HGC ENGINEERING

Howe Gastmeier Chapnik Limited
2000 Argentia Road, Plaza One, Suite 203
Mississauga, Ontario, Canada L5N 1P7
t: 905.826.4044

NOISE AND VIBRATION FEASIBILITY STUDY
PROPOSED RESIDENTIAL DEVELOPMENT
16 ELM DRIVE WEST, EDGE TOWERS, TOWER III
MISSISSAUGA, ONTARIO

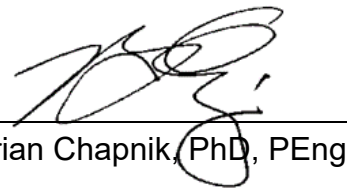
Prepared for:

Solmar (Edge3) Corp.
122 Romina Drive
Concord, ON
L4K 4Z7

Prepared by

Iouri Basmanov, BASc, EIT

and



Brian Chapnik, PhD, PEng

July 24, 2020

Table of Contents

1 Introduction and Summary

Howe Gastmeier Chapnik Limited (HGC Engineering) was retained by Solmar (Edge3) Corp. to perform a Noise Impact Study for a proposed residential development located on Elm Drive West, on the west side of Hurontario Street, in the City of Mississauga. The study is required by the City of Mississauga in support of an application for a zoning by-law amendment (ZBA) for this site.

This is the third building of The Edge Towers development, Tower III (also referenced on site plan as Building C), and it is 50 storeys in height. A key plan is attached as Figure 1, and a site plan is attached as Figure 2. This study is based on "Re-issued for Zoning" architectural drawings dated July 7, 2020, prepared by Cusimano Architect.

Road traffic on Hurontario Street is the primary noise source, with secondary contributions from road traffic on Burnhamthorpe Road West, Central Parkway West, and Kariya Drive. Ultimate road traffic data was obtained from the relevant authorities and was used to predict future traffic sound levels at the locations of the proposed building façades and in the outdoor amenity areas. The predicted sound levels were compared to the guidelines of the Ministry of the Environment, Conservation and Parks (MECP) and the City to develop noise control recommendations.

There is a proposed future Light Rail Transit (LRT) system along the centre of Hurontario Street. Information regarding the Hurontario-Main LRT line was obtained from the report prepared for SNC-Lavalin Inc. as part of the Transit Project Assessment Process (TPAP), and in particular the included Noise and Vibration Impact Assessment Report dated June 4, 2014, by J.E. Coulter Associates Ltd. The findings of this report indicate that sound levels from the LRT will be negligible in comparison with overall sound levels from cars/trucks on the roadways, and perceptible tactile vibration and vibration-induced noise is anticipated to be within the indicated criteria at residential receptors in the proposed building, with the track isolation system recommended in the report.

The future mixed-use development will include non-residential uses on the ground floor, and consideration will need to be given during detailed design of the future non-residential spaces to ensure that those uses do not adversely impact the residential uses above.

Warning clauses for noise and vibration are required to be included in the development agreements and/or lease provisions, and recommended wording for those clauses is provided herein.

2 Site Description

The subject property is located in the City of Mississauga, on the south side of Elm Drive West, on the west side of Hurontario Street. The drawings indicate a 50-storey residential tower on the north side of the site, above a five-storey lower podium and a twelve-storey upper podium that span southward to a private road that serves an existing high-rise development at 3504 Hurontario Street. The ground floor of the east portion of the lower podium will feature retail space, with the entire southwest portion of the lower podium containing an above-ground parking garage, and there are also seven levels of parking below grade. There are indoor and outdoor amenity spaces on the sixth and thirteenth floors (on the podium roofs). Residential suites begin on the second floor, and continue to the top of the tower.

This area is considered Class I (urban) in terms of its acoustical environment. The site is currently vacant, save for a condominium presentation center. As indicated on aerial photos, the majority of the surrounding lands are residential condominium buildings. To the southwest of the site is an Adult Education Centre, and Fairview Public School further to the west. There are no significant stationary sources of noise identified within 500 m of the subject site.

Road traffic on Hurontario Street is the primary noise source affecting this site, including traffic on the future Hurontario LRT line. Road traffic on Burnhamthorpe Road West, Central Parkway West, and Kariya Drive are considered to be secondary sources of noise and have been included in the analysis. As the site is outside the influence area of the Lester B. Pearson International Airport, noise from air traffic has not been considered in this study.

3 Noise Criteria

3.1 Road Traffic Noise

Guidelines for acceptable levels of road traffic noise impacting residential developments are contained in the MECP publication NPC-300, “Environmental Noise Guideline, Stationary and

Transportation Sources – Approval and Planning," August, 2013 (release date October 21, 2013), and are listed in Table 1 below. The values in Table 1 are energy equivalent (average) sound levels (L_{EQ}) in units of A-weighted deciBels (dBA).

Table 1: MECP Road Traffic Noise Criteria (dBA)

Area	Day (dBA) (7:00 – 23:00)	Night (dBA) (23:00 – 7:00)
Outdoor Living Area	55 dBA	--
Inside Living/Dining Rooms	45 dBA	45 dBA
Inside Bedrooms	45 dBA	40 dBA

These criteria apply to the surrounding vehicular traffic. Daytime refers to the period between 07:00 and 23:00, while nighttime refers to the period between 23:00 and 07:00. Corridors and washrooms are usually not considered to be noise-sensitive areas.

The term "Outdoor Living Area" (OLA) is used in reference to common areas associated with high-rise multi-unit buildings where passive outdoor recreation is expected to occur. Balconies with a depth of less than 4 m (measured perpendicular to the building façade) are not considered OLAs under MECP guidelines, and accordingly the noise criteria are not applicable there. Larger balconies or private terraces similarly do not require protection if the common amenity areas meet the applicable noise criteria.

The guidelines in the MECP publication allow the sound level in an Outdoor Living Area to be exceeded by up to 5 dBA, without mitigation, if warning clauses are placed in the rental agreements to the property. Where OLA sound levels exceed 60 dBA, physical mitigation is required to reduce the OLA sound level to below 60 dBA and as close to 55 dBA as feasible.

With respect to the building envelope, no controls are required where road traffic levels are under 50 dBA. Where the road traffic noise level (L_{EQ}) is greater than 60 dBA at night or 65 dBA during the day, windows must be designed to achieve the indoor sound level criteria listed above. Otherwise, any glazing meeting the Ontario Building Code is considered adequate under MECP

guidelines. Where the predicted nighttime and/or daytime sound levels exceed these thresholds, central air conditioning is required so that windows can remain closed against the noise.

4 Road Traffic Noise Assessment

4.1 Road Traffic Data

Road traffic volumes and commercial (truck) percentages for Hurontario Street, Burnhamthorpe Road West, Central Parkway West, and Kariya Drive were obtained from the City of Mississauga in the form of Ultimate Annual Average Daily Traffic (AADT) volumes (see Appendix A). A 90% day/10% night split was used in the analysis, as indicated, along with the posted speed limits of 60 km/h for Hurontario Street and Burnhamthorpe Road West and 50 km/h for Central Parkway West and Kariya Drive. Elm Drive West traffic volumes were not available, and in any case are assumed to be negligible compared to Hurontario Street traffic volumes, and are not included in the analysis. The future volumes used in this study are listed in Table 2. Road traffic data is provided in Appendix A.

Table 2: Ultimate Road Traffic Data

Road Name		Cars	Medium Trucks	Heavy Trucks	Total
Hurontario Street	Daytime	35 165	806	659	36 630
	Nighttime	3 907	90	73	4 070
	Total	**39 072**	**895**	**733**	**40 700**
Burnhamthorpe Road West	Daytime	38 016	871	713	39 600
	Nighttime	4 224	97	79	4 400
	Total	**42 240**	**968**	**792**	**44 000**
Central Parkway West	Daytime	15 801	269	220	16 290
	Nighttime	1 756	30	24	1 810
	Total	**17 557**	**299**	**244**	**18 100**
Kariya Drive	Daytime	3 528	40	32	3 600
	Nighttime	392	4	4	400
	Total	**3 920**	**44**	**36**	**4 000**

4.2 Contribution from the Proposed LRT Line

Information regarding the future Hurontario-Main LRT line was obtained from the Noise and Vibration Impact Study report prepared as part of the Transit Project Assessment Process (TPAP). The findings of the report indicate that there will be no noticeable change in sound levels along most parts of the corridor, and that the contribution of the LRT system to the overall sound level from cars, trucks and buses will be negligible. In particular, the report predicts a -1 dBA impact relative to nighttime traffic noise levels and no change relative to daytime traffic noise levels for receptors along Hurontario Street between Central Parkway and Burnhamthorpe Road, which includes the proposed development. The supporting documents from the report are attached in Appendix B.

4.3 Traffic Noise Predictions

To assess the levels of traffic noise which will impact the site in the future, predictions were made using a numerical computer modeling package (*Cadna-A version 2020 MR1*). The model is based on the methods from ISO Standard 9613-2.2, "*Acoustics - Attenuation of Sound During Propagation Outdoors*", which accounts for reduction in sound level with distance due to geometrical spreading, air absorption, ground attenuation and acoustical shielding by intervening structures.

The road noise sources have been included in the model using the basic road element included in *Cadna-A*, which follows the German guideline RLS-90 for road traffic noise predictions. Our experience suggests that road sound levels predicted by RLS-90 are reasonably accurate. The model road traffic values have been qualified to be within 1 – 2 dBA of those predicted in STAMSON 5.04, a computer algorithm developed by the MECP. *Cadna-A* output is provided in Appendix C.

The model was used to predict traffic noise levels at each of the building facades and in the outdoor amenity spaces. Predicted daytime and nighttime sound levels at the building façades are shown in Figures 3 and 4, respectively. The maximum predicted sound levels at each façade and each outdoor amenity area are shown in Table 3 below.

Table 3: Road Traffic Sound Level Predictions, Typical Daytime and Nighttime Hours [dBA]

Location Description	Day (16-hr avg) (7:00 – 23:00)	Night (8-hr avg) (23:00 – 7:00)
Lower Podium		
North Façade	69	62
East Façade	72	65
South Façade	68	62
West Façade	50	44
Upper Podium		
North Façade	66	60
East Façade	70	63
South Façade	67	60
West Façade	51	44
Tower		
North Façade	65	59
East Façade	68	62
South Façade	64	58
West Façade	53	46
Outdoor Amenity Areas		
6th Floor, North (R1)	52	--
6th Floor, South (R2)	51	--
13th Floor (R3)	53	--

4.4 Traffic Noise Recommendations

The sound levels from road traffic at the façades of the proposed Tower 3 were predicted to be up to 72 dBA during daytime hours, and up to 65 dBA during nighttime hours. The following sections outline preliminary recommendations for building façade constructions and ventilation requirements to achieve the noise criteria discussed in Section 3.

4.4.1 Minimum Building Façade Constructions

Given the projected future sound levels at the building facades, MECP guidelines recommend that the building envelope be designed so that indoor sound levels comply with the MECP noise criteria.

Preliminary calculations have been performed to determine the building envelope constructions likely to be required to maintain indoor sound levels within MECP guidelines. The calculation methods were developed by the National Research Council (NRC). They are based on the maximum predicted future sound levels at the building façades, and the anticipated areas of the façade components (walls, doors and windows) relative to the floor area of the adjacent room.

For the purposes of this preliminary analysis, typical window-to-floor areas were conservatively assumed to be 80% (i.e. 70% fixed, 10% operable elements relative to floor area). Based upon these assumptions, and the maximum predicted sound levels at the associated facades, it was determined that the fixed glazing for the east lower podium façade must achieve a sound transmission class (STC) rating of at least 34 in order to achieve the target indoor sound level criteria. Operable doors and windows can be up to two points lower. The performance of operable elements is typically determined by the seals, and it is particularly important to qualify and include such elements with test data.

The other façades of the proposed lower podium, the upper podium, and the tower are somewhat less impacted. However, in an urban environment such as this, we do not typically recommend less than STC-33, which can be achieved using standard glazing assemblies. Note that this rating is a minimum for the entire assembly (including mullions) and test data should be provided to verify. If more glazing is incorporated, higher STC requirements may apply. Acoustical criteria for the building façades can be optimized as part of the detailed design of the building envelope, if required.

These calculations assume insignificant sound transmission through the walls in comparison with the windows. Exterior walls that are not glazed should have sufficient acoustical insulation value such that the noise transmitted through is negligible in comparison with the windows; to achieve this, exterior wall assemblies with a rating of at least 5-10 STC points above the surrounding window STC requirements are typically required, depending on the amount of wall area relative to window. In most cases, the wall sound insulation is much higher than this; sections of poured or pre-cast concrete will typically have a sound insulation rating of STC-55 or more, and can be discounted. Insulated spandrel or metal panels backed by a drywall assembly generally have sound insulation ratings in the range of STC-45 to STC-55, also well above the requirements for the glazing.

4.4.2 Ventilation Requirements

Predicted sound levels at many of the building facades exceed 65 dBA during the day and/or 60 dBA at night. Central air conditioning is required, and is expected to be included in any event.

4.4.3 Outdoor Living Areas

The drawings show two large outdoor amenity areas throughout the building. There is an outdoor amenity area on the sixth floor, represented by two prediction locations (R1 and R2), and an outdoor amenity area on the thirteenth floor, represented by prediction location R3. Future sound levels at these locations are predicted to be less than 55 dBA during the day. Consequently, no upgraded acoustic mitigation measures are required.

5 Ground Borne Vibration Assessment

As mentioned above, there is a proposed future Light Rail Transit (LRT) system along the centre of Hurontario Street. There will be 2 tracks, with the closer tracks located approximately 20 m from the east façade of the podium.

Information regarding vibrations associated with the Hurontario-Main LRT line was obtained from the Noise and Vibration Impact Study report prepared as part of the Transit Project Assessment Process (TPAP). The report concludes that perceptible tactile vibration from the LRT is not an issue, but ground-borne noise could be in some circumstances. Vibration-induced sound levels are presented, factoring in the possible degree of isolation applied to the track, the proximity to the track, and the operating speed of the streetcars. According to the LRT system plan, the nearest proposed stop is at the intersection of Hurontario Street and Central Parkway West, approximately 150 m away. Thus, it is assumed that streetcars will operate at the posted speed limit of 60 km/h when passing the site. The report presents three levels of vibration isolation, as follows:

- “Level 1: Embedded, soft rubber”
- “Level 2: Embedded, more resilient than Level 1; thicker material”
- “Level 3: Floating slab on a concrete rail bed mounted on rubber isolators (mats)”

At a distance of 20 m and at a speed of 60 km/h, the vibration induced sound levels on the ground floor may slightly exceed the target of 35 dBA, and sound levels on the ground floor mezzanine will

meet the target of 35 dBA, if "Level 1" vibration isolation is included, as recommended in the report. However, residential units begin on the second floor in the proposed building, two levels above grade. Therefore, vibration induced noise and perceptible ground-borne vibration from the LRT vehicles are not anticipated to be an issue for the proposed building, provided that Level 1 vibration isolation has been included in the LRT track design.

The supporting documents extracted from the report are attached in Appendix B.

6 Impact of the Development on Itself

Section 5.9.1 of the Ontario Building Code (OBC) specifies the minimum required sound insulation characteristics for demising partitions, in terms of Sound Transmission Class (STC) values. In order to maintain adequate acoustical privacy between separate suites in a multi-tenant building, inter-suite walls must meet or exceed STC-47. Walls separating a suite from a noisy space such as a refuse chute, or elevator shaft, must meet or exceed STC-55. In addition, it is recommended that the floor/ceiling constructions separating suites from any amenity or commercial spaces also meet or exceed STC-55. Tables 1 and 2 in Section SB-3 of the Supplementary Guideline to the OBC provide a comprehensive list of constructions that will meet the above requirements.

Loading areas for the retail units and the residential tower are located indoors. Major mechanical equipment is contained within the mechanical penthouse. There are two exhaust shafts located at the southern corners of the Tower III site. The exhaust shaft at the southeast corner of the site is located reasonably away from any sensitive uses, and is not anticipated to be a concern. The exhaust shaft at the southwest corner of the site is somewhat closer to the building, however with appropriate selection of fans and/or integrated noise control measures, no significant impacts are anticipated.

Tarion's Builder Bulletin B19R requires the internal design of condominium projects to integrate suitable acoustic features to insulate the suites from noise from each other and amenities in accordance with the OBC, and limit the potential intrusions of mechanical and electrical services of the building on its residents. It is expected that an acoustical consultant will review in greater detail the mechanical and electrical drawings and details of demising constructions and

mechanical/electrical equipment, during design development, to help ensure that the noise impact of the development on itself is maintained within acceptable levels.

7 Impact of the Development on the Environment

Sound levels from stationary (non-traffic) sources of noise such as rooftop air-conditioners, cooling towers, exhaust fans, etc. should not exceed the minimum one-hour L_{EQ} ambient (background) sound level from road traffic, at any potentially impacted residential point of reception, to avoid complaints. Typical minimum ambient sound levels in the area are expected to be 55-65 dBA during the day (depending on exposure to the roadways) and about 5 dB less at night, at nearby residential receptors. Thus, any electro-mechanical equipment associated with this development (e.g. emergency generator testing, fresh-air handling equipment, etc.) should be designed with these targets in mind such that they do not result in noise impact beyond these ranges. The proposed 50-storey tower will overlook all current neighbouring buildings, thus noise from the mechanical penthouse on the roof is not expected to substantially impact any neighbouring buildings, provided that typical control measures are included.

Similarly, the current plans show two parking garage exhaust shafts, at the southeast and southwest corners of the Tower III site plan. With reasonable selection of fans and/or integrated noise control measures, no significant impacts on surrounding off-site receptors are anticipated.

8 Warning Clauses

MECP guidelines recommend that appropriate warning clauses be used in the Development Agreements and in purchase, sale and lease agreements (typically by reference to the Development Agreements), to inform future owners and occupants about potential noise concerns from sources in the area. The actual wording of the warning clause depends on the nature of the excess. For residential uses, the recommended clauses are as follows:

(a) 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 road traffic may on occasion interfere with some activities of the dwelling occupants as the sound levels exceed the Municipality's and the Ministry of Environment, Conservation and Parks' noise criteria.

(b) 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 Ministry of the Environment, Conservation and Parks.

(c) Purchasers/tenants are advised that due to the proximity of this development to nearby retail, institutional and commercial facilities, sound levels from these facilities may at times be audible.

These sample clauses are provided only as examples, and can be modified by the owner's legal representative, in consultation with the City, in order to suit site-specific requirements.

9 Conclusions & Summary of Recommendations

The following list summarizes the conclusions and recommendations made in this report. The reader is referred to the previous sections of the report where these recommendations are discussed in more detail:

1. Certain minimum building and glazing constructions are recommended, as indicated in Section 4.4.1. An updated noise study should be conducted for the building when detailed floor plans and elevations are finalized, to refine the building façade and glazing construction recommendations with respect to traffic noise impacts, based on actual window-to-floor area ratios.

2. Central air conditioning is required, and assumed to be provided in any event.

3. Sound levels at the outdoor amenity areas from road traffic are expected to be within the applicable MECP criteria.

4. Perceptible ground-borne vibration and vibration-induced noise from the future Hurontario-Main LRT line is anticipated to be within the recommended criteria at residential receptors in the proposed building.

5. Noise warning clauses should be included in the property and tenancy agreements to inform future residents of potential noise intrusions from the roads, and of the presence of nearby retail/commercial/institutional facilities. Recommended wording for these clauses is provided in Section 8. Such clauses are often included by reference to the Development Agreements in which they are contained.

6. Demising assemblies must be selected to meet the minimum requirements of the Ontario Building Code (OBC). Where B19R certification is needed, an acoustical consultant is required to review details of demising constructions and mechanical/electrical equipment, when available, to help ensure that the noise impact of the development on itself are maintained within acceptable levels. Outdoor sound emissions should also be checked to ensure that any potential impacts on adjacent properties are suitably minimized.

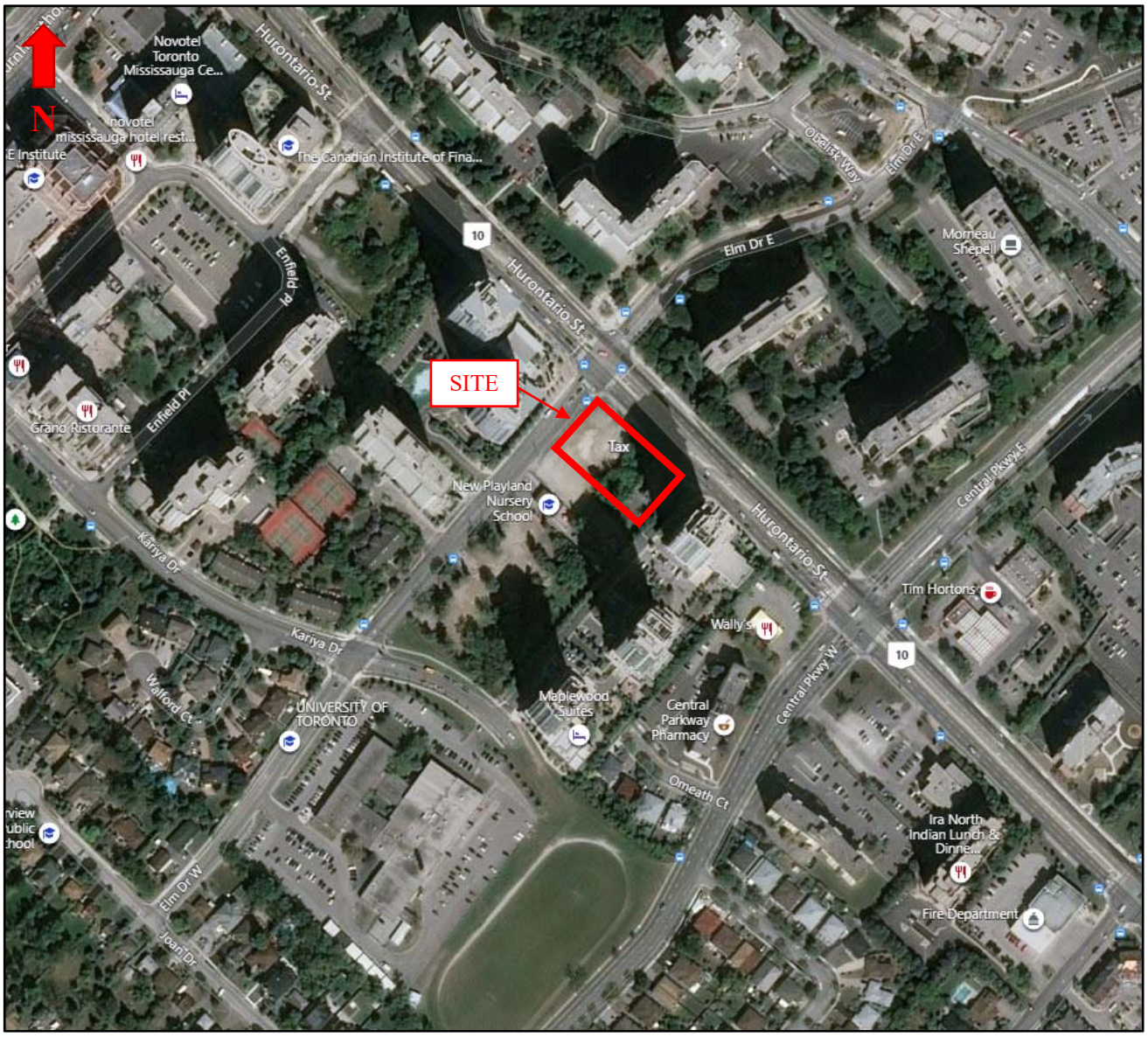


Figure 1: Key Plan

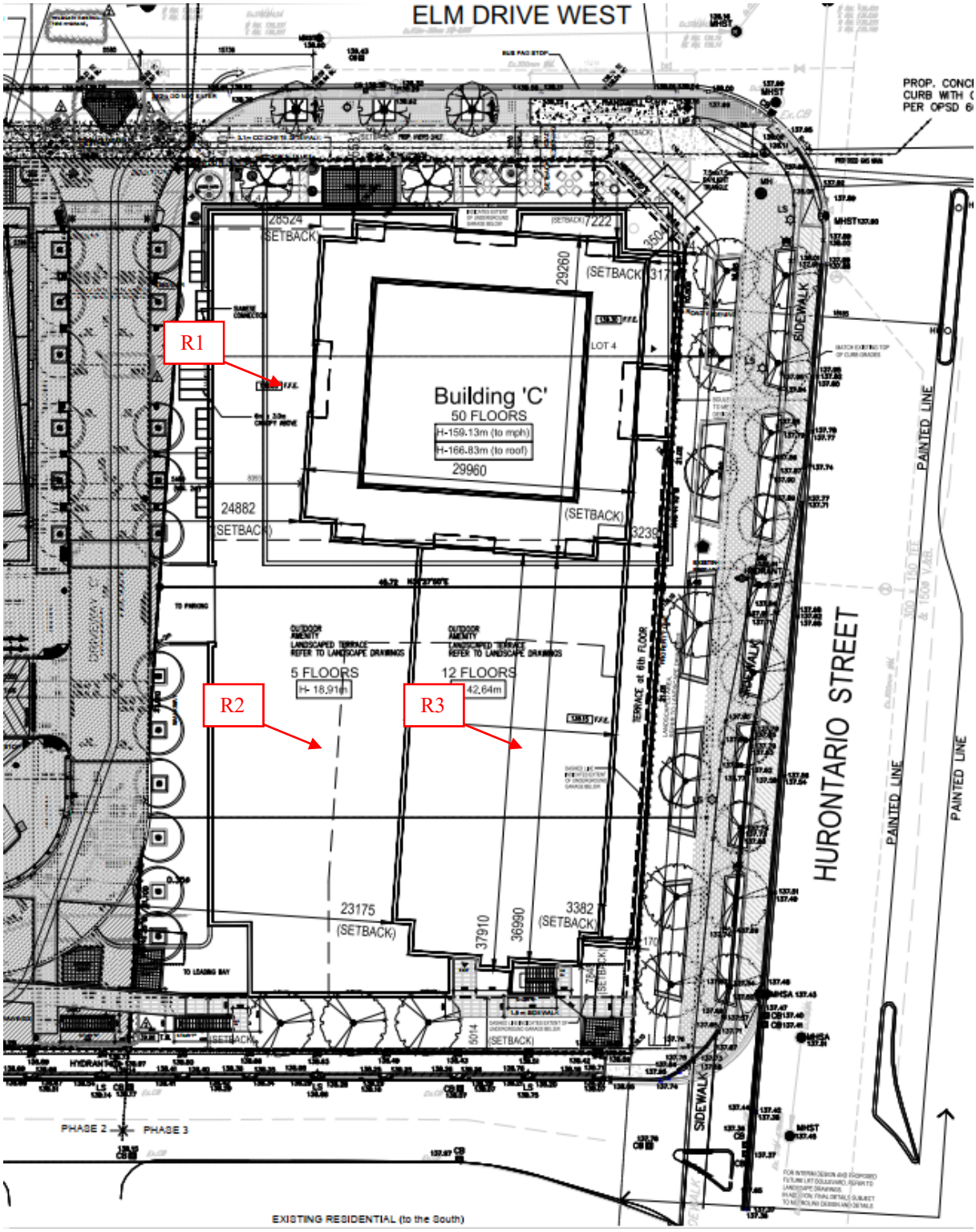


Figure 2: Tower III Site Plan and Receptor Locations in Outdoor Living Areas

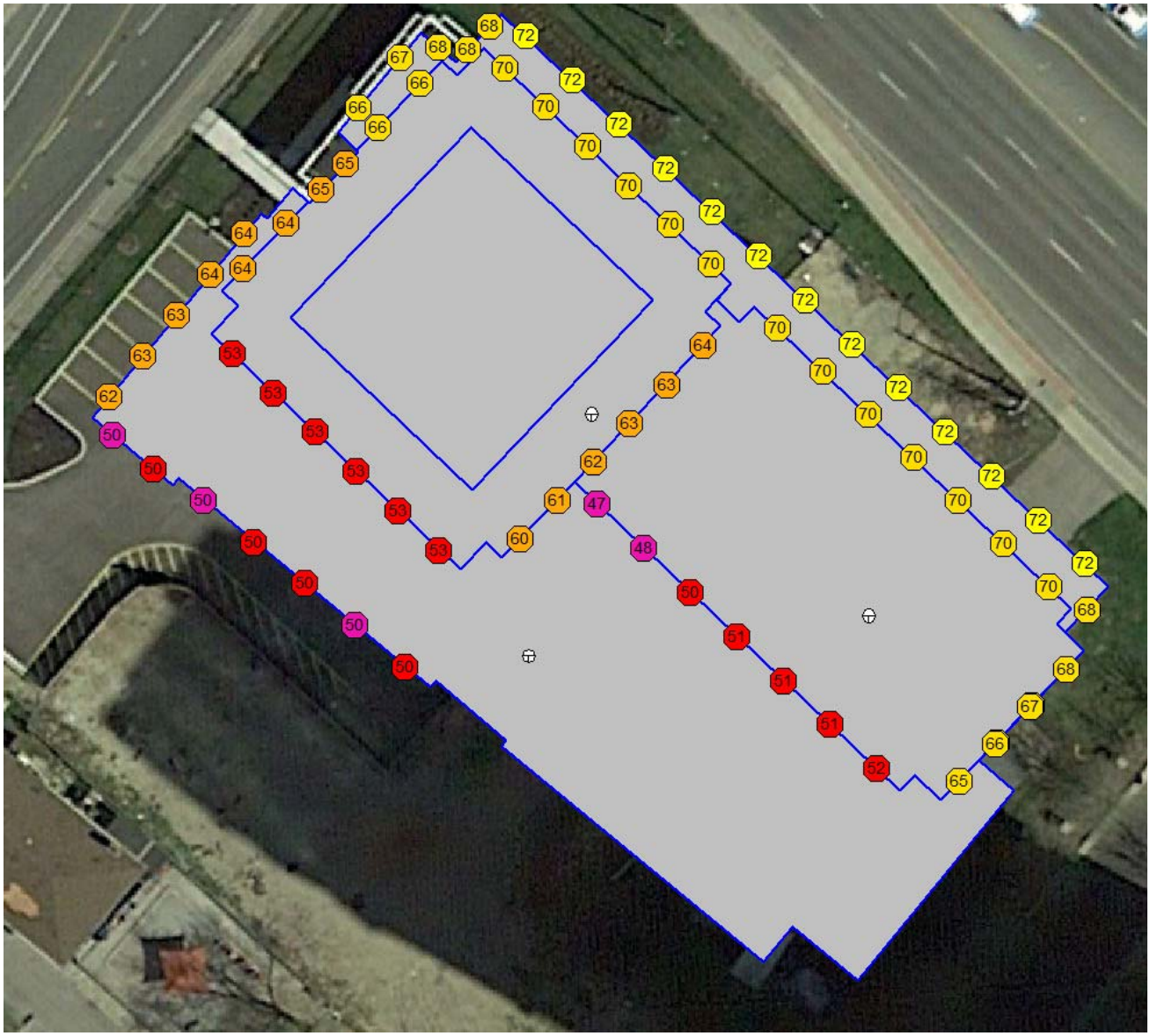


Figure 3: Daytime Sound Level Predictions at Building Façades from Traffic Sources

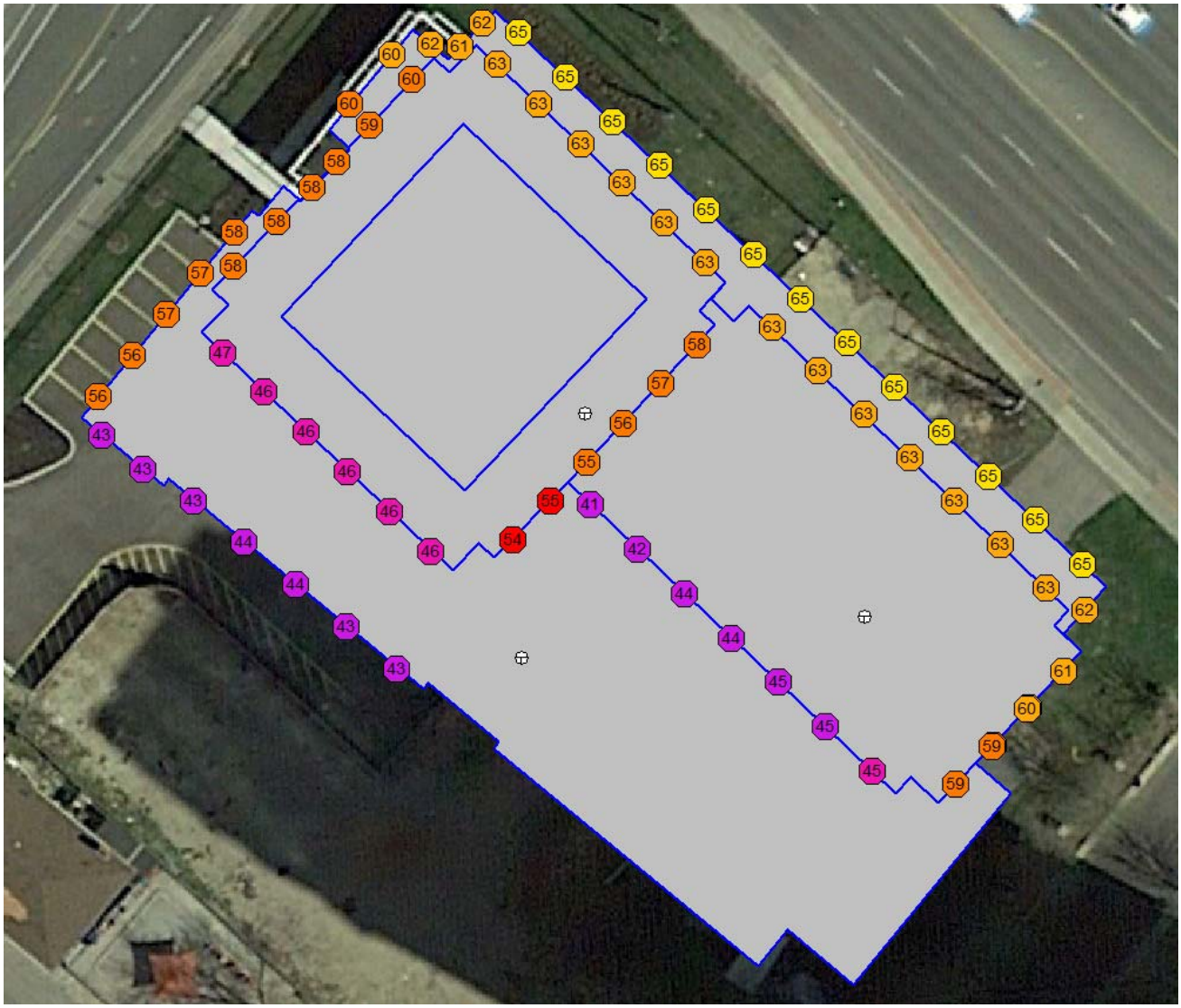


Figure 4: Nighttime Sound Level Predictions at Building Façades from Traffic Sources

APPENDIX A
TRAFFIC DATA

Date:	27-May-19

NOISE REPORT FOR PROPOSED DEVELOPMENT

REQUESTED BY:

Name:	Louri Basmanov
Company:	HGC Engineering

PREPARED BY:

Name	Bertuen Mickle
Tel#:	(905) 615-3200

Location: -Burnhamthorpe Road : From Hurontario Street to Kariya Drive
-Hurontario Street: From Burnhamthorpe Road to Central Parkway
-Central Parkway: from Hurontario Street to Achill Crescent
- Kariya drive: from Burnhamthorpe Road to South End

ID# 421

ON SITE TRAFFIC DATA

Specific	*Street Names*				
	Hurontario Street	Burnhamthoprpe Road	Central Parkway W	Kariya Drive	
AADT:	40,700	44,000	18,100	4,000	
# of Lanes:	6 Lanes	6 Lanes	4 lanes	2 Lanes	
% Trucks:	4%	4%	3%	2 %	
Medium/Heavy Trucks Ratio:	55/45	55/45	55/45	55/45	
Day/Night Split:	90/10	90/10	90/10	90/10	
Posted Speed Limit:	60 km/h	60 km/h	50 km/h	50 km/h	
Gradient Of Road:	<2%	<2%	<2%	<2%	
Ultimate R.O.W:	45m	60m	40m	26m	

Comments:

Ultimate Traffic data only

-There is a proposed LRT line along Hurontario St. with existing lanes may be converted from 6 lanes to 4 lanes with 2 LRT lines in the middle.

-Please contact Farhad Shala @(905) 615-3200 ext. 3377 or farhad.shala@mississauga.ca for more information regarding LRT.

APPENDIX B
SUPPORTING DOCUMENTS

Table 1: Generic Corridor Description

From	To	Length[1]	Track Position	Land Uses[2]	Distance to Closest Sensitive Receptor[3]	Speed (km/h.)[8]	POR[4]
Park St.	Inglewood Dr.	370m	West	East Side = R, West = C	18m	40	1
Inglewood Dr.	QEW	1,400m	Centre	R +C	22m	50	2
QEW	Queensway West	900m	Centre	East Side = R West Side =C	29m	50	-
Queensway West	King St.	740m	Centre	R +C	24m	50	3
King St.	Agnes St.	380m	Centre	C	-	50	-
Agnes St.	CP Rail Galt Sub	560m	Centre	West Side = R + C + E, East Side = C	27m	50	-
CP Rail Galt Sub	Central Parkway	750m	Centre	R + C	22m	50	4
Central Parkway	Burnhamthorpe Rd.	970m	Centre	R + C	26m	60	5
Burnhamthorpe Rd.[5]	Highway 403	1,300m	Centre	R + C	35m	60	-
Hurontario St.[5]	Duke of York Blvd.	800m	Centre	R + C	31m	60	6
Burnhamthorpe Rd.[5]	Rathburn Rd.	800m	East	C + E	-	60	-
Duke of York Blvd.[5]	Hurontario Street	800m	North	C	-	60	-
Highway 403	Ceremonial Drive	1,200m	Centre	R + C	28m	60	7
Ceremonial Drive	Matheson Blvd.	1,600m	Centre	R + C	31m	60	8
Matheson Blvd.	Highway 401	1,600m	Centre	C + I	-	80	-
Highway 401	Ray Lawson Blvd.	4,500m	Centre	C + I	38m	80	9[6]
Ray Lawson Blvd.	Steeles Ave.	1,100m	Centre	R + C	26m	60	10
Steeles Ave.	Nanwood Dr.	1,600m	Centre	R + C	26m	60	11
Nanwood Dr.	Wellington St.	1,300m	Centre	R + C + E	16m	50	12
Wellington St.	GO Kitchener Rail	450m	Side/Split	2nd Storey R + C + E	5m	50	13[7]
Main Street	Brampton GO Station	270m	North	North Side = R	20m	40	14

Notes:
1. Lengths are approximate only
2. Land uses: C-Commercial, I-Industrial, R-Residential, E-Institutional
3. Distance is measured from the centreline of the closest set of tracks
4. Point of Reception within the segment of the LRT
5. These segments are within the Downtown Mississauga loop, where the LRT splits around Mississauga's City Centre
6. Though commercial, a motel/hotel has been selected for review, as it is a place where people may reside
7. Downtown Brampton includes an area where there are 1st-floor commercial and 2nd-/3rd-floor residential components.
8. Speed of LRT and traffic based on posted speed limits.

Table 5: Expected LRT Sound Levels and Impacts

POR	No Project Sound Levels (dBA)		With Project Sound Levels (dBA)						Impact (dB)	
			Daytime (16 hr L_{eq})			Night-time (8 hr L_{eq})				
	Daytime (16 hr L_{eq})	Night-time (8 hr L_{eq})	Traffic Only	LRT Only	TOTAL	Traffic Only	LRT Only	TOTAL	Daytime	Night-time
1	67	60	66	56	66	60	51	61	-1	1
2	67	61	67	59	68	60	54	61	1	0
3	67	61	65	59	66	58	54	59	-1	-2
4	68	62	67	59	68	61	54	62	0	0
5	68	62	67	59	68	60	54	61	0	-1
6	66	59	65	59	66	58	53	59	0	0
7	70	63	68	59	69	62	54	63	-1	0
8	68	61	66	59	67	59	54	60	-1	-1
9	70	63	68	60	69	62	55	63	-1	0
10	69	62	68	59	69	61	54	62	0	0
11	68	62	66	60	67	59	55	60	-1	-2
12	67	60	64	61	66	57	56	60	-1	0
13	68	61	62	63	66	56	58	60	-2	-1
14	55	50	53	58	59	46	53	54	4	4

Notes: The "With Project" sound levels have been divided into Traffic Only and LRT Only sound levels to show the relative significance of each. They are then added together to obtain the TOTAL sound level, which is used to determine the potential impact.

Table 14: Predicted LRV Vibration-Induced Noise (50km/h)

Distance from Track to Building Foundation	Floor	Room	Airborne Sound Level from LRT (dBA)	Vibration-Induced Sound Level Under Various Isolation Systems (dBA)		
				Level 1 Isolation	Level 2 Isolation	Level 3 Isolation
5m	1	Front	54	52	47	37
		Back	-	50	45	35
	2	Front	54	47	42	37
		Back	-	45	40	35
10m	1	Front	51	46	41	36
		Back	-	45	40	35
	2	Front	51	42	37	-
		Back	-	40	35	-
15m	1	Front	50	41	36	-
		Back	-	39	34	-
	2	Front	50	36	-	-
		Back	-	34	-	-
20m	1	Front	48	37	-	-
		Back	-	36	-	-
	2	Front	48	-	-	-
		Back	-	-	-	-

Vibration Isolation Systems:
Level 1 - Embedded, softer rubber.
Level 2 - Embedded, more resilient than Level 1; thicker material.
Level 3 - Floating slab on a concrete rail bed mounted on rubber isolators (mats).

Table 15: Predicted LRV Vibration-Induced Noise (60km/h)

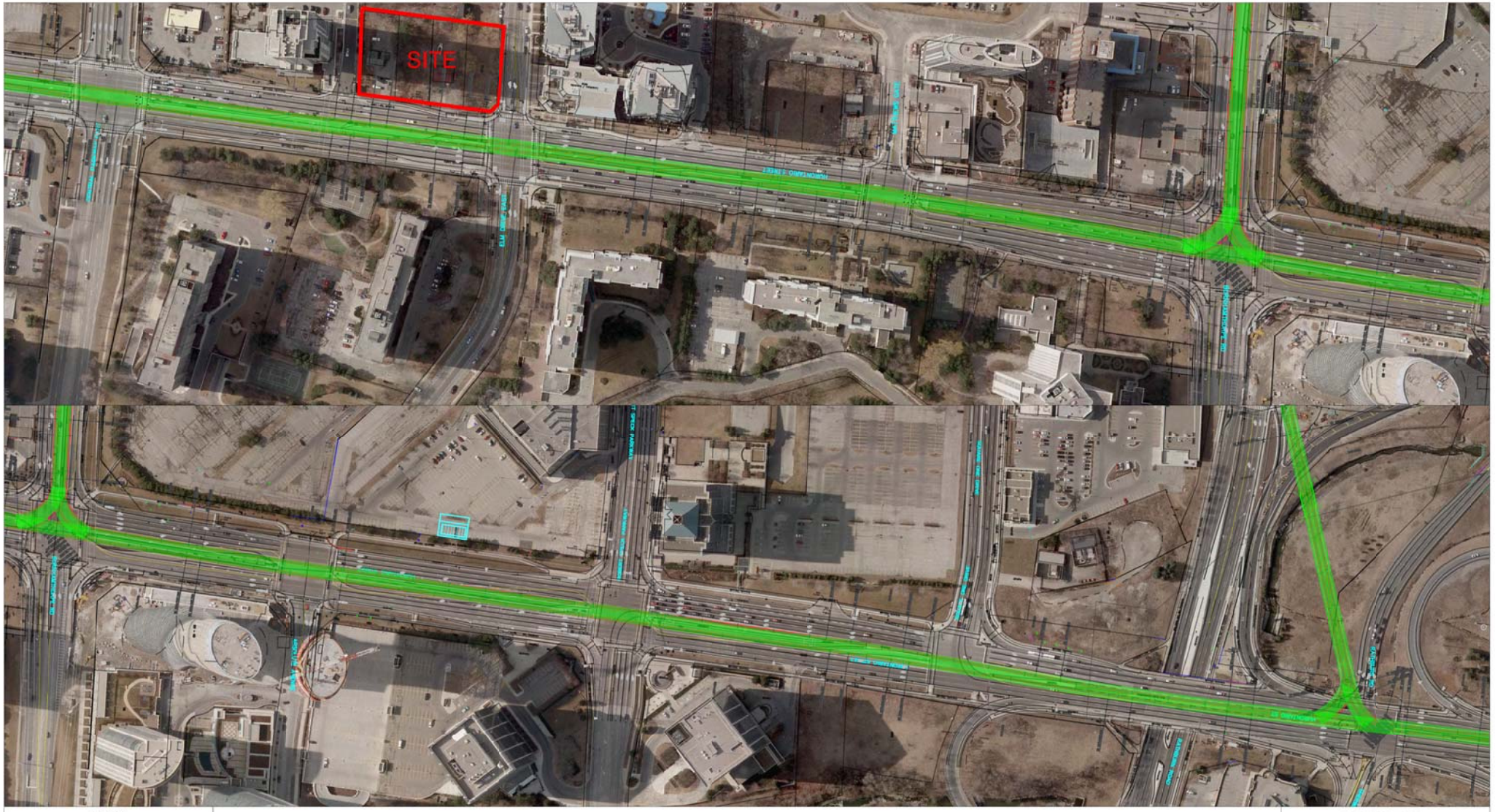
Distance from Track to Building Foundation	Floor	Room	Airborne Sound Level from LRT (dBA)	Vibration-Induced Sound Level Under Various Isolation Systems (dBA)		
				Level 1 Isolation	Level 2 Isolation	Level 3 Isolation
5m	1	Front	56	54	49	39
		Back	-	52	47	37
	2	Front	56	49	44	39
		Back	-	47	42	37
10m	1	Front	53	48	43	38
		Back	-	47	41	37
	2	Front	53	43	38	34
		Back	-	41	36	32
15m	1	Front	52	43	38	-
		Back	-	41	36	-
	2	Front	52	39	34	-
		Back	-	37	32	-
20m	1	Front	51	39	34	-
		Back	-	37	32	-
	2	Front	51	35	-	-
		Back	-	33	-	-

Vibration Isolation Systems:
Level 1 - Embedded, softer rubber.
Level 2 - Embedded, more resilient than Level 1; thicker material.

Table 17: Summary of Preliminary Vibration Isolation Recommendations

Street Name	From	To	Distance to Closest Receptor[3]	Length of Track (m)	Type of Track[8]	Vibration Isolation Required	Insertion Loss/Reduction	Critical Receptor Type	Expected Ground-Borne Vibration levels
Hurontario St.[4]	Port Credit GO Station	Inglewood	33	380	Tangent	Level 1 - Embedded	5 dB	Low rise residential	<0.10 mm/s rms
					Crossover	Level 2 - Embedded	10 dB		
Hurontario St.	Inglewcod	Highway 403	22	1120	All Track	Level 1 - Embedded	5 dB	Low rise residential	<0.10 mm/s rms
Hurontario St.	Highway 403	Queensway	30	1000	Tangent	Level 1 - Embedded	5 dB	High rise residential	<0.10 mm/s rms
					Crossover	Level 2 - Embedded	10 dB		
Hurontario St.	Queensway	King Street	22	600	All Track	Level 1 - Embedded	5 dB	High rise residential	<0.10 mm/s rms
Hurontario St.	King Street	CP Galt Railway	27	950	All Track	Level 1 - Embedded	5 dB	High rise residential	<0.10 mm/s rms
Hurontario St.[5]	CP Galt Railway	Burnhamthorpe Rd.	20	1500	Tangent	Level 1 - Embedded	5 dB	High/low rise residential	<0.10 mm/s rms
					Crossover	Level 2 - Embedded	10 dB		
Burnhamthorpe Rd.	Hurontario St.	Duke of York Blvd.	32	800	All Track	Level 1 - Embedded	5 dB	High rise residential	<0.10 mm/s rms
Duke of York Blvd.	Burnhamthorpe Rd.	Rathburn Rd.	-	800	All Track	Level 1 - Embedded	5 dB	None	-
Rathburn Rd.	Duke of York Blvd,	Hurontario St.	-	900	All Track	Level 1 - Embedded	5 dB	None	-
Hurontario St.	Burnhamthorpe Rd.	Highway 403	31	1300	All Track	Level 1 - Embedded	5 dB	High rise residential	<0.10 mm/s rms
Hurontario St.	Highway 403	Matheson Blvd.	28	2600	All Track	Level 1 - Embedded	5 dB	Low rise residential	<0.10 mm/s rms
Hurontario St.[6]	Matheson Blvd.	Highway 407	27	300	Tangent	Level 1 - Embedded	5 dB	Some Hotel/Motel	<0.10 mm/s rms
					Switches (1)	Level 2 - Embedded[7]	10 dB		
Hurontario St.	Highway 407	Steeles Ave.	26	1600	All Track	Level 1 - Embedded	5 dB	High/low rise residential	<0.10 mm/s rms
Main St.	Steeles Ave.	Nanwood Dr.	26	1800	All Track	Level 1 - Embedded	5 dB	High/low rise residential	<0.10 mm/s rms
Main St.	Nanwood Dr.	John St.	17	1000	All Track	Level 2 - Embedded	10 dB	Low rise residential	<0.10 mm/s rms
Main St.	John St.	Nelson St.	5	330	All Track	Level 3 - Floating	15 dB	2nd storey residential	<0.10 mm/s rms
None	Main St.	Brampton GO Station	20	280	Tangent	Level 1 - Embedded	5 dB	High rise residential	<0.10 mm/s rms
					Crossover	Level 2 - Embedded	10 dB		

Notes:
1. The recommendations in Table 13 are based on the findings in Section 5.4.3 and the predominant receptor type along each section.
2. There are some small areas where the vibration isolation achieved will be slightly better than required because of slightly higher setbacks for individual dwellings. These infrequent cases will need to be identified during Detail Design.
3. The distances are measured from the centreline of the nearest track to the edge of the building. The most critical receptors along the corridor are typically residential receptors.
4. The recommendations for this area does not include adjustments to the levels due to the presence of sandy soils, which tend to transmit vibration more efficiently. The effect of these sandy soils will need to be confirmed during Detail Design.
5. There is a small section in this corridor where Level 2 isolation is required due to the presence of an apartment building with no windows facing directly onto Hurontario Street.
6. Vibration isolation is not required along the entire length of this area due to the lack of sensitive receptors along this section of the corridor and the width of the right-of-way. The exception is in the vicinity of a two motels where the setback is only approximately 27m. The remaining areas do not require vibration isolation. Only the total length of track needing vibration isolation is shown (300m) while the entire length of this area is approximately 5,500m. This area should be reviewed during Detail Design to confirm that this recommendation remains sufficient to meet the guidelines.
7. Level 1 transition is recommended to reduce track fatigue.
8. Tangent track refers to parallel running tracks. Crossovers represent single or double crossovers.



LEGEND

LEVEL 1 (EMBEDDED) - 5 dB REDUCTION

LEVEL 2 (EMBEDDED) - 10 dB REDUCTION

LEVEL 3 (FLOATING) - 15 dB REDUCTION

FIGURE 26
VIBRATION ISOLATION
CENTRAL PKWY. TO HWY. 403

APPENDIX C
CADNA-A OUTPUT

Cadna-A Output

Result Table

Name	M.	ID	Level Lr		Limit. Value		Land Use			Height		Coordinates		
			Day	Night	Day	Night	Type	Auto	Noise Type			X	Y	Z
			(dBA)	(dBA)	(dBA)	(dBA)				(m)		(m)	(m)	(m)
R1			51.5	45.0	0.0	0.0		x	Total	1.50	g	610473.20	4827264.24	20.41
R2			51.1	44.6	0.0	0.0		x	Total	1.50	g	610505.40	4827245.29	20.41
R3			52.6	46.1	0.0	0.0		x	Total	1.50	g	610514.92	4827259.23	44.14

Buildings

Name	M.	ID	RB	Residents	Absorption	Height	
						Begin	
						(m)	
Building A - Podium			x	0		14.00	r
Building A - 25th Floor			x	0		78.15	r
Building A - 29th Floor			x	0		90.74	r
Building A - 35th Floor			x	0		109.22	r
Building A - Level 1 Mechanical Room			x	0		109.22	r
Building A - Tower Roof Level			x	0		118.00	r
Building B - Podium			x	0		14.00	r
Building B - Tower Roof Level			x	0		134.00	r
Building C - 6th Floor			x	0		18.91	r
Building C - 12th Floor			x	0		42.64	r
Building C - MPH			x	0		159.13	r
Building C - Tower Roof Level			x	0		166.83	r
Offsite			x	0	0.2	95.00	r
Offsite			x	0	0.2	105.00	r
Offsite			x	0	0.2	95.00	r
Offsite			x	0	0.2	98.00	r
Offsite			x	0	0.2	98.00	r
Offsite			x	0	0.2	65.00	r
Offsite			x	0	0.2	7.00	r
Offsite			x	0	0.2	3.00	r

Road Sources

Name	M.	ID	Lme			Count Data		exact Count Data						Speed Limit		SCS	Surface		Gradient	Mult. Reflection		
			Day	Evening	Night	DTV	Str.class.	M			p (%)			Auto	Truck	Dist.	Dstro	Type		Drefl	Hbuild	Dist.
			(dBA)	(dBA)	(dBA)			Day	Evening	Night	Day	Evening	Night	(km/h)	(km/h)		(dB)		(%)	(dB)	(m)	(m)
Hurontario Street			70.0	-2.2	63.5			2289.4	0.0	508.8	1.8	0.0	1.8	60		a6ms	3.0	3	0.0	0.0		
Burnhamthorpe Road			70.3	-2.2	63.8			2475.0	0.0	550.0	1.8	0.0	1.8	60		10	3.0	3	0.0	0.0		
Central Parkway			65.0	-3.6	58.4			1018.1	0.0	226.3	1.4	0.0	1.4	50		7	3.0	3	0.0	0.0		
Kariya Drive			58.0	-3.6	51.5			225.0	0.0	50.0	0.9	0.0	0.9	50		4	3.0	3	0.0	0.0		

Geometry of Road Sources

Name	Height				Coordinates				Dist	LSlope
	Begin		End		x	y	z	Ground	(m)	(%)
	(m)		(m)		(m)	(m)	(m)	(m)		
Hurontario Street	0.00	r			610174.86	4827646.37	0.00	0.00		
					610322.79	4827498.39	0.00	0.00		
					610411.74	4827410.71	0.00	0.00		
					610487.10	4827339.07	0.00	0.00		
					610687.90	4827145.37	0.00	0.00		
					610863.04	4826976.57	0.00	0.00		
Burnhamthorpe Road	0.00	r			609863.58	4827277.09	0.00	0.00		
					610172.97	4827647.16	0.00	0.00		
					610406.33	4827920.68	0.00	0.00		
Central Parkway	0.00	r			610405.63	4826815.06	0.00	0.00		
					610496.66	4826901.85	0.00	0.00		
					610531.10	4826947.64	0.00	0.00		
					610557.57	4826998.05	0.00	0.00		
					610599.15	4827074.50	0.00	0.00		
					610609.61	4827096.13	0.00	0.00		
					610623.51	4827114.40	0.00	0.00		
					610642.79	4827138.34	0.00	0.00		
					610692.40	4827194.63	0.00	0.00		
					610788.18	4827289.99	0.00	0.00		
					610835.22	4827336.61	0.00	0.00		
					610888.15	4827380.30	0.00	0.00		
Kariya Drive	0.00	r			609970.47	4827390.26	0.00	0.00		
					610051.41	4827315.01	0.00	0.00		
					610110.27	4827261.17	0.00	0.00		
					610150.72	4827221.14	0.00	0.00		
					610192.86	4827184.48	0.00	0.00		
					610232.04	4827162.57	0.00	0.00		
					610280.92	4827143.61	0.00	0.00		
					610320.11	4827130.54	0.00	0.00		

Partial Day/Night

Source			Partial Level Day		
Name	M.	ID	R1	R2	R3
Hurontario Street			49.6	48.5	50.7
Burnhamthorpe Road			41.4	32.3	41.6
Central Parkway			45.4	47.4	47.1
Kariya Drive			10.5	32.6	25.7

Geometry Building

Name	M.	ID	RB	Residents	Absorption	Height		Coordinates			
						Begin		x	y	z	Ground
						(m)		(m)	(m)	(m)	(m)
Building A - Podium			x	0		14.00	r	610416.93	4827171.12	14.00	0.00
								610440.55	4827199.73	14.00	0.00
								610415.18	4827220.68	14.00	0.00
								610391.56	4827191.99	14.00	0.00
Building A - 25th Floor			x	0		78.15	r	610394.60	4827192.64	78.15	0.00
								610415.29	4827214.58	78.15	0.00
								610434.52	4827196.23	78.15	0.00
								610413.77	4827174.50	78.15	0.00
Building A - 29th Floor			x	0		90.74	r	610396.39	4827194.55	90.74	0.00
								610415.29	4827214.58	90.74	0.00
								610434.52	4827196.23	90.74	0.00
								610415.53	4827176.36	90.74	0.00
Building A - 35th Floor			x	0		109.22	r	610398.13	4827196.41	109.22	0.00
								610415.29	4827214.58	109.22	0.00
								610434.52	4827196.23	109.22	0.00
								610417.30	4827178.23	109.22	0.00
Building A - Level 1 Mechanical Room			x	0		109.22	r	610400.31	4827198.73	109.22	0.00
								610415.29	4827214.58	109.22	0.00
								610434.52	4827196.23	109.22	0.00
								610419.50	4827180.51	109.22	0.00
Building A - Tower Roof Level			x	0		118.00	r	610402.52	4827200.87	118.00	0.00
								610415.29	4827214.58	118.00	0.00
								610434.52	4827196.23	118.00	0.00
								610421.65	4827182.75	118.00	0.00
Building B - Podium			x	0		14.00	r	610448.84	4827209.81	14.00	0.00
								610472.47	4827238.42	14.00	0.00
								610447.10	4827259.37	14.00	0.00
								610423.48	4827230.68	14.00	0.00
Building B - Tower Roof Level			x	0		134.00	r	610429.64	4827231.83	134.00	0.00
								610447.05	4827256.30	134.00	0.00
								610468.59	4827240.99	134.00	0.00
								610451.17	4827216.50	134.00	0.00
Building C - 6th Floor			x	0		18.91	r	610483.00	4827251.10	18.91	0.00
								610488.35	4827246.66	18.91	0.00
								610487.97	4827246.19	18.91	0.00
								610507.89	4827229.76	18.91	0.00
								610510.16	4827232.48	18.91	0.00
								610515.14	4827228.32	18.91	0.00
								610526.97	4827242.82	18.91	0.00
								610524.28	4827245.09	18.91	0.00
								610532.27	4827253.48	18.91	0.00
								610530.92	4827254.88	18.91	0.00
								610534.15	4827258.35	18.91	0.00
								610488.02	4827301.85	18.91	0.00
								610484.55	4827298.22	18.91	0.00
								610481.82	4827300.42	18.91	0.00
								610475.59	4827292.86	18.91	0.00
								610477.08	4827291.41	18.91	0.00
								610473.35	4827287.51	18.91	0.00
								610472.09	4827288.64	18.91	0.00
								610470.20	4827286.36	18.91	0.00
								610469.73	4827286.72	18.91	0.00
								610456.89	4827271.14	18.91	0.00
								610463.02	4827266.05	18.91	0.00
								610463.38	4827266.53	18.91	0.00
								610482.61	4827250.65	18.91	0.00
Building C - 12th Floor			x	0		42.64	r	610493.54	4827266.31	42.64	0.00
								610518.27	4827242.82	42.64	0.00
								610519.40	4827244.00	42.64	0.00
								610521.43	4827242.09	42.64	0.00
								610532.25	4827253.48	42.64	0.00

Name	M.	ID	RB	Residents	Absorption	Height		Coordinates			
						Begin		x	y	z	Ground
						(m)		(m)	(m)	(m)	(m)
								610530.27	4827255.46	42.64	0.00
								610531.34	4827256.61	42.64	0.00
								610507.21	4827279.57	42.64	0.00
								610506.09	4827278.43	42.64	0.00
								610504.33	4827280.09	42.64	0.00
								610505.47	4827281.35	42.64	0.00
								610486.62	4827299.25	42.64	0.00
								610484.63	4827297.23	42.64	0.00
								610483.47	4827298.30	42.64	0.00
								610476.96	4827291.54	42.64	0.00
								610477.09	4827291.39	42.64	0.00
								610473.35	4827287.50	42.64	0.00
								610473.23	4827287.60	42.64	0.00
								610466.73	4827280.81	42.64	0.00
								610467.90	4827279.66	42.64	0.00
								610465.93	4827277.59	42.64	0.00
								610484.83	4827259.62	42.64	0.00
								610486.78	4827261.69	42.64	0.00
								610487.99	4827260.57	42.64	0.00
Building C - MPH			x	0		159.13	r	610493.54	4827266.31	159.13	0.00
								610504.68	4827278.16	159.13	0.00
								610503.51	4827279.19	159.13	0.00
								610505.47	4827281.35	159.13	0.00
								610486.62	4827299.25	159.13	0.00
								610484.63	4827297.23	159.13	0.00
								610483.47	4827298.30	159.13	0.00
								610476.96	4827291.54	159.13	0.00
								610477.09	4827291.39	159.13	0.00
								610473.35	4827287.50	159.13	0.00
								610473.23	4827287.60	159.13	0.00
								610466.73	4827280.81	159.13	0.00
								610467.90	4827279.66	159.13	0.00
								610465.93	4827277.59	159.13	0.00
								610484.83	4827259.62	159.13	0.00
								610486.78	4827261.69	159.13	0.00
								610487.99	4827260.57	159.13	0.00
Building C - Tower Roof Level			x	0		166.83	r	610485.67	4827293.27	166.83	0.00
								610499.51	4827280.11	166.83	0.00
								610485.74	4827265.64	166.83	0.00
								610471.92	4827278.81	166.83	0.00
Offsite			x	0	0.2	95.00	r	610516.87	4827162.70	95.00	0.00
								610539.04	4827143.31	95.00	0.00
								610516.67	4827117.73	95.00	0.00
								610494.50	4827137.11	95.00	0.00
Offsite			x	0	0.2	105.00	r	610549.74	4827231.18	105.00	0.00
								610574.52	4827211.09	105.00	0.00
								610557.98	4827190.70	105.00	0.00
								610533.21	4827210.79	105.00	0.00
Offsite			x	0	0.2	95.00	r	610457.02	4827118.52	95.00	0.00
								610479.20	4827099.13	95.00	0.00
								610456.83	4827073.55	95.00	0.00
								610434.65	4827092.94	95.00	0.00
Offsite			x	0	0.2	98.00	r	610394.62	4827290.25	98.00	0.00
								610415.70	4827317.66	98.00	0.00
								610437.37	4827301.00	98.00	0.00
								610416.28	4827273.58	98.00	0.00
Offsite			x	0	0.2	98.00	r	610374.28	4827358.82	98.00	0.00
								610396.40	4827336.42	98.00	0.00
								610420.39	4827360.11	98.00	0.00
								610398.27	4827382.51	98.00	0.00
Offsite			x	0	0.2	65.00	r	610327.97	4827296.99	65.00	0.00

Name	M.	ID	RB	Residents	Absorption	Height		Coordinates			
						Begin		x	y	z	Ground
						(m)		(m)	(m)	(m)	(m)
								610387.88	4827244.16	65.00	0.00
								610372.43	4827226.64	65.00	0.00
								610312.52	4827279.47	65.00	0.00
Offsite			x	0	0.2	7.00	r	610407.34	4827339.87	7.00	0.00
								610424.86	4827357.02	7.00	0.00
								610441.05	4827340.48	7.00	0.00
								610433.34	4827332.89	7.00	0.00
								610432.64	4827331.60	7.00	0.00
								610432.89	4827325.47	7.00	0.00
								610444.81	4827314.26	7.00	0.00
								610440.48	4827309.67	7.00	0.00
Offsite			x	0	0.2	3.00	r	610436.78	4827336.42	3.00	0.00
								610442.18	4827331.32	3.00	0.00
								610442.68	4827325.40	3.00	0.00
								610437.82	4827320.56	3.00	0.00
								610432.82	4827325.42	3.00	0.00
								610432.59	4827332.50	3.00	0.00