

Noise Feasibility Study

Proposed Residential Development

436 Quaker Road

Welland, Ontario

Prepared for:

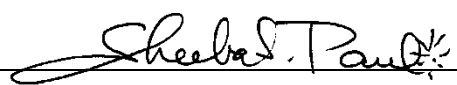
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June 28, 2024

HGC Project No. 02400426

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1 Introduction and Summary

HGC Engineering was retained by Primont (Thorold/Welland) Inc. to conduct a noise feasibility study for a proposed residential development to be located north of Quaker Road and west of Cataract Road in Welland, Regional Municipality of Niagara (RMON), Ontario. The study is required for submission for site plan approval by the RMON to address the noise of traffic on Quaker Road, Cataract Road, and Street D.

Road traffic data for Quaker Road, Cataract Road, and Street D were obtained from the transportation assessment prepared by Associated Engineering entitled, “Northwest Welland Secondary Plan Transportation Assessment Update Preferred Plan” dated December 2023. The data was used to predict future traffic sound levels at various locations of the proposed development. The predicted sound levels were compared to the guidelines of the Ministry of Environment, Conservation and Parks (MECP) and the Region of Niagara.

The sound level predictions indicate that future road traffic sound levels will exceed MECP guidelines at the proposed residential dwellings closest to the roadways. An acoustic barrier is required for the rear yards of dwellings if they are backing onto Quaker Road. Central air conditioning is required for dwellings adjacent to Quaker Road. Forced air ventilation systems with ductwork sized for the future installation of central air conditioning by the occupant will be required for dwellings with some exposure to Quaker Road, or adjacent to Cataract Road or Street D. Upgraded building and glazing constructions are required for dwellings adjacent to Quaker Road. Building constructions meeting the minimum requirements of the Ontario Building Code will provide sufficient acoustical insulation for the remaining dwellings. Warning clauses are also recommended to inform future occupants of the traffic noise impacts and to address sound level excesses.

2 Site Description and Sources of Sound

A key plan showing the location of the proposed site is indicated in Figure 1. The proposed development is located at 436 Quaker Road in Welland, Ontario. A draft plan prepared by A.T. McLaren Limited last revised June 13, 2024 is attached as Figure 2 and shows the prediction locations. The proposed residential development will consist of blocks of townhouses, natural areas, storm water management ponds, and associated roadways.

A site visit was performed by HGC Engineering personnel on June 2024. The primary source of noise is road traffic on Quaker Road, Cataract Road, and Street D. The surrounding lands are primarily existing agricultural/vacant lands to the west, north, and east. Lands to the south of Quaker Road are existing residential, vacant lands and the Quaker Road Public School. There are no significant sources of stationary sound within 500 m of the subject site.

3 Criteria for Acceptable Sound Levels

3.1 Road Traffic Noise Criteria

Guidelines for acceptable levels of road traffic noise impacting residential developments are given in the MECP publication NPC-300, “Environmental Noise Guideline Stationary and Transportation Sources – Approval and Planning”, Part C 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]. These criteria have generally been adopted by the Regional Municipality of Niagara.

Table 1: Road Traffic Noise Criteria

	Daytime L _{EQ} (16 hour) Road	Nighttime L _{EQ} (8 hour) Road
Outdoor Living Areas	55 dBA	--
Inside Living/Dining Rooms	45 dBA	45 dBA
Inside Bedrooms	45 dBA	40 dBA

Daytime refers to the period between 07:00 and 23:00, while nighttime refers to the period between 23:00 and 07:00. The term "Outdoor Living Area" (OLA) is used in reference to an outdoor patio, a backyard, a terrace or other area where passive recreation is expected to occur. Balconies that are less than 4 m in depth are not considered to be outdoor living areas under MECP guidelines.

The guidelines in the MECP publication allow the sound level in an OLA to be exceeded by up to 5 dBA, without mitigation, if warning clauses are placed in the purchase and rental agreements and offers of purchase and sale for the property. When 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 technically, economically and administratively feasible.

A central air conditioning system as an alternative means of ventilation to open windows is required for dwellings where nighttime sound levels outside bedroom/living/dining room windows exceed 60 dBA or daytime sound levels exceed 65 dBA outside bedroom/living/dining room windows. A forced air ventilation system with ducts sized for the future provision of air conditioning, or some other alternative form of mechanical ventilation, is required where nighttime sound levels at bedroom/living/dining room windows are in the range of 51 – 60 dBA or daytime sound levels are in the range of 56 - 65 dBA.

Building components such as walls, windows and doors must be designed to achieve indoor sound level criteria when the plane of bedroom/living/dining room window sound level is greater than 60 dBA or the daytime sound level is greater than 65 dBA due to road traffic noise.

Warning clauses are required to notify future residents of possible excesses when nighttime sound levels exceed 50 dBA at the plane of the bedroom/living/dining room window and daytime sound levels exceed 55 dBA in the outdoor living area and at the plane of the bedroom/living/dining room window due to road traffic.

4 Traffic Sound Level Assessment

4.1 Road Traffic Data

Road traffic data for Quaker Road, Cataract Road, and Street D were obtained from the transportation assessment prepared by Associated Engineering entitled, “Northwest Welland Secondary Plan Transportation Assessment Update Preferred Plan” dated December 2023 and is included in Appendix A. The data was provided as peak hour volumes for the year 2033. The data was further projected to 2034 using a 2.5%/year growth rate. Commercial vehicle percentages of 13% (5% medium trucks and 8% heavy trucks) for Quaker Road; 5% (5% medium trucks and 0% heavy trucks) for Cataract Road as signage on site indicated no heavy trucks; and 3% (2% medium trucks and 1% heavy trucks) for Street D were assumed. A day/night split of 90%/10% was used in the analysis. Speed limits of 50 km/h were used for Cataract Road and Street D. A speed limit of 40 km/h for Quaker Road was used since a school is located to the south of Quaker Road.

Table 2: Projected Road Traffic Data to 2034

Road Name		Cars	Medium Trucks	Heavy Trucks	Total
Quaker Road	Daytime	12 440	715	1 144	14 299
	Nighttime	1 382	79	127	1 588
	Total	13 822	794	1 271	15 557
Cataract Road	Daytime	8 297	393	0	8 690
	Nighttime	830	44	0	874
	Total	9 127	437	0	9 564
Street D	Daytime	5 798	120	60	5 978
	Nighttime	644	13	7	664
	Total	6 442	133	67	6 642

4.2 Road Traffic Noise Predictions

To assess the levels of road traffic noise which would impact the site in the future, road traffic predictions were made using STAMSON version 5.04, a computer algorithm developed by the MECP. Sample STAMSON output is included in Appendix B.

Prediction locations were chosen around the site to obtain a good representation of the future sound levels at various dwelling units. The worst case prediction locations were chosen at the top floor (2nd storey) of the dwellings, as indicated in Figure 2. Reflective surfaces were used for dwelling façades closest to the roadways. The results of these predictions are summarized in Table 3.

Table 3: Future Road Traffic Sound Levels, [dBA], Without Mitigation

Prediction Location	Description	Daytime in OLA LEQ-16 hr	Daytime at Façade LEQ-16 hr	Nighttime at Façade LEQ-8 hr
[A]	Block 1, dwellings backing onto Quaker Rd	66	67	60
[B]	Block 1, dwellings with some exposure to Quaker Rd	55	55	<50
[C]	Block 2, dwellings with backing exposure to Quaker Rd	55	55	<50
[D]	Block 14, dwellings fronting onto Street D	<55	60	53
[E]	Block 33, flanking onto Street D	58	60	54
[F]	Block 30, dwellings backing onto Cataract Road	58	59	53

5 Traffic Noise Recommendations

The predictions indicate that the future traffic sound levels will exceed MECP guidelines at the proposed residential development. Recommendations to address these excesses are discussed below.

5.1 Outdoor Living Areas

The predicted daytime sound level in the rear yard of dwellings with backing exposure onto Quaker Road (prediction location [A]) will be up to 66 dBA, 11 dBA in excess of the MECP limit of 55 dBA. Physical mitigation in the form of an acoustic barrier will be required for these dwellings. An acoustic barrier 2.3 m in height will reduce the sound level in the rear yard to 59 dBA. The

4 dBA sound level excess is acceptable to the MECP with the use of a noise warning clause to inform the future occupants of the minor sound level excesses. Alternatively, if the dwellings at the south of Block 1 are situated such that they are fronting onto a single loaded road with fronting exposure to Quaker Road, the rear yards will be protected by the dwellings themselves and no additional mitigation would be required.

The predicted daytime sound level in the rear yard of dwellings with flanking exposure onto Street D or backing exposure to Cataract Road (prediction location [E] and [F]) will be up to 58 dBA, 3 dBA in excess of the MECP limit of 55 dBA. The 3 dBA sound level excess is acceptable to the MECP with the use of a noise warning clause to inform the future occupants of the minor sound level excesses.

The predicted daytime sound level in the rear yards of the remaining lots will be 55 dBA or less. No further mitigation is required.

As a general note, an acoustic barrier may be a combination of an acoustic wall and/or an earth berm. The wall component of the barrier should be of a solid construction with a surface density of no less than 20 kg/m². The walls may be constructed from a variety of materials such as wood, brick, pre-cast concrete or other concrete/wood composite systems provided that it is free of gaps or cracks. The heights and extents of the barriers should be chosen to reduce the sound levels in the OLA's to below 60 dBA and as close to 55 dBA as is technically, administratively and economically feasible, subject to the approval of the municipality respecting any applicable fence height by-laws.

5.2 Indoor Living Areas

Central Air Conditioning

The predicted future sound levels outside the top storey living room/bedroom windows of the dwellings adjacent to Quaker Road will be greater than 65 dBA during the daytime hours. To address these excesses, the MECP guidelines recommend that the dwelling units be equipped with central air conditioning systems, so that the windows can be closed.

Provision for the Future Installation of Air Conditioning

The predicted future sound levels outside the top storey living room/bedroom windows of dwellings further from Quaker Road, or adjacent to Cataract Road and Street D will be between 56 and 65 dBA during the daytime hours. To address this excess, the MECP guidelines recommend that this dwelling be equipped with a forced air ventilation systems with ducts sized to accommodate the future installation of air conditioning by the occupant.

Figure 3 shows the ventilation requirements for the development. Window or through-the-wall air conditioning units are not recommended for any residential units because of the noise they produce and because the units penetrate through the exterior wall which degrades the overall noise insulating properties of the envelope. The location, installation and sound ratings of the outdoor air conditioning devices should minimize noise impacts and comply with criteria of MECP publication NPC-216. The guidelines also recommend warning clauses for all units with ventilation requirements.

5.3 Building Façade Constructions

Future road traffic sound levels outside dwellings immediately adjacent to Quaker Road will exceed 65 dBA during the day. MECP guidelines recommend that the windows, walls and doors be designed so that the indoor sound levels comply with MECP noise criteria.

The required building components are selected based on the AIF value for road traffic. To do so, calculations were performed to determine the acoustical insulation factors to maintain indoor sound levels within MECP guidelines. The calculation methods were developed by the National Research Council (NRC). They are based on the predicted future sound levels at the building facades, and the anticipated area ratios of the facade components (walls and windows) and the floor area of the adjacent room.

Any exterior wall construction meeting the Ontario Building Code (OBC) will be acceptable for the dwellings. If the dwellings are constructed of brick, the following window requirements will be reduced somewhat. Any insulated metal exterior door meeting OBC requirements will be sufficient to provide noise insulation.

When floor plans and buildings elevations are available, an acoustical consultant should review the plans for the dwellings immediately adjacent to Quaker Road to specify wall and window types with sufficient acoustical insulation for the dwellings units. As an example, a well sealed thermopane unit having a Sound Transmission Class (STC) rating of 30, would provide sufficient noise insulation for the dwellings, as long as the window area to room floor area ratio of the living/dining/family rooms does not exceed 50%. For bedrooms, any double glazed window construction meeting the minimum requirements of the Ontario Building Code (OBC) will provide adequate sound insulation.

For the remaining dwellings in the development the nighttime sound levels at the 2nd storey façade that will be less than 60 dBA. For these dwellings, any exterior wall, and double glazed window construction meeting the minimum requirements of the Ontario Building Code (OBC) will provide adequate sound insulation for the dwelling units.

5.4 Warning Clauses

The MECP guidelines recommend that warning clauses be included in the property and tenancy agreements and offers of purchase and sale for all units with anticipated traffic sound level excesses. Examples are provided below.

Suggested wording for dwellings which have sound level excesses but do not require mitigation measures is given below.

Type A:

Purchasers/tenants are advised that sound levels due to increasing road traffic may occasionally interfere with some activities of the dwelling unit occupants as the sound levels exceed the Municipality's and the Ministry of Environment, Conservation and Parks' noise criteria.

Suggested wording for future dwelling units with daytime OLA sound levels exceeding the MECP criteria by 6 dB or more, for which physical mitigation has been provided is given below.

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 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.

Suitable wording for future dwelling units requiring the provision for future installation of central air conditioning systems is given below.

Type C:

This dwelling unit has been fitted with duct work and rough-in locations for a fan coil unit and an outdoor condenser and the ducting etc., was sized to accommodate central air conditioning. Installation of central air conditioning will allow windows and exterior doors to remain closed, thereby ensuring that the indoor sound levels are within the Municipality's and the Ministry of Environment, Conservation and Parks' noise criteria. (Note: The location and installation of the outdoor air conditioning device should be done so as to minimize the noise impacts and comply with criteria of MECP publication NPC-300, as applicable.)

Suitable wording for future dwellings requiring central air conditioning systems is given below.

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 Municipality's and the Ministry of Environment, Conservation and Parks' noise criteria.

The suggested wording for future dwellings adjacent to the school is given below.

Type E:

Purchasers/tenants are advised that due to the proximity of the adjacent to the Quaker Road Public School, sound levels from this facility may at times be audible.

These sample clauses are provided by the MECP as examples and can be modified by the Municipality as required.

6 Summary and Recommendations

The following list and Table 4 summarizes the recommendations made in this report.

1. Acoustic barriers are required for dwellings with backing exposure to Quaker Road.
2. Central air conditioning is required for dwellings immediately adjacent to Quaker Road. Forced air ventilation systems with ductwork sized for the future installation of central air conditioning system will be required for further dwelling units with some exposure to Quaker Road, or adjacent to Cataract Road and Street D. The location, installation and sound ratings of the air conditioning devices should comply with NPC-216.
3. Upgraded building and glazing constructions are required for dwellings adjacent to Quaker Road. Building constructions meeting the minimum requirements of the Ontario Building Code will provide sufficient acoustical insulation for the indoor spaces for the remaining dwellings.
4. Warning clauses should be used to inform future residents of the traffic noise issues and the presence of the nearby school in the area.

Table 4: Summary of Noise Control Requirements and Noise Warning Clauses

Prediction Location	Description	Acoustic Barrier	Ventilation Requirements	Type of Warning Clause	*Preliminary STC Requirements
[A]	Block 1, dwellings backing onto Quaker Rd	✓	Central A/C	B, D, E	STC-30
[B]	Block 1, dwellings with some exposure to Quaker Rd	--	Forced Air	A, C	OBC
[C]	Block 2, dwellings with backing exposure to Quaker Rd	--	--	--	OBC
[D]	Block 14, dwellings fronting onto Street D	--	Forced Air	A, C	OBC
[E]	Block 33, flanking onto Street D	--	Forced Air	A, C	OBC
[F]	Block 30, dwellings backing onto Cataract Road	--	Forced Air	A, C	OBC
--	Remaining Dwellings	--	--	--	OBC
	Block 26	O	O	O	O

Notes:

-- no specific requirement

OBC – meeting the minimum requirements of the Ontario Building Code

*When detailed floor plans and building elevations are available, window glazing requirements should be refined based on actual window to floor area ratios

O – When siting information is available for these blocks, a detailed noise study should be conducted to determine the acoustic requirements (acoustic barriers, ventilation and building façade construction) when siting, grading, building elevations and floor plans are available and in the case of the innovation hubs, to ensure compliance with NPC-300.

6.1 Implementation

To ensure that the noise control recommendations outlined above are fully implemented, it is recommended that:

1. A detailed noise study is required for the entire site to determine the acoustic requirements when siting information is available.
2. Prior to the issuance of building permits for this development, a Professional Engineer qualified to perform acoustical engineering services in the Province of Ontario should review the grading plans and architectural plans (floor plans and building elevations) for future dwellings with exposure to Quaker Road to refine acoustic barrier heights, building and glazing requirements based on actual window areas to floor areas ratios and to ensure

proposed building constructions are adequately designed to ensure acceptable indoor noise levels.

3. Prior to the issuance of occupancy permits for this development, the City's building inspector or a Professional Engineer qualified to perform acoustical engineering services in the Province of Ontario should certify that the noise control measures have been properly installed and constructed.

Limitations

This document was prepared solely for the addressed party and titled project or named part thereof, and should not be relied upon or used for any other project without obtaining prior written authorization from HGC Engineering. HGC Engineering accepts no responsibility or liability for any consequence of this document being used for a purpose other than for which it was commissioned. Any person or party using or relying on the document for such other purpose agrees, and will by such use or reliance be taken to confirm their agreement to indemnify HGC Engineering for all loss or damage resulting therefrom. HGC Engineering accepts no responsibility or liability for this document to any person or party other than the party by whom it was commissioned.

Any conclusions and/or recommendations herein reflect the judgment of HGC Engineering based on information available at the time of preparation, and were developed in good faith on information provided by others, as noted in the report, which has been assumed to be factual and accurate. Changed conditions or information occurring or becoming known after the date of this report could affect the results and conclusions presented.





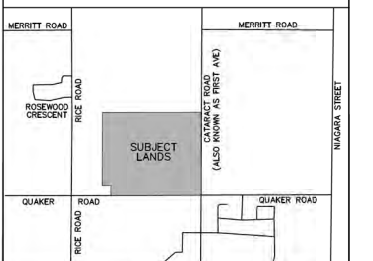
Figure 1 - Key Plan

DRAFT PLAN OF SUBDIVISION

PRIMONT (THOROLD / WELLAND) INC.

PART OF TOWNSHIP LOTS 174 AND 228, GEOGRAPHIC TOWNSHIP OF THOROLD, IN THE CITY OF WELLAND, REGIONAL MUNICIPALITY OF NIAGARA

SCALE 1:1000 METRIC



KEY MAP - NOT TO SCALE

- INFORMATION REQUIRED**
 UNDER SECTION 51 (1) OF THE PLANNING ACT, R.S.O. 1990, c.P.13 AS AMENDED FEBRUARY 21, 2024
- (a) - AS SHOWN
 - (b) - AS SHOWN
 - (c) - AS SHOWN
 - (d) - AS LISTED BELOW
 - (e) - AS SHOWN
 - (f) - AS SHOWN
 - (g) - AS SHOWN
 - (h) - MUNICIPAL WATER
 - (i) - CLAY LOAM
 - (j) - AS SHOWN
 - (k) - MUNICIPAL SANITARY AND STORM SEWERS
 - (l) - AS SHOWN

SURVEYOR'S CERTIFICATE
 I HEREBY CERTIFY THAT THE BOUNDARIES OF THE LANDS TO BE SUBDIVIDED ON THIS PLAN AND THEIR RELATIONSHIP TO THE ADJACENT LANDS ARE ACCURATELY AND CORRECTLY SHOWN.

SIGNED _____
 ROB A. McLAREN, O.L.S.
 A.T. McLAREN LIMITED

OWNER'S CERTIFICATE
 I HEREBY CONSENT TO THE FILING OF THIS PLAN

SIGNED _____
 DATE _____

LAND USE SCHEDULE			
LAND USE	LOTS/BLOCKS	UNITS	AREA
LOW DENSITY RESIDENTIAL (FREEHOLD)	BLOCKS 2-5, 10-14, 16, 19, 20-24, 26, 29, & 33	245-275±	6.127± Ha.
LOW DENSITY RESIDENTIAL (CONDOMINIUM)	BLOCK 1	44±	1.167± Ha.
MEDIUM DENSITY RESIDENTIAL	BLOCK 30	422±	1.109± Ha.
PARK LAND	BLOCK 17		0.749± Ha.
OPEN SPACE	BLOCKS 6, 15, 25		0.101± Ha.
STORM WATER MANAGEMENT	BLOCKS 7, 18, & 31		1.808± Ha.
ENVIRONMENTAL AREA	BLOCKS 27 & 28		14.547± Ha.
CHANNEL	BLOCKS 8 & 9		0.592± Ha.
ROADS RESERVES & WIDENINGS	STREETS A, B, C, D, E, F, G, & H AND BLOCKS 32, 33, 34 & 35		3.937± Ha.
TOTAL		711-741±	30.118± Ha.

No.	DESCRIPTION	DATE	BY
2	UPDATED STORMWATER BLOCKS	JUNE 13, 2024	KM
1	ORIGINAL DRAWING	MARCH 15, 2024	KM

REVISIONS

A.T. McLaren Limited
 LEGAL AND ENGINEERING SURVEYS
 69 JOHN STREET SOUTH, SUITE 230
 HAMILTON, ONTARIO, L8N 2B9
 PHONE (905) 527-8559 FAX (905) 527-0032

METRIC NOTE:
 DISTANCES SHOWN ON THIS PLAN ARE IN METRES AND CAN BE CONVERTED TO FEET BY DIVIDING BY 0.3048

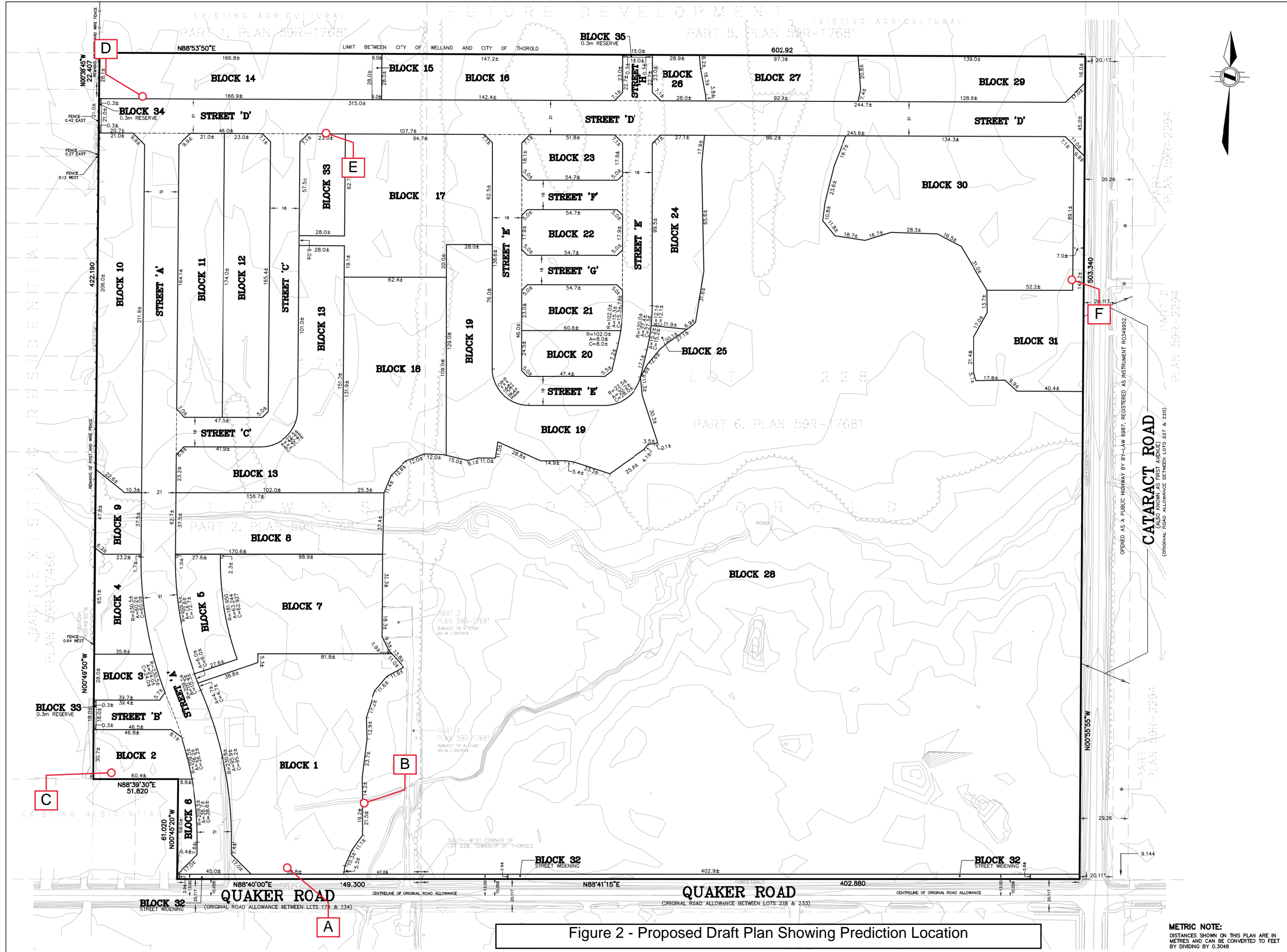


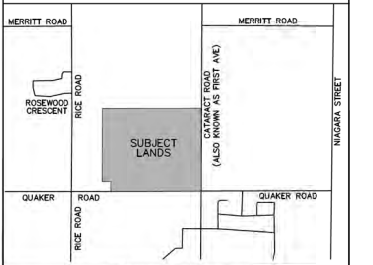
Figure 2 - Proposed Draft Plan Showing Prediction Location

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TOTAL		711-741±	30.118± Ha.

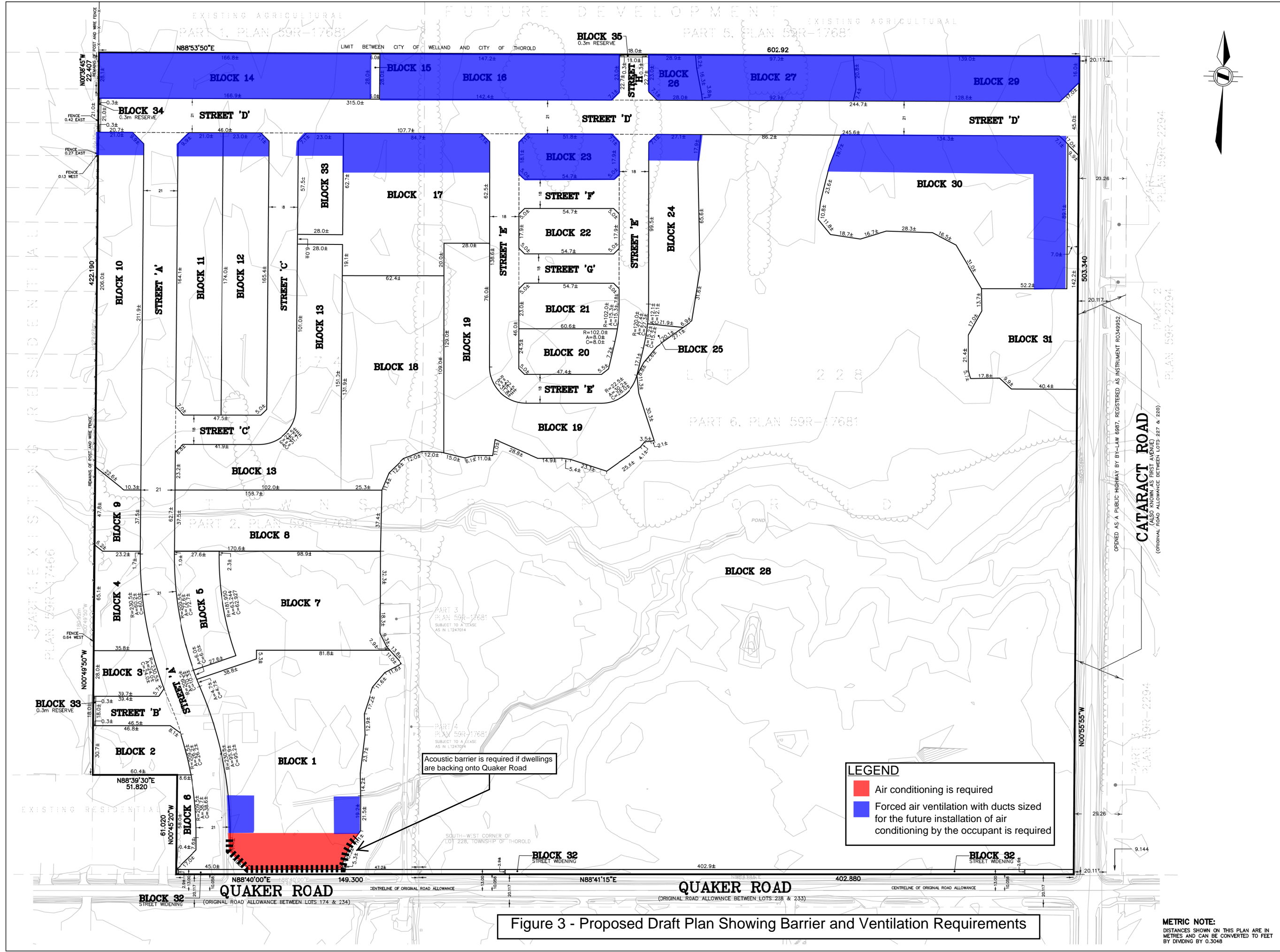
No.	DESCRIPTION	DATE	BY
2	UPDATED STORMWATER BLOCKS	JUNE 13, 2024	KM
1	ORIGINAL DRAWING	MARCH 15, 2024	KM

REVISIONS

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Drawn: KM Checked: RSM Crew Chief: SM Scale: 1:1000 Dwg. No. 36920-DP



LEGEND

- Air conditioning is required
- Forced air ventilation with ducts sized for the future installation of air conditioning by the occupant is required

Figure 3 - Proposed Draft Plan Showing Barrier and Ventilation Requirements

METRIC NOTE:
 DISTANCES SHOWN ON THIS PLAN ARE IN METRES AND CAN BE CONVERTED TO FEET BY DIVIDING BY 0.3048

APPENDIX A

Road Traffic Data



ACOUSTICS



NOISE



VIBRATION

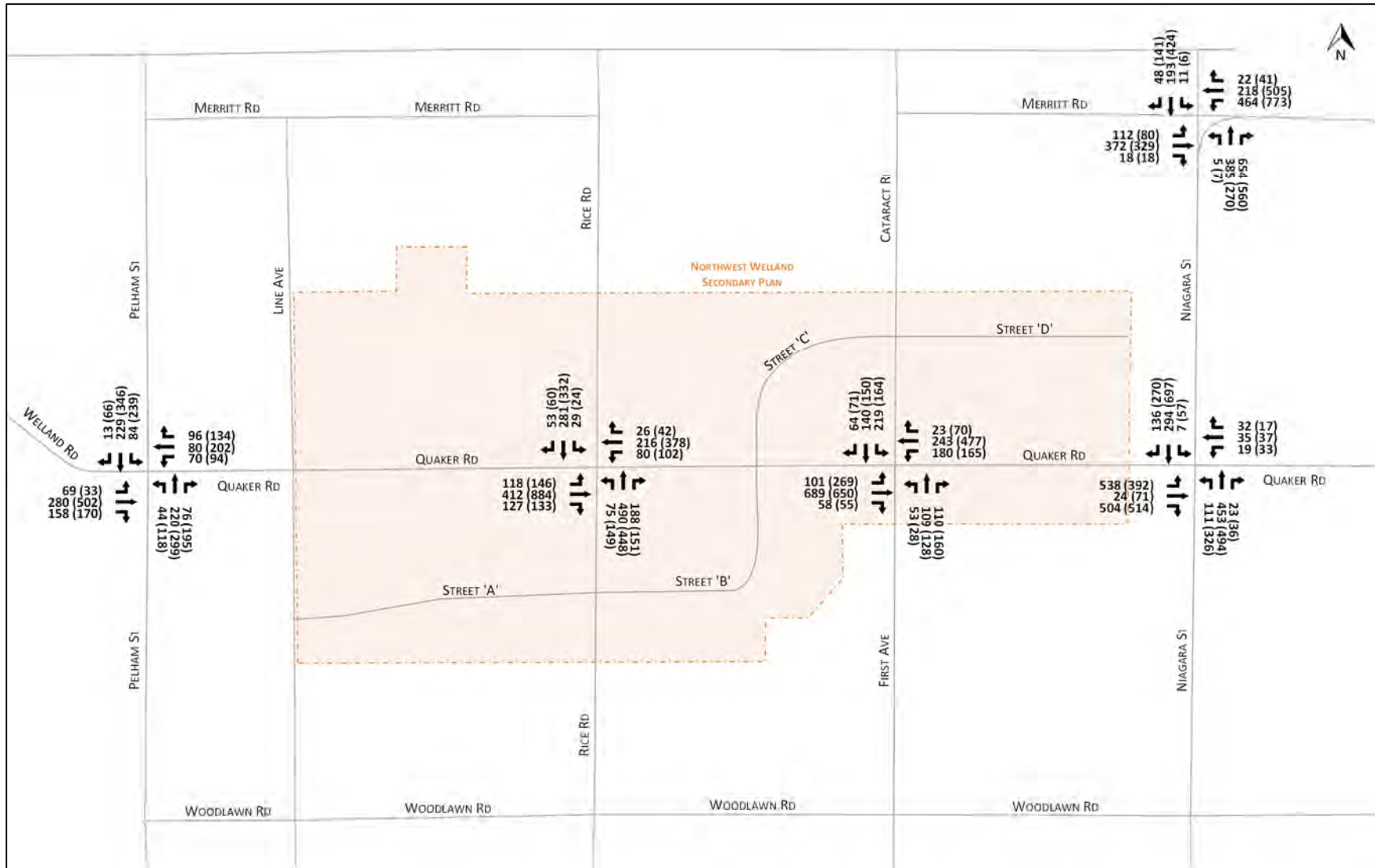


Figure 5-1: Future (2033) Peak Hour Turning Movement Volumes – Major Roads

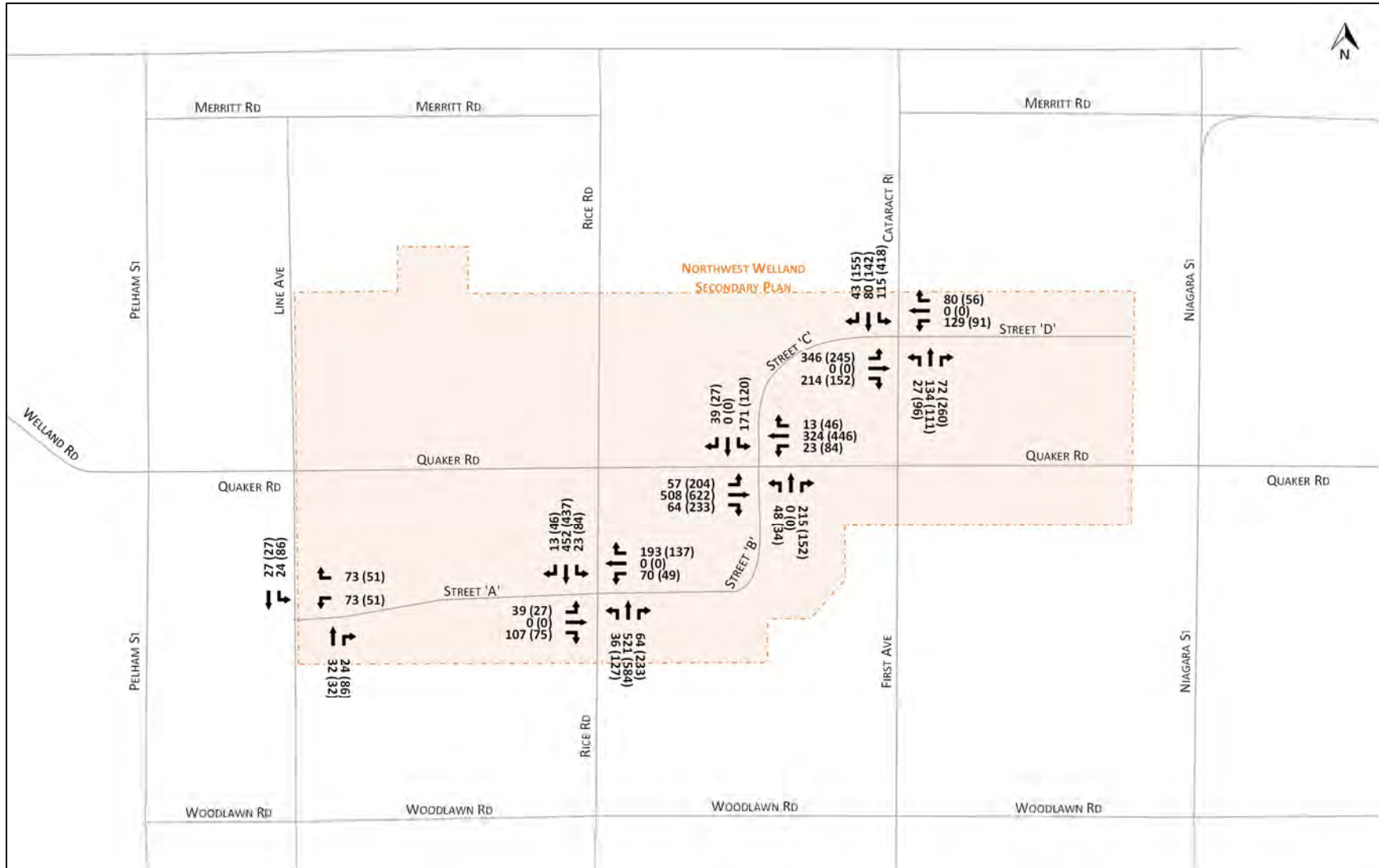


Figure 5-2: Future (2033) Peak Hour Turning Movement Volumes – Collector Roads

APPENDIX B

Sample STAMSON 5.04 Output



ACOUSTICS



NOISE



VIBRATION

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

Description: Block 1, dwellings backing onto Quaker Rd

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

```
-----
Car traffic volume   : 12440/1382   veh/TimePeriod   *
Medium truck volume :    715/79    veh/TimePeriod   *
Heavy truck volume  :   1144/127   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): 15500
Percentage of Annual Growth         : 2.50
Number of Years of Growth           : 1.00
Medium Truck % of Total Volume      : 5.00
Heavy Truck % of Total Volume       : 8.00
Day (16 hrs) % of Total Volume      : 90.00
```

Data for Segment # 1: Quaker (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 : 20.00 / 20.00 m
Receiver height  :   4.50 / 4.50 m
Topography      :      1      (Flat/gentle slope; no barrier)
Reference angle  :   0.00
Results segment # 1: Quaker (day)
```

Source height = 1.68 m

ROAD (0.00 + 66.91 + 0.00) = 66.91 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-90	90	0.00	68.15	0.00	-1.25	0.00	0.00	0.00	0.00	66.91

Segment Leq : 66.91 dBA

Total Leq All Segments: 66.91 dBA

Results segment # 1: Quaker (night)

Source height = 1.68 m

ROAD (0.00 + 60.37 + 0.00) = 60.37 dBA

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

-90	90	0.00	61.62	0.00	-1.25	0.00	0.00	0.00	0.00	60.37
-----	----	------	-------	------	-------	------	------	------	------	-------

Segment Leq : 60.37 dBA

Total Leq All Segments: 60.37 dBA

TOTAL Leq FROM ALL SOURCES (DAY): 66.91 dBA
(NIGHT): 60.37 dBA



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VIBRATION

Filename: aola.te Time Period: 16 hours

Description: OLA of Block, direct backing exposure to Quaker Rd

Road data, segment # 1: Quaker

```
-----
Car traffic volume : 12440 veh/TimePeriod *
Medium truck volume : 715 veh/TimePeriod *
Heavy truck volume : 1144 veh/TimePeriod *
Posted speed limit : 40 km/h
Road gradient : 0 %
Road pavement : 1 (Typical asphalt or concrete)
```

Data for Segment # 1: Quaker

```
-----
Angle1 Angle2 : -90.00 deg 90.00 deg
Wood depth : 0 (No woods.)
No of house rows : 0
Surface : 1 (Absorptive ground surface)
Receiver source distance : 17.00 m
Receiver height : 1.50 m
Topography : 2 (Flat/gentle slope; with barrier)
Barrier angle1 : -90.00 deg Angle2 : 90.00 deg
Barrier height : 0.00 m
Barrier receiver distance : 5.00 m
Source elevation : 0.00 m
Receiver elevation : 0.00 m
Barrier elevation : 0.00 m
Reference angle : 0.00
```

Results segment # 1: Quaker

 Source height = 1.68 m

Barrier height for grazing incidence

```
-----
Source ! Receiver ! Barrier ! Elevation of
Height (m) ! Height (m) ! Height (m) ! Barrier Top (m)
-----+-----+-----+-----
1.68 ! 1.50 ! 1.55 ! 1.55
```

ROAD (0.00 + 65.81 + 0.00) = 65.81 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-90	90	0.65	68.15	0.00	-0.90	-1.45	0.00	0.00	-0.25	65.56*
-90	90	0.65	68.15	0.00	-0.90	-1.45	0.00	0.00	0.00	65.81

* Bright Zone !

Segment Leq : 65.81 dBA

Total Leq All Segments: 65.81 dBA

TOTAL Leq FROM ALL SOURCES: 65.81 dBA



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