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Environmental Engineering

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Mineral Resource Impact Assessment

Proposed Residential Development
Brazeau Lands
Borrisokane Road - Ottawa

Prepared For

Caivan Communities

January 7, 2019

Report PG4752-1 Revision 1

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3809 Borrisokane Road Transportation Impact Assessment - Prepared by CGH Transportation Inc - Project Number 2018-05 - dated November 2018

1.0 Introduction

Paterson Group (Paterson) was commissioned by Caivan Communities to conduct a mineral resource impact assessment for the proposed residential development at the aforementioned site and is required by Section 3.7.4 of the City of Ottawa Official Plan.

The objective of the current assessment was to evaluate the potential for land use impacts relating to land use compatibility between the proposed residential development and the adjacent mineral aggregate resources currently in operation. It is noted in Schedule B of the City of Ottawa Official Plan, the proposed development is located within the urban boundary expansion study area. The primary purpose of this area is to accommodate residential population growth.

Based on Section 2.5 of the Provincial Policy Statement 2014, mineral aggregate resources shall be protected for long term use and, where provincial information is available, deposits of mineral aggregate resources shall be identified.

2.0 Proposed Development

It is understood that the proposed residential development will consist of townhouses and singles with attached garages. Associated driveways, local roadways, a park and landscaping areas are also proposed. It is further understood that the proposed development will be serviced by future municipal water, sanitary and storm services.

3.0 Location and Surface Conditions

The subject site is bordered to the west by undeveloped land (former Brazeau Aggregate Pit), to the north by an existing aggregate resource pit (Costello Pit), to the east by a future residential development, and to the south by undeveloped land. The subject locations are identified in Drawing PG4752-1 - Existing Conditions.

The subject site is a former agricultural pit (former Brazeau Pit). It is understood that the pit has been depleted of the useable aggregate and will be rehabilitated for future development. The subject site is relatively flat, with the southern corner up to 3.5 m higher than the remainder of the site. It is understood that the former Brazeau Pit, located to the west of the proposed development, is presently owned by Caivan Communities and the aggregate removal operation has ceased production. Fill piles were observed to the southwest of the subject site.

4.0 Adjacent Sand and Gravel Pit

4.1 Status, Type and Location of Pit Operation

Costello Pit (Drummond Pit)

The sand and gravel pit, also known as the Costello Pit, to the west of the subject site is located at 3713 Borrisokane Road and is owned by George W. Drummond Limited. Details of the pit are provided below and attached to the current report. A series of historical aerial photographs have been attached to the present letter to provide an extraction history of the aggregate resource.

The legal description of the pit is CON 3RF PT LOT 9 RP 5R-6254; PART 2 LESS RP 5R-13374 PTS; 9 & 10 RD WIDENING, PIN 045920035.

The site consists of approximately 79.5 acres with a frontage of approximately 310 m along Borrisokane Road. Based on the Ministry of Natural Resources and Forestry database, the following information has been provided for the pit:

- ❏ Site ID: 4074
- ❏ Approval Type: Class A Licence
- ❏ Operation Type: Pit
- ❏ Max. Annual Tonnage: 350,000
- ❏ Licenced Area: 22.3 ha
- ❏ Location Name: n/a

4.2 City of Ottawa Official Plan

The subject site is designated Urban Expansion Study Area - Sand and Gravel Resource Area on Schedule B - 'Urban Policy Plan' of the City's Official Plan. The properties north and south are also designated the Urban Expansion Study Area - Sand and Gravel Resource Area. The property to the west is classified as a Sand and Gravel Resource Area and the property to the east is classified as General Urban Area. From Schedule A, the property to the west is classified as a Sand and Gravel Resource Area and the property to the south is considered General Rural Area (the land is not identified on Schedule B). See Figures 2 and 3 on the following page for the extract of the City's Official Plan - Schedule A and Schedule B.

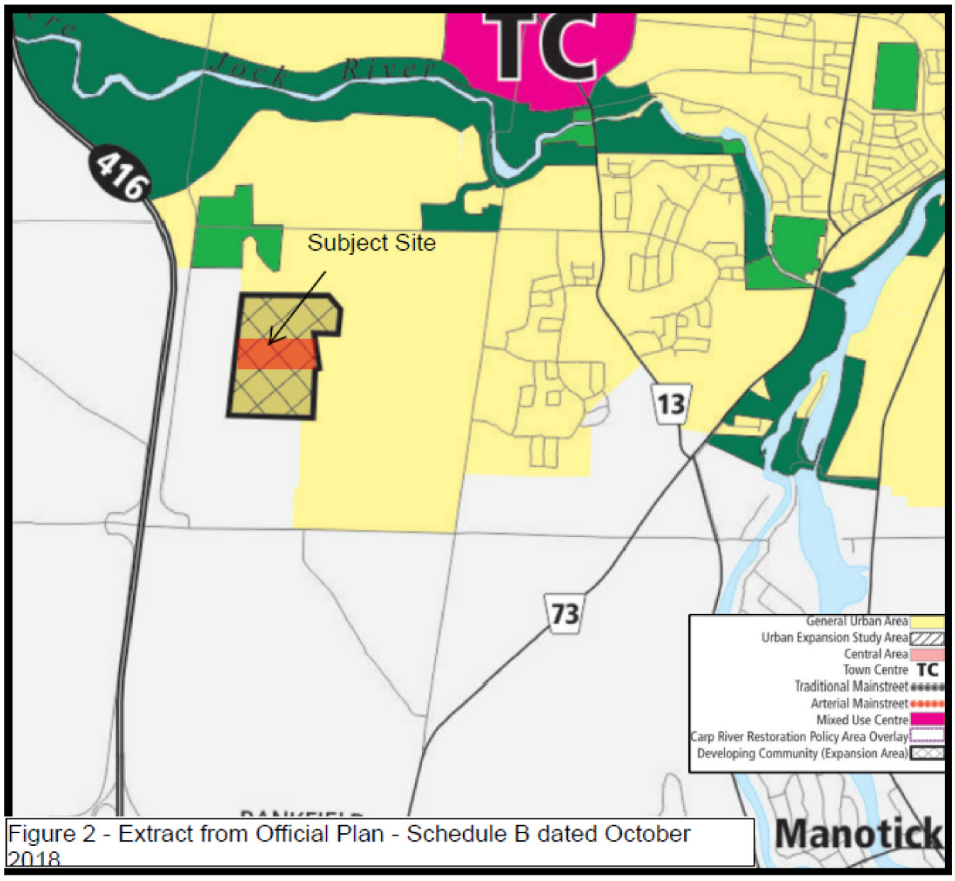

Figure 2 - Extract from Official Plan - Schedule B dated October 2018

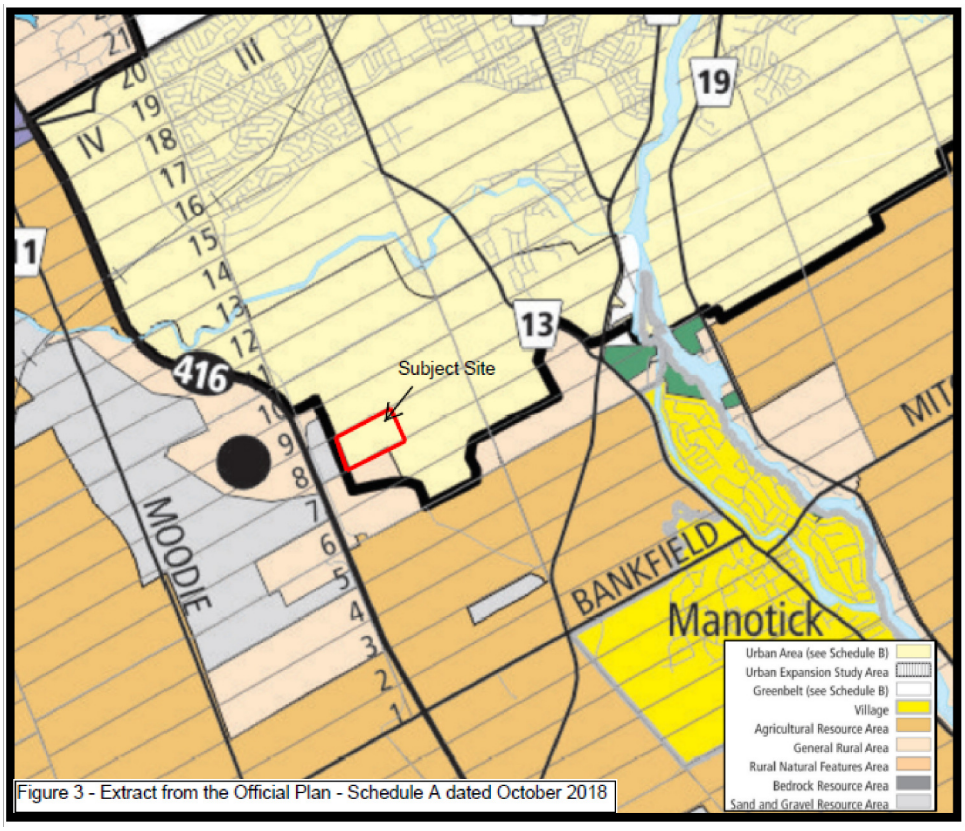

Figure 3 - Extract from the Official Plan - Schedule A dated October 2018

Given the subject sites proximity to a designated Sand and Gravel Resource Area on Schedule A and B of the City's Official Plan, the proposed residential development is required to adhere to restrictions outlined in Policies 10, 11, 12 and 13 of Section 3.7.4 of the City's Official Plan - Development Restriction on Adjacent Lands listed below.

***Policy 10**:*
Limited types of new development may be approved within 500 metres of a Bedrock Resource Area or within 300 metres of a Sand and Gravel Resource Area, provided such development does not conflict with future mineral aggregate extraction.

Policy 11:
Where there is an existing licensed pit or quarry, development may be approved within the area of potential impact, referenced in policy 10, where an impact assessment study is completed and demonstrates that the mineral aggregate operation, including future expansion in depth or extent, will not be affected by the development.

***Policy 12**:*
The Ministry of Natural Resources will be consulted in review of studies necessary.

***Policy 13**:*
Where the City approves the development of land in accordance with policies above, the City may impose conditions to ensure the development provides adequate buffering and/or separation between the new proposed use and the mineral aggregate area/operation.

4.3 Provincial Standards - Aggregate Resources of Ontario

The existing sand and gravel pit north of the subject site is currently being developed as an open pit. It is understood that the future development of the sand and gravel pit will be on the basis of a Category 1 Licence - Class "A" - Extraction of Pit below Water. Therefore, the Costello Pit does contain a licence for an aggregate pit to extract resources to an elevation below the water table. However, it is further understood that the Owner has no intention of extracting resources below the water table.

Based on the Operational Standards Section of the Aggregate Resources of Ontario: Provincial Standards, Version 1.0, excavation setbacks are required for all licenced mineral aggregate operations. Excavation setbacks are defined in **Section 5.10** of the Operational Standards for a Category 1 Licence as the following:

5.10.1 fifteen metres from the boundary of the site;
5.10.2 thirty metres from any part of the boundary of the site that abuts:
5.10.2.1 a highway,
5.10.2.2 land in use for residential purposes at the time the licence was issued, or
5.10.2.3 land restricted to residential use by a zoning by-law when the licence was issued; or
5.10.3 thirty metres from any body of water that is not the result of excavation below the water table; ”

Based on Section 5.10 of the Operational Standards for a Category 1 Licence, a minimum setback of 15 m will be required from the property boundary of the pit operation along the northern border of the proposed residential development. It is understood that the 15 m setback will be applied on the adjacent owner’s land (on the Costello Pit area).

5.0 Compatibility and Mitigation Analysis

Based on recent discussions with the Owner of the Costello Pit (Drummond Pit), it is understood that the aggregate resource located at 3713 Borrisokane Road and adjacent to the northern property boundary of the proposed residential development is currently in operation and is expected to be completed in a 2 year time period.

An existing residential development is located to the east of the aforementioned sand and gravel pit. It should be noted that the pit has already impacted by the adjacent land uses of the existing residential development. Therefore, the proposed development will not add to the additional burden on the continued operation of the sand and gravel pit.

5.1 Noise

A Stationary Noise Source Study was completed for the aforementioned development by Paterson Group and can be found in Appendix 2.

Information included in the noise impact assessment indicates that the Costello Pit has sufficient aggregate for approximately 2 additional years of operation. Therefore, it is assumed that this pit is nearing the end of their operations. Additionally, it was noted that all extraction along the eastern portion has been completed and has been rehabilitated. For the noise analysis, a worst case scenario was devised in order to obtain a conservative result. This scenario indicates that the noise levels of the closest dwellings to Costello Pit will be exceeded, requiring sound mitigation measures to be implemented. The following measures are prescribed:

- ❏ Place a hold on the lots within 30 m of the Costello Pit until the closure of Costello Pit
- ❏ Construct a 4 m high noise barrier (earth berm) along the northern property line of the proposed development
- ❏ Construct a 2.2 m high sound barrier along the western property line of the proposed development

Provided the noise mitigation measures outlined for the Costello Pit are abided by, no additional mitigation measures will be required. Additionally, it is understood that this noise source is temporary in nature, and that all mitigation measures required for the stationary noise source can be removed once the Costello Pit has been closed.

5.2 Traffic

It is understood that the current truck route for the operation at the Costello Pit is Borrisokane Road and will continue utilizing the road for future operations. The proposed residential development will be accessed primarily from Borrisokane Road, and eventually secondary access via new Greenbank Road but the timing of this extension is unknown. Nonetheless, the Traffic Impact Assessment located in Appendix 2 indicates that there will be no significant impact to the current or future operation of the Costello Pit.

5.3 Dust

Under Section 3.1, 3.2 and 3.3 of the Operational Standards of the Aggregate Resources of Ontario: Provincial Standards, Version 1.0, all pit operations are responsible for maintaining dust emissions. Based on recent discussions with the Owner of the Costello Pit, dust control on the haul roads and processing areas at the operation is done regularly using water as a suppressant. It was noted that there may be stockpiles of extracted sand and gravel that may be located within the Costello Pit. These stockpiles should not result in additional dust emissions. Additional dust mitigation measures for the current and future operations of the sand and gravel pit will not be required. It is anticipated the proposed residential development will require water or other approved dust suppressants during the construction stages of the development.

5.4 Vibration

It is understood that current and future operations for the sand and gravel pit will not require blasting for excavation purpose. As a result, sources of vibration from the operation are limited to hauling and excavation equipment only, and have minimal impact on the proposed residential development. Similarly, blasting will not be required for excavation purposes during the construction stages of the proposed residential development, as such, sources of vibrations will be limited to oversized vehicles and construction equipment. Therefore, additional vibration mitigation measures will not be required for the sand and gravel pit or the proposed residential development as the potential impact of vibrations will be minimal.

5.5 Groundwater

It is understood that the subject site will be connected to municipal water and sewer services and will not adversely impact the groundwater levels of the current and future operations of the sand and gravel pit. Based on the Operation Plan of the Costello Pit attached to the current report, it is understood that the long-term groundwater level is expected to be at a geodetic elevation of approximately 95 m. The owner noted that excavation methods below the groundwater table at the sand and gravel pit, if completed, would consist of dredging techniques. However, if any dredging techniques are to be implemented at the sand and gravel pit, the operation will not adversely impact the groundwater levels within the proposed residential development.

6.0 Conclusions

Based on the technical studies relating to noise and dust by others, as well as Paterson's review of the subject site, the proposed residential development will not negatively impact the current and future operation of the aggregate resource pit. Provided that the sound mitigation measures outlined in the Environmental Noise Control Study - Stationary Noise Component report, prepared by Paterson Group and is located in Appendix 2, any excessive noise will be mitigated to acceptable levels and should not negatively impact the proposed development. However, all houses within the 300 m area of influence should contain the following warning clause:

> "Purchasers are advised that due to the proximity of the adjacent gravel pit operations, sound from the gravel pit may, at times, be audible"

It is expected that the operation of the aggregate resource pit will continue to adhere to the Aggregate Resources of Ontario Provincial Standards, Version 1, as well as the adjacent property owners.

7.0 Statement of Limitations

The recommendations provided in this report are in accordance with our present understanding of the project.

The present report applies only to the project described in this document. Use of this report for purposes other than those described herein or by person(s) other than Caivan Communities, or their agent(s) is not authorized without review by Paterson Group for the applicability of our recommendations to the altered use of the report.

Paterson Group Inc.

Stephanie A. Boisvenue, P.Eng.

David J. Gilbert, P.Eng.

Report Distribution:

- ❑ Caivan Communities (3 copies)
- ❑ Paterson Group (1 copy)

APPENDIX 1

DRAWING PG4752-1 - Existing Conditions

Historical Aerial Photographs

Aggregate Resource - Drummond Pit

The Base Mapping Co. Ltd.- Existing Features Plan - Costello Pit - Project No. C 419-90 - Page No. 1 of 2 - Revision 1 dated September 9, 1996

The Base Mapping Co. Ltd. - Operation and Rehabilitation Plan - Costello Pit - Project No. C 419-90 - Page 2 of 2 - Revision 2 dated May 17, 1999

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NO.	REVISIONS	DATE	INITIAL
0			

CAIVAN COMMUNITIES

MINERAL RESOURCE IMPACT ASSESSMENT
BRAZEAU LANDS - BORRISOKANE ROAD

OTTAWA, ONTARIO

Title:

EXISTING CONDITIONS

Scale: 1:7500	Date: 11/2018
Drawn by: MPG	Report No.: PG4752-1
Checked by: SB	Dwg. No.: PG4752-1
Approved by: DJG	Revision No.: 0

p:\autocad drawings\geotechnical\pg47xx\pg4752\pg4752-1 existing conditions.dwg

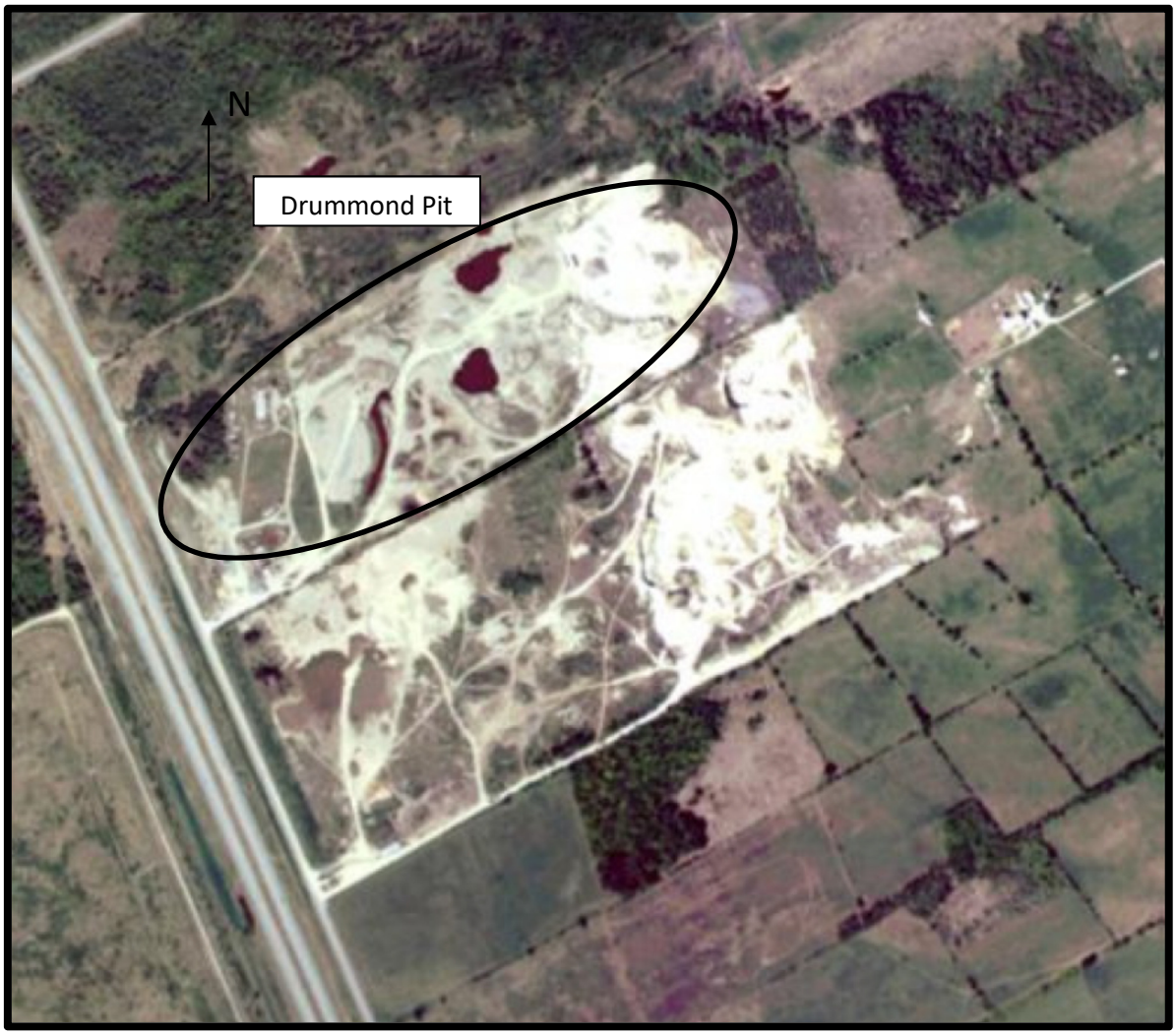


FIGURE 4

HISTORICAL PHOTOGRAPH - 1999

FIGURE 3

HISTORICAL PHOTOGRAPH - 2008

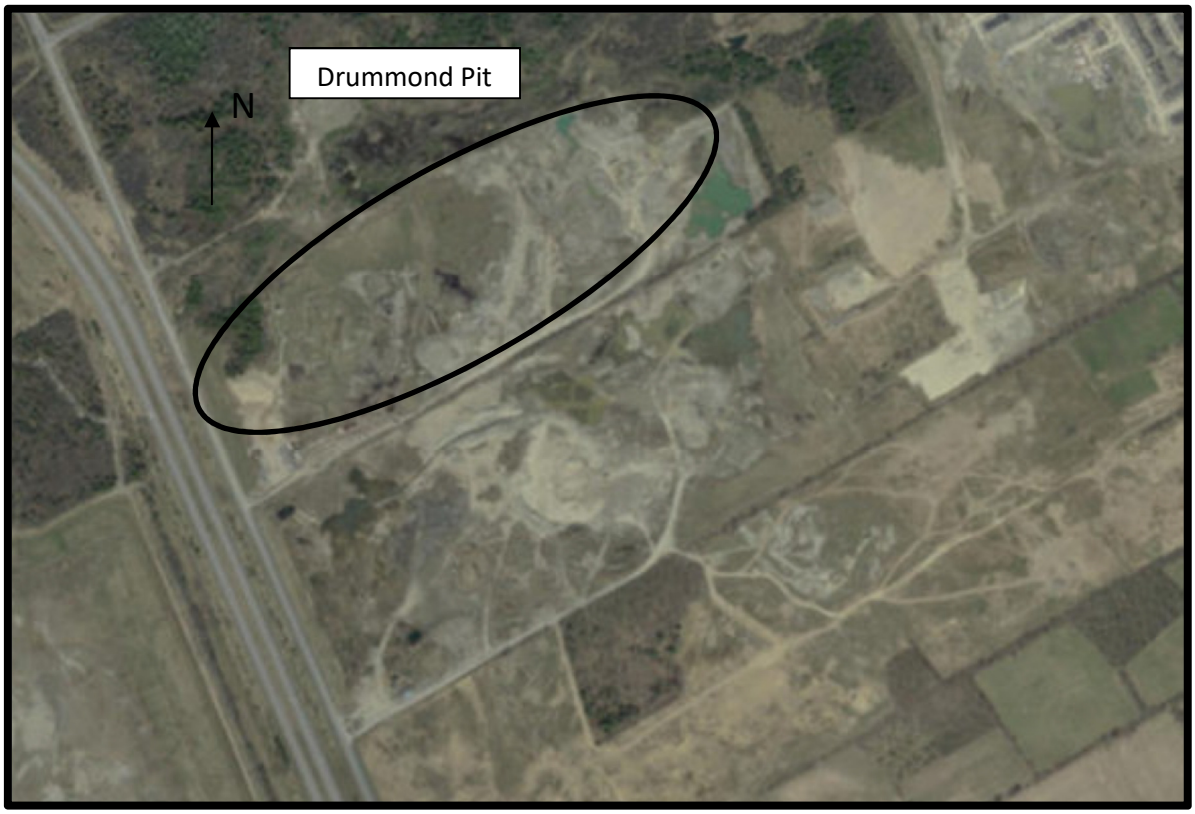


FIGURE 2

HISTORICAL PHOTOGRAPH - 2014

FIGURE 1

HISTORICAL PHOTOGRAPH - 2017

Ontario

PRINT

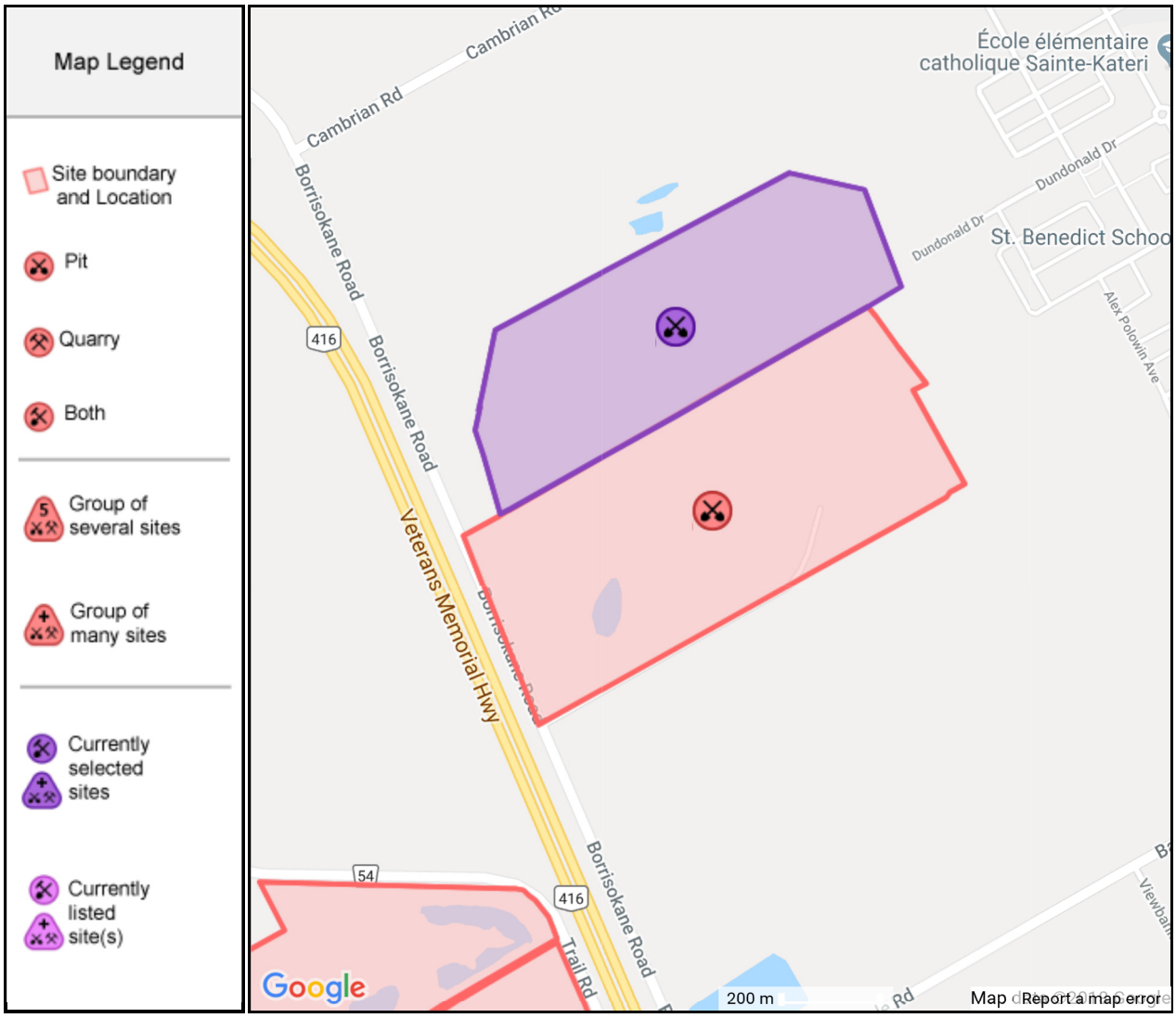
Search Criteria

Geographic Location: Cluster selected. Centre of map is: -75.747927°N,45.237616°W

Approval Type: Class A Licence-or-Class B Licence-or-Aggregate Permit-or-Wayside Permit-or-MTO Permit

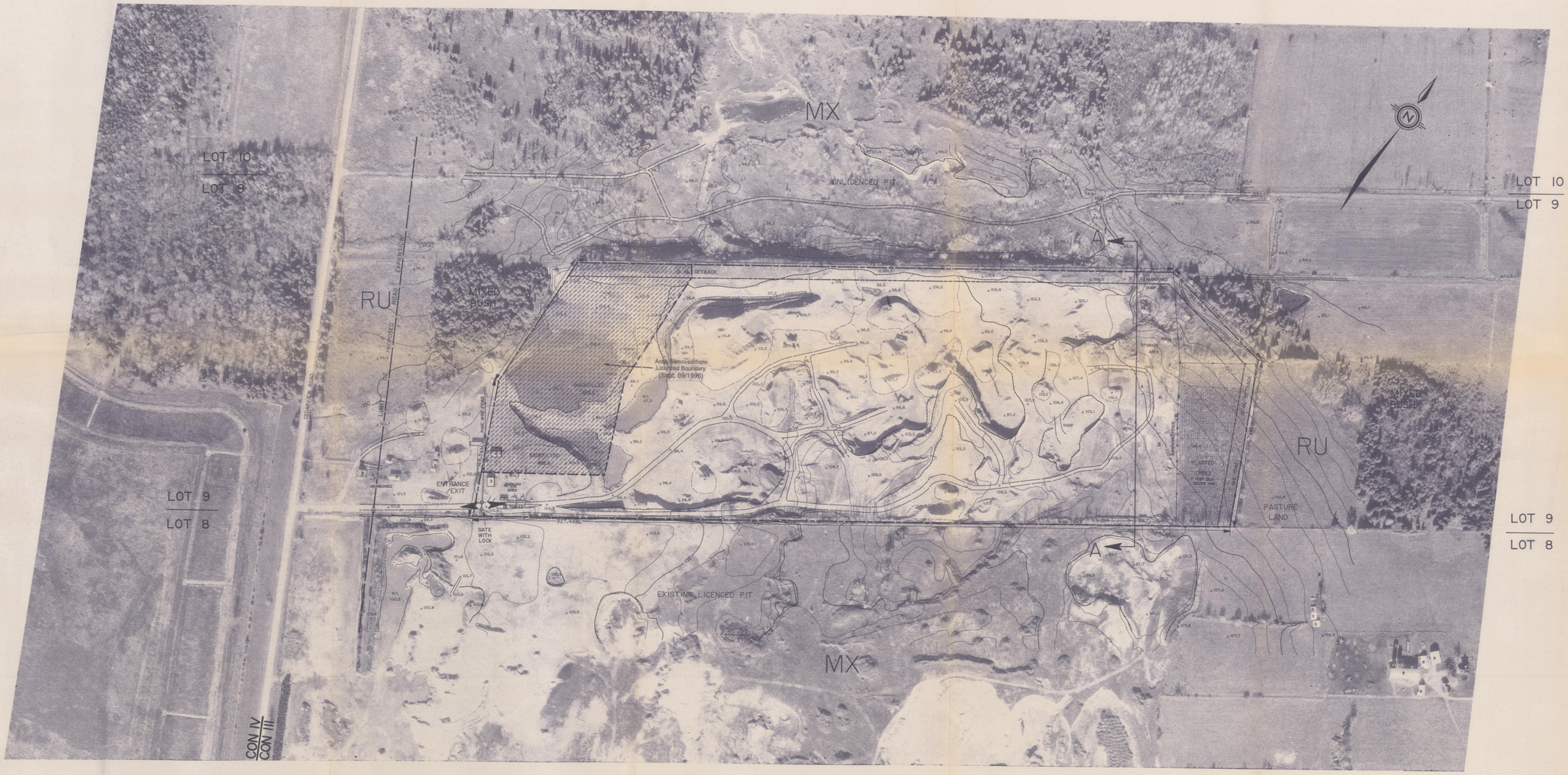
Operation Type: Pit-or-Quarry

Search Results (1)



Site ID	Client Name	Approval Type	Operation Type
4074	George W. Drummond Limited	Class A Licence	Pit
	Location Name	**Max. Annual Tonnage**	**Licenced Area (ha)**
		350000	22.3

Created on Friday, May 18, 2018



EXISTING FEATURES

Property licenced for pit operation as designated under the authority of the Aggregate Resources Act 1989.

A pit area presently exists on the majority of the licenced area. Natural drainage of the property is by seepage into the soil and surface drainage to the east.

A weigh scale, garage, office and barn all present on the site near the entrance/exit to the pit.

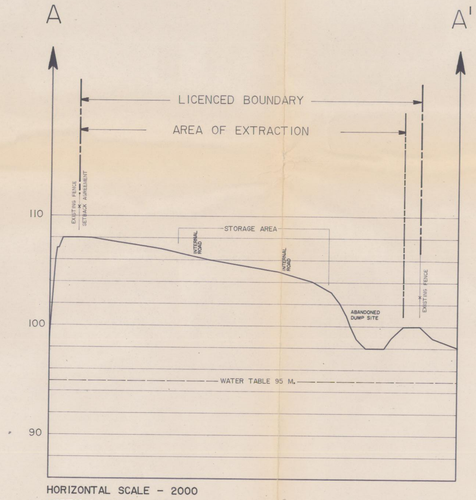
Fencing is not required along the north boundary. Fencing and setback is not required along the south boundary as there exists a boundary agreement between Brazeau and George W. Drummond Ltd., owners of the two properties in concern.

There is no setback along the west boundary as the adjacent property is owned by George Drummond.

A tree plantation of 7 year old Scots pine exists on the licenced property located at the east end. This area has been leased out by Drummond until 2002.

INDEX OF SITE BUILDINGS

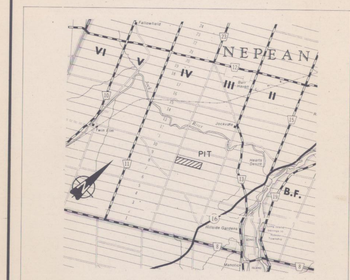
	Classification	Area (m²)
1.	Weigh Scale Office	12.8
2.	Office Trailer	25.0
3.	Storage Garage	109.6
4.	Barn	98.6



HORIZONTAL SCALE - 2000
VERTICAL SCALE - 200

M.O.E. Well Water Data 1991 (in metres)

Con.	Lot	Well No.	Elevation Ft.	Water Found	Static Water Level
III	8	15-6040	97m	20.4	6.4



KEY MAP CITY OF NEPEAN

EXISTING FEATURES

NOTES

	Revision Values as of Sept. 09/1996
1. LICENCED AREA 27.5 ± HECTARES.	23.5 ± ha
2. AREA OF OPERATION 25.8 ± HECTARES.	22.3 ± ha
3. EXISTING DISTURBED AREA 22 ± HECTARES.	20.5± ha.

4. THIS SITE PLAN IS PREPARED FOR SUBMISSION TO THE MINISTRY OF NATURAL RESOURCES IN CONJUNCTION WITH AN APPLICATION FOR A CLASS 'A' LICENCE UNDER THE AGGREGATE RESOURCES ACT & REGULATIONS.
5. THIS PLAN WAS PREPARED USING PHOTOGRAMMETRIC METHODS FROM AERIAL PHOTOGRAPHS.
6. LOT, CONCESSION AND BOUNDARY LINES ON THIS PLAN ARE APPROXIMATE.
7. THIS IS NOT A LEGAL SURVEY DRAWING IN ACCORDANCE WITH THE PROVINCE OF ONTARIO SURVEYORS ACT 1987.

OFFICE COPY

COSTELLO PIT

ARA No. 4074

PART OF LOT 9, CONCESSION III
CITY OF NEPEAN

GEORGE W. DRUMMOND LIMITED
30 RIDEAU HEIGHTS DRIVE
NEPEAN, ONTARIO K2E 7A6

LEGEND

- BOUNDARY OF AREA TO BE LICENCED
- LIMIT OF EXTRACTION (SETBACK LINE)
- ENTRANCE AND OR EXIT
- PIT/QUARRY FACE EXISTING/PROPOSED
- STOCKPILE: EXISTING/PROPOSED
- DIRECTION OF OPERATION AND PHASE
- WELL
- STANDING WATER
- TEST HOLE
- BUILDING: S-SILO, H-HOUSE, G-GARAGE B-BARN, S-SHED.
- FENCE/GATE
- ROAD: PAVED, UNPAVED
- RAILWAY
- POLE: HYDRO/TELEPHONE
- HYDRO TOWER
- LAKE/POND
- WATERCOURSE: DOUBLE, SINGLE, FLOW ARROW
- BRIDGE, CULVERT
- MARSH
- EXISTING CONTOURS
- PROPOSED CONTOURS
- SPOT ELEVATION
- BUSH: DECIDUOUS/CONIFEROUS
- EXISTING BERM
- PROPOSED BERM
- CROSS SECTION
- Area Removed from Licenced Boundary

PHOTO SCALE	ROLL No.	EXPOSURE No.	LINE No.	PHOTO DATE
1:15000	90066	37-39	1	NOV. 1990
MAP SCALE 1:2000	CONTOUR INTERVAL 1 METRE	DATE OF SITE PLAN DEC. 1990		

0 50 100 150 metres

AMENDMENTS	DATE
Modified licenced boundary and corresponding calculations and notes.	Sept. 09, 1996

SITE PLANS APPROVED BY MINISTRY OF NATURAL RESOURCES
SIGNATURE
DATE Sept 17/96

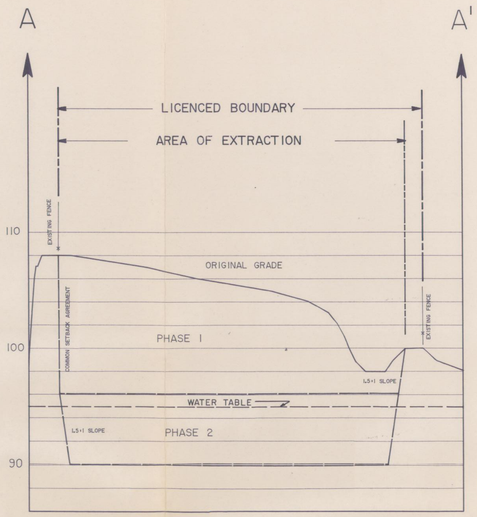
PAGE 1 of 2 | CONTRACT C 419 - 90

THIS IS NOT A CERTIFIED COPY UNLESS EMBOSSED WITH SEAL

THE BASE MAPPING CO. LTD.
UNIT 37 - 81 AURIGA DRIVE, NEPEAN, ONTARIO K2E 7Y3
(613) 723-8100 FAX: (613) 723-8569

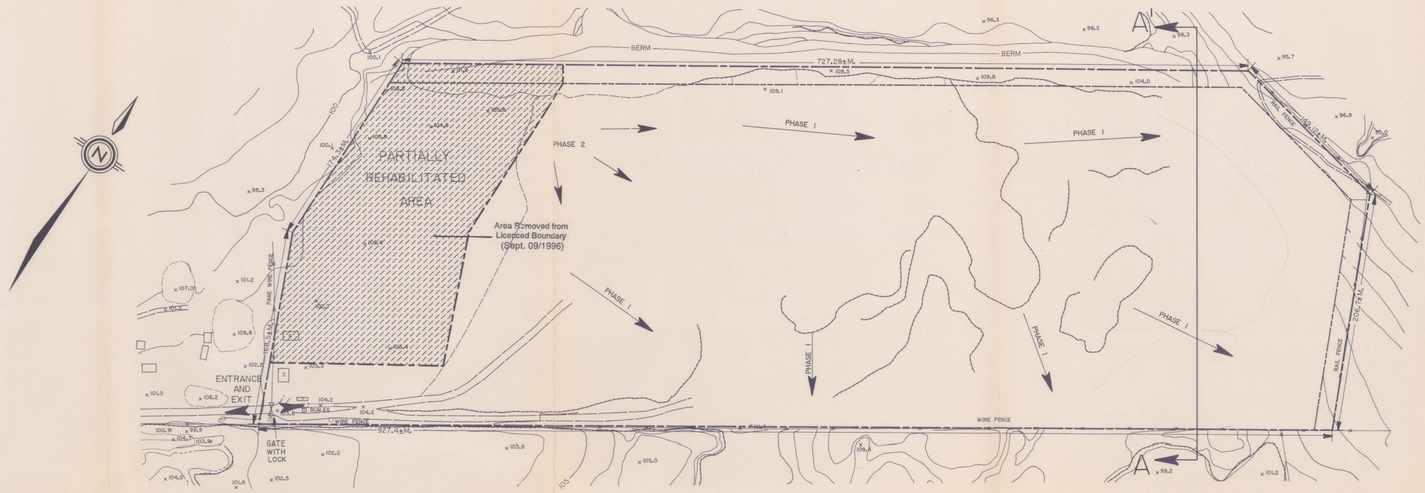
D. Lebrash
SEP 10 1996

OPERATION PLAN



HORIZONTAL SCALE - 2000

VERTICAL SCALE - 200



GENERAL

The pit will operate in accordance with the Aggregate Resources Act 1989.

Fencing and setback is not required along the south limits of the pit as agreed upon by Marcel Irazeau (pit owner to the south of Drummond) and George W. Drummond Ltd. Fencing is also not required for the north boundary. Various locations, where fences need not be established, have been agreed upon by the Ministry of Natural Resources.

The entrance/exit to the pit has a gate with a lock on it.

The entrance/exit to the pit is from Cedarview Road.

There exists no limitations to the types or location of excavation equipment which may operate on the site. All machinery is equipped with noise and dust suppressors.

Information pertaining to water wells is indicated on the Existing Features Plan.

Product stockpiles are stored within the confines of the limit of extraction.

Recycling of asphalt is permitted within the extraction limits. Area for recycling will be kept 10 metres from any open water.

The tree plantation area lease, upon its expiry date, will be subject to mining activity. Operation of this area will fall into regular mining phases as described within the Operation notes.

OPERATION

The licenced pit hectarage will be mined in two phases of operation. Phase 1 above water table, Phase 2 below water table.

Phase 1 mining is active, operating to a depth of approximately 95 metres as indicated on the Operation Plan. Direction of operation moves from the west towards the east.

Phase 2 mining will follow the Phase 1 mining pattern beginning from the westerly limits of the licenced property and proceeding in a easterly direction, as indicated on the Operation Plan.

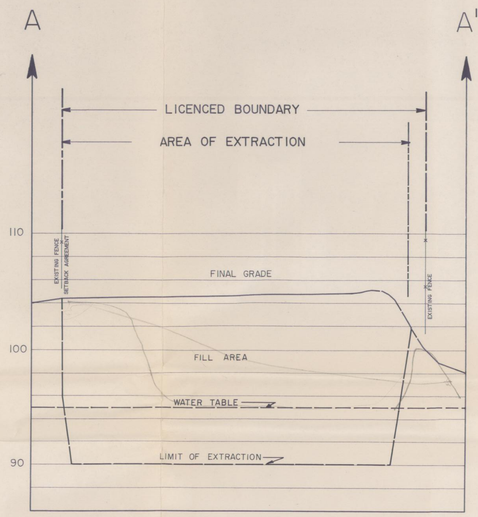
Phase 2 will begin mining operation upon completion of Phase 1. Mining will be below the water table. Extraction of the material will be by dragline methods. No pumping or letting of water will be needed. Final operation depth will be approximately 90 metres.

Amendment – April 29/99

Import topsoil to process for resale.

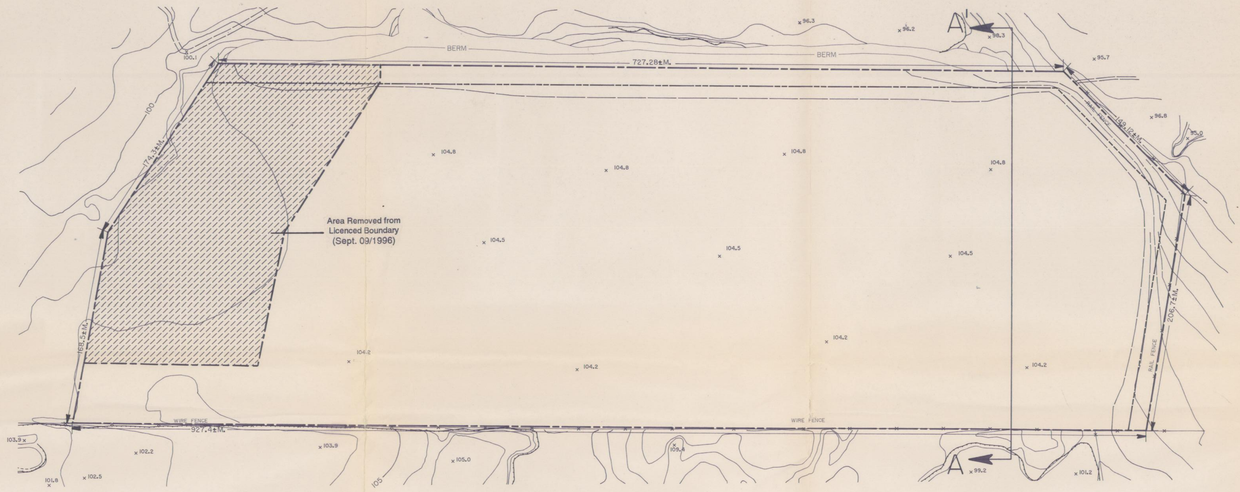
To allow Phases 1 & 2 to operate concurrently and simultaneous in various locations due to the differently quality of material throughout the site and also the high concentration of clay ridges.

PROGRESSIVE REHABILITATION AND FINAL REHABILITATION PLAN



HORIZONTAL SCALE - 2000

VERTICAL SCALE - 200



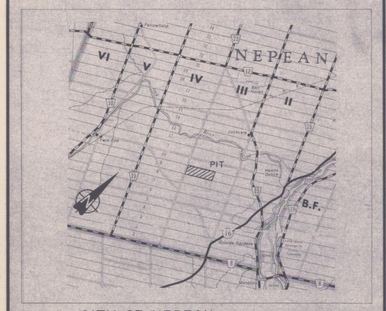
REHABILITATION

Maximum hectarage to be rehabilitated is approximately 22.3 hectares. Progressive rehabilitation will be carried out on the site. In the general this would be carried out by filling from a westerly to easterly direction.

The pit will be backfilled with acceptable inert material. The final site elevation will be approximately 104 metres, sloping slightly to the south, as indicated on the Rehabilitation Plan. The sloped surface will then be sewn with a grass legume mixture.

Adequate soil would be spread on the site to facilitate an adequate growth for grass legume mixture.

The site can then be adequately utilized for building development or pasture.



KEY MAP CITY OF NEPEAN

OPERATION & REHAB. PLANS

NOTES

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2. AREA OF OPERATION 25.9± HECTARES.	22.3 ± ha
3. EXISTING DISTURBED AREA 16.4± HECTARES.	16.4 ± ha

4. THIS SITE PLAN IS PREPARED FOR SUBMISSION TO THE MINISTRY OF NATURAL RESOURCES IN CONJUNCTION WITH AN APPLICATION FOR A CLASS 'A' LICENCE UNDER THE AGGREGATE RESOURCES ACT & REGULATIONS.
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7. THIS IS NOT A LEGAL SURVEY DRAWING IN ACCORDANCE WITH THE PROVINCE OF ONTARIO SURVEYORS ACT 1987.

COSTELLO PIT

ARA No. 4074

PART OF LOT 9, CONCSSION III

CITY OF NEPEAN

GEORGE W. DRUMMOND LIMITED
30 RIDEAU HEIGHTS DRIVE
NEPEAN, ONTARIO K2E 7A6

LEGEND

- BOUNDARY OF AREA TO BE LICENCED
- LIMIT OF EXTRACTION (SETBACK LINE)
- ENTRANCE AND OR EXIT
- PIT/QUARRY FACE EXISTING/PROPOSED
- STOCKPILE: EXISTING/PROPOSED
- DIRECTION OF OPERATION AND PHASE
- WELL
- STANDING WATER
- TEST HOLE
- BUILDING: S-SILO, H-HOUSE, G-GARAGE, B-BARN, S-SHED.
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- HYDRO TOWER
- LAKE/POND
- WATERCOURSE: DOUBLE, SINGLE, FLOW ARROW
- BRIDGE, CULVERT
- MARSH
- EXISTING CONTOURS
- PROPOSED CONTOURS
- SPOT ELEVATION
- BUSH: DECIDUOUS/CONIFEROUS
- EXISTING BERM
- PROPOSED BERM
- CROSS SECTION
- Area Removed from Licenced Boundary

PHOTO SCALE	ROLL No.	EXPOSURE No.	LINE No.	PHOTO DATE
1:15000	90066	37-39	1	NOV. 1990
MAP SCALE	CONTOUR INTERVAL	DATE OF SITE PLAN		
1:2000	1 METRE	DEC. 1990		

0 50 100 150 metres

AMENDMENTS	DATE
Modified licenced boundary and corresponding, calculations and notes.	Sept. 09, 1996
See amendment dated April 29/99	May 17/99

SITE PLANS APPROVED BY MINISTRY OF NATURAL RESOURCES.

SIGNATURE DATE

PAGE 2 of 2	CONTRACT C 419 - 90

THIS IS NOT A CERTIFIED COPY UNLESS EMBOSSED WITH SEAL

THE BASE MAPPING CO. LTD.

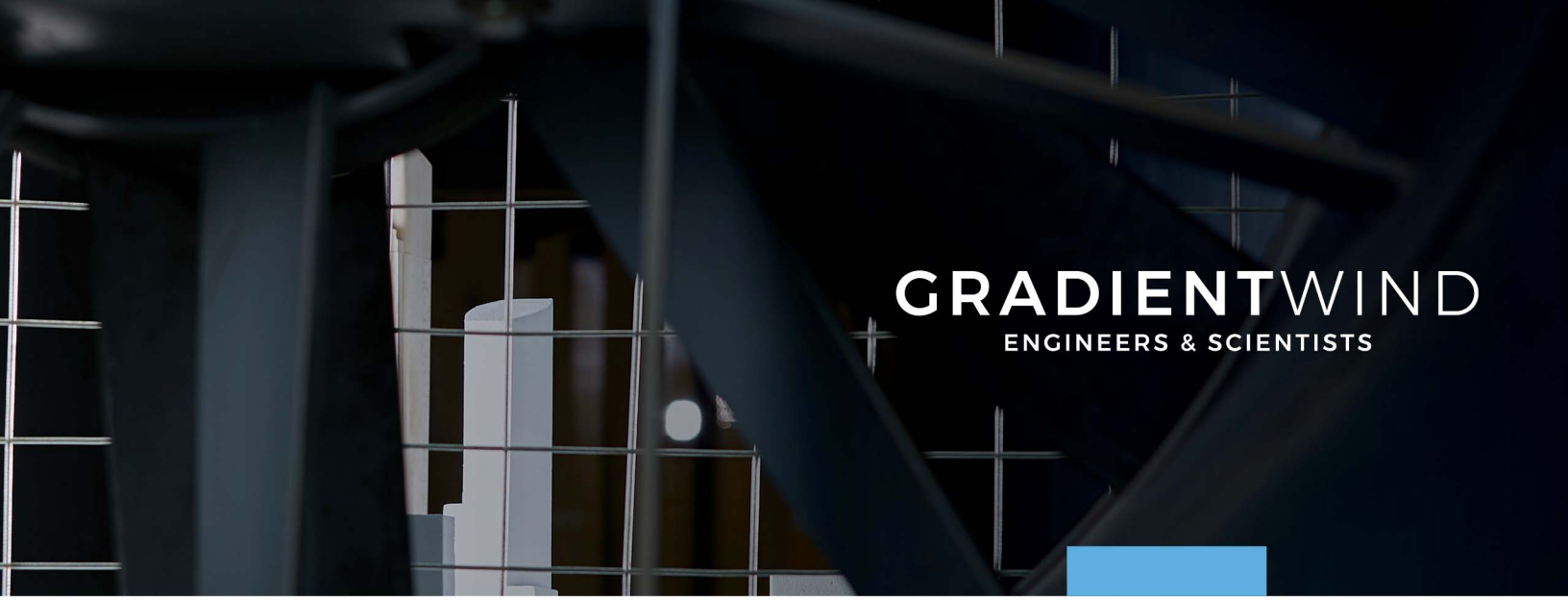
SEP 10 1996

UNIT 37 - 81 AURIGA DRIVE, NEPEAN, ONTARIO K2E 7V3
(613) 723 - 8100 FAX: (613) 723 - 8569

APPENDIX 2

Traffic Noise Feasibility Assessment - Brazeau Subidvision - Ottawa, Ontario - Prepared by Gradient Wind - Project GWE18-198 dated December 18, 2018

Environmental Noise Control Study - Stationary Noise Component - Proposed Residential Development - Brazeau Lands - Borrisokane Road - Ottawa - Prepared by Paterson Group Inc - Report Number PG4752-2 - dated December 21, 2018



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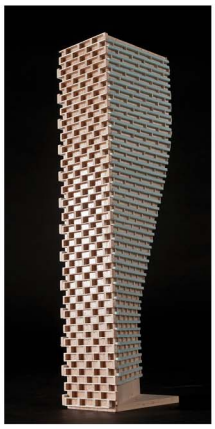
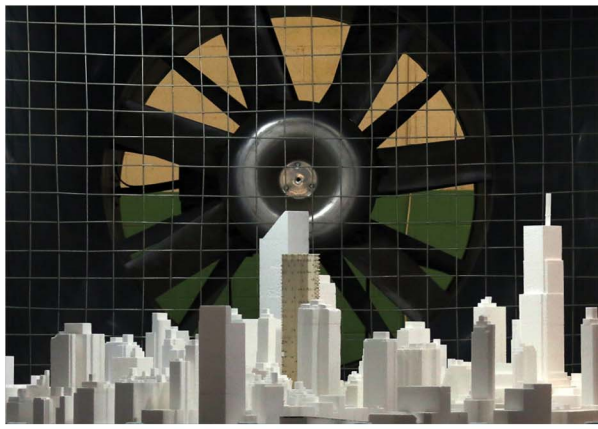
ENGINEERS & SCIENTISTS

TRAFFIC NOISE FEASIBILITY ASSESSMENT

Brazeau Subdivision
Ottawa, Ontario

REPORT: GWE18-198 – Traffic Noise





December 18, 2018

PREPARED FOR

Andrew Finnson
Director, Land Development
Caivan Brazeau Development Corporation
2934 Baseline Road, Suite 302
Ottawa, Ontario
K2H 1B2

PREPARED BY

Giuseppe Garro, MASc., Junior Environmental Scientist
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127 WALGREEN ROAD, OTTAWA, ON, CANADA K0A 1L0 | 613 836 0934
GRADIENTWIND.COM

EXECUTIVE SUMMARY

This report describes a traffic noise feasibility assessment undertaken in support of a rezoning and draft plan of subdivision application for a proposed residential subdivision known as Brazeau situated in Ottawa, Ontario. The proposed development is on a nearly rectangular lot and comprises a mixture of detached homes and townhomes connected by a series of streets and walkways. The development site is bound by aggregate pits to the north and west, realigned Greenbank Road to the east, and vacant land to the south. A park is located on the southwest corner of the site. On the west side, a new road may be constructed connecting the subdivision to Borrisokane Road. Major sources of noise impacting the site are roadway traffic along the realigned Greenbank Road, Borrisokane Road, Highway 416, and the Bus Rapid Transit (BRT) lane in the center of the realigned Greenbank Road. Other sources of noise in the area include the mentioned aggregate pits, but operations are likely to cease prior to construction. A mineral and noise impact assessment has been prepared by Patterson. The focus of this study is impacts from roadway sources. Figure 1 illustrates a complete site plan with surrounding context.

The assessment is based on (i) theoretical noise prediction methods that conform to the Ministry of the Environment, Conservation and Parks (MECP) and City of Ottawa requirements; (ii) noise level criteria as specified by the City of Ottawa's Environmental Noise Control Guidelines (ENCG); (iii) future vehicular traffic volumes based on the City of Ottawa's Official Plan roadway classifications; and (iv) site plan drawings prepared by Gerrard Design Associates Inc. dated October 30, 2018.

The results of the current study indicate that noise levels due to roadway traffic over the site will range between approximately 46 and 62 dBA during the daytime period (07:00-23:00). The highest roadway traffic noise levels will occur nearest to Greenbank Road. Results of the roadway traffic noise calculations also indicate that outdoor living areas having direct exposure to Greenbank Road will likely require noise control measures. Mitigation measures are described in Section 4.4, with the aim to reduce the L_{eq} to as close to 55 dBA as technically, economically and administratively feasible.

A detailed roadway traffic noise study will be required at the time of site plan approval to determine specific noise control measures for the development.

TABLE OF CONTENTS

1. INTRODUCTION

Gradient Wind Engineering Inc. (Gradient Wind) was retained by Caivan Brazeau Development Corporation to undertake a traffic noise assessment in support of site plan application for a proposed residential subdivision known as Brazeau situated in Ottawa, Ontario. This report summarizes the methodology, results, and recommendations related to a roadway traffic noise feasibility assessment and was prepared in consideration of the client's draft plan of subdivision applications. GWE's scope of work involved assessing exterior noise levels throughout the site, generated by local roadway traffic.

The assessment was performed on the basis of theoretical noise calculation methods conforming to the City of Ottawa[1] and Ministry of the Environment, Conservation and Parks (MECP)[2] guidelines. Noise calculations were based on architectural drawings prepared by Gerrard Design Associates Inc. dated October 30, 2018, with future traffic volumes corresponding to the City of Ottawa's Official Plan (OP) roadway classifications.

2. TERMS OF REFERENCE

The focus of this traffic noise assessment in support of a proposed subdivision known as Brazeau situated in Ottawa, Ontario. The proposed development is on a nearly rectangular lot and comprises a mixture of detached homes and townhomes. A park is located on the southwest corner of the site. The development will include creation of new walkways and residential streets feeding into the subdivision from the realigned Greenbank Road. The site will also include a storm water retention pond to the north west.

The development site is bound by aggregate pits to the west and north identified as Brazeau Pit and Costello Pit respectively, realigned Greenbank Road to the east, and vacant land to the south. To the west of the Brazeau Pit is Borrisokane Road as well as Highway 416. On the west side, a new road will be constructed connecting the subdivision to Borrisokane Road. Major sources of noise impacting the site are roadway traffic along the realigned Greenbank Road, Borrisokane Road, Highway 416 and the Bus Rapid Transit (BRT) lane in the center of the realigned Greenbank Road. Other sources of noise in the area include the

[1] City of Ottawa Environmental Noise Control Guidelines, January 2016
[2] Ontario Ministry of the Environment and Climate Change – Environmental Noise Guidelines, Publication NPC-300, Queens Printer for Ontario, Toronto, 2013

mentioned aggregate pits, but operations are likely to cease prior to construction. A mineral and noise impact assessment has been prepared by Patterson. The focus of this study is impacts from roadway sources. The investigation is based on a concept plan drawing prepared by Gerrard Design Associates Inc. Figure 1 illustrates the site plan with surrounding context.

The study site is divided by an urban boundary line which travels north and south, signifying urban development west of the boundary is restricted. A proposed transit station / park-and-ride is located south of the site. Since the station is more than 100 m away from the site, it is considered an insignificant source noise.

3. OBJECTIVES

The principal objective of this work is to calculate the future noise levels on the study site produced by local roadway traffic and explore potential for noise mitigation where required, noise calculations are based on initial concept plan prepared by Gerrard Design Associates Inc, with future traffic volumes corresponding to the City of Ottawa's Official Plan (OP) roadway classifications.

4. METHODOLOGY

4.1 Background

Noise can be defined as any obtrusive sound. It is created at a source, transmitted through a medium, such as air, and intercepted by a receiver. Noise may be characterized in terms of the power of the source or the sound pressure at a specific distance. While the power of a source is characteristic of that particular source, the sound pressure depends on the location of the receiver and the path that the noise takes to reach the receiver. Measurement of noise is based on the decibel unit, dBA, which is a logarithmic ratio referenced to a standard noise level (2×10^{-5} Pascals). The 'A' suffix refers to a weighting scale, which better represents how the noise is perceived by the human ear. With this scale, a doubling of power results in a 3 dBA increase in measured noise levels and is just perceptible to most people. An increase of 10 dBA is often perceived to be twice as loud.

4.2 Roadway Traffic Noise

4.2.1 Criteria for Roadway Traffic Noise

For surface roadway traffic noise, the equivalent sound energy level, L_{eq}, provides a measure of the time varying noise levels, which is well correlated with the annoyance of sound. It is defined as the continuous sound level, which has the same energy as a time varying noise level over a period of time. For roadways, the L_{eq} is commonly calculated on the basis of a 16-hour (L_{eq16}) daytime (07:00-23:00) / 8-hour (L_{eq8}) nighttime (23:00-07:00) split to assess its impact on residential buildings. The City of Ottawa's Environmental Noise Control Guidelines (ENCG) specifies that the recommended Outdoor Living Area (OLA) noise limit is 55 dBA during the daytime period. OLA do not need to be considered during the nighttime period.

Predicted noise levels at the OLA dictate the action required to achieve the recommended sound levels. According to the ENCG, if an area is to be used as an OLA, noise control measures are required to reduce the L_{eq} to 55 dBA. This is typically done with noise control measures outlined in Section 4.4. When noise levels at these areas exceed the criteria, specific Warning Clause requirements may apply. As this is a preliminary assessment, noise control recommendations are of a general nature. Specific mitigation requirements would be the work of a future study.

4.2.2 Theoretical Roadway Noise Predictions

Noise predictions were determined by computer modelling using two programs. To provide a general sense of noise across the site, the employed software program was Predictor-Lima (TNM calculation), which incorporates the United States Federal Highway Administration's (FHWA) Transportation Noise Model (TNM) 2.5. This computer program is capable of representing three-dimensional surface and first reflections of sound waves over a suitable spectrum for human hearing. A receptor grid with 5 × 5 m spacing was placed across the study site, along with a number of discrete receptors at key sensitive areas.

Although this program outputs noise contours, it is not the approved model for roadway predictions by the City of Ottawa. Therefore, the results were confirmed by performing discrete noise calculations with the Ministry of the Environment, Conservations and Parks (MECP) computerized noise assessment program, STAMSON 5.04, at key receptor locations coinciding with receptor locations in Predictor as

shown in Figure 2 and 3, as well as receptor distances. Appendix A includes the STAMSON 5.04 input and output data.

Roadway noise calculations were performed by treating each road segment as separate line sources of noise. In addition to the traffic volumes summarized in Table 1 below, theoretical noise predictions were based on the following parameters:

- Truck traffic on all roadways was taken to comprise 5% heavy trucks and 7% medium trucks, as per ENCG requirements for noise level predictions
- The day/night split was taken to be 92% / 8% respectively for all streets
- Receptor heights taken to be 1.5 m above grade
- Absorptive ground surface between source and receivers
- The study site was treated as having flat or gently sloping topography
- No massing considered as potential noise screening elements
- Roadways exceeding a distance of 500 m from a discrete receptor were omitted

4.2.3 Roadway Traffic Volumes

The ENCG dictates that noise calculations should consider future sound levels based on a roadway's classification at the mature state of development. Therefore, traffic volumes are based on the roadway classifications outlined in the City of Ottawa's Official Plan (OP) and Transportation Master Plan[3] which provide additional details on future roadway expansions. Average Annual Daily Traffic (AADT) volumes are then based on data in Table B1 of the ENCG for each roadway classification. As for the BRT, volumes were used based on Gradient Wind's experience with similar developments. Table 1 (below) summarizes the AADT values used for each roadway included in this assessment.

[3] City of Ottawa Transportation Master Plan, November 2013

TABLE 1: ROADWAY TRAFFIC DATA

Roadway	Roadway Traffic Data	Speed Limit (km/h)	Traffic Volumes	GWE Assumed Volumes
Greenbank Road (Realigned)	4-Lane Urban Arterial Divided (4-UAD)	70	**35,000**	-
Borrisokane Road	2-Lane Urban Collector (2-UCU)	80	**8,000**	-
Northbound Veterans Memorial Highway (Highway 416)	2 Lane Freeway	100	**18,333/Lane**	-
Southbound Veterans Memorial Highway (Highway 416)	2 Lane Freeway	100	**18,333/Lane**	-
Bus Rapid Transit	BRT	80	-	***191/67**

* Daytime and nighttime volumes based on correspondence with the City of Ottawa

5. RESULTS AND DISCUSSION

5.1 Roadway Traffic Noise Levels

The results of the roadway traffic noise calculations for the daytime period, covering the entire study site, are shown in Figure 4. Discrete receptors were also placed at ground level at key locations throughout the site. The noise contours were generated using TNM and verified with discrete receptors using STAMSON 5.04, as shown in Figure 2 and 3, and summarized in Table 2 below. Appendix A contains the complete set of input and output data from all STAMSON 5.04 calculations.

TABLE 2: EXTERIOR NOISE LEVELS DUE TO ROAD TRAFFIC

Receptor Number	Receptor Height Above Grade (m)	Receptor Location	STAMSON 5.04 Noise Level (dBA)	Predictor-Lima Noise Level (dBA)
			Day	Day
1	1.5	OLA – Grade Level – Western Block	50	46
2	1.5	OLA – Grade Level – Central Block	50	45
3	1.5	OLA – Grade Level – Southern Block	52	47
4	1.5	OLA – Grade Level – Eastern Block	58	55
5	1.5	OLA – Grade Level – Eastern Boundary	62	60

As shown above, the results calculated from TNM have good correlation with calculations performed in STAMSON 5.04. A tolerance of 3 dBA between models is generally considered acceptable given human hearing cannot detect a change in sound level of less than 3 dBA. As stated in Section 4.2.2, massing elements, such as buildings, were conservatively ignored as potential screening elements. Results of the roadway traffic noise calculations also indicate that outdoor living areas (R4 and R5) on blocks adjacent to and having direct exposure to Greenbank Road will likely require noise control measures. These measures are briefly described in Section 4.4, with the aim to reduce the L_{eq} to as close to 55 dBA as technically, economically and administratively feasible.

According to Table 2, the blocks orientated east/west situated in the northeast corner of the site will likely require sound barriers along the edge of the rear yards closest to Greenbank Road. However, massing elements along the edge of the development are expected block direct line of sight of the roadways and act as sound barriers, reducing the sound experienced at the inner bocks within the subdivision. It is possible homes along the edge of the development will require noise control measures as outlined in Section 4.4. A detailed roadway traffic noise study will be required at the time of subdivision registration to determine specific noise control measures for the development.

5.2 Noise Control Measures

The noise levels predicted due to roadway traffic, at a number of receptors, exceed the criteria listed in the ENCG for outdoor living areas, as discussed in Section 4.3. Therefore, noise control measures as

described below, subscribing to Table 2.3a in the ENCG and listed in order of preference, will be required to reduce the L_{eq} to 55 dBA:

- Distance setback with soft ground
- Insertion of noise insensitive land uses between the source and sensitive points of reception
- Orientation of buildings to provide sheltered zones in rear yards
- Shared outdoor amenity areas
- Earth berms (sound barriers)
- Acoustic barriers

Based on expected noise levels, blocks in the dark orange and red regions in Figure 4 will require forced air heating with provisions for central air conditioning. Warning clauses will also be required to be placed on agreements of purchase, sale, and lease. Specific mitigation will be determined during detailed design.

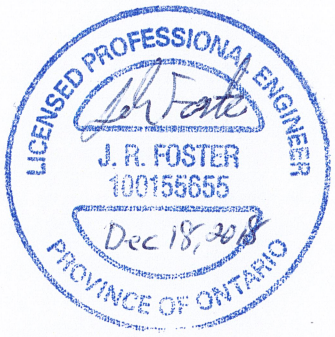
6. CONCLUSIONS AND RECOMMENDATIONS

The results of the current study indicate that noise levels due to roadway traffic over the site will range between approximately 46 and 62 dBA during the daytime period (07:00-23:00). The highest roadway traffic noise levels will occur nearest to Greenbank Road. Results of the roadway traffic noise calculations also indicate that outdoor living areas having direct exposure to Greenbank Road will likely require noise control measures. Mitigation measures are described in Section 4.4, with the aim to reduce the L_{eq} to as close to 55 dBA as technically, economically and administratively feasible. A detailed roadway traffic noise study will be required at the time of site plan approval to determine specific noise control measures for the development.

This concludes our traffic noise assessment and report. If you have any questions or wish to discuss our findings please advise us. In the interim, we thank you for the opportunity to be of service.

Sincerely,

Gradient Wind Engineering Inc.



Giuseppe Garro, MASc.
Junior Environmental Scientist
GWE18-198

Joshua Foster, P.Eng.
Principal

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127 WALGREEN ROAD , OTTAWA, ON
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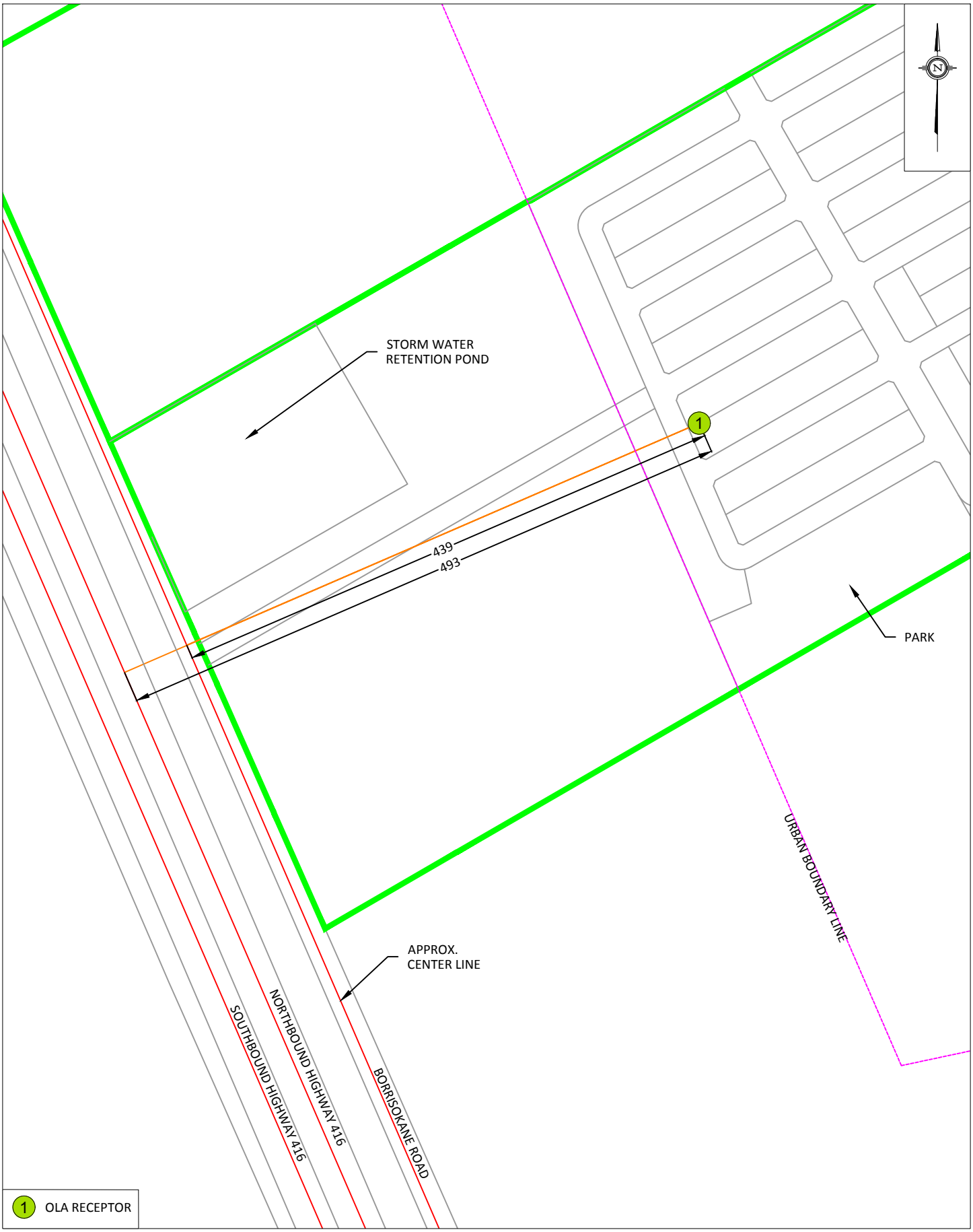
PROJECT	BRAZEAU SUBDIVISION - TRAFFIC NOISE STUDY
SCALE	1:8000 (APPROX.)
DRAWING NO.	GWE18-198
DATE	NOVEMBER 23, 2018
DRAWN BY	G.G.

DESCRIPTION

FIGURE 1:
SITE PLAN AND SURROUNDING CONTEXT



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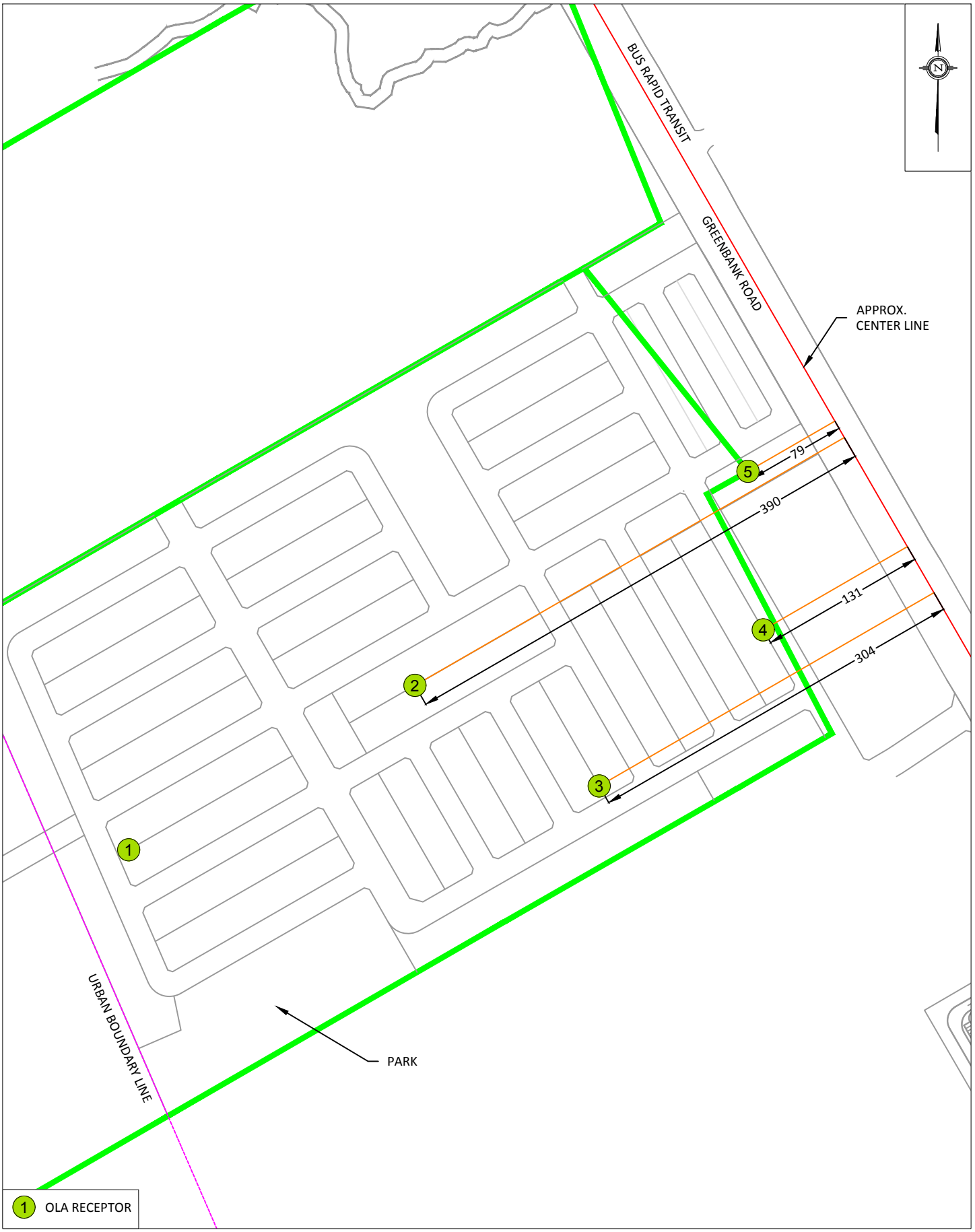
PROJECT	BRAZEAU SUBDIVISION - TRAFFIC NOISE STUDY		DESCRIPTION
SCALE	1:4000 (APPROX.)	DRAWING NO.	GWE18-198
DATE	NOVEMBER 23, 2018	DRAWN BY	G.G.

FIGURE 2:
RECEPTOR 1 LOCATION AND STAMSON INPUT



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PROJECT	BRAZEAU SUBDIVISION - TRAFFIC NOISE STUDY		
SCALE	1:4000 (APPROX.)	DRAWING NO.	GWE18-198
DATE	NOVEMBER 23, 2018	DRAWN BY	G.G.

DESCRIPTION

FIGURE 3:
RECEPTOR 2-5 LOCATIONS AND STAMSON INPUT

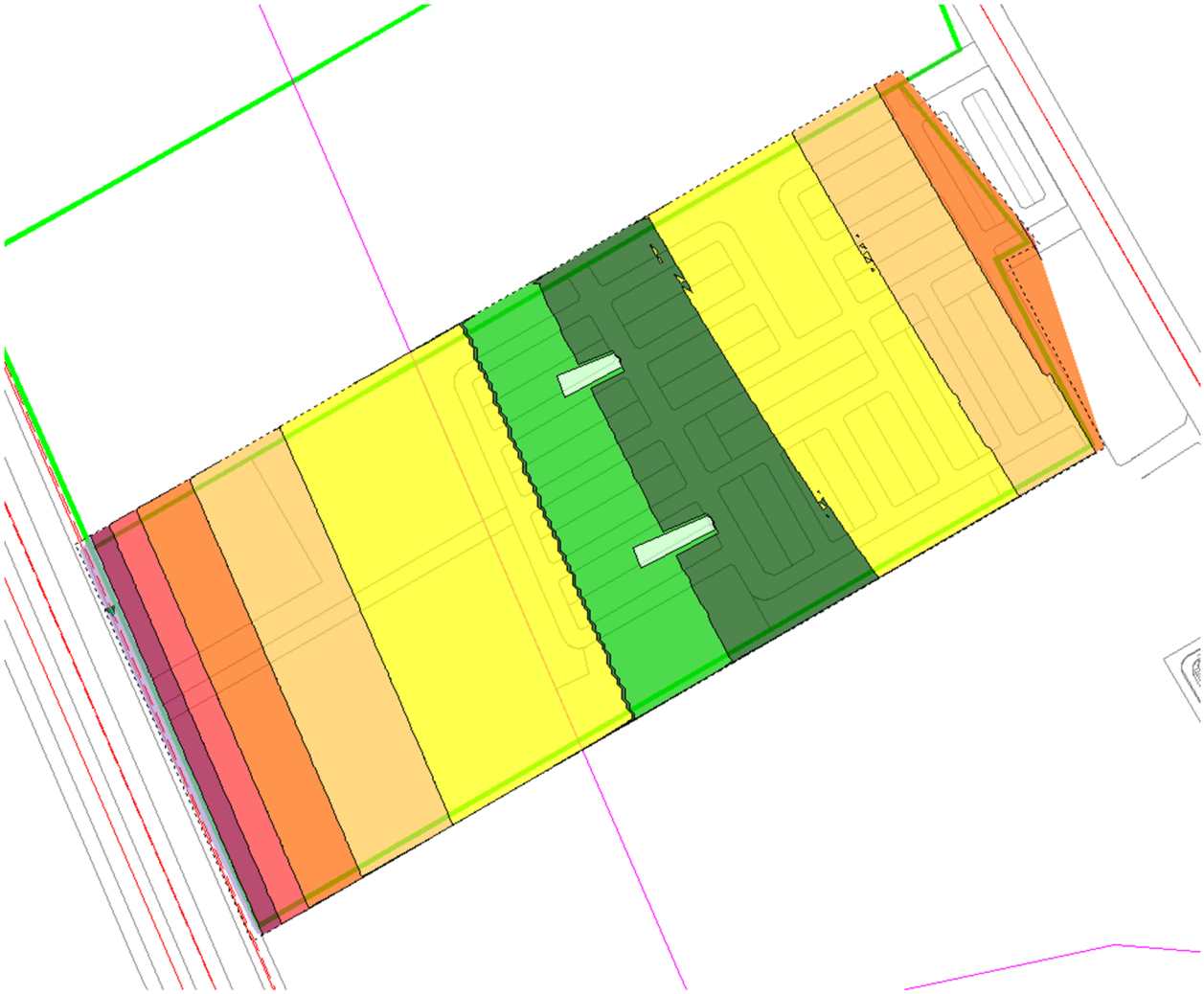
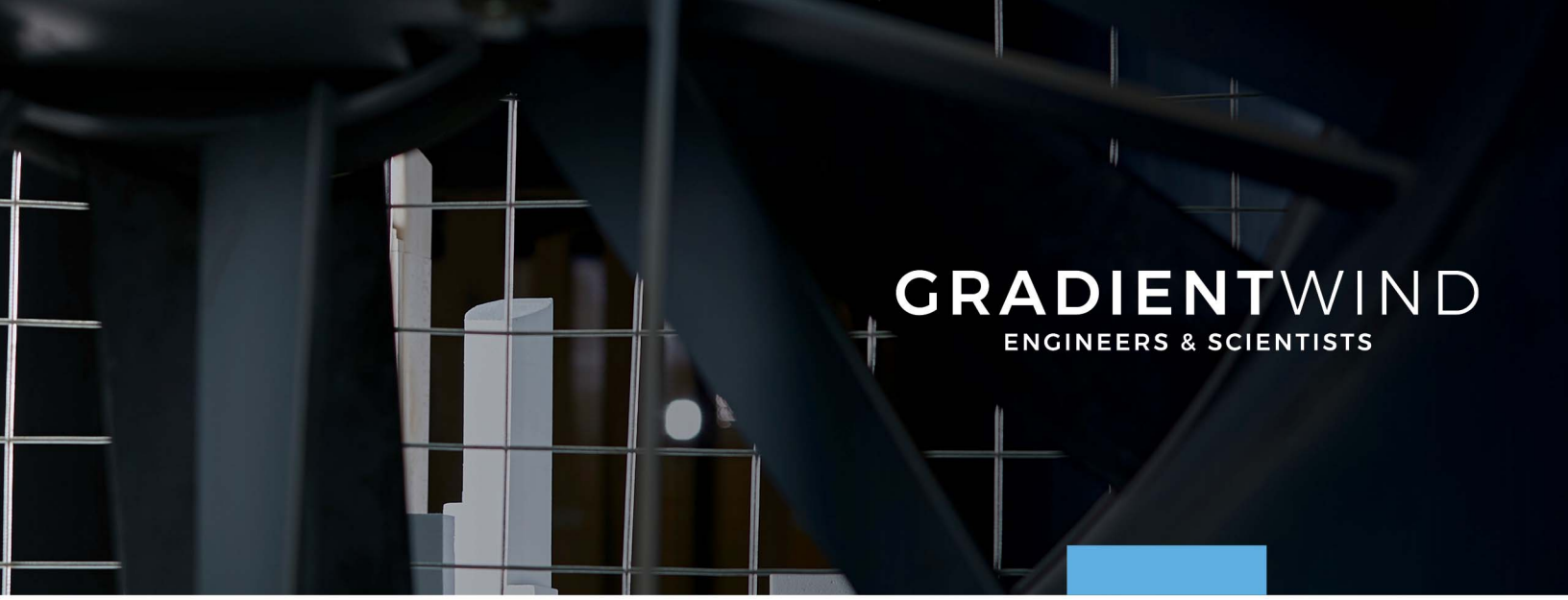


FIGURE 4: GROUND LEVEL NOISE CONTOURS FOR THE SITE (DAYTIME PERIOD)



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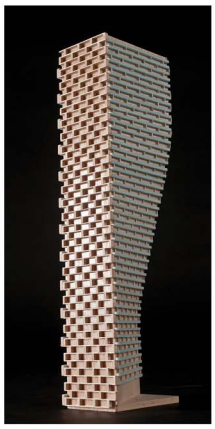

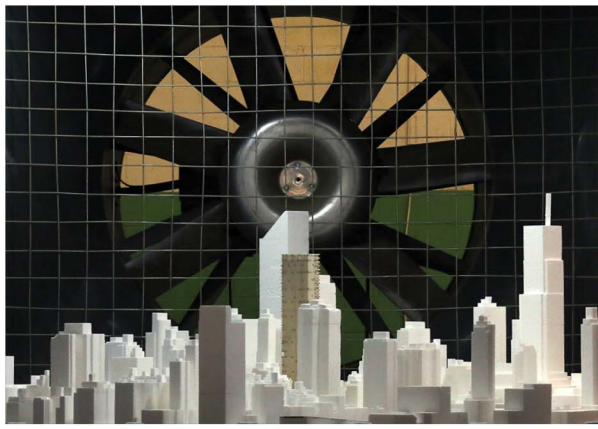

APPENDIX A

SAMPLE CALCULATION INPUT/OUTPUT

127 WALGREEN ROAD, OTTAWA, ON, CANADA K0A 1L0 | 613 836 0934
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STAMSON 5.0 NORMAL REPORT Date: 26-11-2018 13:15:45
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: r1.te Time Period: Day/Night 16/8 hours
Description:

Road data, segment # 1: Borris. Rd (day/night)

Car traffic volume : 6477/563 veh/TimePeriod *
Medium truck volume : 515/45 veh/TimePeriod *
Heavy truck volume : 368/32 veh/TimePeriod *
Posted speed limit : 80 km/h
Road gradient : 0 %
Road pavement : 1 (Typical asphalt or concrete)

* Refers to calculated road volumes based on the following input:

24 hr Traffic Volume (AADT or SADT): 8000
Percentage of Annual Growth : 0.00
Number of Years of Growth : 0.00
Medium Truck % of Total Volume : 7.00
Heavy Truck % of Total Volume : 5.00
Day (16 hrs) % of Total Volume : 92.00

Data for Segment # 1: Borris. Rd (day/night)

Angle1 Angle2 : -45.00 deg 45.00 deg
Wood depth : 0 (No woods.)
No of house rows : 0 / 0
Surface : 1 (Absorptive ground surface)
Receiver source distance : 439.00 / 439.00 m
Receiver height : 1.50 / 1.50 m
Topography : 1 (Flat/gentle slope; no barrier)
Reference angle : 0.00

Road data, segment # 2: NB HWY 416 (day/night)

Car traffic volume : 29685/2581 veh/TimePeriod *
Medium truck volume : 2361/205 veh/TimePeriod *
Heavy truck volume : 1687/147 veh/TimePeriod *
Posted speed limit : 100 km/h
Road gradient : 0 %
Road pavement : 1 (Typical asphalt or concrete)

* Refers to calculated road volumes based on the following input:

24 hr Traffic Volume (AADT or SADT): 36666
Percentage of Annual Growth : 0.00
Number of Years of Growth : 0.00
Medium Truck % of Total Volume : 7.00
Heavy Truck % of Total Volume : 5.00
Day (16 hrs) % of Total Volume : 92.00

Data for Segment # 2: NB HWY 416 (day/night)

```
Angle1   Angle2           : -45.00 deg   45.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  : 493.00 / 493.00 m
Receiver height           :   1.50 / 1.50   m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00
```

Results segment # 1: Borris. Rd (day)

Source height = 1.50 m

ROAD (0.00 + 42.10 + 0.00) = 42.10 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-45	45	0.66	69.76	0.00	-24.34	-3.32	0.00	0.00	0.00	42.10

Segment Leq : 42.10 dBA

Results segment # 2: NB HWY 416 (day)

Source height = 1.50 m

ROAD (0.00 + 49.89 + 0.00) = 49.89 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-45	45	0.66	78.39	0.00	-25.18	-3.32	0.00	0.00	0.00	49.89

Segment Leq : 49.89 dBA

Total Leq All Segments: 50.56 dBA

Results segment # 1: Borris. Rd (night)

Source height = 1.50 m

ROAD (0.00 + 34.51 + 0.00) = 34.51 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-45	45	0.66	62.16	0.00	-24.34	-3.32	0.00	0.00	0.00	34.51

Segment Leq : 34.51 dBA

Results segment # 2: NB HWY 416 (night)

Source height = 1.50 m

ROAD (0.00 + 42.30 + 0.00) = 42.30 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-45	45	0.66	70.79	0.00	-25.18	-3.32	0.00	0.00	0.00	42.30

Segment Leq : 42.30 dBA

Total Leq All Segments: 42.97 dBA

TOTAL Leq FROM ALL SOURCES (DAY): 50.56
(NIGHT): 42.97

STAMSON 5.0 NORMAL REPORT Date: 30-11-2018 14:41:56
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: r2.te Time Period: Day/Night 16/8 hours
Description:

Road data, segment # 1: Greenbank Rd (day/night)

Car traffic volume : 28336/2464 veh/TimePeriod *
Medium truck volume : 2254/196 veh/TimePeriod *
Heavy truck volume : 1610/140 veh/TimePeriod *
Posted speed limit : 70 km/h
Road gradient : 0 %
Road pavement : 1 (Typical asphalt or concrete)

* Refers to calculated road volumes based on the following input:

24 hr Traffic Volume (AADT or SADT): 35000
Percentage of Annual Growth : 0.00
Number of Years of Growth : 0.00
Medium Truck % of Total Volume : 7.00
Heavy Truck % of Total Volume : 5.00
Day (16 hrs) % of Total Volume : 92.00

Data for Segment # 1: Greenbank Rd (day/night)

Angle1 Angle2 : -90.00 deg 90.00 deg
Wood depth : 0 (No woods.)
No of house rows : 0 / 0
Surface : 1 (Absorptive ground surface)
Receiver source distance : 390.00 / 390.00 m
Receiver height : 1.50 / 1.50 m
Topography : 1 (Flat/gentle slope; no barrier)
Reference angle : 0.00

Results segment # 1: Greenbank Rd (day)

Source height = 1.50 m

ROAD (0.00 + 50.05 + 0.00) = 50.05 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-90	90	0.66	75.00	0.00	-23.49	-1.46	0.00	0.00	0.00	50.05

Segment Leq : 50.05 dBA

Total Leq All Segments: 50.05 dBA

Results segment # 1: Greenbank Rd (night)

Source height = 1.50 m

ROAD (0.00 + 42.45 + 0.00) = 42.45 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-90	90	0.66	67.40	0.00	-23.49	-1.46	0.00	0.00	0.00	42.45

Segment Leq : 42.45 dBA

Total Leq All Segments: 42.45 dBA

RT/Custom data, segment # 1: BRT (day/night)
---
1 - Bus:
Traffic volume : 191/67 veh/TimePeriod
Speed : 80 km/h

Data for Segment # 1: BRT (day/night)

Angle1 Angle2 : -90.00 deg 90.00 deg
Wood depth : 0 (No woods.)
No of house rows : 0 / 0
Surface : 1 (Absorptive ground surface)
Receiver source distance : 390.00 / 390.00 m
Receiver height : 1.50 / 1.50 m
Topography : 1 (Flat/gentle slope; no barrier)
Reference angle : 0.00

Results segment # 1: BRT (day)

Source height = 0.50 m

RT/Custom (0.00 + 34.47 + 0.00) = 34.47 dBA

Angle1	Angle2	Alpha	RefLeq	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-90	90	0.66	59.41	-23.49	-1.46	0.00	0.00	0.00	34.47

Segment Leq : 34.47 dBA

Total Leq All Segments: 34.47 dBA

Results segment # 1: BRT (night)

Source height = 0.50 m

RT/Custom (0.00 + 32.93 + 0.00) = 32.93 dBA

Angle1	Angle2	Alpha	RefLeq	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-90	90	0.66	57.87	-23.49	-1.46	0.00	0.00	0.00	32.93

Segment Leq : 32.93 dBA

Total Leq All Segments: 32.93 dBA

TOTAL Leq FROM ALL SOURCES (DAY): 50.17
(NIGHT): 42.91

STAMSON 5.0 NORMAL REPORT Date: 30-11-2018 14:47:49
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: r3.te Time Period: Day/Night 16/8 hours
Description:

Road data, segment # 1: Greenbank Rd (day/night)

Car traffic volume : 28336/2464 veh/TimePeriod *
Medium truck volume : 2254/196 veh/TimePeriod *
Heavy truck volume : 1610/140 veh/TimePeriod *
Posted speed limit : 70 km/h
Road gradient : 0 %
Road pavement : 1 (Typical asphalt or concrete)

* Refers to calculated road volumes based on the following input:

24 hr Traffic Volume (AADT or SADT): 35000
Percentage of Annual Growth : 0.00
Number of Years of Growth : 0.00
Medium Truck % of Total Volume : 7.00
Heavy Truck % of Total Volume : 5.00
Day (16 hrs) % of Total Volume : 92.00

Data for Segment # 1: Greenbank Rd (day/night)

Angle1 Angle2 : -90.00 deg 90.00 deg
Wood depth : 0 (No woods.)
No of house rows : 0 / 0
Surface : 1 (Absorptive ground surface)
Receiver source distance : 304.00 / 304.00 m
Receiver height : 1.50 / 1.50 m
Topography : 1 (Flat/gentle slope; no barrier)
Reference angle : 0.00

Results segment # 1: Greenbank Rd (day)

Source height = 1.50 m

ROAD (0.00 + 51.85 + 0.00) = 51.85 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-90	90	0.66	75.00	0.00	-21.69	-1.46	0.00	0.00	0.00	51.85

Segment Leq : 51.85 dBA

Total Leq All Segments: 51.85 dBA

Results segment # 1: Greenbank Rd (night)

Source height = 1.50 m

ROAD (0.00 + 44.25 + 0.00) = 44.25 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-90	90	0.66	67.40	0.00	-21.69	-1.46	0.00	0.00	0.00	44.25

Segment Leq : 44.25 dBA

Total Leq All Segments: 44.25 dBA

RT/Custom data, segment # 1: BRT (day/night)
---
1 - Bus:
Traffic volume : 191/67 veh/TimePeriod
Speed : 80 km/h

Data for Segment # 1: BRT (day/night)

Angle1 Angle2 : -90.00 deg 90.00 deg
Wood depth : 0 (No woods.)
No of house rows : 0 / 0
Surface : 1 (Absorptive ground surface)
Receiver source distance : 304.00 / 304.00 m
Receiver height : 1.50 / 1.50 m
Topography : 1 (Flat/gentle slope; no barrier)
Reference angle : 0.00

Results segment # 1: BRT (day)

Source height = 0.50 m

RT/Custom (0.00 + 36.26 + 0.00) = 36.26 dBA

Angle1	Angle2	Alpha	RefLeq	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-90	90	0.66	59.41	-21.69	-1.46	0.00	0.00	0.00	36.26

Segment Leq : 36.26 dBA

Total Leq All Segments: 36.26 dBA

Results segment # 1: BRT (night)

Source height = 0.50 m

RT/Custom (0.00 + 34.73 + 0.00) = 34.73 dBA

Angle1	Angle2	Alpha	RefLeq	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-90	90	0.66	57.87	-21.69	-1.46	0.00	0.00	0.00	34.73

Segment Leq : 34.73 dBA

Total Leq All Segments: 34.73 dBA

TOTAL Leq FROM ALL SOURCES (DAY): 51.97
(NIGHT): 44.71

STAMSON 5.0 NORMAL REPORT Date: 30-11-2018 14:51:03
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: r4.te Time Period: Day/Night 16/8 hours
Description:

Road data, segment # 1: Greenbank Rd (day/night)

Car traffic volume : 28336/2464 veh/TimePeriod *
Medium truck volume : 2254/196 veh/TimePeriod *
Heavy truck volume : 1610/140 veh/TimePeriod *
Posted speed limit : 70 km/h
Road gradient : 0 %
Road pavement : 1 (Typical asphalt or concrete)

* Refers to calculated road volumes based on the following input:

24 hr Traffic Volume (AADT or SADT): 35000
Percentage of Annual Growth : 0.00
Number of Years of Growth : 0.00
Medium Truck % of Total Volume : 7.00
Heavy Truck % of Total Volume : 5.00
Day (16 hrs) % of Total Volume : 92.00

Data for Segment # 1: Greenbank Rd (day/night)

Angle1 Angle2 : -90.00 deg 90.00 deg
Wood depth : 0 (No woods.)
No of house rows : 0 / 0
Surface : 1 (Absorptive ground surface)
Receiver source distance : 131.00 / 131.00 m
Receiver height : 1.50 / 1.50 m
Topography : 1 (Flat/gentle slope; no barrier)
Reference angle : 0.00

Results segment # 1: Greenbank Rd (day)

Source height = 1.50 m

ROAD (0.00 + 57.92 + 0.00) = 57.92 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-90	90	0.66	75.00	0.00	-15.62	-1.46	0.00	0.00	0.00	57.92

Segment Leq : 57.92 dBA

Total Leq All Segments: 57.92 dBA

Results segment # 1: Greenbank Rd (night)

Source height = 1.50 m

ROAD (0.00 + 50.32 + 0.00) = 50.32 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-90	90	0.66	67.40	0.00	-15.62	-1.46	0.00	0.00	0.00	50.32

Segment Leq : 50.32 dBA

Total Leq All Segments: 50.32 dBA

RT/Custom data, segment # 1: BRT (day/night)
---
1 - Bus:
Traffic volume : 191/67 veh/TimePeriod
Speed : 80 km/h

Data for Segment # 1: BRT (day/night)

Angle1 Angle2 : -90.00 deg 90.00 deg
Wood depth : 0 (No woods.)
No of house rows : 0 / 0
Surface : 1 (Absorptive ground surface)
Receiver source distance : 131.00 / 131.00 m
Receiver height : 1.50 / 1.50 m
Topography : 1 (Flat/gentle slope; no barrier)
Reference angle : 0.00

Results segment # 1: BRT (day)

Source height = 0.50 m

RT/Custom (0.00 + 42.33 + 0.00) = 42.33 dBA

Angle1	Angle2	Alpha	RefLeq	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-90	90	0.66	59.41	-15.62	-1.46	0.00	0.00	0.00	42.33

Segment Leq : 42.33 dBA

Total Leq All Segments: 42.33 dBA

Results segment # 1: BRT (night)

Source height = 0.50 m

RT/Custom (0.00 + 40.79 + 0.00) = 40.79 dBA

Angle1	Angle2	Alpha	RefLeq	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-90	90	0.66	57.87	-15.62	-1.46	0.00	0.00	0.00	40.79

Segment Leq : 40.79 dBA

Total Leq All Segments: 40.79 dBA

TOTAL Leq FROM ALL SOURCES (DAY): 58.04
(NIGHT): 50.78

STAMSON 5.0 NORMAL REPORT Date: 30-11-2018 14:54:32
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: r5.te Time Period: Day/Night 16/8 hours
Description:

Road data, segment # 1: Greenbank Rd (day/night)

Car traffic volume : 28336/2464 veh/TimePeriod *
Medium truck volume : 2254/196 veh/TimePeriod *
Heavy truck volume : 1610/140 veh/TimePeriod *
Posted speed limit : 70 km/h
Road gradient : 0 %
Road pavement : 1 (Typical asphalt or concrete)

* Refers to calculated road volumes based on the following input:

24 hr Traffic Volume (AADT or SADT): 35000
Percentage of Annual Growth : 0.00
Number of Years of Growth : 0.00
Medium Truck % of Total Volume : 7.00
Heavy Truck % of Total Volume : 5.00
Day (16 hrs) % of Total Volume : 92.00

Data for Segment # 1: Greenbank Rd (day/night)

Angle1 Angle2 : -90.00 deg 90.00 deg
Wood depth : 0 (No woods.)
No of house rows : 0 / 0
Surface : 1 (Absorptive ground surface)
Receiver source distance : 79.00 / 79.00 m
Receiver height : 1.50 / 1.50 m
Topography : 1 (Flat/gentle slope; no barrier)
Reference angle : 0.00

Results segment # 1: Greenbank Rd (day)

Source height = 1.50 m

ROAD (0.00 + 61.56 + 0.00) = 61.56 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-90	90	0.66	75.00	0.00	-11.98	-1.46	0.00	0.00	0.00	61.56

Segment Leq : 61.56 dBA

Total Leq All Segments: 61.56 dBA

Results segment # 1: Greenbank Rd (night)

Source height = 1.50 m

ROAD (0.00 + 53.96 + 0.00) = 53.96 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-90	90	0.66	67.40	0.00	-11.98	-1.46	0.00	0.00	0.00	53.96

Segment Leq : 53.96 dBA

Total Leq All Segments: 53.96 dBA

RT/Custom data, segment # 1: BRT (day/night)
---
1 - Bus:
Traffic volume : 191/67 veh/TimePeriod
Speed : 80 km/h

Data for Segment # 1: BRT (day/night)

Angle1 Angle2 : -90.00 deg 90.00 deg
Wood depth : 0 (No woods.)
No of house rows : 0 / 0
Surface : 1 (Absorptive ground surface)
Receiver source distance : 79.00 / 79.00 m
Receiver height : 1.50 / 1.50 m
Topography : 1 (Flat/gentle slope; no barrier)
Reference angle : 0.00

Geotechnical Engineering

Environmental Engineering

Hydrogeology

Geological Engineering

Materials Testing

Building Science

Archaeological Services

patersongroup

Environmental Noise Control Study - Stationary Noise Component

Proposed Residential Development
Brazeau Lands
Borrisokane Road - Ottawa

Prepared For

Caivan Communities

January 7, 2018

Report: PG4752-2 Revision 1

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Appendices

1.0 Introduction

Paterson Group (Paterson) was commissioned by Caivan Communities to conduct a Stationary Noise Review to supplement the Noise Feasibility study prepared by Gradient Wind for the proposed residential development to be located at Borrisokane Road, in the City of Ottawa. A Report entitled Traffic Noise Feasibility Assessment - Brazeau Subdivision dated December 3 2018 was prepared by Gradient Wind Engineers and Scientists (Gradient Wind) for the subject site. The report prepared by Gradient Wind is an analysis of the surface transportation noise for the phases of the development. It should be noted that Paterson's report was solely prepared to review the stationary noise source, which is identified as the adjacent property (Aggregate extraction operation at Costello Pit).

The following report has been prepared specifically and solely for the aforementioned project which is described herein. It contains our findings and includes acoustical recommendations pertaining to the design and construction of the subject development as they are understood at the time of writing this report.

This study has been conducted according to City of Ottawa document - Engineering Noise Control Guidelines (ENCG), dated January 2016, and the Ontario Ministry of the Environment Guideline NPC-300.

2.0 Background

It is understood that the proposed development will consist of single houses, townhouses and stacked townhouse units. The single houses and townhouses will have outdoor living areas. Local roadways and landscaped areas are also anticipated.

It is further understood that the Costello Pit may cease all operations prior to the commencement of construction, or during construction of the aforementioned residential development. If this is the situation, then the stationary noise source would have been eliminated and all noise attenuation recommendations contained within this document will no longer be required.

3.0 Methodology and Noise Assessment Criteria

Stationary Noise

Stationary noise sources include sources or facilities that are fixed or mobile and can cause a combination of sound and vibration levels emitted beyond the property line. These sources may include commercial air conditioner units, generators and fans. Facilities that may contribute to stationary noise may include car washes, snow disposal sites, transit stations and manufacturing facilities. In this situation, the stationary noise source consists of an existing mineral aggregate pit.

The impact of stationary noise sources are directly related to the location of the subject site within the urban environment. The proposed development can be classified as Class 2 by provincial guidelines and outlined in the ENGC, meaning "a suburban areas of the City outside of the busy core where the urban hum is evident but within the urban boundary."

Table 1 - Guidelines for Stationary Noise - Class 2

Time of Day	Outdoor Point of Reception	Pane of Window
7:00-19:00	50	50
19:00-23:00	45	50
23:00-7:00	-	45

1. Standards taken from Table 3.2a; Guidelines for Stationary Noise - Steady and Varying Sound

If the sound level limits are exceeded the following Warning Clause may be referenced:

Table 2 - Warning Clauses for Sound Level Exceedances

Warning Clause	Description
Warning Clause Type E	"Purchasers/tenants are advised that due to the proximity of the adjacent industry (facility) (utility), noise from the industry (facility) (utility) may at times be audible."

2. Clauses taken from section C8 Warning Clauses; Environmental Noise Guidelines - NPC-300

4.0 Analysis

The stationary noise source consisting of the Costello Pit was identified within the 300 m radius from the proposed development. It is understood that all mineral extraction within the western portion of the pit has been completed and a line indicating this portion of the pit is noted on Figure 1 included in Appendix 1. It is also understood that the Costello Pit will be terminating the mineral extraction process over the entire pit within the next 2 years. Therefore, this stationary noise source is considered temporary and all analysis and recommendations made with respect to this stationary noise source can be removed from all deeds of sale once the pit is closed.

The noise sources were modelled as the worst case indicator as specified by the Owner of the Costello Pit. The equipment utilized in the analysis is representative of the equipment that is used for mineral extraction. The equipment consists of an excavator, two loaders, a screener, an idling truck, and a truck route into and out of the existing Costello Pit. A break down of the frequency's and sound levels of this equipment is included in Appendix 1.

Reception points were selected to obtain a broad definition of the noise levels at the outdoor living areas in addition to the pane of glass at the first level of the proposed houses.

The existing mineral extraction pit is the only stationary noise source located within the proximity of the proposed development. The analysis was completed with specialized noise software: Predictor-Lima Version 11.21. Eleven (11) reception points were selected within the 300 m proximity radius for our analysis. The reception points were selected at a 1.5 m elevations, so that both pane of glass and outdoor living areas could be interpolated. The results of these reception points are included in Appendix 1.

5.0 Discussion

Results of the analysis can be found in Appendix 1. Reception points were analyzed at a 1.5 m elevation. Due to the proximity of the stationary noise source, it is recommended that the northernmost houses that are within 30 m of the active aggregate pit not be constructed.

It is also understood that the existing Costello Pit may cease operations before or during the construction of the aforementioned residential development. Therefore, if the Costello Pit is no longer in operation, all recommendations provided in this report are no longer valid and should be disregarded.

An analysis was completed for the proposed residential development, taking into consideration the lot layouts and approximate dwelling alignment. An initial analysis was performed with no sound mitigation measures. This analysis resulted in a maximum value of 61 dBA, which is well above the 50 dBA limit. Therefore, noise mitigation measures will be required.

As per the Environmental Noise Guidelines prepared by the City of Ottawa, the following chart outlines the procedures to follow for exceedances to the stationary noise levels.

Table 3 - Noise Control Measures for New Development in Proximity to Stationary Noise Sources

Primary Mitigation Measure in order of Preference	Proposed Mitigation Measure
Insertion of noise insensitive land uses between the source and sensitive receptors	No development is to occur within 30 m of the Costello Pit while it is in operation
Orientation of buildings to provide quiet zones in rear yards, interior spaces and amenity areas	only rear yards located on the western portion of the development will have rear yards are directly exposed to the Costello Pit.
construction techniques, enhanced construction quality	Exceedances for outdoor living areas only - standard construction techniques are considered acceptable.
earth berms	a 4 m high earth berm is proposed along the northern property line, adjacent to the Costello Pit
acoustic barriers	proposed to protect the back yards of the proposed residential buildings at the western portion of the site..

It is understood that there is a 30 m development setback from the northern property line. Once the Costello Pit ceases mineral extraction operations, those blocks can be constructed.

A 4 m high soil berm is proposed to cross the lots located along the northern property line in order to provide noise mitigation to the remainder of the development. In addition, a 2.2 m high sound barrier is to be constructed along the western property line, to protect the side yards that are exposed to the Costello Pit. This sound barrier is to extend from the soil berm to the main access road, approximately 160 m. In order to be effective, all sound barriers are to be constructed of solid material with no gaps, cracks, holes or openings and must have a minimum surface weight of 20 kg/m^2. With these noise mitigation measures in place, the maximum value of 59 dBA will still be encountered at reception point 1-2 and 56 dBA at reception point 1-1. The remainder of the reception points are either below 50 dBA, or marginally exceeding the 50 dBA threshold by up to 4 dBA. This is considered acceptable with the understanding that the Costello Pit will be a temporary noise source.

Additionally, due to the proximity of the existing stationary noise source, a Warning Clause Type E should be applied to the deeds of sale in if the Costello Pit is still in operation. The wording of the warning clause should be agreed upon by both the Ministry of Natural Resources and the City of Ottawa. A suggested noise warning clause is as follows:

> Purchasers/land owners are advised that there is a licensed sand and gravel pit less than 300 metres away and that, from time to time, they may experience noise, dust and/or vibration as a result of the ongoing operations.

6.0 Conclusion

It is understood that the Costello Pit may cease operations prior to construction, or during construction of the proposed development. Therefore, noise mitigation measures for the stationary noise source have been recommended. If the Costello Pit ceases operation at any time, all recommendations provided in this report are no longer required as the noise source has been removed.

If the Costello Pit is in operation for the construction of the development, it is understood that there will be a hold on the northern blocks, and a 4 m high soil berm will be constructed across those lots. In addition, a 2.2 m high sound barrier is to be constructed along the western limit of the development, extending from the soil berm to the main access road, an approximate 160 m length.

Due to the proximity of the Costello Pit, a Warning Clause should be on the deed of sale. Suggested wording is as follows:

> Purchasers/land owners are advised that there is a licensed sand and gravel pit less than 300 metres away and that, from time to time, they may experience noise, dust and/or vibration as a result of the ongoing operations.

As it is understood that the Costello Pit will cease all mineral extraction within the next 2 years, this warning clause is considered temporary and is only applicable while the Costello Pit is within operation.

7.0 Statement of Limitations

The recommendations made in this report are in accordance with our present understanding of the project. Our recommendations should be reviewed when the project drawings and specifications are complete.

The present report applies only to the project described in this document. Use of this report for purposes other than those described herein or by person(s) other than the Caivan Communities or their agent(s) is not authorized without review by this firm for the applicability of our recommendations to the altered use of the report.

Paterson Group Inc.

Stephanie A. Boisvenue, P.Eng. David J. Gilbert, P.Eng.

Report Distribution:

- ❑ Caivan Communities (3 copies)
- ❑ Paterson Group (1 copy)

APPENDIX 1

FIGURE 1 - NOISE MODEL

FIGURE 2 - TABLE OF RESULTS - NO NOISE MITIGATION MEASURES

FIGURE 3 - TABLE OF RESULTS - WITH NOISE MITIGATION MEASURES

ITEM PROPERTIES


Moving source
Point sources
Grids
Receivers
Buildings
DIV - Areas
DIV - Lines
DIV - Points
period: Lden
0 m
100 m
scale = 1 : 4013
Units within 30 m of Costello Pit on hold until the closure of Costello Pit
Proposed 4 m high bern/noise barrier
Truck
Loader
Screener
Excavator
Loader
Truck Route
Proposed 2.2 m high sound barrier
REC 1-1
REC 1-2
REC 1-3
REC 1-4
REC 1-5
REC 1-6
REC 1-7
REC 1-8
REC 1-9
REC 1-10
REC 1-11
REC 1-12
REC 1-13
400
0
1600
2000

Table of Results - No noise barriers

Report: Table of Results
Model: no noise barriers
LAeq: total results for receivers
Group: (main group)
Group Reduction: No

Name Receiver	Description	Height	Day	Night
REC 1-1_A		1.50	54.8	54.8
REC 1-1_B		4.50	56.2	56.2
REC 1-10_A		1.50	43.3	43.3
REC 1-10_B		4.50	45.0	45.0
REC 1-11_A		1.50	38.6	38.6
REC 1-11_B		4.50	41.6	41.6
REC 1-12_A		1.50	41.4	41.4
REC 1-12_B		4.50	43.4	43.4
REC 1-13_A		1.50	35.5	35.5
REC 1-13_B		4.50	38.0	38.0
REC 1-2_A		1.50	61.0	61.0
REC 1-2_B		4.50	61.0	61.0
REC 1-3_A		4.50	49.7	49.7
REC 1-4_A		1.50	50.7	50.7
REC 1-4_B		4.50	51.9	51.9
REC 1-5_A		1.50	48.8	48.8
REC 1-5_B		4.50	51.5	51.5
REC 1-6_A		1.50	44.9	44.9
REC 1-6_B		4.50	48.0	48.0
REC 1-7_A		1.50	54.0	54.0
REC 1-7_B		4.50	55.3	55.3
REC 1-8_A		1.50	49.7	49.7
REC 1-8_B		4.50	52.7	52.7
REC 1-9_A		1.50	51.5	51.5
REC 1-9_B		4.50	51.6	51.6

All shown dB values are A-weighted

Table of Results - Including noise barriers

Report: Table of Results
Model: Base Model
LAeq: total results for receivers
Group: (main group)
Group Reduction: No

Name Receiver	Description	Height	Day	Night
REC 1-1_A		1.50	54.1	54.1
REC 1-1_B		4.50	56.0	56.0
REC 1-10_A		1.50	42.8	42.8
REC 1-10_B		4.50	44.9	44.9
REC 1-11_A		1.50	38.6	38.6
REC 1-11_B		4.50	41.6	41.6
REC 1-12_A		1.50	41.3	41.3
REC 1-12_B		4.50	43.3	43.3
REC 1-13_A		1.50	35.5	35.5
REC 1-13_B		4.50	38.0	38.0
REC 1-2_A		1.50	57.4	57.4
REC 1-2_B		4.50	59.0	59.0
REC 1-3_A		4.50	49.6	49.6
REC 1-4_A		1.50	50.0	50.0
REC 1-4_B		4.50	51.4	51.4
REC 1-5_A		1.50	48.7	48.7
REC 1-5_B		4.50	51.5	51.5
REC 1-6_A		1.50	44.8	44.8
REC 1-6_B		4.50	48.0	48.0
REC 1-7_A		1.50	53.1	53.1
REC 1-7_B		4.50	55.1	55.1
REC 1-8_A		1.50	49.7	49.7
REC 1-8_B		4.50	52.7	52.7
REC 1-9_A		1.50	48.1	48.1
REC 1-9_B		4.50	49.8	49.8

All shown dB values are A-weighted

Item Properties

Model: Base Model
version of Brazeau Pit - Brazeau Pit
Group: (main group)
Listing of: Moving source, for method Industrial noise - LimA - ISO 9613.1/2

Name	Lw 63	Lw 125	Lw 250	Lw 500	Lw 1k	Lw 2k	Lw 4k	Lw 8k	Red 63	Red 125	Red 250
Haul Route	79.10	87.80	91.90	96.50	100.20	97.50	90.50	83.60	0.00	0.00	0.00

Item Properties

Model: Base Model
version of Brazeau Pit - Brazeau Pit
Group: (main group)
Listing of: Point sources, for method Industrial noise - LimA - ISO 9613.1/2

Name	No building	No ind.site	Lw 63	Lw 125	Lw 250	Lw 500	Lw 1k	Lw 2k	Lw 4k	Lw 8k
Excavator	No	No	97.00	102.00	99.00	98.00	97.00	96.00	88.00	80.00
Loader	No	No	109.00	114.00	109.00	100.00	99.00	96.00	97.00	94.00
Loader	No	No	109.00	114.00	109.00	100.00	99.00	96.00	97.00	94.00
Screen	No	No	116.80	110.40	103.00	102.60	101.20	99.10	94.90	90.90
Truck	No	No	76.00	89.80	91.60	97.50	107.70	104.80	100.00	93.20

3809 Borrisokane Road Transportation Impact Assessment

Step 1 Screening Report

Step 2 Scoping Report

Step 3 Forecasting Report

Step 4 Strategy Report

Prepared for:

Caivan Communities
2934 Baseline Road, Suite 302
Ottawa, ON K2H 1B2

Prepared by:

CGH Transportation Inc.
13 Markham Avenue
Nepean, ON K2G 3Z1

November 2018

PN: 2018-05

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1 Screening

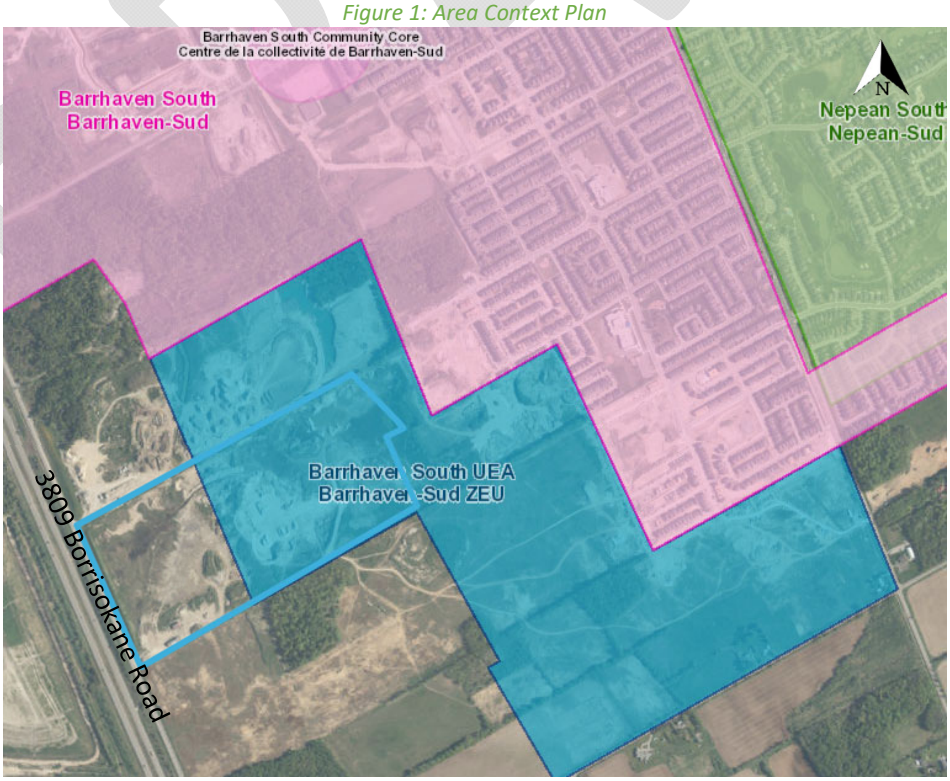
This study has been prepared according to the City of Ottawa's 2017 Transportation Impact Assessment (TIA) Guidelines. Accordingly, a Step 1 Screening Form has been prepared and is included as Appendix A, along with the Certification Form for TIA Study PM. As shown in the Screening Form, a TIA is required.

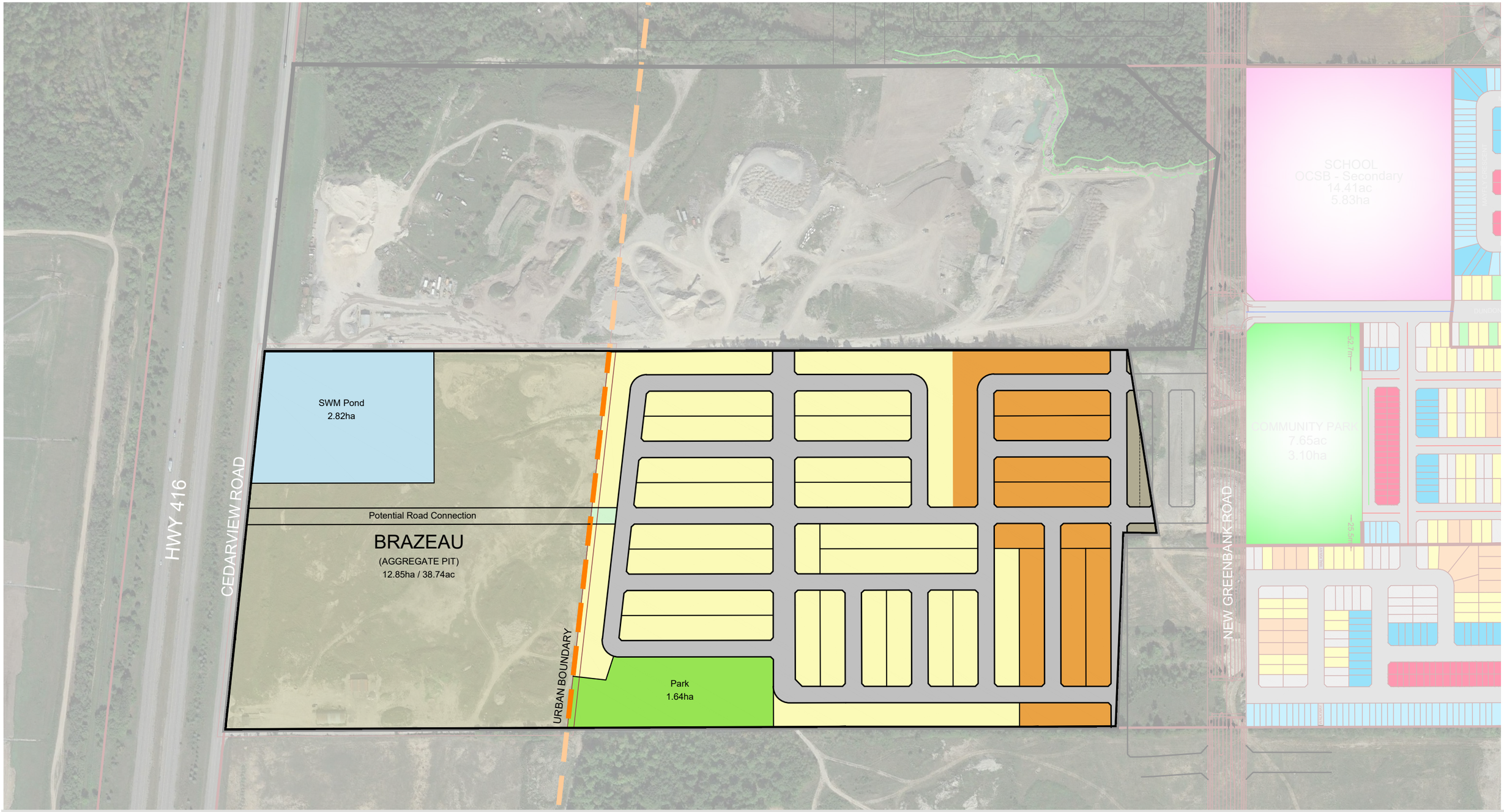
2 Existing and Planned Conditions

2.1 Proposed Development

The proposed development, located at 3809 Borrisokane Road, is currently a greenfield property within the Barrhaven South Urban Expansion Area (UEA). The site is in an area that is currently zoned ME Mineral Extraction Zone. The current zoning modification application would modify the zoning to allow for low-rise residential uses on the eastern portion of the property. Beyond the Urban Boundary the western portion of the land will remain the current zoning, however, a road connection is proposed through to Borrisokane Road, which will be the primary access for the development. The proposed residential development will consist of a mixture of detached homes and townhouses. The concept plan currently considers a total of approximately 500 units, split between townhouse and detached units. Access to the proposed development will be via a full movement access to Borrisokane Road, and ultimately will be accessed via New Greenbank Road. The New Greenbank Road access configuration will be determined once that road is completed. The development will also have connections to the adjacent developments to allow access to shared community services (i.e. parks, schools, etc.). The development traffic will primarily use the main access (Borrisokane Road) to reach the transportation network, but an interim access through Half Moon Bay South will be provided, prior to the implementation of Re-Aligned Greenbank Road. The anticipated full build-out and occupancy horizon is 2025, with three interim phases. The exact phasing and timing of each phase has not been determined at this time. Figure 1 illustrates the Study Area Context. Figure 2 illustrates the proposed concept plan.

Figure 1: Area Context Plan





DRAFT

- All Units In Metric Unless Otherwise Noted.
- Base Information Obtained From Various Sources And Is Approximate.
- Schedule / Plan Information Is Conceptual And Requires Verification by Appropriate Agency.
- Aerial Photo: Google Earth, Approx. Fall 2016

GERRARD DESIGN

CAIVAN DRUMMOND/BRAZEAU | Ottawa, Ontario

PRELIMINARY DEVELOPMENT CONCEPT

OCTOBER 30, 2018

PROJECT 1807

SCALE 1:4000

SK-05

2.2 Existing Conditions

2.2.1 Area Road Network

Borrisokane Road

Borrisokane Road is a City of Ottawa collector road with a two-lane rural cross-section including gravel shoulders and an 80 km/h posted speed limit along the frontage of the site. North of Cambrian Road, Borrisokane Road becomes an Arterial Road, the cross section does not change. The Ottawa Official Plan reserves a 24 metre right of way along the 3908 Borrisokane Road frontage, north of Cambrian Road a 37.5 right of way is reserved.

Cambrian Road

Cambrian Road is a City of Ottawa arterial road with a two-lane rural cross-section including gravel shoulders and a 70 km/h posted speed limit. The Ottawa Official Plan reserves a 37.5 metre right of way from Cedarview (now Borrisokane Road) to Jockvale Road.

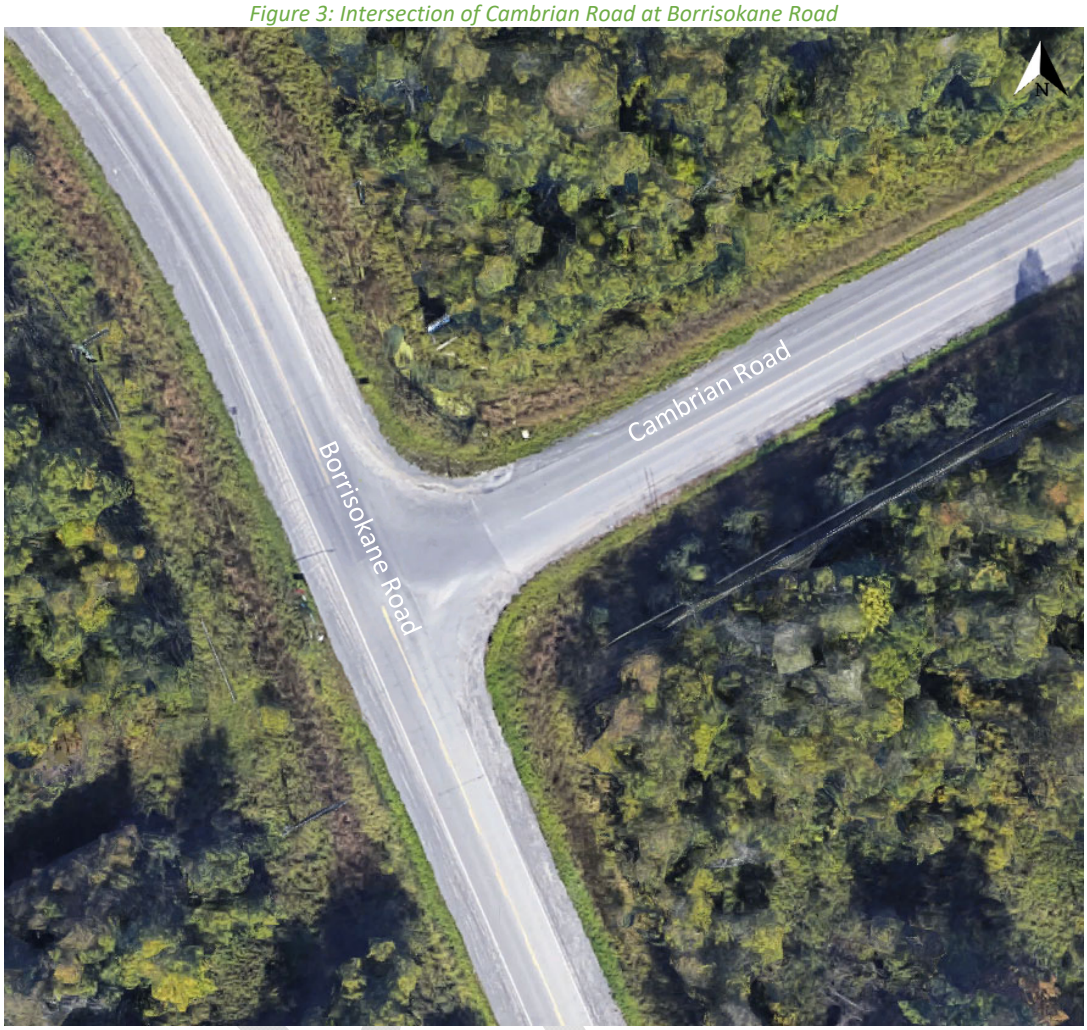
2.2.2 Existing Intersections

There are no existing intersections within one kilometre of the future reserved access onto Borrisokane Road. Just beyond one kilometre to the north and south are the intersections of Borrisokane Road at Cambrian Road and Borrisokane Road at Barnsdale Road, respectively. It is anticipated that, based on the location of this development, that nearly all the traffic will proceed north from the site and pass through the Cambrian Road at Borrisokane Road intersections. Conversely, almost no traffic will proceed south to the Barnsdale intersection (<20 two-way trips, estimated 5% of the traffic will be southbound). Therefore, the intersection of Cambrian Road at Borrisokane Road will be included in the TIA, whereas, the intersection of Barnsdale Road at Borrisokane Road will not be included.

Cambrian Road at Borrisokane Road

The intersection of Cambrian Road at Borrisokane Road is an unsignalized intersection with no auxiliary lanes. The intersection is stop controlled on the Cambrian Road (minor) leg of the road. No crosswalks are present, and none of the legs of the intersection have sidewalks. No cycling facilities are present on any of the legs of the intersection. No turn restrictions are present. Figure 3 illustrates the intersection of Cambrian Road at Borrisokane Road.

Figure 3: Intersection of Cambrian Road at Borrisokane Road



New Greenbank Road does not yet exist and therefore, no intersections along this road exists. A 41.5 metre right-of-way is protected for New Greenbank Road for in the Official Plan, north of the South Urban Community – south limit. The intersection of Borrisokane Road and Barnsdale Road is considered beyond the scope of this study and is currently a low volume intersection (as noted by existing volumes along Borrisokane Road in Section 2.2.7).

The adjacent street network has been prepared in concept but does not exist.

2.2.3 Existing Driveways

There are no existing driveways within 200 metres of the potential future access to Borrisokane Road. The access to the adjacent property is just north of the 3809 Borrisokane Road frontage (more than 200 metres north of the proposed access), accessing the adjacent aggregate area.

2.2.4 Cycling and Pedestrian Facilities

No cycling facilities currently exist along Borrisokane Road, and no future cycling facilities are included in the Cycling Plan. Similarly, no existing or planned pedestrian facilities are shown on Borrisokane Road. As New Greenbank Road has not yet been constructed, no cycling or pedestrian facilities currently exist. The future cross-section has not been determined for New Greenbank Road (South of the urban boundary limit), but it is assumed that it would include pedestrian and cycling facilities, similar to the cross-section contemplated within the Urban Boundary.

2.2.5 Existing Transit

There is no existing transit service along the boundary roads.

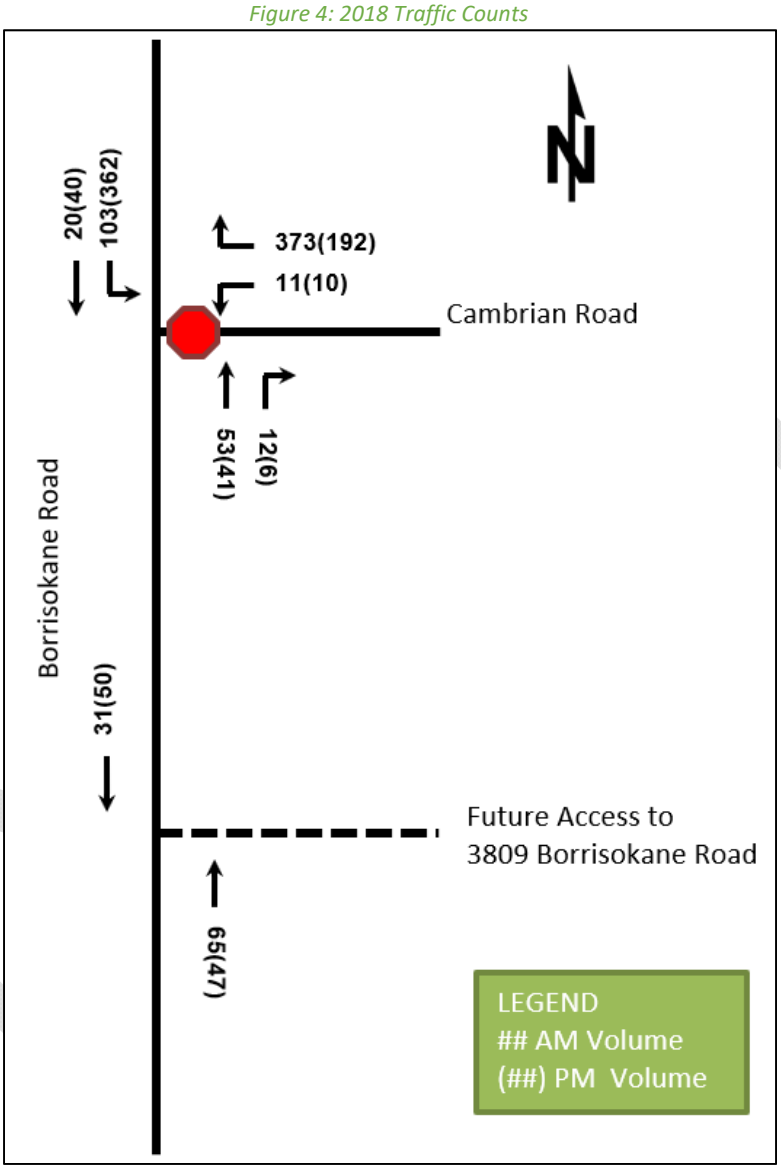
2.2.6 Existing Area Traffic Management Measures

There are no existing area traffic management measures within the Study Area.

2.2.7 Existing Peak Hour Travel Demand

AM and PM two-way traffic volumes along Borrisokane Road and at the intersection of Cambrian Road at Borrisokane Road have been documented in Figure 4 below. Appendix B includes excerpts from the Meadows Phase 5 TIA by others, detailing the turning movement counts.

Figure 4: 2018 Traffic Counts



2.2.8 Collision Analysis

Collision data has been acquired from the City of Ottawa for five years prior to the commencement of this TIA at each of the Study Area intersections. Table 1 summarizes the collisions at the intersection of Cambrian Road at Borrisokane Road.

Table 1: Collision Summary - Cambrian Road @ Borrisokane Road

		Number	%
Total Collisions		**9**	**100%**
Classification	Fatality	0	0%
	Non-Fatal Injury	2	22%
	Property Damage Only	7	78%
Initial Impact Type	Angle	0	0%
	Rear end	4	44%
	Sideswipe	0	0%
	Turning Movement	0	0%
	SMV Other	5	56%
	Other	0	0%
Road Surface Condition	Dry	6	67%
	Wet	1	11%
	Loose Snow	0	0%
	Slush	0	0%
	Packed Snow	0	0%
	Ice	2	22%
Pedestrian Involved		0	0%

Collisions at the intersection of Cambrian Road at Borrisokane Road were primarily on the westbound leg. The collisions were only single motor vehicle and rear end type collisions. It was also noted that 80% of the collisions only involved property damage, indicating low speed collisions, with no fatalities. Collision data is included in Appendix C.

2.3 Planned Conditions

2.3.1 Changes to the Area Transportation Network

The subject development is within the Barrhaven South CDP Urban Expansion Area, however, it was noted as predominantly active sand and gravel pits within the draft demonstration plan. Additionally, the CDP shows a transition / overlap at the boundary between the developed area of the CDP and the "Brazeau" property, indicating that it was anticipated that the gravel pit may eventually develop. As such, it is subject to the planning polices outlined in the ongoing CDP for the Barrhaven South Urban Expansion Area.

The future New Greenbank Road extension, south of Cambrian Road, will pass just east of the proposed development, providing Arterial Road connectivity. However, the timing of this extension is unknown as it is not included in the City of Ottawa's Transportation Master Plan 2031 Affordable Road Network.

2.3.2 Other Study Area Developments

Half Moon Bay South

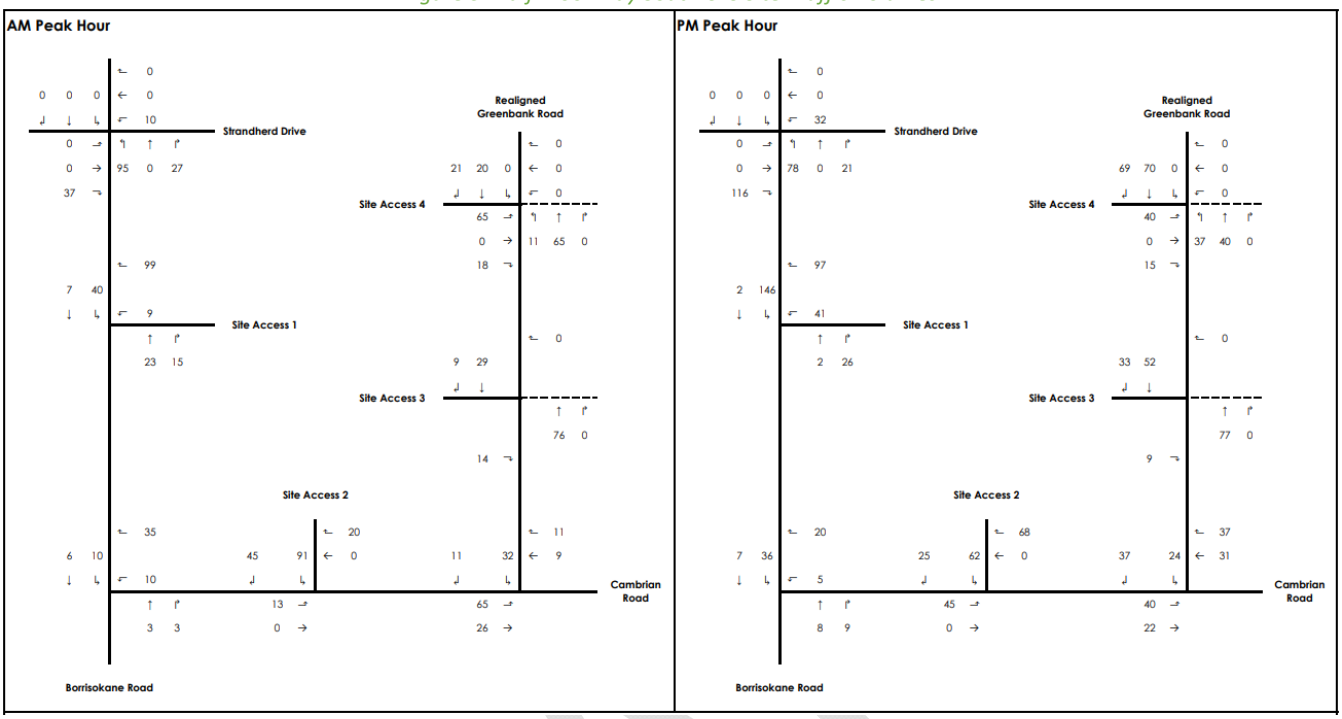
Immediately to the east of the proposed development is the Mattamy Development of Half Moon Bay South. This development is nearing completion and only the final phases remain. 3809 Borrisokane Road will include a connection to the Half Moon Bay South Development. However, this connection will be a secondary access, allowing connectivity to schools and traffic to pass back and forth between the developments. There is anticipated to be minimal traffic flow between the two developments and that each development will utilize the primary access constructed to support that development. As a result, any traffic that flows between the two developments will be minor and will not impact the access intersections for each development.

Half Moon Bay West

North of the proposed development is the Mattamy Development of Half Moon Bay West. Construction has not commenced on this subdivision. This development will not have shared accesses or traffic cross-over but will impact the Study Area intersections. The site trips generated by this site will be accounted for in the traffic

projections. Figure 5 below is an excerpt from the Half Moon Bay West Community Transportation Study, illustrating the net new site traffic volumes.

Figure 5: Half Moon Bay South CTS Site Traffic Volumes



Excerpt from: Half Moon Bay South CTS, Stantec

Barrhaven South Expansion Lands (Quinn's Pointe 2)

To the southeast of the proposed development is the Minto Development of Quinn's Pointe 2. The first phase of this development has been constructed. This development will not have shared accesses or traffic cross-over and will not generate traffic that impacts the Study Area intersections.

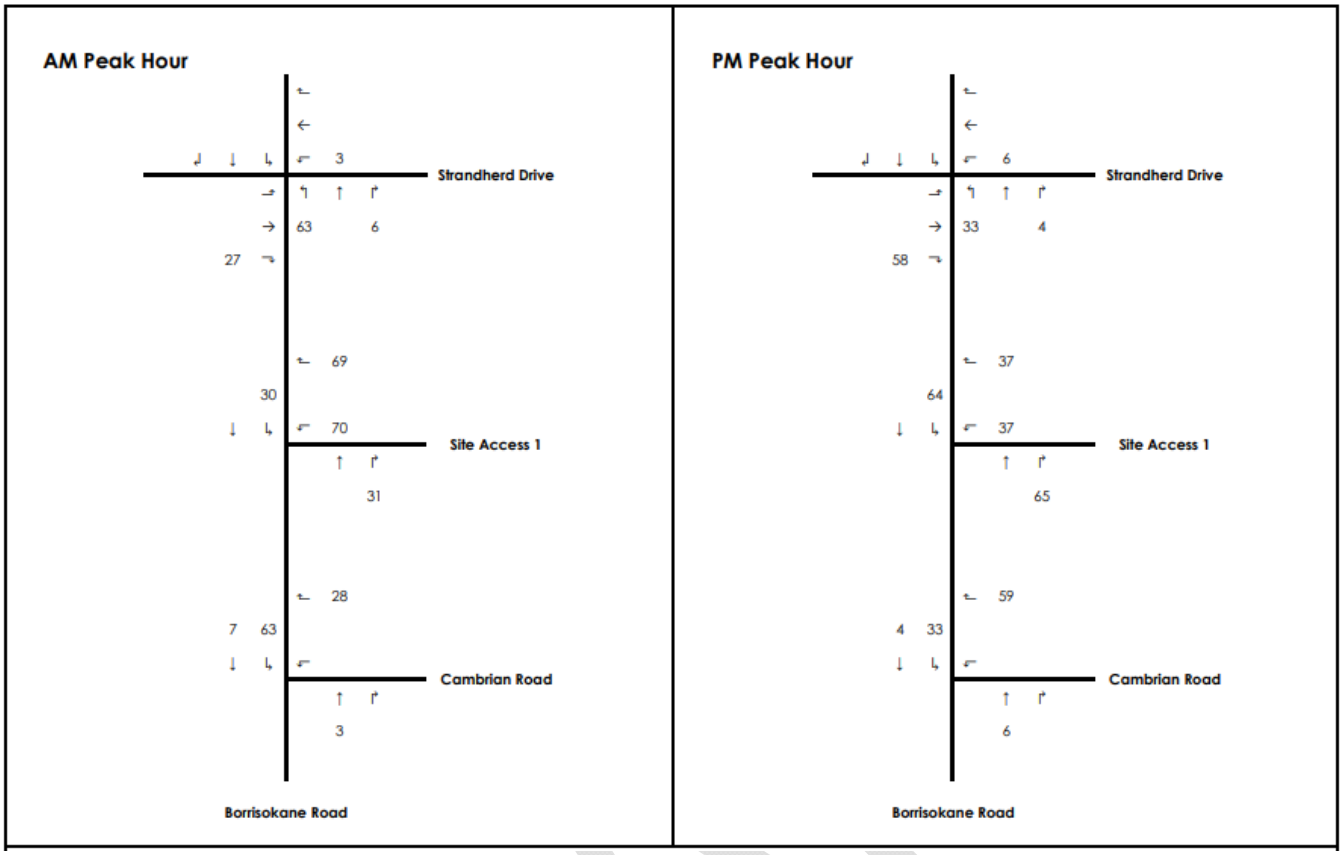
The Meadows Phase 5

North of the proposed development is the Tamarack Development of the Meadows. Phase 5 has a current development application. This development will not have shared accesses or traffic cross-over but will impact the Study Are intersections. The site trips generated by this site will be accounted for in the traffic projections. However, it is understood that while this application is on the City of Ottawa's Development Applications site, the TIA has not been approved, and the traffic projections are not finalized. Once those projections are finalized they will be included in the projections prior to submitting Step 4.

3387 Borrisokane Road

North of the proposed development is the Glenview Development of 3387 Borrisokane Road. Construction has not commenced on this subdivision. This development will not have shared accesses or traffic cross-over but will impact the Study Area intersections. The site trips generated by this site will be accounted for in the traffic projections. Figure 6 below is an excerpt from the 3387 Borrisokane Road Community Transportation Study / Transportation Impact Study Addendum 1, illustrating the net new site traffic volumes.

Figure 6: 3387 Borrisokane Road Site Traffic Volumes



Excerpt from: 3387 Borrisokane Road TIS, Stantec

Other Developments

While an adjacent development is anticipated to the north of the subject development, there is currently no plan or application associated with this development. As this development may occur beyond the development horizon of the subject application, no traffic from this development will be considered.

3 Study Area and Time Periods

3.1 Study Area

The study area will include examining Borrisokane Road as a Boundary Road and will focus on the access intersection on Borrisokane Road and the intersection of Borrisokane Road at Cambrian Road. As discussed previously, the intersection of Barnsdale Road at Borrisokane Road has not been included as the existing intersection has very low volumes and the proposed development is anticipated to have a negligible impact on that intersection.

3.2 Time Periods

As the proposed development is composed entirely of residential units the AM and PM peak hours will be examined.

3.3 Horizon Years

The anticipated build-out year is 2025. As a result, the full build-out plus five years horizon year is 2030.

4 Exemption Review

Table 2 summarizes the exemptions for this TIA.

Table 2: Exemption Review

Module	Element	Explanation	Exempt/Required
Design Review Component			
4.1 Development Design	4.1.2 Circulation and Access	Only required for site plans	**Exempt**
	4.2.3 New Street Networks	Only required for plans of subdivision	Required
4.2 Parking	4.2.1 Parking Supply	Only required for site plans	**Exempt**
	4.2.2 Spillover Parking	Only required for site plans where parking supply is 15% below unconstrained demand	**Exempt**
Network Impact Component			
4.5 Transportation Demand Management	All Elements	Not required for site plans expected to have fewer than 60 employees and/or students on location at any given time	**Required**
4.6 Neighbourhood Traffic Management	4.6.1 Adjacent Neighbourhoods	Only required when the development relies on local or collector streets for access and total volumes exceed ATM capacity thresholds	Exempt
4.8 Network Concept		Only required when proposed development generates more than 200 person-trips during the peak hour in excess of equivalent volume permitted by established zoning	**Required**

5 Development-Generated Travel Demand

5.1 Trip Generation and Mode Shares

The 2009 TRANS Trip Generation Study (TRANS Study) has been reviewed to determine the appropriate residential trip generation rates. Both single detached and townhouse style dwellings are proposed within the subject development. Vehicle trip rates have been determined using Table 6.3 of the TRANS Study. The initial mode share associated with these trips has been determined using Table 3.13 of the TRANS Study. Using this information, the person trip rate has been calculated. Table 3 below summarizes the vehicle trip rates, initial mode shares, and person trip rates, for each land use this study will consider.

Table 3: TRANS Trip Generation Person Trip Rates

Dwelling Type	ITE LUC	Peak Hour	Vehicle Trip Rate	Mode Share			Person Trip Rates
				Vehicle	Transit	Non-Motorized	
Single Detached	210	AM	0.70	55%	25%	9%	1.27
		PM	0.90	64%	19%	6%	1.41
Townhouse	220	AM	0.54	55%	27%	8%	0.98
		PM	0.71	61%	22%	6%	1.16

LUC – Land Use Code

Using the above Person Trip rates, the total person trip generation has been estimates. Table 4 below illustrates the total person trip generation by dwelling type.

Table 4: Total Person Trip Generation

Land Use	Units	AM Peak Hour			PM Peak Hour		
		In	Out	Total	In	Out	Total
Single Detached	315	116	284	400	271	173	444
Townhouse	185	67	114	181	114	101	215
Total Person Trips		**183**	**398**	**581**	**385**	**274**	**659**

Using the most recent National Capital Region Origin-Destination survey (OD Survey), the existing mode shares for South Nepean have been determined.

Table 5: OD Survey Existing Mode Share - South Nepean

Travel Mode	Existing Mode Share
Auto Driver	60%
Auto Passenger	15%
Transit	15%
Non-Auto	10%
Total	100%

There are no major transit upgrades (i.e. BRT, transit priority measures, etc.) within the Study Area that are planned to be in place by the study horizons that will be examined in this study. Therefore, the existing mode shares will be carried forward.

Using the above mode shares and person trip rates the person trips by mode have been projected. Table 6 summarizes the trip generation by mode.

Table 6: Trip Generation by Mode

Travel Mode	Mode Share	In	Out	Total	In	Out	Total
Auto Driver	60%	110	238	349	231	165	395
Auto Passenger	15%	27	60	87	58	41	99
Transit	15%	27	60	87	58	41	99
Non-Auto Modes	10%	19	39	58	38	27	66
Total	100%	183	398	581	385	274	659

As shown above, 581 AM and 659 PM peak hour two-way trips are projected as a result of the proposed development.

No trip reductions factors (i.e. synergy, pass-by, etc.) have been applied as the subject development is composed entirely of residential units.

5.2 Trip Distribution

To understand the travel patterns of the subject development the OD Survey has been reviewed to determine the existing travel patterns. Table 7 below summarizes the distribution.

Table 7: OD Survey Existing Mode Share - South Nepean

To/From	Percent of Trips
North	80%
South	5%
East	10%
West	5%
Total	100%

5.3 Trip Assignment

Using the distribution outlined above, turning movement splits, and access to major transportation infrastructure, the trips generated by the site have been assigned to the Study Area road network.

Figure 7: Site Traffic Assignment (%)

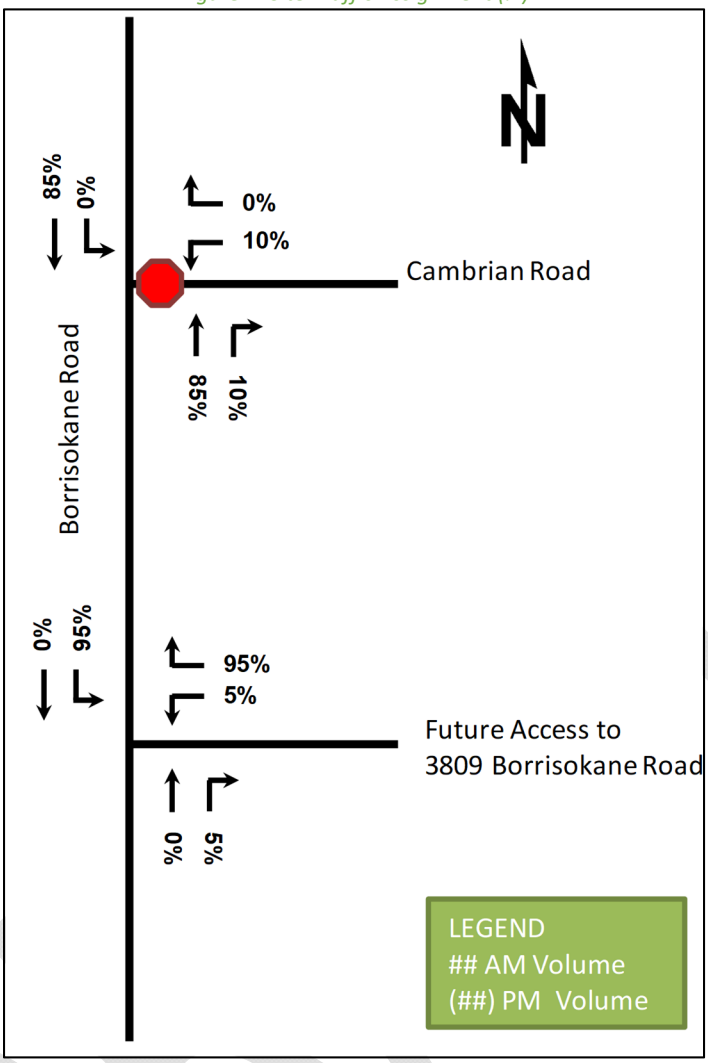
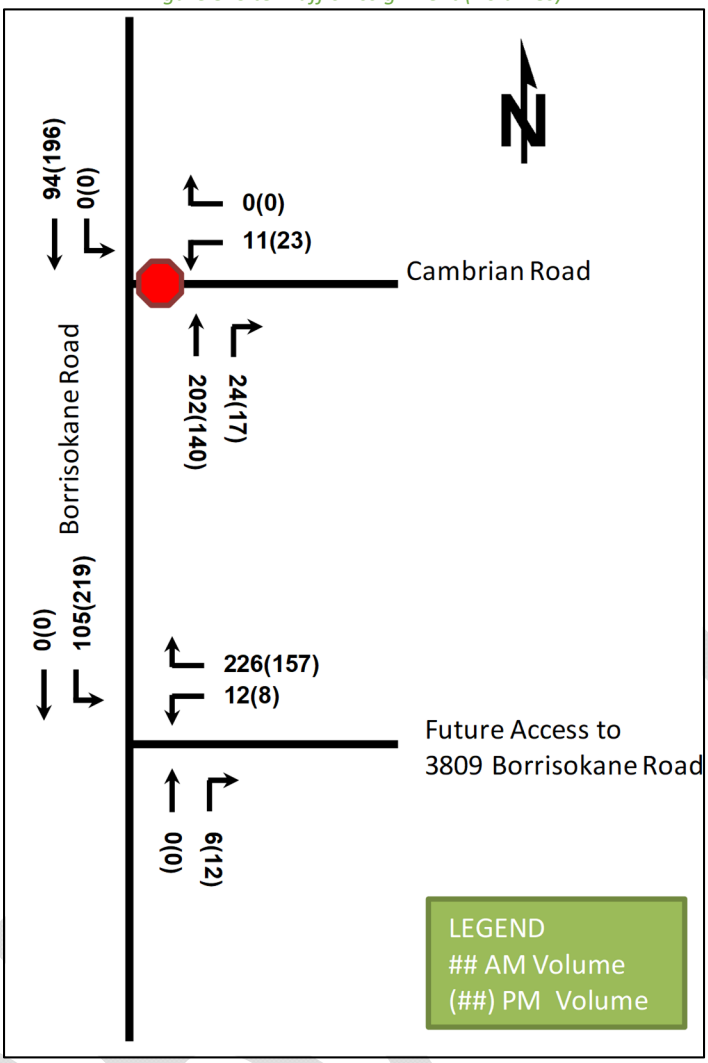


Figure 8: Site Traffic Assignment (Volumes)



6 Background Network Travel Demands

6.1 Transportation Network Plans

There are no planned changes to the Study Area Transportation Network that would influence the Study Area.

6.2 Background Growth

A large amount of background traffic has been accounted for through the other developments that have been documented in Section 2.3.2. This is particularly important along Cambrian Road, where most of the developments have been built or planned. Therefore, no additional background growth has been accounted for along Cambrian Road. Along Borrisokane Road there is less known about the future of the development along this corridor. To account for background growth along this corridor a 3%/annum background growth rate has been applied.

6.3 Other Developments

As detailed in Section 2.3.2, the following developments have been included in the background traffic forecasts:

- Half Moon Bay South
- Half Moon Bay West
- Barrhaven South Expansion Lands (Quinn's Pointe 2)

- The Meadows Phase 5 (to be added once available)
- 3387 Borrisokane Road

Figure 9 illustrates the 2025 future background traffic volumes. Figure 10 illustrates the 2030 future background traffic volumes.

Figure 9: 2025 Future Background Traffic Volumes

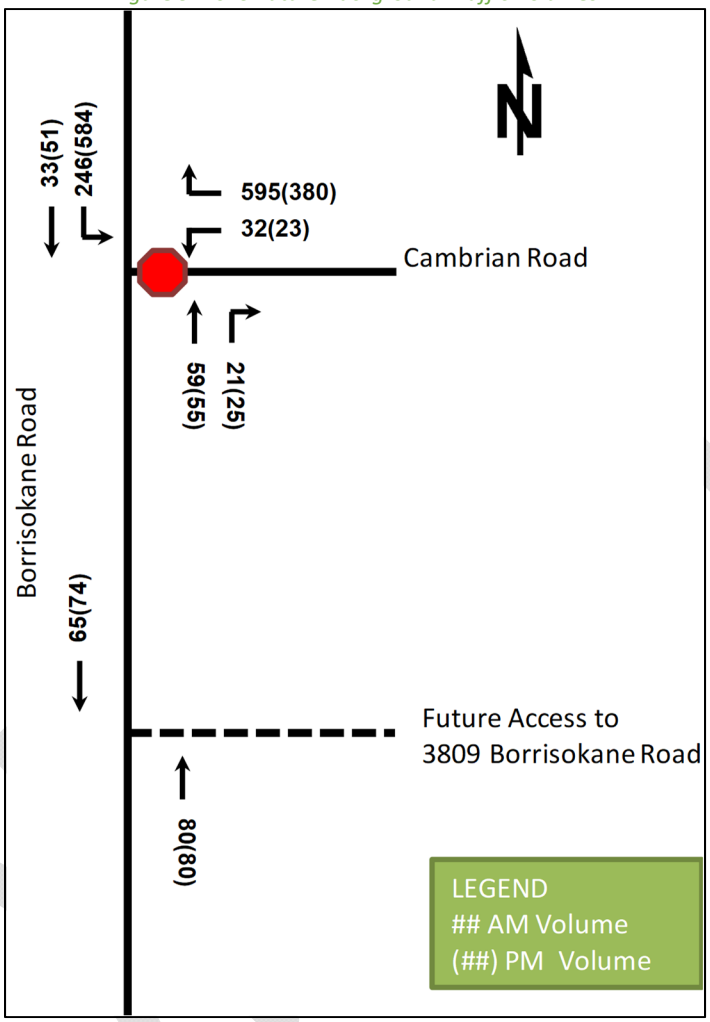
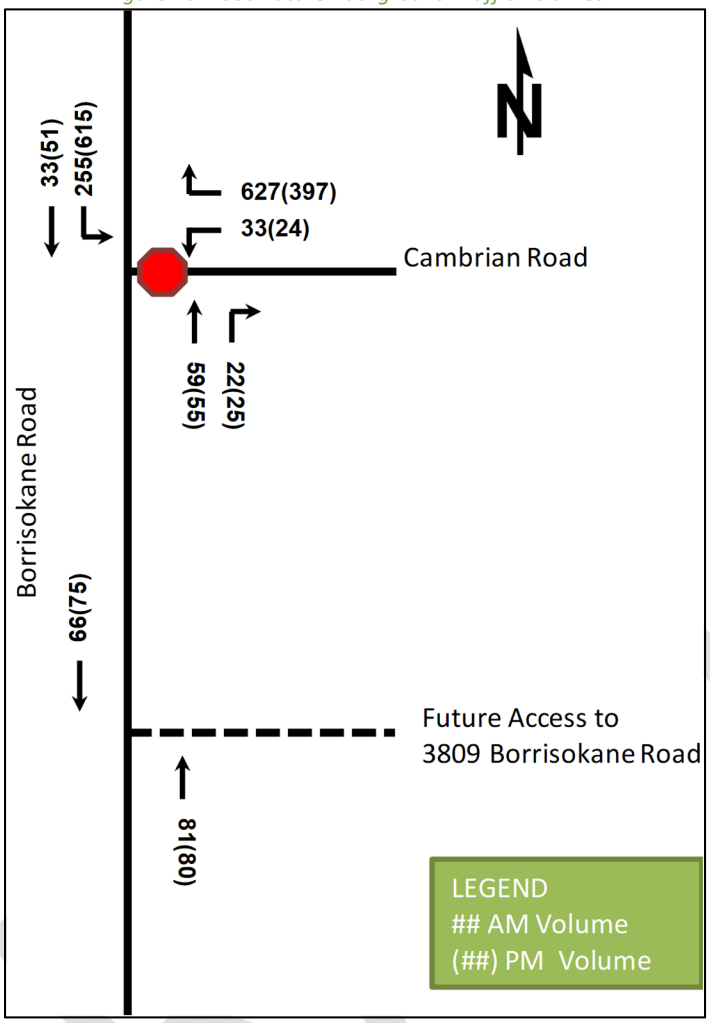


Figure 10: 2030 Future Background Traffic Volumes



7 Demand Rationalization

Figure 9 illustrates the 2025 future background traffic volumes and Figure 10 illustrates the 2030 future background traffic volumes. Table 8 summarizes the 2025 forecasted intersection operations and Table 9 summarizes the 2030 forecasted intersection operations. The level of service is based on the HCM criteria for average delay at signalized intersections. The synchro worksheets have been provided in Appendix D and Appendix E.

Table 8: 2025 Future Background Intersection Operations

Intersection	Lane	AM Peak Hour				PM Peak Hour			
		LOS	Delay	V/C	Q (95th)	LOS	Delay	V/C	Q (95th)
Cambrian Road & Borrisokane Road	WBL/R	C	16.8	0.68	5.6	C	17.7	0.59	3.9
	NBT/R	A	0.0	0.00	0.0	A	0.0	0.00	0.0
	SBL/T	A	6.9	0.16	0.6	A	8.1	0.39	1.8
	Overall	**B**	**12.6**	-	-	**B**	**11.0**	-	-

The future 2025 background conditions are forecasted to operate well during the peak hours as a minor stop-controlled intersection. While both the southbound left-turn and westbound right-turn volumes are significant in both peaks, no operational issues are noted, and no auxiliary turn lanes are recommended.

Table 9: 2030 Future Background Intersection Operations

Intersection	Lane	AM Peak Hour				PM Peak Hour			
		LOS	Delay	V/C	Q (95th)	LOS	Delay	V/C	Q (95th)
Cambrian Road & Borrisokane Road	WBL/R	C	18.3	0.72	6.4	C	20.1	0.65	4.7
	NBT/R	A	0.0	0.00	0.0	A	0.0	0.00	0.0
	SBL/T	A	7.0	0.17	0.6	A	8.3	0.41	2.0
	Overall	**B**	**13.7**	-	-	**B**	**12.0**	-	-

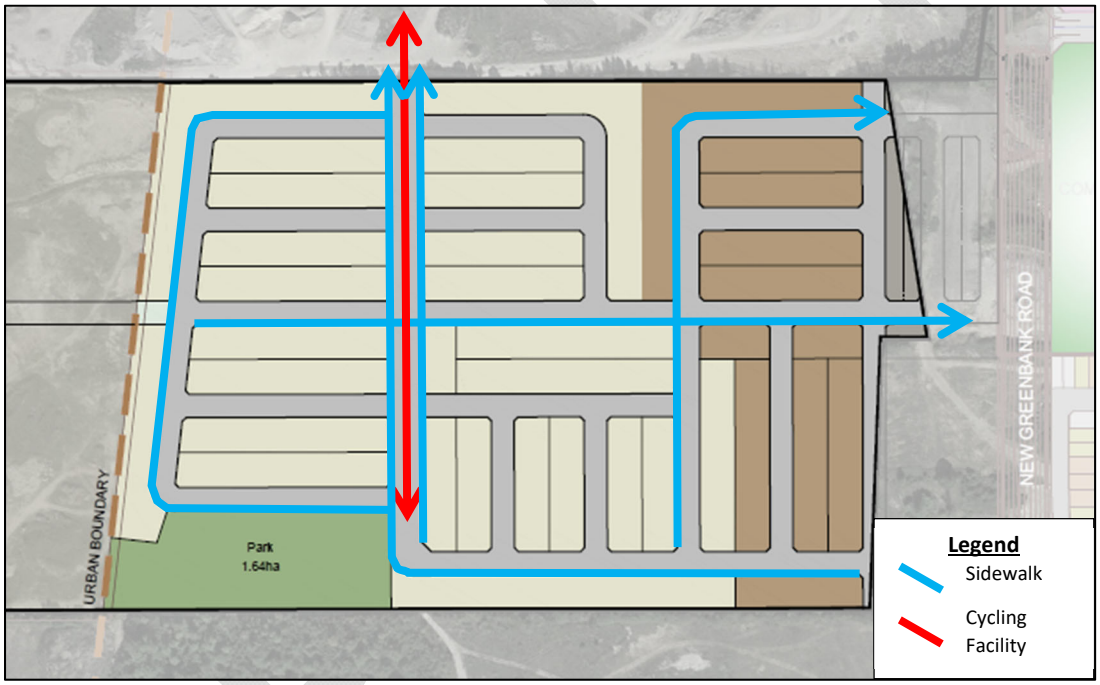
The future 2030 background conditions are forecasted to operate similar to the 2025 background operations. As noted in 2025, no auxiliary turn lanes are recommended.

8 Development Design

8.1 Design for Sustainable Modes

The proposed development is a residential subdivision and therefore auto and bicycle parking areas will be within each resident's home. Figure 11 illustrates the concept active mode network. The plan incorporates the adjacent developments, planned routes on geoOttawa, and the extension of the Barrhaven South Urban Expansion Study Area CDP networks.

Figure 11: Concept Pedestrian Network



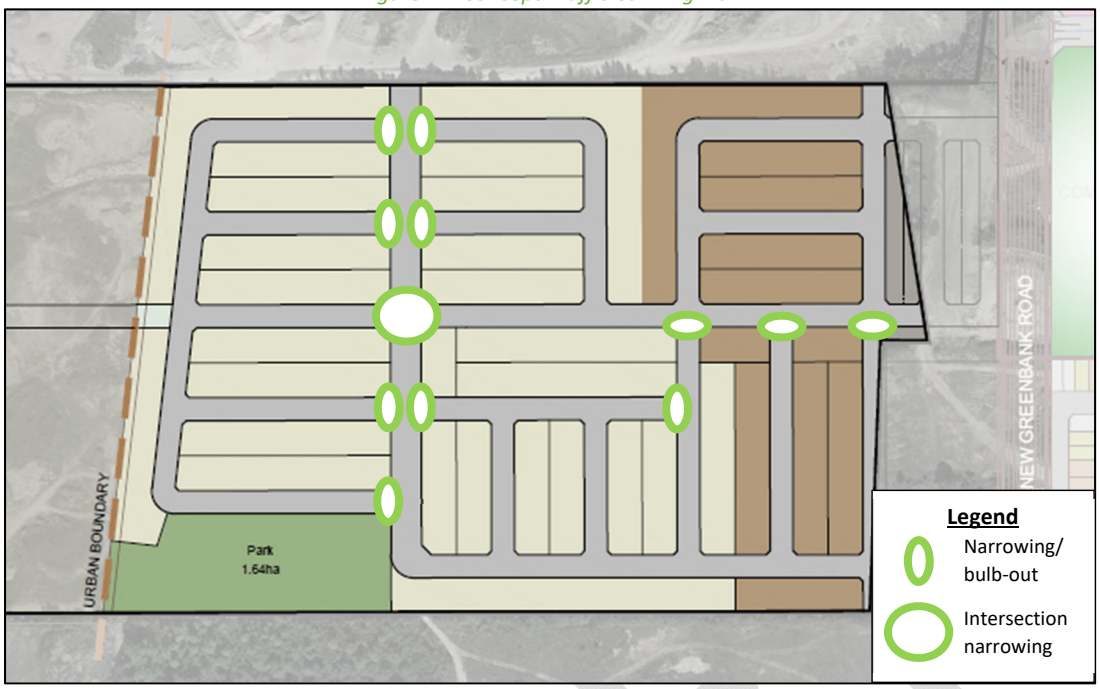
8.2 New Street Networks

The planned street network will include 18.0m local roadways and a single north-south 24.0m collector road. The local roads may include a sidewalk on one side, and the collector road should include sidewalks and cycle tracks on both sides, and parking on one side. It is noted that a multi-use pathway may be substituted to allow for utility spacing required or transit stops along the collector.

The cross-sections from the Barrhaven South Urban Expansion Study Area CDP have been provided in Appendix F for reference.

To support the pedestrian and cycling connectivity within the subdivision, Figure 12 illustrates the concept traffic calming plan. The plan reduces crossing distances for the pedestrian and cycling network, as well as limits the speed of vehicles entering and exiting the local roads from the collector road.

Figure 12: Concept Traffic Calming Plan



The internal road intersections are recommended to be stop-controlled on the minor approaches and an all-way stop is recommended at narrowed intersection of the collector road and east-west local road near the center of the subdivision.

9 Boundary Street Design

Table 10 summarizes the MMLOS analysis for the boundary road of Borrisokane Road. The existing and future conditions are the same and have been provided as a single line. The MMLOS worksheet has been provided in Appendix F.

Table 10: Boundary Street MMLOS Analysis

Segment	Pedestrian LOS		Bicycle LOS		Transit LOS		Truck LOS	
	PLOS	Target	BLOS	Target	TLOS	Target	TrLOS	Target
Borrisokane Road	F	N/A	F	D	D	N/A	C	N/A

The only target level of service applicable to Borrisokane Road, as a general rural area collector road, is the target B for the local cycling route. Cyclist are required to operate in mixed traffic and would require paved shoulders to increase the BLOS to E. The operating speeds would need to be reduced to below 60 km/h or a fully separated facility would be required to meet/exceed the BLOS target. For even a minimal addition of paved shoulders along Borrisokane Road, it would require paving the gravel shoulders from the site access to Strandherd Drive, almost 3km distance. Therefore, no mitigation measures are recommended as part of this development and the active mode network provided by development to the north and east will ultimately provide the connectivity to support this development.

10 Access Intersections Design

10.1 Location and Design of Access

The proposed access to the subdivision is through a temporary access road to Borrisokane Road. The road access is proposed as a full movement access approximately 1,050m south of Cambrian Road. This access would be used

until such time that Re-Aligned Greenbank Road is constructed, and the adjacent development is completed to connect the subject site to Re-Aligned Greenbank Road. This connection does not trigger the removal of the temporary access road but can be re-evaluated at this time.

10.2 Intersection Control

Based on the projected volumes, a minor stop-controlled intersection is recommended at the temporary site access intersection. No further traffic control or turn lanes are warranted to address operational issues.

10.3 Intersection Design

10.3.1 2025 Total Future Conditions

Figure 13 illustrates the 2025 future background traffic volumes and Table 11 summarizes the 2025 forecasted intersection operations. The level of service is based on the HCM criteria for average delay at signalized intersections. The synchro worksheets have been provided in Appendix G.

Left-turn lane warrants do not trigger the need for auxiliary lanes due to the low through volumes along Borrisokane Road. Should the mainline volumes increase as a result of other area developments, it is likely that these new developments would trigger the need for left-turn lanes. The left-turn lane warrants have been provided in Appendix H.

Figure 13: 2025 Future Total Traffic Volumes

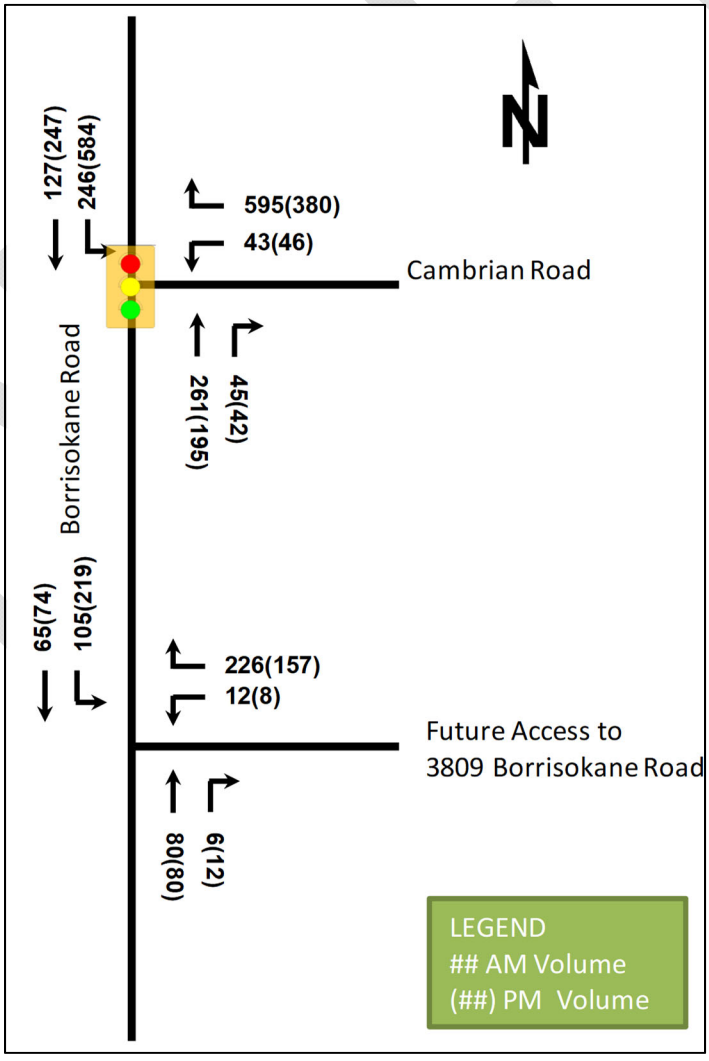


Table 11: 2025 Future Total Access Intersection Operations

Intersection	Lane	AM Peak Hour				PM Peak Hour			
		LOS	Delay	V/C	Q (95th)	LOS	Delay	V/C	Q (95th)
Temp Site Access & Borrisokane Road	WBL/R	B	10.1	0.25	1.0	A	9.8	0.18	0.7
	NBT/R	A	0.0	0.00	0.0	A	0.0	0.00	0.0
	SBL/T	A	4.7	0.07	0.2	A	5.8	0.15	0.5
	Overall	**A**	**6.5**	-	-	**A**	**6.0**	-	-

The temporary access road and Borrisokane Road intersection is anticipated to operate with high levels of service during both peak periods in the 2025 horizon.

10.3.2 2030 Total Future Conditions

Figure 14 illustrates the 2025 future background traffic volumes and Table 12 summarizes the 2025 forecasted intersection operations. The level of service is based on the HCM criteria for average delay at signalized intersections. The synchro worksheets have been provided in Appendix I.

Left-turn lane warrants do not trigger the need for auxiliary lanes due to the low through volumes along Borrisokane Road. Should the mainline volumes increase as a result of other area developments, it is likely that these new developments would trigger the need for left-turn lanes. The left-turn lane warrants have been provided in Appendix H.

Figure 14: 2030 Future Total Traffic Volumes

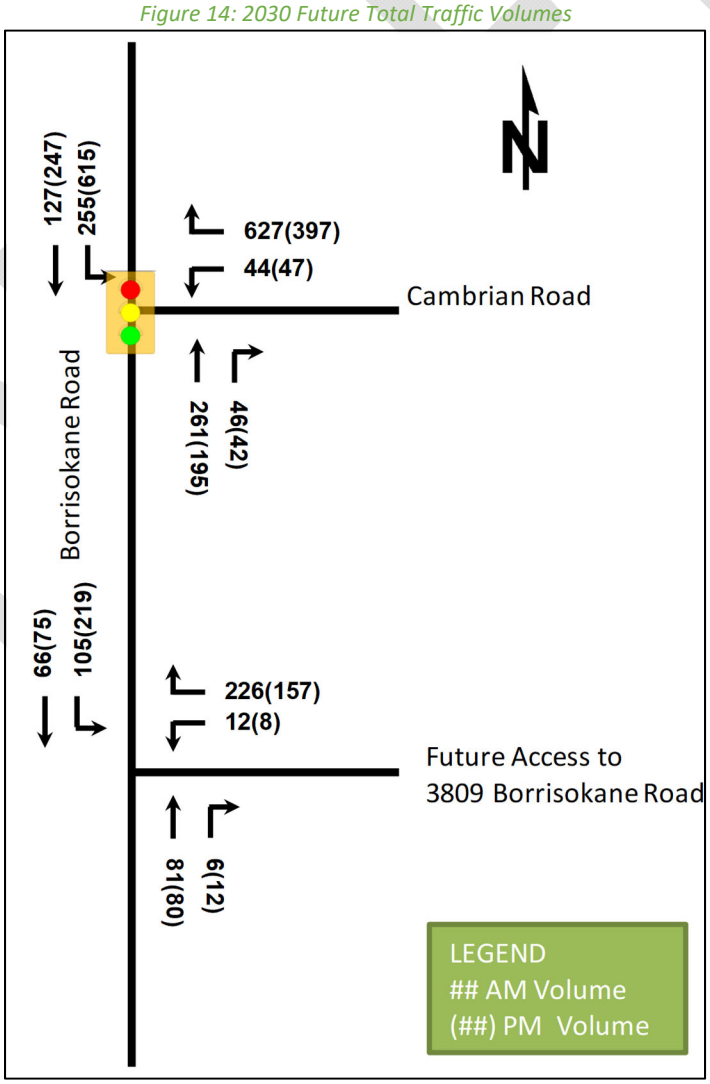


Table 12: 2030 Future Total Access Intersection Operations

Intersection	Lane	AM Peak Hour				PM Peak Hour			
		LOS	Delay	V/C	Q (95th)	LOS	Delay	V/C	Q (95th)
Temp Site Access & Borrisokane Road	WBL/R	B	10.1	0.25	1.0	A	9.8	0.18	0.7
	NBT/R	A	0.0	0.00	0.0	A	0.0	0.00	0.0
	SBL/T	A	4.6	0.07	0.2	A	5.8	0.15	0.5
	Overall	**A**	**6.4**	**-**	**-**	**A**	**6.0**	**-**	**-**

The temporary access road and Borrisokane Road intersection is anticipated to operate with high levels of service during both peak periods in the 2030 horizon.

11 Transportation Demand Management

11.1 Context for TDM

The mode shares used within the TIA represent this area of the City and have not been altered. Should these mode shares not be reached, the subject site accesses Borrisokane Road directly and will not impact any adjacent residential, recreational or natural land uses.

The subject site is not within a design priority or transit-oriented design area.

Total bedrooms within the development is subject to owner purchasing preferences. No age restrictions are noted.

11.2 Need and Opportunity

The subject site has been assumed to rely predominantly on auto travel and those assumptions have been carried through the analysis. A decrease in the low transit or non-auto mode shares will result in higher volumes along Borrisokane Road. The Cambrian Road intersection is anticipated to have residual capacity and will not significantly impact its operations should the auto mode share increase. Little opportunity is available to shift these modes until major infrastructure projects are completed to increase the transit and active mode network connectivity from South Barrhaven to the rest of the City.

11.3 TDM Program

As discussed above, any “suite of post-occupancy TDM measures” are limited in their applicability. It is anticipated that this development will rely predominantly on auto travel and those assumptions have been carried through the analysis.

12 Transit

12.1 Route Capacity

Overall, the forecasted new transit trips would result in approximately an additional bus (single bus, 55-person capacity) being required in the peak direction to accommodate the additional transit trips from the subject site.

As no transit routes are currently routed along the boundary roads, this would require additional service or alterations to existing transit routes to service this development.

12.2 Transit Priority

No transit priority is required/considered for the study area.

13 Review of Network Concept

The background and forecasted site trips do not exceed the anticipated lane capacities on the boundary road network. Beyond the TIA horizons, additional road and transit service via Re-Aligned Greenbank Road, will add additional capacity and promote higher transit use south of the Jock River.

14 Intersection Design

14.1 Intersection Control

The study area intersection of Borrisokane Road and Cambrian Road warrants signalization for the build-out horizon of 2025, as per the TAC signal warrant for the City of Ottawa. The intersection has been considered as a signalized intersection for the future total horizons of 2025 and 2030.

The signal warrant is provided in Appendix J.

14.2 Intersection Design

14.2.1 2025 Future Total Intersection Operations

The 2025 future total intersection volumes are illustrated above in Figure 13 and the operations are summarized below in Table 13. The signal timing has been optimized for the horizon. The synchro worksheets have been provided in Appendix G.

Table 13: 2025 Future Total Study Area Intersection Operations

Intersection	Lane	AM Peak Hour				PM Peak Hour			
		LOS	Delay	V/C	Q (95th)	LOS	Delay	V/C	Q (95th)
Cambrian Road & Borrisokane Road *Signalized*	WBL	B	14.0	0.12	7.9	C	24.3	0.20	11.8
	WBR	B	12.9	0.81	28.1	B	11.3	0.71	19.0
	NBT/R	A	7.8	0.32	35.3	A	3.9	0.20	18.4
	SBL	B	11.3	0.44	37.8	B	19.0	0.80	#123.7
	SBT	A	7.2	0.13	15.8	A	4.3	0.21	21.0
	Overall	**B**	**10.9**	-	-	**B**	**12.4**	-	-

The 2025 future conditions are forecasted to operate acceptably during the peak hours as signalized intersections. Using the TAC equation 9.14.1, the southbound left-turn lane storage length would need to be between 192m and 256m to accommodate 1.5-2 times the minimum storage length (128m). The westbound left-turn lane storage length would need to be meet the City minimum of 38m.

14.2.2 2030 Future Total Intersection Operations

The 2030 future total intersection volumes are illustrated above in Figure 14 and the operations are summarized below in Table 14. The signal timing has been optimized for the horizon. The synchro worksheets have been provided in Appendix I.

Table 14: 2030 Future Total Study Area Intersection Operations

Intersection	Lane	AM Peak Hour				PM Peak Hour			
		LOS	Delay	V/C	Q (95th)	LOS	Delay	V/C	Q (95th)
Cambrian Road & Borrisokane Road *Signalized*	WBL	B	13.0	0.11	7.8	C	29.6	0.22	13.9
	WBR	B	15.3	0.85	36.5	B	12.8	0.75	22.0
	NBT/R	A	8.7	0.33	36.7	A	3.5	0.19	18.8
	SBL	B	13.0	0.47	41.2	B	18.2	0.80	#144.5
	SBT	A	8.0	0.13	16.5	A	4.0	0.20	22.5
	Overall	**B**	**12.6**	-	-	**B**	**12.6**	-	-

The 2030 future total conditions are forecasted to operate similarly to the 2025 future total conditions. Using the TAC equation 9.14.1, the southbound left-turn lane storage length would need to be between 203m and 270m to accommodate 1.5-2 times the minimum storage length (135m) due to the background growth in the area. The westbound left-turn lane storage length would need to be meet the City minimum of 38m.

14.2.3 Intersection MMLOS

The warranted signal at the Borrisokane Road and Cambrian Road intersection has been assessed under the assumed auxiliary lane configuration and that the paved shoulders will transition into bike lanes at the

intersection. Table 15 summarizes the MMMLOS analysis for the future study area intersection. No existing MMLOS analysis has been provided as the intersection is currently a minor stop-controlled intersection. The MMLOS worksheet has been provided in Appendix F.

Table 15: 2030 Future Signal MMLOS Analysis

Intersection	Pedestrian LOS		Bicycle LOS		Transit LOS		Truck LOS		Auto LOS	
	PLOS	Target	BLOS	Target	TLOS	Target	TrLOS	Target	ALOS	Target
Cambrian Road & Borrisokane Road	B	C	E	B	D	-	E	-	C	D

The target level of service for arterial roads in a developing community would be met by a typical signalized intersection with the exception of the bike level of service. Due to the operating speed and need to cross a lane to turn left would require a left-turn box for bikes on the southbound and westbound approaches to meet the level of service target B.

14.2.4 Recommended Design Elements

The study area intersection of Borrisokane Road and Cambrian Road will require signalization due to the heavy turning movements at the intersection and anticipated increase of the northbound and southbound through volumes from the subject development. As such, the conceptual design elements for this intersection would include:

- Lane arrangement to include:
  - Southbound left-turn lane with storage in the range of 190-250m
  - Westbound left-turn lane with City minimum storage of 38m
- Pedestrian crossings on all legs
- Bike lanes provide through the intersection and transition areas
- Left-turn bike boxes on the southbound and westbound approaches

15 Summary of Improvements Indicated and Modifications Options

The following summarizes the analysis and results presented in this TIA report:

Proposed Site and Screening

- The proposed site includes 500 units, split approximately between 315 single detached homes and 185 townhomes
- A temporary access road will be provided from the development to Borrisokane Road, until such time that additional access is provided to Re-Aligned Greenbank Road (once constructed) through adjacent developments
- The temporary access road is proposed as a full movement access
- The development is proposed to be completed as a single phase by 2025
- The Trip Generation, Location, and Safety triggers were all met for the TIA Screening

Existing Conditions

- Borrisokane Road is an 80km/h two-lane rural collector road with gravel shoulders
- No pedestrian, cycling, and transit facilities are provided adjacent to the proposed development
- No collision issues were noted in the study area

Development Generated Travel Demand

- The proposed development is forecasted to generate 580 people two-way trips during the AM peak and 660 people two-way trips during the PM peak

- Based on the study area travel patterns, a total of 350 two-way vehicle trips will be generated during the AM peak and 395 two-way vehicles trips during the PM peak
- 95% of the traffic is estimated to travel north of the site (ultimately 80% north, 10% east, and 5% west) and 5% to the south of the site

Background Conditions

- The background developments of Half Moon Bay South, Half Moon Bay West, Barrhaven South Expansion Lands (Quinn's Pointe 2), The Meadows Phase 5 (to be added once available), and 3387 Borrisokane Road were included within the background conditions, including a 1.5% background growth
- No operational issues are noted in the background horizons of 2025 and 2030 for the Borrisokane Road and Cambrian Road intersection
- The southbound left-turn and westbound right-turn volumes are the primary movements at this intersection

Development Design

- The collector road is provided in the north-south direction within the development with a 24.0m right-of-way and the remaining development roads are 18.0m local roads
- The Barrhaven South Urban Expansion Study Area CDP road cross-sections are recommended for use in the development and would include:
    - A cycle track and sidewalk on both sides of the collector road with one lane of parking
    - No sidewalks or a single sidewalk on the local roads
    - Should utility or cross-sectional constraints be identified on the collector road, a MUP may be substituted for the cycle track and sidewalk
- The internal road intersections are recommended to be minor stop-controlled, with an all-way stop-control located at the collector and east-west local road in the center of the development
- Traffic calming measures are recommended to reduce pedestrian crossing distances where sidewalks are provided and the reduce turning speeds from the collector road to local roads

Boundary Street Design

- The existing and future Borrisokane Road will not meet the cycling targets for MMLOS
- No improvements are recommended as the rural road is outside the urban boundary and any local improvements (e.g. paved shoulders) would still have a connectivity gap of over 2.5km

Access Intersections Design

- A Temporary Site Access Road will be provided from the development to Borrisokane Road
- Once Re-Aligned Greenbank Road is constructed and development extends to the proposed development (beyond 2030), the Temporary Site Access Road may be removed if necessary
- The Temporary Site Access Road is anticipated to operate at a high level of service during the peak hours at the study horizons
- The intersection is recommended to be a stop-control on the minor approach and no auxiliary lanes are required
- It is noted that the southbound left-turn lane is close to being warranted and other area developments may trigger the need to implement a turn-lane if the mainline volumes Borrisokane Road

TDM

- The lack of supporting infrastructure limits the potential for TDM measures to reduce the auto reliance anticipated for the proposed development

- Beyond the study horizons, the transit network along Re-Aligned Greenbank Road and the associated cycling and pedestrian networks will begin to produce the connectivity required to see a mode shift from the proposed development

Transit

- No transit service is provided on the boundary road network, nor future route plans include the proposed development at this time
- To meet minimum area transit use, a single bus, or equivalent capacity, would be required to support the proposed development during the AM and PM peak hours

Network Intersection Design

- The intersection of Cambrian Road and Borrisokane Road will require signalization as the volumes increase along Borrisokane Road from the proposed development due to the very high southbound left-turn volumes
- In addition, based on the volumes and MMLOS analysis, the following design elements should be considered for the future signalized intersection at Cambrian Road and Borrisokane Road:
    - Southbound left-turn lane with storage in the range of 190-250m
    - Westbound left-turn lane with City minimum storage of 38m
    - Pedestrian crossings on all legs
    - Bike lanes provide through the intersection and transition areas
    - Left-turn bike boxes on the southbound and westbound approaches

16 Next Steps

Following the circulation and review of the TIA for draft plan of subdivision, any outstanding comments will be documents within the context of the draft plan of subdivision. Once sign-off has been received from City Transportation Project Manager, a signed and stamped final report will be provided to City staff.

Appendix A

TIA Screening Form and PM Certification Form

TIA Plan Reports

On 14 June 2017, the Council of the City of Ottawa adopted new Transportation Impact Assessment (TIA) Guidelines. In adopting the guidelines, Council established a requirement for those preparing and delivering transportation impact assessments and reports to sign a letter of certification.

Individuals submitting TIA reports will be responsible for all aspects of development-related transportation assessment and reporting, and undertaking such work, in accordance and compliance with the City of Ottawa's Official Plan, the Transportation Master Plan and the Transportation Impact Assessment (2017) Guidelines.

By submitting the attached TIA report (and any associated documents) and signing this document, the individual acknowledges that s/he meets the four criteria listed below.

CERTIFICATION

1. I have reviewed and have a sound understanding of the objectives, needs and requirements of the City of Ottawa's Official Plan, Transportation Master Plan and the Transportation Impact Assessment (2017) Guidelines;
2. I have a sound knowledge of industry standard practice with respect to the preparation of transportation impact assessment reports, including multi modal level of service review;
3. I have substantial experience (more than 5 years) in undertaking and delivering transportation impact studies (analysis, reporting and geometric design) with strong background knowledge in transportation planning, engineering or traffic operations; and
4. I am either a licensed[1] or registered[2] professional in good standing, whose field of expertise [check √ appropriate field(s)] is either transportation engineering √ or transportation planning □.

[1,2] License of registration body that oversees the profession is required to have a code of conduct and ethics guidelines that will ensure appropriate conduct and representation for transportation planning and/or transportation engineering works.

City Of Ottawa
Infrastructure Services and Community Sustainability
Planning and Growth Management
110 Laurier Avenue West, 4th fl.
Ottawa, ON K1P 1J1
Tel. : 613-580-2424
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Urbanisme et Gestion de la croissance
110, avenue Laurier Ouest
Ottawa (Ontario) K1P 1J1
Tél. : 613-580-2424
Télécopieur: 613-560-6006

Dated at ___Ottawa_____ this __20__ day of _____September_____, 2018.
(City)

Name: _____Andrew Harte_____
(Please Print)

Professional Title: _____Professional Engineer_____

_____
Signature of Individual certifier that s/he meets the above four criteria

Office Contact Information (Please Print)
Address: 13 Markham Avenue
City / Postal Code: Ottawa / K2G 3Z1
Telephone / Extension: (613) 697-3797
E-Mail Address: Andrew.Harte@CGHTransportation.com

CGH TRANSPORTATION INC.

13 Markham Avenue
Ottawa, ON K2G 3Z1

City of Ottawa 2017 TIA Guidelines
Step 1 - Screening Form

Date: 26-Jul-18
Project Number: 2018-05
Project Reference: Caivan Brazeau

1. Description of Proposed Development	
Municipal Address	3809 Borrisokane Road
Description of Location	CON 3 RF W PT LOT 8;RP5R-13403 PARTS 2 AND 3;LESS RP 5R-13374 PARTS 15 &;16
Land Use Classification	Residential / Commercial
Development Size	500 Units with a mix of Single and Townhouse units 33% TH / 67% Singles
Accesses	1 Access to Borrisokane + Adjacent Prop. + future access to New Greenbank Road
Phase of Development	N/A
Buildout Year	2025
TIA Requirement	Full TIA Required

2. Trip Generation Trigger		
Land Use Type	Single-family homes	
Development Size	335	Units
Trip Generation Trigger	Yes	

3. Location Triggers	
Does the development propose a new driveway to a boundary street that is designated as part of the City's Transit Priority, Rapid Transit or Spine Bicycle Networks?	Yes
Is the development in a Design Priority Area (DPA) or Transit-oriented Development (TOD) zone?	No
Location Trigger	Yes

4. Safety Triggers	
Are posted speed limits on a boundary street are 80 km/hr or greater?	Yes
Are there any horizontal/vertical curvatures on a boundary street limits sight lines at a proposed driveway?	No
Is the proposed driveway within the area of influence of an adjacent traffic signal or roundabout (i.e. within 300 m of intersection in rural conditions, or within 150 m of intersection in urban/ suburban conditions)?	No
Is the proposed driveway within auxiliary lanes of an intersection?	No
Does the proposed driveway make use of an existing median break that serves an existing site?	No
Is there is a documented history of traffic operations or safety concerns on the boundary streets within 500 m of the development?	No
Does the development include a drive-thru facility?	No
Safety Trigger	Yes

Appendix B

Turning Movement Counts

Survey Date: Tuesday February 15 2018
Weather: Cloudy

TURNING MOVEMENT COUNT SUMMARY - ALL MODES

AM Peak Hour: 7:30 AM to 8:30 AM
MD Peak Hour: 11:30 AM to 12:30 PM
PM Peak Hour: 4:45 PM to 5:45 PM

AADT FACTOR: 1.0

Turning Movement Count - Full Study Summary Report (Vehicles)

Time Period		Borrisokane Road Northbound					Borrisokane Road Southbound					N/S STREET TOTAL	0 Eastbound					Cambrian Road Westbound					E/W STREET TOTAL	Grand TOTAL
		LT	ST	RT	U-Turns	NB TOTAL	LT	ST	RT	U-Turns	SB TOTAL		LT	ST	RT	U-Turns	EB TOTAL	LT	ST	RT	U-Turns	WB TOTAL		
7:00	8:00	0	28	10	0	**38**	72	15	0	0	**87**	**125**	0	0	0	0	**0**	8	0	350	0	**358**	**358**	**483**
8:00	9:00	0	48	13	0	**61**	123	22	0	0	**145**	**206**	0	0	0	0	**0**	5	0	346	0	**351**	**351**	**557**
9:00	10:00	0	24	1	0	**25**	60	22	0	0	**82**	**107**	0	0	0	0	**0**	1	0	209	0	**210**	**210**	**317**
AVG AM Pk HR		0	33	8	0	**41**	85	20	0	0	**105**	**146**	0	0	0	0	**0**	5	0	302	0	**306**	**306**	**452**
11:30	12:30	0	54	9	0	**63**	105	26	0	0	**131**	**194**	0	0	0	0	**0**	4	0	139	0	**143**	**143**	**337**
12:30	13:30	0	48	6	0	**54**	87	23	0	0	**110**	**164**	0	0	0	0	**0**	2	0	117	0	**119**	**119**	**283**
AVG MD Pk HR		0	51	8	0	**59**	96	25	0	0	**121**	**179**	0	0	0	0	**0**	3	0	128	0	**131**	**131**	**310**
15:00	16:00	0	40	1	0	**41**	58	51	0	0	**109**	**150**	0	0	0	0	**0**	13	0	159	0	**172**	**172**	**322**
16:00	17:00	0	25	0	0	**25**	344	43	0	0	**387**	**412**	0	0	0	0	**0**	11	0	162	0	**173**	**173**	**585**
17:00	18:00	0	22	0	0	**22**	352	36	0	0	**388**	**410**	0	0	0	0	**0**	14	0	198	0	**212**	**212**	**622**
AVG PM Pk HR		0	29	0	0	**29**	251	43	0	0	**295**	**324**	0	0	0	0	**0**	13	0	173	0	**186**	**186**	**510**
TOTAL		0	373	56	0	**429**	1,382	282	0	0	**1,664**	**2,093**	0	0	0	0	**0**	66	0	2,110	0	**2,175**	**2,175**	**4,268**
EQ 12Hr		0	519	77	0	596	1921	392	0	0	2313	2909	0	0	0	0	0	91	0	2932	0	3024	3024	5933
Note: These volumes are calculated by multiplying the totals by the appropriate expansion factor.											1.39													
AVG 12Hr		0	519	77	0	596	1921	392	0	0	2313	2909	0	0	0	0	0	91	0	2932	0	3024	3024	5933
Note: These volumes are calculated by multiplying the Equivalent 12 hr. totals by the AADT factor.											1.0													
AVG 24Hr		0	680	101	0	781	2516	514	0	0	3030	3811	0	0	0	0	0	120	0	3841	0	3961	3961	7772
Note: These volumes are calculated by multiplying the Average Daily 12hr. totals by the 12 to 24 expansion factor.													1.31											

Turning Movement Count - Full Study Summary Report (Pedestrians)

Time Period		Borrisokane Road NB Approach (East or West Crossing)	Borrisokane Road SB Approach (East or West Crossing)	N/S STREET TOTAL	0 EB Approach (North or South Crossing)	Cambrian Road WB Approach (North or South Crossing)	E/W STREET TOTAL	Grand TOTAL
7:00	8:00	0	0	**0**	0	0	**0**	**0**
8:00	9:00	0	0	**0**	0	0	**0**	**0**
9:00	10:00	0	0	**0**	0	1	**1**	**1**
11:30	12:30	0	0	**0**	0	0	**0**	**0**
12:30	13:30	0	0	**0**	0	0	**0**	**0**
15:00	16:00	0	0	**0**	0	0	**0**	**0**
16:00	17:00	0	228	**228**	0	0	**0**	**228**
17:00	18:00	0	0	**0**	0	0	**0**	**0**
TOTAL:		0	228	**228**	0	1	**1**	**229**

Turning Movement Count - Full Study Summary Report (Cyclists)

Time Period		Borrisokane Road Northbound	Borrisokane Road Southbound	N/S STREET TOTAL	0 Eastbound	Cambrian Road Westbound	E/W STREET TOTAL	Grand TOTAL
7:00	8:00	0	0	**0**	0	0	**0**	**0**
8:00	9:00	0	0	**0**	0	0	**0**	**0**
9:00	10:00	0	0	**0**	0	0	**0**	**0**
11:30	12:30	0	0	**0**	0	0	**0**	**0**
12:30	13:30	0	0	**0**	0	0	**0**	**0**
15:00	16:00	0	0	**0**	0	0	**0**	**0**
16:00	17:00	0	0	**0**	0	0	**0**	**0**
17:00	18:00	0	0	**0**	0	0	**0**	**0**
TOTAL:		0	0	**0**	0	0	**0**	**0**

Turning Movement Count - Full Study Summary Report (Heavy Vehicles)

Time Period		Borrisokane Road Northbound					Borrisokane Road Southbound					N/S STREET TOTAL	0 Eastbound					Cambrian Road Westbound					E/W STREET TOTAL	Grand TOTAL
		LT	ST	RT	U-Turns	NB TOTAL	LT	ST	RT	U-Turns	SB TOTAL		LT	ST	RT	U-Turns	EB TOTAL	LT	ST	RT	U-Turns	WB TOTAL		
7:00	8:00	0	9	0	0	**9**	16	8	0	0	**24**	**33**	0	0	0	0	**0**	0	0	5	0	**5**	**5**	**38**
8:00	9:00	0	10	2	0	**12**	4	10	0	0	**14**	**26**	0	0	0	0	**0**	2	0	16	0	**18**	**18**	**44**
9:00	10:00	0	12	0	0	**12**	7	13	0	0	**20**	**32**	0	0	0	0	**0**	0	0	10	0	**10**	**10**	**42**
11:30	12:30	0	11	1	0	**12**	2	11	0	0	**13**	**25**	0	0	0	0	**0**	1	0	5	0	**6**	**6**	**31**
12:30	13:30	0	10	3	0	**13**	2	11	0	0	**13**	**26**	0	0	0	0	**0**	0	0	5	0	**5**	**5**	**31**
15:00	16:00	0	2	0	0	**2**	10	2	0	0	**12**	**14**	0	0	0	0	**0**	1	0	11	0	**12**	**12**	**26**
16:00	17:00	0	1	5	0	**6**	6	2	0	0	**8**	**14**	0	0	0	0	**0**	4	0	17	0	**21**	**21**	**35**
17:00	18:00	0	2	1	0	**3**	1	1	0	0	**2**	**5**	0	0	0	0	**0**	2	0	5	0	**7**	**7**	**12**
TOTAL:		0	57	12	0	**69**	48	58	0	0	**106**	**175**	0	0	0	0	**0**	10	0	74	0	**84**	**84**	**259**

Appendix C

Collision Data

City Operations - Transportation Services

Collision Details Report - Public Version

From: January 1, 2013 **To:** December 31, 2017

Location: CAMBRIAN RD @ CEDARVIEW RD

Traffic Control: Stop sign

Total Collisions: 9

Date/Day/Time	Environment	Impact Type	Classification	Surface Cond'n	Veh. Dir	Vehicle Manoeuver	Vehicle type	First Event	No. Ped
2014-Aug-08, Fri,15:30	Clear	SMV other	Non-fatal injury	Dry	West	Going ahead	Automobile, station wagon	Ran off road	
2015-Jan-25, Sun,16:43	Clear	SMV other	P.D. only	Ice	West	Slowing or stopping	Automobile, station wagon	Skidding/sliding	
2015-Jul-10, Fri,08:58	Clear	Rear end	P.D. only	Dry	West	Turning left	Automobile, station wagon	Other motor vehicle	
					West	Turning left	Automobile, station wagon	Other motor vehicle	
2016-Jun-23, Thu,17:10	Clear	Rear end	Non-fatal injury	Dry	South	Going ahead	Pick-up truck	Other motor vehicle	
					South	Turning left	Automobile, station wagon	Other motor vehicle	
2016-Jul-22, Fri,20:56	Rain	SMV other	P.D. only	Wet	West	Slowing or stopping	Automobile, station wagon	Skidding/sliding	
2016-Jul-29, Fri,03:27	Fog, mist, smoke, dust	Rear end	P.D. only	Dry	West	Going ahead	Unknown	Other motor vehicle	
					West	Slowing or stopping	Pick-up truck	Other motor vehicle	
2016-Dec-11, Sun,09:30	Clear	SMV other	P.D. only	Ice	West	Slowing or stopping	Automobile, station wagon	Ditch	

2017-Aug-29, Tue,13:57	Clear	Rear end	P.D. only	Dry	West	Turning right	Automobile, station wagon	Other motor vehicle
					West	Turning right	Pick-up truck	Other motor vehicle
2017-Dec-17, Sun,08:33	Clear	SMV other	P.D. only	Dry	North	Turning right	Automobile, station wagon	Ditch

Appendix D

2025 Future Background Synchro Worksheets

Intersection	
Int Delay, s/veh	12.6

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	32	595	59	21	246	33
Future Vol, veh/h	32	595	59	21	246	33
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	100	100	100	100	100	100
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	32	595	59	21	246	33

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	595	70	0	0	80	0
Stage 1	70	-	-	-	-	-
Stage 2	525	-	-	-	-	-
Critical Hdwy	6.42	6.22	-	-	4.12	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	-	-	2.218	-
Pot Cap-1 Maneuver	467	993	-	-	1518	-
Stage 1	953	-	-	-	-	-
Stage 2	593	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	390	993	-	-	1518	-
Mov Cap-2 Maneuver	390	-	-	-	-	-
Stage 1	953	-	-	-	-	-
Stage 2	495	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	16.8	0	6.9
HCM LOS	C		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	SBL	SBT
Capacity (veh/h)	-	-	920	1518	-
HCM Lane V/C Ratio	-	-	0.682	0.162	-
HCM Control Delay (s)	-	-	16.8	7.8	0
HCM Lane LOS	-	-	C	A	A
HCM 95th %tile Q(veh)	-	-	5.6	0.6	-

Intersection	
Int Delay, s/veh	11

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	23	380	55	25	584	51
Future Vol, veh/h	23	380	55	25	584	51
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	100	100	100	100	100	100
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	23	380	55	25	584	51

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	1287	68	0	0	80	0
Stage 1	68	-	-	-	-	-
Stage 2	1219	-	-	-	-	-
Critical Hdwy	6.42	6.22	-	-	4.12	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	-	-	2.218	-
Pot Cap-1 Maneuver	181	995	-	-	1518	-
Stage 1	955	-	-	-	-	-
Stage 2	279	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	109	995	-	-	1518	-
Mov Cap-2 Maneuver	109	-	-	-	-	-
Stage 1	955	-	-	-	-	-
Stage 2	169	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	17.7	0	8.1
HCM LOS	C		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	SBL	SBT
Capacity (veh/h)	-	-	680	1518	-
HCM Lane V/C Ratio	-	-	0.593	0.385	-
HCM Control Delay (s)	-	-	17.7	8.8	0
HCM Lane LOS	-	-	C	A	A
HCM 95th %tile Q(veh)	-	-	3.9	1.8	-

Appendix E

2030 Future Background Synchro Worksheets

Intersection	
Int Delay, s/veh	13.7

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	33	627	59	22	255	33
Future Vol, veh/h	33	627	59	22	255	33
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	100	100	100	100	100	100
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	33	627	59	22	255	33

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	613	70	0	0	81	0
Stage 1	70	-	-	-	-	-
Stage 2	543	-	-	-	-	-
Critical Hdwy	6.42	6.22	-	-	4.12	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	-	-	2.218	-
Pot Cap-1 Maneuver	456	993	-	-	1517	-
Stage 1	953	-	-	-	-	-
Stage 2	582	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	378	993	-	-	1517	-
Mov Cap-2 Maneuver	378	-	-	-	-	-
Stage 1	953	-	-	-	-	-
Stage 2	482	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	18.3	0	7
HCM LOS	C		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	SBL	SBT
Capacity (veh/h)	-	-	918	1517	-
HCM Lane V/C Ratio	-	-	0.719	0.168	-
HCM Control Delay (s)	-	-	18.3	7.9	0
HCM Lane LOS	-	-	C	A	A
HCM 95th %tile Q(veh)	-	-	6.4	0.6	-

HCM 2010 TWSC
1: Borrisokane Road & Cambrian Road 11-07-2018

Intersection	
Int Delay, s/veh	12

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	24	397	55	25	615	51
Future Vol, veh/h	24	397	55	25	615	51
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	100	100	100	100	100	100
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	24	397	55	25	615	51

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	1349	68	0	0	80	0
Stage 1	68	-	-	-	-	-
Stage 2	1281	-	-	-	-	-
Critical Hdwy	6.42	6.22	-	-	4.12	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	-	-	2.218	-
Pot Cap-1 Maneuver	166	995	-	-	1518	-
Stage 1	955	-	-	-	-	-
Stage 2	261	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	97	995	-	-	1518	-
Mov Cap-2 Maneuver	97	-	-	-	-	-
Stage 1	955	-	-	-	-	-
Stage 2	152	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	20.1	0	8.3
HCM LOS	C		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	SBL	SBT
Capacity (veh/h)	-	-	651	1518	-
HCM Lane V/C Ratio	-	-	0.647	0.405	-
HCM Control Delay (s)	-	-	20.1	9	0
HCM Lane LOS	-	-	C	A	A
HCM 95th %tile Q(veh)	-	-	4.7	2	-

Appendix F

Barrhaven South Urban Expansion Study Area Road Cross-Sections

Figure 35 East - West Collector Proposed Cross-Section (mid-block with Parking on one side)

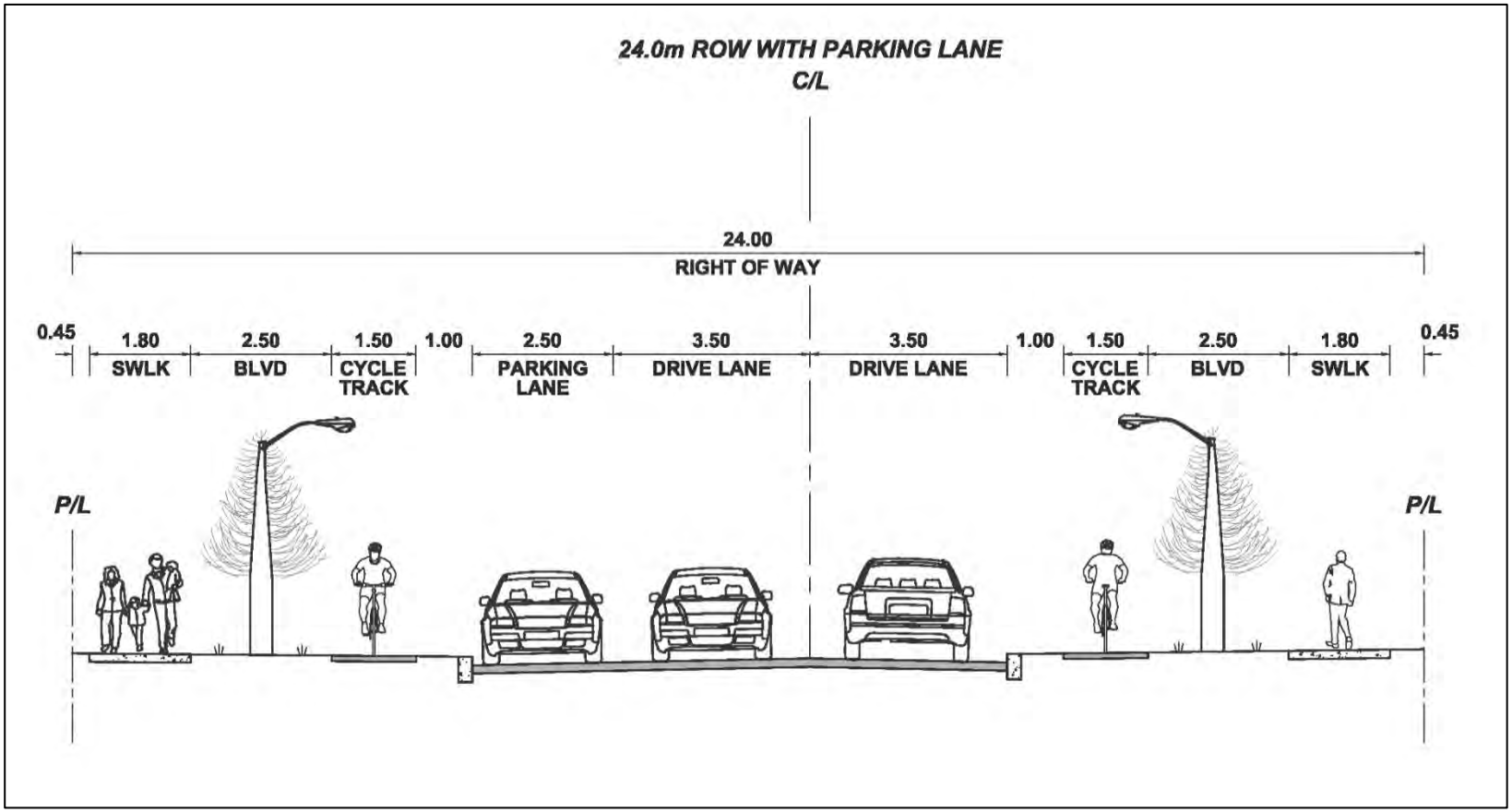
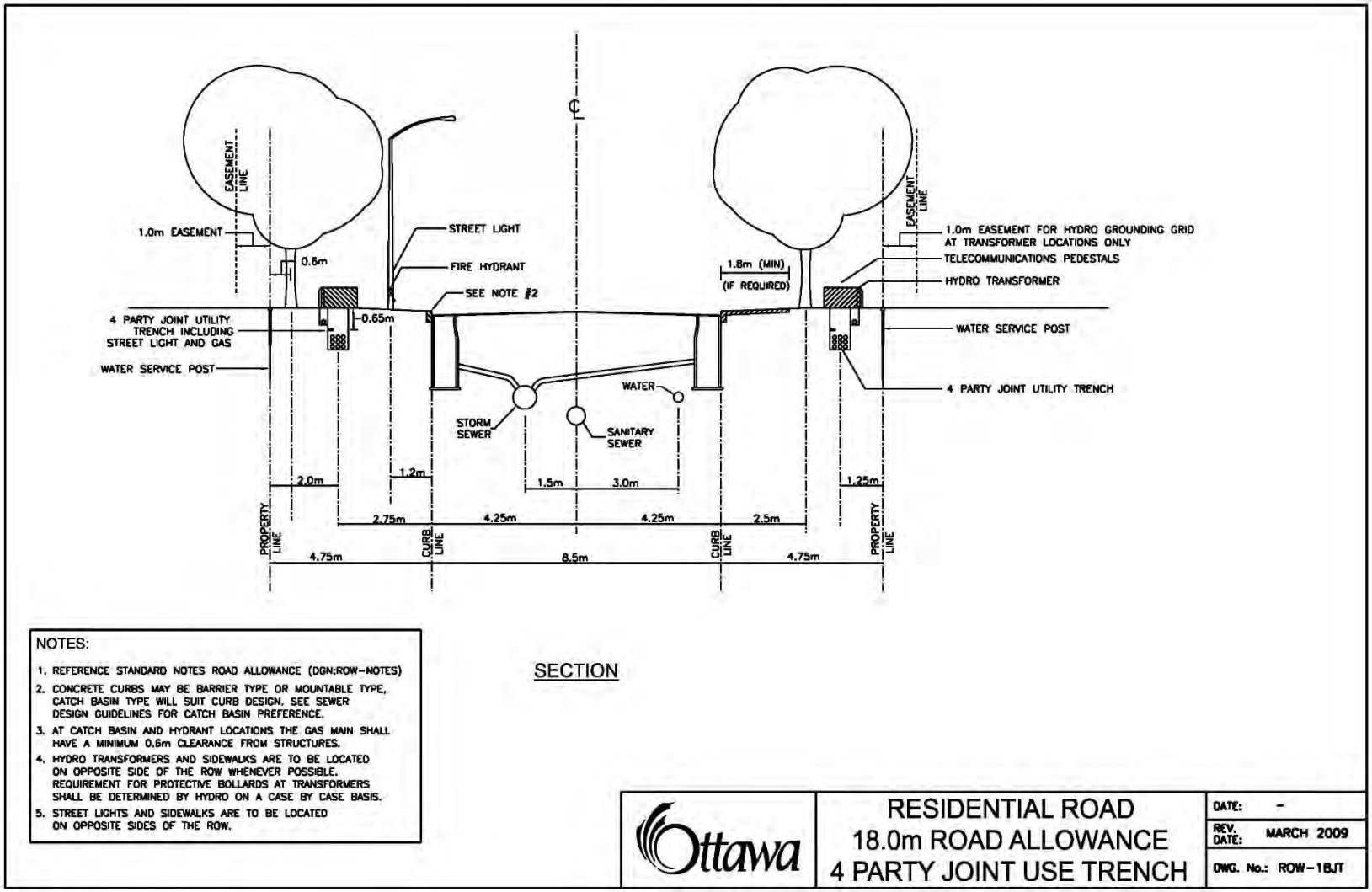


Figure 36 Local Road Proposed Cross-Section – Sidewalks on One (or both) Sides



Appendix G

MMLOS Analysis

Multi-Modal Level of Service - Intersections Form

Consultant	**CGH Transportation**	**Project**	**Caivan Brazeau**
Scenario	**All**	**Date**	**2018-10-31**
Comments			

INTERSECTIONS		Borrisokane-Cambrian (Future)			
	Crossing Side	**NORTH**	**SOUTH**	**EAST**	**WEST**
Pedestrian	Lanes	0 - 2	0 - 2		0 - 2
	Median	No Median - 2.4 m	No Median - 2.4 m		No Median - 2.4 m
	Conflicting Left Turns	No left turn / Prohib.	Permissive		Permissive
	Conflicting Right Turns	Permissive or yield control	No right turn		Permissive or yield control
	Right Turns on Red (RToR) ?	RTOR prohibited	RTOR allowed		RTOR allowed
	Ped Signal Leading Interval?	No	No		No
	Right Turn Channel	No Right Turn	No Channel		No Channel
	Corner Radius	No Right Turn	10-15m		10-15m
	Crosswalk Type	Std transverse markings	Std transverse markings		Std transverse markings
	PETSI Score	**106**	**90**		**85**
	Ped. Exposure to Traffic LoS	**A**	**A**	**-**	**B**
	Cycle Length				
	Effective Walk Time				
	Average Pedestrian Delay				
	Pedestrian Delay LoS	-	-	-	-
	Level of Service	**A**	**A**	**-**	**B**
		B			
	Approach From	**NORTH**	**SOUTH**	**EAST**	**WEST**
Bicycle	Bicycle Lane Arrangement on Approach	Curb Bike Lane, Cycletrack or MUP	Curb Bike Lane, Cycletrack or MUP	Curb Bike Lane, Cycletrack or MUP	
	Right Turn Lane Configuration				
	Right Turning Speed				
	Cyclist relative to RT motorists	**Not Applicable**	**Not Applicable**	**Not Applicable**	**-**
	Separated or Mixed Traffic	**Separated**	**Separated**	**Separated**	**-**
	Left Turn Approach	1 lane crossed		1 lane crossed	
	Operating Speed	≥ 60 km/h		≥ 60 km/h	
	Left Turning Cyclist	**E**	**-**	**E**	**-**
	Level of Service	**E**	**-**	**E**	**-**
		E			
Transit	Average Signal Delay	≤ 20 sec	≤ 10 sec	≤ 30 sec	
	Level of Service	**C**	**B**	**D**	**-**
		D			
Truck	Effective Corner Radius		10 - 15 m	10 - 15 m	
	Number of Receiving Lanes on Departure from Intersection		1	1	
	Level of Service	**-**	**E**	**E**	**-**
		E			
Auto	Volume to Capacity Ratio	0.71 - 0.80			
	Level of Service	**C**			

Multi-Modal Level of Service - Segments Form

Consultant	**CGH Transportation**	**Project**	**Caivan Brazeau**
Scenario	**All**	**Date**	**2018-10-31**
Comments			

SEGMENTS		Street A	Borrisokane 1	Section 2	Section 3
Pedestrian	Sidewalk Width Boulevard Width	F	no sidewalk n/a		
	Avg Daily Curb Lane Traffic Volume		> 3000		
	Operating Speed On-Street Parking		> 60 km/h no		
	Exposure to Traffic PLoS		**F**	-	-
	Effective Sidewalk Width		1.5 m		
	Pedestrian Volume		250 ped/hr		
	Crowding PLoS		**B**	-	-
	Level of Service		**F**	-	-
Bicycle	Type of Cycling Facility	F	Mixed Traffic		
	Number of Travel Lanes		≤ 2 (no centreline)		
	Operating Speed		≥ 60 km/h		
	# of Lanes & Operating Speed LoS		**F**	-	-
	Bike Lane (+ Parking Lane) Width				
	Bike Lane Width LoS		-	-	-
	Bike Lane Blockages				
	Blockage LoS		-	-	-
	Median Refuge Width (no median = < 1.8 m)		< 1.8 m refuge		
	No. of Lanes at Unsignalized Crossing		≤ 3 lanes		
	Sidestreet Operating Speed		>40 to 50 km/h		
	Unsignalized Crossing - Lowest LoS		**B**	-	-
	Level of Service		**F**	-	-
Transit	Facility Type	D	Mixed Traffic		
	Friction or Ratio Transit:Posted Speed		Vt/Vp ≥ 0.8		
	Level of Service		**D**	-	-
Truck	Truck Lane Width	C	≤ 3.5 m		
	Travel Lanes per Direction		1		
	Level of Service		**C**	-	-

Appendix H

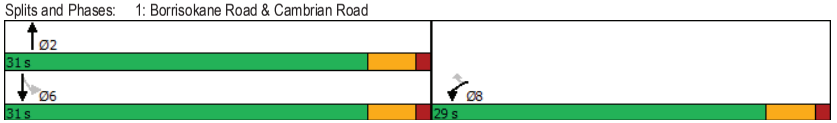
2025 Future Total Synchro Worksheets

Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (vph)	44	627	261	46	255	127
Future Volume (vph)	44	627	261	46	255	127
Satd. Flow (prot)	1621	1450	1672	0	1621	1706
Flt Permitted	0.950				0.573	
Satd. Flow (perm)	1621	1450	1672	0	977	1706
Satd. Flow (RTOR)		507	19			
Lane Group Flow (vph)	44	627	307	0	255	127
Turn Type	Prot	Perm	NA		Perm	NA
Protected Phases	8		2			6
Permitted Phases		8			6	
Detector Phase	8	8	2		6	6
Switch Phase						
Minimum Initial (s)	5.0	5.0	5.0		5.0	5.0
Minimum Split (s)	22.7	22.7	22.7		22.7	22.7
Total Split (s)	29.0	29.0	31.0		31.0	31.0
Total Split (%)	48.3%	48.3%	51.7%		51.7%	51.7%
Yellow Time (s)	3.5	3.5	3.5		3.5	3.5
All-Red Time (s)	1.2	1.2	1.2		1.2	1.2
Lost Time Adjust (s)	0.0	0.0	0.0		0.0	0.0
Total Lost Time (s)	4.7	4.7	4.7		4.7	4.7
Lead/Lag						
Lead-Lag Optimize?						
Recall Mode	None	None	Max		Max	Max
Act Effct Green (s)	12.1	12.1	26.8		26.8	26.8
Actuated g/C Ratio	0.25	0.25	0.55		0.55	0.55
v/c Ratio	0.11	0.85	0.33		0.47	0.13
Control Delay	13.0	15.3	8.7		13.0	8.0
Queue Delay	0.0	0.0	0.0		0.0	0.0
Total Delay	13.0	15.3	8.7		13.0	8.0
LOS	B	B	A		B	A
Approach Delay	15.1		8.7			11.3
Approach LOS	B		A			B
Queue Length 50th (m)	2.8	8.1	10.5		10.4	4.1
Queue Length 95th (m)	7.8	36.5	36.7		41.2	16.5
Internal Link Dist (m)	517.3		1048.8			1050.1
Turn Bay Length (m)	38.0				38.0	
Base Capacity (vph)	828	988	932		540	943
Starvation Cap Reductn	0	0	0		0	0
Spillback Cap Reductn	0	0	0		0	0
Storage Cap Reductn	0	0	0		0	0
Reduced v/c Ratio	0.05	0.63	0.33		0.47	0.13

Intersection Summary
Cycle Length: 60
Actuated Cycle Length: 48.5
Natural Cycle: 55
Control Type: Semi Act-Uncoord
Maximum v/c Ratio: 0.85

Intersection Signal Delay: 12.6 Intersection LOS: B
Intersection Capacity Utilization 66.3% ICU Level of Service C
Analysis Period (min) 15

Splits and Phases: 1: Borrisokane Road & Cambrian Road



HCM 2010 TWSC
2: Borrisokane Road & Temp Site Access 11-07-2018

Intersection	
Int Delay, s/veh	6.4

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	12	226	81	6	105	66
Future Vol, veh/h	12	226	81	6	105	66
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	100	100	100	100	100	100
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	12	226	81	6	105	66

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	360	84	0	0	87	0
Stage 1	84	-	-	-	-	-
Stage 2	276	-	-	-	-	-
Critical Hdwy	6.42	6.22	-	-	4.12	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	-	-	2.218	-
Pot Cap-1 Maneuver	639	975	-	-	1509	-
Stage 1	939	-	-	-	-	-
Stage 2	771	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	593	975	-	-	1509	-
Mov Cap-2 Maneuver	593	-	-	-	-	-
Stage 1	939	-	-	-	-	-
Stage 2	715	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	10.1	0	4.6
HCM LOS	B		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	SBL	SBT
Capacity (veh/h)	-	-	944	1509	-
HCM Lane V/C Ratio	-	-	0.252	0.07	-
HCM Control Delay (s)	-	-	10.1	7.6	0
HCM Lane LOS	-	-	B	A	A
HCM 95th %tile Q(veh)	-	-	1	0.2	-

Timings
1: Borrisokane Road & Cambrian Road 11-07-2018

Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (vph)	47	397	195	42	615	257
Future Volume (vph)	47	397	195	42	615	257
Satd. Flow (prot)	1621	1450	1665	0	1621	1706
Flt Permitted	0.950				0.611	
Satd. Flow (perm)	1621	1450	1665	0	1042	1706
Satd. Flow (RTOR)		397	28			
Lane Group Flow (vph)	47	397	237	0	615	257
Turn Type	Prot	Perm	NA		Perm	NA
Protected Phases	8		2			6
Permitted Phases		8			6	
Detector Phase	8	8	2		6	6
Switch Phase						
Minimum Initial (s)	5.0	5.0	5.0		5.0	5.0
Minimum Split (s)	22.7	22.7	22.7		22.7	22.7
Total Split (s)	22.8	22.8	57.2		57.2	57.2
Total Split (%)	28.5%	28.5%	71.5%		71.5%	71.5%
Yellow Time (s)	3.5	3.5	3.5		3.5	3.5
All-Red Time (s)	1.2	1.2	1.2		1.2	1.2
Lost Time Adjust (s)	0.0	0.0	0.0		0.0	0.0
Total Lost Time (s)	4.7	4.7	4.7		4.7	4.7
Lead/Lag						
Lead-Lag Optimize?						
Recall Mode	None	None	Max		Max	Max
Act Effct Green (s)	9.2	9.2	52.7		52.7	52.7
Actuated g/C Ratio	0.13	0.13	0.74		0.74	0.74
v/c Ratio	0.22	0.75	0.19		0.80	0.20
Control Delay	29.6	12.8	3.5		18.2	4.0
Queue Delay	0.0	0.0	0.0		0.0	0.0
Total Delay	29.6	12.8	3.5		18.2	4.0
LOS	C	B	A		B	A
Approach Delay	14.5		3.5			14.0
Approach LOS	B		A			B
Queue Length 50th (m)	5.7	0.0	5.4		33.9	6.8
Queue Length 95th (m)	13.9	22.0	18.8		#144.5	22.5
Internal Link Dist (m)	517.3		1033.5			1050.1
Turn Bay Length (m)	38.0				38.0	
Base Capacity (vph)	412	665	1237		769	1260
Starvation Cap Reductn	0	0	0		0	0
Spillback Cap Reductn	0	0	0		0	0
Storage Cap Reductn	0	0	0		0	0
Reduced v/c Ratio	0.11	0.60	0.19		0.80	0.20

Intersection Summary
Cycle Length: 80
Actuated Cycle Length: 71.3
Natural Cycle: 80
Control Type: Semi Act-Uncoord
Maximum v/c Ratio: 0.80

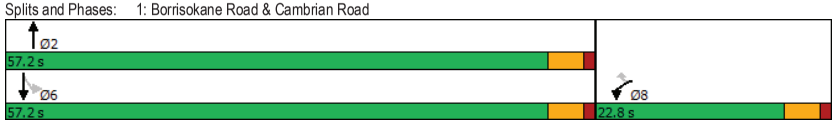
Timings
1: Borrisokane Road & Cambrian Road

11-07-2018

Intersection Signal Delay: 12.6	Intersection LOS: B
Intersection Capacity Utilization 65.4%	ICU Level of Service C
Analysis Period (min) 15	

\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 1: Borrisokane Road & Cambrian Road



HCM 2010 TWSC
2: Borrisokane Road & Temp Site Access

11-07-2018

Intersection	
Int Delay, s/veh	6

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	8	157	80	12	219	75
Future Vol, veh/h	8	157	80	12	219	75
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	100	100	100	100	100	100
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	8	157	80	12	219	75

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	599	86	0	0	92	0
Stage 1	86	-	-	-	-	-
Stage 2	513	-	-	-	-	-
Critical Hdwy	6.42	6.22	-	-	4.12	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	-	-	2.218	-
Pot Cap-1 Maneuver	465	973	-	-	1503	-
Stage 1	937	-	-	-	-	-
Stage 2	601	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	394	973	-	-	1503	-
Mov Cap-2 Maneuver	394	-	-	-	-	-
Stage 1	937	-	-	-	-	-
Stage 2	510	-	-	-	-	-

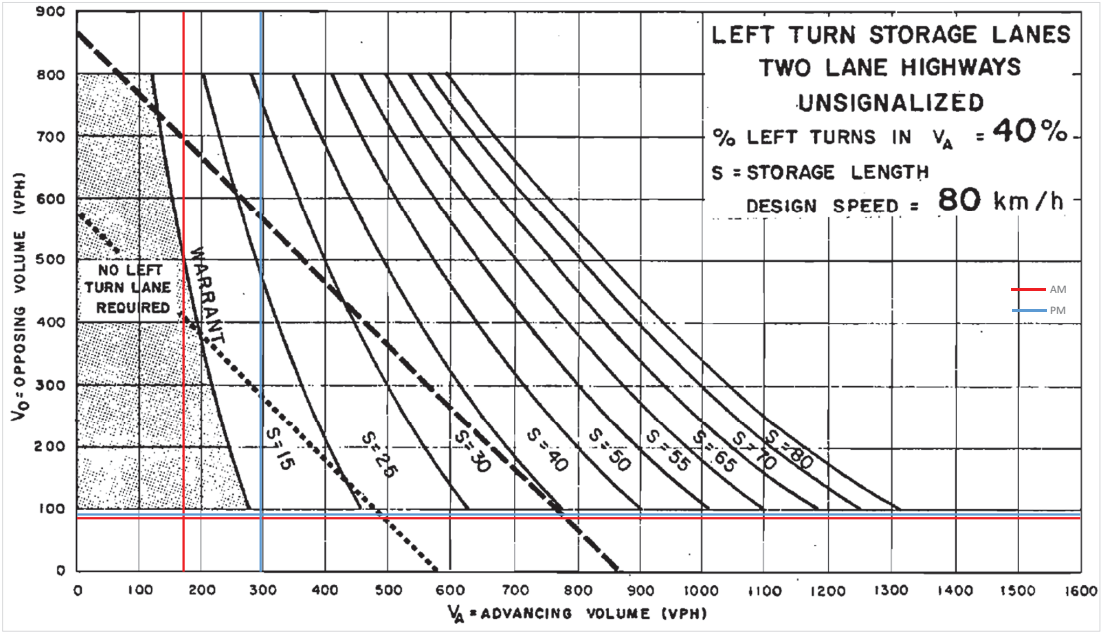
Approach	WB	NB	SB
HCM Control Delay, s	9.8	0	5.8
HCM LOS	A		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	SBL	SBT
Capacity (veh/h)	-	-	908	1503	-
HCM Lane V/C Ratio	-	-	0.182	0.146	-
HCM Control Delay (s)	-	-	9.8	7.8	0
HCM Lane LOS	-	-	A	A	A
HCM 95th %tile Q(veh)	-	-	0.7	0.5	-

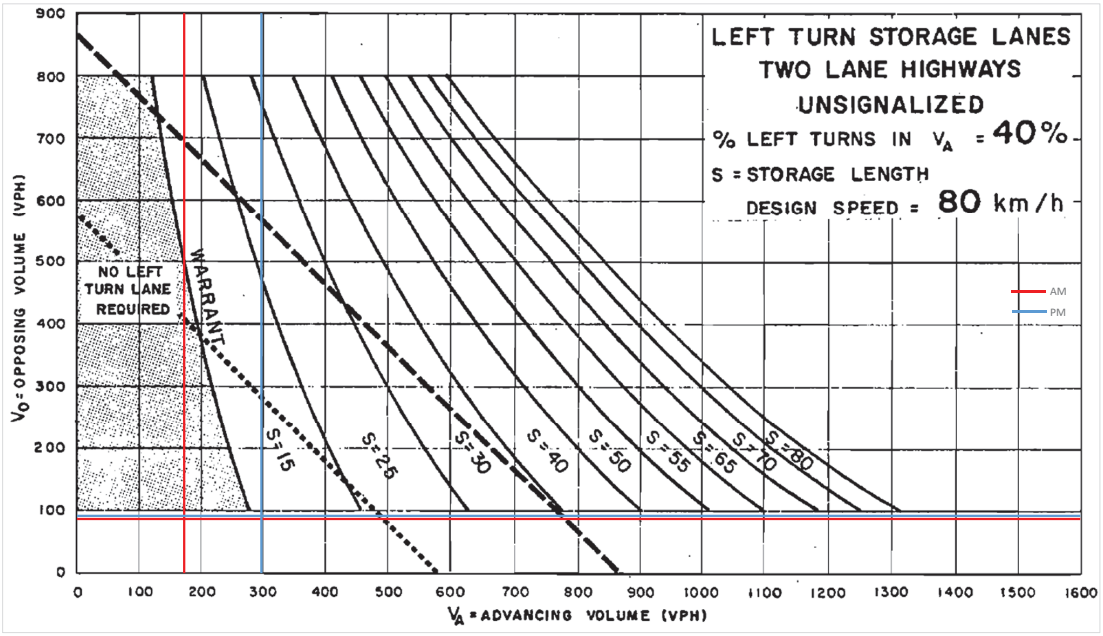
Appendix I

Left-Turn Lane Warrants

Temporary Site Access Road - Southbound Left-Turn Lane 2025



Temporary Site Access Road - Southbound Left-Turn Lane 2030



Appendix J

2030 Future Total Synchro Worksheets

Timings
1: Borrisokane Road & Cambrian Road

11-07-2018

Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (vph)	43	595	261	45	246	127
Future Volume (vph)	43	595	261	45	246	127
Satd. Flow (prot)	1621	1450	1672	0	1621	1706
Flt Permitted	0.950				0.574	
Satd. Flow (perm)	1621	1450	1672	0	979	1706
Satd. Flow (RTOR)		522	19			
Lane Group Flow (vph)	43	595	306	0	246	127
Turn Type	Prot	Perm	NA		Perm	NA
Protected Phases	8		2			6
Permitted Phases		8			6	
Detector Phase	8	8	2		6	6
Switch Phase						
Minimum Initial (s)	5.0	5.0	5.0		5.0	5.0
Minimum Split (s)	22.7	22.7	22.7		22.7	22.7
Total Split (s)	28.0	28.0	32.0		32.0	32.0
Total Split (%)	46.7%	46.7%	53.3%		53.3%	53.3%
Yellow Time (s)	3.5	3.5	3.5		3.5	3.5
All-Red Time (s)	1.2	1.2	1.2		1.2	1.2
Lost Time Adjust (s)	0.0	0.0	0.0		0.0	0.0
Total Lost Time (s)	4.7	4.7	4.7		4.7	4.7
Lead/Lag						
Lead-Lag Optimize?						
Recall Mode	None	None	Max		Max	Max
Act Effct Green (s)	10.9	10.9	27.8		27.8	27.8
Actuated g/C Ratio	0.23	0.23	0.58		0.58	0.58
v/c Ratio	0.12	0.81	0.32		0.44	0.13
Control Delay	14.0	12.9	7.8		11.3	7.2
Queue Delay	0.0	0.0	0.0		0.0	0.0
Total Delay	14.0	12.9	7.8		11.3	7.2
LOS	B	B	A		B	A
Approach Delay	13.0		7.8			9.9
Approach LOS	B		A			A
Queue Length 50th (m)	2.8	4.9	8.8		8.4	3.5
Queue Length 95th (m)	7.9	28.1	35.3		37.8	15.8
Internal Link Dist (m)	517.3		1008.4			1050.1
Turn Bay Length (m)	38.0				38.0	
Base Capacity (vph)	796	978	970		563	982
Starvation Cap Reductn	0	0	0		0	0
Spillback Cap Reductn	0	0	0		0	0
Storage Cap Reductn	0	0	0		0	0
Reduced v/c Ratio	0.05	0.61	0.32		0.44	0.13

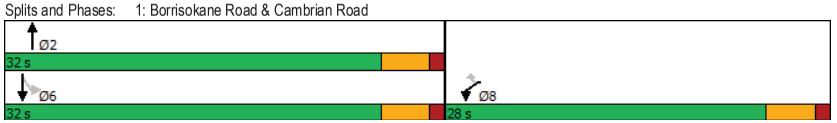
Intersection Summary
Cycle Length: 60
Actuated Cycle Length: 48.3
Natural Cycle: 60
Control Type: Semi Act-Uncoord
Maximum v/c Ratio: 0.81

Timings
1: Borrisokane Road & Cambrian Road

11-07-2018

Intersection Signal Delay: 10.9 — Intersection LOS: B
Intersection Capacity Utilization 64.1% — ICU Level of Service C
Analysis Period (min) 15

Splits and Phases: 1: Borrisokane Road & Cambrian Road



HCM 2010 TWSC
2: Borrisokane Road & Temp Site Access

11-07-2018

Intersection	
Int Delay, s/veh	6.5

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	12	226	80	6	105	65
Future Vol, veh/h	12	226	80	6	105	65
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	100	100	100	100	100	100
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	12	226	80	6	105	65

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	358	83	0	0	86	0
Stage 1	83	-	-	-	-	-
Stage 2	275	-	-	-	-	-
Critical Hdwy	6.42	6.22	-	-	4.12	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	-	-	2.218	-
Pot Cap-1 Maneuver	640	976	-	-	1510	-
Stage 1	940	-	-	-	-	-
Stage 2	771	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	594	976	-	-	1510	-
Mov Cap-2 Maneuver	594	-	-	-	-	-
Stage 1	940	-	-	-	-	-
Stage 2	715	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	10.1	0	4.7
HCM LOS	B		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	SBL	SBT
Capacity (veh/h)	-	-	945	1510	-
HCM Lane V/C Ratio	-	-	0.252	0.07	-
HCM Control Delay (s)	-	-	10.1	7.6	0
HCM Lane LOS	-	-	B	A	A
HCM 95th %tile Q(veh)	-	-	1	0.2	-

Timings
1: Borrisokane Road & Cambrian Road

11-07-2018

Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (vph)	46	380	195	42	584	247
Future Volume (vph)	46	380	195	42	584	247
Satd. Flow (prot)	1621	1450	1665	0	1621	1706
Flt Permitted	0.950				0.611	
Satd. Flow (perm)	1621	1450	1665	0	1042	1706
Satd. Flow (RTOR)		380	28			
Lane Group Flow (vph)	46	380	237	0	584	247
Turn Type	Prot	Perm	NA		Perm	NA
Protected Phases	8		2			6
Permitted Phases		8			6	
Detector Phase	8	8	2		6	6
Switch Phase						
Minimum Initial (s)	5.0	5.0	5.0		5.0	5.0
Minimum Split (s)	22.7	22.7	22.7		22.7	22.7
Total Split (s)	22.7	22.7	47.3		47.3	47.3
Total Split (%)	32.4%	32.4%	67.6%		67.6%	67.6%
Yellow Time (s)	3.5	3.5	3.5		3.5	3.5
All-Red Time (s)	1.2	1.2	1.2		1.2	1.2
Lost Time Adjust (s)	0.0	0.0	0.0		0.0	0.0
Total Lost Time (s)	4.7	4.7	4.7		4.7	4.7
Lead/Lag						
Lead-Lag Optimize?						
Recall Mode	None	None	Max		Max	Max
Act Effct Green (s)	8.7	8.7	42.9		42.9	42.9
Actuated g/C Ratio	0.14	0.14	0.70		0.70	0.70
v/c Ratio	0.20	0.71	0.20		0.80	0.21
Control Delay	24.3	11.3	3.9		19.0	4.3
Queue Delay	0.0	0.0	0.0		0.0	0.0
Total Delay	24.3	11.3	3.9		19.0	4.3
LOS	C	B	A		B	A
Approach Delay	12.7		3.9			14.7
Approach LOS	B		A			B
Queue Length 50th (m)	4.5	0.0	5.2		28.9	6.3
Queue Length 95th (m)	11.8	19.0	18.4		#123.7	21.0
Internal Link Dist (m)	517.3		1024.6			1050.1
Turn Bay Length (m)	38.0				38.0	
Base Capacity (vph)	480	697	1178		732	1199
Starvation Cap Reductn	0	0	0		0	0
Spillback Cap Reductn	0	0	0		0	0
Storage Cap Reductn	0	0	0		0	0
Reduced v/c Ratio	0.10	0.55	0.20		0.80	0.21

Intersection Summary
Cycle Length: 70
Actuated Cycle Length: 61
Natural Cycle: 80
Control Type: Semi Act-Uncoord
Maximum v/c Ratio: 0.80

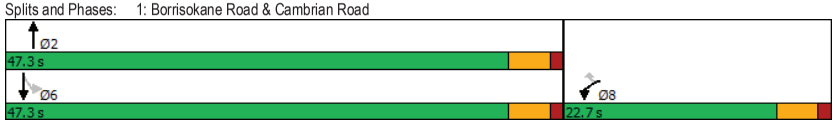
Timings
1: Borrisokane Road & Cambrian Road

11-07-2018

Intersection Signal Delay: 12.4	Intersection LOS: B
Intersection Capacity Utilization 63.6%	ICU Level of Service B
Analysis Period (min) 15	

\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 1: Borrisokane Road & Cambrian Road



HCM 2010 TWSC
2: Borrisokane Road & Temp Site Access

11-07-2018

Intersection	
Int Delay, s/veh	6

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	8	157	80	12	219	74
Future Vol, veh/h	8	157	80	12	219	74
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	100	100	100	100	100	100
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	8	157	80	12	219	74

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	598	86	0	0	92	0
Stage 1	86	-	-	-	-	-
Stage 2	512	-	-	-	-	-
Critical Hdwy	6.42	6.22	-	-	4.12	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	-	-	2.218	-
Pot Cap-1 Maneuver	465	973	-	-	1503	-
Stage 1	937	-	-	-	-	-
Stage 2	602	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	394	973	-	-	1503	-
Mov Cap-2 Maneuver	394	-	-	-	-	-
Stage 1	937	-	-	-	-	-
Stage 2	510	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	9.8	0	5.8
HCM LOS	A		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	SBL	SBT
Capacity (veh/h)	-	-	908	1503	-
HCM Lane V/C Ratio	-	-	0.182	0.146	-
HCM Control Delay (s)	-	-	9.8	7.8	0
HCM Lane LOS	-	-	A	A	A
HCM 95th %tile Q(veh)	-	-	0.7	0.5	-

Appendix K

TAC Signal Warrant

City of Ottawa Canadian Matrix Traffic Signal Warrant Analysis

Main Street (name)	**Borrisokane**	**Direction (EW or NS)**	**NS**	**Road Authority:**	**City of Ottawa**
Side Street (name)	**Cambrian**	**Direction (EW or NS)**	**EW**	**City:**	**Ottawa**
Quadrant / Int #	**1**	**Comments**	**Enter Comments about the analysis here.**	**Analysis Date:**	**2018 Oct 31, Wed**
	CHECK SHEET			**Count Date:**	**2025 Jan 01, Wed**
for Warrant Calculation Results, please hit 'Page Down'				**Date Entry Format:**	(yyyy-mm-dd)

Lane Configuration		Excl LT	Th & LT	Through	Th+RT+LT	Th & RT	Excl RT	UpStream Signal (m)	# of Thru Lanes
Borrisokane	NB					1		1,900	1
Borrisokane	SB		1					2,000	1
Cambrian	WB				1				
Cambrian	EB								

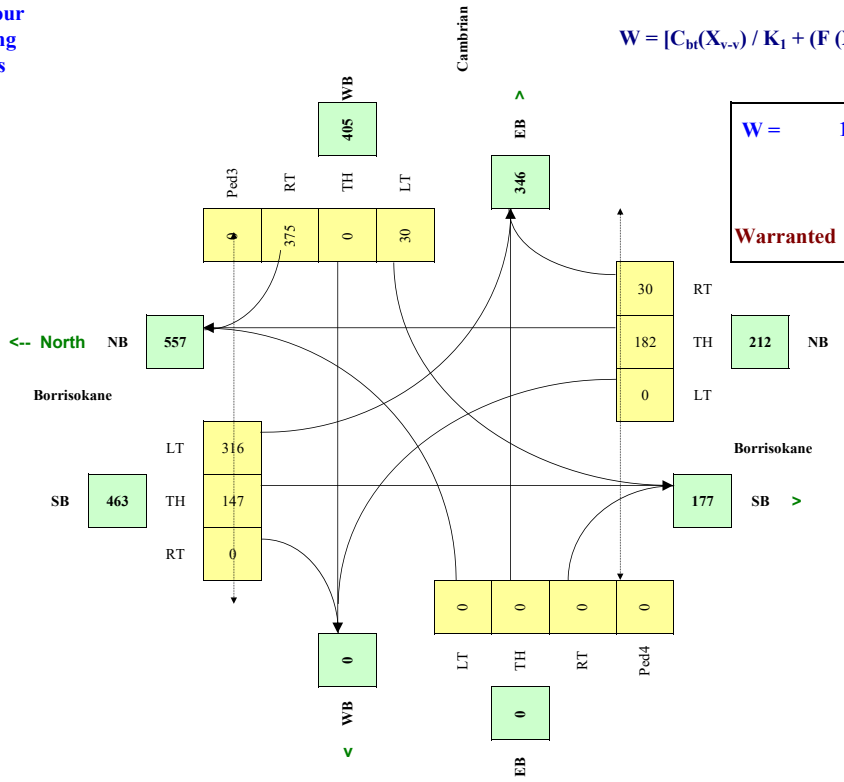
Demographics		
Elem. School/Mobility Impaired	(y/n)	n
Senior's Complex	(y/n)	n
Pathway to School	(y/n)	n
Metro Area Population	(#)	1
Central Business District	(y/n)	n

Other input		Speed (Km/h)	Truck %	Bus Rt (y/n)	Median (m)
Borrisokane	NS	80	2.0%	n	0.0
Cambrian	EW		2.0%	n	

Set Peak Hours

Traffic Input	**NB**			**SB**			**WB**			**EB**			**Ped1**	**Ped2**	**Ped3**	**Ped4**
	LT	**Th**	**RT**	**LT**	**Th**	**RT**	**LT**	**Th**	**RT**	**LT**	**Th**	**RT**	**NS**	**NS**	**EW**	**EW**
press 'Set Peak Hours' Button to set the peak hour periods		227	36	204	105		29		485				0	0	0	0
		262	42	236	121		33		560				0	0	0	0
		159	25	143	73		20		339				0	0	0	0
		85	15	249	111		19		164				0	0	0	0
		175	30	515	229		39		339				0	0	0	0
		186	32	548	243		41		360				0	0	0	0
Total (6-hour peak)	**0**	**1,094**	**180**	**1,895**	**882**	**0**	**181**	**0**	**2,247**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Average (6-hour peak)	**0**	**182**	**30**	**316**	**147**	**0**	**30**	**0**	**375**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

Average 6-hour Peak Turning Movements



$$W = [C_{bt}(X_{v\text{-}v}) / K_1 + (F(X_{v\text{-}p}) L) / K_2] \times C_i$$

W =	**122**	**122**	**0**
		Veh	***Ped***

Warranted

RESET SHEET