Geotechnical Engineering

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Mineral Resource Impact Assessment

Proposed Residential Development
The Meadows - Phase 7 and 8
Greenbank Road - Ottawa

Prepared For

Tamarack (Nepean) Corporation

December 12, 2018

Report PG4242-4 Revision 1

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Table of Contents

Appendix

Appendix 1 DRAWING PG4242-4 - Existing Conditions

Historical Aerial Photographs

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

Appendix 2 Paterson Report PG4242-6 - Environmental Noise Control Study - Stationary Noise Component - Dated December 11, 2018.

IBI Group - Noise Feasibility Report - The Meadows In Half Moon Bay - Phase 5 dated December 2018 dated December, 2017

IBI Group - Transportation Impact Assessment Report - The Meadows Phase 5 - Report No. 115637-3.0 dated April 5, 2018

1.0 Introduction

Paterson Group (Paterson) was commissioned by Tamarack (Nepean) Corporation to conduct a mineral resource impact assessment for Phase 7 and 8 of the proposed residential development at the aforementioned site and is required by Section 3.74 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 resource currently in operation.

Based on Section 2.5 of the Provincial Policy Statement 2014, mineral aggregate resources shall be protected from 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 Phase 7 and 8 of the proposed residential development will consist of townhouses, residential dwellings with attached garages, associated driveways, local roadways and landscaping areas. 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 north and west by treed areas followed by Cambrian Road and Borrisokane Road, respectively. The site is bordered to the east by the remaining phases of the proposed residential development and to the south by a mineral resource extraction operation owned by George W. Drummond Limited, formerly known as the Costello Pit.

4.0 Adjacent Sand and Gravel Pit

4.1 Status, Type and Location of Pit Operation

The sand and gravel pit, also known as the Costello Pit, to the south of the subject site is located at 3713 Borrisokane Road and is owned by George W. Drummond Limited. Details of the pit is 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.

Costello Pit (George W. Drummond Limited)

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

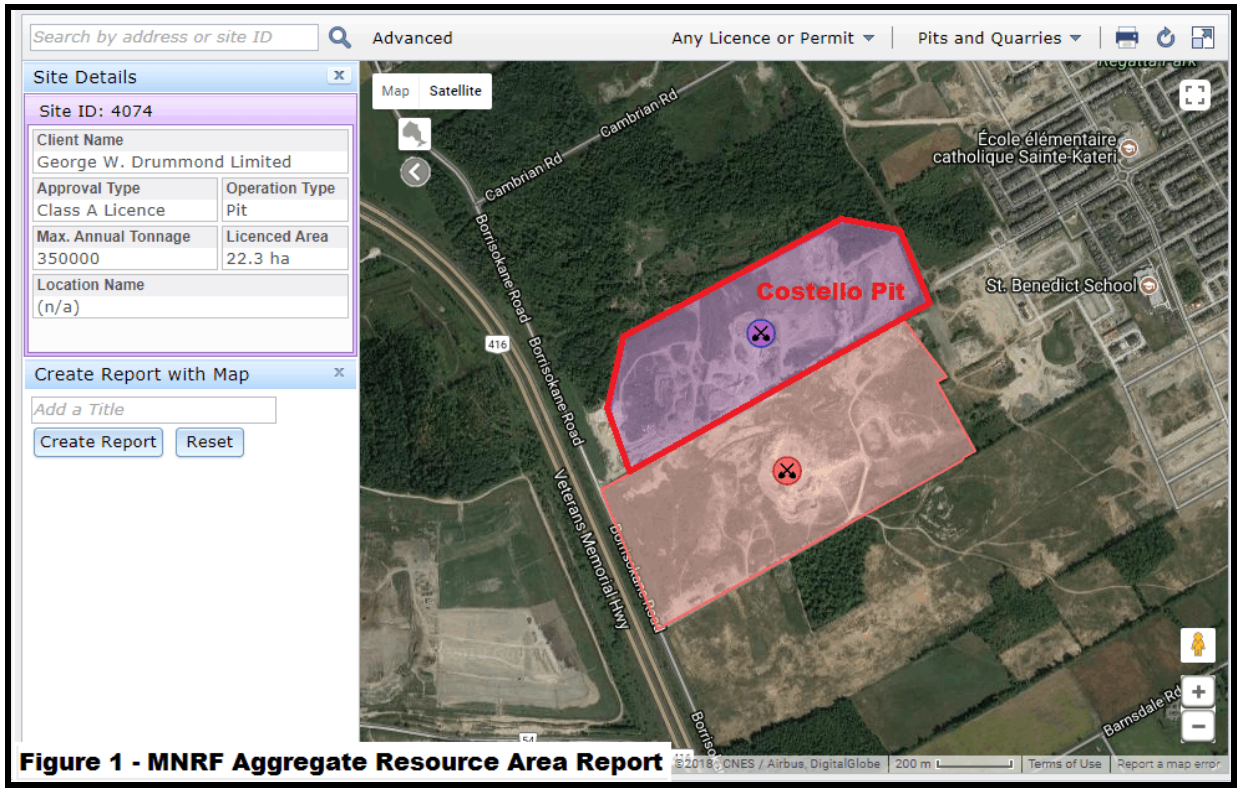

Figure 1 - MNRF Aggregate Resource Area Report

4.2 City of Ottawa Official Plan

The subject site is designated General Urban Area on Schedule B - 'Urban Policy Plan' dated October 2018, of the City's Official Plan. The properties north and east of the subject site are also designated as General Urban Area and to the west is classified as an Urban Area on Schedule A - "Rural Policy Plan', dated October 2018, but is not represented on Schedule B. The property south of the subject site is also designated as a Sand and Gravel Resource Area but have a Developing Community Expansion Area overlay applied. See Figures 2 below for the extract of the City's Official Plan - Schedule A and Schedule B.

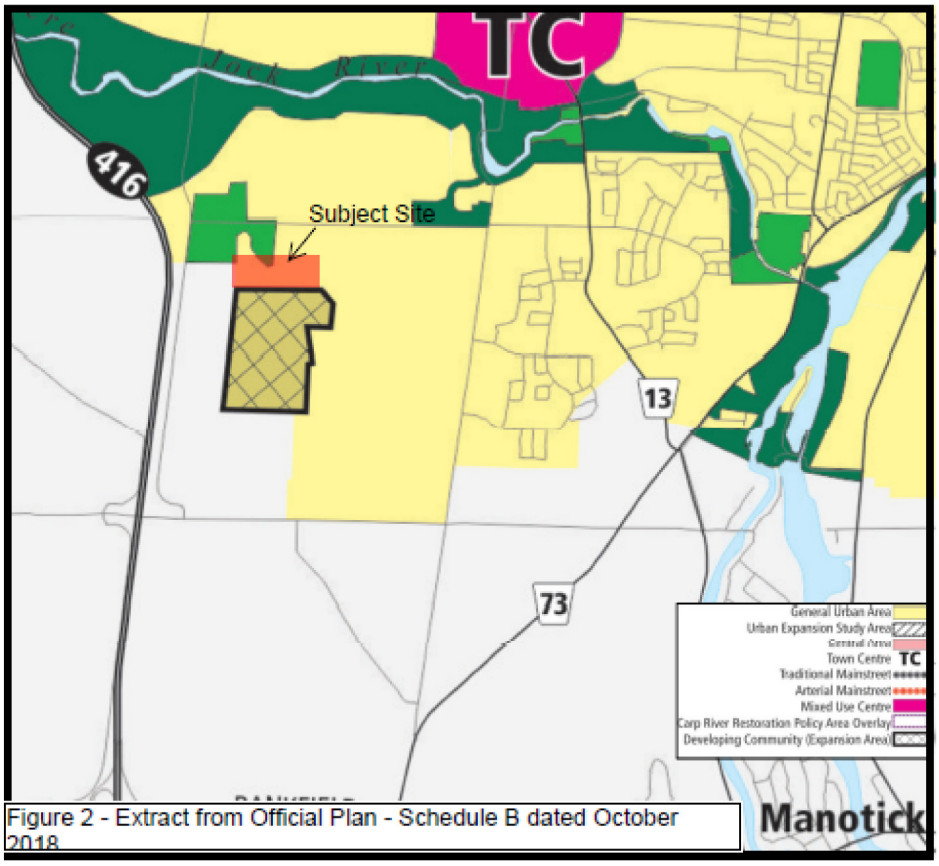

Figure 2 - Extract from Official Plan - Schedule B dated October 2018

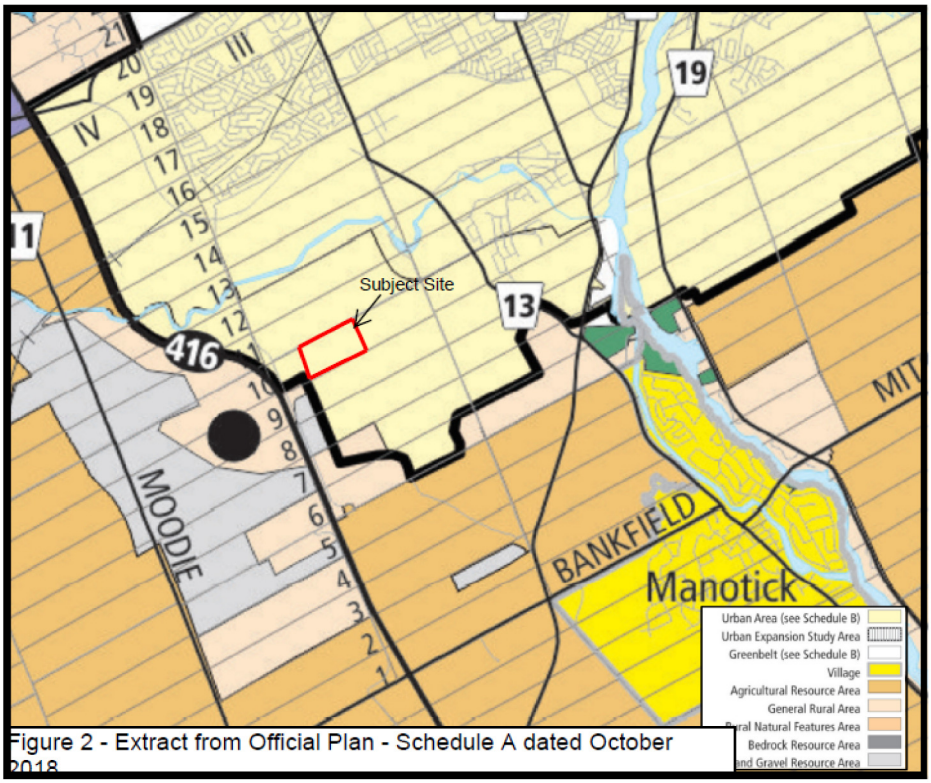

Figure 2 - Extract from Official Plan - Schedule A dated October 2018

Given the subject sites proximity to a designated Sand and Gravel Resource Area on Schedule A of the City's Official Plan (on the southwest corner), 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 southwest of the subject site is currently being developed as an open pit. For the purpose of this report, it is understood that the future development of the sand and gravel pit will be on the basis of a licence for a pit to extract resources to an elevation below the water table (Category 1 Licence - Class "A" pit below water).

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 south border of the proposed residential development. It is understood that the 15 m setback will be applied on the adjacent owner’s land.

5.0 Compatibility and Mitigation Analysis

Based on recent discussions with the Owner of the Costello Pit, it is understood that the aggregate resource located at 3713 Borrisokane Road and adjacent to the south property boundary of the proposed residential development is currently in operation and is expected to continue for approximately 2 years. It should be noted that the Official Plan has been updated to indicate that the property directly to the south is no longer classified as a sand and gravel resource area.

5.1 Noise

A Noise Feasibility Report - The Meadows in Half Moon Bay - Phase 5 dated December 2018 was prepared for this project by IBI Group and is located in Appendix 2.

Additionally, an Environmental Noise Control Study - Stationary Noise Component - Proposed Residential Development - The Meadows - Phases 7 and 8 - Greenbank Road - Ottawa dated December 10, 2108 was prepared for this project by Paterson and is located in Appendix 2.

Costello Pit, an aggregate resource pit (sand and gravel) is identified along the southern property line of Phase 7 and Phase 8 of the proposed residential development and is identified as a stationary noise source. With respect to the Environmental Noise Control Guidelines issued by the City of Ottawa in January 2016, the stationary noise source is to be analysed up to 300 m from the source. This 300 m radius encompasses all of Phase 7 and 8.

Due to the proximity to the Costello Pit, the following warning clause is required on all dwellings within 300 m of the Costello Pit, while the pit is operation. Once the Costello Pit ceases all extraction, the following warning clause is no longer required.

> “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."

A general analysis of a stationary noise source is outlined in the City of Ottawa document Environmental Noise Control Guidelines. Therefore, the analysis for stationary noise is divided into both the daytime and nighttime limits. While the Costello Pit may legally operate overnight, it is assumed that the aggregate resource pit will not be operational in the evening, so the analysis should focus on the daytime limits.

The analysis is also divided into reception points on the pane of window (for an analysis of the interior noise) and the outdoor living areas. It is assumed that if the stationary noise exceeds the limitations at the pane of window, that the building materials will be used in order to ensure adequate soundproofing of the proposed units.

Results of the analysis indicate that noise mitigation measures will be required to protect outdoor living areas if the dwellings are to be occupied while the Costello Pit is in operation. The analysis was divided into Phase 7 and Phase 8, with individual noise mitigation measured provided for each Phase, depending on if the Costello Pit is still in operation.

The mineral extraction at the Costello Pit is understood to be terminated with the next 2 years. Therefore, all mitigation measures provided soley for the stationary noise review are considered to be temporary and only applicable while the pit is in operation.

Several outdoor private spaces will require noise mitigation measures. Three (3) noise barriers are proposed in Phase 7, and a combination of a noise wall and a soil berm are proposed within Phase 8. The berm is intended to be temporary, as once the Costello Pit is closed, dwellings will be constructed where the berm was placed. However, the sound barriers are intended to be permanent, but only to be constructed if the Costello Pit is still in operation. If the Costello Pit is no longer operational when the dwellings are to be occupied, the noise mitigation measures provided for the stationary noise are no longer required. Specific details of the proposed noise mitigation measures are as follows:

Phase 7 - Mitigation Measures (If Required)

It is recommended that a 2.2 m high sound barrier, such as a residential sound wall, be constructed along the southern property lines of Lot 1, 28, 29, 48, and Block 132.

While there are exceedances within the rear yards, standard construction building materials are anticipated to be sufficient. However, Lots 1, 2, 47, 48, 29, 30, 27, 28 and Block 132 should have a provision to include the use of a central air conditioner, to ensure that windows will not need to be opened.

Phase 8 - Mitigation Measures (If Required)

A 3.5 m high soil berm is proposed to cross the Blocks 163 through 171, in order to provide noise mitigation to the remainder of Phase 8. In addition, a 2.2 m high sound barrier is to be constructed along the side yard of Lot 76 and across the rear yards of Lots 76-82.

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, while Phase 7 and Phase 8 of the proposed residential development will be accessed primarily from the proposed Greenbank Road realignment and the proposed Street 2 (intersecting with Cambrian Road). It should be noted that the proposed development is not anticipating to have any frontage along Borrisokane Road. As such, the additional traffic generated by the proposed development will not preclude or hinder future pit operations, nor will truck traffic generated by the pit operation interfere with the proposed development. Therefore, no potential compatibility impacts are anticipated between the proposed residential development and the current and future operation of the Costello Pit.

A transportation Impact Assessment was prepared by IBI Group in April 2018 for the proposed residential development. Refer to IBI Group Report 115637-3.0 - Transportation Impact Assessment (TIA) Report in Appendix 2 for additional details regarding the traffic assessment of the proposed development.

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 recent discussions with the Owner of the sand and gravel pit, excavation work below the groundwater table was completed in select areas of the deposit and may continue in the future. Based on the Operation Plan of the Costello Pit attached to the current report, it is undertstood 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 consists of dredging techniques. Due to dredging techniques implemented at the sand and gravel pit, the operation will not adversely impact the groundwater levels within the proposed residential development.

5.6 Proposed Park

It is understood that a park is proposed to be constructed within Phase 8. It is further understood that construction for Phase 8 will not occur prior to the completion of Phase 7. This construction timeline, combined with the understanding that the Costello Pit should cease its mineral extraction within the next two years, indicates that there may be a very short amount of time where both the Costello Pit and the Park will be operation at the same time. Additionally, it is possible that the Costello Pit may cease operations prior to the construction of the Park, thereby removing the stationary noise source.

An analysis of the stationary noise within the park was completed within Paterson Report PG4242-1 dated December 11, 2012. At that time, it was determined that the noise level within the park will be 54.4 dBA. This is an exceedance above the 50 dBA that is recommended. If the Costello Pit is still in operation while the Park is being constructed, it is recommended that vegetation, such as trees and bushes, be located along the western and southern perimeter of the park to mitigate any noise exceedances.

5.7 Proposed School

It is understood that a portion of the development is set aside for the development of a school (by others). At the time of issuing this report, it is unknown if a school will be located on this lot, or a timeline as to when it will be constructed. However, the school block is within the 30 m setback from the Costello Pit, and therefore can not be constructed until after the Costello Pit has ceased operations. Therefore, there will be no noise from the aggregate pit to interact with the proposed school.

5.8 Slope Stability in Proximity to the Existing Costello Pit

There is a 15 m setback from the extraction of minerals from the aggregate pit. Additionally, there is a 30 m setback for the development while the aggregate pit is in operation. Therefore, the closest that the proposed residential dwellings can be to the extraction area is 45 m. This setback from the top of the slope, provided that the extraction area is completed with a stable 1H:1V slope, will not impact the proposed development.

6.0 Conclusions

Based on the technical studies relating to noise and traffic 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. Similarly, the operation of the aggregate resource pit will not negatively impact the proposed residential development.

All properties within 300 m of the aggregate resource pit will be required to have the following warning clause: "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."

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 Tamarack (Nepean) Corporation, 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:

- ❑ Tamarack (Nepean) Corporation (3 copies)
- ❑ Paterson Group (1 copy)

APPENDIX 1

DRAWING PG4242-4 - Existing Conditions

Historical Aerial Photographs

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

APPENDIX 2

Paterson Report PG4242-6 - Environmental Noise Control Study - Stationary Noise Component - Dated December 11, 2018.

IBI Group - Noise Feasibility Report - The Meadows In Half Moon Bay - Phase 5 dated December 2018 dated December, 2017

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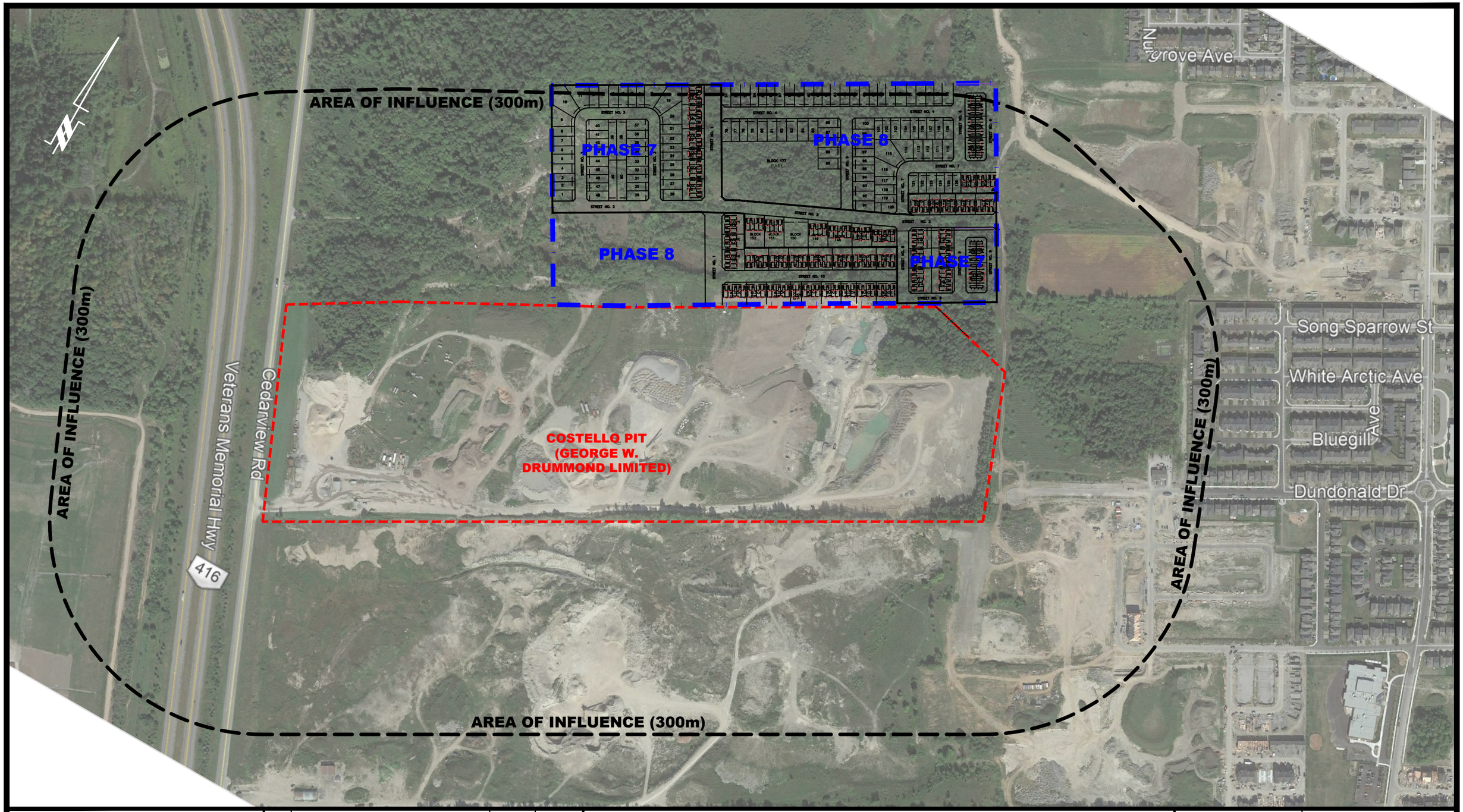

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NO.	REVISIONS	DATE	INITIAL
0			

TAMARACK (NEPEAN) CORPORATION
MINERAL RESOURCE IMPACT ASSESSMENT
PROPOSED RESIDENTIAL DEVELOPMENT - PHASES 7 AND 8
THE MEADOWS - BORRISOKANE ROAD
OTTAWA, ONTARIO

Title:

EXISTING CONDITIONS

Scale: 1:4000	Date: 02/2018
Drawn by: RCG	Report No.: PG4242-REP-4
Checked by: NZ	Dwg. No.: PG4242-4
Approved by: DJG	Revision No.: 0

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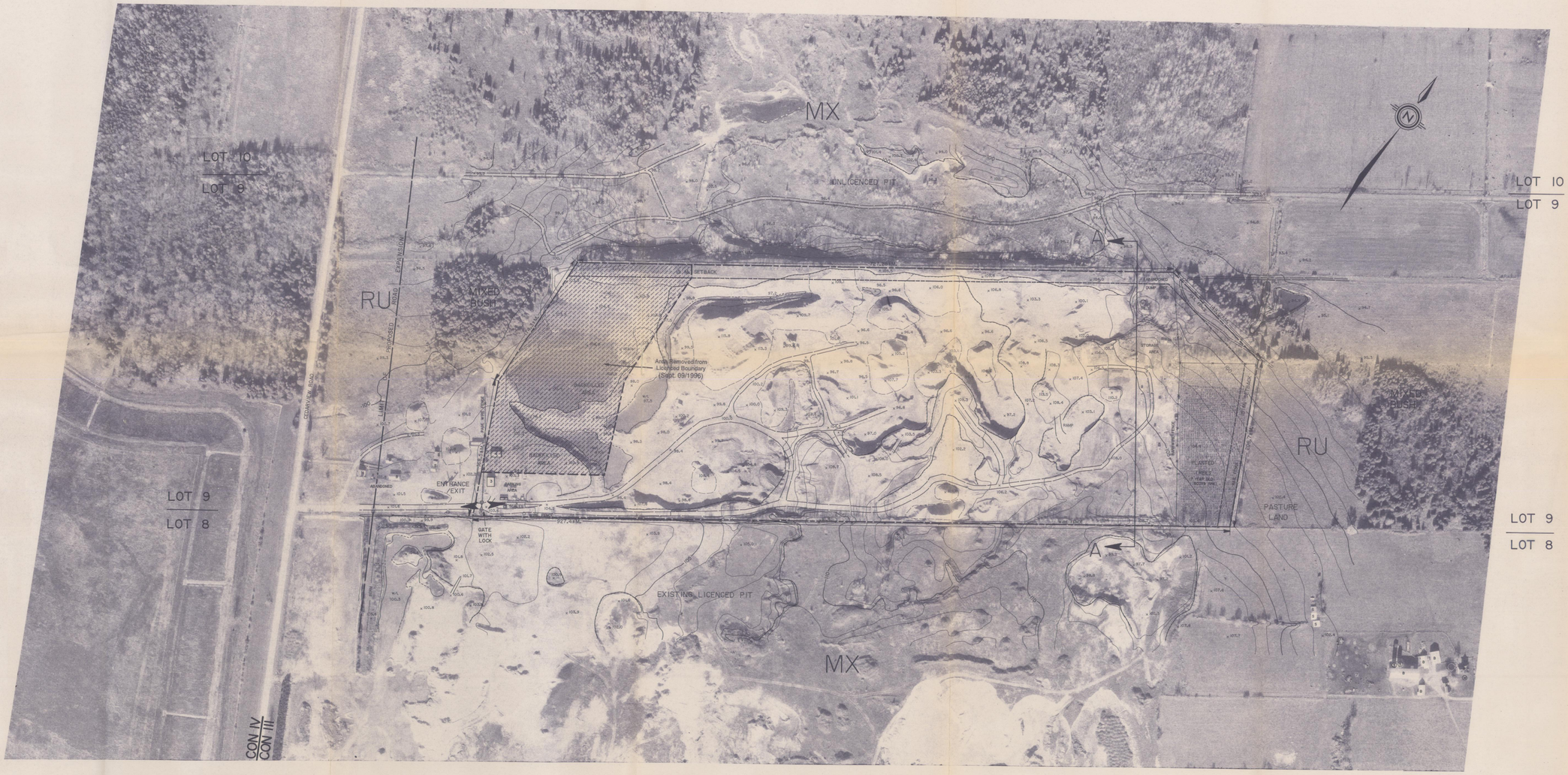


EXISTING FEATURES

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.

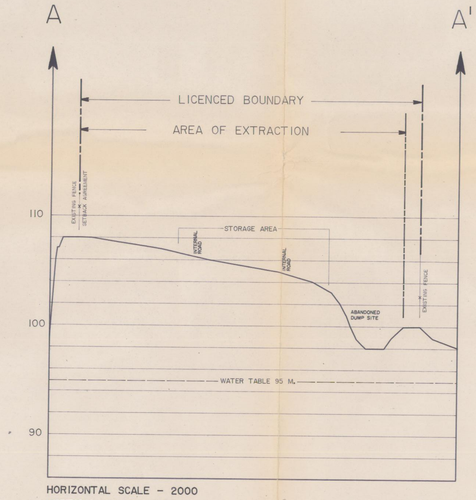
Fencing is not required along the north boundary. Fencing and setback is not required along the south boundary as there exists a boundary agreement between Brazeau and George W. Drummond Ltd., owners of the two properties in concern.

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

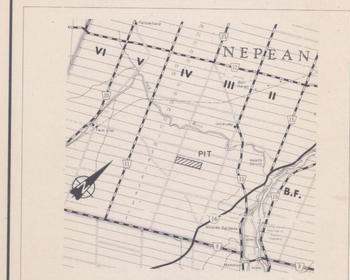
	Classification	Area (m²)
1.	Weigh Scale Office	12.8
2.	Office Trailer	25.0
3.	Storage Garage	109.6
4.	Barn	98.6



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

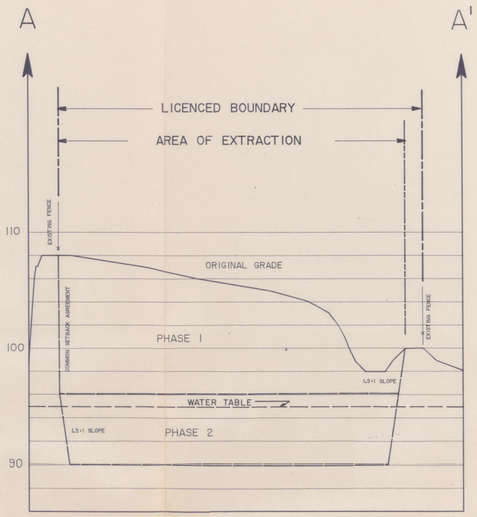
PAGE 1 of 2 | CONTRACT C 419 - 90

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

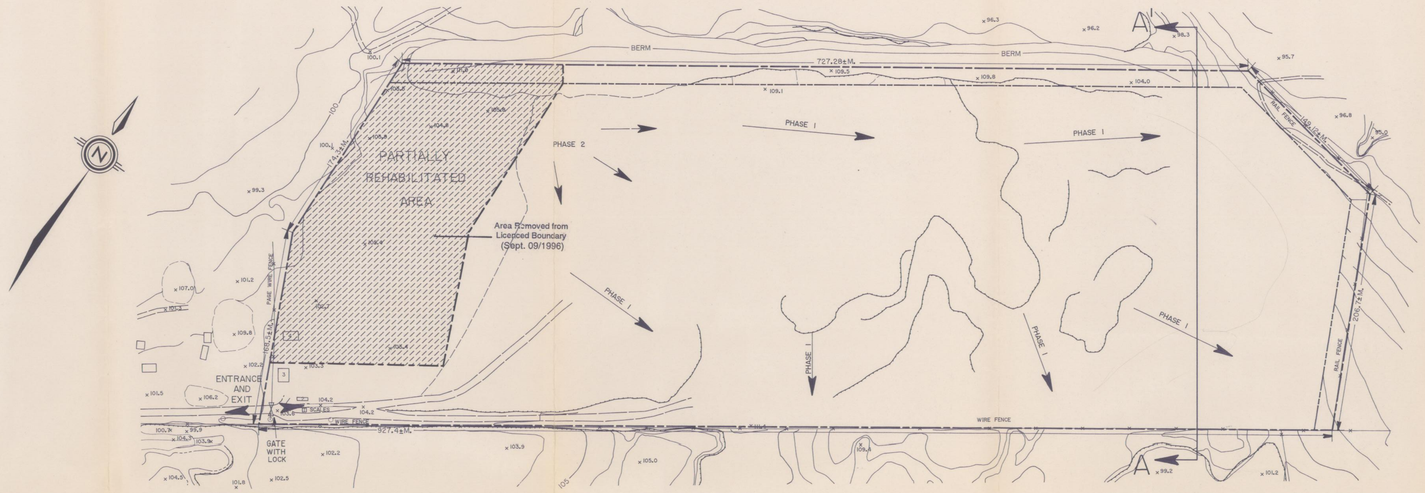
D. Lebrash
SEP 10 1996

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.

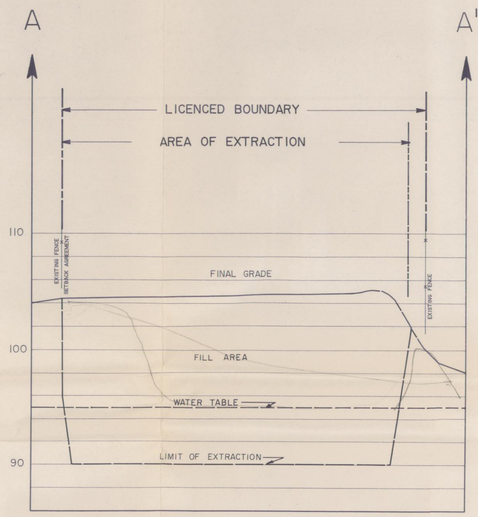
Phase 2 will begin mining operation upon completion of Phase 1. Mining will be below the water table. Extraction of the material will be by dragline methods. No pumping or letting of water will be needed. Final operation depth will be approximately 90 metres.

Amendment – April 29/99

Import topsoil to process for resale.

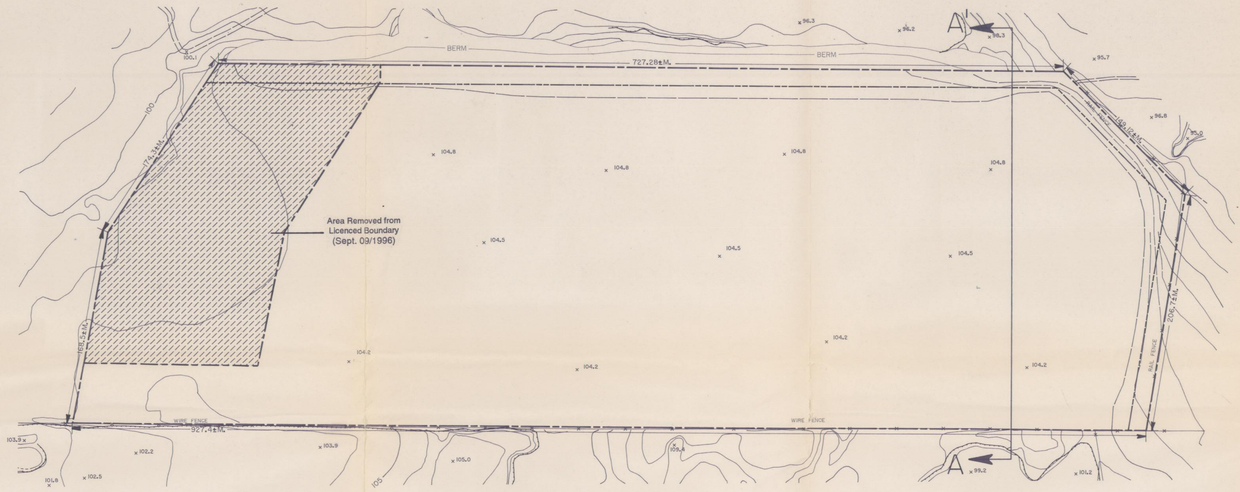
To allow Phases 1 & 2 to operate concurrently and simultaneous in various locations due to the differently quality of material throughout the site and also the high concentration of clay ridges.

PROGRESSIVE REHABILITATION AND FINAL REHABILITATION PLAN



HORIZONTAL SCALE - 2000

VERTICAL SCALE - 200



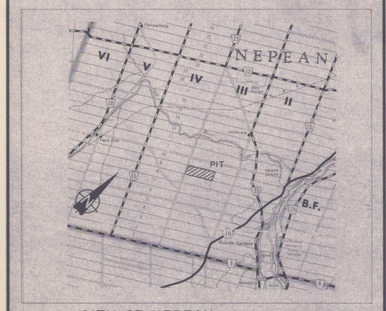
REHABILITATION

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

	Revision Values as of Sept. 09/1996
1. LICENCED AREA 27.5± HECTARES.	23.5 ± ha
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.
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.

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.
- 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	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

Paterson Report PG4242-6 - Environmental Noise Control Study - Stationary Noise Component - Dated December 11, 2018.

IBI Group - Noise Feasibility Report - The Meadows In Half Moon Bay - Phase 5 dated December 2018 dated December, 2017

IBI Group - Transportation Impact Assessment Report - The Meadows Phase 5 - Report No. 115637-3.0 dated April 5, 2018

Geotechnical Engineering

Environmental Engineering

Hydrogeology

Geological Engineering

Materials Testing

Building Science

Archaeological Services

patersongroup

Environmental Noise Control Study - Stationary Noise Component

Proposed Residential Development
The Meadows - Phases 7 and 8
Greenbank Road - Ottawa

Prepared For

Tamarack (Nepean) Corporation

December 11, 2018

Report: PG4242-5

Paterson Group Inc.
Consulting Engineers
154 Colonnade Road South
Ottawa (Nepean), Ontario
Canada K2E 7J5

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Fax: (613) 226-6344
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Table of Contents Page

Appendices

1.0 Introduction

Paterson Group (Paterson) was commissioned by Tamarack (Nepean) Corporation to conduct a Stationary Noise Review to supplement the Noise Feasibility study prepared by IBI Group for Phases 7 and 8 of the proposed The Meadows development to be located at Greenbank Road, in the City of Ottawa. A Report entitled Noise Feasibility Report - The Meadows In Half Moon Bay - Phase 5 dated December 2018 prepared by IBI Group for the subject site. The report prepared by IBI Group 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, however, there will be no outdoor living areas associated with the stacked townhouse blocks. Local roadways and landscaped areas are also anticipated.

It is further understood that The Meadows will be constructed in phases, with Phase 7 being completed prior to Phase 8. Therefore, the analysis has been subdivided per phase. It is further understood that the Costello Pit may cease all operations prior to the construction of Phase 7 or Phase 8. If this is the situation, then the stationary noise source would have been eliminated and all noise attenuation recommendations for Phase 7 and Phase 8 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 3 and Figure 6 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.

Upon review of the proposed phasing plan, it is understood that there will be some stacked townhouses on the eastern portion of the development, both in Phase 7 and Phase 8 that will not include any outdoor living areas. A reception point was included in this proximity in order to determine the levels at the pane of glass. Otherwise, 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.

Upon review of the surface transportation noise study, it is understood that a 2.2 m or a 2.5 m high sound barrier placed along the proposed Greenbank Road realignment and behind a portion of Block 51. These sound barriers have been included in the analysis.

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. Ten (10) reception points were selected within the 300 m proximity radius in both Phase 7 and Phase 8 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 southernmost houses within Phase 8 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 Phase 7 or Phase 8. Therefore, if the Costello Pit is no longer in operation, all recommendations provided in this report are no longer valid and should be disregarded.

Phase 7

An analysis was completed for Phase 7, taking into consideration the lot layouts and approximate dwelling alignment. An initial analysis of Phase 7 was performed with no sound mitigation measures. This analysis resulted in a maximum value of 63.5 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 receptor	Phase 7 includes lots that are the furthest from the existing Costello Pit noise sources
Orientation of buildings to provide quiet zones in rear yards, interior spaces and amenity areas	side walls and rear yards are exposed to the stationary noise source.
construction techniques, enhanced construction quality	Exceedances for outdoor living areas - standard construction techniques are considered acceptable for the proposed dwellings.
earth berms	not proposed
acoustic barriers	proposed to protect the back yards of the proposed residential buildings.

If the residences are to be constructed within Phase 7 while the aggregate pit is in operation, it is recommended that a 2.2 m high sound barrier, such as a residential sound wall, be constructed along the southern property lines of Lot 1, 28, 29, 48, and Block 132. 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. This sound barrier will limit all noise in the outdoor living areas to a maximum value of 58 dBA at reception point 1-2 (back yard for Lot 48) and 58.7 dBA at receptor point 1-10 (back yard to Lot 27). This is considered acceptable with the understanding that the Costello Pit will be a temporary noise source.

While there are exceedances within the rear yards, standard construction building materials are anticipated to be sufficient. However, Lots 1, 2, 47, 48, 29, 30, 27, 28 and Block 132 should have a provision to include the use of a central air conditioner, to ensure that windows will not need to be opened.

Phase 8

An analysis was completed for Phase 8, taking into consideration the lot layouts and approximate dwelling alignment. An initial analysis of Phase 8 was performed with no sound mitigation measures. This analysis resulted in a maximum value of 61.4 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 4 - 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	no 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 3.5 m high earth berm is proposed along Block 163 through Block 171, adjacent to the Costello Pit
acoustic barriers	proposed to protect the back yards of the proposed residential buildings at Lots 76 through 82.

It is understood that there is a 30 m development setback from the southern property line, that will include Blocks 163 through 171. Once the Costello Pit ceases mineral extraction operations, those blocks can be constructed.

A 3.5 m high soil berm is proposed to cross the Blocks 163 through 171, in order to provide noise mitigation to the remainder of Phase 8. In addition, a 2.2 m high sound barrier is to be constructed along the side yard of Lot 76 and across the rear yards of Lots 76-82. 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 57.7 dBA will still be encountered at reception point 1-1, at the rear of Block 154. 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 Phase 7 and 8 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 either Phase 7 or Phase 8. Therefore, noise mitigation measures for the stationary noise source have been recommended with respect to the individual Phase. 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 Phase 7, it is recommended that a 2.2 m high sound barrier be constructed along the rear of Lots 1 and 2, and along the side lots of Lot 28, 27 and 48 in addition to Block 132. Additionally, Lots 1, 2, 47, 48, 29, 30, 27, 28 and Block 132 should have a provision to include the use of a central air conditioner, to ensure that windows will not need to be opened.

If the Costello Pit is in operation for the construction of Phase 8, it is understood that there will be a hold on Blocks 163-171, and a 3.5 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 side of Lot 76 and along the Rear of Lots 76-82.

Due to the proximity of the Costello Pit, a Warning Clause should be on the deed of sale of the units within Phase 7 and Phase 8. 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 Tamarack (Nepean) Corporation 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:

- ❑ Tamarack (Nepean) Corporation (3 copies)
- ❑ Paterson Group (1 copy)

APPENDIX 1

FIGURE 1 - PHASE 7 ONLY WITH NO NOISE BARRIER (TABLE OF RESULT)

FIGURE 2 - PHASE 7 ONLY WITH NOISE MITIGATION MEASURES (TABLE OF RESULT)

FIGURE 3 - MODEL OF PHASE 7

FIGURE 4 - PHASE 8 ONLY WITH NO NOISE BARRIER (TABLE OF RESULT)

FIGURE 5 - PHASE 8 ONLY WITH NOISE MITIGATION MEASURES (TABLE OF RESULT)

FIGURE 6 - MODEL OF PHASE 8

ITEM PROPERTIES

Report: Table of Results
Model: Phase 7 only
LAeq: total results for receivers
Group: (main group)
Group Reduction: No

Name Receiver	Description	Height	Day	Evening	Night	Lden
REC 1-1_A		1.50	60.1	60.1	60.1	66.5
REC 1-10_A		1.50	60.1	60.1	60.1	66.5
REC 1-2_A		1.50	63.0	63.0	63.0	69.4
REC 1-3_A		1.50	62.5	62.5	62.5	68.9
REC 1-4_A		1.50	63.5	63.5	63.5	69.9
REC 1-5_A		1.50	50.1	50.1	50.1	56.5
REC 1-6_A		1.50	52.7	52.7	52.7	59.1
REC 1-7_A		1.50	55.7	55.7	55.7	62.1
REC 1-8_A		1.50	62.3	62.3	62.3	68.7
REC 1-9_A		1.50	59.3	59.3	59.3	65.7

All shown dB values are A-weighted

Report: Table of Results
Model: - Phase 7 only
LAeq: total results for receivers
Group: (main group)
Group Reduction: No

Name Receiver	Description	Height	Day	Night
REC 1-1_A		1.50	56.4	56.4
REC 1-10_A		1.50	58.7	58.7
REC 1-2_A		1.50	58.0	58.0
REC 1-3_A		1.50	57.5	57.5
REC 1-4_A		1.50	58.3	58.3
REC 1-5_A		1.50	50.1	50.1
REC 1-6_A		1.50	52.7	52.7
REC 1-7_A		1.50	55.6	55.6
REC 1-8_A		1.50	57.5	57.5
REC 1-9_A		1.50	55.7	55.7

All shown dB values are A-weighted

Figure 3 - Model of Phase 7

Industrial noise - LimA - ISO 9613.1/2, [version of Drummond Pit - - Phase 7 only] , Predictor V12.01

Phase 7 only

Paterson Group - Canada

Report: Table of Results
Model: - Phase 8
LAeq: total results for receivers
Group: (main group)
Group Reduction: No

Name Receiver	Description	Height	Day	Night
REC 1-1_A		1.50	61.4	61.4
REC 1-10_A		1.50	48.6	48.6
REC 1-2_A		1.50	51.4	51.4
REC 1-3_A		1.50	53.8	53.8
REC 1-4_A		1.50	51.2	51.2
REC 1-5_A		1.50	50.8	50.8
REC 1-6_A		1.50	53.6	53.6
REC 1-7_A		1.50	57.5	57.5
REC 1-8_A		1.50	44.9	44.9
REC 1-9_A		1.50	41.4	41.4

All shown dB values are A-weighted

Report: Table of Results
Model: - Phase 8
LAeq: total results for receivers
Group: (main group)
Group Reduction: No

Name Receiver	Description	Height	Day	Night
Park_A		1.50	54.4	54.4
REC 1-1_A		1.50	57.7	57.7
REC 1-10_A		1.50	48.5	48.5
REC 1-2_A		1.50	50.3	50.3
REC 1-3_A		1.50	54.3	54.3
REC 1-4_A		1.50	51.0	51.0
REC 1-5_A		1.50	50.8	50.8
REC 1-6_A		1.50	53.7	53.7
REC 1-7_A		1.50	53.2	53.2
REC 1-8_A		1.50	44.7	44.7
REC 1-9_A		1.50	41.4	41.4

All shown dB values are A-weighted

Figure 6 - Model of Phase 8

Paterson Group - PG4242

Industrial noise - LimA - ISO 9613.1/2, [version of Drummond Pit - - Phase 8] , Predictor V12.01

Model: Copy of initial model
version of Drummond Pit - Drummond 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

REPORT
PROJECT: 115496-5.2.2

NOISE FEASIBILITY REPORT
THE MEADOWS IN HALF MOON BAY
PHASE 5

Prepared for TAMARACK HOMES
by IBI GROUP

UPDATED: DECEMBER 2018

Table of Contents

List of Figures

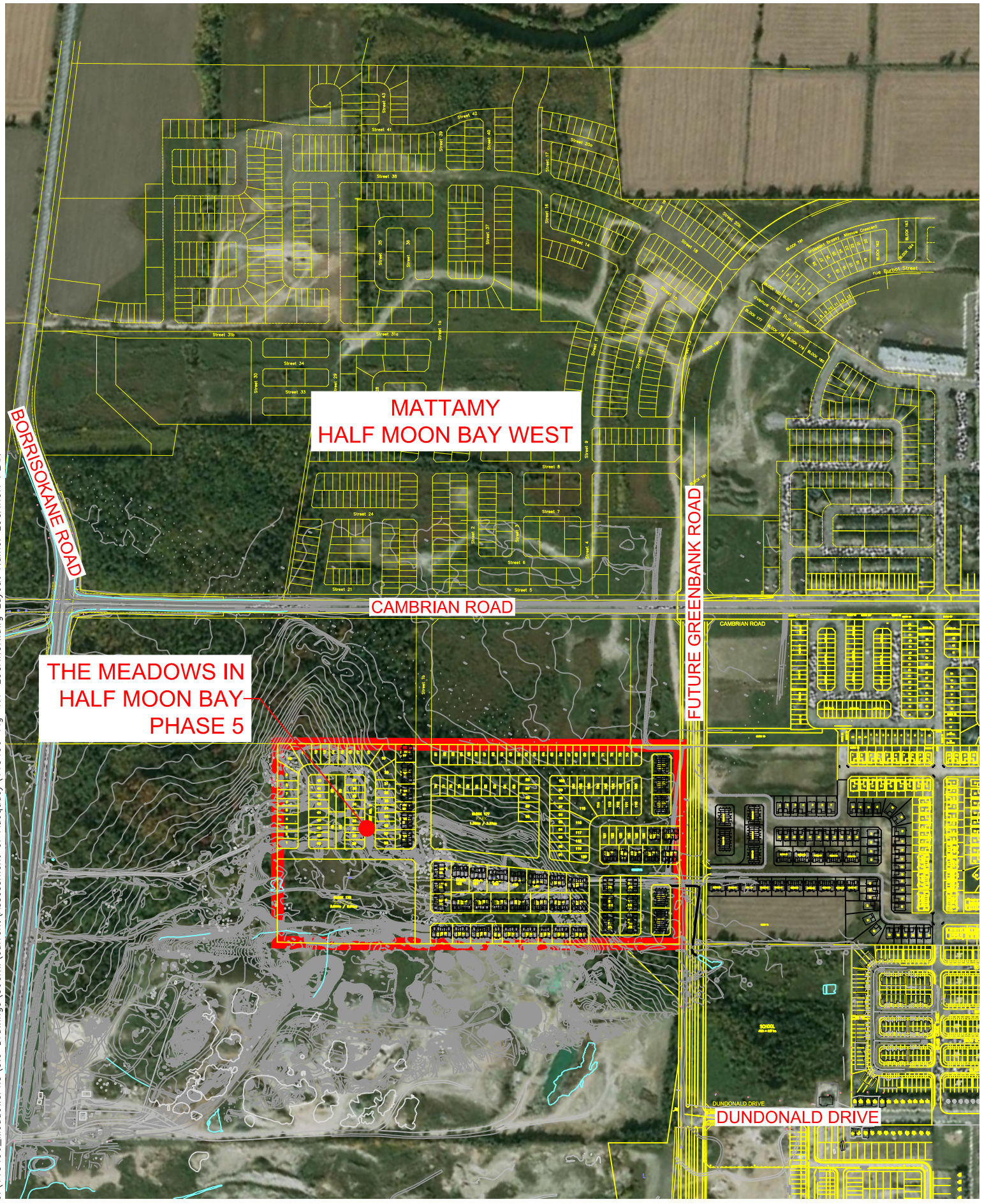
1 INTRODUCTION

This report has been prepared to determine the impact of roadway traffic noise and potential stationary noise on the residential lands of the Meadows in Half Moon Bay Phase 5 developed by Tamarack Homes. The report identifies potential noise levels in the development and any potential required noise control measures.

1.1 Subject Property

The subject property is located in the Barrhaven South Community in the City of Ottawa as shown on the Location Plan **Figure 1.1**. The site is located west of Phase 4 of the Meadows and future Greenbank Road and is surrounded by undeveloped land on the north and west boundaries. An existing aggregate extraction pit is located along the south boundary of the site.

The residential site consists of a mixed single family lots, street townhouse units, back to back townhouse units and semi-detached units. A park is and a school block is located in the site.



J:\115496_MeadowsPh5\5.9 Drawings\59civil\current\Assessment of Adequacy\115496-Fig-1.1-LOCATION.dwg Layout Name: LOCATION PLAN

IBI

Project Title

THE MEADOWS IN
HALF MOON BAY
PHASE 5

Drawing Title

SITE LOCATION

Sheet No.

FIG. 1.1

2 BACKGROUND

2.1 Noise Sources

The study area is subject to traffic noise from future Greenbank Road and from the internal collector road Street No.1. The nearest major roadway in this area is the extension of Cambrian Road which is located approximately 240 meters north of the site and will not be included in this noise analysis. As stated in Section 1.1, there is an existing aggregate (sand and gravel) extraction pit along the south boundary which is identified as a stationary source of noise.

Aircraft noise from the Ottawa International Airport and rail noise is not a factor as the airport and rail lines are not in close proximity to the study areas.

2.2 Sound Level Limits for Road Traffic

Sound level criteria for road traffic is taken from the City of Ottawa Environmental Noise Control Guidelines hereafter referred to as the guidelines and from the Ministry of the Environment Environmental Noise Guideline Publication NPC-300. Noise levels are expressed in the form Leq (T) which refers to a weighted level of a steady sound carrying the same total energy in the time period T (in hours) as the observed fluctuation sound.

2.2.1 Outdoor sound level criterion

As per Table 2.2a of the guidelines the sound level criteria for the outdoor living area (OLA) for the daytime period between 07:00 and 23:00 hours is 55 dBA Leq (16). Sound levels for the OLA are calculated 3 metres from the building face at the centre of the unit or within the center of the OLA at a height of 1.5 meters above the ground.

If the Leq sound level is less than or equal to the above criteria then no further action is required by the developer. If the sound level exceeds the criteria by less than 5 dBA then the developer may, with City approval, either provide a warning clause to prospective purchasers or install physical attenuation. For sound levels greater than 5 dBA above the criteria control measures are required to reduce the noise levels as close to 55 dBA as technically, economically and administratively possible. Should the sound levels with the barrier in place exceed 55 dBA a warning clause is also required.

2.2.2 Indoor sound level criterion – ventilation and warning clause requirements

Similar to outdoor noise levels, the recommended indoor sound, the sound level criteria from Table 2.2b of the guidelines are:

- Bedrooms – 23:00 to 07:00 – 40 dBA Leq (8)
- Other areas – 07:00 to 23:00 – 45 dBA Leq (16)

The sound levels are based on the windows and doors to an indoor space being closed.

For the purpose of assessing indoor sound levels, the outdoor sound levels are observed at the plane of the living room window at 2.5 meters above the ground for daytime noise and at the plane of the bedroom window 4.5 meters above the ground for nighttime noise.

As per NPC-300 C7.1.2.1 and C7.1.2.2 when the outdoor noise levels at the living room are greater than 55 dBA and less than or equal to 65 dBA and/or greater than 50 dBA and less than or equal to 60 dBA at the bedroom window then a warning clause is required and forced air heating with provision for central air conditioning is required.

Should the outdoor noise levels exceed 65 dBA at the living room and/or exceed 60 dBA at the bedroom then central air conditioning is mandatory and a warning clause is required.

2.2.3 Indoor Sound Level Criterion – Building Components

As per NPC-300 C7.1.3 when the outdoor sound levels are less than or equal to 65 dBA at the living room window and/or less than or equal to 60 dBA at the bedroom level then the building must be compliant with the Ontario Building Code. Should the outdoor sound levels exceed this criteria then the building component (walls, windows etc.) must be designed to achieve indoor sound level criteria.

2.3 Stationary Noise

The proposed residential development is located in an existing suburban area of the City of Ottawa and would likely be classified as a Class 2 area as defined in Table 3.0 of the guidelines. A Class 2 area has sound characteristics of a major population center in the daytime and of a rural area in the evening and nighttime.

Sound level limits for new noise sensitive land uses in proximity to existing stationary noise sources for steady and varying sound is outlined in Table 3.2a of the guidelines and summarized as follows:

- Plane of Window - Daytime (07:00 - 19:00) 50 dBA Leq(1)
  - Evening (19:00 – 23:00) 50 dBA Leq(1)
  - Night (23:00 – 07:00) 45 dBA Leq(1)
- Outdoor Living Area - Daytime (07:00 – 19:00) 50 dBA Leq(1)
  - Evening (19:00 – 23:00) 45 dBA Leq(1)

3 ROADWAY NOISE

3.1 Road Traffic Data

The major source of road noise impacting the study area is the traffic moving along future Greenbank Road and Street No.1b.

Future Greenbank Road will be a four lane divided arterial roadway with a posted speed limit of 60 km/hr through the urban area. The future Greenbank Road has Bus Rapid Transit (BRT) lanes in the center median. The City of Ottawa has provided a volume of 270 buses per day, a daytime/nighttime split of 74%/26% and a speed limit of 80 km/hr reduced to 60 km/hr near Cambrian Road which is within the site limits. Street No. 1 will be a two lane urban collector road with a posted speed limit of 50 km/hr. Traffic volumes are taken from Appendix B Table 1 of the guidelines with Greenbank classified as a 4-UAD roadway and Street No. 1 as a 2-UCU road. Table 3.1 summarizes the traffic and road parameters used to assess the noise; traffic volume parameters are taken from Appendix B Table B1 of the guidelines.

TABLE 3.1
TRAFFIC AND ROAD DATA SUMMARY

	FUTURE GREENBANK ROAD	BRT	STREET NO. 1
Annual Average Daily Traffic (AADT)	35,000	270 buses	8,000
Posted Speed Limit (km/hr)	60	60	50
% Medium Trucks	7%	--	7%
% Heavy Trucks	5%	--	5%
% Daytime Traffic	92%	74%	92%

3.2 Calculation Methods

Roadway noise is calculated using the STAMSON 5.04 computer program from the Ontario Ministry of the Environment. The BRT noise is calculated with the RT/Custom function in STAMSON which is used for rapid transit applications. Noise for the northbound and southbound future Greenbank Road lanes are calculated separately and combined together with the BRT noise.

This study will identify the noise contours generated by the traffic for various scenarios. To determine the requirement for an indoor noise warning clause, the contours for the 55 dBA daytime and 50 dBA nighttime levels are determined. For the requirement to evaluate building components, the 65 dBA daytime and 60 dBA night time contours are used. To determine the requirements for noise barriers, the 55 dBA and 60 dBA daytime noise contours are used. The following table provides the offset from centerline of the roadway to the noise contours.

TABLE 3.2
NOISE CONTOUR OFFSETS

NOISE CRITERIA		DISTANCE FROM CENTRELINE (M)	
		FUTURE GREENBANK ROAD	STREET NO. 1
Indoor Daytime	65 dBA	45.4	12.7
	55 dBA	166.5	54.5
Indoor Nighttime	60 dBA	36.3	7.3
	50 dBA	138.2	41.0
Outdoor Living Area	60 dBA	84.9	27.2
	55 dBA	166.5	54.5

Based on the above table, for indoor noise evaluation, the daytime contours are further from centerline than the nighttime levels for each criterion; therefore, only the daytime levels will be used in the evaluation. Noise contours for indoor noise and outdoor living area noise evaluation are shown on **Figure 1.2**. The noise contours have not been adjusted to reflect screening from proposed buildings or combined at intersections.

4 RESULTS

4.1 Indoor Sound Levels

The 65 dBA daytime noise contour shown on **Figure 1.2** represents the limit in which central air conditioning and an acoustical review/design of building components is required along with a Type 'D' warning clause to be included in an Agreement of Purchase and Sale. Based on the offset from centreline, buildings directly facing or flanking future Greenbank Road will exceed the 65 dBA noise level. Between the 65 dBA and 55 dBA contour, a forced air heating system with provision for central air conditioning is required along with a Type 'C' warning clause to be included in the Agreement of Purchase and Sale. The 55 dBA contour impacts all units fronting or flanking the collector roads, requiring the Type 'C' warning clause; these buildings will also screen the noise for the units directly behind the fronting and flanking units. The exact location of the units requiring the Type 'C' and 'D' warning clauses will be determined during detailed design.

Warning clauses for indoor noise from NPC-300 are as follows:

Type 'C'

"This dwelling unit has been fitted with a forced air heating system and the ducting, etc. was sized to accommodate central air conditioning. Installation of central air conditioning by the occupant will allow windows and exterior doors to remain closed, thereby ensuring that the indoor sound levels are within the City's and the Ministry of the Environment's noise criteria. (Note: The location and installation of the outdoor air conditioning device should be done so as to comply with noise criteria of MOE Publication NPC-216, Residential Air Conditioning Devices and thus minimize the noise impacts both on and in the immediate vicinity of the subject property."

Type 'D'

"This dwelling unit has been supplied with a central air conditioning system which will allow windows and exterior doors to remain closed, thereby ensuring that the indoor sound levels are within the City's and the Ministry of the Environment's noise criteria."

4.2 Outdoor Sound Levels

The 60 dBA outdoor noise contour shown on **Figure 1.2** represents the limit in which physical attenuation is required while the 55 dBA represents the limits in which no action is required for noise at the outdoor living areas. For areas above 60 dBA where a noise barrier reduces the noise below 60 dBA but remains above 55 dBA, a Type 'B' warning clause is required in the Agreement of Purchase and Sale. For areas that fall between the 60 dBA and 55 dBA contours a Type 'A' warning clause could be used in lieu of a noise barrier. The back to back townhouses adjacent to future Greenbank Road have no outdoor living areas and are not included in outdoor noise analysis. Street townhouses flanking Greenbank Road will require a noise barrier; due to the high traffic volume on the arterial road, it may not be practical to reduce noise levels below 55 dBA so a Type 'B' warning clause may be required for the units adjacent to future Greenbank Road. Along Street No. 1, there are several units that flank the road exposing the outdoor living areas to noises levels above 60 dBA. Noise barriers are likely required at four locations shown on **Figure 1.2**.

Warning clauses for outdoor noise from NPC-300 are as follows:

Type 'A'

"Purchasers/tenants are advised that sound levels due to Future Greenbank Road and BRT/Street No. 1 road traffic may occasionally interfere with some activities of the dwelling occupants as the sound levels exceed the City's and the Ministry of the Environment's noise criteria."

Type 'B'

"Purchasers/tenants are advised that despite the inclusion of noise control features in the development and within the building units, sound levels due to increasing Future Greenbank Road and BRT/Street No. 1 road traffic may on occasion interfere with some activities of the dwelling occupants as the sound levels exceed the City's and the Ministry of the Environment's noise criteria."

5 STATIONARY NOISE

A study for stationary noise is required for a new noise sensitive land uses within 300 meters of a pit licensed under the Aggregate Resources Act per Section 3.1 of the guidelines. As almost the entire site is within 300 meters from the south boundary a detailed stationary Noise Study is required and is included in the Mineral Resource Impact Assessment prepared by Paterson Group.

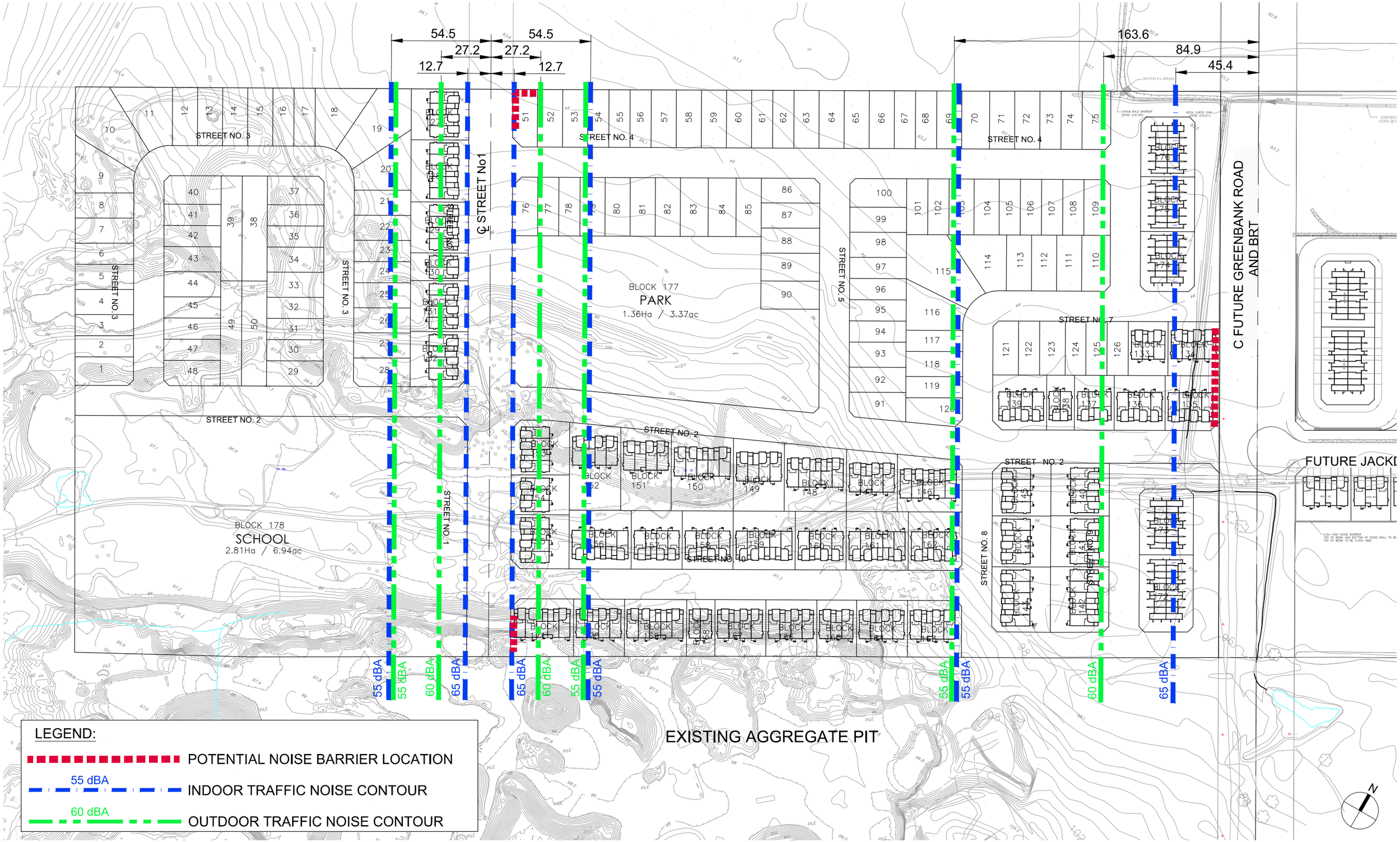
6 CONCLUSIONS

This report outlines the impact of roadway noise on the Meadows in Half Moon Bay Phase 5 development. The exact location of residential units requiring noise warning clauses, ventilation, air conditioning requirements, acoustical review/design of building components, and the potential location and size of noise barriers will be determined during the detailed design phase when site plans and grading plans are finalized.

As this site is located within 300 meters of a pit licensed under the Aggregate Resource Act, a stationary Noise Study is included in the Mineral Resource Impact Assessment prepared by Paterson Group.

Prepared by:

Lance Erion, P. Eng.



J:\115496_MeadowsPh5\5.9 Drawings\59civil\current\Assessment of Adequacy\115496-Fig-1.2-NOISE.dwg Layout Name: Fig 1.2 NOISE Plot Scale: 1:8.704 Plotted At: 12/11/2018 Last Saved By: James.Bottison Last Saved At: Dec. 11, 18

Scale	Project Title	Drawing Title	Sheet No.
N.T.S.	THE MEADOWS IN HALF MOON BAY PHASE 5	NOISE CONTOURS	FIG. 1.2

Appendix

STAMSON 5.0 NORMAL REPORT Date: 05-04-2018 11:45:16
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: in60.te Time Period: Day/Night 16/8 hours
Description: Street 1b 55 dBA daytime

Road data, segment # 1: Street 1b (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	: 50 km/h		
Road gradient	: 1 %		
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: Street 1b (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	: 54.45 / 25.54	m
Receiver height	: 1.50 / 4.50	m
Topography	: 1	(Flat/gentle slope; no barrier)
Reference angle	: 0.00	

Results segment # 1: Street 1b (day)

Source height = 1.50 m

ROAD (0.00 + 55.00 + 0.00) = 55.00 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-90	90	0.66	65.75	0.00	-9.29	-1.46	0.00	0.00	0.00	55.00

Segment Leq : 55.00 dBA

Total Leq All Segments: 55.00 dBA

Results segment # 1: Street 1b (night)

Source height = 1.50 m

ROAD (0.00 + 53.23 + 0.00) = 53.23 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-90	90	0.57	58.16	0.00	-3.63	-1.30	0.00	0.00	0.00	53.23

Segment Leq : 53.23 dBA

Total Leq All Segments: 53.23 dBA

TOTAL Leq FROM ALL SOURCES (DAY): 55.00
(NIGHT): 53.23

STAMSON 5.0 NORMAL REPORT Date: 05-04-2018 11:42:34
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: in60.te Time Period: Day/Night 16/8 hours
Description: Street 1b 60 dBA daytime

Road data, segment # 1: Street 1b (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	:	50 km/h	
Road gradient	:	1 %	
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: Street 1b (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	:	27.20 / 25.54	m
Receiver height	:	1.50 / 4.50	m
Topography	:	1	(Flat/gentle slope; no barrier)
Reference angle	:	0.00	

Results segment # 1: Street 1b (day)

Source height = 1.50 m

ROAD (0.00 + 60.00 + 0.00) = 60.00 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-90	90	0.66	65.75	0.00	-4.29	-1.46	0.00	0.00	0.00	60.00

Segment Leq : 60.00 dBA

Total Leq All Segments: 60.00 dBA

Results segment # 1: Street 1b (night)

Source height = 1.50 m

ROAD (0.00 + 53.23 + 0.00) = 53.23 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-90	90	0.57	58.16	0.00	-3.63	-1.30	0.00	0.00	0.00	53.23

Segment Leq : 53.23 dBA

Total Leq All Segments: 53.23 dBA

TOTAL Leq FROM ALL SOURCES (DAY): 60.00
(NIGHT): 53.23

STAMSON 5.0 NORMAL REPORT Date: 05-04-2018 11:43:23
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: in60.te Time Period: Day/Night 16/8 hours
Description: Street 1b noise at 15 m daytime

Road data, segment # 1: Street 1b (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 : 50 km/h
Road gradient : 1 %
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: Street 1b (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 : 15.00 / 25.54 m
Receiver height : 1.50 / 4.50 m
Topography : 1 (Flat/gentle slope; no barrier)
Reference angle : 0.00

Results segment # 1: Street 1b (day)

Source height = 1.50 m

ROAD (0.00 + 64.29 + 0.00) = 64.29 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-90	90	0.66	65.75	0.00	0.00	-1.46	0.00	0.00	0.00	64.29

Segment Leq : 64.29 dBA

Total Leq All Segments: 64.29 dBA

Results segment # 1: Street 1b (night)

Source height = 1.50 m

ROAD (0.00 + 53.23 + 0.00) = 53.23 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-90	90	0.57	58.16	0.00	-3.63	-1.30	0.00	0.00	0.00	53.23

Segment Leq : 53.23 dBA

Total Leq All Segments: 53.23 dBA

TOTAL Leq FROM ALL SOURCES (DAY): 64.29
(NIGHT): 53.23

Divergence - Line Source Collector Road - 65 dBA indoor

Origin	Distance	d1	15	m
	Noise	n1	64.29	dBA
Receiver	Noise	n2	65	dBA
Distance (est)		d2	12.737707	

Note: Distance (est) = d2 * (10^((n2-n1)/10))
When n2<n1

Distance from centerline for 65 dBA is 12.74m

STAMSON 5.0 NORMAL REPORT Date: 05-04-2018 11:32:52
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: in55.te Time Period: Day/Night 16/8 hours
Description: Future Greenbank Road 55 dBA daytime

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

Car traffic volume : 14168/1232 veh/TimePeriod *
Medium truck volume : 1127/98 veh/TimePeriod *
Heavy truck volume : 805/70 veh/TimePeriod *
Posted speed limit : 60 km/h
Road gradient : 1 %
Road pavement : 1 (Typical asphalt or concrete)

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

24 hr Traffic Volume (AADT or SADT): 17500
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: F Greenbank (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 : 157.35 / 166.05 m
Receiver height : 1.50 / 4.50 m
Topography : 1 (Flat/gentle slope; no barrier)
Reference angle : 0.00

Road data, segment # 2: F Greenbank (day/night)

Car traffic volume : 14168/1232 veh/TimePeriod *
Medium truck volume : 1127/98 veh/TimePeriod *
Heavy truck volume : 805/70 veh/TimePeriod *
Posted speed limit : 60 km/h
Road gradient : 1 %
Road pavement : 1 (Typical asphalt or concrete)

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

24 hr Traffic Volume (AADT or SADT): 17500
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: F Greenbank (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	: 169.85 / 178.55 m	
Receiver height	: 1.50 / 4.50 m	
Topography	: 1	(Flat/gentle slope; no barrier)
Reference angle	: 0.00	

Results segment # 1: F Greenbank (day)

Source height = 1.50 m

ROAD (0.00 + 52.26 + 0.00) = 52.26 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-90	90	0.66	70.67	0.00	-16.94	-1.46	0.00	0.00	0.00	52.26

Segment Leq : 52.26 dBA

Results segment # 2: F Greenbank (day)

Source height = 1.50 m

ROAD (0.00 + 51.71 + 0.00) = 51.71 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-90	90	0.66	70.67	0.00	-17.50	-1.46	0.00	0.00	0.00	51.71

Segment Leq : 51.71 dBA

Total Leq All Segments: 55.00 dBA

Results segment # 1: F Greenbank (night)

Source height = 1.50 m

ROAD (0.00 + 45.37 + 0.00) = 45.37 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-90	90	0.57	63.07	0.00	-16.39	-1.30	0.00	0.00	0.00	45.37

Segment Leq : 45.37 dBA

Results segment # 2: F Greenbank (night)

Source height = 1.50 m

ROAD (0.00 + 44.88 + 0.00) = 44.88 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-90	90	0.57	63.07	0.00	-16.89	-1.30	0.00	0.00	0.00	44.88

Segment Leq : 44.88 dBA

Total Leq All Segments: 48.14 dBA

TOTAL Leq FROM ALL SOURCES (DAY): 55.00
(NIGHT): 48.14

```
STAMSON 5.0         NORMAL REPORT         Date: 05-04-2018 11:36:26
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: in55.te                Time Period: Day/Night 16/8 hours
Description: Future Greenbank Road 60 dBA daytime


Road data, segment # 1: F Greenbank (day/night)
-----------------------------------------------
Car traffic volume  : 14168/1232  veh/TimePeriod  *
Medium truck volume :  1127/98    veh/TimePeriod  *
Heavy truck volume  :   805/70    veh/TimePeriod  *
Posted speed limit  :    60 km/h
Road gradient       :     1 %
Road pavement       :     1 (Typical asphalt or concrete)

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

    24 hr Traffic Volume (AADT or SADT):  17500
    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: F Greenbank (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  :  76.10 / 166.05 m
Receiver height           :   1.50 / 4.50   m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00


Road data, segment # 2: F Greenbank (day/night)
-----------------------------------------------
Car traffic volume  : 14168/1232  veh/TimePeriod  *
Medium truck volume :  1127/98    veh/TimePeriod  *
Heavy truck volume  :   805/70    veh/TimePeriod  *
Posted speed limit  :    60 km/h
Road gradient       :     1 %
Road pavement       :     1 (Typical asphalt or concrete)

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

    24 hr Traffic Volume (AADT or SADT):  17500
    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: F Greenbank (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	: 88.60 / 178.55 m	
Receiver height	: 1.50 / 4.50 m	
Topography	: 1	(Flat/gentle slope; no barrier)
Reference angle	: 0.00	

Results segment # 1: F Greenbank (day)

Source height = 1.50 m

ROAD (0.00 + 57.50 + 0.00) = 57.50 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-90	90	0.66	70.67	0.00	-11.71	-1.46	0.00	0.00	0.00	57.50

Segment Leq : 57.50 dBA

Results segment # 2: F Greenbank (day)

Source height = 1.50 m

ROAD (0.00 + 56.40 + 0.00) = 56.40 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-90	90	0.66	70.67	0.00	-12.80	-1.46	0.00	0.00	0.00	56.40

Segment Leq : 56.40 dBA

Total Leq All Segments: 60.00 dBA

Results segment # 1: F Greenbank (night)

Source height = 1.50 m

ROAD (0.00 + 45.37 + 0.00) = 45.37 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-90	90	0.57	63.07	0.00	-16.39	-1.30	0.00	0.00	0.00	45.37

Segment Leq : 45.37 dBA

Results segment # 2: F Greenbank (night)

Source height = 1.50 m

ROAD (0.00 + 44.88 + 0.00) = 44.88 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-90	90	0.57	63.07	0.00	-16.89	-1.30	0.00	0.00	0.00	44.88

Segment Leq : 44.88 dBA

Total Leq All Segments: 48.14 dBA

TOTAL Leq FROM ALL SOURCES (DAY): 60.00
(NIGHT): 48.14

STAMSON 5.0 NORMAL REPORT Date: 05-04-2018 11:38:27
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: in55.te Time Period: Day/Night 16/8 hours
Description: Future Greenbank Road 65 dBA daytime

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

Car traffic volume : 14168/1232 veh/TimePeriod *
Medium truck volume : 1127/98 veh/TimePeriod *
Heavy truck volume : 805/70 veh/TimePeriod *
Posted speed limit : 60 km/h
Road gradient : 1 %
Road pavement : 1 (Typical asphalt or concrete)

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

24 hr Traffic Volume (AADT or SADT): 17500
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: F Greenbank (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 : 35.80 / 166.05 m
Receiver height : 1.50 / 4.50 m
Topography : 1 (Flat/gentle slope; no barrier)
Reference angle : 0.00

Road data, segment # 2: F Greenbank (day/night)

Car traffic volume : 14168/1232 veh/TimePeriod *
Medium truck volume : 1127/98 veh/TimePeriod *
Heavy truck volume : 805/70 veh/TimePeriod *
Posted speed limit : 60 km/h
Road gradient : 1 %
Road pavement : 1 (Typical asphalt or concrete)

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

24 hr Traffic Volume (AADT or SADT): 17500
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: F Greenbank (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	:	48.30 / 178.55 m	
Receiver height	:	1.50 / 4.50 m	
Topography	:	1	(Flat/gentle slope; no barrier)
Reference angle	:	0.00	

Results segment # 1: F Greenbank (day)

Source height = 1.50 m

ROAD (0.00 + 62.94 + 0.00) = 62.94 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-90	90	0.66	70.67	0.00	-6.27	-1.46	0.00	0.00	0.00	62.94

Segment Leq : 62.94 dBA

Results segment # 2: F Greenbank (day)

Source height = 1.50 m

ROAD (0.00 + 60.78 + 0.00) = 60.78 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-90	90	0.66	70.67	0.00	-8.43	-1.46	0.00	0.00	0.00	60.78

Segment Leq : 60.78 dBA

Total Leq All Segments: 65.00 dBA

Results segment # 1: F Greenbank (night)

Source height = 1.50 m

ROAD (0.00 + 45.37 + 0.00) = 45.37 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-90	90	0.57	63.07	0.00	-16.39	-1.30	0.00	0.00	0.00	45.37

Segment Leq : 45.37 dBA

Results segment # 2: F Greenbank (night)

Source height = 1.50 m

ROAD (0.00 + 44.88 + 0.00) = 44.88 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-90	90	0.57	63.07	0.00	-16.89	-1.30	0.00	0.00	0.00	44.88

Segment Leq : 44.88 dBA

Total Leq All Segments: 48.14 dBA

TOTAL Leq FROM ALL SOURCES (DAY): 65.00
(NIGHT): 48.14

3640 Greenbank Road Transportation Impact Assessment

Step 1 Screening Report

Step 2 Scoping Report

Step 3 Forecasting Report

Step 4 Analysis Report

Prepared for:

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13 Markham Avenue
Nepean, ON K2G 3Z1

December 2018

PN: 2018-05

Table of Contents

List of Figures

List of Tables

List of Appendices

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. Both the Design Review Component and the Network Impact Component will be completed.

2 Scoping

2.1 Existing and Planned Conditions

2.1.1 Proposed Development

The proposed development, located at 3640 Greenbank Road, is currently a greenfield property within the Barrhaven South CDP Area. The site is in an area that is currently zoned DR Development Reserve Zone. The proposed residential development will consist of a mix of detached homes and townhouses. The concept plan considers a total of approximately 350 units, split between townhouse and detached units (221 townhouses and 125 detached homes). Access to the proposed development will be via the adjacent developments, and ultimately will be accessed via realigned Greenbank Road. The realigned 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 (Street 1) to reach the transportation network. The anticipated full build-out and occupancy horizon is 2022, built in two phases, referred to herein as Phase 7 and Phase 8. Figure 1 illustrates the Study Area Context. Figure 2 illustrates the proposed concept plan.

Figure 1: Area Context Plan

EP1

LOT 10

PART 4 4R–25337

PIN 04592 – 0362

OTHER OWNER

500m LANDFILL SETBACK

STREET NO. 1b

concession 3 (RF)

DR

BLOCK 604

PART 2 4R–22695

PIN 04592–2606

OTHER OWNER

BLOCK 603

PIN 04592–2662

BLOCK 192

4M–1585

SUBJECT TO EASEMENT PER INST.NO.OC1769114

PART 1 4R–29284

PART 3 4R–29551

PART 2 4R–29551

SUBJECT

PART 4 4R–29284

PART 3 4R–29284 subject to easement per inst. no. oc1769117

BLOCK 180 RESERVE

BLOCK 181 RESERVE

BLOCK 74

BLOCK 73 RESERVE

GREENBANK ROAD REALIGNMENT

voie Pastel Way

avenue

BLOCK 69

BLOCK 65

FUTURE BLOCK 74

REGISTERED

PART 5 4R–29284

PART 6 4R–29284

SUBJECT TO 4 FOOT INST.NO.OC1769115

N60°19'20"E

241.92

N60°13'40"E

266.89

N60°03'40"E

117.36

309.07

STREET NO. 3

STREET NO. 4

STREET NO. 5

STREET NO. 6

STREET NO. 7

STREET NO. 2

STREET NO. 10

STREET NO. 8

STREET NO. 9

PART

PIN

PH 7

PH 8

PH 7

PH 8

BLOCK 177
PARK
1.36Ha / 3.37ac

LOT
04592

BLOCK 178
SCHOOL
2.81Ha / 6.94ac

PART 1

LOT 9

CONCESSION

21819

2488

2486

21820

4R – 5R – 13403

MR

LOT 10

DR

DR

DR

PIN 04592–2107
PART 1
5R–6254

PIN 04592–2292

BLOCK 181

OTHER OWNER

PART 1

PIN 04592 – 0035

ME2

209.68

116.98

97.37

N61°30'20"E

N59°55'50"E

292.81

N60°20'40"E

143.20

N59°54'35"E

91.46

N 59° 53' 30" E

41.50

26.28

154.74

N29°46'55"W

129.44

125.95

N29°55'05"W

SOUTH LANDFILL SETBACK

FENCE AREA INDARY

PHASE 1
21-38' LOTS 42%
26-45' LOTS 52%
3-50' LOTS 6%
18 GALLERY TOWNS
97 TOWNS

165 UNITS

PHASE 2
35-38' LOTS 46%
35-45' LOTS 46%
6-50' LOTS 8%
24 GALLERY TOWNS
84 TOWNS

184 UNITS

2.1.2 Existing Conditions

2.1.2.1 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. 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 (ROW) south of Cambrian Road, north of Cambrian Road a 37.5 ROW is reserved.

Cambrian Road

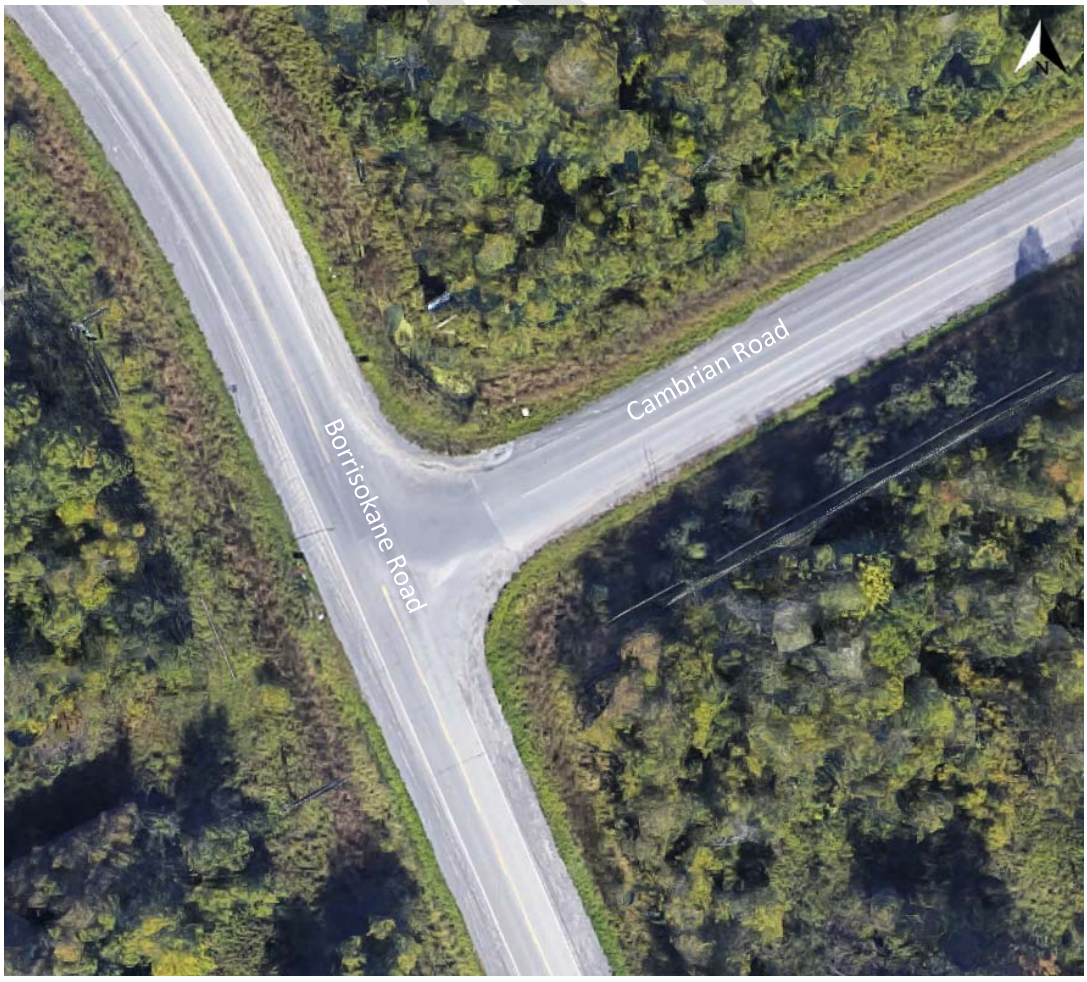
Cambrian Road is a City of Ottawa arterial road with a two-lane rural cross-section including gravel shoulders and a 70 km/h posted speed limit. The Ottawa Official Plan reserves a 37.5 metre ROW from Cedarview (now Borrisokane Road) to Jockvale Road.

2.1.2.2 Existing Intersections

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 ROW is protected for New Greenbank Road for in the Official Plan, north of the South Urban Community – south limit. The adjacent street network has been prepared in concept but does not exist.

2.1.2.3 Existing Driveways

There are no existing driveways within 200 metres of the potential future access.

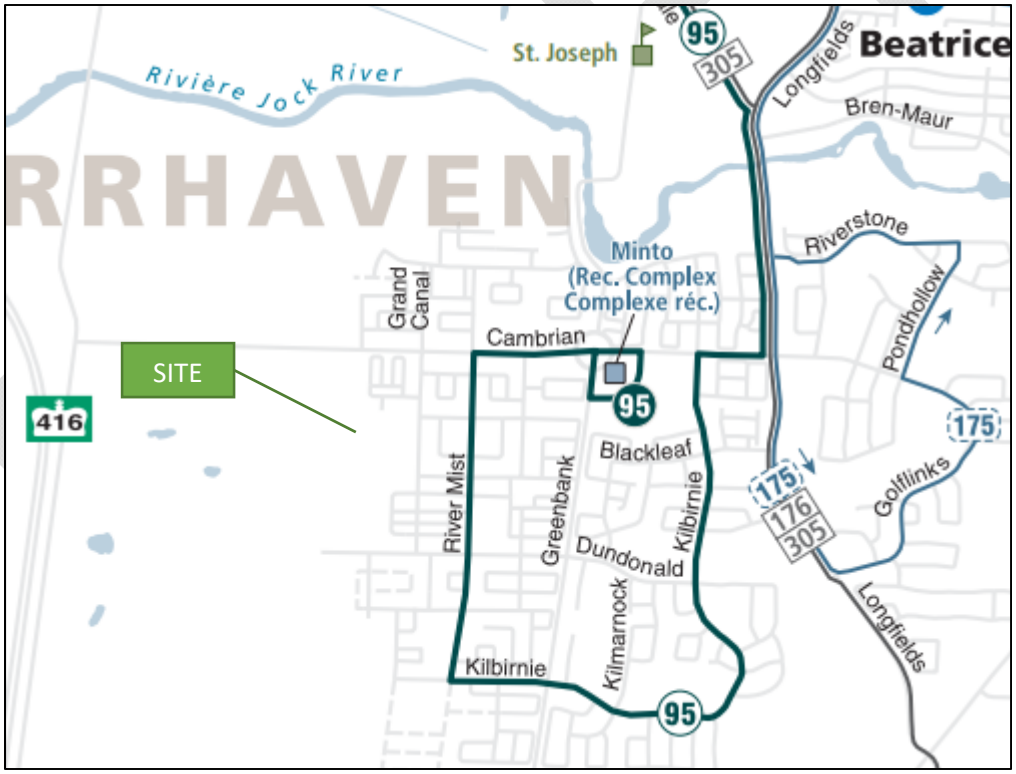
2.1.2.4 Cycling and Pedestrian Facilities

No cycling facilities currently exist along Borrisokane Road or Cambrian 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, like the cross-section contemplated within the Urban Boundary.

2.1.2.5 Existing Transit

There is no existing transit service along the boundary roads. East of the subject development on Cambrian Road Route 95 runs along River Mist Road and Cambrian Road. Figure 4 illustrates the existing transit service.

Figure 4: Existing Transit Service



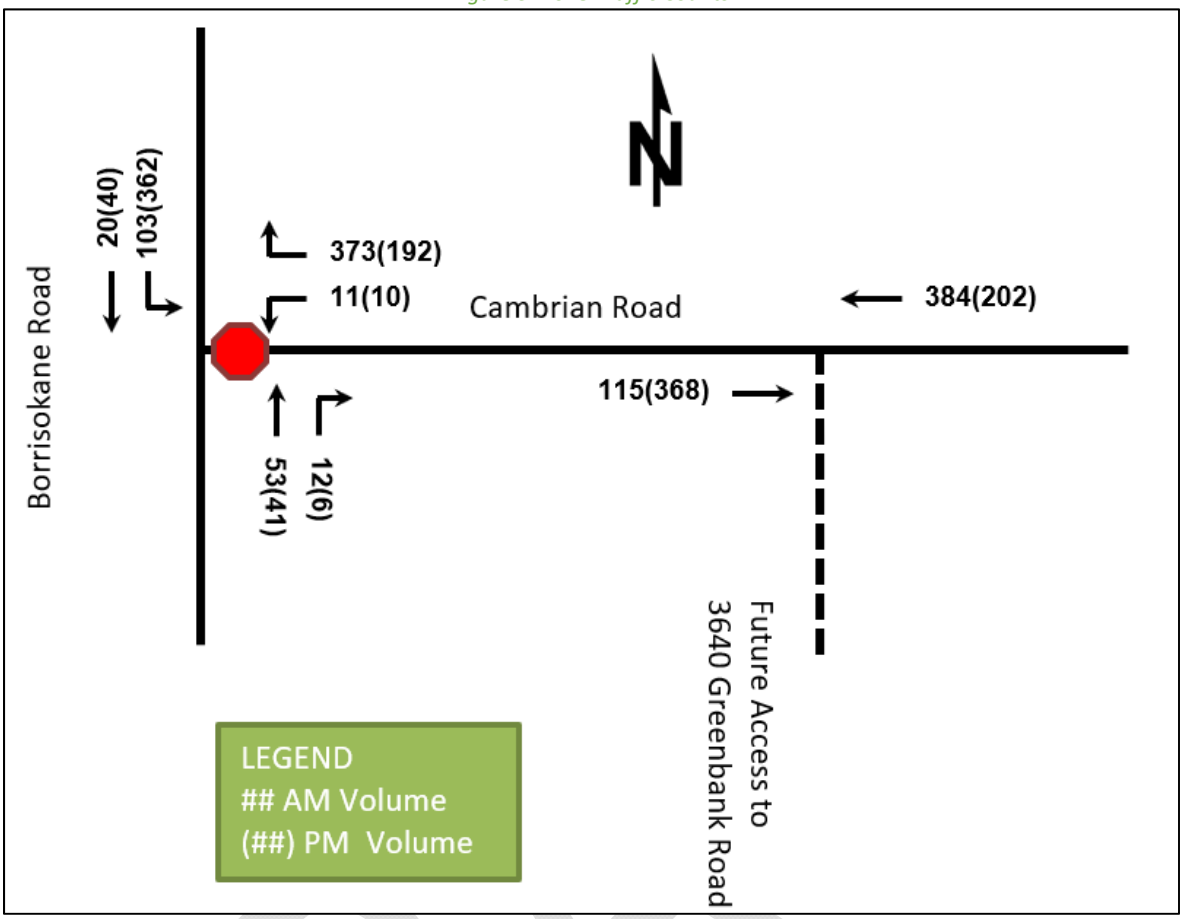
2.1.2.6 Existing Area Traffic Management Measures

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

2.1.2.7 Existing Peak Hour Travel Demand

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

Figure 5: 2018 Traffic Counts



2.1.2.8 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.

2.1.3 Planned Conditions

2.1.3.1 Changes to the Area Transportation Network

Greenbank Road

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.

Cambrian Road

The Cambrian Road Widening Environmental Assessment includes a four-lane cross-section along Cambrian Road from Longfields Drive to the future Realigned Greenbank Road. This EA has been approved by Transportation Committee and City Council, but the widening is not considered in the City of Ottawa's Transportation Master Plan 2031 Affordable Road Network and therefore the timing of this widening is unknown.

2.1.3.2 Other Study Area Developments

Half Moon Bay West

North of the proposed development is the Mattamy Development of Half Moon Bay West. This development will include 518 detached homes and 427 townhouses. Construction has not commenced on this subdivision. The site trips generated by this site will be accounted for in the traffic projections.

Half Moon Bay South

Southeast of the proposed development is the Mattamy Development of Half Moon Bay South. This development is nearing completion and only the final phases remain. It is assumed that any traffic generated by this development is either captured in the existing count or would be so minimal at the Study Area intersections that it would have a negligible impact on the operational analysis. Therefore, no additional traffic has been added to the network to account for this development.

The Meadows Phase 4

East of the proposed development is the Tamarack Development of the Meadows. Phase 4 has a current development application. This development will not have shared accesses or traffic cross-over but will impact the Study Area intersections. This development will include 50 detached homes and 136 townhouses. The site trips generated by this site will be accounted for in the traffic projections.

2.2 Study Area and Time Periods

2.2.1 Study Area

The Study Area will include examining Borrisokane Road as a Boundary Road and will focus on the access intersection on Cambrian Road and the intersection of Borrisokane Road at Cambrian Road.

2.2.2 Time Periods

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

2.2.3 Horizon Years

The anticipated build-out year is 2022. As a result, the full build-out plus five years horizon year is 2027.

2.3 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	Required
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

3 Forecasting

3.1 Development-Generated Travel Demand

3.1.1 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	125	47	113	160	108	69	177
Townhouse	221	78	138	216	136	121	257
Total Person Trips		**125**	**251**	**376**	**244**	**190**	**434**

Using the most recent National Capital Region Origin-Destination survey (OD Survey), the existing mode shares for South Nepean have been determined. Table 5 summarizes the existing mode share.

Table 5: OD Survey Existing Mode Share - South Nepean

Travel Mode	AM Mode Share	PM Mode Share
Auto Driver	61%	63%
Auto Passenger	8%	11%
Transit	27%	24%
Non-Auto	4%	2%
Total	**100%**	**100%**

As per the direction from the City of Ottawa the Transit mode share has been adjusted to lower the transit share for this development. Table 6 summarizes the adjusted mode shares.

Table 6: OD Survey Existing Mode Share - Adjusted

Travel Mode	AM Mode Share	PM Mode Share
Auto Driver	78%	77%
Auto Passenger	8%	11%
Transit	10%	10%
Non-Auto	4%	2%
Total	**100%**	**100%**

Using the above mode shares and person trip rates the person trips by mode have been projected. Table 7 summarizes the trip generation by mode.

Table 7: Trip Generation by Mode

Travel Mode	Mode Share	In	Out	Total	Mode Share	In	Out	Total
Auto Driver	78%	98	196	294	77%	188	146	334
Auto Passenger	8%	10	20	30	11%	27	21	48
Transit	10%	13	25	38	10%	24	19	43
Non-Auto Modes	4%	5	10	15	2%	5	4	9
Total	100%	**125**	**251**	**376**	100%	**244**	**190**	**434**

As shown above, 294 AM and 334 PM peak hour two-way vehicle 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.

3.1.2 Trip Distribution

To understand the travel patterns of the subject development the OD Survey has been reviewed to determine the existing travel patterns. Table 8 below summarizes the distribution.

Table 8: OD Survey Existing Mode Share - South Nepean

To/From	Percent of Trips
North	60%
South	5%
East	35%
West	0%
Total	100%

3.1.3 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 6 illustrates the percent traffic assignment. Figure 7 illustrates the volume traffic assignment.

Figure 6: Traffic Assignment (%)

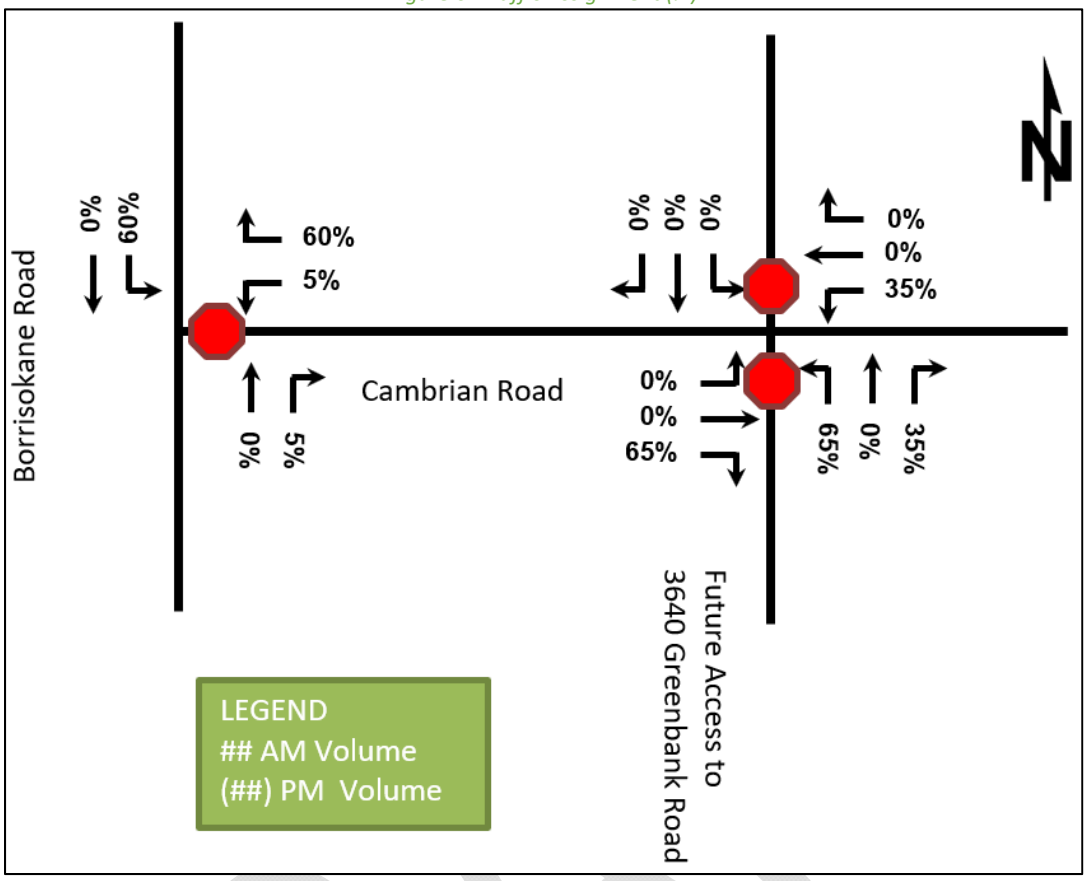
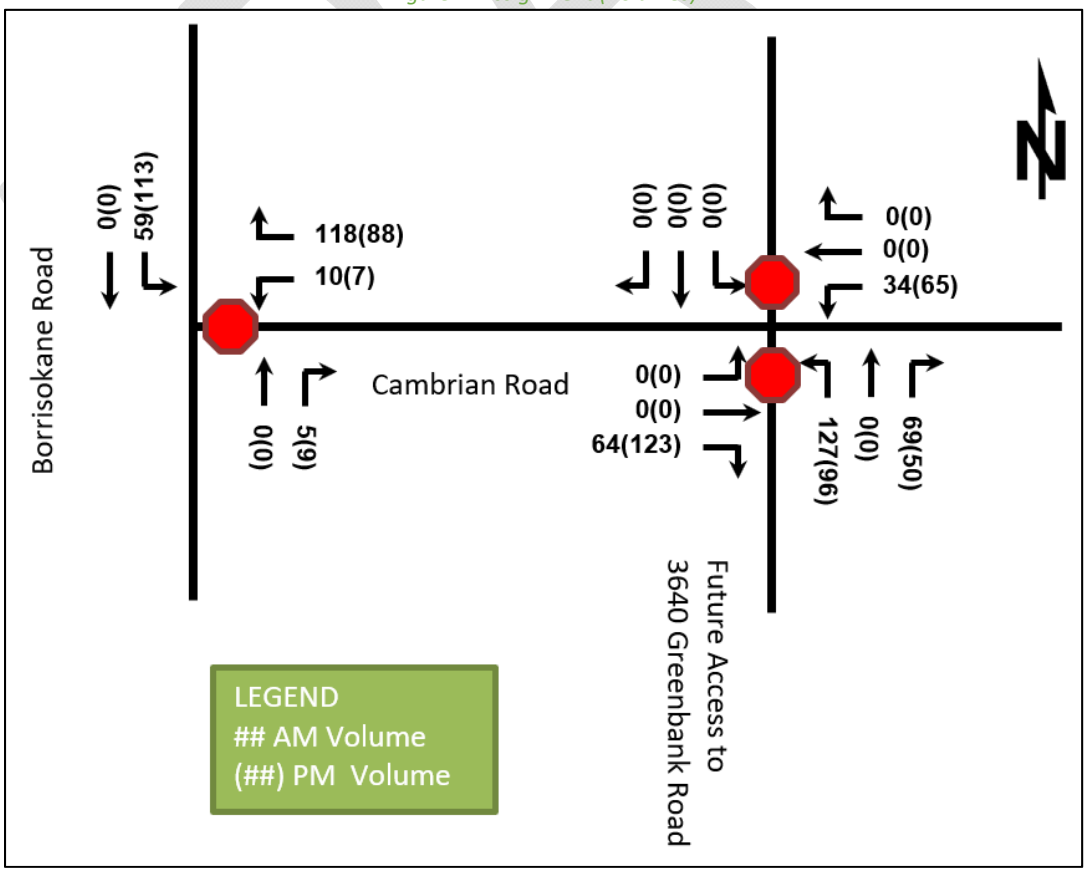


Figure 7: Assignment (Volumes)



3.2 Background Network Travel Demands

3.2.1 Transportation Network Plans

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

3.2.2 Background Growth

A large amount of background traffic has been accounted for through the other developments that have been documented in Section 2.1.3.2. To account for background growth along this corridor a 2%/annum background growth rate has been applied along Cambrian Road and Borrisokane Road.

3.2.3 Other Developments

As detailed in Section 2.1.3.2, the following developments have been included in the background traffic forecasts:

- Half Moon Bay West
- The Meadows Phase 4

Figure 8 illustrates the 2022 future background traffic volumes. Figure 9 illustrates the 2027 future background traffic volumes. Figure 10 illustrates 2022 total future traffic, including the site generated traffic. Figure 11 illustrates the 2027 total future traffic, including the site generated traffic.

Figure 8: 2022 Future Background Traffic Volumes

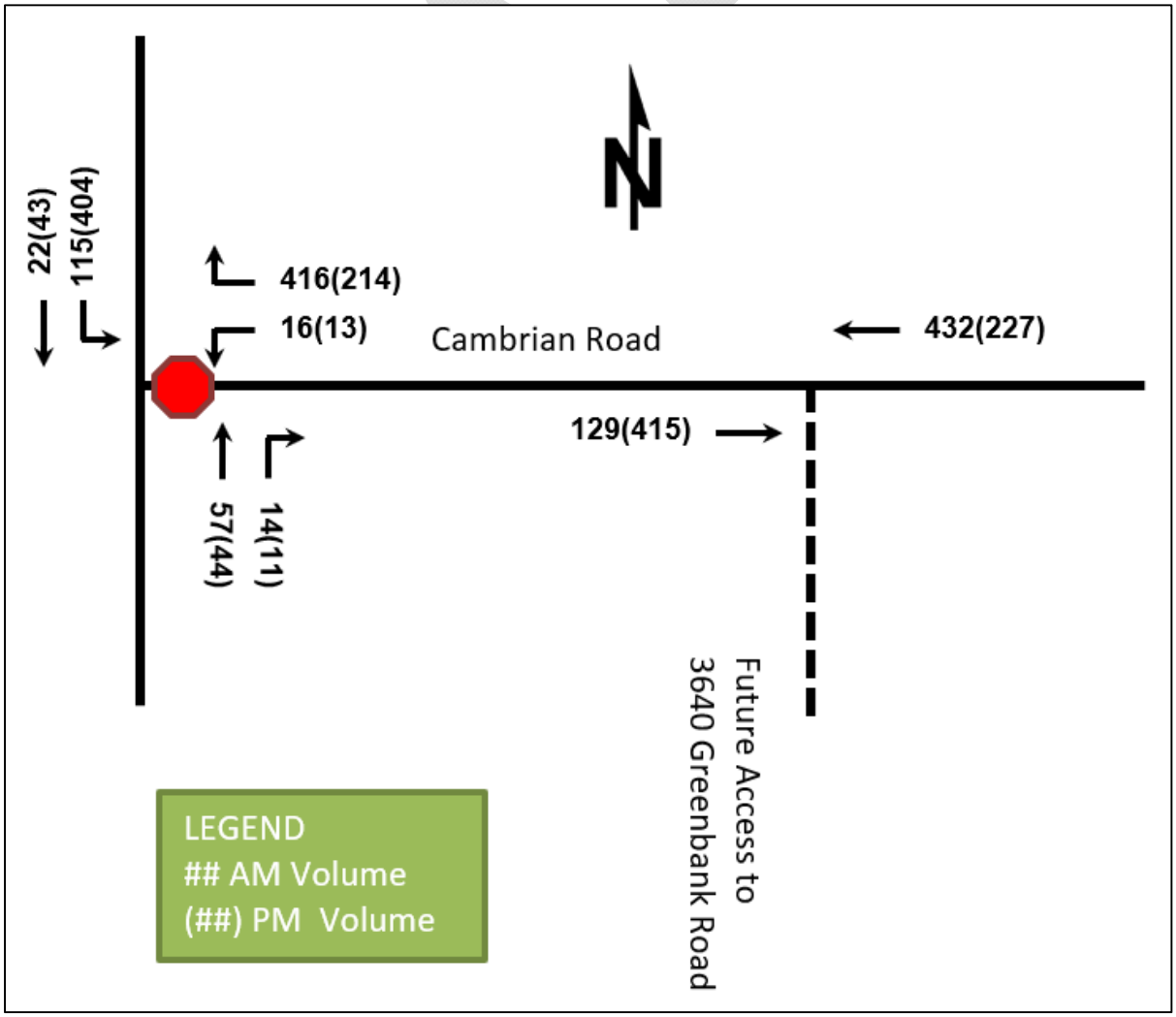


Figure 9: 2027 Future Background Traffic Volumes

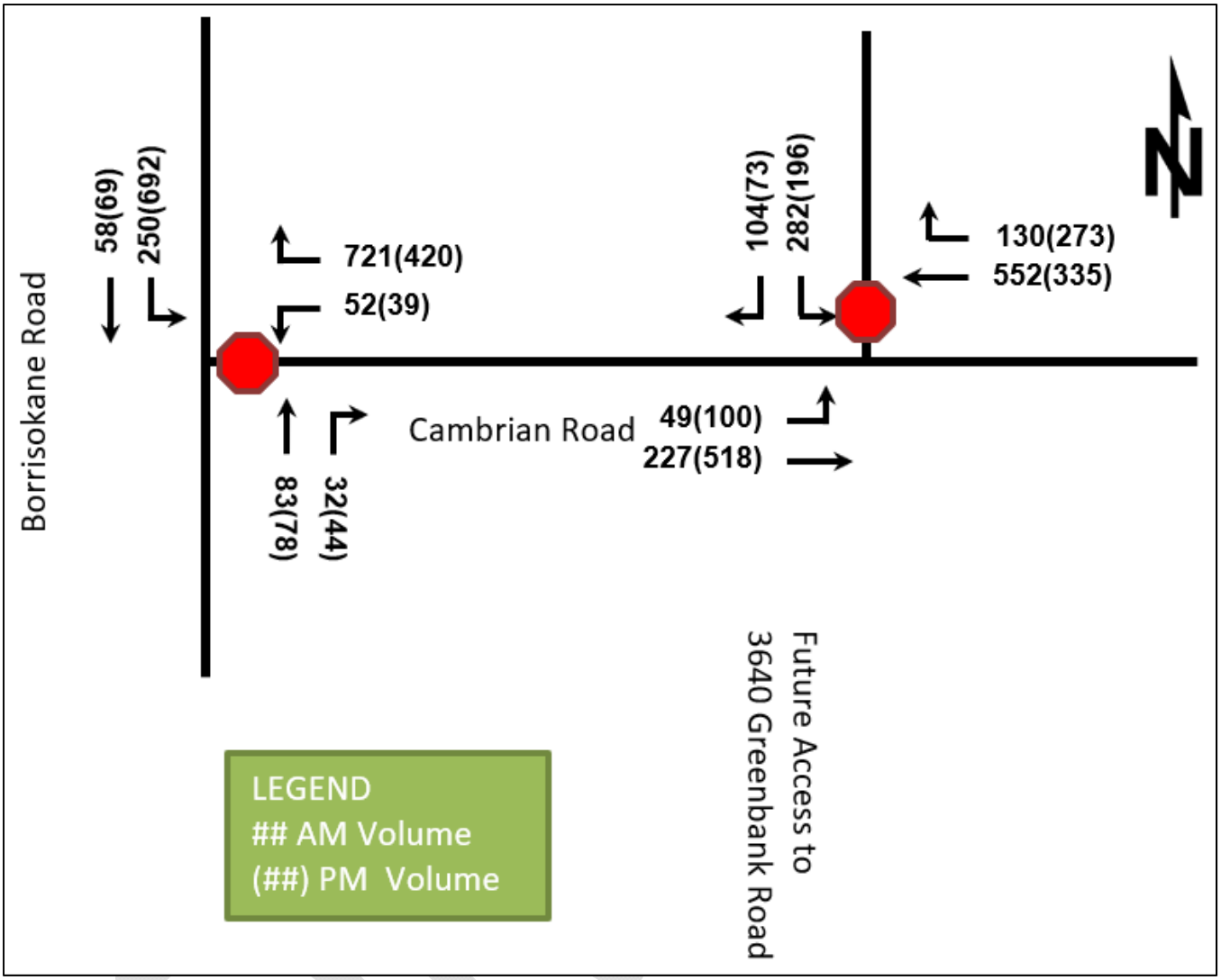


Figure 10: 2022 Future Total Traffic Volumes

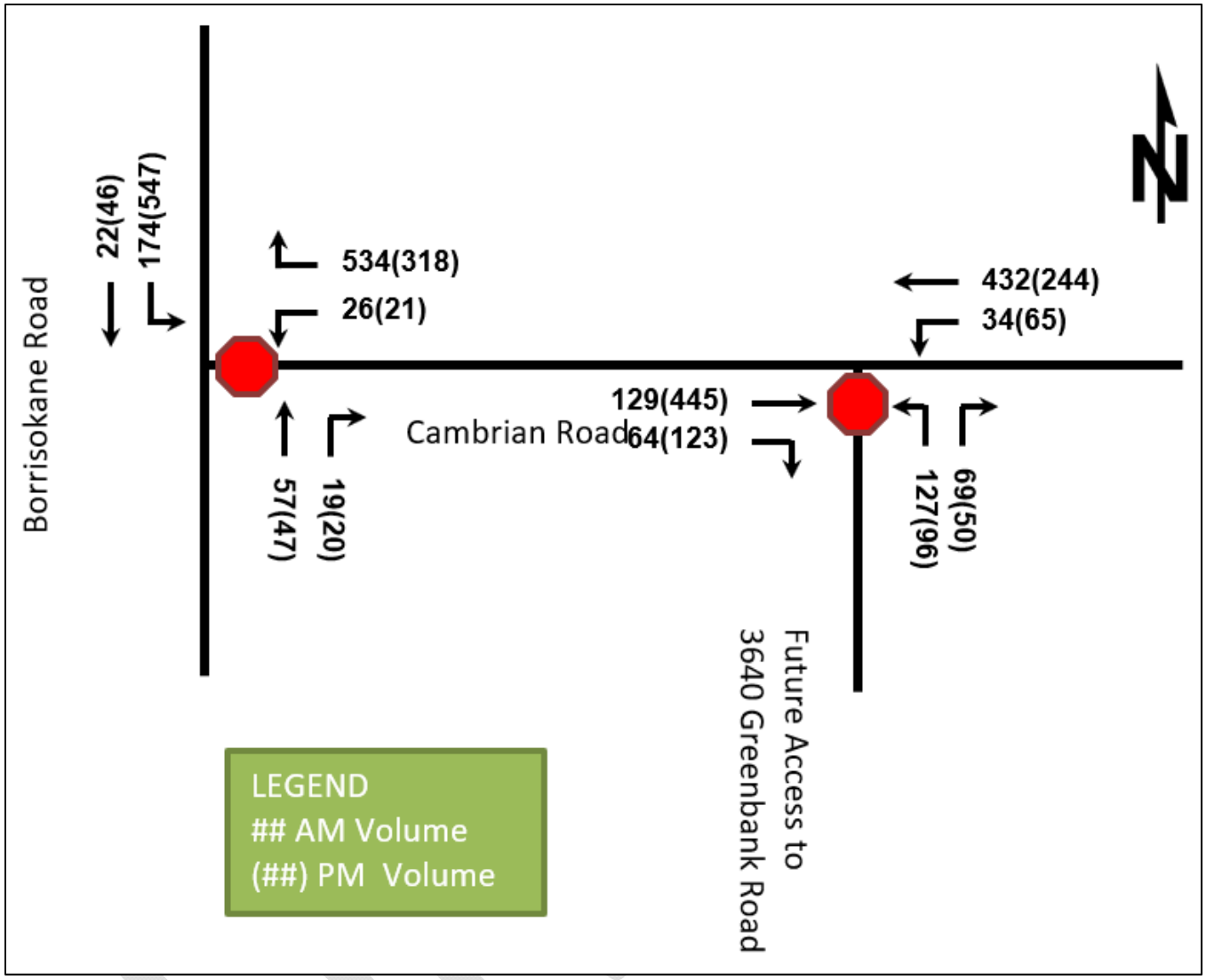
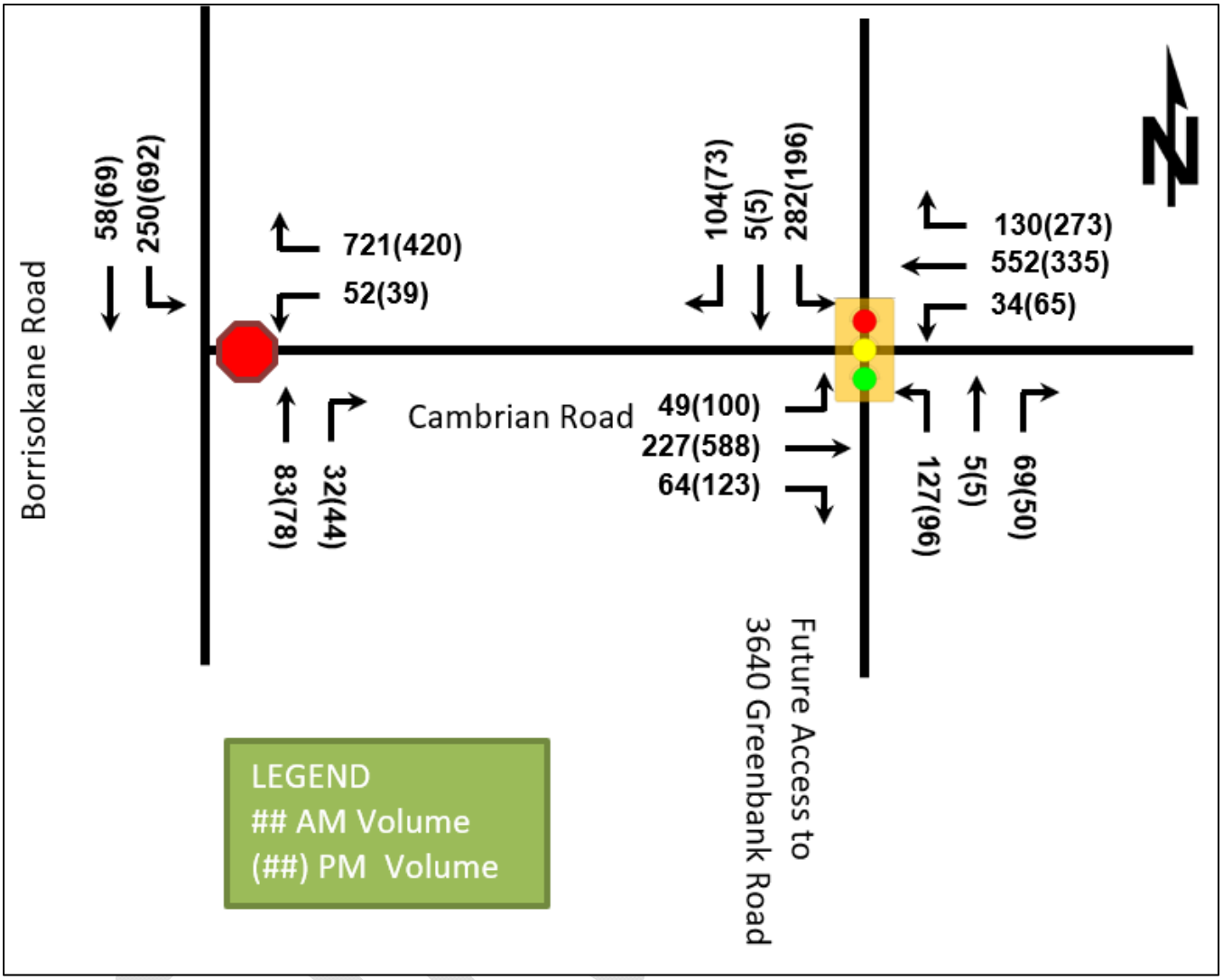


Figure 11: 2027 Future Total Traffic Volumes



3.3 Demand Rationalization

No major capacity issues were noted in the TIAs for nearby developments and the development generated traffic volumes are of a magnitude that is not anticipated to create capacity issues at the Study Area intersections. Therefore, no adjustments have been made to the development generated traffic.

4 Analysis

4.1 Development Design

4.1.1 Design for Sustainable Modes

An existing bus stop is currently located at the intersection of Seeley's Bay Street and Cambrian Road. This bus stop would be beyond the 400-metre maximum walking distance to a transit stop prescribed by the City of Ottawa. It is recommended that transit service be extended west to the proposed Street 1 access, including a turn-around area at the southern edge of the subject site. By providing transit service in this manner 85% of the subject development would be within the 400-metre walking distance to a transit stop. The remaining 15% would be within 500-metre walking distance to a transit stop. This calculation assumes that Realigned Greenbank Road has not been constructed. Upon completion of Realigned Greenbank Road, it is assumed that transit service would be

extended along the corridor (as per the TMP) and would put all areas of the subject development within 400 metres walking distance to transit.

Bike lanes are to be provided along Street No. 1, the main collector road serving the proposed development.

Sidewalks are included as needed to provide access to transit, local amenities, and the adjacent road network.

Figure 12 illustrates the transit walking distance and the sidewalk locations.

4.1.2 Circulation and Access

This TIA is exempt from this element (see Table 2).

4.1.3 New Street Networks

The proposed development is anticipated to connect to both the Meadows Phase 4 (to the east) and the Half Moon Bay West development (to the north). Street 5 will connect to the east and is a local collector road with an 18-metre ROW. This road starts at Street 1 (north-south collector) and continues east to the future Realigned Greenbank Road Corridor. Prior to the construction of that facility Street 5 will connect directly to the development to the east (Meadows Phase 4). Street 1 will be a north-south collector with a 24-metre ROW. This street will connect through the development to the north (Half Moon Bay West) to Cambrian Road, forming the primary access to the proposed development. All other roads serving lots on both sides will have a 16.5-metre ROW. Roads serving lots on a single side will have a 14.5-metre ROW.

With the proposed cycling lanes Street 1 would have a BLOS A. Figure 13 illustrates the proposed 24 metre collector road cross-section.

4.2 Parking

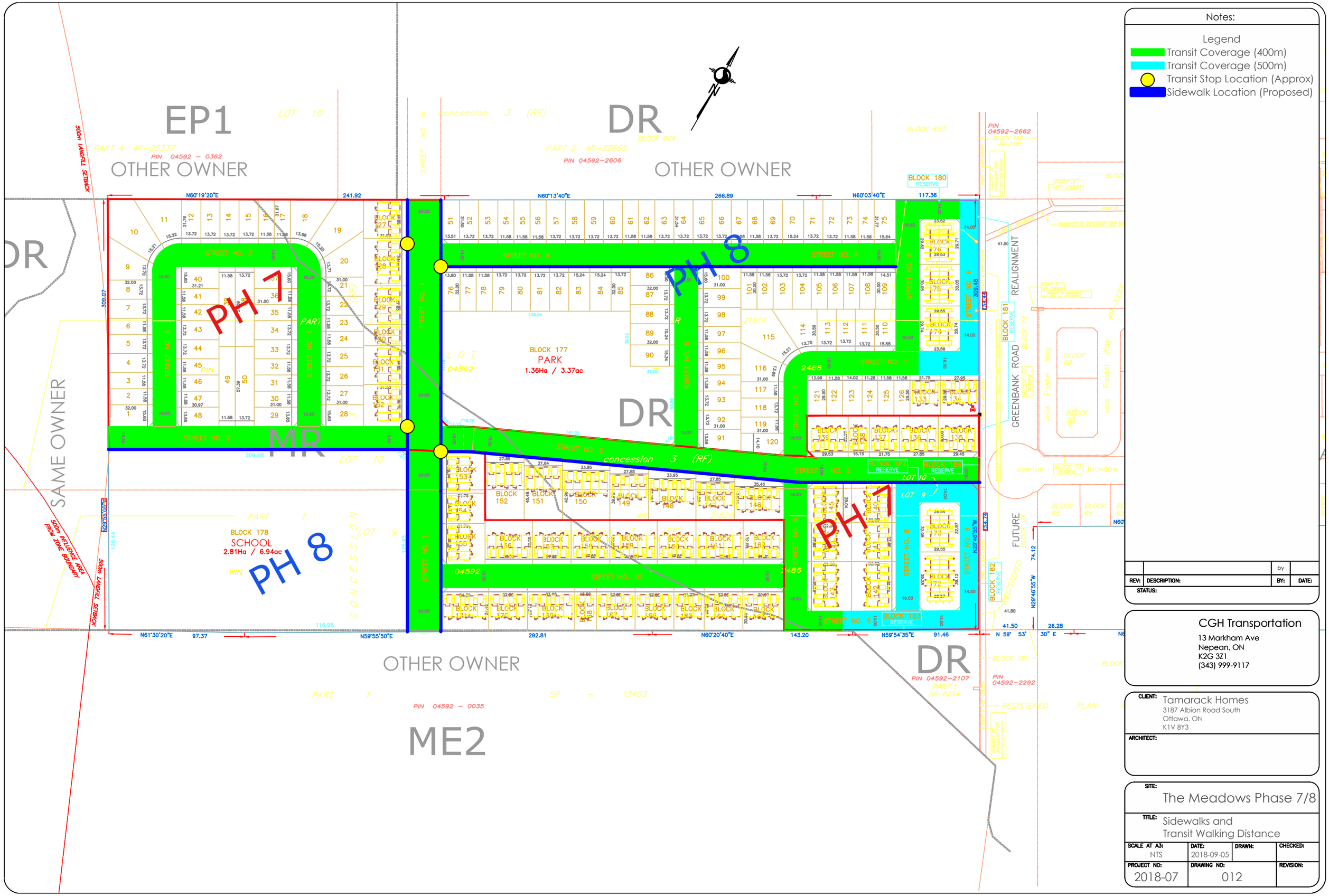
This TIA is exempt from this Module (see Table 2).

4.3 Boundary Street Design

The subject development is surrounded on three sides by future development lands. On the east side is the future corridor for Realigned Greenbank Road. As the timing of this section of Realigned Greenbank Road is unknown, and the section along the frontage of the site will be constructed beyond the development horizon for The Meadows Phase 7 and Phase 8, it has been assumed that the City will determine the appropriate design elements through a future Environmental Assessment and the cross section will be similar to that proposed in the Cambrian Road EA completed for the section between New Greenbank Road and Longfields (formerly Jockvale). For the purposes of this TIA Cambrian Road will be considered as a boundary street and the Segment Multi-Modal Level of Service (MMLOS) will be recorded.

Road Segment	Horizon	MMLOS			
		PLOS	BLOS	TLOS	TkLOS
Cambrian Road	Existing & 2022	F	F	D	B
	2027	B	F	D	B

It has been assumed that by the 2027 that a sidewalk would be built along Cambrian Road along the Half Moon Bay West frontage. This will improve the pedestrian level of service from a PLOS F to a PLOS B. The BLOS is primarily limited by the posted speed. If the speed limit on Cambrian Road were lowered to 50 km/h the BLOS would improve to a BLOS D. East of the subject section Cambrian Road widens to four-lanes and includes an at grade cycling facility on each side. Carrying this cross-section east through the subject section could increase the BLOS to a BLOS B or better.



Notes:

Legend

- Transit Coverage (400m)
- Transit Coverage (500m)
- Transit Stop Location (Approx)
- Sidewalk Location (Proposed)

REV:	DESCRIPTION:	BY:	DATE:
		by	

STATUS:

CGH Transportation
13 Markham Ave
Nepean, ON
K2G 3Z1
(343) 999-9117

CLIENT: Tamarack Homes
3187 Albion Road South
Ottawa, ON
K1V 8Y3

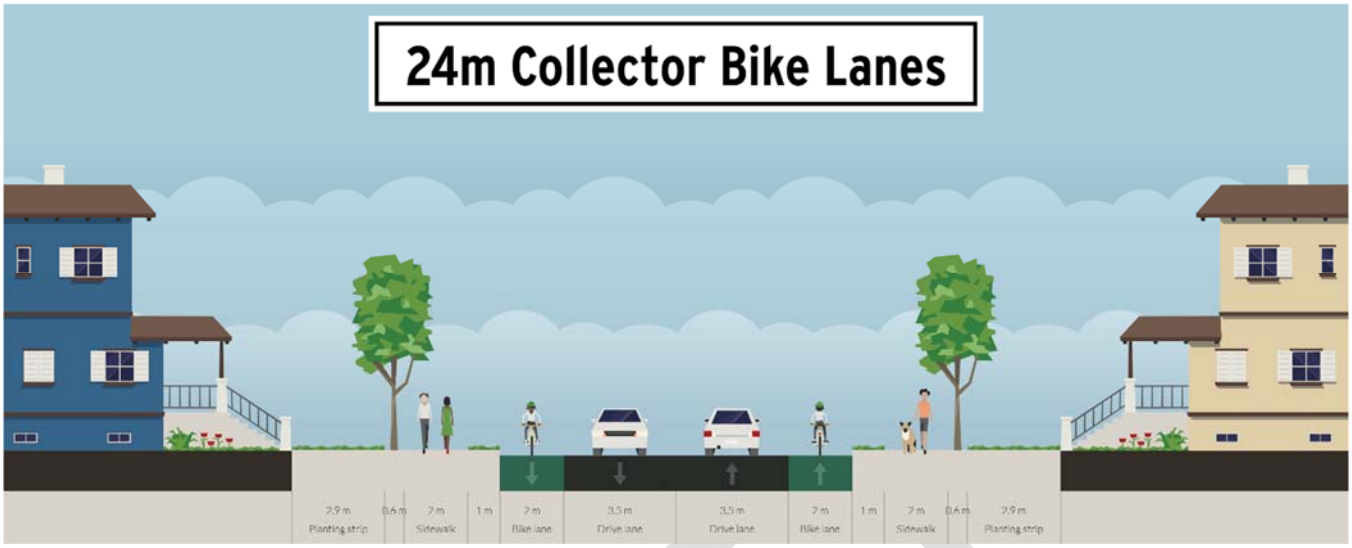
ARCHITECT:

SITE: The Meadows Phase 7/8

TITLE: Sidewalks and Transit Walking Distance

SCALE AT A3:	DATE:	DRAWN:	CHECKED:
NTS	2018-09-05		
PROJECT NO:	DRAWING NO:		REVISION:
2018-07	012		

Figure 13: Proposed Collector Road Cross-section



4.4 Access Intersections

4.4.1 Location and Design of Access

The proposed main access to the site will be through the adjacent Half Moon Bay West development (to the north) and onto Cambrian Road via Street 1. An additional, secondary access is proposed through the adjacent Meadows Phase 4 to the west via Street 5. The operational analysis focuses on the intersection of Street 1 and Cambrian Road as it is anticipated that traffic generated by this site will primarily use this intersection to access the arterial road network. Given the size and unit type of the adjacent Meadows Phase 4 development, it is anticipated that any cross-traffic between the developments would be minor and likely balance out, and therefore have no impact on the operational analysis.

4.4.2 Intersection Control

Street 1 / HMBW Access at Cambrian Road

The intersection of Cambrian Road at Street 1 / HMBW Access has been examined using 2022 and 2027 traffic volumes to determine if signals are warranted. Ontario Traffic Manual (OTM) Book 12 traffic signal warrants have been used, specifically Justification #7. This warrant was shown to reach 107% of the criteria for 2022 volumes and 151% for 2027 volumes. However, when using the Justification 7 warrant for future new intersections, it is required to meet 150% to be considered justified. It is also noted that where the warrant meets 100%, the necessary underground provisions should be made as part of the road works. The warrant is met for the 2027 total future traffic conditions and therefore, signals will be examined in the 2027 future total horizon. Appendix D contains the traffic signal warrant analysis sheets.

In addition to Traffic Signal Justification Warrants, the City of Ottawa's Roundabout Screening Tool has been used to determine the appropriate traffic control for the intersection of Cambrian Road at Street 1 / HMBW Access. Using this tool, it was found that there were no contra-indications. It was found that there was only one suitability factor, that traffic signals are warranted. Therefore, a roundabout is not considered technically feasible at this location.

Borrisokane Road at Cambrian Road

The intersection of Cambrian Road at Borrisokane Road has been examined using 2022 and 2027 traffic volumes to determine if signals are warranted. Ontario Traffic Manual (OTM) Book 12 traffic signals warrants have been

used, specifically Justification #7. This warrant was shown to reach 119% of the criteria for 2022 volumes and 110% for 2027 volumes. However, when using the Justification 7 warrant for future volumes at existing intersections, it is required to meet 120% to be considered justified. It is also noted that where the warrant meets 100%, the necessary underground provisions should be made during construction of the intersection. Therefore, signals will not be considered in the operational analysis. However, if this intersection is reconstructed underground provisions for signals should be included. Appendix D contains the traffic signal warrant analysis sheets.

In addition to Traffic Signal Justification Warrants, the City of Ottawa's Roundabout Screening Tool has been used to determine the appropriate traffic control for the intersection of Cambrian Road at Street 1 / HMBW Access. Using this tool, it was found that there were no contra-indications. It was found that there were no suitability factors.

4.5 Transportation Demand Management

Transportation Demand Management measures are implemented to encourage the use of non-auto modes of travel. This is aimed at reducing the reliance on single occupant auto trips in the City of Ottawa. The proposed development adheres to the City's TDM principles by providing direct connections to adjacent pedestrian, cycling, and transit facilities. The existing mode share for South Nepean has been used for all study horizons. The TDM Measures Checklist has been included in Appendix E. Note that this has been completed at a conceptual level and is subject to change.

4.6 Neighbourhood Traffic Management

The significant access routes to the development include Street 1, through the adjacent development to the north to Cambrian Road. It is assumed that 100% of the site traffic will utilize this route to access the Arterial Road Network. Additional access is provided through the adjacent development to the west via Street 5, however, as this route forces vehicles to travel along a circuitous route to get to Cambrian Road it is assumed that a negligible amount of traffic will use this route.

Local roads within the development are not expected to exceed the 120 vehicle per hour threshold as the local roads will feed the collector road (Street 1), which experiences approximately 200 peak hour peak direction trips. The traffic volumes on all roads are anticipated to be within the volume thresholds outlined in the City of Ottawa TIA Guidelines.

At the intersection of Street No. 1 and Street No. 2 it is recommended that appropriately designed bulb-outs be used on Street No. 2 to calm traffic along Street No. 1.

4.7 Transit

In Section 3.1 the trip generation by mode was estimated, including an estimate of the number of transit trips that will be generated by the proposed development. Table 9 summarizes the transit trip generation.

Table 9: Trip Generation by Transit Mode

Travel Mode	Mode Share	In	Out	Total	Mode Share	In	Out	Total
Transit	10%	13	25	38	10%	24	19	43

The anticipated increase in travel demand is anticipated to be minimal. It is recommended that OC Transpo provide additional transit capacity only as needed once the development is completed. It is expected that once realigned Greenbank Road is constructed, including an upgraded transit facility, that the transit mode share, and therefore the transit trips generated by the proposed development would increase.

4.8 Review of Network Concept

A screenline is a tool used to evaluate the adequacy of traffic capacity at a broad network level. To develop a screenline, an imaginary line is drawn, generally along a relevant geographic feature (i.e. major roadway, river, greenbelt, etc.). Each road that crosses this imaginary line forms a station within that screenline. The traffic volumes and traffic capacity at each of the stations is tabulated. The NCR Trans Committee maintains a database of traffic data for various established screenlines across the City of Ottawa. Two screenlines have been examined to determine if the network can accommodate the proposed development, SL 42 Rideau River and SL 49 Jock River. The 2031 Base scenario and 2031 Network Concept have been summarized in Table 10.

Table 10: 2031 Screenline Capacity

Screenline	AM 2031 Inbound (Base)			AM 2031 Inbound (Network Concept)		
	Demand	Capacity	V/C Ratio	Demand	Capacity	V/C Ratio
SL 42 Rideau River (Manotick)	2928	3800	0.77	2596	3800	0.68
SL 49 Jock River	6405	10200	0.63	6642	13200	0.50

The proposed development does not generate enough traffic to impact the V/C ratio of the above screenlines. Future road projects should proceed on schedule to prevent local traffic issues. These projects include the Cambrian Road widening, Strandherd Drive (currently in the design stage), and realigned Greenbank Road.

4.9 Intersection Design

4.9.1 Intersection Control

As discussed in Section 4.4.2 signals will be analyzed at the intersection of Street 1 at Cambrian Road for the 2027 Future Total Horizon. As roundabouts have been screened out no roundabout analysis will be included.

4.9.2 Intersection Design

To understand the intersection design, an MMLOS analysis of existing, future background, and future total travel demands is required. The existing and future segment MMLOS has been discussed in Section 4.3. The following sections will discuss the vehicle LOS at the Study Area intersections, followed by a discussion of the intersection MMLOS for other modes.

4.9.2.1 Existing Conditions

The existing intersection volumes have been analyzed to establish a baseline condition to compare all future horizons to and determine the impact of the subject development on the Study Area road network. Table 11 summarizes the operational analysis of 2018 existing conditions. Appendix F contains the 2018 Existing Conditions Synchro sheets.

Table 11: 2018 Existing Conditions Operational Analysis

Intersection	Lane	AM Peak Hour				PM Peak Hour			
		LOS	Delay	V/C	Q (95th)	LOS	Delay	V/C	Q (95th)
Borrisokane Road & Cambrian Road *Unsignalized*	WBL/R	B	12	0.44	2	B	11	0.26	1
	NBT/R	-	-	-	-	-	-	-	-
	SBL/T	A	6	0.08	0	A	7	0.26	1

The existing intersection has been shown to operate with good LOS, and no operational concerns. No mitigation measures are required or recommended.

4.9.2.2 2022 Future Background

The 2022 future background intersection volumes have been analyzed to allow a comparison between the future volumes with and without the proposed development. Table 12 summarizes the operational analysis of 2022 future background conditions.

Table 12: 2022 Future Background Conditions Operational Analysis

Intersection	Lane	AM Peak Hour				PM Peak Hour			
		LOS	Delay	V/C	Q (95th)	LOS	Delay	V/C	Q (95th)
Borrisokane Road & Cambrian Road *Unsignalized*	WBL/R	B	12	0.44	2	B	11	0.27	1
	NBT/R	-	-	-	-	-	-	-	-
	SBL/T	A	8	0.08	0	A	8	0.26	1

With the addition of background growth to reflect the 2022 horizon, the existing intersection is anticipated to operate with similar operational characteristics to the existing conditions, and well within City of Ottawa operational thresholds. Appendix G contains the 2022 Future Background Synchro Sheets.

4.9.2.3 2027 Future Background

The 2027 future background intersection volumes have been analyzed to allow a comparison between the future volumes with and without the proposed development. Table 13 summarizes the operational analysis of 2027 future background conditions

Table 13: 2027 Future Background Conditions Operational Analysis

Intersection	Lane	AM Peak Hour				PM Peak Hour			
		LOS	Delay	V/C	Q (95th)	LOS	Delay	V/C	Q (95th)
Borrisokane Road & Cambrian Road *Unsignalized*	WBL/R	D	34	0.9	13	F	87	1.05	15
	NBT/R	-	-	-	-	-	-	-	-
	SBL/T	A	6	0.17	1	A	9	0.47	3
Half Moon Bay West Access & Cambrian Road *Unsignalized*	EBT/R	A	2	0.05	0	A	9	0.10	0
	WBL/T	-	-	-	-	-	-	-	-
	SBL/R	F	168	1.24	18	F	181	1.23	14

With the addition of background growth to reflect the 2027 horizon, including Half Moon Bay North, the existing intersection is anticipated to operate with poor LOS in the PM peak hour. The new access to Half Moon Bay West is anticipated to operate with high delays and poor LOS in the AM and PM peak hour. The signal warrant was found to be met for the full intersection including the access to Meadows Phase 7 and 8. This will be examined further in the 2027 total future conditions. Appendix H contains the 2027 Future Background Synchro sheets.

4.9.2.4 2022 Total Future

The 2022 total future intersection volumes, including the site generated traffic, have been analyzed to understand the impact of the subject development on the Study Area intersections. Table 14 summarizes the operational analysis of 2022 total future conditions.

Table 14: 2022 Total Future Conditions Operational Analysis

Intersection	Lane	AM Peak Hour				PM Peak Hour			
		LOS	Delay	V/C	Q (95th)	LOS	Delay	V/C	Q (95th)
Borrisokane Road & Cambrian Road *Unsignalized*	WBL/R	B	14	0.59	4	B	14	0.43	2
	NBT/R	-	-	-	-		-	-	-
	SBL/T	A	7	0.11	0	A	8	0.34	2
Meadows Phase 7 and 8 Access & Cambrian Road *Unsignalized*	EBL/T	A	0	-	-	A	0	0.39	2
	WBT/R	A	1	0.03	0	A	2	-	-
	NBL/R	B	16	0.38	2	C	21	0.06	0

With the addition of site generated traffic, the existing intersection of Borrisokane Road at Cambrian Road is anticipated to operate with similar LOS and delay as 2022 future background conditions. The access intersection to Meadows Phase 7 and 8 is anticipated to operate with minimal delays as a stop-controlled intersection. Appendix I contains the 2022 Total Future Synchro sheets.

4.9.2.5 2027 Total Future

The 2027 total future intersection volumes, including the site generated traffic, have been analyzed to understand the impact of the subject development on the Study Area intersections.

Table 15: 2027 Total Future Conditions Operational Analysis

Intersection	Lane	AM Peak Hour				PM Peak Hour			
		LOS	Delay	V/C	Q (95th)	LOS	Delay	V/C	Q (95th)
Borrisokane Road & Cambrian Road *Unsignalized*	WBL/R	D	34	0.9	13	F	87	1.05	15
	NBT/R	-	-	-	-	-	-	-	-
	SBL/T	A	6	0.17	1	A	9	0.47	3
Meadows Phase 7 and 8 Access/Half Moon Bay West & Cambrian Road *Unsignalized*	EBL/T/R	A	1	0.05	0	A	1	0.10	0
	WBL/T/R	A	0	0.03	0	A	1	0.07	0
	NBL/T/R	F	129	1.05	9	F	588	2.07	17
	SBL/T/R	F	501	1.99	29	F	1071	3.15	27
Meadows Phase 7 and 8 Access/Half Moon Bay West & Cambrian Road *Signalized*	EBL	A	12	0.18	9	A	10	0.18	13
	EBT	A	11	0.24	25	A	16	0.55	75
	EBR	A	3	0.08	4	A	5	0.13	9
	WBL	A	9	0.06	6	A	12	0.21	11
	WBT	A	18	0.59	70	A	11	0.31	36
	WBR	A	6	0.16	11	A	6	0.28	18
	NBL	A	15	0.32	17	A	14	0.24	15
	NBT/R	A	8	0.08	9	A	10	0.07	8
	SBL	A	21	0.58	36	A	17	0.46	28
	SBT/R	A	8	0.11	11	A	9	0.09	10

By 2027 The unsignalized intersection of Borrisokane Road and Cambrian Road is projected to operate at or slightly above the theoretical capacity of a stop-controlled intersection. However, as shown in Section 4.4.2, this intersection does not meet the warrant for traffic control signals for future volumes at an existing intersection. Given the projected capacity deficiencies the City of Ottawa should monitor this intersection in the future to ensure that, at the time when the eight-hour traffic count volumes meet the traffic signal warrant, signals are implemented.

It is anticipated that by 2027 both Meadows Phase 7/8 and Half Moon Bay North will be complete. As shown in Section 4.4.2, the future intersection of the proposed access intersection on Cambrian Road will meet the warrant for signalization. The signalized intersection operates with good LOS, low delays, and no movements over capacity. Appendix J contains the 2027 Total Future Synchro sheets.

4.9.2.6 Intersection MMLOS

Intersection MMLOS is only undertaken at signalized intersections. There is only one signalized intersection considered in this study, the future intersection of Meadows Phase 7/8 and Half Moon Bay North onto Cambrian Road.

Pedestrian LOS (PLOS) is evaluated using the PETSI score methodology which evaluates various intersection geometry elements and assigns those values a score. Table 16 summarizes the PETSI score evaluation for the proposed signalized intersection of Street 1 at Cambrian Road.

Table 16: PETSI Score

	Crossing East West			Crossing North South		
Element	**Condition**	**Points**		**Condition**	**Points**	
Crossing Distance	3 Lanes No Median	105		4 Lanes No Median	88	
Island Refuge	No	-4		No	-4	
Signal Phasing / Timing						
Left Turn Type	Protected / Permissive	-8		Permissive	-8	
Right Turn Conflict	Permissive	-5		Permissive	-5	
Right Turn on Red	Allowed	-3		Allowed	-3	
Leading Ped. Interval	No	-2		No	-2	
Corner Radius	10m to 15m	-6		10m to 15m	-6	
Crosswalk	Standard Transverse	-7		Standard Transverse	-7	
PETSI LOS	Actual	70	C	Actual	53	D
	Target		C	Target		C

The east-west pedestrian crossing meets the target PLOS C for a collector road in a development community. The north-south pedestrian crossing does not meet the target PLOS C for an arterial road in a developing community. To improve the PLOS, the signal timing could be adjusted to only allow protected left turns. Alternatively, the right turn lanes on the eastbound and westbound lanes could be removed to reduce the crossing distance. Removing the permissive left turn phase on the eastbound and westbound approaches will reduce the vehicle LOS and create an awkward signal timing for motorists. Removing the right turn lanes is not recommended as this can increase the number of rear-end collisions at a signalized intersection. Therefore, in this case the LOS D should be tolerated as it is not reasonable to achieve the target PLOS.

Bicycle LOS (BLOS) is evaluated by examining elements that impact the level of traffic stress (LTS). For the proposed intersection it has been assumed that the "Mixed Traffic on a Signalized Intersection Approach" would apply. Table 17 summarizes the elements that impact the BLOS, the worst of these is taken as the intersection BLOS.

Table 17: Bicycle LOS Criteria

	East-West		North-South	
Right-turn Lane and Turning Speed of Motorists	Right-turn lane 25 to 50 m long, turning speed ≤ 25 km/h (based on curb radii and angle of intersection)	D	No Right Turn Lanes	N/A
Cyclist Making a Left-turn and Operating Speed of Motorists	No lane crossed, ≤ 50 km/h	B	No lane crossed, ≤ 50 km/h	B

The BLOS for the east-west approaches is governed by the right turn lanes on the eastbound and westbound approaches would operate at a BLOS D. This would not meet the target BLOS for the east-west approaches. The north south approaches of the intersection would operate at a BLOS B, meeting the target for this Local Route in a Development Community. As discussed previously in Section 4.3, the segment BLOS is not anticipated to meet the target for the north-south collector (Street 1).

Transit LOS (TLOS) is evaluated by examining the average signal delay and the relative attractiveness of transit compared to automobile trips. While local transit service is anticipated to be extended to the subject development, the TMP Ultimate Network does not include higher order transit facilities or transit signal priority (TSP) measures. Therefore, the TLOS for this intersection is F. Based on the definition of TLOS there are no improvements, aside from adding TSP along the corridor, which is not recommended as Cambrian Road is an arterial road serving developments and only extends from Borrisokane Road to Longfields Drive (2.75km), making it a poor candidate for a rapid transit facility.

Truck LOS (TkLOS) is evaluated for Developing Communities only along Arterial and Collector Truck Routes. The Street 1 collector is not anticipated to be a Truck Route and therefore no TkLOS has been evaluated at the proposed signalized intersection.

4.9.2.7 Access Intersection Design

The signalized intersection of Street 1 at Cambrian Road has been evaluated using the MMLOS methodology, OTM Book 12 Traffic Warrants, and TAC Geometric Standards to determine the appropriate intersection configuration.

Auxiliary Right Turn Lanes

The vehicle LOS has been completed assuming that eastbound and westbound right turn lanes are provided. However, the BLOS at the intersection of Street 1 and Cambrian Road is governed by the presence of these auxiliary lanes. Based on the traffic volumes the vehicle LOS would not be significantly impacted by not including right turn lanes at the subject intersection. As it will improve the BLOS consideration should be given to not including right turn lanes. This should be balanced against the potential increase in rear-end collisions due to the high volume of right turning vehicles in a shared through-right-turn lane configuration. If they are included the eastbound right turn lane (accessing the Meadows Phase 7/8) does not require significant storage space, the 95th percentile queue is projected to be less than 10 metres in either peak hour. Therefore, minimum geometry requirements will dictate the intersection configuration.

Auxiliary Left Turn Lanes

The vehicle LOS has been completed assuming that left turn lanes are provided on all approaches. The left turn lanes into and out of the north leg have been assumed to be consistent with the Half Moon Bay West Community Transportation Study Addendum No. 1, as follows:

- Eastbound Left-turn storage lane 40m
- Southbound Left-turn storage lane 70m

These have been included to show a fulsome description of the intersection and have not been reconfirmed through the analysis herein. The westbound left-turn lane and northbound left-turn lane provide access into and out of the proposed development. The operational analysis of the proposed intersection has indicated that left-turn lane storage should be provided as follows:

- Westbound Left-turn storage lane 15m
- Northbound Left-turn storage lane 20m

These storage lengths would accommodate the anticipated queue lengths, but the actual storage length should be calculated using geometric design principles including applicable minimums, deceleration length, and taper lengths. The recommended auxiliary left-turn lane storage and taper lengths should be confirmed during the detailed design of the proposed intersection.

4.9.2.8 Design Context

It is understood that development applications are underway for adjacent properties to the north. This TIA has included the traffic forecasts to reflect the growth associated with these adjacent developments. These forecasts will be refined through upcoming TIAs for those properties. Once those projections are available the design of the access intersection can be refined to ensure the appropriate lane geometry and signal timing is provided. In advance of that, this application should be allowed to proceed and be deemed complete, with the understanding that the developers of the adjacent properties have agreed to enter into cost sharing agreements to complete the construction of shared elements, such as the access intersection.

5 Conclusions

This Transportation Impact Assessment has documented the existing and future transportation conditions, for all travel modes, in the Study Area. The following conclusions can be offered based on the foregoing:

A. The proposed development, located at 3640 Greenbank Road, is a greenfield development that will include approximately 350 residential units with a mix of townhouses and detached homes (221 townhouses and 125 detached homes).
B. Access to the proposed development will be via the future realigned Greenbank Road once opened. Prior to that, and for the foreseeable future, the development will access Cambrian Road through the adjacent development to the north. Connections will be provided to the development to the east (Meadows Phase 4) but this is not anticipated to be the primary route for access to the development.
C. The existing development is not currently served by transit. However, Route 95 currently serves the adjacent developments to the west and could be easily re-routed / extended to also serve Meadows Phase 7/8.
D. The previous five years of collision history at the existing intersection of Borrisokane Road at Cambrian Road has been reviewed. No patterns emerged that indicated that mitigation measures or further monitoring was required.
E. Using the TRANS Study the residential trip generation rates were calculated. The existing mode shares from the OD Survey were reviewed. City of Ottawa Staff indicated that the mode share should be adjusted to reflect a lower initial transit share for the proposed development. Using these factors, the person trip by mode was calculated. It was found that the proposed development can be anticipated to generate 376 AM and 434 PM peak hour two-way person trips.
F. By providing transit stops at appropriate locations along Street 1 it was shown that 85% of the proposed development units would be within a 400m walking distance to transit, with the remaining 15% no more than 500m from transit. While it is typically desired that all residents would be within 400m of transit, in this case the units beyond 400m walking distance would be serviced by very close transit once realigned Greenbank Road is constructed.
G. It was found that the road segment of Cambrian Road closest to the subject development would meet nearly all of the target MMLOS levels. The major exception is the BLOS, which was found to be BLOS F, whereas the target BLOS is B along Cambrian Road. East of the subject section of Cambrian Road, the road widens to four lanes and includes an at-grade cycling facility. Extending this cross-section along the subject section would increase the BLOS to B, meeting the target for this corridor.
H. The proposed collector road cross-section would provide cycling lanes along each side, which would provide a BLOS A along Street No. 1.

I. Traffic signal control warrants have been examined for the intersection of Street 1 / Half Moon Bay West Access at Cambrian Road. Using OTM Book 12 Justification 7, it was found that the 2027 traffic volumes would meet the volume threshold, and traffic control signals are warranted.

J. Traffic signal control warrants have been examined for the intersection of Borrisokane Road at Cambrian Road. Using OTM Book 12 Justification 7, signals were not warranted. However, it was found that the volumes would warrant the inclusion of underground provisions for signals if the intersection is reconstructed.

K. A review of screenline volumes indicated that there exists adequate network capacity to support the proposed development.

L. Auxiliary right turn lanes have been examined on both the eastbound and westbound approaches of the intersection of Street 1 / HMBW Access at Cambrian Road. It was found that both approaches exceed the 10% of approach volume and are therefore warranted. However, consideration should be given to excluding these lanes as the BLOS at the intersection is reduced to below the minimum desirable MMLOS. The operational analysis projected that the signalized intersection will operate very well, with LOS A on all approaches, and therefore the right turn lanes are not required to address vehicle LOS constraints. As a result, it is recommended that these lanes be excluded from the intersection configuration.

M. Given the low through volumes on the northbound and southbound approaches of the Street 1 / HMBW Access at Cambrian Road intersection, and confirmed through the operational analysis, the shared through-right-turn lane will provide adequate capacity to serve both approaches and no auxiliary right turn lanes are needed northbound or southbound.

N. Auxiliary left turn lanes are proposed on all four legs of the proposed signalized intersection of Street 1 / HMBW Access at Cambrian Road. The geometry of these lanes should be confirmed as part of the functional design process.

O. 3640 Greenbank Road Road is one of several proposed developments that are being put forward in similar timelines. This development application is proceeding prior to TIAs being completed for the proposed development across Cambrian Road. While the traffic projections for the adjacent developments have been included herein, these projections will be refined through upcoming TIAs for those properties. Therefore, while the access intersection has been examined herein, the design of the intersection will have to be refined once traffic projections for the north leg of the intersection have been finalized. Proceeding with a functional design in advance of the availability of these projections will create unnecessary duplication of design efforts. It is recommended that this duplication be avoided by allowing the development application for 3640 Greenbank Road to be deemed complete and all reports be circulated in advance of the preparation of an RMA or functional design for the subject intersection. Construction of this intersection will not proceed until such time as a functional design that satisfies City Staff is prepared and approved. Tamarack and CGH Transportation are committed to working with Mattamy and their consultant, Stantec, to develop an appropriate RMA for the intersection configuration.

The proposed development, with the proposed intersection control, will function within the Study Area Road Network. It is recommended that, from a transportation perspective, the proposed development application proceed.

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Appendix A

TIA Screening Form and PM Certification Form

CGH TRANSPORTATION INC.

13 Markham Avenue
Nepean ON K2G 3Z1

City of Ottawa 2017 TIA Guidelines
Step 1 - Screening Form

Date: 29-Aug-18
Project Number: Jul-18
Project Reference: Meadows Phase 5

1.1 Description of Proposed Development	
Municipal Address	3640 Greenbank Road
Description of Location	Greenfield Development
Land Use Classification	Residential
Development Size	125 Detached / 221 Townhomes
Accesses	Two accesses through adjacent developments
Phase of Development	Single Phase
Buildout Year	2022
TIA Requirement	Full TIA Required

1.2 Trip Generation Trigger		
Land Use Type	Townhomes or apartments	
Development Size	221	Units
Trip Generation Trigger	Yes	

1.3 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?	No
Is the development in a Design Priority Area (DPA) or Transit-oriented Development (TOD) zone?	No
Location Trigger	No

1.4. Safety Triggers	
Are posted speed limits on a boundary street are 80 km/hr or greater?	No
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	No

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.

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Dated at ___Newmarket_____ this __27__ day of _____August_____, 2018.
(City)

Name: _____Mark Crockford_____
(Please Print)

Professional Title: _____Professional Engineer_____

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

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October 11, 2018

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, 2014 **To:** January 1, 2016

Location: CAMBRIAN RD @ GREENBANK RD

Traffic Control: Yield sign **Total Collisions:** 2

Date/Day/Time	Environment	Impact Type	Classification	Surface Cond'n	Veh. Dir	Vehicle Manoeuver	Vehicle type	First Event	No. Ped
2014-Jul-02, Wed,20:45	Clear	Rear end	Non-fatal injury	Dry	West	Slowing or stopping	Automobile, station wagon	Other motor vehicle	
					West	Slowing or stopping	Passenger van	Other motor vehicle	
2014-Aug-30, Sat,12:58	Clear	Sideswipe	Non-fatal injury	Dry	East	Going ahead	Automobile, station wagon	Cyclist	
					East	Going ahead	Bicycle	Other motor vehicle	

Location: CAMBRIAN RD @ REGATTA AVE

Traffic Control: Stop sign **Total Collisions:** 2

Date/Day/Time	Environment	Impact Type	Classification	Surface Cond'n	Veh. Dir	Vehicle Manoeuver	Vehicle type	First Event	No. Ped
2015-Jul-05, Sun,13:15	Clear	Turning movement	P.D. only	Dry	West	Turning left	Passenger van	Other motor vehicle	
					West	Overtaking	Automobile, station wagon	Other motor vehicle	
2015-Aug-11, Tue,22:06	Clear	Angle	P.D. only	Dry	West	Turning left	Pick-up truck	Other motor vehicle	
					North	Stopped	Pick-up truck	Other motor vehicle	

Location: CAMBRIAN RD @ RIVER MIST RD

Traffic Control: Stop sign

Total Collisions: 1

Date/Day/Time	Environment	Impact Type	Classification	Surface Cond'n	Veh. Dir	Vehicle Manoeuver	Vehicle type	First Event	No. Ped
2015-Sep-04, Fri,07:15	Clear	Angle	P.D. only	Dry	East	Going ahead	Automobile, station wagon	Other motor vehicle	
					North	Turning right	Automobile, station wagon	Other motor vehicle	

Location: CAMBRIAN RD btwn BORRISOKANE RD & GRAND CANAL ST

Traffic Control: No control

Total Collisions: 1

Date/Day/Time	Environment	Impact Type	Classification	Surface Cond'n	Veh. Dir	Vehicle Manoeuver	Vehicle type	First Event	No. Ped
2015-Oct-09, Fri,00:00	Clear	SMV unattended vehicle	P.D. only	Dry	West	Unknown	Unknown	Unattended vehicle	

City Operations - Transportation Services

Collision Details Report - Public Version

From: January 1, 2014 **To:** January 1, 2016

Location: CAMBRIAN RD @ GREENBANK RD

Traffic Control: Yield sign **Total Collisions:** 2

Date/Day/Time	Environment	Impact Type	Classification	Surface Cond'n	Veh. Dir	Vehicle Manoeuver	Vehicle type	First Event	No. Ped
2014-Jul-02, Wed,20:45	Clear	Rear end	Non-fatal injury	Dry	West	Slowing or stopping	Automobile, station wagon	Other motor vehicle	
					West	Slowing or stopping	Passenger van	Other motor vehicle	
2014-Aug-30, Sat,12:58	Clear	Sideswipe	Non-fatal injury	Dry	East	Going ahead	Automobile, station wagon	Cyclist	
					East	Going ahead	Bicycle	Other motor vehicle	

Location: DUNDONALD DR @ GREENBANK RD

Traffic Control: Stop sign **Total Collisions:** 6

Date/Day/Time	Environment	Impact Type	Classification	Surface Cond'n	Veh. Dir	Vehicle Manoeuver	Vehicle type	First Event	No. Ped
2014-Jun-24, Tue,13:00	Rain	Turning movement	P.D. only	Wet	South	Going ahead	Pick-up truck	Other motor vehicle	
					North	Turning left	Automobile, station wagon	Other motor vehicle	
2014-Nov-05, Wed,18:20	Clear	Angle	P.D. only	Dry	East	Turning left	Automobile, station wagon	Other motor vehicle	
					South	Going ahead	Automobile, station wagon	Other motor vehicle	
2014-Sep-25, Thu,16:02	Clear	SMV other	Non-fatal injury	Dry	North	Turning left	Automobile, station wagon	Pedestrian	1

2014-Jul-24, Thu,16:07	Clear	Turning movement	Non-fatal injury	Dry	North	Turning left	Automobile, station wagon	Other motor vehicle	
					South	Going ahead	Pick-up truck	Other motor vehicle	
2014-May-19, Mon,15:42	Clear	Angle	P.D. only	Dry	West	Going ahead	Pick-up truck	Other motor vehicle	
					South	Going ahead	Automobile, station wagon	Other motor vehicle	
2015-Oct-09, Fri,14:10	Clear	Angle	P.D. only	Dry	West	Going ahead	Automobile, station wagon	Other motor vehicle	
					North	Going ahead	Automobile, station wagon	Other motor vehicle	

Location: EGRET WAY @ GREENBANK RD

Traffic Control: Stop sign

Total Collisions: 1

Date/Day/Time	Environment	Impact Type	Classification	Surface Cond'n	Veh. Dir	Vehicle Manoeuver	Vehicle type	First Event	No. Ped
2015-Feb-27, Fri,07:32	Clear	Angle	P.D. only	Dry	South	Turning right	Pick-up truck	Other motor vehicle	
					East	Stopped	Automobile, station wagon	Other motor vehicle	

Location: GREENBANK RD btwn CAMBRIAN RD & DUNDONALD DR

Traffic Control: No control

Total Collisions: 2

Date/Day/Time	Environment	Impact Type	Classification	Surface Cond'n	Veh. Dir	Vehicle Manoeuver	Vehicle type	First Event	No. Ped
2015-Jan-10, Sat,10:40	Clear	Approaching	P.D. only	Wet	South	Going ahead	Unknown	Other motor vehicle	
					North	Going ahead	Pick-up truck	Other motor vehicle	
2015-Jan-30, Fri,06:09	Drifting Snow	SMV other	P.D. only	Ice	North	Going ahead	Pick-up truck	Ran off road	

City Operations - Transportation Services

Collision Details Report - Public Version

From: January 1, 2014 **To:** January 1, 2016

Location: CAMBRIAN RD @ RIVER MIST RD

Traffic Control: Stop sign **Total Collisions:** 1

Date/Day/Time	Environment	Impact Type	Classification	Surface Cond'n	Veh. Dir	Vehicle Manoeuver	Vehicle type	First Event	No. Ped
2015-Sep-04, Fri,07:15	Clear	Angle	P.D. only	Dry	East	Going ahead	Automobile, station wagon	Other motor vehicle	
					North	Turning right	Automobile, station wagon	Other motor vehicle	

Location: RIVER MIST RD btwn BRAMBLING WAY & RIVER ROCK AVE

Traffic Control: No control **Total Collisions:** 1

Date/Day/Time	Environment	Impact Type	Classification	Surface Cond'n	Veh. Dir	Vehicle Manoeuver	Vehicle type	First Event	No. Ped
2015-Jun-24, Wed,11:06	Clear	SMV unattended vehicle	P.D. only	Dry	East	Reversing	Automobile, station wagon	Unattended vehicle	

Collision Main Detail Summary

OnTRAC Reporting System

FROM: 2011-01-01 TO: 2014-01-01

CAMBRIAN RD, CEDARVIEW RD to GREENBANK RD

Former Municipality: **Nepean** Traffic Control: **No control** Number of Collisions: **5**

	DATE	DAY	TIME	ENV	LIGHT	IMPACT TYPE	CLASS	DIR	SURFACE COND'N	VEHICLE MANOEUVRE	VEHICLE TYPE	FIRST EVENT	No. PED
1	2011-05-16	Mo	16:00	Rain	Daylight	Rear end	P.D. only	V1 E	Wet	Going ahead	Automobile, station	Other motor vehicle	0
								V2 E	Wet	Stopped	School bus	Other motor vehicle	
2	2012-03-05	Mo	21:00	Clear	Dark	Single vehicle	P.D. only	V1 U	Dry	Unknown	Automobile, station	Unattended vehicle	0
3	2012-10-20	Sat	04:35	Clear	Dark	Single vehicle	P.D. only	V1 E	Wet	Going ahead	Automobile, station	Ran off road	0
4	2013-02-22	Fri	07:00	Unknow	Dawn	Single vehicle	P.D. only	V1 W	Slush	Going ahead	Unknown	Unattended vehicle	0
5	2013-11-14	Thu	07:34	Clear	Daylight	Single vehicle	P.D. only	V1 W	Dry	Going ahead	Automobile, station	Animal - wild	0

CAMBRIAN RD & GREENBANK RD

Former Municipality: **Nepean** Traffic Control: **Stop sign** Number of Collisions: **4**

	DATE	DAY	TIME	ENV	LIGHT	IMPACT TYPE	CLASS	DIR	SURFACE COND'N	VEHICLE MANOEUVRE	VEHICLE TYPE	FIRST EVENT	No. PED
6	2012-03-01	Thu	12:07	Snow	Daylight	Rear end	P.D. only	V1 S	Packed snow	Going ahead	Automobile, station	Skidding/Sliding	0
								V2 S	Packed snow	Going ahead	Automobile, station	Skidding/Sliding	
7	2013-02-14	Thu	16:20	Clear	Daylight	Single vehicle	Non-fatal	V1 N	Mud	Going ahead	School bus	Skidding/Sliding	0
8	2013-09-09	Mo	07:40	Clear	Daylight	Sideswipe	P.D. only	V1 S	Dry	Changing lanes	Automobile, station	Other motor vehicle	0
								V2 S	Dry	Going ahead	Passenger van	Other motor vehicle	
9	2013-12-13	Fri	23:41	Clear	Dark	Single vehicle	P.D. only	V1 N	Dry	Going ahead	Automobile, station	Pole (sign, parking	0

CAMBRIAN RD & GRAND CANAL ST

Former Municipality: **Nepean** Traffic Control: **Stop sign** Number of Collisions: **2**

	DATE	DAY	TIME	ENV	LIGHT	IMPACT TYPE	CLASS	DIR	SURFACE COND'N	VEHICLE MANOEUVRE	VEHICLE TYPE	FIRST EVENT	No. PED
10	2012-12-21	Fri	07:36	Snow	Dawn	Angle	P.D. only	V1 W	Wet	Slowing or	Automobile, station	Other motor vehicle	0
								V2 S	Wet	Turning left	Automobile, station	Other motor vehicle	
11	2013-11-03	Sun	12:41	Clear	Daylight	Turning	Non-fatal	V1 E	Dry	Going ahead	Automobile, station	Other motor vehicle	0
								V2 W	Dry	Turning left	Automobile, station	Other motor vehicle	

(Note: Time of Day = "00:00" represents unknown collision time

GREENBANK RD, BARNSDALE RD to CAMBRIAN RD

Former Municipality: **Nepean** Traffic Control: **No control** Number of Collisions: **3**

	DATE	DAY	TIME	ENV	LIGHT	IMPACT TYPE	CLASS	DIR	SURFACE COND'N	VEHICLE MANOEUVRE	VEHICLE TYPE	FIRST EVENT	No. PED
12	2011-02-10	Thu	07:48	Clear	Daylight	Other	P.D. only	V1 S	Wet	Going ahead	Pick-up truck	Other Moveable	0
								V2 N	Loose snow	Going ahead	Automobile, station	Debris falling off	
13	2011-09-25	Sun	20:50	Clear	Dark	Single vehicle	P.D. only	V1 N	Loose sand or	Going ahead	Automobile, station	Debris on road	0

CAMBRIAN RD, SEELEY'S BAY ST to GRAND CANAL ST

Former Municipality: **Nepean** Traffic Control: **No control** Number of Collisions: **7**

	DATE	DAY	TIME	ENV	LIGHT	IMPACT TYPE	CLASS	DIR	SURFACE COND'N	VEHICLE MANOEUVRE	VEHICLE TYPE	FIRST EVENT	No. PED
14	2011-07-12	Tue	16:30	Clear	Daylight	Single vehicle	P.D. only	V1 W	Dry	Reversing	Farm tractor	Unattended vehicle	0

CAMBRIAN RD & REGATTA AVE

Former Municipality: **Nepean** Traffic Control: **Stop sign** Number of Collisions: **8**

	DATE	DAY	TIME	ENV	LIGHT	IMPACT TYPE	CLASS	DIR	SURFACE COND'N	VEHICLE MANOEUVRE	VEHICLE TYPE	FIRST EVENT	No. PED
15	2011-11-17	Thu	17:09	Rain	Dark	Turning	P.D. only	V1 W	Wet	Turning left	Automobile, station	Other motor vehicle	0
								V2 E	Wet	Going ahead	Pick-up truck	Other motor vehicle	

DUNDONALD DR & GREENBANK RD

Former Municipality: **Nepean** Traffic Control: **Stop sign** Number of Collisions: **2**

	DATE	DAY	TIME	ENV	LIGHT	IMPACT TYPE	CLASS	DIR	SURFACE COND'N	VEHICLE MANOEUVRE	VEHICLE TYPE	FIRST EVENT	No. PED
16	2012-07-13	Fri	21:00	Clear	Dusk	Rear end	P.D. only	V1 W	Dry	Going ahead	Automobile, station	Other motor vehicle	0
								V2 W	Dry	Stopped	Automobile, station	Other motor vehicle	
17	2012-12-13	Thu	09:42	Clear	Daylight	Angle	P.D. only	V1 E	Wet	Going ahead	Pick-up truck	Other motor vehicle	0
								V2 N	Wet	Going ahead	Passenger van	Other motor vehicle	

(Note: Time of Day = "00:00" represents unknown collision time

Appendix D

Traffic Signal Warrant Sheet

Street 1 @ Cambrian Road
2022 Total Future

Justification #7

Justification	Description	Minimum Requirement 1 Lane Highway		Minimum Requirement 2 or More Lanes		Compliance Sectional		Compliance Entire %	Signal
		Free Flow	Restr. Flow	Free Flow	Restr. Flow	Numerical	%		
1. Minimum Vehicular Volume	A. Vehicle volume, all approaches (average hour)	480	720	600	900	512	107%	107%	No
	B. Vehicle volume, along minor streets (average hour)	120	170	120	170	128	107%		
2. Delay to Cross Traffic	A. Vehicle volumes, major street (average hour)	480	420	600	900	384	80%	80%	No
	B. Combined vehicle and pedestrian volume crossing artery from minor streets (average hour)	50	75	120	170	56	112%		

Notes
1. Refer to OTM Book 12, pg 88, Nov 2007
2. Lowest section percentage governs justification
3. Average hourly volumes estiamted from peak hour volumes, AHV = PM/2 or (AM + PM) / 4
4. Due to the increased uncertainty of volume projections for proposed new developments, an increased justification threshold is used in those cases. Justification 1 and Justification 2 are used only and the justification is required to be met to 120% in the case of an existing intersection and 150% in the case of a new intersection for traffic signals to be considered.

Street 1 @ Cambrian Road
2027 Total Future

Justification #7

Justification	Description	Minimum Requirement 1 Lane Highway		Minimum Requirement 2 or More Lanes		Compliance Sectional		Compliance Entire %	Signal
		Free Flow	Restr. Flow	Free Flow	Restr. Flow	Numerical	%		
1. Minimum Vehicular Volume	A. Vehicle volume, all approaches (average hour)	480	720	600	900	889	124%	124%	No
	B. Vehicle volume, along minor streets (average hour)	120	170	120	170	254	150%		
2. Delay to Cross Traffic	A. Vehicle volumes, major street (average hour)	480	420	600	900	635	151%	151%	Yes
	B. Combined vehicle and pedestrian volume crossing artery from minor streets (average hour)	50	75	120	170	178	237%		

Notes
1. Refer to OTM Book 12, pg 88, Nov 2007
2. Lowest section percentage governs justification
3. Average hourly volumes estiamted from peak hour volumes, AHV = PM/2 or (AM + PM) / 4
4. Due to the increased uncertainty of volume projections for proposed new developments, an increased justification threshold is used in those cases. Justification 1 and Justification 2 are used only and the justification is required to be met to 120% in the case of an existing intersection and 150% in the case of a new intersection for traffic signals to be considered.

Borrisokane Road @ Cambrian Road
2022 Total Future

Justification #7

Justification	Description	Minimum Requirement 1 Lane Highway		Minimum Requirement 2 or More Lanes		Compliance Sectional		Compliance Entire %	Signal
		Free Flow	Restr. Flow	Free Flow	Restr. Flow	Numerical	%		
1. Minimum Vehicular Volume	A. Vehicle volume, all approaches (average hour)	480	720	600	900	570	119%	119%	No
	B. Vehicle volume, along minor streets (average hour)	120	170	120	170	337	281%		
2. Delay to Cross Traffic	A. Vehicle volumes, major street (average hour)	480	420	600	900	233	49%	49%	No
	B. Combined vehicle and pedestrian volume crossing artery from minor streets (average hour)	50	75	120	170	102	204%		

Notes
1. Refer to OTM Book 12, pg 88, Nov 2007
2. Lowest section percentage governs justification
3. Average hourly volumes estiamted from peak hour volumes, AHV = PM/2 or (AM + PM) / 4
4. Due to the increased uncertainty of volume projections for proposed new developments, an increased justification threshold is used in those cases. Justification 1 and Justification 2 are used only and the justification is required to be met to 120% in the case of an existing intersection and 150% in the case of a new intersection for traffic signals to be considered.

Borrisokane Road @ Cambrian Road
2027 Total Future

Justification #7

Justification	Description	Minimum Requirement 1 Lane Highway		Minimum Requirement 2 or More Lanes		Compliance Sectional		Compliance Entire %	Signal
		Free Flow	Restr. Flow	Free Flow	Restr. Flow	Numerical	%		
1. Minimum Vehicular Volume	A. Vehicle volume, all approaches (average hour)	480	720	600	900	789	110%	110%	No
	B. Vehicle volume, along minor streets (average hour)	120	170	120	170	462	272%		
2. Delay to Cross Traffic	A. Vehicle volumes, major street (average hour)	480	420	600	900	327	78%	78%	No
	B. Combined vehicle and pedestrian volume crossing artery from minor streets (average hour)	50	75	120	170	141	187%		

Notes
1. Refer to OTM Book 12, pg 88, Nov 2007
2. Lowest section percentage governs justification
3. Average hourly volumes estiamted from peak hour volumes, AHV = PM/2 or (AM + PM) / 4
4. Due to the increased uncertainty of volume projections for proposed new developments, an increased justification threshold is used in those cases. Justification 1 and Justification 2 are used only and the justification is required to be met to 120% in the case of an existing intersection and 150% in the case of a new intersection for traffic signals to be considered.

Appendix E

TDM Measures Checklist

TDM Measures Checklist:
Residential Developments (multi-family, condominium or subdivision)

Legend

BASIC — The measure is generally feasible and effective, and in most cases would benefit the development and its users

BETTER — The measure could maximize support for users of sustainable modes, and optimize development performance

★ — The measure is one of the most dependably effective tools to encourage the use of sustainable modes

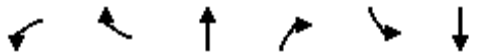
		TDM measures: *Residential developments*	Check if proposed & add descriptions
	1.	**TDM PROGRAM MANAGEMENT**	
	1.1	**Program coordinator**	
BASIC ★	1.1.1	Designate an internal coordinator, or contract with an external coordinator	☐
	1.2	**Travel surveys**	
BETTER	1.2.1	Conduct periodic surveys to identify travel-related behaviours, attitudes, challenges and solutions, and to track progress	☐
	2.	**WALKING AND CYCLING**	
	2.1	**Information on walking/cycling routes & destinations**	
BASIC	2.1.1	Display local area maps with walking/cycling access routes and key destinations at major entrances *(multi-family, condominium)*	☐
	2.2	**Bicycle skills training**	
BETTER	2.2.1	Offer on-site cycling courses for residents, or subsidize off-site courses	☐

		TDM measures: *Residential developments*	Check if proposed & add descriptions
		3. TRANSIT	
		3.1 Transit information	
BASIC		3.1.1 Display relevant transit schedules and route maps at entrances *(multi-family, condominium)*	☐
BETTER		3.1.2 Provide real-time arrival information display at entrances *(multi-family, condominium)*	☐
		3.2 Transit fare incentives	
BASIC	★	3.2.1 Offer PRESTO cards preloaded with one monthly transit pass on residence purchase/move-in, to encourage residents to use transit	☐
BETTER		3.2.2 Offer at least one year of free monthly transit passes on residence purchase/move-in	☐
		3.3 Enhanced public transit service	
BETTER	★	3.3.1 Contract with OC Transpo to provide early transit services until regular services are warranted by occupancy levels *(subdivision)*	☒ Transit service will likely be warranted soon after occupancy begins.
		3.4 Private transit service	
BETTER		3.4.1 Provide shuttle service for seniors homes or lifestyle communities (e.g. scheduled mall or supermarket runs)	☐
		4. CARSHARING & BIKESHARING	
		4.1 Bikeshare stations & memberships	
BETTER		4.1.1 Contract with provider to install on-site bikeshare station (*multi-family)*	☐
BETTER		4.1.2 Provide residents with bikeshare memberships, either free or subsidized *(multi-family)*	☐
		4.2 Carshare vehicles & memberships	
BETTER		4.2.1 Contract with provider to install on-site carshare vehicles and promote their use by residents	☐
BETTER		4.2.2 Provide residents with carshare memberships, either free or subsidized	☐
		5. PARKING	
		5.1 Priced parking	
BASIC	★	5.1.1 Unbundle parking cost from purchase price *(condominium)*	☐
BASIC	★	5.1.2 Unbundle parking cost from monthly rent *(multi-family)*	☐

TDM measures: *Residential developments*				Check if proposed & add descriptions
		6.	**TDM MARKETING & COMMUNICATIONS**	
		6.1	**Multimodal travel information**	
BASIC	★	6.1.1	Provide a multimodal travel option information package to new residents	☐
		6.2	**Personalized trip planning**	
BETTER	★	6.2.1	Offer personalized trip planning to new residents	☐

Appendix F

2018 Existing Synchro



Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (vph)	11	373	53	12	103	20
Future Volume (vph)	11	373	53	12	103	20
Ideal Flow (vphpl)	1800	1800	1800	1800	1800	1800
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.869		0.976			
Flt Protected	0.999					0.960
Satd. Flow (prot)	1549	0	1741	0	0	1713
Flt Permitted	0.999					0.960
Satd. Flow (perm)	1549	0	1741	0	0	1713
Link Speed (k/h)	70		80			80
Link Distance (m)	399.0		269.7			282.6
Travel Time (s)	20.5		12.1			12.7
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	12	414	59	13	114	22
Shared Lane Traffic (%)						
Lane Group Flow (vph)	426	0	72	0	0	136
Sign Control	Stop		Free			Free

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 45.5%		ICU Level of Service A	
Analysis Period (min) 15			

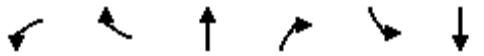
Intersection	
Int Delay, s/veh	9.1

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	11	373	53	12	103	20
Future Vol, veh/h	11	373	53	12	103	20
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	90	90	90	90	90	90
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	12	414	59	13	114	22

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	316	66	0	0	72	0
Stage 1	66	-	-	-	-	-
Stage 2	250	-	-	-	-	-
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	677	998	-	-	1528	-
Stage 1	957	-	-	-	-	-
Stage 2	792	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	626	998	-	-	1528	-
Mov Cap-2 Maneuver	626	-	-	-	-	-
Stage 1	884	-	-	-	-	-
Stage 2	792	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	11.5	0	6.3
HCM LOS	B		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	SBL	SBT
Capacity (veh/h)	-	-	981	1528	-
HCM Lane V/C Ratio	-	-	0.435	0.075	-
HCM Control Delay (s)	-	-	11.5	7.5	0
HCM Lane LOS	-	-	B	A	A
HCM 95th %tile Q(veh)	-	-	2.2	0.2	-



Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (vph)	10	192	41	6	362	40
Future Volume (vph)	10	192	41	6	362	40
Ideal Flow (vphpl)	1800	1800	1800	1800	1800	1800
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.872		0.982			
Flt Protected	0.998					0.957
Satd. Flow (prot)	1536	0	1733	0	0	1689
Flt Permitted	0.998					0.957
Satd. Flow (perm)	1536	0	1733	0	0	1689
Link Speed (mph)	43		50			50
Link Distance (ft)	1309		885			927
Travel Time (s)	20.8		12.1			12.6
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	11	213	46	7	402	44
Shared Lane Traffic (%)						
Lane Group Flow (vph)	224	0	53	0	0	446
Sign Control	Stop		Free			Free

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 49.8%		ICU Level of Service A	
Analysis Period (min) 15			

Intersection	
Int Delay, s/veh	7.8

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	10	192	41	6	362	40
Future Vol, veh/h	10	192	41	6	362	40
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	90	90	90	90	90	90
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	11	213	46	7	402	44

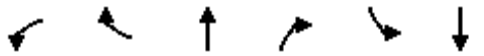
Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	898	50	0	0	53	0
Stage 1	50	-	-	-	-	-
Stage 2	848	-	-	-	-	-
Critical Hdwy	6.42	6.22	-	-	4.12	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	-	-	2.218	-
Pot Cap-1 Maneuver	310	1018	-	-	1553	-
Stage 1	972	-	-	-	-	-
Stage 2	420	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	228	1018	-	-	1553	-
Mov Cap-2 Maneuver	228	-	-	-	-	-
Stage 1	714	-	-	-	-	-
Stage 2	420	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	10.6	0	7.3
HCM LOS	B		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	SBL	SBT
Capacity (veh/h)	-	-	869	1553	-
HCM Lane V/C Ratio	-	-	0.258	0.259	-
HCM Control Delay (s)	-	-	10.6	8.1	0
HCM Lane LOS	-	-	B	A	A
HCM 95th %tile Q(veh)	-	-	1	1	-

Appendix G

2022 Future Background Synchro



Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (vph)	16	416	57	14	115	22
Future Volume (vph)	16	416	57	14	115	22
Ideal Flow (vphpl)	1800	1800	1800	1800	1800	1800
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.870		0.973			
Flt Protected	0.998					0.960
Satd. Flow (prot)	1549	0	1736	0	0	1713
Flt Permitted	0.998					0.960
Satd. Flow (perm)	1549	0	1736	0	0	1713
Link Speed (k/h)	70		80			80
Link Distance (m)	509.6		269.7			282.6
Travel Time (s)	26.2		12.1			12.7
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	16	416	57	14	115	22
Shared Lane Traffic (%)						
Lane Group Flow (vph)	432	0	71	0	0	137
Sign Control	Stop		Free			Free

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 49.4%		ICU Level of Service A	
Analysis Period (min) 15			

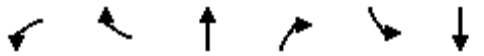
Intersection	
Int Delay, s/veh	9.2

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	16	416	57	14	115	22
Future Vol, veh/h	16	416	57	14	115	22
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	16	416	57	14	115	22

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	316	64	0	0	71	0
Stage 1	64	-	-	-	-	-
Stage 2	252	-	-	-	-	-
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	677	1000	-	-	1529	-
Stage 1	959	-	-	-	-	-
Stage 2	790	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	626	1000	-	-	1529	-
Mov Cap-2 Maneuver	626	-	-	-	-	-
Stage 1	886	-	-	-	-	-
Stage 2	790	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	11.6	0	6.3
HCM LOS	B		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	SBL	SBT
Capacity (veh/h)	-	-	978	1529	-
HCM Lane V/C Ratio	-	-	0.442	0.075	-
HCM Control Delay (s)	-	-	11.6	7.5	0
HCM Lane LOS	-	-	B	A	A
HCM 95th %tile Q(veh)	-	-	2.3	0.2	-



Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (vph)	13	214	44	11	404	43
Future Volume (vph)	13	214	44	11	404	43
Ideal Flow (vphpl)	1800	1800	1800	1800	1800	1800
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.873		0.973			
Flt Protected	0.997					0.957
Satd. Flow (prot)	1553	0	1736	0	0	1708
Flt Permitted	0.997					0.957
Satd. Flow (perm)	1553	0	1736	0	0	1708
Link Speed (k/h)	70		80			80
Link Distance (m)	509.6		269.7			282.6
Travel Time (s)	26.2		12.1			12.7
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	13	214	44	11	404	43
Shared Lane Traffic (%)						
Lane Group Flow (vph)	227	0	55	0	0	447
Sign Control	Stop		Free			Free

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 54.1%		ICU Level of Service A	
Analysis Period (min) 15			

Intersection	
Int Delay, s/veh	7.9

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	13	214	44	11	404	43
Future Vol, veh/h	13	214	44	11	404	43
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	13	214	44	11	404	43

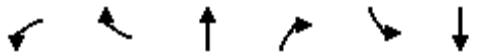
Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	901	50	0	0	55	0
Stage 1	50	-	-	-	-	-
Stage 2	851	-	-	-	-	-
Critical Hdwy	6.42	6.22	-	-	4.12	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	-	-	2.218	-
Pot Cap-1 Maneuver	309	1018	-	-	1550	-
Stage 1	972	-	-	-	-	-
Stage 2	419	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	226	1018	-	-	1550	-
Mov Cap-2 Maneuver	226	-	-	-	-	-
Stage 1	712	-	-	-	-	-
Stage 2	419	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	10.8	0	7.4
HCM LOS	B		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	SBL	SBT
Capacity (veh/h)	-	-	848	1550	-
HCM Lane V/C Ratio	-	-	0.268	0.261	-
HCM Control Delay (s)	-	-	10.8	8.1	0
HCM Lane LOS	-	-	B	A	A
HCM 95th %tile Q(veh)	-	-	1.1	1.1	-

Appendix H

2027 Future Background Synchro



Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (vph)	52	721	83	32	250	58
Future Volume (vph)	52	721	83	32	250	58
Ideal Flow (vphpl)	1800	1800	1800	1800	1800	1800
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.874		0.962			
Flt Protected	0.997					0.961
Satd. Flow (prot)	1555	0	1717	0	0	1715
Flt Permitted	0.997					0.961
Satd. Flow (perm)	1555	0	1717	0	0	1715
Link Speed (k/h)	70		80			80
Link Distance (m)	509.6		269.7			282.6
Travel Time (s)	26.2		12.1			12.7
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	52	721	83	32	250	58
Shared Lane Traffic (%)						
Lane Group Flow (vph)	773	0	115	0	0	308
Sign Control	Stop		Free			Free

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 81.3%		ICU Level of Service D	
Analysis Period (min) 15			

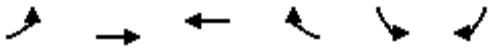
Intersection	
Int Delay, s/veh	23.4

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	52	721	83	32	250	58
Future Vol, veh/h	52	721	83	32	250	58
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	52	721	83	32	250	58

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	657	99	0	0	115	0
Stage 1	99	-	-	-	-	-
Stage 2	558	-	-	-	-	-
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	430	957	-	-	1474	-
Stage 1	925	-	-	-	-	-
Stage 2	573	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	355	957	-	-	1474	-
Mov Cap-2 Maneuver	355	-	-	-	-	-
Stage 1	763	-	-	-	-	-
Stage 2	573	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	33.6	0	6.4
HCM LOS	D		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	SBL	SBT
Capacity (veh/h)	-	-	859	1474	-
HCM Lane V/C Ratio	-	-	0.9	0.17	-
HCM Control Delay (s)	-	-	33.6	7.9	0
HCM Lane LOS	-	-	D	A	A
HCM 95th %tile Q(veh)	-	-	12.5	0.6	-



Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	49	227	552	130	282	104
Future Volume (vph)	49	227	552	130	282	104
Ideal Flow (vphpl)	1800	1800	1800	1800	1800	1800
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.974		0.964	
Flt Protected		0.991			0.965	
Satd. Flow (prot)	0	1768	1738	0	1660	0
Flt Permitted		0.991			0.965	
Satd. Flow (perm)	0	1768	1738	0	1660	0
Link Speed (k/h)		70	70		50	
Link Distance (m)		509.6	247.9		283.1	
Travel Time (s)		26.2	12.7		20.4	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	49	227	552	130	282	104
Shared Lane Traffic (%)						
Lane Group Flow (vph)	0	276	682	0	386	0
Sign Control		Free	Free		Stop	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 86.8%		ICU Level of Service E	
Analysis Period (min) 15			

Intersection	
Int Delay, s/veh	48.5

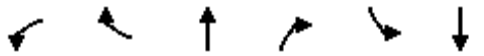
Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	49	227	552	130	282	104
Future Vol, veh/h	49	227	552	130	282	104
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	-	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	49	227	552	130	282	104

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	682	0	-	0	942	617
Stage 1	-	-	-	-	617	-
Stage 2	-	-	-	-	325	-
Critical Hdwy	4.12	-	-	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	2.218	-	-	-	3.518	3.318
Pot Cap-1 Maneuver	911	-	-	-	292	490
Stage 1	-	-	-	-	538	-
Stage 2	-	-	-	-	732	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	911	-	-	-	~ 274	490
Mov Cap-2 Maneuver	-	-	-	-	~ 274	-
Stage 1	-	-	-	-	505	-
Stage 2	-	-	-	-	732	-

Approach	EB	WB	SB
HCM Control Delay, s	1.6	0	167.8
HCM LOS			F

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	911	-	-	-	311
HCM Lane V/C Ratio	0.054	-	-	-	1.241
HCM Control Delay (s)	9.2	0	-	-	167.8
HCM Lane LOS	A	A	-	-	F
HCM 95th %tile Q(veh)	0.2	-	-	-	17.6

Notes			
~: Volume exceeds capacity	$: Delay exceeds 300s	+: Computation Not Defined	*: All major volume in platoon



Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (vph)	39	420	78	44	692	69
Future Volume (vph)	39	420	78	44	692	69
Ideal Flow (vphpl)	1800	1800	1800	1800	1800	1800
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.876		0.951			
Flt Protected	0.996					0.957
Satd. Flow (prot)	1557	0	1697	0	0	1708
Flt Permitted	0.996					0.957
Satd. Flow (perm)	1557	0	1697	0	0	1708
Link Speed (k/h)	71		80			80
Link Distance (m)	509.6		269.7			282.6
Travel Time (s)	25.8		12.1			12.7
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	39	420	78	44	692	69
Shared Lane Traffic (%)						
Lane Group Flow (vph)	459	0	122	0	0	761
Sign Control	Stop		Free			Free

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 91.1%		ICU Level of Service F	
Analysis Period (min) 15			

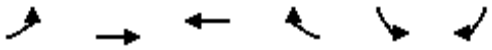
Intersection	
Int Delay, s/veh	34.8

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	39	420	78	44	692	69
Future Vol, veh/h	39	420	78	44	692	69
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	39	420	78	44	692	69

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	1553	100	0	0	122	0
Stage 1	100	-	-	-	-	-
Stage 2	1453	-	-	-	-	-
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	125	956	-	-	1465	-
Stage 1	924	-	-	-	-	-
Stage 2	215	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	64	956	-	-	1465	-
Mov Cap-2 Maneuver	64	-	-	-	-	-
Stage 1	470	-	-	-	-	-
Stage 2	215	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	87.2	0	8.8
HCM LOS	F		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	SBL	SBT
Capacity (veh/h)	-	-	438	1465	-
HCM Lane V/C Ratio	-	-	1.048	0.472	-
HCM Control Delay (s)	-	-	87.2	9.6	0
HCM Lane LOS	-	-	F	A	A
HCM 95th %tile Q(veh)	-	-	14.5	2.6	-



Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	100	518	335	273	196	73
Future Volume (vph)	100	518	335	273	196	73
Ideal Flow (vphpl)	1800	1800	1800	1800	1800	1800
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.939		0.963	
Flt Protected		0.992			0.965	
Satd. Flow (prot)	0	1770	1675	0	1658	0
Flt Permitted		0.992			0.965	
Satd. Flow (perm)	0	1770	1675	0	1658	0
Link Speed (k/h)		48	71		48	
Link Distance (m)		509.6	247.9		283.1	
Travel Time (s)		38.2	12.6		21.2	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	100	518	335	273	196	73
Shared Lane Traffic (%)						
Lane Group Flow (vph)	0	618	608	0	269	0
Sign Control		Free	Free		Stop	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 97.0%		ICU Level of Service F	
Analysis Period (min) 15			

Intersection	
Int Delay, s/veh	33.2

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	100	518	335	273	196	73
Future Vol, veh/h	100	518	335	273	196	73
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
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	100	518	335	273	196	73

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	608	0	-	0	1190	472
Stage 1	-	-	-	-	472	-
Stage 2	-	-	-	-	718	-
Critical Hdwy	4.12	-	-	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	2.218	-	-	-	3.518	3.318
Pot Cap-1 Maneuver	970	-	-	-	207	592
Stage 1	-	-	-	-	628	-
Stage 2	-	-	-	-	483	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	970	-	-	-	~ 177	592
Mov Cap-2 Maneuver	-	-	-	-	~ 177	-
Stage 1	-	-	-	-	537	-
Stage 2	-	-	-	-	483	-

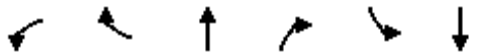
Approach	EB	WB	SB
HCM Control Delay, s	1.5	0	181.1
HCM LOS			F

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	970	-	-	-	219
HCM Lane V/C Ratio	0.103	-	-	-	1.228
HCM Control Delay (s)	9.1	0	-	-	181.1
HCM Lane LOS	A	A	-	-	F
HCM 95th %tile Q(veh)	0.3	-	-	-	13.6

Notes			
~: Volume exceeds capacity	$: Delay exceeds 300s	+: Computation Not Defined	*: All major volume in platoon

Appendix I

2022 Total Future Synchro



Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (vph)	26	534	57	19	174	22
Future Volume (vph)	26	534	57	19	174	22
Ideal Flow (vphpl)	1800	1800	1800	1800	1800	1800
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.871		0.966			
Flt Protected	0.998					0.957
Satd. Flow (prot)	1551	0	1724	0	0	1708
Flt Permitted	0.998					0.957
Satd. Flow (perm)	1551	0	1724	0	0	1708
Link Speed (k/h)	70		80			80
Link Distance (m)	509.6		269.7			282.6
Travel Time (s)	26.2		12.1			12.7
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	26	534	57	19	174	22
Shared Lane Traffic (%)						
Lane Group Flow (vph)	560	0	76	0	0	196
Sign Control	Stop		Free			Free

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 61.1%		ICU Level of Service B	
Analysis Period (min) 15			

Intersection	
Int Delay, s/veh	11

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	26	534	57	19	174	22
Future Vol, veh/h	26	534	57	19	174	22
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	26	534	57	19	174	22

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	437	67	0	0	76	0
Stage 1	67	-	-	-	-	-
Stage 2	370	-	-	-	-	-
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	577	997	-	-	1523	-
Stage 1	956	-	-	-	-	-
Stage 2	699	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	510	997	-	-	1523	-
Mov Cap-2 Maneuver	510	-	-	-	-	-
Stage 1	845	-	-	-	-	-
Stage 2	699	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	14	0	6.8
HCM LOS	B		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	SBL	SBT
Capacity (veh/h)	-	-	955	1523	-
HCM Lane V/C Ratio	-	-	0.586	0.114	-
HCM Control Delay (s)	-	-	14	7.7	0
HCM Lane LOS	-	-	B	A	A
HCM 95th %tile Q(veh)	-	-	3.9	0.4	-

Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (vph)	129	64	34	432	127	69
Future Volume (vph)	129	64	34	432	127	69
Ideal Flow (vphpl)	1800	1800	1800	1800	1800	1800
Storage Length (m)		0.0	15.0		0.0	0.0
Storage Lanes		0	1		1	0
Taper Length (m)			7.6		7.6	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.955				0.952	
Flt Protected			0.950		0.969	
Satd. Flow (prot)	1704	0	1695	1784	1646	0
Flt Permitted			0.950		0.969	
Satd. Flow (perm)	1704	0	1695	1784	1646	0
Link Speed (k/h)	70			70	50	
Link Distance (m)	509.6			247.9	230.8	
Travel Time (s)	26.2			12.7	16.6	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	129	64	34	432	127	69
Shared Lane Traffic (%)						
Lane Group Flow (vph)	193	0	34	432	196	0
Sign Control	Free			Free	Stop	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 42.5%		ICU Level of Service A	
Analysis Period (min) 15			

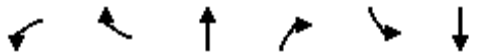
Intersection	
Int Delay, s/veh	4.1

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	129	64	34	432	127	69
Future Vol, veh/h	129	64	34	432	127	69
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	150	-	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	129	64	34	432	127	69

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	193	0	661	161
Stage 1	-	-	-	-	161	-
Stage 2	-	-	-	-	500	-
Critical Hdwy	-	-	4.12	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	-	-	2.218	-	3.518	3.318
Pot Cap-1 Maneuver	-	-	1380	-	427	884
Stage 1	-	-	-	-	868	-
Stage 2	-	-	-	-	609	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1380	-	416	884
Mov Cap-2 Maneuver	-	-	-	-	416	-
Stage 1	-	-	-	-	846	-
Stage 2	-	-	-	-	609	-

Approach	EB	WB	NB
HCM Control Delay, s	0	0.6	16.4
HCM LOS			C

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	511	-	-	1380	-
HCM Lane V/C Ratio	0.384	-	-	0.025	-
HCM Control Delay (s)	16.4	-	-	7.7	-
HCM Lane LOS	C	-	-	A	-
HCM 95th %tile Q(veh)	1.8	-	-	0.1	-



Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (vph)	20	302	44	20	517	43
Future Volume (vph)	20	302	44	20	517	43
Ideal Flow (vphpl)	1800	1800	1800	1800	1800	1800
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.873		0.958			
Flt Protected	0.997					0.956
Satd. Flow (prot)	1553	0	1709	0	0	1706
Flt Permitted	0.997					0.956
Satd. Flow (perm)	1553	0	1709	0	0	1706
Link Speed (k/h)	70		80			80
Link Distance (m)	509.6		269.7			282.6
Travel Time (s)	26.2		12.1			12.7
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	20	302	44	20	517	43
Shared Lane Traffic (%)						
Lane Group Flow (vph)	322	0	64	0	0	560
Sign Control	Stop		Free			Free

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 66.8%		ICU Level of Service C	
Analysis Period (min) 15			

Intersection	
Int Delay, s/veh	9.3

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	20	302	44	20	517	43
Future Vol, veh/h	20	302	44	20	517	43
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	20	302	44	20	517	43

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	1131	54	0	0	64	0
Stage 1	54	-	-	-	-	-
Stage 2	1077	-	-	-	-	-
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	225	1013	-	-	1538	-
Stage 1	969	-	-	-	-	-
Stage 2	327	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	148	1013	-	-	1538	-
Mov Cap-2 Maneuver	148	-	-	-	-	-
Stage 1	636	-	-	-	-	-
Stage 2	327	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	13.5	0	7.9
HCM LOS	B		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	SBL	SBT
Capacity (veh/h)	-	-	743	1538	-
HCM Lane V/C Ratio	-	-	0.433	0.336	-
HCM Control Delay (s)	-	-	13.5	8.5	0
HCM Lane LOS	-	-	B	A	A
HCM 95th %tile Q(veh)	-	-	2.2	1.5	-

Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (vph)	415	123	65	227	96	50
Future Volume (vph)	415	123	65	227	96	50
Ideal Flow (vphpl)	1800	1800	1800	1800	1800	1800
Storage Length (m)		0.0	15.0		0.0	0.0
Storage Lanes		0	1		1	0
Taper Length (m)			7.6		7.6	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.969				0.954	
Flt Protected			0.950		0.968	
Satd. Flow (prot)	1729	0	1695	1784	1648	0
Flt Permitted			0.950		0.968	
Satd. Flow (perm)	1729	0	1695	1784	1648	0
Link Speed (k/h)	70			70	50	
Link Distance (m)	509.6			247.9	230.8	
Travel Time (s)	26.2			12.7	16.6	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	415	123	65	227	96	50
Shared Lane Traffic (%)						
Lane Group Flow (vph)	538	0	65	227	146	0
Sign Control	Free			Free	Stop	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 53.6%		ICU Level of Service A	
Analysis Period (min) 15			

Intersection	
Int Delay, s/veh	3.6

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	415	123	65	227	96	50
Future Vol, veh/h	415	123	65	227	96	50
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	150	-	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	415	123	65	227	96	50

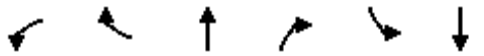
Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	538	0	834	477
Stage 1	-	-	-	-	477	-
Stage 2	-	-	-	-	357	-
Critical Hdwy	-	-	4.12	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	-	-	2.218	-	3.518	3.318
Pot Cap-1 Maneuver	-	-	1030	-	338	588
Stage 1	-	-	-	-	624	-
Stage 2	-	-	-	-	708	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1030	-	317	588
Mov Cap-2 Maneuver	-	-	-	-	317	-
Stage 1	-	-	-	-	585	-
Stage 2	-	-	-	-	708	-

Approach	EB	WB	NB
HCM Control Delay, s	0	1.9	20.5
HCM LOS			C

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	376	-	-	1030	-
HCM Lane V/C Ratio	0.388	-	-	0.063	-
HCM Control Delay (s)	20.5	-	-	8.7	-
HCM Lane LOS	C	-	-	A	-
HCM 95th %tile Q(veh)	1.8	-	-	0.2	-

Appendix J

2027 Total Future Synchro



Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (vph)	52	721	83	32	250	58
Future Volume (vph)	52	721	83	32	250	58
Ideal Flow (vphpl)	1800	1800	1800	1800	1800	1800
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.874		0.962			
Flt Protected	0.997					0.961
Satd. Flow (prot)	1555	0	1717	0	0	1715
Flt Permitted	0.997					0.961
Satd. Flow (perm)	1555	0	1717	0	0	1715
Link Speed (k/h)	69		80			80
Link Distance (m)	509.6		269.7			282.6
Travel Time (s)	26.6		12.1			12.7
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	52	721	83	32	250	58
Shared Lane Traffic (%)						
Lane Group Flow (vph)	773	0	115	0	0	308
Sign Control	Stop		Free			Free

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 81.3%		ICU Level of Service D	
Analysis Period (min) 15			

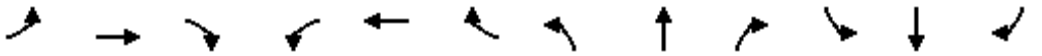
Intersection	
Int Delay, s/veh	23.4

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	52	721	83	32	250	58
Future Vol, veh/h	52	721	83	32	250	58
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	52	721	83	32	250	58

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	657	99	0	0	115	0
Stage 1	99	-	-	-	-	-
Stage 2	558	-	-	-	-	-
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	430	957	-	-	1474	-
Stage 1	925	-	-	-	-	-
Stage 2	573	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	355	957	-	-	1474	-
Mov Cap-2 Maneuver	355	-	-	-	-	-
Stage 1	763	-	-	-	-	-
Stage 2	573	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	33.6	0	6.4
HCM LOS	D		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	SBL	SBT
Capacity (veh/h)	-	-	859	1474	-
HCM Lane V/C Ratio	-	-	0.9	0.17	-
HCM Control Delay (s)	-	-	33.6	7.9	0
HCM Lane LOS	-	-	D	A	A
HCM 95th %tile Q(veh)	-	-	12.5	0.6	-



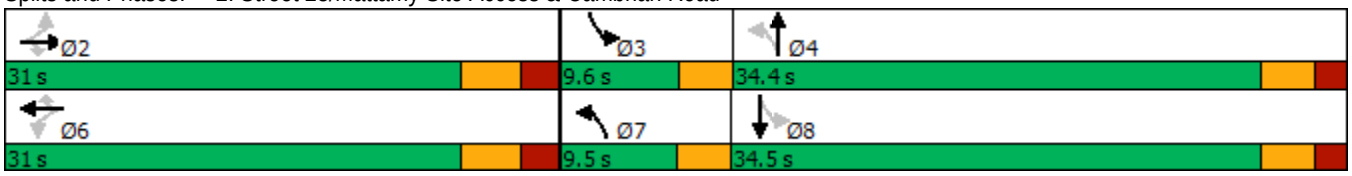
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	49	227	64	34	552	130	127	5	69	282	5	104
Future Volume (vph)	49	227	64	34	552	130	127	5	69	282	5	104
Ideal Flow (vphpl)	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800
Storage Length (m)	40.0		10.0	15.0		10.0	20.0		0.0	70.0		0.0
Storage Lanes	1		1	1		1	1		0	1		0
Taper Length (m)	7.6			7.6			7.6			7.6		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.850			0.850		0.860			0.857	
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1695	1784	1517	1695	1784	1517	1695	1535	0	1695	1529	0
Flt Permitted	0.296			0.617			0.727			0.471		
Satd. Flow (perm)	528	1784	1517	1101	1784	1517	1297	1535	0	840	1529	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			71			71		69			104	
Link Speed (k/h)		69			69			50			50	
Link Distance (m)		509.6			247.9			230.8			283.1	
Travel Time (s)		26.6			12.9			16.6			20.4	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	49	227	64	34	552	130	127	5	69	282	5	104
Shared Lane Traffic (%)												
Lane Group Flow (vph)	49	227	64	34	552	130	127	74	0	282	109	0
Turn Type	Perm	NA	Perm	Perm	NA	Perm	pm+pt	NA		pm+pt	NA	
Protected Phases		2			6		7	4		3	8	
Permitted Phases	2		2	6		6	4			8		
Detector Phase	2	2	2	6	6	6	7	4		3	8	
Switch Phase												
Minimum Initial (s)	10.0	10.0	10.0	10.0	10.0	10.0	5.0	10.0		5.0	10.0	
Minimum Split (s)	30.8	30.8	30.8	30.8	30.8	30.8	9.5	34.4		9.5	34.4	
Total Split (s)	31.0	31.0	31.0	31.0	31.0	31.0	9.5	34.4		9.6	34.5	
Total Split (%)	41.3%	41.3%	41.3%	41.3%	41.3%	41.3%	12.7%	45.9%		12.8%	46.0%	
Maximum Green (s)	25.5	25.5	25.5	25.5	25.5	25.5	6.5	29.5		6.6	29.6	
Yellow Time (s)	3.3	3.3	3.3	3.3	3.3	3.3	3.0	3.0		3.0	3.0	
All-Red Time (s)	2.2	2.2	2.2	2.2	2.2	2.2	0.0	1.9		0.0	1.9	
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Total Lost Time (s)	5.5	5.5	5.5	5.5	5.5	5.5	3.0	4.9		3.0	4.9	
Lead/Lag							Lead	Lag		Lead	Lag	
Lead-Lag Optimize?							Yes	Yes		Yes	Yes	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0		3.0	3.0	
Recall Mode	Min	Min	Min	Min	Min	Min	None	None		None	None	
Walk Time (s)	7.0	7.0	7.0	7.0	7.0	7.0		7.0			7.0	
Flash Dont Walk (s)	18.0	18.0	18.0	18.0	18.0	18.0		21.0			21.0	
Pedestrian Calls (#/hr)	0	0	0	0	0	0		0			0	
Act Effct Green (s)	22.2	22.2	22.2	22.2	22.2	22.2	13.1	10.3		17.8	10.4	
Actuated g/C Ratio	0.44	0.44	0.44	0.44	0.44	0.44	0.26	0.20		0.35	0.21	
v/c Ratio	0.21	0.29	0.09	0.07	0.70	0.18	0.33	0.20		0.58	0.27	
Control Delay	11.9	10.6	2.8	9.0	17.6	5.5	15.1	8.4		20.5	7.8	
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Total Delay	11.9	10.6	2.8	9.0	17.6	5.5	15.1	8.4		20.5	7.8	

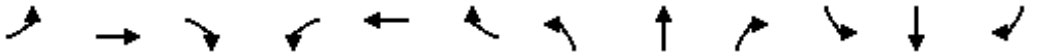
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
LOS	B	B	A	A	B	A	B	A		C	A	
Approach Delay		9.3			15.0			12.6			17.0	
Approach LOS		A			B			B			B	
Queue Length 50th (m)	2.7	13.2	0.0	1.8	40.5	3.1	7.9	0.4		19.6	0.4	
Queue Length 95th (m)	8.6	24.9	4.4	5.6	69.8	10.5	17.2	8.9		#36.3	10.6	
Internal Link Dist (m)		485.6			223.9			206.8			259.1	
Turn Bay Length (m)	40.0		10.0	15.0		10.0	20.0			70.0		
Base Capacity (vph)	275	932	826	575	932	826	393	955		487	968	
Starvation Cap Reductn	0	0	0	0	0	0	0	0		0	0	
Spillback Cap Reductn	0	0	0	0	0	0	0	0		0	0	
Storage Cap Reductn	0	0	0	0	0	0	0	0		0	0	
Reduced v/c Ratio	0.18	0.24	0.08	0.06	0.59	0.16	0.32	0.08		0.58	0.11	

Intersection Summary			
Area Type:	Other		
Cycle Length: 75			
Actuated Cycle Length: 50.4			
Natural Cycle: 75			
Control Type: Actuated-Uncoordinated			
Maximum v/c Ratio: 0.70			
Intersection Signal Delay: 14.0		Intersection LOS: B	
Intersection Capacity Utilization 74.8%		ICU Level of Service D	
Analysis Period (min) 15			

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

Splits and Phases: 2: Street 23/Mattamy Site Access & Cambrian Road





Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	49	227	64	34	552	130	127	5	69	282	5	104
Future Volume (veh/h)	49	227	64	34	552	130	127	5	69	282	5	104
Number	5	2	12	1	6	16	7	4	14	3	8	18
Initial Q, veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj (A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1765	1765	1765	1765	1765	1765	1765	1765	1800	1765	1765	1800
Adj Flow Rate, veh/h	49	227	64	34	552	130	127	5	69	282	5	104
Adj No. of Lanes	1	1	1	1	1	1	1	1	0	1	1	0
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Opposing Right Turn Influence	Yes			Yes			Yes			Yes		
Cap, veh/h	254	734	624	498	734	624	511	20	273	558	17	344
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Prop Arrive On Green	0.42	0.42	0.42	0.42	0.42	0.42	0.08	0.19	0.19	0.13	0.24	0.24
Ln Grp Delay, s/veh	20.1	10.3	9.2	11.9	15.7	9.7	14.7	0.0	17.9	14.0	0.0	16.4
Ln Grp LOS	C	B	A	B	B	A	B		B	B		B
Approach Vol, veh/h		340			716			201			391	
Approach Delay, s/veh		11.5			14.4			15.9			14.7	
Approach LOS		B			B			B			B	

Timer:	1	2	3	4	5	6	7	8
Assigned Phs		2	3	4		6	7	8
Case No		5.0	1.1	4.0		5.0	1.1	4.0
Phs Duration (G+Y+Rc), s		26.8	9.6	14.8		26.8	7.3	17.1
Change Period (Y+Rc), s		5.5	3.0	* 4.9		5.5	3.0	* 4.9
Max Green (Gmax), s		25.5	6.6	* 30		25.5	6.5	* 30
Max Allow Headway (MAH), s		7.8	5.2	9.2		7.9	5.2	9.2
Max Q Clear (g_c+I1), s		18.6	8.6	4.1		15.6	5.0	5.0
Green Ext Time (g_e), s		1.9	0.0	1.0		5.7	0.1	1.5
Prob of Phs Call (p_c)		1.00	0.98	0.99		1.00	0.84	1.00
Prob of Max Out (p_x)		1.00	1.00	0.00		0.88	1.00	0.01

Left-Turn Movement Data								
Assigned Mvmt		5	3			1	7	
Mvmt Sat Flow, veh/h		756	1681			1084	1681	

Through Movement Data								
Assigned Mvmt		2		4		6		8
Mvmt Sat Flow, veh/h		1765		102		1765		69

Right-Turn Movement Data								
Assigned Mvmt		12		14		16		18
Mvmt Sat Flow, veh/h		1500		1413		1500		1441

Left Lane Group Data								
Assigned Mvmt	0	5	3	0	0	1	7	0
Lane Assignment			(Pr/Pm)				(Pr/Pm)	

Lanes in Grp	0	1	1	0	0	1	1	0
Grp Vol (v), veh/h	0	49	282	0	0	34	127	0
Grp Sat Flow (s), veh/h/ln	0	756	1681	0	0	1084	1681	0
Q Serve Time (g_s), s	0.0	3.0	6.6	0.0	0.0	1.1	3.0	0.0
Cycle Q Clear Time (g_c), s	0.0	16.6	6.6	0.0	0.0	5.5	3.0	0.0
Perm LT Sat Flow (s_l), veh/h/ln	0	756	1320	0	0	1084	1279	0
Shared LT Sat Flow (s_sh), veh/h/ln	0	0	0	0	0	0	0	0
Perm LT Eff Green (g_p), s	0.0	21.3	11.2	0.0	0.0	21.3	9.9	0.0
Perm LT Serve Time (g_u), s	0.0	7.7	7.8	0.0	0.0	16.9	9.2	0.0
Perm LT Q Serve Time (g_ps), s	0.0	3.0	1.1	0.0	0.0	1.1	0.1	0.0
Time to First Blk (g_f), s	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Serve Time pre Blk (g_fs), s	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Prop LT Inside Lane (P_L)	0.00	1.00	1.00	0.00	0.00	1.00	1.00	0.00
Lane Grp Cap (c), veh/h	0	254	558	0	0	498	511	0
V/C Ratio (X)	0.00	0.19	0.51	0.00	0.00	0.07	0.25	0.00
Avail Cap (c_a), veh/h	0	317	558	0	0	588	584	0
Upstream Filter (I)	0.00	1.00	1.00	0.00	0.00	1.00	1.00	0.00
Uniform Delay (d1), s/veh	0.0	19.8	13.2	0.0	0.0	11.9	14.5	0.0
Incr Delay (d2), s/veh	0.0	0.4	0.7	0.0	0.0	0.1	0.3	0.0
Initial Q Delay (d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (d), s/veh	0.0	20.1	14.0	0.0	0.0	11.9	14.7	0.0
1st-Term Q (Q1), veh/ln	0.0	0.6	3.0	0.0	0.0	0.3	1.4	0.0
2nd-Term Q (Q2), veh/ln	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0
3rd-Term Q (Q3), veh/ln	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile Back of Q Factor (f_B%)	0.00	1.00	1.00	0.00	0.00	1.00	1.00	0.00
%ile Back of Q (50%), veh/ln	0.0	0.7	3.1	0.0	0.0	0.3	1.4	0.0
%ile Storage Ratio (RQ%)	0.00	3.60	10.38	0.00	0.00	5.23	15.57	0.00
Initial Q (Qb), veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Final (Residual) Q (Qe), veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sat Delay (ds), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sat Q (Qs), veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sat Cap (cs), veh/h	0	0	0	0	0	0	0	0
Initial Q Clear Time (tc), h	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Middle Lane Group Data								
Assigned Mvmt	0	2	0	4	0	6	0	8
Lane Assignment		T				T		
Lanes in Grp	0	1	0	0	0	1	0	0
Grp Vol (v), veh/h	0	227	0	0	0	552	0	0
Grp Sat Flow (s), veh/h/ln	0	1765	0	0	0	1765	0	0
Q Serve Time (g_s), s	0.0	4.4	0.0	0.0	0.0	13.6	0.0	0.0
Cycle Q Clear Time (g_c), s	0.0	4.4	0.0	0.0	0.0	13.6	0.0	0.0
Lane Grp Cap (c), veh/h	0	734	0	0	0	734	0	0
V/C Ratio (X)	0.00	0.31	0.00	0.00	0.00	0.75	0.00	0.00
Avail Cap (c_a), veh/h	0	880	0	0	0	880	0	0
Upstream Filter (I)	0.00	1.00	0.00	0.00	0.00	1.00	0.00	0.00
Uniform Delay (d1), s/veh	0.0	10.0	0.0	0.0	0.0	12.7	0.0	0.0
Incr Delay (d2), s/veh	0.0	0.2	0.0	0.0	0.0	3.0	0.0	0.0
Initial Q Delay (d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (d), s/veh	0.0	10.3	0.0	0.0	0.0	15.7	0.0	0.0
1st-Term Q (Q1), veh/ln	0.0	2.1	0.0	0.0	0.0	6.6	0.0	0.0

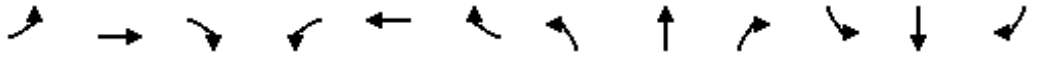
2nd-Term Q (Q2), veh/ln	0.0	0.0	0.0	0.0	0.0	0.6	0.0	0.0
3rd-Term Q (Q3), veh/ln	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile Back of Q Factor (f_B%)	0.00	1.00	0.00	1.00	0.00	1.00	0.00	1.00
%ile Back of Q (50%), veh/ln	0.0	2.2	0.0	0.0	0.0	7.2	0.0	0.0
%ile Storage Ratio (RQ%)	0.00	1.05	0.00	0.00	0.00	7.14	0.00	0.00
Initial Q (Qb), veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Final (Residual) Q (Qe), veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sat Delay (ds), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sat Q (Qs), veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sat Cap (cs), veh/h	0	0	0	0	0	0	0	0
Initial Q Clear Time (tc), h	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Right Lane Group Data								
Assigned Mvmt	0	12	0	14	0	16	0	18
Lane Assignment		R		T+R		R		T+R
Lanes in Grp	0	1	0	1	0	1	0	1
Grp Vol (v), veh/h	0	64	0	74	0	130	0	109
Grp Sat Flow (s), veh/h/ln	0	1500	0	1515	0	1500	0	1510
Q Serve Time (g_s), s	0.0	1.3	0.0	2.1	0.0	2.8	0.0	3.0
Cycle Q Clear Time (g_c), s	0.0	1.3	0.0	2.1	0.0	2.8	0.0	3.0
Prot RT Sat Flow (s_R), veh/h/ln	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Prot RT Eff Green (g_R), s	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Prop RT Outside Lane (P_R)	0.00	1.00	0.00	0.93	0.00	1.00	0.00	0.95
Lane Grp Cap (c), veh/h	0	624	0	293	0	624	0	361
V/C Ratio (X)	0.00	0.10	0.00	0.25	0.00	0.21	0.00	0.30
Avail Cap (c_a), veh/h	0	748	0	874	0	748	0	874
Upstream Filter (I)	0.00	1.00	0.00	1.00	0.00	1.00	0.00	1.00
Uniform Delay (d1), s/veh	0.0	9.1	0.0	17.5	0.0	9.6	0.0	16.0
Incr Delay (d2), s/veh	0.0	0.1	0.0	0.4	0.0	0.2	0.0	0.5
Initial Q Delay (d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (d), s/veh	0.0	9.2	0.0	17.9	0.0	9.7	0.0	16.4
1st-Term Q (Q1), veh/ln	0.0	0.6	0.0	0.9	0.0	1.2	0.0	1.2
2nd-Term Q (Q2), veh/ln	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3rd-Term Q (Q3), veh/ln	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile Back of Q Factor (f_B%)	0.00	1.00	0.00	1.00	0.00	1.00	0.00	1.00
%ile Back of Q (50%), veh/ln	0.0	0.6	0.0	0.9	0.0	1.2	0.0	1.3
%ile Storage Ratio (RQ%)	0.00	10.87	0.00	1.00	0.00	22.85	0.00	1.12
Initial Q (Qb), veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Final (Residual) Q (Qe), veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sat Delay (ds), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sat Q (Qs), veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sat Cap (cs), veh/h	0	0	0	0	0	0	0	0
Initial Q Clear Time (tc), h	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Intersection Summary	
HCM 2010 Ctrl Delay	14.1
HCM 2010 LOS	B

Notes

* HCM 2010 computational engine requires equal clearance times for the phases crossing the barrier.

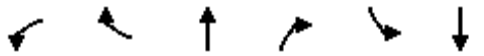


Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	49	227	64	34	552	130	127	5	69	282	5	104
Future Volume (veh/h)	49	227	64	34	552	130	127	5	69	282	5	104
Number	5	2	12	1	6	16	7	4	14	3	8	18
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1765	1765	1765	1765	1765	1765	1765	1765	1800	1765	1765	1800
Adj Flow Rate, veh/h	49	227	64	34	552	130	127	5	69	282	5	104
Adj No. of Lanes	1	1	1	1	1	1	1	1	0	1	1	0
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	254	734	624	498	734	624	511	20	273	558	17	344
Arrive On Green	0.42	0.42	0.42	0.42	0.42	0.42	0.08	0.19	0.19	0.13	0.24	0.24
Sat Flow, veh/h	756	1765	1500	1084	1765	1500	1681	102	1413	1681	69	1441
Grp Volume(v), veh/h	49	227	64	34	552	130	127	0	74	282	0	109
Grp Sat Flow(s),veh/h/ln	756	1765	1500	1084	1765	1500	1681	0	1515	1681	0	1510
Q Serve(g_s), s	3.0	4.4	1.3	1.1	13.6	2.8	3.0	0.0	2.1	6.6	0.0	3.0
Cycle Q Clear(g_c), s	16.6	4.4	1.3	5.5	13.6	2.8	3.0	0.0	2.1	6.6	0.0	3.0
Prop In Lane	1.00		1.00	1.00		1.00	1.00		0.93	1.00		0.95
Lane Grp Cap(c), veh/h	254	734	624	498	734	624	511	0	293	558	0	361
V/C Ratio(X)	0.19	0.31	0.10	0.07	0.75	0.21	0.25	0.00	0.25	0.51	0.00	0.30
Avail Cap(c_a), veh/h	317	880	748	588	880	748	584	0	874	558	0	874
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	19.8	10.0	9.1	11.9	12.7	9.6	14.5	0.0	17.5	13.2	0.0	16.0
Incr Delay (d2), s/veh	0.4	0.2	0.1	0.1	3.0	0.2	0.3	0.0	0.4	0.7	0.0	0.5
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.7	2.2	0.6	0.3	7.2	1.2	1.4	0.0	0.9	3.1	0.0	1.3
LnGrp Delay(d),s/veh	20.1	10.3	9.2	11.9	15.7	9.7	14.7	0.0	17.9	14.0	0.0	16.4
LnGrp LOS	C	B	A	B	B	A	B		B	B		B
Approach Vol, veh/h		340			716			201			391	
Approach Delay, s/veh		11.5			14.4			15.9			14.7	
Approach LOS		B			B			B			B	

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2	3	4		6	7	8
Phs Duration (G+Y+Rc), s		26.8	9.6	14.8		26.8	7.3	17.1
Change Period (Y+Rc), s		5.5	3.0	* 4.9		5.5	3.0	* 4.9
Max Green Setting (Gmax), s		25.5	6.6	* 30		25.5	6.5	* 30
Max Q Clear Time (g_c+I1), s		18.6	8.6	4.1		15.6	5.0	5.0
Green Ext Time (p_c), s		1.9	0.0	1.0		5.7	0.1	1.5

Intersection Summary	
HCM 2010 Ctrl Delay	14.1
HCM 2010 LOS	B

Notes



Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (vph)	39	420	78	44	692	69
Future Volume (vph)	39	420	78	44	692	69
Ideal Flow (vphpl)	1800	1800	1800	1800	1800	1800
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.876		0.951			
Flt Protected	0.996					0.957
Satd. Flow (prot)	1557	0	1697	0	0	1708
Flt Permitted	0.996					0.957
Satd. Flow (perm)	1557	0	1697	0	0	1708
Link Speed (k/h)	69		80			80
Link Distance (m)	509.6		269.7			282.6
Travel Time (s)	26.6		12.1			12.7
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	39	420	78	44	692	69
Shared Lane Traffic (%)						
Lane Group Flow (vph)	459	0	122	0	0	761
Sign Control	Stop		Free			Free

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 91.1%		ICU Level of Service F	
Analysis Period (min) 15			

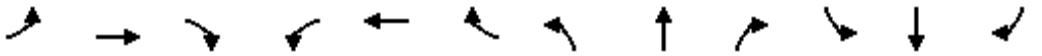
Intersection	
Int Delay, s/veh	34.8

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	39	420	78	44	692	69
Future Vol, veh/h	39	420	78	44	692	69
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	39	420	78	44	692	69

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	1553	100	0	0	122	0
Stage 1	100	-	-	-	-	-
Stage 2	1453	-	-	-	-	-
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	125	956	-	-	1465	-
Stage 1	924	-	-	-	-	-
Stage 2	215	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	64	956	-	-	1465	-
Mov Cap-2 Maneuver	64	-	-	-	-	-
Stage 1	470	-	-	-	-	-
Stage 2	215	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	87.2	0	8.8
HCM LOS	F		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	SBL	SBT
Capacity (veh/h)	-	-	438	1465	-
HCM Lane V/C Ratio	-	-	1.048	0.472	-
HCM Control Delay (s)	-	-	87.2	9.6	0
HCM Lane LOS	-	-	F	A	A
HCM 95th %tile Q(veh)	-	-	14.5	2.6	-

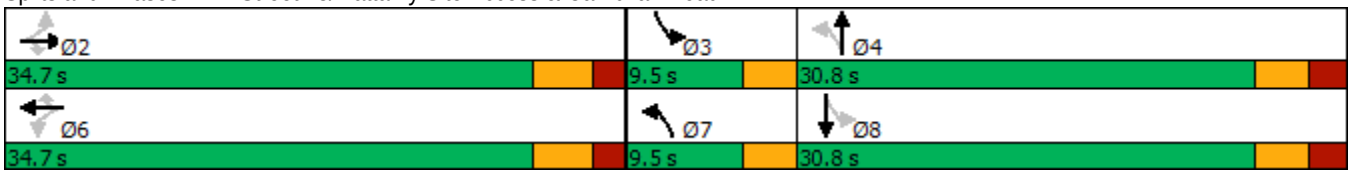


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	100	588	123	65	335	273	96	5	50	196	5	73
Future Volume (vph)	100	588	123	65	335	273	96	5	50	196	5	73
Ideal Flow (vphpl)	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800
Storage Length (m)	40.0		10.0	15.0		10.0	20.0		0.0	70.0		0.0
Storage Lanes	1		1	1		1	1		0	1		0
Taper Length (m)	7.6			7.6			7.6			7.6		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.850			0.850		0.864			0.860	
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1695	1784	1517	1695	1784	1517	1695	1542	0	1695	1535	0
Flt Permitted	0.531			0.292			0.755			0.482		
Satd. Flow (perm)	947	1784	1517	521	1784	1517	1347	1542	0	860	1535	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			76			149		50			73	
Link Speed (k/h)		69			69			50			50	
Link Distance (m)		509.6			247.9			230.8			283.1	
Travel Time (s)		26.6			12.9			16.6			20.4	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	100	588	123	65	335	273	96	5	50	196	5	73
Shared Lane Traffic (%)												
Lane Group Flow (vph)	100	588	123	65	335	273	96	55	0	196	78	0
Turn Type	Perm	NA	Perm	Perm	NA	Perm	pm+pt	NA		pm+pt	NA	
Protected Phases		2			6		7	4		3	8	
Permitted Phases	2		2	6		6	4			8		
Detector Phase	2	2	2	6	6	6	7	4		3	8	
Switch Phase												
Minimum Initial (s)	10.0	10.0	10.0	10.0	10.0	10.0	5.0	10.0		5.0	10.0	
Minimum Split (s)	34.4	34.4	34.4	34.4	34.4	34.4	9.5	30.8		9.5	30.8	
Total Split (s)	34.7	34.7	34.7	34.7	34.7	34.7	9.5	30.8		9.5	30.8	
Total Split (%)	46.3%	46.3%	46.3%	46.3%	46.3%	46.3%	12.7%	41.1%		12.7%	41.1%	
Maximum Green (s)	29.5	29.5	29.5	29.5	29.5	29.5	6.5	25.6		6.5	25.6	
Yellow Time (s)	3.3	3.3	3.3	3.3	3.3	3.3	3.0	3.0		3.0	3.0	
All-Red Time (s)	1.9	1.9	1.9	1.9	1.9	1.9	0.0	2.2		0.0	2.2	
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Total Lost Time (s)	5.2	5.2	5.2	5.2	5.2	5.2	3.0	5.2		3.0	5.2	
Lead/Lag							Lead	Lag		Lead	Lag	
Lead-Lag Optimize?							Yes	Yes		Yes	Yes	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0		3.0	3.0	
Recall Mode	Min	Min	Min	Min	Min	Min	None	None		None	None	
Walk Time (s)	7.0	7.0	7.0	7.0	7.0	7.0		7.0			7.0	
Flash Dont Walk (s)	21.0	21.0	21.0	21.0	21.0	21.0		18.0			18.0	
Pedestrian Calls (#/hr)	0	0	0	0	0	0		0			0	
Act Effct Green (s)	25.1	25.1	25.1	25.1	25.1	25.1	13.1	10.4		16.2	10.4	
Actuated g/C Ratio	0.49	0.49	0.49	0.49	0.49	0.49	0.25	0.20		0.32	0.20	
v/c Ratio	0.22	0.68	0.16	0.26	0.38	0.33	0.25	0.16		0.46	0.21	
Control Delay	10.0	15.5	4.6	12.0	10.5	5.5	14.2	9.8		17.1	8.9	
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Total Delay	10.0	15.5	4.6	12.0	10.5	5.5	14.2	9.8		17.1	8.9	

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
LOS	A	B	A	B	B	A	B	A		B	A	
Approach Delay		13.1			8.6			12.6			14.8	
Approach LOS		B			A			B			B	
Queue Length 50th (m)	5.7	44.3	2.5	3.8	20.8	6.8	5.9	0.4		12.7	0.4	
Queue Length 95th (m)	13.2	74.9	9.2	10.8	36.3	18.0	15.1	8.3		28.3	9.7	
Internal Link Dist (m)		485.6			223.9			206.8			259.1	
Turn Bay Length (m)	40.0		10.0	15.0		10.0	20.0			70.0		
Base Capacity (vph)	565	1064	936	310	1064	965	393	822		427	830	
Starvation Cap Reductn	0	0	0	0	0	0	0	0		0	0	
Spillback Cap Reductn	0	0	0	0	0	0	0	0		0	0	
Storage Cap Reductn	0	0	0	0	0	0	0	0		0	0	
Reduced v/c Ratio	0.18	0.55	0.13	0.21	0.31	0.28	0.24	0.07		0.46	0.09	

Intersection Summary			
Area Type:	Other		
Cycle Length: 75			
Actuated Cycle Length: 51.4			
Natural Cycle: 75			
Control Type: Actuated-Uncoordinated			
Maximum v/c Ratio: 0.68			
Intersection Signal Delay: 11.7		Intersection LOS: B	
Intersection Capacity Utilization 72.1%		ICU Level of Service C	
Analysis Period (min) 15			

Splits and Phases: 2: Street 23/Mattamy Site Access & Cambrian Road



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	100	588	123	65	335	273	96	5	50	196	5	73
Future Volume (veh/h)	100	588	123	65	335	273	96	5	50	196	5	73
Number	5	2	12	1	6	16	7	4	14	3	8	18
Initial Q, veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj (A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1765	1765	1765	1765	1765	1765	1765	1765	1800	1765	1765	1800
Adj Flow Rate, veh/h	100	588	123	65	335	273	96	5	50	196	5	73
Adj No. of Lanes	1	1	1	1	1	1	1	1	0	1	1	0
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Opposing Right Turn Influence	Yes			Yes			Yes			Yes		
Cap, veh/h	401	811	689	271	811	689	482	24	245	528	22	320
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Prop Arrive On Green	0.46	0.46	0.46	0.46	0.46	0.46	0.07	0.18	0.18	0.12	0.23	0.23
Ln Grp Delay, s/veh	14.2	14.3	8.8	20.2	10.2	10.1	16.6	0.0	19.6	14.6	0.0	17.6
Ln Grp LOS	B	B	A	C	B	B	B		B	B		B
Approach Vol, veh/h		811			673			151			274	
Approach Delay, s/veh		13.5			11.2			17.7			15.5	
Approach LOS		B			B			B			B	

Timer:	1	2	3	4	5	6	7	8
Assigned Phs		2	3	4		6	7	8
Case No		5.0	1.1	4.0		5.0	1.1	4.0
Phs Duration (G+Y+Rc), s		30.3	9.5	14.9		30.3	6.8	17.6
Change Period (Y+Rc), s		* 5.2	3.0	* 5.2		* 5.2	3.0	* 5.2
Max Green (Gmax), s		* 30	6.5	* 26		* 30	6.5	* 26
Max Allow Headway (MAH), s		8.0	5.2	9.2		7.2	5.2	9.2
Max Q Clear (g_c+I1), s		16.8	6.9	3.7		21.1	4.5	4.3
Green Ext Time (g_e), s		7.6	0.0	0.6		4.1	0.1	0.9
Prob of Phs Call (p_c)		1.00	0.95	0.97		1.00	0.77	0.99
Prob of Max Out (p_x)		0.78	1.00	0.00		0.89	1.00	0.01

Left-Turn Movement Data								
Assigned Mvmt		5	3			1	7	
Mvmt Sat Flow, veh/h		809	1681			736	1681	

Through Movement Data								
Assigned Mvmt		2		4		6		8
Mvmt Sat Flow, veh/h		1765		138		1765		97

Right-Turn Movement Data								
Assigned Mvmt		12		14		16		18
Mvmt Sat Flow, veh/h		1500		1382		1500		1417

Left Lane Group Data								
Assigned Mvmt	0	5	3	0	0	1	7	0
Lane Assignment			(Pr/Pm)				(Pr/Pm)	

Lanes in Grp	0	1	1	0	0	1	1	0
Grp Vol (v), veh/h	0	100	196	0	0	65	96	0
Grp Sat Flow (s), veh/h/ln	0	809	1681	0	0	736	1681	0
Q Serve Time (g_s), s	0.0	5.1	4.9	0.0	0.0	4.3	2.5	0.0
Cycle Q Clear Time (g_c), s	0.0	12.1	4.9	0.0	0.0	19.1	2.5	0.0
Perm LT Sat Flow (s_l), veh/h/ln	0	809	1343	0	0	736	1316	0
Shared LT Sat Flow (s_sh), veh/h/ln	0	0	0	0	0	0	0	0
Perm LT Eff Green (g_p), s	0.0	25.1	11.4	0.0	0.0	25.1	9.7	0.0
Perm LT Serve Time (g_u), s	0.0	18.2	8.0	0.0	0.0	10.4	9.7	0.0
Perm LT Q Serve Time (g_ps), s	0.0	5.1	0.6	0.0	0.0	4.3	0.0	0.0
Time to First Blk (g_f), s	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Serve Time pre Blk (g_fs), s	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Prop LT Inside Lane (P_L)	0.00	1.00	1.00	0.00	0.00	1.00	1.00	0.00
Lane Grp Cap (c), veh/h	0	401	528	0	0	271	482	0
V/C Ratio (X)	0.00	0.25	0.37	0.00	0.00	0.24	0.20	0.00
Avail Cap (c_a), veh/h	0	465	528	0	0	329	564	0
Upstream Filter (I)	0.00	1.00	1.00	0.00	0.00	1.00	1.00	0.00
Uniform Delay (d1), s/veh	0.0	13.9	14.2	0.0	0.0	19.7	16.4	0.0
Incr Delay (d2), s/veh	0.0	0.3	0.4	0.0	0.0	0.5	0.2	0.0
Initial Q Delay (d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (d), s/veh	0.0	14.2	14.6	0.0	0.0	20.2	16.6	0.0
1st-Term Q (Q1), veh/ln	0.0	1.1	2.2	0.0	0.0	0.9	1.1	0.0
2nd-Term Q (Q2), veh/ln	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0
3rd-Term Q (Q3), veh/ln	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile Back of Q Factor (f_B%)	0.00	1.00	1.00	0.00	0.00	1.00	1.00	0.00
%ile Back of Q (50%), veh/ln	0.0	1.2	2.3	0.0	0.0	0.9	1.2	0.0
%ile Storage Ratio (RQ%)	0.00	6.48	7.71	0.00	0.00	13.91	12.94	0.00
Initial Q (Qb), veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Final (Residual) Q (Qe), veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sat Delay (ds), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sat Q (Qs), veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sat Cap (cs), veh/h	0	0	0	0	0	0	0	0
Initial Q Clear Time (tc), h	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Middle Lane Group Data								
Assigned Mvmt	0	2	0	4	0	6	0	8
Lane Assignment		T				T		
Lanes in Grp	0	1	0	0	0	1	0	0
Grp Vol (v), veh/h	0	588	0	0	0	335	0	0
Grp Sat Flow (s), veh/h/ln	0	1765	0	0	0	1765	0	0
Q Serve Time (g_s), s	0.0	14.8	0.0	0.0	0.0	6.9	0.0	0.0
Cycle Q Clear Time (g_c), s	0.0	14.8	0.0	0.0	0.0	6.9	0.0	0.0
Lane Grp Cap (c), veh/h	0	811	0	0	0	811	0	0
V/C Ratio (X)	0.00	0.73	0.00	0.00	0.00	0.41	0.00	0.00
Avail Cap (c_a), veh/h	0	951	0	0	0	951	0	0
Upstream Filter (I)	0.00	1.00	0.00	0.00	0.00	1.00	0.00	0.00
Uniform Delay (d1), s/veh	0.0	12.0	0.0	0.0	0.0	9.9	0.0	0.0
Incr Delay (d2), s/veh	0.0	2.3	0.0	0.0	0.0	0.3	0.0	0.0
Initial Q Delay (d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (d), s/veh	0.0	14.3	0.0	0.0	0.0	10.2	0.0	0.0
1st-Term Q (Q1), veh/ln	0.0	7.0	0.0	0.0	0.0	3.3	0.0	0.0

2nd-Term Q (Q2), veh/ln	0.0	0.5	0.0	0.0	0.0	0.1	0.0	0.0
3rd-Term Q (Q3), veh/ln	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile Back of Q Factor (f_B%)	0.00	1.00	0.00	1.00	0.00	1.00	0.00	1.00
%ile Back of Q (50%), veh/ln	0.0	7.5	0.0	0.0	0.0	3.4	0.0	0.0
%ile Storage Ratio (RQ%)	0.00	3.62	0.00	0.00	0.00	3.39	0.00	0.00
Initial Q (Qb), veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Final (Residual) Q (Qe), veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sat Delay (ds), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sat Q (Qs), veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sat Cap (cs), veh/h	0	0	0	0	0	0	0	0
Initial Q Clear Time (tc), h	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Right Lane Group Data								
Assigned Mvmt	0	12	0	14	0	16	0	18
Lane Assignment		R		T+R		R		T+R
Lanes in Grp	0	1	0	1	0	1	0	1
Grp Vol (v), veh/h	0	123	0	55	0	273	0	78
Grp Sat Flow (s), veh/h/ln	0	1500	0	1521	0	1500	0	1515
Q Serve Time (g_s), s	0.0	2.6	0.0	1.7	0.0	6.6	0.0	2.3
Cycle Q Clear Time (g_c), s	0.0	2.6	0.0	1.7	0.0	6.6	0.0	2.3
Prot RT Sat Flow (s_R), veh/h/ln	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Prot RT Eff Green (g_R), s	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Prop RT Outside Lane (P_R)	0.00	1.00	0.00	0.91	0.00	1.00	0.00	0.94
Lane Grp Cap (c), veh/h	0	689	0	269	0	689	0	342
V/C Ratio (X)	0.00	0.18	0.00	0.20	0.00	0.40	0.00	0.23
Avail Cap (c_a), veh/h	0	808	0	711	0	808	0	708
Upstream Filter (I)	0.00	1.00	0.00	1.00	0.00	1.00	0.00	1.00
Uniform Delay (d1), s/veh	0.0	8.7	0.0	19.2	0.0	9.8	0.0	17.3
Incr Delay (d2), s/veh	0.0	0.1	0.0	0.4	0.0	0.4	0.0	0.3
Initial Q Delay (d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Control Delay (d), s/veh	0.0	8.8	0.0	19.6	0.0	10.1	0.0	17.6
1st-Term Q (Q1), veh/ln	0.0	1.1	0.0	0.7	0.0	2.7	0.0	1.0
2nd-Term Q (Q2), veh/ln	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0
3rd-Term Q (Q3), veh/ln	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile Back of Q Factor (f_B%)	0.00	1.00	0.00	1.00	0.00	1.00	0.00	1.00
%ile Back of Q (50%), veh/ln	0.0	1.1	0.0	0.7	0.0	2.7	0.0	1.0
%ile Storage Ratio (RQ%)	0.00	21.55	0.00	0.79	0.00	52.59	0.00	0.85
Initial Q (Qb), veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Final (Residual) Q (Qe), veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sat Delay (ds), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sat Q (Qs), veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sat Cap (cs), veh/h	0	0	0	0	0	0	0	0
Initial Q Clear Time (tc), h	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Intersection Summary	
HCM 2010 Ctrl Delay	13.3
HCM 2010 LOS	B

Notes

* HCM 2010 computational engine requires equal clearance times for the phases crossing the barrier.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	100	588	123	65	335	273	96	5	50	196	5	73
Future Volume (veh/h)	100	588	123	65	335	273	96	5	50	196	5	73
Number	5	2	12	1	6	16	7	4	14	3	8	18
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1765	1765	1765	1765	1765	1765	1765	1765	1800	1765	1765	1800
Adj Flow Rate, veh/h	100	588	123	65	335	273	96	5	50	196	5	73
Adj No. of Lanes	1	1	1	1	1	1	1	1	0	1	1	0
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	401	811	689	271	811	689	482	24	245	528	22	320
Arrive On Green	0.46	0.46	0.46	0.46	0.46	0.46	0.07	0.18	0.18	0.12	0.23	0.23
Sat Flow, veh/h	809	1765	1500	736	1765	1500	1681	138	1382	1681	97	1417
Grp Volume(v), veh/h	100	588	123	65	335	273	96	0	55	196	0	78
Grp Sat Flow(s),veh/h/ln	809	1765	1500	736	1765	1500	1681	0	1521	1681	0	1515
Q Serve(g_s), s	5.1	14.8	2.6	4.3	6.9	6.6	2.5	0.0	1.7	4.9	0.0	2.3
Cycle Q Clear(g_c), s	12.1	14.8	2.6	19.1	6.9	6.6	2.5	0.0	1.7	4.9	0.0	2.3
Prop In Lane	1.00		1.00	1.00		1.00	1.00		0.91	1.00		0.94
Lane Grp Cap(c), veh/h	401	811	689	271	811	689	482	0	269	528	0	342
V/C Ratio(X)	0.25	0.73	0.18	0.24	0.41	0.40	0.20	0.00	0.20	0.37	0.00	0.23
Avail Cap(c_a), veh/h	465	951	808	329	951	808	564	0	711	528	0	708
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	13.9	12.0	8.7	19.7	9.9	9.8	16.4	0.0	19.2	14.2	0.0	17.3
Incr Delay (d2), s/veh	0.3	2.3	0.1	0.5	0.3	0.4	0.2	0.0	0.4	0.4	0.0	0.3
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	1.2	7.5	1.1	0.9	3.4	2.8	1.2	0.0	0.7	2.3	0.0	1.0
LnGrp Delay(d),s/veh	14.2	14.3	8.8	20.2	10.2	10.1	16.6	0.0	19.6	14.6	0.0	17.6
LnGrp LOS	B	B	A	C	B	B	B		B	B		B
Approach Vol, veh/h		811			673			151			274	
Approach Delay, s/veh		13.5			11.2			17.7			15.5	
Approach LOS		B			B			B			B	

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2	3	4		6	7	8
Phs Duration (G+Y+Rc), s		30.3	9.5	14.9		30.3	6.8	17.6
Change Period (Y+Rc), s		* 5.2	3.0	* 5.2		* 5.2	3.0	* 5.2
Max Green Setting (Gmax), s		* 30	6.5	* 26		* 30	6.5	* 26
Max Q Clear Time (g_c+I1), s		16.8	6.9	3.7		21.1	4.5	4.3
Green Ext Time (p_c), s		7.6	0.0	0.6		4.1	0.1	0.9

Intersection Summary	
HCM 2010 Ctrl Delay	13.3
HCM 2010 LOS	B

Notes