

APPENDIX E

Noise Impact Assessment Report

FINAL

**NOISE IMPACT ASSESSMENT
PROPOSED HIGHWAY 404 OFF-RAMP EXTENSION
CITY OF MARKHAM**

FOR

CITY OF MARKHAM

PREPARED BY



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1.0 INTRODUCTION

The City of Markham is planning to extend the northbound Highway 404 off-ramp from Major Mackenzie Drive to Markland Street. Gannett Fleming, on behalf of the City of Markham, has retained J.E. COULTER ASSOCIATES LIMITED to complete a Noise Impact Assessment of the proposed extension in support of a Municipal Class Environmental Assessment (MCEA) addendum. The extension consists of building a new roadway (one northbound lane, one southbound lane) connecting the Highway 404 northbound off-ramp at Major Mackenzie Drive to Markland Street. Please refer to Figure 1 in Appendix A for a Key Plan.

The purpose of this report is to document the potential noise impacts of the proposed project at the closest sensitive receptors. If impacts are predicted, noise mitigation measures will be provided to reduce the impacts at the receptors.

2.0 PROJECT DESCRIPTION

A Municipal Class Environmental Assessment (MCEA) Study was approved for the extension of the Highway 404 northbound off-ramp at Major Mackenzie Drive in 2009 and a preferred alignment was selected. However, the project was not carried out and the MCEA has since expired. Vacant lands near the project have since been developed and Markland Street, which the alignment connects to, has also since been constructed. Due to changes in the study environment from development in the area and a lapse of over 10 years since the approval, an addendum to the MCEA is being completed by the City of Markham.

This study reviews potential noise impacts from the preferred alignment based on updated traffic volumes and surrounding environment.

3.0 NOISE GUIDELINES AND POLICIES

The noise impacts of the proposed extension were evaluated based on the Ontario Ministry of Transportation's (MTO) Environmental Guide for Noise (2006) in accordance with the Request For Proposals as the City of Markham does not have any applicable noise guidelines for roadway improvement projects. The City of Markham's Engineering Design Criteria Guidelines Section 'O' has also been reviewed. However, Section 'O' applies to new residential construction built adjacent to City roads and does not contain any guidelines related to the noise generated by new roadways.

3.1 Environmental Noise Guidelines

The MTO noise guide compares the future daytime (0700–2300) equivalent sound levels (16-hour L_{eq}) at a sensitive receptor under two different scenarios, typically 10 years after the construction of the project. The assessment is based on the daytime sound levels calculated at the Outdoor Living Areas (OLA) of the sensitive receptors as per the MTO Guide. The comparison is between the sound levels that would be present under the following scenarios:

- Future No-Build – Future sound levels without the project
- Future Build – Future sound levels with the project

Noise mitigation measures such as noise barriers must be investigated if the predicted noise impacts between these two scenarios are greater than 5 decibels (dB).

The noise guide also states that if the future overall sound levels are greater than 65 dBA 16-hour L_{eq} , then noise mitigation must be considered. However, this criterion was not applied to this project as it is typically applied to provincial highway projects and not regional roads. The criteria used in this assessment are summarized in Table 1, below.

Table 1: Noise Level Criteria

Change in Noise Level due to Proposed Improvements/Projected Future Build Noise Levels	Mitigation Effort Required
< 5 dB change	None
≥ 5 dB change	Investigate noise control measures

If the change in sound levels exceed 5 dB with the project, mitigation is to be provided based on a review of economic, technical, and administrative feasibility outlined in Table 2, below.

Table 2: Noise Mitigation Feasibility Considerations

Economic Feasibility	Carry out a cost-benefit assessment of the noise mitigation (i.e., determine cost per benefitted receiver)
Technical Feasibility	Review the constructability of the noise mitigation (i.e., design of wall, roadside safety, shadow effect, topography, ability to provide a continuous barrier, etc.)
Administrative Feasibility	Determine the ability to locate the noise mitigation on lands within public ownership (i.e., provincial or municipal right-of-way)

3.2 Construction Noise

Similar to other roadway projects, construction noise is not assessed in a quantitative manner. The MTO noise guide outlines that construction activities should abide by municipal by-laws. Generally, municipal by-laws prohibit or limit noisy activity in residential areas during sensitive time periods such as weekends, holidays, and nighttime. For construction related noise, the City of Markham's Noise By-law would apply.

The Ministry of the Environment, Conservation and Parks (MECP) does not promulgate construction noise or vibration limits at receptors. Instead of receptor-based limits, MECP provides equipment-based limits in *NPC-115* and *NPC-118*. These documents outline sound level requirements for individual pieces of construction equipment.

4.0 NOISE SENSITIVE AREAS

For the proposed project, there are no existing residences or other sensitive receptors immediately adjacent to the roadway extension. There is a Noise Sensitive Area (NSA) located north of Markland Street that consists of a low-rise residential subdivision. The closest sensitive receptors in the NSA to the project are located immediately north of Markland Street and have their backyards abutting Markland Street. This NSA was identified using current air photo/mapping/zoning and confirmed through a site visit.

Sound levels are calculated at the Outdoor Living Area (OLA) of the receptors along Markland Street. The MTO noise guide defines an OLA as an area at ground level, intended and designed for the enjoyment of the outdoor environment, and readily accessible from the building. This area is typically the backyard of a dwelling but may be located on any side. The location of the OLA is 3m from the dwelling façade at a height of 1.5m above the existing

ground surface. Table 3 summarizes the closest noise sensitive receptors exposed to the project that are expected to experience the highest potential impact from the project. All other nearby receptors such as those located on Robert Osprey Drive and on the north side of Staglin Court will have lower impacts due to their increased setback distance from the project and additional shielding from the roadways.

Table 3: Noise Sensitive Receptors

Receptor	Address	Description
1	81 Staglin Court	2-Storey Residential
2	63 Staglin Court	2-Storey Residential
3	57 Staglin Court	2-Storey Residential
4	39 Staglin Court	2-Storey Residential
5	19 Staglin Court	2-Storey Residential

The NSA adjacent to Markland Street includes noise barriers, whose presence and details were confirmed via site visit. The existing barriers and their affect on the sound levels have been included in the analysis as per the MTO guide.

5.0 IMPACT ASSESSMENT

5.1 Traffic Volumes

Traffic data in the form of Average Annual Daily Traffic (AADT) for the horizon year 2051 was calculated for the roadways. For the regional roads, peak traffic volumes obtained from the Transportation Study Update – Highway 404 Ramp Extension at Major Mackenzie Drive dated November 2024 and shown in Figures 3 and 4 in Appendix A. The peak hour volumes are typically 10% of the AADT. In order to obtain the AADT traffic volumes, the peak volumes were multiplied by a factor of 10. For Highway 404, the 2021 Summer Average Daily Traffic (SADT) traffic volumes from the MTO were escalated to the year 2051 using a 1% growth rate. The project is assumed to have no change on the highway traffic volumes. The sound levels from the Highway 404 northbound on-ramp would not contribute to the overall sound levels at the receptors due to the significant setback (300m) and were therefore not included. The project would include an elevated section at the intersection of the Highway 404 northbound on-ramp and the new extension. The elevated section would also be approximately 300m away from the nearest receptors and would not contribute to the overall sound levels, which are dominated by Highway 404 and closer roadways.

Truck percentages for the regional road were calculated from turning movement counts. The truck percentages for Markland Street and Russel Dawson Road were less than 1%. To be conservative, truck percentages of 1% have been assumed for these roadways. Truck percentages for Hwy 404 were obtained from MTO. Road traffic volumes for the future 6-lane alignment of Major Mackenzie Drive were used in the assessment. The traffic volumes with and without the project are summarized in Table 4, below.

Table 4: 2051 Traffic Volumes

Roadway	2051 AADT		Truck (%)		Speed Limit (km/h)
	Without Project	With Project	Medium	Heavy	
Markland Street	7,910	10,570	1	1	50
Russel Dawson Road	12,590	7,710	1	1	50
Major Mackenzie Drive	50,310	50,990	1	1	70
Highway 404	212,178	212,178	3	3	100

Roadway	2051 AADT		Truck (%)		Speed Limit
Hwy 404 NB off-ramp extension	N/A	8,010	1	1	40

5.2 Predicted Sound Levels

Sound levels at the receptor OLAs were calculated without the project and with the project. Sound levels were calculated using the MECP's STAMSON v 5.04 computer program implementation of the ORNAMENT prediction model.

The sound levels are calculated in the OLAs, 3m from the façade of the building and 1.5m above the ground on the basis of a 16-hour daytime (07:00–23:00) equivalent sound level (L_{eq}). Elevations of the roadway and the surrounding areas were obtained from the drawings provided by the design team.

Future noise levels were predicted based on the proposed geometry of the Highway 404 NE Ramp. The predicted sound levels without the project (2051) and with the project (2051) are summarized in Table 5, below.

Table 5: Predicted Sound Levels

Receptor	Daytime Sound Level (dBA, 16 hr. L_{eq})		Change in Sound Levels due to Project (dB)	≥ 5 dB Impact
	Without Project (2051)	With Project (2051)		
1	59	59	0	No
2	58	59	1	No
3	57	58	1	No
4	56	57	1	No
5	56	57	1	No

As seen in Table 5, the changes in sound levels with the project do not exceed 5 dB at all the receptors. While not necessarily required for municipal roadway projects, the absolute sound levels are also below 65 dBA ($L_{eq,16hr}$) therefore mitigation would not be required if that criteria applied to this project.

5.3 Noise Mitigation

Noise mitigation is not required as the change in sound levels with the project is less than 5 dB when compared to the sound levels without the project at all the receptors.

6.0 CONSTRUCTION NOISE

Construction noise is temporary and will cease once the project is completed. As it is transient and not permanent, the associated effects of construction noise will be short term in nature. It is recommended the City of Markham Noise By-law be adhered to by the contractor during construction of the project.

In addition to adhering to the by-law, the contractor's equipment must also meet the MECP guidelines as found in *NPC-115* and *NPC-118*, which sets sound emission standards for various items of construction equipment according to the date of manufacture of the equipment.

Much of the construction equipment that is likely to be required for the proposed road construction work is not unusual. As a result, the sounds associated with the construction activities will not be foreign to most residents in an urban area. It is recommended the City's

standard complaints procedure be applied to this project, to provide a forum for residents to voice their concerns over unwarranted construction noise. If warranted, the City may request the contractor to conduct sound level monitoring of construction activities.

7.0 CONCLUSION

The results of the assessment show that the change in future sound levels with the project is at most 1 dB, which is insignificant. Given the lack of impacts, noise mitigation is not required for the nearby sensitive receptors. As the project is unlikely to generate enough traffic to cause a noise impact, further detailed review is not required.

Construction activity should adhere to the City of Markham noise by-laws and provincial guidelines as found in *NPC-115* and *NPC-118*. The City's standard protocol for addressing noise complaints during construction should be applied to the project. A noise monitoring program may be required in the event of complaints from nearby residents, as a result of construction noise.

APPENDIX A: FIGURES AND TRAFFIC DATA



Figure 1: Key Plan

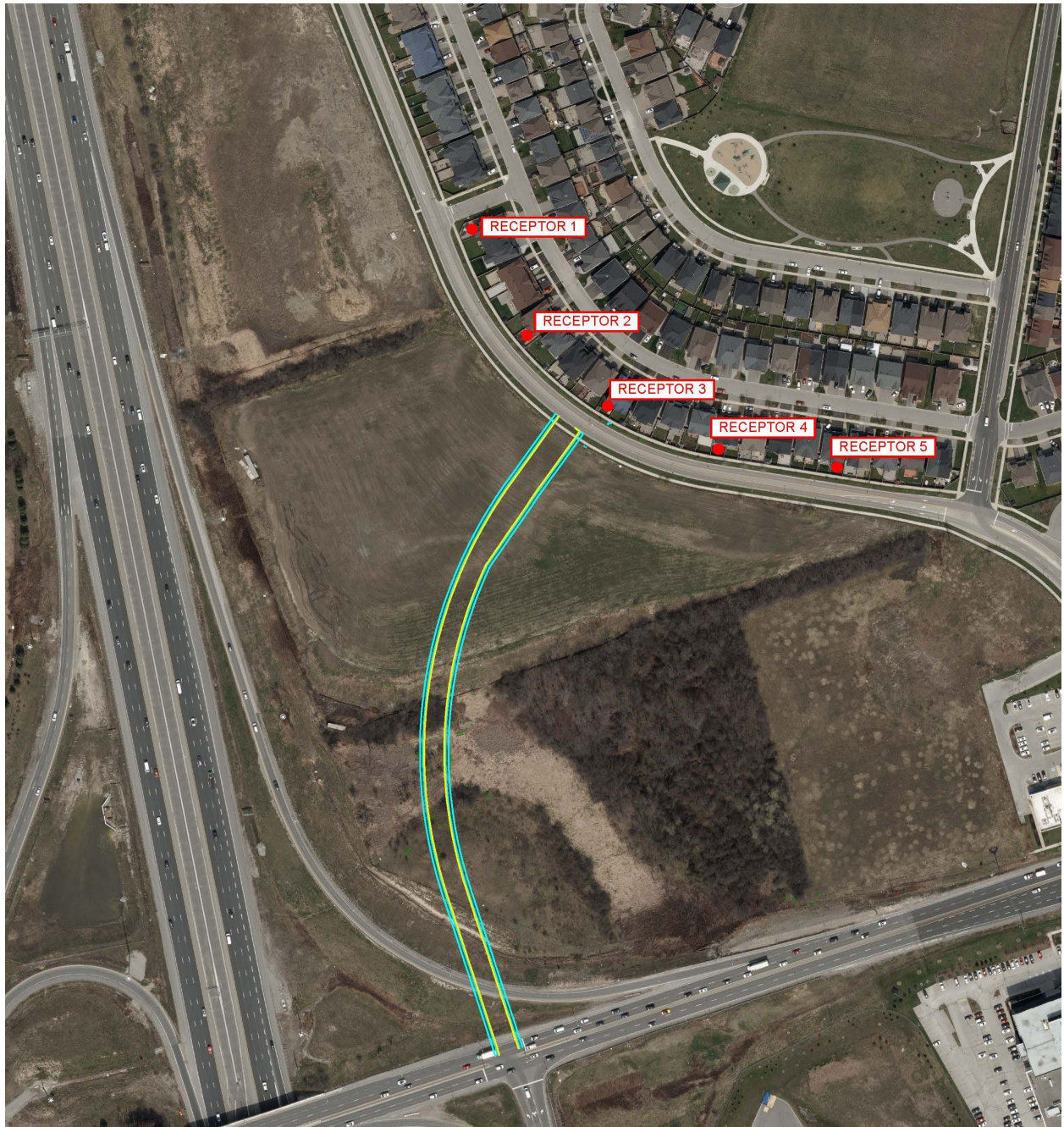


Figure 2: Receptor Locations

Transportation Study Update - Highway 404 Ramp Extension at Major Mackenzie Drive
Exhibit 5-2: 2051 "Do Nothing" Scenario Traffic Volumes

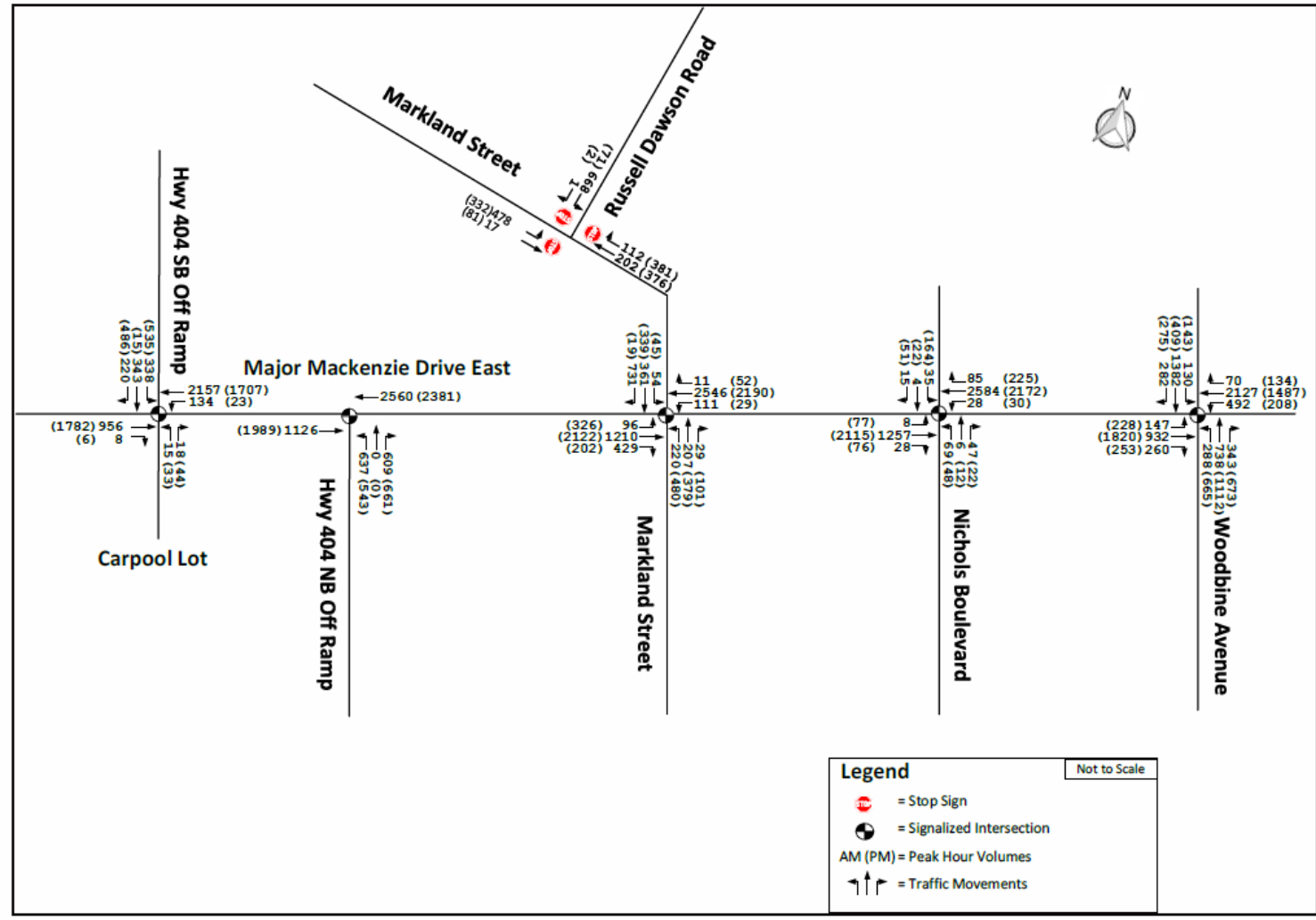


Figure 3: Peak Traffic Volumes without Project

Transportation Study Update - Highway 404 Ramp Extension at Major Mackenzie Drive
 Exhibit 5-3: 2051 Off-Ramp Extension Scenario Traffic Volumes

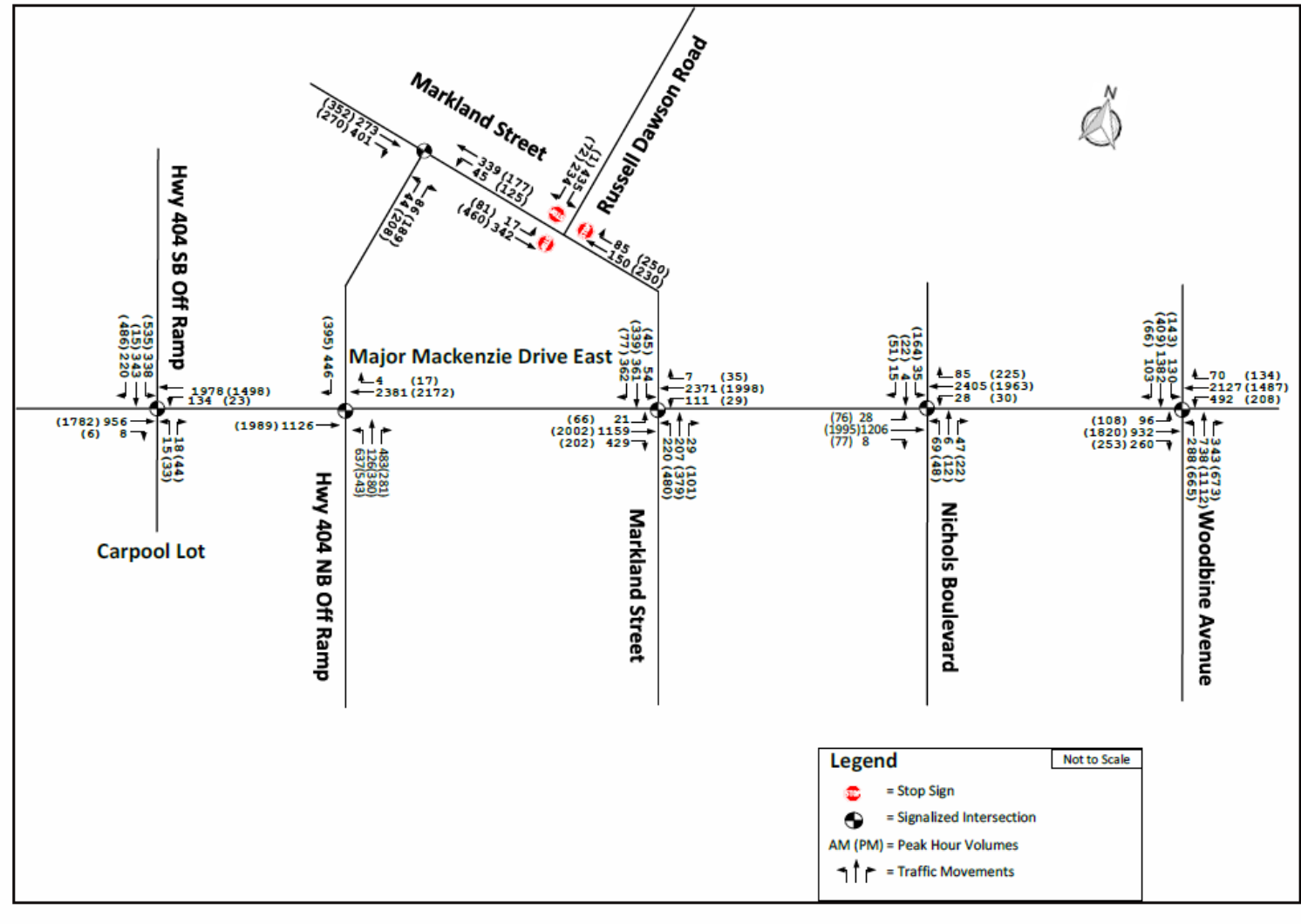


Figure 4: Peak Traffic Volumes with Project

1988	404	MAJOR MACKENZIE DR YORK RD 25 IC-31 MARKHAM	1.9	C	42,900	47,600	47,600	38,600	4,300	25	0.8	3	0.1		
1989	404			C	50,700	56,300	56,800	45,600	5,050	33	0.9	5	0.1		
1990	404			C	51,400	57,100	57,100	46,300	5,150	55	1.5	5	0.1		
1991	404			C	52,200	57,400	57,900	47,500	5,200	45	1.2	7	0.2		
1992	404			C	54,900	59,300	60,900	50,500	5,500	85	2.2	12	0.3		
1993	404			C	56,500	61,600	62,500	52,000	5,650	38	0.9	3	0.1		
1994	404			C	58,200	63,700	64,900	52,700	5,800	62	1.5	1	0.0		
1995	404			C	59,000	64,400	66,100	54,000	5,900	66	1.6	7	0.2		
1996	404			C	61,600	69,800	70,100	55,600	6,800	47	1.1	4	0.1		
1997	404			C	63,400	71,600	72,300	57,100	6,950	61	1.4	4	0.1		
1998	404			C	66,100	74,700	74,700	59,500	7,250	79	1.7	8	0.2		
1999	404			UC	69,800	74,000	81,700	66,300	4,200	71	1.4	6	0.1		
2000	404			UC	71,600	75,900	84,500	67,300	4,300	75	1.5	6	0.1		
2001	404			UC	73,700	78,900	86,700	69,300	4,400	67	1.3	8	0.2		
2002	404			UC	76,100	81,100	89,500	71,300	5,350	71	1.3	6	0.1		
2003	404			UC	78,500	83,000	92,000	74,200	4,700	91	1.6	11	0.2		
2004	404			UC	80,800	86,500	95,100	75,900	4,850	83	1.4	10	0.2		
2005	404			UC	83,200	88,000	97,300	78,000	5,000	92	1.6	4	0.1		
2006	404			UC	85,600	90,500	100,000	80,600	5,150	83	1.4	3	0.0		
2007	404			CR	88,000	106,500	106,500	74,200	5,300	52	0.8	10	0.2		
2008	404			CR	90,300	109,300	108,400	76,100	5,400	46	0.7	9	0.1		
2009	404			IC	92,700	102,900	103,800	82,500	5,550	33	0.5	4	0.1		
2010	404			IC	95,100	105,300	106,100	84,300	5,700	52	0.8	13	0.2		
2011	404			IC	97,400	107,100	111,100	87,400	5,850	37	0.5	6	0.1		
2012	404			IC	99,800	110,600	107,200	88,600	6,000	51	0.7	6	0.1		
2013	404			CR	102,200	122,500	125,700	86,400	6,150	51	0.7	10	0.1		
2014	404			CR	104,600	123,300	122,500	89,100	6,300	47	0.6	3	0.0		
2015	404			CTR	106,900	130,400	131,500	90,900	6,400	48	0.6	7	0.1		
2016	404			CTR	109,300	133,300	134,400	92,900	6,550	54	0.7	6	0.1		
Page 1060															
Year	Highway	Location Description	Dist (KM)	Pattern Type	AADT	SADT	SWADT	WADT	Truck AADT	Total Collisions	Total CR	Trucks Collisions	Truck CR		
2017	404			CTR	111,700	149,300	148,500	91,000	6,700	50	0.6	4	0.1		
2018	404			CTR	114,000	152,200	151,600	92,800	6,850	61	0.8	6	0.1		
2019	404			CTR	116,400	155,100	154,400	94,700	7,000	59	0.7	6	0.1		
2021	404			CTR	121,200	158,000	157,200	98,900	7,250	34	0.4	4	0.0		

Figure 5: MTO Highway 404 Traffic Volumes

APPENDIX B: SOUND LEVEL CALCULATIONS

STAMSON 5.0 NORMAL REPORT Date: 21-10-2024 21:54:19
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: ola3.te Time Period: Day/Night 16/8 hours
Description :Receptor 3 without project

Road data, segment # 1: Hwy 404 (day/night)

Car traffic volume : 133630/65818 veh/TimePeriod *
Medium truck volume : 4265/2101 veh/TimePeriod *
Heavy truck volume : 4265/2101 veh/TimePeriod *
Posted speed limit : 100 km/h
Road gradient : 0 %
Road pavement : 1 (Typical asphalt or concrete)

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

24 hr Traffic Volume (AADT or SADT): 212178
Percentage of Annual Growth : 0.00
Number of Years of Growth : 0.00
Medium Truck % of Total Volume : 3.00
Heavy Truck % of Total Volume : 3.00
Day (16 hrs) % of Total Volume : 67.00

Data for Segment # 1: Hwy 404 (day/night)

Angle1 Angle2 : -90.00 deg 50.00 deg
Wood depth : 0 (No woods.)
No of house rows : 0 / 0
Surface : 1 (Absorptive ground surface)
Receiver source distance : 250.00
Receiver height : 1.50
Topography : 2 (Flat/gentle slope; with barrier)
Barrier angle1 : -90.00 deg Angle2 : 50.00 deg
Barrier height : 2.30 m
Barrier receiver distance : 4.00 / 4.00 m
Source elevation : 213.00 m
Receiver elevation : 214.30 m
Barrier elevation : 214.30 m
Reference angle : 0.00

Road data, segment # 2: Major Mack (day/night)

Car traffic volume : 44373/4930 veh/TimePeriod *
Medium truck volume : 453/50 veh/TimePeriod *
Heavy truck volume : 453/50 veh/TimePeriod *
Posted speed limit : 50 km/h
Road gradient : 0 %
Road pavement : 1 (Typical asphalt or concrete)

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

24 hr Traffic Volume (AADT or SADT): 50310
 Percentage of Annual Growth : 0.00
 Number of Years of Growth : 0.00
 Medium Truck % of Total Volume : 1.00
 Heavy Truck % of Total Volume : 1.00
 Day (16 hrs) % of Total Volume : 90.00

Data for Segment # 2: Major Mack (day/night)

 Angle1 Angle2 : -90.00 deg 70.00 deg
 Wood depth : 0 (No woods.)
 No of house rows : 0 / 0
 Surface : 1 (Absorptive ground surface)
 Receiver source distance : 300.
 Receiver height : 1.50
 Topography : 2 (Flat/gentle slope; with barrier)
 Barrier angle1 : -90.00 deg Angle2 : 70.00 deg
 Barrier height : 2.30 m
 Barrier receiver distance : 4.00
 Source elevation : 212.00 m
 Receiver elevation : 214.30 m
 Barrier elevation : 214.30 m
 Reference angle : 0.00

Road data, segment # 3: Markland (day/night)

 Car traffic volume : 6977/775 veh/TimePeriod *
 Medium truck volume : 71/8 veh/TimePeriod *
 Heavy truck volume : 71/8 veh/TimePeriod *
 Posted speed limit : 50 km/h
 Road gradient : 0 %
 Road pavement : 1 (Typical asphalt or concrete)

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

24 hr Traffic Volume (AADT or SADT): 7910
 Percentage of Annual Growth : 0.00
 Number of Years of Growth : 0.00
 Medium Truck % of Total Volume : 1.00
 Heavy Truck % of Total Volume : 1.00
 Day (16 hrs) % of Total Volume : 90.00

Data for Segment # 3: Markland (day/night)

 Angle1 Angle2 : -90.00 deg 90.00 deg
 Wood depth : 0 (No woods.)
 No of house rows : 0 / 0
 Surface : 2 (Reflective ground surface)
 Receiver source distance : 15.00
 Receiver height : 1.50
 Topography : 2 (Flat/gentle slope; with barrier)
 Barrier angle1 : -90.00 deg Angle2 : 90.00 deg
 Barrier height : 2.30 m

Barrier receiver distance : 4.00
Source elevation : 214.10 m
Receiver elevation : 214.23 m
Barrier elevation : 214.23 m
Reference angle : 0.00

Results segment # 1: Hwy 404 (day)

Source height = 1.32 m

Barrier height for grazing incidence

Source Height (m)	Receiver Height (m)	Barrier Height (m)	Elevation of Barrier Top (m)
1.32	1.50	1.48	215.78

ROAD (0.00 + 54.99 + 0.00) = 54.99 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj
-90	50	0.53	83.07	0.00	-18.66	-1.97	0.00	0.00	-7.45

SubLeq

54.99

Segment Leq : 54.99 dBA

Results segment # 2: Major Mack (day)

Source height = 1.00 m

Barrier height for grazing incidence

Source Height (m)	Receiver Height (m)	Barrier Height (m)	Elevation of Barrier Top (m)
1.00	1.50	1.46	215.76

ROAD (0.00 + 40.14 + 0.00) = 40.14 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj
-90	70	0.54	69.06	0.00	-20.00	-1.49	0.00	0.00	-7.43

SubLeq

40.14

Segment Leq : 40.14 dBA

Results segment # 3: Markland (day)

Source height = 1.00 m

Barrier height for grazing incidence

Source Height (m)	Receiver Height (m)	Barrier Height (m)	Elevation of Barrier Top (m)
1.00	1.50	1.33	215.56

ROAD (0.00 + 52.67 + 0.00) = 52.67 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj
SubLeq									

-90	90	0.00	61.02	0.00	0.00	0.00	0.00	0.00	-8.35
52.67									

Segment Leq : 52.67 dBA

Total Leq All Segments: 57.08 dBA

STAMSON 5.0 NORMAL REPORT Date: 21-10-2024 21:54:58
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: ola3fu.te Time Period: Day/Night 16/8 hours
Description: Receptor 3 with project

Road data, segment # 1: Hwy 404 (day/night)

Car traffic volume : 133630/65818 veh/TimePeriod *
Medium truck volume : 4265/2101 veh/TimePeriod *
Heavy truck volume : 4265/2101 veh/TimePeriod *
Posted speed limit : 100 km/h
Road gradient : 0 %
Road pavement : 1 (Typical asphalt or concrete)

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

24 hr Traffic Volume (AADT or SADT): 212178
Percentage of Annual Growth : 0.00
Number of Years of Growth : 0.00
Medium Truck % of Total Volume : 3.00
Heavy Truck % of Total Volume : 3.00
Day (16 hrs) % of Total Volume : 67.00

Data for Segment # 1: Hwy 404 (day/night)

Angle1 Angle2 : -90.00 deg 50.00 deg
Wood depth : 0 (No woods.)
No of house rows : 0 / 0
Surface : 1 (Absorptive ground surface)
Receiver source distance : 250.00
Receiver height : 1.50
Topography : 2 (Flat/gentle slope; with barrier)
Barrier angle1 : -90.00 deg Angle2 : 50.00 deg
Barrier height : 2.30 m
Barrier receiver distance : 4.00
Source elevation : 213.00 m
Receiver elevation : 214.30 m
Barrier elevation : 214.30 m
Reference angle : 0.00

Road data, segment # 2: Major Mack (day/night)

Car traffic volume : 44973/4997 veh/TimePeriod *
Medium truck volume : 459/51 veh/TimePeriod *
Heavy truck volume : 459/51 veh/TimePeriod *
Posted speed limit : 50 km/h
Road gradient : 0 %
Road pavement : 1 (Typical asphalt or concrete)

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

24 hr Traffic Volume (AADT or SADT): 50990
Percentage of Annual Growth : 0.00
Number of Years of Growth : 0.00
Medium Truck % of Total Volume : 1.00
Heavy Truck % of Total Volume : 1.00
Day (16 hrs) % of Total Volume : 90.00

Data for Segment # 2: Major Mack (day/night)

Angle1 Angle2 : -90.00 deg 70.00 deg
Wood depth : 0 (No woods.)
No of house rows : 0 / 0
Surface : 1 (Absorptive ground surface)
Receiver source distance : 300.00
Receiver height : 1.50
Topography : 2 (Flat/gentle slope; with barrier)
Barrier angle1 : -90.00 deg Angle2 : 70.00 deg
Barrier height : 2.30 m
Barrier receiver distance : 4.00
Source elevation : 212.00 m
Receiver elevation : 214.30 m
Barrier elevation : 214.30 m
Reference angle : 0.00

Road data, segment # 3: Markland (day/night)

Car traffic volume : 9323/1036 veh/TimePeriod *
Medium truck volume : 95/11 veh/TimePeriod *
Heavy truck volume : 95/11 veh/TimePeriod *
Posted speed limit : 50 km/h
Road gradient : 0 %
Road pavement : 1 (Typical asphalt or concrete)

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

24 hr Traffic Volume (AADT or SADT): 10570
Percentage of Annual Growth : 0.00
Number of Years of Growth : 0.00
Medium Truck % of Total Volume : 1.00
Heavy Truck % of Total Volume : 1.00
Day (16 hrs) % of Total Volume : 90.00

Data for Segment # 3: Markland (day/night)

Angle1 Angle2 : -90.00 deg 90.00 deg
Wood depth : 0 (No woods.)
No of house rows : 0 / 0
Surface : 2 (Reflective ground surface)
Receiver source distance : 15.00
Receiver height : 1.50
Topography : 2 (Flat/gentle slope; with barrier)
Barrier angle1 : -90.00 deg Angle2 : 90.00 deg
Barrier height : 2.30 m
Barrier receiver distance : 4.00
Source elevation : 214.10 m
Receiver elevation : 214.23 m
Barrier elevation : 214.23 m
Reference angle : 0.00

Road data, segment # 4: Hwy404 ext (day/night)

Car traffic volume : 7065/785 veh/TimePeriod *
Medium truck volume : 72/8 veh/TimePeriod *
Heavy truck volume : 72/8 veh/TimePeriod *
Posted speed limit : 40 km/h
Road gradient : 0 %
Road pavement : 1 (Typical asphalt or concrete)

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

24 hr Traffic Volume (AADT or SADT): 8010
Percentage of Annual Growth : 0.00
Number of Years of Growth : 0.00
Medium Truck % of Total Volume : 1.00
Heavy Truck % of Total Volume : 1.00
Day (16 hrs) % of Total Volume : 90.00

Data for Segment # 4: Hwy404 ext (day/night)

```

-----
Angle1   Angle2       : -90.00 deg   -20.00 deg
Wood depth      :      0           (No woods.)
No of house rows :      0 / 0
Surface         :      2           (Reflective ground surface)
Receiver source distance : 22.00
Receiver height  :      1.50
Topography       :      2           (Flat/gentle slope; with barrier)
Barrier angle1   : -90.00 deg   Angle2 : -20.00 deg
Barrier height    :      2.30 m
Barrier receiver distance : 4.00
Source elevation  : 214.30 m
Receiver elevation : 214.30 m
Barrier elevation  : 214.30 m
Reference angle   :      0.00

```

Results segment # 1: Hwy 404 (day)

Source height = 1.32 m

Barrier height for grazing incidence

```

-----
Source      ! Receiver      ! Barrier      ! Elevation of
Height (m) ! Height (m) ! Height (m) ! Barrier Top (m)
-----+-----+-----+-----
          1.32 !          1.50 !          1.48 !          215.78

```

ROAD (0.00 + 54.49 + 0.00) = 54.99 dBA

```

Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq

```

```

-----
--
-90      50      0.53  83.07      0.00 -18.66  -1.97      0.00      0.00  -7.45
54.49
-----
--

```

Segment Leq : 54.49 dBA

Results segment # 2: Major Mack (day)

Source height = 1.00 m

Barrier height for grazing incidence

```

-----
Source      ! Receiver      ! Barrier      ! Elevation of
Height (m) ! Height (m) ! Height (m) ! Barrier Top (m)
-----+-----+-----+-----
          1.00 !          1.50 !          1.46 !          215.76

```

ROAD (0.00 + 40.20 + 0.00) = 40.20 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj
SubLeq									

--									
-90	70	0.54	69.11	0.00	-20.00	-1.49	0.00	0.00	-7.43
40.20									

--									

Segment Leq : 40.20 dBA

Results segment # 3: Markland (day)

Source height = 1.00 m

Barrier height for grazing incidence

Source	! Receiver	! Barrier	! Elevation of
Height (m)	! Height (m)	! Height (m)	! Barrier Top (m)
-----+-----+-----+-----			
1.00 !	1.50 !	1.33 !	215.56

ROAD (0.00 + 53.93 + 0.00) = 53.93 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj
SubLeq									

--									
-90	90	0.00	62.28	0.00	0.00	0.00	0.00	0.00	-8.35
53.93									

--									

Segment Leq : 53.93 dBA

Results segment # 4: Hwy404 ext (day)

Source height = 1.00 m

Barrier height for grazing incidence

Source	! Receiver	! Barrier	! Elevation of
Height (m)	! Height (m)	! Height (m)	! Barrier Top (m)
-----+-----+-----+-----			
1.00 !	1.50 !	1.41 !	215.71

ROAD (0.00 + 47.88 + 0.00) = 47.88 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj
SubLeq									

```
-----  
--  
-90    -20    0.00  61.07    0.00  -1.66  -4.10    0.00    0.00  -7.43  
47.88  
-----  
--
```

Segment Leq : 47.88 dBA

Total Leq All Segments: 58.02 dBA

APPENDIX C: REFERENCES

1. Ministry of the Environment, "Model Municipal Noise Control By-Law, Final Report," August 1978.
2. Model Municipal Noise Control By-Law, Final Report, Publication NPC-115, Construction Equipment, August 1978.
3. Ministry of the Environment's STAMSON Computer Programme (Version 5.04).
4. Ministry of Transportation, Environmental Guide for Noise, October 2006.
5. Arcadis, Transportation Study Update – Highway 404 Ramp Extension at Major Mackenzie Drive, Markham, ON, November 2024.
6. City of Markham, Engineering Department Section O – Noise Criteria.