LANARK COUNTY

PLANNING DEPARTMENT

November 10, 2023

Chris Clarke
Zanderplan Inc.
P.O Box 20148
Perth, ON. K7H 3M6

Via e-mail – chris@zanderplan.com

RE: Verification of Complete Application for an Official Plan Amendment
Lot 5, Concession 10, geographic Township of Lanark Highlands, County of Lanark
County of Lanark File No. 0940-OP-23007

This letter is to that the above noted application for the Official Plan Amendment has been determined to be complete having met the requirements of the *Planning Act*. The 'deemed complete' date was November 1, 2023

Should you have any questions or concerns, do not hesitate to contact me at 1-613-267-4200 Ext 1505 or klam@lanarkcounty.ca

Yours truly,

Koren Lam
Senior Planner

ZanderPlan
Your rural land planning experts

October 31, 2023

Planning Department
County of Lanark
99 Christie Lake Road
Perth, ON K7H 3C6

Forbes Symon, Senior Planner (Jp2g)
Township of Lanark Highlands
75 George Street
P.O. Box 340
Lanark, ON K0G 1K0

RE: County of Lanark Official Plan Amendment
Township of Lanark Highlands Official Plan and Zoning By-Law Amendments
McKinnon Pit Expansion (958 Highland Line Road)
Part of Lot 5, Concession 10
Geographic Township of Dalhousie
Township of Lanark Highlands
Applicant: Arnott Brothers Construction Ltd.

Arnott Bros. Construction Ltd. has retained ZanderPlan Inc. to file applications for Amendments to the County of Lanark Sustainable Communities Official Plan (SCOP) and to the Township of Lanark Highlands Official Plan and Zoning By-law, to permit the expansion of McKinnon Pit (ARA License #609261) in Lanark Highlands. The existing Pit resides along Highland Line falling in Part of Lot 6, Concessions 10 and 11. The expansion area, hereinafter known as the subject property, falls in Part of Lot 5, Concession 10 and measures approximately 5.8ha. The existing Pit access/driveway comes from Highland Line and travels through the proposed expansion area in Part Lot 5, Concession 10. Arnott Bros Construction owns the lands where the driveway is located and where the expansion is proposed to be located. Only part of this parcel will be re-zoned and re-designated for expansion of the Pit, while the balance is proposed to be retained in the Rural designation and zone.

In addition to the Pit expansion noted above, the *Aggregate Resources Act* (ARA) application to the Ministry is proposing to change the license for the entire Pit, including the expansion area, to include extraction below the water table. The current license permits extraction to within 1.5

metres of the water table. The new ARA license will seek to allow aggregate to be extracted up to 20 metres below the water table using drag lines or dredging methods. No diversion, storage or drainage of groundwater is proposed within the below-water license.

The proposed amendments to the County of Lanark Official Plan and the Township of Lanark Highlands Official Plan will place a portion of the subject property into the same designations as the current Pit. McKinnon Pit is designated as Licensed Aggregate Extraction Operation in the County of Lanark Sustainable Communities Official Plan, and designated Mineral Resource Area – Pit in the Township's Official Plan. The current Pit is zoned Mineral Aggregate Resources Pit (MXP) in the Township's Zoning By-law. The expansion lands are proposed to be placed in a Mineral Aggregate Resources Pit - Exception (MXP-X) zone. The exception will be to reduce the rear and exterior side yard setback requirements from 15m to 0m to achieve a cohesive licensed area with the current Pit. The County and Township do not appear to have separate designations or zones for Pits above or below water.

SUBJECT PROPERTY AND REGIONAL CONTEXT

The subject property is a vacant parcel of land, which contains the current McKinnon Pit access road, falling in Part of Lot 5, Concession 10, Geographic Dalhousie, to the south of the McKinnon Pit operation (See Figure 1). Only 5.8ha of the overall parcel will be re-zoned and re-designated to facilitate the Pit expansion (See Figure 2). The remaining 19.31 hectares will stay in its current zone and designation.

Figure 1 – Aerial View of the Subject Property in Relation to McKinnon Pit

Figure 2 – Lands to be Re-Zoned and Re-Designated

The property currently contains a mixture of open fields and wooded lands, with some smaller watercourses and wetland areas to the North and East, which will not be affected by the proposed amendments. There is currently no built development on the subject property, with the existing access to the Pit operation off Highland Line. Highland Line is recognized as a municipal road and provides access to the current extraction operation.

The McKinnon Pit operation falls to the North and West of the lands to be re-zoned and re-designated. Further north of the Pit, the lands appear mainly as vacant parcels with natural heritage features. Lands to the east of the area to be re-zoned and re-designated consist of rural residential properties of varying lot sizes. Lands to the South and Southwest of the subject property are primarily rural in nature with some residential lots fronting to Highland Line with larger rural parcels behind. There are two dwellings located at 1025 and 1121 Highland Line. Wheeler's Pancake House is located to the south of the expansion area and Pit operation.

MINISTRY OF NORTHERN DEVELOPMENT, MINES, NATURAL RESOURCES AND FORESTRY (MNDMRNF) PITS AND QUARRIES MAPPING

All licensed extraction operations in Ontario can be found on the Online Pits and Quarries Mapping issued by MNDMNRF. Pits and quarries can be found using their aggregate license number. Information provided for McKinnon Pit confirms the operation is run by Arnott Brothers Construction Ltd. for a Class A Pit greater than 20,000 tonnes, with a maximum annual

tonnage of 150,000 tonnes. The information is correct; however, it is notable that the boundary of the Pit on the mapping is incorrect. The mapping shows the southern boundary of the Pit running along the edge of Highland Line before the road veers east (See Figure 3). The Existing Features Plan submitted with the ARA application shows the boundary is setback from the edge of Highland Line to maintain the 150 metre separation buffer to nearby residential uses (See Figure 4). The mapping confirms a license is already in place for McKinnon Pit.

Figure 3 – Pits and Quarries Online Mapping for McKinnon Pit

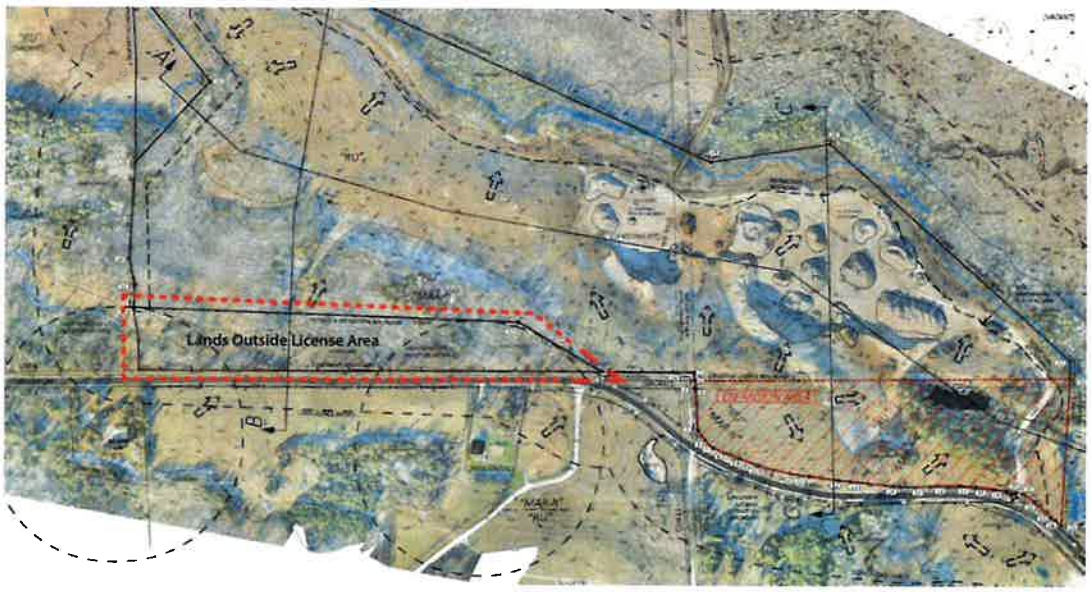

Figure 4 – Showing Lands Outside of Licensed Area abutting Highland Line

PROVINCIAL POLICY STATEMENT (2020)

The Provincial Policy Statement (PPS, 2020), issued under the authority of Section 3 of the *Planning Act*, provides policy direction on matters of Provincial interest related to land use planning and development and provides for appropriate development while protecting resources of provincial interest. The Provincial Policy Statement 2020 came into effect May 1, 2020 replacing the Provincial Policy Statement issued April 30, 2014.

Section 1.0 of the PPS speaks to Building Strong Healthy Communities with policies for Managing and Directing Land Uses to Achieve Efficient and Resilient Development and Land Use Patterns found under Section 1.1. Re-zoning and re-designating the lands to support the expanding aggregate extraction operation would promote efficient development that is compatible and supports the well-being of the Province and municipalities over time (Sec. 1.1.1[a]) that will help meet the long term aggregate needs of the area (Sec. 1.1.1[b]). The extraction area will be outside of any identified natural heritage features, limiting any environmental or public health and safety impacts (Sec. 1.1.1[c]). Development will add additional frontage and access to Highland Line, an existing infrastructure corridor, optimizing available transit investment while minimizing land consumption and servicing (Sec. 1.1.1[e]). Permitting the new designation and zoning of the abutting lands will ensure sufficient land is made available for aggregate extraction to meet projected needs (Sec. 1.1.2). The re-zoning and re-designation will help sustain healthy, liveable and safe communities.

Section 1.1.4 of the PPS speaks to Rural Areas in Municipalities. Expansion of the existing Pit on the subject property allows for the extraction of new aggregate materials which would leverage the available rural resource assets (Sec. 1.1.4.1[a]) while utilizing existing infrastructure for access and transport of extracted materials (Sec. 1.1.4.1[e]). The existing and expanding operation will continue to promote diversification of the economic base, creating new employment opportunities relating to management of resources and job security (Sec. 1.1.4.1[f]). The location of the proposed use is within a Settlement Area and will be directed to rural lands in accordance with the policies of Section 1.1.5 of the PPS.

Section 1.1.5 of the PPS speaks to Rural Lands in Municipalities, permitting the management or use of resources (Sec. 1.1.5.2[a]). The new designation and zoning on the subject property will allow for resource extraction in its place, which is an appropriate use in the rural landscape, consistent with surrounding uses and service levels (Sec. 1.1.5.4). The expanding operation onto the subject property is appropriate for the current rural infrastructure without the need for unjustified or uneconomical expansions (Sec. 1.1.5.5) and will continue to support a

diversified rural economy (Sec. 1.1.5.7). Re-zoning and re-designating the lands to support expansion of the aggregate extraction operation would be a suitable and appropriate use for the lands.

Section 1.3 of the PPS speaks to Employment. The proposed expansion of the existing Pit will continue to provide jobs relating to extraction of aggregate materials, transport, and overall operation of the Pit. Permitting the expansion through re-zoning and re-designating the lands will continue to add to the mix and range of employment opportunities as the operation grows (Sec. 1.3.1[a]). Due to the identified presence of aggregate materials in the area and surrounding, the site represents a strategic site for investment (Sec. 1.3.1[c]). Permitting the re-zoning and re-designation of the property will help to promote economic development and competitiveness pursuant to Section 1.3 of the PPS.

Section 2 of the PPS speaks to the Wise Use and Management of Resources relating to natural heritage, water, agricultural, mineral, mineral aggregates, and cultural heritage & archaeological resources. Natural Heritage policies are located in **Section 2.1**. The lands to be re-zoned and re-designated for Pit expansion do not have any identified natural heritage features. Portions of the parcel falling northeast of the existing Pit access contain natural features and will remain in its current zone and designation to ensure long term protection (Sec. 2.1.1). Lands on the North side of the licensed area contain natural heritage features as well. The re-zoning and re-designation of the expansion area would not affect the identified features (Sec. 2.1.5[e]). A Natural Environment Technical Report has been completed in support of the OPA and ZBLA applications by Ecological Services. The report included an evaluation of the natural features comcluding "*no impacts from the proposed pit activities to the adjacent unevaluated wetland are expected due to a lack of potential wetland/upland interactions, the length and nature of the intervening buffers, and the relative benign nature of normal pit operations*." The rezoning and re-designation would meet the intent of Section 2.1 of the PPS.

Section 2.2 of the PPS speaks to Water with the goal to protect, improve and restore water quality and quantity. The re-zoning and re-designation of the expansion area will not result in any impacts on surface or groundwater features. However, the change in license from extraction above water to extraction below water could present potential impacts on groundwater resources. The Hydrogeological Assessment completed in support of the Pit expansion and license change concluded that no significant change or impacts on groundwater flow or recharge will result from the operation. A groundwater monitoring program is recommended as part of the Hydrogeology Report, which is summarized later in this report.

During the pre-consultation with staff at the County and Township concern was raised over a cold-water Trout Stream located near the existing Pit to be expanded. Ponding on the Pit property has the potential to affect the temperature of the stream impacting the fish habitat present. As the stream represents the only cold water trout habitat within the Township of Lanark Highlands special care should be taken to ensure the viability of the stream over the long term. GRI Inc. is currently doing a supplementary evaluation as part of their Hydrogeology work to ensure Pit activity will not have any impacts on surface water features or the cold water stream.

Section 2.3 of the PPS speaks to Agriculture. There are no agricultural uses or areas identified on or abutting the subject property. Review of the Soil Capability for Agriculture shows there are no prime agricultural soils (Classes 1 – 3) on or abutting the property. Soils in the area mainly consist of Class 7 soils and organic soils.

Section 2.4 of the PPS speaks to Minerals and Petroleum, neither of which has been identified on the property. The Pit area and expansion lands contain sand and gravel resources.

Section 2.5 of the PPS speaks to Mineral Aggregate Resources, stating they shall be protected for long-term use (Sec. 2.5.1). As much of the mineral aggregate resources as realistically possible shall be made available for use (Sec. 2.5.2.1). The proposed expansion lands contain viable aggregate resources up to the edge of Highland Line. The Pit is established north of the travelled road. The road, and uses south of it, would prohibit further expansion south. Including the expansion lands within the licensed area rounds out development and makes available as much aggregate resources as realistically possible. Existing vegetation and buffering along property lines will be retained where possible to ensure extraction is undertaken in a manner which helps minimize impacts on surrounding properties (Sec. 2.5.2.2). This is an important consideration given Wheeler's Pancake House is located close to the Pit operation. The proposed re-zoning and re-designation is meant to support the expansion of the existing operation. Progressive and final rehabilitation plans have been prepared to ensure future land uses can be accommodated once the aggregate resources are extracted (Sec. 2.5.3.1). Extraction has not and will not occur in Prime Agricultural Areas pursuant to Section 2.5.4.

Section 2.6 of the PPS speaks to Cultural Heritage and Archaeology. In support of the ARA application, an Archaeological Assessment was completed by Past Recovery Archaeological Services Inc. A stage 2 field investigation did not find any archaeological resources on the property. It is further recommended no additional investigation is required. The rezoning and re-designation of the property would not impact archaeological or cultural heritage resources.

Section 3.0 of the PPS speaks to Protecting Public Health and Safety with policies for Natural Hazards found in Section 3.1 and Human-made Hazards in Section 3.2. There have been no Natural Hazards such as flooded lands, erosion hazards, or dynamic beach hazards identified on or abutting the property. Mineral aggregate operations constitute a potential man-made hazard. The appropriate design of these operations is very closely guided and regulated in the *Aggregate Resources Act* (ARA) so as to mitigate risk, and to ensure that responsible monitoring takes place through the operation of the License. Progressive rehabilitation back to a naturalized state is required for all operations after extraction has ceased or a license has been surrendered. The controls in place are meant to prohibit access to the extraction areas to ensure residents are not illegally accessing a site where injury could result from the processes occurring. Expansion of the current operation is not expected to create any new man-made hazards on-site.

Overall, the proposal to re-designate and re-zone a portion of the subject property to expand the existing Licensed Pit operation, along with new licenses to extract below water, is consistent with the policies in the 2020 Provincial Policy Statement.

LANARK COUNTY SUSTAINABLE COMMUNITIES OFFICIAL PLAN (2012)

The County of Lanark released its Sustainable Community Official Plan (SCOP) in 2012, which combined an Official Plan with an Integrated Community Sustainable Plan to provide for the implementation of land use policies within the County. The subject property is currently designated Rural Area in the Lanark County Sustainable Communities Official Plan Schedule A – Land Use Designations (See Figure 5). McKinnon Pit falls in the Licensed Aggregate Extraction Operation designation on Schedule A. There are no significant Natural Heritage Features identified on the lot but a Significant Groundwater Recharge Area is identified on Official Plan Schedule B – Source Water Protection (See Figure 6). The proposed Amendment to the County Official Plan will seek to re-designate a 5.8ha portion of the subject property from Rural Area to Licensed Aggregate Extraction Operation to support the expansion of the McKinnon Pit.

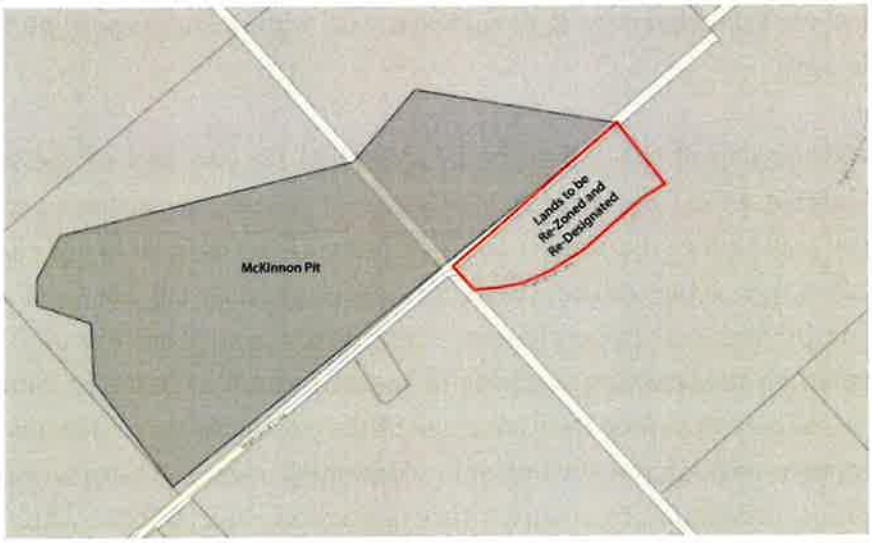

Figure 5 – Interactive County GIS Mapping showing the SCOP Schedule A

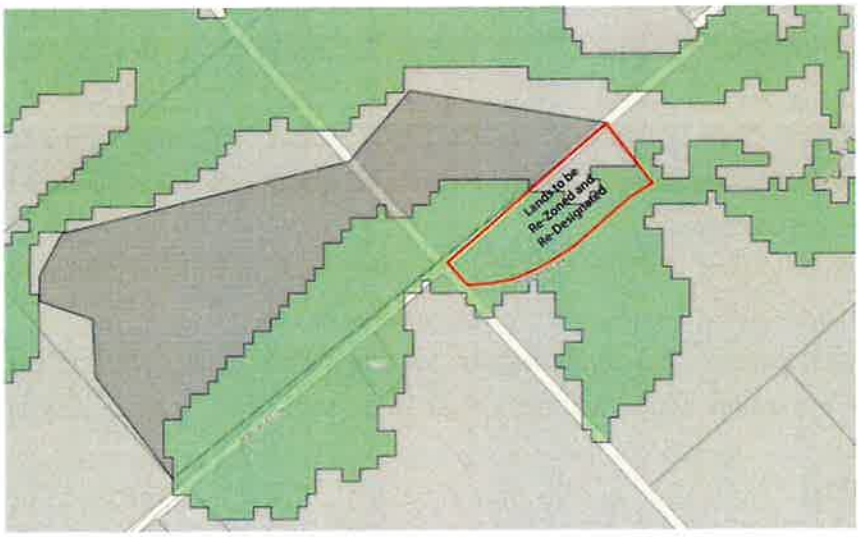

Figure 6 – Interactive County GIS Mapping showing the SCOP Schedule B

Section 3.0 of the County of Lanark SCOP speaks to Rural Area Policies. A re-designation of only part of the property is proposed. Areas east of the current access location contain natural heritage features and will remain in the Rural Area designation. **Section 3.3.1** of the SCOP outlines three distinct objectives for Rural Areas:

1. *To ensure that residential and non-residential development is consistent with rural service levels;*
2. *To maintain the distinct character of rural, waterfront and settlement areas;*

3. *To ensure that development is compatible with natural heritage features and natural resource uses.*

The re-designation to permit the expansion of McKinnon Pit into part of the subject property would be supportable on current rural service levels. Highland Line already provides access to the Pit operation. Inclusion of the subject lands with the Pit access would not change the access location or result in new activities that could not be sustained by current service levels. The Pit is not located on private well or septic due to its mineral extraction nature. The Pit itself is already established on the abutting property. A re-designation of 5.8ha of land to expand the operation is not expected to alter the character of the surrounding rural area. The portion of the subject property east of the Pit entrance containing natural features will remain in its current Rural Areas designation to ensure future extraction is compatible with natural heritage features and natural resource uses.

Section 3.3.2 of the Official Plan outlines General Policies for development providing four key points for consideration:

1. *Local Official Plans will contain policies that ensure that development, redevelopment and the increasing use of rural properties does not result in additional negative environmental impacts.*
2. *Local Official Plans shall include policies which will ensure that rural development will occur on appropriate water and waste water services.*
3. *Rural development shall have regard for the safety of people and property and shall occur in a manner which will not result in an increased need or demand for municipal services.*
4. *Local Official Plans shall ensure that development will be directed to occur in a manner that makes efficient use of existing infrastructure, allows for the maintenance of the area's character and provides for the long term availability of the resources that make the area attractive.*

The proposed re-designation to expand the McKinnon Pit would result in the increasing use of rural property for aggregate extraction, to access an identified resource. To avoid negative impacts on the environment, the portion of the property containing natural features will be left in the current Rural Area designation. A Natural Environment Technical Report was prepared by Ecological Services to assess potential impacts and recommend mitigation measures to further plan for and prevent environmental impacts relating to the Pit expansion. Appropriate safety measures have been put in place through the ARA site plans to ensure the operation respects

the safety of people and property, meeting the Provincial standards and guidelines. The expansion will not result in a demand for increased municipal services. Development will make efficient use of existing infrastructure and access from Highland Line. The re-designation makes available more viable resource lands for extraction while protecting the natural features and open areas that contribute to the rural character of the area.

There is no new lot creation of the Rural Area proposed pursuant to Section 3.3.3. A re-designation of a portion of the subject property for aggregate extraction is compatible with the current Pit use. The expansion of the Pit is not anticipated to create any new adverse impacts on nearby uses as the expansion lands already contain the site access for the Pit (Sec. 3.3.4.1). No development is proposed within the Rural Area designation on the property. Lot frontage, depth and area of the lands remaining in the Rural Area designation will comply with the Township's Zoning By-Law (Sec. 3.3.4.6). A partial re-designation of the property is appropriate under the policies of the Lanark County Sustainable Communities Official Plan.

Section 5.0 of the Lanark County SCOP speaks to Natural Heritage including surface and ground water protection and enhancement. The subject property contains non-evaluated wetlands which have not been deemed significant (Sec. 5.2), but highlights areas with potential ecological function. An EIS has been completed to assess the natural heritage features and is discussed in greater detail below. Areas such as these are typically identified in the local Official Plan where development is permitted provided there is no negative impact on the natural heritage (Sec. 5.4.2) A 30-metre buffer is shown around these features for development to consider the impact and long term viability (Sec. 5.4.4). The new extraction area is proposed outside of these identified areas, complying with the policies in place to protect and conserve the natural features of the subject property.

Section 5.5.8 speaks specifically to surface and groundwater protection and enhancement. The property does reside within a Significant Groundwater Recharge Area similar to the abutting property where the existing pit is located. A hydrogeological investigation was completed in support of the re-designation of the subject property which determined no new impacts would be created from the Pit expansion; the report is described in greater detail below.

Section 6.0 of the Lanark County SCOP speaks to Resources with policies for Mineral Resources found under Section 6.2. Section 6.2.2 states "*mineral and aggregate resources are important to all facets of development in the County as these materials are used in the construction of roads, water and sewer infrastructures, homes, schools and commercial buildings and landscaping projects. As such the identification and long term protection of aggregate resources*

is important to the County's well-being." The proposed Official Plan Amendment will seek to place part of the subject property in the Licensed Aggregate Extraction Operation designation similar to the existing Pit. The overall area is identified as containing aggregate deposits demonstrating the existence of known sources of aggregate material on the site (Sec. 6.2.2.1). Licensed Pits and Quarries are permitted uses in areas of mineral aggregate resources (Sec. 6.2.2.2.1). No prohibited uses are proposed within the lands to be re-designated (Sec. 6.2.2.3) and no prohibitive uses are proposed on the adjacent lands remaining in the Rural Area designation (Sec. 6.2.2.4). A re-designation to bring a 5.8ha area of land into the Pit operation would be permitted under the policies of Section 6.2.2.

Section 6.2.2.5 addresses Zoning and Development Control of Mineral Aggregates. All new or expanding extraction operations require an Amendment to the County Official Plan and to the local Official Plan of the Township and need to be zoned for extraction. Concurrent Township Official Plan and Zoning Amendments are being submitted to ensure the licensed area is recognized in local planning documents. All studies and reports required in accordance with the *Aggregate Resources Act* have been provided to the Ministry for review in support of the re-designation to a Licensed Aggregate Extraction Operation, and are summarized below.

Overall, only a portion of the property will undergo a re-designation under the County and Township Official Plans and re-zoning under the Township Zoning By-law. The proposed expansion of the extraction operation meets the intent of the policies and objectives as found in the County of Lanark Sustainable Communities Official Plan (2012).

LANARK HIGHLANDS OFFICIAL PLAN, 2016

The Lanark Highlands Official Plan, as approved by the Ministry of Municipal Affairs and Housing in 2012 and the Ontario Municipal Board in 2016, provides policy direction for the various land use designations identified within the Plan. The subject property is designated Rural Communities on the Township's Official Plan Schedule A – Land Use and Transportation (See Figure 7). Official Plan Schedule B – Development Constraints identifies the Mineral Aggregate Reserves on the proposed pit area and continues along to the East of abutting properties (See Figure 8). The Official Plan Amendment is seeking to re-designate a portion of the subject property from Rural Communities to Mineral Resource Area - Pit to permit the expansion of the McKinnon Pit extraction operation. The lands to be re-designated will measure 5.8ha with 494.6 metres of frontage on Highland Line.

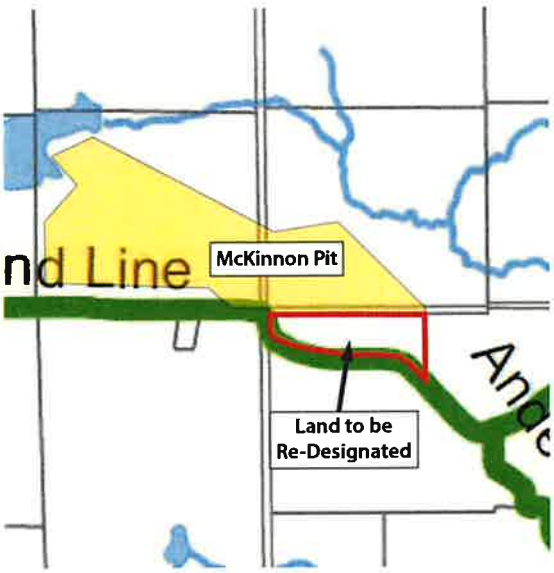

Figure 7 – Lanark Highlands Official Plan Schedule A – Land Use

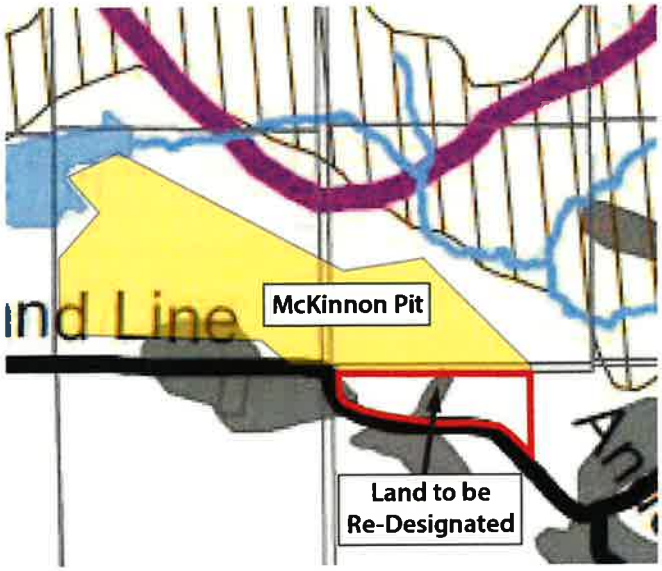

Figure 8 – Lanark Highlands Official Plan Schedule B – Constraints

The Township Official Plan does not show the McKinnon Pit designation on their mapping schedules. Through consultation with Township planning staff it was confirmed an Official Plan Amendment was obtained for McKinnon Pit adopted through By-law No. 2008-871 in March of 2008. The updates to the Official Plan schedules have yet to be made.

Section 3.0 of the Official Plan speaks to Planning Sustainable Communities with Rural Communities policies located in Section 3.3. Part of the subject lands will remain in the Rural Communities designation outside of the Official Plan Amendment. Maintaining part of the property in the Rural Communities designation will help minimize impacts on abutting uses and mitigate impacts on identified natural heritage features by keeping them out of the licensed area to be re-designated (Sec. 3.3.1.3). More than 0.8 ha of land will remain in the Rural Communities designation to ensure it complies with the minimum lot size (Sec. 3.3.6.1) and a minimum of 60 metres of frontage will remain to meet the minimum frontage required (Sec. 3.3.6.2). Leaving greater than 0.8 ha of land and 60 metres frontage will ensure once the licensed area is re-zoned under a concurrent Zoning By-Law Amendment that the portion remaining in the Rural zone and designation will meet minimum zone standards. No development or site alteration is proposed for the lands to remain Rural Communities.

Section 4.0 of the Official Plan speaks to Our Resource Lands stating "*resource lands make up a significant component of land uses in Lanark Highlands. Mineral Resources and forestry are important to the overall economic base of the Township. Aggregate resources such as sand,*

gravel and limestone have been evaluated and appropriate land use policies have been developed to ensure the wise use and conservation of these resources for future generations."

Section 4.1 of the Official Plan provides Mineral Aggregates policies. Both Pits and Quarries are permitted uses within the Mineral Aggregate Resource Policy Area (Sec. 4.1.1). The re-designation will ensure the existing Pit can continue operation into the expansion area by placing the lands in the proper designation (Sec. 4.1.3.1). Access to the Pit operation is located within the lands to be re-designated providing further justification for their inclusion in the overall Pit license and boundary. Section 4.1.3.2 states:

Where an Official Plan amendment is proposed which could result in the re-designation of lands to Mineral Aggregate Resource Policy Area in order to facilitate the establishment or addition of previously unlicensed area to a licensed extraction operation and where the limits of the extraction operation could ultimately be located within 300 metres (984 feet) of a residential, institutional or commercial use on another lot for a licensed pit and 500 meters (1640 feet) for a licensed quarry, such proposed amendment shall be supported by the following:

1. *Hydrogeological investigations, in accordance with the Aggregate Resources Act, conducted by a qualified professional, which demonstrate conclusively that the extraction operation will not result in negative impacts on the existing nonextraction development's water and sewer services;*
2. *Any other investigation as required by the approval authority such as traffic studies, noise studies, vibration studies, slope stability studies etc. are carried out and demonstrate conclusively that the proposed extraction operation can proceed without negative impacts on the existing non-extraction development. Such studies are to carried out by qualified professionals.*

The re-designation to Mineral Aggregate Resource Policy Area will occur on lands within 300 metres of a residential use to the west at 1025 Highland Line Road. A second dwelling further west at 1121 Highland Line Road and the commercial Wheelers Pancake House would fall beyond 300m of the lands to be re-designated (See Figure 9). The new ARA Application is also seeking to expand extraction to 20 metres below the water table. A hydrogeological investigation has been completed by GRI Inc. which found no significant change or impact on groundwater recharge or flow on or around the property will occur from the re-designation of the subject property or extraction below water. Additional supporting studies like an Archaeology Study and a Natural Environment Technical Report have been completed to ensure the expanded area is compatible with surrounding development in accordance with Section 4.1.3.2 of the Official Plan.

Figure 9 – Separation between 1025 Highland Line Road and the Re-Designated Lands

Section 5.0 of the Official Plan speak to Our Environment – Planning for Ecosystem Balance which includes the Township's natural heritage policies. The portion of the subject property to be re-zoned and re-designated for expansion does not contain any natural heritage features. Lands containing natural heritage will be left in their current Rural Communities designation. Lands to the north of the current Pit containing natural features will not be impacted by the proposed Official Plan Amendment. A Natural Environment Technical Report has been completed to evaluate the natural heritage features in this area and is described in greater detail later in this report.

Section 6.0 of the Official Plan speaks to Planning for Public Health and Safety. There are no flooding or erosion hazards identified within the lands to be re-designated pursuant to Section 6.4 of the Official Plan. The sloping nature of the lands is due to the presence of aggregate materials which will be extracted for various purposes. No construction that would be impacted by unstable slopes or organic soils, pursuant to Section 6.5, is proposed. The site is not considered contaminated pursuant to Section 6.6.

Section 6.7 of the Official Plan speaks to Other Health and Safety Concerns. Abandoned Pits and Quarries are addressed in Section 6.7.1. McKinnon Pit is an active extraction operation with safety measures in place to prevent unauthorized access to the Pit area. Re-designating the additional 5.8ha of land to permit the Pit expansion is not anticipated to result in increased noise or vibration. The Pit access travels through the lands to be re-designated. Any noise or

vibrational impacts are not anticipated to be worsened from the inclusion of the lands (Sec. 6.7.2). Due to the existing Pit's proximity to residential dwellings, there are no additional foreseen impacts to arise regarding noise and vibration as the expansion is located further West from current extraction zones.

Overall, the proposed Official Plan Amendment to re-designate a portion of the subject property from Rural Communities to Mineral Aggregate Resource Policy Area (Pit) to permit the proposed expansion of the McKinnon extraction operation meets the intent of the policies of the Township of Lanark Highlands Official Plan.

LANARK HIGHLANDS ZONING BY-LAW (2003-451)

The subject property is currently zoned Rural (RU) and Mineral Aggregate Resources – holding (MAR-h) on the Township's Zoning By-law Schedule A2 - Dalhousie/North Sherbrooke (See Figure 10). The abutting property to the North containing McKinnon Pit is zoned Mineral Aggregate Resource Pit (MXP). The proposed Zoning By-law Amendment would seek to re-zone a portion of the subject property from Rural (RU) and (MAR-h) to Mineral Aggregate Resources Pit - Exception (MXP-x) to permit an expanded extraction operation area for the McKinnon Pit. The exception will be to reduce a rear and exterior side yard setback to zero (0) metres. The lands to be re-zoned will measure 5.8ha with complying frontage on Highland Line.

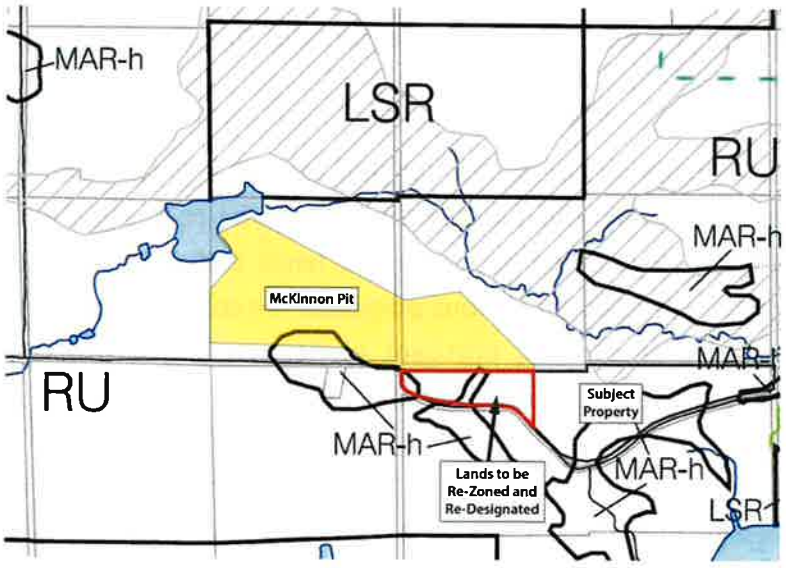

Figure 10 – Lanark Highlands Zoning By-Law Schedule A

Section 4 of the Townships Zoning By-law outlines the general provisions for development. Section 4.28 of the Zoning By-Law provides wording for Pits and Quarries:

> *The making or establishment of pits and quarries within the Municipality is prohibited unless within a Mineral Aggregate Resource MXP or MXQ Zone or is a wayside pit or a wayside quarry as approved by the public body having jurisdiction.*
>
> *A wayside pit or wayside quarry shall not be permitted in within the boundaries of Lanark Village, any Hamlet Zone, any Lake Development (D) Zone, any lands zoned for a Rural Cooperative or on any lands in an Environmental Protection (EP) Zone.*

The purpose of the Zoning Amendment is to place the 5.8ha of land intended to expand McKinnon Pit into an appropriate MXP zone. Applications will be made to both Lanark Highlands Township and the County of Lanark.

Section 4.32 of the zoning by-law speaks to Special Setbacks, Minimum Distance Separation, and Influence Areas. Section 4.32.3 contains policies for Influence Areas surrounding Pits and Quarries stating:

a) *The minimum setback distances for pits and quarries from property lines shall be as set out in the Aggregate Resources Act.*
b) *Within an influence area of 150m (492.1ft.) of a pit excavated above the water table or aggregate reserve, or 300 m (984 ft.) of a pit excavated below the water table, measured from the zone boundary of a Mineral Aggregate (MXP or MAR) Zone, or 500 m (1,640 ft.) from the zone boundary for a quarry (MXQ Zone), or 750 m (2,460 ft.) from the zone boundary of the Tatlock Quarry respectively, the proponent of any sensitive land use shall be required to demonstrate that there will be no adverse or potential impacts (i.e. visual impacts, noise, dust, traffic or ground water quality or quantity) created on the sensitive land use, or impacts that cannot otherwise be appropriately mitigated by the proponent from an existing or proposed aggregate operation. Adverse impacts may be addressed by means of a phasing plan, rehabilitation plan, landscaping berming, specified truck routes or other measures acceptable to Council.*
c) *A pit or quarry or wayside pit or wayside quarry shall be set back a minimum of 30 m (98.4 ft.) from the high water mark of a water body or a distance prescribed or required by regulation or condition(s) of the license under the Aggregate Resources Act.*

The Influence Area policy found in Section 4.32.3[b] states "*the proponent of any sensitive land use shall be required to demonstrate that there will be no adverse or potential impacts (i.e. visual impacts, noise, dust, traffic or ground water quality or quantity) created on the sensitive land use.*" The policy places the onus on the proponent of a sensitive land use to ensure there are no impacts from the existing or proposed extraction operation. Setbacks for Pits to abutting or nearby property lines are addressed in the Aggregate Resources Act. Vertical zoning and setbacks for the expansion are not covered by municipal zoning by-laws. Further, influence areas are not strict setbacks for new development. They represent areas where impacts could be experienced. The proponent of the Pit operation has completed several supporting studies to demonstrate no impacts on property, public health and safety, or the environment will result from the proposed expansion. The expanded Pit will not be located within 30 metres of the high water mark of a water body pursuant to Sec. 4.32.3[c].

Section 6.0 of the Zoning By-Law speaks to the Rural (RU) zone. The proposed re-zoning and re-designation only applies to a portion of the subject property. The remaining lands will remain in the RU zone. No development or site alteration is proposed within the Rural zoned lands. Complying lot area and frontage will be provided pursuant to Section 6.2.1.

Section 18.0 of the Zoning By-Law speaks to Mineral Aggregate Resource Zones. Permitted uses pursuant to Section 18.1 include extractive operations such as pits licensed under the *Aggregate Resources Act*. Zone requirements pursuant to Section 18.2 are minimal but include a 15 metre setback for all yards from property lines. Section 18.3.1 requires a minimum 30 metre setback from lot lines adjacent to public roads.

The subject property is a different parcel of land than where the current McKinnon Pit operation is located. The lands to be re-zoned directly abut the Pit property. If the 15m setback to the rear (north) property line is maintained it would result in a 15m strip that could not be extracted. The proponent is seeking an exception to reduce the required yard setback to zero (0) metres to make available all the aggregate material within the expansion area and prevent any gaps in the material that can be extracted. Similarly, the west side lot line is an exterior side abutting a small portion of unopened road allowance. The proponent is seeking an exception to reduce the setback on the west side to zero (0) metres also. Highland Line Road is located south of the lands to be re-zoned. A 30 metre setback will be maintained along the lot line adjacent to the road to ensure compliance with Sec. 18.3.1. Additionally, native vegetation within the 30m setback will be maintained and a berm constructed to help screen out any operations or site activity from abutting properties.

The east side of the lands to be re-zoned is not a property line for the overall parcel. A significant portion of land, which will remain in the RU zone, falls east of the lands to be re-zoned. There is no requirement for a 15m setback on the east side as it is not a property line, only a zone line. It should be noted the driveway access for the Pit falls on the east side of the lands to be re-zoned. A local wetland falls east of the driveway with a regulated area extending onto the lands to be re-zoned. This natural area will make extraction east of the driveway not feasible. Therefore, the proposed rezoning can comply with the front (south) and interior side (east) yard setback requirements but will require an exception to Section 18.2 to reduce the rear yard (north) and exterior side yard (west) from 15 metres to zero (0) metres.

Based on the supporting information completed to address the proposal, re-zoning a portion of the property from Rural (RU) to Mineral Aggregate Resources Pit - Exception (MXP-x) would meet the intent of the policies of the Township's Zoning By-law concerning Mineral Aggregate Resources, but would require an exception to Section 18.2 to reduce the required exterior side and rear yard setback from 15 metres to zero (0) metres.

HYDROGEOLOGICAL ASSESSMENT

A Level 1 and 2 Hydrogeological Assessment was completed by GRI Inc to support the licensed Pit application under the ARA. The report addresses the requirements of the technical standards, determine the maximum predicted water table and to identify any potential impacts of the operation on groundwater and surface water. The site is located in an area consisting of fine gravel to fine sand with the highest quality ranking for the province's mineral aggregate interests. The new ARA license will seek to allow extraction to 20 metres below the water table with a drag line or other dredging equipment. The report states there will be no diversion, storage or drainage of groundwater from the site.

GRI Inc. advanced three test holes on the site with piezometers installed. Hydraulic conductivity tests were completed and groundwater levels were measured from December 3 2020 to July 28, 2022. The study found no significant change or impact to the groundwater recharge or flow on or around the property will occur from the proposed operation. Recommendations included in Section 13 of the report propose a groundwater monitoring program, to be followed by data collection when the below water excavation begins.

The hydrogeological investigation found the proposed expansion and below water excavation will not result in a significant impact to the surrounding hydrogeological environment.

CULTURAL HERTIAGE RESOURCE REPORT

A Stage 1 and 2 Archaeological Assessment was completed by Past Recovery Archaeological Services. The purpose of the investigation was to assess for the presences of archaeological resources on the subject property, and if found to recommend an appropriate Stage 3 assessment strategy. A pre-Contact archaeological site (BfGd-3) has been registered on the adjacent Lot 6, Concession 10.

The Stage 2 property survey was completed on the 28th and 29th of June, 2021. Shovel test pits and a pedestrian survey at 5 metre intervals across the property was completed to assess for archaeological potential. Field walking intensified to 1 m intervals within 20 m of site BfGd-3. No archaeological resources were found during the course of the survey. The report concludes the cultural heritage value or interest of the study area has been sufficiently documented through the Stage 2 research and no further archaeological assessment of the subject area is required at this time.

NATURAL ENVIRONMENT TECHNICAL REPORT

A Level 1 and 2 Natural Environment Report was prepared by Ecological Services Inc. to assess the potential impacts of the rezoning and re-designation to expand McKinnon Pit. The report included several recommendations summarized below:

- To avoid harm to SAR bats, it is recommended that no trees be removed during the maternity/roost season (April 15 to Sept. 15).
- To help reduce sight and sound impacts to Eastern Meadowlarks, it is recommended that extraction proceed from the north to the south towards Highland Line Road.
- A seasonal Category 2 extraction restriction boundary from April 15 to July 31 (after Weir 2008) is recommended at the southwest end of the existing licence area to provide an extra layer of disturbance minimization for Eastern Whip-poor-will.
- Whip-poor-will surveys will need to be conducted if pit operators are interested in bypassing this timing boundary during any particular year.
- The pit operators will be required to register their pit activity with the MECP due to the Bank Swallow nesting taking place.
- On top of the required 30 m MVCA wetland buffer, it is recommended that a further 15m buffer be added at the northwest corner of the existing licence boundary.

- It is recommended the open water created as part of the closure plan have sloping edges to enhance the creation of littoral zone habitat to support many species.
- It is recommended that all wooded portions bordering the wetland to the north and west of the existing pit licence area be maintained as woodland.
- To protect painted turtle nesting that occurs beside the current extraction area it is recommended that turtle fencing (see MNR 2013) be installed at the edge of the un-vegetated area.

SUMMARY

The 2020 Provincial Policy Statement, the Lanark County Sustainable Communities Official Plan and the Township of Lanark Highlands Official Plan & Zoning By-Law encourage the protection and extraction of aggregate material and recognize its importance to the local economy. The subject property is located on a local transportation route, abuts an active Pit operation, and contains aggregate materials supporting expansion of the existing Pit. Supporting studies have been completed for the new ARA Application to allow for the Pit expansion and to change the classification from extraction above water to extraction below water.

The proposed Amendment to the County Official Plan will seek to re-designate a 5.8ha portion of the subject property from Rural Area to Licensed Aggregate Extraction Operation to support the expansion of the McKinnon Pit. The Official Plan Amendment to the Township of Lanark Highlands Official Plan would re-designate a portion of the subject property from Rural Communities to Mineral Aggregate Resource Policy Area (Pit) to permit an extraction operation. The proposed Zoning By-law Amendment would seek to re-zone a portion of the property from Rural (RU) and Mineral Aggregate Reserves (MAR-h) to Mineral Aggregate Resources Pit - Exception (MXP-X) to permit an expanded extraction area. An exception to Section 18.2 is required to reduce the minimum rear and exterior side yard from 15 metres to zero (0) metres.

Should you have further questions please do not hesitate to contact the undersigned.

Sincerely,

Tracy Zander

Tracy Zander, M.Pl, MCIP, RPP

Chris Clarke

Chris Clarke, B.Sc., CPT

NATURAL ENVIRONMENT TECHNICAL REPORT

Prepared for
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ECOLOGICAL SERVICES

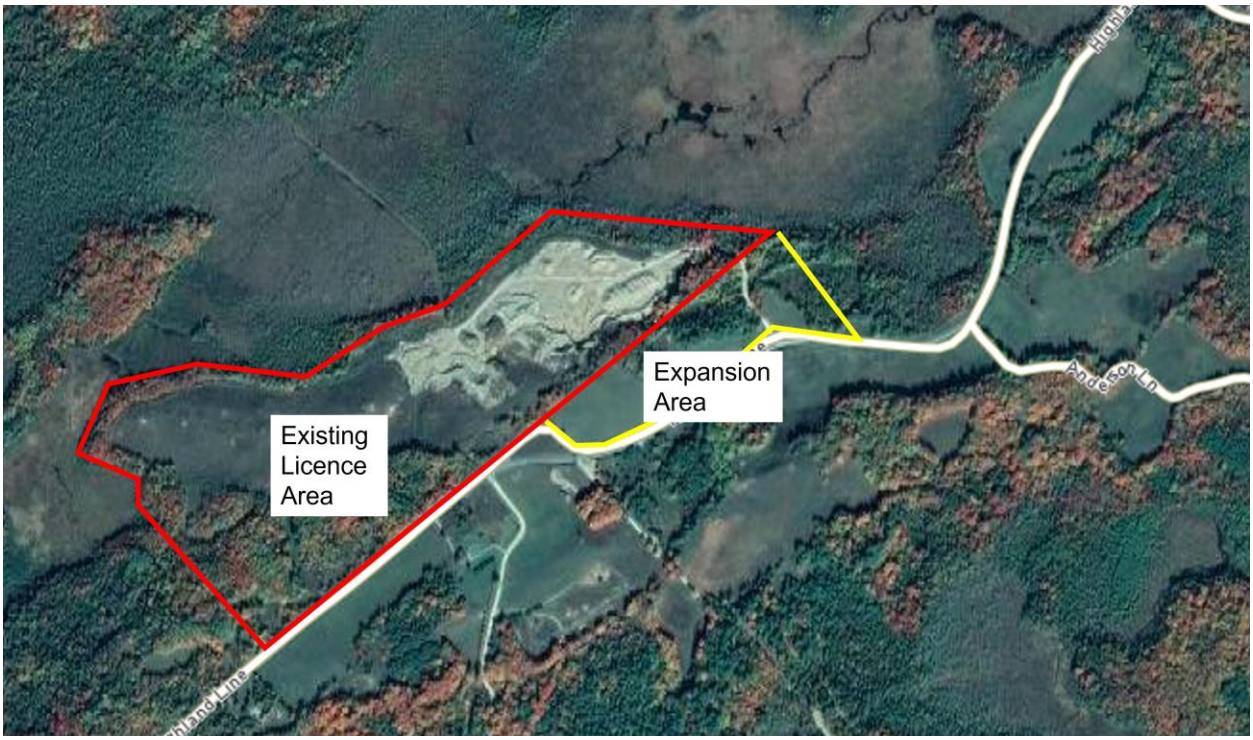
January 26, 2022

Rob Snetsinger

Table of Contents

1. Summary

Under the Provincial Aggregate Resources Act, Arnott Brothers Construction Inc. is applying for an expansion of their Class A pit licence (609261) on the Highland Line in the Township of Lanark Highlands, Lanark County, parts of Lot 6, Concessions 10 and 11. It is known as the Crain-McKinnon Pit. The expansion will involve a below water expansion for the existing licence area, and a boundary expansion into a new area (see below). The original license area was covered in a Natural Environment Level 1&2 Technical Report by Muncaster (2006).



This natural environment assessment report follows the guidelines provided in the 2021 Aggregate Resources of Ontario Standards, which is to investigate whether significant natural heritage features are on or within 120 meters of a pit expansion. If these features are at risk of a negative impact, the natural environment assessment report typically follows three paths.

1. Determine a high impact potential and recommends against the pit expansion.
2. Determines a moderate impact potential and make mitigation and compensation recommendations to minimize or negate the impact.
3. Determines that there is a negligible risk of a negative impact.

This natural environment report also addresses the Natural Heritage assessment requirements (e.g, Environmental Impact Statement (EIS) or Environmental Impact Assessment (EIA)) of the Provincial Policy Statement (PPS) and the Lanark County Official Plan (OP).

Within the proposed pit expansion boundary, there is a species at risk, significant woodland feature and significant wildlife habitat. Within 120 m of the expansion boundary there is a significant woodland feature, significant wildlife habitat, fish habitat, wetland, and the habitat of species at risk. The risk to these significant features is low to moderate and mitigation recommendations are provided accordingly.

2. Summary of Mitigation Recommendations

Species at Risk (SAR)

As a general precaution for avoiding harm to SAR bats, it is recommended that no trees be removed during the maternity/roost season (April 15 to Sept. 15).

To help reduce sight and sound impacts to Eastern Meadowlarks using the fields south of Highland Line Road, it is recommended that extraction proceed from the north to the south towards Highland Line Road, such that extraction machinery will be mostly out of sight behind the height of the aggregate face, and the required roadside berm.

A seasonal Category 2 extraction restriction boundary from April 15 to July 31 (after Weir 2008) is recommended at the southwest end of the existing licence area to provide an extra layer of disturbance minimization for Eastern Whip-poor-will(see pg. 15 image). Whip-poor-will surveys will need to be conducted if pit operators are interested in bypassing this timing boundary during any particular year. However, it could be as many as 20 years before pit activity gets within this Category 2 area and if it is determined that Whip-poor-wills are not present at that time, or are no longer considered a SAR, we see no need for a seasonal restriction boundary during that particular year.

The pit operators will be required to register their pit activity with the MECP due to the Bank Swallow nesting taking place here and we recommend they do so.

Wetland

On top of the required 30 m MVCA wetland buffer, it is recommended that a further 15 m buffer be added at the northwest corner of the existing licence boundary, for a total 45 m (see pg. 18 image).

It is recommended that the open water created as part of the closure plan have sloping edges to enhance the creation of littoral zone habitat, and that several small islands be created that could support habitat to species such as waterfowl and turtles.

Woodland

It is recommended that all wooded portions bordering the wetland to the north and west of the existing pit licence area be maintained as woodland.

Wildlife Habitat

To protect painted turtle nesting that occurs beside the current extraction area it is recommended that turtle fencing (see MNR 2013) be installed at the edge of the unvegetated area (see page 23). The dividing line between unvegetated and vegetated areas is distinct in Google maps. It is also recommended that there be no excavation north of the turtle fencing.

Note of Caution

If the proposed below water table expansion were to significantly alter the hydrological regime of the adjacent wetland, this could result in significant impacts to the wetland, to fish habitat, and to significant wildlife habitat. It is our understanding that the hydrological regime will not be impacted, but we defer to the report by Gorrell (2022) in this regard. There is potential for a net ecological benefit from the creation of an aquatic feature here as part of the closure plans resulting in more wetland habitat, more significant wildlife habitat, more fish habitat, and possibly new SAR habitat.

3. Legislative Requirements

Aggregate Resources of Ontario Provincial Standards (AROPS) for Category 1, Class "A" pit below water licence application

As of 2021 the format for aggregate natural environment assessments has changed as described in *Ontario Standards: A compilation of the four standards adopted by Ontario Regulation 244/97 under the Aggregate Resources Act.* Under section 2.2. Natural Environment Report, natural heritage features on or within 120 m of the site need to be investigated. If they are found then: that have been identified as potentially relevant to a pit application

… the report must identify and evaluate any negative impacts on the natural features or areas, including their ecological functions, and identify any pit preventative, mitigative or remedial measures.

Note: A discussion of significant woodlands and valleylands are not required in ecoregion 5E as noted in 2.2 Natural Environment Report of the *Ontario Standards: A compilation of the four standards adopted by Ontario Regulation 244/97 under the Aggregate Resources Act.*

2020 Provincial Policy Statement (PPS)

Issued under the *Planning Act*, the 2020 version of the PPS requires that municipalities consider natural heritage features in assessing development proposals. Guidance on the extent of adjacent lands is provided in a Natural Heritage Reference Manual (OMNR 2010). The adjacent land width for significant natural heritage features is 120 m. Relevant sections from the PPS that apply to the proposed pit expansion are as follows:

2.1.4 Development and site alteration shall not be permitted in:
a) significant wetlands.

2.1.5 Development and site alteration shall not be permitted in:
d) significant wildlife habitat;

NOTE: Significant woodland restrictions within the PPS only apply to ecoregions 6E and 7E. The proposed pit expansion is in ecoregion 5E.

2.1.6 Development and site alteration shall not be permitted in fish habitat except in accordance with provincial and federal requirements.

2.1.7 Development and site alteration shall not be permitted in habitat of endangered species and threatened species, except in accordance with provincial and federal requirements.

2.1.8 Development and site alteration shall not be permitted on adjacent lands to the natural heritage features and areas identified in policies 2.1.4, 2.1.5, and 2.1.6 unless the ecological function of the adjacent lands has been evaluated and it has been demonstrated that there will be no negative impacts on the natural features or on their ecological functions.

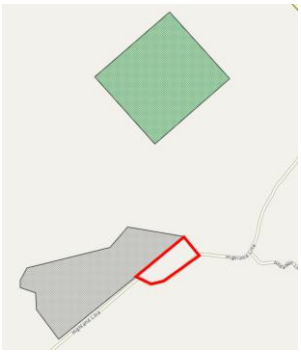
Lanark County Official Plan (2012) Requirements

Relevant Natural Heritage policies from the County Official Plan and Environmental Protection policies from the Township Official Plan require consideration through an Environmental Impact Statement (EIS), and an Environmental Impact Assessment (EIA), respectively. This is due to the proximity of prescribed natural heritage features in the OP. Although the PPS (2020) and the new aggregate policies of 2021 do not require a discussion of significant woodlands in ecoregion 5E, the Lanark County OP has designated Community Forests as significant woodlands, and we note the following from Section 5.5.4 of the OP.

> *…. where Significant Woodlands are located on the Canadian Shield are designated in local Official Plans, development and site alteration may occur on adjacent lands without the need to undertake an Environmental Impact Statement unless it is required in the local Official Plan.*

Relevant Images from the County Official Plans

The adjacent detail is from Schedule A of the Lanark County OP. The green square is marked as significant woodland and it is about 500 m north of the existing licenced area. The black hatched area indicates the existing licensed area, and the red outline is the approximate expansion area.



The adjacent detail is from the Lanark County OP Schedule B Source Water Protection map. The approximate pit license and expansion area is enclosed by the red lines. The green shading represents a significant groundwater recharge area.

Groundwater issues will not be covered directly in this natural environment report, and instead will be addressed by Gorrell (2022).

Township of Lanark Highlands Official Plan (2016) Requirements

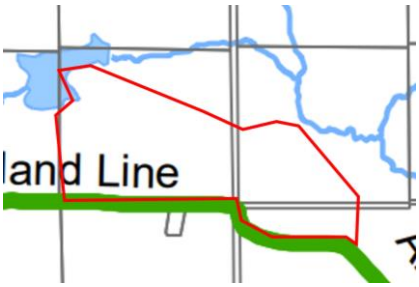
Policies intended to protect natural heritage features are described in Section 5.3 and include:

5.3.1 Endangered or Threatened Species Habitat
5.3.2 Wetlands
5.3.3 Areas of Natural and Scientific Interest (ANSI)
5.3.4 Significant Wildlife Habitat
5.3.5 Fish Habitat
5.3.6 Deer Yards
5.37 Groundwater Protection and Enhancement

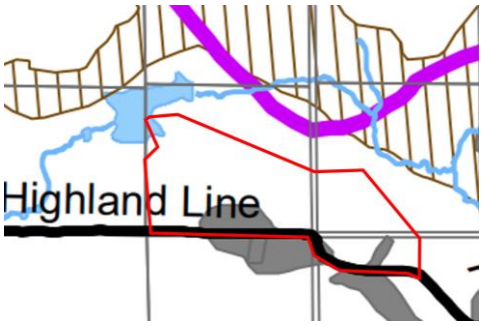
Note: Similar to the PPS (2020) and the 2021 Aggregate Policy for Ecoregion 5E, there is no specific mention of significant woodlands and valleylands in Section 5.3. There is no mention of valleylands at all in the OP, and discussions of significant woodlands are largely absent.

Natural heritage features of note in the Township OP are demoted in Schedule A and Schedule B as follows:

The adjacent detail is from Schedule A of the Township of Lanark Highlands OP, which is intended to show significant wetlands and watercourses. The approximate pit license area and expansion boundaries are enclosed by the red lines. As can be seen, there is no significant wetland noted in Schedule A. The blue areas represent a watercourse, and the larger blue area of water shown to the northwest of the pit license area is supposed to show a pond. From field visits, the existence of this pond is due to beaver activity, and it was largely dry in 2021.



The adjacent detail is from Schedule B: Development Constraints of the Township of Lanark Highlands OP. The approximate pit license area and expansion boundaries are enclosed by red lines. The dark grey associated with Highland Line denotes mineral aggregate reserves, the vertical hatched area at the top of the detail denotes organic soils, and the purple line denotes a deer yard boundary. The boundary of the deer yard would be the upland forest boundary, located about 500 m north of the license area and about 700 m north of the eastward expansion area.



4. Site History

The history of European settlement of these lands dates back to the 1820's and is provided in more detail for this site by Adams (2006). Early settlers would have cleared the land and tried farming, however farmland in Lanark was not particularly profitable and money made from timber harvesting became a necessity to maintain a family, and by the late 1800's much of Lanark County had been cleared (Keddy 1994). Good tillable soil is limited in the County, which meant that farming was never going to be a significant money earner in this region and as a result the marginal farms were abandoned and allowed to regenerate back into woodlands. With its deeper soils, the proposed pit expansion area would have been maintained as farmland longer than the more rugged areas of the County, and farmland along Highland Line south of the pit area is still actively used. Overall, the indication is that the pit area and the expansion area have a 200-year history of notable anthropological disturbance.

5. Methodology

A preliminary Species at Risk (SAR) list was provided by Carolyn Hann (MECP Management Biologist) for this site on Sept 29, 2020. As well, pre-screening for species at risk (SAR) was completed using the MNRF (2018) and MECP (2019a) screening protocols, but also included SAR that were listed in the OP.

The site visits provided in Table 1 are listed by the primary focus of the visit. However, incidental taxa of note would be recorded during all visits. For example, Bank Swallows (Threatened) were observed nesting on April 27, but this was not the primary focus of the visit that day. Habitat communities are described following the methodology outlined in the Ecological Land Classification (ELC) manual for

Southern Ontario (Lee *et al*., 1998) and if applicable, the *Ontario Wetland Evaluation System Southern Manual* (MNR 2002). Photographs of the site were also taken to document natural features observed during the site investigation.

Significant natural features were identified following the criteria outlined in the Natural Heritage Reference Manual (MNR 2010), Significant Wildlife Habitat Ecoregion Criteria Schedules (MNRF 2015) and Significant Wildlife Habitat Technical Guide (MNR 2000).

Breeding bird point count surveys were conducted using methods described in the Ontario Breeding Bird Atlas Guide for Participants (Cadman and Kopysh, 2001) and the Canadian Wildlife Service Forest Bird Monitoring Program. Evening visits were also included to provide a greater level of effort for species active at night such as nightjars and amphibians.

Vascular plant species were used to characterize ELC community types. If specimens could not be identified they would be assessed later using appropriate references (e.g., Gleason and Cronquist 1991; Queen`s University Fowler Herbarium records).

The bat survey methodology was partly based on MNR (2011), MNRF (2014), and MNRF (2015), but was ultimately developed after conversations with Michelle Karam (MECP bat specialist), bat expert Toby Thorne (Toronto Zoo), and Monique Charette (MECP biologist).

Snake surveys were based on SAR snake protocols provided by MNRF (2016). The MNRF also provides protocols for targeted SAR surveys, which are applied where necessary, such as the MNR (2011) Bobolink Survey Methodology the MNR (2012) Whip-poor-will Survey Methodology, and the MNRF (2015) Blanding's Turtle Methodology, and the Canadian Wildlife Service survey protocol (see Jobin et al. 2011) for Least Bitterns.

Table 1 Site visit summary.

Survey Date	Starting Time	Weather Conditions	Surveyor	Main Purpose of Visit
April 7, 2021	1300	17 C, clear	Kenny Ruelland	Herps/SAR
April 8, 2021	1400	20 C, clear	Rob Snetsinger	Herps/SAR
April 27, 2021		12 C, clear	Rob Snetsinger	Herps/SAR
May 2, 2021	700	12 C, clear	Rob Snetsinger	Herps/SAR/Birds
May 19	1700	21 C, clear	Dale Kristensen Rob Snetsinger Kaitlyn Closs	Herps/Bats/Night Birds
May 30	630		Dale Kristensen Rob Snetsinger Kaitlyn Closs	Herps/Bats/Plants/Birds
June 2	2130	25 C, clear	Rob Snetsinger	Herps/Bats/Night Birds
June 5	1050	19 C, clear	Kaitlyn Closs	Herps
June 9	2100	28 C, clear	Rob Snetsinger	Herps/Bats/Night Birds
June 11	700	20 C, clear	Kaitlyn Closs	Herps
June 12	715	20 C, clear	Kaitlyn Closs	Herps
June 22	600	18 C, clear	Dale Kristensen	Herps/Birds
June 23	2100	23 C, clear	Rob Snetsinger	Night Birds

6. Ecological Land Classification

The ELC is based on Banton et al. (2009), which is used for sites in Site Region 5E. The minimum ELC polygon for mapping is 0.5 ha. Habitat types that are less than 0.5 ha., were lumped into the large habitat type. The ELC mapping polygons of Figure 2 are superimposed on a 2021 drone image. The existing licence area is outlined in red, the outward expansion area in blue, and the proposed extraction line with a purple dashed line. The ELC types are outlined in yellow and the ELC codes are described further below.

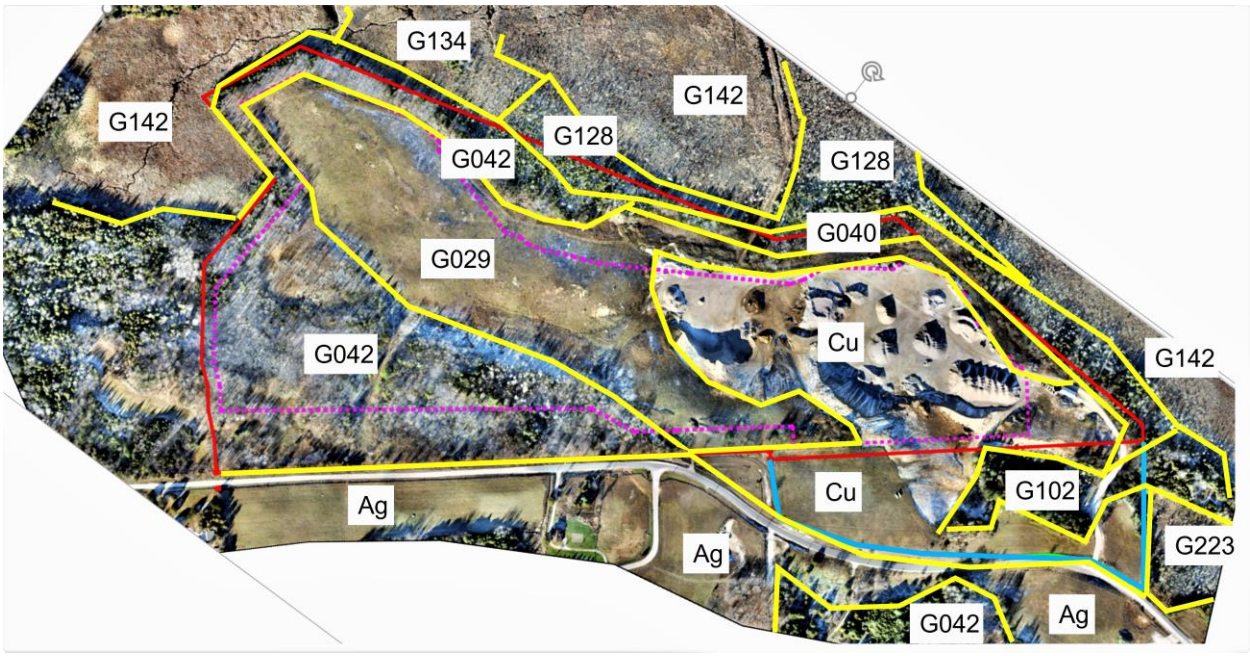


Figure 2. ELC mapping associated with existing licence boundary (red line) and proposed expansion boundary (blue line).

ELC Map Terms (Upland):

Agricultural (Ag): Refers to areas being actively managed for agricultural purposes, including hayfields and cash crops.

Cultural (Cu): Refers to areas that have an ongoing cultural use. Here they refer to the existing operational pit located to the north of Highland Line and the proposed expansion area that includes an area of grassland that has been kept cut short.

Dry, Sandy: Field (G029): Approximately 10.5 hectares, all within the existing licence area. This field has a history of past disturbances and is dominated by non-native grasses and weedy forbs, many of which are non-native species. The vegetative coverage is not dense, likely due to the impoverished nature of the soils.

Dry Sandy: Aspen-Birch Hardwood (G040): An approximate 1 ha. patch, existing as a thin band from 15 to 50 m wide along the north-eastern end of the existing licence area, and acting as a buffer between wetland areas further north and the pit area. The dominant canopy species is *Populus tremuloides*, with lesser amounts of *Betula papyrif*era and *B. alleghaniensis*, *Acer saccharum*, *A. rubrum*, *Abies balsamea*, *Larix laricina*, and *Picea glauca*. The shrub layer includes canopy species saplings, as well as European buckthorn, and *Prunus* spp. Ground cover species include grass spp., and field forbs.

Dry, Sandy: Maple Hardwood (G042): This ELC type wraps around the cleared Dry, Sandy: Field (G029) that encompasses the unexcavated portion of the existing licence area. This G042 area extends westward and southwestward across the Highland Line. However, unlike the woodlands of Wheeler Maple Products, the bulk of the sugar maple trees in the pit property are of a younger age class (20–50 year age range). Sugar maple is the dominant species, but this woodland includes most of the common deciduous and coniferous tree species found in the region. The shrub layer is mostly non-existent, with the non-native invasive European buckthorn being the most prevalent. The ground cover layer is sparse and includes typical ferns and spring ephemerals from this region including wood fern, bracken, cohosh, trillium, sarsaparilla, Solomon's seal, and Canada mayflower.

Fresh, Silty to Fine Loamy: Conifer (G102): This approximately 2.0 ha. patch is bisected by the pit access road, with the largest proportion (~1.3 ha) within the proposed expansion area. It has patchy dominance with some areas being dominated by different conifer species, including balsam fir, white cedar, and white pine. There was no effective shrub layer, and a ground cover layer was largely absent.

ELC Map Terms (Wetland):

Mineral Thicket Swamp (G134): An area of approximately 2.5 ha. located to the northwest of the existing licence area. Primarily dominated by *Alunus rugosa,* but also includes *Salix spp.* and *Cornus stolonifera.* The main emergent observed was *Calamagrostis canadensis,* but also includes several *Carex* spp., *Impatiens capensis, Onoclea sensibilis, Scutellaria galericulata,* and *Ulmus americana.*

Organic Intermediate Conifer Swamp (G128): Located to the north of the existing licence area in two patches. The larger 2.7 ha patch starts about 55 m from the extraction area, and the smaller 1 ha. patch starts about 35 m from the extraction area. The dominant tree species is *Picea mariana*, followed by *Larix laricina, Thuja occidentalis, , Fraxinus nigra, Acer rubrum,* and *Betula alleghaniensis.* Passage through this ecotype is difficult due to large amounts of downed wood debris. The shrub layer is relatively sparse, and mainly occupied by tree saplings. Typical ground cover plants observed include *Cornus canadensis, Coptis trifolia, Maianthemum canadense*, *Equisetum pratense*, and fern and moss spp.

Mineral Intermediate Conifer Swamp (G223): Located directly east of the proposed pit expansion area, this swamp is approximately 1 ha. in size. The canopy is comprised primarily of a mix of *Picea mariana, Abies balsamea, Larix laricina, Betula papyrifera,* and *Acer rubrum.* The shrub layer is comprised of canopy saplings, *Cornus sericea*, *Alnus incana*, and *Salix* spp. The ground cover is variable, but common species observed include *Cornus canadensis, Coptis trifolia*, and *Maianthemum canadense.*

Mineral Meadow Marsh (G142): Refers to three wetland patches located to the west and north of the existing licence area. To the west is an approximate 6 ha area located from 41 to 68 m from the extraction area of the existing licence area. It is a graminoid marsh dominated by *Calamagrostis canadensis* and *Carex stricta*, with lesser amounts of *Typha*, various wetland herbs such as Thelypteris palustris and *Lythrum salicaria,* and sparse shrub patches dominated by *Salix discolor* and *Alnus incana.*

To the north of the existing licence area and associated with a north-south snowmobile trail, is an approximate 9-hectare area of G142 marsh that contains many dead trees (see image below), suggesting a drier history, likely due to beaver activity. It starts approximately 90 m north of the extraction limit. Further east is another G142 type of about 27 hectares that eventually connects to Highland Line. It starts about 75 m north of the existing extraction area.

7. Assessment of Natural Features

7.0 Species at Risk (SAR) (Threatened and Endangered)

A preliminary Species at Risk (SAR) list was provided by Carolyn Hann (MECP Management Biologist) for this site on Sept 29, 2020. As well, pre-screening for species at risk (SAR) was completed using the MNRF (2018) and MECP (2019a) screening protocols, but also included SAR that were listed in the OP.

Restricted Species: There is one restricted Species from the NHIC listings that we are not at liberty to discuss in this report. We have had much experience working with this species and are very aware of its habitat needs. From that, we can confidently say that the pit license area, and the adjacent 120 m, does not represent appropriate habitat. We are available to discuss specific details of this species.

American Eel (Endangered): American Eel have been historically reported for Dalhousie Lake and the Mississippi River, but we could find no records for Long Sault Creek, or its tributary that is associated with the proposed pit area. While eels will travel upstream in shallow streams for short distances, their preferences for deeper waters (>1.5 m) makes it unlikely that they would move through the Long Sault system. It is even further unlikely they would be found in the wetland north of the pit due to blockages provided by at least 3 beaver dams and one section of dense wetland vegetation that contains no water channel. Furthermore, the water associated with the wetland north of the pit area is too shallow to support eels.

Bank Swallow (Threatened): As many as 30+ Bank Swallows were observed nesting in one of the active pit faces. It is not surprising that Bank Swallows were seen as these birds are attracted to the sheer sand faces of sand pits for nest building purposes, and Heneberg (2001) notes that Bank Swallows preferentially move to sand pits over traditional nesting areas due to the good nesting qualities of the sand substrate. As such, it is likely that the Crain-McKinnon pit will continue to provide opportunities for Bank Swallow nesting for many years to come.

If there is a reasonable separation distance of 30 m during the nesting season, it is unlikely that pit activity will impact these swallows. We have observed many examples in Eastern Ontario in pits where Bank Swallows were tolerant to nearby to pit operations if there is no direct destruction of their nests. The pit operators will be required to register their pit activity due to the Bank Swallow nesting and we recommend they do so. Information on how to do this can be obtained from the following link.

http://www.ontario.ca/environment-and-energy/pits-or-quarries-and-endangered-or-threatened-species

A typical restriction usually involves not removing nests during the breeding season (early May to mid-August). The following documents may prove helpful prior to registering:

- Pits & Quarries section of the MNRF Bank Swallow General Habitat Description document.
- Pit and quarry sections of the MNRF (2017): Best Management Practices for the Protection, Creation and Maintenance of Bank Swallow Habitat in Ontario
- Bank Swallow Fact Sheet produced by the Ontario Stone, Sand & Gravel Association.

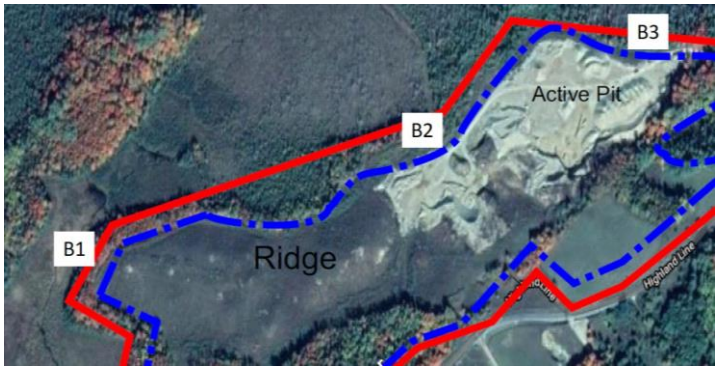
Barn Swallow: Not observed. The existing pit and the proposed expansion area lack suitable nesting structures, and none are known to occur within the adjacent lands.

Bats (Endangered): Four Ontario bat species were added to the Ontario SAR Act because of the impact of White Nose Syndrome, and not from habitat loss. Within several years, this fungus has been able to decimate population numbers because it attacks bats when they hibernate, and since Ontario hibernation sites for these species are limited, this fungus has the potential to wipe out whole populations. The huge reduction in population numbers means that there are extensive areas of summer habitat no longer being used in this region by SAR bats. Consequently, SAR bats are not limited by a lack of summer habitat.

There are a variety of potential bat survey protocols, such as with MNR (2011a), MNRF (2014), and MNRF (2015). However, in correspondence and conversations with the local MECP biologist (Monique Charette), MECP bat specialist biologist (Michelle Karam), and bat expert Toby Thorne, there is yet to be a universally acceptable method for bat surveys in the province.

Snag surveys were completed on April 8, 2021 and repeated on May 19, 2021. The woodlands around the pit area are relatively narrow, ranging in width from 30 to 70 m and three snag transects were run along this entire width. The woodlands on the south side of the pit are younger aged and have experienced recent cutting and contained less than 2 snags/hectare. The woodlands north of the pit contained about 3 snags/hectare. From MNR (2011a), this small number of snags is well below the 10 snag/hectare threshold would otherwise require bat acoustic surveys. However, for the sake of due diligence, bat acoustic surveys were carried out.

Bat acoustic surveys were undertaken using the SM4BAT recorder from Wildlife Acoustics (same equipment used by Michelle Karam, MECP bat biologist). When in flight a bat that passes within about 30 m of the recorder will get recorded if it makes a navigation call, a prey search call, a feeding buzz, or a social call. This call is recorded as a single pass and the number of bat passes per unit time can be used as a measure of bat activity, and also as a way to compare between sites (eg., see Wolbert et al. 2014 Gannon et al. 2003, Hayes 1997, Sherwin et al. 2000, Law et al. 1998, and Thomas 1988). This doesn't necessarily give an indication of an overall population size, but it can give a good indication of bat usage and having undertaken many acoustic surveys over the last 3 years we have developed a good baseline of site comparators.



Over the period of May 30 to June 9, we placed the SM4BAT monitor at three sites along the north edge of the pit area where bat activity should be the highest due to its proximity to a likely foraging area. Over the 10 nights of recording, 2 Little Brown were recorded at B2, and 9 Little Brown and 4 Tri-colored were from B3. It is not unusual for us to record a few SAR bats at any monitoring station as they will forage over several kilometers, but these numbers are far too low to suggest maternity or roost activity. More importantly, all the SAR bat passes were recorded well after sunset, which suggests they were flying in from a distant roost site. Likely from the significant woodland, containing large old trees that is located on the north side of the wetland, about 700 m from the existing licence area.

Pit activity should not be an impediment to continued foraging over the wetland, or even over the pit area itself as bats are very tolerant to nearby human activity. For example, bat numbers are high in urban areas and we have recorded bat foraging activity overhead a downtown city festival containing large crowds of people. Furthermore, bats are only active at night when pit operations are shut down.

The closure plan for the pit will result in the formation of a small lake at this site, that is expected to develop wetland features over time. This is seen as a potential benefit to bats in that it should result in higher insect production for foraging purposes.

It is our understanding that the outer band of trees around the pit licence area will be maintained in a buffering capacity. Like woodlands throughout the region, these trees could be used for roosting purposes at some point. As a general precaution for avoiding harm to SAR bats, we recommend that no trees be removed during the maternity/roost season (April 15 to Sept. 15).

Blanding's Turtle (Threatened): Blanding's Turtles are known to this region, with their favored habitat being that of isolated, but interconnected wetlands with open water. In this regard, the wetland to the north of the existing licence area does not represent favored habitat. No Blanding's Turtles were observed during the field work, that included the placement of a game camera for 33 days on the most suitable open water area associated with the pit licence area. Only Painted Turtles were observed.

Bobolink (Threatened): The closest posting in eBird is about 6 km away and about 18 km away in iNaturalist. No Bobolink were observed on site, nor in the adjacent fields on other side of the Highland Line.

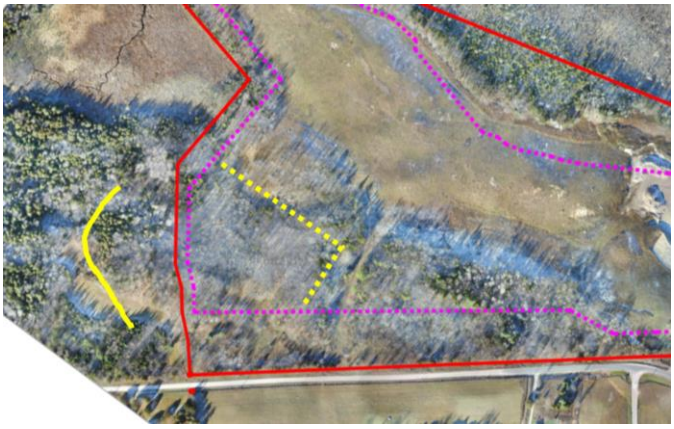
Butternut: Not observed. The closest sighting that we are aware of is more than 4 km to the north.

Eastern Meadowlark (Threatened): A 2017 eBird record by the North Leeds Birds covering a 9.5 km stretch of Highland Line lists 1 Eastern Meadowlark. A similar posting is made in 2003 by Birds Canada for Highland Line. The closest posting in iNaturlist is about 20 km away. During the breeding bird surveys, three Eastern Meadowlark were observed in a hay field south of Highland Line (see red circle in adjacent image) on May 30. A single incident sighting could indicated that the meadowlarks were passing through, but if they were nesting it would put the expansion area and the existing licence area within Category 3 habitat and possibly Category 2 habitat, depending on nest location.

In our experience, Eastern Meadowlark are tolerant of nearby human activity. For example, we have observed them nesting in a small 1 ha. field within the City of Kingston surrounded by houses and apartment buildings, as well as nesting within several meters of busy highways. Impacts could be caused by direct intrusion and disturbance of the nest, which would not be the case with any pit activity as it won't be occurring on the south side of Highland Line. Nevertheless, the construction of the required berm along the north side of the Highland Line should provide sufficient sight and sound buffering. It is our understanding that construction of a berm will be a site plan condition for licence expansion approval, and therefore does not need to be a specific recommendation of the Natural Environment report. However, it is recommended that extraction proceed from the north to the south towards Highland Line, such that extraction machinery will be mostly out of sight behind the berm and the height of the aggregate face.

Eastern Whip-poor-will (Threatened):

Whip-poor-will were calling (see solid yellow line in adjacent image) from the woodland that is west of the existing pit licence area (see Table 1). On May 19, three were calling from this area. On June 2, 9, and 23 only one was calling from this area. This change in numbers is not unusual in the early part of the season as Whip-poor-will compete for prospective sites. Whip-poor-will were also heard on the June nights in proximity to Highland Line, about 800 m west of the pit area.



We often find Whip-poor-will in the vicinity of active pits and quarries, which can also be borne out with a search of eBird records. This may either reflect the landscape that supports these geological features, or it could be that Whip-poor-wills are attracted to the open areas of pits and quarries for aerial feeding and will use adjacent woodlands for nesting. From MNR (2013) the distance of 20 m to 170 m (Category 2) from a nest is considered the approximate defended

territory and is considered to have a moderate tolerance to alteration. We don't consider a pit operation to be a significant source of disturbance, as it does not involve blasting, and the pit operation does not operate at night when Whip-poor-wills are active, and there is little reason why Whip-poor-wills cannot be active over a pit in the evening, especially as there is much evidence to suggest that they are attracted to pits. Nevertheless, we would expect most night feeding flights to focus on the wetland areas further north as these would more likely contain a higher density of aerial insect prey. Nevertheless, a seasonal Category 2 extraction restriction boundary from April 15 to July 31 (after Weir 2008) is recommended at the southwest end of the existing licence area to provide an extra layer of disturbance minimization (see dashed yellow line in above image. Whip-poor-will surveys will need to be conducted if pit operators are interested in bypassing this timing boundary during any particular year. However, it could be as many as 20 years before pit activity gets to within this Category 2 area and if it is determined that Whip-poor-wills are not present at that time, or are no longer considered a SAR, we see no need for a seasonal restriction boundary during that particular year. Category 3 habitat is mainly for foraging, and it has a high level of tolerance to alteration, and in this regard, daily pit activities are not considered a detriment to these birds for reasons discussed above.

Table 1. Whip-poor-will results of four site visits.

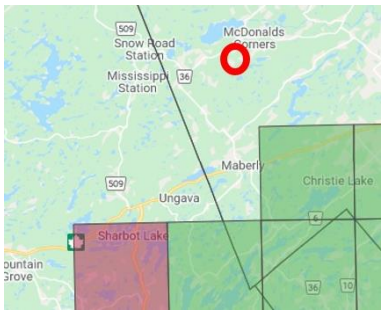
Date (2021)	Beaufort Scale	Background Noise	Call Detail
May 19	0	0	3 calling from forest west of pit licence area, off property about
June 2	0	0	1 calling from forest west of pit licence area, off property about
June 9	0	0	1 calling from forest west of pit licence area, off property about
June 23	0	0	1 calling from forest west of pit licence area, off property about

Flooded Jellyskin (Endangered): There are records in this region (see COSEWIC 2015). It is commonly associated with ash trees and requires humid habitat that is both calcareous and subject to seasonal flooding. Ash trees were largely lacking in the surrounding woodland and this area is not prone to seasonal flooding.

The area around the pit shown with blue in the adjacent image is described in the Ontario Geological Survey to be in Unit 46, which is composed of carbonate metasedimentary rocks of the Grenville Supergroup and Flinton Group that includes marble, calc-silicate rocks, skarn and tectonic breccias. As a result, bedrock conditions in the blue area (i.e., calcareous) are favorable for this lichen. Accordingly, field surveys focused on the wetland/upland interfaces where appropriate conditions might occur, with a specific search for lichen bearing ash trees. No Flooded Jellyskin were observed.

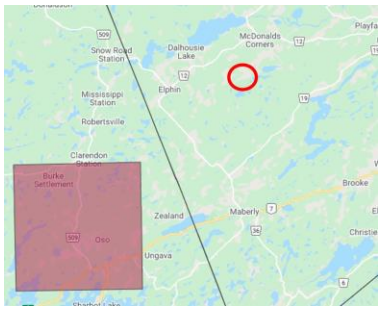
Gray Fox (Threatened): This species is considered a habitat generalist (see ECCC 2018/MECP2019b) and the mix of deciduous woodland and open habitat associated with the pit area represents suitable habitat. However, there are few records from this region in ECCC 2018/MECP2019b and there are no Gray Fox postings in iNaturalist within 50 km of the pit area. No Gray Foxes were observed during the field work.

Gray Ratsnake (Threatened): The pit expansion area (red circle in adjacent image) is beyond the northern range of the ratsnake, as indicated by the red and green squares in the adjacent detail from the Ontario Herp Atlas, although there is a potential sighting in iNaturlist within 10 km area of the pit area. This northward limit is partly due to the shorter season that inhibits this obligate thermoregulator from completing its life cycle.



No ratsnakes were observed during the field work, and the pit licence area and expansion area are mostly too open for snake use from the perspective of predator avoidance and foraging. The site also lacks hibernacula and nesting features.

Hog Nosed Snake (Threatened). The proposed pit expansion area (see red circle) is outside any demonstrated range of the Hog Nose Snake from the Ontario Herp Atlas, where the bulk of the sightings are over 100 km to the west. There is a single Herp Atlas square posting from before 1999 (see red square in adjacent image), but it is from more than 10 km away. No Hog Nosed snakes were observed during the field work.



Least Bittern (Threatened): In eBird the closest posting is from 2013 along the Elphin Maberly Line, more than 6 km away from the proposed pit area. There are no nearby postings in iNaturalist. Nevertheless, Least Bittern surveys were carried out as prescribed in Jobin et al. (2011), and none were detected. This was not particularly surprising as most postings in eBird end near Perth, suggesting that Least Bitterns do not range into this area, and the adjacent portions of the wetland do not contain good Least Bittern habitat features, which would be wetlands with more extensive areas of open water with an emergent vegetation edge.

Monarch Butterfly: Not observed and the open areas of the existing licence area had minimal amounts of milkweed. The closest sighting that we are aware of is more than 5 km to the north.

Pale Bellied Frost Lichen (Endangered). The closest sightings we are aware of is 33 km away on Darling Long Lake and 25 km to Palmerston Lake. It requires a nearby larger water body to provide the appropriate conditions of humidity (Environment Canada 2016) and this is not present here. As well, the adjacent woodlands on site are too narrow, which would allow too much air flow to support the necessary humid conditions. None were observed.

Wood Turtle (Endangered): Despite possible historical references in Central Ontario and associated research (e.g., Amato et al., 2007) there are no Wood Turtle sightings that we are aware of that would be relevant to the proposed pit expansion area. Furthermore, there are no sightings posted in iNaturalist for the province of Ontario, and none were observed during the field work.

7.1 Wetland

The Lanark County and Lanark Township OP's do not recognize provincially significant wetland on or within 120 m of the existing pit licence area or the proposed pit expansion areas. There is an approximate 129 ha. wetland that gets as close as 55 m to the north and west portions of the proposed extraction boundary of the existing licence area and is immediately east of the proposed expansion boundary. The following detail from the Mississippi Valley Conservation Authority (MVCA) shows an estimated boundary of "non-evaluated" wetland in green, the MVCA regulation limit of 30 m from the wetland in yellow, our inclusion of the expansion boundary in red, and a recommended further 15 m buffer in light blue. Other than a few minor changes, the MVCA wetland boundary mapping is very similar to the wetland mapping evident in Figure 2 of this report.

The proposed extraction line for the existing licence area will not extend beyond the 30 m MVCA regulation line. No proposed extraction line is yet proposed for the expansion area, but it is recommended that the MVCA regulation limit be respected at its eastern end.

The MDMNRF considers non-evaluated wetlands as significant, until a wetland proves otherwise. This policy might seem redundant with the advent of Conservation Authority waterways regulations that prohibit development in all wetlands, not just provincially significant wetlands. However, it is reasonable to expect a wetland of this size (i.e., 129 ha.) to score as significant.

The MVCA enforces *Ontario Regulation 153/06, Development, Interference with Wetlands and Alteration to Shorelines and Watercourses Regulation.* Constraints stemming from the regulation are described in MVCA (2019), which includes Section 7.0, which pushes for a 15 m setback from the stable top of slope. We concur with this setback distance and recommend 15 m be out from the woodland edge be added as a buffer at the northeast end of the existing licence area (see blue line in the above figure).

The ELC section of this report describes four wetland communities within 120 m of the existing and expansion pit areas. A meadow marsh (G142), a thicket swamp (G 134), and two conifer swamp types (G128, and G 223). The first three types described above will all be buffered by an intervening woodland, and the last type will be buffered by field habitat

Biological features, such as diversity are not expected to be impacted by the proposed pit due to a lack of biological interactions between the type of upland and the adjacent wetland. The existing pit licence area would have little value to wetland species in their needs for life cycle completion, and ongoing significant

changes to wetland features such as diversity appear to be controlled by factors (i.e., beaver activity) unrelated to adjacent upland land use.

Features of significance that might be relevant to the wetland such as fish habitat and significant wildlife habitat are discussed under separate headings in this report.

The closure plan calls for the conversion of the pit licence area to a small lake that will no doubt develop wetland features as it become colonized by wetland plant and animal species. This is seen as a net wetland gain to the pit project. It is recommended that the "lake" have sloping edges to provide littoral zone habitat, and that several small islands be created that could support habitat to species such as waterfowl and turtles.

It is our understanding from Gorrell (2022) that the creation of the lake will not pull water away from the existing wetland, as this could result in a negative impact to the adjacent wetland.

In summary, no impacts from the proposed pit activities to the adjacent unevaluated wetland are expected due to a lack of potential wetland/upland interactions, the length and nature of the intervening buffers, and the relative benign nature of normal pit operations. Furthermore, the creation of the lake and expected formation of wetland features will result in a net increase in wetland.

7.2 Area of Natural and Scientific Interest (ANSI)

There are no identified ANSI's within 120 m of the pit expansion areas. In this regard, we refer to the following excerpt from Section 4.4 of the Natural Heritage Reference Manual.

> *The need to evaluate the ecological function of adjacent lands (i.e., undertake an EIS or equivalent study) would be removed if proponents choose to avoid having development and site alteration occur within the extent of adjacent lands.*

Accordingly, no further analysis is warranted regarding ANSI's.

7.3 Woodlands

The pit associated woodlands are in Site Region 5E and in the Canadian Shield. They are also within the Township of Lanark Highlands that has woodland cover of over 70% (see MVCA 2011 and 2019), indicated a healthy woodland coverage. A woodland impact assessment is not necessarily required as per the wording in the PPS, Natural Heritage Reference Manual (OMNR 2010), and the updated 2021 Aggregate Policy for Ecoregion 5E. Furthermore, neither the Lanark County or the Lanark Highlands OP's denote the presence of significant woodland on or within 120 m of the pit expansion areas. Nevertheless, the wooded areas that border the wetland provide a valuable riparian function for both habitat use, bank stabilization, and buffering to the adjacent wetland that contains fish habitat and significant wildlife habitat. Accordingly, it is recommended that all wooded portions bordering the wetland of the existing pit licence area be maintained as woodland.

7.4 Wildlife Habitat

The Significant Wildlife Habitat (SWH) Criteria for Site Region 5E (MNRF 2015) describes thresholds for habitat significance of specific types of SWH. Analysis of each type is provided below under the four following headings:

- Seasonal concentration areas
- Rare vegetation communities or specialized habitats for wildlife
- Habitats of species of conservation concern, excluding the habitats of endangered and threatened species.
- Animal movement corridors.

Seasonal Concentration Areas:

Habitats of seasonal concentrations of animals apply when they occur in high densities for specific periods in their life cycles. As described in MNRF (2015), these areas are generally localized and small in relation to the area of habitat used at other times of the year. MNRF (2015) lists 13 types of seasonal concentration habitats for consideration.

Waterfowl stopover and staging areas (terrestrial): Requires seasonally flooded terrestrial communities, which are not present within 120 m of the existing and the proposed pit area.

Waterfowl stopover and staging areas (aquatic): The wetland areas within 120 m of the existing and proposed pit expansion areas lack sufficient open water to support significant waterfowl stopover or staging.

Shorebird migratory stopover area*:* Requires shoreline habitat which is not present on or within 120 m of the existing and proposed pit expansion areas.

Raptor wintering area*:* Requires a combination of fields (for mammal productivity) and woodlands (for roosting), which are present, but the sparsely vegetated and cropped fields of the pit area would not provide suitable mammal productivity to support raptor wintering. It is conceivable that the hay fields to the south might support this functionality, but there are no records of raptor threshold species for this area.

Bat hibernacula*:* These are found in crevice and cave ecosites, which were not observed on or within 120 m of the proposed pit.

Bat Maternity Colonies: The MNR (2015) threshold for SWH bat maternity colonies requires mature woodlands with more than 10/ha large diameter (>25 cm dbh) wildlife trees. The hardwood woodland periphery around the pit is mostly younger aged (adjacent image) and the tree diameter threshold was not met. There were also very few snag trees present and accordingly, the thresholds for significant bat maternity were not met and no further analysis is necessary.

However, in the interests of due diligence, acoustic monitoring was undertaken. The second order of significance for Bat Maternity Colonies is having more than 10 Big Brown Bats and 5 Silver-haired bats within a colony. This can be determined with capture/recapture, but this is rarely done due to costs and concerns to bat well being. It can also be done by exit surveys, but in our experience, and from attending MNRF workshops, this method has a low probability of success. From our numerous bat acoustic monitor sets undertaken in the last three years throughout Eastern Ontario, we know that bats will be recorded at every site where the monitors are placed, and it is our opinion (and noted in the scientific literature) that the number of passes/hours can provide an estimate of bat numbers. For example, at a Big Brown maternity reference site near Sydenham that averages around 15 bats/year, an average pass rate of about 140/hour is not uncommon.

A bat monitor was located at three locations on larger diameter snag trees where it was felt that the potential for recording the highest bat activity was good due to the adjacent wetland.

As expected, bats were recorded by the monitors (Table 2), but the pass/hour numbers were well below what we expect of a maternity roost. We do note that there is a significant woodland starting more than 550 m north of the pit, and the bats from Table 2 could be flying in from there on foraging flights over the wetland.

Table 2. Bat acoustic monitoring

Date In and Out (2021)	Site	Results – passes/hr
May 30 (evening) June 2 (morning)	B1	Big Brown: 2.4 Silver: 8.6
June 2 (evening) June 5 (morning)	B2	Big Brown: 8.7 Silver: 6.4
June 5 (evening) June 9 (morning)	B3	Big Brown: 5 Silver: 1.5

***Turtle Wintering Areas**:* Two potential turtle SWH wintering area were noted in proximity to the pit licence area in the adjacent image (see T1 and T2). Basking surveys were conducted at both sites and a game camera was set up at two locations at T1 for 33 days. Only Painted Turtles were observed, and the highest number of turtles at any one time at T1 was six, starting about 80 m from the licence boundary. The highest number at any one time at T2 was 15, but all sightings were more than 120 m from the proposed extraction boundary.

Due to presumed beaver activity in 2021, the water levels in T1 became too shallow to support overwintering. Overwintering at area T2 should be possible within the two drainage ditches

located on either side of the snowmobile trail that runs through the wetland, with appropriate depths beginning about 190 m north of the extraction boundary.

Threshold numbers of turtles for overwintering SWH within 120 m were not met. On the assumption that water levels at T1 return to appropriate depths for turtle wintering, impacts are not anticipated as there will be no direct aggregate related intrusion into this area, and it will be setback about 80 m from the extraction area, behind an intervening treed buffer.

Snake hibernaculum: MNRF (2015) notes that sites located below the frost line in burrows, rock crevices, and other natural locations are needed. These areas should also have proper moisture levels to keep reptile from drying out during the winter, and south facing slopes are preferred in providing more moderate winter conditions. No hibernacula features were observed within the licence area or the expansion area, or expected due to its topographic features.

Colonially -Nesting Bird Breeding Habitat (Bank and Cliff): Nesting sites for these species includes eroding banks/cliffs, sandy hills, quarries, steep slopes, rock faces or piles. Bank Swallow nesting was observed in sand piles of the existing pit and this is discussed in Section 6.0 Species at Risk.

Colonially -Nesting Bird Breeding Habitat (Trees/Shrubs): No heronries were observed on or within 120 m of the proposed pit.

Colonially -Nesting Bird Breeding Habitat (Ground): The required rocky islands or a peninsula within a lake or large river is not present.

Deer Yarding Areas: Deer yarding areas in Lanark County have been identified, and these are well to the north (i.e., >120 m) from the proposed pit expansion area. We observed no evidence of significant deer use (e.g., well warn trails, scats, browse damage) that would indicate significant yarding or winter congregations.

Rare Vegetation Communities:

Rare vegetation community types are those with SRANKS of S1 to S3 (i.e., extremely rare - rare - uncommon in Ontario). MNRF (2015) lists the following rare types for site region 5E: Beach/Beach Ridge/Bar/Sand Dunes, Shallow Atlantic Coastal Marsh, Cliffs and Talus Slopes, Rock Barren, Sand Barren, Alvar, Old Growth Forest, Bog, Tallgrass Prairie, Savannah, Red Spruce Forest, White Oak Forest. None of these types is present on or within 120 m of the proposed pit. The proposed pit extension is found within the Bancroft Ecodistrict 5E-11, where Henson and Brodribb (2005) identify Atlantic Coastal Plain Shallow Marsh Type (S2), Dry Black Oak – Pine Tallgrass Savannah Type (S1), and Dry Tallgrass Prairie Type (S1). None of these habitat types were observed on or adjacent to the proposed pit area.

Specialized Habitats for Wildlife

Waterfowl Nesting Area*:* The potential waterfowl nesting area extends 120 m into the upland from wetland habitats G129-G135, and G142-G152. To be considered SWH, there needs to be at least 3 or more nesting pairs of the listed species, excluding Mallards, or 10 or more nesting pairs of the listed species, including Mallards. Only Wood Ducks were observed in a flyover, and therefore the threshold for possible significant waterfowl nesting was not observed.

Bald Eagle and Osprey Nesting, Foraging and Perching Habitat: Although both species are known to occur in this region, neither were observed within 120 m of the existing and proposed pit expansion areas. Furthermore, the adjacent wetland lacks the necessary open water that would support foraging activity.

Woodland Raptor Nesting Habitat*:* None of the candidate raptor species were observed, and no raptor nests were observed. The probability of nesting is also low because the adjacent woodlands are mostly composed of younger aged trees.

Turtle and Lizard Nesting Areas*:* Eight recently depredated turtle nests were observed within a partially vegetated area adjacent to an area of active pit activity. At this location, the distinction of active pit activity is noted by aggregate piles, vehicle routes, and no vegetation. Raccoons were observed nearby and were the likely culprits for nest depredations.

The nests extended across an approximate 90 m length marked by the orange rectangle in the adjacent image. Turtles were observed basking on logs within the drainage ditches on either side of the snowmobile trail north of the existing licence area, and it is likely that they move south (see dashed orange line in adjacent image) through the easily passable snowmobile trail to access the nesting area.

Only Painted Turtles have ever been observed here and the presence of 5 or more nests constitutes SWH. This nest area is currently not at risk from excavation as it is our understanding that the pit has reached its floor depth here. However, inadvertent vehicle damage could occur, and it is recommended that turtle fencing be installed (see MNR 2013) at the edge of the unvegetated area to prevent this. This line is clearly visible in Google map images, and varies from 10 to 30 m from the northern tree line.

The pit application is asking to go below grade here and it is recommended that there be no excavation north of the turtle fencing.

Seeps and Springs*:* None found.

***Aquatic Feeding Habitat**:* This category is mainly intended for aquatic areas used by feeding moose. Open water areas of the adjacent wetland are small and mostly devoid of the submergent aquatic vegetation that would attract feeding moose. No moose sign was observed during the field work, but white tail deer sign was (tracks and scats), and sightings of moose in this general region south of Dalhousie Lake are sparse. White tail deer sightings are also more numerous in this region, which can be a negative indicator for moose due to parasite transfer issues.

***Mineral Licks**:* No seepage areas were observed, and there were no track concentrations which might suggest a feature being exploited by Cervids.

***Denning Sites for Mink, Otter, Marten, Fisher, and Eastern Wolf**:* Mink, otter, fisher, and the Eastern wolf are present in the region, but no potential dens were observed, nor evidence of extensive use by these species such as otter runs, scat piles, or tracks.

***Amphibian breeding habitat* (woodland):** There are no woodland ponds associated with the pit area. Numerous logs were turned over looking for salamanders and none were observed.

***Amphibian breeding habitat* (wetland):** Requires wetlands and pools > 500 m^2. Four wetland sites were surveyed (see 1 to 4 in following image) and one pool (see 5 in following image) using the marsh monitoring protocol (BSC 2009). Field data are provided in Table 3. To be considered SWH, requires a Call Level Code 3 for indicator species or the presence of listed salamander species. No s

Table 3. Marsh Monitoring Protocol results of three site visits (2021).

Site	Beaufort Scale (on 3 visits)	Call Level Code (1,2,3): TF –Tree Frog, WF – Wood Frog, SP – Spring Peeper, AT- American Toad			Background Noise Code
		April 8 (8 C)	May 19 (21 C)	June 2 (25 C)	
1	0,0,0	SP1	SP2 TF1	No calls	0,0,0
2	0,0,0	LP1 SP3	SP3	SP3 GF 1	0,0,0
3	0,0,0	WF2 SP2	SP3	SP3	0,0,0
4	0,0,0	WF2 SP2	SP3 AT1	SP3	0,0,0
5 Pit Pond (<500 m^2)	0,0,0	No calls	SP 1 TF 1 AT1	SP1 TF 1	0,0,0

Other incidental amphibian species observed at other times included leopard frogs at Site 1 (in low numbers) and green frogs and leopard frogs at site 3 (in low numbers) and these latter observations were more than 120 m from pit licence boundary.

As can be seen in Table 3, only Spring Peepers attained Call Level 3, but these are not a SWH indicator species for amphibian breeding in wetlands. The Pit Pond was surveyed, but because it is less than the required 500 m^2 threshold size, it cannot be considered SWH. Regardless, Call Level Code 3 numbers were also not met for the pond.

Mast Producing Areas: White tailed deer, Wild Turkey and black bear are known to this region. The most important indicator is a mature forest >0.5 ha containing numerous large beech and red oak trees that supply the energy-rich mast that wildlife prefer. The woodlands associated with the existing pit licence area and the pit expansion area are either dominated by younger sugar maple trees or coniferous trees. While a few mast trees are present, they do not meet the threshold for having 50% coverage of mast tree species in the 40 to 65 cm DBH range. Furthermore, the forest understory is sparsely covered in mast shrub species, and most open areas lack mast shrub species.

Habitat for Species of Conservation Concern

Marsh bird breeding habitat: Three sites were chosen (see adjacent image) to survey for SWH marsh bird breeding habitat as they all contained the required shallow water with emergent vegetation. Swamp areas were also surveyed, but they did not contain appropriate emergent vegetation features.

The potential for Sites 1 to 3 to contain SWH was not high as they did not have much open water that would support use by aquatic waterfowl.

Of the indicator species, an American Bittern was observed at Site 1, but consistently calling from an area of wetland well over 120 m from the existing licence area. A Marsh Wren was heard from Site 2 but calling from an area of wetland well over 120 m from the existing licence area. Three Sandhill Cranes were observed in the open fields of the existing licence area on April 8. This would have been a migratory stopover, as they were not observed after that.

Due to a lack of sufficient numbers of indicator species nesting in the wetland, the threshold for SWH marsh bird breeding habitat was not met.

Open country bird breeding habitat: Requires grassland habitat 30 ha or larger in size. Fields of this size are not present within 120 m of the existing licence area and the proposed pit expansion area.

Shrub/early successional bird breeding habitat: This requires large fields (>30 ha) succeeding to shrub and thicket habitat. This is not present within 120 m of the existing and proposed pit expansion areas.

Special concern and Rare Wildlife Species: Provincial S1, S2, and SC species that are not threatened or endangered (see Table 4).

Table 4. Potential SAR species associated with the pit. Source #'s refer to: 1. Henson and Brodribb, Bancroft Ecodistrict 5E-11 (2005). 2. MNRF (2018) screening protocol (ebird, iNat, NHIC grids 18UQ7877, 7977, 7876, 7976) 3. Lanark OP 4. Field Observations 5. Carolyn Hann (MECP)

Species	Preferred Habitat	Source	Suitable Habitat	Seen <120m
Mammals				
Southern Flying Squirrel (SC)	Woodlands	1	Yes	No
Reptiles				
Snapping Turtle (SC)	Prefer lakes or large rivers with soft bottoms.	2,5	No	No
Five Lined Skink (SC)	Rock Barrens	1,3	No	No
Eastern Ribbon Snake (SC)	Riparian habitat	3	Yes	No
Murk Turtle (SC)	Open water wetland with lily pads	3	No	No
Birds				
Wood Thrush (SC)	A range of woodland habitats	1,2,5	Yes	Yes
Black Tern (SC)	Open water wetlands	1,3	No	No
Cerulean Warbler (SC)	Large mature deciduous woodlands with extensive core habitat	1	No	No
Wood-pewee (SC)	Mature woodlands	2,5	Yes	No
Bald Eagle (SC)	Mature woodlands in association with large water bodies	1,2	No	No
Red-headed Woodpecker (SC)	Open woodlands	1	No	No
Louisiana Waterthrush (SC)		1		No
Plants				
Rams Head Lady Slipper (S3)	Moist coniferous woodlands, usually in proximity to wetlands.	1	Yes	No
Alpine Woodsia (S2)	Calcareous cliffs	1	No	No
Fogg's Goosefoot (S2)	Woodlands, cliffs, rock outcrops	1	Yes	No
Auricled Twayblade (S3)	Alder thickets with alluvial sand	1	No	No
Drooping Bluegrass (S3)	Grasslands	1	Yes	No
Little Prickly Pear Cactus (S3)	Rock barrens	1	No	No
Hidden Fruited Bladderwort (S3)	Wetlands	1	Yes	No
Scrub Oak (S1)	Woodlands	1	Yes	No
Insects				No
Ebony Boghaunter (S2)	Bog habitat	1	No	No

Wood Thrush: One Wood Thrush was calling on two of the site visits, but from well inside the adjacent woodland to the west and therefore well outside of any potential impact range, and in our opinion, mitigation is not required.

Animal Movement Corridors

***Amphibian Movement Corridors**:* Amphibian movement corridors refer to areas that provide movement zones between breeding and summer habitat. To be significant, corridors should consist of native vegetation, not be crossed by roads, and have no gaps such as fields or waterways. The fields and various gaps (eg., roads) of the existing and proposed pit expansion areas do not have these features and therefore would not act as amphibian movement corridors.

***Cervid Movement Corridors**:* Deer movement corridors are those associated with deer wintering habitat. Regional deer linkages and winter deeryards have been identified for Lanark County and none are associated on or within 120 m of the proposed pit expansion area.

Furbearer Movement Corridor: Intended to protect otter and mink denning sites and movement to and from those sites. These are typically found within a riparian area of a lake, river, stream, or wetland. No sign of mink or otter were observed during the field visits or picked up on the game camera. The limited open water and associated fish habitat within 100 m (i.e., the denning site distance threshold) limits its potential as SWH for otter. Any movement of mink or otter in association with the existing licence area and the proposed pit expansion area would be on the northern and western woodland edges. These are outside of any excavation area, and therefore, even if corridor use occurred here, there would be no interference.

Exceptions for EcoRegion 5E

Eco-District 5E-11 – Rare Forest Types: Jack Pine: Any forest stand with more than 40% jack pine coverage is to be considered significant. This is not present within 120 m of the existing and proposed pit expansion areas.

7.5 Fish Habitat

Fish habitat features are largely lacking in the adjacent wetland due to the density of wetland vegetation. As a result, it is mostly confined to a few channels and a beaver pond, as shown in the adjacent image. The distances refer to proximity to the extraction area, although no further extraction is expected at the 120 m and 90 m sites as it is our understanding that this area has reached the pit floor. All three areas are buffered by dense intervening vegetation.

The fish habitat north of the existing and proposed pit expansion area exists in wetland that connects to Long Sault Creek. As a tributary to the Long Sault Creek, it originates in a wetland area that is over 600 m west of the pit at the corner of Highland Line and the 12th Concession Line. From there, it follows a meandering 2.5 km creek before connecting to Long Sault Creek about a kilometer east of the 9th Concession Line.

Fish sampling with seine nets was undertaken by Muncaster Environmental Planning Inc (2006) within open water areas north of the pit licence area signified by "~ 120 m" in the above image. These open water areas are found on either side of a snowmobile trail. The Muncaster (2006) catch results are presented in Table 5. Tolerance levels, thermal regimes and status in Table 5 were provided by the Ontario Freshwater Fishes Life History Database (http://www.ontariofishes.ca/home.htm), which credits Freshwater Fishes of Canada by Scott and Crossman (1973) as a primary information source.

Table 5. Muncaster (2006) fish sampling results.

Common Name	Tolerance Level	Thermal Regime	Status
Brassy Minnow	Intermediate	cool	common
Brook Stickleback	Intermediate	cool	common
Central Mudminnow	Tolerant	cool	common
Creek Chub	Intermediate	cool	common
Finescale Dace	Intermediate	cool	common

Northern Redbelly Dace	Intermediate	cool	common

These results are like those from electrofishing efforts at two sites at the 9th Concession Long Sault Creek crossing which caught Carps, Common Shiner, Creek Chub, Finescale Dace, White Sucker, and Northern Redbelly Dace (see Long Sault Creek 2015 GeoHub data). The MNRF Fish ON-Line database has 2011 data for the main body of Long Sault Creek that crosses the 9th Concession Line as containing Brook Trout, Brown Bullhead, Burbot, Northern Pike, Pumpkinseed, Rock Bass, White Sucker, and Yellow Perch. Brook Trout have been historically stocked in the creek.

Except for Brook Trout, all of the fish caught in Long Sault Creek have a tolerance level of either Tolerant or Intermediate. Brook Trout are considered Intolerant and are thus more sensitive to impacts. In our opinion, the potential for Brook Trout to be found in the wetland system within 120 m of the existing and proposed pit expansion areas is low due to the many fish obstructions between this area and Long Sault Creek including three beaver dams, and dense areas of wetland vegetation.

As can be seen with their associated tolerance levels in Table 5, none of the fish caught near the pit by Muncaster (2006) would be sensitive to adjacent impacts and all are common species. As previously noted, most fish habitat is well setback from potential pit excavation areas, and all the intervening distances are densely vegetated with both wetland and upland vegetation. In our opinion, this is more than adequate to mitigate potential surface impacts to fish associated with the proposed pit expansion. It is also our opinion that silt screens are unnecessary due to the setback distances, and the intervening vegetation.

A potential negative impact to the fish habitat may occur if water is drawn away from the watercourse/wetlands from the below water aspect of the pit expansion application license. We are not qualified to discuss the hydrological aspects of this but would be looking to the hydrological report by Gorrell (2022) to show that there is little risk of water level changes in the adjacent wetland/water course.

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9. Qualifications

Ecological Services has been in operation in eastern Ontario since 1985. Our experience includes environmental impact assessments, management plans, wetland evaluations, and municipal land use planning. We have research experience in aquatic ecology and chemistry, forest fragmentation, avian ecology, and fisheries ecology.

We have worked with government at the federal, provincial, local and international levels. Other clients have included Crown corporations, planning and engineering firms, developers, and local groups. Our association with Queen's University provides us access to current and broad-based research, and also provides us with a pool of expert associates. A work prospectus is available at http://ecologicalservices.webs.com**.**

Report preparation was carried out by Rob Snetsinger.

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8. Appendix 1: Plant List

9. Appendix 2: Bird List

10. Appendix 2: Herp and Mammal List

Herps

Painted Turtle	Up to 30 basking on logs north of pit and captured in game camera
Leopard Frog	Wetland areas
Green Frog	Wetland areas
Spring Peeper	Wetland areas
Tree Frog	Wetland areas
Wood Frog	Wetland areas
American Toad	Wetland areas

Mammals

White Tailed deer	Tracks in pit areas
Racoon	Tracks and captured on game camera
Red Squirrel	Woodlands
Chipmunk	Woodlands
Coyote	Scats and tracks
Big Brown Bat	Recorded by acoustic monitor
Eastern Red Bat	Recorded by acoustic monitor
Hoary Bat	Recorded by acoustic monitor
Silver Bat	Recorded by acoustic monitor
Little Brown Bat	Recorded by acoustic monitor
Tri-Colored Bat	Recorded by acoustic monitor

Hydrogeological Assessment, Level 1 and Level 2 Water Reports and Maximum Predicted Water Table Report

Application for a Class 'A' License
McKinnon Pit

Part of Lot 6, Concession XI
Part of Lot 6, Concession X
Concessions X & XI, in Lot 6
Lots 5 & 6, Concession X
Geo. Township of Dalhousie
Township of Lanark Highlands
Lanark County

Arnott Bros. Construction Ltd.
March 2023

GRI Inc.
www.gri-inc.ca

Executive Summary

Arnott Bros. Construction Ltd. (Arnott) is proposing to amend aggregate license #609261 to permit extraction below the water table at the McKinnon Pit located in the Township of Lanark Highlands (Geo. Twp. Of Dalhousie), County of Lanark. GRI Inc. was retained by Arnott to conduct Level 1 and 2 Water Studies and determine the maximum predicted water table to meet the requirements of the ARA (Ontario Ministry of Natural Resources and Forestry 2020a). The purpose of this report is to address the requirements of the technical standards, determine the maximum predicted water table and to identify any potential impacts of the operation on groundwater and surface water.

The site is located on a major glaciofluvial assemblage that extends from just east of Middleville, southward to Pine Gove, westward to just north of Playfairville, and then parallel to Highland Line and Kingston Line where it crosses County Road 36 and continues into the County of Frontenac. This system, which usually has a central core consisting of sand and gravel surrounded by cavity fills and fans consisting of fine gravel to fine sand (Gorrell and Shaw 1991), has the highest quality ranking for the province's mineral aggregate interests.

The McKinnon Pit is found is situated within the Mississippi Conservation Authorities Mississippi Lake Subwatershed. A 129 ha unevaluated wetland is found around the west, north and east sides of the property. Neighbouring property owners rely on wells for water supply. The wells near the site use the bedrock aquifer.

Arnott current license permits aggregate extraction to within 1.5 m of the water table. The proposed amendment expands the license area and will allow aggregate to be extracted to up to 20 m below the water table. The material will be excavated from below the water table with drag line or other dredging equipment. There will be no diversion, storage or drainage of groundwater from the site.

The application proposes extraction of resources down to, at its deepest, 173 mASL, which is up to 20 m below the water table. The excavated material on the site may be beneficiated with either wet screens or with a classifier.

Three test holes were drilled on the site, and piezometers were installed. In-situ hydraulic conductivity tests were completed and groundwater levels were measured from December 3 2020 to July 28, 2022. Groundwater samples were taken from the wells to measure general groundwater quality characteristics.

This study has found that no significant change or impact to the groundwater recharge or flow on or around the property will occur from the proposed operation. A groundwater monitoring program to extend the database on baseline conditions is recommended, to be followed by data collection when the below water excavation begins. If other beneficiation processes such as a wash plant are planned, a Permit to Take Water and Environmental Compliance Approval will be required. The potential for groundwater contamination is addressed through operations management and due diligence.

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OS Table 2: Summary of Water Well Records

OS Table 3: Summary of Drill Holes

OS Table 4: Groundwater Quality Analysis

Appendices

Appendix A: Water Well Records

Appendix B: Drill Hole Logs and MOECC Cluster Record

Appendix C: Hydraulic Conductivity Tests and Analysis

Appendix D: Laboratory Reports

Below, record changes to the report resulting from external peer review or agency comments, or errata.

Section Heading	Change/ Source	Date	Review Version	

Issued: March 28, 2023. This report supersedes any previously dated or referenced copies.

Format:	Copies:	
PDF	1	Milestone, Arnott Bros. Construction Ltd.
Paper		

GAG, JBG/jg GRI Doc # 23FREPECAM267

1 INTRODUCTION

Arnott Bros. Construction Ltd. (Arnott) is applying to amend existing aggregate licence #609261 to permit extraction below water under the Aggregate Resources Act (ARA). The McKinnon Pit is located on Part of Lots 5 and 6, Concession 10, Part of Lot 6 Concession 11, Part of the Road Allowance between Lots 5 and 6, Concession 10 and Part of the Road Allowance between Concessions 10 & 11 (at Lot 6), Township of Lanark Highlands (Geo. Twp. of Dalhousie), County of Lanark (OS Figure 1).

The McKinnon Pit is one more than 20 active or former sand and gravel pits situated on a sedimentary assemblage that that extends southward from the vicinity of Middleton to Pine Grove and then westward to just north of Playfairville (Inset, OS Figure 1). From there, it extends parallel to Highland Line and Kingston Line and crosses County Road 36 before continuing into the County of Frontenac.

A typical assemblage consists of a central core of sand and gravel, surrounded by fans consisting of fine gravel to fine sand; the coarsest material is usually located on the eastern side of the assemblage. An aggregate assessment completed for the area in 1985 (Gorrell, Van Haaften and Fletcher, Aggregate Assessment of the County of Lanark. 1985) a geological paper completed (Gorrell and Shaw, Deposition in an esker, bead and fan complex, Lanark, Ontario, Canada. 1991) and an updated aggregate resource inventory paper (Lee, V. F. 2013) indicate that the material in the assemblage is the highest quality with respect to the province's mineral aggregate interests.

GRI Inc. (GRI) was retained by Arnott to complete Level 1 and 2 Hydrogeological studies to address the requirements of the Aggregate Resources of Ontario Standards.

Elevations referenced in this document refer to the topographic contour plan for the site prepared by TEC Surveying ((TEC Surveying Inc. 2021).

2 QUALIFICATIONS

This study was prepared by Jennifer Gorrell, M.Sc. P.Eng. P.Geo. and George A. Gorrell, M.Sc. F.G.A.C, P.Geo.. Together they are partners in the engineering firm GRI Inc. They have provided geological, hydrogeological and associated engineering services since 1988.

The field studies found in the references that have been conducted by George Gorrell M.Sc. F.G.A.C P.Geo. since 1979 (see References) are the source of the personal knowledge used in this report. George Gorrell holds a certificate of registration under the Professional Geoscientists Act, 2000 and is a practicing member of the Association of Professional Geoscientists of Ontario. Mr. Gorrell has demonstrated and post-secondary education, including undergraduate and graduate degrees, in hydrology and sedimentology with specialization in water and resource management. He has spent over 40 years studying the geology and mineral aggregate deposits of Eastern Ontario.

Jennifer Gorrell holds a certificate of registration under the Professional Geoscientists Act, 2000 and is a practicing member of the Association of Professional Geoscientists of Ontario, and the Professional Engineers of Ontario. Mrs. Gorrell has demonstrated and post-secondary education, including undergraduate and graduate degrees, in geotechnical engineering with specialization in hydrogeology, hydrology, environmental consulting, geology and soil mechanics. Ms. Gorrell has 40 years of

professional experience in the fields of geology, hydrogeology, and environmental consulting, with more than 30 years' experience related to pits and quarries.

3 PROPOSED OPERATION

The existing conditions of the site, the proposed operation and rehabilitation are described in the draft site plan that were prepared by Milestone Aggregate Consulting Services Inc. (Milestone) dated January 13, 2022. The current license is over 34.3 ha, and lands will be added for an expanded license area of 40.1 ha with an extraction area of 36.1 ha. The elevations on the site plan and used in this report are geodetic from a survey plan prepared by TEC Survey (TEC Surveying Inc. 2021). The current license and proposed expansion area are shown on OS Figure 1, and the site contours are shown on OS Figure 2.

Details provided to GRI by Milestone about the proposed operation are;

- The existing pit has been excavated to an average elevation of 190 mASL (TEC Surveying Inc. 2021). Within the licensed area, the remainder of the material above the water table within the glaciofluvial deposit will be fully excavated, followed by the removal of the material below the water table. The extraction will take place in one or two stages, to a maximum approximate depth of 20 m or approximately 171 mASL;
- A maximum of 250,000 tonnes of aggregate will be removed from the pit annually, an increase from the current 150,000 tonnes;
- Aggregate will be extracted from below the water table using a high-hoe, or dredge or dragline; The material will be excavated without dewatering;
- No off-site diversion of surface water is planned;
- Some of the material that will be excavated will be processed using such types of equipment as wet screens, wash plant or a classifier. If beneficiation methods such as a wash plant or classifier are used, a Permit to Take Water and an Environmental Compliance Approval will be required.
- Fuel storage will be by temporary fuel tank that comply with the Technical Standards and Safety Act, or by fuel bowser
- An asphalt plant or concrete batch plant are not permitted on site.
- Extraction will occur down to the limit of the resource, or a minimum elevation of 171 mASL.

4 STUDY SCOPE

The requirements for the water reports and their requirements are outlined in the Aggregate Resources of Ontario: Technical Reports and Information Standards, August 2020 and Aggregate Resources of Ontario: Amendment standards, August 2020.

The Amendment Standards state:

> *"1.1.4 Notwithstanding the above, where no water report has been previously completed, applicants must prepare a Water Report following requirements that would apply if the application were being made for a new licence or aggregate permit."* (Ontario Ministry of Natural Resources and Forestry 2020b)

The requirements consist of;

1. Maximum Predicted Water Table Report; and
2. Water Report. The Water Report consists of two parts. Level 1 identifies groundwater and surface water resources and their uses and determines the potential for impact by the proposal. Level 2 is required if potential impacts were identified, and the study provides an impact assessment and if appropriate an adaptive management plan to identify and trigger action if the predicted impacts occur. (Ontario Ministry of Natural Resources and Forestry 2020a)

Sections 5 and 6 address the Level 1 Water Report requirements. Although the details on the regional setting are a requirement of the Level 2 Water Report, they are provided in Section 5 to familiarize the reviewer with the conditions on the site and in the surrounding area. Sections 7 to 14 address the Level 2 Water Report requirements and Section 11 provides the Maximum Predicted Water Table Report.

Level 1 Water Report

forested land could be used for maple syrup production, based on the tree species that can be observed on the satellite imagery and in a driving survey of the area.

Not all the wetlands within 2 km of the site have been evaluated. The Mississippi Valley Conservation Authority (MVCA) regulation Public Mapping Browser (Mississippi Valley Conservation Authority 2021) is a non-evaluated wetland. It appears that part of the existing extraction area may be within the regulatory limit, based on the web map.

The County of Lanark Official Plan designates the area around the site as significant groundwater recharge area (CGIS Spatial Solutions 2022).

5.1.2.1 Ecological Services Natural Environment Technical Report

A Natural Environment report prepared by Ecological Services (Ecological Services 2022) investigated the natural heritage features within 120 m of the proposed amendment. The report found that within the proposed license boundary, there are a species at risk, a significant woodland feature and significant wildlife habitat. Additionally, within 120 m of the expansion boundary there is a significant woodland feature, significant wildlife habitat, fish habitat, wetland, and the habitat of species at risk. The risks of the proposed operation were classified as low to moderate and mitigation recommendations were provided.

The report additionally cautions that significant alteration by the operation to the hydrological regime in the adjacent wetland could result in significant impacts to the wetland and to fish and significant wildlife habitat.

5.1.3 Aggregate Operations/ Industrial

Most of the site currently holds an aggregate license (Arnott Brothers Construction Ltd; license #609261). There is one additional licensed property located east of the site that is partly within the study area. The Tackaberry Sand and Stone. Ltd. (Lic.# 4257) is a 63.5 ha pit that is situated north and south of Highland Line. The Lanark Highland's Official Plan shows areas that are designated Mineral Aggregate Resource (holding) but they do not currently hold aggregate licenses. The areas around the site and east along Highland Line to (and beyond) McDonalds Corners Road are shown on OS Figure 1.

The assemblage is one of the largest and principal sources of high-quality aggregate for Lanark County. The sand and gravel assessments that have been completed for the County have indicated that the deposit has primary significance (Gorrell, Van Haaften and Fletcher 1985, Gorrell and Shaw 1991, Lee, V. F. 2013). The references also state that significant proportion of this assemblage has been already extracted or sterilized due to development.

There are more than 8 aggregate pits on the assemblage between the site and Playfairville. There are an additional 7 pits north of Lanark on the Middleville extension. The location of the assemblage and pits is shown on Figure 1.

5.1.4 Residential Development

Residential development has been developed almost exclusively by severance along the area roads. The residences are serviced by individual wells and septic systems.

5.2 Summary of Natural Environment Technical Report (Ecological Services 2022)

The natural environment report investigated whether significant natural heritage features are on or within 120 meters of the pit expansion to address the requirements of the Aggregate Resources Act. The report also addresses the Natural Heritage assessment requirements of an Environmental Impact Statement or Environmental Impact Assessment of the Provincial Policy Statement and the Lanark County Official Plan.

The investigation found there are species at risk, significant woodland feature and significant wildlife habitat within the proposed pit expansion boundary. Within 120 m of the expansion boundary there is a significant woodland feature, significant wildlife habitat, fish habitat, wetland, and the habitat of species at risk. The report identified the risk to these significant features as low to moderate and provided mitigation recommendations.

The mitigation recommendations for the wetlands only are included here as they may relate to the hydrogeological report. The report recommended an additional 15 m buffer be applied to the regulatory 30m buffer administered by Mississippi Valley Conservation Authority for a total of 45 m.

On top of the required 30 m MVCA wetland buffer, it is recommended that a further 15 m buffer be added at the northwest corner of the existing license boundary, for a total 45 m.

The report cautioned that if the proposed below water table expansion were to significantly alter the hydrological regime of the adjacent wetland, this could result in significant impacts to the wetland, to fish habitat, and to significant wildlife habitat, and added there is potential for a net natural environment benefit from the eventual creation of the lake that will be created that will result in the creation of more wetland habitat, more significant wildlife habitat, more fish habitat, and possibly new SAR habitat.

The Level 2 report evaluates the impact of the proposed expansion on the area hydrology (Section 12.2).

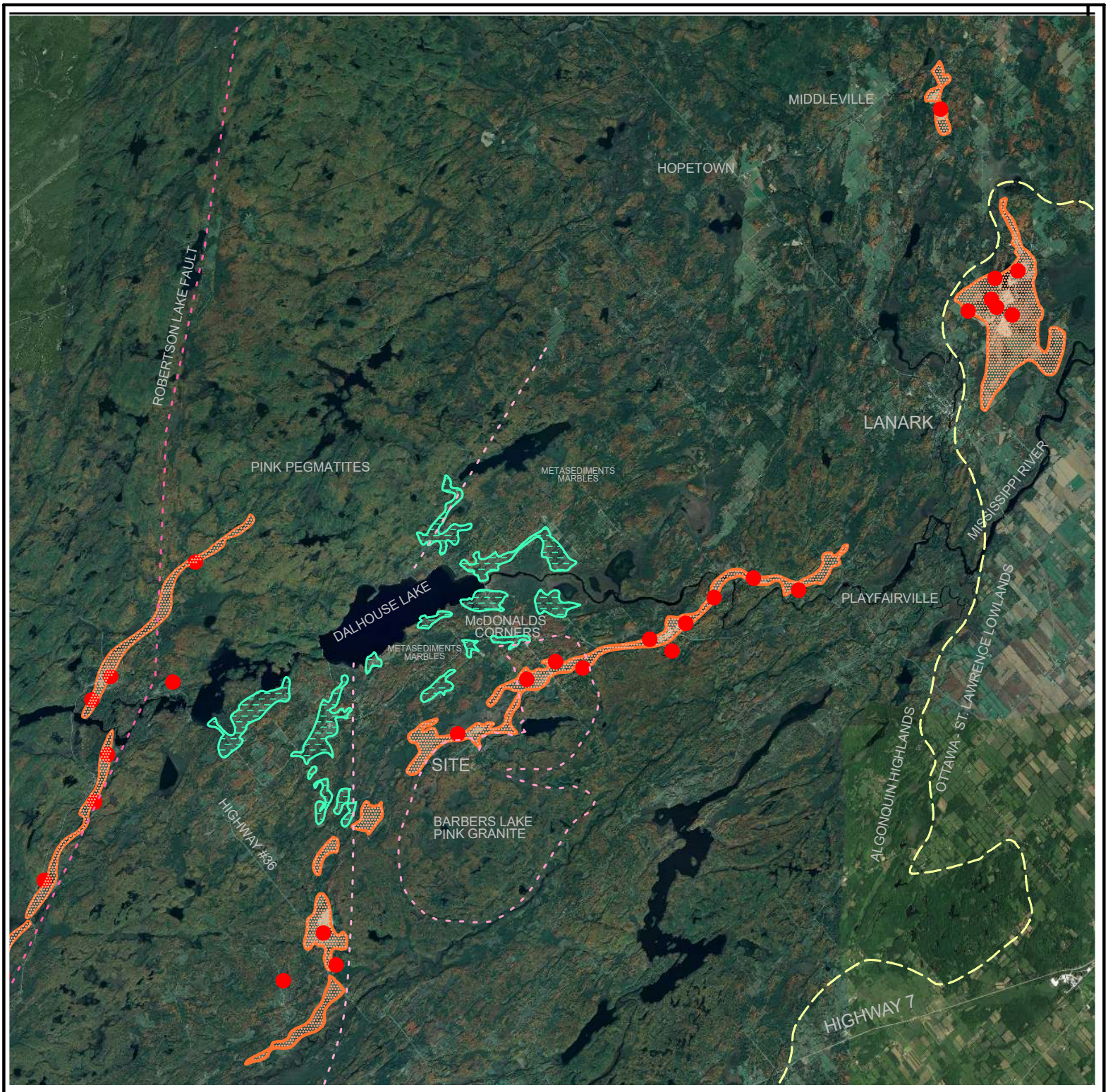
5.3 Surficial Geology

The surficial geology mapping for the area shows that the predominant surficial geology unit in the area is a thin and discontinuous silty till veneer and Precambrian bedrock (E. P. Henderson 1973, Gorrell, Van Haaften and Fletcher 1985, Gorrell and Shaw 1991, Lee, V. F. 2013, Henderson and Kettles 1992). In addition to the Precambrian bedrock, two other surficial units were mapped in the area.

The first is a series of glaciofluvial assemblages that traverse the area in a northeast to southwest orientation (E. P. Henderson 1973, Gorrell, Van Haaften and Fletcher 1985, Gorrell and Shaw 1991). These assemblages appear to originate in the Lanark Highlands. Two of these assemblages, shown on Figure 1, meander through the area and continue to the southwest through Frontenac County.

The material on the site has the characteristics of an esker to proximal cavity fill to bead to mid- to distal- fan (Photo 1, Photo 2). The sediment on the site has a moderate permeability that is consistent with literature values (Gorrell, 1991).

The glaciofluvial assemblages were deposited by meltwater beneath the glacier more than 12,000 years ago. The systems are composed of a central core, located along and south of Highland Line east of the



LEGEND

- GLACIOFLUVIAL ASSEMBLAGES
- GLACIOLACUSTRINE DEPOSITS
- GEOLOGICAL BOUNDARY
- ARA-LICENSED SITE

FIGURE 1

LANARK-McDONALDS CORNERS GLACIOFLUVIAL ASSEMLAGE AND BEDROCK GEOLOGY

CLIENT ARNOTT BROS CONSTRUCTION LTD.	GRI Inc.
PROJECT NO. 21-022	Oxford Mills, ON K0G 1S0
DATE: JULY, 2022	T - (613) 258-2954

23FREPLCAM267

site that consists of sand and gravel. The core is flanked by esker beads and fans consisting of gravel to coarse to fine sand. The sediment was most likely deposited in a proglacial lake or series of lakes that were ice-dammed in the Precambrian Highlands. At the time of deposition, the glacier was probably still present in the Ottawa/St Lawrence Lowlands, while the highlands were relatively ice free (Gorrell, Van Haaften and Fletcher 1985, Gorrell and Shaw 1991, I. M. Kettles 1992a, I. Kettles 1992b, Kettles, Henderson and Henderson 1992).

The systems in the study area originated in the highlands to the northeast and transect the area in a northeast to southwest direction. They can be traced through the Dummer Moraine to the Oak Ridges Moraine in the Lake Ontario Basin (Gorrell, Van Haaften and Fletcher 1985, Gorrell and Shaw 1991, Gorrell and Brennand 1997).

The other units formed by glaciolacustrine processes. When the glacier retreated from the Algonquin Highlands, ice remained in the Ottawa/St. Lawrence lowlands that blocked the existing drainage outlets at the contact between the Paleozoic lowlands and Algonquin Highlands. The meltwater, prevented from draining eastward, ponded in basins and lowlands in the highlands. In the larger basins, glaciolacustrine sediment consisting of massive to rhythmically bedded sand, silt and clay were deposited (E. P. Henderson 1973, Gorrell, Van Haaften and Fletcher 1985, Gorrell and Shaw 1991). These deposits are also shown on Figure 1.

5.4 Bedrock Geology

Geological mapping shows the bedrock in the area is of Late Precambrian age (Pauk 1983). The oldest rocks are metavolcanics and metasediments of the Grenville Supergroup. The metavolcanics are generally basalt while the metasediments are feldspathic sandstone and wacke, quartzite, calcareous mudstone and wacke. Locally the underlying bedrock is likely metasediments consisting of calcitic marble and grey and white banded calcitic marble.

The sand and gravel that was encountered during drilling was composed predominantly of marble even though the some of the underlying bedrock appeared to be granite (Photo 3, Photo 4). The geology map (Pauk 1983) indicates there is a nearby contact - the Barbers Lake Intrusion - in this area that consists of pink granite. Blocks or boulders of granite that have likely eroded from the intrusion are found in the cleared areas on the southern portion of the site (Photo 3 and Photo 4).

5.5 Physiography and Topography

The site is completed situated within the Algonquin Highlands. The terrain in the study area generally consists of thinly veneered to bare bedrock and consist of highlands of Precambrian interspersed with lowlands that usually contain wetlands. The physiography of the area was defined as being underlain by Precambrian bedrock and is characterized by rounded ridges extending 15 to 60 m above the surrounding lowlands (Chapman and Putnam 1984). Wetlands are usually found in the lowlands between the bedrock ridges. There are a few exceptions where glacial deposits such as the glaciofluvial assemblages that wind through the basins between the uplands (Figure 1). Many of the lowland wetlands are underlain by glaciofluvial outwash or subwash. Drilling completed on the margins of the license (TW 2) indicate that there is more than 15 m of sand and gravel beneath the water table.

The thickness of the overburden on the uplands is generally thin and typically less than 2 m, but on the lee (downgradient) side of bedrock outcrops the thickness of the overburden can increase. Chapman and Putnam (1985) indicated that agriculture is minor and that no more than 2% of the physiological unit can be used for agriculture. Within 2 km traditional agriculture comprises approximately 8% of the land use (OS Figure 1).

5.6 Climate

The Drummond Centre Climate Station (Table 1) is located approximately 19 km northeast of the site just south of Mississippi Lake. It is the nearest station with current and a nearly complete precipitation record from 2015 to 2022. Normal data are also available. Monthly and annual precipitation data for are presented in OS Table 1.

Table 1: Drummond Centre Climate Station ID and Location

Climate Station	Drummond Centre
Climate ID	6102j13
Latitude	45°01'56.082" N
Longitude	76°15'10.098" W
Elevation	145.00 m

The Normal and 5-year average precipitation data are compared in OS Table 1, and the precipitation data from the previous 12 months are compared to the precipitation Normal (1981 – 2010) and the 5-year monthly average from 2017 to 2021. The available precipitation data to July 26, 2022 was used in the study.

The precipitation patterns affect groundwater levels and storage, surface water levels and flow, as well as vegetation growth and health. From OS Table 1 and Figure 2 it can be seen that;

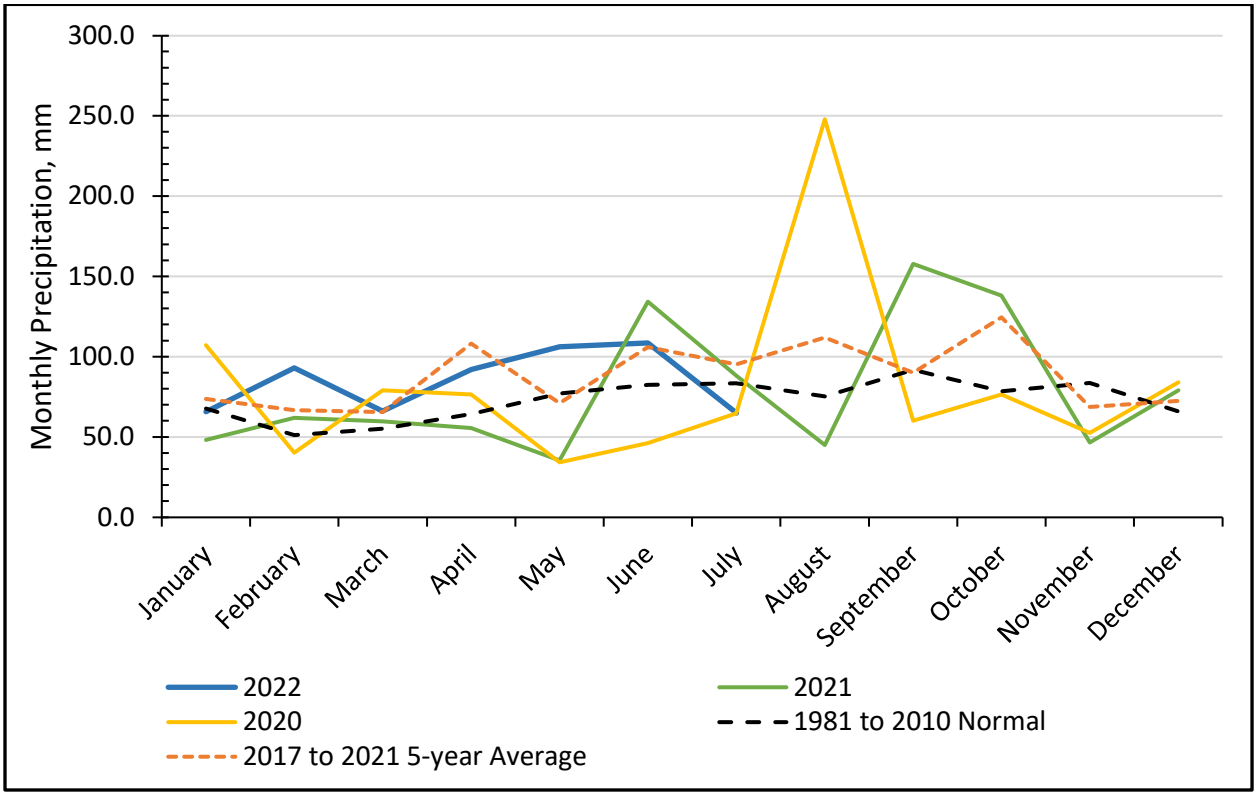
The 1981 to 2021 Normal precipitation showed a reasonably small variation in monthly precipitation, between 51.3 mm (February) and 91.8 mm (September). From the lowest precipitation in February, monthly precipitation increased gradually to peak in June, followed by a decrease to August. There was additional increased precipitation in September and November, with a decline through to February again.

OS Table 1 shows that on average, the precipitation from 2017 to 2021 was about 20.3%, or 177.5 mm higher than Normal. In January, May, September and December, the 5-year average was within 10% of Normal. The variations in the other months ranged from April, which was 68.4% higher than Normal, to November, which was 18.0% lower than Normal.

Over the past 5 years (2017 to 2021) there were precipitation peaks of comparable rainfall in April, June, August, with a slightly higher peak in October. The precipitation was higher than Normal in most months in the past 5 years, and peaks did not occur in a consistent pattern. In 2020, monthly precipitation ranged from 34.2 mm in May to 248 mm in August. In 2021, the range was from 35.4 mm in May to 157.8 mm in September with an additional 138 mm in October. Through to July 26 in 2022, the minimum monthly precipitation was 65 mm in July, and the maximum was 108.6 mm in June. At the end of July, 2022, the precipitation has been 68.1% of Normal and 56.6 of the 5-year average. In comparison, in 2020 and 2021, the precipitation was 51.1% and 55.1% of Normal, and 42.5% and 45.8% of the 5-year average. The precipitation for 2022 to date has on average been slightly higher than Normal.

Approximately 70 to 75% of the annual precipitation falls on the site when the pit will be active (assumed to be between May and December) according to the Normal and 5-year averages.

Figure 2: Monthly Precipitation, Drummond Centre Climate Station



5.7 Regional Hydrogeology

The Renfrew County-Mississippi-Rideau Groundwater Study (Golder Associates Ltd. 2003) describes and maps the regional groundwater systems within title's three areas. The study mapped and characterized the aquifers to identify their quantity and quality potential and to classify their susceptibility to contamination.

The primary aquifers in the RCMRGS study area are in bedrock and the well records show that 93% are completed in and obtain water from the bedrock. The remainder reported obtaining water from the overburden. The RMRGS indicated that the identified aquifers are all generally capable of supplying enough water to support residential development on private services, although the study also indicated that yields within some of the Precambrian-age aquifers may be marginal.

The RMRGS shows that west of Mississippi Lake, the bedrock and aquifer consist of Precambrian-age bedrock. The study indicated that interconnected fractures are the primary means of groundwater recharge and flow. East of Mississippi Lake, the aquifers are in sandstone and dolomite bedrock formations. The study indicated that groundwater flow in the sedimentary bedrock formations is mainly horizonal along fractures and bedding planes.

The RMRGS describes both large and small-scale characteristics of the aquifer using published data such as water well records. The data was subsequently refined into the Source Protection Plan of the

Mississippi Valley Conservation Authority (MVCA)[‡]. The nearest source water protection area shown on the geoportal is about 18 km southeast of the site, just west of the Town of Perth. The information also indicates that that most of the groundwater in the watershed is highly vulnerable[§] because there is little overburden to provide protection from surface contamination.

Well records from the MOECC database within a 2-km area around the site were reviewed by GRI. The data provide details of specific wells at the provided location. For well records drilled before the 1990s, the UTM coordinates were interpreted from the provided driller's information by Provincial staff when current detailed mapping resources were not available and who were less familiar with the area. Consequently, the locations are occasionally mis-matched. To further refine the regional data, the locations were checked from the driller's sketch on the 53 well records that were identified from the provincial water well record database as being in the surrounding area. This was done to attempt to correlate the well records accurately to addresses. Wells records from the past 10 years regularly include civic addresses that improve the location accuracy but older wells were occasionally mismatched.

The well records were analyzed to refine the assessment of the groundwater characteristics in this report's study area to identify:

- aquifers in the area
- aquifers are being used as a water supply.
- groundwater flow directions
- typical well yield.

The well records are summarized in OS Table 2 and the locations are plotted on OS Figure 1. Graphical representation of some of the well data is shown on Figure 3. The regional groundwater flow is shown on OS Figure 3.

There are two groups of well records in the study area that suggest a site specific detailed investigation was conducted. These well records are dated in March 2007 and April 2009 at 811 11 Concession Dalhousie, and 15 well records for test wells and subsequent abandonment wells were associated with these clusters. These wells are not representative of groundwater use in the area. The remaining 38 wells were analysed for select characteristics. The analysed wells ranged in depth from 16.8 to 118.6 m. Wells were most often less than 40 m deep, with an average depth of 38.7 m. The reported water bearing zones occurred over a broad range between 51.5 and 205.2 mASL. The most common water bearing zones (elevation water found on Figure 3) were between 155 and 185 mASL (68.1%). At the site, this corresponds to 15 m or deeper below the current pit floor, and approximately 30 m or more below the ground surface of the proposed expansion. Bedrock was not reported in two wells of all the wells within 2 km of the site.

[‡] http://www.mrsourcewater.ca/PublicMappingTool.html
[§] https://www.mrsourcewater.ca/images/Documents/Mississippi-Rideau-Source-Protection-Plan/Schedules/SchL-HVA.pdf

Out of the wells analysed, none were reported as dry. Wells reporting less than 3 GPM (11.4 L/min) comprised 16.2% of the wells. Most of the wells (70.3%) reported a yield between 3 and 25 GPM (94.6 L/min); 80% reported a yield between 3 and 20 GPM** (Figure 3). A sustainable yield of 3 to 5 GPM (24.3%) is considered suitable for residential use. A residence can be sustained with a yield as low as 1 GPM if the flow is augmented with storage.

Two unconfined aquifers were identified in overburden on and within 500 m around the site. Confined bedrock aquifers were identified from published reports and data.

5.7.1 Overburden Aquifers

The study area is highly vulnerable (Mississippi-Rideau Source Protection Committee 2022). There were two reasons for the high vulnerability in the area, the first because of thin overburden in the south and south-west area, which reduces protection to the bedrock aquifer, and the second due to the high permeability of the glaciofluvial deposit.

A large regionally-extensive overburden aquifer was identified on the site and adjacent properties. The aquifer is in the glaciofluvial complex that transects the area (Section 5.3). The characteristics of the unconfined aquifers were classified using sedimentology and depositional facies (Gorrell and Shaw 1991). The report indicated that the hydraulic conductivity in a glaciofluvial deposit, such as the one being excavated on the site, would be on the order of 10^{-4} to 10^{-6} m/s.

This aquifer, which is referred to in this report as the "granular aquifer" was determined to be the key or significant aquifer with respect to the existing and proposed operation. In addition to two test wells, two water well records indicated the wells were completed in this aquifer (WWR 7106890 and 7274335).

A perched unconfined aquifer is found on the highland in the south-west part of the site and along the south boundary. The aquifer is in relatively shallow sand and till that overlies the bedrock.

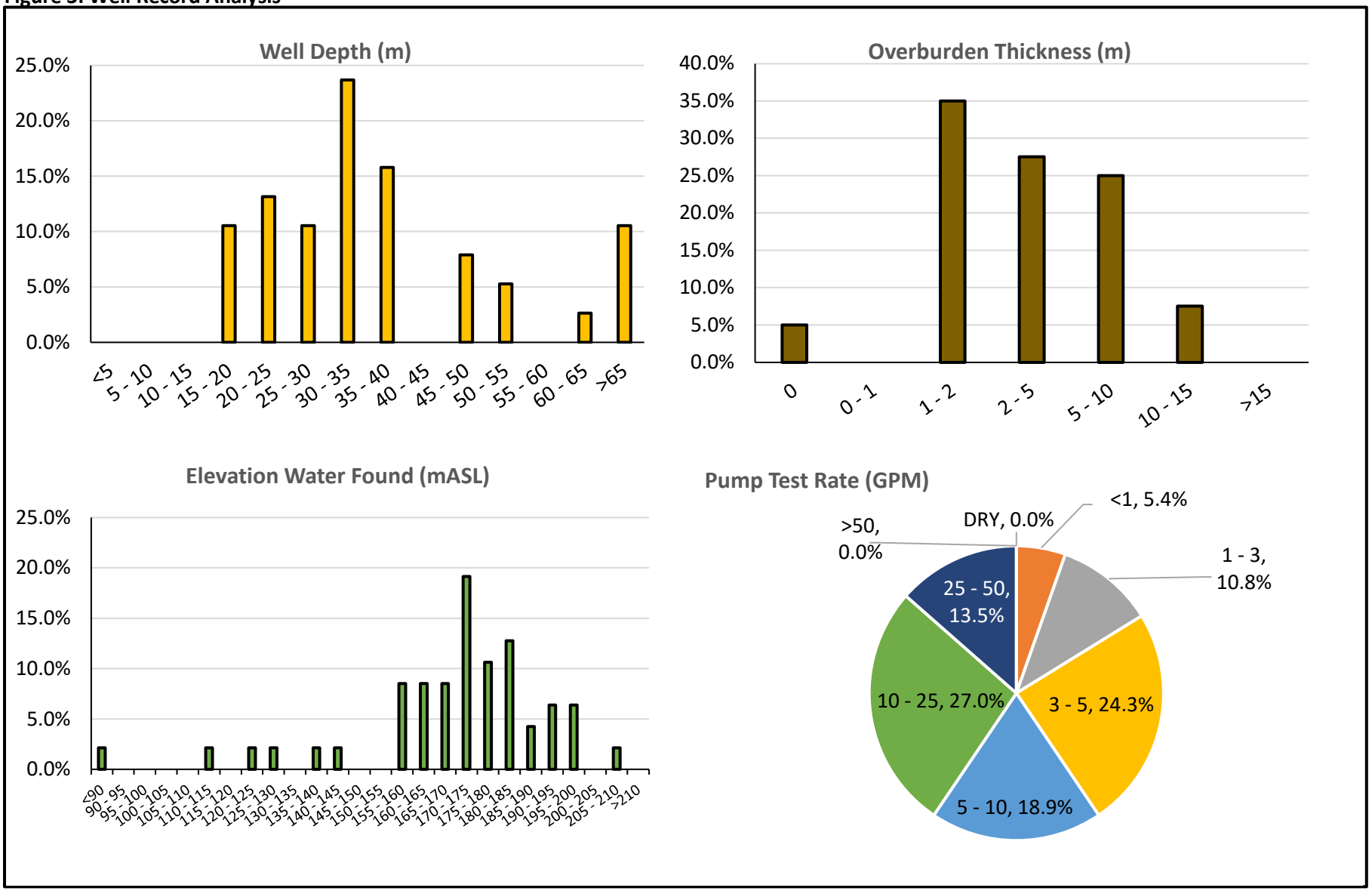
The aquifer characteristics are discussed in detail in Section 10.

5.7.2 Bedrock Aquifer

The underlying bedrock formations are the most common regional groundwater sources for wells. The licensed area is situated along a bedrock contact (Figure 1). Along Highland Line the mapped bedrock is part of the Barbers Lake intrusion that consists of pink granite. This formation was intercepted at the base of TW 1. North, and over most of the license the bedrock formation consist of metasediments such as marble (Pauk 1983). There are two bedrock aquifers, situated within different bedrock formations within the study area, but the description in this report does not differentiate between the two. The bedrock aquifer was evaluated through the water well records in the area (Ministry of Environment, Conservation and Parks 2022).

** Based on driller's test rate. Recommended rate for use may be lower.

Figure 3: Well Record Analysis



The analysis show the wells in the area have reported moderate to high yields of good quality water (Figure 3). The RMRGS (Golder Associates Ltd. 2003) also indicates that the wells drilled in the area generally provide sufficient potable water to support a residence.

Groundwater in the Precambrian bedrock flows through fractures, gaps and voids, or in metasediments, along bedding planes. The transmissivity of the aquifer depends on the fracture connectivity. The geometric mean of transmissivity from wells tested in the Precambrian bedrock is approximately $2x10^{-4}$ m^2/day (Singer, Cheng and Scafe 2003).

The regional groundwater flow in the bedrock aquifer was also interpreted from the water well records. From the data, groundwater in the bedrock flows from the north-west and south to southwest towards a discharge area that is in the low-lying area between the two bedrock highs (OS Figure 3).

5.7.3 Springs

One spring was confirmed on the southern side of the site, approximately 120 m east of TW 1 (OS Figure 2). Infiltration into the sand and till on the height of land along Highland Line emerges as a spring on the slope when a contrastingly lower permeability material (dense till or bedrock) is encountered. After the groundwater discharges from the spring, it flows along the contact for approximately 100 m before completely infiltrating into the glaciofluvial deposit.

The natural environment report (Ecological Services 2022) did not identify any seeps or springs.

5.7.4 Wells

From a review of the individual well records, 7 were matched to locations within 500 m of the site. Out of these, two were records of deepening an existing well. The physical characteristics and details from the water wells are summarized in OS Table 2. The matched well records, which are shown on OS Figure 1, are found in Appendix A. All but two of the well records are completed in bedrock. One of these wells is located approximately 900 m away, and both are located north-east of the site on Highland Road. The well stratigraphy indicates they are completed in gravel at depths of 16.8 and 30.5 m.

Southwest of the site, the bedrock is within 6 m of the surface and although the overburden may contribute some of the water to the well, the water bearing zones represent Precambrian bedrock where the water bearing zones are discrete and are not consistent among nearby wells. West, northwest and southeast of the site there are appreciable thicknesses of sorted material above the bedrock. For wells drilled through this deposit, some of the groundwater may be derived from the overburden.

5.8 Regional Hydrology

The site is within the Mississippi Lake subwatershed, situated at the southeastern end of the Mississippi Valley watershed (Mississippi Valley Conservation Authority 2021). The site comprises less than 0.14% of the Mississippi Lake subwatershed.

The boundary between the subwatershed and the adjacent Fall River subwatershed (south-east) is shown on OS Figure 1.

The Mississippi Lake Subwatershed has a drainage area of 294 km^2 [††] within the overall Mississippi River Watershed of approximately 3,750 km^2 [‡‡]. Long Sault Creek, which is a tributary of the Mississippi River, is approximately 80 m north of the site. Surface drainage on the site is towards the creek, based on topography. However, as indicated above, most precipitation and snow melt infiltrates into the ground. The Highland Line roadside ditch is diverted through the property.

The boundary of an unevaluated wetland is found west, north and east of the site. It has an approximate area of 129 ha and approaches to within 55 m of the north and west boundaries of the site (Ecological Services 2022). The natural environment report found that the wetland boundary within 120 m of the site closely matched the mapping shown by MVCA (Mississippi Valley Conservation Authority 2021). The boundary is shown on OS Figure 1.

The roadside ditch along Highland Line has been diverted through the site about midway along the south property boundary (OS Figure 2) where sand and till overly bedrock. Water in the ditch meanders northerly across the proposed expansion to the pit, and completely infiltrates the pit floor within 65 m. There was no flow or runoff observed from the site into Long Sault Creek. Similarly, most, if not all the precipitation and snow melt on the glaciofluvial deposit is expected to infiltrate into the sand and gravel (OS Figure 2).

5.9 Water Budget

The water budget describes the relationship between the inputs and outputs of a water system. The water budget is defined as;

$$P = E + I + R + \Delta S$$

Where;

P = total precipitation
E = evaporation
I = infiltration
R = runoff
ΔS = change in storage.

Storage change (ΔS) is assumed to be zero in the analysis that considers the long term or steady state condition. The precipitation, evaporation, seepage, water surplus, topography, soil conditions, vegetative cover, infiltration and runoff characteristics at the site are described below. OS Table 1 provides the 1981 – 2010 Normal, 5-year average and the monthly data for precipitation and temperature at the Drummond Centre climate station.

5.9.1 Precipitation

The Normal precipitation is 876.3 mm, compared to the 5-year average (2017 to 2021), which was 1,024.0 mm.

[††] https://mvc.on.ca/wp-content/uploads/2020/08/BGTHREE.pdf
[‡‡] https://mvc.on.ca/watershed-facts/mississippi-river-watershed/

5.9.2 Evaporation

The Thornthwaite Method was used to evaluate evaporation (Thornthwaite 1948). The Thornthwaite equation, is;

$$U = 1.6 \times \sum (10t / TE)^{0.9916}$$

where:

U - Evaporation (cm)
t - mean monthly temperature (OP)
TE - Annual Heat Index = (t/5)1.514

The annual evaporation was calculated as **593 mm** from the mean monthly normal temperature data (1981 to 2010).

5.9.3 Water Surplus

The water surplus is the quantity remaining after evaporation,

876 – 593 = 283.4 mm, is available for runoff or infiltration.

The water surplus component of the water cycle can be subdivided into infiltration and runoff components.

5.9.3.1 Infiltration

An infiltration factor has been used for this report, following MECP criteria (Ministry of Environment and Energy 1995). The infiltration factor is the sum of topographic, soil and vegetative factors.

The property slopes to the west and northwest at approximately 115 m/km. The topographic factors in the reference show “hilly land, average slope of 28 to 47 m/km” has a topographic factor of 0.10. A steeper site would have a lower slope factor.

The factor of 0.1 that has been used for the site overestimates the slope factor within the site boundary. However, over a wider area, the average slope is about 25 m/km from the highland at the site and just south, down to the wetland. The slope factor is representative for the accuracy of the method.

The soil on the site consists of sand and sand and gravel and is classified as a Type A soil (MTC, 1997). A factor of 0.4 (open sandy loam) was used for the soil factor.

The property is generally clear of trees. Therefore, a cover factor of 0.12 was used.

The infiltration factor is the total of the topography, soil and cover factors, or 0.62.

Applied to the water surplus, the resultant infiltration is.

0.62 x 283.4 = 175.7 mm.

Table 2: Water Budget

Water Budget	Site (m/yr)
Precipitation	0.8763
Evaporation	0.5929
Seepage	0
Water Surplus	0.2834
Infiltration	0.1757
Runoff	0.1077

As described above the drainage from Highland Line infiltrates into the ground before it reaches Long Sault Creek.

5.9.3.2 Runoff

Runoff remains when the infiltration is subtracted from the water surplus. The annual runoff is an estimated 107.7 mm for the site.

The water budget is found in Table 2.

6 CONCLUSIONS, LEVEL 1 WATER REPORT

The Level 1 preliminary investigation identified that the pit will be extracted below groundwater and area surface water features. A review of available references, the natural environment report for the application (Ecological Services 2022), and an examination of the site and study area in moderate detail, there are area features that may potentially be affected by the proposed operation. The features that should be assessed in more detail are;

- water wells,
- groundwater aquifers,
- surface water courses and bodies and potentially discharge areas, and
- springs.

The site is not within a Wellhead Protection Area for quantity or quality (Mississippi-Rideau Source Protection Committee 2022). The site is within an area considered to be a highly vulnerable aquifer.

The preliminary hydrogeological review found the potential for impact by the proposed pit to features identified in the Level 1 Water Report. Consequently, a Level 2 Hydrogeological Report, consisting of a field investigation was completed and a detailed analysis of the potential impacts was undertaken.

Level 2 Water Report

7 LEVEL 2 WATER REPORT REQUIREMENTS

The Level 2 Water Report requirements must consider features described in Table 3 (Ontario Ministry of Natural Resources and Forestry 2020a, Ontario Ministry of Natural Resources and Forestry 2020b).

Table 3: Hydrogeology Level 2 Assessment Requirements

Setting and Existing Hydrogeological Features	a. Description of physical setting including local geology, hydrogeology and surface water system b. Water wells c. Springs d. Groundwater aquifers e. Surface water courses and bodies f. Discharge to surface water
Proposed Operation	g. Proposed water diversion, storage and drainage facilities on site h. Method of extraction
Impact Assessment and Mitigation	i. Impact assessment j. Mitigation measures including trigger mechanisms k. Contingency plan l. Monitoring plan
Technical Report	m. Technical support data is the form of tables, graphs and figures

8 SITE INVESTIGATION

The hydrogeological assessment consisted of; reviewing the available hydrogeological information on the site and surrounding area, installing three test wells and installing groundwater monitors, field-testing the physical characteristics of the encountered stratigraphy, measuring the groundwater level in the monitors periodically from December 2020 to July 2022, and sampling the ambient groundwater quality. The data was analyzed and the potential impact to the surface and groundwater features was assessed. Recommendations to assess whether the impacts occur over the site life are provided.

8.1 Information Review

The data sources reviewed for the background on the site and study area included;

- Preliminary notes dated February 2022 prepared by Milestone Aggregate regarding the site and the proposed operation;
- water well records from the provincial well record database maintained by the Ministry of the Environment, Conservation and Parks (MECP) accessed on June 2022;
- geological mapping by the Ontario Geological Survey, Geological Survey of Canada and Ministry of Northern Development and Mines;

- aggregate resource studies completed by the Ministry of Northern Development and Mines;
- aggregate resource studies completed by the Ontario Geological Survey.
- Renfrew County -Mississippi -Rideau Groundwater Study
- The Rideau-Mississippi Source Protection Plan
- groundwater, surface water and flow data and mapping identified and outlined by the Mississippi Valley Conservation Authority.

8.2 Drilling and Monitoring Well Installation

The pit faces in the pits in the immediate area were examined by GRI staff and three monitoring wells were drilled on the site using hollow-stem augers on November 26 and 27, 2020 by George Downing Estate Drilling Ltd (Photo 5 to Photo 7) .

Each hole examined the stratigraphy from the ground surface down to bedrock refusal or to 18 m below the water table. The fineness modulus (FM) was estimated from the sediment grain size. A piezometer constructed of 40-mm diameter PVC screen attached to solid PVC riser was installed in each borehole. A sand pack of #3 silica sand (2.46 mm effective size) was placed around, and for 0.61 m above, the screen. Bentonite chips were used to fill the bore hole from the sand pack to surface. A protective casing and a locking well cap completed the installation. The surface elevation at the test wells was interpolated from the topographic base map (TEC Surveying Inc. 2021).

8.3 Water Level Monitoring

Groundwater levels in the piezometers were seasonal measured manually with a water level meter on December 3 and 21 in 2020, January 11, March 30, April 23, June 10, July 12 and September 16 in 2021 and July 28, 2022 (Table 5).

8.4 Hydraulic Conductivity Testing

In-situ rising and falling head tests were conducted in the piezometers on December 21, 2020 using a “slug” (PVC and copper cylinder filled with sand and capped at both ends). The timed response to an instantaneous change in water level was used to estimate the hydraulic conductivity of the sediment. In falling head tests, a rise in water level is caused by introducing the slug into the well. Rising head tests measure a rising water level created by the removal of a slug after the water level has stabilized. The water levels during the test were measured every half second using a pressure transducer (data logger) installed in the piezometer below the tested zone. A barologger was used to gather barometric data to correct the readings from the loggers. The summary of the tests are found in Table 4.

8.5 Geochemical Sampling

Samples for geochemical analysis were collected from the piezometers on December 3, 2020 and January 11, 2021. To prepare the wells for sampling, they were pumped for approximately one hour to remove more than 20 well volumes using a Waterra™ foot valve set at the level of the well screen, until the discharge appeared clear. Water samples were filtered through 0.45 µm Waterra™ filters into laboratory-supplied bottles. The sample temperature was maintained with ice and submitted to Eurofins Environmental Laboratories in Ottawa within 5 hours.

9 SITE CONDITIONS

9.1 Site Geology

The depositional environment on the site was assessed by the review of surficial mapping for the area, consultant reports which supported the licensing of pits, examining the pit faces on the site and also in the neighbouring pits in the area (Tackaberry Sand and Gravel, Tackaberry & Sons Constr. Co. Ltd., Robert Anderson, Lanark County, and Cavanagh Constr. Pit and Crain Pit), and examining the sediment from the three drill holes. The pit locations are shown on OS Figure 1.

As described in Section 5.3, the site is on a glaciofluvial assemblage that extends from the Village of Middleville, through the Town of Lanark and then extends westward through the Playfairville area to the Frontenac/Lanark County Boundary. The site is situated on the esker, esker-bead and fan portions of the deposit (Gorrell and Shaw 1991).

Four glaciofluvial sedimentological facies were identified on the site: 1) esker, 2) esker/fan, 3 cavity/bead fills and lacustrine sands over esker sediment (Gorrell and Shaw 1991). An esker can be traced from Playfairville along County Road 12 and Highland Line to the central highland portion of the site (Figure 1). The internal sediment arrangement was observed in the Tackaberry and Cavanaugh pits along these roads (OS Figure 1). The core of the esker consists of +30% stone and medium to very coarse sand. The clasts are often imbricated indicating that the clasts bounced and rolled along the base of the flow (Gorrell and Shaw 1991). TW 3 is situated on the north side of the esker, just before the feature crosses Highland Line.

The esker fan formed either at the grounding line of the glacier where the under-ice flow system opened out into a large proglacial lake or a large subglacial cavity. In either case, the flow expanded and sand was deposited in large diffusely bedded beds, and subsequently tabular crossed beds and foresets of sand. The flow expansion resulted in a rapid deceleration of the depositing current and the particle size change from gravel to sand. The esker fan is found south of TW 2 and westward on the site (OS Figure 2). The height of land located south of the existing face roughly corresponds to the zone where the confined flow in the esker expanded into an opening at a grounding line or very large cavity.

In some areas, the flow deposited sediment in small cavities beneath the glacier. The two conical hills located on the western side of the site were deposited in such cavities (Photo 1 and Photo 2). The material in the conical hills will consist of faulted beds of sand and gravel. The faults developed as the glacier melted and the ice supported sides of the deposit were removed. The upper 7 m of TW 1 represents the edge of one of the cavity fills.

The final environment occurred as the ice front retreated from the area. Low lying areas were later coved by sand eroded from the side of the esker assemblage or carried to the site by limnological currents as bars or spits. The finer sand that overlies the sand and gravel at TW 3 is lacustrine sand.

The fineness modulus[§§] of the sediment was estimated to range from less than 1 (medium to medium fine sand with silt/clay layers, TW1) to greater than 3 (sand, gravel TW2 and TW 3). Overall, the deposit appears to coarsen downwards, which is characteristic of a fan (G. A. Gorrell 1991, Gorrell and Shaw 1991).

The drill hole logs and water well records for the test wells are found in Appendix B. OS Table 3 summarizes the characteristics, stratigraphy and installation details of each hole. The sediment thickness measured on the site ranged from 7.62 at TW 1 to greater than 18.9 at TW 2 and TW 3. Bedrock was intercepted only at TW 1 and the hole intercepted the Barber Lake granite intrusion upland located along the southwest periphery of the site. TW 2 and TW 3 did not encounter the underlying bedrock which, based on the geology maps for the area (Pauk 1983) is metasediment marble.

The approximate bedrock elevation ranges from 194.9 at TW 1 to below 174.2 at TW 2 and TW 3. As shown in OS Figure 4 the bedrock rises towards the south-west and is estimated to be at 212 mASL south of Highland Line. Cross-sections of the geology through the site are interpreted on OS Figure 4..

9.2 Water Balance

An annual water surplus of 0.2834 m was calculated from the 1981-2010 climate Normals (Section 5.9.3). In the analysis, the water surplus was used to estimate the recharge and throughflow, assuming all runoff and infiltration was fully absorbed within the catchment. The conditions within the catchment area were averaged with the infiltration factor of 0.62 (Table 2). The permeability of the sediment was a key influence on the relatively high contribution of infiltration compared to runoff. In the site visits for the study, little runoff off site was observed.

The approximate catchment area of the site is shown on OS Figure 2. The two terrain units on the site have different characteristics. At the perched aquifer the slope factor is very low due to the steep terrain (+/-115 m/km). The infiltration slope factor cannot less than 0.1, so even though the slope in the granular aquifer is about 25% of the highland area, 0.1 was used. There are small differences in the hydraulic conductivity of the two areas. The sediment in the granular aquifer has a 1.7 to 1.9 times higher hydraulic conductivity than the perched aquifer. An average infiltration factor of 0.62 was used for the site.

The recharge to the catchment area was calculated to be 138,566 m^3 annually (Calculation 1).

Calculation 1: Site Recharge

Water Budget from Normal (Section 5.9)			Runoff and Infiltration Areas		
Precipitation	0.876	m/yr	Catchment Area:	488,941	m^2
Evaporation	0.593	m/yr	Infiltration Area	488,941	m^2
Seepage					
Water Surplus	0.283	m/yr	Infiltration	85,907	m^3

[§§] Fineness modulus of sand (fine aggregate) is an index that represents the mean size of the particles in sand. It is calculated by adding the cumulative percentage of a sample of aggregate retained on a specified series of sieves and dividing the sum by 100.

Water Budget from Normal (Section 5.9)			Runoff and Infiltration Areas		
Infiltrate	0.1757	m/yr	Runoff	52,659	m^3
Runoff	0.1077	m/yr	**Total (Water Surplus)**	**138,566**	**m^3**

9.3 Site Hydrogeology

The test wells intercepted two overburden aquifers, a perched aquifer in the sand/till in the south-west part of the site, and the unconfined aquifer in the sand and gravel (OS Figure 2). A piezometer was installed in each drill hole and in-situ hydraulic conductivity tests were conducted. The data from the hydraulic conductivity testing and analyses are found in Appendix C. The data were analysed using AQTESOLV software. The Hvorslev method (Hvorslev 1951) was used for the analysis, and the results are tabulated in Table 4.

The literature provides a hydraulic conductivity range for medium fine to medium coarse sand between 9×10^{-7} m/s to 5×10^{-4} m/s (Domenico and Schwartz 1990). The perched "highland" aquifer is represented by TW 1 and the spring (Photo 8 and OS Figure 2). The analysis found the hydraulic conductivity ranged from 2.74×10^{-5} m/s to 2.21×10^{-4} m/s in the perched aquifer. The granular aquifer is represented by TW 2 and TW 3. The hydraulic conductivity ranged from 4.57×10^{-5} m/s (TW 2) to 2.97×10^{-4} m/s (TW 3). The average hydraulic conductivity from the test results for each well and for each aquifer is found in Table 4. The average hydraulic conductivity for the highland unit is 1.07×10^{-4} m/s and the average for the granular unit is approximately 1.8 times higher, at 1.92×10^{-4} m/s.

Table 4: Summary of Hydraulic Conductivity Tests in Terrain Units and Test Wells

	perched "Highland" Unit (sand/till)		**Granular Unit** (glaciofluvial sand and gravel)			
	TW 1		**TW 2**		**TW 3**	
	Hydraulic Conductivity (m/s)	**Type of Test**	**Hydraulic Conductivity (m/s)**	**Type of Test**	**Hydraulic Conductivity (m/s)**	**Type of Test**
	6.00E-05	FH	1.63E-04	FH	2.79E-04	FH
	7.72E-05	RH	4.57E-05	RH	1.58E-04	RH
	4.27E-05	RH (Calc 1)	4.90E-05	FH (Calc 1)	1.75E-04	FH
	2.74E-05	RH (Calc 2)	8.27E-05	FH (Calc 2)		
	2.02E-04	FH	1.01E-04	RH		
	1.15E-04	RH	9.04E-05	FH		
	3.94E-05	FH				
	2.21E-04	RH				
	1.78E-04	FH				
Average	1.07E-04		1.80E-04		2.04E-04	
MAX	2.21E-04		7.32E-04		2.79E-04	
MIN	2.74E-05		4.57E-05		1.58E-04	

The groundwater elevation measured on 9 occasions are found in Table 5. Figure 4 shows the water level variation over the study, which can be compared to monthly precipitation. The groundwater

elevation and flow for select dates are shown in plan view on OS Figure 5 to OS Figure 7, which capture spring recharge, mid-summer and fall. The data illustrate how the groundwater at TW 1 was 8.38 to 11.15 m higher than TW 2 or TW 3.

The spring was at approximately the same elevation as the groundwater in TW 1 (TEC Surveying Inc. 2021) and was interpreted to represent the perched aquifer. Two other areas of ponded water were found near the base of the granular deposit along the north edge and near the eastern end of the existing south license boundary (OS Figure 2). The standing water was in local depressions, and although springs were not observed at the locations, they are possible contributors to the surface water accumulations. The groundwater levels at TW 2 and TW 3 were 0.98 to 3.26 m, and 2.26 to 2.66 m below the ground surface, respectively, and with the site topography, springs would be expected. The boundaries were traversed several times by GRI staff and no springs were found. None were found either in the natural environment field study (Ecological Services 2022).

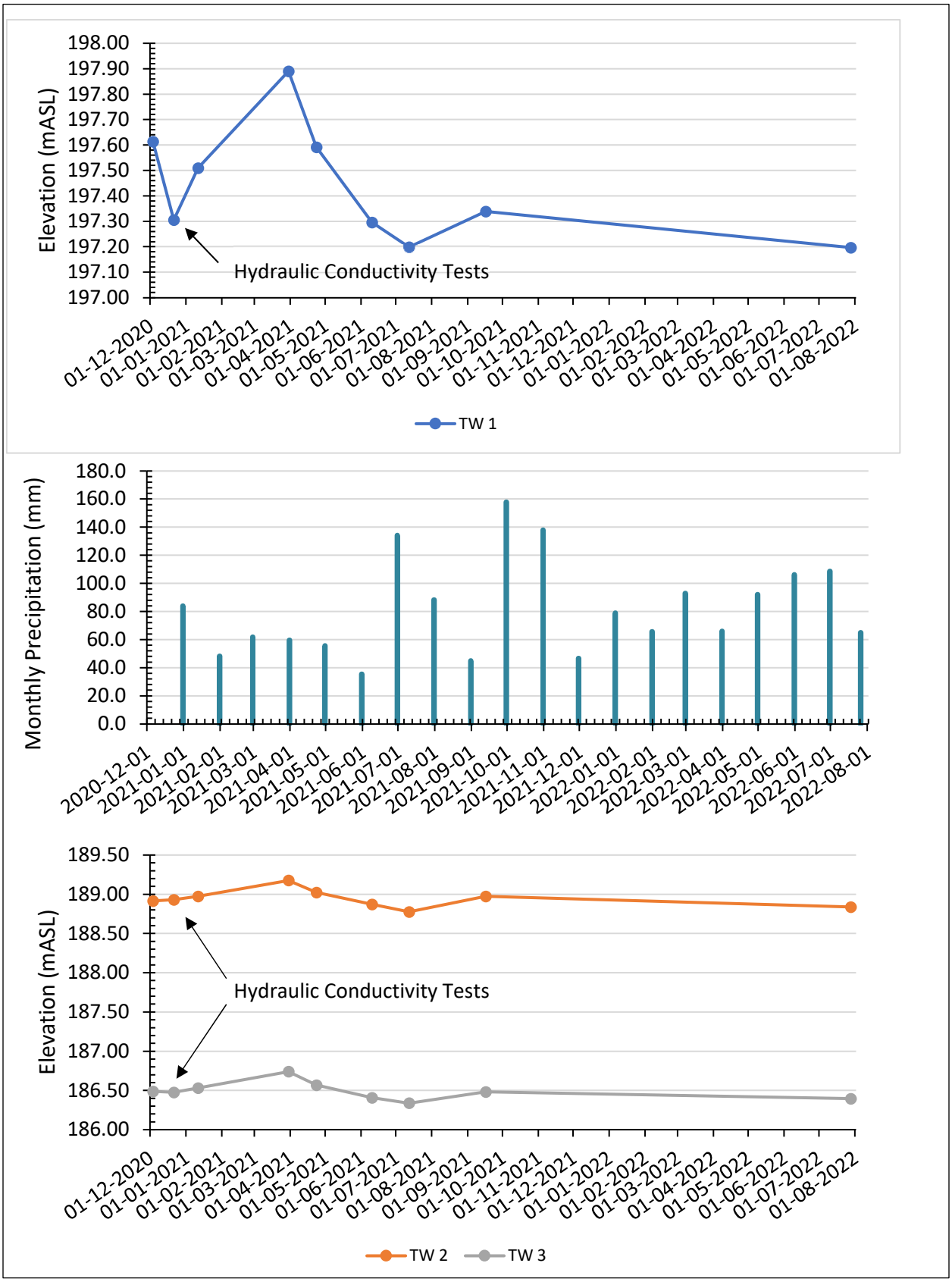
The groundwater elevation at TW 1 was relatively consistent, with a fluctuation between highest and lowest measured levels of 0.69 m. At TW 2 the groundwater elevation fluctuated 0.25 m. The groundwater elevation in TW 3 fluctuated 0.4 m over the period monitored and was an average of 2.45 m lower than TW2 in the granular aquifer. The groundwater flow in the catchment area of the site is interpreted to drain from the perched aquifer on the Barbers Lake intrusion in the south-west part of the site, into the granular aquifer. Within the granular aquifer on the site the flow direction is, it can be inferred that the flow will have localized multi-directional components that are controlled by grainsize and structure. The difference in groundwater elevation between TW 2 and TW 3 suggests an eastward flow component, but the flow direction on the site is expected to be variable and reflects the surficial and bedrock geology as is seen in other similar deposits. There is an interpreted smaller northward flow component that may contribute recharge to the wetland, since the water table in the granular aquifer is slightly higher or approximately at the surface elevation in the north buffer zone. This could be confirmed with the presence of springs, but this area of the site was not completely accessible because of the tangled undergrowth.

Over the monitoring period, the highest water level in both unconfined aquifers was recorded on March 30, 2020 (TW 1 and TW 3), and April 23, 2021 (TW 2). The lowest groundwater level occurred on July 12, 2021 in all three wells. The groundwater levels on July 28 just over one year later were nearly identical.

Table 5: Potentiometric Levels in Test Wells

	Dec 3, 2020	Dec 21, 2020	Jan 11, 2021	Mar 30, 2021	Apr 23, 2021	June 10, 2021
TW 1	197.61	197.31	197.51	197.89	197.59	197.30
TW 2	188.91	188.93	188.98	188.87	189.02	188.87
TW 3	186.49	186.48	186.53	186.74	186.57	186.41
	July 7, 2021	**Sept 16, 2021**	**July 28, 2022**			
TW 1	197.20	197.34	197.20			
TW 2	188.78	188.98	188.84			
TW 3	186.34	186.48	186.40			

Figure 4: Variation in Groundwater Level, TW 1 to TW 3



The March and April high groundwater levels usually coincide with spring rainfall and snowmelt. Although the precipitation from January to April In 2021 was slightly below Normal (94.5%) and 71.7% of the previous 5 year average (OS Table 1), the water levels still followed the expected seasonal pattern.

The groundwater flow through the site, from west to east was estimated (Calculation 2). The flow through the site is approximately 469,787 m^3/yr.

Groundwater flow in the unconfined granular aquifer is eastward, towards Barbers Lake.

Calculation 2: Groundwater Throughflow, Site

$Q = k\ i\ A$

Where:

Q =	groundwater flow, m^3/yr		
k =	hydraulic conductivity, m/yr		
I =	hydraulic gradient in the direction of flow,		
=	d_v/d_h		
		d_v=change in groundwater level across the site	9.5 m
		d_h=distance over which the change occurs	386 m
i =	9.5/386		
=	0.02461		
		average depth of excavation below water table	12.95 m
		width of cross section	285 m
A =	3,691	m^2	
k =	1.64E-04	average for site, m/s	
=	5,172	m/yr	
Q =	**k i A**		
	5,172 *0.02461 * 3,691	m^3/yr	
	469,787.42	**m^3/yr**	

The confined bedrock aquifer will not be intercepted by the proposed operation. Along Highland Line the mapped bedrock is part of the Barbers Lake intrusion that consists of pink granite. This formation was intercepted at the base of TW 1.

The potentiometric groundwater elevation in the confined bedrock aquifer is approximately 200 mASL at the site, based on the analysis of water well records.

9.4 Site Hydrology

The Long Sault Creek/Wetland abuts the site on its northern and western peripheries. The granular aquifer may also provide some recharge to the feature, again based on the groundwater elevation in the aquifer compared to the surface elevation.

The flow in the Highland Line ditch turns and flows through the site about midway along the south property boundary (Photo 9, Photo 10 and OS Figure 2). Water in the ditch initially meanders northerly across the shallow bedrock, but completely infiltrates the pit floor within 65 m once it drains into the granular unit.

9.4.1 Wetland

Part of an approximately 129 ha wetland is found within 120 m around the site on the north and east boundaries of the site. The published mapping indicates it is part of the Long Sault Creek watercourse. The wetland is not identified as Provincially significant, but Ministry of Mines and Development, Natural Resources and Forestry considers non-evaluated wetlands as significant, until otherwise shown. It is reasonable to expect a wetland of this size to score as significant (Ecological Services 2022).

The wetland is within 55 m of the north and west parts of the proposed extraction boundary of the existing license area and immediately east of the proposed expansion boundary (OS Figure 2). The Mississippi Valley Conservation Authority limits activity within 30 m from the wetland. The natural environment report (Ecological Services 2022) recommends the buffer be increased to 45 m along the northeast end of the existing license area due to steep slopes.

Four wetland communities, a meadow marsh, a thicket swamp and two conifer swamp types, were identified within 120 m of the existing and expansion pit areas in the study. These wetlands will be buffered from the pit by a band of woodland.

The report concluded that biological features such as diversity are not expected to be impacted by the proposed pit, since the existing pit license, which for the most part will be between the expansion areas and the wetland has little value to wetland species needs. It also observed that significant changes to wetland features such as diversity appeared to be controlled by factors that are not related to the pit activity, such as beaver activity.

The report finally notes that the lake that will result at rehabilitation may add value to the wetland by adding diversity. Finally, the report does caution that the creation of the lake should not divert water from the wetland, as a negative impact to the wetland could result. This concern is addressed in the impact assessment (Section 12).

9.5 Groundwater Quality

Groundwater samples were collected from TW1, TW2 and TW3 on December 3, 2020 and January 11, 2021. The water samples were clear and odourless. The laboratory reports are found in Appendix D and the geochemical results are presented in OS Table 4. The geochemistry was consistent in the three site wells.

The Ontario Drinking Water Standard provides the limits and objectives for groundwater quality that range through a maximum allowable concentration, (MAC), an interim maximum allowable concentration, an aesthetic objective (AO) or an operation guideline (OG). The limits are included on OS Table 4. The laboratory results from the samples met the respective Ontario drinking water standards.

The sodium and chloride concentrations were elevated at TW 3 in comparison to TW 1 and TW2, which suggests that some local contamination, likely road salt on Highland Line, has occurred. The hardness

concentration was also slightly elevated comparatively as was nitrate. These combined to elevate the total dissolved solids and conductivity. There is high throughflow in the granular aquifer that will help dilute any local contaminants.

The water samples did not indicate the presence of total petroleum hydrocarbons or selected volatile organics that would indicate an impact from the current operation has occurred.

10 CONCEPTUAL HYDROSTRATIGRAPHIC MODEL

Four aquifers were identified on the site and study area; two unconfined aquifers underlain by confined bedrock aquifers.

A large regionally-extensive overburden aquifer was identified on the site and adjacent properties. The aquifer is in the glaciofluvial complex that transects the area (Section 5.3). Where the assemblage is at the surface, such as in the study area, the aquifer is unconfined, but it may be semi-confined to confined elsewhere where it has been buried by organics and fine-grained lacustrine sediments, (G. A. Gorrell 1991). The site mapping and interpretation of the deposit facies suggest this may be the case in the wetland north of the site

The proposed operation will extract below the water table will intercept the unconfined granular aquifer. The investigation determined this aquifer (the granular aquifer) is the key or significant aquifer with respect to the existing and proposed operation. In addition to two of the test wells, two off-site water well records indicated the wells were completed in this aquifer (WWR 7106890 and 7274335). Water levels measured seasonally and over a period between December 3 to July 28, 2022 ranged from 186.3 to 189.0 mASL. In the site wells, the hydraulic conductivity ranged from 4.57 x 10^{-5} m/s (TW 2) to 2.79 x 10^{-4} m/s (TW 3) in the granular aquifer and terrain unit.

A second aquifer, perched and unconfined, is found in highland part of the site in the south-west and along the south boundary. The aquifer is in sand and till that overlies the bedrock. This aquifer currently discharges on the north side of the highland terrain. The behaviour of the aquifer theoretically would not have changed as a result of the current site operation, and there was no evidence that an impact occurred. The aquifer may have originally discharged into the glaciofluvial sediment before it was excavated for aggregate, similarly to the possible spring located near TW 3 (OS Figure 2). The hydraulic conductivity ranged from 2.74 x 10^{-5} m/s to 2.21 x 10^{-4} in the perched highland aquifer. Water levels in the perched aquifer varied between 197.2 and 197.9 mASL.

The field investigation found one seep/spring on the site but no others were confirmed. One was confirmed on the south side of the site where the bedrock of the Barbers Lake intrusion and the till overburden intersect the surface (Photo 8). Others would be expected along the north face of the highland, as described in Section 5.7.3 (OS Figure 2). Water from this seep infiltrates within 70 m as it flows over the into the granular aquifer.

Springs or seeps would also be expected along the north boundary of the site, and one potential location identified from aerial photography is shown on OS Figure 2. The lower elevation along the north edge of the deposit would control the groundwater level in the granular aquifer.

The site and study area have an infiltration and runoff rate comprise approximately 20 and 12% of the precipitation. Runoff on the site is northward.

11 MAXIMUM WATER TABLE

The maximum water table was determined in the hydrogeological investigation. The groundwater levels were measured in three site wells between December 3, 2020 and July 28, 2022. TW 1 represents the perched unconfined aquifer. The other two wells, TW 2 and TW 3 represent the granular aquifer. The granular aquifer is the pertinent aquifer to use to establish the maximum water table for the proposed operation.

At TW 2 the groundwater elevation fluctuated 0.25 m. The groundwater elevation in TW 3 fluctuated 0.4 m over the period monitored and was an average of 2.45 m lower than TW2 in the granular aquifer.

Over the monitoring period, the highest water level in the granular aquifer was recorded on April 23, 2021 in TW 2. The lowest groundwater level occurred on July 12, 2021 (Figure 4). The groundwater levels on July 28 just over one year later were nearly identical (Table 5).

The maximum water table for the site is 189 mASL, determined from the water level data.

12 IMPACT ASSESSMENT

The proposal will excavate the economical material above, and up to 20 m below the water table. The site investigation showed the aggregate extends down to an elevation ranging approximately from 193 mASL in the southwest area near TW 1, to lower than 171 mASL at TW 2 and TW 3 over the remainder of the site. It is highly probable that the base of the resource will not be intercepted over the proposed depth. Before water is required for processing, such as crushing or washing, pertinent permits including a Permit to Take Water, would have to be obtained.

No change to the water table is planned through either pumping or ditching. The planned operation method will excavate below the water table using a dragline or cutter dredge. In general, an operation where the water table is not pumped or lowered by some other means usually does not result in significant hydraulic impacts (Green, Merritt and Leete 2005).

The proposed excavation will be a maximum of 20 m below the water table in the granular aquifer, or to approximately 173 mASL. The water level in the open water in the pit will be +/- 187.7 mASL (the average of the water table measurements over the study period in the granular aquifer).

Overall, the hydraulic impact of the proposed operation on the groundwater and surface water is predicted to be minimal. This is primarily because the operation will not change the groundwater level in the granular aquifer. The operation will not change the current flow or contribution of the perched highland aquifer or divert runoff from the area. The runoff from Highland Line already flows through the pit, presumably by the municipality with the property owner's permission. This will not be changed with the proposed operation.

12.1 Surrounding Groundwater Users

Seven water well records matched to sites within 500 m of the site show the wells use the bedrock aquifer. The nearest well completed in the granular aquifer is approximately 1 km east of the site.

Five of the wells are on Wheeler's Maple at 1001 Highland Line. The wells are clustered at the buildings, at or slightly farther than 500 m from the expansion license boundary. The two closest wells, according

to well records, are south of Highland Line. One of the wells, at 1121 Highland Line south-west of the expansion license boundary was drilled in 2005. The other was drilled in 1962. The drillers map on the record shows the well at 1025 Highand Lane, but only an old foundation remains. The status of this well is unknown, but it would not appear to be in use.

The well records are found in Appendix A, and the pertinent details of the nearby wells are summarized in Table 6. The table contains data from the well record as well as interpreted data.

Table 6: Summary of Neighbouring Wells Data (Appendix A)

WELL ID	UTM	DATE	SURF ELEV^	BEDROCK ELEV	REPORTED WBZ	POT ELEV	PUMP RATE*	FORMATION@
3500651	378359 4976642	Jan-62	212	205.9	193.7	206.2	7 (26.5)	LOAM MSND 6.1 GRNT 21.9
3511715	378090 4976138	Mar-96	215	209.5	205.2, 198.5, 194.3	212.3	12 (45.4)	SAND GRVL 005.5 RED GRNT 24.4
3512581	378090 4976139	Mar-99	215		171.4	211.0	10 (37.9)	(3511715 deepened) PRDR 24.4 RED GRNT 54.9
3512912	378090 4976139	Apr-00	215	210.7	198.2	203.7	7 (26.5)	CLAY GRVL BLDR 4.3 RED GRNT 9.8 RED GRNT GRVL 11.3 RED GRNT18.3
3514108	378087 4976139	May-03	215				7 (26.5)	(3512912 deepened) PRDR 18.3 RED GRNT 30.5
3514109	378087 4976139	May-03	216	214.2			1 (3.8)	SAND BLDR 1.8 RED GRNT 118.6
3515148	377434 4976291	Sep-05	195	192.0	137.4	189.2	3 (11.5)	BLCK LOAM 3.0 RED GRNT 61.0

^ Surface elevation approximated from Google Earth
* Recommended pumping rate on well record, GPM (L/min)
@ Depths converted to metres
Elevations calculated from well record data and surface elevation

The off-site wells are completed in bedrock, although depending on the construction they may also derive some water from the overburden. Two of the well records show existing wells were deepened ("PRDR"). Well 3512581 is the record of deepening WWR 3511715 and WWR 3514108 records the deepening of WWR 3512912. The wells may have been deepened both to try and intercept additional groundwater and to provide in-well storage to compensate for lower yields. Wheeler's operation consists of a restaurant as well as water requirements associated with processing the maple syrup (www.wheelersmaple.com).

The study found the proposed operation will not have an impact on the bedrock aquifer. This is because regionally the bedrock aquifer discharges at the topographically low area along and the north side of the site (OS Figure 3). The wells are also up-gradient of the site, and will intercept the bedrock aquifer before it reaches the site. These are the reasons the bedrock wells would not be impacted by the proposed operation. The five wells completed on the Wheeler property are at or more than 500 m from the site when plotted correctly according to the drillers' maps.

There are two other wells reported that are within +/- 100 m of the proposed expansion boundary. As noted, the status of one well is unknown as it is an old well and all that remains on the lot is a foundation (1025 Highland Lane).

The second well (1121 Highland Lane), drilled in 2005 appears to be in use at an established residence. The well is 100 m or less from the proposed license boundary but will be on the order of 145 m from the excavation boundary determined from the geology (Section 9.1). The information from well record showed there was 3.0 m of overburden over the bedrock and the encountered water bearing zone was deep at +/- 137.4 mASL with a static level was +/- 189.2 mASL. It is most unlikely that this well will be affected by the operation, but as a precautionary measure it is recommended that site specific information on the well be documented for future reference. If possible, and the owner is willing to participate, the well could be included in the groundwater monitoring program.

12.2 Hydrology Impact

There is no predicted change to the groundwater or surface water flow from the proposed operation. Runoff and flow in the perched highland unconfined aquifer will not be redirected from the existing condition by the operation. The proposed excavation below the water table in the granular unconfined aquifer will not have an impact on the water level. There is a potential seepage component from the aquifer to the wetland, and there is possibly a very minor interconnection between the features as a result. However, since the water table is not expected to change, this component will also not be affected. The natural environment report attributed the standing water in the marsh north of the site to beaver activity.

The natural environment report (Ecological Services 2022) cautioned that the creation of the lake should not divert water from the wetland, as a negative impact to the wetland could result.

Evaporation from the open water will be greater than from the original terrain. Extraction below the water table will increase the evaporation rate. This transition from terrestrial to open water will occur gradually. The groundwater system will adapt by initially lowering the open water surface, with gradual restoration to pre-development levels as the natural groundwater surface adjusts to a steady state flow.

The rate of evaporation is related to temperature, humidity and wind speed, as well as to the surface area of the open water.

An average annual evaporation from open water of 597 mm was determined for pits that have been excavated below the water table (Brown, McKay and Chapman 1980). The existing evaporation for the site was calculated as 593 mm (Section 5.9.2). Therefore, there will be minimal change or resulting impact to the system.

12.3 Cumulative Impact

There are currently no aggregate operations within 500 m of the site. GRI understands an application for another pit south-east of the site is pending or has been submitted. The closest pit is the 63.5 ha Tackaberry Sand and Stone Ltd Pit located more than 800 m east of the site. The Tackaberry Pit currently holds a Class A license.

12.4 Groundwater Quality

The greatest potential impact of the proposed operation is from contamination. The groundwater in the study area is classified as highly vulnerable (Mississippi-Rideau Source Protection Committee 2022).

Two sets of water samples taken from the site wells show no indication of contamination from the operation. Field measurements could not be taken because of the winter conditions. Slightly elevated sodium and chloride at TW 3 likely originates from road salting.

Hydrocarbons would be the most likely contaminants from the operation. No concrete or asphalt plant is proposed. The potential for spills should be addressed on the site plan, with prevention as the key objective. It can be achieved with reasonable care and caution in the operational practice.

12.5 Thermal Impacts

The natural environment report provides details on fish sampling that was completed in 2006 by Muncaster Environmental Planning Inc. and other sources. It indicates that Brook Trout were historically stocked in Long Sault Creek although none were identified by Muncaster within 120 m of the site. Ecological Services' Natural Environment Technical Report commented that the potential for Brook Trout to be found within 120 m of the existing and proposed pit expansion is low due to many fish obstructions between Long Sault Creek.

The exposure of the groundwater in the final lake could potentially result in thermal changes to the local groundwater system. Published data indicate the impacts are usually localized. Groundwater returns to normal background temperature within 10s of metres of the pit ponds (Harden Environmental Services Limited 1995, Ostrander, et al. 1998).

The natural environment report recommended a buffer zone of 30 to 45 m between the excavation and the wetland. This zone will provide distance for the groundwater temperature to decrease towards the original temperature as it approaches the wetland. Considering that the natural environment report feel it is unlikely that Brook Trout will be found near the pit, no mitigation is recommended. The other fish species found by Muncaster are considered to be tolerant or intermediate (Ecological Services 2022).

12.6 Flooding

Since there will be no discharge from the pit the operation will not contribute to flooding in the surrounding drainage feature.

12.7 Base Flow

It is not anticipated that the proposed operation will change these flow paths or that changes to the base flow will occur.

13 RECOMMENDATIONS

No impacts are anticipated from the operation as proposed. However, it is recommended that groundwater monitoring program be implemented for several years to support the impact assessment and provide data to protect both Arnott and surrounding groundwater and surface water interests.

Piezometers TW-01, TW-02 and TW-03 were positioned as sentry wells between the proposed operation and neighbouring groundwater users. They will be used to confirm the data analyses, provide continued groundwater assessment and monitor groundwater quality. If the owner is willing to participate, the well at 1121 Highland Line could be included in the groundwater monitoring program.

13.1 Groundwater and Surface Water Level Monitoring

Water levels should be recorded before operations begin each year, and on alternate months through the operating season up to one month after the season ends.

After two years, if a representative baseline has been established, recommendations can be made for changes to the monitoring program, including the necessity to continue it, until below water excavation begins.

When below water excavation begins, the groundwater monitoring program described above should be repeated as a minimum (i.e. assuming no changes have resulted from the original program). A staff gauge should be installed in the pond, and monthly water level measurements should be recorded on the same day as the groundwater levels. As the lake expands, it may be beneficial to install a second staff gauge to record the change in water level across the open surface. For the long-term data loggers could be installed to monitor the water levels in the ponds.

When measurements are taken, observations and/or photos of the site activity should be recorded. Weather conditions on, and for two or three days before the monitoring, should also be noted.

When the monitoring of the below water excavation begins, the data should be checked by a qualified professional as the measurements are taken.

An annual review of the data should be prepared annually by a QP. During the annual review, recommendations may be made for changes to the monitoring program. The reviews should be kept at the company office for future reference.

13.1.1 Off-Site Groundwater Users

Site specific information on the wells at 1025, 1101 and 1121 Highland Line should be documented through a well interview before excavation into the expansion begins. The survey should document the property setting, well location and construction, and confirm the water well record match if possible. A water sample should be taken to establish baseline water quality. As with the baseline groundwater monitoring, the pre-operations sample provides a reference for future use. The recommended list for baseline and any future water quality analysis is found in Table 7.

13.2 Adaptive Management Plan

An Adaptive Management Plan incorporates the information from the monitoring plan to reduce uncertainty about the impact that the pit will have on natural systems on the site and surrounding area.

Table 7: Recommended Baseline Water Quality Analysis, Residences

Group	Parameters
Field Measurements	Total Dissolved Solids, pH, conductivity, dissolved oxygen, turbidity, water temperature, residual chlorine
Bacteriological	Total coliforms, faecal coliforms, e. coli, background plate count
General Characteristics	Total Suspended Solids, Alkalinity as $CaCO_3$, TDS, pH, Conductivity, Hardness as $CaCO_3$, Ca, Mg, Na, K, Cl, Total P, N-NO_2, N-NO_3, SO_4, Total Kjeldahl Nitrogen, N-NH_3, phenols,
Metals	B, Ba, Be, Cd, Cu, Cr, Fe, Mn, Mo, Ni, Pb, Si, Ag, Sr, Tl, V, Zn
Hydrocarbons	Total Petroleum Hydrocarbons (F1 - F4)

13.2.1 Trigger Mechanism

Water levels in the site wells will be measured seasonally. The monitoring will be done for two years. At the end of two years the data will be analysed and recommendations will be made on the need for changes to the monitoring program.

13.2.1.1 Changes in Site Groundwater Level

The data to date found the annual fluctuation in groundwater level ranged from 0.25 m at TW 2 to 0.69 m at TW 1. The groundwater elevation on July 12, 2021 and July 28, 2022 was comparable. For the initial two years of monitoring, if a groundwater level has declined by more than 30% from the previous year at any monitoring period, the cause will be assessed and addressed. The analysis at the end of the initial two years of monitoring will include a recommendation for changes to the trigger mechanism if required.

13.2.1.2 Receipt of Unexpected Well Problem

If an unexpected complaint arises, the license holder will retain a Qualified Professional, who will investigate. If the problem is attributed to the pit operation, remediation or compensation will be offered by the operator as soon as possible. This response will apply within 500 m of the license boundary.

a. A Qualified Person will be retained at the license holder's expense to investigate the issue, and within 15 days provide an opinion on cause and provide recommendations to remediate the issue.
b. In addition, if the issue occurs within 500 m of the license boundary, the operator will provide an interim potable water supply to the affected well, within 24 hours. The interim supply will be continued until the matter is considered resolved by the MOECC or the resident.

If the issue occurs more than 500 km of the license boundary, the MOECC will be notified of the issue. Any direction by the MOECC will be followed by the license holder.

13.2.1.3 Predicted Negative Impact on Neighbouring Wells

The objective is to prevent the predicted impact from occurring. This is because of the low yields and mineralized water that is associated with some Precambrian aquifers.

If a negative impact on a neighbouring well is predicted through hydrogeological data review, the specific well conditions will be evaluated, and the predicted impact will be remediated. The remediation may consist of lowering or replacing the pumping equipment or deepening the well(s) by the operator or their representative (with owners' permission).

13.2.1.4 Replacement Well Quality

To mitigate the potential issue of naturally poor water quality in remediated wells, the effort will be made to construct the well to a final depth as shallow as possible to obtain a suitable water quantity. If natural water quality exceeding the Ontario Drinking Water Standard is encountered, suitable water treatment will be recommended.

13.2.2 Protection of Groundwater and Surface Water Quality

Protection to the groundwater and surface water from contaminants will be accomplished through management and operation of the materials and equipment to the industry standards and legislative requirements. Re-fueling will take place on an impervious surface, and materials storage will be in an appropriate container, with secondary containment. Regulatory requirements of the Technical Standards and Safety Authority will be followed.

A minimum of 30 m will be maintained between a contaminant source, and any surface water source including but not limited to, the pit pond, or any ditch system.

Material imported to the site should meet the regulatory requirements of O. Reg. 347.

13.2.2.1 Emergency Spills Procedure

An emergency spills procedure will be prepared for the site. The site manager should be trained in the emergency spills procedure and pertinent telephone numbers should be kept at the site office. A quantity of appropriate clean-up material such as absorbent mats and granular absorbent material should be kept on site when the quarry is operating.

It is recommended that the emergency plan also include the following components:

- Any unexplained losses of fuel or other contaminants will immediately be reported to appropriate management levels and/or agencies.
- If a spill occurs, action will immediately be taken to contain and absorb the spilled material. The reporting requirements of the Ministry of Environment and Climate Change will be followed under the responsibilities of the designated staff, who will be responsible for assuring that proper clean-up has occurred.

13.2.3 Additional Recommendations

- Operational permits, such as a Permit to Take Water or a Certificate of Approval for Industrial Wastewater Treatment (part of the Environmental Compliance Approval) should be obtained, if necessary.

14 SUMMARY AND CONCLUSIONS, LEVEL 2 HYDROGEOLOGICAL REPORT

Arnott Bros. Construction Ltd. is applying for a site plan amendment that will enlarge the extraction area and permit the excavation to extend below the water table at their pit located in Township of Lanark Highlands (Geo. Twp. of Dalhousie), County of Lanark. The site is approximately 40.1 ha on Part of Lots 5 and 6, Concession 10, Part of Lot 6 Concession 11, Part of the Road Allowance between Lots 5 and 6, Concession 10 and Part of the Road Allowance between Concessions 10 & 11 (at Lot 6).

The property is on part of a glaciofluvial assemblage that extends from near Middleton, southward to Pine Grove westward to just north of Playfairville, parallel to Highland Line and Kingston Line and crosses County Road 36 before continuing into the County of Frontenac. Published reports indicate that the material in the assemblage is the highest quality with respect to the province's mineral aggregate interests

The proposal will extract aggregate from above and below the water table using an excavator, drag line or other dredging equipment. No diversion, storage or drainage of groundwater is planned in the proposed operation.

Three test wells were drilled on the site on November 26 and 27, 2020 and a piezometer was installed in each. The holes were drilled to bedrock refusal or a maximum 18 m below the water table. Rising head and falling head tests were conducted to measure the hydraulic conductivity. Groundwater levels were measured between December 3, 2020 and July 28, 2022. Water samples were taken on December 3, 2020 and January 11, 2021.

Four aquifers were identified on the site; a perched unconfined aquifer ("highland aquifer"), an unconfined aquifer in the glaciofluvial deposit ("granular aquifer") and confined aquifers in two bedrock formations. The highland aquifer drains into the granular aquifer. This condition existed pre-excavation and will continue through and after the site has been excavated. The aquifer flows northward from the bedrock high south of the site, and is found in the south-west part of the property. The granular aquifer has a groundwater elevation that is 10.9 to 11.6 m lower than the highland aquifer.

One spring was found along the existing south property boundary, and two possible springs were identified from aerial photography. The thick and tangled undergrowth prevented a closer examination of the north face. If more springs are found, they will be located where the highland aquifer discharges to the granular aquifer, and where the water table in the granular aquifer intersects the north slope of the deposit along the north property boundary.

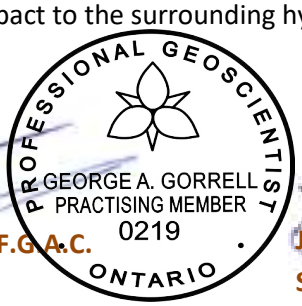
A 129 ha wetland is near the property along the west, north and east boundaries. The natural environment report concluded that the proposed operation would not affect the wetland unless the final lake diverted flow from the wetland. This study found that this will not occur.

The bedrock aquifer was examined through a water well record analysis. There were seven well records found within 500 m of the site, all finished in bedrock. The wells are upgradient of the site and the information indicates there will be no impacts from the operation.

A monitoring and mitigation plan has been recommended to provide additional baseline data during the above water excavation, with a second monitoring period once the below water operation begins. It is also recommended that baseline information and water quality be collected on the neighbouring wells.

In summary, hydrogeological investigation found the proposed expansion and below water excavation will not result in a significant impact to the surrounding hydrogeological environment.

Sincerely;



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Photographs

Photo 1

October 7, 2020

Section in central portion of deposit. This is a typical section in a cavity fill/bead deposit

Photo 2

October 7, 2020

Section in central portion of deposit. Slightly coarsening downward which is typical of a fan/cavity deposit. With processing could meet requirements for high quality aggregate such as concrete or asphalt sand.

Photo 3

April 23, 2021

Pink Granite bounder on southern side of license. This bounder is from the underlying Barbers Lake Granite Intrusion. Hill in background would be the sand and gravel deposit.

Photo 4

April 23, 2021

Pink granite boulder on side western side of license. The boulder is derived from the underlying Barbers Lake Granite Intrusion. The hill in background (on right) would be the sand and gravel deposit.

Photo 5

November 27, 2020.

Drilling on the site to determine type of material and to install monitoring wells. This would be TW 3 and camera is facing east from height of land.

Photo 6

November 27, 2020

Drilling TW 3. Facing north.

Photo 7

December 21, 2020

TW 1. Drilled near the contact between the sand and gravel deposit and Barbers Lake Granite Intrusion.

Photo 8

April 23, 2021

Spring on the Arnott site. The spring discharges where the Barbers Lake Granite Intrusion and the overlying till intercept the base of the hill. Water from spring flows 50 to 60 m towards gravel ridges in background before it infiltrates into ground.

Photo 9

March 30, 2021

Culvert under Highland Line that directs roadside water to the Arnott property. Facing northeast

Photo 10

March 30, 2021

Roadside ditch along Highland Line. Water from properties south of the road and along the road are directed onto the Arnott property.

Oversize Tables

OS Table 1: Precipitation and Mean Daily Temperature Analysis, Drummond Centre Climate Station

	PPT (mm)							
	1981 to 2010 Normal	2017	2018	2019	2020	2021	2017 to 2021 5-year Average	2022
January	67.7	73.8	67.0	72.4	107.2	48.2	73.7	65.6
February	51.3	90.2	67.2	74.4	40.2	61.8	66.8	93.0
March	55.1	74.8	52.2	62.0	79.0	59.6	65.5	66.0
April	64.2	126.2	133.4	149.0	76.4	55.6	108.1	92.0
May	77.0	164.8	33.0	87.8	34.2	35.4	71.0	106.2
June	82.4	166.2	62.8	120.4	46.2	134.2	106.0	108.6
July	83.5	175.0	106.2	42.0	64.6	88.2	95.2	65.0
August	75.3	131.6	82.2	52.4	248.0	45.0	111.8	
September	91.8	28.4	98.6	105.6	60.0	157.8	90.1	
October	78.5	142.8	86.6	179.4	76.4	138.0	124.6	
November	83.6	78.2	108.2	57.2	52.6	46.6	68.6	
December	65.9	60.0	80.8	58.0	84.0	79.0	72.4	
Annual	**876.3**	**1,312.0**	**978.2**	**1,060.6**	**968.8**	**949.4**	**1,053.8**	596.4

	Average Mean Temperature (°C)							
	Normal	2017	2018	2019	2020	2021	2017 to 2021 5-year Average	2022
January	-9.8	-5.2	-9.0	-10.7	-5.5	-6.2	-7.3	-13.9
February	-8.5	-4.3	-4.5	-8.4	-6.3	-7.9	-6.3	-8.7
March	-2.0	-4.7	-1.5	-3.7	1.2	0.3	-1.7	-1.5
April	6.0	7.8	2.7	5.2	5.0	7.7	5.7	5.6
May	12.7	12.2	15.5	11.5	12.6	13.3	13.0	15.0
June	17.8	17.5	17.6	17.5	18.8	19.3	18.1	16.8
July	20.3	19.6	22.3	22.2	23.7	19.3	21.4	16.9
August	19.1	18.5	20.9	19.2	19.7	21.7	20.0	
September	14.4	16.9	16.7	15.2	13.9	14.8	15.5	
October	7.8	11.6	7.4	8.7	7.5	11.4	9.3	
November	1.6	0.6	-1.0	-1.6	4.1	1.4	0.7	
December	-5.8	-9.4	-5.6	-4.6	-2.7	-3.1	-5.1	
Annual	**6.1**	**6.8**	**6.8**	**5.9**	**7.7**	**7.7**	**7.0**	**30.1**

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CON LOT	WELL ID		UTM		DATE	CNTR	WATER ZONES	STATIC LEVEL	PUMPED LEVEL	PUMP RATE	P TEST DUR	WELL USE	FORMATION
DALHOUSIE & N. SHERB													
09 006	7106890	18	379607	4977703 W	Jun-07	4905	FR 0052	7	47	4	1:00	DO	BRWN LOAM GRVL 0034 GREY GRNT 0050 GREY GRVL 0055
08 006	7169100	18	380283	4978972 W	Aug-11	2558	UT 0115 UT		198	4	1:00	DO	RED SAND STNS 0007 BLCK GRNT 0030 RED GRNT SOFT 0035 BLCK GRNT 0050 GREY GRNT 0055 BLCK GRNT 0110 BLCK GRNT 0240
09 005	3511352	18	380199	4977906 L	Dec-94	2558	FR 0195 FR 0215	26		4	1:00	DO	RED SAND 0010 GRVL 0014 GREN LMSN 0193 BLCK LMSN 0220
09 005	7274335	18	380116	4978215 W	Oct-16	2558	UT 0065 UT 0093		21	21	1:00	DO	SAND 0020 GRVL 0050 GRVL 0100
09 006	3506773	18	380429	4978621 W	Mar-84	1567	FR 0040	13	50	30	1:00	DO	PRDG 0017 BRWN GRVL BLDR PCKD 0037 BLUE LMSN HARD 0088 BLCK GRNT HARD 0098 GREY GRNT HARD 0106
09 007	3507744	18	379397	4978834 L	Sep-86	2558	FR 0320			2	1:00	DO	LOAM STNS 0006 GREY LMSN 0245 GREN LMSN 0325
09 007	3514322	18	379394	4978835 L	Oct-03	2558	UK 0157	17		40	1:00	DO	BLDR GRVL 0020 SAND STNS 0026 GREY LMSN 0097 BLCK GRNT 0124 GREY LMSN 0138 BLCK GRNT 0160
09 007	3509906	18	379397	4978834 L	Jul-91	2558	FR 0095	41		5	0:30	DO	SAND STNS 0034 GREY LMSN 0060 BLCK LMSN 0150
10 002	3511072	18	380348	4975622 L	May-94	2558	FR 0115	4		12	1:00	DO	CLAY LOAM 0008 CLAY BLDR 0034 WHIT LMSN 0113 RED LMSN 0120
10 007	3505108	18	378629	4978221 W	Jun-78	2558	FR 0168	15		4	0:30	DO	GREY SAND GRVL 0017 BLCK GRNT 0136 WHIT LMSN 0174
10 008	3511921	18	377947	4978425 L	Nov-96	2558	FR 0057 FR 0090	20		15	1:00	DO	SAND FILL 0005 GREY LMSN 0025 BRWN LMSN 0028 GREY LMSN 0057 GREY LMSN 0090 BRWN LMSN 0092 GREY LMSN 0095
10 008	3505954	18	377829	4978221 W	Sep-80	2558	FR 0062 UK 0079	20		6	0:30	DO	CLAY BLDR 0020 GRVL 0023 GREY LMSN 0084
10 008	3511634	18	377947	4978425 L	Nov-95	2558	FR 0115	11		4	1:00	DO	GRVL BLDR 0030 GREY LMSN 0114 BRWN LMSN 0116 GREY LMSN 0120
10 009	3500645	18	377190	4978721 W	Apr-52	3902	FR 0046	31	35	11	0:30	DO	LOAM MSND 0020 LMSN SHLE 0022 WHIT LMSN 0055
10 009	3514525	18	377544	4978893 L	May-04	1567	FR 0028 FR 0060	6		26	1:00	DO	BRWN SAND BLDR PCKD 0016 GREY LMSN HARD 0028 BLCK GRNT HARD 0091
10 009	3508395	18	377547	4978892 L	Jul-88	2558	FR 0060	14		15	0:30	DO	CLAY BLDR 0018 GREY LMSN 0060 BRWN LMSN 0063 GREY LMSN 0074 BRWN LMSN 0076 GREY LMSN 0080

CON LOT	WELL ID		UTM		DATE	CNTR	WATER ZONES	STATIC LEVEL	PUMPED LEVEL	PUMP RATE	P TEST DUR	WELL USE	FORMATION
10 009	3507737	18	377547	4978892 L	May-86	2558	FR 0099	33		15	0:30	DO	BLDR STNS 0024 GREY LMSN 0082 BRWN LMSN 0100 GREY LMSN 0104
10 009	7114314	18	377001	4978613 W	Oct-08	4905	FR 0046 FR 0089	24	33	12	1:00	DO	BLCK LOAM 0004 GREY SNDS 0100
10 009	3504605	18	377430	4978872 W	Jul-76	2558	FR 0075	11		10	1:00	DO	RED SAND 0005 WHIT LMSN 0080
10 009	3503965	18	377237	4978638 W	Sep-74	4904	FR 0111	48	117	3	1:30	DO	PRDR 0050 WHIT LMSN 0077 GREY GRNT 0106 BLUE LMSN 0117
10 009	7185431	18	377552	4978647 W	Jul-12	2558	UT 0072 UT 0094		14	7	1:00	DO	CLAY GRVL STNS 0012 GREY LMSN FCRD 0100
10 009	3509848	18	377547	4978892 L	May-91	2558	FR 0100	25		8	0:30	DO	CLAY STNS 0017 GREY LMSN 0097 BRWN LMSN 0101 GREY LMSN 0105
11 005	3512912	18	378090	4976139 L	Apr-00	2558	FR 0055	37		30	1:00	DO	CLAY GRVL BLDR 0014 RED GRNT 0032 RED GRNT GRVL 0037 RED GRNT 0060
11 005	3511715	18	378090	4976138 L	Mar-96	2558	FR 0032 FR 0054 FR 0068	9		15	1:00	DO CO	SAND GRVL 0018 RED GRNT 0080
11 005	3500651	18	378359	4976642 W	Jan-62	3902	FR 0060	19	41	7	1:00	ST DO	LOAM MSND 0020 GRNT 0072
11 005	3512581	18	378090	4976139 L	Mar-99	2558	FR 0143	13		12	:	DO CO	PRDR 0080 RED GRNT 0180
11 005	3514109	18	378087	4976139 L	May-03	2558	UK	31		1	1:00	DO	SAND BLDR 0006 RED GRNT 0389
11 005	3515148	18	377434	4976291 W	Sep-05	4905	FR 0189	19	52	3	1:00	DO	BLCK LOAM 0010 RED GRNT 0200
11 005	3514108	18	378087	4976139 L	May-03	2558		41		40	1:00	DO	PRDR 0060 RED GRNT 0100
11 008	3500652	18	377130	4978047 W	Sep-62	4904	FR 0038	18	40	5	1:00	DO	LOAM CLAY 0008 WHIT LMSN 0050 BRWN LMSN 0065
11 008	7122905	18	377278	4977711 W	Apr-09	6571							PRDR 0008
11 008	7122906	18	377328	4977944 W	Apr-09	6571							PRDR 0008
11 008	7122904	18	377291	4977727 W	Apr-09	6571							PRDR 0008
11 008	7122910	18	377277	4977729 W	Apr-09	6571							PRDR 0008
11 008	7122911	18	377285	4977697 W	Apr-09	6571							PRDR 0016
11 008	7045408	18	377320	4977943 W	Apr-07	6571							BRWN SAND SILT STNS 0006 GREY LMSN 0023
11 008	3505569	18	377329	4978021 W	Oct-79	1922	FR 0129	40	120	3	0:15	DO	BRWN LOAM 0010 SNDS 0131
11 008	7045407	18	377328	4977944 W	Apr-07	6571							BRWN SAND SILT STNS 0011 GREY LMSN 0026
11 008	7102998	18	377320	4977943 W	Nov-07	6571					:		PRDR 0023
11 008	7045405	18	377285	4977697 W	Mar-07	6571							BRWN SAND STNS 0005 GREY LMSN 0016
11 008	7122912	18	377339	4977945 W	Apr-09	6571							PRDR 0025
11 008	7045404	18	377278	4977711 W	Mar-07	6571							BRWN SAND STNS 0005 GREY LMSN 0026
11 008	7045403	18	377277	4977729 W	Mar-07	6571							BRWN CLAY SAND STNS 0005 GREY LMSN 0026

CON LOT	WELL ID		UTM		DATE	CNTR	WATER ZONES	STATIC LEVEL	PUMPED LEVEL	PUMP RATE	P TEST DUR	WELL USE	FORMATION
11 008	7045402	18	377291	4977727 W	Mar-07	6571							BRWN CLAY SAND STNS 0006 GREY LMSN 0026
11 009	3500653	18	376831	4978622 W	Aug-62	3902	FR 0069	43	43	5	1:00	DO	LOAM MSND 0005 LMSN SHLE 0026 WHIT LMSN 0072
11 009	3505747	18	376880	4978672 W	Jul-79	1922	FR 0097	30	30		:	DO	BRWN LOAM 0004 GREY LMSN 0096 UNKN 0097
11 009	3506203	18	376829	4978521 W	Jul-81	2558	FR 0100	19		1	1:00	DO	SAND GRVL 0009 GREY LMSN 0105
11 009	3512524	18	376493	4978015 L	Nov-98	2558	FR 0135 FR 0155	41		7	1:00	DO	CLAY GRVL 0004 GREY LMSN 0018 BRWN LMSN 0024 GREY LMSN 0125 GREY LMSN 0135 BRWN LMSN 0140 GREY LMSN 0160
11 009	3507380	18	376493	4978015 L	Aug-85	2558	FR 0112	32		6	0:30	DO	GREY LMSN 0118
11 009	3511070	18	376493	4978015 L	Apr-94	2558	FR 0115	26	120	5	1:00	DO	GREY LMSN 0120
11 009	3511276	18	376493	4978015 L	Oct-94	2558	FR 0083	18		20	1:00	DO	CLAY BLDR 0010 GREY LMSN 0083 GREY LMSN 0094 GREY LMSN 0101
LANARK TOWNSHIP													
11 002	7045406	18	377339	4977945 W	Apr-07	6571							BRWN SAND SILT STNS 0010 GREY LMSN 0025
11 008	7102974	18	377319	4977943 W	Nov-07	6571					:		BRWN SAND SILT STNS 0006 GREY LMSN 0023

NOTES (SOURCE - ONTARIO WATER WELL RECORD DATABASE):

Notes:
UTM: UTM in Zone, Easting, Northing and Datum is NAD83; L: UTM estimated from Centroid of Lot; W: UTM not from Lot Centroid
DATE CNTR: Date Work Completedand Well Contractor Licence Number
CASING DIA: .Casing diameter in inches

PUMP TEST: Static Water Level in Feet / Water Level After Pumping in Feet / Pump Test Rate in GPM / Pump Test Duration in Hour : Minutes
WELL USE: See Table 3 for Meaning of Code
SCREEN: Screen Depth and Length in feet

1. Core Material and Descriptive terms

Code	Description	Code	Description	Code	Description	Code	Description	Code	Description
BLDR	BOULDERS	FCRD	FRACTURED	IRFM	IRON FORMATION	PORS	POROUS	SOFT	SOFT
BSLT	BASALT	FGRD	FINE-GRAINED	LIMY	LIMY	PRDG	PREVIOUSLY DUG	SPST	SOAPSTONE
CGRD	COARSE-GRAINED	FGVL	FINE GRAVEL	LMSN	LIMESTONE	PRDR	PREV. DRILLED	STKY	STICKY
CGVL	COARSE GRAVEL	FILL	FILL	LOAM	TOPSOIL	QRTZ	QUARTZITE	STNS	STONES
CHRT	CHERT	FLDS	FELDSPAR	LOOS	LOOSE	QSND	QUICKSAND	STNY	STONEY
CLAY	CLAY	FLNT	FLINT	LTCL	LIGHT-COLOURED	QTZ	QUARTZ	THIK	THICK
CLN	CLEAN	FOSS	FOSILIFEROUS	LYRD	LAYERED	ROCK	ROCK	THIN	THIN
CLYY	CLAYEY	FSND	FINE SAND	MARL	MARL	SAND	SAND	TILL	TILL
CMTD	CEMENTED	GNIS	GNEISS	MGRD	MEDIUM-GRAINED	SHLE	SHALE	UNKN	UNKNOWN TYPE
CONG	CONGLOMERATE	GRNT	GRANITE	MGVL	MEDIUM GRAVEL	SHLY	SHALY	VERY	VERY

2. Core Color

Code	Description
WHIT	WHITE
GREY	GREY
BLUE	BLUE
GREN	GREEN
YLLW	YELLOW
BRWN	BROWN
RED	RED

3. Well Use

Code	Description	Code	Description
DO	Domestic	OT	Other
ST	Livestock	TH	Test Hole
IR	Irrigation	DE	Dewatering
IN	Industrial	MO	Monitoring
CO	Commercial	MT	Monitoring
TestHole			
MN	Municipal		
PS	Public		

4. Water Detail

Code	Description	Code	Description
FR	Fresh	GS	Gas
SA	Salty	IR	Iron
SU	Sulphur		
MN	Mineral		
UK	Unknown		

OS Table 3: Summary of Drill Holes

	Elevation (mASL)	Depth (m)		Sample	Blows	Description/Comments	Piezometer		
								Depth (m)	
TW 1	**UTM**	**Easting**	**Northing**						
		377946	4976710						
	199.5	0.00	3.66			medium to medium coarse sand, layered with stones, FM ~2 to 3; ALCS < 5 cm	**Screen**	4.60	7.64
	195.8	3.66	4.27			Stone layer, ALCS < 5 cm	**Sand**	3.71	7.64
	195.2	4.27	5.18			medium to medium fine sand, occasional stone layer, but less than 5 cm	**Hole plug**	2.44	3.71
	194.3	5.18	6.10	1	60-28-73	layered medium to medium coarse sand, with stone layers; pushed stn after 48 blows	**Native backfill**	1.52	2.44
	193.4	6.10	7.01			layered medium to medium coarse sand, with stone layers	**Hole plug**	0.00	1.52
	192.5	7.01	7.62		23-25-rfsl	till, grey, dense sandy silt, stny			
	191.9	7.62	7.92			weathered/broken rock			
	191.6	7.92				Bedrock, pink granite, rfsl			
*ALCS - average large clast size, FM - fineness modulus									
TW 2	**UTM**	**Easting**	**Northing**						
		378266	4976951						
	190.0	0.00	6.10	2	1-1-2-6	layers of medium to medium coarse sand and to very coarse gravel, ALCS <5 cm	**Screen**	5.79	8.84
	183.9	6.10	9.14			layers of medium coarse to very coarse sand, ALCS 0.5 to 2 cm, likely<25% stone	**Sand**	5.18	8.84
	180.9	9.14	18.29			layers of medium coarse to very coarse sand, ALCS 0.5 to 2 cm, likely<25% stone	**Hole plug**	4.52	5.18
	171.7						**Native backfill**	1.98	4.52

	Elevation (mASL)	Depth (m)		Sample	Blows	Description/Comments	Piezometer		
								Depth (m)	
							Hole plug	0.00	1.98
TW 3	**UTM**	**Easting**	**Northing**						
		378830	4976959					**metres**	
	189.0	0.00	4.57			loose silty sand	**Screen**	5.18	8.84
	184.4	4.57	6.10	3	1-2-18-16	medium coarse to very coarse sand , pea gravel, ALCS 1 to 2 cm, FM 3 to 3.5	**Sand**	3.96	5.18
	182.9	6.10	13.72			medium coarse to very coarse sand , pea gravel, ALCS 1 to 2 cm, FM 3 to 3.5	**Hole plug**	2.44	3.96
	175.3	13.72	18.29			layered, 10 to 20 cm layers, medium coarse to coarse sand to silty fine sand layers	**Native backfill**	0.00	2.44
	170.7								

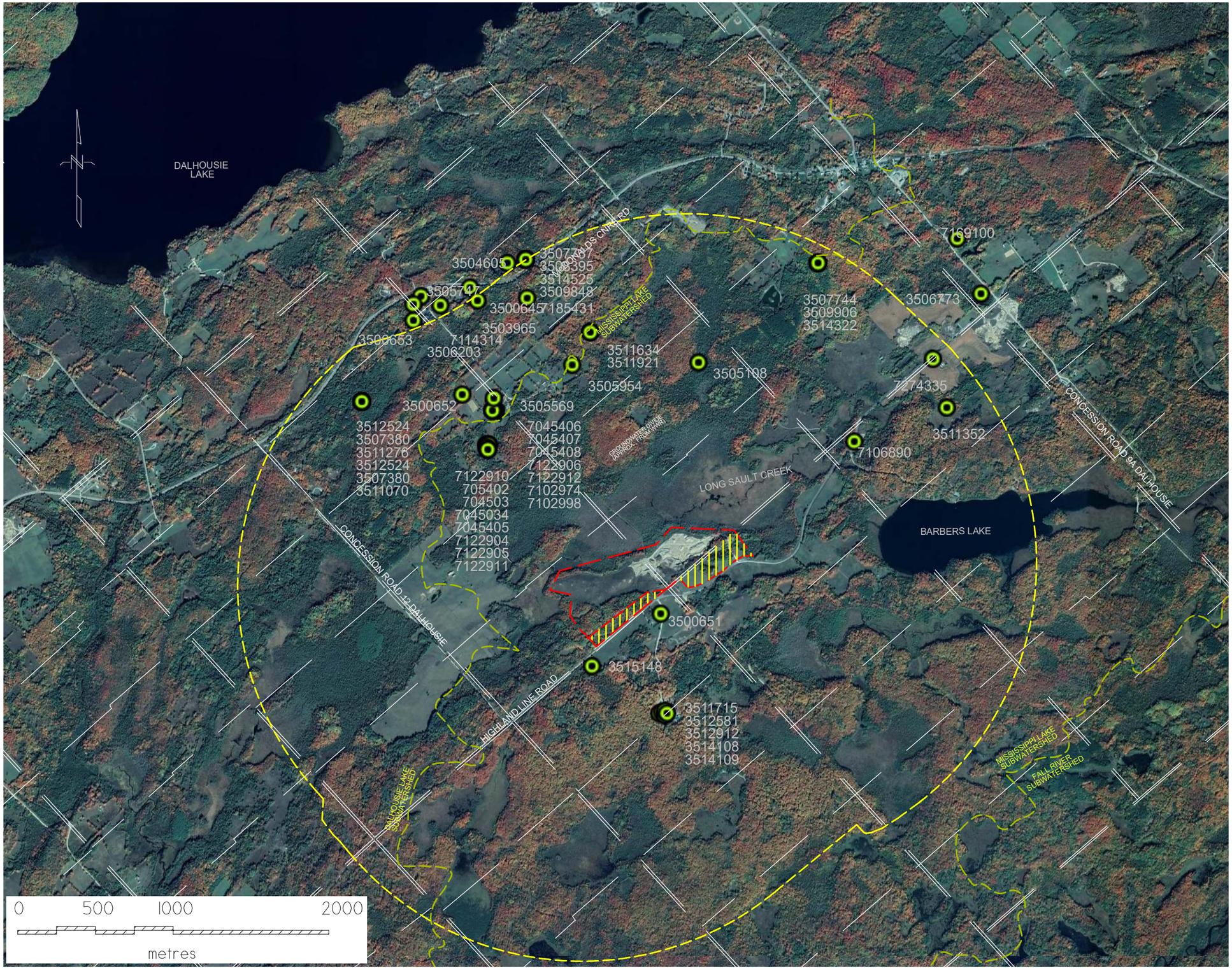
OS Table 4: Groundwater Quality Analysis

Parameter	Units	Guideline	TW 1	TW 2	TW 3	TW 1	TW 2	TW 3
			December 3, 2020			January 11, 2021		
blank = not analysed or calculated								
Field Readings								
Field readings were not possible due to winter conditions								
General Chemistry								
Alkalinity as $CaCO_3$	mg/L		245	236	274	203	226	284
Hardness	mg/L		319	277	271	219	276	383
Chloride (Cl)	mg/L		67	22	83	18	20	111
Conductivity	µS/cm		655	499	811	470	506	927
pH		6.5-8.5	8.33	8.20	8.27	8.33	8.18	8.18
TDS (COND - CALC)	mg/L					306	329	603
Total Suspended Solids	mg/L					<2	2	<2
Sulphate (SO_4)	mg/L		14	13	45	24	16	24
Ion Balance	mg/L		1.03	1.03	0.98	1.03	1.06	1.03
Nutrients								
Nitrite (NO_2)	mg/L					<0.10	<0.10	<0.10
Nitrate (NO_3)	mg/L		0.18	0.57	1.95	<0.10	0.64	3.19
N-NH_3	mg/L					<0.010	<0.010	<0.010
Un-ionized Ammonia (calc)	mg/L	PWQO - 0.02				0.000	0.000	0.000
Total Kjeldahl Nitrogen	mg/L					0.280	0.131	0.453
Total P	mg/L					<0.020	<0.020	<0.020
Phenols	mg/L					<0.001	<0.001	<0.001
Metals								
Silver (Ag)	mg/L	PWQO - 0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Arsenic (As)	mg/L	PWQO 0.005	<0.001	<0.001	<0.001			

Parameter	Units	Guideline	TW 1	TW 2	TW 3	TW 1	TW 2	TW 3
			December 3, 2020			January 11, 2021		
Boron (B)	mg/L	IPWQO - 0.2	0.07	0.01	0.03	0.04	0.01	0.03
Barium (Ba)	mg/L		0.11	0.21	0.10	0.09	0.25	0.19
Beryllium (Be)	mg/L	PWQO - 0.011	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Calcium (Ca)	mg/L		70	78	77	53	81	112
Cadmium (Cd)	mg/L	PWQO - 0.0002	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Cobalt (Co)	mg/L	PWQO 0.0009	0.0034	0.0007	<0.0002			
Chromium (Cr)	mg/L	PWQO-0.001 (Cr VI) 0.0089 (Cr III)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Copper (Cu)	mg/L	PWQO - 0.005	0.002	<0.001	0.002	<0.001	<0.001	<0.001
Fluoride (F^-)	mg/L		0.19	<0.10	<0.10	0.18	<0.10	<0.10
Iron (Fe)	mg/L	PWQO - 0.3	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Potassium (K)	mg/L		4	2	3	2	2	2
Magnesium (Mg)	mg/L		35	20	19	21	18	25
Manganese (Mn)	mg/L	IPWQO - 0.04	0.07	0.02	<0.01	0.06	0.01	<0.01
Molybdenum (Mo)	mg/L	IPWQO - 0.040	0.016	<0.005	0.018	0.010	<0.005	<0.005
Sodium (Na)	mg/L		19	5	75	19	5	50
Nickel (Ni)	mg/L	PWQO - 0.025	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Lead (Pb)	mg/L	PWQO - 0.005	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Antimony (Sb)	mg/L	IPWQO 0.020	<0.0005	<0.0005	<0.0005			
Selenium (Se)	mg/L	PWQO 0.100	<0.001	<0.001	<0.001			
Silicon (Si)	mg/L					4.8	4.4	5.4
Strontium (Sr)	mg/L					0.122	0.139	0.175
Thallium (Tl)	mg/L	IPWQO - 0.0003	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Uranium (U)	mg/L		<0.001	<0.001	<0.001			
Vanadium (V)	mg/L	IPWQO - 0.006	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Zinc (Zn)	mg/L	PWQO - 0.03	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01

Parameter	Units	Guideline	TW 1	TW 2	TW 3	TW 1	TW 2	TW 3
			December 3, 2020			January 11, 2021		
Hydrocarbons								
F1 (C6-C10)	ug/L					<20	<20	<20
F1BTEX (C6-C10)	ug/L					<20	<20	<20
F2 (C10-C16)	ug/L					<20	<20	<20
F3 (C16-C34)	ug/L					<50	<50	<50
F4 (C34-C50)	ug/L					<50	<50	<50
Volatiles								
Benzene	ug/L					<0.5	<0.5	<0.5
Ethylbenzene	ug/L					<0.5	<0.5	<0.5
m/p-xylene	ug/L					<0.4	<0.4	<0.4
o-xylene	ug/L					<0.4	<0.4	<0.4
Toluene	ug/L					<0.5	<0.5	<0.5
Xylene; total	ug/L					<0.5	<0.5	<0.5

Oversize Figures



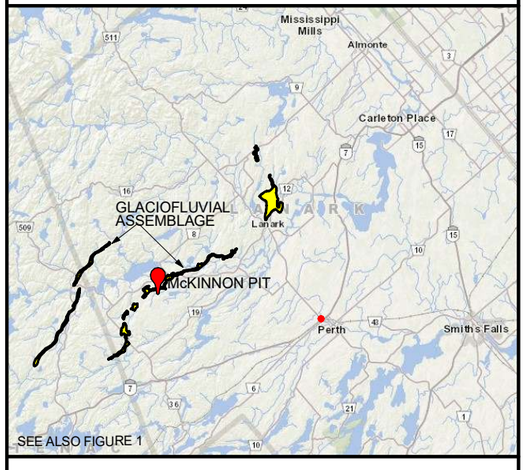
LEGEND

- McKINNON PIT, EXISTING LICENSE (SITE)
- EXPANSION AREA (SITE)
- 2 KM DISTANCE AROUND SITE
- MAR-h ZONED LAND (IN STUDY AREA)
- INDUSTRIAL - PITS
- ARA LICENSES
- SUB-WATERSHED BOUNDARY

LAND USE

- RESIDENTIAL
- AGRICULTURE - CROPS AND PASTURE
- AGROFORESTRY - MAPLE SYRUP
- UNDEVELOPED / WETLAND (NO PATTERN)

3506674 WATER WELL RECORD , REF.



NOTES:
1. BOUNDARIES AND DISTANCES ARE APPROXIMATE

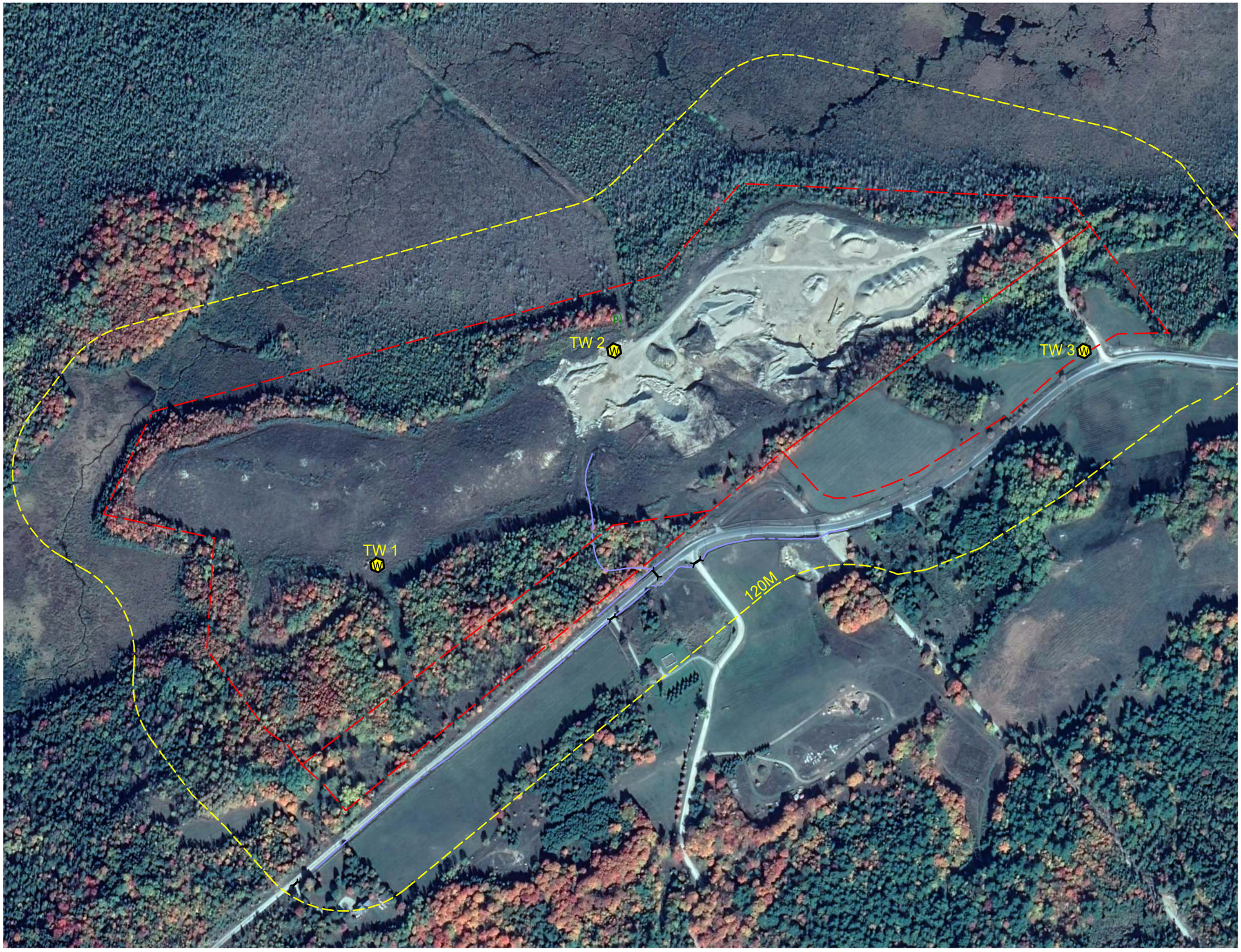
SOURCES:
2. PHOTO IMAGE - GOOGLE EARTH SATELLITE IMAGERY10/10/2019
3. https://www.ontario.ca/environment-and-energy/find-pits-and-quarries
4. MVCA PORTAL - https://camaps.maps.arcgis.com/apps/webappviewer/index.html?id=7083190596 1e470988262c7a703a56af
5. http://www.ontario.ca/environment-and-energy/map-well-record-data
6. LAND USE FROM AIR PHOTO INTRPRETATION AND DRIVE-BY SURVEY

OS FIGURE 1

SITE AND SURROUNDING DETAILS

CLIENT: ARNOTT BROS. CONST.	GRI Inc.
PROJECT NO: 21-022	Oxford Mills, ON K0G 1S0
DATE: AUGUST, 2022	T - (613) 258-2954

23FREPECAM267



LEGEND

- SITE BOUNDARY
- 120 M SURROUNDING LICENSE BOUNDARY
- CROSS SECTION LOCATION
- TW 3 — TEST WELL (GRI, DEC. 2020)
- WATERCOURSE
- CULVERT

(p)

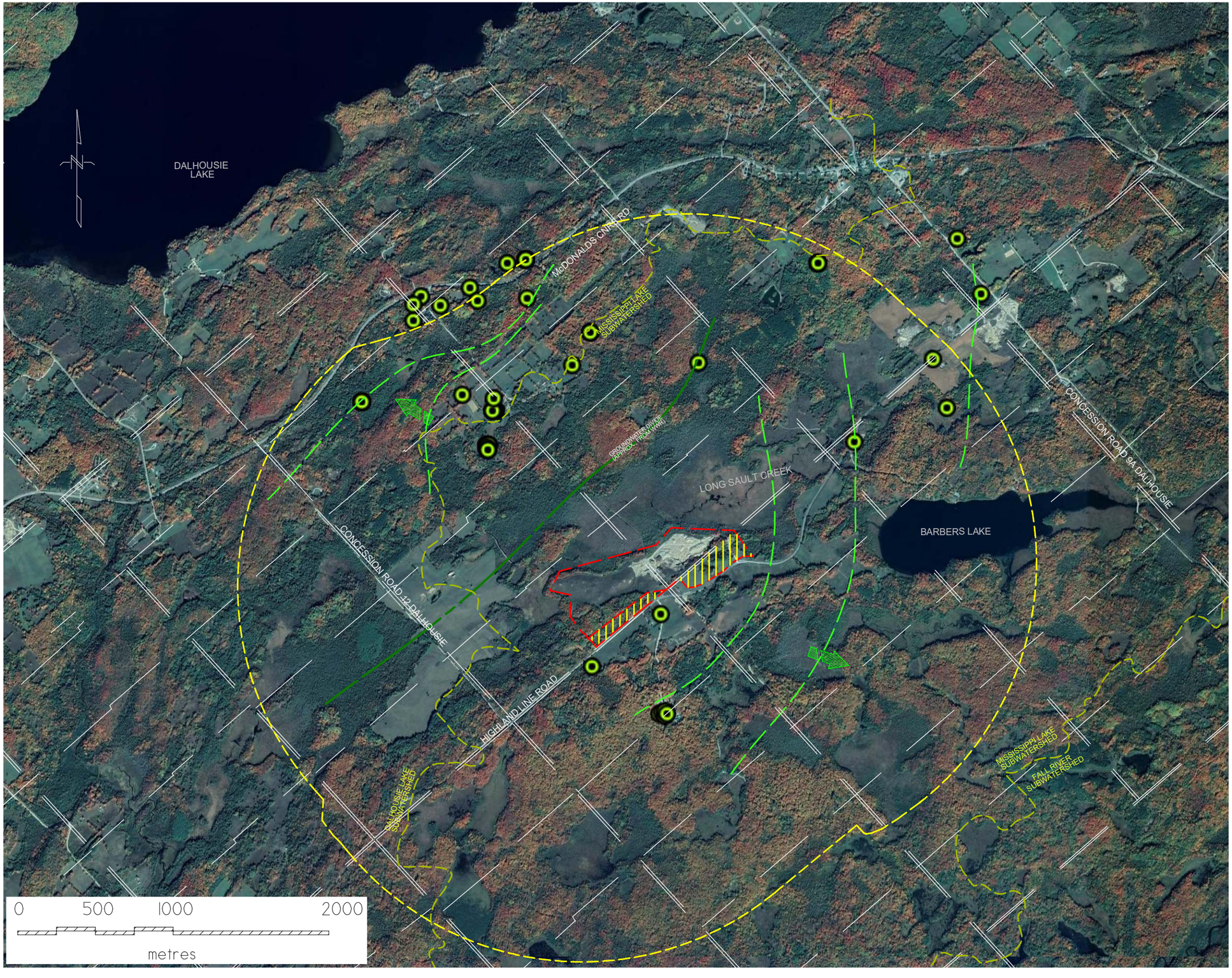
NOTES:
1. BOUNDARIES AND DISTANCES ARE APPROXIMATE
2. PHOTO IMAGE - GOOGLE EARTH SATELLITE IMAGERY10/10/2019
3. GROUNDWATER FLOW INTERPRETED FROM SITE DATA

OS FIGURE 2

SITE DETAILS

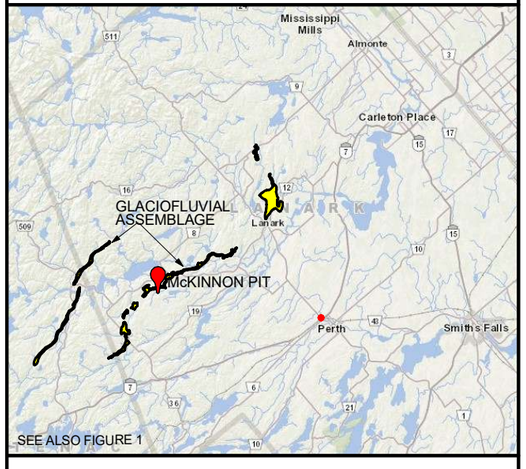
CLIENT: ARNOTT BROS. CONST.
PROJECT NO: 21-022
DATE: APRIL, 2022

GRI Inc.
Oxford Mills, ON K0G 1S0
T - (613) 258-2954



LEGEND

- McKINNON PIT, EXISTING LICENSE (SITE)
- EXPANSION AREA (SITE)
- 2 KM DISTANCE AROUND SITE
- SUB-WATERSHED BOUNDARY
- POTENTIOMETRIC CONTOUR (mASL)
- GROUNDWATER FLOW DIRECTION
- POTENTIOMETRIC CONTOUR (mASL)



NOTES:
1. BOUNDARIES AND DISTANCES ARE APPROXIMATE

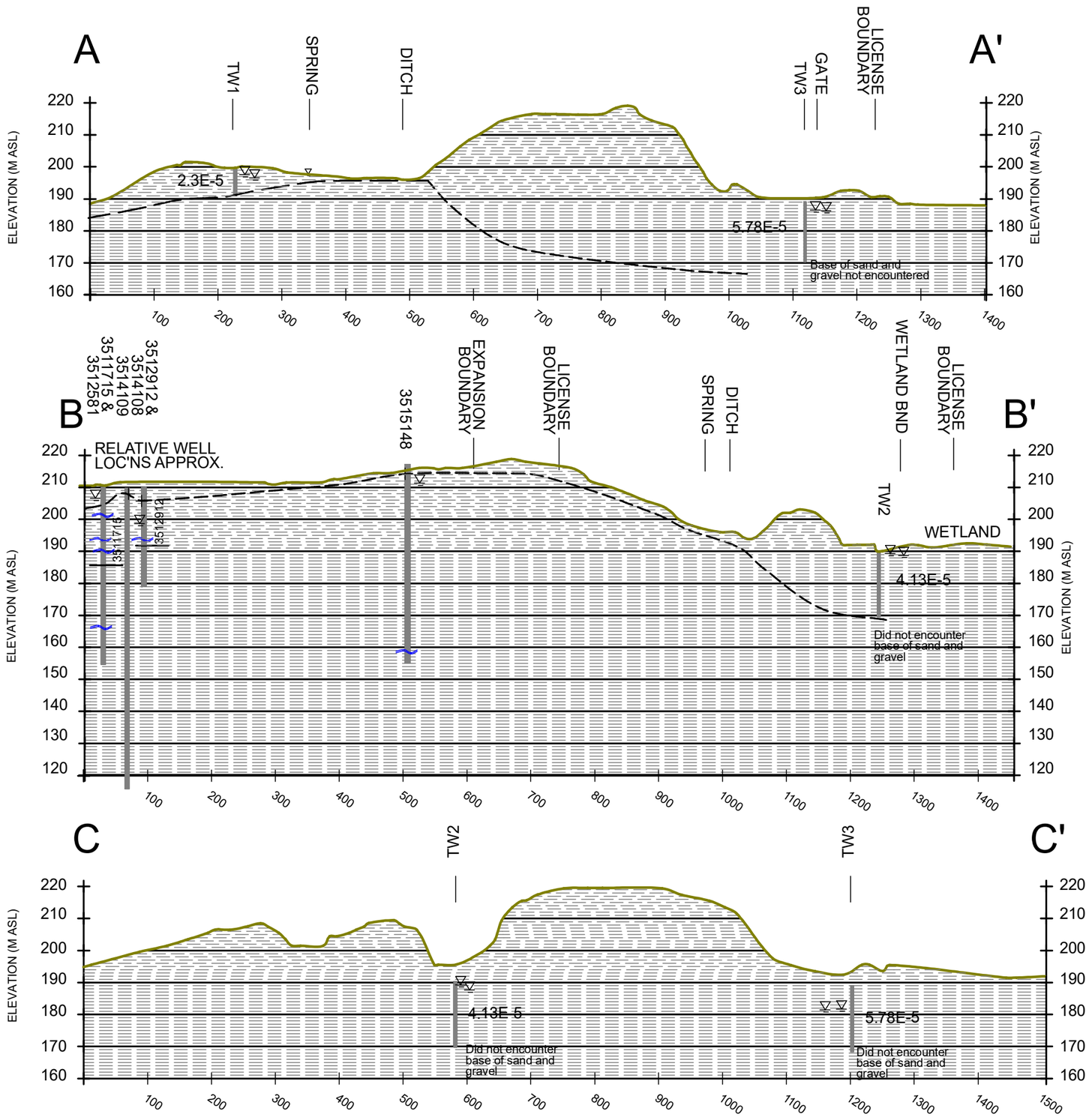
SOURCES:
2. PHOTO IMAGE - GOOGLE EARTH SATELLITE IMAGERY10/10/2019
3. https://www.ontario.ca/environment-and-energy/find-pits-and-quarries
4. MVCA PORTAL - https://camaps.maps.arcgis.com/apps/webappviewer/index.html?id=7083190596 1e470988262c7a703a56af
5. http://www.ontario.ca/environment-and-energy/map-well-record-data
6. LAND USE FROM AIR PHOTO INTRPRETATION AND DRIVE-BY SURVEY

OS FIGURE 3

REGIONAL GROUNDWATER FLOW (FROM WWR)

CLIENT: ARNOTT BROS. CONST.	GRI Inc. Oxford Mills, ON K0G 1S0 T - (613) 258-2954
PROJECT NO: 21-022	
DATE: AUGUST, 2022	

23FREPECAM267

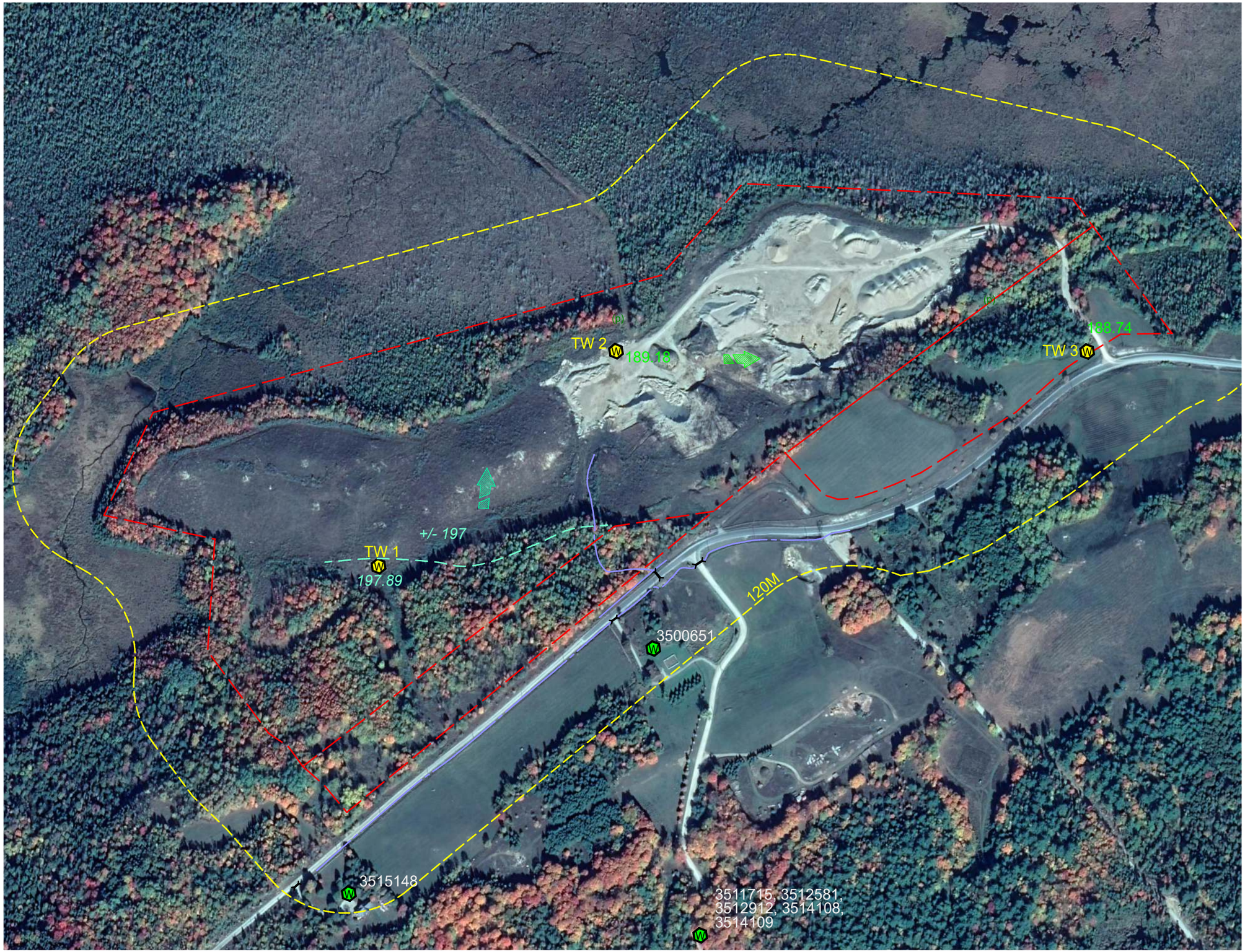


OS FIGURE 4

CROSS SECTIONS

CLIENT: ARNOTT BROS. CONST.
PROJECT NO: 21-022
DATE: APRIL, 2022

GRI Inc.
Oxford Mills, ON K0G 1S0
T - (613) 258-2954



LEGEND

- SITE BOUNDARY
- 120 M SURROUNDING LICENSE BOUNDARY
- CROSS SECTION LOCATION
- TW 3 — TEST WELL (GRI, DEC. 2020)
- WATERCOURSE
- CULVERT
- (p)
- 3500651 — WATER WELL RECORD, REF.
- 190.90 GROUNDWATER LEVEL, SAND AND GRAVEL UNCONF. AQUIFER
- 190.90 GROUNDWATER LEVEL, TILL (PERCHED) UNCONF AQUIFER
- GROUNDWATER ELEVATION CONTOUR (mASL)
- FLOW DIRECTION, PERCHED AQUIFER
- FLOW DIRECTION, GRANULAR AQUIFER

NOTES:
1. BOUNDARIES AND DISTANCES ARE APPROXIMATE
2. PHOTO IMAGE - GOOGLE EARTH SATELLITE IMAGERY10/10/2019
3. GROUNDWATER FLOW INTERPRETED FROM SITE DATA

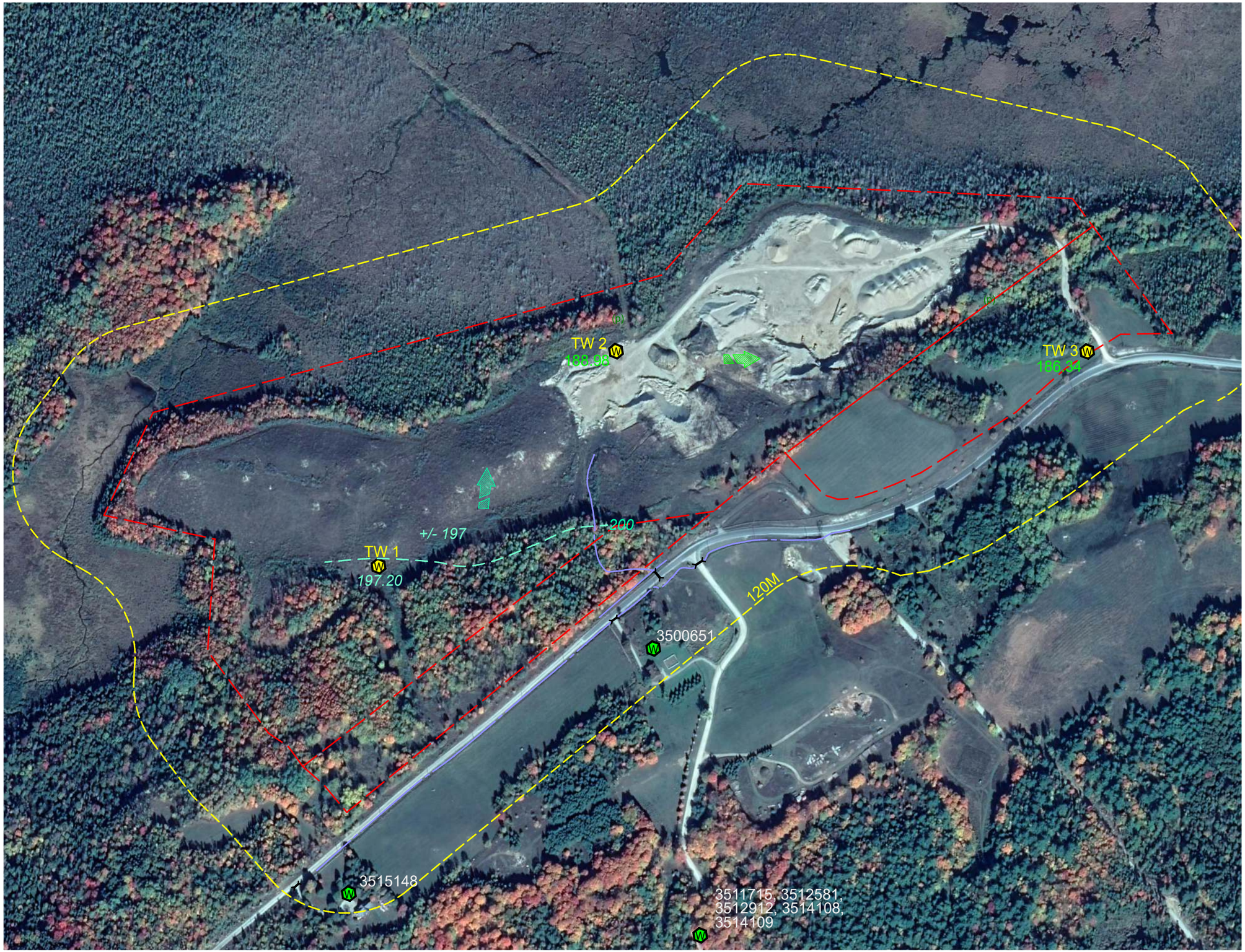
OS FIGURE 5

GROUNDWATER ELEVATION MARCH 30, 2021

CLIENT: ARNOTT BROS. CONST.
PROJECT NO: 21-022
DATE: APRIL, 2022

GRI Inc.
Oxford Mills, ON K0G 1S0
T - (613) 258-2954

23FREPECAM267



LEGEND

- SITE BOUNDARY
- 120 M SURROUNDING LICENSE BOUNDARY
- CROSS SECTION LOCATION
- TW 3 — TEST WELL (GRI, DEC. 2020)
- WATERCOURSE
- CULVERT
- (p)
- 3500651 — WATER WELL RECORD, REF.
- 190.90 GROUNDWATER LEVEL, SAND AND GRAVEL UNCONF. AQUIFER
- 190.90 GROUNDWATER LEVEL, TILL (PERCHED) UNCONF AQUIFER
- GROUNDWATER ELEVATION CONTOUR (mASL)
- FLOW DIRECTION, PERCHED AQUIFER
- FLOW DIRECTION, GRANULAR AQUIFER

NOTES:
1. BOUNDARIES AND DISTANCES ARE APPROXIMATE
2. PHOTO IMAGE - GOOGLE EARTH SATELLITE IMAGERY10/10/2019
3. GROUNDWATER FLOW INTERPRETED FROM SITE DATA

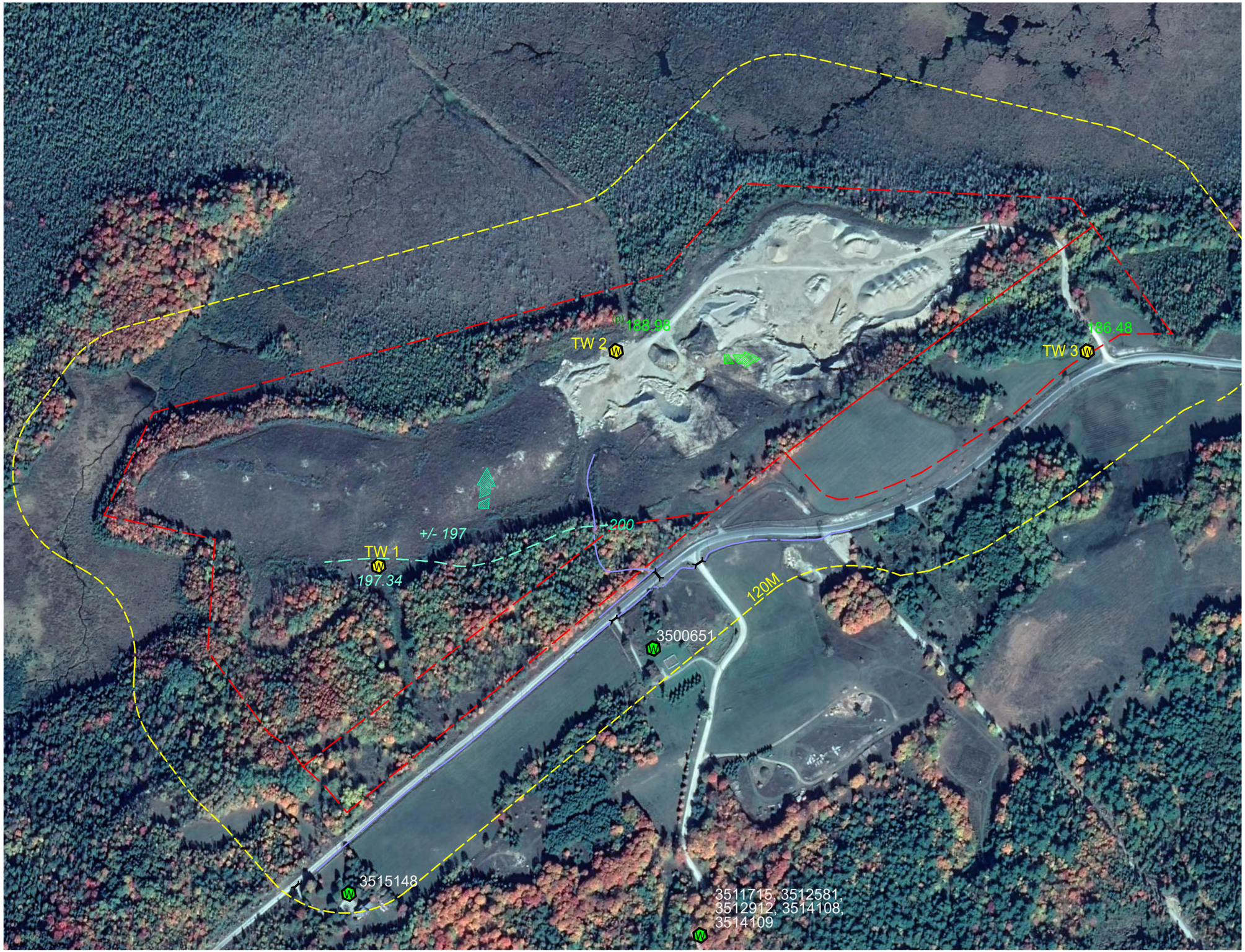
OS FIGURE 6

GROUNDWATER ELEVATION JULY 12, 2021

CLIENT: ARNOTT BROS. CONST.
PROJECT NO: 21-022
DATE: APRIL, 2022

GRI Inc.
Oxford Mills, ON K0G 1S0
T - (613) 258-2954

23FREPECAM267



LEGEND

- SITE BOUNDARY
- 120 M SURROUNDING LICENSE BOUNDARY
- CROSS SECTION LOCATION
- TW 3 — TEST WELL (GRI, DEC. 2020)
- WATERCOURSE
- CULVERT
- (p)
- 3500651 — WATER WELL RECORD, REF.
- 190.90 GROUNDWATER LEVEL, SAND AND GRAVEL UNCONF. AQUIFER
- 190.90 GROUNDWATER LEVEL, TILL (PERCHED) UNCONF AQUIFER
- GROUNDWATER ELEVATION CONTOUR (mASL)
- FLOW DIRECTION, PERCHED AQUIFER
- FLOW DIRECTION, GRANULAR AQUIFER

NOTES:
1. BOUNDARIES AND DISTANCES ARE APPROXIMATE
2. PHOTO IMAGE - GOOGLE EARTH SATELLITE IMAGERY10/10/2019
3. GROUNDWATER FLOW INTERPRETED FROM SITE DATA

OS FIGURE 7

GROUNDWATER ELEVATION SEPTEMBER 16, 2021

CLIENT: ARNOTT BROS. CONST.
PROJECT NO: 21-022
DATE: APRIL, 2022

GRI Inc.
Oxford Mills, ON K0G 1S0
T - (613) 258-2954

23FREPECAM267

Appendix A

Water Well Records

P. H.

UTM 18 Z 378321 E
5 R 4976420 N

Elev. 5 R 0688

Basin 25

County or District Lanark 31 C/15 E

Con. 11 Lot 5

35 No 65

The Ontario Water Resources Commission Act

WATER WELL RECORD

Township, Village, Town or City Dalhousie + N. Sherbrooke (Dalhousie)

Date completed 3 (day) Jan (month) 62 (year)

[redacted] dress Mc Donald's Rrs

Casing and Screen Record

Inside diameter of casing 6¼

Total length of casing 22

Type of screen

Length of screen

Depth to top of screen

Diameter of finished hole 6

Pumping Test

Static level 19

Test-pumping rate 7 G.P.M.

Pumping level 41

Duration of test pumping 1 hr

Water clear or cloudy at end of test Clear

Recommended pumping rate 7 G.P.M.

with pump setting of 65 feet below ground surface

Well Log

Overburden and Bedrock Record	From ft.	To ft.	Water Record: Depth(s) at which water(s) found	Water Record: Kind of water (fresh, salty, sulphur)
Sandy loam	0	20	60	Fresh
Granite	20	72		

For what purpose(s) is the water to be used?

Farm

Is well on upland, in valley, or on hillside? Hillside

Drilling or Boring Firm W. C. Mugent

Address Lanark

Licence Number 642

Name of Driller or Borer James Crosbie

Address RR 7 Perth

Date Jan. 3

W. C. Mugent

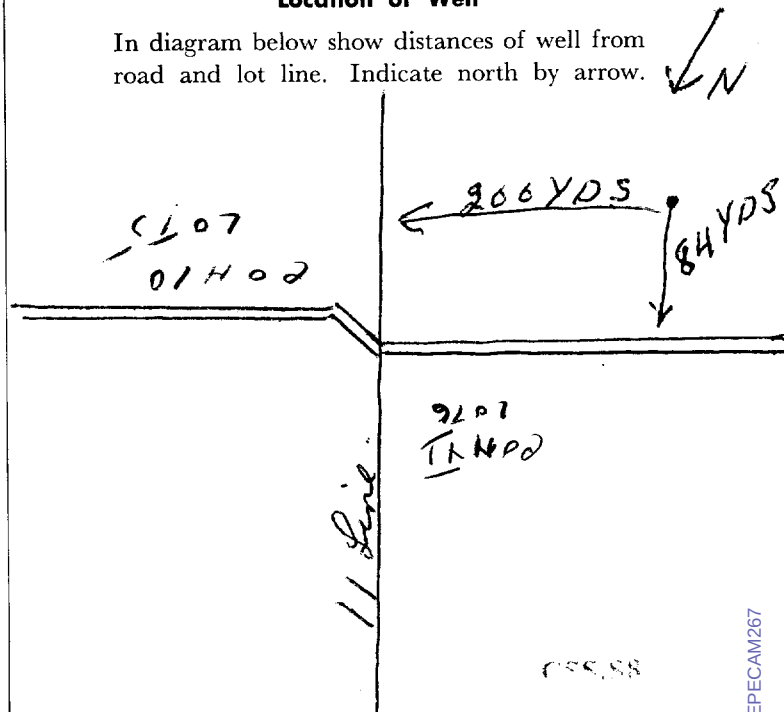
(Signature of Licensed Drilling or Boring Contractor)

Form 7 15M Sets 60-5930

OWRC COPY

Location of Well

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



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) 3511715

Municipality (10 14) 35004 Con. (15 22 23 24) CON

[redacted]

County or District | Township/Borough/City/Town/Village: Dalhousie | Con block tract survey, etc.: 11 | Lot (25-27): 5

Address: RR1 McDonalds Corners. Ont

Date completed: 27 day 3 month 96 year

21 (1 2) T (M 10) (12 17) Northing (18 24) RG (25 26) Elevation (30) RG (31) Basin Code (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
	sand/gravel			0'	18'
Red	granite			18'	80'

31 (10 14 15 21) (32 43) (54 65 75 80)

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

41 WATER RECORD

Water found at – feet	Kind of water
32 (10-13)	1 ☐ Fresh 2 ☐ Salty 3 ☐ Sulphur 4 ☐ Minerals 5 ☐ Gas (14)
54 (15-18)	1 ☑ Fresh 2 ☐ Salty 3 ☐ Sulphur 4 ☐ Minerals 5 ☐ Gas (19)
68 (20-23)	1 ☑ Fresh 2 ☐ Salty 3 ☐ Sulphur 4 ☐ Minerals 5 ☐ Gas (24)
25-28	1 ☐ Fresh 2 ☐ Salty 3 ☐ Sulphur 4 ☐ Minerals 5 ☐ Gas (29)
30-33	1 ☐ Fresh 2 ☑ Salty 3 ☐ Sulphur 4 ☐ Minerals 5 ☐ Gas (34) (40)

51 CASING & OPEN HOLE RECORD

Inside diam inches	Material	Wall thickness inches	Depth – feet From	Depth – feet To
6 (7-11)	1 ☑ Steel (12) 2 ☐ Galvanized 3 ☐ Concrete 4 ☐ Open hole 5 ☐ Plastic	188	0'	22' (13-16)
17-18	1 ☐ Steel (19) 2 ☐ Galvanized 3 ☐ Concrete 4 ☐ Open hole 5 ☐ Plastic			(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	(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.)
0 (10-13)	22' (14-17)	Cement
18-21	22-25	
26-29	30-33 (80)	

71 PUMPING TEST

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

Pumping rate (11-14): 15 GPM

Duration of pumping (12-18): 1 Hours ..... Mins

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

Static level	Water level end of pumping	15 minutes	30 minutes	45 minutes	60 minutes
9' (19-21) feet	(22-24) feet	9 (26-28) feet	9 (29-31) feet	9 (32-34) feet	9 (35-37) feet

If flowing give rate (38-41): GPM

Pump intake set at: 80 feet

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

Recommended pump type: ☑ Shallow ☐ Deep

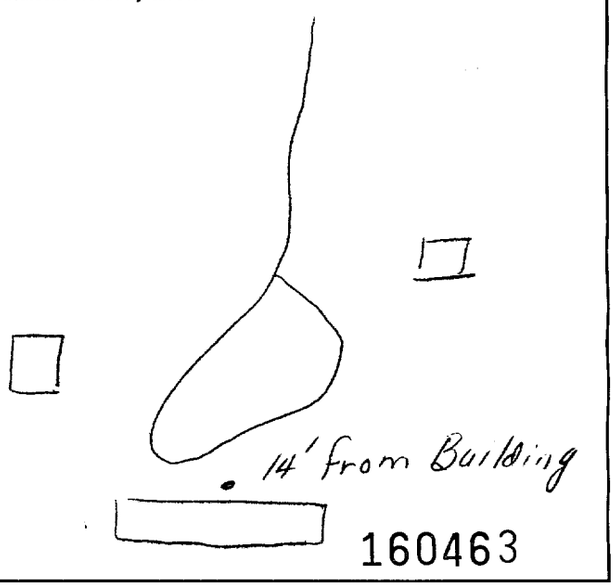
Recommended pump setting (43-45): 55' feet

Recommended pump rate (46-49): 12 GPM

(50-53)

LOCATION OF WELL

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



160463

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: Hall Well Ltd | Well Contractor's Licence No.: 2558

Address: RR1 Mc Donalds Corners. Ont.

Name of Well Technician: Mark Hall | Well Technician's Licence No.: T2228

Signature of Technician/Contractor: Mark Hall | Submission date: 27 day 3 mo 96 yr

MINISTRY USE ONLY

Data source (58) | Contractor: 2558 (59-62) | Date received (63-68): APR 23 1996 (80)

Date of inspection | Inspector

Remarks

CSS.ES

0506 (07/94) Front Form 9

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23FREPEAM267

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) **3512581** Municipality 35004 (10 14) Con. CON (15 22 23 24)

County or District	Township/Borough/City/Town/Village	Con block tract survey, etc.	Lot (25-27)
[redacted]	Dalhousie	11	5

Address: RR1 McDonalds Corners Ont K0G1M0

Date completed: 23 (day) 3 (month) 99 (year)

21 (1 2) T M (10) Northing (12 17) (18 24) RC (25) Elevation (26) RC (30) Basin Code (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
	Previously drilled to 80'				
red & pink	granite			80'	180'

31 (10 14 15 21) 32 (43 54 65 75 80)

41 WATER RECORD

Water found at – feet	Kind of water
143 (10-13)	1 ☑ Fresh 2 ☐ Salty 3 ☐ Sulphur 4 ☐ Minerals 5 ☐ Gas (14)
(15-18)	1 ☐ Fresh 2 ☐ Salty 3 ☐ Sulphur 4 ☐ Minerals 5 ☐ Gas (19)
(20-23)	1 ☐ Fresh 2 ☐ Salty 3 ☐ Sulphur 4 ☐ Minerals 5 ☐ Gas (24)
(25-28)	1 ☐ Fresh 2 ☐ Salty 3 ☐ Sulphur 4 ☐ Minerals 5 ☐ Gas (29)
(30-33)	1 ☐ Fresh 2 ☐ Salty 3 ☐ Sulphur 4 ☐ Minerals 5 ☐ Gas (34) (60)

51 CASING & OPEN HOLE RECORD

Inside diam inches	Material	Wall thickness inches	Depth – feet From	Depth – feet To
(10-11)	1 ☐ Steel 2 ☐ Galvanized 3 ☐ Concrete 4 ☐ Open hole 5 ☐ Plastic (12)			(13-16)
(17-18)	1 ☐ Steel 2 ☐ Galvanized 3 ☐ Concrete 4 ☐ Open hole 5 ☐ Plastic (19)			(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	(30)

61 PLUGGING & SEALING RECORD

☐ Annular space ☐ Abandonment

Depth set at – feet From	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): 12 GPM

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

Static level	Water level end of pumping	Water levels during (25): 1 ☑ Pumping 2 ☐ Recovery			
13' (19-21) feet	(22-24) feet	15 minutes (26-28) 32 feet	30 minutes (29-31) 13 feet	45 minutes (32-34) 13 feet	60 minutes (35-37) 13 feet

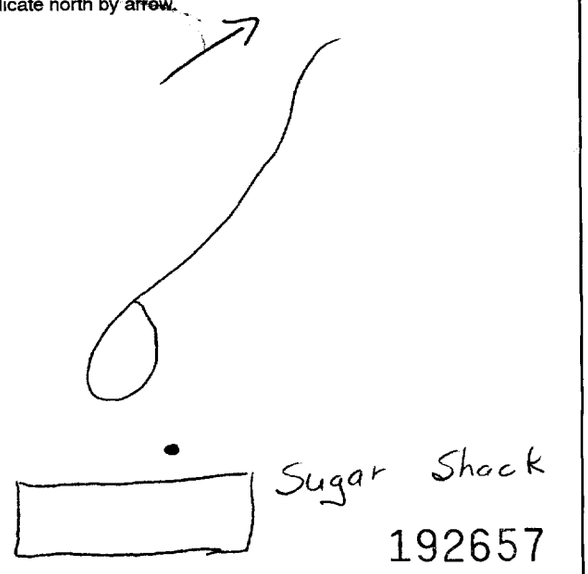
If flowing give rate (38-41)	Pump intake set at	Water at end of test (42)
GPM	180 feet	☐ Clear ☑ Cloudy

Recommended pump type	Recommended pump setting (43-45)	Recommended pump rate (46-49)
☐ Shallow ☑ Deep	160 feet	10 GPM

(50-53)

LOCATION OF WELL

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



192657

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.
Hup Hall Ltd	2558

Address: RR1 McDonalds Corners Ont K0G1M0

Name of Well Technician	Well Technician's Licence No.
Mark Hall	T2228

Signature of Technician/Contractor	Submission date
Hup Hall	23 (day) 3 (mo) 99 (yr)

MINISTRY USE ONLY

Data source (58)	Contractor (59-62)	Date received (63-68) (80)
	2558	APR 0 6 1999

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 **3512912** Municipality 35004 Con. CON

County or District	Township/Borough/City/Town/Village	Con block tract survey, etc.	Lot
[redacted]	Dalhousie	11	5

Address: RR1 McDonalds Corners Ont K0G 1M0 — Date completed: 19 day 4 month 00 year

21 Northing NC 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
	Clay/gravel/boulders			0'	14'
red	granite			14'	32'
red	granite/gravel/sand			32'	37'
red/black	granite			37'	60'

31

32

41 WATER RECORD

Water found at - feet	Kind of water
55'	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 ☑ Steel 2 ☐ Galvanized 3 ☐ Concrete 4 ☐ Open hole 5 ☐ Plastic	188	0'	44'
	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 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.)
0	44'	Cement

71 PUMPING TEST

Pumping test method: 1 ☐ Pump 2 ☑ Bailer — Pumping rate: 30 GPM — Duration of pumping: 1 Hours ... Mins

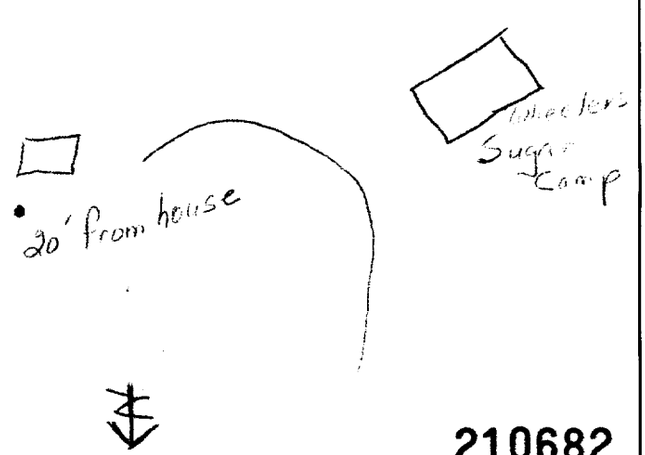
Static level	Water level end of pumping	Water levels during: 1 ☑ Pumping 2 ☐ Recovery			
37' feet	feet	15 minutes: 37 feet	30 minutes: 37 feet	45 minutes: 37 feet	60 minutes: 37 feet

If flowing give rate	Pump intake set at	Water at end of test
GPM	60 feet	☐ Clear ☑ Cloudy

Recommended pump type	Recommended pump setting	Recommended pump rate
☑ Shallow ☐ Deep	5½ feet	7 GPM

LOCATION OF WELL

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



210682

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.
Rud Hall Ltd	2558
Address: RR1 McDonalds Corners Ont K0G 1M0	
Name of Well Technician	Well Technician's Licence No.
Mark Hall	T2228
Signature of Technician/Contractor: Rud Hall	Submission date: 19 day 4 mo 00 yr

MINISTRY USE ONLY

Data source	Contractor	Date received
	2558	MAY 04 2000
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 (1–2) **3514108**

Municipality 35004 (10–14) Con. CON (15–22) (23–24)

County or District	Township/Borough/City/Town/Village	Con block tract survey, etc.	Lot (25-27)
Lanark	Dalhousie	11	5

[redacted]

Address: RR 1, McDonald's Corners

Date completed (18-21): 5 day, 5 month, 03 year

(1–2) (M 10) (12–17) Northing (18–24) RC (25) Elevation (26–29) Basin Code (30–47) 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
	Previously drilled			0'	60'
red	granite			60	100'

31 (10–14) 32 (15–21) (32–43) (54–65) (75–80)

41 WATER RECORD

Water found at - feet	Kind of water
10-13	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	1 ☐ Steel (12) 2 ☐ Galvanized 3 ☐ Concrete 4 ☐ Open hole 5 ☐ Plastic			13-16
17-18	1 ☐ Steel (19) 2 ☐ Galvanized 3 ☐ Concrete 4 ☐ Open hole 5 ☐ Plastic			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	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: 40 GPM (11-14) — Duration of pumping: 1 Hours (15-16) 0 Mins (17-18)

Static level (19-21)	Water level end of pumping (22-24)	Water levels during (25): 1 ☑ Pumping 2 ☐ Recovery			
41 feet	feet	15 minutes (26-28): 41 feet	30 minutes (29-31): 41 feet	45 minutes (32-34): 41 feet	60 minutes (35-37): 41 feet

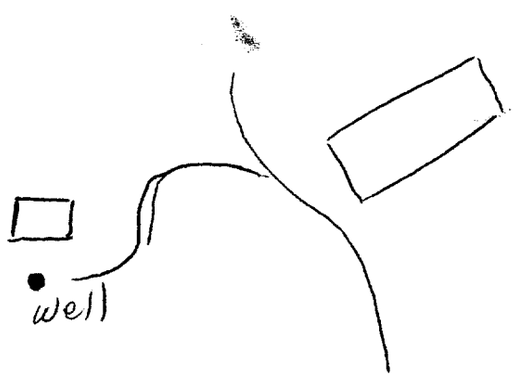
If flowing give rate (38-41): GPM — Pump intake set at: 100 feet — Water at end of test (42): ☐ Clear ☐ Cloudy

Recommended pump type: ☐ Shallow ☑ Deep — Recommended pump setting (43-45): 80 feet — Recommended pump rate (46-49): 7 GPM

(50-53)

LOCATION OF WELL

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



244553

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.
Huff Hall Ltd	2558
Address: RR1 McDonald's Corners, Ont K0G 1M0	
Name of Well Technician: Mark Hall	Well Technician's Licence No.: T2228
Signature of Technician/Contractor: Huff Hall	Submission date: 9 day, 5 mo, 03 yr

MINISTRY USE ONLY

Data source (58)	Contractor (59-62)	Date received (63-68) (80)
	2558	JUN 0 6 2003
Date of inspection	Inspector	
Remarks		

CSS.ES3

2 - MINISTRY OF THE ENVIRONMENT COPY

0506 (07/00) Front Form 9

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 (1 2) **3514109**

Municipality (10 14) B5004 Con. (15 22 23 24) CON

County or District	Township/Borough/City/Town/Village	Con block tract survey, etc.	Lot (25-27)
Lanark	Dalhousie	11	5

Address: RR1 McDonald's Corners Ont

Date completed (49-53): 6 (day) 5 (month) 03 (year)

21 (1 2) UTM (10) (12 17) Northing (18 24) RC (25) Elevation (26 30) RC Basin Code (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
	sand/boulders			0'	6'
red/grey/pink	granite			6'	389'

31 (10 14 15 21)

32 (32 43 54 65 75 80)

41 WATER RECORD

Water found at - feet	Kind of water
2 (10-13)	unsalted (1 Fresh 2 Salty 3 Sulphur 4 Minerals 5 Gas 6 — 14)
(15-18)	(1 Fresh 2 Salty 3 Sulphur 4 Minerals 5 Gas 6 — 19)
(20-23)	(1 Fresh 2 Salty 3 Sulphur 4 Minerals 5 Gas 6 — 24)
(25-28)	(1 Fresh 2 Salty 3 Sulphur 4 Minerals 5 Gas 6 — 29)
(30-33)	(1 Fresh 2 Salty 3 Sulphur 4 Minerals 5 Gas 6 — 34) 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	0'	22' (13 16)
(17-18)	1 ☐ Steel (19) 2 ☐ Galvanized 3 ☐ Concrete 4 ☐ Open hole 5 ☐ Plastic			(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.)
0 (16-13)	22' (14-17)	Cement
(18-21)	(22-25)	
(26-29)	(30-33) (80)	

71 PUMPING TEST

Pumping test method (10): 1 ☑ Pump 2 ☐ Bailer — Pumping rate (11-14): 1 1/3 GPM — Duration of pumping (15-16) Hours (17-18) Mins

Static level	Water level end of pumping	Water levels during (25): 1 ☑ Pumping 2 ☐ Recovery			
31 (19-21) feet	(22-24) feet	15 minutes (26-28) 369 feet	30 minutes (29-31) 349 feet	45 minutes (32-34) 329 feet	60 minutes (35-37) 310 feet

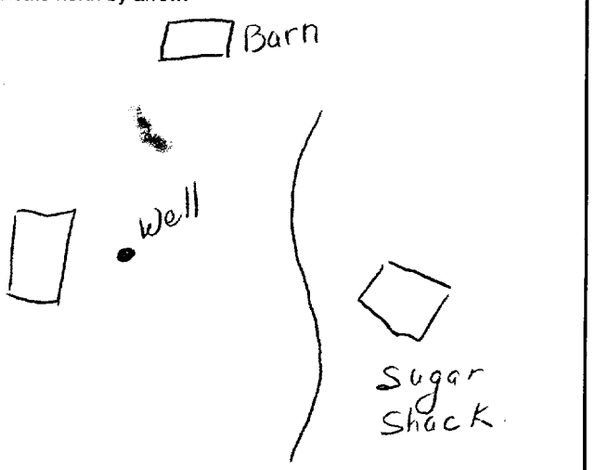
If flowing give rate (38-41) GPM — Pump intake set at 389 feet — Water at end of test (42): ☐ Clear ☑ Cloudy

Recommended pump type: ☐ Shallow ☑ Deep — Recommended pump setting (43-45) 370 feet — Recommended pump rate (46-49) 1 GPM

(50-53)

LOCATION OF WELL

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



244554

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.
Huff Dall Ltd	2558
Address: RR1 McDonald's Corners Ont K0G1M0	
Name of Well Technician	Well Technician's Licence No.
Mark Dall	T2228
Signature of Technician/Contractor: Huff Dall	Submission date: 4 (day) 5 (mo) 03 (yr)

MINISTRY USE ONLY

Data source (58)	Contractor (59-62)	Date received (63-68) (80)
	2558	JUN 06 2003
Date of inspection	Inspector	
Remarks		CSS.ES3

2 - MINISTRY OF THE ENVIRONMENT COPY

0506 (07/00) Front Form 9

Ontario Ministry of the Environment

We A 030507 (nt number below)
A030507

Well Record
Regulation 903 Ontario Water Resources Act

page ___ of ___

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

[redacted]

LANARK COUNTY | Dalhousie | 3 | 11

RR#/Street Number/Name: Highland Line Road | City/Town/Village: McDonalds Corners | Site/Compartment/Block/Tract etc.

GPS Reading: NAD 83 | Zone 18 | Easting 377434 | Northing 4976291 | Unit Make/Model: Magellan Meridian | Mode of Operation: ☐ 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)
Black	Earth.			0	3.0
Red	Granite			3.0	61.0

Hole Diameter

Depth From	Depth To (Metres)	Diameter (Centimetres)
6.1	61.0	15.24

Water Record

Water found at Metres	Kind of Water		
57.6 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	Depth To (Metres)
Casing				
15.85	☒ Steel ☐ Fibreglass ☐ Plastic ☐ Concrete ☐ Galvanized	.188	0	6.1
	☐ Steel ☐ Fibreglass ☐ Plastic ☐ Concrete ☐ Galvanized			
	☐ Steel ☐ Fibreglass ☐ Plastic ☐ Concrete ☐ Galvanized			
Screen				
Outside diam	☐ Steel ☐ Fibreglass ☐ Plastic ☐ Concrete ☐ Galvanized	Slot No.		
No Casing or Screen				
	☑ Open hole		6.1	61.0

Test of Well Yield

Pumping test method: Pump

Pump intake set at - (metres): 58

Pumping rate - (litres/min): 14

Duration of pumping: 1 hrs + ___ min

Final water level end of pumping: 58 metres

Recommended pump type: ☐ Shallow ☑ Deep

Recommended pump depth: 58 metres

Recommended pump rate: 22 (litres/min)

If flowing give rate - (litres/min)

If pumping discontinued, give reason.

	Draw Down Time min	Draw Down Water Level Metres	Recovery Time min	Recovery Water Level Metres
Static Level	Static Level	5.8		
1	1	7	1	13.9
2	2	7.2	2	13.7
3	3	7.3	3	13.5
4	4	7.5	4	13.3
5	5	8.0	5	13.1
10	10	9.2	10	12.3
15	15	10	15	11.5
20	20	10.9	20	10.7
25	25	11.9	25	9.9
30	30	12.0	30	9.1
40	40	13.9	40	7.7
50	50	14.8	50	6.6
60	60	15.8	60	5.8

Plugging and Sealing Record

☑ Annular space ☐ Abandonment

Depth set at - Metres From	To	Material and type (bentonite slurry, neat cement slurry) etc.	Volume Placed (cubic metres)
0	6.1	Cement Slurry	120 Kg.

Method of Construction

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

Water Use

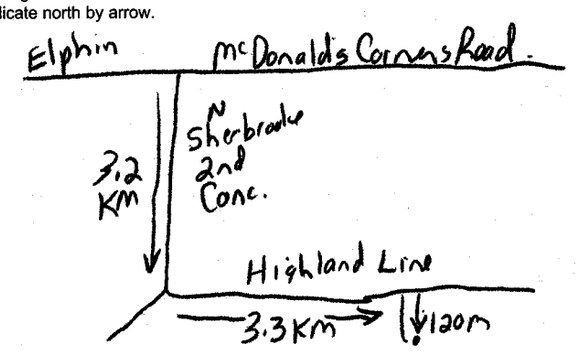
☑ Domestic ☐ Industrial ☐ Public Supply ☐ Other
☐ Stock ☐ Commercial ☐ Not used
☐ Irrigation ☐ Municipal ☐ Cooling & air conditioning

Final Status of Well

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

Location of Well

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



Audit No. Z 32915

Date Well Completed: 2005 09 27

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

Date Delivered: 2005 09 27

Well Contractor/Technician Information

Name of Well Contractor: J.R. Thompson. | Well Contractor's Licence No.: 4905.

Business Address (street name, number, city etc.): 511 Wildlife Rd. Perth On.

Name of Well Technician (last name, first name): Darrell Stevenson. | Well Technician's Licence No.: T2919.

Signature of Technician/Contractor: X Brian Bradley | Date Submitted: 2005 09 27

Ministry Use Only

Data Source | Contractor: 4905

Date Received: NOV 01 2005 | Date of Inspection

Remarks | Well Record Number

0506E (09/03) Contractor's Copy ☐ Ministry's Copy ☑ Well Owner's Copy ☐ *Cette formule est disponible en français*

Ontario Ministry of the Environment

Well T A 034501 (number below)

A 034501

Well Record

Regulation 903 Ontario Water Resources Act

page ___ of ___

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 Help Desk (Toll Free) at 1-888-396-9355.
- **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

[redacted]

RR#/Street Number/Name: Conc 9

City/Town/Village:

Site/Compartment/Block/Tract etc.

GPS Reading: NAD 83 | Zone 18 | Easting 379607 | Northing 4977703 | Unit Make/Model: Magellan Meridian | Mode of Operation: ☐ 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
Brown	Earth	Gravel		0	10.4
Grey	Granite.			10.4	15.2
Grey	Gravel			15.2	16.8

Hole Diameter

Depth From	Depth To	Diameter Centimetres
13.4	16.8	15.24

Water Record

Water found at Metres	Kind of Water		
16 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	Depth To
Casing				
15.24	☑ Steel ☐ Fibreglass ☐ Plastic ☐ Concrete ☐ Galvanized	.188	0	13.4
	☐ Steel ☐ Fibreglass ☐ Plastic ☐ Concrete ☐ Galvanized			
	☐ Steel ☐ Fibreglass ☐ Plastic ☐ Concrete ☐ Galvanized			
Screen				
Outside diam	☐ Steel ☐ Fibreglass ☐ Plastic ☐ Concrete ☐ Galvanized	Slot No.		
No Casing or Screen				
	☑ Open hole		13.4	16.8

Test of Well Yield

Pumping test method: Pump

Pump intake set at - (metres): 15

Pumping rate - (litres/min): 18

Duration of pumping: 1 hrs + ___ min

Final water level end of pumping: 13.5 metres

Recommended pump type: ☑ Shallow ☐ Deep

Recommended pump depth: 15 metres

Recommended pump rate: 22 (litres/min)

If flowing give rate - (litres/min)

If pumping discontinued, give reason.

	Draw Down Time min	Draw Down Water Level Metres	Recovery Time min	Recovery Water Level Metres
Static Level		2.2.		
1		4.6	1	12.7
2		6.9	2	11.0
3		9.2	3	9.4
4		11.7	4	7.9
5		13.1	5	6.5
10		14.2	10	3.9
15		14.2	15	2.2
20		14.2	20	2.2
25		14.2	25	2.2
30		14.2	30	2.2
40		14.3	40	2.2
50		14.3	50	2.2
60		14.2	60	2.2

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	13.4	Cement Slurry	

Method of Construction

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

Water Use

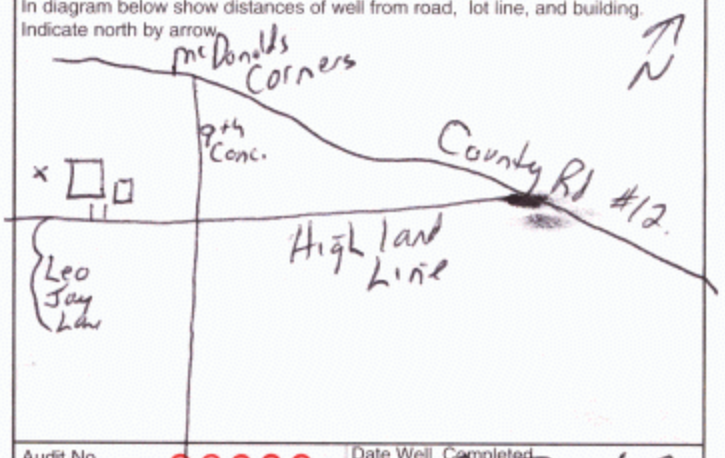
☑ Domestic ☐ Industrial ☐ Public Supply ☐ Other
☐ Stock ☐ Commercial ☐ Not used
☐ Irrigation ☐ Municipal ☐ Cooling & air conditioning

Final Status of Well

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

Location of Well

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



Audit No. Z 80000

Date Well Completed: 2007 06 20

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

Date Delivered: 2007 06 20

Well Contractor/Technician Information

Name of Well Contractor: J.R Thompson

Well Contractor's Licence No.: 4905

Business Address (street name, number, city etc.): 511 Wildlife Rd. PERTH ON.

Name of Well Technician (last name, first name): Darrell Stevenson.

Well Technician's Licence No.: T2919

Signature of Technician/Contractor: x Brian Brady

Date Submitted: 2007 06 20

Ministry Use Only

Data Source | Contractor

Date Received: JUN 25 2008 | Date of Inspection

Remarks | Well Record Number

0506E (08/2006)

Ministry's Copy

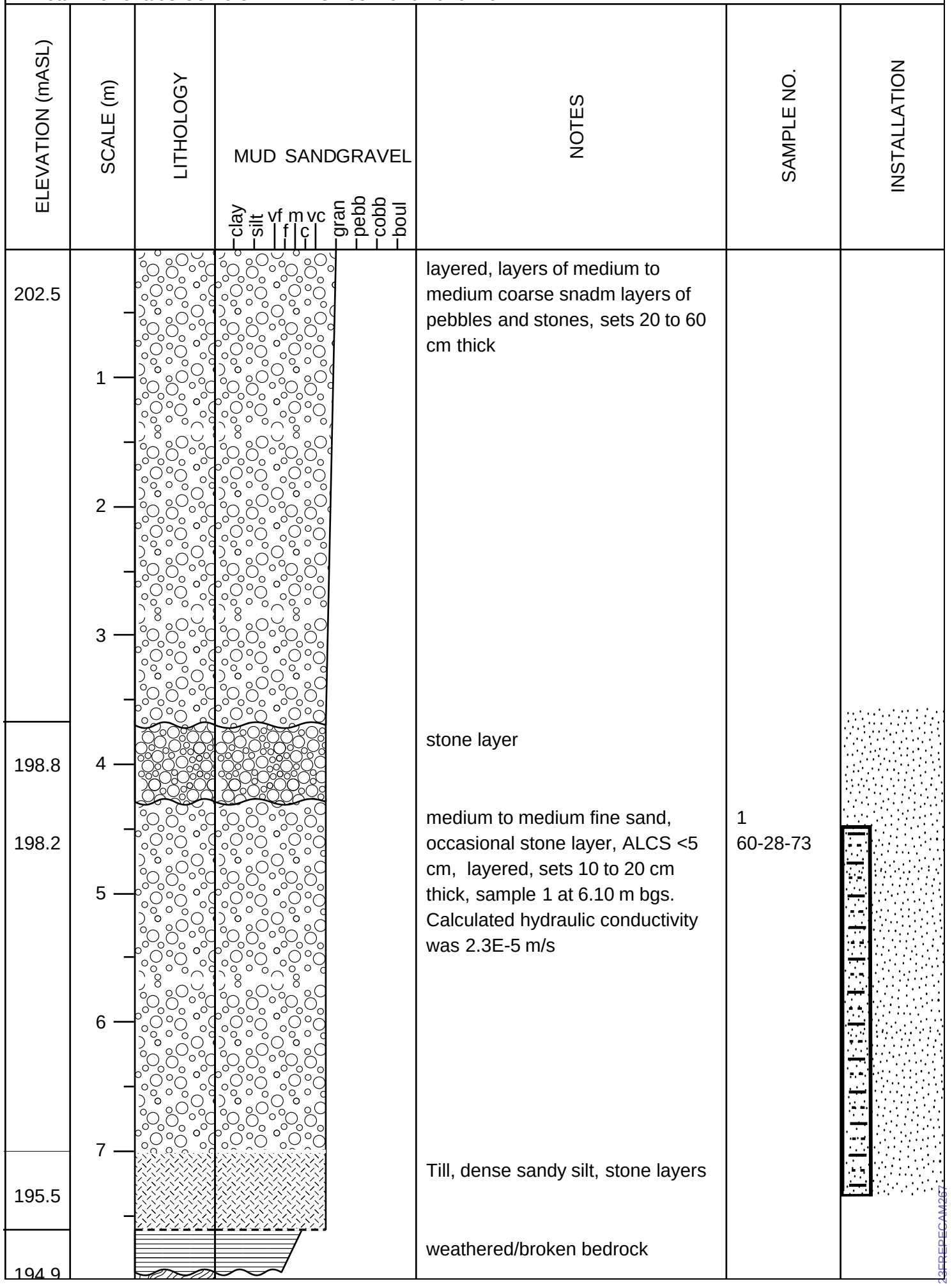
Cette formule est disponible en français

23-REPECAM267

Appendix B

Drill Hole Logs and MOECC Cluster Record

Arnott - McDonalds Corners TW 1 18T 0377946 4976710



Arnott - McDonalds Corners TW 2 18T 0378266 4976951

ELEVATION (mASL)	SCALE (m)	LITHOLOGY (MUD: clay, silt; SAND: vf, f, m, c, vc; GRAVEL: gran, pebb, cobb, boul)	NOTES	SAMPLE NO.	INSTALLATION
192.5	0		layers of medium to medium coarse sand and to very coarse gravel, ALCS <5 cm		
	1				
	2				
	3				
	4				
	5				
	6				
186.4	7		layers of medium coarse to very coarse sand, ALCS 0.5 to 2 cm, likely<25% stone; SA 2 medium coarse to very coarse sand, pebbles. ALCS < 2 cm	sa2 1-1-2-6	
	8				
183.4	9		layers of medium coarse to very coarse sand, ALCS 0.5 to 2 cm, likely<25% stone. Calculated hydraulic conductivity 4.1E-5 m/s	1 60-28-73	
	10				
	11				
	12				
	13				
	14				
	15				
	16				
	17				
	18				
174.2			Stopped at 18.29 mBGS, sand coming up augers		

Arnott - McDonalds Corners TW 3 18T 0378830 4976959

ELEVATION (mASL)	SCALE (m)	LITHOLOGY (MUD SAND GRAVEL: clay silt vf f m c vc gran pebb cobb boul)	NOTES	SAMPLE NO.	INSTALLATION
193.5	0		loose silty sand		
	1				
	2				
	3				
	4				
188.9	5		medium coarse to very coarse sand , pea gravel, ALCS 1 to 2 cm, FM 3 to 3.5		
	6				
187.4	7		medium coarse to very coarse sand , pea gravel, ALCS 1 to 2 cm, FM 3 to 3.5. Calculated hydraulic conductivity was 5.8E-05 m/s	sa3 1-2-18-16	
	8				
	9				
	10				
	11				
	12				
	13				
179.8	14		layered, 10 to 20 cm layers, medium coarse to coarse sand to silty fine sand layers Overall, medium to medium coarse. FM 2 to 2.5. Less than 10% stone.		
	15				
	16				
	17				
	18				
175.2			EOH at 18.29 mBGS. No refusal, just stopped due to augers filling with sand		

Ontario — Ministry of the Environment, Conservation and Parks

Well Record for Well Cluster – Part 1 of 3

(Only for Multiple Test Holes or Dewatering Wells)

Regulation 903 Ontario Water Resources Act

All measurements recorded in: ☒ Metric ☐ Imperial

Follow instructions on the front and back of this form. Print or Type

Well Tag No. of Deepest Well: *(Print Well Tag No.)* A215041

Well No. on Drawing of Deepest Well: TW-2

☐ Dewatering wells ☒ Test holes

No. of wells reported 3

Page 1 of 1

Well Cluster Location Information

Address of Well Location (Street Number(s)/Name(s), RR, if available)	Lot(s)	Concession(s)	Geographic Township	County/District/Upper Tier Municipality
890 HIGHLAND LINE ROAD				

City, Town, Village or Hamlet	Province	GPS Unit Make	Model	Unit Mode of Operation
PERTH	Ontario	GARMIN	ETREX	☐ Undifferentiated ☒ Averaged ☐ Differentiated, specify:

Mandatory Attachments/Additional Information

☒ Land Owner Consent Form must be attached.

☒ Detailed Drawing of All Well Locations must be attached.

I, the person constructing the well, will promptly submit to the Director, on request, any additional information in my custody or control related to any well in the well cluster that I have constructed.

Signature of Technician/Contractor — Date (yyyy/mm/dd): 2021/01/15

Well Details

Well # on Drawing	UTM Coordinates Zone	Easting	Northing	Hole Depth (m/ft)	Hole Diameter (cm/in)	Method of Construction	Casing Material; Diameter (cm/in)	Casing (m/ft) From	Casing To	Screen Interval (m/ft) From	Screen To	Annular Space Material (m/ft) From	Annular Space To	Annular Space Material:	Overburden/Bedrock or Abandonment Filing Material Intervals (m/ft)	Static Water Level (m/ft)	Date of Completion (yyyy/mm/dd)
TW-1	18	377946	4976712	7.92	20.3	HSA	5.08	0	4.88	4.88	7.92	0.9	4.27	BENTONITE	0-6.1 SAND, TILL	N/A	2020/11/26
TW-2	18	378239	4976967	9.14	20.3	HSA	5.08	0	6.1	6.1	9.14	0.9	5.18	BENTONITE	SAND	0.91	2020/11/26
TW-3	18	378288	4976960	9.14	20.3	HSA	5.08	0	6.1	6.1	9.14	1.2	5.18	BENTONITE	SAND	1.52	2020/11/27

Well Contractor and Well Technician Information

Business Name of Well Contractor	Business Address (Street Number/Name, RR)	Municipality	Province
GEORGE DOWNING ESTATE DRILLING LTD	410 RUE PRINCIPALE	GRENVILLE-SUR-LA-ROUGE	QC

Postal Code	Bus. Telephone No.	Well Contractor's Licence No.	Business E-mail Address
J0V1B0	(819) 242-6469	1844	info@forage downingdrilling.com

Name of Well Technician (First Name, Last Name)	Well Technician's Licence No.	Signature of Well Technician	Date Submitted (yyyy/mm/dd)
STEPHEN DOWNING	3326		2021/01/15

Date First Well in Cluster Constructed or Abandoned (yyyy/mm/dd)	Date Last Well in Cluster Completed (yyyy/mm/dd)
2020/11/26	2020/11/27

Well Abandonment

Person Abandoning the Wells:

Name N/A

(Print or Type) - See instruction 11 on the back of this form

Ministry Use Only

Date Received (yyyy/mm/dd)	Audit No.
	C 50689

Comments:

1991E (2020/06)

Ministry's Copy

23FREPECAM267

PERMISSION TO FILE A WELL CLUSTER RECORD

leave with onsite technician, for clusters only

Our firm was recently contracted to either install or abandon groundwater monitoring wells at your property. When this type of well is installed or abandoned, provincial law requires us to file a well record with the Ministry of Environment.

The well record does not provide any information about your property use, your business, or information about the structural or environmental qualities of your property. The purpose of the record is simply to inform the Ministry that a well exists at this location, and provide details illustrating that the well has been properly constructed or decommissioned.

We can file a single record for each well, but it is more economical to file one record for the entire cluster of wells. In order to file this "cluster record", we are required to obtain written permission from the owner of the land. [Ref: Reg 903 16.4(1)4]

It would be greatly appreciated if you would sign and return the following, so that we can comply with the legislation and file the well record. Scanned, emailed or faxed copies are acceptable.

I hereby authorize George Downing Estate Drilling / Eastern Ontario Diamond Drilling to file a cluster of wells installed at the address below

Well Location Information

Street Address : Highland Line

(if no address) Lot & Concession : Lot 5 and 6. Concession X and XI

County/Distric/Municipality : Township of Lanark Highlands, Geo Dalhousie

City/Town/Village : McDonalds Corners

Postal Code : K0G 1M0

Well Tag Number : A215041 Number of Wells : 3

Audit No. : C50689 Wells : TW-1, TW-2, TW-3

Property Owners's Information

Company Name (if applicable): Arnott Bros Construction ltd.

Name: Mike Crain

Mailing Address: #36 Highway 511, Perth Ontario

Email Address : info@arnottbros.com

Phone Number : 613-812-8764 (cell) 613-267-5722 (office)

Signature : _____ **Date:** Jan 12 2021

Ontario

Ministry of the Environment and Climate Change

Well Record for Well Cluster - Part 2 of 3
Land Owner Consent

This form is to be completed by the person who constructs or abandons test holes or dewatering wells that form all or part of a well cluster. If this form is being used to report any well abandonment, these wells must have been previously reported as part of a single well cluster.

Note: For well cluster records, only the owners of the land on which the wells are situated are to give written consent. If the well purchaser (e.g. a consultant who hires the driller) is not the owner of the land, then the well purchaser cannot sign the consent form.

By signing this form, land owners are providing consent to use one well record to report a well cluster of test holes or dewatering wells in accordance with section 16.4 of Regulation 903 made under the *Ontario Water Resources Act.*

This completed **Well Record for Well Cluster Part 2 - Land Owner Consent** must be attached to Parts 1 and 3.

* Please PRINT if completing by hand.

Well Tag Number: # A215041

"Well Record for Well Cluster" Audit Number: # C50689

Well # on Detailed Drawing	Property Location Description	Land Owner's Name	Signature of Land Owner	Date Signed *(yyyy/mm/dd)*
TW-1 TW-2 TW-3	890 HIGHLAND LINE ROAD PERTH, ON	ARNOTT BROS. CONSTRUCTION LTD ATTN: MIKE CRAIN #36 HIGHWAY 511 PERTH, ON K0G 1M0 (613) 267-5722 info@arnott bros.com		2021/01/15

Ministry's Copy

Ontario

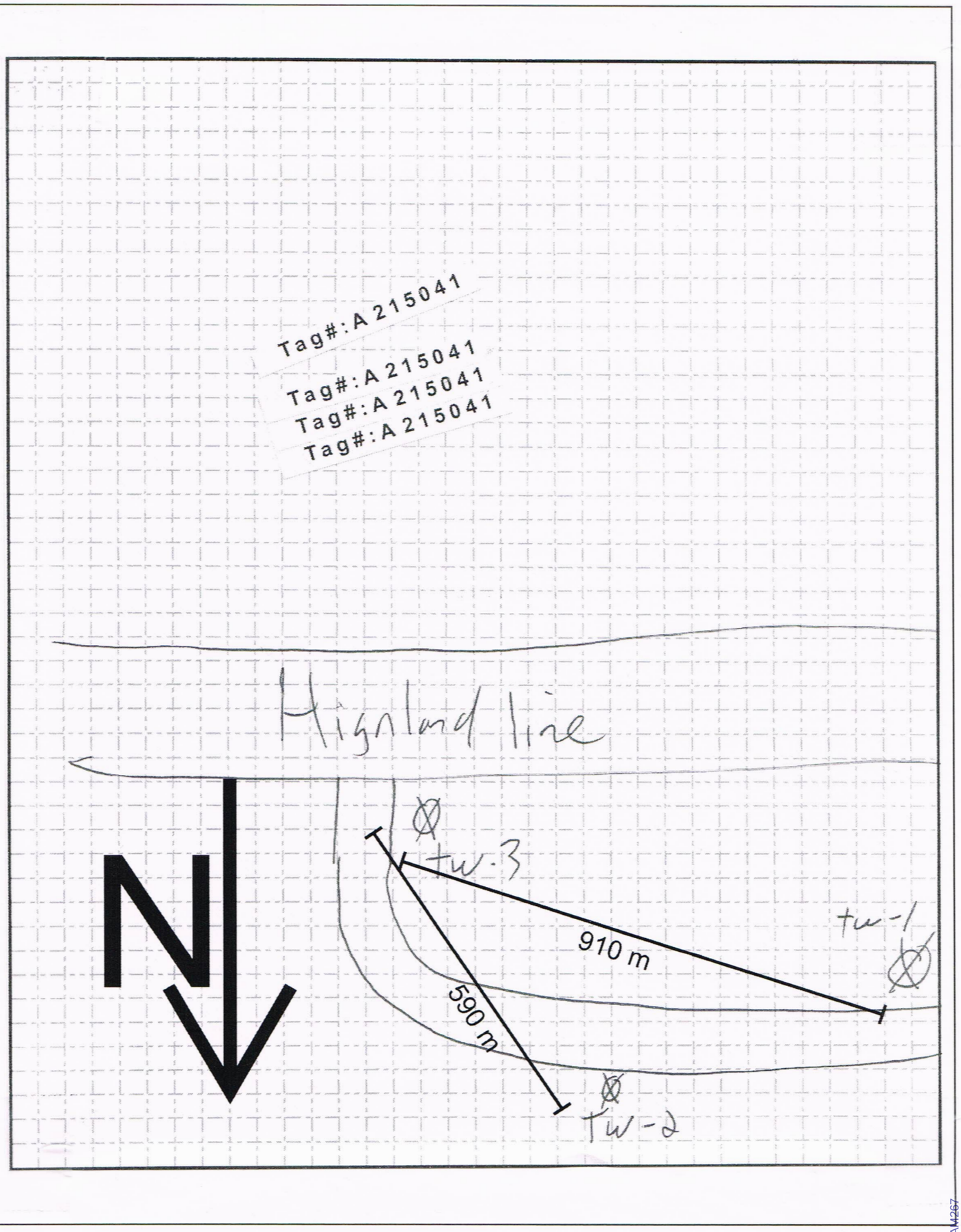
Ministry of the Environment, Conservation and Parks

Well Record for Well Cluster - Part 3 of 3
Detailed Drawing of All Well Locations

Note: This **Well Record for Well Cluster Part 3 - Detailed Drawing of all Well Locations,** must be attached to Parts 1 and 2.
The drawing must include all property boundaries, an arrow indicating the North direction, all named roads and sufficient measurements to locate all wells in the cluster in relation to fixed points. The drawing must show the location of each well and each well must be numbered on the drawing to match number used for that well on the **Well Record for Well Cluster Parts 1 and 2.**
The well with the well tag must be clearly identified on the Drawing.
UTM coordinates should appear beside each well, if space permits. Additional comments on wells can be included on the drawing

Well Tag Number: # A215041

"Well Record for Well Cluster" Form Audit Number: # <50689



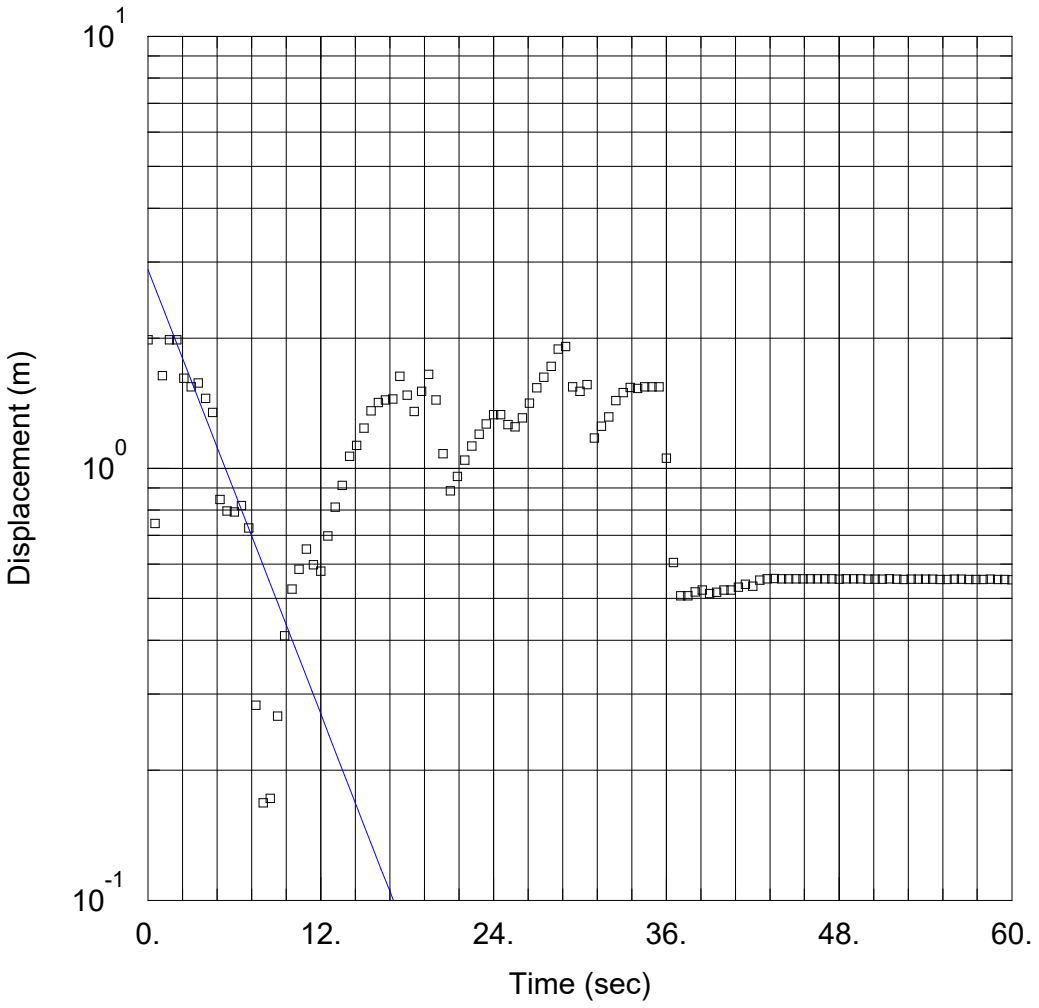
Ministry's Copy

Appendix C

Hydraulic Conductivity Test Data and Analysis

Arnott Sand and Gravel - Below Water Excavation

Prepared By:	Prepared For:
GRI	Arnott Sand and Gravel
Project:	Location:
21-022	Highland Road



SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev

K = 6.005E-5 m/sec y0 = 2.883 m

AQUIFER DATA

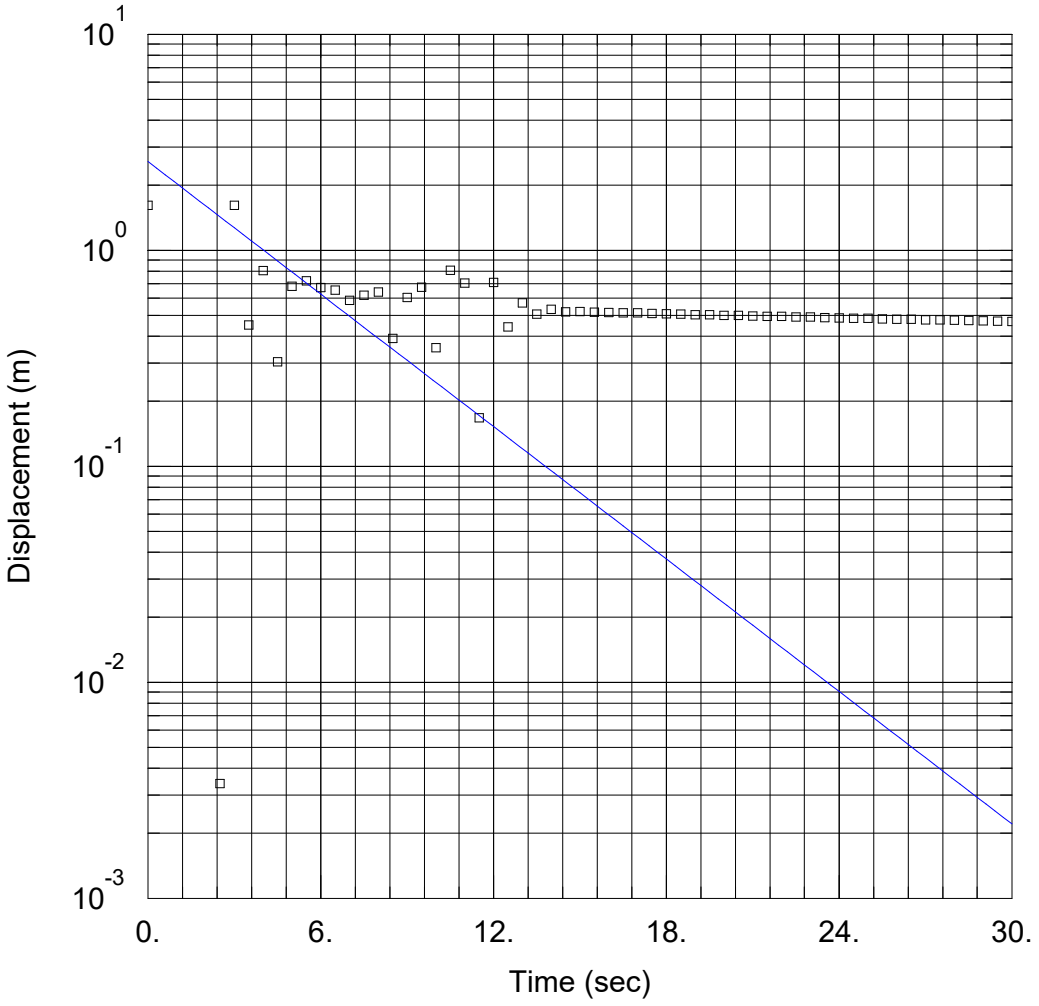
Saturated Thickness: 5.81 m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (TW 1)

Initial Displacement: 1.983 m
Static Water Column Height: 5.81 m
Total Well Penetration Depth: 7.7 m
Screen Length: 3.05 m
Casing Radius: 0.0254 m
Well Radius: 0.0254 m
Gravel Pack Porosity: 0.

Arnott Sand and Gravel - Below Water Excavation

Prepared By:	Prepared For:
GRI	Arnott Sand and Gravel
Project:	Location:
21-022	Highland Road



SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev

K = 7.168E-5 m/sec y0 = 2.574 m

AQUIFER DATA

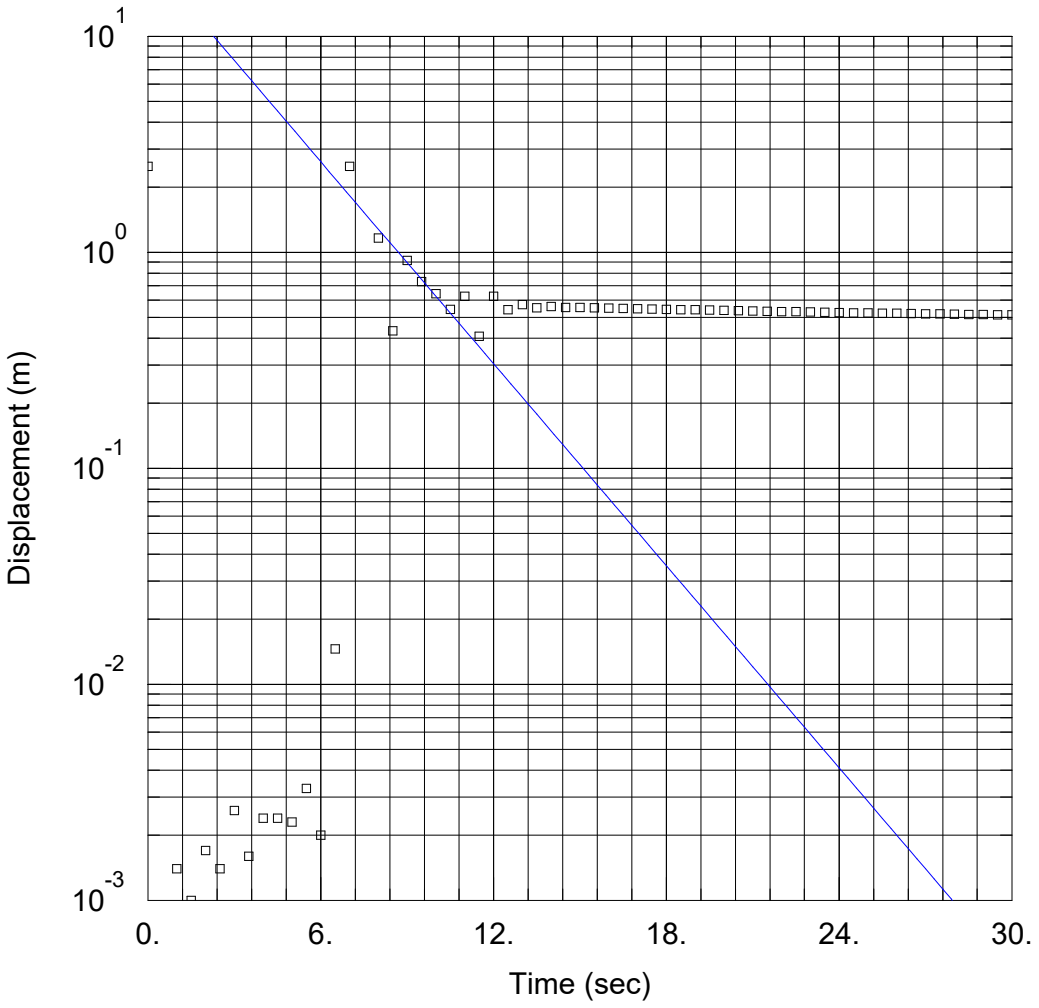
Saturated Thickness: 5.81 Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (TW 1)

Initial Displacement: 1.615 m
Static Water Column Height: 5.81 m
Total Well Penetration Depth: 7.7 m
Screen Length: 3.05 m
Casing Radius: 0.0254 m
Well Radius: 0.0254 m
Gravel Pack Porosity: 0.

Arnott Sand and Gravel - Below Water Excavation

Prepared By:	Prepared For:
GRI	Arnott Sand and Gravel
Project: 21-022	Location: Highland Road



SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev

K = 0.0001093 m/sec y0 = 22.67 m

AQUIFER DATA

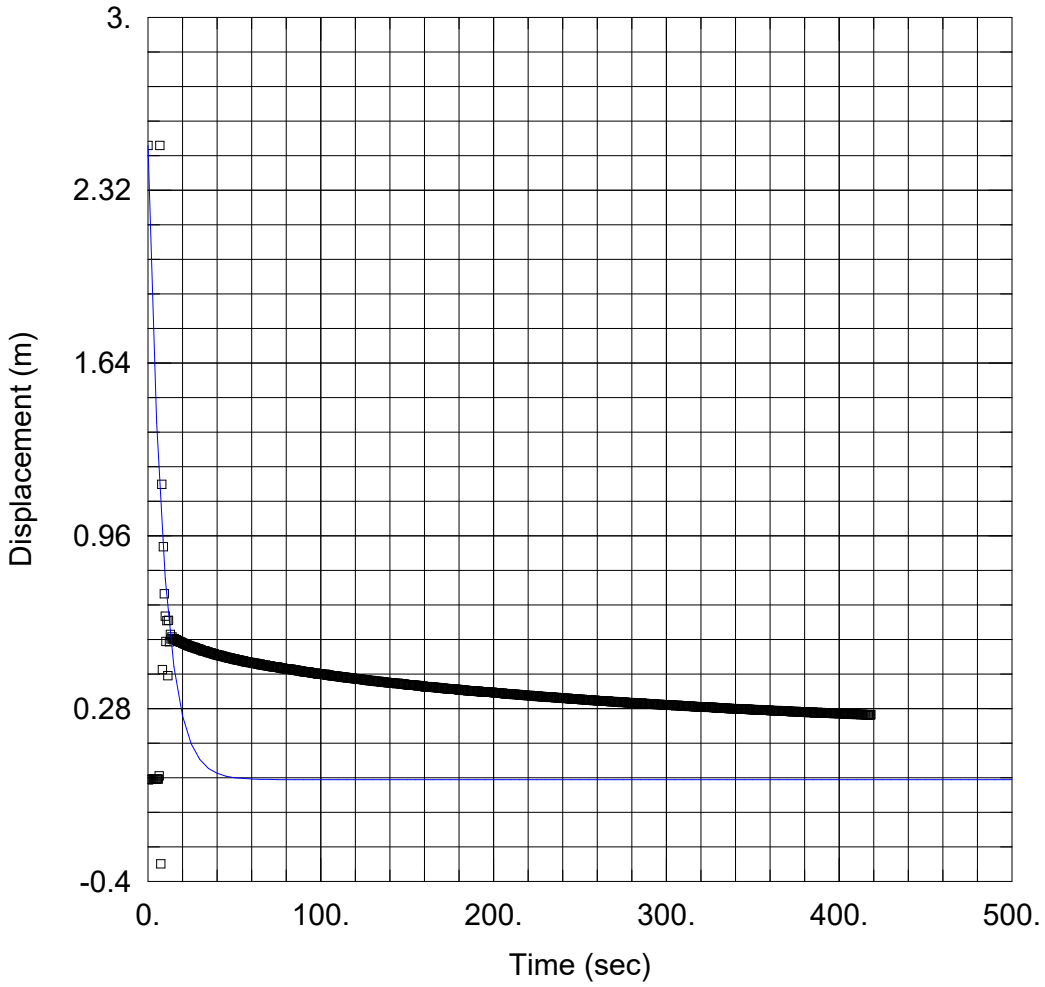
Saturated Thickness: 5.81 Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (TW 1)

Initial Displacement: 2.495 m
Static Water Column Height: 5.81 m
Total Well Penetration Depth: 7.7 m
Screen Length: 3.05 m
Casing Radius: 0.0254 m
Well Radius: 0.0254 m
Gravel Pack Porosity: 0.

Arnott Sand and Gravel - Below Water Excavation

Prepared By:	Prepared For:
GRI	Arnott Sand and Gravel
Project:	Location:
21-022	Highland Road



SOLUTION

Aquifer Model: Unconfined
Solution Method: Springer-Gelhar

K = 2.737E-5 m/sec Le = 1. m

AQUIFER DATA

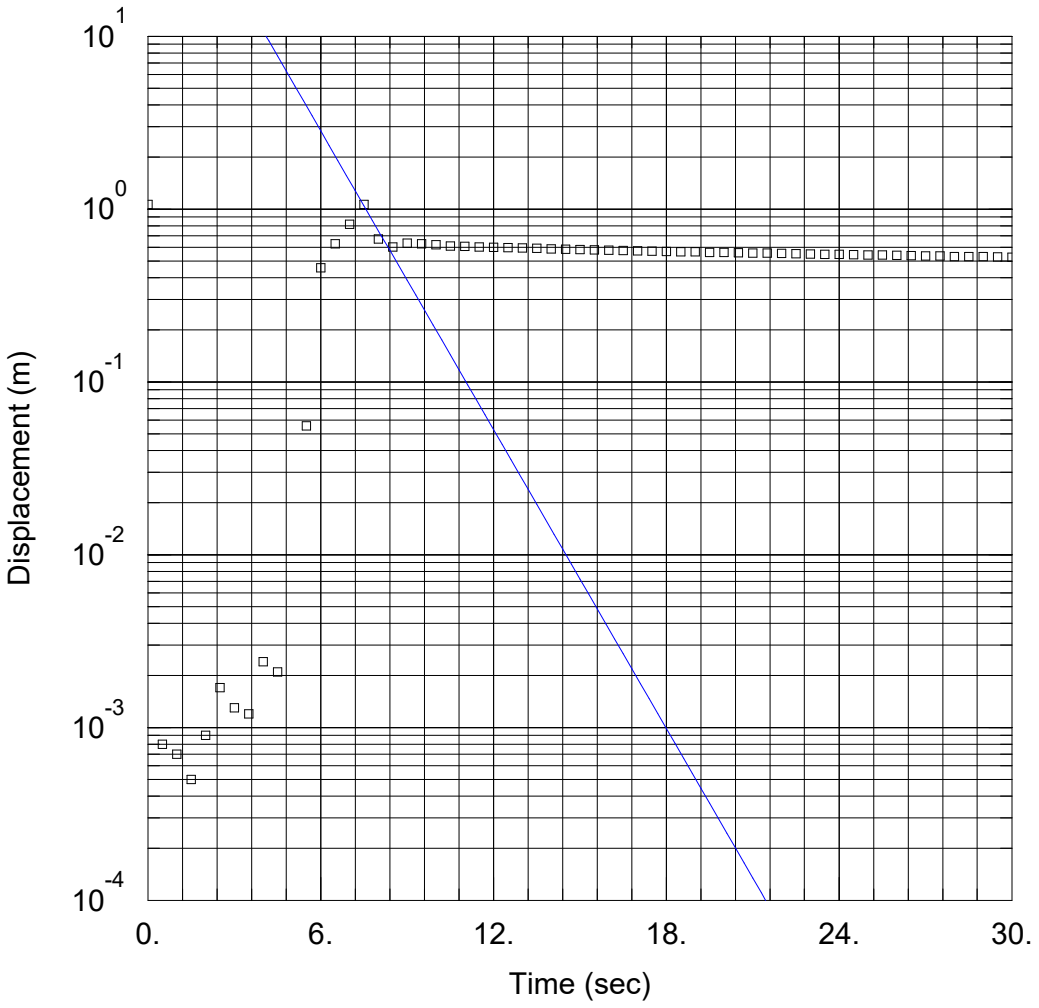
Saturated Thickness: 5.81 Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (TW 1)

Initial Displacement: 2.495 m
Static Water Column Height: 5.81 m
Total Well Penetration Depth: 7.7 m
Screen Length: 3.05 m
Casing Radius: 0.0254 m
Well Radius: 0.0254 m
Gravel Pack Porosity: 0.

Arnott Sand and Gravel - Below Water Excavation

Prepared By:	Prepared For:
GRI	Arnott Sand and Gravel
Project:	Location:
21-022	Highland Road



SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev

K = 0.0002021 m/sec y0 = 152.4 m

AQUIFER DATA

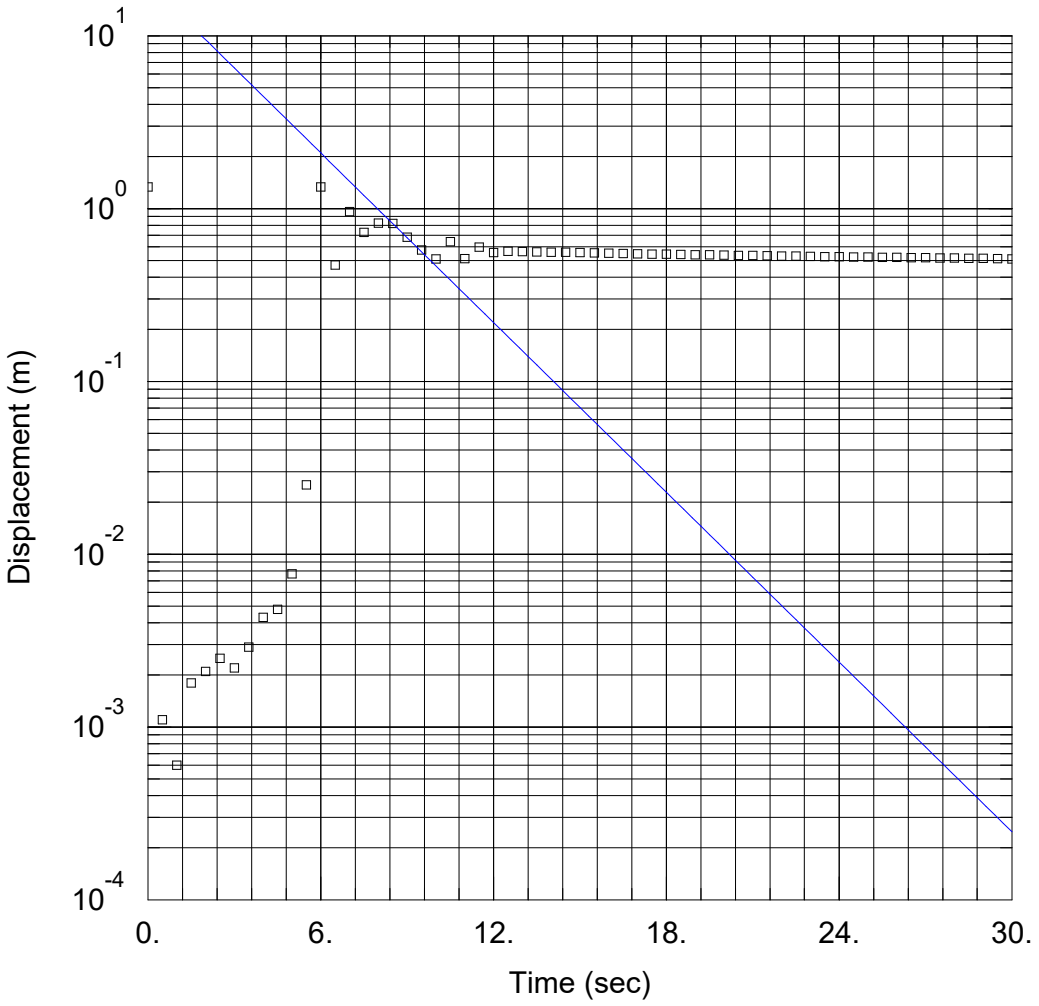
Saturated Thickness: 5.81 m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (TW 1)

Initial Displacement: 1.062 m
Static Water Column Height: 5.81 m
Total Well Penetration Depth: 7.7 m
Screen Length: 3.05 m
Casing Radius: 0.0254 m
Well Radius: 0.0254 m
Gravel Pack Porosity: 0.

Arnott Sand and Gravel - Below Water Excavation

Prepared By:	Prepared For:
GRI	Arnott Sand and Gravel
Project:	**Location:**
21-022	Highland Road



SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev

K = 0.0001148 m/sec y0 = 20.18 m

AQUIFER DATA

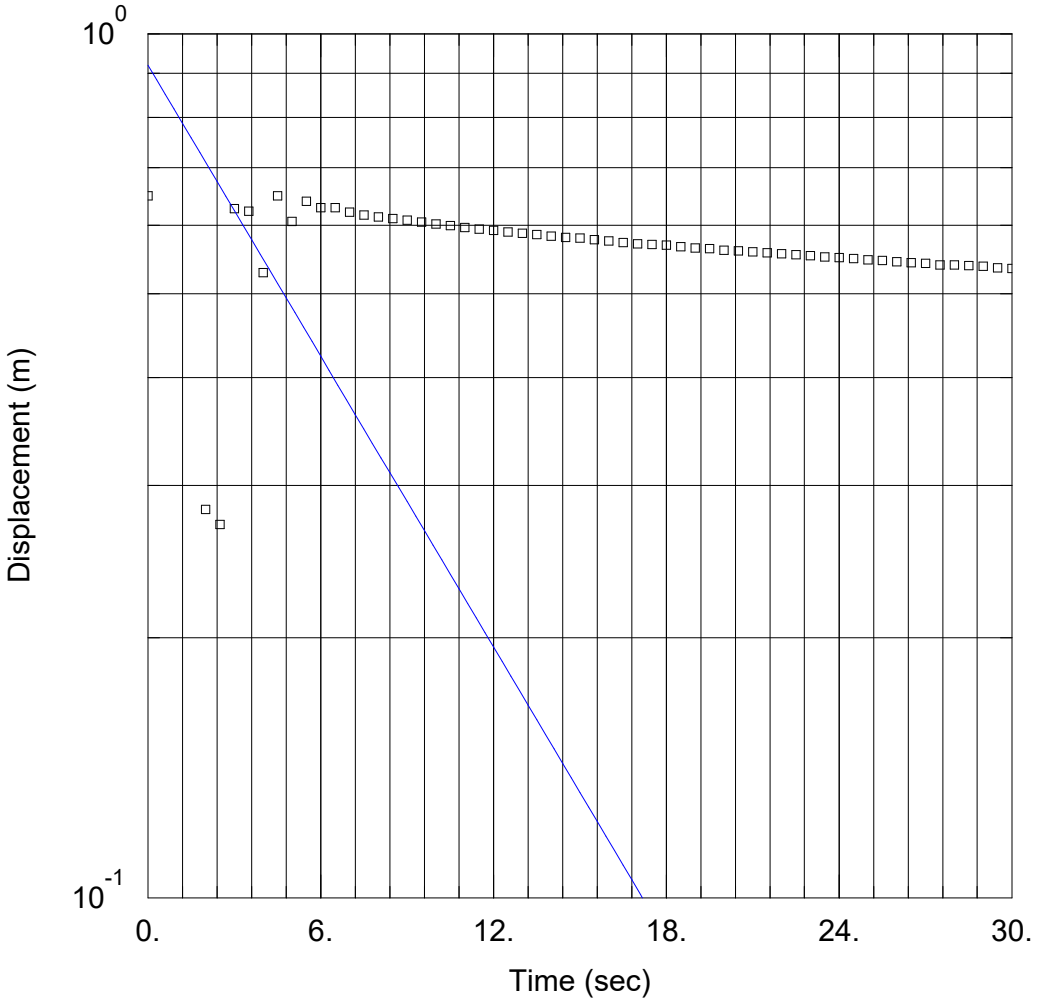
Saturated Thickness: 5.81 m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (TW 1)

Initial Displacement: 1.335 m
Static Water Column Height: 5.81 m
Total Well Penetration Depth: 7.7 m
Screen Length: 3.05 m
Casing Radius: 0.0254 m
Well Radius: 0.0254 m
Gravel Pack Porosity: 0.

Arnott Sand and Gravel - Below Water Excavation

Prepared By:	Prepared For:
GRI	Arnott Sand and Gravel
Project:	**Location:**
21-022	Highland Road



SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev

K = 3.935E-5 m/sec y0 = 0.9196 m

AQUIFER DATA

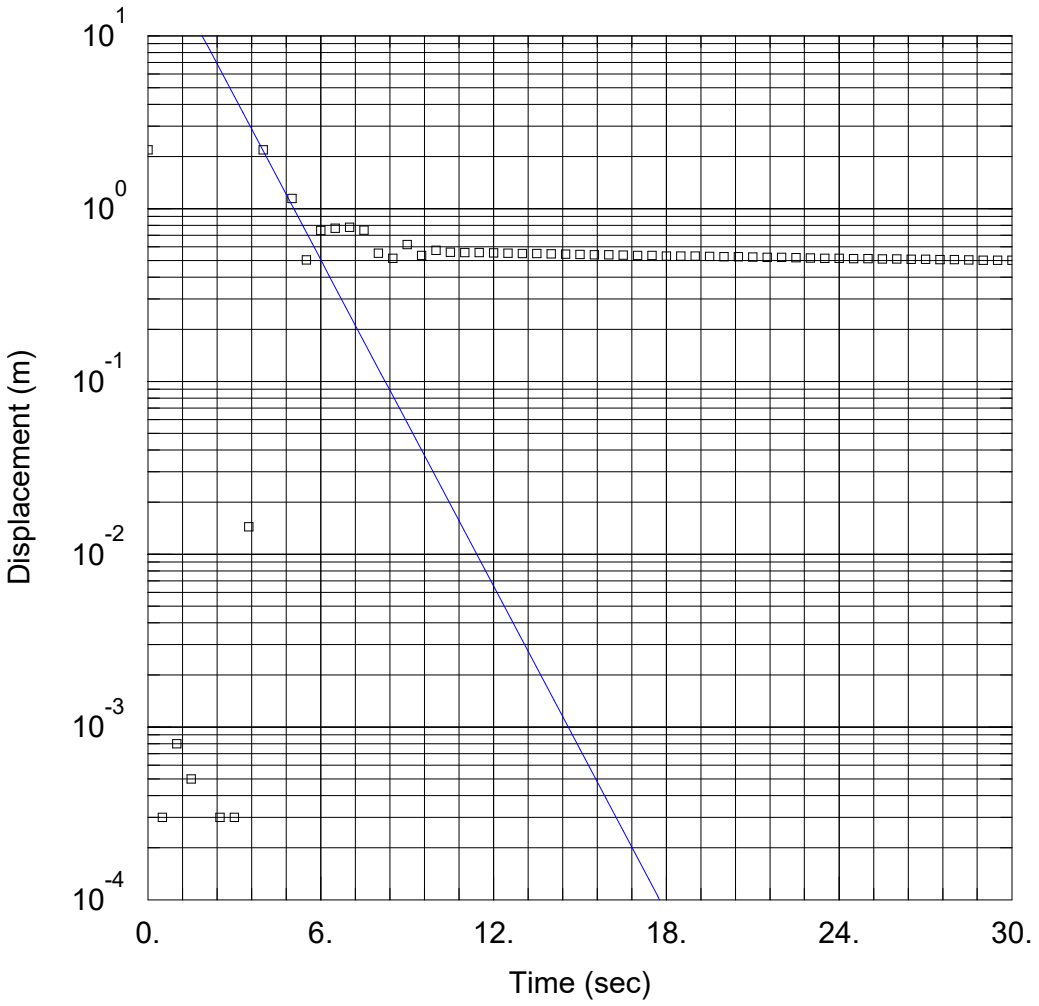
Saturated Thickness: 5.81 m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (TW 1)

Initial Displacement: 0.6494 m
Static Water Column Height: 5.81 m
Total Well Penetration Depth: 7.7 m
Screen Length: 3.05 m
Casing Radius: 0.0254 m
Well Radius: 0.0254 m
Gravel Pack Porosity: 0.

Arnott Sand and Gravel - Below Water Excavation

Prepared By:	Prepared For:
GRI	Arnott Sand and Gravel
Project:	**Location:**
21-022	Highland Road



SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev

K = 0.0002208 m/sec y0 = 39.28 m

AQUIFER DATA

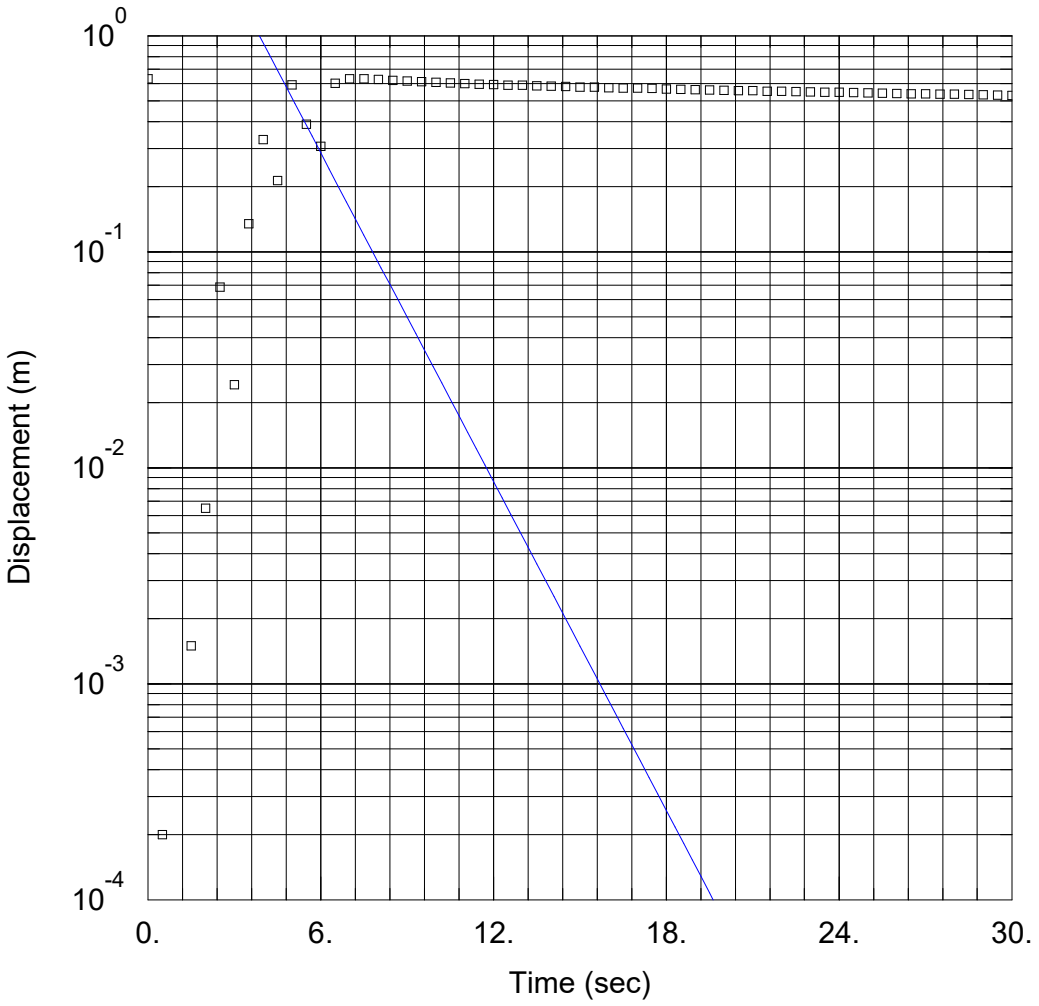
Saturated Thickness: 5.81 m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (TW 1)

Initial Displacement: 2.191 m
Static Water Column Height: 5.81 m
Total Well Penetration Depth: 7.7 m
Screen Length: 3.05 m
Casing Radius: 0.0254 m
Well Radius: 0.0254 m
Gravel Pack Porosity: 0.

Arnott Sand and Gravel - Below Water Excavation

Prepared By:	Prepared For:
GRI	Arnott Sand and Gravel
Project:	**Location:**
21-022	Highland Road



SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev

K = 0.000178 m/sec y0 = 9.587 m

AQUIFER DATA

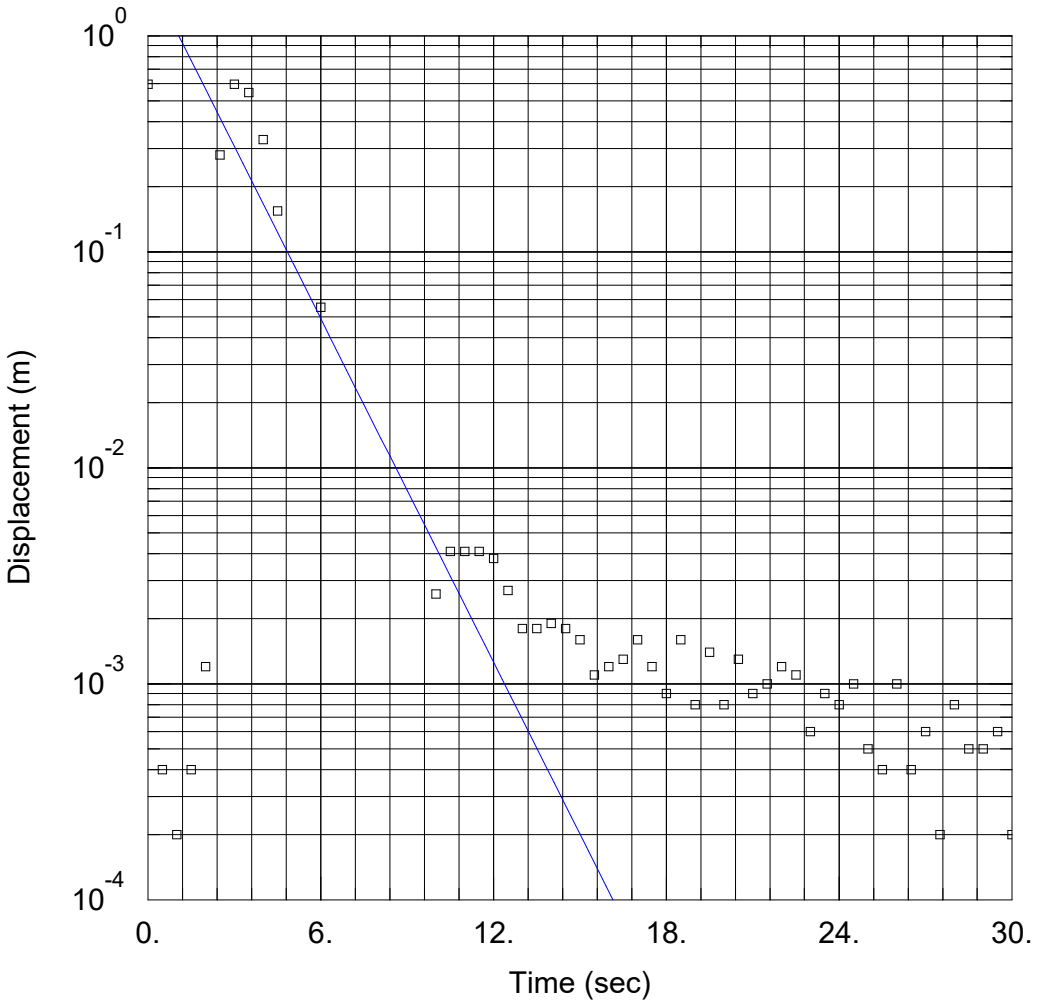
Saturated Thickness: 5.81 m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (TW 1)

Initial Displacement: 0.6323 m
Static Water Column Height: 5.81 m
Total Well Penetration Depth: 7.7 m
Screen Length: 3.05 m
Casing Radius: 0.0254 m
Well Radius: 0.0254 m
Gravel Pack Porosity: 0.

Arnott Sand and Gravel - Below Water Excavation

Prepared By:	Prepared For:
GRI	Arnott Sand and Gravel
Project:	**Location:**
21-022	Highland Road



SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev

K = 0.0001625 m/sec y0 = 1.921 m

AQUIFER DATA

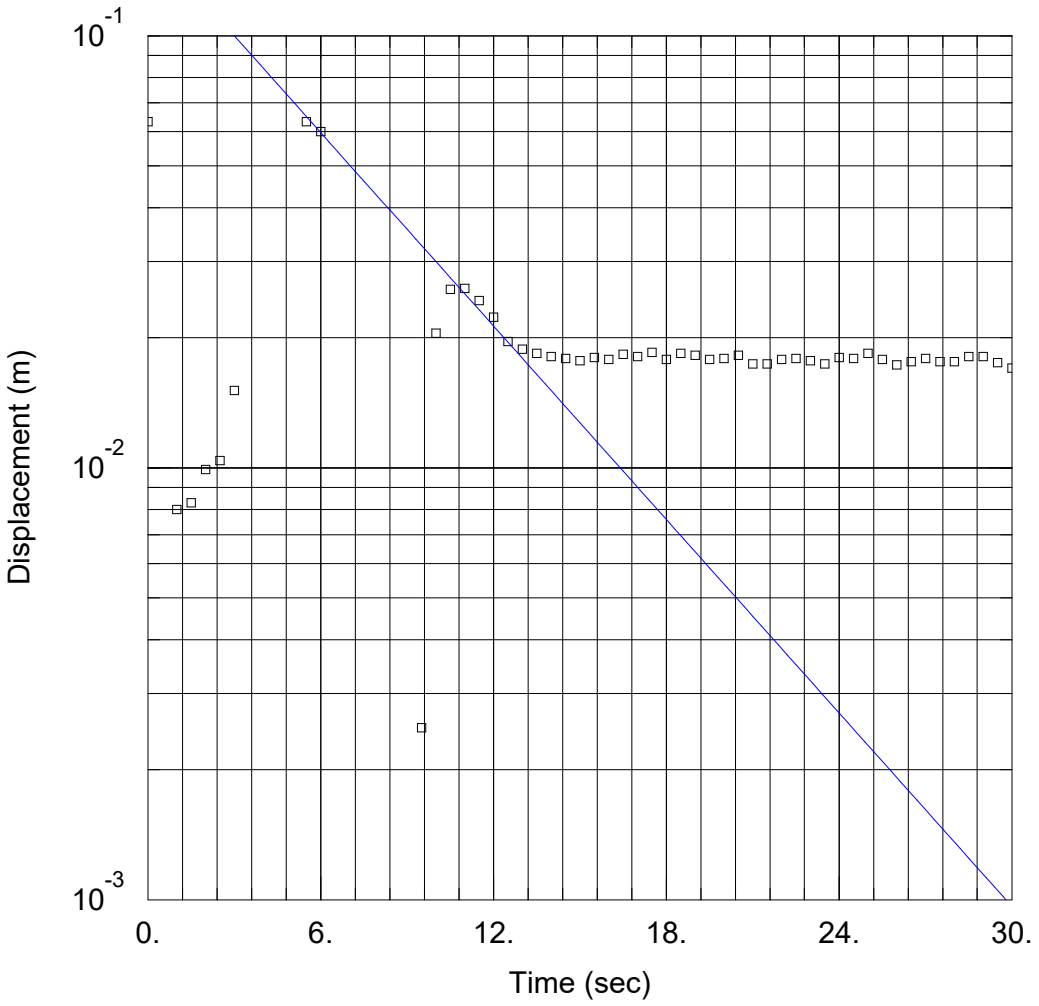
Saturated Thickness: 17.2 m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (TW 2)

Initial Displacement: 0.5967 m
Static Water Column Height: 7.75 m
Total Well Penetration Depth: 8.84 m
Screen Length: 3.05 m
Casing Radius: 0.0254 m
Well Radius: 0.0254 m
Gravel Pack Porosity: 0.

Arnott Sand and Gravel - Below Water Excavation

Prepared By:	Prepared For:
GRI	Arnott Sand and Gravel
Project:	**Location:**
21-022	Highland Road



SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev

K = 4.573E-5 m/sec y0 = 0.1674 m

AQUIFER DATA

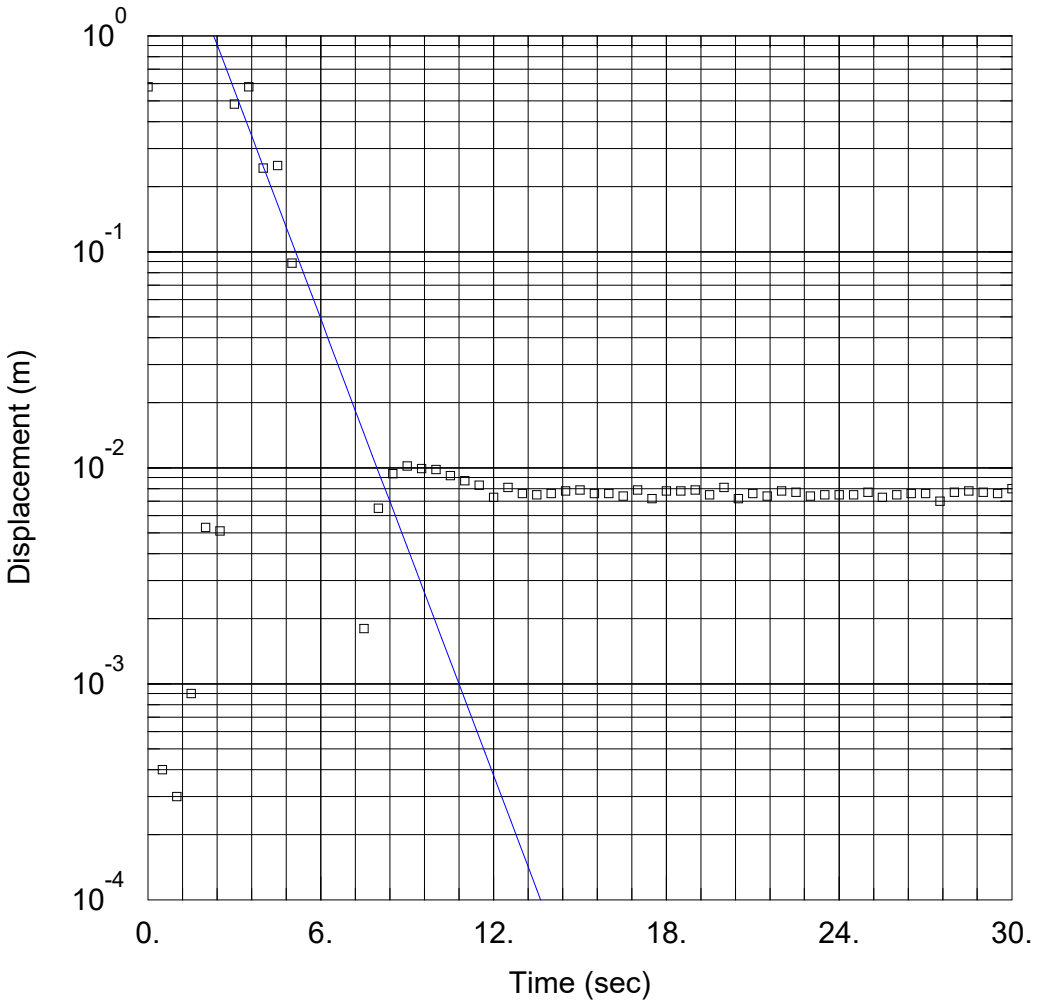
Saturated Thickness: 17.2 m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (TW 2)

Initial Displacement: 0.0633 m
Static Water Column Height: 7.75 m
Total Well Penetration Depth: 8.84 m
Screen Length: 3.05 m
Casing Radius: 0.0254 m
Well Radius: 0.0254 m
Gravel Pack Porosity: 0.

Arnott Sand and Gravel - Below Water Excavation

Prepared By:	Prepared For:
GRI	Arnott Sand and Gravel
Project:	**Location:**
21-022	Highland Road



SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev

K = 0.0002159 m/sec y0 = 6.387 m

AQUIFER DATA

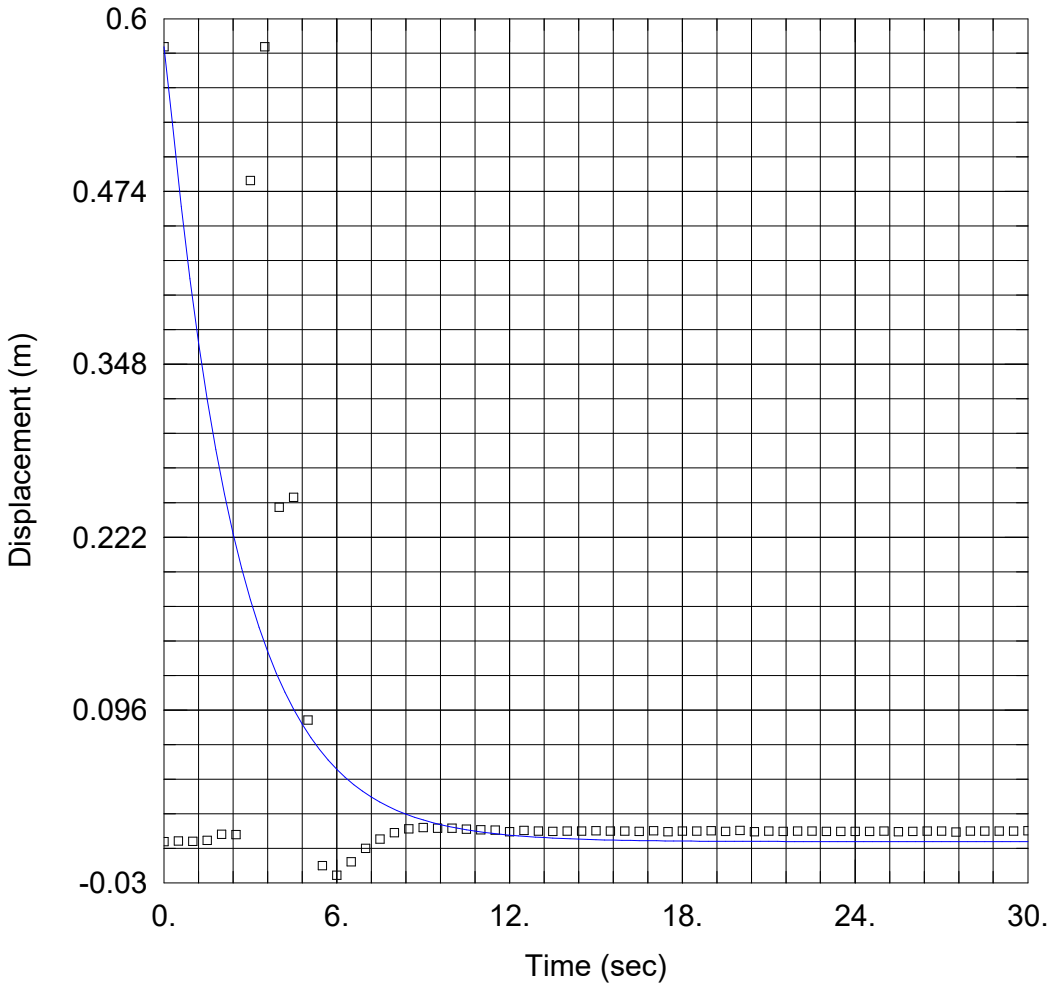
Saturated Thickness: 17.2 m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (TW 2)

Initial Displacement: 0.5797 m
Static Water Column Height: 7.75 m
Total Well Penetration Depth: 8.84 m
Screen Length: 3.05 m
Casing Radius: 0.0254 m
Well Radius: 0.0254 m
Gravel Pack Porosity: 0.

Arnott Sand and Gravel - Below Water Excavation

Prepared By:	Prepared For:
GRI	Arnott Sand and Gravel
Project:	**Location:**
21-022	Highland Road



SOLUTION

Aquifer Model: Unconfined
Solution Method: Springer-Gelhar

K = 8.268E-5 m/sec Le = 1. m

AQUIFER DATA

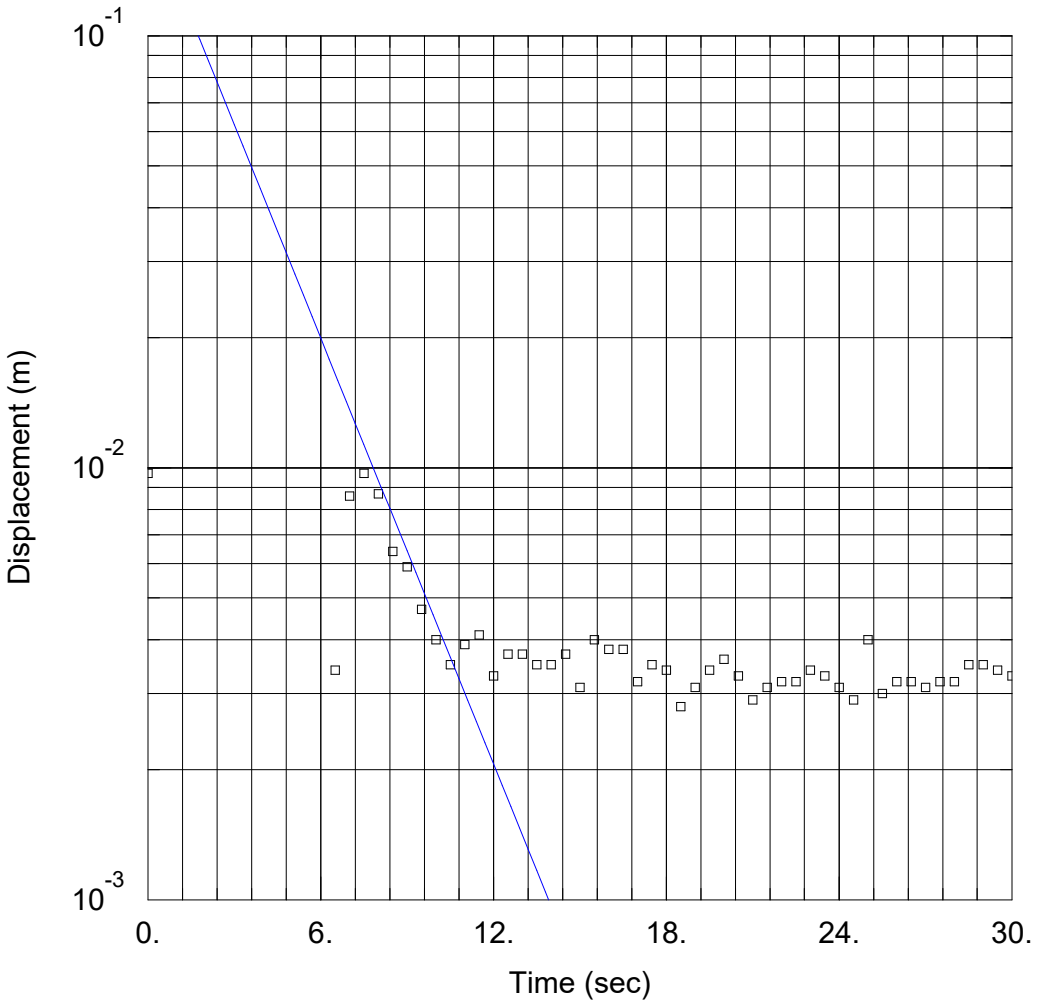
Saturated Thickness: 17.2 m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (TW 2)

Initial Displacement: 0.5797 m
Static Water Column Height: 7.75 m
Total Well Penetration Depth: 8.84 m
Screen Length: 3.05 m
Casing Radius: 0.0254 m
Well Radius: 0.0254 m
Gravel Pack Porosity: 0.

Arnott Sand and Gravel - Below Water Excavation

Prepared By:	Prepared For:
GRI	Arnott Sand and Gravel
Project:	**Location:**
21-022	Highland Road



SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev

K = 0.0001007 m/sec y0 = 0.1937 m

AQUIFER DATA

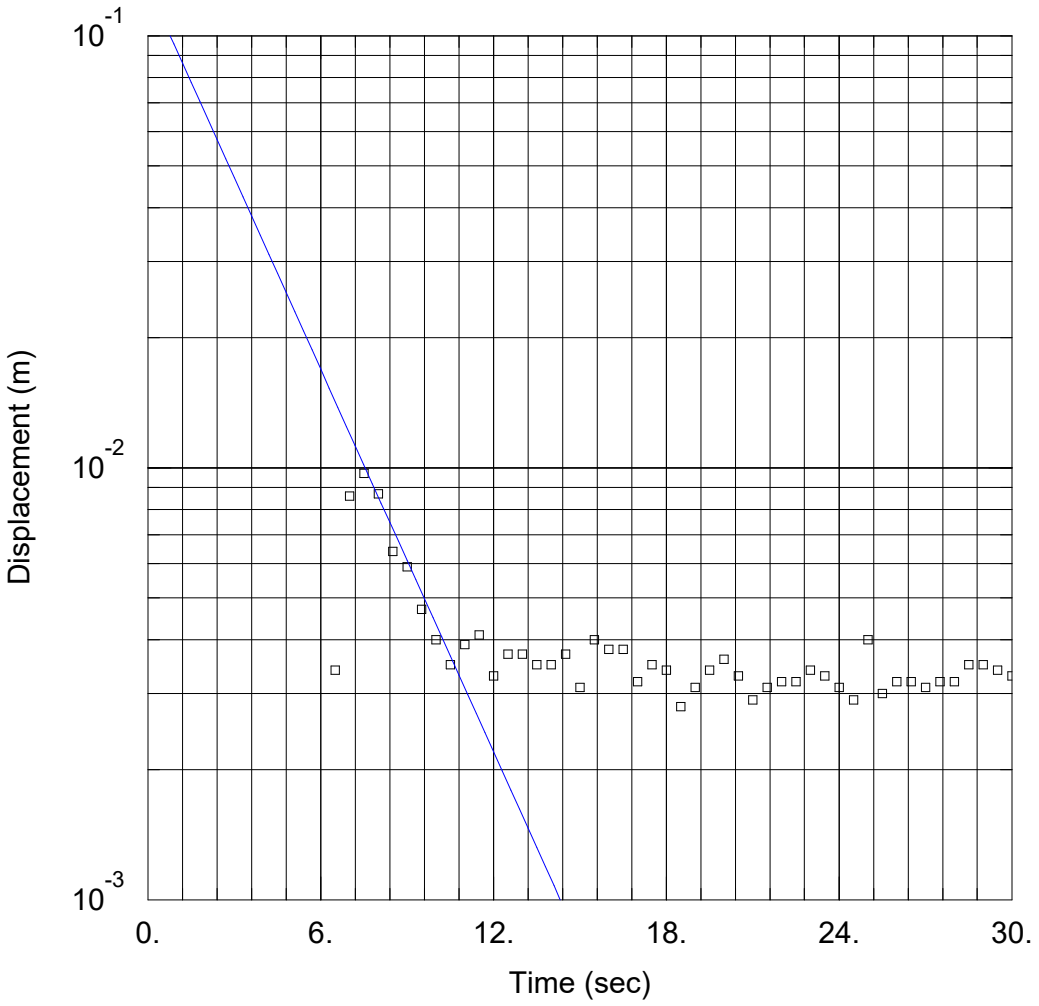
Saturated Thickness: 17.2 m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (TW 2)

Initial Displacement: 0.0097 m
Static Water Column Height: 7.75 m
Total Well Penetration Depth: 8.84 m
Screen Length: 3.05 m
Casing Radius: 0.0254 m
Well Radius: 0.0254 m
Gravel Pack Porosity: 0.

Arnott Sand and Gravel - Below Water Excavation

Prepared By:	Prepared For:
GRI	Arnott Sand and Gravel
Project:	**Location:**
21-022	Highland Road



SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev

K = 9.042E-5 m/sec y0 = 0.13 m

AQUIFER DATA

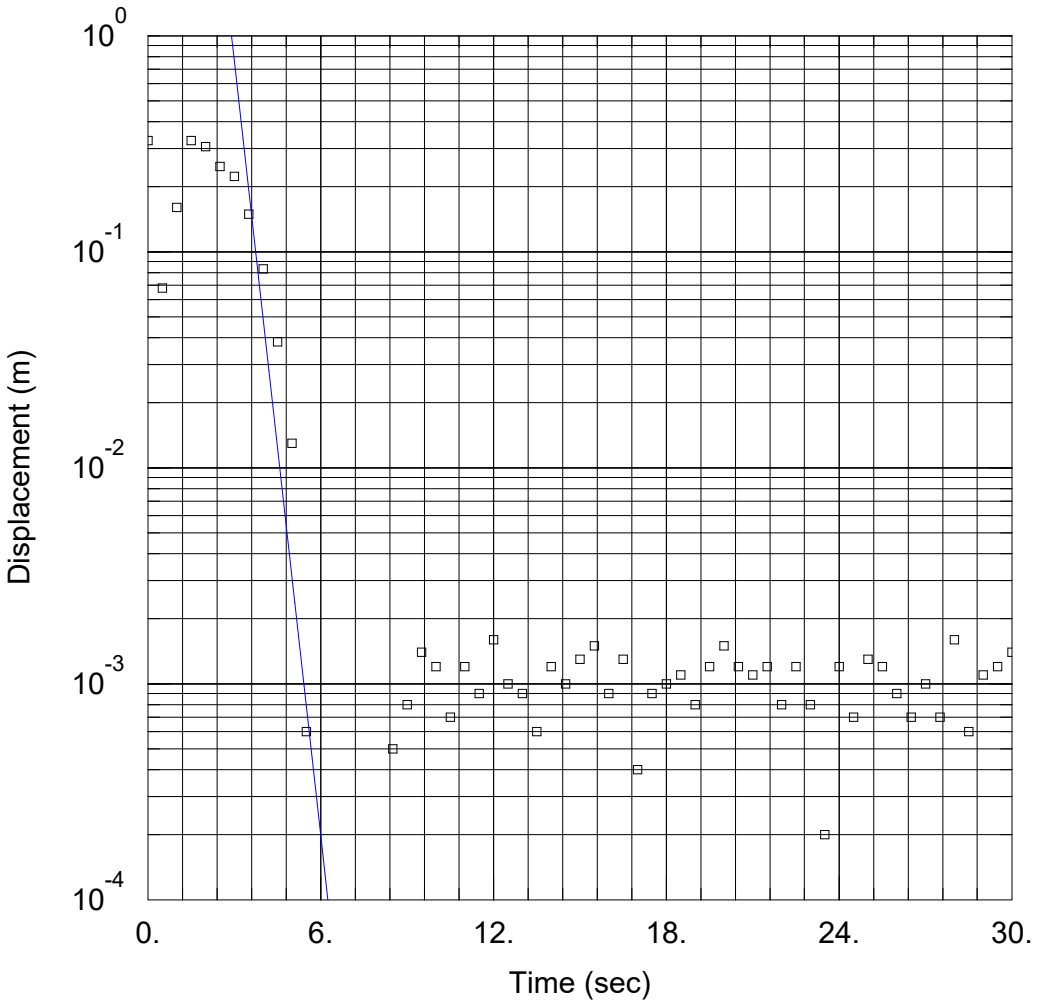
Saturated Thickness: 17.2 m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (TW 2)

Initial Displacement: 0.5755 m
Static Water Column Height: 7.75 m
Total Well Penetration Depth: 8.84 m
Screen Length: 3.05 m
Casing Radius: 0.0254 m
Well Radius: 0.0254 m
Gravel Pack Porosity: 0.

Arnott Sand and Gravel - Below Water Excavation

Prepared By:	Prepared For:
GRI	Arnott Sand and Gravel
Project:	**Location:**
21-022	Highland Road



SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev

K = 0.0007321 m/sec y0 = 2932.1 m

AQUIFER DATA

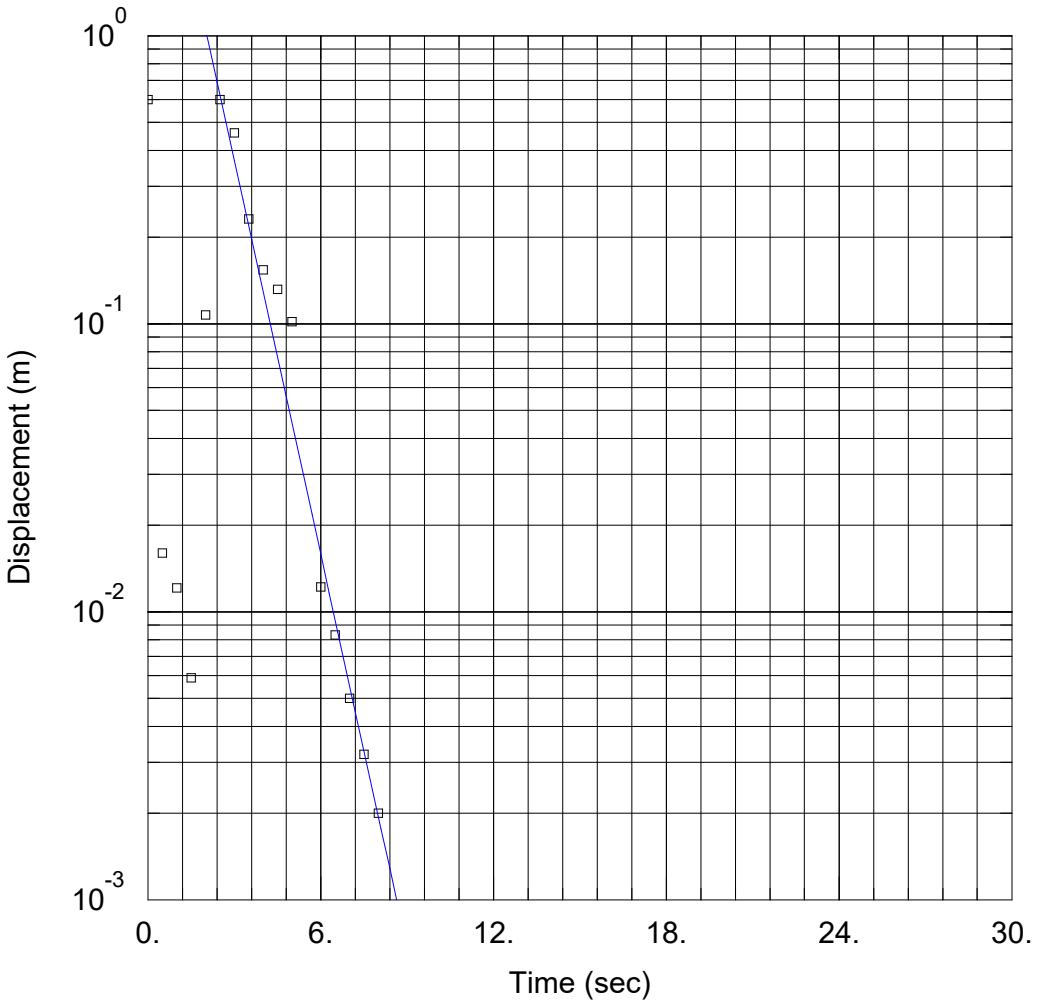
Saturated Thickness: 17.2 m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (TW 2)

Initial Displacement: 0.3272 m
Static Water Column Height: 7.75 m
Total Well Penetration Depth: 8.84 m
Screen Length: 3.05 m
Casing Radius: 0.0254 m
Well Radius: 0.0254 m
Gravel Pack Porosity: 0.

Arnott Sand and Gravel - Below Water Excavation

Prepared By:	Prepared For:
GRI	Arnott Sand and Gravel
Project:	**Location:**
21-022	Highland Road



SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev

K = 0.0002787 m/sec y0 = 8.546 m

AQUIFER DATA

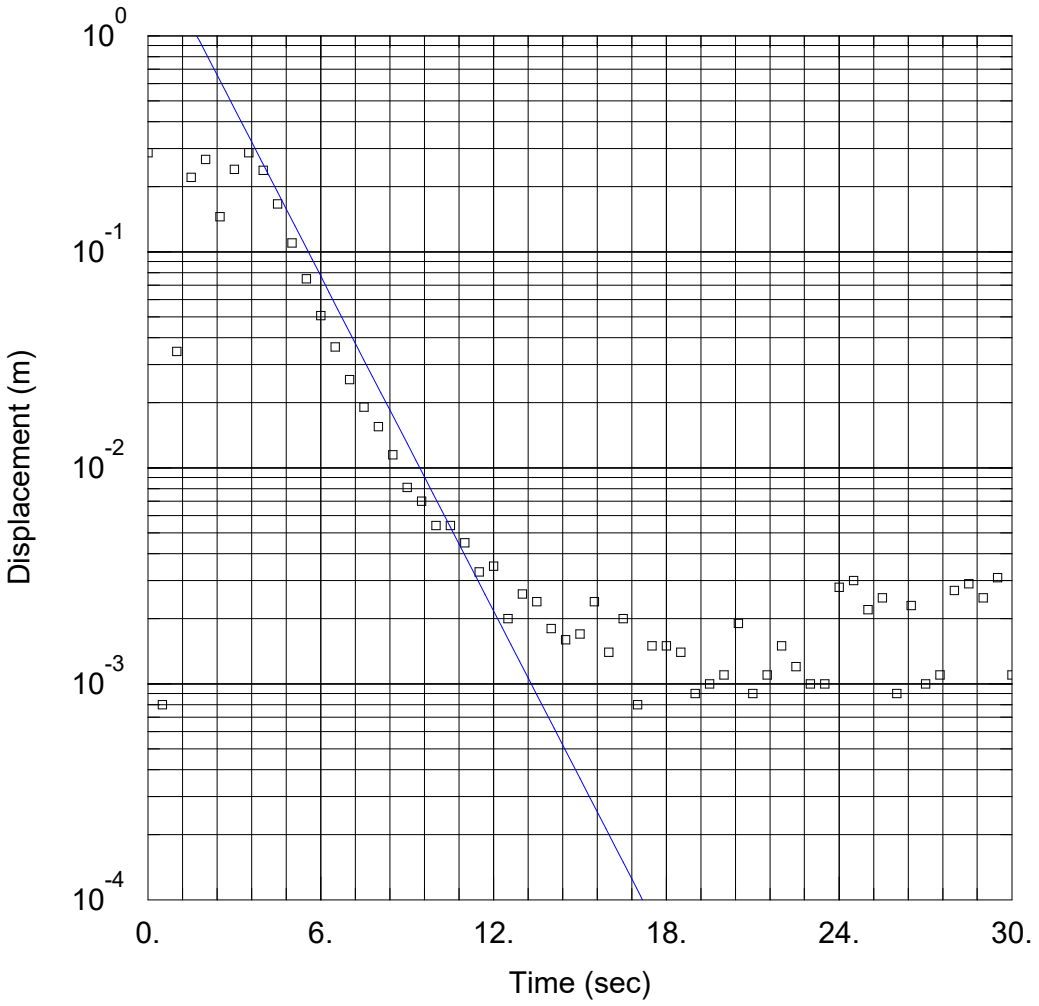
Saturated Thickness: 15.78 m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (TW 3)

Initial Displacement: 0.5998 m
Static Water Column Height: 6.82 m
Total Well Penetration Depth: 9.15 m
Screen Length: 3.05 m
Casing Radius: 0.0254 m
Well Radius: 0.0254 m
Gravel Pack Porosity: 0.

Arnott Sand and Gravel - Below Water Excavation

Prepared By:	Prepared For:
GRI	Arnott Sand and Gravel
Project:	**Location:**
21-022	Highland Road



SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev

K = 0.0001583 m/sec y0 = 2.747 m

AQUIFER DATA

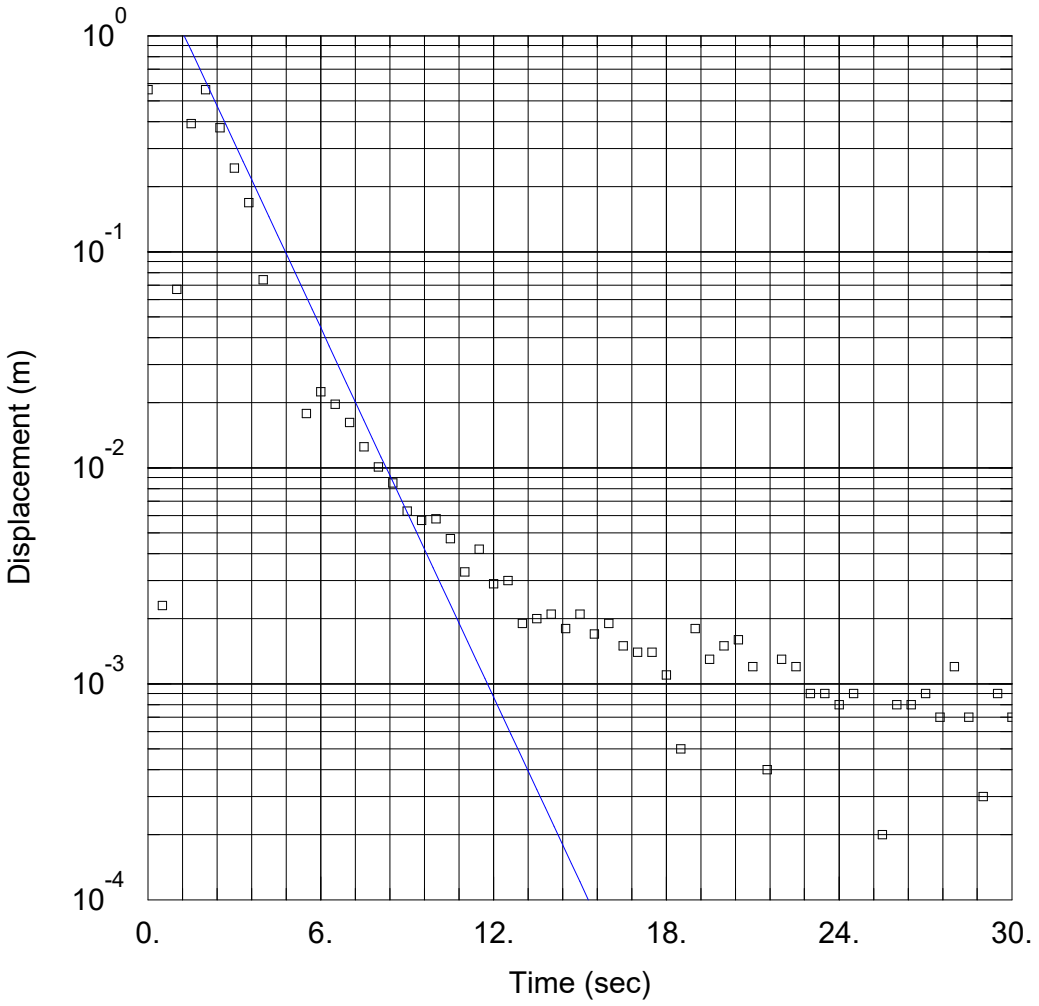
Saturated Thickness: 15.78 m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (TW 3)

Initial Displacement: 0.2875 m
Static Water Column Height: 6.63 m
Total Well Penetration Depth: 9.15 m
Screen Length: 3.05 m
Casing Radius: 0.0254 m
Well Radius: 0.0254 m
Gravel Pack Porosity: 0.

Arnott Sand and Gravel - Below Water Excavation

Prepared By:	Prepared For:
GRI	Arnott Sand and Gravel
Project:	**Location:**
21-022	Highland Road



SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev

K = 0.0001746 m/sec y0 = 2.289 m

AQUIFER DATA

Saturated Thickness: 15.78 m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (TW 3)

Initial Displacement: 0.5622 m
Static Water Column Height: 6.63 m
Total Well Penetration Depth: 9.15 m
Screen Length: 3.05 m
Casing Radius: 0.0254 m
Well Radius: 0.0254 m
Gravel Pack Porosity: 0.

Appendix D

Laboratory Reports

Certificate of Analysis

Client: GRI Inc.
R.R. #1
Oxford Mills, ON
K0G 1S0
Attention: Mr. George Gorrell
PO#:
Invoice to: GRI Inc.

Report Number: 1944180
Date Submitted: 2020-12-03
Date Reported: 2020-12-10
Project: 21-022
COC #: 211448

Dear George Gorrell:

Please find attached the analytical results for your samples. If you have any questions regarding this report, please do not hesitate to call (613-727-5692).

Report Comments:

APPROVAL: Addrine Thomas 2020.12.10 10:34:00 -05'00'

Addrine Thomas, Inorganics Supervisor

All analysis is completed at Eurofins Environment Testing Canada Inc. (Ottawa, Ontario) unless otherwise indicated.

Eurofins Environment Testing Canada Inc. (Ottawa, Ontario) is accredited by CALA, Canadian Association for Laboratory Accreditation to ISO/IEC 17025 for tests which appear on the scope of accreditation. The scope is available at: http://www.cala.ca/scopes/2602.pdf.

Eurofins Environment Testing Canada Inc. (Ottawa, Ontario) is licensed by the Ontario Ministry of the Environment, Conservation, and Parks (MECP) for specific tests in drinking water (license #2318). A copy of the license is available upon request.

Eurofins Environment Testing Canada Inc. (Ottawa, Ontario) is accredited by the Ontario Ministry of Agriculture, Food, and Rural Affairs for specific tests in agricultural soils.

Please note: Field data, where presented on the report, has been provided by the client and is presented for informational purposes only. Guideline values listed on this report are provided for ease of use (informational purposes) only. Eurofins recommends consulting the official provincial or federal guideline as required. Unless otherwise stated, measurement uncertainty is not taken into account when determining guideline or regulatory exceedances.

eurofins | Environment Testing

Certificate of Analysis

Client: GRI Inc.
R.R. #1
Oxford Mills, ON
K0G 1S0
Attention: Mr. George Gorrell
PO#:
Invoice to: GRI Inc.

Report Number: 1944180
Date Submitted: 2020-12-03
Date Reported: 2020-12-10
Project: 21-022
COC #: 211448

Group	Analyte	MRL	Units	Guideline	Lab I.D. / Sample Matrix / Sample Type / Sampling Date / Sample I.D.		
					1532529 Water 2020-12-03 TW1	1532530 Water 2020-12-03 TW2	1532531 Water 2020-12-03 TW3
Anions	Cl	1	mg/L		67	22	83
	F	0.10	mg/L		0.19	<0.10	<0.10
	N-NO3	0.10	mg/L		0.18	0.57	1.95
	SO4	1	mg/L		14	13	45
General Chemistry	Alkalinity as CaCO3	5	mg/L		245	236	274
	Conductivity	5	uS/cm		655	499	811
	pH	1.00			8.33	8.20	8.27
Hardness	Hardness as CaCO3	1	mg/L		319	277	271
Indices/Calc	Ion Balance	0.01			1.03	1.03	0.98
Metals	Ag	0.0001	mg/L		<0.0001	<0.0001	<0.0001
	As	0.001	mg/L		<0.001	<0.001	<0.001
	B	0.01	mg/L		0.07	0.01	0.03
	Ba	0.01	mg/L		0.11	0.21	0.10
	Be	0.0005	mg/L		<0.0005	<0.0005	<0.0005
	Ca	1	mg/L		70	78	77
	Cd	0.0001	mg/L		<0.0001	<0.0001	<0.0001
	Co	0.0002	mg/L		0.0034	0.0007	<0.0002
	Cr	0.001	mg/L		<0.001	<0.001	<0.001
	Cu	0.001	mg/L		0.002	<0.001	0.002
	Fe	0.03	mg/L		<0.03	<0.03	<0.03
	K	1	mg/L		4	2	3
	Mg	1	mg/L		35	20	19
	Mn	0.01	mg/L		0.07	0.02	<0.01
	Mo	0.005	mg/L		0.016	<0.005	0.018
	Na	2	mg/L		19	5	75

Guideline = *** = Guideline Exceedence**

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Certificate of Analysis

eurofins | Environment Testing

Client: GRI Inc.
R.R. #1
Oxford Mills, ON
K0G 1S0
Attention: Mr. George Gorrell
PO#:
Invoice to: GRI Inc.

Report Number: 1944180
Date Submitted: 2020-12-03
Date Reported: 2020-12-10
Project: 21-022
COC #: 211448

Group	Analyte	MRL	Units	Guideline	Lab I.D. Sample Matrix Sample Type Sampling Date Sample I.D.	1532529 Water 2020-12-03 TW1	1532530 Water 2020-12-03 TW2	1532531 Water 2020-12-03 TW3
Metals	Ni	0.005	mg/L			<0.005	<0.005	<0.005
	Pb	0.001	mg/L			<0.001	<0.001	<0.001
	Sb	0.0005	mg/L			<0.0005	<0.0005	<0.0005
	Se	0.001	mg/L			<0.001	<0.001	<0.001
	Tl	0.0001	mg/L			<0.0001	<0.0001	<0.0001
	U	0.001	mg/L			<0.001	<0.001	<0.001
	V	0.001	mg/L			<0.001	<0.001	<0.001
	Zn	0.01	mg/L			<0.01	<0.01	<0.01

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Project: 21-022
COC #: 211448

QC Summary

Analyte	Blank	QC % Rec	QC Limits
Run No 393435 **Analysis/Extraction Date** 2020-12-04 **Analyst** H D **Method** EPA 200.8			
Silver	<0.0001 mg/L	101	80-120
Arsenic	<0.001 mg/L	92	80-120
Boron (total)	<0.01 mg/L	94	80-120
Barium	<0.01 mg/L	94	80-120
Beryllium	<0.0005 mg/L	103	80-120
Cadmium	<0.0001 mg/L	99	80-120
Cobalt	<0.0002 mg/L	96	80-120
Chromium Total	<0.001 mg/L	99	80-120
Copper	<0.001 mg/L	103	80-120
Iron	<0.03 mg/L	91	80-120
Manganese	<0.01 mg/L	94	80-120
Molybdenum	<0.005 mg/L	86	80-120
Nickel	<0.005 mg/L	103	80-120
Lead	<0.001 mg/L	94	80-120
Antimony	<0.0005 mg/L	81	80-120
Selenium	<0.001 mg/L	94	80-120

Guideline = *** = Guideline Exceedence**

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QC Summary

Analyte	Blank	QC % Rec	QC Limits
Thallium	<0.0001 mg/L	93	80-120
Uranium	<0.001 mg/L	85	80-120
Vanadium	<0.001 mg/L	95	80-120
Zinc	<0.01 mg/L	105	80-120
Run No 393500 **Analysis/Extraction Date** 2020-12-08 **Analyst** QT **Method** SM2320,2510,4500H/F			
Alkalinity (CaCO3)	<5 mg/L	103	90-110
Conductivity	<5 uS/cm	99	90-110
F	<0.10 mg/L	100	90-110
pH		102	90-110
Run No 393505 **Analysis/Extraction Date** 2020-12-08 **Analyst** Z S **Method** M SM3120B-3500C			
Calcium	<1 mg/L	104	90-110
Potassium	<1 mg/L	101	87-113
Magnesium	<1 mg/L	101	76-124
Sodium	<2 mg/L	105	82-118
Run No 393649 **Analysis/Extraction Date** 2020-12-10 **Analyst** SKH **Method** SM 4110			
Chloride	<1 mg/L	100	90-110

Guideline = *** = Guideline Exceedence**

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Report Number: 1944180
Date Submitted: 2020-12-03
Date Reported: 2020-12-10
Project: 21-022
COC #: 211448

QC Summary

Analyte	Blank	QC % Rec	QC Limits
N-NO3	<0.10 mg/L	104	90-110
SO4	<1 mg/L	100	90-110
Run No 393657 **Analysis/Extraction Date** 2020-12-10 **Analyst** AET **Method** C SM2340B			
Hardness as CaCO3			
Ion Balance			

Guideline = *** = Guideline Exceedence**

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eurofins 211448

STANDARD CHAIN-OF-CUSTODY

146 Colonnade Road, Unit #8, Ottawa, ON, K2E 7Y1 - Phone: 613-727-5692, Fax: 613-727-5222

Eurofins Workorder #: 1904180

CLIENT INFORMATION

Company: GRI Inc
Contact: George Gornell
Address: 911 County Rd 18
Telephone: 647 502 5224 Cell:
Email: #1: george.gornell@gri-inc.ca
Email: #2:
Project: 21-022 Quote #: 190843

INVOICE INFORMATION (SAME AS CLIENT INFORMATION: YES ☐ NO ☐)

Company: Fax:
Contact: Email: #1:
Address: Email: #2:
Telephone: PO #:

TURN-AROUND TIME (Business Days)

☐ 1 Day* (100%) ☐ 2 Day** (50%) ☐ 3-5 Days (25%) ☑ 5-7 Days (Standard)

Please contact Lab in advance to determine rush availability.
*For results reported after rush due date, surcharges will apply: before 12:00 - 100%, after 12:00 - 50%.
**For results reported after rush due date, surcharges will apply: before 12:00 - 50%, after 12:00 - 25%.

REGULATION/GUIDELINE REQUIRED

☐ Sanitary Sewer, City:
☐ Storm Sewer, City:
☐ ODWSOG
☐ PWQO
☐ O. Reg 347/558
☐ Other:
☑ None

☐ O. Reg 153
Table # ___, Course / Fine, Surface / subsurface.
Type: Com-Ind / Res-Park / Agri / GW / All Other / Sediment
☐ Excess Soil, Table: Type:

The sample results from this submission will form part of a formal Record of Site Condition (RSC) under O.Reg. 153/04
☐ Yes ☐ No

The optimal temperature conditions during transport should be less than 10°C. Sample(s) cannot be frozen, unless otherwise indicated or agreed upon with the Laboratory. Note that this COC is not to be used for drinking water samples. The COC must be complete upon submission of the samples, there will be a $25 surcharge if required information is missing (required fields are shaded in grey).

Sample ID	Date/Time Collected	Sample Matrix	# of Containers	O.Reg.153 parameters: PHC F1 - F4	BTEX	VOCs	PAHs	PCBs	Metals + Inorganics	Metals only	general	metals 5007	RN# (Lab Use Only)
TW1	12/3/20 10:27	W	2								X	X	1532529
TW2	12/3/20 11:51	W	2								X	X	30
TW3	12/3/20 12:49	W	2								X	X	31

	PRINT	SIGN	DATE/TIME	TEMP (°C)
Sampled By:	George Gornell		12/3/20	
Relinquished By:	George Gornell		12/3/20 1427	11.1
Received By:				

COMMENTS:

CUSTODY SEAL: ☐ YES ☐ NO Ice packs submitted: ☐ Yes ☐ No

Certificate of Analysis

eurofins | Environment Testing

Client: GRI Inc.
R.R. #1
Oxford Mills, ON
K0G 1S0
Attention: Mr. George Gorrell
PO#:
Invoice to: GRI Inc.

Report Number: 1946164
Date Submitted: 2021-01-12
Date Reported: 2021-01-19
Project: 21-022
COC #: 212159

Dear George Gorrell:

Please find attached the analytical results for your samples. If you have any questions regarding this report, please do not hesitate to call (613-727-5692).

Report Comments:

Charlie Long Qu 2021.01.19 13:39:00 -05'00'

APPROVAL: _____
Long Qu, Organics Supervisor

All analysis is completed at Eurofins Environment Testing Canada Inc. (Ottawa, Ontario) unless otherwise indicated.

Eurofins Environment Testing Canada Inc. (Ottawa, Ontario) is accredited by CALA, Canadian Association for Laboratory Accreditation to ISO/IEC 17025 for tests which appear on the scope of accreditation. The scope is available at: http://www.cala.ca/scopes/2602.pdf.

Eurofins Environment Testing Canada Inc. (Ottawa, Ontario) is licensed by the Ontario Ministry of the Environment, Conservation, and Parks (MECP) for specific tests in drinking water (license #2318). A copy of the license is available upon request.

Eurofins Environment Testing Canada Inc. (Ottawa, Ontario) is accredited by the Ontario Ministry of Agriculture, Food, and Rural Affairs for specific tests in agricultural soils.

Please note: Field data, where presented on the report, has been provided by the client and is presented for informational purposes only. Guideline values listed on this report are provided for ease of use (informational purposes) only. Eurofins recommends consulting the official provincial or federal guideline as required. Unless otherwise stated, measurement uncertainty is not taken into account when determining guideline or regulatory exceedances.

Certificate of Analysis

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Client: GRI Inc.
R.R. #1
Oxford Mills, ON
K0G 1S0
Attention: Mr. George Gorrell
PO#:
Invoice to: GRI Inc.

Report Number: 1946164
Date Submitted: 2021-01-12
Date Reported: 2021-01-19
Project: 21-022
COC #: 212159

Group	Analyte	MRL	Units	Guideline	Lab I.D. Sample Matrix Sample Type Sampling Date Sample I.D.	1537850 Water 2021-01-11 TW1	1537851 Water 2021-01-11 TW2	1537852 Water 2021-01-11 TW3
Anions	Cl	1	mg/L			18	20	111
	F	0.10	mg/L			0.18	<0.10	<0.10
	N-NO2	0.10	mg/L			<0.10	<0.10	<0.10
	N-NO3	0.10	mg/L			<0.10	0.64	3.19
	SO4	1	mg/L			24	16	24
General Chemistry	Alkalinity as CaCO3	5	mg/L			203	226	284
	Conductivity	5	uS/cm			470	506	927
	pH	1.00				8.33	8.18	8.18
	TDS (COND - CALC)	1	mg/L			306	329	603
	Total Suspended Solids	2	mg/L			<2	2	<2
Hardness	Hardness as CaCO3	1	mg/L			219	276	383
Hydrocarbons	F1 (C6-C10)	20	ug/L			<20	<20	<20
	F1-BTEX (C6-C10)	20	ug/L			<20	<20	<20
	F2 (C10-C16)	20	ug/L			<20	<20	<20
	F3 (C16-C34)	50	ug/L			<50	<50	<50
	F4 (C34-C50)	50	ug/L			<50	<50	<50
Indices/Calc	Ion Balance	0.01				1.03	1.06	1.03
Metals	Ag	0.0001	mg/L			<0.0001	<0.0001	<0.0001
	B	0.01	mg/L			0.04	0.01	0.03
	Ba	0.01	mg/L			0.09	0.25	0.19
	Be	0.0005	mg/L			<0.0005	<0.0005	<0.0005
	Ca	1	mg/L			53	81	112
	Cd	0.0001	mg/L			<0.0001	<0.0001	<0.0001
	Cr	0.001	mg/L			<0.001	<0.001	<0.001
	Cu	0.001	mg/L			<0.001	<0.001	<0.001

Guideline = *** = Guideline Exceedence**

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Certificate of Analysis

eurofins | Environment Testing

Client: GRI Inc.
R.R. #1
Oxford Mills, ON
K0G 1S0
Attention: Mr. George Gorrell
PO#:
Invoice to: GRI Inc.

Report Number: 1946164
Date Submitted: 2021-01-12
Date Reported: 2021-01-19
Project: 21-022
COC #: 212159

Group	Analyte	MRL	Units	Guideline	Lab I.D. Sample Matrix Sample Type Sampling Date Sample I.D.	1537850 Water 2021-01-11 TW1	1537851 Water 2021-01-11 TW2	1537852 Water 2021-01-11 TW3
Metals	Fe	0.03	mg/L			<0.03	<0.03	<0.03
	K	1	mg/L			2	2	2
	Mg	1	mg/L			21	18	25
	Mn	0.01	mg/L			0.06	0.01	<0.01
	Mo	0.005	mg/L			0.010	<0.005	<0.005
	Na	2	mg/L			19	5	50
	Ni	0.005	mg/L			<0.005	<0.005	<0.005
	Pb	0.001	mg/L			<0.001	<0.001	<0.001
	Si	0.1	mg/L			4.8	4.4	5.4
	Sr	0.001	mg/L			0.122	0.139	0.175
	Tl	0.0001	mg/L			<0.0001	<0.0001	<0.0001
	V	0.001	mg/L			<0.001	<0.001	<0.001
	Zn	0.01	mg/L			<0.01	<0.01	<0.01
Nutrients	N-NH3	0.010	mg/L			<0.010	<0.010	<0.010
	Total Kjeldahl Nitrogen	0.100	mg/L			0.280	0.131	0.453
	Total P	0.020	mg/L			<0.020	<0.020	<0.020
PHC Surrogate	Alpha-androstrane	0	%			77	74	79
Subcontract-Inorg	Phenols	0.001	mg/L			<0.001	<0.001	<0.001
VOCs Surrogates	Toluene-d8	0	%			100	102	99
Volatiles	Benzene	0.5	ug/L			<0.5	<0.5	<0.5
	Ethylbenzene	0.5	ug/L			<0.5	<0.5	<0.5
	m/p-xylene	0.4	ug/L			<0.4	<0.4	<0.4
	o-xylene	0.4	ug/L			<0.4	<0.4	<0.4
	Toluene	0.5	ug/L			<0.5	<0.5	<0.5
	Xylene; total	0.5	ug/L			<0.5	<0.5	<0.5

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Date Submitted: 2021-01-12
Date Reported: 2021-01-19
Project: 21-022
COC #: 212159

QC Summary

Analyte	Blank	QC % Rec	QC Limits
Run No 395019 **Analysis/Extraction Date** 2021-01-13 **Analyst** AET **Method** SM2320,2510,4500H/F			
Alkalinity (CaCO3)	<5 mg/L	100	90-110
Conductivity	<5 uS/cm	97	90-110
F	<0.10 mg/L	102	90-110
pH		101	90-110
Run No 395039 **Analysis/Extraction Date** 2021-01-14 **Analyst** C M **Method** CCME O.Reg 153/04			
Petroleum Hydrocarbons F2	<20 ug/L	88	60-140
Petroleum Hydrocarbons F3	<50 ug/L	88	60-140
Petroleum Hydrocarbons F4	<50 ug/L	88	60-140
Run No 395048 **Analysis/Extraction Date** 2021-01-14 **Analyst** SKH **Method** EPA 350.1			
N-NH3	<0.010 mg/L	104	80-120
Run No 395057 **Analysis/Extraction Date** 2021-01-14 **Analyst** SKH **Method** EPA 351.2			
Total Kjeldahl Nitrogen	<0.100 mg/L	93	70-130
Run No 395060 **Analysis/Extraction Date** 2021-01-14 **Analyst** Z S **Method** M SM3120B-3500C			

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QC Summary

Analyte	Blank	QC % Rec	QC Limits
Calcium	<1 mg/L	102	90-110
Potassium	<1 mg/L	95	87-113
Magnesium	<1 mg/L	100	76-124
Sodium	<2 mg/L	96	82-118
Run No 395064 **Analysis/Extraction Date** 2021-01-14 **Analyst** H D **Method** EPA 200.8			
Silver	<0.0001 mg/L	110	80-120
Boron (total)	<0.01 mg/L	98	80-120
Barium	<0.01 mg/L	100	80-120
Beryllium	<0.0005 mg/L	105	80-120
Cadmium	<0.0001 mg/L	109	80-120
Chromium Total	<0.001 mg/L	108	80-120
Copper	<0.001 mg/L	109	80-120
Iron	<0.03 mg/L	95	80-120
Manganese	<0.01 mg/L	109	80-120
Molybdenum	<0.005 mg/L	97	80-120
Nickel	<0.005 mg/L	109	80-120
Lead	<0.001 mg/L	106	80-120

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Date Reported: 2021-01-19
Project: 21-022
COC #: 212159

QC Summary

Analyte	Blank	QC % Rec	QC Limits
Silicon	<0.1 mg/L	100	80-120
Strontium	<0.001 mg/L	104	80-120
Thallium	<0.0001 mg/L	102	80-120
Vanadium	<0.001 mg/L	104	80-120
Zinc	<0.01 mg/L	111	80-120
Run No 395091 **Analysis/Extraction Date** 2021-01-14 **Analyst** AET **Method** SUBCONTRACT P-INORG			
Phenols	<0.001 mg/L	76	69-132
Run No 395105 **Analysis/Extraction Date** 2021-01-15 **Analyst** SKH **Method** SM 4110			
Chloride	<1 mg/L	100	90-110
N-NO2	<0.10 mg/L	104	90-110
N-NO3	<0.10 mg/L	104	90-110
SO4	<1 mg/L	100	90-110
Run No 395135 **Analysis/Extraction Date** 2021-01-15 **Analyst** SKH **Method** SM 4110			
Chloride	<1 mg/L	100	90-110
Run No 395167 **Analysis/Extraction Date** 2021-01-18 **Analyst** SKH **Method** EPA 365.1			

Guideline = *** = Guideline Exceedence**

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Date Reported: 2021-01-19
Project: 21-022
COC #: 212159

QC Summary

Analyte	Blank	QC % Rec	QC Limits
Total P	<0.020 mg/L	95	80-120
Run No 395180 **Analysis/Extraction Date** 2021-01-18 **Analyst** SKH **Method** C SM2340B			
Hardness as CaCO3			
Ion Balance			
TDS (COND - CALC)			
Run No 395196 **Analysis/Extraction Date** 2021-01-19 **Analyst** SKH **Method** C SM2540			
Total Suspended Solids	<2 mg/L	100	90-110
Run No 395209 **Analysis/Extraction Date** 2021-01-19 **Analyst** YH **Method** CCME O.Reg 153/04			
Petroleum Hydrocarbons F1	<20 ug/L	95	60-140
Run No 395222 **Analysis/Extraction Date** 2021-01-18 **Analyst** YH **Method** EPA 8260			
Benzene	<0.5 ug/L	116	60-130
Ethylbenzene	<0.5 ug/L	91	60-130
m/p-xylene	<0.4 ug/L	88	60-130
o-xylene	<0.4 ug/L	103	60-130
Toluene	<0.5 ug/L	90	60-130

Guideline = *** = Guideline Exceedence**

Results relate only to the parameters tested on the samples submitted.
Methods references and/or additional QA/QC information available on request.

MRL = Method Reporting Limit, AO = Aesthetic Objective, OG = Operational Guideline, MAC = Maximum Acceptable Concentration, IMAC = Interim Maximum Acceptable Concentration, STD = Standard, PWQO = Provincial Water Quality Guideline, IPWQO = Interim Provincial Water Quality Objective, TDR = Typical Desired Range

Certificate of Analysis

eurofins | Environment Testing

Client: GRI Inc.
R.R. #1
Oxford Mills, ON
K0G 1S0
Attention: Mr. George Gorrell
PO#:
Invoice to: GRI Inc.

Report Number: 1946164
Date Submitted: 2021-01-12
Date Reported: 2021-01-19
Project: 21-022
COC #: 212159

QC Summary

Analyte	Blank	QC % Rec	QC Limits
Run No 395223 **Analysis/Extraction Date** 2021-01-19 **Analyst** YH **Method** EPA 8260			
Xylene Mixture			
Run No 395224 **Analysis/Extraction Date** 2021-01-19 **Analyst** YH **Method** CCME O.Reg 153/04			
Petroleum Hydrocarbons F1-BTEX			

Guideline = *** = Guideline Exceedence**

Results relate only to the parameters tested on the samples submitted.
Methods references and/or additional QA/QC information available on request.

MRL = Method Reporting Limit, AO = Aesthetic Objective, OG = Operational Guideline, MAC = Maximum Acceptable Concentration, IMAC = Interim Maximum Acceptable Concentration, STD = Standard, PWQO = Provincial Water Quality Guideline, IPWQO = Interim Provincial Water Quality Objective, TDR = Typical Desired Range

eurofins 212159

STANDARD CHAIN-OF-CUSTODY

146 Colonnade Road, Unit #8, Ottawa, ON, K2E 7Y1 - Phone: 613-727-5692, Fax: 613-727-5222

Eurofins Workorder #: 1946164

CLIENT INFORMATION

Company: GRI Inc

Contact: George Gorrell

Address: 911 County Rd 18 Oxford Mills

Telephone: 613 2582954 Cell: 647 5025224

Email: #1: george.gorrell@gri-inc.ca

Email: #2:

Project: 21-022 Quote #: 190938

INVOICE INFORMATION (SAME AS CLIENT INFORMATION: YES ☒ NO ☐)

Company: Fax:

Contact: Email: #1:

Address: Email: #2:

Telephone: PO #:

TURN-AROUND TIME (Business Days)

☐ 1 Day* (100%) ☐ 2 Day** (50%) ☐ 3-5 Days (25%) ☒ 5-7 Days (Standard)

Please contact Lab in advance to determine rush availability.

*For results reported after rush due date, surcharges will apply: before 12:00 - 100%, after 12:00 - 50%.

**For results reported after rush due date, surcharges will apply: before 12:00 - 50%, after 12:00 - 25%.

REGULATION/GUIDELINE REQUIRED

☐ Sanitary Sewer, City:

☐ Storm Sewer, City:

☐ ODWSOG

☐ PWQO

☐ O. Reg 347/558

☐ Other:

☐ None

☐ O. Reg 153

Table # ___, Course / Fine, Surface / subsurface.

Type: Com-Ind / Res-Park / Agri / GW / All Other / Sediment

☐ Excess Soil, Table: Type:

The sample results from this submission will form part of a formal Record of Site Condition (RSC) under O.Reg. 153/04

☐ Yes ☐ No

The optimal temperature conditions during transport should be less than 10°C. Sample(s) cannot be frozen, unless otherwise indicated or agreed upon with the Laboratory. Note that this COC is not to be used for drinking water samples. The COC must be complete upon submission of the samples, there will be a $25 surcharge if required information is missing (required fields are shaded in grey).

Sample Details										Sample Analysis Required									RN# (Lab Use Only)
Field Filtered -->			O.Reg.153 parameters																
Sample ID	Date/Time Collected	Sample Matrix	# of Containers	PHC F1 - F4	BTEX	VOCs	PAHs	PCBs	Metals + Inorganics	Metals only	BTEX F1 - F4	VOC	TDS	NO2	TKN	NH3	Phen-15		
Tw1	01/11/21 1409										X	X	X	X	X	X	X		1537850
Tw2	01/11/21 1342										X	X	X	X	X	X	X		51
Tw3	01/11/21 1334										X	X	X	X	X	X	X		52

	PRINT	SIGN	DATE/TIME	TEMP (°C)
Sampled By:	George Gorrell		01/11/20 13-14:7	
Relinquished By:	George Gorrell		01/12/20 11:46	13.5
Received By:				

COMMENTS:

CUSTODY SEAL: ☐ YES ☐ NO Ice packs submitted: ☐ Yes ☐ No

401 Magnetic Drive, Unit #1, North York, ON, M3J 3H9 - Telephone: 416-661-5287 • 380 Vansickle Road, Unit #630, St. Catharines, ON, L2S 0B5 - Telephone: 905-680-8887 • 608 Norris Court, Kingston, ON, K7P 2R9 - Telephone: 613-634-9307

STAGE 2 ARCHAEOLOGICAL ASSESSMENT FOR THE PROPOSED ARNOTT BROS. McKINNON PIT EXPANSION PART LOT 5, CONCESSION 10 GEOGRAPHIC TOWNSHIP OF DALHOUSIE NOW TOWNSHIP OF LANARK HIGHLANDS COUNTY OF LANARK

Past Recovery
Archaeological Services Inc.

STAGE 2 ARCHAEOLOGICAL ASSESSMENT FOR THE PROPOSED ARNOTT BROS. McKINNON PIT EXPANSION, PART LOT 5, CONCESSION 10, GEOGRAPHIC TOWNSHIP OF DALHOUSIE, NOW TOWNSHIP OF LANARK HIGHLANDS, COUNTY OF LANARK

Prepared for:

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and

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Re: *Aggregate Resources Act (Ontario)*

Prepared by:

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Project No.: PR21-014

Licensee: Stephanie Cleland, M.A., Licence P1201
Past Recovery Archaeological Services Inc.

P.I.F. No.: P1201-0085-2021

Date: January 30th, 2022 Original Report

ACKNOWLEDGMENTS

Mr. Gary McLaren, Milestone Aggregate Consulting Services Inc., provided assistance with background information, mapping and coordinating access to the property.

PROJECT PERSONNEL

Project Manager	Jeff Earl, M.Soc.Sc.
Licence Holder	Stephanie Cleland, M.A. (P1201)
Field Director	Liam Bowman (R1272)
Stage 2 Field Crew	Jeff Earl Adam Pollock, M.A. (P336) Nick Edwards, B.A. Trevor Hockney, B.A. Gabby Kurtzrock Belyea, M.A. (R1195) Sara Lavinge, M.A. James Doherty Morgan Ward, B.A. James Liam McGeer, B.A. (R1268)
GIS/Drafting	Adam Pollock James Liam McGeer
Report Writing	James Liam McGeer
Report Review	Stephanie Cleland

EXECUTIVE SUMMARY

Past Recovery Archaeological Services Inc. (Past Recovery) was retained Milestone Aggregate Consulting Services Inc. on behalf of Arnott Brothers Construction Limited to undertake a Stage 2 archaeological assessment as part of an Application of Consent for a proposed expansion to the McKinnon Pit on Part Lot 5, Concession 10 in the geographic Township of Dalhousie, now within the Township of Lanark Highlands (see Maps 1 and 2).

The purpose of the Stage 2 investigation was to determine whether or not there were archaeological resources on the subject property, and if so to recommend an appropriate Stage 3 assessment strategy. In particular, a pre-Contact archaeological site (BfGd-3) had been registered on the adjacent Lot 6, Concession 10, less than 10 m from the study area. The Stage 2 property survey was completed over the course of two days on the 28th and 29th of June, 2021 by means of both a shovel test pit survey and pedestrian survey at 5 m intervals across all portions of the property determined to exhibit archaeological potential (see Map 5). This included field walking intensification at 1 m intervals within 20 m of site BfGd-3. No archaeological resources were found during the course of the survey.

This report forms the basis for the following recommendation:

1) It has been determined that the cultural heritage value or interest of the study area has been sufficiently documented through the Stage 2 research conducted to date, and no further archaeological assessment of the subject area as presently defined on Map 2 is required.

The following recommendation has been included as per a request from the Algonquins of Ontario:

2) Since the potential always exists to miss important information in archaeological surveys, if any artifacts of Indigenous interest or human remains are encountered during the development of the subject property, please contact: Algonquins of

Ontario Consultation Office, 31 Riverside Drive, Suite 101, Pembroke, ON, K8A 8R6; Tel: 613-735-3759; Fax: 613-735-6307; Email: algonquins@tanakiwin.com.

The reader is also referred to Section 7.0 below to ensure compliance with relevant provincial legislation as it may relate to this project.

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1.0 INTRODUCTION

Past Recovery Archaeological Services Inc. (Past Recovery) was retained by Milestone Aggregate Consulting Services Inc. on behalf of Arnott Bros. Construction Ltd. to undertake a Stage 2 archaeological assessment as part of an *Application for Consent* for the extension of the McKinnon Pit from Part Lot 6, Concession 10 and Part of Lot 6, Concession 11 onto Part Lot 5, Concession 10 in the geographic Township of Dalhousie, now within the Township of Lanark Highlands (Maps 1 and 2). The expansion will be confined to the section of the lot to the northwest of Highland Line and southwest of an existing wetland.

The objectives of a Stage 2 archaeological assessment are as follows:

- To document all archaeological resources on the property
- To determine whether the property contains archaeological resources requiring further assessment; and,
- In the even that an archaeological site requiring further assessment is discovered, to recommend an appropriate Stage 3 assessment strategy.

2.0 PROJECT CONTEXT

This section of the report provides the context for the archaeological work undertaken, including a description of the study area, the related legislation or directives triggering the assessment, and the confirmation of permission to access the property.

2.1 Property Description

This report addresses an approximately 6.26 hectare (15.47 acre) property located within Part Lot 5, Concession 10, in the Township of Lanark Highlands in Lanark County (see Maps 1 and 2). The study area was defined on the basis of project mapping supplied by Milestone Aggregate Consulting Services Inc. The property lies in the southern section of the Township of Lanark Highlands to the northwest of Perth, south of McDonald's Corners and approximately three kilometres south of Dalhousie Lake and the Mississippi River. A portion of the property consists of swampy land, drained by the Long Sault Creek. The remainder contains rolling till uplands, consisting of cleared former pasture and forested areas. The height of the esker within the property is such that a portion of the study area is steeply sloped, with some filling of the lower areas begun at the time of the assessment. A laneway extends through the property from Highland Line into the existing McKinnon Pit on the adjoining lot.

2.2 Development Context

An archaeological assessment was required under the *Aggregate Resources Act (Ontario)* as part of the pit expansion application. A Stage 1 assessment for the study area on Lot 5, Concession 10 was completed in 2006, which recommended Stage 2 assessment in the event of proposed disturbance (Adams Heritage 2006).

2.3 Access Permission

Permission to access the subject property and complete all aspects of the archaeological assessment including photography and artifact collection was granted by Arnott Brothers Construction Limited, the property owner.

2.4 Territorial Acknowledgement

The study area falls within the traditional territory of the Anishinaabeg and forms part of the Algonquins of Ontario (AOO) Settlement Area set out by the current Agreement-in-Principle between the AOO and the federal and provincial governments, signed in 2016.[1]

[1] The Agreement-In-Principle is between the Algonquins of Ontario and the Governments of Ontario and Canada. Algonquins have sought recognition and protection of their traditional territory dating back to

3.0 HISTORICAL CONTEXT

This section of the report includes an overview of human settlement in the region, as well as a review of available maps and written records, prepared with the intention of providing a context for the evaluation of known and potential archaeological sites.

3.1 Regional Pre-Contact Cultural Overview

While our understanding of the pre-Contact sequence of human activity in the region is limited, it is possible to provide a general outline of pre-Contact occupation based on archaeological, historical, and environmental research conducted across what is now eastern Ontario.[2] Archaeologists divide the long sequence of Indigenous occupation into both temporal periods and regional groups based primarily on the presence and/or style of various surviving artifact types within the archaeological record. While this provides a means of discussing the past, it is an archaeological construct and interpretation; it does not reflect the generally gradual nature of change over time, nor the complexities of interactions between different Indigenous groups. Archaeology is not a substitute for Indigenous world views and histories as detailed in the oral traditions of Indigenous communities who have long-standing relationships with the land. The following summary uses the generally accepted archaeological chronology for the pre-Contact period while recognizing its limitations.

Across the region, glaciers began to retreat around 15,000 years ago (Munson 2013:1). The earliest human occupation of Ontario began approximately 13,500 years before present (B.P.) with the arrival of small groups of hunter-gatherers referred to by archaeologists as Palaeo-Indians (Ellis 2013:35). These groups gradually moved northward as the glaciers and glacial lakes retreated. While very little is known about their lifestyle, it is likely that Palaeo-Indian groups travelled widely relying on the seasonal migration of caribou as well as small animals and wild plants for subsistence in a sub-arctic environment. They produced a variety of distinctive stone tools including fluted projectile points, scrapers, burins and gravers. Their sites are rare, and most are quite small (Ellis 2013:35-36). Palaeo-Indian peoples tended to camp along shorelines, and because of the changing environment, many of these areas are now inland. Indigenous settlement of much of eastern Ontario was late in comparison to other parts of Ontario as a result of the high-water levels associated with glacial Lake Algonquin, the early stages of glacial Lake Iroquois and the St. Lawrence Marine Embayment of the post-glacial Champlain Sea (Hough 1958:204). In eastern Ontario, the old shoreline ridges of

1772 and in 1983 the Algonquins of Pikwàkanagàn First Nation (previously Algonquins of Golden Lake) formally submitted a petition to the Government of Canada, and in 1985 to the Government of Ontario. The claim was accepted for negotiations in 1991 and 1992 and an Agreement-In-Principle was signed in 2016 and negotiations are on-going.

[2] Current common place names are used throughout this report while recognizing that the many Indigenous peoples who have lived in the region for thousands of years had, and often maintain, their own names for these places and natural features.

Lake Algonquin, Lake Iroquois, the Champlain Sea and of the emergent St. Lawrence and Ottawa river channels and their tributaries would be the most likely areas to find evidence of Palaeo-Indian occupation (Ellis 2013; Ellis and Deller 1990; Watson 1999).

During the succeeding Archaic period (c. 10,000 to c. 3,000 B.P.), the environment of the region approached modern conditions and more land became available for habitation as water levels in the glacial lakes dropped. Populations continued to follow a mobile hunter-gatherer subsistence strategy, although there appears to have been a greater reliance on fishing and gathered food (e.g. plants and nuts) and more diversity between regional groups. The tool kit became increasingly diversified with the introduction of ground stone tools and with a general reduction in the size of flaked stone projectile points. Both technological changes signal past adaptations to environmental conditions more similar to those of today. Tools made from ground stone included axes, adzes, gouges and other implements believed to have been used for the construction of dug-out canoes, grinding stones for processing nuts and seeds, and specialized net sinkers and plummets for fishing. A wide variety of non-utilitarian items such as gorgets, pipes and 'birdstones' were also manufactured from ground stone, and speak to ceremonialism in life and increasingly elaborate burial practices in death. The middle and late portions of the Archaic period saw the development of trading networks spanning the Great Lakes, and by 6,000 years ago copper was being mined in the Upper Great Lakes and traded into southern Ontario. By the end of this period populations had increased substantially over the preceding Palaeo-Indian occupation (Ellis 2013; Ellis et al. 1990).

More extensive Indigenous settlement of the Eastern Ontario region began during this period, sometime between 7,500 and 6,500 B.P. Artifacts from Archaic sites suggest a close relationship between these communities and what archaeologists refer to as the Laurentian Archaic stage peoples who occupied the Canadian biotic province transition zone between the deciduous forests to the south and the boreal forests to the north. This region included northern New York State, the upper St. Lawrence Valley across southern Ontario and Quebec, and the state of Vermont (Richie 1969; Clermont et al. 2003). The 'tradition' associated with this period is characterized by a more or less systematic sharing of several technological features, including large, broad-bladed, chipped stone and ground slate projectile points, and heavy ground stone tools. This stage is also known for the extensive use of cold-hammered copper tools including "*bevelled spear points, bracelets, pendants, axes, fishhooks and knives*" (Kennedy 1970:59). The sharing of this set of features is generally perceived as a marker of historical relatedness and inclusion in the same interaction network (Clermont et al. 2003). Cemeteries also appear for the first time during the Late Archaic. Evidence of Archaic occupation has been found across eastern Ontario (see Clermont 1999; Clermont et al. 2003; Ellis 2013; Kennedy 1962, 1970; Laliberté 2000; Watson 1990).

Archaeologists use the appearance of ceramics in the archaeological record to mark the beginning of the Woodland period (c. 3,000 B.P. to c. 350 B.P.). Ceramic styles and

decorations suggest the continued differentiation between regional populations and are commonly used to distinguish between three periods: Early Woodland (2,900 to 2,300 B.P.), Middle Woodland (2,300 to 1,200 B.P.), and Late Woodland (1,200 to 400 B.P.). The introduction of ceramics to southern Ontario does not appear to have been associated with significant changes to lifeways, as hunting and gathering remained the primary subsistence strategy throughout the Early Woodland and well into the Middle Woodland. It does, however, appear that regional populations continued to grow in size, and communities continued to participate in extensive trade networks that, at their zenith c. 1,750 B.P., spanned much of the continent and included the movement of conch shell, fossilized shark teeth, mica, copper and silver; a large number of other items that rarely survive in the archaeological record would also have been exchanged, as well as knowledge.[3] Social structure appears to have become increasingly complex, with some status differentiation evident in burials. In southeastern Ontario, the first peoples to adopt ceramics are identified by archaeologists as belonging to the Meadowood Complex, characterized by distinctive biface preforms, side-notched points, and Vinette I ceramics which are typically crude, thick, cone-shaped vessels made with coils of clay shaped by cord-wrapped paddles. Meadowood material has been found on sites across southern Ontario extending into southern Quebec and New York State (Fox 1990; Spence et al. 1990).

In the Middle Woodland period, increasingly distinctive trends or 'traditions' continued to evolve in different parts of Ontario (Spence et al. 1990). Although regional patterns are poorly understood and there may be distinctive traditions associated with different watersheds, the appearance of improved (thinner-walled and containing finer grit temper) ceramic vessels decorated with dentate or pseudo-scallop impressions have been used by archaeologists to distinguish the Point Peninsula Complex. These ceramics are identified as Vinette II and are typically found in association with evidence of distinct bone and stone tool industries. Sites exhibiting these traits are known from throughout south-central and eastern Ontario, northern New York, and northwestern Vermont, and are often found overlying earlier occupations. Some groups appear to have practiced elaborate burial ceremonialism that involved the construction of large earthen mortuary mounds and the inclusion of numerous and often exotic materials in burials, construed as evidence of influences from northern Ontario and the Hopewell area to the south in the Ohio River valley. Investigations of sites with occupations dating to this time period have allowed archaeologists to develop a better picture of the seasonal round followed in order to harvest a variety of resources within a home territory. Through the late fall and winter, small groups would occupy an inland 'family' hunting area. In the spring, these dispersed families congregated at specific lakeshore sites to fish, hunt in the surrounding forest and socialize. This gathering would last through to the late summer

[3] For example, the recent discovery of a cache of charred quinoa seeds, dating to 3,000 B.P. at a site in Brantford, Ontario, indicates that crops were part of this extensive exchange network, which in this case travelled from the Kentucky-Tennessee region of the United States. Thus far, there is no indication that these seeds were locally grown (Crawford et al. 2019).

when large quantities of food would be stored up for the approaching winter (Spence et al. 1990).

Towards the end of the Middle Woodland period (1200 B.P.), groups living in southern Ontario included horticulture in their subsistence strategy. Available archaeological evidence, which comes primarily from the vicinity of the Grand and Credit rivers, suggests that this development was not initially widespread. The adoption of maize horticulture instead appears to be linked to the emergence of the Princess Point Complex which is characterized by decorated ceramics combining cord roughening, impressed lines, and punctate designs; triangular projectile points; T-based drills; steatite and ceramic pipes; and ground stone chisels and adzes (Fox 1990). The distinctive artifacts and horticultural practices have led to the suggestion that these populations were ancestral to the Iroquoian-speaking peoples who later inhabited southern Ontario (Warrick 2000:427).[4]

Archaeologists have distinguished the Late Woodland period by the widespread adoption of maize horticulture by some Indigenous groups primarily across much of southern Ontario and portions of the southeast with favourable soils. The cultivation of corn, beans, squash, sunflowers and tobacco radically altered subsistence strategies and gained economic importance in the region over time. This change is associated with increased sedentarism, and with larger and more dense settlements focused on areas of easily tillable farmland. In some areas, semi-permanent villages with communal 'longhouse' dwellings appeared for the first time. These villages were occupied year-round for 12 to 20 years until local firewood and soil fertility had been exhausted. Many were surrounded by defensive palisades, evidence of growing hostilities between neighbouring groups. Associated with these sites is a burial pattern of individual graves occurring within the village. Upon abandonment, the people of one or more villages often exhumed the remains of their dead for reburial in a large communal burial pit or ossuary outside of the village(s) (Birch and Williamson 2013; Wright 1966). More temporary habitations such as small hamlets, agricultural cabin sites, and hunting and fishing camps were also used. Throughout much of eastern Ontario, however, the shield-like terrain limited the adoption of extensive horticulture and Indigenous groups

[4] There have been several studies, however, that indicate assigning ethnicity to archaeological sites based on ceramic typologies and other kinds of artifacts is problematic (see Hart and Englebrecht 2012; Kapyrka 2017). For instance, Iroquoian-style pottery is found on sites within traditional Anishinaabe territories in eastern New York and Ontario (Hart and Englebrecht 2012: 335, 345). Further, artifact traits associated with particular ethnicities are not always agreed upon by archaeologists and in many cases these traits indicate the presence of more than one group (Fox and Garrad 2004). Though valuable "*in terms of the history of archaeological thought*," equating an Indigenous artifact trait with ethnicity is overly simplistic and lacking any means for evaluation, exemplifying the importance of other lines of evidence, including oral histories, in an interpretive historical framework (Kapyrka 2017).

continued to move frequently across this territory hunting, fishing, and gathering (Pilon 1999).

At the end of the Late Woodland period several Indigenous groups were living within eastern Ontario, although the territories associated with each and the relationships between them were complex and are not fully understood. Anishinaabe oral histories suggest a broad homeland extending far to the west of Ontario and include references to a migration from the Atlantic seaboard, as well as a subsequent return via the St. Lawrence River to the Great Lakes region, with the latter having occurred around 500 B.P. (Hessel 1993; Sherman 2015:27). Those who became known as the Algonquin[5] settled along the Ottawa River or Kichi-Sibi[6] and its tributaries in eastern Ontario and western Quebec; the Ojibwa and Nipissing were located further to the north and west. Living on and around the Canadian Shield, all Anishinaabeg maintained a more nomadic lifestyle than their agricultural neighbours to the south, and accordingly their presence is less visible in the archaeological record (Morrison 2005; Sherman 2015:28).

The so-called St. Lawrence Iroquoians inhabited the St. Lawrence River valley from the east end of Lake Ontario to the Quebec City region and beyond, and have been identified archaeologically based on a distinctive material culture, a horticulture-based subsistence supplemented with fishing, hunting and gathering, and the presence of large semi-permanent villages as well as smaller camps. Numerous discrete settlement clusters have been identified across this vast territory; however, the political and social relationships between these populations is unclear (Tremblay 2006). In eastern Ontario, significant St. Lawrence Iroquoian site clusters have been identified near the Spencerville/Prescott area, and just north of Lake St. Francis (sometimes referred to as the 'Cornwall Cluster'; Tremblay 2006). The material culture and settlement patterns of the fourteenth and fifteenth century Iroquoian sites found along the upper St. Lawrence in Ontario are directly related to the Iroquoian-speaking groups that Jacques Cartier and his crew encountered in A.D. 1535 at Stadacona (Quebec City) and Hochelaga (Montreal Island; Jamieson 1990:386; Tremblay 2006). By the late sixteenth century, however, all of the St. Lawrence Iroquoian settlements appear to have been abandoned. There are various hypotheses for the 'disappearance' of the St. Lawrence Iroquoians, although increasing hostilities with neighbouring populations, notably the Mohawk, is the most widely accepted (Tremblay 2006). At the time of their 'disappearance,' there was a significant increase in St. Lawrence Iroquoian ceramic vessel types on ancestral Huron-Wendat sites and also on some Algonquin sites, suggesting segments of the St. Lawrence Iroquoian

[5] The Algonquin of eastern Ontario increasingly use the Anishinaabemowin word Omàmiwinini to refer to themselves. Omàmiwinini describes the relationship with the land in the language, and though it was largely replaced by 'Algonquin' for many years, efforts are underway to reintroduce the term (Sherman 2008:77).

[6] The Algonquin have various names specific to each part of the Ottawa River. The lower part of the river from Mattawa down to Lake of Two Mountains is traditionally known as the Kichi-Sibi, also spelled Kiji Sibi, Kichisipi, Kichissippi, and Kichisippi (AOO 2020; Morrison 2005:9; Sherman 2015:27).

population relocated to other regions as captives or refugees (Birch 2015:291; Sutton 1990:54; Tremblay 2006).

Agricultural villages of ancestral Huron-Wendat have been recorded along the north shore of Lake Ontario and up the Trent River dating to c. 550 B.P. By c. 450 B.P., the easternmost settlements of the ancestral Huron-Wendat were located between Balsam Lake and Lake Simcoe in the region that would become historic Huronia. This population movement is not fully understood, and undoubtedly involved complex interactions between different cultural groups including the Anishinaabeg and, as noted above, may also have included St. Lawrence Iroquoians. As such, there are conflicting interpretations of the archaeological and historical records related to this period (see Gaudreau and Lesage 2016; Gitiga Migizi 2018; Gitiga Migizi and Kapyrka 2015; Lainey 2006; Richard 2016; Pendergast 1972).

Finally, while the Iroquois or Haudenosaunee[7] homeland was initially south of Ontario in New York state, their oral histories suggest their hunting grounds extended along the north shore of Lake Ontario and the St. Lawrence River into southeastern Ontario and Quebec (Hill 2017). Archaeological data indicates some Haudenosaunee were living year-round in Ontario by the early seventeenth century (Konrad 1981).

The Indigenous population shifts and relationships of the late sixteenth and early seventeenth centuries through the period of initial contact with Europeans were complex and are not fully understood. They were, in part, a result of the disruption of traditional Indigenous exchange patterns brought about by the arrival of the French, Dutch and British along the Atlantic seaboard and the subsequent emergence of the lucrative St. Lawrence River trade route.

3.2 Regional Post-Contact Cultural Overview

The first Europeans to travel into eastern Ontario arrived in the early seventeenth century; predominantly French, they included explorers, fur traders and missionaries. While exploring eastern Ontario and the Ottawa River watershed between c. 1610 and 1613,[8] Samuel de Champlain and others documented encounters with different Indigenous groups speaking Anishinaabemowin, including the Matouweskarini along the Madawaska River, the Kichesipirini at Morrison Island on the Ottawa River, the Otaguottouemin along the river northwest of Morrison Island, the Weskarini in the Petite

[7] Sometime between A.D. 1142 and A.D. 1451 the Mohawk, Oneida, Onondaga, Cayuga, and Seneca united to form the Haudenosaunee Confederacy, also known as the League of Five Nations, and called the Iroquois by the French. When the Tuscarora Nation joined the confederacy in 1722, it became the League of Six Nations.

[8] From this section onwards all dates are presented as A.D.

Nation River basin,[9] and the Onontchataronon[10] living in the South Nation River basin as far west as the Gananoque River basin (Hanewich 2009; Hessel 1993; Sherman 2015:29). These extended family communities subsisted by hunting, fishing, and gathering, and undertook some horticulture (see also Pendergast 1999; Trigger 1987). The Anishinaabeg living in the Upper Ottawa Valley and northward towards the headwaters of the Ottawa River included the Nipissing, Timiskaming, Abitibi (Wahgoshig), and others; however, as the French moved inland, they referred to all these groups who spoke different dialects of Anishinaabemowin as Algonquin (Morrison 2005:18).

At the time of Champlain's travels, the Algonquin were already acting as brokers in the fur trade and exacting tolls from those using the Ottawa River trade route which connected the Upper Great Lakes to the west via Lake Nipissing and Georgian Bay, and the St. Maurice and Saguenay via the Rivières des Outaouais (the portion of the Ottawa River extending eastward into Quebec from Lake Timiskaming). These northern exchange routes circumvented the St. Lawrence River and lower Great Lakes waterways and, therefore, potential conflict with the Haudenosaunee (Joan Holmes & Associates Inc. 1993:2-3). As access to the more southerly route and the extent of settlement in the region fluctuated with the state of hostilities (Joan Holmes & Associates Inc. 1993:3), and given that the fur trade in New France was based in Montreal, the Ottawa River navigation routes were of especial strategic importance in the movement of goods inland and the return of furs down to Montreal. In the wake of Champlain's travels, the Ottawa River became the principal route to the interior for the French. The recovery of European trade goods (e.g., iron axes, copper kettle pieces, glass beads, etc.) from sites throughout the Ottawa River drainage basin provides some evidence of the extent of interaction between Indigenous groups and the French during this period (Kennedy 1970).

With Contact, major population disruptions were brought about by the introduction of European diseases against which Indigenous populations had little resistance; severe smallpox epidemics in 1623-24 and again between 1634 and 1640 resulted in drastic population decline among all Indigenous peoples living in the Great Lakes region (Konrad 1981). The expansion of hunting for trade with Europeans also accelerated decline in the beaver population, such that by the middle of the seventeenth century the centre of the fur trade had shifted northward from what became the northeastern states into southern Ontario. The French, allied with the Huron-Wendat, the Petun, and the Anishinaabeg, refused advances by the Haudenosaunee to trade with them directly. Seeking to expand their territory and disrupt the French fur trade, the Haudenosaunee

[9] The Petite Nation River is in Quebec, with its mouth on the north side of the Ottawa River between Ottawa and Hawkesbury. It is sometimes confused with the South Nation River in eastern Ontario which empties into the south side of the Ottawa River opposite the Petite Nation River. Consequently, the Weskarini territory is sometimes associated with the South Nation River, but this appears to be an error (*cf.* Hessel 1993).

[10] This is a Haudenosaunee term and is, therefore, thought to refer to an Algonquin community that adopted displaced Iroquoians from territory along the St. Lawrence River near Montreal (Fox and Pilon 2016).

launched raids into the region and established a series of winter hunting bases and trading settlements near the mouths of the major rivers flowing into the north shore of Lake Ontario and the St. Lawrence River.[11] The first recorded Haudenosaunee settlements were two Cayuga villages established at the northeastern end of Lake Ontario (Konrad 1981). Between 1640 and 1650, the success of the Haudenosaunee Confederacy in warfare led to the dispersal of the Anishinaabeg and Huron-Wendat who had been occupying much of southern Ontario.

Fort Frontenac was established by the French at the present site of Kingston in 1673, and another fort was constructed at La Presentation (Ogdensburg, New York) in 1700. These forts served to solidify control of the fur trade and to enhance French ties with local Indigenous populations. To this end, the French also encouraged the establishment of Indigenous villages near their settlements (Adams 1986). The full extent of Indigenous settlement in eastern Ontario through to the end of the seventeenth century, however, is uncertain. The Odawa appear to have been using the Ottawa River for trade from c. 1654 onward and some Algonquin remained within the area under French influence, possibly having withdrawn to the headwaters of various tributaries in the watershed. In 1677 the Sulpician Mission of the Mountain was established near Montreal where the Ottawa River empties into the St. Lawrence River. While it was mostly a Mohawk community that became known as Kahnawake, some Algonquin who had converted to Christianity settled at the mission for part of the year and were known as the Oka Algonquin (Joan Holmes & Associates Inc. 1993).

As a result of increased tensions between the Haudenosaunee and the French, and declining population from disease and warfare, the Cayuga villages were abandoned in 1680 (Edwards 1984:17). Around this time, Anishinaabeg began to mount an organized counter-offensive against the Haudenosaunee who were pushed back to their traditional lands further south, leading to the return of the Michi Saagig Nishnabeg, or Mississauga, to southern and south-eastern Ontario from their winter hunting grounds in the north. This change saw Anishinaabeg gain wider access to European trade goods and allowed them to use their strategic position to act as intermediaries in trade between the British and Indigenous communities to the north (Edwards 1984:10,17; Ripmeester 1995; Surtees 1982; Curve Lake First Nation n.d.).

Following almost a century of warfare, the Great Peace was signed in Montreal in 1701 between New France and 39 Indigenous Nations, including the Anishinaabeg, Huron-Wendat and Haudenosaunee. This led to a period of relative peace and stability. During the first half of the eighteenth century, the Haudenosaunee occupation appears to have been largely restricted to south of the St. Lawrence River, while Mississauga and Ojibwa were living in southern and central Ontario, generally beyond the Ottawa River

[11] These settlements included: Quinaouatoua near present day Hamilton, Teiaiagon on the Humber River, Ganatswekwyagon on the Rouge River, Ganaraske on the Ganaraska River, Kentsio on Rice Lake, Kente on the Bay of Quinte, and Ganneious, near Napanee (Adams 1986).

watershed (Joan Holmes & Associates Inc. 1993:3). Algonquin were residing along the Ottawa River and its tributaries, as well as outside the Ottawa River watershed at Trois-Rivières; Nipissing were located around Lake Nipissing and at Lake Nipigon. Reports from c. 1752 suggest that some non-resident Algonquin and Nipissing were trading at the mission at Lake of Two Mountains during the summer but returning to their hunting grounds "*far up the Ottawa River*" for the winter, and there is some indication that they may have permitted Haudenosaunee residents of the mission to hunt in their territory (Joan Holmes & Associates Inc. 1993:3; Heidenreich and Noël 1987:Plate 40).

In 1754, hostilities over trade and the territorial ambitions of the French and British led to the Seven Years' War, in which many Anishinaabeg fought on behalf of the French. With the French surrender in 1760, Britain gained control over New France, though in recognition of Indigenous title to the land the British government issued the Royal Proclamation of 1763. This created a boundary line between the British colonies on the Atlantic coast and the 'Indian Reserve' west of the Appalachian Mountains. This line then extended from where the 45th parallel of latitude crossed the St. Lawrence River near present day Cornwall northwestward to the southeast shore of Lake Nipissing and then northeastward to Lac St. Jean. The proclamation specified that "*Indians should not be molested on their hunting grounds*" (Joan Holmes & Associates Inc. 1993:4) and outlawed the private purchase of Indigenous land, instead requiring all future land purchases to be made by Crown officials "*at some public Meeting or Assembly of the said Indians*" occupying the land in question (cited in Surtees 1982: 9). In 1764, the post at Carillon on the Ottawa River was identified as the point beyond which traders could only pass with a specific licence to trade in "*Indian Territory.*" Petitions in 1772 and again in 1791 described Algonquin and Nipissing territory as the lands on both sides of the Ottawa River from Long Sault to Lake Nipissing. Settlers continued to trespass into this territory, however, cutting trees and driving away game vital to Indigenous lifeways (Joan Holmes & Associates Inc. 1993:5). Akwesasne, within the Haudenosaunee hunting territory, became a permanent settlement towards the middle of the eighteenth century.[12]

At first, the end of the French Regime brought little change to eastern Ontario. Between 1763 and 1776 some British traders traveled to the Kingston area, but the British presence remained sporadic until 1783 when Fort Frontenac was officially re-occupied. With the conclusion of the American Revolutionary War (1775 to 1783), however, the British sought additional lands on which to settle United Empire Loyalists fleeing the United States, disbanded soldiers, and the Mohawk who had fought with the British under Thayendanegea (Joseph Brant) and Chief Deserontyon and were, therefore, displaced from their lands in New York State. To this end, the British government undertook hasty negotiations with Indigenous groups to acquire rights to lands; however, these negotiations did not include Algonquin and Nipissing who were continuously ignored, despite much of the area being their traditional territory (Lanark County Neighbours for Truth and Reconciliation 2019). Initially the focus for settlement was the north shore of

[12] www.firstbatuibs.info/akwesasne.html

Lake Ontario and the St. Lawrence River, resulting in a series of 'purchases' and treaties beginning with the Crawford Purchases of 1783. As noted, these treaties did not include all of the Indigenous groups who lived and hunted in the region and the recording of the purchases – including the boundaries – and their execution were problematic; they also did not extinguish Indigenous rights and title to the land (Joan Holmes & Associates Inc. 1993:5; Royal Commission on Aboriginal Peoples 1996). The *Crown Grant to the Mohawks of the Bay of Quinte* was issued in 1784 in recognition of the Six Nations' support during the American Revolutionary War. It included lands on the Bay of Quinte, originally part of the Crawford Purchases, on which Chief Deserontyon and other Haudenosaunee settled.[13]

Major Samuel Holland, Surveyor General for Canada, began laying out the land within the Crawford Purchases in 1784 with such haste that the newly established townships were assigned numbers instead of names. Euro-Canadian settlement along the north shore of the St. Lawrence River and the eastern end of Lake Ontario began in earnest about this time. By the late 1780s the waterfront townships were full and more land was required to meet both an increase in the size of grants to all Loyalists and grant obligations to the children of Loyalists who were now entitled to 200 acres in their own right upon reaching the age of 21 (H. Belden & Co. 1880:16). In 1792 John Graves Simcoe, Lieutenant Governor of the Province of Upper Canada, offered free land grants to anyone who would swear loyalty to the King, a policy aimed at attracting more American settlers. As government policy also dictated the setting aside of one seventh of all land for the Protestant Clergy and another seventh as Crown reserves, pressure mounted to open up more of the interior. As a result, between 1790 and 1800 most of the remainder of the Crawford Purchases was divided into townships (H. Belden & Co. 1880:16).

A number of other purchases during the late eighteenth century between representatives of the Crown and certain Anishinaabe covered lands immediately west of the Crawford Purchases, from the north shore of Lake Ontario northward to Lake Simcoe and Georgian Bay/Lake Huron. These included the John Collins Purchase of 1785, the Johnson-Butler Purchase[14] of 1787-88, and the 1798 Penetanguishene Purchase (Treaty 5) aimed at acquiring a harbour on Lake Huron for British vessels.[15] The lands purportedly covered by these purchases were often poorly defined and were thus included in the later Williams Treaties of 1923 (see below).

The *Constitution Act* of 1791 created Upper and Lower Canada (later Ontario and Quebec) and established the Ottawa River as the boundary between the two provinces. This effectively divided the Algonquin and Nipissing territories, both of which straddled the

[13] https://www.ontario.ca/page/map-ontario-treaties-and-reserves
[14] Sometimes referred to as the 'Gunshot Treaty' as it reportedly covered the land as far back from the lake shore as a person could hear a gunshot (https://www.ontario.ca/page/map-ontario-treaties-and-reserves).
[15] https://www.ontario.ca/page/map-ontario-treaties-and-reserves

river. The Algonquin and Nipissing sent a letter to the Governor General of the Province of Canada in 1798, requesting that settlers be restricted to the banks of the Ottawa River and detailing the difficulties caused by encroaching settlement (Joan Holmes & Associates Inc. 1993:5; see also Lanark County Neighbours for Truth and Reconciliation 2019). In this letter the Chiefs noted the belt of wampum and map of their lands that was given to Governor Carleton some years earlier, pleading for no more of the encroachment that was driving away game and pushing them into infertile lands; however, there was no response. In the early 1800s, a few Algonquin and Nipissing settled on the shores of Golden Lake, known to them as 'Peguakonagang;' they called themselves 'Ininwezi,' which they translated as 'we people here alone' (Johnson 1928; MacKay 2016).[16] The Golden Lake band, as they initially came to be known, resided in this area for at least part of the year, with various band members maintaining traplines, hunting territories, and sugar bushes.

The War of 1812 between the United States and Great Britain (along with its colonies in North America and its Indigenous allies) brought another period of conflict to the region. In 1815, at the conclusion of the war, the British government issued a proclamation in Edinburgh to further encourage settlement in British North America. The offer included free passage and 100 acres of land for each head of family, with each male child to receive his own 100-acre parcel upon reaching the age of 21 (H. Belden & Co. 1880:16). At the same time, the government was seeking additional land on which to resettle disbanded soldiers from the War of 1812. Demobilized forces could thereby act as a 'force-in-being' to oppose any possible future incursions from the United States. Veterans were encouraged to take up residence within a series of newly created 'military settlements' including those at Perth (1816) and Richmond (1818). The pressure to find more land was exacerbated by the sheer number of settlers moving into the region as a result of these initiatives, which began to push settlement beyond the acquired territory into what had formally been protected as 'Indian Land.'[17]

Additional 'purchases' were signed in the early nineteenth century between the Crown and certain Anishinaabe communities including the Lake Simcoe Purchase (Treaty 16) signed in 1815 and covering lands between Lake Simcoe and Georgian Bay, the Nottawasaga Purchase (Treaty 18) of 1818 to the south and west of the Lake Simcoe Purchase, and the Rice Lake Purchase or Treaty 20 of 1818 which covered a large area around Rice Lake.[18]

Further east, with the settlement of the region underway, Lieutenant Governor Gore ordered Captain Ferguson, the Resident Agent of Indian Affairs at Kingston, to arrange

[16] The Algonquin of River Desert identified The Golden Lake Band using the name "Nozebi'wininiwag," translated as "Pike-Water People" (Speck in Johnson 1928:174).
[17] Between 1815 and 1850 over an estimated 800,000 Euro-Canadian settlers moved into the region (https://www. lanarkcountyneighbours.ca/the-petitions-of-chief-shawinipinessi.html).
[18] https://www.ontario.ca/page/map-ontario-treaties-and-reserves

the purchase of additional lands from the chiefs of the Ojibwa and Mississauga or Michi Saagiig Nishnaabeg. The resulting Rideau Purchase (Treaty 27 and 27¼) extended from the rear of the earlier Crawford Purchases to the Ottawa River and was signed by the Michi Saagiig Nishnaabeg in 1819 and confirmed in 1822. This 'purchase', like the earlier Crawford Purchases, was also problematic and excluded the Algonquin whose traditional territory it covered (Canada 1891:62; Surtees 1994:115). As this purchase included lands within the Ottawa River watershed, the Algonquin and Nipissing protested in 1836 when they became aware of its terms (Joan Holmes & Associates Inc. 1993:6).

As Euro-Canadian settlement spread, Indigenous groups were increasingly pushed out of southern and eastern Ontario, generally moving further to the north and west, although some families remained in their traditional lands, at least seasonally. Records relating to the Hudson's Bay Company, the diaries of provincial land surveyors, the reports of geologists sent in by the Geological Survey of Canada, census returns,[19] store account books and settler's diaries all provide indications of the continued Indigenous settlement in the region, as does Indigenous oral history. In addition to their interactions with the Algonquin who remained in the area, the nineteenth century settlers found evidence of the former extent of Indigenous occupation, particularly as they began to clear the land. In 1819, Andrew Bell wrote from Perth:

> *All the country hereabouts has evidently been once inhabited by the Indians, and for a vast number of years too. The remains of fires, with the bones and horns of deers (sic) round them, have often been found under the black mound... A large pot made of burnt clay and highly ornamented was lately found near the banks of the Mississippi, under a large maple tree, probably two or three hundred years old. Stone axes have been found in different parts of the settlement.*
>
> (cited in Brown 1984:8)

While some Algonquin and Nipissing continued to spend part of the summer at Lake of Two Mountains through this period, most of the year appears to have been spent on their traditional hunting grounds, and by the 1830s there were specific claims for land by individuals such as Mackwa on the Bonnechere River and Constant Pennecy on the Rideau waterway. In 1842, Chief Pierre Shawinipinessi,[20] an Algonquin leader, petitioned the Crown for a land tract of 2,000 acres between the townships of Oso, Bedford and South Sherbrooke to enable his people to sustain themselves (Huitema 2001;

[19] While Indigenous peoples were clearly still residing in the area and making use of the land, they often do not appear in the 1851 to 1871 census records. Huitema (2001:129) notes that Algonquin were sometimes listed in these records as 'Frenchmen' or 'halfbreeds' because they had utilized the mission at Lake of Two Mountains as their summer gathering place and, therefore, were thought of as being French.

[20] There are numerous variations in the spelling of Chief Shawinipinessi's name; he is also known by the name of Peter Stephens or Stevens).

Ripmeester 1995:164-166; Sherman 2008:32-33).[21] A licence of occupation for the 'Bedford Algonquin' was granted in 1844, with Michi Saagiig Nishnaabeg from Alnwick reportedly also living at Bedford (Joan Holmes & Associates Inc. 1993:7-8). Illegal logging operations, however, interfered with life on the reserve, and despite protests from Chief Shawinipinessi and legislation passed in 1838 and then later in 1850 to protect Indigenous lands,[22] it was allowed to continue, depleting the local food resources. In response to an 1861 petition to address the trespassing of settlers, the existence of the Bedford tract was denied (LAC microfilm reel C-13419). At this time some of the community moved to nearby lands while others joined the Algonquin at Kitigan Zibi, and at Pikwàkanagàn where the 'Golden Lake Reserve' was created in 1873 (Hanewich 2009; Joan Holmes & Associates Inc. 1993:9). Around 1836 some consideration was given to facilitating Algonquin and Nipissing settlement in the Grand Calumet Portage and Allumette Island area, but this was not pursued (Joan Holmes & Associates Inc. 1993).

Other treaties signed in the mid-nineteenth century included the St. Regis Purchase (Treaty 57) signed in 1847 between the Crown and the Mohawk and covering a narrow parcel of land, known as the 'Nutfield Tract' extending north of the St. Lawrence River at Cornwall towards the Ottawa River, and the Robinson-Huron Treaty (Treaty 61) of 1850 between the Crown and certain Anishinaabeg for lands east of Georgian Bay and the northern shore of Lake Huron eastward to the Ottawa River.[23]

Through the early twentieth century, off-reserve Algonquin and Nipissing were told to move to established reserves at Golden Lake (Pikwàkanagàn), Maniwaki (Desert River) and at Gibson on Georgian Bay (which had been established for the re-settlement of both Algonquin and Mohawk from Lake of Two Mountains), but many remained in their traditional hunting territories. There is also evidence to suggest that Akwesasne Mohawk trapped and hunted north of their reserve as far as Smiths Falls and Rideau Ferry between c. 1924 and 1948 (Joan Holmes & Associates Inc. 1993:10-11; Sherman 2008:33).

The Williams Treaties of 1923 were signed between the Crown and seven Anishinaabe First Nations to address lands that had not been surrendered via a formal treaty process (see above).[24] These lands covered a large area from the north shore of Lake Ontario to Lake Nipissing and overlapped with a number of other treaties and 'purchases.' The Williams Treaties First Nations include the Chippewas of Beausoleil, Georgina Island and

[21] July 17, 1842 petition 115 addressed to Sir Charles Bagot, Governor General, Library and Archives Canada RG10, V186 part 2, as transcribed in Joan Holmes & Associates Inc. (1993) *Report on the Algonquins of Golden Lake Claim* Vol. 10-12:101.

[22] Chapter XV. An Act for the protection of the Lands of the Crown in this Province, from Trespass and Injury. Thirteenth Parliament, 2nd Victoria, A.D. 1839. An Act for the Protection of the Indians in Upper Canada from Imposition and the Property Occupied or Enjoyed by Them from Trespass and Injury; passed by the government of Upper Canada on August 10, 1850. Available from https://bnald.lib.unb.ca/node/5342; United Canadas (1841-1857) 13 & 14 Victoria – Chapter 74:1409.

[23] https://www.ontario.ca/page/map-ontario-treaties-and-reserves

[24] https://www.ontario.ca/page/map-ontario-treaties-and-reserves

Rama, and the Mississaugas of Alderville, Curve Lake, Hiawatha and Scugog Island. To address further issues with a number of the pre-confederation purchases and treaties, the Williams Treaties First Nations ratified the Williams Treaties Settlement Agreement with Canada and Ontario in June, 2018. This agreement recognized harvesting rights in Treaties 5, 16, 18, 20, 27 and 27¼.[25]

As noted above, lands within traditional Algonquin territory were included in various nineteenth century purchases without Algonquin consultation or consent. Algonquin claims to these lands include a series of petitions to the Crown going back to 1772 that asserted Algonquin rights to land and resources. An official land claim was made in the 1980s and, in 2016, an Agreement-in-Principal was signed by Ontario, Canada and the Algonquins of Ontario, a step towards a treaty recognizing Algonquin rights across much of eastern Ontario.[26]

Dalhousie Township

With the available farmland in the townships in the immediate vicinity of the Perth military settlement rapidly filled, additional land was soon needed to meet the needs of the influx of settlers to the region. Consequently several additional townships, including Dalhousie, were surveyed and opened for settlement. Dalhousie was surveyed by Reuben Sherwood in 1820, and while it saw an initial influx of settlers (mostly weavers and tradesmen from Glasgow and Paisley), it was later described, together with the neighbouring smaller townships of North Sherbrooke and Lavant, as owing

> *its limited population to the nature of its soil and character of its surface. The most rugged and uninviting features of the Laurentian geological formation are here displayed; and the succession of rocky hills, dismal swamps, lakes, rivers and ridges sufficiently explains to the observer why these townships never reached an enviable place in the scale of agricultural excellence. It must not be inferred, however, that this stretch of territory is entirely devoid of soil such as would tempt the eye and kindle the admiration of the husbandman; for, scattered through the two southerly townships especially … are many decidedly handsome and comfort-suggesting strips and squares of fertile country, rendered doubly attractive by contrast with the repulsive aspect of their several surroundings.*
>
> (Belden 1880:22)

The 1820s to 1840s saw an increase in immigrants from first Scotland and then Ireland, many of them skilled in cotton weaving, carpentry, blacksmithing, and shoemaking. Most migrated to escape overcrowding in urban centers following the Napoleonic Wars. A lack of roads through the muddy and steep, rocky terrain, however, prevented substantial growth. Give the lack of farmland, timber-related activities and mining

[25] www.williamstreatiesfirstnations.ca

[26] https://www.ontario.ca/page/map-ontario-treaties-and-reserves

became sources of revenue, with the Dalhousie Iron Mine, opened near Playfairville, the earliest iron-producing mine in the region.[27]

By 1850 the township had 1,478 residents and was described as "*pretty well settled*" containing "*some good land*," though "*much of the north and east of the township is rocky, and marble of different shades is plentiful.*" Maple sugar was an important production component for the farms in this area (Smith 1852:331). A severe flood in 1857, known as the Crotch Lake disaster, destroyed all three bridges in Dalhousie Township and the Currie grist mill on Dalhousie Lake, though the region soon rebounded. Together with the sparsely populated North Sherbrooke and Lavant Townships, the population had grown only slightly to 2,295 by 1871, with that in Dalhousie reaching 1,724 by 1880. Many of the nineteenth century township occupants, despairing at the quality of the farmland, eventually moved further west into southern Ontario or the United States where better land was plentiful (Belden 1880:22).

3.3 Property History

Archival research was conducted in order to develop a general picture of the settlement and land use history for the study area through the nineteenth and twentieth centuries, particularly as it relates to the archaeological potential of the property. Information was compiled from a variety of sources, including a Dalhousie Township patent plan based on an 1820s survey and the 1863 Walling map of Lanark County, as well as twentieth century topographic maps and aerial photographs. Census and land registry records and the Stage 1 report were also consulted, though the latter was more focussed on Lot 6, Concession 10 (Adams Heritage 2006).

The study area is located within the northwest section of Lot 5, Concession 10 about 3 km south of Dalhousie Lake. This lot was originally set aside as part of the Crown reserve. The Crown patent for the east half was finally issued to John Campbell on November 6th, 1857 and the patent for the west half to James Duncan on July 6th, 1870 (Map 3; Lanark County Land Registry Office or LCLRO). These were several decades later than the patents received by the surrounding neighbours: John Livingston was issued the patent for the east half of Lot 6, Concession 10 on August 10th, 1825, John McLean the patent for the west half of the same lot on September 28th, 1826, and Campbell's neighbour, Alexander Livingston, on Lot 5, Concession 11 was issued his patent on August 10th, 1825 (LCLRO). It is likely that both Campbell and Duncan were present on the land prior to receiving their patents. Duncan in particular is listed on Lot 5 in the 1851 census, where he was residing with his wife Joan and children Anne, Euphemia, Jane and John in a log house, continuing to be enumerated in the same location in the 1861 and 1871 census returns (LAC microfilm reels C-11731, C-1042, C-1043 and C-10019). The farm can be seen on the 1863 Walling map, on the opposite side of the travelled road from the study area (see Map 3).

[27] https://www.lanarkhighlands.ca/lh-discover/visiting/our-history

It is less certain that the Campbell family resided on the lot – in the 1851 census returns the occupant is listed as John Gordon, and two years after receiving the patent Campbell sold the east half to Alexander Turnbull (LAC microfilm reel C-11731; LCLRO instrument A228). Turnbull is also shown on the 1863 Walling map, with the farmstead in the east half of the lot and as with the Duncan farm on the opposite side of the road from the study area (see Map 3).

The farm of James Duncan had grown to 250 acres from the original 100 by 1871, though apart from 50 acres on Lot 4, for which he received a Crown patent in 1862, the location of their additional acreage is uncertain (LCLRO; LAC microfilm reel C-10019). James Duncan's son John purchased the eastern half of Lot 5, Concession 10 towards the end of the nineteenth century; it is likely that he was the head for the household at the time, his father having died in 1895 (LCLRO instruments D872 and F1748). The family appears to have remained on Lot 5, Concession 10 throughout the twentieth century: land registry records show it being transferred to John Duncan Jr. from John Duncan Sr. in 1928, and the last line of the registry records in the abstract list shows it is still in the Duncan family as late as 1981 (LCLRO instruments J3466 and 56871).

The land use pattern for the study area during the nineteenth century was one of early optimism, tempered by acceptance of the limited agricultural capability of this part of the township (Adams 2006:15). The 1851 census returns enumerator described the land throughout Concessions 7 to 12 of Dalhousie Township was "*scarcely fit for cultivation*" (LAC microfilm reel C-11731). If not abandoned, the land was eventually deemed unacceptable for habitation and was adapted to more passive agricultural usage. The Duncans were one of the few to remain in their original farmstead at the beginning of the twentieth century, which is partially visible just south of Highland Line on a 1934 aerial photograph (see Map 3).

4.0 ARCHAEOLOGICAL CONTEXT

This section of the report describes the environmental and archaeological context of the study area which, combined with the historical context outlined above, provides the necessary information to assess the archaeological potential of the property.

4.1 Previous Archaeological Research

In order to determine whether any previous archaeological fieldwork has been conducted within or in the immediate vicinity of the present study area, a search of the titles of reports in the *Public Register of Archaeological Reports* maintained by the Ministry of Heritage, Sport, Tourism and Cultural Industries (MHSTCI) was undertaken, supplemented by a search of the Past Recovery corporate library.[28]

Known cultural resource management assessments within or in the immediate vicinity of the study area include the following:

- Adams Heritage (2006) undertook a Stage 1 assessment of the initial McKinnon Pit property, mostly on Lot 6, Concession 10 and Lot 6, Concession 11, but also including the present study area (PIF P003-111-2006).
- Kinickinick Heritage Consultants (2006) completed a Stage 2 assessment for the same proposed pit, but the assessment was confined to Lot 6, Concession 10 and Lot 6, Concession 11 (PIF P039-097-2006). This assessment found five scatters of potentially Palaeo-Indian Indigenous artifacts which were registered as archaeological sites BfGd-3, BfGd-4, BfGd-5, BfGd-6 and BfGd-7. A Stage 3 assessment was recommended for site BfGd-3 which was subsequently completed by Kinickinick Heritage Consultants in 2008 (PIF P039-125-2007). This located what were classified as 178 lithic artifacts representing the production of expedient tools at an early postglacial cultural site. Stage 4 was recommended in the event of future pit expansion to the south, though this appears to have been over-ridden by an Archaeological Review Officer at MHSTCI requiring no further archaeological work.
- Golder Associates Ltd. undertook Stage 1 and Stage 2 assessments for the proposed Duncan Pit in 2020, located on Lots 4 and 5 of Concession 10 (2020, PIF P1107-0027-2020). The Stage 2 resulted in the registration of a nineteenth century

[28] In compiling the results, it should be noted that archaeological fieldwork conducted for research purposes should be distinguished from systematic property surveys conducted during archaeological assessments associated with land use development planning (generally after the introduction of the *Ontario Heritage Act* in 1974 and the Environmental Assessment Act in 1975), in that only those studies undertaken to current industry standards can be considered to have adequately assessed properties for the presence of archaeological sites with cultural heritage value or interest. In addition, it should be noted that the vast majority of the research work undertaken in the area has been focused on the identification of pre-Contact Indigenous sites, while current MHSTCI requirements minimally require the evaluation of the material remains of occupations and or land uses pre-dating 1900.

Euro-Canadian farmstead site (BfGd-8) and a scatter of artifacts related to a second farmstead (BfGd-9), both of which were recommended for Stage 3 and then Stage 4 assessments, all completed by Golder in 2020 (2021b, PIF P1107-0029-2020; 2021e, PIF P1107-0032-2020; 2021c, PIF P1107-0030-2020 and 2021d, PIF P1107-0033-2020). An additional Stage 1 assessment for an expanded pit area was also undertaken by Golder, resulting in a recommendation for Stage 2 assessment for parts of the expanded area (2021a, PIF P1107-0035-2020).

To the knowledge of Past Recovery Staff, no additional archaeological fieldwork has previously been conducted within the limits of the study area as defined on Map 2.

4.2 Previously Recorded Archaeological Sites

The primary source for information regarding known archaeological sites in Ontario is the *Ontario Archaeological Sites Database* maintained by MHSTCI. The database includes all archaeological sites that have been reported to the Province, the majority of which consist of sites discovered by professional archaeologists conducting archaeological assessments required by legislated processes under land use development planning (largely since the late 1980s). An updated search of the *Ontario Archaeological Sites Database* for the current study indicated that there are seven registered sites within 1 km of the study area, all but two of the total number registered in Dalhousie Township (Table 1).

Five of these (BfGd-3 to BfGd-7) consisted of possible Palaeo-Indian expedient tools found during the Stage 2 assessment for the initial McKinnon Pit on Lot 6, Concession 10 and Lot 6, Concession 11. Four of these sites - BfGd-4 (a 200 m by 20 m scatter located on Lot 6, Concession 10), BfGd-5 (an 80 m by 20 m scatter located on Lot 6, Concession 11), BfGd-6 (an isolated find spot on Lot 6, Concession 11) and BfGd-7 (an isolated find spot on Lot 6, Concession 11) were found to have no further archaeological concerns after the Stage 2 assessment. The fifth, BfGd-3 (a 30 m by 20 m scatter located on Lot 6, Concession 10) was found to have further cultural heritage value or interest following a Stage 3 assessment (Kinickinick 2008), but this was over-ridden by MHSTCI with the site determined to have no further archaeological concerns.

The remaining two sites (BfGd-8, the Turnbull Farmstead, and BfGd-9, the Duncan site, both on Lot 5, Concession 10, were related to nineteenth century farmsteads and following Stage 4 assessments were determined to have no further archaeological concerns (Golder 2021d and 2021e).

Table 1. Summary of Registered Archaeological Sites within 1 km of the Study Area.

Borden Number	Site Name	Time Period	Inferred Agency	Inferred Function	Review Status
BfGd-3		Pre-Contact	Indigenous	Scatter	In Database - Awaiting Ministry Review
BfGd-4		Pre-Contact	Indigenous	Scatter	No Further CHVI
BfGd-5		Pre-Contact	Indigenous	Scatter	No Further CHVI
BfGd-6		Pre-Contact	Indigenous	Isolated Find	No Further CHVI
BfGd-7		Pre-Contact	Indigenous	Isolated Find	No Further CHVI
BfGd-8	Turnbull Site	Post-Contact	Euro-Canadian	Farmstead, Homestead	No Further CHVI
BfGd-9	Duncan Site	Post-Contact	Euro-Canadian	Scatter	No Further CHVI

CHVI – Cultural Heritage Value or Interest

4.3 Cultural Heritage Resources

The recognition or designation of cultural heritage resources (here referring only to built heritage features and/or cultural heritage landscapes) provides valuable insight into aspects of local heritage and some of these cultural heritage resources may be associated with significant archaeological features or deposits. Accordingly, this assessment included a review of cultural heritage resources previously identified within or immediately adjacent to the current study area. The following sources were consulted:

- Federal Heritage Buildings Review Office online Directory of Heritage Designations (http://www.pc.gc.ca/eng/progs/beefp-fhbro/index.aspx);
- Canada's Historic Places website (http://www.historicplaces.ca/en/home accueil.aspx);
- Ontario Heritage Properties Database (http://www.hpd.mcl.gov.on.ca/scripts/ hpdsearch/english/default.asp);
- Ministry of Heritage, Sport, Tourism and Culture Industries' List of Heritage Conservation Districts (http://www.mtc.gov.on.ca/en/heritage/heritage_ conserving_list.shtml); and,
- Ontario Heritage Trust website (https://www.heritagetrust.on.ca/en/ index.php/online-plaque-guide).

No cultural heritage resources associated with historically significant places, persons, or events were noted within or immediately adjacent to the study area.

4.4 Heritage Plaques and Monuments

The recognition of a place, person, or event through the erection of a plaque or monument may also provide valuable insight into aspects of local history, given that these markers typically indicate some level of heritage recognition. As with cultural heritage resources, some of these plaques and monuments may be associated with significant archaeological features or deposits. Accordingly, this study included a review of heritage plaques and monuments in the vicinity of the study area. The following sources were consulted:

- The Ontario Heritage Trust Online Plaque Guide (https://www.heritagetrust.on.ca/en/index.php/online-plaque-guide);
- Parks Canada Directory of Federal Heritage Designations (https://www.pc.gc.ca/apps/dfhd/default_eng.aspx); and,
- A listing of historical plaques of Ontario maintained by Sarah J. McCabe (https://ontarioplaques.omeka.net/).

No plaques or monuments associated with historically significant places, persons, or events were noted within or immediately adjacent to the study area.

4.5 Cemeteries

The presence of historical cemeteries in proximity to a parcel of land proposed for development can pose archaeological concerns in two respects. First, cemeteries may be associated with related structures or activities that may have become part of the archaeological record, and thus may be considered features indicating archaeological potential. Second, the boundaries of historical cemeteries may have been altered over time, as all or portions may have fallen out of use and been forgotten, leaving potential for the presence of unmarked graves. For these reasons, a Stage 1 archaeological assessment also includes a search of available sources of information regarding historical cemeteries. For this study, the following sources were consulted:

- A complete listing of all registered cemeteries in the province of Ontario maintained by the Consumer Protection Branch of the Ministry of Consumer Services (last updated 06/07/2011);
- Field of Stones website (http://freepages.history.rootsweb.ancestry.com/~clifford/);
- Ontario Cemetery Locator website maintained by the Ontario Genealogical Society (https://vitacollections.ca/ogscollections/2818487/data?g=d);
- Ontario Headstones Photo Project website (https://canadianheadstones.ca/wp/cemetery-lookup/); and,
- Available historical mapping and aerial photography.

There are no known cemeteries or isolated burials within or immediately adjacent to the present study area.[29]

4.6 Mineral Resource Areas

The presence of scarce mineral resources on or near to a property may indicate potential for archaeological resources associated with both pre-Contact and post-Contact exploration and exploitation. For this reason, the background research conducted for the assessment includes a search of available sources of information on the locations of outcrops of rare and highly valued minerals, such as quartz, chert, ochre, copper, and soapstone, as well as minerals sought out by post-Contact prospectors and miners for more industrial-scale exploitation (i.e. gold, copper, iron, mica, etc.). Useful tools in this search are provided by databases maintained by the Ontario Geological Survey and the Ministry of Northern Development and Mines, including:

- The *Abandoned Mines Information System* (AMIS), which contains a list of all known abandoned and inactive mine sites and associated features in the province;
- *Mining Claims*, which contains a list of all active claims, alienations, and dispositions;
- The *Mineral Deposits Inventory*, which contains a list of known mineral occurrences of economic value in the province; and,
- *Bedrock Geology* data set, which shows the distribution of bedrock units and illustrates geologic rock types, major faults, iron formations, kimberlite intrusions, and dike swarms.

There are no historical records of any active mines or exploited mineral outcrops in the immediate area.

4.7 Local Environment

The assessment of present and past environmental conditions in the region containing the study area is a necessary component in determining the potential for past occupation as well as providing a context for the analysis of archaeological resources discovered during an assessment. Factors such as local water sources, soil types, vegetation associations and topography all contribute to the suitability of the land for human exploitation and/or settlement. For the purposes of this assessment, information from local physiographic, geological and soils research was compiled for the Stage 1 assessment to create a picture of the environmental context for both past and present land uses. This has been updated with information specific to Lot 5, Concession 10.

[29] It should be noted that the research undertaken as part of this Stage 1 archaeological assessment is unlikely to identify the potential for the presence of unrecorded burial plots, such as those of individual families on rural properties. See Section 7.0 of this report for information regarding compliance with provincial legislation in the event that human remains are identified during future development.

The physiography and distribution of surficial material in the area are largely the result of glacial activity that took place in the Late Wisconsinan (Bajc 1994). This period, which lasted from approximately 23,000 to 11,000 years before present, was marked by the repeated advance and retreat of the massive Laurentide Ice Sheet. As the ice advanced, debris from the underlying sediments and bedrock accumulated within and beneath the ice. The debris, a mixture of stones, sand, silt, and clay, was deposited over large areas as till plains, drumlins, and moraines. During deglaciation, as the Late Wisconsinan ice margin receded to the north, massive inflows of glacial meltwater into the Huron-Georgian Bay-Lake Simcoe basin flooded adjacent lands, which had been depressed by the weight of the continental ice sheet, forming glacial Lake Algonquin by 11,500 years ago (Eshman and Karrow 1985 in Gao 2010). These waters created shoreline features that, with isostatic rebound, are now as much as 100 to 150 metres above the present water level in Georgian Bay. Where the northern limit of glacial Lake Algonquin was formed by the retreating ice sheet, new lake outlets developed as progressively lower sills were exposed, and water levels dropped to successively lower levels. About 10,100 B.P., during the Ottawa-Marquette Low Stand, Glacial Lake Algonquin drained away and a series of smaller lakes (called Hough and Stanley) occupied depressions in the Huron Basin below the present-day water level. While low-water conditions continued in the former Laurentide Lake basis for millennia, only c. 500 years later water volumes increased rapidly in the French-Nipissing-Mattawa basin. These changing conditions resulted in much higher water levels in the Mattawa Lowlands and Ottawa River Valley, creating a series of raised post-Algonquin relic shorelines. Modern water levels in the Great Lakes basins only developed sometime after 3,000 years ago, with only minor climate-related fluctuations since that time.

The study area is situated near the eastern edge of the Algonquin Highlands physiographic region which consists of rough topography with bedrock knobs and occasional ridges, generally shallow soils and areas of exposed bedrock (Chapman and Putnam 1984:211). The study area is underlain by Proterozoic Helikian granites and gneisses of the Grenville Province of the Canadian Shield (Sanford and Baer 1981). Soils are generally shallow and stony and/or sandy and acidic, consisting of till-derived gravelly and sandy loams. The White Lake sand soils of the upland parts of the study area are generally not favourable for crop agriculture, although historically within the boundaries of the Township of Lanark Highlands some portions have been farmed, including within the study area. The remainder of the soils on the property are muck (Hoffman et al. 1967).

The study area is part of the Middle Ottawa section of the Great Lakes-St. Lawrence Forest Region. The predominant tree species in this area include sugar maple, beech, red maple, yellow birch, eastern hemlock, eastern white pine and red pine, and to a lesser extent white spruce, balsam fir, trembling aspen, white birch, red oak and basswood. In wetter depressions species include eastern white cedar, tamarack, black spruce, black ash, red maple, white elm, black alder, willow, buttonbush and red-osier. Occasionally

butternut, blue-beech, bitternut hickory, shagbark hickory, black cherry, white oak and rock elm intrude from the hardwood forests surrounding the Precambrian Shield (Rowe 1972:100). The area would have been cleared of its original forest cover with the intensification of Euro-Canadian settlement and extensive logging in the early nineteenth century.

The study area included part of Long Sault Creek and surrounding wetlands, with Barber's Lake lying c. 750 m to the east. It lies within the Mississippi River watershed, draining eastwards into the Ottawa River near Galetta.

5.0 SUMMARY OF THE STAGE 1 ARCHAEOLOGICAL ASSESSMENT RESULTS

This section of the report includes a summary of the archaeological potential determination within the study area as presented in the Stage 1 report (Adams Heritage 2006). Given that this report predates the current Standards and Guidelines for Consultant Archaeologists (2011), the archaeological potential determination has also been updated.

5.1 Optional Property Inspection

A Stage 1 property inspection was carried out as part of the initial assessment, with "*'in the field' observations … evaluated in the light of information on the soils, topography, property history and known archaeological record of the area in order to determine the archaeological potential of the property*" (Adamas Heritage 2006:17).

5.2 Evaluation of Archaeological Potential

The Stage 1 assessment determined that parts of the study area retained archaeological potential given the proximity of water sources (Long Sault Creek and surrounding wetlands) and that there were farmsteads dating to the early nineteenth century on the property corresponding to the initial Euro-Canadian settlement of Dalhousie Township. There were also, however, large areas of wetland and steeply sloping terrain that would not have been occupied and therefore had low archaeological potential, as well as some areas that had already been disturbed in anticipation of the pit development where archaeological potential had been removed (Adams Heritage 2006:18).

For the current Stage 2 study area, additional factors indicating archaeological potential included the following:

- Part of the study area consisted of an esker with White Lake sand loam soil, both an area of raised topography that may have seen habitation at an early period and a well-drained location suitable for Indigenous campsites;
- Most of the study area lay within 100 m of Highland Line, a historical transportation corridor depicted on nineteenth century mapping; and,
- Most of the study area lay within 300 m of a registered archaeological site, either BfGd-3 (a concentration of potentially Palaeo-Indian expedient tools) to the immediate northwest, or BfGd-9 (a scatter of nineteenth century artifacts associated with the Duncan farmstead) on the opposite side of Highland Line.

There were also additional areas of disturbance noted on recent aerial photographs, including the entrance road to the current pit extending through the Stage 2 study area. As most of the property was therefore determined to retain archaeological potential requiring testing, the limits of areas with steep slope, permanent water saturation and deep disturbance were left to be determined in the field.

5.4 Stage 1 Recommendations

The results of the Stage 1 assessment formed the basis for the following recommendations:

1) Archaeological field testing (Stage 2) should be conducted within the areas identified as having archaeological site potential prior to any land altering disturbances. Specifically, archaeological testing should focus on the lands which lie within the proposed licence area (once it has been defined).
2) Since the study area contains a variety of terrains, ranging from seasonally flooded swamp margins to steep, forested slopes, too steep ever to have been settled, the specific areas tested should be determined in the field. Any areas which lie within the 'archaeological potential' zone, and which are to be excluded from archaeological testing, should be fully documented and described, and the approach taken justified.
3) Further site preparation work should not occur until such time as the archaeological testing has been completed, and any further investigations arising from this work have been conducted to the satisfaction of the Ontario Ministry of Culture.

(Adams Heritage 2006:23)

6.0 STAGE 2 ARCHAEOLOGICAL ASSESSMENT

This section of the report describes the methodology used and results of the Stage 2 property survey conducted to determine whether the subject property contains significant archaeological resources.

6.1 Field Methods

The archaeological fieldwork for the Stage 2 property survey was completed over the course of two days, on the 28th and 29th of June, 2021. The crew consisted of a licensed field director and up to seven experienced field technicians. All fieldwork was conducted according to criteria outlined in *Standards and Guidelines for Consultant Archaeologists* (MHSTCI 2011). Over the course of the assessment, the weather varied between clear and sunny to overcast and temperatures stayed around 30° C. Visibility and field conditions were good to excellent for the identification, documentation, and recovery of any archaeological resources during the course of the fieldwork.

In order to ensure full coverage of the study area, the Past Recovery field crew used printed 2019 high-resolution orthographic imagery overlain with the limits of the study area. This map allowed the field crew to accurately identify the subject property in relation to fixed reference landmarks, as well as to accurately record field conditions. In addition, the field crew used 'Mapit Pro' GIS software on a tablet loaded with detailed satellite imagery overlain with the study area. This digital mapping interface, along with a high accuracy, GIS-mapping-grade Global Navigation Satellite System (GNSS) receiver, allowed the field crew to accurately delimit the study area in relation to their 'real time' position.

The study area was composed of a mixture of an open, recently active agricultural field (where ploughing was viable), grassed areas that had been pasture for over 50 years, wooded areas, a low and wet portion, some steep slopes, and some sections of modern disturbance including a gravel road cutting through the property leading to the existing pit (see Map 2; Images 1 to 8). As such, the Stage 2 assessment included both a pedestrian survey and a shovel test pit survey at 5 m intervals (Map 5; Images 9 to 12). All test pits were excavated using shovels and trowels, with back-dirt screened through 6 mm hardware mesh. Shovel test pits were at least 30 cm in diameter and excavation continued for 5 cm into sterile subsoil. All pits were examined for soil stratigraphy, cultural features, and/or evidence of deep and intensive disturbance. Sample test pits were documented with digital photographs and field notes. Once all required recording had been completed, all test pits were backfilled. In areas where either deep disturbance or stripped original grade topsoil was noted, testing was completed judgementally to determine the limits of the disturbance. Soil layers within test pits were assigned lot numbers in the order of appearance.

Pedestrian survey was undertaken on the recently cultivated agricultural land within the study area. The field was ploughed and allowed to weather through at least one heavy rainfall prior to the pedestrian survey. Direction was provided to the contractor undertaking the ploughing to plough deep enough to ensure total topsoil exposure, but not deeper than previous ploughing. At the time of the assessment, surface visibility conditions exceeded the minimum requirements established by MHSTCI, where 80% of the ploughed ground surface must be visible (Image 13). The pedestrian survey was conducted by means of the Past Recovery field crew systematically walking the ploughed field at 5 m intervals and inspecting the exposed surface for the presence of archaeological resources. The pedestrian survey was narrowed to 1 m intervals when within 20 m of site BfGd-3 (Image 14; Map 5). Estimates of survey coverage by method are provided in Table 2 below.

Field activities were recorded digitally through the use of field notes, digital photographs, and shapefiles generated within MapIt GIS. A catalogue of the material generated during the Stage 2 property survey can be found below in Table 3. The complete photographic catalogue is included as Appendix 1, and the locations and orientations of all photographs referenced in the report are shown on Map 5. As per *Terms and Conditions for Archaeological Licences* in Ontario, curation of all photographs and field notes generated during the Stage 2 archaeological assessment is being provided by Past Recovery pending the identification of a suitable repository.

Table 2. Estimates of Survey Coverage during the Stage 2 Assessment.

Landscape Unit	Survey Method & Interval Used	Area Covered	Percentage of Study Area
Wooded terrain and open abandoned pasture	Shovel test pit survey at 5 m intervals	1.53 hectares/ 3.78 acres	24.35%
Low-lying and wet areas with permanently saturated soils	Not tested	0.76 hectares/ 1.88 acres	12.16%
Deep and extensively disturbed land	Judgementally test pitted to confirm disturbance and visual inspection	1.23 hectares/ 3.04 acres	19.64%
Steep slope	Not Tested	0.83 hectares/ 2.05 acres	13.23%
Active agricultural field, ploughed	Pedestrian survey at 5 m intervals	1.92 hectares/ 4.74 acres	30.62%

Table 3. Inventory of the Stage 2 Documentary Record.

Type of Document	Description	Number of Records	Location
Photographs	Digital photographs documenting the Stage 2 fieldwork	81 photographs	On Past Recovery computer network – file PR21-014
Mapping data	Shapefiles (*.shp)	1 .gpkg file	On Past Recovery computer network – file PR21-014
Field notes	Scanned and digital notes on the Stage 2 fieldwork; test pit forms	3 pages (3 .pdf files)	On Past Recovery computer network – file PR21-014

6.2 Results

Much of the Stage 2 study area was determined to retain archaeological potential. As stated above, the property consisted of a recent agricultural field, former pasture that had not been ploughed in over 50 years, an existing pit laneway, small wooded areas and sections of steep slope or permanent water saturation. The surface of the ploughed field consisted of dark brown sand-loam with numerous cobbles and rocks. In the former pastureland flanking the entrance road to the existing pit the soil profile consisted of approximately 18 cm of very dark brown sand-loam topsoil over 11 cm of brown coarse sandy loam subsoil with a high concentration of ground pebbles (B-horizon) over a subsoil C-horizon of coarse light grey-brown beach sand (Image 15). Within the wooded areas soils consisted of 13 cm or less of lightly mottled dark grey-brown silt-sand topsoil over brown compact silt-sand subsoil (Image 16). The area surrounding the existing pit laneway was mostly disturbed; however some natural profiles were present. These soils consisted of approximately 13 cm of very dark brown sand-loam topsoil over a subsoil B-horizon of more than 13 cm of brown silt-sand-loam, lightly mottled with dark brown silt-sand-loam appearing to be a product of natural processes (Image 17). No cultural material was recovered.

6.3 Record of Finds

No artifacts or other archaeological finds were found or retained.

6.4 Analysis and Conclusions

The Stage 2 archaeological assessment consisted of a complete property survey, with all areas with archaeological potential subjected to physical testing by means of either a shovel test pit survey or a pedestrian survey of the ploughed field (see Map 5). No cultural material was recovered from either the test pit survey or the pedestrian survey.

6.5 Stage 2 Recommendations

This report forms the basis for the following recommendation:

1) It has been determined that the cultural heritage value or interest of the study area has been sufficiently documented through the Stage 2 research conducted to date, and no further archaeological assessment of the subject area as presently defined on Map 2 is required.

The reader is also referred to Section 7.0 below to ensure compliance with relevant provincial legislation as it may relate to this project.

7.0 ADVICE ON COMPLIANCE WITH LEGISLATION

In order to ensure compliance with provincial legislation, the reader is advised of the following:

1) This report is submitted to the Minister of Heritage, Sport, Tourism and Culture Industries as a condition of licensing in accordance with Part VI of the *Ontario Heritage Act*, R.S.O. 1990, c 0.18. The report is reviewed to ensure that it complies with the standards and guidelines that are issued by the Minister, and that the archaeological fieldwork and report recommendations ensure the conservation, protection and preservation of the cultural heritage of Ontario. When all matters relating to archaeological sites within the project area of a development proposal have been addressed to the satisfaction of the Ministry of Heritage, Sport, Tourism and Culture Industries, a letter will be issued by the Ministry stating that there are no further concerns with regard to alterations to archaeological sites by the proposed development.
2) It is an offence under Sections 48 and 69 of the *Ontario Heritage Act* for any party other than a licensed archaeologist to make any alteration to a known archaeological site or to remove any artifact or other physical evidence of past human use or activity from the site, until such time as a licensed archaeologist has completed archaeological fieldwork on the site, submitted a report to the Minister stating that the site has no further cultural heritage value or interest, and the report has been filed in the Ontario Public Register of Archaeological Reports referred to in Section 65.1 of the *Ontario Heritage Act*.
3) Should previously undocumented archaeological resources be discovered, they may be a new archaeological site and therefore subject to Section 48 (1) of the *Ontario Heritage Act*. The proponent or person discovering the archaeological resources must cease alteration of the site immediately and engage a licensed consultant archaeologist to carry out archaeological fieldwork, in compliance with Section 48 (1) of the *Ontario Heritage Act*.
4) The *Funeral, Burial and Cremation Services Act*, 2002, S.O. 2002, c.33 requires that any person discovering human remains must notify the police or coroner and the Registrar of Cemeteries at the Ministry of Consumer Services.
5) Archaeological sites recommended for further archaeological fieldwork or protection remain subject to Section 48 (1) of the *Ontario Heritage Act* and may not be altered, or have artifacts removed from them, except by a person holding an archaeological licence.

8.0 LIMITATIONS AND CLOSURE

Past Recovery Archaeological Services Inc. has prepared this report in a manner consistent with that level of care and skill ordinarily exercised by members of the archaeological profession currently practicing under similar conditions in the jurisdiction in which the services are provided, subject to the time limits and physical constraints applicable to this report. No other warranty, expressed or implied, is made.

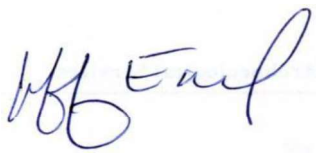
This report has been prepared for the specific site, design objective, developments and purpose prescribed in the client proposal and subsequent agreed upon changes to the contract. The factual data, interpretations and recommendations pertain to a specific project as described in this report and are not applicable to any other project or site location.

Unless otherwise stated, the suggestions, recommendations and opinions given in this report are intended only for the guidance of the client in the design of the specific project.

Special risks occur whenever archaeological investigations are applied to identify subsurface conditions and even a comprehensive investigation, sample and testing program may fail to detect all or certain archaeological resources. The sampling strategies in this study comply with those identified in the Ministry of Heritage, Sport, Tourism and Culture Industries' *Standards and Guidelines for Consultant Archaeologists* (2011).

The documentation related to this archaeological assessment will be curated by Past Recovery Archaeological Services Inc. until such a time that arrangements for their ultimate transfer to an approved and suitable repository can be made to the satisfaction of the project owner(s), the Ontario Ministry of Heritage, Sport, Tourism and Culture Industries and any other legitimate interest group.

We trust that this report meets your current needs. If you have any questions or if we may be of further assistance, please do not hesitate to contact the undersigned.



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Dalhousie Township Map #4 AO I0043355

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1851 Dalhousie Township, Microfilm Reel # C-11731
1861 Dalhousie Township, Microfilm Reel # C-1042 (Nominal)
1861 Dalhousie Township, Microfilm Reel # C-1043 (Agricultural)
1871 Dalhousie Township, Microfilm Reel # C-10019
1881 Dalhousie Township, Microfilm Reel # C-13233
1891 Dalhousie Township, Microfilm Reel # T-6348
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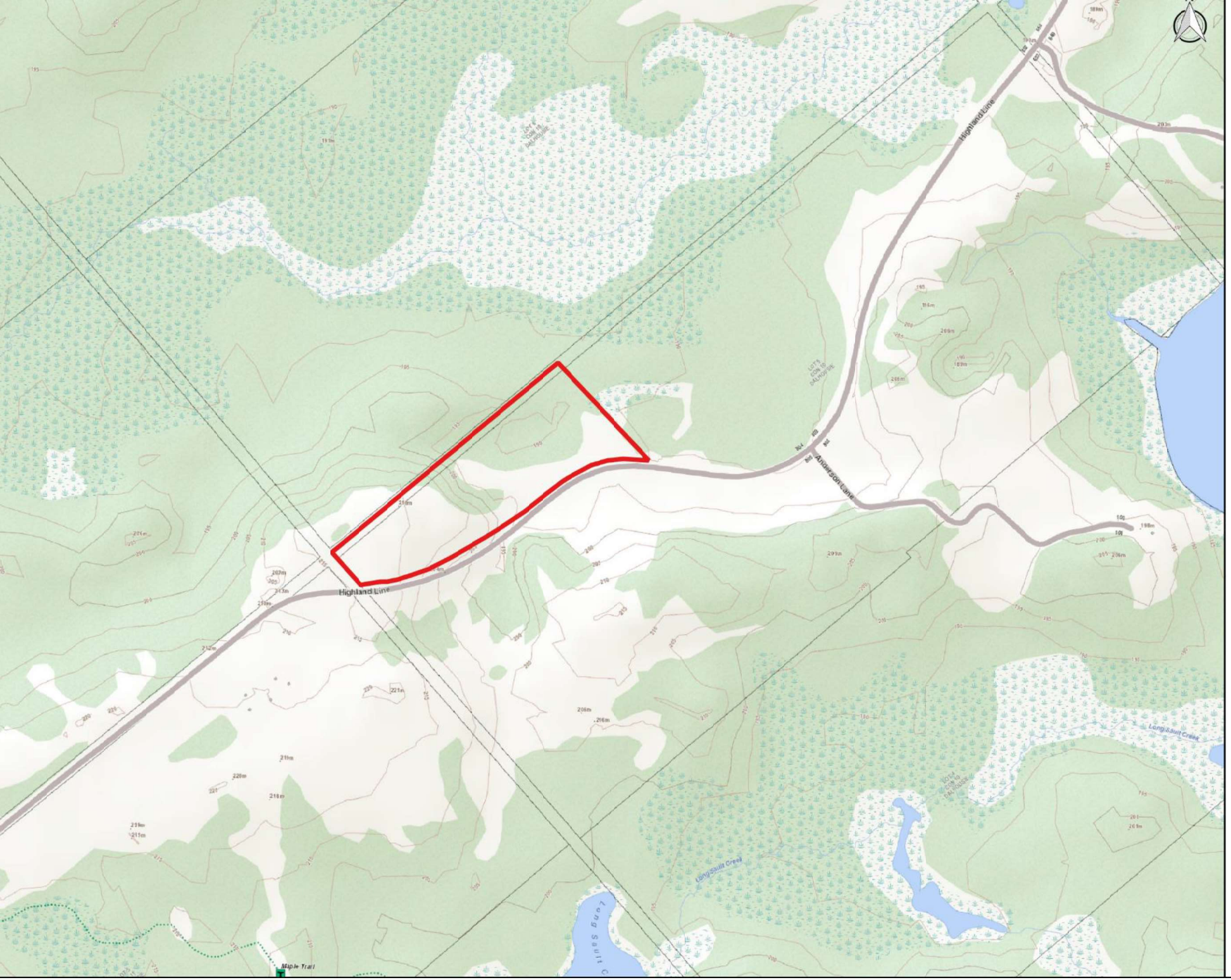
NMC 21920 H.W. Walling Map of Lanark County, 1863

National Air Photo Library (NAPL):

Date	Roll#	Photograph #
1934	A4724	52

10.0 MAPS


Project Layers
Study Area
Highland Line
Anderson Lane
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Maple Trail
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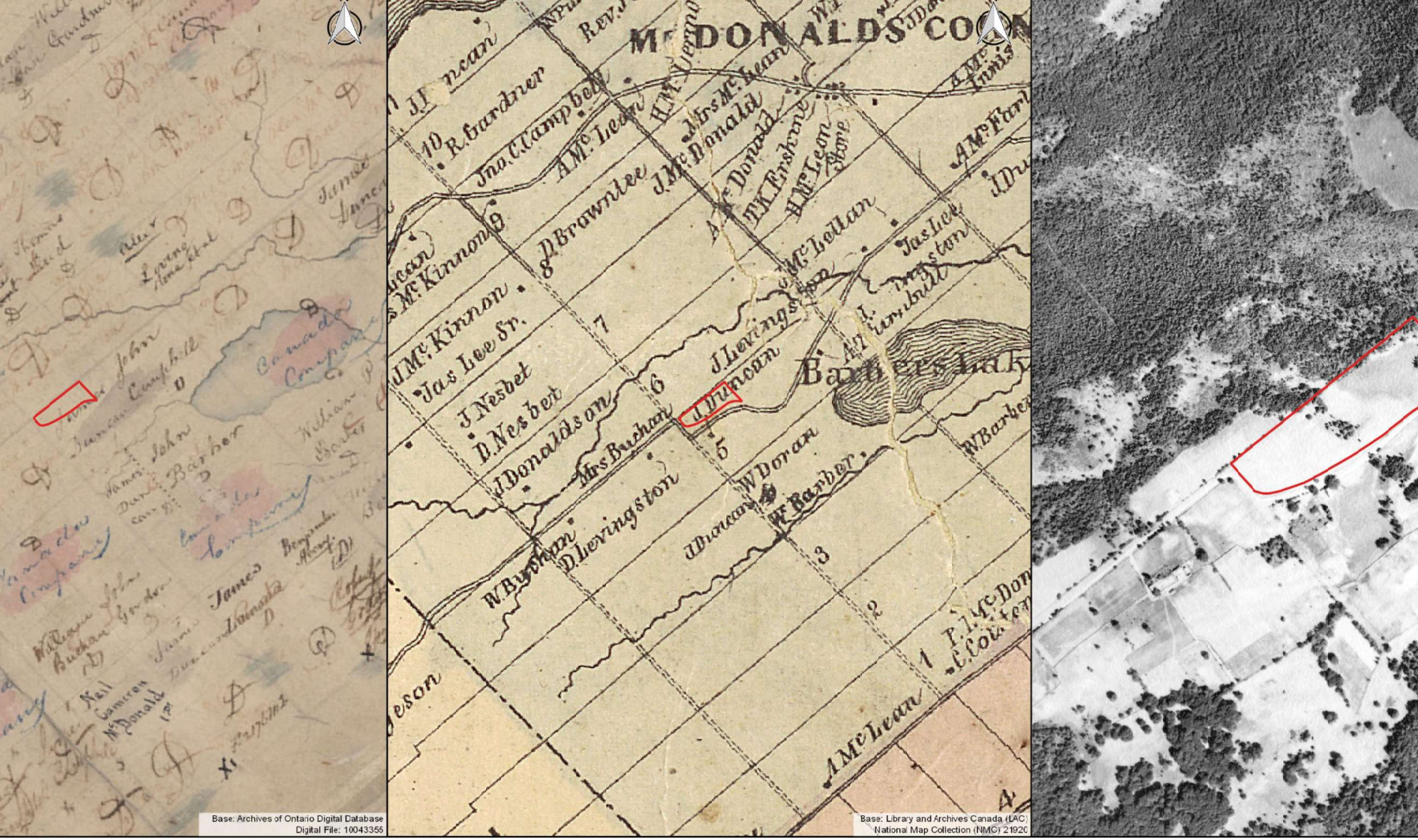
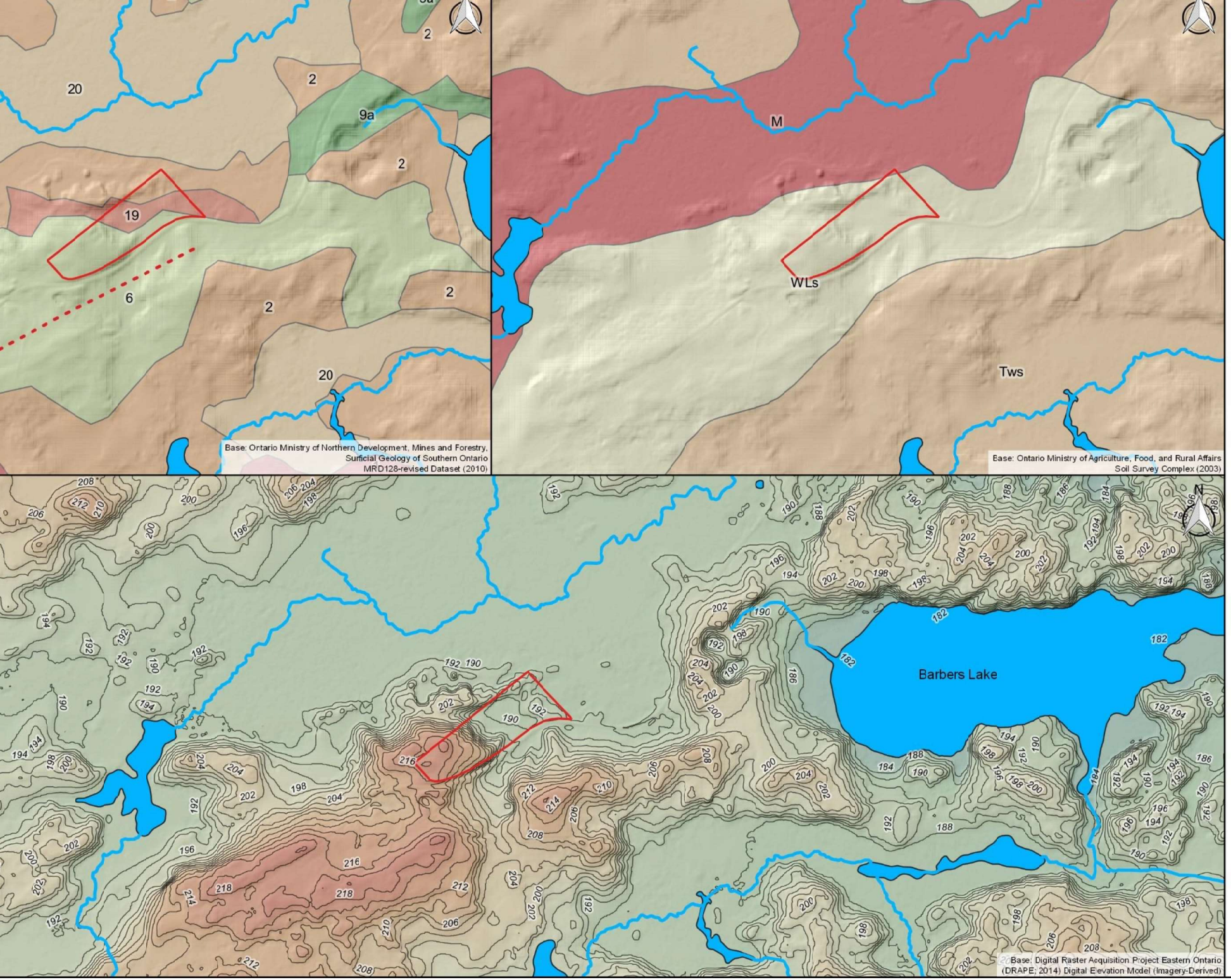
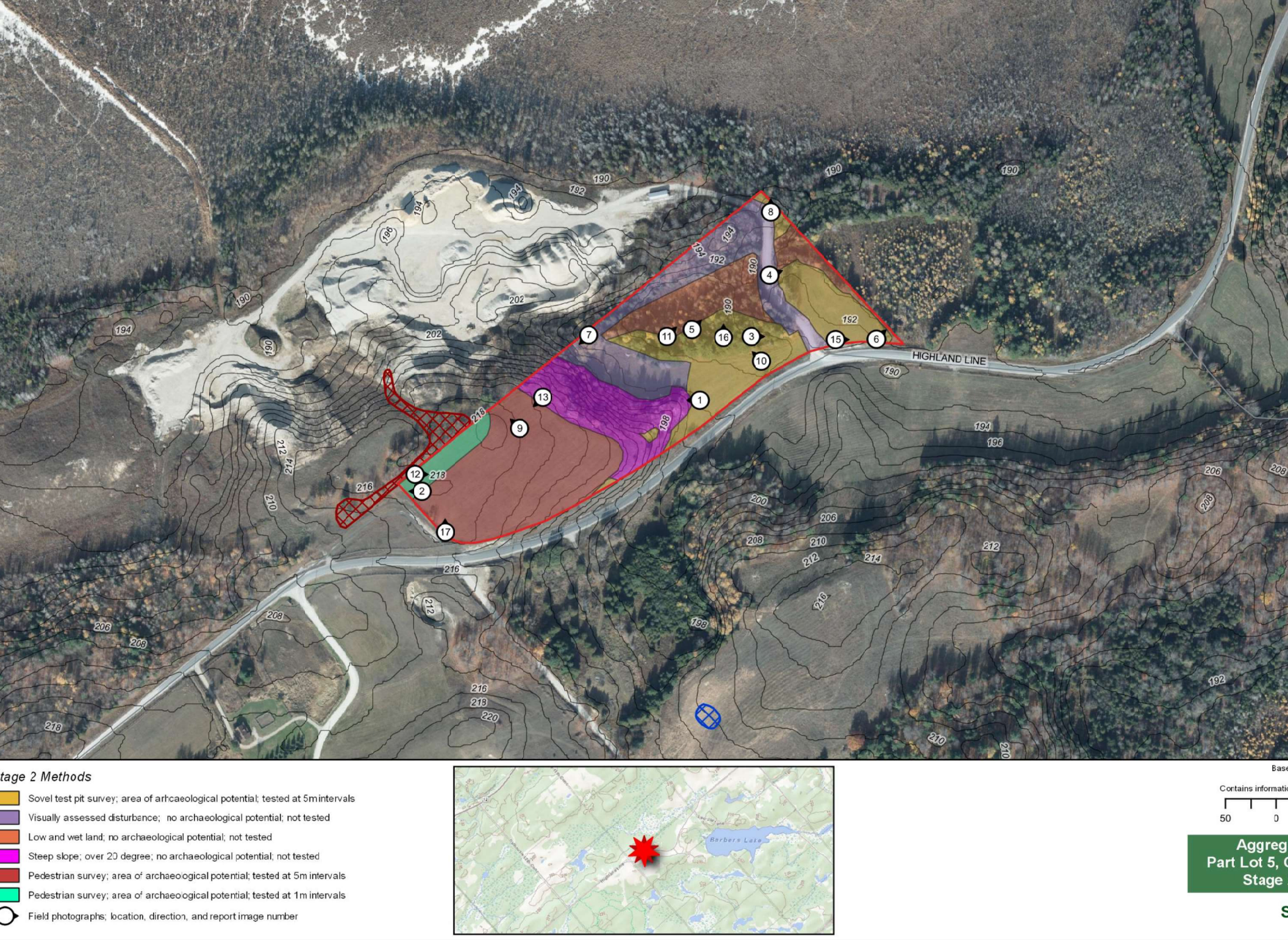
ophotography of the study area showing existing conditions.



g and aerial photography showing the historical development of the study area.



cial geology, topography and soil mapping showing the environmental conditions of the study area.



ophotography of the study area showing the methods and results of the Stage 2 assessment.

11.0 IMAGES

Image 1. Open grassy former pasture in the centre of the property with the crew approaching an area of steep slope, facing west. (PR21-014D041)

Image 2. Recently active ploughed agricultural field, facing west. (PR21-014D015)

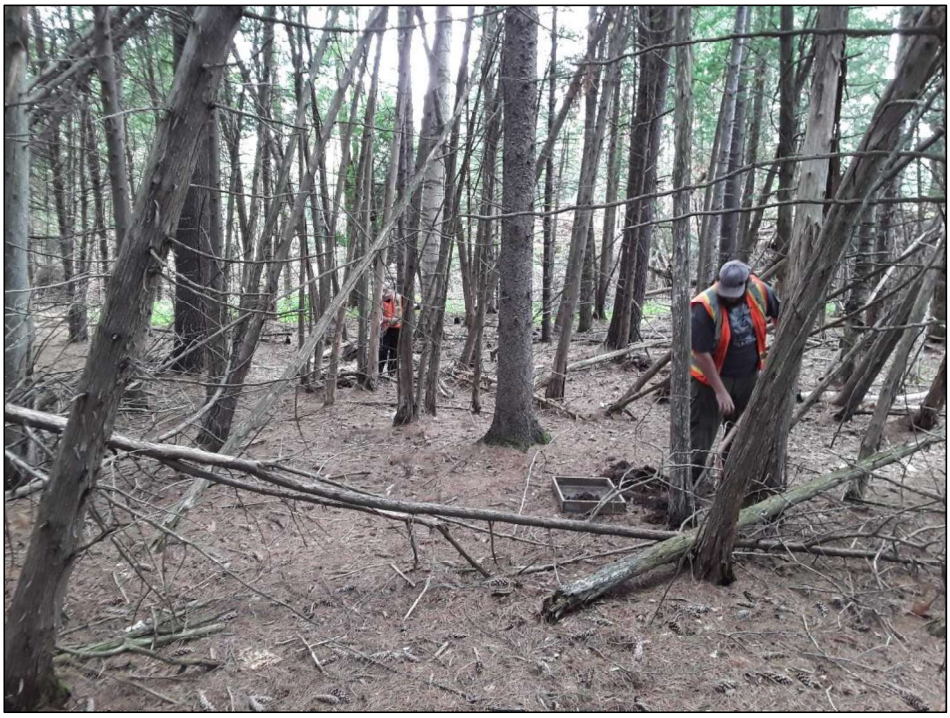


Image 3. Crew testing in one of the wooded areas on the property, facing east. (PR21-014D036)

Image 4. Low, wet area to the east of the pit entrance road, facing east-northeast. (PR21-014D071)

Image 5. Low, wet area with standing water in the centre of the property, facing northeast. (PR21-014D043)

Image 6. View from the southwest edge of the property looking towards steep slope in the background, facing northeast. (PR21-014D069)

Image 7. Disturbed area in the central northern section of the property, facing southwest. (PR21-014D046)

Image 8. Pit entrance road showing added fill to the east, facing north. (PR21-014D072)

Image 9. Crew members undertaking pedestrian survey, facing northwest. (PR21-014D002)

Image 10. Crew field walking at 5 m intervals, facing west. (PR21-014D033)

Image 11. Crew testing at 5 m intervals in former pasture, facing northwest. (PR21-014D034)

Image 12. Crew testing at 5 m intervals in a wooded area, facing northeast. (PR21-014D045)

Image 13. Photograph showing surface visibility, facing southwest. (PR21-014D001)

Image 14. Crew field walking at 1 m intensification intervals near archaeological site BfGd-3, facing east. (PR21-014D003)

Image 15. Typical soil stratigraphy in the former pasture, facing east. (PR21-014D031)

Image 16. Typical soil stratigraphy in the wooded area, facing north. (PR21-014D039)

Image 17. Typical soil stratigraphy in the open area west of the gravel road, facing north. (PR21-014D060)

APPENDIX 1: Photographic Catalogue

Camera: Panasonic Lumix DMC-TS3 and Samsung Galaxy Tablet

Catalogue No.	Description	Dir.
PR21-014D001	Showing condition of ploughing for pedestrian survey	SW
PR21-014D002	Crew completing pedestrian survey	NW
PR21-014D003	1 m intensification previous near site	E
PR21-014D004	1 m intensification previous near site	W
PR21-014D005	Pedestrian survey	S
PR21-014D006	Pedestrian survey intensification	S
PR21-014D007	Crew testing in the field in the northeast end of the property	N
PR21-014D008	Crew testing in the field in the northeast end of the property	NW
PR21-014D009	Field in the northeast end of the property	SW
PR21-014D010	Field in the northeast end of the property	SE
PR21-014D011	Crew testing in the field in the northeast end of the property	N
PR21-014D012	Field in the northeast end of the property	W
PR21-014D013	Crew preforming pedestrian survey	S
PR21-014D014	Ploughed field	W
PR21-014D015	Ploughed field	W
PR21-014D016	Ploughed field	N
PR21-014D017	Crew testing in the field in the northeast end of the property	NW
PR21-014D018	Crew testing in the remnant wooded area to the east of the pit entrance road	NW
PR21-014D019	Crew testing in the remnant wooded area to the east of the pit entrance road	N
PR21-014D020	Crew testing in the remnant wooded area to the east of the pit entrance road	NE
PR21-014D021	Low wet area to the east of the pit entrance road	ENE
PR21-014D022	Crew testing in the remnant wooded area to the east of the pit entrance road	S
PR21-014D023	Pit entrance road showing push-piles	N
PR21-014D024	Pit entrance road showing push-piles	NE
PR21-014D025	Pit entrance road showing added fill to the west	S
PR21-014D026	Crew testing in the remnant wooded area to the east of the pit entrance road, north of the wet area	E
PR21-014D027	Crew testing in the remnant wooded area to the east of the pit entrance road, north of the wet area	S
PR21-014D028	North edge of the wooded area west of the pit entrance road showing disturbance	SW
PR21-014D029	Typical soil stratigraphy in unploughed field	E
PR21-014D030	Typical soil stratigraphy in unploughed field	E
PR21-014D031	Typical soil stratigraphy in unploughed field	E
PR21-014D032	Image of proposed plan	NE
PR21-014D033	Crew field walking at 5 m intervals	W
PR21-014D034	Crew shovel testing at 5 m intervals	NW
PR21-014D035	Crew testing in wooded area in centre of property	W
PR21-014D036	Crew testing in wooded area in centre of property	E
PR21-014D037	Standard stratigraphy for wooded area	N
PR21-014D038	Standard stratigraphy for wooded area	N
PR21-014D039	Standard stratigraphy for wooded area	N

Catalogue No.	Description	Dir.
PR21-014D040	Shovel Test south of gravel pit	NW
PR21-014D041	Crew Testing open field in centre of property	W
PR21-014D042	Ground conditions	W
PR21-014D043	Low wet area with standing water in centre of property	NE
PR21-014D044	Low wet area with standing water in centre of property	NE
PR21-014D045	Crew testing wooded area	NE
PR21-014D046	Disturbed area in centre north of the property	SW
PR21-014D047	Disturbed area in centre north of the property	S
PR21-014D048	Disturbed area in centre north of the property	S
PR21-014D049	Disturbed area in centre north of the property	SE
PR21-014D050	Disturbed area in centre north of the property	E
PR21-014D051	Disturbed area in centre north of the property	E
PR21-014D052	Disturbed area in centre north of the property	N
PR21-014D053	Disturbed area in centre north of the property	W
PR21-014D054	Low wet land in the centre of property	
PR21-014D055	Low wet land in the centre of property	E
PR21-014D056	Disturbed area due to former gravel road	S
PR21-014D057	Buried utilities	S
PR21-014D058	Buried utilities	SW
PR21-014D059	Disturbed area due to former gravel road	S
PR21-014D060	Standard stratigraphy for open area in middle of the property	N
PR21-014D061	Standard stratigraphy for open area in middle of the property	N
PR21-014D062	Disturbed area due to former gravel road	S
PR21-014D063	Pile of deadfall	NE
PR21-014D064	Wet lowlands in middle of study area	NW
PR21-014D065	Gravel pit road entry	N
PR21-014D066	Gravel pit road entry	NW
PR21-014D067	Conditions to the west end of the property near the road	W
PR21-014D068	Wooded area near wetland	N
PR21-014D069	View from SW edge of property	NE
PR21-014D070	Wooded area near wetland	NW
PR21-014D071	Low wet area to the east of the pit entrance road	ENE
PR21-014D072	Gravel road showing disturbance on either side	N
PR21-014D073	Disturbed soils near gravel road	NW
PR21-014D074	Edge of gravel road, showing disturbed area	NE
PR21-014D075	Edge of gravel road, showing disturbed area	NE
PR21-014D076	Edge of gravel road, showing disturbed area	NE
PR21-014D077	Edge of gravel road, showing disturbed area	N
PR21-014D078	Disturbed soils near gravel road	NW
PR21-014D079	Disturbed soils near gravel road	W
PR21-014D080	Wooded area near gravel road	E
PR21-014D081	Wooded area near gravel road	W

APPENDIX 2: Glossary of Archaeological Terms

Archaeology:
The study of human past by excavation of cultural material.

Archaeological Sites:
The physical remains of any building, structure, cultural feature, object, human event or activity which, because of the passage of time, are on or below the surface of the land or water.

Archaic:
A term used by archaeologists to designate a distinctive cultural period dating between c. 8000 and c. 1000 B.C. in eastern North America. The period is divided into Early (8000 to 6000 B.C.), Middle (6000 to 2500 B.C.) and Late (2500 to 1000 B.C.). It is characterized by hunting, gathering and fishing.

Artifact:
An object manufactured, modified or used by humans.

B.P.:
Before Present. Often used for archaeological dates instead of B.C. or A.D. Present is taken to be 1951, the date from which radiocarbon assays are calculated.

Backdirt:
The soil excavated from an archaeological site. It is usually removed by shovel or trowel and then screened to ensure maximum recovery of artifacts.

Chert:
A type of silica rich stone often used for making chipped stone tools. A number of chert sources are known from southern Ontario. These sources include outcrops and nodules.

Contact Period:
The period of initial contact between Indigenous and European populations. In Ontario, this generally corresponds to the seventeenth and eighteen centuries depending on the specific area.

Cultural Resource / Heritage Resource:
Any resource (archaeological, historical, architectural, artifactual, archival) that pertains to the development of our cultural past.

Cultural Heritage Landscapes:
Cultural heritage landscapes are groups of features made by people. The arrangement of features illustrates noteworthy relationships between people and their surrounding environment. They can provide information necessary to preserve, interpret or reinforce the understanding of important historical settings and changes to past patterns of land use. Cultural landscapes include neighbourhoods, townscapes and farmscapes.

Diagnostic:
An artifact, decorative technique or feature that is distinctive of a particular culture or time period.

Disturbed:
In an archaeological context, this term is used when the cultural deposit of a certain time period has been intruded upon by a later occupation.

Excavation:
The uncovering or extraction of cultural remains by digging.

Feature:
This term is used to designate modifications to the physical environment by human activity. Archaeological features include the remains of buildings or walls, storage pits, hearths, post moulds and artifact concentrations.

Flake:
A thin piece of stone (usually chert, chalcedony, etc.) detached during the manufacture of a chipped stone tool. A flake can also be modified into another artifact form such as a scraper.

Fluted:
A lanceolate shaped projectile point with a central channel extending from the base approximately one third of the way up the blade. One of the most diagnostic Palaeo-Indian artifacts.

Lithic:
Stone. Lithic artifacts would include projectile points, scrapers, ground stone adzes, gun flints, etc.

Lot:
The smallest provenience designation used to locate an artifact or feature.

Midden:
An archaeological term for a garbage dump.

Mitigation:
To reduce the severity of development impact on an archaeological or other heritage resource through preservation or excavation. The process for minimizing the adverse impacts of an undertaking on identified cultural heritage resources within an affected area of a development project.

Multicomponent:
An archaeological site which has seen repeated occupation over a period of time. Ideally, each occupation layer is separated by a sterile soil deposit that accumulated during a period when the site was not occupied. In other cases, later occupations will be directly on top of earlier ones or will even intrude upon them.

Operation:
The primary division of an archaeological site serving as part of the provenience system. The operation usually represents a culturally or geographically significant unit within the site area.

Palaeo-Indian:
The earliest human occupation of Ontario designated by archaeologists. The period dates between c. 9000 and c. 8000 B.C. and is characterized by small mobile groups of hunter-gatherers.

Profile:
The profile is the soil stratigraphy that shows up in the cross-section of an archaeological excavation. Profiles are important in understanding the relationship between different occupations of a site.

Projectile Point:
A point used to tip a projectile such as an arrow, spear or harpoon. Projectile points may be made of stone (either chipped or ground), bone, ivory, antler or metal.

Provenience:
Place of origin. In archaeology this refers to the location where an artifact or feature was found. This may be a general location or a very specific horizontal and vertical point.

Salvage:
To rescue an archaeological site or heritage resource from development impact through excavation or recording.

Stratigraphy:
The sequence of layers in an archaeological site. The stratigraphy usually includes natural soil deposits and cultural deposits.

Sub-operation:
A division of an operation unit in the provenience system.

Survey:
To examine the extent and nature of a potential site area. Survey may include surface examination of ploughed or eroded areas and sub-surface testing.

Test Pit:
A small pit, usually excavated by hand, used to determine the stratigraphy and presence of cultural material. Test pits are often used to survey a property and are usually spaced on a grid system.

Woodland:
The most recent major division in the pre-Contact cultural sequence of Ontario. The Woodland period dates from between c. 1000 B.C. and A.D. 1550. The period is characterized by the introduction of ceramics and the beginning of agriculture in southern Ontario. The period is generally divided into Early (1000 B.C. to A.D. 0), Middle (A.D. 0 to A.D. 900) and Late (A.D. 900 to A.D. 1550).

APPENDIX 3: Licensee Qualifications

STEPHANIE CLELAND, M.A.

Staff Archaeologist

Stephanie Cleland is a staff archaeologist with Past Recovery Archaeological Services Inc. Over the past fifteen years Stephanie has participated in archaeological research and cultural resource management projects (Stages 1 through 4) throughout eastern Ontario, in addition to her field school experiences in Belize. She has worked on over 50 Stage 1 through 4 archaeological assessments in the province. Stephanie has an extensive knowledge of both the pre-Contact and historical period cultural chronology of eastern Ontario, expertise in the interpretation of archaeological sites and is proficient in the interpretation and implementation of the 2011 *Standards and Guidelines for Consultant Archaeologists* (Ontario Ministry of Citizenship and Multiculturalism).

EDUCATION

M.A. Anthropology with a special emphasis on Bioarchaeology, University of Western Ontario, 2006
B.Sc. (Hons.), Anthropology/Archaeology, Trent University, 2004

Ontario Ministry of Citizenship and Multiculturalism Professional Licence: P1201
Licensed since 2011

ARCHAEOLOGICAL EXPERIENCE

STAFF ARCHAEOLOGIST, Past Recovery Archaeological Services Inc., 2009-present

- Directed and supervised fieldwork and prepared reports for Stage 1 through 4 archaeological assessments in Eastern Ontario, for clients including private developers, engineering firms, the National Capital Commission, the City of Kingston, the Ontario Ministry of Transportation, and the Ontario Ministry of Natural Resources and Forestry. • Engagement with Indigenous communities. • Field Archaeologist on numerous other projects. • Historical research. • Laboratory assistant.

ARCHAEOLOGICAL TECHNICIAN, Golder Associates Ltd., 2008-2009

- Field archaeologist for a variety of Stage 2 to 4 archaeological assessments in Eastern Ontario for private developments, the National Capital Commission, green energy projects, infrastructure and municipal development. • Historical research. • Laboratory assistant.

VOLUNTEER, 2007

- Archaeo Apprentice Program, Murphy's Point Provincial Park, Ontario.

ANTHROPOLOGY TEACHING ASSISTANT, University of Western Ontario, 2004-2006
Courses included: Mesoamerican Archaeology, Biological Anthropology, Introduction to Physical Anthropology and Introduction to Archaeology. Teaching Assistant Award Nominee (2006).

JUNIOR STAFF ARCHAEOLOGIST, 2003
Social Archaeology Research Project (SARP) Field School, Cayo District Belize

FIELD SCHOOL STUDENT, 2002
SARP Field School, Cayo District Belize

STEPHANIE CLELAND, M.A.

PUBLICATIONS AND REPORTS

Past Recovery Archaeological Services:

2022 Stage 1 Archaeological Assessment Point Crescent Open Space, Lot 9, Broken Front, Geographic Township of Kingston, City of Kingston, Ontario. *Prepared for the City of Kingston.*

2022 Stage 1 & 2 Archaeological Assessments, 100 Foot Park, Part Lots 14 and 15, Concession East of the Cataraqui River, Geographic Township of Pittsburgh, City of Kingston, Ontario. *Prepared for the City of Kingston*

2021 Stage 1 & 2 Archaeological Assessments, Proposed Cooney Pit, Part Lots 22 and 23, Concession 3, Geographic Township of Darling, Now Township of Lanark Highlands, County of Lanark. *Prepared for Cooney Construction & Landscape Ltd.*

2021 Stage 1&2 Archaeological Assessments for the Proposed Houchaimi Subdivision, Part Lot 14, Concession 10, Geographic Township of Ramsay, Now Municipality of Mississippi Mills, County of Lanark.

2021 Stage 1 Archaeological Assessment, Proposed Cooney Pit, Part Lots 22 and 23, Concession 3, Geographic Township of Lanark Highlands, County of Lanark. *Prepared for Cooney Construction and Landscape Ltd.*

2020 Stage 1 and 2 Archaeological Assessments of Bellwood Ridge Subdivision, Part Lots 8 and 9, Concession 2, Geographic Township of Cornwall, Now City of Cornwall, Ontario. *Prepared for Cornwall Gravel Co. Ltd.*

2020 Stage 2 Archaeological Assessment for a Proposed Campsite Electrification Project and Canoe Rack Installation, Lake St. Peter Provincial Park, Part Lots 5 and 6, Concession 12, Geographic Township of McClure, Now Municipality of Hastings Highlands, Hastings County, Ontario. *Prepared for Ontario Parks.*

2020 Stage 1 Archaeological Assessment Bassile Subdivision, Part Lots 7 and 8, Concession A, Geographic Township of Wolford, Now in the Village of Merrickville-Wolford, United Counties of Leeds and Grenville. *Prepared for Zander Plan Inc.*

2019 Stage 1 and 2 Archaeological Assessments, 'Earnscliffe' – 140 Sussex Drive, Part Lot o, Broken Front C, Geographic Township of Nepean, City of Ottawa, Ontario. *Prepared for Gemtec Consulting Engineers and Scientists.*

2019 Stage 1 and 2 Archaeological Assessments for the Replacement of the Laronde Creek Bridge and the Little Cache Creek Culvert, Highway 17 (GWP 5198-13-00), Part of the Nipissing Nation Lands and Part Lot 8, Concession 1, Geographic Township of Beaucage, and Part of Lots 10 and 11, Concession 2, Geographic Township of Springer, Nipissing District. *Prepared for McIntosh Perry Consulting Engineers Ltd.*

2019 Stage 2 Archaeological Assessment for Five Ottawa River Outfalls (Package 2 Locations), Various Los, Geographic Townships of Nepean and Gloucester, City of Ottawa, Ontario. *Prepared for Parsons Inc.*

2019 Stage 1 Archaeological Assessment 7913 Flewellyn Road (Area 6), Part Lots 8 and 10, all of Lot 9, Concession 9, Geographic Township of Goulbourn, City of Ottawa, Ontario. *Prepared for CDCI Research.*

2018 Stage 1 Archaeological Assessment of the Maple Ridge Subdivision (Phases 2 and 3), Part Lot 3, Concession 3, Geographic Township of South Elmsley, Town of Smiths Falls, Ontario. *Prepared for Zander Plan Inc.*

2018 Stage 1 Archaeological Assessment, Class EA for Bell Boulevard Widening Project, Part of Lots 37 and 38, Concession 2, Geographic Township of Sidney, Now City of Belleville, County of Hastings. *Prepared for the City of Belleville.*

2018 Stage 1 Archaeological Assessment of Brockville Long Swamp Fen Provincial Park, Various Lots, Concession 6, Geographic Township of Elizabethtown, Now Township of Elizabethtown-Kitley, United Counties of Leeds and Grenville, Ontario. *Prepared for Ontario Parks.*

2018 Stage 1 Archaeological Assessment of 910 Montreal Road, Part Lot 5, Concession 1, Geographic Township of Cornwall, City of Cornwall, Ontario.

2018 Stage 1 & 2 Archaeological Assessments for the Detail Design Study for the Replacement of Structures on Highway 400 at Innisfil Beach Road and the Barrie-Collingwood Railway and Reconstruction of Innisfil Beach Road I/C and Associated Works (GWP 2493-15-00; Assignment 2017-E-0030), Part Lots 6 and 7, Concessions 6 to 9, Geographic Township of Innisfil, New Town of Innisfil, County of Simcoe. *Prepared for McIntosh Perry Consulting Engineers* Ltd.

2018 Stage 2 Archaeological Assessment for Eleven Ottawa River Outfalls (Package 1 Locations), Various Lots, Geographic Townships of Nepean and Gloucester, City of Ottawa, Ontario. *Prepared for Parsons Inc.*

2018 Stage 1 and 2 Archaeological Assessments, Wellington Road Realignment, Kemptville, Part Lots 28 and 28, Concession 3, Geographic Township of Oxford on Rideau, Municipality of North Grenville. *Prepared for the Municipality of North Grenville.*

2018 Stage 1 and 2 Archaeological Assessment, for 6012 Garvin Road, Ottawa Hydro Substation Class EA, Part Lot 25, Concession 4, Geographic Township of Goulbourn, Village of Richmond, City of Ottawa, Ontario. *Prepared for exp Services Inc.*

2017 Stage 1 Archaeological Assessment, Woodbine Park, Part Lots 3 and 4, Concession 3, Geographic Township of Kingston, City of Kingston, Ontario. *Prepared for the City of Kingston.*

2017 Stage 1 Archaeological Assessment, West Park, Part Lot 4, Concession 1, Geographic Township of Kingston, City of Kingston, Ontario. *Prepared for the City of Kingston.*

2017 Stage 1 Archaeological Assessment, Springer Park, Part Lot 17, Concession 2, Geographic Township of Kingston, City of Kingston, Ontario. *Prepared for City of Kingston.*

2017 Stage 1 Archaeological Assessment, Meadowbrook Park, Part Lots 14 and 15, Concession 2, Geographic Township of Kingston, City of Kingston, Ontario. *Prepared for City of Kingston.*

2017 Stage 1 Archaeological Assessment, Queen Mary to Parkway Pathway, Part Lot 16, Concession 2, Geographic Township of Kingston, City of Kingston, Ontario. *Prepared for City of Kingston.*

2017 Stage 1 and 2 Archaeological Assessments for the McBean Street Bridge Replacement, Part Lot 24, Concession 3, Geographic Township of Goulbourn, Village of Richmond, City of Ottawa, Ontario. *Prepared for Morrison Hershfield Ltd.*

2017 Stage 1 and 2 Archaeological Assessment, for the Proposed Mallorytown Carpool Lot, County Road 5, Part Lot 20, Broken Front Concession, Geographic Township of Yonge, Now Township of Front of Yonge, United Counties of Leeds and Grenville. *Prepared for McIntosh Perry Consulting Engineers Ltd.*

2017 Stage 2 Archaeological Assessment of Proposed Infrastructure Projects at the Lally Homestead Site (BeGb-15), Murphy's Point Provincial Park, Part Lot 14, Concessions 4&5, Geographic Township of North Burgess, Now Tay Valley Township, Lanark County, Ontario. *Prepared for Ontario Parks.*

2017 Stage 1 & 2 Archaeological Assessments, Carp River Erosion Control Project, Part Lot 32, Concession 11, Geographic Township of Goulbourn, Carleton County, Now City of Ottawa, Ontario. *Prepared for McIntosh Perry Consulting Engineers Ltd.*

2017 Stage 1 Archaeological Assessment for Seven Ottawa River Outfalls (Package 2 Locations), Various Lots, Geographic Townships of Nepean and Gloucester, City of Ottawa, Ontario. *Prepared for Parsons Inc.*

2017 Stage 1 Archaeological Assessment for Thirteen Ottawa River Outfalls (Package 1 Locations), Various Lots, Geographic Townships of Nepean and Gloucester, City of Ottawa, Ontario. *Prepared for Parsons Inc.*

2017 Stage 1 Archaeological Assessment of 840 Princess Street, Pat Farm Lot 21, Concession 1, Geographic Township of Kingston, City of Kingston, Ontario. *Prepared for API Development Consultants Inc.*

2017 Stage 1 Archaeological Assessment, Proposed Shea Road, Community, Part Lot 25, Concession 10, Geographic Township pf Goulbourn, Carleton County, Now City of Ottawa, Ontario.

2017 Stage 1 Archaeological Assessment Proposed Pinery Estates Subdivision, Part Lots 1 & 2, Concession 6, Geographic Township of Huntley, Carleton County, Now City of Ottawa, Ontario.

2017 Stage 1 & 2 Archaeological Assessment of 7771/7775 Snake Island Road, Part Lot 20, Concession 6, Geographic Township of Osgoode, Carleton County, Now City of Ottawa, Ontario. *Prepared for McIntosh Perry Consulting Engineers Ltd.*

2017 Stage 1 Archaeological Assessment for the Main Street Reconstruction Project, Highway 15 to Summers Road, Village of Elgin, Geographic Township of South Crosby, Now Township of Rideau Lakes, United Counties of Leeds and Grenville, Ontario. *Prepared for Public Works, United Counties of Leeds and Grenville.*

2017 Stage 1 Archaeological Assessment, 2175 Prince of Wales Drive, Part Lot 26, Concession A, Geographic Township of Nepean, Carleton County, Now City of Ottawa, Ontario. *Prepared for Myers Automotive Group.*

2017 Stage 1 and 2 Archaeological Assessments, of the Proposed South Gower Pit, Part Lots 5 and 6, Concession 5, Geographic Township of South Gower, Municipality of North Grenville. *Prepared for Cornwall Gravel Co. Ltd.*

2017 Stage 1 Archaeological Assessment, 2113-2125 Carp Road, Part Lot 2, Concession 3, Geographic Township of Huntley, Carleton County, Now City of Ottawa, Ontario. *Prepared for Myers Automotive Group.*

2017 Stage 1 Archaeological Assessment, 5639 Bank Street, Part Lot 1, Concession 5, Geographic Township of Osgoode, Carleton County, Now City of Ottawa, Ontario. *Prepared for Myers Automotive Group.*

2013 Stage 1 Archaeological Assessment of the Stonebridge Phase 14 Property, Part Lot 7, Concession 2, Rideau Front, Geographic Township of Nepean, Carleton County, Now in the City of Ottawa. *Prepared for Monarch Corporation.*

2012 Stage 1 & 2 of the Longfields Community Church Property, Part of Lot 13, Concession II, Rideau Front, Geographic Township of Nepean, Carleton County, Now in the City of Ottawa. *Prepared for Vandenberg & Wildeboer Architects Inc.*

2012 Stage 1 Archaeological Assessment for the North Glengarry Regional Water Supply Project Class EA, Various Lots, Geographic Townships of Kenyon and Charlottenburg, Now in the Townships of North and South Glengarry, Current United Counties of Stormont, Dundas and Glengarry. *Prepared for CH2M Hill Canada Limited*

2012 Stage 1 Archaeological Assessment of the Proposed Hammond Pit, Part Lot 2, Concession 5, Geographic Township of Leeds, Now the Township of Leeds and the Thousand Islands, United Counties of Leeds and Grenville, Ontario. *Prepared for ZanderPlan Inc.*

2012 Stage 1 Archaeological Assessment of the Proposed Redeemer Christian Highschool Expansion, Part Lot 30, Concession A, Rideau Front, Geographic Township of Nepean, Carleton County, Now in the City of Ottawa. *Prepared for Kollaard Associates*

2012 Stage 1 &2 Archaeological Assessment of the Bernard Property, Township of Central Frontenac, Official Plan Amendment, Pert Lots 1 and 2, Concession X, Geographic Township of Olden, Frontenac County. *Prepared for Robert Bernard, property owner*

2011 Stage 1 & 2 Archaeological Assessment, the Proposed Shamess Subdivision, Part Lot 4, Concession 8, Geographic Township of Petawawa, Town of Petawawa, Renfrew County, Ontairo. *Prepared for Novatech Engineering Consultants Ltd.*

2011 Stage 1 & 2 Archaeological Assessment of the J.W. Southwell Property, Part Lot 12, Concession XII, Geographic Township of Beckwith, Lanark County. *Prepared for Carlgate Development Inc.*

2011 Stage 1 Archaeological Assessment of Intersection Modifications at Bank Street/Conroy Road/Kemp Drive, Part Lot 14, Concessions IV and V, Geographic Township of Gloucester, City of Ottawa, Ontario. *Prepared for Morrison Hershfield.*

2011 Stage 1 Archaeological Assessment of the Proposed McNabb Single Family Home, Part Town Lot 67 within Lot 14, Concession XII, Geographic Township of Beckwith, Lanark County. *Prepared for Ruth and Brooke McNabb*

2011 Stage 2 Archaeological Assessment of Two Proposed Severances for S&A Developing, Part Lot 6, Concession V, Geographic Township of Pittsburgh, City of Kingston, Frontenac County. *Prepared for S&A Developing.*

2011 Stage 1 & 2 Archaeological Assessment of the Proposed Cronk Severance, Lot 27, Concession VII, Geographic Township of Hinchinbrooke, Frontenac County. *Prepared for Mr. Lynn Cronk.*

2011 Stage 1 Archaeological Assessment of 318 and 320 Alfred Street and 1, 11 and 15 Mack Street, City of Kingston, Ontario. *Prepared for Podium Development.*

2011 Stage 1 & 2 Archaeological Assessment of 505, 513 Albert Street and 605 Princess Street, City of Kingston, Ontario. *Prepared for Podium Development.*

2010 Stage 1 and 2 Archaeological Assessments of the Proposed Ralph Shaw – Townline Road Subdivision, Part Lot 11, Concession XII, Geographic Township pf Beckwith, Lanark County.

2011 Stage 1, 2 & 3 Archaeological Assessment of the Proposed Badger Daylighting Services, Carp Road Property, Part Lot 7, Concession 2, Geographic Township of Huntley, City of Ottawa, Ontario. *Prepared for McIntosh Perry Consulting Engineers Ltd.*

2010 Stage 1 & 2 Archaeological Assessment of the Proposed Kennedy Severance, Part Lots 1 & 2, Concession VII, Geographic Township of Oso, Frontenac County, Ontario. *Prepared for Mr. L. Kennedy.*

2010 Stage 1 & 2 Archaeological Assessment of the Ennis Road Bridge Replacement, Tay Valley Township, Lanark County, Ontario. *Prepared for McIntosh Perry Consulting Engineers Ltd.*

2010 Stage 2 Archaeological Assessment of the Joe's Lake Bridge Replacement, Part Lot 14, Concession III, Geographic Township of Lavant, Lanark County. *Prepared for AECOM & The Township of Lanark Highlands.*

2010 Stage 2 Archaeological Assessment of the Southwest Transitway Extension Proposed Pinecrest Creek Outfall Sewer (North of Baseline Road), City of Ottawa. *Prepared for MMM Group Limited.*

2010 Stage 3 Archaeological Assessment Rock Island Site (BdFx-2), Rock Island Camp Senior's Resort Property, Lot 9, Front of Yonge Township, United Counties of Leeds and Grenville. *Prepared for Mr. Bill Hallett and Mr. Bob Race, Rock Island Camp.*

2010 Stage 1 Archaeological Assessment of the Proposed Don Cooney Gravel Pit, Part Lot 9, Concession VI, Geographic Township of Sidney, Hastings County. *Prepared for G.D. Jewell Engineering Inc.*

2010 Stage 1 Archaeological Assessment of the Dobbs Subdivision, Part Lots 22 and 23, Concession I, Geographic Township of Pembroke, Renfrew County, Ontario. *Prepared for Zander Plan Inc.*

2010 Stage 2 Archaeological Assessment of the Dobbs Subdivision, Part Lots 22 and 23, Concession I, Geographic Township of Pembroke, Renfrew County, Ontario. *Prepared for Zander Plan Inc.*

2009 Stage 1 Archaeological Assessment of the North Grenville Public Library, Lot 27, Concession III, Geographic Township of Oxford, Kemptville, Ontario. *Prepared for MHPM Project Managers Inc.*

2009 Stage 1 Archaeological Assessment of the Proposed Kennebec Lake Development, Part Lots 18 & 19, Concession IX, Geographic Township of Kennebec, Frontenac County, Ontario. *Prepared for McIntosh Perry Consulting Engineers Ltd.*

2009 Stage 2 Archaeological Assessment of the Town of Mississippi Mills Almonte Ward Communal Sewage System Pumping and Treatment Plant Location, Part Lot 16, Concession VIII, , Geographic Township of Ramsay, Lanark County. *Prepared for The Thompson Rosemount Group Inc.*

2009 Stage 1 Archaeological Assessment of the Proposed Russell Pumping Station Sites, Lot 11, Concession III, Geographic Township of Russell, Russell, Ontario. *Prepared for AECOM.*

2009 Stage 2 Archaeological Assessment of the Proposed Russell Pumping Station Sites, Lot 11, Concession III, Geographic Township of Russell, Russell, Ontario. *Prepared for AECOM.*

Golder Associates:

2009 Stage 1 Archaeological Assessment of the Longfields-Jockvale Connecting Link, Strandherd Drive to Jockvale Road, Lots 13, 14, 15, Concession 2, Rideau Front, Geographic Township of Nepean.

Academic:

Primary Author:

2006 Dental Microwear Analysis at Altun Ha, Belize. M.A. Thesis, University of Western Ontario.

Co-Author:

2014 Human Dedicatory Burials from Altun Ha, Belize: Exploring Residentical History Through Enamel Microwear and Tissue Isotopic Compositions. In, The Bioarcheology of Space and Place: Ideology, Power, and Meaning in Maya Mortuary Contexts. Pages 169-192. Springer, New York.

2009 Human Dedicatory Burials from Altun Ha, Belize: Exploring Residential History through Enamel Microwear and Isotopic Analysis. Article submitted to Latin American Antiquity, review pending.

2008 Examining Sacrifice: The Symbolic Roles of 'the other' and the Ideological Role of the Warrior. Presented by Karyn Olsen at the 73rd Annual Meeting of the Society for American Archaeology, Symposium on the Meaning of Violence in Ancient Societies, Vancouver B.C.

2007 Exploring Residential History of Dedicatory Burials at Altun Ha, Belize Using Enamel Microwear and Isotopic Analysis. Presented by Karyn Olsen at the 72nd Annual Meeting of the Society for American Archaeology, Symposium on Maya Archaeology in Belize, Austin TX.

2005 Bioarchaeology Redux: A Holistic Approach to the Study of Biological Material. Presented by Lana Williams at the Annual Meeting of the Canadian Association for Physical Anthropology, London ON.