Planning Justification Report

in support of Official Plan and Zoning By-law Amendments
Proposed Freymond Quarry

Prepared for:
Mr. Lou Freymond

EcoVue Ref: No. 10-1136

July 3, 2012

[redacted]

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SERVICES INC.

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1.0 PURPOSE OF APPLICATION

This report is being submitted in support of an application for an amendment to the County of Hastings Official Plan and an amendment to the Township of Faraday Zoning By-law to permit the development of a quarry and a pit at Lots 51 and 52, Concession W.H.R. in the Township of Faraday in the County of Hastings. The location of the subject property is shown on **Figure 1 – Site Location**. The purpose of these amendment applications is to allow the establishment of a Class 'A' licensed aggregate operation below the water table on the subject lands.

1.1 DESCRIPTION OF THE PROPOSED AGGREGATE EXTRACTION AREA

The licensed area will occupy 35 hectares of the existing 96 hectare lot. The applicant is requesting a license to remove up to 1,000,000 tonnes of material a year which will consist of crushed rock and gravel. The applicant has submitted an application to the Ministry of Natural Resources (MNR) for a Class 'A' license (Category 2 (quarry) – Below the water table) under the *Aggregate Resources Act*. Extraction will take place in an east to west direction.

The Site Plans that will accompany the ARA application are being finalized as of the date of this report. The draft Site Plans will be submitted to the County and Township for comment at a later date.

An existing Class 'B' pit (above the water table) for the extraction of sand is located on the subject property. The proposed Class 'A' quarry will be located southwest of the existing pit. Extraction in the proposed quarry will take place on the north-facing slope of a large hill on the subject property.

1.1.1 Rehabilitation Process

Before extraction begins in each phase, topsoil and subsoil will be removed and stored in berms adjacent to the property boundaries, placed in on-site stockpiles, or used immediately to rehabilitate depleted areas. All berms and stockpiles will be seeded with native grass/legume mixtures to create short term wildlife habitat and prevent erosion and dust from leaving the site.

Depleted areas will be rehabilitated during excavation as soon as it is feasible and practical. The stockpiled topsoil will be used in rehabilitating depleted areas and will assist natural regeneration of native species. Trees and vegetation will be replanted in accordance with the approved rehabilitation plan using native tree species. Topsoil or other materials that will aid rehabilitation may be imported if on-site material or supplies are inadequate.

Rehabilitation of the quarry floor will be uneven in order to allow water to collect and create pools that will develop into small wetlands and potential amphibian breeding habitat. A wetland restoration professional will be consulted to assist with re-establishing wetland amphibian habitats. Conditions will be created in the pool areas that will encourage the establishment of wetland vegetation naturally and by planting.

1.1.2 Pre-Consultation and Required Studies

On January 5, 2011, representatives of EcoVue Consulting met with Township staff, Reeve Tinney, Deputy Reeve Nicholson, County planning staff and representatives of the Ministry of Natural Resources for a pre-consultation meeting regarding the proposed quarry. It was determined at the meeting that several studies would be required to be undertaken in support of the applications. They are as follows:

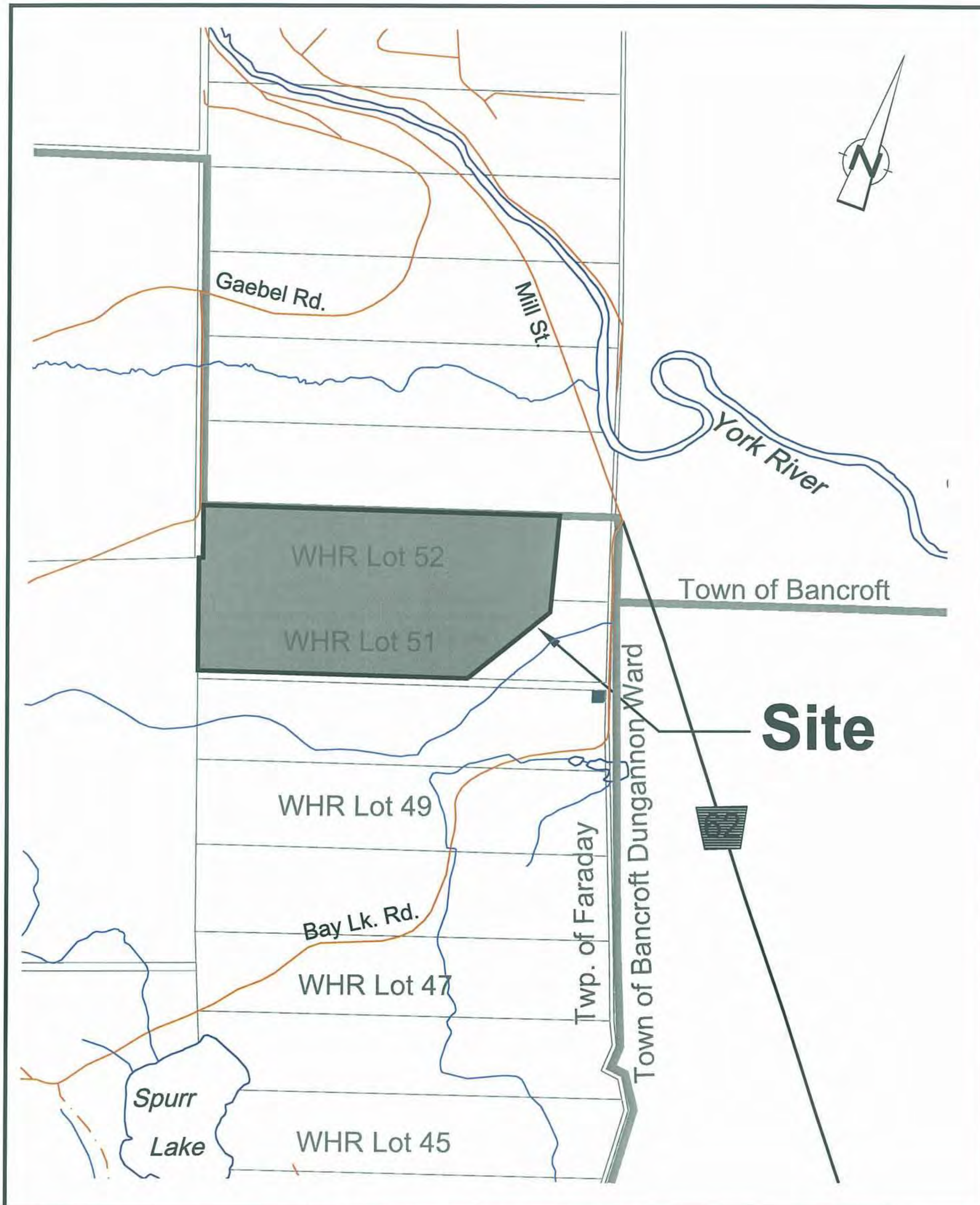
1. **Cultural and Built Heritage Resources Assessment Report (Archaeological Assessment)** – A Stage 1 & 2 Archaeological Assessment was completed by Ken Swayze in February of 2011 and was given clearance by the Ministry of Tourism and Culture (MTC) in September of 2012. The Assessment (with Clearance Letter) has been included as Appendix D to this report.

2. **Hydrogeological Assessment Report** – A Stage 1 & 2 Hydrogeological Assessment was carried out on the subject lands by MTE in 2012 and has been submitted as Appendix B to this report.

3. **Stormwater Management Report** – Stormwater management will be integrated into the site plans that will be submitted as part of the ARA application.

4. **Environmental Impact Study** – A Natural Environment Levels 1 and 2 Report and Environmental Impact Statement was completed by Robin Craig in October of 2011 and has been submitted as Appendix A to this report.

5. **Traffic Impact Assessment Report** – A Traffic Impact Study was completed by Tranplan Associates in May 2012. An Addendum to the study (titled "Traffic Brief: South Site Entrance) was also completed clarifying that the south entrance on the subject property will be used for trucks accessing the quarry. Both the Study and the Brief are being submitted as Appendix C to this report.



EcoVue Consulting Services Inc. 25 Reid Street P.O. Box 129 Lakefield, Ontario, Canada K0L 2H0 Tel: 705-652-8340 Fax: 705-652-1607 www.ecovueconsulting.com	DRAWN BY: MAM	PROJECT No.: 10-1136	Freymond Aggregates Part of Lots 51 and 52, Concession W.H.R. Township of Faraday Site Location Plan
	CHECKED BY: HS	HORIZ. SCALE: 1:12,500	
	REVISION DATE: November 25 2010	PLOT DATE: November 25 2010	Figure 1

2.0 SUBJECT PROPERTY

The subject property is 96 hectares in total area, of which 35 hectares will be licensed for Class 'A' aggregate extraction (below the water table). Freymond Lumber operates a lumber yard and small licensed sand pit on the subject property, along with several buildings used for storage and offices. Transport trucks hauling lumber and dump trucks hauling sand frequently enter and exit the property onto Bay Lake Road.

2.1 LOCATION

The subject property is located at Parts of Lots 51 and 52, Concession WHR, Township of Faraday, and Part of Lot 53 in the Town of Bancroft, County of Hastings. All parts of the property that are subject to this report and *Planning Act* applications are located entirely within the Township of Faraday. The property fronts onto Bay Lake Road and access to and from the subject lands will occur at the existing entrance to the existing lumber yard. The Town of Bancroft (town centre) is 2.3 kilometres north of the site, while the hamlet area of L'Amable is 4.3 kilometres southeast.

2.2 TOPOGRAPHY

The subject property is flat near the road with a large hill occupying much of the property west of the existing structures and sand pit. The proposed extraction will take place on this hill which is composed of Precambrian rock with limited topsoil. The topography is quite rugged and typical of the Canadian Shield, ranging in elevation from 390 metres (1,283 ft.) above sea level in the western part of the property (summit of hill), to 329 metres (1,077 ft.) above sea level near Bay Lake Road.

2.3 VEGETATION

The property is predominantly tree covered with cleared areas near the road where the existing pit and logging operations occur. The trees consist of a dense mixed forest of coniferous and deciduous trees.

2.4 ENVIRONMENTAL CONSIDERATIONS

As outlined in the Environmental Impact Study (EIS) (Appendix A), conducted by Robin Craig, there are no Areas of Natural or Scientific Interest (ANSIs) nor any records of Vulnerable, Threatened, or Endangered Species (VTEs) on or immediately adjacent to the subject lands. There is a small, cool water stream that crosses the southeast corner of the property and empties into the nearby York River about 500 metres east of the subject property. The extraction area will be at least 30 metres from the watercourse and preventative measures will be taken to avoid negative impacts to the creek. The extraction will also have no perceived effect on groundwater flow as demonstrated in the Hydrogeological Study conducted by MTE Consultants. Groundwater will be consistently monitored, as required for Class ‘A’ quarries/pits by the *Aggregate Resources Act.*

2.5 SURROUNDING LAND USES

The subject lands are located in a mainly rural area with some commercial activity to the north and south, along Highway 62. The lands are mostly surrounded by dense, undeveloped forests. There is residential development approximately 350 metres to the south on Bay Lake Road and to the north on Gaebel and Jeffrey Lake Roads. The York River is approximately 400 metres east of the subject lands.

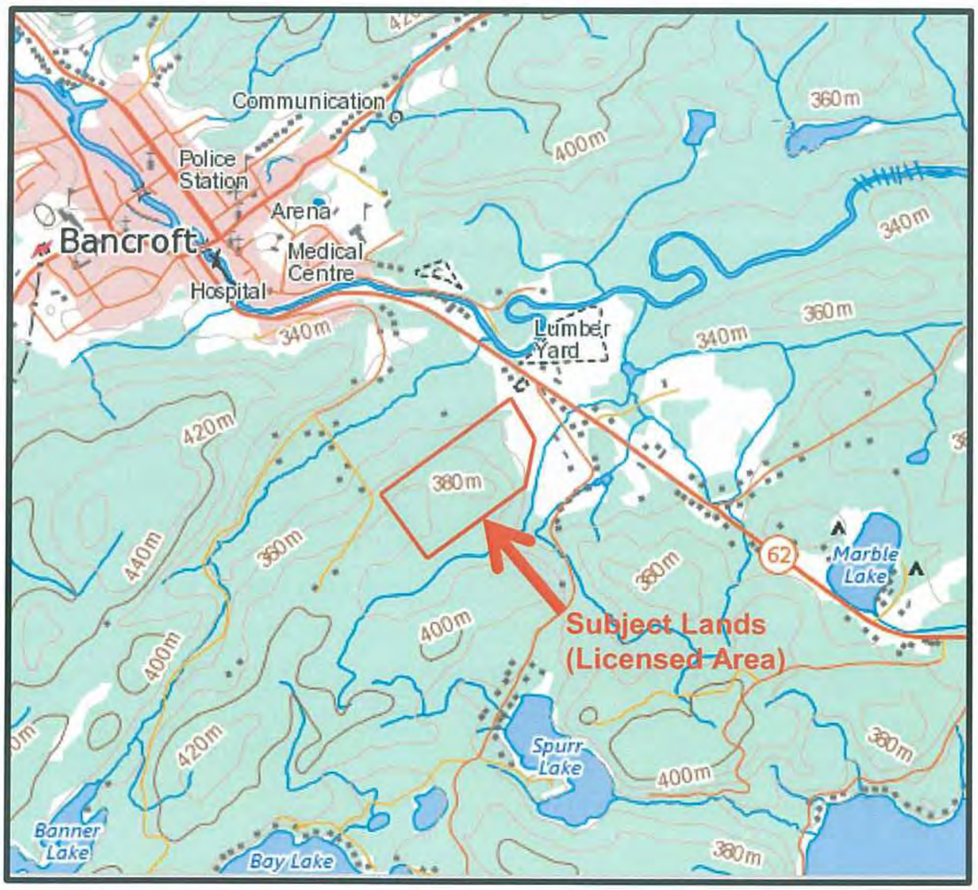


Figure 2 - Topographical Mapping Showing Subject Lands and Surrounding Area

3.0 POLICY CONSIDERATIONS

Land use policies and regulations affecting the subject lands include the *Planning Act R.S.O. 1990, as amended*, and the associated *Provincial Policy Statement* at the provincial level, as well as the County of Hastings Official Plan and the Township of Faraday Zoning By-law at the local level.

3.1 PROVINCIAL POLICY STATEMENT CONSIDERATIONS

The Provincial Policy Statement (PPS) provides a policy framework for land use within the Province of Ontario. It is the responsibility of the local planning authorities, in this case the County of Hastings and Township of Faraday, to uphold the policies of the Provincial Policy Statement, pertaining to land use planning and development. In particular, the planning authority must ensure that its decisions are consistent with key provincial interests including the wise use and management of rural areas, agricultural areas, mineral resources, natural heritage, natural hazards, and water quality.

3.1.1 Managing and Directing Land Use – Rural Areas in Municipalities

Section 1.1.4 of the PPS is intended to control the development of lands outside urban settlement boundaries. The only development accepted in these areas includes management or use of resources, resource-based recreational activities, limited residential development and other rural land uses. The intention of this provision is to limit urban sprawl and direct growth to urban settlement areas with existing municipal services. The establishment of a quarry, a resource-based development, is consistent with this section.

3.1.2 Wise Use and Management of Resources – Natural Heritage

Section 2.1 of the PPS states that Natural Heritage areas shall be protected for the long term. The proposed area to be licensed for extraction does not include a watercourse, nor are there any provincially significant wetlands, woodlands or valleylands nearby. The Environmental Impact Study (EIS) conducted by Robin Craig on the subject lands concludes that there will be no perceived negative environmental impact from the proposed aggregate operation. Rehabilitation has been recommended to restore the site and in some cases enhance natural features such as wildlife corridors by increasing widths, planting and eliminating tillage. Therefore, the proposed quarry on the subject lands appears to be consistent with Section 2.1 of the PPS.

3.1.3 Water

In Section 2.2 of the PPS it is outlined that planning authorities must protect, improve or restore the quality and quantity of water. New development can only be permitted where it has been demonstrated that surface water features, groundwater features, hydrologic functions and natural heritage features will not be adversely impacted. Although extraction on the site will be taking place below the water table, the proposed aggregate development is not expected to result in any impact on water quality or quantity in the area. As shown in the Hydrogeological Assessment (Appendix B), the quality and quantity of water will remain constant throughout the period of extraction. Monitoring wells will be established on site and in the vicinity of the licensed area in order to ensure the ongoing quality and quantity of groundwater during extraction. Therefore, the subject development appears to be consistent with Section 2.2 of the PPS. On-site monitoring will be undertaken to ensure that no adverse impact will occur.

3.1.4 Mineral Aggregate Resources

The proposed aggregate extraction area is located within an area identified as a Mineral Aggregate Area on Schedule 5.2.1 to the County of Simcoe Official Plan. Aggregate resources are identified "*as a key factor in the long-term prosperity of the Province of Ontario. Section 2.5.2 of the PPS states that as much of the mineral aggregate resources as is realistically possible should be made available as close to markets as possible*". This section reflects the recognized demand for aggregate material within the Province of Ontario. Therefore, operators of pits and quarries are not required to demonstrate demand for their product.

The PPS also states that extraction shall be undertaken in a manner which minimizes social and environmental impacts as the extraction area will be separated from nearby sensitive land uses. This includes a large buffer from adjacent properties and a haul route that avoids residential enclaves.

The proposed aggregate extraction will be conducted in a manner consistent with Section 2.5 of the PPS, as well as the *Aggregate Resources Act*, R.S.O 1990, making it a sustainable, long-term resource-based operation. As demonstrated herein, there will be no adverse social and environmental impact as a result of the proposed extraction of the resources from this deposit.

3.1.5 Cultural Heritage and Archaeology

Section 2.6 of the PPS states that *"development and site alteration shall only be permitted on lands containing archaeological resources or areas of archaeological potential if the significant archaeological resources have been conserved by removal and documentation or by preservation on site"*. The archaeological resource potential of the lands was considered and a Stage 1 and 2 Archaeological Assessment (**Appendix D**) was undertaken by Kinickinick Consultants on the subject lands. The Assessment concluded that there are no archaeological resources present on the site. Also, clearance for development has been received from the Ministry of Tourism and Culture (letter of site clearance is included with **Appendix D**). Therefore, the proposed extraction is consistent with the policies of Section 2.6 of the PPS.

3.1.6 Natural Hazards

Section 3.1 of the PPS addresses development that occurs within natural and man-made hazards. The site is not associated with any natural hazard, such as floodplain, steep slopes or unstable soils or bedrock. Also, there is no history of contamination of soils on the site or other suspected man-made hazards on the site. Therefore, the proposed development is consistent with Section 3.1 of the PPS.

3.2 MUNICIPAL PLANNING DOCUMENTS

In addition to demonstrating consistency with provincial planning policies, the proposal must also comply with the upper and lower tier municipal planning documents. The County of Hastings Official Plan, as the primary planning document for the Township of Faraday, provides a guide for the general land use and development issues within the County as well as land use planning specific to the Township of Faraday through detailed policies and provisions respecting local development objectives and issues.

3.2.1 County of Hastings Official Plan

The subject property is designated as <u>Rural</u> on Schedule "A5-1" to the Official Plan of the County of Hastings (**Figure 2 – Schedule 5.1 – County of Hastings Official Plan**). According to Section 3.3 of the Official Plan, new mineral aggregate extraction operations are not permitted within the Rural designation. Therefore, an Official Plan Amendment that redesignates the property <u>Extractive</u> is required in order to permit a quarry on the subject lands.

The County has also identified areas with high potential for future aggregate extraction as Extractive (Reserve) on Schedule "A5-1" to the Hastings Official Plan. According to Schedule "A5-1", the subject lands are not within an Extractive Reserve area. However, the surrounding area is noted as being high in aggregate potential as there are identified reserve areas on adjacent properties to the south, as shown on Schedule "A5-1".

3.2.1.1 EXTRACTIVE DESIGNATION

According to Section 3.8.1 of the County Official Plan the Extractive designation is intended to recognize "*licensed or permitted mines, pits and quarries that involve the extraction of either minerals or aggregates*". Permitted uses in the Extractive designation include: "pits and quarries" (Section 3.8.2). Therefore, the proposed quarry would be permitted under the Extractive designation.

3.2.1.1.1 Amendments to the Official Plan (Extractive)

Section 3.8.3 of the Official Plan speaks to Amendments to the Official Plan, where redesignation to the Extractive designation is concerned. An amendment to the Township of Faraday Zoning By-law 3-93 (see **Section 3.2.2** of this report) is also required, in addition to consistency with the following policies:

a) *Area, Location and Potential*

Areas identified as "Extractive" or as "Extractive (Reserve)" on the Land Use Schedules of this Plan shall be used as a guide in determining the location of new mines, pits or quarries. The proponent shall furnish County Council with an estimate of the quantity and value of material available.

As previously stated in this report, the proposed operation is not within an area identified as Extractive (reserve). However, the proposed extraction site adjacent to a high potential site and is within an area of the Township that has traditionally featured extraction and larger industrial operations. The subject lands are also more than 300 metres from the nearest sensitive land use and is an ideal site for haul routes and access to major roads.

In terms of quantity and quality, the proposed operation will be a "Class A – Category 2" licensed quarry, extracting a maximum of 1,000,000 tonnes of crushed stone and gravel below the water table. Due to demand and equipment constraints, the amount of material extracted from the quarry is not expected to exceed more than 200,000 tonnes per year. The extracted material will be used in a variety of building and construction projects and is of great value to that sector.

The Province of Ontario does not require quarry operators to demonstrate demand for aggregate product. Section 2.5.2 of the PPS does not speak to demonstrating "need" as this section infers that there is a constant need. The quality of aggregate within the proposed quarry is high and can be utilized by the construction industry. Otherwise, there would be no incentive for the land owner to initiate the OPA/ZBA and ARA application and approvals process. Nonetheless, it has been estimated that there is approximately 30,000,000-40,000,000 tonnes of material that can be extracted. Depending on the rate of extraction each year (which will fluctuate), the pit and quarry can be operation for up to 90-100 years or more. This material is of high quality and will be used for construction and building purposes. The demand, combined with the above mentioned access to major provincial highways connecting to larger population centres in the south, east and west, makes the subject property an ideal site for an aggregate operation.

b) *Excavation Boundaries*

No mine, pit or quarry may be excavated in such a way that its face is at a point less than the minimum distance permitted in the implementing zoning by-law from the limit of any road or other property boundary.

Excavation on the site will take place in an east to west direction, away from Bay Lake Road. The face of the excavation will be beyond the required 35 metres from adjacent residential, commercial, community facilities or industrial uses, as stipulated in the Township of Faraday Zoning By-law 3-93. Furthermore, the limit of the licensed area will be beyond the required 350 metres from adjacent residential, commercial, community facilities or industrial uses, as stipulated in the new Township of Faraday Zoning By-law that has not yet been approved.

c) *Impact Assessments*

Councils shall have regard for the potential adverse impacts of the proposal to on-site and off-site conditions including adjacent uses, structures, facilities or the natural environment. To determine conformity with this policy, Councils shall require the assessment of the following:

i) *Noise, dust, vibration, air or water discharges, bright light, erosion, sedimentation, and*

As explained in Section 1.1.2 of this Report, a Noise Study was completed by Hugh Williamson & Associates. The study took into account sensitive receptors within the surrounding area, including residential dwellings and commercial buildings. The Noise Study concluded that the noise emanating from the extractive operations on the subject property will create a minimal impact on nearby sensitive land uses if certain mitigation measures are taken by the quarry operator (explained in further detail in Appendix E). Measures include the introduction of noise barriers during blasting and crushing, as well as avoiding the use of more than one piece of large equipment simultaneously.

The MOE sets out regulations for containing dust on aggregate industrial sites. The proposed quarry will adhere to these regulations. The MOE has also established regulations for monitoring vibration. The proposed equipment that will be used on sight will remain under the vibration limits regulated by the MOE.

Impacts such as air or water discharges and bright light are not applicable to this particular aggregate operation. The quarry will not operate with equipment that will emit significant air or water discharges or flash bright light.

ii) Potential interference with wildlife, vegetation, hydrogeology, surface drainage, roads and aesthetic appearance.

A traffic impact study was undertaken by Tranplan Associates in May of 2012. The Study examined the proposed quarry's impact on existing traffic and the implications for potential modifications to the existing road network. The study (together with an addendum ("Brief")) concluded that the anticipated traffic from the proposed quarry could be absorbed into the existing road network and would not negatively impact existing traffic levels. However, if extraction on-site exceeded 400,000 tonnes per year, a northbound left turn lane on Highway 62 would be required.

A Natural Environmental Report and Environmental Impact Statement (EIS), conducted by Robin Craig, concluded that there will be limited environmental impact from the quarry if certain mitigative measures are applied during extraction and rehabilitation. A hydrogeological study was conducted on the property by MTE and concluded that if certain measures are implemented (as discussed in Appendix B), groundwater will not be negatively affected by excavation below the water table.

Aesthetically, the quarry will operate out of view from regular traffic on Bay Lake Road or Highway 62. The quarry will be well shielded from view on Highway 62 and Bay Lake Road.

d) Cultural and Heritage Resources

Before beginning extraction works, an assessment of cultural and heritage resources of any lands affected by the operation shall be completed, as may be required, in accordance with Provincial Cultural and Heritage Resources guidelines.

As mentioned earlier in this report, an archaeological assessment of the lands has been undertaken by Kinickinick Heritage Consulting. The assessment concluded that there are no known artifacts on the property, and a Stage 3 archaeological assessment is not required. The assessment received clearance from the Ministry of Tourism and Culture (MOTC). There are no known cultural or heritage resources located on the property and the proposed quarry appears to be consistent with Section 2.6 of the PPS (see: **Section 3.1.5**).

e) Site Development Plan and Agreement

The Site Plans are reviewed and approved by the Ministry of Natural Resources (MNR) as part of the ARA Application process. This is expected to take place concurrently with the *Planning Act* applications as described in this report. The Site Plans will incorporate all of the recommended mitigation measures identified in the supporting documents. These include, but are not limited to:

- noise mitigation;
- dust control;
- rehabilitation of the site;
- limits on extraction; and
- operating hours.

Furthermore, the applicant is prepared to enter into a development agreement with the Township and/or County, if required.

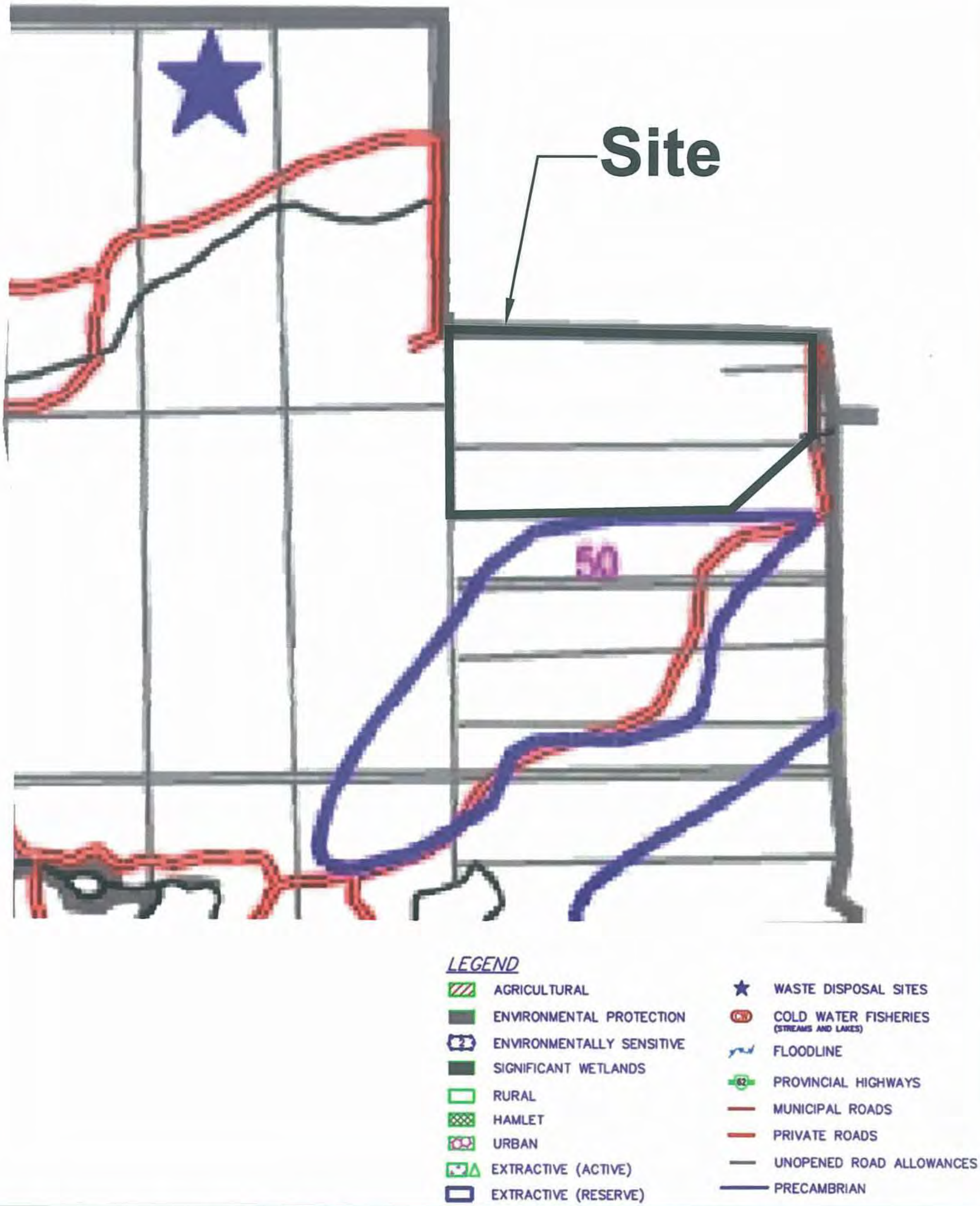
Overall, the development is consistent with the policies of the Extractive designation, including the amendment provisions.

3.2.2 Township of Faraday Zoning By-law

According to Schedule "A" to the Township of Faraday Zoning By-law, the proposed licensed area on the subject lands is zoned the Rural (RU) Zone (as seen on **Figure 4 – Schedule A – Township of Faraday Zoning By-law 3-93**). As discussed in the previous section of this report, the proposed development of an aggregate extraction area will require an amendment to the Zoning By-law that rezones the licensed area from the Rural (RU) Zone to the Extractive Industrial (MX) Zone. The proposed quarry will be developed in accordance with the provisions and regulations of the Extractive Industrial (MX) Zone.

3.3 SUMMARY OF POLICY CONSIDERATIONS

The proposed quarry development is consistent with the provisions set out in the policy and regulations affecting the subject lands, including the *Planning Act, R.S.O. 1990,* as amended, and the associated Provincial Policy Statement. The proposal also maintains the intent of County of Hastings Official Plan, but requires an amendment to redesignated the lands as Extractive. A Zoning By-law amendment that rezones the property from the Rural (RU) Zone and Extractive Industrial (MX) Zone to only the Extractive Industrial (MX) Zone is also required. This change in zoning is consistent with the policies and regulations of the Province, County and Township.



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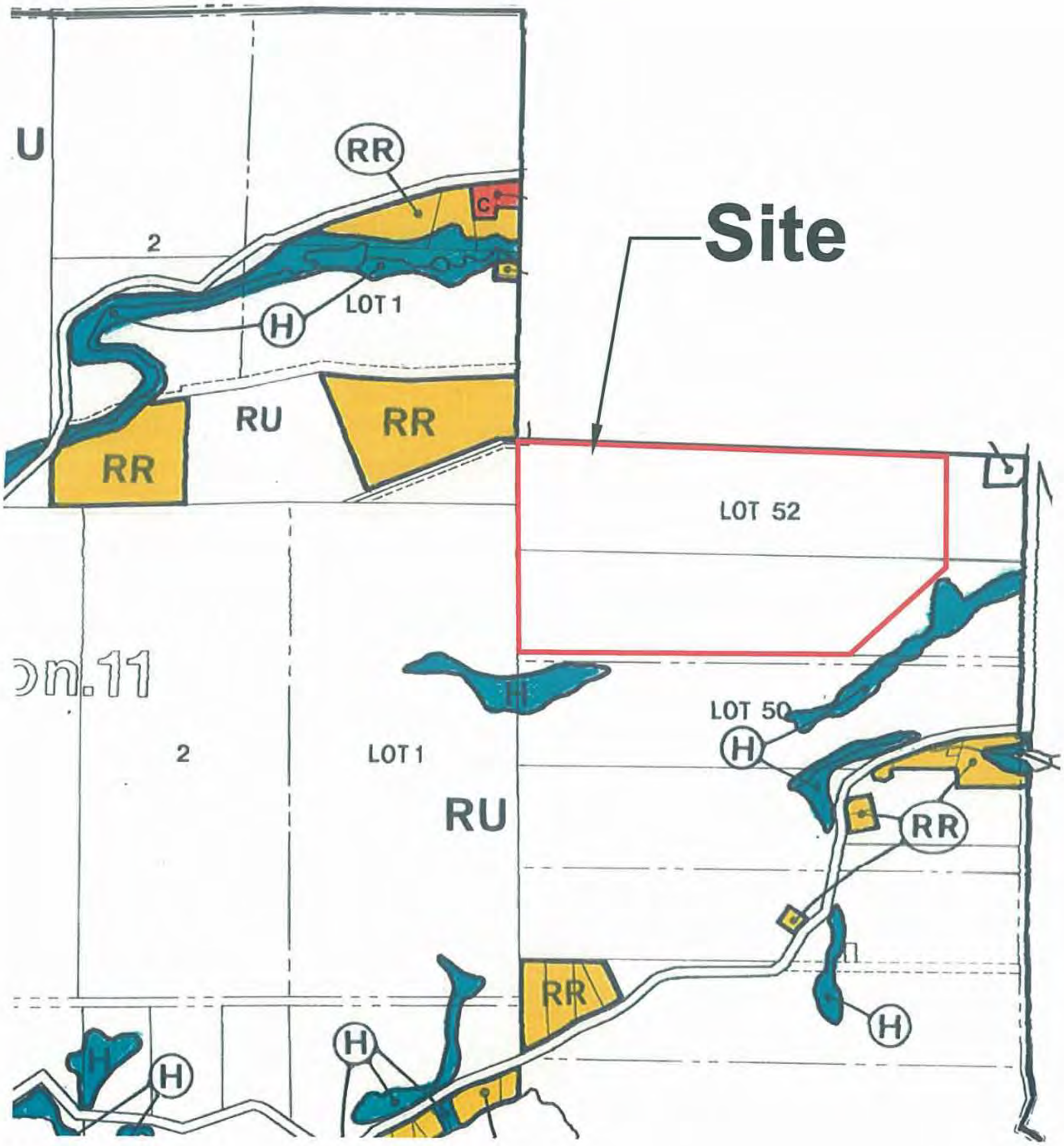
CHECKED BY: HS	HORIZ. SCALE: 1:12,500
REVISION DATE: July 5 2013	PLOT DATE: July 5 2013

Freymond Aggregates
Part of Lots 51 and 52, Concession W.H.R.
Township of Faraday

Official Plan of the County of Hastings

Figure 3



LEGEND

RU	Rural
H	Hazard
RR	Rural Residential
C	Commercial

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REVISION DATE: October 29 2012	PLOT DATE: October 29 2012		

Freymond Aggregates
Part of Lots 51 and 52, Concession W.H.R.
Township of Faraday

Zoning By-law

Figure 4

4.0 SUMMARY

Based on the foregoing review of relevant policy considerations, and a detailed investigation of site suitability, this Report concludes that the proposal to develop a quarry on the subject lands is consistent with both provincial and municipal planning policies and documents, and constitutes good planning.

Respectfully Submitted,

ECOVUE CONSULTING SERVICES INC.

J. Kent Randall B.E.S. MCIP RPP
Intermediate Planner

Appendix A

Natural Environment Levels 1 & 2 Report and Environmental Impact Statement

Robin Craig, Certified Wildlife Biologist

NATURAL ENVIRONMENT LEVELS 1 AND 2 REPORT AND ENVIRONMENTAL IMPACT STATEMENT

FREYMOND LUMBER QUARRY

FARADAY TOWNSHIP

October/2011

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1.0 INTRODUCTION

This report will provide natural environment levels 1 and 2 information, as required by the Aggregate Resources Act of Ontario (ARA), to support a Category 2, Class "A" Quarry "extraction below the water table". The application is being submitted by Freymond Lumber Ltd. who will be referred to throughout this report as "the proponent". The entire property owned by the proponent is 96 ha in area and is located south of Bancroft in Lots 51 and 52, Concession WHR, Township of Faraday and County of Hastings (Figure 1). The area proposed to be licensed under the ARA as a quarry is about 35 ha. A recent aerial view (2008) of the proposed license boundaries may be seen in Figure 2.

The property lies within the jurisdictions of Faraday Township, County of Hastings and the Bancroft Office of the Bancroft District of the Ontario Ministry of Natural Resources (OMNR).

A complete natural environment assessment was undertaken to ensure that the requirements of OMNR Policy A. R. 2.01.07 License Applications: Natural Environment Report Standards March 15, 2006 are met and that no existing natural feature will be impacted by the proposal.

The purposes of this Natural Environment report are to determine the presence of significant natural heritage features/areas and fish habitat in accordance with the Provincial Policy Statement 2005 (PPS), and to ensure that any necessary preventative, mitigative or remedial measures are undertaken for their protection.

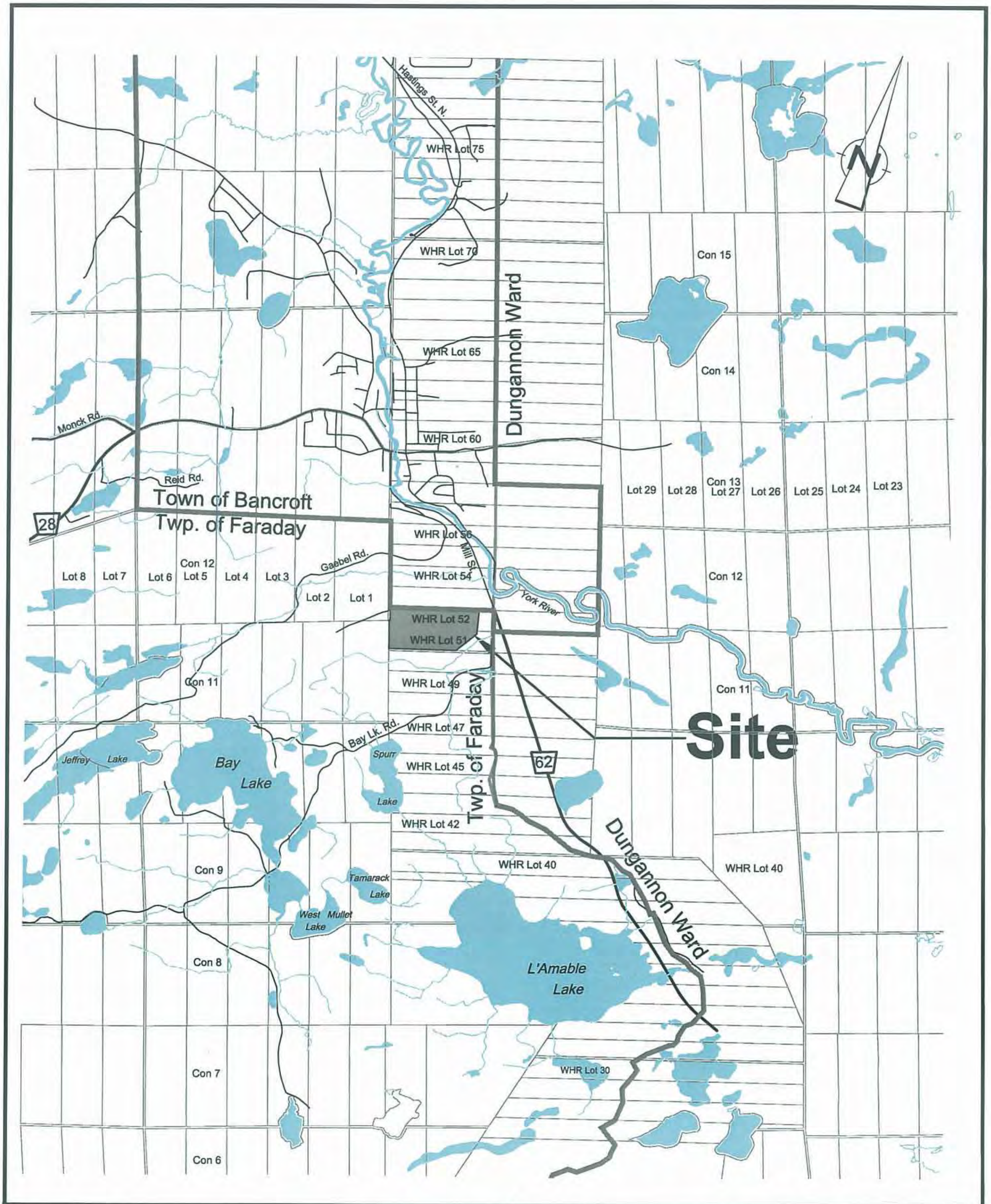
A Natural Environment Level 1 report determines whether one or more of the following exist on site or within 120 metres of the site:

significant wetlands (including significant coastal wetlands);
significant portions of the habitat of endangered and threatened species;
significant Areas of Natural and Scientific Interest (ANSIs);
significant woodlands (south and east of the Canadian Shield);
significant valleylands (south and east of the Canadian Shield);
significant wildlife habitat and;
fish habitat

If any of these features are identified, then an impact assessment (i.e. Natural Environment Level 2 Report) is required to determine any negative impacts on the natural features or ecological functions, and any proposed preventative, mitigative or remedial measures.

The Official Plan (OP) of Hastings County (2002) recognizes that the protection of environmental features is an important objective. The plan also recognizes the importance of protecting aggregate resources for their future long term use.

Geological Investigations and Freymond Lumber Ltd. contracted Robin E. Craig, Environmental Consultant, to conduct Level 1 and Level 2 Natural Environment Studies and EIS on the proposed site and adjacent areas as outlined in the policies of the Aggregate Resources Act of Ontario and the Official Plan of Hastings County.



Site Location - Freymond Lumber Limited
Part of Lots 51 and 52, Concession W.H.R.
Township of Faraday
Figure 1

Scale 1:50,000

Proprosed Boundaries - Freymond Lumber Limited
Part of Lots 51 and 52, Concession W.H.R.
Township of Faraday

Figure 2

Legend
- Proposed Licensed Boundary
- Proposed Extraction Limit

GRAPHIC SCALE
(IN METERS)
50 0 50 100
1:5,000

2.0 METHODS

2.1 Review of Existing Information

All accessible natural resource information at the Ontario Ministry of Natural Resources (OMNR) Bancroft Office was reviewed before any field studies were initiated. In particular, the following were checked; fish and wildlife resource mapping, management reports, current Species at Risk information, wetland mapping, natural feature mapping and stream surveys and classifications.

The Natural Heritage Information Centre (NHIC) at OMNR in Peterborough was also consulted regarding rare, threatened and endangered species and spaces that may have been reported on or near the property.

The County of Hastings Official Plan (2002) was reviewed to determine existing land use and existing environmental designations. The County is in the process of updating its OP and various components were reviewed including the "Natural Heritage Report for the County of Hastings Official Plan Review" (2008). The County of Hastings Interactive Mapping site (2010) was also reviewed.

Other information reviewed included the "Field Guide to the Forest Ecosystems of Central Ontario" (1997), the "Natural Heritage Reference Manual, 1999", "Natural Heritage Reference Manual, Second Edition (2010)" , "Significant Wildlife Habitat Technical Guide, 2000" and "How Much Habitat is Enough" (2004).

2.2 Field Studies

A reconnaissance visit was made on June 2, 2008 to get a general sense of the natural heritage information needs and to begin data collection. To complete the investigation, the site was visited on 9 different dates including; June 2, 2008, April 24, May 29, May 30, June 29, June 30, and September 2, 2009 and April 22, 2010. Additional hours were spent after each site visit confirming identification of species from collected samples and field notes. To conduct a thorough biological survey, all areas of the property were visited and walked through to ensure that the maximum numbers of wildlife and plant species and all vegetation communities were documented. Lands adjacent (120 m) to the proposal were surveyed if owned by the proponent while adjacent lands not owned by the proponent were visually surveyed from property boundary areas and using aerial photos. Visits occurred only when the weather was calm and generally clear to maximize opportunities of seeing and hearing wildlife. Visits were made shortly after dawn on days in May and June to better document potentially breeding birds. Visits were made during the evenings of April 24, May 29 and June 29 2009 and April 22, 2010 to document breeding amphibians on the site.

Vegetation and wildlife data were collected using protocols and guidelines provided by the Ontario Breeding Bird Atlas (Anon., 2001, 2003), Marsh Monitoring Protocol (Bird Studies Canada), Ecological Land Classification for Southern Ontario (Lee et al., 1998) and the "Significant Wildlife Habitat Technical Guide" (OMNR, 2000). Several current and other field guides/keys were consulted to assist in identifying and classifying the numerous plant and animal species encountered during the field portion of the investigation.

All mammals, birds, reptiles, amphibians, butterflies and dragonflies directly observed were documented when encountered on any of the site visits. Indirect observations of wildlife were also used to determine presence including tracks, burrows, food caches, feeding activity, scats, songs, calls, feathers, nests and eggs, insect larvae and other non-adult life stages.

Water temperatures were collected and minnow traps were monitored weekly from June 30 to August 15 2009 at 3 locations along the unnamed stream that flows south of site.

Endangered, threatened and species of concern, as determined by OMNR Bancroft Office, the NHIC, current species at risk lists and Schedules 1-5 of the Endangered Species Act (2007), were specifically searched for.

2.3 Impact Analysis

All background and site specific field data were used to determine the significant natural features on the site of the proposed extraction and on adjacent lands. In addition to reviewing existing information from NHIC, OMNR and the ESA (2007) regarding endangered, threatened and species of concern, the current Provincial (S) and National (G) ranking of all species encountered on the property were documented. This ensured that any previously unidentified species at risk would be noted and included in the impact assessment of the proposal.

Aerial photos (2008), site plans and operational notes prepared for the proposal by Geological Investigations and "Freymond Proposed Quarry Levels 2 Hydrogeological Investigation" by MTE (2011) were also reviewed when assessing potential impacts to natural features and suggesting mitigation.

2.4 Nomenclature

The generally accepted common names of all plant and animal species are used throughout this report. Corresponding scientific names are listed in appendices at the end of the report. All vegetation naming is from Flora Ontario (Newmaster, S.G. and S. Ragupathy. 2005). Avian common and scientific naming follows the seventh edition (1998) of the American Ornithological Union (AOU) "Check-list of North American Birds", and 42^{nd} supplement (2000) to the check-list as presented in Sibley, A. (2000). Mammal naming is from Dobbyn, J. "Atlas of the Mammals of Ontario" (1994). Herpetofaunal naming is from Oldham, M.J. and W.F. Weller, (2000) "Ontario Herpetofaunal Atlas". Dragonfly naming is from the Ontario Odonata Atlas, (2005). Butterfly naming is from the MNR/NHIC species lists.

3.0 EXISTING SITE CONDITIONS

3.1 Existing Land Use

The property is currently forested and managed as a forest reserve. Timber harvest occurs when the proponent's mill needs wood and/or markets are strong. There are open, cleared and gravelled areas at the east end of the site, occupied by buildings and parking areas.

3.2 Land Use Designations

The site is designated as "Rural" within the Township of Faraday.

3.3 Adjacent Land Use

The Freymond Lumber Ltd. mill is located east of the proposed aggregate area. The proponent currently owns the lands north, east and south of the proposal. The lands to the west are not owned by the proponent. Areas to the north, south and west are forested. There is a licenced pit area north east of the site. Lands to the east are cleared and occupied by buildings and parking areas associated with the proponent's lumber mill operation. A road way approaches the north-west property boundary within 120 m of the proposal.

3.4 Watersheds and Surface Water

There are 3 woodland pond areas on the site, 1 is located in the central area and the other 2 are located along the south-west boundary. The pond in the central area, which is roughly circular in shape, has maximum diameter of about 40 m in spring after snow melt. The ponds along the south-west boundary are each linear and about 50 -60 m long by 30 m wide. There are no inlets or outlets to or from any of the ponds. Water in the ponds remains all summer but all of the ponds decrease in area over the season.

A permanent, unnamed stream flows within 120 m south-east of the site. The stream flows through the existing mill grounds eventually entering the York River about 500 m east of the proposal. The stream is about 1 m wide and 15 to 25 cm deep. Large amounts of sawdust are stored within 1 - 3 m of the south bank. The bottom substrate is organic likely the result of inputs of sawdust for many years. The water temperatures ranged from a low of 14 C on June 30 to a high of 25 C on some early August dates (Table 2). Generally, however, the stream was about 20 C indicating a coolwater system.

3.5 Topography

The site is hilly. There are 2 dominant hills, one on the west side with an elevation of 392 mAMSL and a second in the central area with an elevation 389 mAMSL. The land slopes gently to the west and north to elevations of about 375 mAMSL and 365 mAMSL respectively. The site slopes rapidly to the south and east boundaries to reach its lowest elevation of 330 mAMSL to 335 mAMSL along the east boundary.

3.6 Groundwater

Detailed ground water information is contained in a report prepared by MTE (2011).

In summary, the estimated ground water table is at 375 mAMSL but varies over the site because water is actually contained in fractures within the bedrock at various levels.

The vertical gradient is downward with ground water migrating from shallow to deeper systems.

Both the shallow and deep ground water systems move in a north-east direction towards the York River. The ground water system does not contribute to the unnamed stream south of the site.

3.7 Vegetation

All vegetation species encountered on the property are listed in Appendix 1.

A total of 218 plant species were found including 18 trees, 12 shrubs and vines and 187 other vascular plants. A total of 173 (79%) were native species while 45 (21%) were non-native or species considered by OMNR "as not suitable targets for conservation activities" (SNA).

No endangered, threatened or species of concern were reported in background information checks of the site or within 120 m and none were found during field surveys.

3.8 Vegetation Communities

There is one deciduous forest vegetation community that prevails over the entire site. Deciduous forest communities are described as having greater than 60 % tree cover consisting of more than 75 % deciduous tree species.

The site is located in Site District 5E9 and ecosite ES27.1 as described in Chambers et. al. (1997). Stands in this ecosite site are typically dominated by Sugar Maple, White Birch Poplar and White Pine on dry to moderately fresh soils. The soils are generally sandy to coarse loamy.

3.8.1 "V 12"

A forest management plan was prepared in 1998 for the site. It lists the soils as "sandy" the drainage "good" and the topography "hilly". It describes the natural forest community as having been disturbed by selective logging for many years. The history of the site includes the harvesting of timber for the mill and removal of lower grade trees for firewood. The plan inventory describes the forest as composed of "Hard Maple" 50%, "Poplar" 20%, "White Birch" 10% and "White Pine" 10%. The average age of the stand in 1998 was 70 years (in 2011 it is between 80 and 85 years).

Although the Chambers et. al. (1997) classification system should ideally be applied to mature, undisturbed stands, it can cautiously be applied to partially managed sites such as this one. With this in mind, and using Chambers et. al. (1997), the vegetation community on the site most closely resembles "V 12". A V 12 community is described as a Sugar Maple-White Birch dominated stand with associates in the main canopy including Red Maple, White Pine and Red Oak. The understory includes high levels of hardwood regeneration and moderate levels of conifer regeneration. There are also moderate levels of hardwood shrubs and herbs.

3.9 Wildlife

All wildlife species encountered on the property are listed in Appendix 2.

There were 38 bird species, 7 mammal, 6 butterfly, 3 dragonfly, and 4 amphibians (3 frogs and 1 salamander) observed on the site. Amphibian monitoring is detailed in Table 1.

No fish were found on the site, but 1 fish species was found in the stream flowing south of the quarry within 120 m. Fish and temperature monitoring is detailed in Table 2.

Natural Features - Freymond Lumber Limited
Part of Lots 51 and 52, Concession W.H.R.
Township of Faraday

Figure 3

Legend

- Proposed Extraction Limit
- Proposed Licensed Boundary
- Pond
- Water Course
- EC - East Culvert
- WC - West Culvert
- CL - Chip Loop

Legend ELC Vegetation Communities

V12 Sugar Maple, White Birch, Trembling Aspen, Red Maple, Balsam Fir Shrub

Table 1: Amphibian Monitoring

Date	Species	Code *	Estimated Numbers
April 24, 2009	Spring Peeper	2	20 - 30
	Wood Frog	2	10 - 20
May 29, 2009	No frogs calling	-	-
June 29, 2009	No frogs calling	-	-
April 22, 2010	Spring Peeper	2	10 - 20

* Code 1: individual calls do not overlap and calling individuals can be discretely counted;

Code 2: calls of individuals sometimes overlap, but numbers of individuals can still be estimated;

Code 3: overlap among calls seems continuous (full chorus), and a count estimate is impossible;

Table 2; Water Temperatures and Fish Sampling of Stream South of the Site**

Date 2009	Location	Temperature	Fish Caught
June 30	East Culvert (EC)	20 C	-
	West Culvert (WC)	20 C	-
	Chip Loop (CL)	14 C	-
July 5	EC	-	5 Brook Stickleback (BS)
July 9	EC	20 C	1 BS
	WC	20 C	-
	CL	18 C	2 BS
July 16	EC	20 C	4 BS
	WC	19 C	1 BS
	CL	21 C	2 BS
July 23	EC	20 C	4 BS
	WC	19 C	1 BS
	CL	21 C	2 BS
July 30	EC	20 C	-
	WC	25 C	1 BS
	CL	20 C	2 BS
August 6	EC	25 C	1 BS
	WC	20 C	-
	CL	20 C	-
August 13	EC	20 C	-
	WC	21 C	1 BS
	CL	20 C	-

** Acknowledgement; Thanks to D. Freymond for collecting fish and temperature data

No endangered or threatened species were encountered either during review of existing information provided by agencies or during on site field investigations. One species of concern, the Monarch, was encountered on the site.

4.0 PROPOSED DEVELOPMENT

View the accompanying application and site plans for details regarding the proposal.

The proposal is to extract material beginning on the east side of the site and proceeding west, subject to market demand. The proposed pit floor is 332 mAMSL which is the approximate elevation along the east boundary. The estimated water table is at 375 mAMSL, therefore the extraction will be below the water table by up to 43 m.

All topsoil and subsoil will be removed prior to excavation and stored in berms along the property boundaries, in on site stockpiles, or used immediately to rehabilitate depleted areas. All berms and stockpiles will be seeded with native grass/legume mixtures to create short term wildlife habitat, to curtail erosion and to prevent dust from leaving the site.

Since extraction will be below the water, ground water and precipitation collecting in the quarry will be diverted to a sump on the east side to keep the operation in the dry. Each phase of the quarry will be excavated and graded so that excess water will be diverted to the sump. Collected waters will then be allowed to infiltrate. There will not be any dewatering of the site to local surface waters.

There will be a 30 m setback along the west boundary only. Because the proponent currently owns the adjacent lands on the other 3 sides of the proposal, there will be no additional setbacks along these boundaries.

Rehabilitation will be progressive and the site will be restored to a natural forest system including woodland ponds.

5.0 NATURAL ENVIRONMENT IMPACT ANALYSIS AND MITIGATION

All recommended mitigation is re-stated in Appendix 3 and will be included on the site plans accompanying this report.

5.1 Provincially Significant Wetlands (PSW)

A review of OMNR, Township mapping and field investigations do not indicate any Provincially Significant Wetlands on or within 120 m of the property.

5.2 Endangered and Threatened Species

A review of NHIC, Township and OMNR background data does not indicate any endangered or threatened species on or within 120 m of the property and none were encountered during field surveys.

5.3 Areas of Natural and Scientific Interest (A.N.S.I.'s)

A review of OMNR and Township mapping does not indicate any A.N.S.I.'s on or within 120 m of the property.

5.4 Significant Woodlands

As the site is on the Canadian Shield significant woodland policies do not apply.

5.5 Significant Valley Lands

As the site is on the Canadian Shield significant valley land policies do not apply.

5.6 Significant Wildlife Habitat

The designation of SWH is the responsibility of the local municipality. No SWH has been designated on or adjacent to the site by the Township of Faraday or the County of Hastings.

To assist with identifying potentially significant wildlife habitat on the site the "Significant Wildlife Habitat Technical Guide (SWHTG)" (OMNR, 2000) was reviewed for guidance. It suggests that significant wildlife habitat be divided into four broad categories.

- 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

Data from field studies suggest that there are 2 categories that could apply to this property.

1. Seasonal concentration areas;
   a. for breeding woodland amphibians
   b. for species of concern, a butterfly, the Monarch

2. Specialized habitats for wildlife;
   a. forest interior habitat for area sensitive bird species

5.6.1 Amphibian Breeding Habitat (Woodland Ponds)

a. Impact Analysis

The site was visited on 3 evenings in 2009 to monitor amphibians breeding activity. Frogs were heard calling only on the April 24 visit. As a result, monitoring was only conducted on April 22 in 2010. Frogs were heard calling from only the woodland pond in the central area of the site during both years. Later visits confirmed that water in this pond remained well into the summer months and that the hydroperiod was adequate for the maintenance of local frog populations. The number of Spring Peepers heard was 20 – 30 in 2009 and 10 – 20 in 2010. Wood Frog counts were also higher in 2009 with 10 – 20 heard and < 10 in 2010 (Table 1). Blue Spotted Salamander eggs were found in the central pond but no individuals were seen and no estimate of numbers was attempted. No amphibians were heard or found in the 2 ponds along the south boundary of the site.

The "Natural Heritage Reference Manual" (OMNR, 2010) suggests that what constitutes significant wildlife habitat will vary across the province. In Section 9.3.1 it notes that wildlife habitat that is poorly represented in one area may be considered significant while the same habitat in another area where it is well represented may not be considered significant.

In Section 8.5.5 of the "SWHTG" OMNR (2000), it is noted that when assessing amphibian habitats, the greatest significance should be given to ponds that support a high diversity and number of amphibians as well as species of conservation concern.

The landscape of the area of the proposal has been described as controlled by bedrock topography (KBM, 2002). The low permeability of the granitic bedrock controls ground water flow by limiting infiltration creating many wetlands and lakes. These provide abundant breeding habitat for local amphibian populations.

While traveling to and from the site during evenings, the author was very aware of the abundant wetlands and amphibian breeding habitat as calling Spring Peepers could be heard from most roads. The numbers of Spring Peepers was Code 3 in many wetlands and the numbers of individuals calling was well beyond estimation. The presence of Spring Peepers was also likely a good indication of the breeding presence of other amphibian species. A riparian wetland about 300 - 500 m north of the site was visited in both 2009 and 2010 and the intense sound of so many Spring Peepers masked the calls of any Wood Frogs or other species that may have been calling.

Amphibian breeding habitat appears well represented in Faraday and neighbouring Townships. Compared with the on site pond, there are many other ponds and wetlands supporting larger numbers of amphibians. The on site pond supports a minimum of 4 amphibian species but none are species of conservation concern and the numbers on site are low.

The woodland amphibian breeding pond on the site should not, therefore, be considered a candidate significant wildlife habitat.

b. Mitigation/Rehabilitation

Although the amphibian breeding habitat on site may not be SWH, rehabilitation is recommended to restore site to forest cover and to create woodland ponds to provide amphibian breeding habitat in the long term.

5.6.2 Monarch

a. Impact Analysis

The Monarch is a migratory butterfly species that arrives in Ontario in April/May and heads south again in September/October each year (Glassberg, 1999). Adults lay eggs in spring, exclusively on Milkweed species where the larvae feed and develop (OMNR, 2000). In fall adults are abundant and are seen along roadsides and open fields while they are migrating. The Monarch seen on this property was encountered in September and likely represented a migrating individual. During fall migration, butterfly stopover areas greater than 10 ha located within 5 km of the southern Great Lakes are considered significant habitat (OMNR, 2009).

The location of this property and the surrounding area within 120 m is more than 5 km from the shores of any of the Great Lakes indicating that the site in not a stopover area of the Monarch and therefore is not a candidate significant wildlife habitat.

5.6.3 Forest Interior Area Sensitive Bird Species

a. Impact Analysis

Interior forest habitat is defined as forest that is more than 100 m from an edge. The entire site and for more than 100 m north, south and west of the property boundaries is forested. Thus most of the site contains interior forest habitat. The site is located in ecoregion 5E, as stated previously. Unfortunately, criteria regarding area sensitive interior forest birds have not been developed for ecoregion 5E (OMNR 2009).

Information from "How much Habitat is Enough" (2004) indicates that the most significant factor impacting interior forest habitat is total forest cover on a landscape. It is recommended that to maintain all the forest interior species potentially present in a landscape, in this case Faraday Township, at least 10 % of the forest interior and 30 % of the total forest cover should be retained. The current forest cover in Faraday Township is about 80% of the municipality, as estimated from air photos. The temporary reduction in forest cover because of the extraction on this property will be 35 ha. At the township or landscape level, this is a negligible amount. The total forest cover of the Township will remain well over 80 % and therefore the interior forest bird habitat of the Township will not be negatively impacted at a landscape level. No reduction in forest interior species is anticipated.

The removal of rock from the site is a temporary land use requiring the clearing of existing vegetation to allow access to the underlying bedrock. The proposal will only result in the temporary reduction of forest area and will not negatively impact the interior habitat within the Township landscape in the long term. Negative impact is defined in the NHRM as "the loss of the natural feature or ecological functions for which an area is identified". When the extraction phase is complete stored topsoil with its retained seeds, bulbs and other vegetative material will be spread over exposed bedrock areas. During the rehabilitation phase, the site will be restored with planned, native tree plantings and natural regeneration. The forest and interior habitat will, therefore, not be lost but will be only reduced temporarily in area and then restored. Site rehabilitation by re-forestation constitutes "no negative loss" (OMNR, 2010). No ecological function of the forest will be lost permanently.

The interior habitat on the site should not be considered a candidate significant wildlife habitat because the amount of interior habitat within the township is more than twice the recommended minimum, the relative area of the forest interior habitat on the site is minimal by comparison and the forest and interior habitat will be restored during rehabilitation,

b. Mitigation

Although the forest habitat on site may not be a candidate significant wildlife habitat, mitigation is recommended to minimize the impact of the proposal to local wildlife while forest cover is being cleared.

The following mitigative actions are proposed to be implemented and included on the final site plans for the site;

- To minimize the short term impact of forest removal, vegetation clearing will be conducted in phases over time in anticipation of future extraction needs. Only enough land will be cleared at 1 time to allow for about 2 years of extraction.

- No tree cutting or land clearing will occur from April 1 to July 15 to protect breeding wildlife.

- Planting native trees to replace forest habitats will be a major component of the rehabilitation plan to restore the site to forest cover.

5.7 Fish Habitat

a. Impact Analysis

A review of OMNR, and Township mapping and field investigations indicate that there is no fish habitat on the property. There is a permanent stream flowing south and east of the proposed quarry site through the Freymond Lumber Ltd. Mill property, within 120 m. The location of the mill operation and the deposits of sawdust over time have likely had a detrimental impact on life in the stream. Temperature and fish sampling were conducted at 3 accessible sites on the mill property from June 30 to August 13, 2009 (Table 2). Water temperatures over the period ranged from 14 C to 25 C with the majority of samples between 18 C and 21 C, in the coolwater habitat range. The only species of fish caught was Brook Stickleback but it was caught at each sample station and the number of individuals caught on each sampling date ranged from 0 to 5.

Ground water flows as determined by MTE (2011) are to the north-east and do not contribute to the stream. No negative impacts to the quality and quantity of ground water flowing to the stream are expected. As a result, no additional fisheries investigation was undertaken.

During the quarry operation, surface and ground water will be collected in a sump and allowed to infiltrate to be added to existing ground water flows. Because ground water currently leaves the site in a north-east direction towards the York River it could impact fish habitat. As a result the following mitigation is recommended.

b. Mitigation

- All surface water falling on the site will be retained on site and will infiltrate to be added to local ground water supplies.

- A Spills Response Plan will be prepared, implemented and enforced to protect water quality.

- All equipment maintenance and fuel storage will be offsite.

- All re-fuelling of equipment will be from a mobile source brought to the site.

- A monitoring program will be implemented to ensure that the quality of ground water and water in the proposed sump quality meets Provincial Water Quality standards.

6.0 REHABILITATION

All rehabilitation is described in detail on the site plans that are included as part of the license application. Extraction will occur at a rate depending upon market demand.

- Rehabilitation will be progressive with depleted areas being restored as soon as is feasible and practical.

- All stored topsoil and subsoil will be used to rehabilitate depleted areas and will be spread to a minimum depth of 10 cm. This action will assist natural regeneration of native species.

- Topsoil or other materials that will aid rehabilitation may be imported if on site supplies are inadequate.

- The site will also be re-planted to forest cover in accordance with approved plans using native, locally sourced native tree species.

- Planting plans will be developed when post quarry site conditions are understood and will be discussed with agencies such as OMNR if required.

- Planting will be done by hand or by machine which ever is most practical and trees will be grouped by species to encourage natural forest regeneration.

- The rehabilitated quarry floor will be contoured to different elevations so that water can collect creating ponds that will develop into potential amphibian breeding habitat.

- Conditions will be created to encourage the establishment of wetland vegetation both naturally and by planting.

7.0 CONCLUSIONS

This report provides Natural Environment information about the proposed Freymond Lumber Ltd. Quarry as required by the ARA, to support an application for a Category 2, Class "A" Quarry "below the water" aggregate license located in Lots 51 and 52, Concession WHR, Township of, Faraday Township and County of Hastings.

No Provincially significant wetlands, habitat of endangered or threatened species, significant Areas of Natural and Scientific Interest (ANSIs), or significant wildlife habitats are found on or within 120 m of the property. Although no significant forest interior bird or amphibian breeding habitats are present, mitigation is recommended to reduce the negative impact to local populations. No fish habitat is found on the site but fish habitat is found within 120 m south of the site and water leaving the site either as surface or ground water could impact fish habitats off site. Mitigation and monitoring have been recommended to protect surface and ground water quality and quantity flowing from the site.

Rehabilitation is proposed to progressively restore the site to a forest ecosystem and interior forest habitats. Rehabilitation is also proposed to re-create woodland ponds that will allow amphibians to again breed successfully on the site.

The proposal, therefore, meets the test of OMNR Policy A. R. 2.01.07 License Applications: Natural Environment Report Standards March 15, 2006 that no existing natural feature will be negatively impacted by the proposal. The proposal also meets the test and the intent of Natural Heritage Policy 2.1.2 "The diversity and connectivity of natural features in an area, and the long-term *ecological function* and biodiversity of *natural heritage systems*, should be maintained, restored or, where possible, improved, recognizing linkages between and among *natural heritage features* and *areas*, *surface water features* and *ground water features*.".

Respectively submitted

Robin Craig

Digitally signed by Robin Craig
DN: cn=Robin Craig, o, ou, email=robin.craig@bell.net, c=CA
Date: 2011.10.17 13:41:58 -04'00'

Robin Craig

Table 3: Summary of Environmental Impact Assessment and Mitigation for the Proposed Freymond Lumber Ltd. Quarry

Natural Heritage Feature	Potential Impact	Analysis and Mitigation	Anticipated Impact	Monitoring
1. Significant Wetlands	• none in study area	• none required	• none	• none required
2. Significant Habitats of Endangered and Threatened Species	• none in study area	• none required	• none	• none required
3. A.N.S.I.'s	• none in study area	• none required	• none	• none required
4. Significant Woodlands	• not applicable	• none required	• none	• none required
5. Significant Valley Lands	• not applicable	• none required	• none	• none required
6. Significant Wildlife Habitat	• loss of amphibian breeding habitat	• Faraday Township and the local area has abundant amphibian breeding habitat therefore the on site pools are not considered as candidate significant wildlife habitat	• none	• none required
		• new wetland pool areas will be created on the quarry floor restoring amphibian breeding habitat	• increased amphibian breeding habitat in the long term through rehabilitation of site	• none required
	• loss of significant Monarch stop over habitat	• none on site because site is more than 5 km from Great Lakes	• none	• none required

Table 3: Summary of Environmental Impact Assessment and Mitigation for the Proposed Freymond Lumber Ltd. Quarry

Natural Heritage Feature	Potential Impact	Analysis and Mitigation	Anticipated Impact	Monitoring
	• loss of interior forest habitat	• Faraday Township and the local area has 80 % forest cover therefore the interior habitat on site is not considered as candidate significant wildlife habitat	• no loss of significant wildlife habitat and therefore no negative impact at a Township level	• none required
		• Tree removal will be progressive so that the minimum forest area will be impacted at any one time	• protection of locally breeding wildlife	• none required
		• No land clearing will occur from April 1 to July 15.	• protection of locally breeding wildlife	• none required
		• Loss of forest interior habitat will be temporary because the site will be restored to forest by planting native trees and natural regeneration	• forest interior habitat will be restored in the long term	• monitor survival of planted trees • replace if required

7. Fish Habitat	• degradation of surface water quality	• surface water will be retained on site and released to ground water by infiltration	• no negative impact to surface water quality near the site	• none required
	• degradation of surface water quantity	• the site does not contribute to surface water quantity of the area streams	• no negative impact to surface water quantity near the site	• none required
	• degradation of ground water quality leaving site	• equipment maintenance will be conducted off site • re-fuelling will be from a mobile source • a spills response plan will be developed and implemented	• no negative impact to ground water quality near the site	• monitor ground water quality to ensure it meets Provincial water quality standards • make adjustments as required
	• degradation of ground water quantity leaving site	• all groundwater in quarry will be collected in a sump and added to collected surface water will be returned by infiltration to the ground water table	• water balance will be maintained	• none required

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APPENDIX 1: VEGETATION SPECIES LIST

TREES			
Common Name	**Scientific Name**	**G Rank***	**S Rank***
CONIFEROUS TREES	**PINOPSIDA**		
CYPRESS FAMILY	**CUPRESSACEAE**		
Eastern White Cedar	*Thuja occidentalis*	G5	S5
PINE FAMILY	**PINACEAE**		
Balsam Fir	*Abies balsamea*	G5	S5
Red Pine	*Pinus resinosa*	G5	S5
Eastern White Pine	*Pinus strobus*	G5	S5
Eastern Hemlock	*Tsuga canadensis*	G5	S5
DECIDUOUS TREES	**MAGNOLIOPSIDA**		
MAPLE FAMILY	**ACERACEAE**		
Striped Maple	*Acer pensylvanicum*	G5	S5
Sugar Maple	*Acer saccharum*	G5T5	S5
BIRCH FAMILY	**BETULACEAE**		
Speckled Alder	*Alnus incana*	G5T5	S5
Yellow Birch	*Betula alleghaniensis*	G5	S5
White Birch	*Betula papyrifera*	G5	S5
Ironwood	*Ostrya virginiana*	G5	S5
BEAN FAMILY	**FABACEAE**		
Black Locust	*Robinia pseudo-accacia*	G5	SNA
BEECH FAMILY	**FAGACEAE**		
American Beech	*Fagus grandifolia*	G5	S5
Red Oak	*Quercus rubra*	G5	S5
ROSE FAMILY	**ROSACEAE**		
Choke Cherry	*Prunus virginiana*	G5	S5
WILLOW FAMILY	**SALICACEAE**		
Balsam Poplar	*Populus balsamifera*	G5	S5
Large-tooth Aspen	*Populus grandidentata*	G5	S5
Trembling Aspen	*Populus tremuloides*	G5	S5

SHRUBS AND VINES			
Common Name	**Scientific Name**	**G Rank**	**S Rank**
FLOWERING SHRUBS & VINES	**MAGNOLIOPSIDA**		
HONEYSUCKLE FAMILY	**CAPRIFOLIACEAE**		
Fly Honeysuckle	*Lonicera canadensis*	G5	S5
Maple-leaved Viburnum	*Viburnum acerfolium*	G5	S5
DOGWOOD FAMILY	**CORNACEAE**		
Red Osier Dogwood	*Cornus stolonifera*	G5	S5
GOOSEBERRY FAMILY	**GROSSULARIACEAE**		
Prickly Gooseberry	*Ribes cynosbati*	G5	S5
Smooth Gooseberry	*Ribes hirtellum*	G5	S5
ROSE FAMILY	**ROSACEAE**		
Red Raspberry	*Rubus idaeus*	G5T	S5
White-flowering Raspberry	*Rubus parviflorus*	G5	S4
WILLOW FAMILY	**SALIACEAE**		
Slender Willow	*Salix petiolaris*	G4	S5
NIGHTSHADE FAMILY	**SOLANACEAE**		
Climbing Nightshade	*Solanum dulcamara*	G?	SNA
CARRION-FLOWER FAMILY	**SMILCACEAE**		
Herbaceous Carrion-flower	*Smilax herbacea*	G5	S4
MEZEREUM FAMILY	**THYMELAECEAE**		
Leatherwood	*Dirca palustris*	G4	S4?
GRAPE FAMILY	**VITACEAE**		
Inserted Virginia Creeper	*Parthenocissus inserta*	G5	S5

OTHER VASCULAR PLANTS			
Common Name	**Scientific Name**	**G Rank**	**S Rank**
FERNS & ALLIES	**PTERIDOPHYTA**		
BRACKEN FERN FAMILY	**DENNSTAEDITIACEAE**		
Eastern Bracken Fern	*Pteridium aquilinum*	G5	S5
WOOD FERN FAMILY	**DRYOPTERIDACEAE**		
Northern Lady Fern	*Athyrium filix-femina*	G5T5	S5
Spinulose Wood Fern	*Dryopteris carthusiana*	G5	S5
Crested Shield Fern	*Dryopteris cristata*	G5	S5
Marginal Shield Fern	*Dryopteris marginalis*	G5	S5
Oak Fern	*Gymnocarpium dryopterus*	G5	S5
Ostrich Fern	*Matteuccia struthiopteris*	G5	S5
Sensitive Fern	*Onoclea sensibilis*	G5	S5
Christmas Fern	*Polystichum acrosticoides*	G5	S5
HORSETAIL	**EQUISETACEAE**		
Field Horsetail	*Equisetum arvense*	G5	S5
ROYAL FERN FAMILY	**OSMUNDACEAE**		
Interrupted Fern	*Osmunda claytoniana*	G5	S5
Royal Fern	*Osmunda regalis*	G5T	S5
POLYPODY FAMILY	**POLPODIACEAE**		
Rock Polypody	*Polypodium virginianum*	G5	S5
MAIDENHAIR FAMILY	**PTERIDACEAE**		
Northern Maidenhair Fern	*Adiantum pedatum*	G5	S5
Silvery Spleenwort	*Deparia acrostichoides*	G5	S4
Northern Beech Fern	*Thelypteris connectilis*	G5	S5
Marsh Fern	*Thelypteris palustris*	G5	S5
New York Fern	*Thelypteris noveboracensis*	G5	S5
GRASSES, LILIES AND ORCHIDS	**LILIOPSIDA**		
ARUM FAMILY	**ARACEAE**		
Small Jack-in-the-pulpit	*Arisaema triphyllum*	G5T5	S5

OTHER VASCULAR PLANTS			
Common Name	**Scientific Name**	**G Rank**	**S Rank**
SEDGE FAMILY	**CYPERACEAE**		
Drooping Wood Sedge	*Carex arctata*	G5	S5
Bebb's Sedge	*Carex bebbii*	G5	S5
Woodland Sedge	*Carex blanda*	G5	S5
Brownish Sedge	*Carex brunnescens*	G5	S5
Common Beech Sedge	*Carex communis*	G5	S5
Fringed Sedge	*Carex crinita*	G5	S5
Dewey's Sedge	*Carex deweyana*	G5	S5
Northern Sedge	*Carex deflexa*	G5	S5
Graceful Sedge	*Carex gracillima*	G5	S5
Gray's Sedge	*Carex grayi*	G4	S4
Bladder Sedge	*Carex intumescens*	G5	S5
Bristle-stalked Sedge	*Carex leptalea*	G5T?	S5
Distant Sedge	*Carex lucorum*	G4	S4
Hop Sedge	*Carex lupulina*	G5	S5
Long-stalked Sedge	*Carex pedunculata*	G5	S5
Pennsylvania Sedge	*Carex pensylvanica*	G5	S5
Radiate Sedge	*Carex radiata*	G4	S5
Retrorse Sedge	*Carex retrorsa*	G5	S5
Stellate Sedge	*Carex rosea*	G5	S5
Pointed Broom Sedge	*Carex scoparia*	G5	S5
Burreed Sedge	*Carex sparganioides*	G5	S5
Long-beaked Sedge	*Carex sprengelii*	G5?	S5
Blunt Broom Sedge	*Carex tribuloides*	G5	S4S5
Three-fruited Sedge	*Carex trisperma*	G5T	S5
Beaked Sedge	*Carex utriculata*	G5	S5
Fox Sedge	*Carex vulpinoidea*	G5	S5
Dark-green Bulrush	*Scirpus atrovirens*	G5?	S5
Wool-grass	*Scirpus cyperinus*	G5	S5

OTHER VASCULAR PLANTS			
Common Name	**Scientific Name**	**G Rank**	**S Rank**
IRIS FAMILY	**IRIDACEAE**		
Little Blue-eyed-grass	*Sisyrinchium montanum*	G5	S5
RUSH FAMILY	**JUNCACEAE**		
Soft Rush	*Juncus effusus*	G5	S5
Path Rush	*Juncus tenuis*	G5	S5
LILY FAMILY	**LILIACEAE**		
Bluebead Lily	*Clintonia borealis*	G5	S5
Yellow Adder's-tongue	*Erythronium americanum*	G5T5	S5
Wild Lily-of-the-valley	*Maianthemum canadense*	G5	S5
Hairy Solomon's Seal	*Polygonatum pubescens*	G5	S5
Rose Twisted-stalk	*Streptopus lanceolatus*	G5	S5
White Trillium	*Trillium grandiflorum*	G5	S5
Large-flowered Bellwort	*Uvularia grandiflora*	G5	S5
ORCHID FAMILY	**ORCHIDACEAE**		
Common Helleborine	*Epipactis helleborine*	G?	SNA
GRASS FAMILY	**POACEAE**		
Red-top	*Agrostis gigantea*	G4G5	SNA
Bearded Short-husk	*Brachyelytrum erectum*	G5	S4S5
Wood Chess	*Bromus ciliatus*	G5	S5
Awnless Brome	*Bromus inermis*	G4G5T?	SNA
Canada Blue-joint	*Calamagrostis canadensis*	G5	S5
Northern Reed Grass	*Calamagrostis stricta*	G5T5	S5
Broad-leaved Reed Grass	*Cinna latifolia*	G5	S5
Orchard Grass	*Dactylis glomerata*	G?	SNA
Common Hairgrass	*Deschampsia flexuosa*	G5	S5
Common Barnyard Grass	*Echinochloa crusgalli*	G?	SNA
Quack Grass	*Elymus repens*	G?	SNA
Red Fescue	*Festuca rubra*	G5T4	S5
Fowl Manna Grass	*Glyceria striata*	G5	S5
Wood Millet	*Milium effusum*	G5	S4S5

OTHER VASCULAR PLANTS			
Common Name	**Scientific Name**	**G Rank**	**S Rank**
Rough-leaved Rice Grass	*Oryzopsis asperfolia*	G5	S5
Northern Panic Grass	*Panicum boreale*	G5	S4
Witch Grass	*Panicum capillare*	G5	S5
Reed Canary Grass	*Phalaris arundinacea*	G5	S5
Common Timothy	*Phleum pratense*	G?	SNA
Common Reed	*Phragmites australis*	G5	S5
Canada Blue Grass	*Poa compressa*	G?	S5
Wood Blue Grass	*Poa nemoralis*	G5	SNA
Bushy pasture Spear Grass	*Poa salutensis*	G5?	S4
Kentucky Bluegrass	*Poa pratensis*	G5T	S5
False Melic Grass	*Schizachne purpurascens*	G5T?	S5
Green Foxtail	*Setaria viridis*	G?	SNA
CATTAIL FAMILY	**TYPHACEAE**		
Common Cattail	*Typha latifolia*	G5	S5
TYPICAL FLOWERING PLANTS	**MAGNOLIOPSIDA**		
AMARANTH FAMILY	**AMARANTHACEAE**		
Redroot Pigweed	*Amaranthus retroflexus*	G?	SNA
CARROT FAMILY	**APIACEAE**		
Wild Carrot	*Daucus carota*	G?	SNA
Fragrant Water-parsnip	*Sium suave*	G5	S5
DOGBANE FAMILY	**APOCYNACEAE**		
Spreading Dogbane	*Apocynum androsaemifolium*	G5	S5
GINSENG FAMILY	**ARALIACEAE**		
Wild Sarsaparilla	*Aralia nudicaulis*	G5	S5
MILKWEED FAMILY	**ASCLEPIADACEAE**		
Common Milkweed	*Asclepias syriaca*	G5	S5
ASTER FAMILY	**ASTERACEAE**		
Common Yarrow	*Achillea millefolium*	G5T?	SNA

OTHER VASCULAR PLANTS			
Common Name	**Scientific Name**	**G Rank**	**S Rank**
Common Ragweed	*Ambrosia artemisiifolia*	G5	S5
Pearly Everlasting	*Anaphalis margaritacea*	G5	S5
Common Burdock	*Arctium minus*	G?T?	SNA
Panicled Aster	*Aster lanceolatus*	G5T?	S5
Purple-stemmed Aster	*Aster puniceus*	G5T?	S5
Flat-top White Aster	*Aster umbellatus*	G5T?	S5
Nodding Beggar-ticks	*Bidens cernua*	G5	S5
Bull Thistle	*Cirsium vulgare*	G5	SNA
Horseweed	*Conyza canadensis*	G5	S5
Lance-leaved Tickseed	*Coreopsis lanceolata*	G5	S4?
Philadelphia Fleabane	*Erigeron philadelphicus*	G5T?	S5
Large-leaved Aster	*Eurybia macrophylla*	G5	S5
Grass-leaved Goldenrod	*Euthamia graminifolia*	G5	S5
Orange Hawkweed	*Hieracium aurantiacum*	G?	SNA
Yellow Hawkweed	*Hieracium caespitosum*	-	SNA
Ox-eye Daisy	*Leucanthemum vulgare*	G5	SNA
White Rattlesnake-root	*Prenanthes alba*	G5	S5
Canada Goldenrod	*Solidago canadensis*	G5	S5
Hairy Goldenrod	*Solidago hispida*	G5T?	S5
Gray Goldenrod	*Solidago nemoralis*	G5T?	S5
Rough Goldenrod	*Solidago rugosa*	G5?	S5
Lindley's Aster	*Symphyotrichum ciliolatum*	G5	S5
Heart-leaved Aster	*Symphyotrichum cordifolium*	G5	S5
Common Dandelion	*Taraxacum officinale*	G5	SNA
Coltsfoot	*Tussilago farfara*	G?	SNA
TOUCH-ME-NOT FAMILY	**BALSAMINACEAE**		
Spotted Touch-me-not	*Impatiens capensis*	G5	S5
BARBERRY FAMILY	**BERBERIDACEAE**		
Blue Cohosh	*Caulophyllum thalictroides*	G4G5	S5

OTHER VASCULAR PLANTS			
Common Name	**Scientific Name**	**G Rank**	**S Rank**
BORAGE FAMILY	**BORAGINACEAE**		
Viper's Bugloss	*Echium vulgare*	G?	SNA
MUSTARD FAMILY	**BRASSICACEAE**		
Tower Mustard	*Arabis glabra*	G5	S5
BELLFLOWER FAMILY	**CAMPANULACEAE**		
Creeping Bellflower	*Campanula rapunculoides*	G?	SNA
HONEYSUCKLE FAMILY	**CAPRIFOLIACEAE**		
Pale-spiked Lobelia	*Lobelia spicata*	G5	S4
PINK FAMILY	**CARYOPHYLLACEAE**		
Mouse-eared Chickweed	*Cerastium fontanum*	G?	SNA
Bladder Campion	*Silene vulgaris*	G?	SNA
GOOSEFOOT FAMILY	**CHEONPODIACEAE**		
Lamb's Quarters	*Chenopodium album*	G5T5	SNA
Maple-leaved Goosefoot	*Chenopodium simplex*	G5	S5
MORNING-GLORY FAMILY	**CONVOLVULACEAE**		
Hedge Bindweed	*Calystegia sepium*	G4G5T?	SU
DOGWOOD FAMILY	**CORNACEAE**		
Bunchberry	*Cornus canadensis*	G5	S5
PEA FAMILY	**FABACEAE**		
Bird's-foot Trefoil	*Lotus corniculatus*	G?	SNA
Black Medick	*Medicago lupulina*	G?	SNA
Alfalfa	*Medicago sativa*	G?T?	SNA
White Sweet-clover	*Melilotus alba*	G?	SNA
Yellow Clover	*Trifolium aureum*	G?	SNA
Alsike Clover	*Trifolium hybridum*	-	SNA
Red Clover	*Trifolium pratense*	G?	SNA
White Clover	*Trifolium repens*	G?	SNA
Cow Vetch	*Vicia cracca*	G?	SNA

OTHER VASCULAR PLANTS			
Common Name	**Scientific Name**	**G Rank**	**S Rank**
GERANIUM FAMILY	**GERANIACEAE**		
Bicknell's Crane's-bill	*Geranium bicknellii*	G5	S4
WATER MILFOIL FAMILY	**HALORAGACEAE**		
Marsh Mermaid-weed	*Proserpinaca palustris*	G5	S4
ST. JOHN'S-WORT FAMILY	**HYPERICAEAE**		
Common St. John's-wort	*Hypericum perforatum*	G?	SNA
MINT FAMILY	**LAMIACEAE**		
Wild Basil	*Clinopodium vulgare*	G?	S5
Northern Water-horehound	*Lycopus uniflorus*	G5	S5
Field Mint	*Mentha arvensis*	-	S5
Heal-all	*Prunella vulgaris*	G5	S5
HEATH FAMILY	**MONOTROPACEAE**	G5	S5
Indian-pipe	*Monotropa uniflora*	G5	S5
EVENING-PRIMROSE FAMILY	**ONAGRACEAE**		
Smaller Enchanter's Nightshade	*Circaea alpina*	G5	S5
Enchanter's Nightshade	*Ciracea lutetiana*	G5	S5
Northern Willow-herb	*Epilobium ciliatum*	G5T?	S5
Common Evening-primrose	*Oenothera biennis*	G5	S5
WOOD-SORREL FAMILY	**OXALIDACEAE**		
Upright Yellow Wood-sorrel	*Oxalis stricta*	G5	S5
PLANTAIN FAMILY	**PLANTAGINACEAE**		
Narrow-leaved Plantain	*Plantago lanceolata*	G5	SNA
Common Plantain	*Plantago major*	G5	SNA
MILKWORT FAMILY	**POLYGALACEAE**		
Gay Wings	*Polygala paucifloia*	G5	S5
BUCKWHEAT FAMILY	**POLYGONACEAE**		
Buckwheat	*Fagopyrum esculentum*	G?	SNA
Fringed Black Bindweed	*Polygonum cilinode*	G5	S5
Pale Smartweed	*Polygonum lapathifolium*	G5	S5

OTHER VASCULAR PLANTS			
Common Name	**Scientific Name**	**G Rank**	**S Rank**
Sheep Sorrel	*Rumex acetosella*	G5T	SNA
Curled Dock	*Rumex crispus*	G?	SNA
Broad-leaved Dock	*Rumex obtusifolia*	G5	SNA
PRIMROSE FAMILY	**PRIMULACEAE**		
Starflower	*Trientalis borealis*	G5T?	S5
CROWFOOT FAMILY	**RANUNCULACEAE**		
White Baneberry	*Actaea pachypoda*	G5	S5
Red Baneberry	*Actaea rubra*	G5	S5
Sharp-lobed Hepactica	*Anemone acutiloba*	G5	S5
Canada Anemone	*Anemone canadensis*	G5	S5
Thimbleweed	*Anemone cylindrica*	G5	S4
Wild Columbine	*Aquilegia canadenisis*	G5	S5
Kidney-leaf Buttercup	*Ranunculus abortivus*	G5	S5
Tall Buttercup	*Ranunculus acris*	G5	SNA
Tall Meadow-rue	*Thalictrum pubescens*	G5	S5
ROSE FAMILY	**ROSACEAE**		
Agrimony	*Agrimonia gryposepala*	G5	S5
Virginia Strawberry	*Fragaria virginiana*	G5	S5
Yellow Avens	*Geum aleppicum*	G5	S5
Rough Cinquefoil	*Potentilla norvegica*	G5T?	SNA
Rough-fruited Cinquefoil	*Potentilla recta*	G?	SNA
Barren Strawberry	*Waldsteinia frgarioides*	G5	S5
MADDER FAMILY	**RUBIACEAE**		
Cleavers	*Galium aparine*	G5	S5
Fragrant Bedstraw	*Galium triflorum*	G5	S5
Creeping Partridge-berry	*Mitchella repens*	G5	S5
SAXIFRAGE FAMILY	**SAXIFRAGACEAE**		
Naked Bishop's-cap	*Mitella nuda*	G5	S5
False Miterwort	*Tiarella cordifolia*	G5	S5

OTHER VASCULAR PLANTS			
Common Name	**Scientific Name**	**G Rank**	**S Rank**
FIGWORT FAMILY	**SCROPHULARIACEAE**		
Canada Wood-betony	*Pedicularis canadensis*	G5	S5
Common Mullein	*Verbascum thapsus*	G5	S5
American Brooklime	*Veronica americana*	G5	S5
Common Speedwell	*Veronica officinalis*	G5	S5
VIOLET FAMILY	**VIOLACEAE**		
Dog Violet	*Viola conspersa*	G5	S5
Downy Yellow Violet	*Viola pubescens*	G5	S5

*** GRANK Definition**

G4 Common; usually more than 100 occurrences; usually not susceptible to immediate threats.

G5 Very common; demonstrably secure under present conditions.

T denotes that the rank applies to a subspecies variety.

G? Unranked, or if following a ranking, rank is tentatively assigned (e.g. G5?).

***SRANK Definition**

S4 Apparently secure; uncommon but not rare; some cause for long-term concern due to declines or other factors.

S5 Secure; common, widespread, and abundant in the nation or state/province.

SNA Not Applicable; A conservation status rank is not applicable because the species is not a suitable target for conservation activities.

APPENDIX 2: WILDLIFE SPECIES LIST

MAMMALS				
Common Name	**Scientific Name**	**Evidence ***	**G Rank****	**S Rank*****
SHREWS AND MOLES	**INSECTIVORA**			
Star-nosed Mole	*Condylura cristata*	SI/burrows	G5	S5
RODENTS	**RODENTIA**			
Eastern Chipmunk	*Tamias striatus*	OB	G5	S5
Red Squirrel	*Tamiasciurus hudsonicus*	OB	G5	S5
Porcupine	*Erethizon dorsatum*	SI/droppings	G5	S5
CARNIVORES	**CARNIVORA**			
Coyote	*Canis latrans*	TK	G5	S5
Black Bear	*Ursus americanus*	SI/reported	G5	S5
DEER AND BISON	**ARTIODACTYLA**			
White-tailed Deer	*Odocoileus virginianus*	TK	G5	S5

HERPETILES				
Amphibians				
Common Name	**Scientific Name**	**Evidence**	**G Rank**	**S Rank**
MOLE SALAMANDERS	**AMBYSTOMATIDAE**			
Blue Spotted Salamander	*Ambystoma laterale*	SI/egg mass	G5	S4
TREEFROGS	**HYLIDAE**			
Gray Tree Frog	*Hyla versicolor*	V	G5	S5
Spring Peeper	*Pseudacris crucifer*	V	G5	S5
TRUE FROGS	**RANIDAE**			
Wood Frog	*Rana sylvatica*	V	G5	S5

FISH				
Common Name	Scientific Name	Evidence	G Rank	S Rank
STICKLEBACKS	GASTEROSTIDAE			
Brook Stickleback	*Culaea inconstans*	OB	G5	S5

INSECTS				
Butterflies				
Common Name	Scientific Name	Evidence	G Rank	S Rank
SKIPPERS	HESPERIIDAE			
European Skipper	*Thymelicus lineola*	OB	G5	SNA
SWALLOWTAILS	PAPILIONIDAE			
Canadian Tiger Swallowtail	*Papilio canadensis*	OB	G5	S5
WHITES AND SULPHURS	PIERIDAE			
Clouded Sulphur	*Colias philodice*	OB	G5	S5
Cabbage White	*Pieris rapae*	OB	G5	SNA
BRUSHFOOTS	NYMPHALIDAE			
Monarch	*Danaus plexippus*	OB	G4	S2N,S4B
Mourning Cloak	*Nymphalis antiopa*	OB	G5	S5

Dragonflies				
Common Name	Scientific Name	Wildlife Evidence	G Rank	S Rank
SPREADWINGS	LESTIDAE			
Spotted Spreadwing	*Lestes congener*	OB	G5	S5
DARNERS	AESHNIDAE			
Common Green Darner	*Anax junius*	OB	G5	S5
SKIMMERS	LIBELLULIDAE			
Cherry-faced Meadowhawk	*Sympetrum internum*	OB	G5	S5

* Evidence Codes from Lee et al., 1998.

OB – observed, TK – tracks, SI – other signs (specify), VO – vocalization,

**** GRANK Definition**

G4 Common; usually more than 100 occurrences; usually not susceptible to immediate threats.

G5 Very common; demonstrably secure under present conditions.

***** SRANK Definition**

S4 Apparently secure; uncommon but not rare; some cause for long-term concern due to declines or other factors.

S5 Secure; common, widespread, and abundant in the nation or state/province.

SNA Not Applicable; A conservation status rank is not applicable because the species is not a suitable target for conservation activities.

B Breeding migrants/vagrants

N Non-breeding migrants/vagrants

S2S3N: Between 5 and 20 significant migratory concentration areas known (largely along the shorelines of the lower Great Lakes) but others may exist thus the rank range of S2S3. Only these migratory concentration areas are tracked.

APPENDIX 2: WILDLIFE SPECIES LIST – BIRDS

Common Name	Scientific Name	Breeding Evidence *				Listed Species #	G Rank	S Rank
		Ob.	Po.	Pr.	Conf.			
Red-shouldered Hawk	*Buteo lineatus*	X				-	G5	S4B
Ruffed Grouse	*Bonasa umbellus*		H			-	G5	S5
Yellow-bellied Sapsucker	*Sphyrapicus varius*		H			-	G5	S5B
Northern Flicker	*Colaptes auratus*		H			-	G5	S5B
Downy Woodpecker	*Picoides pubescens*		H			-	G5	S5
Hairy woodpecker	*Picoides villosus*		H			-	G5	S5
Pileated Woodpecker	*Drycopus pileatus*		H			-	G5	S4S5
Eastern Phoebe	*Sayornis phoebe*		H			-	G5	S5B
Great Crested Flycatcher	*Myiarchus crinitus*			T		-	G5	S5B
Least Flycatcher	*Empidonax minimus*		H			-	G5	S4B
Eastern Wood Pewee	*Contopus virens*		S			-	G5	S5B
Black-billed Cuckoo	*Coccyzus americanus*		S			-	G5	S4B
Blue Jay	*Cyanocitta cristata*		H			-	G5	S5
Common Raven	*Corvus corax*		H			-	G5	S5
American Crow	*Corvus brachyrhynchos*		H			-	G5	S5B
Tree Swallow	*Tachycineata bicolor*		H			-	G5	S5B
Black Capped Chickadee	*Poecile carolinensis*		H			-	G5	S5
Red -breasted Nuthatch	*Sitta canadensis*		H			-	G5	S5B
White -breasted Nuthatch	*Sitta carolinensis*		H			-	G5	S5
Winter Wren	*Troglodytes troglodytes*			T		-	G5	S5B

Common Name	Scientific Name	Breeding Evidence *				Listed Species #	G Rank	S Rank
		Ob.	Po.	Pr.	Conf.			
American Robin	*Turdus migratorius*			T		-	G5	S5B
Hermit Thrush	*Catharus guttatus*			T		-	G5	S5B
Philadelphia Warbler	*Vireo philadelphicus*		S			-	G5	S5B
Red-eyed Vireo	*Vireo olivaceus*			T		-	G5	S5B
Nashville Warbler	*Vermivora ruficapilla*		H			-	G5	S5B
Chestnut-sided Warbler	*Dendroica pensylvanica*		H			-	G5	S5B
Black-throated Blue Warbler	*Dendroica caerulescens*		S			-	G5	S5B
Black-throated Green Warbler	*Dendroica virens*		S			-	G5	S5B
Yellow Rumped Warbler	*Dendroica coronata*		H			-	G5	S5B
Americn Redstart	*Setophaga ruticilla*		S			-	G5	S5B
Black and White Warbler	*Mniotilta varia*		H			-	G5	S5B
Ovenbird	*Seiurus aurocapillus*			T		-	G5	S5B
Northern Waterthrush	*Seiurus motacilla*		S			-	G5	S5B
Rose Breasted Grosbeak	*Pheucticus ludovicianus*		S			-	G5	S5B
Indigo Bunting	*Passerina cyanea*		S			-	G5	S5B
Chipping Sparrow	*Spizella passerina*		S			-	G5	S5B
White-throated Sparrow	*Zonotrichia albicollis*		S			-	G5	S5B
Song Sparrow	*Melospiza melodia*		S			-	G5	S5B

* Breeding Codes from Ontario Breeding Bird Atlas, 2001, 2003.

Ob. = Observed, X = species observed in its breeding season (no evidence of breeding). Presumed migrants not recorded.

Po. = Possible Breeding, H = species observed in its breeding season in suitable nesting habitat.

S = singing male present, or breeding calls heard, in its breeding season in suitable nesting habitat.

Pr. = Probable Breeding, T = permanent territory presumed thorough registration of territorial song on a least 2 days, a week or more apart, at the same place.

DD = distraction display or injury feigning.

FY = recently fledged young or downy young, including young incapable of sustained flight.

Conf. = Confirmed Breeding, NE = nest containing egg(s)

Listed Species – for ecoregion 5E, no criteria available, from "Significant Wildlife Habitat Ecoregion Criteria Schedules. Addendum to Significant Wildlife Habitat Technical Guide. Working Draft. OMNR, 2009"

*** *GRANK Definition**

G5 Very common; demonstrably secure under present conditions.

***** SRANK Definition**

S4 Apparently secure; uncommon but not rare; some cause for long-term concern due to declines or other factors.

S5 Secure; common, widespread, and abundant in the nation or state/province.

S#S# Range Rank; A numeric range rank (e.g. S2S#) is used to indicate any range of uncertainty about the status of the species.

B Breeding migrants/vagrants

N Non-breeding migrants/vagrants

S4B: Undoubtedly more than 100 breeding EOs of this widespread migratory species that is common in some years. Several to many protected EOs although the quality of these EOs is not known. Threats in Ontario are few and minor. Threats on the wintering grounds in Mexico are greater. Long-term trends not known.'

APPENDIX 3: RECOMMENDED MITIGATION

The following are recommended to be included on the site plans to mitigate impacts to natural features on and within 120m of the site.

- To minimize the short term impact of forest removal, vegetation clearing will be conducted in phases over time in anticipation of future extraction needs. Only enough land will be cleared at one time to allow for about 2 years of extraction.

- No tree cutting or land clearing will occur from April 1 to July 15 to protect breeding wildlife.

- Planting native trees to replace forest habitats will be a major component of the rehabilitation plan to restore the site to forest cover.

- All surface water falling on the site will be retained on site and will infiltrate to be added to local ground water supplies.

- A Spills Response Plan will be prepared, implemented and enforced to protect water quality.

- All equipment maintenance and fuel storage will be offsite.

- All re-fuelling of equipment will be from a mobile source brought to the site.

- A monitoring program will be implemented to ensure that the quality of ground water and water in the proposed sump quality meets Provincial Water Quality standards.

RESUME

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Qualifications and Training

- B.Sc. U. of Guelph, (1970)
- M.Sc., U. of Guelph, (1972)
- Certified Wildlife Biologist, The Wildlife Society (since 1979)
- Ontario Wetland Evaluation Training
- Aquatic Habitat Inventory Training
- Wetland Restoration Training
- Larval Fish Identification Training
- Law Enforcement Training
- Ontario Municipal Board Training
- Negotiation Training
- Stresses and Management of Cold and Warmwater Fish communities Training
- First Nations Culture Training
- Fish Culture Training
- Fish and Wildlife Population Modeling
- Ecosystem Management
- Ecological Sustainability
- Waterfowl Identification and Management
- Provincial Planning Policies
- Federal Fisheries Act Habitat Policies
- Wildlife Management Area Planning
- St. John's Ambulance CPR/First Aid
- Ontario Health and Safely Act
- Butternut Health Assessor (#180)

2001-present Environmental Consultant

- Natural Environment Reports and Environmental Impact Statements for aggregate licence and planning applications
- appeared at 5 Ontario Municipal Board hearings as an expert in natural heritage issues
-conducted Butternut Health assessments as required by the Endangered Species Act (2007)
- Ontario's Ambassador to Canada's Recreational Fisheries Award Program (Federal Department of Fisheries and Oceans)
- assembled wildlife/fisheries data for Severn Sound Remedial Action Plan (SSRAP) de-listing report
- contracts with Ducks Unlimited and private landowners, trade shows, ponds advice and wetland boundaries
- Barrie Ducks Unlimited Fund Raising Committee (Past Chairman). Ducks Unlimited is a non profit group dedicated to wetland restoration across North America

1999-2001 Provincial Community Fisheries and Wildlife Involvement Program (CFWIP) Coordinator

- chair of Provincial Committee that developed program policies and procedures and annually allocated $1.0 million to support over 500 volunteer groups with resource projects
- developed procedures to ensure CFWIP followed revised Fisheries Act protocol and assisted with review of all OMNR programs to ensure adherence to new protocols

1998-1999 Resource Liaison Officer, Midhurst District OMNR

- facilitated agreements with multi-interest volunteer groups regarding operations of Copeland Forest and 4 Simcoe County Provincial Wildlife Areas (PWA's)
- facilitated agreements with Ducks Unlimited to operate OMNR dams at Tiny and Wye Marsh PWAs
- managed SSRAP riparian Habitat restoration project including supervising staff, budgeting, approving projects, technical guidance; more than 85 projects were completed, 65 km of stream buffers created and over $2.0 million in work completed
- worked with First Nations regarding resource issues

1973-1998 OMNR Field Biologist, Niagara and Huronia/Midhurst Districts

- SSRAP planning team member from 1986 involved with identifying issues, developing remedial options and implementing actions
- Provincial CFWIP Committee member for Southern Ontario from 1992-1999
- provided resource input to multi-agency, water quality improvement and landowner funding committees such as NVCA Lands and Waters Committee and SSRAP Non Point Source Committee
- managed various resource inventory and data collection projects such as lake, stream and wetland inventories and angler and hunter surveys
- lead development of local OMNR Fisheries Management Plan, wildlife area management plans, fish and wildlife Land Use Guidelines
- lead team that developed a Controlled Deer Hunt for Simcoe and Dufferin Counties, 1978
- member of a multi-agency Provincial team that developed guidelines for harvesting aquatic plants in Ontario
- worked with City of Barrie to develop a "Fish Habitat Study" to guide waterfront development and protect fish habitat, one result was the building of "habitat" islands by the Barrie Rotary Club in 1998
- conducted radio telemetry studies of walleye and muskellunge to determine spawning habitats in the Nottawasga River and southern Georgian Bay
- conducted workshops for contractors about Provincial Work Permit system and fish habitat protection
- accepted as an expert witness in court cases and Ontario Municipal Board hearings in issues about fish habitat and wetlands
- published papers in peer reviewed journals about wildlife diseases and fish habitat
- trained OMNR and Conservation Authority staff about Fisheries Act fish habitat protocols and procedures
- member of team that trained senior OMNR mangers about sustainable development
- member of team that developed a wetland restoration training course for Ontario Biologists

Appendix B
Hydrogeological Assessment
MTE Consultants

MTE
More Than Engineering
25 YEARS 1985-2010

FREYMOND PROPOSED QUARRY

Final

Level 2 Hydrogeological Investigation

Project Location:
Lot 51 and 52, Concession WHR
Township of Faraday, County of Hastings

Prepared for:
Freymond Lumber Ltd.
c/o Geological Investigations
38 Alpine Drive, P.O. Box 122
Moonstone, ON L0K 1N0

June 3, 2013

MTE File No.: 33886-100

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EXECUTIVE SUMMARY

MTE is working on behalf of Freymond Lumber Ltd. to prepare a Level 1 and Level 2 hydrogeological investigation for a proposed Category 2, Class 'A' quarry below-water-table. The proposed quarry is located on Lot 51 and 52, Concession WHR in the Township of Faraday, County of Hastings (hereby referred to as the "Site").

The purpose of this report is to assess geological, hydrogeological, and hydrological conditions at the Site and indentify any potential post-extraction adverse effects on water resources, water uses, and the natural environment.

As per the Provincial Standards, this report addresses the requirements for a Category 2 Class "A" license for quarry operations, which intends to extract aggregate material from below the established water table. The scope of work includes a review of published geological and water resources maps, and an examination of water well records on file with the Ontario Ministry of the Environment (MOE).

Reconnaissance, geological mapping, and natural features mapping on the Site and the adjacent lands were part of the field work. Field work also included drilling and construction of bedrock monitoring wells at six locations and on-going measurements of groundwater levels.

Based on the hydrogeological investigation, MTE Consultants Inc. offers the following conclusions and recommendations:

- 14 of the 15 private wells identified through MOE well records, have reported water depth found elevations below the floor of the proposed quarry. As such, proposed quarry operations are not interpreted to have the potential to interfere with the ability of these zones within the bedrock groundwater system to produce water to the private wells.
- The one well identified with a water found elevation above the floor of the proposed quarry lies up-gradient of the general bedrock groundwater flow pattern on the Site and is located on a separate topographic high which has been interpreted to be located in a separate local groundwater regime. Quarrying activities are not predicted to have the potential to cause an adverse effect at this well location.
- From the hydrogeological data collected through the preparation of this hydrogeological investigation, the local on-Site groundwater regime can be described as being predominately a low permeability recharge area.
- Groundwater flow in the shallow and deeper bedrock groundwater systems generally mimic each other and flow towards the northeast towards the York River.

- The predicated cone of influence that will be created by the extraction will extend to approximately 100 metres from the active quarry face. Based on the available mapping, no sensitive features have been identified within the predicated cone of influence.
- As an adaptive management action, in order to assess whether a major water bearing fracture or joint has been intersected, MTE recommends that fracture mapping occur on-Site after quarrying activities have commenced, and before the operation goes below the water table. This is expected to be several years after the start of the operation, when the bedrock has been fully exposed.

1.0 INTRODUCTION

Waterloo Geoscience Consultants Ltd. (WGC) merged with MTE Consultants Inc. (MTE) on June 1, 2009. WGC conducted the preliminary hydrogeological work associated with this project.

MTE is working on behalf of Freymond Lumber Ltd. to prepare a Level 1 and Level 2 hydrogeological investigation for a proposed Category 2, Class 'A' quarry below-water-table. The proposed quarry is located on Lot 51 and 52, Concession WHR in the Township of Faraday, County of Hastings (hereby referred to as the "Site"). The Site location is illustrated in Figure 1.

1.1 Scope and Methodology

The purpose of this report is to assess geological, hydrogeological, and hydrological conditions at the Site and indentify any potential post-extraction adverse effects on water resources, water uses, and the natural environment.

As per the Provincial Standards, this report addresses the requirements for a Category 2 Class "A" license for quarry operations, which intends to extract aggregate material from below the established water table. The scope of work includes a review of published geological and water resources maps, and an examination of water well records on file with the Ontario Ministry of the Environment (MOE).

Reconnaissance, geological mapping, and natural features mapping on the Site and the adjacent lands were part of the field work. Field work also included drilling and construction of bedrock monitoring wells at six locations and on-going measurements of groundwater levels.

2.0 SITE DESCRIPTION

The study area including the Site boundary, geological cross-section location, and the location of private water supply wells are illustrated on Figure 2. For the purposes of this investigation, the study area is defined as the area 500 metres beyond the Site boundary. The quarry has a proposed licensed area of 35 hectares (ha) and a proposed extraction area of 28 ha.

2.1 Surface Water and Drainage

Site topography consists of undulating bedrock knobs in the western portion of the Site. Topography peaks at 392 metres above mean sea level (mAMSL) at the northwestern corner of the Site before dipping to a valley at 380 mAMSL, which roughly bisects the central portion of the Site. Site topography rises steeply to the east from this central valley to approximately 389 mAMSL before topography falls sharply to 335 mAMSL at the eastern Site boundary.

While OBM mapping shows that there are no surface water bodies or courses on Site, Site reconnaissance, by Robin Craig (biologist), has identified a permanent surface water body in the north central portion of the Site and two semi-permanent ponds at or just beyond the south west Site boundary. There is an unnamed stream south and southeast of the Site (~50 m away) that drains the surrounding area and flows to the east where it joins the York River, which is the closest major surface water course to the Site. A stretch of the York River falls within the 500 m study area boundary, to the northeast. The closest mapped major surface water body to the Site is Spurr Lake which lies approximately 850 m south of the Site. OBM mapping shows a wetland complex northwest of the Site within the 500 m study area, associated with a small tributary of the York River.

3.0 GEOLOGY AND HYDROGEOLOGY

3.1 Quaternary Geology

Map sheets in publication (Barnett, 1985) regarding Quaternary geology of the Bancroft Area (Figure 3) describe the Site and surrounding area as containing:

1. Bedrock: exposed or with very thin drift cover.
2. Till: silty to sandy; stony.
3. Glaciofluvial outwash and deltaic deposits; gravelly sand, sand, gravel.
4. Bog and swamp deposits: muck, peat, marl.
5. Modern alluvium: unsubdivided-sand, silt, gravel, clay, muck.

3.2 Precambrian Geology

Map sheets in publication (Lumbers and Vertolli, 1998) regarding the Precambrian geology of the Bancroft Area (Figure 4) describe the Site and surrounding area as containing:

1. Rusty weathering, graphitic, pyrite and pyrrhotite-bearing schist.
2. Amphibole-rich metasedimentary rocks. Medium to high metamorphic grade calcareous mudstone and sandstone with a metamorphic fabric and mainly diopside-amphibole-plagioclase gneiss locally containing phases rich in potassium feldspar, quartz, biotite, scapolite, epidote, carbonate, titanite, pyrite and iron-titanium minerals; intercalated thin units of siliceous marble are common.
3. Calcitic Marble (Medium to High Metamorphic Grade). Medium- to coarse-grained, grey to white, gneissic calcitic marble containing up to 20% siliceous impurities; locally contains intercalated units of siliceous marble; Medium- to coarse-grained, gneissic, siliceous calcitic marble containing 20 to 60% siliceous impurities; commonly contains thin interlaced units of amphibole-rich metasedimentary rocks.

4. Dolomitic Marble; medium-to coarse-grained, white to greenish, dolomitic marble containing up to 20% siliceous impurities; local intercalations of tremolite-rich dolomitic marble. Medium- to coarse-grained, cherty, dolomitic marble containing numerous discontinuous layers of coarsely recrystallized chert, possibly in part derived from silicified stromatolites and algal mats.

A hand specimen collected at the Site (central location) appears to closely match the description of the calcitic marble from Unit 3 above.

While the above referenced mapping provided sufficient information regarding Precambrian rock types at the Site, the map did not provide detailed information on the structural geology (joints, fractures, etc.) at the Site. The Precambrian map (Lumbers and Vertolli, 1998) does show a series of regional fault lines north of the Site. These fault lines generally run east-west, so there may be minor faulting on the Site of similar orientation. As such, no detailed information regarding the localized fracture and joint orientation at the Site was available for this hydrogeological assessment.

3.3 Geological Cross-Section

Hydrogeological data related to private supply wells in the study area were obtained from water well records on file with the Ontario Ministry of the Environment (MOE) (Appendix A) and from boreholes constructed on-Site (Section 4.1) and used to construct geological cross-section A-A' through the Site (Figure 5). From the available MOE well records, a total of 15 private wells have been identified within 500 metres of the Site boundary. Based on MOE well records, the geology along the cross-section has been interpreted as being predominately Precambrian bedrock consisting of metasedimentary rock.

4.0 FIELD PROGRAM

4.1 Borehole Construction and Monitoring Well Installation

On April 27, 2009 and May 4, 2009 through May 6, 2009 a total of six nested boreholes were constructed by Freymond Lumber with MTE staff on-Site to monitor and record all drilling and monitoring well installations. Boreholes were constructed using a track-mounted air percussion drill rig. At each borehole location, two monitoring wells (MW) were installed at a relatively shallow (s) and deep (d) elevation in the bedrock to allow for comparison of groundwater levels and determination of hydrogeological characteristics.

The deep monitoring wells (MWd) were constructed with the intent that the bottom elevation of the monitoring well would roughly correspond to the proposed deeper elevations of the quarry floor at that location. The shallow monitoring wells (MWs) were constructed with the intent that the bottom elevation of the monitoring well would roughly correspond to an elevation that approximated the mid-way point of the proposed quarry excavation. The monitoring wells were not constructed to map flow in discrete fractures sets as this practice is most applicable to sedimentary rocks and the process of metamorphism practically reduces this practice. As such, groundwater levels and hydrogeological characteristics collected from MWs and MWd locations would therefore be reflective of the general hydraulic heads and dewatering needs of the Site and allow for greater characterization of the local groundwater system at these locations.

Borehole logs and monitoring well installation details are provided in Appendix B. Each monitoring well was developed using the Waterra™ system to purge any drill cuttings from the monitoring well. Monitoring well locations are illustrated on Figure 2.

During the construction of MW4s, the driller noted inputs of water at 3.05 metres below ground surface (mBGS), 12.2 mBGS, and 18.3 mBGS, with a "significant" (as reported by the driller) amount of water encountered at 18.3 mbGS (~352mAMSL). At MW4d, the driller noted water inputs at 3.04 mBGS, 9.75 mBGS and 16.8 mBGS, with "significant" inputs being encountered at 16.8 mBGS (~353 mAMSL). The elevations of where "significant" groundwater inputs were observed by the driller appear to be common and despite the heterogeneities due to metamorphism, MTE strived to map these common fractures where possible, while considering the approach discussed above. Significant amounts of groundwater inputs were not detected while drilling the other five boreholes.

4.2 Groundwater Levels

Following monitoring well installation in May 2009, MW1s, MW1d, MW2s, MW2d, MW5s, MW5d, MW6s, and MW6d were initially instrumented with a data logger programmed on a linear setting to collect a groundwater level every eight hours. Manually measured groundwater levels were collected on a regular basis to supplement the data logger data and to aid in the calibration of the data logger data. Manually measured groundwater levels and elevations are presented in Table 1 and Table 2 and illustrated on Hydrograph 1. Groundwater elevations generated from the data logger data are illustrated in Hydrograph 2.

By July 2009, no groundwater levels had been reliably collected from MW1d and MW5d and MTE realized that these wells were "dry" and not likely to produce enough groundwater to represent static conditions and could not be used for groundwater maps or for in-situ testing. As such, during the August 2009 monitoring session, the data loggers from MW1d and MW5d were removed from their respective wells, re-programmed, and installed in MW4s and MW4d. Two additional data loggers were installed in MW3s and MW3d during the December 2009 groundwater monitoring session.

Since installation, the data logger data shows that groundwater levels in MW5s, MW6s, and MW6d are representative of natural seasonal fluctuations. Groundwater levels at MW2s, as recorded by the data logger, show that recovery at this location, based on well performance testing (discussed in Section 4.6) took approximately 1 month before assuming natural fluctuations while groundwater levels at MW2d took approximately five months to recovery from the well performance testing before groundwater levels assumed natural seasonal fluctuations.

Groundwater levels as recorded by the data logger at MW1s, show that recovery at this location, from well performance testing (discussed in Section 4.6), took approximately 11 months before assuming natural seasonal fluctuations.

Groundwater levels at MW4s and MW4d, as recorded by the data logger, show that recovery at this location, from well development following installation, took approximately 11 months before assuming natural seasonal fluctuations.

4.2.1 Water Table Elevation

The Provincial Standards that govern Category 2, Class 'A' quarry below-water-table applications have defined the groundwater table in consolidated bedrock materials as:

The groundwater level, or potentiometric surface, is a level that represents the fluid pressure in the water bearing zone and is generally defined by the level to which water will rise in a well.

However, as defined by the American Geological Institute, this is NOT the water table, since the water table must be in equilibrium with atmospheric pressure. In deep fractured rock, this condition cannot exist and the pressures at depth represent a potentiometric surface.

MTE has been advised by the Ministry of Natural Resources (MNR) on previous quarry applications, that when determining the elevation of the water table in bedrock, MNR considers the elevation of the water level in a well to be the top of the water table. As such, MTE has applied this definition to determine the elevation of the "water table" at the Site. This approach has implications on determining potential groundwater inflows into the quarry (discussed in Section 6).

The groundwater elevation in the shallow bedrock groundwater flow system, as defined by the manually measured water levels obtained from MW1s through MW6s ranges from 355.40 mAMSL (MW2s) to 375.22 mAMSL (MW3s). The groundwater elevation in the deeper bedrock groundwater flow system, as defined by the manually measured water levels obtained from MW1d through MW6d ranges from 331.97mAMSL (MW1d) to 373.88 mAMSL (MW3d). The site plans have proposed a quarry floor elevation of 332 mAMSL.

Establishing the maximum depth below-water-table of the proposed quarry was necessary in order to estimate the amount of groundwater that may enter the quarry during active operations (discussed in Section 6). The highest elevation for the water table observed at on-Site monitoring well was 375.22 mAMSL (MW3s). Therefore with the proposed quarry floor of being 332 mAMSL, the maximum depth of the quarry below the observed groundwater level was calculated to be approximately 43 m.

However, the exact elevation at which groundwater will enter the operating quarry will vary across the Site as bedrock groundwater will actually come from fractures in the bedrock located at discrete elevations across the operating face. As detailed in Section 6, the vast majority of water that will need managing at the Site will come from precipitation, and that a sloped quarry floor (as detailed in the site plans) will direct this water away from the operating face so that there will be no stored water on-Site.

4.3 Vertical Gradients

Vertical gradients were calculated for all on-Site monitoring wells using the manually measured groundwater levels. The calculated vertical gradients are presented in Table 3.

Moderate to strong downward vertical gradients are present at all monitoring locations across the Site indicating that at these locations the groundwater system is acting as a recharge zone. At the time of data collection bedrock groundwater was migrating from the shallow bedrock groundwater system to the deeper bedrock groundwater system.

4.4 Groundwater Flow

Groundwater flow mapping was conducted for the shallow (s) and deep (d) wells at the Site using the October 6, 2010 groundwater elevation data. Groundwater contours and flow patterns for the shallower bedrock and deeper groundwater flow systems are illustrated in Figure 6 and Figure 7. Monitoring well MW5d was not used to create the groundwater map since the well was 'dry' at the time of data collection

On October 6, 2010, groundwater in the shallow bedrock flowed in a radial pattern to the North, Northeast, and East from an interpreted groundwater mound centered on MW3. A horizontal hydraulic gradient of 0.045m/m was calculated for the shallow bedrock groundwater system on this day. The unnamed stream to the south of the Site will not have any direct hydraulic connection with the groundwater on the Site since the stream flows over a bedrock surface, and the groundwater elevations are potentiometric, with water originating within the deep fractures of the bedrock. As both precipitation and groundwater are collected in the operating quarry, the water will be directed by gravity, along the quarry floor, towards the gravel deposit within the Site as described in Section 5.1. The unnamed stream and/or the York River may receive some of this water after it has migrated several hundred metres through the unconsolidated deposits. The rest of the quarry discharge water will be incorporated into the regional groundwater system.

On October 6, 2010, groundwater in the deeper bedrock groundwater system flowed in a predominately northeastern direction across the Site towards the York River. A horizontal hydraulic gradient of 0.12 m/m was calculated for the deeper bedrock groundwater system on this day.

4.5 Private Well Inventory

On April 20, 2010, a questionnaire (well inventory form) was delivered by hand to each residence with 500 metres of the Site. The door to door survey was conducted along Bay Lake Road, Gaebel Road, Jeffery Lake Road, and Highway 62. Where possible, local residents were interviewed in person and a private well inventory form was completed. In addition to providing details regarding their well, residents were queried about any past water quality or quantity problems. When no resident was available, a well inventory and covering letter was left with the request that the inventory be completed to the best of the resident's knowledge and returned to MTE in a self-addressed stamped envelope.

A total of 20 well inventories were delivered with seven being returned to MTE at the time of writing. Completed private well inventories are provided in Appendix C and summarized in Table 4. A total of six drilled wells and one dug well were reported. Of the seven private wells identified through the private well inventory, four have been included in the groundwater monitoring program. In general, the response from the public to the private well inventory was positive and assisted in the hydrogeological assessment process.

4.6 Well Performance Testing

Recovery tests were conducted in the newly installed monitoring wells on May 7, 2009 to define the hydraulic conductivity of the bedrock groundwater system around each well. Each monitoring well was pumped 'dry' using Waterra™ tubing and foot valve. Once each well was 'dry', the tubing and foot valve were removed and the recovery was recorded using dedicated pressure transducers (data loggers). The data loggers recorded the recovery rates in the wells every minute until May 8, 2009. Following the recording and the initial recovery, the data loggers were programmed as described in Section 4.2. Recovery curves for MW1s, MW2s, MW2d, and MW6s are presented in Hydrograph 3 through Hydrograph 6.

Recovery data from MW1s, MW2s, MW2d, MW4s, MW4d, and MW6s was used to analyze bedrock hydraulic properties. The hydraulic conductivity of the bedrock surrounding each well was calculated using AquiferTest© software. Recovery curves using the Hvorslev and Bouwer-Rice analyses have been presented in Appendix D. Calculated hydraulic conductivities have been summarized in Table 5. A geometric mean of $4.5x10^{-10}$ m/sec was calculated from the hydraulic conductivities derived from the Hvorslev analysis of the shallower bedrock wells, while a geometric mean of $4.8x10^{-10}$ m/sec was calculated from the Bouwer-Rice analysis .

A geometric mean of $1.1x10^{-10}$ m/sec was calculated from the hydraulic conductivities derived from the Hvorslev analysis of the deeper bedrock wells, while a geometric mean of $1.1x10^{-10}$ m/sec was calculated from the Bouwer-Rice. The comparable hydraulic conductivities indicate that there is no significant difference in the hydraulic conductivity results of the methods employed.

5.0 PROPOSED QUARRY OPERATIONS

5.1 Proposed Water Diversion, Storage, and Drainage Facilities

Since the proposed quarry is for a below-water-table extraction, groundwater and precipitation accumulating in the quarry are to be diverted during the operation to maintain dry operating conditions. A collection sump will be constructed along the eastern boundaries of the Site to collect groundwater, runoff, and precipitation running off the extraction area. Each phase of the quarry will be excavated to a depth and graded such that groundwater and precipitation are directed to the collection sump. There will be no water storage on the Site other than what is collected in the sump.

Drainage and diversions of groundwater and precipitation in the active area of the Site will be via a gravity driven process. There will be no pumping to dewater the Site.

5.2 Discharge to Surface Water

Precipitation and groundwater collected in the collection sump (Section 5.1) will be discharged via a weir to the east of the Site, and allowed to infiltrate into the natural sand/gravel deposit to supplement the shallow groundwater. By collecting water in the sump prior to discharge, fine-grained materials suspended in the water will be allowed to settle out and chemicals (e.g. trace amounts of residual ammonia from blasting) that may be introduced to runoff water during blasting will have time to dissipate. There will be no direct discharge of precipitation or groundwater collected at the Site to surface water features as also described in Section 4.4.

Regular water samples will be collected from the overflow weir to ensure that discharge water meets the Provincial Water Quality Objectives (PWQO). A detailed monitoring program for weir discharge has been presented in Section 9.0.

6.0 WATER BALANCE

A water balance equation shows the natural processes that contribute water to the Site. An understanding of these processes provides:

1. An estimate of the amount of water that may drain under gravity from the quarry.
2. An understanding of how to maintain the overall water balance in order to minimize potential effects on the natural environment.

The intent of the water balance discussion is to evaluate pre- and post-aggregate extraction water inputs to the Site with the goal of assessing what affects the proposed quarry will have on the water balance and surrounding natural features.

During this discussion, several parameters remain constant and are discussed below. These include:

- Evaporation and evapotranspiration rates;
- The annual amount of precipitation (in millimetres);
- Hydraulic conductivity under the Site as determined in Section 4.6 (1.1×10^{-10} m/sec);
- Horizontal hydraulic gradient determined from Figure 7 (0.12 m/m); and
- Depth of the saturated rock face (assumed to be 43.2 metres to correspond with the maximum depth of the quarry below the piezometric surface, as discussed in Section 4.2)

Evaporative Losses and Evapotranspiration

The mean evaporative rate from lakes in the Bancroft area is 700 mm/year (MNR, 1984). MNR derived mean evaporative losses from lakes (excluding the Great Lakes) from isolines printed in the Hydrologic Atlas of Canada. The following excerpt from page 23 of the MNR publication details how mean lake evaporation and evapotranspiration were determined.

The isolines of mean annual lake evaporation were developed using pan evaporation data, as well as evaporative calculated from climatological data including air temperature, wind velocity, relative humidity, and amount of possible bright sunshine. The stations that currently measure pan evaporation are shown on the map [this map can be found on page 22 of the MNR publication].

The isolines for mean annual evapotranspiration were calculated by subtracting mean annual runoff from mean annual precipitation. Over a period of many years, average evapotranspiration is the difference between precipitation and runoff.

Mean annual evapotranspiration at the Site, as determined by MNR, is on the order of 500 mm/year.

Precipitation

The closest Environment Canada weather station to the Site with climate averages from 1971-2000 is located at the Peterborough Airport. The annual average precipitation used in this water balance discussion is 840.3 mm/year or 0.8403 m/year.

Prior to extraction, the Site covers an undisturbed area of 35 hectares (ha). A total of 294,105 m^3 of precipitation falls on the Site in an average year. Using the evapotranspiration rates presented above, a total 175,000 m^3 of water is lost through evapotranspiration.

The pre-extraction runoff volumes were calculated using the Rational Method. The Rational Method uses the following formulae to estimate runoff:

Q(r) = A x c x P

Where: Q(r) = peak runoff
A = drainage area – Site Area = 350,000 m^2
C = runoff coefficient = 0.2 (discussed below)
P = precipitation = 840.3 mm/year or 0.8403 m/year

The runoff coefficient (c) was determined using tabulated values by McCuen (1998). These values are based on variables including:

1. Hydrologic soil group.
2. Slope range.
3. Land use.

The overburden across the majority of the Site has been observed through drilling to be relatively thin and discontinuous with numerous bedrock exposures. The lack of significant overburden soils indicates a high runoff potential which corresponds to soil group D. The Site is steeply sloped and is covered primarily with forest. Therefore, a runoff coefficient of 0.2 was chosen for the rational method. The resulting peak runoff in the pre-extraction scenario has been calculated to be 58,821 m^3/year.

Bedrock groundwater crossed the part of the Site that is below the saturated zone. This component of flow was the volumetric discharge (Q) in m^3/year across the up gradient face. The thickness of the face is equal to the depth of extraction below the water table on the up gradient cut face. To calculate the volumetric discharge, the groundwater flux in the bedrock was required.

The groundwater flux (Darcy velocity) was calculated as follows:

q=K x i

Where: K = geometric mean of the hydraulic conductivity values for tested monitoring wells = 1.1×10^{-10}m/s;
i = is the horizontal hydraulic gradient (0.12m/m) estimated from the equipotential contours described by the on-Site deep observation wells (Figure 7).

Therefore: $q = 1.4\text{x}10^{-11}\text{m/s}$
$= 4.5\text{x}10^{-4}\text{m/year}$

The volumetric discharge was calculated from groundwater flux as:

$Q = q \times A = 10\text{m}^3/\text{year}$

Where: $A = L\text{x } b$
And: b = thickness of the rock face = 43.2m
L = length of up gradient quarry face perpendicular to groundwater flow = 526 m
$A = 526 \text{ m} \times 43.2 \text{ m} = 22{,}723 \text{ m}^2$

Groundwater inputs (10m^3/year) to the Site are insignificant when compared to precipitation inputs.

Infiltration on the Site can be calculated using the formulae below and the water inputs and outputs described above. The following shows the calculation for the infiltration that occurs on the Site before extraction.

$I = P + Q_{gwin} - Q_r - ET - E - Q_{gwout}$

Where: P = precipitation
Q_{gwin} = groundwater underflow input
I = infiltration
Q_r = runoff
E = Evaporation
ET = Evapotranspiration
Q_{gwout} = groundwater underflow output

I = 294,105 m^3/year + 10 m^3/year – 58,821m^3/year -175, 000 m^3/year – 0 m^3/year – 10 m^3/year
I = 60,284 m^3/year

Under the pre-extraction water balance, of 294,105 m^3/year of precipitation that falls on the Site and 10 m^3/year contributed by groundwater underflow, 59.5% is lost to evapotranspiration (175,000 m^3/year) and 20% is runoff (58,821 m^3/year). Groundwater underflow accounts for less than 1% of total inputs. The remaining 20.5% of the inputs (60,284 m^3/year or 115 litres/minute) are available for infiltration to the groundwater system. Differences between percentages and actual numbers are due to rounding. The pre-extraction water balance details are summarized in Table 6.

Post-Aggregate Extraction Water Balance

At the conclusion of extraction, a total of 7 ha will remain undisturbed by quarrying operations. Precipitation (294,105 m^3/year) and groundwater inputs (10 m^3/year) to the Site will remain the same as calculated in pre-extraction water balance.

Under the post-aggregate extraction scenario, the area covered by the extracted quarry was assumed to be devoid of vegetation, so no evapotranspiration would occur. Evapotranspiration from the undisturbed area of the licensed property following quarrying was calculated to be 4 m^3/year.

The post-aggregate extraction runoff volumes were calculated using the Rational Method. The runoff coefficient was determined using the tabulated values by McCuen (1998). These values are based on variables including:

1. Hydrological soil group.
2. Slope range.
3. Land use.

In order to account for the two different land uses that will exist on the Site following extraction, a weighted runoff coefficient (c) was calculated. The disturbed area (quarried area) was assumed to have no overburden and therefore will have a high runoff potential which corresponds to soil group D. The disturbed portion of the Site will be graded to allow gravity to drain the quarry and is assumed to be relatively impervious which resulted in a runoff coefficient of 0.85 being chosen for this portion of the Site. The undisturbed area of the Site was assumed to have pre-aggregate extraction conditions which resulted in a runoff coefficient of 0.2 being chosen for this portion of the Site. The weighted runoff coefficient was calculated using the following:

$$c = [(c_q \times A_q) + (c_{ud} \times A_{cu})]/A_t$$
$$= [(0.85 \times 28) + (0.2 \times 7)]/35$$
$$= 0.72$$

Where:
c_q = runoff coefficient of quarried area = 0.85
A_q = area of quarried area = 28 ha
c_{ud} = runoff coefficient of undisturbed area = 0.2
A_{ud} = undisturbed area = 7 ha
A_t = Total area of the Site = 35 ha

In addition to the runoff generated from precipitation events, groundwater entering the quarry from the up gradient operating face will contribute runoff exiting the quarried area. This component of flow is volumetric discharge (Q) in m^3/year across the up gradient face. The thickness of the face is equal to the depth of extraction below the water table on the up gradient cut face. To calculate the volumetric discharge, the groundwater flux in the bedrock is required.

The groundwater flux (Darcy velocity) was calculated as follows:

$q = K \times i$

Where: K = geometric mean of the hydraulic conductivity values calculated for tested monitoring wells = 1.1×10^{-10} m/sec
i = is the horizontal hydraulic gradient (0.12 m/m)

Therefore: q = 1.4×10^{-11} m/sec
= 4.5×10^{-4} m/year

The volumetric discharge of groundwater that becomes runoff was calculated from groundwater flux as:

$Q = q \times A = 8\ m^3$/year

Where: A = L x b
And: b = thickness of the rock face = 43.2 m
L = length of the up gradient face perpendicular to groundwater flow = 430 m
A = 430 x 42.5 = 18,576 m^2

Therefore, the amount of runoff emanating from the Site under the post-aggregate extraction scenario was calculated as follows:

$Q_{(r)} = c \times [(A \times P) + Q_{gw}]$

Where: $Q_{(r)}$ = peak runoff = 211,762 m^3/yr
A = drainage area = Site area = 35 ha
c = runoff coefficient = 0.72
P = precipitation = 840.3 mm/year or 0.8403 m/year
Q_{gw} = groundwater becoming runoff = 8 m^3/year

Bedrock groundwater will continue to cross the part of the Site that is below the saturated zone and not part of the quarried area (as discussed above). This component of flow is the volumetric discharge (Q) in m^3/year across the up gradient face. The thickness of the rock face is equal to the depth of extraction below the water table on the up gradient cut face. To calculate the volumetric discharge, the groundwater flux in the bedrock is required.

Where: K = geometric mean of the hydraulic conductivity values calculated for tested monitoring wells = 1.1×10^{-10} m/sec
i = is the horizontal hydraulic gradient (0.125 m/m)

Therefore: q = 1.43×10^{-11} m/sec
= 4.49×10^{-4} m/year

The volumetric discharge was calculated from groundwater flux as:

$Q = q \times A = 2\ m^3/year$

Where: $A = L \times b$

And: b = thickness of the rock face = 43.2 m

L = length of the up gradient face perpendicular to groundwater flow = 96 m

$A = 96\ m \times 43.2\ m = 4{,}147 m^2$

Groundwater inputs across the undisturbed portion of the Site were calculated to be 2 m^3/year.

Infiltration (I) on the Site can be calculated using the formulae below and the water inputs and outputs described above. The following shows the calculation for the infiltration that occurs on the Site before and after extraction.

$I = P + Q_{gwin} - Q_r - ET - E - Q_{gwout}$

Where:

P = precipitation

Q_{gwin} = groundwater underflow input

I = infiltration

Q_r = runoff

E = Evaporation

ET = Evapotranspiration

Q_{gwout} = groundwater underflow output

$I = 294{,}105\ m^3/year + 10\ m^3/year - 211{,}762 m^3/year - 4\ m^3/year - 0\ m^3/year - 2 m^3/year$

$I = 82{,}348\ m^3/year$

Under the post-aggregate extraction scenario water balance, 294,105 m^3/year of precipitation falls on the Site and 10 m^3/year of groundwater enters the up-gradient portion(s) of the Site. Of these inputs, less than 1% is lost to evaporation and evapotranspiration (4 m^3/year), 72% is lost to runoff (211,762m^3/year) and less than 1% (2 m^3/year) to groundwater underflow exiting the Site. The remaining 28% of the inputs (82,348 m^3/year) are available for infiltration to the groundwater system. Differences between percentages and actual numbers are due to rounding. The post-aggregate extraction water balance details are summarized in Table 7.

7.0 IMPACT ASSESSMENT

The following section identifies potential impacts that the proposed quarry operations have on surrounding private water uses, natural features, and on quarry operations. An assessment of each potential effect has been provided. Section 8 is dedicated to trigger mechanisms and mitigative measures for each potential adverse effect identified below.

7.1 Local Groundwater Use

A review of MOE well records has identified 15 private wells within 500 metres of the Site boundary (Figure 2). Of these wells, 14 have been reported to obtain water from the Precambrian bedrock while one has been reported to obtain water from glaciofluvial outwash deposits. Fourteen of the 15 wells identified in the MOE well records have been reported as having 'water found' elevations below the proposed quarry elevations of 332 mAMSL.

The elevation of 'water found' has provided an indication where the driller noted significant inputs of groundwater and were interpreted to be the primary source of groundwater for that particular well. With the proposed quarry floor located above the 'water found' elevation, the proposed quarry is interpreted to not have the potential to interfere with the ability of these zones in the bedrock groundwater systems to produce groundwater to the well.

One well (MOE Well 29-12953) has a 'water found' elevation above the proposed quarry floor. However, this well, based on MOE provided UTM co-ordinates, has been located up-gradient of the general groundwater flow direction on the Site. Additionally, Well 29-12953 has been located on a topographic high that is separated from the proposed extraction area by a valley and the unnamed stream south of the Site (Figure 2).

The elevation of the unnamed stream (~370 mAMSL) based on OBM mapping suggests that this stream may be connected to the deeper bedrock groundwater system, but it must be acknowledged that the Site groundwater contours represent a potentiometric surface, with the actual water source from deeper bedrock fractures. Therefore, the unnamed stream is not interpreted to be receiving any water from the shallow or deep groundwater regime within the bedrock. However, the stream could contribute to the groundwater in those areas where surface water could infiltrate into exposed bedrock fractures. This process has no relevance to the proposed quarry activities.

The location of Well 29-12953 in concert with the potential boundary condition presented by the unnamed stream south of the Site suggest that Well 29-12953 is located in a separate localized bedrock groundwater system. Therefore, there is no potential for quarrying activities to cause an adverse effect to this well.

7.2 Groundwater Seeps, Springs, and Wetlands

As discussed in Section 2.2, OBM mapping has identified an unnamed stream that drains lands south of the Site. The bedrock through which groundwater flows has been interpreted to have a low bulk permeability and has a groundwater radial flow pattern. Given the potentiometric conditions at depth described in the previous section, bedrock groundwater at the Site does not directly contribute water to this stream. Therefore, bedrock groundwater quantity reaching this unnamed stream from Site will not be measurably impacted. With respect to potential water quality, no impacts to the unnamed stream are anticipated as there will be no direct discharge to it.

Regardless, the proposed quarry operations will have significant portions of precipitation and groundwater captured in the active quarry to collect. The redirection of precipitation and captured groundwater, after any required treatment, will be infiltrated in the Site's sand and gravel deposits to the North and this water will sustain flows in down-gradient wetlands and streams given that runoff is expected to increase by approximately 52% (Section 6).

During field reconnaissance by MTE staff, no groundwater seeps or springs were observed on-Site.

7.3 Significant Drainage from a Vertical Fracture

The presence of a major vertical fracture in excavations could provide a pathway for a large quantity of water to flow into the quarry. Any significant fracture flow could alter the size and shape of the cone of influence in the direction that the fracture extends from the quarry. In order to further understand bedrock fracture patterns, fracture and joint mapping could be undertaken on-Site once quarrying operations commence to assess the potential of intersecting a major water bearing fracture during quarrying.

The network of observation wells will observe this change in the groundwater flow pattern as it develops over time. Such an event could also allow unacceptable amounts of water to flow into the excavation. High rates of seepage into the quarry would be readily observed (if it ever occurs) and actions to mitigate this condition will be implemented early in the process.

Fracture mapping is anticipated to be necessary before the quarry goes below the water table. This is anticipated to be several years into the quarry operation, when there is a sufficient exposure to the rock to allow for effective mapping.

7.4 Spills

As with any aggregate extraction operation, there exists the possibility of an accidental release of petroleum hydrocarbons from equipment operating on the Site. The release of petroleum hydrocarbons at the Site has the potential to enter groundwater and/or surface water courses and impact water quality.

7.5 Blasting

The proposed operation has the potential to introduce residual ammonia into the groundwater and surface water courses via runoff following blasting. Furthermore, there is the potential that blasting could also increase total suspended solids (TSS) in surface water bodies and courses. To avoid this, water collected in the quarry will be treated before leaving the Site.

7.6 Water Balance

Following quarrying, on-Site infiltration is predicted to increase from 20.5% of inputs to 28% inputs, while losses to evapotranspiration and evaporation (E+ET) are predicted to decrease from 59.5% to <1%. Runoff leaving the Site is predicted to increase from 20% to 72% over the life of the operation. Please note that the quarry phasing will be designed to collect runoff in a way that allows this water to passively drain from the active quarry, and the water will be discharged on-site into a natural sand/gavel deposit for infiltration.

The increase in runoff can be attributed to quarrying operations removing vegetation and topsoil that would normally reduce runoff and allow for infiltration/evaporation and exposing relatively impervious bedrock that would allow precipitation and any groundwater migrating on to the Site to run across the exposed bedrock surface.

Groundwater contributions in both pre- and post-aggregate extraction water balance scenarios account for less than 1% of total inputs and have been considered to be relatively insignificant to the overall water balance at the Site.

7.7 Zone of Influence

As the proposed quarry expands, the excavation will create a zone of influence on the bedrock groundwater system. To estimate the extent of the zone of influence that the proposed quarry may exert on the bedrock groundwater system, the Theis method (1935) was used. The proposed quarry was treated as an over-sized well.

The Theis method (1935) was given as:

$$s = \frac{Q\,W_{(u)}}{4\pi T}$$

where:

s = drawdown (m) at distance r from the Site
Q = pumping rate (m^3/day) = 0.027m^3/day (10m^3/year) – (Section 6)
T = Transmissivity (m^2/day) = 0.00043 m^2/day
W(u) = well function of u and is defined as:

$$u = \frac{r^2 S}{4Tt}$$

where:

r = distance (m) from the centre of the pumped well (in this case the quarry)
S = Storage coefficient (unitless)
T = Transmissivity (m^2/day) = 0.00043 m^2/day
t = time since pumping started (d)

A number of assumptions have been made in order to calibrate the model. A description of these assumptions has been provided below:

Pumping Rate (Q)

Since the proposed quarry will be drained via gravity, the pumping rate (Q) used in the Theis (1935) would equal the rate at which groundwater flows into the quarry under gravity. In order to provide the most conservative estimate of Q, the pumping rate was assumed to equal the pre-extraction volumetric discharge as determined in Section 6. A pre-extraction Q of 10m^3/year or 0.027m^3/day was determined in Section 6.

Transmissivity (T)

A transmissivity (T) of 0.00043 m^2/day was determined based on the theoretical saturated thickness of the bedrock (43.2m) as defined in Section 4.2.1 and the calculated hydraulic conductivity for the deep bedrock groundwater system (Section 4.6).

Time (t)

Time periods of 1 day, 5 days, 10 days, 40 days, and 115 days where selected for the analysis. Since there will be no active pumping and groundwater will enter the quarry via gravity only, groundwater cannot be drawn down below the final floor elevation of the proposed quarry. As such, there will be a time – in this case 115 days - were the bedrock along the immediate up-gradient face will be drained of groundwater and the maximum drawdown will equal the saturated thickness of the bedrock (as defined in Section 4.2.1). At this time and assuming no recharge, the bedrock groundwater system will enter into a steady state and the zone of influence will stabilize around the proposed quarry.

Radial Distance (r)

Various distances were selected from the quarry face to define the predicated drawdown from the proposed quarry. To provide a very conservative estimate of the zone of influence, the area between the operating face and one metre into the un-quarried bedrock was assumed to be completely drained of groundwater. Using the Theis (1935) method and bedrock hydraulic parameters discussed in this section, the measurable zone of influence (0.1m) around the proposed quarry at the conclusion of the extraction is expected to extend no further than approximately 100 metres from the edge of the quarry face.

Storage Coefficient (S)

Conducting a long term pumping test on-Site to determine the storage coefficient of the bedrock groundwater system was not possible due to the low hydraulic conductivity of the bedrock. As such, a storage coefficient of 0.00005 was selected and was determined to be representative of a confined, bedrock groundwater system with little storage (Driscoll, 1986; Fetter, 2001; Freeze and Cherry, 1979).

The results for predicted drawdown around the proposed quarry using the Theis (1935) method have been summarized in Table 8. Detailed calculations have been provided in Appendix E

8.0 MITIGATIVE MEASURES

A limited number of potential detrimental adverse effects to the natural environment have been identified in Section 7. The following describes details for mitigative measures to those potential adverse effects.

8.1 Local Groundwater Use

All existing water wells are protected under the Ontario Water Resources Act, with the intent that groundwater is a resource to be shared by everyone. If a well experiences interference (i.e. an unacceptable reduction in groundwater quantity and/or a degradation in water quality), then the person (or organization) responsible for the interference is responsible for returning the groundwater supply to its former condition.

The following describes a contingency plan that will be executed should groundwater interference be observed during activities at the Freymond Quarry. In the event of a reported interference with a private water supply well, water levels within the well would be measured immediately to assess the degree of interference and the well interference compliant would be investigated by a qualified person. If necessary, the affected residence would be supplied with water by the quarry operator until a suitable resolution can be established.

If the observed well interference is a result of quarry operations and is proven to have an impact on the well then a replacement water supply well will be constructed immediately at the expense of the quarry owner. Drilling a replacement well (deeper and/or in a different set of bedrock fractures) is the most effective way to achieve this objective. Based on the proposed operation and the nature of private wells, there is a very low risk of any private well interference.

8.2 Groundwater, Seeps, Springs, and Wetlands.

Precipitation and groundwater collected in the quarry will be re-directed to a collection sump where fines, and other potential contaminants introduced during blasting and quarrying, will be allowed to settle or removed. The collected water will then be discharged into the sand/gravel deposit at the eastern side of the Site. Provided that the water quality exiting the sump is maintained, no impacts to any receiving water bodies are anticipated. Depending on the location of the settling pond, groundwater migration will be on the order of 150 metres before discharging into the unnamed stream. Groundwater migration to the York River is over 400 metres. Additionally, any increases to groundwater temperature caused by the incorporation of the water collected in the sump to groundwater are expected to be mitigated by the time that groundwater reaches the receiving water bodies.

8.3 Significant Drainage from a Vertical Fracture

The trigger mechanism for mitigative measures will be the direct observation of significant quantity of flow through a fracture or bedding plane into the quarry excavation. The recommended trigger criterion is a flow rate in excess of 200 litres per minute over a 24 hour duration. If there is no evidence of a measurable decrease in flow rate, then a licensed drilling contractor will be contacted in order to grout the vertical fractures at the edge of the quarry. This type of grouting is common practice for many geotechnical projects on fractured rock (e.g. dams).

8.4 Spills

Contingency measures regarding hydrocarbon spills over 20 litres are presented on the operational Site Plans and include the following preventative and release incident measures:

In case of an accidental spill of petroleum products, the contingency plan, as presented on the operational plans for the Site, shall be activated as follows:

1. The Ministry of the Environment shall be notified.
2. For a petroleum leakage, the owner of the quarry shall immediate action will be taken to stop it. At the same time, measures shall be taken to prevent the spread of the leak (i.e. construction of a berm, digging of a ditch). If it is a spill, similar measures as mentioned for preventing the spread of a leak shall be taken.

3. The owner of the quarry will commence recovery procedures by pumping the spilled liquid into containers. The spilled liquid may have to be recovered from the open water body or land or both. For the spill contained in the open water body, recovery may require pumping or skimming or both.
4. The soil in the area affected by the spill or leak will be removed.
5. The contaminated soil, the recovered spill and water will be disposed by the owner of the quarry to locations prescribed by the Ministry of the Environment.
6. The following equipment will be available at the Site:
    - A skimming device
    - A diesel operated pump
    - Portable containers

8.5 Blasting

Groundwater and surface water sampling for ammonia and total suspended solids (TSS) will be conducted seasonally for a two year period following the commencement of operations to monitor potential increases in ammonia and TSS that may occur as a result of blasting. Should elevated concentrations of either parameter be observed, controlling and treatment of water discharged from the Site will be required to reduce ammonia concentrations and allow for the settling of TSS.

8.6 Water Balance

A comprehensive groundwater monitoring plan has been proposed in Section 9.0 that will, in part, monitor local groundwater users that may potentially be affected by the changes in the water balance. Should the changes in the water balance affect existing users, then the contingency measures presented in Section 8.1 will take effect.

8.7 Zone of Influence

The maximum extent of the zone of influence presented in Section 7.7 is representative of conditions at the conclusion of extraction. Based on the maximum extent of the predicted zone of influence of approximately 72 metres and the best available mapping, there are no sensitive features within the predicted zone of influence. Beyond the predicted zone of influence, the natural groundwater flow pattern is expected to be maintained, while impacts to natural features (i.e. streams and/or wetlands) are expected to be minimal to non-existent.

Throughout the course of the life of the active quarry, there will be ample opportunity to monitor the actual zone of influence that the quarry may have to the surrounding groundwater regime through the existing groundwater monitoring network.

9.0 MONITORING PROGRAM

Groundwater Monitoring:

1. Well shall be monitored monthly during the operating season for two years after operations commence. After the first two years, wells shall be monitored seasonally (Spring, Summer, and Fall). Wells to be monitored shall include all on-Site observation wells via data loggers and the five off-Site private wells currently in the monitoring program. Private wells shall be monitored for a minimum of two years, so long as the private well remains readily and safely accessible, and that the owner of any private well currently in the monitoring program continues to grant permission to monitor their well.
2. After two years of operations, the groundwater monitoring program shall be reviewed on an annual basis and revised if necessary.

Effluent Monitoring

1. Effluent from the weir draining the collection sump shall be sampled monthly under non-freezing conditions, provided that there are sufficient volumes of water to be sampled, for a period of two years after operations commence. Samples are to be analyzed for the following parameters:
    a. Total suspended solids (TSS);
    b. Total Ammonia;
    c. Nitrate;
    d. Nitrite;
    e. Total Petroleum Hydrocarbons (F1 through F4)
2. During sampling, the pH and temperature of the water sample will be collected and recorded in-situ. The concentration of un-ionized ammonia shall be calculated using the total ammonia concentration, pH, and temperature using the methodology stipulated in "Ontario's Provincial Water Quality objectives" dated July 1994, as amended, for ammonia (un-ionized).
3. The quarry operator shall measure, record, and calculate the volume of flow discharging over the weir on each day of sampling.
4. After two years of operations, the effluent monitoring program shall be reviewed on an annual basis and revised if necessary.

10.0 CONCLUSIONS AND RECOMMENDATIONS

Based on the hydrogeological investigation, MTE Consultants Inc. offers the following conclusions and recommendations:

- 14 of the 15 private wells identified through MOE well records, have "water found" elevations below the floor of the proposed quarry. As such, proposed quarry operations do not have the potential to interfere with the ability of these zones, within the bedrock groundwater system, to produce water to the private wells.

- The one well identified with a "water found" elevation above the floor of the proposed quarry lies up-gradient of the general bedrock groundwater flow pattern under the Site, and is located on a topographic high, which has be interpreted to be a separate local groundwater regime. Quarrying activities do not have the potential to cause an adverse effect at this well.
- From the hydrogeological data collected through the preparation of this hydrogeological investigation, the local on-Site groundwater regime can be described as being predominately a low permeable recharge area.
- Groundwater flow in the shallow and deep bedrock groundwater systems generally mimic each other and flow towards the northeast towards the York River.
- The predicated zone of influence that will be created by the extraction will extend to approximately 72 metres from the active quarry face. Based on the best available mapping, no sensitive features have been identified within the predicated zone of influence.
- As an adaptive management action, in order to assess whether a major water bearing fracture or joint has been intersected, MTE recommends that fracture mapping occur on-Site after quarrying activities have commenced, and before the operation goes below the water table. This is expected to be several years after the start of the operation, when the bedrock has been fully exposed.

11.0 LIMITATIONS

Services performed by **MTE Consultants Inc.** (MTE) were conducted in a manner consistent with the level of care and skill ordinarily exercised by members of the Environmental Engineering & Consulting profession. No other warranty or representation expressed or implied as to the accuracy of the information, conclusions or recommendations is included or intended in this report.

This report was completed for the sole use of MTE and the client. It was completed in accordance with the Scope of Work referred to in Section 1.1. As such, this report may not deal with all issues potentially applicable to the Site and may omit issues, which are or may be of interest to the reader. MTE makes no representation that the present report has dealt with any and all of the important features, including any or all important environmental features, except as provided in the Scope of Work. All findings and conclusions presented in this report are based on Site conditions as they existed during the time period of the investigation. This report is not intended to be exhaustive in scope or to imply a risk-free facility.

Any use which a third party makes of this report, or any reliance on, or decisions to be made based upon it, are the responsibility of such third parties. MTE accepts no responsibility for liabilities incurred by or damages, if any, suffered by any third party as a result of decisions made or actions taken, based upon this report. Others with interest in the Site should undertake their own investigations and studies to determine how or if the condition affects them or their plans.

It should be recognized that the passage of time may affect the views, conclusions and recommendations (if any) provided in this report because environmental conditions of a property can change. Should additional or new information become available, MTE recommends that it be brought to our attention in order that we may re-assess the contents of this report.

Respectfully Submitted,

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25 YEARS 1985-2010

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FIGURES

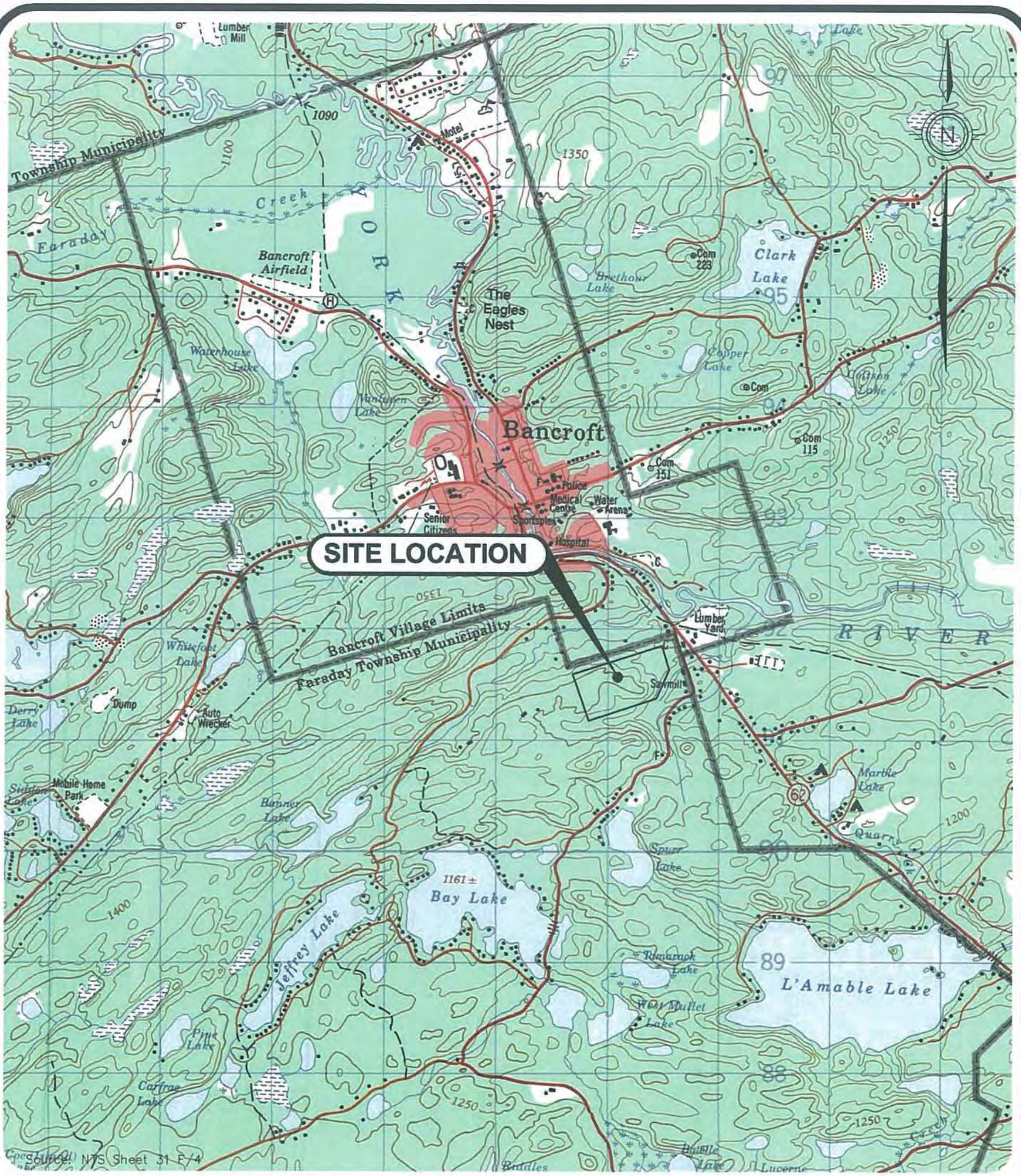
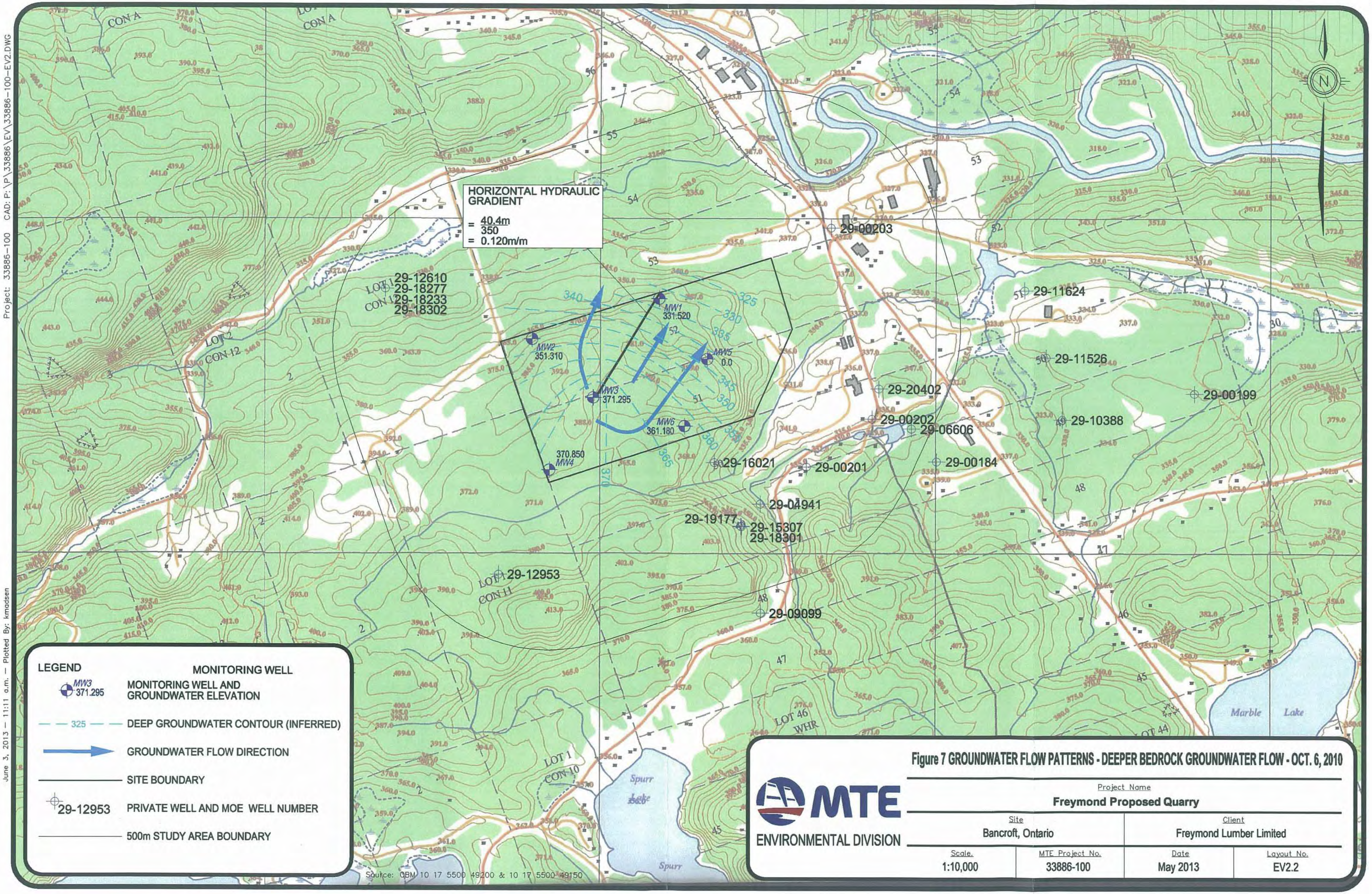


Figure 1 KEY MAP

MTE
ENVIRONMENTAL DIVISION

Project Name			
Fowler Freymond Proposed Quarry			
Site		Client	
Bancroft, Ontario		Freymond Lumber Limited	
Scale.	MTE Project No.	Date	Layout No.
1:50,000	33886-100	May 2013	EV1.1

June 3, 2013 – 11:15 a.m. – Plotted By: kmadsen
Project: 33886-100 CAD: P:\P\33886\EV\33886-100-EV1.DWG



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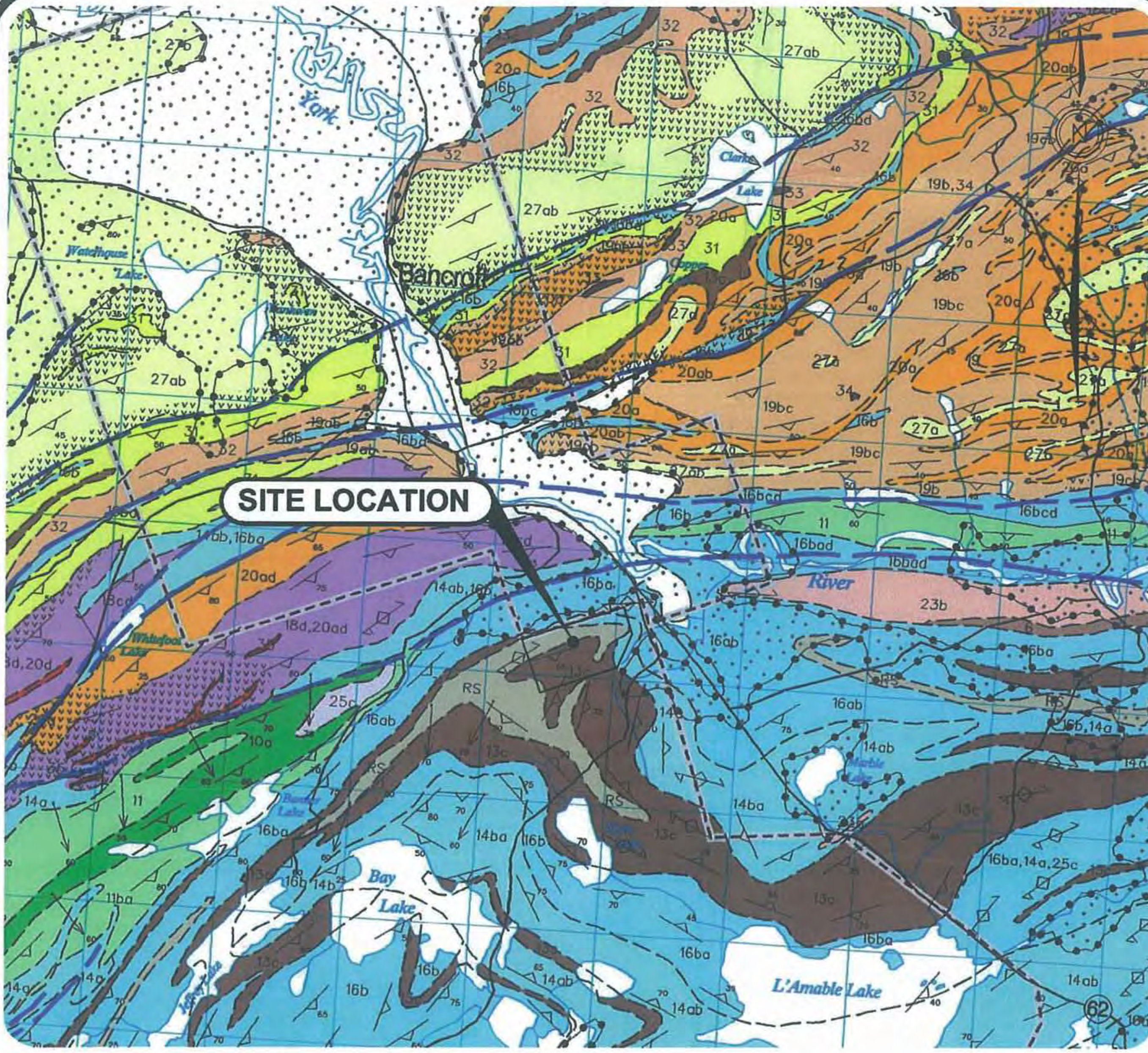
June 3, 2013 — 11:11 a.m. — Plotted By: kmadsen



LEGEND

10	Mafic Metavolcanic Rocks	18	Mafic Alkalic Rocks	32	Fenite
11	Felsic Metavolcanic Rocks	19	Nepheline Syenite	35	Late Pegmatite
13	Amphibole rich Metasedimentary Rocks	20	Alkalic Syenite	RS	Rusty-weathering, graphitic pyrite and pyrrhotite -bearing schist
14	Dolomitic Marble	23	Trondhjemite and Granodiorite		
16	Calcitic Marble Medium to High Metamorphic Grade	27	Felsic Intrusive Rocks		
		31	Fenite		

For symbol definitions refer to OGS Map 3385 or 1: 50 000 National Topographic System. For subgroup descriptions, refer to OGS Map P. 3385

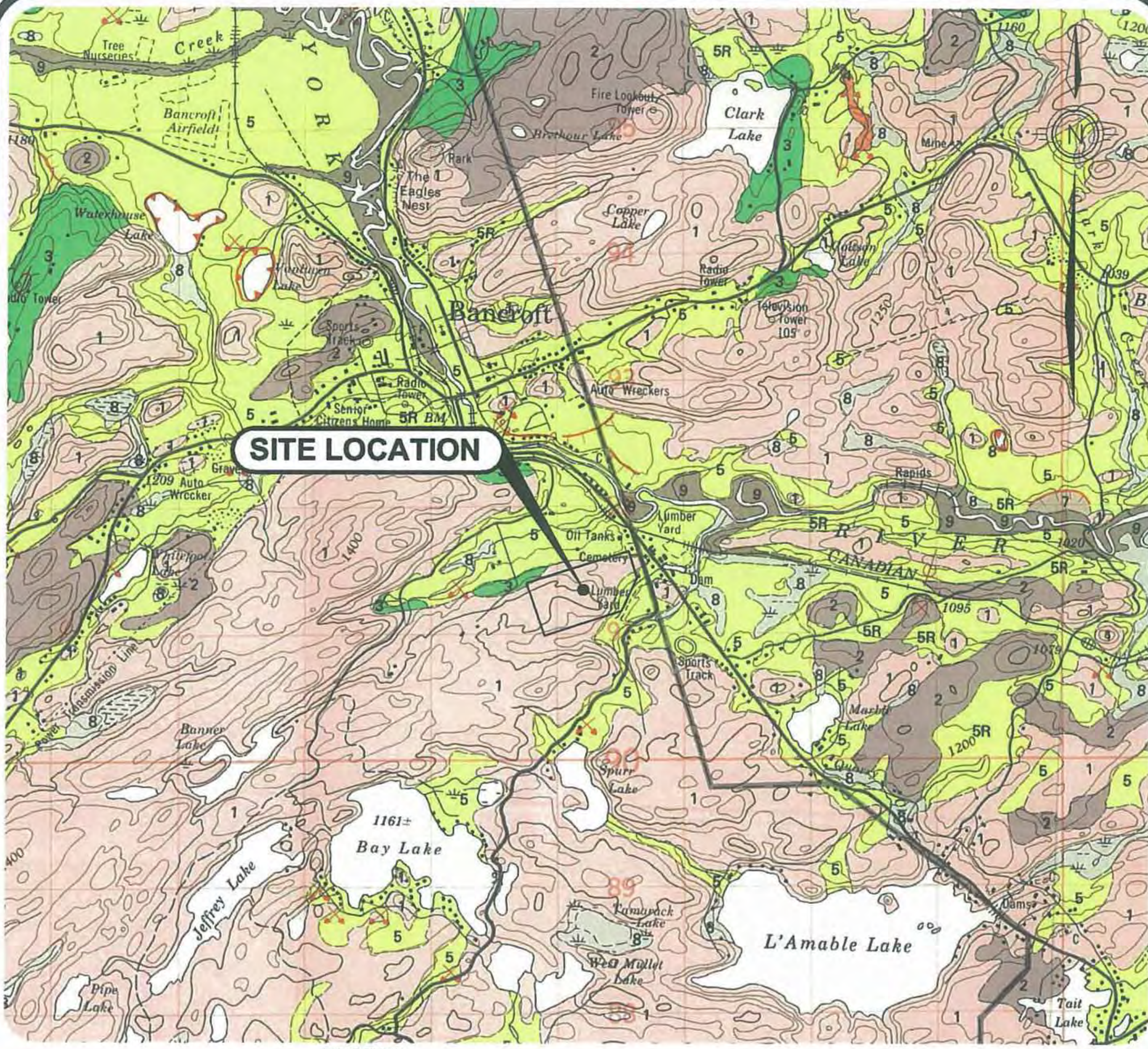
Figure 4 PRECAMBRIAN GEOLOGY

MTE
ENVIRONMENTAL DIVISION

Project Name			
Fowler Freymond Proposed Quarry			
Site		Client	
Bancroft, Ontario		Freymond Lumber Limited	
Scale.	MTE Project No.	Date	Layout No.
1:50,000	33886-100	May 2013	EV1.3

Project: 33886-100 CAD: P:\P\33886\EV\33886-100-EV1.DWG

June 3, 2013 - 11:14 a.m. - Plotted By: kmadsen



LEGEND

1	Pre-Cambrian Bedrock
2	Drift - Bedrock Complex
3	Till: Silty to sandy; Stony
4	Glaciofluvial ice contact Deposits
5	Glaciofluvial outwash and deltaic deposits
8	Bog and swamp deposits
9	Modern Alluvium

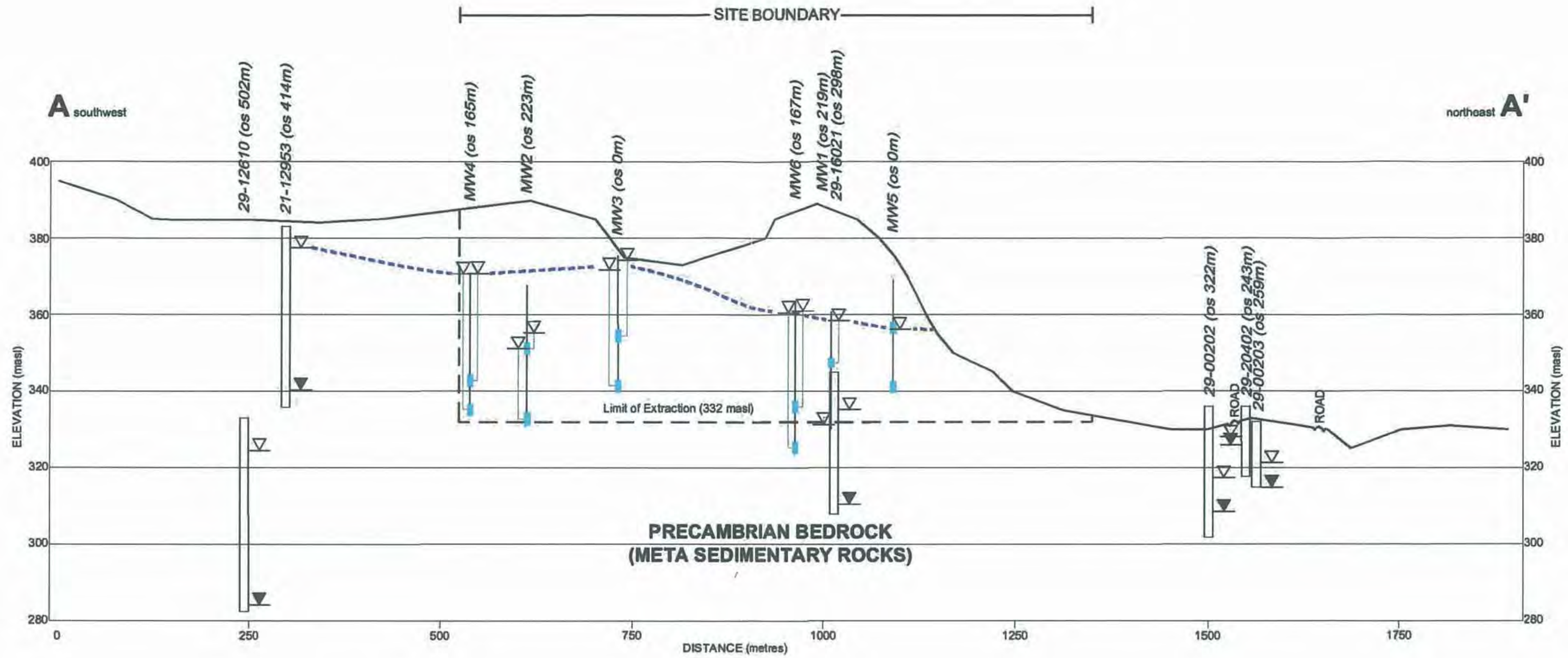
For symbol definitions refer to OGS Map 2500 or 1: 50 000 National Topographic System. For subgroup descriptions, refer to OGS Map 2500

Figure 3 QUATERNARY GEOLOGY

MTE

ENVIRONMENTAL DIVISION

Project Name			
Fowler Freymond Proposed Quarry			
Site: Bancroft, Ontario		Client: Freymond Lumber Limited	
Scale.	MTE Project No.	Date	Layout No.
1:50,000	33886-100	May 2013	EV1.2



LEGEND

- Ground Surface
- Geological Contact Observed
- Geological Contact Inferred
- Potentiometric Surface
- Drilled Borehole/Well
- Static Water Level
- Depth of Water Found

(os 10m) — Offset Distance in metres From Cross-Section

00000 — Private Well, Drilled (MOE Well Number)

MTE ENVIRONMENTAL DIVISION

Figure 5 GEOLOGICAL CROSS-SECTION A-A'

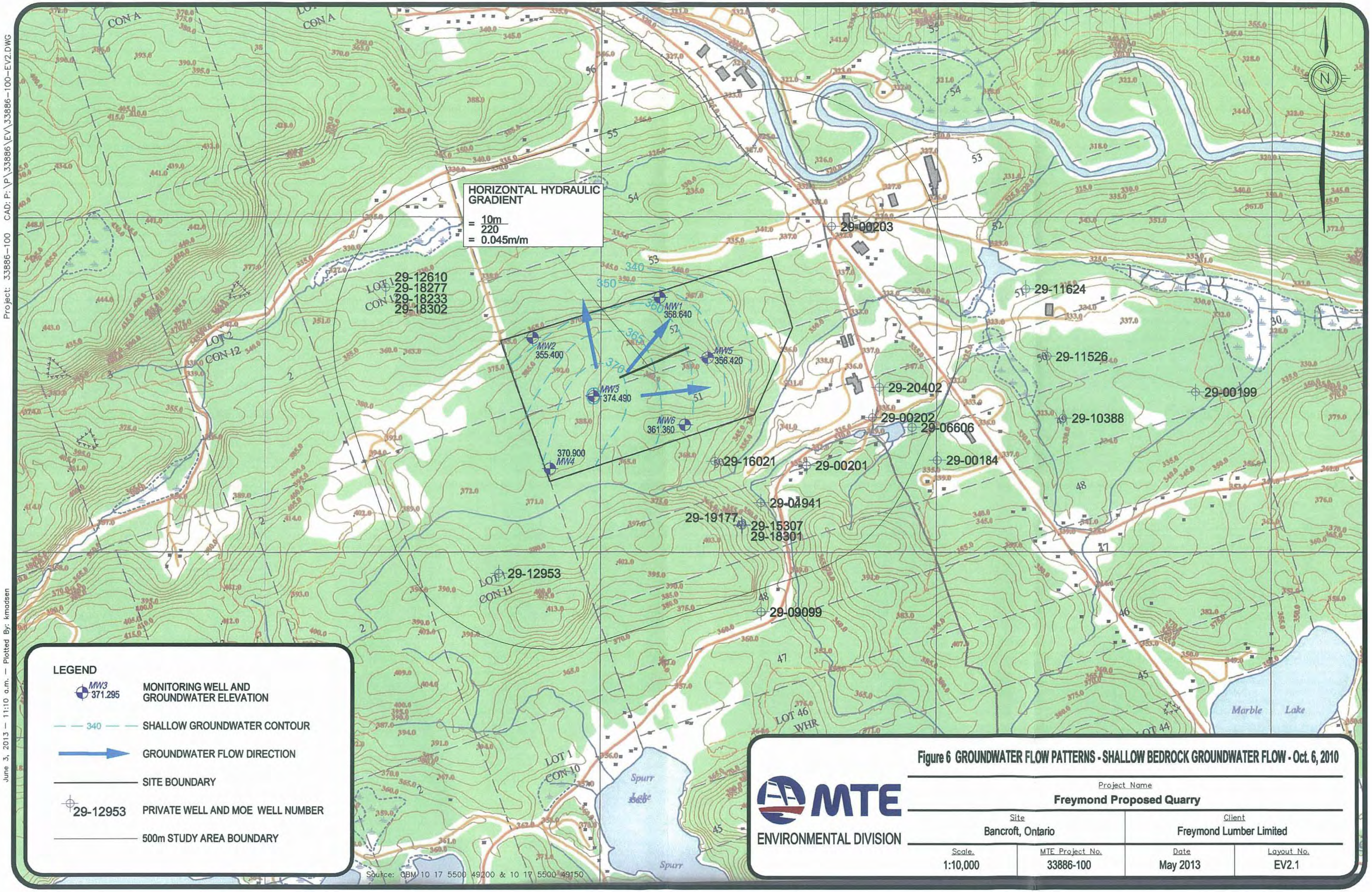
Project Name			
Freymond Quarry			
Site: Township of Faraday, County of Hastings		Client: Freymond Lumber Limited	
Scale: 1:7500	MTE Project No.: 33886-100	Date: May 2013	Layout No.: EV1.7

Project: 33886-100 CAD: P:\P\33886\EV\33886-100-EV1.DWG

June 3, 2013 – 11:28 a.m. – Plotted By: kmadsen

Project: 33886-100 CAD: P:\P\33886\EV\33886-100-EV2.DWG

June 3, 2013 – 11:10 a.m. – Plotted By: kmadsen



Project: 33886-100 CAD: P:\P\33886\EV\33886-100-EV1.DWG

June 3, 2013 — 11:13 a.m. — Plotted By: kmadsen

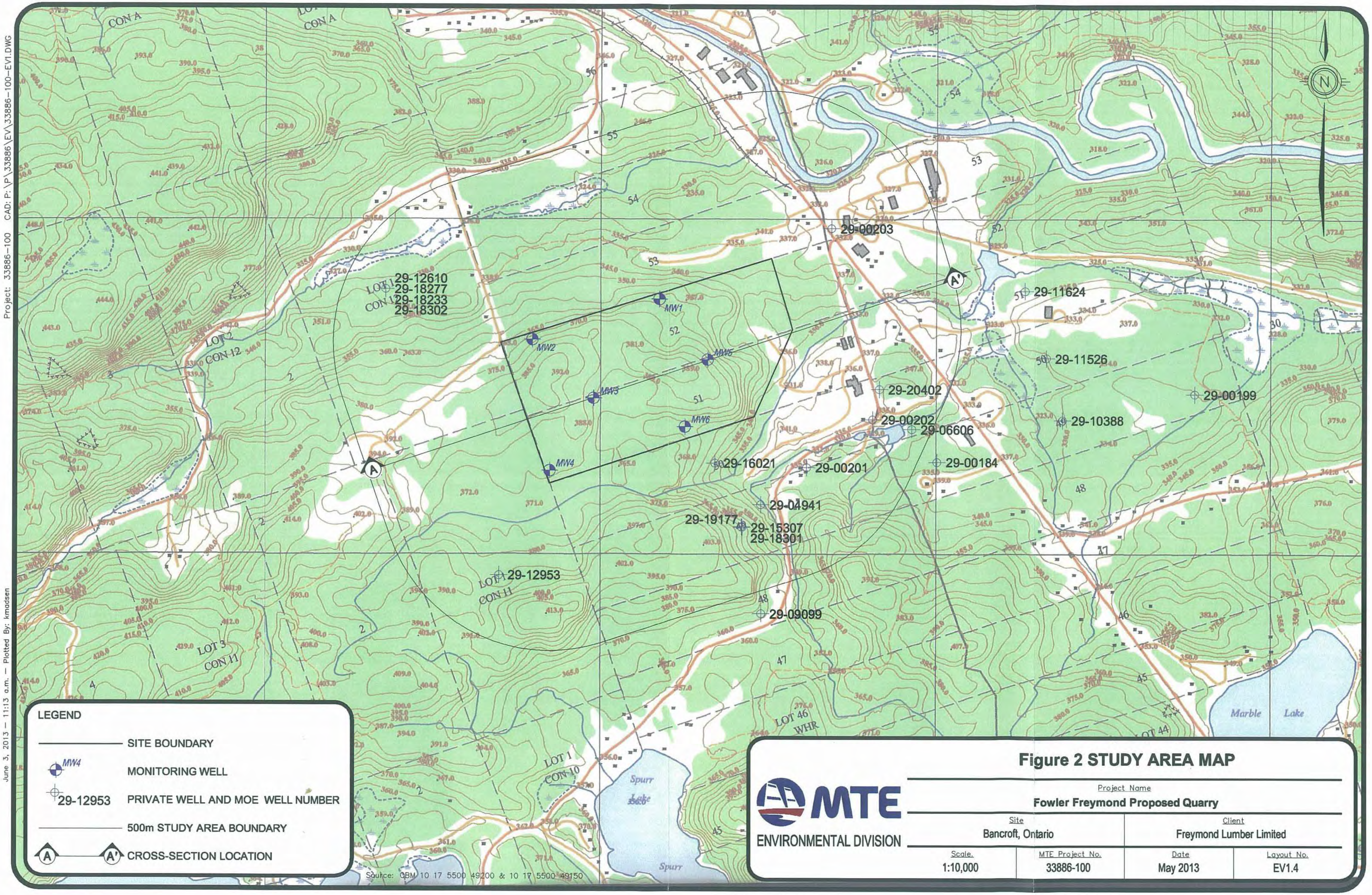


Figure 2 STUDY AREA MAP

TABLES

TABLE 1: GROUNDWATER LEVELS (MBTOC) – MANUALLY MEASURED – 2009 – 2012

DATE	SHALLOW BEDROCK WELLS						DEEPER BEDROCK WELLS					
	MW1S	MW2S	MW3S	MW4S	MW5S	MW6S	MW1D	MW2D	MW3D	MW4D	MW5D	MW6D
21-May-09	12.83	14.70	2.00	26.35	12.93	3.35	31.24	29.83	3.29	35.18	*	3.60
1-Jul-09	9.88	13.06	2.80	18.61	13.05	3.66	31.20	21.66	3.40	25.93	*	3.84
24-Aug-09	6.27	13.32	3.74	10.41	13.18	3.75	*	17.70	4.10	15.57	*	3.78
22-Sep-09	5.09	13.53	3.87	7.41	*	3.94	*	17.25	4.45	12.69	*	3.86
30-Nov-09	3.11	12.85	2.13	2.84	13.30	3.40	30.83	17.04	3.63	5.96	30.22	3.42
19-Apr-10	1.81	11.00	1.32	0.12	13.38	3.33	30.53	16.63	2.77	1.65	30.21	3.31
21-Jun-10	1.73	11.40	1.70	0.86	13.40	3.53	30.38	16.51	3.40	1.08	30.24	3.40
6-Oct-10	1.75	12.68	2.05	0.14	13.48	3.15	30.18	17.28	4.28	0.39	*	3.20
29-Apr-11	1.40	9.70	**	0.66	13.47	2.72	29.73	16.26	2.35	**	*	2.99
15-Aug-11	1.68	11.11	2.95	0.21	13.50	3.55	*	16.22	4.11	0.05	*	3.80
30-Sep-11	2.16	11.65	3.65	0.04	13.56	3.81	29.36	16.77	4.84	0.10	*	4.00
4-May-12	1.50	9.35	1.37	0.20	13.55	2.52	28.90	17.19	2.82	0.12	*	3.41
20-Jul-12	1.72	10.34	3.23	0.05	13.55	3.07	*	17.10	4.00	0.10	*	3.90
29-Oct-12	1.41	11.01	3.90	0.01	13.61	3.13	28.52	17.61	5.13	0.22	*	3.72

*mbTOC = metres below top of casing; * = well was dry at the time of measurement; ** = well was flowing at the time of measurement*

TABLE 2: GROUNDWATER ELEVATIONS (MAMSL) – MANUALLY MEASURED – 2009 – 2012

DATE	SHALLOW BEDROCK WELLS						DEEPER BEDROCK WELLS					
	MW1S	MW2S	MW3S	MW4S	MW5S	MW6S	MW1D	MW2D	MW3D	MW4D	MW5D	MW6D
21-May-09	347.56	353.38	374.53	344.09	356.97	361.34	330.46	338.76	372.94	336.06	*	360.78
1-Jul-09	350.51	355.02	373.73	351.83	356.85	361.03	330.50	346.93	372.83	345.31	*	360.54
24-Aug-09	354.12	354.76	372.79	360.03	356.72	360.94	*	350.89	372.13	355.67	*	360.60
22-Sep-09	355.30	354.55	372.66	363.03	*	360.75	*	351.34	371.78	358.55	*	360.52
30-Nov-09	357.28	355.23	374.40	367.60	356.60	361.29	330.87	351.55	372.60	365.28	339.88	360.96
19-Apr-10	358.58	357.08	375.21	370.32	356.52	361.36	331.17	351.96	373.46	369.59	339.89	361.07
21-Jun-10	358.66	356.68	374.83	370.39	356.50	361.16	331.32	352.08	372.83	370.16	339.86	360.98
6-Oct-10	358.64	355.40	374.49	370.92	356.42	361.54	331.52	351.31	371.95	370.85	*	361.18
29-Apr-11	358.99	358.38	**	370.40	356.43	361.97	331.92	352.34	373.88	**	*	361.39
15-Aug-11	358.71	356.97	373.58	370.85	356.40	361.14	*	325.37	372.12	371.19	*	360.58
30-Sep-11	358.23	356.43	372.88	371.02	356.34	360.88	332.34	351.82	371.39	371.14	*	360.38
4-May-12	358.89	358.73	375.16	370.86	356.34	362.17	332.80	351.41	373.41	371.13	*	360.98
20-Jul-12	358.67	357.74	373.30	371.01	356.35	361.62	*	351.49	372.23	371.14	*	360.48
29-Oct-12	358.98	357.07	372.63	371.05	356.29	361.56	333.18	350.98	371.10	371.02	*	360.66

*mAMSL = metres mean sea level; * = well was dry at the time of measurement; ** = well was flowing at the time of measurement*

TABLE 3: VERTICAL GRADIENTS

Date	MW1	MW2	MW3	MW4	MW5	MW6
21-May-09	-1.11	*	-0.12	†	*	-0.03
1-Jul-09	-1.30	*	-0.07	†	*	-0.03
24-Aug-09	*	-0.21	-0.05	†	*	-0.02
22-Sep-09	*	-0.17	-0.07	†	*	-0.01
30-Nov-09	-1.72	-0.20	-0.14	†	-1.08	-0.02
19-Apr-10	-1.78	-0.28	-0.14	-0.09	-1.07	-0.02
6-Oct-10	-1.76	-0.22	-0.20	-0.01	*	-0.02
29-Apr-11	-1.76	-0.33	-	-	*	-0.03
15-Aug-11		-0.25	-0.11	0.04		-0.03
30-Sep-11	-1.68	-0.25	-0.12	0.02		-0.03
4-May-12	-1.70	-0.39	-0.14	0.03		-0.06
20-Jul-12		-0.34	-0.08	0.02		-0.06
29-Oct-12	-1.68	-0.33	-0.12	0.00		-0.05

*Negative values equal downward vertical gradient; Positive values equal upward vertical gradient; * = deep monitoring well was dry; † = wells still recovering at time of measurement.*

TABLE 4: PRIVATE WELL INVENTORY SUMMARY

ID	TYPE	DIAMETER (M)	DEPTH (M)	WATER SOURCE	IN USE
PW1	Drilled	0.15*	91.44*	Bedrock*	Yes
PW2	Drilled	0.20*	67.05*	Bedrock*	Yes
PW3	Drilled	0.15*	55.47*	Bedrock*	Yes
PW4	Dug	0.90*	4.57*	Overburden*	Yes
PW5	Drilled	0.15*	Unknown	Unknown	Yes
PW6	Drilled	0.20*	Unknown	Overburden*	Yes
PW7	Drilled	0.15*	44.2*	Bedrock	Yes

** = reported by homeowner*

TABLE 5A: BEDROCK HYDRAULIC PROPERTIES SUMMARY – SHALLOW BEDROCK WELLS

LOCATION	TEST TYPE	TEST DATE	MAXIMUM DRAWDOWN (M)	SLUG TEST ANALYSIS	HYDRAULIC CONDUCTIVITY (M/S)
MW1s	Slug	May 7, 2009	14.15	Hvorslev	$7.19x10^{-11}$
MW2s	Slug	May 7, 2009	17.24	Hvorslev	$2.56x10^{-10}$
MW4s	Slug	May 7, 2009	24.47	Hvorslev	$1.83x10^{-10}$
MW6s	Slug	May 7, 2009	21.53	Hvorslev	$1.21x10^{-8}$
Geometric Mean					$4.49x10^{-10}$
MW1s	Slug	May 7, 2009	14.15	Bouwer & Rice	$7.11x10^{-11}$
MW2s	Slug	May 7, 2009	17.24	Bouwer & Rice	$2.13x10^{-10}$
MW4s	Slug	May 7, 2009	24.47	Bouwer & Rice	$1.94x10^{-10}$
MW6s	Slug	May 7, 2009	21.53	Bouwer & Rice	$1.76x10^{-8}$
Geometric Mean					$4.77x10^{-10}$

TABLE 5B: BEDROCK HYDRAULIC PROPERTIES SUMMARY – DEEPER BEDROCK WELLS

LOCATION	TEST TYPE	TEST DATE	MAXIMUM DRAWDOWN (M)	SLUG TEST ANALYSIS	HYDRAULIC CONDUCTIVITY (M/S)
MW2d	Slug	May 7, 2009	30.20	Hvorslev	$6.48x10^{-11}$
MW4d	Slug	May 7, 2009	36.88	Hvorslev	$2.02x10^{-10}$
Geometric Mean					$1.14x10^{-10}$
MW2d	Slug	May 7, 2009	30.20	Bouwer & Rice	$5.29x10^{-11}$
MW4d	Slug	May 7, 2009	36.88	Bouwer & Rice	$2.24x10^{-10}$
Geometric Mean					$1.09x10^{-10}$

TABLE 6: PRE-AGGREGATE EXTRACTION WATER BALANCE SUMMARY

Inputs		
Precipitation (P)	294,105	m^3/yr
Groundwater (Q_{gwin})	10	m^3/yr
Outputs		
Runoff (Qr)	58,821	m^3/yr
Groundwater (Q_{gwout})	10	m^3/yr
Evaporation (E)	0	m^3/yr
Evapotranspiration (ET)	175,000	m^3/yr
Pre-extraction		
$I = P + Q_{gwin} - Q_r - ET - E - Q_{gwout}$	**60,284**	m^3/yr
Pre-extraction		
Infiltration (I)%		20.50
E + ET %		59.50
Groundwater		0.00
Runoff (Qr)%		20.00
		100

TABLE 7: POST-AGGREGATE EXTRACTION WATER BALANCE SUMMARY

Inputs		
Precipitation (P)	294,105	m^3/yr
Groundwater (Q_{gwin})	10	m^3/yr
Outputs		
Runoff (Qr)	211,762	m^3/yr
Groundwater (Q_{gwout})	2	m^3/yr
Evaporation (E)	0	m^3/yr
Evapotranspiration (ET)	4	m^3/yr
Pre-extraction		
$I = P + Q_{gwin} - Q_r - ET - E - Q_{gwout} =$	**82,348**	m^3/yr
Pre-extraction		
Infiltration (I)%		28.00
E + ET %		0.00
Groundwater		0.00
Runoff (Qr)%		72.00
		100

TABLE 8: ZONE OF INFLUENCE PREDICTION SUMMARY – THEIS METHOD

Values for drawdown s(r,t) (m)						
t (days)	r(m)--->	1	10	50	100	195
1		16.73	0.08	0.00	0.00	0.00
5		25.63	2.62	0.00	0.00	0.00
10		29.50	5.17	0.0004	0.00	0.00
30		35.66	10.34	0.14	3.16E-05	0.00
40		37.27	11.82	0.57	4.30E-04	0.00
115		43.20	17.49	2.36	1.30E-01	3.19E-05

25 YEARS 1985-2010

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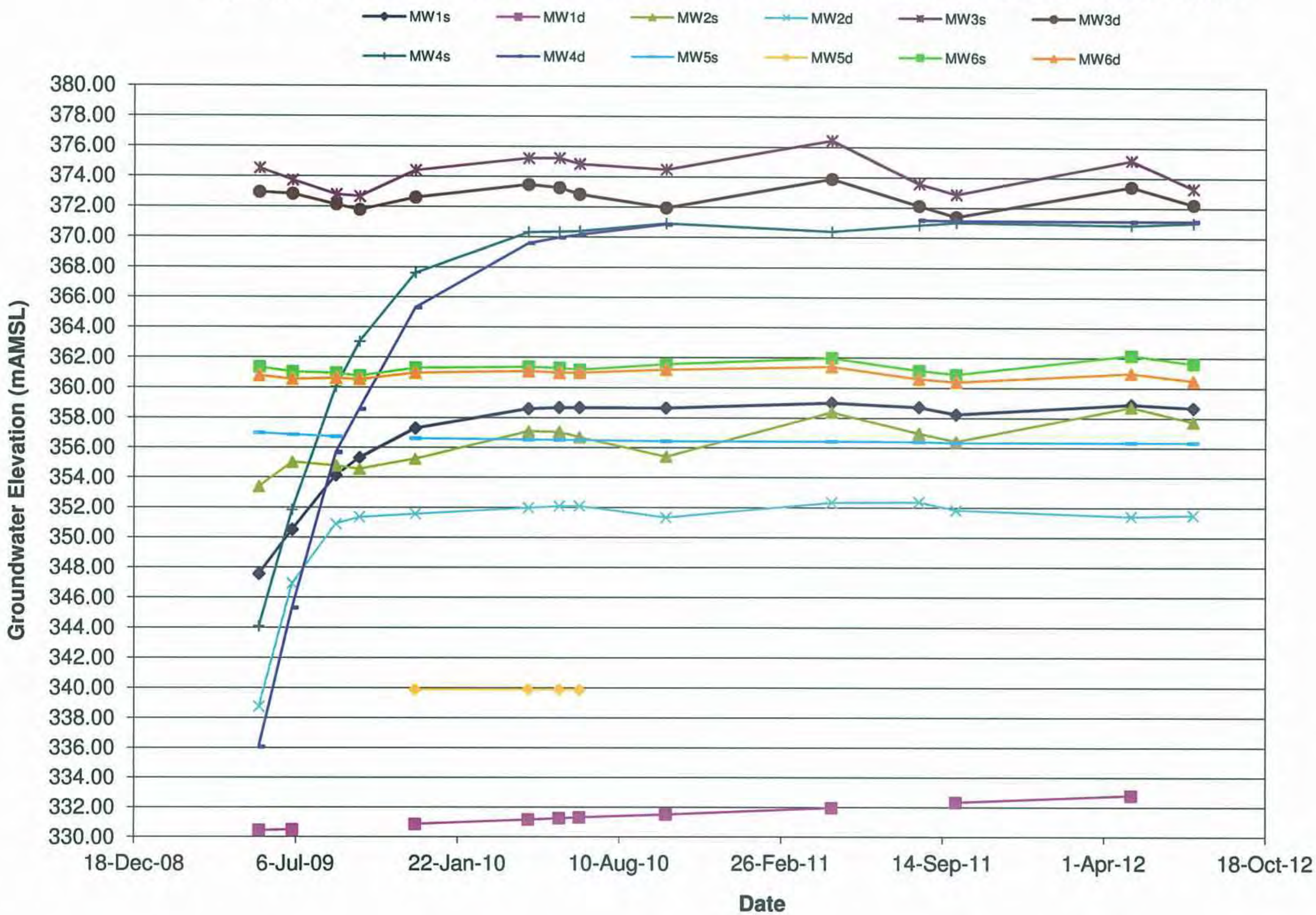
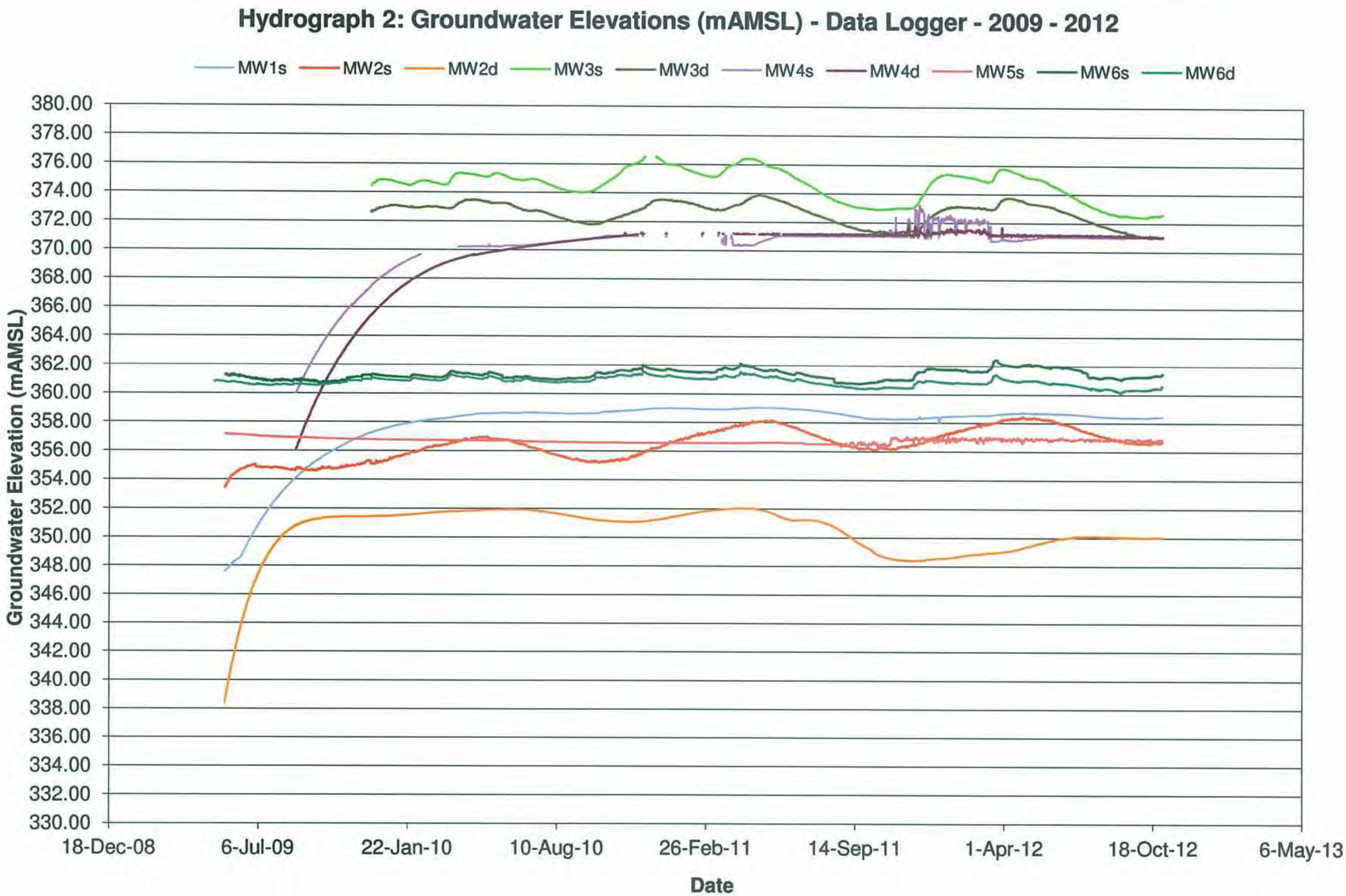
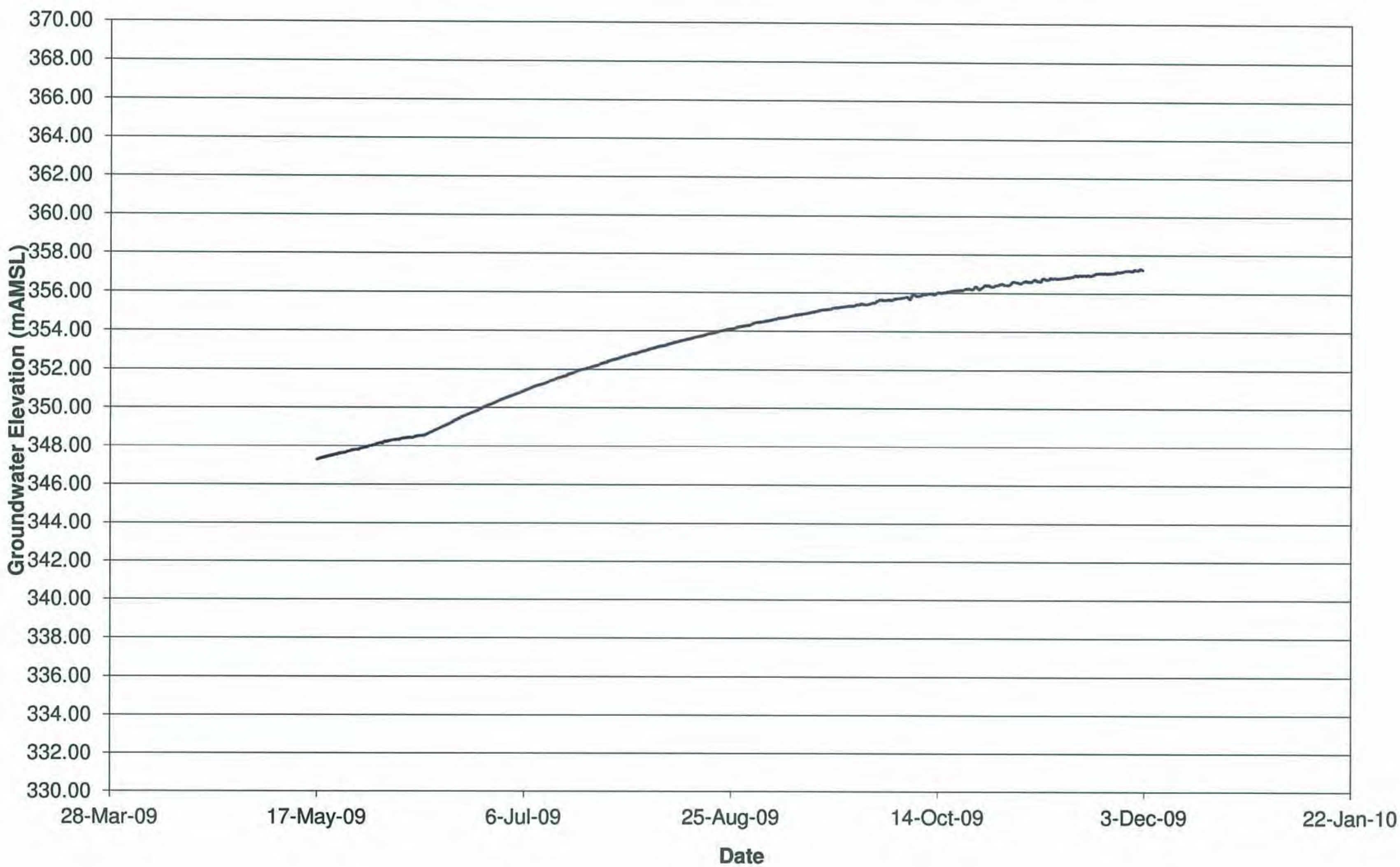
HYDROGRAPHS

Hydrograph 1: Groundwater Elevations (mAMSL) - Manually Measured - 2009 - 2012

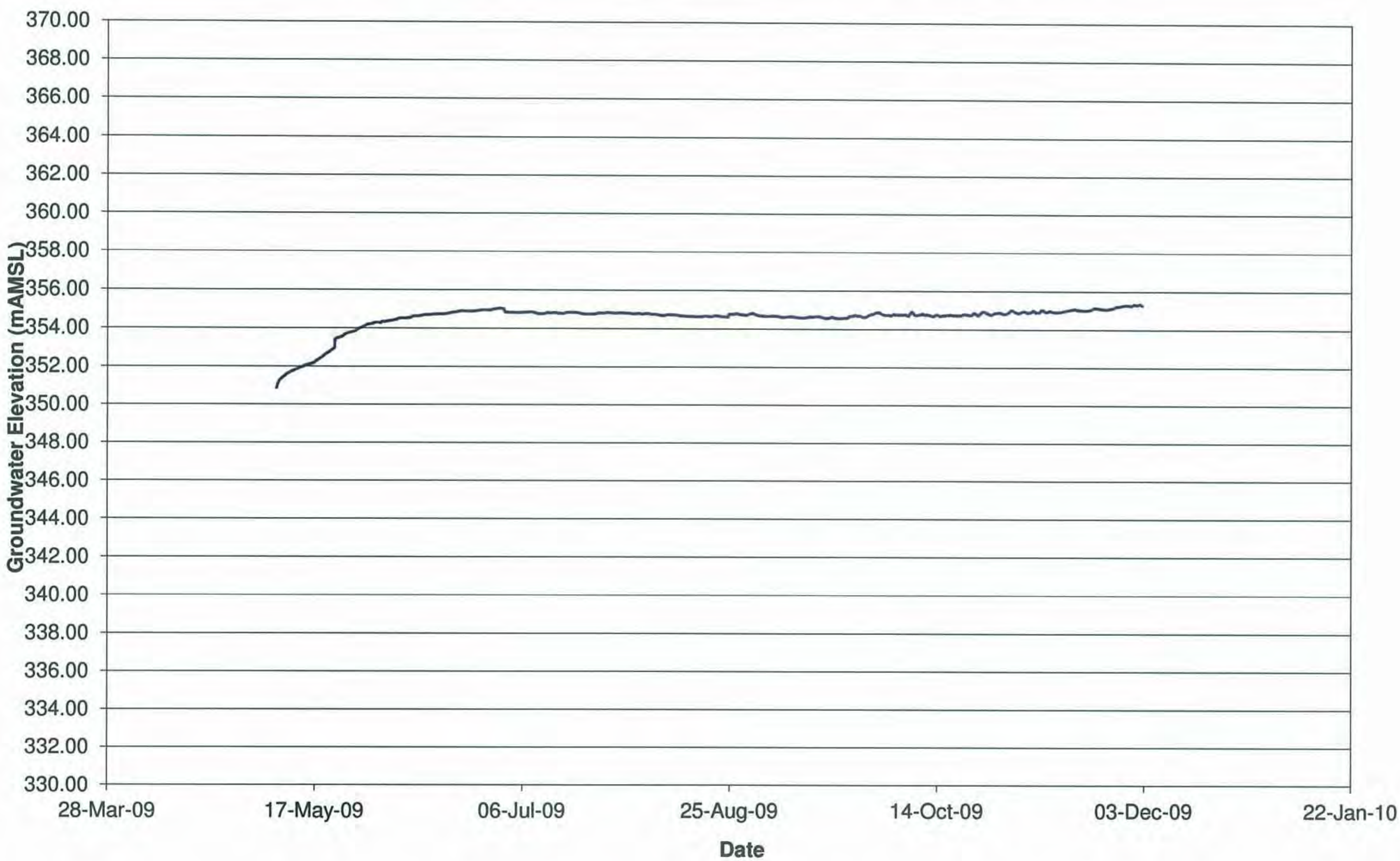



Hydrograph 2: Groundwater Elevations (mAMSL) - Data Logger - 2009 - 2012
MW1s
MW2s
MW2d
MW3s
MW3d
MW4s
MW4d
MW5s
MW6s
MW6d
Groundwater Elevation (mAMSL)
380.00
378.00
376.00
374.00
372.00
370.00
368.00
366.00
364.00
362.00
360.00
358.00
356.00
354.00
352.00
350.00
348.00
346.00
344.00
342.00
340.00
338.00
336.00
334.00
332.00
330.00
18-Dec-08
6-Jul-09
22-Jan-10
10-Aug-10
26-Feb-11
14-Sep-11
1-Apr-12
18-Oct-12
6-May-13
Date

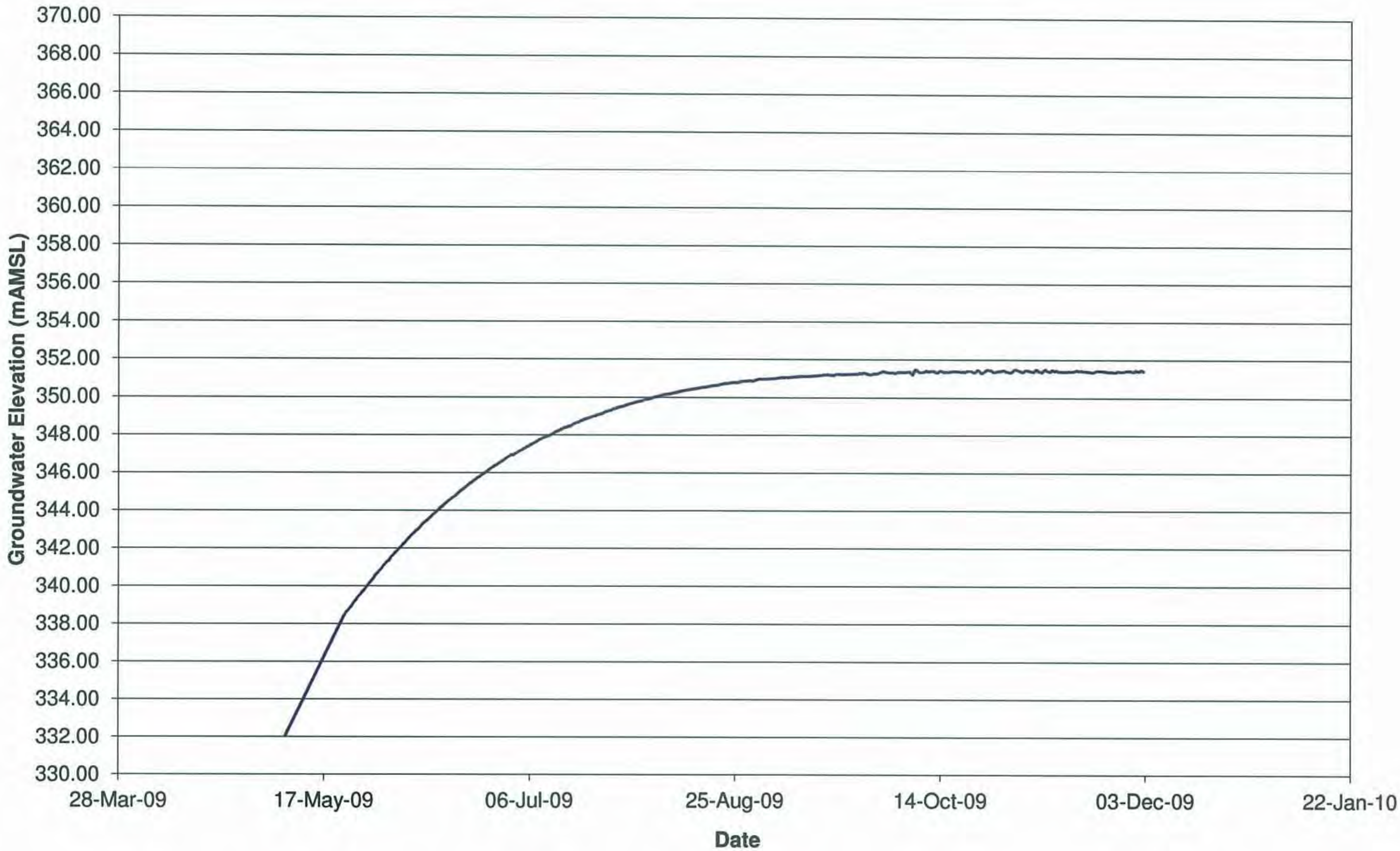
Hydrograph 3: Groundwater Elevations (mAMSL) - MW1s - Recovery



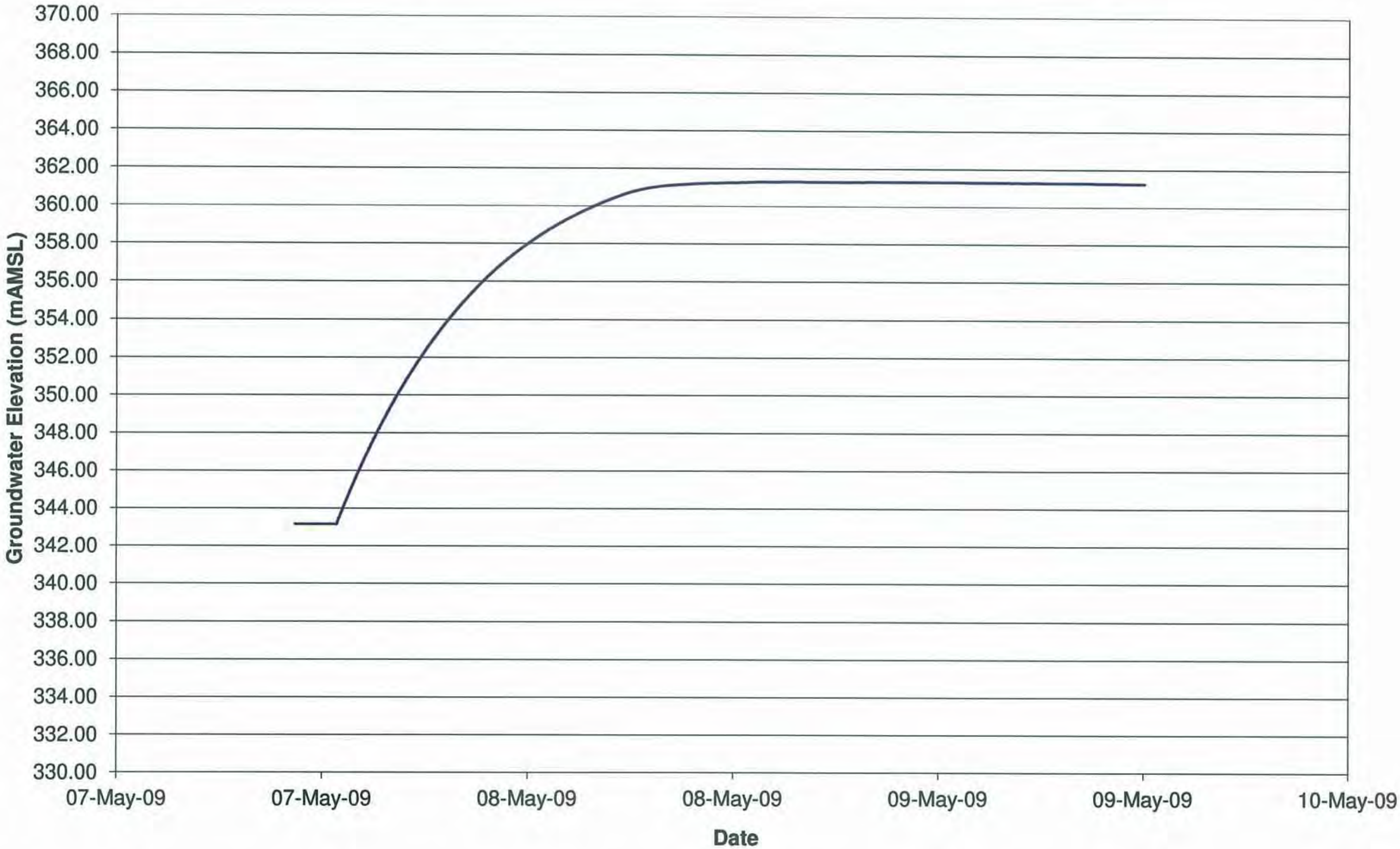
Hydrograph 4: Groundwater Elevations (mAMSL) - MW2s - Recovery



Hydrograph 5: Groundwater Elevations (mAMSL) - MW2d - Recovery



Hydrograph 6: Groundwater Elevations (mAMSL) - MW6s - Recovery



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25 YEARS 1985-2010

APPENDIX A

MINISTRY OF THE ENVIRONMENT WELL DATA SHEETS

TOWNSHIP CONCESSION (LOT)	UTM[1]	DATE[2] CNTR[3]	CASING DIA[4]	WATER[5,6] DETAIL	STAT LVL/PUMP LVL[7] RATE[8]/TIME HR:MIN	WATER USE[9]	SCREEN INFO[10]	WELL # (AUDIT#) WELL TAG # DEPTHS TO WHICH FORMATIONS EXTEND5,11
DUNGANNON TOWNSHIP HR E (049)	18 277003 4991274[W]	1958/02 1821	06	FR 0040	040 / / :0	NU		2900184 () FSND 0020 QSND 0075 GREY GRNT 0140
DUNGANNON TOWNSHIP HR E (049)	18 277379 4991399[L]	1983/05 3668	06		024 / 329 / 2:0	CO		2910388 () BRWN FSND 0071 GREY GRNT HARD 0329
DUNGANNON TOWNSHIP HR E (049)	18 276929 4991372[W]	1974/10 1805	06	FR 0147	130 / / :0	IN		2906606 () BRWN SAND 0006 GRNT 0395
DUNGANNON TOWNSHIP HR E (049)	18 277774 4991476[W]	1961/04 4513	02 02	FR 0085	022 / 030 002 / 2:0	PS		2900199 () GRNT 0003 GREY GRNT 0090
DUNGANNON TOWNSHIP HR E (050)	18 277330 4991584[L]	1987/04 1748	06	FR 0050 FR 0108	018 / 120 002 / 1:0	DO		2911526 (09229) SAND STNS 0029 GREY GRNT 0120
DUNGANNON TOWNSHIP HR E (050)	18 276812 4991401[W]	1958/08 3532	06 06	FR 0090 FR 0082	037 / 100 002 / 2:0	IN		2900202 () FILL MSND 0003 GREY GRNT 0100
DUNGANNON TOWNSHIP HR E (050)	18 276616 4991258[W]	1961/04 4513	02 02	FR 0061	061 / 072 001 / 3:0	DO		2900201 () RED MSND BLDR 0017 GRNT 0020 RED GRNT 0112
DUNGANNON TOWNSHIP HR E (050)	18 276833 4991491[W]	2004/08 3611	06	FR 0033	026 / 090 045 / 1:0	DO		2920402 (Z08181) A008101 BRWN SAND 0011 WHIT MRBL HARD 0028 WHIT MRBL SOFT FCRD 0032 WHIT MRBL 0060
DUNGANNON TOWNSHIP HR E (051)	18 277265 4991785[L]	1987/05 3651	06 06	FR 0065 FR 0098 FR 0047	016 / 105 005 / 2:0	DO		2911624 (1643) BRWN LOAM 0008 GREY GRNT 0105
DUNGANNON TOWNSHIP HR E (052)	18 276689 4991972[W]	1952/02 3532	06	FR 0056	035 / 035 010 / :0	IN		2900203 () MSND GRVL 0056
DUNGANNON TOWNSHIP HR E (059)	18 276744 4993390[L]	1989/08 3651	06 06	FR 0255	025 / 256 009 / 1:0	DO		2912945 (59926) BRWN HPAN BLDR 0006 RED GRNT 0087 WHIT GRNT 0095 GREY GRNT 0124 RED GRNT 0145 GREY GRNT 0253 GREN ROCK 0268
DUNGANNON TOWNSHIP HR E (060)	18 276690 4993586[L]	2001/06 3651	06 06	FR 0245	001 / 275 010 / 1:0	DO		2919096 (227851) BLCK LOAM 0004 BRWN GRVL SAND HARD 0039 GREY HPAN BLDR 0097 GREY GRNT MRBL 0239 BLCK GRNT 0245 GREY GRNT MRBL 0282
DUNGANNON TOWNSHIP HR E (061)	18 276644 4993766[L]	1999/10 3651	06 06	FR 0200	/ 235 005 / 1:0	DO		2918433 (211104) BRWN SAND FGVL 0012 BRWN GRVL CLAY 0025 GREY HPAN BLDR 0043 RED GRNT 0240
DUNGANNON TOWNSHIP HR E (061)	18 276644 4993766[L]	1994/02 3651	06 06	FR 0140 FR 0230	009 / 260 002 / 3:0	DO		2916154 (138155) BRWN LOAM 0010 GREY HPAN BLDR 0050 GREY CLAY 0065 GREY HPAN BLDR 0129 GREY GRNT 0138 BRWN GRNT FCRD 0141 GREY LMSN 0215 GREY GRNT 0240 GREY GRNT 0260
DUNGANNON TOWNSHIP HR E (061)	18 276644 4993766[L]	1994/05 2664	05					2916135 (138877)

Well Computer Print Out Data as of May 30 2008

TOWNSHIP CONCESSION (LOT)	UTM[1]	DATE [2] CNTR [3]	CASING DIA [4]	WATER[5,6] DETAIL	STAT LVL/PUMP LVL[7] RATE[8]/TIME HR:MIN	WATER USE[9]	SCREEN INFO[10]	WELL # (AUDIT#) WELL TAG # DEPTHS TO WHICH FORMATIONS EXTEND5,11
FARADAY TOWNSHIP CON 10(029)	18 265129 4986421W	1981/04 3668	06 06	FR 0047	008 / 052 040 / 1:30	DO		2909868 () BRWN SAND FGVL 0031 GREY LMSN LTCL 0052
FARADAY TOWNSHIP CON 10(029)	18 265443 4986111W	2003/09 3611	05 06	UK 0079	008 / 009 050 / :0	DO		2920030 (263302) BRWN SAND 0046 GREY SAND SILT 0065 GREY LMSN 0081
FARADAY TOWNSHIP CON 10(029)	18 265281 4986133W	2004/05 7052	06	FR 0056	012 / 030 / 2:40	DO		2920260 (Z13206) A013110 BRWN FSND 0034 WHIT DLMT ROCK 0065
FARADAY TOWNSHIP CON 10(029)	18 265429 4986111W	2003/09 3611				NU		2920029 (263310)
FARADAY TOWNSHIP CON 10(072)		1987/05 3651	06 05	FR 0240 FR 0090	003 / 248 001 / 1:0	DO		2911620 (10605) BRWN LOAM STNS 0011 BRWN QSND CLAY 0028 GREY ROCK SOFT FCRD 0083 GREY GRNT 0248
FARADAY TOWNSHIP CON 10()		1984/08 3668	06 06	FR 0278 FR 0245	/ 005 / 3:0	DO		2910739 () BRWN GRVL FSND DRY 0020 GREY QSND WBRG 0140 BRWN SAND BLDR HARD 0185 RED CLAY 0200 RED ROCK QTZ SOFT 0221 RED ROCK QTZ SOFT 0290
FARADAY TOWNSHIP CON 11(001)	18 275698 4990937L	1989/08 3651	06 06	FR 0140	018 / 155 010 / 1:0	DO		2912953 (59932) BRWN HPAN 0010 GREY GRNT 0084 GREY GRNT 0138 GREY GRNT 0141 GREY GRNT 0155
FARADAY TOWNSHIP CON 11(005)	18 274119 4990352W	1974/10 3610	06 06	UK 0069	034 / 064 007 / 3:0	DO		2906688 () BRWN LOAM 0004 GRNT PORS 0007 GREY GRNT 0070
FARADAY TOWNSHIP CON 11(005)	18 274122 4990406L	2003/10 3651	06 05	FR 0130 FR 0255	019 / 264 012 / 2:0	DO		2920068 (267251) BRWN LOAM 0005 GREY GRNT HARD 0189 GREY GRNT SOFT 0235 BRWN GRNT 0269
FARADAY TOWNSHIP CON 11(007)	18 273351 4990142L	1996/08 3651	06 06	FR 0122	013 / 016 010 / 1:30	DO		2917238 (171075) BRWN FSND 0045 GREY QSND 0095 BRWN CGVL 0110 GREY GRNT 0142
FARADAY TOWNSHIP CON 11(008)	18 272981 4990017L	1990/09 3651	06 06	FR 0038	024 / 200 001 / 1:0	DO		2914022 (80658) BRWN SAND 0010 GREY GRNT 0200
FARADAY TOWNSHIP CON 11(008)	18 272784 4989912W	1965/04 4603	02 02	FR 0083	010 / 022 002 / 1:0	DO		2900296 () CSND GRVL 0016 GREY GRNT 0090
FARADAY TOWNSHIP CON 11(009)	18 272417 4987641W	2006/05 3651	06	FR 0035 FR 0095	027 / 059 020 / 1:0	DO		2921151 (Z33919) A031221 BRWN SAND LOOS BLDR 0002 GREY GRNT LTCL 0120
FARADAY TOWNSHIP CON 11(012)	18 271379 4989684L	1994/04 3611	06 01 06	MN 0055 UK 0084 UK 0091	021 / 040 035 / 10:0	DO		2916112 (138847) BRWN SAND GRVL 0021 GREY FSND 0055 GREY GRNT GRVL WBRG 0076 BRWN GRNT FCRD 0081 WHIT LMSN SOFT 0084 BLCK GRNT SHST CGRD 0091 GREN ROCK CGRD 0095
FARADAY TOWNSHIP CON 11(012)	18 271279 4990372W	1975/10 3610	06 06	FR 0200 FR 0122	020 / 195 011 / 5:0	CO		2907365 () FSND 0118 GREY GRNT 0210

Well Computer Print Out Data as of May 30 2008

TOWNSHIP CONCESSION (LOT)	UTM[1]	DATE[2] CNTR[3]	CASING DIA[4]	WATER[5,6] DETAIL	STAT LVL/PUMP LVL[7] RATE[8]/TIME HR:MIN	WATER USE[9]	SCREEN INFO[10]	WELL # (AUDIT#) WELL TAG # DEPTHS TO WHICH FORMATIONS EXTENDS,11
FARADAY TOWNSHIP CON 11(017)	18 269279 4988772W	1975/09 2104	06	FR 0037	005 / 010 049 / 12:0	MN	0032 04	2907146 () BRWN STNS SAND FILL 0001 BRWN FSND CLAY LOOS 0005 BRWN SAND GRVL LOOS 0037 RED GRVL WBRG LOOS 0042 RED GRVL SAND LOOS 0048
FARADAY TOWNSHIP CON 11(018)	18 269129 4988822W	1976/11 3668	06	FR 0057	012 / 022 025 / 2:0	IN		2907793 () HPAN 0055 GRVL 0057
FARADAY TOWNSHIP CON 11(025)	18 266354 4987964L	1992/10 1748	06 06	FR 0057 FR 0026 FR 0063	021 / 070 005 / 1:0	DO		2915433 (123861) BRWN SAND GRVL LOOS 0001 WHIT GRNT ROCK 0018 BLCK GRNT 0070
FARADAY TOWNSHIP CON 11(027)		1988/09 1748	06	FR 0095	025 / 105 008 / 1:0	DO		2912233 (41906) LOAM 0003 BLCK GRNT 0105
FARADAY TOWNSHIP CON 11(030)		1986/07 1748	06	FR 0080	010 / 084 008 / 1:0	DO		2911494 (01058) LOAM STNS 0006 WHIT GRNT 0084
FARADAY TOWNSHIP CON 11(032)		1981/07 1748	06	FR 0025	020 / 040 015 / 1:0	DO		2910824 () BRWN SAND STNS LOAM 0004 BLCK GRNT QTZ 0040
FARADAY TOWNSHIP CON 12(001)	18 275360 4991790L	1999/07 3611	06 06	UK 0155	016 / 060 020 / 1:0	DO		2918277 (193993) BRWN SAND STNS PCKD 0038 WHIT LMSN 0130 GREY GRNT 0145 GREY GRNT 0162
FARADAY TOWNSHIP CON 12(001)	18 275360 4991790L	1999/05 6016	06 06	UK 0093	007 / 100 007 / 2:0	DO		2918233 (200335) BRWN LOAM 0004 BRWN SAND 0016 WHIT DLMT 0100
FARADAY TOWNSHIP CON 12(001)	18 275360 4991790L	1999/08 3611	06 06	UK 0222	011 / 230 018 / 1:0	DO		2918302 (205829) BRWN SAND CLAY HPAN 0052 GREY LMSN 0180 WHIT LMSN 0230
FARADAY TOWNSHIP CON 12(001)	18 275360 4991790L	1989/04 3611	06 06	FR 0160	028 / 166 004 / 1:0	DO		2912610 () BRWN FSND 0051 GREY SAND PCKD 0057 GREY MRBL 0115 BLCK GRNT 0136 WHIT MRBL 0166
FARADAY TOWNSHIP CON 12(002)	18 275021 4991797W	1960/09 4513	02 02	FR 0082	020 / 030 003 / 2:0	DO		2900298 () PRDG 0014 HPAN 0016 GREY GRNT 0087
FARADAY TOWNSHIP CON 12(003)	18 274536 4991524L	2000/04 3611	06 06	UK 0218 UK 0180	021 / 240 003 / 1:0	DO		2918617 (205914) BRWN SAND FILL 0008 BRWN FSND 0053 WHIT LMSN 0062 GREY GRNT 0242
FARADAY TOWNSHIP CON 12(009)	18 272335 4990701L	1988/07 3651	06 06	FR 0096 FR 0071	014 / 130 006 / 1:0	CO		2912159 (29741) BRWN SAND FGVL 0009 GREY GRNT 0015 WHIT LMSN 0025 GREY GRNT 0061 WHIT LMSN 0078 GREY GRNT 0094 GREY GRNT LMSN 0110 GREY GRNT 0115 WHIT LMSN 0130
FARADAY TOWNSHIP CON 12(010)	18 271828 4990521W	1981/08 3668	06 06	FR 0170	030 / 240 001 / 2:0	DO		2909867 () BRWN SAND 0004 WHIT LMSN 0040 GREY GRNT 0160 WHIT LMSN 0200 GREY GRNT 0249
FARADAY TOWNSHIP CON 12(011)	18 271611 4990338L	1996/11 3651	06 06	FR 0162	018 / 160 005 / 1:0	DO		2917280 (175133) BRWN GRVL CGRD 0030 BRWN GRVL FSND 0080 BRWN SAND BLDR 0095 BRWN SAND FGVL 0101 WHIT ROCK SOFT 0110 BLCK GRNT LYRD 0162 BRWN GRNT 0164 BLCK GRNT 0182

Well Computer Print Out Data as of May 30 2008

TOWNSHIP CONCESSION (LOT)	UTM[1]	DATE[2] CNTR[3]	CASING DIA[4]	WATER[5,6] DETAIL	STAT LVL/PUMP LVL[7] RATE[8]/TIME HR:MIN	WATER USE[9]	SCREEN INFO[10]	WELL # (AUDIT#) WELL TAG # DEPTHS TO WHICH FORMATIONS EXTEND5,11
FARADAY TOWNSHIP HR W (039)	18 278785 4989728[W]	1966/12 3611	05 05	FR 0130	015 / 100 010 / 1:0	DO		2900306 () LOAM MSND 0005 GREY GRNT 0132
FARADAY TOWNSHIP HR W (039)	18 277778 4989496[L]	2001/04 3651	06 06	FR 0149 FR 0039	026 / 137 004 / 1:0	DO		2919022 (227795) BRWN SAND GRVL 0004 GREY GRNT 0160
FARADAY TOWNSHIP HR W (039)	18 277781 4989494[L]	1991/11 3651	06 06	FR 0104 FR 0112	015 / 122 007 / 1:0	DO		2914964 (113108) BRWN LOAM 0002 GREY GRNT SOFT 0008 GREY GRNT HARD 0050 GREY GRNT 0122
FARADAY TOWNSHIP HR W (039)	18 277781 4989494[L]	1987/08 1748	06	FR 0060 FR 0180	009 / 200 001 / 1:0	DO		2911632 (17926) SAND 0018 GREY GRNT 0200
FARADAY TOWNSHIP HR W (040)	18 277662 4989587[L]	1991/05 3651	06 06	FR	028 / 200 002 / 1:0	DO		2914422 (90190) GREY HPAN 0006 GREY GRNT HARD 0060 GREY GRNT HARD 0170 GREY GRNT HARD 0200
FARADAY TOWNSHIP HR W (045)	18 276709 4990350[L]	1994/08 3611	06 06	UK 0206	045 / 220 002 / 2:0	DO		2916313 (138890) BRWN SAND 0001 GREY GRNT 0220
FARADAY TOWNSHIP HR W (046)	18 276642 4990531[L]	1995/11 3611	06 06		014 / 180 005 / 1:0	DO		2916913 (138825) BRWN LOAM 0002 GREY MRBL 0180
FARADAY TOWNSHIP HR W (046)	18 276079 4990422[W]	1974/08 3610	06 06	FR 0072	039 / 060 008 / 2:0	DO		2906700 () SAND 0066 GRNT 0073
FARADAY TOWNSHIP HR W (046)	18 276642 4990531[L]	1995/09 3611	06 06	UK 0159	014 / 162 020 / 1:0	DO		2916805 (153724) BLCK LOAM 0007 BRWN GRVL LOOS 0016 GREY MRBL HARD 0162
FARADAY TOWNSHIP HR W (047)	18 276563 4990703[L]	1987/11 3651	06 06	FR 0040	010 / 044 020 / 1:0	DO		2911801 (10556) BRWN SAND BLDR 0015 GREY GRNT HARD 0040 BLUE GRNT SOFT 0042 GREY GRNT HARD 0044
FARADAY TOWNSHIP HR W (048)	18 276479 4990822[W]	1979/06 3668	06 06	FR 0150	004 / 322 001 / 1:0	DO		2909099 () PRDG 0007 STNS 0008 GREY GRNT 0322
FARADAY TOWNSHIP HR W (049)	18 276423 4991079[L]	1992/07 3611	06 06	FR 0184 FR 0193	032 / 195 020 / 2:15	DO		2915307 (102949) BRWN FSND SHRP 0035 GREY QSND 0057 GREY CLAY SAND SOFT 0086 GREY CLAY SAND PCKD 0135 WHIT GRNT 0169 BLCK GRNT SHST 0184 BLCK GRNT SHST 0193 GREY GRNT 0201
FARADAY TOWNSHIP HR W (049)	18 276423 4991079[L]	1999/07 3611	06 05	UK 0196	027 / 202 007 / 1:0	DO		2918301 (193983) BRWN SAND QSND FSND 0110 GREY GRVL STNS 0125 GREY LMSN 0202
FARADAY TOWNSHIP HR W (049)	18 276479 4991147[W]	1971/06 3610	06 06	FR 0068	040 / 050 020 / 2:0	CO		2904941 () BRWN FSND 0062 GREY GRNT 0070
FARADAY TOWNSHIP HR W (049)	18 276421 4991081[L]	2001/08 3651	06 06	FR 0170	023 / 048 010 / 1:0	DO		2919177 (227899) BRWN SAND GRVL BLDR 0080 GREY GRNT QTZ 0180
FARADAY TOWNSHIP HR W (050)	18 276342 4991271[L]	1993/12 3611	06 06	UK 0113	035 / 110 080 / 1:30	DO		2916021 (138845) BRWN SAND PCKD 0052 BRWN SAND GRVL 0103 GREY LMSN MRBL 0122

TOWNSHIP CONCESSION (LOT)	UTM[1]	DATE [2] CNTR [3]	CASING DIA [4]	WATER[5,6] DETAIL	STAT LVL/PUMP LVL[7] RATE[8]/TIME HR:MIN	WATER USE[9]	SCREEN INFO[10]	WELL # (AUDIT#) WELL TAG # DEPTHS TO WHICH FORMATIONS EXTEND5,11
FARADAY TOWNSHIP HR W (056)	18 275962 4992445[L]	1989/01 3611	06 06	FR 0122	038 / 145 005 / 2:0	DO		2912611 () BRWN SAND CGVL 0045 BRWN FSND 0080 GREY SAND CLAY PCKD 0105 GREY GRNT 0118 BRWN SNDS LYRD 0122 GREY GRNT 0145
FARADAY TOWNSHIP HR W (057)	18 275899 4992638[L]	1999/10 3651	06 06	FR 0085 FR 0095	021 / 098 007 / 1:0	DO		2918434 (211110) BRWN LOAM 0004 GREY HPAN BLDR 0030 BLCK GRNT 0038 BLCK GRNT QTZ 0084 BLCK GRNT 0095 BLCK GRNT 0100
FARADAY TOWNSHIP HR W (057)	18 275896 4992639[L]	2003/07 3611	05 06	UK 0160 UK 0225	066 / 240 003 / 1:0	DO		2919950 (263296) UNKN 0009 BLCK GRNT HARD 0241
FARADAY TOWNSHIP HR W (058)	18 276105 4992713[W]	1956/10 2801	10	FR 0040	015 / 021 063 / 40:0	PS	0032 11	2900312 () LOAM 0002 GRVL MSND BLDR 0011 MSND GRVL 0030 MSND GRVL BLDR 0040 GRVL BLDR MSND 0044
FARADAY TOWNSHIP HR W (058)	18 276107 4992713[W]	1956/08 2801	10					2900311 () LOAM 0001 GRVL BLDR 0007 GRVL CLAY BLDR 0012 GRVL BLDR 0018 FSND GRVL 0028 HPAN 0049 LMSN 0052
FARADAY TOWNSHIP HR W (058)	18 276113 4992722[W]	1956/08 2801	10		015 / 024 066 / 8:0	NU		2900310 () LOAM 0002 GRVL BLDR 0007 GRVL CLAY BLDR 0013 GRVL 0017 HPAN 0023 CSND GRVL 0035 FSND CSND GRVL 0043 CLAY MSND GRVL 0062 LMSN 0063
FARADAY TOWNSHIP HR W (058)	18 275834 4992828[L]	2001/08 3651	06 05	FR 0165	015 / 164 004 / 1:0	DO		2919175 (227892) BRWN SAND BLDR GRVL 0127 GREY GRNT 0180
FARADAY TOWNSHIP HR W (058)	18 276120 4992741[W]	1956/08 2801	10					2900308 () GRVL BLDR 0002 FSND 0020 CSND 0027 FSND 0030 GRVL BLDR 0034 CLAY MSND BLDR 0045 LMSN 0050
FARADAY TOWNSHIP HR W (058)	18 276120 4992741[W]	1956/08 2801	08					2900309 () GRVL BLDR 0002 FSND 0020 CSND 0027 FSND 0030 GRVL BLDR 0034 CLAY BLDR 0045 LMSN 0050
FARADAY TOWNSHIP HR W (066)	18 275626 4994486[W]	2004/06 3651	06	FR 0072	013 / 052 036 / 1:0	DO		2920337 (Z07731) A007637 BRWN LOAM 0004 GREY GRNT 0071 WHIT MRBL 0073 GREY GRNT 0080
FARADAY TOWNSHIP HR W (070)	18 274702 4995079[W]	1955/09 1651	04	FR 0020	016 / 019 002 / :0	DO		2900313 () BRWN LOAM 0018 GRVL 0020
FARADAY TOWNSHIP HR W (070)	18 274657 4995130[W]	1956/08 1821	06	FR 0023	010 / 010 002 / 2:0	DO		2900314 () GRVL 0025
FARADAY TOWNSHIP HR W (071)	18 275054 4995258[L]	2001/04 3611	06 05		045 / 374 004 / 1:45	DO		2919059 (222182) BRWN LOAM 0002 GREY GRNT 0012 GREY GRNT HARD 0480
FARADAY TOWNSHIP HR W (074)	18 274843 4996062[W]	1957/12 2402	10 10	FR 0192	032 / 140 015 / 12:0	DO		2900316 () LOAM 0001 MSND 0011 FSND 0048 RED GRNT 0194
FARADAY TOWNSHIP HR W (074)	18 274601 4996063[W]	1956/07 1806	06	FR 0063	053 / / :0	DO		2900315 () CSND 0063

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APPENDIX B

BOREHOLE LOGS

Client: Freymond Lumber Ltd.

Project: Freymond Quarry

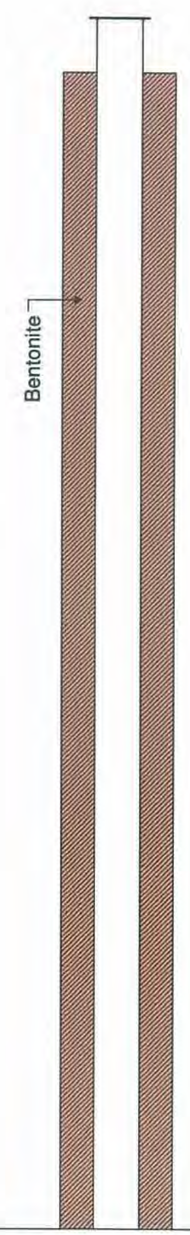
Location: Lot 51 & 52, Township of Faraday, Hastings County

Borehole Number: MW1d

Job Number: 33886-100

Drill Date: April 27, 2009

Depth (ft)	Depth (m)	Elevation (m)	Soil Description	Symbol	Number	Type	N-Value	Standard Penetration Graph (25 50 75)	Headspace (ppm)	Groundwater Observations and Well Details
-5.0										
-3.0										
-1.0		360.69	Ground Elevation							
1.0		0.00								
3.0	1.0									
5.0										
7.0										
9.0	3.0									
11.0										
13.0										
15.0										Bentonite
17.0	5.0									
19.0										
21.0										
23.0	7.0									
25.0										
27.0										
29.0	9.0									
31.0										
33.0										
35.0										
37.0	11.0									
39.0			**PRECAMBRIAN** Metasedimentary Rock							
41.0										
43.0	13.0									
45.0										
47.0										
49.0	15.0									
51.0										
53.0										
55.0	17.0									
57.0										
59.0										
61.0										
63.0	19.0									
65.0										



Reviewed By: WSC

Method: Air Percussion

Notes:

MTE Consultants Inc.
520 Bingemans Centre Drive
Kitchener, Ontario
N2B 3X9
(519) 743-6500

Logged By: MDE

Client: Freymond Lumber Ltd.

Project: Freymond Quarry

Location: Lot 51 & 52, Township of Faraday, Hastings County

Borehole Number: MW1d

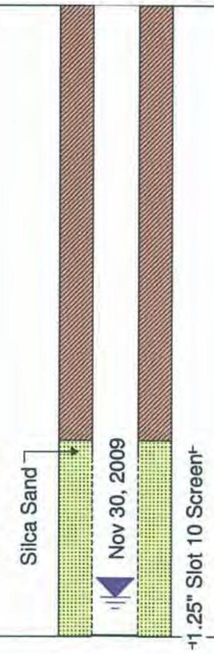
Job Number: 33886-100

Drill Date: April 27, 2009

Depth (m)	Elevation (m)	Soil Description	Symbol	Number	Type	N-Value	Standard Penetration Graph (25 50 75)	Headspace (ppm)	Groundwater Observations and Well Details
24.38	336.31	**PRECAMBRIAN** Metasedimentary Rock							
30.58	330.11								

Depth scale (ft): 67.0, 69.0, 71.0, 73.0, 75.0, 77.0, 79.0, 81.0, 83.0, 85.0, 87.0, 89.0, 91.0, 93.0, 95.0, 97.0, 99.0, 101.0, 103.0, 105.0, 107.0, 109.0, 111.0, 113.0, 115.0, 117.0, 119.0, 121.0, 123.0, 125.0, 127.0, 129.0, 131.0, 133.0, 135.0

Depth scale (m): 21.0, 23.0, 25.0, 27.0, 29.0, 31.0, 33.0, 35.0, 37.0, 39.0, 41.0



Reviewed By: WSC

Method: Air Percussion

Notes:

MTE Consultants Inc.
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Kitchener, Ontario
N2B 3X9
(519) 743-6500

Logged By: MDE

Client: Freymond Lumber Ltd.

Project: Freymond Quarry

Location: Lot 51 & 52, Township of Faraday, Hastings County

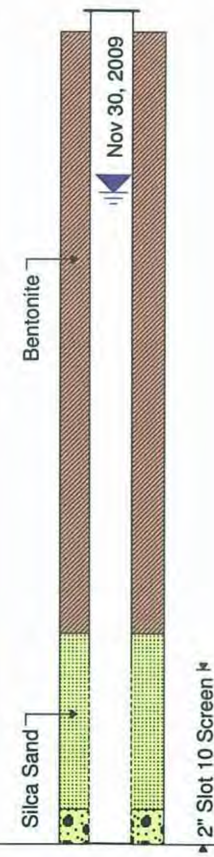
Borehole Number: MW1s

Job Number: 33886-100

Drill Date: April 27, 2009

Depth (m)	Elevation (m)	Soil Description	Symbol	Number	Type	N-Value	Standard Penetration Graph (25 50 75)	Headspace (ppm)	Groundwater Observations and Well Details
	359.64 / 0.00	Ground Elevation							
0.00 – 14.15		**PRECAMBRIAN** Metasedimentary Rock							
	345.49 / 14.15								

Depth scale: ft -5.0 to 65.0; m 1.0 to 19.0



Reviewed By: WSC

Method: Air Percussion

Notes:

MTE Consultants Inc.
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Kitchener, Ontario
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Logged By: MDE

Sheet: 1 of 1

Client: Freymond Lumber Ltd.

Project: Freymond Quarry

Location: Lot 51 & 52, Township of Faraday, Hastings County

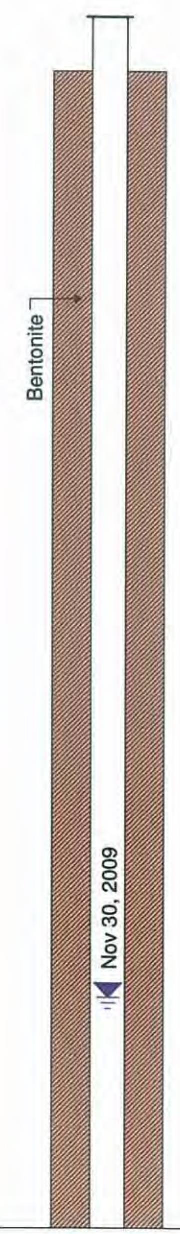
Borehole Number: MW2d

Job Number: 33886-100

Drill Date: May 5, 2009

Depth (m)	Elevation (m)	Soil Description	Symbol	Number	Type	N-Value	Standard Penetration Graph (25 50 75)	Headspace (ppm)	Groundwater Observations and Well Details
0.00	367.66	Ground Elevation							
9.14	358.52	**PRECAMBRIAN** Metasedimentary Rock							

Depth scale: ft -5.0, -3.0, -1.0, 1.0, 3.0, 5.0, 7.0, 9.0, 11.0, 13.0, 15.0, 17.0, 19.0, 21.0, 23.0, 25.0, 27.0, 29.0, 31.0, 33.0, 35.0, 37.0, 39.0, 41.0, 43.0, 45.0, 47.0, 49.0, 51.0, 53.0, 55.0, 57.0, 59.0, 61.0, 63.0, 65.0; m 1.0, 3.0, 5.0, 7.0, 9.0, 11.0, 13.0, 15.0, 17.0, 19.0



Reviewed By: WSC

Method: Air Percussion

Notes:

MTE Consultants Inc.
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Kitchener, Ontario
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Logged By: MDE

Sheet: 1 of 2

Client: Freymond Lumber Ltd.

Project: Freymond Quarry

Location: Lot 51 & 52, Township of Faraday, Hastings County

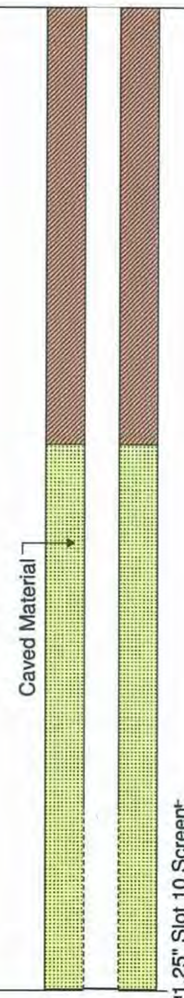
Borehole Number: MW2d

Job Number: 33886-100

Drill Date: May 5, 2009

Depth (m)	Elevation (m)	Soil Description	Symbol	Number	Type	N-Value	Standard Penetration Graph (25 50 75)	Headspace (ppm)	Groundwater Observations and Well Details
67.0 – 75.0 (21.0 – 23.0)									
75.0 (22.86)	344.80 22.86	**PRECAMBRIAN** Metasedimentary Rock							
77.0 – 119.0 (23.0 – 36.0)									
120.0 (36.58)	331.08 36.58								
121.0 – 135.0 (37.0 – 41.0)									

Depth scale: 67.0, 69.0, 71.0, 73.0, 75.0, 77.0, 79.0, 81.0, 83.0, 85.0, 87.0, 89.0, 91.0, 93.0, 95.0, 97.0, 99.0, 101.0, 103.0, 105.0, 107.0, 109.0, 111.0, 113.0, 115.0, 117.0, 119.0, 121.0, 123.0, 125.0, 127.0, 129.0, 131.0, 133.0, 135.0; 21.0, 23.0, 25.0, 27.0, 29.0, 31.0, 33.0, 35.0, 37.0, 39.0, 41.0



Reviewed By: WSC

Method: Air Percussion

Notes:

MTE Consultants Inc.
520 Bingemans Centre Drive
Kitchener, Ontario
N2B 3X9
(519) 743-6500

Logged By: MDE

Client: Freymond Lumber Ltd.

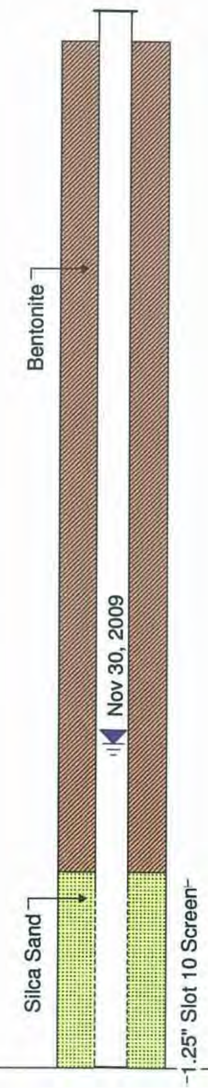
Project: Freymond Quarry

Location: Lot 51 & 52, Township of Faraday, Hastings County

Borehole Number: MW2s

Job Number: 33886-100

Drill Date: May 4, 2009

Depth (m)	Elevation (m)	Soil Description	Symbol	Number	Type	N-Value	Standard Penetration Graph (25 50 75)	Headspace (ppm)	Groundwater Observations and Well Details
0.00	367.53 / 0.00	Ground Elevation							
0.00–17.88		**PRECAMBRIAN** Metasedimentary Rock							
17.88	349.65 / 17.88								

Depth scale: ft -5.0 to 65.0; m 1.0 to 19.0

Reviewed By: WSC

Method: Air Percussion

Notes:

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Sheet: 1 of 1

Client: Freymond Lumber Ltd.

Project: Freymond Quarry

Location: Lot 51 & 52, Township of Faraday, Hastings County

Borehole Number: MW3d

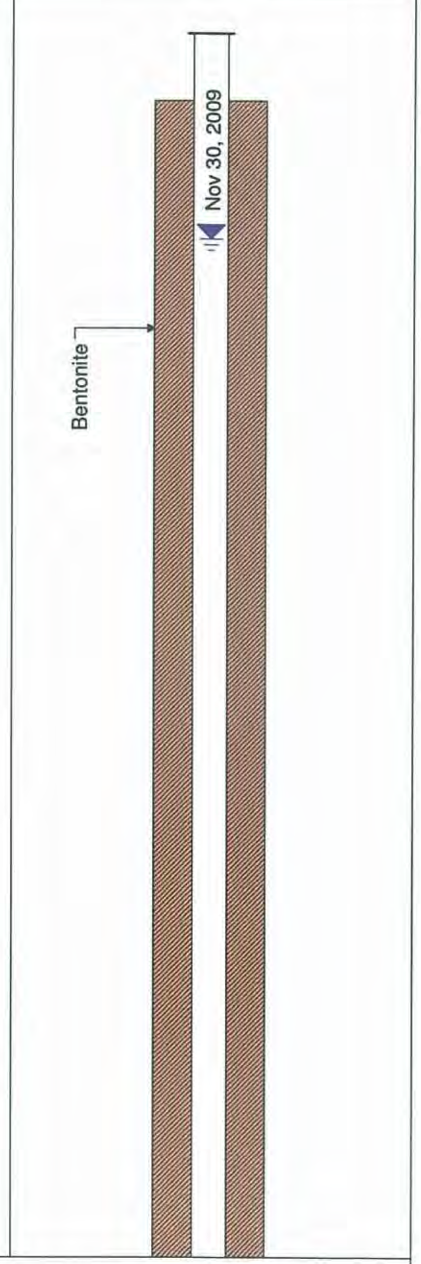
Job Number: 33886-100

Drill Date: May 4, 2009

Depth (m)	Elevation (m)	Soil Description	Symbol	Number	Type	N-Value	Standard Penetration Graph (25 50 75)	Headspace (ppm)	Groundwater Observations and Well Details
0.00	375.33	Ground Elevation							
9.14	366.19	**PRECAMBRIAN** Metasedimentary Rock							

Depth scale (ft): -5.0, -3.0, -1.0, 1.0, 3.0, 5.0, 7.0, 9.0, 11.0, 13.0, 15.0, 17.0, 19.0, 21.0, 23.0, 25.0, 27.0, 29.0, 31.0, 33.0, 35.0, 37.0, 39.0, 41.0, 43.0, 45.0, 47.0, 49.0, 51.0, 53.0, 55.0, 57.0, 59.0, 61.0, 63.0, 65.0

Depth scale (m): 1.0, 3.0, 5.0, 7.0, 9.0, 11.0, 13.0, 15.0, 17.0, 19.0



Reviewed By: WSC

Method: Air Percussion

Notes:

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Logged By: MDE

Client: Freymond Lumber Ltd.

Project: Freymond Quarry

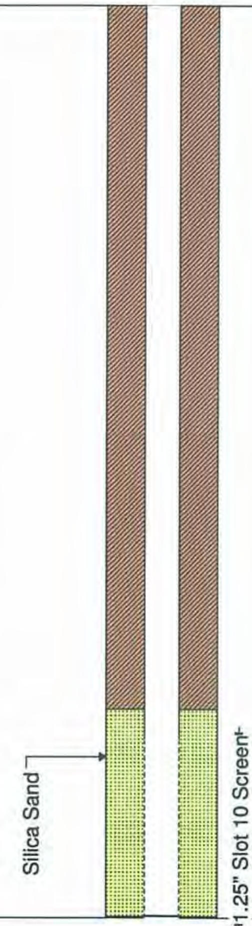
Location: Lot 51 & 52, Township of Faraday, Hastings County

Borehole Number: MW3d

Job Number: 33886-100

Drill Date: May 4, 2009

Depth (m)	Elevation (m)	Soil Description	Symbol	Number	Type	N-Value	Standard Penetration Graph (25 50 75)	Headspace (ppm)	Groundwater Observations and Well Details
67.0 / 69.0 – 21.0 / 71.0 / 73.0 / 75.0 – 23.0 / 77.0 / 79.0	350.95								
81.0 – 25.0 / 83.0 / 85.0 / 87.0 / 89.0 – 27.0 / 91.0 / 93.0 / 95.0 – 29.0 / 97.0 / 99.0 / 101.0 – 31.0 / 103.0 / 105.0 / 107.0 / 109.0 – 33.0 / 111.0 / 113.0 / 115.0 – 35.0	24.38	**PRECAMBRIAN** Metasedimentary Rock							
117.0 / 119.0 / 121.0 – 37.0 / 123.0 / 125.0 / 127.0 – 39.0 / 129.0 / 131.0 / 133.0 / 135.0 – 41.0	339.97 35.36								



Reviewed By: WSC

Method: Air Percussion

Notes:

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Logged By: MDE

Client: Freymond Lumber Ltd.

Project: Freymond Quarry

Location: Lot 51 & 52, Township of Faraday, Hastings County

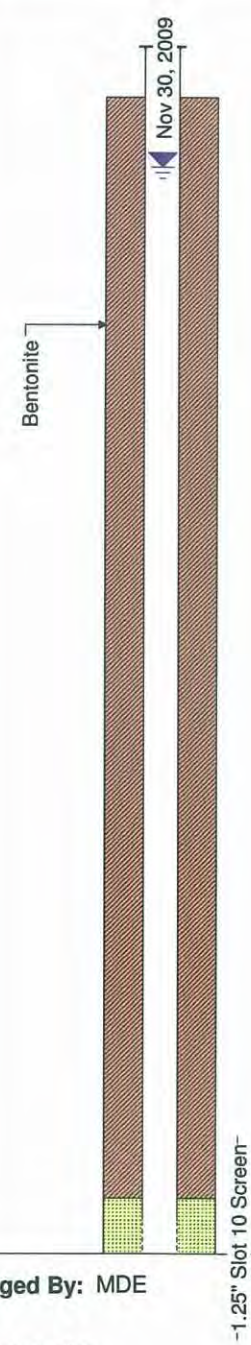
Borehole Number: MW3s

Job Number: 33886-100

Drill Date: May 4, 2009

Depth (m)	Elevation (m)	Soil Description	Symbol	Number	Type	N-Value	Standard Penetration Graph (25 50 75)	Headspace (ppm)	Groundwater Observations and Well Details
0.0	375.33 / 0.00	Ground Elevation							
0.0 – 19.5+		**PRECAMBRIAN** Metasedimentary Rock							

Depth scale: ft -5.0, -3.0, -1.0, 1.0, 3.0, 5.0, 7.0, 9.0, 11.0, 13.0, 15.0, 17.0, 19.0, 21.0, 23.0, 25.0, 27.0, 29.0, 31.0, 33.0, 35.0, 37.0, 39.0, 41.0, 43.0, 45.0, 47.0, 49.0, 51.0, 53.0, 55.0, 57.0, 59.0, 61.0, 63.0, 65.0; m 1.0, 3.0, 5.0, 7.0, 9.0, 11.0, 13.0, 15.0, 17.0, 19.0



Reviewed By: WSC

Method: Air Percussion

Notes:

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Sheet: 1 of 2

Client: Freymond Lumber Ltd.

Project: Freymond Quarry

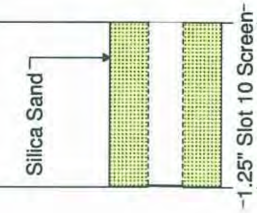
Location: Lot 51 & 52, Township of Faraday, Hastings County

Borehole Number: MW3s

Job Number: 33886-100

Drill Date: May 4, 2009

Depth (m)	Elevation (m)	Soil Description	Symbol	Number	Type	N-Value	Standard Penetration Graph (25 50 75)	Headspace (ppm)	Groundwater Observations and Well Details
67.0 / 69.0 – 21.0 / 71.0 / 73.0	352.70 / 22.63								
75.0 – 23.0 / 77.0 / 79.0 / 81.0 – 25.0 / 83.0 / 85.0 / 87.0 / 89.0 – 27.0 / 91.0 / 93.0 / 95.0 – 29.0 / 97.0 / 99.0 / 101.0 – 31.0 / 103.0 / 105.0 / 107.0 / 109.0 – 33.0 / 111.0 / 113.0 / 115.0 – 35.0 / 117.0 / 119.0 / 121.0 – 37.0 / 123.0 / 125.0 / 127.0 – 39.0 / 129.0 / 131.0 / 133.0 / 135.0 – 41.0									



Reviewed By: WSC

Method: Air Percussion

Notes:

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Client: Freymond Lumber Ltd.

Project: Freymond Quarry

Location: Lot 51 & 52, Township of Faraday, Hastings County

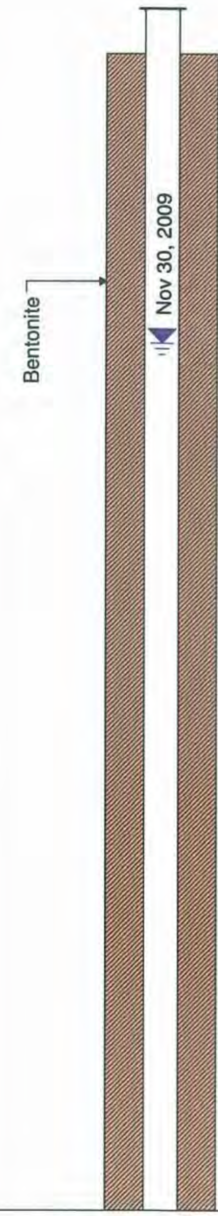
Borehole Number: MW4d

Job Number: 33886-100

Drill Date: May 5, 2009

Depth (m)	Elevation (m)	Soil Description	Symbol	Number	Type	N-Value	Standard Penetration Graph (25 50 75)	Headspace (ppm)	Groundwater Observations and Well Details
0.0	370.44 / 0.00	Ground Elevation							
9.14	361.30 / 9.14	**PRECAMBRIAN** Metasedimentary Rock							

Depth scale: ft -5.0 to 65.0; m 1.0 to 19.0



Reviewed By: WSC
Method: Air Percussion
Notes:

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Logged By: MDE

Sheet: 1 of 3

Client: Freymond Lumber Ltd.

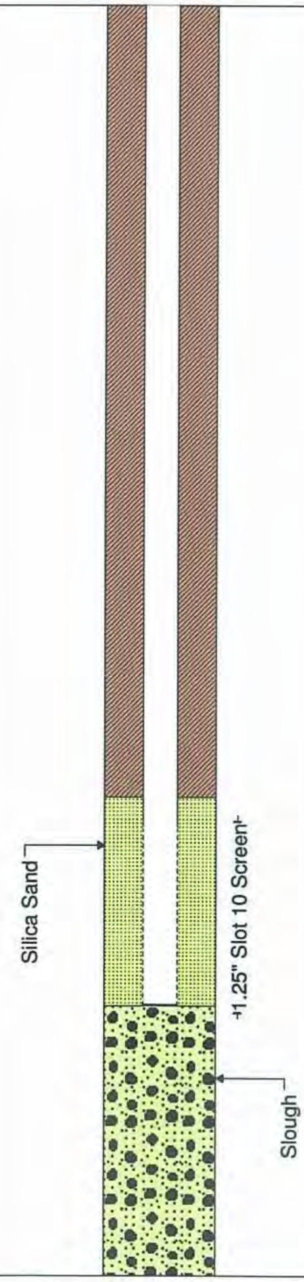
Project: Freymond Quarry

Location: Lot 51 & 52, Township of Faraday, Hastings County

Borehole Number: MW4d

Job Number: 33886-100

Drill Date: May 5, 2009

Depth (m)	Elevation (m)	Soil Description	Symbol	Number	Type	N-Value	Standard Penetration Graph (25 50 75)	Headspace (ppm)	Groundwater Observations and Well Details
67.0 – 135.0 (scale); 21.0, 23.0, 25.0, 27.0, 29.0, 31.0, 33.0, 35.0, 37.0, 39.0, 41.0	339.96 / 30.48	**PRECAMBRIAN** Metasedimentary Rock							

Depth scale: 67.0, 69.0, 71.0, 73.0, 75.0, 77.0, 79.0, 81.0, 83.0, 85.0, 87.0, 89.0, 91.0, 93.0, 95.0, 97.0, 99.0, 101.0, 103.0, 105.0, 107.0, 109.0, 111.0, 113.0, 115.0, 117.0, 119.0, 121.0, 123.0, 125.0, 127.0, 129.0, 131.0, 133.0, 135.0

Reviewed By: WSC

Method: Air Percussion

Notes:

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Logged By: MDE

Client: Freymond Lumber Ltd.

Project: Freymond Quarry

Location: Lot 51 & 52, Township of Faraday, Hastings County

Borehole Number: MW4d

Job Number: 33886-100

Drill Date: May 5, 2009

Depth (ft)	Depth (m)	Elevation (m)	Soil Description	Symbol	Number	Type	N-Value	Standard Penetration Graph (25 50 75)	Headspace (ppm)	Groundwater Observations and Well Details
137.0 – 139.0		327.77								
141.0	43.0	42.67								
143.0, 145.0, 147.0	45.0									
149.0, 151.0, 153.0, 155.0	47.0									
157.0, 159.0, 161.0	49.0									
163.0, 165.0, 167.0	51.0									
169.0, 171.0, 173.0, 175.0	53.0									
177.0, 179.0, 181.0	55.0									
183.0, 185.0, 187.0	57.0									
189.0, 191.0, 193.0, 195.0	59.0									
197.0, 199.0, 201.0	61.0									
203.0, 205.0										

Reviewed By: WSC

Method: Air Percussion

Notes:

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Client: Fowler Construction Company Limited

Project: Freymond Quarry

Location: Lot 51 & 52, Township of Faraday, Hastings County

Borehole Number: MW4s

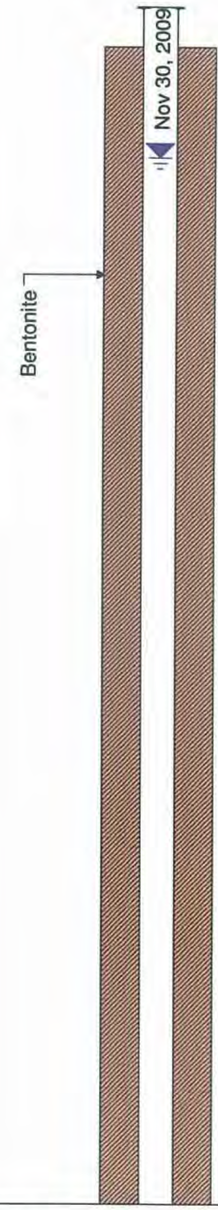
Job Number: 33886-100

Drill Date: May 5, 2009

Depth (m)	Elevation (m)	Soil Description	Symbol	Number	Type	N-Value	Standard Penetration Graph (25 50 75)	Headspace (ppm)	Groundwater Observations and Well Details
	369.74 / 0.00	Ground Elevation							
9.14	360.60 / 9.14	**PRECAMBRIAN** Metasedimentary Rock							

Depth scale (ft): -5.0, -3.0, -1.0, 1.0, 3.0, 5.0, 7.0, 9.0, 11.0, 13.0, 15.0, 17.0, 19.0, 21.0, 23.0, 25.0, 27.0, 29.0, 31.0, 33.0, 35.0, 37.0, 39.0, 41.0, 43.0, 45.0, 47.0, 49.0, 51.0, 53.0, 55.0, 57.0, 59.0, 61.0, 63.0, 65.0

Depth scale (m): 1.0, 3.0, 5.0, 7.0, 9.0, 11.0, 13.0, 15.0, 17.0, 19.0



Reviewed By: WSC

Method: Air Percussion

Notes:

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Sheet: 1 of 2

Client: Fowler Construction Company Limited

Project: Freymond Quarry

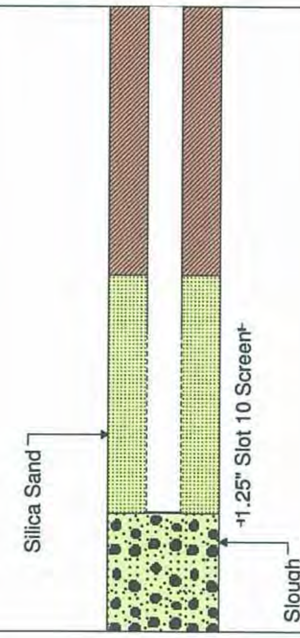
Location: Lot 51 & 52, Township of Faraday, Hastings County

Borehole Number: MW4s

Job Number: 33886-100

Drill Date: May 5, 2009

Depth (m)	Elevation (m)	Soil Description	Symbol	Number	Type	N-Value	Standard Penetration Graph (25 50 75)	Headspace (ppm)	Groundwater Observations and Well Details
69.0 / 21.0	348.40 21.34	**PRECAMBRIAN** Metasedimentary Rock							
99.0 / 30.0	339.26 30.48								



Reviewed By: WSC

Method: Air Percussion

Notes:

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Sheet: 2 of 2

Client: Freymond Lumber Ltd.

Project: Freymond Quarry

Location: Lot 51 & 52, Township of Faraday, Hastings County

Borehole Number: MW5d

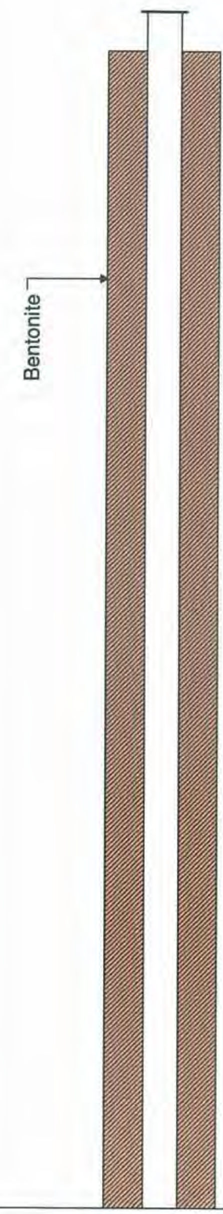
Job Number: 33886-100

Drill Date: May 5, 2009

Depth (m)	Elevation (m)	Soil Description	Symbol	Number	Type	N-Value	Standard Penetration Graph (25 50 75)	Headspace (ppm)	Groundwater Observations and Well Details
0.0	369.20	Ground Elevation							
0.00 – 65.0 ft (19.8 m)	0.00	**PRECAMBRIAN** Metasedimentary Rock							Bentonite

Depth scale (ft): -5.0, -3.0, -1.0, 1.0, 3.0, 5.0, 7.0, 9.0, 11.0, 13.0, 15.0, 17.0, 19.0, 21.0, 23.0, 25.0, 27.0, 29.0, 31.0, 33.0, 35.0, 37.0, 39.0, 41.0, 43.0, 45.0, 47.0, 49.0, 51.0, 53.0, 55.0, 57.0, 59.0, 61.0, 63.0, 65.0

Depth scale (m): 1.0, 3.0, 5.0, 7.0, 9.0, 11.0, 13.0, 15.0, 17.0, 19.0



Reviewed By: WSC

Method: Air Percussion

Notes:

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Logged By: MDE

Client: Freymond Lumber Ltd.

Project: Freymond Quarry

Location: Lot 51 & 52, Township of Faraday, Hastings County

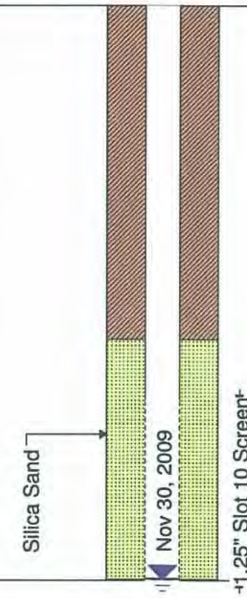
Borehole Number: MW5d

Job Number: 33886-100

Drill Date: May 5, 2009

Depth (m)	Elevation (m)	Soil Description	Symbol	Number	Type	N-Value	Standard Penetration Graph (25 50 75)	Headspace (ppm)	Groundwater Observations and Well Details
24.38	344.82	**PRECAMBRIAN** Metasedimentary Rock							
29.62	339.58								

Depth scale: 67.0, 69.0, 71.0, 73.0, 75.0, 77.0, 79.0, 81.0, 83.0, 85.0, 87.0, 89.0, 91.0, 93.0, 95.0, 97.0, 99.0, 101.0, 103.0, 105.0, 107.0, 109.0, 111.0, 113.0, 115.0, 117.0, 119.0, 121.0, 123.0, 125.0, 127.0, 129.0, 131.0, 133.0, 135.0 / 21.0, 23.0, 25.0, 27.0, 29.0, 31.0, 33.0, 35.0, 37.0, 39.0, 41.0



Reviewed By: WSC

Method: Air Percussion

Notes:

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Client: Freymond Lumber Ltd.

Project: Freymond Quarry

Location: Lot 51 & 52, Township of Faraday, Hastings County

Borehole Number: MW5s

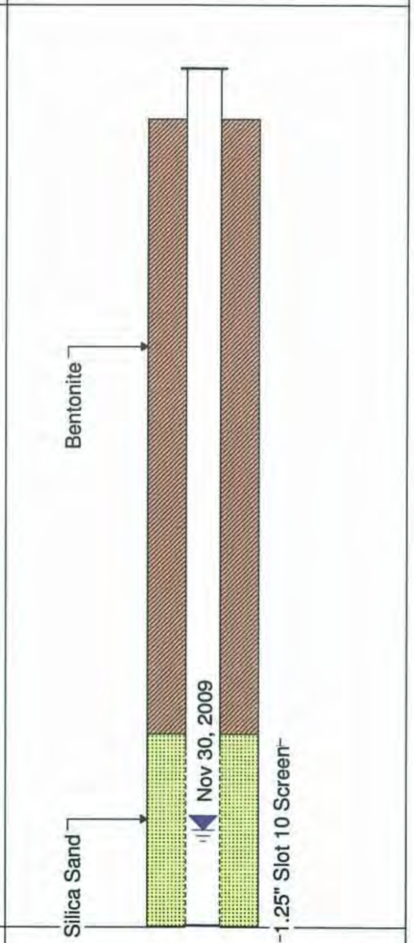
Job Number: 33886-100

Drill Date: May 6, 2009

Depth (m)	Elevation (m)	Soil Description	Symbol	Number	Type	N-Value	Standard Penetration Graph (25 50 75)	Headspace (ppm)	Groundwater Observations and Well Details
	369.20	Ground Elevation							
	0.00	**PRECAMBRIAN** Metasedimentary Rock							
	355.13 14.07								

Depth scale (ft): -5.0, -3.0, -1.0, 1.0, 3.0, 5.0, 7.0, 9.0, 11.0, 13.0, 15.0, 17.0, 19.0, 21.0, 23.0, 25.0, 27.0, 29.0, 31.0, 33.0, 35.0, 37.0, 39.0, 41.0, 43.0, 45.0, 47.0, 49.0, 51.0, 53.0, 55.0, 57.0, 59.0, 61.0, 63.0, 65.0

Depth scale (m): 1.0, 3.0, 5.0, 7.0, 9.0, 11.0, 13.0, 15.0, 17.0, 19.0



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Method: Air Percussion

Notes:

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Sheet: 1 of 1

Client: Freymond Lumber Ltd.

Project: Freymond Quarry

Location: Lot 51 & 52, Township of Faraday, Hastings County

Borehole Number: MW6d

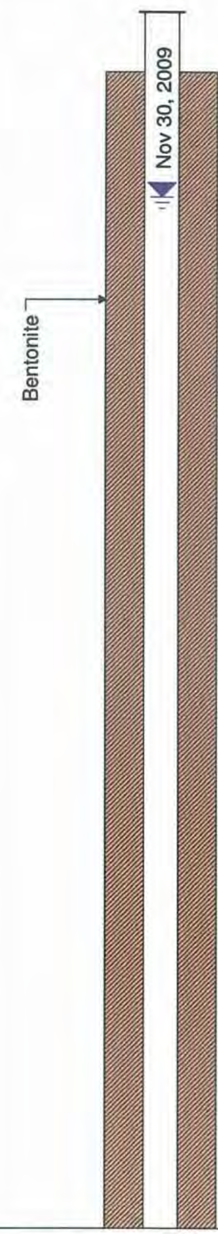
Job Number: 33886-100

Drill Date: May 6, 2009

Depth (m)	Elevation (m)	Soil Description	Symbol	Number	Type	N-Value	Standard Penetration Graph (25 50 75)	Headspace (ppm)	Groundwater Observations and Well Details
	363.31 0.00	Ground Elevation							
	354.17 9.14	**PRECAMBRIAN** Metasedimentary Rock							

Depth scale — ft: -5.0, -3.0, -1.0, 1.0, 3.0, 5.0, 7.0, 9.0, 11.0, 13.0, 15.0, 17.0, 19.0, 21.0, 23.0, 25.0, 27.0, 29.0, 31.0, 33.0, 35.0, 37.0, 39.0, 41.0, 43.0, 45.0, 47.0, 49.0, 51.0, 53.0, 55.0, 57.0, 59.0, 61.0, 63.0, 65.0

Depth scale — m: 1.0, 3.0, 5.0, 7.0, 9.0, 11.0, 13.0, 15.0, 17.0, 19.0



Reviewed By: WSC

Method: Air Percussion

Notes:

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Logged By: MDE

Client: Freymond Lumber Ltd.

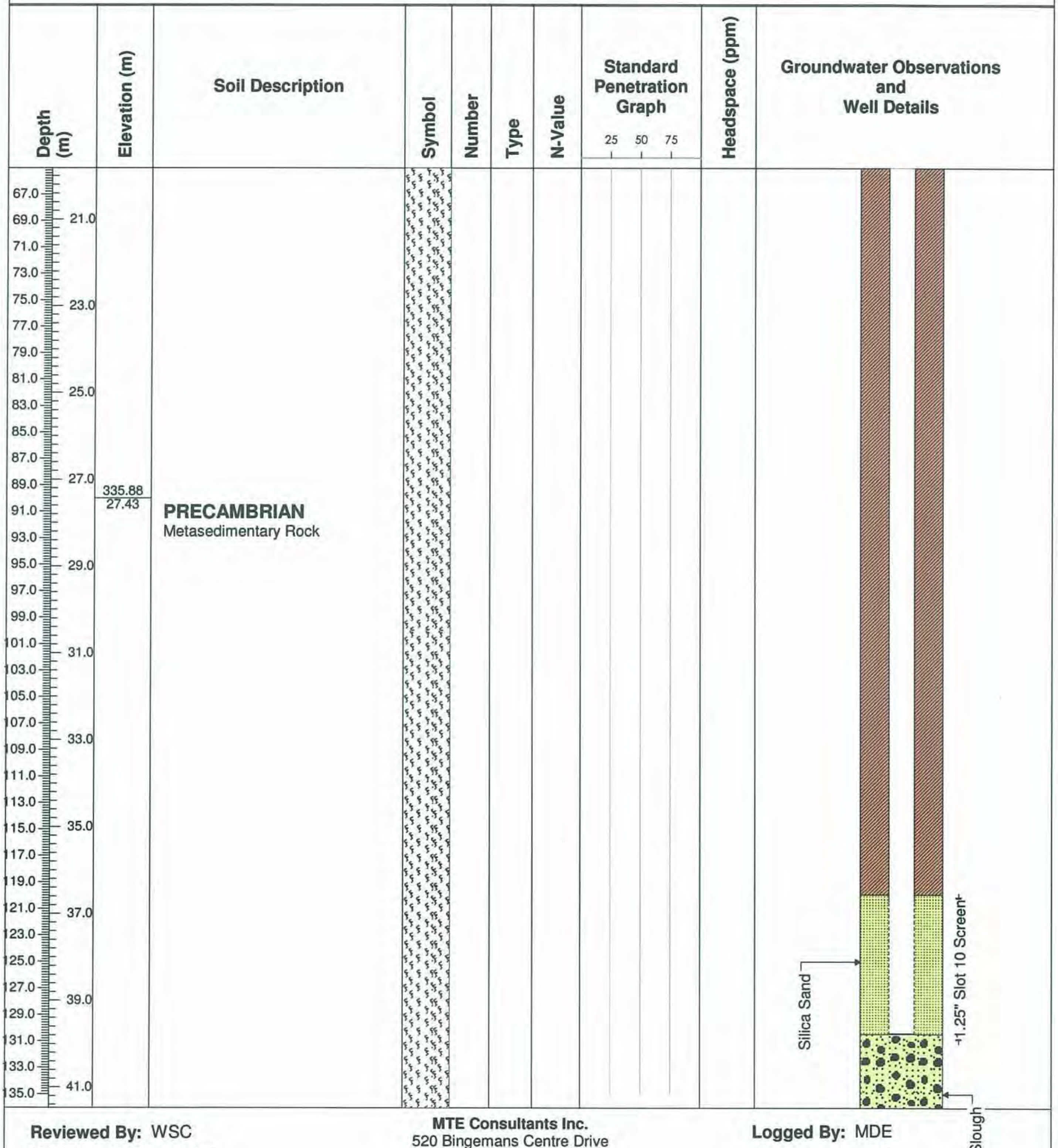
Borehole Number: MW6d

Project: Freymond Quarry

Job Number: 33886-100

Location: Lot 51 & 52, Township of Faraday, Hastings County

Drill Date: May 6, 2009



Reviewed By: WSC

Method: Air Percussion

Notes:

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Sheet: 2 of 3

Client: Freymond Lumber Ltd.

Project: Freymond Quarry

Location: Lot 51 & 52, Township of Faraday, Hastings County

Borehole Number: MW6d

Job Number: 33886-100

Drill Date: May 6, 2009

Depth (ft)	Depth (m)	Elevation (m)	Soil Description	Symbol	Number	Type	N-Value	Standard Penetration Graph (25 50 75)	Headspace (ppm)	Groundwater Observations and Well Details
137.0										Slough
139.0		320.64								
141.0	43.0	42.67								
143.0										
145.0										
147.0	45.0									
149.0										
151.0										
153.0										
155.0	47.0									
157.0										
159.0										
161.0	49.0									
163.0										
165.0										
167.0	51.0									
169.0										
171.0										
173.0										
175.0	53.0									
177.0										
179.0										
181.0	55.0									
183.0										
185.0										
187.0	57.0									
189.0										
191.0										
193.0	59.0									
195.0										
197.0										
199.0										
201.0	61.0									
203.0										
205.0										

Reviewed By: WSC

Method: Air Percussion

Notes:

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Logged By: MDE

Client: Freymond Lumber Ltd.

Project: Freymond Quarry

Location: Lot 51 & 52, Township of Faraday, Hastings County

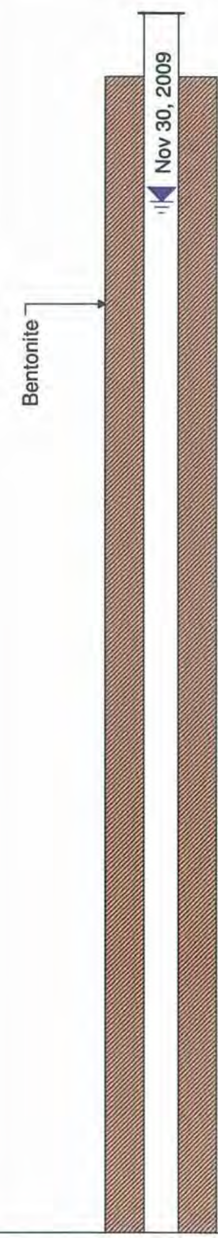
Borehole Number: MW6s

Job Number: 33886-100

Drill Date: May 6, 2009

Depth (m)	Elevation (m)	Soil Description	Symbol	Number	Type	N-Value	Standard Penetration Graph (25 50 75)	Headspace (ppm)	Groundwater Observations and Well Details
	363.56 0.00	Ground Elevation							
		PRECAMBRIAN Metasedimentary Rock							

Depth scale: ft: -5.0, -3.0, -1.0, 1.0, 3.0, 5.0, 7.0, 9.0, 11.0, 13.0, 15.0, 17.0, 19.0, 21.0, 23.0, 25.0, 27.0, 29.0, 31.0, 33.0, 35.0, 37.0, 39.0, 41.0, 43.0, 45.0, 47.0, 49.0, 51.0, 53.0, 55.0, 57.0, 59.0, 61.0, 63.0, 65.0; m: 1.0, 3.0, 5.0, 7.0, 9.0, 11.0, 13.0, 15.0, 17.0, 19.0



Reviewed By: WSC

Method: Air Percussion

Notes:

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Logged By: MDE

Sheet: 1 of 2

Client: Freymond Lumber Ltd.

Project: Freymond Quarry

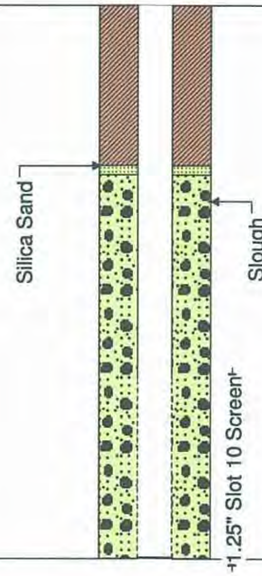
Location: Lot 51 & 52, Township of Faraday, Hastings County

Borehole Number: MW6s

Job Number: 33886-100

Drill Date: May 6, 2009

Depth (m)	Elevation (m)	Soil Description	Symbol	Number	Type	N-Value	Standard Penetration Graph (25 50 75)	Headspace (ppm)	Groundwater Observations and Well Details
67.0, 69.0 – 21.0, 71.0, 73.0									
75.0 – 23.0	340.70 / 22.86	**PRECAMBRIAN** Metasedimentary Rock							
77.0, 79.0, 81.0 – 25.0, 83.0, 85.0, 87.0, 89.0 – 27.0, 91.0, 93.0, 95.0 – 29.0	334.30 / 29.26								
97.0, 99.0, 101.0 – 31.0, 103.0, 105.0, 107.0, 109.0 – 33.0, 111.0, 113.0, 115.0 – 35.0, 117.0, 119.0, 121.0 – 37.0, 123.0, 125.0, 127.0 – 39.0, 129.0, 131.0, 133.0, 135.0 – 41.0									



Reviewed By: WSC

Method: Air Percussion

Notes:

MTE Consultants Inc.
520 Bingemans Centre Drive
Kitchener, Ontario
N2B 3X9
(519) 743-6500

Logged By: MDE

Sheet: 2 of 2

More Than Engineering

APPENDIX C

PRIVATE WELL INVENTORIES

Water Well Inventory – Page 1

33886-100

Resident Name PW1

911 Number ____ Road ____

Address ____

Phone Number ____ email ____

Property Owner: ☒ Yes ☐ No If No, Property Owner's Name ____

Previous Property Owners ____

Number of Wells on property 1 ☐ Don't Know

Type of Well: ☒ Drilled ☐ Dug ☐ Sand Point ☐ Other ____ ☐ Don't Know

Diameter of Well: ☐ 2 inches ☐ 4 inches ☒ 6 inches ☐ 8 inches ☐ 3 feet ☐ Don't Know

Depth of Well 300 ft ☐ Don't Know

Depth to Water 37 ft ☐ Don't Know

Pump Depth 200 ☐ Don't Know

Pump Type Submersible ☐ Don't Know

Water Source: ☒ Bedrock ☐ Sand/Gravel/Overburden ☐ Don't Know

Name of Well Driller Earl V. Marquardt & Son Inc. ☐ Don't Know

Date Installed Nov. 25, 2005 ☐ Don't Know

I have the MOE Water Well Record ☒ Yes ☐ No ☐ Don't Know

MOE Water Well Record Number A032653 ☐ Don't Know

Type of Water Use: ☒ Domestic ☐ Farm ☐ Irrigation ☐ Industrial ☐ Other ____

Water Treatment: ☐ Softener ☐ Sand Filter ☐ Carbon Filter ☒ Fiber Filter ☐ Aluminum Oxide ☐ UV ☐ Reverse Osmosis ☐ Distillation ☐ Ion Exchange ☐ Ozonation

Other Water Treatment ____ ☐ Don't Know

Water Well Inventory – Page 2

33886-100

Condition of Well Casing ☒Good ☐Buried ☐Corroded ☐Seized ☐Broken ☐Don't Know

Other ______

Any problems with water quantity in the past? ☐Yes ☒No

Any problems with water quality in the past? ☐ Yes ☒No

If yes, what type ? ☐Sulphur smell ☐Iron taste ☐Brown water ☐Bacteria

Other ______

Location of Septic Bed West end of house

Potential Sources of Contamination: ☐barn ☐manure pile ☐gas tanks ☐heating oil tank

Other ______

Is the well easily accessible? ☒Yes ☐No

If Yes, may we measure the water level in this well? ☒Yes ☐ No

Describe Well Location East end of house

Sketch a diagram to show the location of well(s), house, buildings, road(s), and septic bed:

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www.wellaware.ca

Water Well Inventory – Page 1

33886-100

Resident Name PW2

911 Number ____ Road ____

Address ____

Phone Number ____ email ____

Property Owner: ☒ Yes ☐ No If No, Property Owner's Name ____

Previous Property Owners ____

Number of Wells on property 2 ☐ Don't Know

Type of Well: ☒ Drilled ☐ Dug ☐ Sand Point ☐ Other and dug ☐ Don't Know

Diameter of Well: ☐ 2 inches ☐ 4 inches ☐ 6 inches ☒ 8 inches ☐ 3 feet ☐ Don't Know

Depth of Well 220 ft ☐ Don't Know

Depth to Water 200 ft ☐ Don't Know

Pump Depth 150 ☐ Don't Know

Pump Type submersible ☐ Don't Know

Water Source: ☒ Bedrock ☐ Sand/Gravel/Overburden ☐ Don't Know

Name of Well Driller Terry Marquardt ☐ Don't Know

Date Installed 1997 ☐ Don't Know

I have the MOE Water Well Record ☐ Yes ☒ No ☐ Don't Know

MOE Water Well Record Number ____ ☐ Don't Know

Type of Water Use: ☒ Domestic ☐ Farm ☐ Irrigation ☐ Industrial ☐ Other ____

Water Treatment: ☐ Softener ☐ Sand Filter ☐ Carbon Filter ☐ Fiber Filter ☐ Aluminum Oxide

☐ UV ☐ Reverse Osmosis ☐ Distillation ☐ Ion Exchange ☐ Ozonation

Other Water Treatment ____ ☐ Don't Know

Water Well Inventory – Page 2

33886-100

Condition of Well Casing ☒ Good ☐ Buried ☐ Corroded ☐ Seized ☐ Broken ☐ Don't Know

Other ______________________

Any problems with water quantity in the past? ☐ Yes ☒ No

Any problems with water quality in the past? ☐ Yes ☒ No

If yes, what type ? ☐ Sulphur smell ☐ Iron taste ☐ Brown water ☐ Bacteria

Other ______________________

Location of Septic Bed north side of house

Potential Sources of Contamination: ☐ barn ☐ manure pile ☐ gas tanks ☐ heating oil tank

Other ______________________

Is the well easily accessible? ☒ Yes ☐ No

If Yes, may we measure the water level in this well? ☒ Yes ☐ No

Describe Well Location south side of house

Sketch a diagram to show the location of well(s), house, buildings, road(s), and septic bed:

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www.wellaware.ca

Water Well Inventory – Page 1

33886-100

Resident Name PW3

911 Number ______ Road ______

Address ______

______

Phone Number ______ email ______

Property Owner: ☒ Yes ☐ No If No, Property Owner's Name ______

Previous Property Owners ______

Number of Wells on property 3 ☐ Don't Know

Type of Well: ☒ Drilled ☐ Dug ☐ Sand Point ☐ Other and dug ☐ Don't Know

Diameter of Well: ☐ 2 inches ☐ 4 inches ☒ 6 inches ☐ 8 inches ☐ 3 feet ☐ Don't Know

Depth of Well 182 ft ☐ Don't Know

Depth to Water ______ ☐ Don't Know

Pump Depth ______ ☒ Don't Know

Pump Type ______ ☒ Don't Know

Water Source: ☒ Bedrock ☐ Sand/Gravel/Overburden ☐ Don't Know

Name of Well Driller Marquardt Well Drilling ☐ Don't Know

Date Installed 1991 ☐ Don't Know

I have the MOE Water Well Record ☐ Yes ☐ No ☒ Don't Know

MOE Water Well Record Number ______ ☒ Don't Know

Type of Water Use: ☒ Domestic ☐ Farm ☐ Irrigation ☐ Industrial ☐ Other ______

Water Treatment: ☐ Softener ☐ Sand Filter ☐ Carbon Filter ☐ Fiber Filter ☐ Aluminum Oxide

☐ UV ☐ Reverse Osmosis ☐ Distillation ☐ Ion Exchange ☐ Ozonation

Other Water Treatment ______ ☒ Don't Know

Water Well Inventory – Page 2

33886-100

Condition of Well Casing ☒Good ☐Buried ☐Corroded ☐Seized ☐Broken ☐Don't Know

Other ______

Any problems with water quantity in the past? ☒Yes ☐No

Any problems with water quality in the past? ☒ Yes ☐No

If yes, what type ? ☐ Sulphur smell ☐ Iron taste ☐ Brown water ☒ Bacteria

Other from road (oil)

Location of Septic Bed side of house at front on East side

Potential Sources of Contamination: ☐ barn ☐ manure pile ☐ gas tanks ☐ heating oil tank

Other ______

Is the well easily accessible? ☒ Yes ☐ No

If Yes, may we measure the water level in this well? ☒ Yes ☐ No

Describe Well Location well is at the back west side of house

Sketch a diagram to show the location of well(s), house, buildings, road(s), and septic bed:

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Water Well Inventory – Page 1

33886-100

Resident Name PW4

911 Number ______ Road ______

Address ______

Phone Number ______ email ______

Property Owner: ☒ Yes ☐ No If No, Property Owner's Name ______

Previous Property Owners ______

Number of Wells on property 1 ☐ Don't Know

Type of Well: ☐ Drilled ☐ Dug ☒ Sand Point ☐ Other dug wellpit ☐ Don't Know

Diameter of Well: ☐ 2 inches ☐ 4 inches ☐ 6 inches ☐ 8 inches ☒ 3 feet ☐ Don't Know

Depth of Well 15 ft ☐ Don't Know

Depth to Water 6 ft ☐ Don't Know

Pump Depth 15 ☐ Don't Know

Pump Type ______ ☐ Don't Know

Water Source: ☐ Bedrock ☒ Sand/Gravel/Overburden ☐ Don't Know

Name of Well Driller Charly Hannah (deceased) ☐ Don't Know

Date Installed ~May 1975 ☐ Don't Know

I have the MOE Water Well Record ☐ Yes ☒ No ☐ Don't Know

MOE Water Well Record Number ______ ☐ Don't Know

Type of Water Use: ☒ Domestic ☐ Farm ☐ Irrigation ☐ Industrial ☒ Other no drinking

Water Treatment: ☐ Softener ☐ Sand Filter ☐ Carbon Filter ☐ Fiber Filter ☐ Aluminum Oxide

☐ UV ☐ Reverse Osmosis ☐ Distillation ☐ Ion Exchange ☐ Ozonation

Other Water Treatment treated yearly with chlorine ☐ Don't Know

Water Well Inventory – Page 2

33886-100

Condition of Well Casing ☐ Good ☒ Buried ☐ Corroded ☐ Seized ☐ Broken ☐ Don't Know

Other 1/4 above ground tile

Any problems with water quantity in the past? ☐ Yes ☒ No

Any problems with water quality in the past? ☐ Yes ☒ No

If yes, what type ? ☐ Sulphur smell ☐ Iron taste ☐ Brown water ☒ Bacteria

Other vegitation Tree roots?

Location of Septic Bed 10 feet behind house on the right side

Potential Sources of Contamination: ☐ barn ☐ manure pile ☐ gas tanks ☐ heating oil tank

Other put in legally (Hawley)

Is the well easily accessible? ☒ Yes ☐ No

If Yes, may we measure the water level in this well? ☒ Yes ☐ No

Describe Well Location left hand of cottage in line of pump about 30 feet from house.

Sketch a diagram to show the location of well(s), house, buildings, road(s), and septic bed:

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Water Well Inventory – Page 1

33886-100

Resident Name PW5

911 Number ______________ Road ______________

Address ______________

____

Phone Number ______________ email ______________

Property Owner: ☒ Yes ☐ No If No, Property Owner's Name ______________

Previous Property Owners ______________

Number of Wells on property 1 ☐ Don't Know

Type of Well: ☒ Drilled ☐ Dug ☐ Sand Point ☐ Other ______________ ☐ Don't Know

Diameter of Well: ☐ 2 inches ☐ 4 inches ☒ 6 inches ☐ 8 inches ☐ 3 feet ☐ Don't Know

Depth of Well ______________ ☒ Don't Know

Depth to Water ______________ ☒ Don't Know

Pump Depth ______________ ☒ Don't Know

Pump Type ______________ ☒ Don't Know

Water Source: ☐ Bedrock ☒ Sand/Gravel/Overburden ☐ Don't Know

Name of Well Driller Terry Marquardt ☐ Don't Know

Date Installed 2001? ☐ Don't Know

I have the MOE Water Well Record ☐ Yes ☒ No ☐ Don't Know

MOE Water Well Record Number ______________ ☒ Don't Know

Type of Water Use: ☒ Domestic ☐ Farm ☐ Irrigation ☐ Industrial ☐ Other ______________

Water Treatment: ☐ Softener ☒ Sand Filter ☐ Carbon Filter ☐ Fiber Filter ☐ Aluminum Oxide

☐ UV ☐ Reverse Osmosis ☐ Distillation ☐ Ion Exchange ☐ Ozonation

Other Water Treatment ______________ ☐ Don't Know

Water Well Inventory – Page 2

33886-100

Condition of Well Casing ☒ Good ☐ Buried ☐ Corroded ☐ Seized ☐ Broken ☐ Don't Know

Other ____________________

Any problems with water quantity in the past? ☐ Yes ☒ No

Any problems with water quality in the past? ☐ Yes ☒ No

If yes, what type ? ☐ Sulphur smell ☐ Iron taste ☐ Brown water ☐ Bacteria

Other ____________________

Location of Septic Bed ____________________

Potential Sources of Contamination: ☐ barn ☐ manure pile ☐ gas tanks ☐ heating oil tank

Other ____________________

Is the well easily accessible? ☒ Yes ☐ No

If Yes, may we measure the water level in this well? ☒ Yes ☐ No

Describe Well Location Lower driveway next to lawn

Sketch a diagram to show the location of well(s), house, buildings, road(s), and septic bed:

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Water Well Inventory – Page 1

33886-100

Resident Name PW6

911 Number ______ Road ______

Address ______

______

Phone Number ______ email ______

Property Owner: ☒ Yes ☐ No If No, Property Owner's Name ______

Previous Property Owners ______

Number of Wells on property 1 ☐ Don't Know

Type of Well: ☒ Drilled ☐ Dug ☐ Sand Point ☐ Other ______ ☐ Don't Know

Diameter of Well: ☐ 2 inches ☐ 4 inches ☐ 6 inches ☒ 8 inches ☐ 3 feet ☐ Don't Know

Depth of Well ______ ☒ Don't Know

Depth to Water ______ ☒ Don't Know

Pump Depth ______ ☒ Don't Know

Pump Type ______ ☒ Don't Know

Water Source: ☐ Bedrock ☒ Sand/Gravel/Overburden ☐ Don't Know

Name of Well Driller ______ ☒ Don't Know

Date Installed ______ ☒ Don't Know

I have the MOE Water Well Record ☐ Yes ☒ No ☐ Don't Know

MOE Water Well Record Number ______ ☐ Don't Know

Type of Water Use: ☒ Domestic ☐ Farm ☐ Irrigation ☐ Industrial ☐ Other ______

Water Treatment: ☐ Softener ☐ Sand Filter ☐ Carbon Filter ☐ Fiber Filter ☐ Aluminum Oxide

☐ UV ☐ Reverse Osmosis ☐ Distillation ☐ Ion Exchange ☐ Ozonation

Other Water Treatment Sand Filter ☐ Don't Know

Water Well Inventory – Page 2

33886-100

Condition of Well Casing ☒ Good ☐ Buried ☐ Corroded ☐ Seized ☐ Broken ☐ Don't Know

Other ______________________________

Any problems with water quantity in the past? ☐ Yes ☒ No

Any problems with water quality in the past? ☐ Yes ☒ No

If yes, what type ? ☐ Sulphur smell ☐ Iron taste ☐ Brown water ☐ Bacteria

Other ______________________________

Location of Septic Bed ______________________________

Potential Sources of Contamination: ☐ barn ☐ manure pile ☐ gas tanks ☐ heating oil tank

Other ______________________________

Is the well easily accessible? ☒ Yes ☐ No

If Yes, may we measure the water level in this well? ☒ Yes ☐ No

Describe Well Location Behind house, next to pool house

Sketch a diagram to show the location of well(s), house, buildings, road(s), and septic bed:

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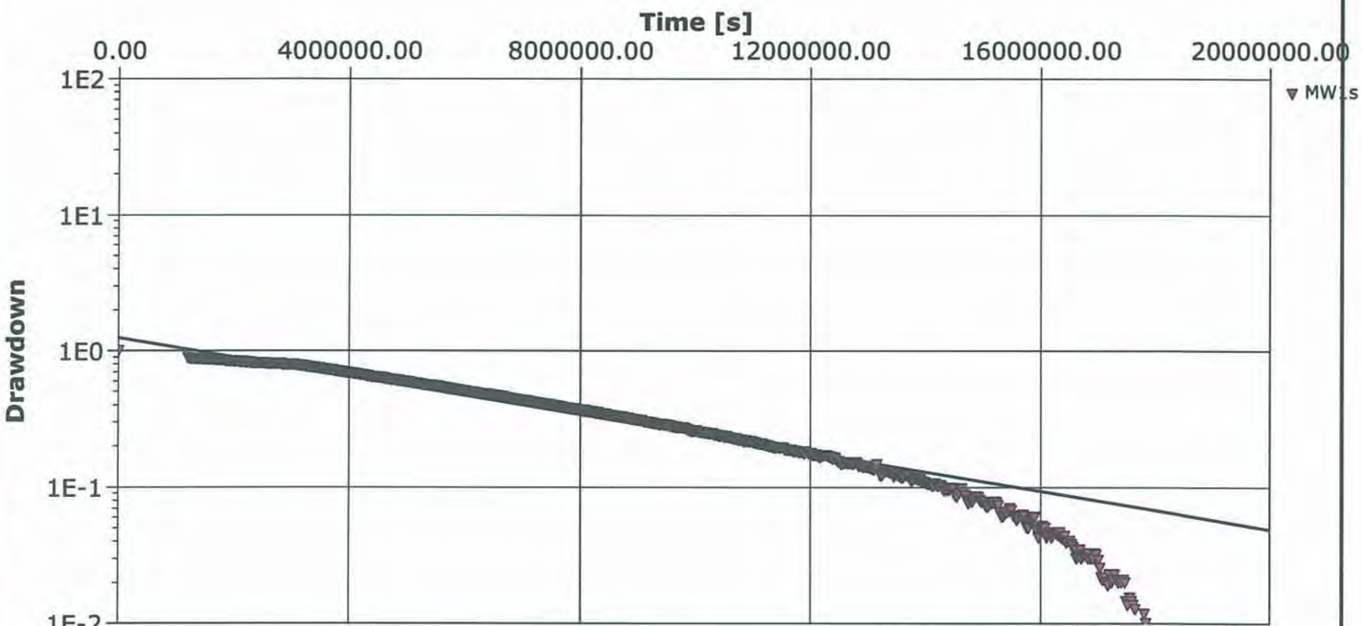
APPENDIX D

AQUIFER TEST DATA SHEETS

MTE Consultants Inc. 520 Bingemans Centre Dr. Kitchener, ON N2B 3X9	**Slug Test Analysis Report** Project: Freymond Quarry Number: 33886-100 Client: Freymond Quarry

Location: Lot 51&52, Con.WHR, Twn.Faraday	Slug Test: MW1s	Test Well: MW1s
Test Conducted by:		Test Date: 2/2/2010
Analysis Performed by:	Hvorslev	Analysis Date: 2/2/2010
Aquifer Thickness: 11.03 m		



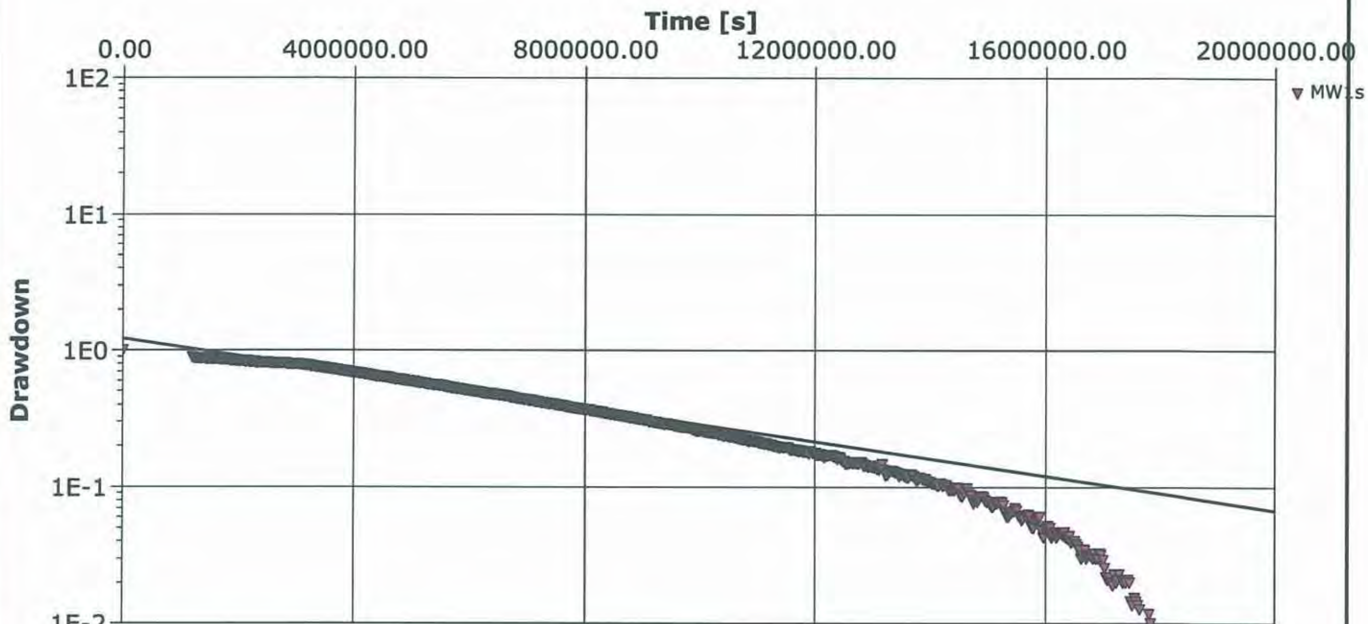
Calculation using Hvorslev

Observation Well	Hydraulic Conductivity [m/s]
MW1s	7.19×10^{-11}

MTE Consultants Inc.
520 Bingemans Centre Dr.
Kitchener, ON N2B 3X9

Slug Test Analysis Report	
Project: Freymond Quarry	
Number: 33886-100	
Client: Freymond Quarry	

Location: Lot 51&52, Con.WHR, Twn.Faraday	Slug Test: MW1s	Test Well: MW1s
Test Conducted by:		Test Date: 2/2/2010
Analysis Performed by:	Bouwer & Rice	Analysis Date: 2/2/2010
Aquifer Thickness: 11.03 m		

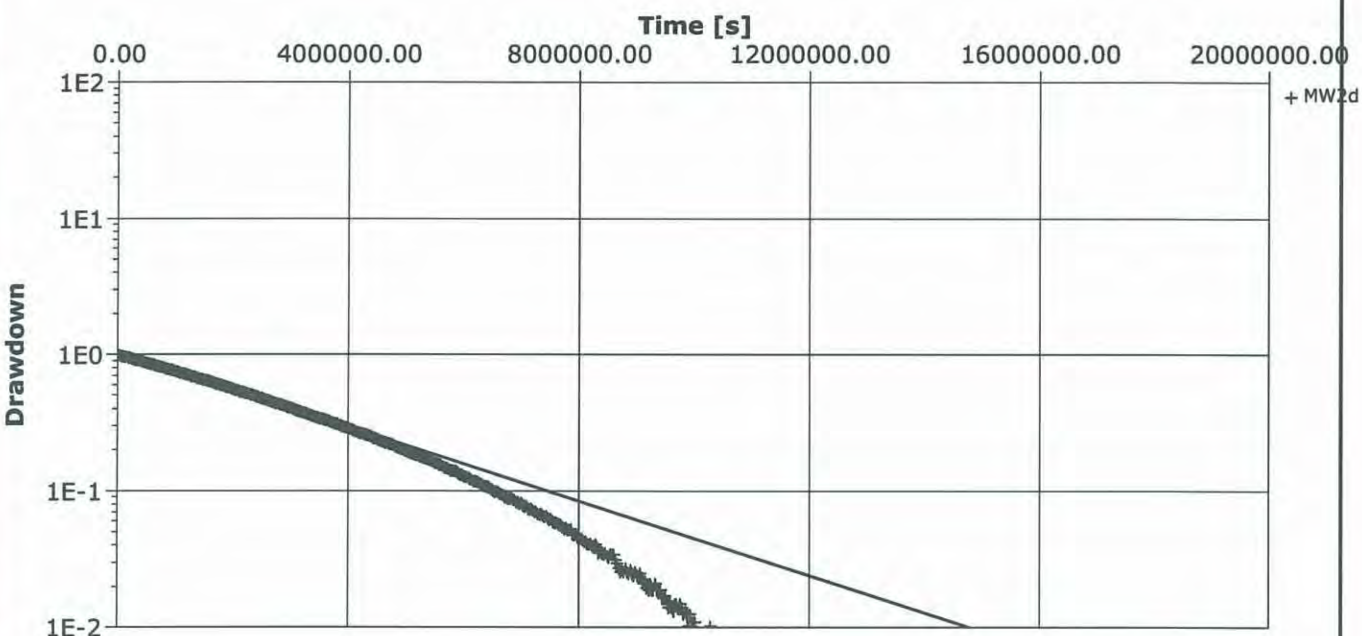


Calculation using Bouwer & Rice

Observation Well	Hydraulic Conductivity [m/s]	
MW1s	4.90×10^{-11}	

MTE Consultants Inc. 520 Bingemans Centre Dr. Kitchener, ON N2B 3X9	**Slug Test Analysis Report**
	Project: Freymond Quarry
	Number: 33886-100
	Client: Freymond Quarry

Location: Lot 51&52, Con.WHR, Twn.Faraday	Slug Test: MW2d Recovery	Test Well: MW2d
Test Conducted by: MDE		Test Date: 2/2/2010
Analysis Performed by:	Bouwer & Rice	Analysis Date: 2/2/2010
Aquifer Thickness: 19.28 m		



Calculation using Bouwer & Rice		
Observation Well	Hydraulic Conductivity [m/s]	
MW2d	5.04×10^{-11}	

MTE Consultants Inc.
520 Bingemans Centre Dr.
Kitchener, ON N2B 3X9

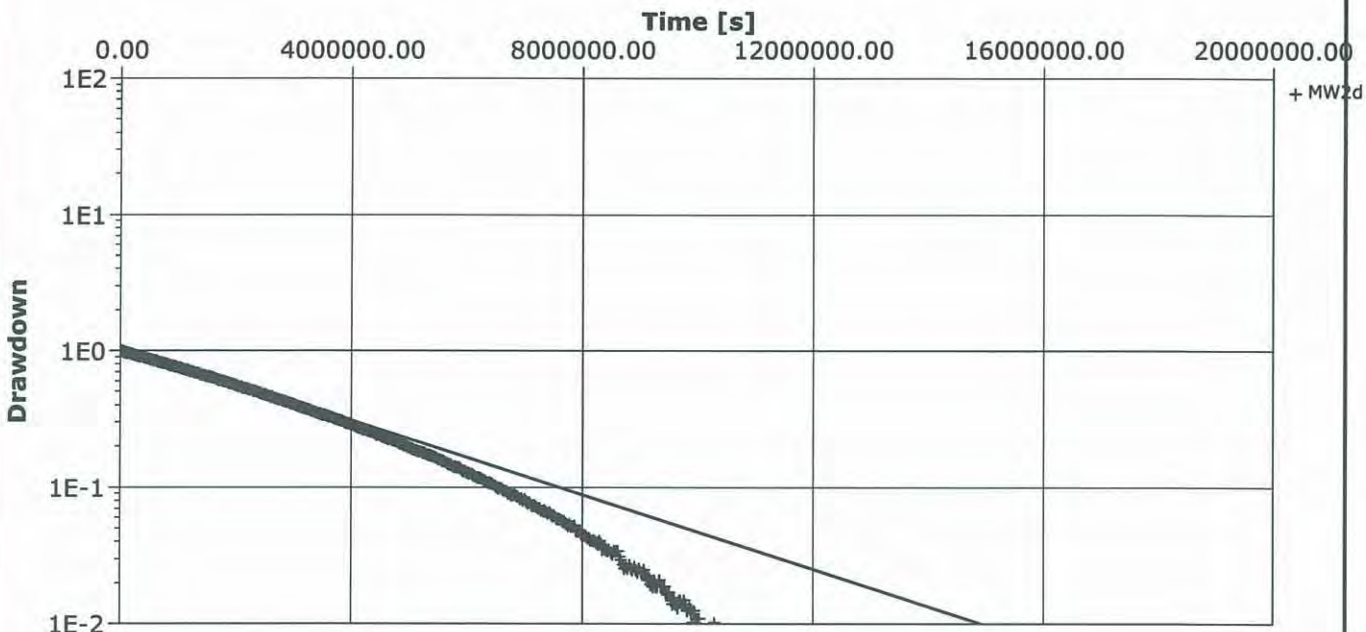
Slug Test Analysis Report

Project: Freymond Quarry

Number: 33886-100

Client: Freymond Quarry

Location: Lot 51&52, Con.WHR, Twn.Faraday	Slug Test: MW2d Recovery	Test Well: MW2d
Test Conducted by: MDE		Test Date: 2/2/2010
Analysis Performed by:	Hvorslev	Analysis Date: 5/26/2010
Aquifer Thickness: 19.28 m		



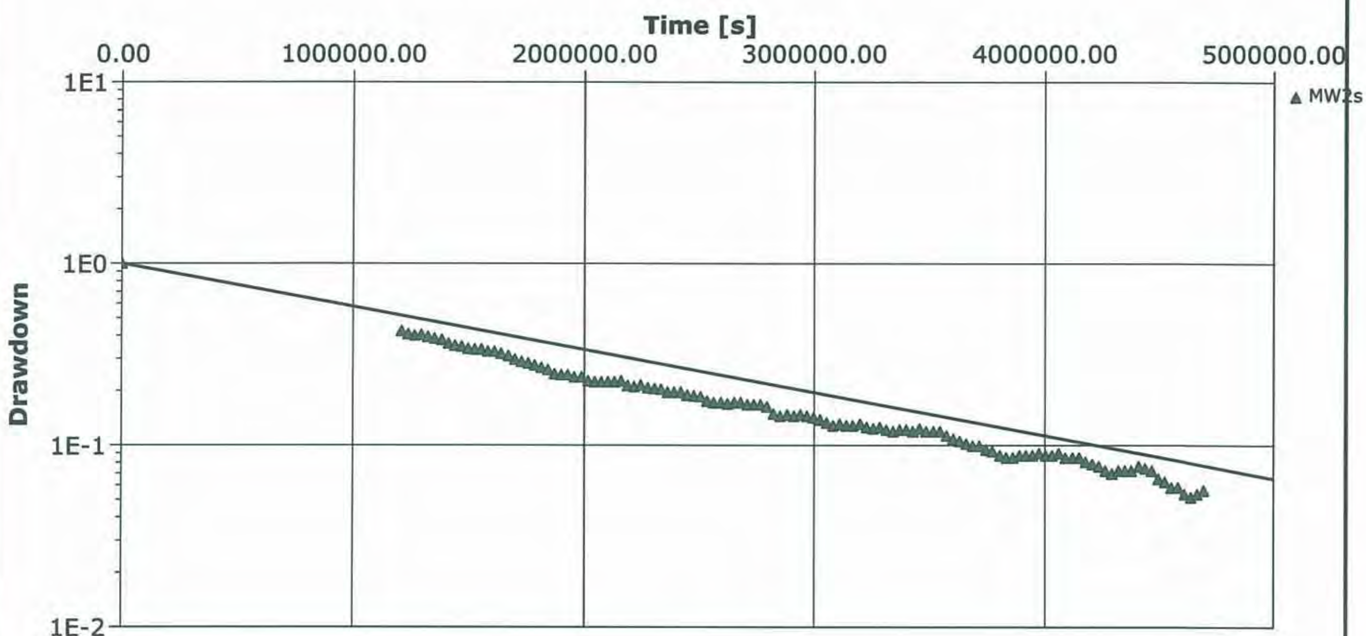
Calculation using Hvorslev

Observation Well	Hydraulic Conductivity [m/s]	
MW2d	6.53×10^{-11}	

MTE Consultants Inc.
520 Bingemans Centre Dr.
Kitchener, ON N2B 3X9

Slug Test Analysis Report
Project: Freymond Quarry
Number: 33886-100
Client: Freymond Quarry

Location: Lot 51&52, Con.WHR, Twn.Faraday	Slug Test: MW2s (long)	Test Well: MW2s
Test Conducted by:		Test Date: 2/4/2010
Analysis Performed by:	Hvorslev	Analysis Date: 2/4/2010
Aquifer Thickness: 5.07 m		



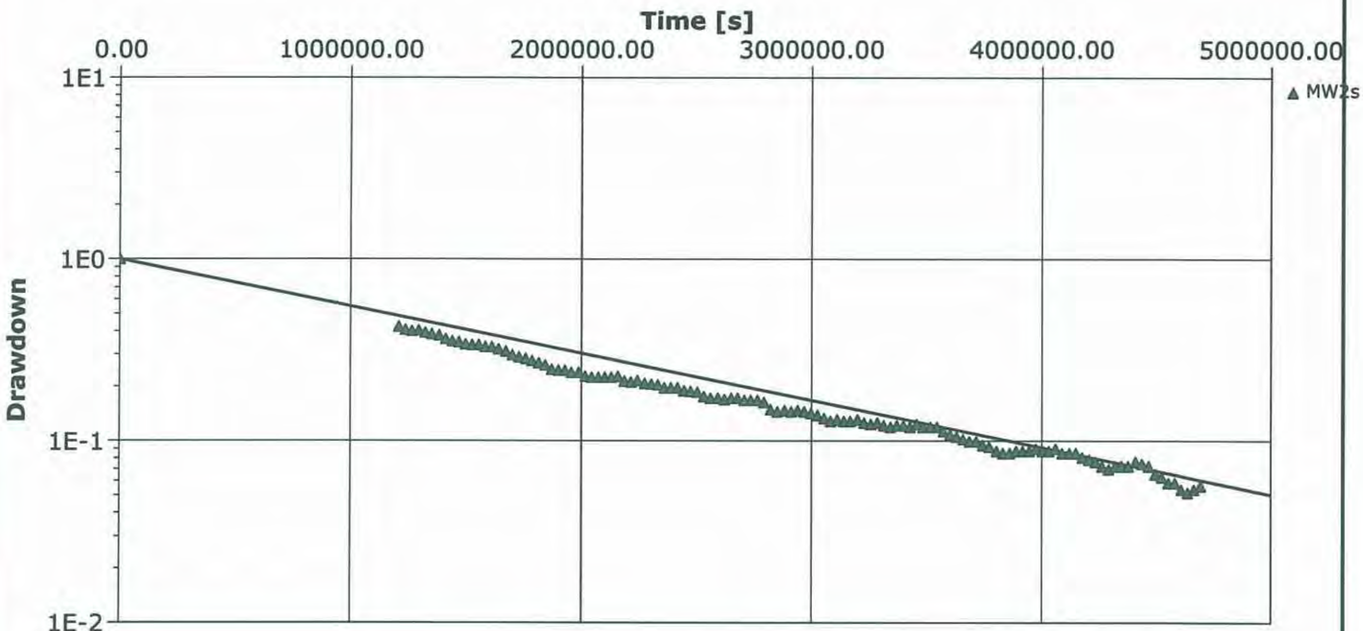
Calculation using Hvorslev

Observation Well	Hydraulic Conductivity [m/s]	
MW2s	2.56×10^{-10}	

MTE Consultants Inc.
520 Bingemans Centre Dr.
Kitchener, ON N2B 3X9

Slug Test Analysis Report	
Project: Freymond Quarry	
Number: 33886-100	
Client: Freymond Quarry	

Location: Lot 51&52, Con.WHR, Twn.Faraday	Slug Test: MW2s (long)	Test Well: MW2s
Test Conducted by:		Test Date: 2/4/2010
Analysis Performed by:	Bouwer & Rice	Analysis Date: 2/4/2010
Aquifer Thickness: 5.07 m		

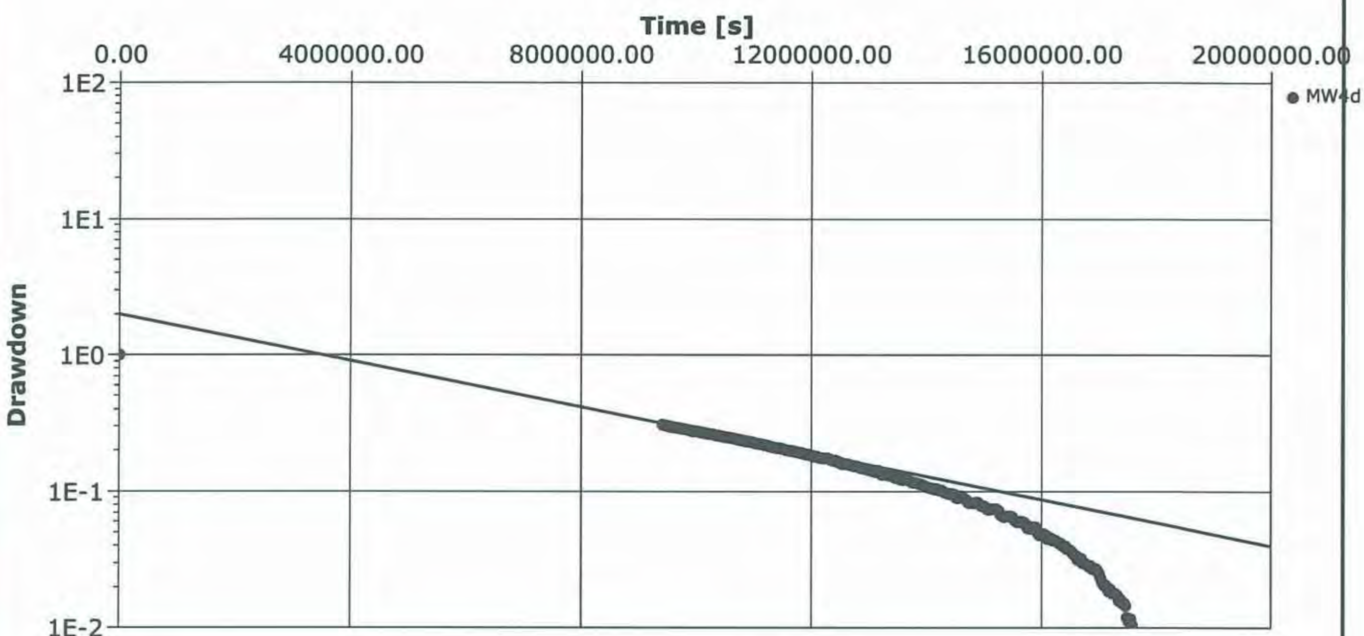


Calculation using Bouwer & Rice

Observation Well	Hydraulic Conductivity [m/s]
MW2s	2.13×10^{-10}

MTE Consultants Inc. 520 Bingemans Centre Dr. Kitchener, ON N2B 3X9	**Slug Test Analysis Report**
	Project: Freymond Quarry
	Number: 33886-100
	Client: Freymond Quarry

Location: Lot 51&52, Con.WHR, Twn.Faraday	Slug Test: MW4d Recovery	Test Well: MW4d
Test Conducted by:		Test Date: 2/2/2010
Analysis Performed by:	Hvorslev	Analysis Date: 2/2/2010
Aquifer Thickness: 30.38 m		

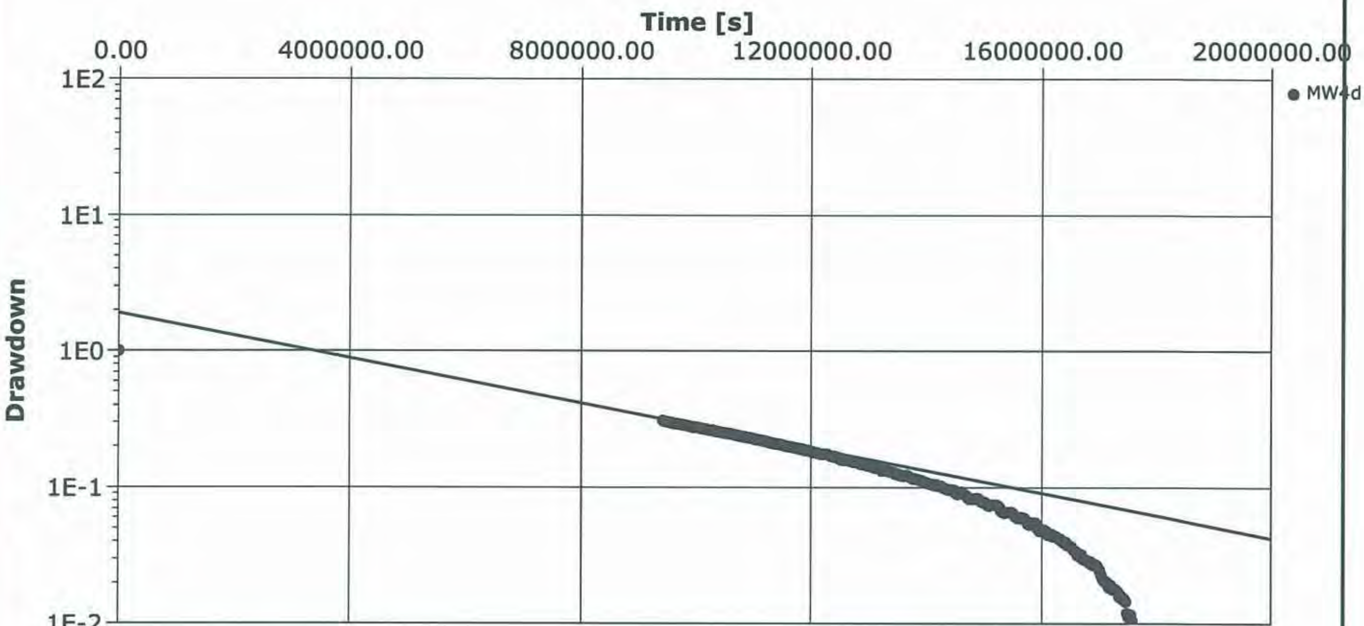


Calculation using Hvorslev

Observation Well	Hydraulic Conductivity [m/s]	
MW4d	8.91×10^{-11}	

MTE Consultants Inc.
520 Bingemans Centre Dr.
Kitchener, ON N2B 3X9

Slug Test Analysis Report		
Project: Freymond Quarry		
Number: 33886-100		
Client: Freymond Quarry		
Location: Lot 51&52, Con.WHR, Twn.Faraday	Slug Test: MW4d Recovery	Test Well: MW4d
Test Conducted by:		Test Date: 2/2/2010
Analysis Performed by:	Bouwer & Rice	Analysis Date: 2/2/2010
Aquifer Thickness: 30.38 m		



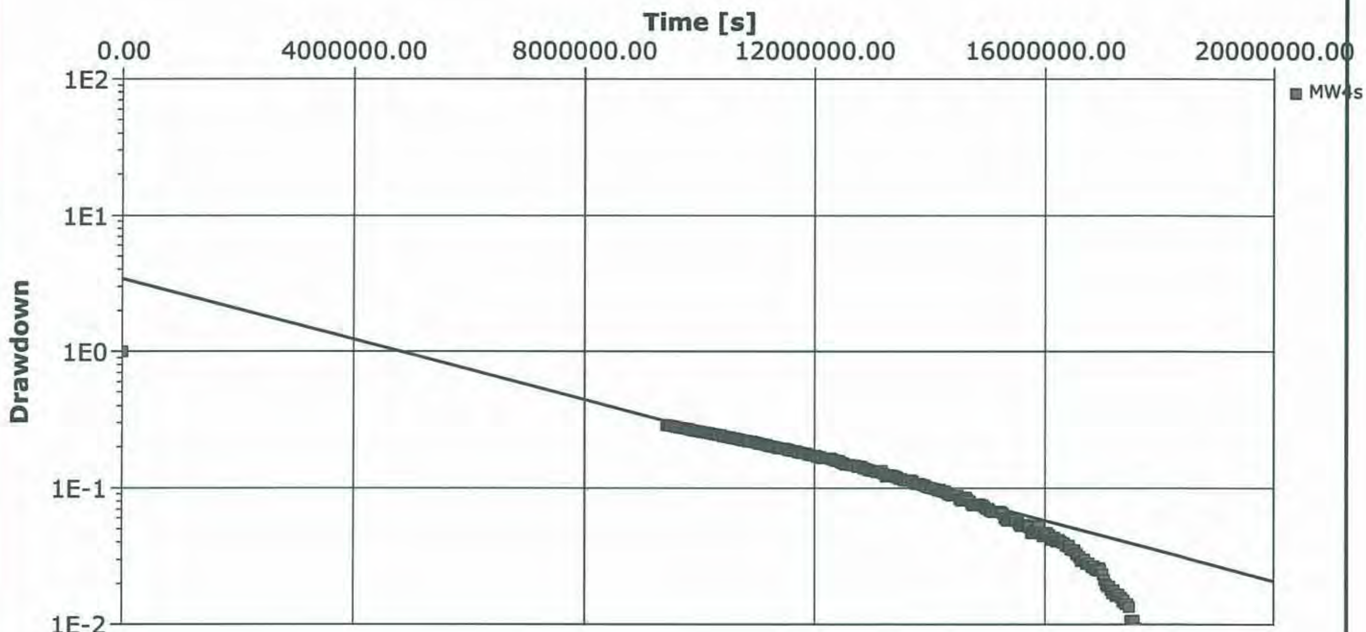
Calculation using Bouwer & Rice

Observation Well	Hydraulic Conductivity [m/s]
MW4d	6.61×10^{-11}

MTE Consultants Inc.
520 Bingemans Centre Dr.
Kitchener, ON N2B 3X9

Slug Test Analysis Report	
Project: Freymond Quarry	
Number: 33886-100	
Client: Freymond Quarry	

Location: Lot 51&52, Con.WHR, Twn.Faraday	Slug Test: MW4s	Test Well: MW4s
Test Conducted by:		Test Date: 2/2/2010
Analysis Performed by:	Hvorslev	Analysis Date: 2/2/2010
Aquifer Thickness: 25.39 m		

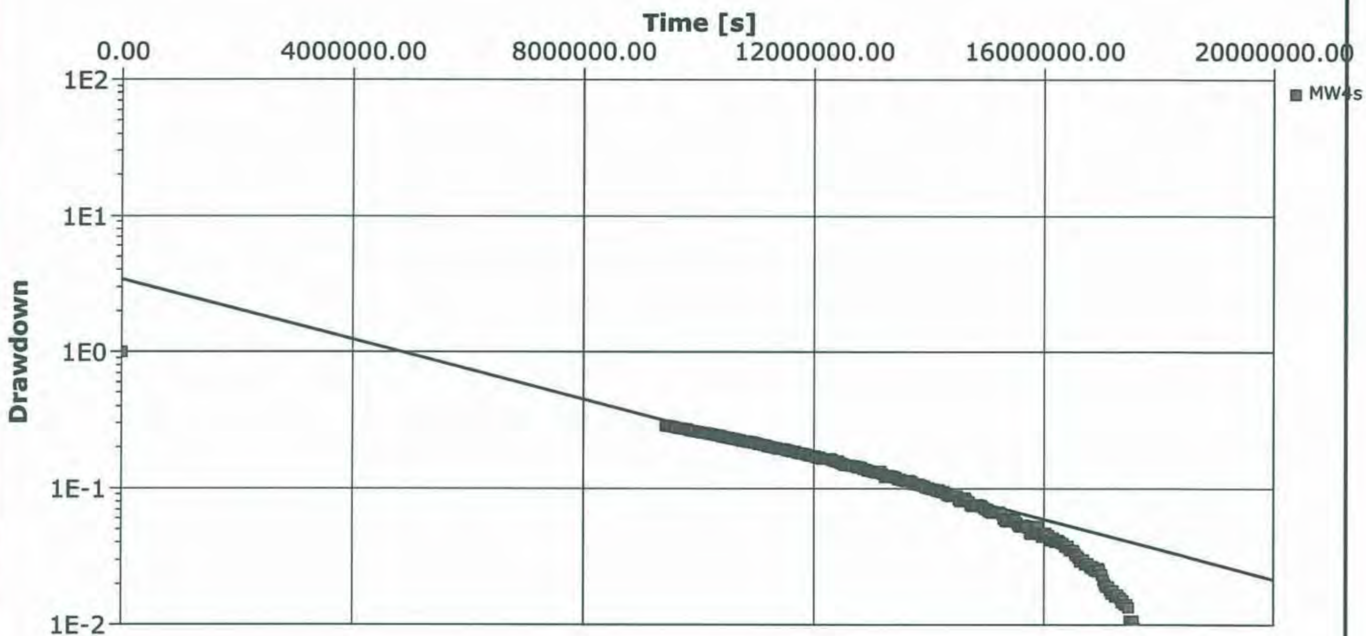


Calculation using Hvorslev

Observation Well	Hydraulic Conductivity [m/s]	
MW4s	1.06×10^{-10}	

MTE Consultants Inc. 520 Bingemans Centre Dr. Kitchener, ON N2B 3X9	**Slug Test Analysis Report**
	Project: Freymond Quarry
	Number: 33886-100
	Client: Freymond Quarry

Location: Lot 51&52, Con.WHR, Twn.Faraday	Slug Test: MW4s	Test Well: MW4s
Test Conducted by:		Test Date: 2/2/2010
Analysis Performed by:	Bouwer & Rice	Analysis Date: 2/2/2010
Aquifer Thickness: 25.39 m		



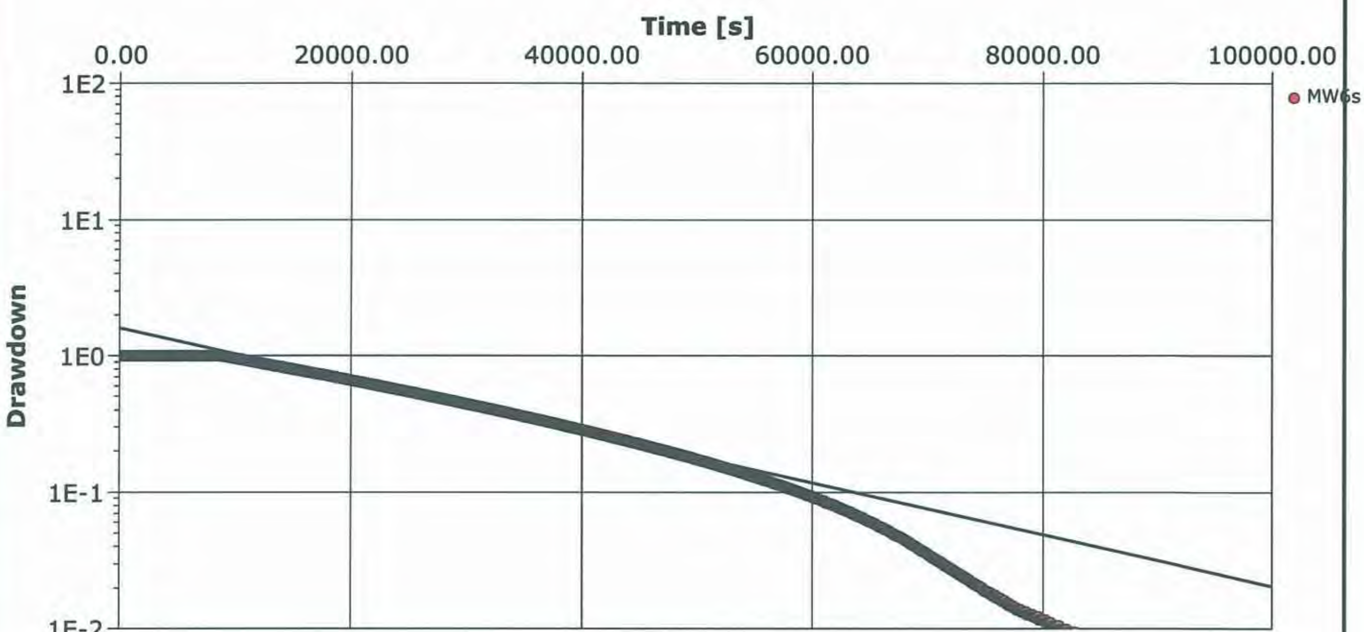
Calculation using Bouwer & Rice

Observation Well	Hydraulic Conductivity [m/s]
MW4s	8.02×10^{-11}

MTE Consultants Inc.
520 Bingemans Centre Dr.
Kitchener, ON N2B 3X9

Slug Test Analysis Report
Project: Freymond Quarry
Number: 33886-100
Client: Freymond Quarry

Location: Lot 51&52, Con.WHR, Twn.Faraday	Slug Test: MW6s Rcvry	Test Well: MW6s
Test Conducted by: ME/BC		Test Date: 6/3/2009
Analysis Performed by:	Hvorslev	Analysis Date: 6/3/2009
Aquifer Thickness: 26.25 m		



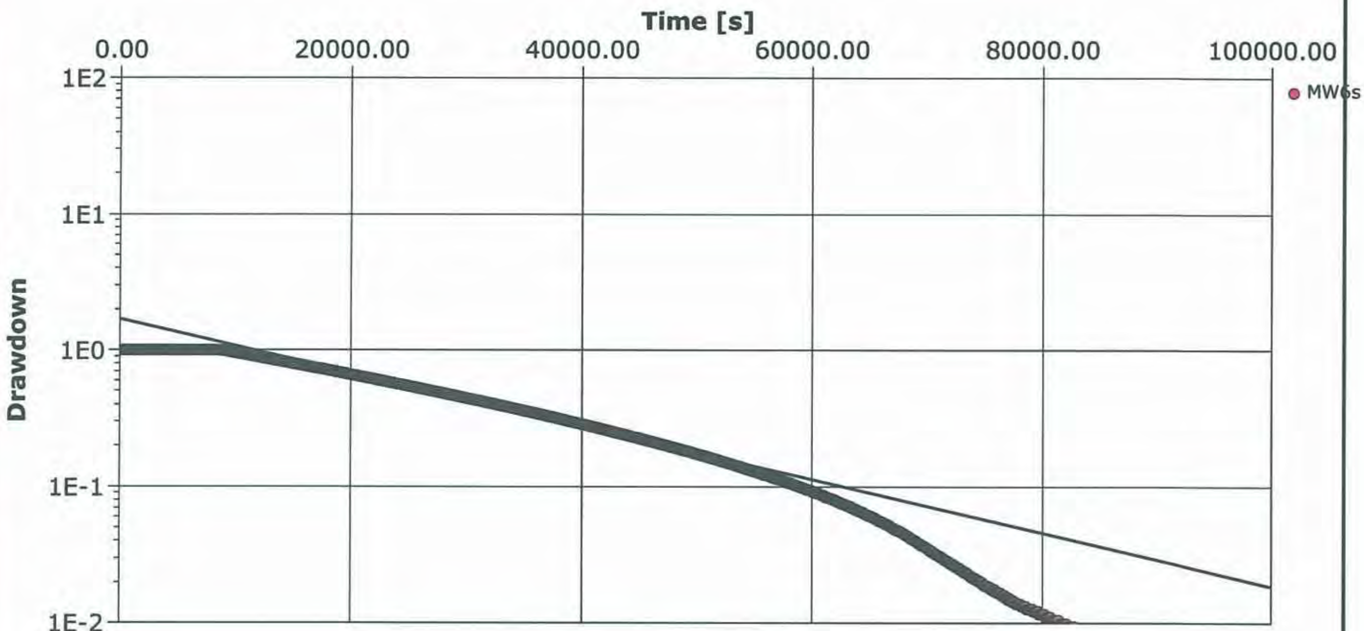
Calculation using Hvorslev

Observation Well	Hydraulic Conductivity [m/s]	
MW6s	1.21×10^{-8}	

MTE Consultants Inc.
520 Bingemans Centre Dr.
Kitchener, ON N2B 3X9

Slug Test Analysis Report	
Project: Freymond Quarry	
Number: 33886-100	
Client: Freymond Quarry	

Location: Lot 51&52, Con.WHR, Twn.Faraday	Slug Test: MW6s Rcvry	Test Well: MW6s
Test Conducted by: ME/BC		Test Date: 6/3/2009
Analysis Performed by:	Bouwer & Rice	Analysis Date: 2/2/2010
Aquifer Thickness: 26.25 m		



Calculation using Bouwer & Rice

Observation Well	Hydraulic Conductivity [m/s]	
MW6s	9.64×10^{-9}	

MTE
More Than Engineering
25 YEARS 1985-2010

APPENDIX E

THEIS CALCULATIONS

Table E1: Theis Calculations - Freymond Proposed Quarry

Aquifer parameters and Pumping Rate

K	1.14E-10	m/s
S	0.00005	
b	43.2	m
Q	3.47E-07	m^3/sec
Q	0.03	m^3/day
T	4.26E-04	m^3/day

Values of u (r,t)						
t (days)	r(m)--->	**1**	**10**	**50**	**100**	**195**
1		0.029377015	2.93770155	73.44253875	293.770	1117.061
5		0.005875403	0.58754031	14.68850775	58.754	223.412
10		0.002937702	0.293770155	7.34425387	29.377	111.706
30		0.000979234	0.097923385	2.44808462	9.792	37.235
40		0.000734425	0.073442539	1.83606347	7.344	27.927
115		0.000255452	0.025545231	0.63863077	2.555	9.714

Values of Well Function W[u(r,t)]						
t (days)	r(m)--->	**1**	**10**	**50**	**100**	**195**
1		2.98	0.01	0.00	0.00	0.00
5		4.57	0.47	0.00	0.00	0.00
10		5.26	0.92	7.85E-05	0.00	0.00
30		6.35	1.84	2.56E-02	5.63E-06	0.00
40		6.64	2.11	1.02E-01	7.67E-05	0.00
115		7.70	3.12	4.21E-01	2.32E-02	5.69E-06

Values for drawdown s(r,t) (m)						
t (days)	r(m)--->	**1**	**10**	**50**	**100**	**195**
1		16.73	0.08	0.00	0.00	0.00
5		25.63	2.62	0.00	0.00	0.00
10		29.50	5.17	0.0004	0.00	0.00
30		35.66	10.34	0.14	3.16E-05	0.00
40		37.27	11.82	0.57	4.30E-04	0.00
115		43.20	17.49	2.36	1.30E-01	3.19E-05

Appendix C
Traffic Impact Study
Tranplan Associates

Freymond Aggregates Quarry
Bay Lake Rd., Twp. of Faraday

Traffic Impact Study

Prepared by:
Tranplan Associates
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Lakefield, ON
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Prepared for:
EcoVue Consulting Services

May 2012

May 22, 2012

Heather Sadler, B.A., M.A., MCIP, RPP
Principal and Senior Planner
EcoVue Consulting Services Inc.
25 Reid Street
Lakefield, ON K0L 2H0

Dear Ms. Sadler:

RE: Traffic Impact Study for the Proposed Freymond Aggregates Quarry Located on Bay Lake Road on part of Lots 51 and 52, Concession W.H.R. in the Township of Faraday County of Hastings, Ontario

Tranplan Associates is pleased to present the results of the traffic study carried out in support of the proposed Freymond Aggregates Quarry to be located west of the Highway 62 (Mill Street) and Bay Lake Road intersection in the Township of Faraday, County of Hastings, Ontario.

The future traffic volumes expected to be generated by the proposed development of the Freymond Aggregates Quarry can be accommodated with the implementation of the proposed mitigation measures detailed in this report. These mitigation measures will accommodate new site traffic and will maintain the existing acceptable traffic conditions in the Highway 62 and Bay Lake Road corridors.

Additional background information on the traffic analyses is available in the study working papers. Tranplan Associates is pleased to have the opportunity to work with the EcoVue Consulting Services study team in completing this study for the Freymond Aggregates Quarry.

Yours truly,

William Copeland, P.Eng.
Principal
Tranplan Associates

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LIST OF TABLES

1. INTRODUCTION

1.1 Background

Tranplan Associates is pleased to present the results of this traffic impact study carried out in support of development of the proposed *Freymond Aggregates Quarry*. This report has been prepared as part of the documentation for the planning approval process for the proposed site. It is our understanding that the approving agency is the Town of Bancroft, the Township of Faraday and the County of Hastings.

The quarry will be located in part of Lots 51 and 52, Concession W.H.R. in the Township of Faraday, County of Hastings. The study site is located just south of the Town of Bancroft on Bay Lake Road, west of Highway 62 as illustrated in *Exhibit 1 – Study Area* and *Exhibit 2 – Site Context*.

Two site visits were carried out by members of the project team to examine the study site, assess current traffic operations, collect data and evaluate intersection sight lines. The information gathered during these visits provided input to the traffic analyses. These analyses assessed the impacts of new traffic generated by the proposed quarry operation.

1.2 Principal Findings

The principal findings derived from the study analyses include the following:

- There will be no operational issues at the study intersections. All intersection turning movements are forecast to operate at acceptable levels of service (LoS) with good volume to capacity (v/c) ratios during all site development scenarios.
- It has been assumed that the proposed quarry development could occur in three scenarios. Scenarios 1 and 2 are based on a 2018 planning horizon. Scenario 1 will have a maximum production of 400,000 tonnes per year and generate 27 two-way trips during the peak hour period. Scenario 2 will have a maximum production of 1 million tonnes per year and generate 75 two-way trips during 2018 peak hour periods. Scenario 3 assumed large scale quarry operations would not occur until 2022. Scenario 3 assumed 1 million tonnes of production also generating 75 two-way trips during the peak hour.
- Access to the proposed site will be via the existing north entrance to the *Freymond Mill*. The current entrance has the capacity to accommodate future traffic volumes.
- Based on MTO standards, an improved right turn taper (80 m) will be required on Highway 62 to accommodate south bound right turns to Bay Lake Road.
- The Left Turn Lane Warrant Analyses determined that a warrant for a north bound left turn lane is met once quarry production exceeds 400,000 tonnes per year.
- Available sight distance for the site entrance and the Bay Lake/Highway 62 intersection meets current standards for acceptable stopping sight distance.

The following sections of this report provide details of the traffic analyses used to develop the conclusions and study recommendations as summarized above.

2. EXISTING CONDITIONS

This chapter describes the roadway network, traffic volumes, operational analysis results and other notable characteristics under the baseline conditions.

2.1 The Study Area

The study/site area is located in the Township of Faraday just south of the Town of Bancroft, Ontario. The surrounding area supports some limited agricultural uses but is primarily comprised of small lakes, woodlots and recreational properties (see *Exhibit 1 – Study Area*). The immediate area around the study site, along the Bay Lake Road corridor is primarily wooded but also includes rural residential land uses (see *Exhibit 2 – Site Context*). The *Freymond Lumber Ltd.* lumber mill is located along the south boundary of the proposed quarry. The mill includes both sawing and planning operations. The main entrance to the mill is about 180 m south of the existing entrance to the study site. It will be noted that there are two rural residences located on Bay Lake Road between the study site entrance and Highway 62.

2.2 The Study Site

The study site is located on part of Lots 51 and 52, Concession W.H.R. in the Township of Faraday. The study site presently has an entrance to Bay Lake Road. This entrance is gated with restricted access. The site contains fuel storage tanks, a bank of solar panels and an industrial type building with a surrounding parking area. This provides storage for other *Freymond* operations and equipment. Remaining portions of the study site are undeveloped and primarily wooded. A more detailed description of the site is available in the related planning documentation that has been prepared in support of the planning process for the proposed new quarry development.

2.3 The Haul Route

2.3.1 Overview

The following proposed haul route will form the primary travel route for trucks travelling to/from the proposed quarry site. Future site traffic will exit/enter the site via an access point located about 175 m south of Highway 62. From here they will travel in a northerly direction along Bay Lake Road to an existing "T"-intersection with Highway 62. At this point they will travel either north or south to connect to the following markets:

- North – towards both the Town of Bancroft to Highway 62 north and the Highway 28 corridor to markets east and west of the town.
- South – serving markets along Highway 62 south towards Madoc and the Highway 7 corridor.

Exhibit 3 – Haul Route illustrates these key study intersections and roadways in the study area. A more detailed description of these roadways and intersections is provided in the following Sections.

2.3.2 *Bay Lake Road*

Within the immediate study area Bay Lake Road is under the joint jurisdiction of the Township of Faraday and the Town of Bancroft. Bay Lake Road is a rural collector road that runs in a loop to the west of the Highway 62 corridor. It provides access to recreational properties and permanent residences west of Highway 62. It rejoins Highway 62 several kilometres to the south at the Village of L'Amable. In the vicinity of the study site it is aligned in a north-south direction. It has a 6.3 m all-weather surface with 1.0 m gravel shoulders. Immediately south of the site entrance it is in a deep fill section. The proposed site entrance will be based on the existing site entrance. This entrance now has an 8.5 m gravel cross-section. This entrance is located approximately 175 m south of the Bay Lake Road/Highway 62 intersection. In reviewing *Exhibit 3* it will be noted that there is a short radius turn located about 140m north of the proposed access location on the approach to Highway 62. This limits the operating speed of traffic between Highway 62 and the present site entrance.

2.3.3 *Highway 62*

Highway 62 is normally under the jurisdiction of the Ministry of Transportation Ontario. However, within the immediate study area it is a "Connecting Link" and is under the jurisdiction of the Town of Bancroft. Highway 62 serves as a major rural arterial road connecting the Town of Bancroft (to the north) to communities to the south and the Highway 7 TransCanada corridor. Further south it connects to Highway 401 and Belleville, the County seat.

In the vicinity of the study site Highway 62 is generally aligned in a north-south direction; however, in the immediate study area, it is aligned in a northwest-southeast direction. It has a two-lane, two-way rural cross-section with a pavement width of 8.4 m including partial paved shoulders and 2.8 m gravel shoulders. There is localized widening at the intersection with Bay Lake Road. The posted speed limit in the vicinity of the study area is 70 km/h. When approaching the study area from the south, the posted speed limit of 80 km/h is reduced to 70 km/h approximately 220 m south of the Bay Lake Road intersection.

2.3.4 *Highway 62 – Bay Lake Road Intersection*

This is the main study intersection of the haul route. The original skewed angle of intersection of Bay Lake Road and Highway 62 has been reconstructed to form a 90 degree intersection. The result is a short radius turn in the Bay Lake Road approach. This tends to reduce the speed of traffic that has exited Highway 62 and is travelling south on Bay Lake Road. Sight distances from Bay Lake Road along the Highway 62 corridor exceed the MTO requirement of 200 m for a design speed of 90 km/h.

The existing lane configuration at this intersection was documented during the field review and is described as follows:

- Northbound Highway 62: one shared through-left turn lane;
- Southbound Highway 62: one shared through-right turn lane;

- Eastbound Bay Lake Road: one shared left-right turn lane with a flared approach at the stop bar.

During the field review the following intersection characteristics were noted:

- A community mail box located in the north side of Bay Lake Road just west of the intersection. The parking area around the mail boxes appears sufficient. As described above, speeds on this section of Bay Lake Road are low.
- Two commercial driveways on the east side of Highway 62 located in close proximity to the intersection including:
    - An access to *Jan Woodlands Inc.* lumber mill to the north
    - A franchise *Rona* store to the south.

2.3.5 The Proposed Site Access

The proposed quarry site access will utilize the existing north access to the *Freymond Mill* as illustrated in *Exhibit 2 – Site Context*. It forms a 3-legged, T-intersection on the west side of Bay Lake Road and is located about 175m to the south of Highway 62. For the purposes of analysis the site entrance was assumed to be aligned in an east-west direction. Based on discussions with the client, this existing access is rarely used by the mill. It is presently gated. Therefore, it was assumed that on a typical day no mill traffic will use this entrance.

A field assessment of operating speeds on Bay Lake Road was carried out during the second site visit. Because of the road geometrics in the southbound direction operating speeds ranged from 30 to 50 km/h depending on the vehicle. Northbound traffic travelled in the range of 50 to 60 km/h. The speed of the northbound traffic was lower because much of it was truck traffic exiting from the south entrance of the mill. There is a right angle bend in Bay Lake Road about 175 m south of the south entrance to the mill. This limits the speed of northbound through traffic.

The sightlines at the proposed access location were reviewed against the standards contained in the *MTO's Geometric Design Standards for Ontario Highways* (GDSOH) manual. The available sightline from the proposed entrance along Bay Lake Road to the north is about 100 m. The preferred MTO distance for a commercial entrance for 50 km/h is 120 m. However, the sight distance exceeds the MTO minimum stopping sight distance of 65 m for 50 km/h. The 100 m sight distance will provide adequate stopping sight distance for speeds approaching 70 km/h. From the site entrance to the south, there is clear sight distance to the south *Freymond Mill* entrance and beyond. The south sight distance exceeds 200 m. Based on operating speeds on Bay Lake Road and the measured sight distances, the available sight distances at the proposed site entrance are acceptable.

2.4 Traffic Data

Bay Lake Road is considered to be a rural collector roadway that provides access to residences and rural homes on the west side of the Highway 62 corridor, south of the Town of Bancroft.

Traffic on the haul route will be comprised of commercial and truck traffic accessing the *Freymond Lumber Inc.* mill and local traffic accessing permanent and recreational residences in the immediate area as well as seasonal cottage traffic during the summer months.

The Ministry of Transportation was able to supply inventory traffic counts for Highway 62 at a count station located 8.6 km north of Hastings Road 620. Daily traffic volume data was extracted from the ministry web site for the section of Highway 62 immediately south of the Bay Lake Road intersection. These data included volumes from 1988 to 2008 inclusive. These data were supplemented with weekday peak period turning movement counts collected by the study team at the Bay Lake Road intersection with Highway 62. These data were collected on Monday March 5th and Tuesday March 6th, 2012 during the weekday, morning and afternoon peak hour periods.

Highway 62 approaching Bancroft has an LT (low tourist) classification. As Bancroft and surrounding area is considered to be a recreational destination with numerous seasonal cottages, a review of the seasonal variation of Highway 62 traffic volumes was carried out based on the MTO daily volume data. It was determined that the seasonal variation of the traffic was significant and a seasonal adjustment factor should be applied to the March, 2012 traffic counts. This factor expanded the lower observed volumes in March to the typical higher summer traffic that occur during July-August. The seasonal adjustment factor was determined to be 1.60 for a 60% increase to be applied to the observed March 2012 traffic.

A summary of the existing traffic applied to our analysis is contained in *Exhibit 4 – Observed and Summer Existing Traffic Volumes*.

2.5 Intersection Capacity Analyses

Intersection capacity analyses were carried out at the Highway 62/Bay Lake Road intersection based on forecast 2012 summer traffic volumes. The analysis procedure followed the methodology contained in the *Transportation Research Board's Highway Capacity Manual* (HCM) 2010 for unsignalized intersections and was carried out using *Trafficware's Synchro 8* software. The following Table summarizes the results of the analyses for both weekday peak hour periods.

Table 1: 2012 Summer Intersection Operational Analysis Results

Highway 62 / Bay Lake Road (unsignalized)				
	AM Peak Hour – Critical Movement		PM Peak Hour – Critical Movement	
	LOS (Delay)	V/C	LOS (Delay)	V/C
2012 Summer	EB Left: **B** (12.7s)	0.10	EB Left: **B** (13.8s)	0.14

As discussed in *Section 2.3.5*, no site traffic is presently using the proposed quarry access on a regular basis. The entrance is gated. Therefore, the intersection capacity analysis was only carried out at the Highway 62 / Bay Lake Road intersection. The operational analyses results under the 2012 summer traffic volume scenario show that all of the movements at the study intersection operate at good levels of service (LoS) and volume-to-capacity (v/c) ratios during AM and PM peak hour periods. There is considerable residual capacity to accommodate future growth in background traffic. A summary of the analysis results is provided in the *Technical Appendix – Existing Traffic Intersection Capacity Analyses*.

3. THE DEVELOPMENT

This chapter describes the existing site, proposed changes to the buildings/operations, and the development of the site generated traffic.

3.1 Overview

The study site is located on part of Lots 51 and 52, Concession W.H.R. in the Township of Faraday. The site presently contains fuel storage tanks, a bank of solar panels and an industrial type building surrounded by a parking area that provides storage for other *Freymond* operations and equipment. Remaining portions of the study site are undeveloped and primarily wooded. A more detailed description of the site is available in the related planning documentation that has been prepared in support of the planning approval for the proposed new quarry development.

Planned future development and site operations were discussed with the client to gain an understanding of potential future traffic that might be generated on the quarry operation. It is understood that production at the quarry will depend on market conditions. As such, three production scenarios were developed to cover a range of possibilities. They include two production scenarios in the short term and one longer term scenario:

- Scenario 1: produce a maximum of 400,000 tonnes (T) per year of material (short term);
- Scenario 2: produce up to a 1,000,000 tonnes (T) per year of material (short term);
- Scenario 3: produce up to a 1,000,000 tonnes (T) per year of material (long term).

Scenarios 1 and 2 are based on a 6 year planning horizon to 2018. Based on further discussions with the client, the ability to produce 1 million T of material per year may take additional time to develop. A longer term planning horizon to 2022 (10 years) was developed to evaluate this scenario.

3.2 Scenario 1 - Site Trip Generation (2018)

In Scenario 1 of site operations, the principal production will be the extraction of aggregate. This material will be crushed on-site and transported in a range of truck sizes from dual axle dump trucks to large belly-dump tractor/trailer combination vehicles. The material is expected to be sold into the local market aimed primarily at the forestry industry.

From a traffic generating perspective, it has been assumed that the main pit operations will occur from Monday to Friday from about 7am to 6 pm. Some material could be shipped on a Saturday but this would not be typical of the operation. Quarry operation times will occur during weekdays in the normal construction season that usually runs from May until November. There will be limited shipments during the winter months for such things as sanding roads. During the spring months shipments are usually limited by half-load regulations.

Assuming these daily start and end times, employee trips and truck trips will arrive on site before the normal AM peak hour and depart after the usual PM peak hour. However, the analyses in this report assumes that a worst case condition occurs when the peak of the site traffic coincides with the peak of the adjacent roadways.

Based on the discussions with the client and Tranplan Associates' past experience evaluating the impacts of quarry operations, the following assumptions have been made for the Scenario 1 400,000 tonne production:

- One loader on site with the ability to load 10 trucks per hour
- 4 permanent employees on site
- 2 service vehicles per day to account for equipment servicing, courier etc.

Based on these assumptions the site trip generation developed for Scenario 1 is summarized in *Table 2* below.

Table 2: Scenario 1 Site Trip Generation (vph)

	AM Peak Hour			PM Peak Hour		
	In	Out	Total	In	Out	Total
Employee Trips	4	1	5	1	4	5
Truck Trips	10	10	20	10	10	20
Service Trips[A]	1	1	2	1	1	2
New Trips	**15**	**12**	**27**	**12**	**15**	**27**

A – The service trips were assumed to be split between the AM and PM peak hours.

3.3 Scenario 2 - Site Trip Generation (2018)

Scenario 2 for quarry operations has assumed that the type of material, operating hours and operating season will remain the same as Scenario 1. However, production of the aggregate material will increase to 1 million T per year. This will result in an increase in truck trips as well as the number of employees. The following operational assumptions have been made for the Scenario 2:

- Three loaders on site with the ability to load up to 30 trucks per hour
- 11 permanent employees on site
- 2 service vehicles per day to account for equipment servicing, courier etc.

Based on these assumptions the site trip generation developed for Scenario 2 is summarized in *Table 3* below.

Table 3: Scenario 2 Site Trip Generation (vph)

	AM Peak Hour			PM Peak Hour		
	In	**Out**	**Total**	**In**	**Out**	**Total**
Employee Trips	11	2	13	2	11	13
Truck Trips	30	30	60	30	30	60
Service Trips[A]	1	1	2	1	1	0
New Trips	**42**	**33**	**75**	**33**	**42**	**75**

A – The service trips were assumed to be split between the AM and PM peak hours.

3.4 Scenario 3 - Site Trip Generation (2022)

Based on discussions with client staff, development of quarry production to reach 1 million T per year may not be achieved until some time in the future. A site development scenario was developed that assumed 1 million T per year production that would not be achieved until 2022. This scenario would have the same peak hour site traffic as Scenario 2, but the background traffic would reach higher levels because of growth in this traffic from 2018 to 2022.

3.5 Trip Distribution

The distribution and assignment of vehicle trips associated with the proposed development is based on the location of trip generators and attractors and their proximity to the proposed development. In this study, it was assumed that all site-generated trips will follow the haul route along Bay Lake Road to Highway 62. At that point, trips will either travel north or south on Highway 62. The March 2012 observed distribution of Bay Lake Road traffic to/from Highway 62 was between 70% and 80% to the north with the exception of the AM peak hour when inbound traffic to Bay Lake Road was 63% from the north. Based on this observed trip distribution, the following directional splits were applied to the truck trips and the employee trips for all three Scenarios:

- Employee Trips:
  - North on Highway 62: 60%
  - South on Highway 62: 40%
- Truck Trips:
  - North on Highway 62: 50%
  - South on Highway 62: 50%

The assumption that 50% of all site-generated truck trips will travel to/from the south may overstate this movement given the proximity of the Town and the Highway 28 corridor to the north. However, it represents a higher level demand of site traffic to/from the south. This in turn will produce a conservative forecast in evaluating the need for a northbound left turn lane on Highway 62 at the intersection with Bay Lake Road.

4. FUTURE CONDITIONS

This chapter summarizes the assumptions used to develop future year traffic volumes, the operational analysis results and associated impacts to the transportation infrastructure.

4.1 Future Summer Background Traffic

As described in *Section 3*, two future planning horizons have been developed to evaluate quarry traffic impacts on Bay Lake Road and Highway 62. The first planning horizon - 2018 covers a 6 year time span that is usually considered in most traffic impact studies. The 2018 planning horizon allows for a year of planning approvals and site development and then five years of growth in site and background traffic. This study has also considered potential longer term impacts from maximum site development that might occur over the next 10 years to 2022.

The forecast of future background traffic volumes was based on data developed from a review of traffic growth in the Highway 62 corridor. Historic MTO daily traffic volume data were available for the years 1988 to 2008 inclusive. These data identified an annual average traffic growth rate of just under 1.5% per year (compounded). For the purposes of this study, and to provide a worst case scenario, it was assumed that future growth in traffic would grow at 2% per year (compounded). This rate of growth was used to expand the 2012 summer background traffic to both the 2018 and 2022 summer background traffic volumes.

No roadway network changes were identified for the study area roads. All other developments in the vicinity of the proposed site that could occur by the 2018 and 2022 planning horizons were considered to be accounted for in the 2% per year traffic growth rate. The forecast 2018 and 2022 summer background traffic volumes are illustrated in *Exhibit 5 – Background Traffic Volumes*.

4.2 Future Summer Total Traffic

As discussed in *Section 3*, three future site development scenarios were prepared. The first two could occur by the 2018 planning horizon and the third by a 2022 planning horizon. The total traffic volumes for each were computed as follows:

- 2018 Scenario 1 - AM and PM Peak Hours:
    - Observed March 2012 traffic volumes increased by;
    - A seasonal adjustment factor of 1.6 (increase by 60%); times
    - A compounding 2% per annum growth factor from 2012 to 2018; plus
    - Scenario 1 site-generated traffic as described in Section 3.2.
- 2018 Scenario 2 - AM and PM Peak Hours:
    - Observed March 2012 traffic volumes increased by;
    - A seasonal adjustment factor of 1.6 (increase by 60%); times
    - A compounding 2% per annum growth factor from 2012 to 2018; plus
    - Scenario 2 site-generated traffic as described in Section 3.3.

- 2022 Scenario 3 - AM and PM Peak Hours:
  - Observed March 2012 traffic volumes; increased by;
  - A seasonal adjustment factor of 1.6 (increase by 60%); times
  - A compounding 2% per annum growth factor from 2012 to 2022; plus
  - Scenario 3 site-generated traffic as described in Section 3.4.

The forecast total traffic volumes for the three scenarios are illustrated in *Exhibit 6 – 2018 Total Traffic Volumes* and *Exhibit 7 – 2022 Total Traffic Volumes*.

4.3 Future Conditions Capacity Analysis

4.3.1 2018 Planning Horizon

Capacity analyses were carried out for each of the study intersections using the 2018 total forecast traffic volumes. The analysis procedure followed the *Transportation Research Board's Highway Capacity Manual* (HCM) methodology for unsignalized intersections. The software tool applied was Trafficware's *Synchro 8*. The following *Table 4* summarizes the results for the AM and PM peak hours for summer 2012, 2018 background, 2018 Scenario 1 total, and 2018 Scenario 2 total traffic conditions.

Table 4: Summary of 2018 Intersection Capacity Analysis Results

Highway 62 / Bay Lake Road (unsignalized)				
	AM Peak Hour – Critical Movement		**PM Peak Hour – Critical Movement**	
	LOS (Delay)	**V/C**	**LOS (Delay)**	**V/C**
2012 Summer	EB Left: **B** (12.7s)	0.10	EB Left: **B** (13.8s)	0.14
2018 Background	EB Left: **B** (13.6s)	0.13	EB Left: **B/C** (15.2s)	0.18
2018 Scenario 1 Total	EB Left: **B** (13.8s)	0.15	EB Left: **B/C** (15.6s)	0.21
2018 Scenario 2 Total	EB Left: **B/C** (14.5s)	0.19	EB Left: **C** (16.4s)	0.27

Bay Lake Road / Site Access (unsignalized)				
	AM Peak Hour – Critical Movement		**PM Peak Hour – Critical Movement**	
	LOS (Delay)	**V/C**	**LOS (Delay)**	**V/C**
2012 Summer	*n/a*	*n/a*	*n/a*	*n/a*
2018 Background	*n/a*	*n/a*	*n/a*	*n/a*
2018 Scenario 1 Total	EB Left: **A** (9.2s)	0.02	EB Left: **A** (9.4s)	0.02
2018 Scenario 2 Total	EB Left: **A** (9.4s)	0.05	EB Left: **A** (9.7s)	0.06

The operational analyses of the future 2018 traffic scenarios indicate that all of the movements at the study intersections will operate at acceptable levels of service (LoS) C or better and volume-to-capacity (v/c) ratios 0.27 or better. Drivers accessing Highway 62 from Bay Lake Road will face acceptable levels of delay. A detailed summary of the capacity analysis results is provided in the *Technical Appendix – Intersection Capacity Analyses*.

4.3.2 2022 Planning Horizon

An analysis of the two study area intersections was carried out assuming the maximum level of site development that might occur over a longer planning period to 2022 (Scenario 3). The analysis procedure followed the methodology contained in the *Transportation Research Board's Highway Capacity Manual* (HCM) 2010 for unsignalized intersections. Table 5 following summarizes the results of the analyses for both weekday peak hour periods.

Table 5: Summary of 2022 Intersection Capacity Analysis Results

Highway 62 / Bay Lake Road (unsignalized)				
	AM Peak Hour – Critical Movement		**PM Peak Hour – Critical Movement**	
	LOS (Delay)	**V/C**	**LOS (Delay)**	**V/C**
2012 Summer	EB Left: **B** (12.7s)	0.10	EB Left: **B** (13.8s)	0.14
2022 Background	EB Left: **B/C** (14.4s)	0.15	EB Left: **C** (16.4s)	0.21
2022 Scenario 3 Total	EB Left: **B/C** (15.5s)	0.22	EB Left: **C** (17.8s)	0.34

Bay Lake Road / Site Access (unsignalized)				
	AM Peak Hour – Critical Movement		**PM Peak Hour – Critical Movement**	
	LOS (Delay)	**V/C**	**LOS (Delay)**	**V/C**
2012 Summer	*n/a*	*n/a*	*n/a*	*n/a*
2022 Background	*n/a*	*n/a*	*n/a*	*n/a*
2022 Scenario 3 Total	EB Left: **A** (9.5s)	0.05	EB Left: **A** (9.7s)	0.06

The operational analyses of Scenario 3 shows that all of the movements at the study intersections will operate at acceptable levels of service (LoS) C or better and volume-to-capacity (v/c) ratios 0.34 or better. Future peak hour site traffic will have an acceptable level of impact on both Bay Lake Road and Highway 62. A detailed summary of the capacity analysis results is provided in the *Technical Appendix – Intersection Capacity Analyses*.

4.4 Auxiliary Lane Analyses

4.4.1 Left Turn Lane Analyses

Left turn lane warrant analyses were carried out for the Highway 62/Bay Lake Road intersection to determine the need for a northbound left turn lane on Highway 62. The analyses were completed for all three planning Scenarios. The assessment was done using the methodology contained in the Ontario Ministry of Transportation's (MTO) *Geometric Design Standards for Ontario Highways* (GDSOH) document.

Based on a 90 km/h design speed and total Scenario 1 traffic volumes, the warrant analyses show there is no requirement for a northbound left turn lane on Highway 62. A sensitivity analysis was carried out to evaluate the need for the left turn lane by the 2018 planning horizon based on Scenario 2 (1 million tonnes per year). Under Scenario 2 the left turn lane would be required. Similarly a left turn lane warrant analysis was carried out for Scenario 3. Based on the higher levels of quarry production in Scenario 3, a northbound left turn lane would be required. A summary of the warrant analysis results is provided below in *Table 6*.

Table 6: Highway 62-Bay Lake Road Intersection Left Turn Lane Warrant Analysis

Scenario/Horizon	Left Turn Lane Warrant
2018 Background	No
2018 Scenario 1 Total	No
2018 Scenario 2 Total	Yes
2022 Background	No
2022 Scenario 3 Total	Yes

A detailed summary of the warrant analysis inputs and results plotted on the MTO warrant nomographs is contained in the *Technical Appendix – Left Turn Lane Warrant Analyses*.

4.4.2 *Right Turn Lane Analysis*

There is presently a partial paved shoulder on the southbound west side of Highway 62. This is supported with an additional 20 m partial taper on the approach to the Bay Lake Road intersection. A review of the southbound Highway 62 approach to Bay Lake Road was carried out to determine the need for a right turn lane in the southbound direction. The Bancroft Connecting Link portion of Highway 62 is really part of the overall Highway 62 corridor. So the right turn lane criteria contained in the *Geometric Design Standards for Ontario Highways* (GDSOH) document was applied to this assessment. Based on the MTO standard there is a need for a right turn direct taper lane on southbound Highway 62. Suggested guidelines for the design of the southbound right turn direct taper lane are illustrated in the *Technical Appendix – Design Standards*.

4.5 The Proposed Site Access

The recommended lane configuration at the intersection of the proposed quarry site access and Bay Lake Road includes the following:

- Eastbound Bay Lake Road: one shared through-left lane (no exclusive left turn lane required)

- Westbound Bay Lake Road: one shared through-right lane (no exclusive right turn lane required)
- Southbound Site Access: one shared left-right outbound lane and one inbound lane

A guide to finalizing the site entrance requirements can be taken from entrance design *CSAS-23 Truck Access* taken from the current MTO *Commercial Site Access and Standard Designs*. In addition, all signage and pavement markings should be constructed in accordance with the guidance provided in the *Ontario Traffic Manual* (OTM) and *the Manual of Uniform Traffic Control Devices of Canada* (MUTCDC).

4.6 Mitigating Measures

Based on the study analyses the following mitigating measures have been developed to minimize the future traffic impacts of the proposed quarry. They include the following:

- Construction of a southbound right turn direct taper lane on Highway 62 at the approach to the Bay Lake Road intersection. This taper should be constructed to meet current ministry standards.
- If future quarry production exceeds 400,000 T per year (Scenarios 2 & 3), northbound left turning traffic on Highway 62 at Bay Lake Road will warrant the construction of a left turn lane on Highway 62. This left turn lane should be constructed to standards for a 90 km/h design speed.
- Because of the reduced sight distance from the site entrance north along Bay Lake Road, a *Truck Entrance Sign* (Wc-8R) should be installed on Bay Lake Road at an appropriate location south of Highway 62 before the site entrance.

5. CONCLUSIONS AND RECOMMENDATIONS

This chapter summarizes the salient findings of the analysis and identifies any necessary changes to the transportation infrastructure.

5.1 Conclusions

The following conclusions have been drawn from the traffic impact analyses completed for the proposed quarry:

- The intersection capacity analyses show that there are presently no operational issues at the study intersections. All of the intersection turning movements operate at acceptable levels of service with good volume to capacity ratios during current peak hour periods.
- The two study intersections are forecast to operate at good LoS during the peak hours of all three traffic scenarios assumed in the study analyses. There will be residual capacity for additional growth in site and background traffic beyond the 2022 planning horizon assumed in these analyses.
- Based on quarry production up to about 400,000 tonnes per year, the study site will generate up to 27 two-way trips during weekday peak hour periods.
- Based on quarry production up to 1 million tonnes per year, the study site will generate up 75 two-way trips during the peak hour periods.
- Access to the proposed site will be via the existing north entrance to the *Freymond Mill*. This entrance appears to have been constructed to standards that are close to MTO truck entrance standards.
- Based on MTO standards, a right turn direct taper lane is required on the west side of the Highway 62 approach to Bay Lake Road to accommodate southbound right turns from Highway 62.
- Left turn lane warrant analyses identified the need for a northbound left turn lane on Highway 62 if quarry production exceeds 400,000 tonnes per year.
- There is a reduced sight line distance at the site entrance north along Bay Lake Road. All other sight lines at the two study intersections meet or exceed MTO requirements.

5.2 Recommendations

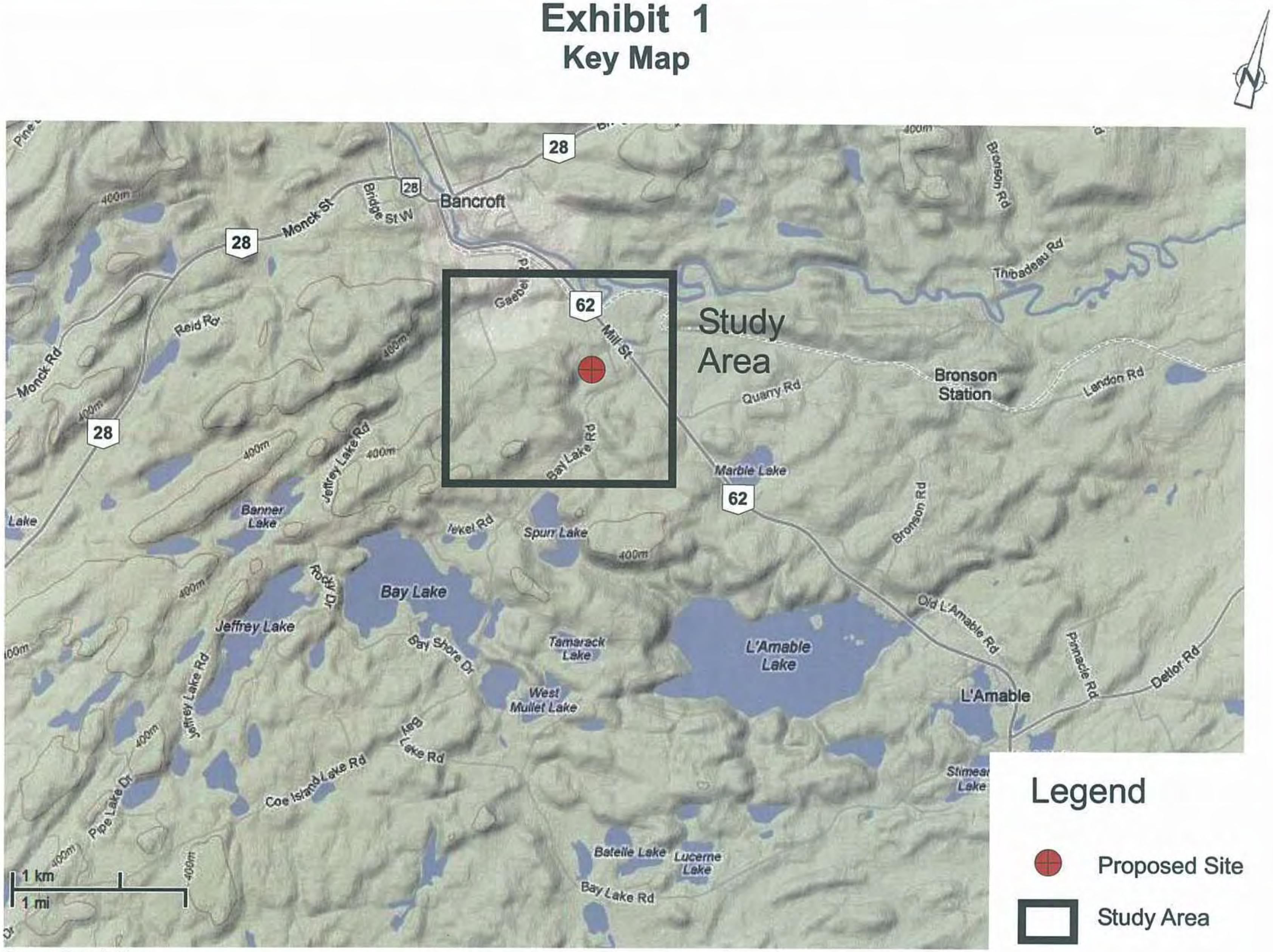
The following recommendations have been developed from the study analyses and conclusions:

- That a southbound right turn direct taper lane be installed at the Highway 62 / Bay Lake Road intersection. Suggested guidelines for the design of the southbound right turn direct taper lane are illustrated in the *Technical Appendix – Design Standards*.
- If/when quarry production exceeds 400,000 tonnes per year, a northbound left turn lane will be required on Highway 62 at the Bay Lake Road,
- That a *Truck Entrance Sign* (Wc-8R) be installed on the west side of Bay Lake Road at an appropriate location south of Highway 62 before the site entrance.

- That the existing site entrance be reviewed against current Township standards for commercial entrances to assure it meets Township requirements.
- That all signage and pavement markings be constructed in accordance with the guidance provided in the *Ontario Traffic Manual* (OTM) and *the Manual of Uniform Traffic Control Devices of Canada* (MUTCDC).

REPORT EXHIBITS

Exhibit 1
Key Map



Source: Google Maps

Exhibit 2
Site Context

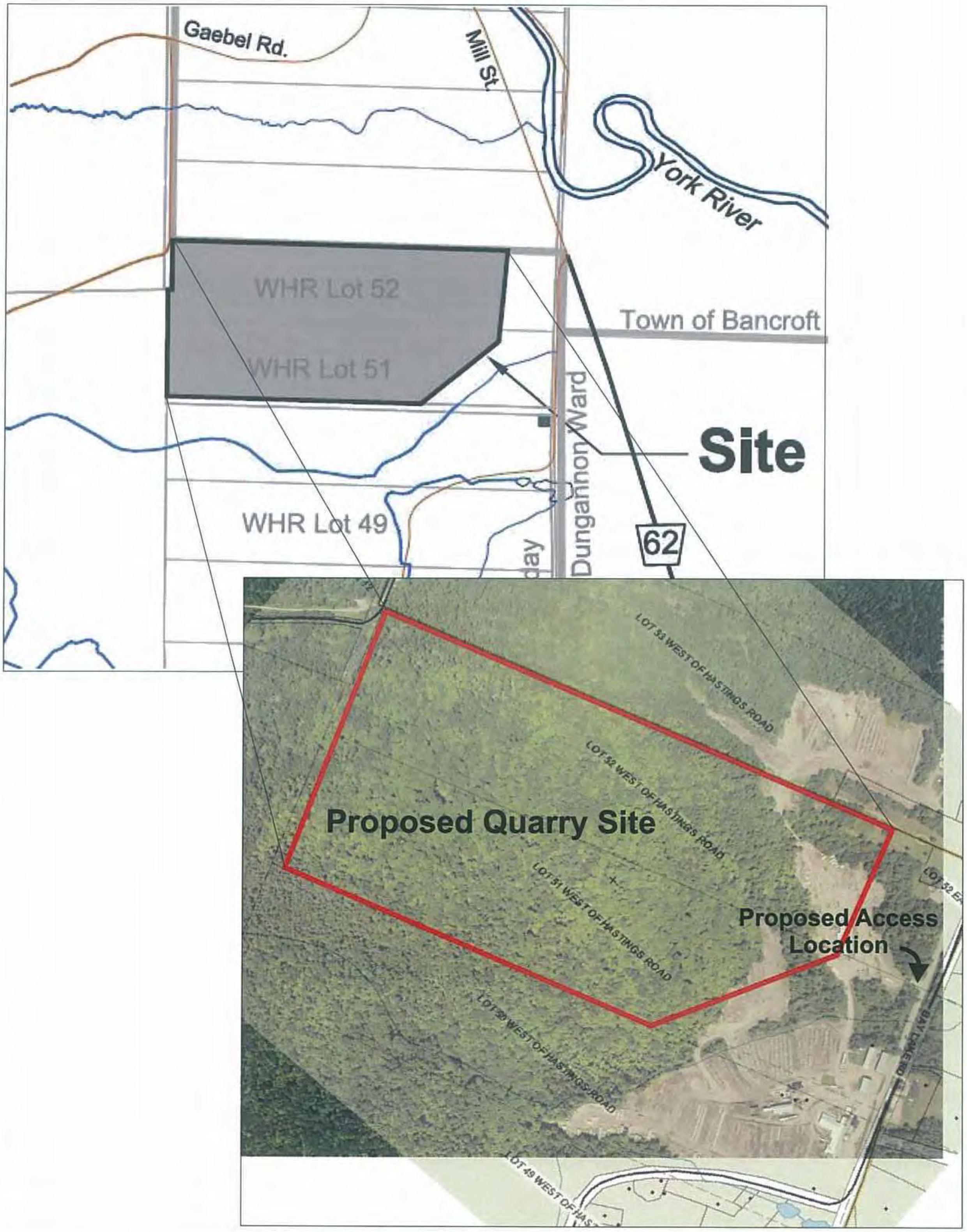


Exhibit 3
Proposed Haul Route

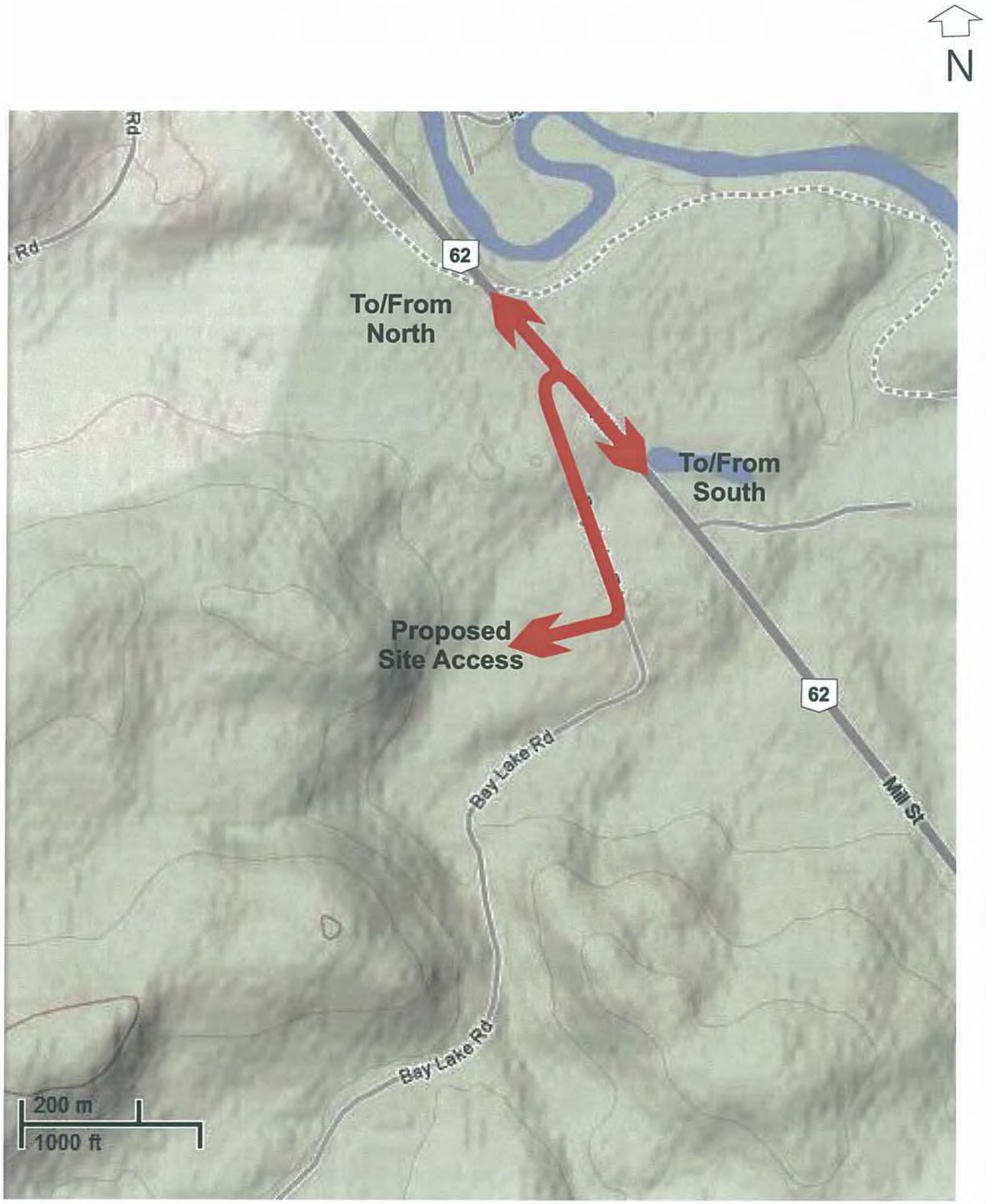
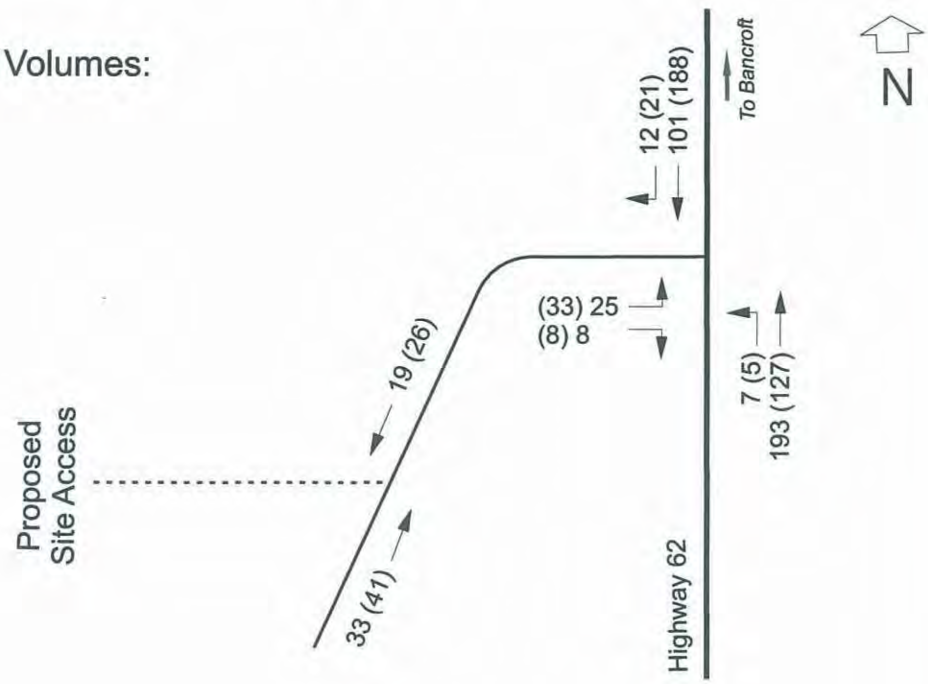
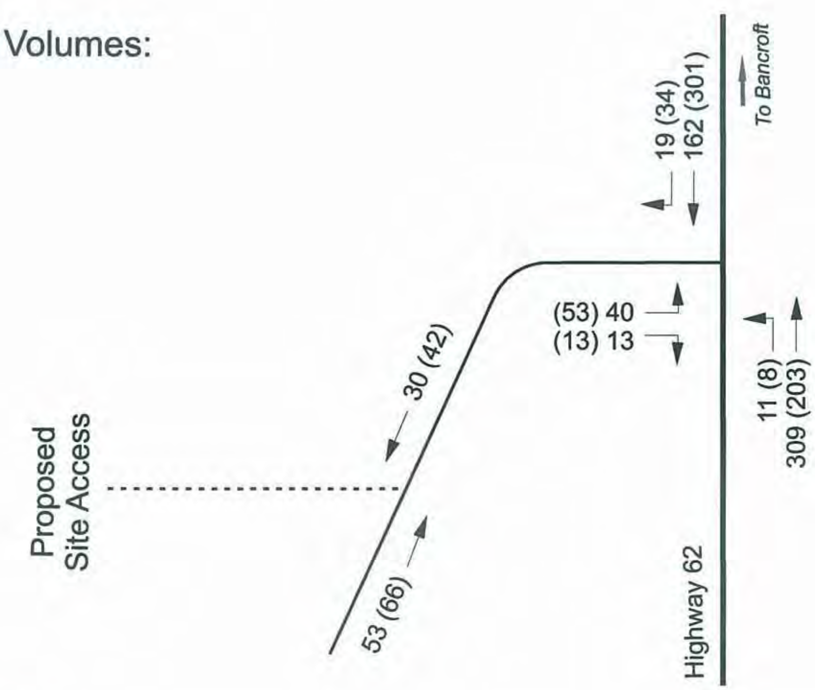


Exhibit 4
2012 Existing Traffic Volumes

2012 Observed Volumes:



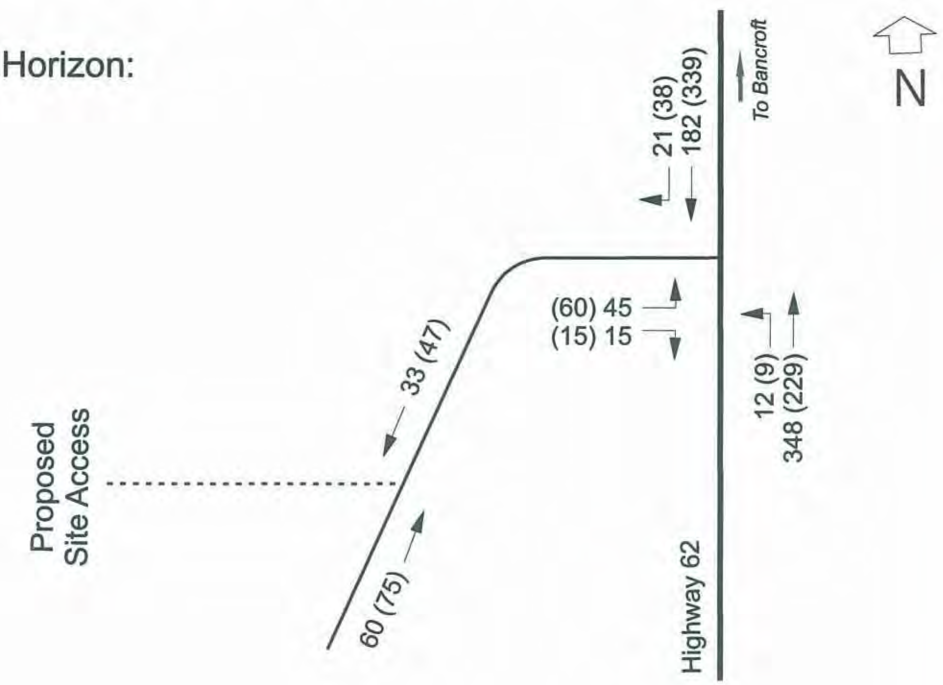
2012 Summer Volumes:



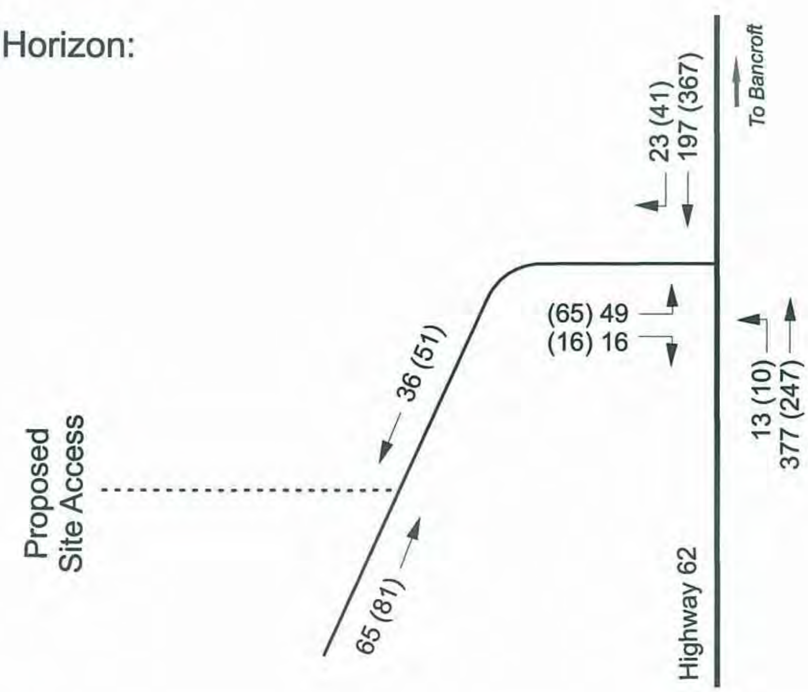
xx AM Peak Hour Volumes
(xx) PM Peak Hour Volumes

Exhibit 5
Background Traffic Volumes

2018 Planning Horizon:



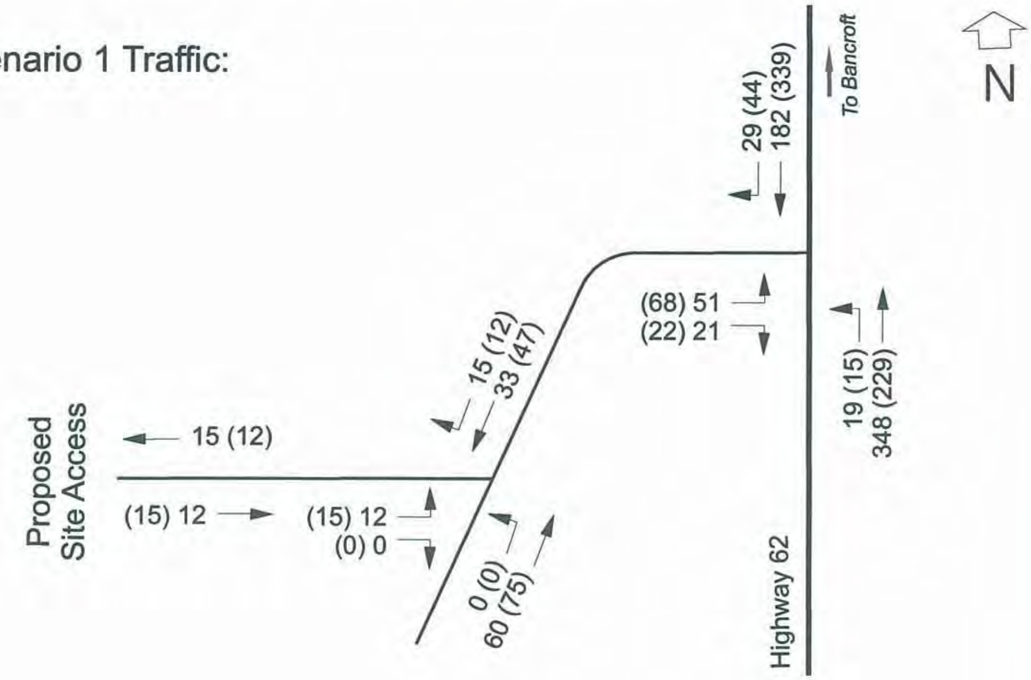
2022 Planning Horizon:



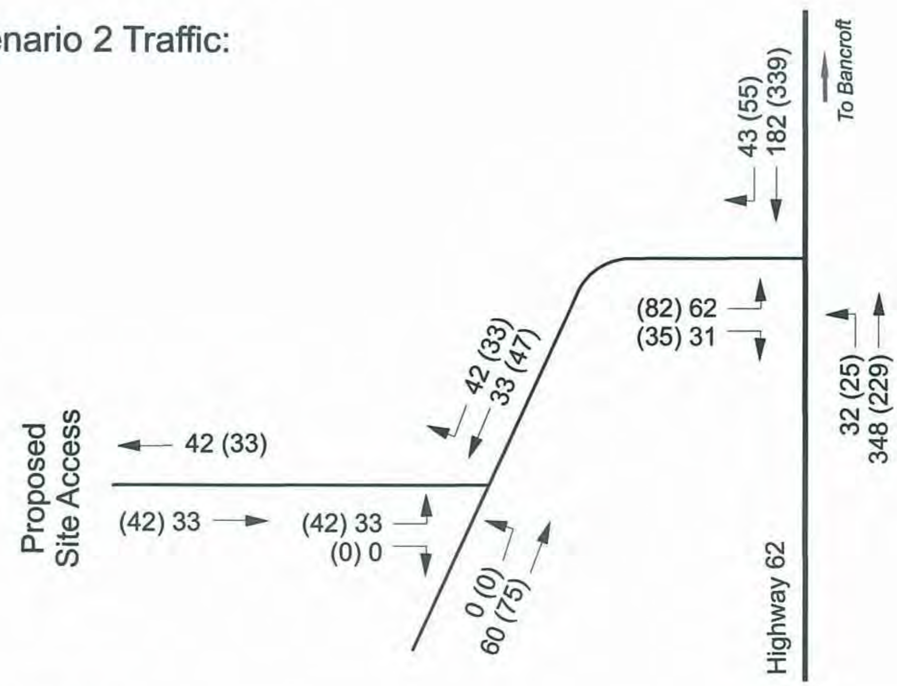
xx AM Peak Hour Volumes
(xx) PM Peak Hour Volumes

Exhibit 6
2018 Total Traffic Volumes

2018 Scenario 1 Traffic:



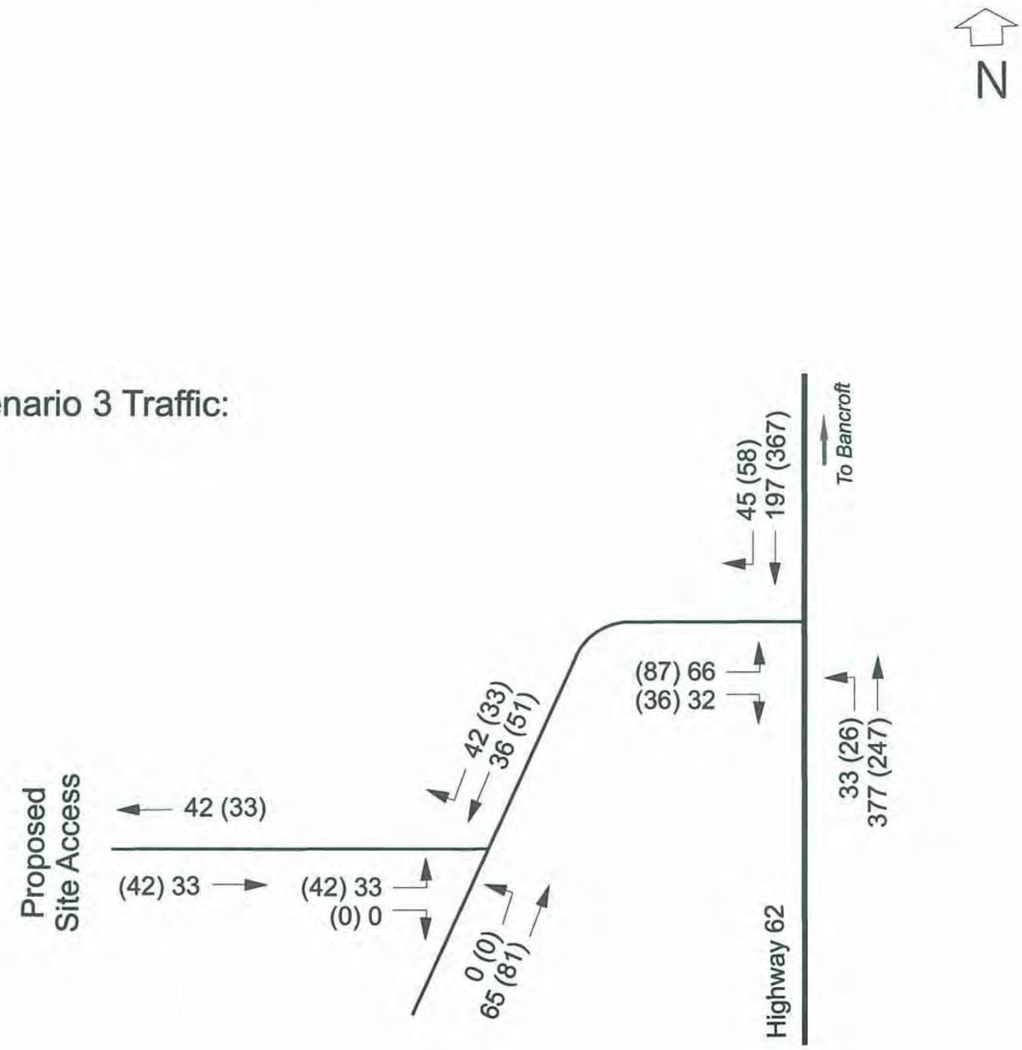
2018 Scenario 2 Traffic:



xx AM Peak Hour Volumes
(xx) PM Peak Hour Volumes

Exhibit 7
2022 Total Traffic Volumes

2022 Scenario 3 Traffic:



xx AM Peak Hour Volumes
(xx) PM Peak Hour Volumes

TECHNICAL APPENDIX I

Intersection capacity analysis

2012 Planning Horizon

HCM Unsignalized Intersection Capacity Analysis
1: Hwy 62 & Bay Lake Rd

2012 Existing AM

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	40	13	11	309	162	19
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.85	0.85	0.85	0.85	0.85	0.85
Hourly flow rate (vph)	47	15	13	364	191	22
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)		1				
Median type				None	None	
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	591	202	213			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	591	202	213			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	90	98	99			
cM capacity (veh/h)	460	831	1340			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	62	376	213
Volume Left	47	13	0
Volume Right	15	0	22
cSH	610	1340	1700
Volume to Capacity	0.10	0.01	0.13
Queue Length 95th (m)	2.7	0.2	0.0
Control Delay (s)	12.7	0.4	0.0
Lane LOS	B	A	
Approach Delay (s)	12.7	0.4	0.0
Approach LOS	B		

Intersection Summary			
Average Delay	1.4		
Intersection Capacity Utilization	35.2%	ICU Level of Service	A
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
1: Hwy 62 & Bay Lake Rd

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	↰	↱		↰↑	↑↱	
Volume (veh/h)	53	13	8	203	301	34
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.85	0.85	0.85	0.85	0.85	0.85
Hourly flow rate (vph)	62	15	9	239	354	40
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)		1				
Median type				None	None	
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	632	374	394			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	632	374	394			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	86	98	99			
cM capacity (veh/h)	436	665	1148			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	78	248	394
Volume Left	62	9	0
Volume Right	15	0	40
cSH	543	1148	1700
Volume to Capacity	0.14	0.01	0.23
Queue Length 95th (m)	4.0	0.2	0.0
Control Delay (s)	13.8	0.4	0.0
Lane LOS	B	A	
Approach Delay (s)	13.8	0.4	0.0
Approach LOS	B		

Intersection Summary			
Average Delay	1.6		
Intersection Capacity Utilization	27.9%	ICU Level of Service	A
Analysis Period (min)	15		

2018 Planning Horizon

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	45	15	12	348	182	21
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.85	0.85	0.85	0.85	0.85	0.85
Hourly flow rate (vph)	53	18	14	409	214	25
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)		1				
Median type				None	None	
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	664	226	239			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	664	226	239			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	87	98	99			
cM capacity (veh/h)	416	805	1311			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	71	424	239
Volume Left	53	14	0
Volume Right	18	0	25
cSH	555	1311	1700
Volume to Capacity	0.13	0.01	0.14
Queue Length 95th (m)	3.5	0.3	0.0
Control Delay (s)	13.6	0.4	0.0
Lane LOS	B	A	
Approach Delay (s)	13.6	0.4	0.0
Approach LOS	B		

Intersection Summary			
Average Delay	1.5		
Intersection Capacity Utilization	38.0%	ICU Level of Service	A
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
1: Hwy 62 & Bay Lake Rd

2018 Background PM

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	60	15	9	229	339	38
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.85	0.85	0.85	0.85	0.85	0.85
Hourly flow rate (vph)	71	18	11	269	399	45
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)		1				
Median type				None	None	
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	712	421	444			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	712	421	444			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	82	97	99			
cM capacity (veh/h)	391	626	1101			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	88	280	444
Volume Left	71	11	0
Volume Right	18	0	45
cSH	489	1101	1700
Volume to Capacity	0.18	0.01	0.26
Queue Length 95th (m)	5.2	0.2	0.0
Control Delay (s)	15.2	0.4	0.0
Lane LOS	C	A	
Approach Delay (s)	15.2	0.4	0.0
Approach LOS	C		

Intersection Summary			
Average Delay	1.8		
Intersection Capacity Utilization	30.1%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	51	21	19	348	182	29
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.85	0.85	0.85	0.85	0.85	0.85
Hourly flow rate (vph)	60	25	22	409	214	34
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)		1				
Median type				None	None	
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	685	231	248			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	685	231	248			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	85	97	98			
cM capacity (veh/h)	402	801	1300			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	85	432	248
Volume Left	60	22	0
Volume Right	25	0	34
cSH	568	1300	1700
Volume to Capacity	0.15	0.02	0.15
Queue Length 95th (m)	4.2	0.4	0.0
Control Delay (s)	13.8	0.6	0.0
Lane LOS	B	A	
Approach Delay (s)	13.8	0.6	0.0
Approach LOS	B		

Intersection Summary			
Average Delay	1.9		
Intersection Capacity Utilization	43.8%	ICU Level of Service	A
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
1: Hwy 62 & Bay Lake Rd

2018 Total PM (Phase 1)

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	68	22	15	229	339	44
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.85	0.85	0.85	0.85	0.85	0.85
Hourly flow rate (vph)	80	26	18	269	399	52
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)		1				
Median type				None	None	
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	729	425	451			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	729	425	451			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	79	96	98			
cM capacity (veh/h)	379	623	1094			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	106	287	451
Volume Left	80	18	0
Volume Right	26	0	52
cSH	502	1094	1700
Volume to Capacity	0.21	0.02	0.27
Queue Length 95th (m)	6.3	0.4	0.0
Control Delay (s)	15.6	0.7	0.0
Lane LOS	C	A	
Approach Delay (s)	15.6	0.7	0.0
Approach LOS	C		

Intersection Summary			
Average Delay	2.2		
Intersection Capacity Utilization	34.8%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	62	31	32	348	182	43
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.85	0.85	0.85	0.85	0.85	0.85
Hourly flow rate (vph)	73	36	38	409	214	51
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)		1				
Median type				None	None	
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	724	239	265			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	724	239	265			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	81	95	97			
cM capacity (veh/h)	377	792	1282			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	109	447	265
Volume Left	73	38	0
Volume Right	36	0	51
cSH	565	1282	1700
Volume to Capacity	0.19	0.03	0.16
Queue Length 95th (m)	5.7	0.7	0.0
Control Delay (s)	14.5	0.9	0.0
Lane LOS	B	A	
Approach Delay (s)	14.5	0.9	0.0
Approach LOS	B		

Intersection Summary			
Average Delay	2.4		
Intersection Capacity Utilization	45.7%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	82	35	25	229	339	55
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.85	0.85	0.85	0.85	0.85	0.85
Hourly flow rate (vph)	96	41	29	269	399	65
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)		1				
Median type				None	None	
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	759	431	464			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	759	431	464			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	73	93	97			
cM capacity (veh/h)	360	618	1082			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	138	299	464
Volume Left	96	29	0
Volume Right	41	0	65
cSH	513	1082	1700
Volume to Capacity	0.27	0.03	0.27
Queue Length 95th (m)	8.6	0.7	0.0
Control Delay (s)	16.4	1.1	0.0
Lane LOS	C	A	
Approach Delay (s)	16.4	1.1	0.0
Approach LOS	C		

Intersection Summary			
Average Delay	2.9		
Intersection Capacity Utilization	44.1%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	Y			↰↑	↑↱	
Volume (veh/h)	12	0	0	60	33	15
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.85	0.85	0.85	0.85	0.85	0.85
Hourly flow rate (vph)	14	0	0	71	39	18
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	118	48	56			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	118	48	56			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	98	100	100			
cM capacity (veh/h)	870	1013	1529			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	14	71	56
Volume Left	14	0	0
Volume Right	0	0	18
cSH	870	1529	1700
Volume to Capacity	0.02	0.00	0.03
Queue Length 95th (m)	0.4	0.0	0.0
Control Delay (s)	9.2	0.0	0.0
Lane LOS	A		
Approach Delay (s)	9.2	0.0	0.0
Approach LOS	A		

Intersection Summary			
Average Delay	0.9		
Intersection Capacity Utilization	13.3%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	Y			↰	↱	
Volume (veh/h)	15	0	0	75	47	12
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.85	0.85	0.85	0.85	0.85	0.85
Hourly flow rate (vph)	18	0	0	88	55	14
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	151	62	69			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	151	62	69			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	98	100	100			
cM capacity (veh/h)	834	994	1513			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	18	88	69
Volume Left	18	0	0
Volume Right	0	0	14
cSH	834	1513	1700
Volume to Capacity	0.02	0.00	0.04
Queue Length 95th (m)	0.5	0.0	0.0
Control Delay (s)	9.4	0.0	0.0
Lane LOS	A		
Approach Delay (s)	9.4	0.0	0.0
Approach LOS	A		

Intersection Summary			
Average Delay	0.9		
Intersection Capacity Utilization	13.9%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	Y			↰↑	↑↱	
Volume (veh/h)	33	0	0	60	33	42
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.85	0.85	0.85	0.85	0.85	0.85
Hourly flow rate (vph)	39	0	0	71	39	49
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	134	64	88			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	134	64	88			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	95	100	100			
cM capacity (veh/h)	852	993	1489			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	39	71	88
Volume Left	39	0	0
Volume Right	0	0	49
cSH	852	1489	1700
Volume to Capacity	0.05	0.00	0.05
Queue Length 95th (m)	1.1	0.0	0.0
Control Delay (s)	9.4	0.0	0.0
Lane LOS	A		
Approach Delay (s)	9.4	0.0	0.0
Approach LOS	A		

Intersection Summary			
Average Delay	1.9		
Intersection Capacity Utilization	14.3%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	42	0	0	75	47	33
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.85	0.85	0.85	0.85	0.85	0.85
Hourly flow rate (vph)	49	0	0	88	55	39
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	163	75	94			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	163	75	94			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	94	100	100			
cM capacity (veh/h)	821	979	1481			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	49	88	94
Volume Left	49	0	0
Volume Right	0	0	39
cSH	821	1481	1700
Volume to Capacity	0.06	0.00	0.06
Queue Length 95th (m)	1.5	0.0	0.0
Control Delay (s)	9.7	0.0	0.0
Lane LOS	A		
Approach Delay (s)	9.7	0.0	0.0
Approach LOS	A		

Intersection Summary			
Average Delay	2.1		
Intersection Capacity Utilization	14.5%	ICU Level of Service	A
Analysis Period (min)	15		

2022 Planning Horizon

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	49	16	13	377	197	23
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.85	0.85	0.85	0.85	0.85	0.85
Hourly flow rate (vph)	58	19	15	444	232	27
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)		1				
Median type				None	None	
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	719	245	259			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	719	245	259			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	85	98	99			
cM capacity (veh/h)	386	786	1289			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	76	459	259
Volume Left	58	15	0
Volume Right	19	0	27
cSH	512	1289	1700
Volume to Capacity	0.15	0.01	0.15
Queue Length 95th (m)	4.2	0.3	0.0
Control Delay (s)	14.4	0.4	0.0
Lane LOS	B	A	
Approach Delay (s)	14.4	0.4	0.0
Approach LOS	B		

Intersection Summary			
Average Delay	1.6		
Intersection Capacity Utilization	40.3%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	65	16	10	247	367	41
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.85	0.85	0.85	0.85	0.85	0.85
Hourly flow rate (vph)	76	19	12	291	432	48
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)		1				
Median type				None	None	
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	770	456	480			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	770	456	480			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	79	97	99			
cM capacity (veh/h)	361	598	1067			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	95	302	480
Volume Left	76	12	0
Volume Right	19	0	48
cSH	449	1067	1700
Volume to Capacity	0.21	0.01	0.28
Queue Length 95th (m)	6.3	0.3	0.0
Control Delay (s)	16.4	0.4	0.0
Lane LOS	C	A	
Approach Delay (s)	16.4	0.4	0.0
Approach LOS	C		

Intersection Summary			
Average Delay	1.9		
Intersection Capacity Utilization	32.1%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	66	32	33	377	197	45
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.85	0.85	0.85	0.85	0.85	0.85
Hourly flow rate (vph)	78	38	39	444	232	53
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)		1				
Median type				None	None	
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	779	258	285			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	779	258	285			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	78	95	97			
cM capacity (veh/h)	349	773	1260			

Direction, Lane #	EB 1	NB 1	NB 2	SB 1
Volume Total	115	39	444	285
Volume Left	78	39	0	0
Volume Right	38	0	0	53
cSH	518	1260	1700	1700
Volume to Capacity	0.22	0.03	0.26	0.17
Queue Length 95th (m)	6.8	0.8	0.0	0.0
Control Delay (s)	15.5	7.9	0.0	0.0
Lane LOS	C	A		
Approach Delay (s)	15.5	0.6		0.0
Approach LOS	C			

Intersection Summary			
Average Delay	2.4		
Intersection Capacity Utilization	30.2%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	↰	↱	↰	↑	↱	
Volume (veh/h)	87	36	26	247	367	58
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.85	0.85	0.85	0.85	0.85	0.85
Hourly flow rate (vph)	102	42	31	291	432	68
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)		1				
Median type				None	None	
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	818	466	500			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	818	466	500			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	69	93	97			
cM capacity (veh/h)	332	591	1049			

Direction, Lane #	EB 1	NB 1	NB 2	SB 1
Volume Total	145	31	291	500
Volume Left	102	31	0	0
Volume Right	42	0	0	68
cSH	425	1049	1700	1700
Volume to Capacity	0.34	0.03	0.17	0.29
Queue Length 95th (m)	11.9	0.7	0.0	0.0
Control Delay (s)	17.8	8.5	0.0	0.0
Lane LOS	C	A		
Approach Delay (s)	17.8	0.8		0.0
Approach LOS	C			

Intersection Summary			
Average Delay	2.9		
Intersection Capacity Utilization	34.3%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	33	0	0	65	36	42
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.85	0.85	0.85	0.85	0.85	0.85
Hourly flow rate (vph)	39	0	0	76	42	49
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	144	67	92			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	144	67	92			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	95	100	100			
cM capacity (veh/h)	842	988	1484			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	39	76	92
Volume Left	39	0	0
Volume Right	0	0	49
cSH	842	1484	1700
Volume to Capacity	0.05	0.00	0.05
Queue Length 95th (m)	1.2	0.0	0.0
Control Delay (s)	9.5	0.0	0.0
Lane LOS	A		
Approach Delay (s)	9.5	0.0	0.0
Approach LOS	A		

Intersection Summary			
Average Delay	1.8		
Intersection Capacity Utilization	14.5%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	42	0	0	81	51	33
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.85	0.85	0.85	0.85	0.85	0.85
Hourly flow rate (vph)	49	0	0	95	60	39
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	175	79	99			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	175	79	99			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	94	100	100			
cM capacity (veh/h)	808	973	1475			

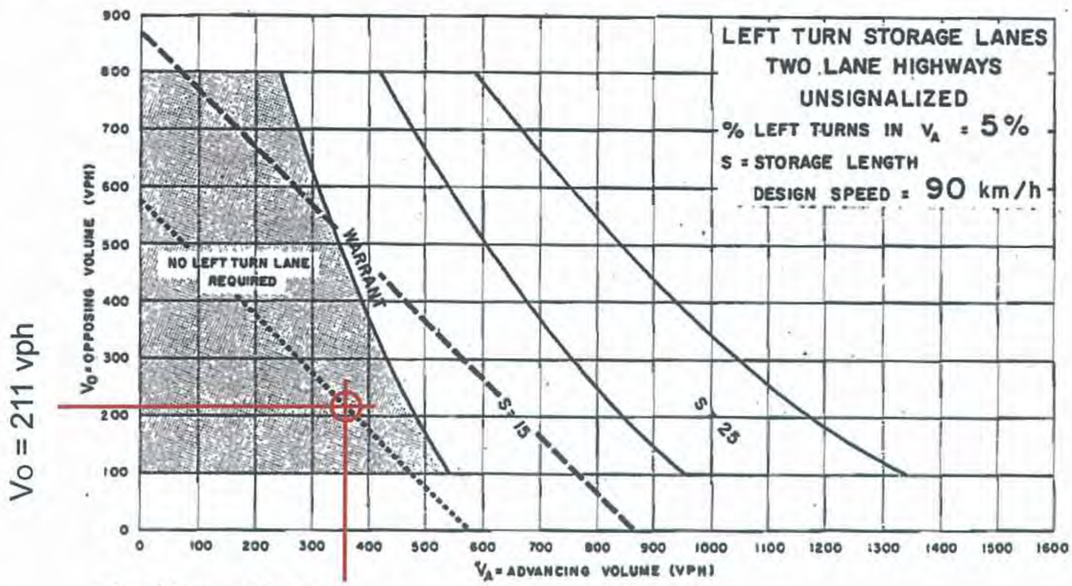
Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	49	95	99
Volume Left	49	0	0
Volume Right	0	0	39
cSH	808	1475	1700
Volume to Capacity	0.06	0.00	0.06
Queue Length 95th (m)	1.6	0.0	0.0
Control Delay (s)	9.7	0.0	0.0
Lane LOS	A		
Approach Delay (s)	9.7	0.0	0.0
Approach LOS	A		

Intersection Summary			
Average Delay	2.0		
Intersection Capacity Utilization	14.7%	ICU Level of Service	A
Analysis Period (min)	15		

TECHNICAL APPENDIX II
Left Turn Lane Warrant Analyses

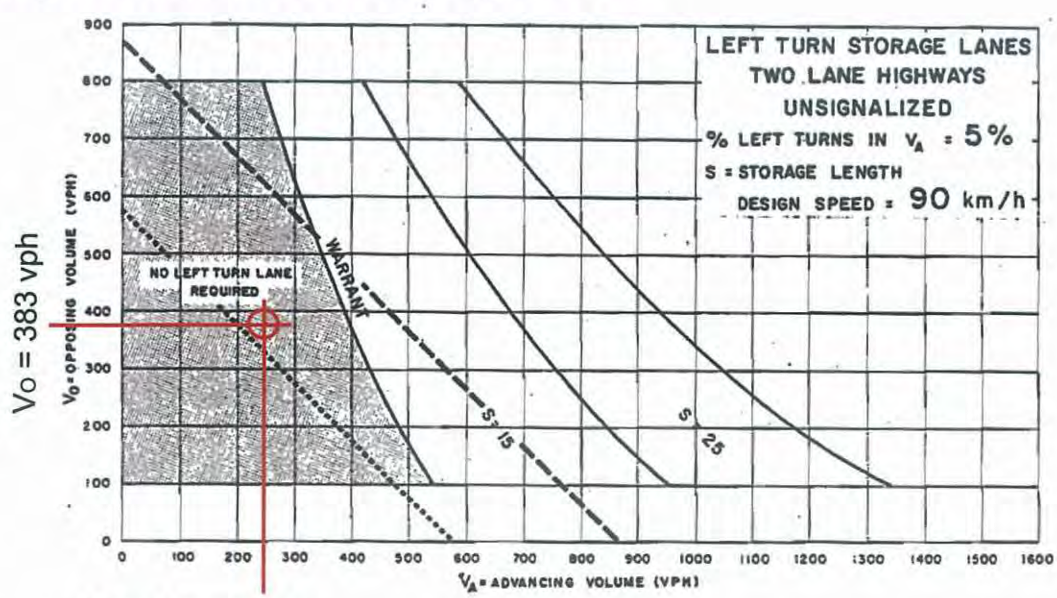
Northbound Left Turn Lane Warrant Analyses
2018 Scenario 1 Total Traffic

Weekday AM Peak Period - GDSOH Figure EA-19:



Northbound Left:
V_A = 367 vph
V_L = 19 vph
Left turns = 5.2%

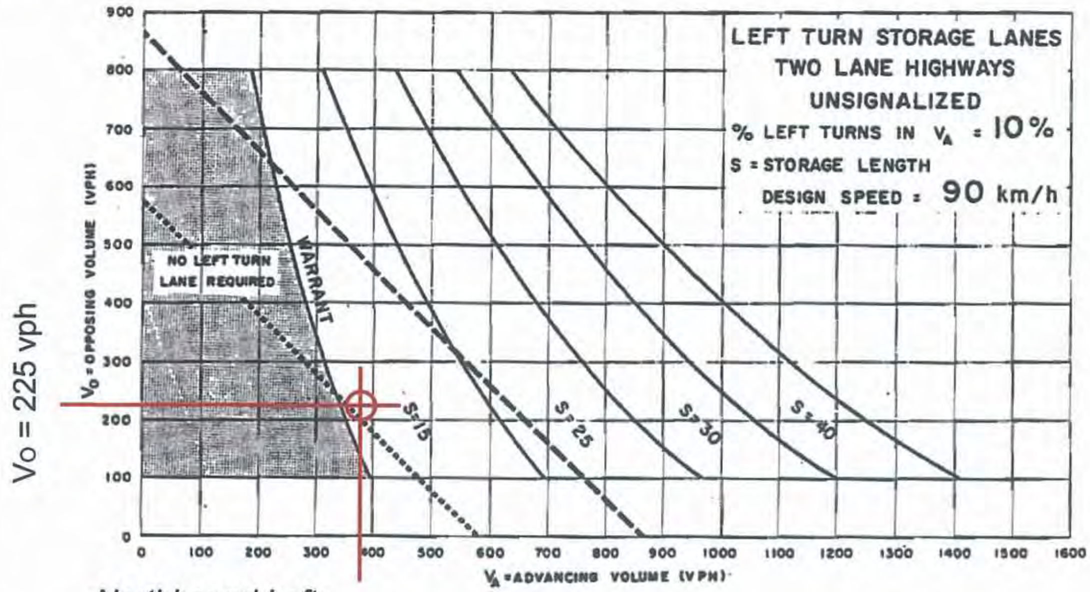
Weekday PM Peak Period - GDSOH Figure EA-19:



Northbound Left:
V_A = 244 vph
V_L = 15 vph
Left turns = 6.1%

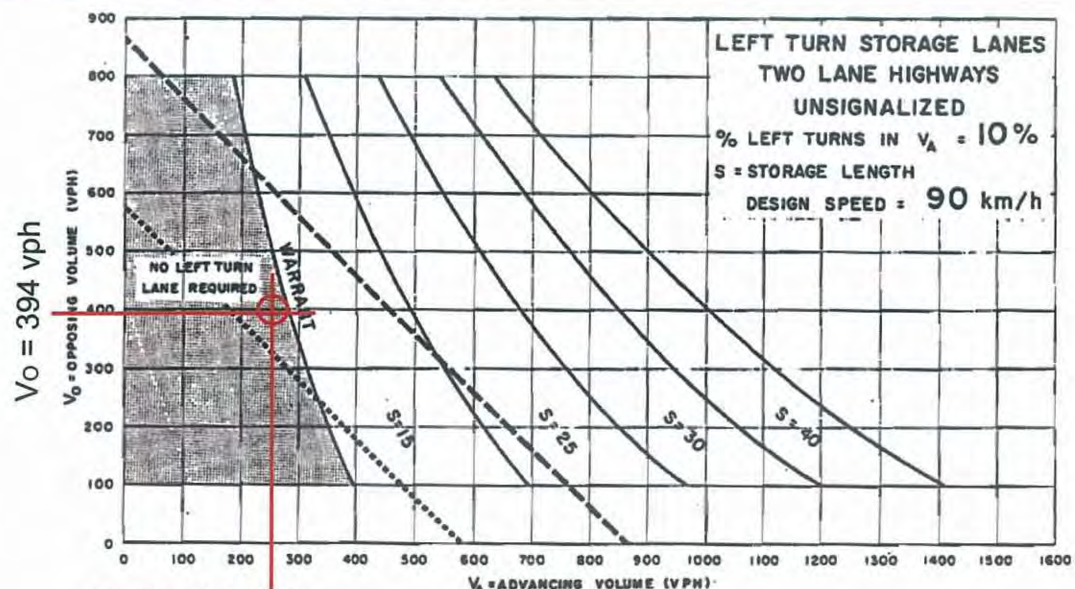
Northbound Left Turn Lane Warrant Analyses
2018 Scenario 2 Total Traffic

Weekday AM Peak Period - GDSOH Figure EA-19:



Northbound Left:
V_A = 380 vph
V_L = 32 vph
Left turns = 8.4%

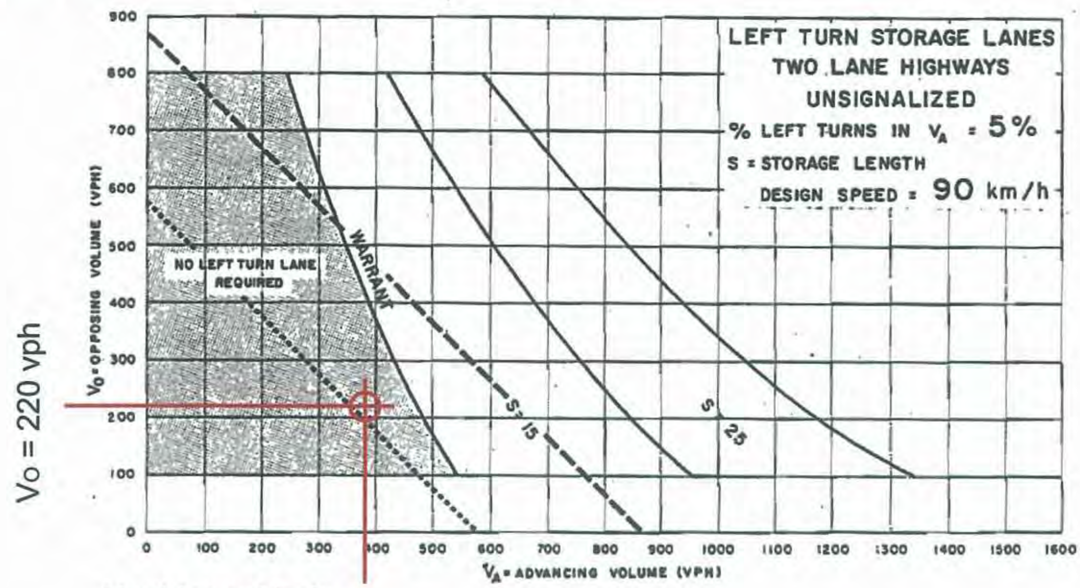
Weekday PM Peak Period - GDSOH Figure EA-19:



Northbound Left:
V_A = 254 vph
V_L = 25 vph
Left turns = 9.8%

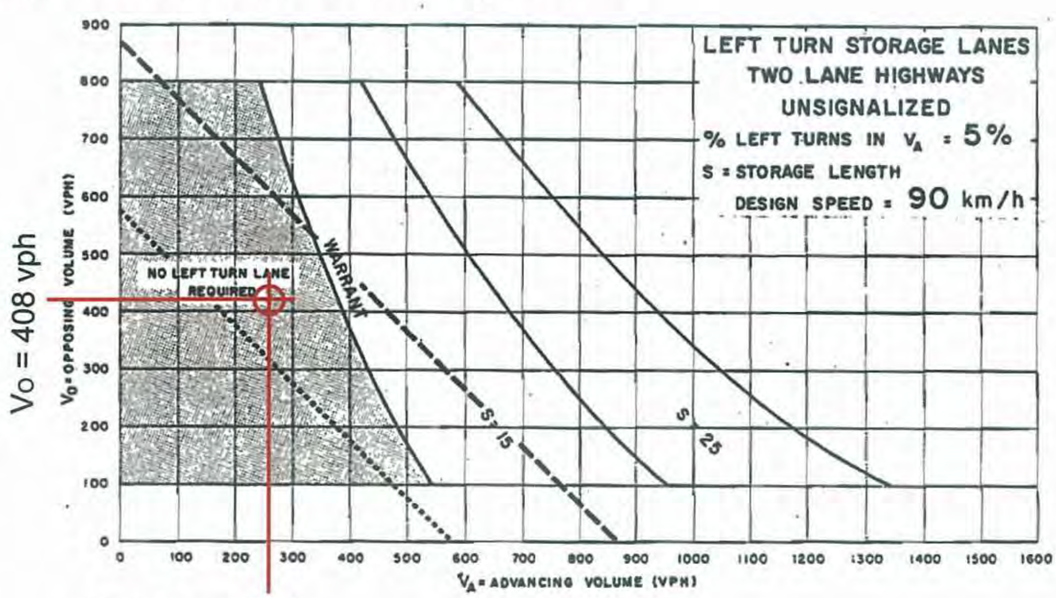
Northbound Left Turn Lane Warrant Analyses
2022 Background Traffic

Weekday AM Peak Period - GDSOH Figure EA-19:



Northbound Left:
V_A = 390 vph
V_L = 13vph
Left turns = 3.3%

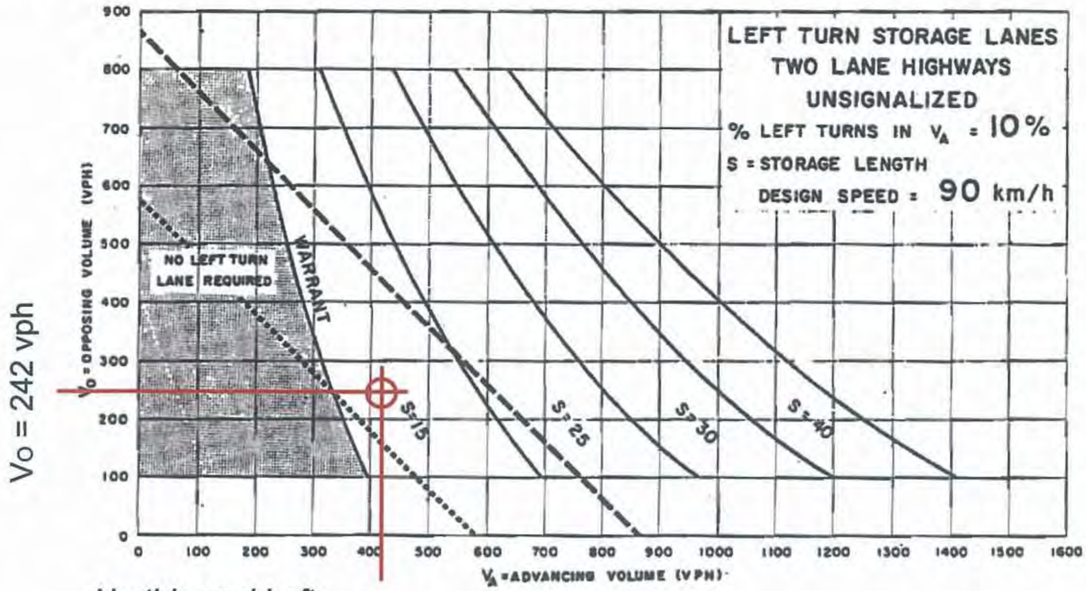
Weekday PM Peak Period - GDSOH Figure EA-19:



Northbound Left:
V_A = 257 vph
V_L = 10 vph
Left turns = 3.9%

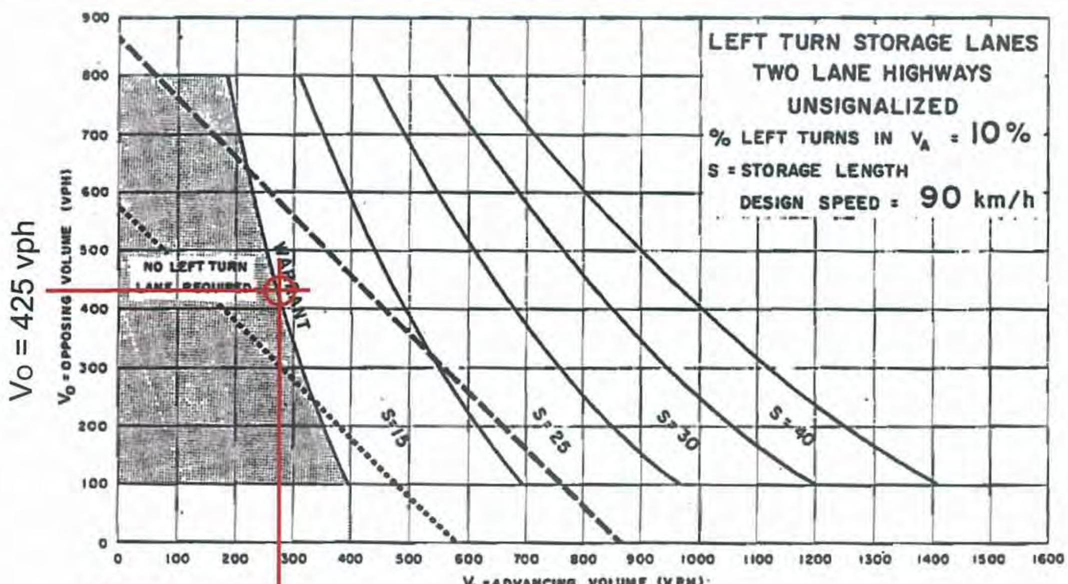
Northbound Left Turn Lane Warrant Analyses
2022 Scenario 3 Total Traffic

Weekday AM Peak Period - GDSOH Figure EA-19:



Northbound Left:
V_A = 410 vph
V_L = 33 vph
Left turns = 8%

Weekday PM Peak Period - GDSOH Figure EA-19:



Northbound Left:
V_A = 273 vph
V_L = 26 vph
Left turns = 9.5%

TECHNICAL APPENDIX III

Design Standards

Southbound Right Turn Direct Taper Lane
MTO Design Standards

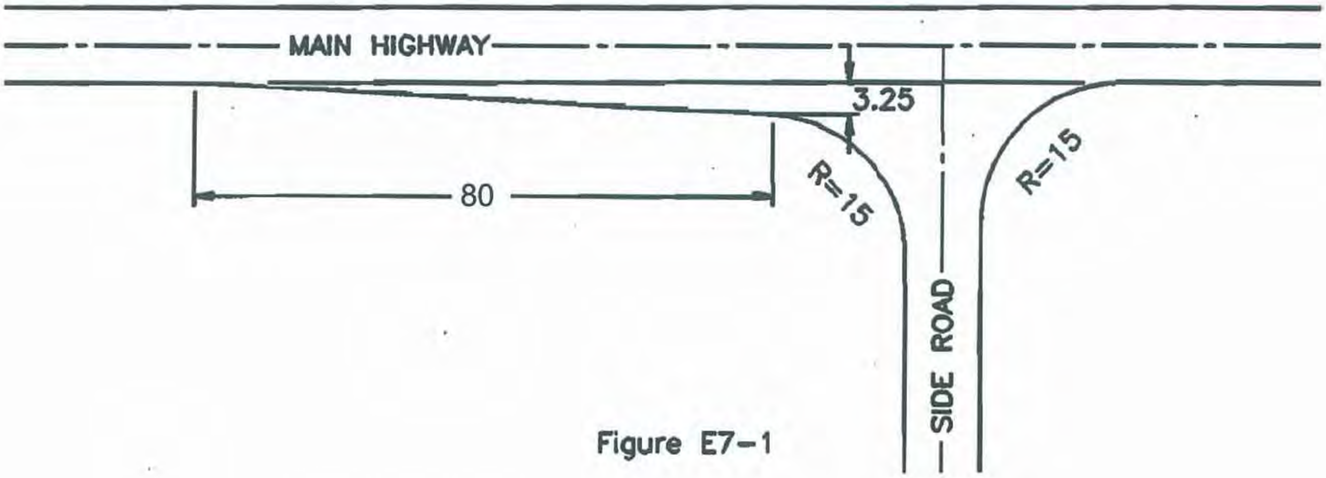


Figure E7-1

Right Turn Taper Lane Design at 'T' Intersections

Source: MTO's GDSOH, Figure E7-1

Freymond Aggregates Quarry
Bay Lake Rd., Twp. of Faraday

Traffic Brief
South Site Entrance

Prepared by:
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Prepared for:
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July 2012

July 17, 2012

Heather Sadler, B.A., M.A., MCIP, RPP
Principal and Senior Planner
EcoVue Consulting Services Inc.
25 Reid Street
Lakefield, ON K0L 2H0

Dear Ms. Sadler:

RE: Traffic Assesment - Revised Site Entrance for Proposed Freymond Quarry Bay Lake Road, Township of Faraday, County of Hastings

1.0 BACKGROUND

In May, 2012 Tranplan Associates completed a full traffic impact study[1] for the proposed Freymond Quarry that will be located on Bay Lake Road in the Township of Faraday on the the south side of the Town of Bancroft, Ontario. The May, 2012 report assumed that quarry access to Bay Lake Road would be an existing north entrance to the study site (see *Exhibit 1 - Site Access* following report text and *Sections 2.3.5* and *4.5* of the May, 2012 Report). Since the original report was published, the proponent has revised his access strategy. Planned access to the quarry will now be through a south site entrance which now serves as the main access to *Freymond Lumber Ltd.* mill located at 2287 Bay Lake Road. The main reason for this change is to take advantage of an existing weigh scale location that is presently located in close proximity to the south entrance.

2.0 THE PROPOSED SITE ENTRANCE

The present *South Site Entrance* is located about 180 m south of the original planned entrance to the quarry (see *Exhibit 1*). A site visit was carried out on Friday June 22, 2012 to assess traffic operations at the south entrance. For the purposes of discussion in this brief it has been assumed that Bay Lake Road runs in a north/south direction and the *South Site Entrance* approach runs in an easterly direction to access Bay Lake Road in a "T" intersection. This entrance serves as the main site entrance to the present lumber mill. A mix of traffic was observed accessing/departing the mill during the site visit. This mix included large tractor trailers, smaller trucks and pickup trucks assumed to be on business/service calls or making retail purchases. There are two parking areas in the immediate vicinity of the entrance. One is on the west side of Bay Lake Road just north of the entrance the other opposite the entrance on the east side of Bay Lake Road. Both lots were about 75% full with what is assumed to be employee vehicles parked for the day.

A field assessment of vehicle operating speeds was carried out along Bay Lake Road in the immediate vicinity of the *South Site Entrance*. Southbound traffic was observed to be traveling at about 45 - 50 kph. These lower speeds are influenced by a crest vertical curve about 75 m south of the entrance followed by a sharp right angle turn to the west in the Bay Lake Road alignment (see *Exhibit 1*). Northbound traffic was observed to be traveling about 50-55 kph.

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1 Freymond Aggregates Quarry, Bay Lake Road, Traffic Impact Study, Prepared for EcoVue Consulting Services Inc., by Tranplan Associates, pub., May 2012

The northbound speed was a little higher because this traffic has crested the vertical curve south of the site entrance and has clear visibility and a straight alignment for about 200 m to the north.

3.0 SITE ENTRANCE ASSESSMENT

3.1 Sight Lines

Sight lines at the *South Site Entrance* were measured as part of the June 22, 2012 field assessment. There is about 90 m of sight distance to the south of the proposed entrance. This sight line is restricted by a crest vertical curve in Bay Lake Road. To the north the sight distance exceeds 210 m. These sight lines were reviewed against standards contained in the MTO's *Geometric Design Standards for Ontario Highways* (GDSOH) manual. Sight distance to the south was assessed against the observed 50-55 kph operating speed of the northbound traffic approaching from the south. The available sight distance is about 90 m. The MTO recommended *Stopping Sight Distance* (SSD) for 55 kph is 75 m. The available 90 m sight distance exceeds the minimum SSD. The MTO preferred sight distance for a commercial entrances[2] for 55 kph is about 130 m. Based on Township Road Needs Study data (see attachment following *Exhibit 1*), the planned/posted speed for this section of Bay Lake Road is 60 kph. The SSD for 60 kph is 85 m. The available SSD of 90 m to the south of the entrance exceeds this minimum requirement.

The southbound traffic stream on Bay Lake Road is operating at about 45-55 kph. This lower operating speed is likely a result of the fact that most of the drivers on Bay Lake Road are familiar with the restricted sight lines caused by the crest vertical curve followed by the right angle turn to the west. The 210 m sight line to the north is exceeds the MTO recommended sight distance for commercial entrances for speeds up to 90 kph.

3.2 Traffic Operations

Traffic operations of the *South Site Entrance* were assessed using forecast traffic volumes prepared for the May, 2012 report. As a worst case scenario the assessment was based on 2022 total traffic conditions illustrated in *Exhibit 7* of the May, 2012 report. Site traffic was re-assigned to the south entrance. Approach volumes at the Bay Lake Road/South Site Entrance intersection are all forecast to be less than 100 vehicles per hour (vph). Based on these approach volumes, all traffic movements at the site entrance will operate at acceptable levels of driver delay consistent with current *Highway Capacity Manual* (HCM) standards. Since all forecast approach volumes are less than 100 vph, there will be no requirement for auxiliary turning lanes on Bay Lake Road to support forecast volumes accessing the study site.

3.3 Entrance Requirements

The recommended lane configuration at the intersection of the South Site Entrance and Bay Lake Road is as follows:

[2] See Table 1, Commercial Site Access Policy and Standard Designs, MTO pub. 1994.

- Northbound Bay Lake Road, a shared through/left turn lane
- Southbound Bay Lake Road, a shared through/right turn lane
- Eastbound Site Entrance, one shared left turn/right turn lane and one inbound lane.

The present *South Site Entrance* is slightly skewed to the north. This entrance should be aligned to 90 degrees to Bay Lake Road. This would improve sight visibility to the south with its lesser sight distance. A guide to finalizing the site entrance requirements a suggested design *CSAS-23 Truck Access* can be taken from the current MTO *Commercial Site Access* manual.

4.0 CONCLUSIONS AND RECOMMENDATIONS

The conclusions and recommendations contained in *Section 5* of the May, 2012 report remain valid with the exception of the original site entrance comments. *Section 5.1*, Bullet No. 5 and the final bullet of the May, 2012 report are superceded by the findings of this traffic brief. Access to the proposed site will now be via the existing South Site Entrance to the *Freymond Lumber Ltd.* mill. There is a reduced sight line distance to the south of the proposed site entrance. This sight line exceeds MTO recommended SSD requirements. All other sight lines meet or exceed MTO sight line requirements as defined in *Table 1* of the MTO *Commercial Site Access* manual.

In *Section 5.2 - Recommendations*, Bullet No 3 of the May 2012 report is superceded by the findings of this Traffic Assessment. The recommended *Truck Entrance Sign* (Wc-8L) should be installed on the east side of Bay Lake Road at an appropriate location south of the South Site Entrance. The remaining recommendations of the May 2012 report remain valid.

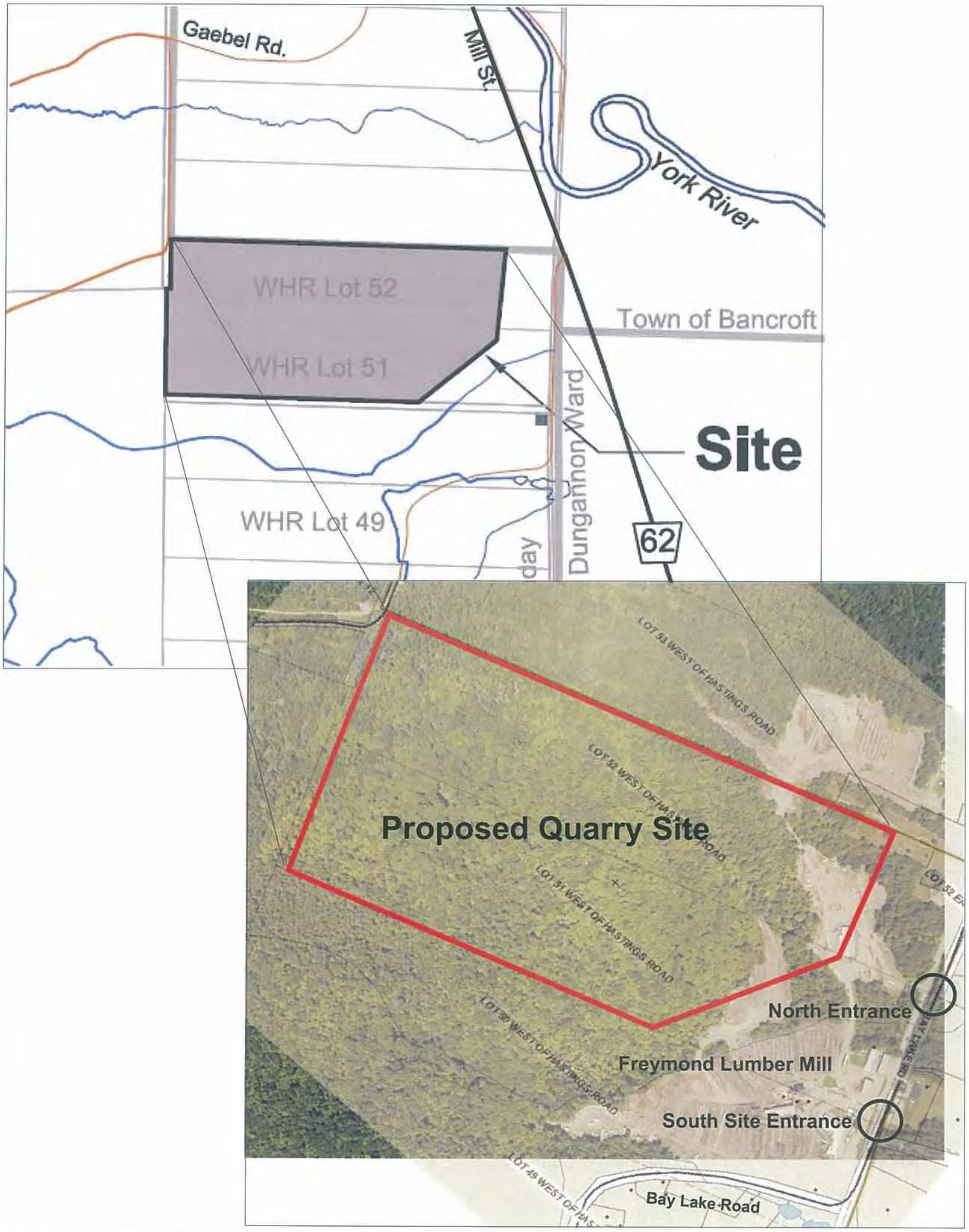
With the implementation of the recommendations of this traffic assessment, the existing South Site Entrance to Freymond Lumber mill will provide adequate access to the proposed quarry development. An additional consideration not included in the May, 2012 report is the internal circulation of on-site traffic. The original study analyses assumed a north entrance that would provide almost direct access from the quarry operation to Bay Lake Road. With the planned utilization of the existing South Site Entrance there will be a mix of quarry and mill traffic. It is recommended that in preparing the overall site plan for the development, that consideration be given to providing appropriate safe on-site routing for the two separate sources of site traffic.

Additional background information on the traffic analysis is available in study working papers. I would be pleased to provide such further information as you may require.

Yours truly,

William Copeland, P.Eng.
Principal

Exhibit 1
Site Access



Road Appraisal Sheet

Section No	1210	**Length**	3.4	**Old Sect No**	121
Road Name	Bay Lake Road A				
From	Hwy 62	**Km**	0.5	**Direction**	S
To	Barton Lane	**Km**	0	**Direction**	
Surf Type	LCB	**Platform Width**	7	**Surface Width**	6
		Road Allowance:	Forced Road		
Road Environ	R	**Drainage**	ND	**Speed**	60
Boundary Road	N	**Classification**	5	**Old Class**	M5
Road Condition	6				

Construction: $650,063

Ditching: $0

Remarks

Appendix D

Stage 1 & 2 Archaeological Assessment

Kinickinick Heritage Consulting

PIF P039-160-2010

A STAGE 1 ARCHAEOLOGICAL ASSESSMENT OF FREYMOND QUARRY PART OF LOTS 51 & 52 CONCESSION WHR DUNGANNON TWP. (GEO.) HASTINGS COUNTY

prepared for: Freymond Lumber Ltd.
2287 Bay Lake Road
Bancroft, Ontario K0L 1C0
Tel.: (613) 332-3020 Fax.: (613) 332-5554

prepared by: Ken Swayze
Archaeological Consultant (Lic. # P039)
Kinickinick Heritage Consulting
207 Old Mine Road, R. R. # 5 Cobden, Ontario K0J 1K0
Tel.: (613) 791-4391

December 2010

Summary: K. Swayze PIF P039-160 Kinickinick Heritage Consulting December 2010

A STAGE 1 ARCHAEOLOGICAL ASSESSMENT OF FREYMOND QUARRY PART OF LOTS 51 & 52 CONCESSION WHR DUNGANNON TWP. (GEO.) HASTINGS COUNTY

In late October Freymond Lumber Ltd. retained Ken Swayze, of Kinickinick Heritage Consulting, to prepare a Stage 1 archaeological assessment of property where they propose to develop a hard rock quarry. A Stage 1 archaeological assessment is a background review of surficial geology, post-glacial landscape evolution, historical land use, and considers the present condition of the property. The purpose of this Stage 1 assessment is to determine if the study area has archaeological potential and to plan appropriate procedures for Stage 2 assessment. Geographic terrain analysis is used to estimate the potential for pre-contact archaeological sites, while the potential for historical Euro-Canadian archaeological deposits is determined by a consideration of historical maps and aerial photographs.

The proposed quarry property is in the western ¾ of lots adjacent the southern boundary of Bancroft about 1 km southwest of the York River on the west side of a historical colonization route, the former Hastings Road. The characteristic landforms of the study area are steep-sided rocky ridges separated by a stream. The northern ridge has 56 m relief, while only the northern flank of the southern ridge is in the study area. The parcel is located at the intersection of the Canadian Shield and a Pleistocene spillway composed of a surface deposit of glacial outwash. Above 365 m asl, the terrain is bedrock with shallow drift cover. Below 365 m asl, the bedrock and boulders are mantled by sandy, gravelly, outwash that forms an apron at the foot of the hill. An escarpment rings the summit of the northern ridge and part of the north-facing hillside of the southern ridge. The east-facing hillside of the northern ridge is a steep 18^0 slope that fans out at the base.

The bedrock ridge in the study area would have become available for occupation by early postglacial hunter-gatherers by about 11,500 BP during the Early Palaeo-Indian period. By 11,200 BP the ice front would have withdrawn and the water level in the spillways would have dropped considerably, perhaps to 340 and 335 m asl. Then the level fell to 320 m asl, probably by 10,000 BP.

Archaeological potential occurs when the development zone is in proximity to a feature of archaeological interest. In eastern Ontario, a buffer zone of archaeological potential extends for 200 m around each feature of archaeological interest. Figure 9a shows the location of features of archaeological interest in the study area. Figure 9b shows the areas of high, moderate, and low archaeological potential.

The consultant concludes that some areas have potential for archaeological material from the Late Palaeo-Indian and Early Archaic cultural periods, because they would have been in proximity to early postglacial river shores. The terrain above 365 m asl has moderate archaeological potential, due to its proximity to the relatively short-lived relict shoreline that occurred at that elevation, as well as proximity to an existing secondary water source. The areas of potential areas require Stage 2 archaeological assessment to determine the presence or absence of archaeological material. Test pit survey at regular intervals is the recommended method of assessment. A test pit interval of 5 m is recommended for the high potential area and a 10 m interval for the moderate potential area.

However, given the nature of archaeological phenomena, it is possible that deeply buried archaeological deposits, or human remains may be disturbed during construction and quarry operation. If artifacts are discovered the Heritage Operations Unit should be notified immediately (416-314-7123); if human remains are disturbed, the Registrar or Deputy Registrar of the Cemeteries Regulation Unit of the Ministry of Consumer and Commercial Relations should be notified (416-326-8404).

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A STAGE 1 ARCHAEOLOGICAL ASSESSMENT OF FREYMOND QUARRY PART OF LOTS 51 & 52 CONCESSION WHR DUNGANNON TWP. (GEO.) HASTINGS COUNTY

Introduction

In late October Lou Freymond, of Freymond Lumber Ltd. in Bancroft, retained Ken Swayze, of Kinickinick Heritage Consulting, to prepare a Stage 1 archaeological assessment of part of lots 51 & 52 Concession WHR Dungannon Twp (geo.), where he proposes to develop a hard rock quarry (Figures 1, 2 & 3). This assessment follows the Ministry of Tourism and Culture standards and guidelines (OMTC 2009).

A Stage 1 archaeological assessment is a background review of surficial geology, post-glacial landscape evolution, historical land use, and considers the present condition of the property. It also reviews the OMTC data file on archaeological sites and previous archaeological studies in the vicinity. The purpose of this Stage 1 assessment is to determine if the study area has archaeological potential and, in the event that it does have potential, to plan appropriate procedures for Stage 2 assessment. Geographic terrain analysis is used to estimate the potential for pre-contact archaeological sites, while the potential for historical Euro-Canadian archaeological deposits is determined by a consideration of historical maps and aerial photographs.

STAGE 1

1.0 Description of the Property

The proposed quarry property is located at 2287 Bay Lake Road in the western ¾ of lots 51 & 52. Freymond Lumber Ltd. sawmill occupies the eastern ¼ fronting Bay Lake Road (Figure 3). The parcel is adjacent the southern boundary of Bancroft about 1 km southwest of the York River (Figure 2) on the west side of Bay Lake Road, which, is a remnant of the Hastings Road, a historical colonization route (Figure 4). A historical cemetery, near the northeast corner of the study area, is also located beside the former Hastings Road (Figure 6).

The characteristic landforms of the study area are steep-sided rocky ridges (sometimes called "hogs back" ridges), which are separated by a small-order stream. The northern ridge has 56 m relief, from 329 m asl, at the east end, to over 385 at the summit (Figures 3 and 9a). Only the northern flank of the southern ridge is within the study area and, given the lack of a development plan at this stage, it may not be in the extraction zone. The parcel is located at the intersection of the Canadian Shield and a Pleistocene spillway composed of a surface deposit of glacial outwash (Figures 7&8). Above 365 m asl, the terrain is bedrock with shallow drift cover. At the summit, the polished bedrock is visible in places despite the forest cover (Figure 11b). Below 365 m asl, the bedrock and boulders are mantled by sandy, gravelly, outwash that forms an apron at the foot of the hill (Figure 13b). An escarpment rings the summit of the northern ridge and part of the north-facing hillside of the southern ridge. The east-facing hillside of the northern ridge is a steep 18^0 slope that fans out at the base.

The property is covered with secondary growth of hardwood, predominantly maple inter-mixed with conifers. It appears to have been logged several times in the past. Recently some maple sap has been collected and a small sugar shack has been built at the foot of the hill. The historical atlas (Figure 4) shows the location of the property in respect to the Hastings Road colonization route in the late 19^{th} century; however there is no built infrastructure portrayed. A18252-25, a historical aerial photograph (Figure 6) taken about 1946, show no indication of any homestead activities or historical buildings.

The consultant conducted a site inspection of the study area on November 16 2010 in order to ground truth maps and aerial photography and gain first-hand information about archaeological potential of the project. Permission to access the site was obtained from Freymond Lumber Ltd. The weather was ideal for the purpose and the consultant was able to walk the periphery and inspect all areas of the parcel. Several pertinent aspects that affect archaeological potential and do not apparent in maps and photographs were observed in the course of this inspection. The 5 m contour interval of the MNR base map (Figure 3) is not adequate to portray a fluted linear feature at 340 m asl at the base of the northern ridge that the consultant interprets as a fluvial landform, perhaps a relict beach formation from the early postglacial period. Similarly, the contour lines, which indicate hillsides with 15^0 to 18^0 slopes, do not truly portray the precipitous nature of the slopes in many places. The inspection also revealed the shallowness of the drift that barely covers the bedrock everywhere over 365 m asl. Based on what he saw, the consultant would say that the glacial outwash indicated in the preliminary surficial geology map (Figure 8) is quite thick at the base of the ridge (Figure 13b) and actually extends higher up the hillside (to about 365 m asl) than is indicated by the map.

2.0 Surficial Geology and Post-Glacial Landscape Evolution

The following account references the dates of geological episodes to cultural time periods in order to underline the effect these processes had upon the relative attractiveness of landscape features of the study area for human use, either for habitation or specific resource exploitation activities. The cultural periods referred to, and their approximate dates before present (BP) are: Palaeo-Indian 11,500-10,000 BP; Early Archaic 10,000-6,000 BP; Middle Archaic 6,000-4,500 BP; Late Archaic 4,500-2,500 BP; Woodland 2,500 BP-1600 AD and Historic 1600-1900 AD.

The most significant and dramatic effect of deglaciation in eastern Ontario was the creation of the Champlain Sea, which existed for thousands of years—first, as an arm of the North Atlantic Ocean, and later as a series of riverine lakes. Beginning about 12,700 BP the entire St. Lawrence Lowlands was submerged under the Champlain Sea (Gilbert 1994:6). The northwestern arm of this sea (Barnett 1988) occupied the upper Ottawa Valley. The maximum extent of the Champlain Sea has been radiocarbon dated, from shells at 170 m a.s.l. near Shawville, to 11,400 BP and to 11,000 BP, at 160 m near Martindale in the Gatineau Valley. At Almonte and Rigaud, the high water level has been dated to 11,200 BP, at 154 m, and 160 m a.s.l., respectively (Fulton and Richard 1987: Table 7). Thus, the period of maximum extent of the Champlain Sea corresponded with the early Palaeo-Indian period.

The ice front did not recede north of the Mattawa River until about 10,500 BP (Lewis and Anderson 1989) and for several millennia before that the enormous glacial run-off poured off the Algonquin Dome into the Madawaska drainage network through a vast system of postglacial spillways (Chapman 1975 map 2228). After the ice withdrew, the drainage through the spillways on the flanks of the Algonquin Dome was greatly reduced and the modern Madawaska drainage network began to take shape. Because the land took some time to recover from the weight of the ice, many river basins in former spillways still held greater volumes of water than at present and the water levels fell successively lower through time.

The sands and gravels interpreted as out wash in the York River below Bancroft (Figure 7) are most likely a transitional sequence from a deltaic environment to that of large braided streams that deposited sediments up to an elevation of 365 m asl (Barnett and Leyland 1980). Surficial features related to this episode are clearly visible in A18252-25 taken about 1946 when the north side of the river was clear of trees, probably as a result of forest fire. An early postglacial relict shoreline occupies the interface between the outwash in the valley and the bedrock shield country above it to the north. After the ice withdrew from the Algonquin Dome, after 10,500 BP, the water level in the spillway basin would have dropped considerably through successive levels. Several of these lower river levels can be determined from the preliminary surficial geology map and aerial photograph (Figures 6 & 8). There is a fluvial terrace indicated near the arena at about 340 m asl and other cut banks at about 335 m asl several hundred meters back from the present river. The aerial photograph clearly shows where former river ox bows cut into the outwash up to 320 m asl.

The bedrock ridge in the study area would have become available for occupation by early postglacial hunter-gatherers by about 11,500 BP during the Early Palaeo-Indian period. At this time, the ice field still lay heavily on the Algonquin Dome and the spillways indicated on Chapman's (1975) map (Figure 7) would have been full of sediment-laden meltwater. By 11,200 BP the ice front would have withdrawn to the Nipissing-Mattawa Lowlands and the water level in the spillways would have dropped considerably, perhaps to 340 and 335 m asl, as indicated in Barnett and Leyland 1980 (Figure 8). It is not clear how long the water remained that high or when the level fell to 320 m asl, as indicated by the abandoned ox-bow channel in A18252-25 (Figure 6), but the transformation would probably be complete by 10,000 BP at the advent of the Holocene epoch and the Early Archaic cultural period.

3.0 Previous Archaeological Research and Known Sites in the Vicinity

The Ministry of Culture archaeological site data is based on the Borden System. (Borden 1952) that is used throughout Canada. A "Borden Block" is ten degrees latitude (long) and ten degrees longitude (wide) and is named by a co-ordinate system, which uses upper and lower case letters. Canadian archaeologists refer to "Borden Blocks" and "Borden Numbers" and "Bordenize" sites when they register them. Sites within a Borden Block are numbered sequentially. The proposed quarry is in the BgGk Borden Block and there are no previously recorded archaeological sites within a 2 km radius of it.

4.0 Archaeological Potential of the Property

Archaeological potential occurs when there are previously identified archaeological sites within 2 km of the study area and when the development zone is in proximity to, or contains, a feature of archaeological interest. In eastern Ontario, a buffer zone of archaeological potential extends for 200 m around each feature of archaeological interest.

Figure 9a shows the location of features of archaeological interest in the study area. The blue line is a stream, a secondary water source. The red line on the 365 m elevation marks the approximate limit of sandy outwash deposit and the elevation of an early postglacial relict shoreline. The northern ridge at that time was a low bedrock islet surrounded by melt water and, although technically habitable, the islet was perhaps not an economically attractive place from a hunter-gatherer's perspective. The yellow lines along the 340 and 335 m contour lines indicate the water level in the study area when the fluvial terraces indicated by the surficial geology map were active riverbanks in the Palaeo-Indian period. By the Early Archaic period, beginning 10,000 BP, the river level had probably dropped to 320 m asl removed more than 200 m from the study area. The green line along the 380 m contour line indicates the summit of the northern ridge that would have afforded a 360 view of the surrounding terrain to early postglacial hunter-gatherers. By Middle Archaic times the ancestral York and Madawaska Rivers would have taken their modern form and would not be in proximity to the study area. The sole feature of archaeological interest from the Middle Archaic onwards, would have been the creek, a secondary water source. Therefore, the area within 200 m of the creek has moderate potential for post-Early Archaic potential. The consultant has no data to indicate that the study area has Euro-Canadian historical potential.

Figure 9b shows the areas of high (yellow), moderate (green), and low (gray) archaeological potential. The high and moderate potential areas indicate where Palaeo-Indian or Early Archaic archaeological material may be deposited, based on proximity to the identified features of archaeological interest. Low potential areas (indicated in gray) are steep slopes.

5.0 Conclusions and Recommendations

The consultant concludes that the summit of the northern ridge and the apron of outwash at its base have potential for archaeological material from the Late Palaeo-Indian and Early Archaic cultural periods, because they would have been in proximity to early postglacial river shores. High archaeological discovery potential occurs at the foot of the hill, where there is an apparent fluvial feature, and on the summit, where a hunter-gather lookout site may occur. The terrain above 365 m asl has moderate archaeological potential, due to its proximity to the relatively short-lived relict shoreline that occurred at that elevation, as well as proximity to an existing secondary water source.

The high and moderate potential areas require Stage 2 archaeological assessment to determine the presence or absence of archaeological material. Test pit survey at regular intervals is the recommended method of assessment. A test pit interval of 5 m is recommended for the high potential area and a 10 m interval for the moderate potential area, because of the shallowness of the drift. The low potential escarpment areas do not require field tests. When the quarry extraction process has been better defined, some of the areas of potential in Figure 9b may fall outside of the extraction zones and therefore need not be surveyed.

However, given the nature of archaeological phenomena, it is possible that deeply buried archaeological deposits, or human remains may be disturbed during construction and quarry operation. If artifacts are discovered the Heritage Operations Unit should be notified immediately (416-314-7123); if human remains are disturbed, the Registrar or Deputy Registrar of the Cemeteries Regulation Unit of the Ministry of Consumer and Commercial Relations should be notified (416-326-8404).

6.0 References

Barnett, P.J.
1988 "History of the northwestern arm of the Champlain Sea", In; Gadd, N.R. (ed.) The Late Quaternary Development of the Champlain Sea Basin, *Geological Association of Canada*, Special Paper 35, pp. 25-36.

Barnett, P.J. and J.G. Leyland
1980 "Quaternary Geology of the Bancroft Area, Southern Ontario" *Ontario Geological Survey* Preliminary map P.2376, Geological Series, scale 1:50,000. Geology 1978, 1979. Toronto.

Borden, C. E.
1952 "A Uniform Site Designation Scheme for Canada" *Anthropology in British Columbia* vol. 3:44-48, Victoria.

Chapman, L.J.

1975 "The physiography of the Georgian Bay-Ottawa Valley Area of Southern Ontario" *Geoscience Report* 128, Ontario Division of Mines, Ministry of Natural Resources. Toronto.

Fulton, R.J. and S.H. Richard
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1994 "A Field Guide to the Glacial and Postglacial Landscape of Southeastern Ontario and Part of Québec" *Geological Survey of Canada*, Bulletin 453, Ottawa Canada.

Lewis C.F.M. and T.W. Anderson
1989 "Oscillations of levels and cool phases of the Laurentian Great Lakes caused by inflows from glacial Lake Agassiz and Barlow-Ojibway" *Journal of Palaeolimnology* v.2:99-146.

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2009 "Standards and Guidelines for Consultant Archaeologists. Fieldwork and Reporting. Ministry of Culture, Toronto.

Phelps, E.C. (ed.)
2000 *Belden's Illustrated Historical Atlas of the County of Hastings, Ontario, 1881* facsimile, Millenium Edition, Alexander Publishing, Ancaster Ontario.

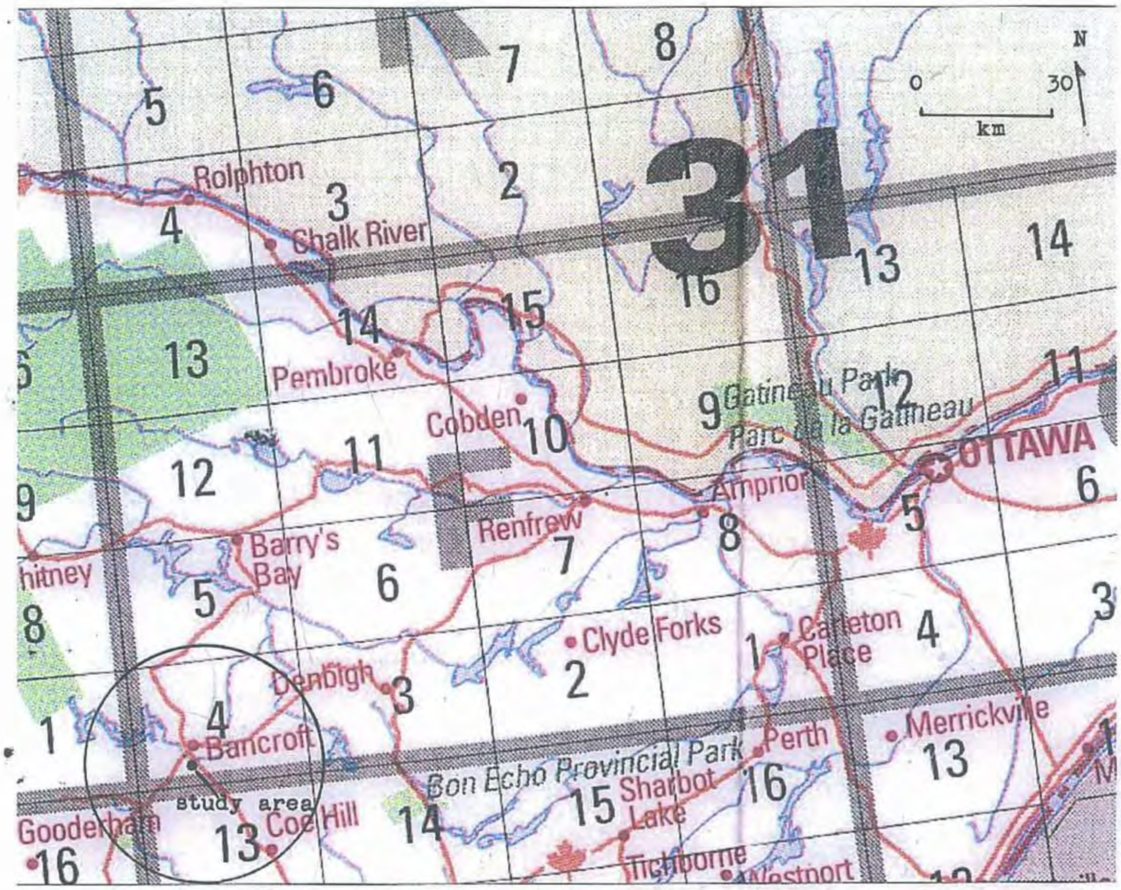


Figure 1: Location of the proposed quarry

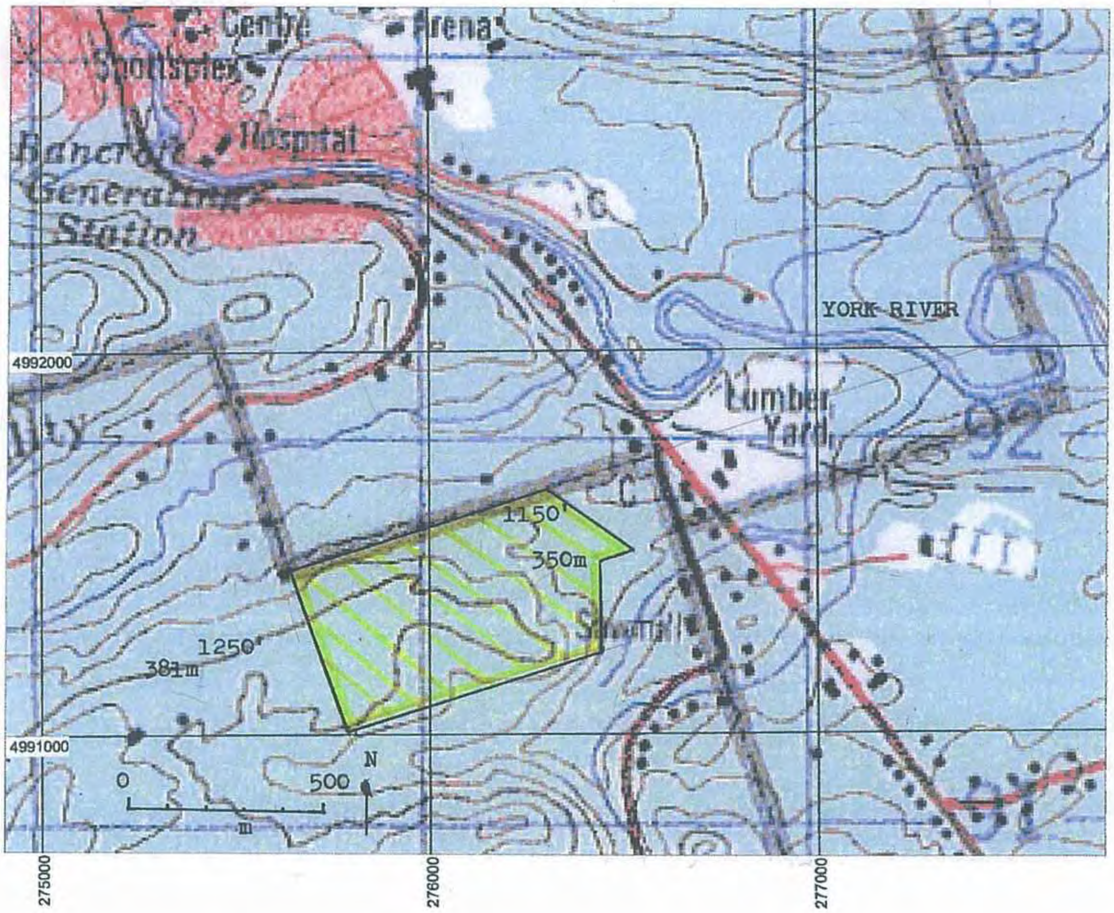


Figure 2: Topography, drainage and infrastructure, NTS 31 F/4.

Grid: UTM (NAD27)

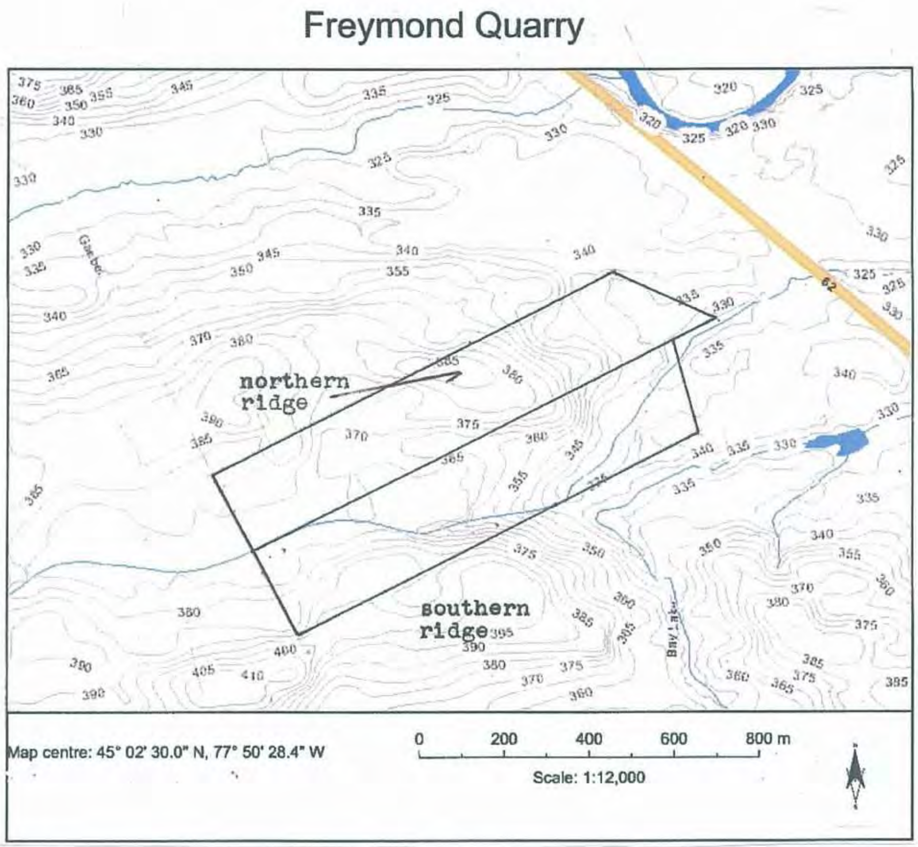


Figure 3: Plan of the proposed quarry

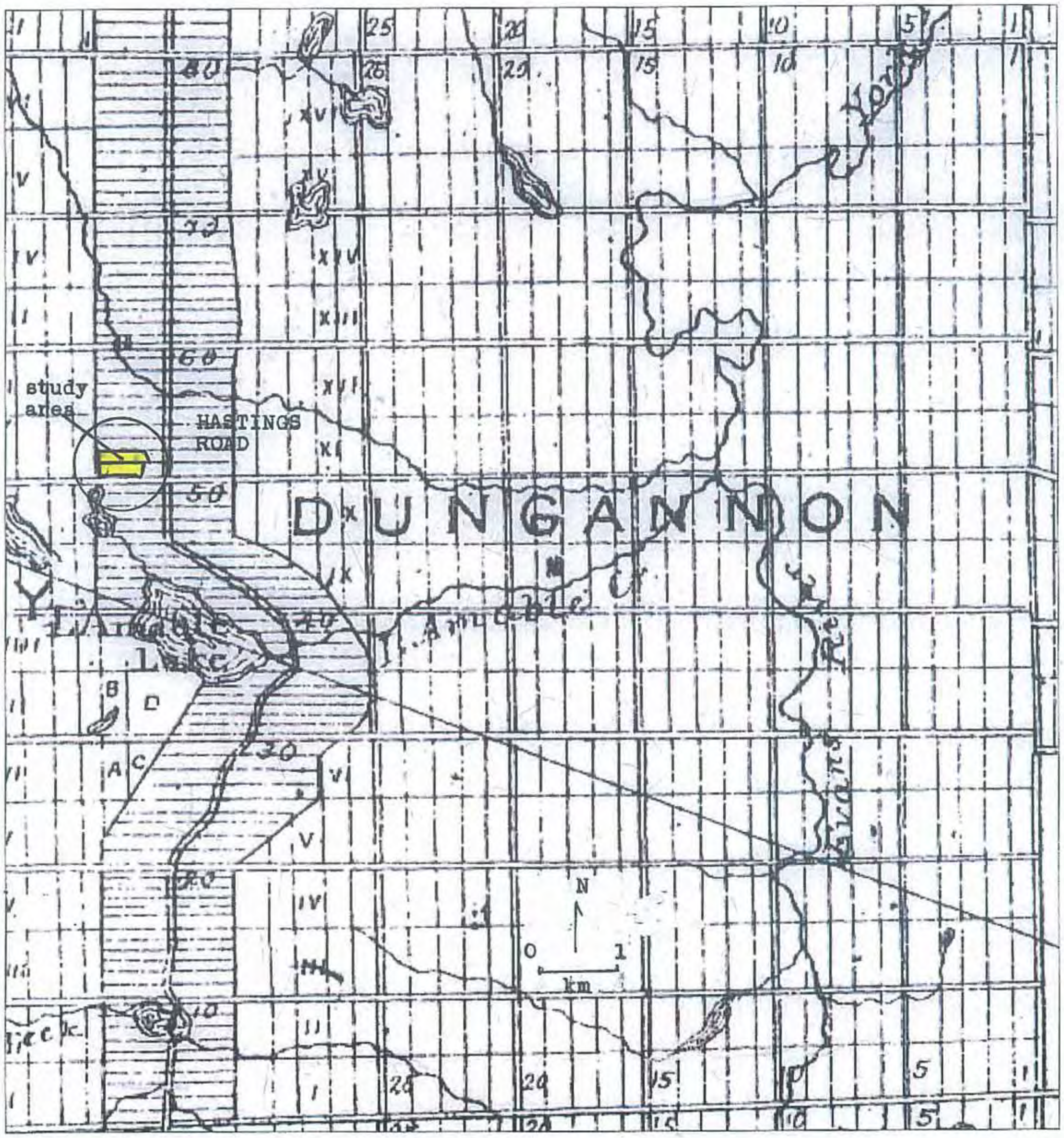


Figure 4: From the Historical Atlas of Hastings County (1881).

Figure 5: Modern aerial photograph of the proposed quarry

Figure 6: Historical aerial photograph A18252-25, about 1946.

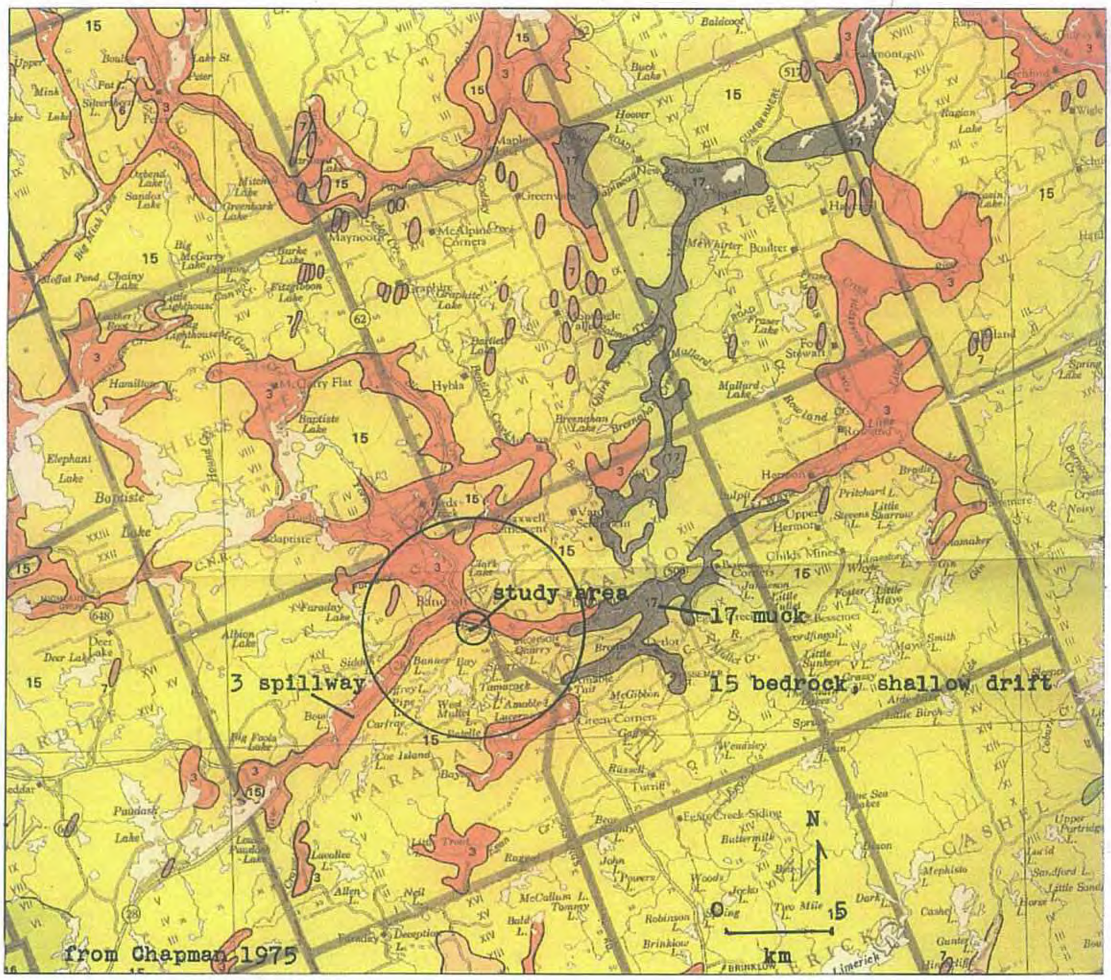
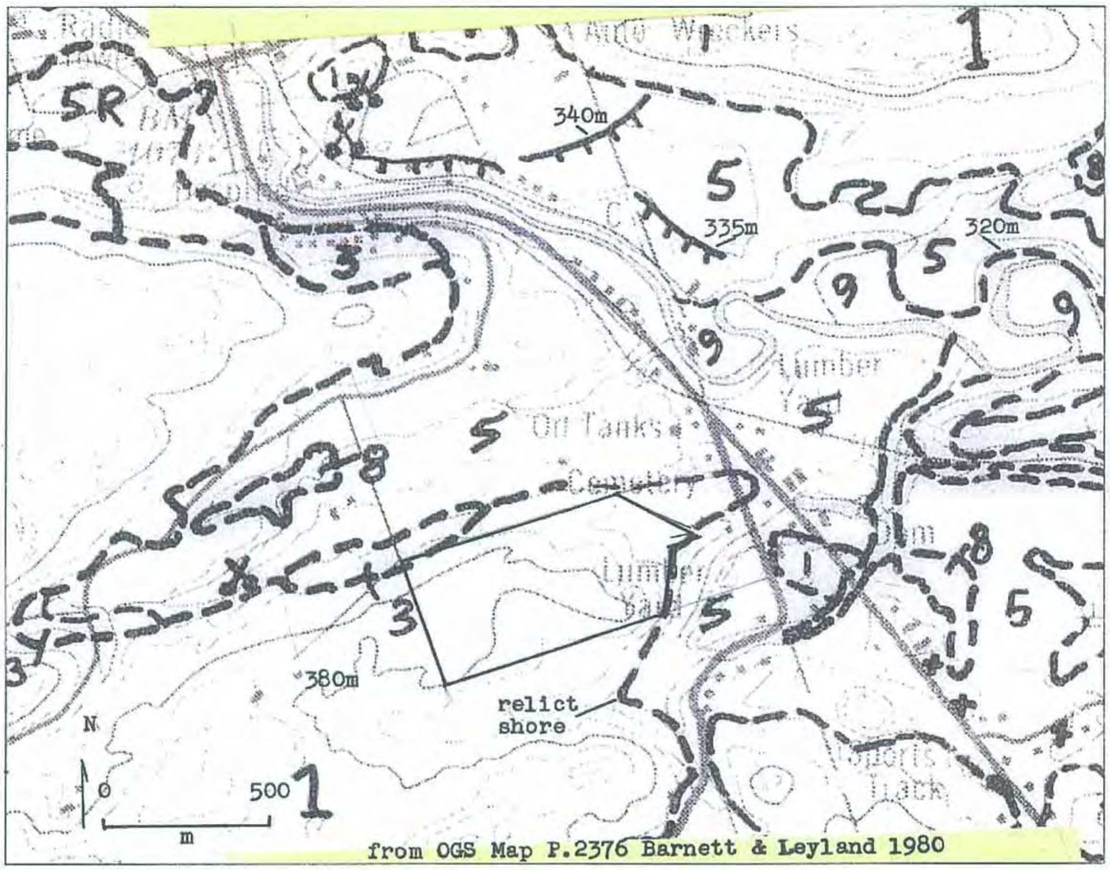


Figure 7: Physiography of the York River region.



1	Bedrock: exposed or with very thin drift cover	8	Bog and swamp deposits: muck, peat, marl
3	Till, silty to sandy; stony	9	Modern alluvium: unsubdivided - sand, silt, gravel, clay, muck
5	Glaciofluvial outwash and deltaic deposits: gravelly sand, sand, gravel		

Figure 8: Surficial geology of the proposed quarry.

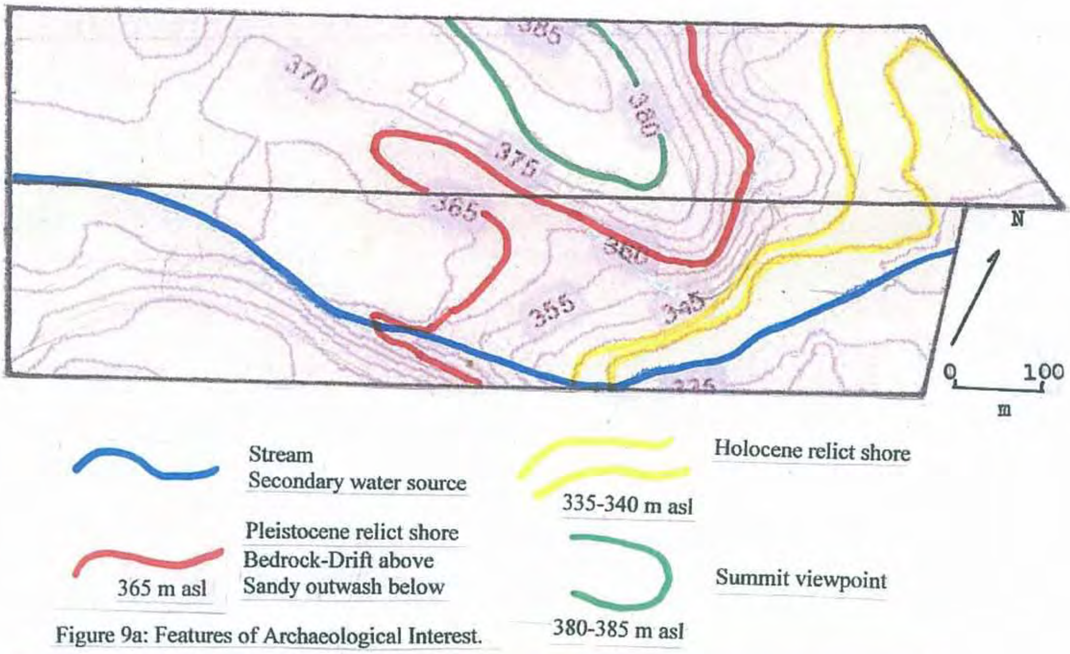


Figure 9a: Features of Archaeological Interest.

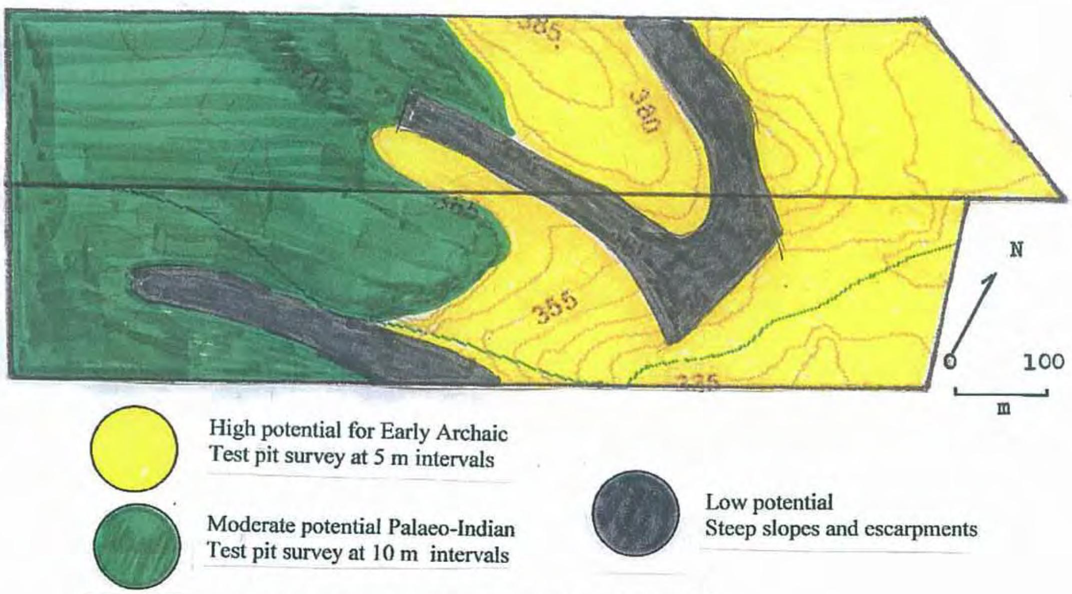


Figure 9b: Areas of High, Moderate, and Low Archaeological Potential.

Figure 9: Archaeological Potential of the proposed quarry.

Figure 10a: Looking northwest at the proposed quarry.

Figure 10b: Looking west at a relict beach area at the foot of the hill.

Figure 10: Photographs of the proposed quarry, November 16 2010.

Figure 11a: Looking southeast towards the rock knob above the creek.

Figure 11b: Looking east at the summit of the rock knob.

Figure 11: Photographs of the proposed quarry, November 16 2010.

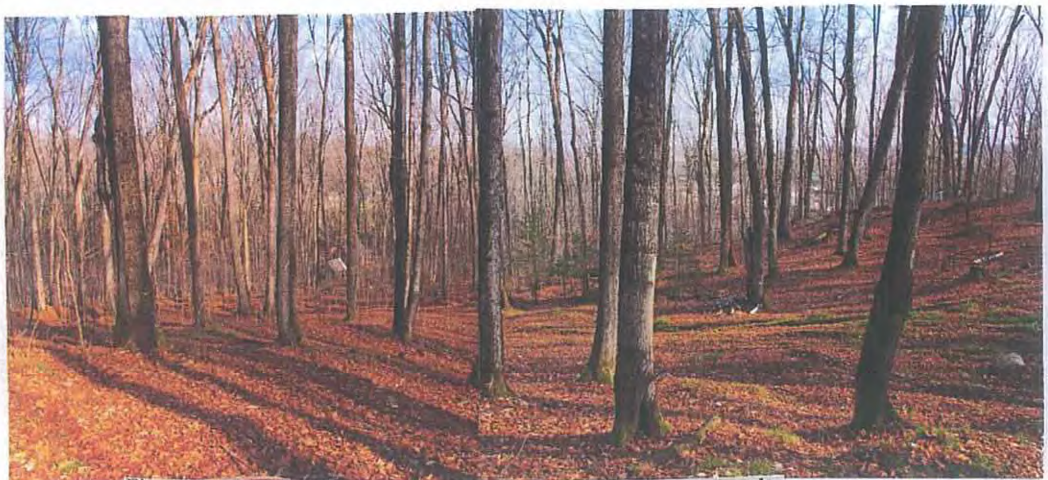


Figure 12a: Looking down slope at the sugar shack on the relict beach.

Figure 12b: Looking at a dune at about 335 m asl.

Figure 12: Photographs of the proposed quarry, November 16 2010.

Figure 13a: Looking west at the creek at the foot of the hill.

Figure 13b: Looking northwest at outwash sand deposit.

Figure 13: Photographs of the proposed quarry, November 16 2010.

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Culture Programs Unit
Programs and Services Branch
Culture Division
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Telephone: 416/314-7132
Facsimile: 416/314-7175
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Ontario

September 4, 2012

Ken Swayze
Kinickinick Heritage Consulting
207 Old Mine Road, RR 5
Cobden, Ontario K0J 1K0

RE: **Entry into the Ontario Public Register of Archaeological Reports: Archaeological Assessment Report Entitled, "A Stage 1 Archaeological Assessment of Freymond Quarry Part of Lots 51 & 52 Concession WHR Dungannon Twp. (Geo.) Hastings County", Dated February 2011, Received by MTCS Toronto Office on February 14, 2011, MTCS Project Information Form Number P039-160-2010, MTCS RIMS Number 12AG109**

Dear Mr. Swayze,

This office has reviewed the above-mentioned report, which has been submitted to this ministry as a condition of licensing in accordance with Part VI of the Ontario Heritage Act, R.S.O. 1990, c 0.18. This review has been carried out in order to determine whether the licensed professional consultant archaeologist has met the terms and conditions of their licence, that the licensee assessed the property and documented archaeological resources using a process that accords with the 1993 *Archaeological Assessment Technical Guidelines* set by the ministry, and that the archaeological fieldwork and report recommendations are consistent with the conservation, protection and preservation of the cultural heritage of Ontario.

This report was subjected to a review that focused specifically on concerns for archaeological resources and/or sites in relation to the outcomes and recommendations of the report. This focused review does not alter or affect your obligation as the licensee to ensure that all reports submitted meet the Ministry technical guidelines and terms and conditions of licence.

The report states that the subject property has archaeological potential and recommends Stage 2 assessment be completed.

Based on the information contained in the report, the ministry is satisfied that the fieldwork and reporting for the archaeological assessment is consistent with the ministry's 1993 *Archaeological Assessment Technical Guidelines* and the terms and conditions for archaeological licences. This report will be entered into the Ontario Public Register of Archaeological Reports. Please note that the ministry makes no representation or warranty as to the completeness, accuracy or quality of reports in the register.

I trust this information is of assistance. Should you require any further information regarding this matter, please feel free to contact me.

Sincerely,

Jim Sherratt
Archaeology Team Lead

c. Archaeology Licensing Office

---

*In no way will the Ministry be liable for any harm, damages, costs, expenses, losses, claims or actions that may result: (a) if the Report(s) or its recommendations are discovered to be inaccurate, incomplete, misleading or fraudulent; or (b) from the issuance of this letter. Further measures may need to be taken in the event that additional artifacts or archaeological sites are identified or the Report(s) is otherwise found to be inaccurate, incomplete, misleading or fraudulent.

Appendix E
Acoustic Assessment Report
Hugh Williamson Associates Inc.

HUGH WILLIAMSON ASSOCIATES INC.

Ottawa, Ontario, Canada

ACOUSTIC ASSESSMENT REPORT

FREYMOND QUARRY

TOWNSHIP OF FARADAY
HASTINGS COUNTY

LICENSED PROFESSIONAL ENGINEER
H. W. WILLIAMSON
PROVINCE OF ONTARIO

Prepared for

Freymond Lumber Ltd.

Prepared by

Hugh Williamson Associates Inc.

15th May 2013

Postal Address: PO Box 74056, RPO Beechwood, Ottawa, Ontario, K1M 2H9, Canada
Phone/Fax: (613) 747 0983, Email: hugh@hwacoustics.ca, http://www.hwacoustics.ca

ACOUSTIC ASSESSMENT OF THE PROPOSED FREYMOND QUARRY TOWNSHIP OF FARADAY HASTINGS COUNTY

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Appendix 3 Acoustic Modeling Details

Appendix 4 Background Traffic Noise Analysis

Resumes, Dr. Hugh Williamson, Michael Wells

ACOUSTIC ASSESSMENT OF THE FREYMOND QUARRY TOWNSHIP OF FARADAY

1.0 Introduction

Freymond Lumber Ltd. are in the process of applying to the Ministry of Natural Resources for a License under the Aggregate Resources Act for the proposed Freymond Quarry, located in the Township of Faraday, see Figures A1.1 and A1.2, Appendix 1.

This report describes an assessment, carried out by Hugh Williamson Associates, of the potential impact of noise from operations at the Freymond Quarry on nearby receptors in accordance with Ontario Ministry of Environment (MoE) guidelines for stationary noise sources.

This report has been prepared in accordance with the MoE Document NPC-233, *Information to be Submitted for Approval of Stationary Sources of Sound*, October 1995[1]. Noise from the facility is to be assessed according to MoE Documents: NPC-205, *Sound Level Limits for Stationary Sources in Class 1 & 2 (Urban) Areas*, October 1995[2] and NPC-232, *Sound Level Limits for Stationary Sources in Class 3 (Rural) Areas*, October 1995[3]. The report follows the recommended format contained in, *Sample Application Package, Basic Comprehensive Certificate of Approval (Air and Noise)*, July 2009[4].

The noise assessment methodology is summarised below.

- Identification of noise sensitive receptors in the vicinity of the quarry. Potential noise sensitive receptors include residences, motels, places of worship, schools and hospitals.

- Determination of the MoE sound level limits[2, 3] which will apply at each of the noise sensitive receptors.

- Identification of the sources of noise that will arise from quarry operations. In the current study, the strengths of the various noise sources were obtained from noise measurements of similar operations at other aggregate operations in Ontario.

- Based on the strengths of the individual noise sources, noise levels due to quarry operations are predicted at nearby noise sensitive receptors using a prediction procedure[5] which is favoured by the MoE. The MoE methodology requires that compliance be assessed under predictable "worst case" conditions for normal operations.

- Assessment of compliance of the noise due to quarry operations with MoE sound level limits. Where appropriate, mitigation measures are recommended such that compliance with MoE sound level limits is achieved at all receptors.

Note that this assessment considers all noise sources on the site except for the noise and vibrations caused by blasting. The impacts of blasting at the Freymond Quarry will be assessed by others.

Surrounding Lands, Acoustic Environment and Critical Receptors

The Freymond Quarry is located in a heavily wooded and hilly area on the west side of Bay Lake Road, Part of Lots 51 and 52, Concession W.H.R. in the Township of Faraday, Hastings County. The site is at the intersection of Bay Lake Road and Highway 62 as shown in Figure A1.1. Highway 62 carries significant traffic on a 24-hour basis.

Note that directions in this report are referenced to Site North as shown in Figure A1.1.

The legal description of the land occupied by the Freymond Quarry is as follows:

Part of Lots 51 and 52, Concession W.H.R.
Township of Faraday
Hastings County

The land surrounding the proposed Freymond Quarry is a mixture of Marginal Agriculture, Rural Industrial, Environmental Protection, Rural Residential, Limited Service Residential and Recreational / Resort Commercial land uses, as shown on the Zoning Map (refer Appendix 2). The site is zoned Marginal Agriculture.

Highway 62 is located approximately 175 m to the east of the eastern boundary of the proposed quarry and has a significant effect on the background noise levels in the vicinity.

Immediately north of the quarry the land is predominantly natural vegetation and forest. Further north runs Jeffrey Lake Road. A number of residences exist in this direction fronting Jeffrey Lake Road. The closest residences in this direction have been selected as critical receptors.

To the east of the quarry the land is zoned Marginal Agriculture, zoned MA, with pockets of Rural Industrial to the northeast, zoned RI, and, Environmental Protection to the southeast zoned EP. Bay Lake Road lies to the east of the site and intersects with Highway 62 at approximately 175 m east of the site's northeast corner. A number of residences fronting Bay Lake Road and Highway 62 lie in this direction. The closest residences in this direction have been selected as critical receptors.

South of the proposed quarry the land is predominantly natural vegetation and forest, zoned Marginal Agriculture, Environmental Protection and Rural Residential, with existing residences fronting Bay Lake Road in this direction. The closest residences in this direction have been selected as critical receptors.

To the west of the proposed Freymond Quarry the land is predominantly natural vegetation and forest zoned Marginal Agriculture with a small area of land zoned Limited Service Residential to the northwest. A number of residences fronting Gaebel Road lie in this direction. The closest residences in this direction have been selected as critical receptors.

The quarry site and surroundings lie on undulating land with moderate changes in elevation.

The surrounding land is relatively hilly sloping down to the north and south of the site which lies on an undulating ridge running east west across the site.

The quarry site itself consists of an undulating ridge running east west across the site. The ridge rises in the mid portion of the site to an elevation of approximately 385 m and towards the site's western boundary to an elevation of 390 m. A saddle runs between the two rises, dropping to an elevation of approximately 375 m in the mid-west region of the site. The land slopes down to the north and south of this ridge, to an elevation of approximately 360 m to 340 m at the site's northern boundary and to an elevation of approximately 370 m to 365 m at the site's southern boundary. The ridge slopes down to the east to an elevation of approximately 330 m at the site's eastern boundary. See Figure A1.2.

The noise sensitive receptors, which have been selected for detailed analysis, are shown in Figure A1.1. These were selected as being the receptors most likely impacted by noise from the Freymond Quarry. Other noise sensitive receptors are at greater distances and will be less affected by noise from the quarry. Table 1 lists the noise sensitive receptors selected for analysis.

Table 1: Points of Reception

Point of Reception	Description
POR 1	Residence (closest to the northeast) 2344 Bay Lake Road
POR 2	Residence (closest to the east) 27915 Highway 62
POR 3	Residence (closest to the east) 2258 Bay Lake Road
POR 4	Residence (closest to the southeast) A-B 2204 Bay Lake Road
POR 5	Residence (closest to the south) 2001 Bay Lake Road
POR 6	Residence (closest to the west) 431 Gaebel Road
POR 7	Residence (closest to the northwest) 342 Gaebel Road
POR 8	Residence (to the north) 169 Jeffrey Lake Road

For assessment purposes, points of reception, (POR), have been taken as upper floor windows (4.5 m above grade) and Outdoor Living Areas (30 m from Residence, 1.5 m above grade) in acoustic calculations.

2.0 Detailed Facility Description

The stone at the Freymond Quarry is extracted through drilling and blasting. Blasting produces large pieces of rock which are then crushed and screened into aggregate products of various grades before being shipped off site.

The operations plan calls for all crushing and screening to be done with a portable plant located near the pile of blasted rock. After blasting, a loader will be used to feed rock into the portable crushing and screening plant. The aggregates produced will then be placed in stockpiles, using conveyors. A loader will then load the stockpiled aggregates onto highway trucks which are used to haul the product off-site.

Excavation of the Freymond Quarry will take place in a number of lifts of varying height. For the purposes of assessing worst-case noise impacts for the extraction operation, equipment is assumed to be located on the surface and/or one or more lifts down.

The entry to the Quarry, as shown in Figure A1.2, is onto Bay Lake Road which connects through to Highway 62.

Hours of Operation

Daytime Operations (07:00 – 19:00) - During the Daytime period, all significant noise sources are assumed to be in operation, and include the following:

- One Standard Hydraulic Rock Drill or One Low Noise Hydraulic Rock Drill;
- One Portable Crushing Plant, may consist of primary, secondary and tertiary crushing and screening units (up to three total) and an associated diesel generator;
- Up to Two Loaders;
- On-Site Truck movements, to haul the product off-site;

Night Operations (19:00 – 07:00) – Loading and Hauling operations only may take place at night. Noise sources assumed to be in operation at night include the following:

- One Loader;
- On-Site Truck movements, to haul the product off-site;

It is understood that under normal circumstances, there are no plans to operate the quarry at night. Night operations have been modeled to access the impacts of loading and hauling which may occur under exceptional circumstances.

3.0 Noise Source Summary

The following noise sources have been used to model noise generated by operations at the Freymond Quarry. In brackets are the shortened names of the noise sources as used in the acoustic model. The characteristics of these sources, as used in acoustic modelling, are summarized in Table 2.

- Rock Drill (source Rockdrill_TH_72);
- Low Noise Rock Drill (source Rockdrill_SmartRIG);
- Portable Crushing Plant (source Crusher_CR) – Includes primary, secondary and tertiary crushing and screening units and an associated diesel generator;
- Loaders (source Loader);
- On-site Truck Movements (sources HWYTruck_Slow58).

The strengths of the noise sources, i.e. the sound powers shown in Table 2 and used in this analysis, are taken from a database of noise measurements made by Hugh Williamson Associates of similar operations at other aggregate operations in Ontario. Conveyors used to transfer crushed stone to stockpiles are considered as insignificant noise sources.

Noise from the loading operations is estimated using the area source method. It is assumed that a maximum of two (2) loaders will operate concurrently during the daytime period (07:00 to 19:00) and a maximum of one (1) loader will operate during periods of maximum capacity during the nighttime period (19:00 to 07:00).

Noise from the haul routes is estimated using the moving point source method. It is assumed that a maximum of 8 loads per hour will be shipped during periods of maximum capacity during the daytime period (07:00 to 19:00) and a maximum of 4 loads per hour will be shipped during periods of maximum capacity during the nighttime period (19:00 to 07:00).

Portable equipment for site preparations and rehabilitation

Portable construction equipment will be used occasionally for site preparation (e.g. land clearing and construction of berms) and rehabilitation. This equipment would typically include excavators, hydraulic shovels, dozers and scrapers. To minimize the impact of noise during site preparation and rehabilitation, the construction equipment used, excavators, bulldozers, etc., will comply with MoE Publication NPC-115[5], *Construction Equipment*, August 1978. This publication gives noise standards to be met by construction equipment in Ontario.

Site preparation and rehabilitation activities will take place only during daytime hours (07:00 – 19:00).

Table 2: Noise Source Summary Table

Source ID	Source Description	Sound Power (dBA)	Source Ht. above ground (m)	Sound Characteristics	Noise Control Measures
Standard Hydraulic Rock Drill (Rockdrill_TH_72)	Portable hydraulic rock drill	120.8	2	Steady, non-tonal, non-directional noise source	As per Section 5.0*
Low Noise Hydraulic Rock Drill (Rockdrill_SmartRIG)	Portable hydraulic Low Noise rock drill with sound power (Lw) less than or equal to 108.3 dBA	108.3	2	Steady, non-tonal, non-directional noise source	As per Section 5.0*
Portable Crushing Plant (Crusher_CR)	Crushing and screening units powered by a generator	120.5	3	Steady, non-tonal, non-directional noise source	As per Section 5.0*
Loader (Loader)	Wheeled loader CAT or similar	107.5	3	Steady, moving, non-tonal, non-directional noise source	As per Section 5.0*
Truck Movements (HWYTruck_Slow58)	Slow moving highway truck, no Jake brakes, maximum speed 20 kph	110.1	3	Steady, moving, non-tonal, non-directional noise source	As per Section 5.0*

* Location and shielding restrictions apply in some situations as set out in Section 5.0; Refer to Section 5.0 for recommended Noise Mitigation Measures.

4.0 Point of Reception Summary

Noise levels have been predicted at the critical receptors using "worst case" assumptions under normal operations and using the ISO sound propagation methodology[5], as implemented in the sound prediction software Cadna-A, version 4.2.141. The ISO methodology, which is favored by the MoE, provides a conservative (i.e. high) estimate of the noise level at each receptor taking into account adverse wind and meteorological conditions.

The estimation method includes the following:

- Distance attenuation is based on spherical spreading.
- Atmospheric attenuation.
- Ground attenuations, as appropriate.
- Barrier attenuation, as appropriate.

In order to consider cases of worst noise impacts, a number of operational scenarios have been modeled. In general, the worst impacts are those which occur when the equipment is operating on the original surface, i.e. at grade, with the impact becoming less as the equipment is located on lower lifts, i.e. below grade. The following three worst cases scenarios are presented in this report and are the basis of the mitigation recommendations specified in Section 5.0.

Scenario 1: Worst case, All equipment in operation on surface, Low Noise Rock Drill unshielded located minimum 350 m from POR 7, Existing terrain shielding POR 4 and POR 8 from Portable Crushing Plant - Day only; Figures A1.3 & A1.4

Scenario 2: Worst case, All equipment in operation, Low Noise Rock Drill with 4 m high barrier located less than 350 m from POR 7, 5.2 m high barrier or berm shielding POR 4 and POR 8 from Crushing Plant - Day only; Figures A1.5 & A1.6

Scenario 3: Worst Case, Loading and Hauling only – Day or Night operation; Figures A1.7 & A1.8

Detailed prediction results are contained in Appendix 3, with Tables A3.7.1 to 3.6.3 giving a summary of predicted noise impacts at each point of reception (POR) for the individual sources.

5.0 Recommended Noise Mitigation Measures

Noise mitigation measures for quarry operations are detailed below. It is recommended that these measures be reflected in the Site Plan for the Quarry.

The predicted noise impacts in Tables A3.7.1, A3.7.2, and, A3.7.3 are based on the implementation of the following mitigation measures.

1. The operation of a Standard Hydraulic Rock Drill, can take place only during the daytime period (07:00 – 19:00), and, shall comply with the following:

    a. The operation of a Standard Hydraulic Rock Drill is not to operate concurrently with other equipment.

    b. Noise barriers are to be provided such that points of reception (POR) are shielded from noise from the Standard Hydraulic Rock Drill as specified in Table 3.

Table 3: Standard Hydraulic Rock Drill Shielding Specification Table

Shielding	Distance to point of reception (m) 50 dBA limit (applies to POR 1, 2, 3, 4)	Distance to point of reception (m) 45 dBA limit (applies to POR 5, 6, 7, 8)
No barrier	> 585 m	> 850 m
4 m high barrier at maximum 10 m from source	585 m to 255 m	850 m to 450 m
4 m high barrier at maximum 5 m from source	255 m to 190 m	450 m to 315 m
6 m high barrier at maximum 5 m from source	190 m to 140 m	315 m to 215 m
6 m high barrier at maximum 10 m from source; operating 30 minutes per hour maximum	140 m to 100 m	215 m to 160 m
Not to operate	< 100 m	< 160 m

2. The operation of a Low Noise Hydraulic Rock Drill, can take place concurrently with other operations anywhere in the extraction area, above or below grade, and, shall comply with the following:

    a. The Low Noise Rock Drill may operate only during the daytime period (07:00 – 19:00).

    b. When operating the Low Noise Rock Drill on the surface less than 350 m from POR 7, a 4 m high barrier located at a maximum of 5 m from source is to be provided shielding line of site (LOS) to POR 7.

3. The operation of the Portable Crushing and Screening Plant, can take place only during the daytime period (07:00 – 19:00) and shall comply with the following:

    a. The Portable Crushing and Screening Plant is to be located at an elevation of plus or minus 338 m (or lower) in location shown in Figure A1.3.

    b. A noise barrier is to be provided, shielding line of sight (LOS) to POR 1, POR 2, and, POR 3, as shown in Figure A1.3 and Figure A1.5. The barrier is to comply with one of the following options:

        i. Minimum 5.2 m high located at a maximum of 5 m from plant, OR,

        ii. Minimum 6 m high located at a maximum of 10 m from plant, OR,

        iii. Minimum 8 m high located at a maximum of 20 m from plant.

    c. A 5.2 m high barrier is to be provided shielding line of sight (LOS) to POR 4, as shown in Figure A1.5. The existing terrain to the south of the plant may be utilized to provide shielding in this direction providing the terrain is a minimum of 5.2 m high and shields line of sight (LOS) to POR 4, as shown in Figure A1.3.

    d. A 5.2 m high barrier, located at a maximum of 60 m from plant, is to be provided shielding line of sight (LOS) to POR 8, as shown in Figure A1.5. The existing terrain to the north of the plant may be utilized to provide shielding in this direction providing the terrain is a minimum of 5.2 m high and shields line of sight (LOS) to POR 8, as shown in Figure A1.3.

4. The operation of Loaders may take anywhere in the extraction area, above or below grade and comply with the following:

    a. The operation of a maximum of two Loaders can take place during the daytime period (07:00 – 19:00).

    b. The operation of a maximum of one (1) Loader can take place during the nighttime period (19:00 – 07:00).

    c. A 6 m high barrier is to be provided shielding POR 1 and POR 2 as shown in Figure A1.3.

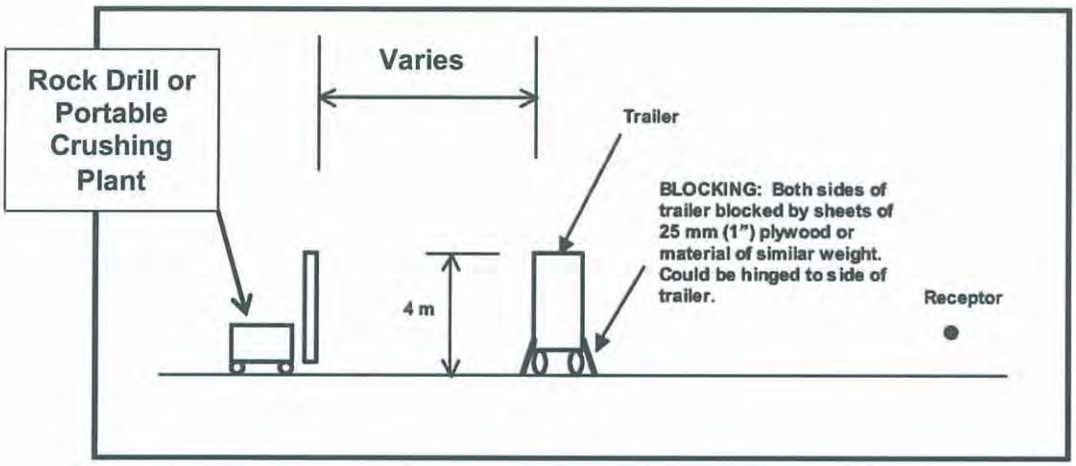
5. The loading and shipping of aggregate product from stockpiles using Highway Trucks may take place on a 24-hour basis.

6. When operating on-site, Highway Trucks shall not exceed 20 kph and shall not use compression braking (Jake Brakes).

7. Noise barriers or berms are to be solid, having no gaps, and are to have a surface density of no less than 20 kg/m^2. Examples of suitable barriers or berms are as follows:

    a. Earth, gravel or aggregate berms;
    b. Lift Face or existing terrain;
    c. Concrete or brick walls;
    d. Commercial noise barriers;
    e. A shipping container;
    f. A portable barrier such as a truck trailer equipped with movable flaps to block the space between the ground and the bottom of the trailer. (Refer to Diagram 1).

Diagram 1: Example of Portable Noise Barrier (not to scale)



8. Portable construction equipment used for site preparation (e.g. land clearing and construction of berms) and rehabilitation shall comply with MoE Publication NPC-115[5], *Construction Equipment*, August 1978. (This publication gives noise standards to be met by construction equipment in Ontario.) Site preparation and rehabilitation activities shall take place only during daytime hours (07:00 – 19:00).

9. If a new process is introduced to the site, then this process shall be assessed by a qualified acoustical consultant as soon as possible after commissioning. Noise mitigation measures shall be reviewed, and altered if necessary, to ensure that MoE sound level limits are met at all points of reception.

6.0 Assessment Criteria, Performance Limits

Sound level limits in the MoE guidelines[2,3] depend on the acoustical classification of the area as Class 1, 2 or 3.

> **Class 1 Area (Urban)** 'an area with an acoustical environment typical of a major urban area, where the background noise is dominated by urban hum (primarily road traffic noise)'
>
> **Class 2 Area (Urban)** 'an area with an acoustical environment that has qualities representative of both Class 1 and Class 3 Areas, and in which a low ambient sound level, normally occurring between 23:00 and 07:00 hours in Class 1 areas, will typically be realised as early as 19:00 hours.
>
> **Class 3 Area (Rural)** 'acoustical environment that is dominated by natural sounds having little or no road traffic ....'

Due to the high levels of road traffic along Highway 62, the area in which POR 1, POR 2, POR 3, POR 4 are located is subject to road traffic noise, particularly during the period from 07:00 to 23:00 hours. Hence these receptors are classified as Class 2 Area (Urban). Receptors POR 5, POR 6, POR 7 and POR 8 are somewhat further from Highway 62, located on Bay Lake Rd, Jeffrey Lake Rd and Gaebel Rd, in a rural area, with occasional daytime traffic but dominated by natural sounds for the majority of the time. As such receptors POR 5, POR 6, POR 7 and POR 8 can be classified as Class 3 Area (Rural).

For a Class 2 Area (Urban) and a Class 3 Area (Rural), the applicable outdoor sound limits at noise sensitive receptors, based on 1-hour equivalent sound levels, $L_{EQ,}$ are either the exclusion noise limits given in Table 4, <u>or higher limits</u> if established by an assessment of background noise.

A background noise assessment was carried out at the points of reception in close proximity to Highway 62. While this assessment indicated elevated sound levels at a number of receptors, the worst case points of reception lie in locations shielded from highway noise. As such the levels given in the Table 4 are taken as the sound level limits at all points of reception for the purpose of this assessment.

Appendix 4 contains an analysis of background traffic noise at points of reception based on road traffic data obtained from the Ontario Ministry of Transportation for Highway 62.

Table 4: Exclusion Sound Level Limits by Time of Day for a Class 2 Area (Urban)[2] and a Class 3 Area (Rural)[3]

Time of Day	Class 2 Area (Urban) LEQ (dBA)	Class 3 Area (Rural) LEQ (dBA)
Day 07:00 – 19:00	50	45
Night 19:00 – 07:00	45	40

Notes: Sound level limits are based on 1-hour equivalent sound levels.
Bldg. Points of Reception are at the residential buildings, height 2 – 4.5 m,
OLA = Outdoor Living Area, up to 30 m from the residence, height 1.5 m
** Daytime Limit is 50 dBA at POR 2 where location shielded from highway noise.

7.0 Impact Assessment

Noise impacts of the Freymond Quarry at nearby receptors have been completed for the day and night operations. The analyzed operations are for worst case conditions and locations of equipment, and include the recommended mitigation measures set out in Section 5.0.

In Table 5, estimated noise levels at the nearest receptors for the worst cases among all scenarios are compared with the applicable sound level limits. More detailed estimates, for all sources and scenarios are contained in Appendix 3, Tables A3.7.1 to A3.7.3. Note that these worst cases will occur for only brief periods during the many year life of the quarry.

Statement of Compliance

With the recommended mitigation measures, the noise impacts of operations at the Freymond Quarry are predicted to meet the applicable MoE guideline limits[2, 3] for both day and night operations.

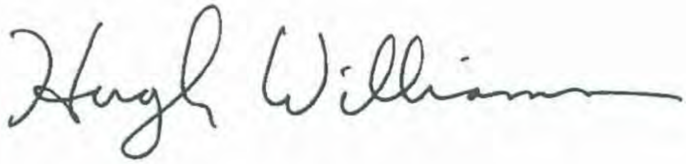
Table 5: Acoustic Assessment Summary Table, Worst Cases

Point of Reception ID	Day 07:00 to 19:00			Night 19:00 to 07:00		
	Estimated Sound Level at POR (worst case)	Sound Level Limit 07:00-19:00	Compliance With Performance Limit	Estimated Sound Level at POR (worst case)	Sound Level Limit 19:00-07:00	Compliance With Performance Limit
POR 1	50 dBA	50 dBA	Yes	42 dBA	45 dBA	Yes
POR 2	50 dBA	50 dBA	Yes	40 dBA	45 dBA	Yes
POR 3	49 dBA	50 dBA	Yes	35 dBA	45 dBA	Yes
POR 4	50 dBA	50 dBA	Yes	36 dBA	45 dBA	Yes
POR 5	31 dBA	45 dBA	Yes	18 dBA	40 dBA	Yes
POR 6	45 dBA	45 dBA	Yes	25 dBA	40 dBA	Yes
POR 7	44 dBA	45 dBA	Yes	29 dBA	40 dBA	Yes
POR 8	44 dBA	45 dBA	Yes	31 dBA	40 dBA	Yes

* The highest predicted sound level at window or outdoor living area are given above as these where the most critical at each point of reception. Refer to Tables A3.7.1, A3.7.2 and A3.7.3 in Appendix 3 for more detailed sound level estimates by source.

8.0 Conclusions

An acoustic assessment of operations at the proposed Freymond Quarry has been conducted according to MoE noise assessment procedures. Operations include Rock Drilling, Crushing and Screening, Loading of Highway Trucks and Shipping off-site. It has been found that noise levels from the operations at nearby receptors are in compliance with MoE sound level limits as set out in publications NPC-205[2] and NPC-232[3], provided that the mitigation measures described in Section 5.0 are followed.



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References

1. Ministry of Environment Publication NPC-233, *Information to be Submitted for Approval of Stationary Sources of Sound*, October 1995.
2. Ministry of Environment Publication NPC-205, *Sound Level Limits for Stationary Sources in Class 1 & 2 (Urban) Areas*, October 1995.
3. Ministry of Environment Publication NPC-232, *Sound Level Limits for Stationary Sources in Class 3 (Rural) Areas*, October 1995.
4. Ministry of Environment, *Sample Application Package, Basic Comprehensive Certificate of Approval (Air and Noise)*, July 2009.
5. Ministry of Environment Publication NPC-115, *Construction Equipment*, August 1978.
6. International Standards Organization, *Acoustics - Attenuation of Sound During Propagation Outdoors, Part 2: General Method of Calculation*, ISO 9613-2: 1996(E).
7. City of Ottawa, *City of Ottawa Environmental Noise Control Guidelines,* May 2006.
8. Ministry of Environment Publication NPC-104, *Sound Level Adjustments*

Appendix 1

Figures

Contents:

Figure A1.1: Area Plan Showing Receptor Locations

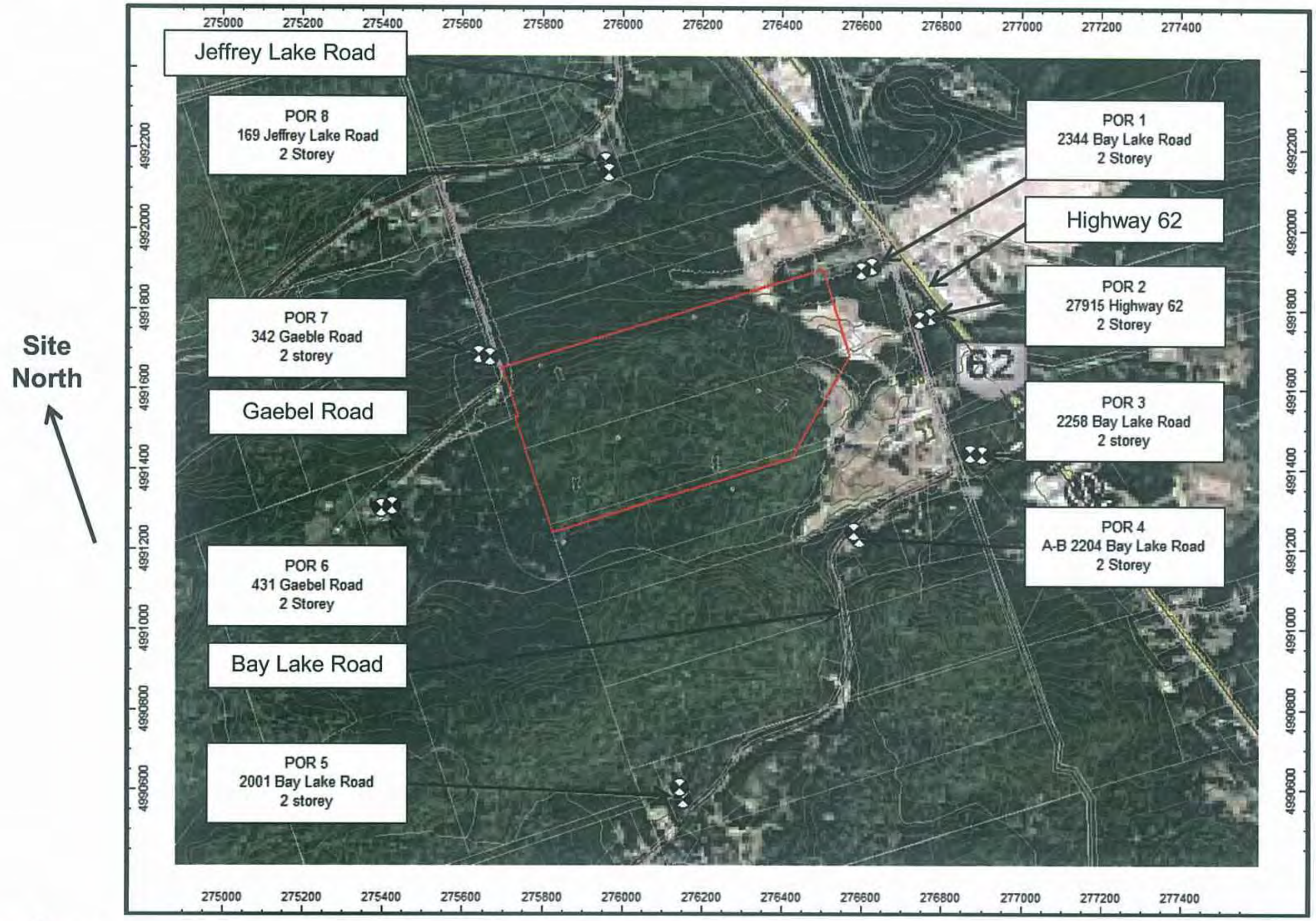


Figure A1.2: **Site Detail & Surface Elevation Contours** (elevation contours at 5 meter intervals)

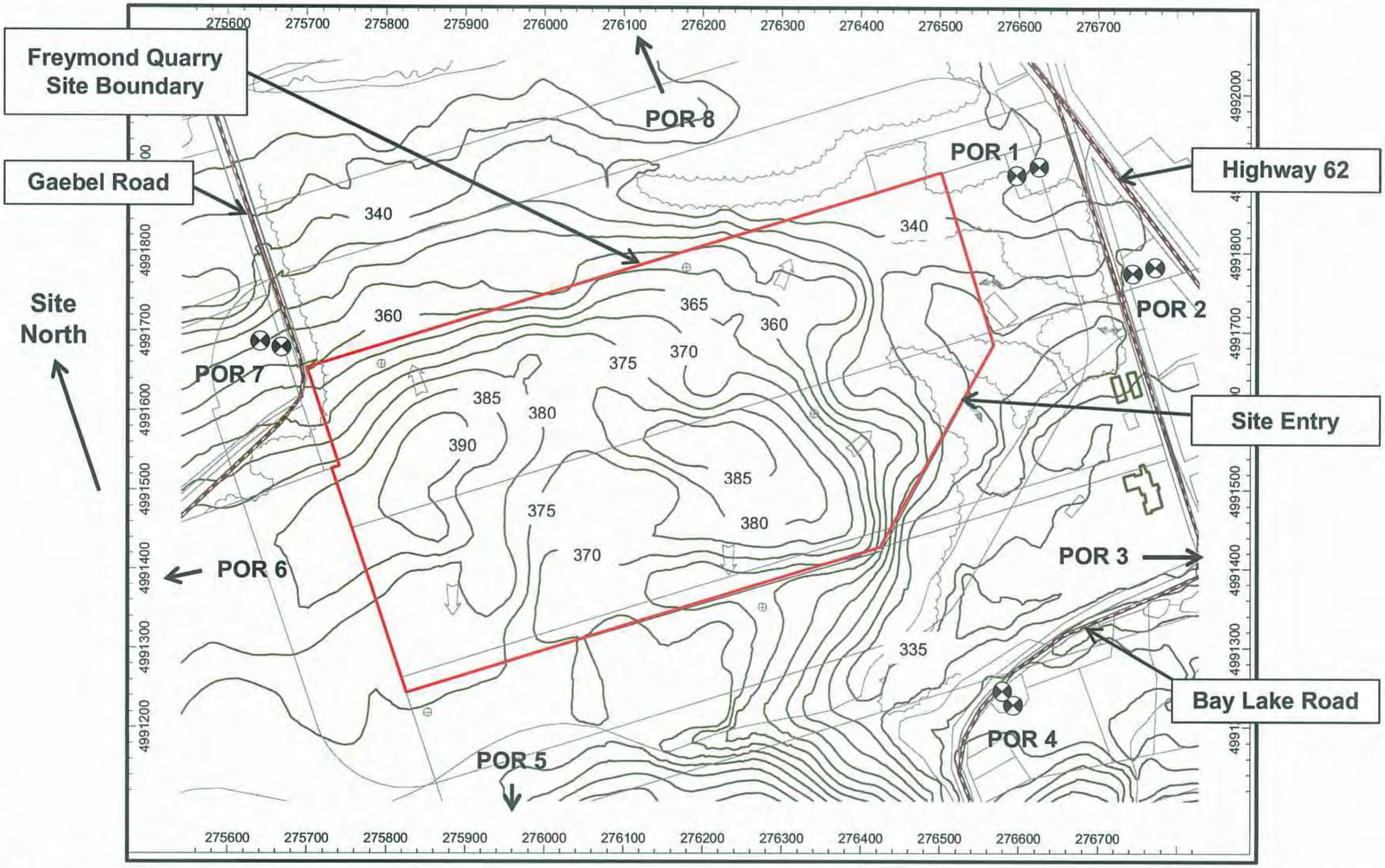


Figure A1.3: **Scenario 1: Worst case, All equipment in operation on surface, Low Noise Rock Drill unshielded located minimum 350 m from POR 7 (Day only)**

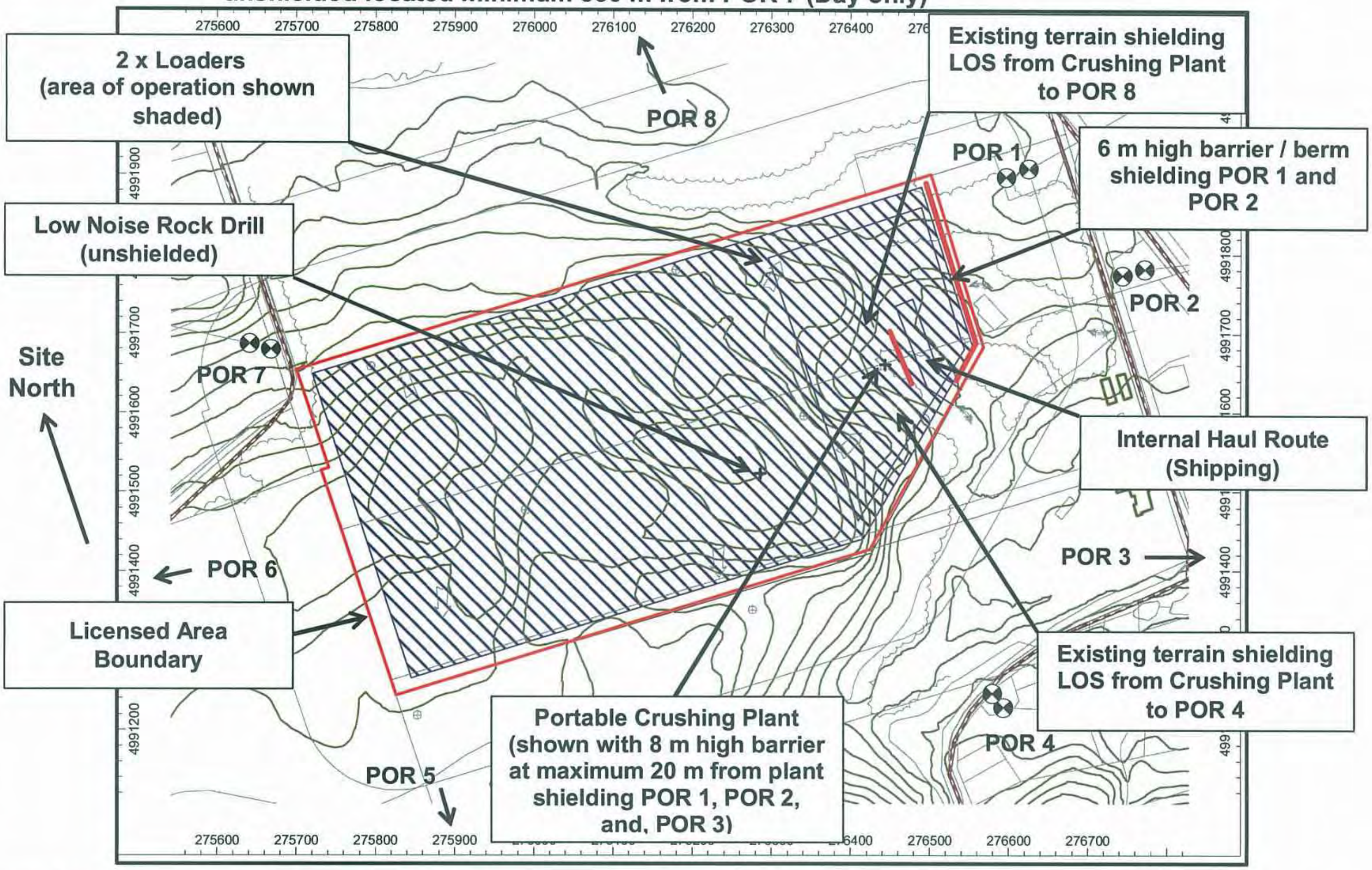


Figure A1.4: **Scenario 1: Noise Contours, Day: (Noise levels at 4.5 m)**

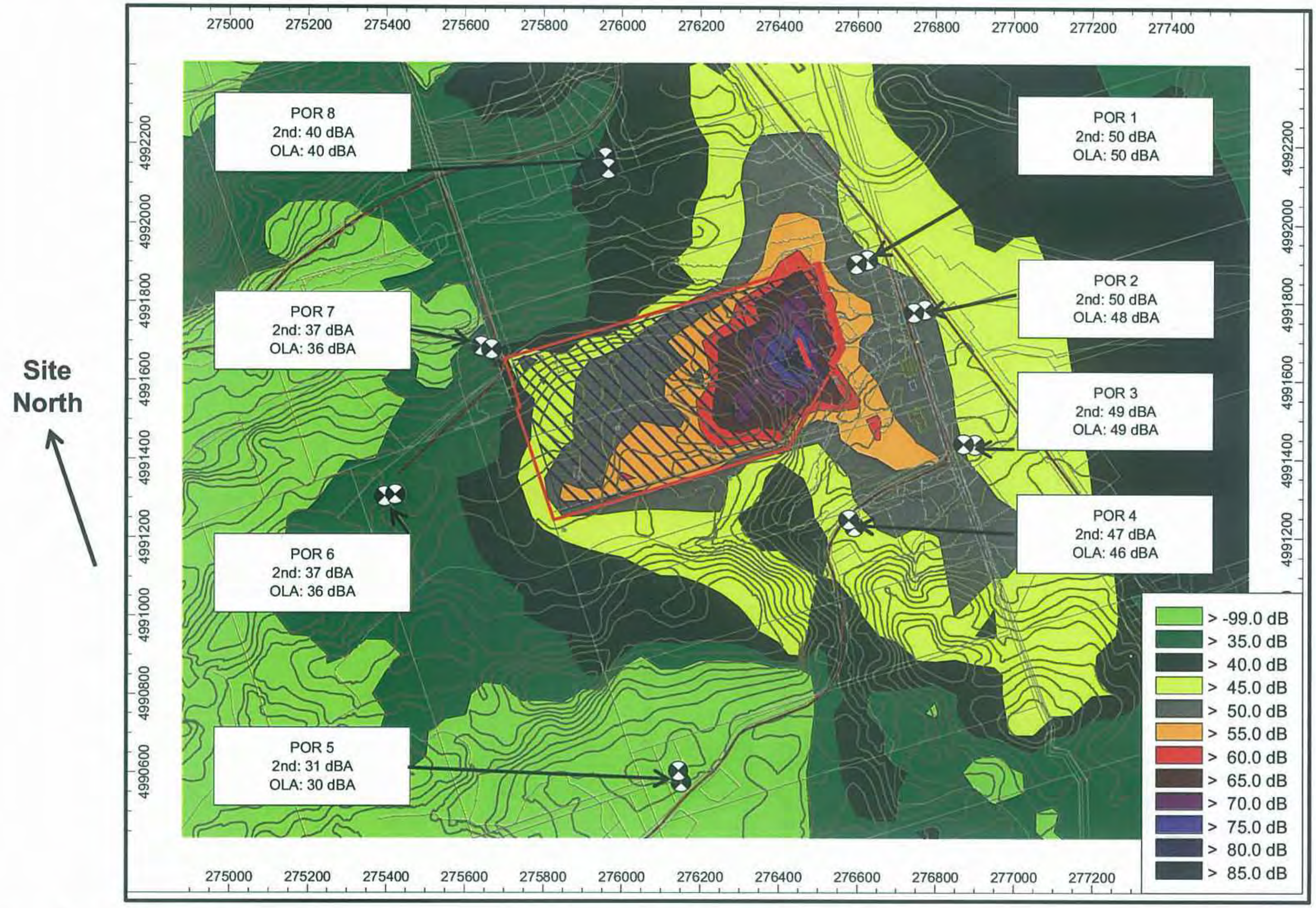


Figure A1.5: **Scenario 2: Worst case, All equipment in operation, Low Noise Rock Drill with 4 m high barrier located less than 350 m from POR 7 (Day only)**

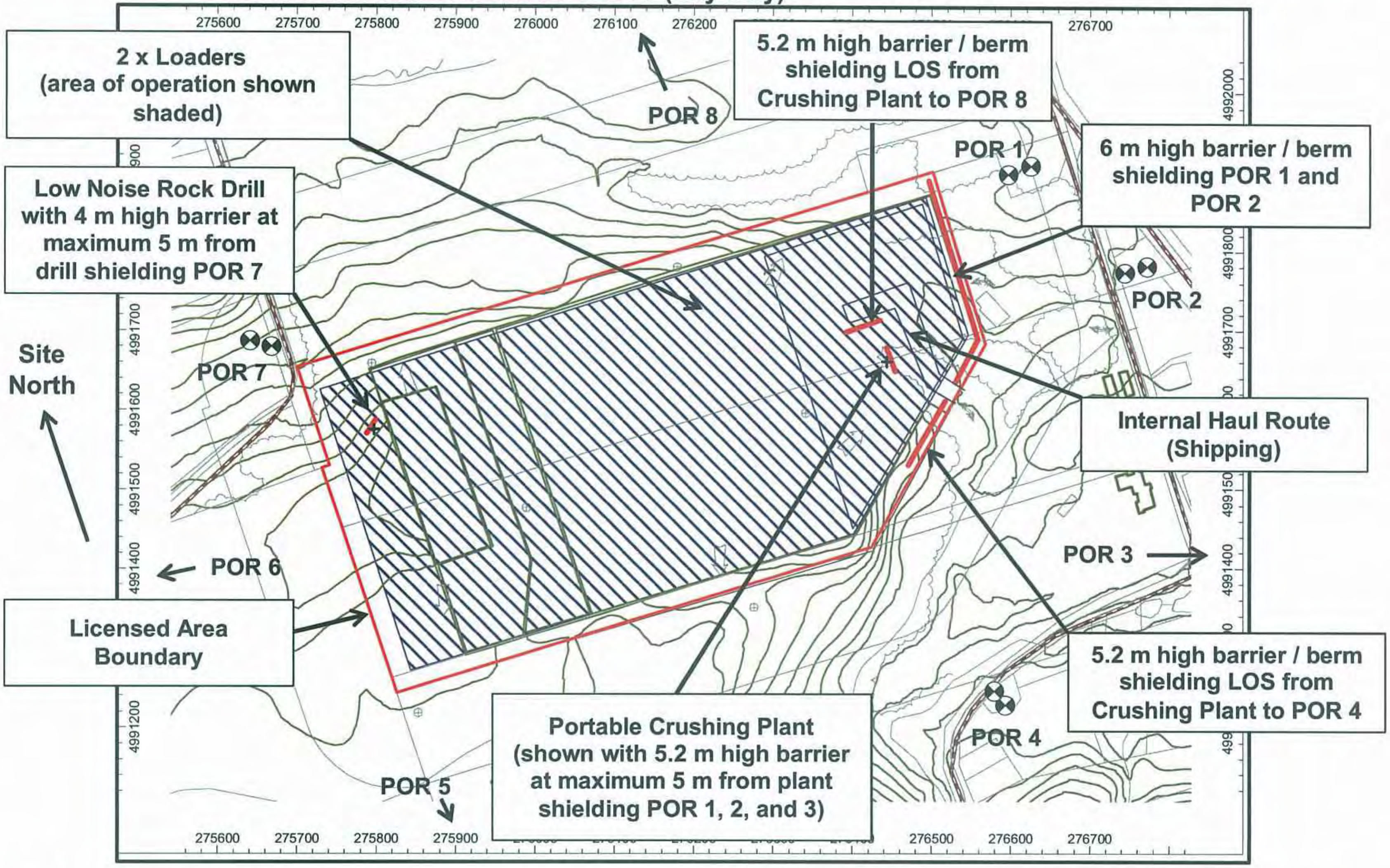


Figure A1.6: Scenario 2: Noise Contours, Day: Worst case (Noise levels at 4.5 m)

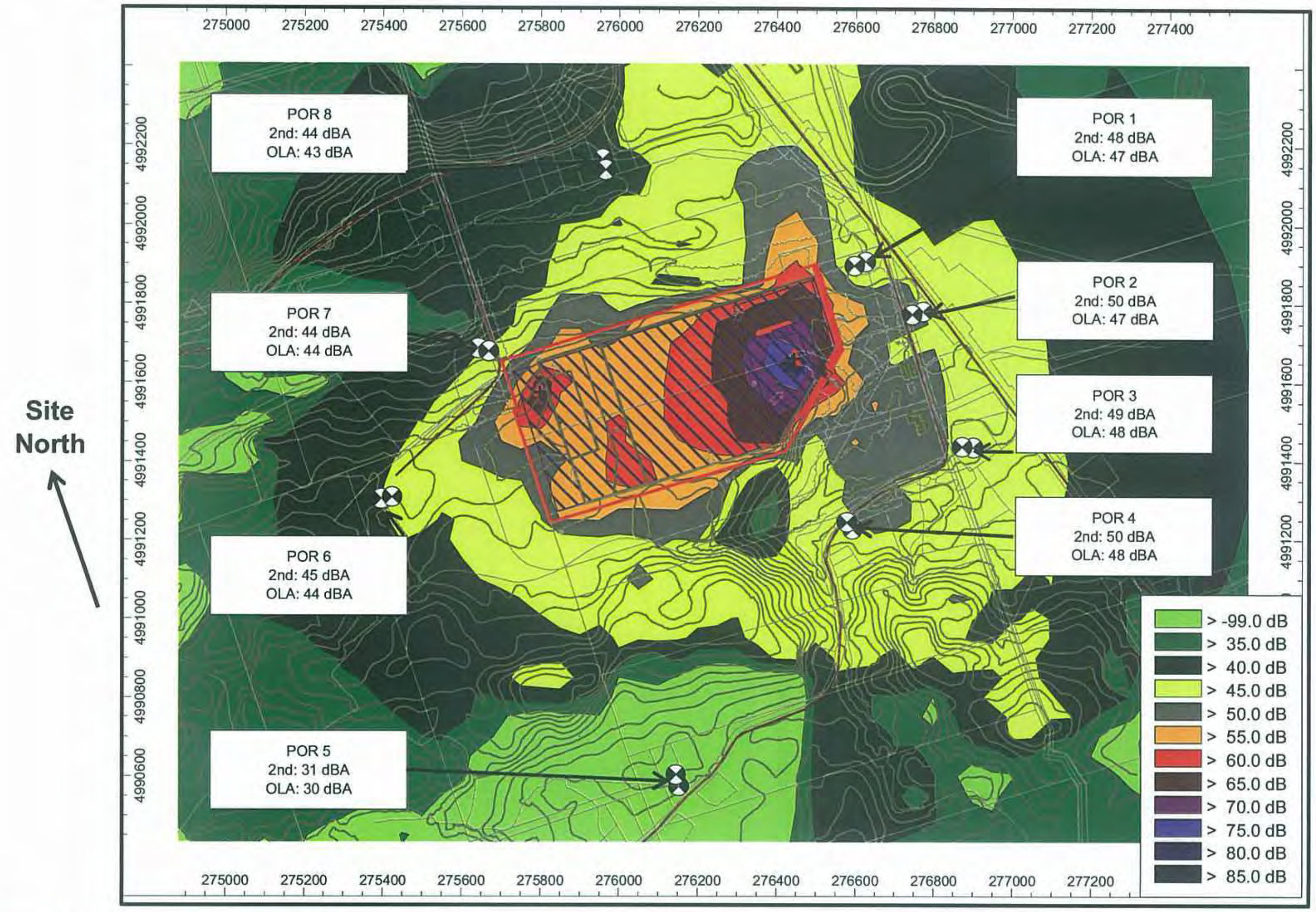


Figure A1.7: Scenario 3: Worst case, Loading and Hauling only (Night)

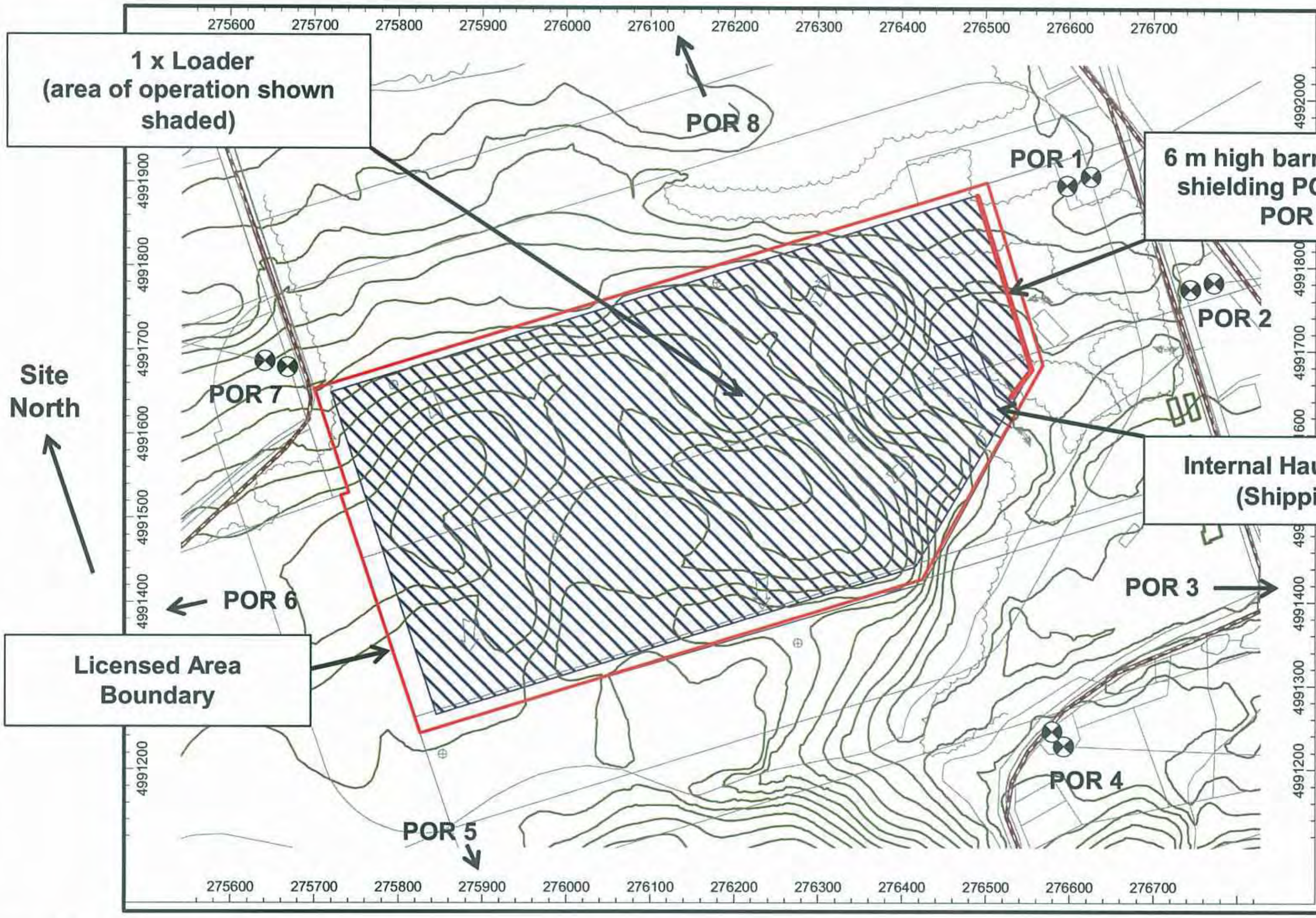
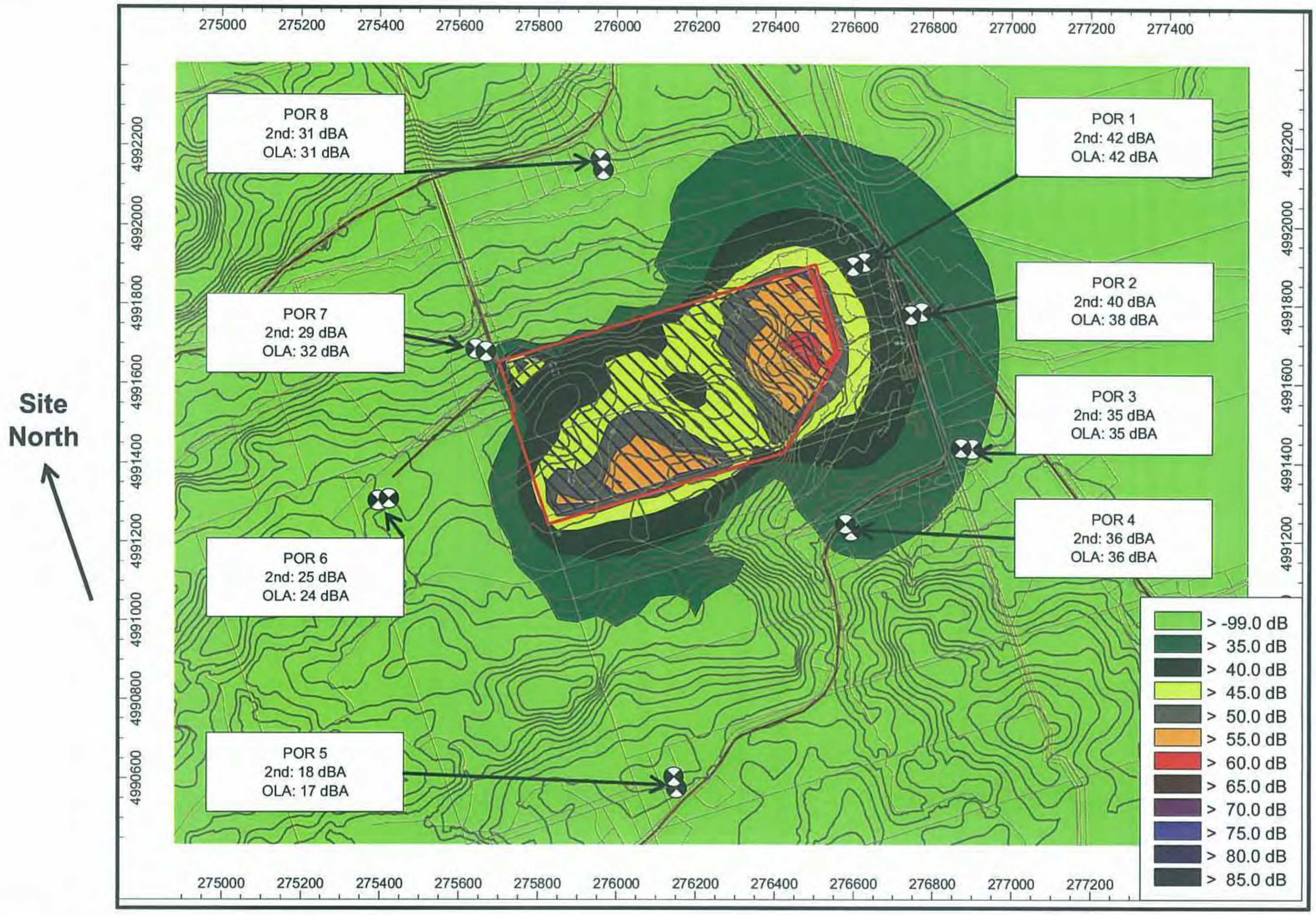


Figure A1.8: **Scenario 3: Noise Contours, Night: Worst case (Noise levels at 4.5 m)**



Appendix 2

Zoning Plan and Land Use Designations

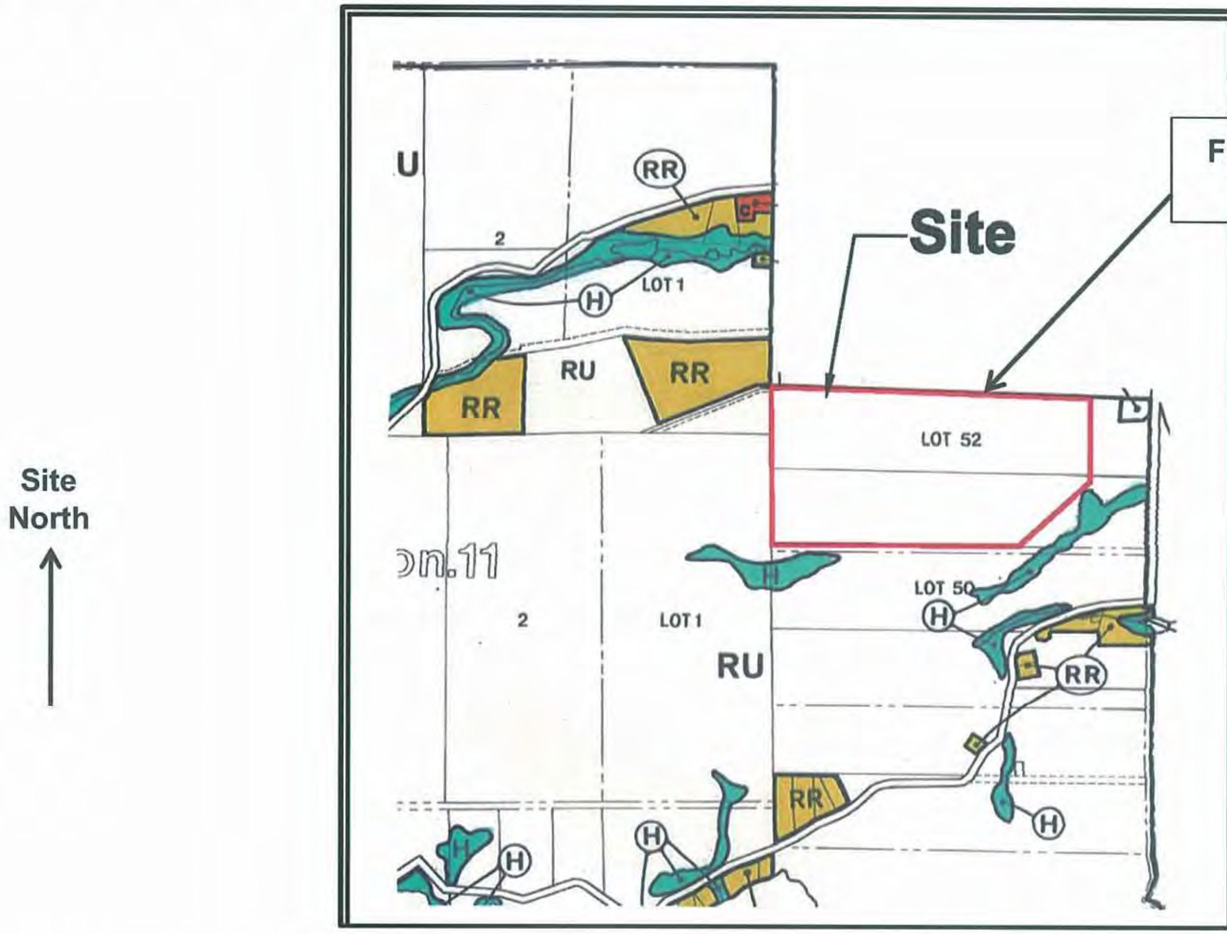
Contents:

- **Detailed Zoning Plan - Township of Faraday**
- **Official Plan Schedule A5-1 - Township of Faraday**
- **Official Plan Schedule A6-1 - Township of Bancroft**

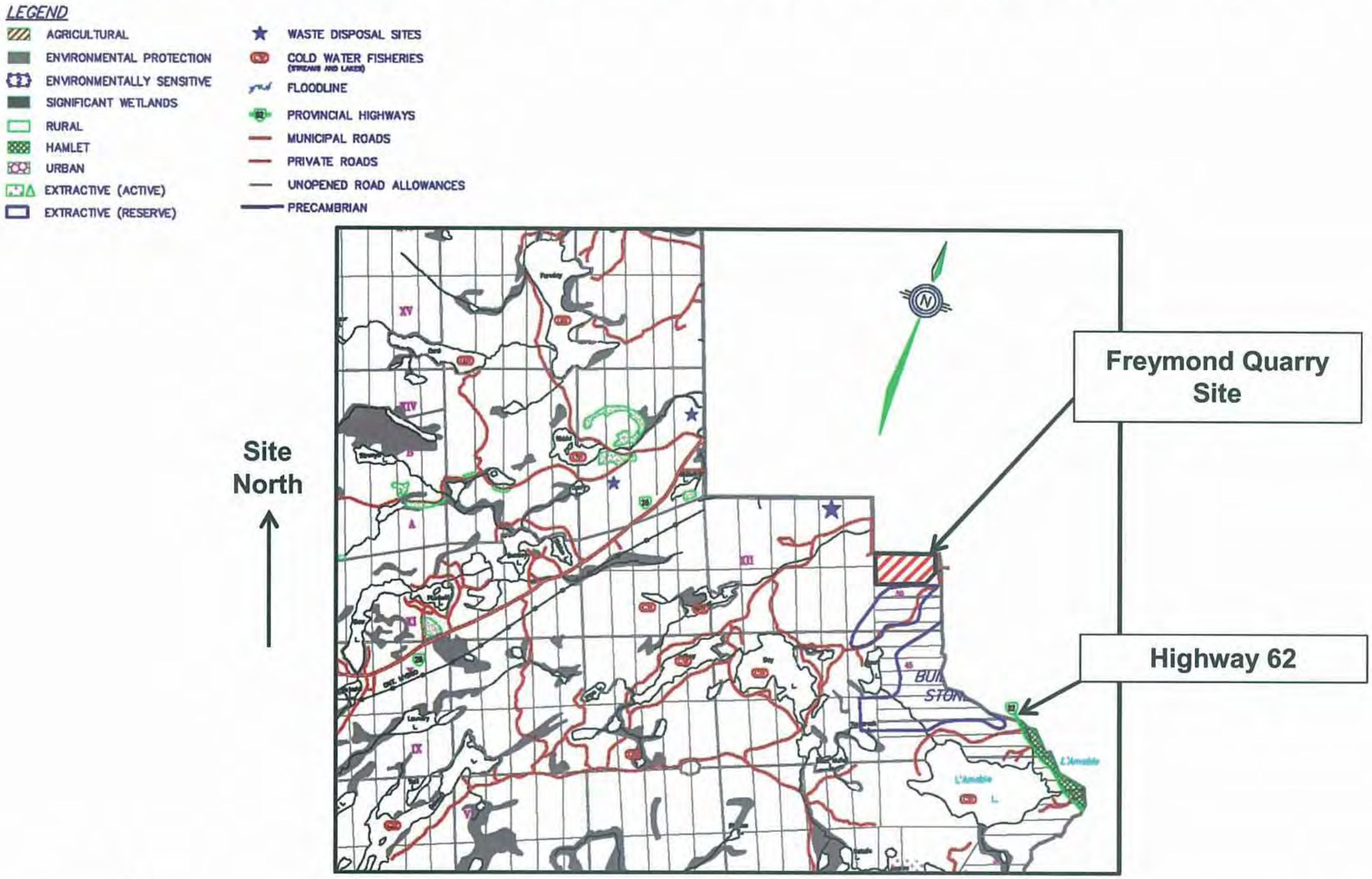
Legend for Land Use Designations for Detailed Zoning Plan:

RU	-	Rural
H	-	Hazard
RR	-	Rural Residential
C	-	Commercial

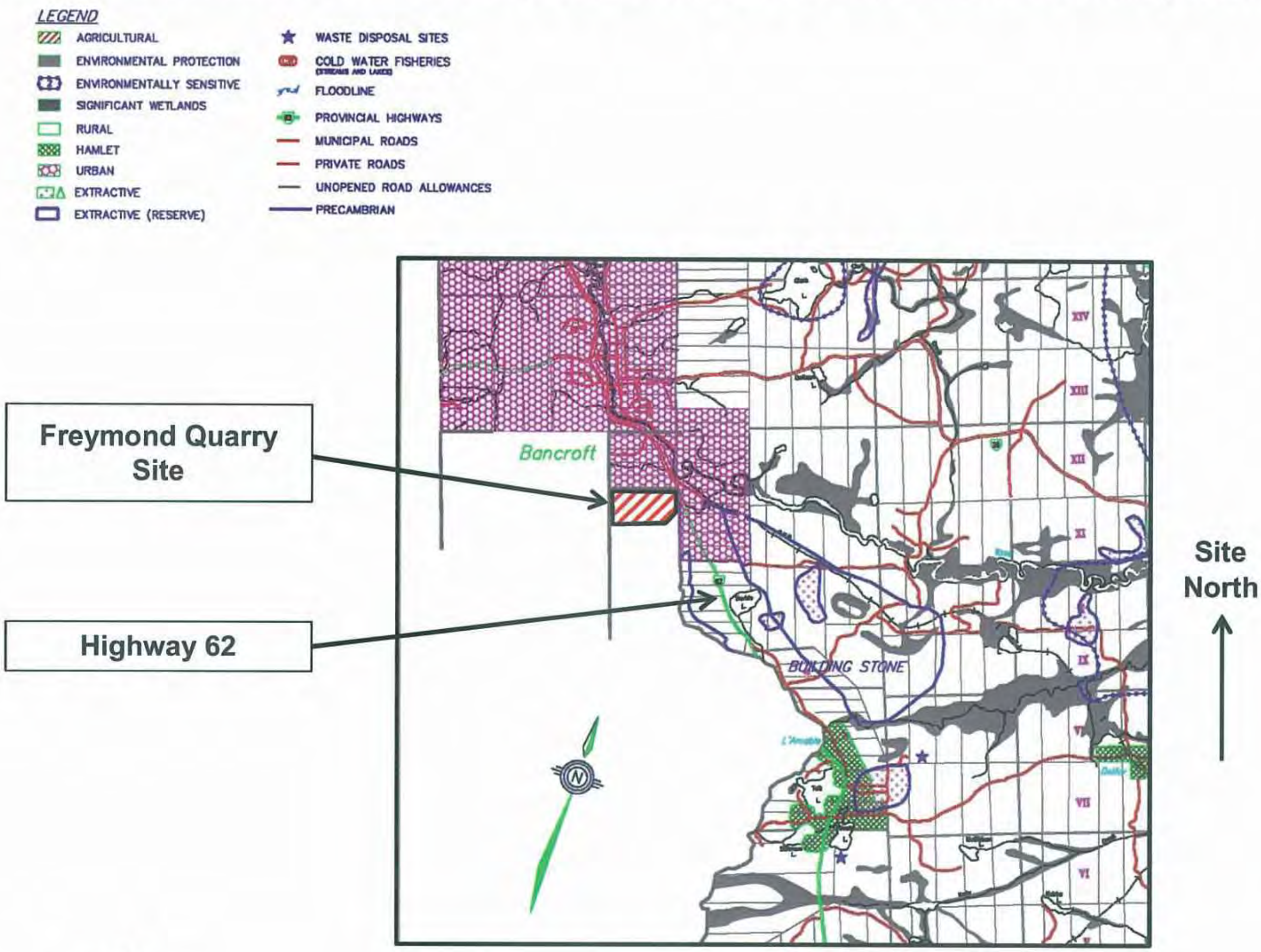
Detailed Zoning Plan, source: EcoVue Consulting Services Inc. – Township of Faraday Zoning By-law



Official Plan Schedule A5-1 - Township of Faraday, source: Official Plan of the County of Hastings



Official Plan Schedule A6-1 - Township of Bancroft, source: Official Plan of the County of Hastings



Appendix 3

Acoustic Modelling Details

Modeling Notes:

1. Acoustic model developed using Cadna-A software, Version 4.2.141.
2. Sound propagation is modeled according to ISO 9613-2: 1996(E).
3. The whole of the extraction area is modeled as reflective, a conservative assumption.
4. MoE favoured conservative modelling assumptions are used, that is, 'no subtraction of negative ground attenuation' and 'no negative path differences'.

Contents:

Table A3.1 Calculation Configuration

Configuration	
Parameter	Value
General	
Country	Germany (TA Lärm)
Max. Error (dB)	0.00
Max. Search Radius (m)	2000.00
Min. Dist Src to Rcvr	0.00
Partition	
Raster Factor	0.50
Max. Length of Section (m)	1000.00
Min. Length of Section (m)	1.00
Min. Length of Section (%)	0.00
Proj. Line Sources	On
Proj. Area Sources	On
Ref. Time	
Reference Time Day (min)	60.00
Reference Time Night (min)	60.00
Daytime Penalty (dB)	0.00
Recr. Time Penalty (dB)	6.00
Night-time Penalty (dB)	10.00
DTM	
Standard Height (m)	0.00
Model of Terrain	Triangulation
Reflection	
max. Order of Reflection	0
Search Radius Src	100.00
Search Radius Rcvr	100.00
Max. Distance Source - Rcvr	1000.00 1000.00
Min. Distance Rvcr - Reflector	1.00 1.00
Min. Distance Source - Reflector	0.10
Industrial (ISO 9613)	
Lateral Diffraction	some Obj
Obst. within Area Src do not shield	On
Screening	Excl. Ground Att. over Barrier
	Dz with limit (20/25)
Barrier Coefficients C1,2,3	3.0 20.0 0.0
Temperature (°C)	10
rel. Humidity (%)	70
Ground Absorption G	1.00
Wind Speed for Dir. (m/s)	3.0
Roads (RLS-90)	
Strictly acc. to RLS-90	
Railways (Schall 03)	
Strictly acc. to Schall 03 / Schall-Transrapid	
Aircraft (???)	
Strictly acc. to AzB	

Table A3.2 Point of Reception Location Table

Name	ID	Height	Coordinates, ground		
		Above Ground	X	Y	Z
		(m)	(m)	(m)	(m)
POR 1 W	POR_1_W	4.5	276625.1	4991908.3	339.5
POR 1 OLA	POR_1_OLA	1.5	276596.6	4991897.6	336.5
POR 2 W	POR_2_W	4.5	276771.8	4991781.6	339.5
POR 2 OLA	POR_2_OLA	1.5	276743.7	4991773.6	336.5
POR 3 W	POR_3_W	4.5	276900.4	4991436.3	336.5
POR 3 OLA	POR_3_OLA	1.5	276871.7	4991437.8	335.4
POR 4 W	POR_4_W	4.5	276593.2	4991227.7	342.1
POR 4 OLA	POR_4_OLA	1.5	276579.4	4991245.5	337.8
POR 5 W	POR_5_W	4.5	276152.0	4990574.8	366.6
POR 5 OLA	POR_5_OLA	1.5	276145.2	4990603.6	366.5
POR 6 W	POR_6_W	4.5	275395.2	4991304.1	394.5
POR 6 OLA	POR_6_OLA	1.5	275423.0	4991309.2	389.7
POR 7 W	POR_7_W	4.5	275640.7	4991686.5	358.8
POR 7 OLA	POR_7_OLA	1.5	275667.7	4991679.3	358.5
POR 8 W	POR_8_W	4.5	275956.5	4992167.2	334.5
POR 8 OLA	POR_8_OLA	1.5	275963.7	4992139.6	331.5

Table A3.3 Point Sources

Name	Result. PWL			Lw / Li	Noise Source	Operating Time			Direct.	Source
	Day	Evening	Night	Type	Library File	Day	Evening	Night		Height
	(dBA)	(dBA)	(dBA)			(min/Hr)	(min/Hr)	(min/Hr)		(m)
Rock Drill - Smart Rig	108.3	108.3	108.3	Lw	Rockdrill_SmartRIG				(none)	2
Crusher	120.5	120.5	120.5	Lw	Crusher_CR				(none)	3
Rock Drill - Standard	120.8	120.8	120.8	Lw	Rockdrill_TH_72				(none)	2

Table A3.4 Line Sources

Name	Point Source PWL			Numbers of vehicles per hour			Modelling Type/ Noise Source Lib. File	Speed	Source
	Day	Evening	Night	Day	Evening	Night			Height
	(dBA)	(dBA)	(dBA)					(km/h)	(m)
Internal Haul Route (IHR)	102.9	102.9	98.2	8	4	4	Moving Point Source/ HWYTruck_Slow58	20	4

Table A3.5 Area Sources

Name	Result. PWL			Number of Moving Pt. Sources			Modelling Type/ Noise Source Lib. File	Lw / Li	Source
	Day	Evening	Night	Day	Evening	Night			Height
	(dBA)	(dBA)	(dBA)					Type	(m)
Loader	107.5	107.5	107.5	2	1	1	Moving Point Source/ Loader	PWL-Pt	3

Table A3.6 Noise Source Library

ID	Type	Spectra (dB)											Source*
		31.5	63	125	250	500	1000	2000	4000	8000	A	lin	
Rockdrill_TH_72	Lw	113.4	112.8	114.6	111.1	110.9	111.5	115.8	114.4	112.1	120.8	122.8	Measured 2007
Rockdrill_SmartRIG	Lw	103.4	109.4	112.6	106.8	102.2	101.7	102.5	98.6	91.3	108.3	116	Measured Aug 2011
Crusher_CR	Lw	121.7	124.5	125.1	116.2	116.2	115.7	114.1	107.5	95.3	120.5	129.6	Williamsberg Meas.
Loader	Lw	113.9	117.4	103.5	93.9	92.6	106.6	97.2	85.8	76.1	107.5	119.4	Measured April 2012
HWYTruck_Slow58	Lw	115.9	112.7	110.2	101.6	101.4	105	104.2	97.6	103.5	110.1	119	Brockville McDowell

* Measured by Hugh Williamson Associates at a similar facility or in similar circumstances in Ontario.

Table A3.7.1 Point of Reception Impacts by Source for Scenario 1, day only

	Day (07:00 to 19:00)															
	POR 1		POR 2		POR 3		POR 4		POR 5		POR 6		POR 7		POR 8	
	dBA		dBA		dBA		dBA		dBA		dBA		dBA		dBA	
Sources	4.5 m	OLA	4.5 m	OLA	4.5 m	OLA	4.5 m	OLA	4.5 m	OLA	4.5 m	OLA	4.5 m	OLA	4.5 m	OLA
Rock_Drill_S1	43	42	42	41	40	39	39	39	28	27	36	35	33	30	34	33
Crusher_S1	46	45	48	43	48	47	45	43	26	25	30	29	33	31	35	34
IHR_S1	35	32	34	33	31	31	34	33	9	8	12	10	12	11	23	21
Loader_S1	40	39	38	37	34	34	35	35	17	17	25	24	30	32	31	31
Loader_S1	46	45	44	44	41	41	42	40	19	18	23	22	25	24	36	36
Total	**50**	**50**	**50**	**48**	**49**	**49**	**48**	**46**	**31**	**30**	**38**	**36**	**37**	**36**	**40**	**40**

Table A3.7.2 Point of Reception Impacts by Source for Scenario 2, day only

	Day (07:00 to 19:00)															
	POR 1		POR 2		POR 3		POR 4		POR 5		POR 6		POR 7		POR 8	
	dBA		dBA		dBA		dBA		dBA		dBA		dBA		dBA	
Sources	4.5 m	OLA	4.5 m	OLA	4.5 m	OLA	4.5 m	OLA	4.5 m	OLA	4.5 m	OLA	4.5 m	OLA	4.5 m	OLA
Rock_Drill_S2	33	30	31	30	29	28	26	24	20	19	42	41	43	43	39	38
Crusher_S2	46	45	49	45	48	48	49	48	30	29	42	41	39	37	42	40
IHR_S2	37	35	38	35	34	34	32	32	11	11	22	22	21	19	25	24
Loader_S2	41	39	41	39	37	37	36	35	17	14	23	21	24	23	30	30
Loader_S2	37	35	38	36	32	32	31	30	20	19	28	27	29	30	30	29
Total	**48**	**47**	**50**	**47**	**49**	**48**	**50**	**48**	**31**	**30**	**45**	**44**	**44**	**44**	**44**	**43**

Table A3.7.3 Point of Reception Impacts by Source for Scenario 3, day or night

	Night (19:00 to 07:00)															
	POR 1		POR 2		POR 3		POR 4		POR 5		POR 6		POR 7		POR 8	
	dBA		dBA		dBA		dBA		dBA		dBA		dBA		dBA	
Sources	4.5 m	OLA	4.5 m	OLA	4.5 m	OLA	4.5 m	OLA	4.5 m	OLA	4.5 m	OLA	4.5 m	OLA	4.5 m	OLA
IHR_S3	32	28	32	31	29	29	31	29	5	5	9	7	10	8	17	15
Loader_S3	41	42	39	37	34	34	35	35	18	17	25	24	29	32	31	31
Total	**42**	**42**	**40**	**38**	**35**	**35**	**37**	**36**	**18**	**17**	**26**	**24**	**29**	**32**	**31**	**31**

Appendix 4

Background Traffic Noise Analysis

This Appendix presents the results of an analysis of background noise from road traffic on Highway 62, south of Bancroft, approx. 8.6 km north of the intersection with Hastings Road, in the vicinity of the Freymond Quarry, conducted in October 2010.

The 24-hour period occurring on Wednesday the 6th of October 2010 was selected on the basis that this period of time represented the lowest traffic volumes occurring during a period of time that the Freymond Quarry is proposed to be in operation. This results in the calculation of the minimum background noise from Highway 62 at the selected points of reception.

The minimum background noise level is determined for one time period.

Day: 07:00 to 19:00 – daytime operational period for the Freymond Quarry

Contents:

Table A4.1: Traffic Volumes and Background Noise Estimates for Highway 62 near Proposed Freymond Quarry

Project: Proposed Freymond Quarry
Traffic count from MTO - Kingston
Count from Highway 62, south of Bancroft, Approx. 8.6 km north of Hastings Road intersection Highway 62.
Posted Speed Limit: 60 km/h
Traffic Count Date: Wednesday 6th October, 2010

		Estimated split**			Noise Predictions in dBA, STAMSON		
Hour Beginning	Total Vehicles Count no.	Cars no.	Medium Trucks no.	Heavy Trucks no.	POR 2 2nd Storey d = 30 m h = 1.5 m	POR 2 OLA d = 30 m h = 4.5 m	***
0:00	6						
1:00	2						
2:00	1						
3:00	3						
4:00	19						
5:00	28						
6:00	79						
7:00	118						
8:00	152						
9:00	161						
10:00	140						
11:00	159						
12:00	148						
13:00	150						
14:00	163						
15:00	156						
16:00	181						
17:00	152						
18:00	**90**	**79.2 (79)**	**6.3 (6)**	**4.5 (5)**	**54.38**	**53.95**	*
19:00	75						
20:00	49						
21:00	41						
22:00	20						
23:00	10						
Total	2103						

* Minimum background sound level for Day, 18:00 to 19:00 inclusive
** Estimated Split based on City of Ottawa Environmental Noise Control Guidelines as no suitable data available. Split used for Medium Trucks to Heavy Trucks is 7% and 5% respectively.
*** Receptors effected by Highway 62 Background Noise.

Data from the MTO Kingston, hourly traffic counts - Hwy 62 South of Bancroft

(T)raffic
E ngineering
(S)oftware

Weekly Volume Summary

Thu, Nov 18, 2010

Location: Hwy 62 - 8.6 km North of Hastings Rd 620
LHRS/Offset: 33780 / 0.0 **Region:** Eastern
Pattern Type: Low Tourist **PCS#:** 49 **Hwy. TVIS#:** 62125
Count Direction: NB/SB **Report Dates:** Sep 30, 2010 **to** Oct 6, 2010

Hour Interval	Thu 10/09/30	Fri 1	Sat 2	Sun 3	Mon 4	Tue 5	Wed 6	Thu 7
0:00- 1:00		12	10	22	2	5	6	2
1:00- 2:00		8	15	6	10	8	2	3
2:00- 3:00		6	9	4	2	4	1	5
3:00- 4:00		2	5	5	4	3	3	7
4:00- 5:00		13	7	3	15	10	19	14
5:00- 6:00		21	12	10	35	33	28	21
6:00- 7:00		58	19	18	78	65	79	71
7:00- 8:00		117	77	30	132	113	118	117
8:00- 9:00		138	119	47	176	159	152	175
9:00-10:00		169	183	96	160	139	161	161
10:00-11:00		161	199	172	157	129	140	174
11:00-12:00		193	205	182	154	136	159	158
AM Total	0	898	860	595	925	804	868	908
12:00-13:00	151	206	231	216	170	151	148	
13:00-14:00	151	166	232	217	166	152	150	
14:00-15:00	161	205	203	233	153	179	163	
15:00-16:00	189	229	223	213	166	169	156	
16:00-17:00	162	234	182	194	188	152	181	
17:00-18:00	180	219	169	157	172	154	152	
18:00-19:00	110	151	109	105	95	98	90	
19:00-20:00	83	111	88	111	69	76	75	
20:00-21:00	65	64	71	57	42	36	49	
21:00-22:00	60	67	56	44	25	32	41	
22:00-23:00	23	50	50	18	24	26	20	
23:00-24:00	19	23	26	6	6	6	10	
PM Total	1,354	1,725	1,640	1,571	1,276	1,231	1,235	0
24 Hr. Total	1,354	2,623	2,500	2,166	2,201	2,035	2,103	908
Noon - Noon	2,252	2,585	2,235	2,496	2,080	2,099	2,143	
	ADT	AWD	AADT	AAWD	SADT	SAWDT	WADT	DHV
	2,270	2,144	2,154	2,081	2,950	2,767	1,594	274

Page 3 of 3

Samples of Traffic Noise Predictions using STAMSON

```
STAMSON 5.0          SUMMARY REPORT          Date: 08-09-2012 17:17:36
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: por2_w.te              Time Period: 1 hours

Description: POR 2 2nd Storey

Road data, segment # 1:
-----------------------
Car traffic volume  :    79 veh/TimePeriod
Medium truck volume :     6 veh/TimePeriod
Heavy truck volume  :     5 veh/TimePeriod
Posted speed limit  :    60 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

Data for Segment # 1:
---------------------
Angle1   Angle2            : -90.00 deg   90.00 deg
Wood depth                 :      0       (No woods.)
No of house rows           :      0
Surface                    :      1       (Absorptive ground surface)
Receiver source distance   :  30.00 m
Receiver height            :   4.50 m
Topography                 :      1       (Flat/gentle slope; no
barrier)
Reference angle            :   0.00

Result summary
--------------

                    !  source  !   Road   !  Total
                    !  height  !   Leq    !   Leq
                    !   (m)    !  (dBA)   !  (dBA)
--------------------+----------+----------+---------
 1.                 !     1.54 !    54.38 !    54.38
--------------------+----------+----------+---------
                      Total                  54.38 dBA

TOTAL Leq FROM ALL SOURCES:       54.38
```

```
STAMSON 5.0          SUMMARY REPORT          Date: 08-09-2012 17:18:48
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: por2_OLA.te          Time Period: 1 hours
```

Description: POR 2 OLA

```
Road data, segment # 1:
------------------------
Car traffic volume  :    79 veh/TimePeriod
Medium truck volume :     6 veh/TimePeriod
Heavy truck volume  :     5 veh/TimePeriod
Posted speed limit  :    60 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

Data for Segment # 1:
----------------------
Angle1   Angle2           : -90.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  :  30.00 m
Receiver height           :   1.50 m
Topography                :      1       (Flat/gentle slope; no
barrier)
Reference angle           :   0.00

Result summary
--------------

                    !  source  !   Road   !  Total
                    !  height  !   Leq    !   Leq
                    !   (m)    !  (dBA)   !  (dBA)
--------------------+---------+---------+---------
 1.                 !    1.54 !   53.95 !   53.95
--------------------+---------+---------+---------
                      Total                 53.95 dBA
```

TOTAL Leq FROM ALL SOURCES: 53.95

HUGH WILLIAMSON ASSOCIATES INC.

Ottawa, Ontario, Canada

RESUMÉ: Dr. HUGH WILLIAMSON, P.Eng.

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Ph.D. Mechanical Engineering, University of New South Wales, 1972

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Member, American Society of Heating, Refrigeration and Air-conditioning Engineers

KEY COMPETENCIES:

- Environmental noise and vibration assessments, Environmental Compliance Approval (ECA). Noise assessment for land use planning
- Architectural and building acoustics, acoustics of office spaces, meeting rooms, auditoriums and studios, noise and vibration control of building mechanical services.
- Industrial noise and vibration assessment and control.
- Transportation noise and vibration.

PROFESSIONAL EXPERIENCE:

Hugh Williamson is a professional engineer with many years of experience in the measurement, analysis and control of noise and vibration. Hugh Williamson Associates was incorporated in 1997 and provides consulting services in architectural, building, industrial, transportation and environmental acoustics and vibration. Clients include architects, engineering firms, industrial firms and government departments. Prior to establishing Hugh Williamson Associates, his career included extensive periods in industry as well as university level research and teaching. He is a former Director of the Acoustics and Vibration Unit at the Australian Defence Force Academy. He has published over 50 engineering and scientific papers and has been an invited speaker on noise and vibration at national and international conferences. He has more than 20 years of experience as a consultant.

CLIENT LIST:

Hugh Williamson Associates provides consulting services to large and small clients including: National Research Council, National Capital Commission, J. L. Richards & Associates, Barry Padolsky Associates, HOK Urbana Architects, Genivar, Nasittuq Corporation, PWGSC, R. W. Tomlinson, Geo. Tackaberry Construction and Miller Paving.

RESUMÉ: MICHAEL WELLS

QUALIFICATIONS:

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- Architectural and building acoustics, acoustics of office spaces, meeting rooms, auditoriums and studios, noise and vibration control of building mechanical services.
- Industrial noise and vibration assessment and control.
- Transportation noise and vibration.
- Design services including sketch design, design development (development / permit applications), contract documents, tendering and contract administration.

PROFESSIONAL EXPERIENCE:

Michael Wells is a professional Architect registered in NSW with many years of experience in the Architectural and Construction industries. With key competencies in measurement, analysis and control of noise and vibration, Michael Wells joined Hugh Williamson Associates in 2012 and provides consulting services in architectural, building, industrial, transportation and environmental acoustics and vibration. Clients include architects, engineering firms, industrial firms and government departments. Prior to joining Hugh Williamson Associates, his career includes the founding of Michael Wells Architect in Sydney Australia which specialized in the design of institutional, commercial and residential projects. He is a Director of Architectural Workshops Australia and Vision Blue Pty Ltd. He has more than 10 years of experience as a consultant.

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