

APPENDIX D

NOISE ASPECTS ACOUSTICAL ENGINEERING REVIEW

**NOISE IMPACT ASSESSMENT
PROPOSED BUS TERMINAL
CITY OF WOODSTOCK**

FOR

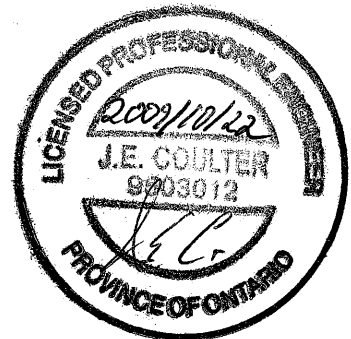
IBI GROUP

PREPARED BY



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OCTOBER 22, 2009

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1.0 INTRODUCTION

At the request of IBI Group, J. E. Coulter Associates Limited has reviewed the acoustic aspects of the proposed bus terminal to be located on the northwest corner of the intersection of Dundas Street and York Street in Woodstock, Ontario. The proposed bus terminal will be situated in part on the existing roadway, resulting in the closing off of York Street between Dundas Street and Adelaide Street. Please see Figure 1 in Appendix A for the Site Plan.

2.0 DESCRIPTION OF PROJECT

The proposed bus terminal is a relocation and expansion of an existing facility. The expanded terminal is designed to accommodate local transit requirements. Presently, at the existing terminal located at the Dundas/Wellington Street area in downtown Woodstock, there are 6 city buses operating routes nearby that will use this terminal. It is anticipated that over the period of 10 years after the construction of the project, the bus terminal use will increase to 8 city buses. There will be approximately 16 buses per hour through the terminal, each idling for a maximum of 2 minutes per trip. Buses are expected to enter and exit via either Adelaide, York, or Dundas Street. Future bus service is expected to begin at 6:30AM and terminate at 6:30PM.

3.0 DESCRIPTION OF SURROUNDS

Adjacent to the proposed bus terminal are primarily commercial receptors. The most sensitive receptor is a four-unit residence located immediately to the north of the site, fronting Adelaide Street. Because of its proximity to the bus terminal itself as well as to the roadway that the buses will use, this receptor is the most critical. If the sound level limits are met at this receptor, then all other areas, due to their increased setbacks or higher ambient sound levels, will also meet the guidelines. The critical receptor is identified in Figure 1 in Appendix A.

4.0 NOISE IMPACT ASSESSMENT GUIDELINES

4.1 Roadway Traffic Increases

For the proposed bus terminal, two sets of guidelines apply. Firstly, the increase in bus movements on Adelaide Street and on Dundas Street are treated as a typical transit expansion. The guidelines are based on the MTO/MOE protocol. Under this protocol, two scenarios are examined at a time horizon of 10 years after the project's anticipated completion. The anticipated daytime (16-hour

L_{eq}) and nighttime (8-hour L_{eq}) sound levels, assuming the project is completed, and operation are compared to the anticipated daytime and nighttime sound levels, assuming the project was not completed. Based on this increase in sound levels, the following criteria dictate whether or not noise mitigation needs to be considered..

- < 3 dB change is generally considered not noticeable in terms of in human perception and is therefore considered no impact to low impact. Mitigation will not be considered for changes at this level.
- 3 to 4 dB change is considered to be a noticeable difference in human perception, but is not considered sufficient to warrant a review of noise mitigation under Provincial Guidelines.
- 5 dB to 9 dB change is considered to be a substantial change and a noticeable difference in human perception and is sufficient to warrant a review of the technical and economic feasibility of noise controls.
- 10 dB or greater change would be perceived as very substantial and as a doubling in sound loudness and special efforts to mitigate are normally attempted if technically and economically feasible.

4.2 Terminal Noise

While buses are circulating on the site of the terminal itself, the noise emanating from the site is treated as a "stationary source." Stationary sources must adhere to the MOE's guidelines as stipulated in *NPC 205*. The areas adjacent to the bus terminal are classified as a Class 1 Urban area. Under this classification, the bus terminal bus must meet the higher of either the hourly L_{eq} of 50dB during the daytime (0700-1900), 47dB during the evening (1900-2300), and 45dB during the nighttime (2300-0700) or existing ambient roadway noise. As Dundas Street is a major roadway and the bus terminal is situated in downtown Woodstock, the local ambient sound levels are in excess of the minimum exclusion criteria. Based on the traffic study completed by IBI Group, the future (2014) traffic volumes on Dundas Street are approximately 15400 AADT, with the assumption of typical urban truck percentages of 2.5% heavy and 2.5% medium. This is based on an afternoon peak hour volume of 1200 vehicles (see excerpt of study in Appendix B). The most critical hour during the daytime is between 0700-0800. At this time, hourly traffic is roughly 4.8%% of the average daily traffic. The previous period (0600-0700) contains less traffic but will also contain half as many buses as Woodstock Transit begins operations at 6:30AM. Between 0600-0700, there will be 8 buses through the terminal while between 0700-0800 there will be 16 buses through the terminal. As such, compared to the hour before, the period between 0700-0800

will contain 3dB more noise (16 buses vs. 8 buses), but only a 1.4dB higher guideline limit (4.8% vs. 3.5% of daily traffic). Consequently, the most critical hour of operation for the terminal with respect to noise is the period between 0700-0800. Based on the above data, the sound level limit during this period at the most critical residential receptor to the north is 54dB L_{eq} . All other hours have either higher ambient sound levels or fewer buses and are not as critical.

5.0 NOISE IMPACT ASSESSMENT RESULTS

5.1 Roadway Traffic Increases

As the future revised bus routes are similar to the existing bus routes (see Figures 2 and 3 in Appendix A), most areas do not see an increase in the number of buses using each roadway. In fact, some streets will show a reduction in bus traffic. Appendix B shows daily traffic volumes for a selection of typical Woodstock side streets, which can be representative of streets future routes may use. For example, Beale Street has an average annual daily traffic volume of 939. Daytime traffic is 859 vehicles and nighttime traffic is 80 vehicles. A full service route along this street would add 46 bus passbys during the daytime and 2 bus passbys during the nighttime. The net daytime and nighttime impact would then be conservatively estimated as 2dB and 0dB, assuming minimal existing truck percentages of 1% heavy and 1% medium. Similarly, impacts are not expected along other side streets with similar or greater volumes for future routes. The rerouting of existing routes does not generate any noise impacts.

5.2 Terminal Noise

The proposed bus terminal is treated as a stationary noise source. This noise source is comprised of bus idling and bus manoeuvring. The noise from each of these activities is combined and compared to the guideline limit established in Section 3.2. A layout of the bus terminal is provided in Figure 4 in Appendix A.

Bus Idling

Buses are expected to idle for 2min during each stopover. Engines will be shut down if longer idling periods are required. Data from the manufacturers of the Nova Bus indicate that the buses produce approximately 59dBA at 15m during idle. The total 1 hour L_{eq} from bus idling at the critical receiver is 47.9dB L_{eq} .

Bus Manoeuvring

Buses are expected to traverse the site regularly from one end to the other. It is expected that each bus will pass around the northern tip of the terminal once per trip. Measurements were conducted for the existing older bus and a new Nova bus in Woodstock. For a Nova bus stopping at the closest bay (Bay 1, see Figure 4) and the accelerating away and around the terminal, the SEL was measured to be around 78dBA at the location of the critical receiver (approximately 22m from the northern tip of the terminal). For a Nova bus rounding the tip of the terminal and stopping at the next bay (Bay 2, see Figure 4), the SEL was measured to be 77dBA at the location of the critical receiver. For the older bus, under both of the above conditions, the SEL was measured to be 82dBA. As such, assuming 2 older buses and 6 new buses through the terminal as is currently planned, the overall 1 hour equivalent sound level from bus manoeuvring will be 55.6dBA L_{eq} . This is slightly conservative as the two worst-case bus bays have been assumed to be representative of the remaining bus bays.

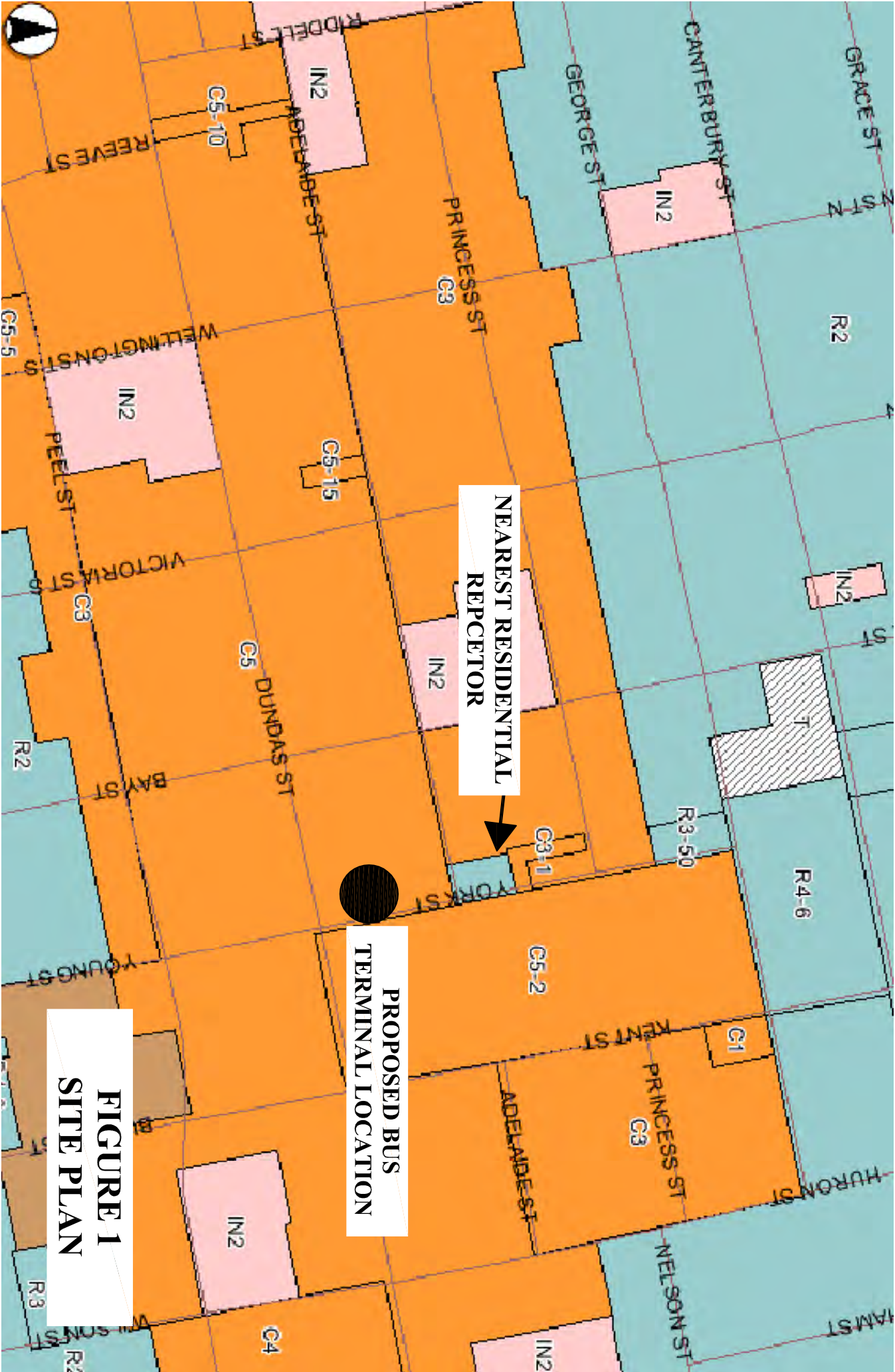
The combined 1-hour equivalent sound level from bus idling and bus manoeuvring is expected to be 56dBA L_{eq} . This is 2dB above the criterion of 54dB. It should be noted that during the other hours of operation, especially between 0600-0700, this excess above the criterion will be reduced as there are either more buses or higher ambient sound levels. Mitigation in the form of an acoustic barrier is not feasible given the terminal's location relative to the nearest receptor. This excess, though perhaps detectable in some cases, is minor and is not expected to generate a significant impact at the receptor.

6.0 CONCLUSION

The proposed terminal expansion results in a modest 2dB impact between the hours of 0700-0800 at the nearest residential receptor. During other hours, the receptor will experience lower or no impacts. Mitigation at this location is not feasible given the terminal's layout and proximity to the receptor. As such, no mitigation can be recommended to reduce this impact. Given the magnitude of the increase in noise, it is expected that the increase in sound may be detectable, but will not generate a significant impact at the residence, especially during the critical sleeping hours (2300-0700). No noise impacts are expected as a result of additional routes or rerouting of existing routes.

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APPENDIX A - FIGURES



NEAREST RESIDENTIAL RECEPTOR

PROPOSED BUS TERMINAL LOCATION

FIGURE 1
SITE PLAN

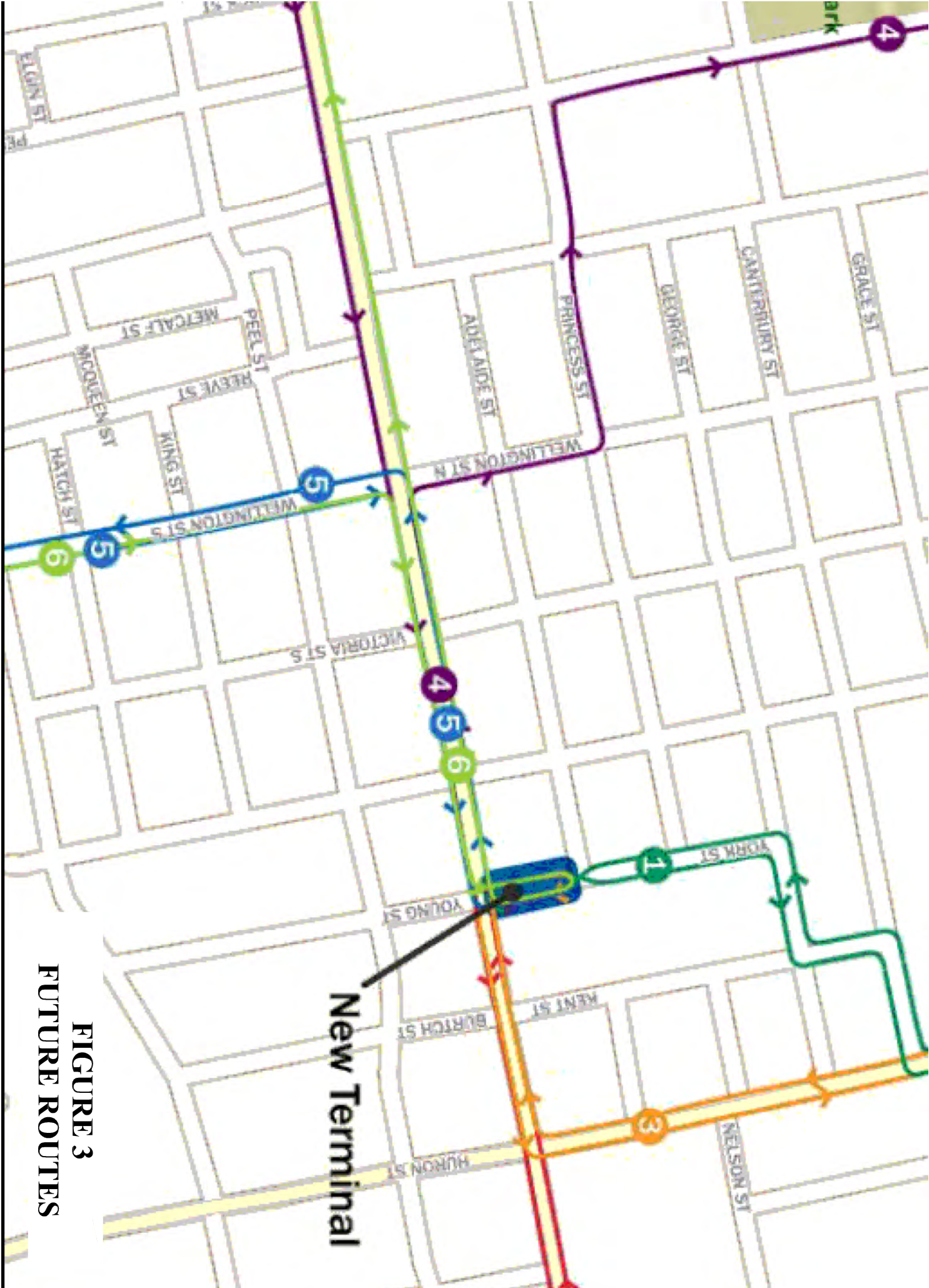


FIGURE 3
FUTURE ROUTES

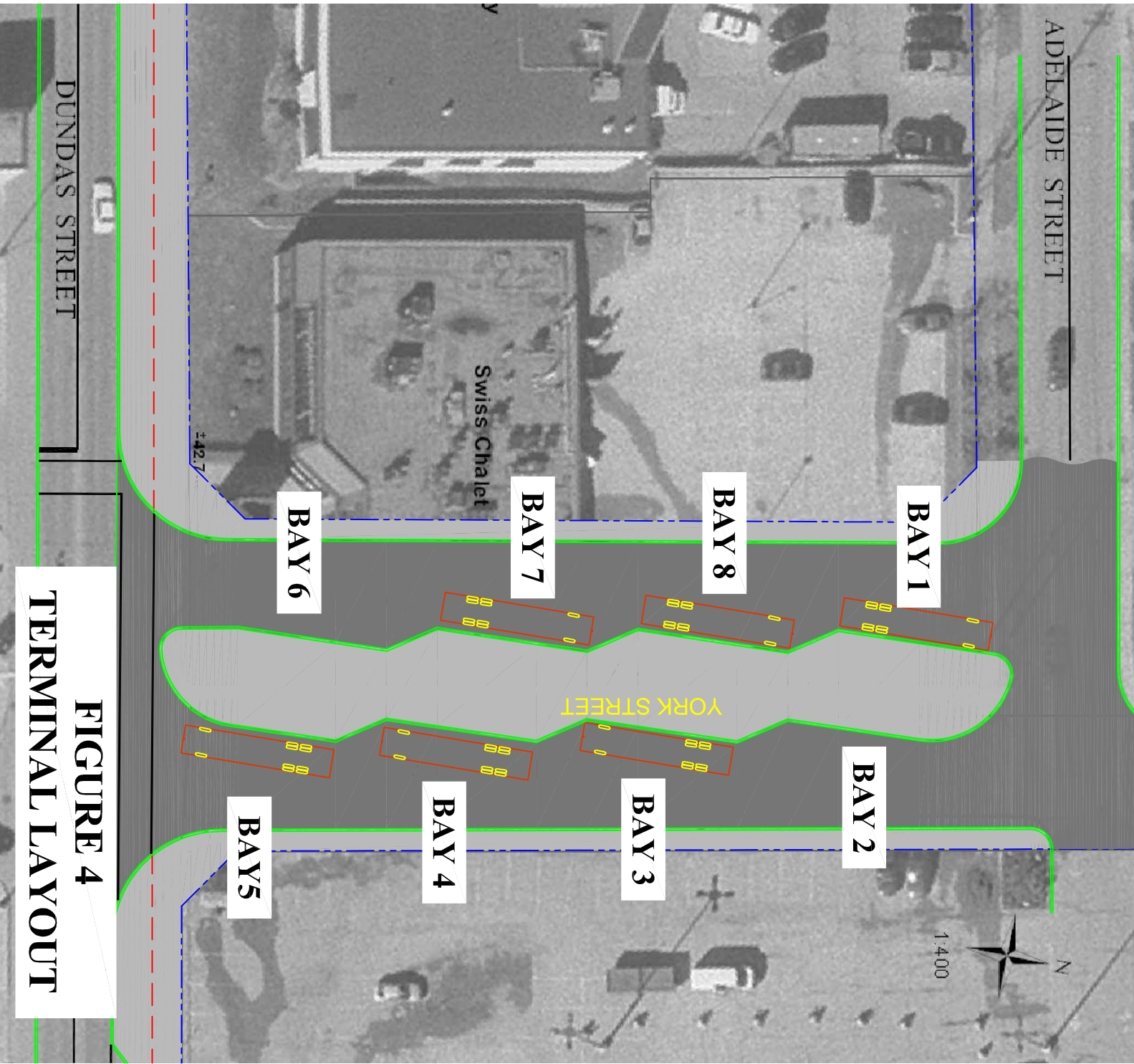


FIGURE 4
TERMINAL LAYOUT

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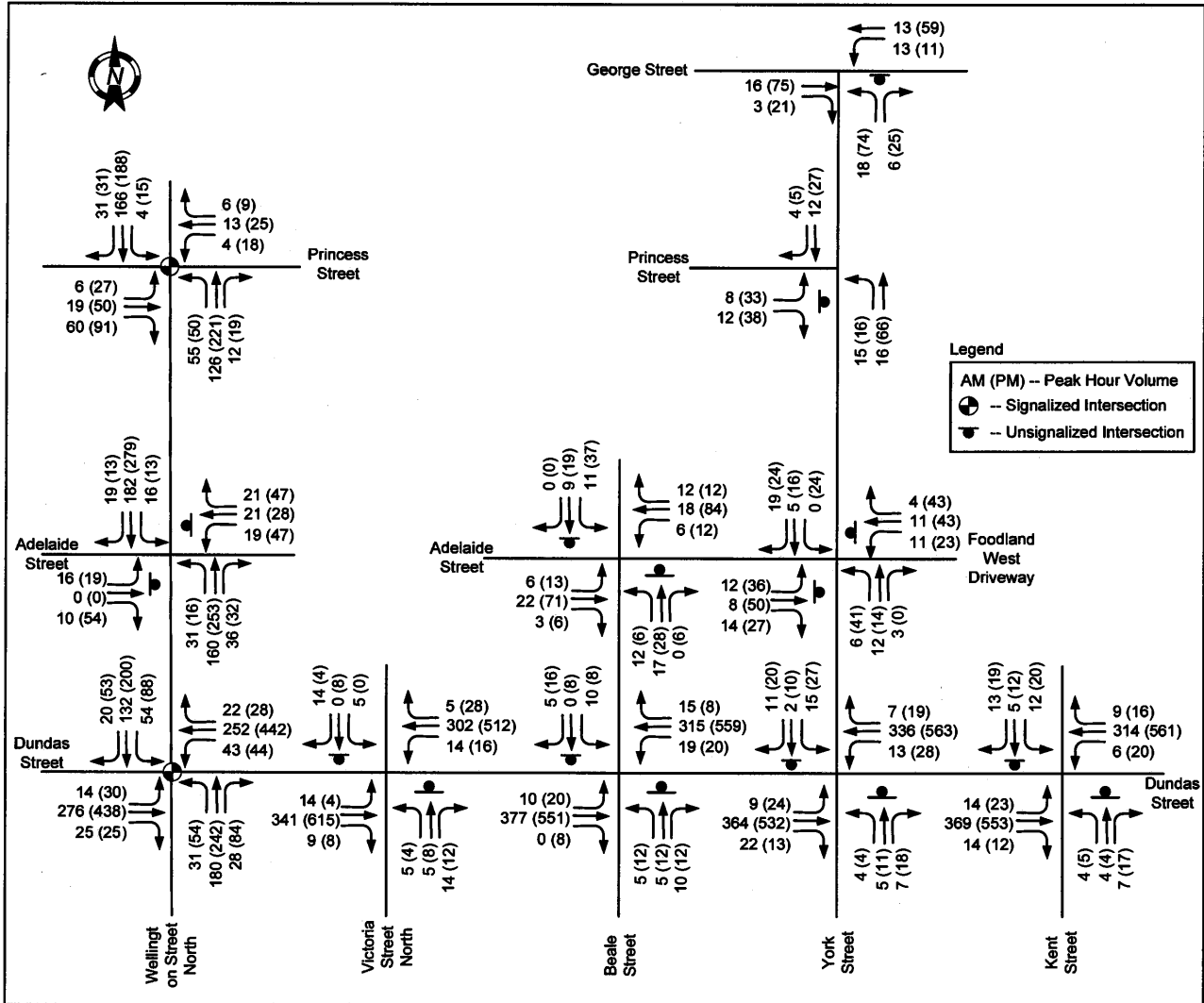
APPENDIX B - TRAFFIC DATA

4.2 2014 Traffic Background Scenario

4.2.1 TRAFFIC VOLUMES

Exhibit 4-1 shows the projected 2014 future background traffic volumes.

Exhibit 4-1: 2014 Future Background Traffic Volumes



4.2.2 INTERSECTION OPERATIONS

Intersection operations for the 2014 background traffic scenario were assessed under current operating conditions (lane configurations, signal timings and phasings) using the Highway Capacity Manual methodology and specifically the Synchro 6.0 analysis package. The analysis results are summarized in Exhibit 4-2. Full analysis summaries are included in Appendix C.

Station Name:
Site ID:PRINCESS0093
Station Num:JULY20090000
Description:East of Beale
City:Woodstock
County:Oxford
Start Date/Time:07/19/09 00:00
End Date/Time:07/25/09 23:59

	19- Sun	20- Mon	21- Tue	22- Wed	23- Thu	24- Fri	25- Sat	Total	Daily- Avg.
00:00			1	4	3	2		10	3
01:00			3	5	1	2		11	3
02:00			3	2	2	4		11	3
03:00			6	3	2	1		12	3
04:00			2	3	1	2		8	2
05:00			9	6	7	7		29	7
06:00			11	12	12	13		48	12
07:00			23	22	20	24		89	22
08:00			43	42	43	34		162	41
09:00			52	50	61	74		237	59
10:00			77	69	87	59		292	73
11:00			73	82	112	85		352	88
12:00			68	101	97	79		345	86
13:00			68	90	81	94		333	83
14:00			76	74	87			237	79
15:00		104	107	90	89			390	98
16:00		87	97	94	76			354	89
17:00		72	70	77	71			290	73
18:00		45	66	37	41			189	47
19:00		57	41	33	44			175	44
20:00		28	45	30	37			140	35
21:00		18	21	10	16			65	16
22:00		8	12	14	7			41	10
23:00		10	10	8	11			39	10
Total		429	984	958	1008	480		3859	985
Percentag		11.12%	25.50%	24.83%	26.12%	12.44%		100.00%	25.51%

Station Name:
Site ID:WELLINGT0094
Station Num:JULY20090000
Description:North of Dundas
City:Woodstock
County:Oxford
Start Date/Time:07/19/09 00:00
End Date/Time:07/25/09 23:59

	19- Sun	20- Mon	21- Tue	22- Wed	23- Thu	24- Fri	25- Sat	Total	Daily- Avg
00:00			27	34	32	57		150	38
01:00			22	40	15	29		106	27
02:00			5	12	10	24		51	13
03:00			11	11	7	8		37	9
04:00			16	9	15	18		58	15
05:00			31	36	40	57		164	41
06:00			115	123	135	131		504	126
07:00			226	235	250	255		966	242
08:00			507	450	466	430		1853	463
09:00			583	509	598	625		2315	579
10:00			643	585	675	670		2573	643
11:00			736	676	729	723		2864	716
12:00			723	683	790	739		2935	734
13:00			712	739	721	758		2930	733
14:00			656	649	786			2091	697
15:00			681	728	712			2121	707
16:00		662	742	685	772			2861	715
17:00		545	582	623	555			2305	576
18:00		460	525	533	501			2019	505
19:00		435	369	417	482			1703	426
20:00		254	317	310	288			1169	292
21:00		208	190	201	243			842	211
22:00		121	136	122	131			510	128
23:00		66	70	48	57			241	60
Total		2751	8625	8458	9010	4524		33368	8693
Percentag		8.24%	25.85%	25.35%	27.00%	13.56%		100.00%	26.05%

Station Name:
Site ID:YORK0000091
Station Num:JULY20090000
Description:North of Dundas
City:Woodstock
County:Oxford
Start Date/Time:07/12/09 00:00
End Date/Time:07/18/09 23:59

	12-Jul	13-Jul	14-Jul	15-Jul	16-Jul	17-Jul	18-Jul	Total	Daily- Avg
00:00			5	3	8	9		25	6
01:00			4	3	6	6		19	5
02:00			3	4	3	7		17	4
03:00			3	7	4	1		15	4
04:00			1		6	6		13	4
05:00			8		6	10		24	8
06:00			12		16	26		54	18
07:00			27		30	29		86	29
08:00			49		56	64		169	56
09:00			65		62	74		201	67
10:00			90		86	89		265	88
11:00			86		89	104		279	93
12:00		92	97		105	102		396	99
13:00		80	103		99	131		413	103
14:00		83	82	93	95	105		458	92
15:00		82	100	86	101			369	92
16:00		104	106	98	91			399	100
17:00		102	98	111	114			425	106
18:00		79	72	89	118			358	90
19:00		75	64	77	91			307	77
20:00		65	50	53	61			229	57
21:00		27	22	30	32			111	28
22:00		3	11	12	17			43	11
23:00		9	11	8	8			36	9
Total		801	1169	674	1304	763		4711	1246
Percentag		17.00%	24.81%	14.31%	27.68%	16.20%		100.00%	26.44%

Station Name:
Site ID:BEALE0000092
Station Num:JULY20090000
Description:North of Dundas
City:Woodstock
County:Oxford
Start Date/Time:07/12/09 00:00
End Date/Time:07/18/09 23:59

	12-Jul	13-Jul	14-Jul	15-Jul	16-Jul	17-Jul	18-Jul	Total	Daily- Avg
00:00			6	11	9	16		42	11
01:00			7	9	5	16		37	9
02:00			7	8	11	11		37	9
03:00			5	2	3	7		17	4
04:00			2	14	1	8		25	6
05:00			8	10	17	8		43	11
06:00			11	16	25	14		66	17
07:00			37	36	34	30		137	34
08:00			35	39	41	41		156	39
09:00			82	43	44	54		223	56
10:00			67	54	57	56		234	59
11:00		48	69	65	68	69		319	64
12:00		50	70	95	71	56		342	68
13:00		55	60	59	58	79		311	62
14:00		59	58	71	77	70		335	67
15:00		48	76	59	65	37		285	57
16:00		68	84	57	88			297	74
17:00		68	83	70	75			296	74
18:00		73	61	51	83			268	67
19:00		58	46	53	62			219	55
20:00		30	40	43	50			163	41
21:00		28	20	17	26			91	23
22:00		14	25	16	23			78	20
23:00		10	16	11	16			53	13
Total		609	975	909	1009	572		4074	939
Percentag		14.95%	23.93%	22.31%	24.77%	14.04%		100.00%	23.05%

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APPENDIX C - CALCULATIONS

Project:	IBI Group - Woodstock Bus Terminal Idling Bus		
Location:	Bay 2 - Correction for Idling Time Not Included		
		Overall SPL w/No Barrier:	52.4 dBA
Source to Receiver:	32.0 m	Temp. (0/10/20/30°C):	20 °C
Source Height:	2.00 m	Rel. Humidity (10-90%):	50 %
Source Base Elev:	0.00 m		
Top of Source Elev:	2.00 m	Foliage depth, A(foilage), 200m max:	0.00 m
Receiver Height:	4.50 m	Housing depth:	0.00 m
Receiver Base Elev:	0.00 m	Housing density, A(housing):	0.00 %
Top of Receiver Elev:	4.50 m	Industrial depth, A(site):	0.00 m
Ground Condition (Flat/Gentle slope or Elevated):	E		
Mean Propogation Height:	3.24 m		
Minimum Elevation S-R:	0.00 m	N/A	0.00 m
Receiver to B1:	0.00 m	Barrier Thickness:	0.00 m
Barrier Height (B1):	0.00 m	Barrier Length (N/A):	999.00 m
B1 Base Elevation:	0.00 m		
Receiver to B2 (N/A) -->	0.00 m	Barrier Length (N/A):	999.00 m
Barrier Height (B2):	0.00 m		
B2 Base Elevation:	0.00 m		

SUMMARY **NO BARRIER**

Use PWL or SPL (P/S)?	Impulse Data (Y/N): N
s	
Source SPL (dBA), re: 15.0m:	59.0 dBA
Source Area Correction (dB):	0.0 dB
A(directionality):	-2.9 dB
Ref. A(misc), (dB):	0.0 dB
Ref. A(divergence, re: 15m):	34.5 dB
Ref. A(ground) correction, (dB):	0.0 dB
Ref. A(air) correction, (dB):	0.0 dB

Source PWL (dBA):	90.6 dBA
A(directionality):	-2.9 dB
A(div):	41.1 dB
A(gr)	0.0 dB
A(bar), No Barrier:	0.0 dB
A(air):	0.1 dB
A(foilage):	0.0 dB
A(housing):	0.0 dB
A(site):	0.0 dB

Overall SPL:	52.4 dBA

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Project:	IBI Group - Woodstock Bus Terminal Idling Bus		
Location:	Bay 6 - Correction for Idling Time Not Included		
		Overall SPL w/No Barrier:	44.3 dBA
Source to Receiver:	80.0 m	Temp. (0/10/20/30°C):	20 °C
Source Height:	2.00 m	Rel. Humidity (10-90%):	50 %
Source Base Elev:	0.00 m		
Top of Source Elev:	2.00 m	Foliage depth, A(foilage), 200m max:	0.00 m
Receiver Height:	4.50 m	Housing depth:	0.00 m
Receiver Base Elev:	0.00 m	Housing density, A(housing):	0.00 %
Top of Receiver Elev:	4.50 m	Industrial depth, A(site):	0.00 m
Ground Condition (Flat/Gentle slope or Elevated):	E		
Mean Propagation Height:	3.25 m		
Minimum Elevation S-R:	0.00 m	N/A	0.00 m
Receiver to B1:	0.00 m	Barrier Thickness:	0.00 m
Barrier Height (B1):	0.00 m	Barrier Length (N/A):	999.00 m
B1 Base Elevation:	0.00 m		
Receiver to B2 (N/A) -->	0.00 m	Barrier Length (N/A):	999.00 m
Barrier Height (B2):	0.00 m		
B2 Base Elevation:	0.00 m		

SUMMARY

NO BARRIER

Use PWL or SPL (P/S)?	Impulse Data (Y/N): N
s	
Source SPL (dBA), re: 15.0m:	59.0 dBA
Source Area Correction (dB):	0.0 dB
A(directionality):	-3.0 dB
Ref. A(misc), (dB):	3.1 dB
Ref. A(divergence, re: 15m):	34.5 dB
Ref. A(ground) correction, (dB):	0.0 dB
Ref. A(air) correction, (dB):	0.0 dB
Source PWL (dBA):	93.7 dBA
A(directionality):	-3.0 dB
A(div):	49.1 dB
A(gr):	3.1 dB
A(bar), No Barrier:	0.0 dB
A(air):	0.2 dB
A(foilage):	0.0 dB
A(housing):	0.0 dB
A(site):	0.0 dB
Overall SPL:	44.3 dBA

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21-Oct-09
 2:20:56 PM

STAMSON 5.0 NORMAL REPORT Date: 21-10-2009 13:58:29
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: ibiwoo.te Time Period: 1 hours
Description: **Ambient Sound Level at Critical Receptor**

Road data, segment # 1: Open

Car traffic volume : 704 veh/TimePeriod
Medium truck volume : 18 veh/TimePeriod
Heavy truck volume : 18 veh/TimePeriod
Posted speed limit : 50 km/h
Road gradient : 0 %
Road pavement : 1 (Typical asphalt or concrete)

Data for Segment # 1: Open

Angle1 Angle2 : -90.00 deg 0.00 deg
Wood depth : 0 (No woods.)
No of house rows : 1
House density : 90 %
Surface : 1 (Absorptive ground surface)
Receiver source distance : 102.00 m
Receiver height : 4.50 m
Topography : 1 (Flat/gentle slope; no barrier)
Reference angle : 0.00

Road data, segment # 2: Open

Car traffic volume : 704 veh/TimePeriod
Medium truck volume : 18 veh/TimePeriod
Heavy truck volume : 18 veh/TimePeriod
Posted speed limit : 50 km/h
Road gradient : 0 %
Road pavement : 1 (Typical asphalt or concrete)

Data for Segment # 2: Open

Angle1 Angle2 : -90.00 deg 0.00 deg
Wood depth : 0 (No woods.)
No of house rows : 0
Surface : 2 (Reflective ground surface)
Receiver source distance : 102.00 m
Receiver height : 4.50 m
Topography : 1 (Flat/gentle slope; no barrier)
Reference angle : 0.00

Results segment # 1: Open

Source height = 1.25 m

ROAD (0.00 + 40.30 + 0.00) = 40.30 dBA

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

-90 0 0.58 65.31 0.00 -13.13 -4.33 0.00 -7.55 0.00 40.30

Segment Leq : 40.30 dBA

Results segment # 2: Open

Source height = 1.25 m

ROAD (0.00 + 53.98 + 0.00) = 53.98 dBA

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

-90 0 0.00 65.31 0.00 -8.33 -3.01 0.00 0.00 0.00 53.98

Segment Leq : 53.98 dBA

Total Leq All Segments: 54.16 dBA

TOTAL Leq FROM ALL SOURCES: 54.16