	EPA SW-846 5030 & 8260	(P&T)GC/MS
Ethylene Dibromide	VOL-91-5001	EPA SW-846 5030 & 8260	(P&T)GC/MS
Tetrachloroethylene	VOL-91-5001	EPA SW-846 5030 & 8260	(P&T)GC/MS
1,1,1,2-Tetrachloroethane	VOL-91-5001	EPA SW-846 5030 & 8260	(P&T)GC/MS
Chlorobenzene	VOL-91-5001	EPA SW-846 5030 & 8260	(P&T)GC/MS
Ethylbenzene	VOL-91-5001	EPA SW-846 5030 & 8260	(P&T)GC/MS
m & p-Xylene	VOL-91-5001	EPA SW-846 5030 & 8260	(P&T)GC/MS
Bromoform	VOL-91-5001	EPA SW-846 5030 & 8260	(P&T)GC/MS
Styrene	VOL-91-5001	EPA SW-846 5030 & 8260	(P&T)GC/MS
1,1,2,2-Tetrachloroethane	VOL-91-5001	EPA SW-846 5030 & 8260	(P&T)GC/MS
o-Xylene	VOL-91-5001	EPA SW-846 5030 & 8260	(P&T)GC/MS
1,3-Dichlorobenzene	VOL-91-5001	EPA SW-846 5030 & 8260	(P&T)GC/MS
1,4-Dichlorobenzene	VOL-91-5001	EPA SW-846 5030 & 8260	(P&T)GC/MS
1,2-Dichlorobenzene	VOL-91-5001	EPA SW-846 5030 & 8260	(P&T)GC/MS

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Method Summary

CLIENT NAME: GOLDER ASSOCIATES LTD.

AGAT WORK ORDER: 16T167719

PROJECT: 1655070 (5000)

ATTENTION TO: Devin Hannan

SAMPLING SITE:

SAMPLED BY:AK/KS

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
1,2,4-Trichlorobenzene	VOL-91-5001	EPA SW-846 5030 & 8260	(P&T)GC/MS
1,3-Dichloropropene (Cis + Trans)	VOL-91-5001	EPA SW-846 5030 & 8260	(P&T)GC/MS
Xylene Mixture (Total)	VOL-91-5001	EPA SW-846 5030 & 8260	(P&T)GC/MS
n-Hexane	VOL-91-5001	EPA SW-846 5030 & 8260	(P&T)GC/MS
Toluene-d8	VOL-91-5001	EPA SW-846 5030 & 8260	(P&T)GC/MS
4-Bromofluorobenzene	VOL-91-5001	EPA SW-846 5030 & 8260	(P&T)GC/MS

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PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Water Analysis			
Electrical Conductivity	INOR-93-6000	SM 2510 B	PC TITRATE
pH	INOR-93-6000	SM 4500-H+ B	PC TITRATE
Saturation pH		SM 2320 B	CALCULATION
Langelier Index		SM 2330B	CALCULATION
Total Hardness (as CaCO3)	MET-93-6105	EPA SW-846 6010C & 200.7	ICP/OES
Total Dissolved Solids	INOR-93-6028	SM 2540 C	BALANCE
Alkalinity (as CaCO3)	INOR-93-6000	SM 2320 B	PC TITRATE
Bicarbonate (as CaCO3)	INOR-93-6000	SM 2320 B	PC TITRATE
Carbonate (as CaCO3)	INOR-93-6000	SM 2320 B	PC TITRATE
Hydroxide (as CaCO3)	INOR-93-6000	SM 2320 B	PC TITRATE
Fluoride	INOR-93-6004	SM 4110 B	ION CHROMATOGRAPH
Chloride	INOR-93-6004	SM 4110 B	ION CHROMATOGRAPH
Nitrate as N	INOR-93-6004	SM 4110 B	ION CHROMATOGRAPH
Nitrite as N	INOR-93-6004	SM 4110 B	ION CHROMATOGRAPH
Bromide	INOR-93-6004	SM 4110 B	ION CHROMATOGRAPH
Sulphate	INOR-93-6004	SM 4110 B	ION CHROMATOGRAPH
Ortho Phosphate as P	INOR-93-6004	SM 4110 B	ION CHROMATOGRAPH
Reactive Silica	INOR-93-6047	AQ2 EPA-122A & SM 4500 SiO2 D	AQ2 DISCRETE ANALYSER
Ammonia as N	INOR-93-6059	QuikChem 10-107-06-1-J & SM 4500 NH3-F	LACHAT FIA
Total Phosphorus	INOR-93-6057	QuikChem 10-115-01-3-A & SM 4500-P I	LACHAT FIA
Total Organic Carbon	INOR-93-6049	EPA 415.1 & SM 5310	SHIMADZU CARBON ANALYZER
Colour	INOR-93-6046	SM 2120 B	SPECTROPHOTOMETER
Turbidity	INOR-93-6044	SM 2130 B	NEPHELOMETER
Calcium	MET-93-6105	EPA SW-846 6010C & 200.7	ICP/OES
Magnesium	MET-93-6105	EPA SW-846 6010C & 200.7	ICP/OES
Sodium	MET-93-6105	EPA SW-846 6010C & 200.7	ICP/OES
Potassium	MET-93-6105	EPA SW-846 6010C & 200.7	ICP/OES
Aluminum	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Antimony	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Arsenic	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Barium	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Beryllium	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Boron	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Cadmium	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Chromium	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Cobalt	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Copper	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Iron	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Lead	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Manganese	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Mercury	MET-93-6100	EPA SW 846 7470 & 245.1	CVAAS
Molybdenum	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Nickel	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Selenium	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Silver	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Strontium	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Thallium	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS

AGAT Laboratories

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
http://www.agatlabs.com

Method Summary

CLIENT NAME: GOLDER ASSOCIATES LTD.

AGAT WORK ORDER: 16T167719

PROJECT: 1655070 (5000)

ATTENTION TO: Devin Hannan

SAMPLING SITE:

SAMPLED BY:AK/KS

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Tin	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Titanium	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Tungsten	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Uranium	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Vanadium	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Zinc	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Zirconium	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
% Difference/ Ion Balance		SM 1030 E	CALCULATION

AGAT Laboratories

5835 Coopers Avenue
Mississauga, Ontario L4Z 1Y2
Ph: 905.712.5100 Fax: 905.712.5122
webearth.agatlabs.com

Chain of Custody Record

If this is a Drinking Water sample, please use Drinking Water Chain of Custody Form (potable water intended for human consumption)

Laboratory Use Only

Work Order #: 16T167719

Cooler Quantity: 2 Blks.

Arrival Temperatures: 1.5 | 1.6 | 1.8 (ice)
2.5 | 2.0 | 2.3 (ice)

Custody Seal Intact: ☐ Yes ☐ No ☐ N/A

Notes:

Report Information:

Company: Golder Associates
Contact: Devin Hannam
Address: 121 Commerce Park Drive
Unit L - Barrie
Phone: 416 356 4920 Fax:
Reports to be sent to:
1. Email: DHannam@golder-com
2. Email:

Regulatory Requirements:

☐ No Regulatory Requirement

(Please check all applicable boxes)

☐ Regulation 153/04
Table (Indicate One) ☐ Ind/Com ☐ Res/Park ☐ Agriculture
Soil Texture (Check One) ☐ Coarse ☐ Fine

☐ Sewer Use
☐ Sanitary ☐ Storm
Region (Indicate One)

☐ Regulation 558
☐ CCME
☐ Prov. Water Quality Objectives (PWQO)
☐ Other
(Indicate One)

Is this submission for a Record of Site Condition? ☐ Yes ☐ No

Report Guideline on Certificate of Analysis ☐ Yes ☐ No

Turnaround Time (TAT) Required:

Regular TAT ☑ 5 to 7 Business Days

Rush TAT (Rush Surcharges Apply)

☐ 3 Business Days ☐ 2 Business Days ☐ 1 Business Day

OR Date Required (Rush Surcharges May Apply):

Please provide prior notification for rush TAT
**TAT is exclusive of weekends and statutory holidays*

Project Information:

Project: 1655070 (5000)
Site Location:
Sampled By: AL/KS
AGAT Quote #: PO:
Please note: If quotation number is not provided, client will be billed full price for analysis.

Invoice Information:

Bill To Same: Yes ☑ No ☐

Company:
Contact:
Address:
Email:

Sample Matrix Legend

B	Biota
GW	Ground Water
O	Oil
P	Paint
S	Soil
SD	Sediment
SW	Surface Water

Sample Identification	Date Sampled	Time Sampled	# of Containers	Sample Matrix	Comments/ Special Instructions	Y / N	Field Filtered - Metals, Hg, CrVI (Please Circle)	Metals and Inorganics	Metal Scan	Hydride Forming Metals	Client Custom Metals	ORPs: ☐ B-HWS ☐ Cl ☐ CN ☐ C^{6+} ☐ EC ☐ FOC ☐ NO_3/NO_2 ☐ Total N ☐ Hg ☐ pH ☐ SAR	Nutrients: ☐ TP ☐ NH_3 ☐ TKN ☐ NO_3 ☐ NO_2 ☐ NO_3/NO_2	Volatiles: ☐ VOC ☐ BTEX ☐ THM	CCME Fractions 1 to 4	ABNs	PAHs	Chlorophenols	PCBs	Organochlorine Pesticides	TCLP Metals/Inorganics	Sewer Use	WQA	Ecoli	Coliform
07-DH-154	Dec 5/16	5:15 pm	14	GW		Y								✓	✓								✓	✓
07-DH-160		12:45 pm				Y								✓	✓								✓	✓
07-DH-169		1:28 pm				Y								✓	✓								✓	✓
MW 16-1A		3:28 pm				Y								✓	✓								✓	✓
MW 16-1B		2:40 pm			removed prescreen Lab filter	N								✓	✓								✓	✓
MW 16-2		2:15 pm				Y								✓	✓								✓	✓

Samples Relinquished By (Print Name and Sign):	Date	Time	Samples Received By (Print Name and Sign):	Date	Time
Kennedy	Dec 5/16	6:27	Neil Ramnarain	Dec 5/16	6:27 pm
By (Print Name and Sign):	Date	Time	Samples Received By (Print Name and Sign):	Date	Time
By (Print Name and Sign):	Date	Time	Samples Received By (Print Name and Sign):	Date	Time

Page ____ of ____

N°: T 035926

511,011

Pink Copy - Client | Yellow Copy - AGAT | White Copy- AGAT

Date Issued: Feb 15, 2016

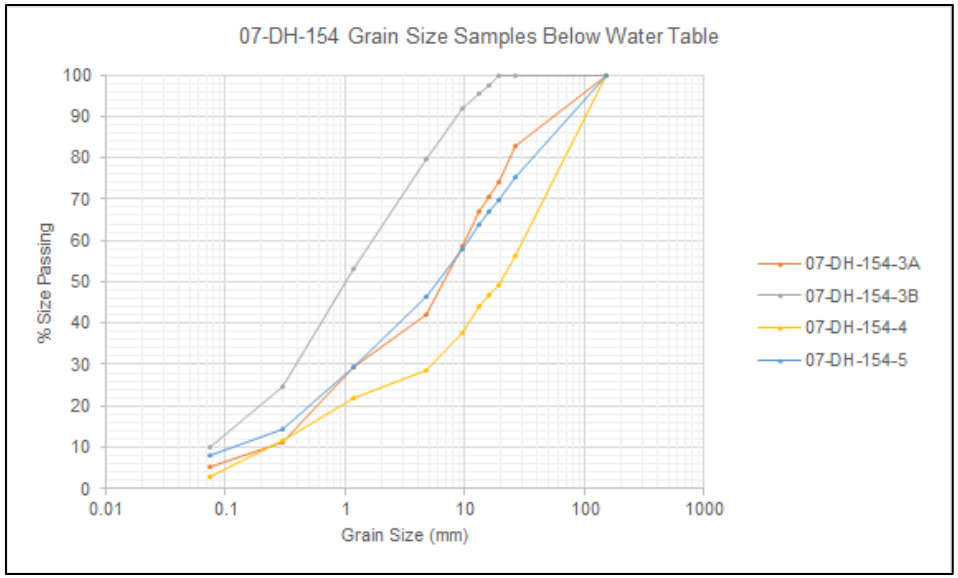
APPENDIX D

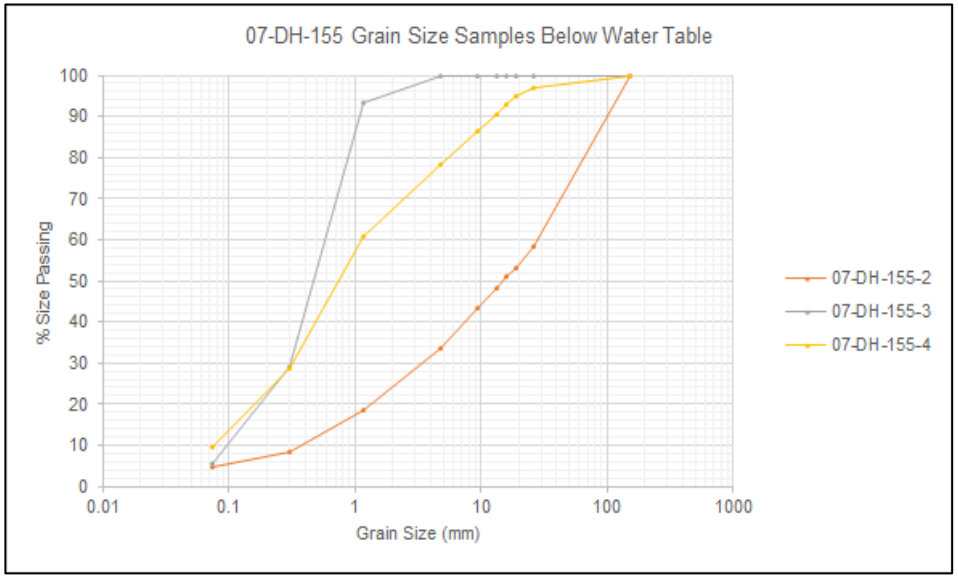
Grain Size Analysis

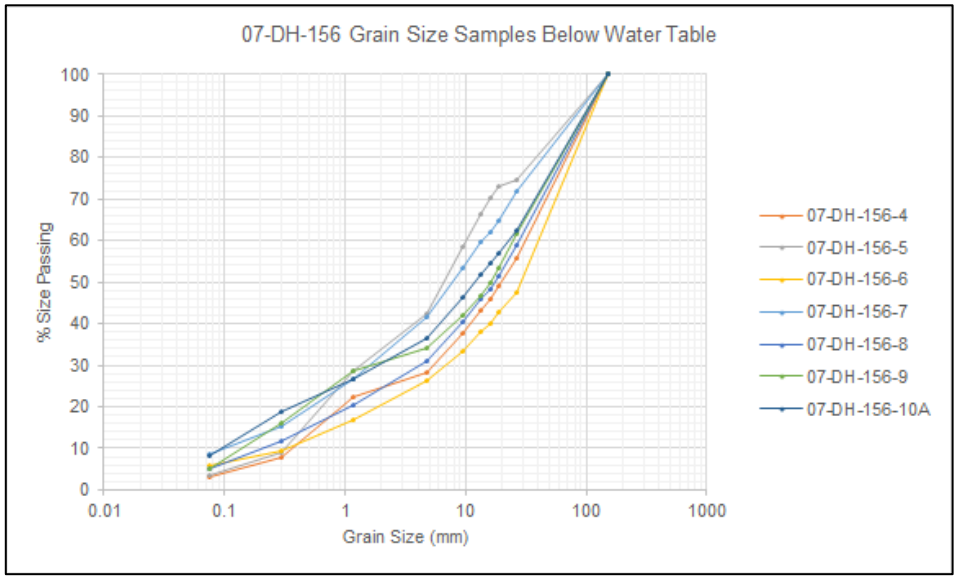
GRAIN SIZE ANALYSIS SUMMARY

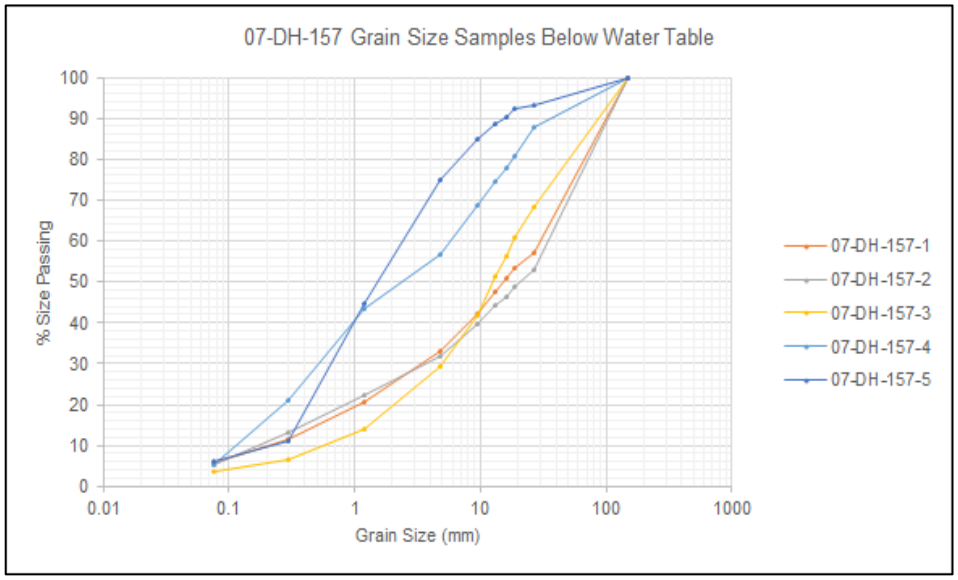
Sample	Interval (mbgs)	D_{10} (mm)	K (m/s)
07-DH-154-3A	3.05 to 3.66	0.22	5E-04
07-DH-154-3B	3.66 to 4.57	0.08	6E-05
07-DH-154-4	4.57 to 6.10	0.22	5E-04
07-DH-154-5	6.10 to 7.62	0.1	1E-04
07-DH-155-2	1.52 to 3.05	0.4	2E-03
07-DH-155-3	3.05 to 4.57	0.1	1E-04
07-DH-155-4	4.57 to 5.33	0.08	6E-05
07-DH-156-4	4.57 to 6.10	0.35	1E-03
07-DH-156-5	6.10 to 7.62	0.3	9E-04
07-DH-156-6	7.62 to 9.14	0.3	9E-04
07-DH-156-7	9.14 to 10.67	0.1	1E-04
07-DH-156-8	10.67 to 12.19	0.2	4E-04
07-DH-156-9	12.19 to 13.72	0.15	2E-04
07-DH-156-10A	13.72 to 14.48	0.1	1E-04
07-DH-157-1	0.00 to 1.52	0.2	4E-04
07-DH-157-2	1.52 to 3.05	0.15	2E-04
07-DH-157-3	3.05 to 4.57	0.6	4E-03
07-DH-157-4	6.10 to 7.62	0.12	1E-04
07-DH-157-5	7.62 to 9.14	0.2	4E-04
07-DH-158-6	7.62 to 9.14	0.15	2E-04
07-DH-158-7	9.14 to 10.67	0.2	4E-04
07-DH-158-8	10.67 to 12.19	0.1	1E-04
07-DH-158-9	12.19 to 13.72	0.08	6E-05
07-DH-159-5	6.10 to 7.62	No D10	
07-DH-160-6	7.62 to 9.14	0.3	9E-04
07-DH-160-7	9.14 to 10.67	0.3	9E-04
07-DH-160-8	10.67 to 12.19	0.15	2E-04
07-DH-161-3	3.04 to 4.57	0.5	3E-03
07-DH-161-4	4.57 to 6.10	0.35	1E-03
07-DH-162-7	9.14 to 10.67	0.08	6E-05
07-DH-162-8	10.67 to 12.19	No D10	
07-DH-162-9	12.19 to 13.72	No D10	
07-DH-162-10	13.72 to 15.24	No D10	
07-DH-163-7	9.14 to 10.67	0.25	6E-04
07-DH-163-8A	10.67 to 11.28	0.15	2E-04
07-DH-163-8B	11.28 to 12.19	No D10	
07-DH-163-10	13.72 to 15.24	No D10	
07-DH-164-5	6.10 to 7.62	0.3	9E-04
07-DH-164-6	7.62 to 9.14	0.2	4E-04
07-DH-164-8	10.67 to 12.19	No D10	
07-DH-166-8	10.67 to 12.19	No D10	
07-DH-166-9	12.19 to 13.72	No D10	
07-DH-167-8	10.67 to 12.19	No D10	
07-DH-168-10	13.72 to 15.24	0.075	6E-05
07-DH-168-12	16.76 to 18.29	No D10	
07-DH-169-8	10.67 to 12.19	0.075	6E-05
07-DH-169-9	12.19 to 13.72	0.15	2E-04
07-DH-169-10A	13.72 to 14.33	No D10	
07-DH-062-10A	13.72 to 14.63	0.11	1E-04
07-DH-063-9	12.19 to 13.72	0.2	4E-04
07-DH-063-10	13.72 to 15.24	0.075	6E-05
07-DH-063-11	15.24 to 16.76	0.3	9E-04
07-DH-064-10	13.72 to 15.24	0.14	2E-04
07-DH-064-11	15.24 to 16.76	0.12	1E-04
07-DH-064-12	16.76 to 18.29	0.15	2E-04

Geomean:	*3E-04*
Max:	*4E-03*
Min:	*6E-05*





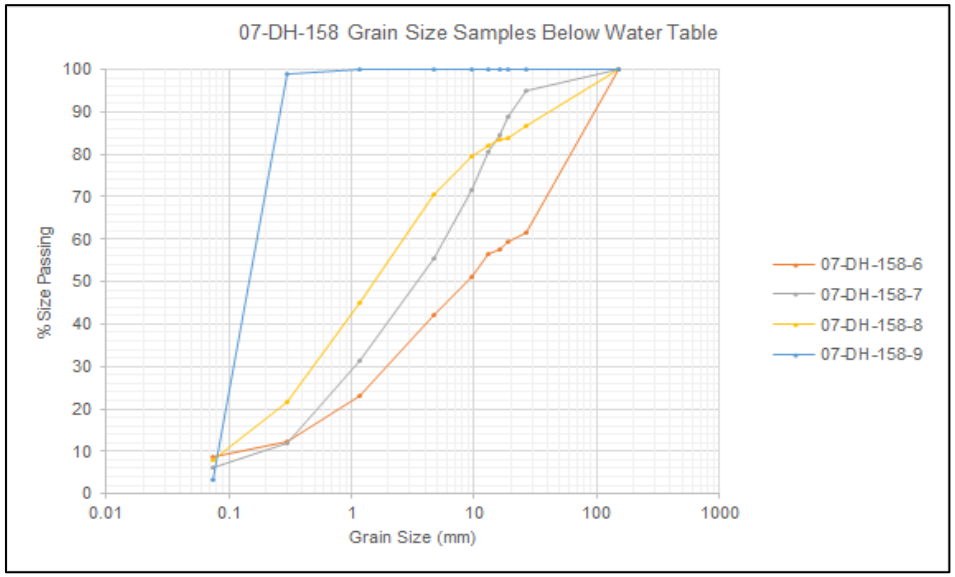


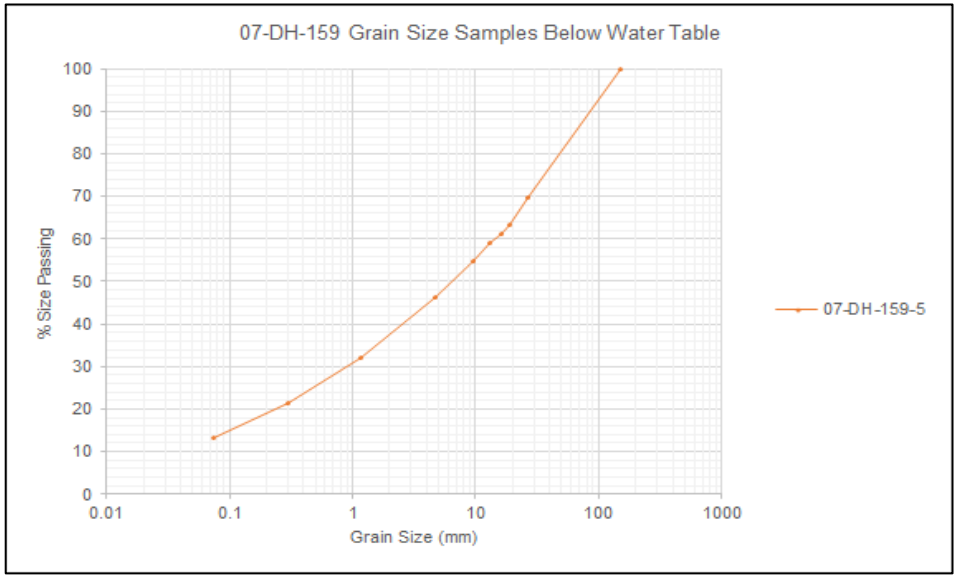


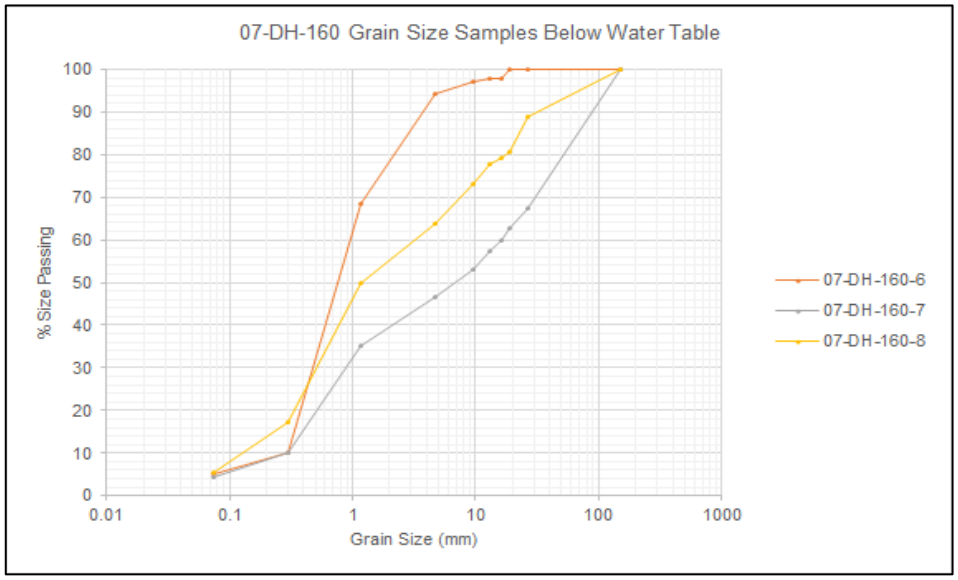
LAFARGE CANADA INC: PIT NO.3 EXTENSION

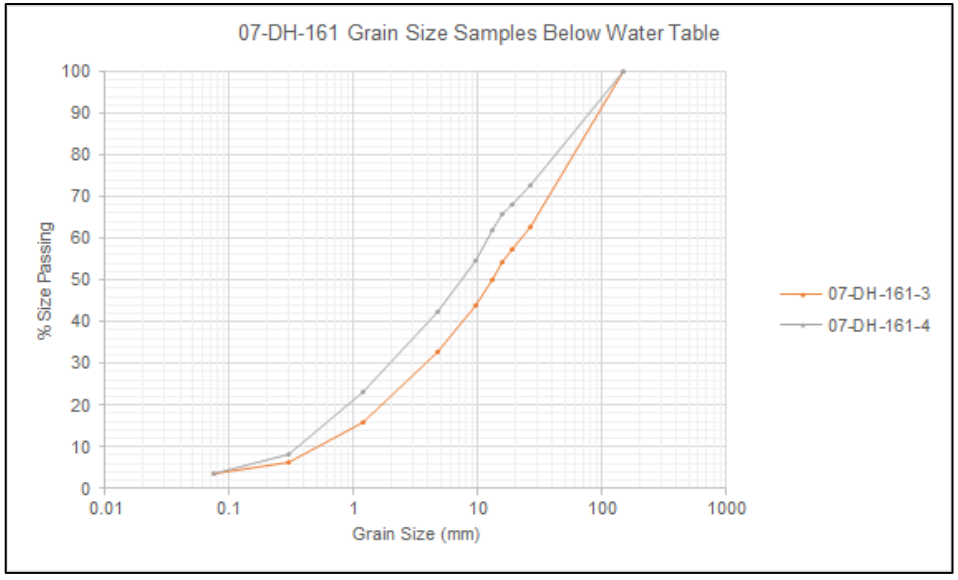
GRAIN SIZE CURVES (07-DH-154, 07-DH-155, 07-DH-156, 07-DH-157)

MARCH 2019	PROJECT: 1655070	FIGURE: D1





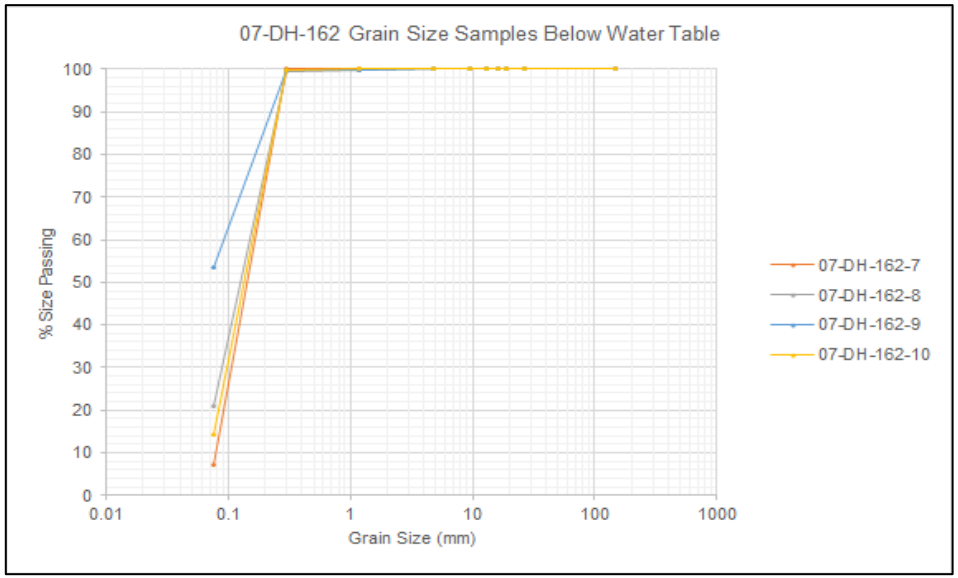


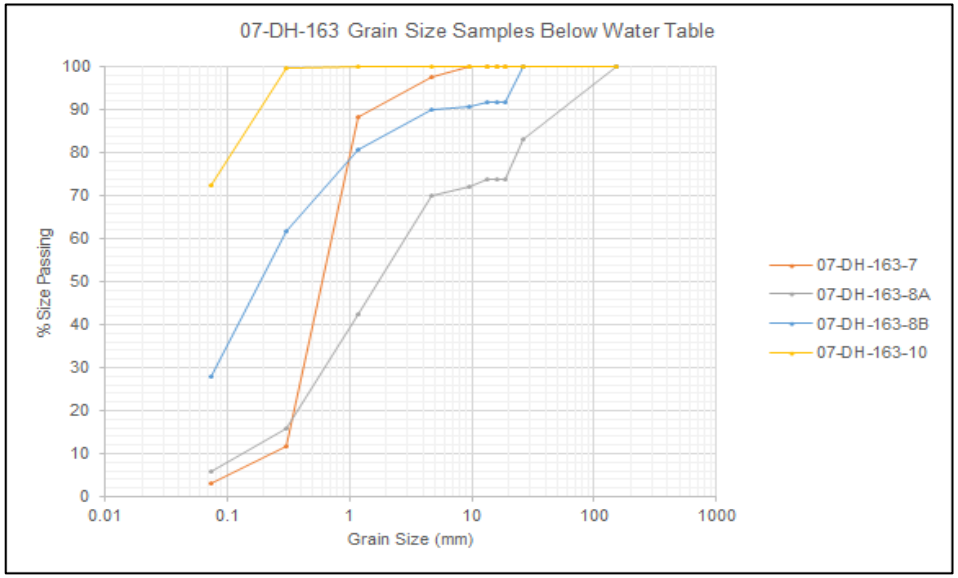


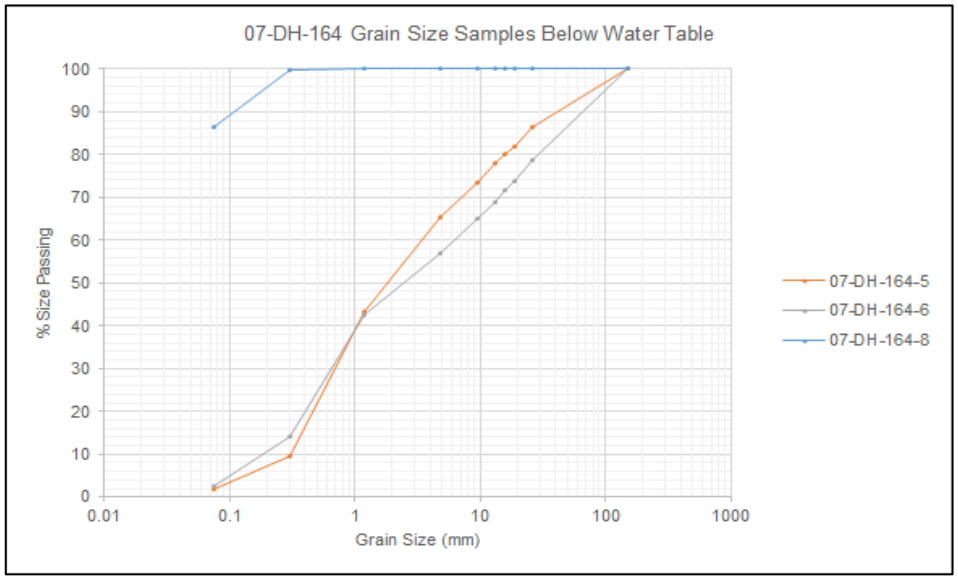
LAFARGE CANADA INC: PIT NO.3 EXTENSION

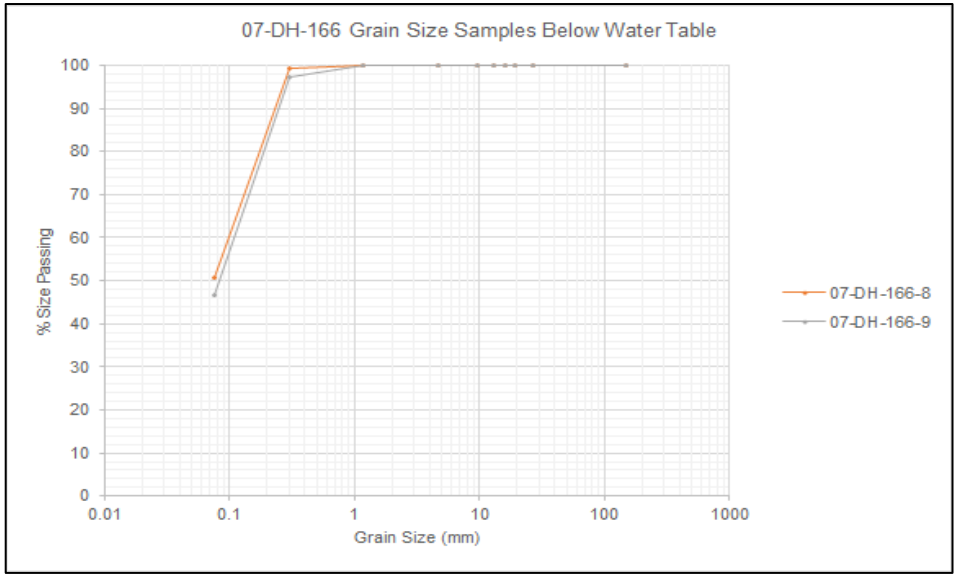
GRAIN SIZE CURVES (07-DH-158, 07-DH-159, 07-DH-160, 07-DH-161)

MARCH 2019	PROJECT: 1655070	FIGURE: D2





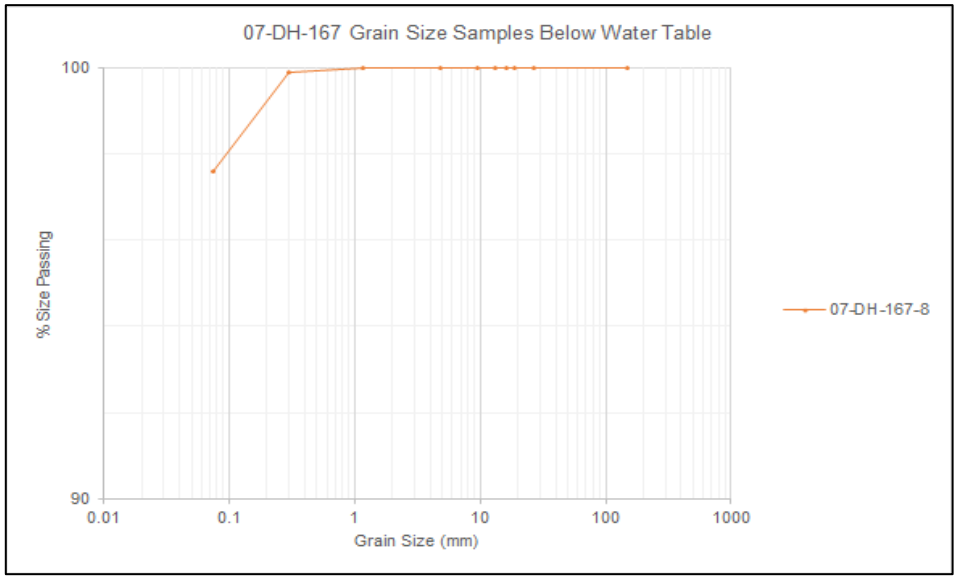


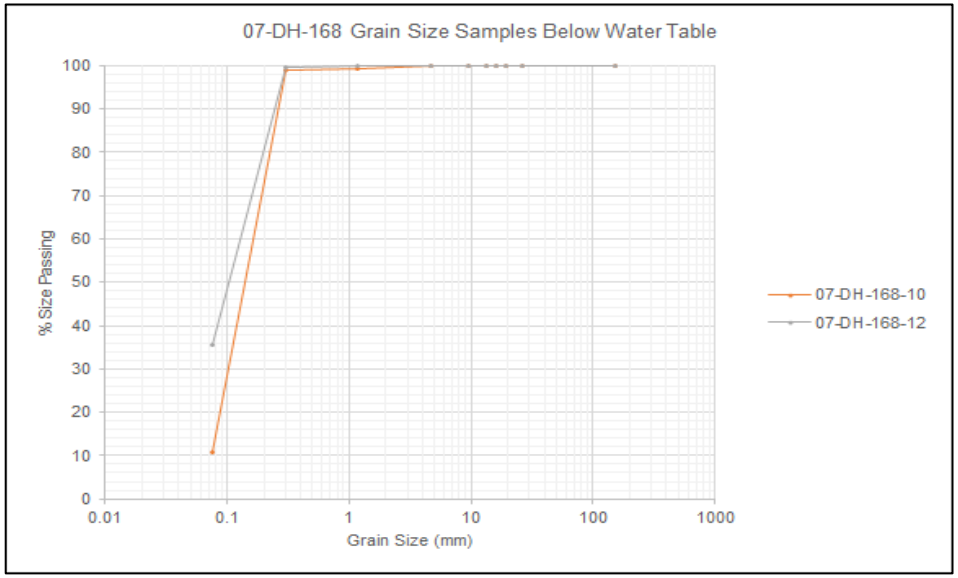


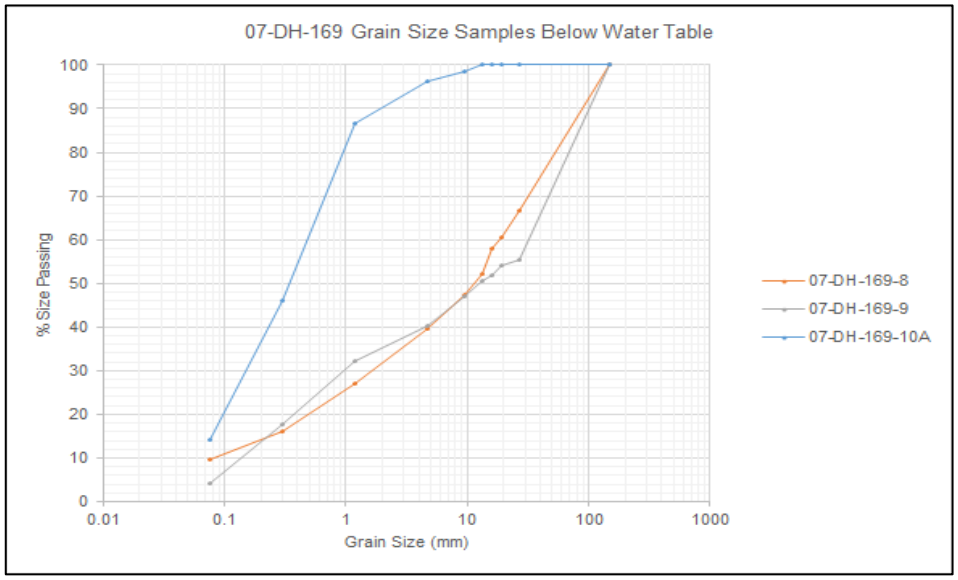
LAFARGE CANADA INC: PIT NO.3 EXTENSION

GRAIN SIZE CURVES (07-DH-162, 07-DH-163, 07-DH-164, 07-DH-166)

MARCH 2019	PROJECT: 1655070	FIGURE: D3



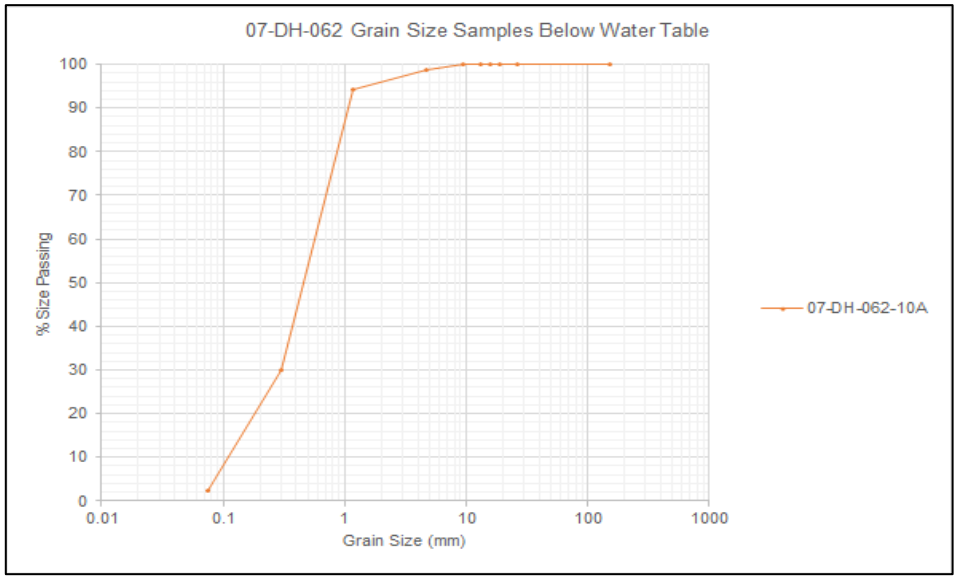


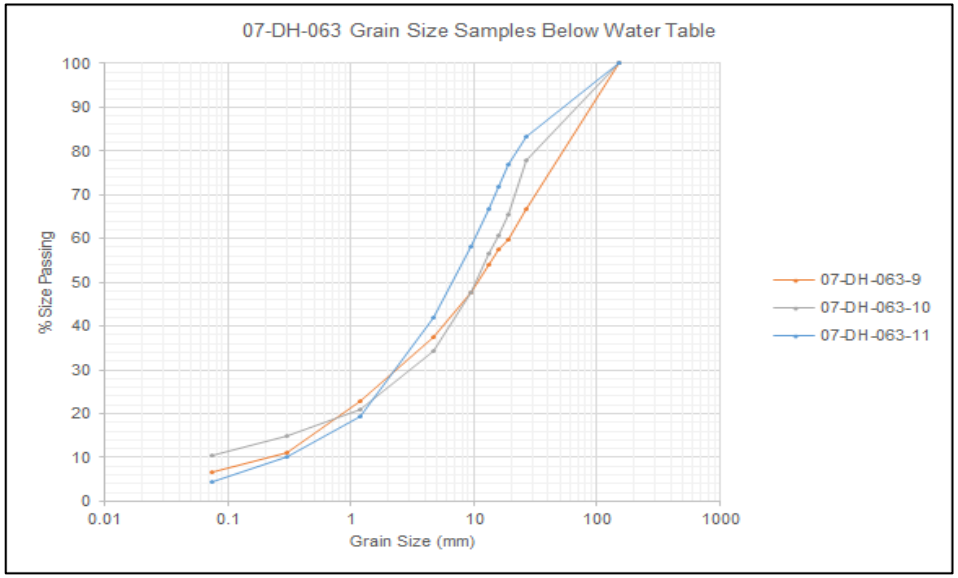


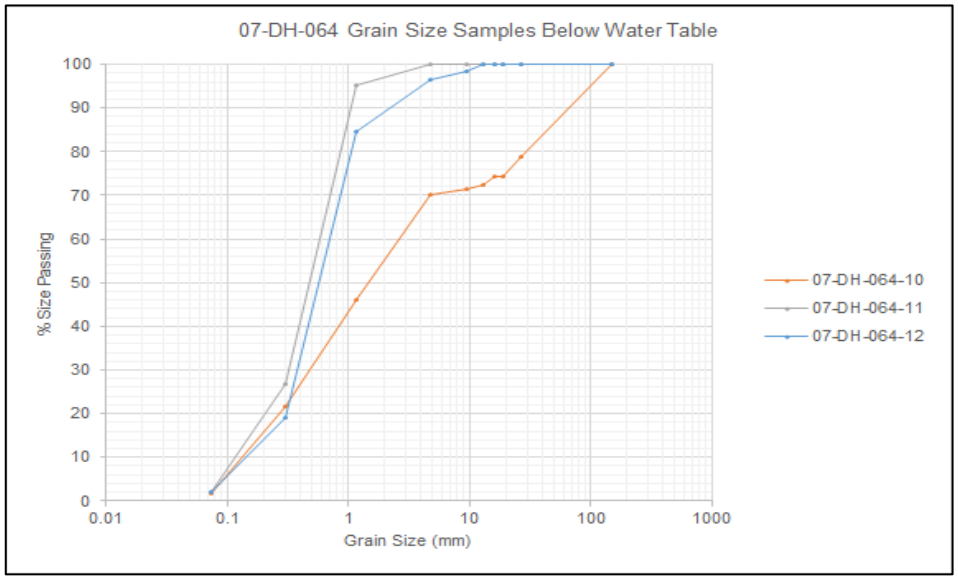
LAFARGE CANADA INC: PIT NO.3 EXTENSION

GRAIN SIZE CURVES (07-DH-167, 07-DH-168, 07-DH-169)

MARCH 2019	PROJECT: 1655070	FIGURE: D4







LAFARGE CANADA INC: PIT NO.3 EXTENSION

GRAIN SIZE CURVES (07-DH-062, 07-DH-063, 07-DH-064)

MARCH 2019	PROJECT: 1655070	FIGURE: D5

APPENDIX E

Curriculum Vitae

DR. SEAN MCFARLAND

Senior Hydrogeologist, Senior Principal/Fellow, Geotech & Water

Areas of practice

Hydrogeology and Geology

Languages

English

PROFILE

As a Senior Hydrogeologist and Geologist, Dr. McFarland has more than 35 years of professional experience and a broad background in conducting, managing and directing hydrogeological and geological work programs for nuclear, aggregate, waste management, mining, power, oil and gas, and ground water management and protection, municipal, and land development projects. He has served as expert witness hydrogeologist for an Ontario Municipal Board (OMB) and Environmental Assessment (EA) hearings.

Sean's experience in nuclear facilities including his current role leading the hydrogeological work program for the ongoing new build at the Bruce nuclear site. He conducted a hydrogeological and geological component of the hydrogeological work programs for Low Level Radioactive Waste Management (LLRWM facility concepts) for the federal government. This involved as a senior hydrogeologist and project manager for in Port Hope for a hydrogeological assessment in support of potential siting of a deep cavern for disposal of low-level radioactive waste in limestone bedrock beneath or adjacent to Lake Ontario, involving the drilling, geophysical logging, and packer testing of a deep geological borehole. Sean was the senior hydrogeologist and project manager for a hydrogeological assessment for the federal government at the Chalk River nuclear laboratory for the potential siting of a deep cavern disposal facility for disposal of low-level radioactive waste which involved geological mapping, identification of fault zones and fracturing and the drilling, geophysical logging, hydrogeophysical logging and packer testing of a deep angled borehole drilled through a fault zone. He also conducted a geological terrain analysis for siting of nuclear waste in northern Ontario. He also acted as an executive client sponsor for the Bruce Nuclear and OPG nuclear sites.

Sean acted as the senior hydrogeologist and project manager for numerous proposed aggregate, landfill and where he conducted hydrogeological investigations extended periods, engaged in public consultation and provided expert witness testimony at an OMB and EA hearings. He has been involved in extensive contaminated site investigations including legal disputes. He was the senior hydrogeologist and project manager for the extensive Adams Mine landfill project, which involved the successful permitting of a 20 million tonne hydraulic containment engineered landfill facility, within a 200 m deep former open pit iron mine in low permeability bedrock, following hydrogeological investigations collected over a 10-year period. He served as an expert witness at the Environmental Assessment (EA) and OMB hearings for successful approval of the landfill facility.

He also was the senior hydrogeologist and project manager for large scale provincially funded municipal groundwater studies including for the City of Kawartha Lakes and the City of Stratford as well as extensive work in contaminated site assessments.

EDUCATION

PhD, Osgoode Hall Law School, York University	2013
LLM, Osgoode Hall Law School, York University	2005
MBA, Athabasca University	2001
M.Sc. Earth Sciences, Brock University	1997
H.B.Sc. Geological Sciences (Honours), University of Toronto	1985

AWARDS

Master's Thesis Award, Ontario Petroleum Institute (OPI)	1997

PROFESSIONAL ASSOCIATIONS

Professional Geoscientist, Ontario,	P.Geo.
Project Management Professional	PMP

CAREER

Senior Hydrogeologist and Senior Principal/Fellow, WSP	2022 – Present
Senior Hydrogeologist and Principal, Golder Associated Ltd., Ontario (WSP Acquisition)	1987 – 2022
Hydrogeologist then Senior Hydrogeologist, Golder Associated Ltd., Ontario (WSP Acquisition)	1987 – Present
Managing Principal, Vice President, Canada	2005 – 2014
Geologist and Hydrogeologist Regina Associates Ltd., Kingston, Ontario	1983 – 1987

PROFESSIONAL EXPERIENCE

Nuclear

- Bruce Power New Build, Kincardine, Ontario (2022/23): Hydrogeologist. Sean is currently the senior hydrogeologist and geologist and lead for the ongoing hydrogeological assessment of the new build at Bruce Nuclear. This includes a hydrogeological assessment based on existing information and a field investigation based on a gap analysis of existing data that includes borehole drilling, monitoring well installations, hydraulic conductivity sampling, groundwater sampling and data analysis and reporting. He is also responsible for leading a hazard assessment that includes a senior impact assessment including retaining outside experts in the field. Client: Bruce Nuclear
- Hydrogeological Investigation for LLRWM, Port Hope, Ontario: Hydrogeologist and project manager for a hydrogeological assessment at Port Hope for the low level radioactive (LLRWM) facility concepts as part of regulatory approvals for the Canadian federal government for the Siting Task Force Secretariat (STFS). This involved the potential siting of a deep cavern for disposal of low-level radioactive waste in limestone bedrock beneath or adjacent to Lake Ontario, involving the drilling, geophysical logging, and packer testing of a deep geological borehole to assess the subsurface hydrogeological conditions at the site. Client: Federal Government - STFS (LLRWM).
- Hydrogeological Investigation for LLRWM, Chalk River Ontario: Senior hydrogeologist and project manager for a hydrogeological assessment for the federal government, for the Siting Task Force Secretariat (STFS), at the Chalk River nuclear laboratory for the potential siting of a deep cavern disposal facility for disposal of low-level radioactive waste which involved geological mapping, identification of fault zones and fracturing and the drilling, geophysical logging, hydrogeophysical borehole logging and packer testing of a deep angled borehole drilled through a fault zone. Conducted groundwater quality using a flow through cell. The result of the

work program were used to assess the suitability of the site for disposal of low level radioactive waste. Client: Federal Government -STFS (LLRWM).

- Nuclear Waste Site Selection Northern Ontario: Geologist. Geologist for assessment of geological and terrain analysis of areas in northern Ontario as part of a project to identify potential suitable candidate sites for siting of a low level radioactive waste disposal facility. Client: Federal Government.

Aggregate Industry

- Aggregate Resource Evaluation, Regional Municipality of Peel, Ontario: Project Manager and geologist for evaluation of sand and gravel and bedrock resources in the Regional Municipality of Peel, Ontario for the provincial Ministry of Municipal Affairs and Housing (MMAH). The project was carried out as part of the development of the official plan for the Region. Client: Regional Municipality of Peel.
- Aggregate Resource Inventory Paper, Regional Municipality of Peel, Ontario: Technical advisor for ARIP (Aggregate Resource Inventory Paper) report for the Regional Municipality of Peel. The project involves and evaluation of shale and gravel, limestone and shale resources in the Region and was submitted to the Ontario Geological Survey for publication as a government document ARIP Paper. Client: Regional Municipality of Peel.
- Navan Quarry, Navan, Ontario: Project Manager and geologist for evaluation of sand and gravel and bedrock resources in the Regional Municipality of Peel, Ontario for the provincial Ministry of Municipal Affairs and Housing (MMAH). The project was carried out as part of the development of the official plan for the Region.
- Brockville Quarry, Brockville, Ontario: Project Manager and hydrogeologist for hydrogeological evaluation of the Permanent Lafarge Brockville Quarry. The results of the evaluation were used to negotiate the liability of the quarry to alleged water well interference associated with quarry expansion with the Ontario Ministry of the Environment.
- Dufferin Aggregates, Ontario: Project Director and senior hydrogeologist for numerous aggregate projects at quarries and sand and gravel pits within Ontario including resource evaluations, hydrogeological investigations and environmental assessments.
- Due Diligence Studies, Southern Ontario: Project Manager and senior hydrogeologist for due diligence studies as part of the potential purchase of aggregate companies and operating pits and quarries in Ontario.
- Site Selection Studies, Southern Ontario: Project Director for site selection studies for development of quarries and sand and gravel operations in Ontario.
- North Quarry, Flamborough, Ontario: Role on Project Director for hydrogeological program at the Lafarge (formerly Redland) Quarry Operations in Flamborough, Ontario, to meet the regulatory requirements of the Ontario Ministry of the Environment. Client: Lafarge Canada Inc.
- Proposed Halminen Quarry, Buckhorn, Ontario: Project Manager for a private application for a license for a proposed limestone quarry near Buckhorn, Ontario. The project involved management of multi-disciplinary project team public meetings, and application for a Class A licence under the Aggregate Resources Act.
- Bowmanville, Ontario: Project Director for the development of a limestone/dolostone mine under Lake Ontario. The work programs involve drilling

and testing of a 275m deep borehole under the lake, development of an underground mine plan, preparation of an EA document for regulatory approvals and public participation programs. Client: Votorantim Cimentos.

- Milton Limestone Quarry Peer Review, Milton, Ontario: Project Director for the peer review of the hydrogeological and adaptive management plan report for the proposed Dufferin Aggregates Milton Quarry expansion. The work program involved meetings with the hydrogeological consultant and legal counsel and attendance at Ontario Municipal Board hearings.
- SAROS Study, Greater Golder Horseshoe, Ontario: Evaluation of supply and demand of aggregate resources in the Greater Golden Horseshoe for the MMNR (Ministry of Natural Resources and Forestry). The project includes resource estimates for 25 quarries and 120 pits and unlicensed sand and gravel resources in the study area.. Ministry of Natural Resources and Forestry.
- Nelson Quarry Expansion, Burlington, Ontario (year): Project Director for the proposed Nelson Quarry extension including extensive borehole drilling and monitoring well installations, water quality sampling, a surface water program, groundwater flow modeling, impact assessments, preparation of an Adaptive Management Plan (AMP), reporting and acting as an expert witness at an Ontario Municipal Board hearing.
- Lafarge South Quarry Expansion, Dundas, Ontario: Project Director for a hydrogeological and hydrological work programs in support of a license application for the expansion of the Lafarge South Quarry near Dundas, Ontario (ongoing). The work program involves borehole drilling and monitoring well installations, geophysical borehole logging, water quality sampling and analyses, hydrological analyses of streams and wetlands, a karst assessment, a water well survey, geological and hydrogeological interpretation, groundwater flow modeling, agency interaction and attendance at public meetings. Client: Lafarge Canada Inc.
- Lafarge Fonthill Pit PTTW Renewal, Fonthill, Ontario: Project Director for a hydrogeological work program in support of a Permit to Take Water (PTTW) application for the Lafarge, The work program included interpretation of pumping wells records, evaluation of drawdown in water wells related to pumping, water quality analyses and preparation and submission of a report in support of the permit application. Client: Lafarge Canada Inc.
- Lafarge North Quarry Expansion, Dundas, Ontario: Project Director for a hydrogeological work program conducted in support of a license application for the expansion of the Lafarge North Quarry. The work program involved borehole drilling and monitoring well installations, pumping tests, groundwater flow modelling, a water well survey, an impact assessment of potential effects on water wells and an adjacent provincially significant wetland, agency interaction and preparation of a report submitted in support of the license application. The application was approved with an Ontario Municipal Board hearing. Client: Lafarge Canada Inc.
- Lafarge PTTW Monitoring Programs, Ontario: Project Director for hydrogeological monitoring programs for a portfolio of more than 50 pits and quarries in Ontario. The programs involved water level and water quality monitoring, evaluation of pumping records, effects assessments and preparation and submission of monitoring reports for compliance with the permits. Client: Lafarge Canada Inc.
- RW Tomlinson Quarry License Application, Brechin, Ontario: Project Co-director for the hydrogeological work program for a hydrogeological work program

performed in support of a license application for a dolostone quarry in the Carden Plain. The work program involved borehole drilling and monitoring well installation, geophysical borehole logging, packer testing, well response testing, pump testing, water quality sampling, groundwater flow monitoring, an impact assessment including potential effects on surrounding water wells and an adjacent wetland, development of a monitoring program preparation of a report in support of the application and agency interaction. Client: R. W Tomlinson Limited.

- Proposed Lafarge Glen Morris Pit, Ontario: Project Director and senior hydrogeologist for the hydrogeological work program in support of a license application for the proposed Glen Morris Pit. The work program included borehole drilling, monitoring well installations, groundwater level monitoring and the provision of data and preparation of a hydrogeological report. Client: Lafarge Canada Inc.
- Lafarge Wellington Quarry PTTW and ECA Renewal, Ontario: Project Director and senior hydrogeologist for the Lafarge Wellington Quarry Renewal. The field program involved borehole drilling, packer testing, monitoring well installations, groundwater level monitoring, a field pumping test, development of a water budget and groundwater quality sampling. A hydrogeological impact assessment was developed to assess the potential impacts of quarry groundwater level drawdown related to quarry dewatering activities on surrounding private water wells and municipal wells. The work program included the modification of the regional source water protection to incorporate site data to assess the potential affects on the Guelph municipal wells. Client: Lafarge Canada Inc.
- Lafarge Regan Resource Drilling, Ontario: Role on Project. Project Manager and senior geoscientist for resource drilling at the Lafarge Regan site using some drilling techniques. The results of the work program were provided to Lafarge for their resource assessment. Client: Lafarge Canada Inc.
- Lafarge Hagersville Quarry, Hagersville, Ontario: Senior Hydrogeologist for the assessment of quarry dewatering and pumping for the Lafarge Hagersville Quarry as part of the PTTW monitoring program. Client: Lafarge Canada Inc.
- Arbour Farms License Application, Ontario: Senior Hydrogeologist for the Arbour Farms license application for a pit below water. The work program included borehole drilling, installation of monitoring wells, groundwater level monitoring and assessment of potential affects on an adjacent water course. Three-dimensional groundwater flow and heat transport modeling was completed to assess the potential thermal impacts on the surrounding surface water courses. Client: Arbour Farms.
- Port Colborne Quarry Extension, Port Colborne, Ontario: Project Director for a multi-disciplinary work program for a license application for an extension of the Port Colborne Quarry. The work program involved hydrogeological, hydrological, blasting, noise, air, natural environment, planning, agricultural and archaeological studies and a resource estimate. Senior Hydrogeologist for the hydrogeological work program that involved borehole drilling, monitoring well installations, groundwater quality sampling and analysis, an impact assessment and a monitoring and response program for potential impacts on surrounding water wells. Client: Rankin Construction Inc.
- Lafarge Goodwood Pit Extension, Goodwood, Ontario: Project Director and senior hydrogeologist for a license application for the Lafarge Goodwood Pit extension, for a Category 1 Class EA pit below water. The objective of the work program was to characterize the existing hydrogeological and hydrological conditions in the vicinity

of the site, including the depth and elevation of the water table and assess potential affects of the operational and rehabilitation scenarios. The work program involved borehole drilling, monitoring well installations, groundwater level monitoring, development of a water budget and a hydrogeological impact assessment. Client: Lafarge Canada Inc.

- Lafarge Woodstock Quarry Expansion, Woodstock, Ontario: Project Director and senior hydrogeologist for the hydrogeological investigation of the Woodstock quarry for support of a license amendment. The field program involved borehole drilling, packer testing, monitoring well installations, groundwater quality sampling and analysis, a field water well survey and development of a water budget. An impact assessment was conducted to assess the potential affect of quarry related groundwater level drawdown on surrounding water wells and surface water courses. Client: Lafarge Canada Inc.
- CRH Resource Evaluation and Due Diligence, Ontario: Project Manager and senior geoscientist for a resource evaluation of a property near Orangeville, Ontario for potential acquisition for quarry development. The work program included borehole drilling, geological logging of the rock core, monitoring well installations to determine the depth of the water table, aggregate quality testing and reporting.
- Limestone and Sandstone Resource Evaluation and Due Diligence, Ontario: Project Director and senior hydrogeologist for a resource evaluation for a property developer for potential acquisition of an existing quarry near Mississauga. The work program involved borehole drilling, core logging, aggregate quality testing and reporting. Client: Regional Municipality of Peel.
- Stouffville Resource Drilling, Stouffville, Ontario: Project Manager and senior hydrogeologist for the resource drilling at Lafarge Stouffville Quarry. The drilling was conducted using a sonic drill rig with continuous core sampling. The results were provided to the Lafarge geologist for the resource assessment. Client: Lafarge Canada Inc.
- Lakeridge Resource Drilling, Ontario: Project Manager and senior geoscientist for the resource drilling at the Lafarge Lakeridge site. The drilling was conducted using sonic coring and the results provided to the Lafarge geologist for development of a resource assessment. Client: Lafarge Canada Inc.
- Votorantim Thomas Quarry License Application, Ontario: Senior hydrogeologist for the hydrogeological component of the Votorantim Thomas Quarry Extension license application. The work program involved borehole drilling, packer testing, geophysical borehole logging monitoring well installations and groundwater quality sampling and analysis. Three-dimensional groundwater flow monitoring was conducted to assessment the potential hydrogeological impacts of the quarry. Client: Votorantim Cimentos.
- Lafarge Pinkney Pit #3, Ontario: Senior Hydrogeologist for the hydrogeological work program for the Lafarge Pinkney Pit #3 license application. The work program involved borehole drilling, monitoring well installations and a hydrogeological impact assessment. Client: Lafarge Canada Inc.
- Lafarge Mosport Resource Drilling, Ontario: Project Manager and senior geoscientist for the sonic borehole drilling at the Lafarge Mosport Pit. The results of the resource drilling were provided to the Lafarge geologist as part of the site resource assessment. Client: Lafarge Canada Inc.

- Lafarge Goodwood Resource Drilling, Ontario: Project Manager and senior geoscientist for sonic borehole drilling of the resource near the Lafarge Goodwood Pit. The results of the drilling were provided to the Lafarge geologist for a resource assessment. Client: Lafarge Canada Inc.
- APAO - Water Consumption Study, Ontario: Project Director for a study for the APAO to determine the consumption of water associated with pits and quarries. Client: Aggregate Producers Association of Ontario.
- Lafarge Sunningdale Pit Monitoring Program, Ontario: Senior Hydrogeologist for the Lafarge Sunningdale Pit Monitoring Program. The work program includes hydrogeological monitoring, an assessment of potential impacts and preparation of an annual monitoring report. Client: Lafarge Canada Inc.
- Votorantim Resource Assessment, Ontario: Project Manager and senior geoscientist for a resource assessment at a Votorantim Quarry in central Ontario. The work program involved borehole drilling and borehole geophysics were used to identify and correlate the geological formations and members at the site. Client: Votorantim Cimentos.
- Cox Construction Monitoring Well Network, Wellington County, Ontario: Role on Project. Project Manager and senior hydrogeologist for borehole drilling and monitoring well installations at a property in Wellington County to provide baseline date for potential future licensing as a quarry. The wells were installed in the thick sequence of Amabel Formation at this locates. Groundwater level monitoring was performed to determine the depth to water table. Client: Wellington County.
- Cox Construction Resource Evaluation and Due Diligence, Ontario: Project Director for a drilling program to evaluate to the limestone resource for potential acquisition of a property for development. The work program involved borehole drilling, geological logging of the rock core, monitoring well installations, aggregate quality testing and reporting.

Waste Management

- Adams Mine, Kirkland Lake, Ontario: Project Hydrogeologist and Project Manager for the hydrogeological assessment of the Adams Mine near Kirkland Lake, Ontario over a five-year period as part of the proposed development of 20 million tonne engineered landfill facility for solid non-hazardous waste. The facility will receive waste from the Greater Toronto Area (GTA) via a rail line system. The landfill facility incorporates a hydraulic containment design, which prevents outward migration of contaminants from the landfill, which reduces environmental impacts and long-term operating costs. Provided expert witness testimony in an environmental assessment (EA) hearing. Client: Adams Mine.
- Brow Landfill, Dundas, Ontario: Project Hydrogeologist then Project Manager for hydrogeological assessment for landfill expansion of the existing Redland Quarries Inc. (formerly Steetley Quarry Products Ltd.) solid industrial waste Brow Landfill in Flamborough, Ontario. Subsequent work included ongoing groundwater and surface water quality monitoring and preparation monitoring reports submitted to the MOE, followed by development of a closure plan and an ongoing compliance monitoring program.
- South Quarry Landfill, Flamborough, Ontario: Project Hydrogeologist for hydrogeological assessment of the proposed Redland Quarries Inc. (formerly Steetley Quarry Products Ltd.) South Quarry in Flamborough, Ontario for the proposed development of an engineered landfill facility. Participated in

environmental assessment (EA) hearings and assisted with the preparation of final arguments with legal counsel. Client: Redland Quarries Inc.

- Siting Task Force Secretariat, Chalk River, Ontario: Project Hydrogeologist, then Project Manager for geological and hydrogeological characterizations of the Chalk River Nuclear laboratories property, near Chalk River, Ontario for siting of a proposed facility for the disposal of low-level nuclear waste for the federal Siting Task Force Secretariat (STFS).
- Siting Task Force Secretariat, Port Hope, Ontario: Project Hydrogeologist then Project Manager for geological and hydrogeological characterization of the Lakeshore site in Port Hope, Ontario, for the federal Siting Task Force Secretariat (STFS). The work was carried out as part of the feasibility level I study for dispose of low-level waste in engineered caverns beneath Lake Ontario and the Cameco Uranium fuel processing facility in Port Hope.
- Interim Waste Authority, Regional Municipality of Peel, Ontario: Project Hydrogeologist for geological and hydrogeological characterization comparative evaluation of five short-listed sites for siting of an engineered landfill facility as part of the provincial Interim Waste Authority (IWA) landfill site selection process for the Region of Peel. Client: Regional Municipality of Peel.
- Guelph-Wellington County WMMP, Wellington County, Ontario: Project Hydrogeologist for geological and hydrogeological characterization of five candidate sites and identification of a preferred site in Wellington County for siting of an engineered municipal landfill facility, as part of the joint City of Guelph - County of Wellington Waste Management Master Plan (WMMP).
- Model City Landfill, Lewiston, NY: Project Hydrogeologist for hydrogeological investigation of the Model City hazardous waste landfill, near Lewiston, New York, carried out as part of landfill expansion.
- Welland-Wainfleet WWMP, Townships of Welland and Wainfleet, Ontario: Project Hydrogeologist for the identification of preferred sites for development of a municipal landfill facility, as part of the Welland-Wainfleet Waste Management Master Plan (WMMP).
- Brock South Landfill, Pickering, Ontario: Role on Project. Project Hydrogeologist for assessment of the proposed Brock South Landfill near Pickering, Ontario, to assess the suitability of the site for development of an engineered municipal landfill facility for Metropolitan Toronto.
- Redland Queenston Quarry, Queenston, Ontario: Project Hydrogeologist for hydrogeological assessment of the Redland Quarries Inc., Queenston Quarry to determine the suitability of the site for disposal of waste rock saline shale, from the construction of the proposed diversion tunnels of the Sir Adam Beck III hydroelectric generating facility in Niagara Falls, Ontario.
- Fly Ash Disposal Facility, , Ontario: Project Hydrogeologist for hydrogeological investigations at four quarries located near Hagersville, Cayuga, Smithville and Milton to determine their suitability for development an engineered landfill for disposal of fly ash from the Ontario Hydro Lakeview Power Generating Station
- Mohawk Street Landfill, Brantford, Ontario: Project Hydrogeologist for assessment of groundwater and surface water quality impacts at the municipal Mohawk Street Landfill in Brantford, Ontario.

- Vale Industrial Landfill, Port Colborne, Ontario: Project director for the preparation of an annual report for the groundwater monitoring program for an industrial waste landfill at a former nickel refinery. The work program included interpretation of groundwater flow directions and water quality trends, evaluation of the extent of the leachate plume, and an impact assessment.
- Vale Industrial Refinery Landfill Monitoring, Port Colborne, Ontario: Project Director and senior hydrogeologist for an evaluation of the effectiveness of the purge well system at a former nickel refinery and the development of mitigation and rehabilitation measures for well clogging. The work program involved step drawdown pumping tests, longer term pumping tests, hydraulic analysis of pumping test data, assessment of the decline of well efficiency due to scaling and bio fouling and the development of a work program for well rehabilitation and maintenance including acidification.
- Project Title, City, Ontario: Role on Project. Brief project description.
- Municipal Landfill Annual Monitoring Programs, Niagara Region, Ontario: Project Director for the annual monitoring program for 8 landfills in bedrock and escarpment settings in Niagara Region. The work program involves field water quality sampling, groundwater level monitoring, and provision of progress and annual reports.
- Proposed Walker Ingersoll Landfill, Ontario: Senior Hydrogeologist for the hydrogeological investigation for the proposed Walker Landfill near Ingersoll, Ontario. The field program involved borehole drilling, monitoring well installations, packer testing, geophysical borehole logging, downhole flow profiling, groundwater quality sampling and analysis, a karst study and a water well survey. Three-dimensional groundwater flow modeling was conducted to assess the potential impacts of the landfill.

Shale Industry

- Mississauga, Ontario: Role on Project. Specialist for assessment of geological controls upon shale quality at the Canada Brick Britannia Road quarry site. The work was carried out in conjunction with quality control estimate of shale reservoir on the property. Client: Canada Brick.
- Halton Region, Ontario: Project Manager for a hydrogeological work program in support on an application for a license for the Hanson Brick Tremaine Quarry in Halton Region, Ontario. Client: Canada Brick.
- Halton and Peel Region, Ontario: Project Director for a hydrogeological and surface water program in support of a license application for a proposed shale quarry for a brick manufacturer. The work programs involved borehole drilling and monitoring well installations, surface water flow monitoring, water quality sampling, groundwater flow modelling and preparation of an Adaptive Management Plan (AMP). Client: Brampton Brick Limited.
- Halton Region, Ontario: Project Director for the assessment of the potential gas migration from a landfill to an adjacent brick manufacturing facility containing a brick kiln. The program identified potential risks and a monitoring and response program. Client: Hanson Brick Limited.

Mining

- Elliot Lake, Ontario: Project Hydrogeologist for assessment of the Rio Algom Stanleigh Mine near Elliot Lake, Ontario. The project included development of a three-dimensional flow model of a low-level radioactive waste tailings facility in

Precambrian bedrock of the Canadian Shield. The model was used to develop estimates of seepage rates from the facility and was submitted to the Atomic Energy Control Board (AECB) as part of the regulatory approvals process. Client: Stanleigh Mine.

- Labrador: Technical specialist for hydrogeological modelling at the Voisey's Bay Mine site involving development of three-dimensional groundwater flow models of a proposed tailings basin, mine waste rock disposal facility, and an open pit mine at the Voisey's Bay Mine Site in Labrador. The modelling was carried out for the Voisey's Bay Nickel Company (VBNC) as part of the hydrogeological assessment of the mine. The work was subject to regulatory review and presented as evidence at an environmental assessment hearing. Client: Voisey's Bay Mine.
- Balry, Russia: Project Hydrogeologist for an Environmental Impact Assessment (EIA) as part of a feasibility study for mine expansion. The hydrogeological component included evaluation of potential for water quality impacts for an open pit mine and tailings basin, reduction of flow in stream and interference with the municipal water well supply. Client: Baley Gold Mine.
- Kamchatka, Russia: Project Hydrogeologist of the proposed Asacha Gold Mine in northeastern Russia. The assessment focused upon chemical water quality and streamflow impacts associated dewatering of an underground mine and construction of a tailings basin. The results of the assessment formed part of the mine feasibility study. Client: Asacha Gold Mine.
- Timmins Mine Water Study, Timmins, Ontario: Project Hydrogeologist for assessment of flooding of an extensive array of underground mine working beneath the City of Timmins. The assessment included evaluation of the potential impacts arising from the discharge of water from the flooded mine workings at surface within the city. Client: Timmins Mine.
- Saskatchewan, Manitoba: Project Hydrogeologist for assessment of potential groundwater inflows into proposed shaft in northern Saskatchewan for the Cigar Lake Mining Corporation (CLMC). The results of the assessment were used as the basis for the engineering design at the shaft. Client: Cigar Lake Mining Corporation.
- Elliot Lake, Ontario: Project Hydrogeologist for an assessment of low-level nuclear waste tailings basin at the Denison Mines near Elliot Lake, Ontario. The hydrogeology study included assessment of seepage of uranium-impacted groundwater from the basin. Client: Denison Mines.
- Kirkland Lake, Ontario: Project Hydrogeologist for hydrogeological assessment at the Lac Minerals MaCassa Mine tailing basins in Precambrian bedrock near Kirkland Lake, Ontario. The work was carried out to evaluate the potential impacts during operation and following decommissioning of the facility. Client: MaCassa Mines.

Contaminated Industrial Sites

- Nobel, Ontario: Hydrogeological assessment of groundwater and surface water quality at the former ICI explosives and war productions plant near Parry Sound, Ontario for ICI Canada. The program included assessment of groundwater and surface water quality impacts and removal of buried underground fuel storage tanks. The results of the investigations were submitted to the Ontario Ministry of the Environment as part of the site decommissioning.
- North York, Ontario: Dewatering of a groundwater collection gallery and discharge of the contaminated (chlorinated solvent) wastewater to the municipal sewer system

(under special conditions), at the Ford Motor Company Plant in North York, Ontario. Client: Ford Motor Company.

- North York, Ontario: Dewatering of a groundwater collection gallery and discharge of the contaminated (chlorinated solvent) wastewater to the municipal sewer system (under special conditions), at the Ford Motor Company Plant in North York, Ontario. Client: Shell Oil.
- Cole Harbour, NS: Excavation of underground storage tank (fuel oil) at the Beaver Lumber store at Cole Harbour, Nova Scotia. The results of the investigation favoured Beaver Lumber, by indicating that damage to the store was due to lack of delivery of the fuel supplier rather than leakage from the site fuel storage tank. Client: Beaver Lumber.
- Oakville, Ontario: Hydrogeological impact assessment of cadmium concentrations in groundwater at the ICI Surfactants (formerly Atkemix) site in Oakville, Ontario. The results of the monitoring were submitted to the Ministry of Environment and Energy for regulatory purposes. Client: ICI Surfactants.
- Batawa, Ontario: Participation in the hydrogeological investigation of chlorinated solvent contamination of a bedrock limestone aquifer at the Bata Footwear plant site in Batawa, Ontario. The results of the hydrogeological impact assessment were submitted to the Ministry of Environment and Energy and used during subsequent legal proceedings to determine financial liability of Bata Footwear for the groundwater contamination. Client: Bata Footwear.
- Niagara Falls, Ontario: Project Director and senior hydrogeologist for the annual operational and monitoring programs for a hydrogeological work program involving groundwater contaminated with chlorinated solvents at the Niagara Recycling Centre related to prior industrial land use. The work program involved operation of the groundwater injection remediation system, assessment of subsurface contamination and preparation of annual monitoring reports. Client: Niagara Recycling Centre.
- Rankin Construction Fill Management Plan, Port Colborne, Ontario: Project Director and senior geoscientist for the development of a fill management plan for Pit 1 at the Rankin Construction Port Colborne Quarry. The program included a plan to take excess fill from the area to fill Pit 1. This included a sampling and reporting program to meet MECP requirements. Client: Rankin Construction.

Oil & Gas

- Assessment of Natural Gas Storage Potential, Lake Erie, Ontario: Project Manager for an assessment of the potential for natural gas storage on Crown Lands beneath Lake Erie. The study involved the assessment of natural gas reservoirs to evaluate their suitability for use as gas storage facilities. Estimated available storage volumes were provided for each of the reservoirs.
- Assessment of Natural Gas Storage Potential, Southwestern Ontario, Ontario: Project Manager for an evaluation of the hydrocarbon resources in Southwestern Ontario for the Petroleum Resources Centre of the Ministry of Natural Resources. The study included the interpretation and mapping of pool boundaries for major pools, calculations of in place and recoverable reserves, tabulation of reservoir characteristics, and estimation of potential hydrocarbon resources in the Ordovician strata of southern Ontario.

Municipal Groundwater Studies

- Groundwater Study for the County of Victoria, Ontario: Project Director and senior hydrogeologist for a large-scale groundwater study for the County of Victoria with funding from the Provincial Water Protection Plan (PWPP). The work program involved a groundwater resource assessment, evaluation of existing groundwater usage, contamination assessment, development of management options and protection strategies, and an economic evaluation.
- Groundwater Study for the City of Stratford, Ontario: Project Director and senior hydrogeologist for a Groundwater Study for the City of Stratford involving an assessment of groundwater resources, source of contamination, pump testing of deep wells in limestone bedrock, and development of groundwater management options and protection strategies.
- Simcoe and South Simcoe Groundwater Studies, Ontario: Provided specialist hydrogeological services for both the North Simcoe Groundwater Study and South Simcoe Groundwater Study. The work program involved a characterization of the hydrogeology of the study areas and numerical groundwater modelling of Well Head Protection Areas for municipal wells (WHPAs).

KARST

- Nelson Quarry Extension, Ontario: Project Director and Senior Hydrogeologist for karst assessment of the proposed Nelson Quarry extension that involved mapping of the Amabel Formation along the exposed cliff faces of the Mount Nemo outlier, identification of karstic springs in the Medad Valley and associated water courses, mapping of karst features along more than 1 km of exposed quarry faces. Examination of surface karst features including sinkholes and internal drainage were mapped in the area of the quarry. An ERI (Electrical Resistivity Imaging) survey was conducted over a linear distance to identify potential anomalies that could represent karstic features. Boreholes were drilled into the karstic features to evaluate karstic conditions. The boreholes were video logged along the length of the hole to evaluate karstic features such as solution enlarged fractures and voids. The flow in the boreholes were pumped and logged during an impeller flow meter to assess inflow into boreholes from potential karstic features. An array of 8 wells and a pumping well were drilled to conduct a tracer test using fluorescein dye. The dye was injected into the wells and the travel time and dye concentrations were recorded to evaluate karstic flow paths and velocities. The results were incorporated in a report submitted as part of the regulatory approvals process and presented and defended at an Ontario Municipal Board hearing.
- Proposed Redland Quarries Landfill, Ontario: Project Hydrogeologist for a karst study as part of a geological and hydrogeological evaluations of a proposed hydraulic containment engineered landfill facility in a quarry near Dundas, Ontario. The karst study involved examination and evaluation of karstic features in the vicinity of the quarry including solution-enhanced weathering and extensive network of surficial dolostone plain, and examination of epi-karst on more than 1 km of quarry faces including solution enlarged and materialized vertical joints. The results of groundwater level monitoring results were evaluated for patterns indicative of presence of karst including rapid rises in groundwater levels (‘spiking’). Pump tests were analysed to evaluate the drawdown and recovery responses characteristic of karst.
- Proposed Dundas Quarry Extension, Ontario: Project Director and Senior Hydrogeologist for a karst assessment as part of a hydrogeological work program for

the approval of an application for a large dolostone quarry near Dundas, Ontario. The work program involved an ERI surface geophysical survey along more than 500 m of line to test for potential karstic anomalies. Boreholes were drilled in the areas of identified anomalies to evaluate the potential presence of karst. The faces of the quarries were also examined for layers of karstic groundwater inflow. The results of the karst study have been peer reviewed and are currently being used in support of the license application for quarry expansion.

- Karst Remediation, Hamilton, Ontario: Role on Project. Senior Hydrogeologist for a karst assessment of a remediated industry site in the area of the Eramosa Karst Conservation Area in Hamilton, Ontario. The work program involved a review of literature on karst in the area. An inspection of the karstic features includes sinkholes, internal drainage and inferred subsurface karstic flow pathways was undertaken in areas around the site. A report in support of a property transaction was provided to regulatory authorities and agencies.
- Brow Landfill Monitoring Program, Ontario: Project Hydrogeologist for an assessment of leachate seepage from an industrial solid waste landfill along karstic flow pathways including epi-karst, solution weathered vertical joints and horizontal fracture networks. The assessment involved monitoring of the flow rates from leachate springs and water quality of springs.
- Hydrocarbon Reserve Evaluation, Southwestern Ontario, Ontario: Project Director and Senior Geologist/Hydrogeologist for the estimation of hydrocarbon reserves in Southern Ontario for the Petroleum Resource Centre of Ontario Ministry of Natural Resources. The work program involved extensive analysis of karstic reservoirs formed and dolomitization from solution weathering and collapse along vertical joints and horizontal sub horizontal fracture networks. Prepared a report summarizing the study and provided to the MNR as a commercial publication. Land Development and Infrastructure
- Peer Review, Ontario: Peer review of the hydrogeological work program for a proposed residential development in Palgrave for the Town of Caledon planning department. The work program involved review of hydrogeological reports, discussions with the Town and preparation of a peer review reports with recommendations. Client: Town of Caledon.
- Peer Review, Caledon, Ontario: Peer review of the hydrogeological and geotechnical work program for a proposed residential development in Beaverhall for the Town of Caledon planning department. The work program involved review of hydrogeological reports, discussions with the Town and preparation of a peer review reports with recommendations. Client: Town of Caledon.
- Niagara-on-the-Lake, Ontario: Hydrogeological assessment of the potential impacts associated with the development of an infrastructure for a zipline facility along the Niagara river at Thompsons Point. The work program involved an evaluation of the potential for reduction of groundwater seepage along the Niagara Gorge and related environmental effects. A report was prepared that was submitted to agencies as part of the regulatory approvals process. Client: Niacon Construction.
- Niagara Falls, Ontario: Senior hydrogeologist for the hydrogeological assessment of the existing conditions and potential impacts associated with the development of a condominium adjacent to the Niagara River in Niagara Falls. The work program involved borehole drilling, monitoring wells installation, groundwater level monitoring and assessment of groundwater levels and flow directions. The results of

the work program were incorporated into a geotechnical and hydrogeological report. Client: Time Developments.

- \Niagara Falls, Ontario: Phase 1 and Phase 2 Environmental Site Assessments (ESA) for regulatory approval for condominium development on River Road in Niagara Falls, Ontario. The work program involved test pitting and surface sampling as well as collection and analysis of soil and water samples and evaluation of potential soil and water contamination. Client: Time Developments.
- Oakville, Ontario: Hydrogeological assessment of the excavation and construction of a water pumping station in till and bedrock adjacent to a surface water course. The work program involved borehole drilling, monitoring well installations, hydraulic conductivity testing and a hydrogeological assessment of impacts on surrounding private wells associated with construction dewatering. Client: AECOM.
- Hydrogeological assessment in support of approval for a proposed residential development involving borehole drilling, monitoring well installations, hydraulic conductivity testing, groundwater level monitoring, determination of groundwater levels and flow directions and a hydrogeological impact assessment involving a water balance to evaluate reduction in infiltration and potential interference with surrounding water wells and effects on an adjacent provincially significant wetland. Participated in meetings with the TRCA as part of the approvals process. A report was prepared in support of the approvals process. Client: Geranium Homes Woodview Development.
- Hydrogeological assessment in support of approval for a proposed residential development. The work program involved borehole drilling, monitoring well installations, groundwater level monitoring, development of a water balance and a hydrogeological impact assessment. A report was prepared in support of the application. Client: Geranium Homes Altona Development.

KEVIN M. MACKENZIE, MSc, PEng

Senior Business Practice Leader & Water Resources Engineer

Areas of practice

Hydrology, Hydraulics

Water Resources Engineering

Languages

English - Fluent

PROFILE

Mr. MacKenzie joined Golder Associates in 1997. Principal responsibilities include hydrologic and hydraulic modelling, design of hydraulic structures and erosion control measures and providing technical water resources support for a wide variety of environmental studies. Project experience includes unsteady hydraulic modelling of mixed sub and supercritical flood waves, prediction of flood flows from extreme design storms, flow monitoring and rating curve development, regional hydrological analyses, water budgets and balances, water management planning and consideration of fluvial geomorphology and ecological principles in design.

Water resources work has been completed for clients in the Power Generation, Power Transmission, Aggregate and Mining Sectors as well as Regional Government Agencies and Environment Canada.

Prior to joining Golder Associates, Mr. MacKenzie was involved in water resources research for four years, as part of his graduate studies, then as a research associate at the University of Guelph. Mr. MacKenzie has an excellent understanding of a wide variety of hydrology, hydraulics, soil erosion and fluvial geomorphology disciplines.

EDUCATION

PhD Candidate Water Resource Engineering, University of Guelph,	In Progress
MSc (Eng.) Water Resource Engineering, University of Guelph	1995
BSc (Eng.) Water Resource Engineering, University of Guelph Minor: Environmental Engineering	1993

PROFESSIONAL ASSOCIATIONS

Professional Engineers Ontario, since 1999	PEO
Engineers Nova Scotia, since 2018	Engineers NS

CAREER

Senior Principal, Water Resources Engineer, WSP Cambridge, ON	2022 -Present
Principal, Water Resources Engineer, Golder Associates Ltd., Cambridge, ON	1997 – 2021
Research Associate, University of Guelph Guelph, Ontario	1995 - 1996

PROFESSIONAL EXPERIENCE

HYDROLOGY/HYDRAULICS

- Sioux Lookout Flood Mapping and Mitigation Study, Sioux Lookout, Ontario, Canada: Project Director. Reviewed 1D/2D HECRAS and HECHMS modelling of the English River and Pelican Creek to assess the flood hazard areas along the shoreline and propose mitigation measures with Class D cost estimates.
- Moira River Flood Mitigation Alternatives Assessment, Foxboro, Ontario: Reviewed and updated floodplain mapping for the Foxboro area, identified several alternative flood mitigation alternatives ranging from floodways and hydraulic controls to lot level flood proofing. Alternatives were assessed and compared based on triple bottom line scores. Triple bottom line analysis considered detailed economic analysis using regions specific flood damage curves developed by Golder's project partner.
- Atlantic Gold Hydraulic and Geomorphic Channel Assessments, Central Nova Scotia: Senior reviewer and technical advisor for hydraulic and fluvial geomorphic characterization and baseline studies for a mine development northeast of Halifax, Nova Scotia. Tributaries of 15 Mile Stream were inventoried and used as analogues to design channel diversions around proposed open pit mine excavations.
- Low Impact Development Treatment Train Tool (LID-TTT),GTA, Ontario: Team lead and hydrology advisor for development of a software tool for modelling and evaluating water balance and nutrient budgets for development sites. Worked with three large conservation authorities in the GTA, through several phases implementation of the LID-TTT, to progressively add model capability for assessing the benefits of various LIDs to support planning and early stage engineering of urban development sites.
- Garson Mine Water Management and Inundation Study, Sudbury, Ontario: Senior review and technical advice for flood inundation study downstream of the Vale Garson Mine near Sudbury Ontario. The study included an options assessment, development of improved water management operating practices and conceptual design of reservoir retrofits.
- International Falls Dam Rule Curve Cultural Study, Rainy River, Ontario: The effects of a recently updated operating rule curve at the International Falls Dam on water levels in Rainy River and the potential for changed water levels to affect locations of cultural significance are being investigated on behalf of the International Joint Commission on the Great Lakes.
- Credit River Floodline Mapping, Mississauga, Ontario: Golder completed the most recent comprehensive update of the flood risk investigation and floodline mapping for the Credit River between Old Derry Road and Lake Ontario. This reach alternately flows through an entrenched bedrock valley and remnant beach plains adjacent to Lake Ontario in the most urbanised part of Mississauga. Mr. MacKenzie served as project staff on this project.
- Water Quality Forecasting and Infrastructure, Annapolis Basin, Nova Scotia: Golder was part of a project team working with the Atlantic Innovation Fund / Applied Geomatics Research Group to develop a complex water quality forecasting tool for use by the shell fishing industry in the Digby Gut area. Real time weather forecasts were used to drive real time hydrology and database scenario models of runoff, water quality (bacteriological) and Bay of Fundy tidal fluctuations and their effects on contaminant movement in the Digby Gut. Hydrodynamic modelling was used to estimate contaminant movement and exposure of shell fishing areas to contamination. This information was packaged for use by shell fishers in order to

minimize harvests of contaminated shellfish, thereby protecting the resource and minimizing post-harvest dupurification costs. Mr. MacKenzie was the hydrology and hydrometry technical lead for Golder on this project.

- Brookfield Homes – Channel Rehabilitation, Brantford, Ontario: Assisted a channel rehabilitation/stabilization assessment and associated 'field fit' design for Brookfield at a tributary of Fairchild Creek to address debris removal and channel instability - responsible for field investigations and construction supervision/inspections.
- River Diversion Design, Northern Ontario: Technical advisor for baseline channel hydraulics and fluvial geomorphic studies in support of a major mine development project in Northern Ontario to characterize baseline conditions at several stream channels, as well as to advance a conceptual design for a proposed diversion channel.
- Borer's Creek Modelling and Restoration Design, Dundas, Ontario: HEC-RAS modelling and assessment of a failing reach of Borer's Creek that threatened to expose a high-pressure natural gas pipeline. Design of remedial measures for failing banks and restoration of the affected reach. Coordinated regulatory approvals. The project was successfully implemented before the spring freshet and significantly reduced the risk of damage to the pipeline.
- Voisey's Bay Nickel Mine, Voisey's Bay, Labrador: A theoretical tailings dam breach was investigated using DAMBREAK to quantify potential impacts on an environmentally sensitive creek. Flood passage downstream of the breach was complicated by several small ponds and alternating sub and supercritical river reaches. Proposed mining operations at the Voisey's Bay nickel deposit require extensive management of surface waters. Five small dams were considered to safely convey clean water around the proposed tailings facility and to contain and treat tailings water. Modelling and design of the reservoirs and outflow structures was completed using GAWSER.
- Plains Midstream – Dechlorination and Approval, Sarnia, Ontario: Technical advisor for the design and permitting of a dechlorination system for the Plains Midstream fractionation plant in Sarnia, Ontario. The system is being designed to reduce the free chlorine concentration in the wastewater discharge. Golder is also preparing the ECA (Industrial Sewage Works) amendment package for the facility, to include additional Limited Operational Flexibility (LOF) for the facility for the additional of the dechlorination system, and future sewage work modifications. LOF for the facility will grant future modifications to the works through the appropriate MOE reporting progress, if a professional engineer can demonstrate the modifications will not alter the process discharge quantity and quality limits established for the facility.
- Channel Restoration Design, Algonquin Park, Ontario: Technical advisor for the hydraulic design of a stream re-alignment with associated grade controls at an historic train derailment site. Contaminated materials will be removed from the stream bed and banks and adjacent railway embankment. Removal of the contaminated materials will result in a net loss of stream substrate and a change to the fluvial geomorphology of the reach. Grade and stream bank controls were designed to minimize the risks of mobilizing residual contaminants and of significant channel migration.
- Omya – Stormwater Management Design and Approvals, Perth, Ontario: A review of existing stormwater management infrastructure was completed for an industrial mineral processing site near Perth Ontario. As a result of incremental development of the site, parts of the stormwater management infrastructure were found to be inadequate. Additional stormwater management works were conceptualized and

submitted to MOE for approval. Following approval, Golder provided liaison with the local Conservation Authority, completed basic design drawings suitable for design-build and applied for permitting under the Conservation Authorities Act.

- OSSGA Carden Plain Cumulative Impact Assessment, Carden, Ontario: Due to the increased level of aggregate extraction activity in the Carden Plain area, the Ontario Ministry of the Environment (MOE) requested a multidisciplinary study and impact assessment to evaluate the potential cumulative impacts of quarry dewatering at multiple sites on groundwater, surface water and ecological receptors. Golder was retained by the Ontario Stone, Sand & Gravel Association to complete the required study. The project included extensive interaction with the MOE and the Ministry of Natural Resources (MNR). The objectives of the study were to screen out areas where cumulative impacts are unlikely, identify areas where cumulative impacts are likely, and to provide a preliminary assessment of the potential magnitude of predicted cumulative impacts. For the purpose of this study, a cumulative impact was defined as the additive effect of multiple quarry dewatering operations on groundwater, surface water and/or natural environment features. Golder was responsible for all aspects of this project including the development of the final field programs in consultation with personnel from the MOE. Mr. MacKenzie was the surface water lead for the project and participated in the public consultation aspects of the project.
- Technical Reviewer Contaminated Site Channel Design, Mississauga, Ontario: Golder was retained to review an options analysis and remedial channel design for a PCB contaminated channel in Mississauga. The remedial design included removal of the most contaminated material and design of a hardened channel lining to secure residual contaminants in-situ. Mr. MacKenzie reviewed the hydraulic channel analysis and design and provided a technical review report for consideration by the municipality and the channel designer.
- Contaminated Site Channel Stability Analysis, Welland, Ontario: Golder recently completed Phase IV of an assessment of 12 sites in the Niagara River Area of Concern that were identified in the RAP Stage 1 Update as requiring further assessment. The Phase IV study is a detailed assessment of remedial alternatives for the site including passive and intervention options. In support of the passive treatment options, Golder completed a detailed investigation of the complicated stream and wetland hydraulics of one of the sites on Lyon's Creek. In the intervening years since the historic contamination, the site had developed into a wetland, which provided habitat for threatened plant and animal species. The hydraulic conditions were evaluated using one- and two-dimensional hydraulic models (HEC-RAS and RIVER-2D) to identify areas that are at risk for re-suspension of contaminated sediments and areas that are likely to accumulate new un-contaminated sediment with time. The results supported the passive treatment alternative. Mr. MacKenzie led the hydraulic investigation component of the Lyon's Creek study.
- Confidential Mine Site Closure, Eastern Ontario: Technical advisor for comprehensive surface water investigations in support of a risk assessment at two former uranium mines near Bancroft, Ontario. The studies included meteorology and flow monitoring, water column profiling with a particular focus on lake stratification and turnover, and water quality sampling.
- Confidential Mine Site Closure, Northern Ontario: Technical advisor for surface water investigations, including streamflow studies, lake column profiling and water quality sampling, at a former nickel mine near Kenora, Ontario.

- OPG Atikokan – Environmental Compliance Approval, Northern Ontario: Technical advisor for the Environmental Compliance Approval ('ECA') Sewage (including Stormwater) amendment application for the Atikokan GS Biomass Conversion project. The study included a review of existing sewage works and associated ECA and MISA conditions. Implications from the proposed site changes to the sewage works, consisting of process streams (Furnace Ash Treatment Plant, Condenser Cooling Water), sanitary sewage system/lagoons and the coal pile runoff pond, along with their associated ECA conditions.
- Confidential Manufacturing Client, Norval, Ontario: Baseline characterisation and impact assessment modelling of a proposed shale quarry in order to quantify and where necessary mitigate potential flow, water quality and thermal effects of the quarry on nearby watercourse and wetlands. Included conceptual design of mitigation measures and preparation of application materials for re-zoning and license under the Ontario Aggregate Resources Act.
- Big Bay Point Water Balance, Barrie, Ontario: Monthly and annual water budgets were prepared using the Thornthwaite Water Budget method. This water budget assessment was performed to determine the rate of marina water pumping required from the proposed development area at Big Bay Point, to the golf course and Environmental Protection Area in support of detailed design of stormwater management facilities to meet post-development peak flow targets. Mr. MacKenzie provided technical advice and senior review for this project.
- Baseline Hydrology Study for Proposed Mine, Ring of Fire, Northern Ontario: Technical advisor for baseline hydrology studies and effects evaluations in support of a major mine development project in Northern Ontario. Assessments were prepared as part of a multi-disciplinary Environmental Impact Statement (EIS) and Environmental Assessment (EA) under the Canadian Environmental Assessment Act (CEAA).
- Quarry License Expansion, Flamborough, Ontario: A level II hydrogeology study was completed in support of a rock quarry license expansion application. The surface water component of the study included establishment of eight continuous stream flow gauges and associated baseflow separation analysis. The baseflow separations were used to estimate mean annual recharge to groundwater. This information was provided to Golder hydrogeologists for use in estimating boundary conditions for the FEFLOW groundwater model. In addition, monthly and annual surface water balances were modelled using the Thornthwaite Water Budget method coupled to a GIS procedure. The fraction of surplus water that infiltrates was estimated using GIS and the method outlined in MOE 2003. The infiltration estimates were initially assumed to equal recharge. The resulting modelled groundwater levels were reviewed to identify areas of upward gradient or minimal downward gradient. This information was used in subsequent iterations to adjust the recharge estimates.
- Aggregate Site Water Use Study, Southern Ontario: Participated in a “typical water use” study for the aggregate industry. The study was initiated by the Aggregate Producers Association of Ontario (now the Ontario Stone Sand and Gravel Association) in preparation for planned changes, by the MOE, to the Permit to Take Water application process. Changes to the process were anticipated to include charges for water taking or use. The MOE was simultaneously working on new Source Water Protection legislation. As a result, the APAO felt it would be prudent to quantify actual water use versus maximum permitted water taking rate and to illustrate typical water use at aggregate sites.

- Aggregate Site Permitting and Approvals, Southern Ontario: Application packages including MNRF and MECP applications and supporting studies and reports have been prepared for numerous aggregate sites across Southern Ontario. Applications have been completed for aggregate pit and quarry licenses under the Aggregate Resources Act, Permits to Take Water (PTTW) to allow quarry dewatering and for Environmental Compliance Approvals (ECA) under Section 53 of the Ontario Water Resources Act to allow offsite discharge of quarry and storm water.
- Simcoe County Groundwater Studies, Simcoe County, Ontario: A base flow survey was conducted to quantify groundwater discharge in a series of watershed in Simcoe County. The project was conducted in two phases, one for North Simcoe and one for South Simcoe. Water budget and average annual infiltration calculations were completed in support of groundwater modelling. Surface-groundwater interactions were estimated throughout the region to provide a water balance Hydrology Studies for Quarry Developments
- Ottawa Region, Ontario: A series of water resources investigations were completed for aggregate producing clients in the Ottawa area. The studies were completed in support of Certificate of Approval applications made under Section 53 of the Water Resources Act. Each study included a water balance analysis for the quarry and an estimate of future quarry discharge rates. These data were used to estimate the effects of quarry development on downstream water resources.
- Water Supply Studies, Sudbury, Ontario: Two municipal water supplies were investigated as Groundwater Under Direct Influence of surface water (GUDI). Surficial water resources were investigated, and a water balance was prepared in support of groundwater modelling studies.
- Hydrological Effects Assessment, Hagersville, Ontario: A long-term field monitoring programme was designed and implemented to track changes in flow regime resulting from closure of an underground Gypsum mine. Part of the mine was closed and allowed to flood. Three flow monitoring stations were established in Boston Creek, which flows over the mine. The stations were selected to represent background conditions upstream of the mines influence, conditions above the mine and downstream of the mine influence. Data loggers and transducers were installed to continuously (hourly) record water levels and flows in the creek.
- GORO Nickel Mine, New Caledonia: The GORO Nickel mine is located in an area of extreme precipitation. Hydrological and preliminary erosion assessments were completed in support of mine development planning and design. These data were used, by the multi-disciplinary project team, to design tailing basin capacities, diversion ditches and dams.
- Round Lake Water Level Control Study, Engelhart, Ontario: Flow exiting Round Lake flows down several kilometres of a very mild sloped reach of the Blanche River before cascading down a set of rapids at a rock outcrop. The rock outcrop was historically blasted to facilitate log driving practices. This modification has caused large fluctuations in water levels in Round Lake and the Blanche River. A hydrological and hydraulic study of the river and lake were completed and a fish-friendly rock-fill weir was designed to stabilise water levels.
- Bruce Nuclear Generating Station, Bruce County, Ontario: Participated in background water quality assessments in the surrounding environment. This work included water quality sampling in Baie du D'Or and Lake Huron. The data were used to assess potential effects of the generating station on the quality of surrounding water resources.

- Pickering-A Nuclear Generating Station, Pickering, Ontario: A multi-disciplinary environmental assessment was completed for the re-start of four CANDU reactors at the Pickering A generating station. A comprehensive review of existing water quantity and quality data was completed. Potential effects, of operating the station, on surrounding water resources were identified and evaluated.
- Falconbridge Smelter Area Closure, Falconbridge, Ontario: Performing a detailed analysis of water quantity and quality to address potential long-term impacts of the closure on the watersheds of Coniston and Emery Creeks. A daily water budget and reservoir routing model was implemented on a spreadsheet to investigate the efficiency of a variety of different closure scenarios. Also involved in hydrometry, automated water level monitoring, water quality sampling, hydrologic modelling.
- Fire Water Intake, Blind River, Ontario: Alternative designs for a fire water intake structure modification were assessed to minimise maintenance and sediment deposition and increase safety. Two-dimensional finite element flow modelling of the intake environment and one dimensional, coupled, unsteady, sediment and hydraulic modelling of the river reach was completed. Modelling results indicated that relocating the intake structure would reduce the risk of failure resulting from sediment accumulation.
- Asacha Gold Mine, Russia: The Asacha gold mine lies close to the divide between a pristine watershed and a partially developed watershed. Hydrologically modelled areas potentially affected by mining operations to aid in developing a safe and detailed water management plan.

LINEAR INFRASTRUCTURE

- Trans Canada Pipelines Vaughan Mainline Expansion, Vaughan, Ontario: Senior technical advisor for baseline hydrology studies, effects assessments and permitting, in support of the environmental and socio-economic assessment (ESA) under the National Energy Board (NEB) filing process and construction planning and design for a ~12 km pipeline expansion in the Greater Toronto Area.
- Trans Canada Pipelines Eastern Mainline Expansion, Vaughan, Ontario: Senior technical advisor for baseline hydrology studies, effects assessments and permitting in support of the environmental and socio-economic assessment (ESA) under the National Energy Board (NEB) filing for the Eastern Mainline Expansion in Ontario (~260 km long gas pipeline through central and eastern Ontario).
- Trans Canada Pipelines Parkway West Connection, Vaughan, Ontario: Senior technical advisor for baseline hydrology studies, effects assessments and permitting, in support of the environmental and socio-economic assessment (ESA) under the National Energy Board (NEB) filing process for a local service connection in the Greater Toronto Area.
- Trans Canada Pipelines Kings North Connection, Ontario: Surface water discipline lead for the Kings North Connection Project, including baseline hydrology studies and effects assessments in support of the environmental and socio-economic assessment (ESA) under the National Energy Board (NEB) process. Scour assessments, sag-bend setback recommendations and permitting were also completed to support construction activities.
- Pipeline Corridor Investigations, Timmins, Ontario: A pipeline was proposed to slurry tailing from the Kidd Metallurgical Site to the Kidd Mine, approximately 35 km away. The tailings are to be used for paste back-filling of depleted areas of the underground mine. An environmental review of water resources along the proposed pipeline corridor was completed. Larger watercourse crossings were mapped, and directional drilling was proposed to mitigate environmental effects.
- Trans Canada Pipelines Borer's Creek Modelling and Restoration Design, Dundas, Ontario: HEC-RAS modelling and assessment of a failing reach of Borer's Creek that threatened to expose a high pressure natural gas pipeline. Design of remedial measures for failing banks and restoration of the affected reach. Coordinated regulatory approvals. The project was successfully implemented before the spring freshet and significantly reduced the risk of damage to the pipeline.

CLIMATE *CHANGE*

- Senior review and technical advisor for an assessment of potential climate change effects and vulnerabilities on a multi-site water management system including eight reservoirs, flooded underground mine works, an active smelter complex, a water treatment plant and associated dams and infrastructure. A Goldsim model of the water management system was constructed and validated. Ensemble Global Circulation Model (GCM) results, from approximately ninety model runs, were obtained for the 2050 horizon. Monte Carlo simulations were used to simulate daily weather patterns constrained by the GCM results and the same daily weather patterns were used to model a potential future range of water management scenarios using the Goldsim water management model.
- Glencore Sudbury Integrated Nickel Operations – East End Infrastructure Assessment, Sudbury, Ontario: Evaluated climate change risks to several small flow conveyance structures including culverts, pipes and flow measurement structures. Peak flows from small sub-catchments are typically sensitive to short duration intense precipitation events. A trend analysis and curve fitting exercise was completed on observed maximum annual events, over recent site history, for a range of event durations ranging up to 24 hours. The trend analysis was used to estimate potential changes to Intensity-Duration-Frequency statistics at the 2050 horizon. This information was used to assess the capacity of existing flow conveyance infrastructure in small sub-catchments.
- Meteorological Service of Canada – Environment Canada, Ottawa and across Canada: Participated on a national research team studying the effects of climate change on hydrological variables. Contribution to the study was to complete a regionalization study based on measured hydrologic variables from the Reference Hydrometric Basin Network (RHBN) including mean annual flow, lowest annual daily flow and peak annual daily flow. The data series were grouped according to their similarity using a cluster analysis routine. The homogeneous hydrologic regions identified by this method were compared to hydrologic regions identified in previous studies using meteorological and physiographic variables. Cluster analysis results consistently identified three homogeneous regions in the British Columbia mountains as well as several regions in Ontario, the Maritimes and along the St. Lawrence. The study demonstrated a significant lack of RHBN coverage in the northern part of the Prairie Provinces and the North West Territories, such that homogenous regions, if they exist in these areas, could not be identified by cluster analysis.
- Infrastructure Ontario (Ontario Realty Corp.) – Infrastructure Climate Risk Assessment, Ontario: Completed the water resources and drainage components of a climate risk assessment on three typical buildings owned by Infrastructure Ontario. Risk was assessed using guidance provided in Engineers Canada's PIEVC protocol. Co-led focus group workshops with building operators and subject matter experts to assess potential future risk.
- Iqaluit Water Supply, Nunavut: Senior technical reviewer for a climate risk investigation of the Town of Iqaluit's water supply. A Goldsim model was developed for the lake-based water supply. Various scenarios were investigated to assess the vulnerability of the supply to climate change.
- BHP Billiton, Elliot Lake, Ontario: Technical advisor for applying climate change projections to extreme precipitation events used to assess potential climate change implications for tailings storage facilities and water management ponds. This work was completed as a part of the Dam Safety Surveillance and Management program at BHP Billiton's closed Canadian and U.S. sites.

SOURCE WATER PROTECTION

- Ontario Clean Water Agency, Lake Ontario, Canada: Hydrology and river boundary conditions lead for the Ontario Clean Water Agency (OCWA) Lake Ontario Decision Support System (DSS). OCWA, in partnership with GTA municipalities, is developing a DSS for managing Lake Ontario based drinking water intakes. Golder teamed with DHI to develop a hydrodynamic, thermodynamic and water quality model to integrate into a web-based forecasting platform for Lake Ontario. The system is expected to go live in 2021 to provide municipalities with the advance information to anticipate and mitigate the effects of accidental spills on water supply infrastructure.
- Source Water Protection: Midland and Penetanguishene Tier 3, Midland, Ontario: Surface water lead for the Midland and Penetanguishene Tier 3 water budget and water quantity risk level assessment. This study involved implementation of a combined surface and groundwater model using MIKE-SHE. The modelled recharge distribution was applied to a groundwater model developed by Golder using FEFLOW in order to further refine drawdown effects in close proximity to wells and surface water features. The study area included the whole of the Midland Peninsula and areas of provincially significant wetlands in close proximity to municipal wells with GUDI designation. Groundwater and surface water interactions, both recharge and discharge areas were significant in spatial scale and an important part of this project.
- Source Water Protection: Peer Reviewer York Region Tier 3, York Region, Ontario: Peer reviewer for the surface water components of the ongoing York Region Tier 3 water budget and water quantity risk level assessment for the area between and surrounding Aurora and Stouffville. The project team is proposing to use GSFLOW to model both the surface and groundwater systems. GSFLOW is an integrated surface and groundwater hydrology model developed by the US Geological Survey, based on MODFLOW and PRMS components. The study area is complex as it includes the southern flank of the Oak Ridges Moraine and straddles the divide between Lake Ontario and Lake Simcoe. Stouffville is in the headwaters of the Rouge River watershed.
- Source Water Protection: Peer Reviewer Halton Hills Tier 3, Halton, Ontario: Peer reviewer for the surface water components of the ongoing Halton Region Tier 3 water budget and water quantity risk level assessment for the Georgetown and Acton areas. The project team used MIKE-SHE to model surface and groundwater hydrology and applied the modelled recharge distribution to FEFLOW to provide further discretization around key areas of interest including wells and surface water features. The study area is complex as it includes the Niagara Escarpment, the Acton re-entrant valley and several buried bedrock valleys which are believed to play and important role in delivering groundwater to the area. The study area also straddles the divide between the Grand River and Credit River watersheds.
- Source Water Protection: Peer Reviewer Orangeville Tier 3, Orangeville, Ontario: Peer reviewer for the surface water components of the ongoing Orangeville, Mono and Amaranth Pilot Tier 3 water budget and water quantity risk level assessment. The project team is using HSPF and MODFLOW to model surface and groundwater hydrology respectively. The study area is complex as it includes the Niagara Escarpment and the Oak Ridges Moraine. The study area also straddles the divides between the Grand River, Credit River and Nottawasaga River watersheds.
- Source Water Protection: Peer Reviewer CTC Tier 1 and Tier 2, Southern Ontario: Peer reviewer for the surface water components of the Tier 1 and Tier 2 water

quantity stress assessments for the CTC Source Protection Region, which includes the Credit River (CVC), Toronto Region (TRCA) and Central Lake Ontario (CLOCA) watersheds. Data availability and modelling approaches used by the different conservation authorities and their consultants varied across the CTC region.

- Source Water Protection: Lower Speed River (Guelph) Tier 3, Guelph, Ontario: Golder Associates teamed with AquaResource to complete a Tier 3 water budget and water quantity risk level assessment for the Lower Speed River watershed. The study area includes the City of Guelph, part of Cambridge and contributing drainage and recharge areas located north and east of Guelph. An extensive baseflow survey was conducted across the study. Baseflow was measured at thirty-two locations during the spring, summer and autumn of 2008. This information was used to estimate varying groundwater discharge and recharge rates to support definition of boundary conditions for the groundwater model.
- Source Water Protection: Nickel District CA Valley East Tier 3, Sudbury, Ontario: Senior technical advisor for the Valley East Tier 2 and Tier 3 water quantity stress assessment. The City of Sudbury draws drinking water from several wells located in the Valley East area. Worked with project team to identify a modelling approach that would make the best use of, sometimes limited, existing data. The Tier 2 results led to the initiation of the Tier 3 Local Area Water Budget for the groundwater supply in Valley East.
- Source Water Protection: Ramsay Lake Tier 1 and Tier 2, Sudbury, Ontario: Senior technical advisor for the Ramsay Lake Tier 3 water budget and water quantity risk level assessment. The City of Sudbury draws water directly from Ramsay Lake for part of its drinking water supply. Ramsay Lake and its contributing drainage areas are being modelled using HEC-HMS (Hydraulic Engineering Corps - Hydrological Modelling System). Based on existing information, it appears that the hydrology of Ramsay Lake is dominated by surface water inputs and as such, there is no plan to include groundwater modelling at this time. HEC-HMS will be used to complete the risk level assessments. Additional field data collection has been initiated to fill existing data gaps regarding key inflows to the lake and the outflow adjacent to Science North.
- Source Water Protection: Bronte Creek, Halton, Ontario: Golder Associates were commissioned to undertake a Threats Assessment of a potential intake at Bronte Creek. Mr. MacKenzie directed the project for Golder. The intake, intended to deliver surface water to a small water treatment plant, was identified as one potential alternative for providing a drinking water supply to nearby residential properties possibly affected through the construction of an adjacent quarry. The Threats Assessment identified eleven water quality issues at the potential intake location, attributing causes to a number of likely contaminant sources throughout the watershed. In accordance with MOE Draft Guidance Modules, the work undertaken as part of this assessment included stakeholder liaison, hydraulic modelling, IPZ delineation, vulnerability analysis, the compilation of issues and threats inventories and a description of data knowledge gaps. Should surface water abstraction from Bronte Creek be identified as the preferred alternative for providing long-term drinking water supply, this Threats Assessment report will provide the basis for the Tier 2 assessment.
- Source Water Protection: Timmins IPZ Study, Timmins, Ontario: An Intake Protection Zone (IPZ) and the vulnerability scores for the City of Timmins drinking water treatment plant on the Mattagami River were assessed. The delineation of the IPZ included the consideration of river flow conditions, influences of dam operation,

location of significant potential upstream sources of contamination, local transportation routes, storm sewer drainage patterns and the behaviour of spills in the river. The project also included the collection of site-specific data through a field program. The field program used non-conventional methods to measure travel time due to restrictions on the use of dye tracers in the river because of the presence of private drinking water intakes. The field program collected detailed velocity data that was used to estimate dispersion and to calibrate a HEC-RAS model that was used to predict the travel time under various flow conditions.

WASTE MANAGEMENT

- Barrie Landfill Reclamation, Barrie, Ontario: Technical advisor for stormwater management modelling and conceptual stormwater infrastructure design. The project included a significant removal and replacement of historic municipal waste. Daily and permanent cover design required new stormwater management strategies and facility design. Interacted with groundwater modellers to develop representative and conservative boundary conditions for modelling.
- Nexcycle, Southern Ontario: Technical advisor in support of the ECA (Sewage) application package for a glass recycling facility. The project included conceptual design of Best Management Practices and source controls to improve stormwater quality.
- Eagleson Landfill Brookside Creek Channel Design, Northumberland, Ontario: Ongoing support regarding a channel remediation design/assessment for the County of Northumberland on a reach of Brookside Creek located downstream of the closed Eagleson Landfill to reroute unaffected surface water flows away from a zone of leachate influenced groundwater.
- Edgewood Landfill Monitoring, Flamborough, Ontario: Designed and implemented a flow and water quality monitoring programme to assess potential historic effects of watercourses surrounding the closed Edgewood Landfill site in Flamborough Ontario. This work was completed as part of an inventory and assessment of historic landfill operations in the City of Hamilton.
- Bath CKD Landfill Design and Monitoring, Kingston, Ontario: Monitored existing water quality and flows associated with an existing Cement Kiln Dust landfill. Designed stormwater control measures for design of a new landfill cover for the existing landfill as well as four new cells to increase the capacity of the landfill.
- Brow Landfill Storm-water Management Plan, Flamborough, Ontario: Developed a storm-water management plan to address drainage requirements for the site and mitigation measures required to control potential impacts as part of the closure process. Designed drainage channels, a stormwater management pond, hydraulic flow control structures and a drop structure to safely convey stormwater over the edge of the Niagara Escarpment into a purpose designed plunge pool.
- Adams Mine Landfill, Kirkland Lake, Ontario: Completed a baseline hydrology assessment including flow and water quality monitoring as part of an investigation into the feasibility of a proposed land-filling operation at Adams Mine. Monitoring included flow measurements from boats in medium to large rivers.

PUBLICATIONS AND PRESENTATIONS

Publications

MacKenzie, K.; Auger, S.; Beitollahpour, S.; Gharabaghi, B. The Role of Stream Restoration in Mitigating Sediment and Phosphorous Loads in Urbanizing Watersheds. Water 2024, 16, 363. https://doi.org/10.3390/w16020363

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S. I. Ahmed, K. MacKenzie, B. Gharabaghi, R.P. Rudra, W.T. Dickinson. (2011). Within-storm rainfall distribution effect on soil erosion rate. ISELE Paper Number 11000. International Symposium on Erosion and Landscape Evolution. Anchorage, Alaska September 18-21, 2011.

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Mackenzie, K.M., R.P. Rudra and W.T. Dickinson. (1996). Modelling the inter-rill detachment process: Some considerations for improving model results. ASAE Paper No. NABEC96-94, Amer. Soc. Agr. Engr., St. Joseph, MI.

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MacKenzie, Kevin. (2007). Industrial Wastewater Approvals. Canadian Environmental Compliance Conference and Trade Show (CANECT). Metro Toronto Convention Centre, April 2007.

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